AUTOMATIC TRANSMISSION 17A

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GENERAL DESCRIPTION

Effective January 1977 2,0 litre engine Transit vehicles are available with C3 automatic transmission as an optional extra.

Apart from minor modifications this transmission will be similar to the C3 transmission assembly already fitted to passenger cars, Fig. 1.

The selector lever is located in an instrument panel gear shift gate, with the drive positions required being selected by appropriate lever operation.

Position sequence and symbols are shown on the selector escutcheon.

In the event of impact the selector lever will engage in the gear shift gate. It may subsequently be withdrawn again and a clearly audible clicking noise will indicate proper lever engagement (in the absence of such noise it may be necessary for the lever to be moved slightly to the right or left).

For identification of transmission provision is made for a metal tag on extension housing.

Transmission Identification Tag

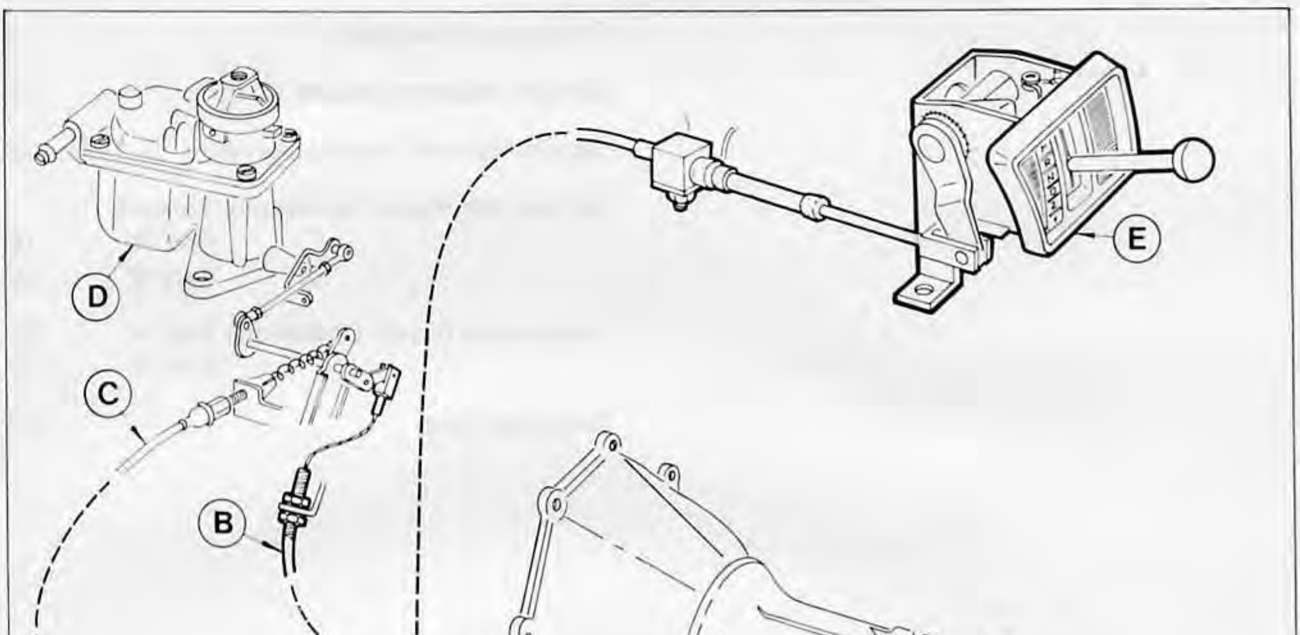


Fig. 1. Automatic transmission operating system

A – Accelerator pedal
B – Downshift cable
C – Throttle cable
D – Carburettor
E – Gear shift gate
F – Selector cable

GENERAL DESCRIPTION (cont'd)

This automatic three-speed transmission has three forward speed selection ranges D, 2 and 1 and in addition it has the selector positions P, R and N. A starter inhibitor prevents the engine being started up with a gear selected. **The engine can be started only in the N (Neutral) and P (Park) position.**

When the engine has warmed up to its working temperature the creep of the car is slight, **but even then the footbrake must be applied before the selector lever is moved from the P or N position to start driving.**

When the position 'D' is selected, automatic gear changes upwards and downwards occur in relation to the speed of the vehicle and, in addition, kickdown is possible. Kickdown occurs when the accelerator pedal is fully pushed down against the bottom stop.

P = Park. In this position the output shaft is locked by a parking pawl which engages in the parking gear wheel. The selector lever must never be moved into the P position unless the **car is stationary.**

R = Reverse. The R position may be selected when the car is stationary.

Never position the selector lever in R (reverse) when the vehicle is still moving forwards.

Never position the selector lever in D, 2 or 1 when the vehicle is still moving backwards.

N = Neutral. When the selector lever is in neutral, no gear changing operations take place.

NOTE: Because of the carburettor's automatic choke, engines have a very much increased idling speed when they are cold and for several minutes after they have been started. This makes the vehicle move off immediately the selector lever is moved to position R, D, 2 or 1, so that in this case it is necessary to apply the hand or footbrake.

Selector lever in position D. In this position the vehicle will start off in 1st gear and will automatically change up from 1st to 2nd gear and from 2nd to top gear as the speed of the vehicle increases. Changing down to the appropriate lower gear also occurs automatically as the vehicle speed decreases. Only in this position can kickdown from top to 2nd and down to 1st gear occur.

Selector lever position 2. In this position the vehicle will start off in 2nd gear and remain in 2nd gear. It is advisable to select the position '2' for **gentle downhill slopes** or successions of 'S' bends (winding road). The continuously engaged 2nd gear with its engine braking effect, cuts down the work of the footbrake and improves road holding.

NOTE: Select the position '2' only when the vehicle speed is less than 80 km/h (50 mph). At speeds of more than 80 km/h (50 mph) position 'D' should be selected.

Selector lever position 1. In this position the car will start off in 1st gear and remain in 1st gear. To protect the brakes it is advisable to select '1' for **steep downhill slopes** so as to obtain the 1st gear engine braking effect. If this is done while travelling in top gear, the automatic transmission immediately changes down to 2nd gear and the engine braking action becomes noticeable.

If the selector lever is left in position '1', the transmission changes down automatically from 2nd gear to 1st gear when the vehicle speed has dropped to about 50 to 20 km/h (30 to 12 mph). The transmission then remains in 1st gear when the speed is increased again. Automatic gear shifting occurs only when the selector lever is moved back from position '1' to position 'D'.

NOTE: **The selector lever must not be moved into position '1' while the vehicle is travelling at over 80 km/h 50 (mph).**

Kickdown. This can take place in any driving situation where downward gear changes are advisable, e.g. in hilly areas or to accelerate to overtake. Kickdown from top to 2nd gear and from 2nd to 1st gear can be effected only when the selector lever is in the 'D' position.

Vehicle Towing

If a vehicle with automatic transmission has to be towed, put the selector lever in the 'N' position. If the distance to the destination does not exceed 20 km (12 miles), the vehicle may be towed at a speed of about 30 to 40 km/h (19 to 25 mph).

Before towing for distances exceeding 20 km (12 miles), remove the driveshaft or lift the rear axle of the vehicle.

Safety Tip

Before any carburettor checks are carried out with the engine running on a vehicle with automatic transmission, **it is essential to first move the selector lever to the 'P' or 'N' position and apply the handbrake hard.**

NOTE: When 'P' or 'N' is selected, on no account allow the engine to turn at more than 4500 rev/min as this will result in damage to the gearbox.

C2 Transmission – cutaway view

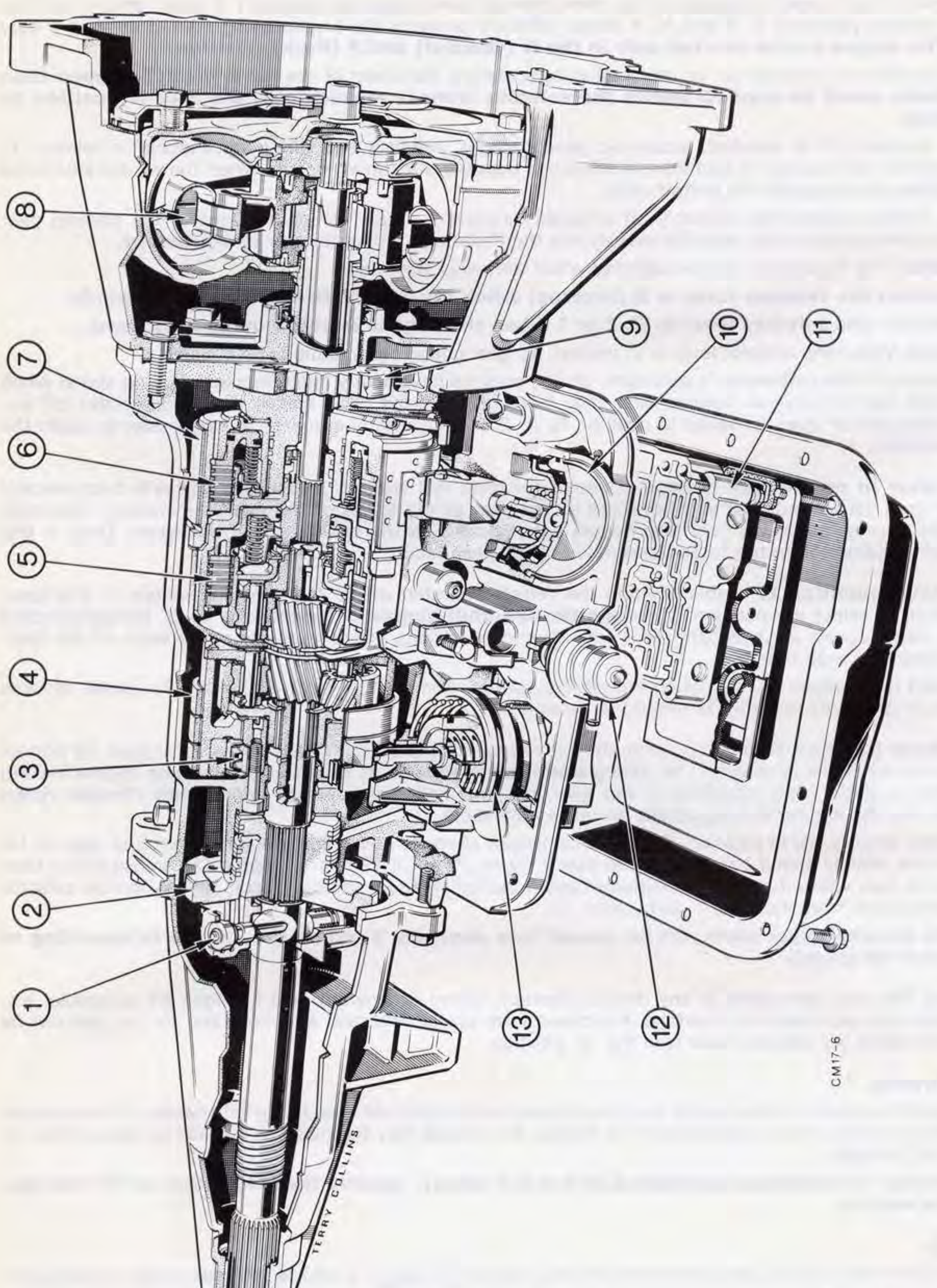


Fig. 2.
1. Governor assembly
2. Governor hub
3. One-way clutch
4. Rear brake band
5. Forward clutch
6. Reverse and top gear clutch
7. Front brake band
8. Torque converter
9. Hydraulic pump
10. Front servo
11. Valve body
12. Vacuum diaphragm
13. Rear servo

PRINCIPLE OF OPERATION

HYDRAULIC SYSTEM – SELECTOR POSITION 'P' OR 'N'

Legend
Red = Main pipe pressure
Red/black = Torque converter pressure

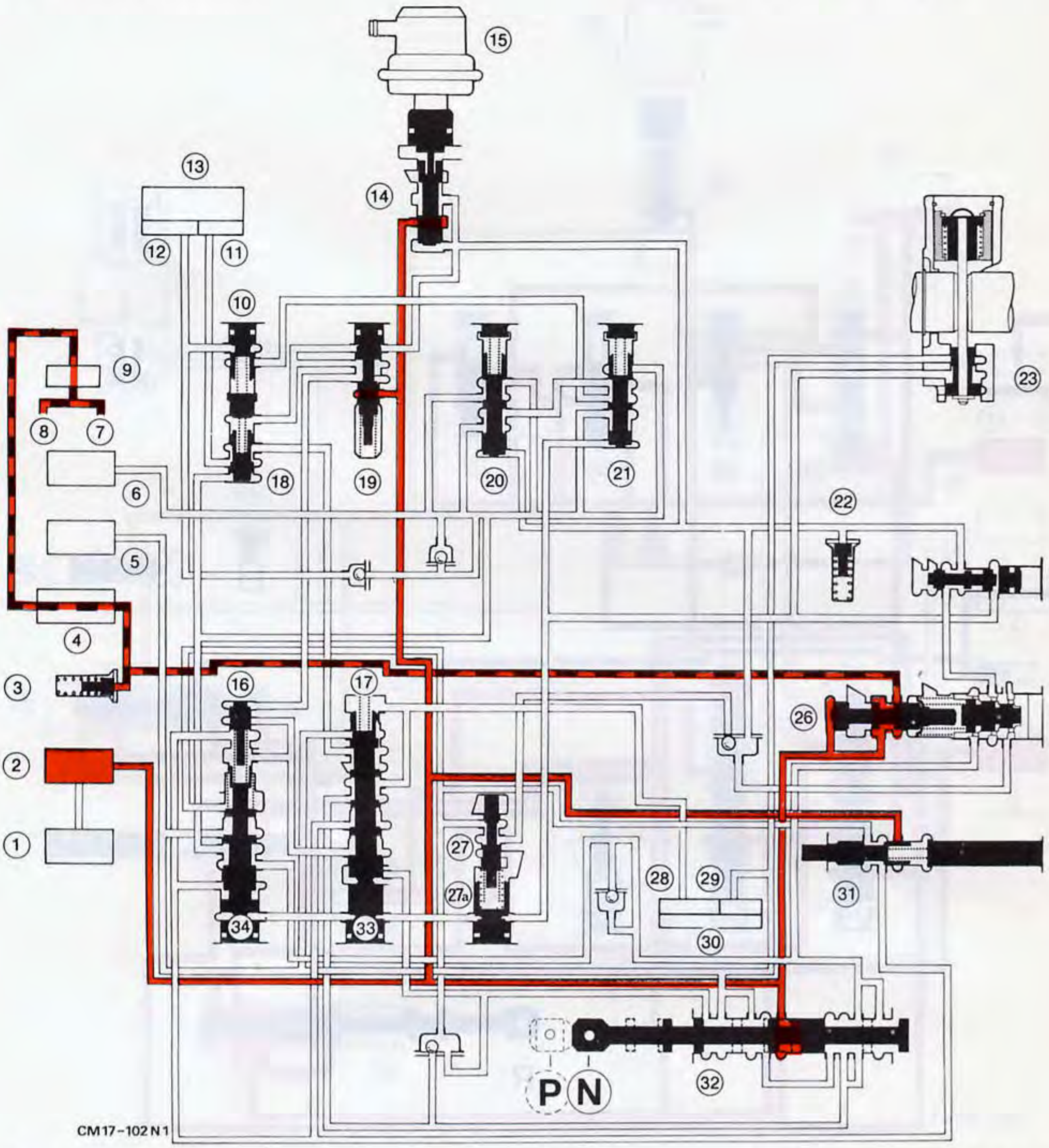


Fig. 3.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)
27a. Pressure boost valve (1st/2nd lever position)
28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION 'R'

Legend

Red = Main pipe pressure
Yellow = Throttle pressure
Red/black = Torque converter pressure

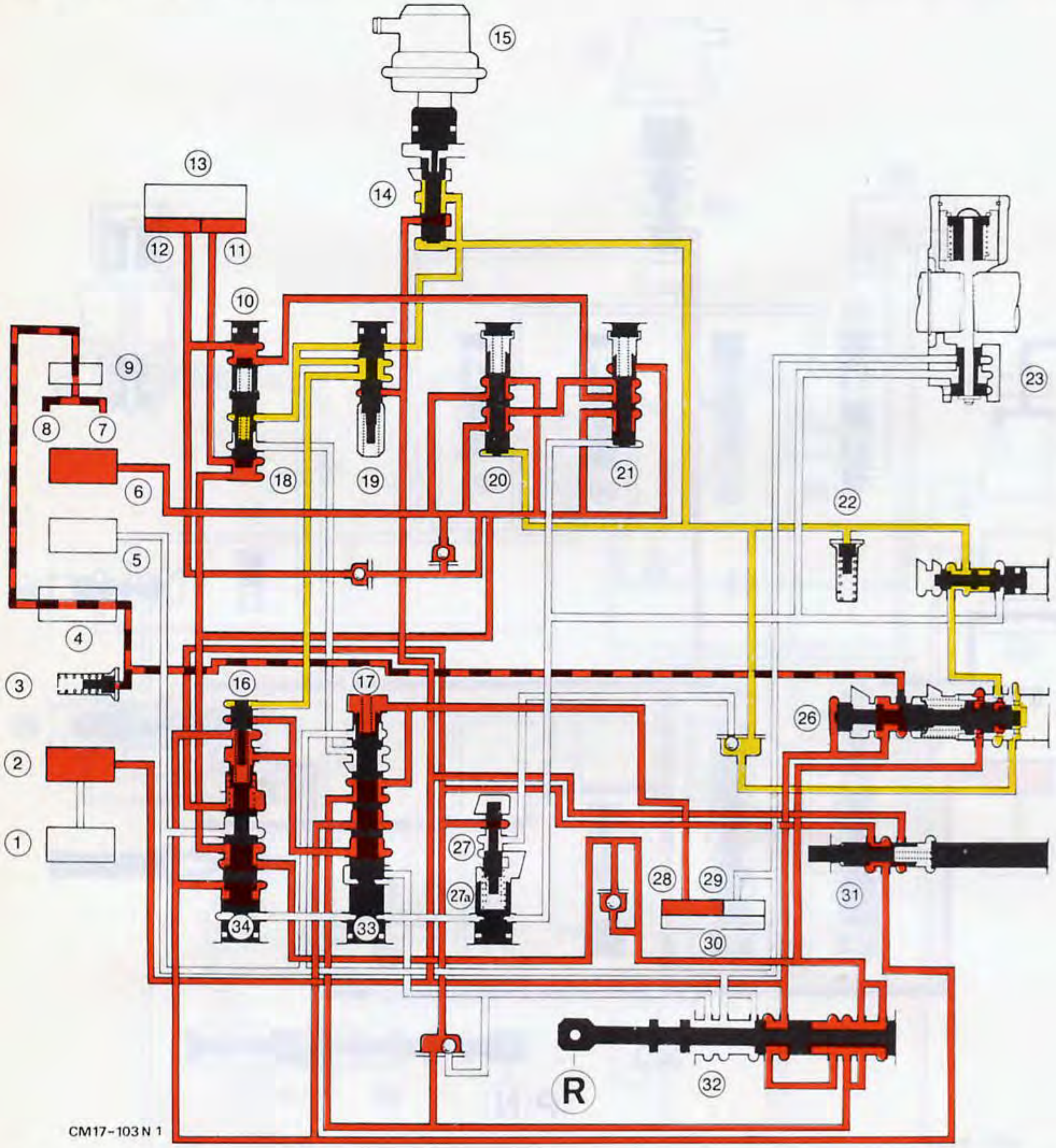


Fig. 4.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION 'D-1'

Legend

Red = Main pipe pressure
Blue = Governor pressure
Yellow = Throttle pressure
Red/black = Torque converter pressure
Yellow/black = Reduced throttle pressure

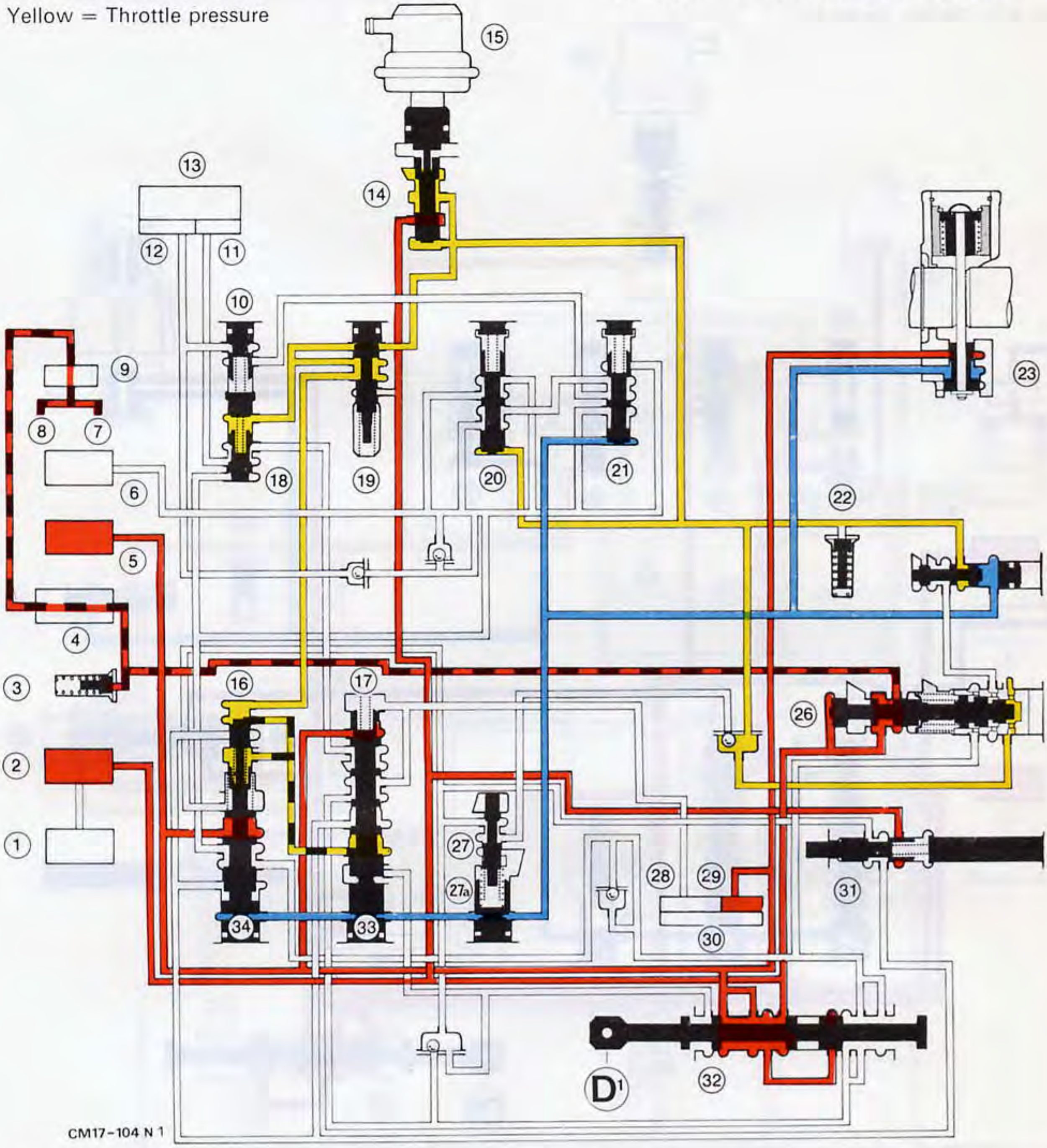


Fig. 5.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION 'D-2'

Legend

Red = Main pipe pressure
Blue = Governor pressure
Yellow = Throttle pressure
Red/black = Torque converter pressure
Yellow/black = Reduced throttle pressure

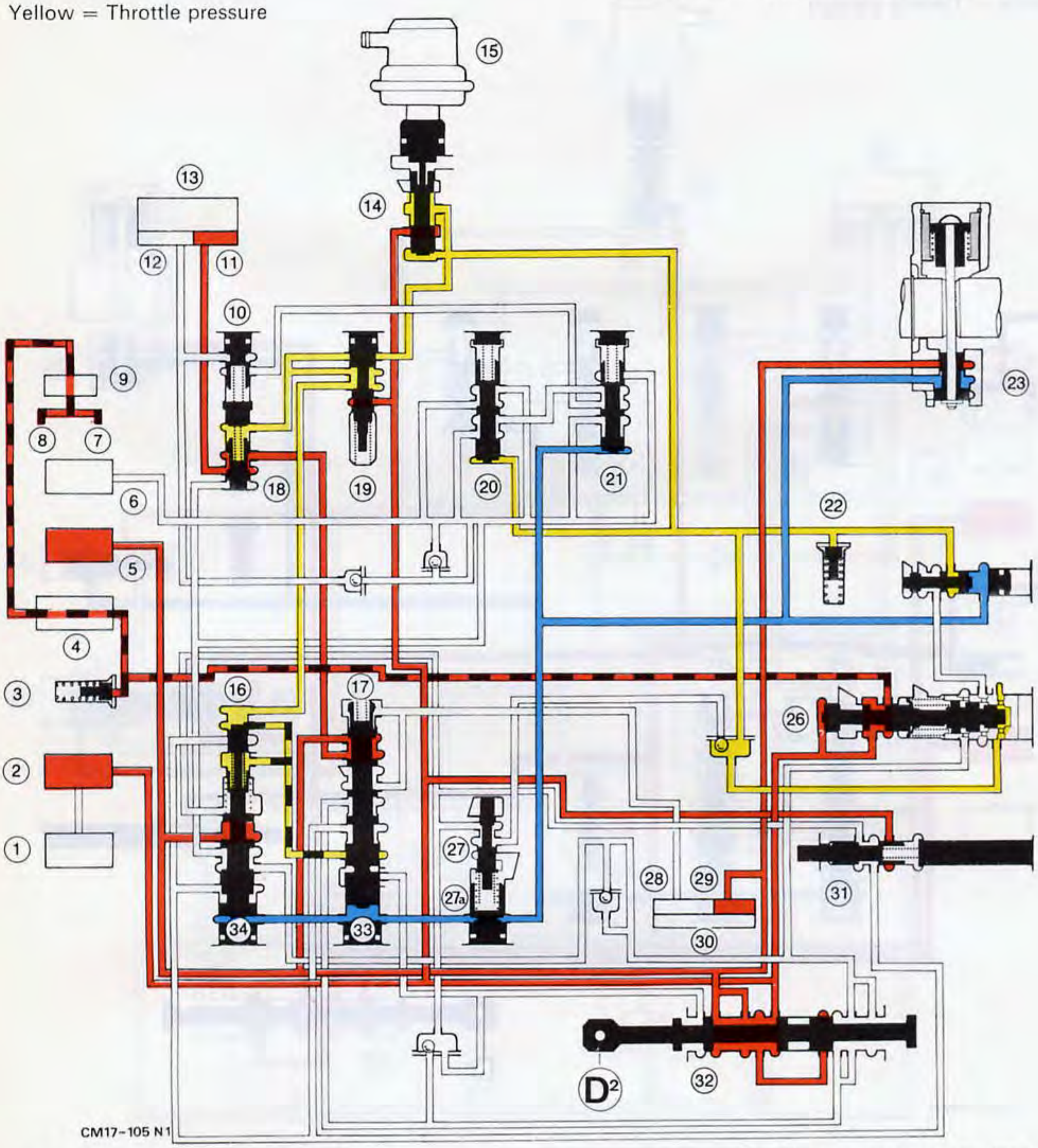


Fig. 6.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION 'D-3'

Legend

Red = Main pipe pressure
Blue = Governor pressure
Yellow – Throttle pressure
Red/black = Torque converter pressure
Yellow/red = Boosted throttle pressure

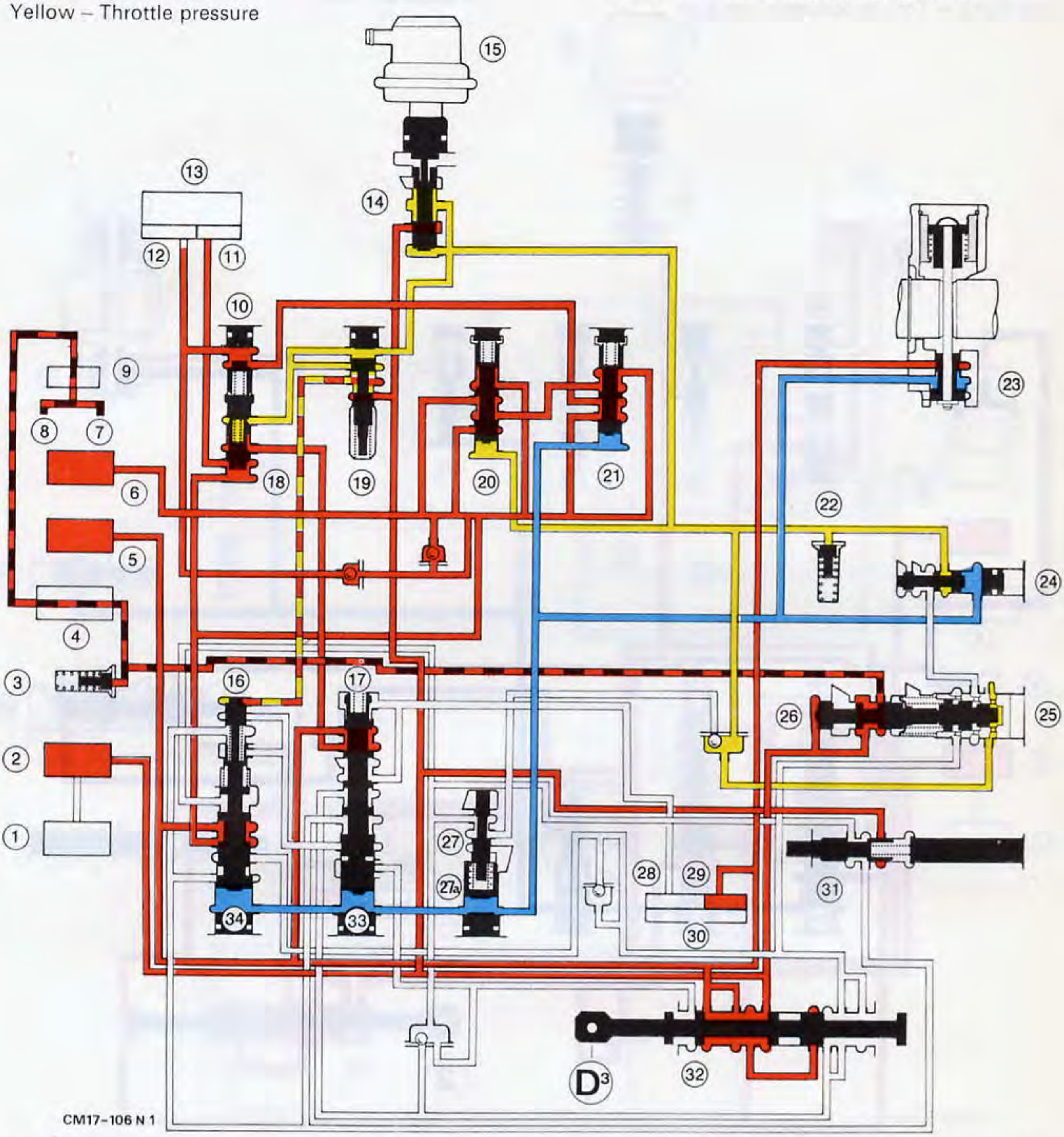


Fig. 7.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION '2'

Legend

Red = Main pipe pressure
Blue = Governor pressure
Red/black = Torque converter pressure
Blue/red = Pressure to boost the main pipe pressure (rear wheels driving engine), with selector lever in position 1 or 2

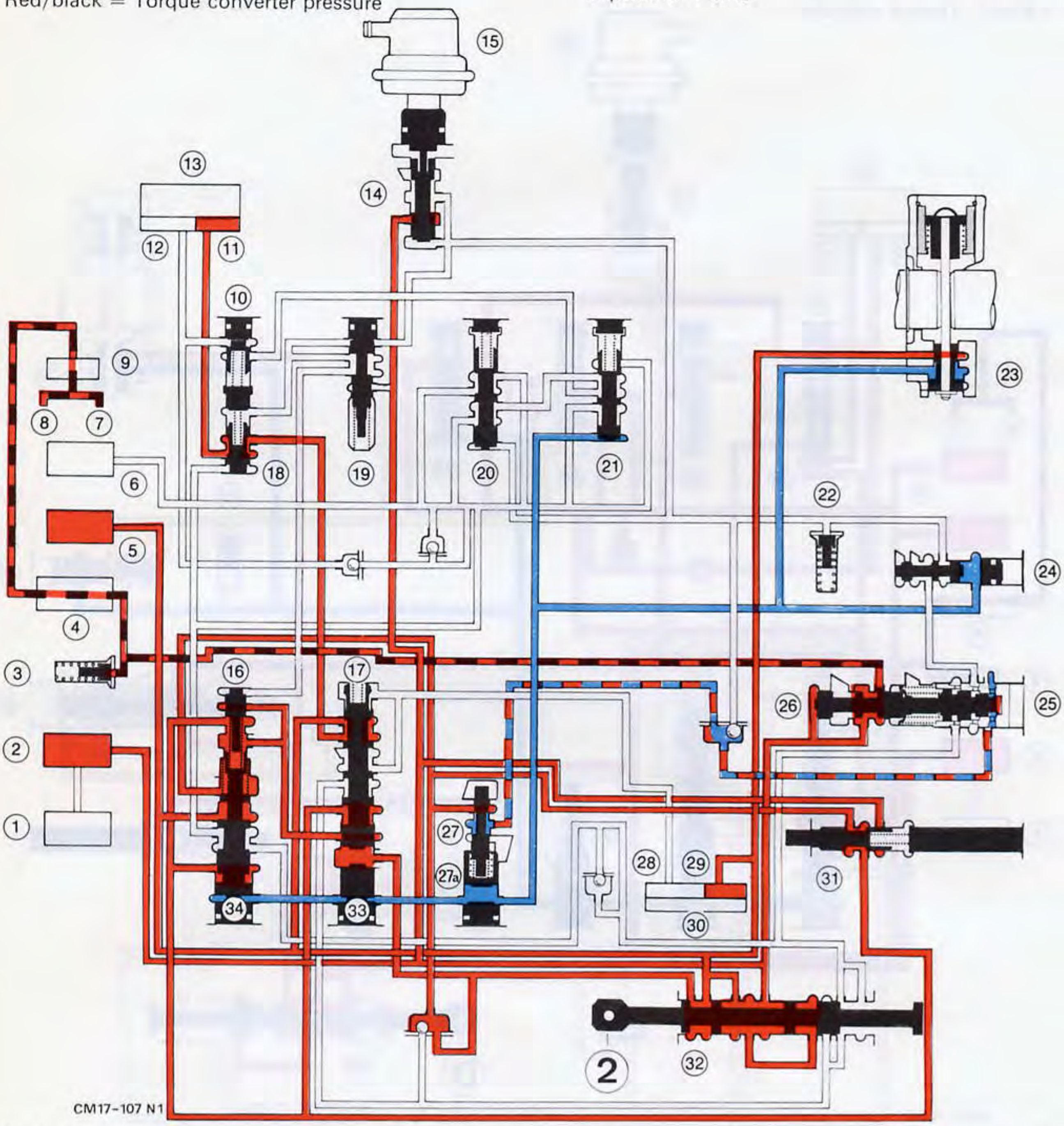


Fig. 8

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

HYDRAULIC SYSTEM – SELECTOR LEVER POSITION '1'

Legend

Red = Main pipe pressure
Blue = Governor pressure
Yellow = Throttle pressure
Red/black = Torque converter pressure

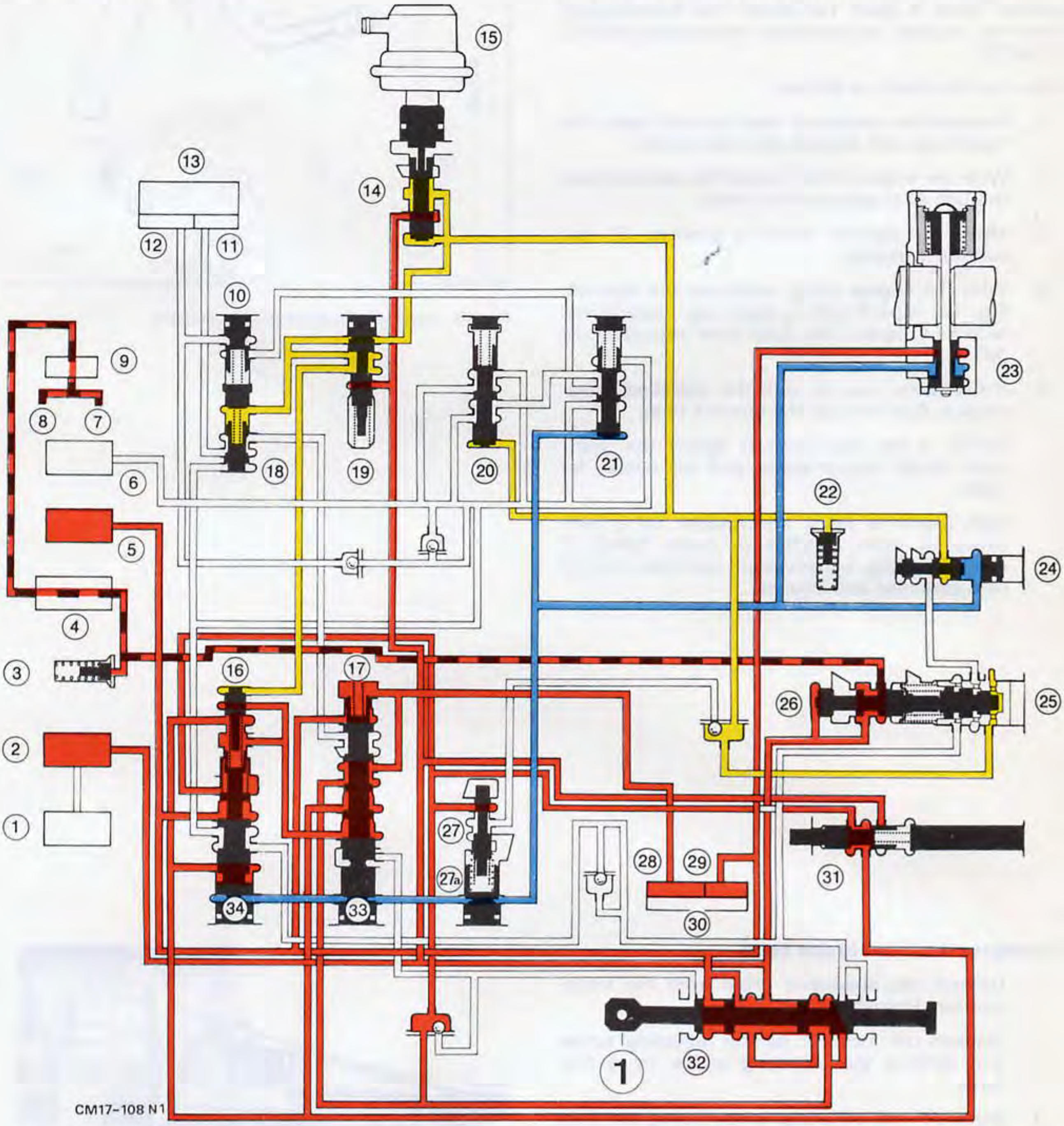


Fig. 9.

1. Oil filter
2. Hydraulic pump
3. Torque converter pressure relief valve
4. Torque converter
5. Forward clutch
6. Reverse and direct gear clutch
7. Rear lubrication
8. Front lubrication
9. Oil cooler and return valve
10. Band release delay valve
11. Load side, front servo
12. Discharge side, front servo
13. Front servo
14. Pressure throttle valve
15. Vacuum diaphragm
16. Pressure balancing throttle valve
17. 2nd gear valve
18. Servo regulator valve (2nd/3rd gear)
19. Pressure boost throttle valve
20. Switching control valve (3rd/2nd gear)
21. Modulator valve
22. Pressure relief throttle valve
23. Mechanical governor
24. Main pipe pressure reduction valve
25. Main pipe boost valve
26. Main pipe regulator valve
27. Pressure boost valve (1st/2nd lever position)

27a. Pressure boost valve (1st/2nd lever position)

28. Load side, rear servo
29. Discharge, rear servo
30. Rear servo
31. Kickdown valve
32. Manual selector slide valve
33. Switching valve (1st/2nd gear)
34. Switching valve (2nd/3rd gear)

SERVICE ADJUSTMENTS AND CHECKS

Fluid level check

An accurate fluid level check is best carried out directly after a short run when the transmission fluid has reached its operating temperature (65 °C) (150 °F).

Carry out the check as follows:

1. Position the vehicle on level ground, apply the handbrake and depress the brake pedal.
2. With the engine idling, move the selector lever through all positions three times.
3. Move the selector lever to position 'P' and wait for 1 minute.
4. With the engine idling withdraw the dipstick, Fig. 10, wipe it with a clean rag, replace and withdraw again. The fluid level should be at 'Max'.
5. If necessary, top up with the specified transmission fluid through the dipstick tube.

   NOTE: If the fluid level is below the 'min.' mark check transmission and oil cooler for leaks.

   Dark brown or black transmission oil is indicative of worn clutches or brake bands; if necessary, the transmission assembly should be dismantled and cleaned.

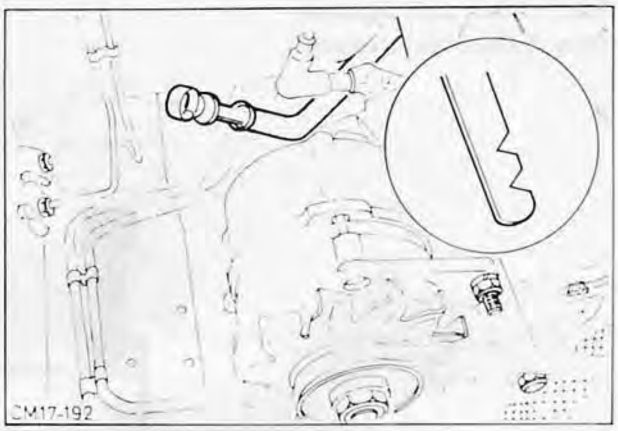


Fig. 10. Automatic gearbox fluid level check

To adjust the front brake band

1. Unhook the downshift cable from the transmission downshift lever.
2. Slacken the lock nut on the adjusting screw and slacken the adjusting screw by a few turns.
3. Screw in the adjusting screw using the Tool 17–005, Fig. 11, until the torque wrench disengages.
4. Slacken the **adjusting screw by $1\frac{1}{2}$ turns** and secure it with the lock nut, holding the adjusting screw still while doing so
5. Connect the downshift cable to transmission downshift lever.

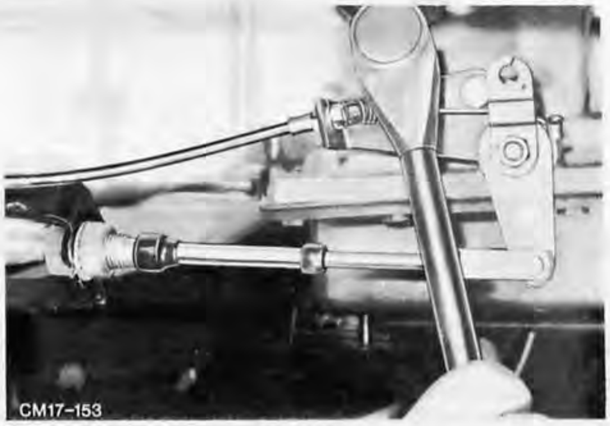


Fig. 11. Brake band adjustment

Check main line pressure (Oil pressure test)

1. Connect oil pressure gauge to transmission housing measuring connection, Fig. 12.

2. Position gauge in vehicle in such a manner that it can be easily read from the driver's seat.

3. Run the engine until transmission operating temperature is reached.

4. Check oil pressure at idling speed:

Selector position:	MN/m^2	kgf/cm^2	lbf/in^2
R	0,60–0,90	(6,0–9,0)	(86–128)
P-N	0,34–0,50	(3,4–5,0)	(49–71)
D-2-1	0,40–0,60	(4,0–6,0)	(57–85)

Low oil pressure at idling speed:
(a) check oil level.
(b) check valve body.
(c) check torque converter and pump gears, if necessary dismantle and clean transmission assembly.

High oil pressure at idling speed:
(a) check engine idling speed.
(b) check vacuum connections on engine, vacuum line and connector as well as throttle valve.
(c) check valve body.

5. Check oil pressure at stall speed:

Selector position:	MN/m^2	kgf/cm^2	lbf/in^2
R	1,67–1,90	(16,7–19,0)	(238–270)
D	1,00–1,14	(10,0–11,4)	(143–162)

Low oil pressure at stall speed:
(a) check vacuum line and throttle valve.
(b) check valve body.
(c) check forward clutch and/or reverse and top gear clutch and rear servo.

High oil pressure at stall speed:
(a) check valve body assembly.

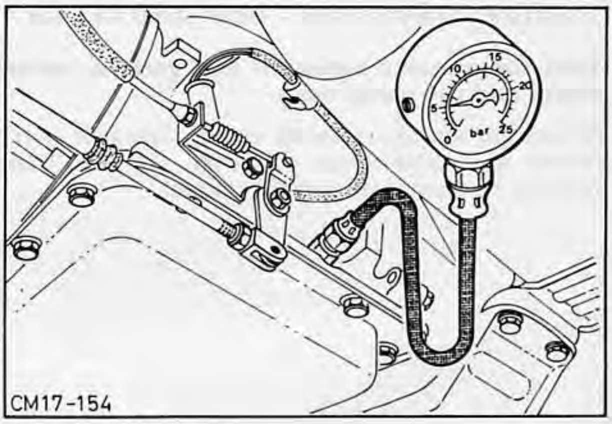


Fig. 12. Check oil pressure

SERVICE ADJUSTMENTS AND CHECKS (cont'd)

TORQUE CONVERTER – TEST AND CLEAN

Test for contact between the turbine wheel stator and the pump case

Mount the torque converter on the hydraulic pump hollow shaft and rotate converter, Fig. 13. There must be no sounds of metallic contact.

Fig. 13. Check the contact between turbine wheel stator and pump case

Test for contact between the stator and the turbine

Turn the converter round. Push through the input shaft and rotate, Fig. 14. There must be no sounds of metallic contact.

Fig. 14. Check for contact between stator and turbine

Examine the torque converter hub for scoring or wear in the hydraulic pump oil seal area, Fig, 15.

Check the three torque converter mounting bosses for proper attachment and cracks at the welds, Fig. 15.

To clean the torque converter

Drain the converter, and flush thoroughly with about 1 litre (1,75 pints) of clean paraffin through the hollow hub. If metal particles are found, the torque converter should be renewed complete, since it is not possible to clean it satisfactorily.

Torque converter identification

Owing to dependence on engine type the converter is identified by 2 letters (after part number) on front face. See Fig. 15 (right-hand part of illustration).

Fig. 15. Check the converter hub for scoring or wear
A – Mounting bosses (3)
B – Drain plug

FAULT DIAGNOSIS CHART

	Symptoms	Action to be taken
Starting	Engine fails to start (battery and starter motor OK)	Replace starter inhibitor switch
	Engine fails to start in 'N' or 'P'	Adjust selector rod
	Engine can be started in all selector lever positions	Replace starter inhibitor switch
Moving off	No gearshift noticeable or no drive in any driving position	Check in line with testing instructions sub-operation 3 and 4. Carry out oil pressure test. If oil pressure OK mechanical fault: Check input shaft splines, forward clutch, rotor, if necessary dismantle and clean transmission assembly
	No gear change noticeable in selector lever 'R' position Gear change correct in 'D', '2' and '1' No drive in 'R'	Check engine braking effect in '1', if OK repair reverse and top gear clutch, if not OK remove rear servo and check together with brake band
	No gear change noticeable in 'D', '2' and '1' No drive in 'D', '2' and '1' OK in 'R'	Carry out oil pressure test. If too low in 'D', '2' and '1' check rear servo as well as forward clutch oil seals. If oil pressure OK, mechanical fault: check output shaft front planet gear assembly
	No gear change noticeable in 'D' OK in '2' and '1' No drive in 'D'	Adjust selector rod. Transmission freewheel assembly faulty. Completely dismantle and clean transmission and housing
	Very rough gear change in all positions	Adjust engine idling speed in 'D' 650–700 rev/min. Check vacuum system, carry out oil pressure test
	Vehicle creeping in all positions except 'P' and 'R'	Forward clutch locked (failing to disengage). Dismantle and clean transmission
	Loud mechanical noises when stationary in all positions	Carry out stationary converter test, actuating hand and foot brakes. No noise in 'N', noise becoming audible in 'R' and 'D' and louder when opening throttle. Replace converter, dismantle and clean transmission
	Loud mechanical noises when starting off (vehicle moving)	Drive power transmission to planet gears etc. faulty
	Slurping noises or sudden interruption of drive power when moving off	Check oil level. If oil level OK check oil pressure, oil filter. If OK check hydraulic pump
Stall testing	Stall test not feasible in 'R' and 'D' Engine revving up Gear changes OK	Check throttle system. Carry out oil pressure test. If pressure low, check first governor, then hydraulic pump
	Stall test not feasible in 'R' Engine revving up Stall test in 'D', '2' and '1' OK	Check engine braking effect in '1' if not OK check rear servo. If OK repair reverse and top gear clutch assemblies
	Stall test not feasible in 'D' Engine revving up Stall test in 'R' OK	Carry out check in '2' and '1'. If OK freewheel faulty. Dismantle and clean transmission

FAULT DIAGNOSIS CHART (cont'd)

	Symptoms	Action to be taken
	Bad acceleration. Final speed and engine OK	Remove torque converter. Check stator
	Unsatisfactory performance Final speed not being obtained (Engine OK, acceleration OK). Oil becoming very hot	Test according to test schedule (full throttle and kickdown). If OK, remove torque converter and check freewheel operation
Gear changing	With accelerator pedal moderately depressed (1500–2000 rev/min) transmission changes to 2nd gear at speed above 45 km/h (30 mph) (gear change delayed)	Check vacuum system. Carry out oil pressure test. Check governor, if OK check 1st/2nd gear shift valve. If OK check oil seals on governor hub
	With gradual acceleration (accelerator pedal moderately depressed, 1500–2000 rev/min) transmission changing directly from 1st to 3rd gear	Check front brake band adjustment, carry out oil pressure test, check front servo, check transmission housing, 1st/2nd gear shift valve
	With gradual acceleration (accelerator pedal moderately depressed: 1500–2000 rev/min) transmission fails to change to 3rd gear	Carry out oil pressure test. Check governor, check transmission housing, 2nd /3rd gear shift valve. Dismantle and clean transmission assembly
	Either no gear change occurs or starting off in 2nd or 3rd gear with selector lever in 'D'	Carry out oil pressure test. Check governor, check transmission housing, check oil seals (3) on governor hub
	Kickdown shift speeds too low Gearshift changes too early	Check kickdown cable adjustment. Carry out oil pressure test. Check governor. Check oil seals (3) on governor hub
	Shift speed too high when changing up from 1st to 2nd gear and/or 2nd to 3rd gear full throttle (kickdown) change (gear change delayed)	Carry out oil pressure test. Check governor, check transmission housing, check oil seals (3) on governor hub
	Loud whining noises at higher engine speeds	Check oil filter and check hydraulic pump and intake systems
	Transmission not changing down to 2nd gear with accelerator pedal fully depressed (kickdown) at 65 km/h (40 mph) in 'D'	Check kickdown cable adjustment. Carry out oil pressure test. Check kickdown valve in transmission housing
	Transmission not changing down to 2nd gear with accelerator pedal depressed approx. 3/4 of travel at 50 km/h (30 mph) in 'D', otherwise OK	Carry out oil pressure test, check governor, check transmission housing
	*With change from 'D' to '1' at 70 km/h (44 mph) and with accelerator pedal released no braking effect by changing back to 2nd gear	Adjust front brake band. Carry out oil pressure test. Check front servo
	*Transmission changing to 1st gear at speeds above 70 km/h (44 mph) when changing from 'D' to '1' at 50 km/h (30 mph) with accelerator pedal released	Carry out oil pressure test. Check transmission housing (shift valves), check governor
	*Transmission changing to 1st gear at speed below 25 km/h (16 mph) when shifting from 'D' to '1' at 70 km/h (44 mph) with accelerator pedal released	Carry out oil pressure test. Check transmission housing. Check rear servo. Check governor
	Parking inhibitor not operative on steep gradients	Adjust selector linkage. Check parking mechanism

*With these symptoms drive car with oil pressure gauge connected and check whether main line pressure increases (as it should do) when changing manually at 80 km/h (50 mph) from 'D' to '2' or '1'.

FAULT DIAGNOSIS CHART (cont'd)

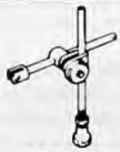
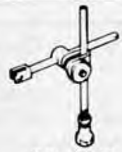
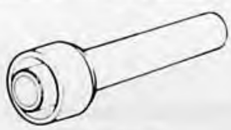
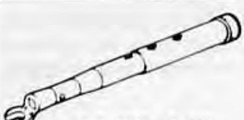
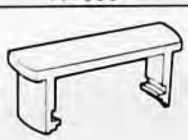
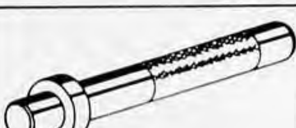
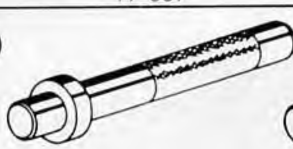
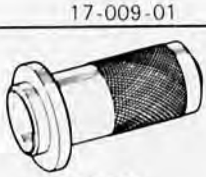
OTHER POSSIBLE CAUSES OF FAULTS

Symptoms	Action to be taken
Selector lever difficult to move or locked	Check selector lever Check selector linkage and transmission manual shift valve Check Neutral switch Check correct seating of Code plate (on transmission housing)
Converter leaks Correct location of converter guide bush in converter housing must be ensured when replacing transmission hydraulic pump oil seal	Check: Engine rear gasket, Transmission oil pump seal, Converter housing to transmission housing bolts (with aluminium washers), Torque converter oil drain plug, Torque converter weld nuts, Torque converter welds
Transmission leaks	Check: Extension housing oil seal, Transmission side connections and circuits, Front servo adjusting screw, Selector lever and kickdown lever O-ring seals, Extension housing to transmission housing seal, Test connection, Oil sump seal, Speedometer drive sealing ring, Vacuum plug socket sealing ring
Oil loss without external leak	Replace vacuum diaphragm

General recommendations on remedial action:

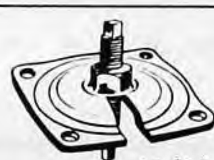
1. If several possibilities of remedial action are indicated in the fault diagnosis chart in relation to any one symptom, start with the first operation specified and check results before proceeding to the next operation.
2. If more than one symptom is applicable start with the remedial action which involves the minimum workload.
3. The operation 'Dismantle and clean transmission assembly' is specified in respect of instances where faults are attributable to wear or damage. In connection with the relevant operation(s) shavings or brake band abrasive dust must be removed from **all** transmission parts in order to avoid consequential damage. In particular the torque converter, oil cooler and oil cooler pipes should be thoroughly flushed.

SPECIAL SERVICE TOOL RECOGNITION

British Sourced	European Sourced	German Sourced	Tool Name
	 15-008		Dial gauge mounting block
 P-4008	 15-022	 G2-4209-E	Dial indicator holding fixture
	 17-001		Transmission extension housing oil seal remover
	 17-002		Transmission extension housing oil seal replacer
 17-005-A OR CBW-547-A-50		 17-005 OR GAT-701	Brake band torque wrench
	 17-006		Gearbox mounting bracket
	 17-007		Clutch spring compressor
 P-7126	 17-008	 GAT-706	Shift lever oil seal replacer
	 17-009-01		Oil pump aligner
	 17-010		Pump housing oil seal installer

G/4/2841D

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

British Sourced	European Sourced	German Sourced	Tool Name
	 17-011		Pump housing oil seal remover
	 21-023		Universal spindle
 CBW-1-C		 GAT-702	Oil pressure test gauge
	 17-012		Piston rod checking gauge

G/4/283/D

SERVICE AND REPAIR OPERATIONS CONTENT – PART 'A'

		Described	Contained in operation	Unique for Transit
17 214	Automatic transmission assembly – remove and install	X		X
17 634	Gear-selector mechanism – remove and install	X		X
17 634 8	Selector lever assembly – dismantle and reassemble	X		X
17 667	Cable-selector lever – remove and install	X		X
17 683	Cable-downshift – remove and install	X		X

SERVICE AND REPAIR OPERATIONS CONTENT – PART 'B'

AUTOMATIC TRANSMISSION		Described in this publication	Contained in operation	Also applicable to certain variants in the following model ranges			
				Escort '75 onwards	Capri II	Taunus '76 Cortina '77	Consul Granada
17 111	Automatic transmission assembly – check	X		X	X	X	X
17 132	Brake band – front – adjust	X		X	X	X	X
17 214 8	Automatic transmission assembly – overhaul (transmission removed)	X		X	X	X	X
17 234 4	Valve body assembly – remove and install (sump removed)	—	17 214 8	X	X	X	X
17 238	Vacuum diaphragm – remove and install	X		X	X	X	X
17 252	Servo assembly – front – remove and install	X		X	X	X	X
17 256	Servo assembly – rear – remove and install	X		X	X	X	X
17 274 4	Pump – front – remove and install (transmission removed)	—	17 214 8	X	X	X	X
17 354	Governor – remove and install	X		X	X	X	X
17 376	Seal – extension housing – replace	X		X	X	X	X
17 382	Gear – speedometer driven – remove and install	X		X	X	X	X
17 682	Cable – downshift – adjust	—	17 683	X	X	X	X
17 694	Inhibitor switch – remove and install	X		X	X	X	X

SERVICE AND REPAIR OPERATIONS - PART 'A'

17 214 AUTOMATIC TRANSMISSION ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drive vehicle over pit or on to ramp.
2. Disconnect earth cable from battery.
3. Remove exhaust pipe from exhaust manifold, unhook assembly from rear retaining strap and swing to side.

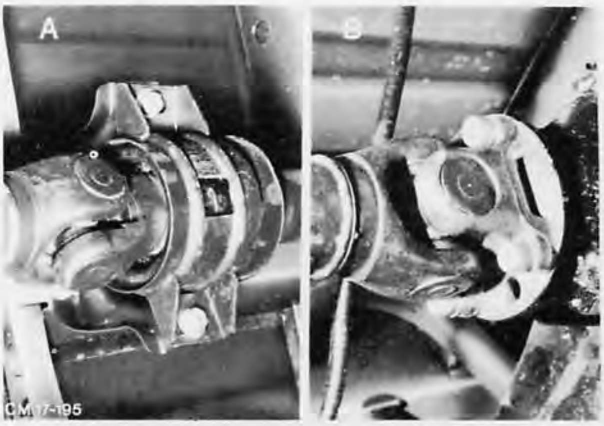


Fig. 16. Driveshaft fixing
A – Centre bearing
B – Rear axle flange

4. Remove driveshaft assembly, Fig. 16 (6 bolts). To prevent oil loss slide driveshaft stub or output shaft dust cap into gearbox extension housing, Fig. 17.
It should be possible for dust cap and/or driveshaft stub to freely slide into extension housing. Cap and/or stub should be clean and have no sharp edges.

Fig. 17. Output shaft dust cap

5. Disconnect oil cooler pipes from transmission housing, Fig. 18. Plug pipe ends to prevent dirt from penetrating into oil pipes.

Fig. 18. Oil pipes, transmission to cooler

PART 'A'

17 214 (cont'd)

6. Disconnect vacuum pipe from vacuum diaphragm, Fig. 19.

Fig. 19. Vacuum diaphragm

7. Remove selector lever cable from transmission lever (split pin) and bracket, Fig. 20.

Fig. 20. Remove selector lever cable

8. Remove downshift cable from transmission downshift lever and bracket, Fig. 21.

9. Disconnect cable from starter inhibitor switch.

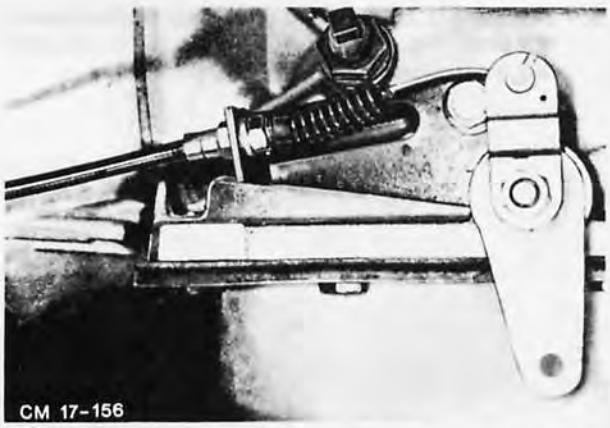


Fig. 21. Disconnect downshift cable from transmission and bracket

PART 'A'

10. Remove speedometer drive cable from extension housing (1 bolt), Fig. 22.

11. Disconnect starter motor cable and remove starter motor assembly (2 bolts).

Fig. 22. Speedometer drive cable removed

12. Remove cover plate with cable bracket from converter housing (4 bolts), Fig. 23.

Fig. 23. Remove cover plate and selector cable bracket

13. Remove torque converter drive plate bolts (3) through starter motor aperture, Fig. 24.

Fig. 24. Remove torque converter drive plate bolt through starter motor aperture

PART 'A'

17 214 (cont'd)

14. Disconnect oil filler pipe from engine (1 bolt) then withdraw from transmission housing, Fig. 25.
To protect transmission from dirt penetration, plug oil filler opening.

Fig. 25. Oil filler pipe

15. Remove downshift cable bracket assembly from engine block (2 bolts), Fig. 26.

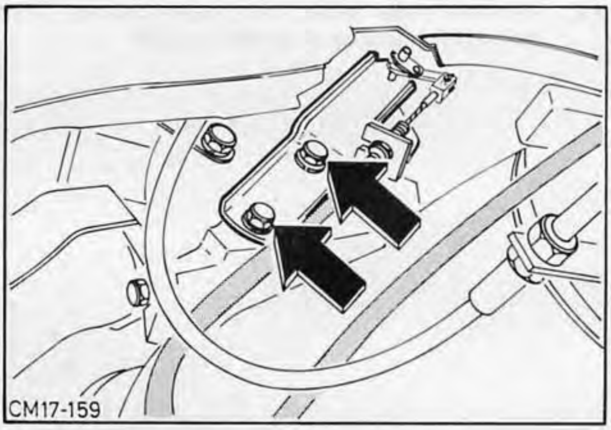


Fig. 26. Remove downshift cable bracket

16. Remove transmission support bracket from transmission and body (5 bolts), Fig. 27, supporting transmission during removal.
17. Remove transmission flange bolts (5) and place earth strap together with vacuum pipe bracket on one side.
18. Carefully lower transmission assembly and remove.

    NOTE: Torque converter is filled with oil and should therefore be pressed firmly against transmission when lifting out transmission.

Fig. 27. Transmission support bracket

PART 'A'

To Install

Tighten all bolts and nuts to specified torque.

If necessary place adapter plate on engine flange guide bushes and centralise.

19. Replace transmission and torque converter. **When installing transmission attention should be paid to the following points:**

    (a) Converter oil drain plug must be aligned on drive plate opening.

    (b) With torque converter hub fully engaged in oil pump drive gear distance 'A' between converter casing flange and centring pivot should be **at least 10 mm (0,4 in),** Fig. 28. **Strict compliance with converter installation instruction is essential to prevent damage to transmission and flywheel assemblies.**

    NOTE: With converter casing flush with engine block converter should rotate easily. Only then should flange bolts be fitted and tightened.

20. Fit transmission flange bolts, at the same time securing earth strap and vacuum pipe bracket.

21. Fit transmission support bracket assembly to body and transmission, Fig. 29, and torque to specification.

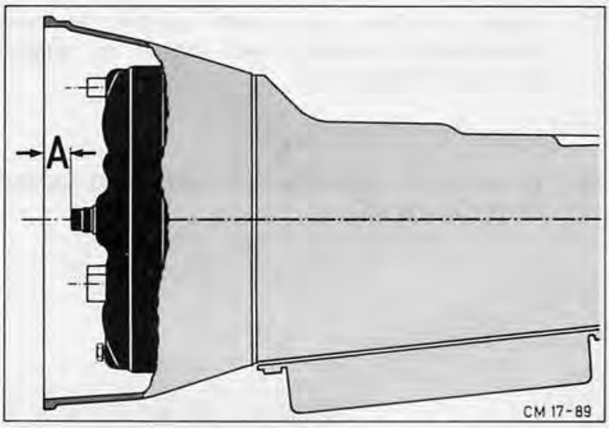


Fig. 28. Converter installation dimension 'A'

Fig. 29. Fit transmission support bracket assembly

22. Attach downshift cable bracket to engine block, Fig. 30.

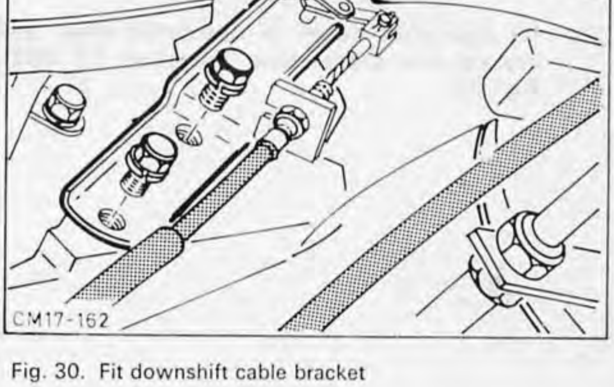


Fig. 30. Fit downshift cable bracket

PART 'A'

17 214 (cont'd)

23. Insert oil filler tube with sealing lip into transmission housing and attach to engine block with flange bolt.

24. Fit torque converter to drive plate and tighten bolts (3), Fig. 31.

Fig. 31. Torque converter to drive plate bolt

25. Bolt cover plate and gearshift cable to converter casing.

26. Install starter motor and connect cable.

27. Connect speedometer cable to transmission, Fig. 32.

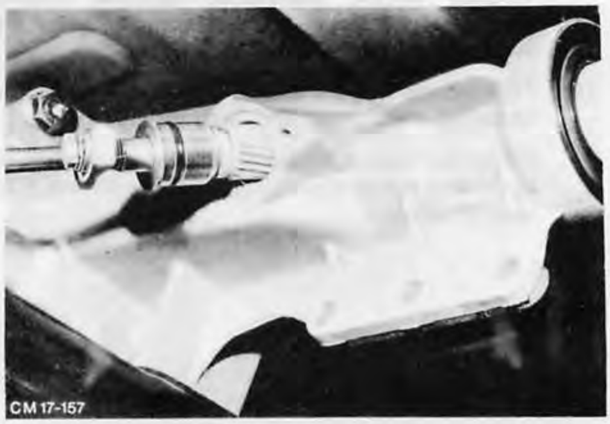


Fig. 32. Connect speedometer cable

28. Connect cable to starter inhibitor switch.

29. Fit downshift cable to downshift lever and bracket and adjust (see Operation 17 682), Fig. 33.

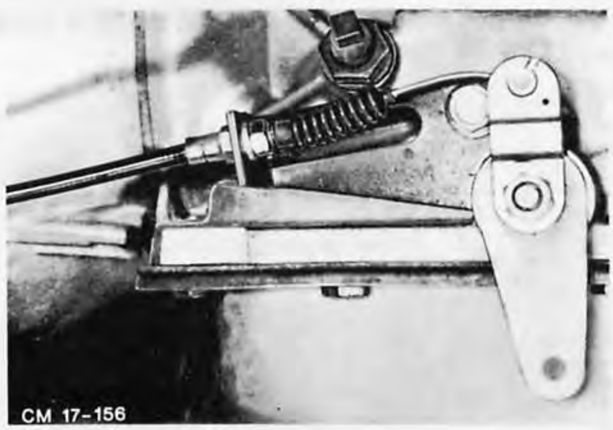


Fig. 33. Fit downshift cable

PART 'A'

30. Attach selector lever cable to transmission lever and bracket and adjust (see Operation 17 667), Fig. 34.

31. Connect vacuum pipe to vacuum diaphragm.

Fig. 34. Fit selector lever cable

32. Remove plug and attach oil pipes to transmission, Fig. 35.

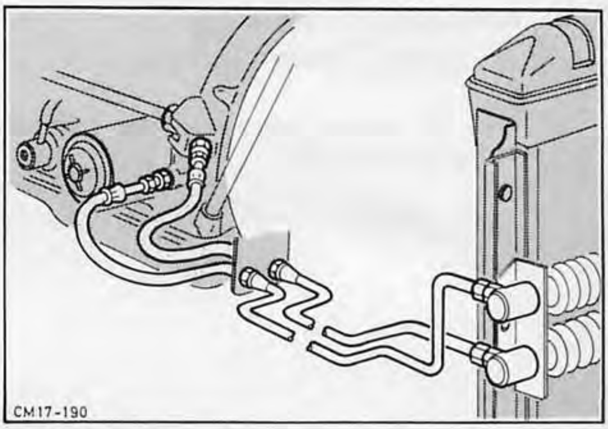


Fig. 35. Connect oil pipes to transmission

33. Remove plug from extension housing and fit driveshaft **without strain**, Fig. 36.

34. Fit exhaust pipe to exhaust manifold and hook into rear retaining strap.

35. Connect battery earth strap.

36. Top up with specified transmission oil (see 'Service Adjustments and Checks').

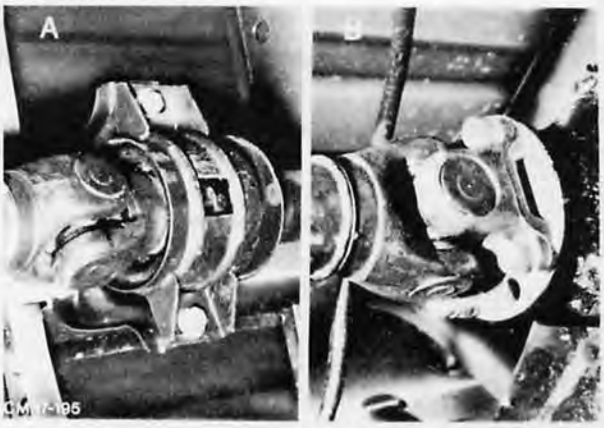


Fig. 36. Driveshaft installed
A – Centre bearing
B – Rear axle flange

PART 'A'

17 634 GEAR SELECTOR LEVER ASSEMBLY – REMOVE AND INSTALL

To Remove

1. Disconnect battery earth strap.
2. Remove instrument cluster cowl (2 bolts front, clipped in on top).
3. Remove instrument cluster complete with cover plate (2 bolts), Fig. 37. Disconnect cable connections and speedometer drive cable and lift out instrument cluster assembly.

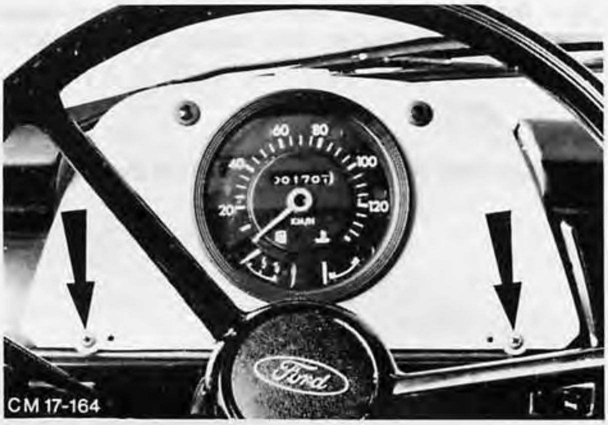


Fig. 37. Remove instrument cluster assembly

4. Remove selector lever knob.
5. Prise off selector lever escutcheon (clipped in at 3 points), Fig. 38.

Fig. 38. Lift off selector lever escutcheon

6. Remove escutcheon illumination.
7. Remove demister nozzle (inside left), (2 bolts), Fig. 39.
8. Remove fresh air and demister nozzle hoses (outside left) from distributor box and place on side.
9. Disconnect and remove heater control switch.
10. Disconnect and remove heated rear window switch (where fitted).

Fig. 39. Remove demister nozzle

PART 'A'

11. Disconnect selector cable from shift selector lever (1 split pin).

12. Remove selector lever with housing from instrument panel (6 bolts), Fig. 40.

Fig. 40. Remove selector housing bolts

To Install

13. Fit selector lever with housing and bolt to instrument panel, commencing with bottom bolts.
14. Attach selector cable to shift selector lever (1 split pin), Fig. 41.
15. Fit heated rear window switch and connect cable (where fitted).
16. Connect fresh air and demister nozzle hoses (outside left) to distributor box.
17. Fit demister nozzle (inside left).

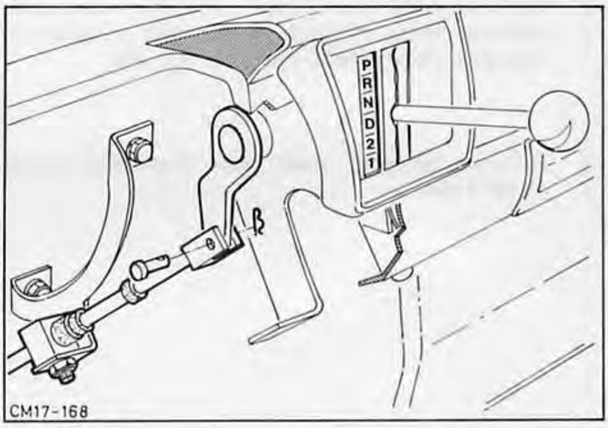


Fig. 41. Connect selector cable to shift selector lever

18. Fit escutcheon illumination assembly and install selector lever escutcheon, Fig. 42.
19. Connect cables and speedometer drive cable and fit instrument cluster complete with cover plate.
20. Fit instrument cluster cowl.
21. Fit selector lever knob.
22. Connect battery earth strap.

Fig. 42. Fit selector lever escutcheon

PART 'A'

17 634 8 SELECTOR LEVER ASSEMBLY – DISMANTLE AND REASSEMBLE (selector lever removed)

Special Service Tools Required: None

To Dismantle

1. Remove selector lever clip from selector housing (2 bolts), Fig. 43.

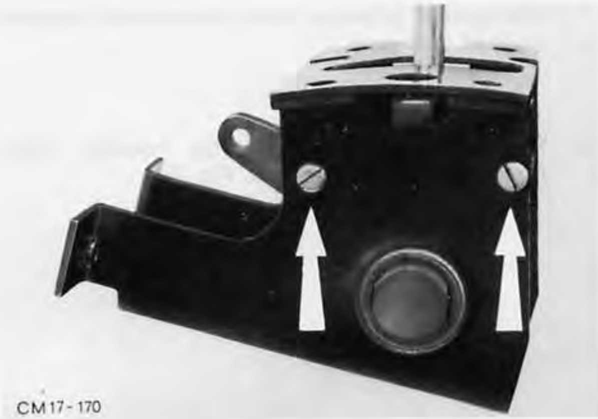


Fig. 43. Remove selector lever clip

2. Remove retaining clamp from yoke and slide selector lever through shift shaft installation aperture downwards and out, Fig. 44.

3. Remove selector lever yoke from shift shaft (1 split pin).

Fig. 44. Remove retaining clamp

4. Remove shift shaft from selector housing (1 circlip).

5. Press shift shaft bushes out of selector housing, using suitable length of tubing, Fig. 45.

Fig. 45. Press out shift shaft bushes

PART 'A'

To Reassemble

6. Drive shift shaft bushes flush with selector housing.

7. Install shift shaft (lightly greased) in housing and secure with circlip, Fig. 46.

Fig. 46. Install and secure shift shaft

8. Fit selector lever yoke to selector lever (1 split pin), Fig. 47.

Fig. 47. Fit selector lever yoke

9. From underside insert selector lever through shift shaft installation aperture, with the selector lever lock pin engaging in the yoke recess, Fig. 48. Secure selector lever by means of retaining clamp.

10. Attach selector lever clip and guide bushes to selector housing, using 2 bolts.

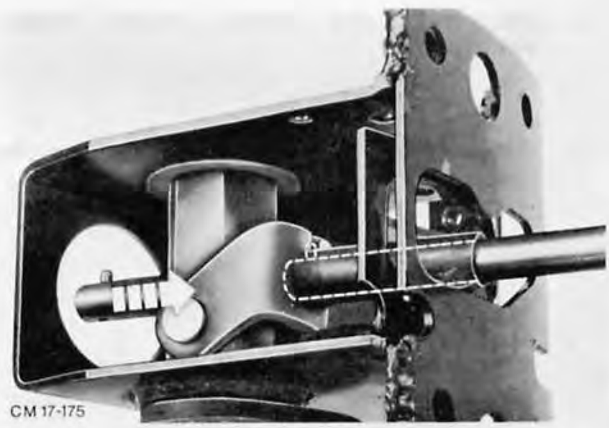


Fig. 48. Fit selector lever

PART 'A'

17 667 SELECTOR CABLE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Disconnect battery earth strap.
2. Remove selector cable from transmission lever (1 split pin).
3. Remove selector cable from converter housing bracket. Back off selector cable locking nut and unhook cable from bracket, Fig. 49.

Fig. 49. Remove selector lever cable

4. Remove instrument cluster cowl (2 front bolts, clip in top fitting).
5. Remove instrument cluster complete with cover plate (2 bolts). Disconnect cables and speedometer drive cable and lift out instrument cluster assembly, Fig. 50.

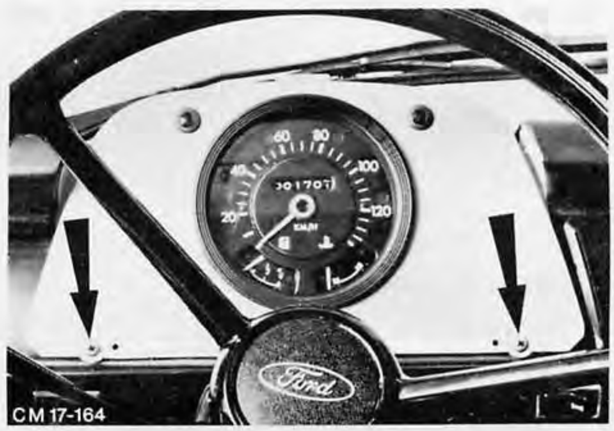


Fig. 50. Remove instrument cluster

6. Disconnect and remove heater blower switch.
7. Remove selector cable from shift shaft bracket (1 split pin), Fig. 51.

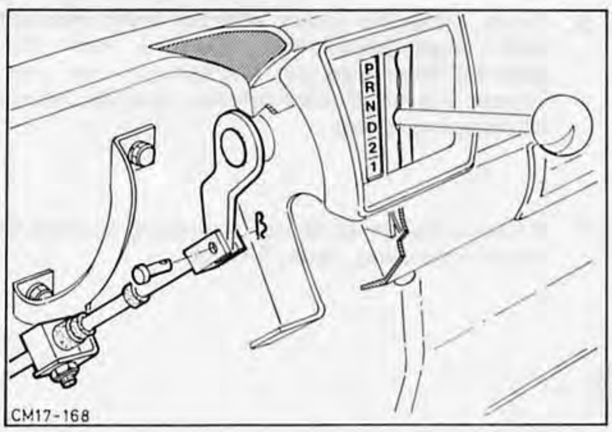


Fig. 51. Disconnect selector cable (split pin)

PART 'A'

8. Remove selector cable from heater assembly bracket (1 nut) and lift out cable assembly, Fig. 52.

To Install

9. Fit cable assembly and attach to heater assembly bracket (ensuring correct location and paying attention to rubber grommet).
10. Attach selector cable to shift shaft lever.
11. Connect heater assembly switch and install.

Fig. 52. Disconnect selector cable from heater assembly bracket

12. Connect cables and speedometer drive cable and fit instrument cluster complete with cover plate.

13. Fit instrument cluster cowl, Fig. 53.

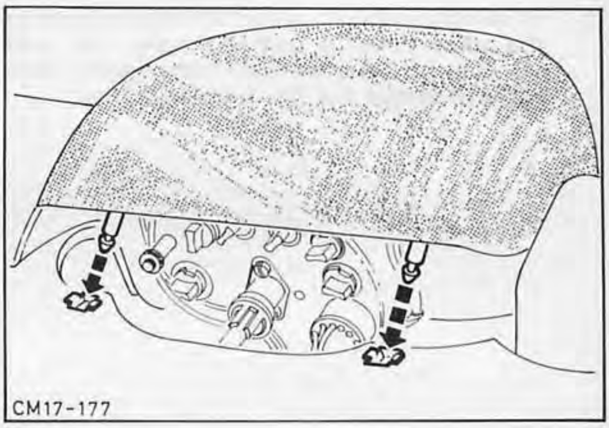


Fig. 53. Fit instrument cluster cowl

14. Engage selector lever in 'D' position, Fig. 54.

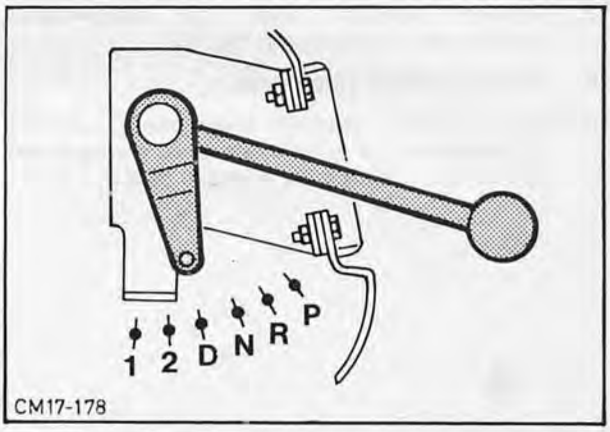


Fig. 54. Selector lever in 'D' position

PART 'A'

15. Move transmission selector lever to 'D' position, Fig. 55 (2 notches from front abutment).

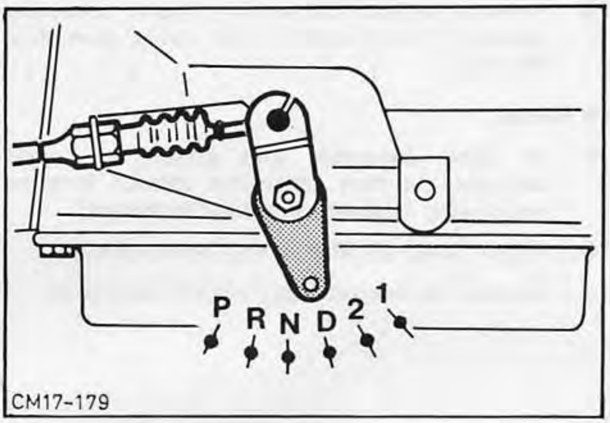


Fig. 55. Transmission selector lever in 'D' position

16. Fit selector cable to converter housing bracket and adjust cable in such a manner that split pin may be inserted into transmission lever **without strain**, Fig. 56. Tighten lock nut.

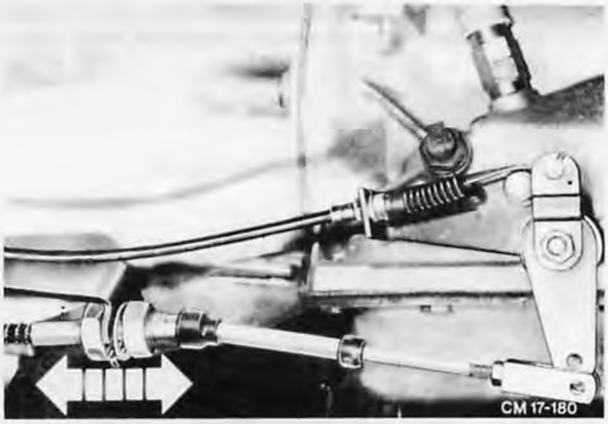


Fig. 56. Adjust cable

17. Connect selector cable to transmission selector lever and secure, Fig. 57.
18. Connect battery earth strap.
19. Using manual gearshift lever check whether all positions are obtainable and engagement can be felt. If necessary readjust cable.

Fig. 57. Fit cable

PART 'A'

17 683 DOWNSHIFT CABLE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove air filter.
2. Disconnect cable top end from carburettor linkage connecting lever (split pin), Fig. 58.

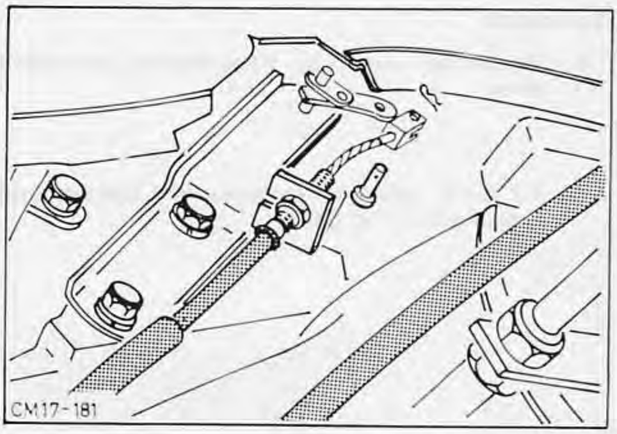


Fig. 58. Disconnect downshift cable from carburettor linkage connecting lever

3. Remove outer cable from top bracket. Unscrew adjusting nut from threaded coupling, pull outer cable right back and unhook from bracket (slot), Fig. 59.

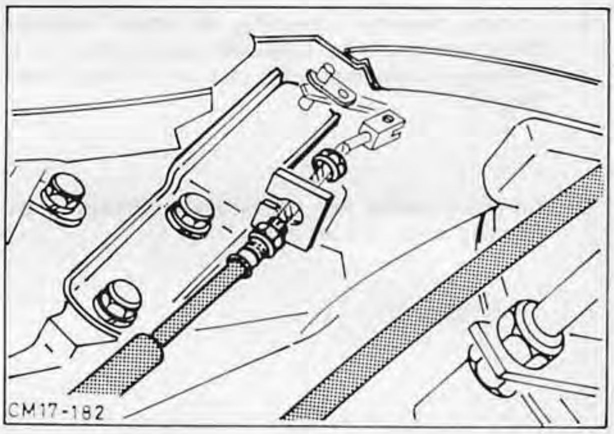


Fig. 59. Unhook outer cable from bracket (slot)

4. Remove outer cable from transmission bracket. Unscrew nut from threaded coupling and unhook cable from bracket (slot), Fig. 60.
5. Unhook cable from transmission downshift lever and withdraw cable assembly.

Fig. 60. Remove downshift cable from transmission and bracket

PART 'A'

To Install

6. Reconnect cable to transmission downshift lever.

7. Fit outer cable to transmission bracket and install cable, Fig. 61.

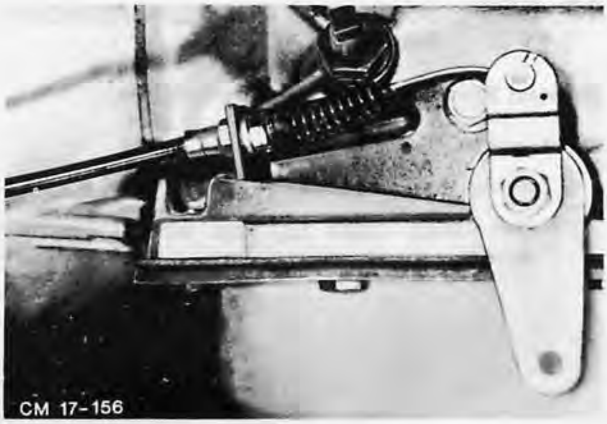


Fig. 61. Fit outer cable to transmission bracket

8. Locate threaded coupling in upper bracket. Inner nut must be screwed completely on to threaded coupling, outer nut only a few turns, Fig. 62.

9. Connect cable to carburettor linkage connecting lever (1 split pin).

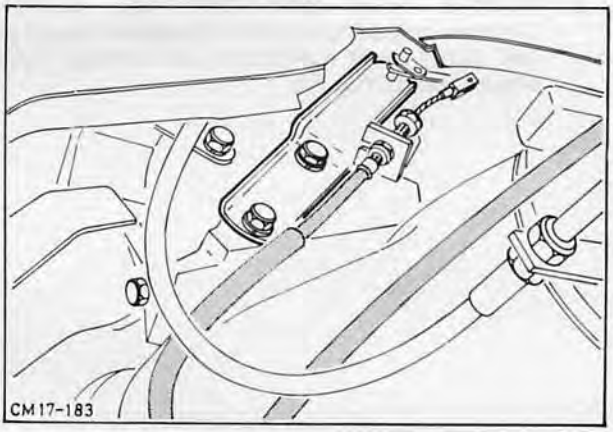


Fig. 62. Connect outer cable to upper bracket

10. Adjust downshift cable.
Before adjusting downshift cable check that the throttle plate is fully open when accelerator pedal is completely depressed.
Depress accelerator pedal far enough for throttle plate to fully open. Using screwdriver then press downshift cable lever away from operating shaft lever and shorten or lengthen cable by means of adjusting screws until clearance of 0,5 to 1,3 mm (0,02 to 0,05 in) is obtained between operating shaft lever and downshift cable, Fig. 63. Tighten lock nuts.

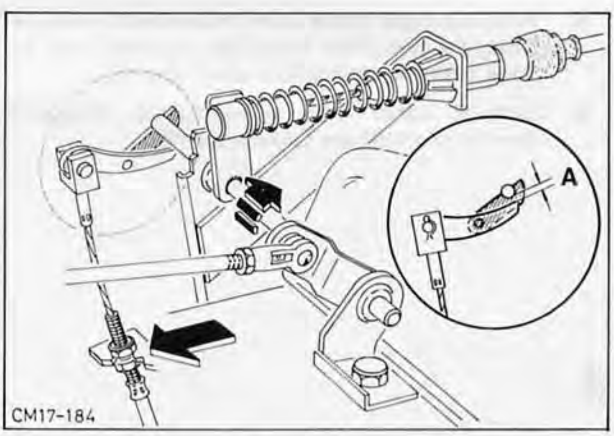


Fig. 63. Adjust downshift cable
A – 0,5 to 1,3 mm (0,02 to 0,05 in)

SERVICE AND REPAIR OPERATIONS – PART 'B'

17 111 AUTOMATIC TRANSMISSION ASSEMBLY – CHECK

Special Service Tools Required: None

1. Engine should start with selector lever in positions 'P' and 'N' only.
2. A slight response must always be felt when selecting positions R, D, 2 and 1.
3. Stall speed in selector positions 'D' and 'R' must be below 2600 rev/min. Unless fitted to the vehicle, connect a tachometer to the engine, locating the tachometer where it can be easily read from the driver's seat. Firmly apply the handbrake and actuate the foot brake.

   NOTE: The stall speed check must not be allowed to exceed 5 seconds, with intervals of approx. 15 seconds in position 'N'.
4. With gentle acceleration in position 'D' (accelerator pedal slightly depressed) and road speed below 45 km/h (28 mph) the transmission must change from 1st to 2nd gear and with road speed 60 km/h (37 mph) from 2nd to 3rd gear.
5. At full throttle (with kickdown) engine speed with changes from 1st to 2nd gear and from 2nd to 3rd gear should be 5300 rev/min.

   If, owing to local conditions, the speeds associated with the change from 2nd to 3rd gear are not practicable the following test should be carried out: If the accelerator pedal is fully depressed at 75 km/h (46 mph) (kickdown) with the selector lever in position 'D' the transmission must change down to 2nd gear.
6. At 50 km/h (30 mph) road speed, with the selector lever in position 'D' and the accelerator pedal depressed approximately three-quarters of its travel the transmission must change down to 2nd gear.
7. With gear change from 'D' to '1' at 90 km/h (56 mph) and accelerator pedal released the transmission should immediately change to 2nd gear and between 75 and 25 km/h (45 to 15 mph) an automatic downshift to 1st gear should occur.
8. When parking the vehicle on steep gradients engagement of the parking inhibitor gear must prevent any movement of the car. (Selector position 'P'.)

17 132 BRAKE BAND – FRONT – ADJUST

Special Service Tools Required:

Brake band torque wrench 17–005

1. Disconnect downshift cable from transmission downshift lever.
2. Slacken lock nut of adjustment screw and slacken adjustment screw by a few turns.
3. With torque wrench, Tool 17–005, tighten adjustment screw until wrench releases, Fig. 64.
4. **Slacken adjustment screw by 1½ turns and tighten lock nut.** The adjusting screw should not turn.
5. Replace downshift cable to downshift lever.

Fig. 64. Adjust brake band

PART 'B'

TRANSMISSION – EXPLODED VIEW

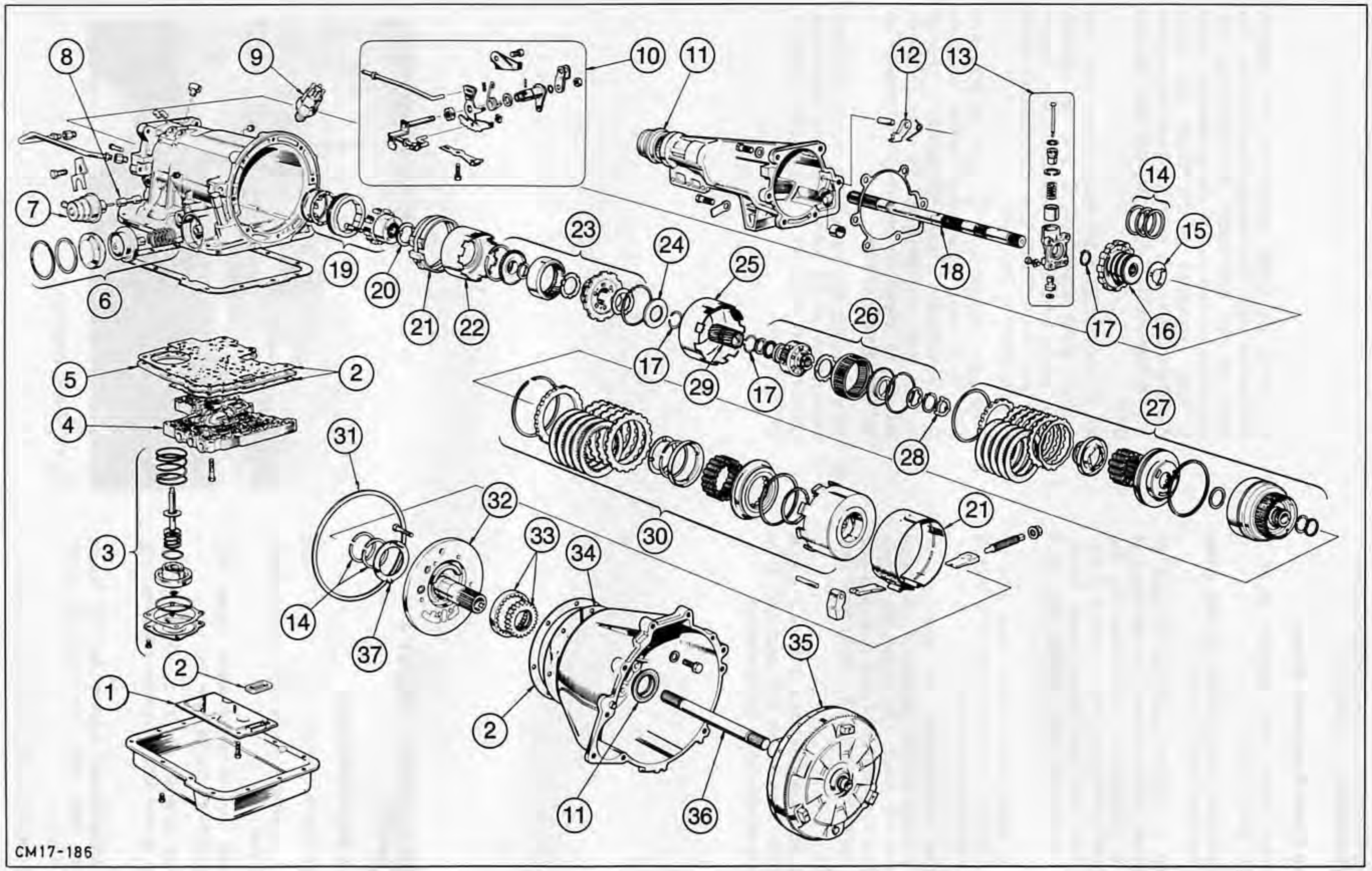


Fig. 65.

1. Filter
2. Gasket
3. Rear servo assembly
4. Valve body
5. Cover plate
6. Front servo assembly
7. Vacuum diaphragm
8. Throttle valve
9. Inhibitor switch
10. Interlock and parking mechanism
11. Oil seal
12. Parking pawl
13. Governor assembly
14. Piston rings
15. Thrust washer No. 8
16. Governor hub
17. Circlip
18. Output shaft
19. Free-wheel clutch
20. Thrust washer No. 7.
21. Brake band
22. Brake drum
23. Rear planet gear
24. Thrust washer No. 6
25. Input bell housing
26. Front planet gear
27. Forward clutch
28. Thrust washer No. 3
29. Sun gear
30. Reverse and direct drive clutch
31. Sealing ring
32. Oil pump
33. Oil pump gears.
34. Intermediate plate
35. Torque converter
36. Input shaft
37. Thrust washer No. 1

PART 'B'

17 214 8 AUTOMATIC TRANSMISSION ASSEMBLY – OVEHAUL (Transmission Removed)

Special Service Tools Required:

Transmission extension housing oil seal remover	17–001
Transmission extension housing oil seal replacer	17–002
Brake band torque wrench	17–005
Transmission mounting bracket	17–006
Clutch spring compressor	17–007
Selector lever oil seal replacer	17–008
Oil pump aligner	17–009–01
Pump housing oil seal installer	17–010
Pump housing oil seal remover	17–011
Piston rod checking gauge	17–012
Dial gauge mounting block	15–008

Fig. 66. Transmission with bracket 17–006 on stand

To Dismantle

1. Remove torque converter and withdraw input shaft. The oil removed from converter or residues contained in it, may be useful for diagnostic purposes (see also **Converter test and clean** under **General**). Mount transmission, with mounting bracket 17–006 on stand, Fig. 66.
2. In order to prevent oil sludge and swarf from penetrating into gearbox, remove oil sump (still filled with oil) downward (13 bolts), Fig. 67.

Fig. 67. Remove sump pan bolts

3. Swing transmission through 180° and remove filter (3 bolts), Fig. 68. Remove gasket.
4. Remove interlock spring (1 bolt), Fig. 68.

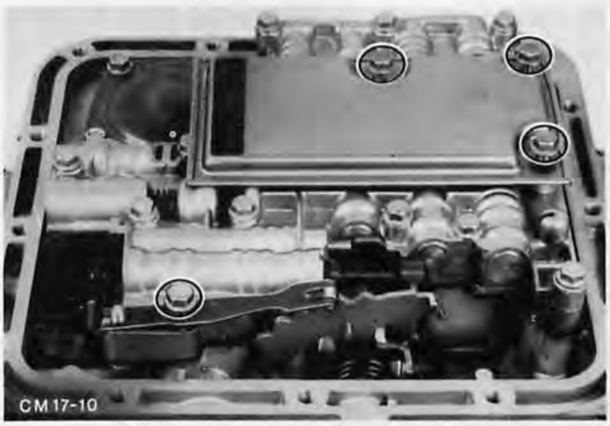


Fig. 68. Oil filter and interlock spring bolts

PART 'B'

17 214 8 (cont'd)

5. Slackening bolts (4) evenly, remove spring-loaded servo cover, Fig. 69. Remove servo piston and spring. Watch out for oil.

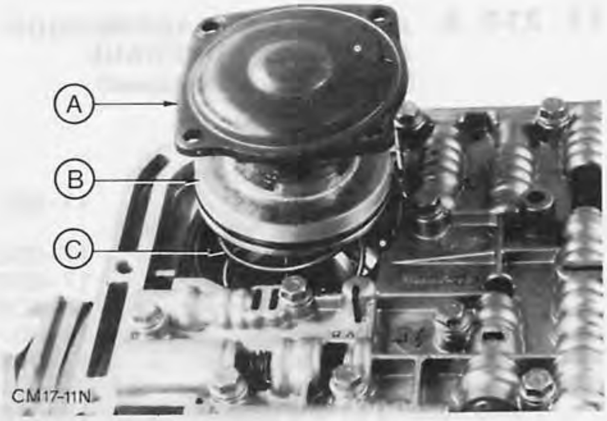


Fig. 69. Rear servo
A – Servo cover
B – Servo piston
C – Spring

6. Remove bolts (14) from valve body, Fig. 70. Raise valve body slightly and move it sideways so that selector lever connecting link slides out of manual selector stick. Remove valve body and gasket.

   Manual selector slide may slide out of valve body.

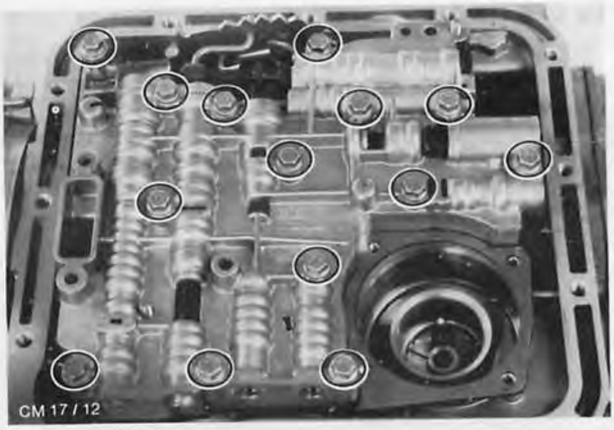


Fig. 70. Valve body bolts

7. Remove pump oil seal using Tool 17–011, holding tool with a spanner, Fig. 71.

Fig. 71. Remove pump oil seal using Tool 17–011

PART 'B'

8. Turn transmission into vertical position. Unbolt converter casing (8 bolts with aluminium washers) and remove complete with pump, Fig. 72. Remove thrust washer No. 1, gasket and sealing ring.

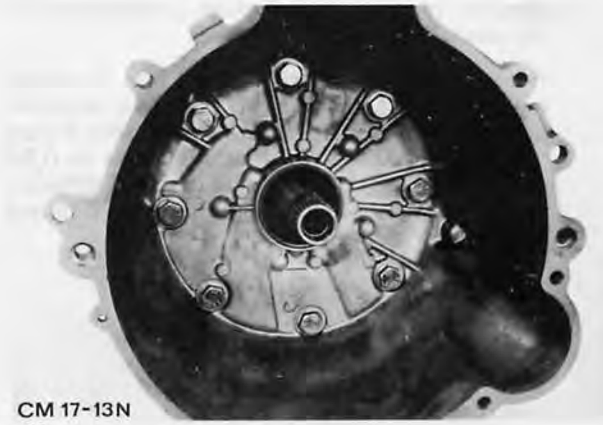


Fig. 72. Converter casing bolts

9. Detach pump from converter casing (5 bolts) and remove with intermediate plate, Fig. 73A. Mark oil pump gear engagement and then remove the gears. Check pump body for wear (suction/delivery side). See Fig. 73B.

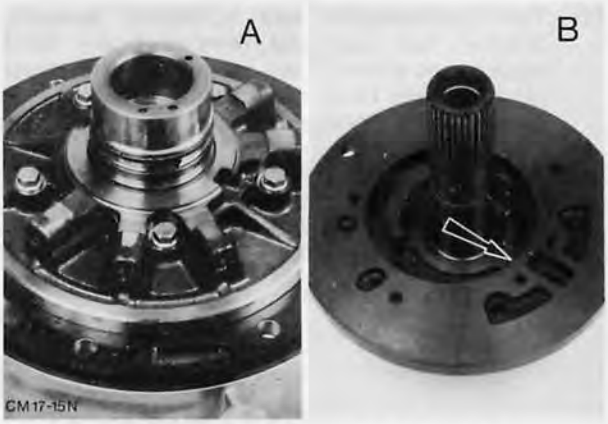


Fig. 73. A – Pump body bolts B – Pump body wear

10. Before proceeding further, measure end-float of assembly:

    Position pump body together with thrust washer No. 1 in transmission housing, making sure that front assembly is correctly engaged.

    Place gauge block 15–008 with dial gauge, on pump body. Set dial gauge to '0', Fig. 74.

Fig. 74. Set dial gauge on pump body to '0'

PART 'B'

17 214 8 (cont'd)

Position plunger of dial gauge on transmission housing. Note reading, Fig. 75.

Repeat procedure at point opposite. If second reading differs from first, add two together and divide by two to obtain mean. This should be within specified tolerance of 0,20 to 0,80 mm (0,008 to 0,032 in). If it is not, a different size thrust washer No. 1 should be used during subsequent reassembly.

Remove pump and thrust washer.

Fig. 75. Dial gauge on transmission housing

11. Turn transmission into horizontal position. Slacken lock nut and remove brake band adjustment screw. Take out brake band struts (2) and brake band. (To facilitate removal and reinstallation, brake band may be held with a brass clip, Fig. 76.)

Fig. 76. Brake band with brass clip fitted

12. Remove front assembly and thrust washer No. 5, Fig. 77.

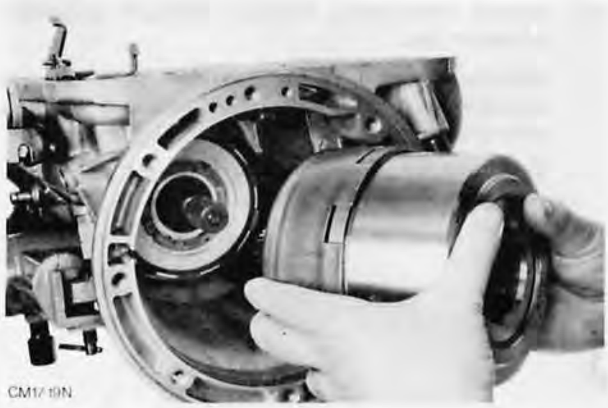


Fig. 77. Remove front assembly

PART 'B'

13. Press front servo cover **slightly** inwards and remove circlip. Carefully push servo piston out with compressed air, Fig. 78. It may be necessary to cover up the two bores. Watch out for oil leakage. Separate piston from cover.

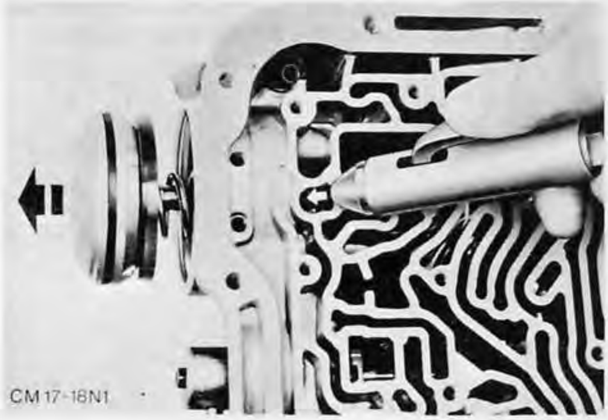


Fig. 78. Use compressed air to remove servo piston

14. Remove extension housing bolts (6). Remove extension housing together with gasket, Fig. 79. Remove parking pawl return spring together with pawl. Remove bolt from extension housing.

Fig. 79. Remove extension housing

15. Remove large circlip from rear planet carrier, Fig. 80. Take out planet carrier together with thrust washer No. 5. Then remove small circlip from output shaft, Fig. 80.

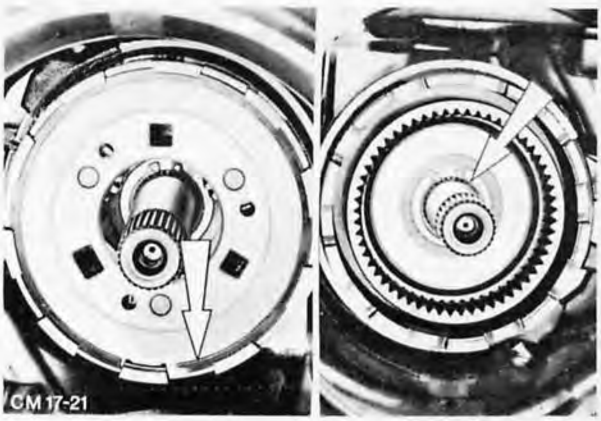


Fig. 80. Planet carrier circlip and output shaft circlip

PART 'B'

17 214 8 (cont'd)

16. Withdraw output shaft complete with governor and thrust washer No. 8 from rear, Fig. 81.

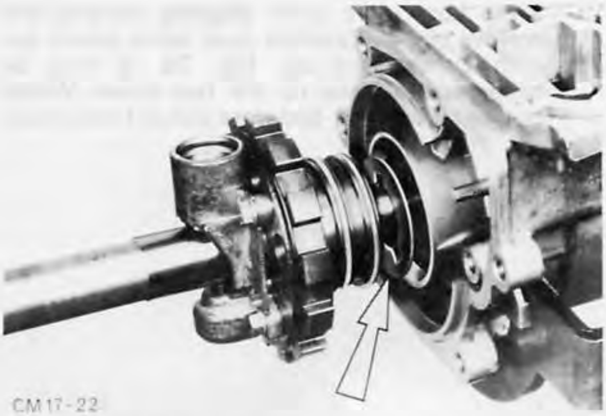


Fig. 81. Output shaft complete with governor and thrust washer No. 8

17. Take out annulus, brake drum, rear brake band and thrust washer No. 7 from transmission housing, Fig. 82.

Fig. 82. Remove annulus, brake drum and rear brake band

18. Remove one-way clutch inner ring (5 Allen screws), Fig. 83. Check inner ring for wear.

Fig. 83. One-way clutch inner ring Allen screws

PART 'B'

19. Remove bolt securing vacuum diaphragm retainer to transmission housing. Remove vacuum diaphragm and actuating pin, then withdraw throttle valve from housing with aid of a magnet. Remove O-ring from diaphragm, Fig. 84.

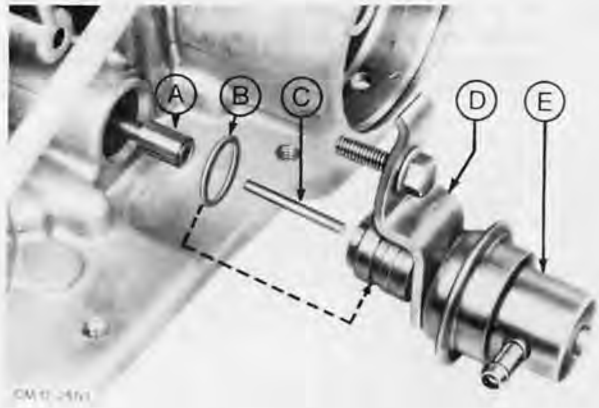


Fig. 84. Remove vacuum diaphragm
A – Throttle valve
B – O-ring
C – Actuating pin
D – Vacuum diaphragm retainer
E – Vacuum diaphragm

20. Unscrew starter inhibitor switch and remove O-ring, Fig. 85. Remove downshift cable bracket.

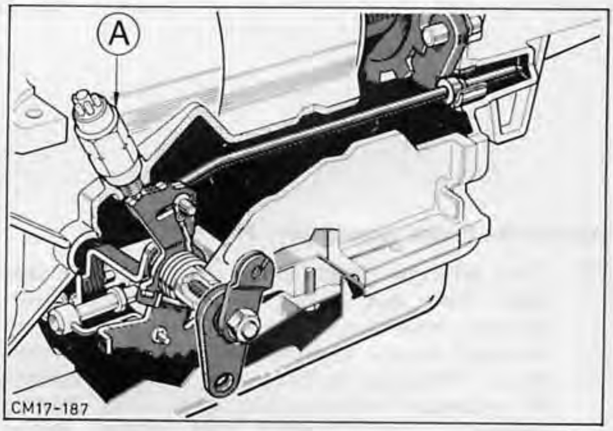


Fig. 85. Interlock and parking pawl mechanism
A – Starter inhibitor switch

Selector Lever Oil Seal – Renew

21. Remove downshift lever and press downshift lever shaft inwards. Remove O-ring. Withdraw selector lever locking pin with pliers. Remove inner selector lever nut and press off interlock. Release and remove parking pawl actuating rod. Remove selector lever from outside and downshift lever shaft from inside, Fig. 86. Carefully prise oil seal out with a screwdriver.

A – Manual selector slide
B – Downshift lever shaft
C – Parking pawl actuating rod
D – Torsion spring
E – Clip
F – Selector lever
G – O-ring
H – Downshift lever
J – Pin
K – Lock washer
L – Interlock
M – Tie rod

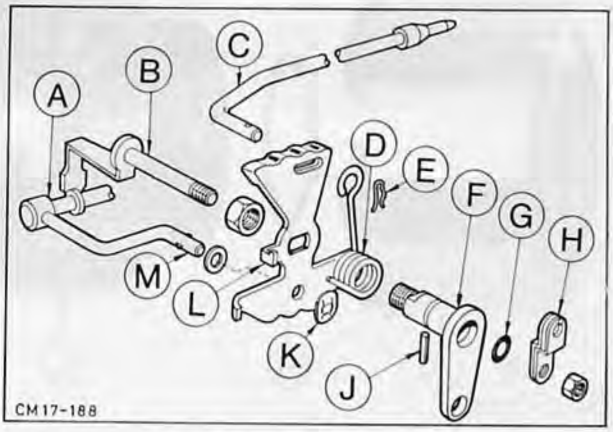


Fig. 86. Interlock and parking pawl assembly dismantled

PART 'B'

17 214 8 (cont'd)

22. Fit a new oil seal using Tool 17–008, Fig. 87. Install downshift lever shaft with nut on it, shift stop and spring from inside and selector lever from outside.

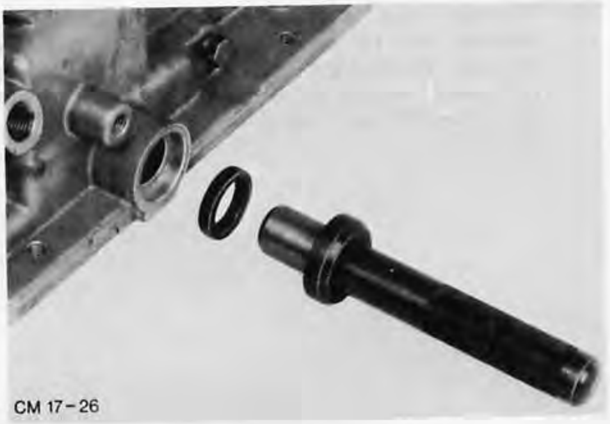


Fig. 87. Press in oil seal using Tool 17–008

Dismantle Front Assembly, Fig. 88

23. Take off input bell-housing complete with sun gear. Take out planet carrier together with annulus and thrust washer No. 3. Remove forward clutch together with thrust washer No. 2. (Reverse and top gear clutch remain.) If necessary remove sun gear after having removed locking plate and renew thrust washer No. 6.

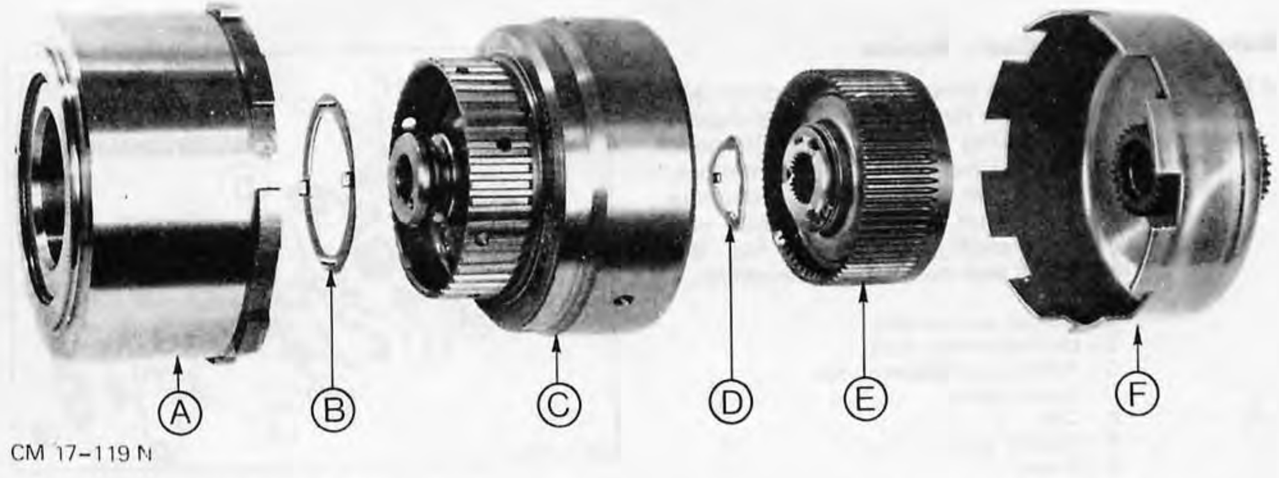


Fig. 88. Front assembly dismantled
A – Reverse and top gear clutch
B – Thrust washer No. 2
C – Forward clutch
D – Thrust washer No. 3
E – Annulus with hub and circlip
F – Input bell-housing with sun gear and thrust washer No. 6

PART 'B'

Dismantling Reverse and Top Gear Clutch

24. Remove pressure plate circlip, Fig. 91, and take out plate pack. Compress springs using Tool 17–007, Fig. 89, remove circlip, slowly release springs and take out springs and spring retainer.

Fig. 89. Compress springs using Tool 17–007

Withdraw hydraulic piston by hand or, if necessary, push it out with compressed air applied through channel in pump body, Fig. 90. Remove sealing rings from piston.

Fig. 90. Remove hydraulic piston using compressed air

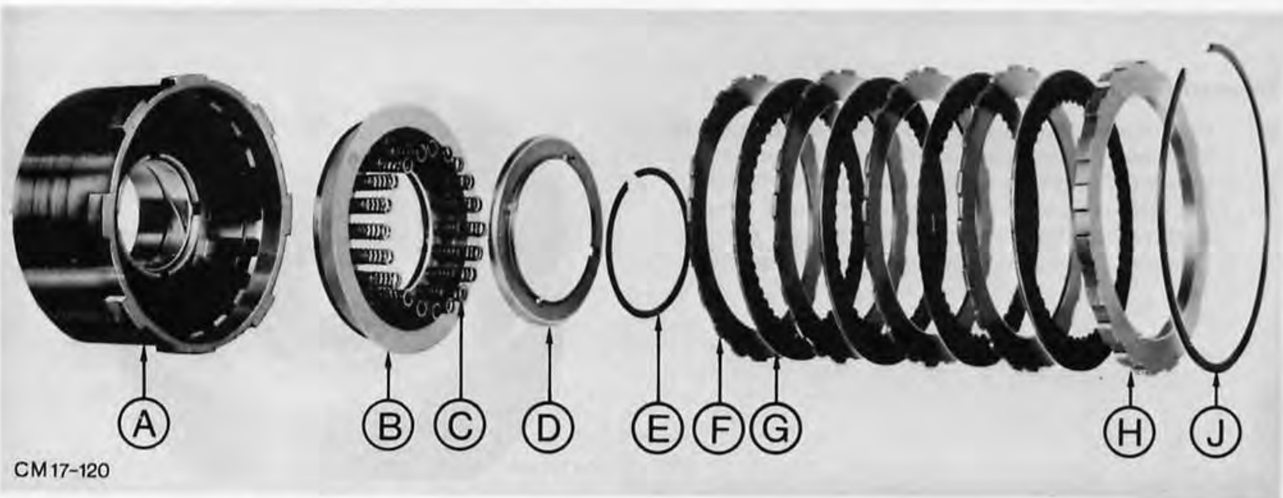


Fig. 91. Reverse and top gear clutch dismantled
A – Clutch body
B – Hydraulic piston with sealing rings
C – Springs (20-off)
D – Spring retainer
E – Circlip
F – Secondary clutch plate
G – Primary clutch plate
H – Retaining plate
J – Circlip

PART 'B'

17 214 8 (cont'd)

Assembly of Reverse and Direct Drive Clutch

Inspect secondary and primary clutch plates for wear damage or effects of overheating and if necessary renew whole plate pack. Immerse new clutch plates in automatic transmission fluid for ½ hour before fitting.

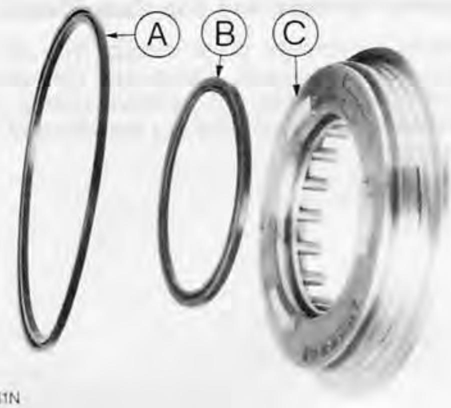


Fig. 92. Reverse and top gear clutch piston
A – Sealing ring (outer)
B – Sealing ring (inner)
C – Clutch piston

25. Fit new sealing rings on piston, Fig. 92, sealing lips facing compression chamber. Carefully insert clutch piston moving it gently to and fro. Fit springs (20) and spring retainer. Compress springs using Tool 17–007 and insert circlip. Remove tool. Insert clutch plates in correct order (secondary, primary (lined), alternately), fit retaining plate, Fig. 91, and secure with a circlip. Press clutch plates tightly together and measure clearance between circlip and pressure plate with a feeler gauge, Fig. 93.

    If clearance is outside specified limits, 1,4 to 2,1 mm (0,055 to 0,083 in), an appropriate circlip should be fitted (for selection, see Parts Catalogue).

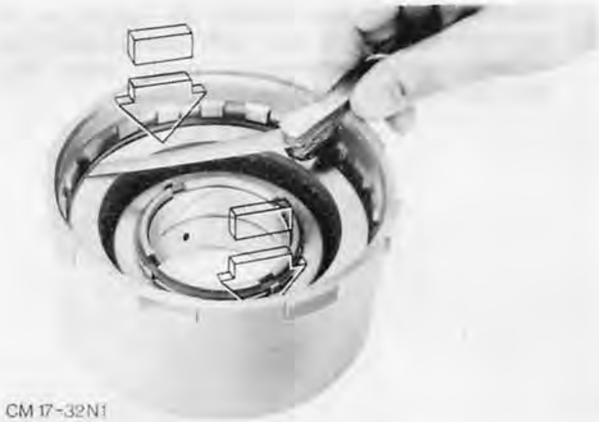


Fig. 93. Measure clearance between circlip and pressure plate

Dismantling Forward Clutch

26. Remove circlip in front of pressure plate and take out plate pack together with corrugated washer. Compress springs using Tool 17–007, Fig. 94, taking care not to damage piston. Remove circlip and carefully release springs. Take out spring retainer together with springs.

Fig. 94. Compress springs using Tool 17–007

PART 'B'

Turn clutch body round and insert pump stub into clutch body. Carefully blow compressed air into pump port shown and push piston out, Fig. 95. Remove pump. Remove rubber sealing rings from piston and, if necessary, piston rings from clutch body.

Fig. 95. Remove clutch piston using compressed air

Assembling Forward Clutch

Check primary and secondary clutch plates for wear, damage due to overheating and renew whole plate pack if necessary. Immerse new clutch plates in automatic transmission fluid for $\frac{1}{2}$ hour before fitting.

27. Lubricate new sealing rings with automatic transmission fluid and fit them on to clutch piston. Press piston in **carefully** by hand, slowly rotating it.

    Insert springs (15) and spring retainer, Fig. 96. Compress springs using Tool 17–007 and fit circlip. Insert corrugated washer and then clutch plates in correct order (grooved washer secondary and primary, alternately), fit pressure plate, Fig. 97, and secure with a circlip. Measure clearance between circlip and pressure plate as described in sub-operation 25 and correct if necessary.

Fig. 96. Clutch body and piston, with springs fitted

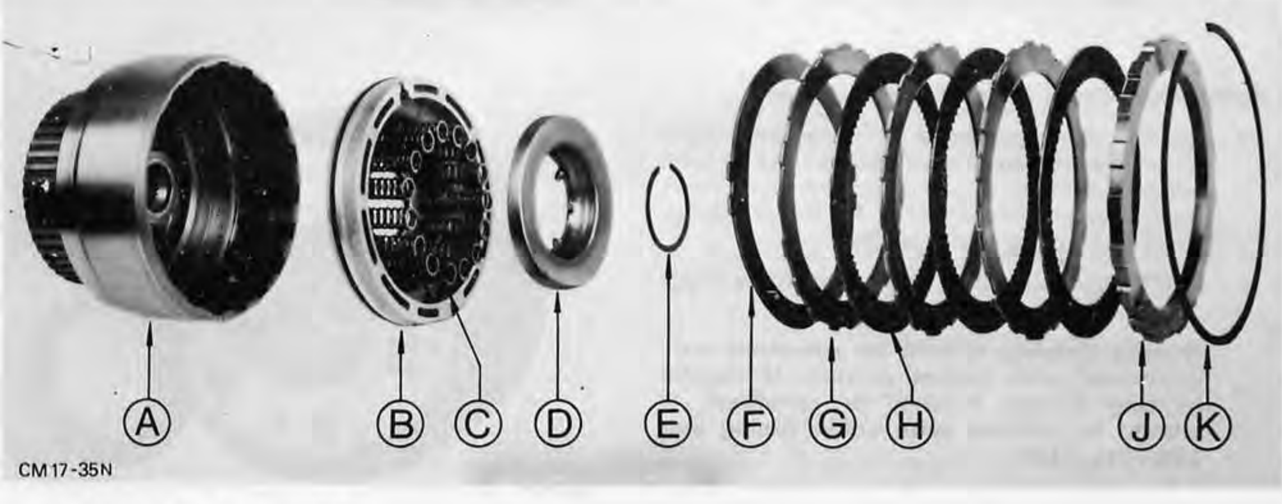


Fig. 97. Forward clutch, dismantled
A – Clutch body
B – Hydraulic piston with sealing rings
C – Springs (15-off)
D – Spring retainer
E – Circlip
F – Corrugated washer
G – Secondary plate
H – Primary plate
J – Pressure plate
K – Circlip

PART 'B'

17 214 8 (cont'd)

Carefully fit new piston rings on to clutch stub, Fig. 98.

Fig. 98. Clutch stub sealing rings

Dismantling Front Planet Gear Assembly

28. Remove circlip and annulus plus planet carrier and take off thrust washer No. 4. Separate annulus from planet carrier and remove thrust washer No. 5, Fig. 99.

A – Circlip
B – Thrust washer No. 4
C – Annulus with hub and circlip
D – Thrust washer No. 5
E – Planet carrier
F – Needle bearing thrust washer

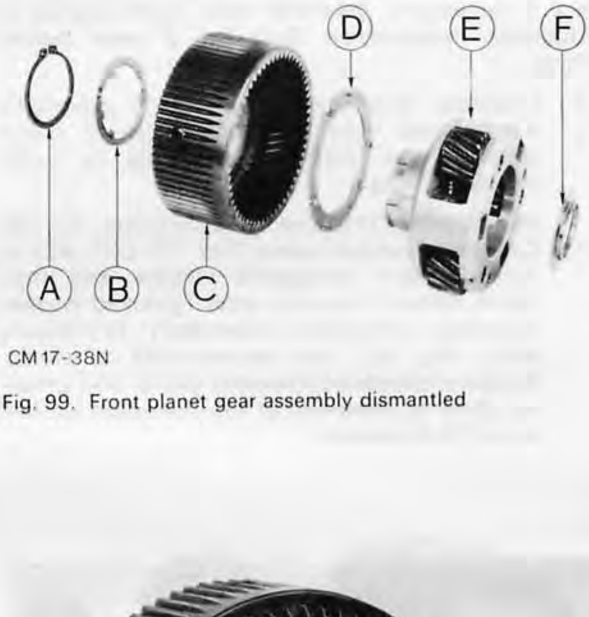


Fig. 99. Front planet gear assembly dismantled

Assembling Front Planet Gear Assembly

29. Renew damaged parts if necessary. Stick thrust washer No. 5 on to planet carrier with aid of automatic transmission fluid and insert them together into annulus. Fit thrust washer No. 4 and secure it with circlip.

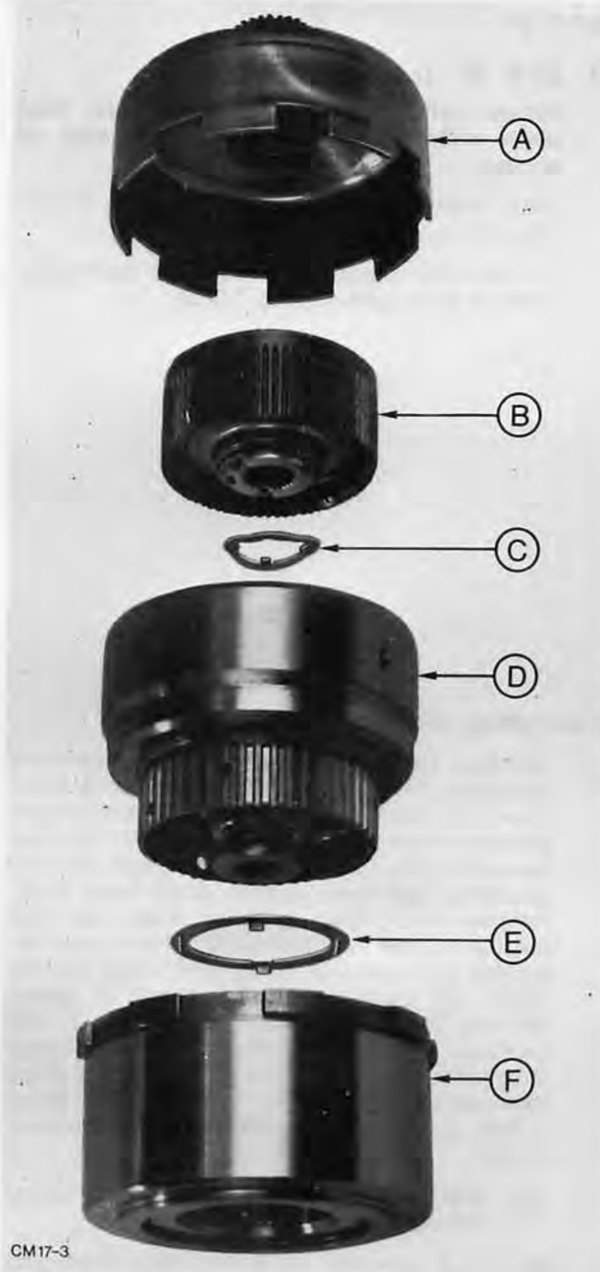
NOTE: Annulus should be able to rotate freely on planet carrier.

Needle bearing should be renewed only complete with planet carrier. If needle bearing thrust washer is removed, it should be refitted with collar facing sun gear, Fig. 100.

Fig. 100. Needle bearing thrust washer

PART 'B'

Fig. 101. Front assembly dismantled
A – Input bell-housing with sun gear and thrust washer No. 6
B – Annulus with front planet gear
C – Thrust washer No. 3
D – Forward clutch
E – Thrust washer No. 2
F – Reverse and top gear clutch



Assembling Front Assembly

30. Place reverse and top gear clutch vertically on an assembly bench. Fit thrust washer No. 2 and insert forward clutch (together with the planet gear assembly previously fitted). Stick thrust washer No. 3 to planet carrier with grease (vaseline) and insert together with annulus into forward clutch. During assembly, rotate hub of forward clutch slightly so that reverse and top gear clutch plate pack engages. Insert sun gear in planet carrier and body of reverse and top gear clutch, Fig. 101.

Dismantling and Reassembling One-way Clutch

31. Remove one-way clutch circlip from brake drum. Take out roller cage with springs and rollers (10), Fig. 102. (Springs are pushed on to cage.)

    Fit roller cage and springs and secure with circlip. Compress springs with screwdriver and fit rollers.

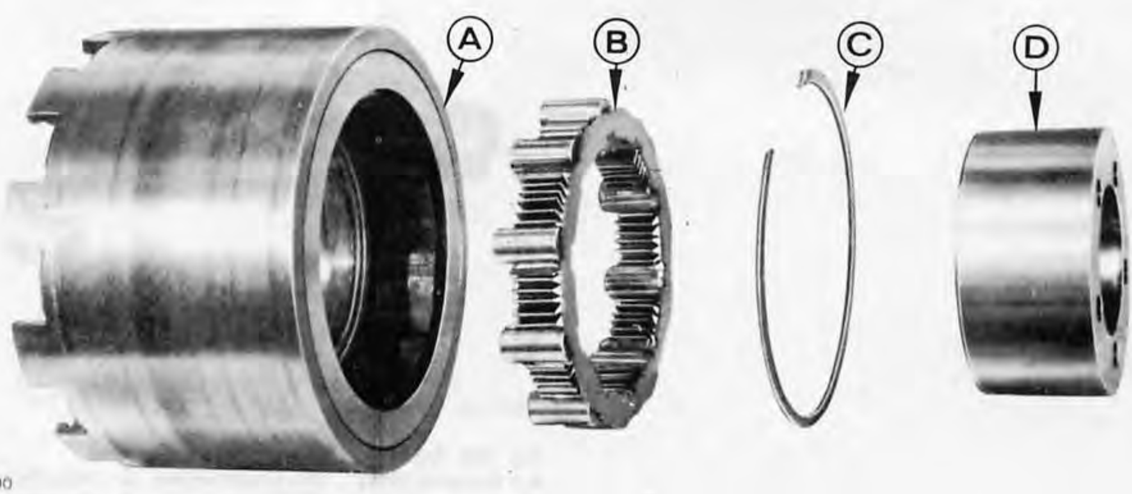


Fig. 102. Freewheel mechanism (exploded)
A – Rear brake drum with outer freewheel ring
B – Roller cage with fitted springs and rollers
C – Circlip
D – Inner freewheel ring

PART 'B'

17 214 8 (cont'd)

When refitting rollers make sure that each roller is in contact with end of spring.

With inner ring fitted, check operation of one-way clutch, Fig. 103A.

Fit one-way clutch complete with rear brake drum (5 Allen screws), Fig. 103B.

Fig. 103. A – Check operation of one-way clutch
B – Clutch inner ring recuring bolts

Dismantling and Reassembling Governor

32. Remove circlip from governor rod (without damaging bearing surface of rod) and withdraw rod. Take out governor valve and detach governor from governor hub, Fig. 104. Remove governor body from output shaft from rear and governor hub from output shaft from front. Remove circlip from governor body and take out flyweights. Remove circlip from outer flyweight and take out spring and inner weight. Clean all parts, renewing them if worn. Remove piston rings from governor hub and carefully fit new rings. Piston ring gaps must always be checked prior to fitting piston rings. Reassemble governor in reverse order using a new spring clip, Fig. 105. After reassembly, check:

    (a) that spring clip is up against outer shoulder on governor rod;

    (b) that governor valve and two flyweights move freely.

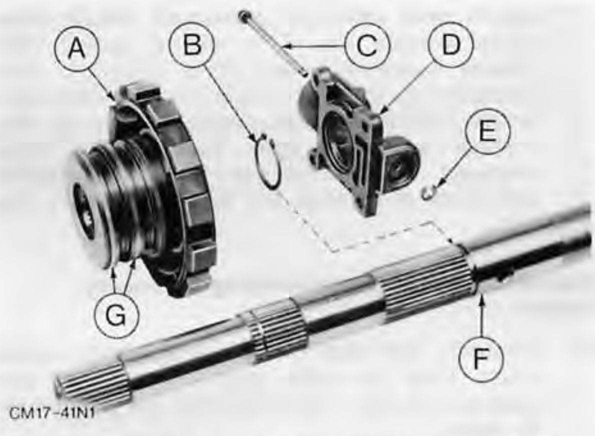


Fig. 104. Output shaft with governor and governor hub
A – Governor hub
B – Circlip
C – Governor rod
D – Governor body
E – Spring clip
F – Output shaft
G – Piston rings

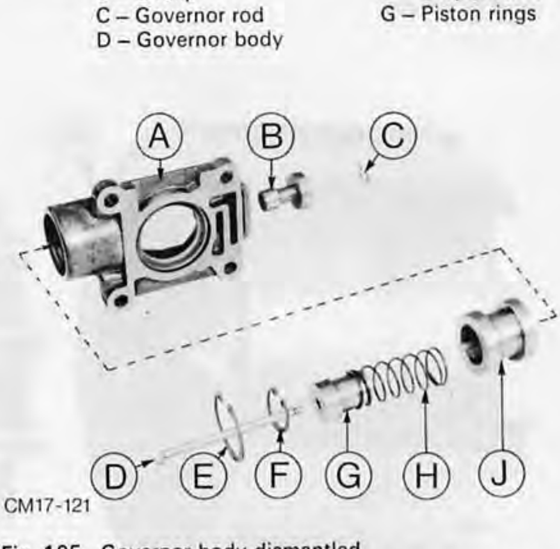


Fig. 105. Governor body dismantled
A – Governor body
B – Governor valve
C – Spring clip
D – Governor rod
E – Circlip
F – Circlip
G – Inner flyweight
H – Governor spring
J – Outer flyweight

PART 'B'

Servo Piston

33. If necessary renew 'O'-rings of front servo piston, Fig. 106.

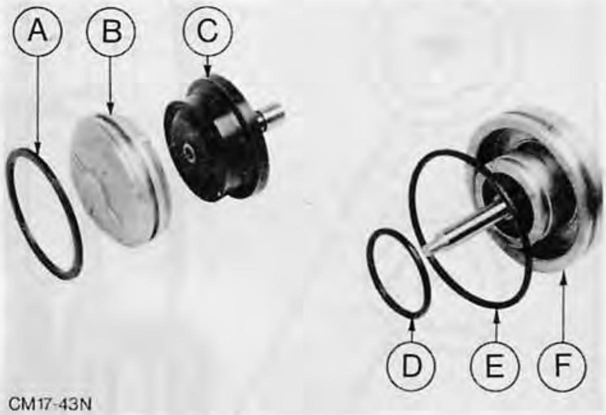


Fig. 106. Front and rear servo pistons
A – O-ring
B – Servo cover
C – Front servo piston
D – O-ring
E – O-ring
F – Rear servo piston

To Reassemble Transmission

NOTE: Before reassembly, lightly lubricate all sliding parts with specified automatic transmission fluid.

During reassembly stick thrust washers on to mating parts, using vaseline, Fig. 109.

34. Press a new hydraulic pump oil seal into converter housing using Tool 17–010, Fig. 107.

Fig. 107. Press in hydraulic pump oil seal using Tool 17–010

35. Fit throttle valve (with bore facing outwards) and install actuating pin and vacuum diaphragm with a new 'O'-ring, Fig. 108. Fit bracket (1 bolt). Diaphragm should be firmly up against housing. Bracket should not be distorted.

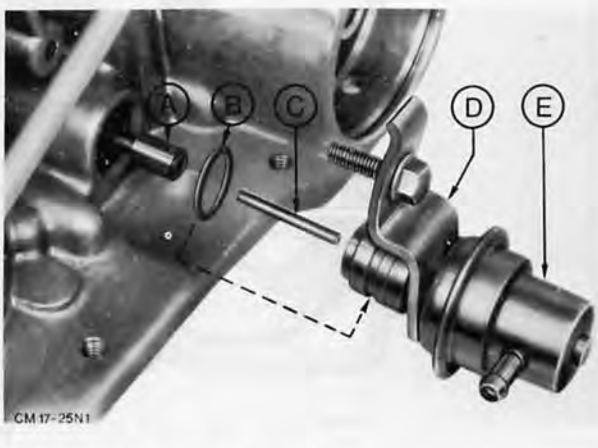


Fig. 108. Fit vacuum diaphragm
A – Throttle valve
B – O-ring
C–Actuating pin
D – Vacuum diaphragm bracket
E – Vacuum diaphragm

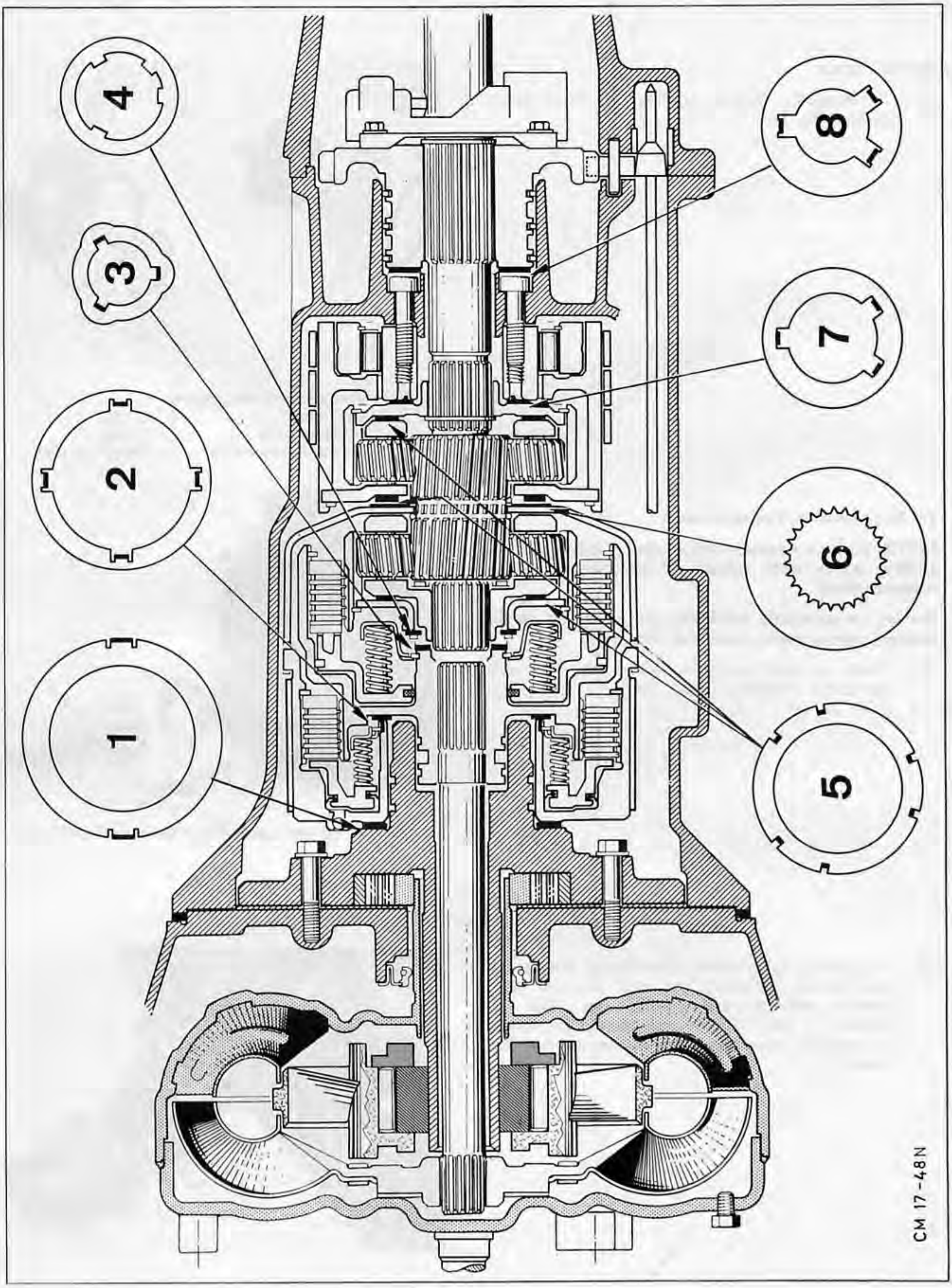


Fig. 109 Location and numbering of various thrust washers in transmission assembly
Thrust washer No. 1 is available in five different thicknesses; thrust washer No. 5 is available in three different thicknesses and fitted as follows:
(a) in front of the front planet carrier (b) in front of the rear planet carrier (c) behind the rear planet carrier

PART 'B'

36. Fit thrust washer No. 8, Fig. 110, in transmission housing.

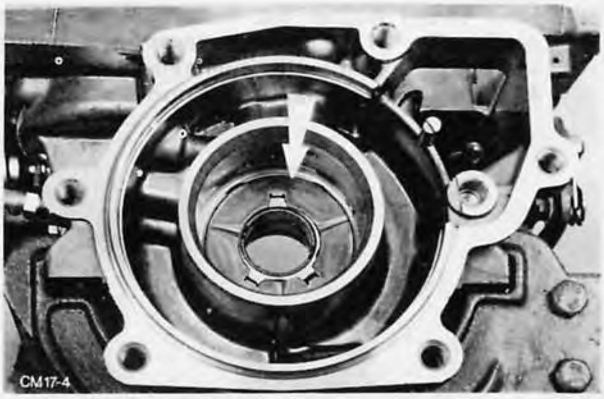


Fig. 110. Thrust washer No. 8

37. Install output shaft complete with governor, taking care not to damage piston rings on governor hub, Fig. 111.

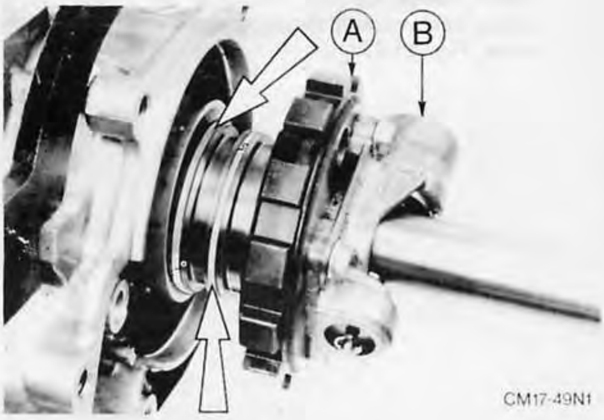


Fig. 111. Output shaft complete with governor
A – Governor hub
B – Governor body

38. Fit thrust washer No. 7 into housing, Fig. 112. Install annulus and secure with circlip.

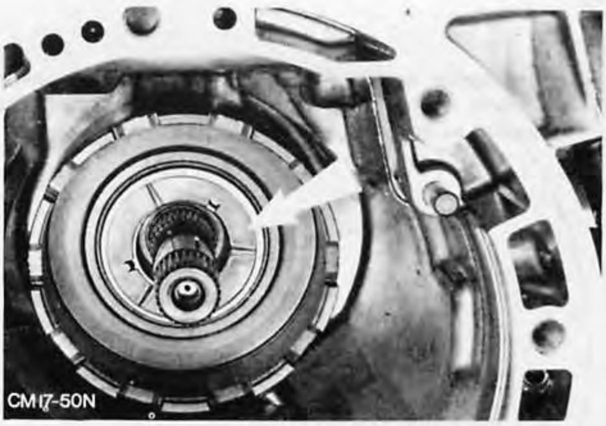


Fig. 112. Thrust washer No. 7 in transmission housing

PART 'B'

17 214 8 (cont'd)

39. Stick thrust washer No. 5 to back of planet carrier, Fig. 113. Fit planet carrier and secure with circlip. To do this pull rear brake drum forward a little so that circlip groove is free.

Fig. 113. Insert thrust washer No. 5 together with planet carrier into transmission housing

40. Locate rear brake band (with two recesses on abutment pins) in housing. Fig. 114

Then check correct location of brake band, using screwdriver through rear servo operating bore, Fig. 114.

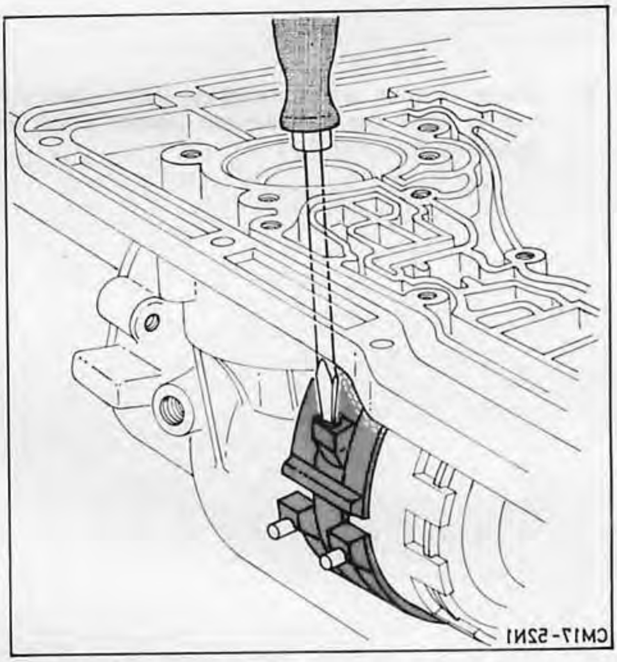


Fig. 114. Check brake band location, using screwdriver through rear servo operating bore

41. Immerse servo piston in oil and fit cover. Insert coil spring and piston complete with cover in housing and secure, Fig. 115.

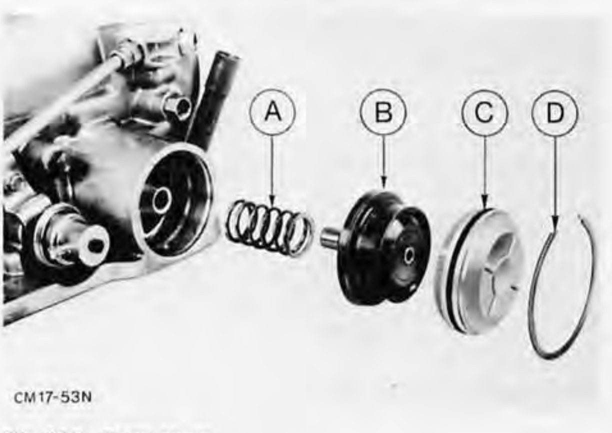


Fig. 115. Front servo
A – Spiral spring
B – Servo piston
C – Servo cover with O-ring
D – Circlip

PART 'B'

42. Stick thrust washer No. 5 on to planet carrier and ensure that intermediate lever of front brake band is in downward position. Fit completed front assembly while turning output shaft slightly, Fig. 116. When fitting front assembly take care that parts do not become separated.

Fig. 116. Insert completed front assembly into transmission housing

43. Place front brake band in position and fit struts together with adjustment screw, starting with strut nearest servo piston, Fig. 117. Remove brass clip. Screw adjustment screw in far enough to make it impossible for struts to fall out.

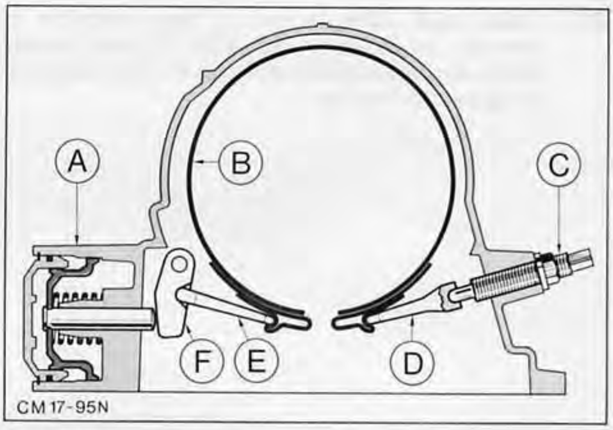


Fig. 117. Front brake band fitted
A – Front servo
B – Brake band
C – Brake band adjustment screw
D – Strut
E – Strut
F – Intermediate lever

44. Turn transmission round on stand until output shaft faces downwards. Carefully insert hydraulic pump body together with thrust washer No. 1 into front assembly, Fig. 118.

In process, do not damage piston rings and ensure that thrust washer No. 1 sticks to pump body.

Measure end-float as described in sub-operation 10.

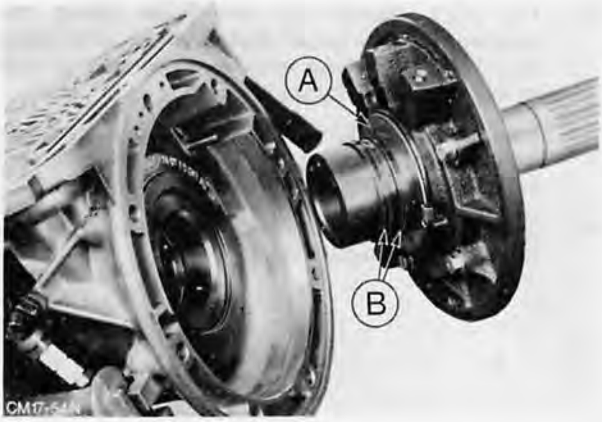


Fig. 118. A – Thrust washer No. 1
B – Piston rings

PART 'B'

17 214 8 (cont'd)

45. Remove hydraulic pump body again, while holding front gear train with a screwdriver. Fig. 119A.

    When installing, small gear wheel should be fitted with recess **upwards** and large gear wheel with spot mark **downwards,** Fig. 119B.

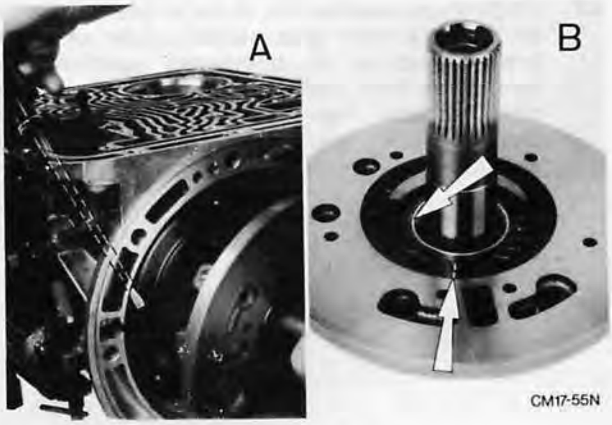


Fig. 119. A – Removing pump body
B – Relative positioning of pump gear wheels

46. Place steel plate on pump (pay attention to position of bores), Fig. 120. Slowly rotate pump and steel plate and place them together on converter casing.

Fig. 120. Align bores in steel plate with hydraulic pump and converter casing

47. Fig. 121. Screw up the bolts fixing the hydraulic pump finger tight at first, and apply tool 17–009–01 far enough to cause the stub to engage in the hydraulic pump.

    Insert the output shaft into the pump and lightly tighten the bolts. Now rotate tool and impeller clockwise to check for free rotation.

48. Tighten bolts to specified torque and remove tool (see Technical Data).

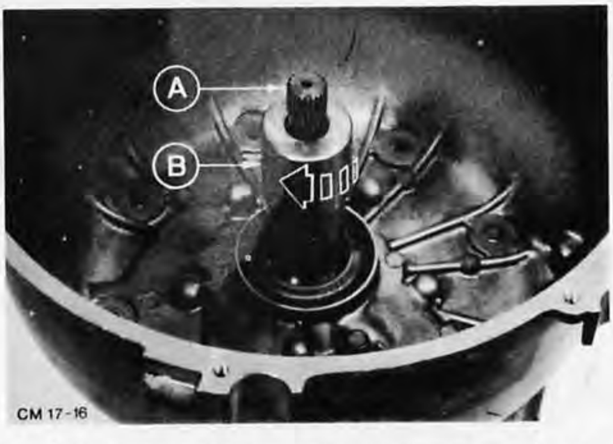


Fig. 121. Centring of converter housing/pump using Special Tool 17–009–01
A – Input shaft
B – Special Tool 17–009–01

PART 'B'

49. Stick thrust washer No. 1 to pump housing. Fit sealing ring on to converter housing and place a paper gasket on to transmission housing. Carefully mount converter housing complete with pump, without damaging pump piston rings, Fig. 122. Insert bolts, with new aluminium washers, and torque as specified (see Technical Data).

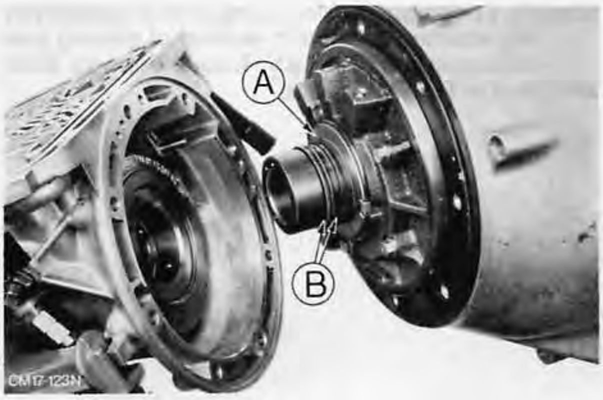


Fig. 122. Install converter casing
A – Thrust washer No. 1
B – Piston rings

50. Screw in brake band adjustment screw using Tool 17–005, Fig. 123, until torque wrench releases. **Then slacken adjustment screw by 1½ turns** and secure adjustment screw with a new lock nut.

51. Fit downshift cable bracket.

Fig. 123. Adjust front brake band using Tool 17–005

52. Fit return spring and parking pawl together with dowel in transmission extension housing, Fig. 124.

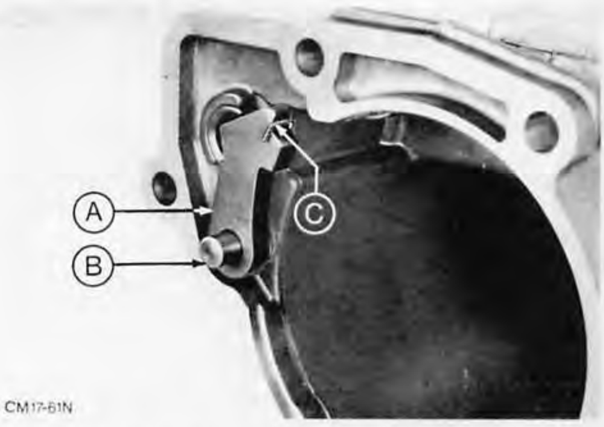


Fig. 124. Extension housing with parking pawl
A – Parking pawl
B – Dowel
C – Return spring

PART 'B'

17 214 8 (cont'd)

53. Fit extension housing using a new gasket paying attention to correct seating of parking pawl actuating rod, Fig. 125. Torque bolts as specified in Technical Data.

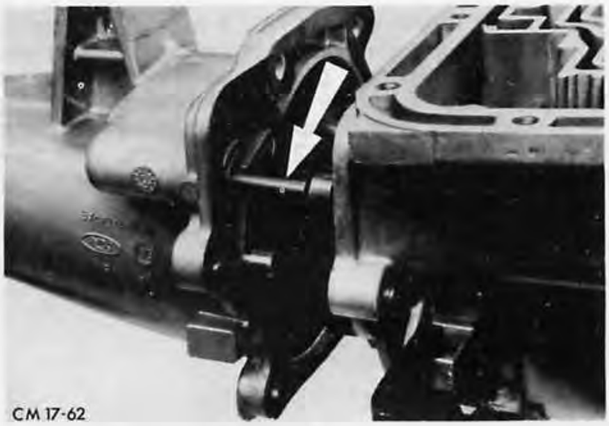


Fig. 125. Fit extension housing paying attention to correct seating of parking pawl actuating rod

54. Remove extension housing oil seal using Tool 17–001, Fig. 126.

Driveshaft bearing bush in extension housing is not available as a separate part.

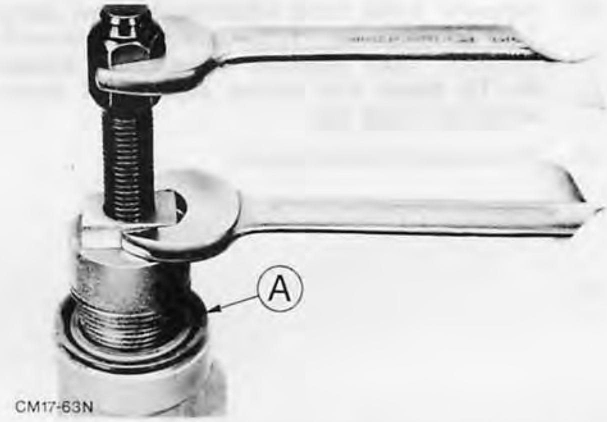


Fig. 126. Remove extension housing oil seal, holding tool with an open ended spanner
A – Oil seal

55. Press in a new extension housing oil seal using Tool 17–002, Fig. 127.

Fig. 127. Press in a new extension housing oil seal using Tool 17–002

PART 'B'

Overhaul of Valve Body

When dismantling valve body take care not to interchange valve springs in spite of their colour markings. Carefully clean oil channels and all parts with paraffin, blow through with compressed air and inspect for burring, groove formation and deposits due to gum formation. If necessary, renew valve body.

56. Remove cover plate bolts (2), Fig. 128 and carefully lift off plate and gasket. Take out ball valves (5) and two pressure relief valves with springs. Remove retaining plates, dowels, plugs and valves with springs.

Fig. 128. Cover plate securing bolts
A – Identification plate

57. Oil all parts with automatic transmission oil and check that they move easily.

Carefully refit valves, springs (note colour markings) and plugs as shown in Fig. 131 and then secure valves with retaining plates or pins.

58. Fit ball and relief valves and springs. Fig. 132. Install cover plate with new gasket, Fig. 129, fitting outer mounting bolts (11) for alignment of intermediate plate and valve body. Tighten two cover plate bolts to specified torque and remove remaining bolts.

Fig. 129. Fit valve body

59. Place valve body on transmission housing with a new gasket, locating link rod into manual selector valve, Fig. 130A. Fit bolts (pay attention to different lengths) and torque as specified. Fit interlock spring (1 bolt). Downshift lever (kickdown) should be in position between stop and downshift valve, Fig. 130B.

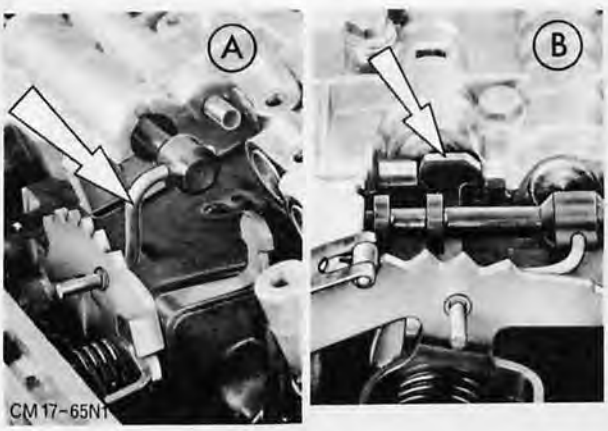


Fig. 130. A – Install valve body locating connecting rod into manual selection slide
B – Downshift lever (kickdown) should be in position between stop and downshift valve

PART 'B'

17 214 8 (cont'd)

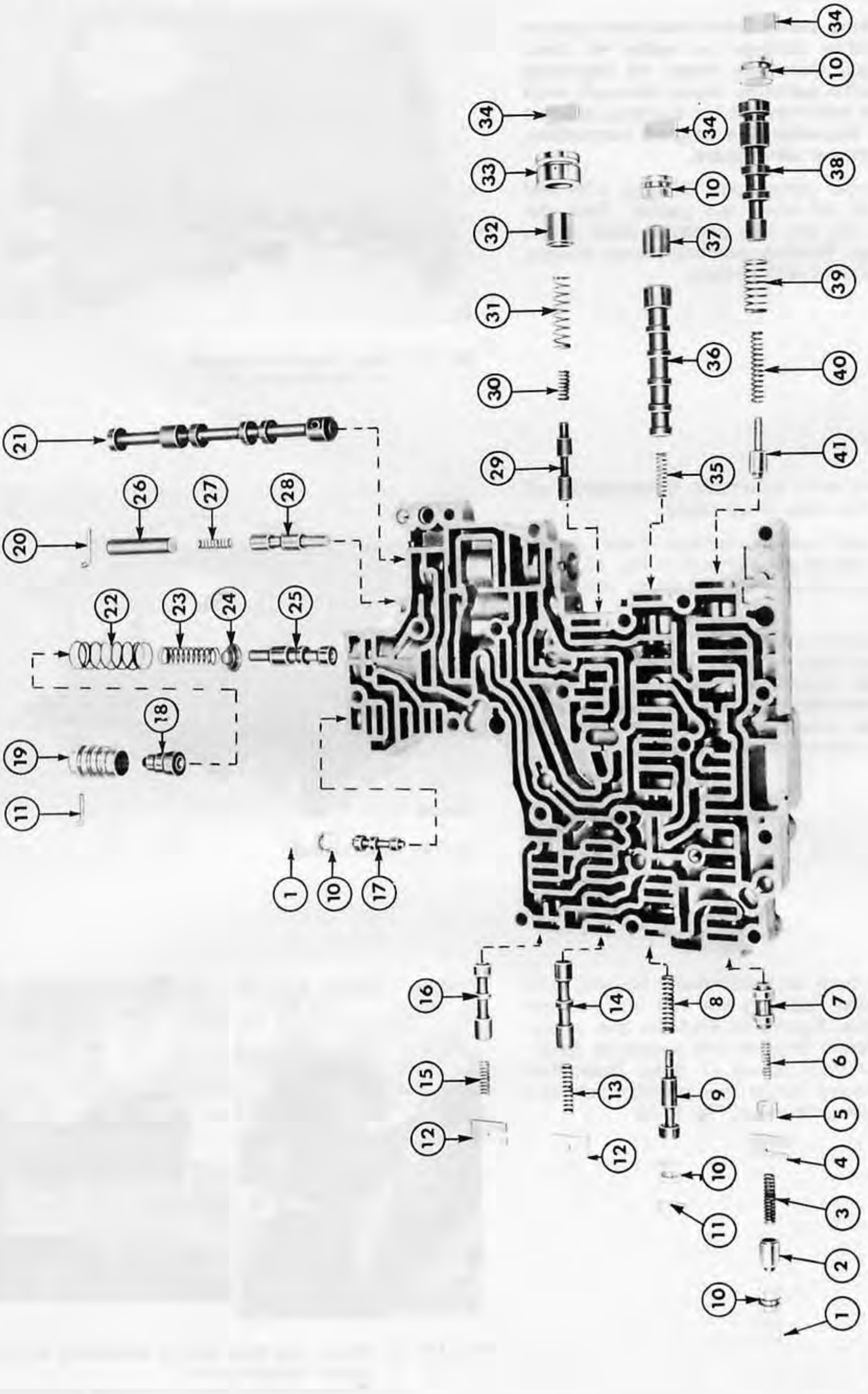
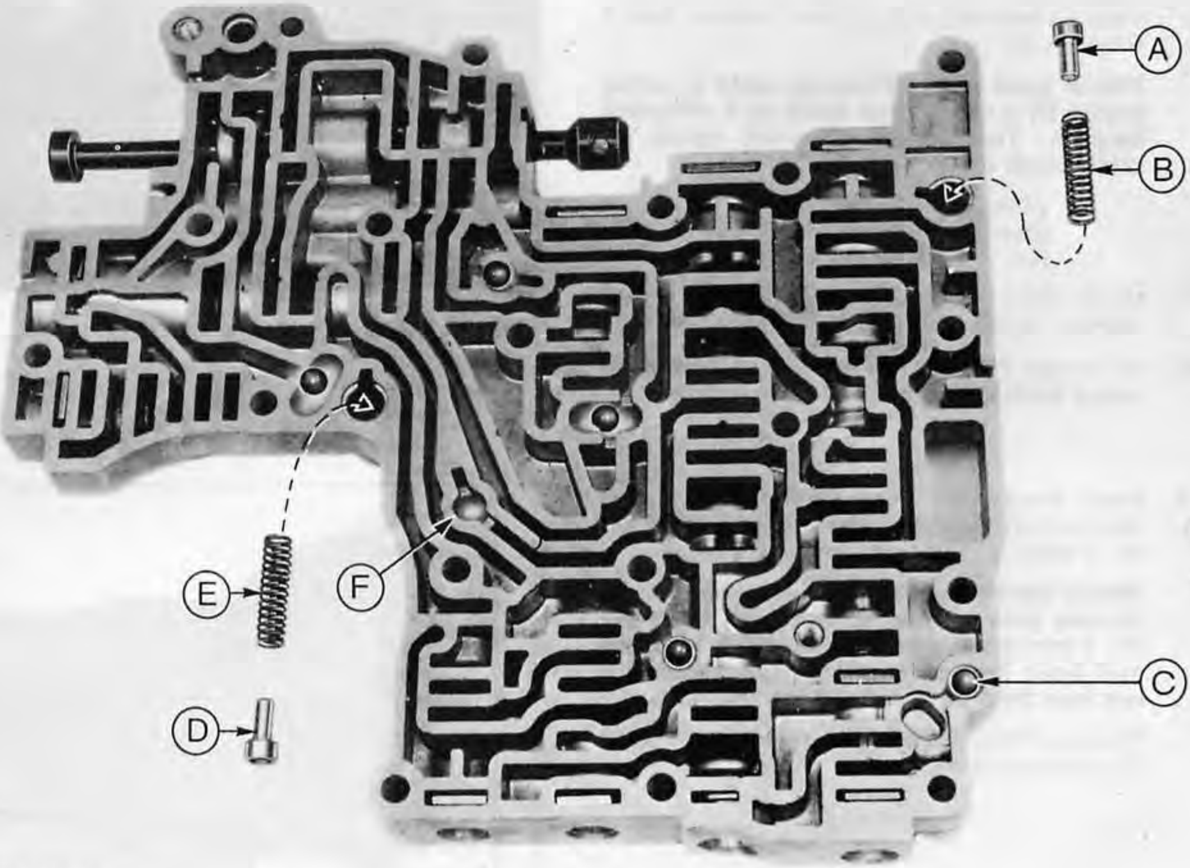


Fig. 131. Valve body dismantled

PART 'B'

Fig. 131. Valve body dismantled

1. Retaining plate
2. Band release delay valve
3. Valve spring (light green)
4. Retaining plate
5. Spacer
6. Valve spring (dark blue)
7. Servo regulator valve (2nd-3rd gear)
8. Valve spring (dark blue)
9. Throttle pressure boost valve
10. Plug
11. Retaining pin (fit in top groove)
12. Retaining plate
13. Valve spring (brown)
14. Shift control valve (3rd-2nd gear)
15. Valve spring (orange)
16. Modulator valve (3rd-2nd gear)
17. Line pressure reducer valve
18. Line pressure boost valve
19. Bush
20. Retaining pin
21. Manual selector slide
22. Valve spring (dark blue)
23. Valve spring (orange)
24. Spring retainer
25. Line regulator valve
26. Spacer
27. Valve spring (yellow)
28. Kickdown valve
29. Pressure boost valve (selector position 1st-2nd gear)
30. Valve spring (light green)
31. Valve spring (light blue)
32. Pressure boost valve (selector position 1-2)
33. Plug
34. Retaining plate
35. Valve spring (white)
36. 2nd gear valve
37. Shift valve (1st-2nd gear)
38. Shift valve (2nd-3rd gear)
39. Valve spring (dark blue)
40. Valve spring (orange)
41. Throttle pressure reducing valve



CM17-45N2

Fig. 132. A – converter relief valve B – valve spring (white) C – ball valve (5 off)
D – throttle relief valve E – valve spring (white)
Earlier transmission assemblies have valve springs of different length (valve spring B short, valve spring E long)

PART 'B'

60. Insert rear servo piston with its spring into housing and fit cover with a new gasket.

If transmission housing, servo piston or rear brake band has been renewed, length of piston push rod must be determined as follows:

Install servo piston complete with any piston rod and spring. Fit Tool 17–012 (adjustment screw fully retracted) with a new gasket and tighten bolts to specified torque. (One of the three stop nipples must be exactly under measurement slot.) Measure distance between cover and piston with a depth gauge and note it, Fig. 133. Screw in adjustment screw with Tool 17–005 until torque wrench jumps a notch, Fig. 134. Measure new distance and note it.

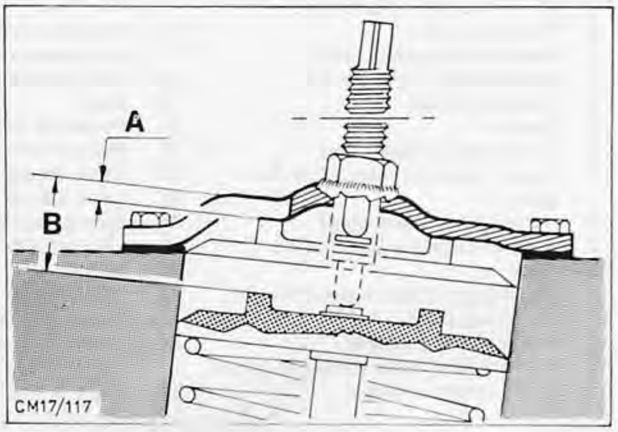


Fig. 133. Determine stroke of rear servo piston
A – 3,7 mm (0,147 in)
B – 8,3 mm (0,327 in)

Example:

Measurement 'B'	8,3 mm (0,327 in)
Measurement 'A'	3,7 mm (0,147 in)
Servo piston stroke	4,6 mm (0,180 in)

Piston stroke should be between 4,0 and 7,0 mm (0,16 to 0,27 in).
If it is above top limit a longer piston push rod must be selected, if it is below bottom limit a shorter one.

Piston push rods, which are held in servo piston by a circlip, are made in 3 different lengths. They have coloured spots to distinguish them:

yellow	84,25 mm (3,317 in)
green	86,75 mm (3,415 in)
red	89,25 mm (3,514 in)

Fig. 134. Adjust adjustment screw with Tool 17–005

61. Fit oil filter using a new gasket and starter inhibitor switch using a new O-ring.

62. Fit oil pan using a new gasket (13 bolts) and torque bolts as specified.

63. Insert input shaft (with short splines facing direction of travel) and insert torque converter up to stop.

When converter hub is fully engaged in driving gear of hydraulic pump, distance 'A' between flange of converter housing and front face of locating stub should be not less than 10 mm (0,14 in), Fig. 135.

Remove transmission from stand and bracket from transmission.

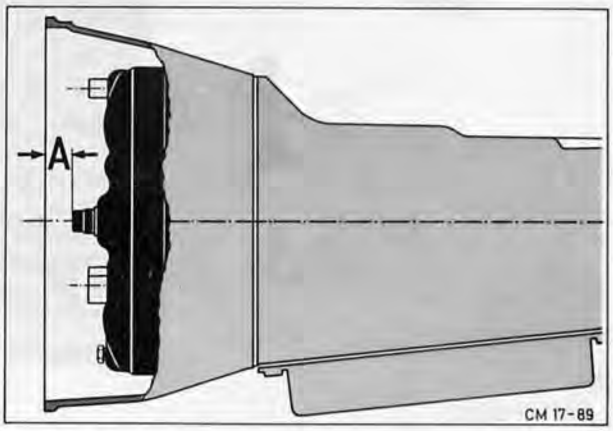


Fig. 135. Distance between converter housing flange and converter locating stub
A – Not less than 10 mm (0,4 in)

PART 'B'

17 238 VACUUM DIAPHRAGM – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Undo clamp and disconnect vacuum hose at vacuum diaphragm.
2. Remove diaphragm bracket bolt and remove bracket, Fig. 136.
3. Take out diaphragm and actuating pin.

To Install

4. Check freedom of movement of throttle valve.
5. Oil a new O-ring and fit it on (diaphragm) connection. Fit actuating pin and diaphragm.
6. Fit diaphragm bracket. Connect vacuum hose and secure it with clamp.
7. Check oil level in accordance with instructions and top up with specified oil if necessary.

Fig. 136. Vacuum diaphragm attachment

17 252 SERVO ASSEMBLY – FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. To remove servo. Slacken brake band adjusting screw by four turns.

   With aid of a screw clamp, press servo piston in far enough to allow circlip to be removed, Fig. 137B. **In order not to damage the housing, a piece of wood should be inserted, Fig. 137A.** Take out servo piston and spring. Watch out for oil leakage.

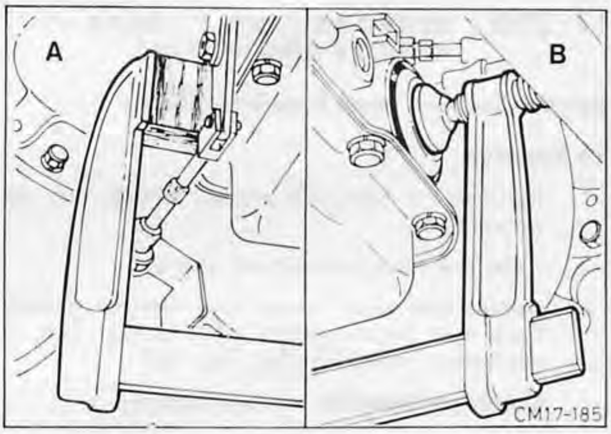


Fig. 137. Removal of front servo using a screw clamp
A – Protect housing with wooden block
B – Remove servo piston spring

2. If spring force will not push out servo cover, force parts out carefully with compressed air as shown, after oil pan has been removed (watch out for oil). Cover outlet hole in process, Fig. 138.

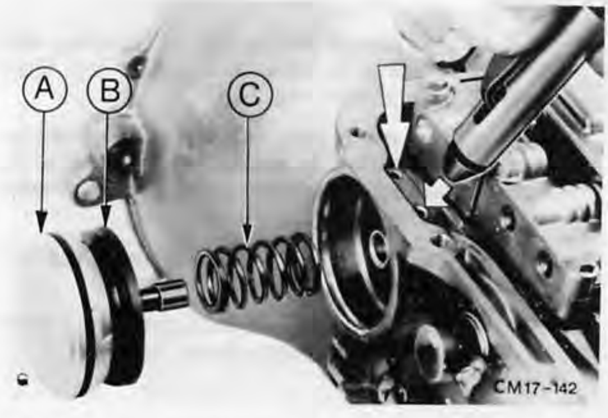


Fig. 138. Front servo removed
A – Servo cover with oil seal
B – Servo piston
C – Spiral spring

PART 'B'

To Install

3. Renew servo cover oil seal if necessary and insert coil spring into housing. Install piston and cover, pushing cover in far enough to allow circlip to be properly fitted.
4. Fit oil pan using a new gasket and tighten bolts to specified torque in two stages, Fig. 139.
5. Adjust brake band as described in Operation 17 132.
6. Fill up with specified oil and check oil level in accordance with instructions.

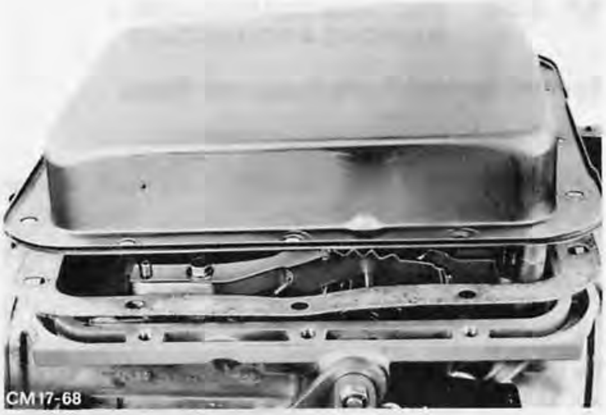


Fig. 139. Fit oil pan with a new gasket

17 256 SERVO ASSEMBLY – REAR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove oil pan (13 bolts). Watch out for escaping oil.
2. Unbolt oil filter and remove gasket.
3. Unbolt rear servo cover and remove gasket. Take out servo piston and spring, and, if necessary, renew O-rings, Fig. 140.

   Cover is raised by force of spring.

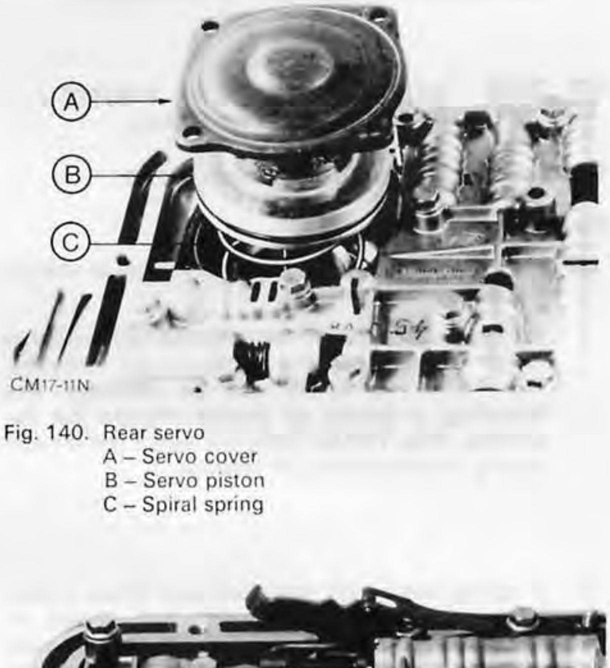


Fig. 140. Rear servo
A – Servo cover
B – Servo piston
C – Spiral spring

To Install

4. Place servo piston and spring in housing and fit cover using a new gasket. Fit oil filter using a new gasket, Fig. 141.

   The piston push rod, which is retained in servo piston by a circlip, is available in three lengths (colour coded, see Parts Catalogue).

5. Fit oil pan using a new gasket and tighten bolts to specified torque in two stages.
6. Fill up with specified oil and check oil level in accordance with instructions.

Fig. 141. Fit oil filter

PART 'B'

17 354 GOVERNOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove driveshaft (6 bolts).
2. Detach transmission support bracket from floor assembly and transmission extension assembly (5 bolts), Fig. 142. Lower transmission carefully.
3. Detach speedometer drive (1 bolt) and unbolt extension housing (6 bolts).

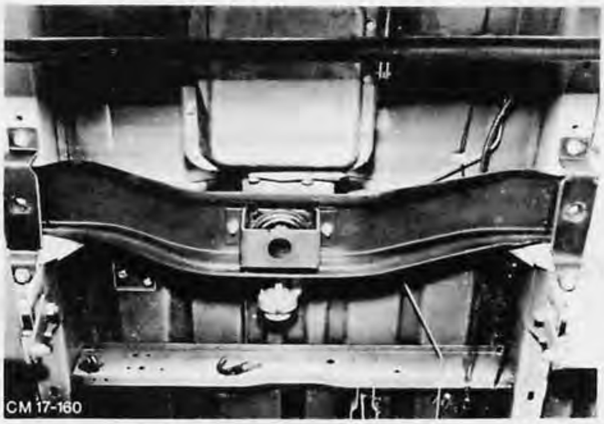


Fig. 142. Transmission support bracket

4. Remove circlip from governor connecting pin and withdraw governor valve. Detach governor from governor hub (4 bolts), Fig. 143.

To Install

5. Slide governor on to output shaft, align and bolt on to governor hub.

   Governor will only fit in one position. Turn it through 180° if necessary.

6. Fit governor connecting pin and valve and secure with a **new** circlip, Fig. 143.

   Circlip must be up against outer collar of pin.

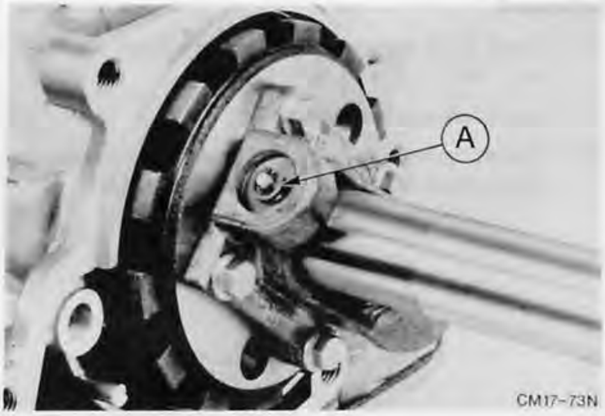


Fig. 143. Governor installed
A – Connecting pin circlip

7. Fit transmission extension housing using a new gasket, paying attention to correct seating of parking pawl actuating rod, Fig. 144. Torque bolts as specified.
8. Raise transmission and secure support bracket to floor assembly and extension housing. Torque bolts as specified.
9. Fit speedometer drive and install driveshaft.
10. Check oil level in accordance with instructions and top up if necessary.

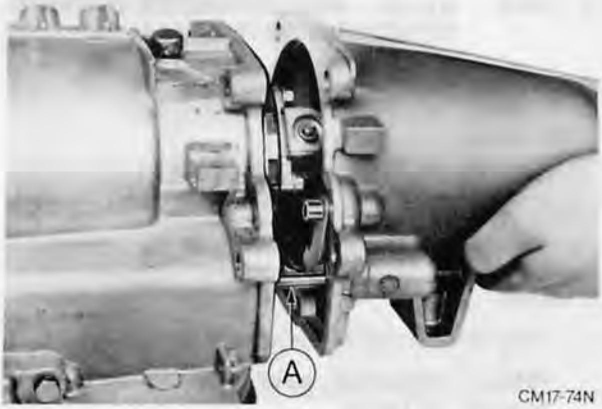


Fig. 144. Fit extension housing
A – Parking pawl actuating rod

PART 'B'

17 376 SEAL – EXTENSION HOUSING – REPLACE

Special Service Tools Required:

Transmission extension housing oil seal remover 17–001
Transmission extension housing oil seal replacer 17–002

To Remove

1. Drive vehicle over a pit or on to a ramp and remove driveshaft assembly.
2. Remove oil seal using Tool 17–001, Fig. 145.

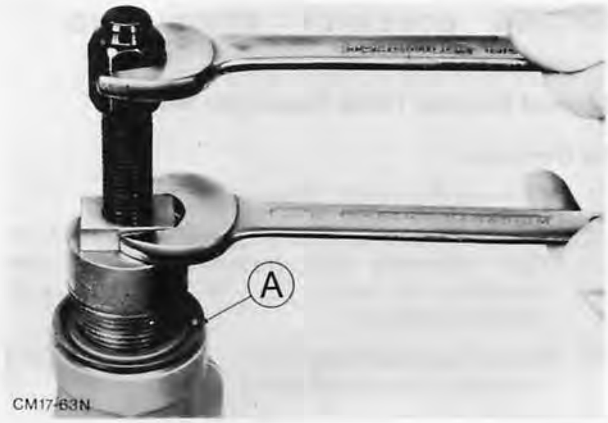


Fig. 145. Remove transmission extension oil seal holding Special Tool with a spanner
A – Oil seal

To Install

3. Press in a new oil seal using Tool 17–002, Fig. 146.
4. Install driveshaft assembly.
5. Check transmission oil level in accordance with instructions and top up if necessary.

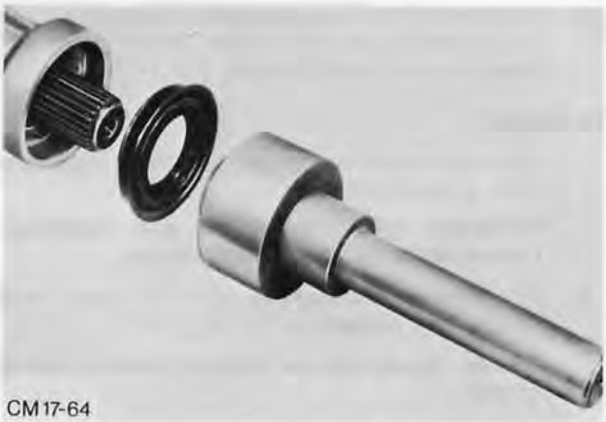


Fig. 146. Press oil seal into transmission extension housing using Tool 17–002

17 382 GEAR – SPEEDOMETER DRIVEN – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove input shaft bracket on transmission (1 bolt) and withdraw cable with gear.
2. Remove clip and withdraw gear from cable.

To Install

3. Slide gear into position and fit clip.

   When renewing gear pay attention to number of teeth.

4. Fit cable and gear in transmission housing and fit bracket, Fig. 147.

Fig. 147. Remove speedometer gear with shaft

PART 'B'

17 694 INHIBITOR SWITCH – REMOVE AND INSTALL

Special Service Tools Required: None

1. Disconnect cable plug connector from switch.
2. Unscrew starter inhibitor switch and remove O-ring, Fig. 148.

To Install

3. Screw starter inhibitor switch into transmission housing using a new O-ring. Pay attention to tightening torque.
4. Fit cable plug connector.
5. Check that engine starts only when selector lever is in 'P' or 'N' position and that reversing light comes on only in 'R' position (when ignition is turned on). Neither of these things must happen in any other position.

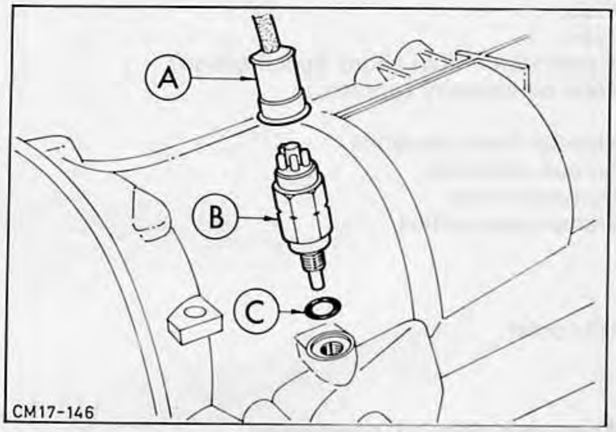


Fig. 148. Starter inhibitor switch
A – Connector
B – Inhibitor
C – 'O'-ring

TECHNICAL DATA

Make	Ford
Type	C3
Transmission fluid (Ford Specification)	SQM-2C-9007-AA (M2C-33G)
Total oil capacity (approx.)	Transmission with converter and oil cooler – 6,5 litres (11,4 pints)
Selector lever positions	P-R-N-D-2-1
Torque converter	Trilock (hydraulic)
Converter ratio	2,35 : 1
Transmission ratios	1st gear – 2,47 : 1 2nd gear – 1,47 : 1 3rd gear – 1 : 1 Reverse gear 2,11 : 1
Oil cooler	Twin-tube type

Transmission oil pressures	MN/m^2	kgf/cm^2	lbf/in^2
1. With engine idling (no pressure on accelerator pedal):			
Selector position – R	0,6 to 0,9	6,0 to 9,0	85 to 128
– P-N	0,34 to 0,50	3,4 to 5,0	48 to 71
– D-2-1	0,4 to 0,6	4,0 to 6,0	57 to 85
2. At stall speed (accelerator pedal fully depressed):			
Selector position – R	1,67 to 1,90	16,7 to 19,0	237 to 270
– D-2-1	1,00 to 1,14	10,0 to 11,4	142 to 162

Tightening torques		Nm	kgf m	lbf ft
Torque converter housing to transmission housing	M10 × 30	36 to 52,3	3,6 to 5,3	26 to 38
Transmission extension to transmission housing	M10 × 30	36 to 52,3	3,6 to 5,3	26 to 38
Hydraulic pump to converter housing	M6 × 35	9 to 13	0,9 to 1,3	7 to 9
Drive disc to converter	M10 × 14	36 to 41	3,6 to 4,1	26 to 30
Control block to transmission housing	M6 × 35 M6 × 40 M6 × 45 M6 × 30	9 to 12,1	0,9 to 1,2	7 to 9
Intermediate plate to control block	M6 × 25	9 to 12,1	0,9 to 1,2	7 to 9
Cover to servo housing	M6 × 20	9 to 13	0,9 to 1,3	7 to 9
One-way clutch to housing	M6 × 25	9 to 13	0,9 to 1,3	7 to 9
Oil pan to transmission housing	M8 × 14	16 to 23,5	1,6 to 2,4	12 to 17
Governor to governor hub	M6 × 16	9 to 13	0,9 to 1,3	7 to 9
Downshift cable bracket	M8 × 14	16 to 23,5	1,6 to 2,4	12 to 17
Nut, downshift lever (outer)	M8 × 1	10 to 15	1,0 to 1,5	7 to 11
Nut, downshift lever (inner)	M14 × 1,5	41 to 54	4,1 to 5,4	30 to 39
Starter inhibitor switch	M12	16 to 20	1,6 to 2,0	12 to 14
Brake band adjusting screw lock nut	½ in. – 16	47 to 61	4,7 to 6,1	34 to 44
Vacuum diaphragm bracket	M6 × 20	1,7 to 2,6	0,17 to 0,3	14 – 26 lbf/in.
Oil line to connector	½ in. – 24 (½ in. – 20)	9 to 14	0,9 to 1,4	7 to 10
Oil cooler line to connector	½ in. – 20	16 to 20	1,6 to 2,0	12 to 14
Oil line connector to transmission housing	⅛ in. – 27	14 to 20	1,4 to 2,0	10 to 14
Converter housing to engine	M10	30 to 37	3,0 to 3,7	22 to 27
Converter drain plug	⅛ in. – 27	27 to 40	2,7 to 4,0	20 to 29

AUTOMATIC TRANSMISSION 17B

Index **Page**

GENERAL DESCRIPTION

The floor mounted gear selector housing and lever bracket is retained at its floor location with four bolt and washer assemblies. Covering this is a sound insulation gaiter retained with three crosshead screws. The gaiter has two thicknesses at the base 'A' Fig. 1, availability depending on the thickness of carpet fitted.

The selector mechanism comprises a lever and handle with built in push type release button. When the button is pressed a cable inside the lever lifts a pawl stub out of the selected notch in a guide plate. The guide plate is attached to the bracket, at the base of the lever, Fig. 10.

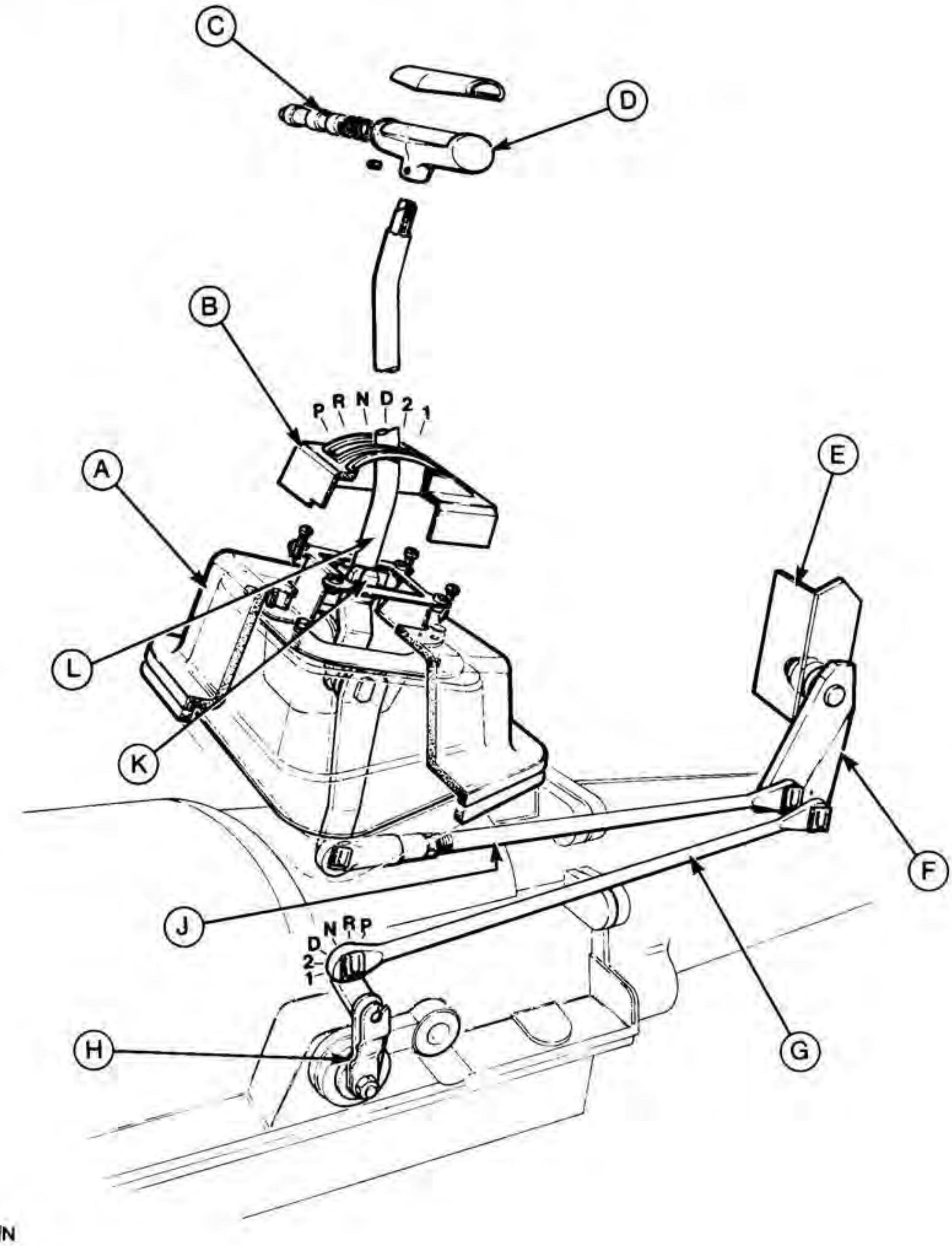


Fig. 1. Gear selector (RHD shown)

A – Sound insulation gaiter
B – Control indicator
C – Push button assembly
D – Control handle
E – Relay lever bracket
F – Control rod relay
G – Lower rod assembly
H – Transmission control lever
J – Upper rod assembly
K – Lamp shroud location
L – Lever

GENERAL DESCRIPTION (cont'd)

Two rods situated below the floor pan transmit movement of the selector lever to the transmission box.

The upper rod is connected between the selector arm and the control rod relay lever. Adjustment to the upper rod can be made at the selector arm end. The lower rod, which is of fixed length, is attached to the control rod relay lever, then runs to the transmission control lever.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
G/7/079/D	No special service tools required

SERVICE AND REPAIR OPERATION – CONTENT

AUTOMATIC TRANSMISSION		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range.					
				Transit '77	Fiesta	Escort '75 onwards	Capri II	Taunus 76/ Cortina 77	Granada '78
17 634	Gear selector mechanism – remove and install	X	—	—	X	X	X	X	X
17 634 8	Gear selector mechanism – overhaul (selector mechanism removed)	X	—	—	X	X	X	X	X
17 666	Cable – selector – adjust	X	—	—	X	X	X	X	X
17 667	Cable – selector – remove and install	—	17 634 8	—	X	X	X	X	X
17 673	Rods – selector – remove and install	X	—	—	—	—	—	—	—
17 682	Cable – downshift – adjust	—	17 683	—	X	X	X	X	X
17 683	Cable – downshift – remove and install	X	—	—	X	X	X	X	X

SERVICE AND REPAIR OPERATIONS

17 634 GEAR – SELECTOR MECHANISM – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Lift off selector indicating, housing from selector lever bracket, 'A' in Fig. 3.
2. Remove three screws lift off sound insulation gaiter from selector lever bracket, 'B' in Fig. 3.
3. Remove lamp shroud by sliding upwards from its location on selector lever, pull out bulb assembly, Fig. 4.

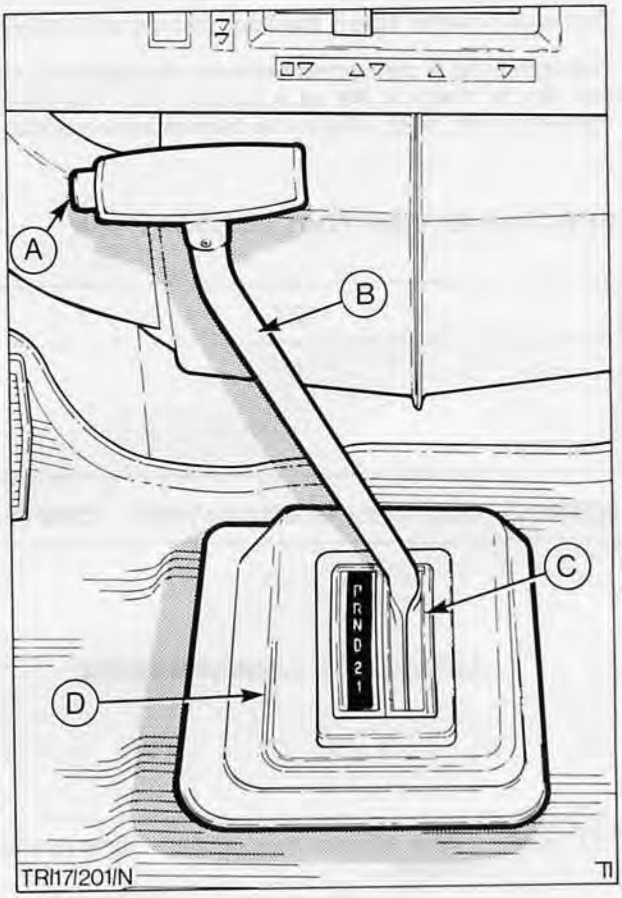


Fig. 2. Gear selector (LHD shown)
A – Push button
B – Lever
C – Indicator
D – Sound insulation gaiter

4. Remove four bolts and washers, detach selector lever bracket and gasket from floor pan location, Fig. 4.
5. Raise selector mechanism to gain access to retaining clip of gearshift lever end.

   NOTE: The end of the gearshift lever is attached to the upper selector rod. When the clip is removed and the selector mechanism unhooked, the upper rod will drop out of reach below the vehicle. Therefore it will necessitate wiring the rod in position for easy refitment.

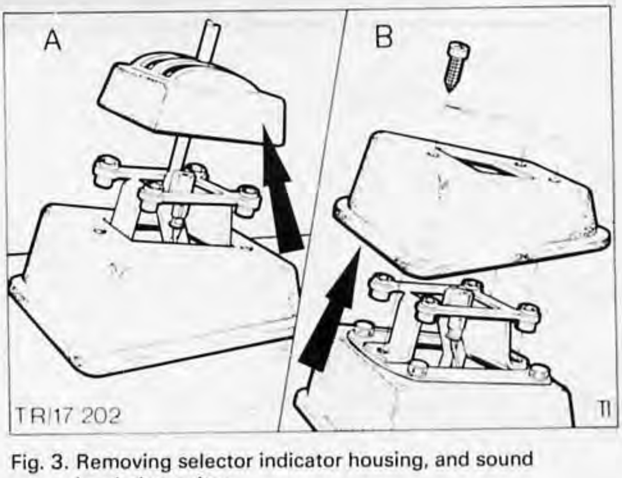


Fig. 3. Removing selector indicator housing, and sound insulation gaiter
A – Selector indicator housing
B – Sound insulation gaiter

6. Remove retaining clip, Fig. 5.
7. Unhook and take out selector lever assembly.

To Install

8. Reposition selector lever mechanism lower end to upper rod, remove holding wire, secure retaining clip. Adjust if necessary, refer to Operation No. 17 673.
9. Fit selector lever bracket and gasket to floor pan location. Secure four bolts to 8,5 to 10,0 Nm (0,8 to 1,0 kgf.m) (6 to 8 lbf.ft).
10. Resecure lamp shroud and bulb assembly to selector lever.
11. Position sound insulation gaiter to selector lever bracket. Secure with three screws.
12. Press selector indicating housing back onto selector lever bracket.

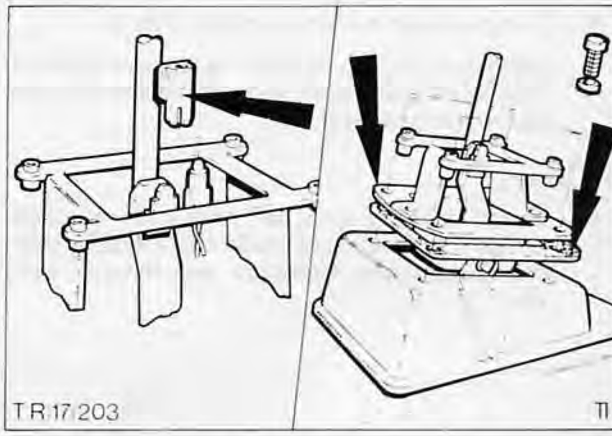


Fig. 4. Remove lamp shroud and selector lever bracket

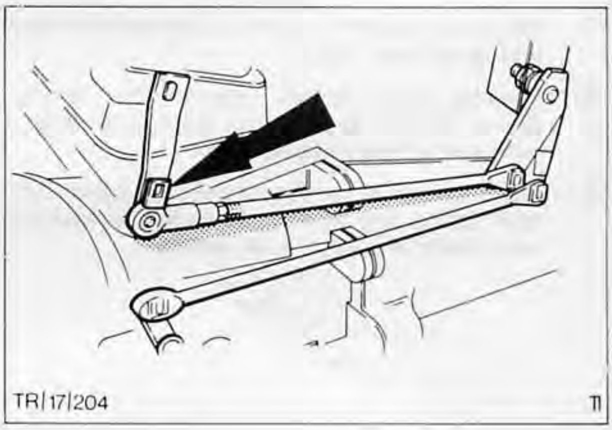


Fig. 5. Remove clip from gearshift lower end

17 634 8 GEAR – SELECTOR MECHANISM – OVERHAUL (Selector mechanism removed)

Special Service Tools Required: None

To Remove

1. Remove rubber grommet from lower end of selector lever housing, Fig. 6. Unscrew nut, press lever arm out of housing. Remove bushes from housing.
2. Unscrew locknut on operating cable, withdraw selector pawl and, spring from the bottom end of selector lever, Fig. 7.
3. Remove socket head cap screw from selector lever handle, remove handle. Disengage cable nipple from roller assembly at top of selector lever.

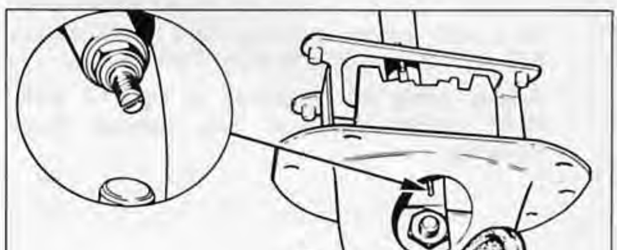


Fig. 6. Remove grommet from selector lever housing (insert shows locknut on operating cable)

17 634 8 (cont'd)

4. Remove push button assembly, Fig. 8.
5. Drive out pin, Fig. 9. remove operating cable combined guide bush and top linkage through bottom end of lever arm.

To Install

6. Install operating/cable back up through bottom of lever arm. Refit cable nipple over roller assembly. Resecure top linkage with pin.

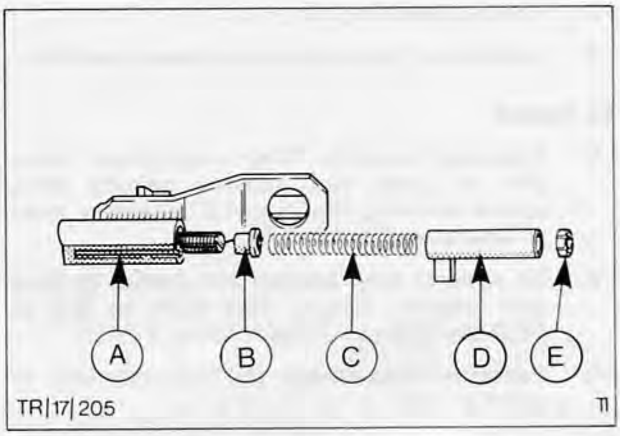


Fig. 7. Lower selector lever assembly
A – Lever
B – Bush
C – Spring
D – Selector pawl
E – Locknut

7. Refit push button to handle, longest key way first. See insert Fig. 8.
8. Holding push button against the spring, locate handle to selector lever and secure with socket head cap screw.
9. Apply smear of grease to selector pawl, refit with spring and guide bush back into selector lever lower end. Screw on locknut.

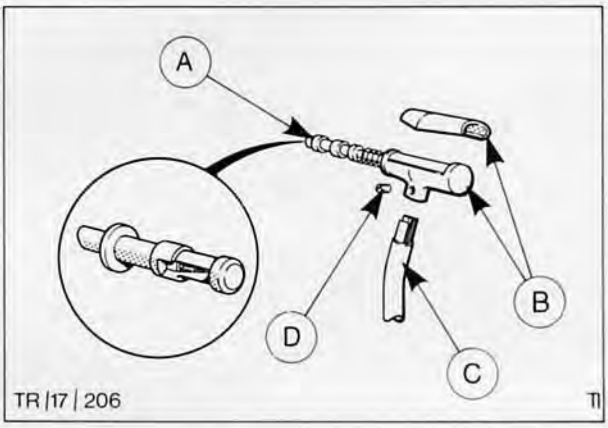


Fig. 8. Selector lever handle assembly
A – Push button
B – Handle
C – Lever top
D – Socket head cap screw

10. Position bushes in selector lever housing fill slots with grease meeting Ford Specification EM-1C-18, install lever arm. Tighten nut.
11. Adjust cable as described in Op. 17 666. Refit rubber grommet into selector lever housing.

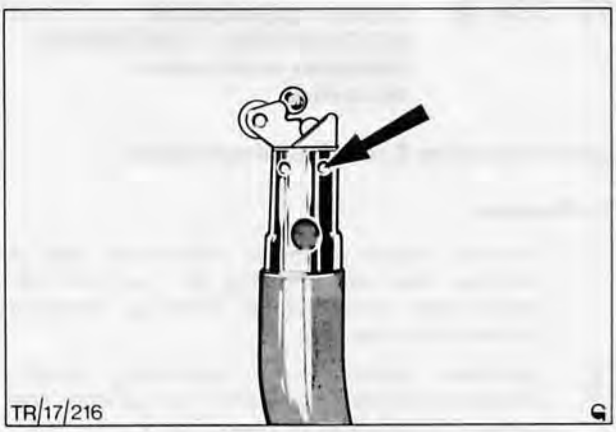


Fig. 9. Selector lever operating cable top linkage

17 666 CABLE – SELECTOR – ADJUST

Special Service Tools Required: None

To Adjust

1. Engage selector lever in 'D' position, remove selector indicator housing.

   NOTE: To make necessary adjustments to the operating cable, the rubber grommet has to be removed from the selector lever housing, see Fig. 6.

2. Using a feeler gauge, adjust operating cable by means of locknut to give 0,1 to 0,2 mm (0,004 to 0,008 in) clearance between selector pawl stub and notch, Fig. 10, on selector lever housing.
3. Refit grommet back into selector lever housing.
4. Refit selector indicator housing.

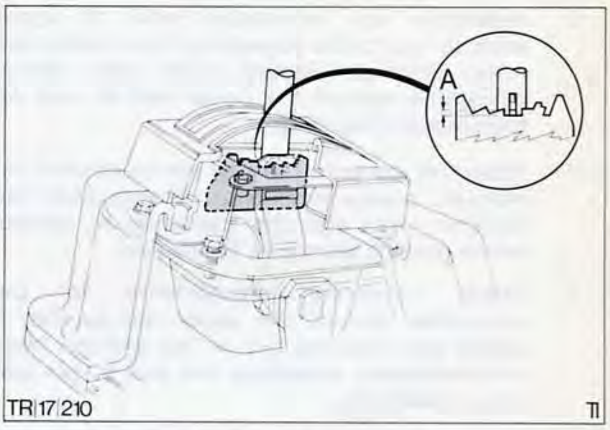


Fig. 10. Selector pawl stub and notch clearance
A – 0,1 to 0,2 mm (0,004 to 0,008 in) in 'D' position

17 673 RODS – SELECTOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove clips from each end of upper gear shift rod 'A' in Fig. 11. Unhook rod.
2. Remove clips from each end of lower gear shift rod 'B' in Fig. 11. Unhook rod.

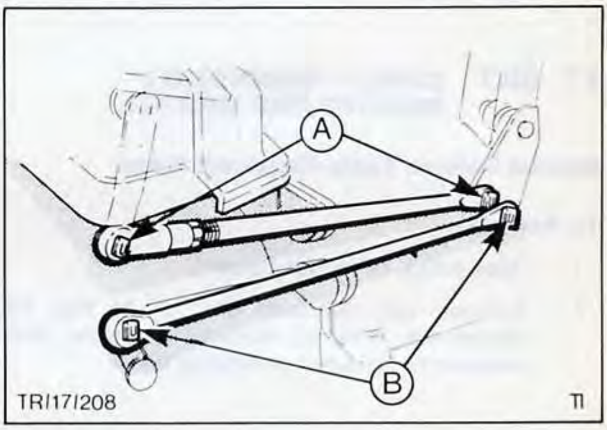


Fig. 11. Selector rod retaining clips
A – Upper gear shift rod clips
B – Lower gear shift rod clips

3. If necessary renew selector rod and selector lever bushes. Fig. 12.

To Install

   NOTE: The vehicle must be standing on road wheels when adjusting selector lever.

4. Engage selector lever in 'D' position.
5. Locate transmission control lever, 'H' in Fig. 1. in 'D' position two notches from extreme forward position and secure.

   NOTE: This is achieved by pushing the transmission control lever fully forward and then moving it backwards by two notches. Ensure the transmission control lever remains in this position whilst adjustment of the selector rods is carried out.

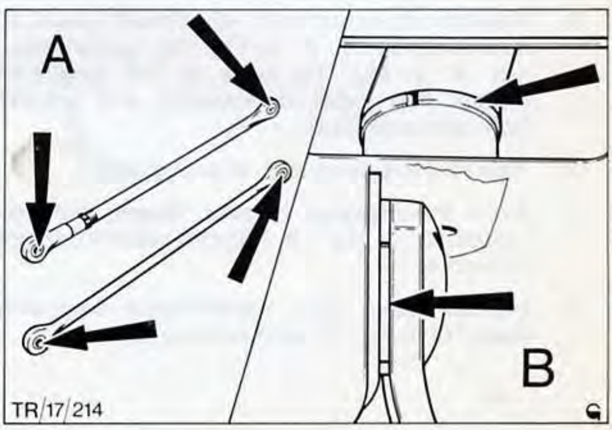


Fig. 12. Bush locations
A – Selector rod bushes
B – Selector lever bushes

17 673 (cont'd)

6. Assemble non adjustable end of upper selector rod to the forward pin on control rod relay bracket. Secure with clip. Allow adjustable end of the upper rod to rest on transmission housing.
7. Assemble lower rod to rear pin on control rod bracket, secure with clips. Ensure both the selector lever and the transmission control levers are still secure in 'D'position.
8. Make necessary adjustments to the adjustable end of the upper rod so that it aligns with locating pin on the selector lever arm assembly, assemble the end to pin and secure with clip.
9. Tighten locknut, Fig. 13, making sure that adjustable end of gear shift rod remains vertical.
10. Check that selector lever can be engaged in every selector position and that engagement can be felt.

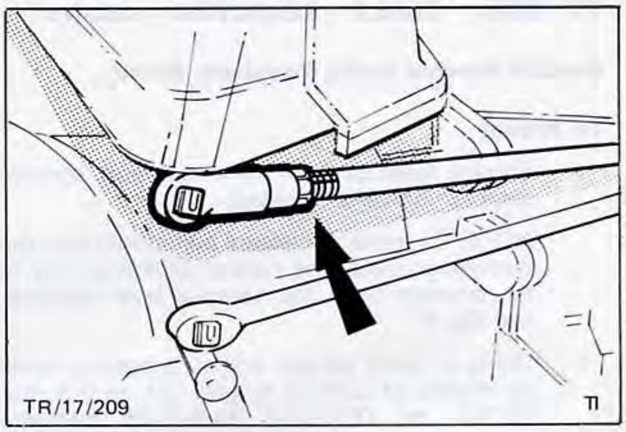


Fig. 13. Adjustable end on upper control rod

17 683 CABLE – DOWNSHIFT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender cover.
2. Remove split pin and pin, 'A' in Fig. 14, disconnect end of downshift cable from carburettor linkage connecting lever.

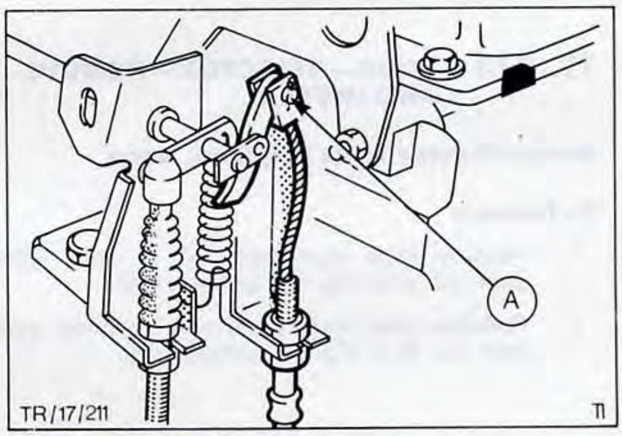


Fig. 14. Downshift cable connection at carburettor
A – Split pin and pin

3. Remove upper nut from adjustment thread on downshift cable, 'A' in Fig. 15, screw lower nut 'A' in Fig. 15, back to full length of thread. Pull cable downwards and unhook from slot in bracket.
4. Raise vehicle front end, fit axle stands.
5. From transmission bracket, loosen nuts on thread, 'B' in Fig. 15, unhook cable from slot in bracket.
6. Unhook cable from transmission downshift lever, 'C' in Fig. 15, and remove cable.

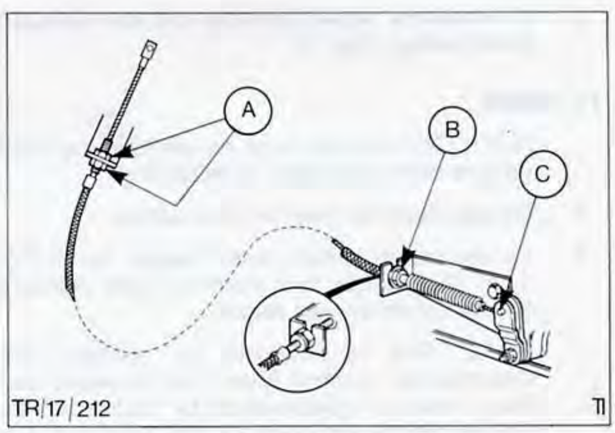


Fig. 15. Downshift cable assembly
A – Upper cable adjustment nuts
B – Lower cable retaining nuts
C – Transmission downshift lever

To Install

7. Hook cable back into transmission downshift lever.
8. Position cable back into slot in bracket at transmission end. Secure the nuts.
9. Remove axle stands, lower vehicle to ground.
10. Position cable back into slot in bracket carburettor end.
11. Connect cable end to carburettor linkage connecting lever, Replace split pin.
12. Adjust downshift cable as follows: Press downshift cable connecting lever, 'B' Fig. 16, away from operating shaft lever, 'A' Fig. 16, by using a suitable screwdriver. Lengthen or shorten cable by means of the adjustment nut on the upper thread of the cable until a clearance of 0,2 to 1,0 mm (0,008 to 0,04 in) is obtained between operating shaft lever, 'A' Fig. 16, and downshift cable connecting lever, 'B' Fig. 16. Secure the nuts.
13. Remove fender cover, close hood.

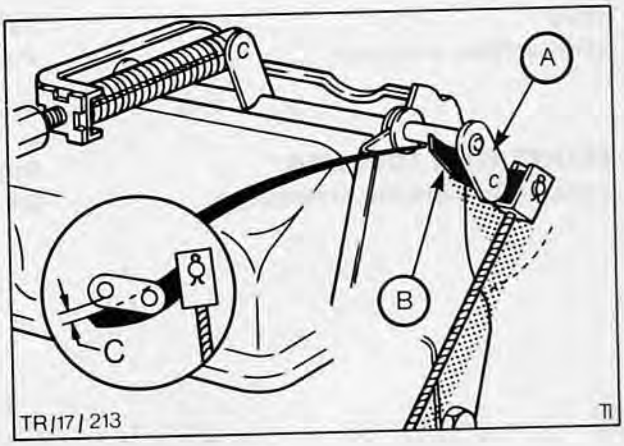


Fig. 16. Adjustment setting
A – Operating shaft lever
B – Cable connecting lever
C – Clearance 0,2 to 1,0 mm (0,008 to 0,04 in)

TECHNICAL DATA

Make	Ford
Selector lever positions	P-R-N-D-2-1

TIGHTENING TORQUES

	Nm	kgf. m	lbf. ft
Selector lever bracket to floor bolts	8,5 to 1,0	0,8 to 1,0	6 to 8

Braking System 12

GENERAL DESCRIPTION

The Transit braking system is hydraulically operated on all front and rear wheels with a dual line system to provide separate hydraulic circuits for front disc and rear drum brakes. Should one circuit fail the other circuit is unaffected and the vehicle can be brought to a halt. The hydraulic pressure is applied from the master cylnder to each operating cylinder through metal bundy pipes with flexible hoses at each wheel to compensate for suspension and steering movements.

The hydraulic system is split, either between the front and rear brakes, known as 'vertically split', Figs.1 & 2, or with the rear brakes and the lower of the two pistons in the four piston caliper as one circuit and the upper two pistons in the caliper as the other circuit. This system is known as 'horizontally split', Fig.3.

The front calipers are either two or four piston design depending on model variants and territorial requirements, the calipers operate on 269,7mm (10,62in) solid or ventilated cast iron discs. The calipers are self-adjusting during operation of the brake pedal.

Each rear brake utilises one leading and one trailing shoe operated by a double acting cylinder on each wheel brake assembly. The linings are bonded to the brake shoes, the leading shoe being approximately twice as thick as that of the trailing shoe. This allows for the greater rate of wear on the leading shoe and ensures that both linings have similar service life.

Both front and rear brakes are self-adjusting during normal operation of the foot brake pedal. The handbrake mechanism is mechanically operated with a lever mounted between the front seats, operating an adjustable primary rod through a yoke and nylon cable to operate the mechanism in the rear brake assemblies.

To reduce pedal effort a brake servo unit of the suspended vacuum type is fitted between the brake pedal and master cylinder. Should the servo unit fail the push rod still acts mechanically to provide non-servo assisted braking.

A pressure delay valve is fitted into the front brake hydraulic circuit, to optimise brake performance during light braking application. This allows rear brake hydraulic pressure to be higher in this condition.

Dependent on territorial requirements, a load apportioning valve (L.A.V.) is fitted to the rear brake circuit minimising the possibility of early 'lock up' of the rear wheels under heavy or emergency braking conditions with the vehicle in an unladen or partly laden condition.

IMPORTANT NOTES:

- Brake system components must be kept clean of any foreign matter. If necessary any hydraulic component should be washed in clean brake fluid, industrial alcohol or methylated spirits to remove any foreign matter and dried with a clean non-fluffy cloth. Do not use a mineral base fluid such as petrol, paraffin, etc.

  Brake fluid must not be allowed to come into contact with brake pads/shoes or with disc or drum surfaces. Industrial alcohol or methylated spirits must be used to flush out the system and for washing fluid from disc or drum surfaces.

  Ensure that sealing lips are perfectly formed, concentric with the bore of the seal, free from knife edges, surface blemishes or marks. Any seal that is not perfect should be rejected. Seals should not be turned inside out when inspecting them, since this strains the surface skin and may eventually lead to failure. All pistons and housings must be carefully inspected before assembly. Any imperfections or scores on a piston or cylinder bore may provide a track for fluid leaks under pressure and any damaged parts must be renewed. Parts must be handled carefully to prevent any accidental scoring. Prior to assembly immerse hydraulic components in clean brake fluid to provide initial lubrication for working surfaces. Due to the complexity of braking systems, when renewing or overhauling component, care must be taken to ensure that only correct parts are fitted.

  Any brake fluid accidentally spilt onto a painted surface must be cleaned off immediately using cold water to prevent damage to paintwork.

- Asbestos dust when inhaled can be injurious to health. Do not blow out dust with an airline. A vacuum cleaner, brush or rag should be carefully used to remove any dust. Any dust should be contained in a sealed bag for disposal.

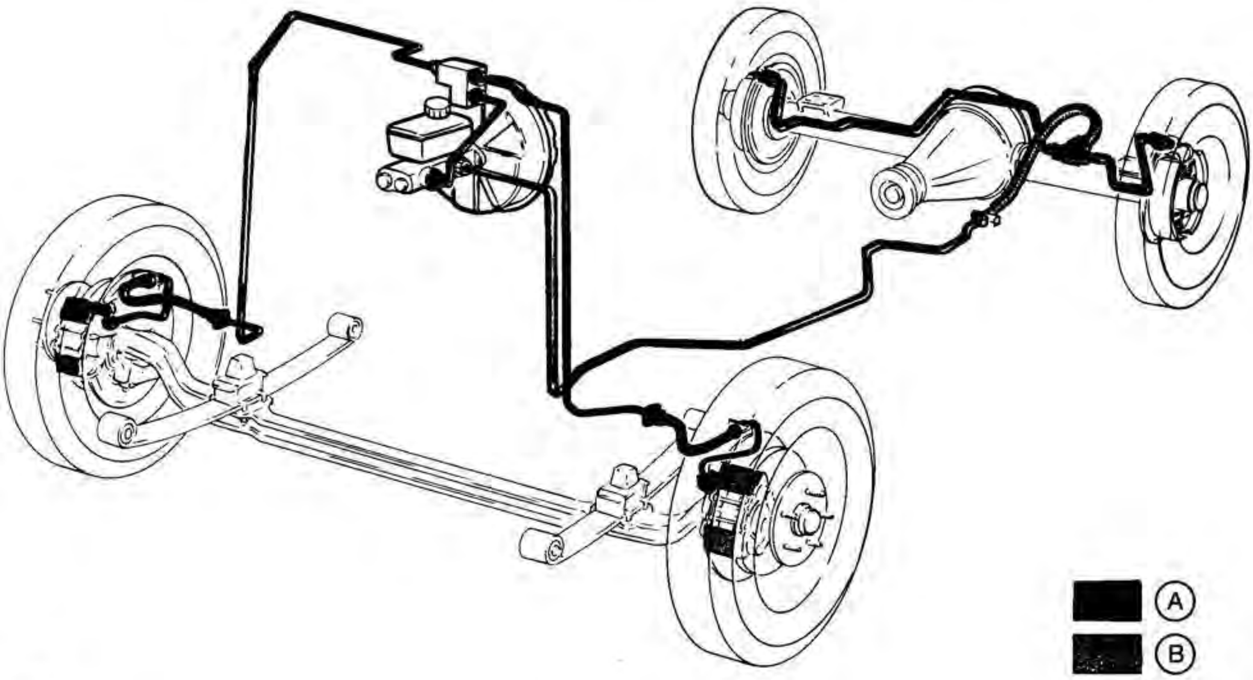


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Fig.1. Vertical Split Braking System (LCX).
A - Rear brake circuit
B - Front brake circuit

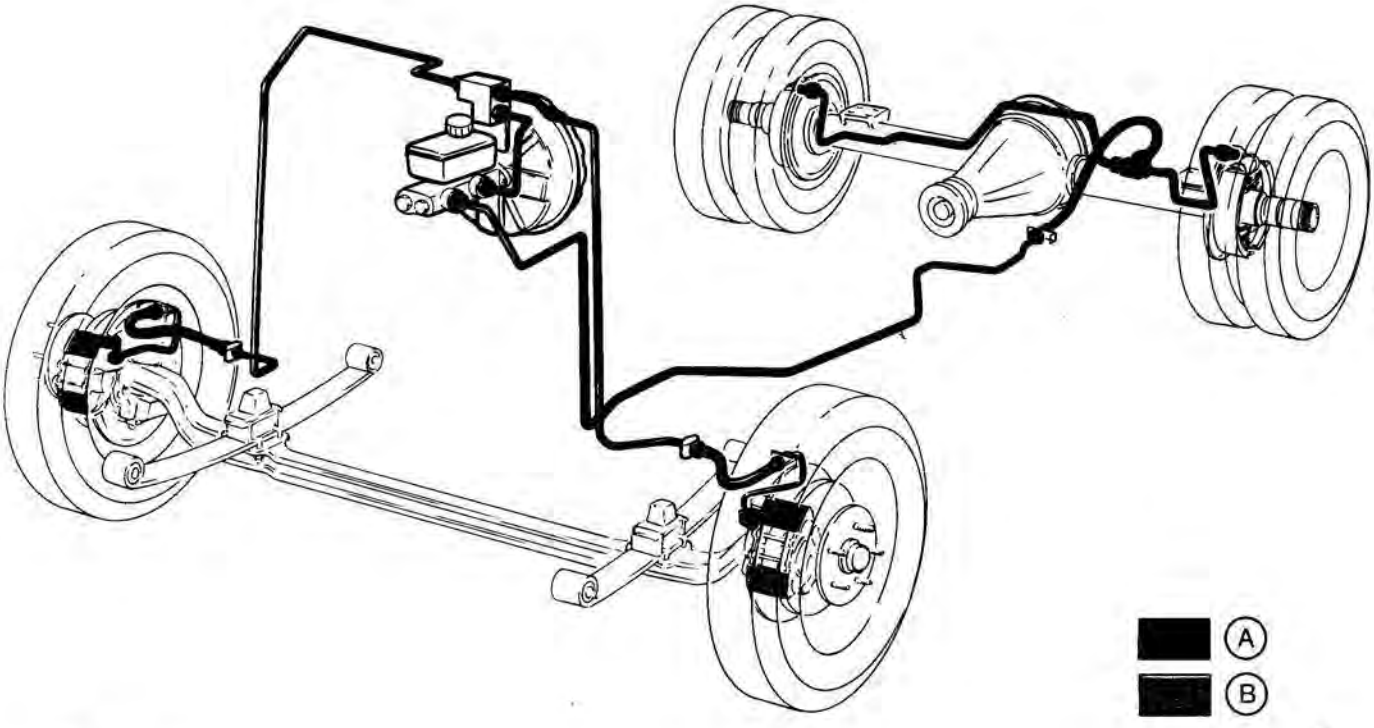

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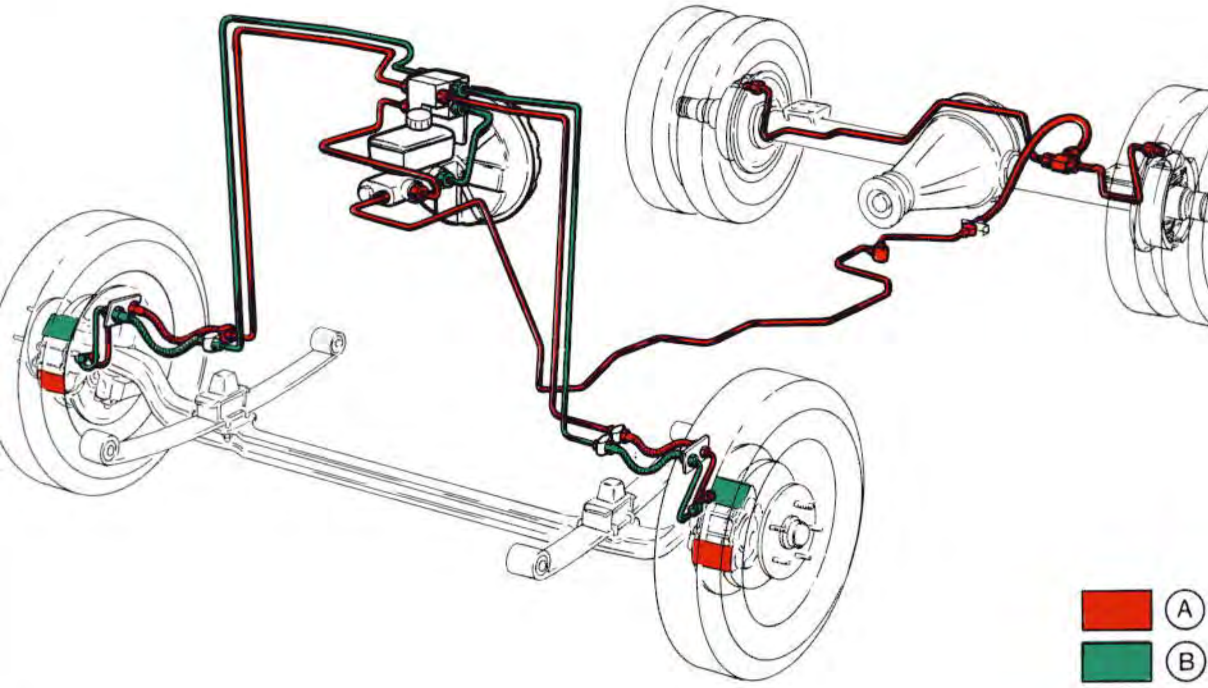
Fig.2. Vertical Split Braking System (LCY).
A - Rear brake circuit
B - Front brake circuit



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3. Horizontal Split Braking System.
   A - Rear brake and lower front brake caliper circuit
   B - Upper front brake caliper circuit

Master Cylinder

The master cylinder is operated by the brake pedal and is a tandem type to provide separate braking circuits. Transits equipped with the vertically split systems have two sizes of master cylinder fitted. Variants with 23,8 mm (0,937 in) internal diameter cylinder have the primary chamber feeding the front brakes, and the secondary, the rear brakes, Fig.4. Variants fitted with the 22,2mm (0,875 in) master cylinder have the ports reversed.

For vehicles with horizontal split braking systems, the secondary chamber provides fluid pressure to the rear brakes, and the lower caliper chamber of the four piston calipers and the primary chamber provides fluid pressure to the upper pistons of the four piston caliper only. The primary chamber is identified as the port nearest cylinder mounting flange.

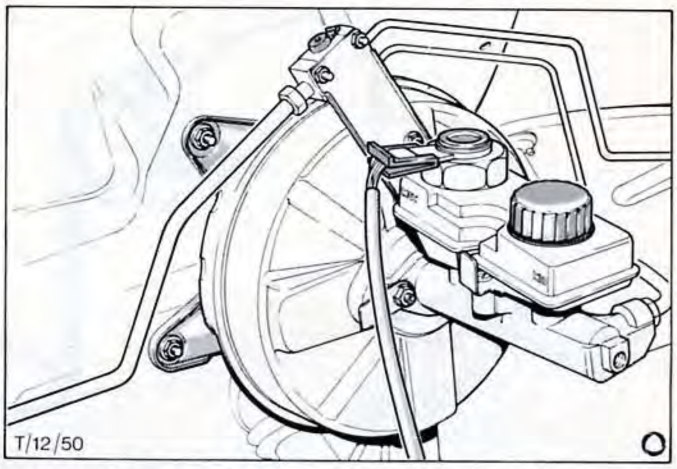


Fig.4. Master cylinder and servo assembly.

The brake fluid is housed in a semi-transparent reservoir which contains a separation baffle. The baffle ensures that, in the event of a fluid leak in one circuit, fluid is still available to operate the other.

Operation of the foot brake causes the master cylinder pistons to be pushed along the bore against the fluid. As brake fluid is incompressible, movement is transmitted along the length of the brake pipes. The total master cylinder displacement is divided between the split braking circuits.

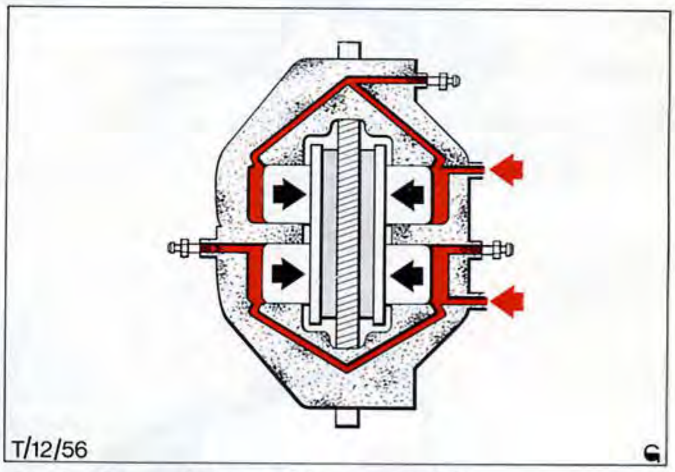


Fig.5. Four piston caliper operation.

Front Disc and Caliper Assemblies

Each front brake is actuated by fluid pressure pushing the pistons against the brake pads, causing them to come into firm contact with the brake discs. When the brake pedal is released the piston is withdrawn a small distance by the piston seal shape. As the pads wear, the piston moves out further than it is retracted by the seal, thus the brake self adjusts. Fig.5.

Rear Drum Brake

The rear drum brake is actuated by the fluid pressure causing the pistons in the wheel cylinder bore to expand the brake shoes until they come into contact with the brake drum.

The rear brakes are self adjusting during operation of the brake pedal.

The self adjusting mechanism consists of a spacer strut and a pair of toothed ratchets. The spacer strut is attached to the trailing shoe and the adjusting ratchets are attached to the leading shoe. Fig.6.

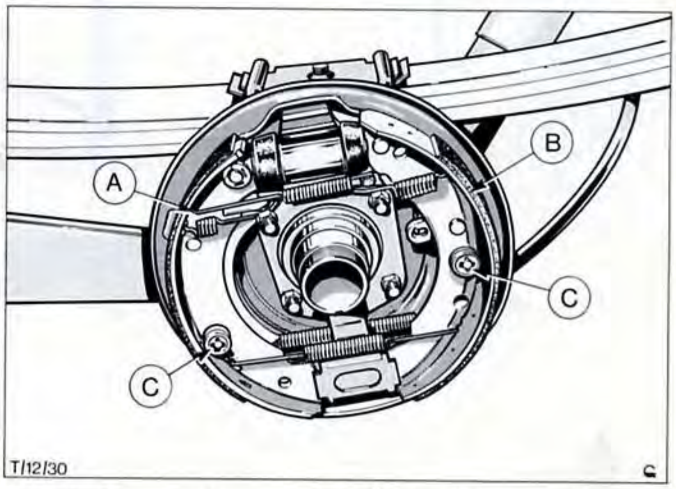


Fig.6. Rear brake assembly (LCX illustrated).
A - Leading shoe
B - Trailing shoe
C - Shoe hold-down springs

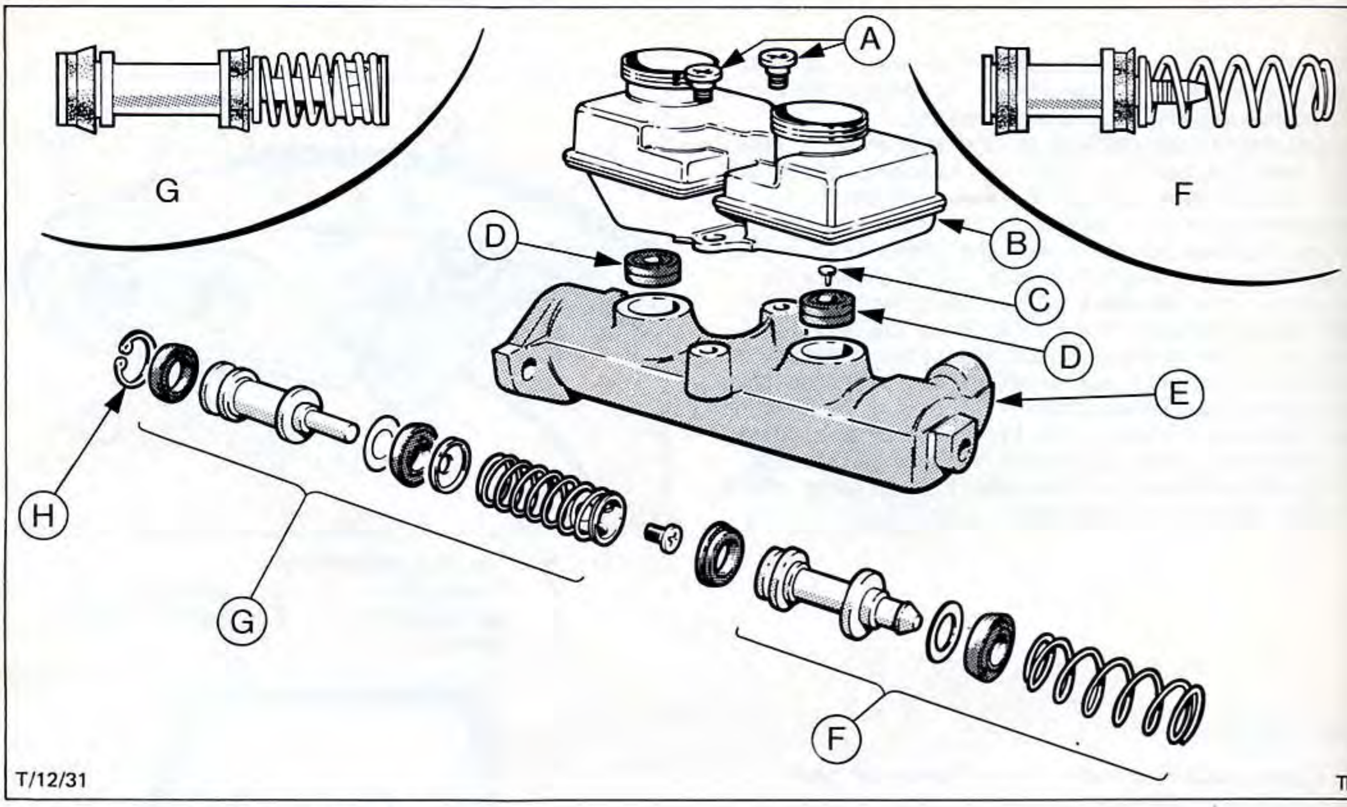


Fig.7. Master cylinder assembly.
A - Reservoir retaining screws
B - Semi-transparent reservoir
C - Secondary piston stop pin
D - Reservoir housing seals
E - Master cylinder body
F - Secondary piston assembly
G - Primary piston assembly
H - Piston retaining circlip

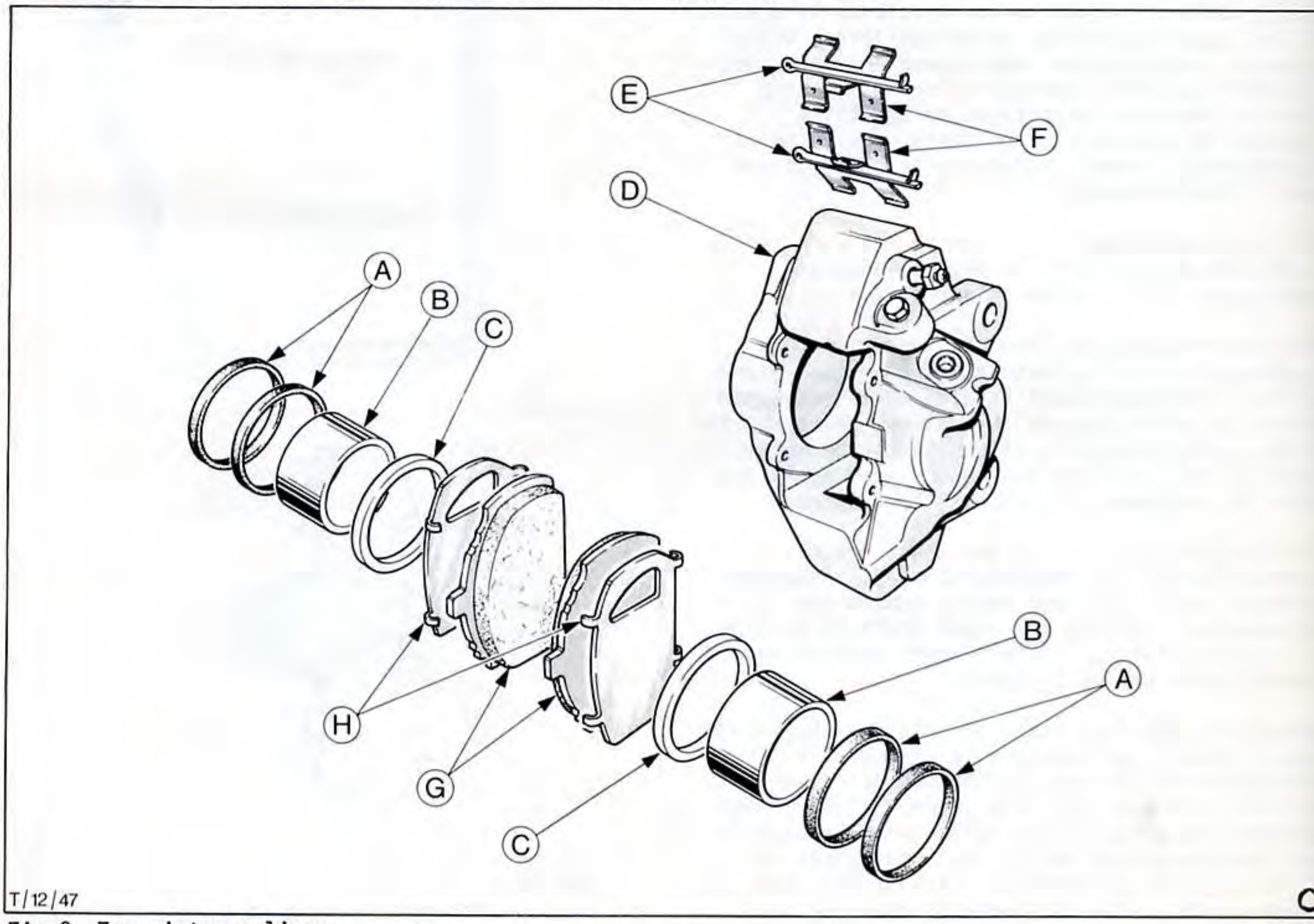


Fig.8. Two piston caliper.
A - Fluid seals
B - Piston
C - Seal retainers
D - Caliper housing
E - Pad retaining pins
F - Pad retaining clips
G - Brake pads
H - Shims

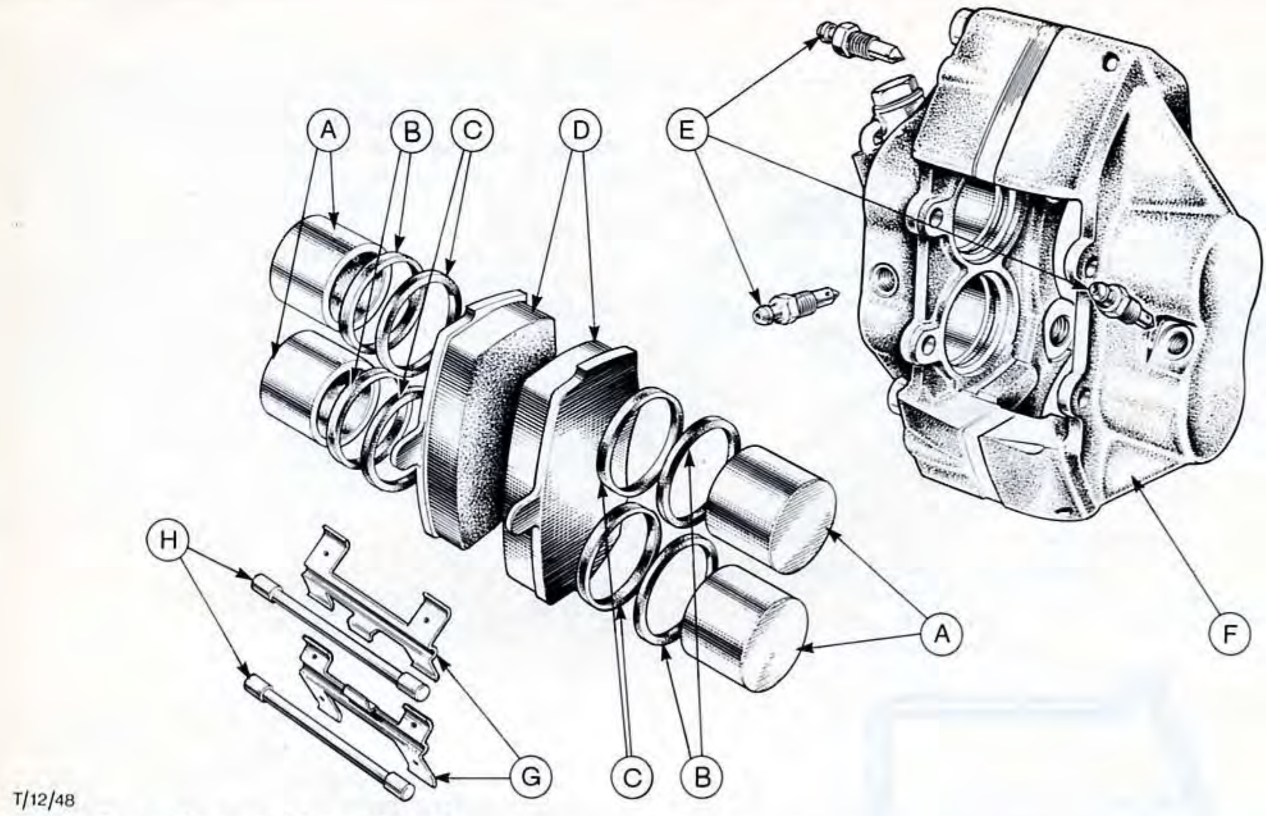


Fig.9. Four piston caliper assembly.

A - Pistons
B - Fluid seals
C - Piston seal retainers
D - Brake pads
E - Bleed valves
F - Caliper housing
G - Anti-rattle clips
H - Pad retaining pins

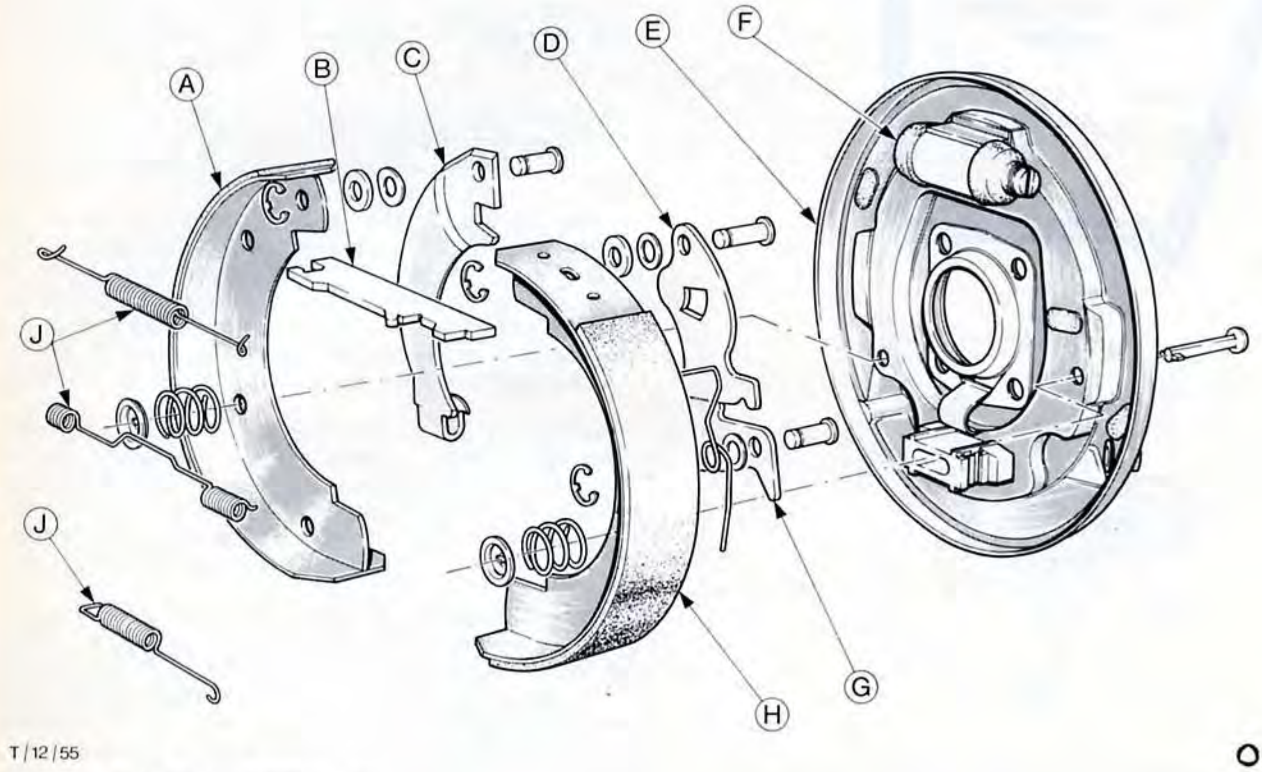


Fig.10. Rear brake assembly.

A - Trailing shoe
B - Spacer strut
C - Handbrake lever
D - Ratchet
E - Carrier plate
F - Wheel cylinder
G - Adjustment ratchet
H - Leading shoe
J - Shoe return springs

The self adjusting mechanism is designed to ensure that correct brake shoe lining to drum clearance is maintained during normal braking.
Adjustment is maintained by the operation of the foot brake actuating a pair of ratchets fixed to the leading shoe through movement of the adjustment strut attached to the trailing shoe. On application of the brake the strut senses the shoe lining to drum clearance, if clearance is excessive the movement of the strut will rotate the larger ratchet inwards accross the smaller ratchet. The serrations on the ratchet mating faces will adopt a new setting, on releasing the foot brake the brake shoes will adjust to this new position and correct shoe lining to drum clearance is obtained. This clearance will be maintained until further wear of the shoe lining takes place and adjustment is required.

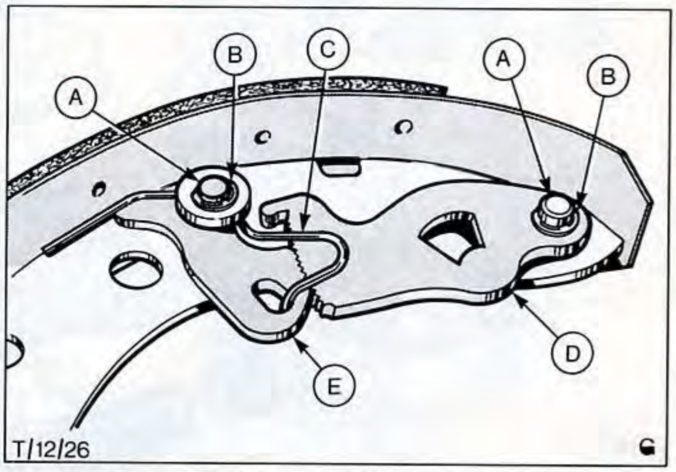


Fig.11. Self adjust mechanisms.
A - Pivot pin
B - Spring clip
C - Spring
D - Ratchet
E - Small ratchet

Brake Servo

To reduce pedal effort a brake servo of the suspended vacuum type is fitted between brake pedal and master cylinder.

The servo unit is designed to provide controlled power assistance during vehicle braking. For petrol variants vacuum servo assistance is created by the vacuum within the inlet manifold. Diesel variants create vacuum from a pump driven by the crankshaft pulley. Vacuum is created on both sides of the servo diaphragm, by admitting atmospheric pressure to the brake pedal side of the diaphragm, power assistance is obtained and pedal effort reduced.

Should servo vacuum failure occur the push rod still acts mechanically to provide adequate braking but with a higher pedal effort.

With the footbrake in the 'off' position the diaphragm is held against its stop by the return spring. The input shaft is also fully retracted within the valve body by the return spring, as far as the piston stop will allow. With the input shaft in this position the vacuum port opens and there is a vacuum each side of the diaphragm.

When the brake is applied the input rod moves forward opening the atmospheric port. Atmospheric pressure enters the rear casing behind the diaphragm and assists the input shaft in pushing the fulcrum plate and output shaft forward thereby actuating the master cylinder.

Immediately the foot brake is released the vacuum port is opened and atmospheric pressure is extracted from the rear of the chamber drawn into the front chamber, and from there into the inlet manifold via a non-return valve. The atmospheric port remains closed whilst the input shaft returns to its original position assisted by the diaphragm return spring. The diaphragm is then again suspended in vacuum until the brake pedal is depressed.

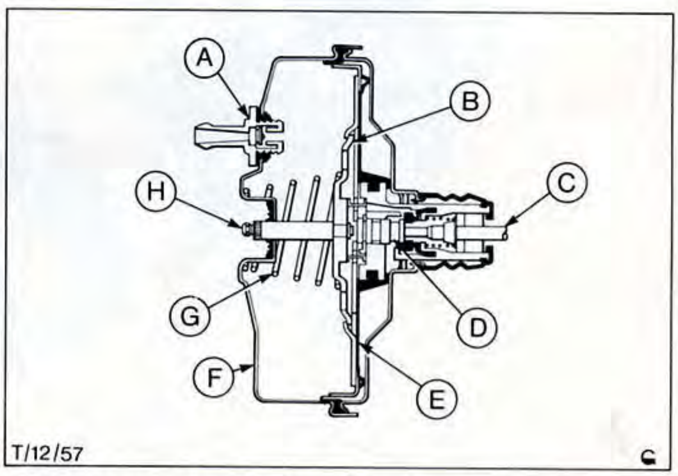


Fig.12. Sectional view of brake servo assembly.
A - Non-return valve
B - Fulcrum plate
C - Input shaft
D - Atmospheric port
E - Diaphram
F - Casing
G - Spring
H - Master cylinder push rod

Pressure Delay Valve

All disc braked variants are fitted with a pressure delay valve. The initial pressure required to actuate the rear drum brakes is higher than that for the front disc brakes. The purpose of the pressure delay valve is to restrict the pressure applied to the front brakes during brake operation until sufficient pressure is applied to the rear brakes.

The pressure delay valve is not serviceable and can only be replaced as a complete unit. The valve may be overridden to assist in brake bleeding if necessary, by depressing the 'button' on the valve throughout brake bleeding, Fig.13.

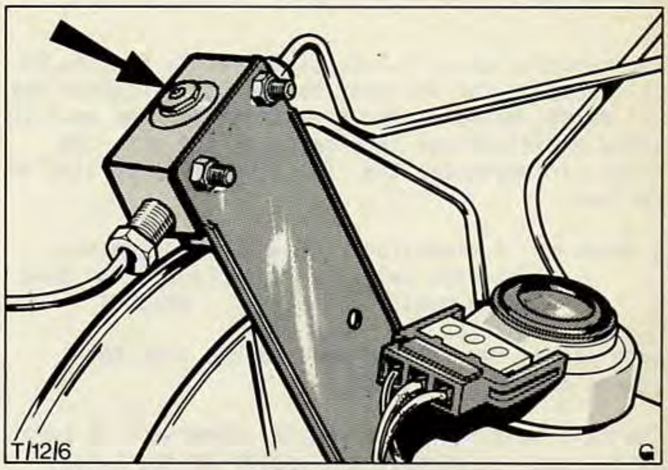


Fig.13. Pressure delay valve button.

Load Apportioning Valve (L.A.V.)

Dependent on territorial requirements a Load Apportioning Valve is fitted in production to the rear brake circuit. The function of the L.A.V. is to minimise the possibility of early 'lock-up' of the rear wheels under heavy or emergency braking, conditions with the vehicle in an unladen or partly laden condition.

The L.A.V. assembly is mounted on the vehicle chassis forward of the rear axle, and is connected to the rear axle via a lever and load sensing spring to the rear axle bracket.

Vehicles fitted with a L.A.V. (Austria and E.E.C. territories) also have an identification plate fitted to the left or right hand door step riser.

Variants produced for sale in Germany, Italy, Holland, Belgium, Denmark and Luxembourg have the plate depicting 'X' and 'Z' dimension, Fig.14. Variants built for United Kingdom and France have a L.A.V. check plate which is unique to that variant build, Fig.15.

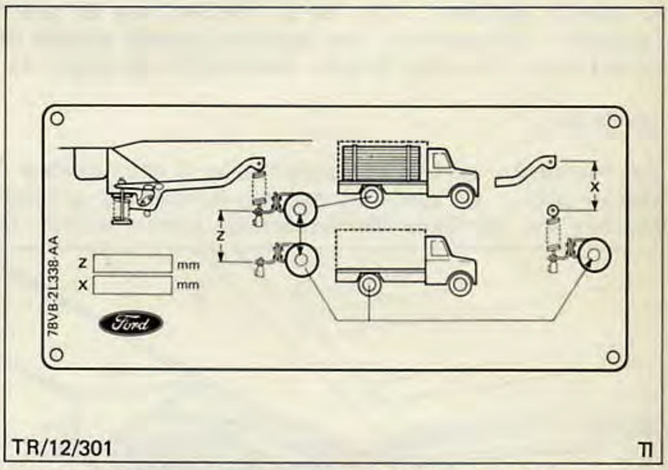


Fig.14. LAV identification plate unique to Germany Italy, Holland, Belgium, Denmark and Luxemburg.

All dimensions quoted on these plates are legal check dimensions and are calculated and stamped at plant or body builders, to comply with legal requirements. The 'X' dimension is the only adjustment possible to the Load Apportioning Valve. This setting determines the balance between front and rear brakes of the vehicle.

The 'Z' value indicates the useful travel of the Load Apportioning Valve. As this travel is a function of the vehicle design it cannot be adjusted and has no relevance to service adjustment or repairs. However, for territories specified above, it is a legal requirement for the 'Z' value to be stamped on the L.A.V. identification plate.

For standard factory produced bodies the 'X' and 'Z' value are stamped on the L.A.V. plate during manufacture.

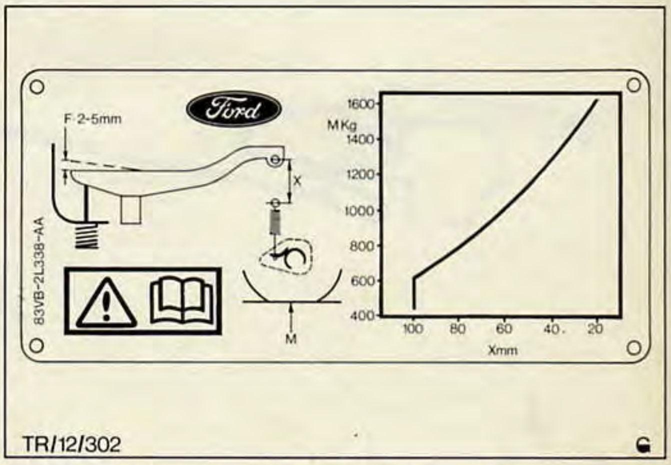


Fig.15. LAV plate unique to U.K. and France only.

Load Apportioning Valve (L.A.V.)

Vehicles with Specialist Bodies and Conversions

For vehicles using L.A.V. plates as in Fig.14. it is necessary for the body builder to calculate the 'Z' value, based on the kerb weight of the vehicle after modifications have been carried out. In these circumstances the 'Z' value is calculated as follows:

Z value = X dimension (at kerb weight after modification) minus X dimension (at plated rear axle weight)

Both values for 'X' can be obtained from the charts on pages 34 to 45.

The resultant 'Z' value and 'X' dimension at kerb weight must be stamped and appear on the L.A.V. identification plate.

The graphical type L.A.V. plate fitted to French and U.K. variants are for legal check applications only and no stamping is required. Fig.15.

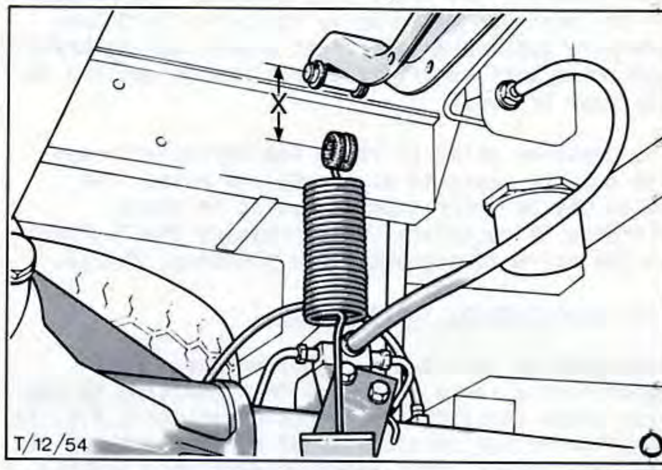


Fig.16. L.A.V. 'X' dimension.

To enable vehicle L.A.V. to be checked and or set it is essential that the vehicle is first weighed (unladen) to ascertain the correct ground weight of the rear axle. The 'X' dimension setting can then be obtained from the graphs and charts on pages 34 to 45.

Handbrake

The handbrake system is operated by a cab mounted lever between the front seats and acts on the rear wheels only. On applying the handbrake the primary rod is pulled forward, placing the handbrake under tension and operates the handbrake levers within the rear drum brakes.

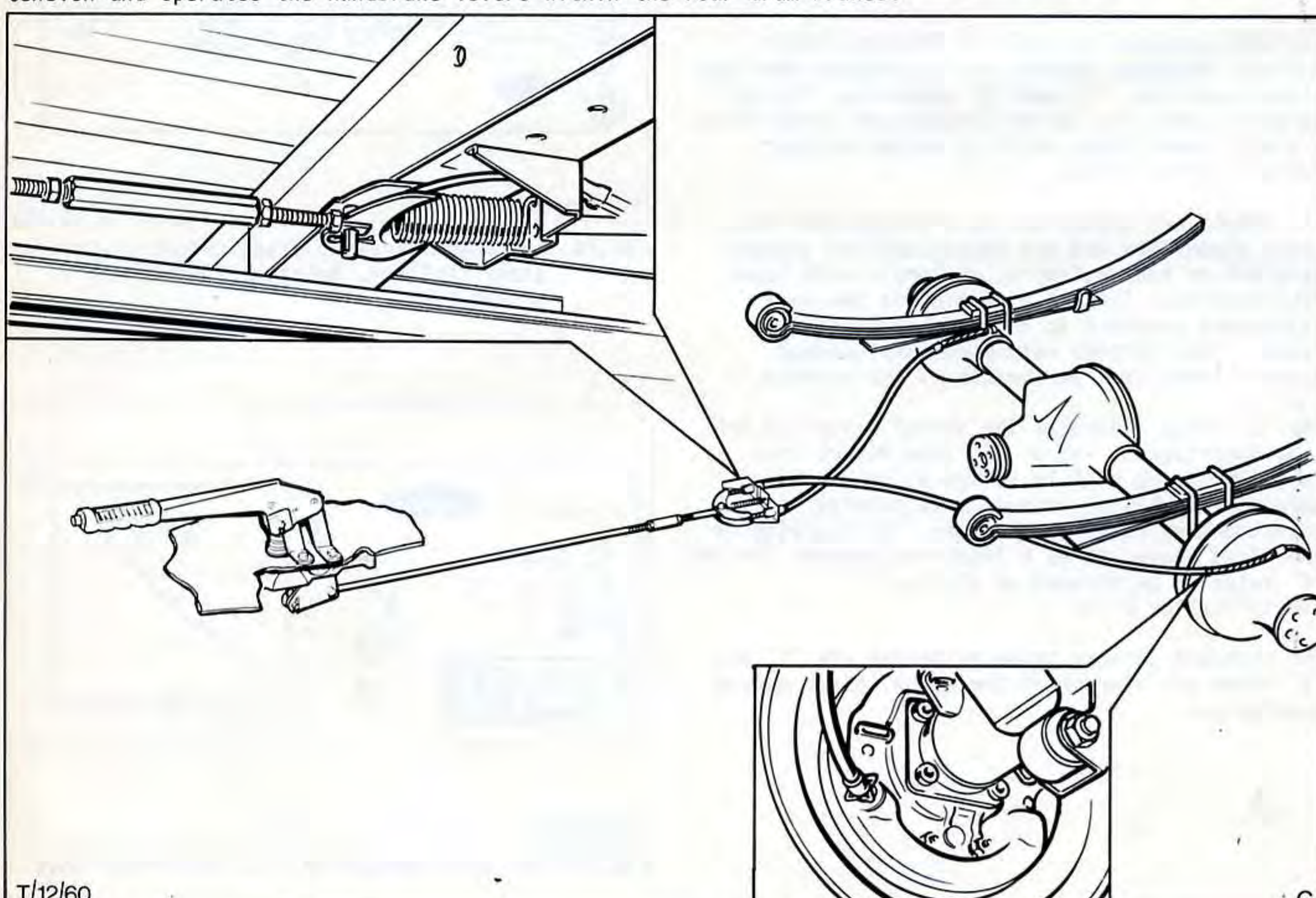
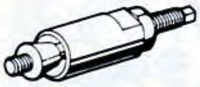
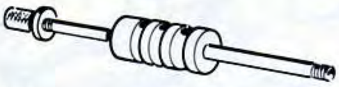
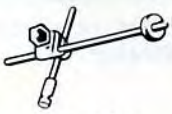


Fig.17. The handbrake system.

SPECIAL SERVICE TOOL RECOGNITION

TOOL	TOOL NAME
 12-005	Wheel cylinder retaining clip replacer
 15-011	Slide hammer
 15-022	Dial indicator holding fixture
 15-029	Rear hub nut wrench
 15-046	Metric dial indicator gauge
 CP-3072-4B	Slide hammer adaptor*
 GE-2031	Caliper piston expander*

G

TR/12/54/N

* This is a proprietary servicing tool available from suppliers such as V L Churchill & Company Limited, V Lowener and Optom SA and their agents.

SERVICE ADJUSTMENTS AND CHECKS

At the specified service intervals the following operations should be checked:

- Check and top up brake fluid reservoir
- Inspect brake hoses and hydraulic pipes for signs of leaks or chafing
- Check front brake pads and rear brake linings for wear
- Lubricate handbrake cable linkage

SERVICE AND REPAIR OPERATIONS

12 141 BRAKES - BLEED

SPECIAL SERVICE TOOLS REQUIRED: NONE

CAUTION: If brake fluid is spilt on paintwork, the affected area must be washed down with cold water immediately.

1. Remove reservoir cap and top up reservoir ensuring that both chambers of the reservoir are filled up to the 'MAX' mark with specified fluid.

2. Remove dust cap from R.H./L.H. caliper bleed nipple (caliper nearest master cylinder). Vehicles fitted with the four piston calipers have three bleed nipples, these must all be bled simultaneously.

3. Unscrew bleed nipples about half a turn, depress brake pedal and allow it to return to its stop. Continue to pump pedal until clear air free fluid is pumped into container.

NOTE: During this operation the master cylinder must be kept topped up to the 'MAX' mark.

4. Bleed remaining caliper and then rear brake circuit.

5. Top up reservoir to 'MAX' mark and replace cap and brake fluid/brake failure warning light connection.

12 154 4 BRAKE SYSTEM HYDRAULIC FLUID - REPLACE

SPECIAL SERVICE TOOLS REQUIRED:

Caliper piston expander .. .. GE 2031

NOTE: This procedure details how old brake fluid can be purged from the system by draining both front circuits of fluid and replenishing with new fluid. Rear brakes can be replenished in the normal method of bleeding both rears.

CAUTION: If brake fluid is spilt on paintwork, the affected area must be washed down with cold water immediately.

1. With vehicle jacked up or raised on ramp, connect bleed tube to both front calipers. Place other ends of tube in suitable containers to collect purged fluid, unscrew both front bleed nipples.

2. Remove master cylinder reservoir cap. Pump brake pedal fully and allow it to return quickly to rest. Continue to pump brake pedal until all fluid is purged and air is being pumped into containers (pause between strokes to allow brake master cylinder to recuperate).

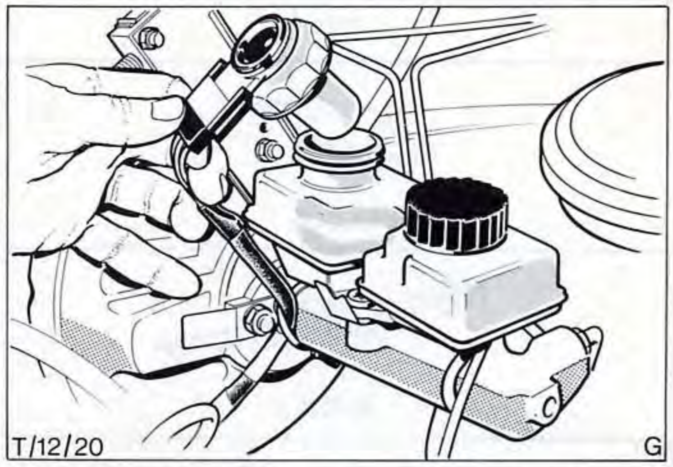


Fig.18. Master cylinder reservoir and fluid warning indicator.

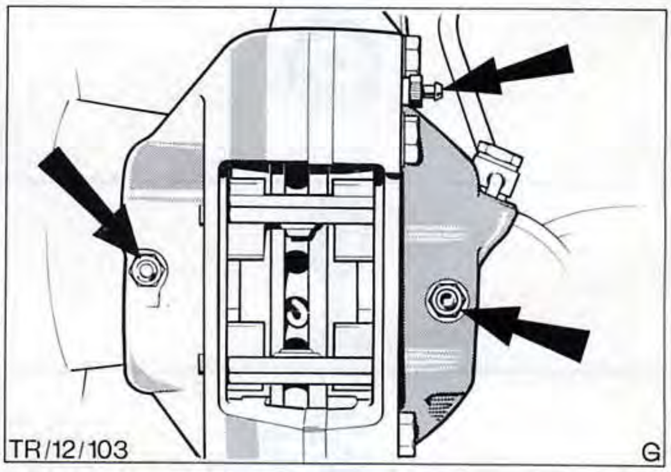


Fig.19. Four piston caliper bleed nipples.

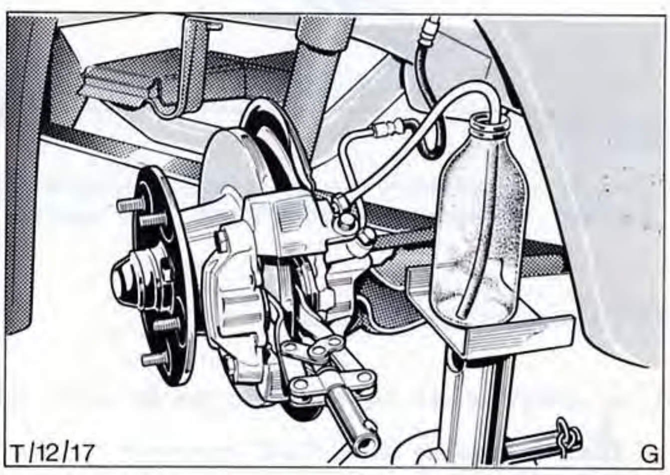


Fig.20. Caliper expander fitted to the two piston type caliper.

(Vehicles with four piston type caliper)

3. Insert suitable spacers between opposite pistons and disc face to allow each brake circuit to be purged individually.

4. Fit piston expander, and completely retract caliper piston. Continue depressing brake pedal until only air is being pumped out. Tighten bleed screw.

5. When first caliper has been purged, loosely refit pads to prevent pistons being forced out when second side is purged. After second caliper has been purged do not remove expander.

6. Position bleed tube from caliper to which caliper expander is still fitted, in a glass jar, containing a small quantity of approved brake fluid. Position jar at least 300 mm (12 in) above bleed nipple. This is to ensure that the bleed nipple itself is subjected to fluid pressure, thereby preventing possibility of air leaking past threads of bleed nipple and into braking sytem. Ensure end of bleed tube is kept immersed in brake fluid.

7. Unscrew bleed nipple.

8. Fill reservoir with new unused fluid meeting Ford Specification SAM-6-9103 A (amber). Continue depressing brake pedal pausing after each stroke until 'air free' fluid is seen passing through the bleed tube. With brake pedal held fully depressed retighten bleed screw and top up reservoir with new fluid as required.

9. Carefully unscrew piston expander to obtain maximum caliper piston travel. Depress brake pedal carefully, so moving caliper piston to its fully extended position. With pedal still depressed, unscrew bleed nipple. Using piston expander, force pistons back to their fully retracted position and then retighten bleed screw. Remove piston expander and refit brake pads.

10. Remove pads as fitted in sub-operation 5, and fit piston expander to other caliper so that pistons are in the fully retracted position. Repeat sub operations 6 to 9 for other front caliper circuit.

11. Bleed rear brake circuit until clean new fluid can be seen.

12. Check and top up brake fluid if necessary. Do not fill above 'MAX' mark on reservoir. Refit reservoir cap and electrical connections.

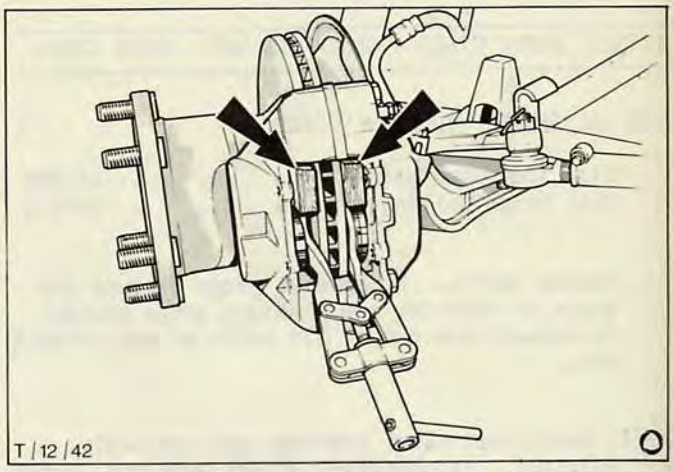


Fig.21. Fit suitable spacers between opposite pistons and disc face to enable each circuit to be purged individually. (four piston type caliper)

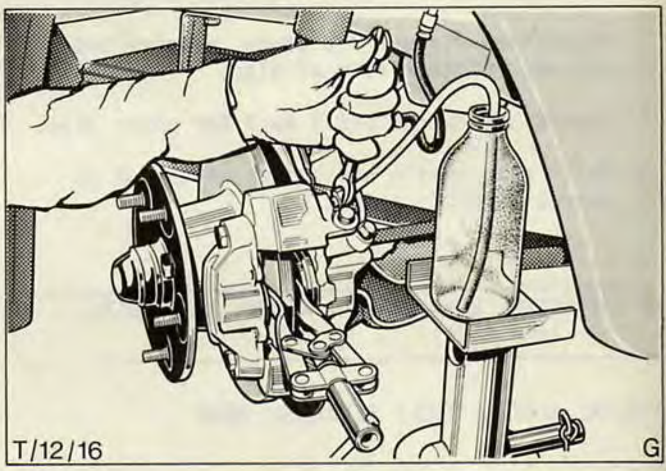


Fig.22. Position bleed jar 300 mm above bleed nipple.

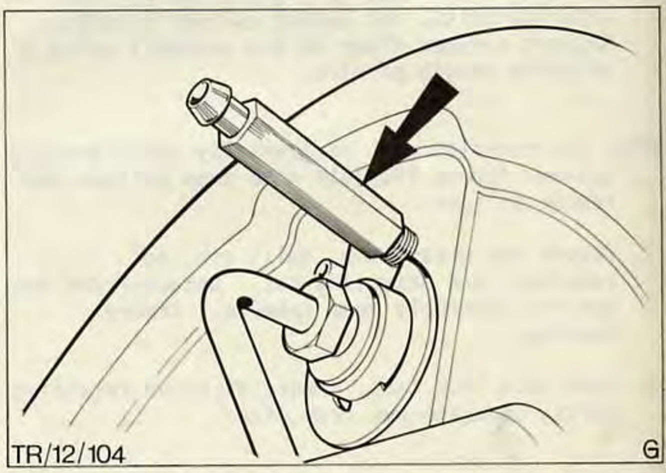


Fig.23. Rear brake bleed valve.

12 221 BRAKE DISCS - CHECK RUN OUT - BOTH SIDES

SPECIAL SERVICE TOOLS REQUIRED:

Dial indicator gauge	15-046
Dial gauge holding fixture	15-022

1. Remove wheels. Mount dial gauge fixture and gauge to steering arm. Adjust gauge plunger to measure run out at mid point of pad contact area.

NOTE: Check that wheel bearings are correctly adjusted. If necessary adjust bearings, refer to Operation 12 223.

2. Measure total run out, this should not exceed 0,13 mm (0,005 in). If this figure is exceeded the cause must be eliminated.
3. Reposition fixture and gauge, measure total run out of other face of disc.
4. Repeat sub-operations 1 to 3 for other disc.
5. Refit road wheels and torque wheel nut to correct specification.

12 223 DISC FRONT BRAKE - REMOVE AND INSTALL (one side)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove road wheels.
2. Bend back lock tabs and remove two caliper securing bolts, and detach caliper assembly. Support caliper clear of hub assembly using a suitable length of wire.

NOTE: For vehicles with horizontally split braking systems remove flexible hose from caliper and remove caliper.

3. Remove hub grease cap, split pin, nut retainer, and adjusting nut. Detach front hub and disc assembly from spindle. Remove bearing.
4. Bend back lock tabs, remove disc/hub retaining bolts, separate hub from disc.

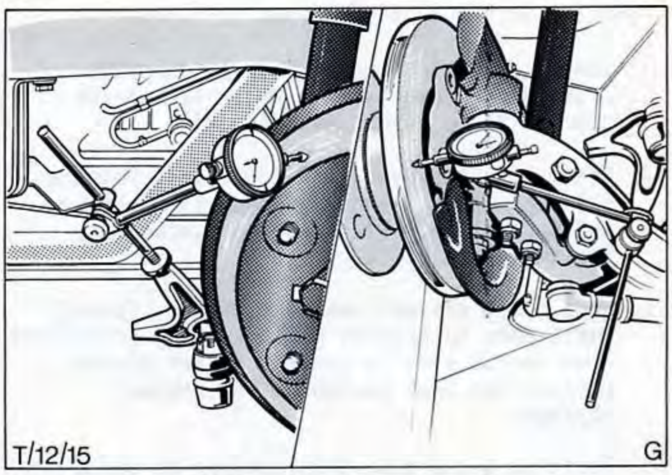


Fig.24. Check disc run-out.
A - Front of disc run-out check
B - Rear of disc run-out check

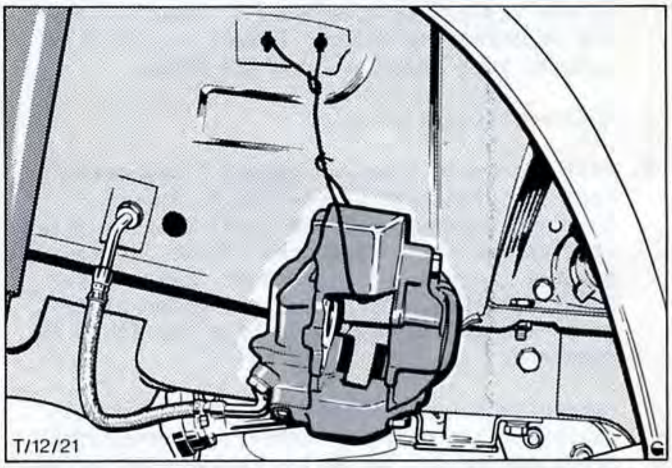


Fig.25. Suspend caliper to prevent undue strain on brake hoses.

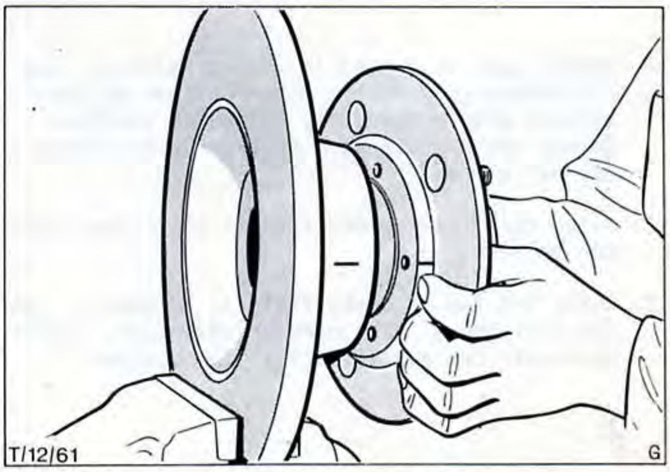


Fig.26. Front disc and hub aligning marks.

12 223

To Install

5. Ensure both contact faces on hub and disc are clean and free from any preservative, grease or burrs, Fig.26.

6. Refit disc to hub assembly, align mating face marks. Using new lock tabs, secure disc to hub and torque to specification, Fig.27.

7. Refit hub and disc assembly to spindle, fit taper roller bearing, washer and adjusting nut.

8. Check front disc run out, refer to Operation 12 221.

9. Reposition caliper assembly and secure. Torque bolts to specification (see Technical Data), secure lock tabs.

10. Refit road wheel and tighten wheel nuts.

11. Adjust wheel bearings.

 - Tighten adjusting nut to 20 to 25 Nm (2,0 to 2,5 Kgfm - 15 to 18 lbf.ft), while rotating the hub assembly in an anti-clockwise direction.
 - Slacken adjusting nut one half turn (180°), spin road wheel and retighten nut finger tight.
 - Ascertain that some free play exists, grasp top and bottom of wheel and impart a rocking motion, a small perceptible movement must be felt.
 - Fit nut retainer and new split pin, refit hub grease cap.

12. On vehicles with horizontally split braking system, refit brake hoses and bleed brakes, refer to Operation 12 141.

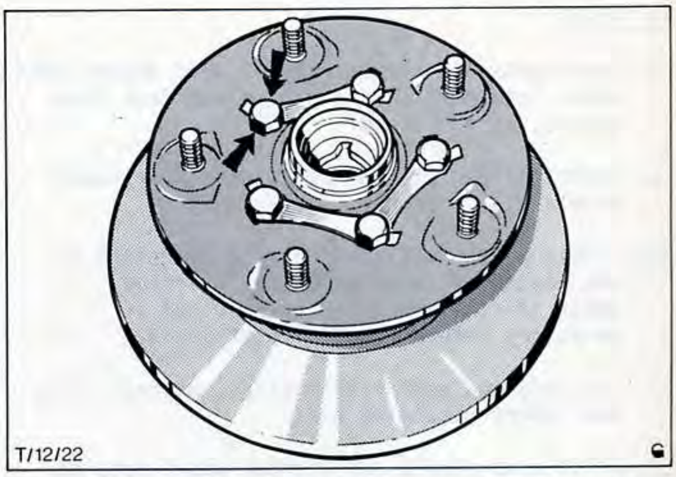


Fig.27. Hub to disc retaining bolts and locktabs.

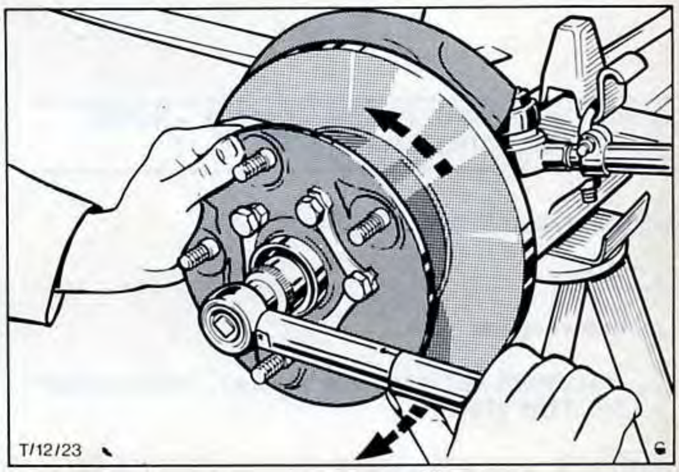


Fig.28. Torque hub adjusting nut to 20-25 Nm. (wheel removed for clarity)

12 233 DISC PADS - REPLACE (ONE SIDE)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove brake fluid reservoir cap and cover with clean cloth.

2. Remove front road wheels.

3. On four piston calipers, depress anti-rattle clips and remove two pad retaining pins and anti-rattle clips. On two piston calipers, straighten split retaining pin, depress clips and remove pin clips.

4. Remove disc pads, by pulling pads from caliper housing.

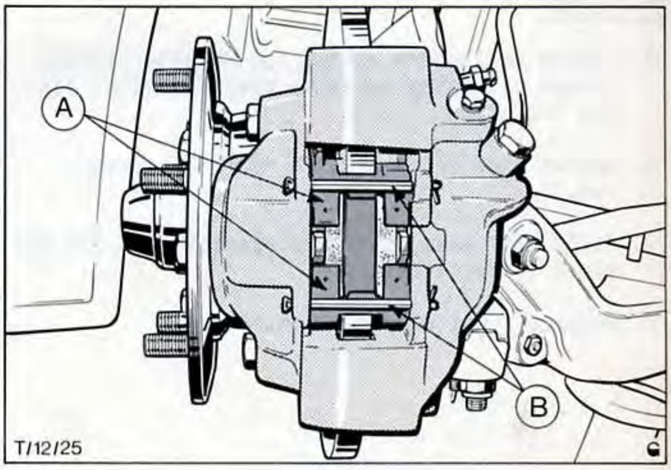


Fig.29. Disc pad retaining pins and clips.
A - Retaining clips
B - Retaining pins

12 233

To Install

5. Check pads are correct type. Also ensure that pads, retaining pins and disc are free from grease, oil or dirt.

6. Lever caliper pistons back into their bores with a flat iron bar.

NOTE: This action will cause fluid to return to the master cylinder which may overflow. To avoid this, examine fluid level and if necessary remove a quantity of fluid.

7. Fit pads and anti-rattle clips, depress clips and insert retaining pins.

8. Refit road wheels and tighten wheel nuts to specification.

9. Operate brake pedal several times to bring the pads into correct adjustment. Check and if necessary top up fluid reservoir. Replace reservoir cap.

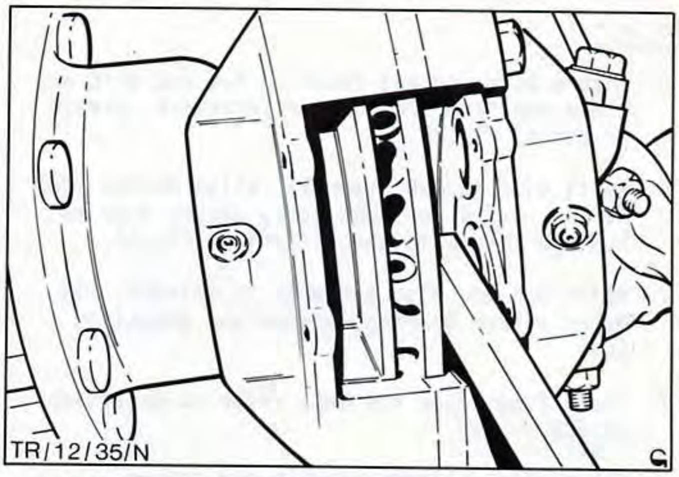


Fig.30. Lever caliper pistons back into bores using flat iron bar.

12 243 FRONT BRAKE CALIPER ASSEMBLY - REMOVE AND INSTALL (One Side)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove front wheel.

2. Disconnect caliper feed pipe(s), from caliper fit line plug(s).

3. Remove disc pads, refer to operation 12 333.

4. Prise back lock tabs, remove two caliper retaining bolts and detach caliper assembly from spindle carrier, Fig.31.

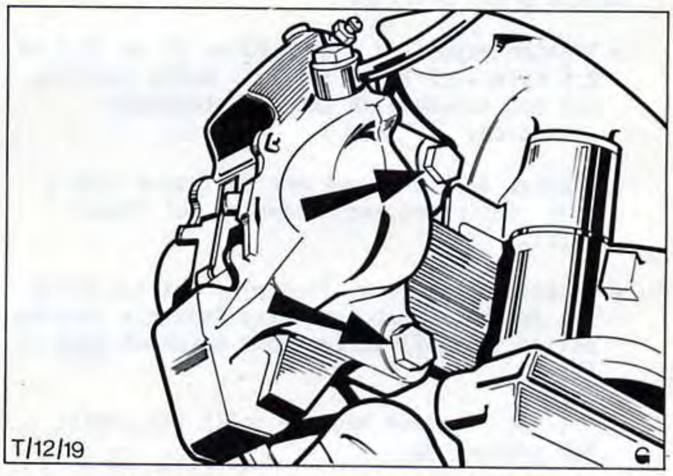


Fig.31. Caliper securing bolts to spindle carrier.

To Install

5. Locate and secure caliper on spindle carrier torque retaining bolts to specification, fit new lock tabs.

6. Remove line plugs and fit hydraulic hoses, Fig.32.

7. Refit disc pads, refer to operation 12 333 and bleed brake circuit.

8. Replace front wheels, tighten.

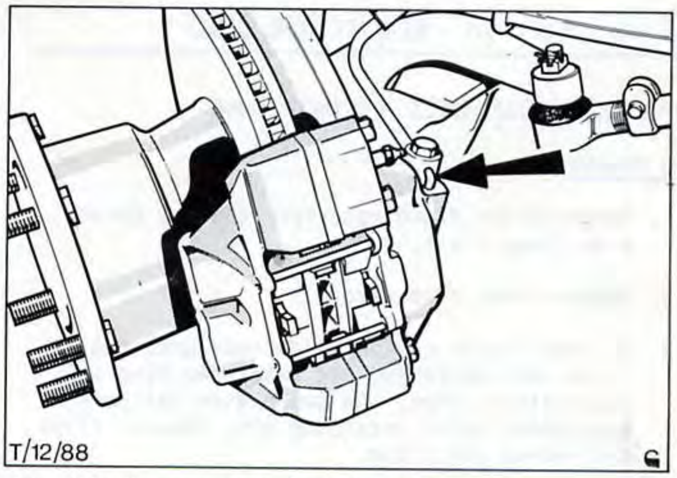


Fig.32. Reconnect hydraulic fluid pipes to caliper ensuring guide pin is located correctly in caliper.

12 285 SHOES - REAR BRAKE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Rear hub nut wrench 15-029

CAUTION: Brake dust when inhaled can be injurious to health.

To Remove

1. LCX variants only

   Slacken wheel nuts, remove wheels. Release handbrake, carefully remove brake drum.

   125 LCX and all LCY variants

   Remove axle shaft nuts, withdraw axle shaft. Bend up tags of nut retainer and unscrew bearing locknut using service tool 15 029. Remove adjusting nut and outer bearing cone. Remove hub, drum and wheel assembly.

2. Remove shoe hold down spring and cup, from leading shoe. Disconnect return spring from leading shoe, lift lower end of shoe up and away from carrier plate assembly and remove upper return spring, remove leading shoe.

3. Remove trailing shoe, hold down spring and cup. Pull shoe clear of wheel cylinder disconnect handbrake cable.

4. Dismantle leading shoe:

   - Remove spring clip from ratchet pawl, and withdraw pivot pin.
   - Remove spring clip from auto-adjust ratchet and remove pivot pin.

5. Dismantle trailing shoe:

   Remove spring and strut from handbrake lever and shoe, remove spring clip and pivot pin form trailing shoe.

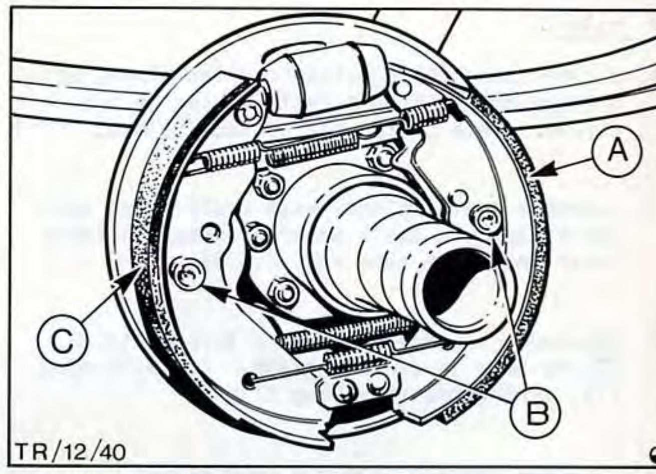


Fig.33. Rear brake shoe assembly. (LCY illustrated)
A - Leading shoe
B - Shoe hold down springs
C - Trailing shoe

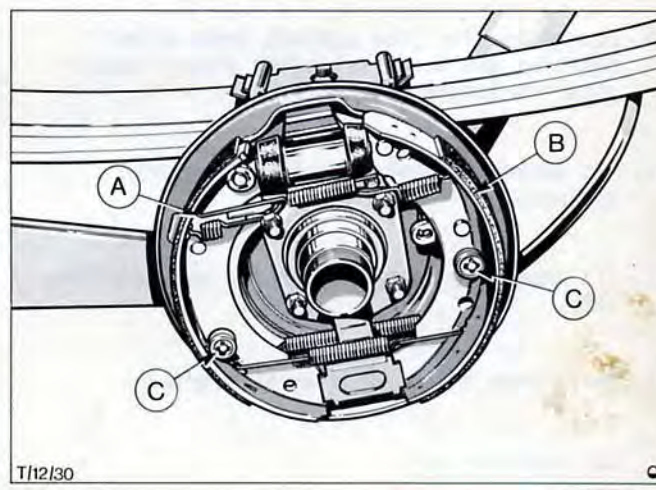


Fig.34. Rear brake shoe assembly. (LCX illustrated)
A - Leading shoe
B - Trailing shoe
C - Hold down clips

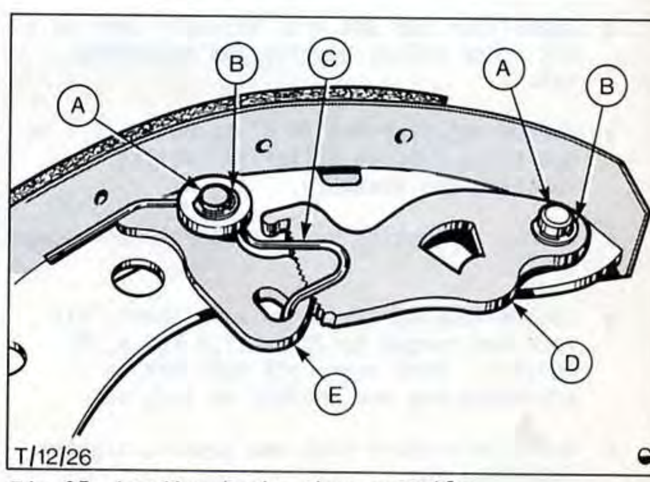


Fig.35. Leading brake shoe assembly.
A - Clevis pin
B - Circlip
C - Spring
D - Large ratchet
E - Small ratchet pawl

12 285

To Install

6. Before reassembling clean carrier plate, apply a light smear of Wolfrakote grease to the carrier plate brake shoe contact points.

7. Assemble trailing shoe with brake lever and strut, apply a small smear of grease between lever and brake shoe web, Fig.36.

8. Reconnect handbrake cable to lever, Fig.38. Secure shoe to carrier plate. Fit hold down pin, spring and retaining clip.

9. Assemble leading shoe and auto adjust ratchets, apply smear of lubrication between ratchets and shoe web, Fig.35.

10. Locate leading shoe against lower pivot position and wheel cylinder, ensure spacer strut is located correctly.

11. Fit upper and lower brake shoe return springs.

12. Fit shoe hold down pin, spring and retaining clip.

13. Refit drum or hub/drum wheel assembly.

LCX variants only

- Refit brake drum, locating drum correctly against hub fit wheel and tighten wheel nuts.

125 LCX and all LCY variants

- Reposition hub and drum assembly onto axle. Fit outer roller bearing and adjusting nut.
- Torque adjuster nut to 67 to 88 Nm (6,7 to 8,8 kgf,m - 50 to 65 lbf.ft) whilst rotating hub assembly.
- Slacken adjusting nut one quarter of a turn (45°).
- Locate locking tab on to axle shaft, fit lock nut torque to 70 Nm (7,0 Kgf.m, 52 lbf,ft). Bend over lock tabs one on adjusting nut and another on lock nut.
- Refit axle shaft with new gasket, tighten retaining nut.

14. Apply foot brake several times to ensure correct auto adjustment.

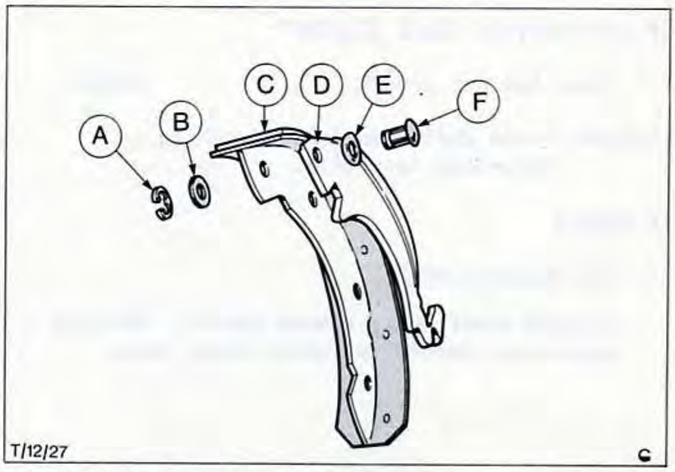


Fig.36. Assemble trailing shoe.
A - Circlip D - Handbrake lever
B - Plain washer E - Wave washer
C - Trailing shoe F - Clevis pin

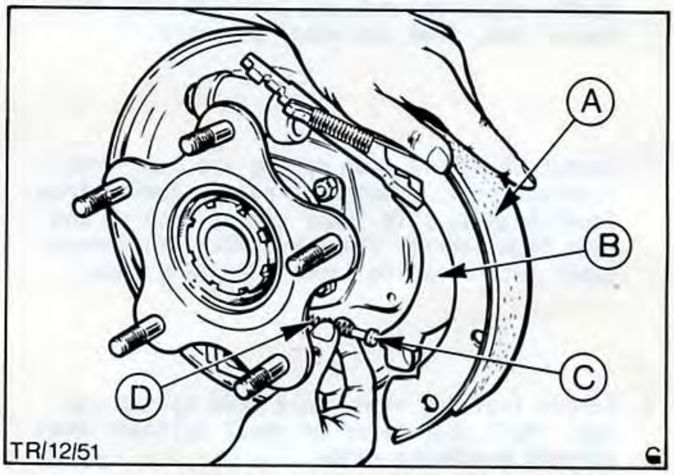


Fig.37. Reconnect handbrake cable to trailing shoe.
A - Trailing shoe C - Handbrake cable
B - Handbrake lever D - Cable spring

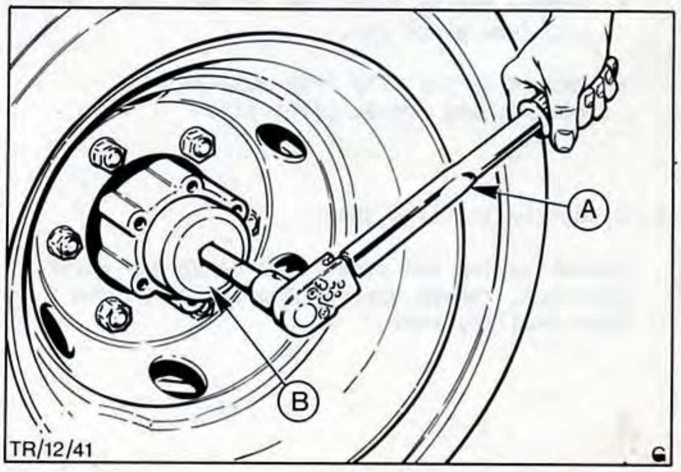


Fig.38. Torque rear hub bearing.
A - Torque wrench
B - Special service tool 15 029

12 305 WHEEL CYLINDER - BRAKE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Circlip installer 12-005

To Install

1. Remove brake shoe assembly, refer to Operation 12 285.
2. Disconnect hydraulic brake fluid pipe from wheel cylinder. Blank off to prevent excessive loss of fluid. Remove bleed nipple.
3. Prise cylinder retaining clip from its groove and remove wheel cylinder from brake carrier plate.

To Install

4. Locate wheel cylinder on carrier plate ensure roll pin locates in hole on plate.
5. Assemble Special Service Tool 12 005 to cylinder and fit retaining clip.
6. Refit bleed nipple and hydraulic pipe. Tighten hydraulic pipe sufficient to seal.
7. Refit brake shoe assemblies refer to Operation 12 285.
8. Bleed brake system refer to Operation 12 141.

12 305 8 WHEEL CYLINDER - REAR BRAKE - OVERHAUL (CYLINDER REMOVED)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Dismantle

1. Remove rubber dust covers, pull out pistons one from each end and remove spring from cylinder bore.
2. Using suitable tool remove piston seals.

   Before reassembly check cylinder bores for rust or scores, if either are present a new cylinder must be fitted.

To Reassemble

3. Ensure wheel cylinder bore and pistons are wiped clean of any foreign matter with a clean non-fluffy cloth using clean brake fluid or methylated spirits.
4. Fit new seals to wheel cylinder pistons.
5. Slide one of the pistons into cylinder bore. From the other end insert spring and second piston. Fit new rubber dust covers.

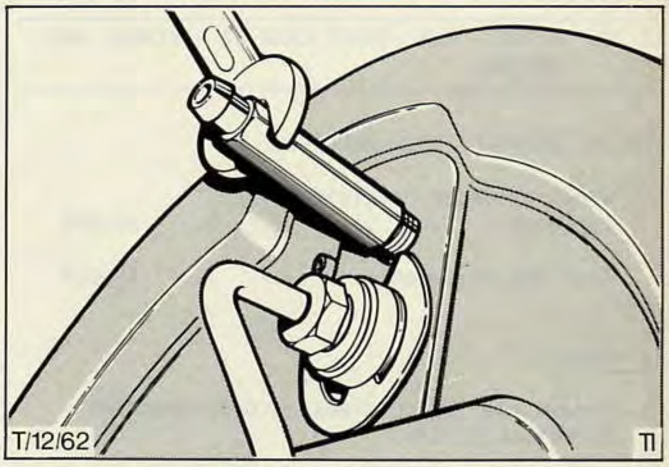


Fig.39. Disconnect hydraulic line and bleed valve.

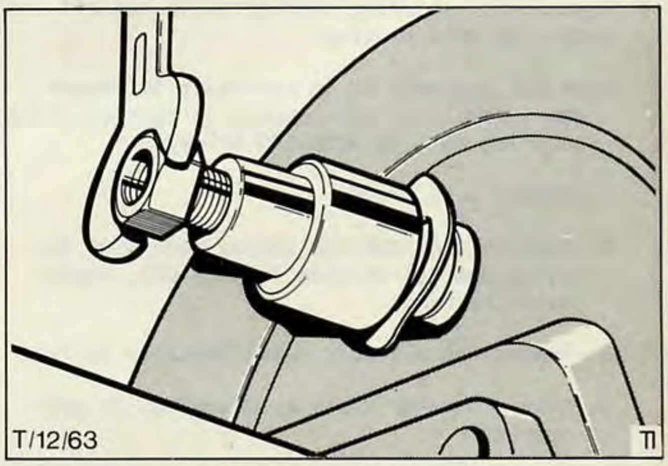


Fig.40. Special Service Tool 12-005 fitted to wheel cylinder.

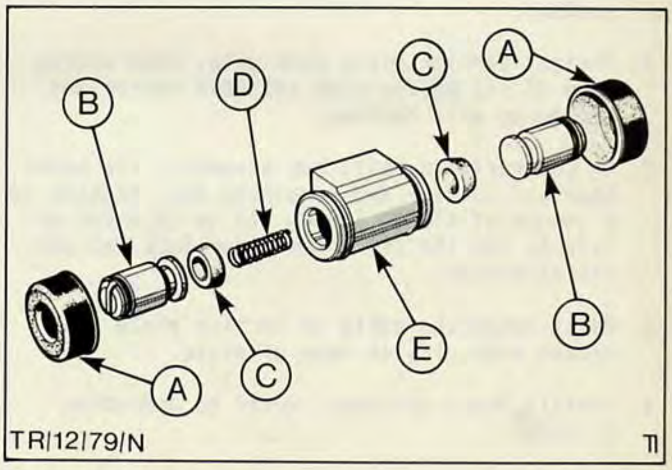


Fig.41. Wheel cylinder assembly.
A - Dust cover
B - Piston
C - Seal
D - Spring
E - Cylinder

12 313 PLATE - REAR BRAKE CARRIER - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Wheel cylinder retaining clip replacer	12-005
Rear hub nut wrench	15-029

To Remove

1. Remove rear brake shoes as described in Operation 12 285.
2. Remove wheel cylinder, refer to operation 12 305.
3. Remove handbrake cable securing clip from carrier plate, remove handbrake cable.
4. Remove nuts securing carrier plate and oil baffle to axle housing.

   o On LCX variants it is necessary to remove hub assembly to gain access to carrier plate securing nuts as detailed below:

   a. Remove axle shaft.

   b. Bend up lock tab and remove retaining nut using Special Service Tool 15 029, remove outer bearing.

   c. Remove hub assembly using suitable puller.

   d. Remove carrier plate as described in sub-operation 4.

To Install

5. Before reassembly ensure carrier plate and oil baffle mating faces are free and clean of old sealant.
6. Install carrier plate onto axle, coat mating face of oil baffle with suitable sealer and secure to axle housing.
7. On LCX variants refit hub assembly, fit outer bearing, locktab and retaining nut, tighten to a torque of 176 to 189 Nm (18 to 19,5 kgf.m) (130 to 140 lbf.ft). Bend over lock tab and fit halfshaft.
8. Refit handbrake cable to carrier plate and secure with clip at rear of plate.
9. Install wheel cylinder, refer to Operation 12 305.
10. Assemble and install rear brake shoes, refer to Operation 12 285.
11. Bleed brake circuit, refer to Operation 12 141.

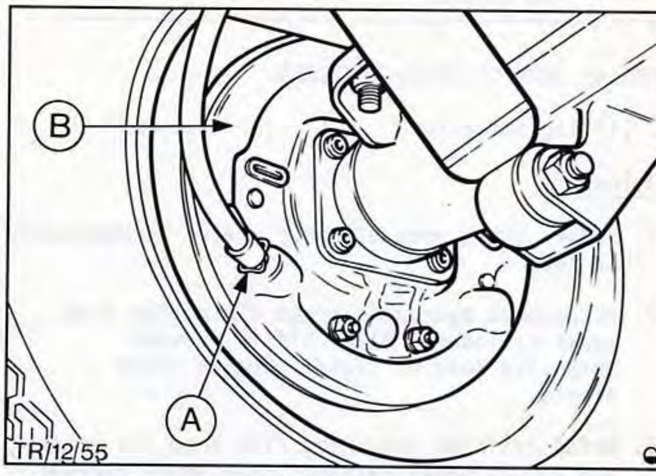


Fig.42. Remove handbrake cable to carrier plate retaining clip.
A - Retaining clip
B - Brake carrier plate

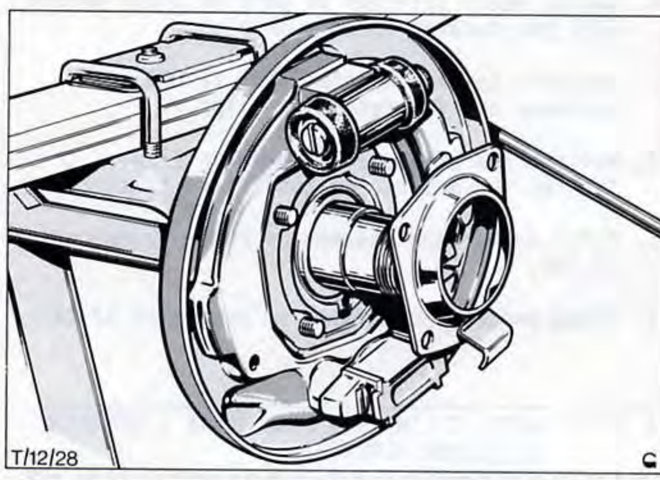


Fig.43. Locate carrier plate and oil baffle on axle housing.

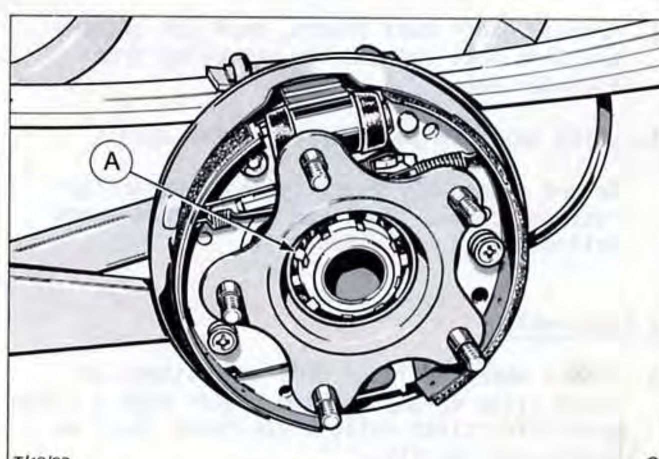


Fig.44. Assemble rear hub retaining nut and lock tab.
A - Bend over lock tab to secure retaining nut

12 333 BRAKE PEDAL - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove spring clip and clevis pin connecting brake pedal to servo operating rod.

2. Remove heater assembly, refer to Operation 34 354.

3. Disconnect pedal, return spring and circlip from left hand end of pedal shaft.

4. Withdraw brake pedal cross shaft and remove brake pedal.

5. Remove pedal bushes and pedal pad.

To Install

6. Install bushes and refit pedal pad if removed, Fig.47.

7. Install pedal cross shaft to brake and clutch pedal, ensure cut out in pedal box locates with flat on shaft, push fully home and secure with circlip.

8. Refit brake pedal return spring.

9. Install heater, refer to Operation 34 354.

10. Align servo connecting rod with brake pedal fit clevis pin and spring clip.

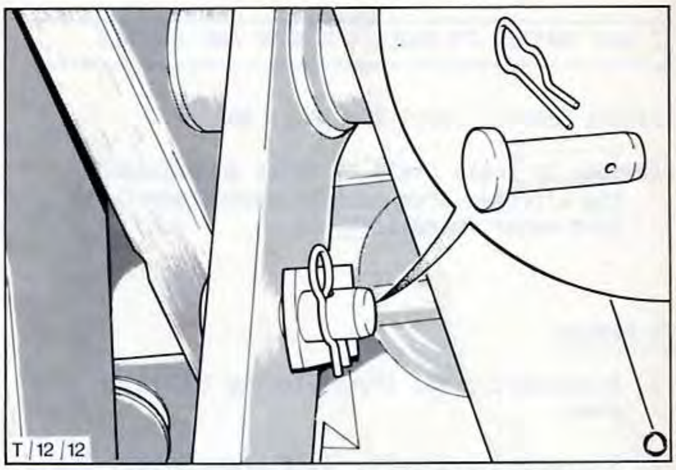


Fig.45. Disconnect brake pedal to servo operating rod. Clevis and spring clip.

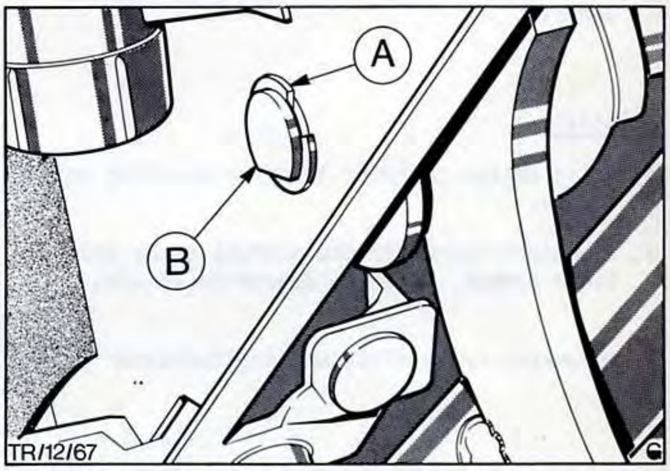


Fig.46. Pedal cross shaft securing circlip.
A - Circlip
B - Pedal shaft

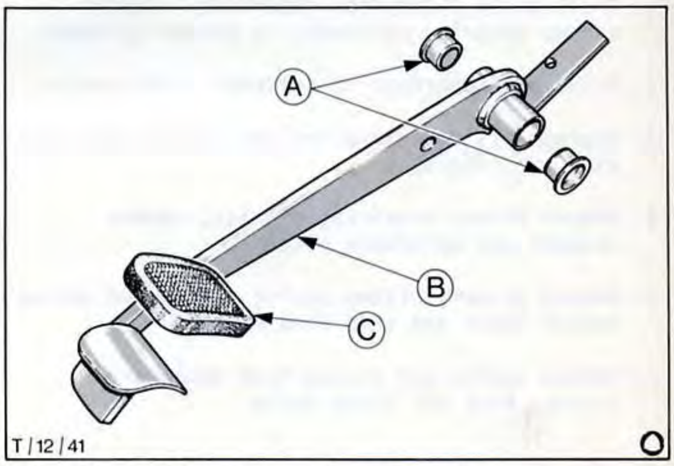


Fig.47. Pedal bushes and pedal pad.
A - Pedal bushes
B - Brake pedal
C - Pedal pad

12 343 MASTER CYLINDER - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

CAUTION: If brake fluid is spilt on paintwork the affected area must be washed down with cold water immediately.

To Remove

1. Disconnect brake fluid warning indicator loom.
2. Disconnect hydraulic fluid brake pipes, fit blanking plugs to prevent excessive fluid loss or dirt entry.
3. Remove nuts securing master cylinder to servo housing, carefully remove cylinder from vehicle.

To Install

4. Refit master cylinder to servo mounting and secure.
5. Reconnect hydraulic fluid brake pipes and bleed brakes, refer to Operation 12 141.
6. Reconnect brake fluid warning indicator loom.

12 343 8 MASTER CYLINDER OVERHAUL - (CYLINDER REMOVED)

To Dismantle

1. Drain brake fluid from reservoir. Remove screws securing reservoir to master cylinder.
2. Prise out reservoir to cylinder fluid seals.
3. Depress piston assemblies and remove secondary stop pin, Fig.50.
4. Remove piston retaining circlip, remove primary and secondary piston.
5. Remove primary piston spring sleeve and screw, remove seals and shim from piston.
6. Remove spring and sleeve from secondary piston, hook off fluid seals.

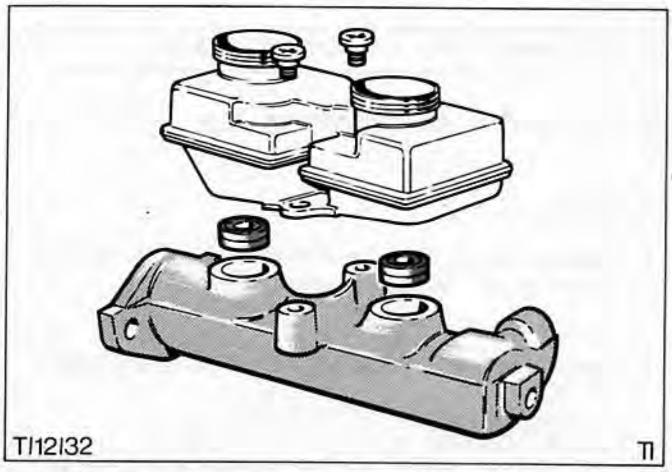


Fig.48. Remove reservoir and cylinder to reservoir fluid seals.

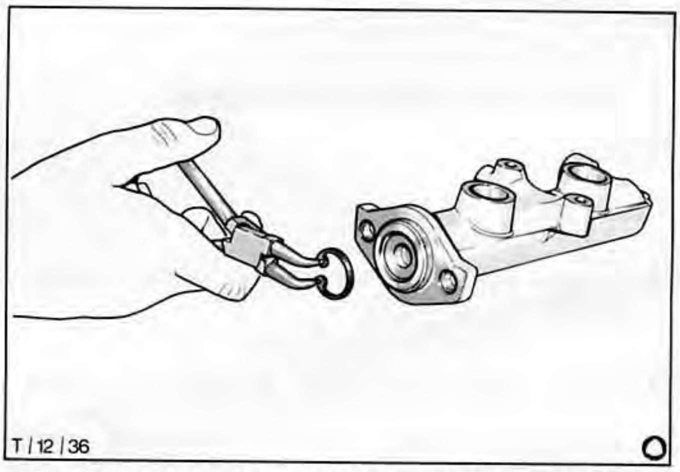


Fig.49. Remove master cylinder piston retaining circlip.

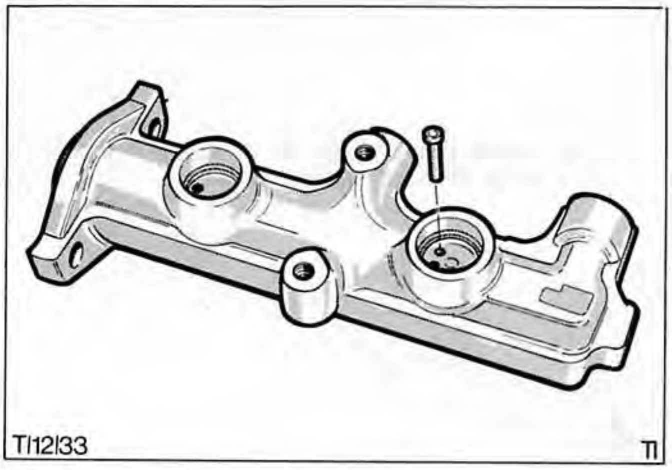


Fig.50. Remove secondary piston stop pin.

12 343 8

To Assemble

Before assembly check cylinder bore and pistons for damage, renew if necessary.

7. Assemble primary and secondary pistons with new seals dip pistons into clean brake fluid and assemble into master cylinder.

8. Fit piston retaining circlip. Depress piston assemblies fully and insert secondary piston stop pin into its cylinder location hole.

9. Insert reservoir seals and refit fluid reservoir, secure with two screws.

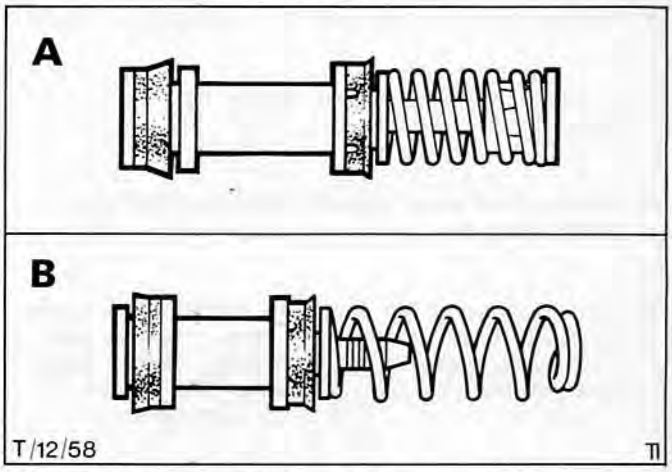


Fig.51. Master cylinder piston assemblies.
A - Primary piston
B - Secondary piston

12 414 VACUUM PUMP - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood fit fender covers, disconnect battery.

2. Drain cooling system and disconnect radiator hoses.

3. Remove upper radiator mounting bolts and insulators.

4. Remove front grille securing bolts, remove grill leaving radiator still in position.

5. Remove radiator lower mounting bolts, lift out radiator.

6. Slacken vacuum pump drive belt jockey wheel securing nut and bolt, remove drive belt.

7. Slacken pump drive pulley centre nut. Remove three bolts securing drive pulley to pump drive hub, remove pulley.

8. Using suitable puller remove pump drive hub, and remove woodruff key from tapered shaft.

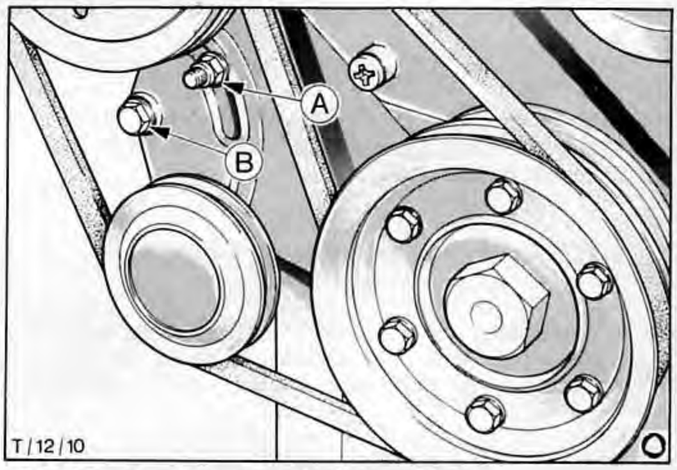


Fig.52. Slacken pump jockey pulley.
A - Adjusting locknut
B - Pivot bolt

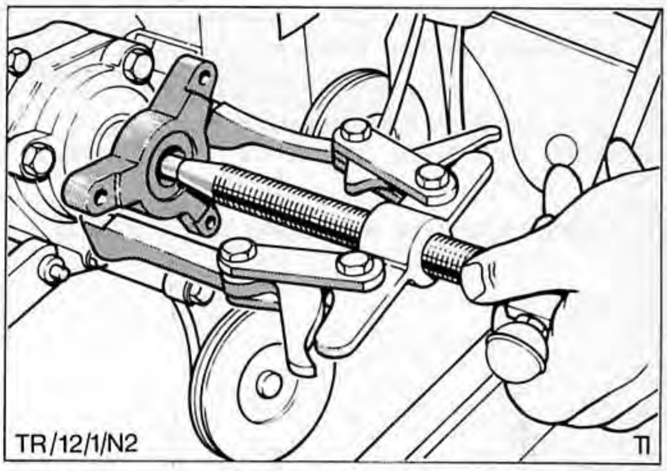


Fig.53. Remove pulley and hub assembly using suitable puller.

9. Remove seal housing and seal assembly, Fig.55.

10. Disconnect vacuum servo supply hose and adaptor.

11. Remove rear pump support bracket retaining bolts, Fig.54.

12. Remove three bolts securing vacuum pump cover to front engine mounting plate. Remove two bolts and one nut securing pump, remove pump from engine.

13. Remove seal from intermediate vacuum pump mounting plate.

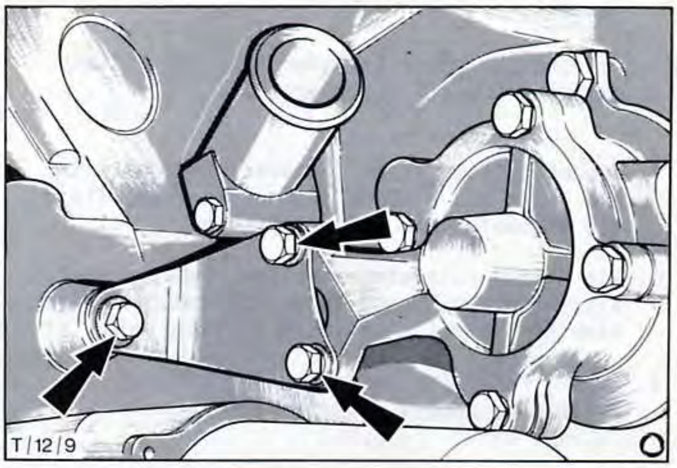


Fig.54. Vacuum pump support bracket.

To Install

14. Fit new seal to intermediate mounting plate. Fit and secure vacuum pump together with new crimped gasket.

15. Refit vacuum pump rear support bracket.

16. Replace seal in housing, refit housing over pump driveshaft, fit woodruff key to shaft. Locate hub on shaft and secure, refit pulley.

17. Reconnect vacuum hose connections to pump.

18. Refit drive belt, adjust belt tension to give a total free movement of 12 mm (0,5 in) on the longest span of belt, Fig.56.

19. Refit radiator on lower mountings, and secure reconnect radiator hoses.

20. Refit front grille, reconnect hood release cable, and secure upper radiator mountings.

21. Reconnect battery and remove fender covers.

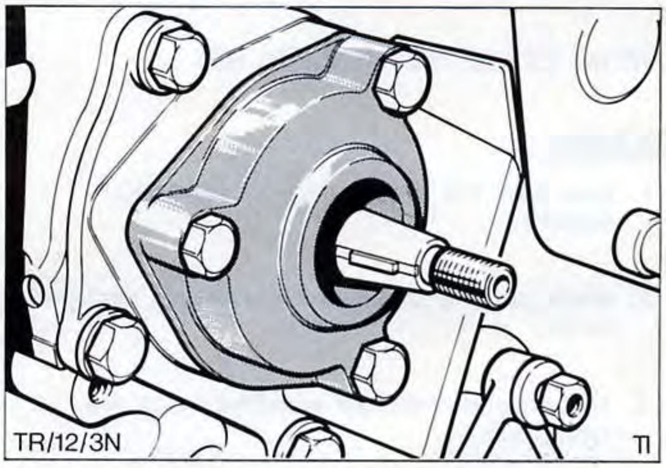


Fig.55. Remove seal and seal housing.

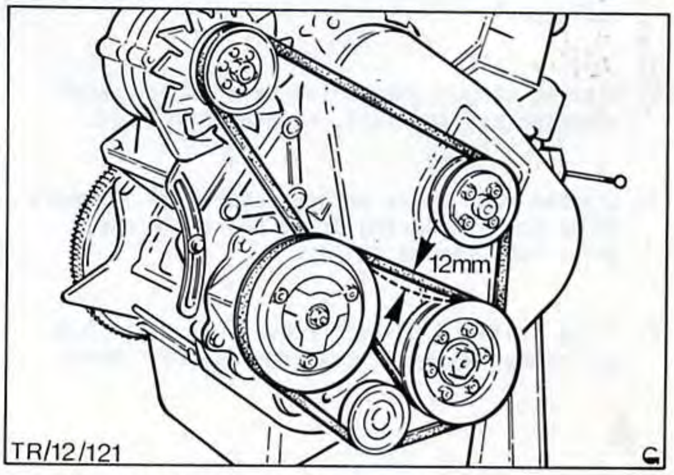


Fig.56. Check drive belt free play.

12 451 SERVO - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

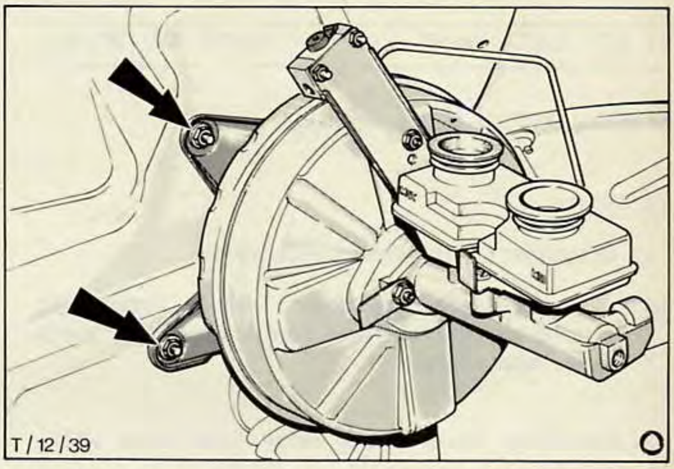


Fig.57. Servo mounting bracket to bulkhead retaining nuts.

To Remove

1. Disconnect fluid hydraulic pipes from master cylinder and pressure delay valve. Fit blanking plugs to master cylinder and pipes to prevent dirt ingress and fluid loss.
2. Carefully remove vacuum check valve from servo housing, (remove buzzer switch if fitted).
3. Detach servo operating rod from brake pedal.
4. Remove three nuts and washers securing servo bracket to bulkhead, remove servo and brake master cylinder from vehicle.
5. Remove gaiter and servo bracket from servo unit.
6. Remove master cylinder and pressure delay valve assemblies from servo unit.

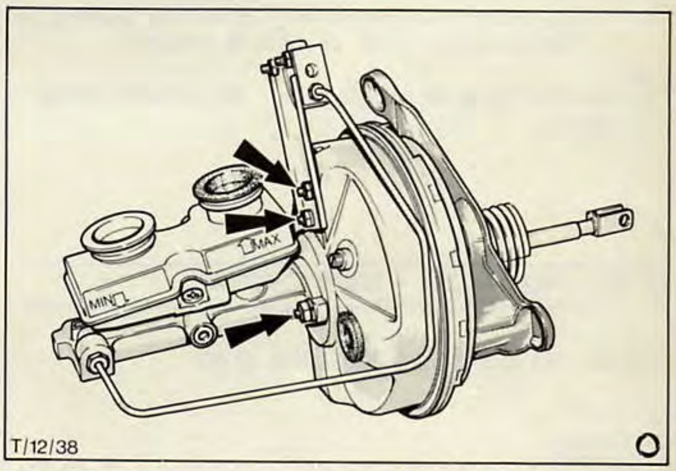


Fig.58. Remove master cylinder and pressure delay valve.

To Install

7. Fit master cylinder and pressure delay valve assemblies to servo.
8. Refit servo mounting bracket and gaiter to servo tighten servo bracket retaining nuts.
9. Locate servo unit onto studs in bulkhead and secure.
10. Install check valve to servo housing (reconnect buzzer switch if fitted).
11. Reconnect fluid lines to master cylinder and pressure delay valve.
12. Fit clevis pin and spring clip to brake pedal servo operating rod.
13. Bleed brakes as described in Operation 12 141.

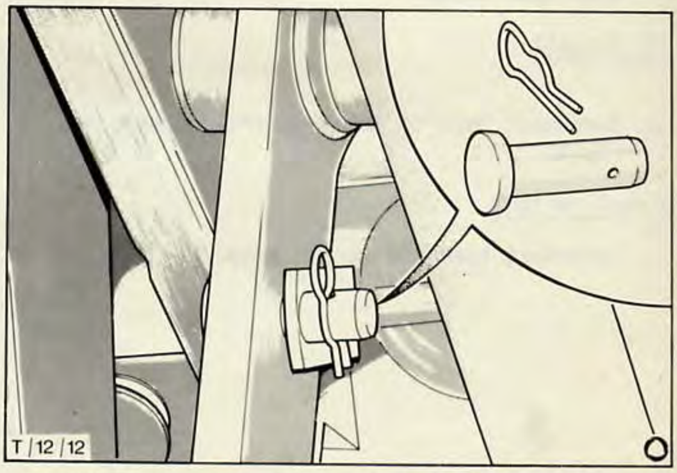


Fig.59. Servo operating rod to brake pedal.

12 457 CHECK VALVE - SERVO - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect hose from check valve.

NOTE: If a crimped type hose clamp is fitted, it should be cut free and replaced with a screw type hose clamp.

2. Carefully lever check valve from servo unit.

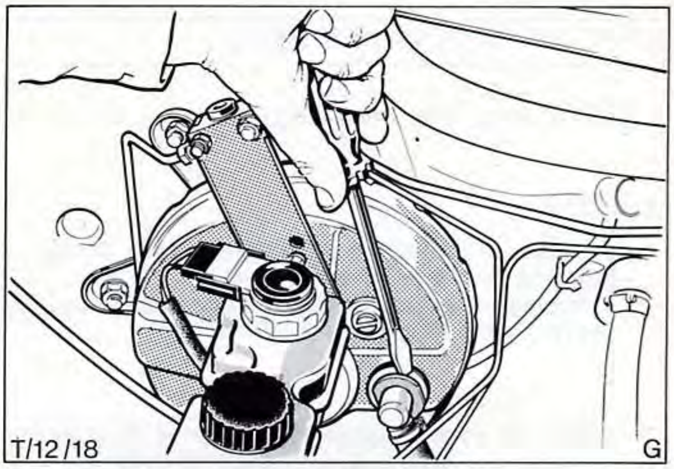


Fig.60. Servo vacuum check valve

To Install

3. Press valve into servo unit ensuring outlet is in the same position as before removal.
4. Connect hose to check valve and secure screw clamp.

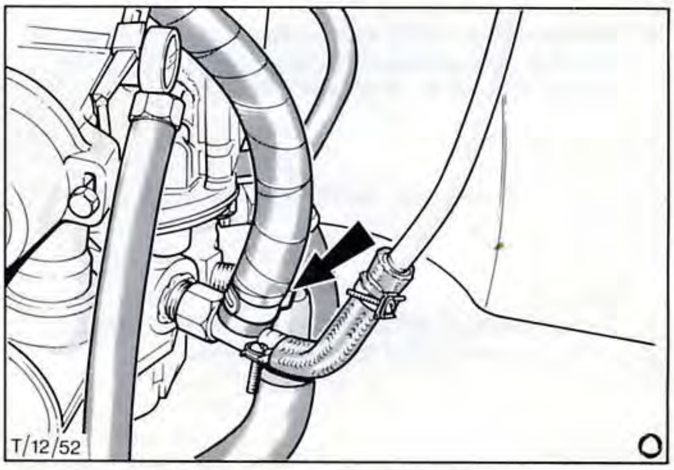


Fig.61. Manifold connection OHC variants.

12 481 VACUUM HOSE - SERVO - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect hose from inlet manifold and servo check valve.

NOTE: If a crimped type hose clamp is fitted it should be cut free and replaced with a screw type hose clamp.

To Install

2. Reconnect hose to inlet manifold connection. Fig.61.

Diesel variant

Reconnect hoses to vacuum pump, Fig.62.

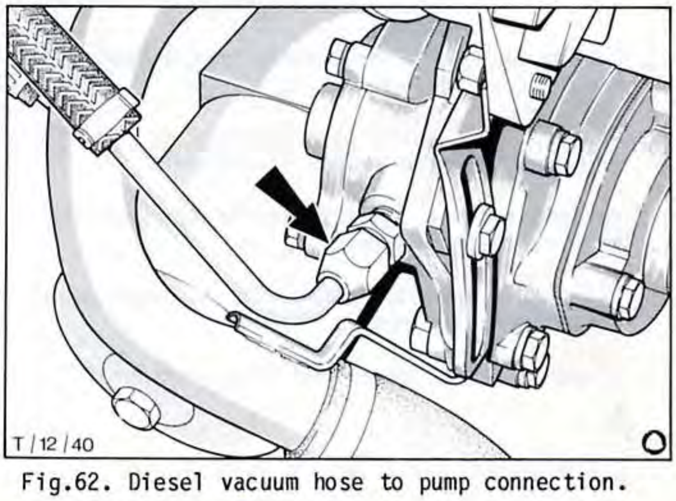


Fig.62. Diesel vacuum hose to pump connection.

12 662 HANDBRAKE - ADJUST

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Adjust

1. Release handbrake lever.

2. Slacken handbrake adjuster by slackening locknuts and rotating adjuster.

3. Apply footbrake to ensure correct auto adjustment.

4. Determine number of teeth on handbrake lever. This can be achieved by pulling the lever up one 'click' and measuring the distance vertically from the lever button to the floor covering. If the distance is more than 200 mm (7,8 in) an eight (8) tooth ratchet is fitted. If the distance is less than 200 mm (7,8 in), an eleven (11) tooth ratchet is fitted.

5. Release lever, pull up lever six (6) 'clicks' on an eleven (11) toothed ratchet and three (3) clicks on the eight toothed ratchet.

6. Tighten adjuster hand tight, rear brakes should just start to bind.

7. Ensure visible threads are equal in length on both sides of the adjuster, and thread is visible through the holes in the adjuster, Fig.64.

8. Tighten adjuster locknuts.

NOTE: After final adjustment the handbrake lever should pull up:

7 to 8 'clicks' for vehicles with eleven teeth, or

4 to 5 'clicks' for vehicles with an 8 tooth ratchet.

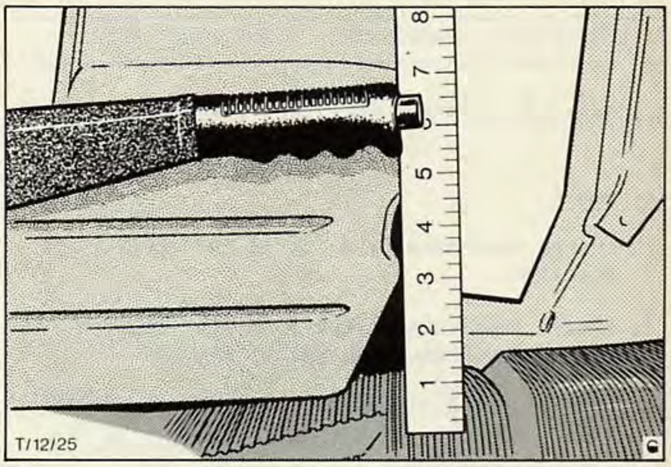


Fig.63. Measure distance between button and floor covering.
7,8 in. = 8 toothed ratchet
less than 7,8 in.= 11 tooth ratchet

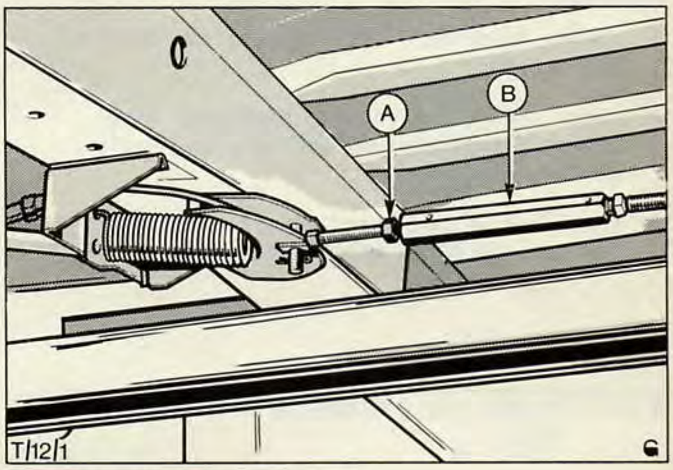


Fig.64. Handbrake adjuster.
A - Locknuts
B - Barrel nut adjuster

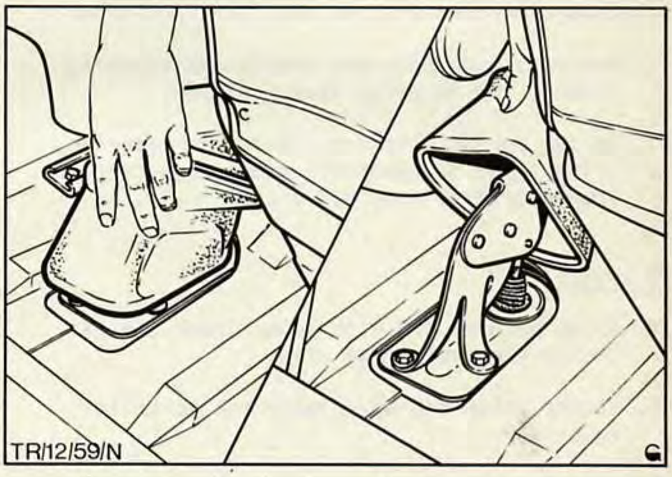


Fig.65. Remove handbrake gaiter.

12 664 LEVER - HANDBRAKE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Ensure handbrake lever is in the "off" position.
2. Remove handbrake gaiter from its location around lever mounting bolts, Fig.65.
3. Detach spring clip and clevis from handbrake lever and relay link rod.
4. Remove handbrake lever mounting bolts and remove handbrake (Fig.66).

To Install

5. Locate handbrake lever in position on floor and secure.
6. Align relay link rod and handbrake lever, insert clevis pin and spring clip, refit gaiter, Fig.66.
7. Check and if necessary adjust handbrake linkage, refer to Operation 12 662.

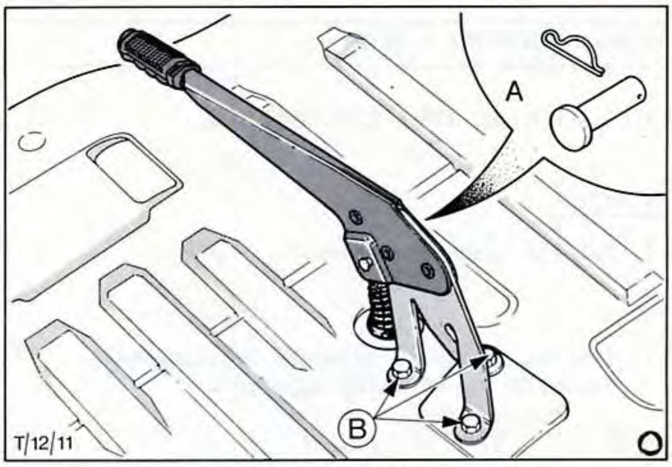


Fig.66. Handbrake mounting bolts.
A - Relay link clevis pin and clip
B - Handbrake mounting bolts

12 673 PRIMARY ROD - HANDBRAKE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Ensure handbrake is in the "off" position.
2. Remove spring clip and clevis pin securing primary rod to relay lever, Fig.68.
3. Remove spring clip and clevis pin securing primary rod to handbrake cable equaliser, remove primary rod, Fig.67.

To Install

4. Align primary rod with relay lever and fit clevis pin and spring clip.
5. Secure other end of primary rod to cable equaliser.
6. Adjust handbrake as described in Operation 12 662.

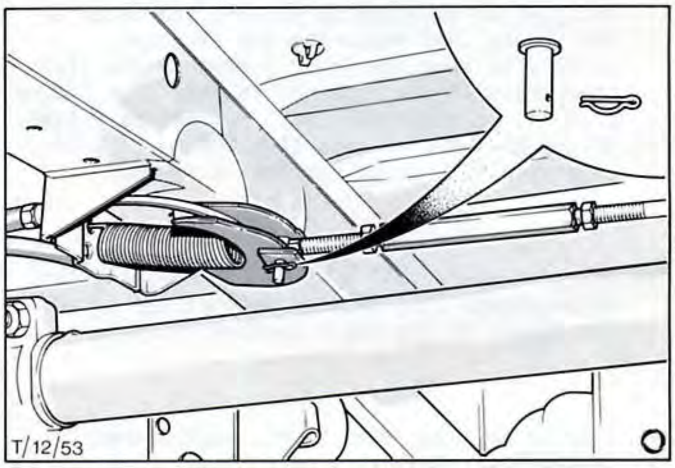


Fig.67. Remove spring clip and clevis pin from equaliser.

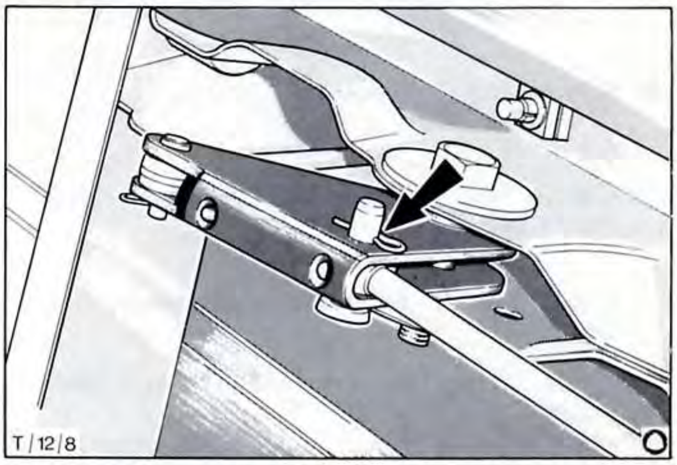


Fig.68. Disconnect primary rod to relay lever.

12 675 REAR CABLE - HANDBRAKE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Ensure handbrake is in the "off" position.
2. Remove spring clip and clevis pin from primary rod to equaliser. Remove return spring from equaliser, Fig.69.
3. Remove rear brake drums, refer to Operation 12 285.
4. Remove handbrake cable from operating lever by pulling back spring and unhooking cable.
5. Detach outer cable from brake carrier plates and withdraw cable.
6. Unhook cable from its brackets and remove cable.

To Install

7. Insert cables through carrier plates and hook cables onto operating levers.
8. Fit retaining clips onto outer cables at rear of carrier plates.
9. Insert cable onto equaliser, locate outer cables on equaliser body bracket and fit pull off spring.
10. Secure equaliser to primary rod, fit clevis pin and spring clip.
11. Secure outer cables in body support brackets.
12. Assemble rear brake drums as described in Operation 12 285.
13. Adjust handbrake refer to Operation 12 662.

NOTE: On short wheel base variants, cables cross over each other. Ensure clip is fitted securely, Fig.71.

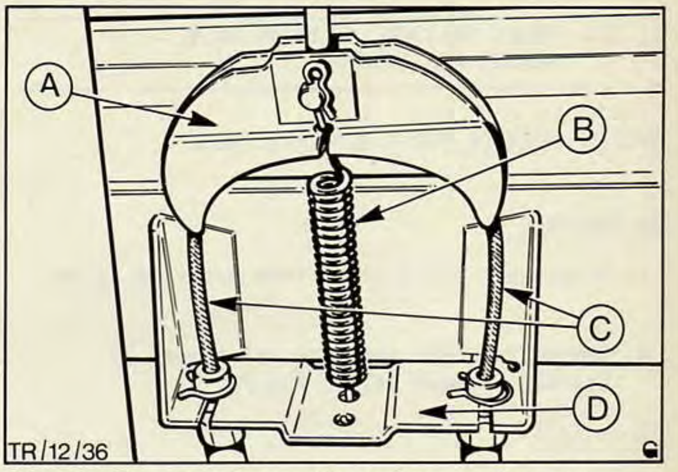


Fig.69. Disconnect equaliser from spring and primary rod.
A - Equaliser
B - Retaining spring
C - Cable
D - Equaliser bracket

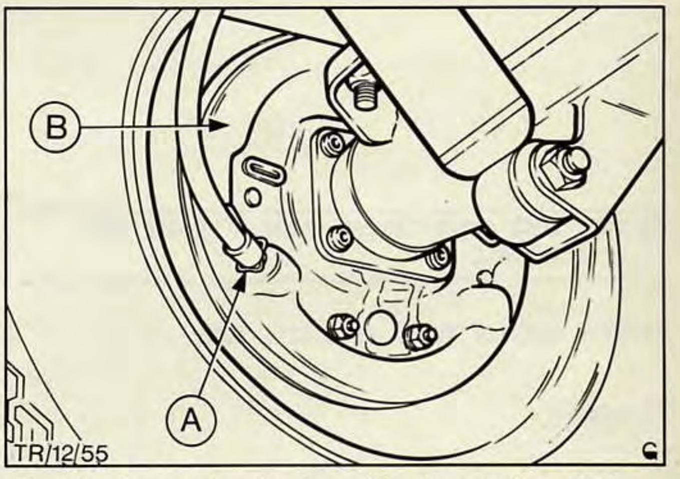


Fig.70. Remove handbrake cable to carrier plate retaining clip.
A - Retaining clip
B - Brake carrier plate

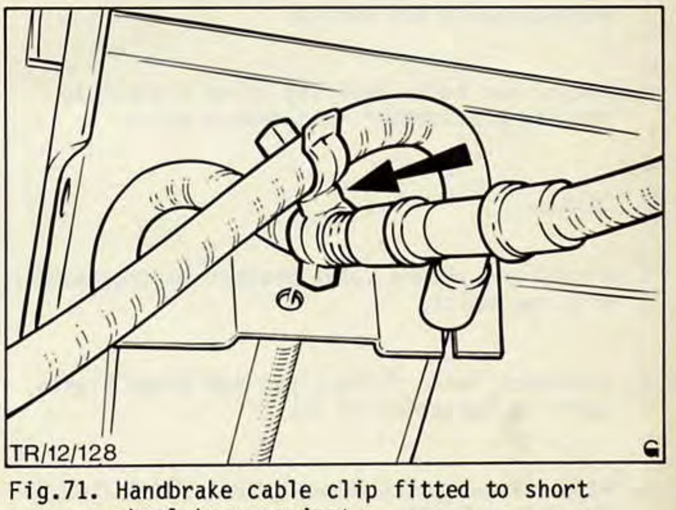


Fig.71. Handbrake cable clip fitted to short wheel base variants.

12 688 BRAKE PRESSURE METERING VALVE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect fluid pipes from metering valve.
2. Remove two nuts securing valve body to bracket, remove valve, Fig.72.

To Install

3. Fit valve and secure, reconnect brake fluid pipes.
4. Bleed brake circuit, refer to Operation 12 141.

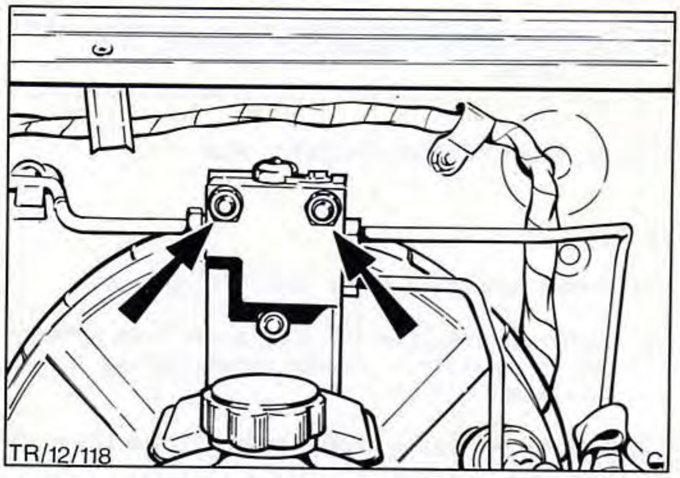


Fig.72. Metering valve mounting to servo bracket.

12 752 LOAD APPORTIONING VALVE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect brake pipes from valve, fit blanking plugs to fluid pipes to prevent excessive fluid loss.
2. Remove spring clip and clevis pin from operating arm and spring.
3. Remove two bolts securing valve bracket to chassis crossmember, and remove valve.

To Install

4. Locate and secure valve bracket to crossmember with two bolts.
5. Reconnect brake fluid pipes and bleed brakes, refer to Operation 12 141.
6. Adjust load apportioning valve as detailed in Operation 12 136.

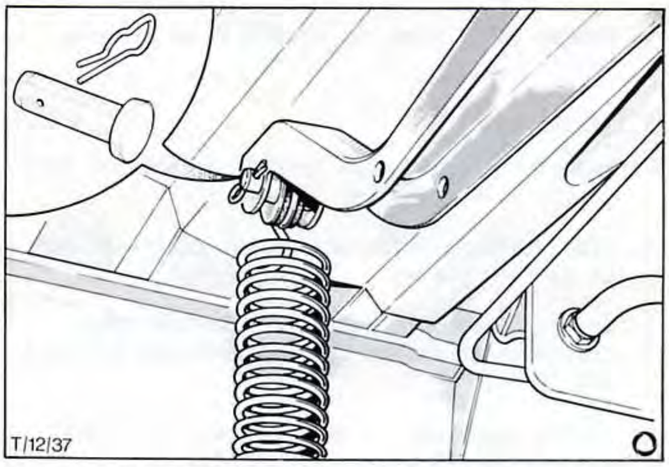


Fig.73. Disconnect spring clevis pin from LAV operating arm.

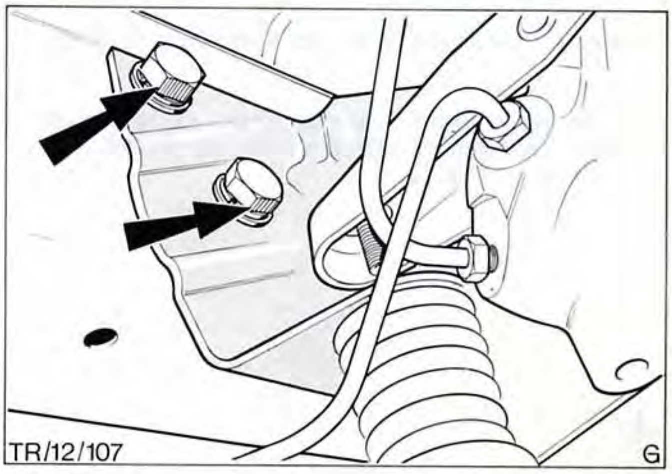


Fig.74. LAV bracket mounting bolts.

12 753 BRACKET AND BUSH ASSEMBLY - L.A.V. REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Carefully slacken nipple locknut, and remove adjusting nipple from end of spring.

CAUTION: LOAD APPORTIONING VALVE SPRING IS UNDER TENSION AND CARE MUST BE TAKEN WHEN SLACKENING NIPPLE LOCK NUT.

2. Remove two bolts securing bracket to rear axle, remove bracket.

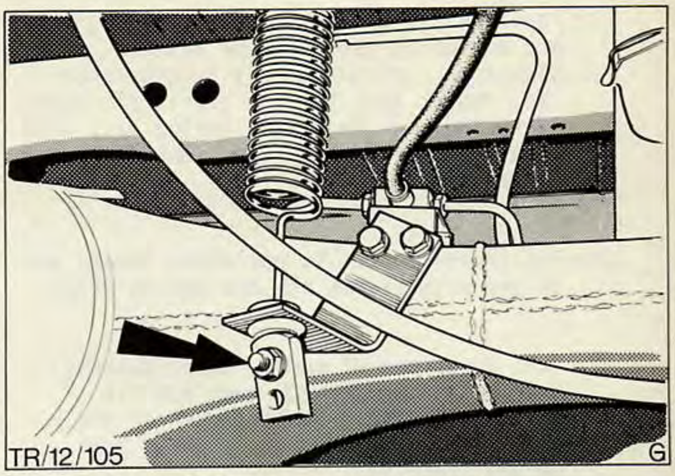


Fig.75. Adjusting nipple and locknut.

To Install

3. Position bracket onto axle casing and secure.

4. Remove spring clip and clevis pin from LAV arm and spring eye.

5. Slide adjusting nipple onto spring tang and tighten only finger tight.

6. Adjust L.A.V. as detailed below:

NOTE: Vehicle MUST be in the unladen condition.

(1) Establish light laden valve 'X' dimension:

a) For STANDARD factory produced bodies this dimension may be read directly from the chart on page 12-35.

b) For chassis cab variants and variants with non-standard bodies

(i) Weigh the vehicle using weighbridge and determine the rear axle weight

(ii) Determine the type of rear suspension designated on the vehicle identification plate

(iii) Read setting from appropriate graph on pages 35 to 45

(2) Push vehicle body down by hand and set dimension in the road spring 'rising' condition.

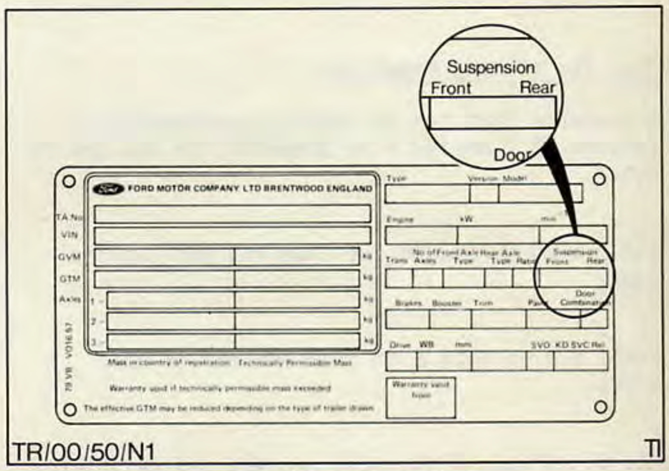


Fig.76. Vehicle identification plate.
'A' Designated - standard suspension
'B' Designated - heavy duty suspension

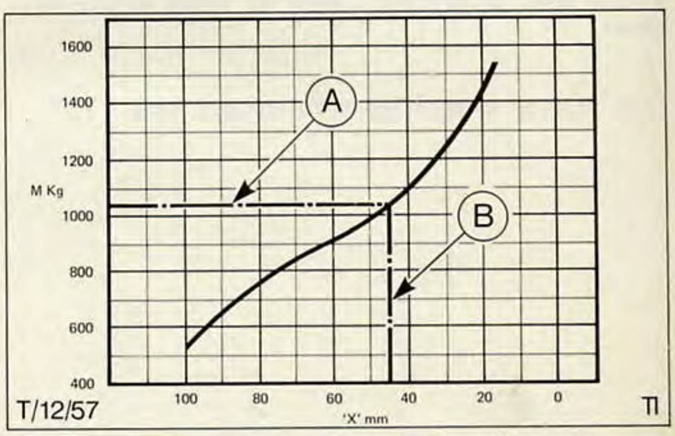


Fig.77. Graph as shown on LAV plate (UK and France).
A - Rear axle unladen weight
B - 'X' dimension setting in mm.

(3) Position spring vertically below operating arm and using tool set the setting dimension. With tool set to dimension 'X', insert tool through clevis pin holes in spring and arm. Mark spring tail with a felt pen or masking tape immediately above bush.

(4) Fit spring to L.A.V. operating lever, and secure with clevis pin and spring clip.

(5) Pull lower end of spring down, passing tail of spring through bush and fit adjustable nipple so that mark on the spring tail is immediately above bush. Secure clamp nut.

(6) If a new spring has been fitted cut off any surplus spring tail below adjustable nipple.

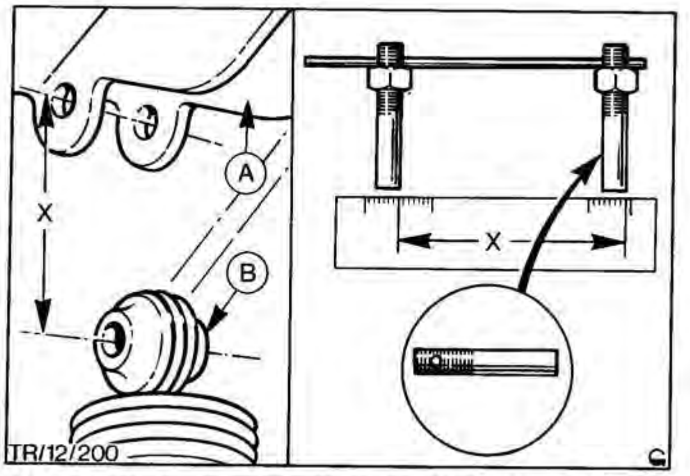


Fig.78. Measuring 'X' dimension/tool for setting dimension 'X'.
A - Arm C - Setting dimension
B - Spring

Tool for setting dimension

A suitable tool can be simply fabricated from lengths of 3 mm and 8 mm diameter rod and two M8 nuts.

Cut 2 x 50 mm lengths of 8 mm rod and chamfer ends.

Drill a 3 mm hole 6 mm from one end of each piece.

Cut M8 threads 20 mm long on same end as drilled holes of each piece.

Cut a 200 mm length of 3 mm rod and assemble as shown in Fig.78.

Adjust tool to setting dimension using a rule as shown.

Lock tool by tightening nuts against rod.

TECHNICAL DATA

LOAD APPORTIONING VALVE SETTING

The following pages, 31 to 44 are to be used when checking or adjusting the Load Apportioning Valve. The specifications and setting procedures are divided into two main categories; those for vehicles with standard factory produced bodies and those for vehicles with specialist bodies. Each of these categories is sub-divided as follows:-

Category A - Vehicles with standard bodies

- Setting dimensions - All standard factory produced bodies except bus and crewbus
- Setting dimensions - All bus and crew bus

Category B - Specialist non-standard produced variants - (bodied and floated - single and double chassis cab - cowls and windshields - vans and kombis with body conversions or modifications)

- Introduction notes for vehicles with specialist bodies
- Information for specialist vehicle body builders
- L.A.V. setting charts for all vehicles built for Germany, Italy, Holland, Denmark, Belgium and Luxembourg only
- L.A.V. setting graphs for variants built for France and U.K. fitted with the graphical type identification plate

Key to 'X' dimension setting charts (pages 35 to 44)

S/CAB = Single cab
D/CAB = Double cab
P = Petrol
D = Diesel
A = Standard level rear suspension
B = Heavy duty rear suspension
(A and B are designated on rating plate)

Category A - Vehicles with standard bodies

- Setting dimensions - All standard factory produced bodies except bus and crewbus

<table>
<tr><th>BODY</th><th>ENGINE TYPE</th><th>80</th><th>100</th><th>120/ 115</th><th>100L</th><th>130</th><th>150/ 160</th><th>175</th><th>190</th></tr>
<tr><td rowspan="2">VAN</td><td>PETROL</td><td rowspan="2">100</td><td rowspan="2">100</td><td rowspan="2">100</td><td rowspan="2">100</td><td rowspan="2">105</td><td rowspan="2">105*
(118)</td><td rowspan="2">105</td><td rowspan="2">105*
(125)</td></tr>
<tr><td>DIESEL</td></tr>
<tr><td rowspan="2">PARCEL DELIVERY VAN</td><td>PETROL</td><td rowspan="2">—</td><td rowspan="2">—</td><td rowspan="2">95,5</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td>76</td><td rowspan="2">-</td></tr>
<tr><td>DIESEL</td><td>95,5</td></tr>
<tr><td rowspan="2">KOMBI EXCEPT EEC/ECE M1 & SWEDEN, SWISS LCX & AUSTRIA</td><td>PETROL</td><td>100</td><td>100</td><td>100</td><td>100</td><td rowspan="2">109</td><td rowspan="2">109*
(129)</td><td rowspan="2">109</td><td rowspan="2">109</td></tr>
<tr><td>DIESEL</td><td>100</td><td>100</td><td>105</td><td>100</td></tr>
<tr><td rowspan="2">KOMBI # EEC/ECE M1 & SWEDEN & SWISS LCX</td><td>PETROL</td><td>100</td><td>100</td><td>100</td><td rowspan="2">-</td><td>105</td><td>-</td><td rowspan="2">-</td><td rowspan="2">(129)</td></tr>
<tr><td>DIESEL</td><td>105</td><td>105</td><td>105</td><td>-</td><td>105</td></tr>
<tr><td rowspan="2">KOMBI AUSTRIA Only</td><td>PETROL</td><td>89</td><td>89</td><td>89</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>DIESEL</td><td>100</td><td>100</td><td>100</td></tr>
</table>

= EXCEPT AUSTRIA * = EXCEPT SWEDEN ( ) = SWEDEN ONLY

TECHNICAL DATA

Category A - Vehicles with standard bodies cont'd

- All bus and crewbus (applicable to both standard and heavy duty suspension)

VEHICLE TYPE	ENGINE TYPE	NUMBER OF SEATS 9	12	15	13	17
BUS	PETROL	89	95,5	100*	-	-
	DIESEL	100		(118)		
CREWBUS	PETROL	-	-	-	100	105
	DIESEL					

* = EXCEPT SWEDEN () = SWEDEN ONLY. All other settings are common.

Category B - Specialist non-standard produced variants - (bodied and floated - single and double chassis cab - cowls and windshields - vans and kombis with body conversions or modifications)

- Introduction notes for vehicles with specialist bodies

Category B contains all necessary information for the setting and calculation of the 'X' or 'X' and 'Z' value/dimensions of the load apportioning valve in conjunction with Operation 12 753 of this section. There are two types of LAV identification plates currently fitted, these may be fitted to the left or right hand door step riser. Variants built for sale in Germany, Italy, Holland, Belgium, Denmark, and Luxemburg have a plate depicting 'X'and 'Z' value/dimension. Variants built for the United Kingdom and France have a L.A.V. graphical check plate unique to these markets. All dimensions quoted on these plates are legal check dimensions and are calculated and stamped at plant or by body builders, to comply with the particular territorial legal requirements.

- Information for specialist vehicles body builders only

Vehicles built for Germany, Italy, Holland, Denmark, Belgium, and Luxembourg.

After fitting a specialist body it is necessary to establish and stamp the 'X' or 'X' and 'Z' value/dimensions on the LAV identification plate to comply with local legal requirements (Germany, Italy, Holland, Denmark, Belgium and Luxemburg only). To determine the 'X' dimension at kerb weight, refer to Operation 12 753 page 29 of this section. To establish the value for the 'Z' dimension it is necessary to establish a second 'X' dimension for the vehicle's plated weight. This can be read direct from the appropriate charts or graphs on pages 33 to 45. Once both 'X' dimensions have been established the 'Z' value may be calculated as described below.

'Z' value = 'X' dimension at kerb weight after modification minus 'X' dimension at plated rear axle weight

TECHNICAL DATA

Catergory B - cont'd.

- Information for specialist vehicle body builders only -cont 'd

Example

Model - 80		Body type	- Van
Engine - Petrol		Rear spring code	- 'A'

Rear axle load at kerb weight - 700 kg
Rear axle plated weight - 1170 kg

'X' dimension kerb weight - 90 mm
'X' dimension plated weight - 52 mm

Both of these dimensions have been taken from chart on page 47.

'Z' dimension = Unladen 'X' dimension minus Plated 'X' dimension

= 90 minus 52

= 38 mm

The 'Z' value (dimension) obtained is to be stamped on the L.A.V. identification plate in the appropriate box provided.

NOTE:

Both 'X' and 'Z' dimensions are legal requirements for the particular vehicle variant. Any change or modification affecting kerb weights carried out to the vehicle after the L.A.V. plate has been stamped requires the 'X' and 'Z' dimensions to be rechecked and a new L.A.V. plate fitted and stamped as per the above procedure.

Vehicles built for France and United Kingdom only (with graphical type plate).

For vehicles fitted with the graphical type L.A.V. plate it is not necessary for the 'X' or 'Z' value/dimension to be stamped onto the plate after the conversion or modification has been carried out.

To calculate the correct L.A.V. setting form the graphical type plate the following information must first be obtained:

i - Determine vehicle type and model
ii - Obtain the rear axle unladen weight
iii - Check corresponding graph to L.A.V. plate fitted to the door step riser

Example:

Model 100L. Body type - Van
Engine - Petrol
Rear suspension code 'A'
Rear axle weight - 925 kg
L.A.V. Plate Part Number - 83VB-2L338-BA
'X' dimension from graph 54 mm

MODEL 100L

Body Type -	Van & C/Cab
Engine Type -	Petrol/Diesel
Spring Type -	'A'
Rear Axle Plated Kg.-	1530
Plate Part Number-	83VB-2L338-BA.

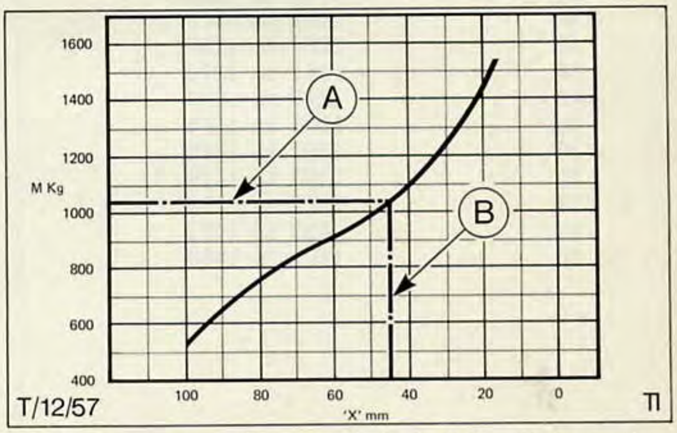


Fig.79. Corresponding graph to L.A.V. plate part.
A - Rear axle weight Kg.
B - L.A.V. setting mm.

TECHNICAL DATA

Specialist non-standard produced variants

(for key to chart see page 31)

MODEL	80	100	100
BODY TYPE	VAN/KOMBI	VAN/KOMBI	S/D CAB
ENGINE TYPE	P/D	P/D	P/D
SPRING TYPE	A/B	A	A
R/AXLE PLATED Kg.		1460	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
112	408 to 431
110	432 to 456
108	457 to 481
106	482 to 506
104	507 to 531
102	532 to 555
100	556 to 580
98	581 to 605
96	606 to 630
94	631 to 655
92	656 to 679
90	680 to 704
88	705 to 729
86	730 to 754
84	755 to 779
82	780 to 803
80	804 to 828
78	829 to 853
76	854 to 878
74	879 to 903
72	904 to 927
70	928 to 952
68	953 to 977
66	978 to 1002
64	1003 to 1027
62	1028 to 1051
60	1052 to 1076
58	1077 to 1101
56	1102 to 1126
54	1127 to 1151
52	1152 to 1175
50	1176 to 1200
48	1201 to 1225
46	1226 to 1250
44	1251 to 1275
42	1276 to 1299
40	1300 to 1324
38	1325 to 1349
36	1350 to 1374
34	1375 to 1399
32	1400 to 1423
30	1424 to 1448

MODEL	100	100
BODY TYPE	VAN/KOMBI	S/D CAB
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	1530	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
115	411 to 428
113	429 to 447
111	448 to 465
109	466 to 483
107	484 to 502
105	503 to 520
103	521 to 539
101	540 to 557
99	558 to 575
97	576 to 594
95	595 to 613
93	614 to 633
91	634 to 653
89	654 to 673
87	674 to 693
85	694 to 713
83	714 to 733
81	734 to 753
79	754 to 773
77	774 to 793
75	794 to 813
73	814 to 833
71	834 to 853
69	854 to 874
67	875 to 895
65	896 to 917
63	918 to 938
61	939 to 960
59	961 to 981
57	982 to 1003
55	1004 to 1026
53	1027 to 1048
51	1049 to 1071
49	1072 to 1094
47	1095 to 1117
45	1118 to 1140
43	1141 to 1163
41	1164 to 1190
39	1191 to 1218
37	1219 to 1246
35	1247 to 1274
33	1275 to 1302
31	1303 to 1330
29	1331 to 1358
27	1359 to 1386
25	1387 to 1414
23	1415 to 1442
21	1443 to 1472
19	1473 to 1502

TECHNICAL DATA

(for key to chart see page 31)

MODEL	120	120	100
BODY TYPE	VAN/KOMBI	S/D CAB	S/D CAB
ENGINE TYPE	P/D	P/D	P/D
SPRING TYPE	A/B	A/B	B
R/AXLE PLATED Kg.		1650	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
115	411 to 428
113	429 to 447
111	448 to 466
109	467 to 484
107	485 to 503
105	504 to 522
103	523 to 541
101	542 to 559
99	560 to 578
97	579 to 599
95	600 to 620
93	621 to 641
91	642 to 662
89	663 to 683
87	684 to 704
85	705 to 725
83	726 to 745
81	746 to 766
79	767 to 787
77	788 to 809
75	810 to 833
73	834 to 857
71	858 to 882
69	883 to 906
67	907 to 931
65	932 to 955
63	956 to 980
61	981 to 1004
59	1005 to 1029
57	1030 to 1057
55	1058 to 1086
53	1087 to 1114
51	1115 to 1143
49	1144 to 1171
47	1172 to 1199
45	1200 to 1228
43	1229 to 1256
41	1257 to 1285
39	1286 to 1317
37	1318 to 1352
35	1353 to 1387
33	1388 to 1422
31	1423 to 1457
29	1458 to 1492
27	1493 to 1527
25	1528 to 1562
23	1563 to 1599
21	1600 to 1638

MODEL	100	
BODY TYPE	VAN/KOMBI	S/D CAB
ENGINE TYPE	P/D	
SPRING TYPE	A	
R/AXLE PLATED Kg.	1530	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
110	462 to 473
108	474 to 486
106	487 to 499
104	500 to 512
102	513 to 525
100	526 to 538
98	539 to 551
96	552 to 564
94	565 to 577
92	578 to 590
90	591 to 603
88	604 to 616
86	617 to 629
84	630 to 642
82	643 to 655
80	656 to 668
78	669 to 681
76	682 to 694
74	695 to 707
72	708 to 720
70	721 to 733
68	734 to 745
66	746 to 758
64	759 to 771
62	772 to 784
60	785 to 797
58	798 to 810
56	811 to 823
54	824 to 840
52	841 to 857
50	858 to 875
48	876 to 892
46	893 to 909
44	910 to 931
42	932 to 953
40	954 to 975
38	976 to 997
36	998 to 1019
34	1020 to 1046
32	1047 to 1074
30	1075 to 1102
28	1103 to 1130
26	1131 to 1158
24	1159 to 1187
22	1188 to 1215
20	1216 to 1243
18	1244 to 1272
16	1273 to 1300
14	1301 to 1346
12	1347 to 1394
10	1395 to 1441
8	1442 to 1488

TECHNICAL DATA

(for key to chart see page 31)

MODEL	130	160
BODY TYPE	VAN - S/D CAB	VAN - S/CAB
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	2240	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
120	541 to 562
118	563 to 584
116	585 to 607
114	608 to 629
112	630 to 651
110	652 to 674
108	675 to 697
106	698 to 723
104	724 to 750
102	751 to 776
100	777 to 802
98	803 to 828
96	829 to 855
94	856 to 881
92	882 to 907
90	908 to 933
88	934 to 960
86	961 to 986
84	987 to 1012
82	1013 to 1041
80	1042 to 1070
78	1071 to 1100
76	1101 to 1129
74	1130 to 1158
72	1159 to 1188
70	1189 to 1217
68	1218 to 1247
66	1248 to 1276
64	1277 to 1305
62	1306 to 1340
60	1341 to 1375
58	1376 to 1411
56	1412 to 1446
54	1447 to 1482
52	1483 to 1522
50	1523 to 1563
48	1564 to 1604
46	1605 to 1645
44	1646 to 1686
42	1687 to 1727
40	1728 to 1768
38	1769 to 1812
36	1813 to 1861
34	1862 to 1910
32	1911 to 1960
30	1961 to 2009
28	2010 to 2058
26	2059 to 2108
24	2109 to 2157
22	2158 to 2207

MODEL	130	160
BODY TYPE	KOMBI	KOMBI
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	2240	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
111	705 to 730
109	731 to 756
107	757 to 783
105	784 to 809
103	810 to 835
101	836 to 861
99	862 to 888
97	889 to 914
95	915 to 940
93	941 to 966
91	967 to 993
89	994 to 1019
87	1020 to 1048
85	1049 to 1078
83	1079 to 1107
81	1108 to 1136
79	1137 to 1166
77	1167 to 1195
75	1196 to 1225
73	1226 to 1254
71	1255 to 1283
69	1284 to 1313
67	1314 to 1349
65	1350 to 1384
63	1385 to 1420
61	1421 to 1455
59	1456 to 1491
57	1492 to 1532
55	1533 to 1573
53	1574 to 1614
51	1615 to 1655
49	1656 to 1697
47	1698 to 1738
45	1739 to 1779
43	1780 to 1824
41	1825 to 1874
39	1875 to 1923
37	1924 to 1972
35	1973 to 2022
33	2023 to 2071
31	2072 to 2120
29	2121 to 2170
27	2171 to 2219

TECHNICAL DATA

(for key to chart see page 31)

MODEL	130
BODY TYPE	VAN - S/D CAB
ENGINE TYPE	P/D
SPRING TYPE	A
R/AXLE PLATED Kg.	2020
L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
121	542 to 561
119	562 to 581
117	582 to 601
115	602 to 621
113	622 to 641
111	642 to 661
109	662 to 681
107	682 to 701
105	702 to 720
103	721 to 740
101	741 to 760
99	761 to 780
97	781 to 800
95	801 to 820
93	821 to 841
91	842 to 865
89	866 to 889
87	890 to 913
85	914 to 937
83	938 to 961
81	962 to 985
79	986 to 1009
77	1010 to 1034
75	1035 to 1061
73	1062 to 1087
71	1088 to 1114
69	1115 to 1141
67	1142 to 1167
65	1168 to 1194
63	1195 to 1221
61	1222 to 1254
59	1255 to 1286
57	1287 to 1318
55	1319 to 1350
53	1351 to 1383
51	1384 to 1415
49	1416 to 1447
47	1448 to 1482
45	1483 to 1520
43	1521 to 1557
41	1558 to 1594
39	1595 to 1631
37	1632 to 1674
35	1675 to 1721
33	1722 to 1768
31	1769 to 1814
29	1815 to 1861
27	1862 to 1908
25	1909 to 1954
23	1955 to 2001

MODEL	130	160
BODY TYPE	VAN S/D CAB	VAN - S/CAB
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	2020	
L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)	
112	708 to 727	
110	728 to 747	
108	748 to 767	
106	768 to 787	
104	788 to 807	
102	808 to 827	
100	828 to 848	
98	849 to 872	
96	873 to 896	
94	897 to 920	
92	921 to 944	
90	945 to 968	
88	969 to 992	
86	993 to 1016	
84	1017 to 1043	
82	1044 to 1069	
80	1070 to 1096	
78	1097 to 1123	
76	1124 to 1149	
74	1150 to 1176	
72	1177 to 1203	
70	1204 to 1232	
68	1233 to 1264	
66	1265 to 1296	
64	1297 to 1329	
62	1330 to 1361	
60	1362 to 1393	
58	1394 to 1425	
56	1426 to 1458	
54	1459 to 1495	
52	1496 to 1532	
50	1533 to 1569	
48	1570 to 1606	
46	1607 to 1643	
44	1644 to 1689	
42	1690 to 1736	
40	1737 to 1783	
38	1784 to 1830	
36	1831 to 1876	
34	1877 to 1923	
32	1924 to 1970	
30	1971 to 2016	

TECHNICAL DATA

(for key to chart see page 31)

MODEL	160	175
BODY TYPE	VAN - S/D CAB	VAN - S/CAB
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	2330	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
119	554 to 567
117	568 to 591
115	592 to 615
113	616 to 639
111	640 to 663
109	664 to 689
107	690 to 716
105	717 to 744
103	745 to 771
101	772 to 799
99	800 to 827
97	828 to 854
95	855 to 882
93	883 to 909
91	910 to 937
89	938 to 966
87	967 to 997
85	998 to 1028
83	1029 to 1059
81	1060 to 1091
79	1092 to 1122
77	1123 to 1153
75	1154 to 1184
73	1185 to 1221
71	1222 to 1259
69	1260 to 1297
67	1298 to 1334
65	1335 to 1372
63	1373 to 1410
61	1411 to 1448
59	1449 to 1488
57	1489 to 1531
55	1532 to 1574
53	1575 to 1617
51	1618 to 1660
49	1661 to 1705
47	1706 to 1755
45	1756 to 1804
43	1805 to 1853
41	1854 to 1902
39	1903 to 1954
37	1955 to 2012
35	2013 to 2071
33	2072 to 2129
31	2130 to 2187
29	2188 to 2245
27	2246 to 2303

MODEL	160
BODY TYPE	KOMBI
ENGINE TYPE	P/D
SPRING TYPE	B
R/AXLE PLATED Kg.	2330

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
110	707 to 734
108	735 to 761
106	762 to 789
104	790 to 817
102	818 to 844
100	845 to 872
98	873 to 899
96	900 to 927
94	928 to 955
92	956 to 986
90	987 to 1017
88	1018 to 1048
86	1049 to 1079
84	1080 to 1110
82	1111 to 1142
80	1143 to 1173
78	1174 to 1207
76	1208 to 1245
74	1246 to 1283
72	1284 to 1321
70	1322 to 1358
68	1359 to 1396
66	1397 to 1434
64	1435 to 1472
62	1473 to 1515
60	1516 to 1558
58	1559 to 1601
56	1602 to 1645
54	1646 to 1688
52	1689 to 1737
50	1738 to 1786
48	1787 to 1835
46	1836 to 1884
44	1885 to 1934
42	1935 to 1991
40	1992 to 2049
38	2050 to 2108
36	2109 to 2166
34	2167 to 2224
32	2225 to 2282

TECHNICAL DATA

(for key to chart see page 31)

MODEL	175	190
BODY TYPE	VAN - S/CAB	VAN - S/D CAB
ENGINE TYPE	P/D	P/D
SPRING TYPE	B	A
R/AXLE PLATED Kg.	2600	

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
119	551 to 576
117	577 to 603
115	604 to 629
113	630 to 656
111	657 to 682
109	683 to 709
107	710 to 741
105	742 to 777
103	778 to 812
101	813 to 847
99	848 to 883
97	884 to 918
95	919 to 955
93	956 to 997
91	998 to 1039
89	1040 to 1081
87	1082 to 1123
85	1124 to 1166
83	1167 to 1212
81	1213 to 1258
79	1259 to 1304
77	1305 to 1350
75	1351 to 1397
73	1398 to 1453
71	1454 to 1509
69	1510 to 1565
67	1566 to 1621
65	1622 to 1678
63	1679 to 1738
61	1739 to 1798
59	1799 to 1858
57	1859 to 1918
55	1919 to 1980
53	1981 to 2050
51	2051 to 2120
49	2121 to 2190
47	2191 to 2260
45	2261 to 2330
43	2331 to 2401
41	2402 to 2476
39	2477 to 2551

MODEL	190
BODY TYPE	KOMBI
ENGINE TYPE	P/D
SPRING TYPE	A
R/AXLE PLATED Kg.	2600

L.A.V. SET DIM. (mm)	Rear Axle Load at Ground (Kg)
109	736 to 771
107	772 to 806
105	807 to 841
103	842 to 877
101	878 to 912
99	913 to 948
97	949 to 990
95	991 to 1032
93	1033 to 1074
91	1075 to 1116
89	1117 to 1158
87	1159 to 1204
85	1205 to 1250
83	1251 to 1296
81	1297 to 1342
79	1343 to 1388
77	1389 to 1444
75	1445 to 1500
73	1501 to 1556
71	1557 to 1612
69	1613 to 1668
67	1669 to 1728
65	1729 to 1788
63	1789 to 1848
61	1849 to 1908
59	1909 to 1968
57	1969 to 2038
55	2039 to 2108
53	2109 to 2178
51	2179 to 2248
49	2249 to 2318
47	2319 to 2388
45	2389 to 2463
43	2464 to 2538

TECHNICAL DATA

Specialist non-standard produced variants France and U.K. only

(for key to chart see page 31)

MODEL: 160

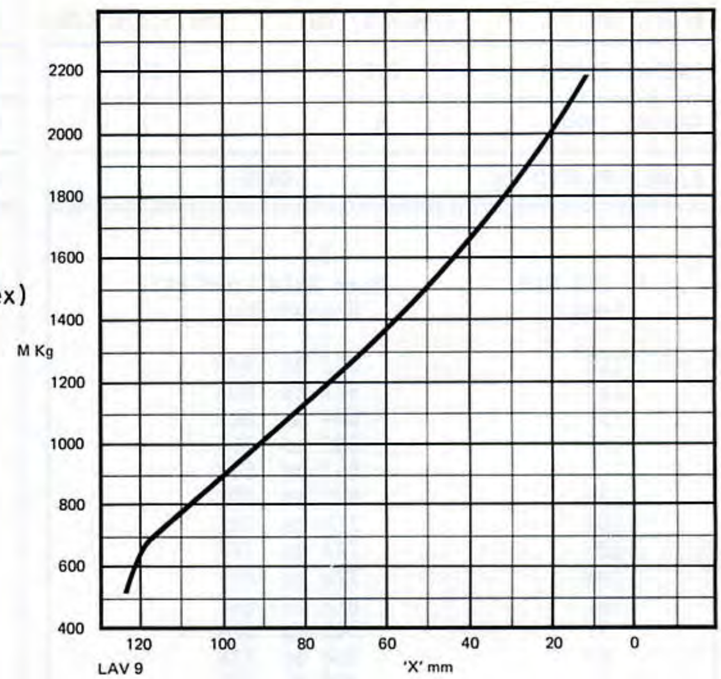
BODY TYPE: CHASSIS WINDSCREEN VAN FLOOR AND CHASSIS COWL VAN FLOOR FOR AMBULANCE CONVERSION

ENGINE TYPE: PETROL (2,0L OHC/ 3,0L Essex)

SPRING TYPE: SN (SVE AMBULANCE SUSPENSION)

R/AXLE PLATED Kg. 2240

L.A.V. Identification Plate
Part Number: V83VB-2L338-AA



MODEL 80 100 120

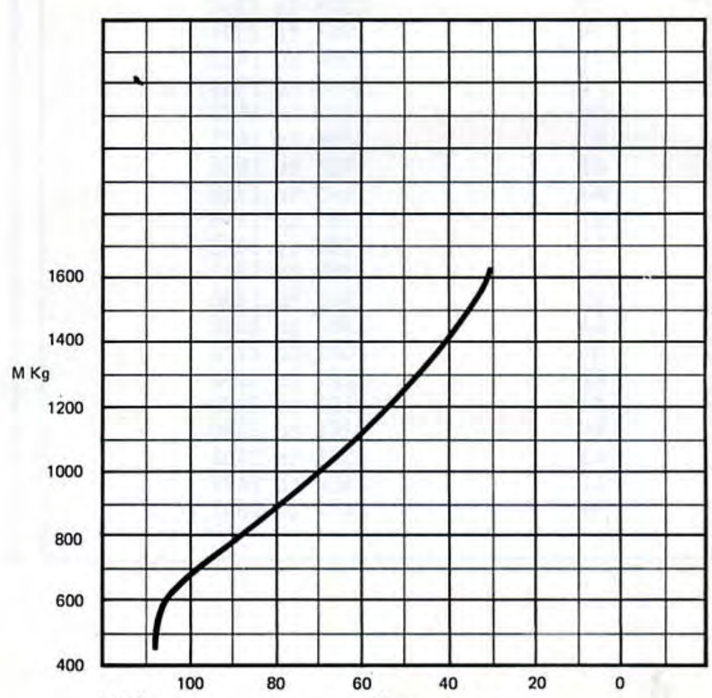
BODY TYPE VAN/KOMBI D/S CHASSIS CAB

ENGINE TYPE Petrol / Diesel

SPRING TYPE A/B

R/AXLE PLATED Kg. 1170/1460/1530/1590/1650

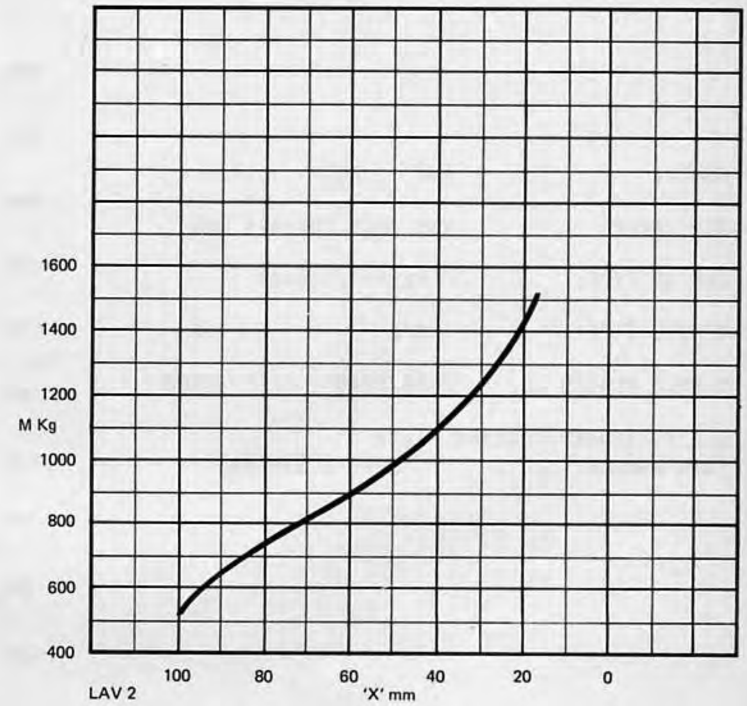
L.A.V. Identification Plate
Part Number: 83VB-2L338-AA



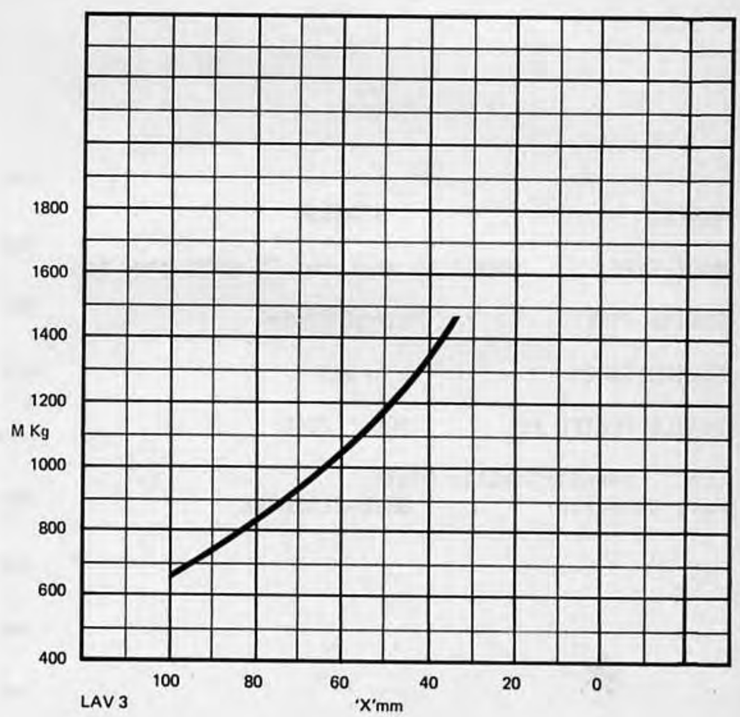
TECHNICAL DATA

(for key to chart see page 31)

MODEL:	100L
BODY TYPE:	VAN & C/CAB
ENGINE TYPE:	Petrol/Diesel
SPRING TYPE:	A
R/AXLE PLATED Kg.	1530
L.A.V. Identification Plate Part Number:	83VB-2L338-BA



MODEL:	100L
BODY TYPE:	KOMBI
ENGINE TYPE:	Petrol/Diesel
SPRING TYPE:	A
R/AXLE PLATED Kg.	1530
L.A.V. Identification Plate Part Number:	83VB-2L338-CA



TECHNICAL DATA

(for key to chart see page 31)

MODEL: 100L

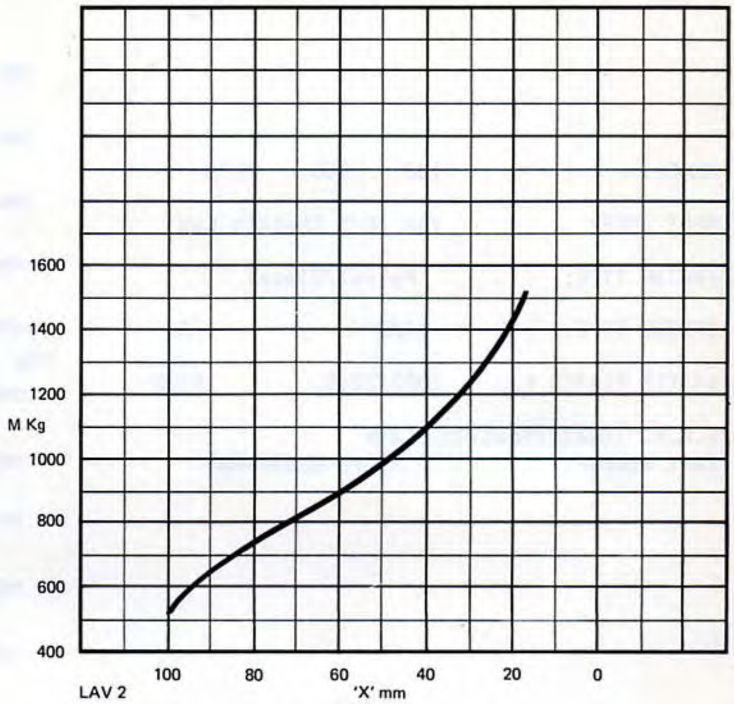
BODY TYPE: VAN & C/CAB

ENGINE TYPE: Petrol/Diesel

SPRING TYPE: A

R/AXLE PLATED Kg. 1530

L.A.V. Identification Plate
Part Number: 83VB-2L338-BA



MODEL: 100L

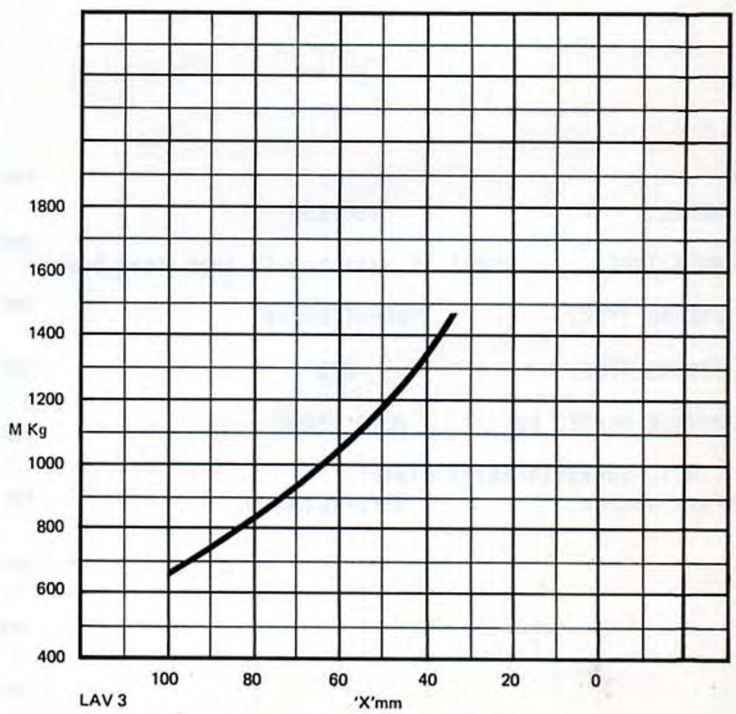
BODY TYPE: KOMBI

ENGINE TYPE: Petrol/Diesel

SPRING TYPE: A

R/AXLE PLATED Kg. 1530

L.A.V. Identification Plate
Part Number: 83VB-2L338-CA



TECHNICAL DATA

(for key to chart see page 31)

MODEL: 130 160 175

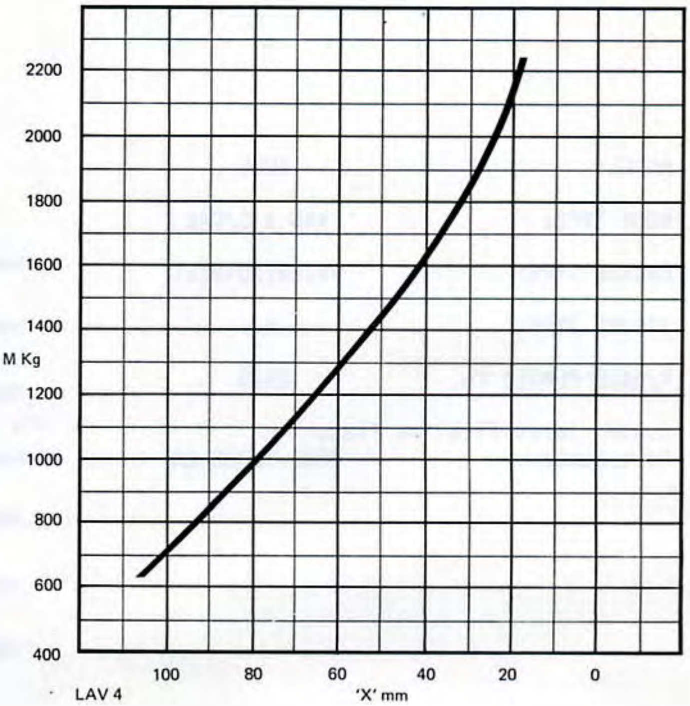
BODY TYPE: Van D/S Chassis Cab

ENGINE TYPE: Petrol/Diesel

SPRING TYPE: A/B A

R/AXLE PLATED Kg. 2020/2240 2300

L.A.V. Identification Plate
Part Number: 83VB-2L338-DA



MODEL: 130/160

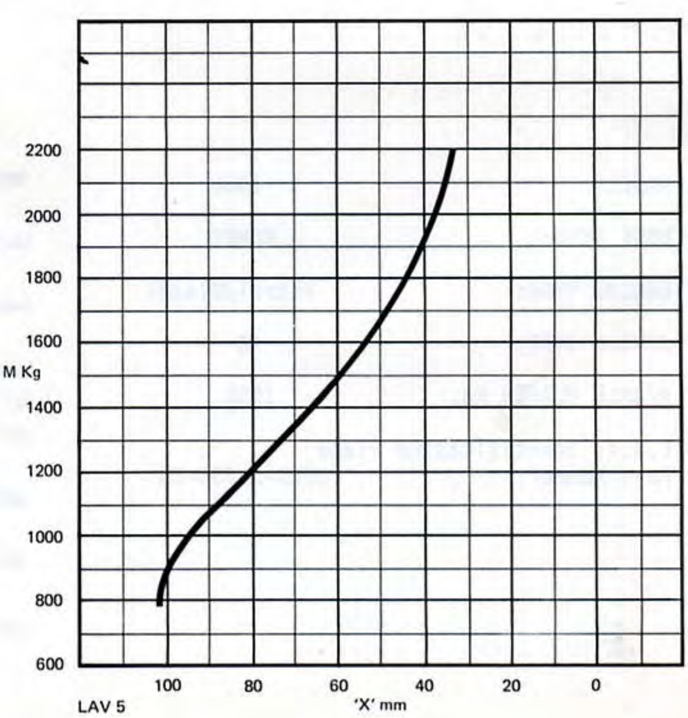
BODY TYPE: KOMBI 15 seat bus 17 seat crew bus

ENGINE TYPE: Petrol/Diesel

SPRING TYPE: A/B

R/AXLE PLATED Kg. 2020 2240

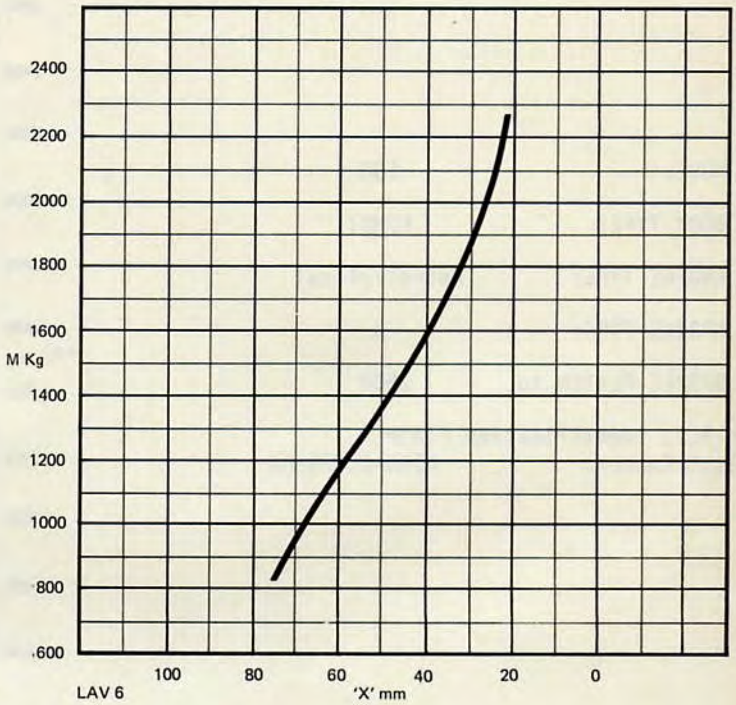
L.A.V. Identification Plate
Part Number: 83VB-2L338-EA



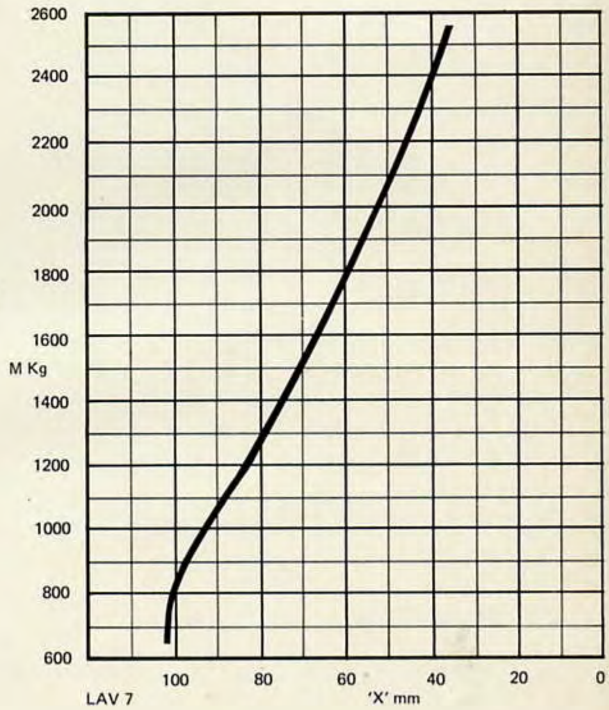
TECHNICAL DATA

(for key to chart see page 31)

MODEL:	175
BODY TYPE:	Parcel Delivery Van
ENGINE TYPE:	Petrol
SPRING TYPE:	B
R/AXLE PLATED Kg.	2330
L.A.V. Identification Plate Part Number:	83VB-2L338-FA



MODEL:	175	175	190
BODY TYPE:	Vans - Chassis Cab	PDV	Van D/S Chassis Cab
ENGINE TYPE:	Petrol/Diesel	Diesel	Petrol/Diesel
SPRING TYPE:	B	B	A
R/AXLE PLATED Kg.	2330	2330	2600
L.A.V. Identification Plate Part Number:		83VB-2L338-GA	

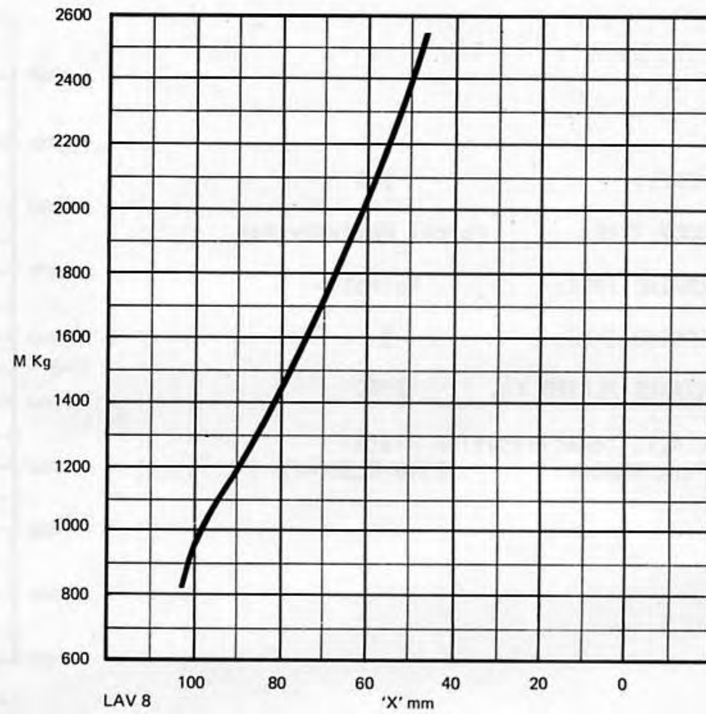


TECHNICAL DATA

(for key to chart see page 31)

MODEL:	190
BODY TYPE:	KOMBI
ENGINE TYPE:	Petrol/Diesel
SPRING TYPE:	A
R/AXLE PLATED Kg.	2600

L.A.V. Identification Plate
Part Number: 83VB-2L338-HA



TECHNICAL DATA

System	Dual line, split either vertically or horizontally
Type	Front disc/caliper, rear drum/shoe
Handbrake	Rod/Cable operation. Manual adjustment, handbrake operation on rear wheels only

Front Brakes

Disc diameter mm (in) - inner outer	270 (10,62) 156 (6,14)
Disc thickness mm (in) (solid)	14,15 (0,55)
Disc thickness mm (in) (ventilated)	23,90 (0,94)
Disc run out (including hub) mm (in)	0,13 (0,005)
Piston bore diameter mm (in)	57,15 (2,25) 41,40 (1,63)
Pad area (both wheels) cm^2 (in^2)	154,83 (24,00) 193,54 (30,00)
Pad material	Ferodo 2430

Rear Brakes

Drum diameter mm (in)	228,6 (9,00) 254,0 (10,00)
Shoe width mm (in)	44,4 (1,75) 57,1 (2,25) 69,8 (2,75)
Wheel cylinder diameter mm (in)	20,3 (0,8) 22,2 (0,87) 23,8 (0,93)
Lining material	Ferodo FF616 Ferodo AM14

Lubricant

General Grease	EM-1C-18

Tightening Torques	Nm.	Kgf.m	lbf.ft
Caliper to front suspension unit	90 to 110	9,0 to 11,0	66 to 81
Carrier plate to axle housing	30 to 35	3,0 to 3,5	22 to 25
Hydraulic unions	12,0 to 15,0	1,2 to 1,5	8 to 11
Bleed valves - sufficient to seal	10,2 max	1,0 max	8 max

ENGINE 21B

GENERAL DESCRIPTION

Transit range vehicles may have both diesel engines and various petrol engine types fitted. Petrol engines are in-line as well as V4 and V6 versions.

This section covers the Ford diesel engine **only**. For easier identification this engine is designated with the code letter 'G' in line with other workshop manuals. The table below lists the engine types built in Germany and the United Kingdom respectively.

ENGINE SUMMARY

Cubic Capacity Litres	Compression Ratio	Type	HP (kw)	Engine Code		Source	
				Vehicle plate	Workshop Manual	Germany	U.K.
2.4	DIESEL	OHV/I-4	62 (46)	4A	G	X	X
1,5	LC	OHV/V4	60 (44)	EX	D	X	—
1,6	LC	OHV/I-4	65 (48)	L1	A	—	X
1,7	LC	OHV/V4	65 (48)	MX	D	X	—
2,0	LC	OHV/V4	70 (51)	NX	E	X	X
2,0	HC	OHV/V4	80 (59)	NY	E	—	X
3,0	LC	OHV/V6	100 (74)	HX	F	—	X

OHV = overhead valves

I-4 = in-line 4 cylinder engine

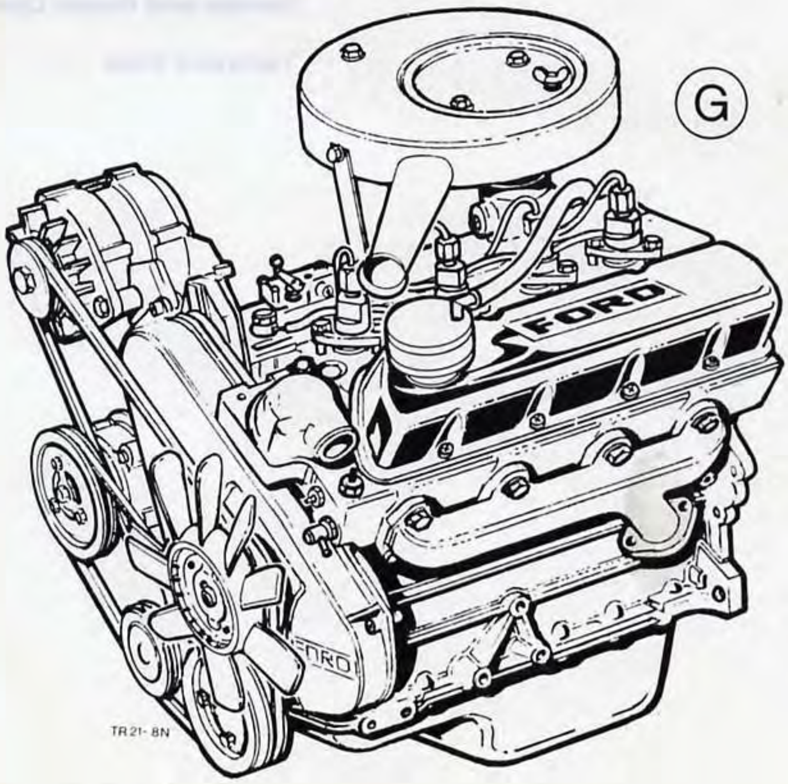


Fig. 1. 'G' Engine

GENERAL DESCRIPTION (cont'd)

The 'G' engine is a water-cooled 4 cylinder 4 stroke in-line indirect injection diesel engine (Fig. 1).

The combined fuel injection and fuel lift pump, fuel filter, brake pump and full-flow oil filter are all located on the right-hand side of the engine. The rotor oil pump is located at the front and is driven by a crankshaft gear. The fuel injection pump is driven via a toothed belt which also drives the camshaft. Similarly, alternator, brake pump and water pump are driven by the crankshaft via a V-belt.

In order to achieve low overall height (compact layout) the cylinders are mounted at an angle of 22,5 degrees to the left of vertical. To give maximum crankshaft drive stability the crankshaft is carried on five main bearings. Centre main bearing end float is determined by four half thrust washers.

The floating piston pins are located in the connecting rods (with bushes) and secured with two circlips. Pistons have two compression rings and one oil scraper ring. The camshaft which is carried on five bearings is located in the cylinder block on one side of the engine and driven by the crankshaft via a toothed belt which, as already mentioned, also drives the fuel injection pump. A drilling through the shaft carries oil to the replaceable bearings.

Overhead valve timing is effected via tappets, push rods and rocker arms. The rocker shaft has a drilling for rocker arm lubrication. Valves are arranged in the cylinder head in alternating sequence, commencing with an exhaust valve at the front of the engine. Inlet valves have one progressive coil spring and exhaust valves two. Valve adjusting screws are self-locking. Inlet and exhaust valves have different seat angles. Cylinder head valve guides are exchangeable.

The thermostart control incorporated in the inlet manifold ensures quick starting of the engine in low temperature conditions.

An automatic shut-off control fitted to the engine compartment splash shield enables the injection pump to be set to zero lift via a cable, thereby stopping the engine.

The fuel injection pump timing mark is located on the advance unit on top of the pump.

The engine has combustion chambers divided into a turbulence chamber located in the cylinder head and the main combustion chamber in the cylinder itself.

GENERAL DESCRIPTION (cont'd)

Lubrication Circuit, Fig. 2

The rotor oil pump located at the front of the engine block is driven by a gear on the crankshaft and draws oil via a strainer and suction pipe (lower drilling) from the oil sump.

The filtered oil is fed through the upper drilling via the pump relief valve into the full-flow oil filter and from there through the central axis of the oil filter cartridge to the main oil gallery. A by-pass valve located on the filter central axis opens in order to enable oil to pass directly into the main gallery in the event of oil filter cartridge blockage (by sludge, etc.).

The pump relief valve in the cylinder block, between the oil pump and the full-flow oil filter, is connected to the main oil gallery. Excessive oil pressure will force a small spring-loaded plunger downwards, with the downward movement of the plunger freeing the valve plunger drillings in the direction of the lower gallery thereby providing a direct connection between oil suction tube and pressure duct.

The five main bearings are connected to the main oil gallery. The big end journals are supplied with oil via diagonal lubrication passages from the nearest main crankshaft bearing.

The first four main bearing supports in the cylinder block have splash oil drillings which ensure splash lubrication of piston pins and better cooling of piston tops.

From the centre main bearing the oil passes via the centre camshaft bearing to the camshaft and from there through drillings to the remaining camshaft bearings.

Oil flows from the centre camshaft bearing through a cylinder block drilling to the cylinder head into the rocker arm shaft and to the rocker arms. Valve stems are lubricated by means of oil discharged through the rocker arm drilling.

Both the fuel injection pump and the lift pump are permanently lubricated with oil from the main oil gallery fed to the pumps via engine block and timing cover drillings. The return oil flow to the pump passes through the timing cover. The oil pressure switch which is screwed into the gallery on the right-hand side of the engine block is in direct communication with the main oil gallery.

GENERAL DESCRIPTION (cont'd)

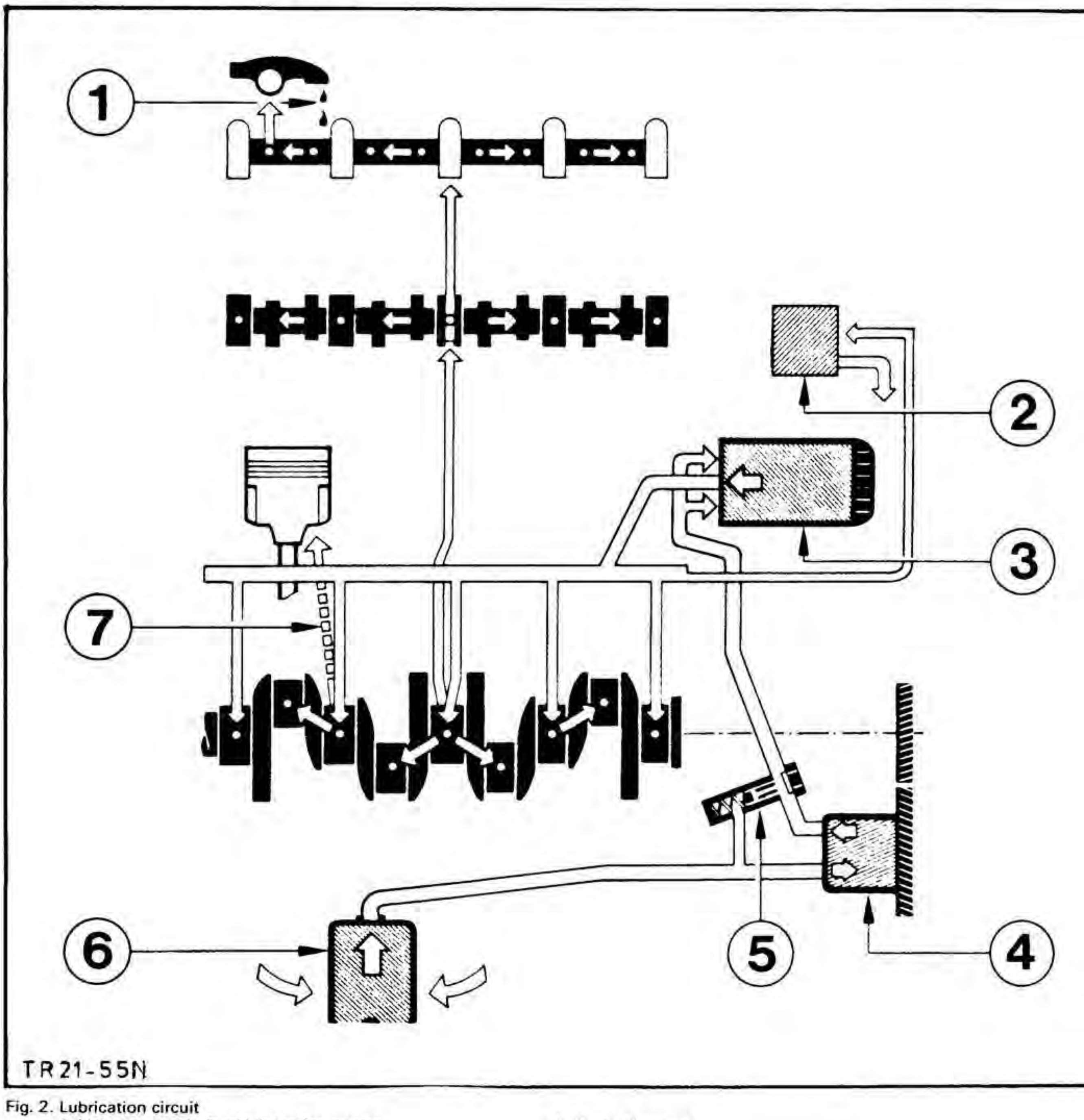


Fig. 2. Lubrication circuit

1. Valve stem drip feed lubrication system
2. Fuel injection pump
3. Exhauster pump
4. Full-flow oil filter
5. Rotor oil pump
6. Oil pump relief valve
7. Oil suction strainer
8. Piston splash lubrication system

GENERAL DESCRIPTION (cont'd)

Engine Ventilation System, Fig. 3

The mixture of air and crankcase fumes passes through the cylinder head into the rocker cover from where it is drawn through the oil separator and oil filler connecting hose into the inlet manifold and the filtered air, together with the air drawn through the air cleaner, is fed into the cylinder combustion chambers.

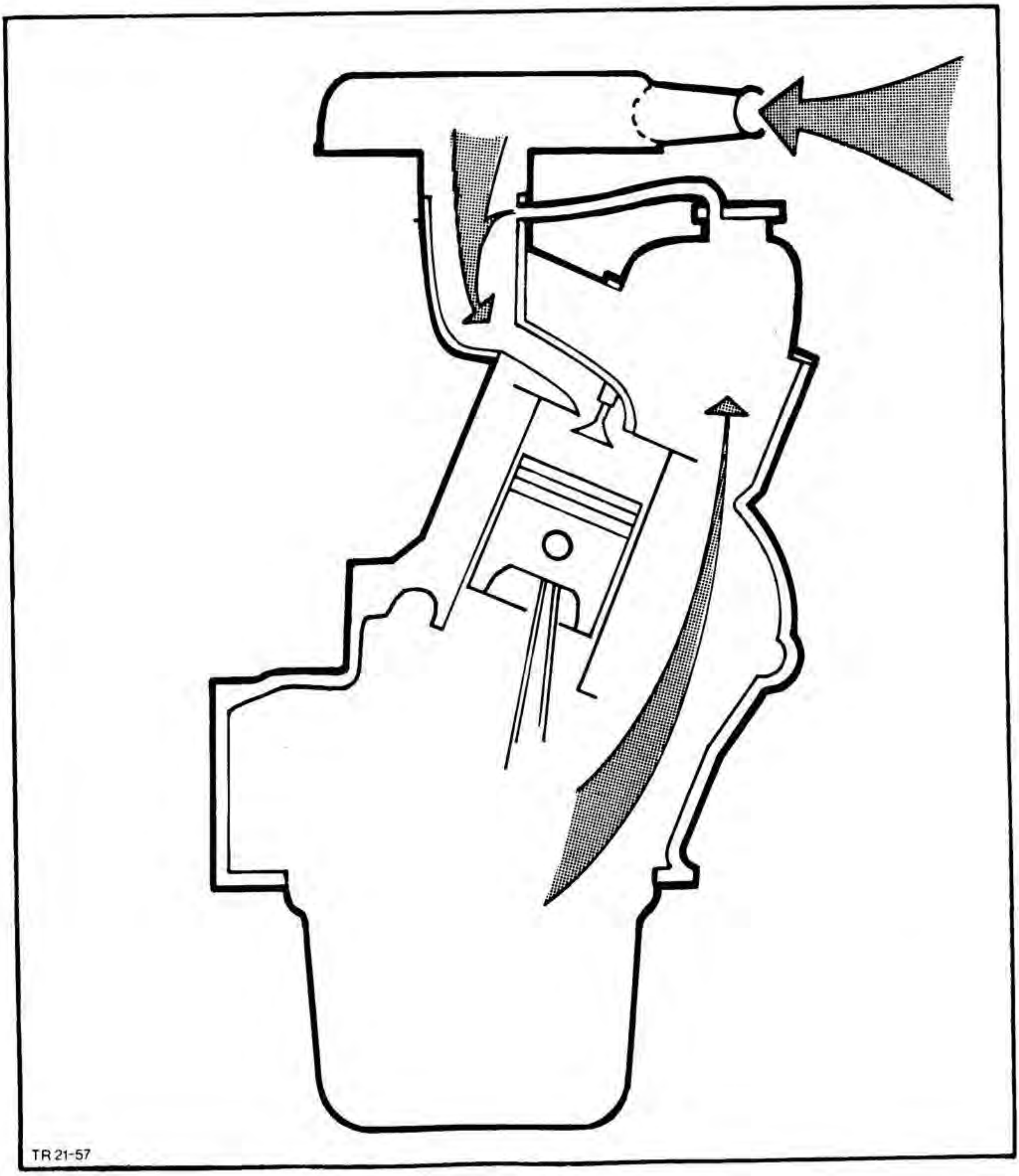


Fig. 3. Engine ventilation

GENERAL DESCRIPTION (cont'd)

Engine Identification and Engine Serial Numbers

Regulations in force in certain countries provide for engines to be marked with identification codes and serial numbers. Fig. 4 and 5 show where these data are marked on the engine. Minimum height of letters and numbers is 6 mm (0,25 in) and both codes and serial numbers (e.g. on replacement engines) should be marked in such a manner that they can be clearly recognised by the appropriate testing authorities, thereby preventing rejection of engines.

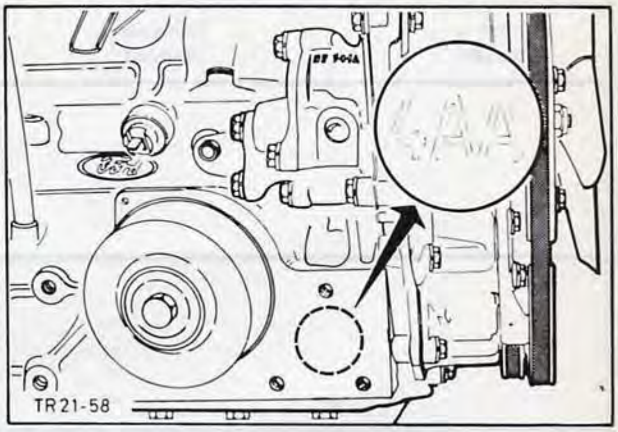


Fig. 4. Engine identification code

SERVICE ADJUSTMENT AND CHECKS

To check the engine oil level the vehicle should stand on level ground and the engine should be at normal operating temperature. Before carrying out the check, wait a short time to allow all oil to drain back into the sump.

Withdraw the dipstick, wipe it clean with a non-fluffy rag, replace and withdraw it again. The oil on the dipstick indicates the oil level in the sump, which should lie between the two marks, Fig. 6. The quantity of oil required to top up from the bottom mark to the top mark is approximately 1,7 litre (3,0 pints).

If necessary, top up through the filler neck, with engine oil to FORD specification.

Topping up is not necessary until the oil level drops to the bottom mark. Do not allow the oil level to drop any further. Never top up to above the top mark since the excess oil is wasted, i.e. the oil consumption is increased.

The engine oil should be changed and the full-flow oil filter renewed at 5000 km (3000 mile) intervals. If conditions of use are severe, e.g. short trips, frequent starts from cold, dusty roads, etc., the oil should be changed and the oil filter renewed at shorter intervals.

If the specified engine oil is not used the inevitable consequence will be excessive wear or damage to the engine. The oil film becomes discontinuous and engine components under high thermal stresses are subjected to increased wear. Residues collect in the sump and block oil passages. In addition, poor quality oil does not protect against corrosion so that rust forms on the cylinder walls. After a relatively short time the efficiency of the engine will decrease and there will be increased fuel and oil consumption. Always use a branded oil complying with FORD specifications.

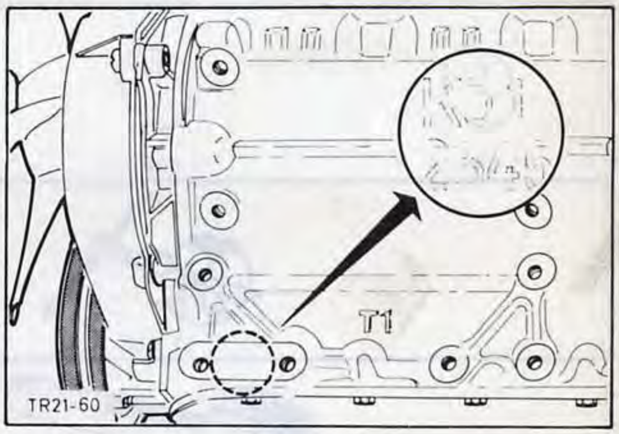
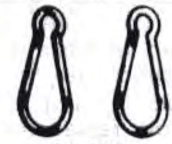
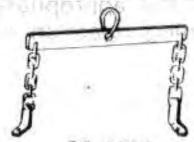
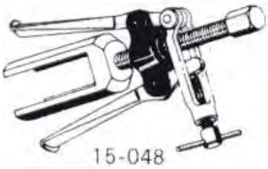
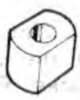
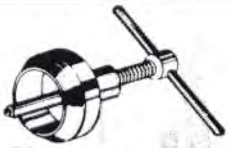
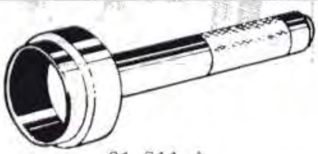
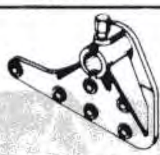
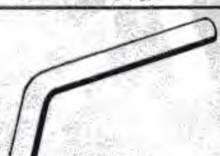


Fig. 5. Engine serial number

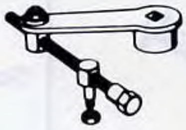
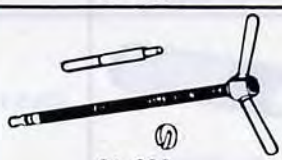
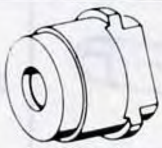
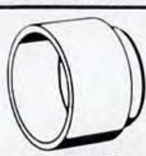
Fig. 6. Engine oil dipstick

SPECIAL SERVICE TOOL RECOGNITION

British Sourced	European Sourced	German Sourced	Tool Name
		 G1-6000	Engine lifting eyes (additional for G2–6000)
		 G2-6000	Engine lifting tackle
	 15-048	 G2-4676-A1	Camshaft oil seal remover
 15-048-01	 15-048-01	 G2-4676-A2	Camshaft oil seal remover adaptor (for use with 15–048)
	 21-010		Crankshaft rear oil seal remover
	 21-011-A		Crankshaft rear oil seal replacer
	 21-015		Engine mounting bracket
	 21-016		Timing gear alignment pin
	 21-017		Camshaft oil seal replacer and aligner

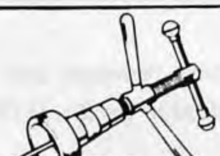
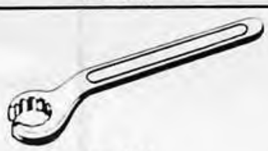
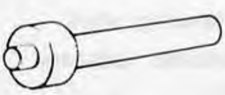
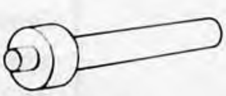
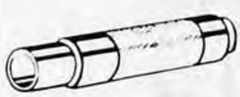
G/7/070/D

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

British Sourced	European Sourced	German Sourced	Tool Name
	 21-018		Crankshaft flange holding wrench
	 21-019		Crankshaft bolt remover and replacer (adaptor for 21–018)
	 21-021		Valve guide – remover/installer
	 21-022		Camshaft bearing remover/installer (main tool)
	 21-022-01		Camshaft bearing shell remover/installer (adaptor for 21–022)
	 21-022-02		Camshaft bearing shell remover/installer (adaptor for 21–022)
	 21-023		Universal spindle
	 21-025		Crankshaft front oil seal aligner
	 21-026		Engine lifting eye – front

G/7/071/D

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

British Sourced	European Sourced	German Sourced	Tool Name
	 21-027		Engine lifting eye – rear
 7600-A	 21-036	 G1-7600-A	Spigot bearing remover
 CT-9044	 21-041	 CT-9044	Injector pipe nut wrench
 CP-7112-A	 21-044	 G1-7600-B	Clutch disc locator
 CP-7123	 21-045	 G3-7041-B2	Spigot bearing installer

G/7/072/D

SERVICE AND REPAIR OPERATIONS – CONTENT

ENGINE		Description in this publication	Contained in Operation	Unique for TRANSIT
21 111	Engine – check compressions	X		X
21 112	Oil pressure – check	X		X
21 132	Engine and transmission assembly – remove and install	X		X
21 134 8	Engine – dismantle and reassemble (engine removed)	X		X
21 146	Cover-timing belt – remove and install	—	21 288	X
21 148	Timing cover – remove and install	—	21 467	X
21 154	Sump – remove and install	X		X
21 163	Cylinder head – remove and install	X		X
21 213	Valve clearances – adjust	X		X
21 217 4	Valves – remove and install (cylinder head removed)	X		X
21 231 9	Valve seat – recut (valves removed)	X		X
21 235 4	Valve guides – replace (valves removed)	X		X
21 255 9	Rocker shaft assembly – overhaul (rocker shaft removed)	X		X
21 286 6	Bearings – camshaft – replace (engine dismantled)	X		X
21 288	Seal – camshaft – replace	X		X
21 304	Timing belt – replace	X		X
21 467	Seal – crankshaft front – replace	X		X
21 468 4	Seal – crankshaft rear – replace (engine or transmission removed)	X		X
21 505 5	Piston – replace (piston and connecting rod assembly removed)	X		X
21 584 5	Ring gear – flywheel – replace (flywheel removed)	X		X
21 714	Oil pump – remove and install	X		X
21 714 8	Oil pump – overhaul (oil pump removed)	X		X
21 875	Engine rubber mounting – front – replace	X		X

SERVICE AND REPAIR OPERATIONS

21 111 ENGINE – CHECK COMPRESSIONS

Special Service Tools and Testing Equipment Required:

Injection pipe nut wrench 21–041
Standard compression testing equipment

The majority of test instruments are of different design and usually enable compression to be checked on one cylinder only. Determination of the actual compression pressure is dependent on several factors, e.g. varying starter motor speeds, or state of charge of the battery. It is, however, essential for at least two requirements to be met, namely, that the engine temperature is normal and valve clearances are adjusted as specified in Technical Data.

To Check

1. Remove inlet manifold.
2. Disconnect cable from shut-off unit to interrupt fuel supply.
3. Unscrew fuel injector pipes using Special Tool 21–041, Fig. 7 and disconnect overflow pipe from nozzle brackets.
4. Remove injectors and withdraw nozzle bracket sealing ring and heat balancing plate.
5. Screw compression pressure tester with new graph paper to injector nozzle orifice concerned, Fig. 8 and crank engine until pointer of tester rises no further (compression pressure data see Technical Data).
6. Vent tester, adjust graph paper for next cylinder and repeat sub-op 5 for all other cylinders.
7. Fit new sealing ring and new heat balancing plate with domed side facing upwards, Fig. 9 and tighten injector nozzles as specified in Technical Data.
8. Fit injector pipes as specified, using Special Tool 21–041 and install overflow pipe.
9. Connect cable to shut-off motor and fit air cleaner.

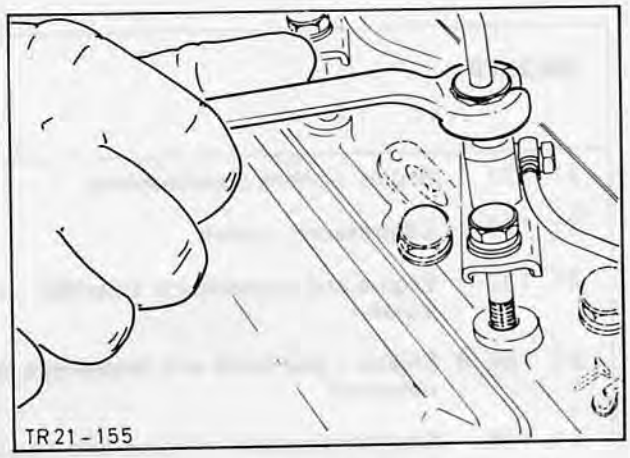


Fig. 7. Remove injector pipes using Special Tool 21–041

Fig. 8. Install compression tester adaptor into orifice

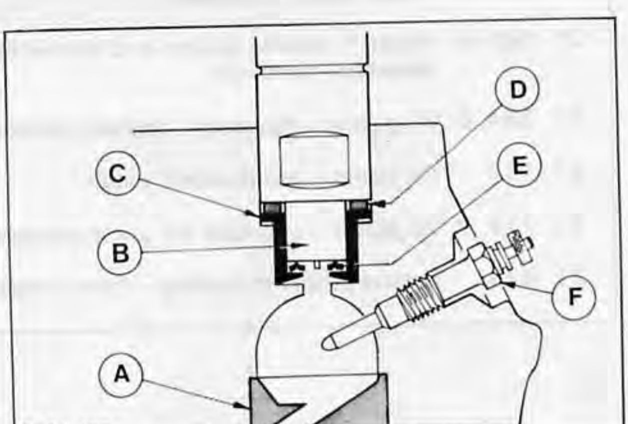


Fig. 9. Turbulence combustion chamber
A – Turbulence combustion chamber element
B – Engine heat shield
C – Engine heat shield gasket
D – Nozzle bracket sealing ring
E – Heat balancing plate

21 112 OIL PRESSURE – CHECK

Testing equipment required:

Oil pressure test gauge

Oil pressure depends on various factors (engine speed, oil temperature, oil pump rotor clearance, etc.). Pressure should always be checked at an oil temperature of 355 °K (80 °C) (176 °F). At idling speed oil pressure should be 1,0 bar (kgf/cm²) (14,2 lbf/in²). Maximum pressure should however, not exceed 5 bar (kgf/cm²) (71 lbf/in²) at speeds above 2000 rpm.

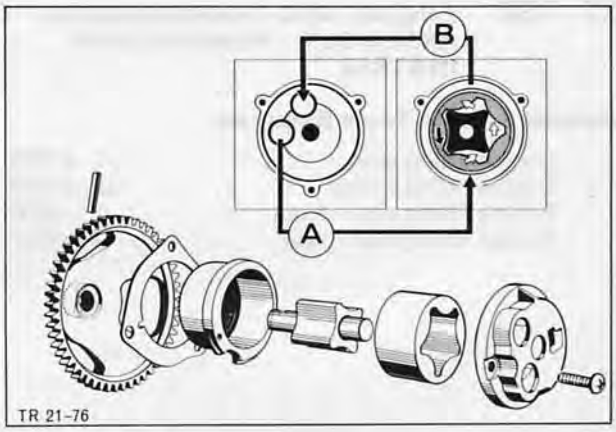


Fig. 10. Oil pump dismantled
A – Suction pipe
B – Pressure pipe

If pressures are outside these limits first eliminate oil pump, Fig. 10 or relief valve, Figs. 11 and 12, as possible sources of fault. The following faults can occur, e.g.:

Pressure too high at speeds over 2000 rev/min; Failure of relief valve to open because of fouling.

Pressure too low at all engine speeds: Clogged intake strainer, intake pipe loose or broken, oil pump worn, etc.

Pressure too low at low engine speeds: Relief valve jammed in open position due to dirt.

Fig. 11. Relief valve location (vacuum pump removed for clarity)

To measure oil pressure

1. Remove oil pressure switch connecting lead and remove oil pressure switch.
2. Connect test pressure gauge to engine block, using adaptors, if necessary.
3. Start engine and check oil pressure at idling speed and at over 2000 rev/min.
4. Remove test pressure gauge. Replace oil pressure switch and connect lead as specified in Technical data.

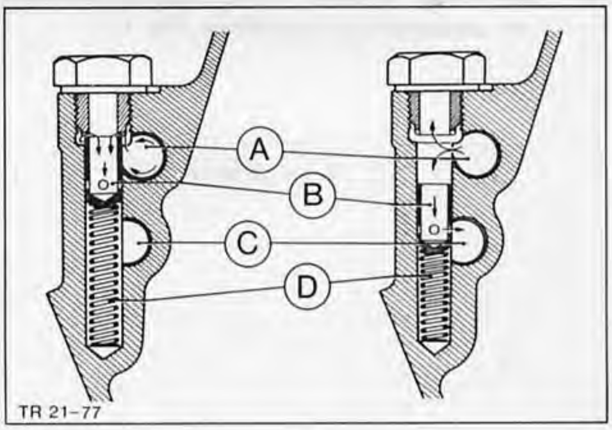


Fig. 12 Relief valve
A – Pressure pipe
B – Suction pipe
C – Valve plunger
D – Compression spring

21 132 ENGINE AND TRANSMISSION ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required:

Engine lifting eyes	G1–6000
Engine lifting tackle	G2–6000
Engine lifting eye – front	21–026
Engine lifting eye – rear	21–027

Fig. 13. Drain coolant

To Remove

1. Disconnect both battery earth cables, as well as positive lead from left-hand battery.
2. Disconnect washer assembly hoses from nozzles and retaining clamps and remove hood (4 bolts).
3. Drain coolant into tray, disconnecting lower radiator hose from water neck, Fig. 13, and upper hose from thermostat water neck and remove.
4. Remove coolant expansion tank connecting pipe (2 bolt), Fig. 14 and remove expansion tank complete with bracket from engine (3 bolts).

Fig. 14. Unscrew expansion tank connecting pipe

5. Disconnect radiator (2 bolts) bottom mounting from crossmember mountings, Fig. 15.

Fig. 15. Remove radiator bottom mounting from crossmember

6. Unhook hood cable at catch end (Fig. 16) and disconnect from radiator grille panel.

Fig. 16. Unhook hood cable

7. Remove right-hand and left-hand headlamp surround (1 bolt each).
8. Remove radiator grille panel complete with radiator and expansion tank, as well as connecting pipe, Fig. 17.

Fig. 17. Remove radiator grille panel complete with radiator, expansion tank and connecting pipe

9. Remove air cleaner (2 bolts).
10. Disconnect cables from shut-off motor and injection pump, Fig. 18.

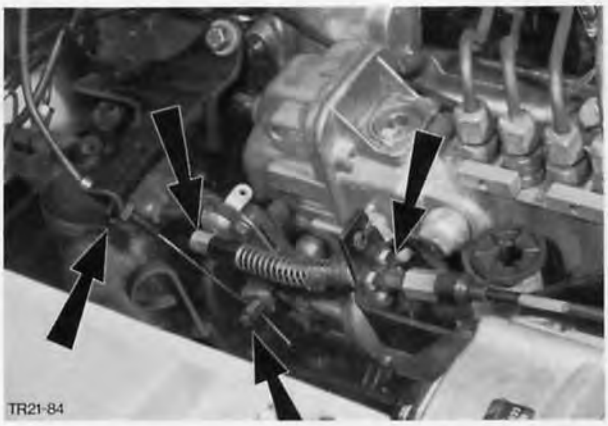


Fig. 18. Disconnect shut-off motor and injection pump cables

21 132 (cont'd)

11. Disconnect fuel feed and return line from pump and remove fuel filter and thermostart reservoir lines from intake manifold.
12. Disconnect temperature sender unit, oil pressure switch, glow plugs, starter motor and alternator. Remove positive left-hand battery cable from body.
13. Disconnect brake servo vacuum hose from pipe and remove, Fig. 19.

Fig. 19. Remove brake servo vacuum hose

14. Remove water drain neck and heater hoses from splash panel, Fig. 20.


Fig. 20. Remove heater hoses

15. Disconnect exhaust pipe from manifold (2 bolts).
16. Remove transmission gearshift lever mounting bracket (6 bolts) and raise gaiter. Remove gear shift lever cap nut, Fig. 21 and withdraw gearshift lever.


Fig. 21. Remove transmission gearshift lever nut

17. Remove clutch cable from pedal bracket, Fig. 22.

Fig. 22. Remove clutch cable from pedal bracket

18. Disconnect left-hand and right-hand earth cables from clutch housing and remove speedometer drive cable from transmission (1 bolt), Fig. 23.

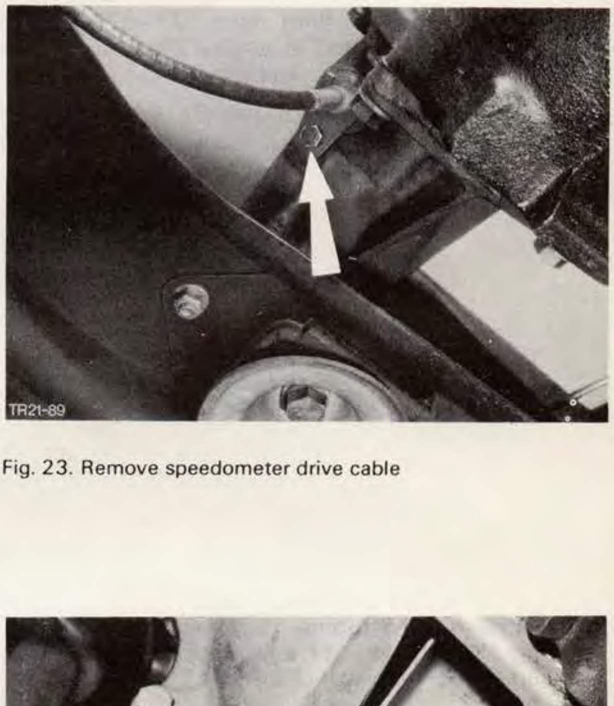


Fig. 23. Remove speedometer drive cable

19. Pull back gaiter and unhook clutch cable from release lever, Fig. 24.

Fig. 24. Unhook clutch cable from release lever

21 132 (cont'd)

20. Disconnect drive shaft at rear axle flange (4 bolts), Fig. 25 and floor pan centre bearing (2 bolts), withdraw drive shaft from gearbox extension housing and fit blanking plug.

Fig. 25. Remove driveshaft

21. Attach engine lifting eyes 21–026/27 to engine, Fig. 26 and fit engine lifting appliance G2–6000 with engine lifting eye G1–6000.
22. Hook engine lifting appliance into standard workshop lifting jack and gently take up engine weight.

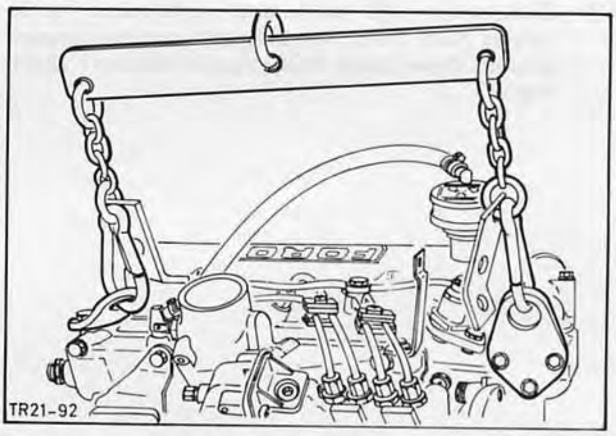


Fig. 26. Fit engine lifting eyes and lifting chain

23. Remove transmission from rear engine mounting (1 bolt), Fig. 27 and engine from mounting rubber insulator (2 nuts).
24. Carefully raise engine complete with transmission and lift out of engine compartment.

Fig. 27. Remove transmission from rear engine mounting

To Install

25. Carefully position engine complete with gearbox in engine compartment and fit on front and rear engine mounting. Tighten as specified in Technical data.
26. Remove engine lifting appliance.
27. Withdraw blanking plug from gearbox extension housing, carefully insert driveshaft and attach to rear axle flange and centre bearing as specified in Technical data, Fig. 28.

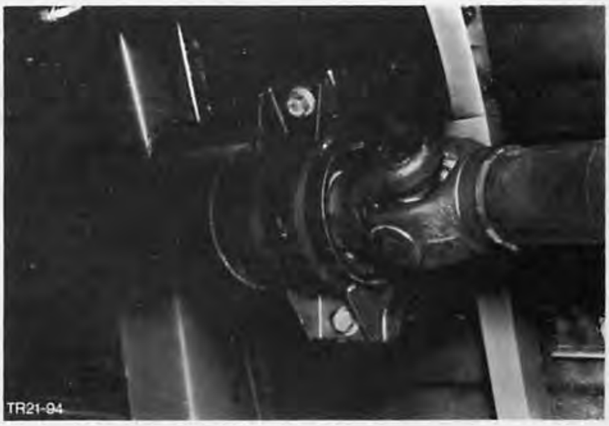


Fig. 28. Fit driveshaft centre bearing

28. Connect speedometer drive cable. Hook clutch cable into release lever and install gaiter. Fit earth cable left and right to clutch housing and attach left-hand battery positive lead to body.
29. Adjust clutch cable clearance at pedal bracket, Fig. 29.

Fig. 29. Adjust clutch cable clearance

30. Install gearshift lever and tighten nut. Locate gaiter and fit mounting bracket.
31. Bolt exhaust pipe to manifold.
32. Fit heater hoses and water drain neck, Fig. 30.

Fig. 30. Fit water drain hose

21 132 (cont'd)

33. Slide brake servo vacuum hose on to line and secure, Fig. 31.
34. Connect leads to temperature sender unit, oil pressure switch, glow plugs, starter motor and alternator.

Fig. 31. Slide brake servo vacuum hose on to line and secure

35. Connect fuel filter and thermostart reservoir pipes to inlet manifold and fit fuel feed and return lines to pump.
36. Fit fuel injection pump and shut-off motor cables, then bleed the fuel system – refer to Op. 23 142, Fig. 32/33.

Fig. 32. Vent fuel-filter

37. Fit air cleaner.

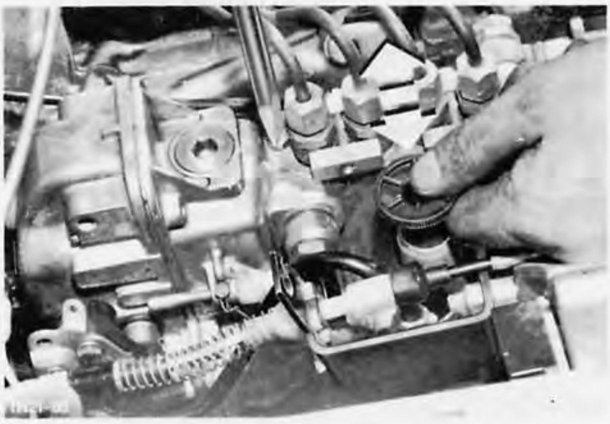


Fig. 33. Vent fuel pump

38. Insert radiator grille panel complete with radiator and expansion tank and secure, Fig. 34. Fit both headlamp surrounds.

Fig. 34. Install radiator grille panel complete with radiator, connecting pipe and expansion tank

39. Hook hood cable into catch, Fig. 35 and fit to radiator grille panel.

Fig. 35. Fit hood cable

40. Replace radiator at bottom location to cross-member mountings, Fig. 36.

Fig. 36. Fit radiator at bottom location

21 132 (cont'd)

41. Fit expansion tank with bracket to engine, Fig. 37 and attach expansion tank connecting pipe.

Fig. 37. Fit expansion tank

42. Replace lower and upper radiator hoses and secure, Fig. 38.

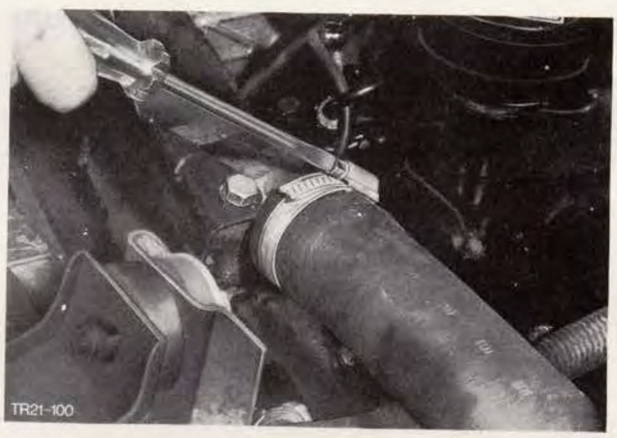


Fig. 38. Fit upper radiator hoses and secure

43. Top up coolant and engine oil. Check transmission oil level and top up, if required.
44. Position hood, hand-tighten bolts, align hood and secure. Position washer system hoses, Fig. 39 and slide on to nozzles.
45. Connect earth cables to both batteries and positive lead to left-hand battery.

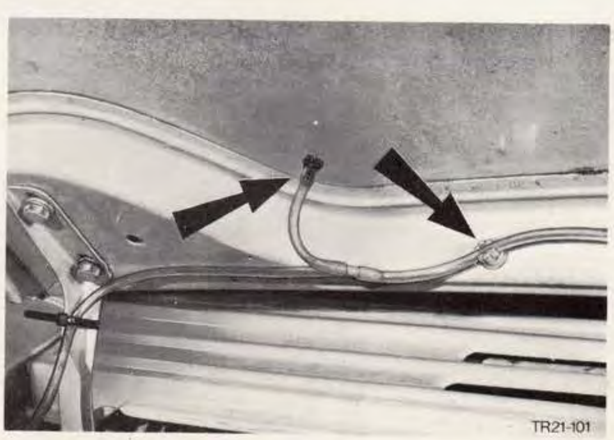
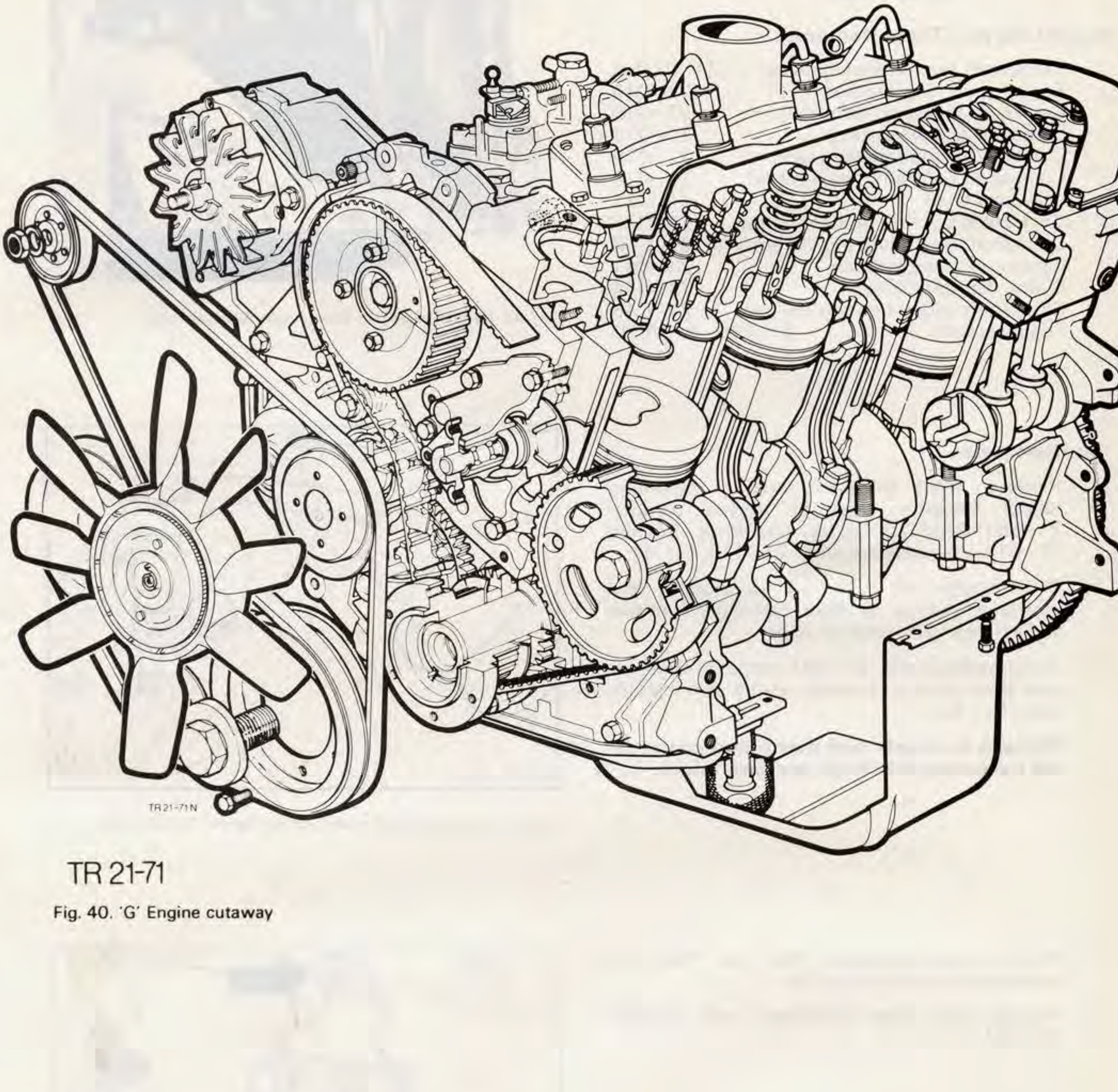


Fig. 39. Position washer system hoses

21 134 8



TR 21-71

Fig. 40. 'G' Engine cutaway

21 134 8 ENGINE – DISMANTLE AND REASSEMBLE (ENGINE REMOVED)

Special Service Tools Required:

Crankshaft rear oil seal installer	21–011–A
Engine mounting bracket	21–015
Camshaft gear alignment pin	21–016
Camshaft oil seal installer	21–017
Crankshaft flange holding wrench ..	21–018
Crankshaft bolt remover/replacer ..	21–019
Universal shaft	21–023
Crankshaft front oil seal centraliser ..	21–025
Crankshaft spigot bearing extractor ..	21–036
Injector pipe nut wrench	21–041
Clutch disc centraliser	21–044
Crankshaft spigot bearing installer ..	21–045
Engine stands	21–061–A/B/C/D

Fig. 41. Secure engine to stand, using Special Tools

To Dismantle

1. Remove front left-hand engine mounting rubber insulator, then fit engine stand(s) 21–061–A/B/C/D using mounting bracket 21–015 and universal shaft 21–023, Fig. 41.
2. Drain engine oil, withdraw oil dipstick and unscrew full-flow oil filter cartridge. Remove oil filler cap with breather hose.
3. Using special tool 21–041 remove overflow pipe from nozzles, injection pump and injector lines, Fig. 42.

   Fit caps to nozzle and pump line connectors for protection from contamination.

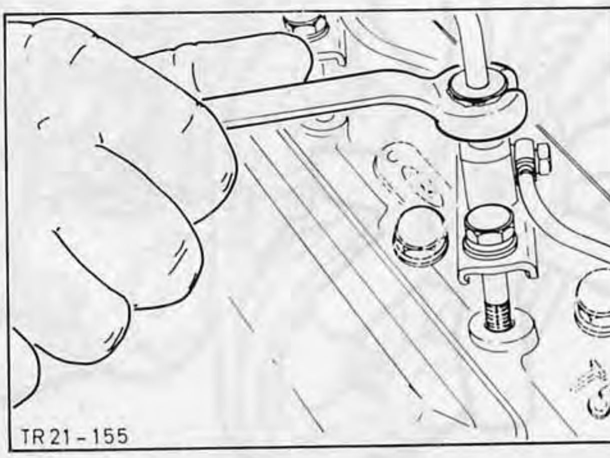


Fig. 42. Unscrew injector lines using Special Tool 21–041

4. Remove injection pump filter fuel lines and engine vacuum pump air line.
5. Remove fuel filter complete with bracket (3 bolts), Fig. 43.

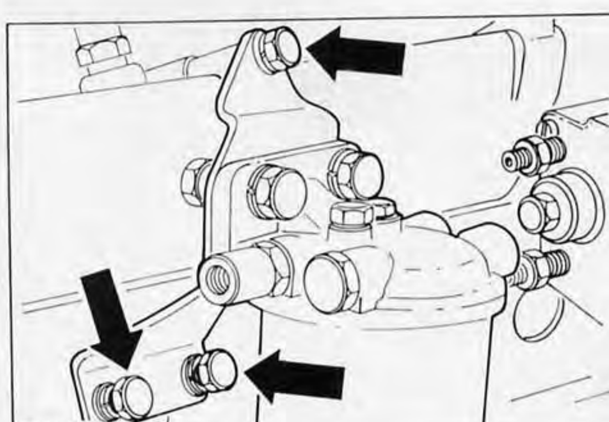


Fig. 43. Remove fuel filter with bracket

6. Slacken vacuum pump V-belt tension roller Fig. 44 and alternator V-belt adjuster, then remove both V-belts.
7. Remove alternator complete with bracket (4 bolts).
8. Remove fan with pulley (4 bolts).
9. Remove crankshaft pulley (6 bolts).

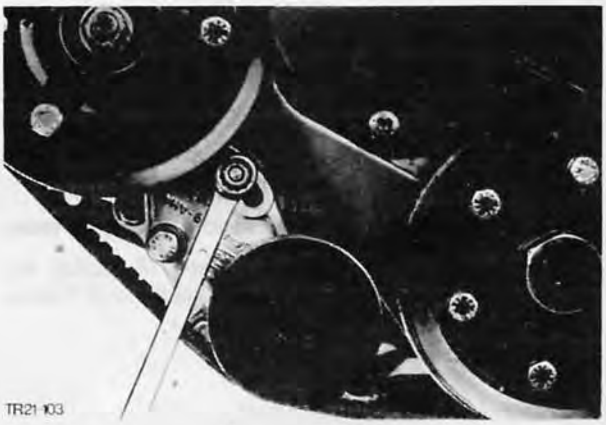


Fig. 44. Slacken vacuum V-belt tension roller

10. Remove upper and lower toothed belt cover bolts and remove cover, Fig. 45.
11. Remove rocker cover (6 bolts).
12. Remove three lower then five upper rocker support bracket bolts. Remove rocker shaft and withdraw push rods.

    Do not interchange push rods when removing and installing.

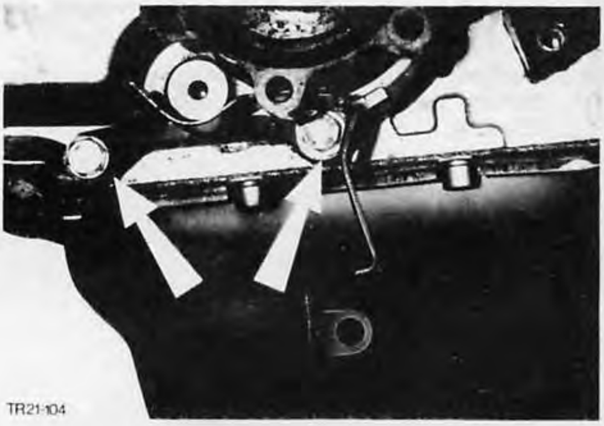


Fig. 45. Remove lower toothed belt cover

13. Remove injector nozzles (2 bolts each), then lift out nozzle holder sealing rings and heat balancing plate. Withdraw heat shields and gaskets, using 2 screwdrivers.
14. Remove water neck (2 bolts) and lift out thermostat, noting location, Fig. 46.

Fig. 46. Remove thermostat

21 134 8 (cont'd)

15. Slacken water pump to cylinder head by-pass hose, Fig. 47.

16. Remove cylinder head bolts (18), unscrewing them in reverse order from that in which they were tightened (for tightening sequence see Fig. 90). Lift off cylinder head complete with inlet and exhaust manifolds.

Do not place cylinder head on gasket face.

17. Remove clutch pressure plate (6 bolts) flywheel (8 bolts), and engine backplate (2 bolts).

Fig. 47. Slacken by-pass hose

18. Remove sump (24 bolts) downwards to prevent sludge or swarf getting into engine.

19. Slacken toothed belt tensioner and remove toothed belt, Fig. 48, then remove tensioner (2 bolts).

Fig. 48. Remove toothed belt

20. Remove crankshaft hub bolt, using Special Tool 21–018/019, Fig. 49. Remove crankshaft hub using standard extractor.

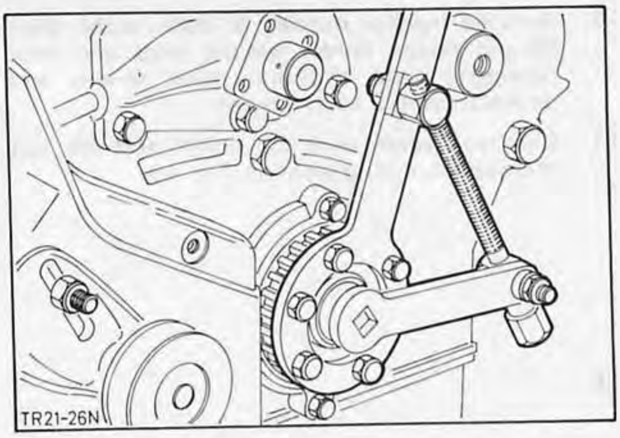


Fig. 49. Slacken crankshaft hub bolt using Special Tool 21–018/019

21. Lock camshaft toothed belt gear with Special Tool 21–016, Fig. 50. Unscrew bolt and press off gear using two levers.

Fig. 50. Lock camshaft toothed belt gear using Special Tool 21–016

22. Remove water pump with by-pass hose from intermediate plate (7 bolts), Fig. 51.

Fig. 51. Remove water pump

23. Remove vacuum pump pulley, Fig. 52, using standard extractor if necessary.

Fig. 52. Remove vacuum pump pulley

21 134 8 (cont'd)

24. Remove front cover from intermediate plate (10 bolts).
25. Remove oil pump with mounting (3 bolts) from engine block, Fig. 53.

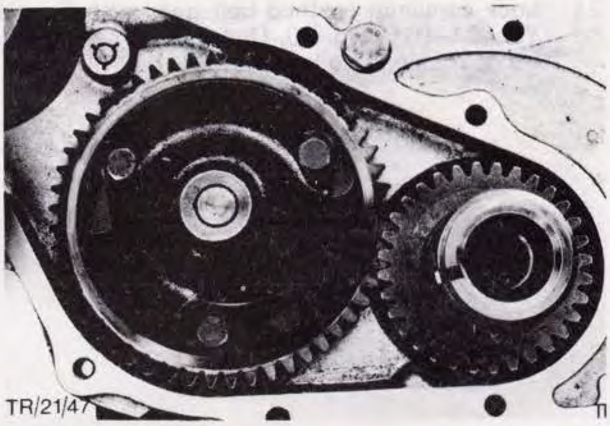


Fig. 53. Remove oil pump

26. Remove vacuum pump bracket and pump from intermediate plate (3 bolts) Fig. 54.

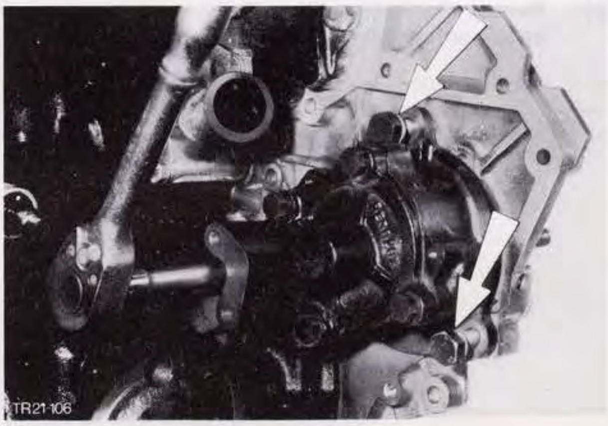


Fig. 54. Remove vacuum pump

27. Remove injection pump bracket from engine block (2 bolts), then remove intermediate plate complete with injection pump (10 bolts), Fig. 55.

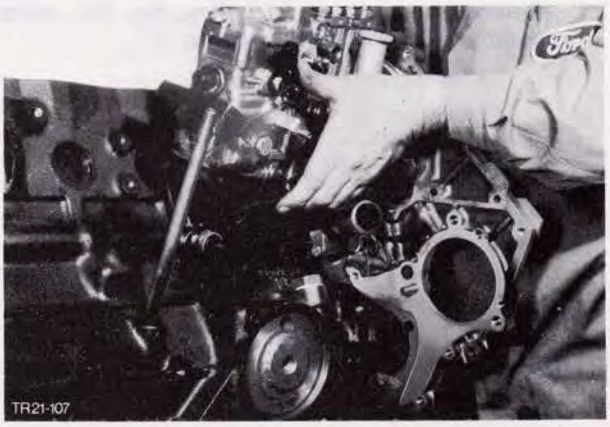


Fig. 55. Remove injection pump and intermediate plate

28. Remove camshaft and crankshaft spacer, as well as crankshaft gear, by hand.
29. Withdraw crankshaft spigot bearing, using Special Tool 21–036, Fig. 56.

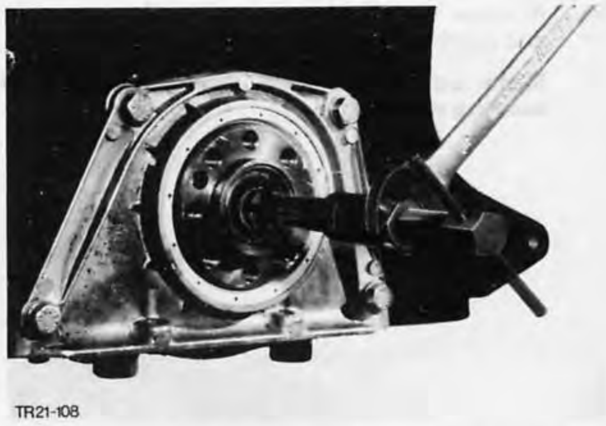


Fig. 56. Remove crankshaft needle bearing using Special Tool 21–036

30. Remove crankshaft rear oil seal carrier (4 bolts), Fig. 57.
31. Remove camshaft rear cover plate bolts (3) and camshaft thrust plate bolts (2), Fig. 58. Remove plates and carefully withdraw camshaft.

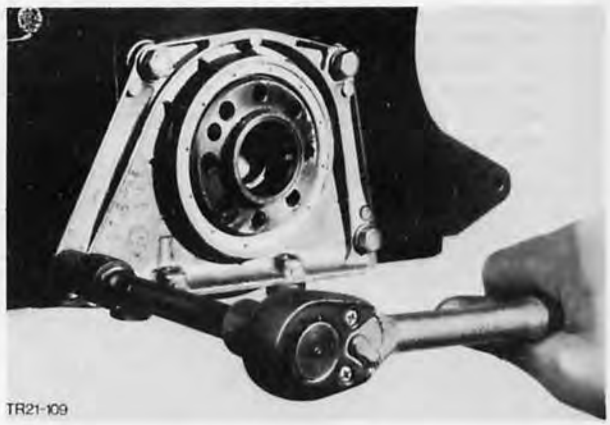


Fig. 57. Remove crankshaft oil seal carrier

32. Remove tappets from engine block.

    Do not interchange tappets when removing and installing.
33. Remove oil pump suction pipe (2 bolts).

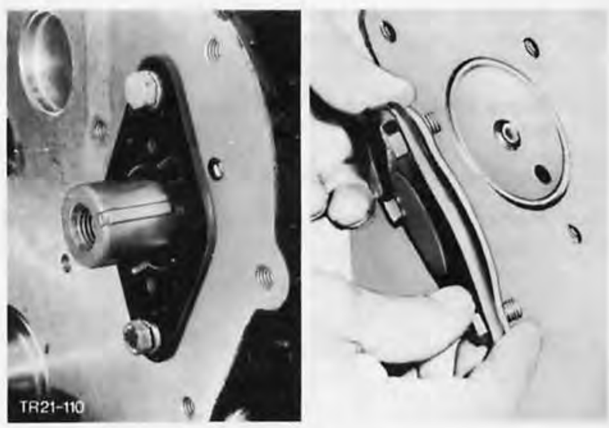


Fig. 58. Remove camshaft thrust plate

21 134 8 (cont'd)

34. Remove big end bearing caps (2 nuts each) and bearing shells.

    Note connecting rod, bearing cap and bearing markings.

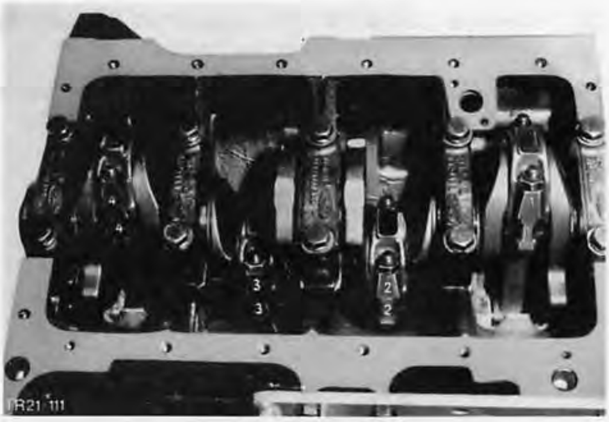


Fig. 59. Big end journal markings

35. Carefully scrape off carbon deposits from cylinder bore top ends, then withdraw piston and connecting rod assemblies upwards from the block. Remove piston rings, clean grooves and fit new rings into grooves, with 'TOP' mark pointing upwards, Fig. 60.

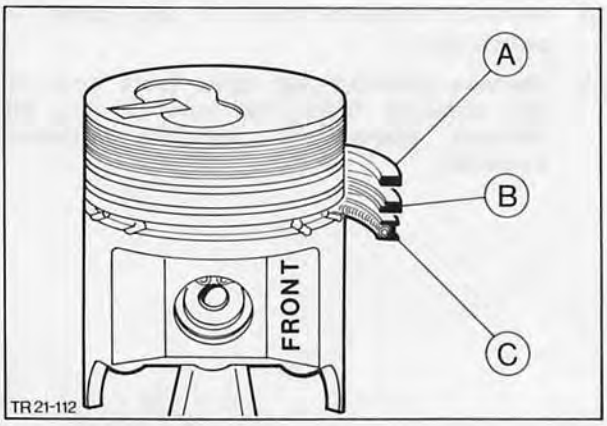


Fig. 60. Fit piston rings
A – Upper piston ring
B – Lower stepped ring
C – Oil scraper ring

36. Remove main bearing caps (2 bolts each) and shells. Note centre main bearing thrust washers.

    Note bearing shell and cap markings, Fig. 61.

37. Carefully lift crankshaft out of engine block.

38. Remove oil pressure switch and pressure relief valve.

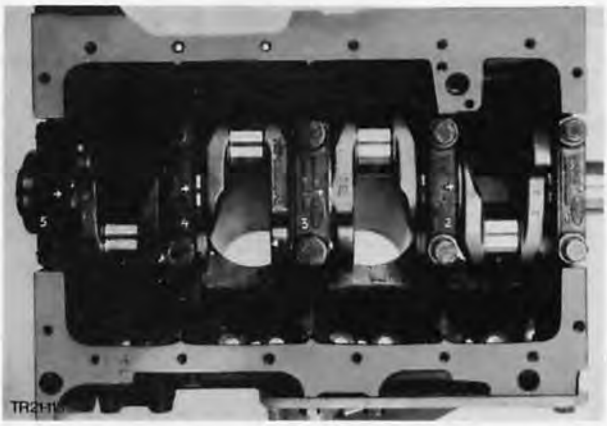


Fig. 61. Main bearing markings

To Reassemble

The type and degree of cleaning of a given part before reassembly must depend on the hours the engine has run, the extent of any damage and its possible re-use. This applies particularly to the cylinder block with its corners, angles and bores. If necessary, remove all plugs and covers and clean their seats, using suitable cleaning agents and tools (brushes, scrapers). The oil galleries in particular, e.g. in the cylinder block, cylinder head, etc., should be free from dirt and abrasive particles, Fig. 62. If press-fit plugs and screw plugs are removed, they, like all seals and gaskets, should be renewed.

Measuring Bearing Clearance

Measuring bearings (even with undersize crankshafts) can be eliminated and determination of required bearing shells can be considerably simplified by use of:

'PLASTIGAGE' made by:
PERFECT CIRCLE CORPORATION,
HAGERSTOWN, INDIANA, USA.

UK supplier:
Norman Gaydon (International) Ltd.,
68 London Road,
Southend-on-Sea,
Essex, SS1 1PG.

West German supplier:
K. H. ERN,
Schinkelstrasse 46–48,
Dusseldorf.

'PLASTIGAGE' is the name of an accurately calibrated plastic filament.

Type	Colour	Measuring range
PG-1	green	0,025–0,075 mm (0,001–0,003 in)
PR-1	red	0,050–0,150 mm (0,002–0,006 in)
PB-1	blue	0,100–0,230 mm (0,004–0,01 in)

Requirements for use of 'Plastigage'

1. Bearing should be dry and clean.
2. Crankshaft should not be turned during measuring operation.
3. Points of measurement should be close to top dead centre position.
4. Bearing caps should not be seated with hammer blows.

Place length of Plastigage across width of bearing on crankshaft or big end journal. Fit main or big end bearing cap together with bearing shells and torque as specified. The plastic filament will be compressed more or less depending on bearing clearance. Remove bearing cap.

Each main bearing should be measured separately without other bearing caps being fitted.

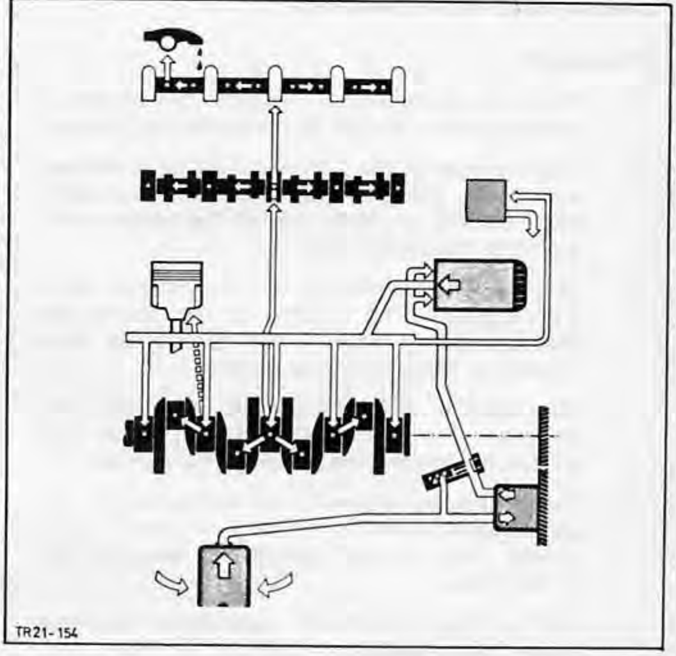


Fig. 62. Oil circuit

Width of compressed plastic filament can be measured by means of scale printed on PLASTIGAGE pack, Fig. 63; reading shows bearing clearance.

Only bolts in good condition should be used for securing bearing caps on crankshaft and they should not be tightened in excess of specified torque.

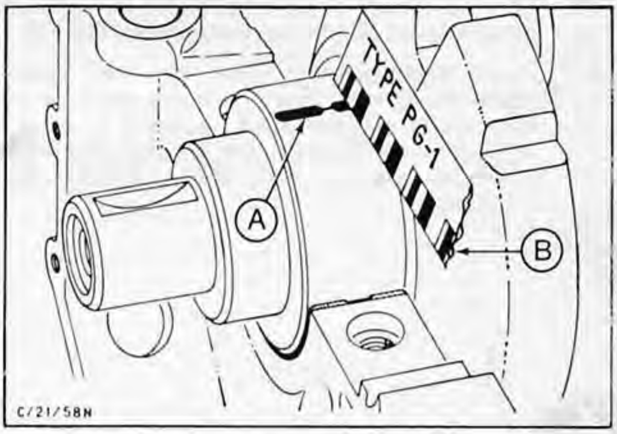


Fig. 63. Measuring bearing play
A – Compressed plastic thread
B – Measurement scale

23 134 8 (cont'd)

Measuring Piston Clearance

Procedure

(a) When re-assembling an engine, the piston to bore clearance should be measured as follows.

(b) The diameter of the piston should be measured when cold, using a micrometer. The measurement should be made across the piston skirt, at 90° to the piston axis.

(c) This micrometer reading is then used to 'zero' a bore gauge. The reading on the dial of the bore gauge in situ is the piston to bore clearance. (See Technical Data.)

Alternatively, the bore can be measured with an internal micrometer, and the piston size subtracted to give the piston to bore clearance.

(d) The measurement must be taken below any visible wear marks in the bore. To detect bore ovality, two readings should be taken at 90° to each other.

NOTE: The maximum difference between these two readings should not be more than 0,025 mm (0,001 in).

(e) Inspect the bores for visible wear, damaged lips, etc.

(f) If the clearance in sub-section (c) above is excessive, or if ovality, or any of the faults in sub-section (e) above is detected, the block should be rebored to suit oversize pistons.

(g) Before installing pistons, check piston ring gaps. (Fig. 64).

Fig. 64. Check piston ring gap

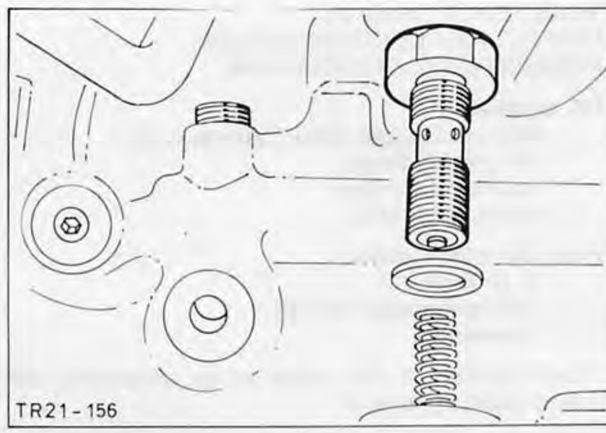


Fig. 65. Fit oil pressure switch

39. Fit oil pressure switch. Lubricate oil pressure valve tappets and fit valve assembly, Fig. 65.

40. Insert main bearing shells dry into engine block, on centre bearing locate both thrust washers in cylinder block recesses in such a manner that oilways are visible (Fig. 66). Lubricate bearing shells and carefully insert crankshaft.

Fig. 66. Fit thrust washers

41 (a) Refit main bearing cap complete with lubricated bearing shells, again paying attention to correct location of thrust half washers on centre main bearing cap, Fig. 67. Tighten bearing cap bolts as specified in Technical Data.

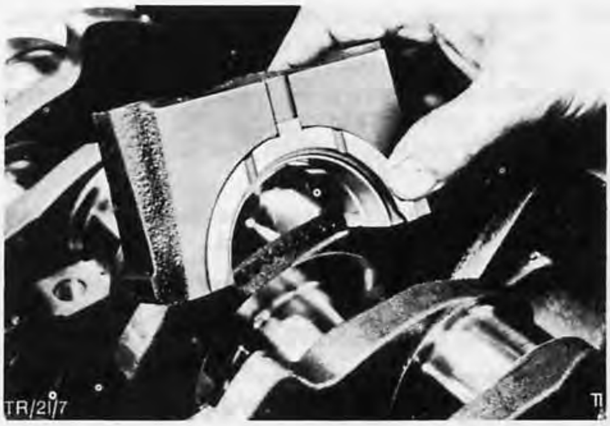


Fig. 67. Fit centre bearing with thrust washers

(b) Fit centre main bearing cap bolts finger-tight only. Press crankshaft first to rear against stop, then slowly and firmly against front stop and hold in position and torque bolts, Fig. 68. (This operation is necessary to ensure uniform seating of thrust washers.)

Main bearing caps should be fitted with arrow pointed forward.

Fig. 68. Align thrust washers

42. Check crankshaft end float using standard dial indicator, Fig. 69. Use oversize thrust washers, if necessary.

Fig. 69. Check crankshaft end float

21 134 8 (cont'd)

43. Apply engine oil to pistons and cylinder bores. Stagger piston rings with maximum spacing. Compress piston rings with standard ring compressor and press pistons into cylinders using hammer handle, Fig. 70, guiding connecting rods with oiled bearing shells on to big end journals by hand.

    Front marking on pistons and connecting rods should point forward.

44. Fit big end bearing caps complete with oiled bearing shells and torque new self-locking bolts as specified in Technical Data.

    Marks on connecting rods and bearing caps should be on one side.

Fig. 70. Fit piston using standard ring compressor

45. Oil valve tappets and fit into same bores as on removal. Oil and carefully insert camshaft, paying attention to correct location of camshaft oil gallery sealing balls. Fit cover plate and thrust plate.

Fig. 71. Press in crankshaft rear oil seal using Special Tool 21-011-A

46. Replace crankshaft rear oil seal:
    Drive oil seal from oil seal carrier using hammer and mandrel, slightly oil sealing lip of new oil seal and carefully drive into oil seal carrier, using Special Tool 21–011–A, Fig. 71. Then fit oil seal carrier and new oil seal, centralise with same Special Tool and secure, Fig. 72.

    Check correct location of oil seal carrier on sump sealing surface.

Fig. 72. Centralise rear oil seal carrier using Special Tool 21-011-A

47. Fit oil pump suction pipe with new gasket.

48. Fit crankshaft needle bearing using Special Tool 21–045, Fig. 73.

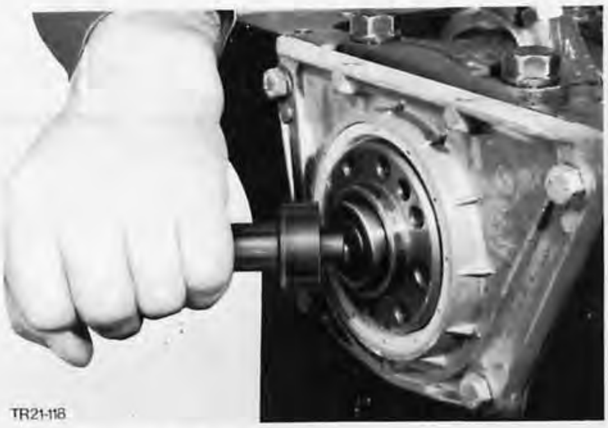


Fig. 73. Fit crankshaft needle bearing using Special Tool 21–045

49. Fit crankshaft gear.

Fig. 74. Fit camshaft oil seal in intermediate plate using Special Tool 21–017

50. Replace camshaft oil seal:
Drive oil seal from intermediate plate using hammer and mandrel, slightly oil sealing lip of new oil seal and carefully draw into intermediate plate using Special Tool 21–017 with bolt and washer, Fig. 74. Then fit intermediate plate with new gasket complete with injection pump (also with new O-rings), centralise with same Special Tool, fit bolts in correct sequence as specified in Technical Data, Fig. 75.

Check correct location of intermediate plate on oil sump sealing face.

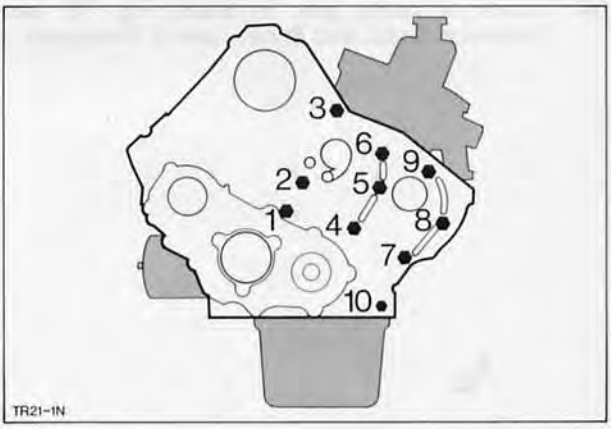


Fig. 75. Intermediate plate bolt tightening sequence

21 134 8 (cont'd)

51. Fit injection pump bracket to engine block.

52. Fit vacuum pump with bracket to intermediate plate.

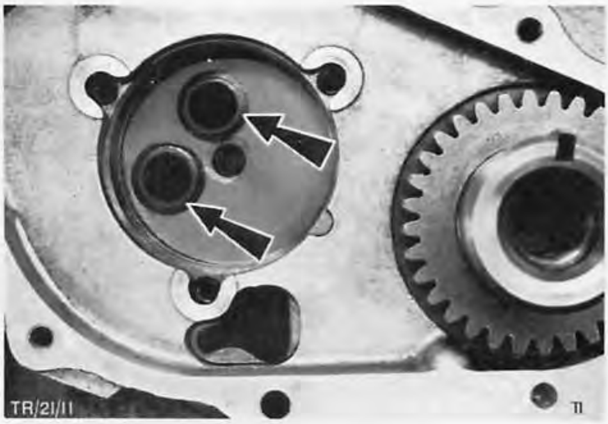


Fig. 76. Fit oil pump O-rings

53. Fit oil pump with new O-rings, Fig. 76 and secure, Fig. 77.

Before installing oil pump rotate by hand and fill with engine oil.

Oil pump bores are offset and pump can therefore be installed in one position only.

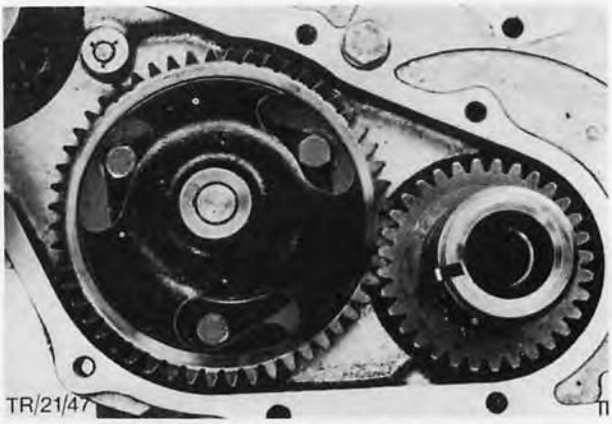


Fig. 77. Fit oil pump

54. Check oil pump gear backlash, Fig. 78, (see Technical Data) and fit new gears, if required.

Fig. 78. Check oil pump gear backlash

55. Replace crankshaft front oil seal:
Drive oil seal out of timing cover using hammer and mandrel. Slightly oil sealing lip of new oil seal, carefully drive into timing cover, using Special Tool 21–025, Fig. 79, then fit timing cover and new gasket to intermediate plate. Centralise with same Special Tool, Fig. 80 and secure, fitting bolts coated with sealing compound.

Fig. 79. Fit crankshaft front oil seal to timing cover, using Special Tool 21–025

56. Fit vacuum pump pulley and hub.

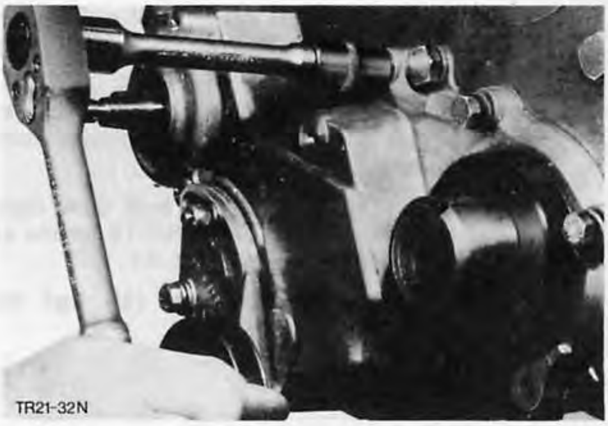


Fig. 80. Centralise timing cover using Special Tool 21–025

57. Fit water pump with new gasket to intermediate plate, Fig. 81.

Fig. 81. Fit water pump

21 134 8 (cont'd)

58. Apply oil to camshaft spacer mating surface, slide on to camshaft and coat front face with sealing compound.

59. Lock camshaft gear using Special Tool 21–016 and torque as specified in Technical Data, Fig. 82.

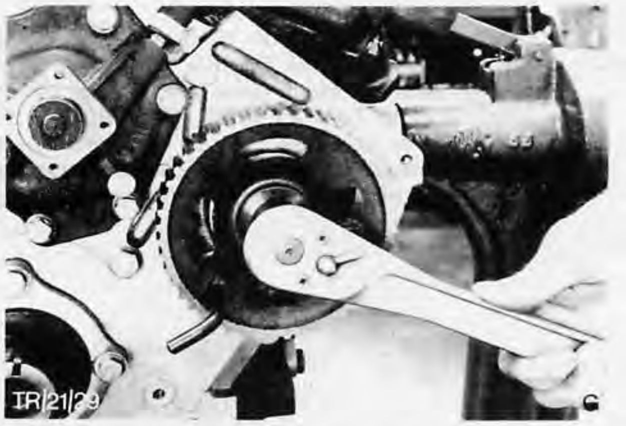


Fig. 82. Lock camshaft gear using Special Tool 21–016 and secure

60. Apply oil to crankshaft spacer mating surface, slide on to crankshaft and coat front face with sealing compound.

61. Fit toothed belt thrust washer and fit crankshaft journal, coating inside of bolt with sealing compound.

62. Fit crankshaft journal centre bolt hand-tight and using Special Tool 21–018/019 torque as specified in Technical Data, Fig. 83.

10 spindle turns = 150 Nm (15 kgf m) (108 lbf ft).

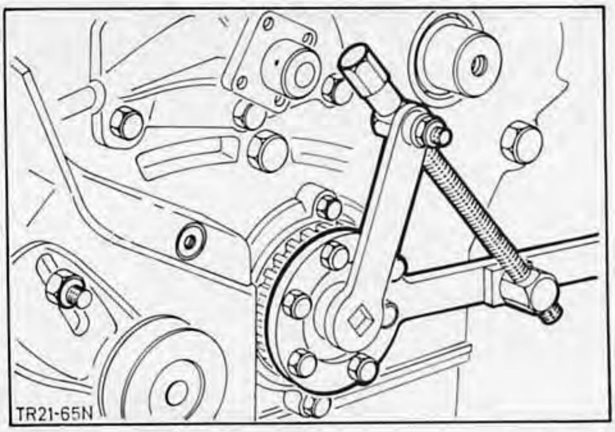


Fig. 83. Secure crankshaft journal bolt using Special Tool 21–018/019

63. Pre-load toothed belt tensioner and fit hand-tight. Align gears on marks, rotating crankshaft until crankshaft gear hub groove is aligned on timing cover mark. Check adjusting peg 21–016 is still correctly located in camshaft gear. Set injector adjuster to zero position. Rotate injection pump gear until setting specified in Technical Data is obtained. Then tighten injection pump gear nuts.

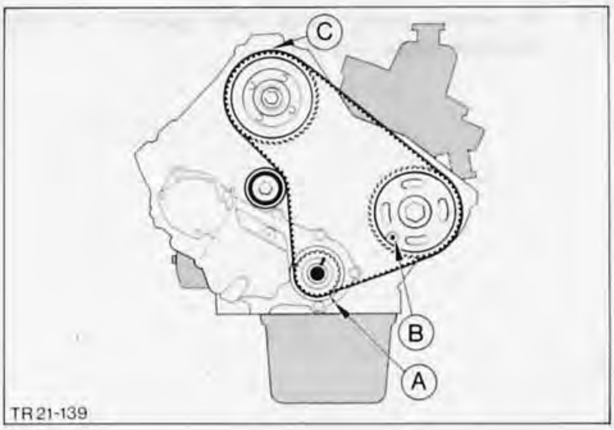


Fig. 84. Fuel injection pump marking

64. Position toothed belt, withdraw adjusting peg 21–016 from camshaft gear, rotate crankshaft through 2 revolutions, recheck markings, press toothed belt tensioner against belt and tighten, Fig. 85.

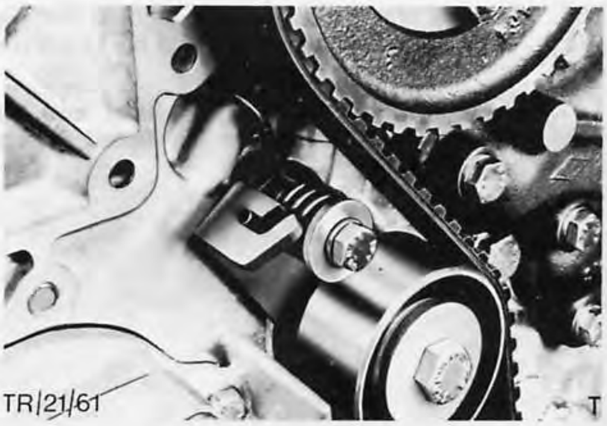


Fig. 85. Tighten belt tensioner

65. Position sump gasket, applying sealer to joints and gasket around joints, Fig. 86. Locate oil sump and torque bolts as specified in Technical Data.

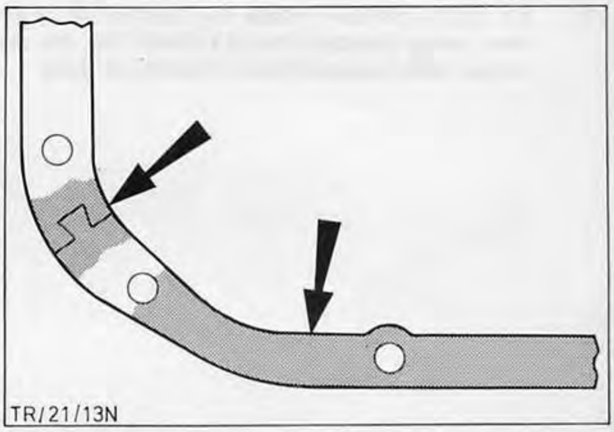


Fig. 86. Apply sealing compound to sump gasket

Fit two Allen screws each, front and rear, and secure, Fig. 87.

Fig. 87. Tighten front and rear sump bolts

21 134 8 (cont'd)

66. Fit back plate and flywheel, tighten bolts as specified in Technical Data and check for run-out, Fig. 88.

Flywheel bolt holes are offset and the flywheel can therefore be fitted in one position only.

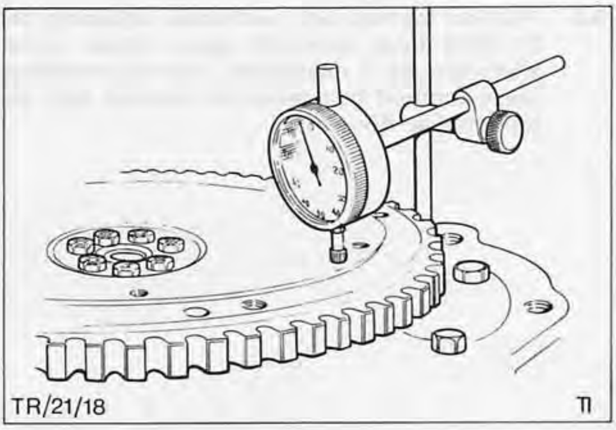


Fig. 88. Check flywheel run-out

67. Fit clutch pressure plate and centralise clutch disc, using Special Tool 21–044, Fig. 89 and torque bolts as specified in Technical Data.

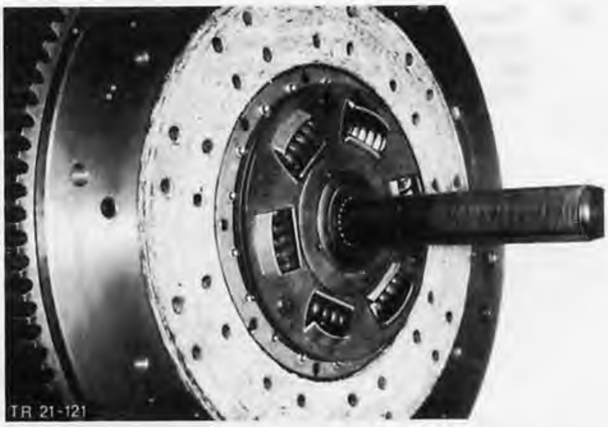


Fig. 89. Centralise clutch disc using Special Tool 21–044

68. Position cylinder head gasket with Part No. facing upwards and carefully locate cylinder head on guide sleeves, taking care to ensure correct assembly of by-pass hose. Fit cylinder head bolts in sequence shown in Fig. 90 and torque as specified in Technical Data.

Before replacing cylinder head check correct location of combustion chamber inserts.

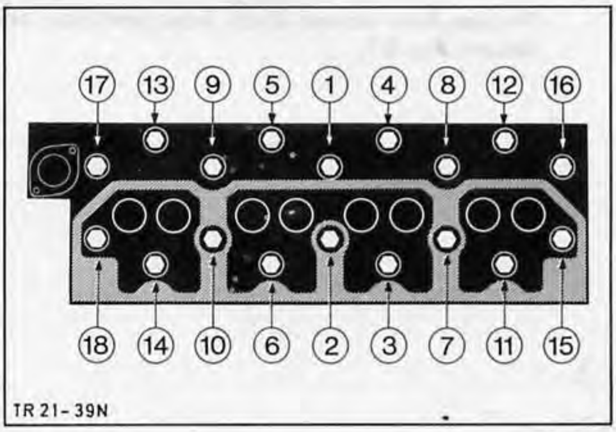


Fig. 90. Cylinder head bolt tightening sequence

69. Fit thermostat, Fig. 91, and install water neck with new gasket.

Fig. 91. Fit thermostat

70. Insert heat shields with new gaskets. Position new heat balancing plates, with convex side upwards, and new nozzle holder sealing rings, Fig. 92, and uniformly torque injector nozzles as specified in Technical Data.

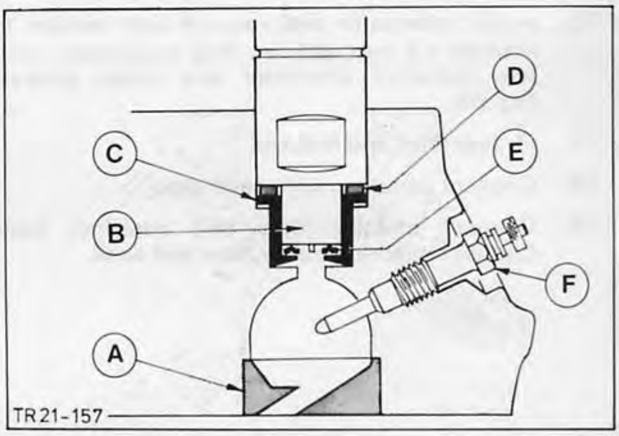


Fig. 92. Combustion chamber – cut-away view
A – Combustion chamber insert
B – Heat shield
C – Heat shield gasket
D – Nozzle holder gasket
E – Heat balancing plate

71. Lubricate push rods and guide them into the same sockets from which they were removed. Fit rocker shaft, inserting push rods into rocker arm sockets, Fig. 93. Tighten upper five rocker shaft bolts, followed by three lower bolts.

Fig. 93. Fit push rods in rocker arm sockets

21 134 8 (cont'd)

72. Adjust valve clearance Fig. 94 (see Operation 21–213), cranking engine **only** in direction of rotation.

73. Evenly tighten rocker cover bolts with new gasket. Fit oil filler cap and breather tube.

74. Fit upper and lower toothed belt cover.

75. Fit crankshaft pulley and fan with spacer. Install alternator complete with bracket.

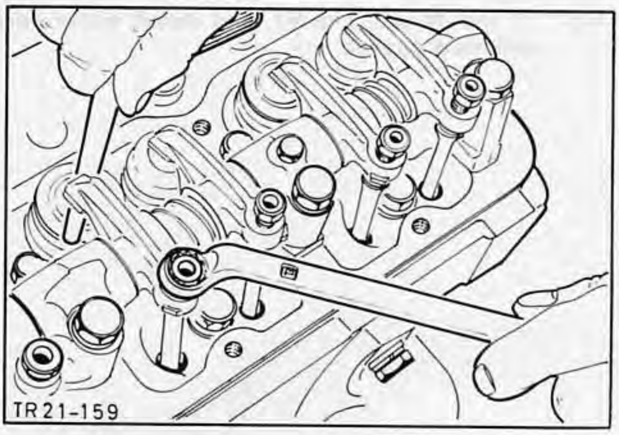


Fig. 94. Adjust valve clearance

76. Adjust alternator and vacuum belt tension to achieve 13 mm (0,5 in) free movement midway between alternator and pump pulleys, Fig. 95.

77. Fit fuel filter and bracket.

78. Connect vacuum pump feed pipe.

79. Connect injector lines and overflow pipe. Connect injection pump filter fuel lines.

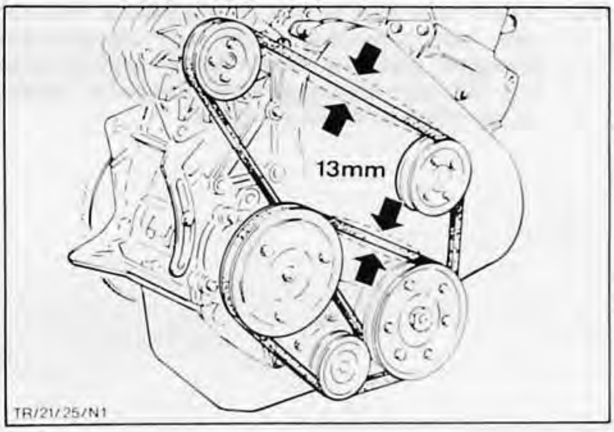


Fig. 95. Adjust alternator and vacuum pump V-belt tension

80. Using suitable hand syringe, fill not less than 1 litre (1,75 pints) engine oil through full-flow oil filter drilling into main oil gallery, then secure full-flow oil filter complete with new cartridge and gasket as specified in Technical Data, Fig. 96. Insert oil dipstick.

81. Remove engine from engine assembly stand and refit front left-hand engine mounting rubber insulator.

Fig. 96. Fit full-flow oil filter

21 154 SUMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Jack up vehicle or drive over pit.
2. Drain engine oil.
3. Remove sump (24 bolts), removing rear Allen screws using standard tool, Fig. 97.

Fig. 97. Remove Allen screws

To Install

4. Clean engine block to sump sealing faces. Stick gasket to block using grease, applying sealer to joints and gasket in vicinity of joints, Fig. 98.

5. Carefully locate sump, fit screws (front and rear 2 Allen screws each) and evenly torque as specified in Technical Data.
6. Top up engine oil, start engine and check for leaks.
7. Lower vehicle or remove from pit, as applicable.

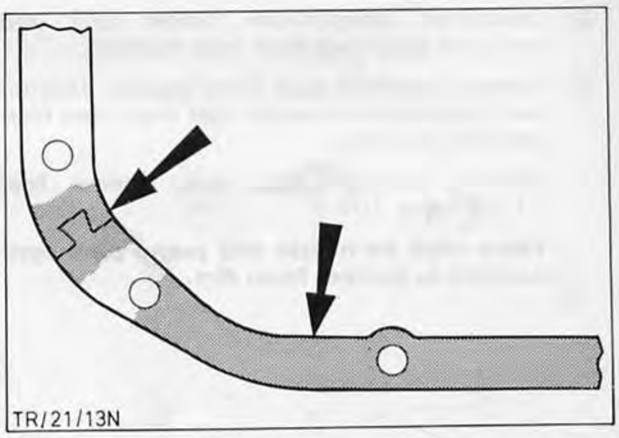


Fig. 98. Apply sealer to sump gasket

21 163 CYLINDER HEAD – REMOVE AND INSTALL

Special Service Tool Required:

Injector pipe nut wrench 21–041

To Remove

1. Remove earth strap from both batteries.
2. Drain coolant into tray, disconnecting lower radiator hose from water neck, Fig. 99 and top hose from thermostat water neck. Remove thermostat.

Fig. 99. Drain coolant

3. Remove air cleaner complete with bracket (2 bolts). Remove oil filler cap with breather hose.
4. Remove coolant expansion tank complete with bracket from cylinder head (3 bolts), Fig. 100.

Fig. 100. Remove coolant expansion tank

5. Disconnect temperature sender unit and two glow plug leads from inlet manifold.
6. Remove overflow pipe from nozzles. Disconnect thermostart reservoir fuel lines from filter and inlet manifold.
7. Remove injector pipes, using Special Tool 21–041, Fig. 101.

   Place caps on nozzle and pump pipe connectors to protect from dirt.

Fig. 101. Remove injector pipes using Special Tool 21–041

8. Remove fuel filter bracket from inlet manifold (1 bolt).
9. Disconnect water outlet connector (Fig. 102).
10. Disconnect heater hose at cylinder head front.
11. Remove exhaust pipe from manifold (2 nuts).
12. Remove rocker cover (6 bolts). Remove three lower then five upper rocker support bracket bolts. Remove rocker shaft and push rods.

    Do not interchange push rods when removing and installing.
13. Remove injector nozzles (2 bolts each).

Fig. 102. Remove water outlet connector

14. Remove engine mounting rubber insulators front right and left-hand side (2 nuts) and carefully raise engine from underneath sump to gain access for removal of toothed belt cover to cylinder head bolt and of water pump to cylinder head by-pass hose, Fig. 103.

Fig. 103. Remove by-pass hose

15. Remove cylinder head bolts (18), reversing tightening sequence (for tightening sequence see Fig. 104). Lift out cylinder head complete with inlet and exhaust manifolds.

To Install

16. Clean cylinder head and engine block joint faces. Position new cylinder head gasket with part number facing upwards and carefully place cylinder head on locating bushes, ensuring correct assembly of by-pass hose. Tighten cylinder head bolts in sequence shown in Fig. 104 and torque as specified in Technical Data. Secure by-pass hose.

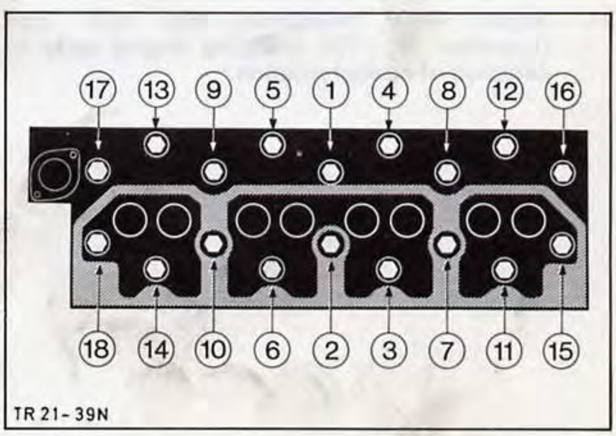


Fig. 104. Cylinder head bolt tightening sequence

21 163 (cont'd)

17. Insert toothed belt cover bolt in cylinder head.
18. Lower engine and fit right-hand and left-hand engine mounting rubber insulators, Fig. 105.

Fig. 105. Fit engine mounting rubber insulators

19. Carefully replace injector nozzles and tighten evenly.
20. Lubricate push rods and insert in same sequence as on removal. Fit rocker shaft, locating push rods in rocker arm sockets, Fig. 106. Tighten five upper, then three lower bracket bolts.

Fig. 106. Insert push rods in rocker arm sockets

21. Adjust valve clearances, Fig. 107, (see Operation 21 213), cranking engine **only** in direction of normal rotation.

Fig. 107. Adjust valve clearances

22. Uniformly tighten rocker cover with new gasket.
23. Fit exhaust pipe to manifold.
24. Assemble heater hose to cylinder head, Fig. 108.

Fig. 108. Fit heater hose

25. Fit water outlet connector, Fig. 109.
26. Fit fuel filter bracket to inlet manifold.
27. Connect injector pipes and tighten as specified in Technical Data, using Special Tool 21–041.
28. Reconnect thermostart reservoir fuel lines to filter and inlet manifold and overflow oil line to nozzles.
29. Connect temperature sender unit and glow plug leads (2).
30. Fit coolant expansion tank with bracket to cylinder head.

Fig. 109. Fit water outlet connector

31. Refit oil filler cap and breather hose. Fit air cleaner complete with bracket, Fig. 110.
32. Slide lower and upper radiator hoses into position, tighten and top up coolant.
33. Reconnect both batteries.
34. Start engine and check for leaks.

Fig. 110. Fit air cleaner

21 213 VALVE CLEARANCE – ADJUST

Special Service Tools Required: None

1. Remove water outlet connector, Fig. 111 and remove rocker cover (6 bolts).

Fig. 111. Remove water outlet connector

2. Adjust valve clearances as follows:

   Rotate crankshaft pulley clockwise until valve No. 1 cylinder is fully open, then adjust valve No. 4 (inlet) and No. 7 (exhaust). Continue rotating crankshaft pulley and adjust all valve clearances as set out below, Fig. 112.

Valve open	Adjust valve
No. 1	No. 4 (inlet) and 7 (exhaust)
No. 2	No. 5 (exhaust) and 8 (inlet)
No. 4	No. 1 (exhaust) and 6 (inlet)
No. 5	No. 2 (inlet) and 3 (exhaust)

3. Fit rocker cover with new gasket and tighten. Fit water outlet connector.

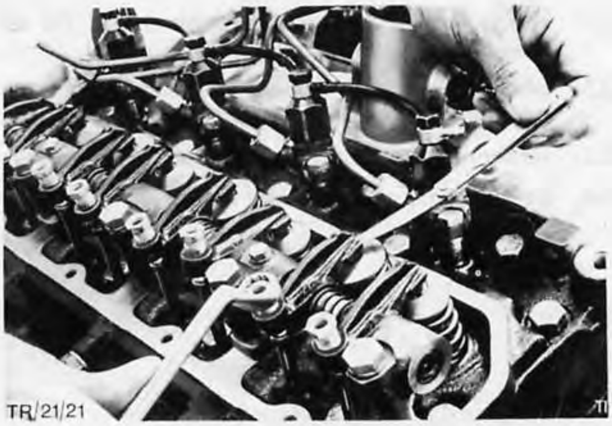


Fig. 112. Adjust valve clearances

21 217 4 VALVES – REMOVE AND INSTALL (cylinder head removed)

Special Service Tools Required: None

To Remove

1. Remove inlet and exhaust manifolds from cylinder head (8 bolts each) Fig. 113.
2. Remove caps from valve retainers and valve stems by tapping with plastic mallet.

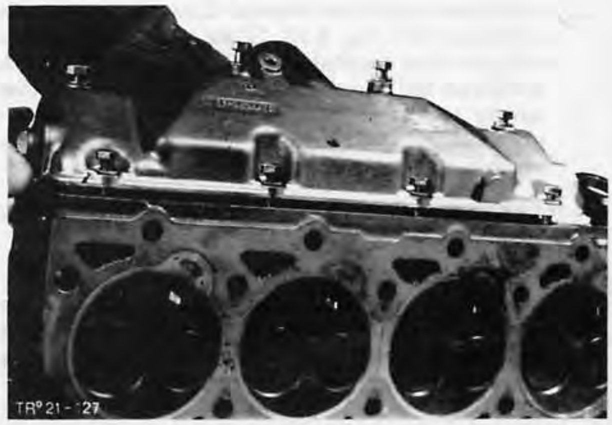


Fig. 113. Remove inlet manifold

3. Compress valve spring(s) using standard valve spring compressor, Fig. 114. Remove collets, release pressure on spring(s) and remove spring(s) and spring retainer. Withdraw valve stem seal and remove valve. Fit valve spring compressor to next valve and similarly remove remaining valves.

   When removing and refitting valve springs it is essential to ensure that valve stem is not damaged by valve spring when it is pressed down to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result would be excessive oil consumption and valve guide wear.

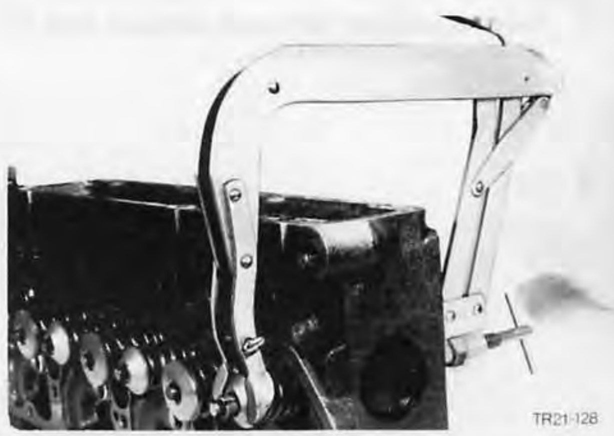


Fig. 114. Compress valve spring using standard compressor

To Install

4. Remove carbon and other deposits from valves and cylinder head galleries, then grind in valves, Fig. 115 and remove all traces of grinding paste from cylinder head.

Fig. 115. Grind in valve

5. Lubricate and insert valves. Cover splines with adhesive foil, Fig. 116. Slide valve stem seals into position against stop, Fig. 117 and remove adhesive foil. Replace valve springs and valve spring retainers, compress with spring compressor and refit collets, paying attention to correct collet seating.

   Exhaust valves have 2 valve springs, Fig. 118.

   Every time valves are removed and installed new valve stem seals should be used. Cover valve splines with adhesive foil to prevent damage to valve stem seals.

Fig. 116. Cover valve splines with adhesive foil

6. Release pressure on valve spring(s) and remove spring compressor.

Fig. 117. Fit valve stem seals

7. Fit inlet and exhaust manifold and tighten bolts as specified in Technical Data.

Fig. 118. Exhaust valve – exploded view

21 231 9 VALVE SEAT – RECUT

Special Service Tools Required: None

Valve seat cutting will serve a useful purpose only if valve guide bores are not damaged. Prior to cutting therefore check valve stem clearance in guide and if necessary replace valve guide.

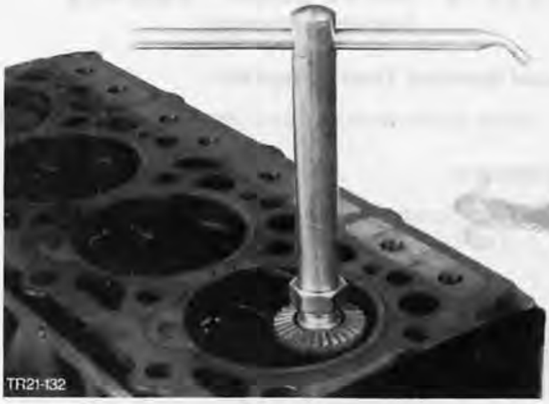


Fig. 119. Cut valve seat

1. Machine valve seat using standard valve seat milling cutters, Fig. 119, then re-machine valve seat width using correcting cutter and measure valve head depth in cylinder head, Fig. 120.

   When machining valve seat pay attention to differing valve seat angles in cylinder head, Fig. 121 (see Technical Data).

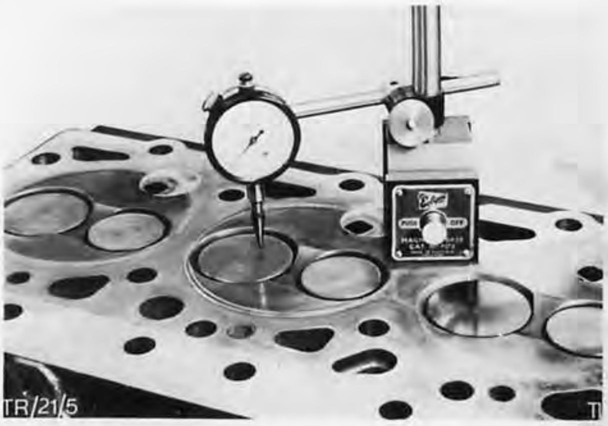


Fig. 120. Valve head depth in cylinder head

2. Remove swarf from cylinder head and valves.

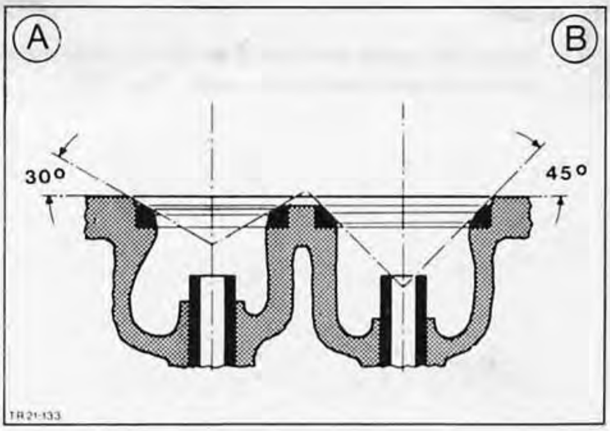


Fig. 121. Valve seat angle
A – Exhaust valve
B – Inlet valve

21 235 4 VALVE GUIDE – REPLACE (valves removed)

Special Service Tool Required:

Valve guide remover and installer . . 21–021

To Remove

1. Using Special Tool 21–021 press valve guide out of cylinder head from below, Fig. 122.

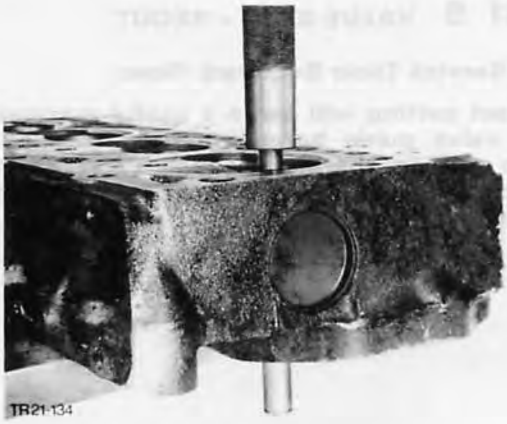


Fig. 122. Remove valve guide

To Install

2. Using the same tool press in valve guide from top in cylinder head up to mark, Fig. 123.

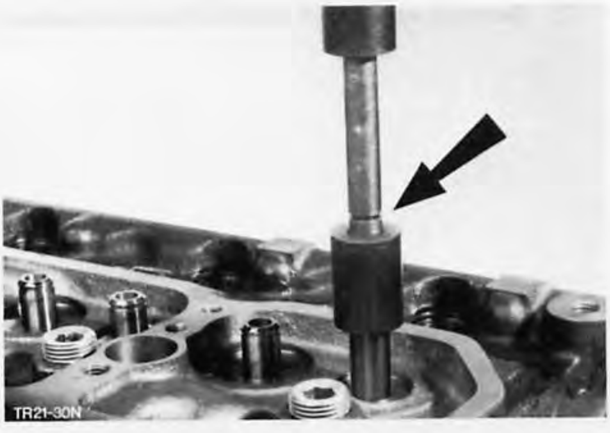


Fig. 123. Fit valve guide

21 255 9 ROCKER SHAFT ASSEMBLY – OVERHAUL (rocker shaft removed)

Special Service Tools Required: None

To Dismantle

1. Remove outer rocker supports (2) and outer rocker arms (4) with springs (2) from rocker shaft.
2. Remove inner rocker supports (2) from shaft (2 bolts), then remove inner rocker arms (4) with springs (2), and centre support.

To Reassemble

3. Assemble rocker shaft as shown in Fig. 124, having previously lubricated rocker shaft and rocker arm sliding faces.

   With rocker shaft fitted oil bores for rocker shaft lubrication must point upwards.

   On new rocker shafts check plugs in both shaft ends.

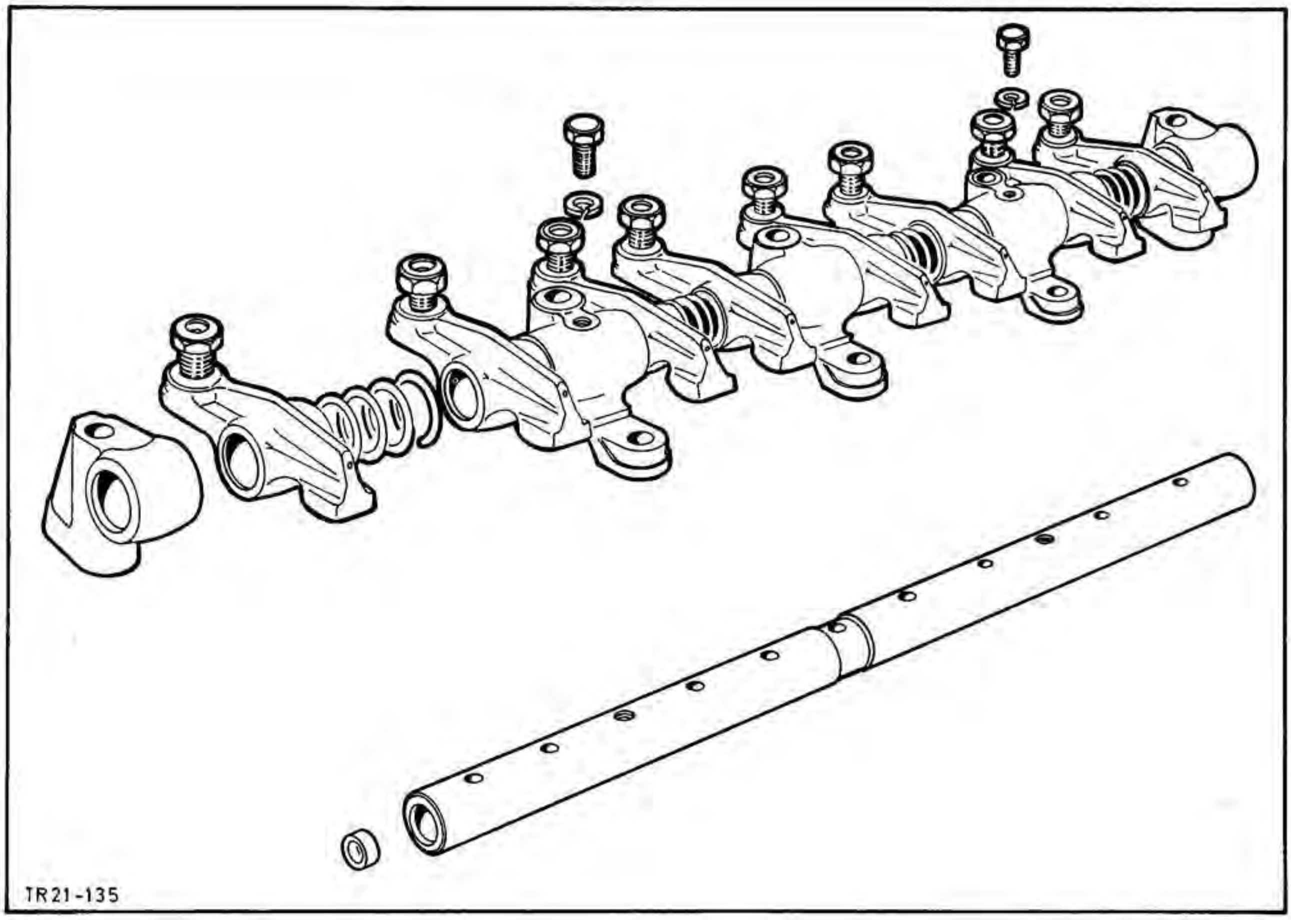


Fig. 124. Rocker shaft assembly dismantled

21 286 6 CAMSHAFT BEARINGS – REPLACE (engine dismantled)

Special Service Tools Required:

Camshaft bearing remover/replacer .. 21–022
Adaptors .. 21–022–01 and 21–022–02

1. From front of engine remove bushes Nos. 5, 4, 3 and 2 using Special Tool 21–022 and associated adaptors 21–022–01 and 21–022–02, Fig. 125.

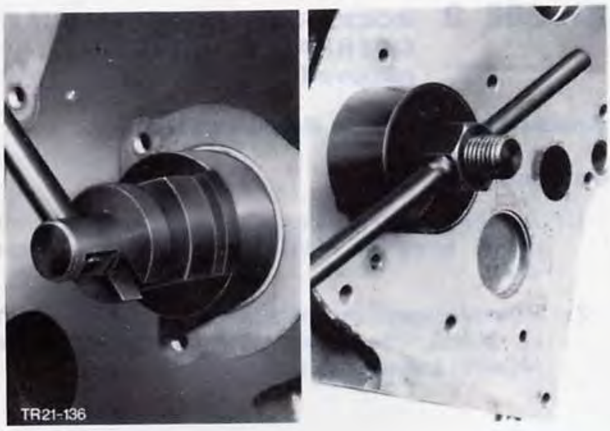


Fig. 125. Withdraw bearing bush No. 5 from front using Special Tool 21–022–01/02

2. Back off main tool spindle and fit new bearing bushes Nos. 5, 4, 3 and 2, using same Special Tool, Fig. 126.

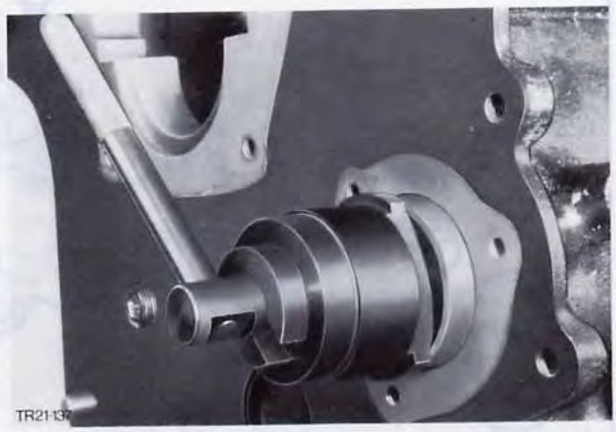


Fig. 126. Back off spindle and fit new bearing bush No. 5

3. Replace bearing bush No. 1, paying attention to lug being aligned on bush bore, then secure bush, Fig. 127.

Fig. 127. Replace bearing bush No. 1

21 288 CAMSHAFT OIL SEAL – REPLACE

Special Service Tools Required:

Camshaft oil seal remover ..	.. 15–048
Remover adaptor	15–048–01
Camshaft gear timing peg ..	.. 21–016
Camshaft oil seal replacer ..	.. 21–017

To Remove

1. Remove earth strap from both batteries.
2. Drain coolant into trays, removing lower radiator hose from water pipe, Fig. 128 and upper hose from thermostat water neck.

Fig. 128. Drain coolant

3. Remove radiator hose and expansion tank by-pass hose from radiator.
4. Remove radiator (4 bolts) and lift out.
5. Slacken vacuum pump V-belt tensioner (1 bolt and 1 nut), Fig. 129 and alternator bracket (4 bolts) and remove both V-belts.

Fig. 129. Slacken vacuum pump V-belt tensioner

6. Remove fan with pulley (4 bolts).
7. Remove toothed belt cover (5 bolts).
8. Rotate engine until crankshaft, camshaft and injection pump gear markings are aligned on timing cover mark, Fig. 130.

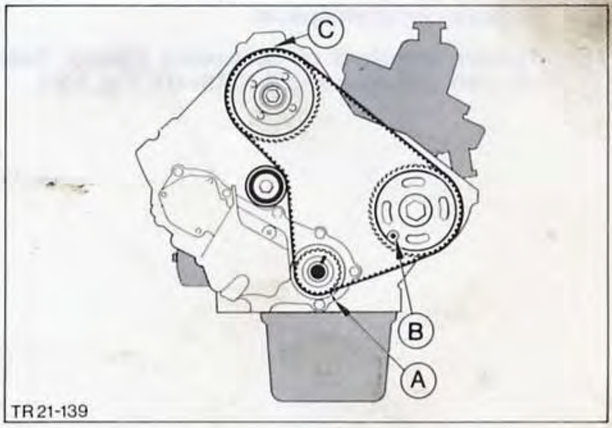


Fig. 130. Toothed belt pulley markings
A – Crankshaft
B – Camshaft
C – Fuel injection pump

21 288 (cont'd)

9. Slacken toothed belt tensioner, Fig. 131, reduce tension using screwdriver and remove toothed belt.

Do not crank engine after toothed belt removal as this would cause damage to pistons and valves.

Fig. 131. Slacken toothed belt tensioner

10. Lock camshaft gear using Special Tool 21–016, Fig. 132, remove bolt and press off gear by means of two levers.

Fig. 132. Lock camshaft gear using Special Tool 21–016

11. Remove camshaft spacer.
12. Remove camshaft oil seal using Special Tool 15–048 and adaptor 15–048–01, Fig. 133.

Fig. 133. Remove camshaft oil seal using Special Tool 15–048/048–01

To Install

13. Lubricate camshaft oil seal lip and using Special Tool 21–017 with bolt carefully press fully home, Fig. 134 ensuring camshaft alignment is not disturbed. Then again remove bolt.
14. Lubricate spacer rear surface, slide spacer on to camshaft and apply sealer to front.
15. Fit camshaft gear, lock with Special Tool 21–016 and torque as specified in Technical Data, applying sealer to bolt head inside. Remove timing peg.

Fig. 134. Fit camshaft oil seal using Special Tool 21–017

16. Check crankshaft, camshaft and injection pump markings. Slacken toothed belt tensioner and position toothed belt, Fig. 135.
17. Press tensioner against toothed belt, crank engine twice in direction of rotation and secure tensioner.
18. Fit toothed belt cover.
19. Fit fan and pulley.

Fig. 135. Position toothed belt

20. Position alternator and vacuum pump V-belts and adjust tension in such a manner that free play at a point midway between pulleys is 13 mm (0,5 in), Fig. 136.
21. Insert and secure radiator. Fit and tighten expansion tank radiator hoses as well as upper and lower radiator hoses.
22. Top up coolant and check engine oil level.
23. Connect earth strap on both batteries, start engine and check for leaks.

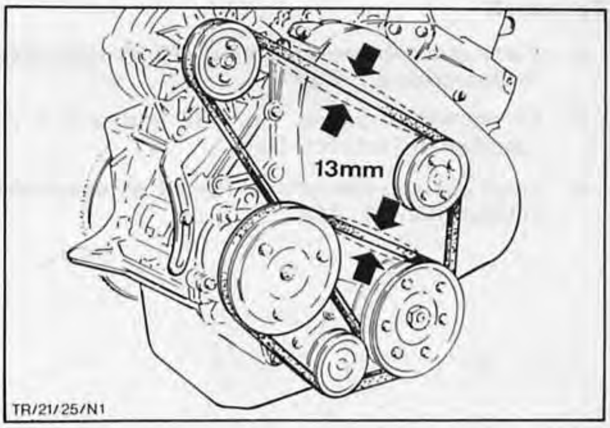


Fig. 136. Adjust alternator and vacuum V-belt tension

21 304 TIMING BELT – REPLACE

Special Service Tools Required: None

With the exception of crankshaft pulley removal this operation is contained in **Operation 21 288 – Camshaft oil seal – replace** and should be carried out as follows:

Fig. 137. Remove crankshaft pulley

To Remove

1. Carry out sub-operations 1–6 as described in Operation 21 288.
2. Remove crankshaft pulley (6 bolts) Fig. 137.
3. Carry out sub-operations 7–9 as described in Operation 21 288.

To Install

4. Carry out sub-operations 16–18 as described in Operation 21 288.
5. Fit crankshaft pulley, Fig. 138 and secure as specified in Technical Data.
6. Carry out sub-operations 19–23 as described in Operation 21 288.

Fig. 138. Fit crankshaft pulley

21 467 SEAL – CRANKSHAFT FRONT – REPLACE

Special Service Tools Required:

Camshaft gear timing peg	21–016
Crankshaft flange holding wrench ..	21–018
Crankshaft flange bolt remover/replacer	21–019
Crankshaft front oil seal aligner	21–025

To Remove

1. Remove earth strap from both batteries.
2. Drain coolant into tray, slackening and removing lower radiator hose from water pipe, Fig. 139 and upper hose from thermostat water neck.

Fig. 139. Drain coolant

3. Remove radiator hose and expansion tank bypass hose from radiator.
4. Remove radiator at bottom location (2 bolts) from crossmember mountings, Fig. 140.

Fig. 140. Unscrew radiator at bottom location

5. Unhook hood cable at catch, Fig. 141 and unscrew from radiator grille panel.

Fig. 141. Unhook hood cable

21 467 (cont'd)

6. Remove right-hand and left-hand headlamp surround (1 bolt each).
7. Remove radiator grille panel complete with radiator (11 bolts).
8. Slacken vacuum pump (1 bolt, 1 nut) and alternator bracket tensioner (4 bolts) and remove both V-belts, Fig. 142.

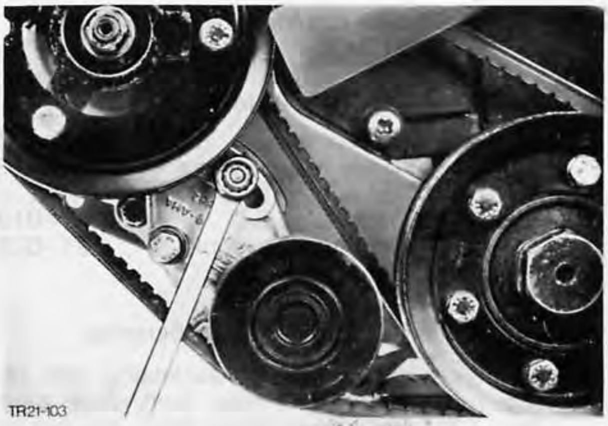


Fig. 142. Slacken vacuum pump V-belt tensioner

9. Remove fan and pulley (4 bolts).
10. Remove crankshaft pulley (6 bolts), Fig. 143.
11. Remove upper (5) and lower (2) toothed belt cover bolts and remove covers.

Fig. 143. Remove crankshaft pulley

12. Crank engine until crankshaft gear mark is aligned on timing cover mark, Fig. 144.

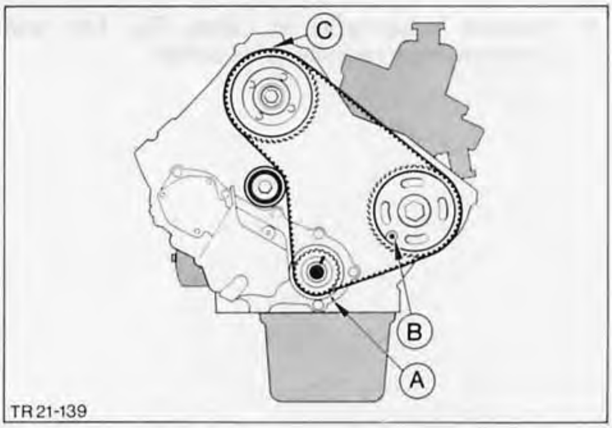


Fig. 144. Toothed belt pulley markings
A – Crankshaft
B – Camshaft
C – Fuel injection pump

13. Slacken toothed belt tensioner, Fig. 145 using screwdriver and remove toothed belt.

    Do not crank engine after toothed belt removal as this will cause damage to pistons and valves.

Fig. 145. Slacken toothed belt tensioner

14. Slacken crankshaft hub centre bolt using Special Tool 21–018/19, Fig. 146 and remove bolt.
15. Remove crankshaft hub using standard remover and remove toothed belt thrust washer.
16. Remove vacuum pump pulley (3 bolts).

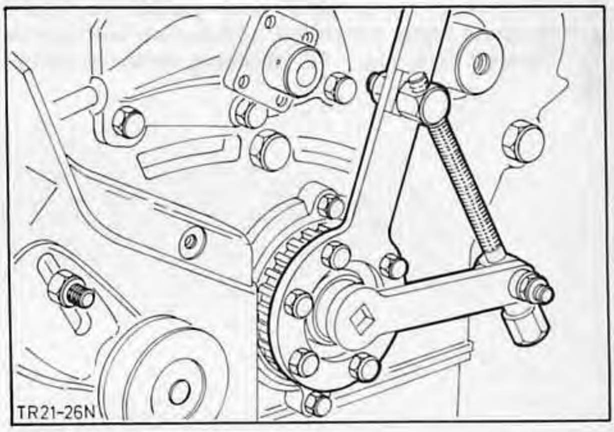


Fig. 146. Slacken crankshaft hub centre bolt using Special Tool 21–018/019

17. Remove vacuum pump hub (1 nut) using standard remover, Fig. 147.
18. Remove timing cover from intermediate plate (10 bolts).
19. Press off crankshaft spacer and remove.
20. Using hammer and mandrel, drive crankshaft oil seal to rear out of timing cover.

Fig. 147. Remove vacuum pump hub

21 467 (cont'd)

To Install

21. Lubricate crankshaft oil seal lip and insert oil seal into timing cover from rear up to stop, using Special Tool 21–025, Fig. 148.

Fig. 148. Fit crankshaft oil seal using Special Tool 21–025

22. Fit timing cover with new gasket to intermediate plate, centralise and secure with same Special Tool, Fig. 149, applying sealer to bolts.

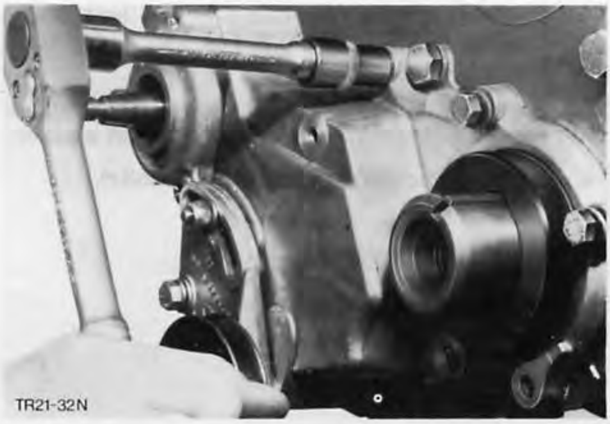


Fig. 149. Centralise timing cover using Special Tool 21–025

23. Fit vacuum pump hub and secure pulley.
24. Lubricate crankshaft spacer rear face, slide on to crankshaft and coat front with sealer.
25. Slide toothed belt thrust washer into position and fit crankshaft hub, Fig. 150, applying sealer to bolt head inside.

Fig. 150. Fit crankshaft hub

26. Fit crankshaft hub centre bolt hand-tight and torque as specified in Technical Data using Special Tool 21–018/019, Fig. 151.

    10 spindle turns = 150 Nm (15 kgf m) (108 lbf ft).

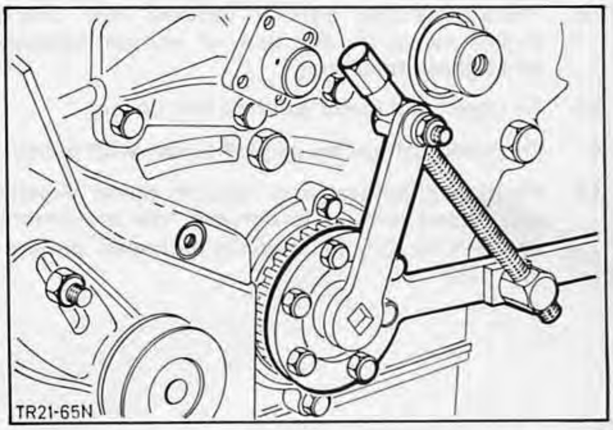


Fig. 151. Fit crankshaft hub centre bolt using Special Tool 21–018/019

27. Check markings on crankshaft, camsnaft and injection pump, Fig. 152, using timing peg 21–016.

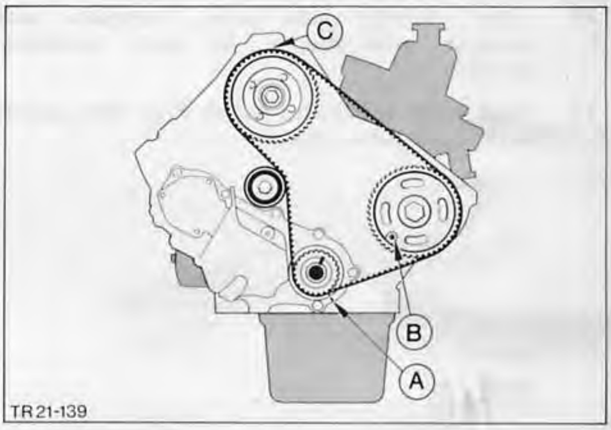


Fig. 152. Toothed belt pulley markings
A – Crankshaft
B – Camshaft
C – Fuel injection pump

28. Slacken toothed belt tensioner and position toothed belt, Fig. 153.

Fig. 153. Position toothed belt

29. Press tensioner against toothed belt, crank engine twice in direction of normal rotation and tighten tensioner.
30. Fit upper and lower toothed belt covers.
31. Fit crankshaft pulley as well as fan with pulley.
32. Position alternator and vacuum pump V-belts and adjust tension to achieve free movement of 13 mm (0,5 in) midway between pulleys, Fig. 154.

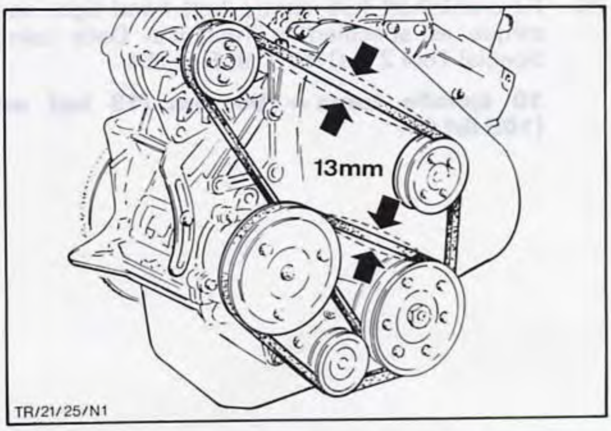


Fig. 154. Adjust alternator and vacuum pump V-belt tension

33. Insert radiator grille panel, complete with radiator, and secure, fit both headlamp surrounds.
34. Hook hood cable into catch, Fig. 155, and fit to radiator grille panel.

Fig. 155. Fit hood cable

35. Fit radiator at bottom location to crossmember mountings, Fig. 156.
36. Fit radiator hose and by-pass hose to expansion tank and fit upper and lower radiator hoses and tighten.
37. Top up coolant and check engine oil level.
38. Connect earth straps to both batteries, start engine and check for leaks.

Fig. 156. Fit radiator at bottom location

21 468 4 OIL SEAL – CRANKSHAFT – REAR – REPLACE (engine or gearbox removed)

Special Service Tools Required:

Crankshaft rear oil seal remover . .	21–010
Crankshaft rear oil seal installer . .	21–011–A
Clutch disc locator	21–044

To Remove

1. Remove clutch pressure plate and clutch disc (6 bolts).
2. Remove flywheel (8 bolts).
3. Remove crankshaft oil seal using Special Tool 21–010, Fig. 157.

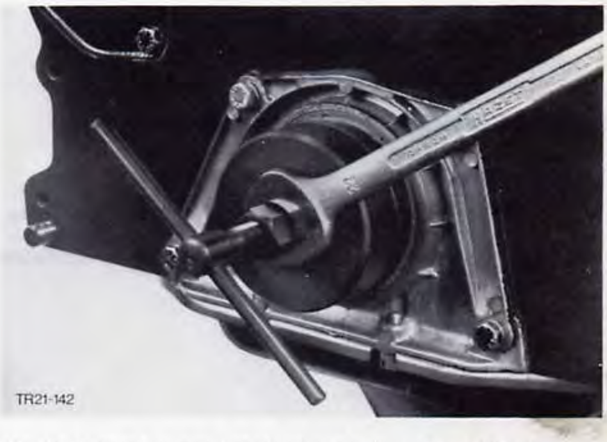


Fig. 157. Remove crankshaft oil seal using Special Tool 21–010

To Install

4. Lubricate crankshaft oil sealing lip and drive in up to stop, using Special Tool 21–011–A, Fig. 158.

Fig. 158. Drive in oil seal with Special Tool 21–011–A

5. Fit flywheel and secure as specified in Technical Data.

   Flywheel bolt holes are offset and flywheel may therefore be installed in one position only.

6. Centralise clutch pressure plate and clutch disc using Special Tool 21–044, Fig. 159 and torque as specified in Technical Data.

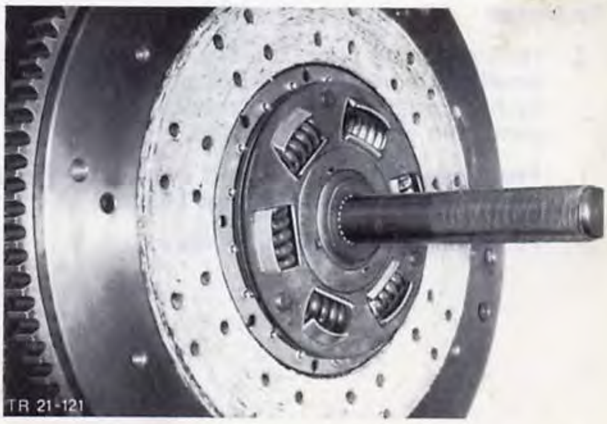


Fig. 159. Centralise clutch disc using Special Tool 21–044

21 505 5 PISTON – REPLACE (piston and connecting rod assembly removed)

Special Service Tools Required: None

To Remove

1. Remove circlips, Fig. 160 from piston pin bore.
2. Tap piston pin out of piston using a suitable hammer and drift.

Fig. 160. Remove circlips

Fig. 161. Heat piston on heater plate

To Install

3. Heat piston on hot plate, Fig. 161, apply oil to small end bore and slide piston pin into piston by hand until pin becomes located, then insert piston pin centrally into piston.

   Front mark on piston and connecting rod must be on same side, Fig. 162.

4. Fit circlips into piston pin bores.

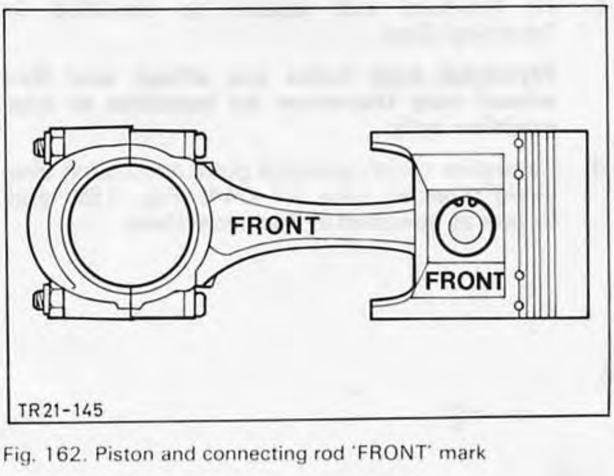


Fig. 162. Piston and connecting rod 'FRONT' mark

21 584 5 RING GEAR – FLYWHEEL – REPLACE (flywheel removed)

Special Service Tools Required: None

To Remove:

1. Centre punch ring gear and drill two holes approximately 7 or 8 mm (0,3 in) diameter offset as illustrated, Fig. 163.

   Drill must only pass through ring gear and not flywheel.

Fig. 163. Drill ring gear

2. Remove ring gear from flywheel by tapping with hammer, Fig. 164.
3. Place new ring gear on a plate some 2 to 3 mm (0,08 to 0,12 in) thick and heat up plate to 260° to 280 °C (500° to 540 °F) from below, in area of ring gear itself, using a welding torch to give uniform heating, Fig. 165. To monitor temperature, mark ring gear with a thermochromatic coloured pencil (Faber Castell 2815) before starting heating operation. On reaching temperature indicated on cover, colour marked on ring gear changes to colour on pencil cover.

Fig. 164. Remove ring from flywheel

Example

If coloured pencil is green and cover black, indicated temperature (260° to 280 °C (500° to 540 °F)) is reached when green coloured mark on ring gear goes black.

To Install

4. Slip ring gear over flywheel with tongs so that ring gear comes to rest on abutment rim. Allow to cool in this position.

   Starter ring gear is induction-hardened and loses this hardness as soon as it is heated to over 290 °C (550 °F).

Fig. 165. Heat ring gear

21 714 OIL PUMP – REMOVE AND INSTALL

Special Service Tools Required:

Camshaft gear timing peg ..	.. 21–016
Crankshaft flange holding wrench	.. 21–018
Crankshaft flange bolt remover/replacer	.. 21–019
Crankshaft front oil seal aligner	.. 21–025

With the exception of removal and installation, as well as checking oil pump gear backlash this operation is contained in Operation **21 467 – Crankshaft front oil seal – replace** and should be carried out as follows:

To Remove

1. Carry out sub-operations 1–19 as described in Operation 21 467.
2. Remove oil pump complete with mounting from engine block (3 bolts), Fig. 166.

To Install

3. Fit oil pump with new O-rings, Fig. 167 to mounting.

   Before installation crank oil pump by hand and fill with engine oil.

   Oil pump bores are offset and the pump may therefore be installed in one position only.

4. Check oil pump gear backlash, Fig. 168 (see Technical Data) and fit new gears if required.
5. Carry out sub-operations 22–38 as described in Operation 21 467.

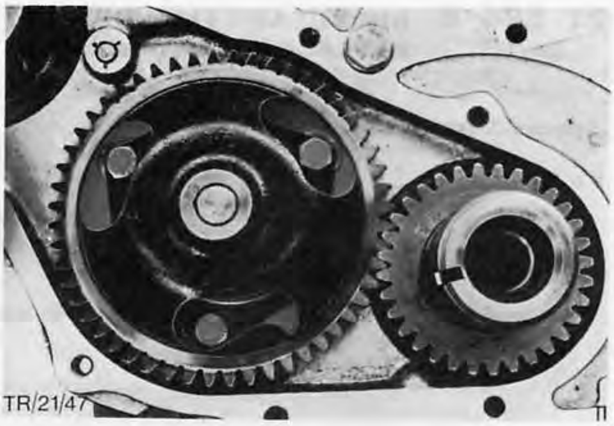


Fig. 166. Remove oil pump

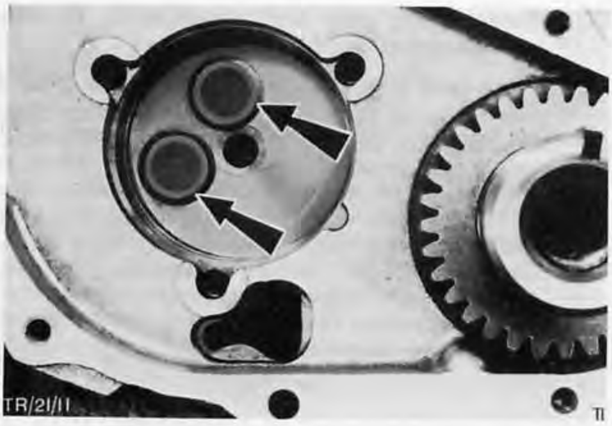


Fig. 167. Fit O-rings

Fig. 168. Check backlash

21 714 8 OIL PUMP – OVERHAUL (oil pump removed)

Special Service Tools Required: None

To Dismantle

1. Remove oil pump cover (1 bolt).
2. Remove outer rotor by inverting pump.
3. Drive retaining pin out of gear and inner rotor and press out rotor, pump housing and retainer plate by means of suitable press.

To Reassemble

4. Assemble pump housing, retainer plate and inner rotor, sliding retainer plate recess behind housing lug, Fig. 169 and press gear on to shaft.

   If existing shaft is to be re-used drill retaining pin bore at 90° to the existing bore.

5. Drill **new** hole in rotor shaft. Secure rotor and gear with retaining pin.
6. Insert outer rotor with chamfered side into housing, Fig. 170.

Fig. 169. Slide oil pump retainer plate behind pump housing lug

Fig. 170. Insert outer rotor with chamfered side into housing

7. Fit pump housing cover, ensuring bolt simultaneously engages in retainer plate recess, Fig. 171.

Fig. 171. Fit pump housing cover

21 714 8 (cont'd)

Check Oil Pump Wear:

(a) Clearance between inner and outer rotor, Fig. 172.

Fig. 172. Measure inner/outer rotor clearance

(b) Clearance between pump housing and outer rotor, Fig. 173.

Fig. 173. Measure clearance pump housing/outer rotor

(c) Clearance between rotors and pump housing joint face, Fig. 174.

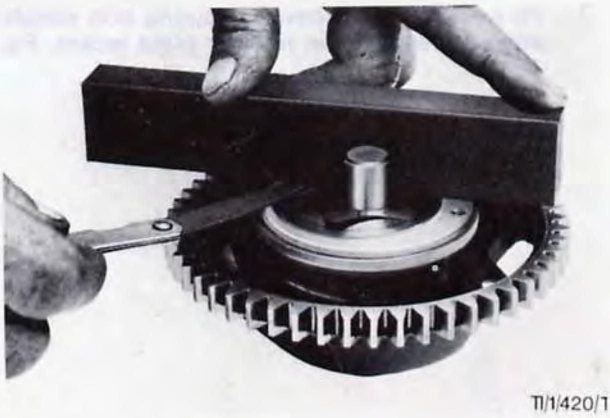


Fig. 174. Check axial play

21 875 ENGINE FRONT MOUNTING RUBBER INSULATOR – REPLACE

Special Service Tools Required: None

To Remove

1. Remove upper and lower engine mounting rubber insulator nuts, Fig. 175.
2. Raise engine with jack and suitable wooden block from underneath sump far enough to enable rubber insulator complete with plate and washer to be removed.

Fig. 175. Remove nuts from engine mounting rubber insulator

To Install

3. Fit rubber insulator with plate and washer, Fig. 176 and lower engine.
4. Secure upper and lower nut as specified in Technical Data.

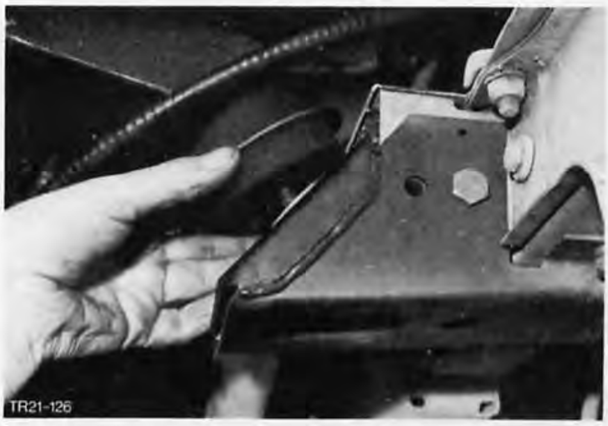


Fig. 176. Fit rubber insulator

TECHNICAL DATA

'G'-ENGINE (OHV/1-4)

Engine

Engine code			4AA
Firing order			1-2-4-3
Bore		mm (in)	93,67 (3,69)
Stroke		mm (in)	85,60 (3,37)
Cubic capacity		cm^3	2358
Compression ratio			21,5:1
Compression pressure		bar (kgf/cm^2) (lbf/in^2)	28,0 (28,0) (406)
Cylinder pressure deviation approx.		bar (kgf/cm^2) (lbf/in^2)	8,0 (8,0) (116)
Output at 3600 rev/min		kw (hp)	46 (62)
Torque at 2750 rev/min		Nm (kgf m) (lbf ft)	130 (13,3) (96)
Idling speed rev/min			750

Cylinder Block

Number of main bearings			5
Cylinder bore dia. (measured 90 mm below top face)			
	grade 1	mm	93,648-93,680
	grade 2	mm	93,660-93,672
	grade 3	mm	93,672-93,684
	grade 4	mm	93,684-93,696
Main bearing bore	rear	mm	81,00-81,02
	remainder	mm	74,00-74,02
Camshaft bearing bore		mm	61,000-61,046

Crankshaft

Main bearing crank pin dia.	rear	mm	76,98-77,00
	remainder	mm	69,98-70,00
Main bearing shell length	front	mm	27,95-28,45
	intermediate	mm	34,04-34,30
	centre	mm	35,55-35,60
	rear	mm	30,10-30,85
Main bearing shell thickness	standard red	mm	1,970-1,979
	blue	mm	1,980-1,989
	undersize	mm	0,25/0,50/0,75
	oversize	mm	0,40
Main bearing clearance		mm	0,052-0,090
Main bearing shell width	front and intermediate	mm	22,87-23,13
	centre	mm	26,86-27,10
	rear	mm	21,87-22,13
Thrust washer thickness	standard	mm	2,31-2,36
	oversize	mm	0,06/0,12/0,18
		mm	0,25/0,40/0,50
Crankshaft end float		mm	0,05-0,25
Permissible wear		mm	0,33
Max. crankshaft cranking torque (without pistons)		Nm (kgf m) (lbf ft)	3 (0,3) (2,2)
Crankpin dia.		mm	59,98-60,00
Crankpin length		mm	32,28-32,38
Crankpin clearance		mm	0,036-0,088
Crankpin shell thickness	standard	mm	1,726-1,735
	undersize	mm	0,25/0,50/0,75/1,0
Crankpin shell width		mm	25,87-26,13
Number teeth crankshaft gear			32

Flywheel

Permissible run-out (at 120 mm radius) (T.I.R.)	mm (in)	0,16 (0,006 in)
Number of teeth on ring gear		108
Flywheel bolts		M 10×1
Flywheel ring gear fitting method (Interference shrink fit)	mm	0,30-0,53

TECHNICAL DATA (cont'd)

Cylinder Head

Valve guide length	standard inlet and exhaust	mm	61,50
Valve guide inside dia.	production	mm	8,982–9,013
	service	mm	8,988–9,008
Valve guide outside dia.	standard	mm	14,725–14,738
Valve seat insert recess dia.	standard inlet	mm	45,71–45,75
	exhaust	mm	37,96–38,00
Valve seat insert recess depth	inlet	mm	9,02–9,31
	exhaust	mm	9,02–9,31
Valve seat inserts – oversize	inlet outside dia.	mm	0,25 and 0,5
	exhaust outside dia.	mm	0,25 and 0,5
Valve seat angle	inlet	from	45° to 45°30'
	exhaust	from	30° to 30°30'
Valve head depth cylinder head	inlet	mm	0,66–1,18
	exhaust	mm	0,40–0,92

Tappets/Push Rods

Push rod length	mm	154,4–155,4
Push rod dia.	mm	7,72–8,03
Tappet dia.	mm	15,973–15,984
Tappet length	mm	62,00

Rocker Shaft/Rocker Arms

Rocker shaft dia.		mm	18,87–18,90
Number rocker arm springs			4
Spring length	at 1,8–2,3 kgf (4–5 lbf)	mm	26,92
Rocker arm bearing clearance		mm	0,02–0,08

Valves

Head dia.	inlet	mm	44,20–44,40
	exhaust	mm	36,20–36,40
Valve head seat angle	inlet		44°30' to 45°
	exhaust		29°30' to 30°
Valve stem clearance	inlet	mm	0,016–0,072
	exhaust	mm	0,034–0,090
Valve stem dia.	inlet	mm	8,941–8,966
	exhaust	mm	8,923–8,948

Valve Springs

Number of coils	exhaust outside		6,5
	exhaust inside		7,5
	inlet		6,2
Valve spring free length	exhaust outside	mm	51,4
	exhaust inside	mm	47,1
	inlet	mm	44,45
Spring pressure – valve open	exhaust outside	kgf (lbf)	59,7–64,3 (132–142)
	exhaust inside	kgf (lbf)	35,1–37,9 (77–83)
	inlet	kgf (lbf)	103,5 (338)

Valve Timing/Clearance

Valve timing at 0,534 mm (0,021 in) clearance	inlet valve opens		10 degrees B.T.D.C.
	closes		30 degress A.B.D.C.
	exhaust valve opens		54 degrees B.B.D.C.
	closes		10 degrees A.T.D.C.
Valve lift	inlet	mm	9,75
	exhaust	mm	10,50
Valve clearance cold, inlet and exhaust valve		mm	0,35 (0,014)

Camshaft

Number of bearings			5
Drive			via toothed belt
Cam lift	inlet	mm	6,5
	exhaust	mm	7,0
Bearing – oversize – outside dia.		mm	0,508
Journal dia.		mm	55,942–55,960
Camshaft bearing clearance		mm	0,075–0,114
Camshaft end float		mm	0,05–0,20

Pistons

Ring groove width	compression ring upper	mm	2,258–2,278
	lower	mm	2,426–2,451
	oil scraper ring	mm	4,776–4,800
Piston pin bore	red	mm	28,9925–28,9950
	yellow	mm	28,9950–28,9975
	blue	mm	28,9975–29,0000
Piston clearance in bore		mm	0,128–0,152
Piston dia.	grade 1	mm	93,508–93,520
	grade 2	mm	93,520–93,532
	grade 3	mm	93,532–93,544
	grade 4	mm	93,544–93,556
Piston oversize		mm	0,65/1,00
Clearance between piston crown and block face at TDC		mm	0,114–0,213

Piston Ring

Compression ring	upper		chrome plated, barrel faced
	lower		chrome plated, stepped
Oil scraper ring			chrome plated, expansion spring
Ring gap	compression ring, upper	mm	0,25–0,50
	lower	mm	0,25–0,50
	oil scraper ring	mm	0,25–0,58
Ring width	compression ring, upper	mm	2,158–2,178
	lower	mm	2,350–2,375
	oil scraper ring	mm	4,724–4,737
Ring to groove clearance	compression rings	mm	0,041–0,089
	oil scraper ring	mm	0,039–0,076

Piston Pin

Type		floating in piston and connecting rod
Outside dia.	mm	28,990–28,998
Clearance in piston at 20 °C (68 °F)	mm	0,000–0,005
Retention method		circlips

Connecting Rods

Length	mm	153,975–154,025
Small end bore with bush	mm	29,010–29,022
Clearance between small end bush and piston pin	mm	0,0125–0,032
Big end bore	mm	63,506–63,520
Big end journal clearance	mm	0,036–0,088
Big end journal end float	mm	0,127–0,279

TECHNICAL DATA (cont'd)

Engine Lubrication

System		pressure feed
Oil grade		HD multi-purpose oil
Oil specification		ESEE-M2C-1004A or SP-M2C-9104A
	Viscosity below +10 °C (50 °F)	5W/20
	−20° to +10 °C (−4° to 50 °F)	5W/30
	−10° to +32 °C (14° to 90 °F)	10W/30
	−10° to +40 °C (14° to 104 °F)	10W/40
		10W/50
		20W/40
	above +20 °C (68 °F)	20W/50
Oil change	interval km (miles)	5000 (3000)
Oil capacity	without filter litre (pints)	5,2 (9,2)
	with filter litre (pints)	6,2 (10,9)

Oil Pump

Type			twin rotor
Drive gear backlash		mm	0,051–0,338
Capacity	at 2460 rev/min	litres/min	56
Pump housing bore dia.		mm	57,2262–57,3024
Drive shaft dia.		mm	15,8242–15,8369
Rotor end float		mm	0,017–0,098
Inner to outer rotor clearance	max.	mm	0,152
Outer rotor to housing clearance		mm	0,1362–0,3132

Tightening Torques

		Nm	kgf m	lbf ft
Main bearing bolts	1)	120–130	12,0–13,0	90
	2)	130–140	13,0–14,0	96
Connecting rod bolts	1)	48–62	4,8–6,2	40
	2)	62–73	6,2–7,3	50
Cylinder head (see tightening sequence)		142–152	14,2–15,2	105
Flywheel		60–65	6,0–6,5	45
Camshaft pulley		105–120	10,5–12,0	85
Oil drain plug		21–28	2,1–2,8	17
Rocker shaft	bolts M10	66–70	6,6–7,0	50
	M8	16–20	1,6–2,0	14
Cylinder block intermediate plate	bolts 1–9	27–33	2,7–3,3	21
	bolts 10	20–25	2,0–2,5	11
Oil pump cover intermediate plate		20–25	2,0–2,5	11
Oil sump		17–20	1,7–2,0	12
Inlet manifold		12–15	1,2–1,5	9
Exhaust manifold		41–51	4,1–5,1	33
Crankshaft centre bolt		318–346	31,8–34,6	240
Cylinder block rear oil seal carrier		18–21	1,8–2,1	14
Oil pump/cylinder block		17–20	1,7–2,0	14
Intermediate plate injection pump		22–30	2,2–3,0	17
Intermediate plate water pump		11–15	1,1–1,5	9
Camshaft/cylinder block blanking plate		13–18	1,3–1,8	11
Camshaft/cylinder block thrust plate		25–30	2,5–3,0	20
Vacuum pump intermediate plate		32–40	3,2–4,0	26
or blanking cover in lieu of vacuum pump		25–30	2,5–3,0	20
Oil filter – cylinder block (full flow filter)		21–25	2,1–2,5	17
Oil pump suction pipe		12–15	1,2–1,5	9
Oil pressure relief valve bolt		55–60	5,5–6,0	41
Toothed belt cover		5–9	0,5–0,9	5
Alternator bracket		20–29	2,0–2,9	17
Alternator to bracket		20–29	2,0–2,9	17

GENERAL DESCRIPTION

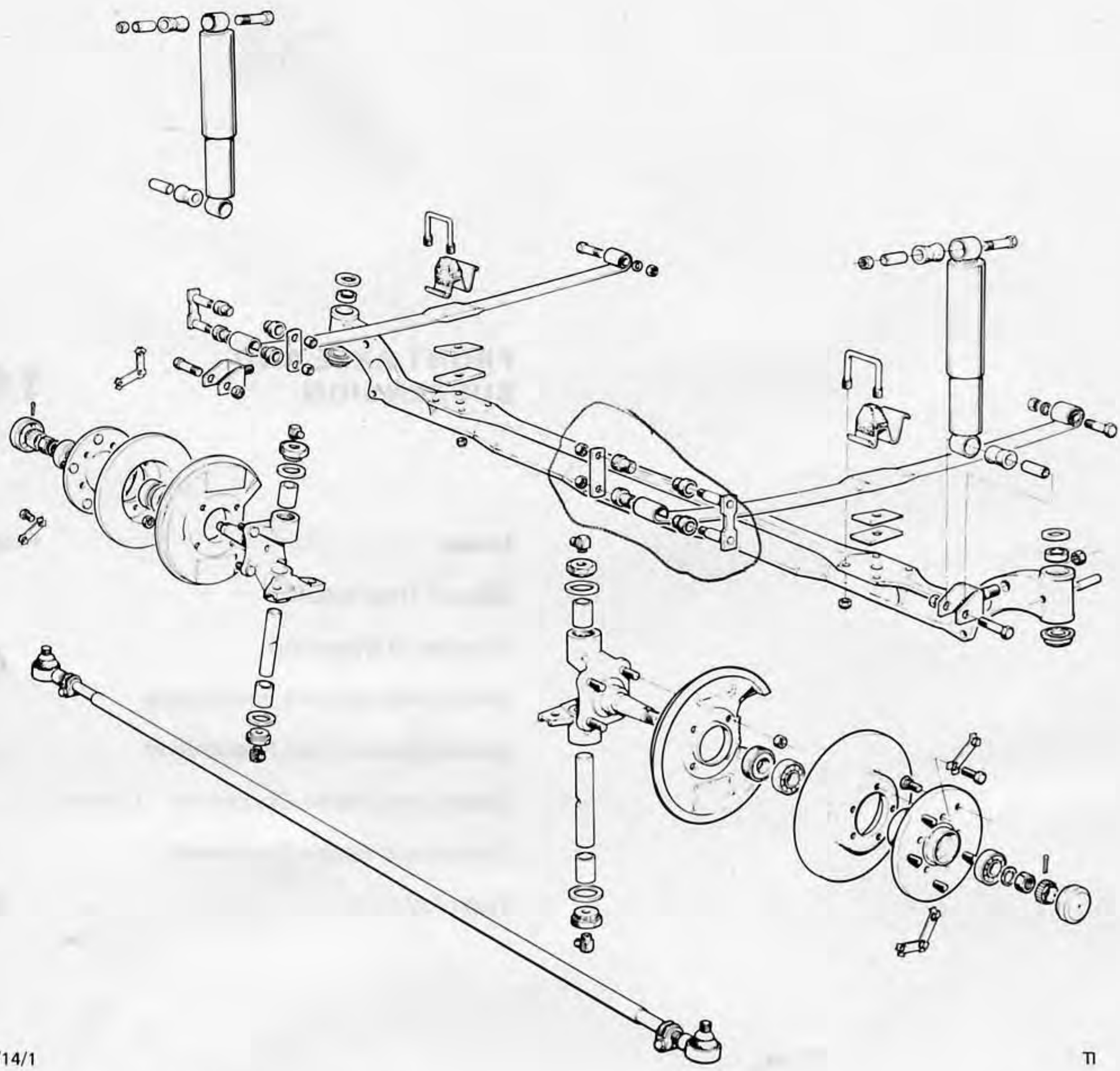


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Fig. 1. Transit front axle and suspension assembly

GENERAL DESCRIPTION

The Transit front axle and suspension system is comprised of a forged steel I section beam axle supported by two single-leaf, semi-elliptic parabolic taper road springs. Telescopic shock absorbers are mounted between the axle beam and vehicle body to dampen vehicle oscillations, particularly over uneven road surfaces.

The hubs are mounted on stub axles connected to the axle beam by vertical kingpins, with parallel grooved pins driven into the axle beam to lock the kingpin in position. Two taper roller bearings are located on each stub axle and run in cups pressed into the wheel hub. The wheel mounting studs are a splined and pressed fit into the hub flange. Rubber bushes are fitted at the mounting points for the road springs and shock absorbers.

PRINCIPLE OF OPERATION

The Transit front axle and suspension assembly fulfils two functions:

1. Damping the effect of road irregularities on vehicle ride.
2. Allowing the front wheels to turn in response to steering control.

The first objective is achieved by cushioning the movement imparted to the front road wheels, through semi-elliptic leaf springs. The energy created is dampened by telescopic shock absorbers. The transmission of road noise and vibration is minimised by rubber insulated mounting points between the chassis and springs and between the chassis and shock absorber.

The second objective is achieved by the front hub assemblies pivoting in response to steering movement. The pivot centres are spindle bolts locked to the axle by parallel grooved pins.

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MK I } RUBBERS
MK II

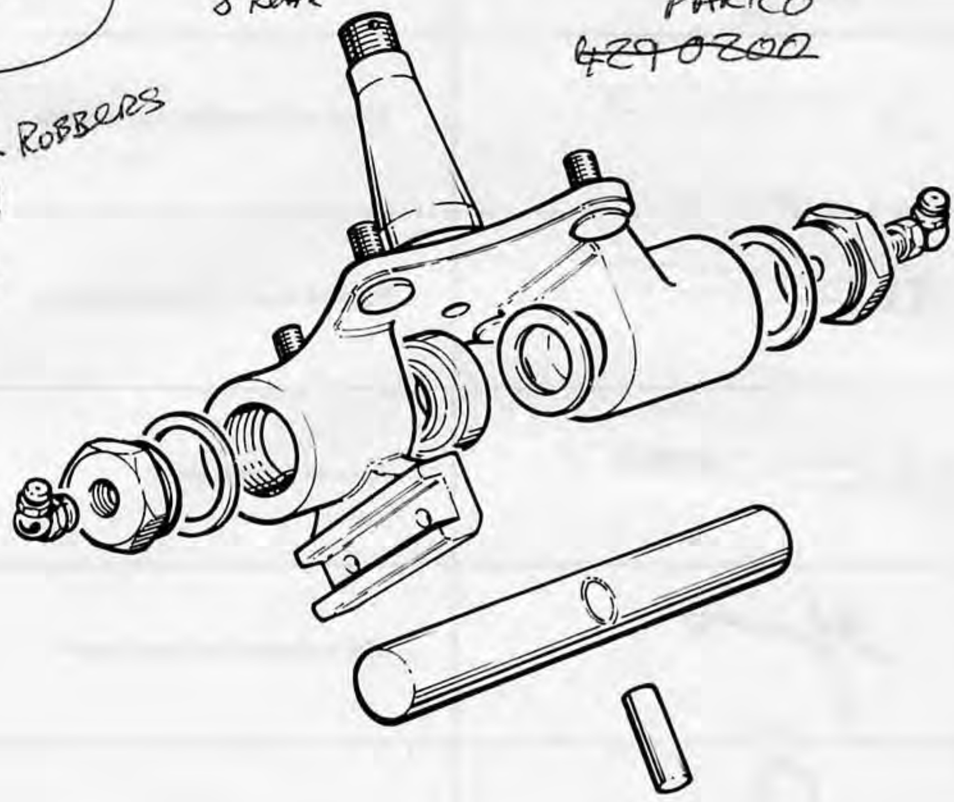

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Fig. 2. Front stub axle assembly

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals, the following checks should be carried out:

Shock Absorbers

Check for evidence of oil leaks on front shock absorbers.

Ball Joints, Bushes and Mountings

Check condition of all ball joints, bushes and mountings.

If the above checks reveal evidence of excessive wear of faulty operation, the relevant items should be replaced by reference to the operations within this section of the workshop manual.

Check front wheel bearings for correct adjustment. Adjust bearings, if necessary. Refer to Operation No. 14-303 for procedure.

If uneven tyre wear is evident, or if accident damage to the front suspension is suspected, a check on the toe setting of the vehicle should be carried out.

Toe-setting

Check the front wheel toe-setting. Refer to Operation No. 14-117

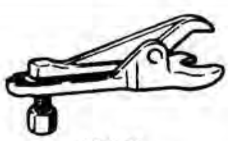
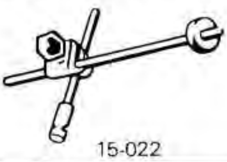
Kingpin Lubrication

Grease the nipples fitted on each end of the kingpin retaining nuts, using grease meeting Ford Specification SMIC-4515A, until grease appears.

'U' Bolts

Check and if necessary adjust the tightening torque of the 'U' bolt nuts.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 13-006	Ball joint separator
 14-010	Front hub bearing cup replacer
 14-011	Spindle bush remover/replacer
 14-012	Spindle bush reamer
 15-022	Dial indicator holding fixture
 15-046	Metric dial indicator gauge

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SERVICE AND REPAIR OPERATIONS – CONTENT

FRONT AXLE AND SUSPENSION		Described in this publication	Contained in operation	Also applicable to certain variants in the listed model range: Transit '7	Fiesta	Escort '75 onwards	Capri	Taunus '76/Cortina '77	Granada '78 onwards
14 111	Front wheel alignment – check	X		X					
14 117	Toe-in – check and adjust	X		X	X	X	X	X	X
14 212	Front axle and suspension assembly – remove and install	X		X					
14 214	Front axle assembly – remove and install	X		X					
14 218 4	Beam – front axle – replace	X		X					
14 363	Stub axle – remove and install	X		X					
14 365	Bushes – stub axle – replace	X		X					
14 371	Hub assembly – front – remove and install	X		X					
14 371 6	Hub assembly – front – replace	X		X		X	X	X	X
14 403	Wheel bearings – adjust	X		X					
14 411 4	Wheel bearings – replace – inner and outer	X		X	X	X	X	X	X
14 414 4	Wheel bearing – front – inner – replace	—	14 411 4	X	X	X	X	X	X
14 416 4	Wheel bearing – front – outer– replace	—	14 411 4	X	X	X	X	X	X
14 423 4	Grease retainer – front wheel bearing – replace	—	14 411 4	X	X	X	X	X	X
14 443	Stud – replace	X		X	X	X	X	X	X
14 621	Front spring – remove and install	X		X					
14 653	Bushes – front spring replace – all	X		X					
14 665	Bush – front spring hanger – replace	—	14 653	X					
14 673	'U' bolts – front spring – replace	X		X					
14 791	Shock absorber – remove and install	X		X					

SERVICE AND REPAIR OPERATIONS

14 111 FRONT WHEEL ALIGNMENT – CHECK (Castor, Camber, Toe-setting)

Special Service Tools Required:

The following procedure utilises Optoflex equipment. If alternative equipment is used the manufacturers instructions must be used.

NOTE: Vehicle must be checked in unladen condition.

1. Before carrying out a wheel alignment check, suspension and steering components should be examined to ensure there are no signs of damage, wear or maladjustment. Tyre pressures should also be checked, and corrected if necessary.
2. Position vehicle in correct position relative to optoflex screen and on a level surface with front wheels on locked turntables and rear wheels on wooden blocks of same height as turntables.
3. Secure projectors to front wheels. Projector pivot must be aligned to centre of wheel, Fig. 3.
4. Jack up front wheel and adjust projector bracket to eliminate wheel run out. Jack should be positioned under axle as near to front wheel as possible. Run out is eliminated by rotating wheel and observing movement of projected image on screen. Position wheel at maximum run out position and adjust bracket by turning adjusting screw nearest to horizontal plane, Fig. 4.
5. Remove locking pin from turntable and lower wheel onto centre of turntable.
6. Repeat sub-operations 4 and 5 for other wheel Bounce front of vehicle at centre of bumper to settle suspension and ensure the turntables do not bind at 20° lock (both LH and RH).
7. Fit pedal depressor to footbrake to lock front wheels, Fig. 5.
8. By turning steering wheel, align RH front wheel to straight ahead position. Aim projector at mirror through cut-out in screen and reflect image back onto projector. Focus image, turn wheel to align image centre with zero mark on projector. Wheel is now exactly in straight ahead position. Do not move this wheel until sub-operation 10.
9. Refocus projector onto screen and slide RH screen across to align zero setting of toe-in/out to centre of image.
10. By turning steering wheel align LH front wheel to straight ahead position as sub-operation 8.
11. Record toe-in/out from position of projected image on RH screen. This is total toe-in or out, Fig. 6.

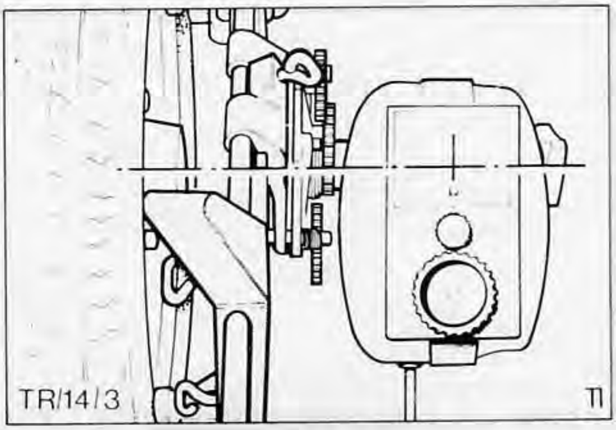


Fig. 3. When fitting equipment ensure projector spindle is in line with wheel centre

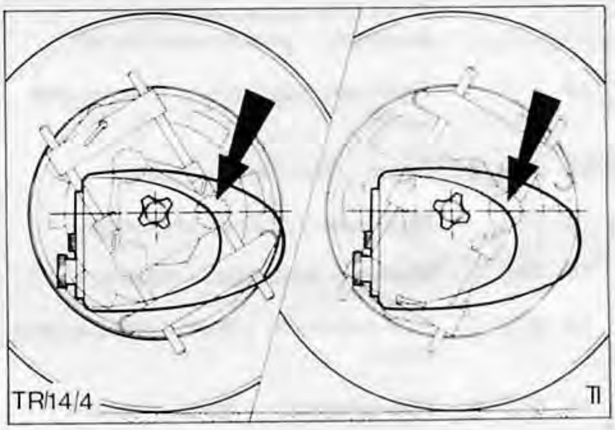


Fig. 4. A and B show two possible positions of adjuster Always use adjuster nearest horizontal plane

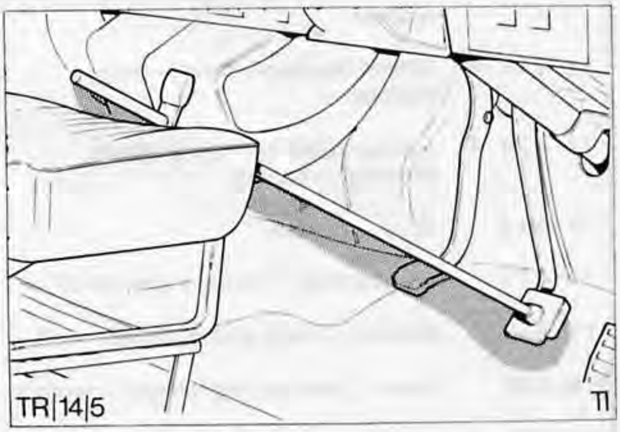


Fig. 5 Foot brake pedal depressor

12. Align LH side of screen to LH projected image. Repeat as for sub-operation 9.
13. Record camber for both wheels. A direct reading is obtained for each wheel from the projected image. Reading is shown by a fine line across each scale.
14. Turn RH wheel to left 20° lock position at horizontal line and zero projected castor scale by turning knob positioned above projector lens.
15. Turn RH wheel to right 20° lock position at horizontal line and record castor angle from projected scale.
16. Repeat sub-operations 14 and 15 for LH wheel, setting castor zero with wheel on right 20° lock and reading value on left 20° lock.
17. Remove pedal depressor and projectors from vehicle and remove vehicle from turntables.
18. Compare values obtained with specified tolerances.

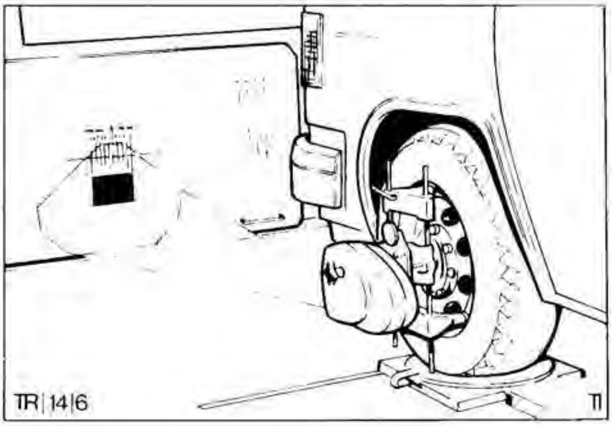


Fig. 6. Projector showing total toe-in.

14 117 TOE-IN-CHECK AND ADJUST

Equipment Required:

Suitable tracking gauge, i.e. Dunlop, Churchill and Lowener.

(Following procedure is based on above equipment, if other equipment is used follow manufacturers instructions.)

For equipment with a facility to eliminate effects of wheel/tyre run-out (e.g. Optoflex) it is only required to take one toe-in reading. However for equipment that does not incorporate a facility to eliminate wheel/tyre runout (i.e. Churchill type 96 gauge) it is necessary to take two toe readings at wheel centre height on wheel rim edges.

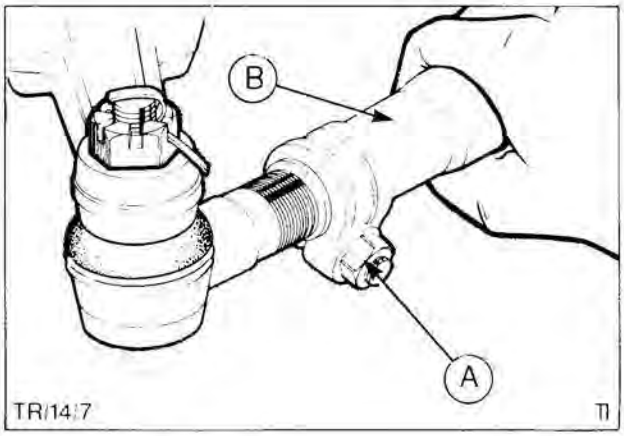


Fig. 7. Adjusting toe-in.

Second reading must be recorded at a position on the wheels exactly 180° from first reading, and two readings averaged to reduce effects of wheel/tyre runout, and give actual toe measurement.

Important: Vehicle should be in an unladen condition and must be rolled forwards onto a flat level surface before commencing toe measurement check.

Position toe setting gauge at front inner edge of wheels, roll vehicle forward so that wheels rotate through 180° and note toe setting reading. Mark tyre.

Remove gauge and re-locate at front inner edge of wheels. Roll vehicle foward so that wheels rotate through 180° and note toe setting reading.

Combine two readings and average out to reduce effects of wheel/tyre runout and give an actual toe measurement figure.

If the toe-in figure is outside specification then it should be adjusted as follows:
NOTE: The connecting rod ends have left and right hand threads. Thus, the overall length of the assembly can be adjusted by slackening the clamp bolts and rotating the connecting rod. It is not necessary to detach either end of the rod.

1. Loosen clamp bolts on connecting rod.
2. Rotate rod in the appropriate direction to achieve the specified toe-in figure, Fig. 7.
3. Tighten clamp bolts.

14 212 FRONT AXLE AND SUSPENSION ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required:

Ball joint separator 13 006

To Remove

1. Remove hub caps, if fitted, loosen wheel nuts. Jack-up front of vehicle, fit stands.
2. Remove wheel nuts, and remove front road wheels.
3. Remove split pin and remove nut from joint at drag link and drop arm.
4. Separate drag link and cranked arm joint by using ball joint separator tool 13 006, Fig. 8.
5. Disconnect shock absorbers from top mountings on both sides.
6. Disconnect brake hoses from caliper on both sides.
7. With a suitable jack placed under the axle beam support the weight of the axle.
8. Remove two nuts from each rear shackle plate on either side and remove rear shackle plate, Fig. 9.
9. Remove front spring eye bolts on each side.
10. Lower axle and suspension assembly to ground and withdraw from vehicle.

To Install

11. Reposition assembly under vehicle and raise in to position using a suitable jack.
12. Fit front spring eye bolts, Fig. 10, through body brackets and front springs.
13. Fit rear shackle plates and secure with nuts.
14. Take up the weight of the vehicle with the jack and torque the front spring eye bolts, and the rear shackle plate nuts, to the specified torques. When taking up the weight of the vehicle care must be taken not to raise the vehicle off the stands.
15. Reconnect front brake hoses to calipers.
16. Reconnect shock absorbers to top body mountings.
17. Connect drag link to drop arm, fit nut and secure with a new split pin.
18. Bleed brake circuit, refer to Operation 12-141.
19. Refit wheels, lower vehicle to ground, finally tighten wheel nuts, to specified torque and refit hub caps, if fitted.

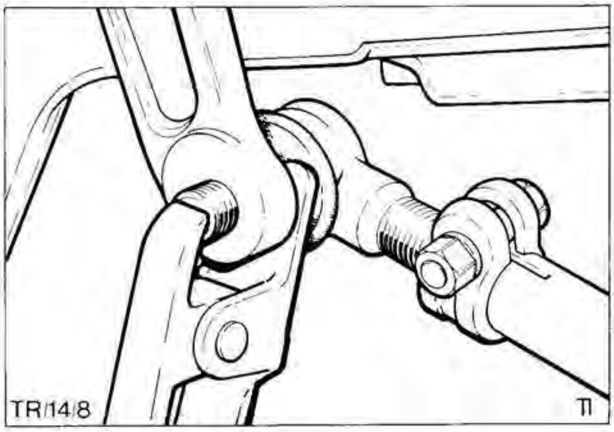


Fig. 8. Separating drag link and cranked arm joint using tool 13 006

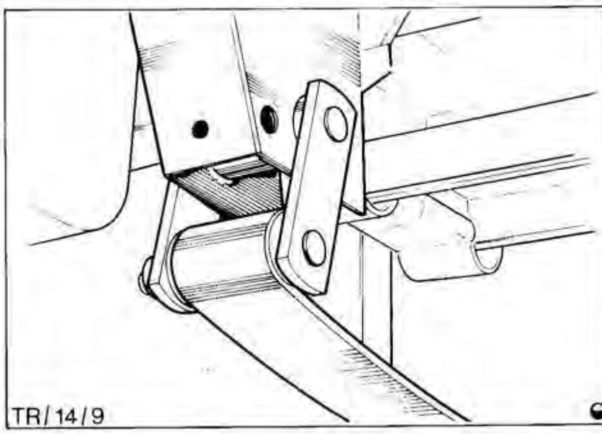


Fig. 9. Rear spring shackle plate

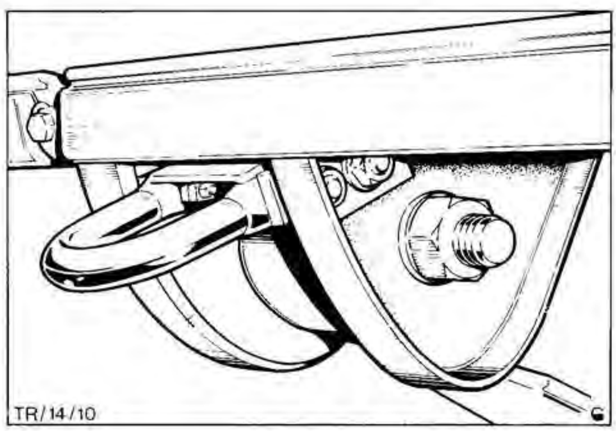


Fig. 10. Front spring eye bolts

14 214 FRONT AXLE ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required:

Ball joint separator 13 006

To Remove

1. Remove hub caps where fitted, slacken off front wheel nuts.
2. Jack-up, fit stands and remove front road wheels.
3. Remove split pin and nut and separate drag link from steering arm, using ball joint separator 13-006.
4. Remove lower shock absorber mounting nuts and withdraw bolts both sides, Fig. 11.
5. Disconnect brake hoses from front calipers.
6. Support the axle beam on a jack.
7. Remove two 'U' bolts securing beam to spring on both sides and lower axle beam and withdraw from vehicle.

To Install

8. Position axle beam relative to springs.
9. Raise axle and secure to springs with 'U' bolts, ensuring packing wedges and bump stops are correctly fitted. Wedges fit with the thickest portion towards the rear, Fig. 12.
10. Reconnect brake hoses both sides, Fig. 13.
11. Insert lower shock absorber bolts through lower shock absorber bush and secure with nut, tightening to the specified torque.
12. Reconnect drag link to drop arm and secure nut with new split pin.
13. Bleed brakes refer to Operation 12 141.
14. Fit both front road wheels.
15. Lower vehicle and finally tighten wheel nuts. Finally torque 'U' bolt nuts, refer to Technical Data for correct tightening sequence.
16. Refit hub caps, where applicable.

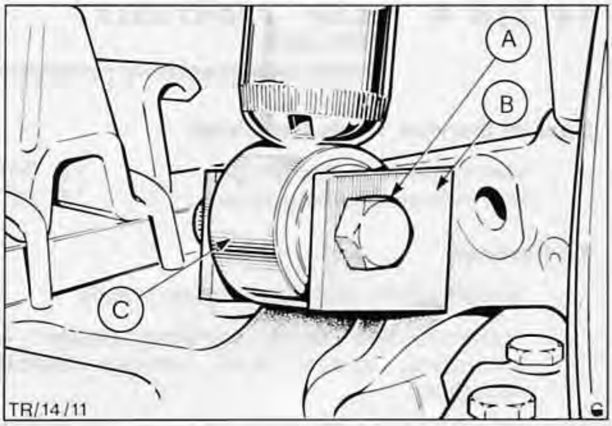


Fig. 11. Lower shock absorber mounting

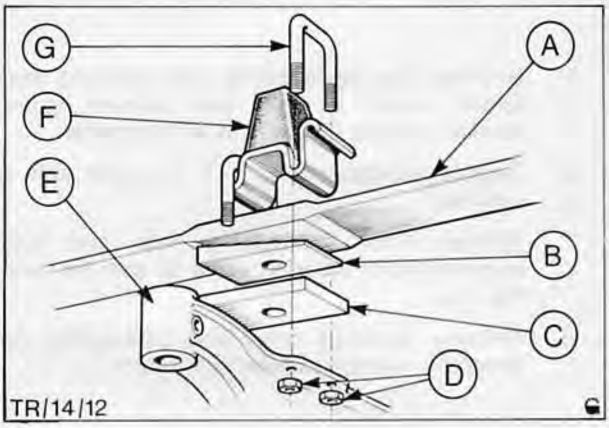


Fig. 12. Front spring and 'U' bolt assembly

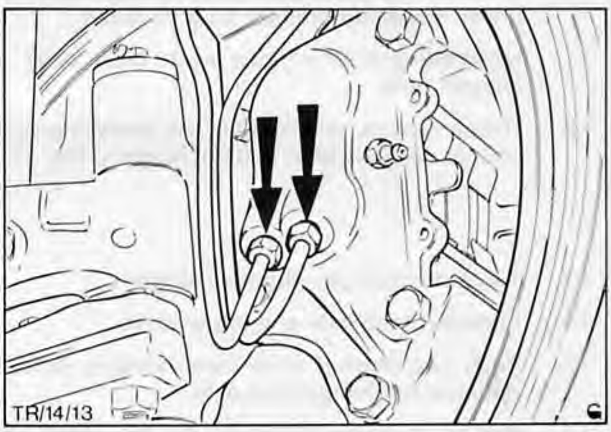


Fig. 13. Front brake hose connection to caliper (horizontally split braking system shown)

14 218 4 BEAM – FRONT AXLE – REPLACE (Front axle assembly removed)

Special Service Tools Required:

Metric dial indicator gauge	15 046
Dial indicator holding fixture	15 022

To Remove

1. Support front axle assembly on stands.
2. Remove two bolts securing caliper to mounting spacer and remove caliper assembly.
3. Remove wheel bearing dust cap from hub. Remove split pin, nut retainer, adjusting nut, washer and outer bearing, Fig. 14.
4. Remove front hub and disc assembly from front axle spindle.

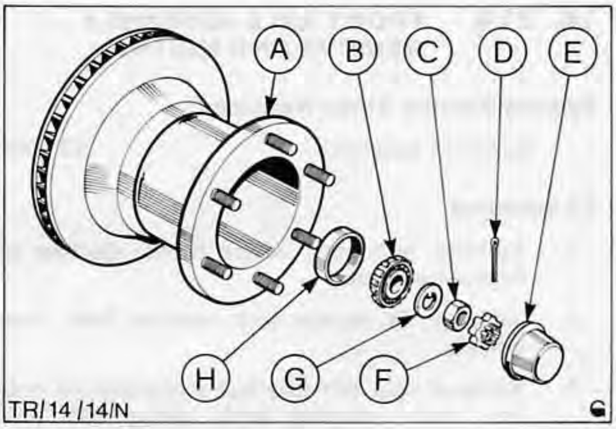


Fig. 14. Front hub and bearing assembly

5. Remove four self-locking nuts securing front splash shield to axle and remove splash shield. Remove caliper mounting spacer.
6. Repeat sub-operations 2–5 for other side of vehicle.
7. Remove four self-locking nuts and bolts securing both steering arms to spindle body, Fig. 15.
8. Remove steering arms and connecting rod assembly complete from axle beam.

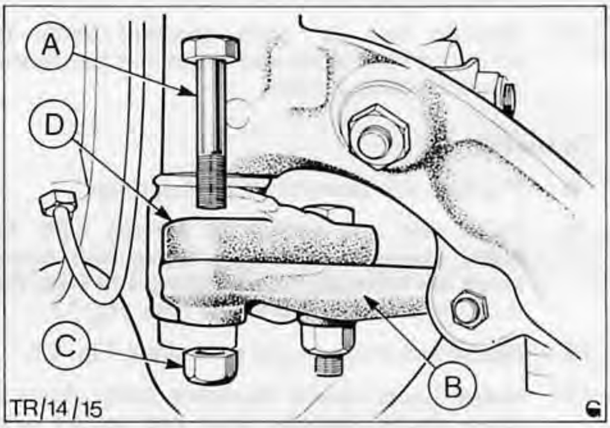


Fig. 15. Removing nuts and bolts securing steering arm to spindle body

9. Remove spring 'U' bolts and nuts, from each spring and remove both springs bump stops, and packing wedges from axle beam.
10. Remove nut and bolt from shock absorber lower mounting bracket on both sides.
11. Unscrew grease nipples from both ends of kingpin nuts.
12. Unscrew nuts, and remove nut complete with copper washer, both ends of kingpin, Fig. 16.

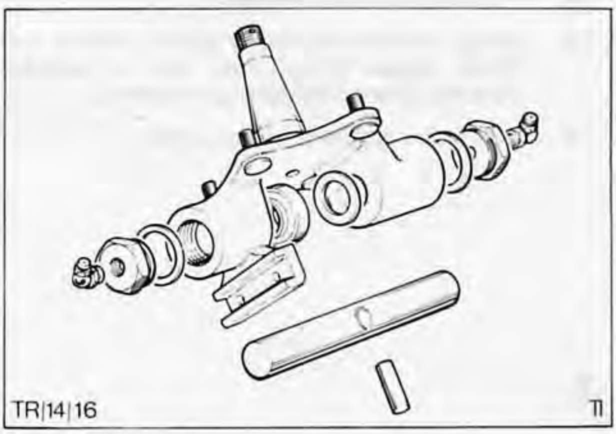


Fig. 16. Front stub axle and kingpin assembly

13. Tap out cotter pin. Remove kingpin.
14. Slide out stub axle and upper shim.
15. Push out bearing from lower kingpin hole, if required to change stub axle.
16. Repeat sub-operations 11-15 for other side of axle.

To Replace

17. Refit lower kingpin hole bearing if removed in sub-operation 15.

18. Refit stub axle to axle beam ensuring shim, Fig. 17, is fitted between top face of stub axle and lower face of upper hole in axle beam. Select shims to give a maximum clearance of 0,1 mm (0,004 in) and a minimum clearance of 0,025 mm (0,001 in). Insert kingpin.

19. Align cut-out in kingpin with hole in axle beam and refit cotter pin.

20. Refit nuts and copper washers to both ends of kingpin.

21. Refit grease nipples both ends of kingpin nuts.

22. Repeat sub operations 17–21 for other side of axle beam. Lubricate grease nipples on stub axle with grease meeting Ford Specification SM-IC-4515-A until grease appears. Clean off excess grease.

23. Refit lower shock absorber mounting brackets to axle beam and secure with nut and bolt both sides.

24. Refit springs to axle beam, Fig. 19. Ensure packing piece and wedge is fitted between spring and axle, and that wedge has its thickest position rearwards. Secure springs and bump stop to axle with 'U' bolts and nuts, both sides.

25. Refit steering arms and connecting rod assembly to spindle body and secure with four bolts and self-locking nuts.

26. Refit splash shield to stub axle, secure with self-locking nuts, both sides.

27. Refit caliper mounting spacer. Clean spindle. Renew grease retainer if damaged, Fig. 18.

28. Refit hub and disc assembly onto spindle.

29. Refit outer wheel bearing, washer, and retaining nut.

30. Tighten wheel bearing retaining nut to a torque of 23 to 33 Nm whilst rotating hub to seat the wheel bearings.

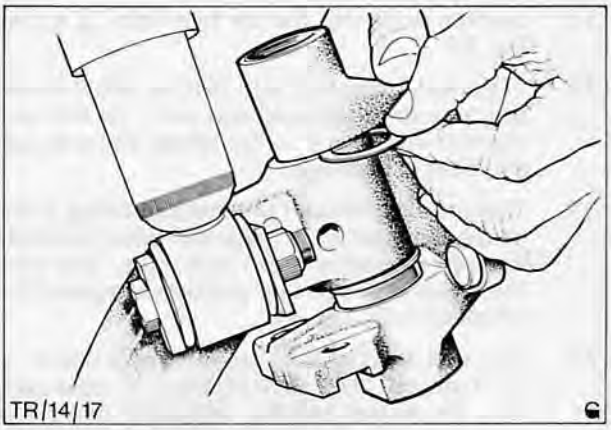


Fig. 17. Fitting shim between stub axle and axle beam

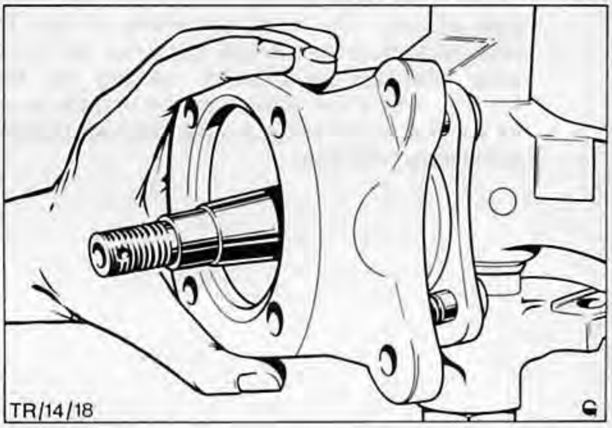


Fig. 18. Replacing caliper mounting spacer

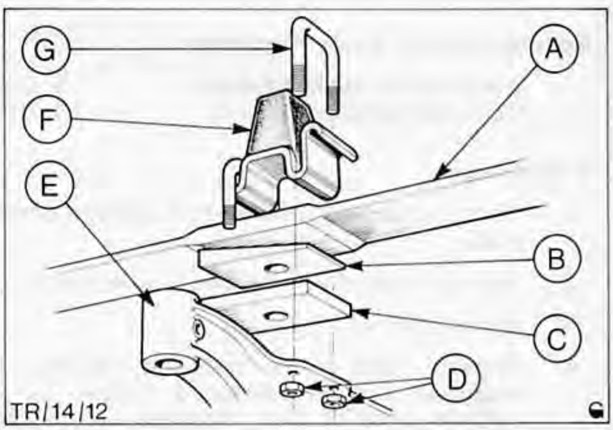


Fig 19. Front spring and wedge assembly

31. Slacken adjusting nut by four flats ($\frac{2}{3}$ turns), Fig. 20.
32. Vigorously rock hub and disc to settle wheel bearings and then push and pull – do not rock the hub and disc in a horizontal plane to feel end float in bearings.
33. The end float should be checked using a dial gauge fastened by a magnetic base or simple bracket fabricated from two nuts, and with the stylus of the gauge positioned against the wheel spindle, Fig. 21.
34. The end float should be between 0,025 to 0,13 mm (0,001 to 0.005 in). If necessary turn the wheel bearing adjusting nut either way until the correct end float is obtained. Remove dial indicator gauge.
35. Fit retainer and new split pin. Fit dust cap. Refit caliper and secure with two bolts. Bleed brake circuit. Refer to Operation 12 141.
36. Repeat sub-operations 27 to 35 for other side of axle. The final tightening of the 'U' bolt nuts must be carried out after the front axle assembly has been refitted to the vehicle, when the weight of the vehicle is on its wheels. Refer to Technical Data for correct tightening sequence.

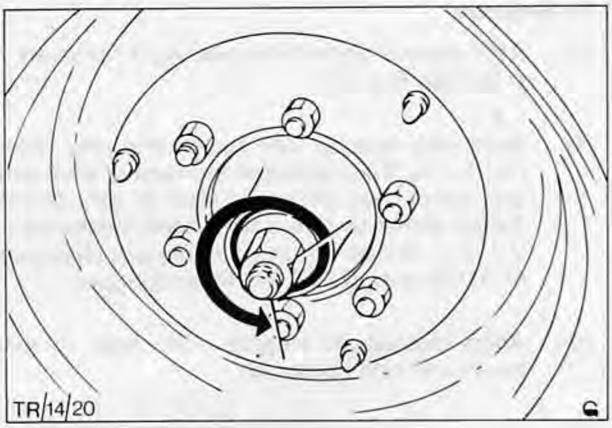


Fig. 20. Slacken nut $\frac{2}{3}$ turns

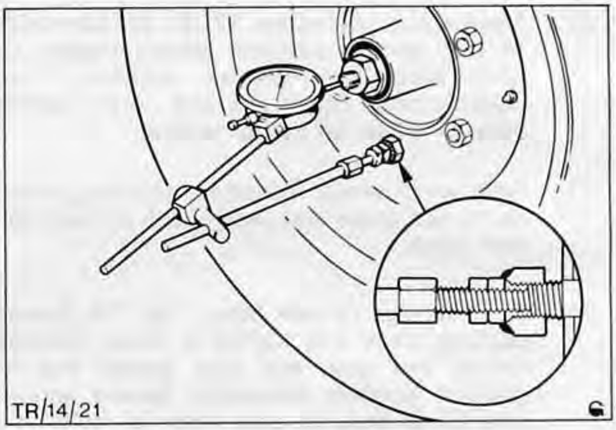


Fig. 21. Checking end float

14 363 STUB AXLE – REMOVE AND INSTALL

Special Service Tools Required:

Dial indicator holding fixture	15 022
Metric dial indicator gauge	15 046

To Remove

1. Remove hub cap, where fitted, slacken wheel nuts.
2. Jack-up front of vehicle, and fit axle stands.
3. Remove wheel.
4. Remove two bolts securing caliper to mounting bracket. Suspend caliper by a suitable piece of wire, attached securely to vehicle. On vehicles with horizontal split braking system, disconnect fluid line.

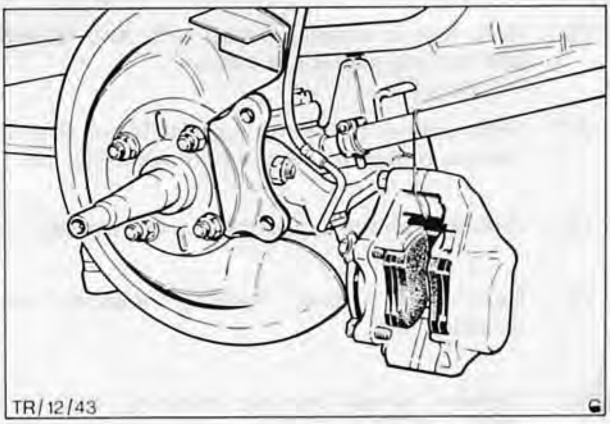


Fig. 22. Suspend caliper by a suitable piece of wire. (Hub and disc removed for clarity)

5. Remove dust cap, split pin, nut retainer, and wheel bearing adjusting nut. Remove washer and hub/disc assembly complete with outer bearing.
6. Remove four self-locking nuts securing splash shield to spindle.
7. Remove caliper.
8. Remove two nuts and bolts securing steering arm to stub axle and lower steering arm clear of stub axle.
9. Unscrew grease nipples from both ends of kingpin nuts.
10. Unscrew kingpin nut, Fig. 23, and copper shims and remove.
11. Tap out cotter pin and remove kingpin.
12. Slide out stub axle and upper shim.
13. Push out bearing from lower kingpin hole, Fig. 24.

To Install

14. Refit bearing to lower kingpin hole.
15. Refit stub axle to axle beam. Select and fit shims to give a maximum clearance of 0,1 mm (0,004 in) and a minimum clearance of 0,025 mm (0,001 in) between the top face of stub axle and lower face of upper hole in axle beam. Insert kingpin.
16. Align cut-out in kingpin with hole in axle beam and refit cotter pin, Fig. 25.
17. Refit nuts and copper washers to both ends of kingpin.
18. Refit grease nipples both ends. Lubricate grease nipples with grease meeting Ford Specification SM- 1C-4515-A until grease appears. Clean off excess grease.
19. Refit steering arm to stub axle and secure with two nuts and bolts.
20. Refit caliper mounting bracket.
21. Refit caliper splash shield and secure with self-locking nuts.
22. Refit hub and disc assembly. Refit outer bearing, washer and adjusting nut. Refit wheel. Tighten wheel nuts.
23. Tighten wheel bearing retaining nut to a torque of 23 to 33 Nm (2,35 to 3,5 kg f.m) (17 to 25 lbf.ft) whilst rotating hub to seat the wheel bearings.
24. Slacken adjusting nut by four flats ($\frac{2}{3}$ turns.)

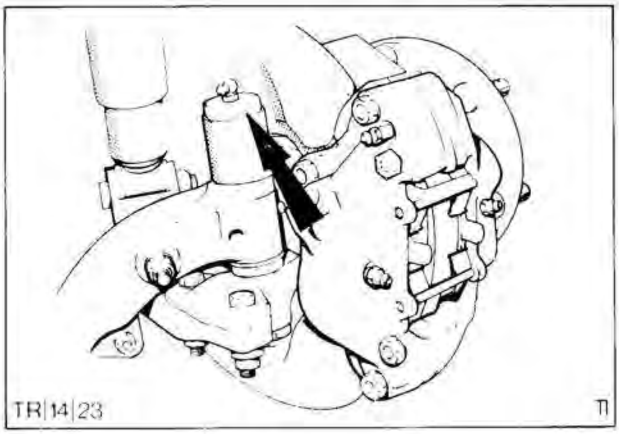


Fig. 23. Removing kingpin nut

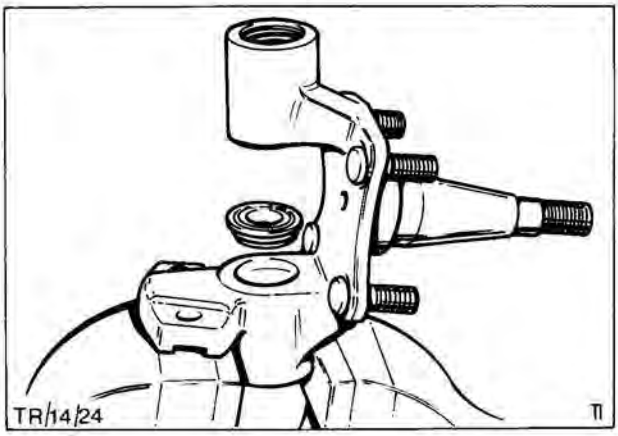


Fig. 24. Removing bearing from lower kingpin hole

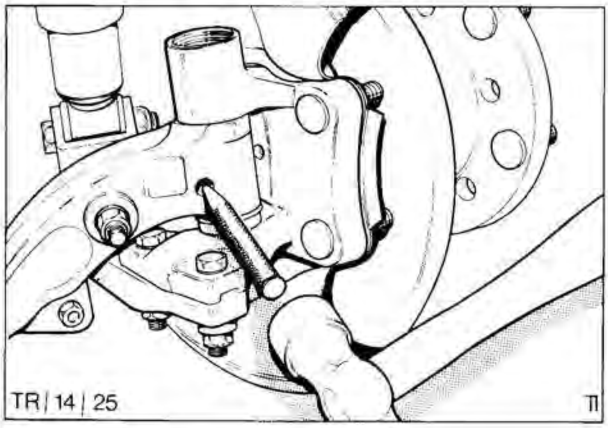


Fig. 25. Refitting cotter pin

25. Vigorously rock hub and disc to settle wheel bearings and then push and pull do not rock the hub and disc in a horizontal plane to feel end float in bearings.

26. The end float should be checked using a dial gauge fastened by a magnetic base or simple bracket fabricated from two nuts, and with the stylus of the gauge positioned against the wheel spindle, Fig. 26.

27. The end float should be between 0,025 to 0,13 mm (0,001 to 0,005 in). If necessary turn the wheel bearing adjusting nut either way until the correct end float is obtained. Remove dial indicator gauge.

28. Fit retainer and new split pin. Fit dust cap. Refit caliper and secure with two bolts. Reconnect fluid tube, bleed brake circuit where applicable. Refer to Operation 12 141.

29. Lower vehicle to ground.

30. Finally tighten wheel nuts to specified torque and fit hub cap.

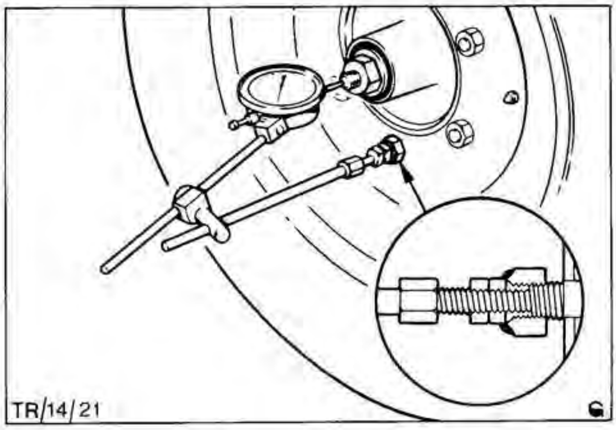


Fig. 26. Dial gauge mounted to check bearing end float

14 365 BUSHES – STUB AXLE – REPLACE

Special Service Tools Required:

Spindle bush remover/replacer	14 011
Spindle bush reamer	14 012

To Remove

1. Remove stub axle assembly as described in Operation 14–363.

2. Place stub axle in a vice, or other suitable fixture, ensuring that jaws are protected.

3. Using Tool No. 14 011 remove upper stub axle bushes from the axle, Fig. 27.

4. Invert stub axle and remove lower bush using Tool No. 14 011.

5. Clean the stub axle prior to fitting new bushes.

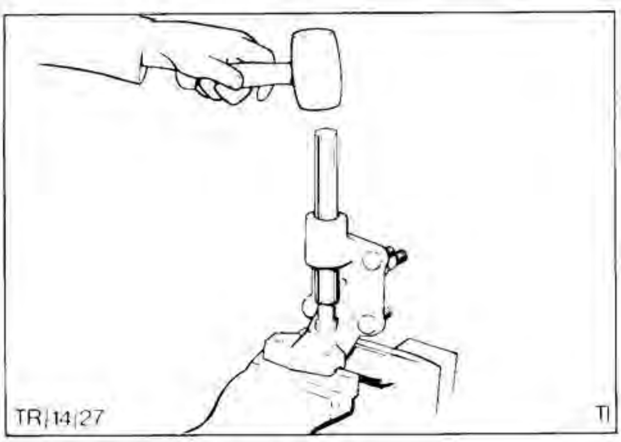


Fig. 27. Removing stub axle bushes

To Replace

6. Using Tool No. 14 011, fit new bush to stub axle ensuring bush is pushed fully home, Fig. 28.
7. Invert stub axle and fit other new bush.
8. Assemble reamer Tool 14 012, and set size of cutting teeth to $21{,}84^{+0{,}02}_{-0{,}00}$ mm ($0{,}86^{+0{,}0007}_{-0{,}00}$ in)
9. Fit reaming guide to the underside of the lower bush hole and pass reamer through the stub axle bushes. The reamer should be lubricated with clean oil to ensure a smooth finish is obtained, Fig. 29.
10. Refit stub axle assembly as described in Operation 14-363.

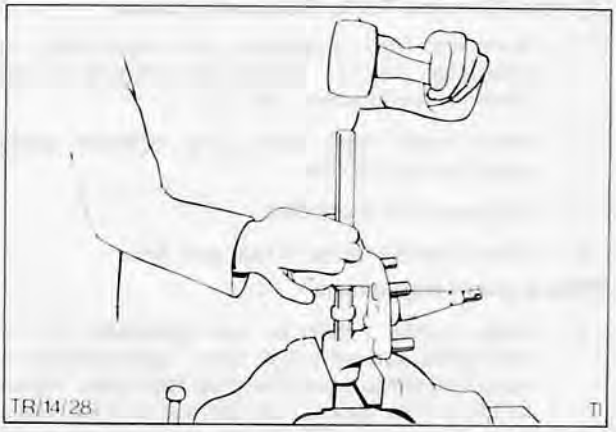


Fig. 28. Replacing stub axle bushes

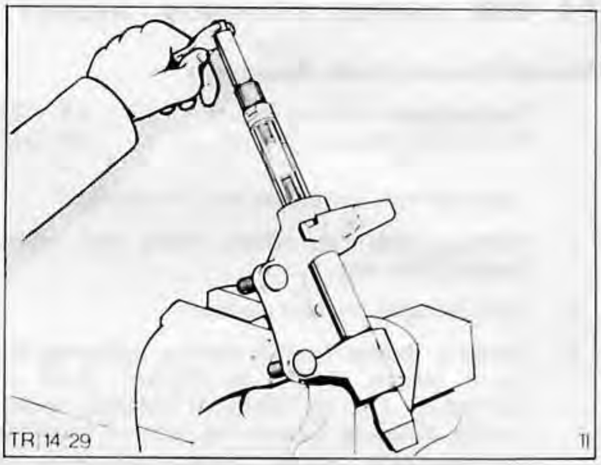


Fig. 29. Reaming stub axle bushes

14 371 HUB ASSEMBLY – FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove hub cap, where fitted, loosen wheel nuts. Raise front of vehicle and fit stands. Remove road wheel.
2. Remove caliper mounting bolts and detach the caliper assembly. Support the caliper clear of the hub assembly by a suitable length of wire. On vehicles with horizontally split braking system, disconnect fluid tube and remove caliper.
3. Remove dust cap from wheel bearing. Remove split pin, nut retainer, nut and washer.
4. Remove hub and disc assembly from stub axle spindle, Fig. 30.

To Install

5. Refit hub and disc assembly onto spindle.
6. Refit washer, adjuster nut.
7. Position caliper, secure with two bolts. Reconnect fluid tube where applicable. Bleed brake circuit. Refer to Operation 12 141.
8. Refit road wheel and tighten wheel nuts.
9. Adjust wheel bearing as described in operation 14-303.
10. Lower vehicle to ground, fully tighten wheel nuts, if applicable refit hub cap.

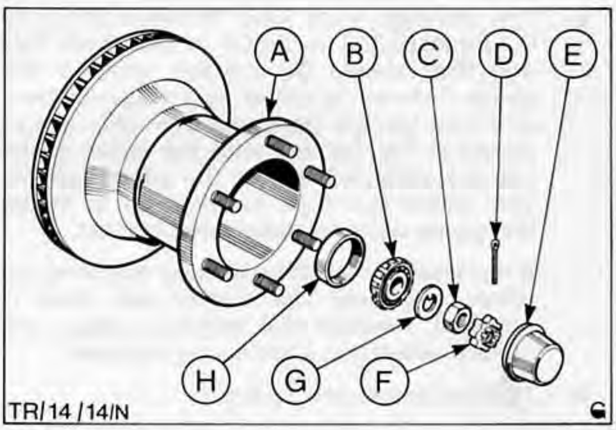


Fig. 30. Front hub and disc assembly

14 371 6 HUB ASSEMBLY – FRONT – REPLACE

Special Service Tools Required: None

1. Remove hub assembly as described in Operation 14-371. Mark both hub and disc to assist in realignment, Fig. 31.
2. Bend back lock tabs and remove bolts securing hub to disc.
3. Separate hub from disc.
4. Clean mating faces of hub and disc.

This is most important

5. Align marks made in sub-operation 1 and refit bolts and new lock tabs. Tighten bolts to specified torque and bend up lock tabs. When fitting a new disc to an old hub or vice versa the disc run-out must be checked as described in Operation 12-221. It may be necessary to rotate the position of the disc relative to the hub to bring the run-out within specification.

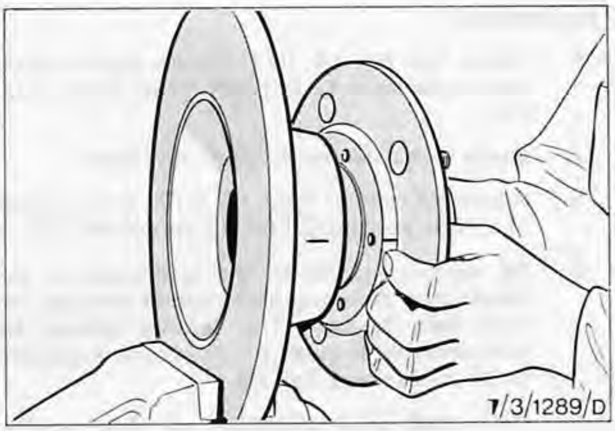


Fig. 31. Front disc and hub aligning marks

14 403 WHEEL BEARINGS – ADJUST

Special Service Tools Required:

Dial indicator holding fixture	15 022
Metric dial indicator gauge	15 046

1. Jack-up front of vehicle and fit stands.
2. Remove hub cap where fitted and wheel bearing dust cap.
3. Remove split pin and retainer.
4. Using a torque wrench tighten adjusting nut to a torque of 23 to 33 Nm (2,35 to 3,5 kgf.m) (17 to 25 lbf.ft) rotating wheel during torquing process to ensure bearings are accurately seated. Slacken adjusting nut by four flats ($\frac{2}{3}$ turns).
5. Vigorously rock wheel to settle wheel bearing, and then holding wheel firmly push and pull **(do not rock)** wheel in a horizontal plane to feel end float in the bearings.
6. The bearings must have between 0,025 to 0,13 mm (0,001 to 0,005 in) end float. This end float should be checked using a dial gauge fastened to wheel by a magnetic base or simple bracket fabricated from two nuts as shown in Fig. 26 and with the stylus of the gauge positioned against the wheel spindle. One wheel nut must be removed to fit the dial gauge using this fabricated bracket.
7. If necessary, turn wheel bearing adjusting nut either way until the correct end float is obtained. Remove dial indicator gauge and replace wheel nut, if previously removed.
8. Fit retainer and new split pin.
9. Fit dust cap and hub cap, where fitted.
10. Remove stands and lower vehicle to ground.

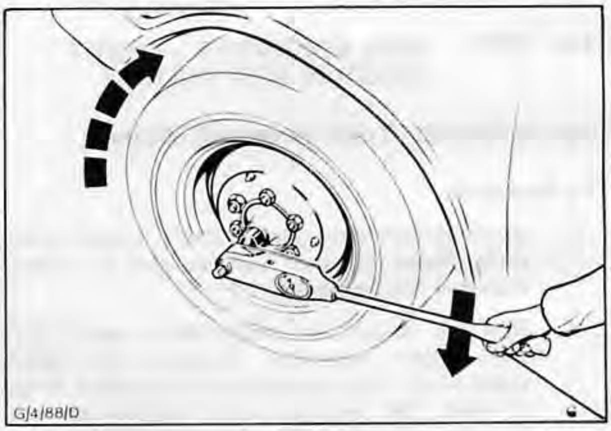


Fig. 32. Torquing front hub bearing whilst rotating wheel

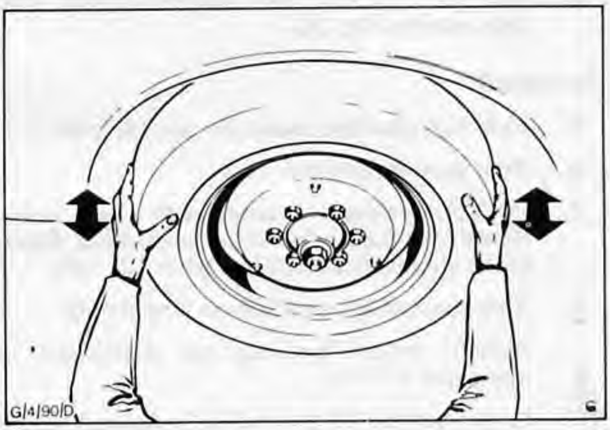


Fig. 33. Feeling end float in front hub bearings

14 411 4 WHEEL BEARINGS REPLACE – INNER AND OUTER (hub assembly removed)

Special Service Tools Required:

Front hub bearing cup replacer 14 010

To Remove

1. Remove outer bearing cone from hub.
2. Lever out grease seal from inner bearing, Fig. 34, and remove inner bearing cone.
3. Drift out both outer races from hub. Use a punch and hammer to tap alternatively at diametric opposite points of the cup, do not allow cup to tilt in hub.

   NOTE: Ensure punch is in good condition and take care not to raise burrs on cup seals as this may prevent new cups from seating properly.
4. Clean hub assembly. Discard old cone and roller assemblies.

To Replace

Note: It is essential to avoid contamination of grease and bearings.

5. Fit both bearing cups using Special Service Tool 14 010 to drift or press each cup firmly into position. Check with feeler gauges that cups are fitting tightly against abutment faces.

   NOTE: Bearing cup and roller bearing assemblies must be from the same manufacturer.
6. Pack cone and roller assemblies with lithium base grease meeting Ford Specification S-MIC-4515-A. Ensure grease is well packed between the roller.
7. Position inner bearing cone. Fit new grease retainer. Apply a light dressing of lithium-based grease between lips of retainer.
8. Fit outer bearing cone into position.
9. Protect all components from dirt or foreign matter until assembled to the vehicle.

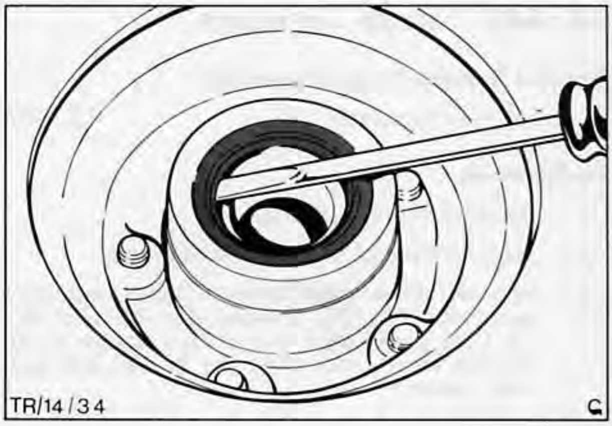


Fig. 34. Levering out grease seal

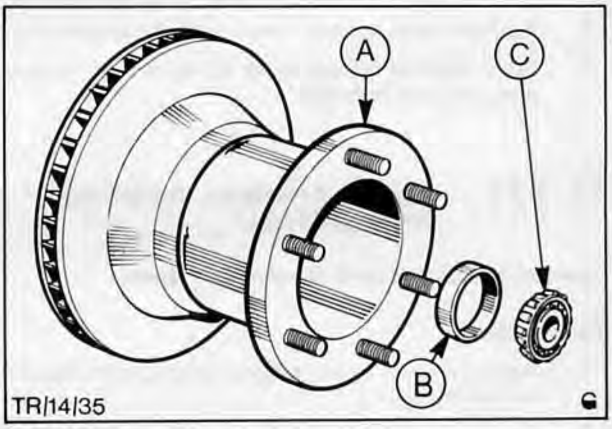


Fig. 35. Front hub and outer race
A – Front hub C – Race
B – Cup

Fig. 36. Refitting inner bearing cup

14 443 STUD – REPLACE

Special Service Tools Required:

Ball joint separator 13 006

To Remove

1. Remove hub cap, if fitted.
2. Jack-up front of vehicle and fit stands.
3. Remove front road wheel. Using ball joint separator, Fig. 37, Special Service Tool No. 13 006 press stud out of hub flange or on models where tool does not fit, tap out stud with mallet.

To Install

4. Lightly lubricate new stud splines, locate stud in its hole and draw it into position using a suitable spacer, and a wheel nut reversed, i.e. tapered face outwards.
5. Fit road wheel, replace wheel nuts.
6. Remove axle stands, lower vehicle to ground.
7. Fully tighten wheel nuts to specified torque and, replace hub cap.

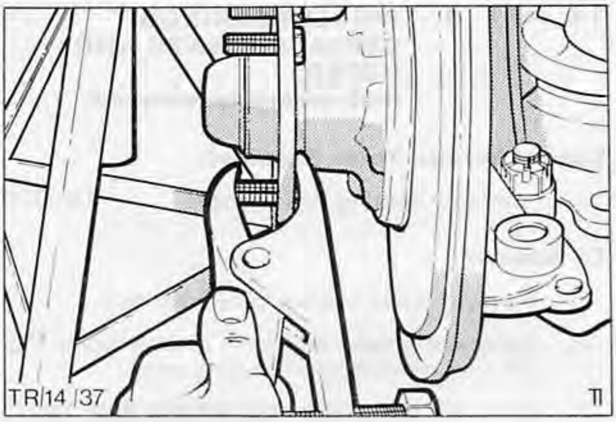


Fig. 37. Removing wheel stud using Special Service Tool 13 006

14 621 FRONT SPRING – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove hub caps where fitted, and loosen wheel nuts.
2. Jack-up vehicle and fit stands at front and remove front road wheels.
3. Remove four nuts from 'U' bolt and remove bolts, wedges and bump rubber.
4. Remove two nuts from rear spring shackle plate, withdraw shackle plate.
5. Remove nut and bolt securing front spring eye to body and remove spring, Fig. 39.

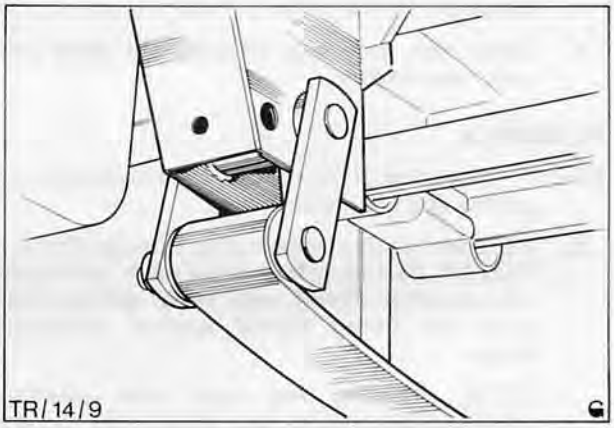


Fig. 38. Rear spring shackle plate

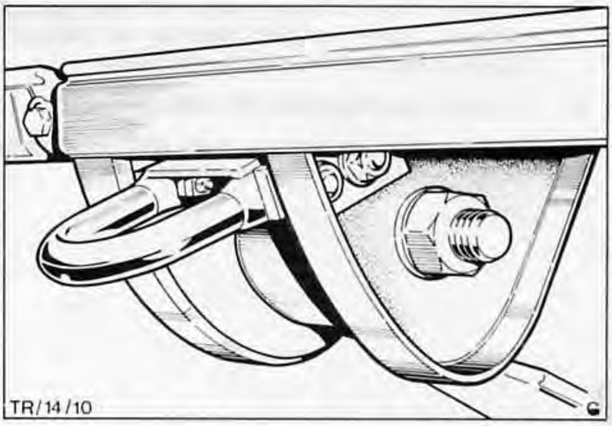


Fig. 39. Front spring eye bolt

To Install

6. Position spring and fit front eye bolt and nut but do not fully tighten.
7. Fit rear spring shackle plate and secure with two nuts, but do not fully tighten.

8. Position bump rubber on spring ensuring packing wedge is correctly positioned between spring and beam with the thicker portion of the wedge rearwards.
9. Secure bump rubber and spring with 'U' bolts. Tighten nuts to secure.
10. Fit front road wheel.
11. Lower vehicle to ground.
12. Tighten rear spring hanger and front eye nuts to the specified torque. Tighten spring 'U' bolts, refer to Technical Data for correct procedure, Fig. 40.
13. Finally tighten wheel nuts and fit hub cap where fitted.

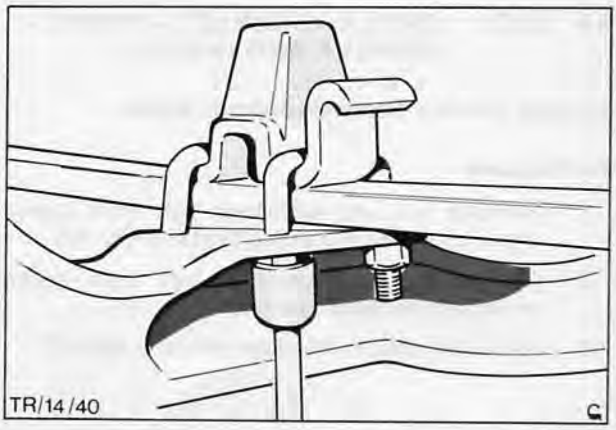


Fig. 40. Tightening spring 'U' bolts

14 653 BUSHES – FRONT SPRING – REPLACE – ALL

Special Service Tools Required: None

To Remove

1. Remove front spring as described in Operation 14-621.
2. Pull out bushes from rear spring eye.
3. Place spring in press and by using a suitable adaptor press out bush from front spring eye.

To Replace

4. Fit new bush to front spring eye using a suitable adaptor and press.
5. Fit new bushes to rear spring eye.
6. Install front spring as described in Operation 14-621

14 673 'U' BOLTS – FRONT SPRING REPLACE

To Remove

1. Jack-up, fit stands.
2. Remove nuts from both 'U' bolts, and remove bolts.

To Replace

3. Install new bolts ensuring bump rubber and packing wedge between spring and axle are correctly positioned, Fig. 41.

   The thicker portion of the wedge faces rearwards.
4. Secure 'U' bolts with nuts and tighten. Nuts must be finally tightened with the vehicle weight on the wheels, refer to Technical Data for correct tightening procedure.
5. Lower vehicle to ground.

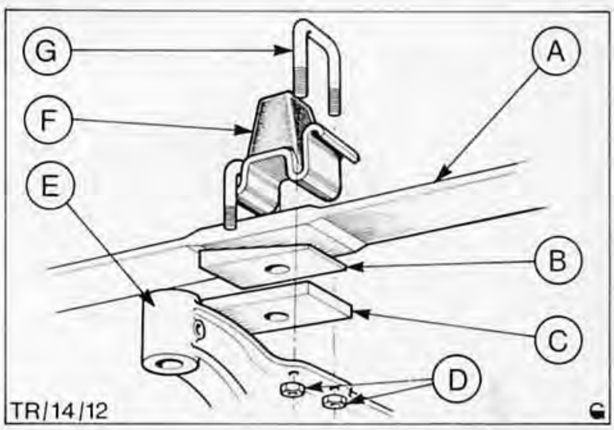


Fig. 41. Front spring and 'U' bolt assembly

14 791 SHOCK ABSORBER – FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove nut and withdraw bolt from upper shock absorber mounting bracket, Fig. 42.
2. Remove nut and withdraw bolt from lower mounting on front axle beam, Fig. 41.
3. Withdraw shock absorber from the vehicle.

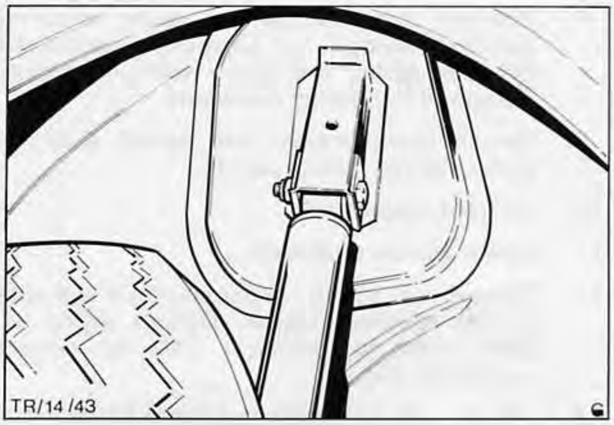


Fig. 42. Shock absorber upper mounting

To Install

4. Position shock absorber on its upper and lower mounting positions.
5. Insert lower mounting bolt from outside to inside, and secure with nut, tightening to the specified torque.
6. Insert upper mounting bolt from rear to front and secure with nut, tightening to the specified torque.

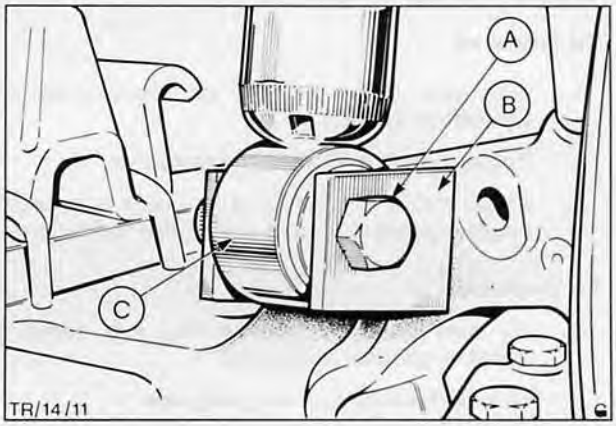


Fig. 43. Shock absorber lower mounting

TECHNICAL DATA

Front Suspension

Suspension type	Forged steel I Section beam supported by semi-elliptic springs. Springs are single rate with a parabollic taper	
Shock absorbers	Telescopic hydraulic double acting	
Castor	75–115	130–190
	5° 45′ max. 3° 15′ min.	6° max. 4° min.
Camber	0° to 1°	
Toe-in	2,38 to 3,97 mm (0,094 to 0,156 in)—Cross ply tyres 0,00 to 1,60 mm (0,00 to 0,063 in)—Radial ply tyres	
Kingpin inclination	5°±10′	
Spindle body to axle beam clearances	0, 1 mm (0,004 in) max. 0,025 mm (0,001 in) min.	

Wheel bearings

Tightening torque	23 to 33 Nm (2,35 to 3,5 kgm) (17 to 25 lbf.ft) Back off nut to give end-float of 0,025 to 0,13 mm (0.001 to 0.005 in)

Front Springs

Type	Semi-elliptic mounted on rubber bushed shackles and pins

Tightening Torques

	Nm	kgf.m	lbf.ft
Shock absorber mounting bolts	70 to 90	7 to 9	51 to 66
Caliper to mounting bracket	90 to 110	9,0 to 11,0	66 to 81
Spring 'U' bolts 1st stage	20 to 25	2.0 to 2,5	15 to 18
2nd stage	40 to 45	4,0 to 4.5	30 to 33
Final stage	54 to 61	5,4 to 6,1	40 to 45
Steering arm to stub axle bolts	55 to 63	5,5 to 6,3	40 to 46
Disc to hub	48 to 62	4,8 to 6,2	37 to 44
Wheel nuts—5 stud wheels	75 to 95	7,5 to 9,5	55 to 70
—6 stud wheels	155 to 180	15,5 to 18,0	114 to 132

FUEL SYSTEM 23A

Index **Page**

GENERAL DESCRIPTION

The fuel system on Transit vehicles comprises 4 major components:

- Carburettor and controls
- Air cleaner
- Fuel pump
- Fuel tank, level indicator, delivery lines.

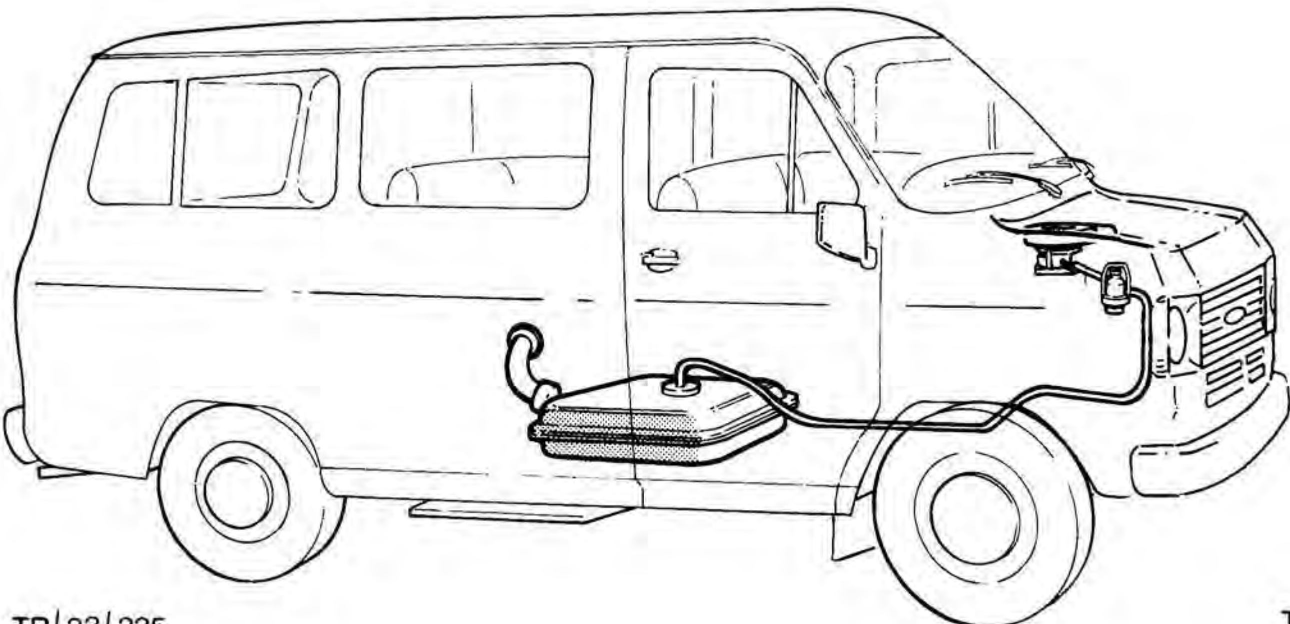


Fig. 1. Fuel system lay-out

The Motorcraft carburettor as fitted to all variants is of a single venturi down draught design which utilises fixed size jet systems. Cold starting is assisted by a choke plate located above the venturi which is operated either by a control mounted on the dash panel or automatically controlled by a 'bi-metal' spring which reacts to the temperature of the coolant. A throttle plate, located at the base of the venturi, controls the volume of air/fuel mixture entering the engine in response to the pedal operated cable.

The idle system on Transit carburettors is fitted with a tamperproof sealing device which has to be destroyed in order to gain access to the idle mixture screw. The objective is to prevent unqualified persons from adjusting the carburettor idle mixture (and hence altering the CO reading) whilst still retaining the adjustment capability for authorised persons in service.

The carburettor is mounted on a water heated cast aluminium inlet manifold which ensures full fuel vaporisation when the engine is at operating temperature.

FUEL (PETROLEUM SPIRIT) HANDLING SAFETY PRECAUTIONS

When carrying out repairs to vehicle fuel systems it is very easy to become complacent about handling fuel particularly in relation to draining fuel tanks. The risks involved should not be under-estimated.

The basic precautions which must be taken if fuel is to be handled safely, and other areas of risk that must not be overlooked, are listed on page 12.

GENERAL DESCRIPTION (cont'd)

The mechanical fuel pump is driven by a lobe on the engine camshaft or auxilliary shaft and draws fuel from the fuel tank, situated on the underside of the body floor pan, and feeds it to the carburettor float chamber.

The quantity of fuel in the tank is measured electrically by a sender unit in the tank and indicated by a gauge on the instrument panel. The fuel gauge is designed to minimise needle fluctuation whilst the vehicle is in motion. With this type of gauge the needle moves slowly taking up to 30 seconds to indicate the true reading after switching on the ignition.

It should be noted that a correctly adjusted fuel system pays a major role in the control of exhaust emission levels, an aspect which is becoming increasingly important as more stringent regulations are introduced. For this reason it is essential that the correct service repair and setting procedures are used in conjunction with the relevant specification in the Technical Data section.

Carburettor, Fig. 2

(Fig. 3 shows a full exploded view of the carburettor)

In addition to the main jet system the carburettor also utilises an accelerator pump which injects a small quantity of fuel into the venturi to ensure a smooth and rapid transition from the idling to the main system. A vacuum operated power valve provides additional enrichment when the engine is operating at high loads.

An important feature of this carburettor is the 'Sonic by pass' idle system. This is designed to provide improved control of air/fuel mixture and consequently reduce CO emissions at idle and small throttle openings.

Consequently the mixture screw will not normally require adjustment and idle adjustment can be confined to the idle speed screw.

If at P.D.I. the idle quality is poor CO meters should not be used and mixture should be adjusted at 50 rpm below the optimum speed. Replacement plugs which have to be fitted in the event that any adjustment should be necessary are available to authorised workshops only.

Fitted to most carburettors is an idle mixture shut off valve mounted into the carburettor idle gallery. When the ignition is switched off a plunger is pushed into the idle gallery, blocking the flow of fuel through the idle system. This prevents the engine from dieseling.

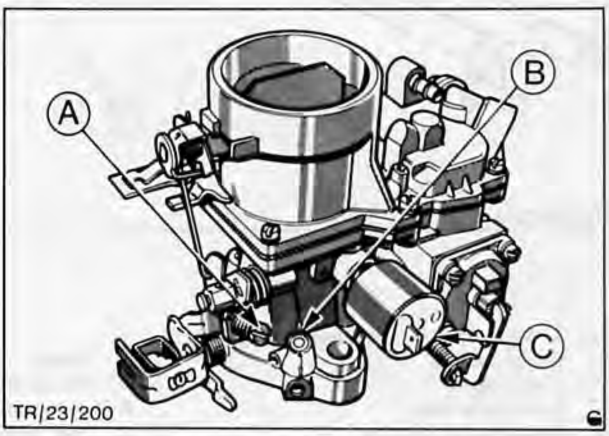


Fig. 2. Motorcraft (IV) carburettor with manual choke
A – Idle speed adjusting screw
B – Tamperproof plug covering idle mixture screw
C – Idle mixture shut off valve

GENERAL DESCRIPTION (cont'd)

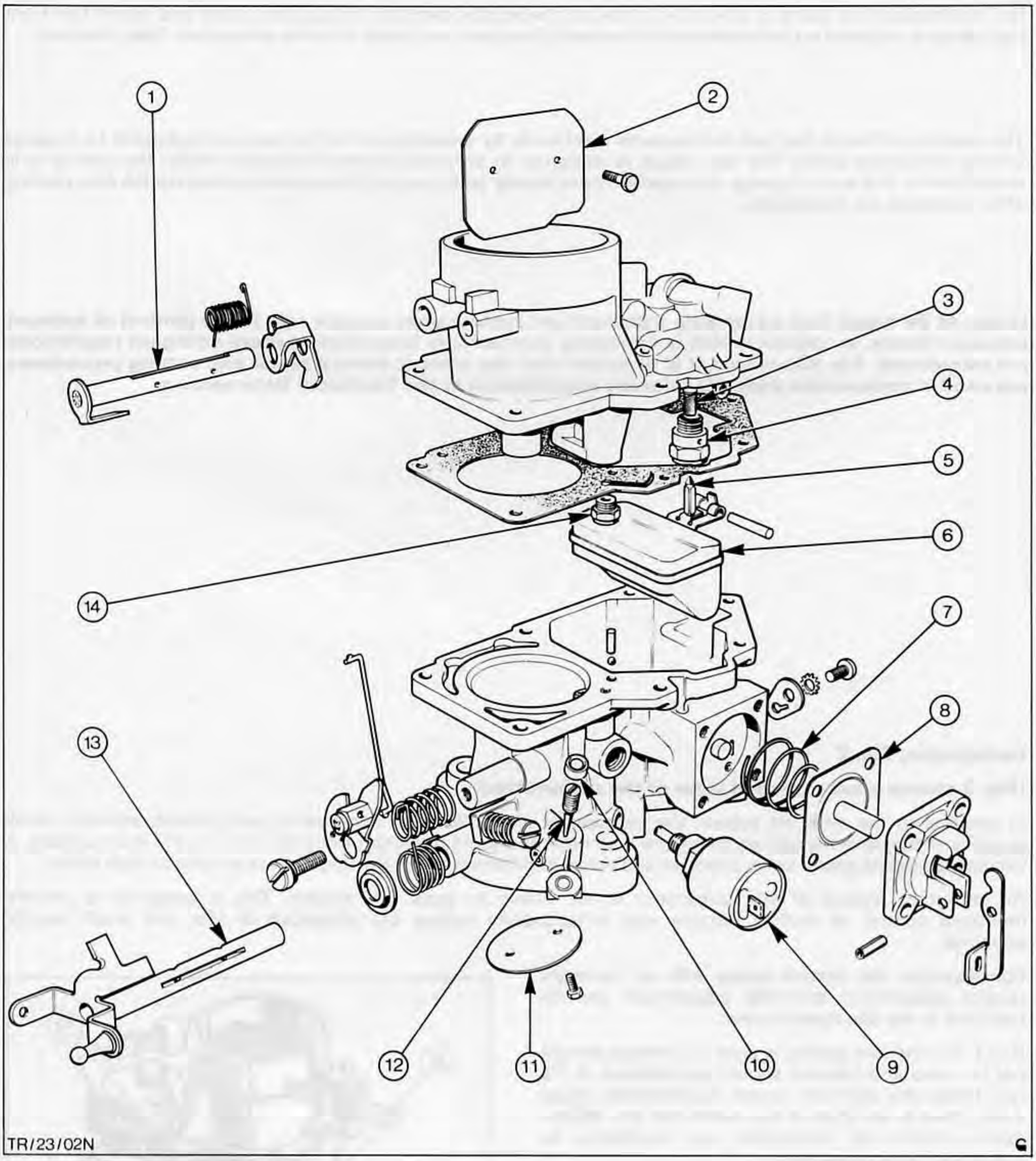


Fig. 3. Motorcraft manual choke carburettor

1. Choke spindle
2. Choke plate
3. Fuel intake filter
4. Needle valve housing
5. Needle valve
6. Float
7. Pump return spring
8. Accelerator pump diaphragm
9. Idle mixture shut off valve
10. Tamperproof seal
11. Throttle plate
12. Mixture screw
13. Throttle spindle
14. Main jet

General Description (cont'd)

Air Cleaners, Fig. 4

The air cleaners fitted on the Transit range use a paper filter element which should be changed at the specified service intervals. The cleaner is of the swing spout type which can be set for Summer or Winter use.

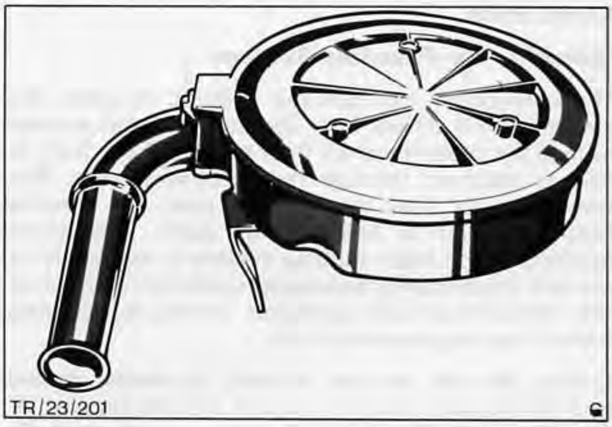


Fig. 4. Air cleaner Assembly
(OHC Type Illustrated)

Fuel Pump, Fig. 5

The mechanical type fuel pump is mounted on the left hand side of the cylinder block and incorporates a nylon mesh filter located in the pump top cover.

With the exception of the seal and filter the pump is a sealed unit and cannot be overhauled.

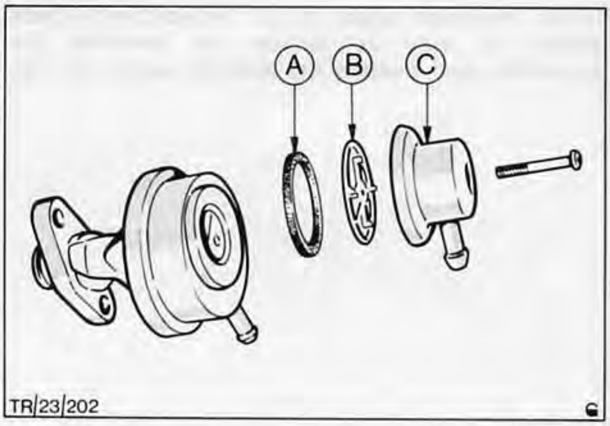


Fig. 5. Fuel pump assembly
A – Seal
B – Nylon mesh filter
C – Pump cover

Fuel Tank, Fig. 6

The fuel tank is located on the underside of the body floor pan and is held in position by two straps. A combined fuel outlet and sender unit is located on the top face of the tank and cannot be removed without first removing tank.

The filler neck protrudes through the left hand quarter panel. Ventilation is by means of a breather pipe located on the upper surface of the tank. When draining the tank the vehicle should be parked outside at least 7m (20 ft) from any building. Also fuel should be pumped into a clean closed container. Details of fuel handling safety precaution are shown on page 12.

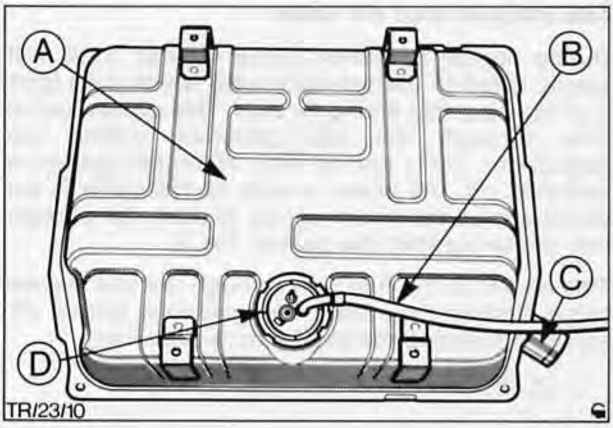


Fig. 6. Fuel tank assembly
A – Tank
B – Ventilation pipe
C – Fuel filler pipe
D – Tank sender unit

PRINCIPLE OF OPERATION

Carburettor

'Sonic' or By-Pass Idle System

The carburettor incorporates a Sonic by-pass idle system which differs from the conventional system in that the majority of air flow and all of the fuel, at idle, is obtained through the by-pass system. The remaining air flow is provided past the throttle butterfly which is held slightly open. This small opening of the main throttle system is necessary to prevent the butterfly becoming siezed in the bore as the carburettor body contracts during the cooling period after engine switch off.

During idle the throttle butterfly is almost closed and air is drawn into the by-pass system at point 'A' Figs. 7 and 8. The air travels along the channel 'E', mixes with the rich air/fuel mixture obtained via the mixture screw 'C' and the air/fuel mixture is drawn into the engine through the sonic discharge tube 'B'.

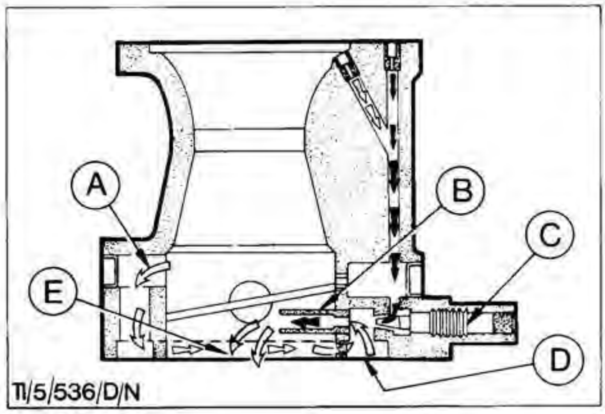


Fig. 7. 'By-pass' idle system
A – Air entry to by-pass system
B – Sonic discharge tube
C – Idle mixture screw
D – Air/fuel mixing chamber
E – Air distribution channel

NOTE: The point where the air enters the by-pass system 'A' may be located by inverting the carburettor and holding the throttle open, see Fig. 8.

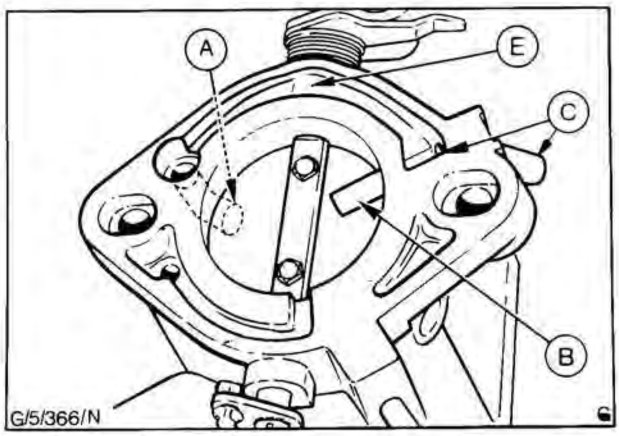


Fig. 8. 'By-pass' idle system
A – Air entry into by-pass system
B – Sonic discharge tube
C – Idle mixture screw
D – Air distribution channel

Idle mixture shut off valve

During normal operation of the vehicle, a 12 volt supply is fed to the solenoid valve which pulls back a plunger against spring tension. This allows fuel to flow through the idle galleries, within the carburettor, in the normal way. When the ignition is switched off, the power supply to the valve is cut which allows the return spring to push the plunger into the carburettor idle gallery, Fig. 9.

This results in the fuel flow through the idle system being blocked the instant the ignition is turned off, and so preventing the engine from dieselling.

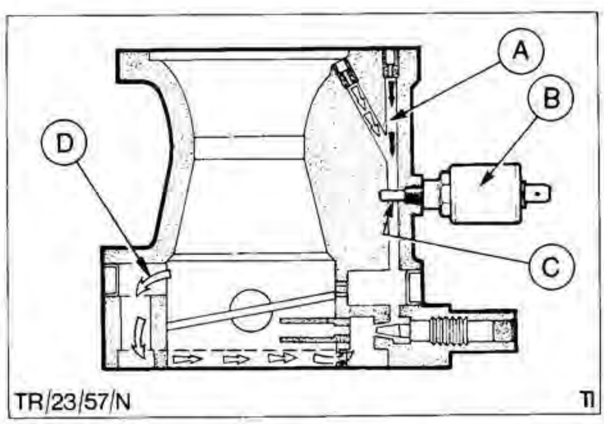


Fig. 9. Idle mixture shut off valve
A – Idle gallery
B – Anti-dieselling valve
C – Plunger blocking idle gallery
D – Air intake to by-pass idle system

PRINCIPLE OF OPERATION (cont'd)

Fuel Pump, Figs. 10 and 11

The pump consists of a diaphragm, push rod, filter, 2 one way valves and return and pressure control springs. The pump push rod rests on the end of a second push rod actuated by an eccentric cam. The cam rotates until the pump rod is pushed in. As the cam rotates through 180° the push rod is returned by a spring causing fuel to be drawn into the pump via a one way valve, A in Fig. 10. As the cam completes 360° the push rod is pushed in forcing fuel out of the pump via a second one way valve, D in Fig. 11.

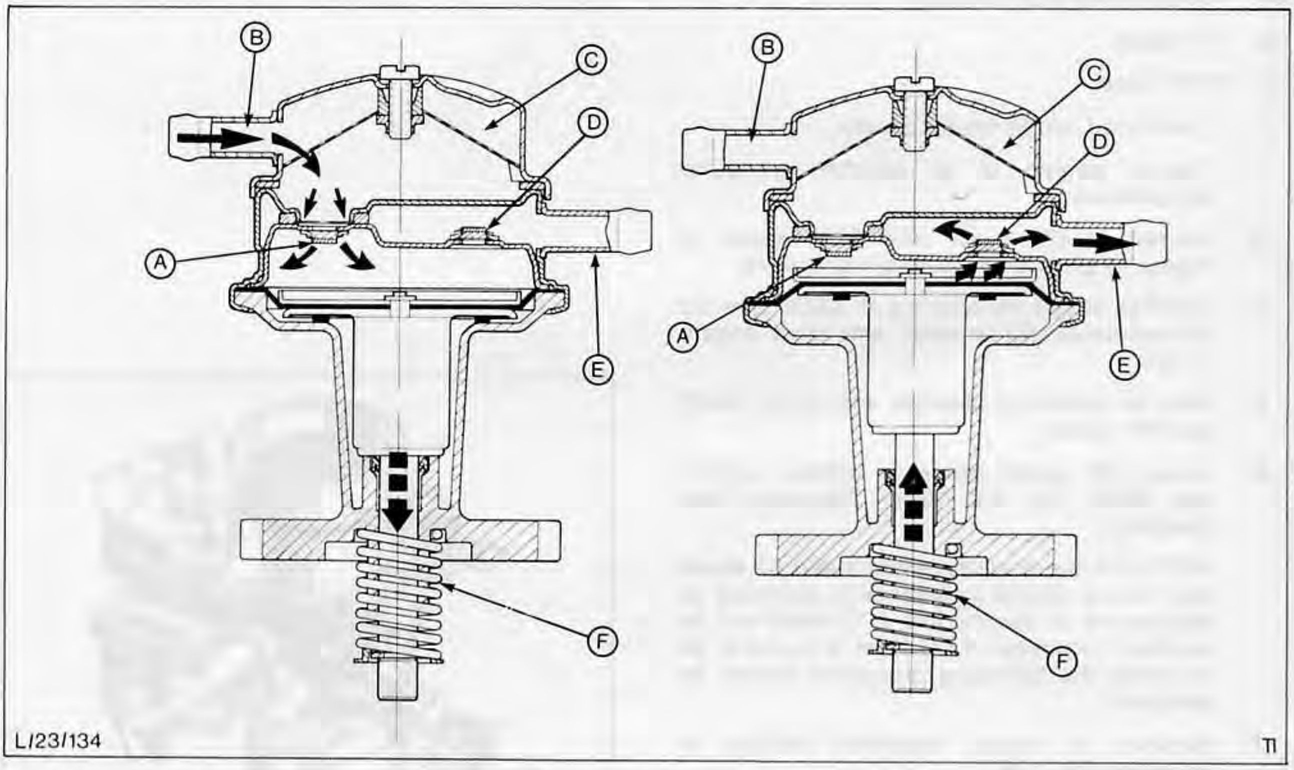


Fig. 10. Fuel drawn into pump
A – One way valve (fuel intake)
B – Fuel inlet connection
C – Fuel filter

Fig. 11. Fuel being discharged from pump
D – One way valve (fuel outlet)
E – Fuel outlet connection
F – Operating rod return spring

Fuel Tank

Tanker Sender Unit, Fig. 12

As the level in the fuel tank fluctuates, the sender unit float rises or falls and alters the resistance of the rheostat from which it is pivoted. The bi-metal type fuel gauge is actuated by the resulting variation in voltage.

Ventilation

As the fuel level in the tank falls air must be vented into the tank to ensure that a partial vacuum is not created. Ventilation for the Transit is by means of a vent pipe secured to the top face of the tank and open to atmosphere.

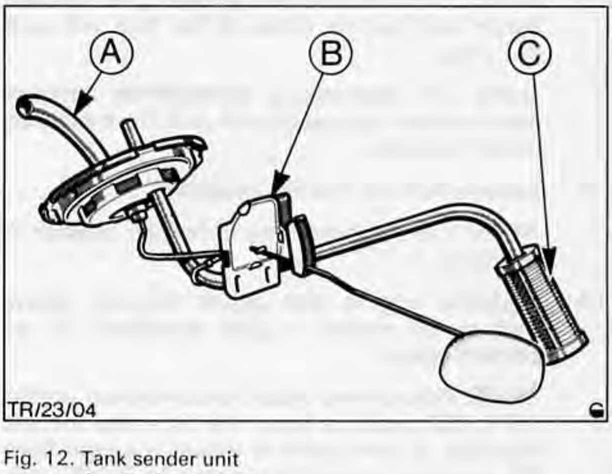


Fig. 12. Tank sender unit
A – Fuel outlet pipe
B – Rheostat
C – Filter

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals, the carburettor normal idle and mixture and fast idle settings should be checked and if necessary adjusted as detailed below. A check should also be made of the entire fuel system for evidence of fuel leaks, and if any leaks are found, they should be rectified immediately.

CARBURETTOR – ADJUST

Special Equipment Require:

(a) Tamperproof plug remover

(b) CO meter

(c) RPM meter

1. Open hood and fit fender covers.
2. Ensure engine is at normal operating temperature.
3. Connect a CO meter and RPM meter to engine as per manufacturers instructions.
4. Stabilise engine by running at 3,000 rpm for approximately 30 seconds and allow engine to idle.
5. Wait for meters to stabilise and record % CO and idle speed.
6. Adjust idle speed screw to achieve correct idle RPM, Fig. 13. (Refer Technical Data Section.)

   NOTE: On these carburettors it will be found that during routine maintenance servicing no adjustment of the mixture (CO level) will be required. However, if CO level is found to be incorrect the following procedure should be adopted.
7. Remove air cleaner assembly detailed in operation 23 174.
8. Using remover, Fig 20, detach tamperproof plug as follows, Fig. 14.

   Position tool in centre of plug and break through the centre section. Screw in the tool and detach plug.

   NOTE: Tool will bottom against the mixture screw and further turns of the tool will pull out plug.

   Using an electrician's screwdriver remove centre knock out section of plug from mixture screw housing.
9. Loosely refit air cleaner assembly.

   NOTE: It is not necessary to bolt air cleaner in position.
10. Stabilise engine and adjust mixture screw and speed screw to give specified CO at correct speed.

    NOTE: Adjustment must be carried out within 10 to 30 seconds from the time the meters stabilise. If time taken to adjust is longer than 30 seconds, rev engine again to 3,000 rpm for 30 seconds and re-check.
11. Re-check idle speed and CO and re-adjust as necessary.

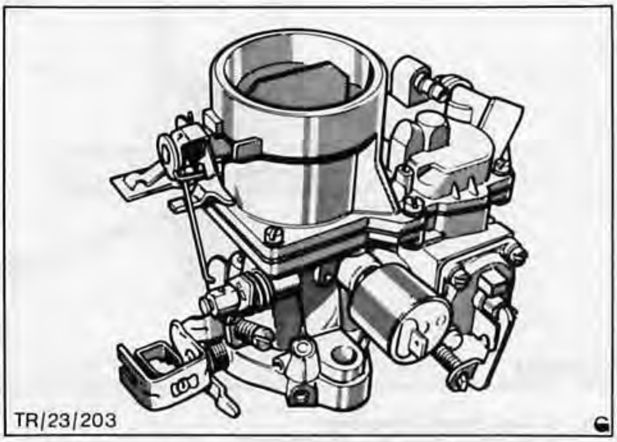


Fig. 13. Motorcraft manual choke carburettor (By-pass idle)
A – Idle speed adjusting screw

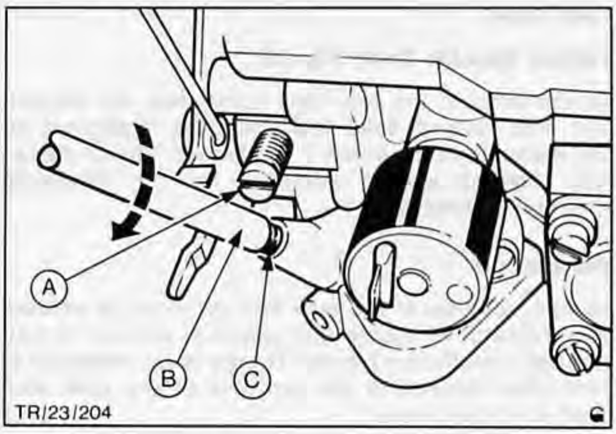


Fig. 14. Plug removal
A – Speed adjusting screw
B – Remover in position through plug
C – Tamperproof plug

SERVICE ADJUSTMENTS AND CHECKS (cont'd)

12. Replace tamperproof plug as follows:

    Remove air cleaner assembly.

    Position new plug on housing and tap home.

    NOTE: On some models a punch will be required for tapping plug fully in position.

    Plug should finally be positioned flush with housing, Fig. 15.

    The service replacement plugs are blue in colour.

    Refit air cleaner assembly.

13. Remove fender covers and close hood.

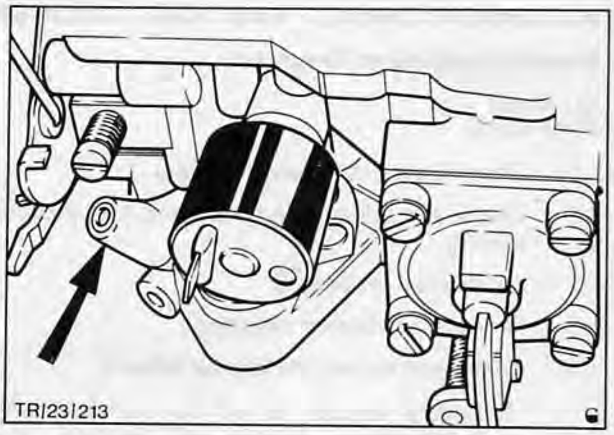


Fig. 15. Tamper proof plug fully installed
Note: Plug flush with housing

MANUAL CHOKE – FAST IDLE – ADJUST

(Air cleaner removed)

Special Equipment Required:

CO Meter
RPM Meter

1. Check and adjust idle speed and fuel mixture setting. As detailed on page 8.
2. Check and adjust choke pull down setting as follows:

   Hold choke mechanism in the fully closed position, by rotating cam on its stop. Open choke plate against spring tension up to stop and measure clearance between down draught side of choke plate and air horn with a guage rod or twist drill shank.

   Adjustment is carried out by bending tag marked, Fig. 16.

   Refer Technical Data.

3. Check and adjust fast idle as follows:

   With engine at normal operating temperature manually hold **choke plate** fully open and operate **choke control mechanism** as far as possible without altering choke plate position.

   NOTE: This will be approximately $\frac{1}{3}$ of total choke control travel.

   Hold choke plate open and record fast idle.

   Stop engine and adjust as required by bending tag shown in Fig. 17.

4. Recheck fast idle.
5. Recheck basic idle speed.

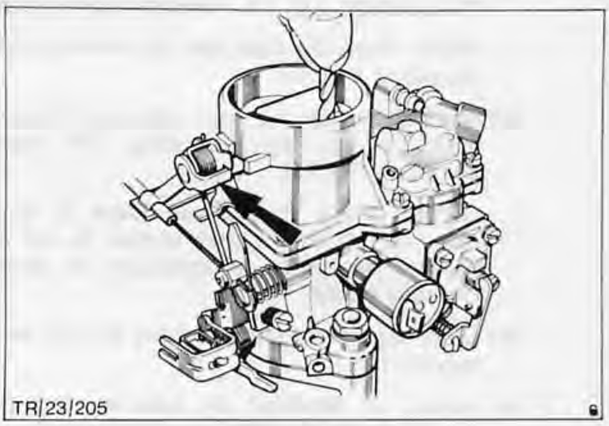


Fig. 16. Choke mechanism held in closed position to check choke plate pull down. Adjusting tag marked

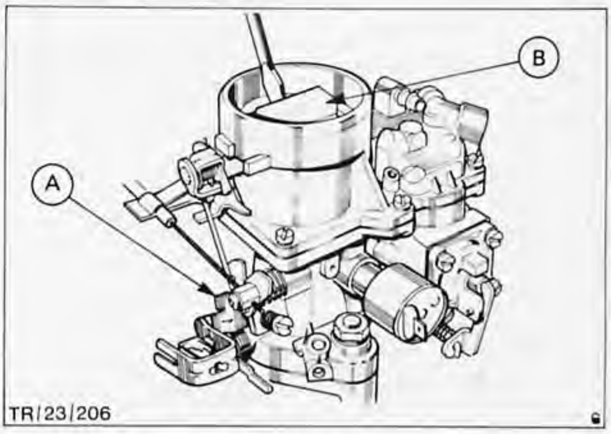


Fig. 17. Carburettor set for fast idle check
A – Adjusting tag B – Choke plate held open

SERVICE ADJUSTMENTS AND CHECKS (cont'd)

AUTOMATIC CHOKE – FAST IDLE – ADJUST

Special Equipment Required:

CO Meter
RPM Meter

1. Open hood and fit fender covers.
2. Check and adjust idle speed and fuel mixture setting.

   As detailed on page 8.
3. Remove air cleaner assembly.
4. Check and adjust fast idle as follows:
   - (i) Ensure engine is at normal operating temperature. Switch off ignition and connect a tachometer to engine.
   - (ii) Manually hold choke plate fully closed, then partially open throttle to allow fast idle cam to locate in the 'high cam' position. Release throttle to hold cam in this position, Fig. 18. Release choke plate.

     NOTE: Fast idle cam can be viewed with the aid of a mirror.
   - (iii) Manually push the fast idle cam downwards on to the first step. ('V' mark position), Fig. 19.

     NOTE: Check that choke plate is fully open, if not then either engine is not at normal operating temperature or auto-choke is faulty.
   - (iv) Start engine without touching throttle and record rpm.
   - (v) Adjust as required by bending tag on throttle lever, Fig. 19.
     To bend tag either use a pair of pliers, or to make adjustment easier make up a special tool as shown on page 11.
5. Refit air cleaner assembly.
6. Remove fender covers and close hood.

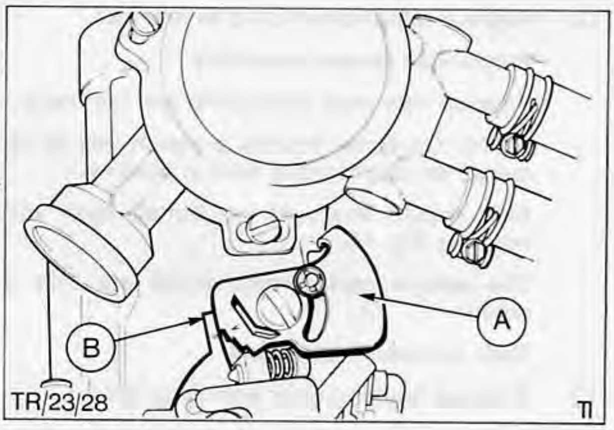


Fig. 18. Auto-choke mechanism set in the 'high cam' position
A – Fast idle cam
B – Choke set on 'high cam'
(Carburettor viewed from the rear)

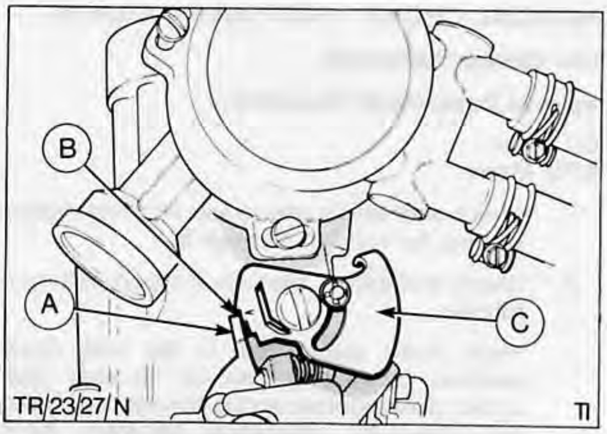
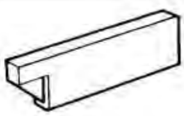
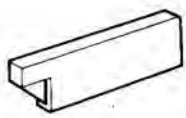
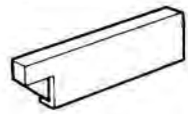


Fig. 19. Auto-choke mechanism set in the 'fast idle' position
('V' mark lined up with top of throttle lever)
A – Adjusting lever
B – Choke set on 'V' mark (Fast idle)
C – Fast idle cam

SPECIAL SERVICE TOOL RECOGNITION

British Sourced	European Sourced	German Sourced	Tool Name
 23-009	 23-009	 23-009	Fuel tank fender unit lock ring wrench
		 GH-9552	Choke control wrench
 MS-69	 23-010	 23-010	Vacuum pull down weight

F/23/18

Carburettor Service Tools

A. Tamperproof plug remover.

Although only the speed screw will normally require adjustment, should it be required to adjust the idle CO the tamper-proof plug must be removed.

A useful tool to facilitate removal of the plug can be readily fabricated as follows, Fig. 20.

(i) Obtain

(a) A thin bladed screwdriver with a minimum overall length of 260 mm (10.2 in).

(b) A Taunus Cortina lower trim panel retaining screw or similar.

NOTE: These screws are ideal as they have a lead in chamfered on the end which will ensure, when tool is used, that mixture screw is not damaged.

(ii) Cut down screwdriver to give an overall length of 240 mm (9.5 in).

(iii) Cut down the chamfered end of the screws to give a 2 mm (0.08 in) lead in section.

(iv) Grind off head of screw and braze in position on the end of the screw-driver ensuring overall length is 260 mm (10.2 in) ± 5 mm (0.2 in).

B. Fast Idle adjuster.

To adjust fast idle on Motorcraft carburettors a tag, located on the throttle lever, has to be bent. Although pliers can be used for this operation a tool made up to the dimensions shown in Fig. 21 will make the operation easier.

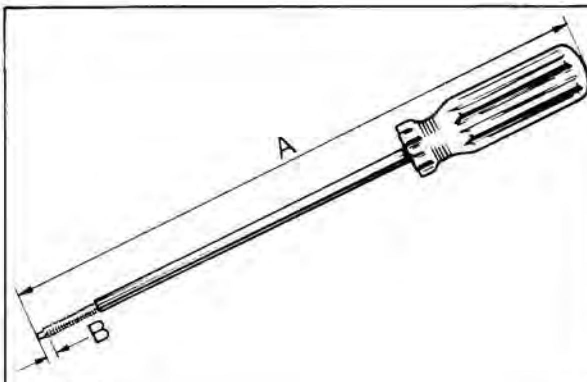


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Fig. 20. Motorcraft tamperproof plug remover
Dimension
A – 260 mm (10.2 in) ± 5 mm (0.2 in)
B – 2 mm (0.08 in)

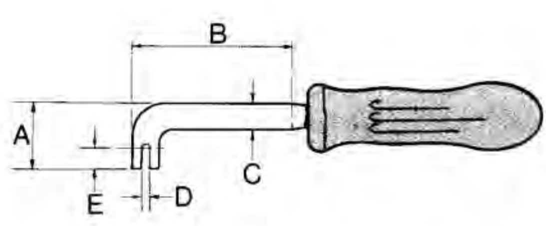

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Fig. 21. Special tool for fast idle adjustment
A – 25 mm (1.0 in)
B – 50 mm (2.0 in)
C – 10 mm (0.38 in)
D – 2.5 mm (0.1 in)
E – 8.0 mm (0.32 in)

FUEL (PETROLEUM SPIRIT) HANDLING SAFETY PRECAUTIONS

When carrying out repairs to vehicle fuel systems it is very easy to become complacent about handling fuel, particularly in relation to draining fuel tanks. The risks involved should not be under-estimated. The following information provides the basic precautions which must be taken if fuel is to be handled safely and points out some other areas of risk that must not be overlooked.

1. Disconnect the battery when carrying out any work on fuel systems.
2. Always empty fuel tanks in the open, preferably in a designated no-smoking area. If this is not possible portable warning notices should be positioned around the vehicle when carrying out the draining operation.
3. Always have a suitable fire extinguisher close at hand.
4. Empty the tank using suitable pumping equipment, not by disconnecting the fuel line from the sender unit.
5. Ensure there are no naked lights or other ignition sources (i.e. welding equipment) within 7 metres (20 feet) of the vehicle, before commencing the emptying process.
6. Do not empty the tank over an inspection pit. Petrol vapour is heavier than air and will remain in a pit for several hours. This also applies when removing carburettor float bowls or fuel pumps as small amounts of petrol can produce sufficient vapour to constitute a source of risk.
7. Empty the fuel into a closed, clearly marked container. There are containers on the market which are specifically suited to this purpose incorporating such devices as a flame arrestor and a pressure vented cap.
8. Having removed the fuel, do not leave it standing in the workshop. Petrol should only be kept in a store which meets with the approval of local by-laws and/or National legislation.

SERVICE AND REPAIR OPERATIONS – CONTENT

FUEL SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76/Cortina '77	Granada '78
23 122	Fuel system and carburettor – clean	X		X					
23 174	Air cleaner assembly – remove and install	X		X	X	X	X	X	
23 184	Element – cleaner – replace	X		X	X	X	X	X	
23 212	Carburettor – clean – Motorcraft	X		X	X	X	X	X	
23 213	Carburettor – adjust – Motorcraft	X		X	X	X	X	X	
23 217 4	Manual choke – fast idle – adjust – Motorcraft	X		X	X	X	X	X	
23 224	Carburettor – remove and install – Motorcraft	X		X	X	X	X	X	
23 224 6	Carburettor – clean – inspect and adjust – Motorcraft (Carburettor removed)	X		X	X	X	X	X	
23 244	Needle valve – replace – Motorcraft	X		X	X	X	X	X	

SERVICE AND REPAIR OPERATION CONTENT (con't)

FUEL SYSTEM (cont'd)		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range: Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76/Cortina '77	Granada '78
23 271	Automatic choke fast idle – adjust	X		X		X	X	X	
23 274	Automatic choke – adjust	X		X		X	X	X	
23 278	Automatic choke – overhaul	X		X		X	X	X	
23 283	Hose – automatic – choke – replace (one)	X		X		X	X	X	
23 284	Hose – automatic – choke – replace (both)		23 283						
23 531	Fuel pump delivery pressure – check	X		X	X	X	X	X	X
23 532	Fuel pump – clean	X		X	X	X	X	X	X
23 534	Fuel pump – remove and install	X		X	X	X	X	X	X
23 534 4	Fuel pump – remove and install (engine removed)		23 534						
23 552 2	Fuel tank – clean (fuel tank removed)		23 122						
23 554	Fuel tank – remove and install	X		X					
23 558	Ventilation tube – fuel tank – remove and install		23 554						
23 572	Fuel tank – filler pipe – remove and install	X		X					
23 572 4	Fuel tank – filler pipe – remove and install (Fuel tank removed)		23 572						
23 581 2	Fuel line – clean		23 122						
23 583	Fuel line – fuel tank to pump – remove and install	X		X					
23 583 4	Fuel line – fuel tank to pump – remove and install		23 583						
23 587	Fuel line – fuel pump to carburettor remove and install	X		X					
23 598	Hose – fuel line connecting – replace (One)		23 583						
23 811	Linkage – accelerator – adjust	X		X					
23 822	Pedal – accelerator – remove and install	X		X					
23 824	Accelerator shaft – remove and install	X		X					
23 826	Cable – accelerator – remove and install	X		X					
23 872	Manual choke control – adjust	X		X	X	X	X	X	
23 874	Choke control cable – remove and install	X		X					

23 122 FUEL SYSTEM AND CARBURETTOR – CLEAN

Special Service Tools Required:

Fuel tank sender unit wrench 23–009

Special Equipment Required:

CO Meter

RPM Meter

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 174.
4. Disconnect fuel supply pipe at carburettor.

   If a crimped type hose is fitted it must be cut free and replaced with a screw type hose clamp, Fig. 22.
5. Disconnect fuel pump outlet pipe at pump and detach fuel pipe.
6. Strip down carburettor ready to clean.

   Detailed in Operation 23 212.
7. Disconnect fuel pump inlet pipe at pump.
8. Remove fuel pump cover and detach filter.

   Detailed in Operation 23 532.
9. Remove fuel tank assembly.

   Detailed in Operation 23 554.
10. Clean complete fuel system.

    Extreme care must be taken to ensure that fire risk is kept to a minimum.

    Wash out tank with clean petrol.

    Using wrench No. 23–009 remove tank sender unit, clean filter and refit sender unit with a new seal.

    Clean carburettor and pump as detailed in Operations 23 212 and 23 532 respectively.

    Clean fuel lines with compressed air.
11. Refit fuel tank assembly.

    Detailed in Operation 23 554.
12. Reassemble pump filter to cover and refit assembly to pump, Fig. 23.

    NOTE: Ensure seal is not damaged.
13. Reconnect pump inlet hose, Fig. 22.
14. Reconnect pump outlet hose.

    Refer sub-operation 4 and Fig. 22.
15. Reassemble carburettor.

    Detailed in Operation 23 212.

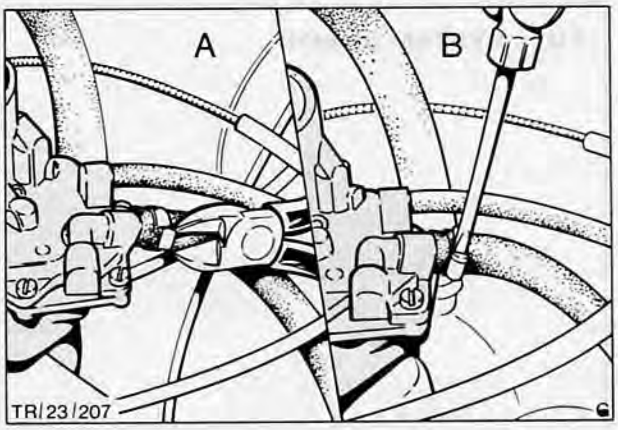


Fig. 22. Disconnecting and reconnecting carburettor supply pipe
A – Crimped type hose clamp
B – Screw type hose clamp

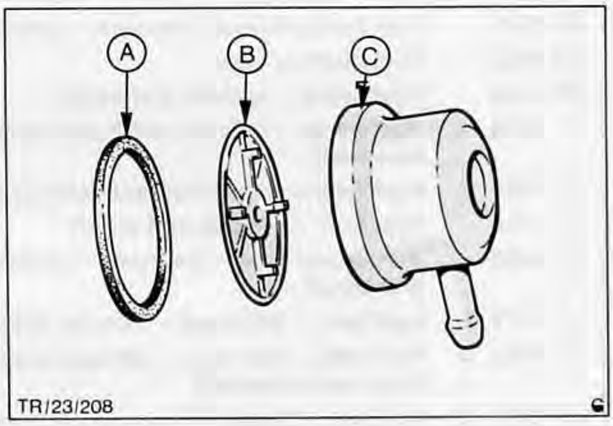
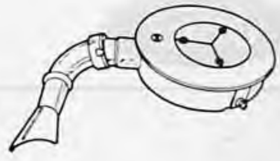


Fig. 23. Fuel pump assembly
A – Seal
B – Filter
C – Pump cover

16. Reconnect carburettor supply hose.
17. Refit air cleaner assembly.
18. Refill tank with clean petrol.
19. Reconnect battery.
20. Check and adjust engine idle speed and fuel mixture setting.

    Detailed in Operation 23 213.
21. Remove fender covers and close hood.



23 174 AIR CLEANER ASSEMBLY REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   1.6 litre Kent OHV
   Using a screwdriver carefully prise out three mounting stays clear of air cleaner.

   1.6 and 2.0 litre OHC
   Remove one bolt and loosen cleaner to manifold clamp.
4. Remove air cleaner element.

   Detailed in operation 23 184.

To Install

5. Refit element to air cleaner body.
6. Refit air cleaner assembly in reverse order as shown in sub operation 3.
7. Reconnect battery.
8. Remove fender covers and close hood.

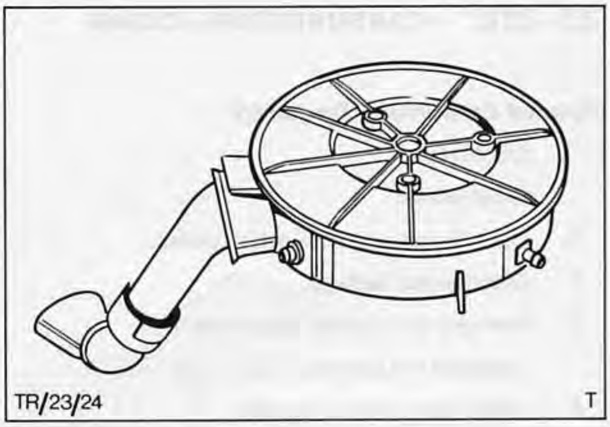


Fig. 24. Air cleaner assembly 1.6 litre Kent (OHV)

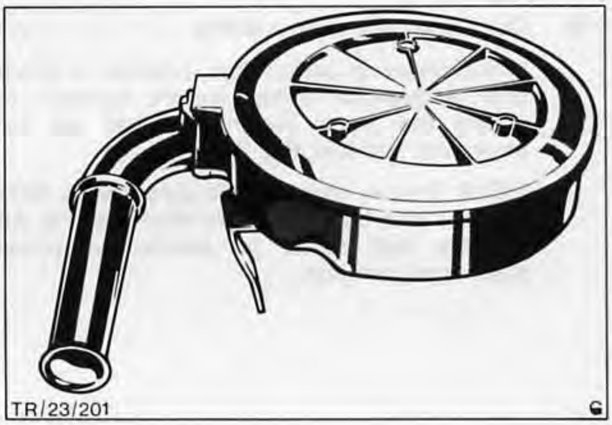


Fig. 25. Air cleaner assembly (OHC)

23 184 ELEMENT AIR CLEANER REPLACE

Special Service Tools Required: None

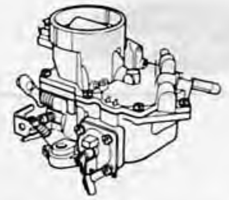
To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove three self tapping, screws, unclip lid and detach element, Fig. 26.

To Install

4. Refit air cleaner in reverse order shown in sub-operation 3 ensuring lid fully clips onto cleaner base.
5. Reconnect battery.
6. Remove fender covers and close hood.

Fig. 26. Air cleaner element removal



23 212 CARBURETTOR – CLEAN

Special Equipment Required:

CO Meter

RPM Meter

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 173.
4. Clean carburettor exterior.
5. Disconnect fuel bowl vent tube.
6. Remove seven screws, lift off carburettor upper body, disconnect choke link and position clear of carburettor, Fig. 27.
7. Soak out fuel from float chamber.
8. Clean float chamber and jets.

   When cleaning carburettor, position a finger over accelerator pump weight location to ensure that valve weight and ball are not blown out and lost, Fig. 28.

   NOTE: Ensure that full air pressure **is** NOT directed into bleed location shown in Fig. 28 as this will result in accelerator pump diaphragm damage.

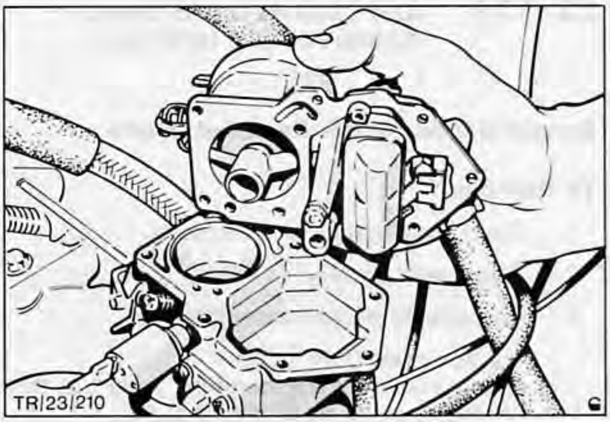


Fig. 27. Removal of carburettor upper body

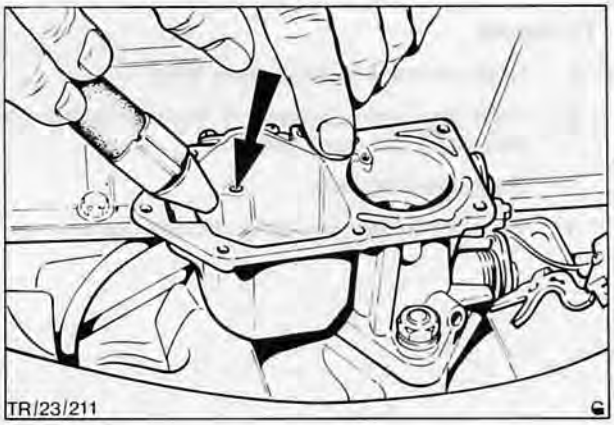


Fig. 28. Accelerator ball valve and weight held in position when cleaning
Accelerator pump bleed arrowed

9. Refit carburettor upper body as follows.

   Reconnect choke link, position gasket and upper body and secure. For vehicles with manual choke when positioning upper body hold choke mechanism in the fully closed position. This ensures that choke cam does not over-centre when upper body is installed, Fig. 29.
10. Reconnect fuel bowl vent tube.
11. Refit air cleaner assembly.
12. Reconnect battery.
13. Check and adjust engine idle speed and fuel mixture setting.

    Detailed in Operation 23 213.
14. Remove fender covers and close hood.

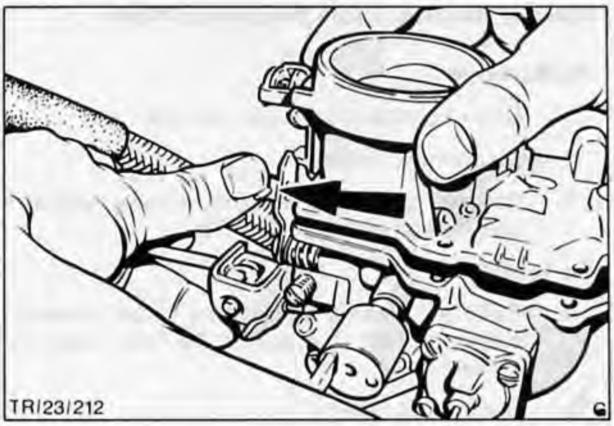
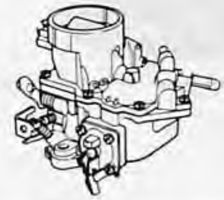


Fig. 29. Choke mechanism held in closed position when installing upper body



23 213 CARBURETTOR – ADJUST

Special Equipment Required:

CO Meter
RPM Meter
Tamperproof plug remover

NOTE: Description of how to manufacture the plug remover tool is shown in the special tool section page 11.

1. Open hood and fit fender covers.
2. Warm up engine to normal operating temperature.
3. Connect a CO meter and RPM meter to engine as per manufacturers instructions.
4. Stabilise engine by running at 3000 rpm for approximately 30 seconds and allow engine to idle.
5. Wait for meters to stabilise and record % CO and idle speed.
6. Adjust idle speed screw to achieve correct idle RPM Fig. 30 (800 rpm).

   NOTE: On these carburettors it will be found that during routine maintenance servicing no adjustment of the mixture (CO level) will be required. However, if CO level is found to be incorrect the following procedure should be adopted.
7. Using remover, Fig 20, detach tamperproof plug as follows, Fig. 31.

   Position tool in centre of plug and break through the centre section. Screw in the tool and detach plug.

   NOTE: Tool will bottom against mixture screw and further turns of the tool will pull the plug out.
8. Using an electrician's screwdriver remove centre knock out section of plug from mixture screw housing.
9. Stabilise engine and adjust mixture screw and speed screw to give specified CO at correct speed.

   NOTE: Adjustment must be carried out within 10 to 30 seconds from the time the meters stabilise. If time taken to adjust is longer than 30 seconds, rev engine again to 3000 rpm for 30 seconds and recheck.
10. Recheck idle speed and CO and re-adjust as necessary.
11. Replace tamperproof plug as follows:
    Position new plug on housing and tap home.

    NOTE: On some models a punch will be required for tapping plug fully in position.
    Plug should finally be positioned flush with housing, Fig. 32.
    The service replacement plugs are blue in colour.
12. Remove fender covers and close hood.

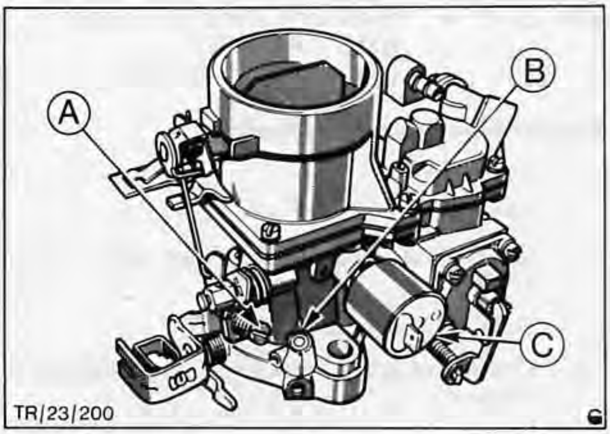


Fig. 30. Motorcraft manual choke carburettor (By-pass idle)
A – Idle speed adjusting screw
B – Location of mixture (CO) adjusting screw

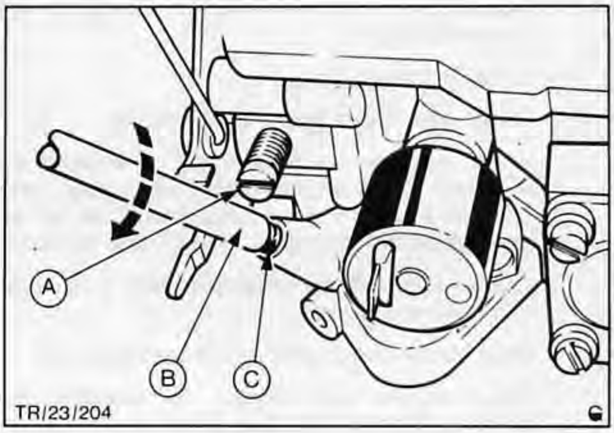


Fig. 31. Plug removal
A – Speed adjusting screw
B – Remover in position through plug
C – Tamperproof plug

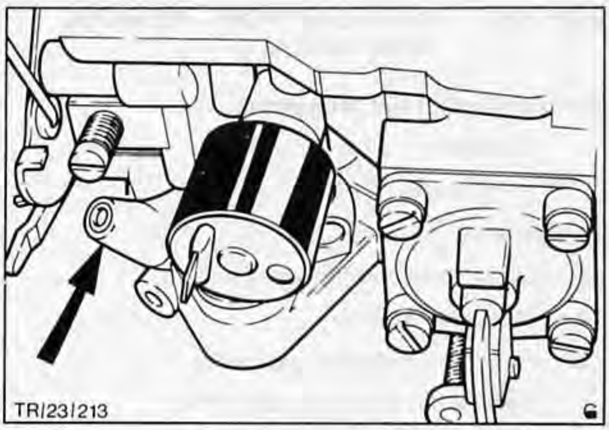
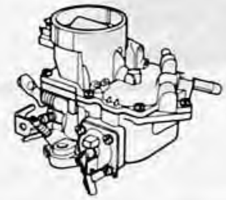


Fig. 32. Tamperproof plug fully installed
NOTE: Plug flush with housing



23 217 4 MANUAL CHOKE – FAST IDLE – ADJUST (Air cleaner removed)

Special Equipment Required:

CO Meter

RPM Meter

1. Check and adjust idle speed and mixture setting.

   Detailed in operation 23 213.

2. Check and adjust choke pull down setting as follows:

   Hold choke mechanism in the fully closed position by rotating cam on to its stop. Open choke plate against spring tension up to stop and measure clearance between down draught side of choke plate and air horn with a gauge rod or twist drill shank.

   Adjustment is carried out by bending tag marked, Fig. 33.

   Refer Technical Data.

3. Check and adjust fast idle as follows:

   With engine at operating temperature manually hold choke plate fully open and operate choke control mechanism as far as possible without altering choke plate position.

   NOTE: This will be approximately $\frac{1}{3}$ of total choke control travel.

   Hold choke plate open and record fast idle.

   Stop engine and adjust as required by bending tag shown in Fig. 34.

4. Recheck fast idle.
5. Recheck basic idle speed.

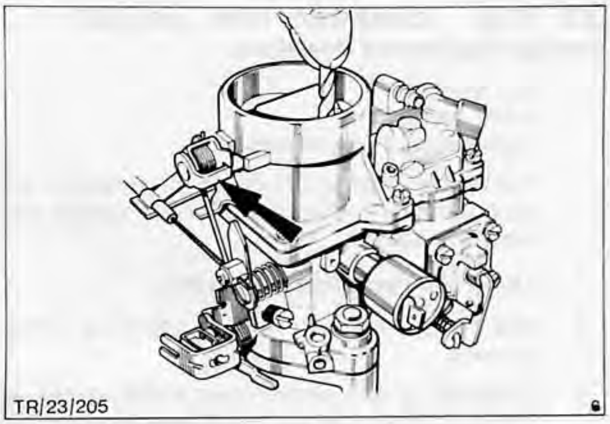


Fig. 33. Choke mechanism held in closed position to check choke plate pull down. Adjusting tag marked

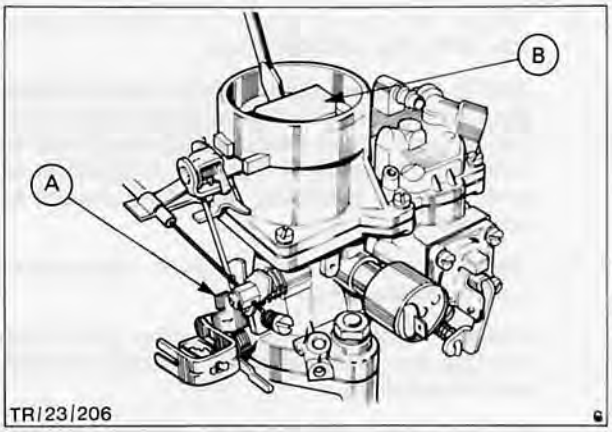


Fig. 34. Carburettor set for fast idle check
A – Adjusting tag B – Choke plate held open

23 224 CARBURETTOR – REMOVE AND INSTALL

Special Equipment Required:

CO Meter

RPM Meter

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 174.

4. Disconnect throttle link at carburettor.
5. Disconnect choke inner and outer cable from carburettor, Fig. 35.

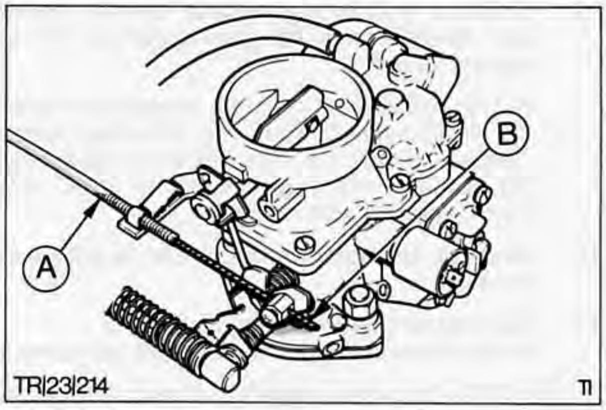
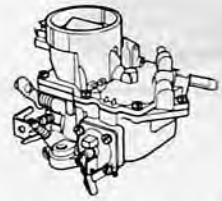


Fig. 35. Carburettor choke cable
A – Outer cable B. – Inner cable



6. For automatic choke variants, disconnect both auto-choke hoses at carburettor.

   Before disconnecting hoses ensure that cooling system is not pressurised (by removing radiator cap and refitting) and that radiator cap is in position.

   Position disconnected hoses facing upwards, this will ensure that only a negligible amount of coolant is lost.

7. Disconnect vacuum, vent and fuel feed pipes. If a crimped type hose clamp is fitted to the fuel supply pipe it must be cut free and replaced with a screw type clamp, Fig. 36.

8. Remove two nuts and washers and detach carburettor assembly, Fig. 37.

To Install

9. Clean gasket faces.

10. Transfer throttle clip to new carburettor.

11. Position carburettor with a new gasket and secure.

12. Manual choke variants, reconnect choke cable and adjust by pulling out cable from dash approximately 6 mm (0,25 in) and reconnecting cable to carburettor taking out all slack. Push home cable.

13. Automatic choke variants, reconnect both autochoke hoses. Check and top up coolant level as required.

14. Reconnect throttle link.

15. Reconnect vacuum, vent and fuel feed pipes.

16. Refit air cleaner assembly.

17. Reconnect battery.

18. Check and adjust engine idle speed and fuel mixture setting.

    Detailed in Operation 23 213.

19. Remove fender covers and close hood.

23 224 6 CARBURETTOR – CLEAN, INSPECT AND ADJUST (Carburettor removed)

Special Equipment Required:

Tamperproof plug removed.

1. Clean carburettor exterior.

2. Remove seven screws, disconnect choke link and detach upper body assembly, Fig. 38.

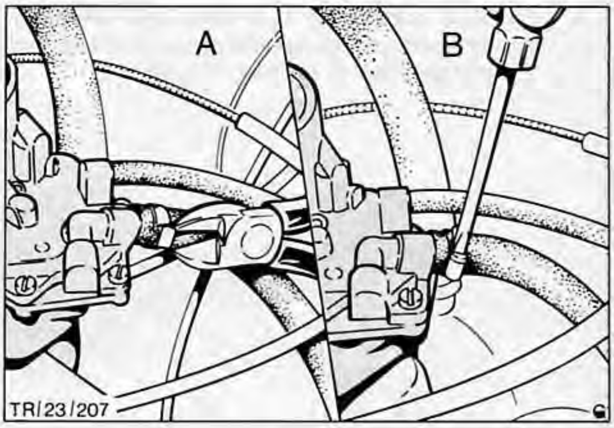


Fig. 36. Disconnecting and reconnecting carburettor supply pipe
A – Crimped type hose clamp
B – Screw type hose clamp

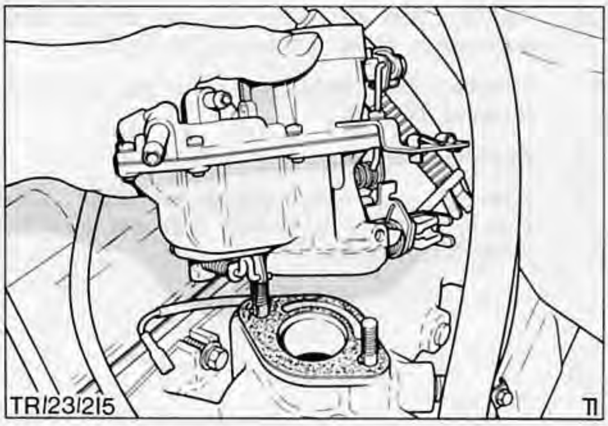


Fig. 37. Carburettor removal

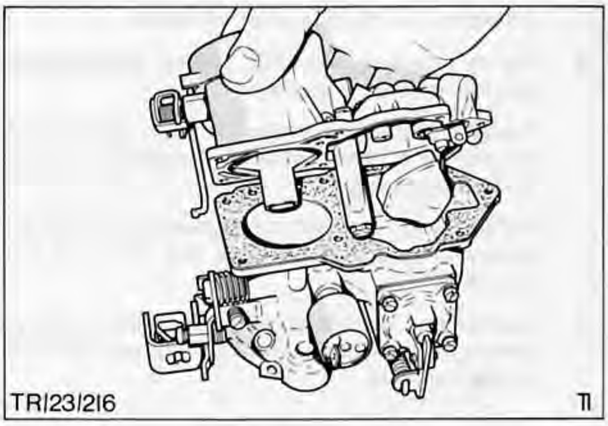
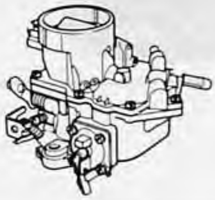


Fig. 38. Removal of carburettor upper body



3. Remove accelerator ball valve and weight by turning carburettor upside down and allowing weight and ball to fall out, Fig. 39.

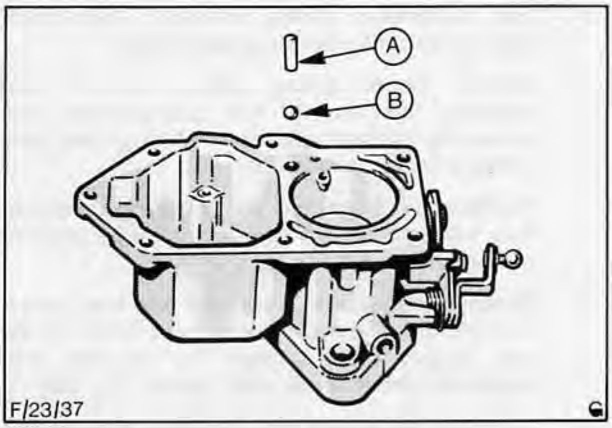


Fig. 39. A – Accelerator ball valve weight
B – Accelerator ball valve

4. Tap out float retaining pin and lift out float and needle valve, remove upper gasket.

   Unscrew valve housing and detach filter from housing, Fig. 40.

5. Remove main jet.

6. Remove accelerator pump assembly. Care should be taken to ensure that return spring is not lost, Fig. 44.

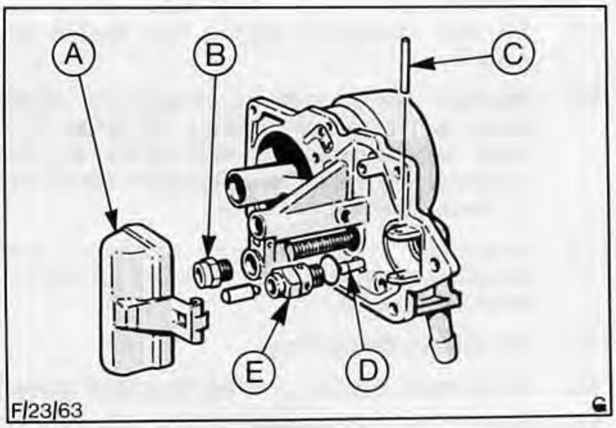


Fig. 40. Carburettor upper body dismantled
A – Float
B – Main jet
C – Float retaining pin
D – Intake filter
E – Valve housing

7. Remove idle mixture shut off valve.

8. Using remover, Fig. 20, detach tamperproof plug as follows, Fig. 41.

   Position tool in centre of plug and break through the centre section. Screw in the tool and detach plug.

   NOTE: Tool will bottom against the mixture screw and further turns of the tool will pull out plug.

9. Using an electrician's screwdriver remove centre knock out section of plug from mixture screw housing.

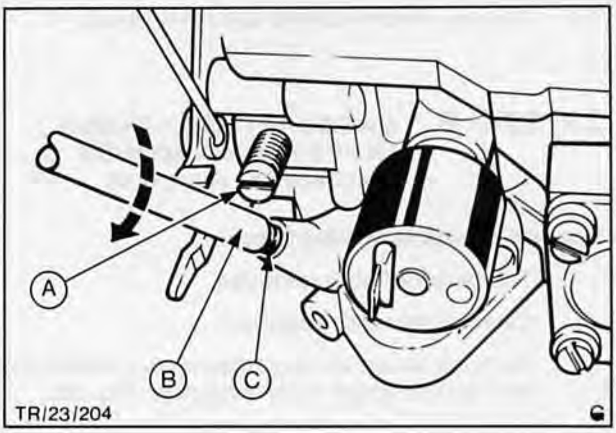


Fig. 41. Plug removal
A – Speed adjusting screw
B – Remover in position through plug
C – Tamperproof plug

10. Clean carburettor float chamber and jets.

    Concentrate on components and jets shown, Fig. 42.

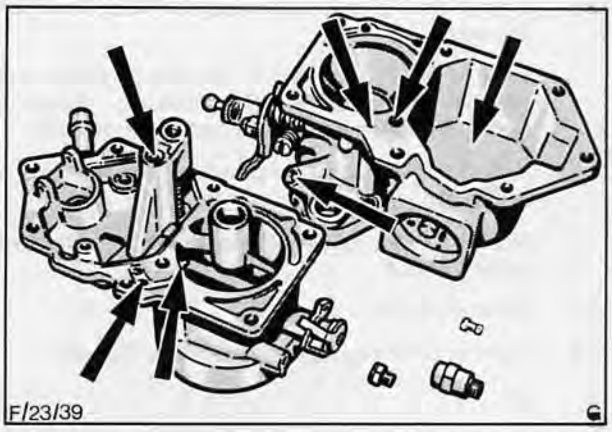


Fig. 42. Main items to be cleared

11. Inspect carburettor components.

    The main items for inspecting are shown in Fig. 43.

    The float checked for leaking, pump diaphragm and gasket inspected for splits and mixture screw, needle valve and throttle spindle checked for wear.

12. Refit mixture screw.

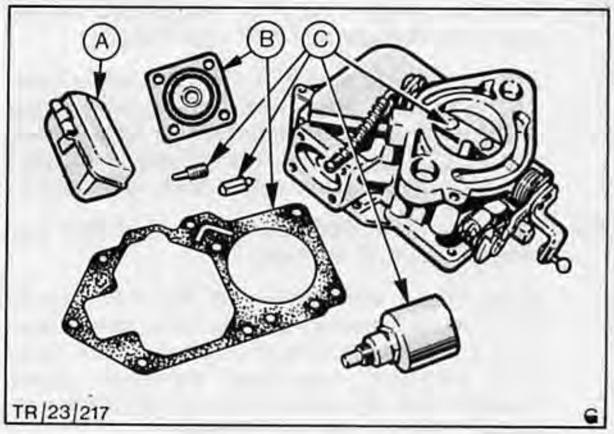


Fig. 43. Carburettor main body dismantled
A – Checked for leaks
B – Checked for splits or damage
C – Checked for wear or damage

13. Reassemble accelerator pump assembly.

    NOTE: Main return spring is tapered outwards, Fig. 44.

14. Reassemble needle valve assembly and float in the reverse order detailed in sub-operation 4. Ensure that the filter and sealing washer are fitted to valve housing before housing assembly is fitted to carburettor, Fig. 40.

15. Refit idle mixture shut off valve.

    Ensure sealing washer is fitted.

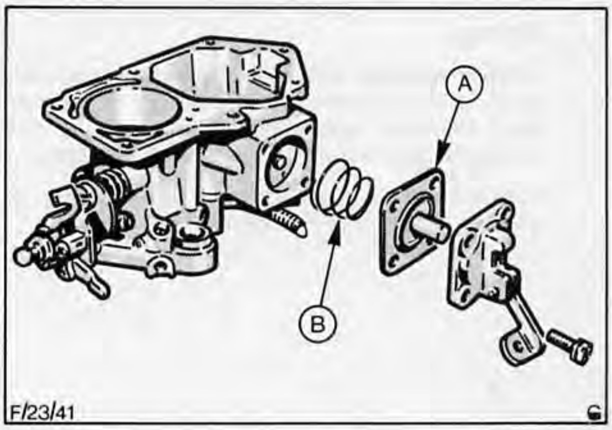
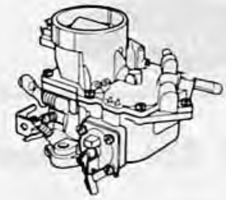


Fig. 44. Accelerator pump dismantled
A – Accelerator pump diaphragm
B – Diaphragm return spring



16. Check and if necessary adjust float level as follows.

    With upper body held in vertical position and needle valve shut off, measure distance between upper body face and base of float.

    Adjust as required by bending tag marked A in Fig. 45.

    NOTE: Upper body gasket must be removed during check.

17. Refit main jet.
18. Refit accelerator ball and weight, Fig. 39.

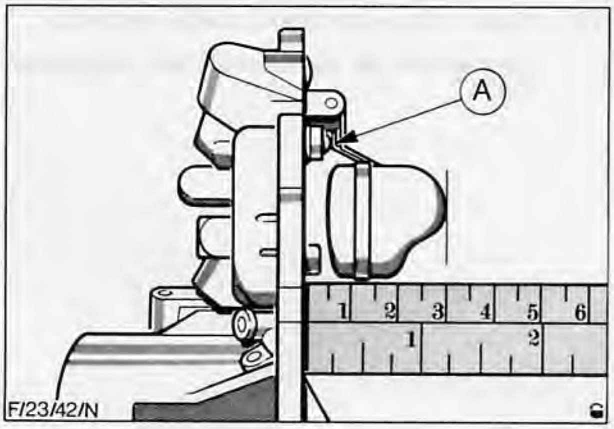


Fig. 45. Float level adjustment
A – Adjusting tag

19. Position upper gasket, reconnect choke operating linkage and refit upper body.

    Ensure that cranked end of choke link is fitted at the bottom. Also when positioning upper body hold choke mechanism in fully closed position. This ensures that choke cam does not over-centre when upper body is installed.

20. Check and if necessary adjust choke pull down setting as follows.

    Hold choke mechanism in the fully closed position, by rotating cam on to its stop. Open choke plate against spring tension up to stop and measure clearance between down draught side of choke plate and air horn with a gauge rod or twist drill shank.

    Adjustment is carried out by bending tag marked, Fig. 46. Refer Technical Data.

21. Check and if necessary adjust accelerator pump stroke as follows.

    Wind back idle speed adjusting screw clear of linkage.

    With throttle in fully closed position manually push in the accelerator diaphragm to its stop and measure clearance using a twist drill shank between pump lever and diaphragm.

    Adjustment is carried out by opening or closing 'U' section on control link, Fig. 47.

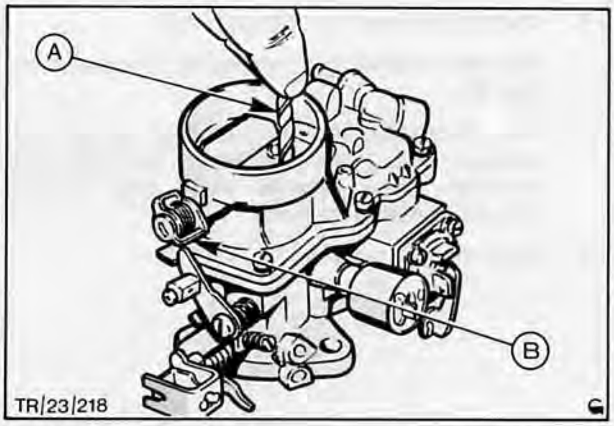


Fig. 46. Choke mechanism held in closed position to check choke plate pull down
A – Specified twist drill B – Adjusting tag

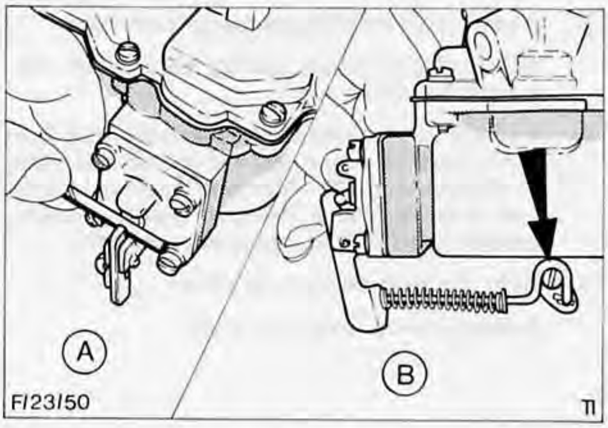
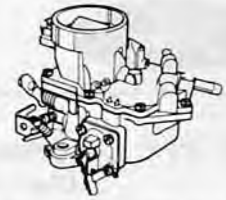


Fig. 47. Accelerator pump adjustment
A – Checking pump stroke
B – Adjustment position



23 244 NEEDLE VALVE – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 174.
4. Clean carburettor exterior.
5. Disconnect fuel bowl vent tube.
6. Disconnect fuel supply pipe.

   If a crimped type hose clamp is fitted it must be cut free and replaced with a screw type clamp, Fig. 48.
7. Remove seven screws, disconnect choke link and detach upper body assembly.
8. Tap out float retaining pin and lift out float and needle valve. Unscrew valve housing and detach filter from housing, Fig. 49.
9. Clean carburettor float chamber and jets.

   Ensure accelerator ball valve and weight are not blown out. Refer, Fig. 28. Operation 23 212.
10. Refit needle valve assembly and float.

    Refit in reverse order detailed in sub-operation 8.

    Ensure that filter and sealing washers are fitted to valve housing before housing is refitted to carburettor upper body.
11. Check and adjust float level setting.

    Detailed in Operation 23 224 6, Fig. 45.
12. Reconnect choke link, position upper body and secure. For vehicles with a manual choke when positioning upper body hold choke mechanism in the fully closed position. This ensures that choke cam does not over-centre when upper body is installed, Fig. 50.
13. Reconnect fuel bowl vent tube.
14. Reconnect fuel supply pipe. (Fig. 48.)
15. Refit air cleaner assembly.
16. Reconnect battery.
17. Check and adjust engine idle speed and fuel mixture setting as required.

    Detailed in Operation 23 213.
18. Remove fender covers and close hood.

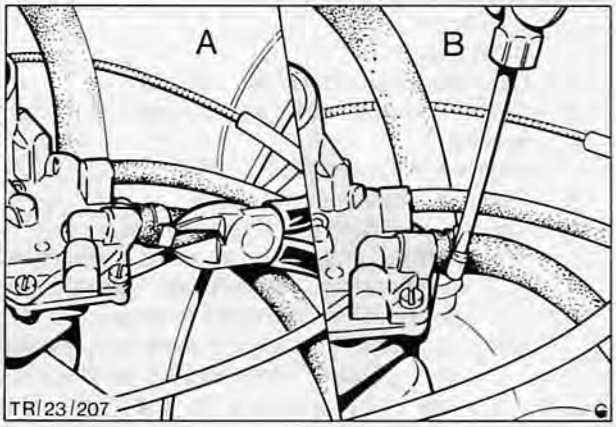


Fig. 48. Disconnecting and reconnecting fuel supply pipe
A – Crimped type hose clamp
B – Screw type hose clamp

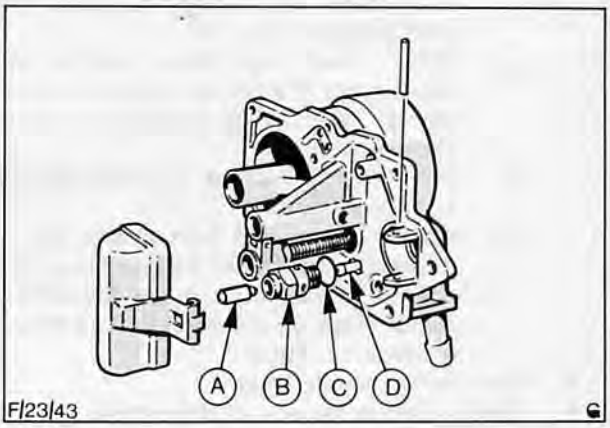


Fig. 49. Needle valve assembly dismantled
A – Needle valve
B – Valve housing
C – Sealing washer
D – Intake filter

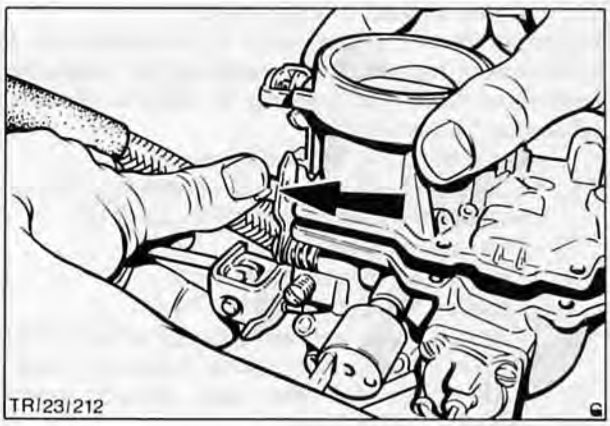
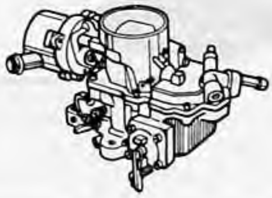


Fig. 50. Choke mechanism held fully closed when refitting upper body



23 271 AUTOMATIC CHOKE – FAST IDLE – ADJUST

Special Equipment Required:

CO Meter
RPM Meter

1. Open hood, and fit fender covers.
2. Check and adjust idle speed, and fuel mixture setting.
   Detailed in Operation 23 213.
3. Remove air cleaner assembly.
4. Check and adjust fast idle as follows:
   (i) Ensure engine is at normal operating temperature. Switch off ignition and connect a tachometer to engine.
   (ii) Manually hold choke plate fully closed, then partially open throttle to allow fast idle cam to locate in the 'high cam' position. Release throttle to hold cam in this position, Fig. 51. Release choke plate.
   NOTE: Fast idle cam can be viewed with the aid of a mirror.
   (iii) Manually push the fast idle cam downwards on to the first step. ('V' mark position), Fig. 52.
   NOTE: Check that choke plate is fully open, if not then either engine is not at normal operating temperature or auto-choke is faulty.
   (iv) Start engine without touching throttle and record rpm.
   (v) Adjust as required by bending tag on throttle lever, Fig. 52. To bend tag use a pair of pliers, or to make adjustment easier make up a special tool as shown on page 11, Fig. 21.
5. Refit air cleaner assembly.
6. Remove fender cover and close hood.

23 274 AUTOMATIC CHOKE – ADJUST

Special Equipment required:

CO Meter
RPM Meter
Choke preload tool (23–010).

Important Note: If technician is inexperienced in auto-choke repairs than removal of complete carburettor before attempting 'V' mark or dechoke adjustments is advisable.

1. Open hood and fit fender covers.
2. Check and adjust idle speed and fuel mixture setting. Detailed in Operation 23 213.
3. Disconnect battery.
4. Remove air cleaner assembly.
   Detailed in Operation 23 174.
5. Remove three screws and pull of automatic choke housing and spring assembly, swing clear of carburettor and detach sealing gasket.

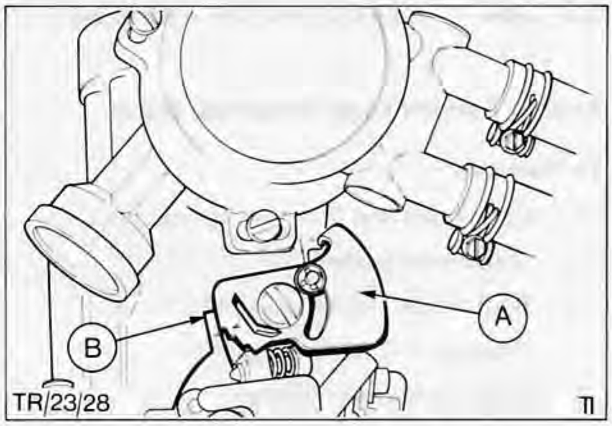


Fig. 51. Autochoke mechanism set in the 'high cam' position
A – Fast idle cam
B – Choke set on 'high cam' (Carburettor viewed from the rear)

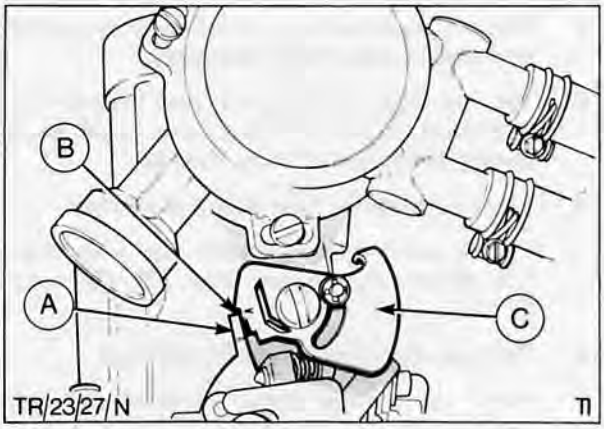


Fig. 52. Auto-choke mechanism set in the 'fast idle' position ('V' mark lined up with top of throttle lever).
A – Adjusting lever
C – Fast Idle cam
B – Choke set on 'V' mark ('Fast Idle')

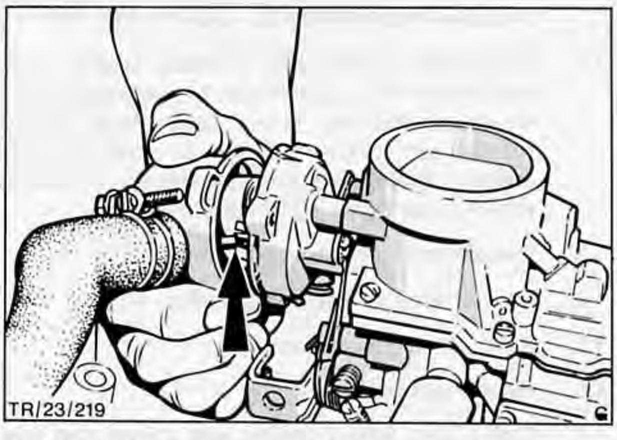


Fig. 53. Choke housing removal screws

6. Check and if necessary adjust 'V' mark setting as follows:

   Fit an elastic band to choke plate lever and position band so that it holds the choke plate closed. Open throttle to allow the choke plate to fully close and release throttle.

   Position a gauge rod or twist drill of correct size between the down draught side of choke plate and air horn. (Refer to Technical Data.)

   Partially open throttle to allow fast idle cam to drop into its operating position and using a mirror check that the 'V' mark on the cam lines up with top of throttle lever, Fig. 54 (Fast idle position).

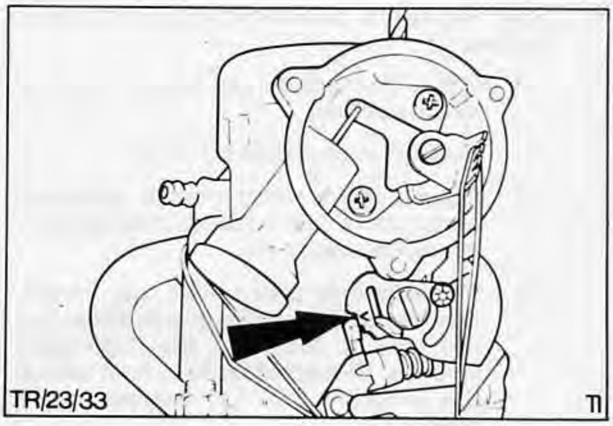


Fig. 54. 'V' mark on cam lines up with throttle lever establishing correct 'V' mark setting

   Adjustment is carried out by bending the choke control rod. Ensure that the control rod is located at the end of the slot in the fast idle cam when the check or adjustment is being carried out, Fig. 55.

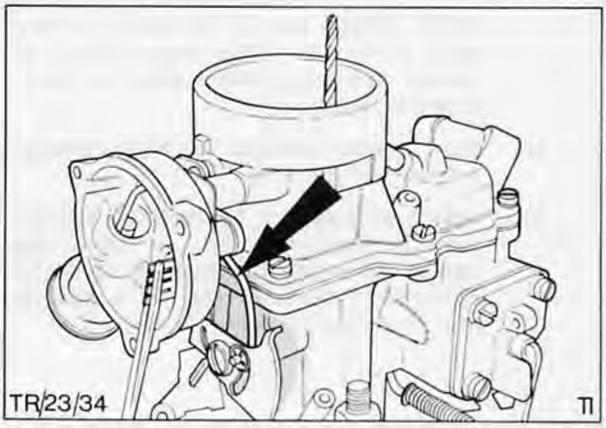


Fig. 55. 'V' mark setting adjustment carried out by bending control rod shown

7. Check and if necessary adjust de-choke as follows:

   With choke plate still held in the fully closed position, fully open throttle. The choke plate will de-choke just before full throttle. Adjustment is checked by measuring between the choke plate and air horn, with a gauge rod or twist drill on down draught side of choke plate.

   Adjust by bending de-choke lever on the fast idle cam, shown in Fig. 56.

   NOTE: Care must be taken to ensure that the gauge rod is not dropped down into inlet manifold.

8. Reconnect battery and remove elastic band.

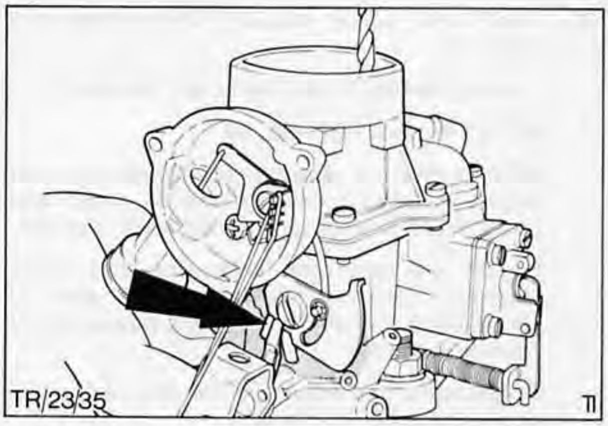
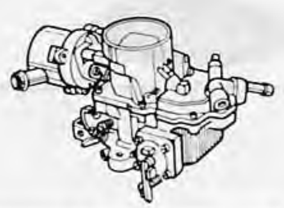


Fig. 56. De-choke adjustment. Adjusting tag marked Carburettor viewed from the rear



9. Start engine and check and adjust fast idle as follows:

   (i) Check and adjust idle speed and fuel mixture setting.

   Detailed in operation 23 213.

   (ii) Ensure engine is at normal operating temperature and connect a tachometer to engine, switch off.

   (iii) Manually hold choke plate fully closed, then partially open throttle to allow fast idle cam to locate in the 'high cam' position. Release throttle to hold cam in this position, Fig. 57. Release choke plate.

   NOTE: Fast idle cam can be viewed with the aid of a mirror.

   (iv) Manually push the fast idle cam downwards on to the first step. ('V' mark position), Fig. 58.

   NOTE: Check that choke plate is fully open, if not then either engine is not at normal operating temperature or auto-choke is faulty.

   (v) Start engine without touching throttle and record rpm.

   (vi) Adjust as required by bending tag on throttle lever, Fig. 58. To bend tag either use a pair of pliers, or to make adjustment easier make up a special tool as shown on page 11, Fig. 21.

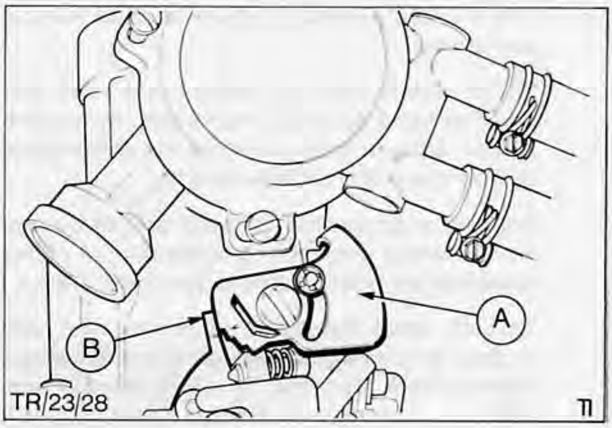


Fig. 57. Auto-choke mechanism set in the 'high cam' position
A – Fast idle cam
B – Choke set on 'high cam'
(Carburettor viewed from the rear)

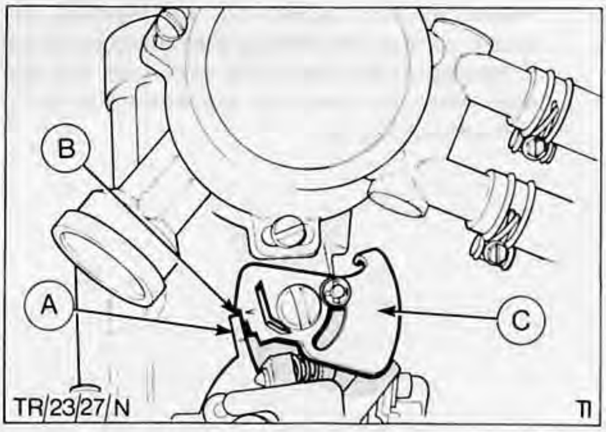


Fig. 58. Auto-choke mechanism set in the 'fast idle' position ('V' mark lined up with top of throttle lever)
A – Adjusting lever
B – Choke set on 'V' mark (fast idle)
C – Fast idle cam

10. Check and adjust vacuum choke plate pull down.

   Locate throttle in the 'High Cam' position.

   NOTE: Not fast idle, Fig. 59.

   With engine at operating temperature start engine without touching throttle pedal and position pre-load tool on choke lever, Fig. 59.

   Ensure pre-load tool is floating and check clearance between down draught side of choke plate and air horn using a gauge rod or twist drill shank.

   Stop engine and adjust by bending choke pull down lever. ('C' in Fig. 59.)

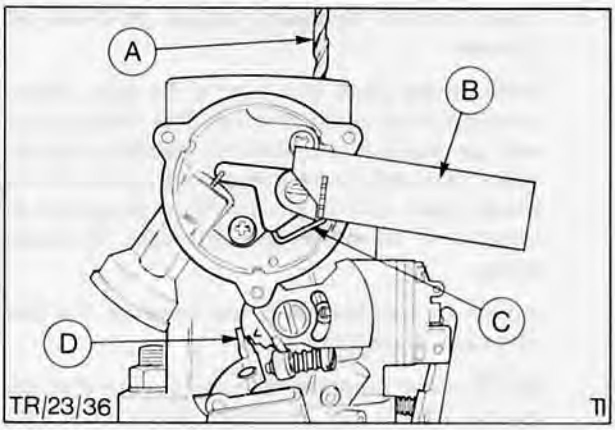
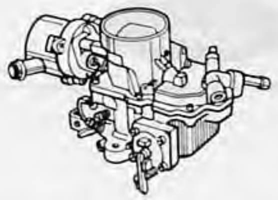


Fig. 59. A – Twist drill
B – Auto-choke pre-load tool (23 011)
C – Pull down lever (Adjustment)
D – Throttle set on high cam



11. Position gasket and refit choke housing and spring assembly as follows:

    Connect choke spring into specified slot on operating link. (Refer Technical Data to ascertain correct slot.) Position housing and loosely fit three retaining screws. Rotate housing till mark on spring housing lines up with appropriate mark on auto-choke housing. Lock up three screws, Fig. 60.

12. Refit air cleaner assembly.
13. Remove fender cover and close hood.

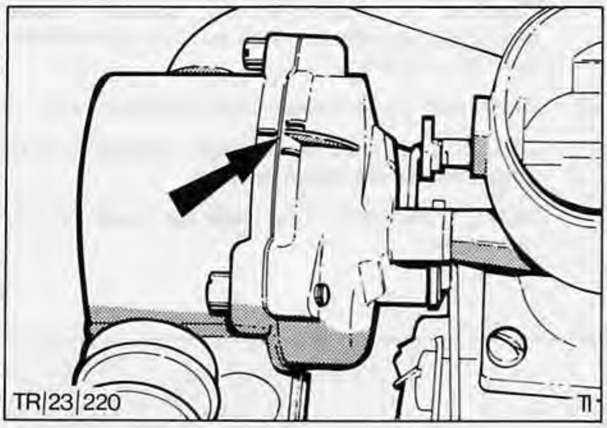


Fig. 60. Alignment marks for auto-choke housing

23 278 AUTOMATIC CHOKE – OVER HAUL

Special Equipment Required:

CO Meter
RPM Meter

Pre-load tool (23–010)

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 174.

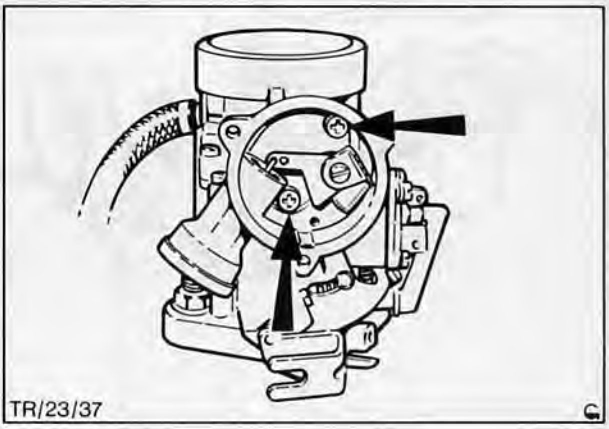


Fig. 61. Choke housing securing screws (Carburettor viewed from the rear)

4. Remove three screws, detach outer housing and bi-metal spring assembly and swing clear of carburettor.

   Remove housing gasket.

5. Remove two screws securing auto-choke body to carburettor, Fig. 61.
6. Remove a single screw securing choke linkage to operating spindle and detach assembly, Fig. 62.

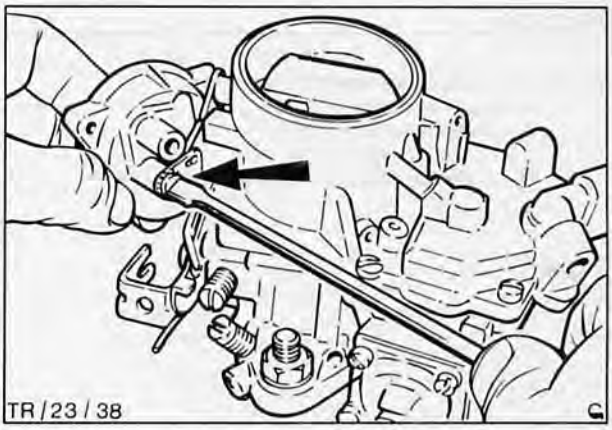
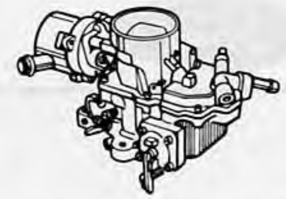


Fig. 62. Disconnecting choke linkage from auto-choke assembly



AUTOMATIC CHOKE MOTORCRAFT SINGLE CHOKE CARBURETTOR

7. Remove a single screw, detach choke operating spindle and pull out vacuum piston, linkage, Fig. 63.

8. Clean and inspect auto-choke components.

   Checking for wear or damage. Ensure that all components are clean and dry.

   NOTE: Lubricant must **not** be used on re-assembly.

9. Reassemble vacuum piston, operating spindle and operating linkage, Fig. 63.

   Ensure that the plastic sleeve 'F' is refitted to the spindle 'B' when reassembling unit.

10. Reconnect auto-choke linkage to spindle position main body and secure.

    Ensure that the sealing rubber, 'A' in Fig. 63, is correctly located between the main choke body and the carburettor when installing unit.

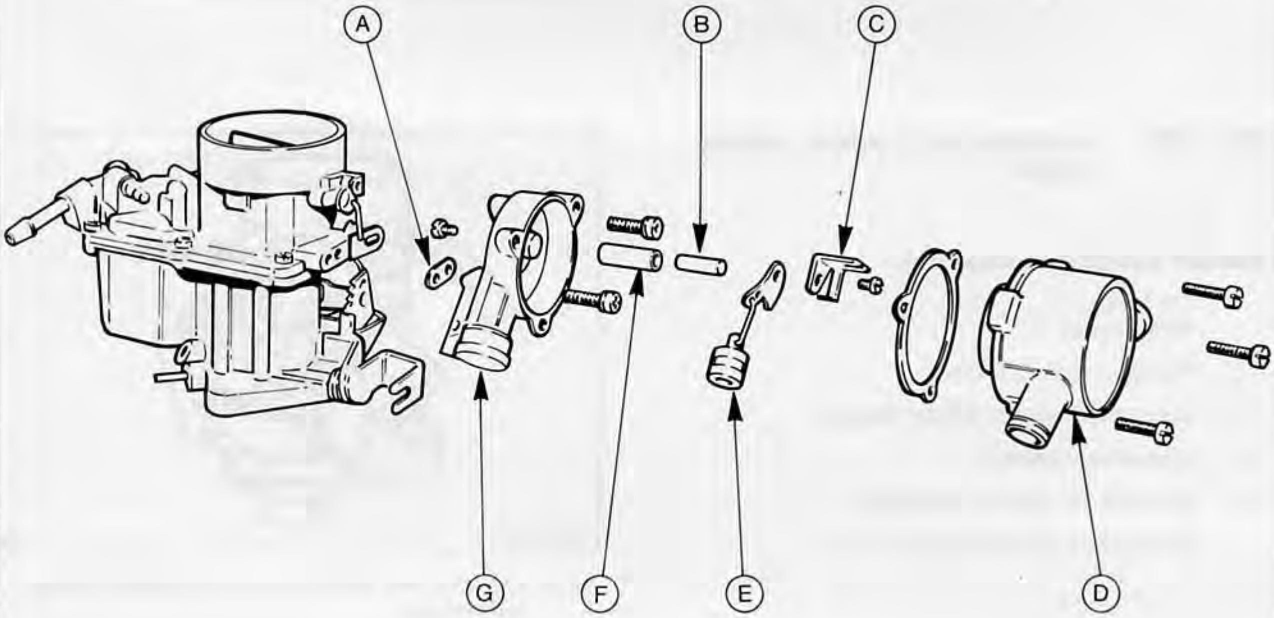


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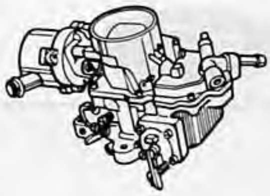
Fig. 63. Ford auto-choke assembly dismantled.
A – Sealing rubber
B – Choke spindle
C – Operating link
D – Outer housing and bi-metal spring
E – Vacuum piston assembly
F – Spindle sleeve
G – Main choke housing



11. Check and adjust 'V' mark setting as required. Detailed in Operation 23 274.
12. Check and adjust de-choke setting. Detailed in Operation 23 274.
13. Check and adjust vacuum pull down. Detailed in Operation 23 274.
14. Refit choke housing and bi-metal spring assembly.

    With a new gasket connect choke bi-metal spring into the specified slot on choke operating link, 'C' in Fig. 63. (Refer Technical Data to ascertain correct slot.) Place outer housing in position and loosely fit three retaining screws.

    Rotate housing till the mark on spring housing lines up with the appropriate mark on auto-choke housing. Lock up three screws, Fig. 64.
15. Reconnect battery.
16. Start engine and check and adjust fast idle as required. Detailed in Operation 23 274.
17. Refit air cleaner assembly.
18. Remove fender covers and close hood.

23 283 HOSE - AUTOMATIC - CHOKE – REPLACE (ONE)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender cover.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation 23 174.
4. Remove engine splash shield.
5. Partially drain cooling system. Disconnect bottom hose at radiator and allow to drain, Fig. 65.
6. Disconnect hose at both ends and detach.

To Install

7. Transfer clips to new hose.
8. Position and reconnect hose.
9. Refill cooling system with specified water-antifreeze solution.
10. Refit engine splash shield.
11. Refit air cleaner assembly.
12. Reconnect battery.
13. Start engine, check for leaks and top up as required.
14. Remove fender covers and close hood.

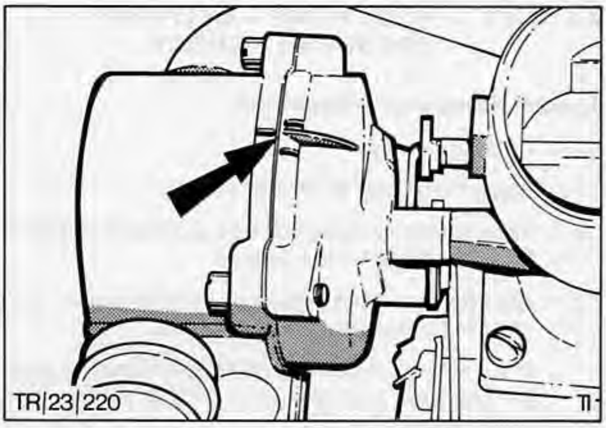


Fig. 64. Auto-choke alignment marks

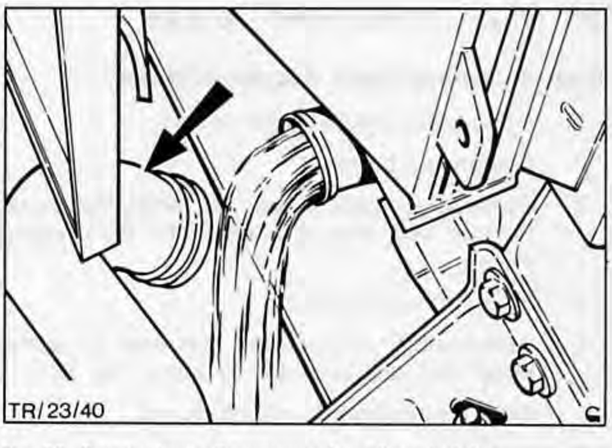


Fig. 65. Bottom hose disconnected to allow draining

23 531 FUEL PUMP – DELIVERY PRESSURE – CHECK

Special Equipment Required:

Pressure gauge

1. Open hood and fit fender covers.
2. Ensure that carburettor has sufficient petrol in float chamber to run engine.
3. Disconnect fuel pump outlet-hose and connect pressure gauge to pump.

   If a crimped type hose clamp is fitted it must be cut free and replaced with a screw type hose clamp, Fig. 66.

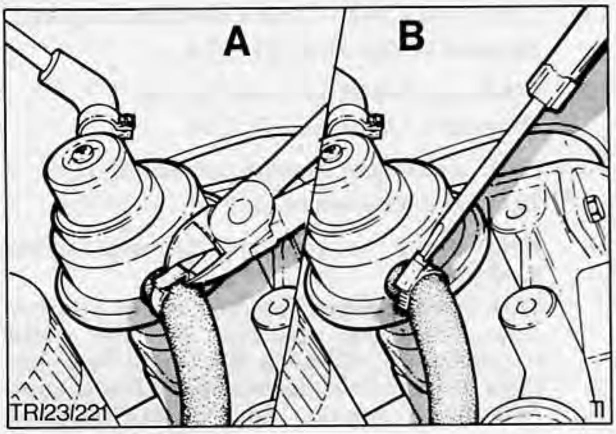


Fig. 66. Removal and reconnecting fuel outlet hose
A – Crimped type hose clamp
B – Screw type hose clamp

4. Check pump delivery pressure, Fig. 67, by starting engine and recording pressure at idle speed. Momentary race engine and again note pressure. Refer Technical Data.
5. Disconnect gauge and reconnect fuel pump outlet hose, Fig. 66.
6. Remove fender covers and close hood.

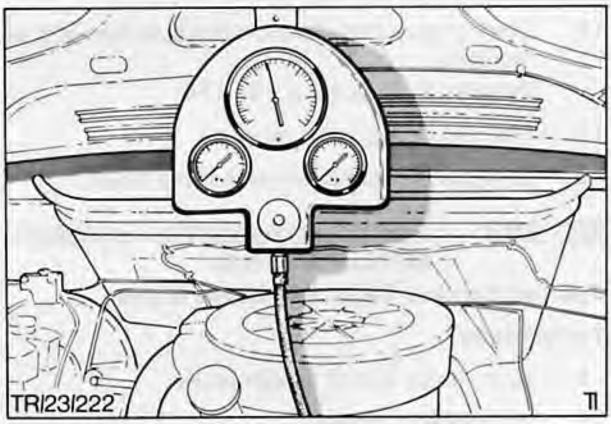


Fig. 67. Pressure gauge connected to fuel pump for pressure check

23 532 FUEL PUMP – CLEAN

Special Service Tools Required: None

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove a single screw, lift off pump cover, remove seal and withdraw filter from pump cover.
4. Clean pump and filter.
5. Reassemble pump filter and seal to pump cover and refit assembly to pump, Fig. 68.

   Ensure pump seal is not damaged.
6. Reconnect battery.
7. Remove fender covers and close hood.

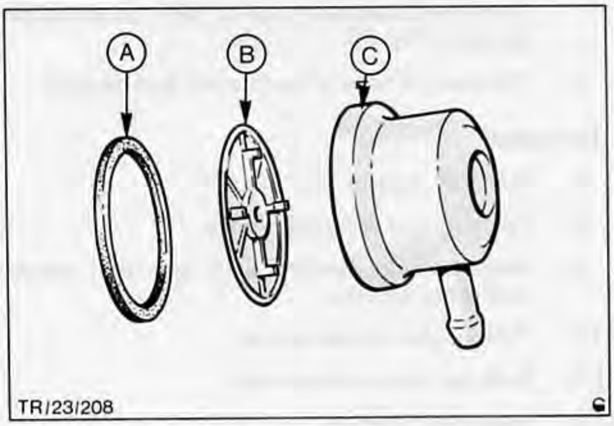


Fig. 68. Fuel pump cover removed for cleaning
A – Fuel pump cover
B – Fuel pump filter
C – Fuel pump seal

23 534 FUEL PUMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect fuel pump inlet and outlet hose.

   If a crimped type hose clamp is fitted it must be cut free and replaced with a screw type hose clamp, Fig. 69.
4. Remove two bolts and detach pump assembly.

To Install

5. Clean pump and block gasket faces.
6. Position pump with a new gasket and secure.
7. Reconnect inlet and outlet hoses.
   Refer Sub-operation 3 and Fig. 69.
8. Reconnect battery.
9. Check operation.
10. Remove fender covers and close hood.

23 554 FUEL TANK – REMOVE AND INSTALL

Special Service Tools Required:

Fuel tank sender unit wrench 23–009

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Pump fuel into a closed container.

   Important Note: Ensure that the fuel safety precautions detailed on page 12 are carried out.
4. Jack up rear end of vehicle and fit stands.
5. Clean work area.
6. From under vehicle disconnect fuel inlet pipe from tank, Fig. 70.
7. Loosen two tank securing straps, support tank and unclip straps.

   NOTE: To loosen straps a box spanner will make the operation easier.
8. Lower tank and disconnect sender unit loom, vent pipe and fuel outlet pipe, Fig. 71.
9. Detach fuel tank assembly.

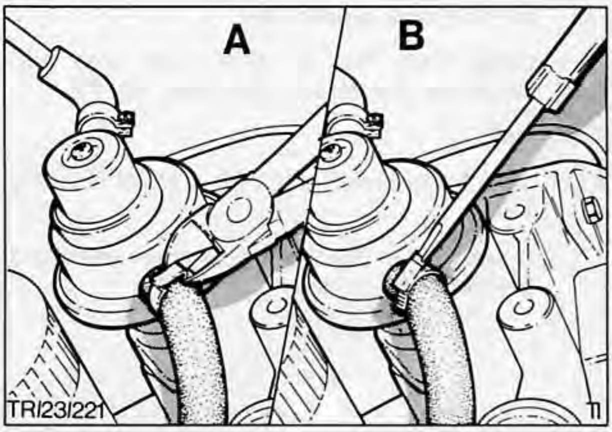


Fig. 69. Disconnecting and reconnecting fuel pump outlet
A – Crimped type hose clamp
B – Screw type hose clamp

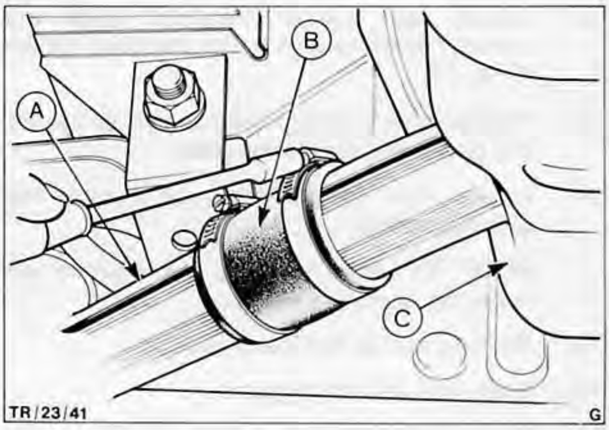


Fig. 70. A – Fuel inlet pipe
B – Fuel inlet pipe connection
C – Fuel tank

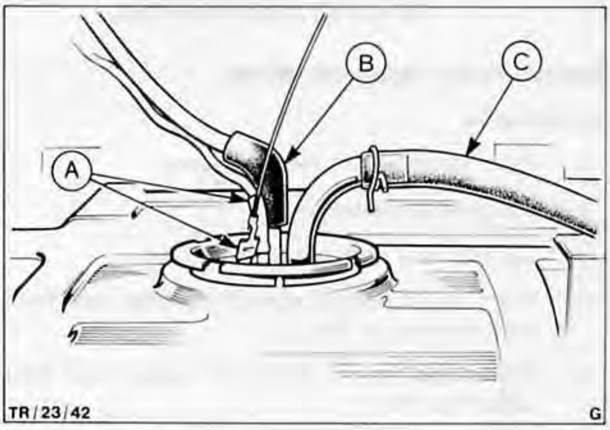


Fig. 71. Fuel tank sender unit
A – Sender unit loom
B – Fuel outlet pipe
C – Ventilation pipe

10. Remove tank sender unit.

    Using tool No. 23–009 turn unit anti-clockwise and detach from tank, Fig. 72.

To Install

11. Refit tank sender unit with a NEW seal, Fig. 72.

    A used seal distorts on removal making it unsuitable for re-use.

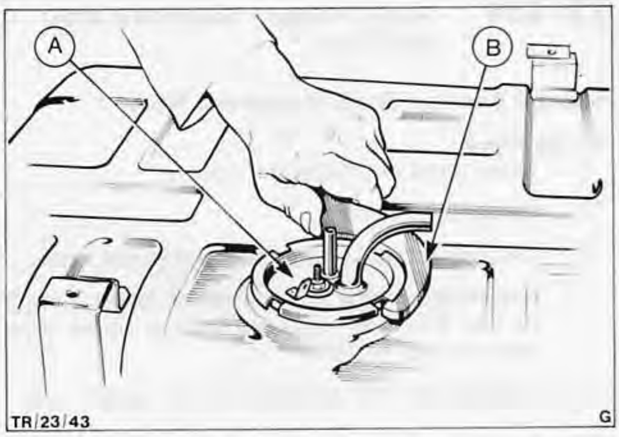


Fig. 72. Removal of tank sender unit
A – Tank sender unit
B – Tool No. 23–009

12. Ensure four rubber insulator pads are correctly stuck to tank in the positions shown in Fig. 73.
13. Position tank and reconnect sender unit loom, fuel outlet and ventilation pipe.
14. Locate tank in position and secure two securing straps.

    NOTE: To secure straps a box spanner will make the operation easier.

15. Remove stands and lower vehicle.
16. Refill tank with clean petrol.
17. Reconnect battery.
18. Remove fender covers and close hood.

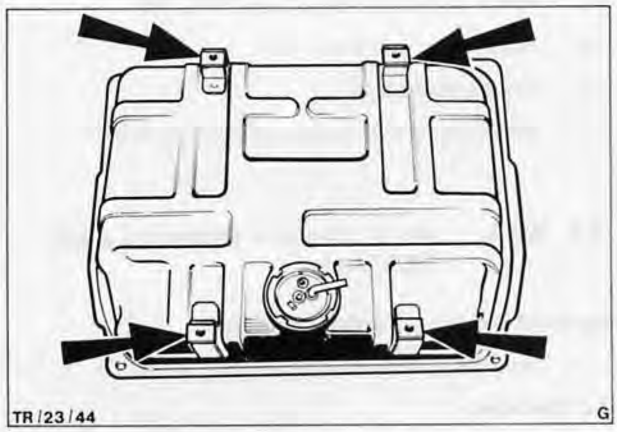


Fig. 73 Tank rubber insulator pads

23 572 FUEL TANK FILLER PIPE – REMOVE AND INSTALL

Special Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Jack up rear end and fit stands.
4. From under vehicle disconnect filler pipe from tank connector, Fig. 74.
5. Disconnect tank ventilation tube from filler pipe. Fig. 74.

   Ensure fuel level is below tank filler connection (approximately $\frac{1}{4}$ tank). If not tank will have to be emptied using the fuel handling procedure on page 12.

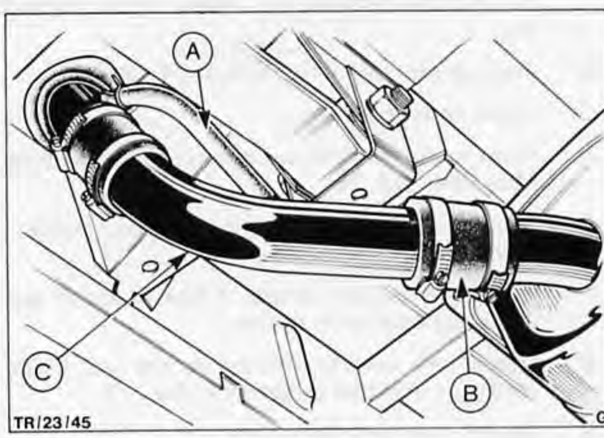


Fig. 74. Tank filler pipe assembly
A – Tank ventilation tube
B – Filler pipe connector
C – Filler pipe

6. Remove filler pipe extension and remove pipe to body sealing ring, Fig. 75.
7. Remove filler cap, pull out sealing ring and remove three screws securing filler pipe neck to body, Fig. 76.
8. From inside vehicle remove filler pipe cover panel (if applicable) and detach pipe.

To Install

9. From inside vehicle place filler pipe in position, secure neck securing screws, Fig. 76, and from under vehicle refit sealing ring, Fig. 75.
10. Refit extension pipe and secure clips.
11. Reconnect ventilation tube, Fig. 74.
12. Refit filler pipe neck sealing ring and refit cap.
13. Refit filler pipe cover panel. (if applicable).
14. Remove stands and lower vehicle.
15. Reconnect battery.
16. Remove fender covers and close hood.

23 583 FUEL LINE – FUEL TANK TO PUMP – REMOVE & INSTALL

Special Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Raise vehicle on ramp.
4. Disconnect fuel line at the tank, Fig. 77.

   NOTE: Fuel line can be disconnected with the tank in situ.

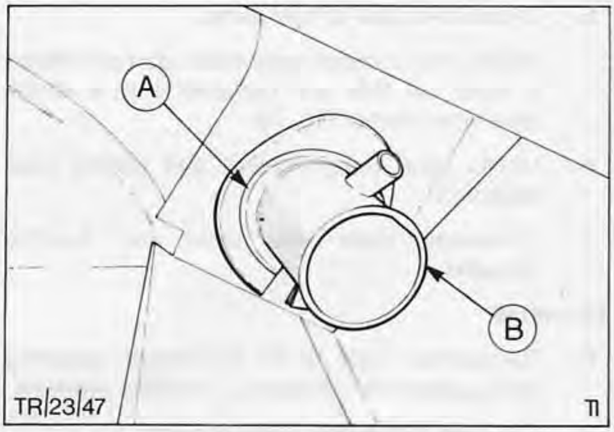


Fig. 75. Fuel filler pipe with extension pipe removed
A – Pipe sealing ring
B – Filler pipe extension

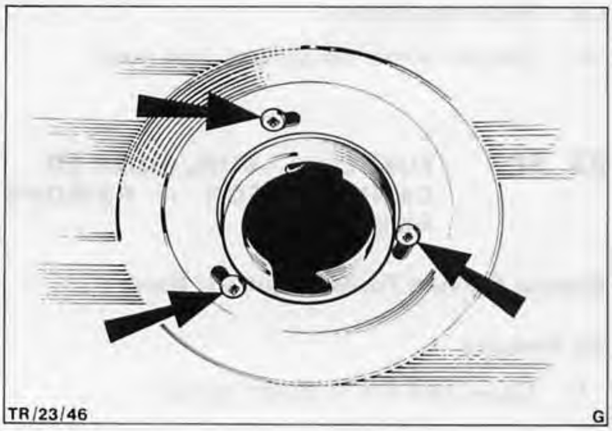


Fig. 76. Filler pipe neck securing screws

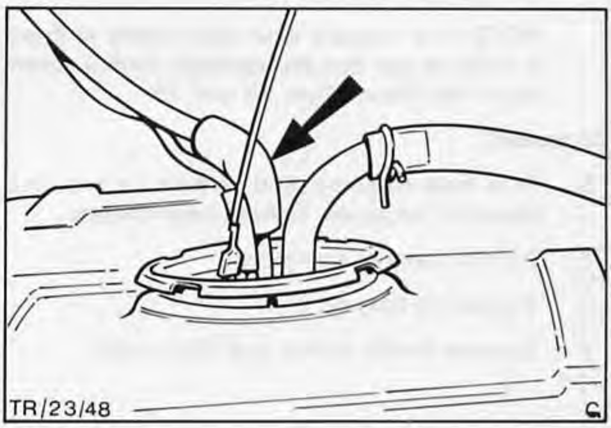


Fig. 77. Fuel line connection at the tank

5. Disconnect pipe at fuel pump.

   NOTE: If a crimped type hose clamp is fitted it must cut free and replaced with a screw type hose clamp, Fig. 78.

6. Unclip pipe along chassis and detach pipe assembly.
7. Dismantle pipe into solid and flexible sections.

To Install

8. Reassemble pipe to its full length, ensuring full engagement of hose up to white markers.
9. Clip pipe in position along chassis.
10. Reconnect fuel line to tank.
11. Reconnect pipe to fuel pump, Fig. 78.
12. Lower ramp.
13. Reconnect battery.
14. Remove fender covers and close hood.

23 587 FUEL LINE – FUEL PUMP TO CARBURETTOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23–174.

4. Disconnect pipe at fuel pump and carburettor. Detach fuel line.

   NOTE: If a crimped type hose clamp is fitted it must be cut free and replaced with a screw type hose clamp, Figs. 78 and 79.

To Install

5. Refit hose to pump, and carburettor ensuring hose fully engages. Tighten hose clamps.
6. Refit air cleaner assembly.
7. Reconnect battery.
8. Remove fender covers and close hood.

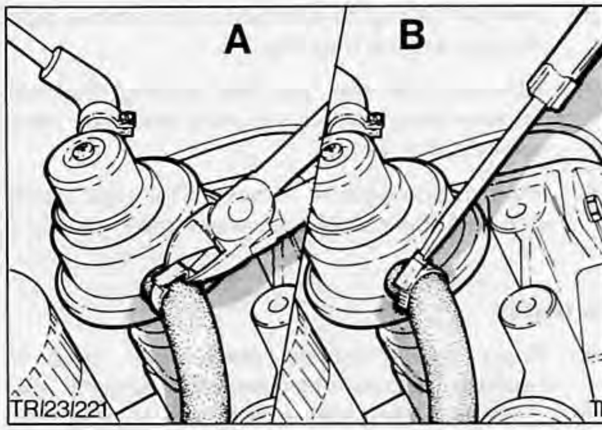


Fig. 78. Disconnecting and reconnecting fuel pump outlet hose
A – Crimped type hose clamp
B – Screw type hose clamp

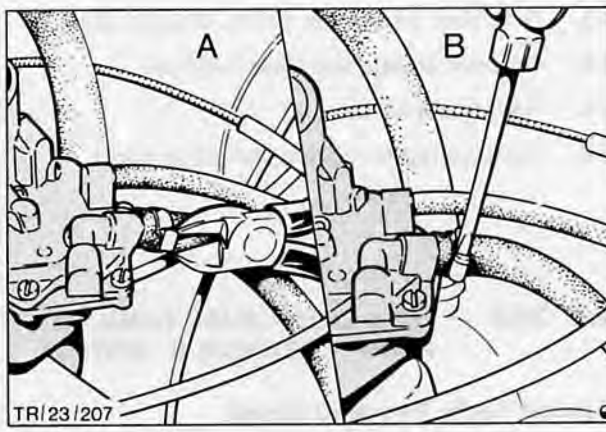


Fig. 79. Disconnecting and reconnecting carburrettor supply pipe
A – Crimped type hose clamp
B – Screw type hose clamp

23 811 CABLE – ACCELERATION – ADJUST

Special Service Tools Required: None

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Locate throttle in the wide open position and hold open with a suitable block of wood.

   NOTE: On auto-transmission variants kick down cable adjustment should also be checked to ensure kick down cable does not prevent wide open throttle being achieved.
4. Wind back adjusting sleeve nut to a point where carburettor linkage is just in the fully open position, Fig. 80.
5. Release throttle pedal and re-apply checking that wide open throttle is just achieved, re-adjust if necessary.
6. Reconnect battery.
7. Remove fender covers and close hood.

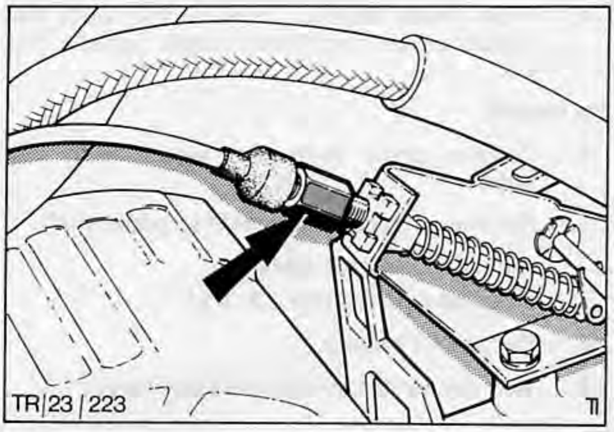


Fig. 80. Accelerator cable adjusting sleeve

23 822 ACCELERATOR PEDAL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Prise pedal flange away from pedal shaft spigot and remove pedal and spring.

To Install

2. Locate spring on spigot shaft then clip pedal flanges on spigots. Check flanges for correct seating and that pedal pivots correctly, Fig. 81.

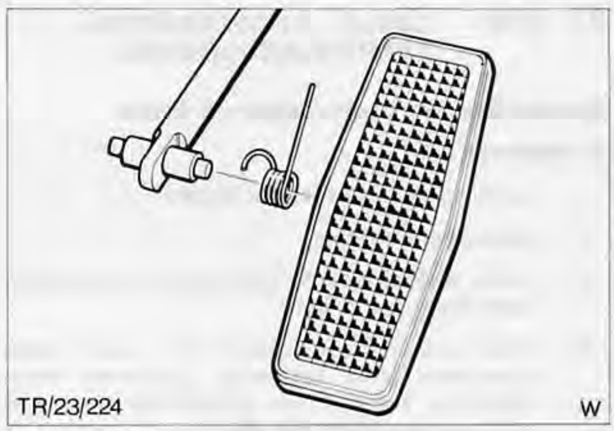


Fig. 81. Throttle pedal and torsion spring

23 824 ACCELERATOR SHAFT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. From inside vehicle prise off retaining clip and disconnect accelerator cable from pedal shaft, Fig. 82.

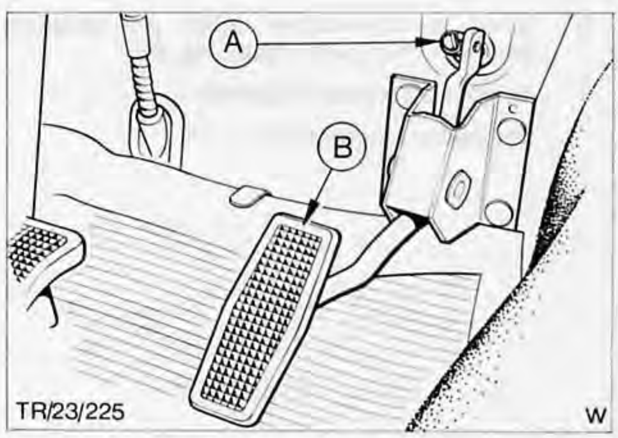


Fig. 82. Pedal shaft assembly
A – Accelerator cable
B – Accelerator pedal

4. From under bonnet, remove four nuts and detach pedal shaft from inside vehicle. Fig. 83.

To Install

5. Position pedal shaft and secure with four nuts.
6. Reconnect accelerator cable to pedal shaft.
7. Adjust accelerator cable.
   Detailed in Operation 23 811.
8. Reconnect battery.
9. Remove fender covers and close hood.

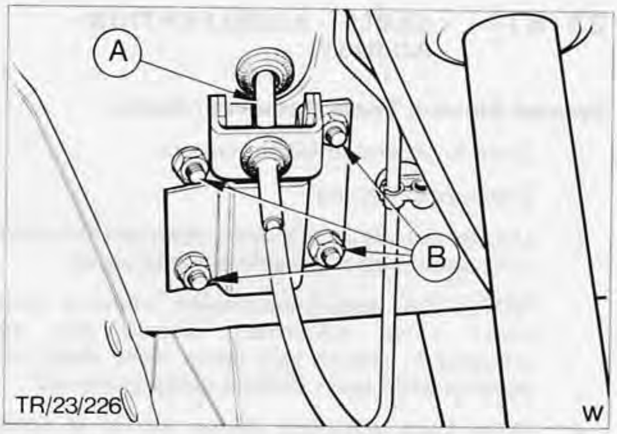


Fig. 83. Pedal shaft assembly
A – Accelerator cable
B – Pedal shaft securing nuts

23 826 CABLE – ACCELERATOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. From inside vehicle disconnect accelerator cable from pedal shaft.
4. From under hood disconnect outer cable complete with retaining grommet from mounting bracket. To disconnect prise out with a screwdriver, Fig. 84.

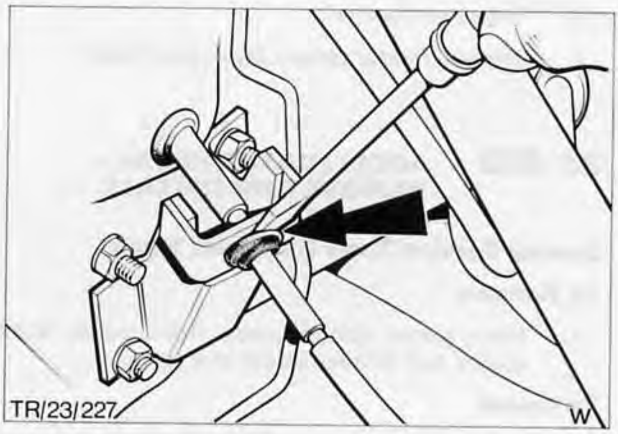


Fig. 84. Disconnecting outer cable from mounting bracket

5. Using a screwdriver prise off retaining grommet from outer cable, Fig. 85.
6. Remove air cleaner assembly.
   Detailed in Operation 23 174.

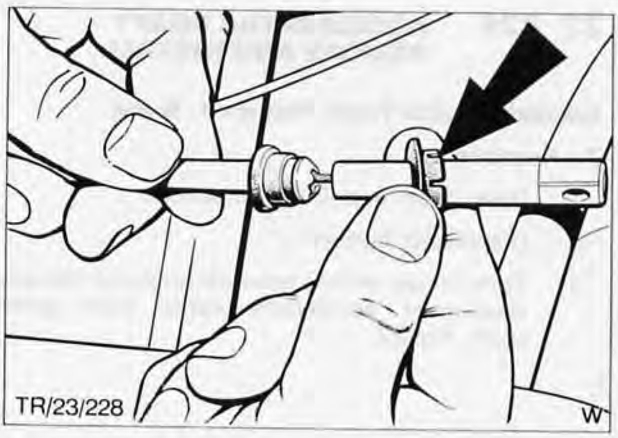


Fig. 85. Removing retaining grommet from outer cable

7. Using a spare cable bracket (Part number 72GB9677UA) make up a special tool for disconnecting cable from bracket.

   To manufacture tool, grind off approximately 3 mm (0.12 in) from outer edges and punch four dot holes in the positions shown in Fig. 86.

8. Disconnect inner cable from carburettor.

9. Unclip outer cable from bracket and detach cable assembly as follows:

   To disconnect cable from bracket, prise out retaining clip and slide the special tool into position so that the four pegs on the clip are fully compressed.

   Slide out cable from bracket and detach tool.

   NOTE: The use of this special tool is to ensure outer cable is not damaged on removal and to enable the operation to be carried out more efficiently.

   An alternative method is to depress the pegs individually using a screwdriver and twist out the cable.

   NOTE: This method is difficult and can be the cause of damage to cable.

To Install

10. Position cable and reconnect to carburettor linkage.

11. Reconnect cable to throttle pedal as follows:

    Clip retaining grommet into the outer cable support bracket, Fig. 87, slide cable through the grommet and clip into place.

12. From inside vehicle reconnect inner cable to throttle pedal.

13. Adjust cable as detailed in operation 23 811, Fig. 88.

14. Refit air cleaner assembly.

15. Reconnect battery.

16. Remove fender covers and close hood.

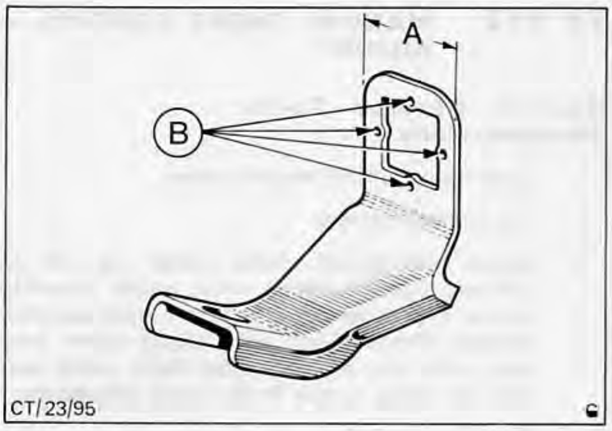


Fig. 86. Accelerator cable remover Dimension
A – 25 mm (1.0 in)
B – 4 dot holes

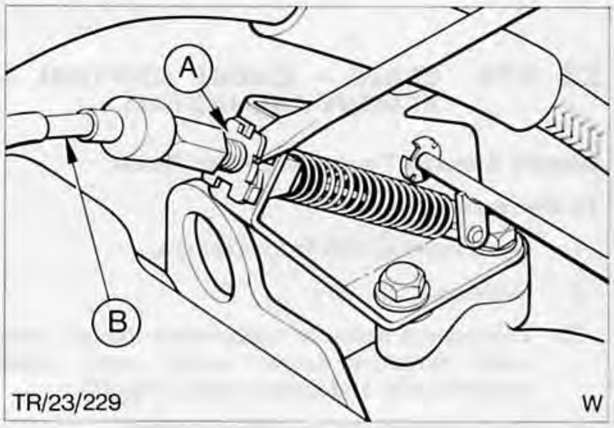


Fig. 87. Removal of accelerator cable retaining clip
A – Cable retaining clip
B – Accelerator cable

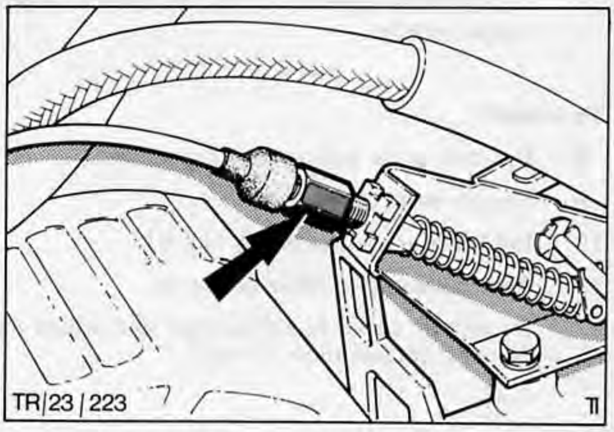


Fig. 88. Accelerator cable adjusting sleeve

23 872 MANUAL CHOKE CONTROL – ADJUST

Special Service Tools Required: None

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Check and adjust choke cable, Fig. 89 as follows. Loosen choke inner cable securing screw. Pull inner cable out from dash approximately 6 mm ($\frac{1}{4}$ in), with choke plate fully open take out all slack from inner cable and lock up clamp screw. Push choke fully home.

   Check operation.
4. Reconnect battery.
5. Remove fender covers and close hood.

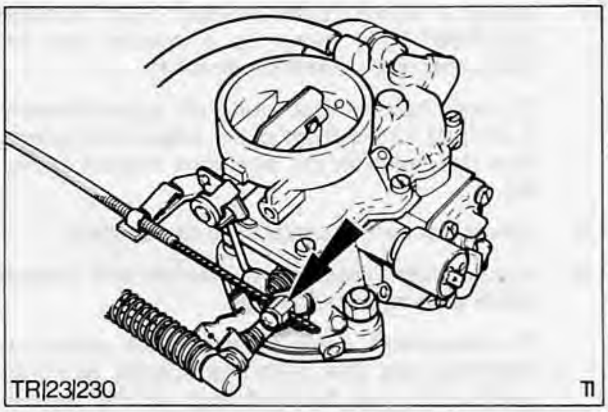


Fig. 89. Choke inner cable securing clamp

23 874 CABLE – CHOKE CONTROL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect cable at carburettor loosen inner cable retaining screw, unclip outer cable retaining clip and detach cable, Fig. 90.
4. Detach bulkhead to cable grommet.
5. Remove two screws and detach heater control panel, Fig. 91.
6. Remove outer cable to dash securing nut (17 mm).
7. Attach draw cord to cable and remove from inside vehicle.

To Install

8. Position cable and remove draw cord.
9. Secure outer cable to dash.
10. Refit heater control panel, Fig. 91.
11. Refit bulkhead to cable grommet.
12. Reconnect cable to carburettor and adjust as detailed in Operation 23–872.

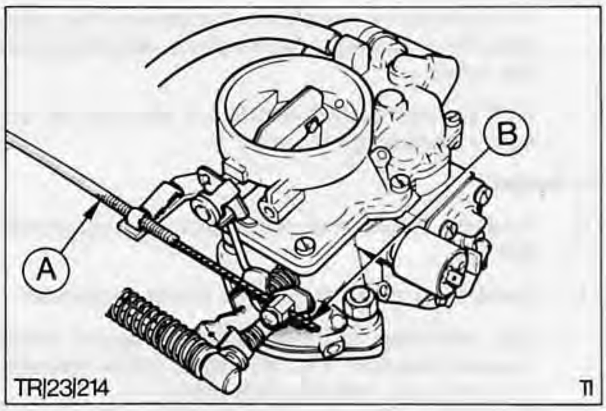


Fig. 90. Choke cable securing points
A – Outer cable securing clip
B – Inner cable securing screw

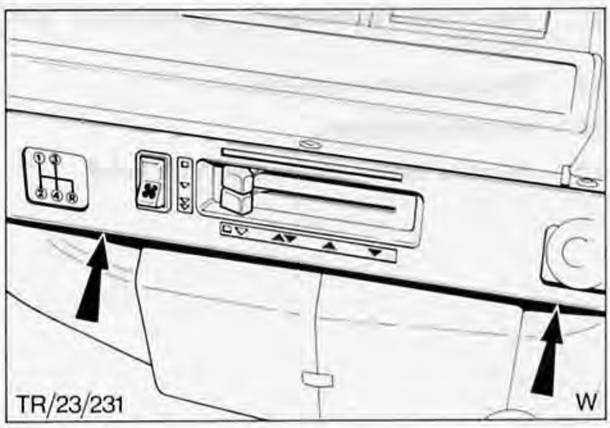


Fig. 91. Heater panel securing screws

TECHNICAL DATA

Fuel Tank

Capacity .. .. 64 Litres (14,3 gallons)

Fuel Pump

	Bar	kgf/cm²	lbf/in²
Delivery pressure	0,28 to 0,36	(0,27 to 0,35)	(4 to 5)

Carburettor

Tuning Details

All dimensions in mm with inches in brackets.

Engine Type and cc	Transmission Type	Idle Speed rpm	Mixture % CO	Fast Idle Manual Choke	Fast Idle Automatic Choke	Float Level Setting	Accelerator Pump Stroke
MOTORCRAFT (1V)							
Allowable Variations	—	±25	±0,2	±100	±100	±0,75 (±0,03)	±0,13 (±0,005)
1600 OHV	MAN		1,25	1100	—	31,0 (1,21)	2,6 (0,10)
1600 OHC	MAN			—	2000		2,8 (0,11)
2000 Economy OHC	MAN	800		1000	—		2,0 (0,08)
2000 OHC	MAN		1,0		—	29,0 (1,14)	
2000 OHC	MAN			—	2000		2,8 (0,11)
2000 OHC	AUTO			—			

Choke Specification (Manual and Automatic chokes)

MOTORCRAFT (1V)

Engine Type and cc	Transmission Type	Manual Choke		Automatic Choke					
		Choke Plate Pull Down	Fast Idle	Vacuum Pull Down	Fast Idle	De-choke	'V' Mark	Bi-Metal Spring Adjustment	Thermostatic Spring Slot
Allowable Variation	—	±0,25 (±0,01)	±100	±0,25 (±0,01)	±100	±0,5 (±0,02)	—	—	—
1600 OHV	MAN	4,5 (0,18)	1100	—	—	—	—	—	—
1600 OHC	MAN	—	—	3,0 (0,12)	2000		5,0 (0,20)	Centre	Centre
2000 Economy OHC	MAN	3,0 (0,12)	1000	—	—	—	—	—	—
2000 OHC	MAN	4,5 (0,18)		—	—	—	—	—	—
2000 OHC	MAN	—	—	3,8 (0,15)	2000	5,3 (0,21)	5,0 (0,20)	Centre	Centre
2000 OHC	AUTO	—	—						

TECHNICAL DATA (cont'd)

Carburettor

Detailed Specification

MOTORCRAFT (IV)

Engine Type and cc	Carburettor Part No.	Transmission Type	Choke Type	Throttle Barrel Diameter	Venturi Diameter	Main Jet
1600 OHV	77IF 9510 KNA	MAN	MAN	36	28	135
1600 OHC	78HF 9510 KEA	MAN	AUTO	36	27	137
2000 Economy O.H.C.	78HF 9510 KJA	MAN	MAN	32	23	115
2000 OHC	78HF 9510 KFA	MAN	MAN	36	27	135
2000 OHC	78HF 9510 KGA	MAN	AUTO	36	27	135
2000 OHC	78HF 9510 KHA	AUTO	AUTO	36	27	127

IGNITION SYSTEM 22

Index **Page**

GENERAL DESCRIPTION

The ignition system consists of a coil, distributor, ballast resistor, spark plugs and high tension leads. These components are designed to provide a powerful spark for the combustion process at the correct point in the engine cycle and to vary the timing of the spark to suit engine speed and load conditions.

The basic items in the ignition system that require periodic checks and adjustments are, ignition timing, dwell angle, and spark plug gaps. Alterations to ignition timing are achieved by rotating the complete distributor assembly.

A maladjusted ignition system will radically affect engine performance and fuel economy. The ignition system also plays a major part in the control of exhaust emission levels, an aspect which is becoming progressively important as more stringent regulations are introduced.

It is therefore, essential that the correct service repair and setting procedures are used in conjunction with the relevant specifications contained in the technical data section.

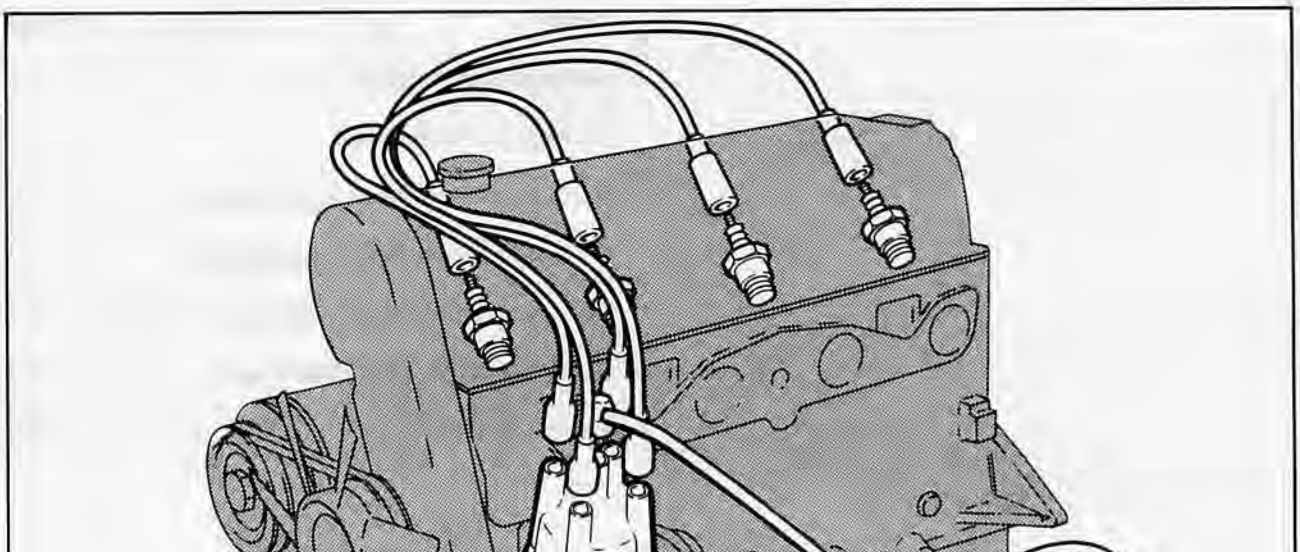


Fig. 1 Ignition System (OHC variant illustrated)

Components that make up the ignition system are described individually in the following pages

GENERAL DESCRIPTION (cont'd)

(a) Coil

The ignition coil is mounted on the battery support bracket for all model variants.

The coil consists of a cylindrical metal casing which contains two concentrically-wound copper wire coils immersed in thin mineral oil to prevent over-heating. The coil is designed to run under normal conditions with a 6 volt supply to the low tension terminal. This voltage is increased to approximately 31000 volts by the coil windings working in conjunction with the distributor contact breaker points.

The coil has three terminals, Fig. 2, two low tension (LT) and one high tension (HT). The positive LT lead supplies the power source to the coil from the battery via the ignition switch. The negative LT lead connects the coil to the distributor.

The main HT lead supplies the high voltage, created within the coil, to the spark plugs via the distributor cap.

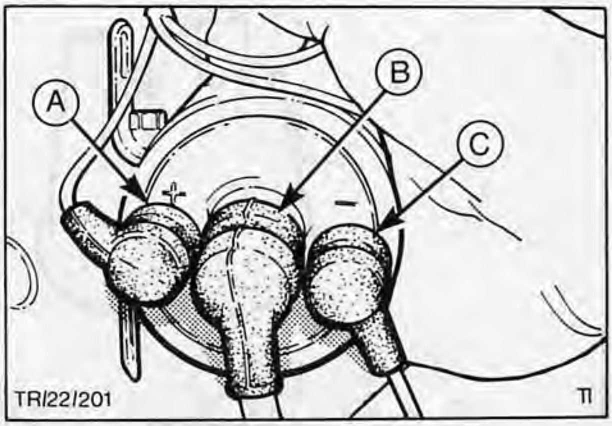


Fig. 2 Ignition coil
A – Positive (+) terminal to loom
B – Main HT terminal to distributor cap
C – Negative (–) terminal to distributor

(b) Distributor (Figs. 5 and 6 show full exploded views)

The distributor is driven at half engine speed by a skew gear from the camshaft/auxiliary shaft, and rotates in a clockwise direction on all variants except the Kent OHV engine.

The ignition advance is mechanically controlled according to engine speed by governor weights inside the distributor body and according to engine load by vacuum control.

Motorcraft distributors are used on all Transit petrol variants with minor variations to suit the various engines in the range.

The distributor fitted on the Kent OHV variant has a much smaller overall length, Fig. 4, when compared with the OHC distributor, Fig. 3.

All components that make up the distributor are available individually as Service Replacement parts, including such components as advance weights springs and drive gears.

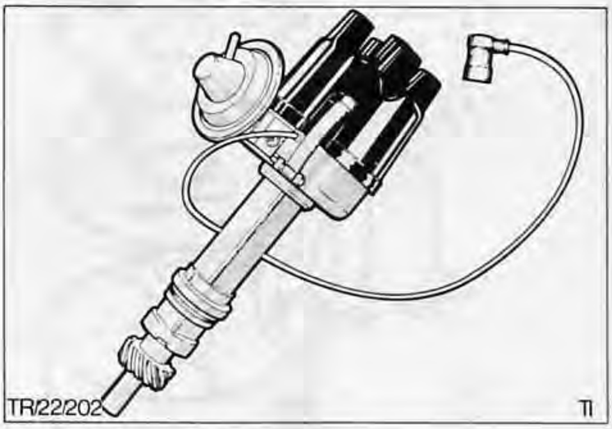


Fig. 3 Motorcraft distributor OHC type

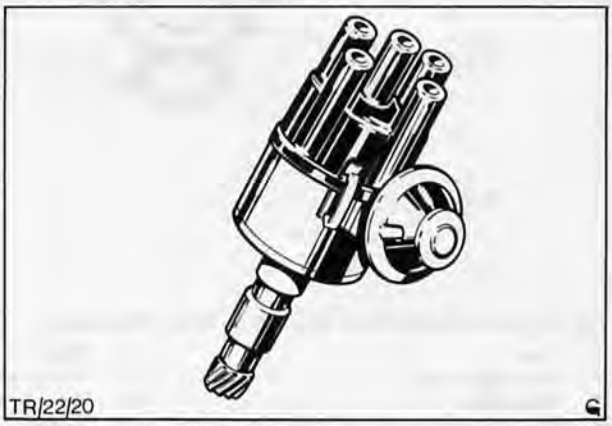


Fig. 4 Motorcraft distributor Kent OHV type

GENERAL DESCRIPTION (cont'd)

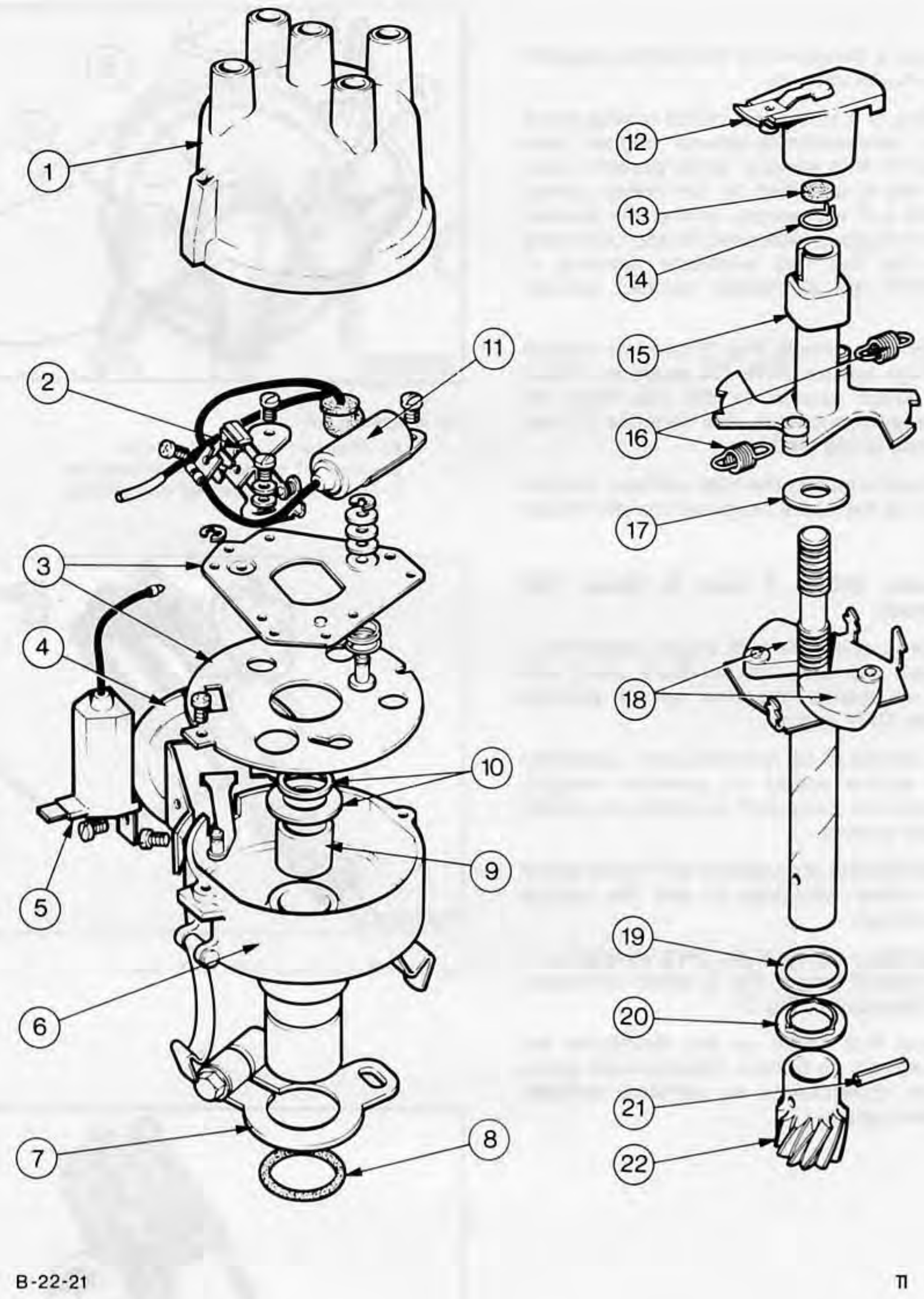


Fig. 5. Motorcraft distributor as fitted on Kent OHV variants

1. Cap
2. Points assembly
3. Base plate
4. Vacuum unit
5. Radio suppressor
6. Body
7. Distributor clamp
8. Seal
9. Bush
10. Thrust washers
11. Condenser
12. Rotor
13. Felt wick
14. Circlip
15. Cam
16. Advance springs
17. Washer
18. Advance weight assembly
19. Spacer
20. Washer
21. Pin
22. Gear

GENERAL DESCRIPTION (cont'd)

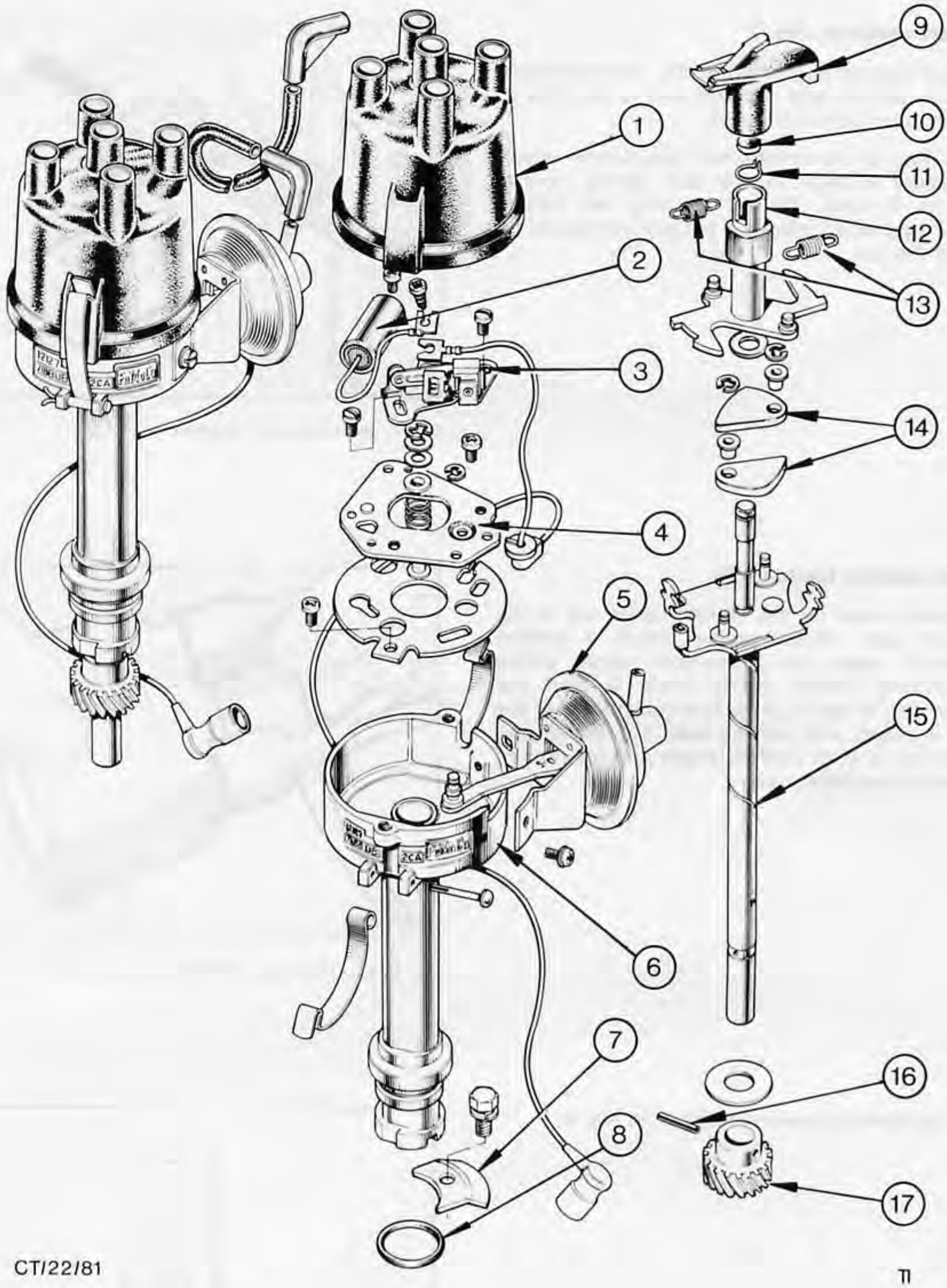


Fig. 6. Motorcraft distributor as fitted on OHC variants

1. Cap
2. Condenser
3. Contact breakers
4. Base plate
5. Vacuum unit
6. Body
7. Distributor clamp
8. Seal
9. Rotor arm
10. Felt wick
11. Circlip
12. Cam
13. Advance springs
14. Advance weights
15. Shaft
16. Pin
17. Gear

GENERAL DESCRIPTION (cont'd)

(c) Ballast resistor, Fig. 7

The ballast resistor is located in the loom between the ignition switch and the coil and is secured to the battery tray support bracket.

The unit has a pre-determined resistance which limits battery voltage to the coil during normal running to 6 volts. During starting the ballast resistor is by-passed allowing battery voltage to be applied to the coil.

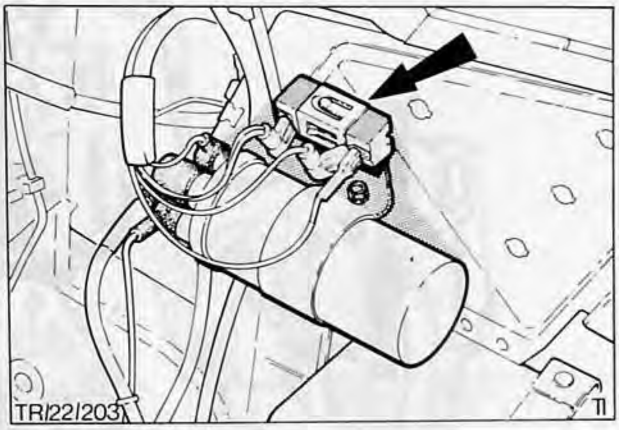


Fig. 7. Ballast resistor location

(d) High tension leads (HT)

The HT leads used on the Transit range are of the suppressor type which utilise either a carbon impregnated rayon or glass-fibre core. When disconnecting these leads from either the distributor cap or spark plugs it is essential that the terminal is pulled and not the lead, Fig. 8. All plug HT leads vary in their overall length and for ease of identification are numbered.

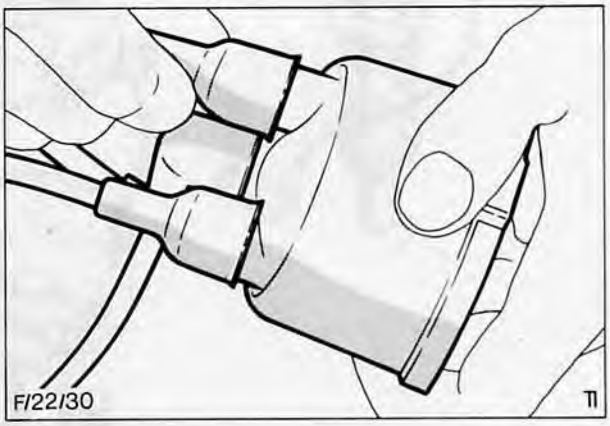


Fig. 8. Disconnecting HT leads by pulling terminal not lead

Cylinder numbering sequence shown in Fig. 9.

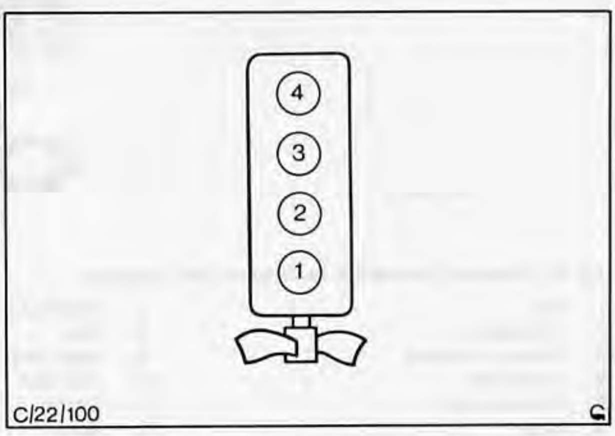


Fig. 9. Cylinder numbering sequence (All in line engine variant)

PRINCIPLE OF OPERATION

(a) Coil circuit

The ignition system is of the ballast resistor type and uses a 6 volt coil.

Under normal operating conditions the 12 volt feed to the coil is reduced by a ballast resistor to approximately 6 volts.

During starting however the ballast resistor is by-passed allowing full available battery voltage to be fed to the coil. This ensures that during cold starting, when the starter motor current draw would be high, sufficient voltage is still available at the coil to produce a powerful spark, e.g. under extreme cold conditions a starter motor can reduce the battery voltage to as low as 8 volts which with a 6 volt coil will still be adequate. If a 12-volt coil was used the HT voltage produced would not be sufficient and poor starting may be experienced.

NOTE: It is essential that the correct coil is used as a service replacement.

Fig. 10 shows in schematic form the circuit that is used when the ignition switch is in the 'off' position.

Fig. 11 shows the circuit used when the ignition switch is in the 'start' position. Note that the ballast resistor is by-passed and full available battery voltage is applied to the coil ensuring a powerful spark is achieved and thereby improving starting characteristics.

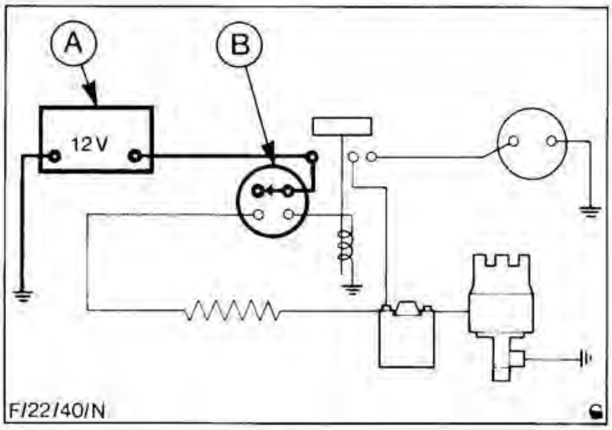


Fig. 10. Ignition switch in 'off' position
A – Battery
B – Ignition switch

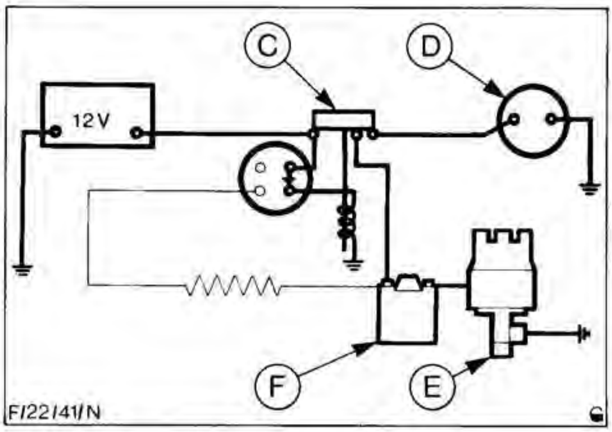


Fig. 11. Ignition switch in 'start' position
C – Starter solenoid
D – Starter motor
E – Distributor
F – Ignition coil

Fig. 12 shows the circuit used for normal operation of the ignition system. Note that the 12-volt supply is now directed through the ballast resistor before being applied to the coil.

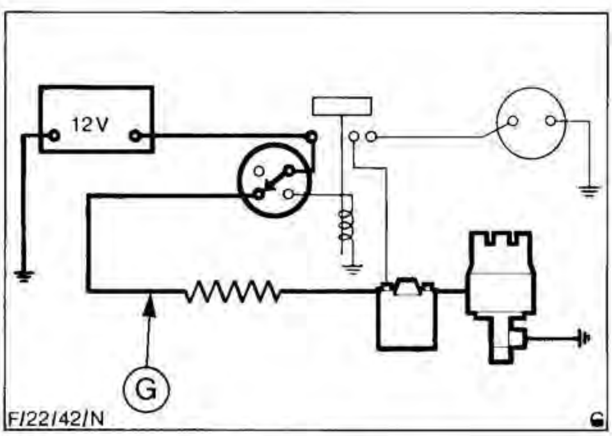


Fig. 12. Ignition switch in 'on' position
G – Ballast resistor

PRINCIPLE OF OPERATION (cont'd)

(b) Distributor

The distributor is driven at half engine speed by a skew gear on the camshaft/auxiliary shaft and rotates in a CLOCK-WISE direction when viewed from the top on OHC models and in an ANTI-CLOCK-WISE direction on Kent OHV HT voltage from the coil is fed into the distributor through the centre terminal of the cap, which is connected to a carbon rod fitted inside the cap. The voltage is then applied through the rotor arm to HT output terminals which supply the individual spark plugs.

Ignition spark advance is achieved by two separate systems (a) mechanical advance weights Fig. 13, and (b) vacuum diaphragm unit Fig. 14. Correction of spark advance is necessary because of the wide variations in engine speed and load under normal operating conditions. When accelerating or climbing hills the engine load can be high and the spark advance required is not necessarily as much as it would be on level ground at an equivalent engine speed.

(a) The mechanical governor mechanism consists of two weights pivoted so that they move outwards from the distributor shaft as the engine speed rises. As the weights move outwards they turn the cam relative to the distributor shaft and thus advance the firing point. The weights are restrained by two springs of different tension thus giving a progressive advance action, and the amount the weights move outwards is in direct proportion to the distributor shaft speed. To maintain a smooth operation throughout the engine speed range the weights follow the contours of fixed cam segments as they move outwards, and this system has the advantage of reducing the number of moving parts to a minimum.

(b) In the vacuum control mechanism, one side of the diaphragm is linked to the breaker plate and the other side is connected by a vacuum line to the carburettor, just above the throttle plate. A spring is fitted between the vacuum side of the diaphragm and the vacuum unit connection.

The vacuum applied at the diaphragm, combined with the action of the diaphragm spring, gives correct spark by moving the base plate in relation to the cam. Spark advance will vary according to the load placed on the engine. As the vacuum advance does not operate at idling speed due to the carburettor throttle plate being almost closed, a correctly retarded spark is obtained for starting.

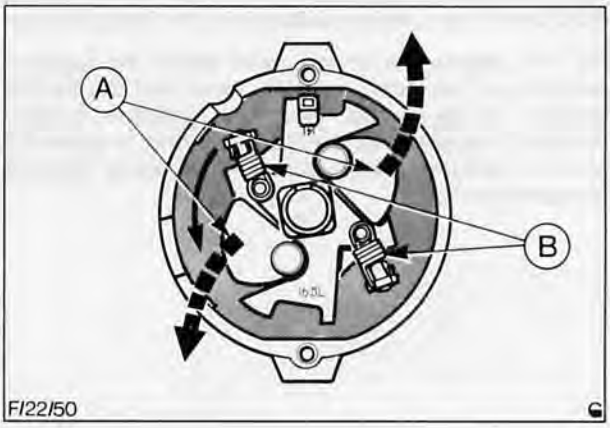


Fig. 13. Mechanical advance system
A – Advance weights
B – Advance springs

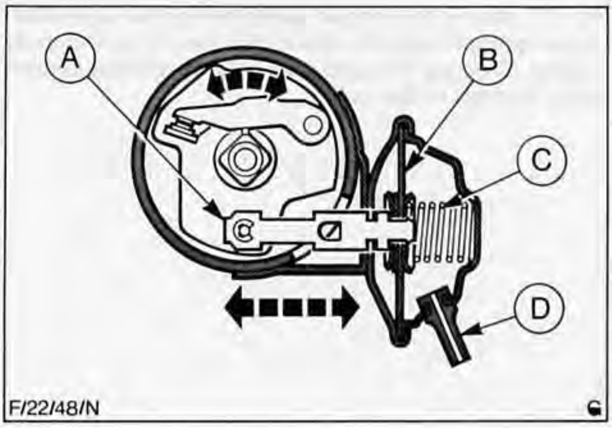


Fig. 14. Vacuum advance system
A – Vacuum advance arm
B – Diaphragm
C – Return spring
D – Vacuum supply pipe

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals, the following items on the ignition system should be checked.

1. Clean spark plugs and adjust gaps, or renew if necessary.

   The normal method of cleaning is with abrasive in a spark plug cleaner. After cleaning, the centre electrode should be filed square and gap adjusted to specified clearance.

   Ensure that all abrasive is removed from plug and clean ceramic insulator.

   Oily or wet plugs should be dried before cleaning.

   Ensure, if applicable, that sealing ring is in good condition.

   Replace plugs in cylinder head and tighten to a 3,8 Nm (38 kgf.m) (28 lbf.ft).

2. Clean high tension leads and check for security.

3. Examine distributor points, renew if necessary, clean distributor cap and coil.

   Points which have become dirty or contaminated with oil or grease should be cleaned with a stiff brush.

   Distributor contact breaker points should only be changed if they are worn, badly burnt, have excessive metal transfer or have a 'high resistance', i.e. voltage drop across points exceeds 0,25 volts.

   Contacts showing a greyish colour and only slight signs of pitting need not be renewed.

4. Lubricate:

   (a) distributor cam spindle wick with two drops of engine oil, Fig. 15.

   (b) distributor cam with high melting point grease, Spec. ESF-M1C66-A, Fig. 16.

   NOTE: Do not over lubricate any part of distributor, otherwise lubricant may reach contact breaker points, resulting in burning and difficult starting.

5. Check ignition timing, and adjust if necessary, as described overleaf.

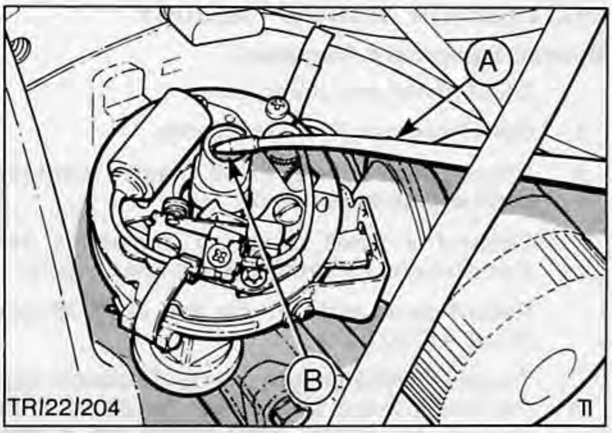


Fig. 15. Lubricating distributor cam spindle wick
A – Oil can
B – Distributor cam spindle

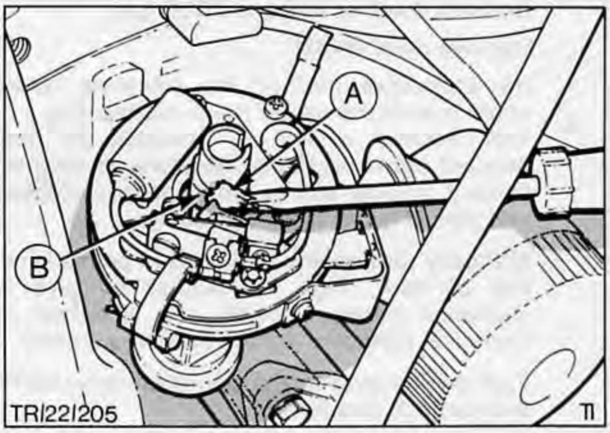


Fig. 16. Lubricating distributor cam
A – High melting point grease
B – Distributor cam

SERVICE ADJUSTMENTS AND CHECKS (cont'd)

DISTRIBUTOR TIMING – ADJUST

Special Equipment Required:

Dwell meter and timing lamp.

1. Open hood and fit fender covers.

2. Check and adjust dwell angle (contact breaker gap) as required.

   Connect a dwell meter to engine as per manufacturers instructions and start engine.

   Record dwell angle at idle and at 2000 rpm (4 cyl. 48° to 52°.)

   To adjust, stop engine, unclip distributor cap and swing to one side, detach rotor arm. With ignition on, crank over engine on starter motor and adjust contact breaker points.

   NOTE: To crank engine, either use ignition switch or connect a hand switch between a live terminal and starter solenoid power pick up connection.

   Recheck dwell at idle and 2000 rpm.

   Remove dwell meter.

   An alternative method for adjusting dwell angle is with the use of feeler blades, Fig. 17. This method is not as accurate as that detailed above but is satisfactory as long as contact breaker points are in good condition and care is taken when adjusting.

   Manually turn engine until heel of points is on top of cam, Fig. 17. Adjust to give a clearance between points, as specified in Technical Data and tighten retaining screws.

   Turn engine over to the opposite cam (180°) and recheck clearance.

3. Check and adjust ignition timing as required.

   Disconnect and plug vacuum pipe. Manually turn engine to locate timing marks on crankshaft pulley and using a piece of chalk 'high-light' TDC mark, Fig. 18. Connect timing light to engine and allow to idle at specified speed. Check ignition timing. Refer Technical Data.

   NOTE: The timing mark identification for OHC variants is illustrated in Fig. 33.

   To adjust timing, stop engine, loosen distributor clamp and rotate complete assembly. Tighten clamp and recheck timing.

4. Check ignition mechanical and vacuum advance.

   NOTE: To carry out ignition advance check, the timing light must be of the type that includes an advance meter.

   With the timing lamp still connected, restart engine and hold at 2000 rpm, adjust timing lamp and note mechanical advance, reconnect vacuum advance pipe and measure total advance. To obtain a vacuum advance figure subtract mechanical advance figure from total. Refer Technical Data.

5. Remove fender covers and close hood.

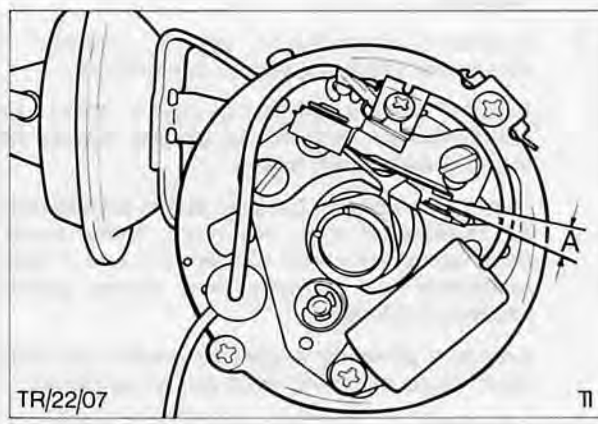


Fig. 17. Alternative method of adjusting dwell by checking contact breaker points gap
A – Points gap

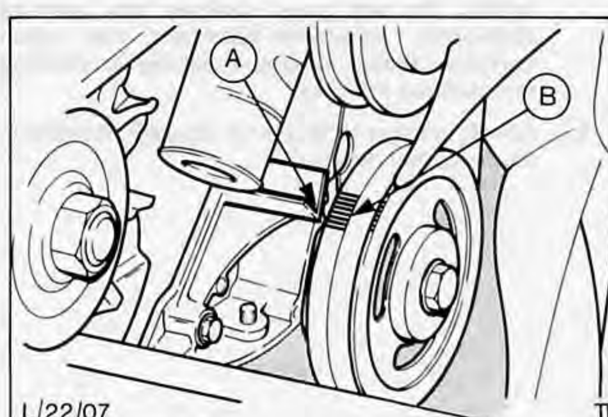


Fig. 18. Engine set on TDC
A – Timing pointer
B – TDC notch on crankshaft pulley (OHC illustrated)

SPECIAL SERVICE TOOL RECOGNITION

British Sourced	European Sourced	German Sourced	Tool Name
			No special service tools required

SERVICE AND REPAIR OPERATIONS – CONTENT

IGNITION SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the listed model range: Transit '77	Fiesta	Escort '75 onwards	Capri II	Taunus '76/Cortina '77	Granada '78 onwards
22 111	Ignition system – test	X		X	X	X	X	X	X
22 213	Distributor timing – adjust	X		X	X	X	X	X	X
22 214	Distributor – remove and install	X		X	X	X	X	X	X
22 214 8	Distributor – overhaul (distributor removed)	X		X	X	X	X	X	X
22 224 4	Vacuum unit – replace (distributor removed)	X		X	X	X	X	X	X
22 226 4	Gear – distributor – replace (Distributor removed)		22 214 8						
22 234	Contact breaker points – replace	X		X	X	X	X	X	X
22 234 4	Contact breaker points – replace (Distributor removed)		22 234						
22 244	Condenser – replace	X		X	X	X	X	X	X
22 244 4	Condenser – replace (distributor removed)		22 244						
22 284	Cap – distributor – replace	X		X	X	X	X	X	X
22 284 4	Cap – distributor – replace		22 284						
22 411	Ignition coil – test	X		X	X	X	X	X	X
22 411 1	Ignition coil – test (coil removed)		22 411						
22 414	Ignition coil – remove and install	X		X	X	X	X	X	X
22 414 4	Ignition coil – remove and install		22 414						
22 451	High tension leads resistance – check (all)	X		X	X	X	X	X	X
22 451 1	High tension leads resistance – check (all)		22 451						
22 454	Leads – high tension – replace (all)	X		X	X	X	X	X	X
22 484	Spark plugs – remove and install	X		X	X	X	X	X	X
22 484 4	Spark plugs – remove and install		22 484						
22 481 1	Spark plugs – check and adjust – (Spark plugs removed)	X		X	X	X	X	X	X

22 111 IGNITION SYSTEM – TEST

Special Equipment Required:

Electronic test equipment which includes an ohm meter, dwell meter, oscilloscope and timing light.

NOTE: If the technician is unfamiliar with use of electronic test equipment then it is essential that reference be made to existing training material before attempting the following operation.

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect two LT leads and one HT lead at coil.

   To disconnect leads pull on end of terminal not cable, Fig. 19.

   LT—Low Tension.

   HT—High Tension.
4. Disconnect HT leads at spark plugs, unclip distributor cap and detach assembly.
5. Test HT leads resistance as follows:

   Connect ohm meter to HT lead terminal and to distributor cap to rotor arm connection, record resistance, Fig. 20. If resistance is high, HT lead to cap connection should be cleaned and resistance rechecked before lead is replaced. Refer Technical Data.

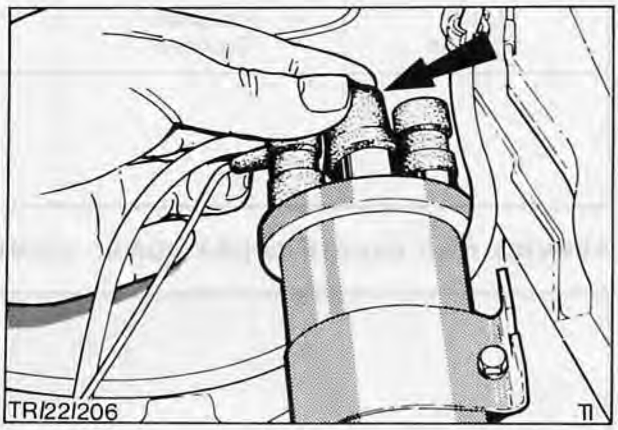

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Fig. 19. HT lead removal. Hold terminal NOT lead

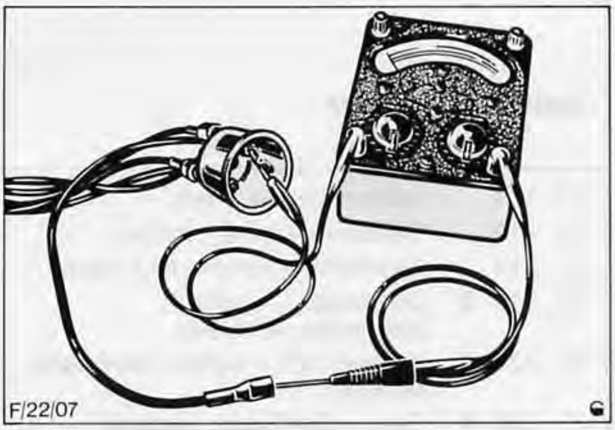
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Fig. 20. HT lead resistance being checked. AVO ohm meter shown

6. Test coil resistance as follows:

   (a) Primary Circuit, Fig. 21.

   Connect ohm meter between two LT connections on coil, select appropriate scale and record resistance. Refer Technical Data.

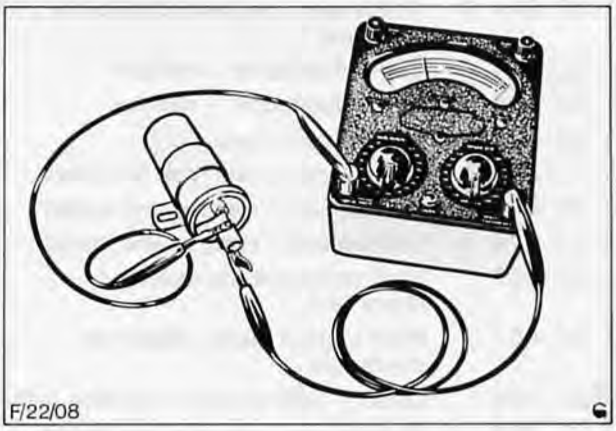
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Fig. 21. Primary circuit resistance test
Note: Coil shown off vehicle for clarity

(b) Secondary Circuit, Fig. 22
Reconnect ohm meter to coil HT lead connection and either one of the two LT connections, select scale and record resistance. Refer Technical Data.

7. Remove rotor arm and inspect contact breaker points for wear or excessive burning.

8. Clean, inspect and refit rotor arm. Inspect for wear, hairline cracks and burning.

9. Inspect distributor cap for hairline cracks and connections for wear or burning, paying particular attention to the centre carbon pick up in cap. Clean cap and refit. Reconnect HT leads to spark plugs.

10. Connect test set to engine in accordance with manufacturers instructions.

11. Reconnect battery, start engine and warm up to normal operating temperature.

12. Check dwell angle, dwell variation and dwell overlap. Refer Technical Data.

(a) Dwell Angle: 48° to 52°.
This measurement is checked at idle using a dwell meter and is an average angle for all four cylinders.

(b) Dwell Variation (4° Max).
Hold engine at 2000 rpm and re-record dwell. Variation is the difference between angle recorded at idle and angle recorded at 2000 rpm.

(c) Dwell Overlap, Fig. 23 (3° Max).
Is checked using primary pattern on oscilloscope showing four cylinder super-imposed.
Overlap is difference in dwell angle between each cylinder.

NOTE: Some types of diagnostic equipment do not include an oscilloscope but still have the facility to carry out the following operations. In these cases, for detailed procedures reference should be made to the equipment manufacturers instructions.

13. Check coil polarity and maximum coil output.

(a) Coil Polarity.

With engine idling, display secondary circuit on oscilloscope and check polarity, Fig. 24. A is correct, B is incorrect.

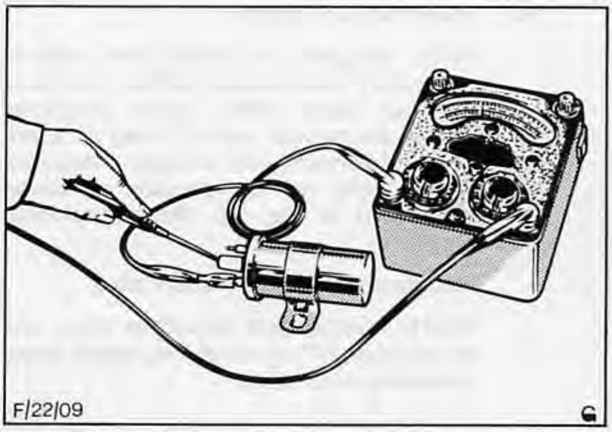


Fig. 22. Coil secondary circuit resistance test
Note: Coil shown off vehicle for clarity

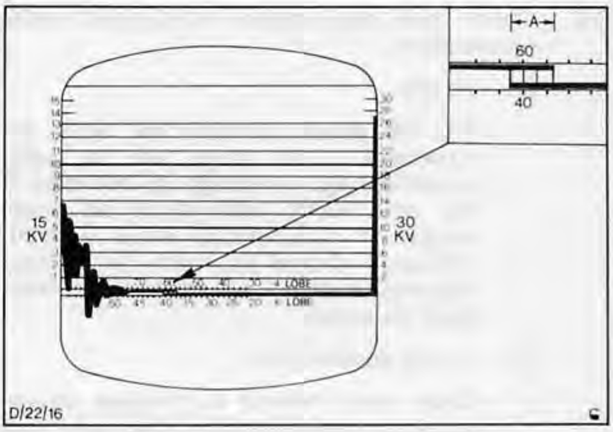


Fig. 23. Dwell overlap shown as 'A'

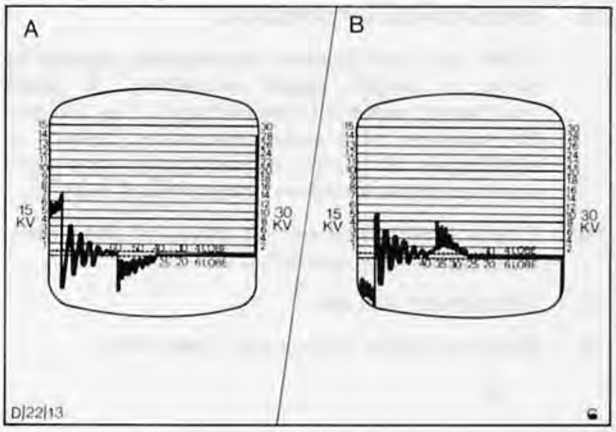


Fig. 24. Coil polarity check
A – Correct polarity B – Incorrect polarity

(b) Maximum coil output.

With engine at 1000 rpm adjust secondary oscilloscope pattern to show all four spark lines. Using insulated pliers, disconnect one HT lead at spark plug. Maximum coil voltage measured in Kilo volts will be recorded on scope as shown in Fig. 25. Refer Technical Data.

Reconnect HT lead to spark plug.

NOTE: Special care should be taken not to damage HT terminal insulation when removing with pliers.

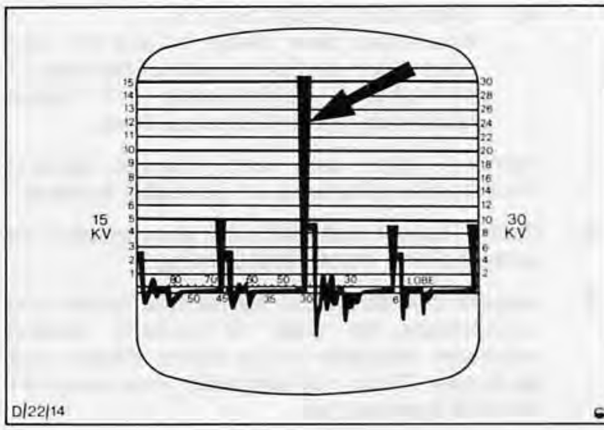


Fig. 25. Maximum coil voltage

14. Check spark plug voltage at idle and under acceleration.

(a) At idle.

Fig. 26 shows pattern that would be expected if all plugs are in good condition e.g. a voltage of between 9 KV and 10 KV and all of an equal length. If observations show a fault, reference should be made to existing training material to ascertain correct fault diagnosis.

(b) Under acceleration.

Snap open throttle to increase engine speed to approximately 3000 rpm, note plug KV readings and release throttle. On initial acceleration the plug voltage will rise to a peak, this peak should not be in excess of two-thirds of maximum coil output, sub-operation 13B

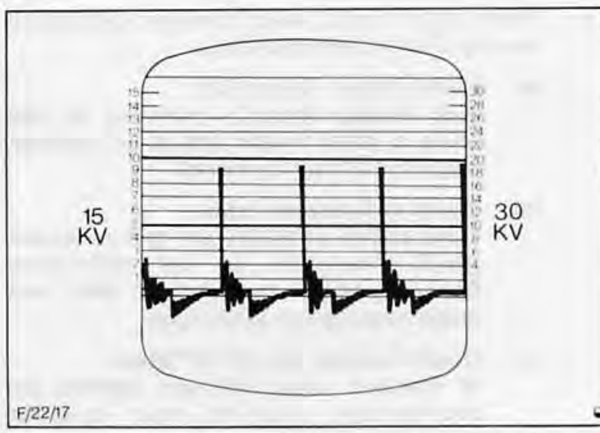


Fig. 26. Secondary scope pattern showing four cylinders

15. Check condenser condition.

Open out oscilloscope secondary pattern to show a single spark sequence. A good condenser pattern is shown as A, Fig. 27 and an example of a poor condenser pattern is shown as B. Note difference in size and number of peaks when comparing A with B.

16. Check timing and timing advance characteristic, detailed in operation 22-213.

17. Disconnect test set.

18. Remove fender covers and close hood.

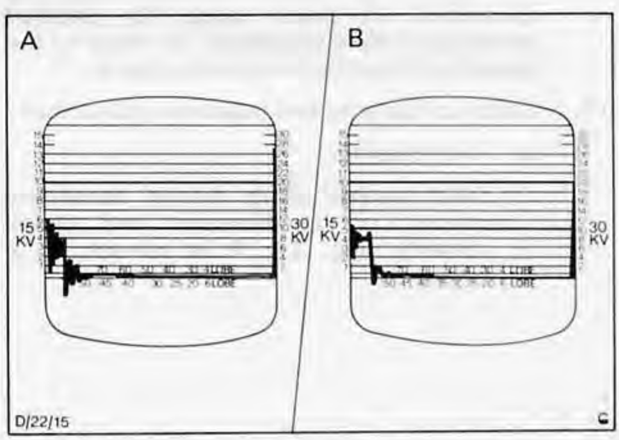


Fig. 27. Condenser pattern shown on the scope. A shows a good pattern. B shows a poor pattern

22 213 DISTRIBUTOR TIMING – ADJUST

Special Equipment Required:

Dwell meter and timing lamp.

1. Open hood and fit fender covers.

2. Check and adjust dwell angle (contract breaker gap) as follows:

   Connect a dwell meter to engine as per manufacturers instructions and start engine.

   Record dwell angle at idle and at 2000 rpm. (48° to 52°)

   To adjust, stop engine, unclip distributor cap and position to one side, detach rotor arm. With ignition on, crank over engine on starter motor and adjust contact breaker points.

   NOTE: To crank engine, either use ignition switch or connect a hand switch between a live terminal and starter solenoid power pick up connection.

   Recheck dwell at idle and 2000 rpm.

   An alternative method for adjusting dwell angle is with the use of feeler blades. This method is not as accurate as that detailed above but is satisfactory as long as contact breaker points are in good condition and care is taken when adjusting. Manually turn engine till heel of points is on top of cam, Fig. 28. Adjust to give a clearance between points, as specified in Technical Data and lock up two retaining screws. Turn engine over to the opposite cam (180°) and recheck clearance.

3. Check and adjust ignition timing as required.

   Manually turn engine to locate timing notch on crankshaft pulley and using a piece of chalk 'highlight' notch. Connect timing light to engine as per manufacturers instructions, start engine and allow to idle at specified idle speed. Disconnect and plug vacuum pipes and check ignition timing. Refer Technical Data.

   NOTE: The timing mark identification for OHC variants is illustrated in Fig. 33.

   To adjust timing, stop engine, loosen distributor clamp and rotate complete assembly.

   Tighten clamp bolt and recheck timing, Fig. 29.

4. Check ignition mechanical and vacuum advance.

   NOTE: To carry out ignition advance checks, the timing light must be of the type that includes an advance meter.

   With timing lamp still connected restart engine and hold at 2000 rpm, adjust timing lamp and note mechanical advance, reconnect vacuum advance pipe and measure total advance. To obtain a vacuum advance figure subtract mechanical advance figure from total. Refer Technical Data.

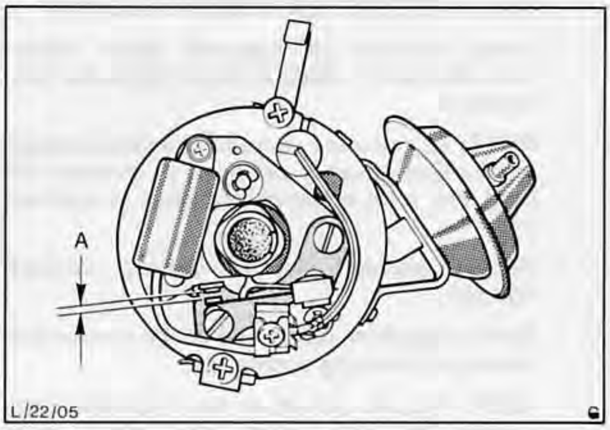


Fig. 28. Contact breaker points gap 'A'
Note: Heel of points on top of cam

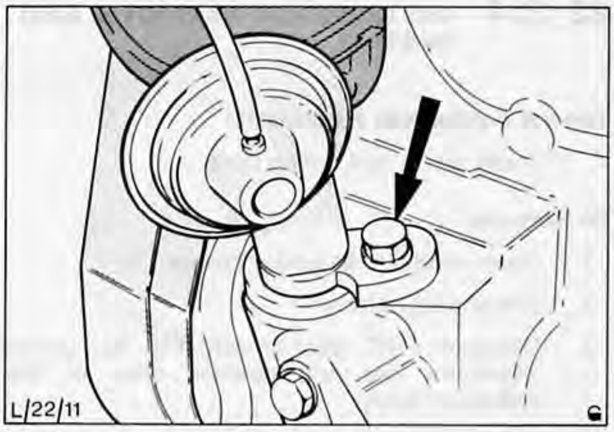


Fig. 29. Distributor clamp bolt

When investigating ignition problems more detailed checks of the advance characteristics may be required i.e. at varying engine rpm and vacuums. This can be done in two ways:

(a) Using distributor test equipment.
There are many different types of equipment and in all cases a test procedure will be supplied by the manufacturer.

Important Note: The Technical Data section shows advance figures in crankshaft degrees, and to obtain distributor degrees, figures quoted should be divided by two.

(b) An alternative method of checking advance characteristic is by using a vacuum hand pump, Fig. 30.

i Connect hand pump directly to distributor, Fig. 31.

ii Start engine and adjust idle to 1000 rpm.

iii Adjust timing light to bring crankshaft notch back to TDC and note mechanical advance.

iv Pump vacuum to required figure (Refer Technical Data) readjust timing light and note advance.

NOTE: To calculate vacuum advance subtract mechanical advance obtained in element (iii) from the total advance obtained in element (iv).

v Repeat element (iv) at varying vacuum figures.

vi Remove vacuum pump and check mechanical advance at varying engine rpm.

NOTE: Figures quoted in the Technical Data section do not include the initial static advance.

vii Reconnect vacuum advance pipe.

5. Remove fender covers, close hood.

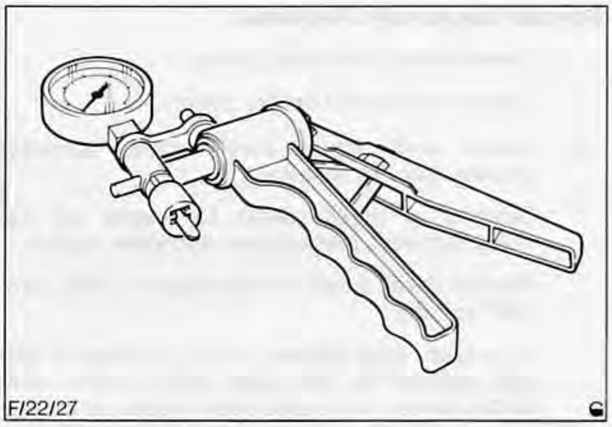


Fig. 30. Hand operating vacuum hand pump

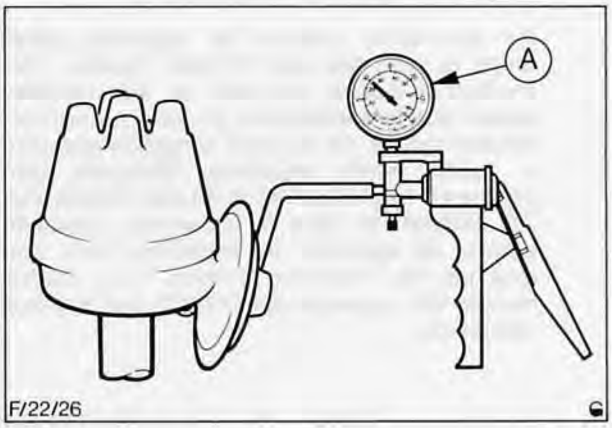


Fig. 31. Hand vacuum pump connected to distributor
A – Vacuum pump

22 214 DISTRIBUTOR – REMOVE AND INSTALL

Special Equipment Required:

Dwell meter and timing lamp.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT lead at coil, Fig. 32, unclip distributor cap and position clear of the distributor body.

   NOTE: When disconnecting lead pull on terminal not lead

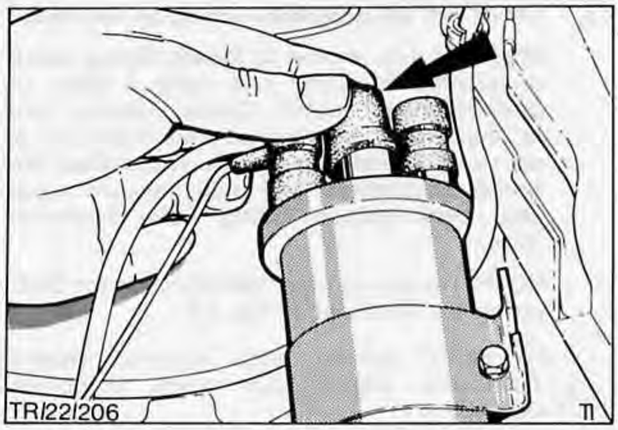


Fig. 32. HT lead removal from coil

4. Position engine on TDC No. 1 cylinder by manually turning engine to a point where rotor arm would be touching No. 1 contact in distributor cap and TDC mark on crankshaft pulley lines up with timing mark, Fig. 33.

   NOTE: The timing mark identification for the crankshaft pulley is in Fig. 33.

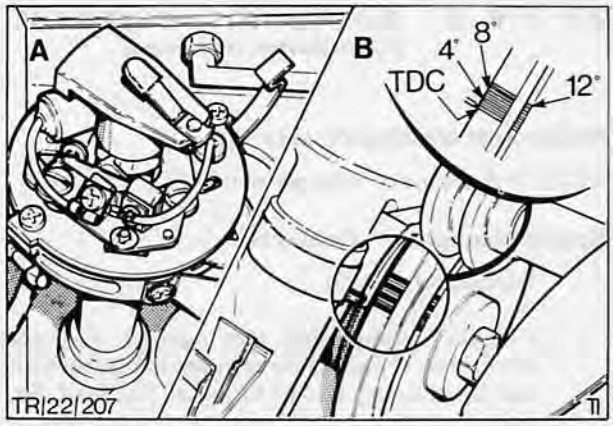


Fig. 33. Engine position on TDC No. 1
A – Rotor arm facing No. 1 contact
B – Crankshaft pulley lined up on TDC
(OHC distributor illustrated)

5. Remove single bolt located at base of distributor, slide out assembly and mark position of rotor arm relative to body, Fig. 34.

   A scribed mark will be of help when refitting distributor.

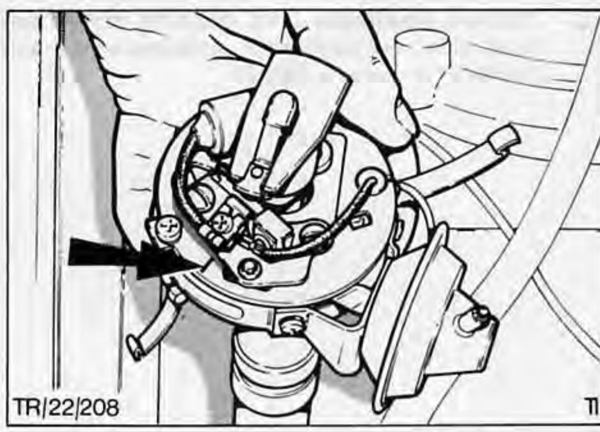


Fig. 34. Rotor arm position marked relative to body
A – Rotor arm B – Scribed line

To Install

6. Ensure engine is at TDC No. 1 position and rotor arm points to mark on body. Slide distributor assembly into position and tighten securing bolt, Fig. 35.
7. Reconnect battery.
8. Check and adjust distributor dwell angle as required.

   Detailed in operation 22 213.
9. Ensure distributor cap is clean and reconnect HT leads. Refit Cap.
10. Check and adjust ignition timing as required and tighten securing bolt, Fig. 35.

    Detailed in operation 22 213.
11. Remove fender covers and close hood.

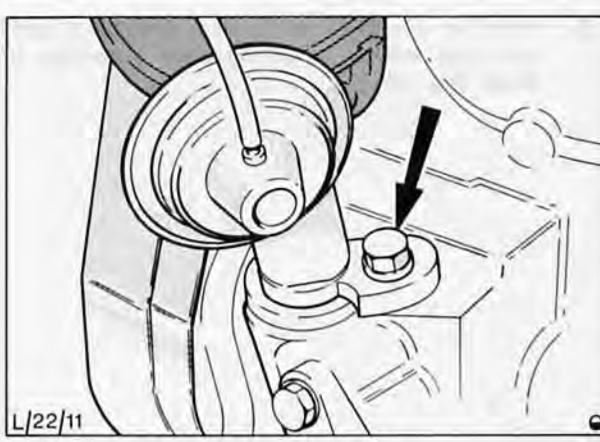


Fig. 35. Distributor securing bolt

22 214 8 DISTRIBUTOR – OVERHAUL (Distributor removed)

Motorcraft distributor only

NOTE: Full exploded view shown in Figs 5 and 6.

Special Equipment Required:

Distributor test rig.

1. Release spring clips and remove cap and rotor arm. If necessary remove HT leads from cap by gripping end of terminal, not lead, Fig. 36.

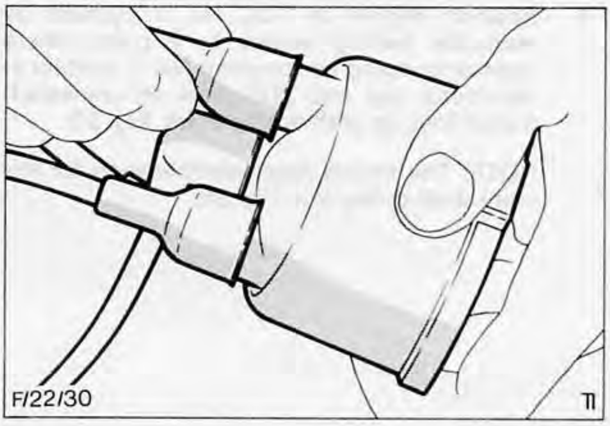


Fig. 36. Removing HT lead

2. Slacken condenser lead retaining screw and lead. Unscrew condenser retaining screw and remove condenser, Fig. 37.

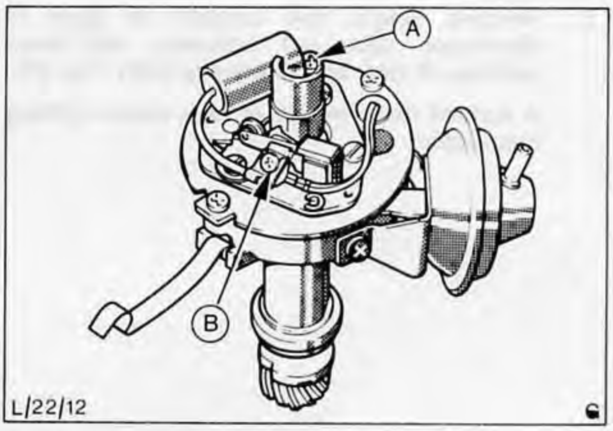


Fig. 37. Condenser removal
A – Condenser retaining screw
B – Condenser lead retaining screw

3. Remove circlip from vacuum unit pivot post and two screws retaining base assembly to body, Fig. 38.

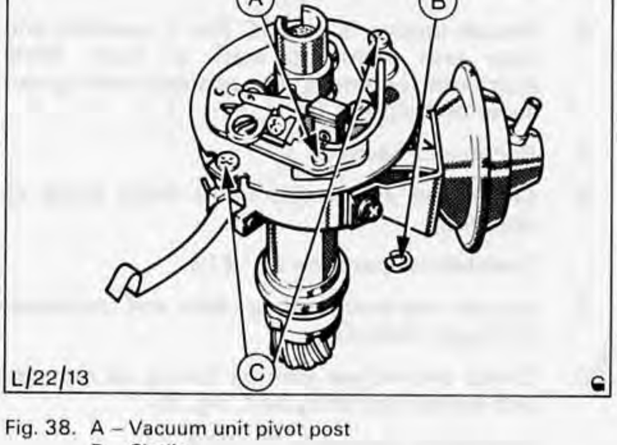
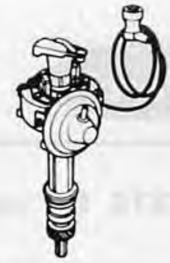


Fig. 38. A – Vacuum unit pivot post
B – Circlip
C – Base plate assembly retaining screws



4. Remove base plate assembly and overhaul as follows:

   Remove two screws securing contact breaker assembly to base plate, disconnect LT lead and detach assembly, Fig. 39.

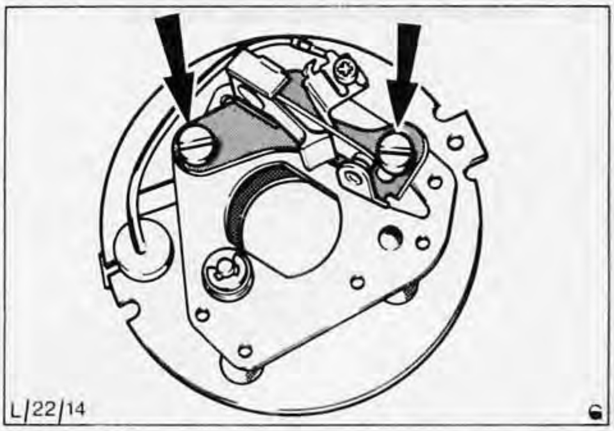


Fig. 39. Contact breaker assembly retaining screws

Remove circlip securing upper plate pivot post and remove upper plate spring and washers, Fig. 48.

Examine component parts for wear or damage and replace with new parts where necessary.

Reassemble upper and lower plates and secure with circlip noting washer sequence, Fig. 40.

Replace contact breaker assembly and loosely secure with two screws.

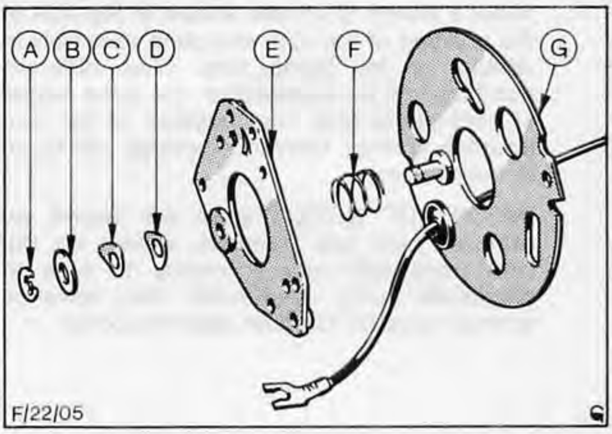


Fig. 40. Base plate assembly

A – Circlip
B – Washer
C – Wavy washer
D – Wavy washer
E – Upper plate
F – Spring
G – Base plate

5. Remove two screws retaining vacuum unit to body and detach unit, Fig. 41.

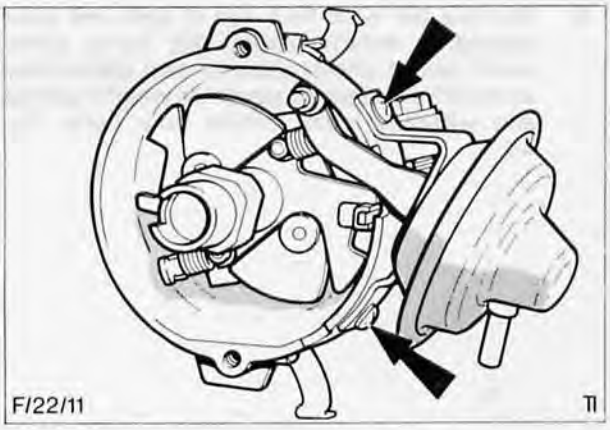


Fig. 41. Vacuum unit securing screws

22 214 8 (cont'd)

6. Prise off plastic bump stop, Fig. 42.

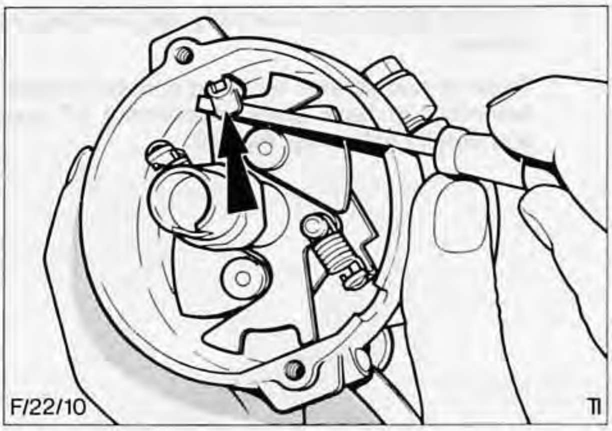


Fig. 42. Prising off plastic bump stop

7. Make a sketch (Example shown in Fig. 43) of the position of the cam and plate assembly in relation to the bump stop. (Two different numbers will be stamped on the outer edges of cam plate) also note position of the two advance springs. (Advance springs will be of different sizes).

   IMPORTANT NOTE: Figure 43 shows an example only and numbers shown on the cam plate will vary according to type of distributor being overhauled. Also advance springs could be fitted on opposite posts.

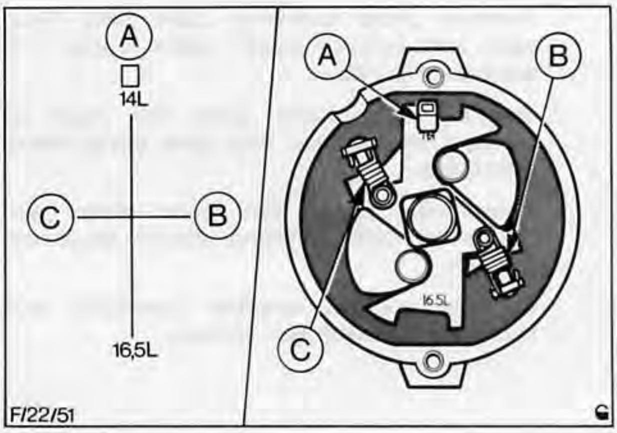


Fig. 43. Cam plate and advance spring location
A – Bump stop
B – Thin advance spring
C – Thick advance spring

8. Remove felt wick from top of cam and plate assembly, detach spring clip using either small pair of circlip pliers or two electricians screwdrivers. Detach governor weight springs and withdraw cam spindle from body, Fig. 44.

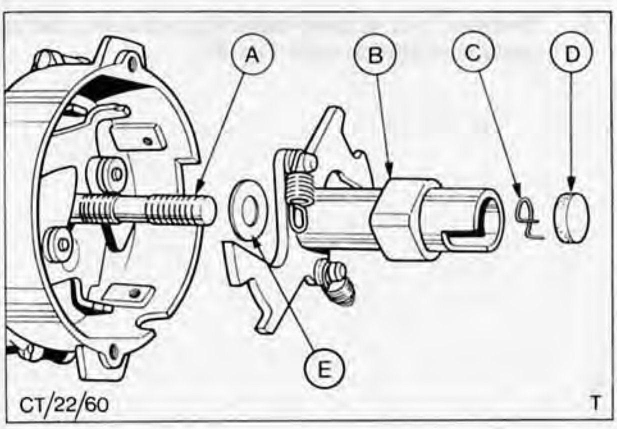
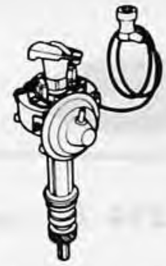


Fig. 44. A – Shaft
B – Cam and plate assembly
C – Spring clip
D – Felt wick
E – Thrust washer (OHC only)



9. Note gear position relative to shaft and scribe a mark.

   Drift out pin retaining drive gear and remove gear from shaft, Fig. 45.

   NOTE: Drive gear is a tight fit to the shaft and extreme care should be taken on removal to avoid damage to shaft.

10. Remove shaft from distributor body and examine all components for wear, replacing parts where necessary.

11. Lubricate shaft with specified oil, replace and secure drive gear with a new roll pin.

    NOTE: Check gear is not 180° out when refitting as pin bores may then be slightly misaligned.

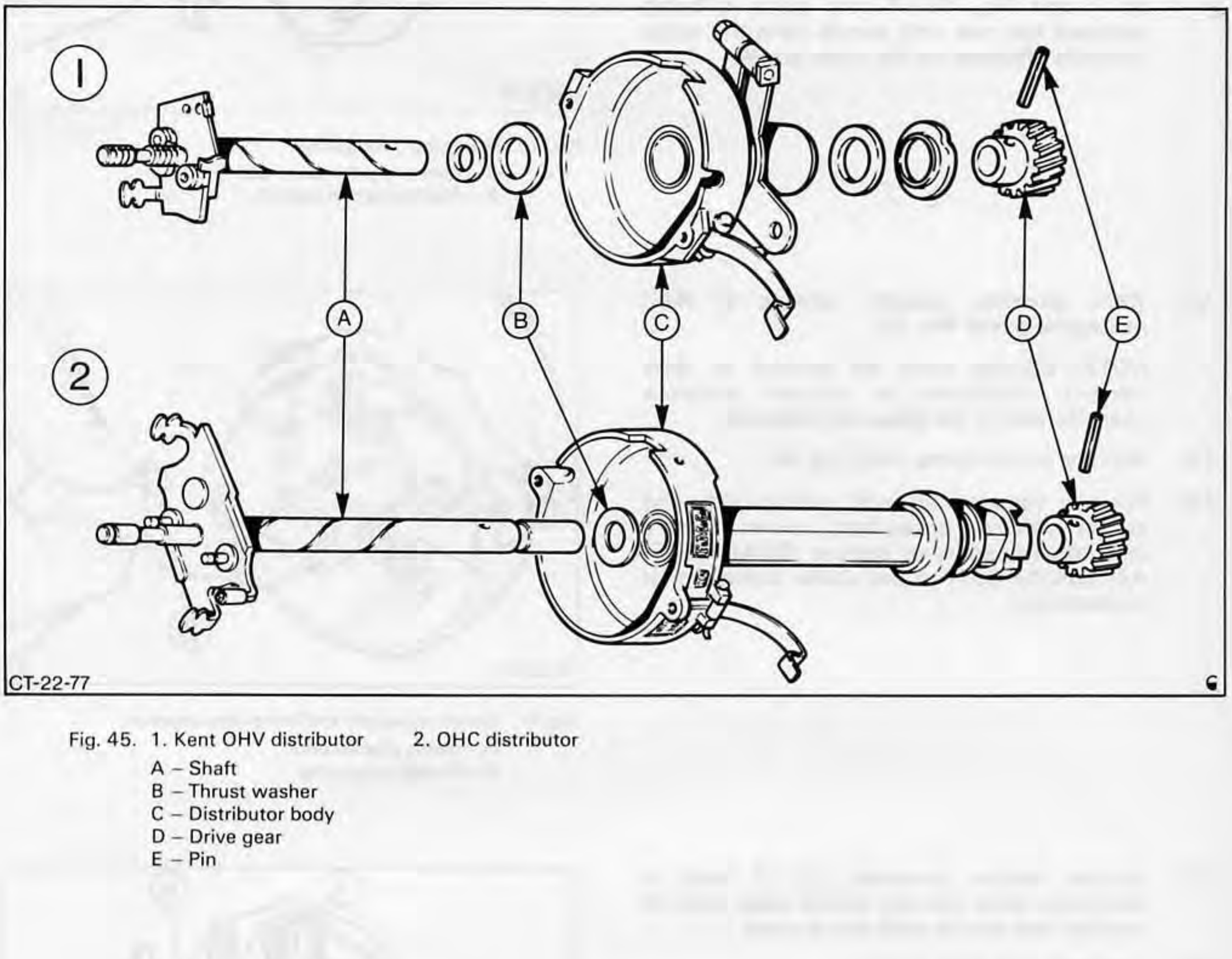
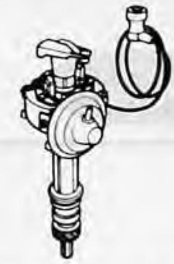


Fig. 45. 1. Kent OHV distributor 2. OHC distributor
A – Shaft
B – Thrust washer
C – Distributor body
D – Drive gear
E – Pin



22 214 8 (cont'd)

12. Position thrust washer over main shaft. (E in Fig. 44.)
13. Coat upper shaft with No. 1 grade lithium based grease (Spec. ESF-M1C74-1) ensuring undercut is completely filled. Replace cam and plate assembly and secure in position with circlip, position circlip tangs at 90° to rotor arm slot, Fig. 46.

    NOTE: Ensure cam plate is fitted correct way round in relation to the bump stop. Refer sub op 7 and Fig. 43. If cam plate is being replaced the new unit should have the same numbers stamped on the outer edges.

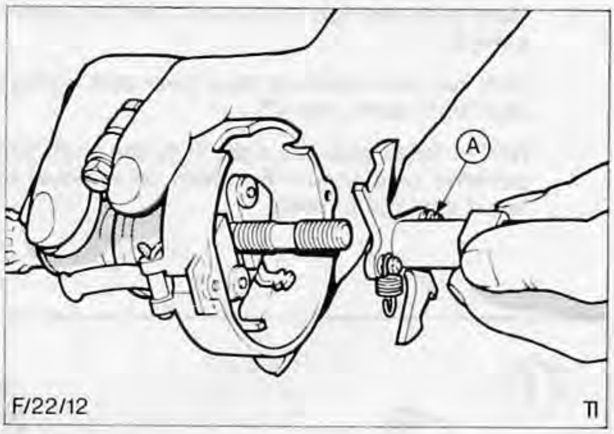


Fig. 46. Replacing cam spindle
A – Cam and plate assembly
B – Shaft undercut section

14. Refit governor weight springs to their respective posts, Fig. 43.

    NOTE: Springs must be refitted in their correct positions to ensure advance characteristic is not adversely affected.
15. Replace plastic bump stop, Fig. 47.
16. Position vacuum advance unit to body and secure with two cross head screws. Add a very small quantity of sealant (SM4G-4645-AA) (Loctite 601) to the screw threads prior to assembly.

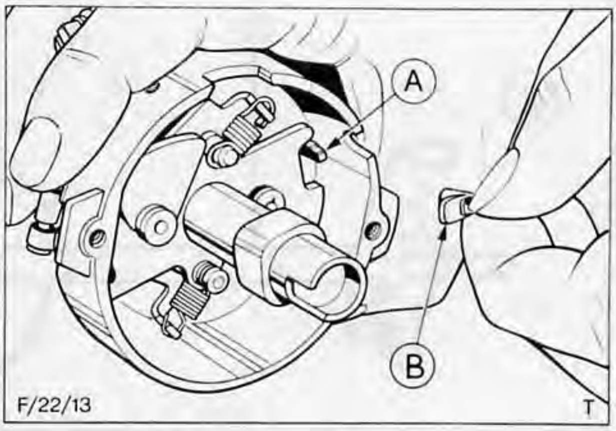


Fig. 47. Governor weight and bump stop location
A – Bump stop location
B – Plastic bump stop

17. Locate rubber grommet of LT lead in distributor body cut-out, locate base plate in position and secure with two screws.
18. Lubricate post with grease.
19. Align vacuum unit pivot post with base plate and secure with circlip, Fig. 48.

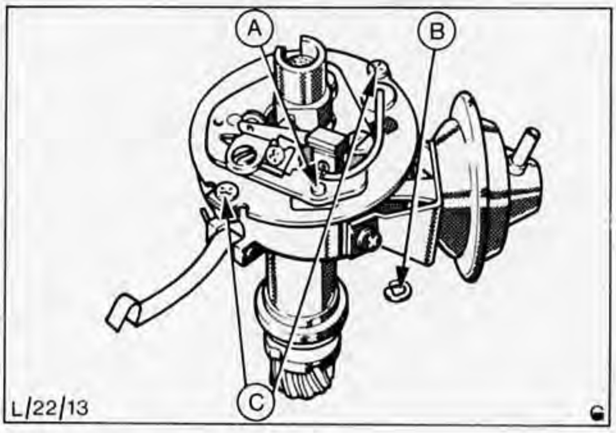


Fig. 48. A – Vacuum unit pivot post
B – Circlip
C – Base plate assembly retaining screws

20. Replace condenser on base plate and secure with screw. Front of condenser mounting should locate in cut-out in base plate.
21. Reconnect condenser and LT leads, Fig. 49.

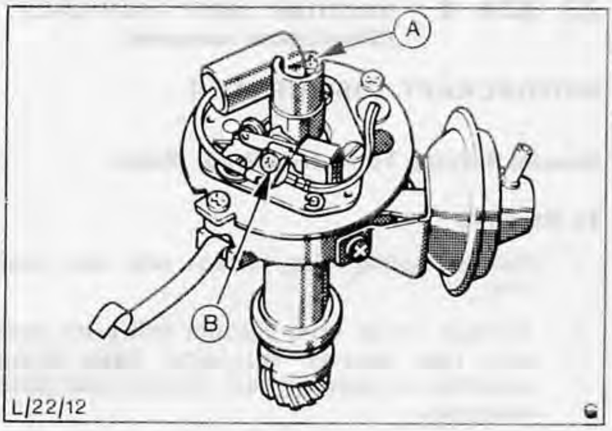


Fig. 49. A – Condenser retaining screw
B – Condenser lead retaining screw

22. Check points gap and adjust, Fig. 50.

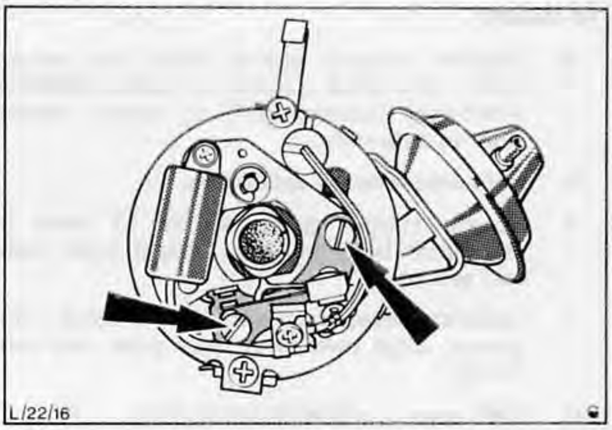


Fig. 50. Contact breaker adjusting screws

23. Check and adjust mechanical advance characteristic.

    This operation should be carried out using distributor test equipment and reference must be made to the equipment manufacturers instructions for correct procedure.

    Adjustment is carried out by bending the advance spring securing posts, Fig. 51. The thinner advance spring affects the advance characteristics at the lower rpm and should be correctly adjusted before adjustment is made to the thicker spring.

    NOTE: The Technical Data section shows advance figures in crankshaft degrees and to obtain distributor degrees figures quoted should be divided by two.

24. Replace rotor arm, distributor cap and HT leads.

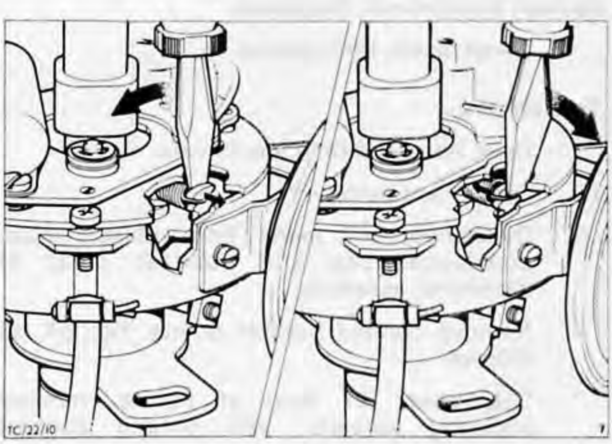


Fig. 51. Mechanical advance spring adjustment

22 224 4 VACUUM UNIT – REPLACE (Distributor removed)

MOTORCRAFT DISTRIBUTOR

Special Service Tools Required: None

To Remove

1. Release spring clips, detach cap and rotor arm.
2. Remove circlip from vacuum unit pivot post and two screws retaining base plate assembly to body, Fig. 52. Detach base plate assembly.

   NOTE: Where fitted remove radio suppressor (1 screw) from vacuum unit.
3. Remove two screws retaining vacuum unit to body and detach unit, Fig. 53.

To Install

4. Position vacuum unit to body and secure. Add a very small quantity of sealant (SM4G-4645-AA) (Loctite 601) to screw threads prior to assembly.
5. Refit suppressor if applicable.
6. Locate rubber grommet of LT lead in distributor body cut-out. Locate base plate and secure.
7. Lubricate pivot post with high melting point grease, align post with base plate and refit circlip.
8. Refit rotor arm and distributor cap.

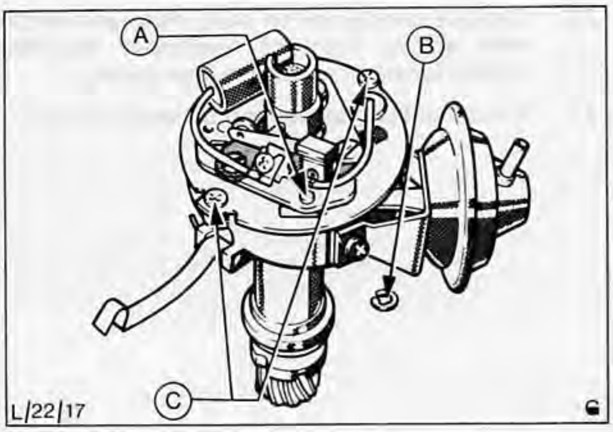


Fig. 52. Base plate removal (Motorcraft distributor)
A – Vacuum unit pivot post
B – Circlip
C – Base plate retaining screws

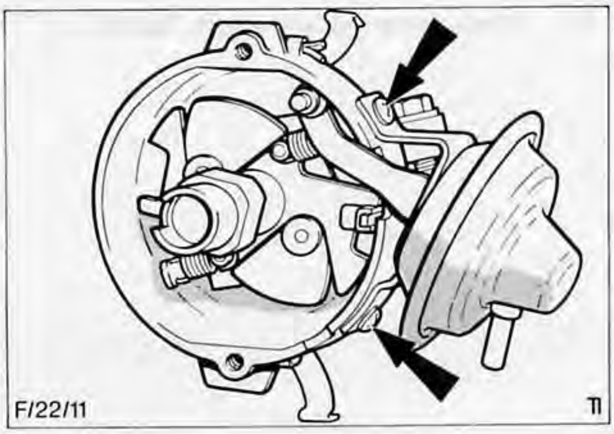


Fig. 53. Vacuum unit securing screws (Motorcraft distributor)

22 234 CONTACT BREAKER POINTS – REPLACE

Special Equipment Required:

Dwell meter, timing lamp.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT leads from plugs, unclip distributor cap and position clear of distributor assembly.
4. Remove contact breaker points, Fig. 54, as follows:

   Disconnect LT lead at points, remove securing screw(s) and detach contact breakers.

   Important Note: Care must be taken to ensure securing screw is not dropped down inside distributor. If this should occur the screw **must** be removed.

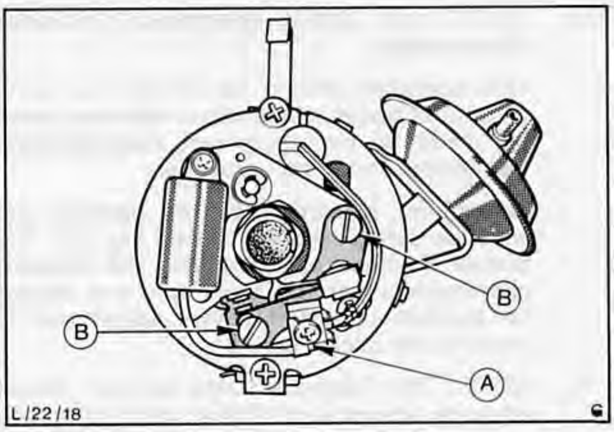


Fig. 54. Contact breaker points removal (Motorcraft distributor)
A – LT lead connection
B – Contact breaker securing screws

To Install

5. Replace points.

   Position contact breakers, refit securing screw(s) and reconnect LT lead. Grease cams using grease supplied with new points.

6. Manually turn engine until heel on contact breakers is on top of cam. Adjust to give a clearance as specified in Technical Data, and tighten retaining screw, Fig. 55.

7. Recheck clearance on opposite cam (180°).

8. Refit rotor arm and distributor cap, reconnect HT leads.

9. Reconnect battery.

10. Check and adjust ignition timing.

    Connect a dwell meter and timing light to engine. Start engine, check dwell angle.

    Using timing light, check and adjust ignition timing as required, detailed in Operation 22 213.

11. Remove fender covers and close hood.

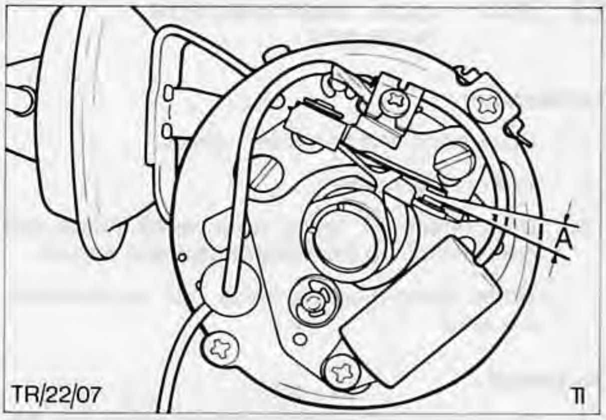


Fig. 55. Contact breaker points gap 'A'
Note: Heel of points on top of cam
(Motorcraft distributor illustrated)

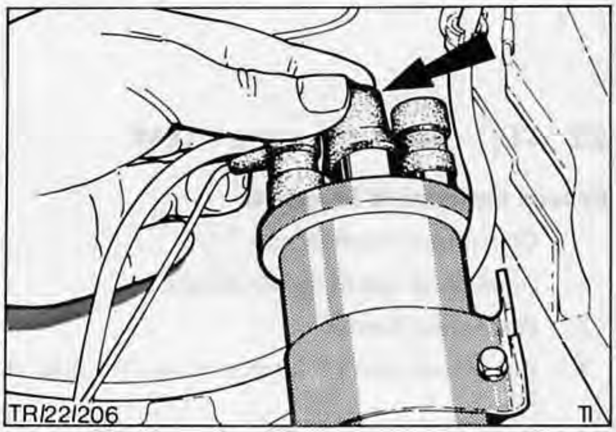


Fig. 56. HT lead removal from coil

22 244 CONDENSER – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT lead at coil, Fig. 56, unclip cap and position clear of the distributor body.

   NOTE: When disconnecting HT leads pull terminal not lead.

4. Loosen condenser lead retaining screw and disconnect lead. Remove retaining screw and detach condenser, Fig. 57.

To Install

5. Position condenser, secure and reconnect lead(s).
6. Refit distributor cap and reconnect HT lead at coil ensure cap is clean before installation.
7. Reconnect battery.
8. Remove fender covers and close hood.

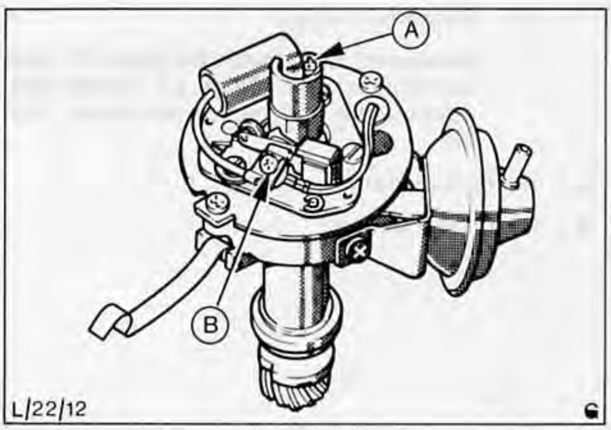


Fig. 57. Motorcraft condenser removal
A – Condenser securing screw
B – Condenser lead retaining screw

22 284 CAP – DISTRIBUTOR – REPLACE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT leads from spark plugs and coil, unclip cap from distributor and detach.

   When disconnecting leads pull on terminal, not lead.

To Install

4. Reconnect HT leads in correct order, Fig. 58. and clip cap in position.
5. Reconnect battery.
6. Start engine and check operation.
7. Remove fender covers and close hood.

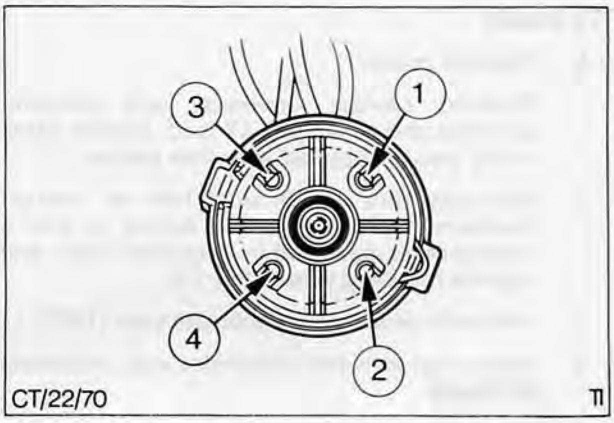


Fig. 58. Motorcraft distributor cap showing HT lead connections

22 411 IGNITION COIL – TEST

Special Equipment Required:

Ohm meter, oscilloscope.

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect two LT leads and one HT lead at coil.
4. Test coil resistance. Refer Technical Data.

   (a) Primary circuit

   Connect ohm meter between two LT connections on coil. Select appropriate scale and record resistance, Fig. 59.

   (b) Secondary circuit.

   Reconnect ohm meter between HT lead connection and either LT connection, select scale and record resistance, Fig. 60.

5. Reconnect loom to coil.
6. Reconnect battery.

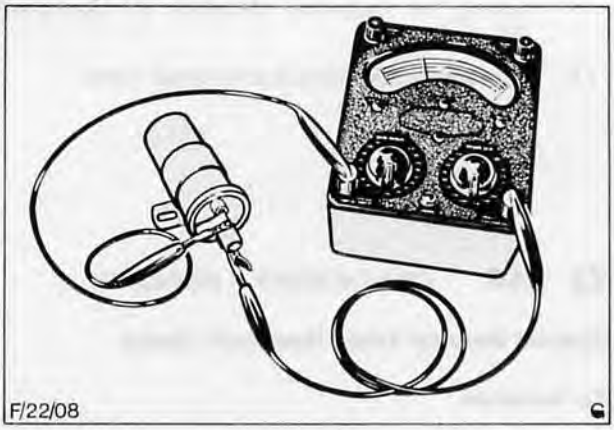


Fig. 59. Coil primary circuit resistance check (Coil removed for clarity)

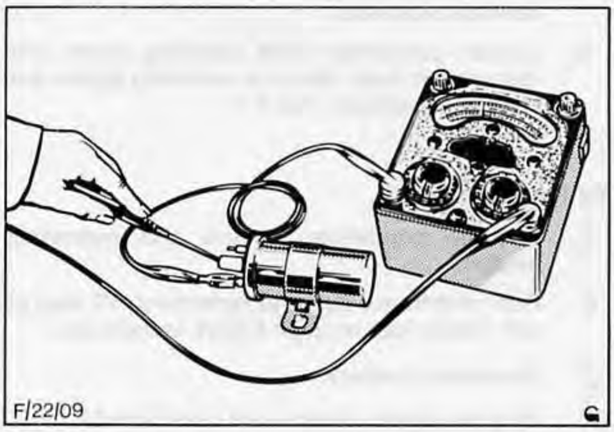


Fig. 60. Coil secondary circuit resistance check (Coil removed for clarity)

7. Test coil polarity and maximum output:

   (a) Coil polarity.

   Connect a test set oscilloscope to engine as per manufacturers instructions. Select primary circuit and display on oscilloscope start engine and check coil polarity, Fig. 61.

   A is correct, B is incorrect.

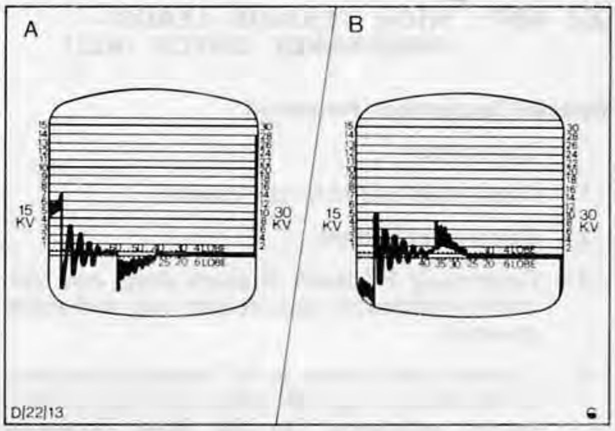


Fig. 61. Coil polarity check
A – Correct B – Incorrect

   (b) Maximum coil output.

   With engine at 1000 rpm, select secondary oscilloscope pattern and using insulated pliers disconnect one of the HT leads at a spark plug. Maximum voltage measured in kilo volts, will be recorded on scope as shown in Fig. 62. Refer Technical Data.

   NOTE: Special care should be taken not to damage HT terminal insulation when removing with pliers.

8. Reconnect HT lead and disconnect test set.

9. Remove fender covers and close hood.

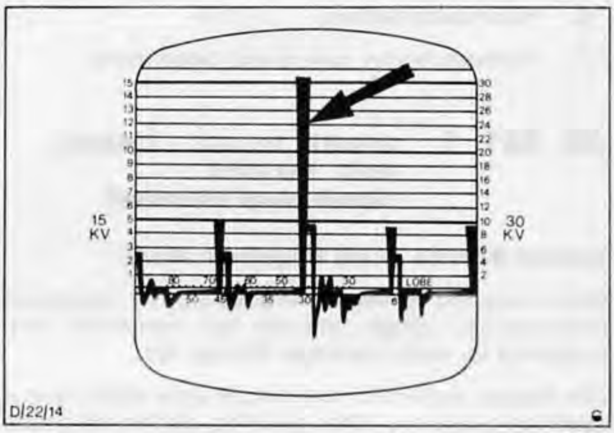


Fig. 62. Maximum coil voltage read on the RH scale

22 414 IGNITION COIL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT and LT connections at coil.
4. Remove two screws and detach coil and strap assembly.

To Install

5. Position coil and strap assembly secure with two screws. Reconnect HT and LT connections. Positive terminal to loom. Negative terminal to distributor, Fig. 63.
6. Reconnect battery.
7. Start engine and check operation.
8. Remove fender covers and close hood.

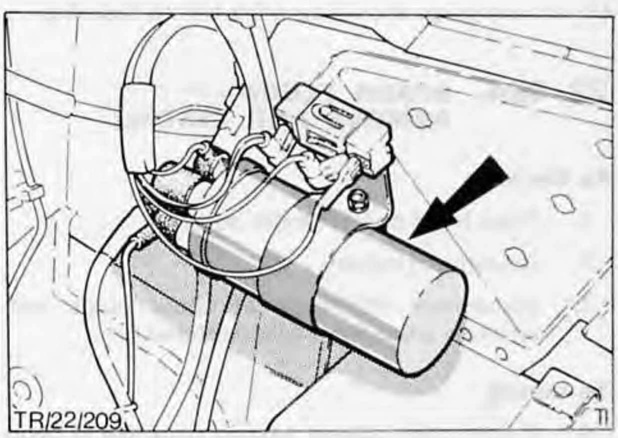
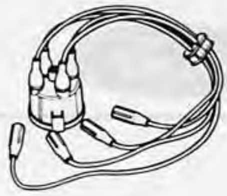


Fig. 63. Coil installation



22 451 HIGH TENSION LEADS – RESISTANCE CHECK (ALL)

Special Equipment Required:

Ohm meter.

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT leads at spark plugs and coil. Unclip distributor cap, detach cap and leads assembly.
4. Connect ohm meter to HT terminal lead and to distributor cap to rotor arm connection, record resistance, Fig. 64. Refer Technical Data. If resistance is high, lead to cap connection should be cleaned and resistance rechecked before lead is replaced.
5. Clean distributor cap and refit assembly, reconnect HT leads.
6. Reconnect battery.
7. Remove fender covers and close hood.

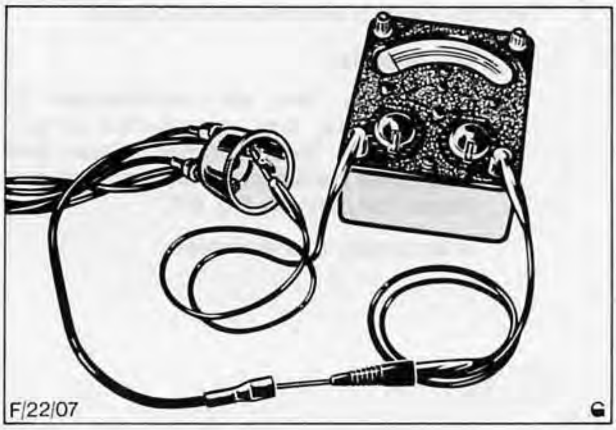


Fig. 64. Resistance check

22 481 1 SPARK PLUGS – CHECK AND ADJUST (Spark plugs removed)

Special Service Tools Required: None

When required by service intervals or by suspected malfunction, plugs should be removed and examined for wear, damage, fouling, etc.

The normal method of cleaning is with abrasive in a spark plug cleaner. After cleaning, centre electrode should be filed square and gap adjusted to specified clearance.

Ensure that all abrasive is removed from plug, clean ceramic insulator if necessary to remove all traces of dirt.

Oily or wet plugs should be dried before cleaning.

22 484 SPARK PLUGS – REMOVE AND INSTALL

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect HT leads at spark plugs and unscrew plugs from cylinder head.

To Install

4. If applicable, ensure sealing rings are in good condition, replace plugs and tighten to 3,8 Nm (3,8 kg.m) (28 lb.ft)
5. Reconnect battery.
6. Remove fender covers and close hood.

TECHNICAL DATA

Coil

Manufacturer	Bosch, Femsa, Lucas or Polmot
Type	Low voltage for use with 1,5 ohm ballast resistor
Output	31,0 kilovolt (minimum) – Open circuit condition on test rig
	23,0 kilovolt (minimum) – Open circuit condition in vehicle
Primary resistance	0,95 to 1·35 ohms
Secondary resistance	5000 to 9000 ohms

Spark Plugs

Type OHV (Kent) 1600	Motorcraft AGR 22
OHC 1600	Motorcraft BF22
OHC 2000	Motorcraft BF32
Electrode Gap	
All	0,60 mm (0,025 in)
Firing Order OHC	1, 3, 4, 2
OHV (Kent)	1, 2, 4, 3

Distributor

Manufacturer	Motorcraft
Type	Single pair contact breaker point
Automatic advance	Mechanical and vacuum control
Drive OHV (Kent)	Screw gear from camshaft
OHC	Screw gear from auxiliary shaft
Rotation (view from top)	
OHV (Kent)	Anti-clockwise
OHC	Clockwise
STATIC ADVANCE (Initial)	
All Models (except Nigeria)	6° B.T.D.C.
Nigeria only (Heavy duty)	2° B.T.D.C.
Condenser capacity	0,21 to 0,25 m.fd
Contact breaker points gap	0,64 mm (0,025 in)
Dwell angle	48° to 52°
Dwell variation	4° maximum
Dwell overlap	3° maximum
Distributor shaft end float	0,64 to 0,84 mm (0,025 to 0,033 in) (end float figure is a preload rating on OHV)
Lubrication (distributor shaft)	Turbine hydraulic oil ESF-M2C70-A
	e.g. Shell Turbo 41-Mobil DTE extra heavy – Texaco Rando-F-Castrol Perfecto heavy

HT Leads

Resistance	30,000 ohms maximum per lead

TECHNICAL DATA (cont'd)

Advance Characteristics

Advance at 2000 rpm (Engine rpm)	Mechanical	Vacuum	Total
January to April '78			
1.6 Kent (OHV)	7° to 11°	22° to 30°	29° to 41°
1.6 OHC (LC)	16° to 20°	6° to 10°	22° to 30°
2.0 OHC (Manual)	7.5° to 11.5°	13° to 19°	20.5° to 30.5°
2.0 OHC (Automatic)	7.5° to 11.5°	9° to 15°	16.5° to 26.5°
2.0 OHC (Economy)	7° to 11°	13° to 19°	20° to 30°
2.0 OHC (Nigeria)	5° to 9°	20° to 28°	29° to 37°
April '78 onwards			
1.6 Kent (OHV)	7° to 11°	22° to 30°	29° to 41°
1.6 OHC (LC)	13° to 17°	9° to 13°	22° to 30°
2.0 OHC (Manual)	5° to 9°	16° to 22°	21° to 31°
2.0 OHC (Automatic)	5° to 9°	11° to 17°	16° to 26°
2.0 OHC (Economy)	7° to 11°	13° to 19°	20° to 30°
2.0 OHC (Nigeria)	5° to 9°	20° to 28°	25° to 37°

Detailed Advance Characteristics

1600 Kent OHV Colour Code Red/Orange 761F 12100 AA

Mechanical		Vacuum	
Engine rpm	Degrees Advance (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
400 and below	O	76 (3.0) and below	O
500	−1° to +1°	104 (4.0)	−1° to +1.5°
1000	−1° to +1.5°	127 (5.0)	−1° to +5°
1500	2.5° to 6.5°	152 (6.0)	3.5° to 9.5°
2000	7° to 11°	203 (8.0)	11.5° to 17.5°
2500	11.5° to 15.5°	254 (10.0)	18° to 25°
3000	16° to 20°	304 (12.0)	21.5° to 29°
3500	21° to 25°	330 (13.0) and above	22° to 30°
4000	25° to 29°		
4350 and above	28.5° to 32.5°		

1600 OHC (LC) Colour Code Yellow/Orange 76HF 12100 EA
January to March '78

Mechanical		Vacuum	
Engine rpm	Degrees Advance (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
400 and below	O	50.8 (2.0) and below	O
500	−1° to +1°	63.5 (2.5)	−1° to +1°
950	−1° to +1°	114.3 (4.5)	−1° to +2°
1000	−1° to +1.5°	127.0 (5.0)	−1° to +3.5°
1050	−1° to 2.5°	152.4 (6.0)	2.5° to 6.5°
1500	7° to 11°	177.8 (7.0) and above	6° to 10°
2000	16° to 20°		
2200	20° to 24°		
3000	24° to 28°		
4000	29.5° to 33.5°		
4600 and above	32.5° to 36.5°		

TECHNICAL DATA (cont'd)

Detailed Advance Characteristics (cont'd)

1600 OHC (LC)
April '78 onwards

Colour Code Brown/Green

78HF 12100 NA

Mechanical		Vacuum	
Engine rpm	Degrees Advance (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
600 and below	−1.0° to +1.0°	50 (1.97) and below	0
960	−1.0° to +1.0°	60 (2.4)	−1.0° to +1.0°
1080	−1.0° to +3.0°	125 (4.8)	−1.0° to +3.0°
2000	13.0° to 17.0°	180 (7.1)	6.0° to 10.0°
3000	21.5° to 25.5°	205 (8.1) and above	9.0° to 13.0°
4600 and above	32.5° to 36.5°		

2000 OHC (Manual)
January to April '78

Colour Code Yellow/Green

78HF 12100 AA

Mechanical		Vacuum	
Engine rpm	Degrees Advance (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
400 and below	0	70 (2.76) and below	0
500	−1° to +1°	80 (3.15)	−1° to +0.75°
1000	−1° to +1°	90 (3.55)	−1° to +1.25°
1500	+1.5° to +5.5°	100 (3.94)	−1° to +2°
2000	7.5° to 11.5°	110 (4.33)	−1° to +5°
2500	13.5° to 17.5°	120 (4.73)	+1° to +8°
3000	19.75° to 23.5°	130 (5.12)	5° to 10.75°
3500	24.0° to 28°	140 (5.52)	7° to 13°
4000	27.0° to 31°	150 (5.91)	9.5° to 15.25°
4500	30.5° to 34.5°	160 (6.30)	11.25° to 17.5°
4800 and above	32.5° to 36.5°	170 (6.70) and above	13° to 19.0°

2000 OHC (Manual)
April '78 onwards

Colour Code Brown/Blue

78HF 12100 RA

Mechanical		Vacuum	
Engine rpm	Degrees Advance (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
1200 and below	−1.0° to +1.0°	70 (2.8) and below	0
1400	−1.0° to +3.0°	75 (3.0)	−1.0° to +0.5°
2000	5.0° to 9.0°	100 (3.9)	−1.0° to +2.0°
3000	14.5° to 19.5°	110 (4.3)	−1.0° to +5.0°
4000	24.5° to 30.0°	150 (5.9)	9.4° to 15.4°
4800 and above	32.5° to 36.5°	190 (7.5) and above	16.0° to 22.0°

TECHNICAL DATA (cont'd)

Detailed Advance Characteristics (cont'd)

2000 OHC (Automatic) Colour Code Brown/Red 78HF 12100 BA
January to April '78

Mechanical	
Engine rpm	Degrees Advance (Crankshaft)
400 and below	O
500	−1° to +1°
1000	−1° to +1°
1500	+1.5° to +5.5°
2000	7.5° to 11.5°
2500	13.5° to 17.5°
3000	19.75° to 23.5°
3500	24.0° to 28°
4000	27.0° to 31°
4500	30.5° to 34.5°
4800 and above	32.5° to 36.5°

Vacuum	
Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
70 (2.76) and below	O
80 (3.15)	−1° to +0.75°
90 (3.55)	−1° to +1.5°
100 (3.94)	−1° to +2°
110 (4.33)	−1° to +5.5°
120 (4.73)	+2° to +9°
130 (5.12)	4.5° to 11°
140 (5.52)	7° to 13.25°
150 (5.91) and above	9° to 15°

2000 OHC (Automatic) Colour Code Brown/Orange 78HF 12100 SA
April '78 onwards

Mechanical	
Engine rpm	Degrees Advance (Crankshaft)
1200 and below	−1.0° to +1.0°
1400	−1.0° to +3.0°
2000	5.0° to 9.0°
3000	14.5° to 19.5°
4000	24.5° to 30.0°
4800 and above	32.5° to 36.5°

Vacuum	
Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
70 (2.8) and below	O
75 (3.0)	−1.0° to +0.5°
100 (3.9)	−1.0° to +2.0°
110 (4.3)	−1.0° to +5.0°
150 (5.9)	9.4° to 15.4°
160 (6.3) and above	11.0° to 17.0°

2000 OHC (Economy) Colour code Yellow/Grey 78HF 12100 EA

Mechanical	
Engine rpm	Degrees Advance (Crankshaft)
400 and below	O
500	−1° to +1°
1000	−1° to +1°
1500	+2° to +6°
2000	7° to 11°
2500	12° to 17°
3000	17.5° to 22.5°
3500	23° to 28°
4000	28° to 34°
4500	33° to 39.5
4700 and above	35.5° to 39.5°

Vacuum	
Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
130 (5.12) and below	
140 (5.52)	−1° to +0.75°
150 (5.91)	−1° to +1.5°
160 (6.30)	−1° to +2.0°
170 (6.69)	−1° to +5°
180 (7.09)	+2° to +8°
190 (7.48)	4.5° to 10.5°
200 (7.87)	7° to 13°
210 (8.27)	9° to 15°
220 (8.66)	11° to 17°
230 (9.06) and above	13° to 19°

TECHNICAL DATA (cont'd)

Detailed Advance Characteristics (cont'd)

2000 OHC (Nigeria Only) Colour Code Yellow/Black 78HF 12100 FA

Mechanical	
Engine rpm	Degrees Advance (Crankshaft)
500 and below	O
1000	−1° to +1°
1500	0° to +4°
2000	5° to 9°
2500	10° to 14.5°
3000	15° to 20°
3500	20° to 25°
4000	25° to 30°
4500	29.5° to 35°
5000	34.5° to 40.5°
5200 and above	36.5° to 40.5°

Vacuum	
Vacuum mm Hg (in Hg)	Degrees Advance (Crankshaft)
50 (1.97) and below	O
100 (3.94)	−1° to +2°
150 (5.91)	+7° to +15°
200 (7.87)	15.5° to 23°
250 (9.84)	19.5° to 27.5°
252 (9.92) and above	20° to 28°

MANUAL TRANSMISSION AND CLUTCH 16

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GENERAL DESCRIPTION

All TRANSIT models are fitted with four-gear transmission with full synchromesh. Models are equipped with one of two different gearbox types. To simplify identification of these gearboxes in the Workshop Manual, they are given the letters 'F' and 'G' respectively.

The 'Gearbox Usage Table' given overleaf indicates which vehicles are fitted with the gearbox variants.

'F' Gearbox

In this gearbox the 1st/2nd gear synchroniser hub is pressed onto the mainshaft and forms a unit with it (also see Fig. 33 on page 21), the end float being controlled by selective circlips.

In addition to the standard 'F' gearbox, Fig. 1, an uprated version can be installed. This depends upon vehicle model, type and the engine fitted.

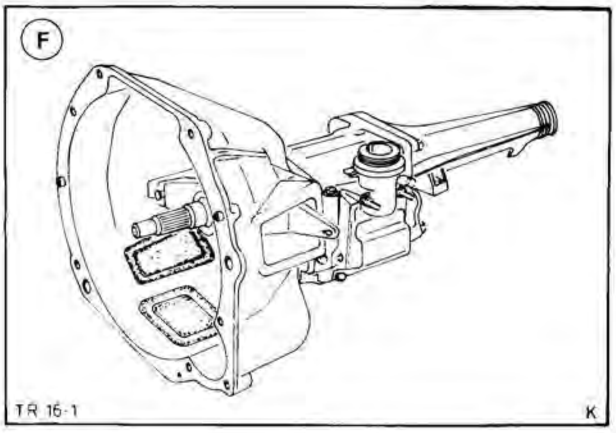


Fig. 1. 'F' gearbox

'G' Gearbox

The 'G' gearbox, Fig. 2, is a heavy duty unit.

Here the mainshaft ball bearing race is seated in a bearing block. Like the 'F' gearbox, this unit has a bolt-on clutch housing. In both variants the clutch release lever and thrust bearing have to be removed with the clutch housing. Only then, after removing a spring washer, can the release lever and thrust bearing be detached.

Depending on the version, the 'G' gearbox is fitted with one of two different extension housings (also see Fig. 64 on page 32).

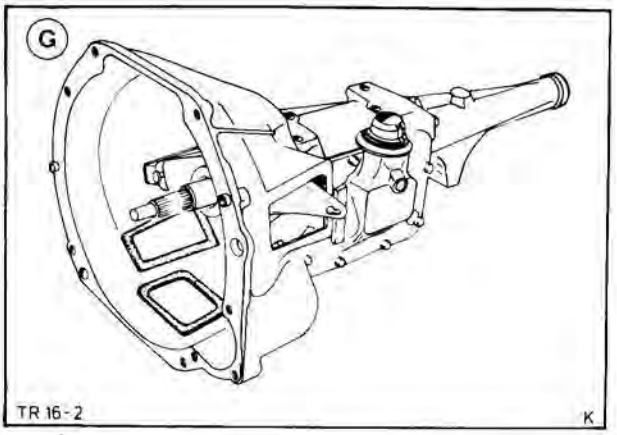


Fig. 2. 'G' gearbox

GEARBOX USAGE TABLE

Vehicle Type	Gearbox	Engine	Vehicle Version
FT 80	F or G	1,6 l Kent (OHV) 1,6 l LC (OHC)	Van, Kombi
FT 100	F* or G	1,6 l Kent (OHV) 1,6 l LC (OHC) 2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab Platform/chassis+dual cab
FT 100 L	F* or G	2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab
FT 120	F* or G	1,6 l LC (OHC) 2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab Platform/chassis+dual cab
FT 130	F* or G	2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab Platform/chassis+dual cab
FT 130 B	G	2,0 l LC (OHC)	Kombi
FT 160	F* or G	2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab
	F* or G	2,0 l LC (OHC) 2,4 l Diesel (OHV)	Van Kombi Platform/chassis+single cab Platform/chassis+dual cab
FT 190	F* or G	1,6 l LC (OHC) 2,0 l LC (OHC) 2,4 l Diesel (OHV)	Bus – 9 seater
	F* or G	1,6 l LC (OHC) 2,0 l LC (OHC) 2,4 l Diesel (OHV)	Bus – 12 seater
FT 130	G	2,0 l LC (OHC) 2,4 l Diesel (OHV)	Bus – 15 seater

*Uprated F gearbox can be fitted as option

NOTE: The individual gearbox variants are subject to vehicle version, type and the engine fitted.

CLUTCH

The clutch mechanism consists of a single-plate dry clutch with a diaphragm-spring pressure plate bolted to the flywheel. The clutch is operated by means of a cable (see Principle of Operation) and the release lever with the thrust bearing located in the clutch housing.

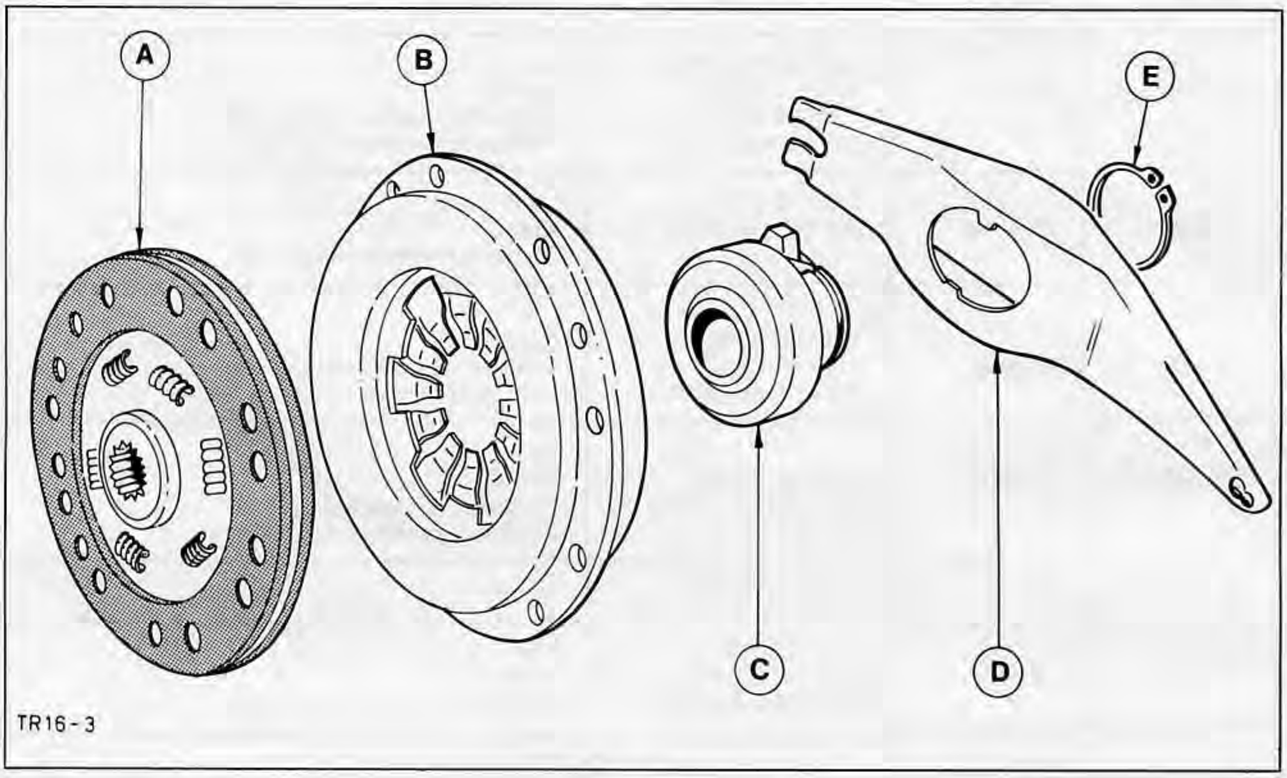


Fig. 3. A – Clutch disc
B – Pressure plate
C – Thrust bearing with guide hub
D – Release lever
E – Circlip

PRINCIPLE OF OPERATION

Gearbox

The engine torque is transmitted via the clutch and gearbox to the rear axle when a gear is selected. The matched ratios allow adaptation to varying road conditions, e.g. up or down gradients, or acceleration.

The helically cut forward gears on the mainshaft are in constant mesh with the corresponding countershaft gears, with the first small gear on the input shaft engaging in the largest countershaft gear.

The forward gears are selected with the aid of synchroniser hubs and synchroniser rings. When selecting the next higher gear, the higher gear on the mainshaft rotates faster than the synchroniser hub.

After disengaging the clutch and moving the gear lever to select a gear, the selector ring of the synchroniser hub is pushed towards the gear selected. The selector ring pushes the synchroniser ring onto the gear cone with the blocker bars.

The speed of the faster turning gear is reduced by the friction cone of the ring to that of the mainshaft, enabling gears to be selected.

The reverse gear on the countershaft is straight cut and drives the 1st and 2nd sliding gear on the mainshaft via the engaged idler gear.

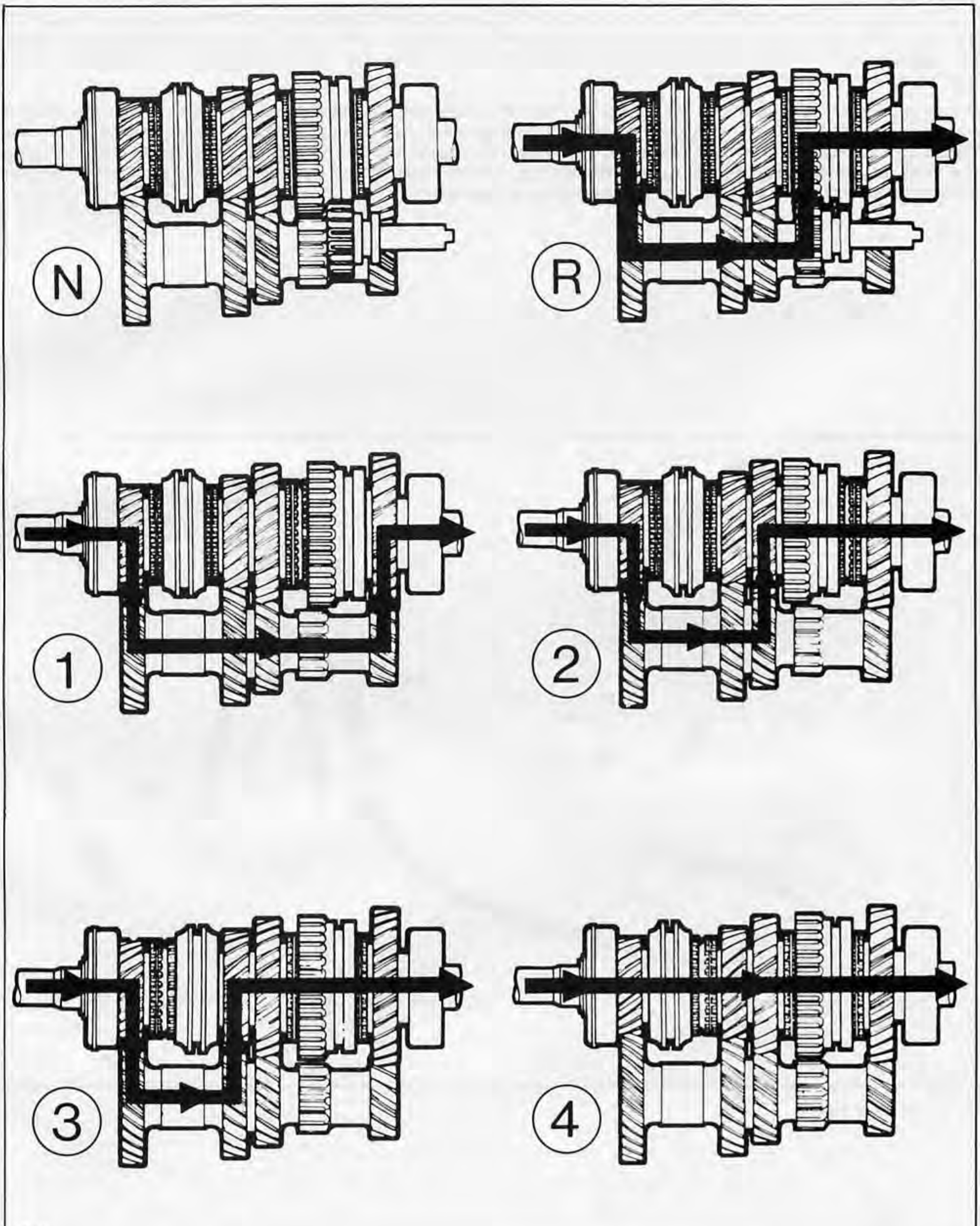


Fig. 4. Power flow

Clutch

The friction disc connected to the gearbox input shaft lies between flywheel and pressure plate. The clutch disc is a steel disc with a friction lining (resilient axially) riveted on both sides. The central diaphragm spring presses the pressure plate against the clutch disc and the flywheel. The diaphragm spring is located between two fulcrum rings riveted to the clutch cover.

When engaged, the diaphragm spring presses the pressure plate against the clutch disc so that the engine torque is transmitted to the gearbox. When declutching, the thrust bearing exerts a load on the centre of the diaphragm spring, pressing it towards the flywheel. The diaphragm spring tilts on the fulcrum ring, relieving the load on the pressure plate. At the same time, spring-steel straps riveted on the clutch cover lift the pressure plate off the clutch disc, thus disengaging engine drive.

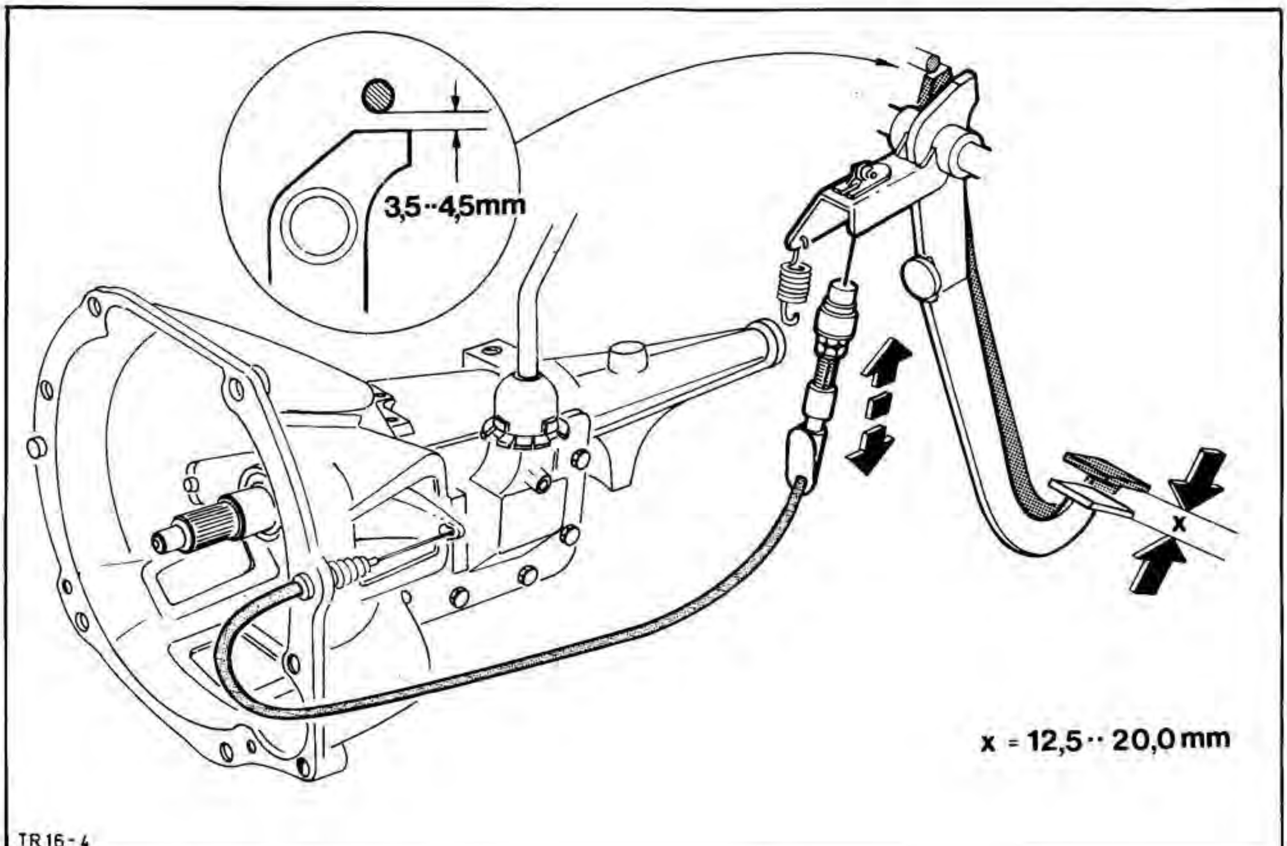


Fig. 5. Clutch mechanism

FAULT DIAGNOSIS – GEARBOX

Fault	*Cause*	*Remedy*
Jumping out of gear – forward gears	Coupling teeth on gear, or selector ring worn or faulty.	Replace gear and selector ring.
	Axial play in mainshaft, mainshaft bearing or abutment face damaged or worn.	Fit new mainshaft bearing or new gearbox extension housing. NOTE: Check circlip thickness first so mainshaft has no axial play when fitted; see operation 16 118 8 – for F gearbox only. In G gearbox – fit new mainshaft bearing.
	Mainshaft nut lock-washer faulty (G gearbox only).	Replace lock-washer, torque nut as specified and lock.
	Selector housing bolts loose.	Torque bolts as specified and bend washer tab over at 90° to inner teeth.
	Mainshaft damaged or inaccurately machined.	Replace mainshaft complete.
	Selector ring of synchroniser hub sticking.	If selector ring and hub are damaged, replace synchroniser ring as well. NOTE: In F gearbox synchroniser hub and mainshaft for 1st and 2nd gear form a unit so replace mainshaft complete if necessary.
	Insufficient spring loading in gear interlock (ball and plunger).	Replace interlock springs – with balls as well if necessary.
	Wear in selector forks.	Fit new selector forks.
Jumping out of gear – reverse gear	Worn teeth on reverse gear idler wheel.	Replace reverse gear idler wheel.
	Bush of reverse gear idler wheel worn or incorrectly inserted.	Replace reverse gear idler wheel, changing spindle as well if damaged.
Gears jamming	Selector housing bolts loose.	Torque bolts as specified and lock.
	Selector forks not engaging completely in selector ring.	Check both parts and bring into engagement, fitting new parts as necessary. Check fork retaining pin has not dropped out or been damaged – if so replace.
	Locking pins worn.	Fit new locking pins.
Noises when selecting gear	Synchroniser ring or synchroniser ring teeth worn.	Replace both parts, changing associated selector ring or gear with cone as well if necessary.
	Synchroniser springs faulty or fitted incorrectly.	Fit synchroniser springs correctly or replace.
	Blocker bars worn or damaged.	Replace blocker bars.
Stiffness when selecting gear	See under 'Jumping out of Gear' and 'Noises when selecting gear'.	

Noises are inevitable in new gearboxes or when new gears are fitted, so a new gearbox should not be stripped if at all possible during running in.

Also check before seeking faults in the gearbox itself that the fault in question is not to be found in the clutch.

NOTE: The advice given here is only intended as a guide to faster fault-diagnosis. It is always advisable to have fault-finding carried out by someone with sufficient experience, able to diagnose the causes of noises quickly and accurately.

FAULT DIAGNOSIS – CLUTCH

Fault	*Cause*	*Remedy*
Clutch slipping	Clutch pedal play incorrectly adjusted.	Adjust to specification.
	Linings of clutch disc smeared with oil or grease residues.	Fit new oil seal to guide sleeve if leaking, then fit new clutch disc.
	Clutch lining worn.	Replace clutch disc.
	Contact pressure of pressure plate too low.	Fit new diaphragm spring or replace pressure plate complete.
	Clutch has overheated.	Replace clutch complete.
Clutch snatching	Engine or gearbox mounting faulty.	Repair or replace as necessary.
	Clutch lining dirty or glazed	Clean clutch disc or replace as necessary.
	Pressure plate or release lever pressing on one side.	Check diaphragm spring and if necessary replace pressure plate complete. Check release lever and thrust bearing function correctly when fitted. Replace both parts if necessary.
	Clutch disc torsion springs faulty.	Replace clutch disc.
Clutch noisy	Thrust bearing faulty.	Replace thrust bearing.
	Torsion spring faulty.	Replace clutch disc.
	Diaphragm spring faulty.	Replace pressure plate complete.
	Pilot bearing or bush of gearbox input shaft faulty.	Replace pilot bearing or bush.

SERVICE CHECKS AND ADJUSTMENTS

Gearbox

The oil level in the gearbox should only be checked with the vehicle standing on level ground, having allowed sufficient time for the oil to cool since the gearbox oil tends to warm up and foam when the vehicle has been running. When the level is correct, the oil comes up to the lower edge of the filler opening, Fig. 6. If this is not the case, top up with oil of the stipulated specification (see Technical Data). A shortage of oil in the gearbox can only arise if there is a leak.

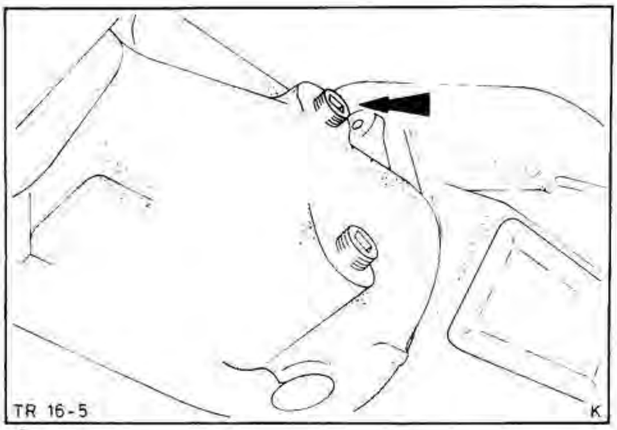


Fig. 6. Check oil level

Clutch

Smooth gear-changes and complete transmission of the engine torque to gearbox and rear axle are only ensured if the clutch is correctly adjusted.

The clutch play is measured at the pedal, and is adjusted, where necessary, as follows, Fig. 7.

Slacken lock nut and adjusting nut and turn adjusting nut until clutch pedal can be raised by amount 'X' then tighten lock nut and depress clutch pedal fully several times. Check clutch play again and repeat adjustment operation if necessary.

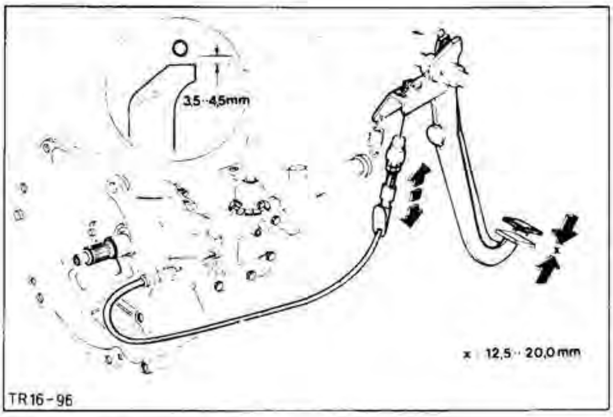
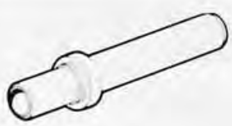
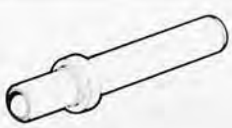
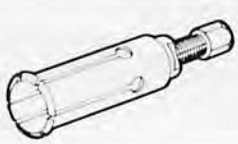
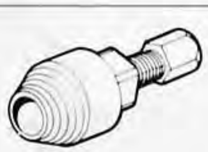
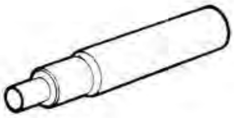


Fig. 7. Clutch play adjustment

SPECIAL SERVICE TOOL RECOGNITION

Tool			Tool Name
	16–003	G	Dummy countershaft
	16–009	F G	Gearbox mounting bracket
	16–011	G	Gearbox extension housing bush remover
	16–015	F	Installer for gearbox extension housing bush and oil seal
	16–016	G	Installer for gearbox extension housing bush and oil seal
	16–025	F	Gearbox extension housing bush remover
	16–027	G	Mainshaft nut wrench
	17–001	F G	Gearbox extension housing oil seal remover
	21–036	A B G	Flywheel bearing remover
	21–044	B G	Clutch plate installer/aligner

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

Tool	Tool Name
 21–080A	Clutch plate locator and flywheel bearing replacer

SERVICE AND REPAIR OPERATIONS – CONTENT

Manual Transmission and Clutch 'F' gearbox 'G' gearbox		Described		Contained in operation	Also applicable to the models below				
					Fiesta	Escort	Capri	Taunus/ Cortina	Granada
Gearbox		F	G						
16 114	Transmission assembly – remove and install	X	X	—	—	—	—	—	—
16 118 8	Transmission assembly – overhaul	X	X	—	—	—	—	—	—
16 134 5	Pilot bearing – remove and install	X	X	—	—	X	X	X	X
16 144 4	Seal – input shaft – replace	—	—	16 118 8	—	—	—	—	—
16 146 5	Bearing – input shaft – replace	—	—	16 118 8	—	—	—	—	—
16 154 4	Bearing – main shaft – replace	—	—	16 118 8	—	—	—	—	—
16 162 4	Extension housing – remove and install	—	—	16 118 8	—	—	—	—	—
16 164	Bush – extension housing – replace	X	X	—	—	X	X	X	X
16 166 4	Seal – extension housing – replace	—	—	16 164	—	—	—	—	—
16 172	Gear – speedometer driven – remove and install	X	X	—	—	—	—	—	—
16 202 4	Synchroniser rings – replace	—	—	16 118 8	—	—	—	—	—
16 264 8	Selector housing – overhaul	X	X	—	—	—	—	—	—
16 284 4	Selector mechanism – remove and install	—	—	16 264 8	—	—	—	—	—
16 524	Gear lever – remove and install	X	X	—	—	—	—	—	—
Clutch									
16 724 4	Clutch disc and pressure plate – remove and install	X	X	—	X	X	X	X	X
16 756 4	Linings – clutch disc – replace	X	X	—	X	X	X	X	X
16 784 4	Clutch housing – remove and install	—	—	16 118 8	—	—	—	—	—
16 812	Clutch pedal – remove and install	X	X	—	—	—	—	—	—
16 813	Bushes – clutch pedal – replace	—	—	16 812	—	—	—	—	—
16 814	Cable – clutch operating – remove and install	X	X	—	—	—	—	—	—

16 114 TRANSMISSION ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drive vehicle over a pit or onto ramp, open hood, fit wing covers. Disconnect earth strap from battery.
2. Slacken clutch cable at pedal bracket, Fig. 8. Disconnect reversing lamp switch (where fitted) and disconnect gearbox earth strap. Loosen oil filler plug.

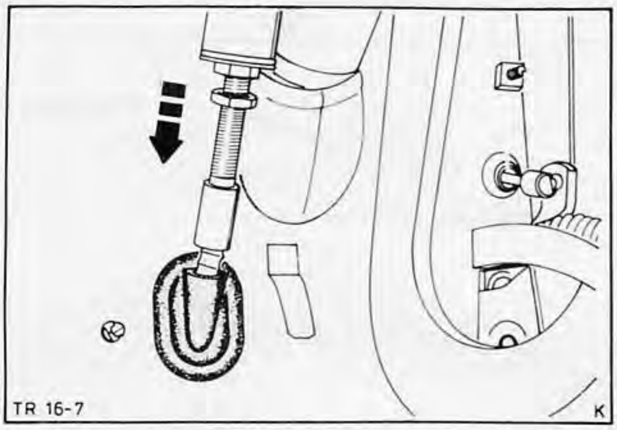


Fig. 8. Clutch cable slackened at pedal bracket

3. Pull off release lever gaiter. Detach clutch cable from release lever, pulling cable downwards by hand in front of the release lever, holding it with pliers and disconnecting cable end, Fig. 9.

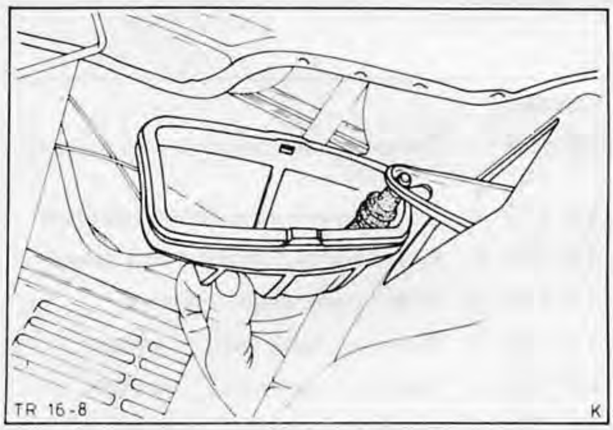


Fig. 9. Disconnect clutch cable from release lever

4. Remove gear lever from underneath, Fig. 10.
5. Disconnect starter motor lead.
6. Remove starter motor (3 bolts).
7. Detach speedometer cable from drive.
8. Detach clutch housing cover (2 bolts).

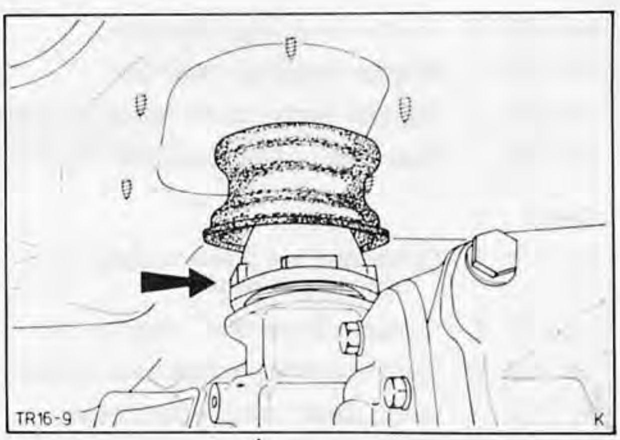


Fig. 10. Remove gear lever from underneath

9. Unbolt driveshaft from drive flange and floor pan centre bearing (6 bolts), Fig. 11. Draw shaft complete out of gearbox extension housing.

   To ensure no oil escapes, slide an old drive shaft stub or mainshaft cap into extension housing.

10. Detach gearbox cross-member complete from floor pan and gearbox (5 bolts).

    NOTE: Support gearbox.

11. Remove flange bolts (5) securing engine to gearbox.

12. Lift out gearbox carefully.

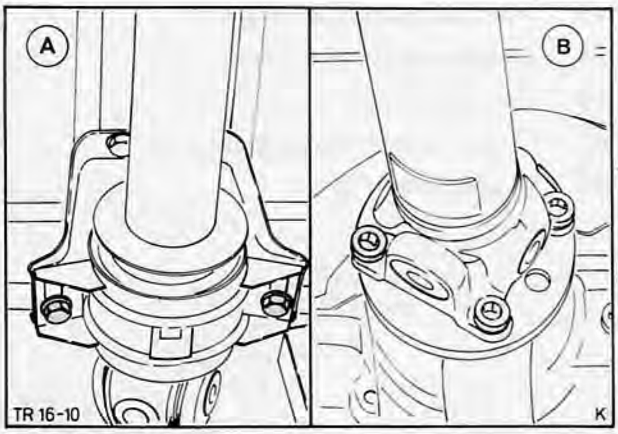


Fig. 11. Driveshaft mounting – rear axle flange and centre bearing
A – Centre bearing
B – Rear axle flange

To Install

13. Lightly grease gearbox input shaft and fit gearbox.

14. Locate clutch housing with two opposing bolts done up finger tight. Then insert remaining bolts. Torque all bolts as specified, Fig. 12.

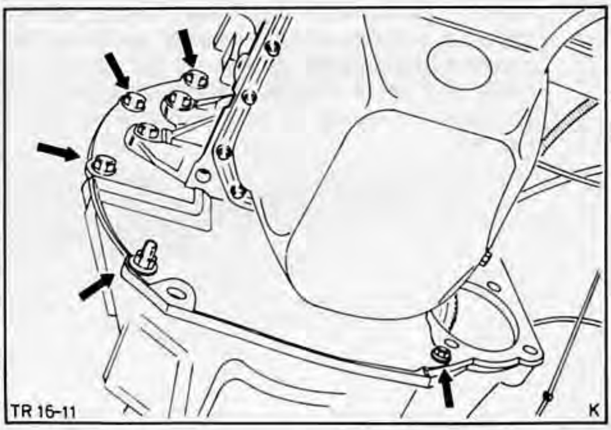


Fig. 12. Fit gearbox to engine flange

15. Attach gearbox cross member to gearbox and floor pan and tighten bolts to specified torque, Fig. 13.

16. Remove plug from extension housing and refit driveshaft complete. Loosely locate centre bearing with shims on floor pan. Connect driveshaft to rear axle flange and tighten bolts to specified torque. Then secure centre bearing so as to be parallel with the driveshaft and free of stress, tightening bolts to specified torque.

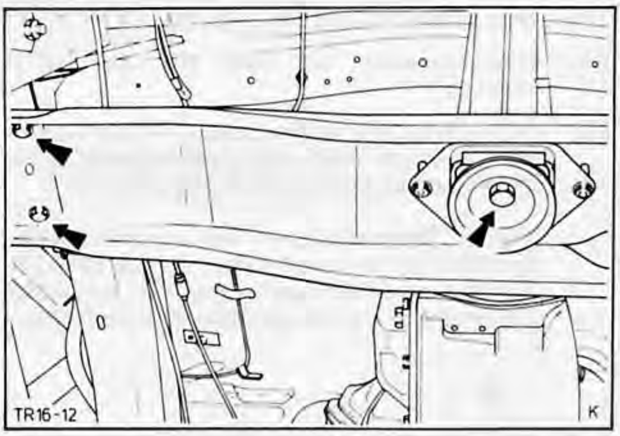


Fig. 13. Gearbox cross-member secured to floor pan

16 114 (cont'd)

17. Refit clutch housing cover.
18. Attach speedometer cable.
19. Fit starter motor.
20. Connect starter motor lead.
21. Fit gear lever, Fig. 14.

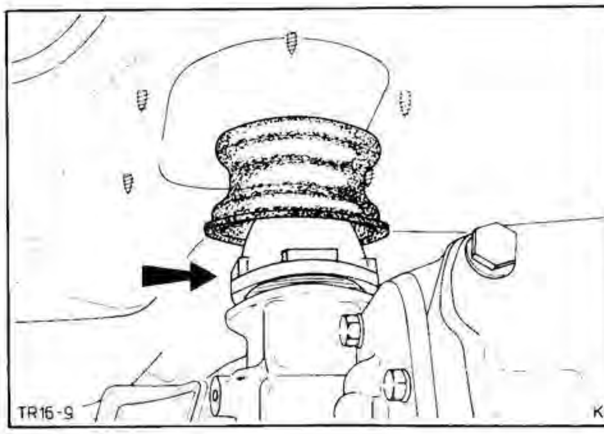


Fig. 14. Fit gear lever

22. Attach clutch cable to release lever. To do this, pass clutch cable through guide in the clutch housing and slip on gaiter. Draw the cable out of its sheath, hold with pliers and connect to release lever. Fit gaiter in place, Fig. 15.

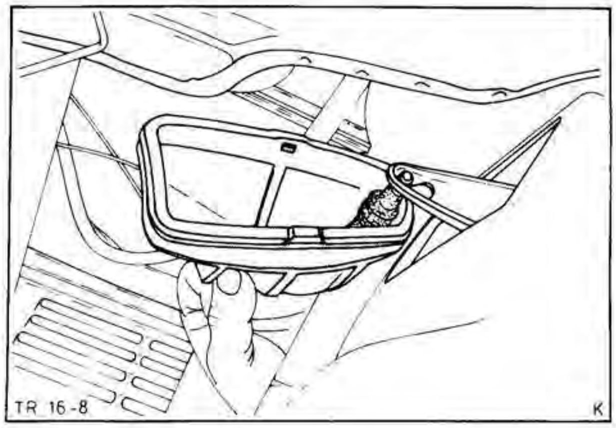


Fig. 15. Attach clutch cable to release lever

23. Adjust clutch pedal play, Fig. 16.
24. Check gearbox oil level and top up if necessary.
25. Connect battery earth strap, reversing lamp switch (where fitted) and gearbox earth strap. Close hood and remove wing covers.

NOTE: Depending on the variant, either the EARTH terminal only, or the EARTH terminal and LIVE cable support brackets are retained by the gearbox flange bolts.

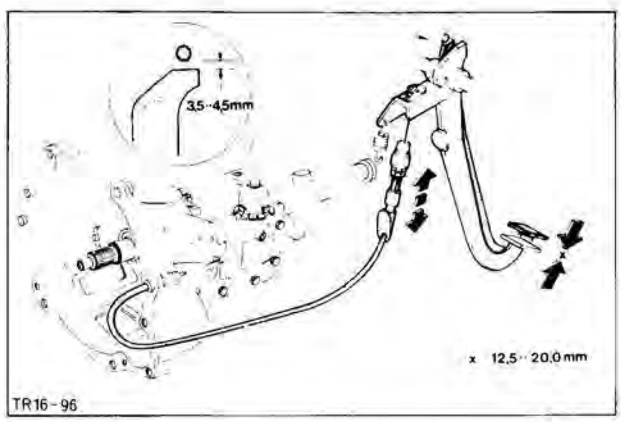


Fig. 16. Adjusting clutch play Pedal movement

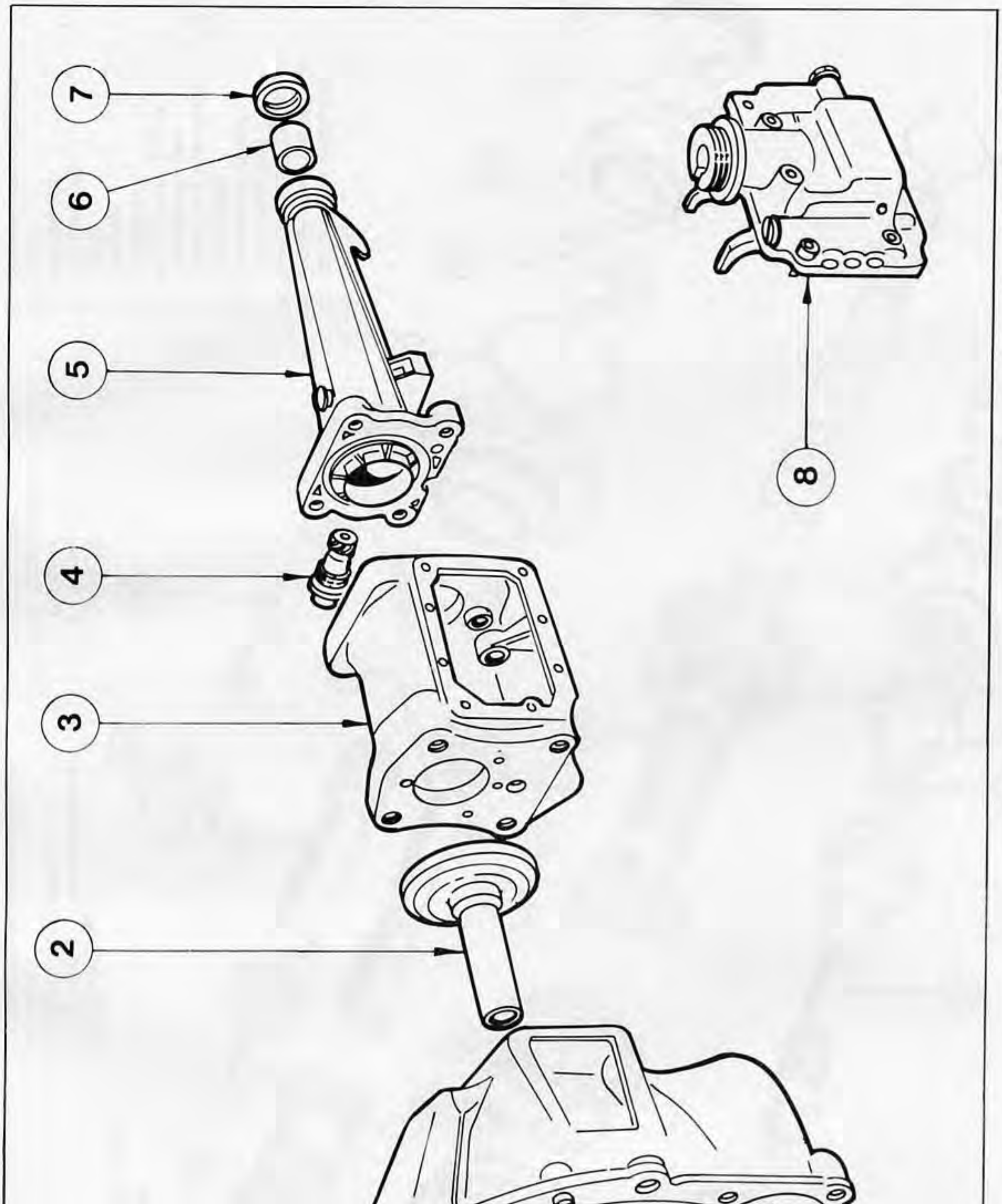
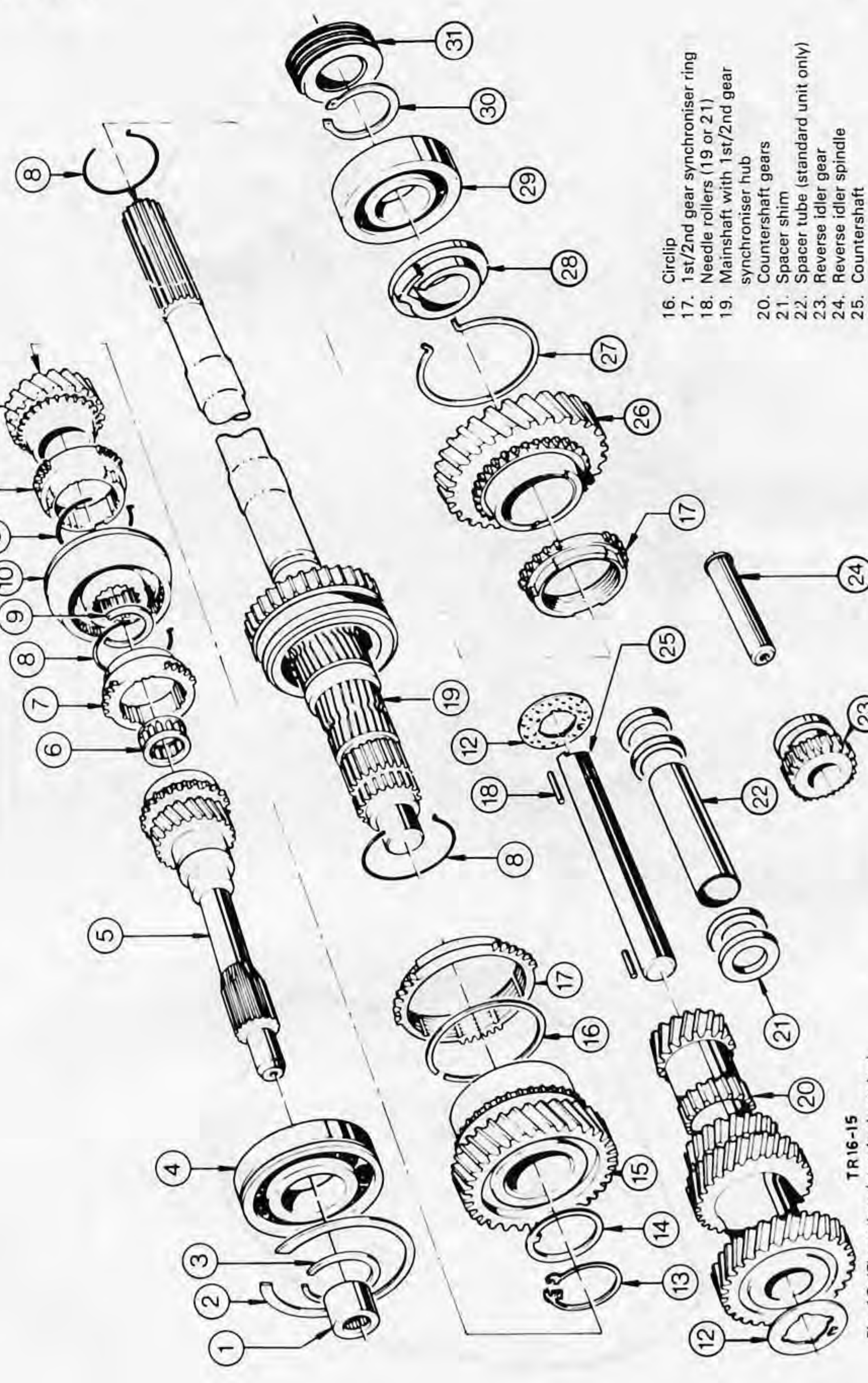


Fig. 17.

1. Clutch housing
2. Guide sleeve
3. Gearbox casing
4. Speedometer drive pinion
5. Gearbox extension housing
6. Extension housing bush
7. Oil seal
8. Selector housing



TR16-15

Fig. 18. 'F' gearbox (standard version)

1. Pilot bearing
2. Circlip
3. Circlip
4. Grooved ball bearing
5. Input shaft
6. Needle bearing
7. 3rd/4th gear synchroniser ring
8. Synchroniser spring
9. Circlip
10. 3rd/4th gear synchroniser hub
11. 3rd Gear
12. Thrust washer
13. Circlip
14. Thrust washer
15. 2nd gear
16. Circlip
17. 1st/2nd gear synchroniser ring
18. Needle rollers (19 or 21)
19. Mainshaft with 1st/2nd gear synchroniser hub
20. Countershaft gears
21. Spacer shim
22. Spacer tube (standard unit only)
23. Reverse idler gear
24. Reverse idler spindle
25. Countershaft
26. 1st gear
27. Circlip
28. Oil scoop ring
29. Ball bearing
30. Circlip
31. Speedometer worm gear

16 118 8 TRANSMISSION ASSEMBLY – OVERHAUL (Gearbox removed)

Special Service Tools Required:

Gearbox mounting bracket	16–009
Installer for extension housing bush and oil seal	16–015
Extension housing bush remover	16–025
Extension housing oil seal remover	17–001

To Dismantle

1. Unscrew oil plugs and drain oil.
2. Unbolt clutch housing (4 bolts).
3. Remove clutch thrust bearing with release lever, Fig. 19.
4. Secure gearbox to stand with Special Tool No. 16–009 for further dismantling, Fig. 20.

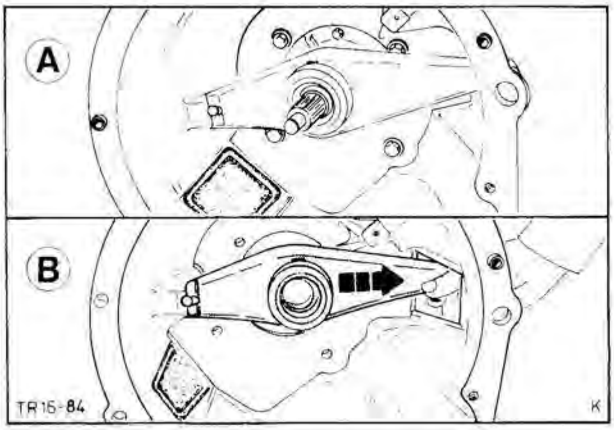


Fig. 19. Remove thrust bearing and release lever
A – Detach clutch housing
B – Remove release lever

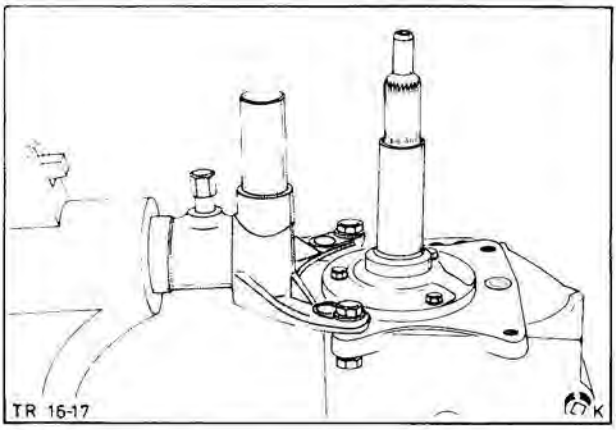


Fig. 20. Secure gearbox to stand with Special Tool No. 16–009

5. Detach selector housing from gearbox casing (7 bolts), Fig. 21.
6. Take out selector forks for 1st/2nd and 3rd/4th gears.

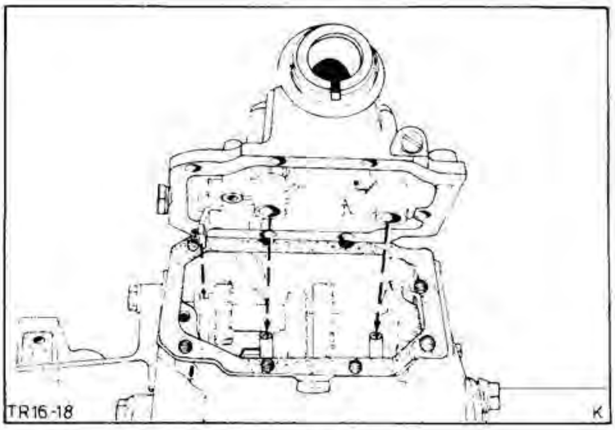


Fig. 21. Selector housing removed

16 118 8 (cont'd)

7. Remove extension housing oil seal with Special Tool No. 17–001, Fig. 22.

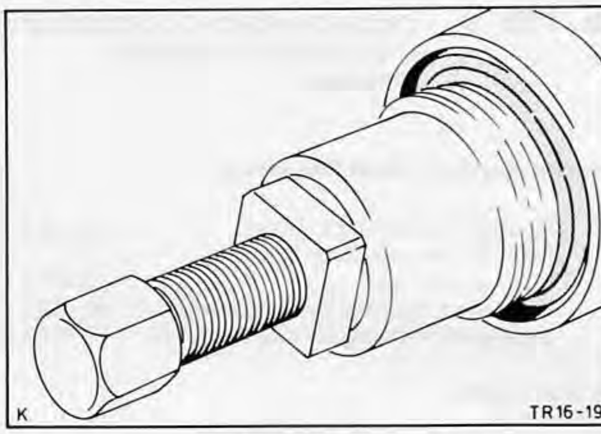


Fig. 22. Remove seal with Special Tool No. 17–001

8. Extract extension housing bush with Special Tool No. 16–025, Fig. 23.

   Extension housing oil seal or bush can only be changed when extension housing and mainshaft are fitted in place.

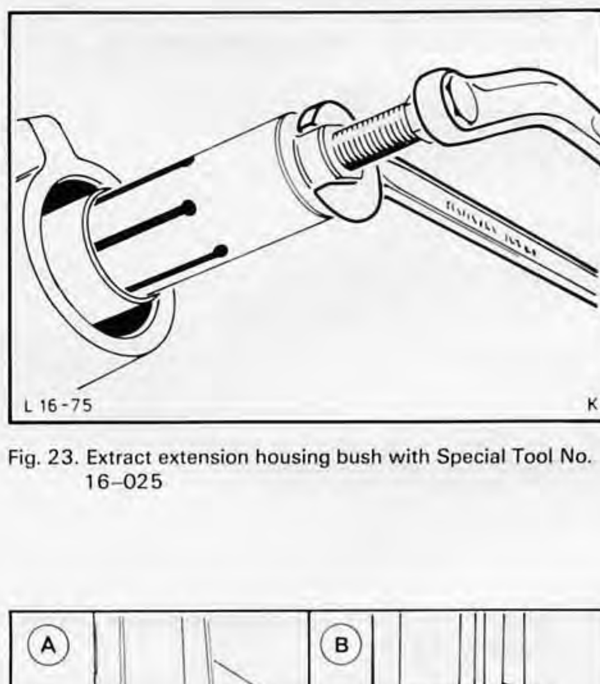


Fig. 23. Extract extension housing bush with Special Tool No. 16–025

9. Remove 4 bolts securing extension housing, pull extension housing out of seat in gearbox casing and turn until there is sufficient space to remove countershaft, Fig. 24.

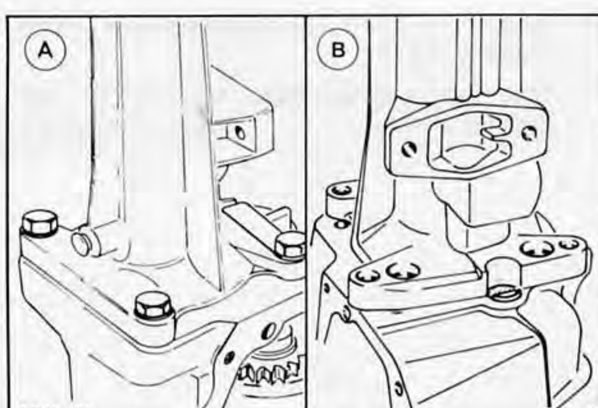


Fig. 24. With extension housing bolts removed, turn extension housing until countershaft can be removed

10. Tap countershaft *backwards* out of press fit from front end using dummy countershaft (countershaft shortened to a length of 177 mm).

    Dummy countershaft must be in constant contact with countershaft so that the needle rollers do not fall out of place.

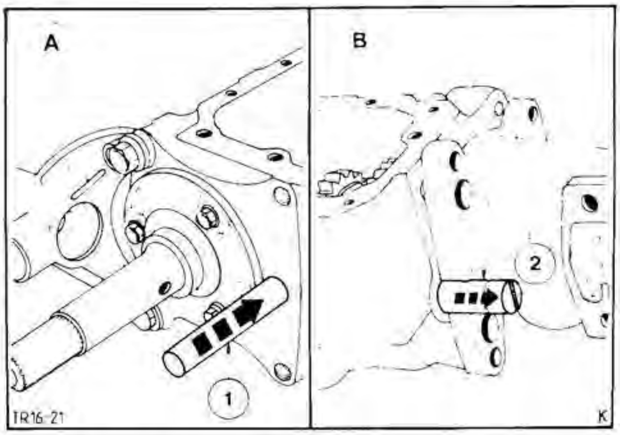


Fig. 25. Tap out countershaft
A1 – Dummy shaft (countershaft shortened to 177 mm)
B2 – Countershaft

11. Remove main drive gear bearing retainer (3 bolts), Fig. 26.

    NOTE: When removing bearing retainer, make sure oil seal is not damaged. Replace if necessary when reassembling.

12. Move countershaft gears to one side, draw out input shaft towards the front.

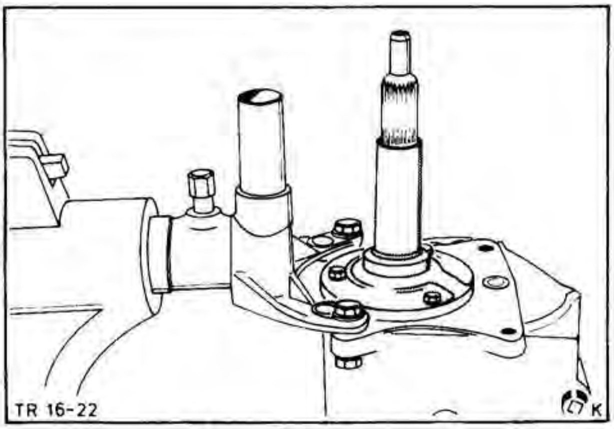


Fig. 26. Detach main drive gear bearing retainer

13. Remove extension housing with mainshaft assembly, Fig. 27.

14. Remove countershaft gears with dummy countershaft and 2 thrust washers from gearbox casing.

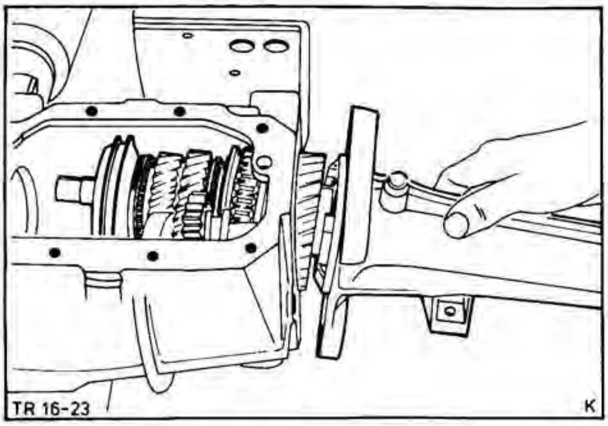


Fig. 27. Remove extension housing complete

16 118 8 (cont'd)

'F' GEARBOX

15. Remove reverse gear idler shaft, Fig. 28. To do this, take a copper mandrel and drive reverse gear idler shaft out towards the rear, remove reverse gear.

    NOTE: Do not strike gearbox casing when removing idler shaft (risk of cracking).

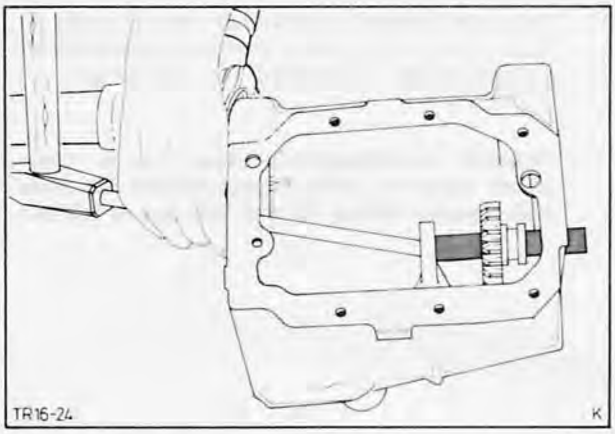


Fig. 28. Remove reverse gear idler shaft

16. Unscrew speedometer drive unit complete from gearbox extension housing. Then remove drive gear bearing, Fig. 29.

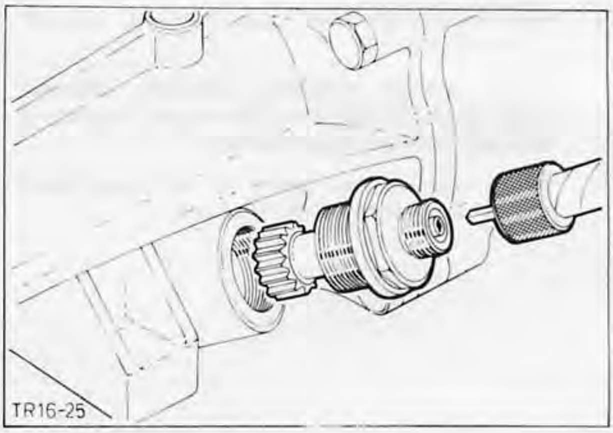


Fig. 29. Remove speedometer drive unit

To Dismantle Mainshaft

17. Remove mainshaft bearing retaining ring from groove in extension housing, Fig. 30. Drive mainshaft out of the extension housing using a copper hammer.

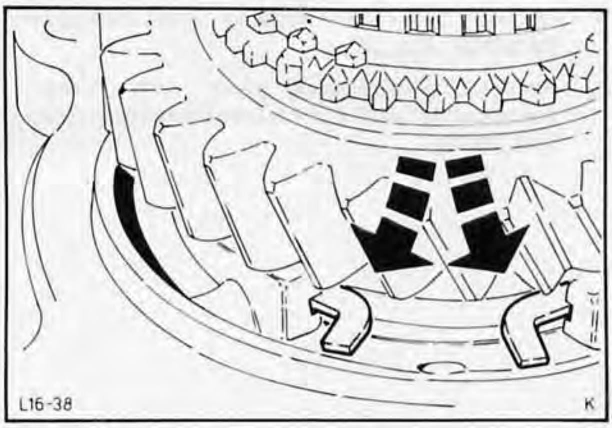


Fig. 30. Remove bearing retaining ring from extension housing

18. Remove circlip from 3rd/4th gear synchroniser hub. Detach synchroniser hub with 3rd gear by hand, Fig. 31.

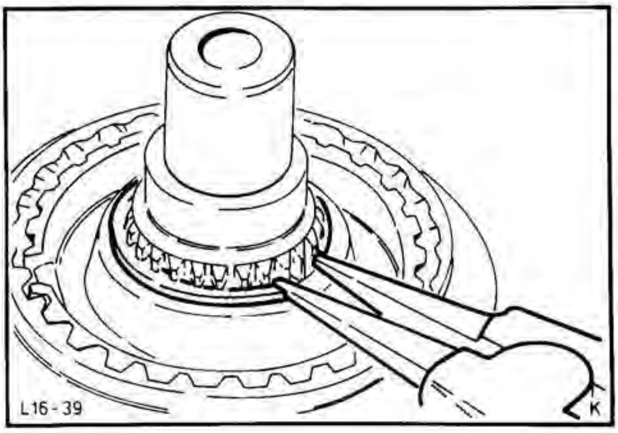


Fig. 31. Remove circlip from 3rd/4th gear synchroniser hub

19. After removing circlip and thrust washer, detach 2nd gear from mainshaft, Fig. 32.

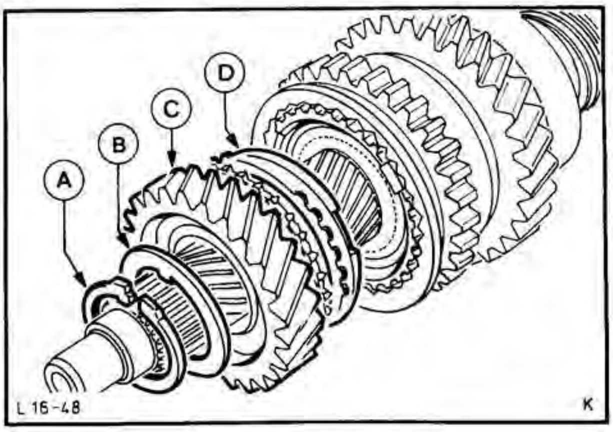


Fig. 32. Remove circlip, pull off 2nd gear
A – Circlip
B – Thrust washer
C – 2nd gear
D – Synchroniser ring

20. Dismantle 1st/2nd gear synchroniser assembly.

NOTE: 1st/2nd gear synchroniser hub and mainshaft are fitted together to form a unit, Fig. 33.

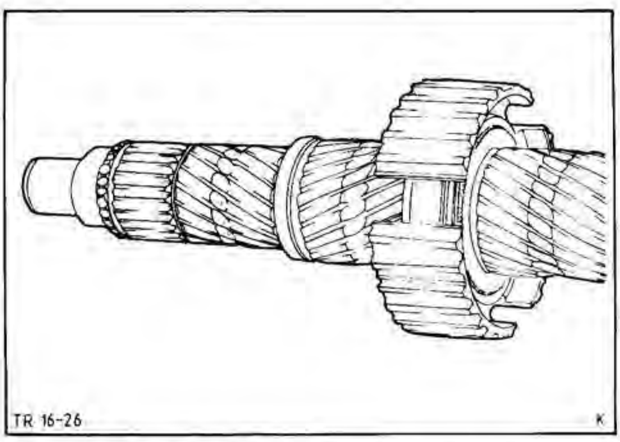


Fig. 33. Mainshaft with 1st/2nd gear synchroniser hub

16 118 8 (cont'd)

21. Remove mainshaft bearing circlip at the rear. Press off ball bearing and speedometer worm gear, Fig. 34.

    NOTE: To remove the bearing, locate a suitable U-shaped remover under 1st gear.

22. Then detach spacer ring and extension housing circlip.

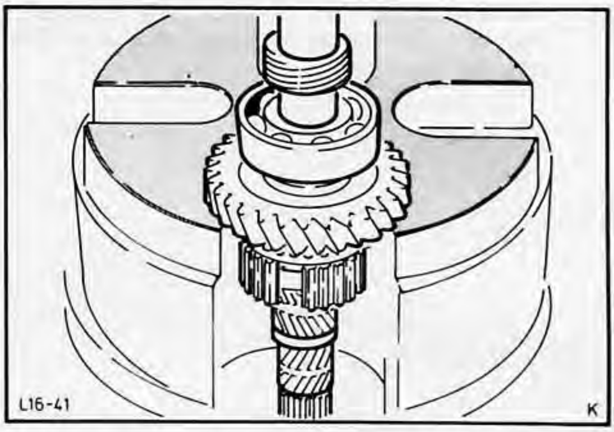


Fig. 34. Press off mainshaft bearing

23. Dismantle 3rd/4th gear synchroniser hub, Fig. 35. Remove selector ring, blocker bars and springs.

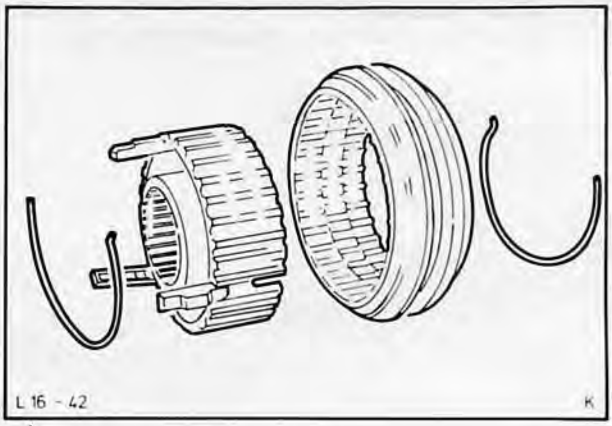


Fig. 35. Synchroniser hub exploded

To Reassemble Mainshaft

24. Assemble 3rd/4th gear synchroniser hub: insert blocker bars and fit springs so that they are staggered with their opposite ends located in the same blocker bar, Fig. 36.

    The marks on selector ring and hub must coincide.

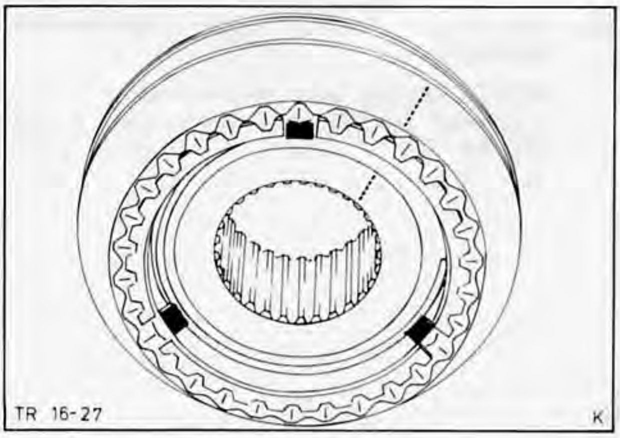


Fig. 36. Synchroniser hub reassembled

25. Insert 1st gear synchroniser spring in hub, Fig. 37. To do this, first insert blocker bars and then fit the synchroniser springs offset relative to one another, starting with the same blocker bar.

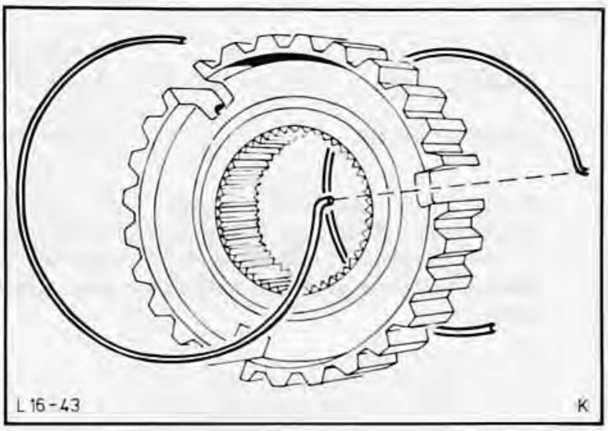


Fig. 37. Fit synchroniser springs

26. Slide 1st gear with synchroniser ring and oil scoop ring onto the mainshaft, Fig. 38.

NOTE: Large diameter oil scoop ring faces the ball bearing side.

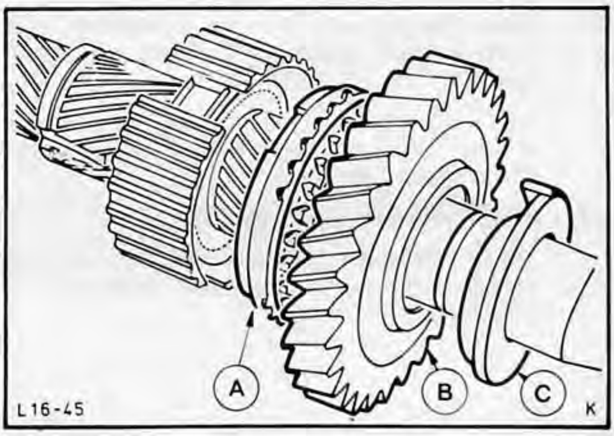


Fig. 38. Slide 1st gear with synchroniser ring and oil scoop ring onto mainshaft
A – Synchroniser ring
B – 1st gear
C – Oil scoop ring

27. Establish thickness of extension housing circlip for mainshaft bearing. **When using a new bearing or a new extension housing, the thickness of the circlip must be established as follows:**

Locate circlip in the groove in the extension housing and press outwards so that it bears on the shoulder. Measure distance between bearing stop and top edge of circlip exactly (total height) using a depth gauge, Fig. 39. Measure breadth of bearing to be fitted and deduct bearing width from total height, Fig. 40. This gives the circlip thickness.

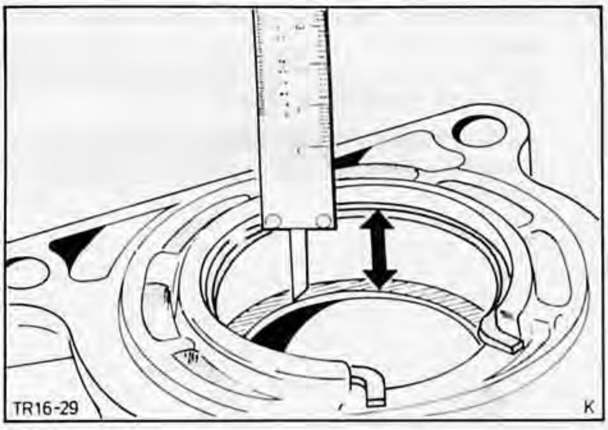


Fig. 39. Establish circlip thickness

16 118 8 (cont'd)

Example

Total height	17,98 mm
Bearing width	15,92 mm
Required circlip	2,06 mm

From the available range of circlip thicknesses (see Parts Catalogue) choose one of this size and fit it loosely on the mainshaft. **The circlip used must not have any axial play.**

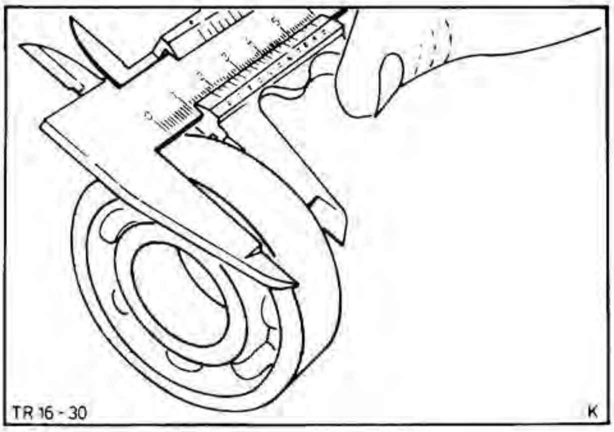


Fig. 40. Measure thickness of mainshaft bearing

28. Coat bearing seat on the mainshaft with multi-purpose grease, fit bearing and insert circlip.

    NOTE: Circlip must not have any axial play. If it does, select the right circlip from the range in the Parts Catalogue.

29. Fit speedometer worm gear, Fig. 41.

    NOTE: Distance between ball bearing and speedometer worm gear outer edge must be 82,25 mm

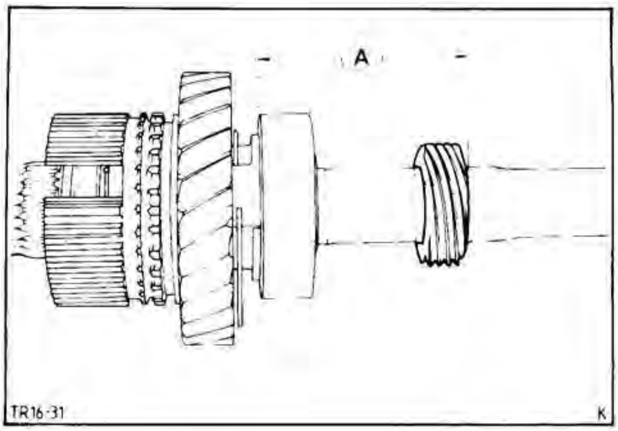


Fig. 41. Location of speedometer worm gear
A – 82,25 mm

30. Reassemble 1st/2nd gear synchroniser hub: insert blocker bars and fit synchroniser springs staggered with their opposite ends in the same blocker bar, Fig. 42.

    NOTE: Marks on sliding gear and hub must coincide, with selector groove pointing to front.

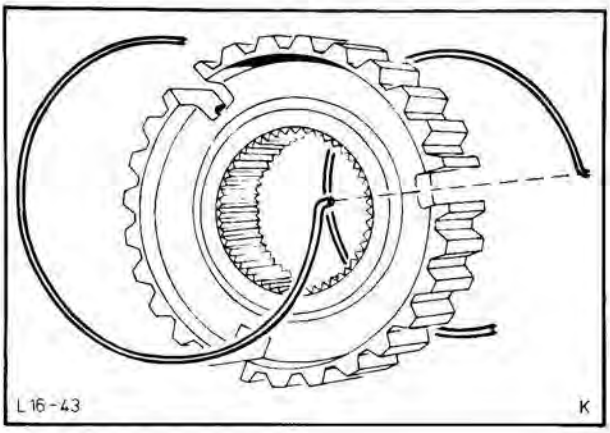


Fig. 42. Insert synchroniser springs

31. Slide 2nd gear with synchroniser ring and thrust washer onto mainshaft, fit circlip, Fig. 43.

    NOTE: Locate circlip correctly.

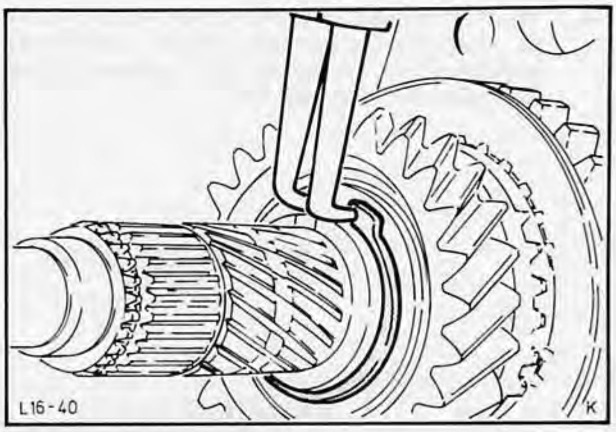


Fig. 43. 2nd gear with thrust washer and circlip fitted

32. Slide 3rd gear with synchroniser ring onto the mainshaft, Fig. 44.

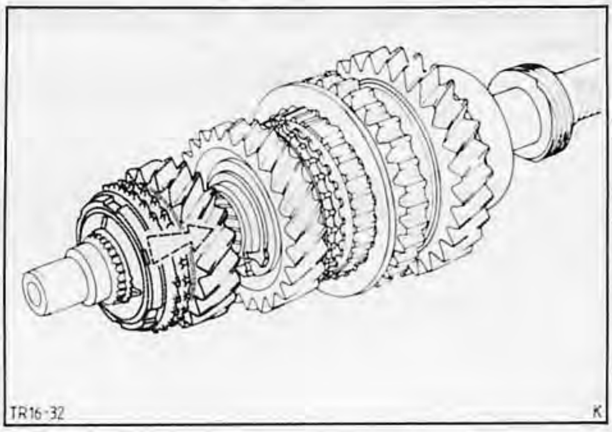


Fig. 44. Slide 3rd gear and synchroniser ring onto mainshaft

33. Slide 3rd/4th gear synchroniser hub onto the mainshaft with the long side of the hub to the front, fit circlip, Fig. 45.

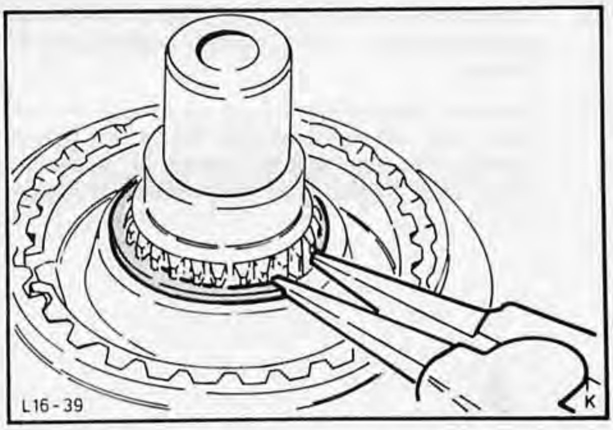


Fig. 45. Fit circlip to 3rd/4th gear synchroniser hub

16 118 8 (cont'd)

'F' GEARBOX

34. Warm extension housing in hot water and fit to mainshaft assembly. Insert previously loosely fitted circlip in the groove in the extension housing, Fig. 46.

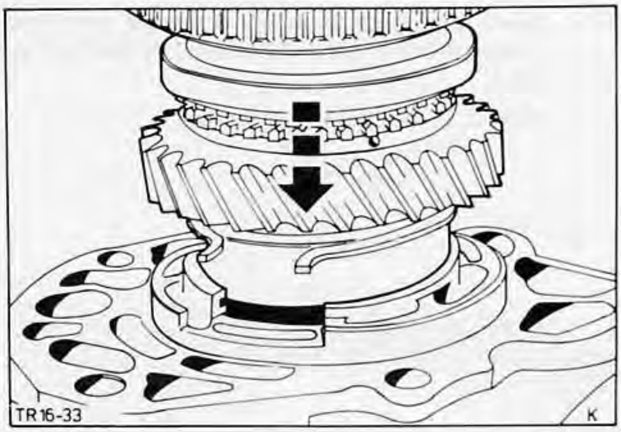


Fig. 46. Insert mainshaft in extension housing

To Overhaul Input Shaft and Countershaft Gears

35. Detach circlip from input shaft and press off input shaft bearing, Fig. 47.

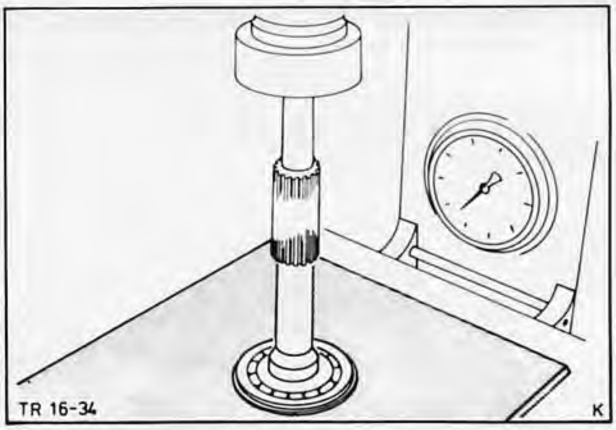


Fig. 47. Press off input shaft bearing

36. Coat bearing seat on input shaft with multi-purpose grease, press on ball bearing and fit circlip.
37. Remove dummy shaft from countershaft gear train, Fig. 48, remove the 19 or 21 needle rollers with the spacer shims (2 each) on either side of the gear train. Remove spacer tube.

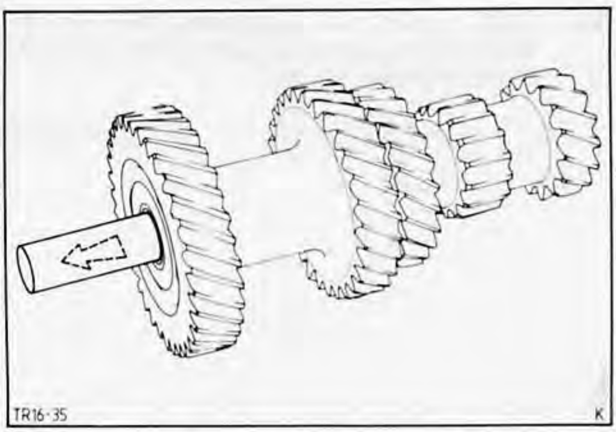


Fig. 48. Remove dummy shaft from countershaft gear train

16 118 8 (cont'd) **'F' GEARBOX**

38. Reassemble countershaft gear train: slide dummy shaft with spacer tube into gear train, fill space between shaft and bore with multi-purpose grease then introduce needle rollers and spacer shims, Fig. 49.

    NOTE: Long needle rollers at the rear.

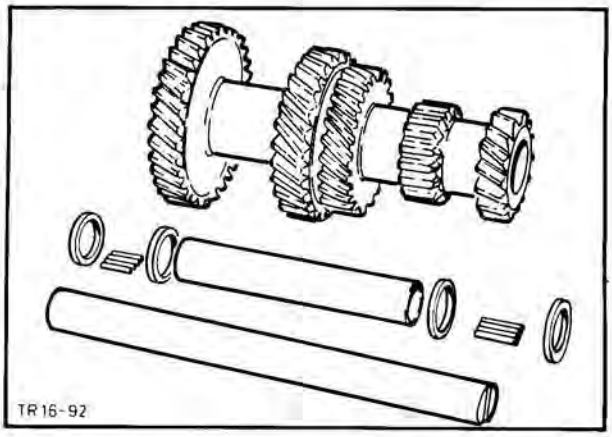


Fig. 49. Countershaft gear train dismantled

39. Remove oil seal of main drive gear bearing retainer, Fig. 50.
40. Using a suitable piece of tube, carefully insert new bearing retainer oil seal with the sealing lip facing the gearbox casing when in position. First coat sealing lip with multi-purpose grease.

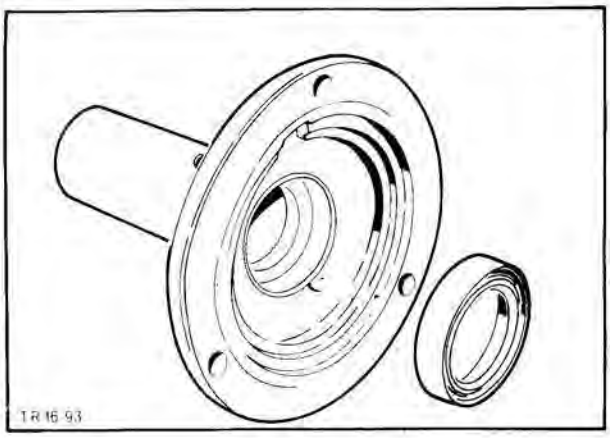


Fig. 50. Bearing retainer oil seal

To Reassemble Gearbox

Clean all parts thoroughly and lightly coat with specified gearbox oil before installing.

Bolts which come into contact with the gearbox oil chamber must be coated with sealing compound.

41. Fit reverse idler gear with selector groove to the rear. Insert shaft and tap in with copper hammer until about 0,2 to 0,8 mm countersunk, Fig. 51. First grease shaft with multi-purpose grease G3-7140.

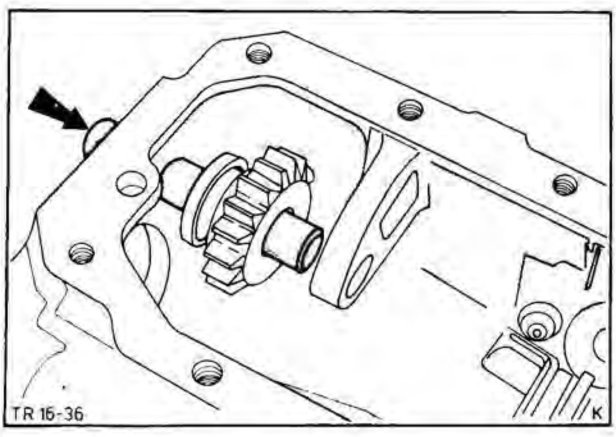


Fig. 51. Fit reverse idler gear

16 118 8 (cont'd)

'F' GEARBOX

42. Stick front thrust washer of countershaft gear train to recess in gearbox casing with grease, Fig. 52.
43. Place countershaft gear train with dummy shaft in gearbox casing and fit rear thrust washer.

    NOTE: Thrust washers must not be moved.

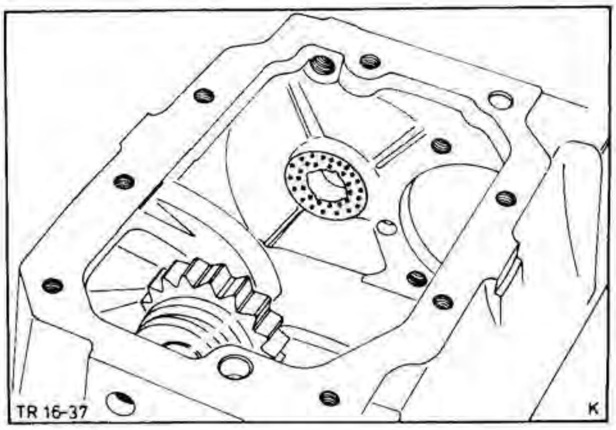


Fig. 52. Stick thrust washers of countershaft gear train to gearbox casing

44. Fit extension housing with mainshaft and then turn housing so that the countershaft can be installed, Fig. 53.

    NOTE: Stick extension housing gasket to flange using grease so as to avoid damage.

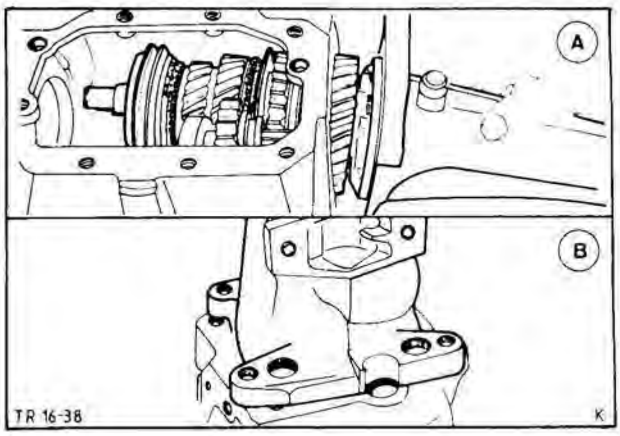


Fig. 53. A/B – Fit extension housing and then turn so that hole for countershaft is accessible

45. Oil needle bearing and fit to input shaft. Slide synchroniser ring over input shaft cone.
46. Slide input shaft with ball bearing into gearbox casing until the circlip on the outside rests against the casing, Fig. 54.

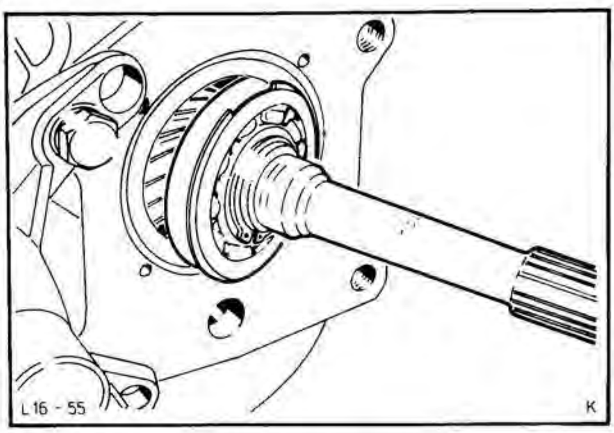


Fig. 54. Slide input shaft into casing

47. Fit main drive gear bearing retainer with a new gasket, Fig. 55.

NOTE: Fit bolts coated with sealing compound. Oil port must line up with hole in gasket and bearing retainer.

When fitting the bearing retainer, bind input shaft splining (with adhesive tape or the like) to avoid damaging oil seal.

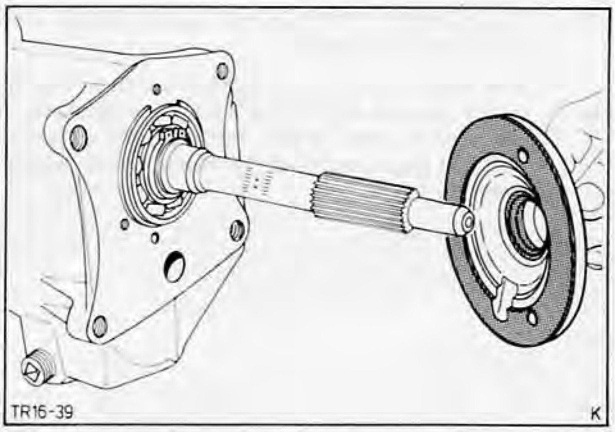


Fig. 55. Fit main drive gear bearing retainer

48. Turn gearbox through 180° until countershaft gear train engages with main and input shafts. Then line up countershaft gear train with the holes in the casing, ensuring correct seating of thrust washers at the same time. Tap countershaft into the casing from the rear, keeping it in constant contact with the dummy shaft, and drive in flush with a copper hammer (on clutch housing side). Remove dummy shaft.

NOTE: The flattened end of the shaft must be **horizontal**, Fig. 56.

Then turn gearbox casing back into correct position.

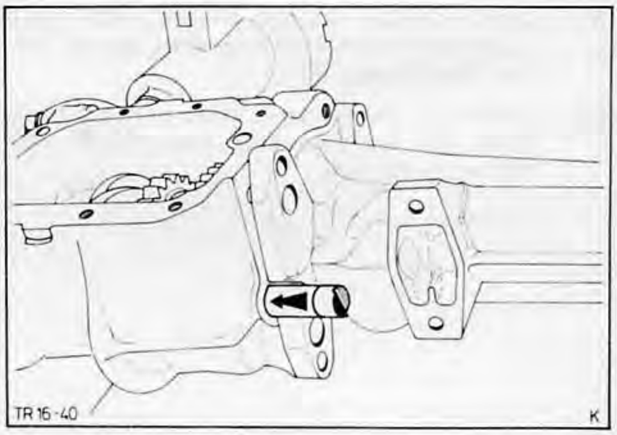


Fig. 56. Fit countershaft

49. Line up extension housing, coat bolts (4) with sealing compound and insert then tighten, Fig. 57.

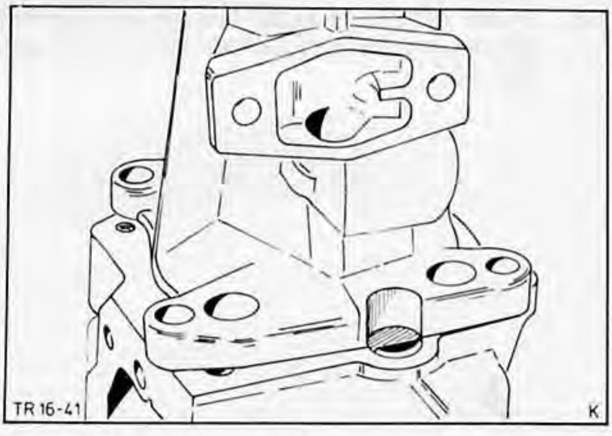


Fig. 57. Extension housing lined up

16 118 8 (cont'd)

'F' GEARBOX

50. Fit extension housing bush with Special Tool No. 16–015, Fig. 58.

    The bush must be installed so that the oil return groove sits in the extension housing at the bottom and to the rear, thereby ensuring that the gap (notch) in the bush is not located over the oilway.

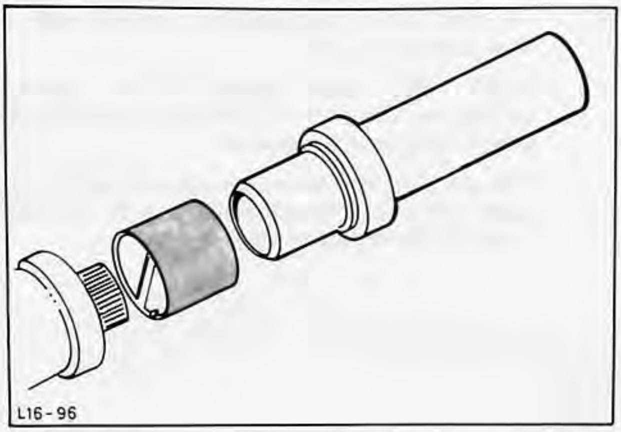


Fig. 58. Press in extension housing bush with Special Tool No. 16–015

51. Coat extension housing oil seal with multi-purpose grease and fit seal with Special Tool No. 16–015, Fig. 59.
52. Screw in speedometer drive unit complete (gear and bearing). First coat thread with sealing compound.

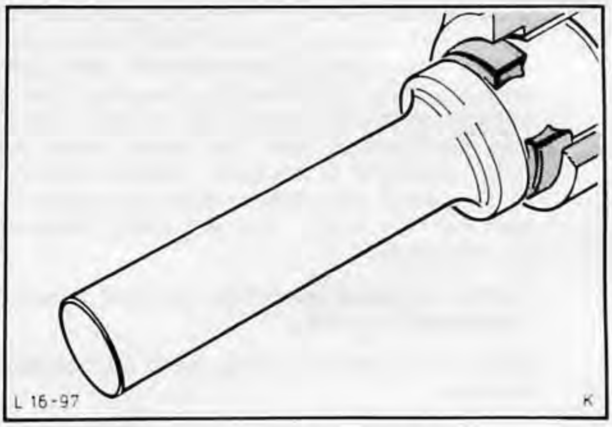


Fig. 59. Fit oil seal with Special Tool No. 16–015

53. Install selector forks for 1st/2nd and 3rd/4th gears with the cast number facing the front, Fig. 60.

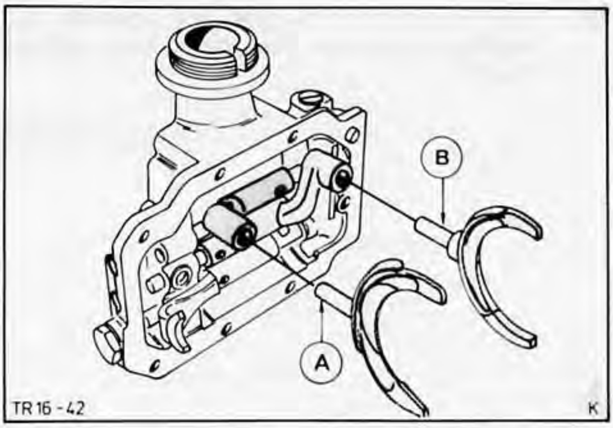


Fig. 60. Fit selector forks
A – 1st/2nd gear fork
B – 3rd/4th gear fork

54. Fit the selector housing with new gasket, Fig. 61.

NOTE: Coat bolts with sealing compound before inserting.

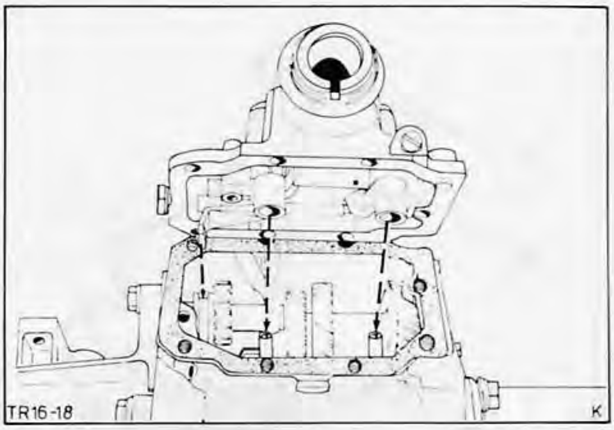


Fig. 61. Fit selector housing

55. Detach gearbox from stand, Fig. 62.

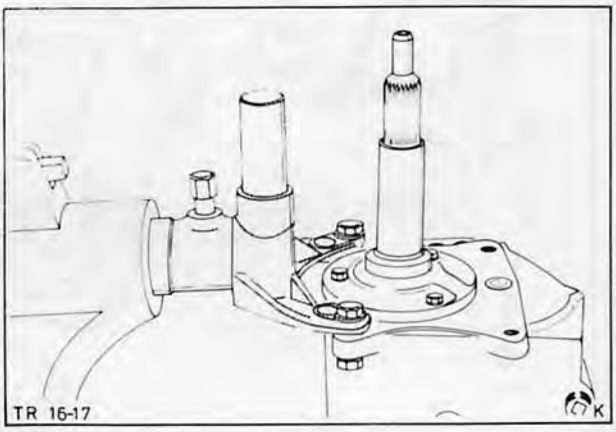


Fig. 62. Detach gearbox from stand

56. Assemble clutch thrust bearing and release lever and secure with circlip, Fig. 63. Then insert release lever in clutch housing.

57. Attach clutch housing, coating through-bolts with sealing compound before insertion, then torque bolts as specified.

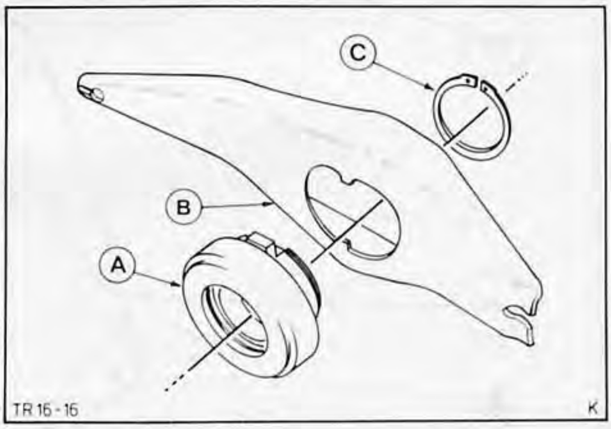


Fig. 63. Fit clutch thrust bearing with release lever
A – Thrust bearing
B – Release lever
C – Circlip

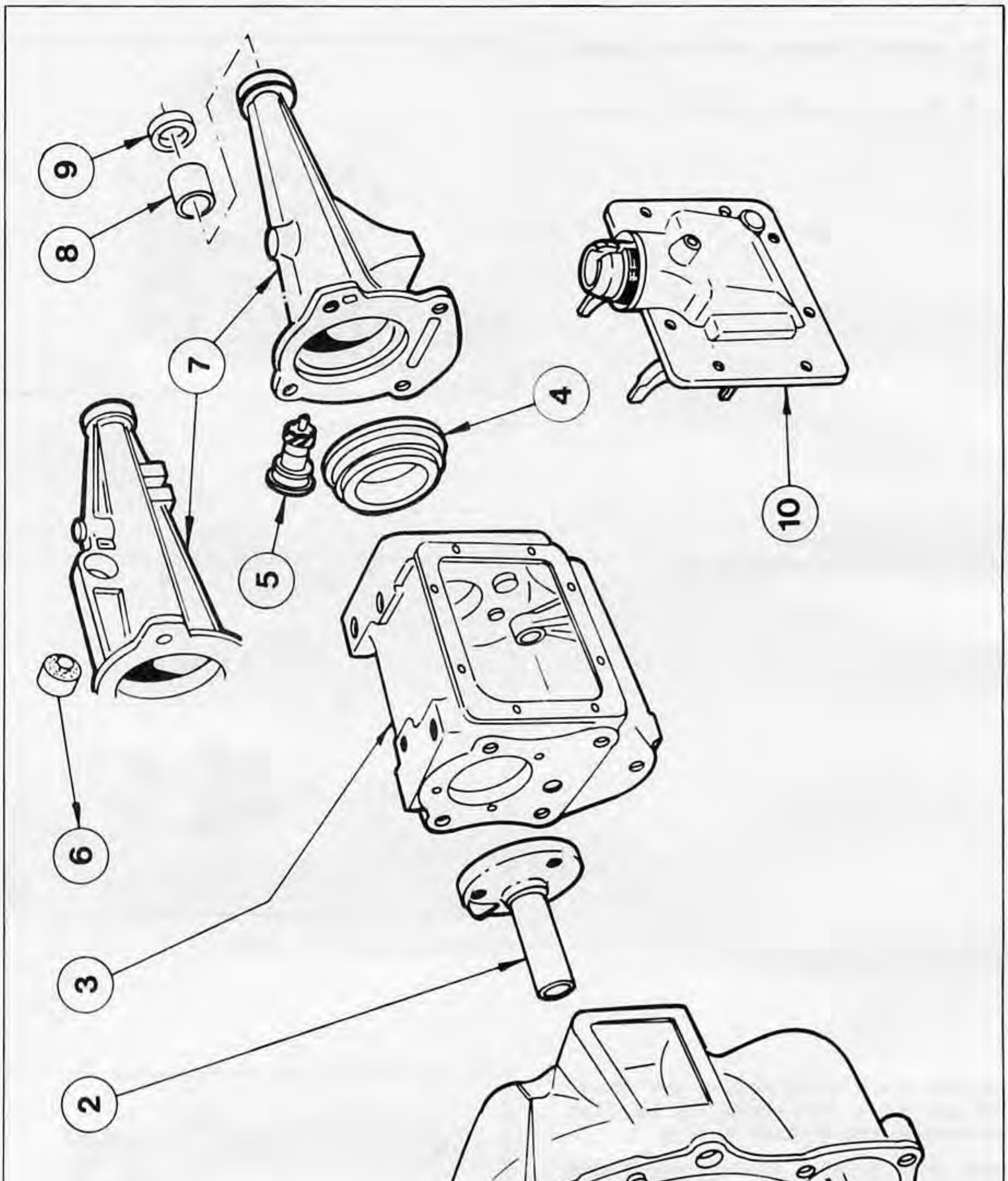


Fig. 64. 1. Clutch housing
2. Main drive gear bearing retainer
3. Gearbox casing
4. Bearing retainer
5. Speedometer drive pinion
6. Rubber bush – extension housing
7. Extension housing
8. Extension housing bush
9. Oil seal
10. Selector housing

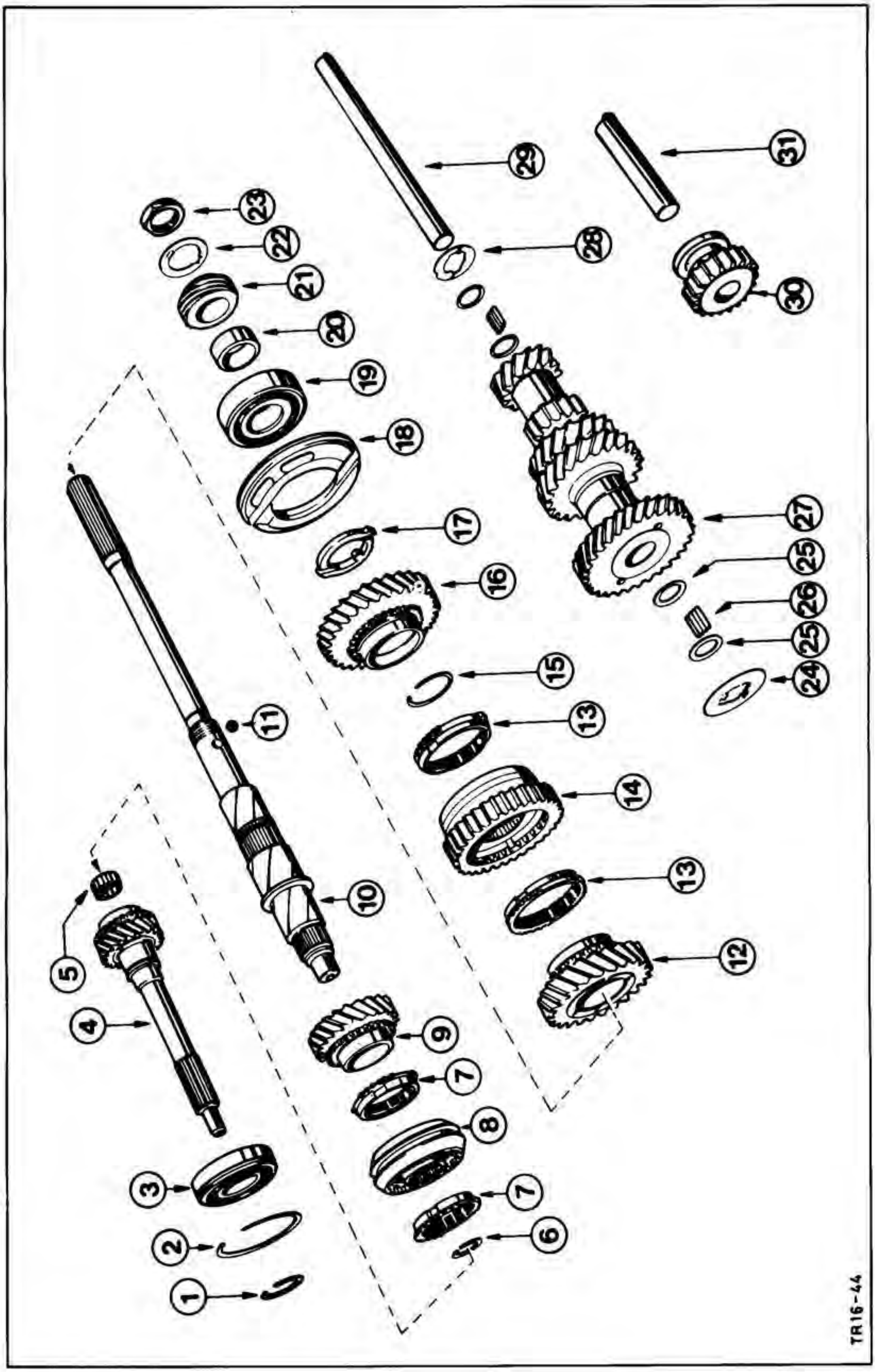


Fig. 65.

1. Circlip
2. Circlip
3. Ball bearing
4. Input shaft
5. Needle bearing
6. Circlip
7. Synchroniser sleeve (3rd/4th gear hub)
8. 3rd/4th gear synchroniser hub
9. 3rd gear
10. Mainshaft
11. Speedometer worm locking ball
12. 2nd gear
13. Synchroniser sleeve (1st/2nd gear hub)
14. 1st/2nd gear synchroniser hub
15. Circlip
16. 1st gear
17. Oil scoop ring
18. Bearing retainer
19. Ball bearing
20. Spacer sleeve
21. Speedometer worm
22. Lock washer
23. Mainshaft nut
24. Thrust washer
25. Spacer shim
26. Needle rollers (22)
27. Countershaft gears
28. Thrust washer
29. Countershaft
30. Reverse gear idler
31. Idler shaft

16 118 8 TRANSMISSION ASSEMBLY – OVERHAUL (Gearbox removed)

Special Service Tools Required:

Dummy countershaft	16–003
Gearbox mounting bracket	16–009
Extension housing bush remover	16–011
Extension housing bush and oil seal installer	16–016
Mainshaft nut wrench	16–027
Extension housing oil seal remover	17–001

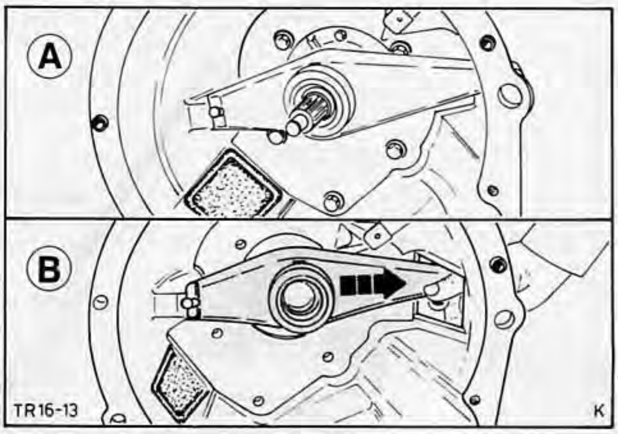


Fig. 66. Remove thrust bearing with release lever
A – Unbolt clutch housing
B – Remove release lever

To Dismantle Gearbox

1. Unscrew oil plug and drain oil.
2. Detach clutch housing and thrust bearing with release lever (5 bolts), Fig. 66. Separate clutch housing, thrust bearing and release lever.
3. Secure gearbox to stand with Special Tool No. 16–009 for further dismantling, Fig. 67.

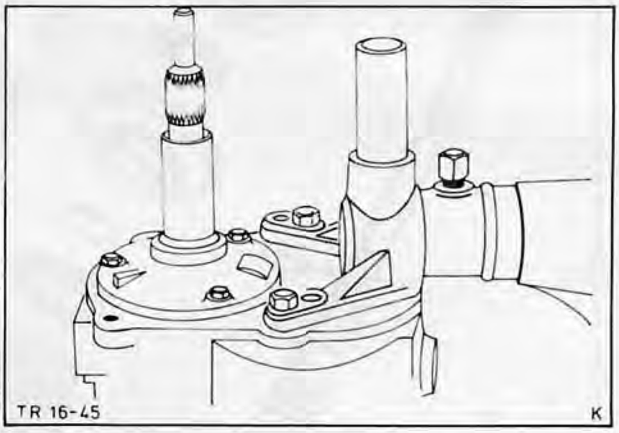


Fig. 67. Secure gearbox to stand with Special Tool No. 16–009

4. Detach gearbox selector housing (8 bolts), Fig. 68.

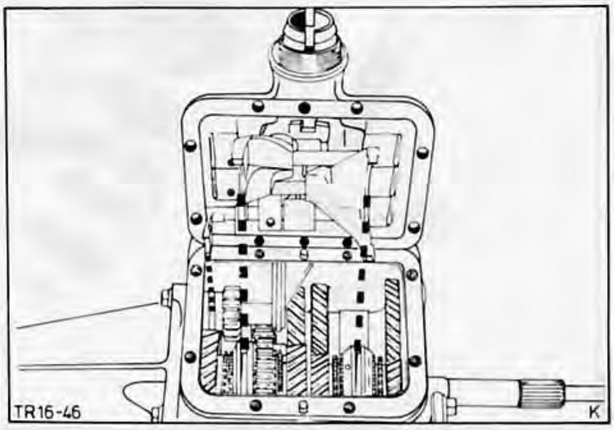


Fig. 68. Gearbox selector housing removed

5. Remove extension housing oil seal with Special Tool No. 17–001, Fig. 69.

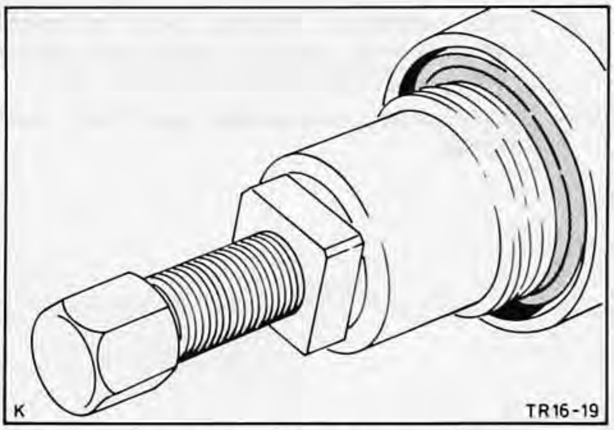


Fig. 69. Remove oil seal with Special Tool No. 17–001

6. Extract extension housing bush with Special Tool No. 16–011, Fig. 70.

   Extension housing oil seal or bush can only be changed while extension housing and mainshaft are installed.

   Remove bolts (4) securing extension housing. Draw extension housing out of seat in casing and remove.

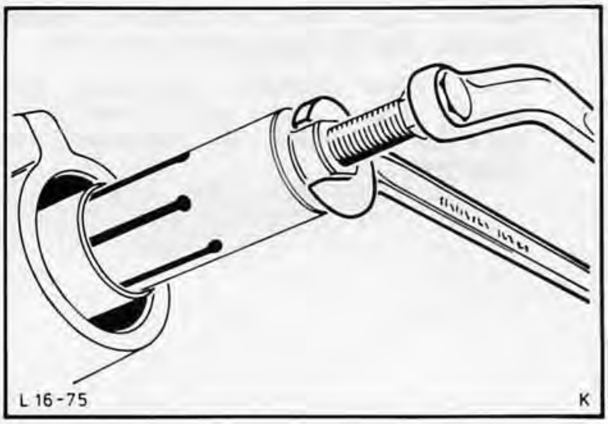


Fig. 70. Extract extension housing bush with Special Tool No. 16–011

7. Drive countershaft out of press fit from front **towards the rear** using Special Tool No. 16–003, Fig. 71. Lower countershaft gear train.

   Dummy countershaft 16–003 must remain in constant contact with the countershaft so that the needle rollers do not drop out.

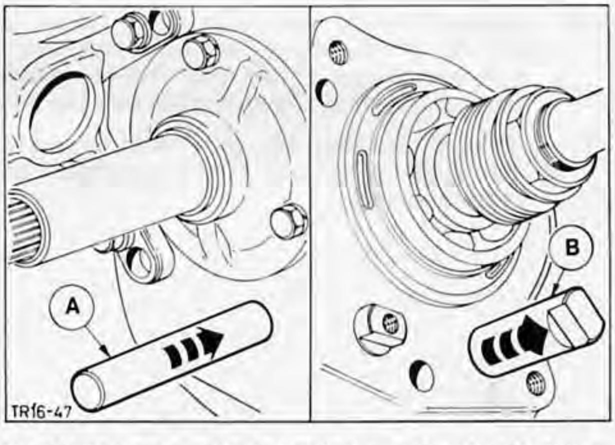


Fig. 71. Push out countershaft with Special Tool No. 16–003
A – Special Tool No. 16–003
B – Countershaft

16 118 8 (cont'd)

8. Draw extension housing with mainshaft complete from gearbox casing and remove input shaft needle roller bearing, Fig. 72.

   NOTE: Move countershaft gear train away slightly.

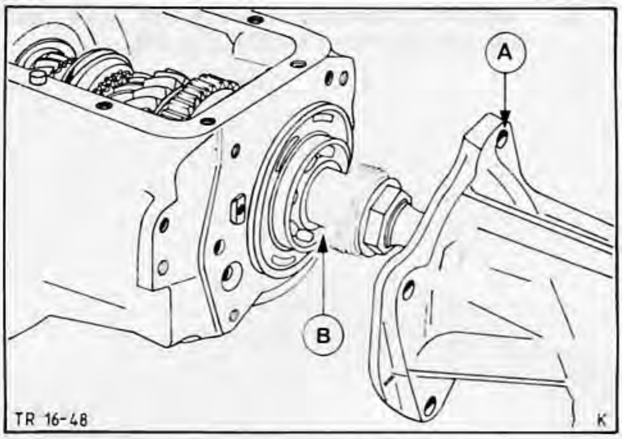


Fig. 72. Withdraw complete extension housing
A – Extension housing
B – Mainshaft complete

9. Remove main drive gear bearing retainer (3 bolts), Fig. 73. Then pull out input shaft.

   NOTE: When removing main drive gear bearing retainer, make sure oil seal is not damaged. Replace if necessary on reassembly.

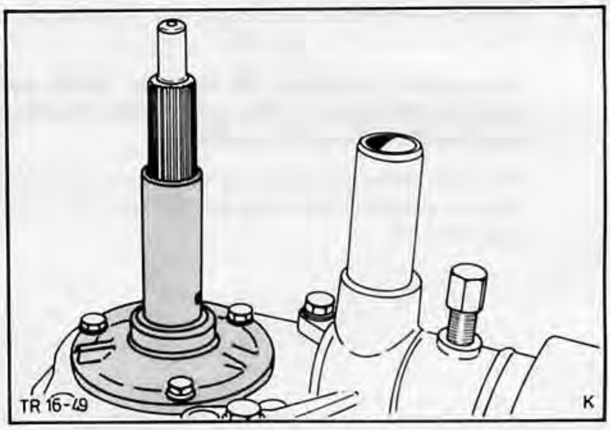


Fig. 73. Remove main drive gear bearing retainer

10. Remove reverse gear idler shaft. Screw an M8×60 mm (5/16 in×24G) bolt fitted with a nut, washer and socket into the idler shaft. Draw out shaft by tightening the nut, Fig. 74.
11. Remove countershaft gear train complete with dummy shaft and 2 thrust washers from gearbox casing.

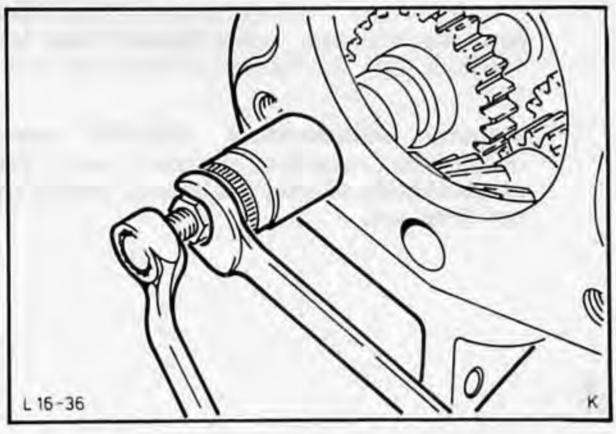


Fig. 74. Remove reverse gear idler shaft

To Dismantle Mainshaft

12. Remove circlip of 3rd/4th gear synchroniser hub and pull off synchroniser hub and 3rd gear with suitable remover, Fig. 75.

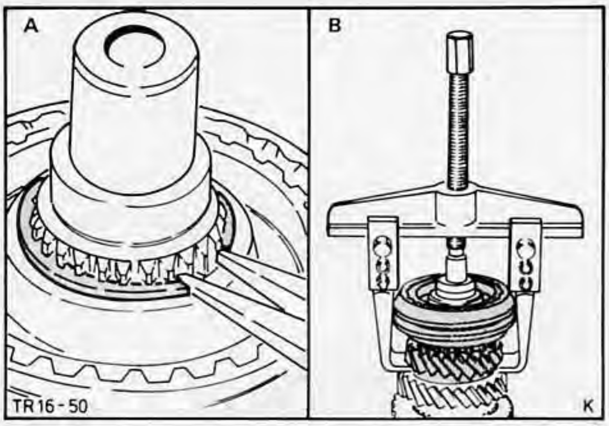


Fig. 75. A – Remove circlip of 3rd/4th gear synchroniser hub
B – Remove 3rd/4th gear synchroniser hub and 3rd gear

13. Unlock mainshaft nut and remove with Special Tool No. 16–027, Fig. 76.
14. Pull off speedometer worm gear and remove interlock ball.

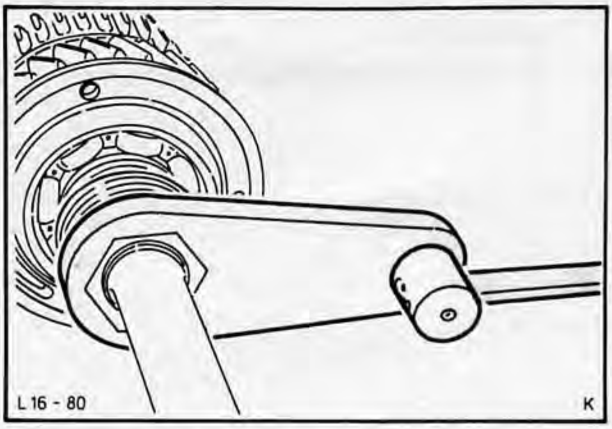


Fig. 76. Remove mainshaft nut with Special Tool No. 16–027

15. Remove spacer sleeve and press off ball bearing complete with bearing retainer, Fig. 77.
16. Remove ball bearing from retainer.

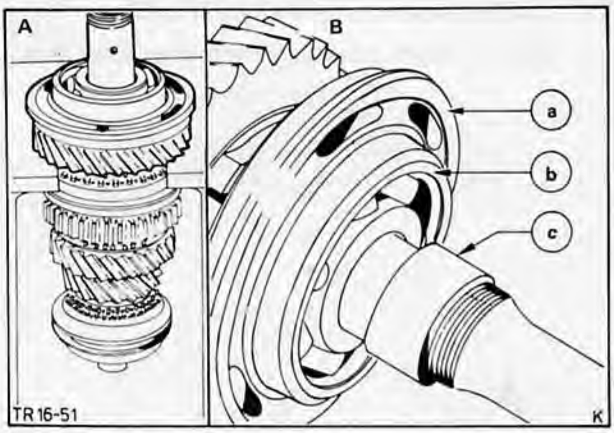


Fig. 77. A – Bearing with retainer and spacer sleeve
B – Remove bearing and retainer
a – Retainer
b – Bearing
c – Spacer

16 118 8 (cont'd) 'G' GEARBOX

17. Remove oil scoop ring and 1st gear, Fig. 78.

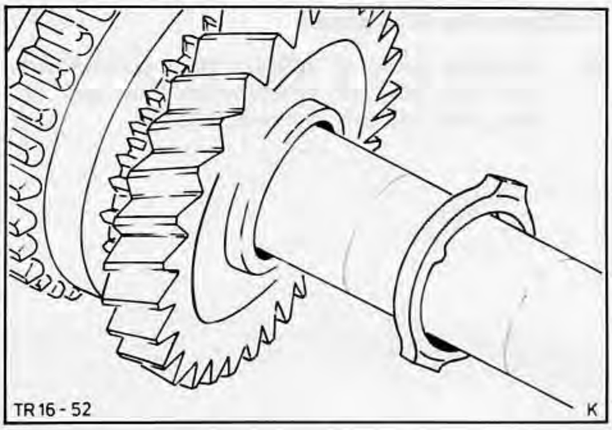


Fig. 78. Remove oil scoop ring and 1st gear

18. Detach circlip of 1st/2nd gear synchroniser hub, Fig. 79.
19. Remove synchroniser hub with 2nd gear.

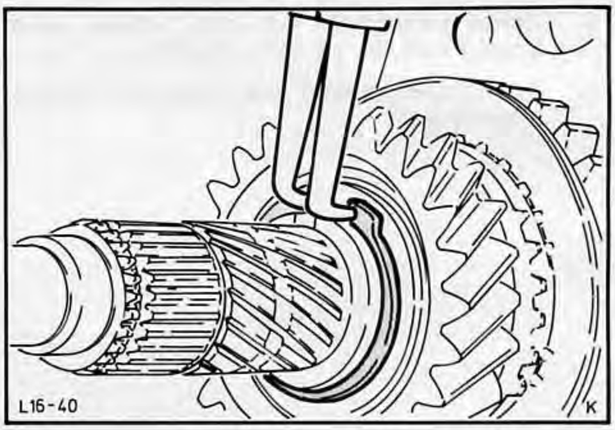


Fig. 79. Remove circlip of 1st/2nd gear synchroniser hub

20. Dismantle synchroniser hubs, Fig. 80.
    NOTE: Check marks on hub and selector ring.

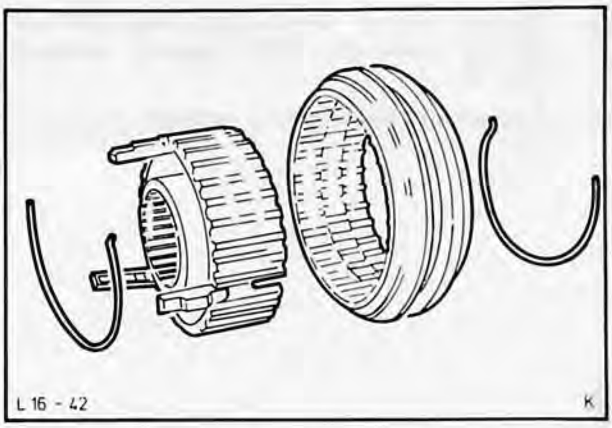


Fig. 80. Synchroniser hub dismantled

To Reassemble Mainshaft

Clean all parts thoroughly, check them and lubricate lightly with specified gearbox oil before installing.

21. Assemble synchroniser hubs.

    NOTE: Peripheral groove on sliding gear and bearing face of hub must line up one above the other.

    Insert blocker bars and fit synchroniser springs staggered with their opposite ends located in the same blocker bar, Fig. 81.

    Marks on selector ring and hub must line up.

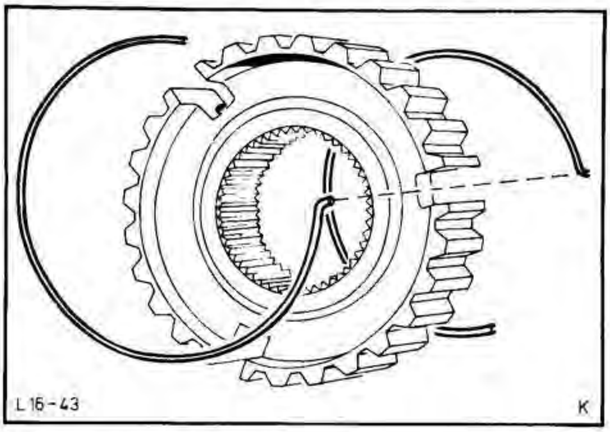


Fig. 81. Fit synchroniser springs

22. Fit 2nd gear with synchroniser ring, Fig. 82, and 1st/2nd gear synchroniser hub and secure with circlip.

    NOTE: Peripheral groove on sliding gear must point towards the rear.

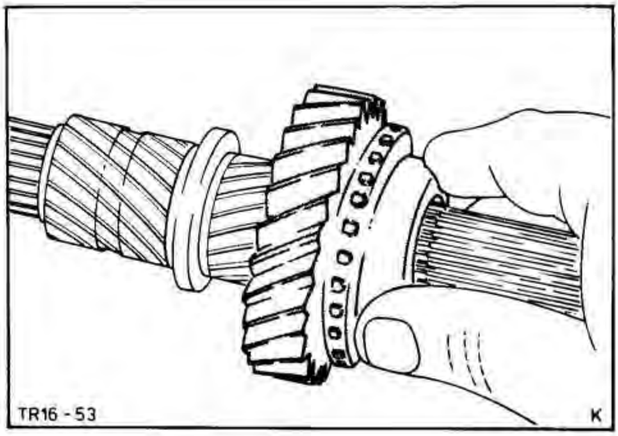


Fig. 82. Fit 2nd gear

23. Fit 1st gear with synchroniser hub, Fig. 83.

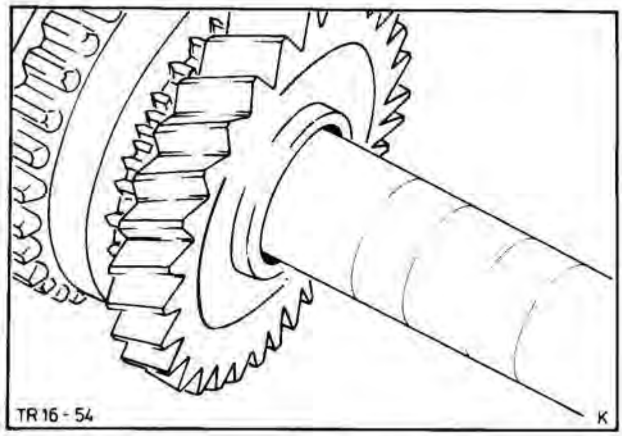


Fig. 83. 1st gear and synchroniser ring fitted

16 118 8 (cont'd)

24. Fit oil scoop ring with oil groove facing the gear, Fig. 84.

    NOTE: Make sure guide groove is located correctly.

25. Insert ball bearing in retainer.

    NOTE: Coat bearing seat in retainer with multi-purpose grease.

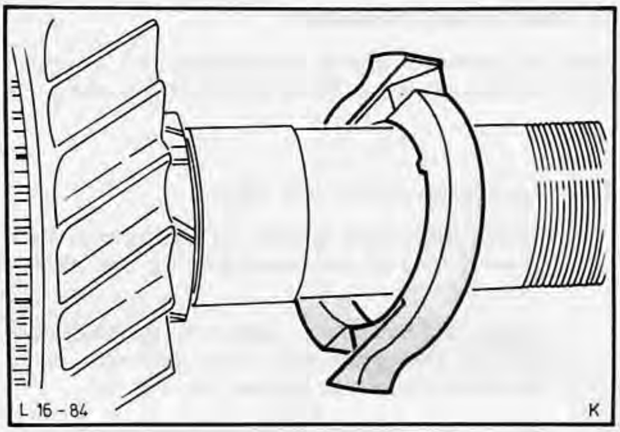


Fig. 84. Oil scoop ring with oil groove facing gear

26. Press bearing and retainer into place using a suitable piece of tubing.

27. Fit spacer sleeve, insert interlock ball and slide on speedometer worm gear, Fig. 85.

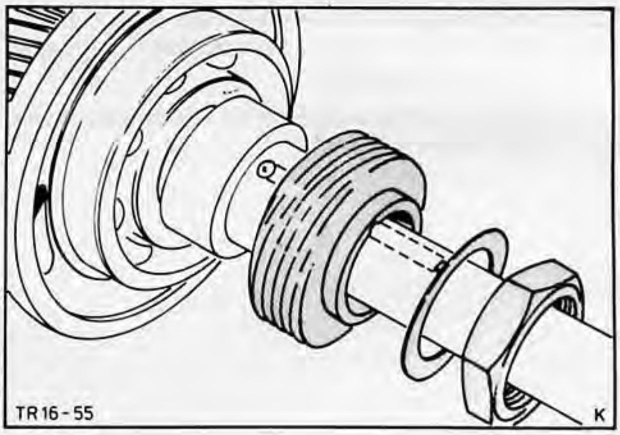


Fig. 85. Fit spacer sleeve with speedometer worm gear

28. Insert lock washer with tabs in recess in speedometer worm .gear. Tighten mainshaft nut to specified torque with Special Tool No. 16–027 and lock, Fig. 86.

    NOTE: Bend tabs of washer for mainshaft nut at 90° to inner teeth.

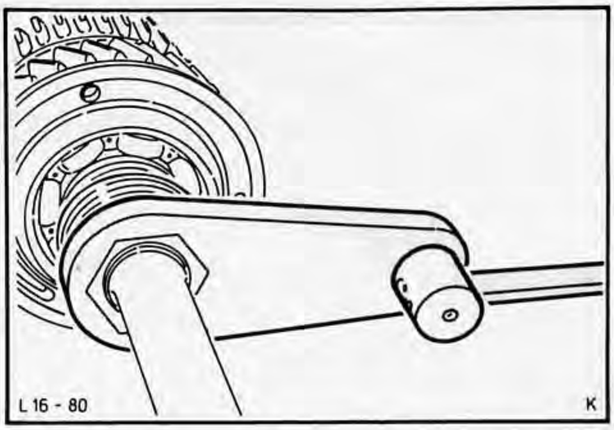


Fig. 86. Torque nut to specified value with Special Tool No. 16–027

29. Fit 3rd gear with synchroniser ring and engage 3rd/4th gear synchroniser hub, then press into place using a suitable piece of tube and fit circlip.

    NOTE: Fit 3rd/4th gear synchroniser hub with the peripheral groove on the sliding gear facing the rear, Fig. 87.

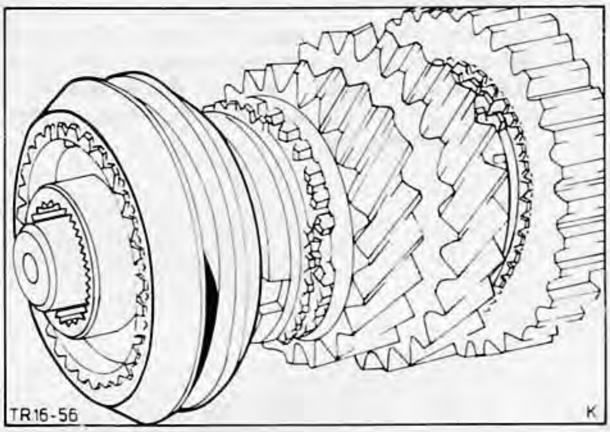


Fig. 87. Synchroniser hub fitted

Overhaul Input Shaft and Countershaft Gear Train

30. Remove circlips from input shaft and ball bearing, Fig. 88. Then press ball bearing off input shaft.

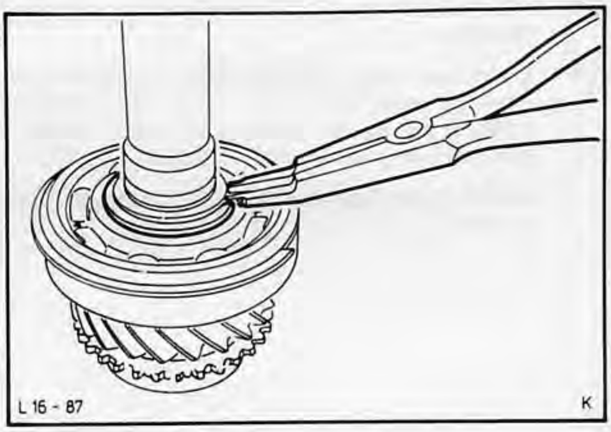


Fig. 88. Remove circlips

31. Press ball bearing onto input shaft, Fig. 89. and fit circlips to bearing and input shaft.

    NOTE: Coat bearing seat with multi-purpose grease before fitting.

32. Remove dummy shaft from countershaft gear train and take out in each case 22 needle rollers with the spacer shims (2 each) at both ends of the countershaft gear train.

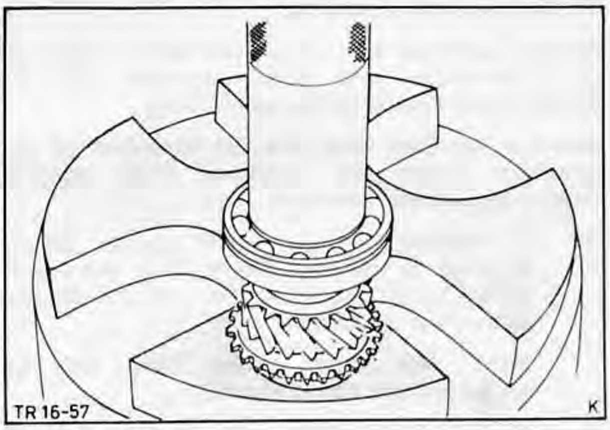


Fig. 89. Fit input shaft bearing

33. Reassemble countershaft gear train: insert dummy shaft, fit spacer shim, 22 needle rollers and then another spacer shim, turn countershaft gear train carefully and fit a further 22 needle rollers with a spacer shim on either side, Fig. 90.

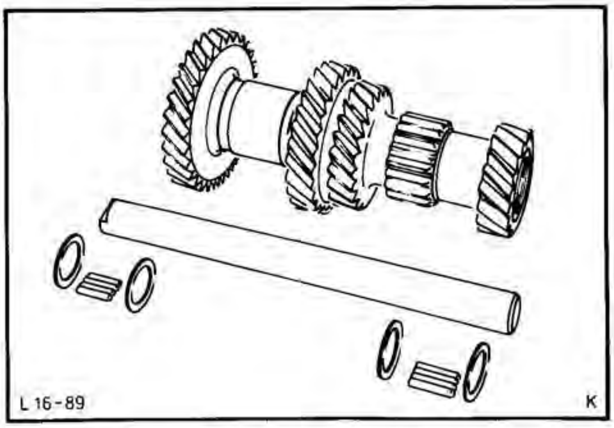


Fig. 90. Countershaft gear train with shaft, spacer shims and needle rollers

34. Remove oil seal from main drive gear bearing retainer.
35. Using a suitable piece of tube, carefully insert new oil seal into main drive gear bearing retainer so that the sealing lip points towards the gearbox casing when installed, Fig. 91.

    NOTE: Coat sealing lip with multi-purpose grease.

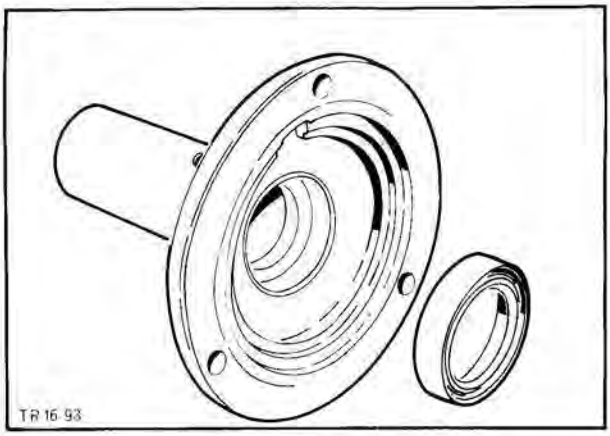


Fig. 91. Main drive gear bearing retainer installed

To Reassemble Gearbox

Remove gearbox filler plug from casing, clean all parts thoroughly and lightly lubricate with the specified gearbox oil before assembling.

Bolts in contact with the oil chamber of the gearbox must be coated with sealing compound when inserted.

36. Fit reverse idler gear with selector groove pointing to the rear. Insert shaft and tap in with a copper hammer until only the flat end of the shaft projects.

    Rear flat end must line up on countershaft bore, Fig. 92.

    NOTE: Coat shaft with grease S-M1C-4505A.

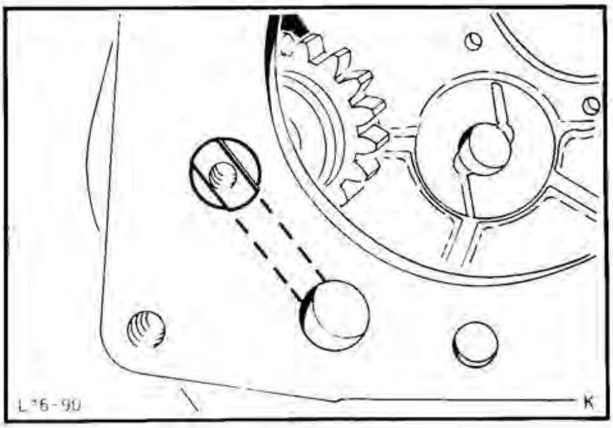


Fig. 92. Position of reverse gear shaft when fitted

37. Stick countershaft gear train thrust washers to recess in the casing with grease, Fig. 93.

Tabs of thrust washers must face the casing when fitted – large thrust washer at the front.

38. Carefully insert countershaft gear train with dummy shaft 16 003 in casing and lower.

NOTE: Thrust washers must not be moved during this operation.

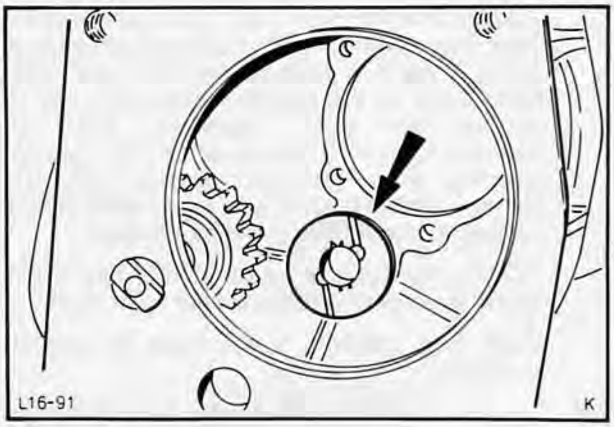


Fig. 93. Stick thrust washers of countershaft gear train in casing

39. Insert input shaft with bearing into gearbox casing until circlip abuts.

40. Fit main drive gear bearing retainer with a new gasket.

NOTE: Oil return port must line up with hole in gasket and bearing retainer, Fig. 94. When installing bearing retainer, bind splining of input shaft (with adhesive tape or similar) to prevent damage to oil seal. Then coat the bolts with sealing compound and insert.

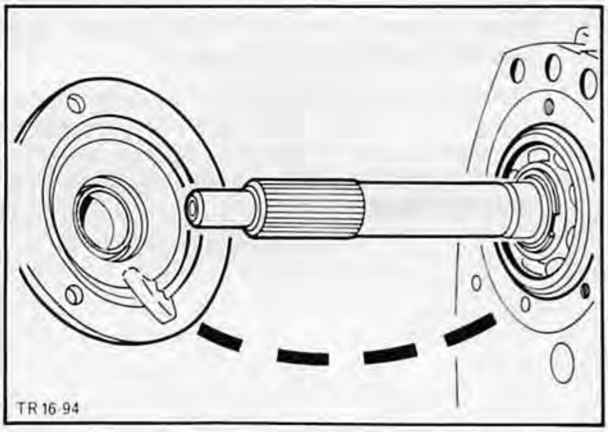


Fig. 94. Line up oil return ports

41. Lubricate needle rollers and insert around input shaft. Slide synchroniser ring over the cone on the input shaft.

42. Insert complete mainshaft in gearbox casing, Fig. 95.

NOTE: Extension housing gasket must be fitted on gearbox casing before mainshaft is installed.

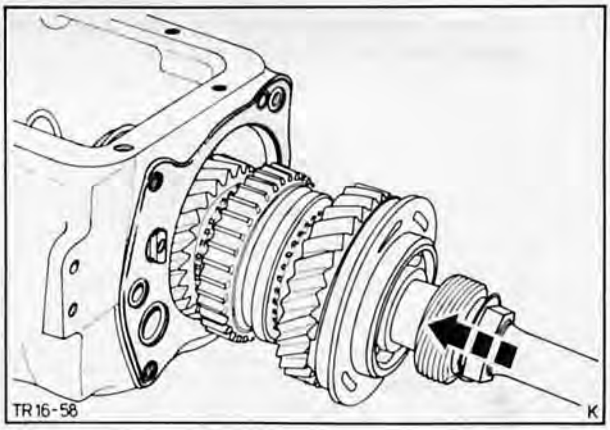


Fig. 95. Fit mainshaft

43. Turn gearbox through 180° until countershaft gear train meshes with mainshaft and input shaft. Then line up countershaft gear train with bores in the casing, taking care not to disturb the thrust washers. Push in countershaft from the rear of the casing, keeping it in constant contact with the dummy shaft 16–003, and tap in flush with a copper hammer. Remove dummy shaft.

    NOTE: The flat end of the shaft must point along the recess for the reverse gear shaft.

    Then turn gearbox casing back to original position.

44. Line up bearing retainer hole with the guide pin in the extension housing, Fig. 96.

45. Fit extension housing (4 bolts).

    NOTE: Coat bolts with sealing compound, insert and torque as specified.

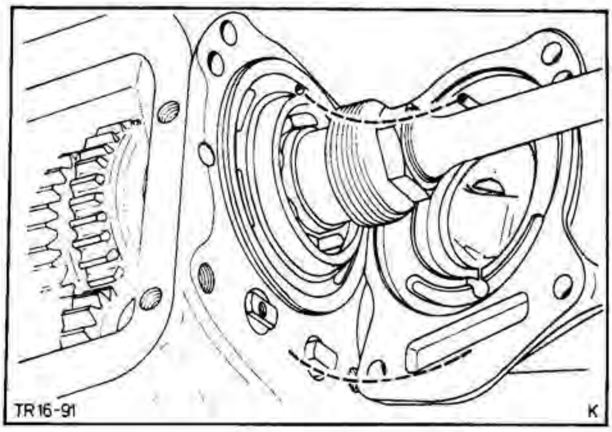


Fig. 96. Line up bearing retainer hole with guide pin

46. Press in new extension housing bush with Special Tool No. 16–016, Fig. 97.

    The bush must be installed so that the oil return groove sits in the extension housing at the bottom and to the rear, thereby ensuring that the gap (notch) in the bush is not located over the oilway.

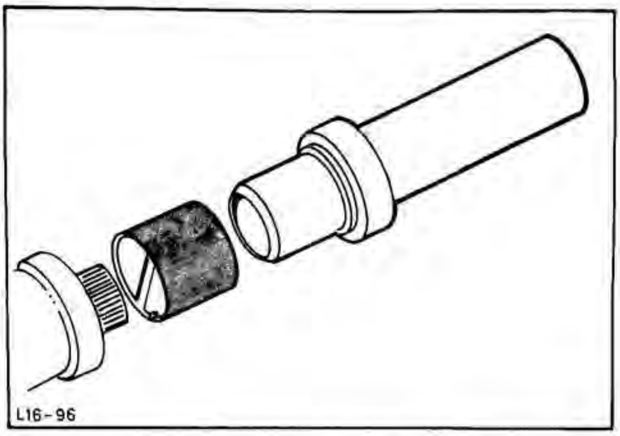


Fig. 97. Fit extension housing bush with Special Tool No. 16–016

47. Fit new extension housing oil seal with Special Tool No. 16–016, Fig. 98.

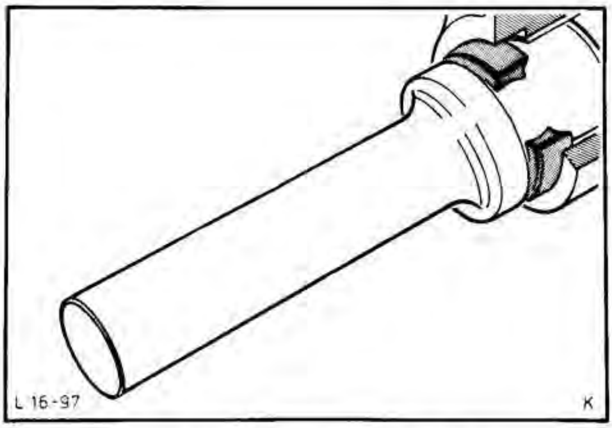


Fig. 98. Fit oil seal with Special Tool No. 16–016

48. Fit speedometer drive gear with a new O-ring, Fig. 99.

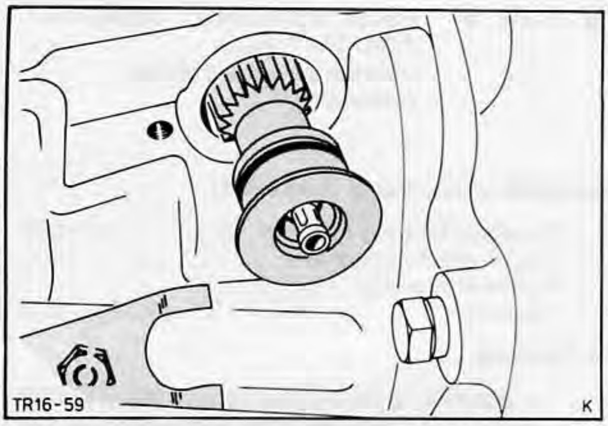


Fig. 99. Fit speedometer drive gear

49. Fit selector housing with selector forks and secure, Fig. 100.

NOTE: Use new gasket for selector housing.

50. Detach gearbox from stand and remove Special Tool No. 16–009.

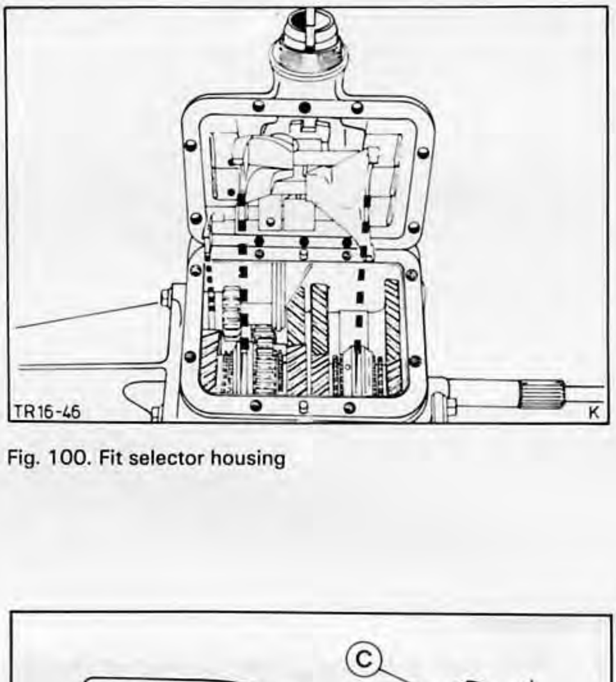


Fig. 100. Fit selector housing

51. Install clutch thrust bearing and release lever in clutch housing, Fig. 101.

52. Attach clutch housing to gearbox casing.

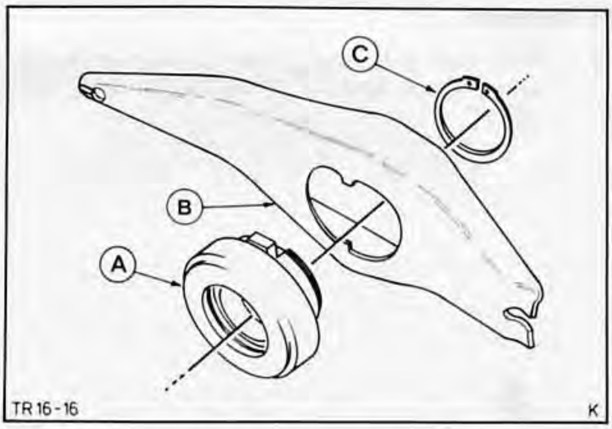


Fig. 101. Fit release lever with thrust bearing
A – Thrust bearing
B – Release lever
C – Circlip

16 134 5 PILOT BEARING – REMOVE AND INSTALL (Clutch pressure plate removed)

Special Service Tools Required:

Flywheel bearing remover	21–036
Clutch plate locator and flywheel bearing replacer	21–080/21–004

To Remove

1. Locate side arms of Special Tool No. 21–036 behind the pilot bearing and withdraw the bearing by tightening the nut, Fig. 102.

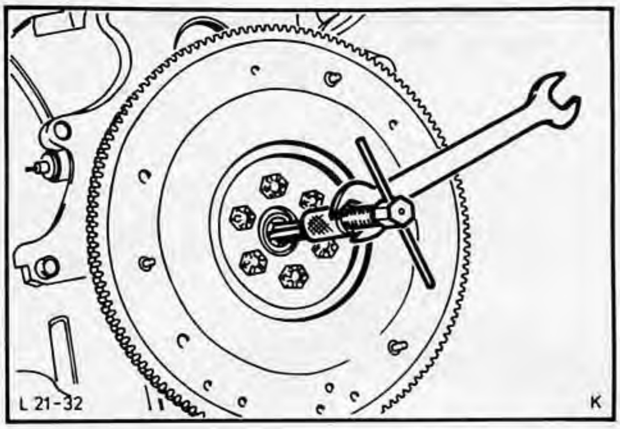


Fig. 102. Remove pilot bearing with Special Tool No. 21–036

To Replace

2. Press new pilot bearing into crankshaft flange with Special Tool No. 21–044/21–080, Fig. 103.

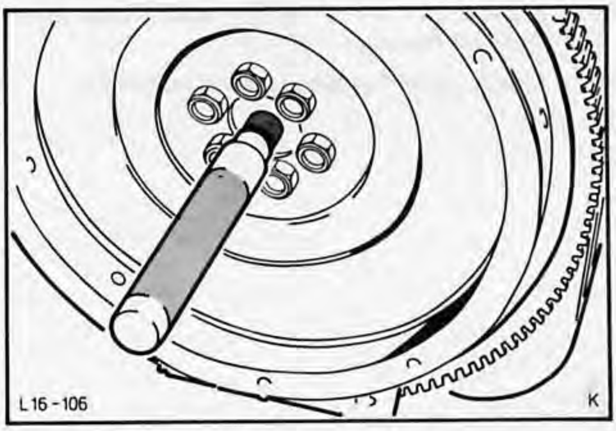


Fig. 103. Fit pilot bearing with Special Tool No. 21–044/21–080

16 164 BUSH – EXTENSION HOUSING – REPLACE

Special Service Tools Required:

Extension housing bush remover	16–011/16–025
Extension housing bush and oil seal installer	16–015/16–016
Extension housing oil seal remover	17–001

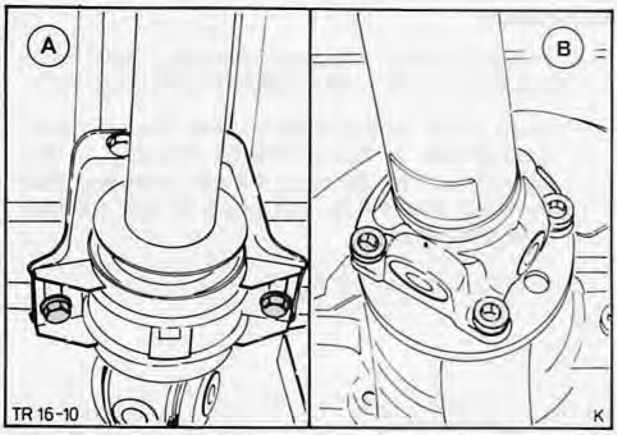


Fig. 104. Driveshaft mountings – rear axle flange and centre bearing
A – Centre bearing
B – Rear axle flange

To Remove

1. Drive vehicle over a pit or onto a ramp and detach driveshaft from rear axle flange (4 bolts), Fig. 104.
2. Disconnect driveshaft centre bearing (2 bolts), Fig. 104. Draw shaft complete from extension housing, placing oil tray underneath.

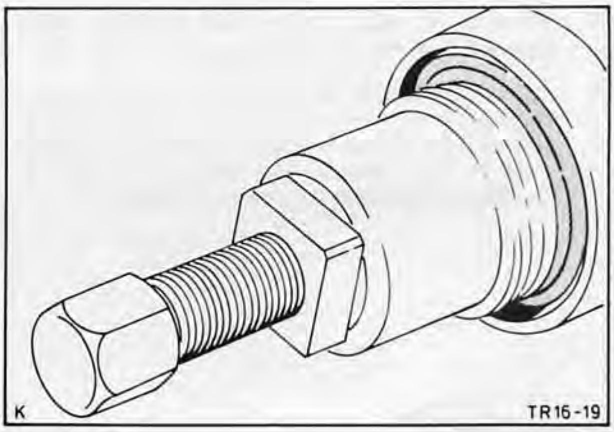


Fig. 105. Remove extension housing oil seal with Special Tool No. 17–001

3. With the centre spindle wound out, screw tool 17–001 into oil seal until firmly held, Fig. 105. Extract seal by screwing spindle in, holding tool firmly with an open-ended spanner.
4. Remove extension housing bush with Special Tool No. 16–011/16–025, Fig. 106.

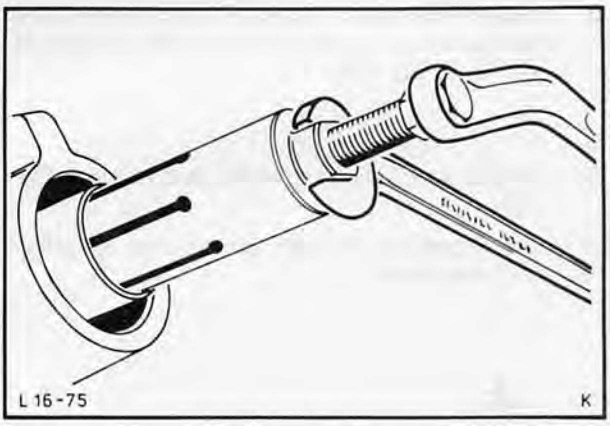


Fig. 106. Extract extension housing bush with Special Tool No. 16–011/16–025

To Replace

5. Press in new extension housing bush with Special Tool No. 16–015/16–016, Fig. 107.

   Bush must be installed so that the oil return groove sits in the extension housing at the bottom and to the rear, thereby ensuring that the gap (notch) in the bush is not located over the oilway.

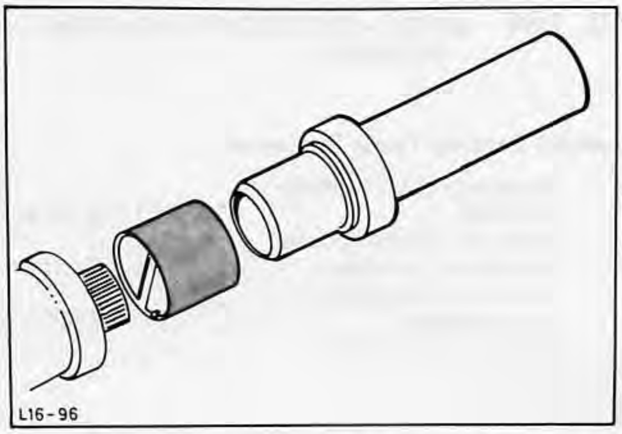


Fig. 107. Fit extension housing bush with Special Tool No. 16–015/16–016

6. Fit new oil seal in extension housing using Special Tool No. 16–015/16–016, Fig. 108.
7. Insert driveshaft in extension housing and engage with splining on gearbox mainshaft, taking care not to damage extension housing oil seal. Then attach driveshaft centre bearing to floor pan so that it is free of strain.

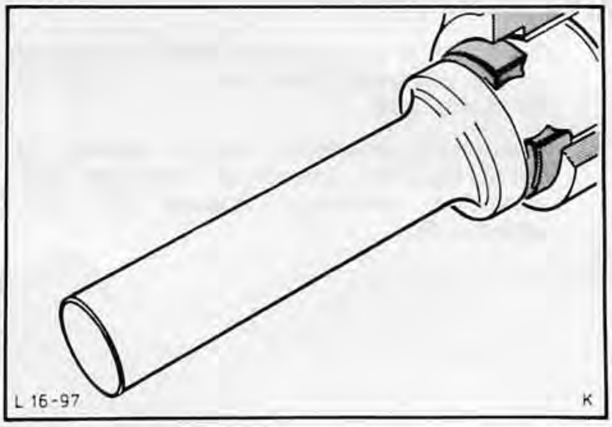


Fig. 108. Fit oil seal with Special Tool No. 16–015/16–016

8. Attach driveshaft to rear axle flange with bolts and new spring washers and torque as specified, Fig. 109.
9. Torque centre bearing bolts as specified, Fig. 109.
10. Check gearbox oil level, top up with specified oil if necessary.

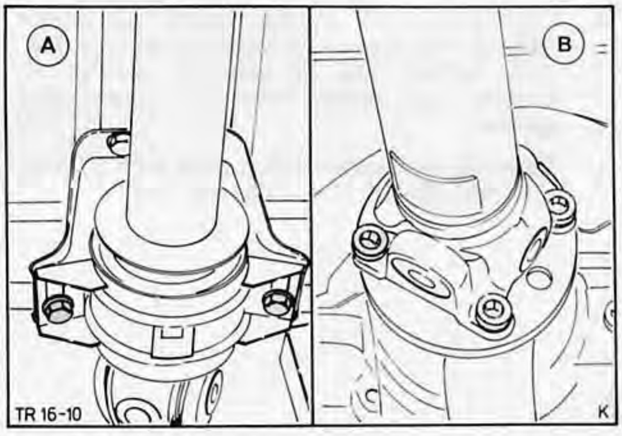


Fig. 109. Driveshaft mountings – rear axle flange and centre bearing
A – Centre bearing
B – Rear axle flange

16 172 GEAR – SPEEDOMETER DRIVEN – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drive vehicle over pit or onto a ramp.

2. Remove bolt (1) with speedometer cable bracket and detach cable (G gearbox), Fig. 110. Slacken knurled nut of speedometer drive unit, detach cable and unscrew complete drive unit from extension housing (F gearbox), Fig. 111.

   NOTE: Catch oil.

3. Pull out speedometer drive unit (bearing and drive gear) (G gearbox).

4. Detach bearing from drive gear and check for signs of wear or scoring.

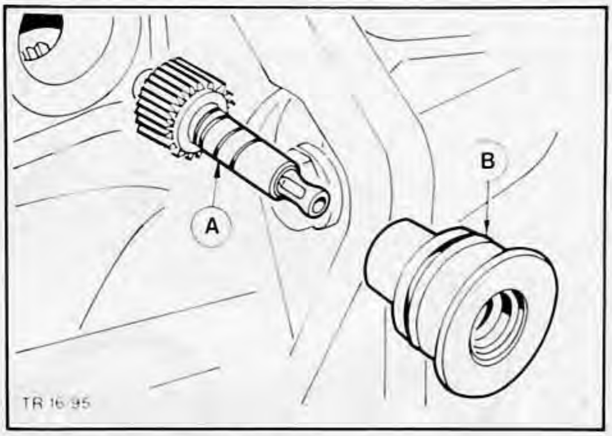


Fig. 110. Speedometer drive unit removed (G gearbox)
A – Drive pinion
B – Drive pinion bearing

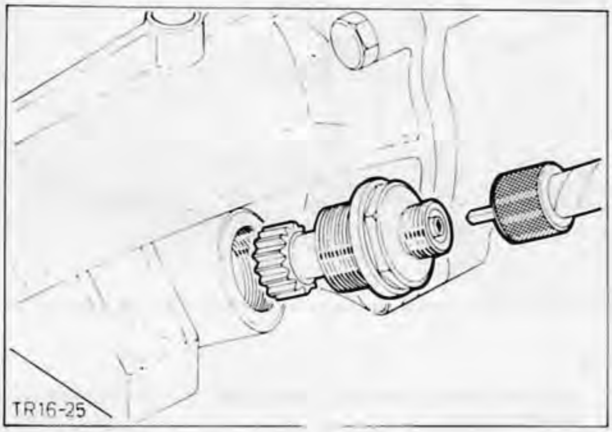


Fig. 111. Speedometer drive unit removed (F gearbox)

To Install

5. Lubricate and slide drive gear into bearing. Check that it turns freely.

6. Replace bearing and drive gear or complete speedometer drive unit in extension housing. Then attach bolt and bracket (G gearbox). Screw in complete speedometer drive unit, coating thread with sealing compound (F gearbox).

   NOTE: In G gearbox replace O-ring if necessary.

7. Connect speedometer cable.

8. Check oil level in gearbox and top up with specified oil if necessary, Fig. 112.

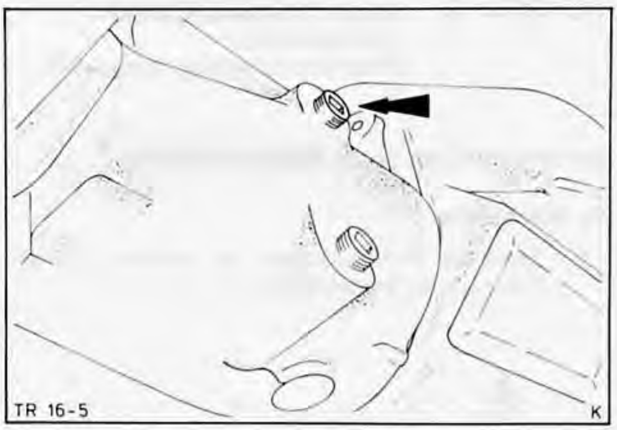


Fig. 112. Check oil level

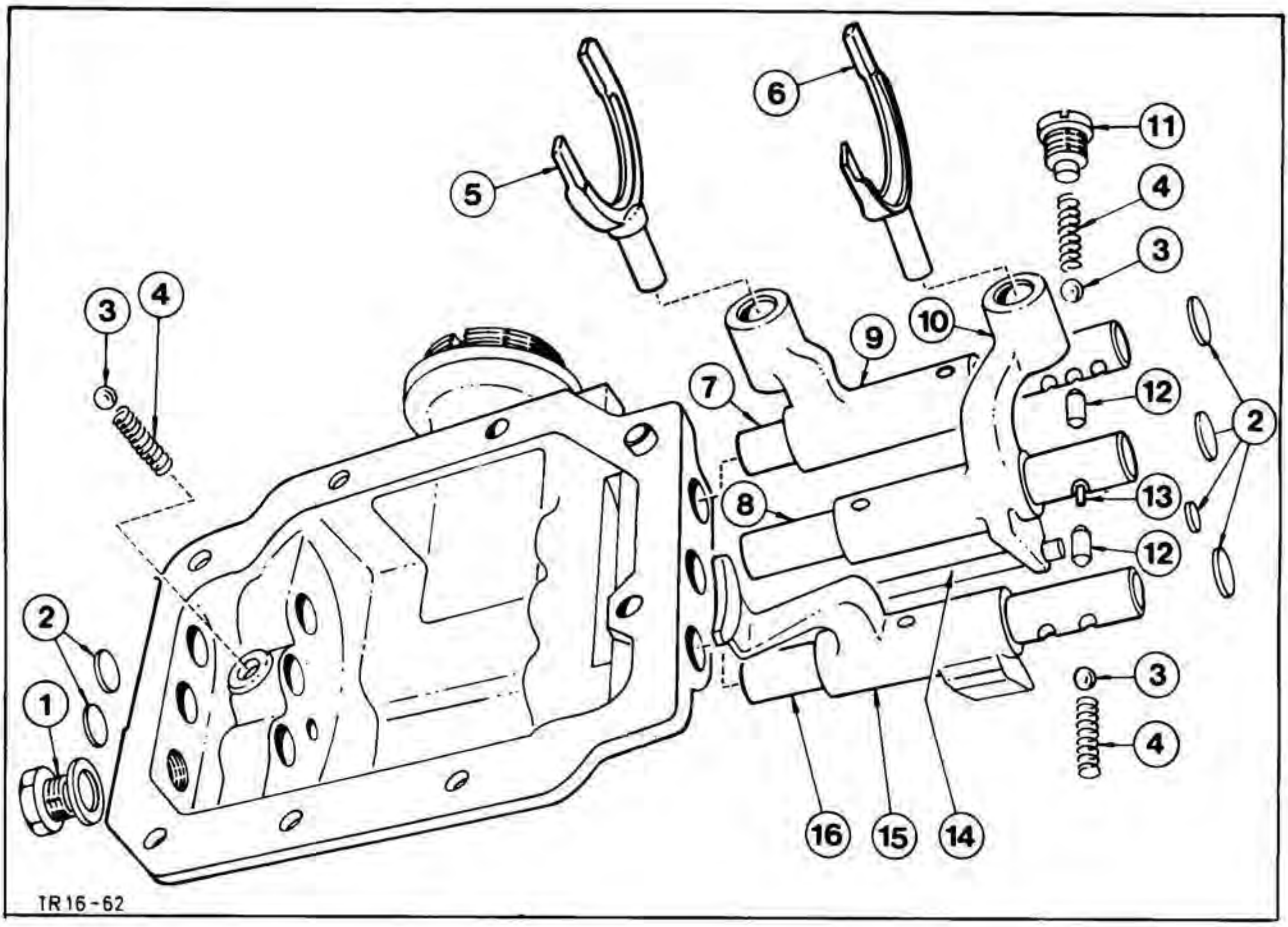


Fig. 113

1. Plug with seal or reversing lamp switch
2. Blanking disks
3. Interlock ball
4. Spring
5. 1st/2nd gear selector fork
6. 3rd/4th gear selector fork
7. 1st/2nd gear selector rail
8. 3rd/4th gear selector rail
9. 1st/2nd gear fork carrier
10. 3rd/4th gear fork carrier
11. Selector detent plug
12. Interlock plunger
13. Interlock pin
14. Fork guide rod
15. Reverse gear selector fork
16. Reverse gear selector rail

16 264 8 SELECTOR HOUSING – OVERHAUL (Selector housing removed)

Special Service Tools Required: None

To Dismantle

1. Remove threaded plug of selector detent. Take out spring and ball, Fig. 114.

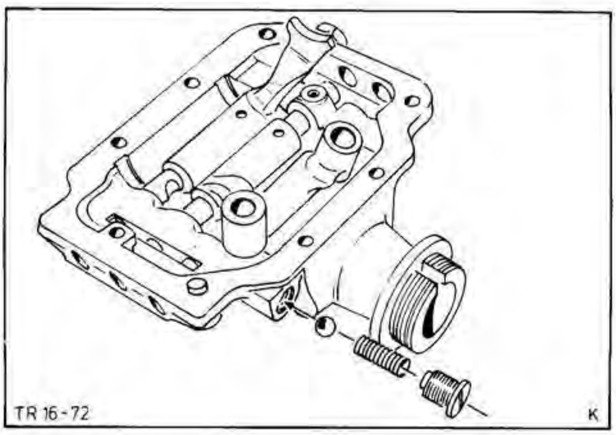


Fig. 114. Selector detent mechanism exploded

2. Detach blanking disks and threaded plug or reversing lamp switch from selector housing, Fig. 115.

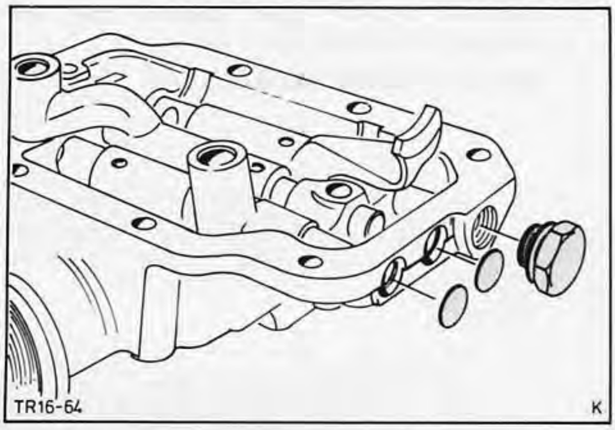


Fig. 115. Detach blanking disks and plug from selector housing

3. Drive all locking pins from selector rails, Fig. 116.

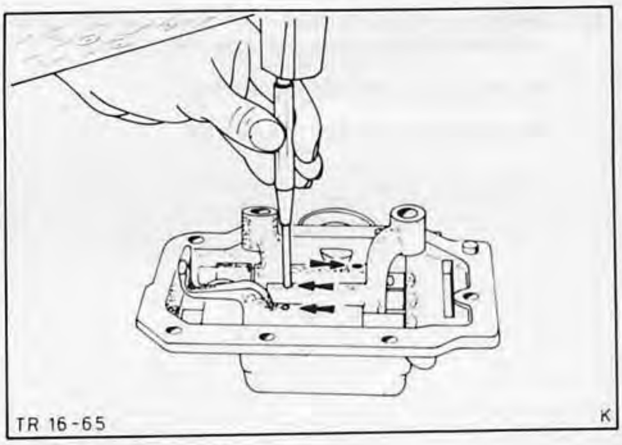


Fig. 116. Remove locking pins

4. Remove 1st/2nd gear selector rail and selector fork carrier, Fig. 117.

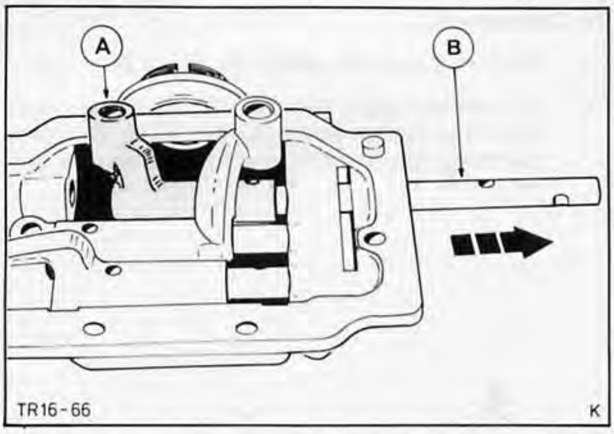


Fig. 117. Remove 1st/2nd gear selector rail
A – Selector fork carrier
B – Selector rail

16 264 8 (cont'd)

5. Remove 3rd/4th gear selector rail and selector fork carrier, Fig. 118.

   Watch out for ball and spring.

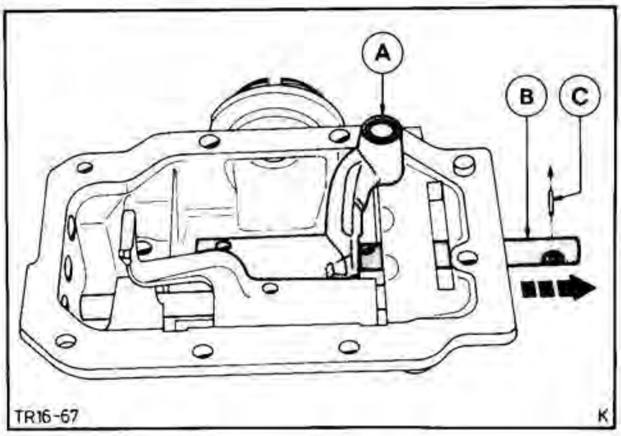


Fig. 118. Remove 3rd/4th gear selector rail
A – Selector fork carrier
B – Selector rail
C – Interlock pin

6. Remove plungers and take out reverse gear selector rail and selector fork, Fig. 119.

   Remove ball and detent spring.

7. Remove selector fork guide rod.

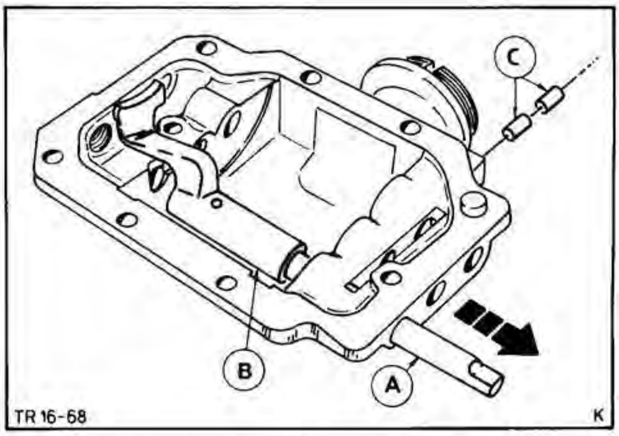


Fig. 119. Remove reverse gear selector rail and selector fork
A – Selector rail
B – Selector fork carrier
C – Interlock plungers

To Reassemble

8. Refit selector fork guide rod, Fig. 120.

9. Fit reverse gear selector rail and fork, first inserting spring and ball, Fig. 120, and then pressing down until selector rail can be slid in.

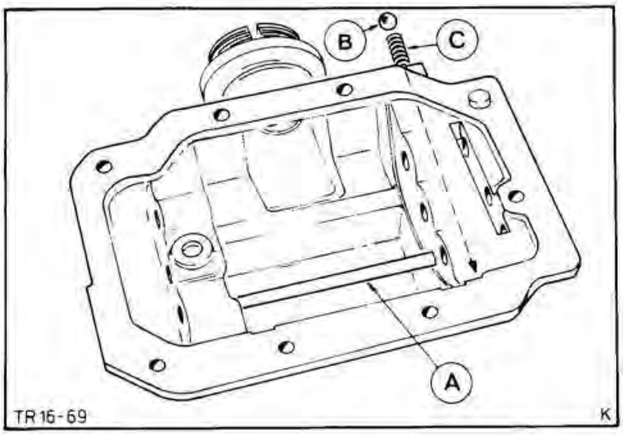


Fig. 120. Selector fork guide rod fitted
A – Guide rod
B – Interlock ball
C – Spring

10. Fit 3rd/4th gear selector rail and fork carrier in the manner described in sub-operation 9. In addition the interlock pin also has to be inserted in the hole in 3rd/4th gear selector rail together with the interlock plunger for reverse and 3rd/4th gear selector rails, Fig. 121.

11. Fit 1st/2nd gear selector rail and fork carrier, insert interlock plunger between 3rd/4th gear and 1st/2nd gear selector rails then press in selector rail.

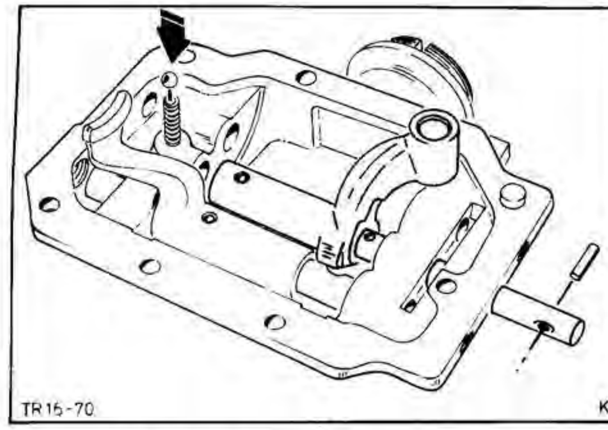


Fig. 121. Fit 3rd/4th gear selector rail and fork carrier

12. Secure all the selector rails and fork carriers with locking pins, Fig. 122.

13. Fit blanking disks and threaded plug or reversing lamp switch in selector housing.

    NOTE: Apply sealing compound when fitting blanking disks.

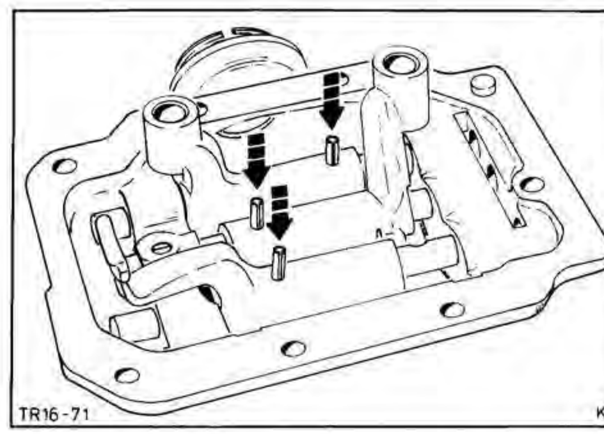


Fig. 122. Secure selector rails and fork carriers with locking pins

14. Insert spring and ball of 1st/2nd gear selector rail and screw in selector detent plug.

    Always bring all selector rails to neutral position after installing, Fig. 123.

    NOTE: Sealing compound must be applied when screwing in plug.

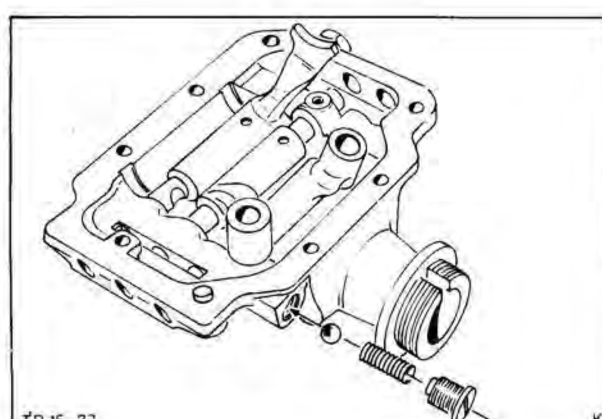


Fig. 123. Insert spring and ball of 1st/2nd gear selector rail

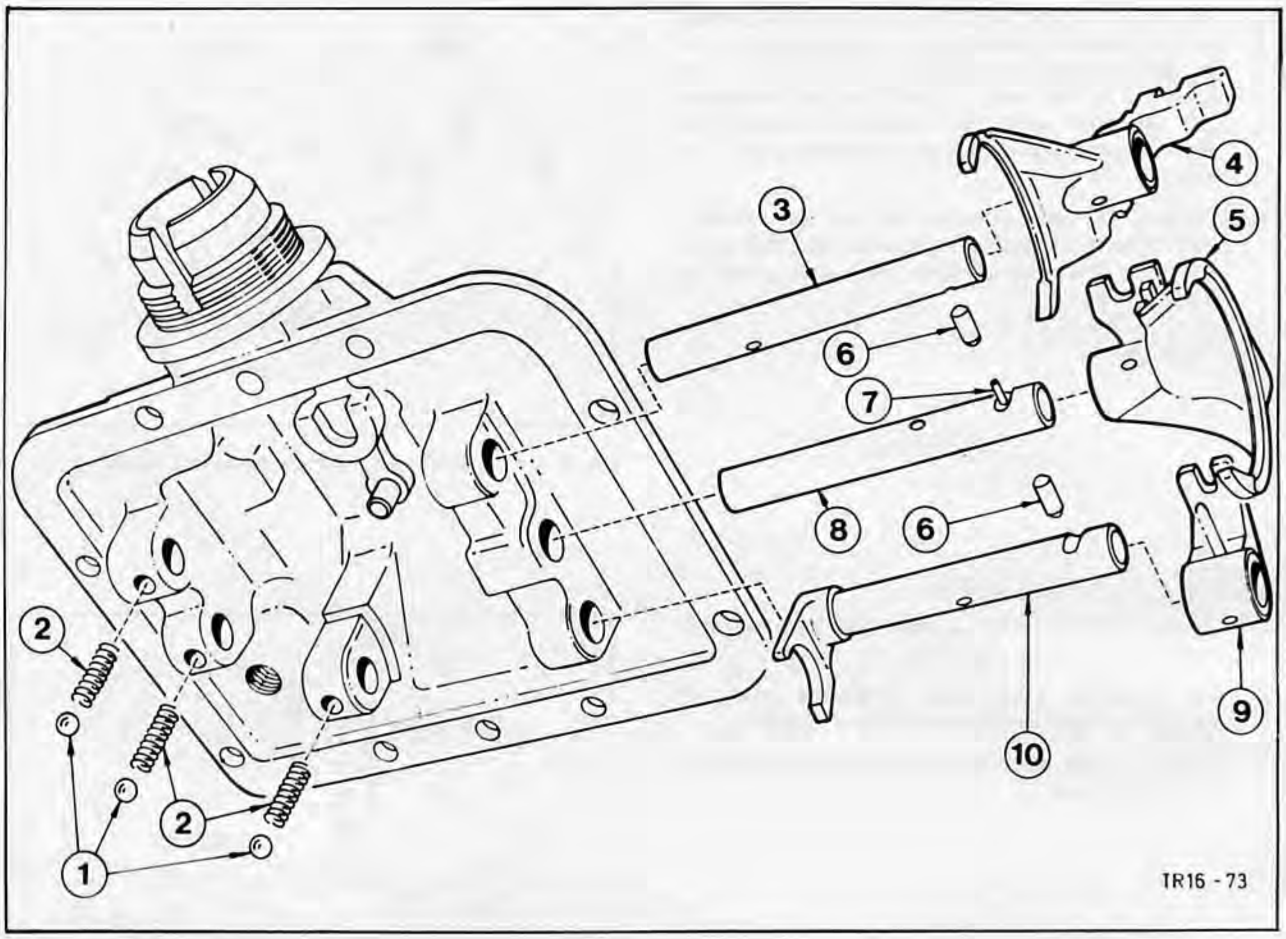


Fig. 124.

1. Interlock ball
2. Spring
3. 1st/2nd gear selector rail
4. 1st/2nd gear selector fork
5. 3rd/4th gear selector fork
6. Interlock plunger
7. Interlock pin
8. 3rd/4th gear selector rail
9. Reverse gear selector dog
10. Reverse gear selector rail with fork

16 264 8 SELECTOR HOUSING – OVERHAUL (Selector housing removed)

Special Service Tools Required: None

To Dismantle

1. Remove locking pin from 1st/2nd gear selector fork and rail. Then drive rail out from one side and detach selector fork. Watch out for ball and spring, Fig. 125.
2. Remove 3rd/4th gear selector fork and rail (as described in sub-operation 1). Here again watch out for ball, spring and interlock pin.

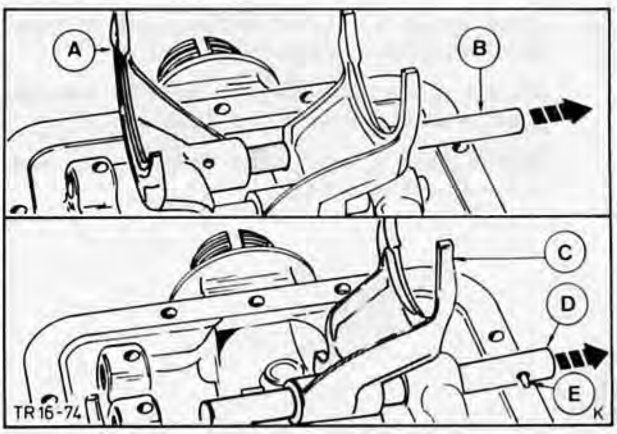


Fig. 125 A – 1st/2nd gear selector fork
B – 1st/2nd gear selector rail
C – 3rd/4th gear selector fork
D – 3rd/4th gear selector rail
E – Interlock pin

3. Remove reverse gear selector rail and fork, Fig. 126. (See sub-operation 1 for procedure).

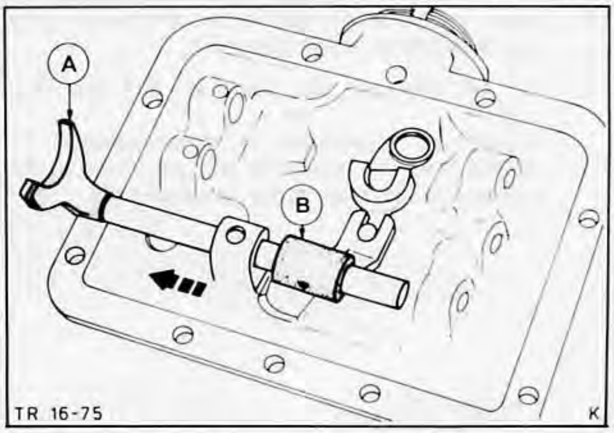


Fig. 126. A – Remove reverse gear selector fork and rail
B – Reverse gear selector dog on rail

4. Take out selector rail interlock plungers by turning selector housing on its side, Fig. 127.

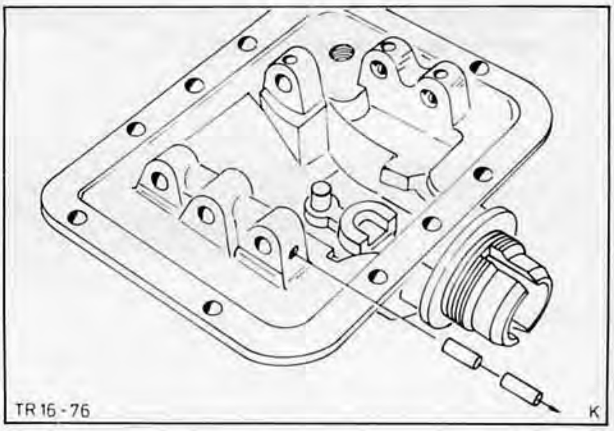


Fig. 127. Remove selector rail plungers (turn selector housing on its side)

To Reassemble

5. Fit reverse gear selector fork and rail. To do this, insert spring and ball and press down until selector rail can be pushed in, Fig. 128.

   NOTE: Insert selector fork so that the holes for the locking pin line up. Tap in locking pin.

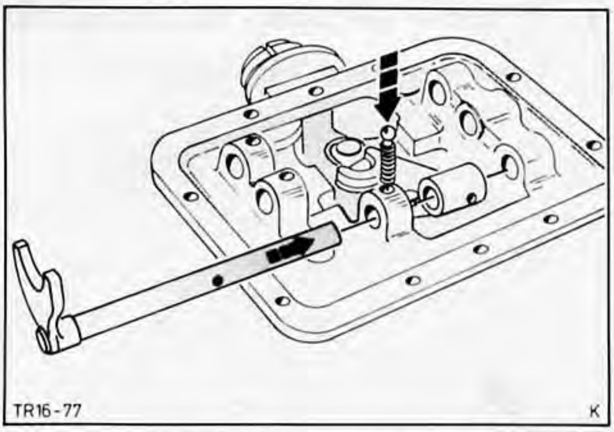


Fig. 128. Fit reverse gear selector fork and rail (fit ball and spring at same time)

16 264 8 (cont'd)

6. Insert interlock plunger between reverse gear and 3rd/4th gear selector rails.
7. Fit 3rd/4th gear selector fork and rail, Fig. 129.
   (Install as described in sub-operation 5, noting that the interlock pin also has to be inserted in the hole in the selector rail.)

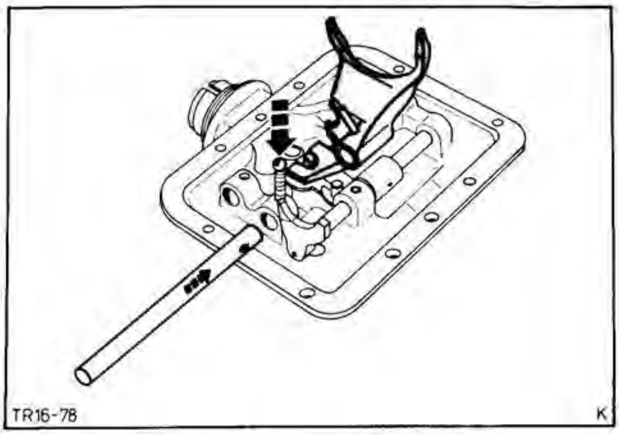


Fig. 129. Fit 3rd/4th gear selector fork and rail

8. Insert interlock plunger between 3rd/4th gear and 1st/2nd gear selector rails, Fig. 130.

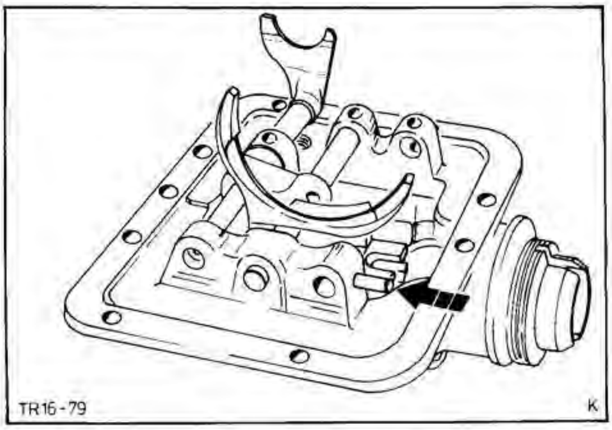


Fig. 130. Insert interlock plunger between 3rd/4th gear and 1st/2nd gear selector rails

9. Fit 1st/2nd gear selector fork and rail, Fig. 131.
   (Install as described in sub-operation 5.)

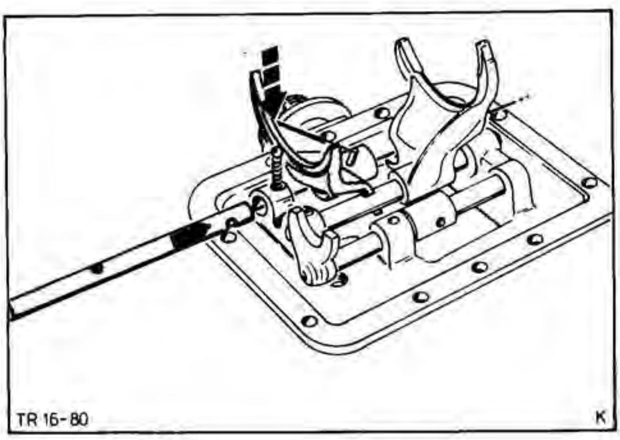


Fig. 131. Fit 1st/2nd gear selector fork and rail

16 724 4 CLUTCH DISC AND PRESSURE PLATE – REMOVE AND INSTALL
(Engine or gearbox removed)

Special Service Tools Required:

Clutch plate installer and aligner	21–080/21–044

To Remove

1. Release clutch pressure plate from flywheel, slackening the 6 bolts evenly, and remove, Fig. 132. Detach pressure plate and clutch disc.

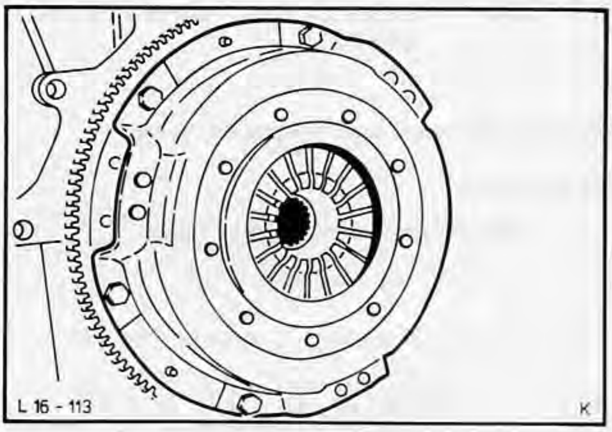


Fig. 132. Remove clutch pressure plate

To Install

2. Locate pressure plate and clutch disc on flywheel with Special Tool 21–044/21–080, ensuring that flat side of clutch disc faces the flywheel, Fig. 133.
3. Secure pressure plate, tightening bolts evenly corner to corner to specified torque.
4. Remove centering tool 21–044/21–080.

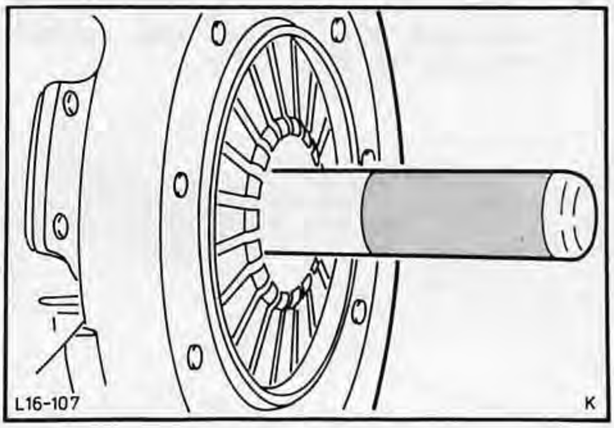


Fig. 133. Fit pressure plate and clutch disc using centering tool 21–044/21–080

16 756 4 LININGS – CLUTCH DISC – REPLACE
(Clutch disc removed)

Special Service Tools Required: None

To Remove

1. Detach clutch disc lining. **Drill out rivet heads carefully so as not to damage clutch disc, Fig. 134.**

To Replace

2. Rivet on clutch disc linings. **Rivet linings one at a time corner to corner. Only use hollow flat-head rivets.**

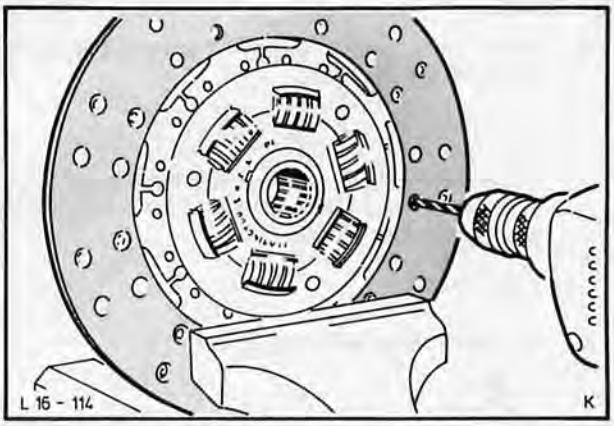


Fig. 134. Drill out rivets of clutch disc linings

16 524 GEAR LEVER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Unscrew gear lever knob by hand.

2. Remove cover plate (6 screws), Fig. 135.

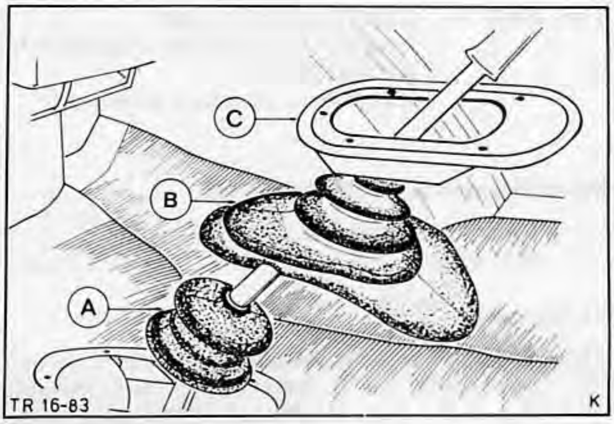


Fig. 135. A – Bottom rubber gaiter
B – Top rubber gaiter
C – Cover plate

3. Remove rubber gaiter and plastic cap from underneath, take out gear lever assembly complete, Fig. 136.

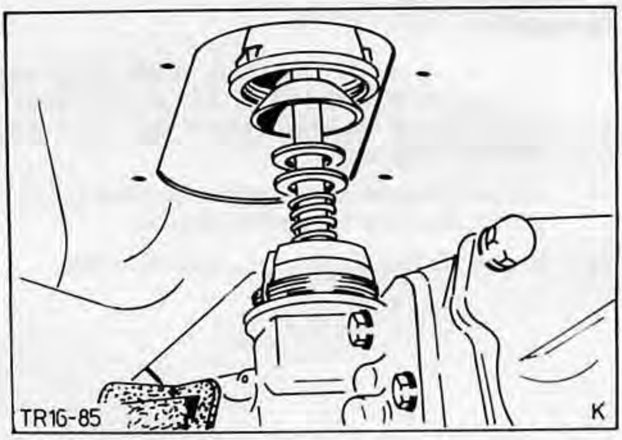


Fig. 136. Take out complete gear lever assembly

To Install

4. Insert gear lever and attach plastic cap from underneath, Fig. 137.

5. Slide new rubber gaiters onto gear lever with the aid of glycerine. Then fold bottom rubber gaiter over the plastic cap.

6. Fit cover plate with top gaiter.

7. Screw on gear lever knob.

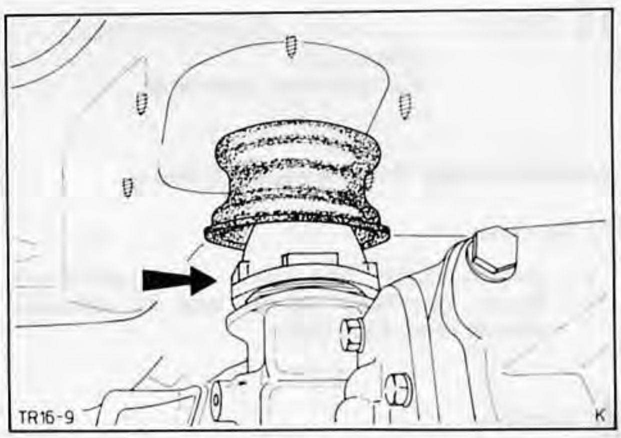


Fig. 137. Fit gear lever assembly

16 812 CLUTCH PEDAL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Slacken clutch operating cable, unhook return spring and detach retaining clip from pedal shaft, Fig. 138.

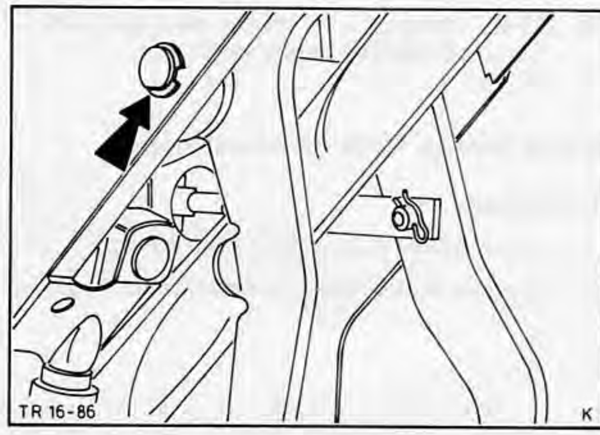


Fig. 138. Clutch pedal shaft retaining clip

2. Slide pedal shaft along until clutch pedal can be pulled out of pedal bracket. Press retaining pin in clutch pedal out of the plastic yoke and remove. Disconnect clutch cable, Fig. 139.

   Detach clutch pedal with bushes.

3. Replace clutch pedal bushes.

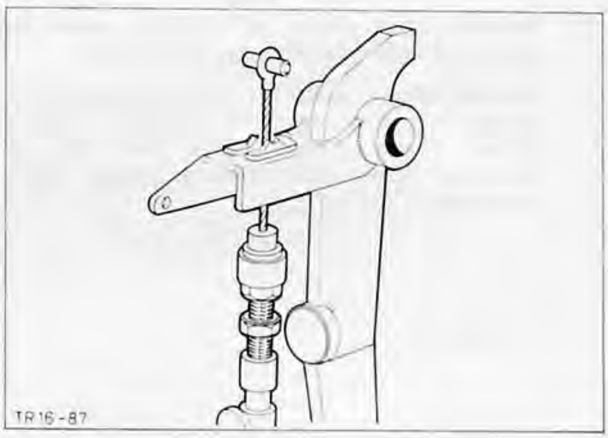


Fig. 139. Disconnect clutch cable

To Install

4. Slide clutch pedal, fitted with new bushes, into pedal bracket, Fig. 140, and connect the clutch cable. Attach return spring. Then hold pedal in line with opening and slide pedal shaft back as far as stop.

   NOTE: Coat pedal shaft and bushes with molybdenum disulphide grease.

5. Attach pedal shaft retaining clip.
6. Check clutch pedal play and adjust as specified.

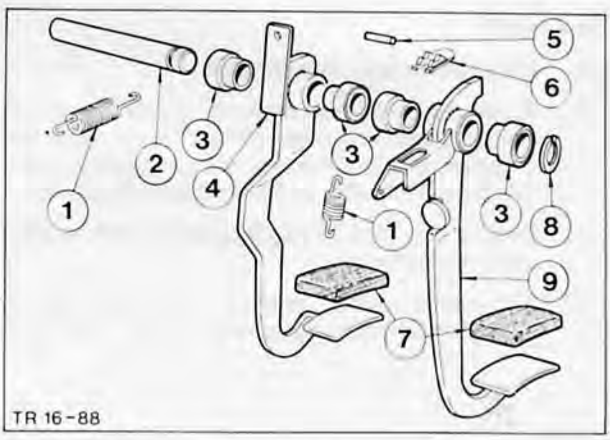


Fig. 140. Clutch mechanism exploded

1. Return spring	4. Brake pedal	7. Pedal rubber
2. Shaft	5. Retaining pin	8. Circlip
3. Bush	6. Yoke	9. Clutch pedal

16 814 CABLE – CLUTCH OPERATING – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drive vehicle over a pit or onto a ramp.
2. Slacken clutch cable at pedal mounting, Fig. 141.

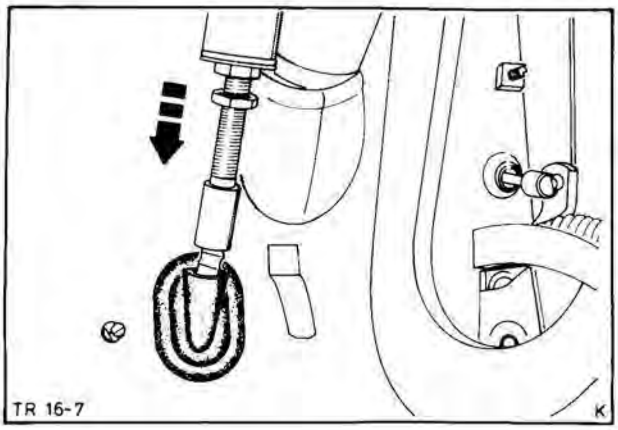


Fig. 141. Slacken clutch cable at pedal

3. Detach clutch cable from clutch pedal by removing retaining pin from cable yoke.
4. Pull out rubber gaiter on clutch release lever, disconnect cable from lever, Fig. 142. Detach gaiter. Press rubber cable seal out of bulkhead panel and remove clutch cable complete.

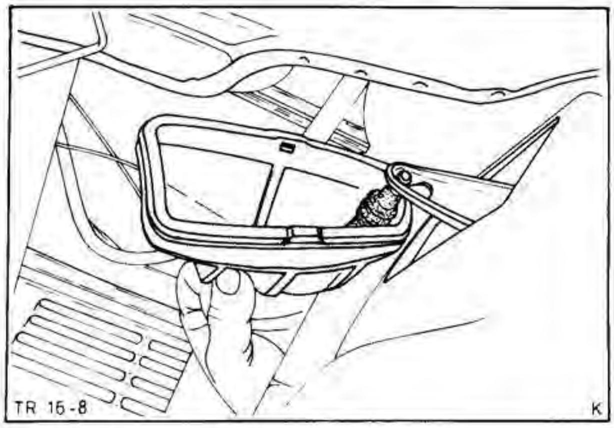


Fig. 142. Disconnect clutch cable from release lever

To Install

5. Insert complete clutch cable.
6. Pass clutch cable through guide in clutch housing and fit rubber gaiter. Draw cable out of cover and connect to clutch release lever. Then insert rubber gaiter in clutch housing.
7. Secure top end of clutch cable in cable yoke with retaining pin.
8. Fit rubber cable seal in bulkhead panel. Adjust clutch play as specified, Fig. 143.

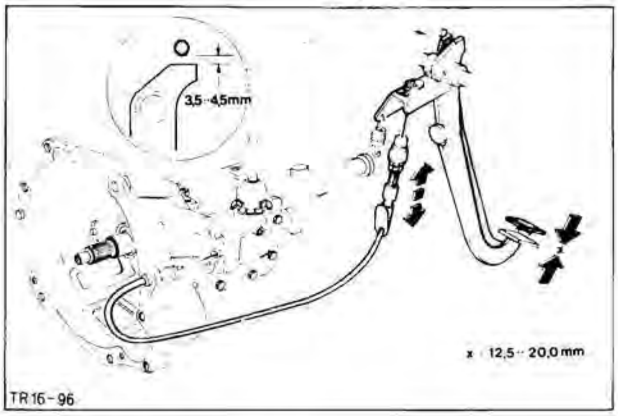


Fig. 143. Clutch play adjustment

TECHNICAL DATA

Gearbox

	'F' gearbox Standard	'F' gearbox Uprated		'G' gearbox
Axial play – countershaft gear train	0,15 to 0,46			0,18 to 0,53
Countershaft diameter	17,38 to 17,3673	19,301 to 19,314		19,329 to 19,342
Ratios – 1st gear	3,96:1	3,98:1	3,65:1	4,41:1
2nd gear	2,28:1	2,327:1	1,97:1	2,35:1
3rd gear	1,41:1	1,42:1	1,37:1	1,51:1
4th gear	1,00:1	1,00:1	1,00:1	1,00:1
reverse gear	4,238:1	3,99:1	3,66:1	4,67:1
Oil specification	SQM-2C9008-A			
Oil capacity	1,45 l			1,985 l

Clutch	STD	HD	STD	HD	STD	HD	100L
Manufacturer	Laycock	Fichteal Sachs	Laycock L.U.K. Fichtel Sachs	Automotive Products Fichtel Sachs	Automotive Products Fichtel Sachs	Automotive Products	Automotive Products
Engine	1,6 Ltr Kent		1,6 Ltr and 2,0 Ltr (OHC)		2, Ltr Diesel		
Type	Single-plate dry clutch						
Clutch Size	$8\frac{1}{2}$"	9"	$8\frac{1}{2}$"	$9\frac{1}{2}$"	$9\frac{1}{2}$"	$10\frac{1}{2}$"	$9\frac{1}{2}$"
Lining Material	Ferodo 2124F	Porner 11046 (UK) 846 (EUR)	Ferodo 2124 F	Mintex H 26/1	DON DSW8 (UK) Small+ Parkes	Minex H 26/1	Ferodo 2124 F
Operated by	Cable						
Outer Lining Diameter	216	228	216	242	242	267	242
Inner Lining Diameter	146	150	153	156	162	172	156
Clamped Thickness	7,25	9,3	8,40	8,40	8,40	8,52	8,40
Number of Torsion Springs	5	6	6	6	6	6	6
Diaphragm Spring Pressure	5120 (512)	4880 (488)	4410 (441)	4930 (493)	4930 (493)	5780 (578)	4930 (493)

TIGHTENING TORQUES Nm (kpm)

	'F' gearbox Nm	'F' gearbox (kpm)	'G' gearbox Nm	'G' gearbox (kpm)
Clutch housing to gearbox casing	55 to 65	(5,5 to 6,5)	55 to 65	(5,50 to 6,50)
Pressure plate to flywheel	16 to 20	(1,6 to 2,0)	16 to 20	(1,60 to 2,00)
Main drive gear bearing retainer to gearbox casing	21 to 25	(2,1 to 2,5)	16,5 to 20,5	(1,65 to 2,05)
Nut – gearbox mainshaft			35,0 to 41,0	(3,50 to 4,10)
Extension housing to gearbox casing	45 to 49	(4,5 to 4,9)	55,0 to 62,0	(5,50 to 6,20)
Selector housing to gearbox casing	21 to 25	(2,1 to 2,5)	16,5 to 20,5	(1,65 to 2,05)

	Nm	(kpm)
Transmission to cross member insulator	70 to 90	(7,0 to 9,0)
Transmission cross member to body	40 to 50	(4,0 to 5,0)
Driveshaft bearing to support member	20 to 25	(2,0 to 2,5)
Driveshaft flange to differential	60 to 65	(6,0 to 6,5)

Engine	Gearbox man	Gearbox auto	Gearbox STD	Gearbox RPO	Ratios Rear axle G	Ratios Rear axle F	Ratios Rear axle H man	Ratios Rear axle H auto	Vehicle version
1,6 ltr Kent (OHV)	X		X 	 X		4,63 5,14	4,56 5,14		FT80 van and kombi
1,6 ltr LC (OHC)	X		X 	 X		5,14 4,63	5,14 4,56		FT100, 120 van and kombi 9 and 12–seater bus FT100, 120 platform/chassis+ single cab FT100, 120 platform/chassis + dual cab
2,0 ltr LC (OHC)			X	 X X X	4,63 5,14 5,83		4,11 4,44 4,56 5,14	 4,44 4,44 HD	FT100*, 120*† van and kombi FT100L–190 van and kombi FT130B kombi 9 and 12–s bus*†; 15–s bus FT100*, 120*† platform/chassis+ single cab FT100L–190 platform/chassis+ single cab FT100*, 120*† platform/chassis+ dual cab FT130, 190 platform/chassis+ dual cab
2,4 ltr Diesel (OHV)	X	X		X X	5,83 4,63 5.14		4,11 4,44		FT100, 120 van and kombi FT100L–190 van and kombi 9 and 12–s bus; 15–s bus FT100, 120 platform/chassis+ single cab FT100L–190 platform/chassis+ single cab FT100, 120 platform/chassis+ dual cab FT130, 190 platform/chassis+ dual cab

Ratio R.axle	Tyre size 165 x14	Tyre size 185 x14	Tyre size 195 x14	Tyre size 205 x14	Speedo Teeth Worm	Speedo Teeth Gear
4,11:1	G				6	21
	GB	G			6	20
		GB	GB/G	GB/G	6	19
4,44:1	GB	G			6	22
		GB	GB/G	G	6	21
				GB	6	20
	G				5	19
4,63:1			G	G	6	22
	G				5	20
	GB	GB/G	GB	GB	5	19
5,14:1	G				5	22
	GB	G			5	21
		GB	GB/G	G	5	20
				GB	5	19
5,83:1	G				4	20
	GB	GB/G	GB	GB	4	19
			G	G	4	18

*Automatic transmission optional

†Uprated H rear axle with 4,44 HD ratio in conjunction with 2,0 ltr LC (OHC) engine and automatic transmission

MANUAL TRANSMISSION AND CLUTCH (Overdrive) 16B

Contents

GENERAL DESCRIPTION

As optional equipment, an overdrive unit is available on Transits fitted with the 2,0 litre petrol, 2,4 litre diesel and 3,0 litre petrol engines from the start of 1980 model year, Fig.1.

The overdrive unit is fitted on the rear of the manual gearbox, in place of the normal tailshaft housing. It contains a planetary gear train which connects the input and output shafts to one another. Depending on whether the planetary gear train is disengaged or engaged, the speed of the output shaft is changed from 1 : 1 to 0,778 : 1.

The unit is operated electrically. A sliding switch in the gearshift lever knob switches electrical current on ("IN") or off ("OUT"), correspondingly a solenoid valve opens or closes the hydraulic circuit in the overdrive unit.

Spring pressure or the hydraulic pressure acts on a clutch to hold the planetary gear train in place (1 : 1, direct drive) or to allow it to rotate freely (0,778 : 1, overdrive).

The hydraulic pressure in the overdrive unit is produced by its own plunger type pump. In order that the overdrive can only be engaged in 3rd or top gear, inhibitor switches are fitted to the shift rods of 1st, 2nd and reverse gears of the 4-speed gearbox, which then break the electrical circuit, to prevent incorrect engaging of overdrive.

The overdrive can be engaged or disengaged at any speed, but should usually only be engaged at speeds of over 50 km/h (30 miles/h) (driving in 3rd and top gear) as road and driving conditions permit. When driving at high road speeds, especially in 3rd gear, the overdrive should not be disengaged because this causes excessive engine revolutions.

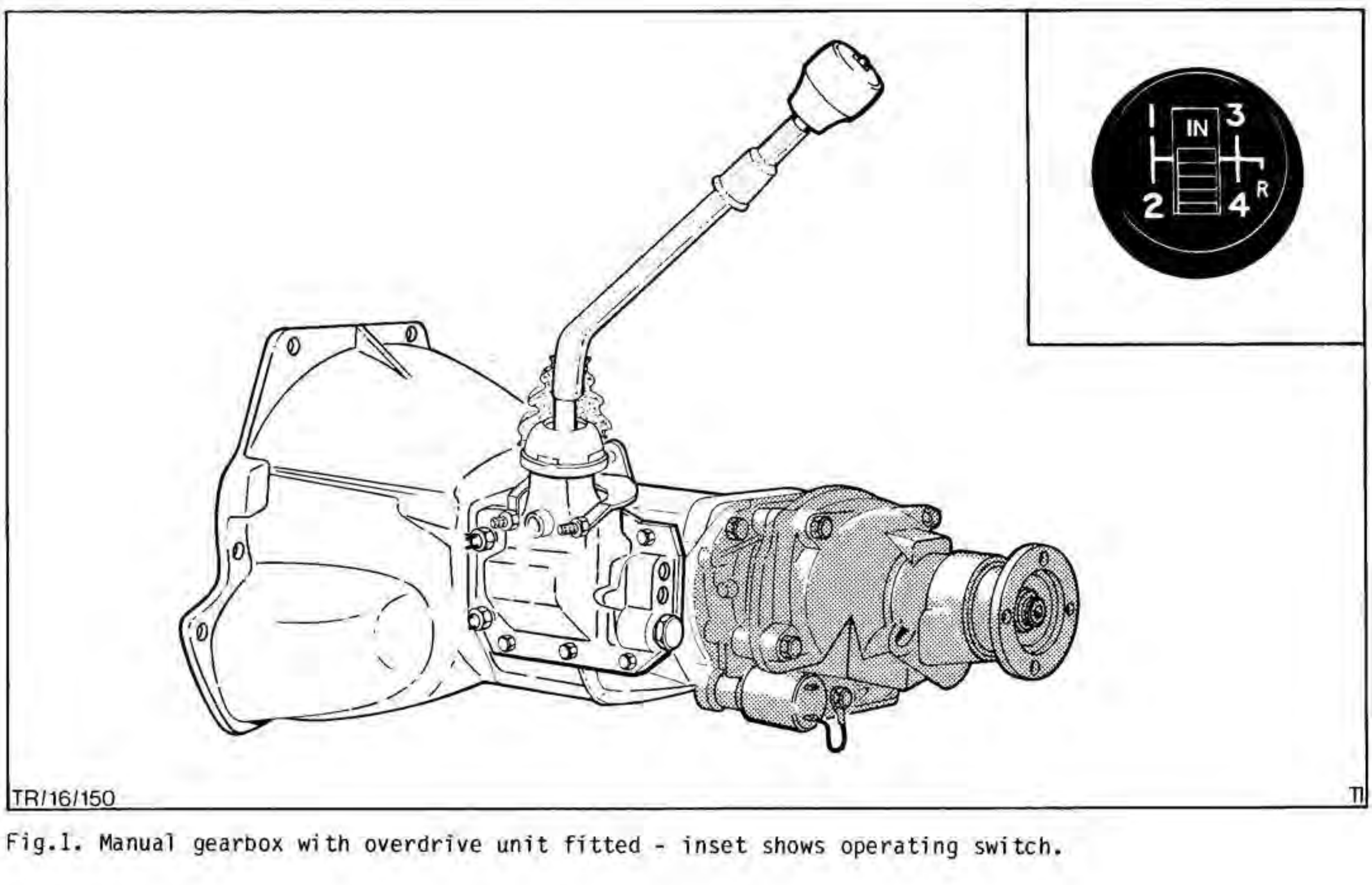


Fig.1. Manual gearbox with overdrive unit fitted - inset shows operating switch.

PRINCIPLE OF OPERATION

Power flow in the overdrive ("OUT" position), Fig.2A

In direct drive, input and output shafts are connected with one another so that they turn together. The cone clutch is locked in contact to the output annulus (ring gear). The uni-directional clutch is meshed.

Power flow in the overdrive ("IN" position), Fig.2B

As soon as the overdrive is engaged, the frictional connection (cone clutch - output annulus) is loosened by means of hydraulic pressure, and the cone clutch is pressed against the fixed brake ring. Cone clutch and sunwheel are held stationery; the planet carrier rotates with the input shaft at the same speed. The planet wheels roll off the sunwheel and drive the ring gear at their speed. The output shaft now turns at a faster speed than the input shaft, and the uni-directional clutch is over-run. At the same vehicle speed, the engine will run more slowly and efficiently, reducing fuel consumption and engine noise.

The oil pump and control unit are part of the hydraulic system of the overdrive unit and are described separately.

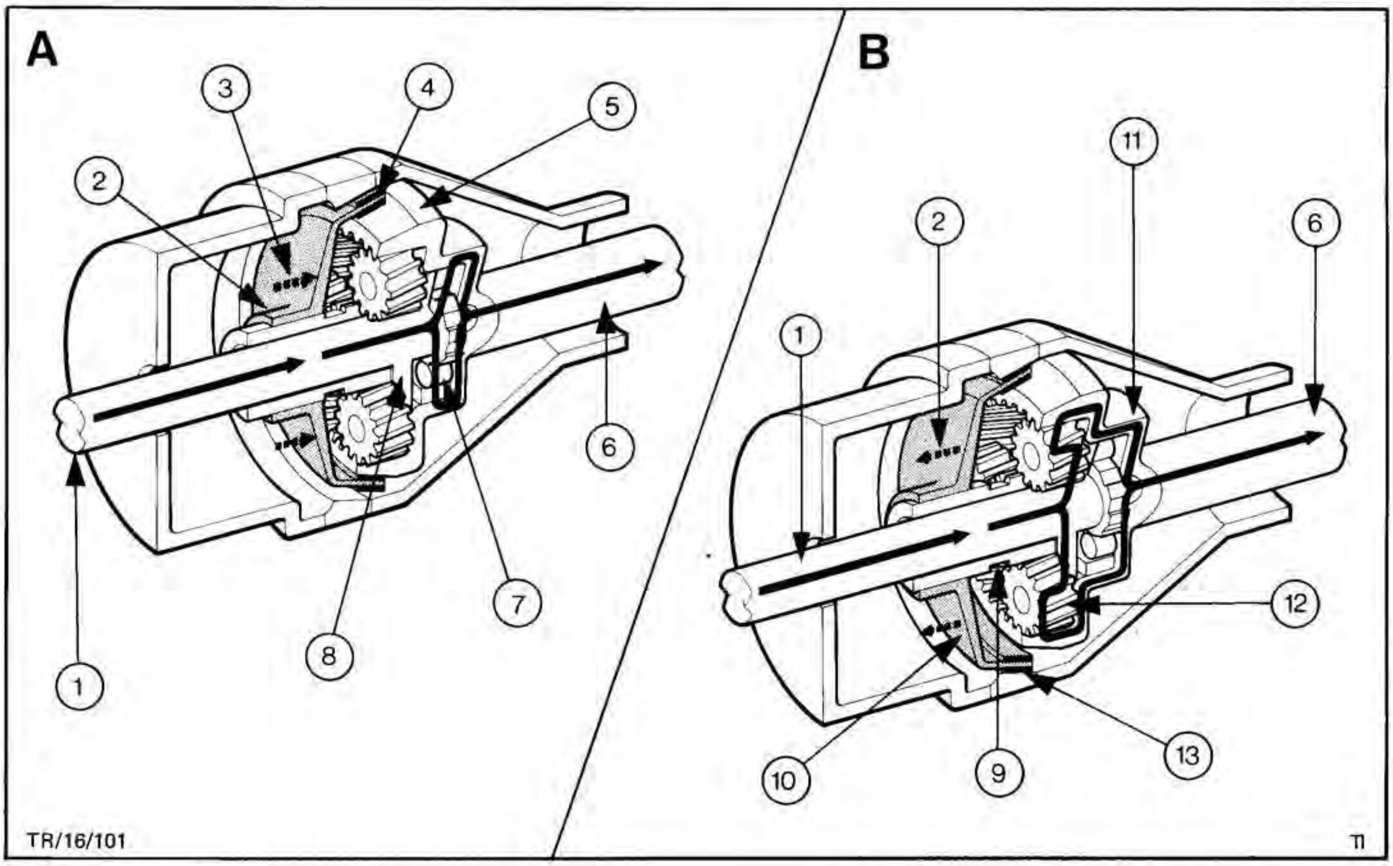


Fig.2. A - POWER FLOW IN "OUT" POSITION

1 - Input shaft
2 - Cone clutch (sliding)
3 - Spring pressure
4 - Annulus and sunwheel locked
5 - Output annulus (ring gear)
6 - Output shaft
7 - Uni-directional clutch (clamping rollers)
8 - Planet carrier
9 - Sunwheel
10 - Hydraulic pressure

B - POWER FLOW IN "IN" POSITION

11 - Output annulus (ring gear
12 - Planet wheel
13 - Locked cone clutch holds sunwheel stationary.

PRINCIPLE OF OPERATION (cont'd)

Hydraulic system

The plunger-type oil pump in the overdrive is operated via a cam on the input shaft. The pump draws oil from the oil sump through a suction filter and delivers this oil via a non-return ball valve through a pressure filter to the operating pistons, solenoid valve and relief valve.

In the relief valve, there is also an integrated spring dashpot which, by giving a progressive load application between the cone clutch and brake ring, ensures a smooth engagement and disengagement of the cone clutch under varying driving conditions.

In direct drive, a residual hydraulic pressure of approximately 1,5 - 3,0 Bar is maintained within the system. When overdrive is engaged, this pressure is increased to an operating pressure of approximately 36 - 38,5 Bar.

Hydraulic system with overdrive engaged, Fig.4

The overdrive switch (in the gearshift-lever knob) operated by the driver causes the solenoid switch to open the control valve.

The hydraulic pressure moves the operating pistons forward, overcoming the spring pressure of the cone clutch, and the cone clutch is pressed into the conical brake ring.

For purposes of self-lubrication, the oil then flows to the input shaft, flows through it to the rear bearing in the annulus and is then distributed for the purpose of lubricating the moving parts and planet wheels before it finally returns into the oil sump.

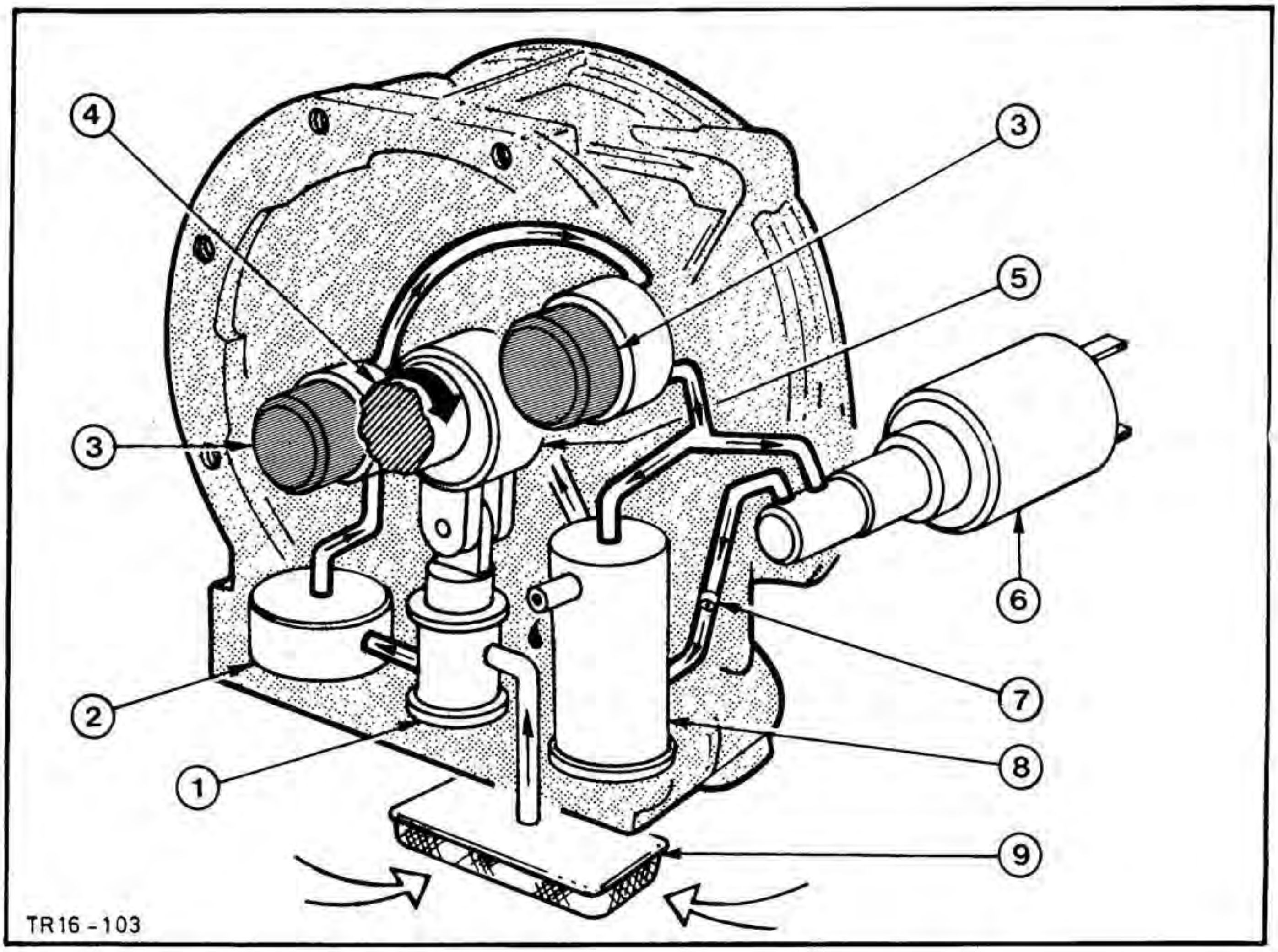


Fig.4. Hydraulic circuit with overdrive engaged.

1 - Oil pump
2 - Hydraulic pressure filter
3 - Operating pistons
4 - Input shaft
5 - Oil pump cam
6 - Solenoid valve
7 - Restrictor passage
8 - Hydraulic control
9 - Oil sump with suction filter

PRINCIPLE OF OPERATION

Hydraulic oil pressure system with overdrive disengaged

After the overdrive switch is brought into the "OUT" position, the control valve is closed by the solenoid valve, cutting off the oil supply from the pump to the dashpot piston.

By this means, oil is exhausted from the dashpot by way of the exhaust port, the spring in the relief valve is relaxed, and the valve returns to its direct drive position. Simultaneously, the springs of the dashpot valve move the dashpot piston until it reaches its stop.

The operating pressure can now be progressively reduced, and the cone clutch is gently brought into contact with the output annulus (ring gear) by the clutch return springs.

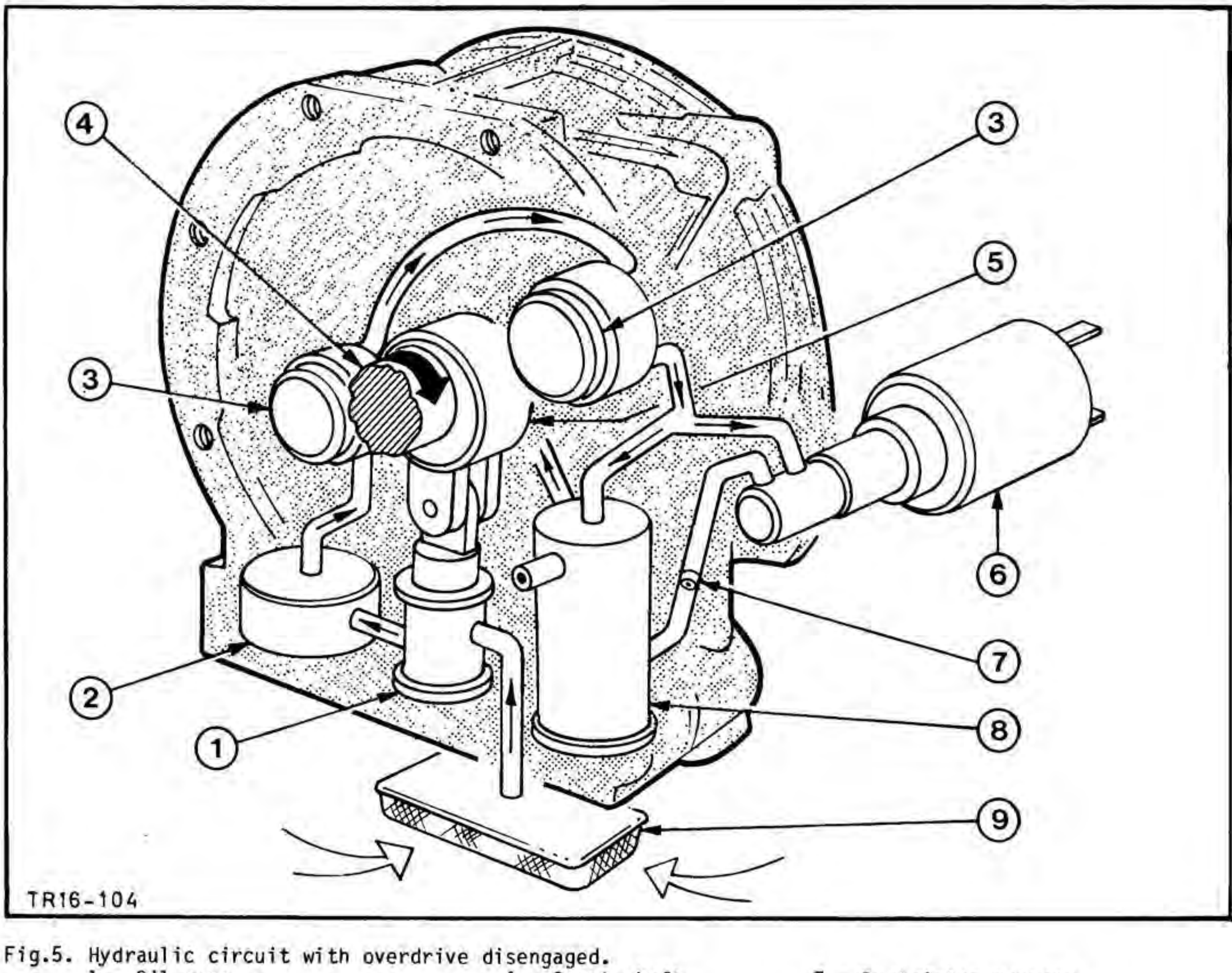


Fig.5. Hydraulic circuit with overdrive disengaged.

1 - Oil pump
2 - Hydraulic pressure filter
3 - Operating pistons
4 - Input shaft
5 - Oil pump cam
6 - Solenoid valve
7 - Restrictor passage
8 - Hydraulic control
9 - Oil sump with suction filter

ELECTRICAL CONTROL SYSTEM, Fig.6.

When the control switch in the gearshift-lever knob is put into the "IN" position, the solenoid valve receives electrical current via the two inhibitor switches in the gearshift cover.

The electrical circuit is broken by the inhibitor switches in 1st, 2nd and reverse gears.

FAULT FINDING

Disconnect the terminal of the power cable from the solenoid. Connect a test lamp between this cable and earth. Engage top gear, and put overdrive control switch (with ignition on) into "IN" position. The test lamp should now light.

If this is not the case, trace the fault in the electrical system, e.g. at the fuse, in the wiring, at the solenoid or inhibitor switches. If the test lamp does not go out with 1st, 2nd or reverse gear engaged, the operation of the inhibitor switches must be checked.

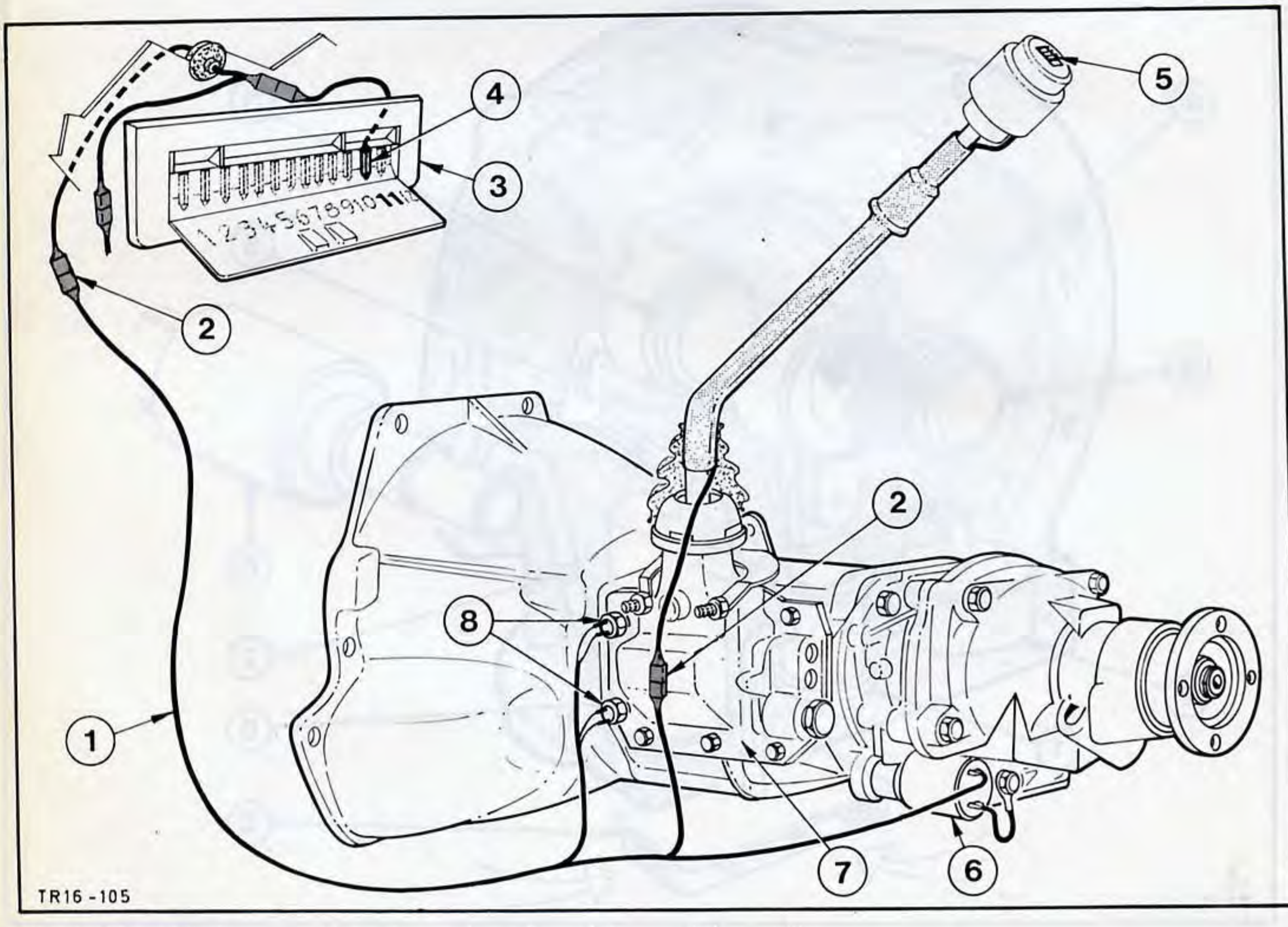


Fig.6. Electrical connections in conjunction with overdrive unit.
1 - Wiring loom
2 - Plug and socket connection
3 - Fuse box
4 - Fuse No.11
5 - Operating switch
6 - Solenoid
7 - Gearshift cover
8 - Gear inhibitor switch (2)

FAULT FINDING (cont'd)

Overdrive does not engage

1. Too little oil in gearbox.
2. Fault in electrical circuit.
3. Insufficient pump pressure as a result of bad sealing off of pump non-return valve ball (probably dirty valve seat).
4. Insufficient pump pressure as a result of a blockage in the relief valve or a sticking piston.
5. Pump does not work because of filter blockage.
6. Damaged parts in the overdrive.
7. Blocked restrictor passage.
8. Faulty solenoid valve.

Overdrive does not disengage

Caution: If the overdrive does not disengage, be sure not to reverse the vehicle, otherwise extensive damage may be caused.

1. Fault in electrical circuit.
2. Cone clutch is sticking.
   This problem can occur with a new overdrive because the cone clutch has not yet been run in adequately. The clutch can usually be loosened with several blows (with a non-metallic hammer) on the brake ring.
3. Damaged parts in the overdrive.
4. Seized dashpot/relief valve.
5. Restrictor passage blocked.
6. Faulty solenoid valve.

Overdrive slips when engaging

1. Too little oil in the gearbox.
2. Insufficient pump pressure as a result of bad sealing off of the pump non-return valve ball (probably dirty valve seat).
3. Insufficient pump pressure as a result of bad sealing of the relief valve.
4. Partially blocked filters.
5. Clutch lining worn or glazed.
6. Faulty solenoid valve.

Overdrive disengagement slow and/or no engine braking effect in over-run

1. Blockage in restrictor passage.
2. Dashpot/relief valve sticking.
3. Faulty solenoid valve.

Overdrive slips/no drive in reverse

1. Seized dashpot/relief valve piston. -)
)
2. Restrictor valve partially blocked. -) - High residual pressure
)
3. Solenoid control valve faulty. -)
4. Sunwheel circlip adrift.
5. Glazed/worn cone clutch lining.

SERVICE ADJUSTMENTS AND CHECKS

Lubrication

Gearbox and overdrive unit have a common oil supply (see Technical Data). The oil level may be checked by means of the plug on the gearbox, fill to the bottom of the plug hole.

The overdrive unit is equipped with pressure lubrication, whereby the oil from the relief valve flows through drillings to an annular channel in the front casing section, from there it flows through the centre drilling of the input shaft to the rear bearing in the ring gear. From here it is directed by an oil thrower onto a catcher disc in the planet carrier to the planet bearings via the hollow planet bearing pins.

Following complete draining and refilling, the oil level must be checked again after a short trial run. It is essential that only prescribed oil be used for topping up or for an oil change.

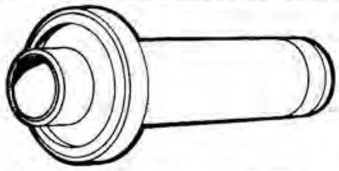
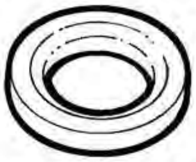
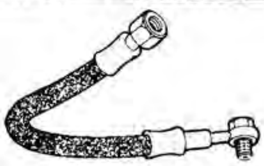
ON NO ACCOUNT SHOULD ANY ANTI-FRICTION ADDITIVES BE USED

Since the gearbox and the overdrive have a common oil supply, scrupulous cleanliness must be maintained throughout all servicing operations.

For cleaning externally or internally, use only petrol or paraffin, since otherwise damage may occur to oil seals and other parts of the unit.

On no account should water be used during cleaning operations because this would also affect the operation of the overdrive.

SPECIAL SERVICE TOOLS

 13-007	Hydraulic test equipment
 15-010 A	Installation mandrel with spacer ring
 21-063	Sealing ring - rear overdrive housing
 16-030	Pressure take-off adaptor
 21-096	Extractor, sealing ring - overdrive housing rear

SERVICE AND REPAIR OPERATIONS - CONTENTS

SERVICE AND REPAIR OPERATIONS

16 401 OVERDRIVE ASSEMBLY - CHECK (includes top up oil level and pressure check)

SPECIAL SERVICE TOOLS REQUIRED:

Hydraulic test equipment	13-007
Pressure take off adaptor	16-030

1. Before checking the oil pressure, check for current flow at the solenoid valve using a test lamp, with 3rd or top gear engaged.

2. After first ensuring that the oil level is correct, remove the screw plug, Fig.7, and then connect the hydraulic test equipment 13-007 with the adaptor 16-030, Fig.8.

3. Jack up the rear of the vehicle and fit stands, then measure the overdrive oil pressure as follows:

   Run the transmission in top gear at approximately 40 km/h (25 miles/h) which should show a residual oil pressure of approximately 1,7 Bar on the pressure gauge. When overdrive is engaged, the oil pressure should rise to approximately 36 - 38,5 Bar. With the overdrive disengaged, the pressure gauge should return to the residual oil pressure.

   If the prescribed oil pressure is not reached, this points to a fault in the hydraulic system.

4. Refit screw plug with new sealing ring.

5. Jack up, remove stands and lower rear of vehicle. Remove hydraulic test equipment and adaptor.

6. Check oil level - if necessary top up with specified oil.

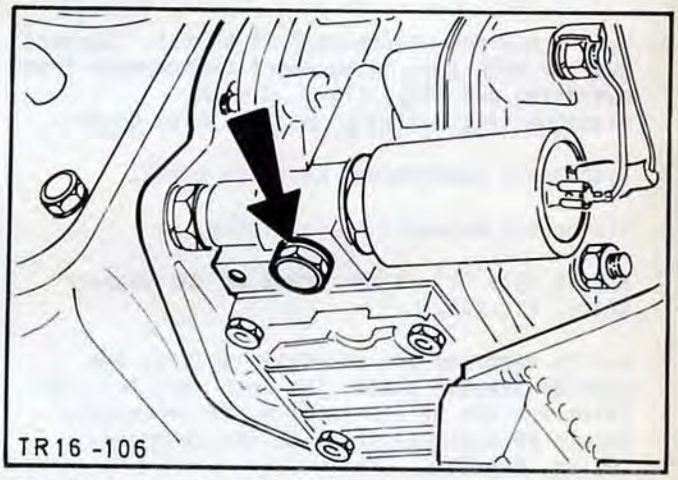


Fig.7. Screw plug for oil pressure check.

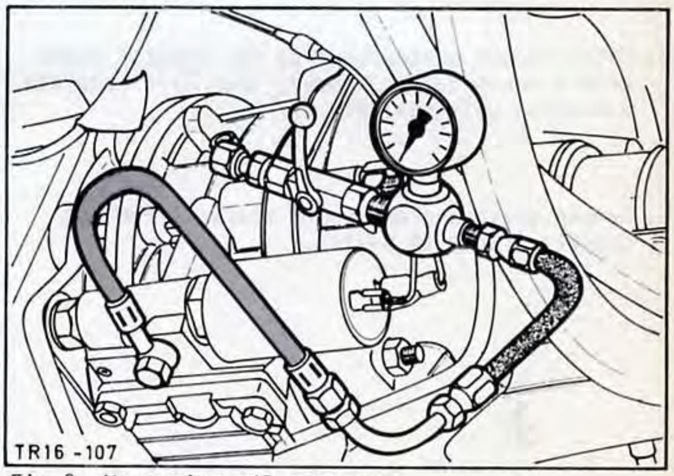


Fig.8. Measuring oil pressure.

16 404 OVERDRIVE ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

NOTE: Before removing the overdrive unit, the vehicle should be driven with overdrive engaged. Then disengage overdrive with the clutch depressed. This is the starting position for the removal of the overdrive unit. This releases the spline loading between planet carrier and uni-directional clutch which could make removal difficult. This measure is only possible when the overdrive unit can still be engaged. Otherwise it may be necessary to proceed as described under Item 8.

1. Disconnect earth lead from the battery.
2. Drain gearbox/overdrive oil.
3. Separate driveshaft from overdrive flange (4 bolts).
4. Remove gearbox crossmember (4 bolts). Support gearbox with jack, disconnect crossmember from overdrive and body, Fig.9, thereby disconnecting one side complete with holder.
5. Disconnect speedometer cable (1 bolt).
6. Disconnect solenoid-valve wiring.
7. Remove nuts (8) at the front of the adaptor plate, Fig.10A.
8. Before removing the overdrive unit at the gearbox adaptor plate, the rear nuts (6), for releasing the spline loading, if necessary, should be loosened flush on the overdrive casing, Fig.10B.

NOTE: This is only necessary if the spline loading has not previously been released (see introduction).

9. First loosen overdrive from the adaptor plate with a non-metallic hammer, then lift complete overdrive unit out, Fig.11.
10. Remove gearbox crossmember bracket from the overdrive unit (4 bolts).

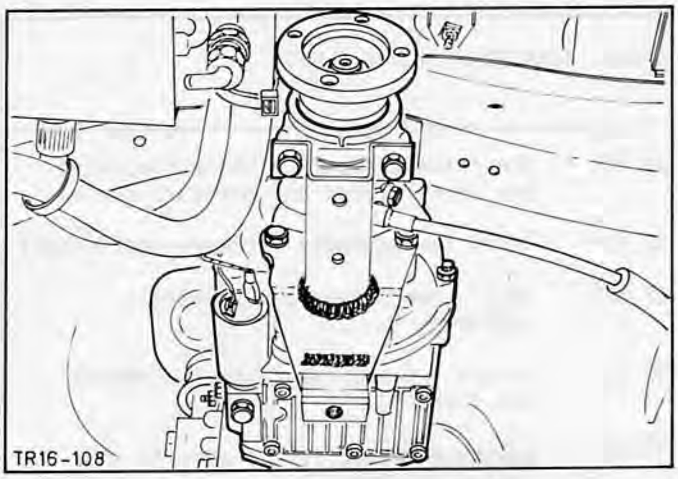


Fig.9. Gearbox crossmember dismantled.

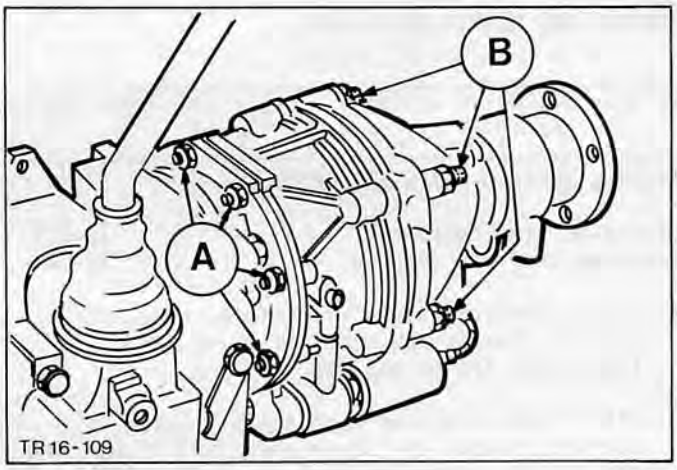


Fig.10. A - Nuts securing overdrive to adaptor plate
B - Nuts securing rear overdrive casing

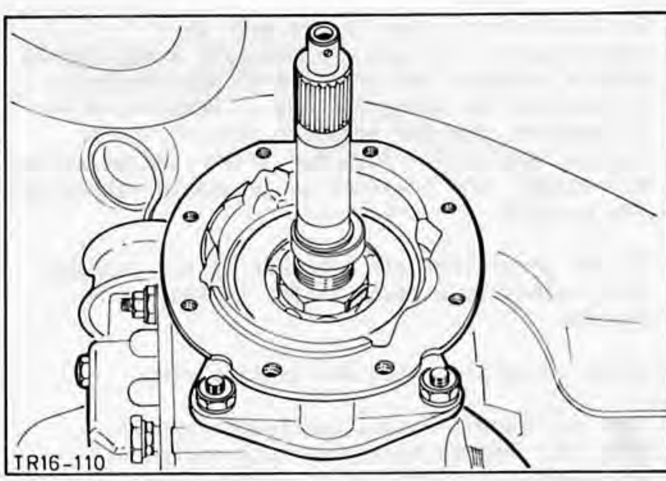


Fig.11. Gearbox with overdrive removed.

16 404

To Refit

11. Refit gearbox crossmember bracket to overdrive.

12. Fit overdrive with new gasket (do not use jointing compound), Fig.12. First align splines by turning (in a clockwise direction) the output shaft while pressing the overdrive against the gearbox until the splines become engaged. Fit and tighten the nuts (8) securing the overdrive to the adaptor plate.

NOTE: If the overdrive fails to meet the adaptor plate face by approximately 16 mm, this means that the splines of the uni-directional clutch have become misaligned. In this case, remove the overdrive unit, and re-align the splines.

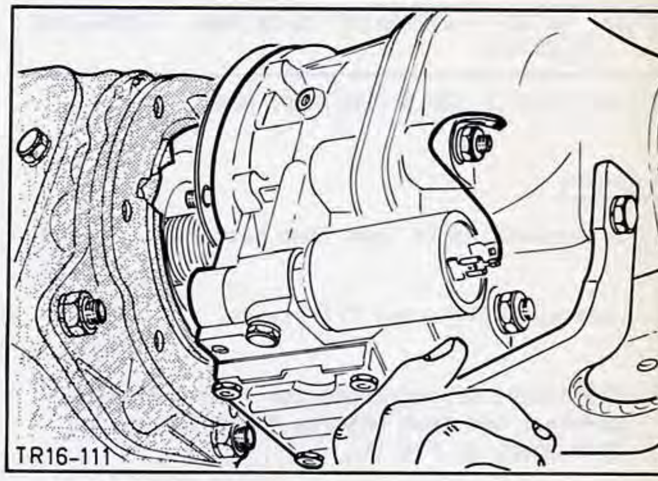


Fig.12. Refitting overdrive unit.

13. Connect solenoid wiring.

14. Refit speedometer cable.

15. Refit gearbox crossmember to body and overdrive unit, Fig.13.

16. Refit driveshaft to overdrive rear flange, (use new bolts and nuts).

17. Fill transmission with specified oil. (See Technical Data).

18. Refit earth lead to battery.

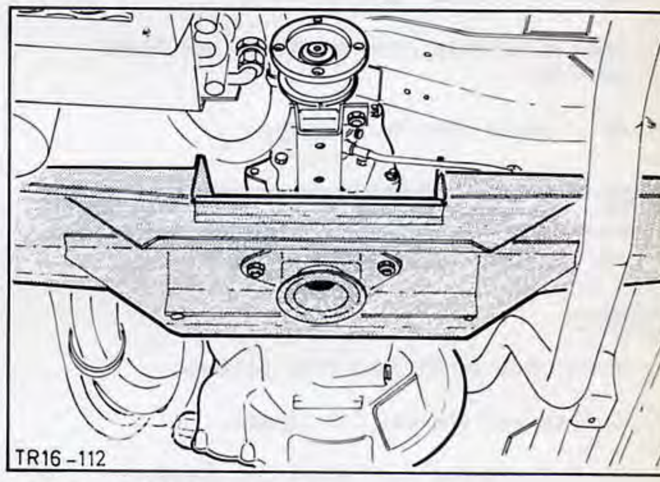


Fig.13. Refitting gearbox crossmember.

33 562 SWITCH - OVERDRIVE CONTROL - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect earth lead from battery.

2. Remove gear lever knob, Fig.14. and disconnect wiring from overdrive control switch.

3. Unscrew overdrive control switch from gear lever knob.

To Install

4. Screw overdrive control switch to gear lever knob.

5. Connect wiring to overdrive control switch and replace gear lever knob.

6. Refit earth lead to battery.

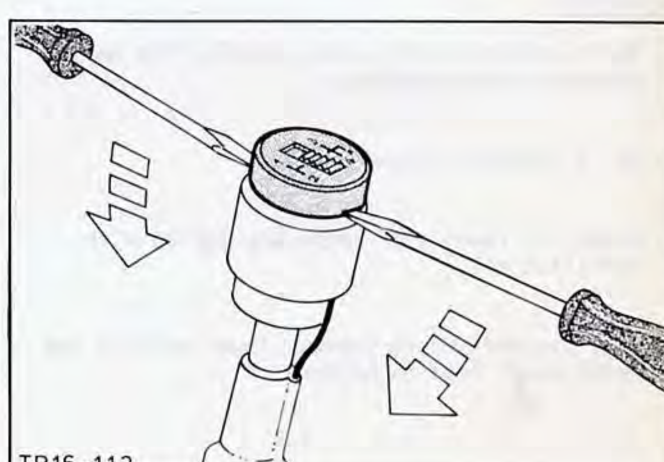


Fig.14. Remove gear lever knob.

33 563 SWITCH - OVERDRIVE INHIBITOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect earth lead from battery.
2. Jack up vehicle and fit stands.
3. Disconnect wiring connector from inhibitor terminal and then unscrew inhibitor switch from gearbox, Fig.15.

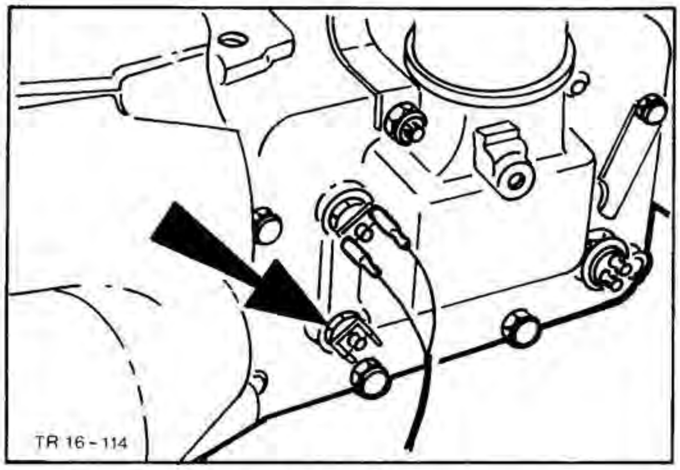


Fig.15. Remove inhibitor switch.

To Install

4. Fit new sealing ring to inhibitor switch, refit inhibitor switch to gearbox. Connect inhibitor switch wiring.
5. Jack up vehicle, remove stands and lower vehicle.
6. Refit earth lead to battery.

33 752 SOLENOID - OVERDRIVE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect earth lead from battery.
2. Jack up vehicle and fit stands.
3. Support gearbox and remove crossmember.
4. Disconnect solenoid wiring and remove solenoid, Fig.16.

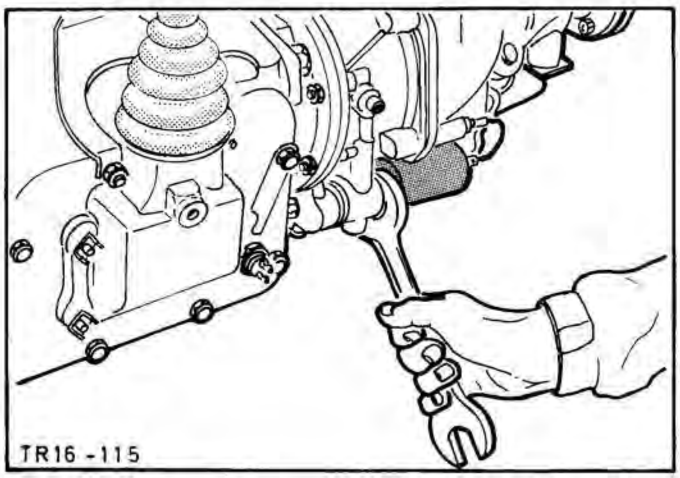


Fig.16. Remove solenoid.

To Install

5. Refit solenoid with a new sealing ring and connect solenoid wiring.
6. Refit gearbox crossmember.
7. Check oil level - if necessary top up with specified oil.
8. Jack up and remove stands, lower vehicle and refit earth lead to battery.

TECHNICAL DATA

Manufacturer	Laycock
Model	I 28
Overall transmission ratio	0,778 : 1
Oil pressure with overdrive disengaged ..	1,5 to 3,0 Bar
Oil pressure with overdrive engaged	36 to 38,5 Bar
Oil specification	SQM-2C 9008-A
Oil quantity (gearbox with overdrive) ..	3,1 litres

Tightening torques	Nm	kgf.m	lbf.ft
Stud - gearbox to adaptor..	33 to 40	3,3 to 4,0	23,1 to 28
Nut - gearbox to adaptor	50 to 62	5,0 to 6,2	35 to 43,4
Stud - adaptor to overdrive housing	3,6 to 4,3	0,36 to 0,43	2,5 to 3
Nut - adaptor to overdrive housing	7,1 to 11,4	0,71 to 1,14	5 to 8
Nut - extension to overdrive housing	13 to 18,5	1,3 to 1,85	9 to 13
Screw plug - Oil pressure test	13 to 21,5	1,3 to 2,15	9 to 15
Bolt - Mounting bracket to overdrive	38 to 48	3,8 to 4,8	26,6 to 33,6
Bolt - Mounting bracket to body crossmember..	70 to 90	7,0 to 9,0	49 to 63
Bolt - Crossmember to body bracket	40,5 to 51	4,05 to 5,1	28 to 36

ENGINE 21/

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GENERAL DESCRIPTION

TRANSIT variants may be fitted with either a 2,4 litre Diesel engine or a range of petrol engines. The petrol engines are OHC/I-4 and OHV/I-4 engines. A 3,0 litre OHV/V6 engine is available as an S.V.O. (Special Vehicle Option)

OHC - overhead camshaft
OHV - overhead valves
I-4 - in-line engine - 4 cylinders

This section deals with all petrol engines except the 3,0 litre V6 engine.

The 3,0 litre V6 engine is described in Section 21C and the Diesel engine is dealt with in Section 21B of this manual.

For simplification, the engines are only identified by a letter in the following description, as is the practice in other Workshop Manuals.

The chart below indicates which engines are fitted.

Engine Summary

Cubic capacity in litres	Compression ratio	Engine type	kW (HP)	Engine code on block	Identification in workshop manual
1,6*	LC	OHV/I-4	47 (63)	LIC	A
1,6	LC	OHC/I-4	48 (65)	LAT	B
2,0 Economy	LC	OHC/I-4	43 (58)	NUT	B
2,0	LC	OHC/I-4	57 (78)	NAT	B
2,0 (with auto. transmission)	LC	OHC/I-4	55 (75)	NAV	B
2,0 (variants with HD version)	LC	OHC/I-4	57 (78)	NAW	B
2,0 (with HD cooling)	LC	OHC/I-4	57 (78)	NAW	B
3,0	LC	OHV/V6	74 (100)	HX	F
2,4	Diesel	OHV/I-4	46 (62)	4AA	G

LC = low compression
* = Great Britain only

The 'A' engine, Fig. 1, is a water-cooled, 4-cylinder, 4-stroke, in-line, petrol engine. The overhead valves are operated by tappets, pushrods and rocker arms. The camshaft is located to one side of the block and is driven by a roller chain. The drive gear for distributor and oil pump is located behind the second cam, the eccentric driving the fuel pump is located between the sixth and seventh cams. The cylinder head is of crossflow design, the combustion chambers extend into a bowl in the crown of the pistons.

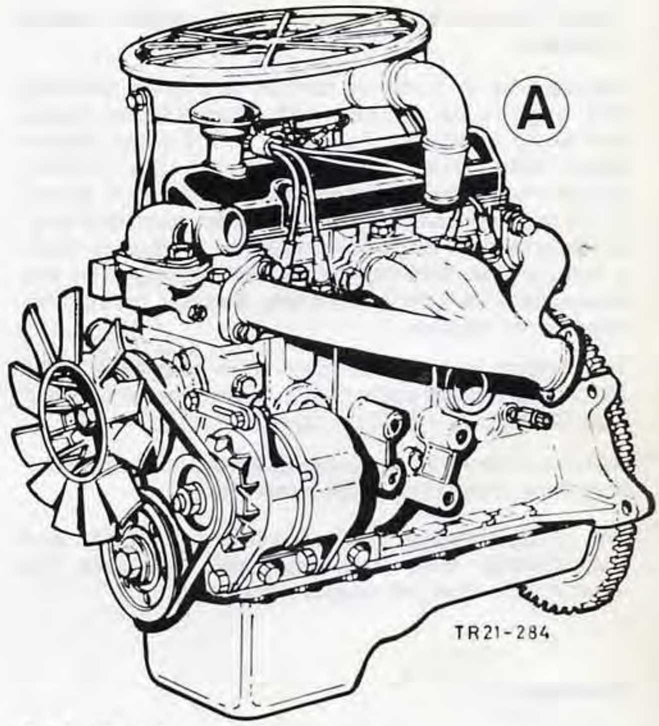


Fig. 1. 'A' engine

The 'B' engine, Fig. 2, is a water-cooled 4-cylinder 4-stroke in-line petrol engine. The overhead valves are arranged in the cylinder head in slight V-formation and directly actuated via cam followers. The camshaft is located centrally above the cam followers in the cylinder head and is driven from the crankshaft via a toothed belt which also drives the auxiliary shaft. The auxiliary shaft drives distributor, oil and fuel pump. The cylinder head in which the combustion chambers are located is of crossflow design.

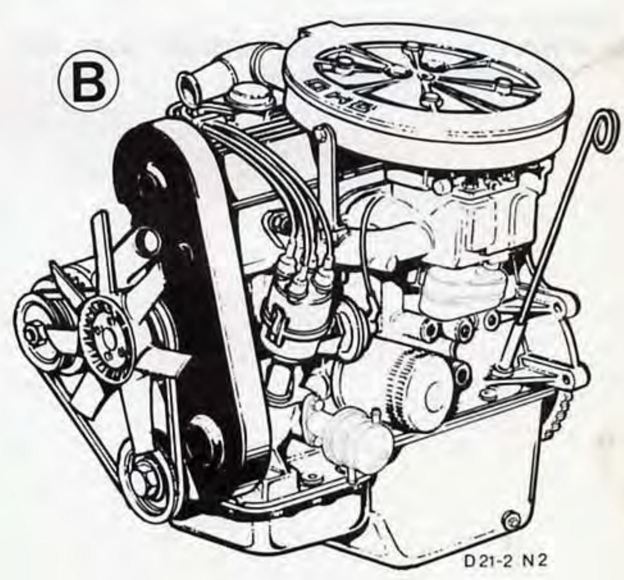


Fig. 2. 'B' engine

GENERAL DESCRIPTION (cont'd)

Engine identification code and engine serial numbers

Regulations in force in certain countries demand that engines be marked with identification codes and serial numbers. Figures 3 and 4 show where these data should be marked on the engine. Minimum height of letters and numbers is 6 mm (0,25 in.) and both codes and serial numbers (e.g. on replacement engines) should be marked in such a manner that they can be clearly recognized by the appropriate testing authorities, thereby preventing rejection of engines.

The engine number consists of a two-digit build year/build month code and a 5-digit serial number (see Section 00 – Vehicle Identification).

A five-pointed star is stamped before and after the complete seven digit engine number.

The 3-digit engine code comprises capacity and compression ratio data and also indicates the vehicle type to which engines are fitted.

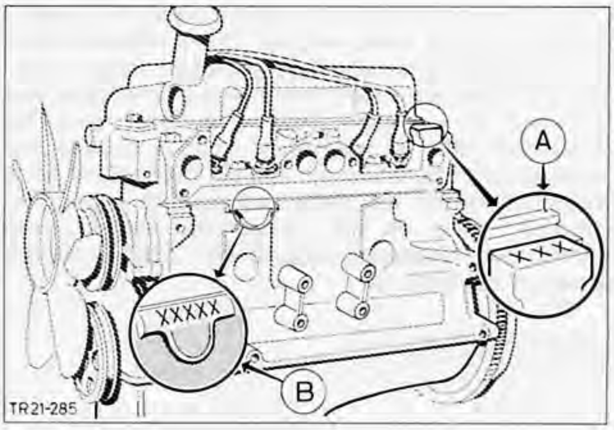


Fig. 3. 'A' engine
A – Engine code
B – Engine number

Example: LAT
L = 1,6:1
A = low compression
T = Transit

Engine code definition

1st digit = engine capacity
L = 1,6:1
N = 2,0:1

2nd digit = compression ratio
A = LC
U = LC
1 = LC

3rd digit = model variant
Marked by the relevant assembly plant and relating to model variant only.

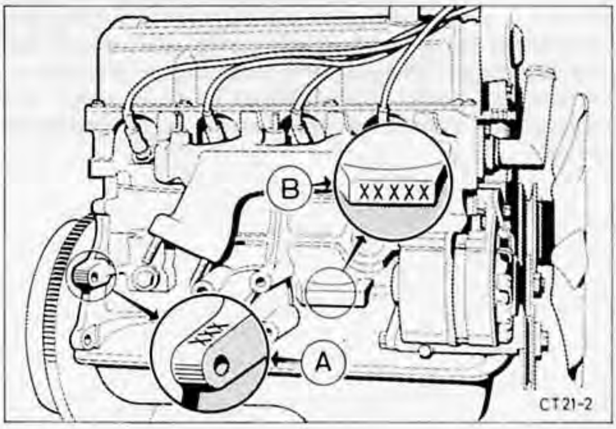


Fig. 4. 'B' engine
A – Engine code
B – Engine number

SERVICE ADJUSTMENTS AND CHECKS

To check the engine oil level the vehicle should stand on level ground and the engine should be at normal operating temperature. Before carrying out the check, wait a short time to allow all oil to drain back into the sump.

Withdraw the dipstick, wipe it clean with a rag, replace and withdraw it again. The oil on the dipstick indicates the oil level in the sump, it should lie between the two marks, Fig. 5 and 6. The quantity of oil required to top up from the bottom mark to the top mark is 0,75 to 1,0 litre (1,3 to 1,75 pints) approximately, depending on the engine capacity.

If necessary, top up through the filler neck with engine oil to FORD specification.

Topping up is not necessary until the oil level drops to the bottom mark. Do not allow the oil level to drop any further. Never top up to above the top mark since the excess oil is wasted, i.e. the oil consumption is increased.

The engine oil should be changed and the oil filter renewed at least every 10 000 km (6000 miles). If conditions of use are severe, e.g. short trips, frequent starts from cold, dusty roads etc, the oil should be changed and the oil filter renewed at shorter intervals.

If the specified engine oil is not used the inevitable consequence will be excessive wear or damage to the engine. The oil film becomes discontinuous and engine components under high thermal stresses are subjected to increased wear. Residues collect in the sump and block the oil passages. In addition, poor quality oil does not protect against corrosion so that rust forms on the cylinder walls. After a relatively short time the efficiency of the engine will decrease and there will be increased fuel and oil consumption.

Always use a branded oil complying with FORD specification (Refer to Technical Data).

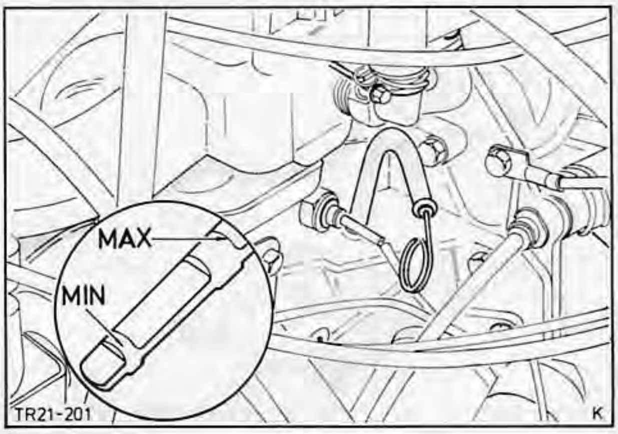


Fig. 5. Engine oil level check – 'B' engine

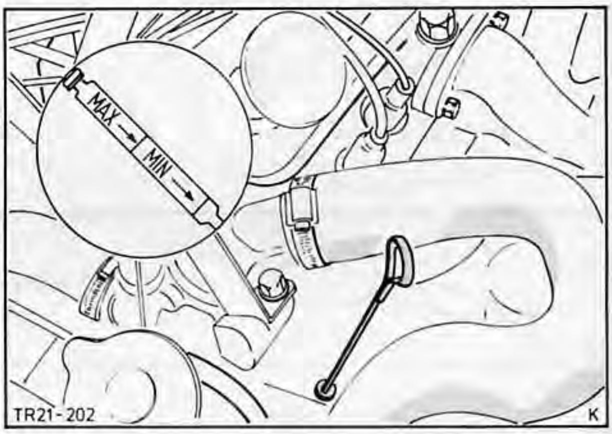
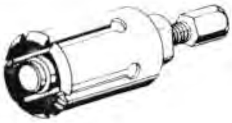
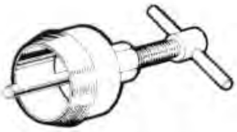
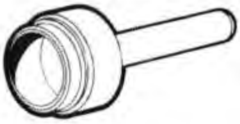
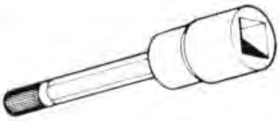
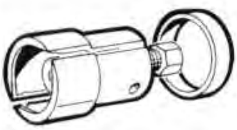
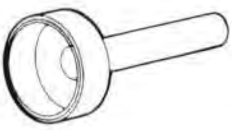
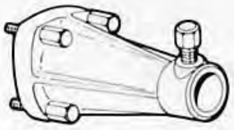
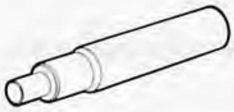
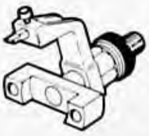
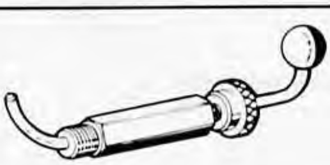


Fig. 6. Engine oil level check – 'A' engine

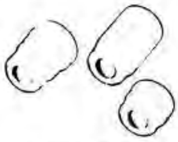
SPECIAL SERVICE TOOL RECOGNITION (cont'd)

Tool		Tool Name
	21–008–A	Camshaft, crankshaft and auxiliary shaft oil seal remover
	21–009–A	Camshaft, crankshaft and auxiliary shaft oil seal replacer
	21–010	Crankshaft rear oil seal remover
	21–011–A	Crankshaft rear oil seal replacer
	21–012	Oil pump bolt and drive belt tensioner socket
	21–013–A	Camshaft bearing remover/installer
	21–014	Piston pin installer
	21–023	Universal spindle
	21–028	Crankshaft gear remover
	21–030	Crankshaft rear oil seal installer

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

Tool	Tool Name
 21–031	Engine mounting bracket
 21–034	Cylinder head bolt wrench
 21–036	Flywheel bearing remover
 21–042	Valve guide reamer
 21–044	Flywheel bearing replacer and clutch disc aligner
 21–046	Crankshaft front oil seal installer
 21–047	Oil seal retainer cutter (seal carrier)
 21–051	Multi-purpose oil seal remover
 21–056	Valve spring compressor
 21–057	Valve retainer

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

Tool	Tool Name
 21–062	Camshaft bush remover/installer (main tool)
 21–062–01	Camshaft bush remover/installer (adaptor for 21–062)
 21–068 (G1–6000 and G2–6000)	Engine lifting bracket
 21–071 (GC–6035–B)	Valve guide reamer 0,2 mm oversize
 21–072 (GC–6085–C)	Valve guide reamer 0,4 mm oversize
 21–073	Valve guide reamer – 0,6 mm oversize
 21–074	Valve guide reamer – 0,8 mm oversize
 21–080	Flywheel bearing installer and clutch disc aligner

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

The modification shown in Fig. 6a must be made to the existing valve spring compressor 21–005 to facilitate work on TRANSIT vehicles.

This modified tool can still be used on all other vehicles.

The modified tool has been numbered 21–005–A by the manufacturer.

So when re-ordering, the valve spring compressor is now only available with the new tool number.

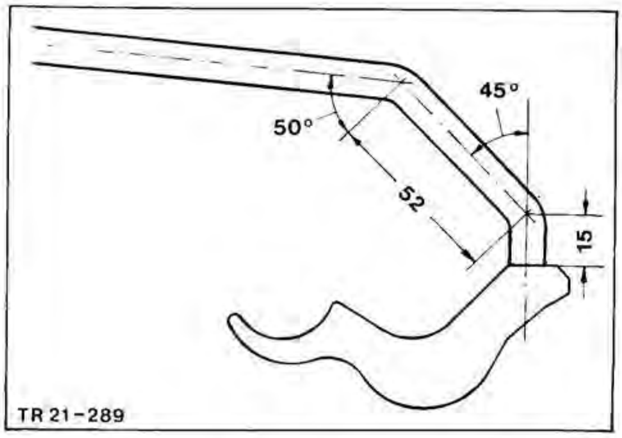


Fig. 6a. Modification to valve spring compressor 21–005

SERVICE AND REPAIR OPERATIONS CONTENT

ENGINE		Described for engine		Contained in operation	Also applicable to following models				
		A	B		Fiesta	Escort	Taun/Cort.	Capri	Granada
21 111	Engine – check compressions	X	X		X	X	X	X	X
21 112	Oil pressure – check	X	X		X	X	X	X	X
21 134	Engine – remove and install	X	X		X	X	X	X	X
21 134 8	Engine assembly – dismantle and reassemble (engine removed)	X	 X		X —	X —	X X	X X	— X
21 154	Sump – remove and install	X	X		—	—	—	—	—
21 163	Cylinder head – remove and install	X	 X		X —	X —	X X	X X	— X
21 165 5	Cylinder head – replace (cylinder head removed)	X	 X		X —	X —	X X	X X	— X
21 213	Valve clearances – adjust	X	 X		X —	X —	X X	X X	— X

SERVICE AND REPAIR OPERATIONS CONTENT (cont'd)

ENGINE		Described for engine		Contained in operation	Also applicable to certain variants in the following model ranges				
		A	B		Fiesta	Escort	Taun/Cort.	Capri	Granada
21 215 4	Valve – remove and install (one) (cylinder head removed)	X	X		X	X	X	X	X
21 231 9	Valve seat – cut (one) (valve removed)	—	—	21 233 9	X	X	X	X	X
21 233 9	Valve guide – ream (one) (valve removed)	X	X		X	X	X	X	X
21 238	Seals – valve stem – replace (all)	X			X	X	X	X	—
			X		—	—	X	X	X
21 255 9	Rocker shaft – overhaul (rocker shaft removed)	X			X	X	X	X	—
21 288	Seal – camshaft – replace		X		—	—	X	X	X
21 304	Timing belt – replace		—	21 467 'B'	—	—	X	X	X
21 467	Seal – crankshaft front – replace	X			X	X	X	X	—
			X		—	—	X	X	X
21 468 4	Seal – crankshaft rear – replace (engine or gearbox removed)	X	X		X	X	X	X	X
21 469 4	Oil carrier – crankshaft rear – cut out (flywheel removed)	X			X	X	X	X	—
21 505 5	Piston – replace (piston and connecting rod removed)	X			X	X	X	X	—
			X		—	—	X	X	X
21 553	Auxiliary shaft – remove and install		X		—	—	X	X	X
21 556	Seal – auxiliary shaft – replace		—	21 553 'B'	—	—	X	X	X
21 584 5	Ring gear – flywheel – replace (flywheel removed)	X	X		X	X	X	X	X

21 111 ENGINE – CHECK COMPRESSION

Testing Appliance Required:

Standard compression tester

The varying compression tester designs and fluctuating starter motor speed mean that for the most part one can only check for even compression in the individual cylinders. Measurement of the actual compression is dependant on several factors and requires certain pre-conditions. The engine should be at normal operating temperature and valve clearances must be set correctly.

NOTE: it is important also to disconnect the coil L.T. leads when removing H.T. leads. Failure to do this could constitute a fire risk or result in H.T. electrical shock.

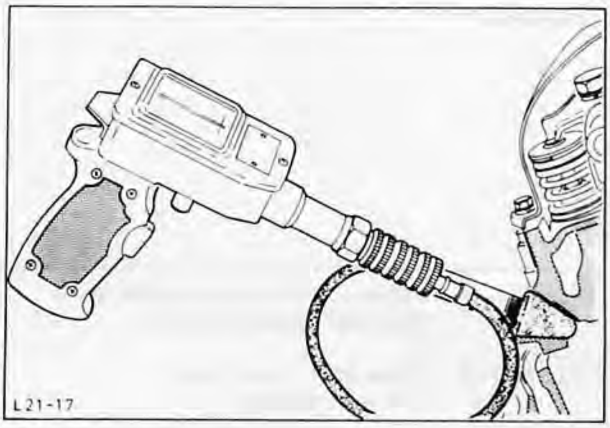


Fig. 7. Compression tester

To Check

1. Disconnect HT leads and remove spark plugs. Insert graph paper into tester. Press tester with its rubber seal tightly into spark plug orifice, Fig. 7. With throttle fully open, crank engine with starter motor until pointer of tester rises no further.

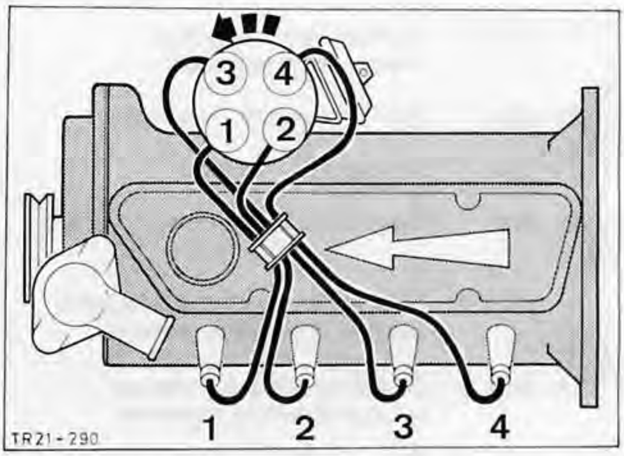


Fig. 8. HT leads (Firing order) 'A' engine

2. Vent tester, adjust graph paper for next cylinder and repeat procedure described in sub-operation 1 for each of other cylinders.

   Replace spark plugs and reconnect HT leads, Figs. 8 and 9.

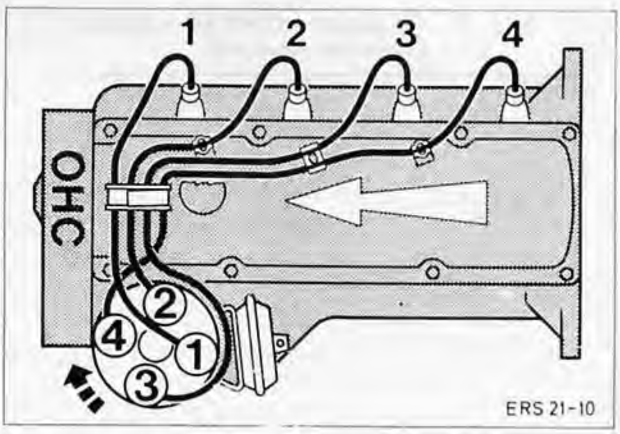


Fig. 9. HT leads (Firing order) 'B' engine

21 112 OIL PRESSURE – CHECK

Testing Appliance Required:

Oil pressure test gauge.

Oil pressure depends on various factors (engine speed, oil temperature, rotor clearance etc.). Pressure should always be checked at an oil temperature of 350 °K (80 °C) (175 °F). The oil pressure at idle should be at least 1 bar (1 kgf/cm²) (14 lbf/in²). Maximum pressure at speeds above 2000 rev/min should, however, not exceed 5 Bar (5 kgf/cm²) (71 lbf/in²).

If the pressures are outside these limits first eliminate the oil pump, Fig. 10, as the source of the fault. The following faults can occur, e.g:

Pressure too high at speeds over 2000 rev/min;

Failure of relief valve to open because of fouling;

Pressure too low at all engine speeds: Low oil level, clogged intake strainer, intake pipe broken or loose, oil pump worn etc;

Pressure too low at low engine speeds;

Relief valve jammed in the open position due to dirt.

To measure the oil pressure

1. Remove oil pressure switch lead connector and remove oil pressure switch, Fig. 11. In case of pressure gauge, remove pressure line and connector.
2. Connect test pressure gauge to engine block, using adaptors if necessary, Fig. 12
3. Start engine and check oil pressure at idling speed and at over 2000 rev/min.
4. Remove test pressure gauge and adaptor. Replace oil pressure switch or pressure gauge and connect up.

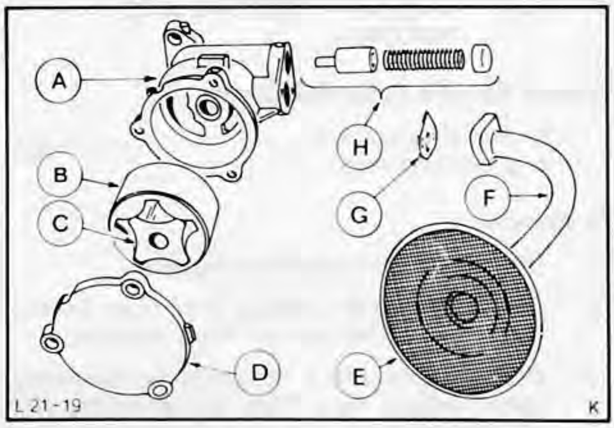


Fig. 10. Dismantled oil pump 'B' engine
A – Oil pump body
B – Outer rotor
C – Inner rotor
D – Cover
E – Strainer
F – Pick-up pipe
G – Gasket
H – Relief valve

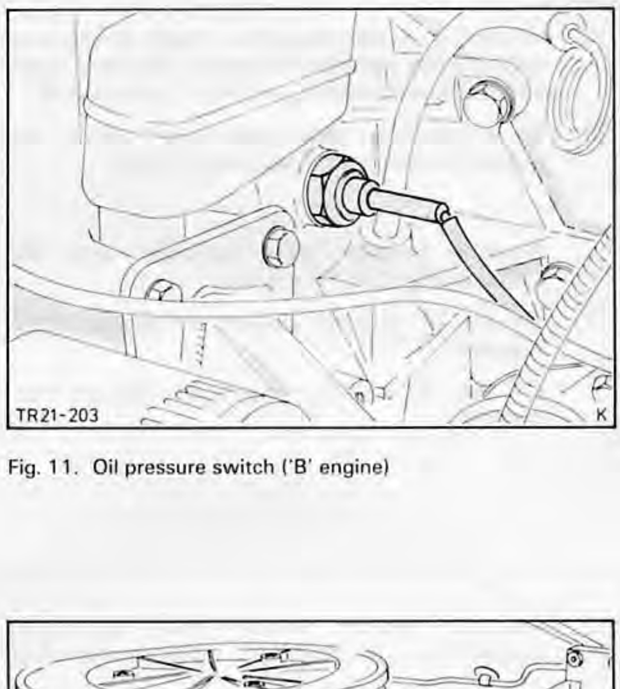


Fig. 11. Oil pressure switch ('B' engine)

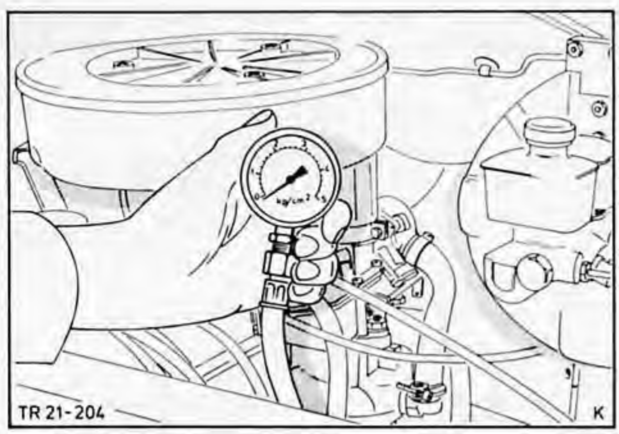


Fig. 12. Connect pressure gauge

21 134 ENGINE – REMOVE AND INSTALL

Special Service Tools Required:

Engine lifing bracket
Engine lifting eyes 21–068

To Remove

1. Disconnect earth lead from battery.
2. Disconnect screen washer hose from T-piece and retaining clip, remove hood (4 bolts).
3. Drain coolant into a receptacle by detaching lower radiator hose from water pump, Fig. 13, and disconnect top hose from thermostat housing and remove.
4. On the 'A' engine, unbolt fairing (4 bolts) and remove complete with radiator.

Sub Operations 5 and 6 only apply to the 'B' engine.

5. Disconnect hood cable from catch spring and unbolt from radiator grill panel. Remove right and left-hand headlamp units (2 bolts each).
6. Detach bumper side pieces from clips and unbolt bumper with brackets (2 nuts).

   Remove radiator grille complete with the radiator, Fig. 14 (19 bolts).
7. On the 'A' engine, detach air cleaner from brackets.

   On the 'B' engine, detach air cleaner with bracket.
8. Remove heater hoses from automatic choke/inlet manifold and water pump, Fig. 15.

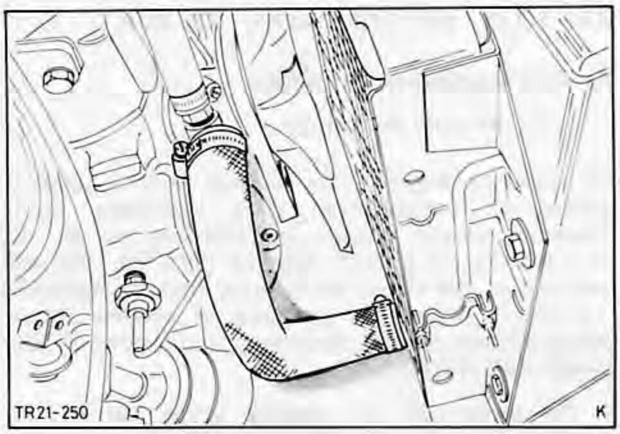


Fig. 13. Detach radiator hose from water pump ('A' engine)

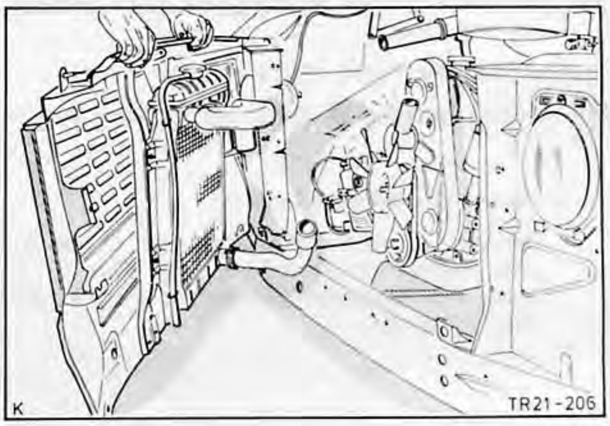


Fig. 14. Remove radiator grille panel with radiator (only necessary on 'B' engine)

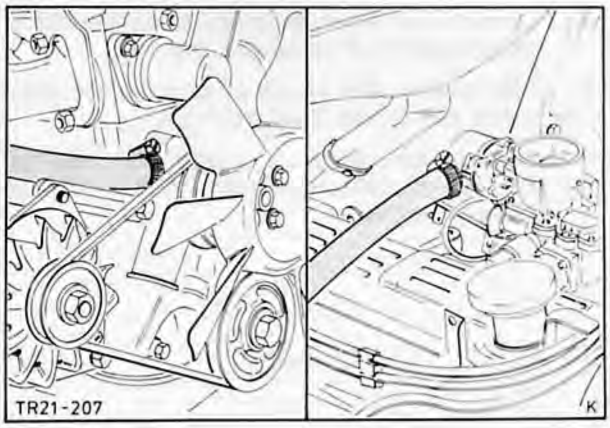


Fig. 15. Detach heater hoses ('B' engine)

9. Disconnect throttle cable from throttle linkage. Unbolt retaining bracket from inlet manifold (2 bolts) and detach with accelerator cable. Disconnect choke cable, when fitted.
10. Detach fuel line from petrol pump, Fig. 16. Detach brake servo vacuum hose from inlet manifold.

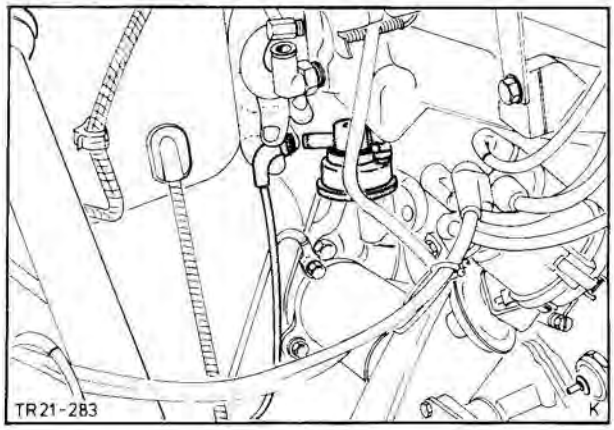


Fig. 16. Remove fuel line from petrol pump ('A' engine)

11. Disconnect leads from oil pressure switch, alternator, temperature gauge sender unit, coil and idling cut-off valve.
12. Disconnect starter leads and remove starter motor (3 bolts), unbolt exhaust pipe from exhaust manifold (2 bolts), Fig. 17.

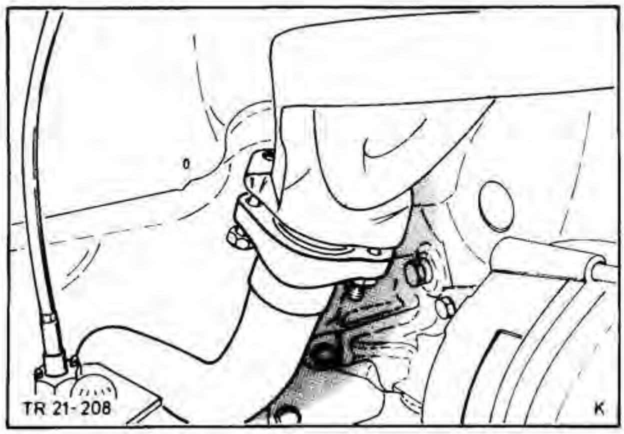


Fig. 17. Unbolt exhaust pipe ('B' engine)

13. Attach engine lifting bracket to engine. Remove both engine mountings by undoing the four bolts of each from the block and the lower nut of rubber insulators. Remove clutch housing cover (3 bolts or 2 clips).
14. Disconnect engine from clutch housing flange (6 bolts) and at the same time detach earth and positive leads of battery when applicable.
15. Support gearbox, move engine forwards with engine lifting gear and lift out of vehicle, Fig. 18.

    NOTE: Turn 'A' engine at right angles to longitudinal axis of vehicle before lifting it out.

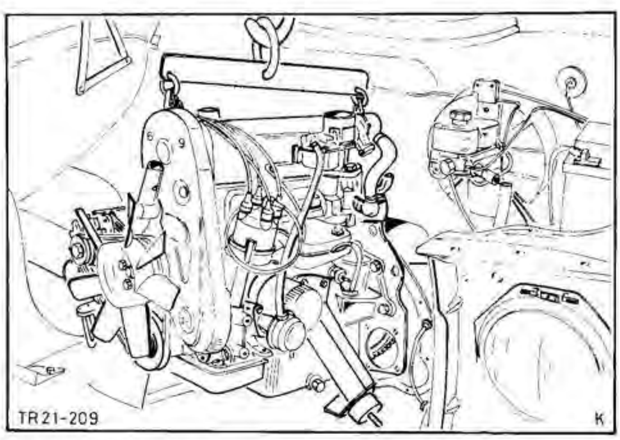


Fig. 18. Lift out engine with Special Tool 21–068

To Install

16. If necessary, transfer guide bushes from clutch housing to engine block and attach adaptor plate, Fig. 19. Lightly grease input shaft.

    Make sure clutch release lever is located correctly.

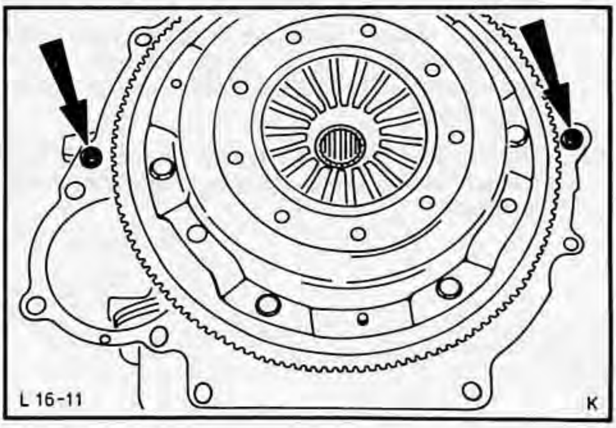


Fig. 19. Clutch housing dowel bushes, 'B' engine

17. Locate engine in vehicle using lifting gear.

    NOTE: Insert 'A' engine at right angles to longitudinal axis of vehicle and turn inside engine compartment.

    Slide engine on gearbox input shaft until it comes to rest against clutch housing flange then tighten bolts to prescribed torque. Refer to Technical Data. Also attach battery earth and positive leads when fitted. Remove support from gearbox.

18. Bolt engine mountings to cylinder block and secure rubber insulators to engine bearer to prescribed torque. Refer to Technical Data. Detach engine lifting gear and fit clutch housing cover.

19. Fix exhaust pipe to exhaust manifold with seal and retaining flange. Refit starter motor and connect starter motor lead, Fig. 20.

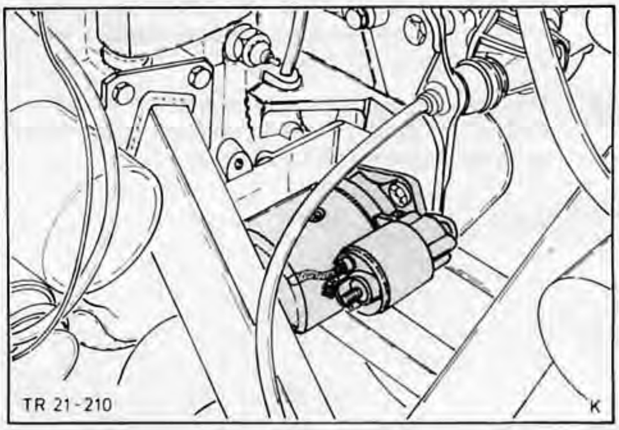


Fig. 20. Starter motor fitted in position ('B' engine)

20. Check clutch play and adjust if necessary. Reconnect leads to alternator, temperature gauge sender unit oil pressure switch and coil.

21. Connect brake servo vacuum hose to inlet manifold and attach lead to idling shut-off valve, Fig. 21.

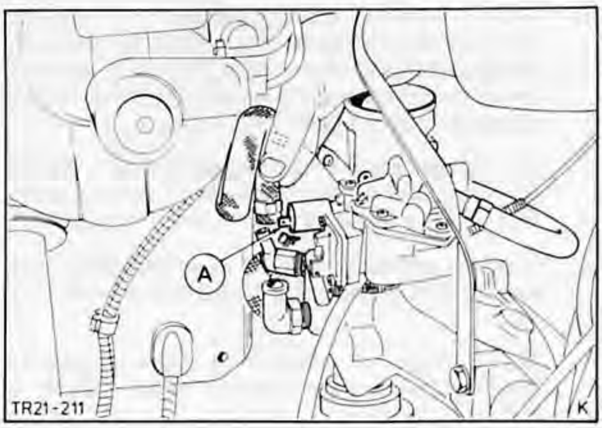


Fig. 21. Brake servo vacuum hose ('A' engine)
A – Idling cut-off valve

22. Secure fuel line to petrol pump. Attach throttle cable to throttle linkage and bolt retaining bracket securely to inlet manifold. Attach choke operating cable and adjust.
23. Attach heater hoses to water pump and automatic choke or inlet manifold, Fig. 22.
24. On the 'A' engine, install radiator complete with fairing and bolt securely.

Sub operations 25 and 26 only apply to 'B' engine.

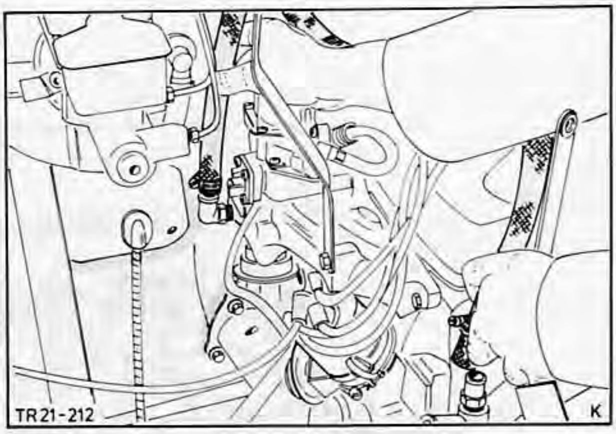


Fig. 22. Attach heater hoses ('A' engine)

25. Install radiator grille complete with radiator, Fig. 23, and bolt securely. Attach bumper with bracket and fit side pieces.
26. Refit both headlamp units. Connect hood cable to catch spring and secure to radiator grille panel. Adjust hood cable, Fig. 24.
27. Attach top and bottom radiator hoses and tighten fixing clips. Pour in coolant. Check engine oil level, topping up if necessary.
28. Attach hood and align correctly.

    Slip hose of screen-washer onto T-piece and secure.
29. Attach earth lead to battery and complete engine adjustments at normal working temperature. Refer Sections 22 and 23A. Dwell angle, ignition timing, idling speed and CO content.
30. Recheck coolant level after reaching thermostat opening temperature. Then fit air cleaner.

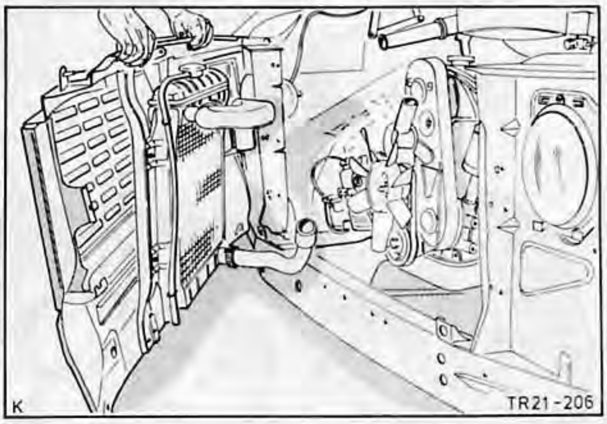


Fig. 23. Install radiator grille panel with radiator (only necessary with 'B' engine)

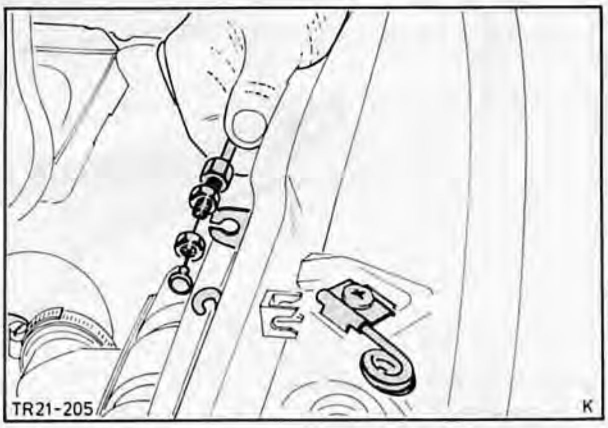


Fig. 24. Attach hood cable (only necessary with 'B' engine)

ENGINE 'A'

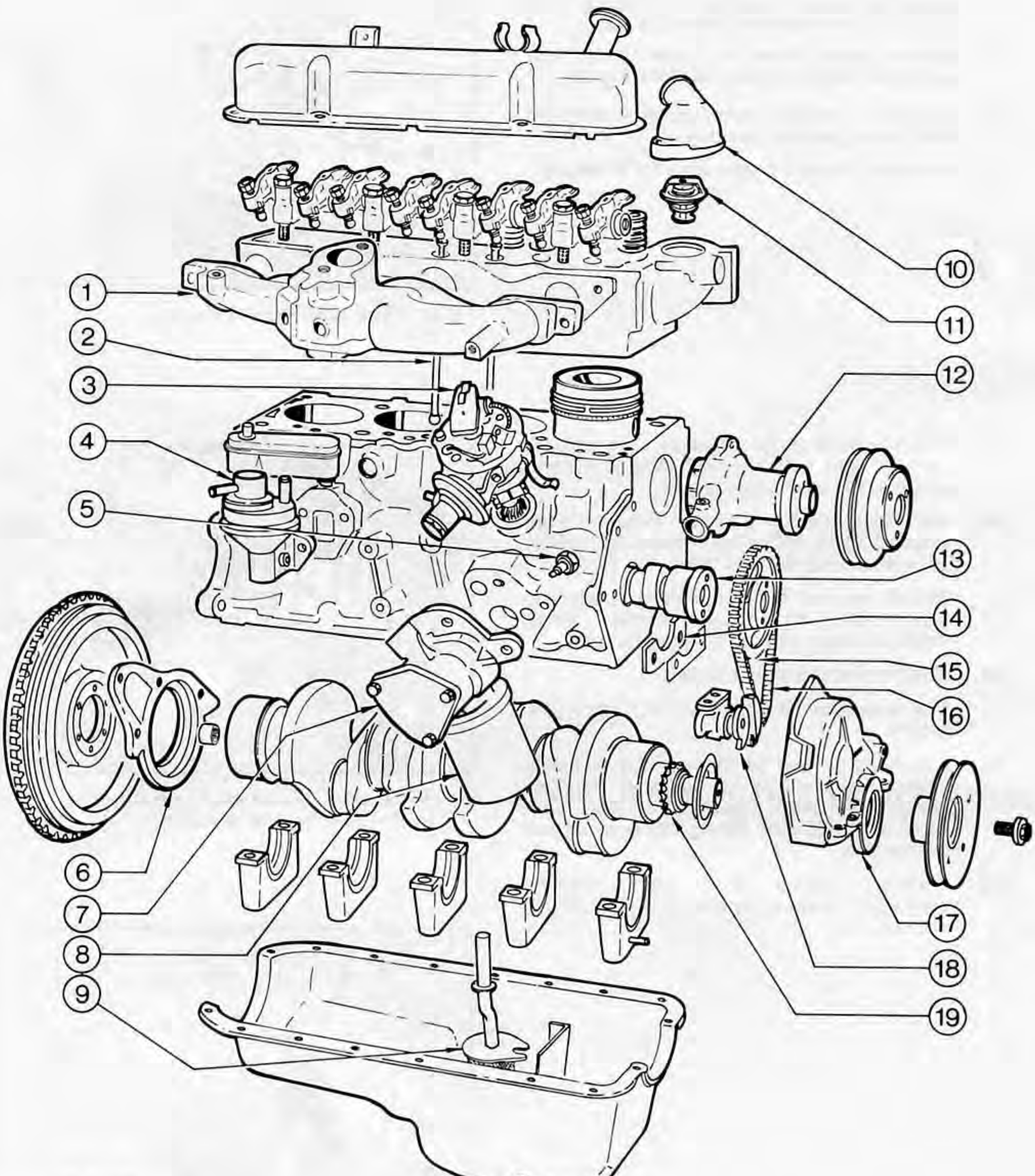


Fig. 25. 'A' engine, exploded view

1. Inlet manifold
2. Valve pushrod
3. Distributor
4. Petrol pump
5. Oil pressure switch
6. Crankshaft oil seal carrier
7. Oil pump
8. Oil filter
9. Oil pump strainer with suction pipe
10. Water outlet connection
11. Thermostat
12. Water pump
13. Camshaft
14. Camshaft thrust plate
15. Camshaft sprocket
16. Timing chain
17. Timing cover with gasket
18. Chain tensioner
19. Crankshaft sprocket

Lubrication circuit, Fig. 26

The oil pump draws oil via a strainer from the oil sump and feeds it into the full-flow oil filter. The filtered oil, passing along the central axis of the oil filter cartridge, reaches the oil pressure switch via a short drilling (on the right-hand side of the engine) and the main oil gallery (on the left-hand side of the engine) via a transverse drilling. The main bearings have direct connections to the main oil gallery and the camshaft bearings in their turn have connections to the front, centre and rear main bearings. The big end journals are supplied with oil through diagonal drillings from the nearest main bearing. An oil bore in the big end ensures splash lubrication of the piston pins and the trailing side of cylinders. The timing chain and sprockets are also lubricated via a splash oil drilling. The front bearing journal of the crankshaft has a pad at its centre from which the pressurised oil is supplied intermittently to the rocker shaft (via a drilling in the cylinder block and cylinder head).

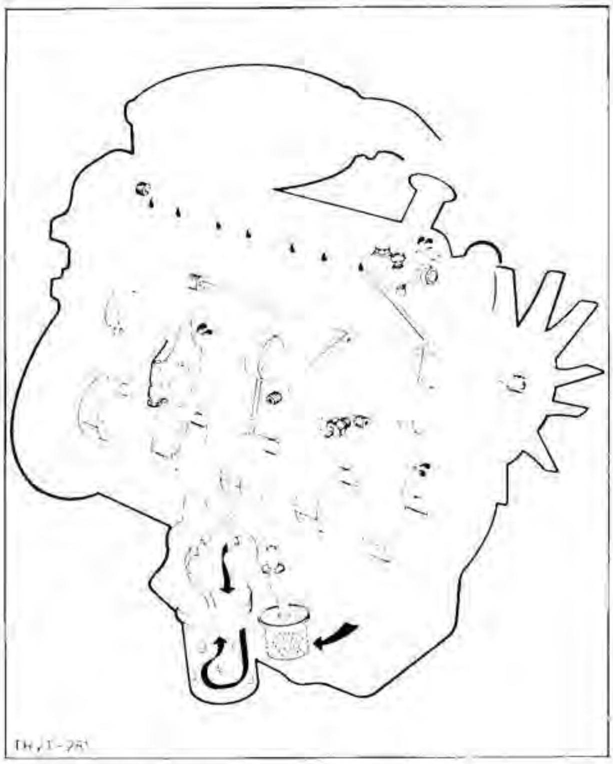


Fig. 26. Oil flow

Closed ventilation system, Fig. 27

The ventilation of the crankcase depends on the amount of air drawn by the engine when it is running and on the throughput of the vent valve. Fresh air enters at the rocker cover via the oil filler neck, flows through the crankcase and is drawn in by the running engine through the vent valve on the right hand side of the engine and burnt with the carburettor mixture. The vent valve controls the rate of air flow as a function of the engine load.

The vent valve, like the steel-wool filter in the oil filler cap, must be cleaned with a cleaning agent and/or replaced at the specified intervals.

Fig. 27. Closed ventilation system

21 134 8 ENGINE ASSEMBLY – DISMANTLE AND REASSEMBLE (Engine removed)

Special Service Tools Required:

Engine stand	Löwener or Churchill
Universal spindle	21–023
Crankshaft rear oil seal installer	21–030
Engine mounting bracket	21–031
Cylinder head bolt wrench	21–034
Crankshaft bearing remover	21–036
Flywheel bearing installer and clutch disc aligner	21–080

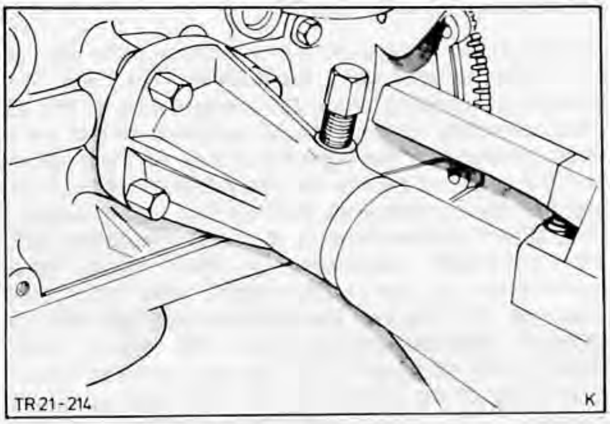


Fig. 28. Secure engine to stand using mounting bracket 21–031

To Dismantle

1. Secure engine to stand by means of engine mounting bracket 21–031, and universal spindle 21–023, Fig. 28.
2. Remove clutch pressure plate (6 bolts) and clutch disc from flywheel, Fig. 29.

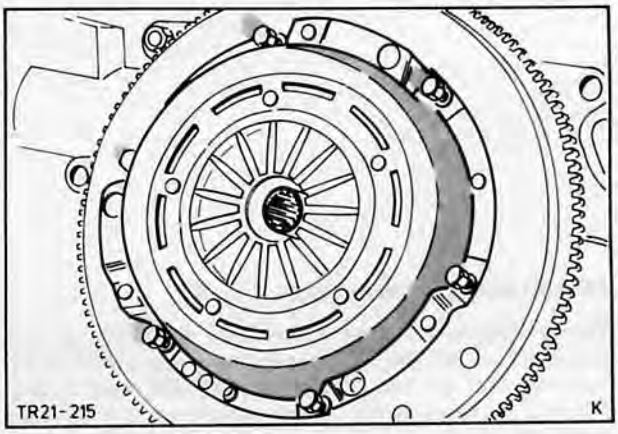


Fig. 29. Remove clutch pressure plate with clutch disc from flywheel

3. Drain engine oil and remove oil filter using oil filter wrench, Fig. 30.
4. Disconnect HT leads and remove distributor cap and leads. Remove spark plugs.
5. Disconnect vacuum advance line from carburettor.

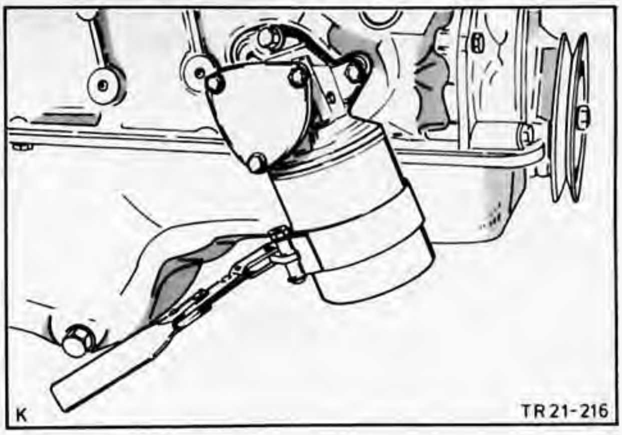


Fig. 30. Remove oil filter

6. Disconnect fuel line from carburettor and withdraw breather hose together with vent valve from oil separator.
7. Slacken alternator bracket. Take off V-belt and remove alternator with its bracket (3 bolts), Fig. 31. Remove fan and pulley (4 bolts).

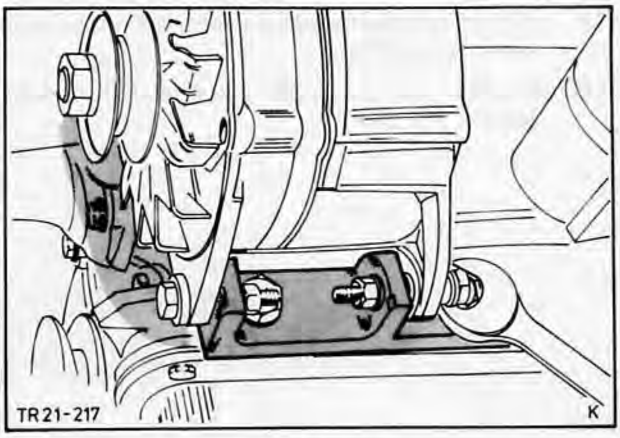


Fig. 31. Remove alternator with bracket

8 Remove crankshaft pulley (1 bolt), using Special Tool, Fig. 32 and rocker cover (4 screws).
9. Remove water connection (2 bolts). Remove gasket and take thermostat out of cylinder head.

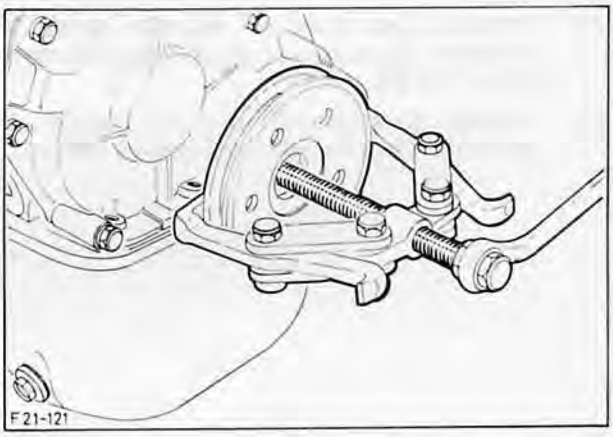


Fig. 32. Pull off crankshaft pulley using Special Tool

10. Detach rocker shaft (4 bolts), Fig. 33, and remove push rods. **Do not interchange push rods when reinstalling.**
11. Remove cylinder head bolts (10 bolts), unscrewing them in reverse order from that in which they were tightened. (See Fig. 67 for tightening sequence.)

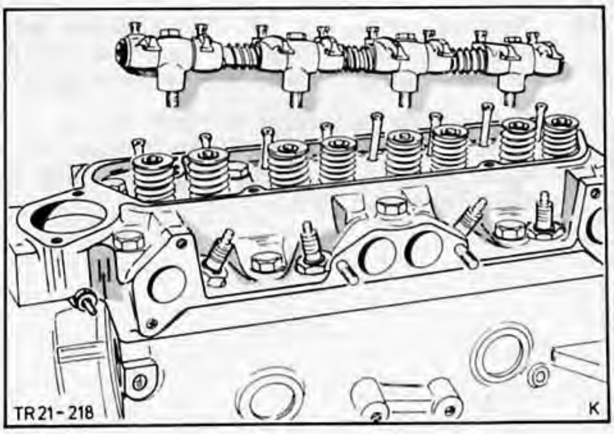


Fig. 33. Remove rocker shaft

21 134 8 (cont'd)

12. Lift off cylinder head complete with inlet and exhaust manifolds.
13. Detach fuel pump (2 bolts) together with spacer, Fig. 34.

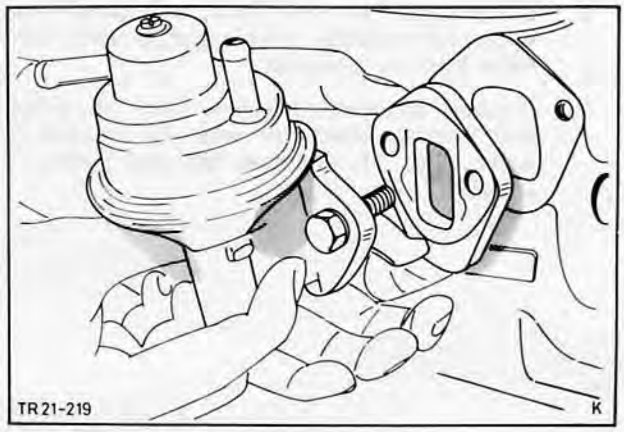


Fig. 34. Remove fuel pump

14. Withdraw bolt from oil separator. Prise oil separator out of engine block, using a screw-driver, Fig. 35.
15. Remove distributor (1 bolt) and detach oil pump (3 bolts). Remove oil pressure switch.

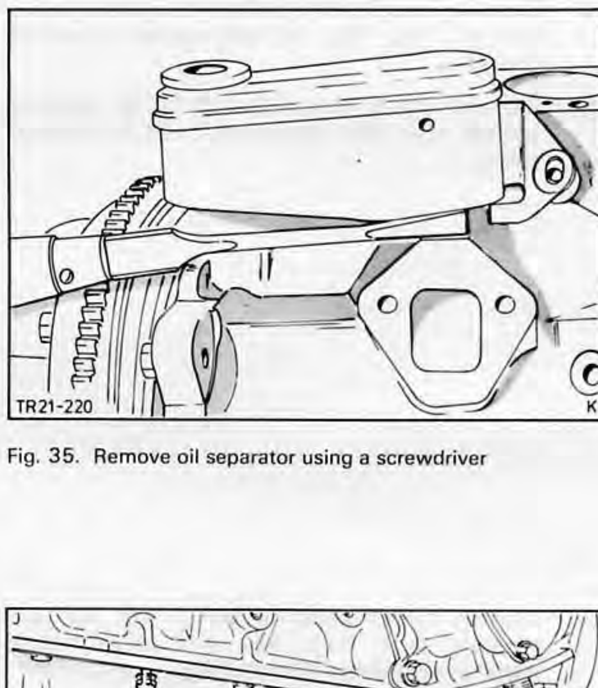


Fig. 35. Remove oil separator using a screwdriver

16. Remove sump, Fig. 36. Detach sump with engine mounted upright in the stand. This is to avoid sludge or swarf getting into engine.
17. Set pistons at centre of their stroke and remove carbon deposits from cylinder head faces using a suitable scraper, without touching piston bore.

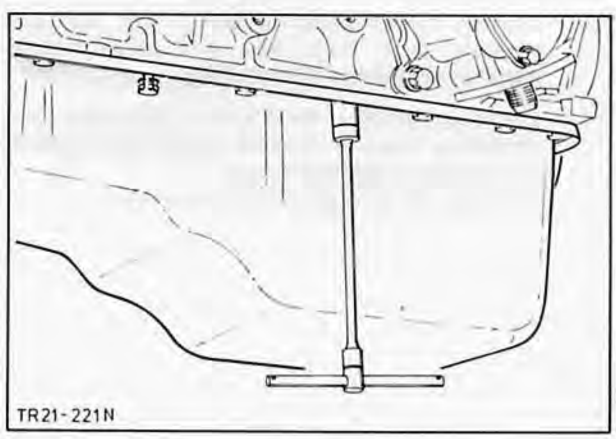


Fig. 36. Detach oil sump

18. Place a large tray under engine, invert engine and catch remaining oil, the carbon which has been detached and coolant.
19. Remove water pump (3 bolts), Detach timing cover (4 bolts) and remove oil slinger from crankshaft, Fig. 37.

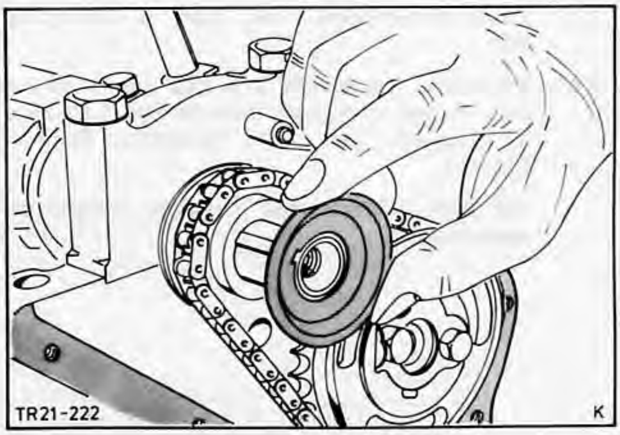


Fig. 37. Remove oil slinger

20. Detach oil pump suction pipe (1 bolt) and moving it to and fro, withdraw it from cylinder block.
21. Withdraw tensioner arm from pin of front mainbearing cap and detach chain tensioner (2 bolts), Fig. 38.

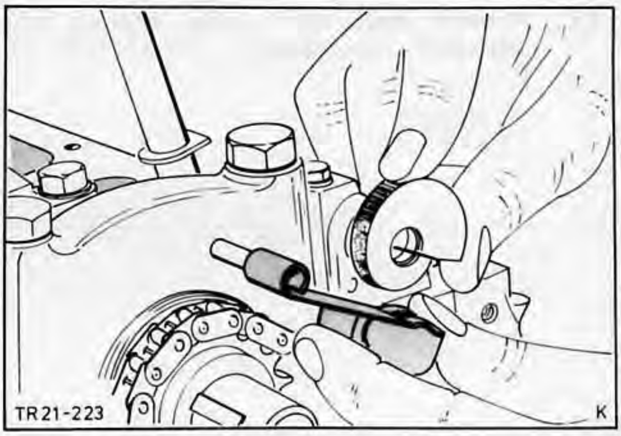


Fig. 38. Detach chain tensioner arm

22. Bend over lock tabs, remove two bolts and detach camshaft gear complete with timing chain, Fig. 39.

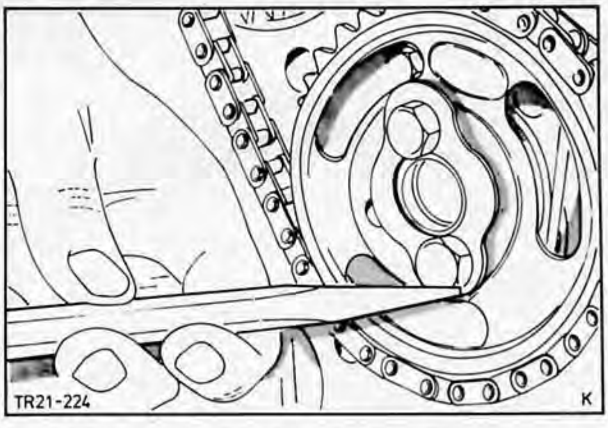


Fig. 39. Bend back camshaft sprocket lock tab

21 134 8 (cont'd)

23. Remove camshaft thrust plate (2 bolts), Fig. 40.
24. Withdraw camshaft towards front, having first turned camshaft through 360° to bring all tappets into TDC position. Remove tappets.

    Do not interchange tappets when re-assembling.

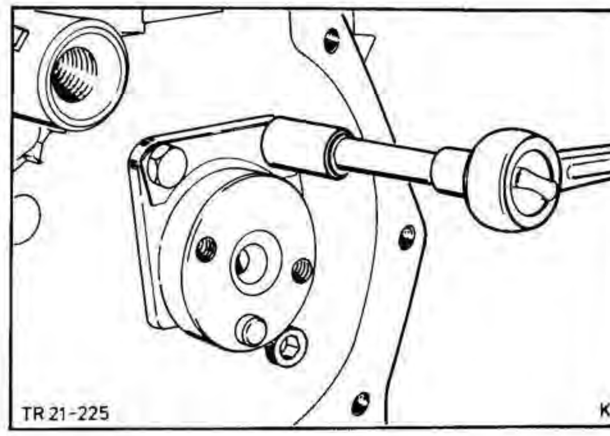


Fig. 40. Remove camshaft thrust plate

25. Remove input shaft spigot bearing from crankshaft using Special Tool 21–036, Fig. 41.

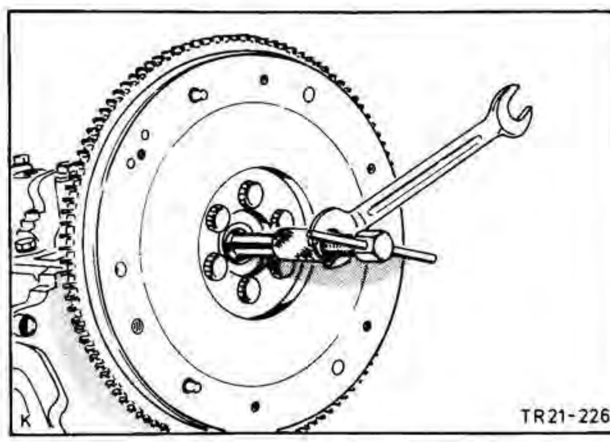


Fig. 41. Withdraw crankshaft needle bearing using Special Tool 21–036

26. Pull off crankshaft gear using standard puller, Fig. 42.

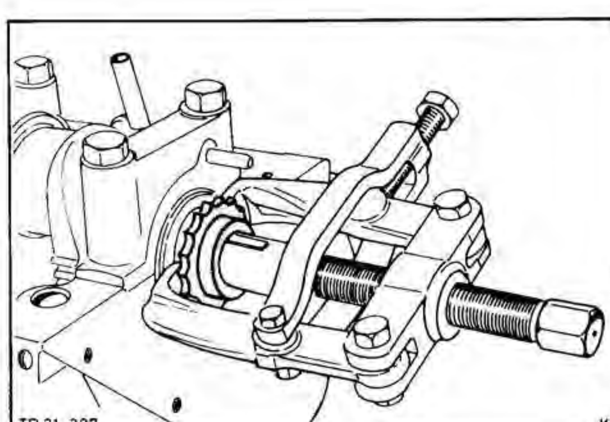


Fig. 42. Pull off crankshaft sprocket using standard puller

27. Check markings of big end and main bearing caps, Fig. 43, for subsequent reassembly.

28. Remove big end bearing caps one by one, together with bearing shells. Push pistons complete with connecting rods and bearing shells out of engine. If big end bearing shells are removed before pistons are taken out, mark shells to correspond with connecting rods, for purposes of subsequent reassembly.

29. Detach flywheel (6 bolts) and rear cover plate.

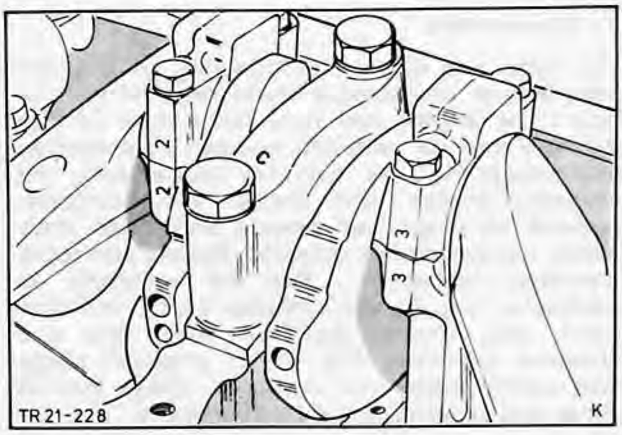


Fig. 43. Markings of big end bearing caps

30. Remove rear oil seal carrier (4 bolts), Fig. 44.

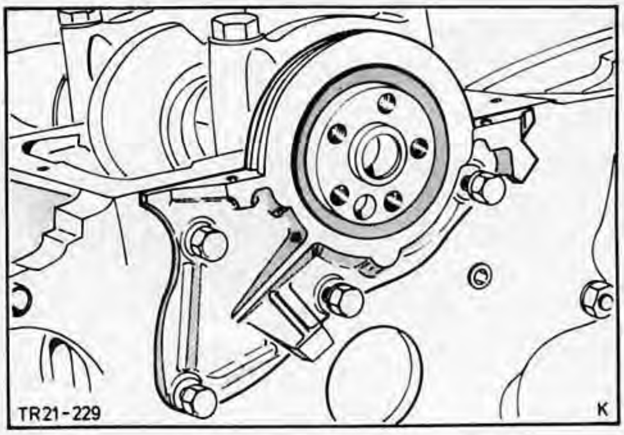


Fig. 44. Remove rear oil seal carrier

31. Remove main bearing caps complete with bearing shells.

32. Lift crankshaft out of the cylinder block, remove bearing shells and both half thrust washers of middle main bearing, Fig. 45, and mark for possible re-use.

33. Remove oil seals from timing cover and rear oil seal carrier.

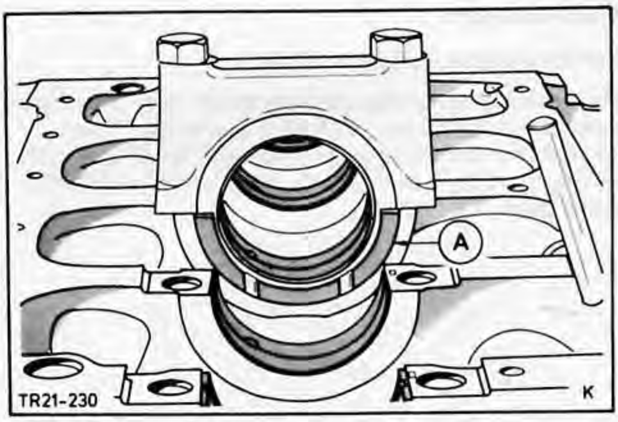


Fig. 45. Cylinder block with half thrust washer fitted
A – Half thrust washer

To Reassemble

The type and degree of cleaning of a given part before reassembly must depend on the hours the engine has run, the extent of any damage and its possible re-use. This applies particularly to the cylinder block with its corners, angles and bores. If necessary, remove all plugs and covers and clean their seats, using suitable cleaning agents and tools (brushes, scrapers). The oil galleries in particular, e.g. in the cylinder block, cylinder head, etc. should be free from dirt and abrasive particles, Fig. 46. If press-fit plugs and screw plugs are removed, they, like all seals and gaskets, should be renewed.

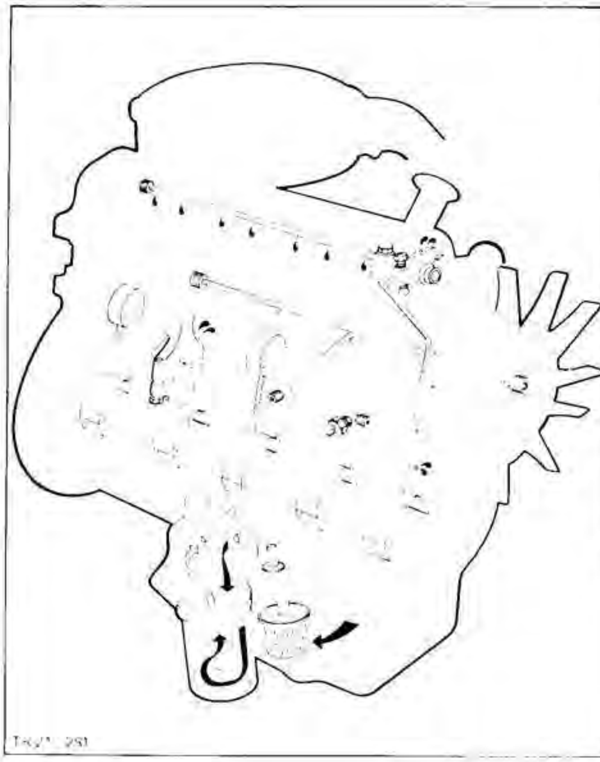


Fig. 46. Oil circuit

Main Bearings

Parent bore in cylinder block

The parent bore in the cylinder block may be either standard or 0,38 mm (0,015 in) oversize. There is no marking for the standard parent bore, but with an oversize bore the bearing caps are marked with white paint, Fig. 47.

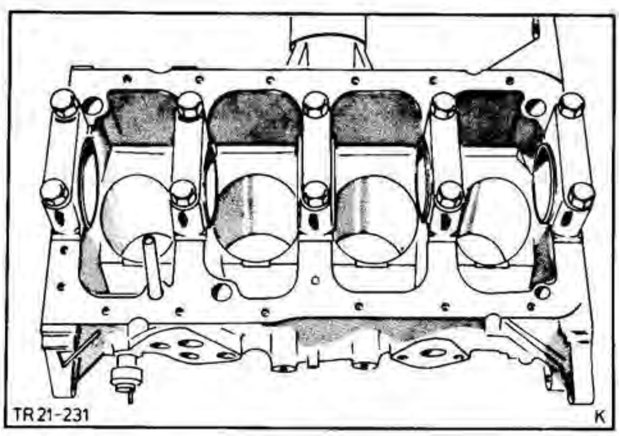


Fig. 47. Colour marking of main bearing caps

Crankshaft main bearing journals

The crankshaft main bearing journals may be standard or (also in new engines) 0,25 mm (0,01 in) undersize. Standard main bearing journals are not marked, while the crankshaft web adjacent to an undersize main journal is marked with a green stripe, Fig. 48.

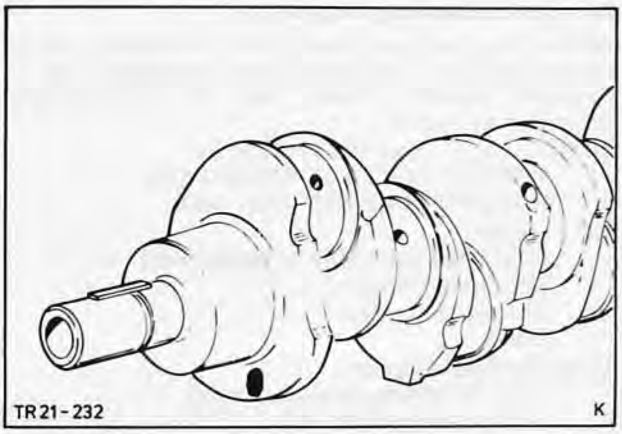


Fig. 48. Colour marking of main bearing journal

Big end bearing journals

The big end bearing journals may also be standard or (also in new engines) 0,25 mm (0,01 in) undersize.

Standard big end bearing journals are not marked, while the undersize is marked with a green paint spot on the web next to the journal, Fig. 49.

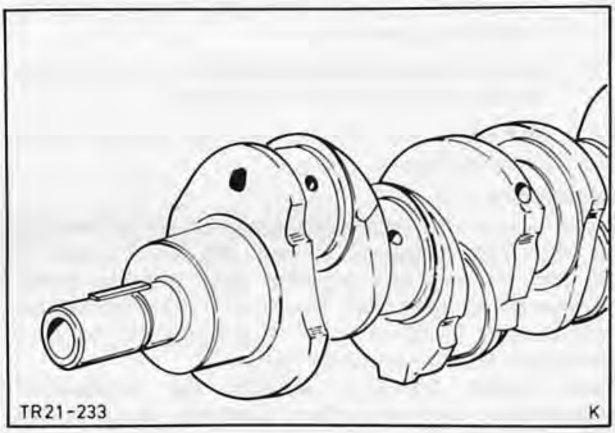


Fig. 49. Big end bearing journal colour marking

Bearing shells

Standard main bearing and big end bearing shells are not marked. Bearing shells for undersize crankshafts or oversize cylinder blocks have an appropriate inscription on the back (see Parts Catalogue) while colour markings on production repair sizes are on the outer edge at the side, Fig. 50, with the exception of pure service main and big end bearing shells (0,5/0,75/and 1,0 mm (0,02/0,03/0,04 in) undersize crankpins).

When selecting new bearing shells, it should be verified against the Parts Catalogue that they are the appropriate ones and, in addition, they should be measured.

In order to remain within the specified tolerances (see Technical Data), the journals, parent bores and bearing shells should be measured individually.

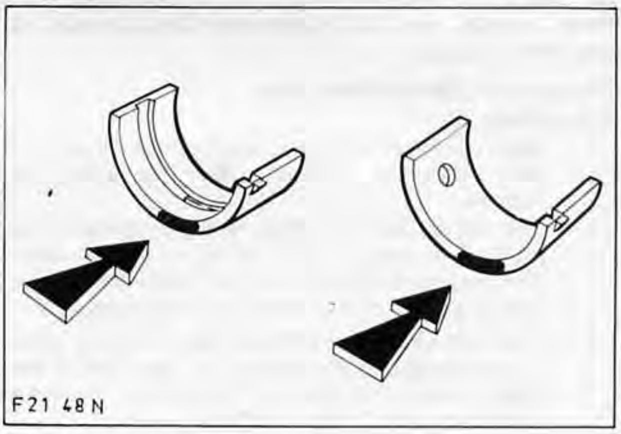


Fig. 50. Bearing shell colour coding
(Production-repair size)

Measuring bearing clearance

Measuring bearings (even with undersize crankshafts) can be eliminated and determination of required bearing shells can be considerably simplified by use of:

'PLASTIGAGE' (type PG 1) made by:
PERFECT CIRCLE CORPORATION
HAGERSTOWN, INDIANA, USA.

UK Supplier:
NORMAN GAYDON (International) Ltd.
68 London Road
Southend-on-Sea
Essex.

West German supplier:
K. H. ERN/Motorenteile GmbH
Schinkelstrasse 46–48
D-4000 Dusseldorf.

'PLASTIGAGE' is the name of an accurately calibrated plastic filament.

Requirements for use of 'Plastigage'

1. Bearing should be dry and clean.
2. Crankshaft should not be turned during measuring operation.
3. Points of measurement should be close to top and bottom dead centre position.
4. Bearing caps should not be seated with hammer blows.

Procedure

Place length of Plastigage across width of bearing on crankshaft or big end journal, Fig. 51. Fit main or big end bearing cap together with bearing shells and torque as specified. The plastic filament will be compressed more or less depending on bearing clearance. Remove bearing cap.

Each main bearing should be measured separately without other bearing caps being fitted.

Width of compressed plastic filament can be measured by means of scale printed on PLASTIGAGE pack, Fig. 151, reading shows bearing clearance.

Only bolts in good condition should be used for securing bearing caps on crankshaft and they should not be tightened in excess of specified torque.

Measuring Piston Clearance

Procedure

1. When reassembling an engine the piston to bore clearance should be measured as follows.
2. The diameter of the piston should be measured when cold, using a micrometer. The measurement should be made across the piston skirt at 90° to the piston pin axis.
3. This micrometer reading is then used to 'zero' a bore gauge. The reading on the dial of the bore gauge in situ is the piston to bore clearance (see Technical Data).
   Alternatively, the bore can be measured with an internal micrometer, and the piston size subtracted to give the piston to bore clearance.
4. The measurement must be taken below any visible wear marks in the bore. To detect bore ovality, two readings should be taken at 90° to each other.
   NOTE: The maximum difference between these two readings should not be more than 0,025 mm (0,001 in).
5. Inspect the bores for visible wear, damaged lips, etc.
6. If the clearance in sub-section 3 above is excessive, or if ovality, or any of the faults in sub-section 5 above is detected, the block should be rebored to suit oversize pistons.
7. Before installing pistons, check piston ring gaps.
8. Before fitting the pistons, check ring gaps (Fig. 52). Indicated values (see Technical Data) are for the gauge ring used in production and can be exceeded by 0,15 mm, measuring in the cylinder.

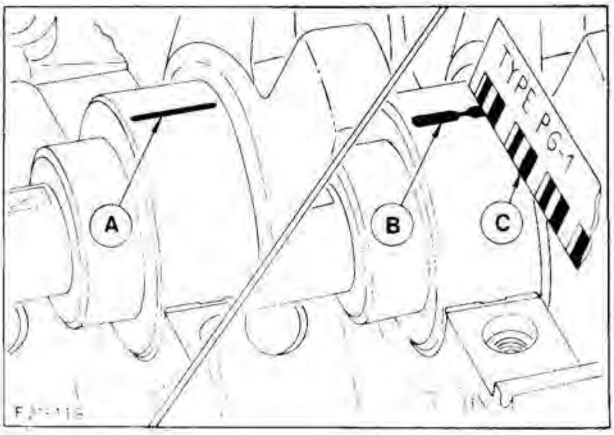


Fig. 51. Measuring bearing clearance
A – Calibrated plastic filament
B – Compressed filament
C – Scale

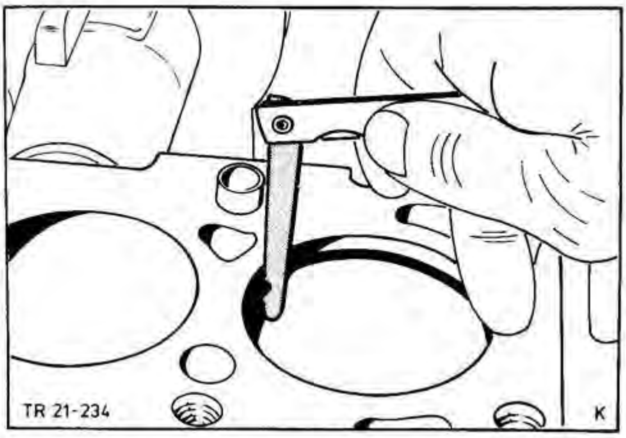


Fig. 52. Check piston ring gaps

To Assemble

34. Press oil seal into oil seal carrier using Special Tool 21–030 and oil Seal into timing cover using a suitable tube, Fig. 53.

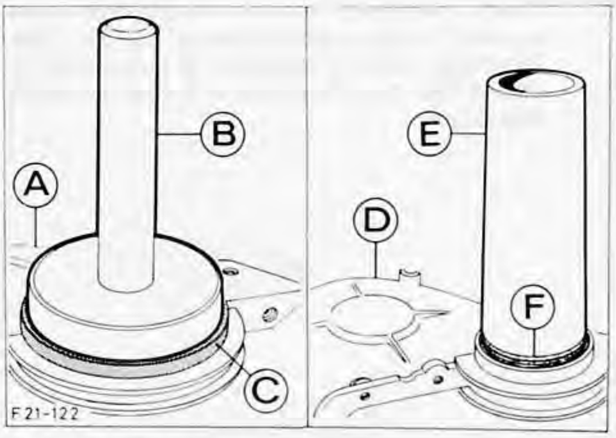


Fig. 53. Press in oil seals
A – Oil seal installer
B – Secial Tool 21–030
C – Oil seal
D – Front cover
E – Tube
F – Oil seal

35. Insert new crankshaft spigot bearing using Special Tool 21–080, Fig. 54, and press into crankshaft. Line up crankshaft sprocket on spring washer and press on.

36. Oil tappets and insert them into cylinder block.

37. Oil camshaft bearings, camshaft and thrust plate. Insert camshaft from front. Attach thrust plate and torque as specified and lock bolts with lock tabs.

38. Insert main bearing shells and half thrust washers dry in block, apply engine oil and then fit crankshaft.

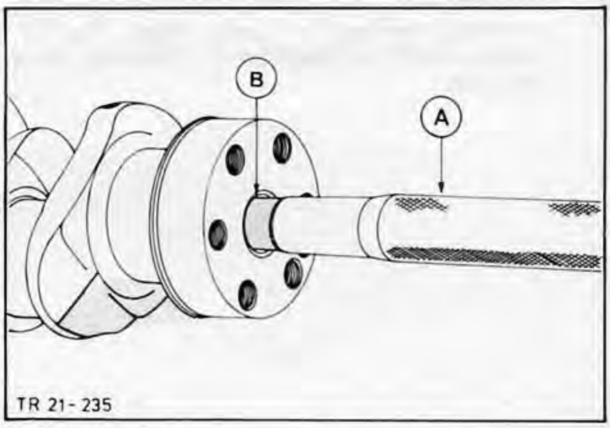


Fig. 54. Press crankshaft needle pilot into position
A – Special Tool 21–080
B – Guide bearing

39. Fit main bearing caps complete with oiled bearing shells.

The arrows on main bearing caps should point towards front of engine. Fig. 55.

40. Tighten bearing cap bolts uniformly to torque specified in Technical Data.

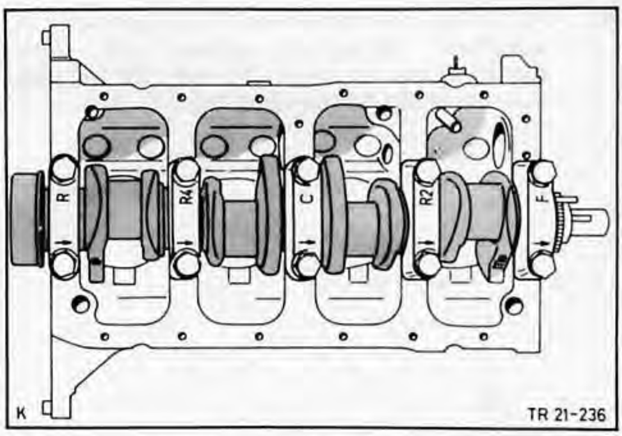


Fig. 55. Main bearing caps in position

21 134 8 (cont'd)

41. Check end-float of the crankshaft and camshaft using a dial indicator, Fig. 56. (See Technical Data). If end-float is excessive, fit thicker half thrust washers or a new camshaft thrustplate.

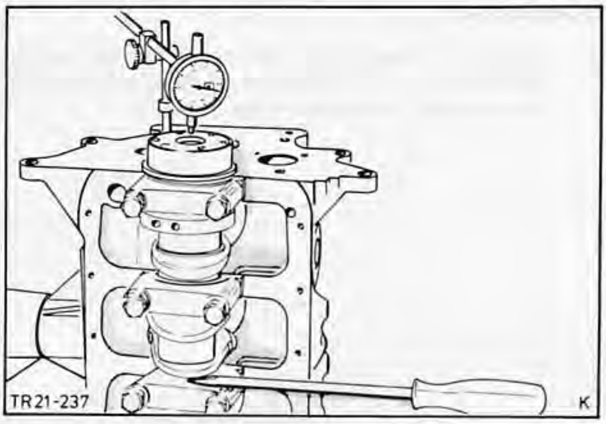


Fig. 56. Check end-float of crankshaft

42. Fit camshaft gear together with timing chain, ensuring markings on gears align, Fig. 57. Torque bolts as specified in Technical Data and lock.

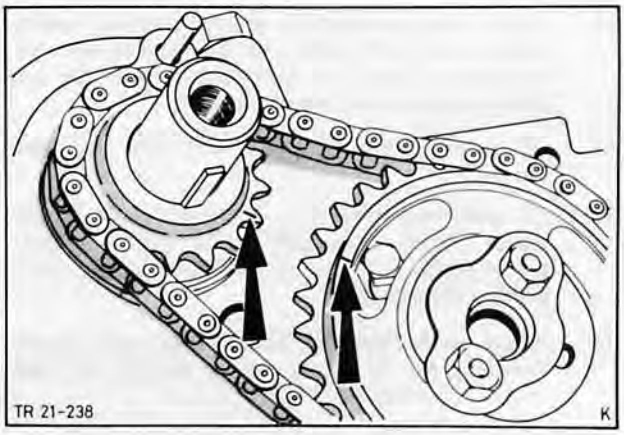


Fig. 57. Sprocket markings

43. Fit timing chain tensioner and torque bolts as specified. Compress spring and slide tensioner arm on to pin on main bearing cap. Release chain tensioner spring, Fig. 58.

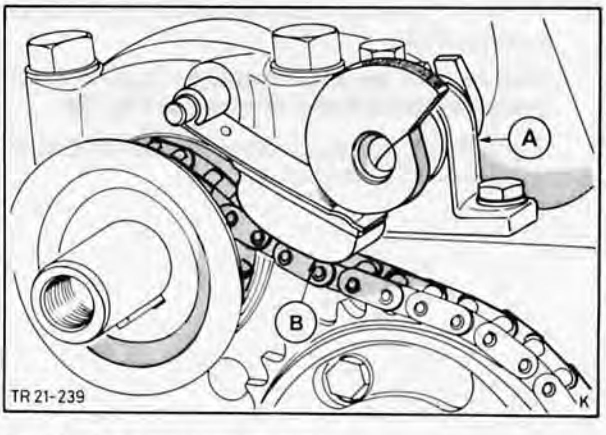


Fig. 58. Chain tensioner installed
A – Chain tensioner
B – Tensioner arm

44. Slide on oil slinger. Centre front cover equipped with a new oil seal (sealing lip lightly lubricated) with crankshaft pulley, Fig. 59.

45. Tighten bolts of front cover and crankshaft pulley to specified torque.

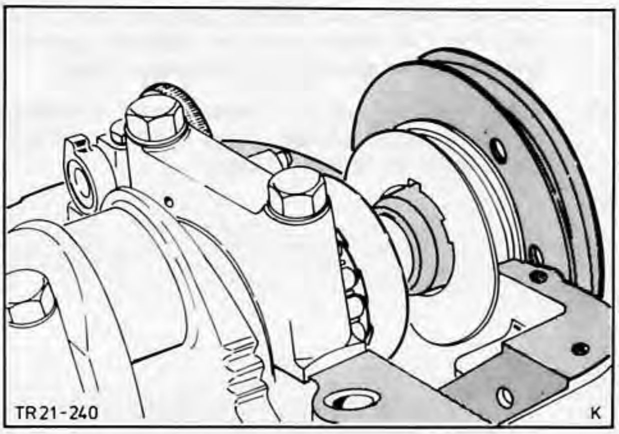


Fig. 59. Centre front cover with crankshaft pulley

46. Refit rear oil seal carrier fitted with a new oil seal (sealing lip lightly lubricated). Tighten oil seal carrier bolts to specified torque.

47. Invert engine and position rear cover. Fit flywheel, Fig. 60, and torque as specified in Technical Data.

Re-use only bolts, which are in good condition and lubricated.

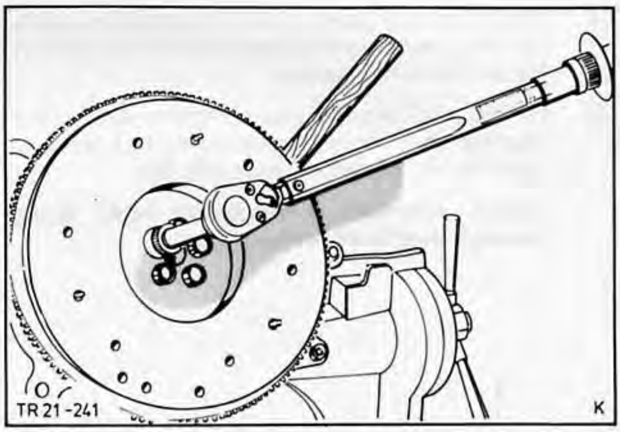


Fig. 60. Fit flywheel

48. Position clutch disc using Special Tool 21–080, Fig. 61. Place pressure plate on dowels and torque as specified in Technical Data.

49. Apply engine oil to pistons and cylinder bores. Stagger piston rings with specified gaps. Refer to Technical Data.

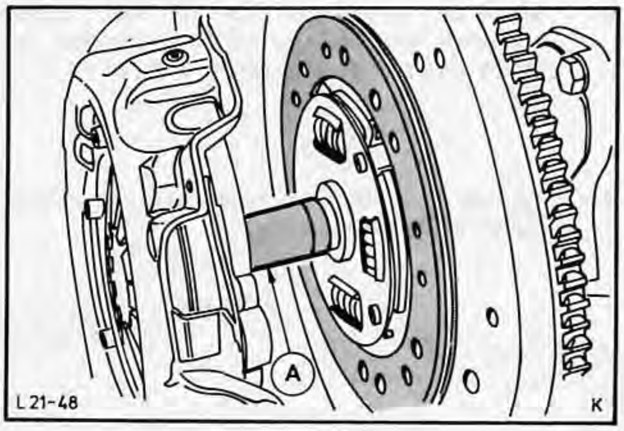


Fig. 61. Centre clutch disc and pressure plate
A – Special Tool 21–080

50. Compress piston rings with a standard tool (ring compressor), Fig. 62. Slide piston into cylinder using a hammer handle, guiding connecting rod on to big end journal by hand.

The 'front' marking on piston (arrow, notches, etc.) should point towards front cover.

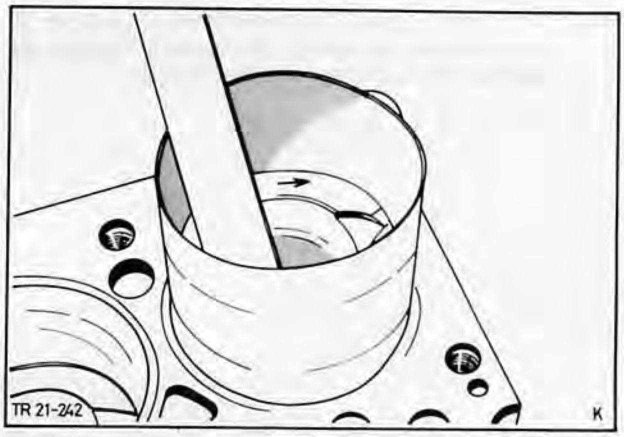


Fig. 62. Fit piston using a ring compressor

51. Place big end bearing shell in position, apply oil and press connecting rod firmly against big end bearing journal.

52. Fit big end bearing cap complete with oiled bearing shell. Torque connecting rod bolts as specified in Technical Data, Fig. 63.

Check whether connecting rods have enough endfloat on journals.

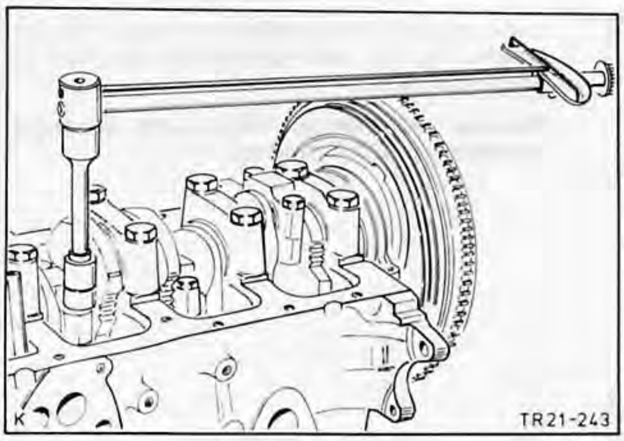


Fig. 63. Torque connection rod bolts as specified in Technical Data

53. Apply metal jointing compound (Loctite) to oil pump suction pipe and press in position. Torque bolts as specified in Technical Data.

54. Insert rubber seal in groove of rear seal carrier and locate cover.

    Apply sealing compound to cylinder block mating surface at joint of cover and rear seal carrier. Place sump gasket in position and slide projections on cork gasket under cut-outs in rubber gasket, Fig. 64.

55. Place sump in position and torque bolts as specified, in two stages.

    1st stage 4,7 Nm (0,4 to 0,7 kgf.m) (4 lbf.ft)

    2nd stage 8,11 Nm (0,8 to 1,1 kgf.m) (7 lbf.ft)

56. Crank engine.

    Insert oil separator up to stop and secure with bolt.

57. Torque oil pressure switch as specified in Technical Data.

58. Fit water pump with gasket, Fig. 65, only tighten bolt of alternator bracket finger-tight.

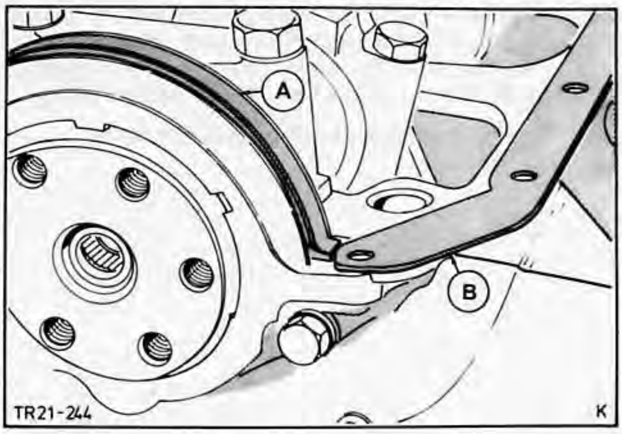


Fig. 64. Fitting sump gasket
A – Rubber half seal of rear oil seal carrier
B – Cork gasket

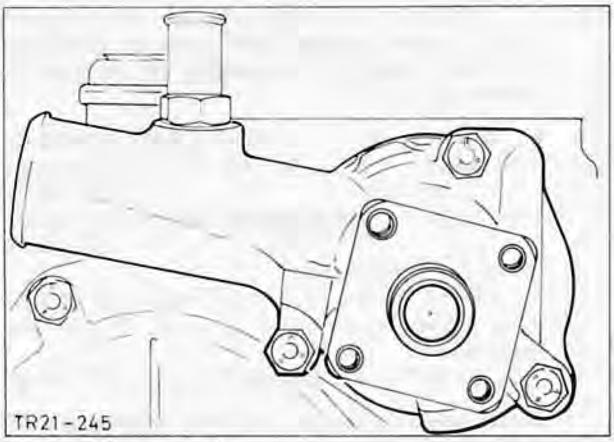


Fig. 65. Install water pump

59. Fit oil pump complete with gasket and torque bolts as specified in Technical Data, Fig. 66.

    When a new or overhauled oil pump is used, it should be turned by hand through a complete rotation and filled with engine oil prior to installation.

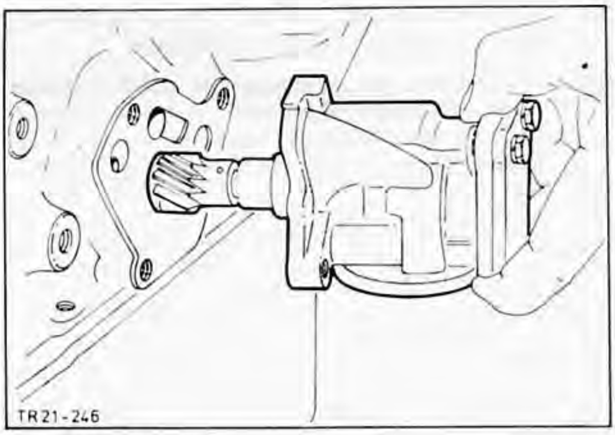


Fig. 66. Fit oil pump

21 134 8 (cont'd)

60. Screw on oil filter cartridge until rubber gasket makes contact with filter head, then tighten a further $\frac{3}{4}$ turn. Apply engine oil to rubber gasket and mating flange face before fitting.

61. Position cylinder head gasket correctly.

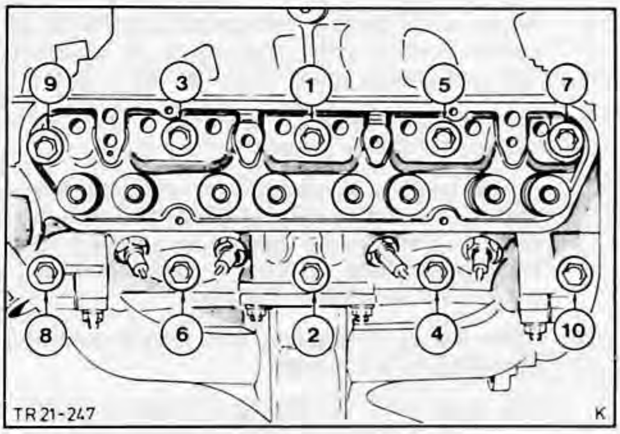


Fig. 67. Tightening sequence for cylinder head bolts

62. Fit cylinder head and tighten bolts finger tight. Torque cylinder head bolts as specified in three stages proceeding in sequence shown in Fig. 67.

1st stage	7 Nm (0,7 kgf.m) (5 lbf.ft)
2nd stage	27 to 40 Nm (2,7 to 4,0 kgf.m) (25 lbf.ft)
3rd stage	68 to 75 Nm (6,8 to 7,5 kgf.m) (53 lbf.ft)

10 to 20 minutes later
88 to 95 Nm (8,8 to 9,5 kgf.m) (67 lbf.ft)
After engine has run for at least 15 minutes retighten to
88 to 95 Nm (8,8 to 9,5 kgf.m) (67 lbf.ft)

Bolts vary in length to suit thickness of cylinder head.

63. Apply engine oil to both ends of push rods and place them in push rod sockets.

64. Place rocker shaft in position, guiding rocker lever adjusting screws into push rod sockets. Tighten rocker shaft bolts by hand, then torque them as specified in Technical Data, Fig. 68.

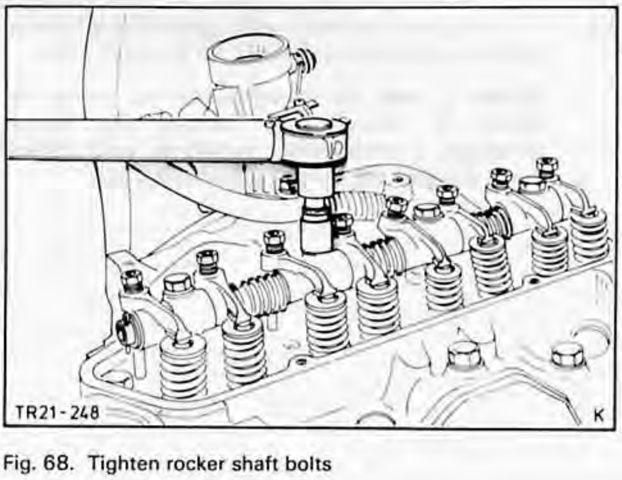


Fig. 68. Tighten rocker shaft bolts

65. Insert thermostat into cylinder head, Fig. 69. Place gasket in position and fit thermostat housing.

66. Adjust valve clearances (see Operation 21 213), refit rocker cover and tighten bolts evenly to specified torque.

67. Fit alternator complete with bracket. Fit fan complete with pulley, to water pump.

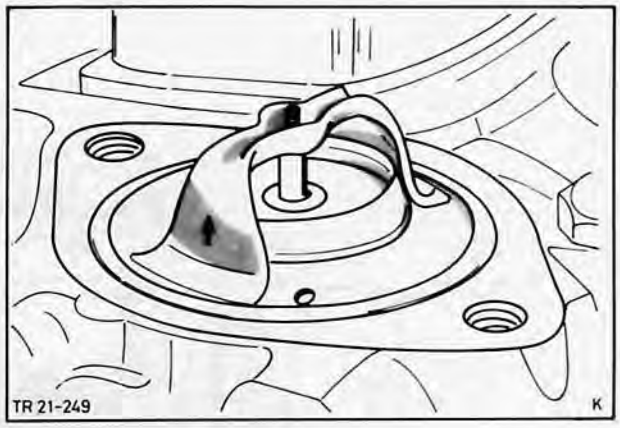


Fig. 69. Thermostat in position

68. Refit fan belt and adjust belt tension to achieve 13 mm (0,5 in) total slackness between alternator and fan.

69. Refit fuel pump with gaskets and spacer. Torque bolts as in Technical Data, Fig. 70.

70. Connect fuel line to carburettor and insert vent valve into oil separator.

71. Set 1st cylinder of engine to TDC (valves of 4th cylinder overlap). Turn rotor arm to mark of 1st cylinder and insert distributor in block.

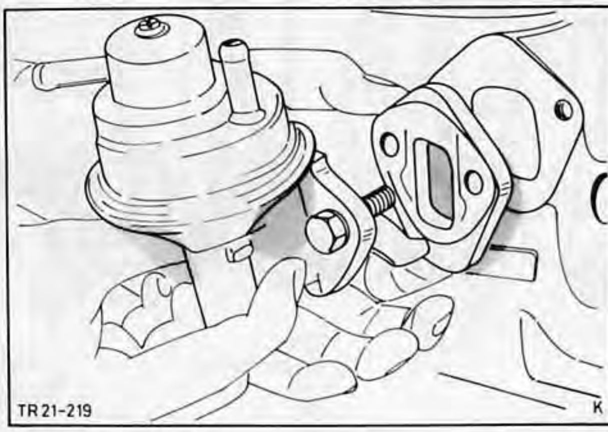


Fig. 70. Fit fuel pump

72. Fit spark plugs and torque as specified in Technical Data. Refit distributor cap and connect HT leads to spark plugs, arranged as shown in Fig. 71. Connect vacuum line to carburettor.

73. Fit oil drain plug complete with new washer and torque as specified in Technical Data.

Every time oil is changed and oil drain plug is removed a new washer should be fitted.

74. Insert dipstick and remove engine from stand.

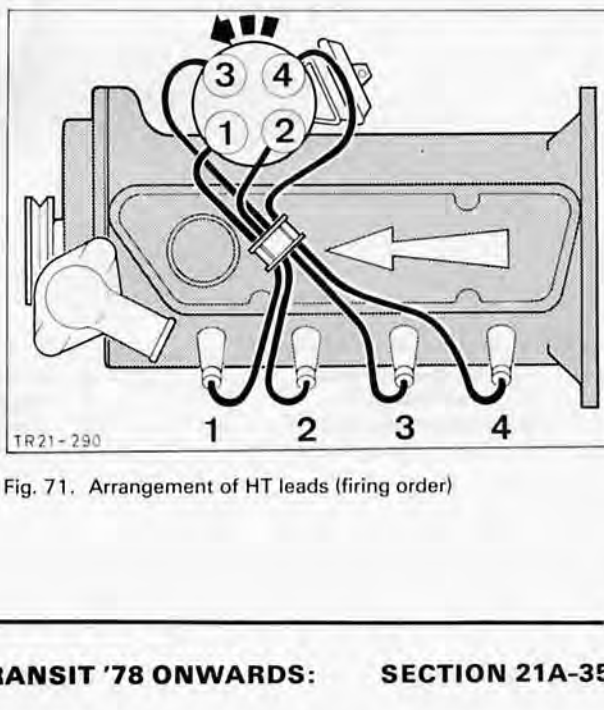


Fig. 71. Arrangement of HT leads (firing order)

ENGINE 'B'

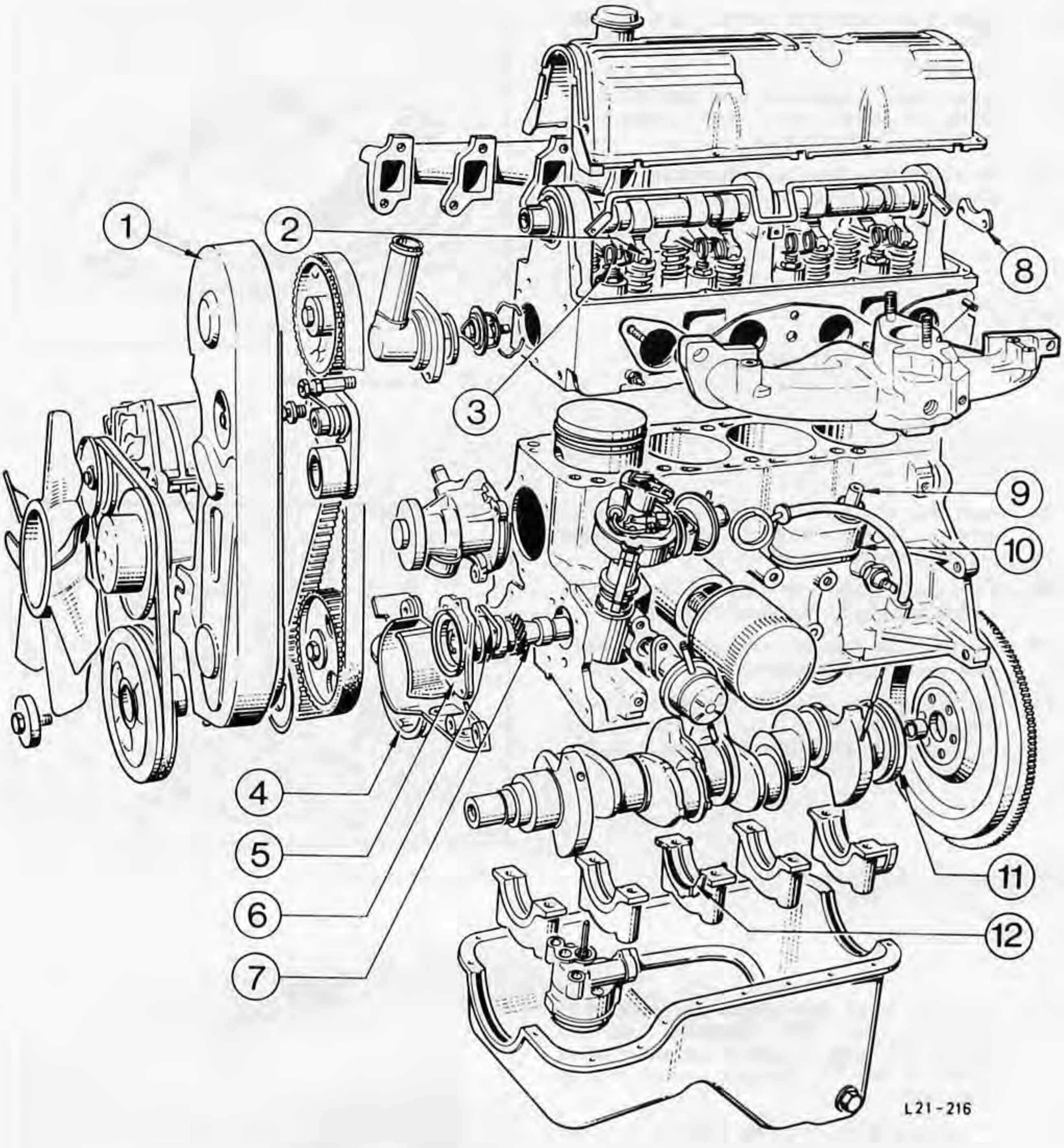


Fig. 72. 'B' engine – exploded view

1. Toothed belt guard
2. Cam follower
3. Cam follower spring
4. Crankshaft timing cover
5. Auxiliary shaft front cover
6. Auxiliary shaft thrust plate
7. Auxiliary shaft
8. Camshaft thrust plate
9. Vent valve
10. Oil separator
11. Crankshaft oil seal
12. Thrust half ring

Lubrication circuit, Fig. 73.

The oil pump draws oil via a strainer from the oil sump and feeds it into the full-flow oil filter. The filtered oil, passing along the central axis of the oil filter cartridge, reaches the oil pressure switch via a short drilling (on the right hand side of the engine) and the main oil gallery (on the left-hand side of the engine) via a transverse drilling. The main bearings have direct connections to the main oil gallery and the camshaft bearings in their turn have connections to the front, centre and rear main bearings. The big end journals are supplied with oil through diagonal drillings from the nearest main bearing. An oil bore in the big end ensures splash lubrication of the piston pins and the trailing side of cylinders. The timing chain and sprockets are also lubricated via a splash oil drilling. The front bearing journal of the crankshaft has a pad at its centre from which the pressurised oil is supplied intermittently to the rocker shaft (via drillings in the cylinder block and cylinder head).

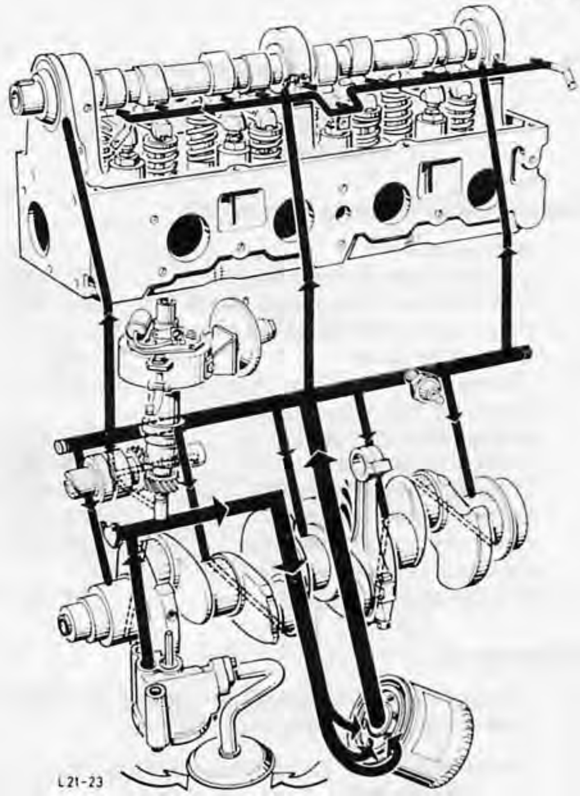


Fig. 73. Oil flow

Closed ventilation system, Fig. 74

The ventilation of the crankcase depends on the amount of air drawn by the engine when it is running and on the throughput of the vent valve. Fresh air enters at the rocker cover via the oil filler neck, flows through the crankcase and is drawn in by the running engine through the vent valve on the right hand side of the engine and burnt with the carburettor mixture. The vent valve controls the rate of air flow as a function of the engine load.

The vent valve and the steel wool filter in the oil filler cap must be cleaned with a suitable cleaner or replaced at the specified intervals.

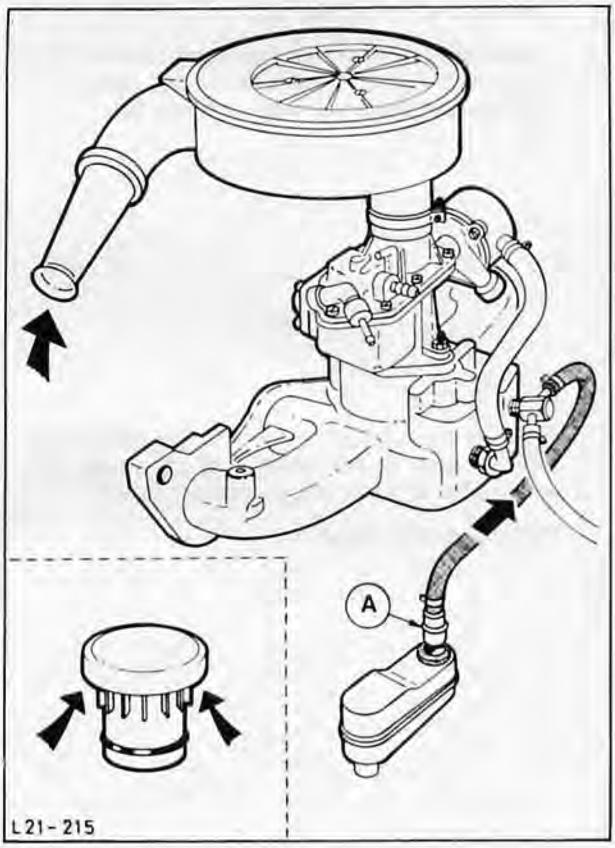


Fig. 74. Closed ventilation system
A – Vent valve

21 134 8 ENGINE ASSEMBLY – DISMANTLE AND REASSEMBLE (Engine removed)

Special Service Tools Required:

Engine stand	
Cylinder head bolt wrench	21–002
Cylinder head alignment studs	21–003
Valve adjustment locknut wrench	21–004–A
Oil seal remover	21–009–A
Crankshaft rear oil seal installer	21–011–A
Oil pump bolt and drive belt tensioner socket	21–012
Universal spindle	21–023
Crankshaft gear remover	21–028
Engine mounting bracket	21–031
Flywheel bearing remover	21–036
Flywheel bearing installer and clutch disc aligner	21–044

To Dismantle

1. Secure engine to stand by means of engine mounting bracket 21–031, Fig. 75.
2. Drain engine oil and remove oil filter, Fig. 76. Remove dipstick.
3. Remove clutch pressure plate (6 bolts) and clutch disc from flywheel.
4. Disconnect HT leads and remove distributor cap and leads. Remove spark plugs and distributor complete with vacuum line.

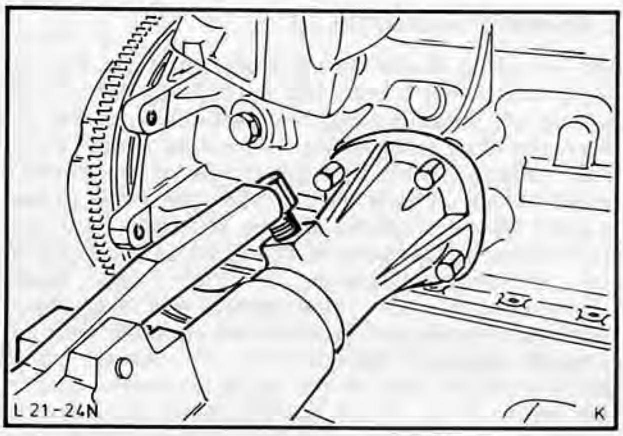


Fig. 75. Fit engine to stand using engine mounting bracket 21–031

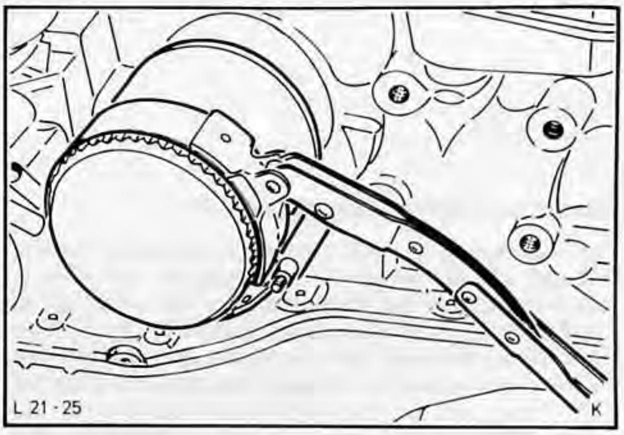


Fig. 76. Remove oil filter

5. Remove timing belt cover (3 bolts). Withdraw toothed belt guard to side of retaining bolt which also secures water pump, Fig. 77.

   Remove rocker cover.

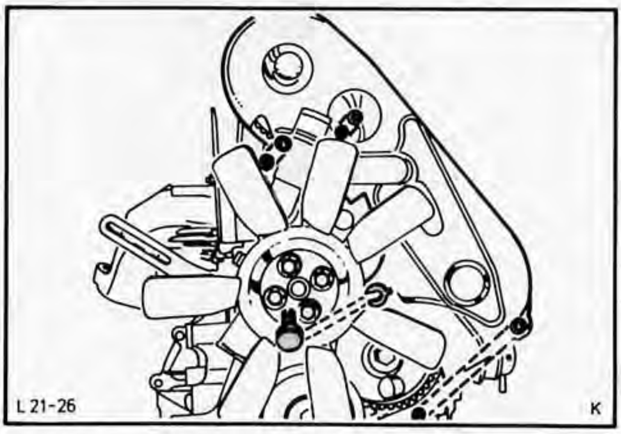


Fig. 77. Remove timing belt guard

6. Remove alternator with bracket (4 bolts).

   Take off V-belt and detach fan and pulley (4 bolts) from water pump.

7. Slacken crankshaft pulley (1 bolt) and remove together with thrust washer.

8. Remove auxiliary shaft bolt with toothed belt pulley.

9. Slacken toothed belt tensioner, using Special Tool 21–012 (1 bolt, 1 special bolt) press against spring pressure and retighten, Fig. 78.

   Remove toothed belt.

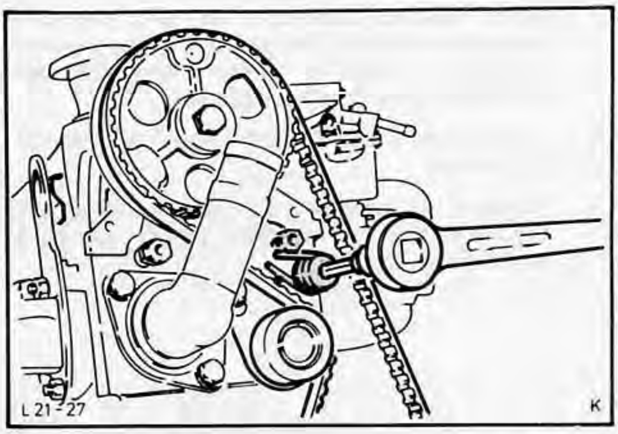


Fig. 78. Slacken toothed belt tensioner using Special Tool 21–012

10. Remove auxiliary shaft and crankshaft pulleys. On jammed crankshaft pulley use Special Tool 21-028, Fig. 79.

11. Remove fuel line from carburettor and withdraw breather hose with vent valve from oil separator.

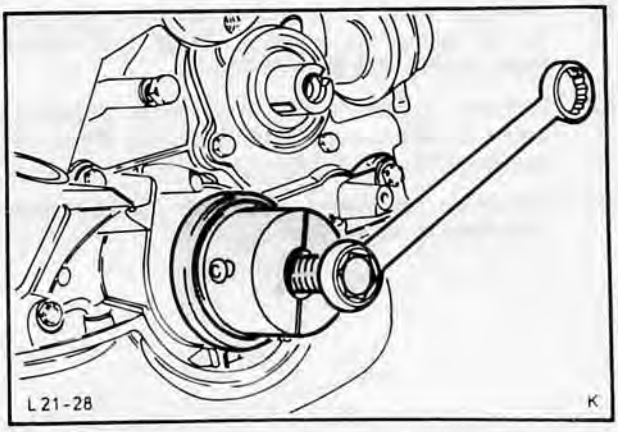


Fig. 79. Remove crankshaft pulley using Special Tool 21–028

12. Slacken cylinder head bolts (10) using Special Tool 21–002, Fig. 80. For unscrewing bolts reverse tightening sequence, Fig. 113. Remove bolts.

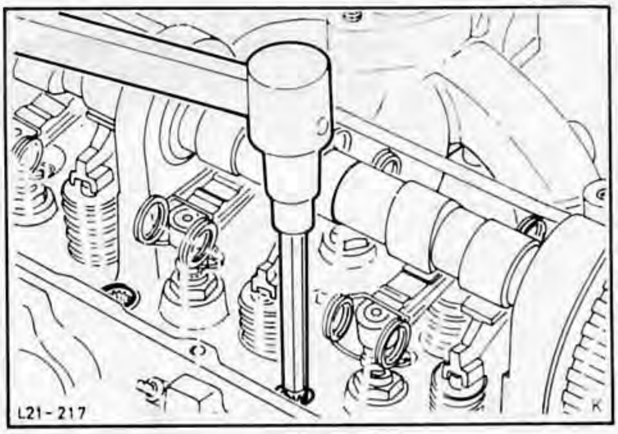


Fig. 80. Unscrew cylinder head bolts with Special Tool 21–002

21 134 8 (cont'd)

13. Lift off cylinder head complete with inlet and exhaust manifolds. Remove water connection (2 bolts). Remove spacer and lift out thermostat together with gasket.
14. Detach fuel pump (2 bolts) and fuel line. Lift out tappet.
15. Remove oil pressure switch and prise oil separator out of engine block, using a screwdriver, Fig. 81.

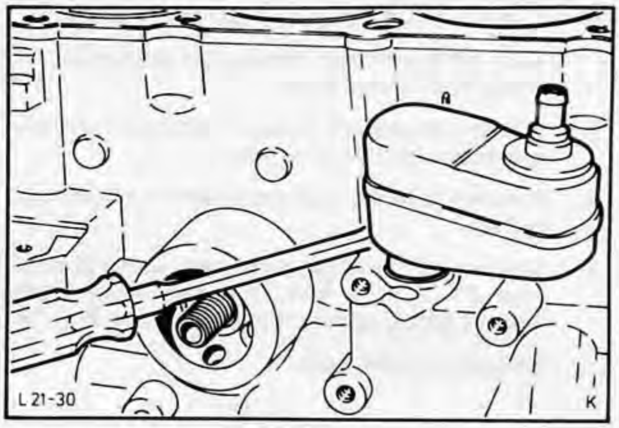


Fig. 81. Remove oil separator using a screwdriver

16. Remove sump with engine mounted upright in the stand, to prevent sludge and swarf from getting into engine, Fig. 82.
17. Remove auxiliary shaft front cover (3 bolts) and crankshaft front cover (4 bolts). Press oil seal out of both covers.
18. Remove retaining plate (2 bolts) and withdraw auxiliary shaft.

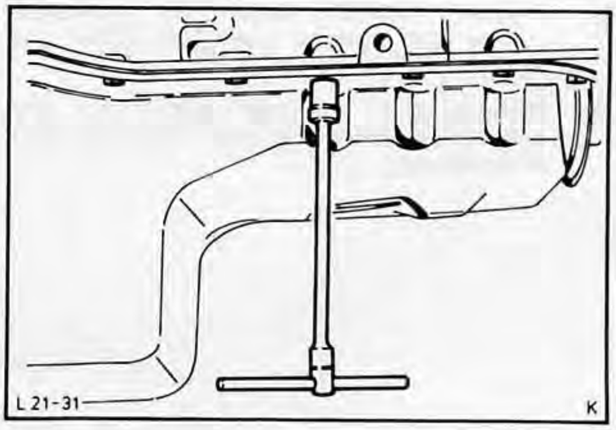


Fig. 82. Detach oil sump

19. Remove crankshaft needle roller bearing from crankshaft, using Special Tool 21–036, Fig. 83.

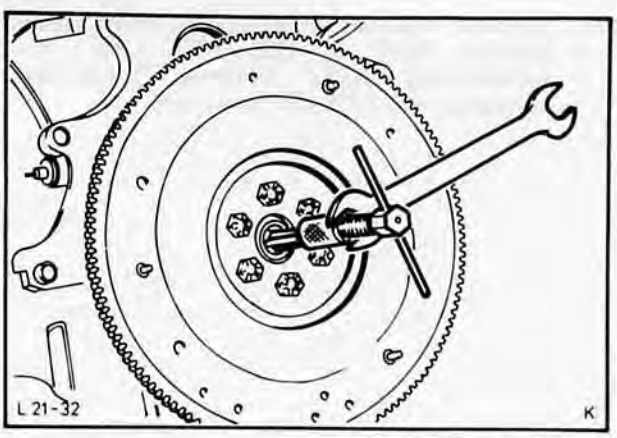


Fig. 83. Remove crankshaft needle bearing, using Special Tool 21–036

20. Set pistons at centre of their stroke and remove carbon deposits from cylinder head faces using a suitable scraper, Fig. 84, without touching piston bore.

21. Place a large tray under engine, invert engine and catch remaining oil, carbon remains and coolant.

22. Remove water pump (2 screws, 1 bolt).

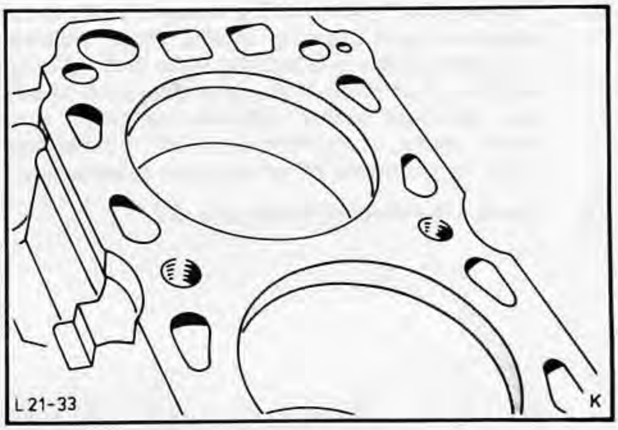


Fig. 84. Remove carbon deposits from cylinder head face

23. Remove oil pump (3 bolts) using Special Tool 21–012, Fig. 85, Lift out oil pump drive shaft.

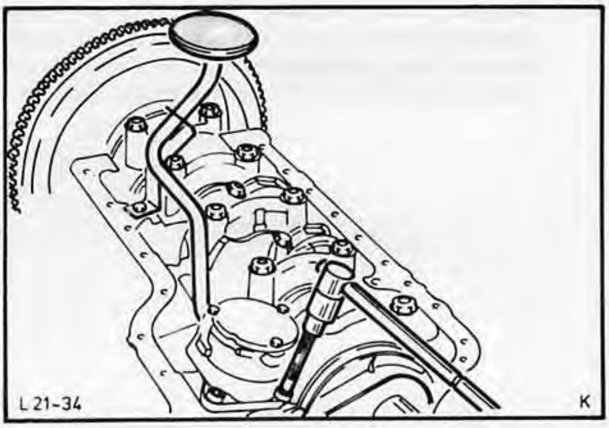


Fig. 85. Remove oil pump using Special Tool 21–012

24. Check markings on big end bearing caps and main bearing caps for subsequent reassembly, Fig. 86.

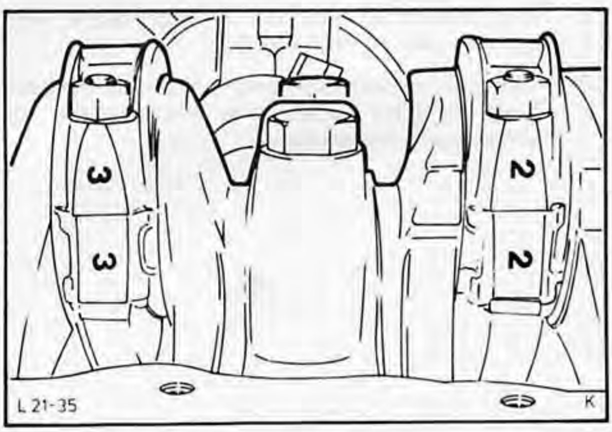


Fig. 86. Markings of big end and main bearing caps

21 134 8 (cont'd)

25. Remove big end bearing caps one by one, together with bearing shells. Push pistons complete with connecting rods and bearing shells out of engine. If big end bearing shells are removed before pistons are taken out, mark shells to correspond with connecting rods, for purposes of subsequent reassembly.
26. Detach flywheel (6 bolts), Fig. 87.

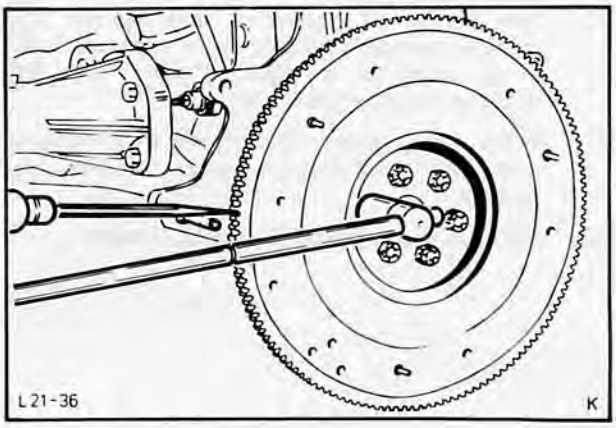


Fig. 87. Detach flywheel

27. Remove main bearing caps together with bearing shells. When removing centre main bearing cap, note position of two half thrust washers and mark them accordingly, Fig. 88.

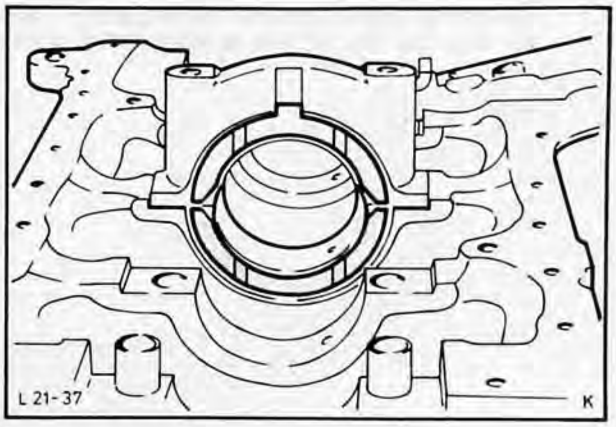


Fig. 88. Half thrust washers centre main bearing

28. Lift crankshaft out of cylinder block and remove rear oil seal, Fig. 89.
29. Remove bearing caps and half thrust washers from cylinder block and mark them for subsequent reassembly.

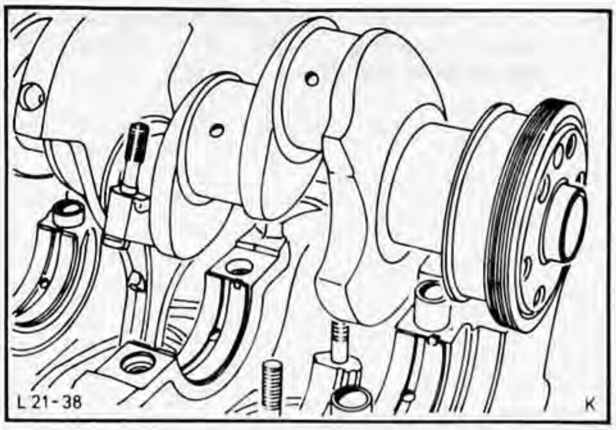


Fig. 89. Remove crankshaft

To Reassemble

The type and degree of cleaning of a given part before reasembly must depend on the hours the engine has run, the extent of any damage and its possible re-use. This applies particularly to the cylinder block with its corners, angles and bores. If necessary, remove all plugs and covers and clean their seats, using suitable cleaning agents and tools (brushes, scrapers). The oil galleries in particular, e.g. in the cylinder block, cylinder head, etc., should be free from dirt and abrasive particles, Fig. 90. If press-fit plugs and screw plugs are removed, they, like all seals and gaskets, should be renewed.

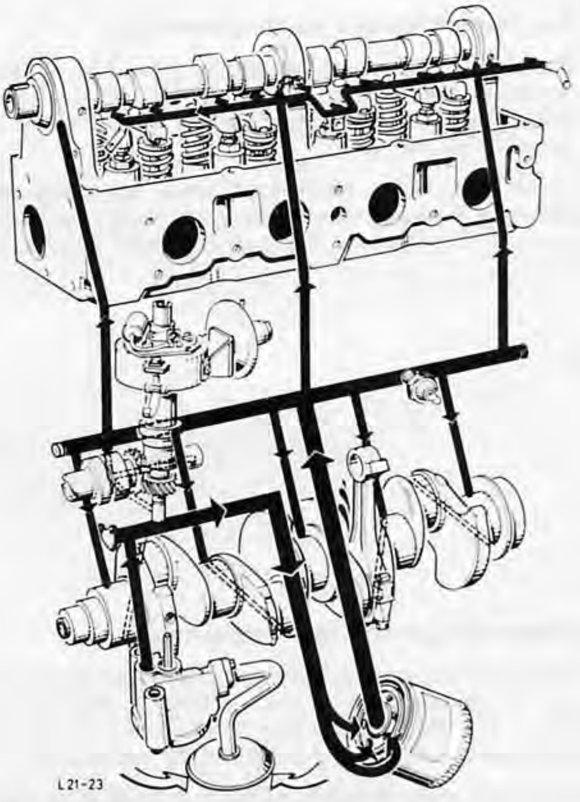


Fig. 90. Oil circuit

MAIN BEARINGS

Parent bore in cylinder block

The parent bore in the cylinder block may be either standard or 0,40 mm (0,015 in) oversize. There is no marking for the standard parent bore, but with an oversize bore the bearing caps are marked with white paint, Fig. 91.

Crankshaft main bearing journals

The crankshaft main bearing journals may be standard or (also in new engines) 0,25 mm (0,010 in) undersize. Standard main bearing journals are not marked, while the crankshaft web adjacent to an undersize main journal is marked with a green stripe.

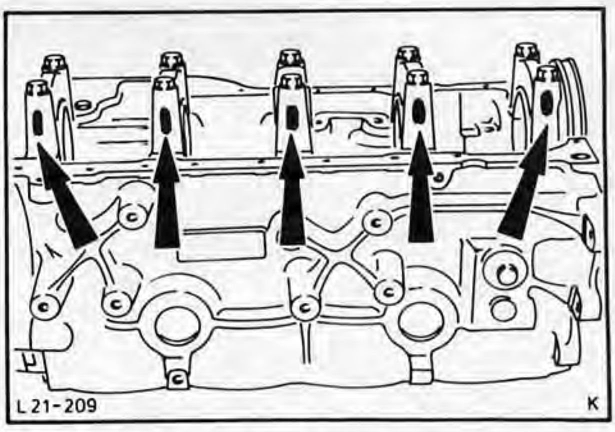


Fig. 91. Colour marking of main bearing caps

Crankshaft big end bearing journals

Standard big end bearing journals are not marked. Journals which are 0.25 mm (0,01 in) undersize are marked with a green paint spot on web next to the journal, Fig. 92.

Crankshafts with **undersize main and big end bearing journals** are marked with both stripe and spot on the front of the web adjacent to journals, Fig. 92.

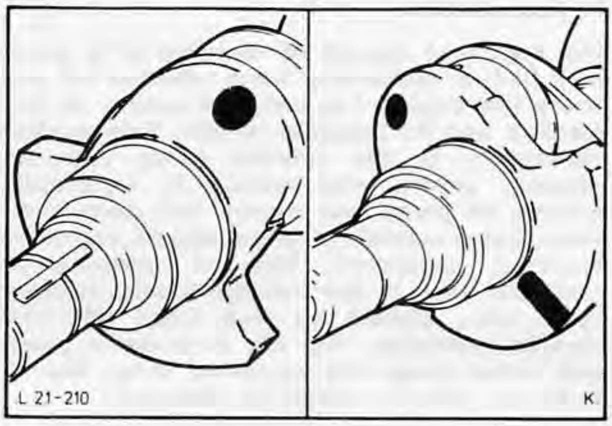


Fig. 92. Crankshaft colour markings

Connecting rods and bearing caps

The red mark on connecting rod and connecting rod cap is located on the side of the big end bearing boss, Fig. 93. Both colour marks must be on the same side in order to prevent faulty installation.

Standard main bearing and big end bearing shells are not marked. Bearing shells for undersize crankshafts or oversize cylinder blocks have an appropriate inscription on the back (see Parts Catalogue) while colour markings on production repair sizes are on the outer edge at the side, Fig. 94, with the exception of service main and big end bearing shells (0,5/0,75/ and 1,0 mm (0,02/0,03/0,04 in) undersize crankpins).

When new bearing shells are selected they should be checked against the Spare Parts Catalogue to ensure they are the appropriate ones and in addition they should be measured.

In order to remain within the specified tolerances (see Technical Data) journals, parent bores and bearing shells should be measured individually.

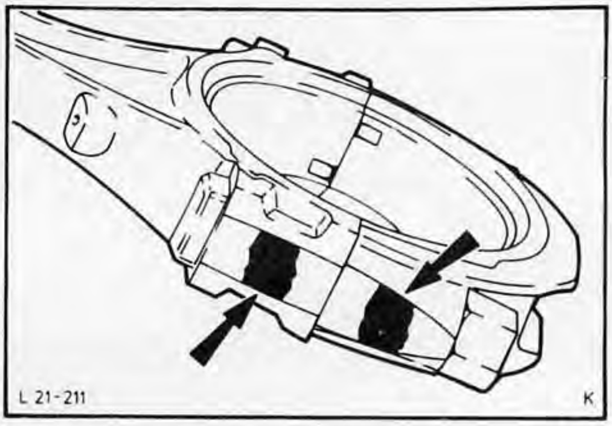


Fig. 93. Connecting rod colour markings

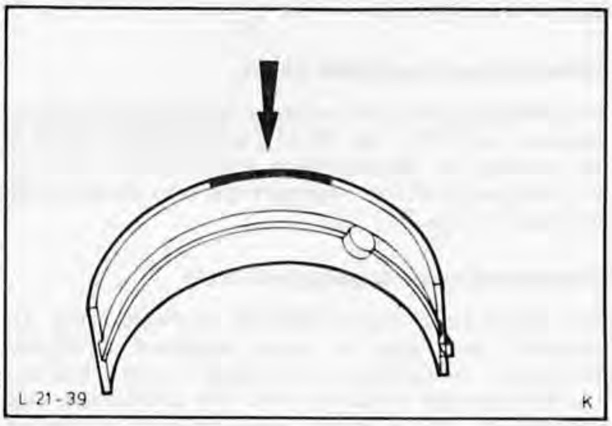


Fig. 94. Bearing shell colour marking

Measuring bearing clearance

Measuring bearings (even with undersize crankshafts) can be eliminated and determination of required bearing shells can be considerably simplified by use of:

'PLASTIGAGE' (type PG1) made by:

PERFECT CIRCLE CORPORATION,
HAGERSTOWN, INDIANA, USA.

UK Supplier:
NORMAN GAYDON (International)
68 London Road
Southend-on-Sea
Essex.

West German suppliers:
K. H. ERN/Motorenteile GmbH
Schinkelstrasse 46–48
D–4000 Dusseldorf.

'PLASTIGAGE' is the name of an accurately calibrated plastic filament.

Requirements for use of 'Plastigage'

1. Bearing should be dry and clean.
2. Crankshaft should not be turned during measuring operation.
3. Points of measurement should be close to top and bottom dead centre position.
4. Bearing caps should not be seated with hammer blows.

Procedure

Place length of Plastigage across width of bearing on crankshaft or big end journal, Fig. 95. Fit main or big end bearing cap together with bearing shells and torque as specified. The plastic filament will be compressed more or less depending on bearing clearance. Remove bearing cap.

Each main bearing should be measured separately without other bearing caps being fitted.

Width of compressed plastic filament can be measured by means of scale printed on PLASTIGAGE pack, Fig. 96, reading shows bearing clearance.

Only bolts in good condition should be used for securing bearing caps on crankshaft and they should not be tightened in excess of specified torque.

Measuring Piston Clearance

Procedure

1. When re-assembling an engine, the piston to bore clearance should be measured as follows.
2. The diameter of the piston should be measured when cold, using a micrometer. The measurement should be made across the piston skirt, at 90° to the piston pin axis.
3. The micrometer reading is then used to 'zero' a bore gauge. The reading on the dial of the bore gauge in situ is the piston to bore clearance (see Technical Data).

   Alternatively, the bore can be measured with an internal micrometer, and the piston size subtracted to give the piston to bore clearance.
4. The measurement must be taken below any visible wear marks in the bore. To detect bore ovality, two readings should be taken at 90° to each other.

   NOTE: The maximum difference between these two readings should not be more than 0,025 mm (0,001 in).
5. Inspect the bores for visible wear, damaged lips etc.
6. If the clearance in sub-section 3 above is excessive, or if ovality, or any of the faults in sub-section 5 above is detected, the block should be rebored to suit oversize pistons.
7. Before installing pistons, check piston ring gaps.

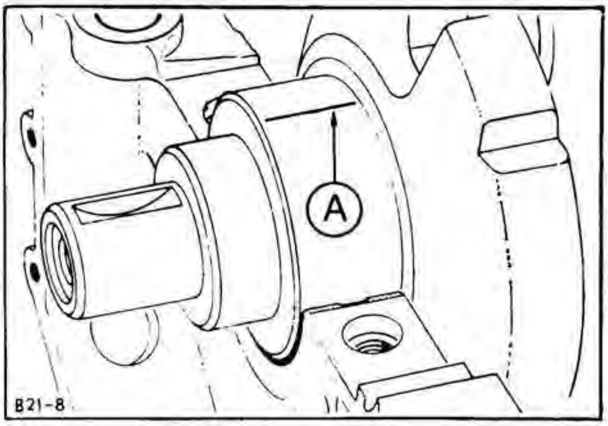


Fig. 95. Location of Plastigage thread
A – Calibrated plastic thread

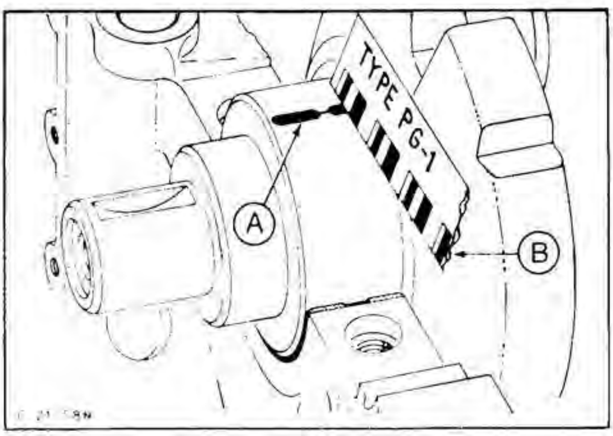


Fig. 96. Measuring bearing play
A – Compressed plastic thread
B – Measurement scale

21 134 8 (cont'd)

30. Press new pilot bearing into crankshaft, using Special Tool 21–044, Fig. 97.

31. Insert main bearing shells dry into cylinder block, apply engine oil and place crankshaft in position.

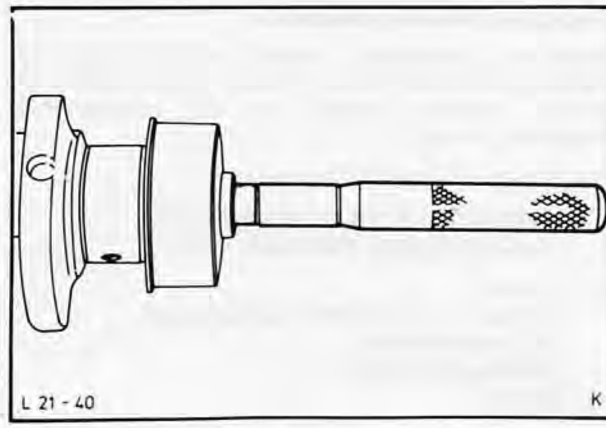


Fig. 97. Fitting crankshaft pilot bearing using Special Tool 21–044

32. Apply thin coat of sealing compound (Part No. A 70SX-19554-BA) to main bearing cap contact faces, Fig. 98, position main bearing caps complete with oiled bearing shells, rear main bearing cap on rear of contact face. Ensure thrust rings are fitted to centre bearing.

    Arrows on main bearing caps should point to front of engine.

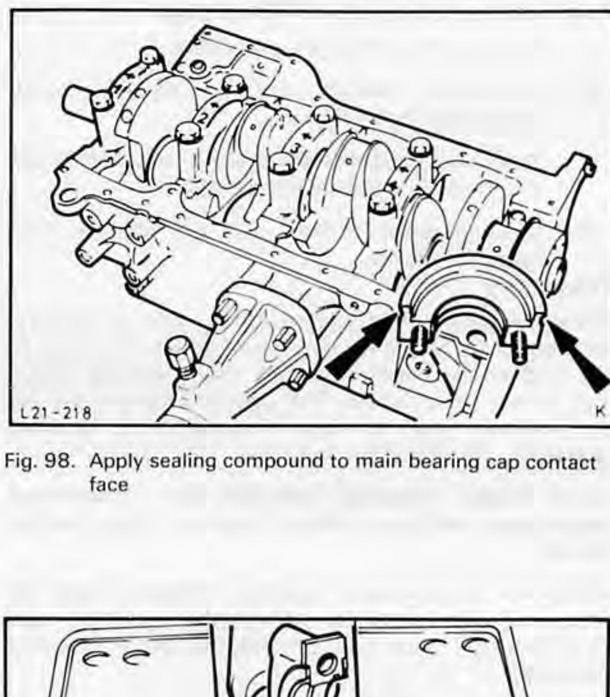


Fig. 98. Apply sealing compound to main bearing cap contact face

33. Tighten bearing cap bolts uniformly to torque specified in Technical Data. On this engine two guide bushes each are provided for securing rear and centre main bearing caps, Fig. 99.

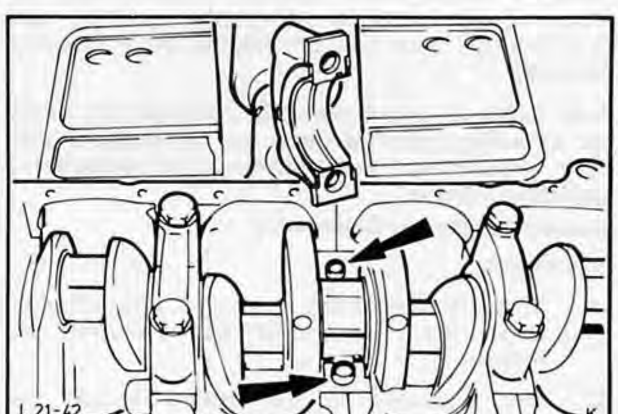


Fig. 99. Centre main bearing bushes

34. Check crankshaft end-float with a standard dial indicator, Fig. 100, and correct using thrust washers (see Technical Data).

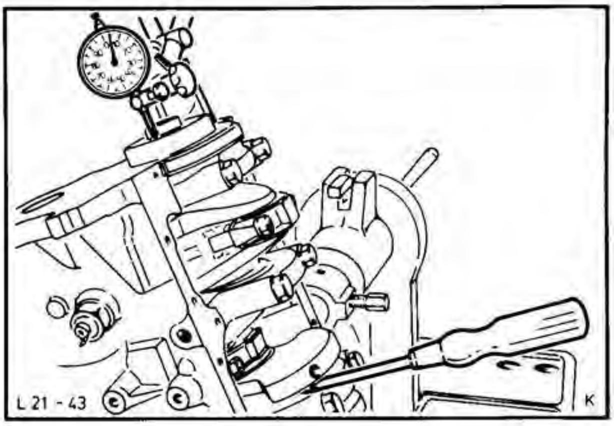


Fig. 100. Check crankshaft end-float

35. Moisten sealing lip of new rear oil seal. Slide new oil seal onto Special Tool 21–011–A and press firmly against rear main bearing, Fig. 101.

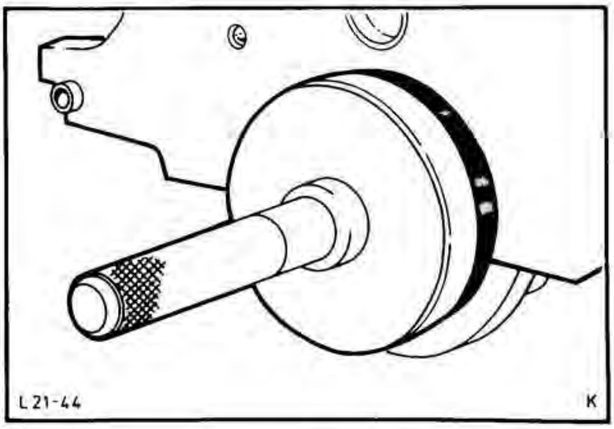


Fig. 101. Fit rear oil seal using Special Tool 21–011–A

36. Coat rear main bearing cap inserts with sealing compound (Part No. A 70SX-19554-BA) and press in, using a **blunt** screwdriver, Fig. 102. Rounded face of dowel bush has red mark and should be fitted pointing towards bearing cap.

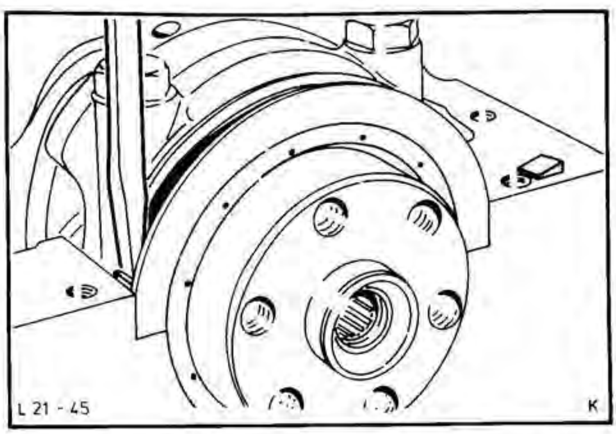


Fig. 102. Press in rear main bearing cap inserts, using **blunt** screwdriver

21 134 8 (cont'd)

37. Align crankshaft timing cover with new oil seal and new gasket on sump mating surface, using Special Tool 21–009–A, Fig. 103, to avoid damage to sealing lip. Torque timing cover as specified in Technical Data.

38. Install auxiliary shaft and fit thrust plate. Fit front cover with new oil seal, sealing lip slightly lubricated, using Special Tool 21–009–A to avoid damage to sealing lip.

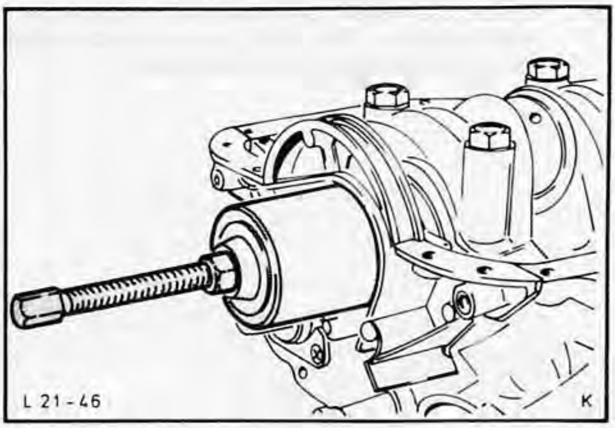


Fig. 103. Centre timing cover, using Special Tool 21–009–A

39. Fit flywheel, Fig. 104, and torque as specified in Technical Data.

Re-use only bolts which are in good condition and lubricated.

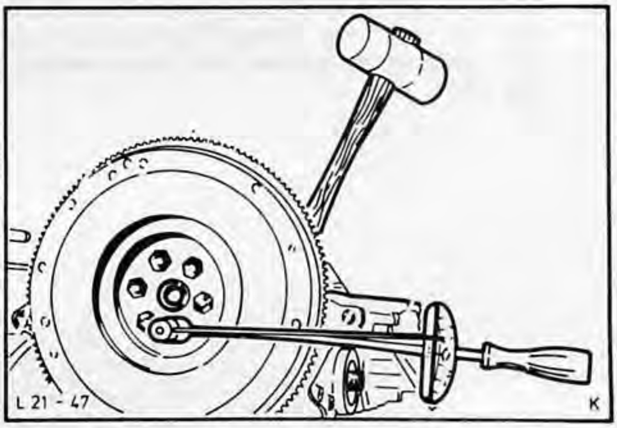


Fig. 104. Fit flywheel

40. Centre clutch disc, using Special Tool 21–044, Fig. 105. Place pressure plate on dowels and torque as specified in Technical Data.

41. Invert engine. Apply engine oil to pistons and cylinder bores. Stagger piston rings to specified gaps, refer to Technical Data.

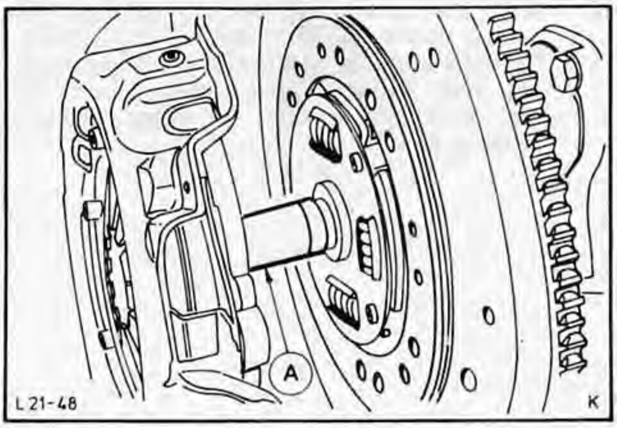


Fig. 105. Centre clutch disc using
A – Special Tool 21–044

42. Compress piston rings with a standard tool (ring compressor), Fig. 106. Slide piston into cylinder using a hammer handle, guiding connecting rod on to big end journal by hand. **The 'front' marking on piston (arrow, notches, etc.)** should point to front of engine.

43. Invert engine.

    Place big end bearing shell in position, apply oil and press connecting rod firmly against big end bearing journal.

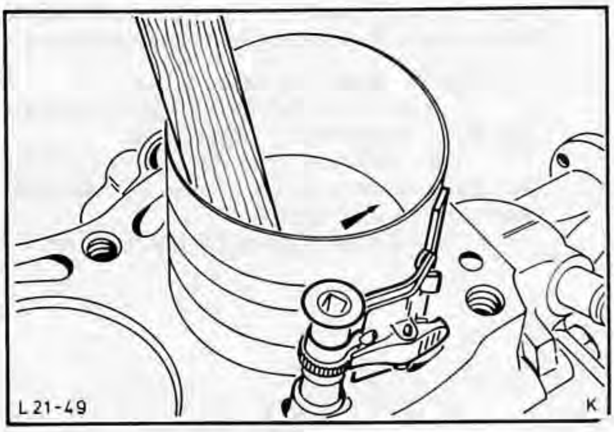


Fig. 106. Fit piston using a ring compressor

44. Fit big end bearing cap complete with oiled bearing shell. Torque connecting rod bolts as specified in Technical Data, Fig. 107.

    Check whether connecting rods have enough endfloat on journals.

45. Fit oil pump drive shaft. Place oil pump complete with suction pipe on centring bush and torque as specified in Technical Data.

    When a new or overhauled oil pump is used, it should be turned by hand through a complete rotation and filled with engine oil prior to installation.

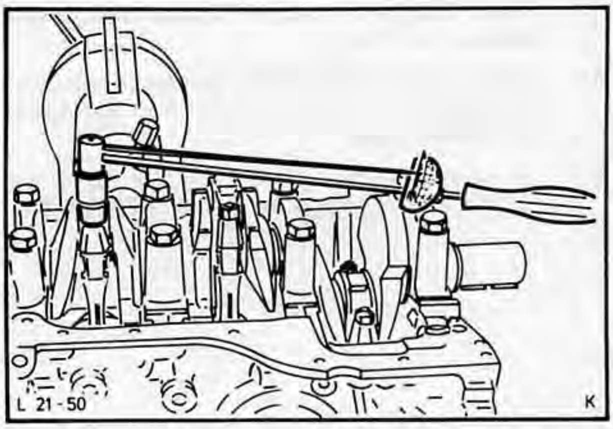


Fig. 107. Torque connecting rod bolts as specified in Technical Data

46. Insert rubber seal in groove of rear seal carrier. Apply sealing compound to cylinder block mating surface at joint of cover and rear seal carrier. Place sump gasket in position and slide projections on cork gasket under cut-outs in rubber gasket, Fig. 108.

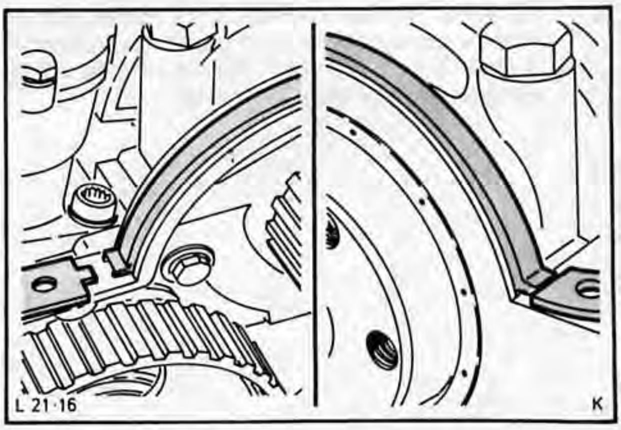


Fig. 108. Fit oil sump gasket

21 134 8 (cont'd)

47. Place sump in position, Fig. 109, and torque bolts, as specified, in three stages as follows:

1st stage commencing with bolt 'A'
1 to 2 Nm (0,1 to 0,2 kgf.m) (1 lbf.ft)
2nd stage commencing with bolt 'B'
6 to 8 Nm (0,6 to 0,8 Kgf.m) (5 lbf.ft)
3rd stage, after running engine 20 minutes, commencing with bolt 'A'
8 to 10 Nm (0,8 to 1,0 kgf.m) (7 lbf.ft).

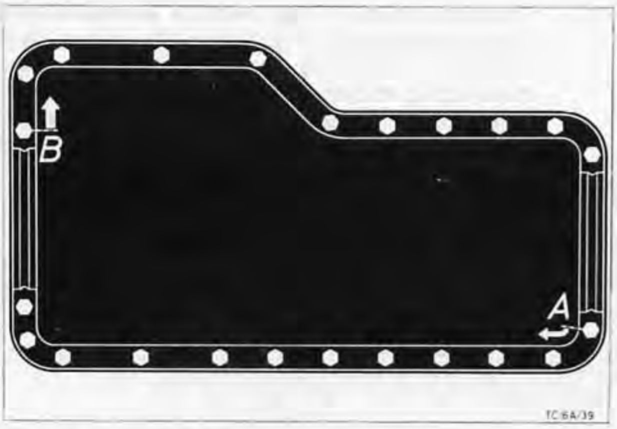


Fig. 109. Sump bolt tightening sequence

48. Insert fuel pump tappet in bore and fit fuel pump, Fig. 110.

49. Invert engine. Apply metal jointing compound (Loctite) to oil separator and press up to stop in cylinder block.

50. Fit water pump with gasket, in doing so, tighten bolt of alternator bracket finger-tight.

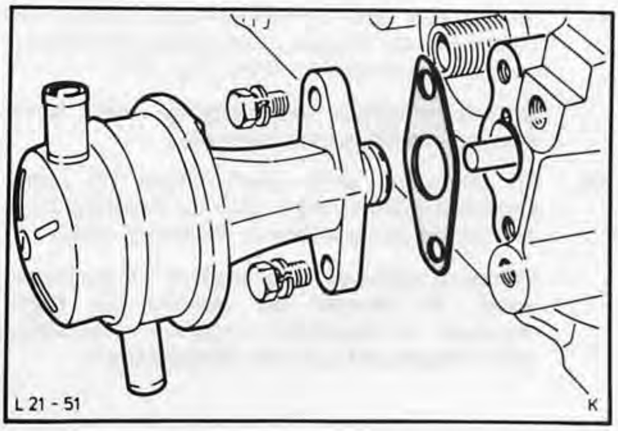


Fig. 110. Fit fuel pump

51. Screw in oil filter cartridge until rubber gasket makes contact with housing, then tighten a further $\frac{3}{4}$ turn, Fig. 111. **Apply engine oil to rubber gasket before fitting.**

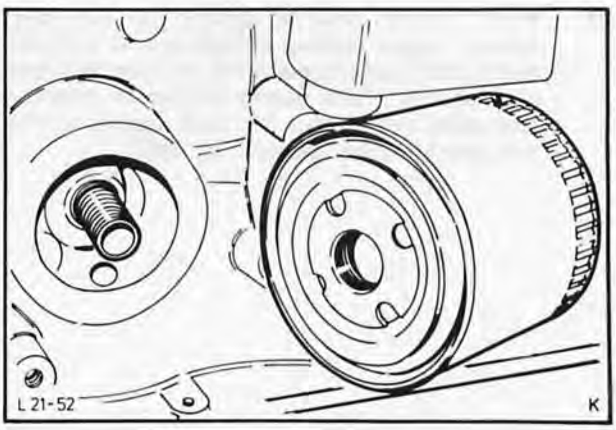


Fig. 111. Fit oil filter cartridge

52. Fit oil pressure switch and torque as specified in Technical Data.

53. Fit auxiliary shaft toothed belt pulley with reinforced side facing inwards. Attach crankshaft toothed belt pulley (with chamfered side inwards) with thrust washer and belt pulley.

The thrust washer is dished and must be fitted with the concave side facing the toothed pulley.

54. Screw in Special Tool 21–003, as shown in Fig. 112, in place of cylinder head bolts 7 and 9, Fig. 113, and fit head gasket.

To avoid damage to valves and pistons, crankshaft must be turned before fitting cylinder head so that piston of 1st cylinder is some 2 cm before TDC.

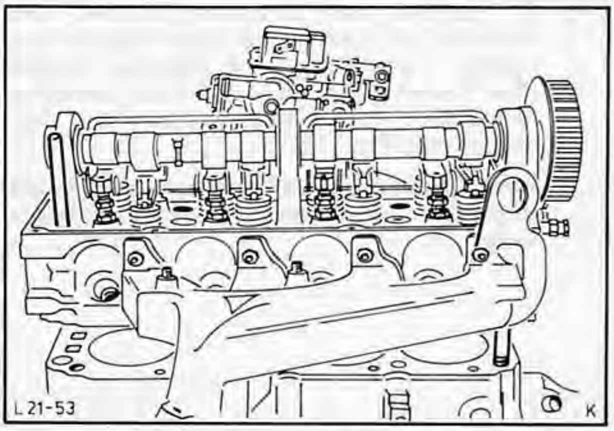


Fig. 112. Fit cylinder head with aid of locating studs 21–003

55. Fit cylinder head, Fig. 112, and insert bolts finger-tight. Replace the two locating studs with the two remaining bolts. Torque cylinder head bolts as specified using Special Tool 21–002 in three stages proceeding in the sequence shown in Fig. 113.

1st stage: 40–55 Nm (4,0–5,5 kgf.m) (35 lbf.ft)
2nd stage: 50–70 Nm (5,0–7,0 kgf.m) (44 lbf.ft)
10–20 minutes later: 85–95 Nm (8,5–9,5 kgf.m) (66 lbf.ft)

When the engine is fitted in the vehicle, retighten cylinder head bolts as indicated in stage 4 (see Technical Data).

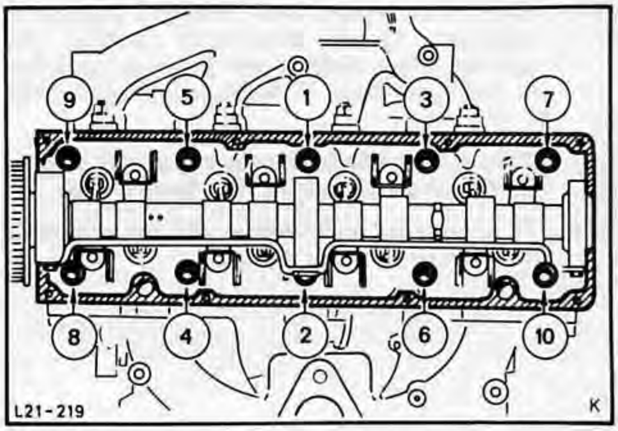


Fig. 113. Cylinder head bolt tightening sequence

Before fitting toothed belt, first turn camshaft toothed belt pulley to TDC mark on cylinder head, Fig. 114. Then turn crankshaft belt pulley to TDC mark by the shortest route.

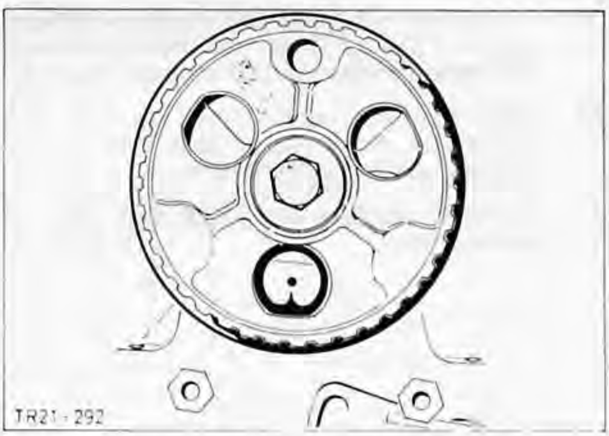


Fig. 114. Camshaft toothed belt pulley on TDC mark

21 134 8 (cont'd)

56. Fit toothed belt. Slacken toothed belt tensioner so that it can rest against the toothed belt after twice cranking engine. After cranking tighten toothed belt tensioner to specified torque, hexagon bolt first, then special bolt, Fig. 115.

After positioning of toothed belt crank engine in direction of normal rotation only.

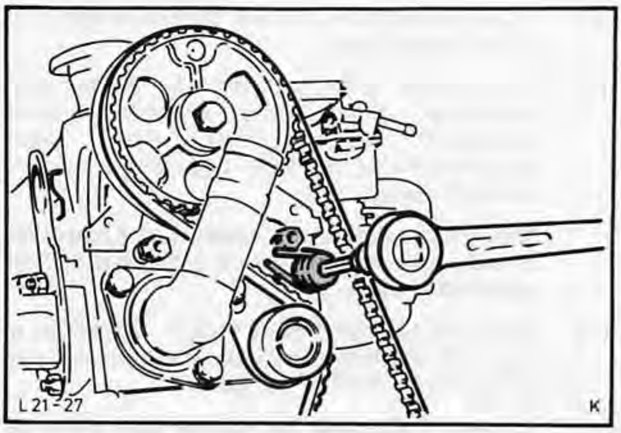


Fig. 115. Tighten belt tensioner

57. Slide thrust washer and crankshaft pulley into position. Torque crankshaft pulley and auxiliary shaft toothed belt pulley as specified in Technical Data. Fit toothed belt guard, Fig. 116.

Thrust washer is cup-shaped and should be fitted with hollow side facing gear.

58. Fit alternator and bracket. Fit fan complete with pulley to water pump.

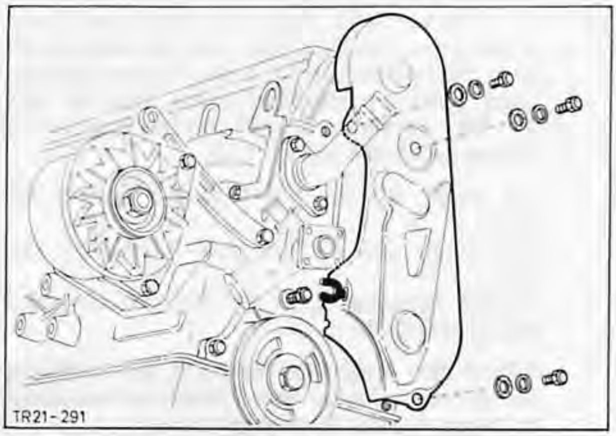


Fig. 116. Fit toothed belt guard

59. Fit fan belt and adjust belt tension to achieve 13 mm (0,5 in) free movement midway between alternator and fan pulleys, Fig. 117.

60. Crank engine to bring cylinder No. 1 to TDC and install distributor so that rotor arm is also at mark for No. 1 cylinder.

61. Connect vacuum line and fuel line to carburettor.

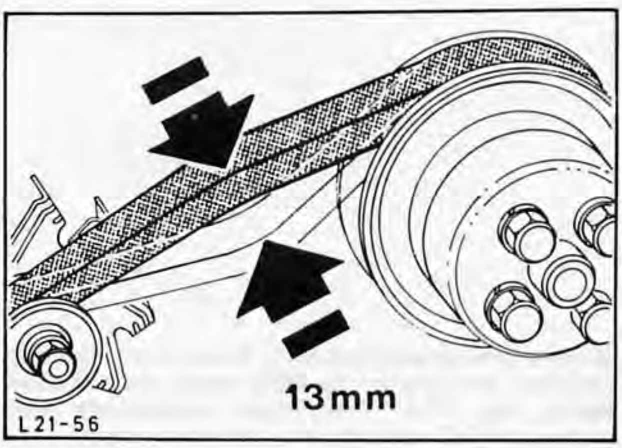


Fig. 117. Tighten fan belt

62. Check valve clearances and adjust, if necessary (see Operation No. 21 213 'B' engine), Fig. 118.

63. Fit rocker cover, ensuring correct engagement of gasket projection.

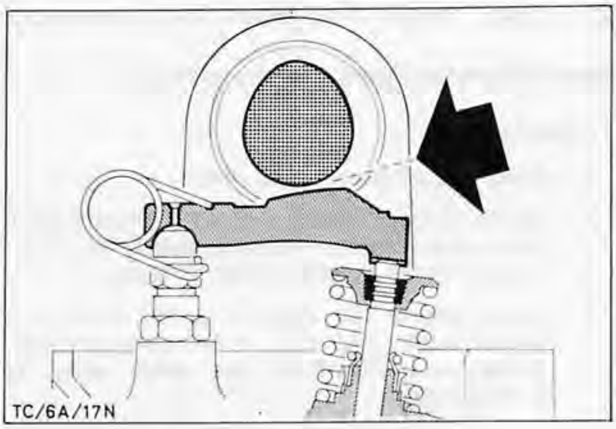


Fig. 118. Adjust valve clearances

64. Torque rocker cover bolts as specified in four stages, proceeding in sequence specified, Fig. 119.

    1st stage, tighten bolts 1–6
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
    2nd stage, tighten bolts 7 and 8
    2 to 2,5 Nm (0,2 to 0,25 kgf.m) (1,7 lbf.ft)
    3rd stage, tighten bolts 9 and 10
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
    4th stage, tighten bolts 7 and 8
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)

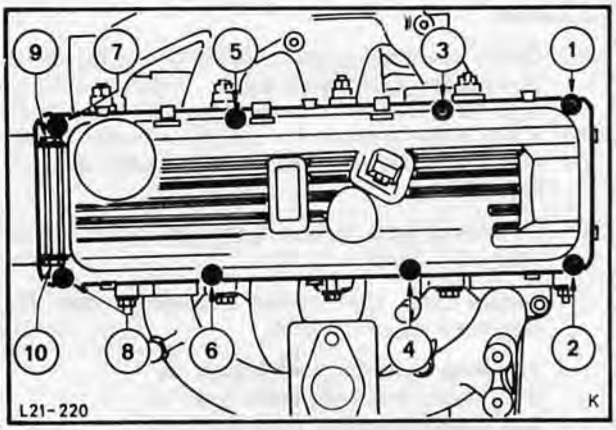


Fig. 119. Rocker cover bolt tightening sequence

65. Fit spark plugs and torque as specified in Technical Data. Refit distributor cap and connect HT leads to spark plugs as shown in Fig. 120.

66. Fit oil drain plug complete with new washer and torque as specified in Technical Data.

    Every time oil is changed and oil drain plug is removed a new washer should be fitted.

67. Fit breather hose together with vent valve in oil separator.

68. Insert dipstick and remove engine from stand.

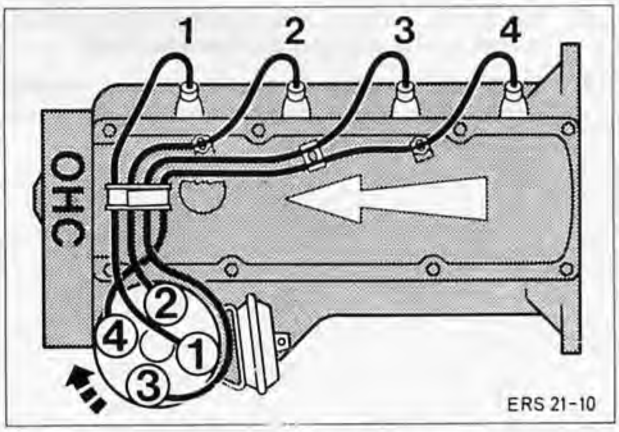


Fig. 120. Arrangement of HT leads (firing order)

21 163 CYLINDER HEAD – REMOVE AND INSTALL

Special Service Tool Required:

Cylinder head bolt wrench 21–034

To Remove

1. Disconnect battery earth strap, drain coolant into tray by disconnecting radiator hose from radiator bottom neck and engine water outlet at top, Fig. 124.

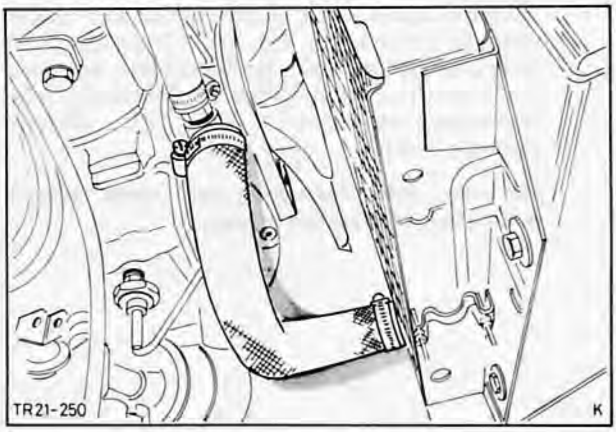


Fig. 124. Disconnect radiator hose from radiator

2. Remove air cleaner and disconnect fuel line from carburettor and engine breather hose from oil separator. Remove brake servo vacuum hose from inlet connector.
3. Detach throttle cable with bracket from inlet manifold (2 bolts) and disconnect throttle linkage at carburettor, Fig. 125. Unscrew choke cable at carburettor.

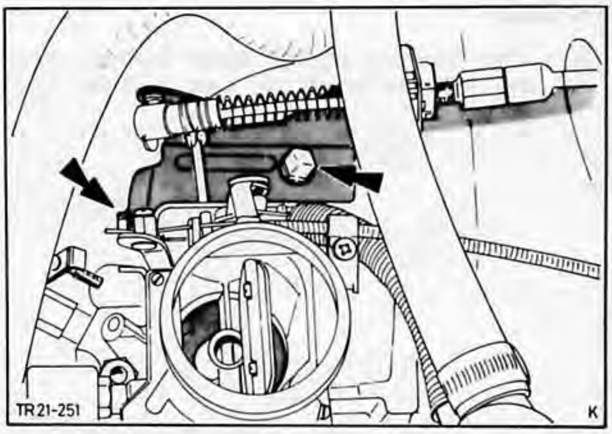


Fig. 125. Unhook throttle cable at throttle linkage and remove with bracket

4. Detach vacuum line from carburettor and disconnect hot water hose from inlet manifold.
5. Disconnect lead from idling cut-off valve temperature sender unit and HT leads from spark plugs and ignition coil. Remove distributor cap and distributor rotor arm.
6. Detach cylinder head water elbow (2 bolts) and remove thermostat, Fig. 126. Disconnect exhaust pipe from exhaust manifold (2 nuts).

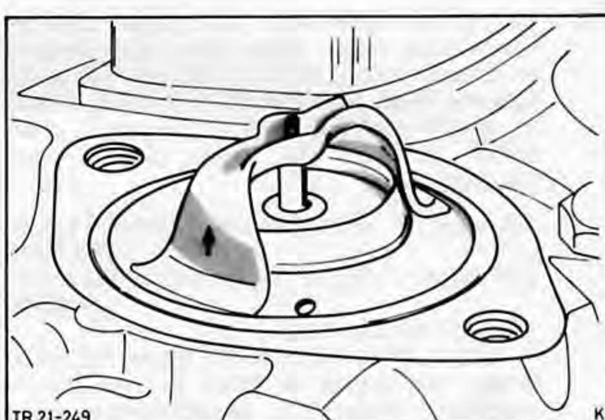


Fig. 126. Remove thermostat

21 163 (cont'd)

7. Remove spark plugs, rocker cover and rocker shaft (4 bolts each), Fig. 127. Take out push rods and remove cylinder head bolts, slackening bolts in reverse order to tightening (see tightening sequence in Fig. 129). Detach cylinder head.

Do not interchange push rods when removing and re-installing.

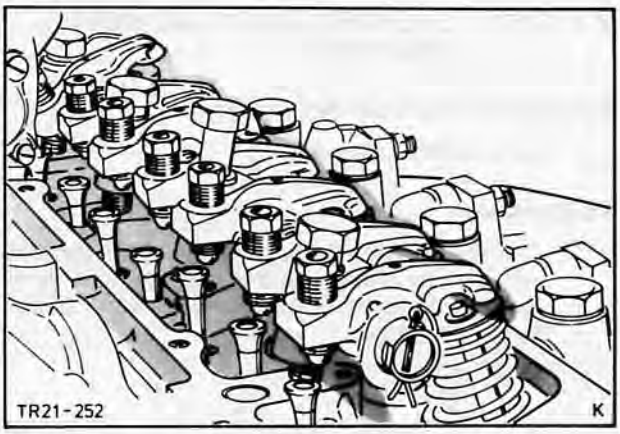


Fig. 127. Remove rocker shaft

To Install

8. After cleaning mating faces (cylinder head and cylinder block), fit new cylinder head gasket.

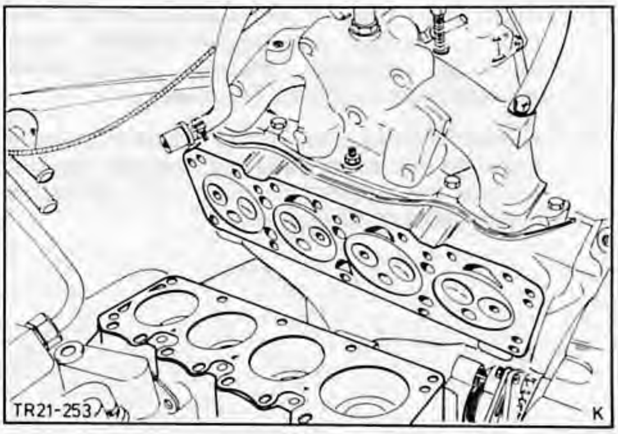


Fig. 128. Replace cylinder head

9. Fit cylinder head, Fig. 128. Insert cylinder head bolts finger tight. Take out locating studs and replace them by the last two bolts. Cylinder head bolts should then be tightened to specified torque in four stages in order shown in Fig. 129, using Special Tool 21–034.

1st stage	40 to 55 Nm (4,0 to 5,5 kgf.m) (35 lbf.ft)
2nd stage	50 to 70 Nm (5,0 to 7,0 kgf.m) (44 lbf.ft)

10 to 20 minutes later
85 to 95 Nm (8,5 to 9,5 kgf.m) (66 lbf.ft)

When the engine is fitted to the vehicle retighten cylinder bolts as indicated in stage 4 (see Technical Data)

Bolts are of different lengths to suit different thicknesses of cylinder head.

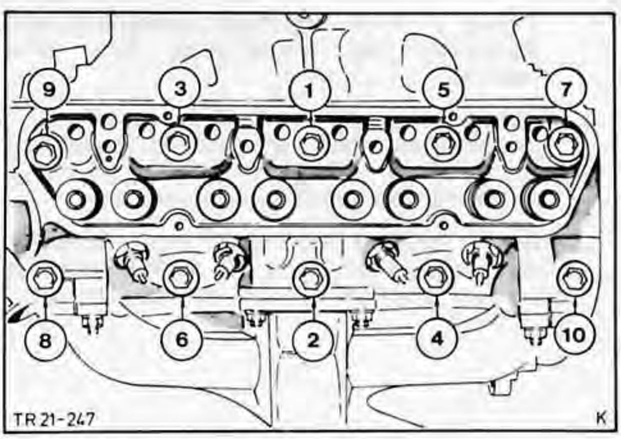


Fig. 129. Cylinder head bolts, tightening sequence

10. Lubricate both ends of push rods and place them in push rod sockets. Fit rocker shaft, guiding rocker arm adjusting screws into push rod sockets. Insert rocker shaft bolts and torque them as specified in Technical Data, Fig. 130.

11. Adjust valve clearances (see Operation No. 21 213, 'A' engine). Fit spark plugs and rocker cover.

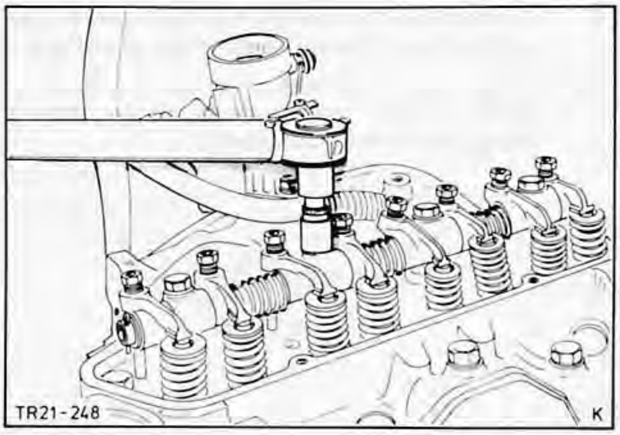


Fig. 130. Torque rocker shaft bolts as specified in Technical Data

12. Insert thermostat, locate gasket and attach water outlet connection with air cleaner bracket. Attach exhaust pipe to exhaust manifold.

13. Connect leads to idling cut-off valve, temperature sender unit and attach HT leads to sparking plugs and coil. Fit distributor rotor arm and cap.

14. Connect vacuum line to carburettor and attach hot water hose to inlet manifold.

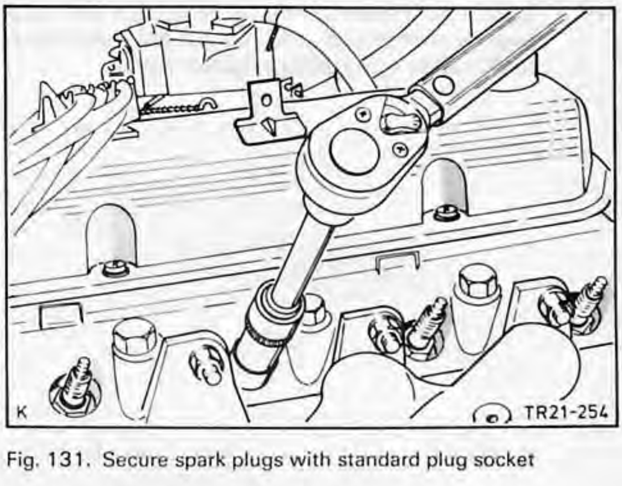


Fig. 131. Secure spark plugs with standard plug socket

15. Assemble throttle cable with bracket, hook up to throttle linkage, Fig. 132, and adjust. Attach choke cable, if fitted, and adjust.

16. Secure brake servo vacuum line to inlet connector. Connect engine breather hose to oil separator and fuel line to carburettor.

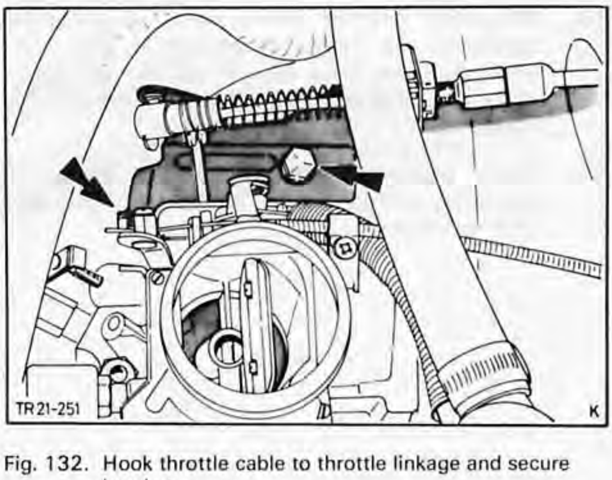


Fig. 132. Hook throttle cable to throttle linkage and secure bracket

17. Connect radiator hoses, Fig. 133, and top up with coolant. Connect earth strap to battery.
18. Allow engine to warm up for 15 mins. at 1000 rev/min, adjust dwell angle, timing, idling speed and CO content.

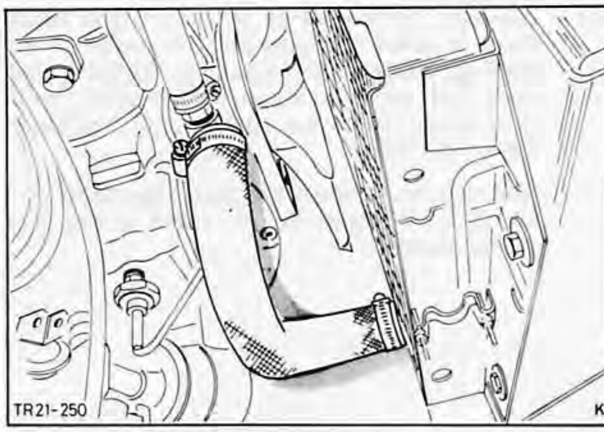


Fig. 133. Connect hose to radiator

19. After adjustments have been carried out with engine warmed up, disconnect HT leads from spark plugs and remove rocker cover.

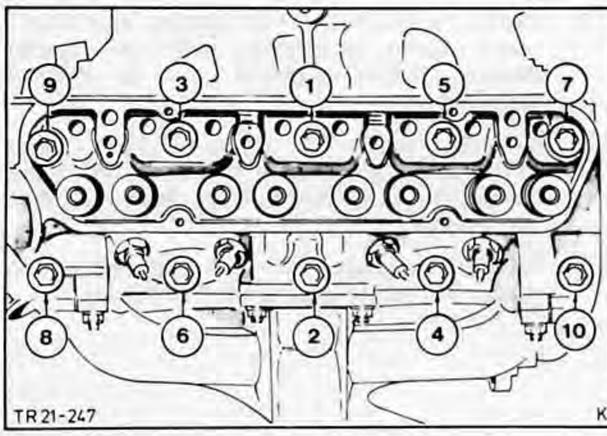


Fig. 134. Cylinder head bolt tightening sequence

20. Retighten cylinder head bolts to specified torque in the sequence shown in Fig. 134, using Special Tool No. 21–034. Retighten bolts securing rocker shaft and recheck valve clearances.
21. Refit rocker cover tightening bolts to specified torque, fit HT leads, Fig. 135, and refit air cleaner.

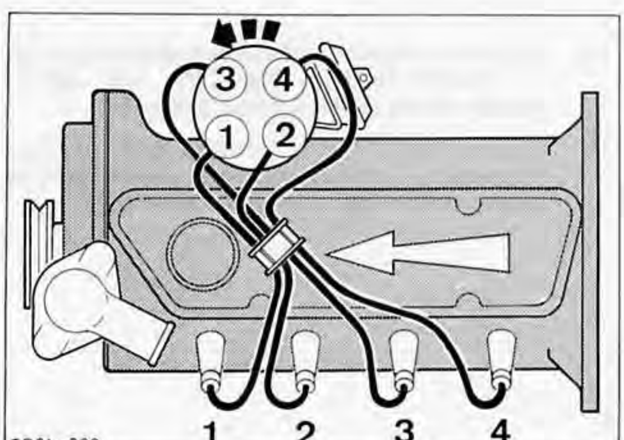


Fig. 135. Spark plug HT lead arrangement (firing order)

21 163 CYLINDER HEAD – REMOVE AND INSTALL (ONE)

Special Service Tools Required:

Cylinder head bolt wrench	21–002
Cylinder head alignment studs	21–003
Valve adjustment locknut wrench	21–004–A
Oil pump bolt and drive belt tensioner socket	21–012

To Remove

1. Disconnect battery earth strap and remove engine splash shield (5 screws), Fig. 136 Drain coolant into tray by disconnecting radiator hose from radiator bottom neck and engine water outlet at top.
2. Remove air cleaner and disconnect fuel line(s) from carburettor and engine breather hose from oil separator.
3. Disconnect brake servo vacuum hose from inlet manifold connection. Unhook throttle cable at throttle linkage and remove with bracket, Fig. 137.
4. Disconnect lead from temperature sender unit and HT leads from spark plugs and ignition coil. Remove distributor cap and distributor rotor arm.
5. Remove vacuum hose from carburettor, disconnect heater hose from automatic choke and exhaust pipe from exhaust manifold (2 nuts).

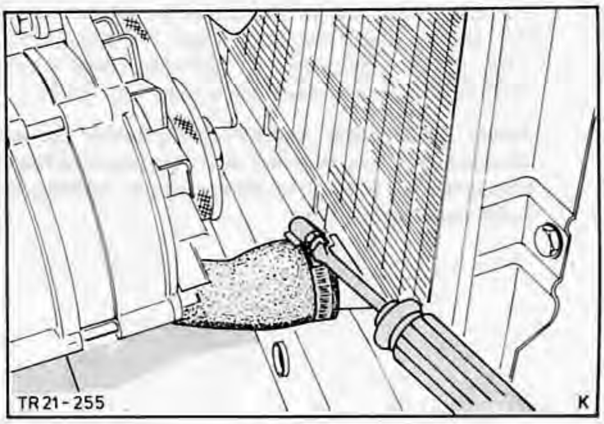


Fig. 136. Remove radiator hose from radiator

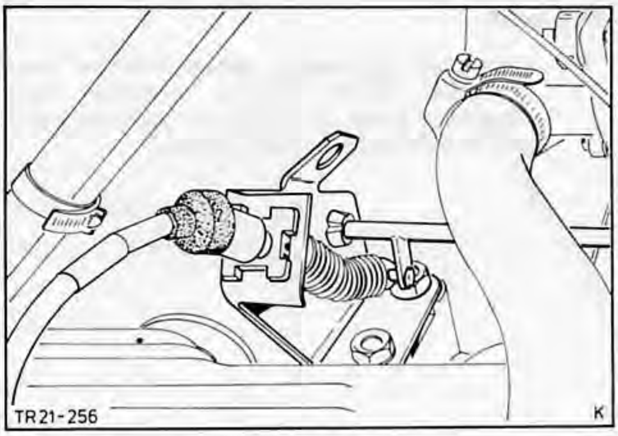


Fig. 137. Unhook throttle cable and remove with bracket

6. Remove toothed belt guard (3 bolts) and rocker cover (10 bolts). Slacken toothed belt tensioner using Special Tool 21–012 (1 hexagon bolt, 1 special bolt) Fig. 138, press against spring pressure and retighten. Remove toothed belt from camshaft toothed belt pulley.

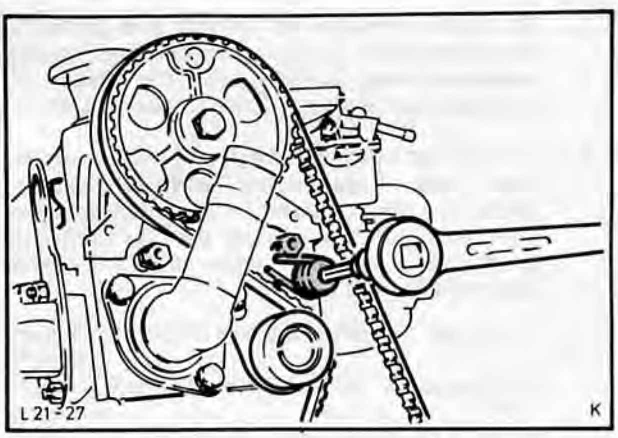


Fig. 138. Slacken toothed belt tensioner using Special Tool 21–012

7. Remove spark plugs and detach cylinder head (10 bolts) using Special Tool 21–002, Fig. 139. When unscrewing cylinder head bolts reverse tightening sequence (see Fig. 141).

   After complete removal cylinder head should not be placed on mating surface because of possible damage to valves in fully open position.

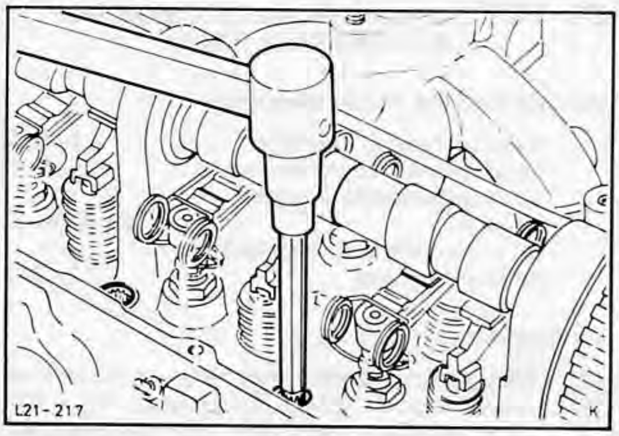


Fig. 139. Remove cylinder head using Special Tool 21–002

To Install

8. After cleaning mating faces (cylinder head –cylinder block), screw cylinder head alignment studs 21–003 into cylinder block and fit new cylinder head gasket.

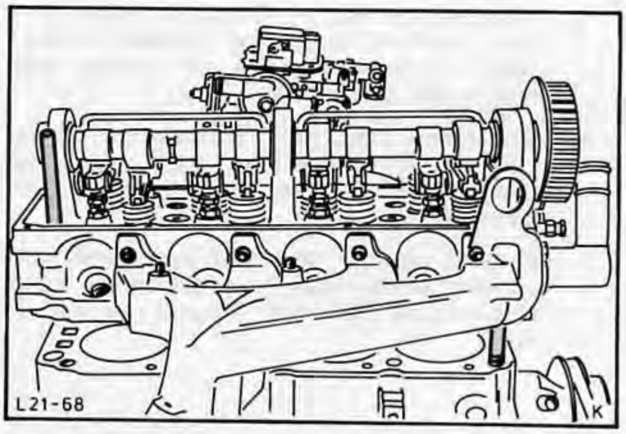


Fig. 140. Fit cylinder head using centering studs 21–003

To avoid damage to valves and pistons, the crankshaft must be turned before the cylinder head is fitted so that piston of 1st cylinder is about 2 cm before TDC.

9. Fit cylinder head, Fig. 140, and insert cylinder head bolts finger tight. Take out locating studs and replace them by the last two bolts. Cylinder head bolts should then be tightened to specified torque in three stages in order shown in Fig. 141.

1st stage	40 to 55 Nm (4,0 to 5,5 kgf.m) (35 lbf.ft)
2nd stage	50 to 70 Nm (5,0 to 7,0 kgf.m) (44 lbf.ft)

10 to 20 minutes later
85 to 95 Nm (8,5 to 9,5 kgf.m) (66 lbf.ft)

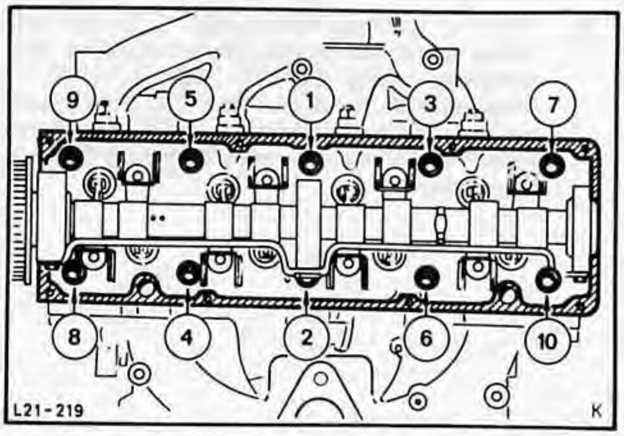


Fig. 141. Cylinder head bolt tightening sequence

Before fitting toothed belt, first turn camshaft toothed belt pulley to TDC mark on cylinder head. Then turn crankshaft belt pulley to TDC mark by taking shortest route, and set distributor rotor arm to mark for 1st cylinder, Fig. 142.

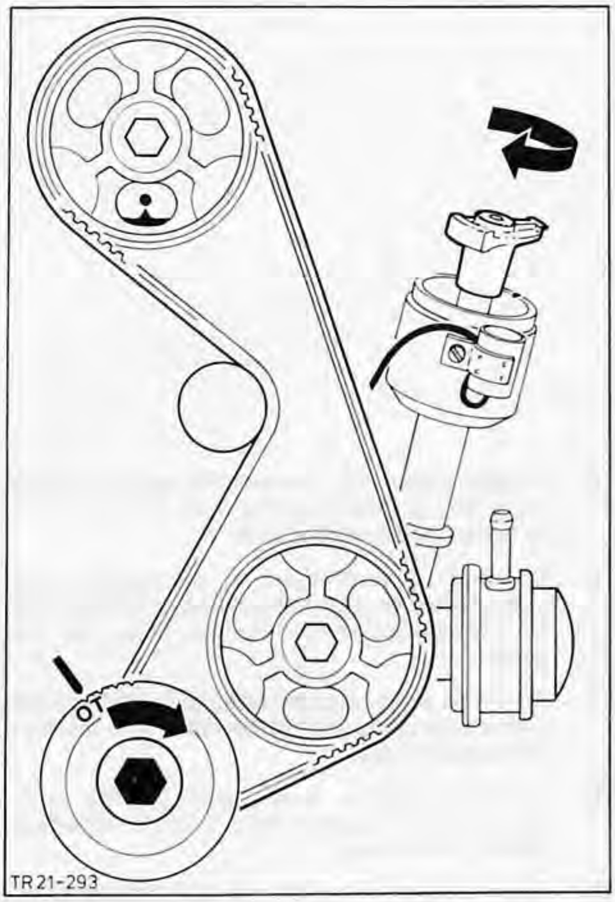


Fig. 142. Piston of No. 1 cylinder at TDC

10. Fit toothed belt. Slacken belt tensioner so that it will rest against the toothed belt when the engine is cranked over twice. After cranking, torque belt tensioner as specified in Technical Data.

    After positioning toothed belt crank engine in direction of rotation only.

11. Check valve clearances, and adjust if necessary, using Special Tool 21–004–A (see Operation No. 21 213, 'B' engine).

12. Fit rocker cover ensuring that gasket dovetail engages correctly.

13. Tighten rocker cover bolts to prescribed torque (see Technical Data) as shown in Fig. 143, in the following four stages.

    1st stage, tighten bolts 1 to 6
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
    2nd stage, tighten bolts 7 and 8
    2 to 2,5 Nm (0,2 to 0,25 kgf.m) (1,7 lbf.ft)
    3rd stage, tighten bolts 9 and 10
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
    4th stage, tighten bolts 7 and 8
    5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)

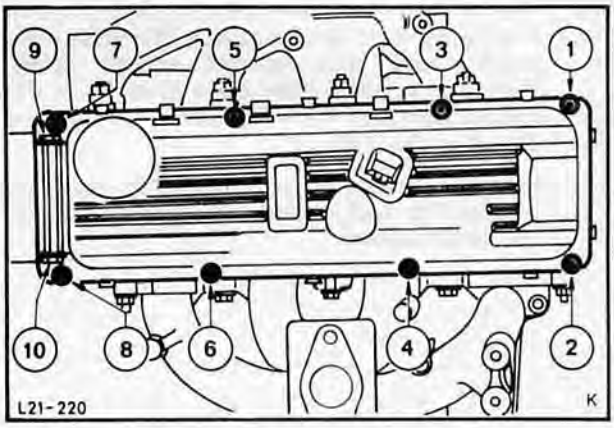


Fig. 143. Rocker cover bolt tightening sequence

21 165 5 CYLINDER HEAD – REPLACE (Cylinder head removed)

Special Service Tools required:

Valve spring compressor	21–024
(Main tool)	or 21–056
Adaptors	21–024–02

To Dismantle

1. Remove inlet manifold (5 bolts) complete with carburettor, Fig. 147, and exhaust manifold (6 nuts) from cylinder head.
2. Remove exhaust manifold studs (6) and temperature sender unit.

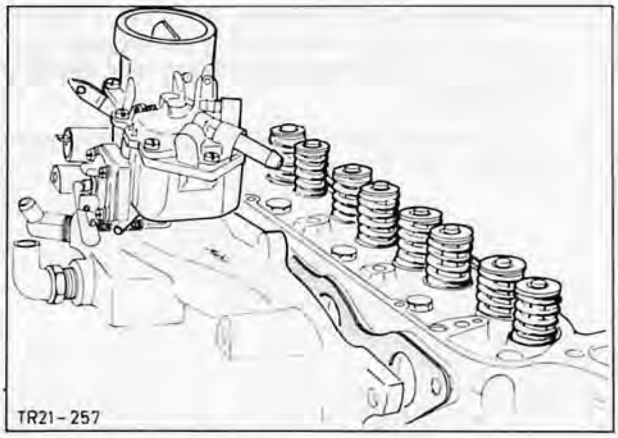


Fig. 147. Remove inlet manifold with carburettor

3. Compress valve springs and retainers using standard valve spring compressor and remove collets. Fig. 148.

   When removing and refitting valve springs it is essential to ensure that the valve stem is not damaged by valve spring retainer when it is pressed down in order to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result is excessive oil consumption and wear in the valve guides.

4. Release valve spring compressor, remove valve retainers and springs, take off valve stem seals and take out valves.

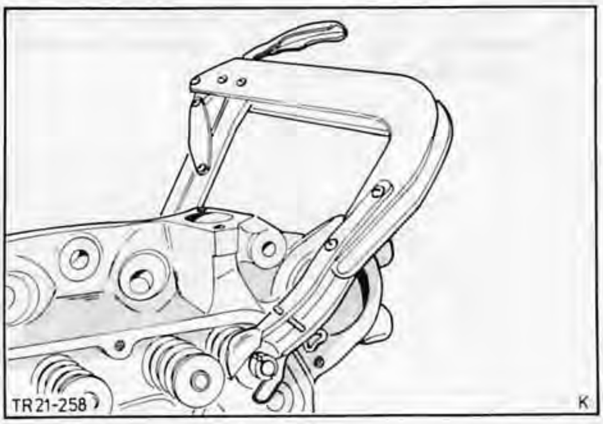


Fig. 148. Removal of valve springs, using standard valve compressor

To Assemble

Before assembling new cylinder head, check parts of old cylinder head intended to be re-used for wear and serviceability.

5. Lubricate valves and valve guides. Insert valves, and cover splines with adhesive foil.
6. Fit valve stem seals, Fig. 149, remove adhesive foil from valve stem.

   Every time valves are taken out and refitted, new valve stem seals should be used. Cover valve splines with adhesive foil to prevent damage to valve stem seals.

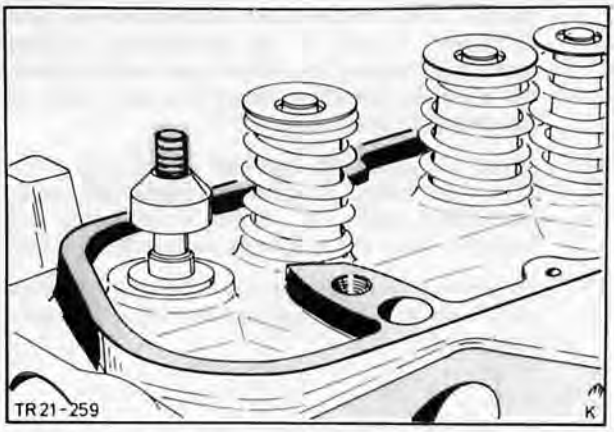


Fig. 149. Slide valve stem seal on valve stem

7. Compress valve springs and valve spring retainers, using valve spring compressor and fit collets. **Pay attention to correct seating of collets.**
8. Refit exhaust manifold studs and temperature sender unit, Fig. 150.

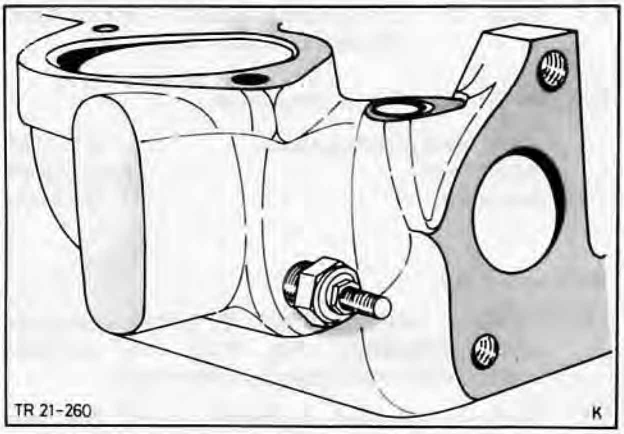


Fig. 150. Fit temperature sender unit

9. Replace inlet manifold complete with carburettor, Fig. 151, and exhaust manifold, using new gaskets.

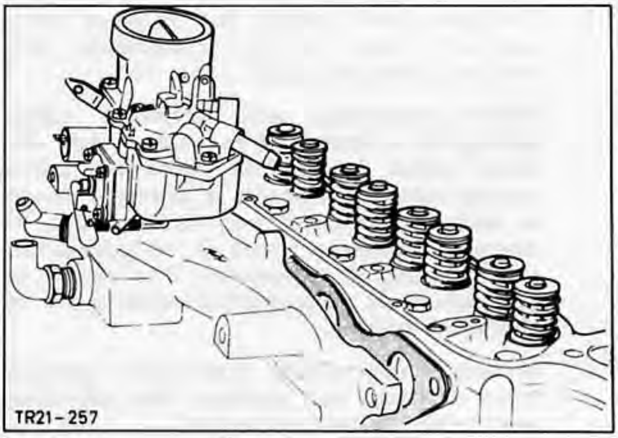


Fig. 151. Install inlet manifold with carburettor

When used valves are installed in a new cylinder head, it is essential before installing them to reface the valve head on a valve grinding machine and then to proceed as follows:

10. Grind in valves in cylinder head, Fig. 152. Clean all traces of grinding paste off valves and valve seats, oil valves, valve seats and inserts. Cover valve splines with adhesive foil.
11. Fit valve seals and remove adhesive foil from valve stem. Continue as described in sub-operation 7.

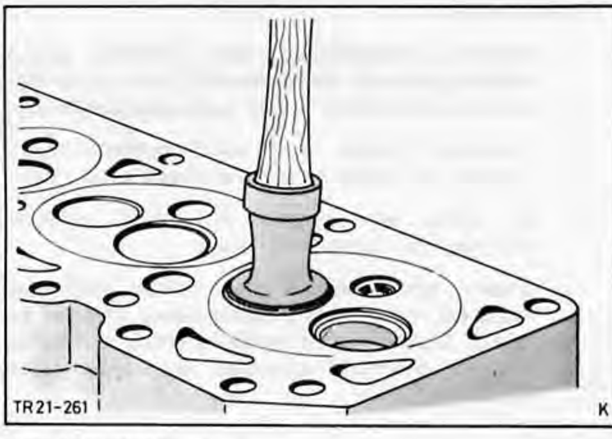


Fig. 152. Grind in valves

21 165 5 CYLINDER HEAD – REPLACE (Cylinder head removed)

Special Service Tools Required:

Valve adjusting locknut wrench	21–004–A
Valve spring compressor	21–005–A
Valve stem oil seal installer	21–007
Camshaft oil seal installer	21–009–A
Oil pump bolt and drive belt tensioner socket	21–012

o Dismantle

1. Support front and rear of cylinder head with two wooden-blocks of equal size in order to prevent damage to valves.
2. Remove inlet manifold (4 bolts, 2 nuts) complete with carburettor, Fig. 153, and water connection (2 bolts) from cylinder head.
3. Remove exhaust pipe (2 bolts) and exhaust manifold (8 nuts).
4. Detach oil pipe (3 bolts). Remove inlet manifold studs (2) and exhaust manifold studs (8) with two lock nuts, as well as temperature sender unit.
5. Unhook cam follower retaining springs, compress valve spring retainer and valve springs using Special Tool 21–005, remove cam followers, Fig. 154, and take out collets, Fig. 155.

When removing and refitting valve springs it is essential to ensure that the valve stem is not damaged by valve spring retainer when it is pressed down in order to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result is excessive oil consumption and wear in the valve guides.

6. Release valve springs. Remove valve spring retainer and valve springs, withdraw valves and remove valve stem seals.

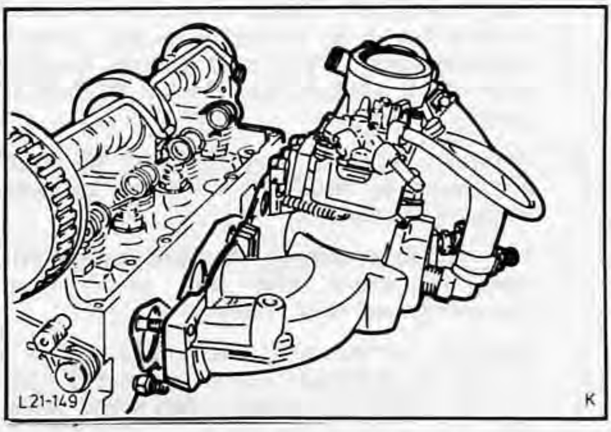


Fig. 153. Remove inlet manifold with carburettor

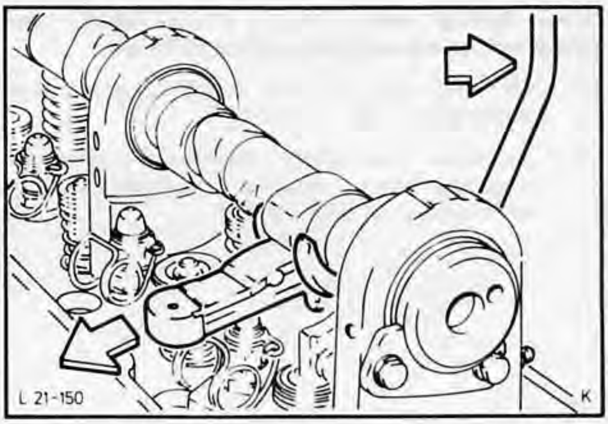


Fig. 154. Remove cam followers using Special Tool 21–005

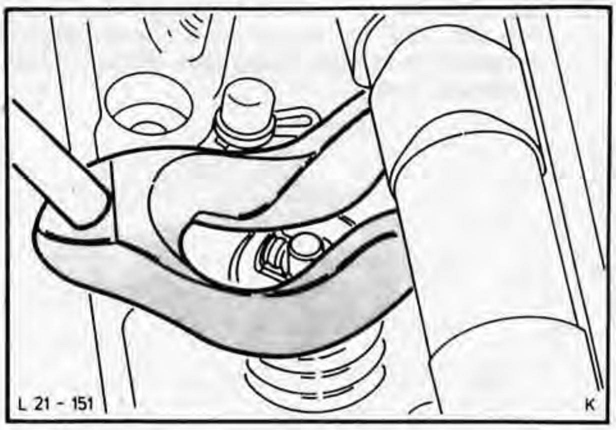


Fig. 155. Remove valve collets, spring retainers and springs, using Special Tool 21–005.

21 165 5 (cont'd)

7. Hold camshaft in position with open ended spanner on boss behind 6th cam, detach camshaft gear (1 bolt) and remove together with thrust washer. Remove oil retainer (3 bolts).

8. Remove camshaft retaining plate (2 bolts) and carefully withdraw camshaft to rear. Remove ball pins (8).

   Do not interchange re-used camshaft, cam followers and ball pins when removing and re-installing.

9. Remove toothed belt tensioner (2 bolts, 1 spring), using Special Tool 21–012, Fig. 156, and remove toothed belt guard spacer bolts (2).

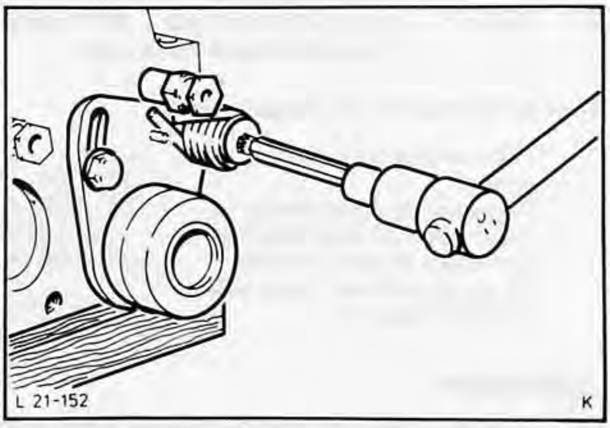


Fig. 156. Remove toothed belt tensioner, using Special Tool 21–012

To Install

Before assembling new cylinder head check parts of old cylinder head intended to be re-used for wear and serviceability.

When fitting new parts, e.g. camshaft, cam followers or valves proceed as follows:

10. Fit inlet and exhaust manifold studs and temperature sender unit.

11. Lubricate camshaft bearings, camshaft, retaining plate, ball pins and cam followers with hypoid oil SAE 80/90.

12. Carefully insert camshaft through rear bearing, Fig. 157. Fit retaining plate and measure camshaft end-float using dial indicator (see Technical Data).

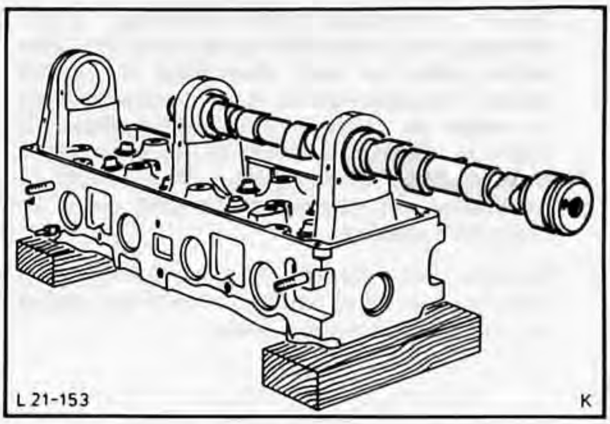


Fig. 157. Fit camshaft

13. Fit ball pin complete with lock nut, Fig. 158. Lubricate valve guides and valves with hypoid oil SAE 80/90. Insert valves and cover valve splines with adhesive foil.

14. Lubricate valve guides and valves with hypoid oil SAE 80/90. Insert valves and cover splines with adhesive foil.

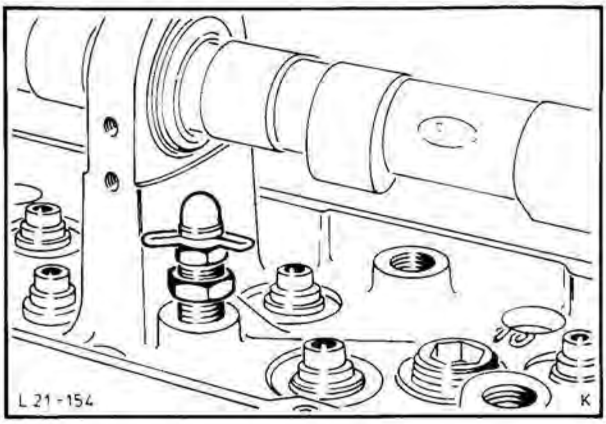


Fig. 158. Fit ball pin with lock nut and retaining clip

15. Lubricate valve stem seals and install on stems provided on new cylinder head, using Special Tool 21–007, Fig. 159. Remove adhesive foil from valve stem.

Every time valves are removed and refitted new valve stem seals should be used and valve splines covered with adhesive foil to avoid damage to valve stem seals.

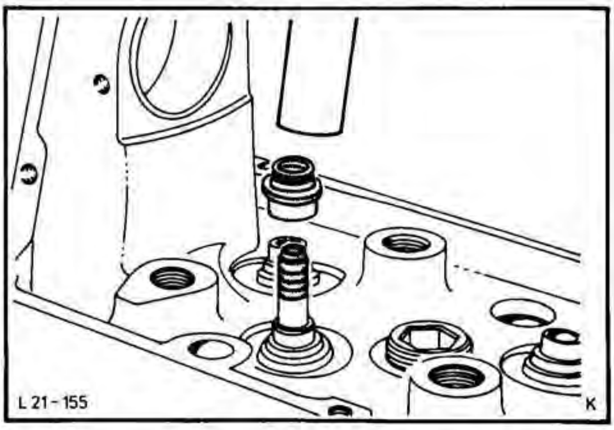


Fig. 159. Fit valve stem seals using Special Tool 21–007

16. Fit valve springs and retainers, compress with Special Tool 21–005 and fit valve collets, Fig. 160. Insert cam followers.

Check correct seating of valve collets.

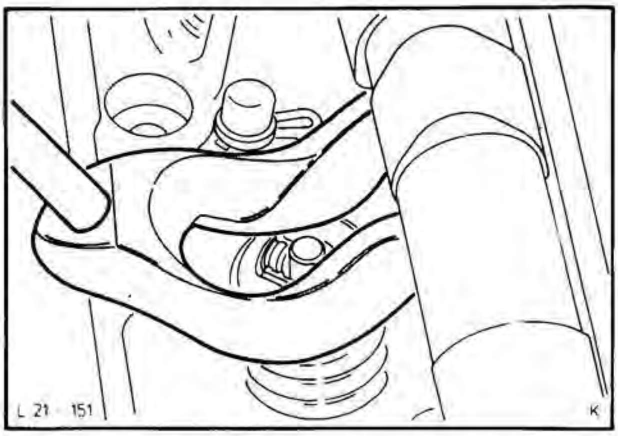


Fig. 160. Fitting of valve springs, retainers and collets, with Special Tool 21–005

21 165 5 (cont'd)

17. Lightly grease sealing lip of new oil seal and install oil seal, using Special Tool 21–009–A, Fig. 161.

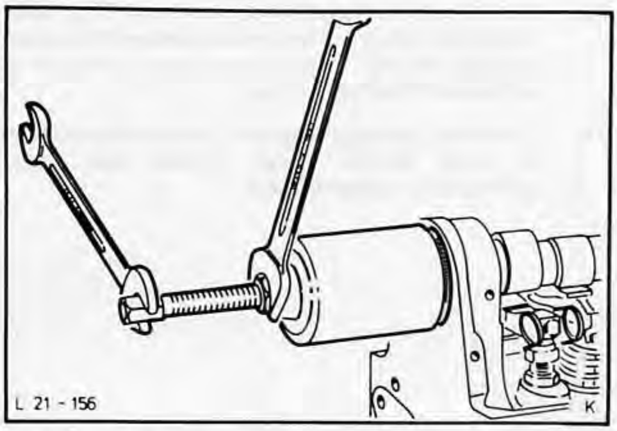


Fig. 161. Fit oil seal, using Special Tool 21–009–A

18. Fit camshaft pulley thrust washer with reinforced side facing outward. Torque bolt as specified in Technical Data, holding camshaft in position with open-ended spanner, Fig. 162.

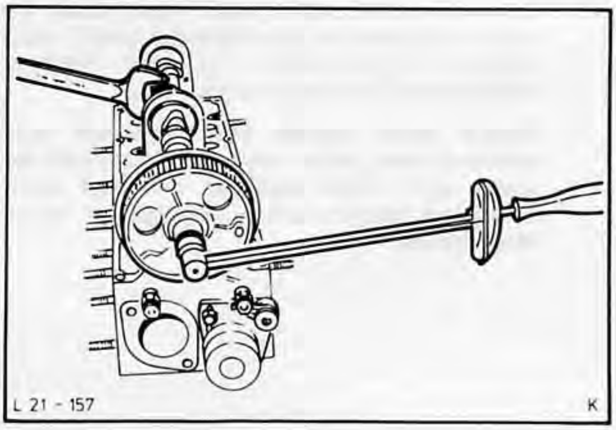


Fig. 162. Tighten camshaft pulley bolt to specified torque

19. Secure cam followers by means of retaining springs, Fig. 163, adjust valve clearances using Special Tool 21–004–A (see Operation No. 21 213 'B' engine).

20. Install toothed belt guard spacer bolts together with tensioner.

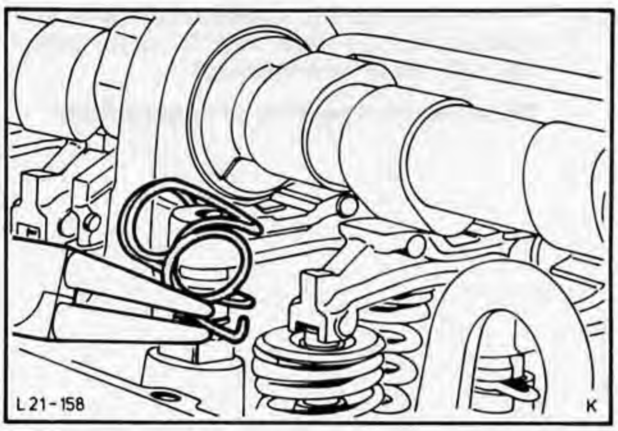


Fig. 163. Secure cam follower by means of retaining springs

21. Fit oil splash tube and fit water connection complete with thermostat and new gasket to cylinder head, Fig. 164.

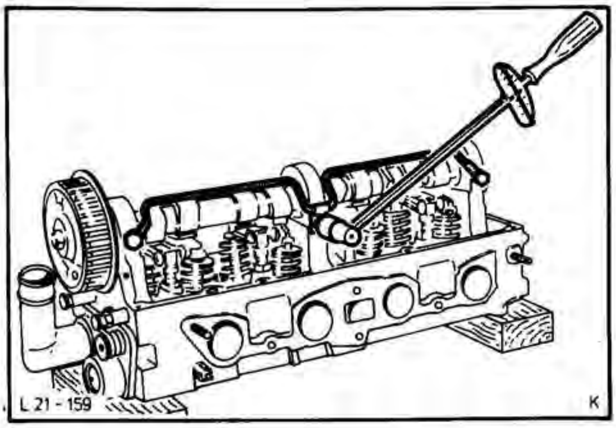


Fig. 164. Fit oil slinger pipe

22. Fit inlet manifold complete with carburettor and exhaust manifold with new gaskets. Apply sealing compound Part No. A 70SX-19554-BA not less than 5 mm (0,2 in) wide to either side of gasket on water connection (cylinder head – inlet manifold), Fig. 165. Fit exhaust manifold shield.

When used valves are installed in a new cylinder head it is essential before installing them to reface valve head on a valve grinding machine and then to proceed as follows:

23. Grind in valves in cylinder head, clean all traces of grinding paste off valves and valve seats, oil and insert valves.

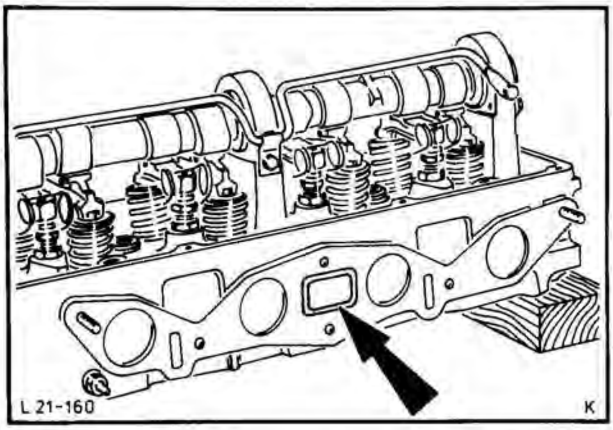


Fig. 165. Apply sealing compound to either side of inlet manifold gasket

24. Cover valve splines with adhesive foil and fit lubricated valve stem seals using Special Tool 21–007, Fig. 166.

Cover valve splines with adhesive foil to prevent damage to splines.

25. Remove adhesive foil from valve stem, fit valve springs and valve retainers, compress with Special Tool 21–005, fit collets and cam followers.

Pay attention to correct seating of valve collets.

Carry out remaining repair operations as described from sub-operation 17 onwards.

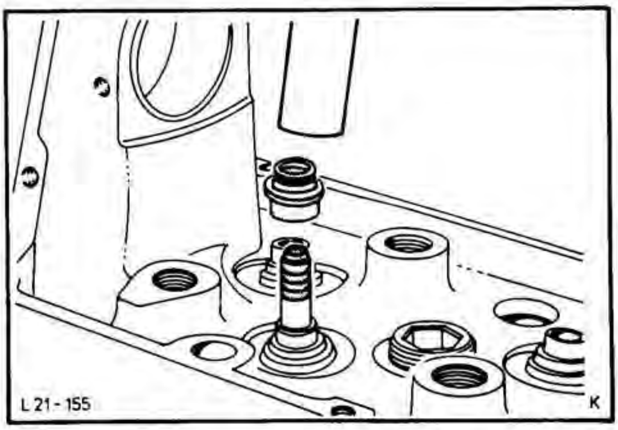


Fig. 166. Fit valve stem seals using Special Tool 21–007

21 213 VALVE CLEARANCES – ADJUST (ALL)

Special Service Tools Required: None

1. Remove air cleaner, disconnect HT leads from spark plugs and remove rocker cover.
2. During adjustment of valve clearances, crank engine only in direction of normal rotation. For first valve adjustment, align crankshaft pulley mark with TDC mark on timing cover, Fig. 167.

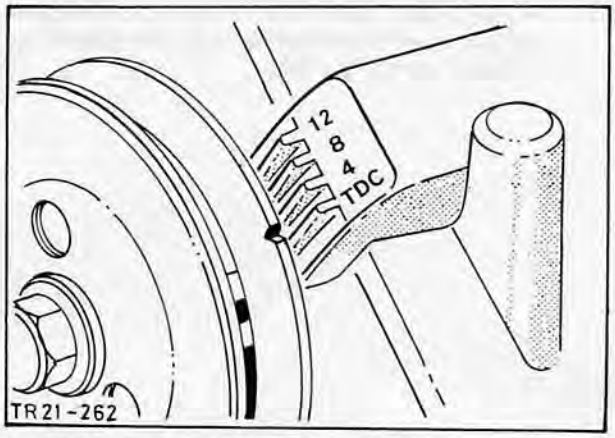


Fig. 167. Pulley on TDC mark

If pulley is now turned to and fro a little the valves of cylinders No. 1 or 4 will be rocking, Fig. 168, i.e. the two rocker arms and push rods move in opposite directions. If the valves of cylinder No. 4 are rocking the valve clearances on No. 1 cylinder should be adjusted. If pulley is now turned through 180°, valve clearances on No. 2 or No. 3 cylinder can be adjusted etc. according to firing order (for adjustment see Technical Data).

Cylinder No. 4 rocking – Adjust cylinder No. 1.
Cylinder No. 3 rocking – Adjust cylinder No. 2.
Cylinder No. 1 rocking – Adjust cylinder No. 4.
Cylinder No. 2 rocking – Adjust cylinder No. 3.

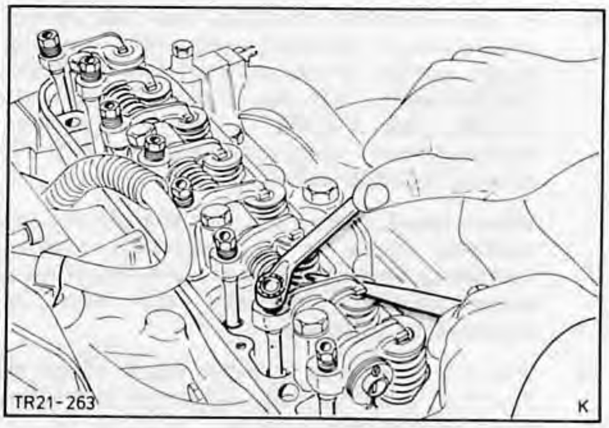


Fig. 168. Adjust valve clearances of No. 1 cylinder

3. Replace rocker cover and torque bolts to specification. Connect HT leads, Fig. 169, and fit air cleaner.

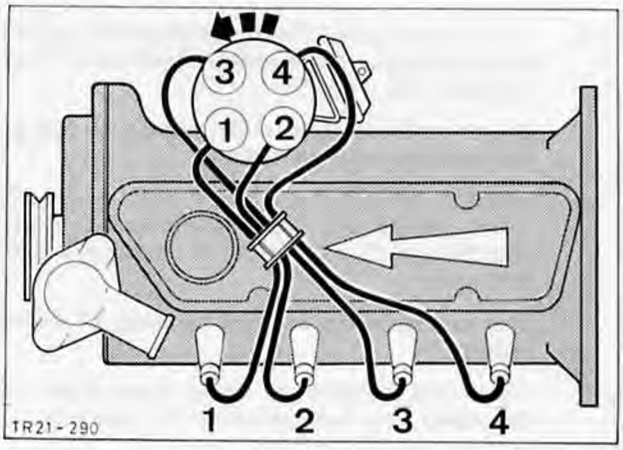


Fig. 169. HT lead arrangement (Firing order)

21 213 VALVE CLEARANCES – ADJUST (ALL)

Special Service Tool Required:

Valve adjustment locknut wrench 21–004–A

1. Remove air cleaner. Disconnect HT leads from spark plugs and remove rocker cover (10 bolts).
2. Adjust valve clearances, proceeding as follows: Rotate cams one by one so that they point upwards and measure valve clearance between cam follower and cam, Fig. 170. Adjust clearance at ball pin. Torque ball pin lock nut as specified in Technical Data, using Special Tool 21–004–A (see Technical Data).

Crank engine in direction of rotation only

3. Fit rocker cover, ensuring correct engagement of gasket protrusion.
4. Tighten rocker cover bolts to specified torque in four stages, as shown in Fig. 171.

   1st stage, tighten bolts 1–6.
   5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
   2nd stage, tighten bolts 7 and 8
   2 to 2,5 Nm (0,2 to 0,25 kgf.m) (1,7 lbf.ft)
   3rd stage, tighten bolts 9 and 10
   5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft)
   4th stage, tighten bolts 7 and 8
   5 to 7 Nm (0,5 to 0,7 kgf.m) (4,4 lbf.ft).

5. Connect HT leads, Fig. 172, and fit air cleaner.

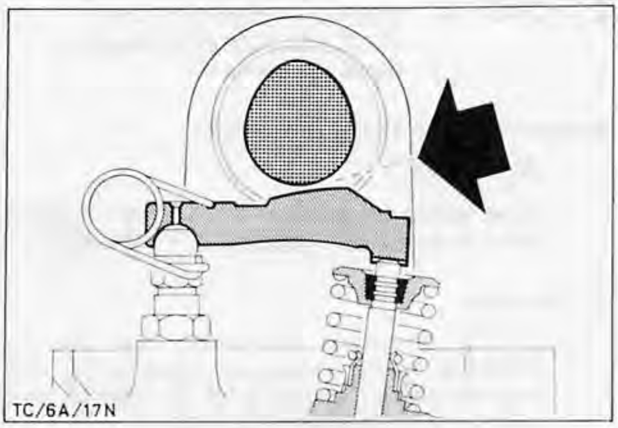


Fig. 170. Measure valve clearance

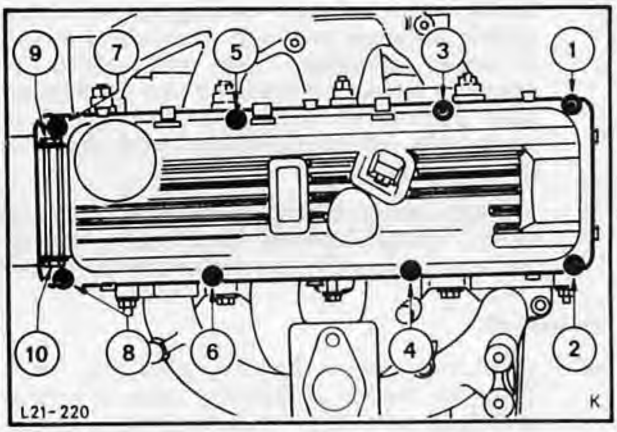


Fig. 171. Rocker cover bolt tightening sequence

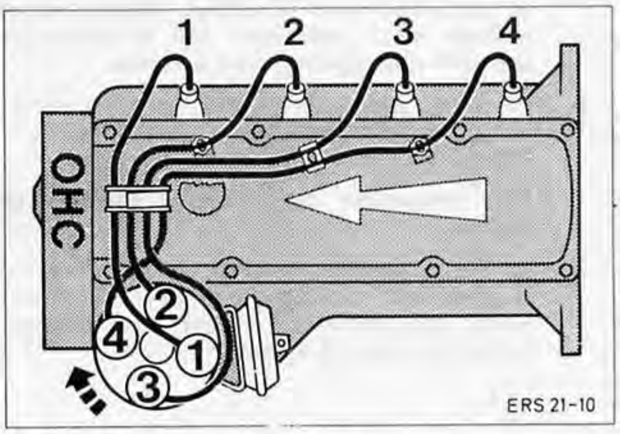


Fig. 172. Arrangement of HT leads (firing order)

21 215 4 VALVE – REMOVE AND INSTALL (ONE) (Cylinder head removed)

Special Service Tools Required:

'B' ENGINE

Valve spring compressor	21–005–A
Valve stem oil seal installer	21–007

To Remove

1. On the 'B' engine, disconnect cam follower retaining spring, compress valve spring and retainer using Special Tool 21–005–A and take out cam follower, Fig. 173.
2. Compress valve spring and valve retainer with standard valve spring compressor and take out collets, Fig. 174.

   When removing and refitting valve springs it is essential to ensure that the valve stem is not damaged by valve spring retainer when it is pressed down in order to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result is excessive oil consumption and wear in the valve guides.
3. Slacken valve spring compressor, remove valve spring retainer and valve spring. Remove valve stem seal and withdraw valve.

To Install

4. Grind in valve in cylinder head, Fig. 152. Clean all traces of grinding paste off valve and valve seat. Insert and cover valve splines with adhesive foil.
5. Lubricate valve stem seal and install (on 'B' engine using Special Tool 21–007), Fig. 175. Remove adhesive foil from valve stem.

   Use new valve stem seal whenever valve is removed and installed. Cover valve splines with adhesive foil in order to prevent damage to valve splines.
6. Fit valve spring and valve spring retainer, compress with valve spring compressor and fit collets.

   Pay attention to correct seating of collets.
7. On the 'B' engine, compress valve spring and retainer with Special Tool 21–005–A and insert cam follower. Secure cam follower using the retaining spring.

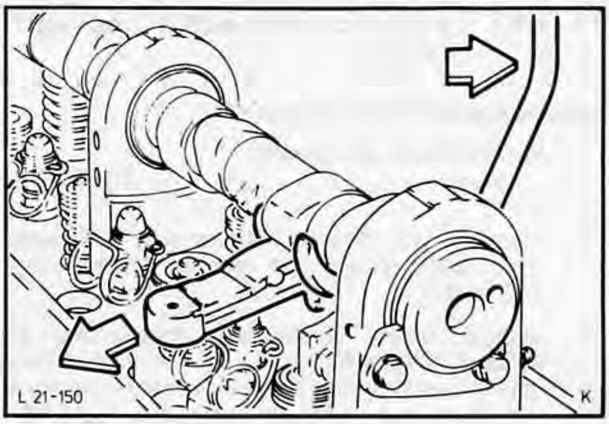


Fig. 173. Remove cam follower with Special Tool 21–005–A, 'B' engine

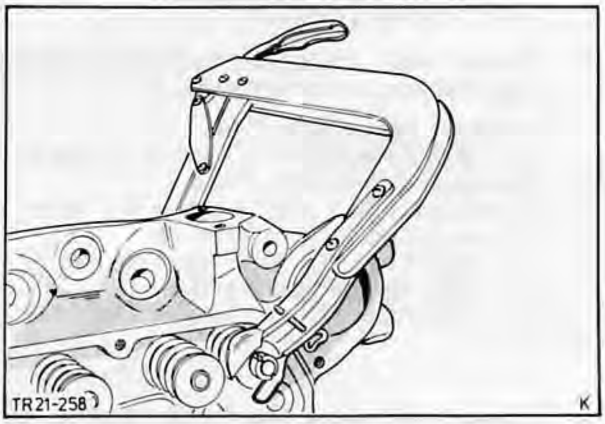


Fig. 174. Remove collets with standard valve spring compressor, – 'A' engine

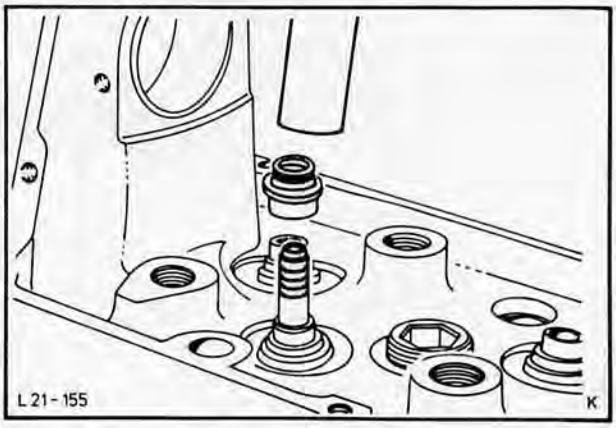


Fig. 175. Fit valve stem seal, using Special Tool 21–007, 'B' engine

21 233 9 VALVE GUIDE – REAM (Valve removed)

Special Service Tools Required:

'A' engine	
Valve guide reamer	21–042
'B' engine	
Valve guide reamer	
0,2 mm oversize	21–071
0,4 mm oversize	21–072
0,6 mm oversize	21–073
0,8 mm oversize	21–074

1. Insert existing valve in valve guide and determine play by pressing sideways, Fig. 176.

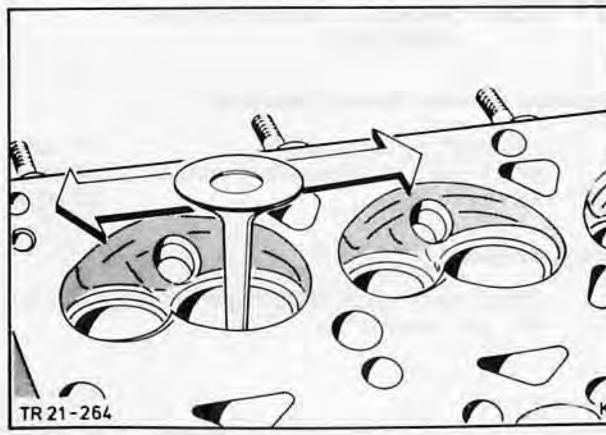


Fig. 176. Measure valve guide play by pressing sideways

2. Using reamer, ream valve guide from valve seat end, Fig. 177. After they have been used for a considerable time valve guides wear into an oval shape. When rectifying, reaming should always be carried out from the **valve seat end.** The size of bore chosen depends on the amount of wear of the guide bore and the valve oversizes available (see Parts Catalogue). When reaming the **smallest** reamer should always be used initially, since with the larger ones the depth of cut is too great. To lubricate, use drilling oil or petrol.

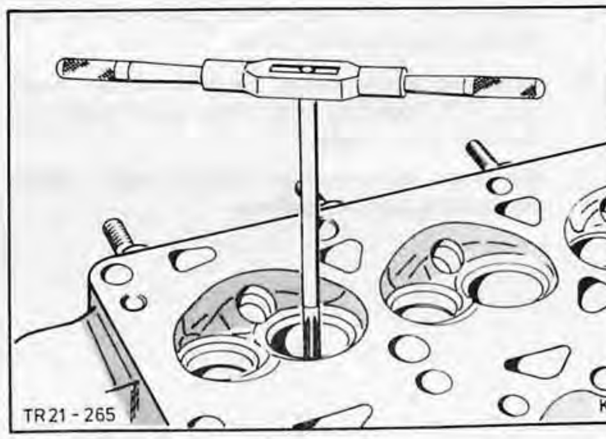


Fig. 177. Ream valve guide

3. Using Special Tool recut valve seat as specified (see Technical Data), Fig. 178.

   Before seat is recut, it is essential that the valve guide be checked or reamed using the appropriate Special Tool.

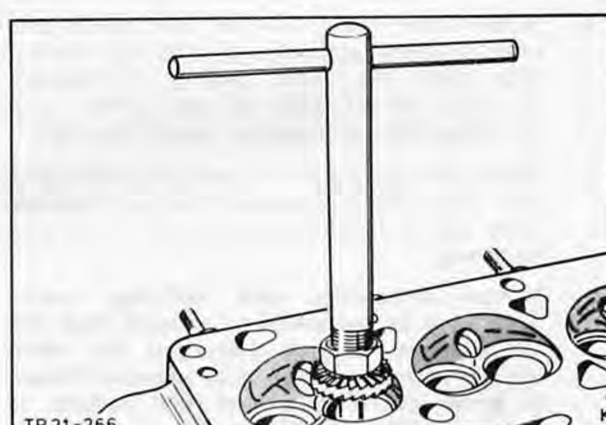


Fig. 178. Recut valve seat

21 238 SEALS – VALVE STEM – REPLACE

Special Service Tools Required:

Valve spring compressor	21–056
(or 21–024 in conjunction with 21–024–02)	
Valve retainer	21–057

To Remove

1. Disconnect earth strap from battery and take off air cleaner.

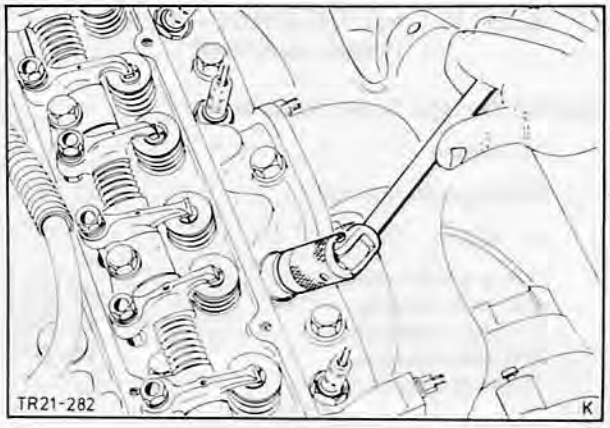


Fig. 179. Remove sparking plugs

2. Disconnect HT leads from spark plugs and remove rocker cover bolts.
3. Unscrew spark plugs, remove rocker shaft Fig. 179, together with valve stem seals and remove push rods.

   Do not interchange push rods when removing and installing.

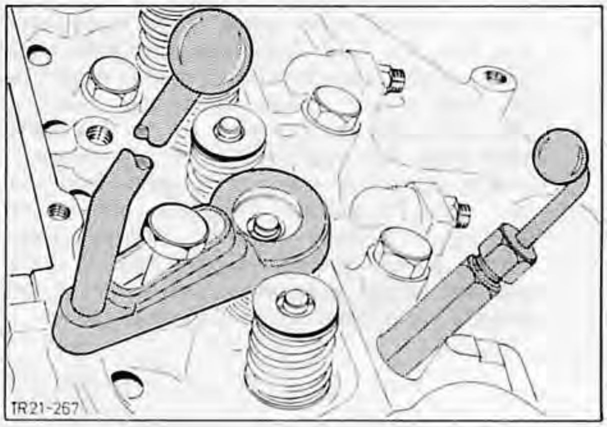


Fig. 180. Removing valve spring with Special Tools 21–056 and 21–057

4. Screw valve holder 21–057 into spark plug hole, position against valve spring retainer and lock. Fit valve spring compressor 21–056 (or 21–024 in conjunction with 21–024–02) to cylinder head, Fig. 180.
5. Press valve spring down, remove collets, Fig. 181, and release pressure on spring. Remove valve spring retainer, valve spring and valve stem seal.

   When removing and refitting valve springs it is essential to ensure that the valve stem is not damaged by valve spring retainer when it is pressed down in order to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result is excessive oil consumption and wear in the valve guides.

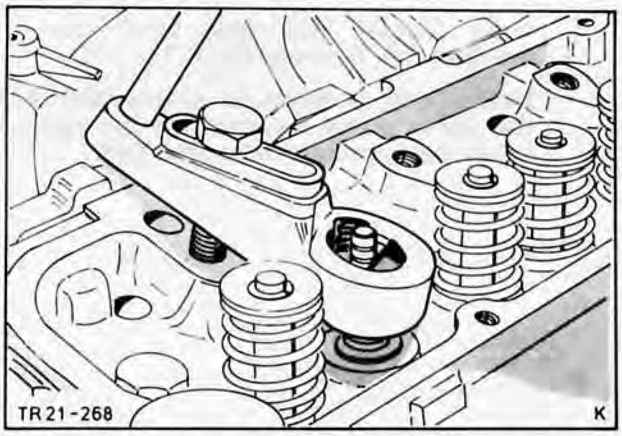


Fig. 181. Remove collets

To Install

6. Cover valve spline with adhesive foil, slide new valve stem seal down valve stem, Fig. 182, against stop. Remove adhesive foil from valve stem. Fit valve spring and valve spring retainer, compress with Special Tool and fit collets. Release pressure on valve spring and remove Special Tool.

   Pay attention to correct seating of collets.

   Repeat sub-operations 4–6 on each cylinder.

   Use new valve stem seal whenever valve is removed and installed. Cover valve splines with adhesive foil to prevent damage to valve stem seal.

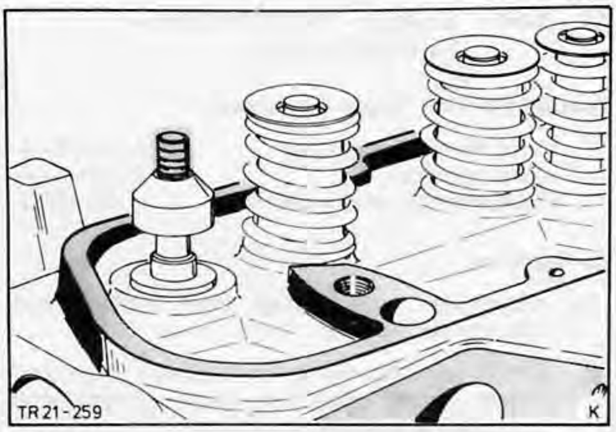


Fig. 182. Fit seal to valve stem

7. Insert push rods into tappet sockets. Position rocker shaft guiding rocker arm adjusting screws into push rod sockets. Replace rocker shaft bolts and torque as specified, Fig. 183, (see Technical Data).

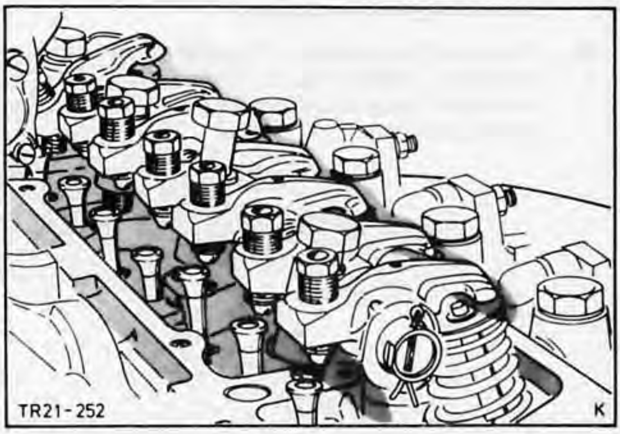


Fig. 183. Torque rocker shaft bolts as specified (see Technical Data)

8. Adjust valve clearances (see Operation No. 21 213).
9. Screw in spark plugs and replace rocker cover.
10. Connect HT leads to spark plugs, Fig. 184, refit air cleaner. Connect earth strap to battery.

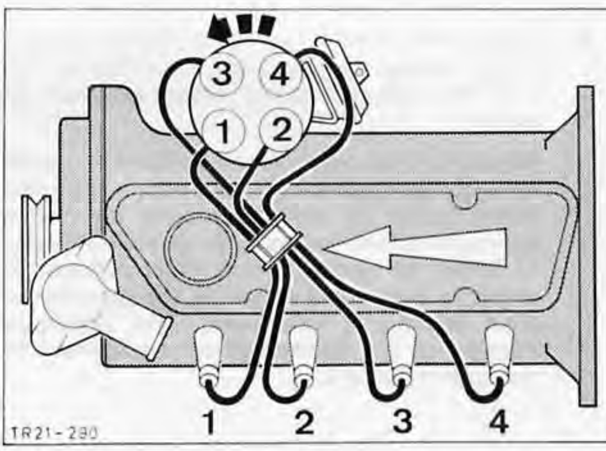


Fig. 184. HT leads (firing order)

21 238 SEALS – VALVE STEM – REPLACE (ALL)

Special Service Tools Required:

Valve spring compressor	21–005–A
Valve retainer	21–006–A
Valve stem oil seal installer	21–007

To Remove

1. Disconnect earth strap from battery and remove air cleaner.
2. Disconnect HT leads from spark plugs and rocker cover. Remove rocker cover and remove spark plugs.
3. Unhook cam follower springs, Fig. 185, press valve spring and valve spring retainer down, using Special Tool 21–005–A, and remove cam followers, Fig. 186.

   Do not interchange cam followers when removing and installing.
4. Remove heat shield (2 bolts) from exhaust manifold. Screw valve retainer 21–006–A into spark plug hole, position it against valve head and lock.

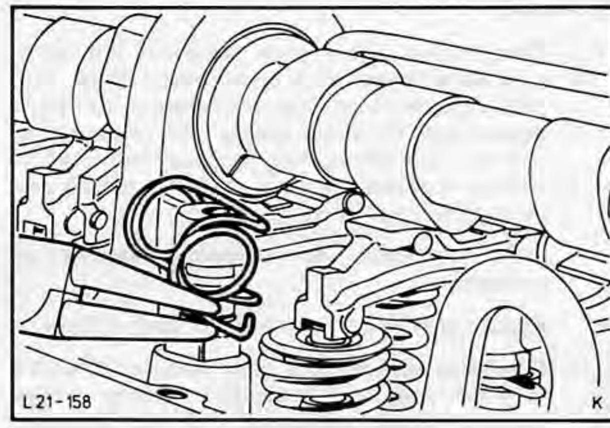


Fig. 185. Unhook cam follower springs

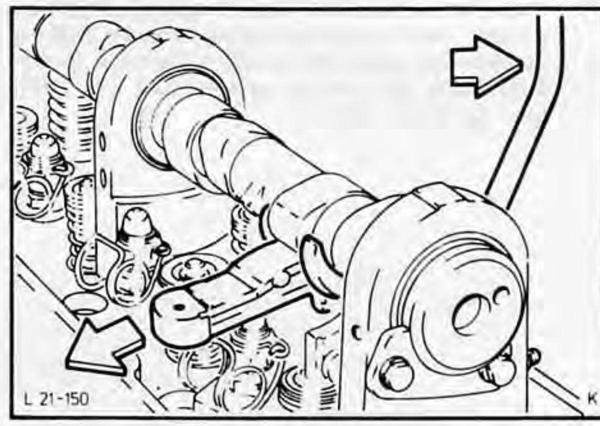


Fig. 186. Remove cam follower using Special Tool 21–005–A

5. Press valve spring and valve spring retainer down, using Special Tool 21–005–A, Fig. 187. Remove collets and release pressure on spring.

   When removing and refitting valve springs it is essential to ensure that the valve stem is not damaged by valve spring retainer when it is pressed down in order to remove and refit collets. If stem is damaged there is no guarantee that sealing is adequate. The result is excessive oil consumption and wear in the valve guides.

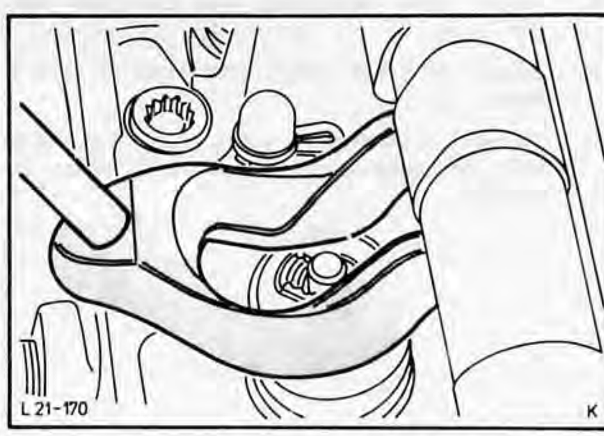


Fig. 187. Remove valve spring using Special Tools 21–005–A and 21–006–A

21 238 (cont'd)

6. Remove valve spring retainer and valve spring. Prise valve stem seal off cylinder head with screwdriver, Fig. 188.

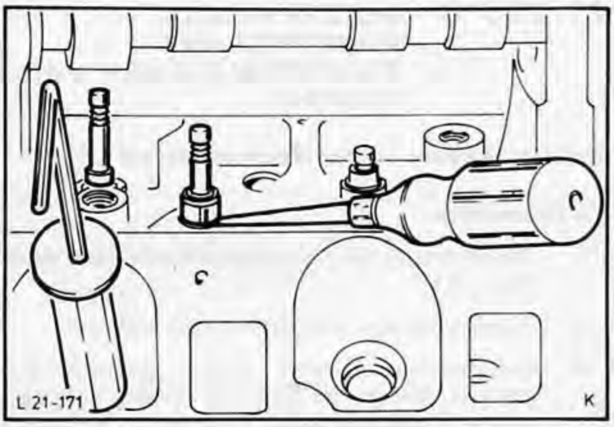


Fig. 188. Remove valve stem seal using screwdriver

To Install

7. Cover valve splines with adhesive foil. Fit new lubricated valve stem seal using Special Tool 21–007, Fig. 189, and remove adhesive foil from valve stem. Position valve spring and valve spring retainer, press down using Special Tool 21–005–A and fit collets. Release pressure on spring and remove Special Tool.

   Pay attention to correct seating of collets.

   Before installing valve stem seals cover valves splines with adhesive foil to prevent damage to valve stem seals.

   Use new valve stem seal whenever valve is removed and installed.

8. Fit cam followers and cam follower springs. Check valve clearances and adjust, if necessary. (Refer to Operation 21–213 Engine–'B').
9. Fit spark plugs and rocker cover as specified. Bolt heat shield to exhaust manifold.
10. Connect HT leads, Fig. 190, and connect battery earth strap.

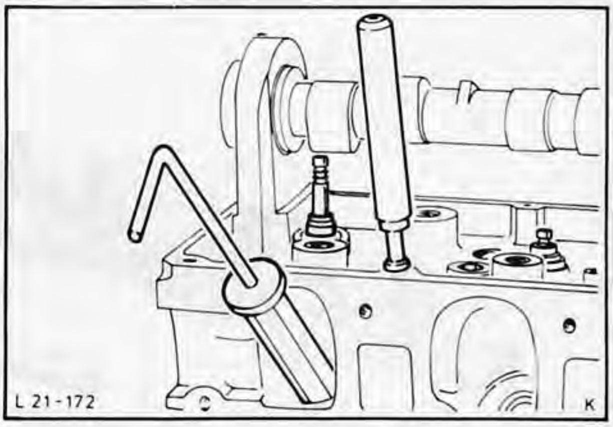


Fig. 189. Fit valve stem seal, using Special Tool 21–007

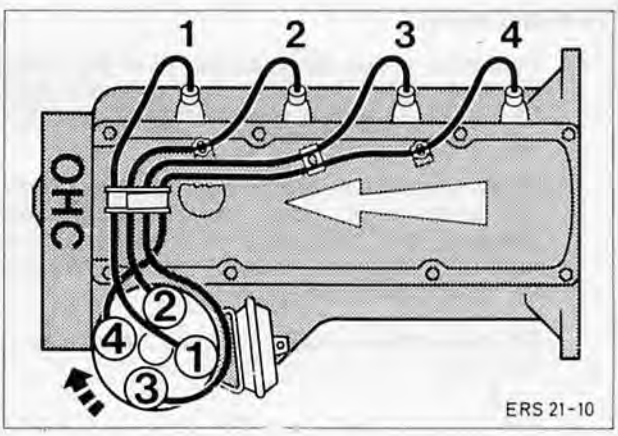


Fig. 190. Arrangement of HT leads (firing order)

21 255 9 ROCKER SHAFT – DISMANTLE AND REASSEMBLE (Rocker shaft removed)

Special Service Tools Required: None

To Dismantle

1. Remove split pin from one end of rocker shaft (Fig. 191).
2. Remove spring washer and two washers.
3. Remove rocker arms, rocker supports and springs. Knock off jammed rocker supports with a plastic hammer.

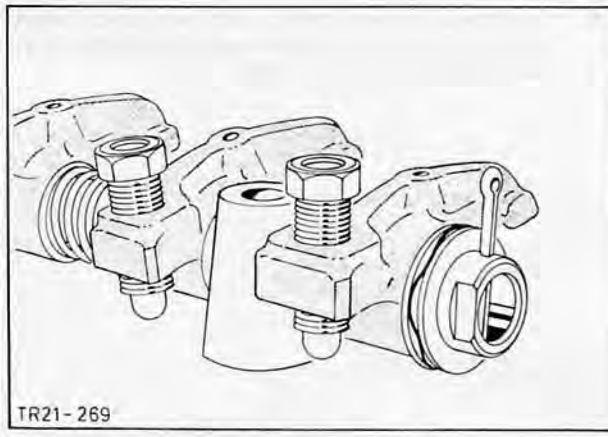


Fig. 191. Remove split pin from rocker shaft

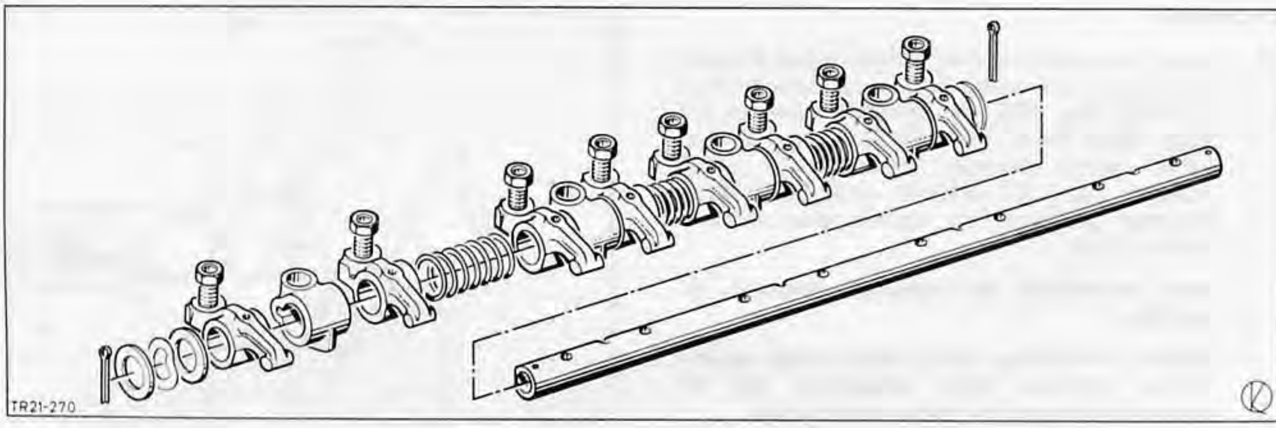


Fig. 192. Rocker shaft dismantled

To Reassemble

4. Assemble rocker shaft as shown in Fig. 192, first lubricating rocker shaft and rocker arm bearing faces with hypoid oil SQM-2C-9002-AA.

   When assembled, the oil port for rocker arm lubrication must point **to the front and downwards.** This position is marked by a notch on the end face of the completely assembled rocker shafts, Fig. 193.

   On new rocker shaft, note the end covers, Fig. 193.

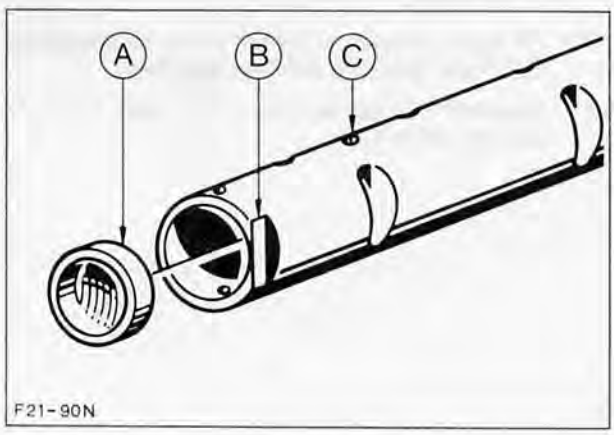


Fig. 193. Front end of rocker shaft (viewed from underneath)
A – End cover
B – Notch
C – Oil port

21 288 SEAL – CAMSHAFT – REPLACE

Special Service Tools Required:

Oil seal remover	21-008-A
Oil seal installer	21-009-A
Oil pump bolt and drive belt tensioner socket	21–012

To Remove

1. Disconnect battery earth strap. Drain coolant into tray, disconnecting radiator hose from radiator bottom neck, Fig. 194, and engine water outlet at top.

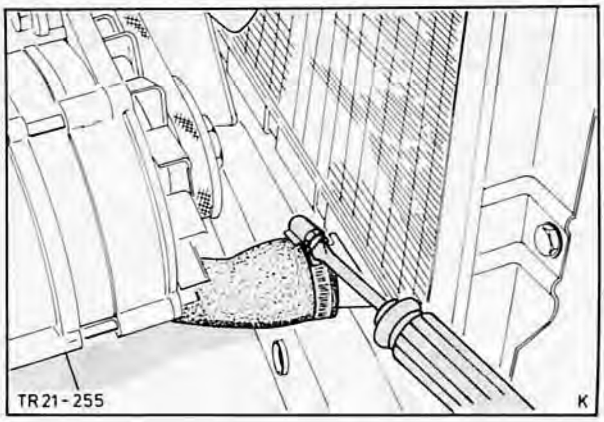


Fig. 194. Disconnect radiator hose from radiator

2. Remove radiator (4 bolts) and toothed belt guard (3 bolts), Fig. 195. Detach water outlet elbow (2 bolts).

   To avoid damage to valves and pistons the following is essential: Before detaching toothed belt, crank engine until crankshaft belt pulley is set on TDC mark on timing cover and thrust washer of camshaft toothed belt pulley lines up on 1st cylinder mark on cylinder head.

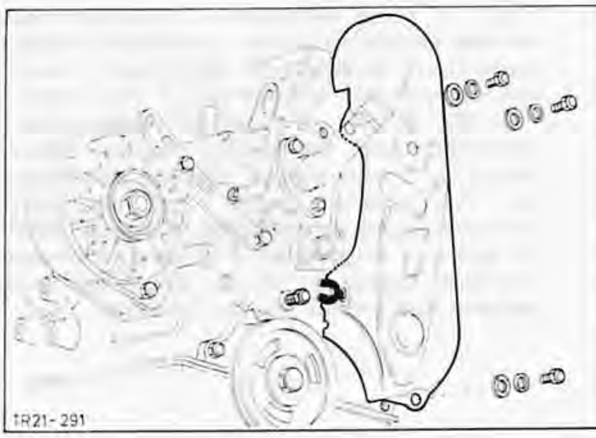


Fig. 195. Remove toothed belt guard (fan removed for clarity)

3. Remove camshaft pulley bolt. Slacken toothed belt tensioner, using Special Tool 21–012 (1 hexagon bolt, 1 special bolt), Fig. 196 against spring pressure and retighten. Remove toothed belt from camshaft belt pulley (see note below).

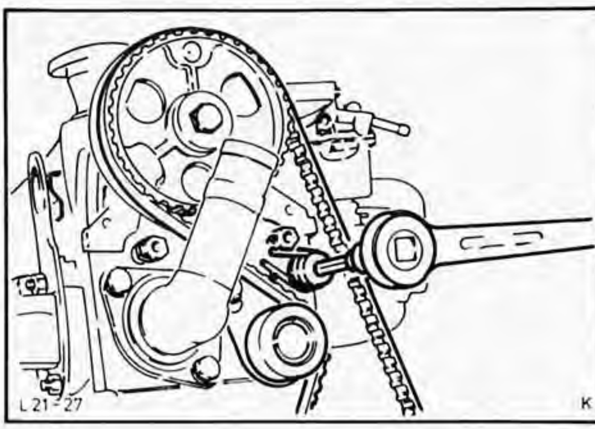


Fig. 196. Slacken toothed belt tensioner using Special Tool 21–012

21 288 (cont'd)

4. Remove camshaft pulley and thrust washer, Remove oil seal using Special Tool 21–008–A, Fig. 194.

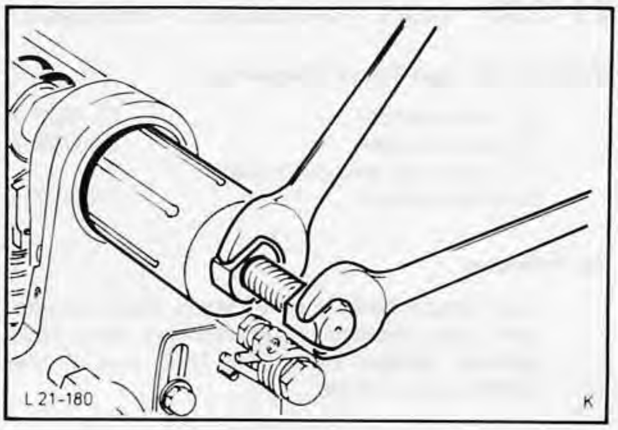


Fig. 197. Remove oil seal, using Special Tool 21–008–A

Prior to each refitting of toothed belt always check whether camshaft pulley, crankshaft pulley and distributor rotor are aligned on cylinder No. 1 TDC mark, Fig. 198. If after removal of toothed belt camshaft and crankshaft marks were found to be no longer aligned camshaft or crankshaft must not in any circumstances be rotated through 360° to achieve alignment on mark. Choose shortest travel to mark, ensuring that pistons and valves are not fouling.

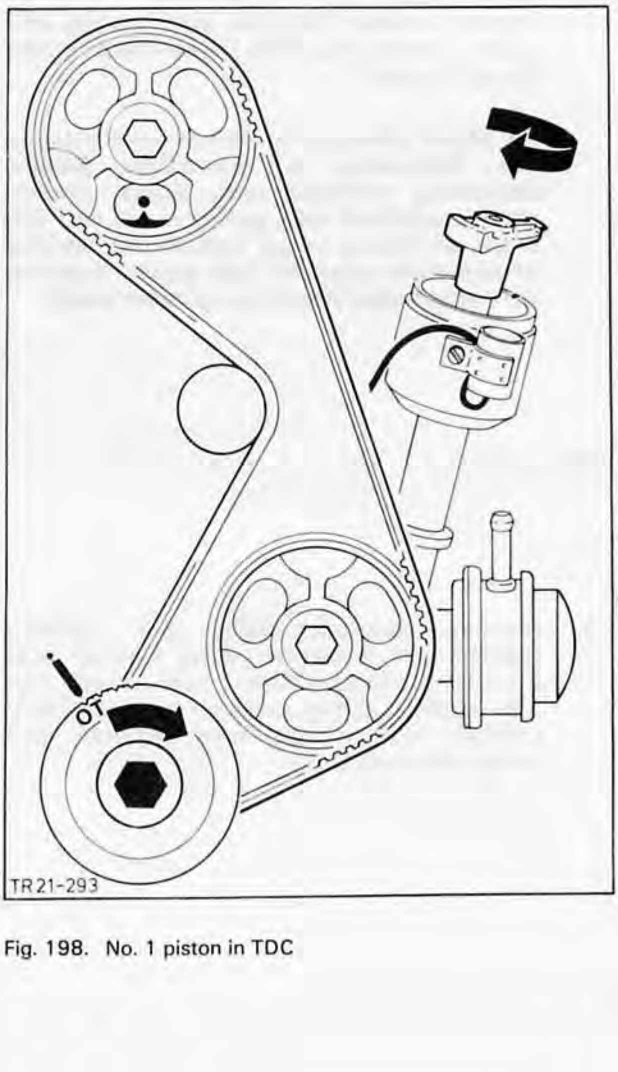


Fig. 198. No. 1 piston in TDC

To Install

5. Fit new oil seal (with sealing lip slightly oiled) using Special Tool 21–009–A, Fig. 199.
6. Slide thrust washer with reinforced side facing outwards and camshaft belt pulley, into position and secure with bolt.
7. Check whether camshaft, crankshaft and distributor rotor are aligned on cylinder No. 1 TDC mark. Position toothed belt.

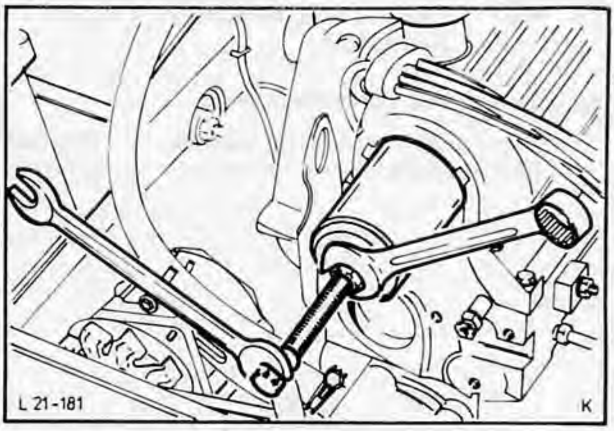


Fig. 199. Fit camshaft oil seal using Special Tool 21–009–A

8. Slacken toothed belt tensioner to enable it to become positioned against toothed belt after cranking engine twice, Fig. 200. After cranking torque tensioner and camshaft pulley bolts as specified in Technical Data. (Hexagonal bolt first, then special bolt.)

   After positioning of toothed belt crank engine in direction of rotation only.

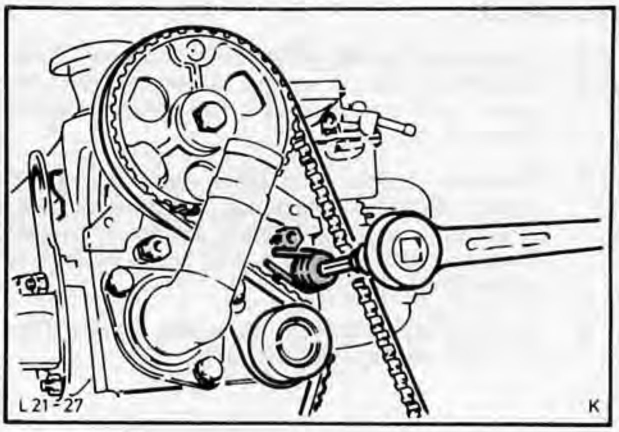


Fig. 200. Slacken toothed belt tensioner, using Special Tool 21–012

9. Fit water connections and toothed belt guard. Fig. 201.
10. Fit radiator, connect radiator hoses and top up with coolant.
11. Connect battery earth strap, check engine oil level and top up, if necessary.

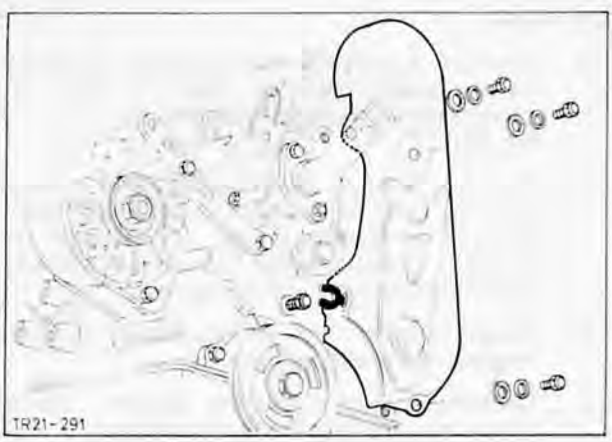


Fig. 201. Fit toothed belt guard

21 467 SEAL – CRANKSHAFT FRONT – REPLACE

Special Service Tools Required:

Crankshaft front oil seal installer	21–046
Milti-purpose oil seal remover	21–051

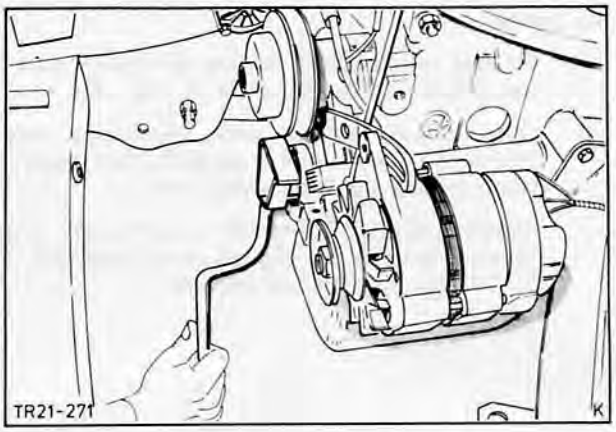


Fig. 202. Remove oil seal using Special Tool 21–051

To Remove

1. Disconnect earth strap from battery. Drain coolant, by disconnecting radiator hoses from lower radiator neck and from engine water elbow at top.
2. Remove radiator complete with fairing (4 bolts). Slacken alternator bolts and pivot alternator to the side. Remove V-belt. Remove fan (4 bolts) and crankshaft belt pulley (1 bolt).
3. Remove crankshaft oil seal using Special Tool 21–051 as shown in Fig. 202.

To Install

4. Press in a new oil seal (sealing lip lightly oiled), using Special Tool 21–046 in conjunction with pulley and bolt, as shown in Fig. 203.
5. Remove special tool, fit fan and pulley, torquing bolts as specified in Technical Data. Replace alternator V-belt and tension to achieve 13 mm (0,5 in) movement midway between alternator and fan pulleys.
6. Install radiator with fairing. Attach radiator hoses and fill with coolant.
7. Reconnect earth strap to battery. Check engine oil level and top up if necessary.

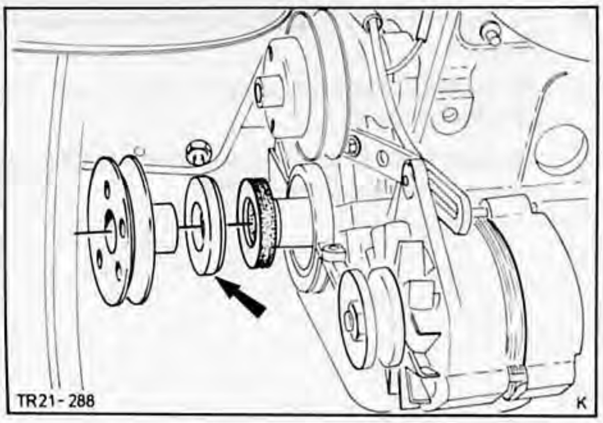


Fig. 203. Fit oil seal. Special Tool No. 21–046

21 467 SEAL – CRANKSHAFT FRONT – REPLACE

Special Service Tools Required:

Oil seal remover	21–008–A
•Oil seal installer	21–009–A
Drive belt tensioner socket	21–012
Crankshaft gear remover	21–028

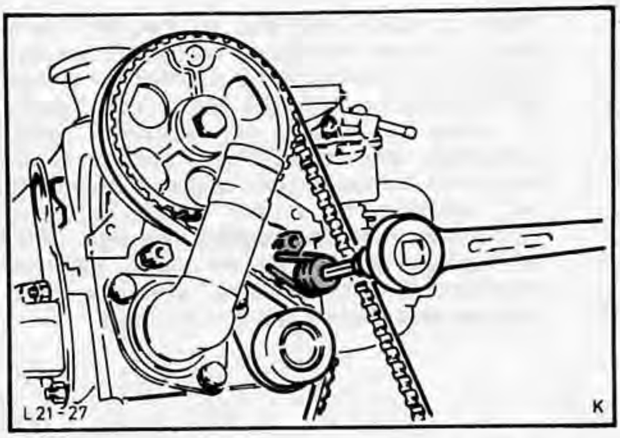


Fig. 204. Slacken toothed belt tensioner using Special Tool 21–012

To Remove

1. Disconnect earth strap from battery. Drain coolant into tray by disconnecting radiator hoses from lower radiator neck and from engine water elbow.
2. Remove radiator (4 bolts). Slacken alternator bolts and pivot alternator. Take off V-belt. Remove crankshaft pulley (1 bolt) with thrust washer and toothed belt guard (3 bolts).
3. Slacken toothed belt tensioner using Special Tool 21–012 (1 hexagon bolt, 1 special bolt), Fig. 204, press against spring pressure and retighten.

   Remove toothed belt. Pull off crankshaft pulley using Special Tool 21–028, Fig. 205, and withdraw oil seal with Special Tool 21–008–A, Fig. 206.

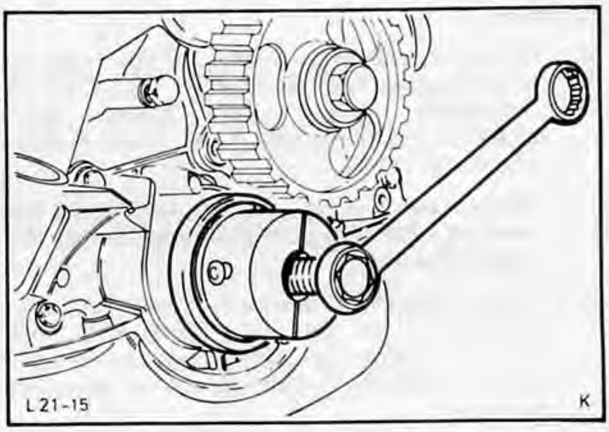


Fig. 205. Pull off crankshaft pulley using Special Tool 21–028

In order to prevent damage to pistons and valves it is essential for the following operations to be carried out:

Prior to removal of toothed belt always crank engine until mark on crankshaft pulley is aligned on TDC mark on timing cover and mark on camshaft pulley thrust washer is aligned on No. 1 cylinder head mark. Leave engine in this position, remove toothed belt and continue operations without any further cranking of engine.

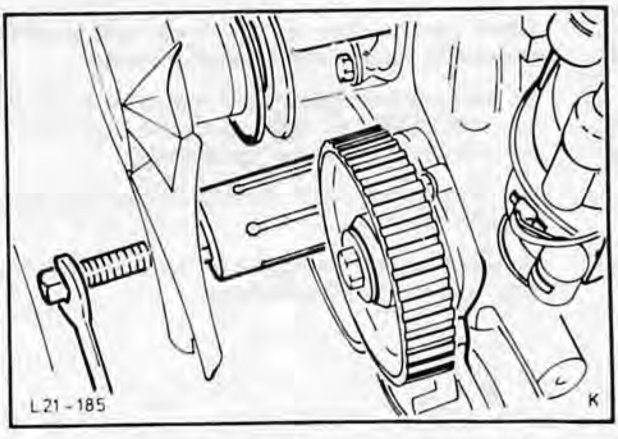


Fig. 206. Remove oil seal using Special Tool 21–008–A

Prior to each refitting of toothed belt always check whether camshaft pulley, crankshaft pulley and distributor rotor are aligned on cylinder No. 1 TDC mark. If after removal of toothed belt, camshaft and crankshaft marks were found to be no longer aligned camshaft or crankshaft must not in any circumstances be rotated through 360° to achieve alignment on mark. Choose shortest travel to mark, ensuring that pistons and valves are not fouling.

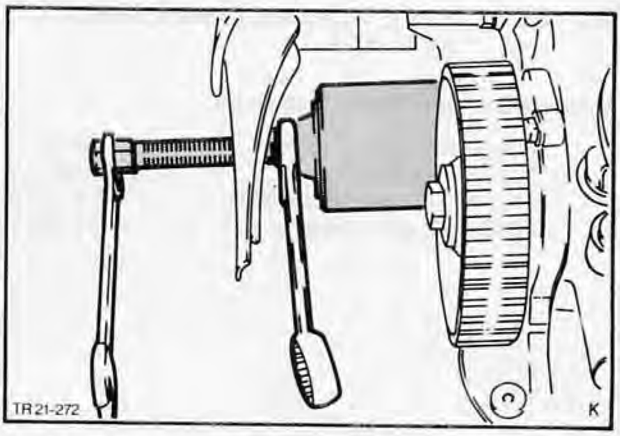


Fig. 207. Fit oil seal, using Special Tool 21–009–A

To Install

4. Fit new oil seal (with sealing lip slightly oiled), using Special Tool 21–009–A, Fig. 207. Fit crankshaft toothed belt pulley (with chamfered side inwards) and thrust washer and V-belt pulley.

   Thrust washer is dished and must be located with the concave side facing the toothed pulley.

5. Check whether camshaft, crankshaft and distributor rotor marks line up on TDC mark for 1st cylinder, Fig. 208, fit toothed belt and secure crankshaft belt pulley to specified torque.

6. Using Special Tool 21–012 slacken toothed belt tensioner to enable it to become positioned against toothed belt after cranking engine twice. After cranking torque tensioner bolts as specified in Technical Data. (Hexagon bolt first, then special bolt.)

   After positioning of toothed belt crank engine in direction of rotation only.

7. Fit toothed belt guard and adjust to achieve 13 mm (0,5 in) free movement midway between alternator and fan pulleys.

8. Fit radiator, connect radiator hoses and top up with coolant.

9. Connect battery earth strap, check engine oil level and top up, if necessary.

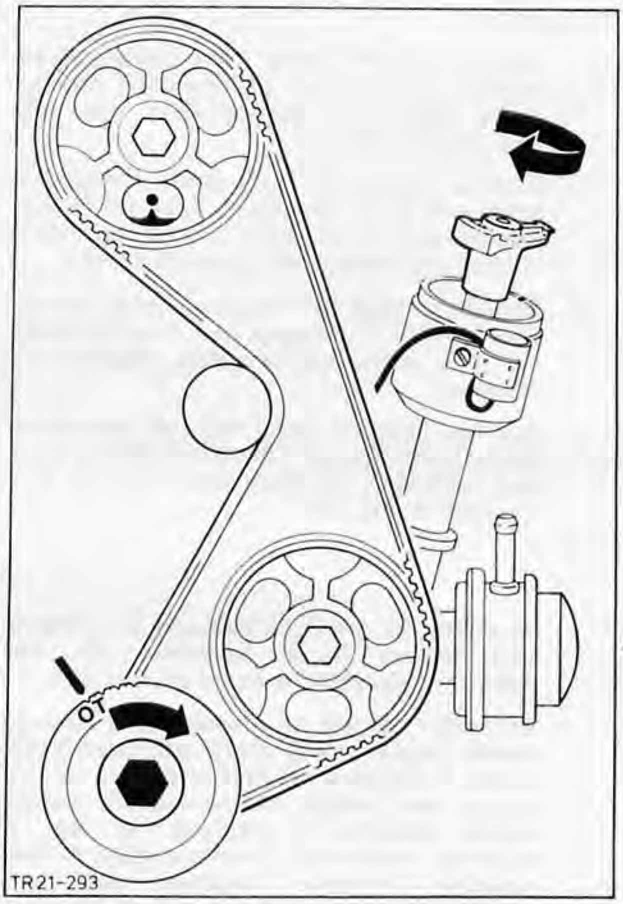


Fig. 208. No. 1 piston in TDC

21 468 4 SEAL – CRANKSHAFT REAR – REPLACE (Engine or gearbox removed)

Special Service Tools Required:

Rear oil seal remover	21–010
Crankshaft rear oil seal installer	21–011–A
'A' Engine:	
Clutch disc aligner	21–080
'B' Engine:	
Clutch disc aligner	21–044

To Remove

1. Remove clutch pressure plate (6 bolts) and clutch disc from flywheel.
2. Remove flywheel (6 bolts).
3. Withdraw oil seal, using Special Tool 21–010, Fig. 209. First completely tighten press spindle, firmly screw taper thread section into oil seal and withdraw oil seal by tightening press spindle.

   On the 'A' engine, before the oil seal can be replaced, the seal carrier must be cut out with Special Tool 21–047 (see Repair Operation No. 21 469 4)

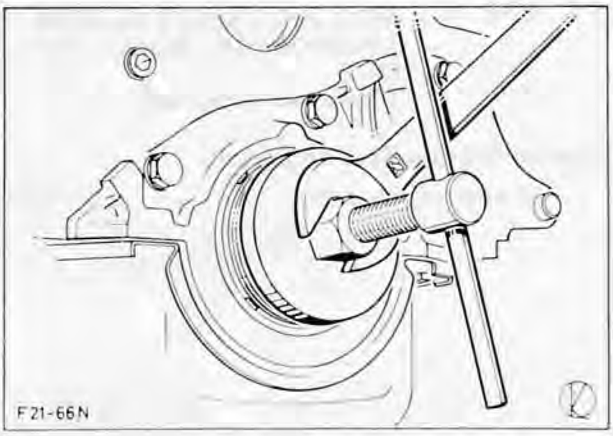


Fig. 209. Remove oil seal using Special Tool 21–010

To Install

4. Slide new oil seal onto Special Tool 21–011–A and drive in up to rear crankshaft bearing stop, Fig. 210.
5. Clean crankshaft flange and flywheel assembly. Fit flywheel and secure as specified.

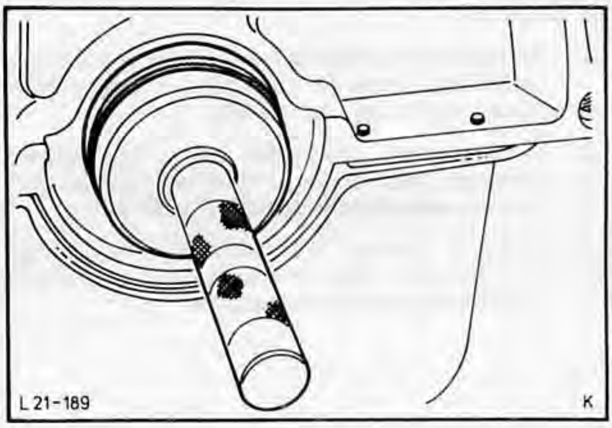


Fig. 210. Drive in oil seal, using Special Tool 21–011–A

6. Fit clutch disc and pressure plate, centering clutch disc by means of Special Tool 21–044 or 21–080, Fig. 211, and tighten bolts to prescribed torque.

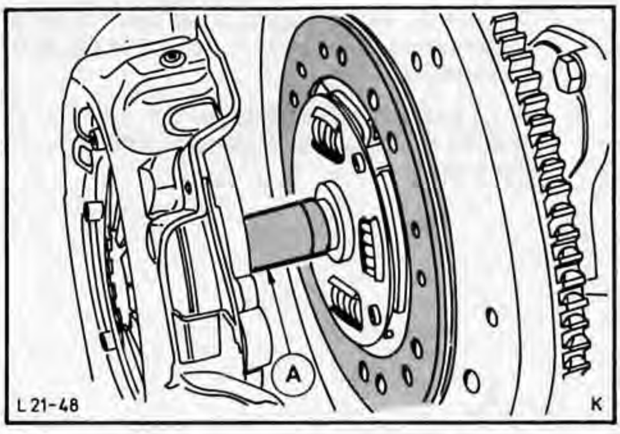


Fig. 211. Fit clutch pressure plate and clutch disc
A – Special Tool

21 469 4 SEAL ABUTMENT FLANGE – CRANKSHAFT REAR – CUT OUT (Flywheel removed)

Special Service Tool Required:

Oil seal retainer cutter	21–047

To Cut Out

1. Secure Special Tool 21–047 with knurled nut (left-hand thread) slackened, to flywheel flange by means of two bolts.
2. Rotate cutter clockwise, using open-ended spanner, and tighten knurled nut until oil seal abutment surface is cut off, Fig. 212.
3. Remove Special Tool from flywheel flange and carefully clean working area to prevent swarf from getting into engine.

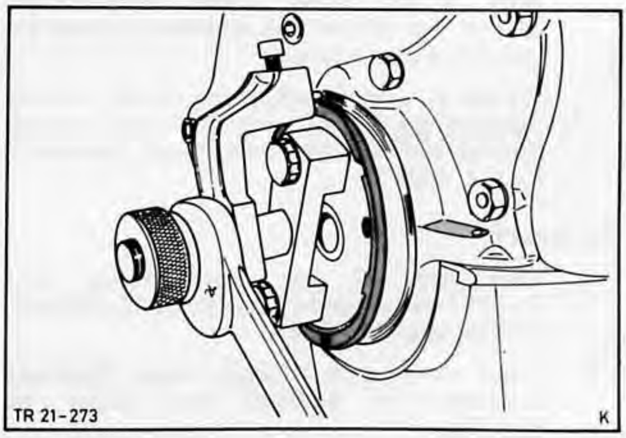


Fig. 212. Cut out oil seal carrier, using Special Tool 21–047

4. Remove oil seal, using Special Tool 21–010, as described in Operation No. 21 468, sub-operation 3.
5. Fit oil seal using Special Tool 21–011–A, as described in Operation No. 21 468 4, sub-operation 4.

21 505 5 PISTON – REPLACE (ONE) (Piston and connecting rod removed)

Special Service Tools Required: None

General

The piston and piston pin together form a unit and may only be renewed together. The piston pin bores and piston pin diameters are graded, with corresponding paint marks and they must match on another. The paint marks are on the piston crown and the edge of the pin.

If a cylinder has to be bored out by 1,0 mm it is necessary to bore out the other cylinders by the same amount. Unequal bores would cause trouble, since at 1,0 mm oversize, weight deviations of up to 10 g are possible.

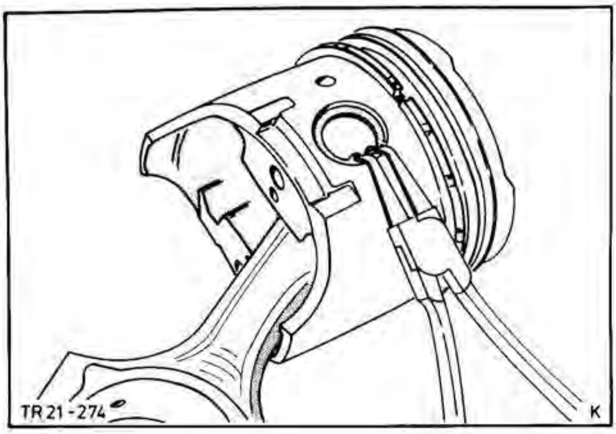


Fig. 213. Remove circlips

1. Remove circlips, Fig. 213, from piston pin bore.
2. Drive piston pin out of piston using a suitable drift, Fig. 214.

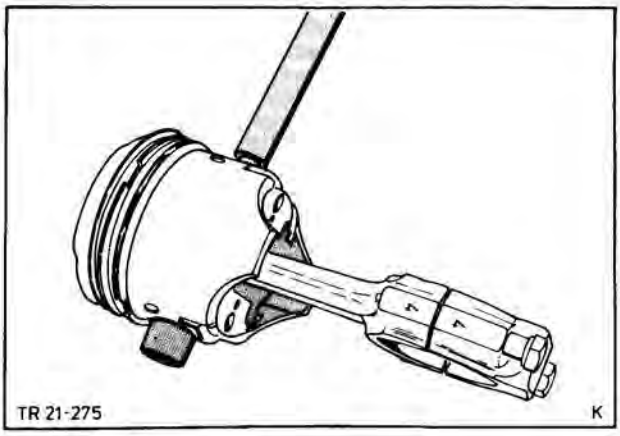


Fig. 214. Remove piston pin

To Install

3. Fit a new circlip in piston ring bore on one side of piston, Fig. 215.

   Check play in connecting rod bore (see Technical Data) before fitting piston pin.

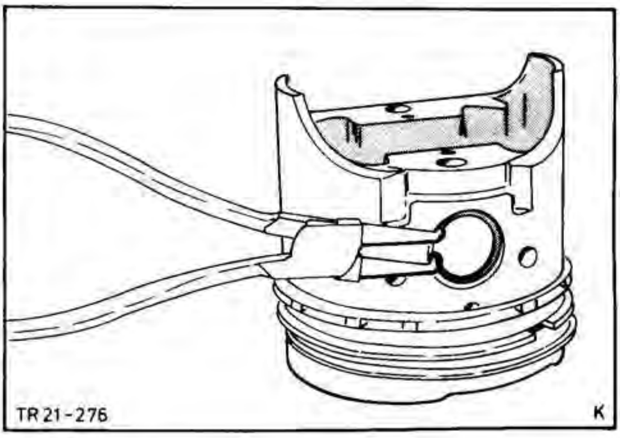


Fig. 215. Fit circlip

21 505 5 (cont'd)

4. Heat piston on a hot plate (Max. 100 °C) Fig. 216.

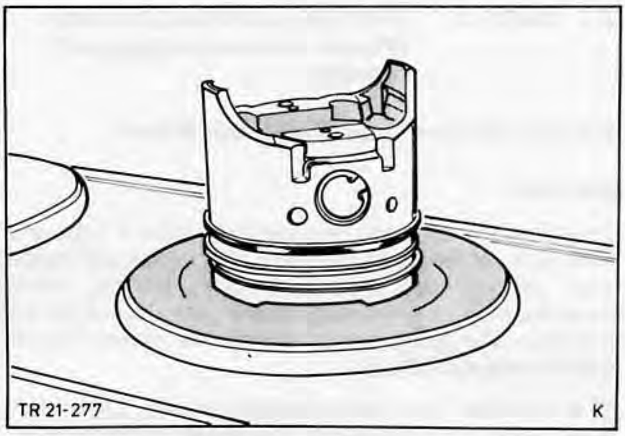


Fig. 216. Heat piston

5. Apply oil to connecting rod small-end bore and insert it into heated piston so that small-end aligns with piston pin bore.

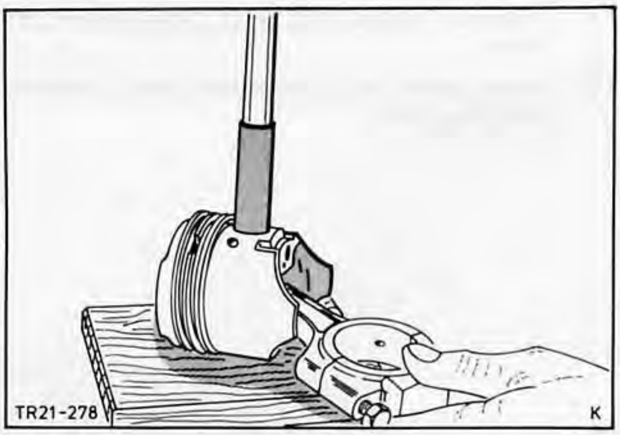


Fig. 217. Fit piston pin

6. Slide piston pin in up to first circlip fitted earlier, Fig. 217. Fit second new circlip.

During fitting the front marking on piston (arrow, notch, etc.) should point in same direction as front marking on connecting rod, Fig. 218.

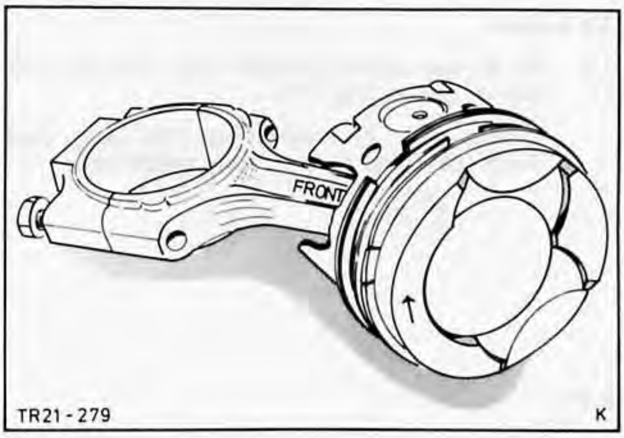


Fig. 218. Relationship of front markings

21 505 5 PISTON – REPLACE (ONE) (Piston and connecting rod removed)

Special Service Tool Required:

Piston pin installer 21–014

General

The piston and piston pin form a unit and may only be renewed together. The piston pin bores and piston-pin diameters are graded, with corresponding paint marks and they must match one another. The paint marks are on the piston crown and the edge of the pin.

It is essential for the sequence of operations using Special Tool, as described below, to be strictly adhered to because piston pin position cannot be changed after cooling of connecting rod.

If a cylinder has to be bored out by 1,0 mm, it is necessary to bore out the other cylinders by the same amount. Unequal bores would cause trouble, since at 1,0 mm oversize, weight deviations of up to 10 g are possible.

To Remove

1. Drive piston pin out of piston using a suitable drift, Fig. 219.
2. Measure connecting rod on surface plate, using feeler gauge. For maximum deviations from alignment see Fig. 220.

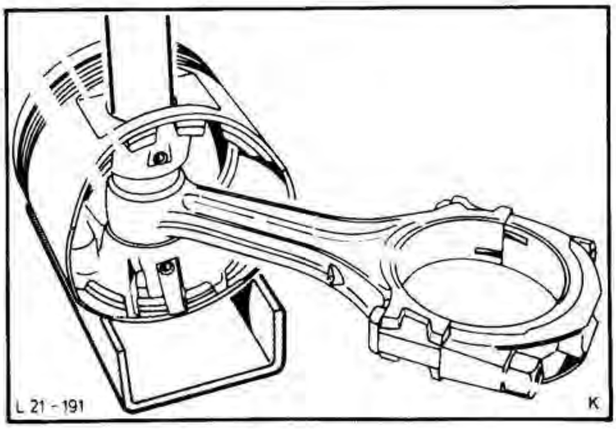


Fig. 219. Drive out piston pin, using drift

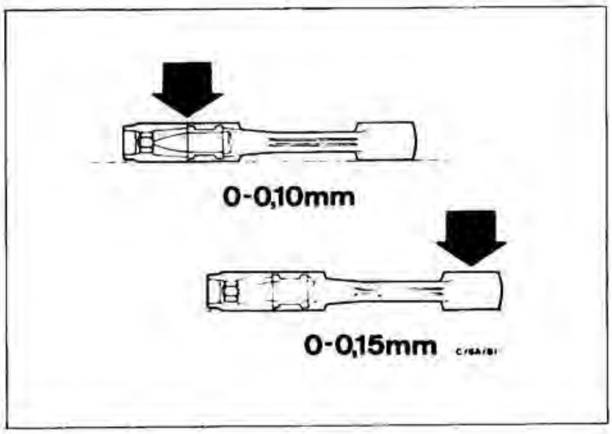


Fig. 220. Maximum deviations from alignment. (0,10 mm = 0,004 in—0,15 mm = 0,006 in

To Install

3. Clamp Special Tool 21–014 in vice. Completely withdraw guide pin, Fig. 221.

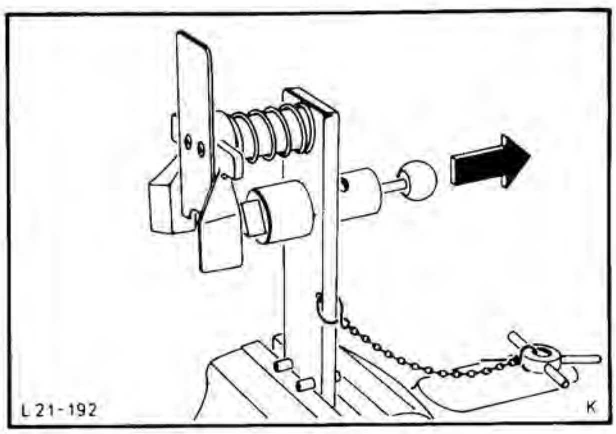


Fig. 221. Piston pin installer 21–014

4. During fitting front markings on piston and connecting rod should be positioned in relation to each other as shown in Fig. 222.

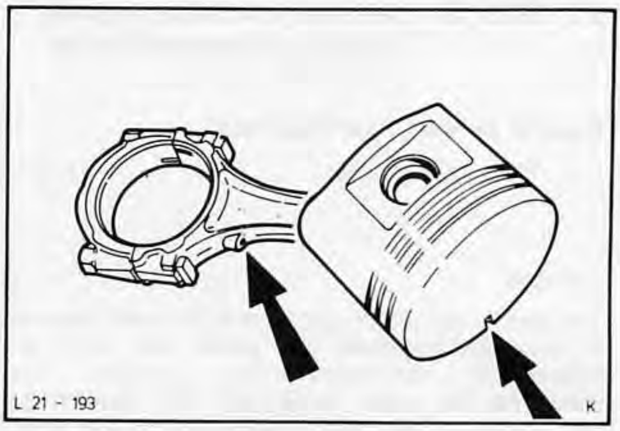


Fig. 222. Relationship of front marking and connecting rod bore

5. Clamp piston in Special Tool with front marking (arrow or notch) pointing away from Special Tool. Apply engine oil to both piston pin bores and slide guide pin through bore up to boss, Fig. 223.

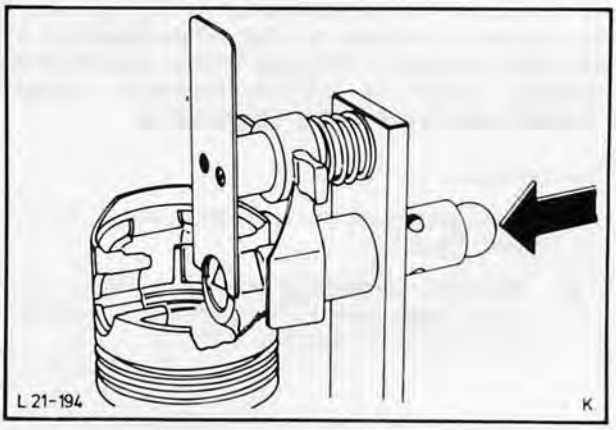


Fig. 223. Slide guide pin through bore up to boss

6. Slide piston pin up to inside edge of other piston bore. Fig. 224.

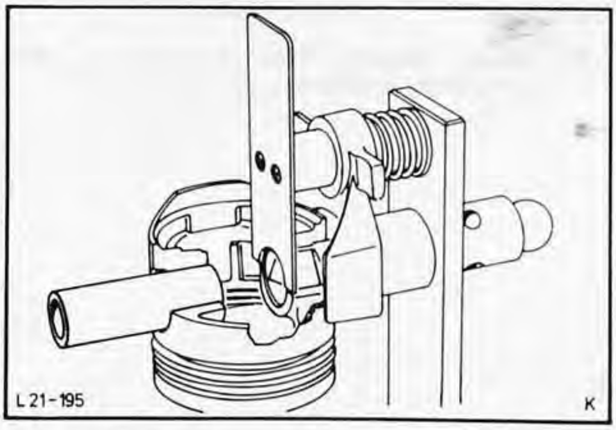


Fig. 224. Fit piston pin

7. Select stop gauge according to engine variant, Fig. 225.

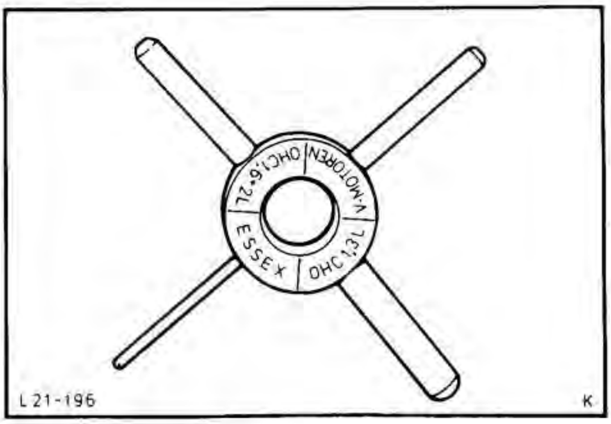


Fig. 225. Installer stop gauge

8. Insert stop gauge into Special Tool, Fig. 226.

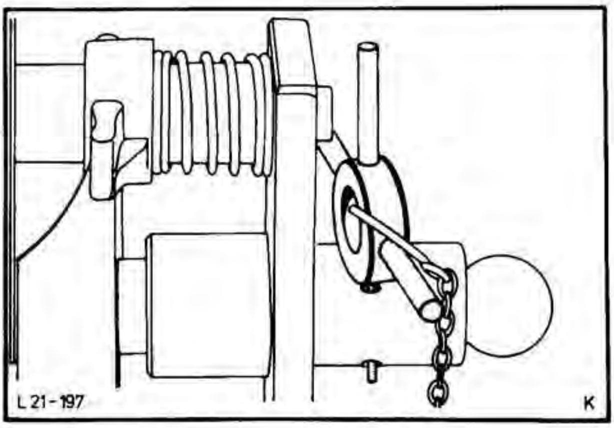


Fig. 226. Fit stop gauge

9. Heat connecting rod on a hotplate as shown in Fig. 227. Heat up piston bore to 530–570 °K (260–300 °C). To monitor temperature, mark piston bore with thermochromatic coloured pencil (Faber Castell 2815) before starting heating operation. On reaching temperature desired, colour marked on bore changes to colour of pencil cover.

Example:

If coloured pencil is green and cover black, indicated temperature of 550 °K (280 °C) is reached when green coloured mark on piston bore goes black.

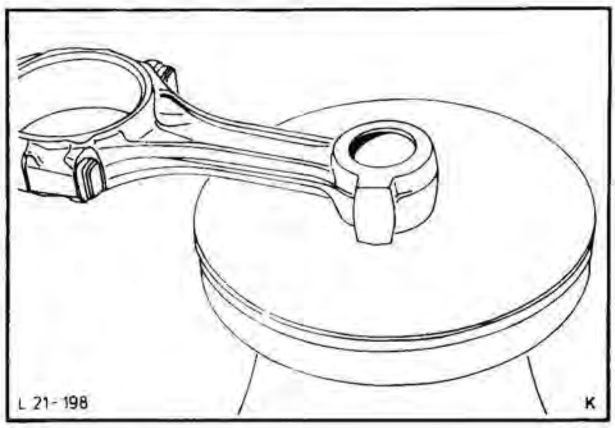


Fig. 227. Heat connecting rod

21 505 5 (cont'd)

10. On reaching temperature quickly insert connecting rod into piston, then quickly slide piston pin through connecting rod up to stop, Fig. 228.

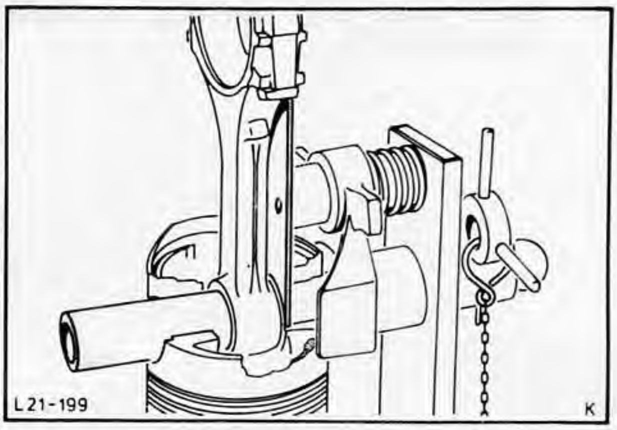


Fig. 228. Slide piston pin through bore up to stop

11. Allow connecting rod to cool slightly before removing from Special Tool.

    During cooling connecting rod must abut against Special Tool, Fig. 229 and piston pin be pressed fully home.

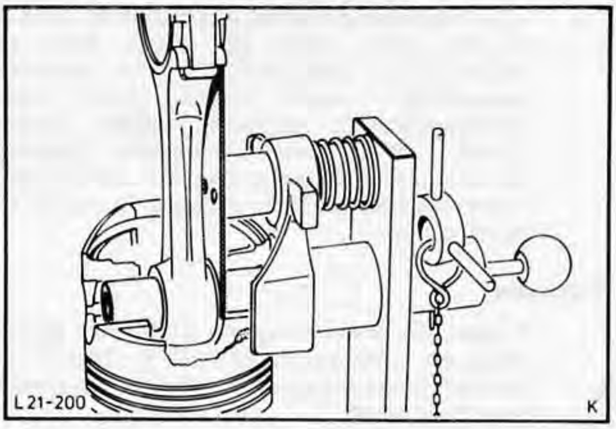


Fig. 229. Position connecting rod against Special Tool

21 553 AUXILIARY SHAFT – REMOVE AND INSTALL

Special Service Tools Required:

Oil seal installer	21–009–A
Oil pump bolt and drive belt tensioner socket	21–012

To Remove

1. Disconnect battery earth strap, slacken alternator, pivot and remove V-belt.
2. Remove toothed belt guard (3 bolts), and crankshaft pulley (1 bolt) together with thrust washer.
3. Slacken belt tensioner using Special Tool 21–012 (1 hexagon bolt, 1 special bolt), press against spring pressure and retighten, Fig. 230. Remove toothed belt.

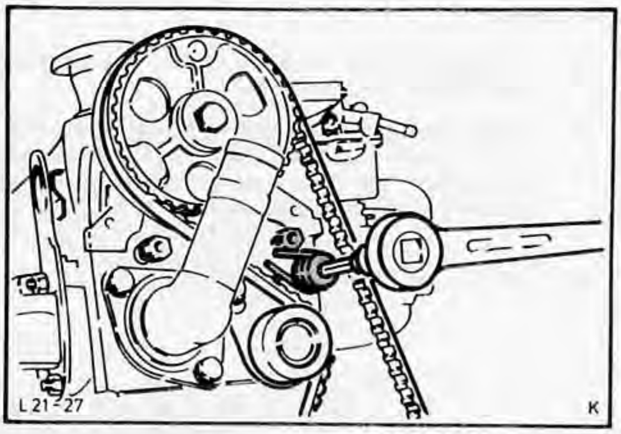


Fig. 230. Slacken belt tensioner using Special Tool 21–012

4. Remove distributor cap and remove distributor, Fig. 231. Unscrew auxiliary shaft toothed belt pulley bolt.

   Pay attention to special note in Operation 21 467 'B' engine.

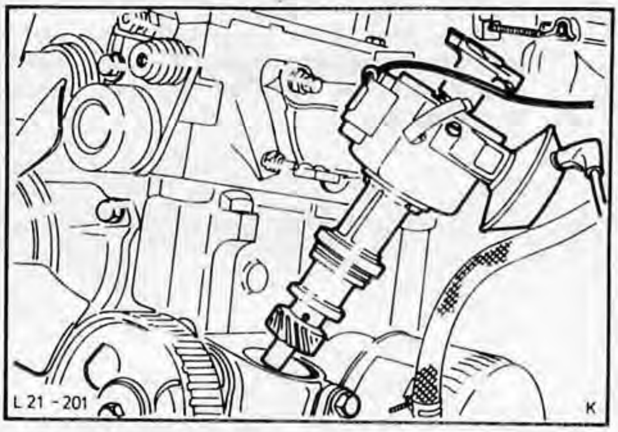


Fig. 231. Remove distributor

5. Remove fuel pump (2 bolts) and remove fuel pump tappet from cylinder block. Before doing so remove fuel lines, if necessary.
6. Remove auxiliary shaft toothed belt pulley. Remove auxiliary shaft front cover (3 bolts) thrust plate (2 bolts) and withdraw auxiliary shaft.
7. Drive oil seal out of front cover, using suitable drift, Fig. 232.

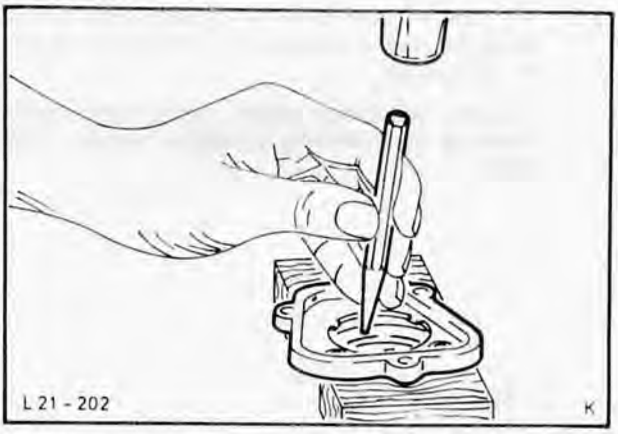


Fig. 232. Drive auxiliary shaft oil seal out of front cover, using drift

21 553 (cont'd)

To Install

8. Fit new oil seal to front cover, ensuring oil seal is level with outer face.
9. Install auxiliary shaft and fit thrust plate, Fig. 233. Check end-float (see Technical Data) and adjust by fitting other thrust plate or auxiliary shaft, if necessary.

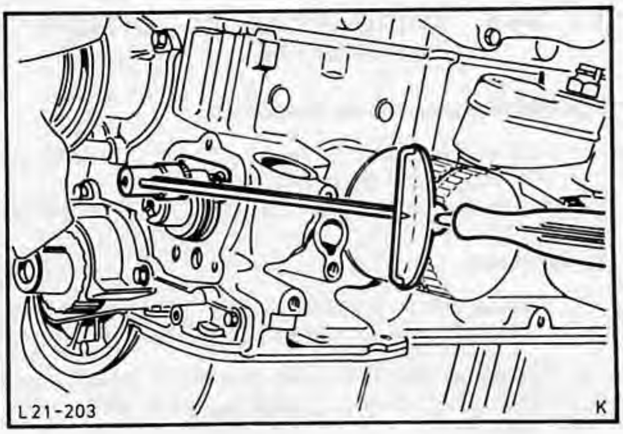


Fig. 233. Torque auxiliary shaft thrust plate bolts as specified in Technical Data

10. Slightly lubricate oil seal sealing lip. Fit auxiliary shaft front cover with new gasket **(cut off gasket not required)**, using Special Tool 21–009–A, Fig. 234, to avoid damage to sealing lip.

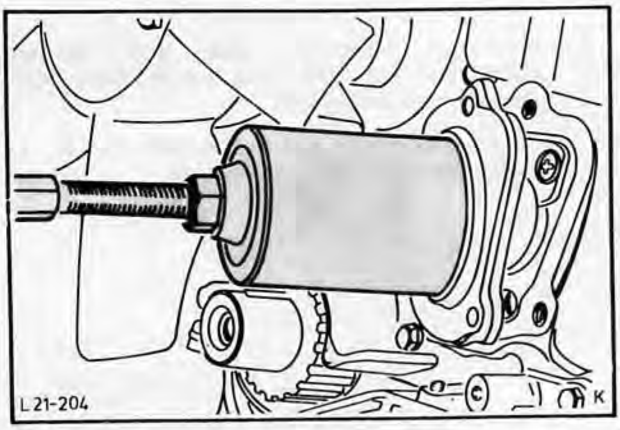


Fig. 234. Fit auxiliary shaft front cover, using Special Tool 21–009–A

11. Fit toothed belt pulley and secure with bolt. Slide fuel pump tappet into cylinder block and fit fuel pump.

    Ensure auxiliary shaft gear with reinforcing ribs facing cylinder block, Fig. 235.

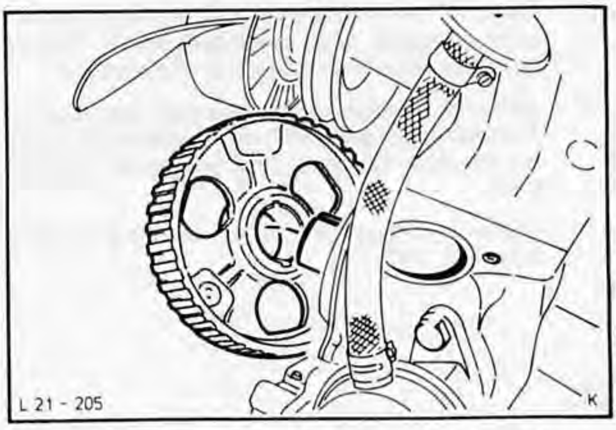


Fig. 235. Fit auxiliary shaft pulley with reinforcing ribs facing cylinder block

12. Check whether camshaft and crankshaft are aligned on No. 1 cylinder TDC mark. Fit distributor and similarly align on No. 1 cylinder mark, Fig. 236.

13. Fit toothed belt. Slacken belt tensioner so that it can become positioned against toothed belt after cranking engine twice. Torque toothed belt tensioner and auxiliary shaft pulley bolts as specified in Technical Data, hexagon bolt first, then special bolt.

    While torquing lock auxiliary shaft pulley through bolt holes.

    After positioning toothed belt crank engine in direction of rotation only.

14. Slide thrust washer and crankshaft pulley into position and torque as specified in Technical Data.

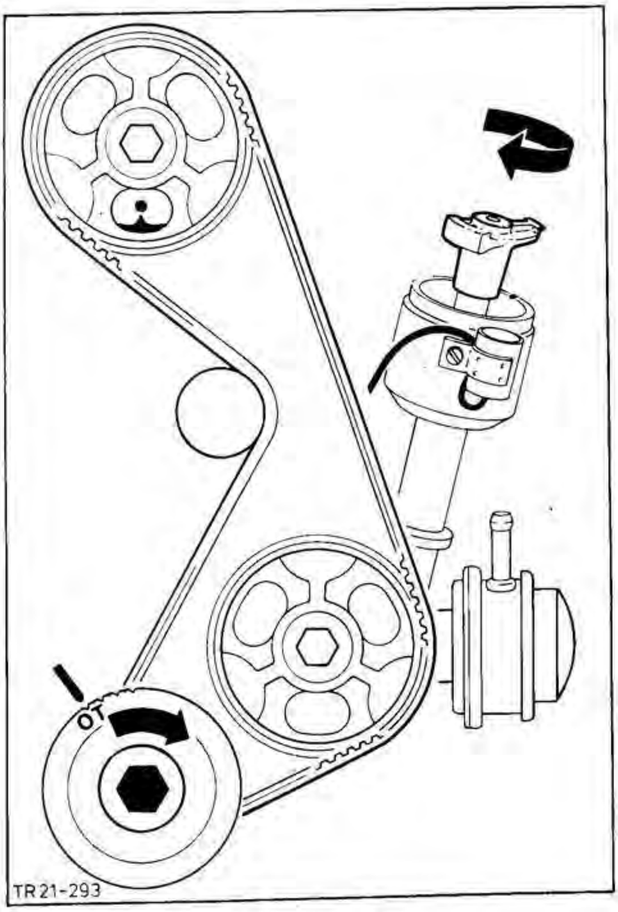


Fig. 236. No 1 cylinder piston in TDC

15. Fit toothed belt guard, Fig. 237. Position V-belt and adjust to achieve 13 mm (0,5 in) play midway between alternator and fan pulleys.

16. Fit distributor cap and connect battery earth strap.

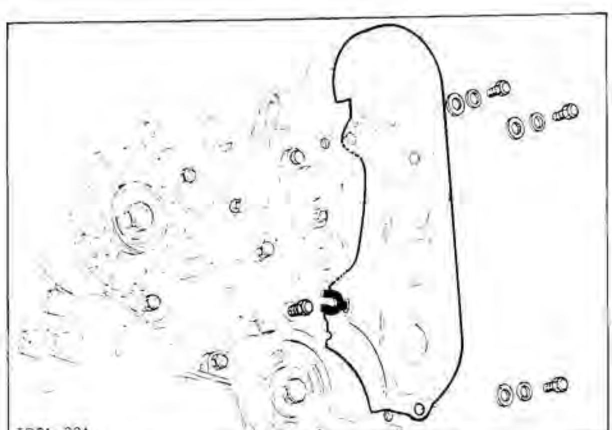


Fig. 237. Fit toothed belt guard (fan removed for clarity)

21 584 5 RING GEAR – FLYWHEEL – REPLACE (Flywheel removed)

Special Service Tools Required: None

To Remove

Centre-punch ring gear and drill two holes approximately 7 or 8 mm (0,28–0,30 in) diameter offset as illustrated, Fig. 238.

Drill must only pass through ring gear and not flywheel.

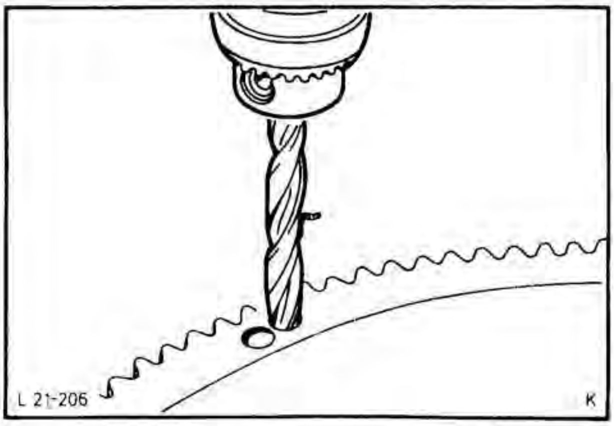


Fig. 238. Drill ring gear

2. Remove ring gear by means of light blow with a hammer, Fig. 239.

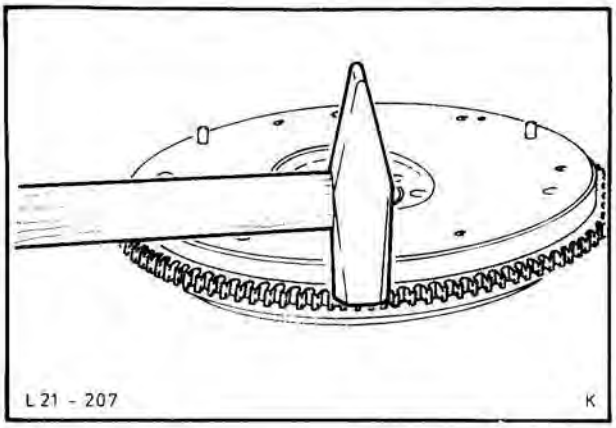


Fig. 239. Remove ring gear from flywheel

3. Place new ring gear on a plate some 2 to 3 mm (0,08–0,12 in) thick and heat up plate to 530–550 °K (260–280 °C) (500–540 °F) from below, in area of ring gear itself, using a welding torch to give uniform heating, Fig. 240.

   To monitor temperature, mark ring gear with a thermochromatic coloured pencil (Faber Castell 2815) before starting heating operation. On reaching temperature required, colour marked on ring gear changes to colour of pencil cover.

Example:

If coloured pencil is green and cover black, indicated temperature of 530–550 °K (260–280 °C) (500–540 °F) is reached when green coloured mark on ring gear goes black.

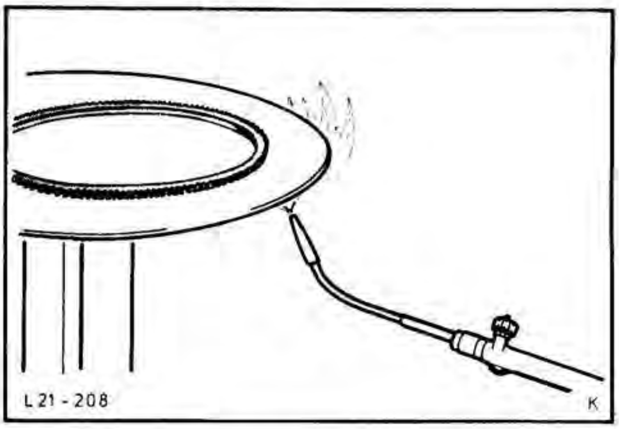


Fig. 240. Heat up ring gear

To Install

4. Slip ring gear over flywheel with tongs so that ring gear comes to rest on abutment rim. Allow to cool in this position.

   Starter ring gear is induction-hardened and loses this hardness as soon as it is heated to over 560 °K (290 °C) (550 °F).

TECHNICAL DATA

'A' Engine (OHV/I–4) 1,6 LC

General

Engine code			L1
Firing order			1–2–4–3
Bore		mm	80,98
Stroke		mm	77,62
Cubic capacity	effective	cm^3	1598
Compression ratio			8,0:1
Pressure (compression)	at starter speed	kgf/cm^2 (lbf/in^2)	9,0–11,0 (14)
Idling speed		1/min	800±25
Engine speed	max. continuous	1/min	5800
	max. intermittent	1/min	6100
Engine power	(DIN)	kW (HP)	47 (63)
	at	1/min	5000
Torque	(DIN)	Nm (kgf.m) (lbf.ft)	110 (11,2) (81)
	at	1/min	2500

Cylinder Block

Cast identification number			711M-6015-AA
Number of main bearings			5
Cylinder liner bore		mm	84,112–84,138
Cylinder bore diameter	standard A	mm	80,947–80,957
	B	mm	80,957–80,967
	C	mm	80,967–80,977
	D	mm	80,977–80,987
	E	mm	80,987–80,997
	F	mm	80,997–81,007
Bearing width (without thrust half rings)		mm	26,822–26,873
Main bearing shells inside diameter (fitted)			
	standard	mm	54,013–54,040
	0,254 undersize	mm	53,759–53,786
	0,508 undersize	mm	53,505–53,532
	0,762 undersize	mm	53,251–53,278
Main bearing parent bore diameter	standard	mm	57,683–57,696
	oversize	mm	58,064–58,077
Camshaft bearings in block	standard	mm	42,888–42,913
	oversize	mm	43,396–43,421

Crankshaft

Axial play		mm	0,071– 0,276
Main bearing journal diameter	standard	mm	53,983–54,003
	0,254 undersize	mm	53,729–53,749
	0,508 undersize	mm	53,475–53,495
	0,762 undersize	mm	53,221–53,241
Main bearing shell width		mm	25,147–25,527
Play in main bearing journal shell		mm	0,010– 0,060
Big-end bearing journal diameter	standard	mm	49,195–49,215
	0,254	mm	48,941–48,961
	0,508	mm	48,687–48,707
	0,762	mm	48,433–48,453
Thrust half ring thickness	standard	mm	2,311– 2,362
	oversize	mm	2,502– 2,553

TECHNICAL DATA

			'A' Engine (OHV/I–4) 1,6 LC
Camshaft			
Number of camshaft bearings			3
Drive			by chain
Camshaft retaining plate thickness		mm	4,470–4,521
Cam lift	inlet	mm	5,984
	exhaust	mm	5,894
Cam length (heel to toe)	inlet	mm	33,236
	exhaust	mm	33,460
Camshaft bearing diameter	front, centre, rear	mm	39,616–39,637
	undersize	mm	39,216–39,237
Internal bearing diameter	front, centre, rear	mm	39,662–39,675
	undersize	mm	39,662–39,713
Camshaft axial play		mm	0,064 – 0,191
Timing Chain			
Length	46 links	mm	438,15
Pistons			
Combustion chamber volume in piston		cm^3	46,786–48,171
Piston diameter	KD standard class D	mm	80,944–80,954
	E	mm	80,954–80,964
	F	mm	80,964–80,974
Piston diameter	0,064 oversize	mm	80,978–81,038
	0,38 oversize	mm	81,294–81,354
	0,76 oversize	mm	81,674–81,734
Piston to bore clearance		mm	0,023– 0,043
Piston ring gap (fitted)	top	mm	0,23 – 0,35
	centre	mm	0,23 – 2,35
	bottom	mm	0,23 – 0,35
Ring gap position	top		180° to scraper ring gap
	centre		90° to scraper ring gap
	bottom		aligned with piston pin
Piston Pins			
Piston pin length		mm	70,99 –71,37
Pin diameter	1	mm	20,623–20,625
	2	mm	20,625–20,628
	3	mm	20,628–20,630
	4	mm	20,630–20,633
Interference in piston	at 21 °C	mm	0,003– 0,008
Play in connecting rod	at 21 °C	mm	0,004– 0,10
Connecting Rods			
Bore diameter	big end	mm	52,89 –52,91
	small-end	mm	20,629–20,640
Internal diameter	standard	mm	49,221–49,256
	0,051 undersize	mm	49,170–49,204
	0,254 undersize	mm	48,967–49,001
	0,508 undersize	mm	48,713–48,747
	0,762 undersize	mm	48,459–48,495
	1,016 undersize	mm	48,205–48,239
Connecting rod journal to bearing shell clearance		mm	0,006– 0,060
Cylinder Head			
Cast marks			37
Valve seat angle		degrees	44° 30'–450
Valve seat width			1,5–2,0
Valve stem bore (inlet and exhaust)	standard	mm	7,907–7,938
	0,076 oversize	mm	7,983–8,014
	0,381 oversize	mm	8,288–8,319

TECHNICAL DATA

'A' Engine (OHV/I–4) 1,6 LC

Valves

Valve actuation			by tappet, pushrod and rocker ar
Inlet valve	opens	degrees	21° before TDC
	closes	degrees	55° after BDC
Exhaust valve	opens	degrees	70° before BDC
	closes	degrees	22° after TDC
Valve clearance	inlet	mm	0,20
	exhaust	mm	0,55
Tappet diameter		mm	13,081–13,094
Tappet clearance in block		mm	0,013– 0,058
Internal valve spring diameter		mm	20,25 –20,75
Valve spring wire diameter		mm	3,84 – 3,89
Number of turns			5,5

Inlet Valve

Valve length		mm	110,45 –111,46
Valve head diameter		mm	38,02 – 38,28
Valve stem diameter	standard	mm	7,869– 7,887
	0,381 oversize	mm	8,250– 8,268
Valve stem guide clearance		mm	0,020– 0,069
Valve lift (excluding valve clearance)		mm	9,15
Free valve spring length		mm	37,6

Exhaust Valve

Valve length		mm	111,04 –112,04
Valve head diameter		mm	31,35 – 31,60
Valve stem diameter	standard	mm	7,846– 7,864
	0,381 oversize	mm	8,227– 8,245
Valve stem guide clearance		mm	0,043–0,091
Valve lift (excluding valve clearance)		mm	9,15
Free valve spring length		mm	36,2

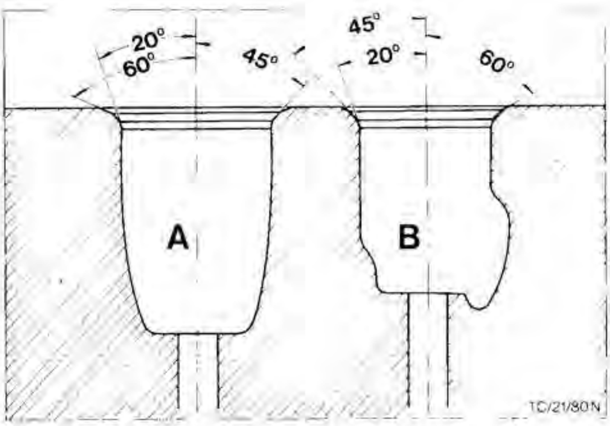


Fig. 241. Valve seat angle
A – inlet valve seat
B – exhaust valve seat

TECHNICAL DATA

'A' Engine (OHV/I–4)
1,6 LC

Engine Lubrication

Oil type			HD multigrade oil
Viscosity	from –23 °C to +32 °C		SAE 10W-30/10W-40/10W-50
	over –18 °C		SAE 15W-40/15W-50
	over –12 °C		SAE 20W-40/20W-50
	below –23 °C		SAE 5W-20/5W-30
Ford specification			SSM-2C-9001AA
Initial fill capacity	with filter	litres	3,85
Oil change	interval	km	10,000
	without filter change	litres	3,00
	with filter change	litres	3,25
Minimum oil pressure	at 750 rpm (80 °C)	kgf/cm² (lbf/in²)	0,6 (8,5)
	at 2000 rpm (80 °C)	kgf/cm² (lbf/in²)	1,5 (21,3)
Oil pressure warning light	comes on at	kgf/cm² (lbf/in²)	0,4±0,1 (5,7±1,4)
Relief valve	opens at	kgf/cm² (lbf/in²)	2,46–2,81 (35–40)
Oil pump (rotor/casing clearance)		mm	0,140–0,267
Inner/outer rotor clearance		mm	0,051–0,127
Rotor/end cover clearance		mm	0,026–0,076

Tightening Torques

		Nm	(kgf.m)	lbf.ft
Main bearings		75–82	7,5–8,2	58
Big-end bearings		41–48	4,1–4,8	33
Rear oil seal carrier		17–21	1,7–2,1	14
Flywheel		69–76	6,9–7,6	53
Clutch pressure plate		17–21	1,7–2,1	14
Chain tensioner		7–10	0,7–1,0	6
Camshaft retaining plate		4– 5	0,4–0,5	3,3
Camshaft sprocket		17–21	1,7–2,1	14
Timing cover		7–10	0,7–1,0	6
Water pump $\frac{1}{4}\times 20$		7–10	0,7–1,0	6
Water pump $^{5}/_{16}\times 18$		17–21	1,7–2,1	14
Crankshaft belt pulley		33–38	3,3–3,8	26
Fuel pump		16–20	1,6–2,0	13
Oil pump		18–21	1,8–2,1	14
Oil pump cover		7–10	0,7–1,0	6
Oil pump inlet pipe		18–21	1,8–2,1	14
Sump	(1)	4– 7	0,4–0,7	4
	(2)	8–11	0,8–1,1	7
Oil drain screw		27–34	2,7–3,4	22
Oil pressure switch		13–35	1,3–1,5	10
Rocker supports		35–41	3,5–4,1	28
Cylinder head	(1)	7	0,7	5
	(2)	27–40	2,7–4,0	25
	(3)	68–75	6,8–7,5	53
after 10 to 20 min wait	(4)	88–95	8,8–9,5	67
retighten when engine warm (15 mins at 1000 rpm)	(5)	88–95	8,8–9,5	67
later retightening of cylinder head not needed				
Rocker cover		4– 5	0,4–0,5	39
Exhaust manifold		21–25	2,1–2,5	17
Inlet manifold		17–21	1,7–2,1	14
Thermostat housing		17–21	1,7–2,1	14
Spark plugs		25–38	2,5–3,8	25
Temperature sender unit		4,5– 7	0,45–0,7	10

TECHNICAL DATA

'B' Engine (OHC/I–4)

General

			1,6 LC	2,0 LC
Identification code			LC	WL
Firing	order		1–3–4–2	
Bore		mm	87,67	90,82
Stroke		mm	66,00	76,95
Cubic capacity	effective	cm³	1593	1993
	fiscal rating	cm³	1576	1954
Compression ratio			8,2:1	8,2:1
Compression pressure at starter speed		kgf/cm² (lbf/in²)	9–11 (128–156)	10–12 (129–156)
Idling speed		1/min	800±50	
Max. speed continuous		1/min	5800	
Engine power – manual transmission	(DIN)	kW (HP)	48 (65)	57 (78)
	at	1/min	4750	4500
– automatic transmission	(DIN)	kW (HP)	—	55 (75)
	at	1/min	—	4400
Torque – manual transmission	(DIN)	Nm (kgf.m) (lbf.ft)	114 (11,6) (84)	147 (15,0) (35)
	at	1/min	2800	2800
– automatic transmission	(DIN)	Nm (kgf.m) (lbf.ft)	—	145 (14,8) (107)
	at	1/min	—	2800

Cylinder Block

			1,6 LC	2,0 LC
Cast marks			16	20
Number of main bearings			5	
Cylinder bore diameter	standard class 1	mm	87,650–87660	90,800–90,810
	2	mm	87,660–87,670	90,810–90,820
	3	mm	87,670–87,680	90,820–90,830
	4	mm	87,680–87,690	90,830–90,840
	oversize class A	mm	88,160–88,170	91,310–91,320
	B	mm	88,170–88,180	91,320–91,330
	C	mm	88,180–88,190	91,330–91,340
	standard KD	mm	87,680–87,690	90,830–90,840
	0,5 oversize	mm	88,180–88,190	91,330–91,340
	1,0 oversize	mm	88,680–88,690	91,830–91,840
Bearing width		mm	27,17–27,22	
Main bearing shells internal diameter (fitted)				
	standard	mm	57,000–57,033	
	0,25 undersize	mm	56,750–56,788	
	0,50 undersize	mm	56,500–56,538	
	0,75 undersize	mm	56,250–56,288	
	1,00 undersize	mm	56,000–56,038	
Main bearing parent bore diameter	standard	mm	60,620–60,640	
	0,40 oversize	mm	61,020–61,040	

Crankshaft

Axial play		mm	0,08 – 0,28
Main bearing journal diameter	standard	mm	56,97 –56,99
	0,25 undersize	mm	56,72 –56,74
	0,50 undersize	mm	56,47 –56,49
	0,75 undersize	mm	56,22 –56,24
	1,00 undersize	mm	55,97 –55,99
Thrust half ring thickness	standard	mm	2,30 – 2,35
	undersize	mm	2,50 – 2,55
Main bearing shell to journal clearance	alu	mm	0,010– 0,064
Big-end bearing journal diameter	standard	mm	51,98 –52,00
	0,25 undersize	mm	51,73 –51,75
	0,50 undersize	mm	51,48 –51,50
	0,75 undersize	mm	51,23 –51,25
	1,00 undersize	mm	50,98 –51,00

TECHNICAL DATA

			'B' ENGINE (OHC/I–4) 1,6 LC	2,0 LC
Camshaft				
Number of camshaft bearings			3	
Drive			by toothed belt	
Camshaft retaining plate thickness		mm	3,98–4,01	
Cam lift (inlet and exhaust)		mm	5,9639	6,3323
Cam length (heel to toe)		mm	35,234–35,894	36,26–36,60
Camshaft bearing journal diameter	front	mm	41,99–42,01	
	centre	mm	44,61–44,63	
	rear	mm	44,99–45,01	
Bearing inner diameter	front	mm	42,035–42,055	
	centre	mm	44,655–44,675	
	rear	mm	45,035–45,055	
Camshaft axial play		mm	0,104–0,024	
Auxiliary Shaft				
Auxiliary shaft axial play		mm	0,04–0,12	
Pistons				
Piston diameter	standard 1	mm	87,615–87,625	90,765–90,775
	2	mm	87,625–87,635	90,775–90,785
	3	mm	87,635–87,645	90,785–90,795
	4	mm	87,645–87,655	90,795–90,805
	KD standard	mm	87,630–87,655	90,780–90,805
	KD 0,5 oversize	mm	88,130–88,155	91,280–91,305
	KD 1,0 oversize	mm	88,630–88,655	91,780–91,805
Piston to bore clearance		mm	0,025–0,060	
Piston ring gap (fitted)	top	mm	0,38–0,58	
	centre	mm	0,38–0,58	
	bottom	mm	0,4–1,4	
Ring gap position	top		150° from 1 side of spreader gap	
	centre		150° from opposite side of spreader gap, top mark towards piston crown	
	bottom		Spreader opposite marked front of piston, intermediate rings 25 mm either side of spreader gap	
Piston Pins				
Pin length		mm	72,0–72,8	
Pin diameter	red	mm	23,994–23,997	
	blue	mm	23,997–24,000	
	yellow	mm	24,000–24,003	
Clearance in piston		mm	0,008–0,014	
Interference in connecting rod		mm	0,018–0,039	
Connecting Rods				
Bore diameter (excl. shells)	big-end	mm	55,00–55,02	
	small end	mm	23,964–23,976	
Internal bearing diameter (fitted)	standard	mm	52,006–52,044	
	0,25 undersize	mm	51,756–51,794	
	0,50 undersize	mm	51,506–51,544	
	0,75 undersize	mm	51,256–51,294	
	1,00 undersize	mm	51,006–51,044	
Big-end journal/shell clearance	alu	mm	0,006–0,060	
	composite	mm	0,006–0,064	
Cylinder Head				
Cast marks			6	0
Combustion chamber volume		cm^3	37,5–40,5	48,6–51,6
Valve seat angle		degrees	44° 30'–45°	
Stem bore (inlet and exhaust)	standard	mm	8,063–8,088	
	0,2 oversize	mm	8,263–8,288	
	0,4 oversize	mm	8,463–8,488	
Camshaft bearing bore in head	front	mm	45,072–45,102	
	centre	mm	47,692–47,722	
	rear	mm	48,072–48,102	

TECHNICAL DATA

			'B' Engine (OHC/I-4) 1,6 LC	2,0 LC
Valves				
Valve actuation			cam follower+toothed belt	
Valve clearance	inlet	mm	0,20	
	exhaust	mm	0,25	
Inlet valve	opens		22° before TDC	24° before TDC
	closes		54° after BDC	64° after BDC
Exhaust valve	opens		64° before BDC	70° before BDC
	closes		12° after TDC	18° after TDC
Inlet Valve				
Valve length		mm	112,65–113,65	110,65–111,65
Valve head diameter		mm	41,80–42,20	
Valve stem diameter	standard	mm	8,025–8,043	
	0,2 oversize	mm	8,225–8,243	
	0,4 oversize	mm	8,425–8,443	
	0,6 oversize	mm	8,625–8,643	
	0,8 oversize	mm	8,825–8,843	
Valve stem guide clearance		mm	0,020–0,063	
Valve lift (excl. valve clearance)		mm	9,5034	10,121
Free valve spring length		mm	44,0	
Exhaust Valve				
Valve length		mm	112,05–113,05	110,05–111,05
Valve head diameter		mm	34,00–34,40	35,80–36,20
Valve stem diameter	standard	mm	7,999–8,017	
	0,2 oversize	mm	8,199–8,217	
	0,4 oversize	mm	8,399–8,417	
	0,6 oversize	mm	8,599–8,617	
	0,8 oversize	mm	8,799–8,817	
Valve stem guide clearance		mm	0,046–0,089	
Valve lift (excl. valve clearance)		mm	9,5034	10,121
Free valve spring length		mm	44,0	

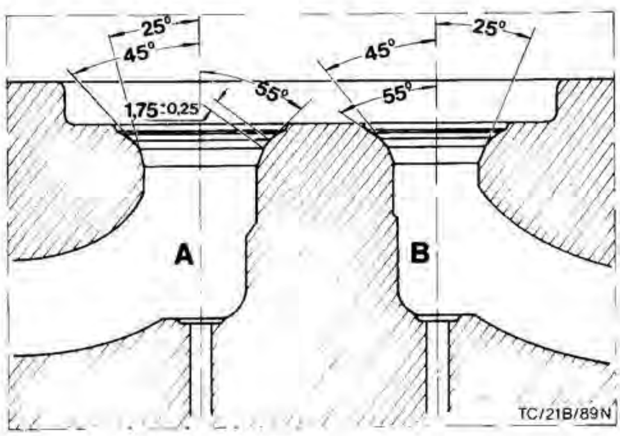


Fig. 242. Valve seat angle
A – Inlet valve seat
B – Exhaust valve seat

TECHNICAL DATA

			'B' Engine (OHC/I–4) 1,6 LC / 2,0 LC
Engine Lubrication			
Oil type			HD oil
Viscosity	below –12 °C		SAE 5W-20
	below 0 °C		SAE 5W-30
	–23 °C to +32 °C		SAE 10W-30/40/50
	above –18 °C		SAE 15W-40/50
	above –12 °C		SAE 20W-40/50
Ford specification			SS-M2C-9001 AA
Initial fill capacity with filter		litres	3,75
Oil change without filter change		litres	3,25
Oil change with filter change		litres	3,75
Min. oil pressure at	750 rpm	kgf cm² (lbf/in²)	1,0 (14)
(SAE 10W-30,	2000 rpm	kgf cm² (lbf/in²)	2,5 (36)
Relief valve opens at 80 °C)	1000 rpm	kgf cm² (lbf/in²)	4,00–4,70 (57–67)
Oil pressure warning light comes on at		kgf/cm² (lbf/in²)	0,30–0,60 (4,3–8,5)
Oil pump – rotor/casing clearance		mm	0,150–0,301
– inner/outer rotor clearance		mm	0,05–0,20
Axial clearance – rotor/sealing face		mm	0,028–0,104

Tightening Torques			**Nm**	**(kpm)**	**lbf.ft**
Main bearings			88–102	8,8–10,2	70
Big-end bearings			41–48	4,1–4,8	33
Crankshaft belt pulley			55–60	5,5–6,0	42
Camshaft and auxiliary shaft toothed belt pulley			45–50	4,5–5,0	35
Flywheel			65–71	6,5–7,1	50
Oil pump to cylinder block			17–21	1,7–2,1	14
Oil pump cover to oil pump			9–13	0,9–1,3	8
Sump		(1)	1–2	0,1–0,2	1
		(2)	6–8	0,6–0,8	5
	after running engine 20 mins	(3)	8–10	0,8–1,0	7
Oil drain screw			21–28	2,1–2,8	18
Oil pressure switch			12–15	1,2–1,5	10
Ball pin – valve adjustment			45–50	4,5–5,0	35
Cylinder head		(1)	40–55	4,0–5,5	35
		(2)	50–70	5,0–7,0	44
	after 10 to 20 mins wait	(3)	85–95	8,5–9,5	66
Retighten after engine warm (15 mins at 1000 rpm)		(4)	90–110	9,0–11,0	74
Later retightening of cylinder head is not needed					
Rocker cover	(bolts 1–6)	(1)	5–7	0,5–0,7	4,4
	(bolts) 7+8)	(2)	2–2,5	0,2–0,25	1,7
	(bolts 9+10)	(3)	5–7	0,5–0,7	4,4
	(bolts 7+8)	(4)	5–7	0,5–0,7	4,4
Timing cover			13–17	1,3–1,7	11
Inlet manifold			17–21	1,7–2,1	14
Exhaust manifold			21–25	2,1–2,5	17
Fuel pump			17–21	1,7–2,1	14
Clutch pressure plate to flywheel			17–21	1,7–2,1	14
Water pump	(2 M8 bolts)		17–21	1,7–2,1	14
	(1 M10 bolt)		36–43	3,6–4,3	29
Water connector – thermostat housing			17–21	1,7–2,1	14
Fan to water pump flange			17–21	1,7–2,1	14
Spark plugs			20–28	2,0–2,8	18

REAR AXLE/REAR SUSPENSION/DRIVESHAFT 15

Index **Page**

GENERAL DESCRIPTION

Depending on their equipment, Ford Transit '78 vehicles can be fitted with one of 3 different rear axles, Figs. 1, 2 and 3.

These rear axles are designated 'F', 'G' and 'H' in the following text.

On the 'F' and 'G' axles, the differential is mounted directly in the axle housing, so when repairs are carried out on the rear axle, the rear axle must be removed.

The 'H' axle has a bolt-on differential. So repairs to this differential do not entail removal of the axle.

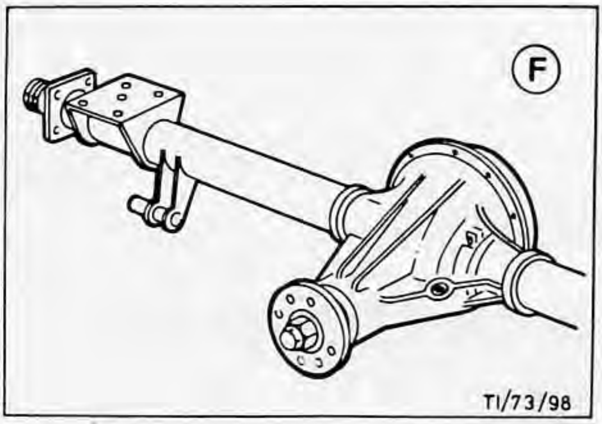


Fig. 1. 'F' axle

Rear Suspension

The rigid rear axle is supended on semi-elliptical leaf springs with telescopic shock-absorbers.

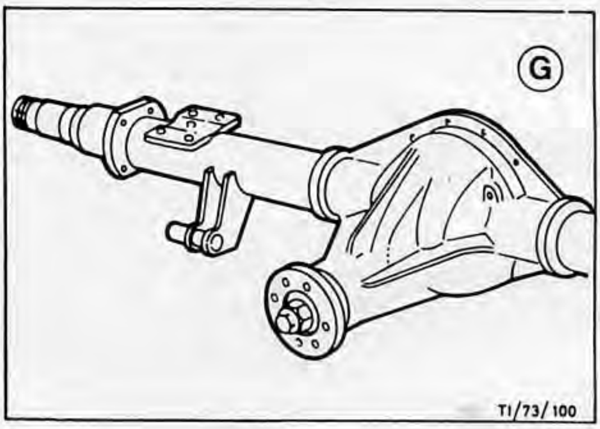


Fig. 2. 'G' axle

Driveshafts

Two part driveshafts are used to transmit torque from the gearbox to the rear axle. The split drive-shaft has a centre bearing and a universal joint. The centre bearing is a ball bearing (in a flexible soft rubber mounting) which is secured in a housing on the floor pan. When fitting this driveshaft the installation procedure in operation 15 514 must be followed.

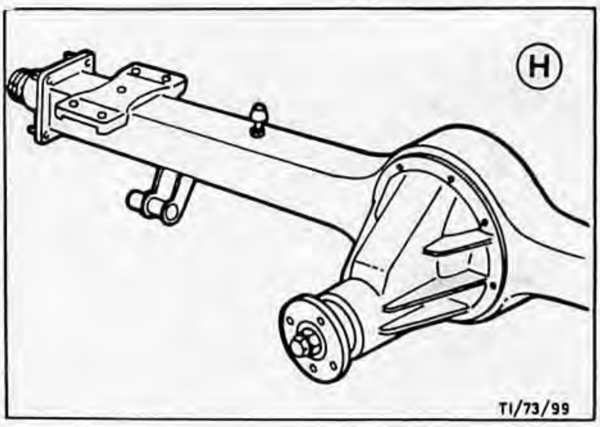


Fig. 3. 'H' axle

REAR AXLE USAGE CHART

Engine	Transm.		Ratios						Vehicle version
					Rear axle				
	man	auto	STD	RPO	G	F	H man	H auto	
1,6 ltr Kent (OHV)	X		X			4,63	4,56		FT80 van and kombi
				X		5,14	5,14		
1,6 ltr LC (OHC)	X		X			5,14	5,14		FT100, 120 van and kombi 9 and 12–seater bus
				X		4,63	4,56		FT100, 120 cowl/chassis+single cab FT100, 120 cowl/chassis+dual cab
2,0 ltr LC (OHC)									FT100*, 120*† van and kombi
			X		4,63		4,11		FT100L–190 van and kombi
				X	5,14		4,44		FT130B kombi 9 and 12–seat bus*†
								4,44	15–seat bus
				X	5,83		4,56		FT100*, 120*† cowl/chassis+
	X	X						4,44	single cab
				X			5,14		FT100L–190 cowl/chassis+single cab
								HD	FT100*, 120*† cowl/chassis+dual cab
									FT130, 190 cowl/chassis+dual cab
2,4 ltr Diesel (OHV)									FT100, 120 van and kombi
		X			5,83		4,11		FT100L–190 van and kombi 9 and
				X	4,63		4,44		12–seat bus, 15–seat bus
	X			X	5,14				FT100, 120 cowl/chassis+single cab
									FT100L–190 cowl/chassis+single cab FT100, 120 cowl/chassis+dual cab FT130, 190 cowl/chassis+dual cab

* automatic transmission optional

† uprated H axle with ratio of 4,44 HD in conjunction with 2,0 ltr LC (OHC) engine and automatic transmission

PRINCIPLE OF OPERATION

(a) **Drive Pinion**

In all three axles the drive pinion runs in 2 taper roller bearings. The bearings are held in position:

1. By a clamping sleeve on the 'F' and 'H' axles.
2. By a spacer sleeve on the 'G' axle, the dimensions of which are established as indicated in operation 15 214 8.

The correct depth of mesh of the drive pinion in the crown wheel is set by means of suitable shims between the head of the drive pinion and the taper roller bearing.

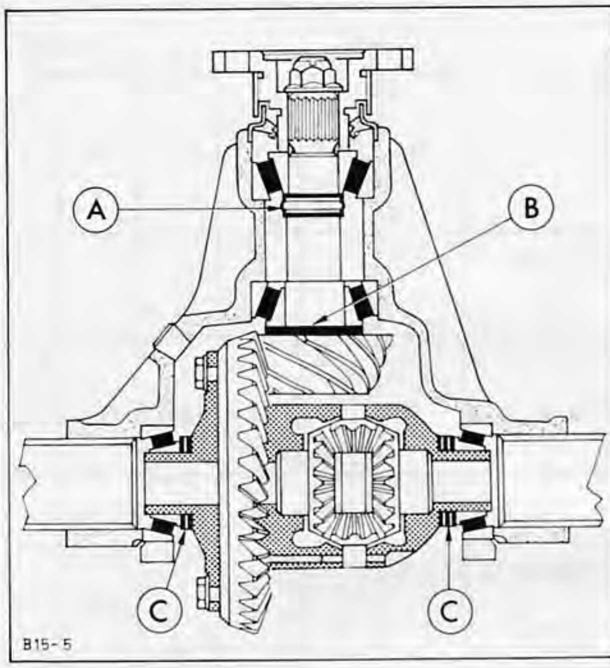


Fig. 4. 'F' axle
A – Clamping sleeve
B – Drive pinion shim
C – Differential housing shims

(b) **Half-shaft Taper Roller Bearings**

The half-shaft taper roller bearings are preloaded:

1. By shims between axle casing and differential on the 'F' axle.
2. By ring nuts on the axle casing on the 'G' axle.
3. By ring nuts in the differential housing on the 'H' axle.

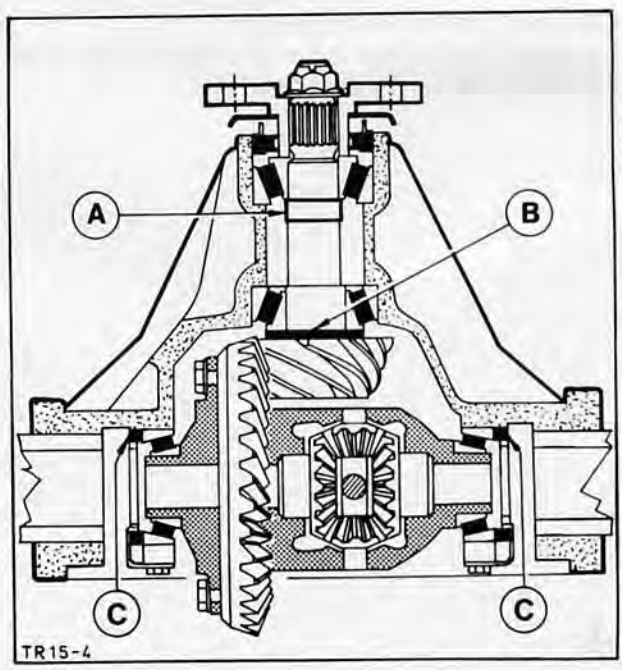


Fig. 5. 'G' axle
A – Spacer sleeve
B – Drive pinion shim
C – Ring nuts

(c) **Power Flow**

1. In the 'F' and 'H' axles the power flows via 2 or via 4 differential gears and 2 half-shaft gears (side gears).

2. In the 'G' axle power flow is basically via 4 differential gears and 2 half-shaft gears (side gears).

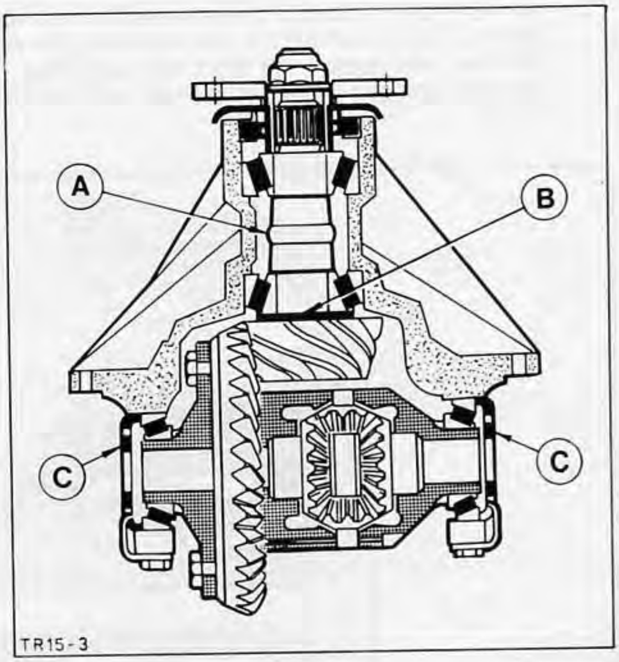


Fig. 6. 'H' axle
A – Clamping sleeve
B – Drive pinion shim
C – Ring nuts

(d) **Half-Shafts**

In all three axles the half-shafts are splined to the side gears. Differences exist only in the wheel-hub mountings which are the same only in the 'F' and 'H' axles.

1. IN the 'F' and 'H' axles the half-shaft drives the wheel-hub which is mounted on the axle tube in a ball bearing (lubricated by the rear axle oil). The assembly is sealed by means of a sealing ring which sits in the hub and seals it off from the axle tube. The half-shaft is also sealed off at the hub by a gasket located between half-shaft flange and hub. The bearing is held in position by means of a spacer ring, Fig. 7.

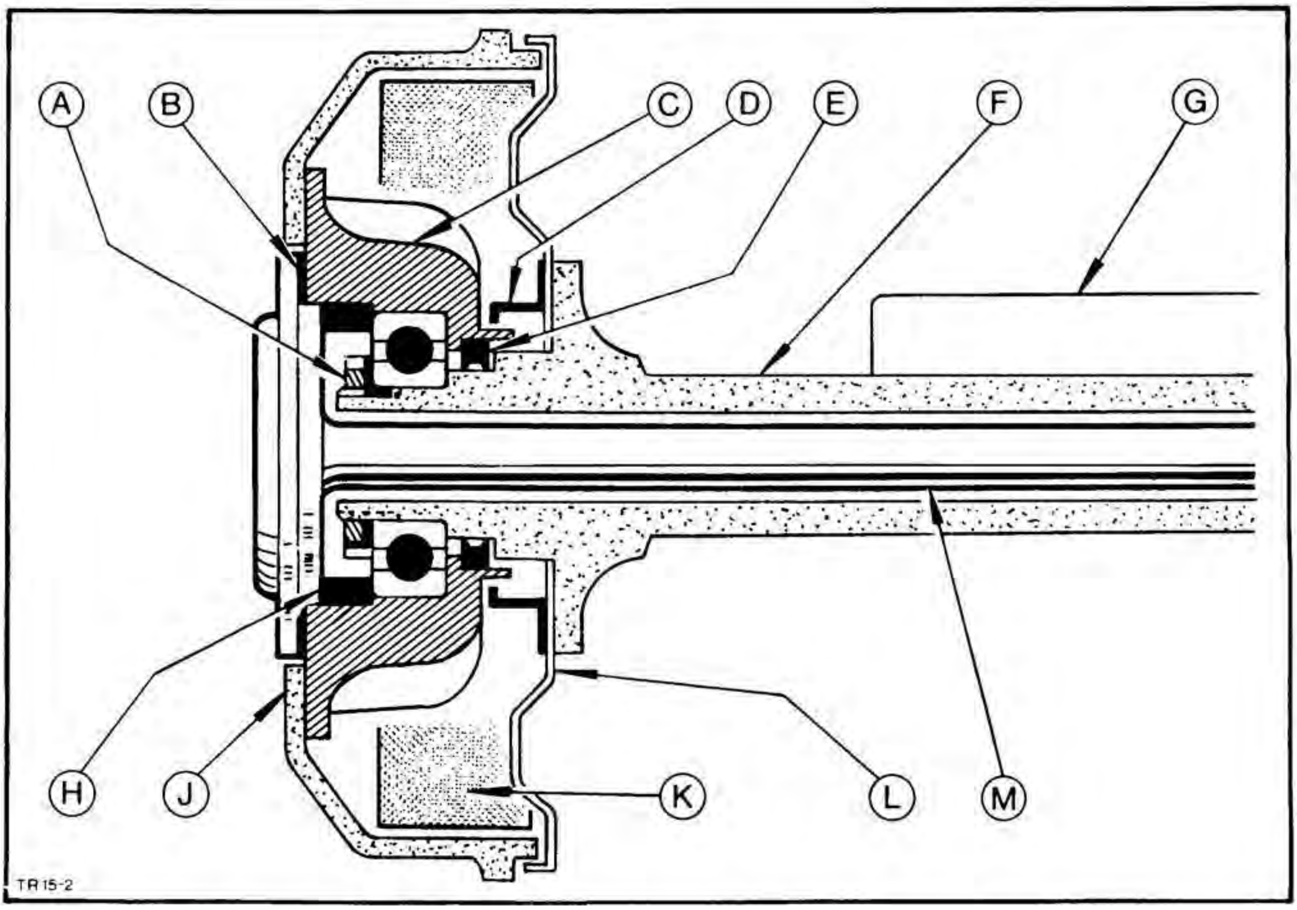


Fig. 7. Hub – 'F' and 'H' axles

A – Nut
B – Gasket half-shaft/hub
C – Hub
D – Gaurd
E – Oil seal axle-tube/hub
F – Axle tube
G – Spring bearer
H – Spacer ring
J – Brake drum
K – Brake
L – Brake carrier plate
M – Half-shaft

2. On the 'G' axle the wheel-hub is mounted on the axle tube with two taper roller bearings. These taper roller bearings are lubricated by the rear axle oil. The axle-tube/hub sealing is effected by an oil seal located in front of the inner bearing. Another seal is located between the half-shaft flange and the wheel-hub. Here the bearing play is set with locknuts, Fig. 8.

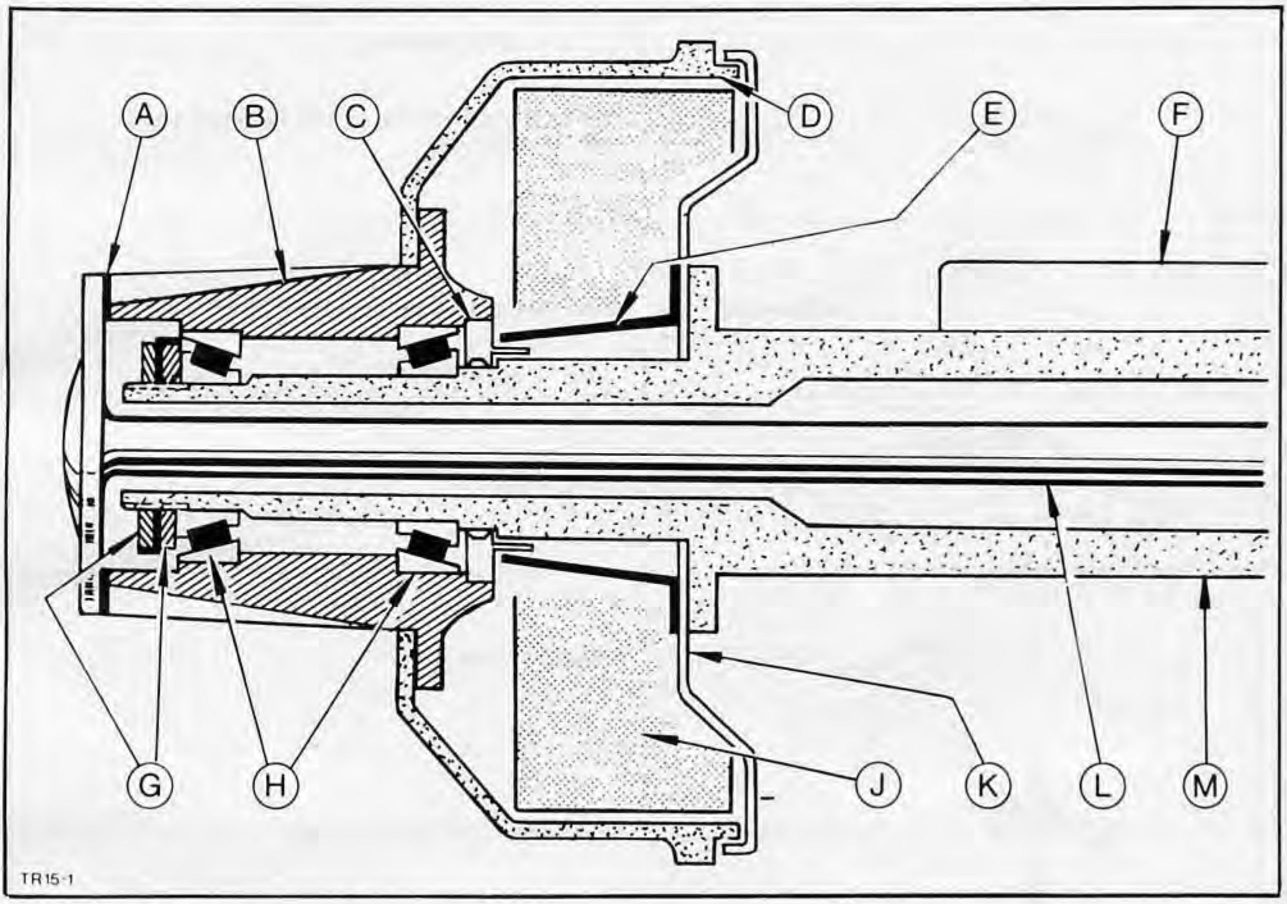


Fig. 8. Wheel-hub – 'G' axle

A – Gasket half-shaft/hub
B – Hub
C – Seal axle-tube/hub
D – Brake drum

E – Gaurd
F – Spring bearer
G – Locknuts
H – Taper roller bearing

J – Brake
K – Brake carrier plate
L – Half-shaft
M – Axle tube

SERVICE ADJUSTMENTS AND CHECKS

To check the oil level in the rear axle, the vehicle must be standing on level ground. Oil level should be up to the lower edge of the filler opening, Fig. 9. Top up with specified oil (see Technical Data) if necessary.

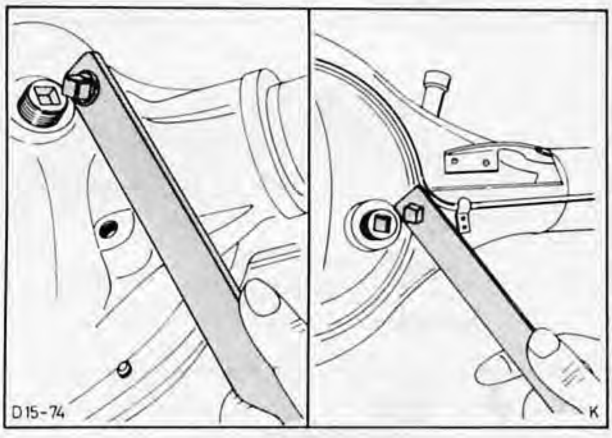
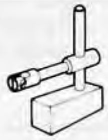
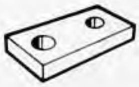
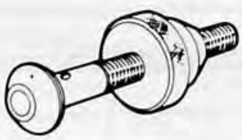
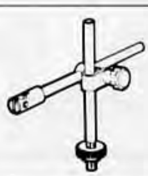
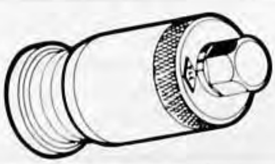
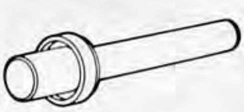
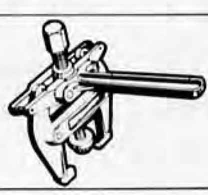
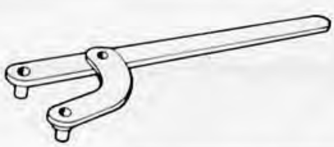
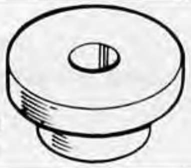
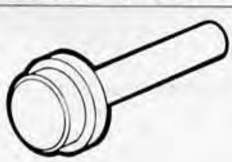
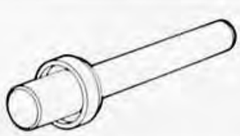
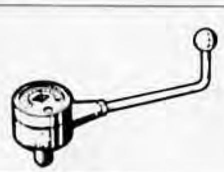


Fig. 9. Check oil level in rear axle

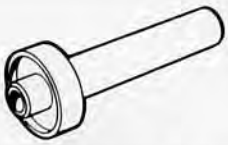
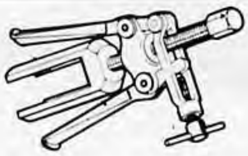
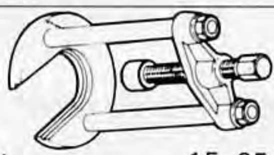
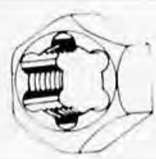
SPECIAL SERVICE TOOL RECOGNITION

	15–008	F G H	Dial indicator mounting block
	15–008–01	F G H	Dial indicator holding fixture (adaptor used with 15–022–A)
	15–008–03B	F G H	Dial indicator setting gauge
	15–019	F G H	Gauge bar
	15–020	G F H	Master pinion
	15–022A	F G H	Dial indicator holding fixture
	15–023	F G H	Pre-load sleeve
	15–024	G	Master spacer
	15–025A	F H	Differential bearing cone installer
	15–026A	F G H	Differential bearing cone remover

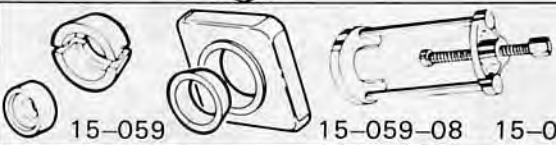
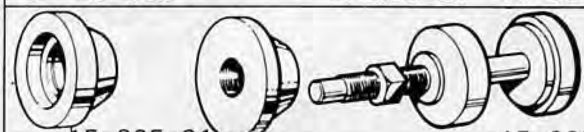
SPECIAL SERVICE TOOL RECOGNITION (cont'd)

	15–026–51	G	Adaptor for 15–026
	15–027	G	Differential bearing adjusting nut wrench
	15–028	G	Rear hub nut wrench
	15–029	F H	Rear hub nut wrench
	15–030	F G H	Universal flange holding wrench
	15–033	F H	Pinion bearing cup installer
 	15–035 and 15–064 15–065 and 15–065–01	G	Pinion bearing cup installer (main tool and adaptor)
	15–036	F	Rear hub grease seal installer adaptor (use with 550 handle)
	15–037	G	Differential bearing installer adaptor (use with 550 handle)
	15–041	F G H	Pre-load gauge

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

	15–042	F H	Pinion bearing installer
	15–046	F G H	Metric dial indicator gauge
	15–047B	F G H	Pinion oil seal installer
	15–048	F G H	Pinion oil seal remover
	15–049	F	Pressure spindle differential bearing adjustment
	15–049–01	F	Pressure pads (use with 15–049)
 15–059 and 15–059–01	 15–054	F H	Taper base and pinion bearing remover adaptor
	15–057	F G	Rear axle mounting bracket (use with 21–023)
	15–060	F	Rear hub remover
	15–061	F	Axle die nut

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

 15–062 G	Rear hub nut wrench
 15–059 15–059–08 15–063 G	Pinion bearing remover/installer
 15–065–01 15–065 G	Pinion bearing cup installer and adaptor
 16–009 H	Rear axle mounting bracket
 21–023A F G H	Universal spindle (only in conjunction with stand)

SERVICE AND REPAIR OPERATIONS – CONTENT

REAR AXLE/REAR SUSPENSION/DRIVESHAFT		Described for axle			Also applicable to following models		
		F	G	H	Escort	Taunus/ Cortina	Capri
15 212	Rear axle and suspension assembly – remove and install	X	X	X	—	—	—
15 214	Rear axle assembly – remove and install	X	X	X	—	—	—
15 214 8	Rear axle assembly – overhaul	X	X	X	X	X	X
15 254	Differential assembly – remove and install	—	—	X	X	—	X
15 254 8	Differential assembly – overhaul	—	—	X	X	—	X
15 302	Seal – drive pinion – replace	X	X	X	X	X	X
15 514	Driveshaft assembly – remove and install	X	X	X	—	—	—
15 564 4	Centre bearing – driveshaft – replace	X	X	X	X	X	X
15 621	Rear spring assembly – remove and install	X	X	X	—	—	—

SERVICE AND REPAIR OPERATIONS

15 212 REAR AXLE AND SUSPENSION ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Jack-up vehicle at rear and fit stands under side members. Leave jack under rear axle.
2. Detach driveshaft from drive pinion flange.
3. Detach brake pipes from brake hoses and unhook spring of load-conscious brake valve at the top, Fig. 10.

   When spring is detached at the bottom, the load-conscious brake valve must be adjusted as in operation 12 136 after assembly.

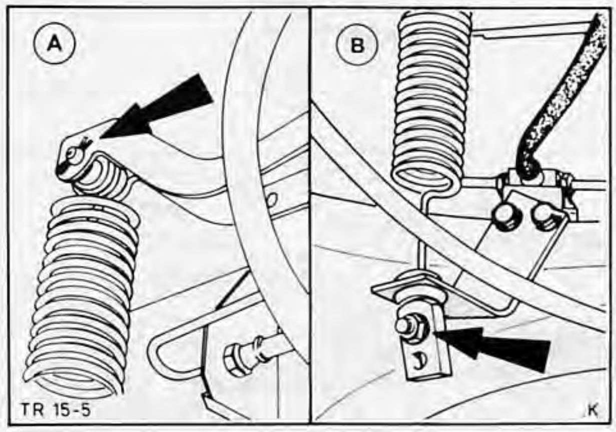


Fig. 10. Unhook spring of load-conscious brake valve
A – Unhook at top
B – Unhook at bottom

4. Detach exhaust from body at the rear.
5. Detach handbrake cable from linkage, body and bracket, Fig. 11 (1 bolt, 2 clips and 2 screws).
6. Detach shock absorbers from body on left and right hand sides (1 bolt each).

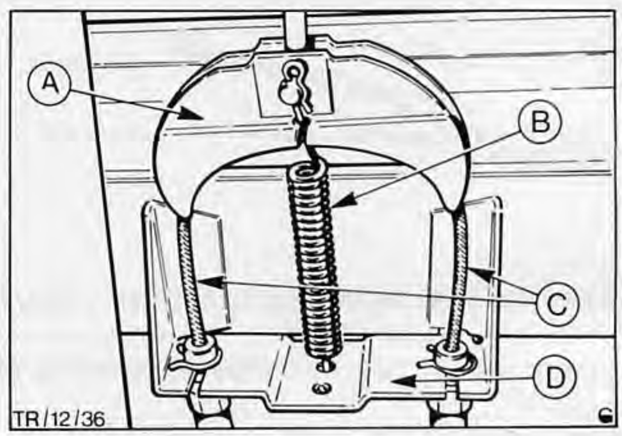


Fig. 11. A – Balancing yoke
B – Return spring
C – Handbrake cables
D – Support bracket

7. Detach rear springs from body at front and rear mountings on left and right hand sides (4 bolts), Fig. 12.
8. Take out rear axle and suspension assembly complete using the jack.

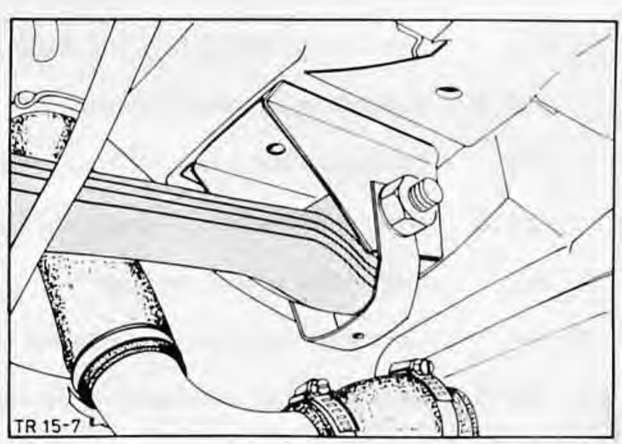


Fig. 12. Detach rear springs from body

To Install

9. Locate complete rear axle assembly in position, Fig. 13.
10. Bolt rear springs in place in following order front left, front right, rear left and rear right.

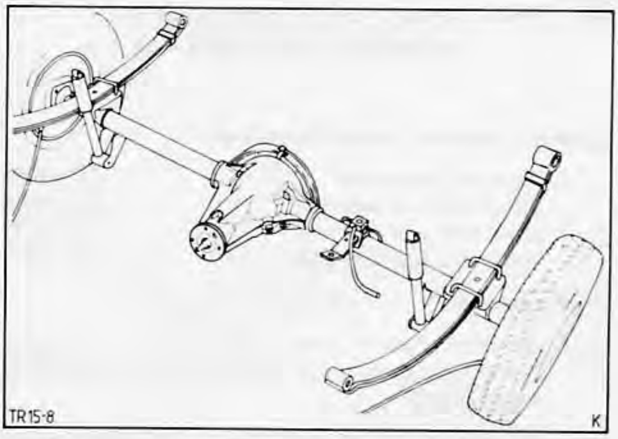


Fig. 13. Locate complete rear axle assembly

11. Fix right and left shock absorbers to body, Fig. 14.
12. Attach handbrake cable to linkage, body and bracket and adjust.
13. Attach exhaust to body at rear.
14. Connect spring of load-conscious brake valve and attach brake pipe to brake hose.

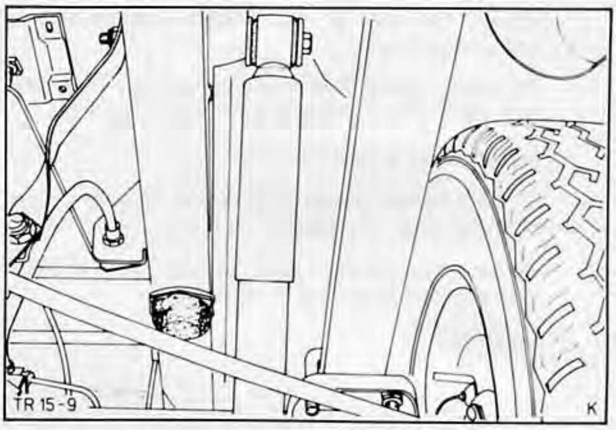


Fig. 14. Fix shock absorbers to body

15. Bolt driveshaft to drive pinion flange, Fig. 15.
16. Bleed rear brake circuit.

    NOTE: All rear spring mountings must only be tightened with suspension under load.

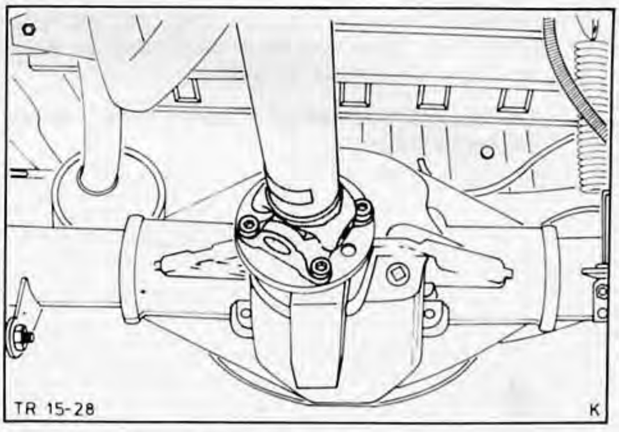


Fig. 15. Attach driveshaft to drive pinion flange

15 214 REAR AXLE ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required:

Rear hub remover	15–060
Rear hub nut wrench	15–028
Rear hub nut wrench	15–026
Rear hub nut wrench	15–062

To Remove

1. Slacken wheel nuts, remove left and right hand axle shafts, Fig. 16 (6 nuts or 5 bolts in each case).

   NOTE: On the 'H' axle remove or install brake drums before axle shafts.

2. Jack up vehicle and fit stands under side members, detach wheels and brake drums.

   NOTE: On the 'G' axle remove brake drums with wheel hub.

3. Remove wheel hubs using Special Tool No. 15–060 after releasing locknuts, Fig. 17.

   NOTE: Plug axle tubes with rag.

4. Detach brake pipes from brake hoses, wheel cylinder and rear axle.
5. Detach handbrake cable at rear from linkage and body (1 bolt and 2 clips).
6. Remove brake carriers on right and left hand sides, Fig. 18 (4 nuts each on 'F' and 'H' axles and 6 nuts each on 'G' axle).
7. Disconnect driveshaft from drive pinion flange (4 bolts).

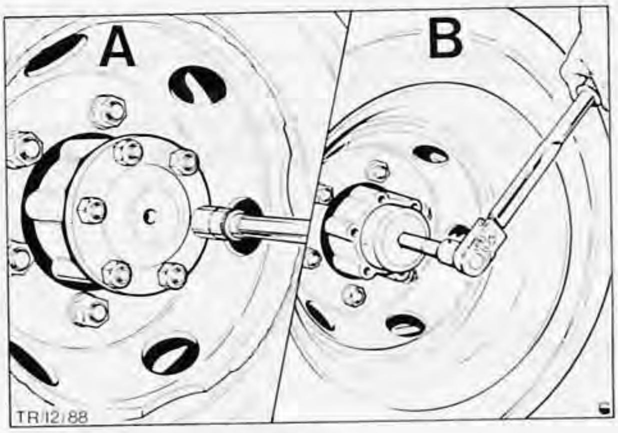


Fig. 16. A – Unscrew axle shaft nuts
B – Undo locknut with special tool no. 15–029

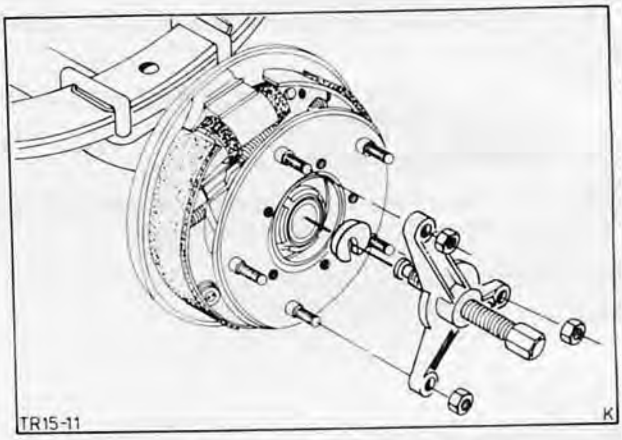


Fig. 17. Remove hub with special tool no. 15–060 ('F' axle shown)

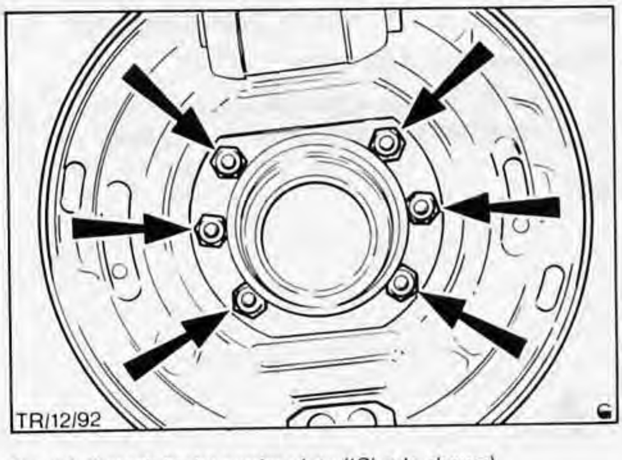


Fig. 18. Detach brake carrier plate ('G' axle shown)

8. Detach both shock absorbers from the rear axle (1 bolt each).
9. Remove spring U-bolts on left and right hand sides (4 nuts in each case), Fig. 19.
10. Take out rear axle.

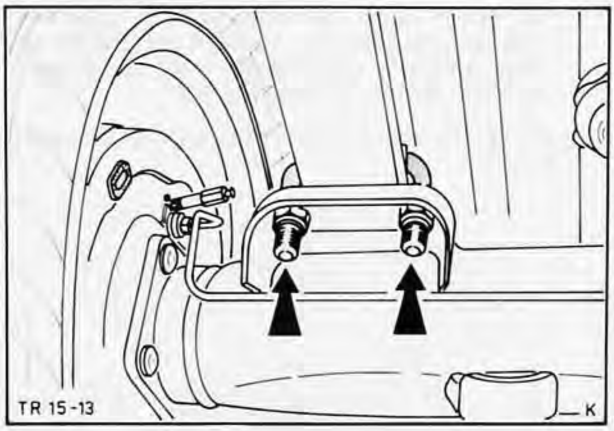


Fig. 19. Remove U-bolts

To Install

11. Locate rear axle in position and centre axle with the centering bolts, Fig. 20.
12. Attach U-bolts with retaining plate on right and left hand sides.
13. Secure both shock absorbers to the rear axle.

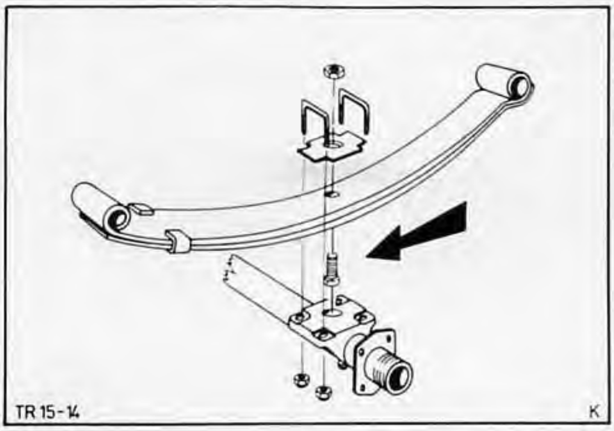


Fig. 20. Centre axle with centering bolts

14. Fix driveshaft to drive pinion flange, Fig. 21.
15. Attach brake carriers on right and left hand sides.
16. Connect brake pipes to wheel cylinder and rear axle and attach brake pipe to brake hose.

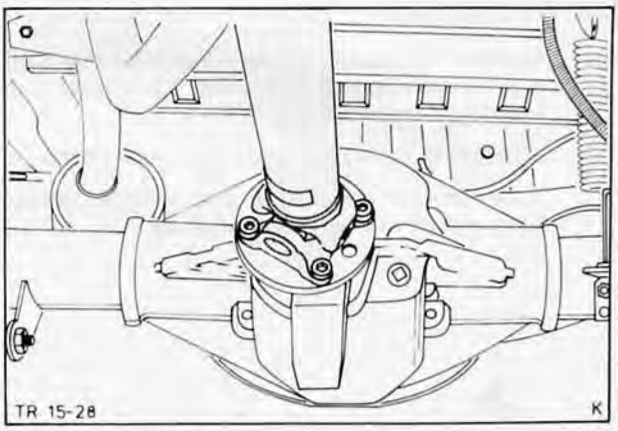


Fig. 21. Fix driveshaft to drive pinion flange

15 214 (cont'd)

17. Fit wheel hubs, torquing nuts as specified with Special Tool No. 15–029 for 'F' and 'H' axles, and tool 15–028 (67 mm) or 15–062 (65 mm) for the 'G' axle, Fig. 22.

    NOTE: On the 'G' axle, fit brakes drums with hub.

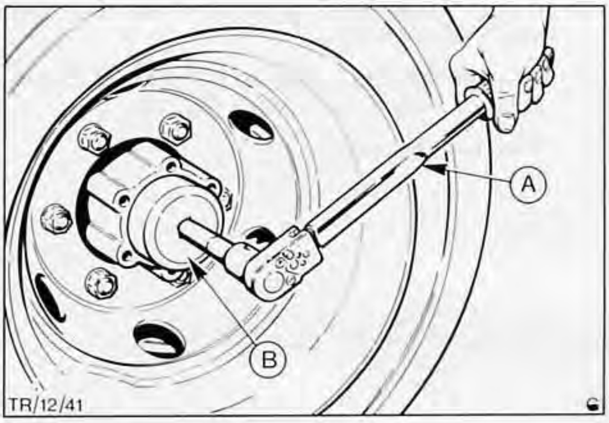


Fig. 22. Tighten nuts with special tool
A – Torque wrench
B – Special tool no. 15–029
('G' axle shown)

18. Fit brake drums.
19. Remove rag plugs, attach handbrake cable at rear to linkage and body, Fig. 23, adjust and bleed rear brake circuit.
20. Fit wheels, install left and right hand-shafts.
21. Take vehicle off stands and tighten wheel nuts and fill axle with specified oil.

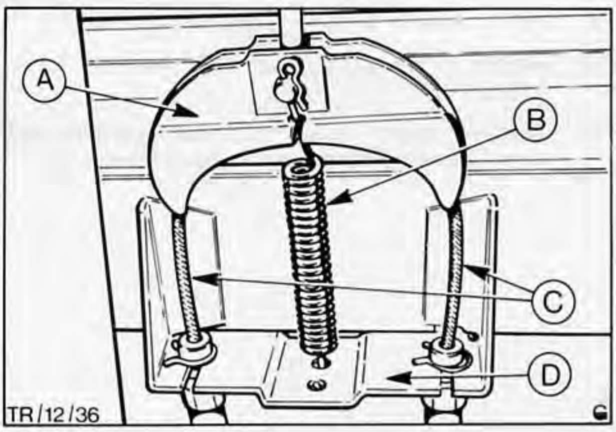


Fig. 23. A – Balancing yoke
B – Return spring
C – Handbrake cables
D – Support bracket

15 214 8 REAR AXLE ASSEMBLY – OVERHAUL

Special Service Tools Required:

Dial indicator mounting block	15–008
Adaptor for dial indicator holding fixture 15–022–A	15–008–01
Dial Indicator setting gauge	15–008–03B
Gauge bar	15–019
Master pinion	15–020
Dial indicator holding fixture	15–022A
Pre-load sleeve	15–023
Differential bearing cone installer	15–025A
Differential bearing cone remover	15–026
Adaptor for 15–026	15–026–51
Rear hub nut wrench (67 mm)	15–028
Universal flange holding wrench	15–030
Differential bearing installer	15–037
Metric dial indicator	15–046
Drive pinion oil seal installer	15–047B
Rear axle mounting bracket (only in conjunction with 21–023)	15–057
Rear hub nut wrench (65 mm)	15–062
Drive pinion remover	15–063
Pinion bearing cup installer	15–065
Adaptor for 15–065	15–065–01
Universal shaft – only in conjuntion with stand	21–023

To Dismantle Rear Axle

1. Mount rear axle on stand, Fig. 24, and detach rear axle casing cover (12 bolts).
2. Pivot axle and drain oil.
3. Detach locking plates from bearing cap, Fig. 25.
4. Undo differential (4 bolts) and take differential gear train with adjusting nuts from axle casing.
5. Remove drive pinion (1 nut). To do this, hold flange with Special Tool and undo nut, Fig. 26, tap drive pinion out downwards with a copper hammer. Detach flange.
6. Press oil seal and outer taper roller bearing out of housing simultaneously with a suitable tube. Detach inner taper roller bearing from drive pinion using Special Tool No. 15–063.

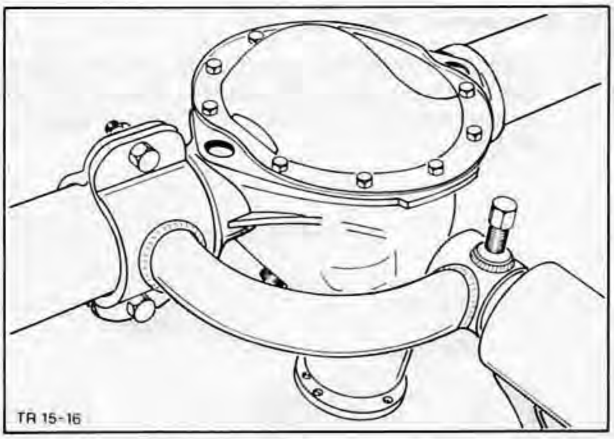


Fig. 24. Mount rear axle on stand
'F' + 'G' axle mounting stand 15–057
'H' axle mounting stand 16–009
Use in conjunction with 21–023

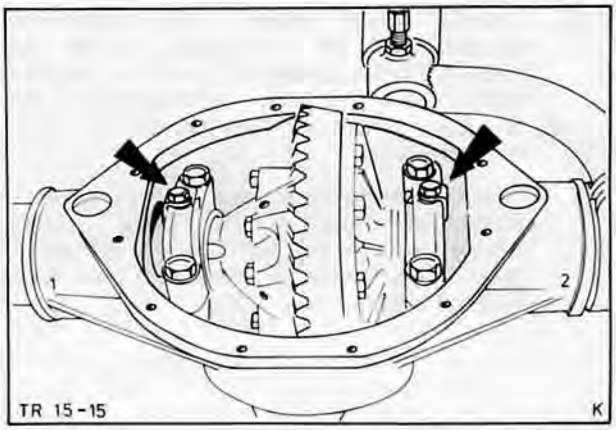


Fig. 25. Detach lock plates from bearing cap

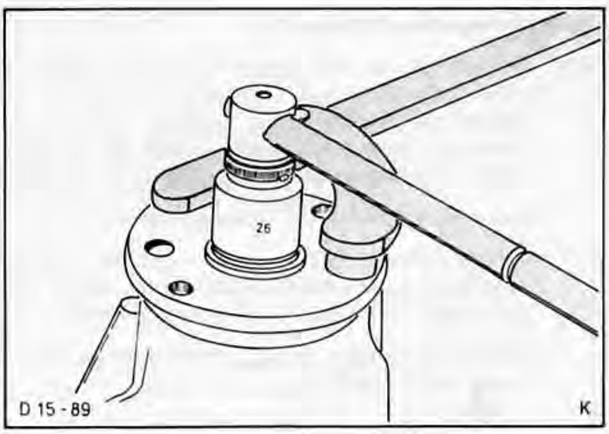


Fig. 26. Hold flange with special tool no. 15–030

15 214 8 (cont'd) 'G' AXLE

To Dismantle Differential

7. Detach differential taper roller bearing from differential housing. To do this, clamp one leg of Special Tool in a vice and pull off bearing, Fig. 27.

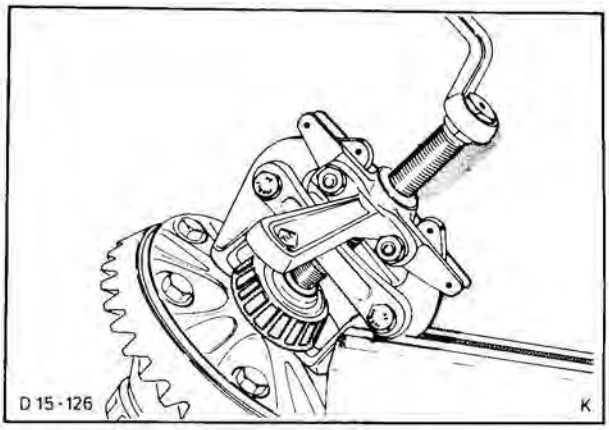


Fig. 27. Clamp special tool in vice by one leg and detach bearing

8. Detach crown wheel from differential housing, Fig. 28 (10 bolts). To do this, slacken 3 bolts spaced out over the periphery (remove the remainder completely) so that the crown wheel can be removed by tapping the bolt heads.
9. Take differential gears and side gears out of differential housing (8 bolts), detach differential housing half, lift out differential gears with differential cross and side gears. Remove shims.

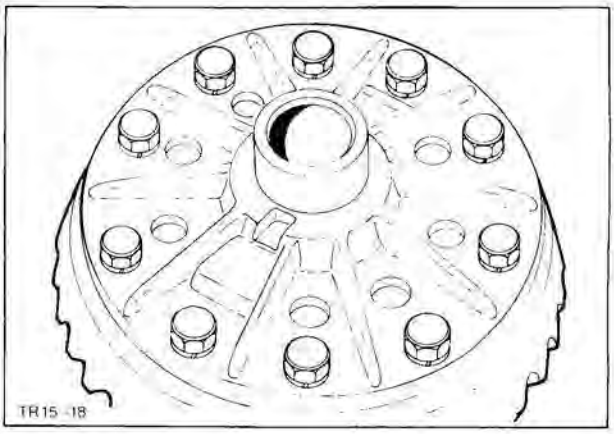


Fig. 28. Detach crown wheel from differential housing

To Reassemble Differential

10. Install differential gears and side gears in differential housing, inserting side gears with shims and differential gears with thrust washers and differential cross in housing halves in reverse order, Fig. 29.

    Assemble differential housing halves.

    NOTE: Coat bolts with 'Loctite' before insertion. Grooved side of shims must face side gear. Align marks on housing halves.

    When using new shims, check side gears run easily with a half-shaft.

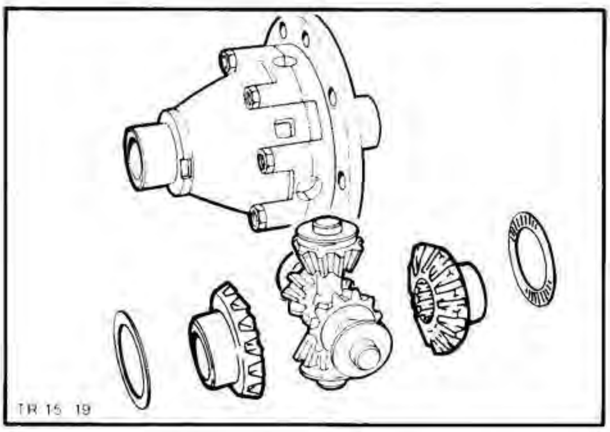


Fig. 29. Remove differential gears with differential cross and side gears

11. Attach crown wheel (10 bolts), secure crown wheel to differential housing evenly.

    NOTE: Use new bolts and spring washers, heat crown wheel before fitting.

12. Remove and re-install outer bearing cup of drive pinion taper roller bearing with Special Tool, Fig. 30.

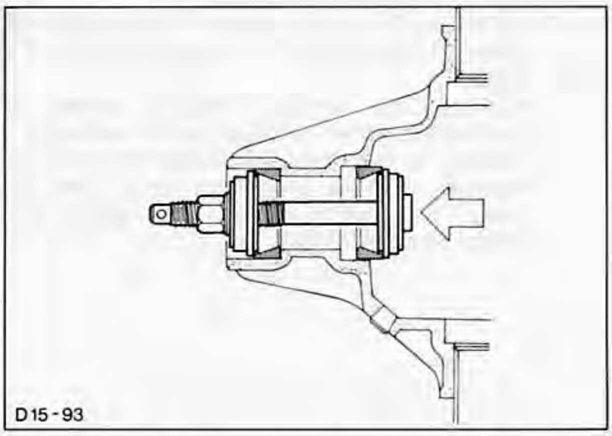


Fig. 30. Remove outer drive pinion bearing cup with special tool no. 15–035 15–064

13. Remove and re-install inner bearing cup of drive pinion taper roller bearing with Special Tool No. 15–065 15–065–01.

    NOTE: Only replace one bearing cup at a time as one cup always provides support for the installation tool.

Determine Thickness of Drive Pinion Shim

14. Slide shim that has been removed or a new shim of any thickness onto master pinion with inner taper roller bearing, Fig. 31.

    NOTE: Moisten taper roller bearing with rear axle oil and secure with the conical nut.

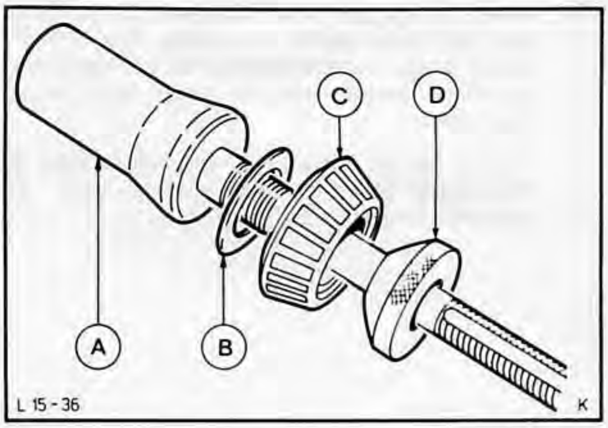


Fig. 31. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

15. Insert master pinion in axle casing, fit outer bearing and handle, screw on pre-load sleeve. Grasp handle of master pinion firmly and turn hexagonal end of pre-load sleeve clockwise, in the case of new bearings until the outer bell of the tool lines up on the A mark (use B mark for used bearings), Fig. 32.

    Rotate the master pinion several times so that the bearings are correctly seated.

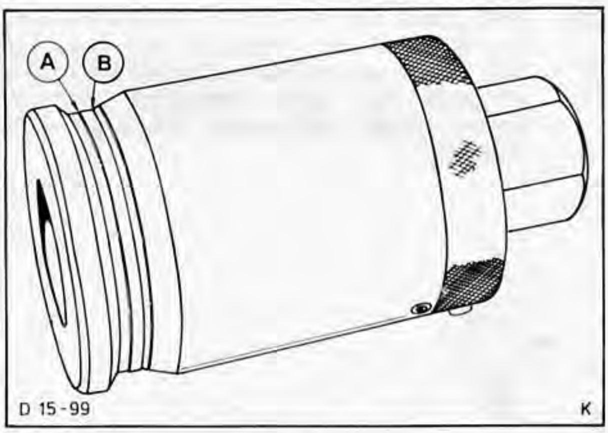


Fig. 32. Pre-load sleeve 15–023
A – Mark for new bearings
B – Mark for used bearings

15 214 8 (cont'd)

'G' AXLE

16. Establish the torque needed to turn unit with pre-load gauge 15–041 and note value, Fig. 33.
NOTE: This torque reading **must** be maintained when drive pinion is installed. If reading is 2,3 Nm (23 cmkp) for instance, reading must be the same (+0,3 Nm (+3 cmkp) for friction of oil seal) when drive pinion has been fitted.

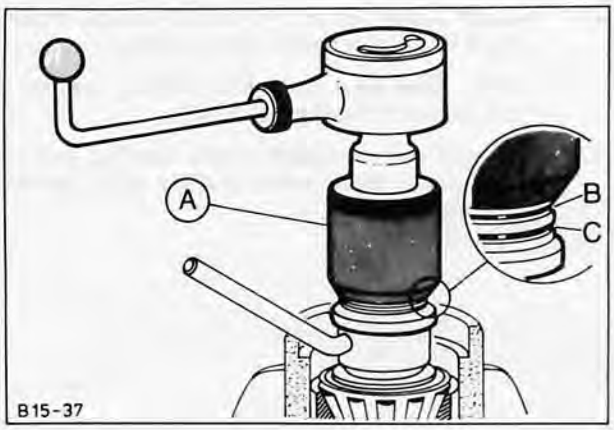


Fig. 33. Pre-load sleeve 15–023
A – Pre-load sleeve
B – Mark for used bearing
C – Mark for new bearing

17. Insert gauge bar with bearings to be fitted and adjusting nuts in casing, Fig. 34. Fit bearing cap (numbers coincide) and secure to specified torque, slacken again and do up finger-tight.

NOTE: Do up adjusting nuts finger-tight so that they bear on the bearing cups. Oil bearings and fit.

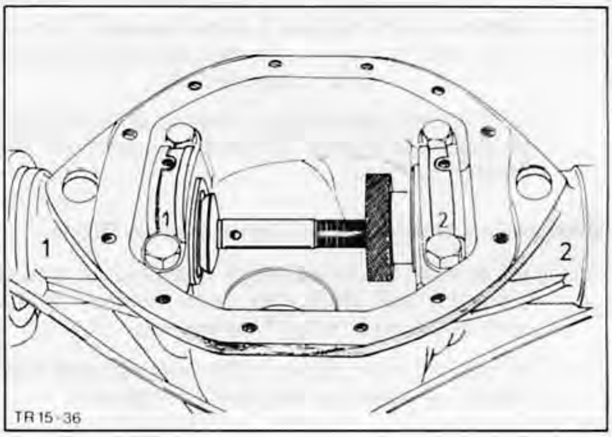


Fig. 34. Gauge bar located in rear axle casing

18. Hold gauge bar still with a suitable mandrel, Fig. 35, and turn adjusting nuts outwards until gauge bar can just be turned by hand at adjusting nut (after removing mandrel). Rotate gauge bar several times to settle bearings.

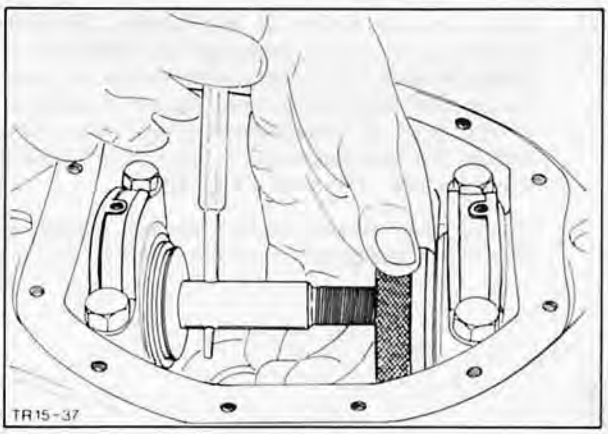


Fig. 35. Set up gauge bar

19. Secure dial indicator with holding fixture on rear axle casing and position plunger on centre of gauge bar. Turn bar slowly and observe total deflection of dial pointer, Fig. 36. Then turn gauge bar until dial indicator reading is half the deflection measured. Gauge bar must not be turned any more.

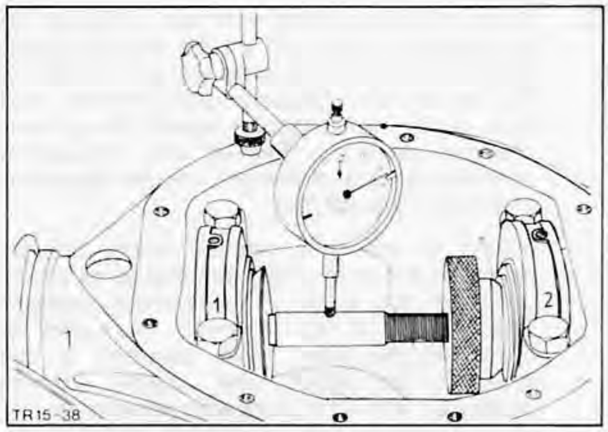


Fig. 36. Adjust gauge bar 15–019

20. Set up master pinion. To do this, locate dial indicator on outer edge of master pinion end close to the gauge bar. Rotate master pinion slowly through one full turn and observe total deflection of dial pointer, Fig. 37. Then continue turning master pinion until dial indicator reading is half the total deflection measured. Master pinion must not be turned any more after this operation.

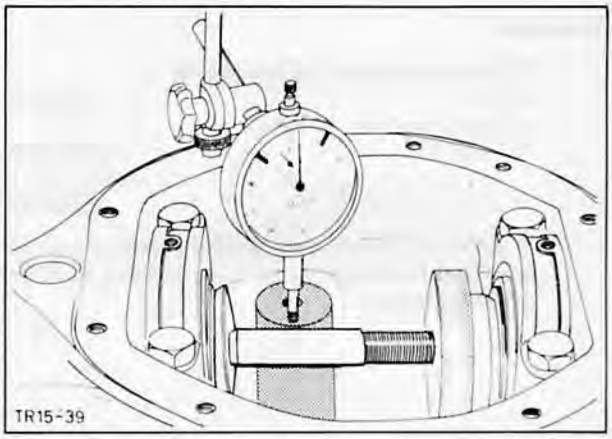


Fig. 37. Adjust master pinion

21. Remove dial indicator from holding fixture and mount in block. Locate mounting block with dial indicator on a ground surface and zero with the aid of the setting gauge as shown, Fig. 38.

NOTE: The rear axle code letters are engraved on the step gauge below the individual steps, e.g. 'A+E'. The dial indicator must be zeroed on 'G' step of the step gauge before measuring a 'G' rear axle.

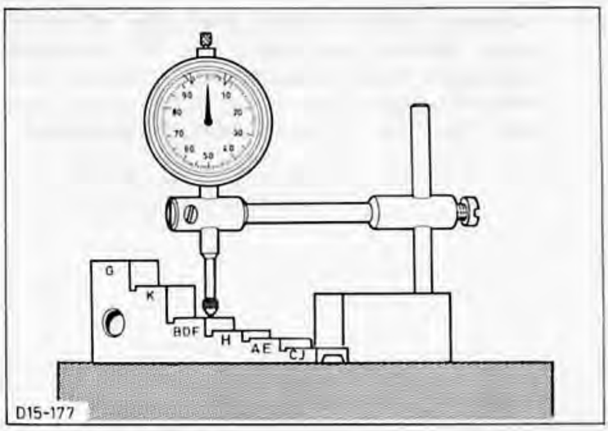


Fig. 38. Zero dial indicator

15 214 8 (cont'd)

'G' AXLE

22. Place mounting block with dial indicator on the middle of the end of the master pinion and move plunger of indicator slowly across the gauge bar. Observe dial indicator and stop at the precise point where the pointer changes direction. Repeat this measuring operation several times and ensure maximum precision, Figs. 39/40.

NOTE: If indicator pointer reads 95 for example, the shim under the master pinion is 0,05 mm too thick. If the pointer changes direction at 4 for instance, the shim is 0,04 mm too thin. (This assumes a dial indicator in which the pointer moves clockwise when the plunger is pressed in).

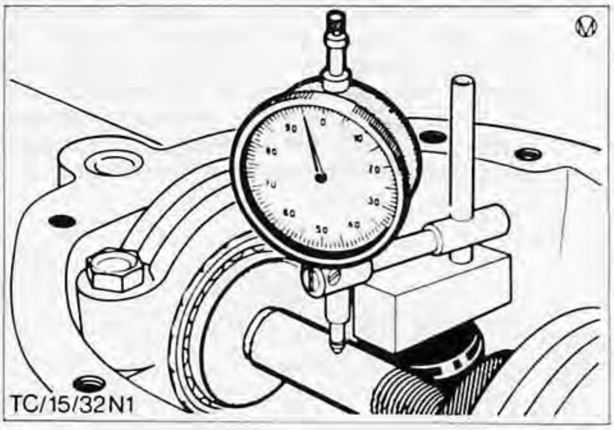


Fig. 39. Indicator reading 95 – shim under master pinion too thick

Example

Thickness of shim under master pinion	1,75 mm
Indicator pointer to left of 'O', e.g. 95	−0,05 mm
	1,70 mm

This is the thickness of shim that must be provided between taper roller bearing and top of drive pinion.

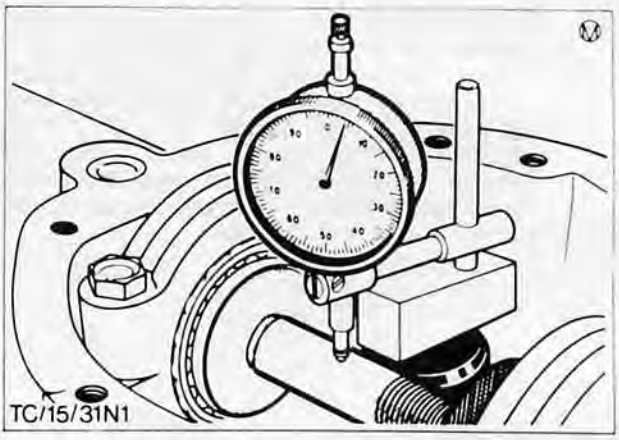


Fig. 40. Indicator reading 4 – shim under master pinion too thin

23. Remove master pinion and take off taper roller bearing and shim, Fig. 41. Establish new shim from measurement. Measure shim with micrometer to match value determined (see Parts Catalogue for shim part numbers).

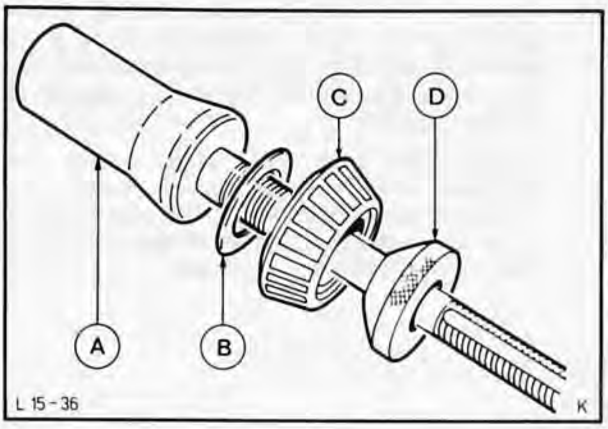


Fig. 41. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

24. Slip chosen shim onto master pinion and screw up conical nut.

25. Fit master pinion as specified in sub-operation 17.

26. Set up master pinion as indicated in sub-operation 20.

27. Re-check zero of dial indicator in mounting block with aid of setting gauge and place block on the end of the master pinion. If plunger of dial indicator is moved across the gauge bar as beforehand (in sub-operation 22), indicator must read 'O' if the preceding measurements were accurate, Fig. 42. Discrepancies of a maximum of 0,01 mm from 'O' are permissible.

    If however deviation from 'O' is more, the measuring operation must be repeated as described and a new shim must be found.

    Repeat checking operation.

28. Remove master pinion and gauge bar. Detach taper roller bearing and chosen shim from master pinion.

    NOTE: After removal, taper roller bearing and differential bearing cup must not be located on the other side.

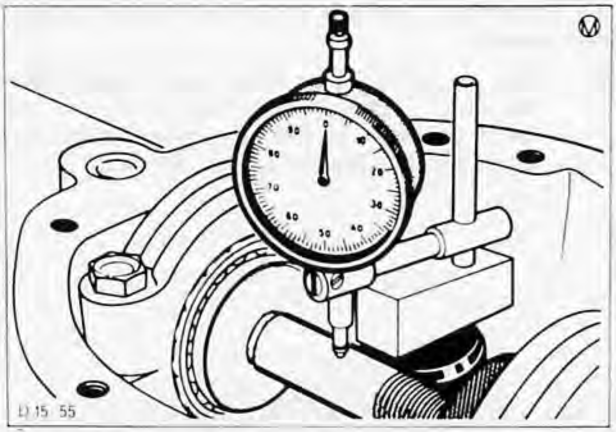


Fig. 42. Dial indicator at 'O' (max. discrepancy 0,01 mm)

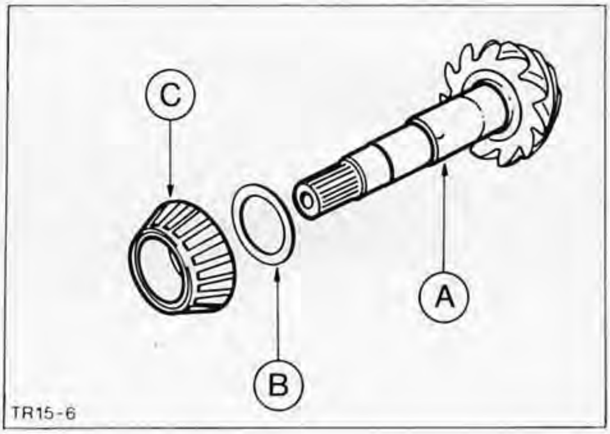


Fig. 43. Press taper roller bearing and chosen shim onto drive pinion
A – Drive pinion
B – Shim
C – Taper roller bearing

29. Press taper roller bearing and chosen shim onto drive pinion, Fig. 43.

30. Fit both differential housing taper roller bearings with Special Tool No., Fig. 44.

    NOTE: Fit first taper roller bearing to crown wheel rear side of differential housing.

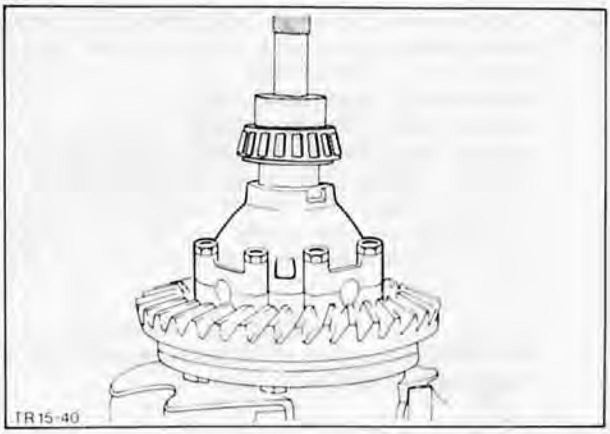


Fig. 44. Press on taper roller bearing with special tool no. 15–031

15 214 8 (cont'd)

To Determine Length of Drive Pinion Spacer and Install

31. Slip gauge ring over drive pinion. Bend 2 mm diameter soldering wire into a ring of the same diameter as the drive pinion shaft and place it on the Master spacer, Fig. 45.

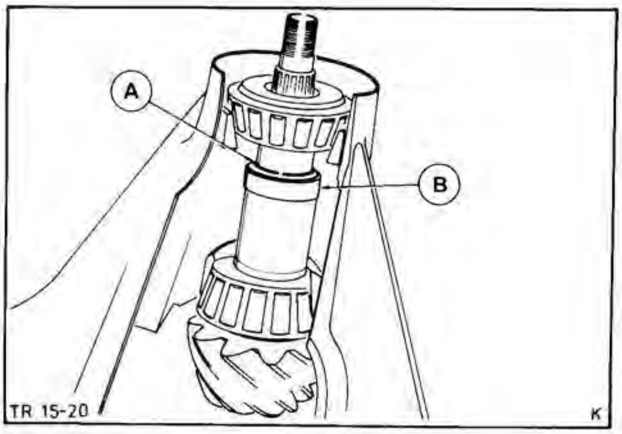


Fig. 45. Determine length of spacer
A – Ring of soldering wire
B – Master spacer 15–024

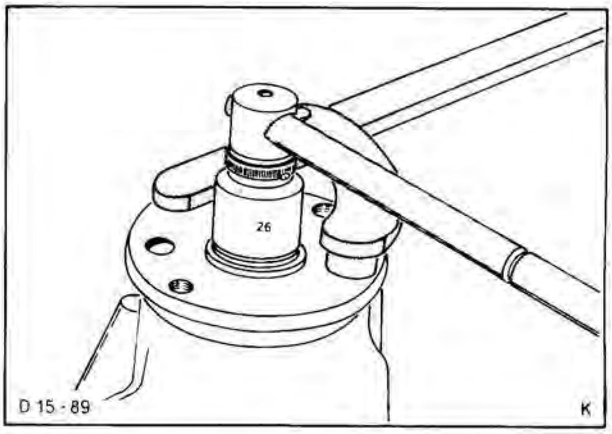


Fig. 46. Hold drive pinion flange and tighten nut slowly

32. Locate drive pinion in axle casing. Fit taper roller bearing and drive pinion flange. Screw on the old self-locking nut kept from the dismantling operation. Hold drive pinion flange with flange-holding wrench and tighten nut slowly, Fig. 46. Keep constant check on drive pinion running torque with pre-load gauge. Do up nut until same torque is reached as that noted at the start when adjusting the master pinion (e.g. 2,3 Nm), Fig. 47.

NOTE: If this torque is exceeded, the described operation must be repeated with a new piece of soldering wire.

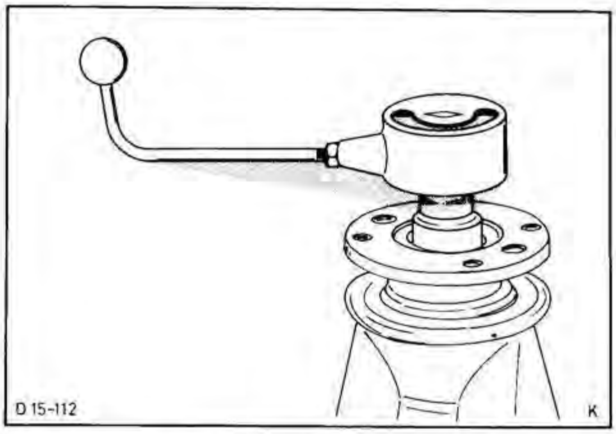


Fig. 47. Check turning torque of drive pinion

33. Remove drive pinion and carefully detach compressed soldering wire from pinion and measure its thickness at two opposing points, Fig. 48. If the values differ, add the two figures together and divide by two. Add this value (e.g. 1,21 mm) to the height of the gauge ring (9,5 mm) giving 9,5+1,21 = 10,71 mm in this example. Choose from the available spacers (see Parts Catalogue) a ring of this size.

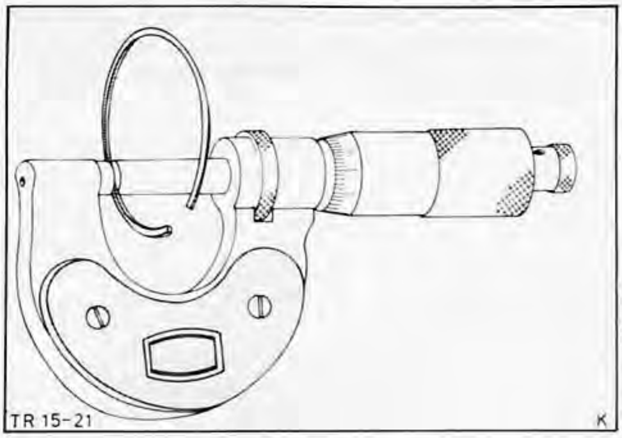


Fig. 48. Measure thickness of compressed soldering wire

34. **Check:** Drive pinion torque. To this end, assemble drive pinion with chosen spacer, taper roller bearing, drive pinion flange and old self-locking nut, Fig. 49. Tighten nut to specified torque.

Rotate drive pinion several times then check turning torque with pre-load gauge. (with this drive pinion 2,3 Nm (23 cmkp) for example). If this torque is exceeded or not reached, a narrower or wider spacer must be selected and the torque then checked again.

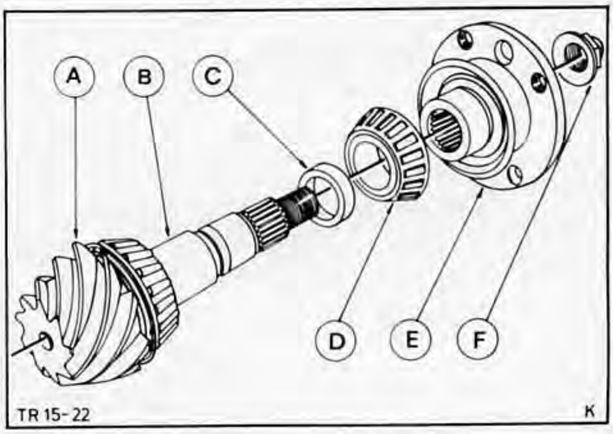


Fig. 49. Assemble complete drive pinion

A – Taper roller bearing
B – Pinion
C – Spacer
D – Taper roller bearing
E – Pinion flange
F – Pinion retaining nut

35. Detach drive pinion flange and fit new seal with Special Tool No. 15–047, Fig. 50. Grease on seal as supplied must not be removed.

36. Attach drive pinion flange and tighten new self-locking nut to specified torque.

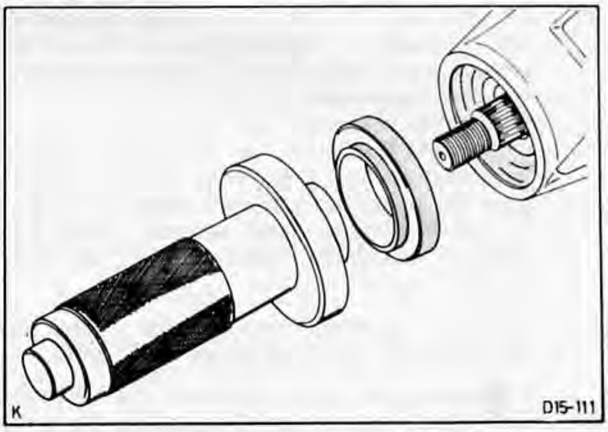


Fig. 50. Press on oil seal with special tool no. 15–047

15 214 8 (cont'd)

'G' AXLE

37. Fit shim in axle casing. Insert differential with both adjusting nuts. Fit bearing caps, secure, slacken and then do up finger-tight, Fig. 51.

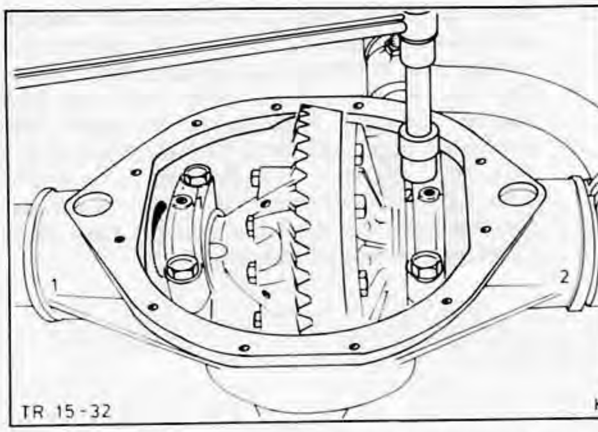


Fig. 51. Fit bearing caps (numbers match) and torque bolts as specified

NOTE: Adjusting nuts must bear on bearing cups.

38. Set backlash. To do this, locate plunger of dial indicator at right angles on one of the crown wheel teeth, Fig. 52. Tighten adjusting nuts on crown wheel side and slacken nut on differential housing side such that backlash value of 0,01 mm is attained. Tighten adjusting nut on differential housing side to give the specified backlash value of 0,12—0,22 mm. Rotate gear several times and recheck backlash measurement at three points.

Tighten bearing cap bolts. Backlash discrepancies must not exceed 0,01 mm.

If backlash has to be corrected, the adjusting nuts must only be turned evenly by the same amount so as to preserve the pre-load on the bearings.

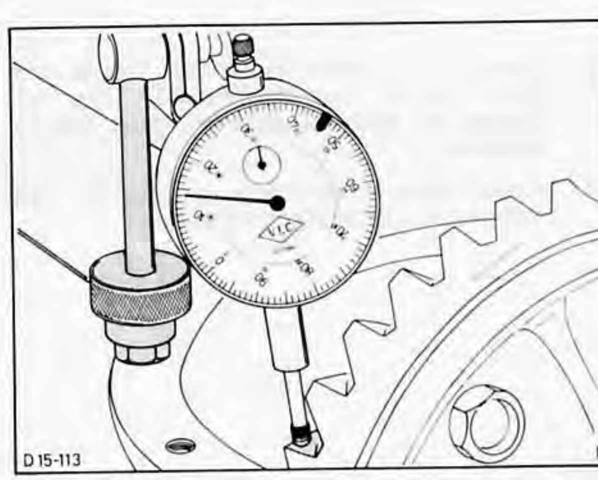


Fig. 52. Locate plunger of dial indicator at right angles on one of crown wheel teeth

39. Check tooth pattern: New crown wheels will still show optimum tooth pattern marks left by testing in the factory, Fig. 53.

Coat teeth of crown wheel with marker. Place wrench on nut of drive pinion flange and turn drive pinion until all the teeth have been in mesh. In the process, apply a hardwood wedge to the outer edge of the crown wheel to produce a braking effect, Fig. 54.

As backlash has great influence on tooth pattern, an unsatisfactory tooth pattern can only be rectified by increasing or reducing the backlash within the specified tolerances.

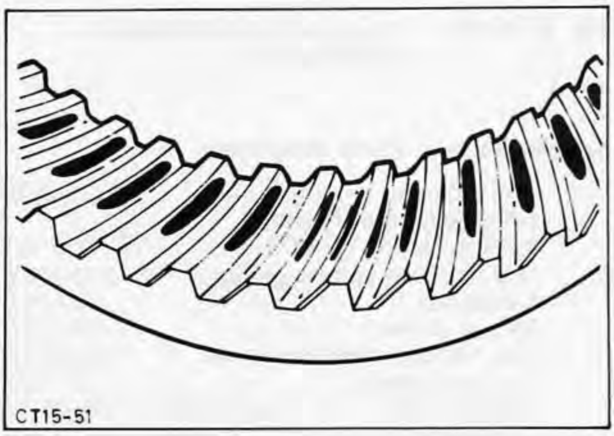


Fig. 53. Optimum tooth pattern

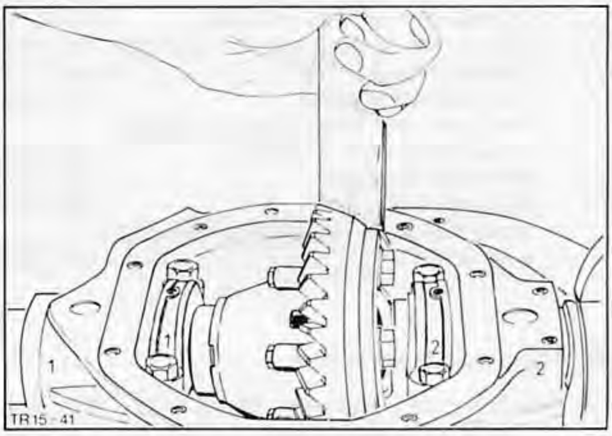


Fig. 54. Brake crown wheel with a hardwood wedge

40. Attach lock plates (2) to ring nuts, Fig. 55. Fit cover to rear axle casing and bolt securely.

NOTE: Coat bolts with sealing compound before insertion.

41. Detach rear axle from stand.

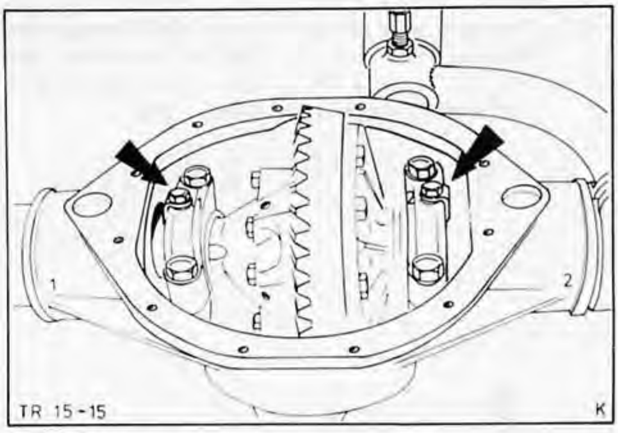


Fig. 55. Attach lock plates to ring nuts

15 214 8 REAR AXLE ASSEMBLY – OVERHAUL

Special Service Tools Required:

Dial indicator mounting block	15–008
Adaptor for dial indicator holding fixture 15–002–A	15–008–01
Dial Indicator setting gauge	15–008–03B
Gauge bar	15–019
Master pinion	15–020
Dial indicator holding fixture	15–022A
Pre-load sleeve	15–023
Differential bearing cone installer	15–025A
Differential bearing cone remover	15–026A
Rear hub nut wrench	15–029
Universal flange holding wrench	15–030
Axle casing bearing cup installer	15–033
Pre-load gauge	15–041
Pinion bearing installer	15–042
Metric dial indicator	15–046
Drive pinion oil seal installer	15–047B
Differential bearing adjusting spindle	15–049
Adaptors for 15–049	15–049–01
Drive pinion remover	15–054
Rear axle mounting bracket (only in conjunction with 21–023)	15–057
Rear hub remover	15–060
Axle die nut	15–061
Universal shaft—only in conjunction with stand	21–023

To Dismantle Rear Axle

1. Mount rear axle on stand, Fig. 56, and remove axle casing cover (10 bolts).
2. Pivot axle and drain oil.
3. Remove differential—to do this, detach both bearing caps (4 bolts) and lift differential out of axle casing with two pointed square section pieces of wood, Fig. 57.
4. Remove drive pinion (1 nut). Hold flange with Special Tool No. 15–030 and unscrew nut, Fig. 58. Tap out drive pinion downwards with a copper hammer and detach flange.

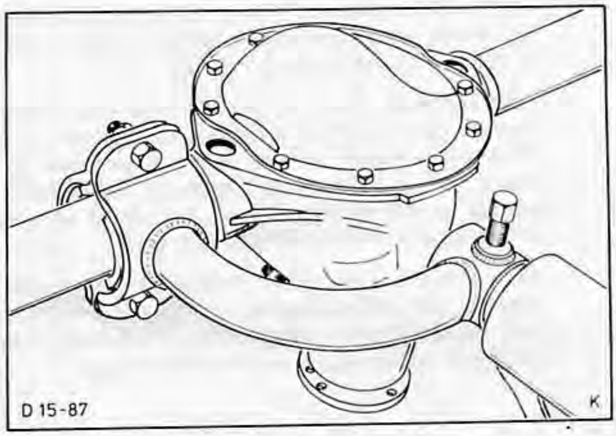


Fig. 56. Rear axle in mounting bracket 15–057 on stand

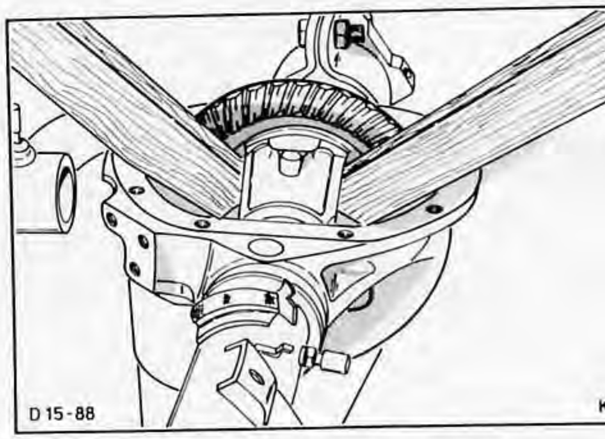


Fig. 57. Lift out differential with two hardwood wedges

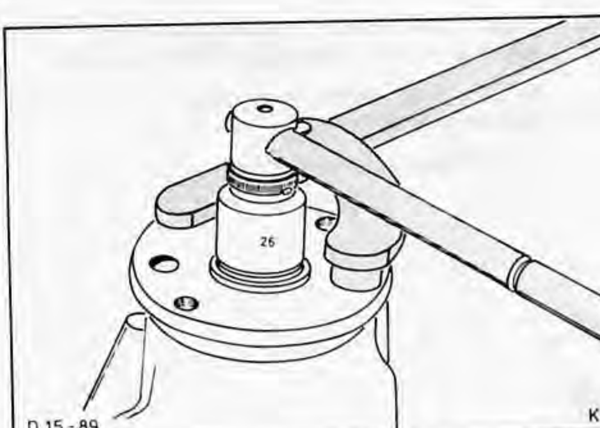


Fig. 58. Hold drive pinion flange with special tool no. 15–030

5. Press oil seal and outer taper roller bearing out of casing simultaneously with the Special Tool, Fig. 59.
6. Pull inner taper roller bearing from drive pinion with Special Tool.

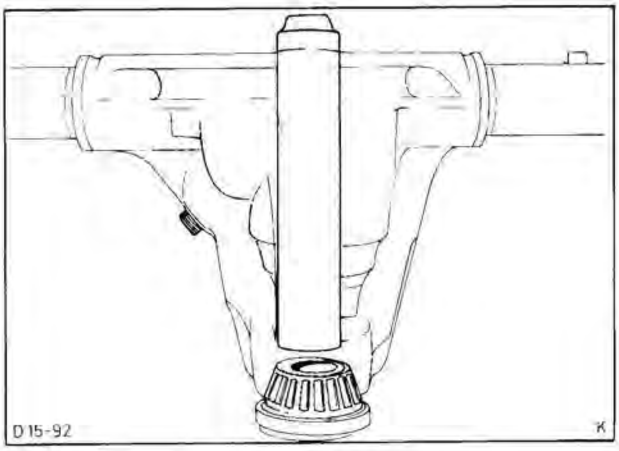


Fig. 59. Press out small taper roller bearing and oil seal

To Dismantle Differential Assembly

7. Remove taper roller bearings from both sides of differential housing with the Special Tool, Fig. 60. To do this, clamp Special Tool in vice by one leg and pull off bearings.

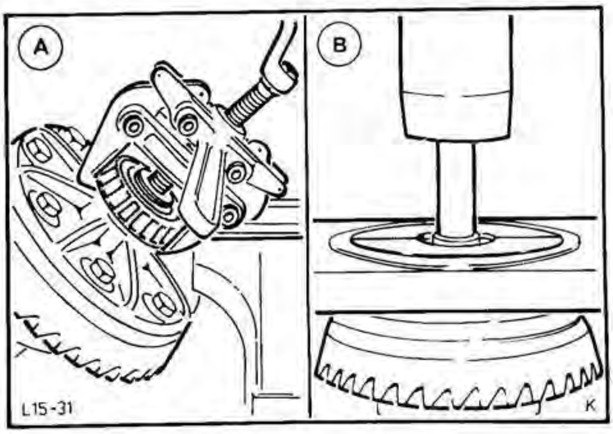


Fig. 60. Remove taper roller bearings from differential housing
A – Special Tool 15–026A
B – Alternative method using press

8. Detach crown wheel from differential housing (8 bolts), Fig. 61. To do this, slacken 3 bolts spaced around the periphery (remove the others completely) so that crown wheel can be removed by tapping bolt heads.

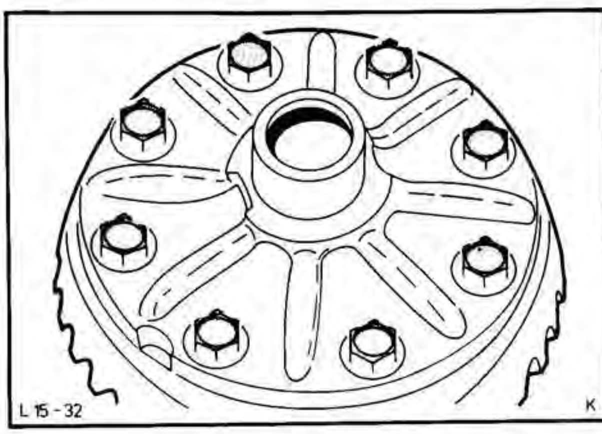


Fig. 61. Crown wheel mounting on differential housing

15 214 8 (cont'd)

9. Measure play between side gear bearing faces and differential housing using a feeler gauge, Fig. 62.

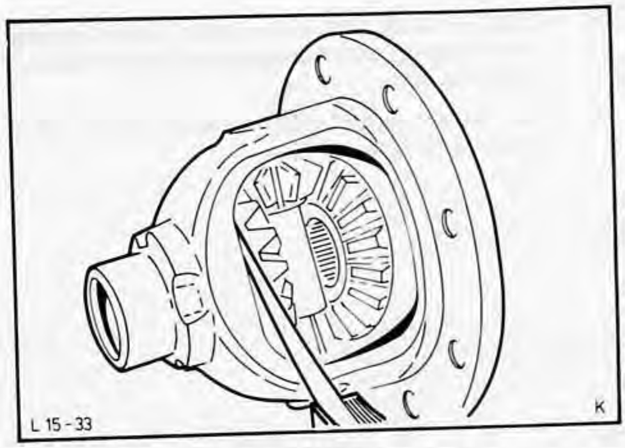


Fig. 62. Measure side gear play with feeler gauge

NOTE: Check play before removing differential gears. Play must not exceed 0,15 mm max.
If necessary, use new washers (see Parts Catalogue).

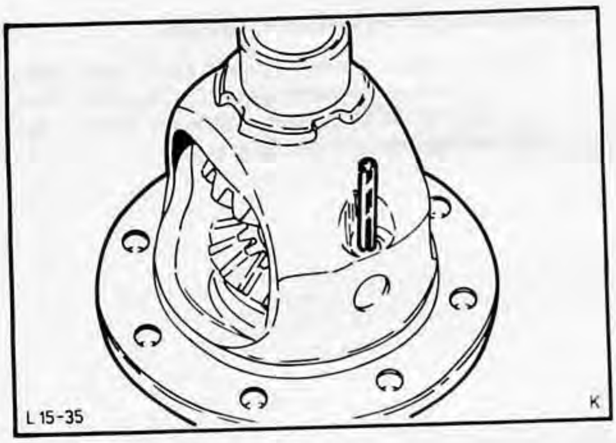


Fig. 63. Roll pin of differential shaft

10. Remove differential gears and side gears from differential housing, Fig. 64. With a suitable drift, force out roll pin securing differential shaft or cross in the differential housing, Fig. 63.

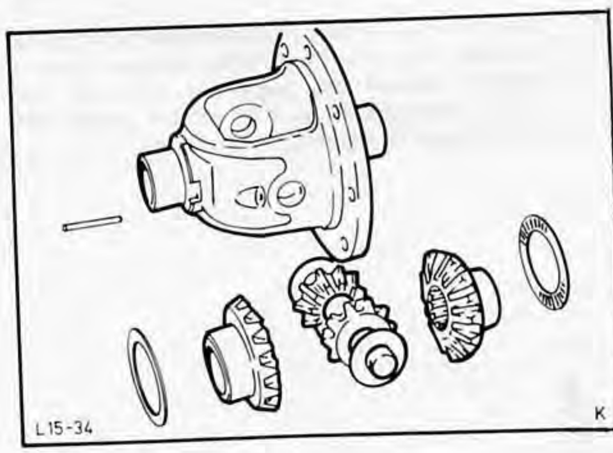


Fig. 64. Differential exploded

To Reassemble Differential

11. Install differential gears and side gears in differential housing. Insert side gears in the housing with the chosen shims. At the same time bring differential gears with thrust washers into mesh between side gears and slide in differential shaft or cross. Secure shaft with roll pin.

    NOTE: Grooved side of shims must face side gear, Fig. 65. When using new shims, re-check play as described in sub-operation 9.

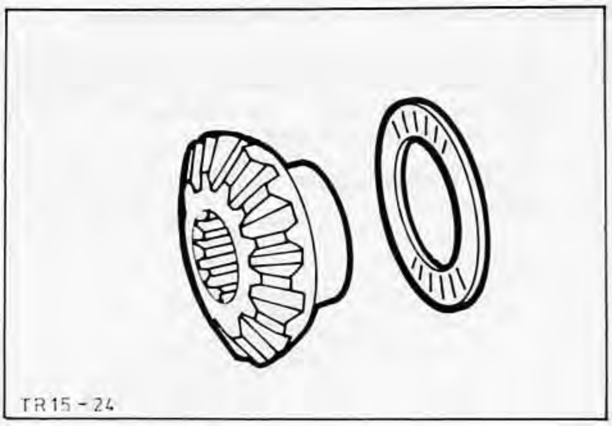


Fig. 65. Grooved side of shim must face side gear

12. Fit crown wheel (8 bolts) ensuring that crown wheel is bolted down evenly on differential housing, Fig. 66.

13. Remove and install outer cup of drive pinion taper roller bearing with Special Tool.

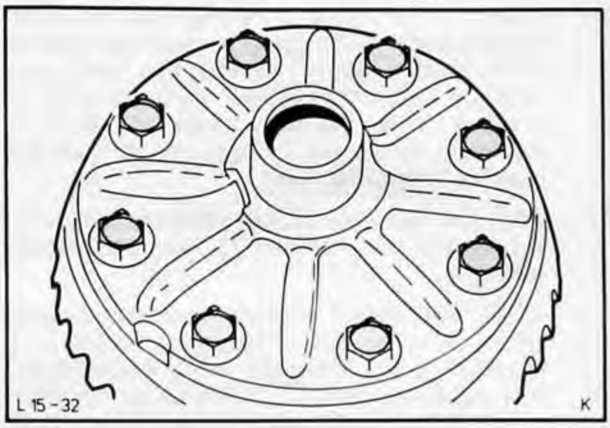


Fig. 66. Secure crown wheel evenly on differential housing

14. Remove and install inner cup of drive pinion taper roller bearing with Special Tool, Fig. 67.

    NOTE: Only replace one bearing cup at a time as one cup always serves to support the installing tool.

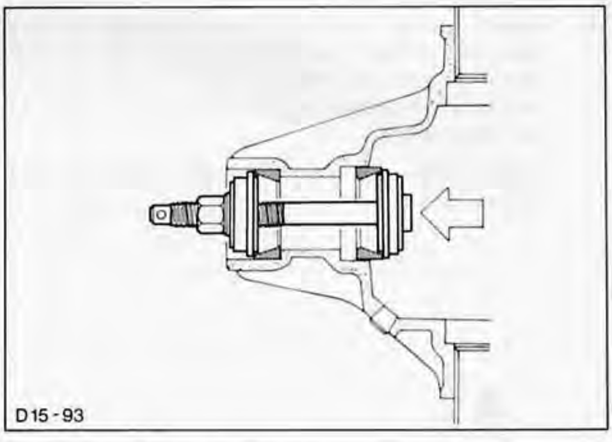


Fig. 67. Install outer bearing cup

15 214 8 (cont'd) 'F' AXLE

Establish Thickness of Drive Pinion Shim

15. Slide removed shim (or a new shim of any thickness) onto the master pinion together with the inner taper roller bearing and secure with the conical nut, Fig. 68.

    NOTE: Moisten taper roller bearing with rear axle oil.

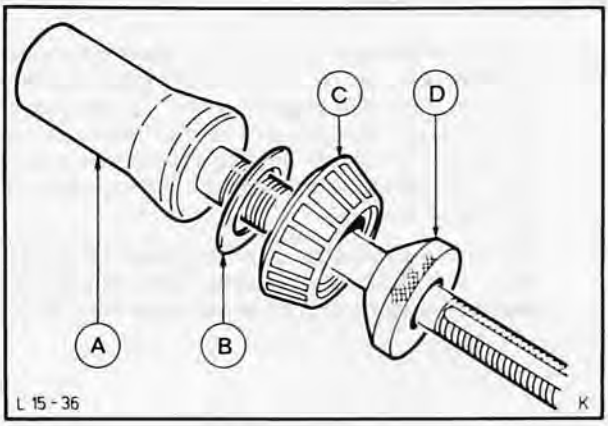


Fig. 68. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

16. Insert master pinion in casing, slide on outer bearing and handle, screw on pre-load sleeve. Hold master pinion handle still and turn hexagon of pre-load sleeve clockwise until, in the case of new bearings, the outer bell of the tool lines up on the C mark (use B mark for used bearings), Fig. 69.

17. With the pre-load gauge, measure and note the torque now needed to turn the master pinion.

    NOTE: This torque reading must be the same when the drive pinion has been installed. If the reading is 2,3 Nm (23 cmkp) for example, this must also be the reading once the drive pinion is fitted (+3 cmkp for the friction of oil seal).

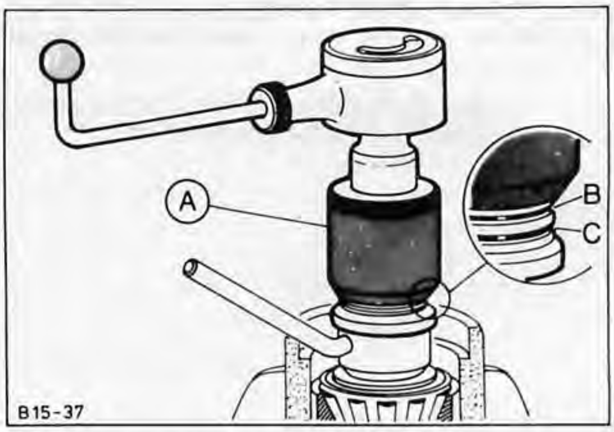


Fig. 69. Pre-load sleeve 15–023
A – Pre-load sleeve
B – Mark for used bearings
C – Mark for new bearings

18. Insert gauge bar with the bearings to be installed in rear axle casing, Fig. 70. Fit the bearing caps (numbers match) and secure to specified torque, slacken again and then do up finger-tight.

    NOTE: Moisten bearings with rear axle oil before fitting.

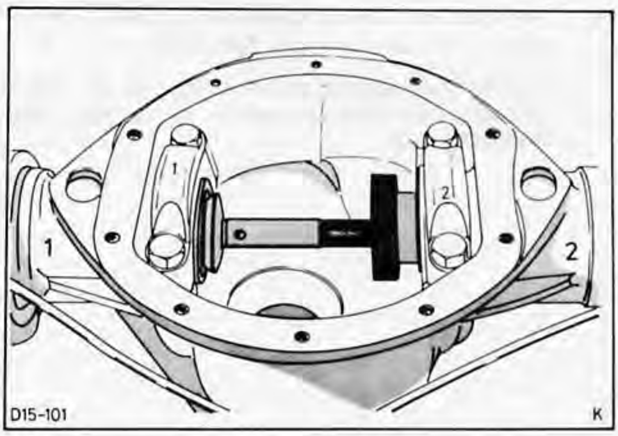


Fig. 70. Gauge bar located in rear axle casing

19. Hold gauge bar still with suitable mandrel, Fig. 71, and turn adjusting nut outwards until gauge bar can just be turned by hand by the adjusting nut (after removing mandrel). Turn gauge bar several times so that bearings seat correctly.

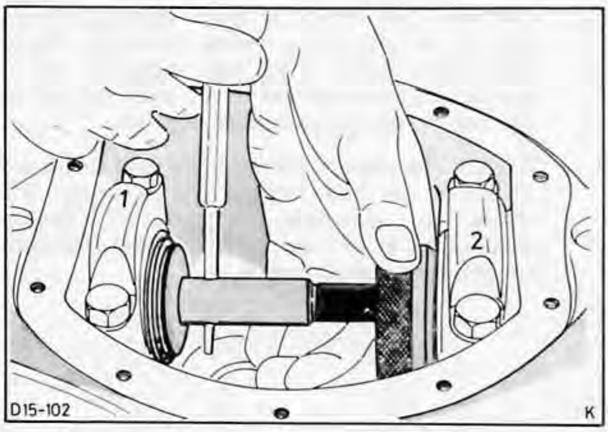


Fig. 71. Set up gauge bar special tool no. 15–019

20. Secure dial indicator 15–046 with holding fixture 15–008–01, to axle casing and position plunger of dial indicator on middle of gauge bar, Fig. 72. Turn bar slowly and observe total deflection of dial pointer. Then turn gauge bar until dial indicator reading is half the measured deflection. After this the gauge bar must not be moved.

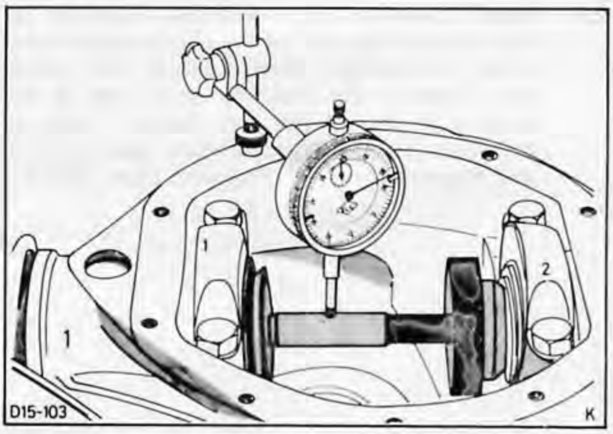


Fig. 72. Adjust gauge bar

21. Set up master pinion. To do this, position dial indicator on outer edge of end of master pinion close to the gauge bar, Fig. 73. Rotate gauge bar another full turn and note total deflection on indicator. Then continue turning master pinion until dial indicator reading is half the total deflection measured. After this, the master pinion must not be moved.

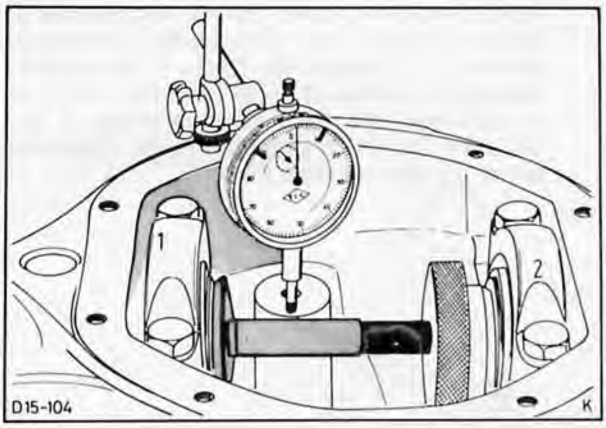


Fig. 73. Adjust master pinion special tool no. 15–020

15 214 8 (cont'd)

'F' AXLE

22. Remove dial indicator from holding fixture and fit in mounting block 15–008. Place mounting block with dial indicator on a ground surface and set to 'O' with the aid of the setting gauge as shown, Fig. 74.

NOTE: The code letters for the rear axles are engraved on the setting gauge under the steps in question, e.g. 'A+E'. Before measuring an 'F' rear axle the dial indicator must be zeroed on step F.

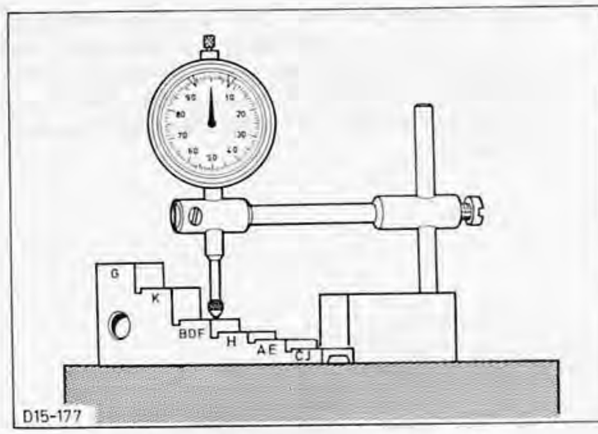


Fig. 74. Zero the dial indicator using setting gauge 15–008–03B

23. Place mounting block with dial indicator on the centre of the end of the master pinion and move the plunger slowly across the gauge bar. Observe dial indicator and stop at the precise point where the pointer changes direction. Repeat this operation several times and ensure maximum precision, Figs. 75/76.

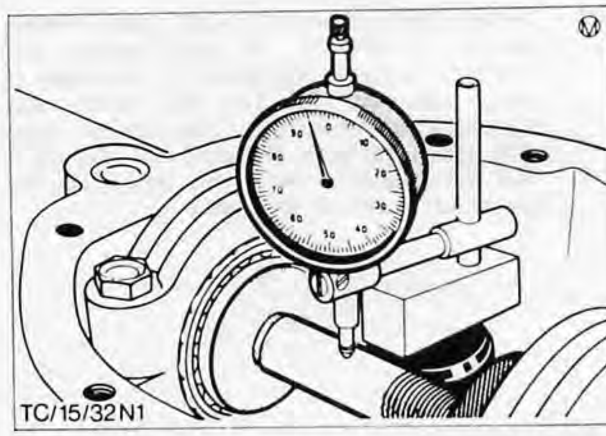


Fig. 75. Dial indicator reading 95 – shim under master pinion too thick

NOTE: If dial indicator pointer now stands at 95 for example, the shim under the master pinion is 0,05 mm too thick. If the pointer changes direction at 4 for example, the shim is 0,04 mm too thin. (This assumes a dial indicator in which pointer moves clockwise when plunger is pressed in).

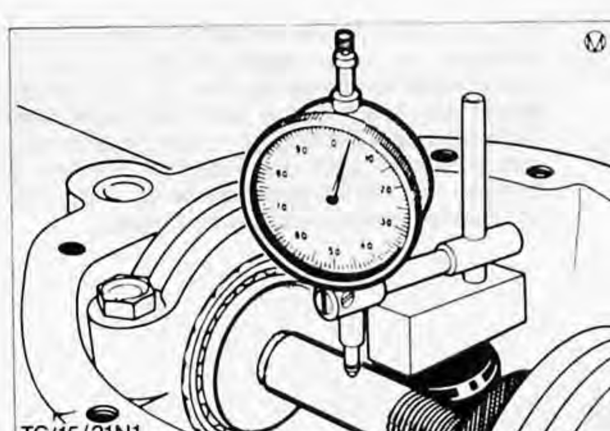


Fig. 76. Dial indicator reading 4 – shim too thin

Example

Thickness of shim under master pinion:	1,25 mm
Dial indicator reading to left of 'O' e.g. 95:	–0,05 mm
	1,20 mm

This value is thickness of shim needed between taper roller bearing and top of drive pinion.

24. Remove master pinion and detach taper roller bearing with shim, Fig. 77. Identify new shim from measurement. With a micrometer check shim corresponding to measured value (see Parts Catalogue for part numbers of shims).

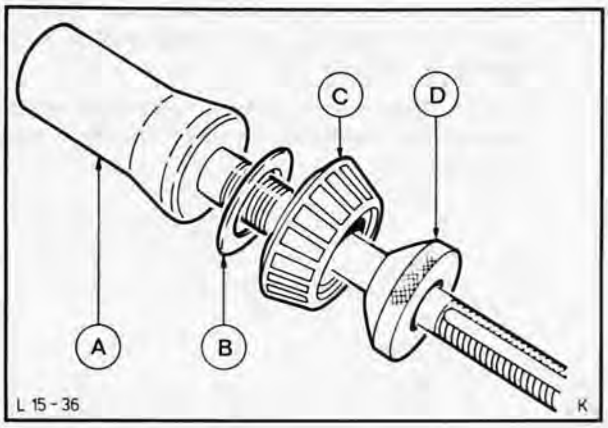


Fig. 77. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

25. Slide chosen shim onto master pinion and screw up conical nut.
26. Fit master pinion as indicated in sub-operation 16.
27. Set up master pinion as indicated in sub-operation 21.

28. Re-check zero setting of dial indicator in dial indicator mounting block using setting gauge and place mounting block on the end of the master pinion. If dial indicator plunger is now moved across gauge bar as before (sub-operation 23), indicator reading must be 'O' if previous measurements were accurate. Discrepancies of up to 0,01 mm from 'O' are permissible, Fig. 78.

But if deviations from 'O' are more, measurement must be repeated as described and a new shim chosen. **Repeat check operation.**

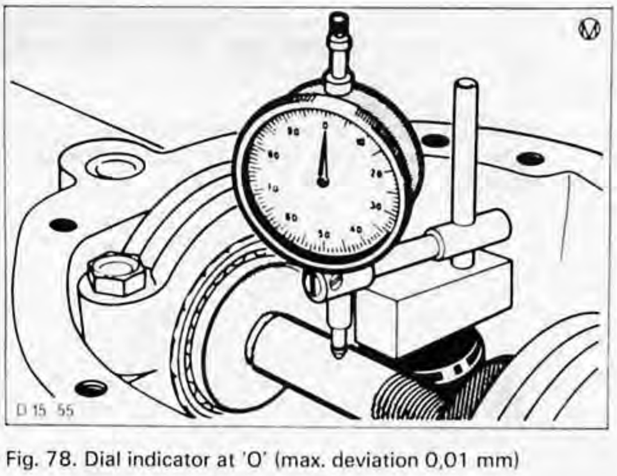


Fig. 78. Dial indicator at 'O' (max. deviation 0,01 mm)

15 214 8 (cont'd)

'F' AXLE

29. Remove master pinion and gauge bar. Detach taper roller bearing and chosen shim from master pinion, Fig. 79.

NOTE: Taper roller bearing and differential bearing cup must not be used for other side after removal.

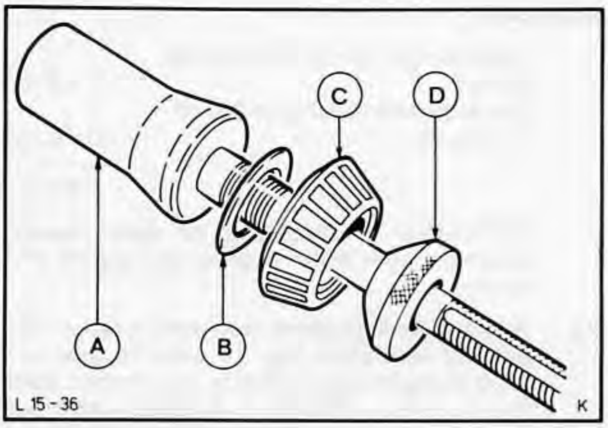


Fig. 79. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

30. Press taper roller bearing and chosen shim onto drive pinion.

31. Press on both differential housing taper roller bearings with Special Tool, No. 15–031 Fig. 80.

NOTE: First fit a taper roller bearing on the crown wheel rear side of the differential housing.

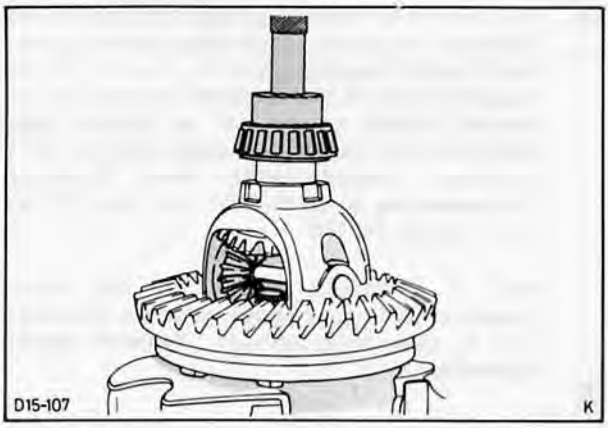


Fig. 80. Fit taper roller bearing with special tool no. 15–031

Establish Thickness (Total Thickness) of Differential Housing Shims

32. Insert thrust buttons in axle tube, Fig. 81, and insert differential assembly with bearing cups. Fit bearing caps (numbers match) and tighten bolts. Turn differential train several times and re-check value at spindle with torque wrench—5 Nm (0,5 mkp). Secure dial indicator to axle casing so that plunger bears on crown wheel boss.

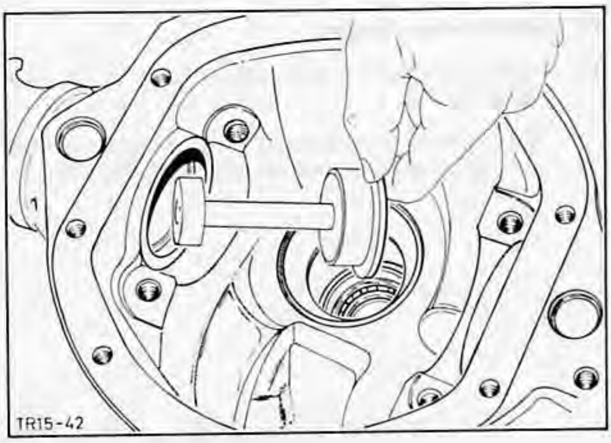


Fig. 81. Insert thrust buttons

33. Then insert spindle in the other axle tube and tighten to a torque of 5 Nm (0,5 mkp) again, Fig. 82.

NOTE: Do not turn differential train any more.

Depending on the side from which pressure is exerted, dial indicator needle will move clockwise or anti-clockwise and must therefore be watched carefully during measuring. Read off value shown by dial indicator and note down as this is total play of differential housing in axle casing (e.g. 1,35 mm), Fig. 83.

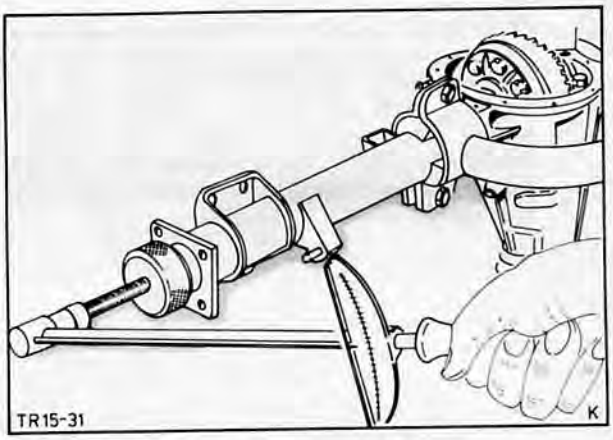


Fig. 82. Insert spindle 15–021 and tighten

34. Release spindle. Swing dial indicator to one side. Remove differential assembly, spindle and thrust buttons.

NOTE: From now on, taper roller bearings and differential bearing cups must not be interchanged.

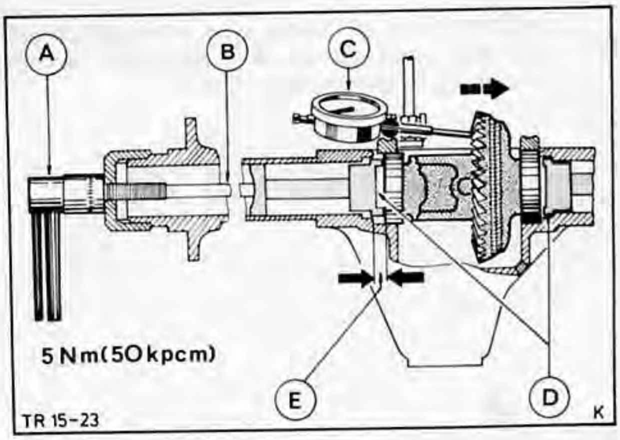


Fig. 83. A – Torque wrench
B – Spindle 15–021
C – Dial indicator
D – Thrust buttons
E – Total play of differential housing

15 214 8 (cont'd)

'F' AXLE

To Install Drive Pinion

35. Insert outside taper roller bearing in axle casing.
36. Fit oil seal with Special Tool. Grease in seal as supplied must not be removed, Fig. 84.

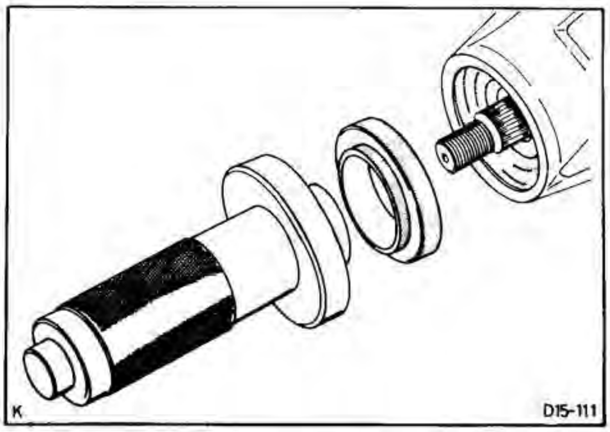


Fig. 84. Fit oil seal with special tool 15–047A

37. Fit drive pinion with new clamping sleeve, fit on drive pinion flange and attach new nut, Fig. 85. Hold flange with Special Tool No. 15–030 and tighten nut, taking repeated torque measurements, until value found previously (+0,3 Nm (3 cmkp) for oil seal friction) is reached. (Measure torque with pre-load gauge 15–041, Fig. 86).

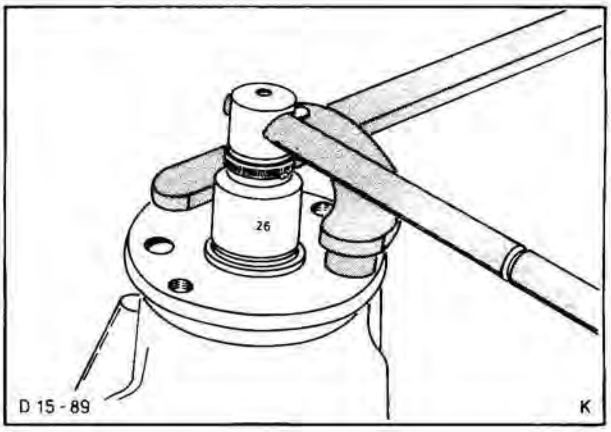


Fig. 85. Hold drive pinion flange and tighten nut slowly

NOTE: If nut of drive pinion is tightened too far and required torque is exceeded, a new clamping sleeve must be fitted.

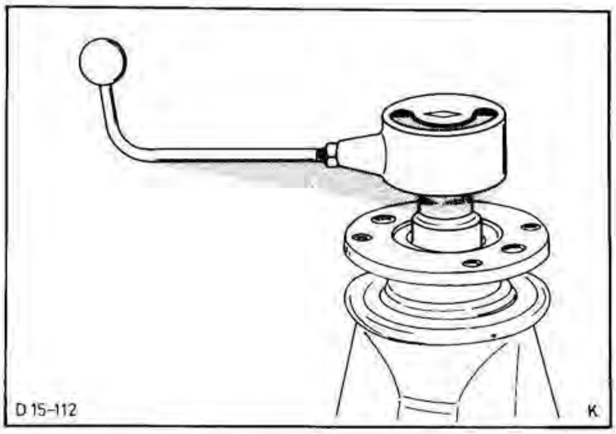


Fig. 86. Check running torque of drive pinion using pre-load gauge 15–041

To Establish Drive Pinion/Crown Wheel Backlash

38. Slip both thrust buttons back into the axle tubes, Fig. 87. Place differential assembly with bearing cups in axle casing. Fit bearing caps. Tighten bolts and slacken them again, do them up very lightly with the wrench.

39. With spindle, press differential housing away from drive pinion as far as stop with torque of 5 Nm (0,5 mkp). Turn drive pinion several times. Check again that torque is 5 Nm (0,5 mkp).

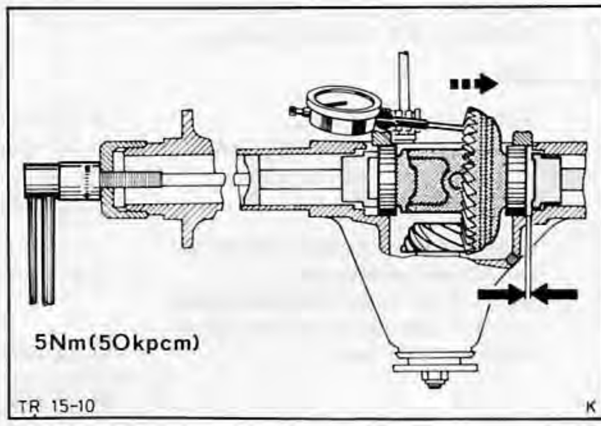


Fig. 87. Press differential housing away from drive pinion with spindle. Read value on dial indicator.

40. Place dial indicator plunger at right angles on one of the crown wheel teeth, Fig. 88. Measure backlash at four points (turning crown wheel on in increments of two bolt-heads). Discrepancies in backlash must not exceed 0,05 mm. Introduce spindle in the other axle tube and screw in slowly until backlash of 0,01 mm is measured.

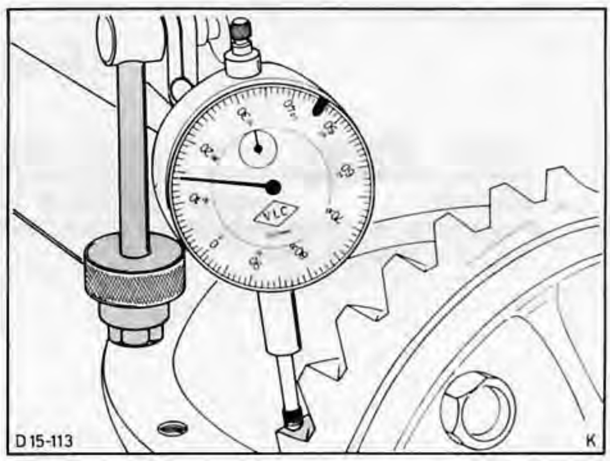


Fig. 88. Place dial indicator plunger at right angles on one of crown wheel teeth

41. Now position dial indicator with plunger inside on crown wheel boss, Fig. 89. Set scale to 'O'. Then fit spindle in the other axle tube and screw in with tightening torque of 5 Nm (0,5 mkp). Read off and note value shown on dial indicator (e.g. 0,64 mm).

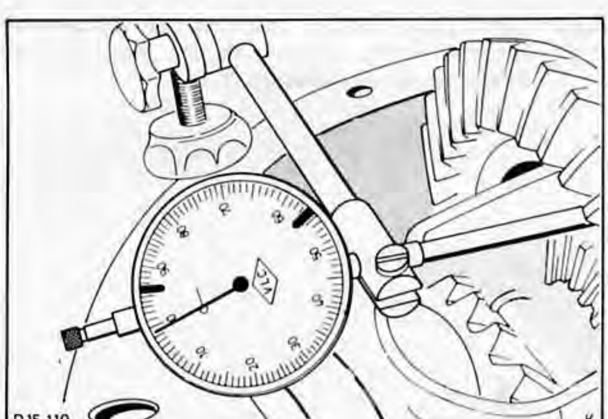


Fig. 89. Place dial indicator plunger on inner crown wheel boss

15 214 8 (cont'd)

Remove spindle, differential and thrust buttons from the axle casing.

Example

Total play measured:	1,35 mm
Mean pre-load (always in addition):	+0,05 mm
	1,40 mm
Measured thickness of shim on crown wheel rear side:	0,64 mm
Deduct value for backlash (this value is constant and has been confirmed by tests):	–0,12 mm
	0,52 mm
Shim thickness on crown wheel side Rest of shims are located on this side of the differential.	
Total play:	1,40 mm
Deduct shim thickness on crown wheel rear side:	–0,52 mm
	0,88 mm

42. Remove differential housing taper roller bearing, Fig. 90. Place removal tool on one of differential housing bearings and clamp in vice by one leg. Remove both bearings in this way, one after the other.

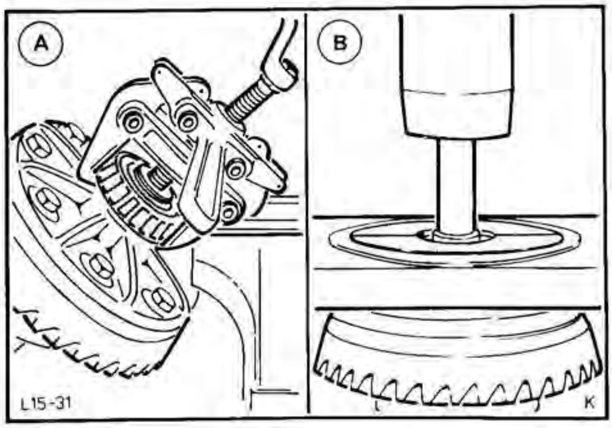


Fig. 90. Remove differential housing taper roller bearing using special tool 15–026A
A – Special Tool 15–026A
B – Alternative method using press

43. Refit taper roller bearings to differential housing with chosen shims, Fig. 91, as described in sub-operation 31.

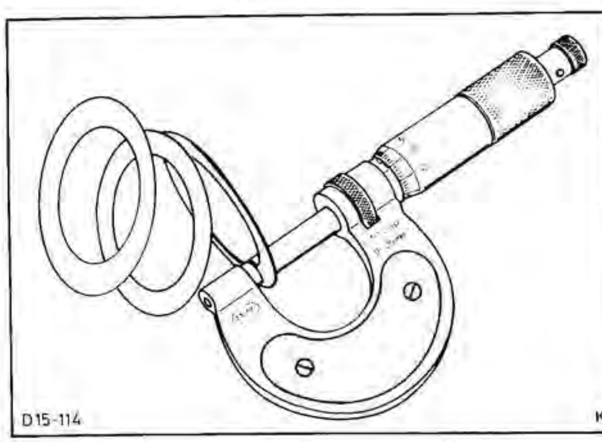


Fig. 91. Choose correct shims

To Install Differential Assembly

44. Press differential assembly into rear axle. Fit bearing caps (numbers match), Fig. 92. Coat bolts with sealing compound when inserting.

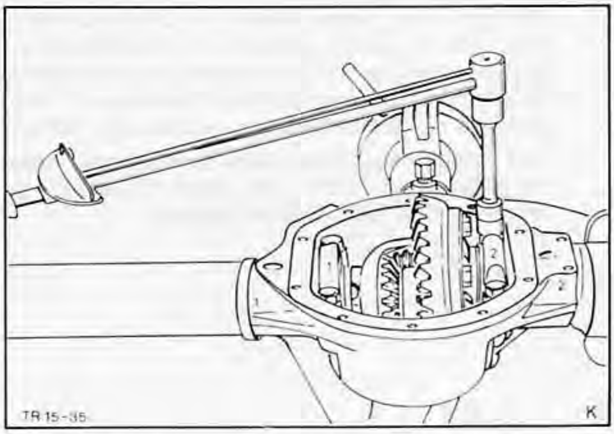


Fig. 92. Fit bearing caps (numbered) and torque bolts as specified

45. Measure backlash. If backlash is not between 0,1 and 0,2 mm, differential assembly must be removed again, Fig. 93.

    NOTE: 0,12 mm to 0,22 mm for 'F' axle.

    If backlash is too much, shims must be removed on crown wheel side (long side) and placed under the other taper roller bearing. Proceed other way round if backlash is too small. Do not take away or add any shims in the process. Only interchange from one side to the other.

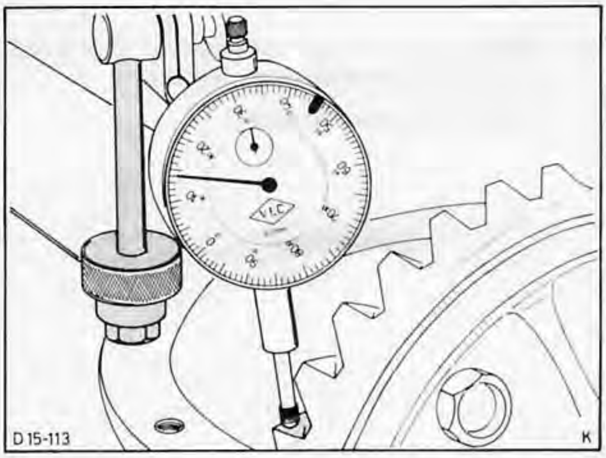


Fig. 93. Position dial indicator plunger at right angles on one of crown wheel teeth

46. Check tooth pattern: New crown wheels will still show optimum tooth pattern markings produced by testing in the factory.

    Coat crown wheel teeth with marker. Fit wrench on drive pinion nut and turn until all crown wheel teeth have been in mesh, braking crown wheel with wooden wedge, Fig. 94.

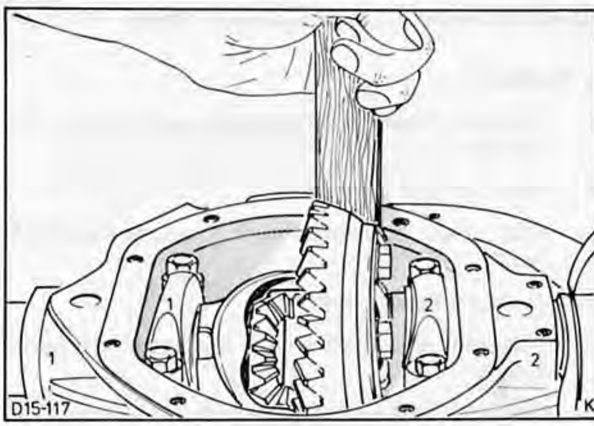


Fig. 94. Brake crown wheel with hard wooden wedge

15 214 8 (cont'd) — 'F' AXLE

Backlash has great effect on tooth pattern, Fig. 95. If tooth pattern is unsatisfactory, rectification can only be made by increasing or reducing backlash within tolerances. In the process do not take away or add any shims, but interchange them from one or other side of differential. 0,01 mm shim thickness is equivalent to 0,01 mm of backlash.

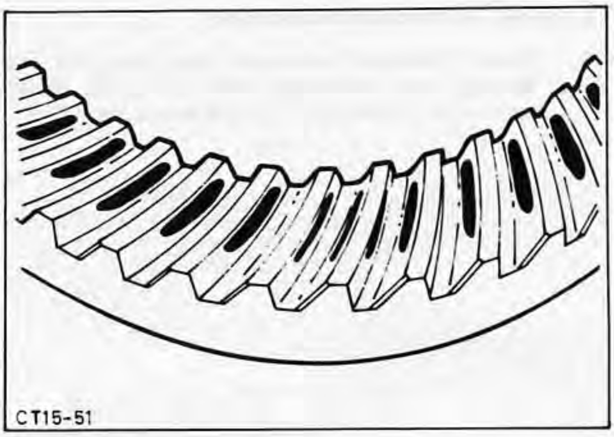


Fig. 95. Optimum tooth pattern

47. Attach cover to rear axle casing. Coat bolts with sealing compound on insertion.
48. Detach rear axle from stand.

15 254 DIFFERENTIAL ASSEMBLY – REMOVE AND INSTALL — 'H' AXLE

Special Service Tools Required: None

To Remove

1. Slacken wheel nuts and jack up vehicle. Fit stands.
2. Remove rear wheels.
3. Disconnect driveshaft from rear axle flange (4 bolts).
4. Detach brake drums.
5. Remove axle half-shafts (5 bolts on each side).
6. Remove differential assembly from rear axle (8 bolts), Fig. 96.

   NOTE: Catch oil spills.

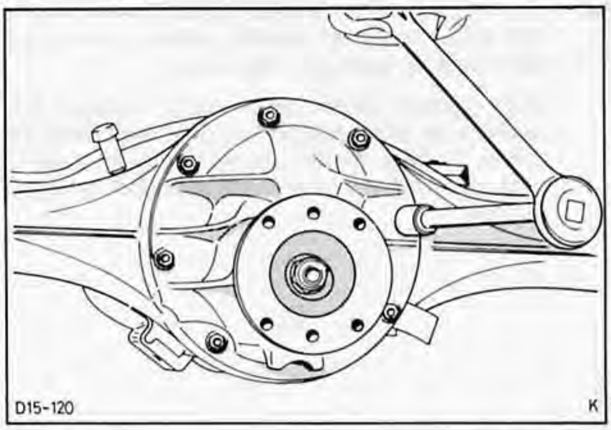


Fig. 96. Attachment of differential and axle casing

15 254 (cont'd)

'H' AXLE

To Install

7. Fit differential assembly in rear axle, Fig. 97.
8. Insert half-shafts and secure.
9. Attach brake drums.
10. Connect driveshaft to rear axle flange.
11. Refit wheels and lower vehicle to ground.
12. Tighten wheel nuts.
13. Fill rear axle with oil.

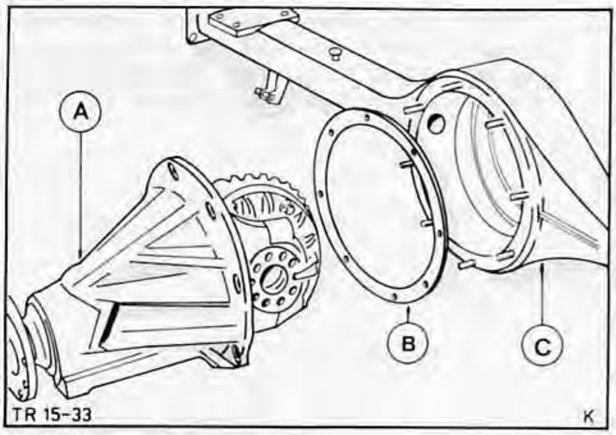


Fig. 97. A – Differential assembly
B – Gasket
C – Axle casing

15 254 8 DIFFERENTIAL ASSEMBLY – OVERHAUL ('H' Axle)

Special Service Tools Required:

Dial indicator mounting block	15–008
Setting gauge	15–008–03B
Gauge bar	15–019
Master pinion	15–020
Dial indicator holding fixture	15–022A
Pre-load sleeve	15–023
Differential bearing remover	15–026A
Universal flange holding wrench	15–030
Pinion bearing cup installer	15–033
Pre-load gauge	15–041
Drive pinion bearing installer	15–042
Dial indicator	15–046
Drive pinion oil seal installer	15–047B
Drive pinion bearing remover	15–054
Rear axle mounting bracket	16–009

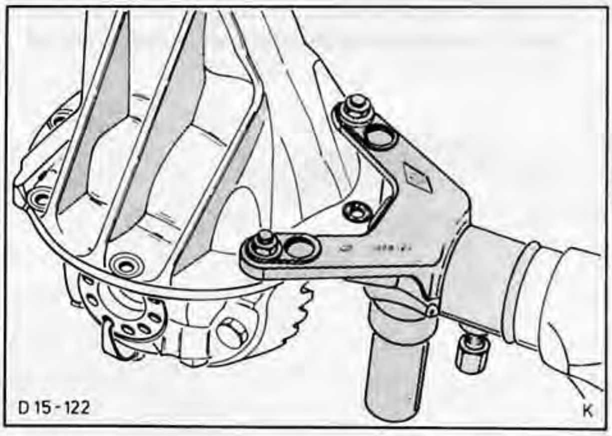


Fig. 98. Differential assembly in mounting bracket 16–009 on stand

To Remove Drive Pinion and Differential Train

1. Mount differential assembly on stand, Fig. 98.
2. Detach locking elements from ring nuts (2 bolts).
3. Remove differential gear train. To do this, detach differential bearing caps (4 bolts) and take gear train and adjusting nuts out of the housing.

   NOTE: Mark right and left sides of bearing caps and differential housing, Fig. 99.

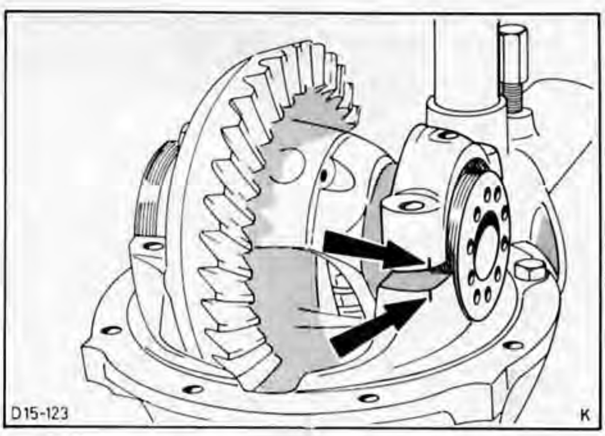


Fig. 99. Mark bearing caps and unbolt

15 254 8 (cont'd)

4. Remove drive pinion (1 nut). Hold flange with Special Tool No. 15–030, Fig. 100, unscrew nut and tap out drive pinion downwards with a soft faced hammer. Detach flange, Fig. 101.

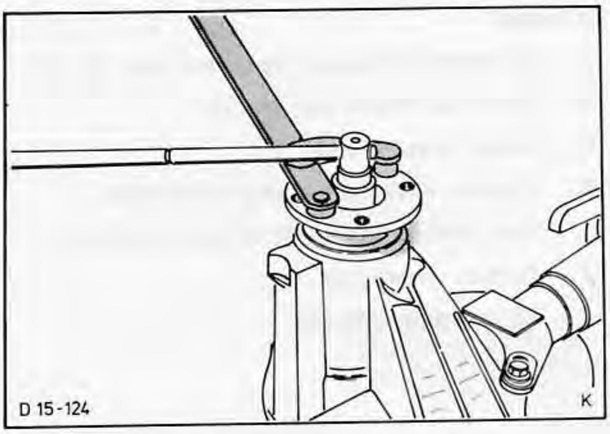


Fig. 100. Hold drive pinion flange and unscrew nut

5. Press oil seal and outer taper roller bearing out of housing simultaneously using Special Tool 15–042.

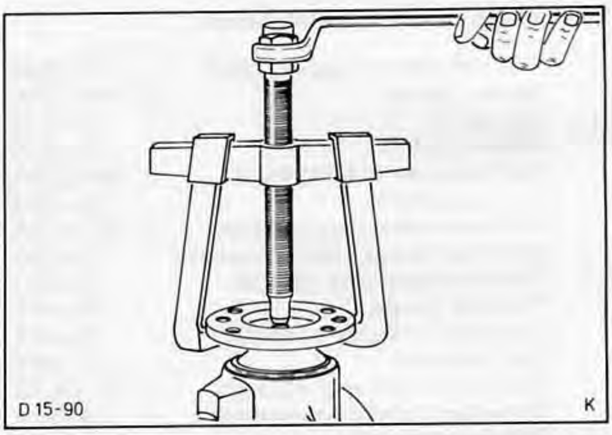


Fig. 101. Remove drive pinion flange with standard remover

6. Detach inner taper roller bearing from drive pinion with Special Tool, Fig. 102.

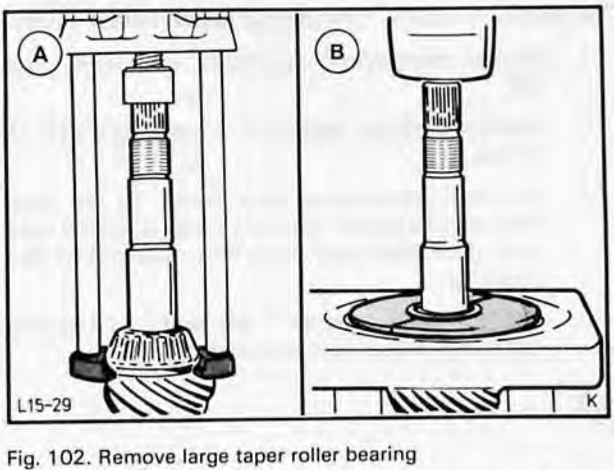


Fig. 102. Remove large taper roller bearing
A – Tool 15–054
B – Base plate 15–059 with adaptor 15–059–01

To Dismantle Differential Gear Train

7. Detach differential taper roller bearing from differential housing (both sides). Clamp Special Tool in a vice by one leg and pull off bearing, Fig. 103.

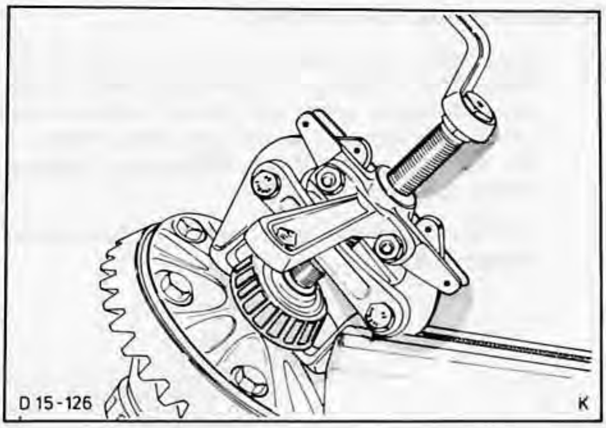


Fig. 103. Detach taper roller bearing from differential housing

8. Detach crown wheel from differential housing (8 bolts), Fig. 104, by slackening 3 bolts spaced out on the periphery (remove rest completely) so that crown wheel can be removed by tapping the bolt heads.

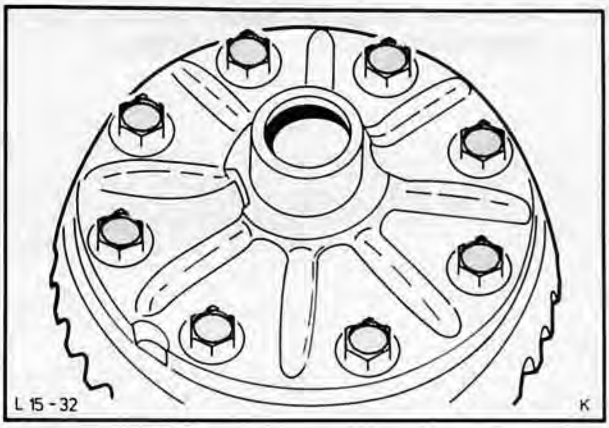


Fig. 104. Detach crown wheel from differential housing

9. Remove differential gears and side gears from differential housing, Fig. 105. Separate halves of housing with a copper mandrel, lift out the differential gears with differential cross or shaft and side gears. Remove shims.

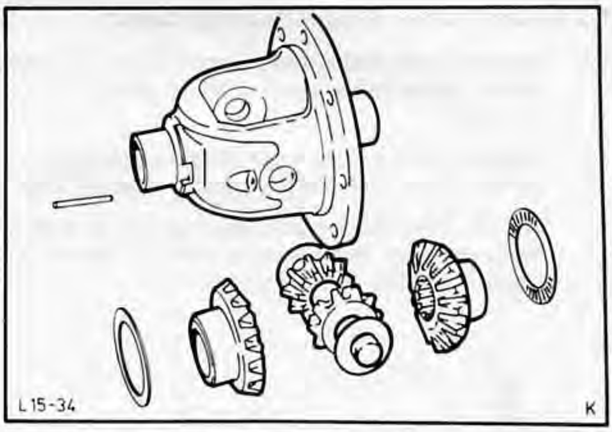


Fig. 105. Differential gear train exploded

15 254 8 (cont'd)

'H' AXLE

To Reassemble Differential

10. Install differential gears and side gears in the differential housing. Fit side gears with shims and differential gears with thrust washers and differential cross or shaft in housing halves in the reverse order. Bring differential housing halves together, Fig. 106.

    NOTE: Use new bolts. Heat crown wheel before fitting it.

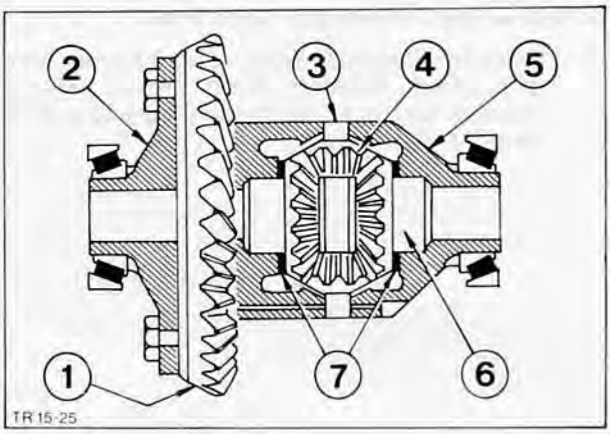


Fig. 106. Differential gear train
1 – Crown wheel
2 – Housing half
3 – Differential shaft
4 – Differential gear
5 – Housing half
6 – Side gear
7 – Shims

11. Fit crown wheel (8 bolts), securing crown wheel evenly on differential housing.

To Replace Drive Pinion Bearing Cups

12. Remove and install outer bearing cup of drive pinion taper roller bearing using Special Tool, Fig. 107.
13. Remove and install inner bearing cup of drive pinion taper roller bearing using Special Tool.

    NOTE: Only change one bearing cup at a time because one bearing cup always serves as support for the installing tool.

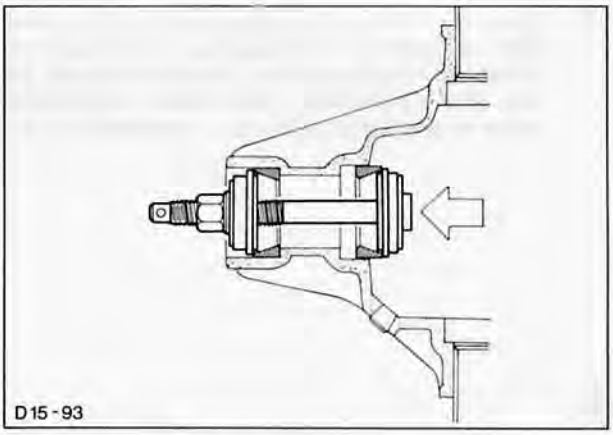


Fig. 107. Install outer bearing cup

To Establish Thickness of Shim for Drive Pinion

14. Slide shim that has been removed or a new shim of any thickness together with the inner taper roller bearing onto the master pinion, Fig. 108.

    NOTE: Moisten taper roller bearing with rear axle oil and secure with conical nut.

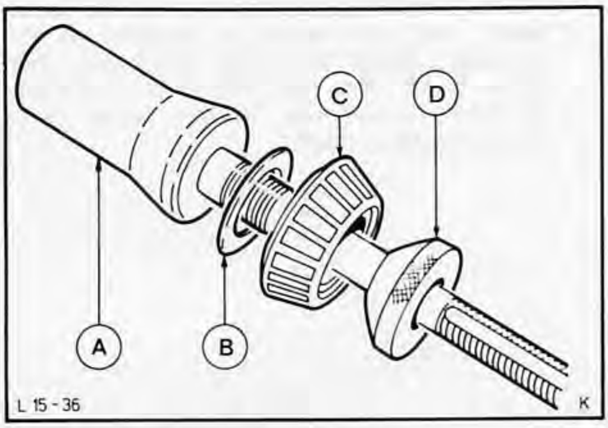


Fig. 108. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

15. Insert master pinion in axle casing, slide on outer bearing and handle, screw on pre-load sleeve. Hold handle of master pinion still and turn hexagon of pre-load sleeve clockwise until, with new bearings, the outer bell of the tool lines up on the 'C' mark (use 'B' mark for used bearings).

    Turn master pinion several times so that the bearings settle.

16. Measure torque now needed for rotation with pre-load gauge and note value, Fig. 109.

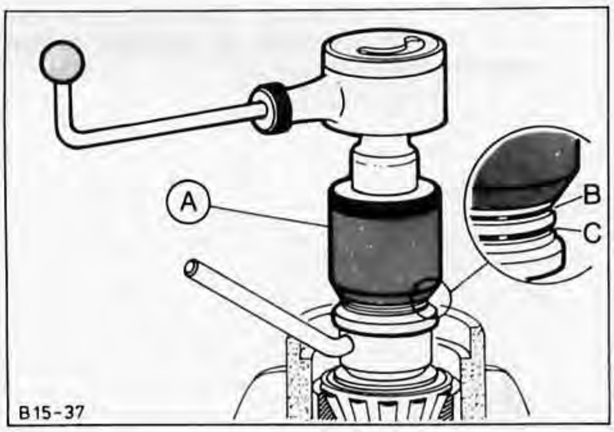


Fig. 109. Pre-load sleeve 15–023 and pre-load gauge 15–041
A – Pre-load sleeve
B – Mark for used bearings
C – Mark for new bearings

NOTE: This torque reading must be the same when the drive pinion is installed. If for instance reading is 2,3 Nm (23 cmkp), this value must also be repeated (+0,3 Nm (3 cmkp) for oil seal friction) when drive pinion has been fitted.

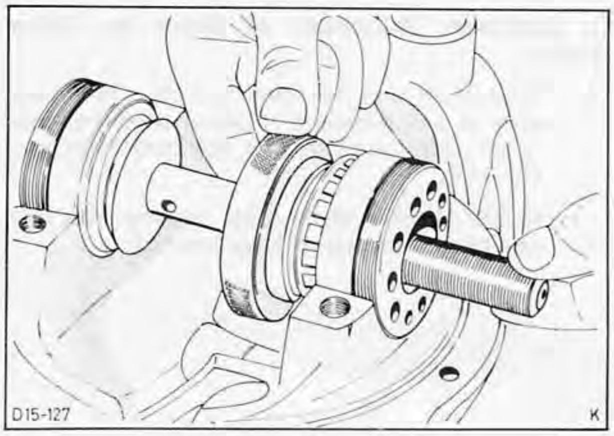


Fig. 110. Insert gauge bar

17. Insert gauge bar in casing with bearings to be installed and ring nuts, Fig. 110. Fit bearing caps ('R'/'L') and secure bolts with prescribed torque, slacken again and then do up finger-tight.

NOTE: Do up adjusting nuts until they just touch the bearing cups. Oil bearings before insertion, Fig. 111.

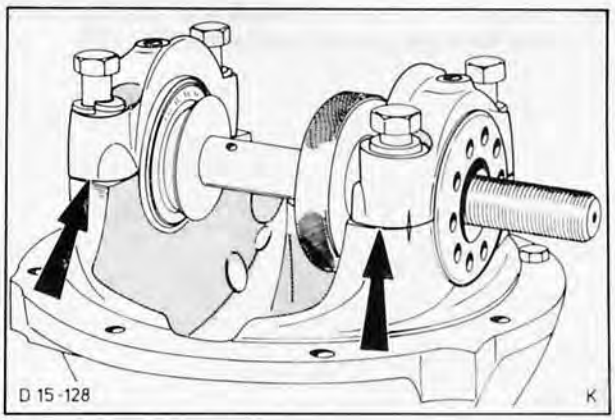


Fig. 111. Fit bearing caps ensuring correct location (arrow)

18. Hold gauge bar with a suitable mandrel and turn adjusting nut outwards until gauge bar can just be turned by hand at adjusting nut (after removing mandrel). Turn gauge bar several times so that bearings settle.

19. Adjust gauge bar. To do this, secure dial indicator with holding fixture on rear axle casing and position plunger on centre of bar, Fig. 112.

    Turn bar slowly and observe total deflection of dial indicator pointer. Then rotate gauge bar until dial indicator reading is half the deflection measured. Thereafter the gauge bar must not be turned any more.

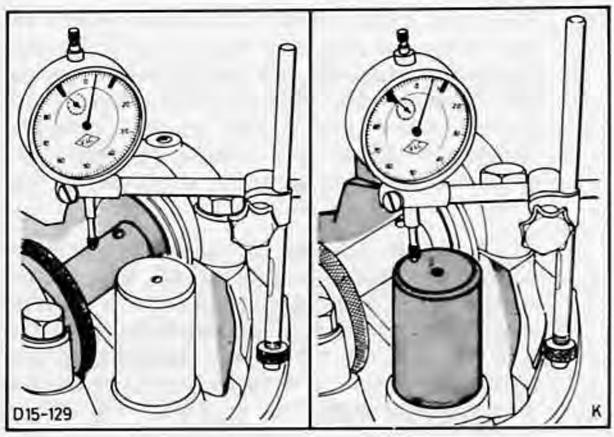


Fig. 112. Adjust gauge bar and master pinion

20. Adjust master pinion. To do this, set up dial indicator on outer edge of end of master pinion close to the gauge bar, Fig. 112. Rotate master pinion another complete turn and observe total deflection of dial indicator needle. Then continue turning master pinion until dial indicator reading is half the total deflection measured.

    After this operation the master pinion must not be turned any more.

21. Remove dial indicator from holding fixture and secure in mounting block. Place mounting block with dial indicator on a ground surface and set to 'O' with the aid of the setting gauge as illustrated, Fig. 113.

    NOTE: The code letters of the rear axles are engraved on the setting gauge under the individual steps, e.g. 'A+E'. Before measuring an 'H' axle, dial indicator must be zeroed on this step.

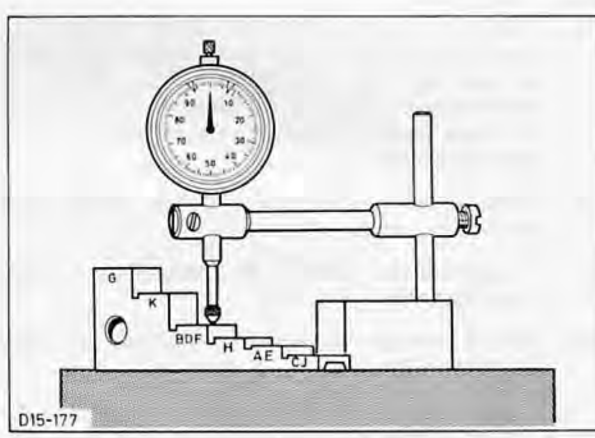


Fig. 113. Zero dial indicator using setting gauge

15 254 8 (cont'd) **'H' AXLE**

22. Place mounting block with dial indicator on end of master pinion in the centre and move plunger of dial indicator slowly across gauge bar. Observe dial indicator and stop at the precise point where the pointer changes direction. Repeat this measuring operation several times and ensure great precision, Fig. 114.

NOTE: If dial indicator pointer now stands at 95 for example, the shim under the master pinion is 0,05 mm too thick. If the pointer changes direction at 4 for example, the shim is 0,04 mm too thin. (This assumes a dial indicator where pointer moves clockwise when plunger is pressed in), Figs. 114/115.

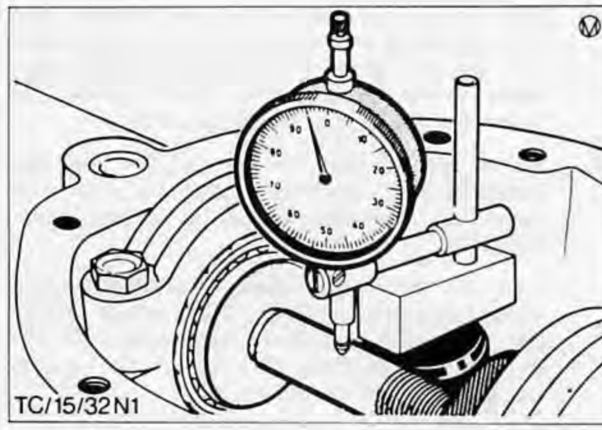


Fig. 114. Dial indicator reading 95 – shim under master pinion too thick

Example

Thickness of shim under master pinion:	3,85 mm
Dial indicator reading left of 'O', e.g. 95:	–0,05 mm
	3,80 mm

This value is the thickness of shims needed between taper roller bearing and top of drive pinion.

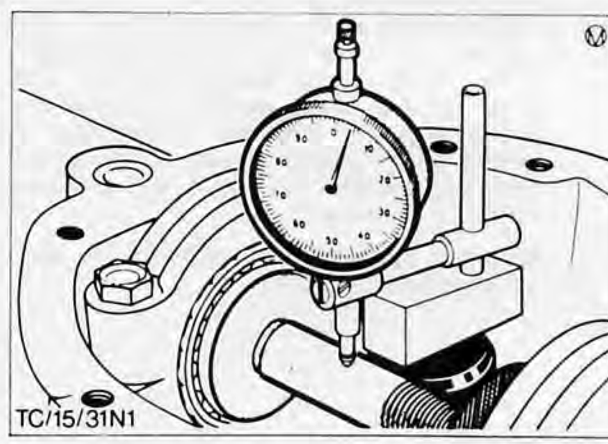


Fig. 115. Dial indicator reading 4 – shim under master pinion too thin

23. Remove master pinion and detach taper roller bearing with shim, Fig. 116. Select new shim according to measurement. With a micrometer measure up shim corresponding to value found, (see Parts Catalogue for shim part numbers).
24. Slide chosen shim onto master pinion and screw up conical nut.
25. Install master pinion as indicated in sub-operation 15.
26. Adjust master pinion as indicated in sub-operation 20.

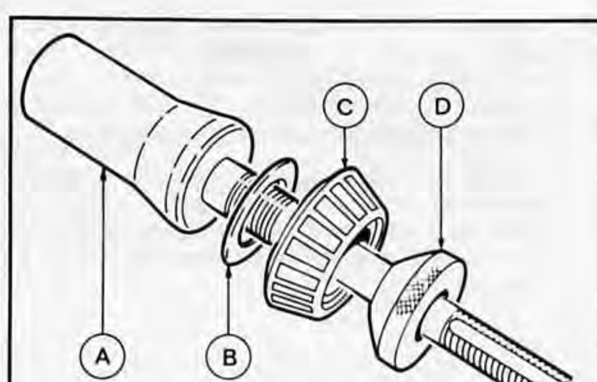


Fig. 116. Master pinion 15–020
A – Master pinion
B – Shim
C – Taper roller bearing
D – Conical nut

27. Re-check zero setting of dial indicator in mounting block with setting gauge and place mounting block on end of master pinion. If dial indicator plunger is now moved across the gauge bar as before (sub-operation 22), dial indicator must read 'O' if preceding measurements were accurate. Discrepancies from 'O' of up to 0,01 mm are permissible, Fig. 117.

    If larger deviations from 'O' are found, the measuring operation must be repeated as described and a new shim found.

    Repeat checking operation.

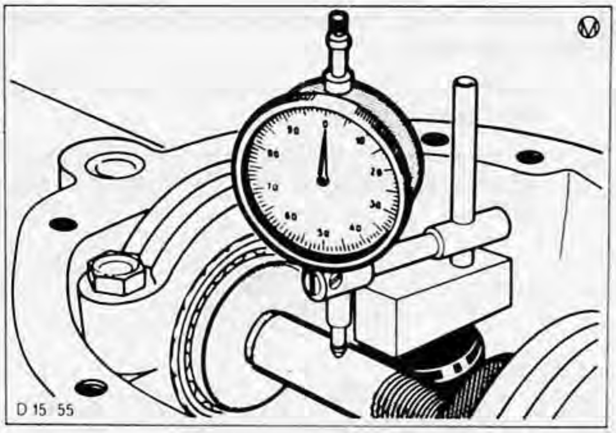


Fig. 117. Dial indicator zeroed (max. discrepancy 0,01 mm)

28. Remove master pinion and gauge bar, Fig. 118. Detach taper roller bearing with chosen shim from master pinion.

    NOTE: After removal, taper roller bearing and differential bearing cup must not be used on the wrong side.

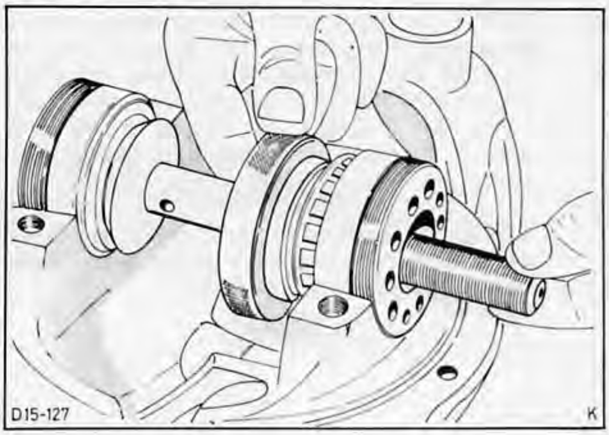


Fig. 118. Remove gauge bar

29. Fit taper roller bearing with chosen shim on drive pinion, Fig. 119.

30. Press on both differential housing taper roller bearings with Special Tool.

    NOTE: First fit a taper roller bearing on the crown wheel rear side of the differential housing.

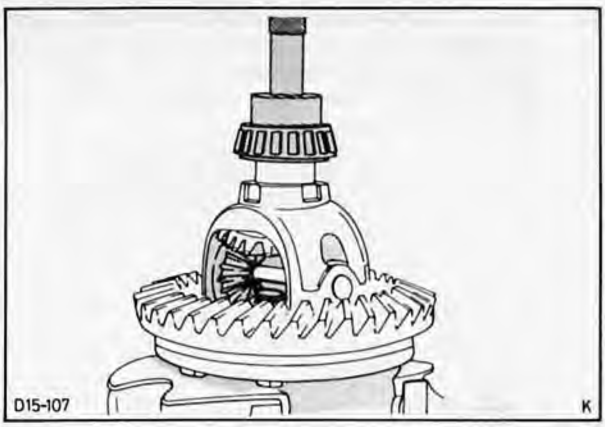


Fig. 119. Fit taper roller bearing with special tool no. 15–025A

15 254 8 (cont'd)

'H' AXLE

To Install Drive Pinion and Differential Gear Train in Housing

31. Insert external drive pinion taper roller bearing in housing.

32. Fit oil seal with Special Tool. Grease on seal when supplied must not be removed, Fig. 120.

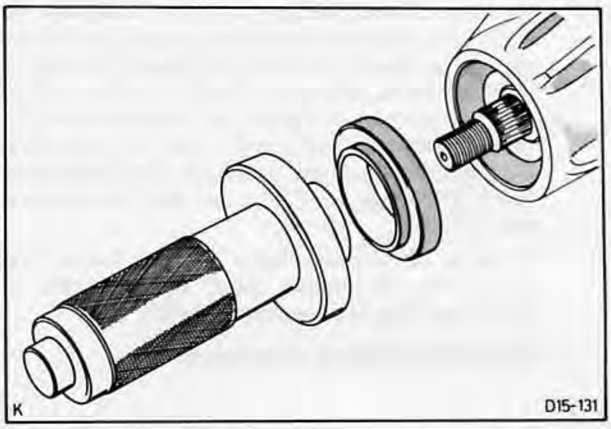


Fig. 120. Install oil seal with special tool no. 15–047B

33. Insert drive pinion with new clamping sleeve in housing. Hold flange with Special Tool No. 15–030 and tighten nut, taking repeated torque readings, until value found previously (+0,3 Nm (3 cmkp) for friction of new oil seal) is attained. Use pre-load gauge, Fig. 121.

    NOTE: If permissible torque is exceeded while tightening the drive pinion nut, a new clamping sleeve must be fitted.

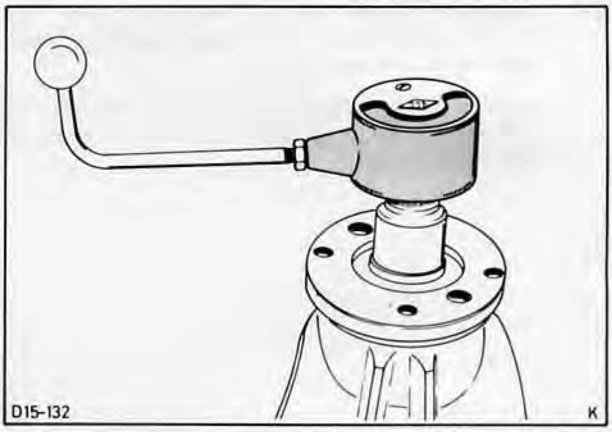


Fig. 121. Check running torque of drive pinion with pre-load gauge 15–041

34. Insert differential assembly with both adjusting nuts in housing, Fig. 122. Fit bearing caps, tighten bolts, slacken and then do up again finger-tight. Adjusting nuts must bear on the bearing cups.

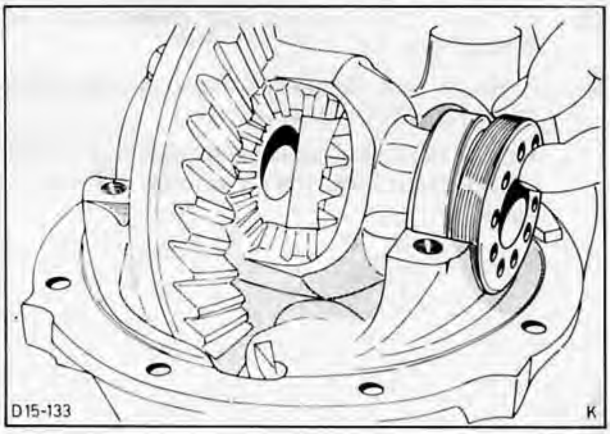


Fig. 122. Insert differential with ring nuts in housing

35. Set backlash. To do this, position plunger of dial indicator at right angles on one of crown wheel teeth, Fig. 123. Tighten adjusting nuts on crown wheel side, slackening nut on differential housing side, so as to produce a backlash of 0,01 mm. Tighten adjusting nut on differential housing side until prescribed backlash of 0,12 to 0,22 mm is attained. Turn drive pinion several times and measure backlash at three points again to check, Fig. 124.

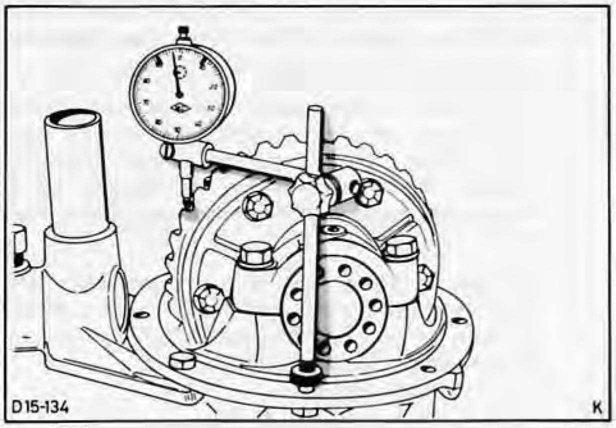


Fig. 123. Position dial indicator plunger at right angles on one of crown wheel teeth

Tighten bearing cap bolts.

Discrepancies in backlash must not exceed 0,01 mm.

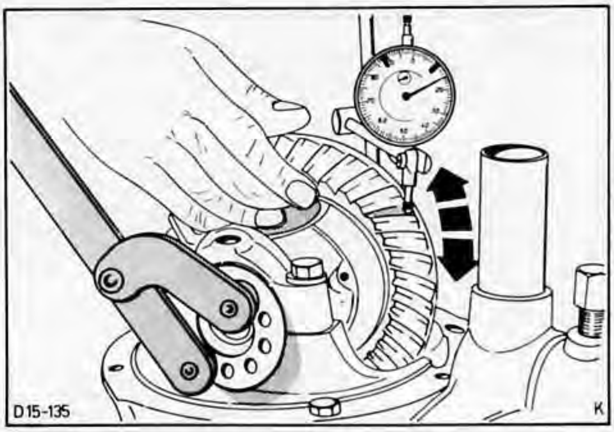


Fig. 124. Set backlash, turning crown wheel to and fro by hand

If backlash has to be rectified, the adjusting nuts can only be turned evenly by the same amounts so as to maintain bearing pre-load, Fig. 125.

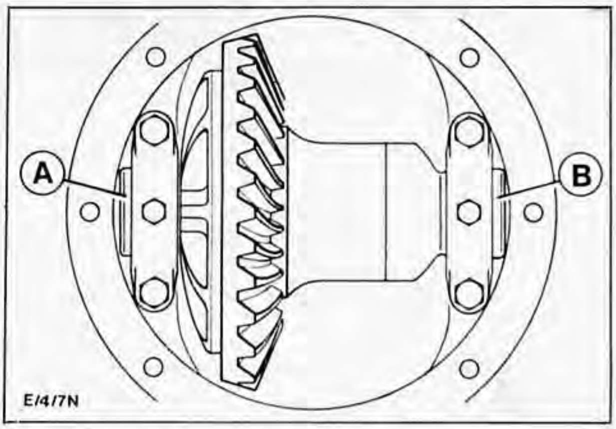


Fig. 125. A – Adjusting nut – crown wheel rear side
B – Adjusting nut – crown wheel front side

15 254 8 (cont'd)

36. Check tooth pattern: New crown wheels will still show marks of optimum tooth pattern left during testing at the factory, Fig. 126.

    Coat crown wheel teeth with marker. Place wrench on nut of drive pinion flange and turn drive pinion until all teeth have been in mesh, braking the crown wheel by means of a hardwood wedge on the outer periphery, Fig. 127.

    As the backlash has a great influence on tooth pattern, an unsatisfactory tooth pattern can only be rectified by increasing or reducing the backlash within the tolerances.

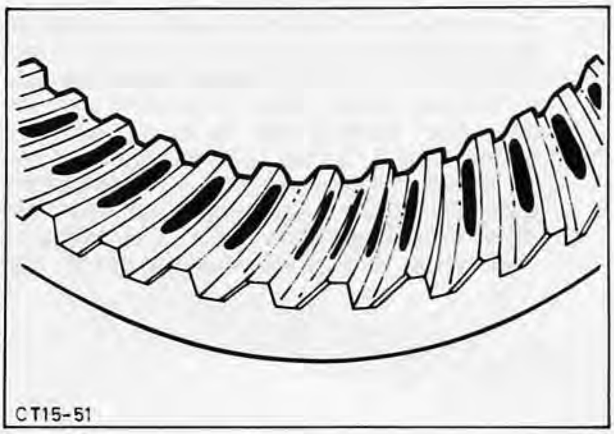


Fig. 126. Optimum tooth pattern

37. Attach locking elements (2) to ring nuts, Fig. 128.

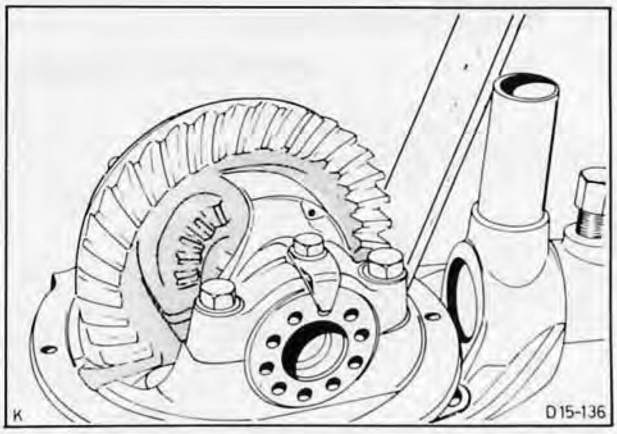


Fig. 127. Brake crown wheel with hardwood wedge

38. Detach differential assembly from stand.

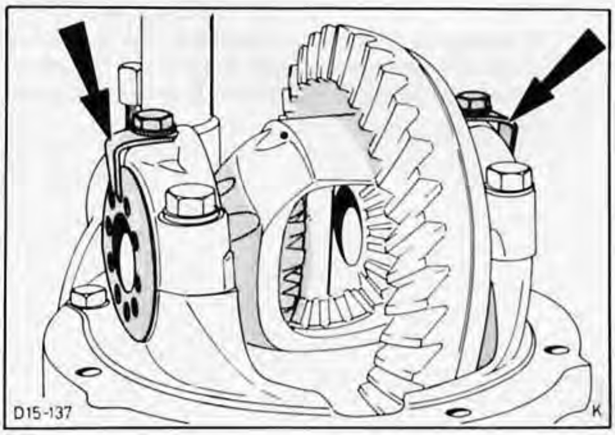


Fig. 128. Lock ring nuts

15 302 SEAL – DRIVE PINION – REPLACE

Special Service Tools Required:

Universal flange holding wrench	15–030
Pre-load gauge	15–041
Drive pinion oil seal installer	15–047B
Drive pinion oil seal remover	15–048

To Remove

1. Slacken wheel nuts. Jack-up vehicle fit stands and remove rear wheels.
2. Disconnect driveshaft from rear axle flange (4 bolts), Fig. 129.

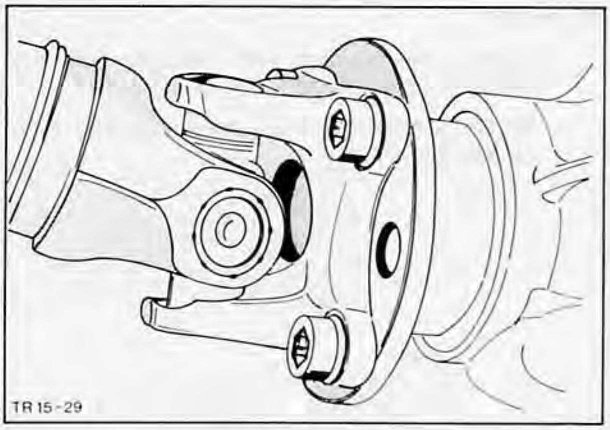


Fig. 129. Detach driveshaft from rear axle flange

3. Measure drive pinion running torque with pre-load gauge, Fig. 130. Turn drive pinion smoothly and read off value and note it down, e.g. 0,8 Nm (8 cmkp).

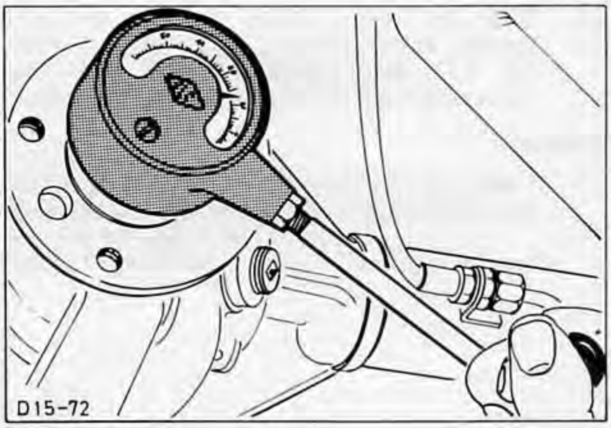


Fig. 130. Check running torque of axle at drive pinion with special tool no. 15–041

4. Hold flange with Special Tool No. 15–030 and unscrew nut.
5. Pull off flange with Conventional Tool.
6. Remove oil seal using Special Tool, Fig. 131.

   NOTE: Position drain can to catch oil spillage.

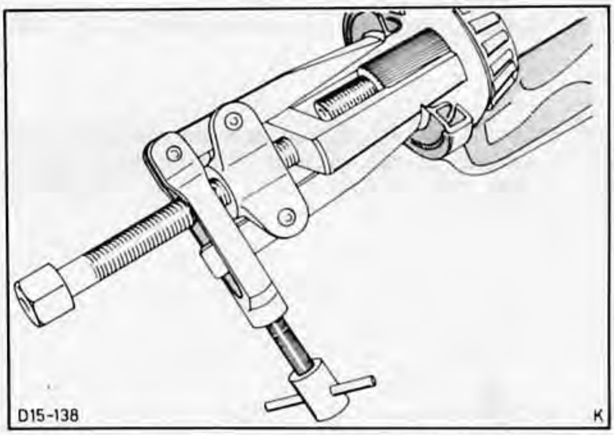


Fig. 131. Remove seal with special tool no. 15–048

15 302 (cont'd)

'H' and 'F' AXLES

To Install

7. Install new oil seal with Special Tool and lightly grease sealing lips, Fig. 132.

   NOTE: Grease on seal when supplied must not be removed.

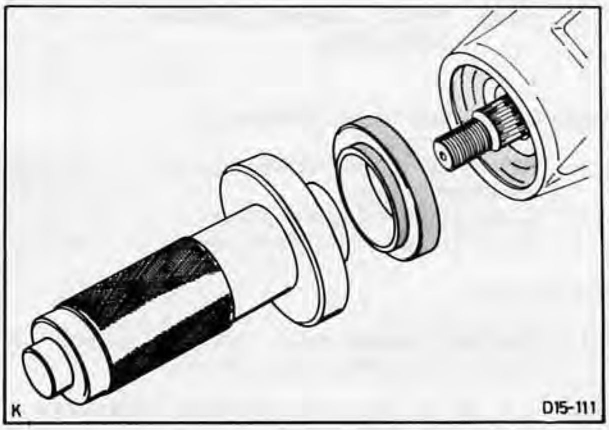


Fig. 132. Fit oil seal with special tool no. 15–047B

8. Slide on flange, screw on new nut and tighten (holding flange with Special Tool), Fig. 133, until repeated checks show that value measured previously has been reached.

Example

Value measured previously	0,8 Nm (8 cmkp)
Constant value	0,4 Nm (4 cmkp)
Torque required	1,2 Nm (12 cmkp)

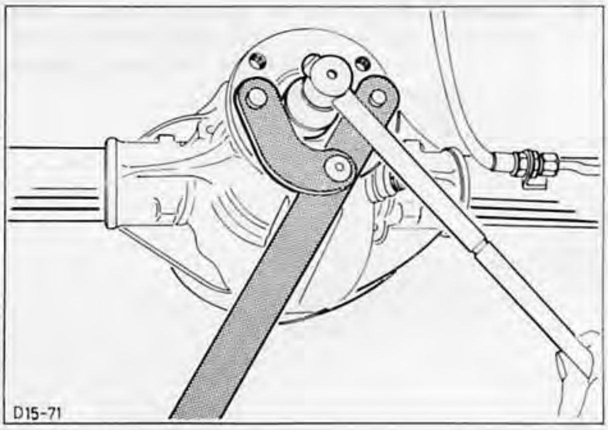


Fig. 133. Hold drive pinion flange and tighten nut slowly

9. Attach driveshaft to rear axle flange, Fig. 134.

10. Attach wheels, top up rear axle oil and lower vehicle to the ground. Fully tighten wheel nuts.

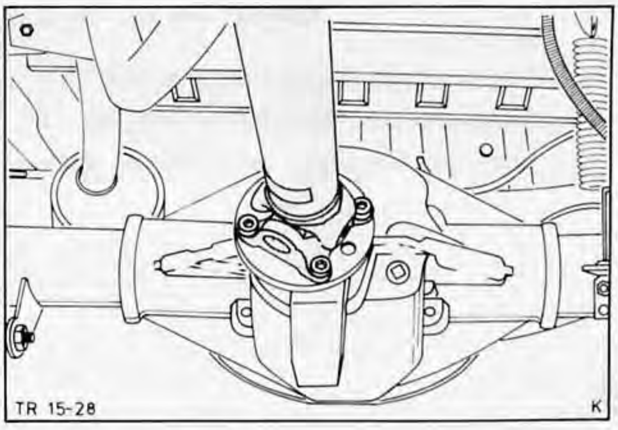


Fig. 134. Attach driveshaft to rear axle flange

15 302 SEAL – DRIVE PINION – REPLACE

Special Service Tools Required:

Universal flange holding wrench	15–030
Drive pinion oil seal installer	15–047B
Drive pinion oil seal remover	15–048

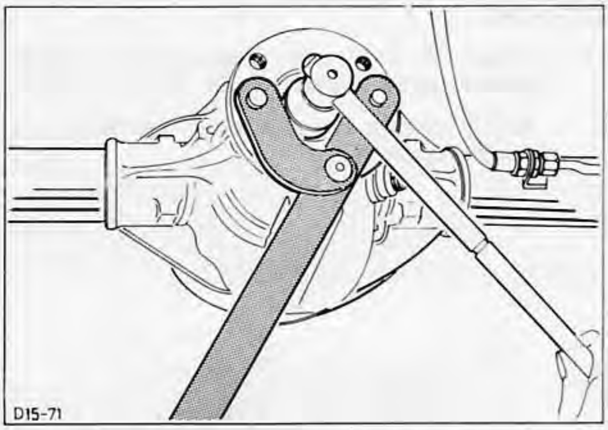


Fig. 135. Hold flange with special tool no. 15–030 and unscrew nut

To Remove

1. Disconnect driveshaft from rear axle flange (4 bolts).
2. Hold flange with Special Tool and unscrew nut, Fig. 135.
3. Remove flange with Standard Tool.

   NOTE: Catch oil spills.
4. Remove oil seal with Special Tool, Fig. 136.

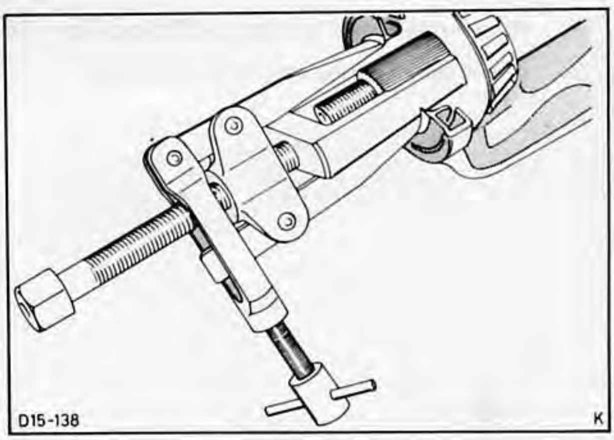


Fig. 136. Remove oil seal with special tool no. 15–048

To Install

5. Install oil seal with Special Tool. Lightly grease seal between the two lips, Fig. 137.

   NOTE: Grease on seal when supplied must not be removed.

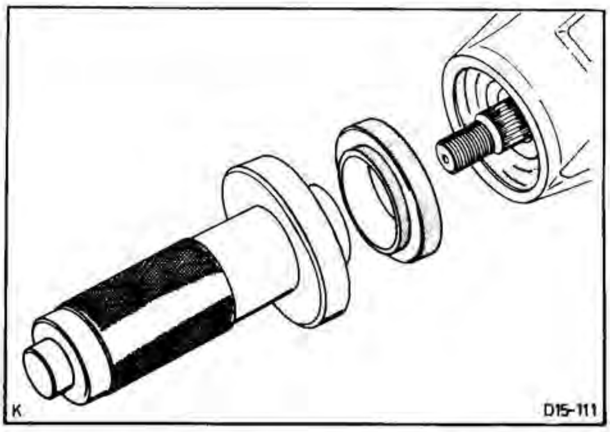


Fig. 137. Install oil seal with special tool no. 15–047B

6. Fit flange, hold with Special Tool, screw on new nut and tighten to specified torque.

   NOTE: Use new nut.

7. Attach driveshaft to rear axle flange, Fig. 138.
8. Check oil level and top up if necessary.

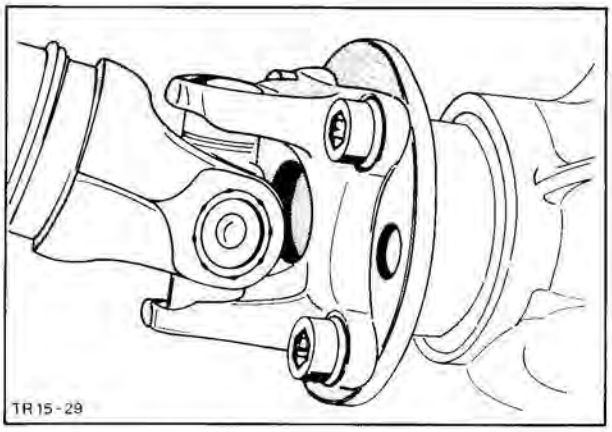


Fig. 138. Attach driveshaft to rear axle flange

15 514 DRIVESHAFT ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Disconnect driveshaft from rear axle flange (4 bolts), Fig. 139.
2. Disconnect centre bearing from floor pan (2 bolts).

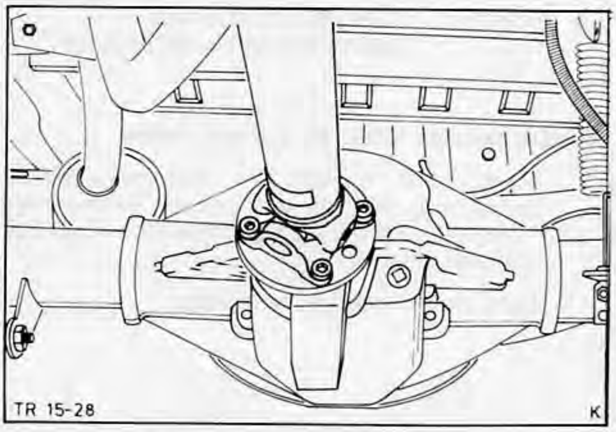


Fig. 139. Detach driveshaft from rear axle flange

3. Draw driveshaft out of gearbox extension housing and insert old driveshaft stub or suitable plastic cap in extension housing, Fig. 140.

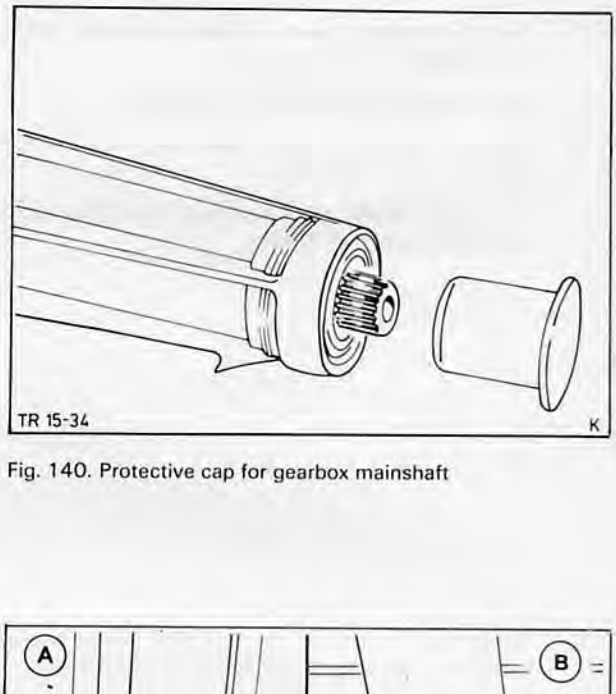


Fig. 140. Protective cap for gearbox mainshaft

To Install

4. Remove cap or driveshaft stub and insert driveshaft into extension housing.
5. Attach driveshaft to rear axle flange, Fig. 141.
6. Bolt centre bearing free of strain to floor pan, Fig. 141.
7. Check transmission oil level and top up if necessary.

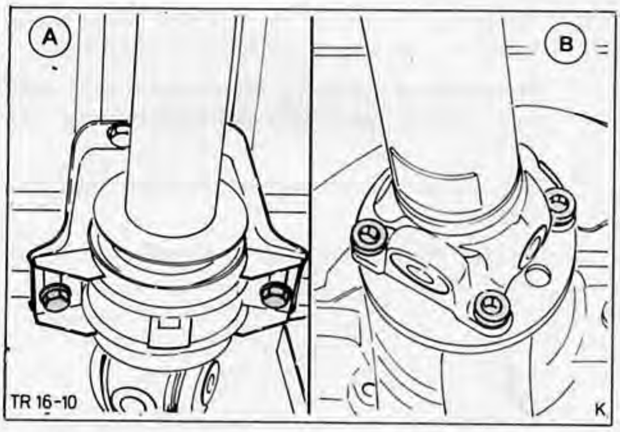


Fig. 141. A – Centre bearing attached to floor pan
B – Driveshaft attached to drive pinion flange

15 564 4 CENTRE BEARING – DRIVESHAFT – REPLACE

Special Service Tools Required: None

1. Mark both halves of driveshaft before separating, this ensures correct balance on reassembly. Bend up locking tab on retaining bolt and undo bolt.

   Draw out 'U' retainer sideways.

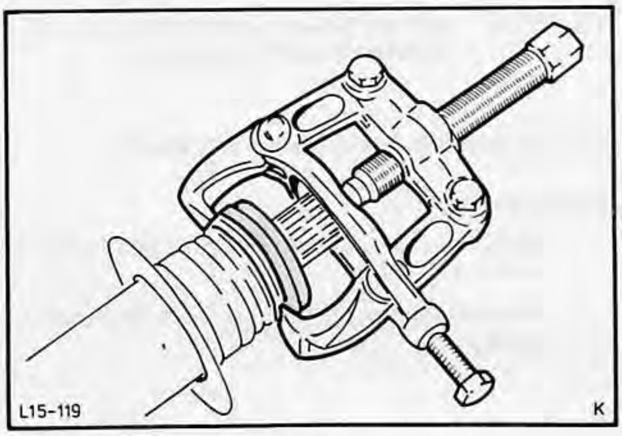


Fig. 142. Remove ball bearing with protective cap

2. Detach housing with rubber insulator from ball bearing.
3. Pull rubber insulator out of housing.
4. Remove bearing with caps (2). Use two-legged puller, Fig. 142.
5. Drive ball bearing with caps onto shaft using a suitable piece of tubing.

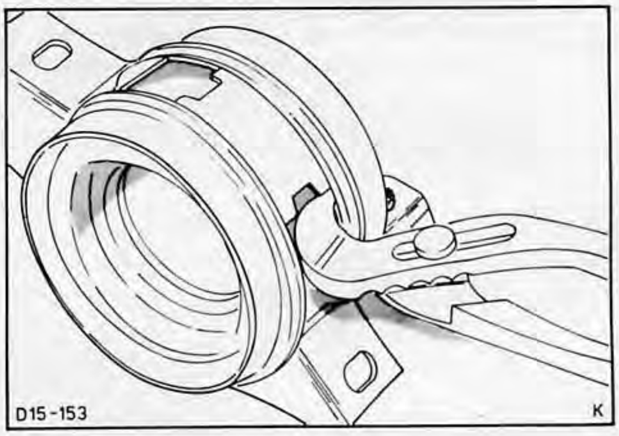


Fig. 143. Bend metal tabs (6) over rubber bead

6. Fit rubber insulator in housing. Bend metal tabs (6) outwards to facilitate insertion.

   Remember marking. Bend metal tabs back over rubber bead with adjustable pliers, Fig. 143.
7. Slip housing with rubber insulator over ball bearing.

   NOTE: Mark must point in direction of travel, Fig. 144.

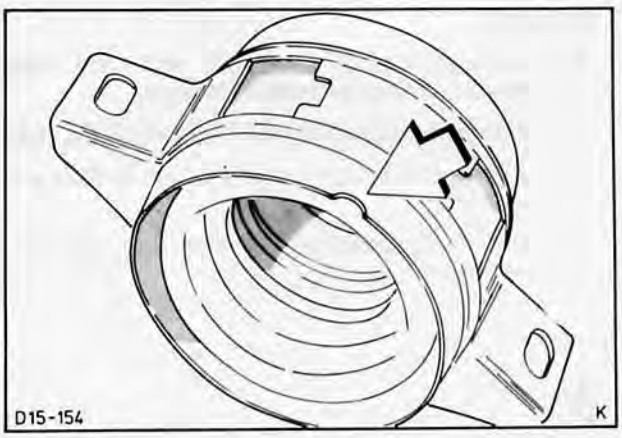


Fig. 144. Housing mark (direction of travel)

8. Insert bolt with locking plate into front half of driveshaft until U-retainer can just be slid into place, Fig. 145.
9. Assemble driveshaft halves, **lining marks up as before.**

   Insert 'U' retainer with pin facing splining, tighten bolt and secure with lock plate.

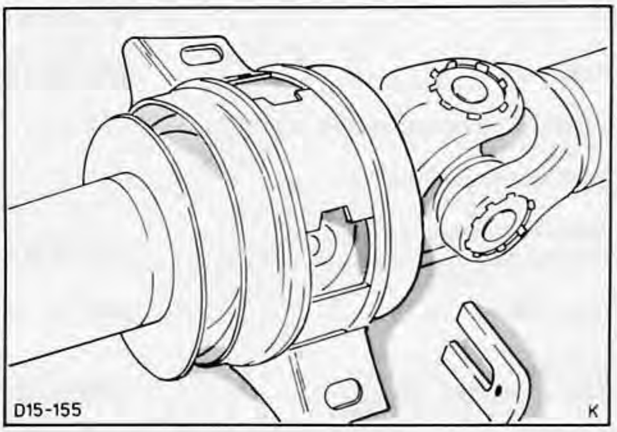


Fig. 145. Insert 'U' retainer

15 621 REAR SPRING ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Jack-up vehicle and fit stands at rear, remove spring 'U' bolts (4 nuts).
2. Detach spring hanger at rear, Fig. 146.
3. Detach spring bolts at front end and take out rear spring assembly.

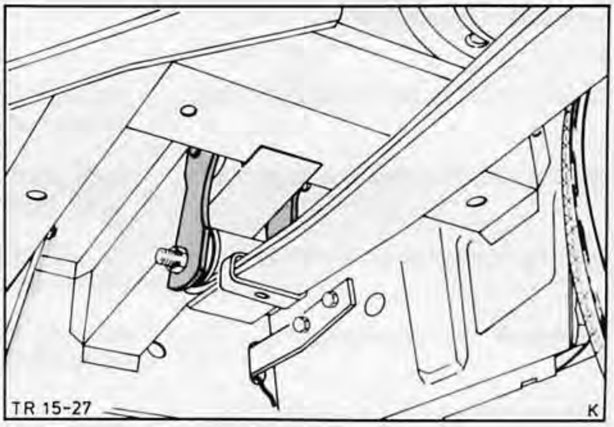


Fig. 146. Detach rear spring hanger

To Install

4. Insert rear spring assembly, and fit bolts at front.
5. Fit spring hanger at rear end.
6. Attach spring 'U' bolts, centering axle with centering bolt, and lower vehicle, Fig. 147.

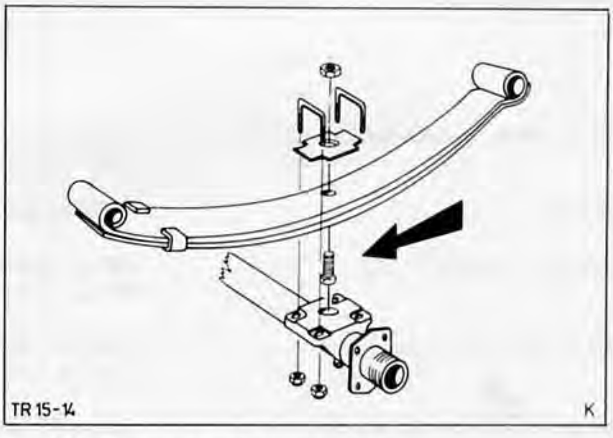


Fig. 147. Centre axle with centering bolt

TECHNICAL DATA: For rear axle ratios see REAR AXLE USAGE CHART on page 3.

	'F' AXLE	'G' AXLE	'H' AXLE
Backlash	0,12 to 0,22 mm	0,12 to 0,22 mm	0,10 to 0,20 mm
Width of clamping sleeve	11,7 mm	10,30 to 11,95 mm	
Width of spacer sleeve			52,45 mm
Shim thickness: Differential	0,06 to 0,5		
Drive Pinion	0,84 to 1,25 mm	1,72 to 2,25 mm	3,73 to 0,13 mm
Oil type	SRM 2C 9102 A		
Axle capacity	1,40 ltr (2,45 pt.)	1,72 ltr (3,25 pt.)	2,70 ltr (4,75 pt.)

TIGHTENING TORQUES	**'F' AXLE**	**'G' AXLE**	**'H' AXLE**
Bearing cap to axle casing	60 to 70 Nm 44 to 52 lb.ft.	99 to 118 Nm 74 to 87 lb.ft.	95 to 109 Nm 72 to 81 lb.ft.
Differential housing to axle casing			54 to 61 Nm 39 to 44 lb.ft.
Crown wheel to differential housing	79 to 86 Nm 58 to 63 lb.ft.	99 to 118 Nm 74 to 87 lb.ft.	68 to 75 Nm 50 to 55 lb.ft.
Driveshaft centre bearing to bracket	20 to 25 Nm 15 to 18 lb.ft.		
Bearing bracket to under-body	20 to 25 Nm 15 to 18 lb.ft.		
Driveshaft to pinion flange	60 to 65 Nm 44 to 49 lb.ft.		
Differential housing to bearing cap lock bolts		15 to 21 Nm 12 to 15 lb.ft.	17 to 21 Nm 13 to 15 lb.ft.
Wheel hub nut	200 to 240 Nm 148 to 184 lb.ft.	(locknut) 70 Nm 52 lb.ft.	
Drive pinion nut		99 to 118 Nm 74 to 87 lb.ft.	to give running torque of 2,6 to 3,2 Nm 1,5 to 2 lb.ft. (excluding oil seal)
Rear cover to axle casing	20 to 25 Nm 15 to 18 lb.ft.	20 to 25 Nm 15 to 18 lb.ft.	
Sealer	SDM-49-9105-A Loctite typ 275		
Spring 'U' bolts	88 to 100 Nm 63 to 74 lb.ft.	120 to 130 Nm 96 to 104 lb.ft.	88 to 100 Nm 63 to 74 lb.ft.
Rear spring to front shackle	157 to 196 Nm 116 to 146 lb.ft.		
Rear spring to rear shackle	60 to 70 Nm 44 to 52 lb.ft.	(120 only 60 to 70 Nm 44 to 52 lb.ft.) 157 to 196 Nm 116 to 146 lb.ft.	(100 L only 157 to 196 Nm 116 to 146 lb.ft.) 60 to 70 Nm 44 to 52 lb.ft.

Steering Gear and Linkage 13

GENERAL DESCRIPTION

The steering gear fitted to Transit variants may be either standard or of a heavy duty design. This section covers both types of gear, related linkages and steering column assemblies.

Both steering boxes are of similar design and of the recirculating ball design, but the standard steering box has a worm and nut and the heavy duty a worm and peg drive. Correct steering 'feel' is achieved for both gears by a preloaded rocker shaft.

The steering shaft is integral with the steering box and supported by a column tube assembly. The column tube is clamped to the steering gear, and at its upper end by a bracket bolted through the pedal box and secured to the dash panel.

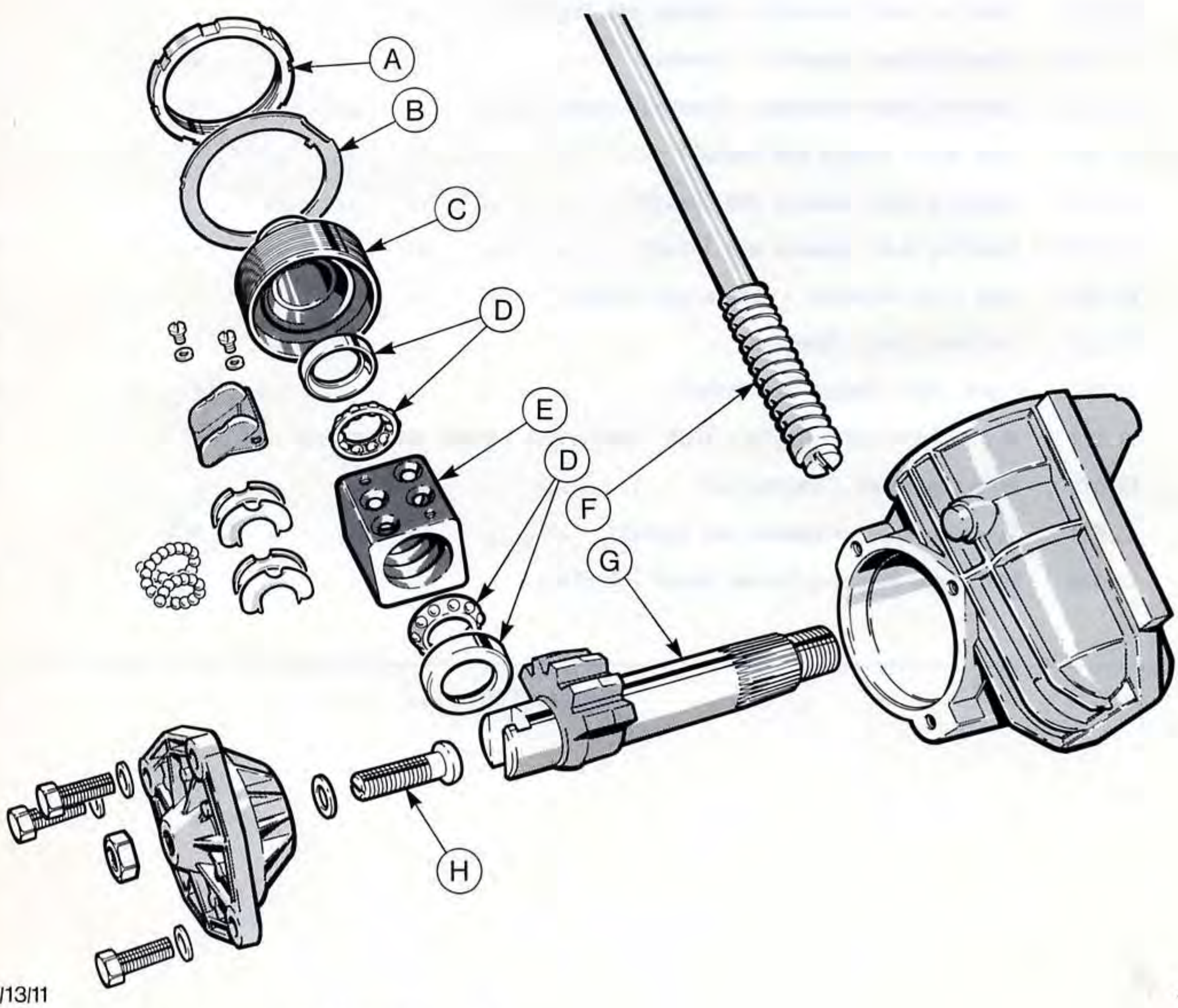


Fig.1. Steering gear assembly (standard gear).

A - Adjusting screw locknut
B - Lock washer
C - Adjusting screw
D - Thrust bearings
E - Worm nut
F - Steering shaft worm
G - Rocker shaft
H - Rocker shaft adjusting screw

GENERAL DESCRIPTION (cont'd)

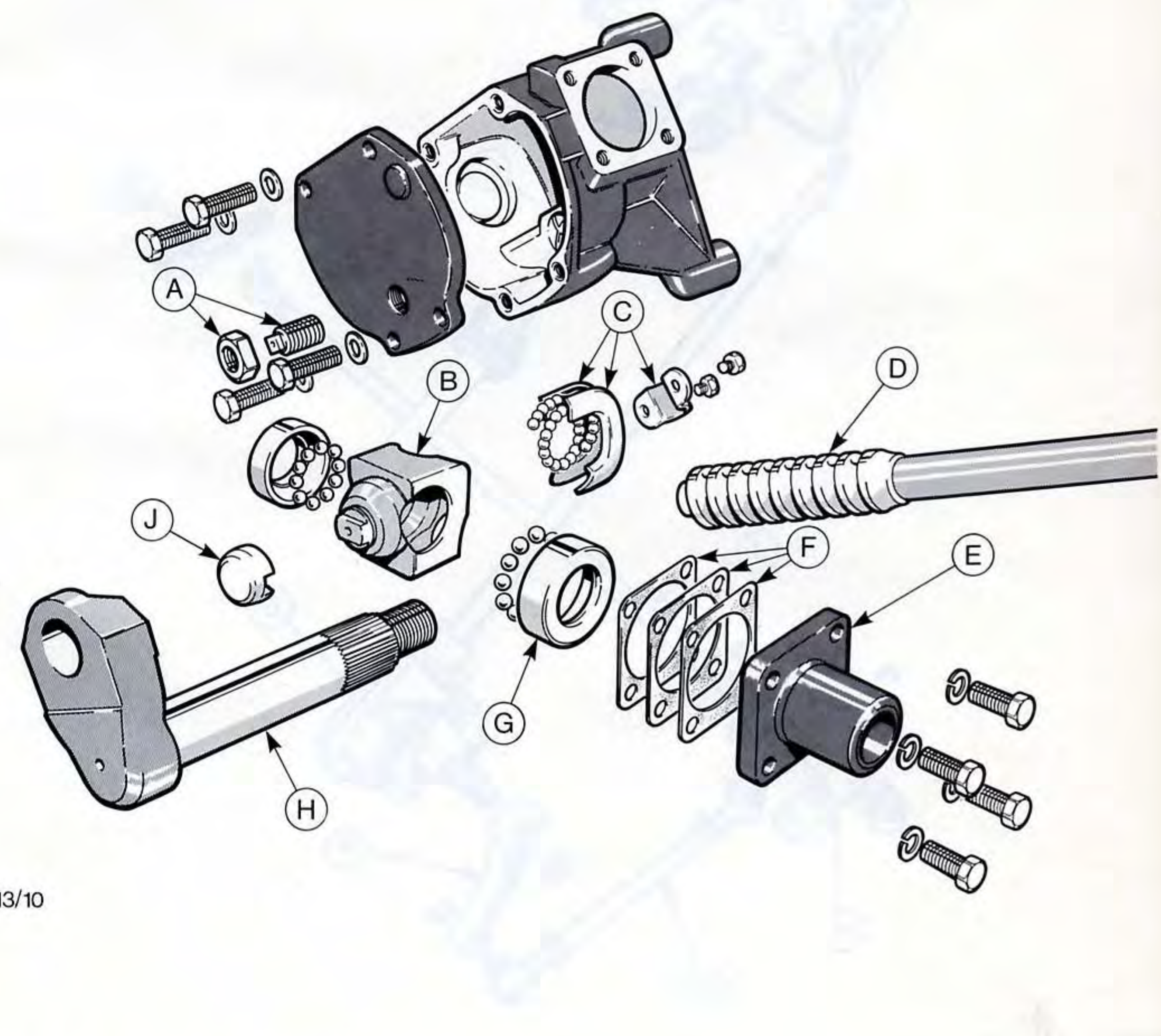


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Fig.2. Steering gear assembly, (heavy duty gear)

A - Adjusting screw and locknut
B - Worm nut
C - Transfer tube and steel balls
D - Steering shaft worm
E - Upper bearing pre-load cover plate
F - Selective pre-load shims
G - Upper bearing assembly
H - Rocker shaft
J - Sliding pivot

GENERAL DESCRIPTION (cont'd)

The steering linkage consists of an adjustable drag link connecting the steering box drop arm to the stub axle steering arm. An adjustable track rod, links both L.H. and R.H. steering arms. The steering arms are bolted to the stub axle spindle assembly.

Ball joints are handed left and right hand thread to permit adjustment of track and drag links without removal.

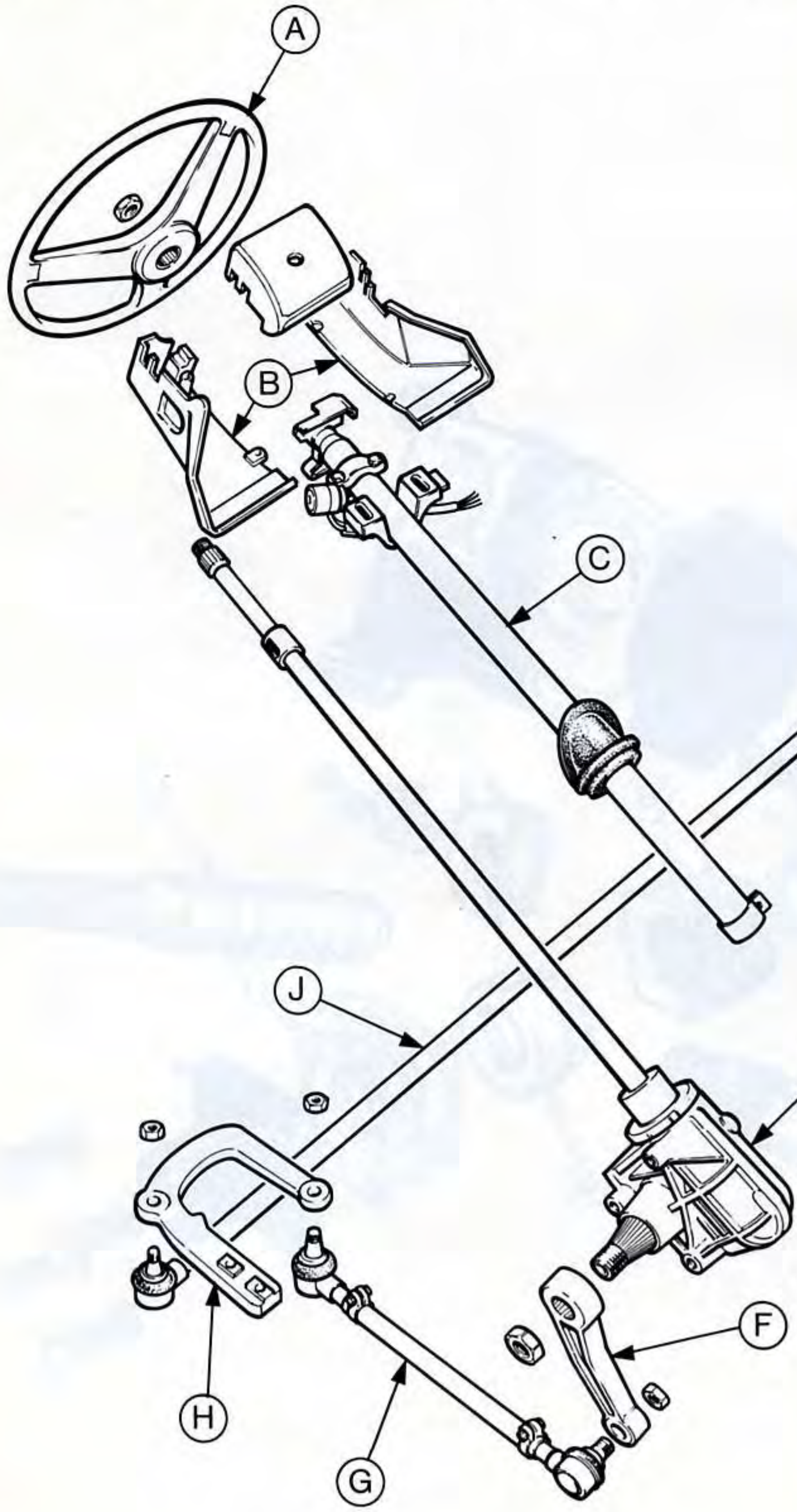

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Fig.3. Steering linkage and gear assembly.

A - Steering wheel
B - Steering column shrouds
C - Column tube
D - Non-drivers side steering arm.
E - Steering gear assembly.
F - Drop arm.
G - Drag link.
H - Drivers side steering arm.
J - Track rod

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following checks should be carried out:

- Rocker shaft pre load
- Check steering gear for leaks

When investigating complaints of noisy, stiff (heavy) or excessive movement of steering wheel the following should be checked before any adjustments to the steering box are made.

(i) check tyre pressures, and if necessary, adjust to specification. Check for uneven tyre wear.

(ii) check steering linkage ball joints for looseness, wear or seized condition

(iii) check king pin free play and movement. Ensure king pins are well lubricated

(iv) check security of drop arm to steering box rocker shaft

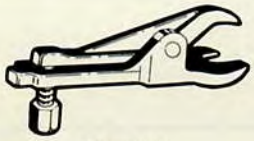
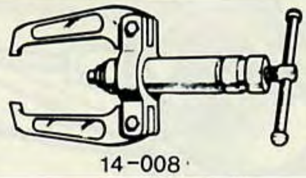
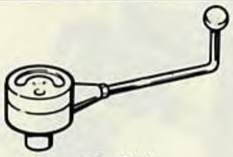
(v) check security of steering box to chassis member

(vi) incorrect steering column/gear alignment

(vii) noisy steering may be caused by steering column upper bush

(viii) Burman heavy duty steering box is correctly filled with specified oil

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 13-002	Steering shaft bearing nut adjuster
 13-006	Ball joint separator
 14-008	Drop arm remover
 15-041	Pre-load gauge

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13 114 STEERING ROCKER SHAFT PRELOAD - ADJUST

NOTE: This procedure detailed below is for the standard steering gear. The Burman heavy duty adjustment procedure is detailed in operation 13 116 8.

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator	13-006
Preload gauge	15-041

1. Position road wheels in straight ahead position and maintain for duration of adjustment.

2. Jack up front of vehicle and fit axle stands.

3. Remove split pin and castellated nut, using Service Tool 13 006, disconnect drag link from drop arm.

4. Note total number of steering wheel turns for full travel of steering gear. Establish steering gear centre travel, the approximate position can be achieved by halving the total number of steering wheel rotations.

NOTE: Centre of steering gear travel is when 'high spot feel', and steering column shaft alignment mark is at 12 o'clock.

5. Position the steering wheel one turn anti-clockwise from this central position.

6. Slacken adjusting screw locknut.

7. Remove steering wheel emblem. Using special service gauge 15 041 and suitable socket measure torque required to rotate steering column shaft clockwise two complete revolution from the position set in sub-operation 5. Turn adjuster screw until 1,6 to 2,2 Nm is measured for gears with six turns or 2,5 to 3,0 Nm. on gears with seven turns (as previously established in sub - operation 4).

8. Hold screw and tighten adjuster locknut. See Technical Data. Re-check steering column shaft turning torque.

9. Reconnect drag link to drop arm and torque nut to specified torque. Fit new split pin.

10. Refit steering wheel centre emblem.

11. Remove axle stands and lower vehicle to ground.

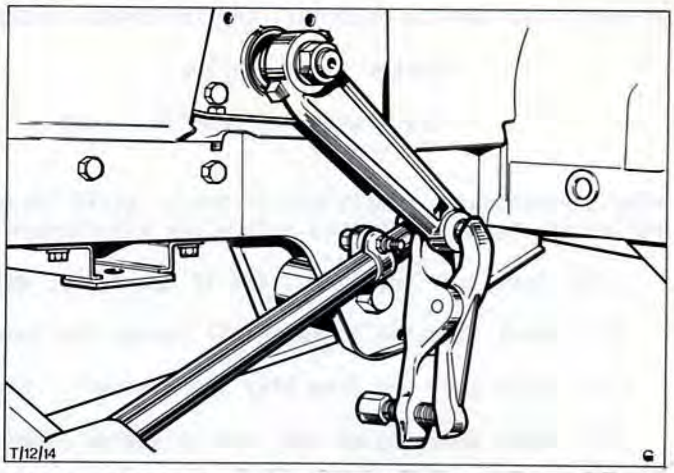


Fig.4. Disconnect drag link from drop arm using Service tool 13 006.

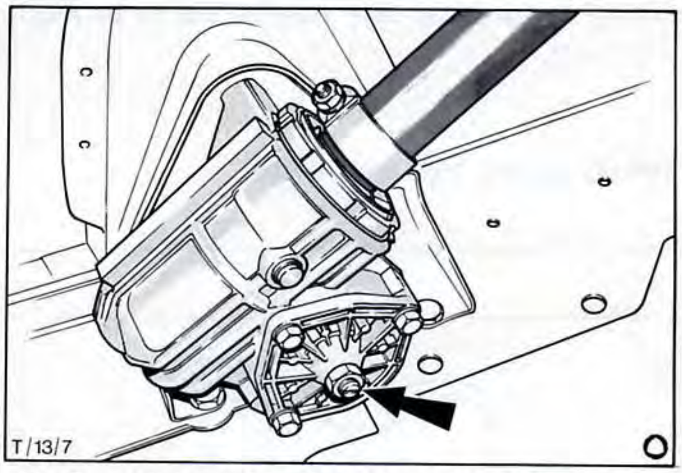


Fig.5. Rocker shaft adjusting screw and locknut.

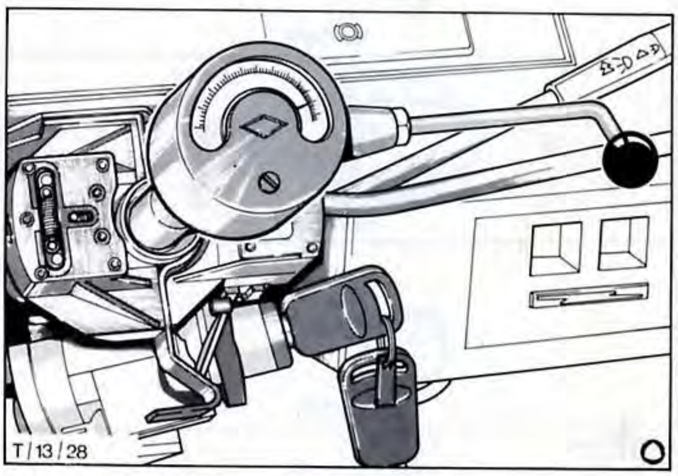


Fig.6. Measure torque required to rotate steering column shaft.

13 116 STEERING GEAR ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator	13-006
Puller	14-008

To Remove

1. Carefully prise off steering wheel centre emblem. Remove steering wheel locknut, remove steering wheel.

2. Remove cross head screw and detach column upper shrouds.

3. Remove cross head screws, detach two halves of the steering column lower shrouds.

4. Detach multi function switches and bracket from column. Disconnect loom connection from steering ignition lock.

5. Remove two nuts and plain washers from steering column top mounting.

6. From engine compartment loosen clamp bolt at lower end of steering column tube.

7. Disconnect drop arm nut and washer from steering gear rocker arm, using service tool 14 008 puller, pull off drop arm.

8. Remove steering gear to chassis retaining bolts. Fig.9.

9. Withdraw steering column tube upwards and remove from dash panel location.

10. Remove steering gear from vehicle, withdraw complete with steering shaft out through lower front of vehicle.

NOTE: On DIESEL variants it is necessary to remove the cooling system bypass tube from radiator bottom hose and water pump hose to achieve access. Position drain tray beneath engine to collect coolant. Loosen two hose clips and clamp bolt retaining bypass tube bracket, swing hose away from vehicle.

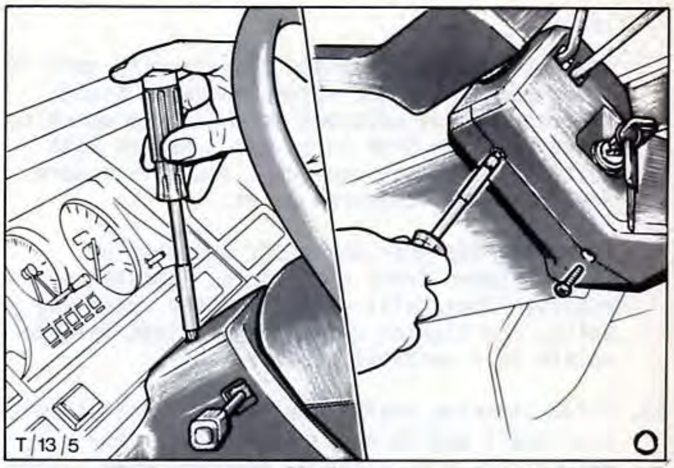


Fig.7. Remove crosshead screws securing column shrouds.

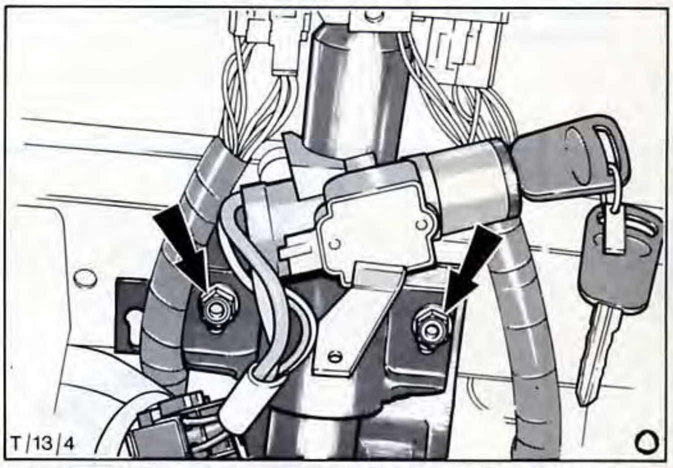


Fig.8. Remove upper steering column mounting nuts and plain washers.

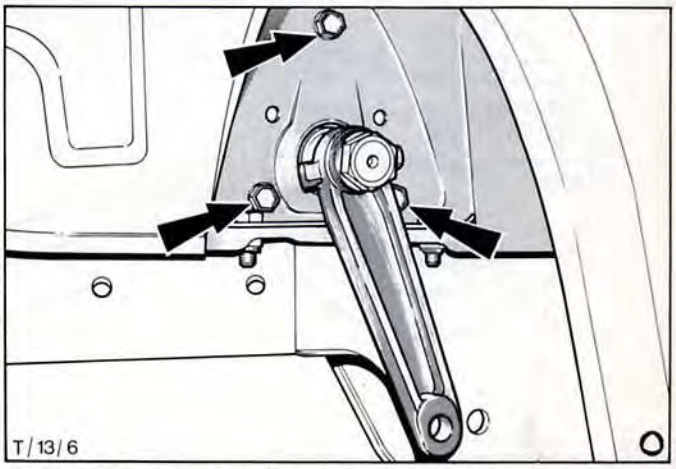


Fig.9. Remove steering gear to chassis lower mounting bolts.

To Install

11. Inspect the surface where the steering gear is to be mounted on the apron bracket. Ensure surface is flat adjacent to the three mounting holes and free from burrs etc. Rework with suitable files as required. Touch in rework area with body coloured paint.

12. Pass steering gear and shaft assembly up through lower front of vehicle. Locate in position then refit original three retaining bolts, and tighten until gear is just free to rotate in a vertical plane.

13. Slide steering shaft tube, grommet and clamp over shaft and through bulkhead. Locate column tube over steering gear 'O' ring. This should be possible without forcing the steering shaft downwards.

NOTE: If a foul condition exists between the steering shaft tube and the pedal box bracket, refer to Part 'A' of the realignment procedure.

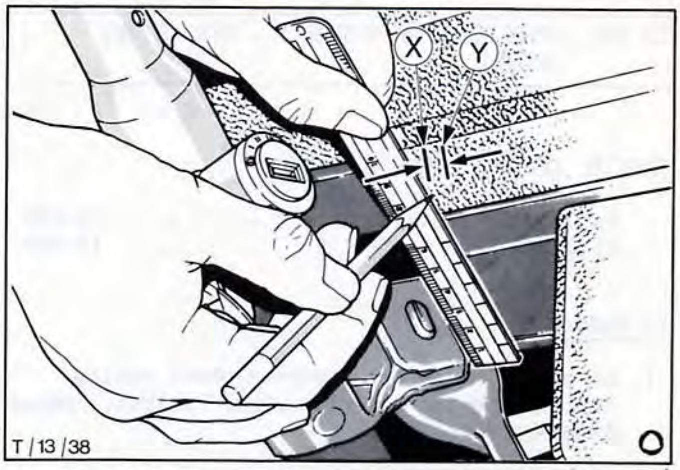


Fig.10. Measuring horizontal displacement 'X' and 'Y'.

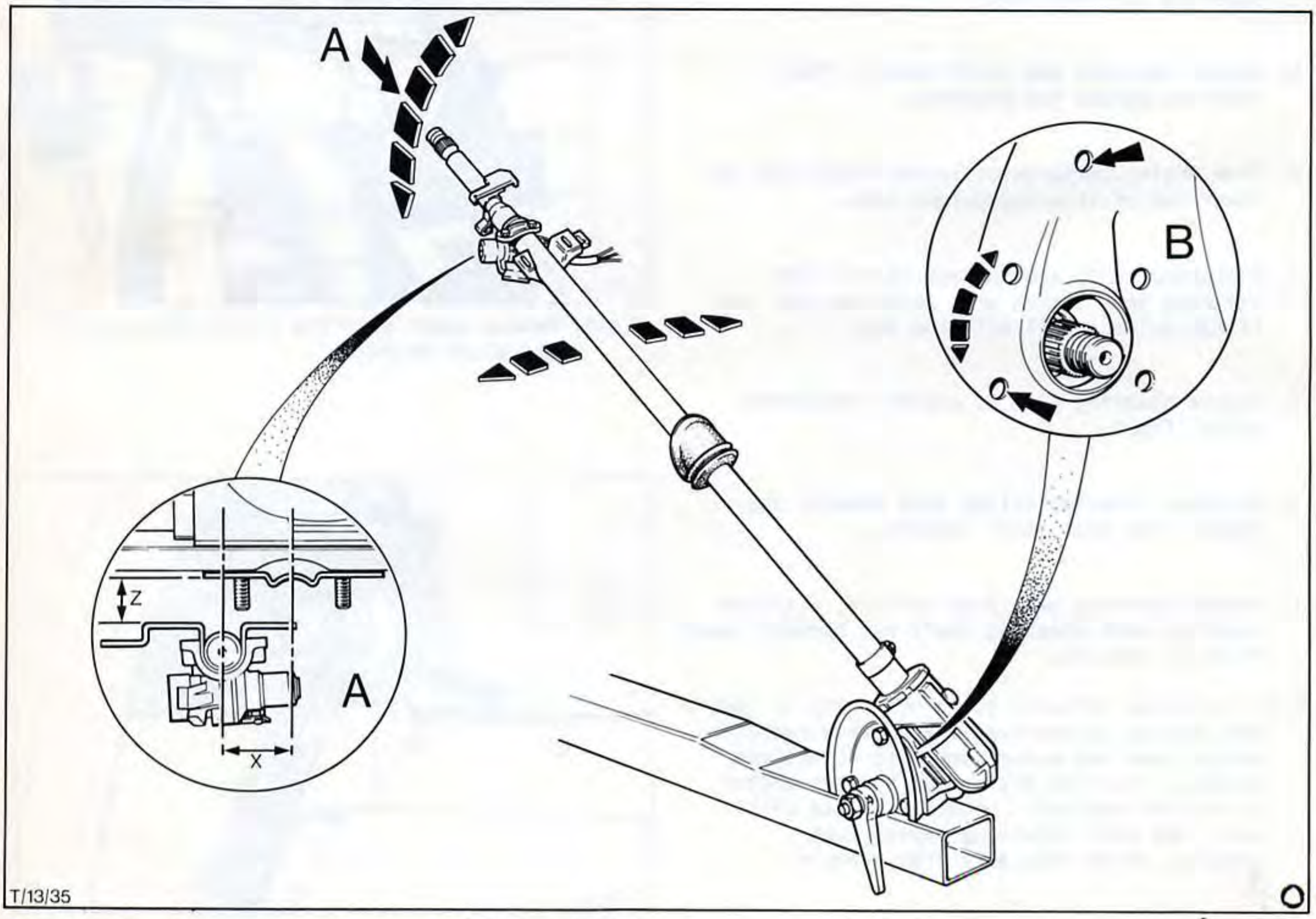


Fig.11. Steering gear vertical and horizontal alignments.
A) X = Horizontal displacement
Z = Vertical alignment
B = Rework steering gear mounting to adjust vertical alignment

13 116

14. Secure clamp bolt at lower end of steering column tube and tighten to 20-25 Nm (15 - 18 lbf.ft).

15. Fit two nuts and plain washers to upper steering column fixing (see note below) and tighten the nuts until a 5,0 mm (0,20 in) clearance exists between tube bracket and pedal box bracket.

NOTE: This should be possible without the steering shaft tube fouling the pedal box bracket. If a foul condition exists refer to Part 'A' and 'C' of the realignment procedure detailed on Page 11.

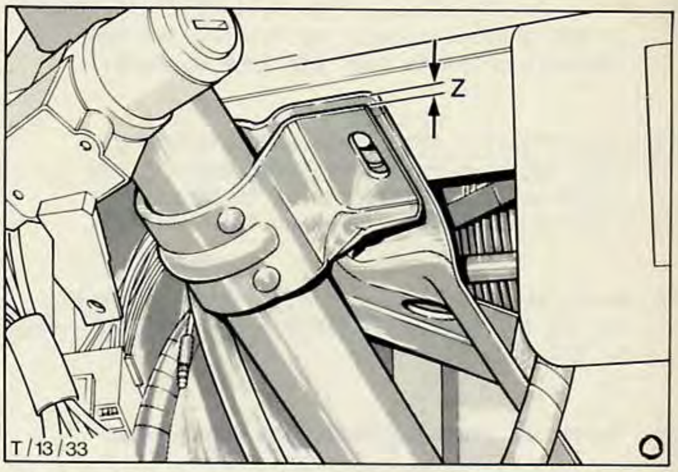


Fig.12. Adjust steering column until a gap of 5mm (Z) exists between bracket and pedal box bracket.

16. Tighten the three steering gear retaining bolts to 54 - 65 Nm (40 - 48 lbf.ft).

17. Mark horizontal position of the steering shaft tube bracket relative to the belt rail, see 'X', Fig.10.

18. Remove the two nuts/washers fitted in operation fifteen (15) and push the two studs up through the belt rail so that the steering column is free to adopt its natural position.

19. Measure the distance between the pedal box bracket and the steering shaft tube dimension 'Z'. in Fig.12.

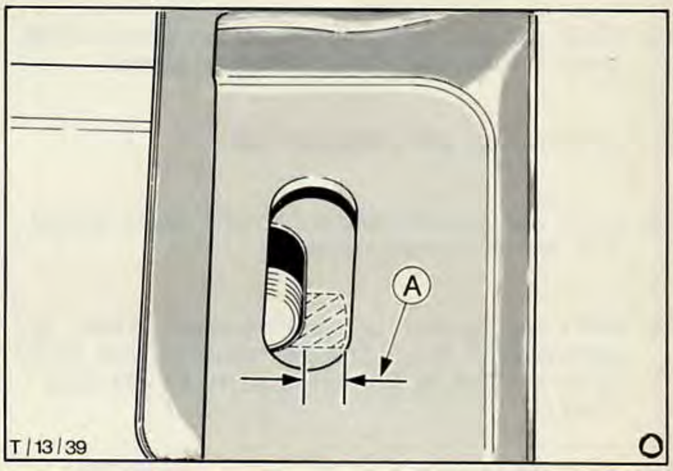


Fig.13. Mark horizontal displacement position of steering shaft. Rework belt rail to a maximum of 4 mm.

20. Mark the new horizontal position of the steering shaft tube relative to the belt rail, 'Y' in Fig.10. Note the difference between positions 'X' and 'Y'.

NOTE: If the dimension 'Z' is less than 9 mm, it is possible that the steering shaft tube may foul on the pedal box bracket preventing it from adopting its free horizontal position. Should this occur, it will be necessary to slacken the three steering gear retaining bolts to allow the steering column to drop clear of the pedal box bracket. Retorque the three steering gear retaining bolts in order to obtain the correct position for 'Y'. If this does not give sufficient vertical clearance refer to operation 'A' on page 11.

- The horizontal and vertical dimensions obtained in operations 19 and 20 should be between 0 and 8 mm.
- If either exceeds 8 mm refer to the realignment procedure detailed on page 11 before continuing reassembly.

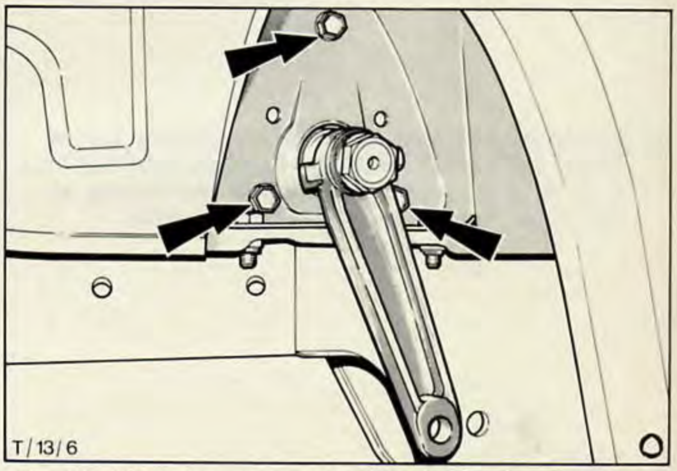


Fig.14. Steering gear mounting bolts to apron bracket.

21. Relocate the studs in the belt rail and secure column bracket to belt rail using two new locknuts or plain nuts and lock washers.

22. One bolt at a time, remove the existing steering gear retaining bolts and fit new patch bolts. Tighten to 54 to 65 mm (5,4 to 6,5 kgf.m - 40,0 to 48,0 lbf.ft).

23. Refit and secure drop arm, tighten retaining nut to 152 to 180 Nm (15,2 to 18,0 kgf.m - 110 to 130 lbf.ft).

24. Reconnect steering lock loom connection.

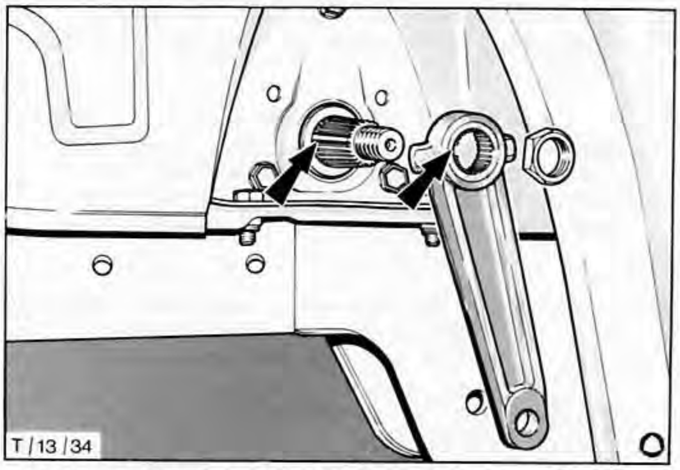


Fig.15. Refit drop arm locating master spline.

25. Refit multi switches and bracket to steering column and secure with two screws, Fig.16.

26. Refit and secure two halves of steering column lower shroud using two crosshead screws.

27. Refit spring and indicator cam.

28. Refit and secure steering column upper shroud with one crosshead screw.

29. Refit and centralise steering wheel, refer to operation 13 523. Tighten retaining nut to 28 to 34 Nm (2,8 to 3,4 kgf.m 20 to 25 lbf.ft), Fig.17.

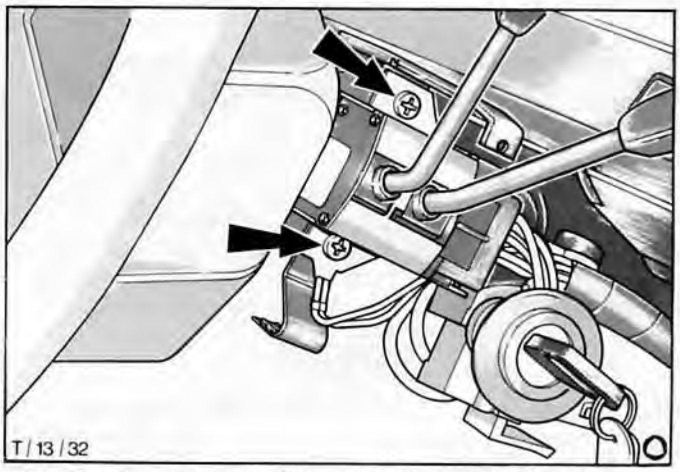


Fig.16. Reconnect multi- function switches to steering column.

30. Refit steering wheel centre emblem.

31. On diesel variants only refit cooling system hoses and refill system. Replace coolant loss from drip tray using specified antifreeze or corrosion inhibitor and water solution.

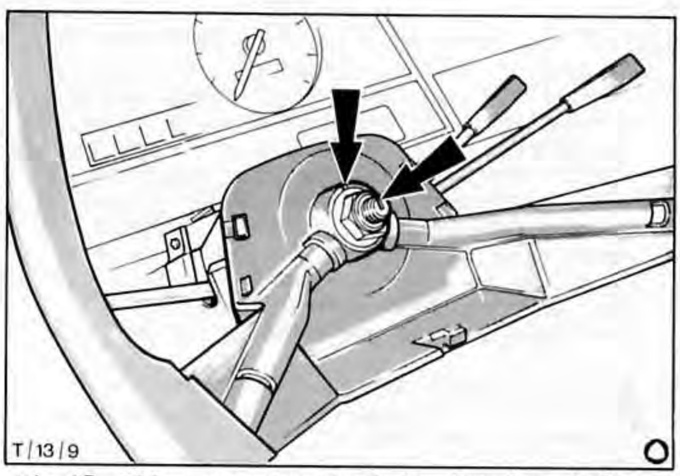


Fig.17. Align steering wheel to steering shaft.

13 116

Realignment Procedure

If during the steering gear installation difficulty is experienced in installing the steering shaft tube (Operation 13 and/or 15) or either of the dimensions obtained in Operations 19 or 20 are in excess of 8 mm the following procedure should be employed to correct these conditions.

The realignment procedure is broken down into three sections as follows:

A - STEERING SHAFT TOO HIGH

Steering column tube fouls pedal box bracket/belt rail during assembly.

Rework apron bracket by drilling the two holes 'B' and 'C' to 12 mm to permit gear and shaft assembly to rotate about hole 'A' and allow clearance condition at pedal box bracket, Fig.18.

NOTE: Ensure holes are free from burrs since this will affect horizontal positioning. Touch in reworked area with body coloured paint.

B - STEERING SHAFT TOO LOW

In excess of 8 mm between pedal box bracket and steering shaft tube

Alignment 8 mm to 14 mm too low

This can be overcome by positioning a maximum of three 2 mm thick washers to each stud, between the pedal box bracket and the steering shaft tube bracket, e.g. if alignment measures 10 mm then fit one washer to each stud. Fig.19.

Alignment 14 mm to 24 mm too low

Carry out operations detailed in 'A' and use three packing washers per stud

C - STEERING SHAFT DISPLACED HORIZONTALLY

In excess of 8 mm between the steering shaft and the pedal box bracket

If the horizontal displacement is between 8 and 12 mm. File slots in the belt rail/pedal box bracket location to a maximum of 4 mm, as shown in Fig.20.

If the horizontal displacement is 12 to 16 mm file out as described in the operation above and loosen the nuts securing the pedal box to the bulkhead.

NOTE: It is not necessary to remove the servo/master cylinder for access to these nuts.
Tighten the steering shaft tube bracket to belt rail nuts and apply pressure to the pedal box in the required direction to improve alignment. Resecure the pedal box to bulkhead.

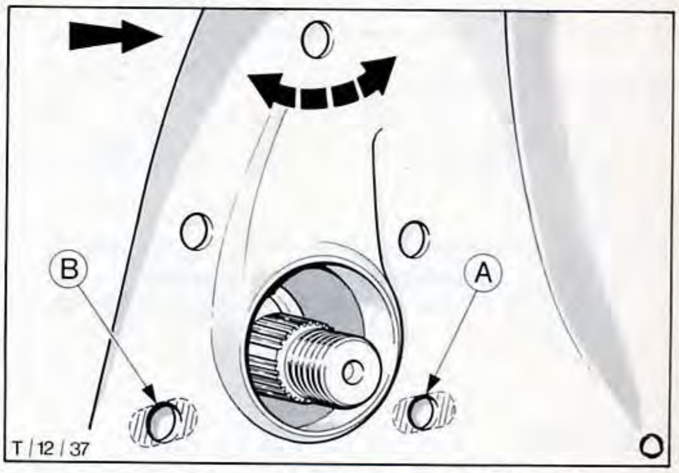


Fig.18. Rework apron bracket by drilling holes 'A' and 'B' to 12 mm.

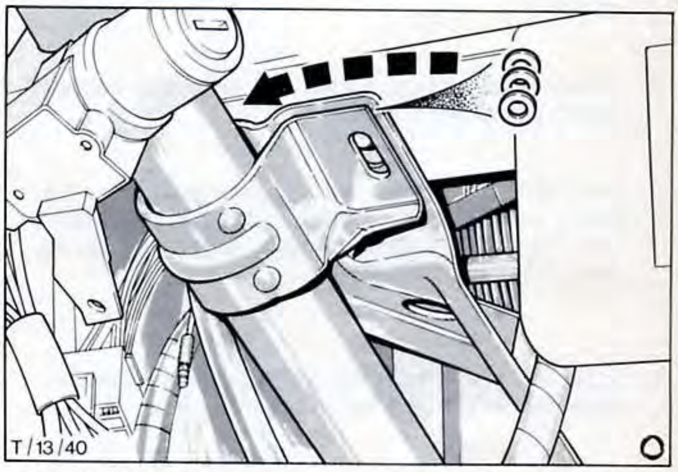


Fig.19. Insert 2 mm thick washers between steering shaft and column brackets.

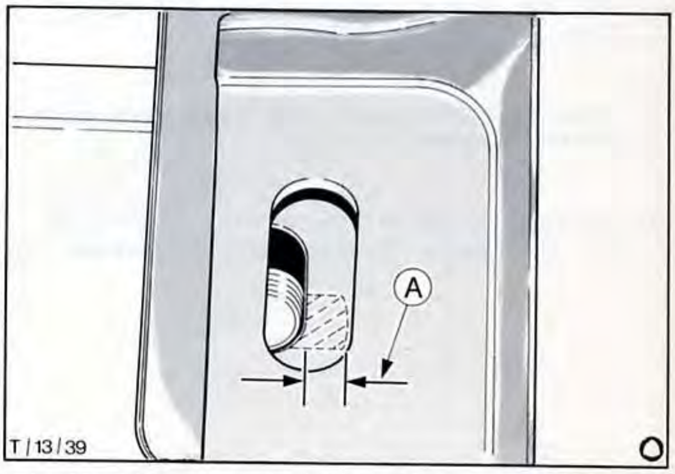


Fig.20. File slots in belt rail and pedal box to compensate for horizontal displacement.
A - Maximum of 4 mm

13 116 8 STEERING GEAR ASSEMBLY - OVERHAUL

SPECIAL SERVICE TOOLS REQUIRED

'C' Spanner 13 002
Torque gauge 15 041

NOTE: The procedure detailed below is for the standard steering gear. For overhaul procedure of the Burman Heavy duty refer to page 14.

To Dismantle

1. Remove rocker shaft adjusting screw locknut.

2. Remove bolts securing rocker shaft cover to housing, remove cover and rocker shaft assembly.

3. Screw in adjusting screw and separate rocker shaft and cover, Fig.21.

4. Bend back lock tang and slacken off steering shaft adjusting screw locknut using Special Service Tool 13 002. Remove adjusting screw and lock tab, Fig.22.

5. Unscrew thrust bearing adjuster and withdraw steering shaft and bearings from housing.

6. Remove clamp securing transfer tube to worm nut, remove transfer tubes and sixty-two steel balls, Fig.23.

NOTE: The worm shaft, nut and balls are matched sets and are not serviceable as individual items.

7. Prise out bearing cups from housing and upper bearing adjuster.

8. Thoroughly clean all components, inspect for wear and damage. Replace parts as necessary.

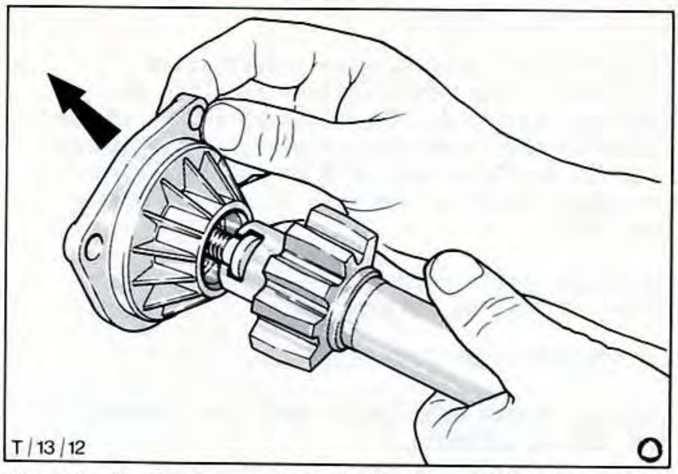


Fig.21. Separate rocker shaft from side cover and adjusting screw.

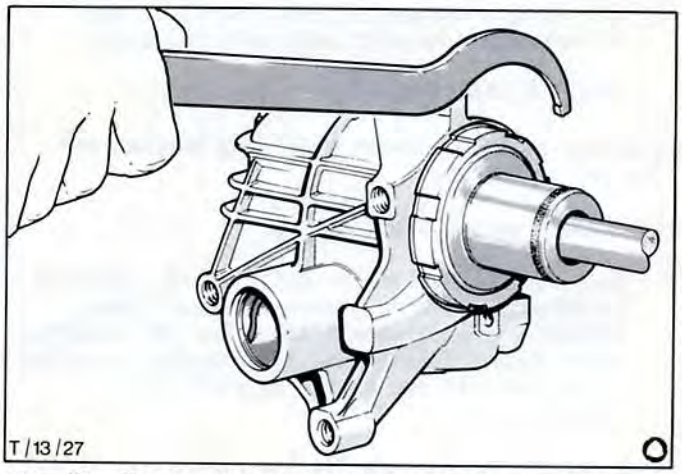


Fig.22. Remove thrust bearing adjuster, using service tool 13 002.

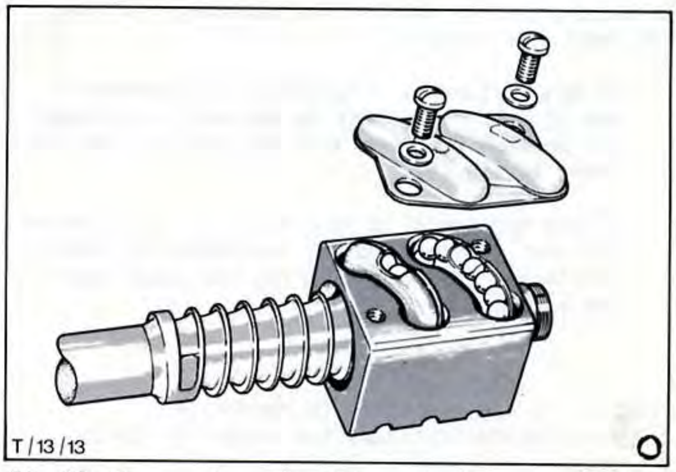


Fig.23. Remove transfer tube and sixty-two (62) steel balls.

To Assemble

9. Fit new bearing cups to housing and upper bearing adjuster, renew seal.

10. Slide worm nut over steering shaft, support worm nut and feed in the sixty-two steel balls. Refit transfer tubes and secure clamp.

NOTE: The steel balls are graded by a process which ensures all are of the same size and matched to the worm and nut.

11. Fit new bearing to worm shaft. Lubricate steering shaft assembly and worm bearings. with grease meeting Ford Specification, SLM-1C9110-A.

12. Fit new worm bearings into housing. Assemble nut and worm shaft assembly to housing.

13. Adjust upper bearing preload by screwing in steering shaft adjuster, screw in until a turning torque of 0,3 to 0,8 Nm (3,0 to 8 kgf cm - 0,3 to 1,7 lbf.in) is measured on preload gauge tool No. 15 041 Fig.25.

14. Holding steering shaft adjuster screw in position replace lock tab and lock nut, tighten to specified torque (see Technical Data).

15. Recheck turning torque of steering shaft, if correct, bend over lock tab.

16. Select adjusting screw shim to give a clearance between screw head and contact surface in rocker shaft 0,05 mm (0,002 in).

NOTE: Thickness of shims must be selected to ensure that adjusting screw can rotate freely.

17. Replace rocker shaft adjusting screw into cover.

18. Position rocker shaft side cover to rocker shaft, loosely fit locknut.

19. Fill steering gear with 2,2 Kg. of grease meeting Ford specification SLM-1C9110-A.

20. Fit new side cover gasket, slide rocker shaft assembly through housing, ensure correct tooth mesh. Secure rocker shaft side cover with three bolts and lock washers. Torque bolts to specification (see Technical Data). Fig.26.

21. Centralise steering shaft and adjust rocker shaft pre load as detailed in Operation 13 114 sub operation 7 and 8.

22. Tighten adjusting screw locknut.

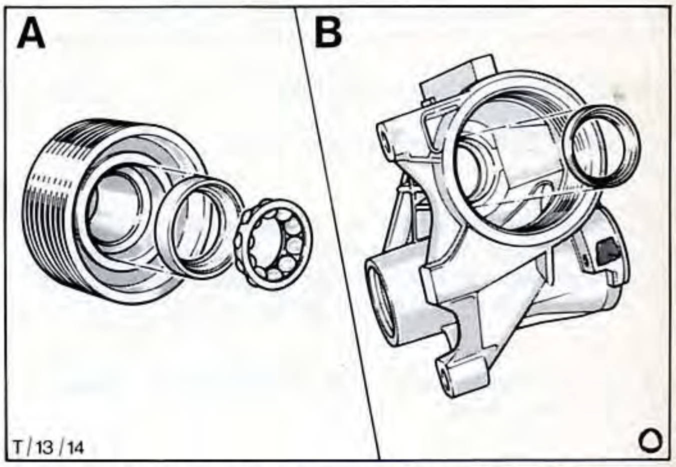


Fig.24. Assemble bearing cups into steering gear housing.
A - Locate upper bearing cup into adjuster
B - Locate lower bearing cup into steering gear housing

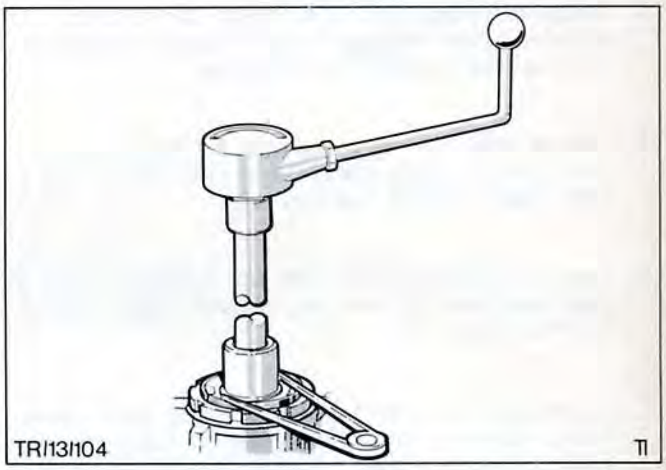


Fig.25. Check steering gear turning torque using Service tool 15 041.

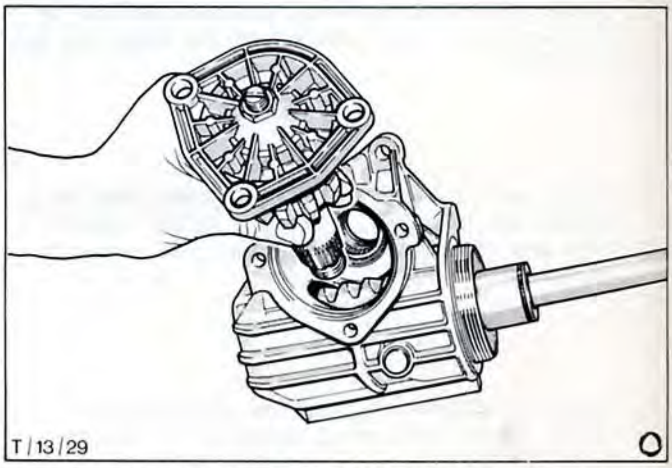


Fig.26. Assemble rocker shaft through housing ensure correct tooth mesh.

13 116 8 STEERING GEAR ASSEMBLY - OVERHAUL

SPECIAL SERVICE TOOLS REQUIRED: NONE

Heavy Duty Steering Gear only.

1. Drain steering box oil, remove bolts securing side cover to steering box, carefully remove cover and gasket. Remove adjusting stud and locknut from cover. Fig.27.

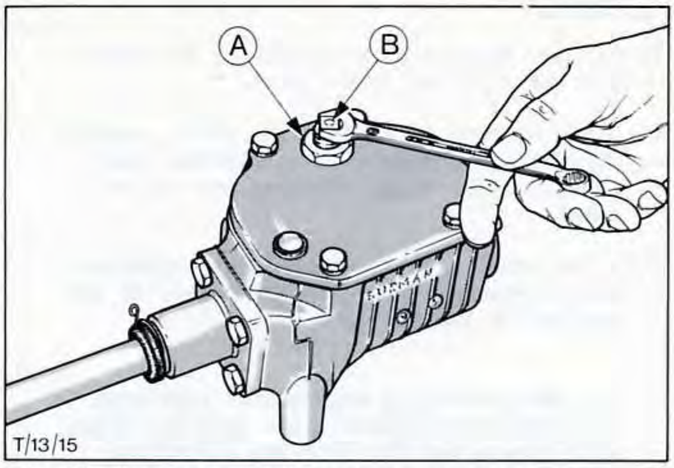


Fig.27. Remove adjusting stud and lock nut.
A - Adjusting screw locknut
B - Rocker shaft adjusting screw

2. Slide rocker shaft out from housing, remove sliding pivot.

3. Remove upper bearing retainer bolts, remove retainer gasket and shims from shaft.

4. Place steering gear over clean drain tray. Withdraw steering shaft until upper thrust bearing cup is clear of housing.

5. Remove upper bearing cup and thirteen (13) steel balls, also remove ten (10) steel balls from lower thrust bearing cup.

6. Remove steering shaft and nut assembly through side aperture of housing, remove lower thrust bearing cup.

7. Clamp steering shaft in vice using soft jawed vice, remove clamp from transfer tube, remove both halves of tube. Remove twenty seven (27) balls Fig.28.

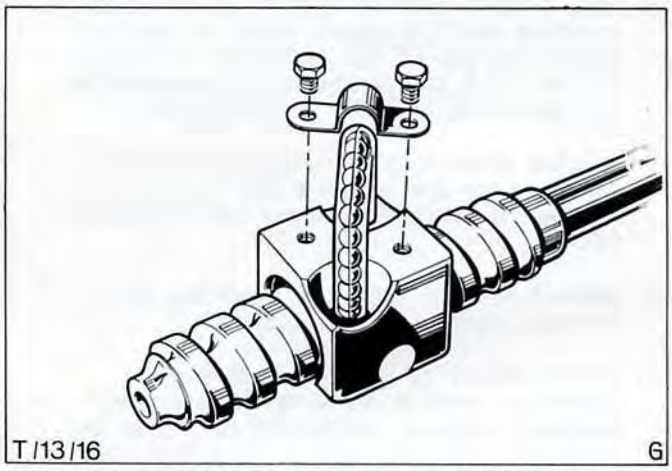


Fig.28. Remove transfer tube and steel balls.

NOTE: Care should be taken not to lose any of the steel balls. The twenty seven (27) balls are graded by a process which ensures all are of the same size, and matched to the worm and nut assembly.

8. Remove and discard the 'O' ring and seal from behind the retainer. Inspect rocker shaft bush and if unserviceable carry out sub operations 9 and 10.

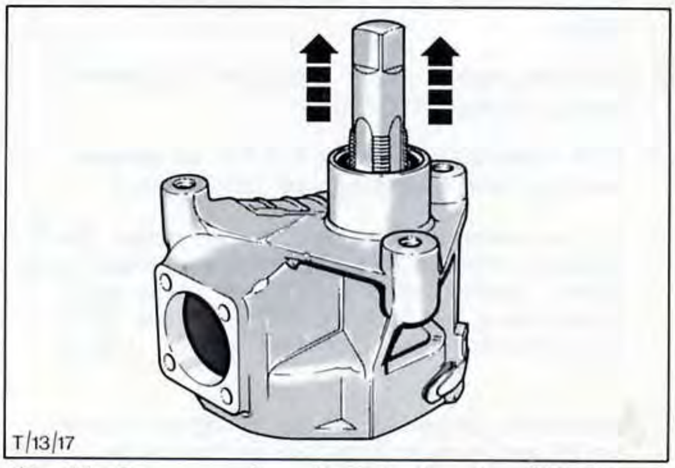


Fig.29. Remove rocker shaft bush using 7/8 BSP tap.

9. Carefully remove the staking from end of rocker shaft bore using suitable chisel, discard retainer.

13 116 8

10. Remove rocker shaft bush by screwing a 7/8 B.S.P. tap into shaft bush and pressing out tap and bush from housing. Fig.29.

11. Clean and inspect all parts, replacing any which are unserviceable.

NOTE: The ball bearings used in the worm nut are larger than those used in the upper and lower bearings. The rocker shaft is replaceable, but shaft worm and nut are only serviced as an assembly.

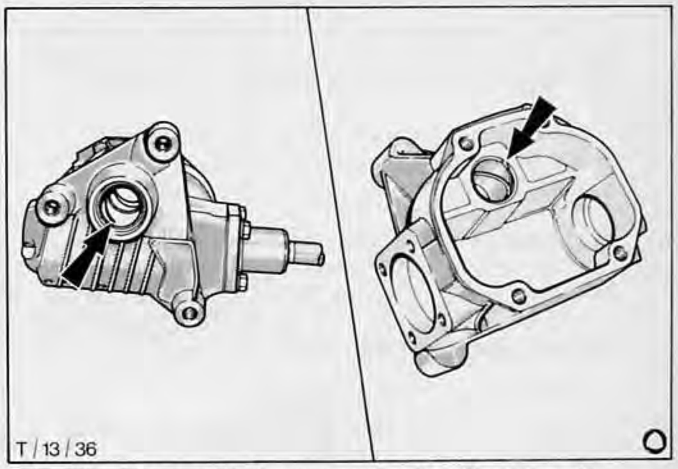


Fig.30. Ensure that open end of oil grove is open to the inside of the steering gear housing.

To Reassemble

12. If rocker shaft bush has been removed, press new bush into housing with open end of oil groove facing inside of housing.

13. Ream shaft bush to a diameter of 28,55 to 28,575 mm (1,124 to 1,125 in) clean all traces of swarf from steering housing Fig.30.

14. Fit new 'O' ring seal and retainer, stake outside of housing in four places to secure retainer, Fig.31.

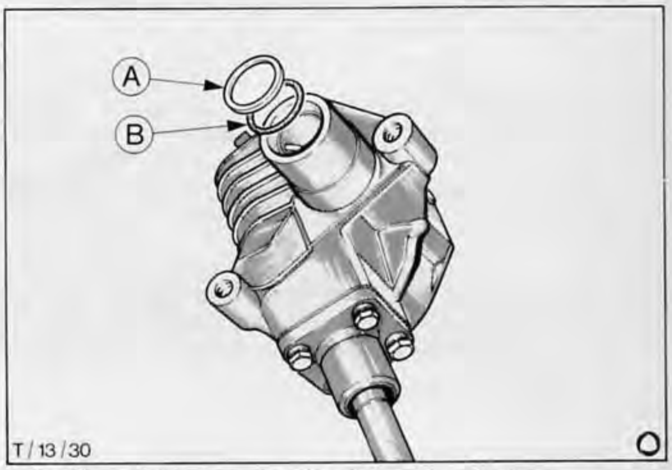


Fig.31. Rocker shaft 'O'ring and retainer.
A - Retainer
B - 'O'ring seal

15. Position worm nut onto steering shaft worm, feed twenty seven (27) steel balls into worm nut and transfer tube.

If difficulty is found in filling all the steel balls, fit transfer tube and carefully turn worm nut on shaft. Remove tube and repeat procedure until all steel ball have been fitted.

16. Clamp steering shaft and nut assembly by securing nut in a soft jawed vice. Fit the transfer tube clamp and bolts, bend over end of clamp to lock bolts.

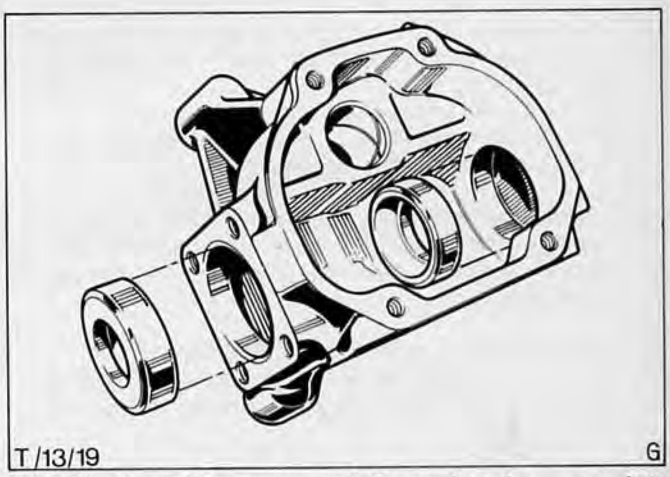


Fig.32. Assemble upper and lower bearing cups into steering housing.

17. Fit lower thrust bearing cup in steering box housing. Pass shaft and nut assembly through the side aperture positioning worm nut with transfer tube away from the aperture.

18. Using a small quantity of suitable grease retain the steel balls in the upper and lower bearings. Carefully pass upper bearing over the steering shaft and locate in housing.

NOTE: There are 13 steel balls in the upper bearing and 10 steel ball in the lower bearing.

19. Fit shim pack and new gasket over steering shaft, secure upper bearing retainer to steering box. Tighten 21 to 25 Nm bolts to (2,1 to 2,5 Kgf.m - 15 to 18 lbf.ft) whilst turning the steering shaft.

NOTE: Turning torque should be achieved without the rocker shaft fitted.

NOTE: When all four securing bolts are torqued to correct specification the shim thickness should just eliminate shaft end float. Shims should be added or removed as necessary until a turning torque of 0,23 to 0,45 Nm (2 to 4 lfb,in) is achieved.

20. Remove bearing retainer bolts and apply sealer to mating faces and bolts, refit bearing retainer and tighten bolts to 21 to 25 Nm (2,1 to 2,5 kgf.m - 15 to 18 lbf.ft). Recheck turning torque of steering shaft.

21. Turn steering shaft so that worm nut is in central position, fit sliding pivot to worm nut, locate rocker shaft to housing to engage on worm nut.

22. Fit new side cover gasket, fit side cover and secure torque bolts to 21 to 25 Nm (2,1 to 2,5 kgf.m - 15 to 18 lbf.ft).

NOTE: Coat the two shorter bolts with suitable sealer to prevent oil seepage up the threads.

23. Coat rocker shaft adjusting screw with sealer and screw into side cover until the maximum overall gear turning torque is 1,0 to 1,5 Nm (9 to 13 lbf,in) when the steering gear is in the central position. Fit and tighten locknut to secure adjusting screw.

NOTE: When the steering gear is fitted to the vehicle the drag link must be disconnected befor checking steering gear turning torque, (pre-load).

24. Fill steering gear with 0,42 litre (0,74 pints) of SAE80 (specification SQM2C 9008 AA) steering gear oil, through filler hole, fit filler plug.

NOTE: When assembled the steering gear should turn smoothly without harshness from lock to lock. At no stage should the turning torque exceed the torque in the central position by more than 0,4 Nm (4 lbf,in).

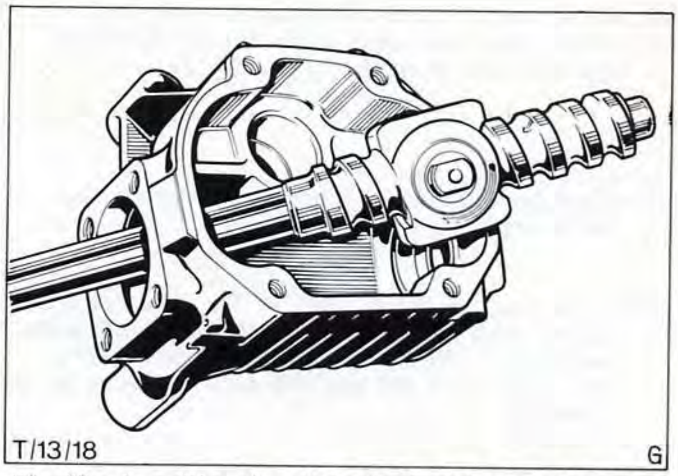


Fig.33. Assemble steering shaft and nut through steering box housing.

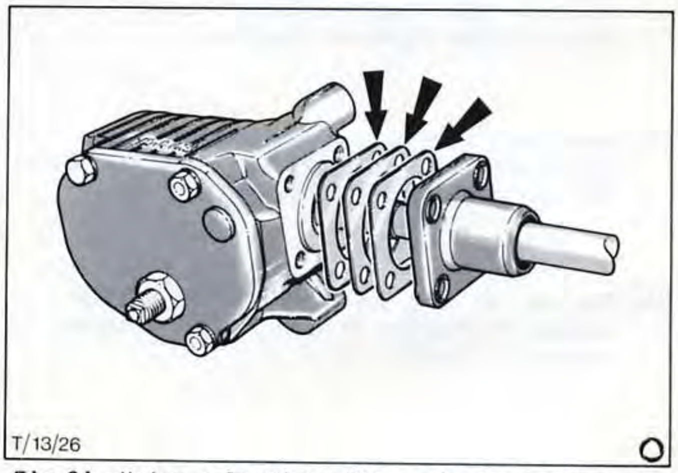


Fig.34. Using selective shims adjust steering gear per-load.

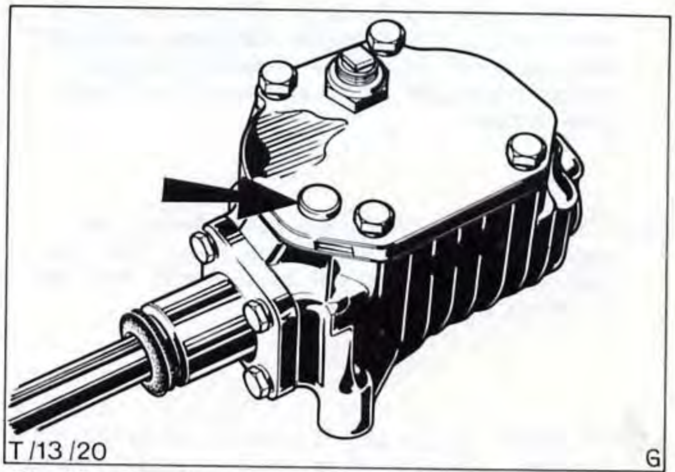


Fig.35. Steering gear filler plug.

13 222 DROP ARM - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator..	13 006
Puller	14 008

To Remove

1. Remove split pin, slacken castellated nut, using service tool 13 006 disconnect drag link from drop arm.

2. Slacken drop arm retaining nut, using service tool 14 008 puller remove drop arm from steering box Fig.36.

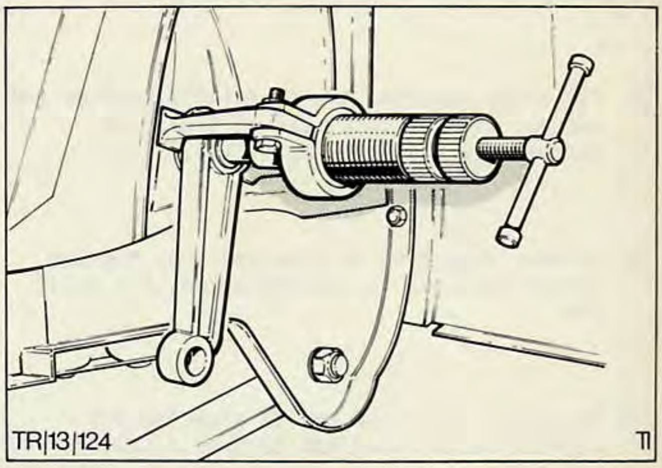


Fig.36. Remove drop arm using service tool 14 008.

To Install

3. Centralise steering, fit drop arm, tighten locknut to specified torque (see Technical Data).

4. Reconnect drag link to drop arm. Fit castellated nut torque to correct specification (see Technical Data), fit new split pin.

5. Centralise steering, adjust drag link if necessary ensure that steering gear is at centre of travel (i.e. high spot) and front wheels are in the straight ahead position.

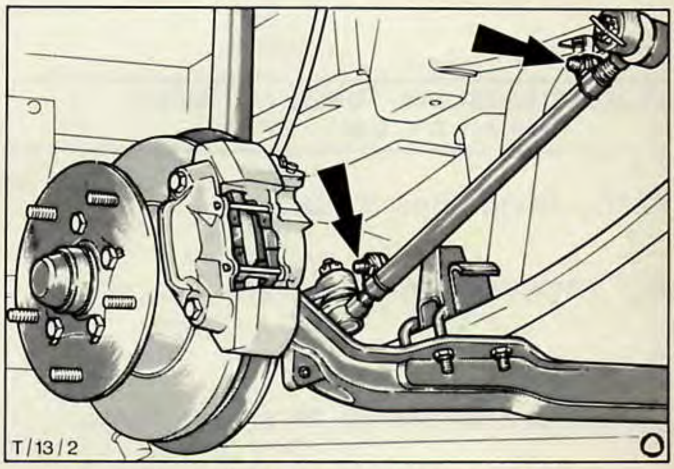


Fig.37. Drag link to drop arm securing nut. Ensure that drag link clamp bolts are upper most.

13 242 STEERING ARM - REMOVE AND INSTALL (drivers side)

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator	13 006

To Remove

1. Jack up front of vehicle and fit chassis stands.

2. Remove split pin and slacken castellated nut securing drag link to steering arm, using service tool 13 006 remove ball joint Fig.38.

3. Remove split pin and slacken castellated nut securing track rod ball joint to steering arm, using service tool 13 006 release taper.

4. Remove lock nuts and bolts securing steering arm to spindle carrier.

NOTE: Before refitting throughly clean off steering arm and spindle carrier.

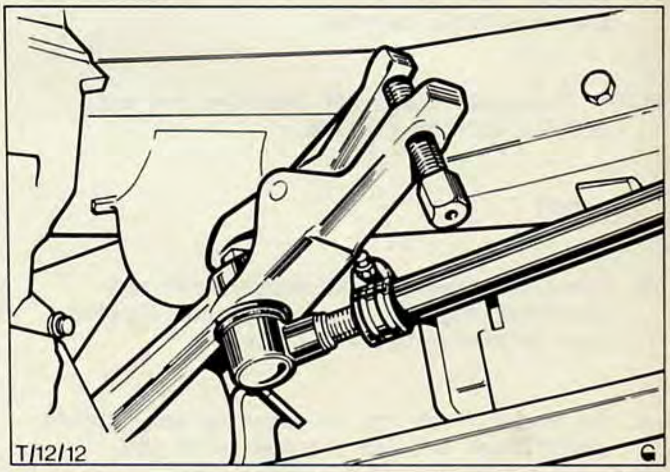


Fig.38. Remove drag link ball joint from steering arm.

13 242

To Install

5. Fit clean steering arm to spindle carrier and secure, tighten lock nuts to specified torque (see Technical Data) Fig.39.

6. Connect drag link to steering arm, tighten castellated nut to specification, fit split pin.

7. Reconnect track rod end to steering arm tighten castellated nut to specification, fit split pin.

8. Remove chassis stands and lower vehicle.

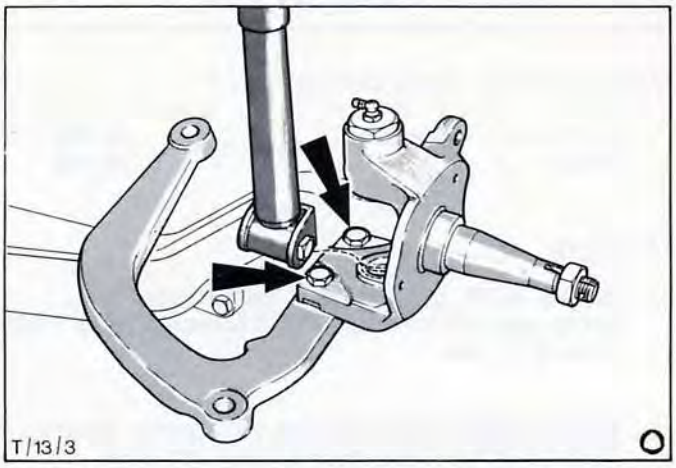


Fig.39. Steering arm fixing bolts (drivers side).

13 242 STEERING ARM - REMOVE AND INSTALL (non-drivers side)

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator 13 006

To Remove

1. Jack up front end and fit chassis stands.

2. Remove track rod end split pin, slacken castellated nut. Using service tool 13 006 disconnect track rod end from steering arm Fig.40.

3. Remove lock nuts and bolts securing steering arm to spindle carrier.

NOTE: Throughly clean off steering arm and spindle carrier fixture.

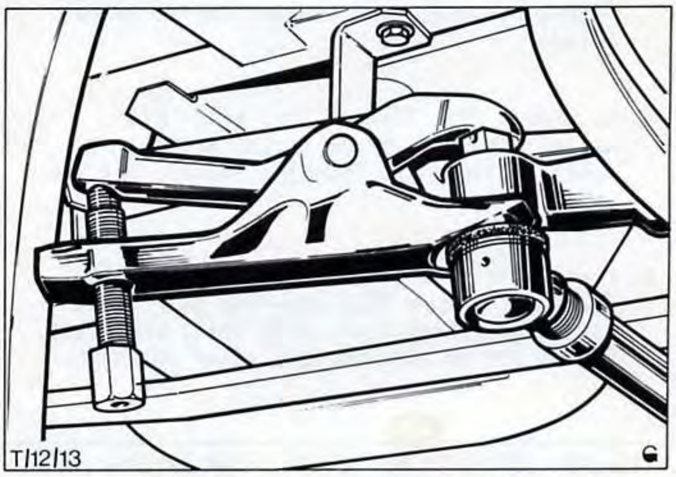


Fig.40. Remove track rod end from steering arm using service tool 13-006.

To Install

5. Fit clean steering arm secure with new locknuts, tighten to correct specification (see Technical Data). Fig.41.

6. Reconnect track rod to steering arm, tighten castellated nut and fit new split pin.

7. Remove chassis stands and lower vehicle.

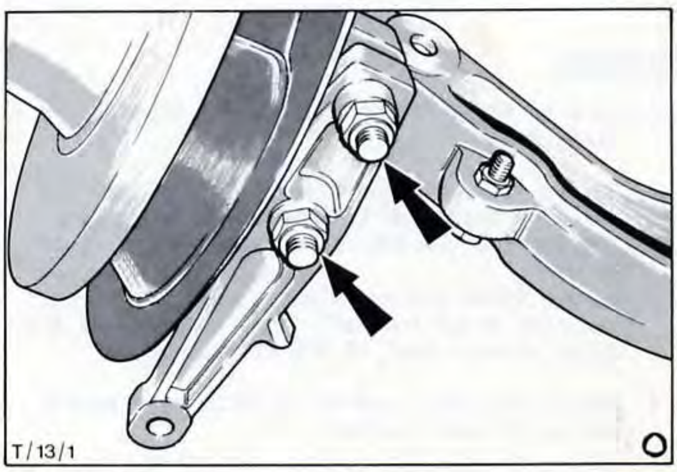


Fig.41. Steering arm fixing bolts. (non-drivers side)

13 252 DRAG LINK ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator 13 006

To Remove

1. Remove split pins and slacken castellated nuts securing drag link ends to steering arm and drop arm.

2. Using special service tool 13 006 release tapers, and remove drag link Fig.42.

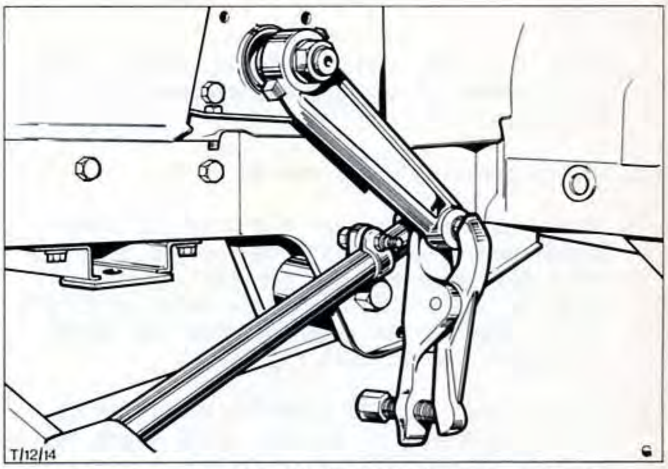


Fig.42. Detach drag link from drop arm using service tool 13 006.

To Install

3. Connect drag link to drop arm and steering arm, tighten castellated nuts to correct torque (see Technical Data).

4. Slacken off clamps, centralise steering, adjust drag link, if necessary. Ensure that steering gear is at its centre of travel position and front wheels in the straight ahead position.

NOTE: Drag link clamps should be positioned with clamp bolt above the drag link and bolt head towards centre of vehicle Fig.43.

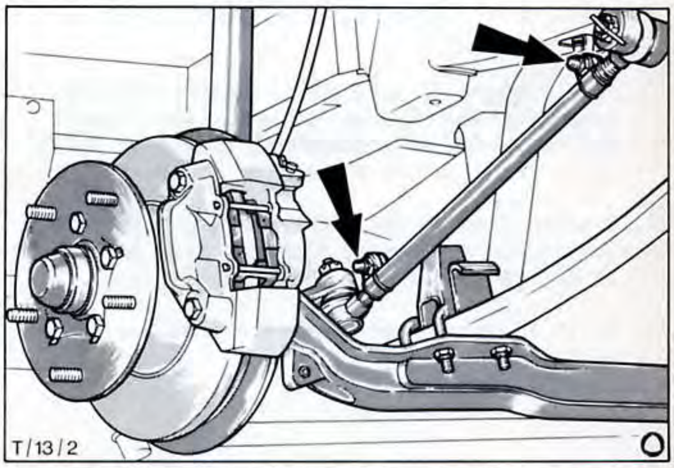


Fig.43. Assemble drag link clamp bolts uppermost with bolt heads towards centre of vehicle.

13 254 END - DRAG LINK - REPLACE

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator 13 006

To Remove

1. Jack up front of vehicle and fit chassis stands.

2. Set road wheels in straight ahead position.

3. Remove split pin, slacken castellated nut, using service tool 13 006 separate drag link ball joint and steering arm.

4. Slacken clamp bolt on drag link, unscrew drag link end ball joint.

NOTE: The drag link ends have left and right hand threads.

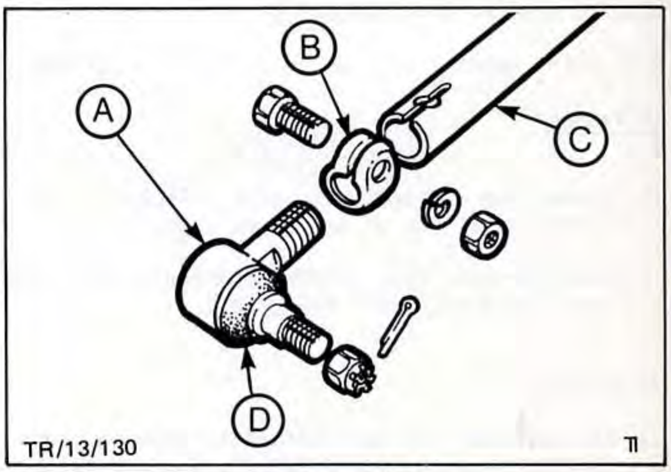


Fig.44. Drag link end assembly.
A - Drag link end C - Drag link
B - Clamp D - Rubber cap

13 254 (cont'd)

To Install

5. Refit drag link end ball joint, ensure that an equal number of threads are engaged into both drag ends.

6. Remove steering wheel emblem.

7. Determine steering gear mid-point of travel (total number of turns from lock to lock 5,5 for a 20:1 gear and 6,5 for 24:1 gear) the steering shaft alignment mark being at 12 o' clock. Centralise steering wheel to shaft. (see Operation 13 523) Fig.45.

8. Connect drag link to steering arm (without moving road wheels) tighten castellated nut to correct torque, fit new split pin.

NOTE: Steering wheel alignment may alter during the fitting of the drag link.

9. Adjust drag link length until steering shaft/wheel is correctly aligned in the 12 o' clock position.

10. Total length of ball joint centres will be approximately 45,5 cm (18 in). This length may be varied to accommodate tolerance build up in the steering mechanism.

11. Tighten clamp bolts, ensure clamp bolts are positioned above drag link and ball joints are at 90° to each other. See Fig.43.

12. Refit steering wheel centre emblem and lower vehicle

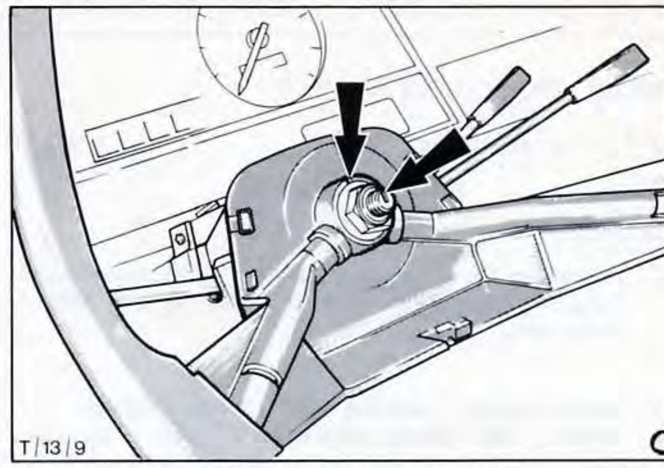


Fig.45. Centralise steering wheel shaft 12 o'clock position.

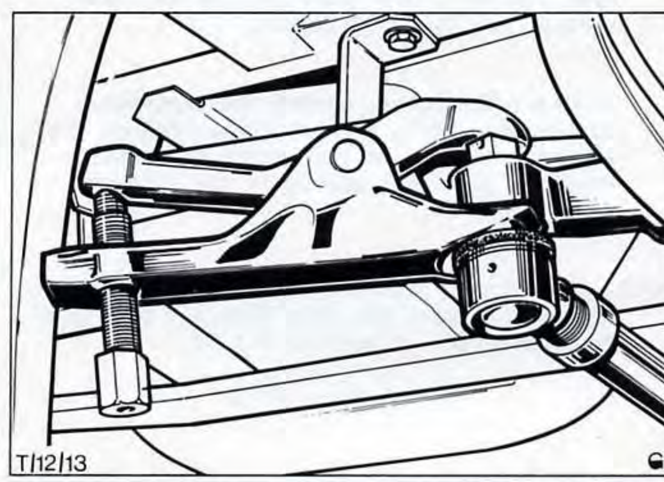


Fig.46. Detach track rod ball joints from steering arms using service tool 13 006.

13 262 TRACK ROD - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator 13 006

To Remove

1. Remove and discard split pins, slacken castellated nuts on track rod ends.

2. Using service tool 13 006 separate joints from steering arms remove track rod.

To Install

3. Locate track rod ball joints in steering arms tighten nuts to specification, fit new split pins.

4. Check and adjust toe-setting if necessary refer to Operation 14 113.

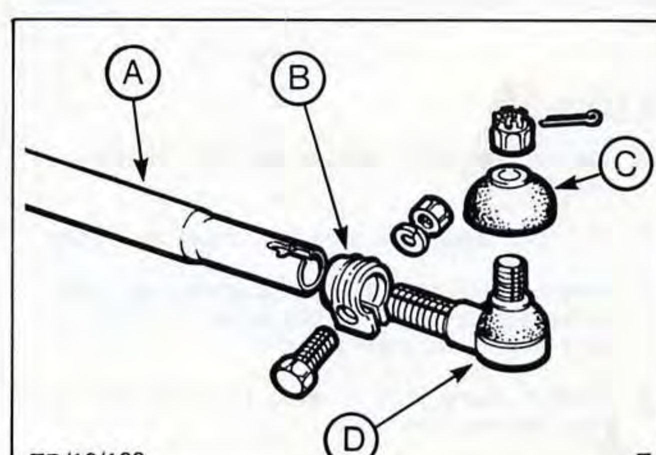


Fig.47. Track rod end assembly.
A - Track rod C - Rubber cap
B - Clamp D - Track rod end

13 273 END - TRACK ROD - REPLACE (one)

SPECIAL SERVICE TOOLS REQUIRED:

Ball joint separator 13 006

To Remove

1. Remove split pin and slacken castellated nut.
2. Using ball joint separator Tool No. 13 006 separate ball joint from steering arm.
3. Slacken clamp bolt on track rod unscrew track rod end.

NOTE: Track rod ends have left and right hand threads.

To Install

4. Refit track rod end, ensure that same number of threads are engaged as original.
5. Refit track rod to steering arm, tighten castellated nut to correct specification. Fit new split pin.
6. Adjust toe setting. Refer to Operation 14 117.
7. Tighten track rod end clamp bolt.

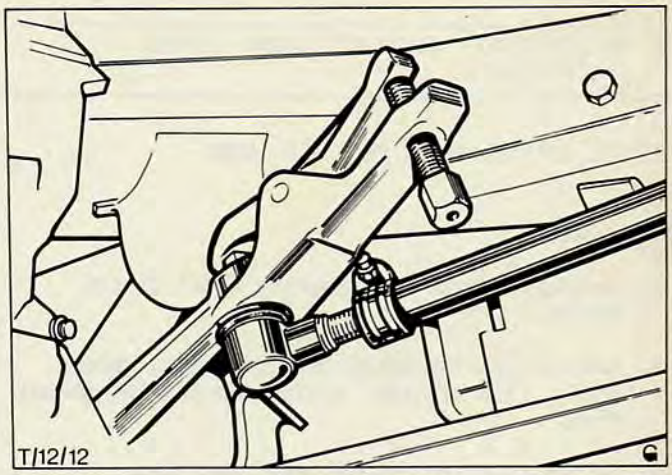


Fig.48. Disconnect ball joint using service tool 13 006.

13 523 STEERING WHEEL - CENTRALISE

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Set road wheels in straight ahead position.
2. Remove steering wheel centre emblem.
3. If alignment mark on steering shaft is within 30° of 12 o'clock position remove steering wheel retaining locknut and centralise steering wheel Fig.49.
4. Refit locknut and torque to 28 to 34 Nm and replace centre emblem.
5. Re-Alignment if more than 30° from 12 o'clock position.

- Slacken drag link clamp bolts and nuts, adjust drag link until alignment mark is in the 12 o'clock position.
- Rotate if necessary through the smallest angle until the clamp bolts are horizontally above the drag link Fig.50.
- Carry out procedures 1 to 4 as detailed above to finally align steering wheel.

NOTE: Each steering shaft spline is equal to 10° so when steering wheel is centralised, shaft alignment marks should be no more than three (3) splines from the 12 o'clock position.

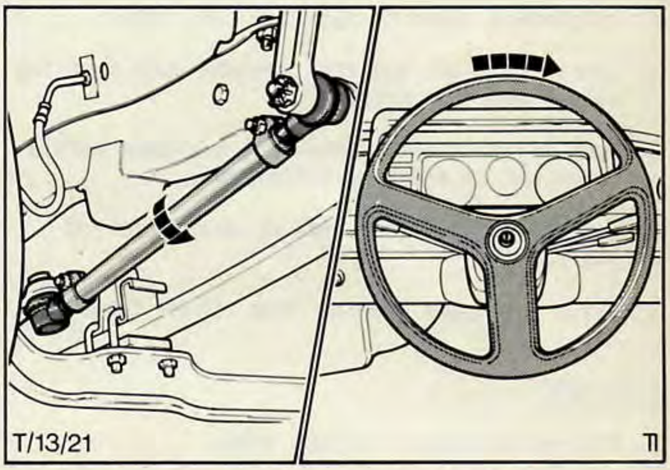


Fig.49. Steering wheel misaligned clockwise, rotate drag link anti-clockwise.

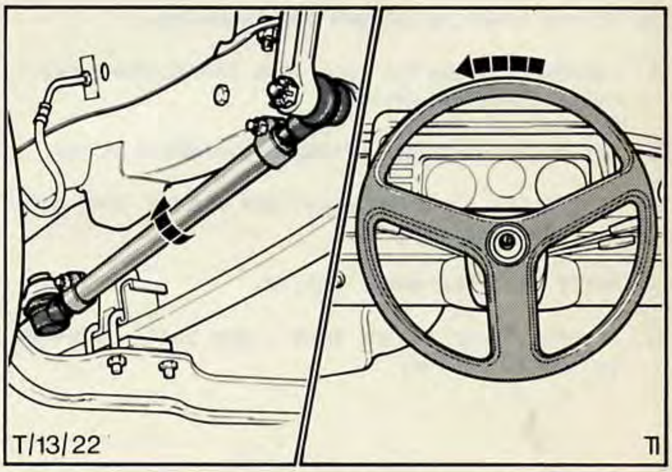


Fig.50. Steering wheel misaligned anti-clockwise, rotate drag link clockwise.

13 548 BEARING - STEERING COLUMN - UPPER - REPLACE)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Carefully prise off steering wheel centre emblem.
2. Remove steering wheel retaining nut, remove wheel, lift off cam, spring and bearing thrust ring.
3. Remove steering column upper and lower shrouds by removing retaining screws.
4. Detach multi function switches and bracket from column.
5. Disconnect steering ignition lock loom.
6. Remove two nuts and flat washers from steering column upper mounting.
7. From engine compartment, loosen clamps bolt at lower end of steering column tube.
8. Withdraw column tube upwards over steering shaft.
9. Prise out upper bearing from column tube.

To Install

10. Fit new bearing to column tube.
11. Position clamp on tube, slide steering column tube over shaft, through dash panel.
12. Carefully locate steering column tube over 'O' ring on steering gear.
13. Secure steering column top mounting.
14. Reconnect steering lock loom connection, refit multi function switches.
15. Refit thrust ring, spring and indicator cam.
16. Centralise steering wheel and secure lock nut to specification.
17. Refit steering wheel emblem.
18. Tighten lower column tube clamp bolt. Tighten to specification.

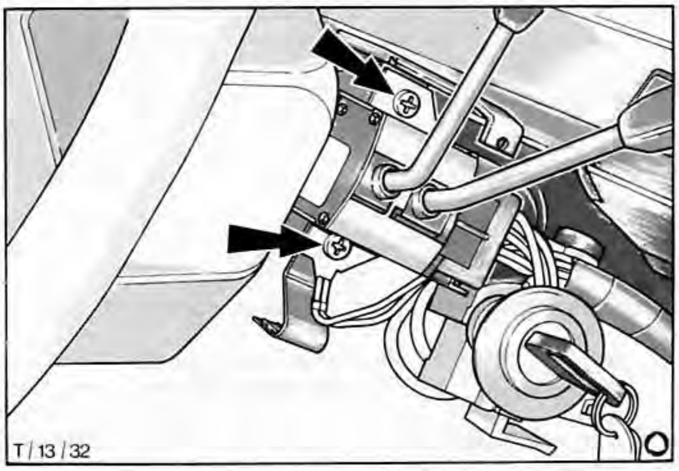


Fig.51. Remove two screws securing multi-function switches.

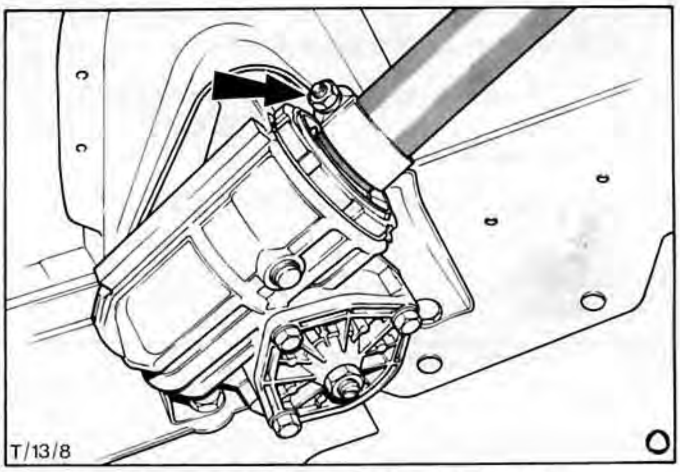


Fig.52. Column tube lower clamp bolt and upper fixings.

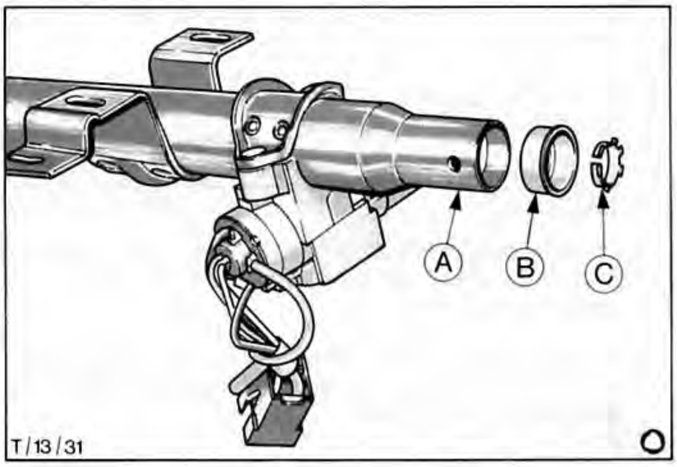


Fig.53. Assemble bearing to column tube.
A - Steering column tube
B - Bearing
C - Thrust ring

TECHNICAL DATA

Type ..	Worm and Nut		
Total pre-load (worm shaft) Standard ..	1,6 to 2,2 Nm for low ratio gear (6 turns) 2,5 to 3,0 Nm for high ratio gear (7 turns)		
Lubrication ..	Grease .. Oil ..		SLM 1C 9110-A SQM 2C 9008-A
Capacity - Standard ..	Grease ..		2,2 Kg.
Capacity - heavy duty ..	Oil ..		0,42 Litre.
Ratio - standard ..	20:1 (6 turns)	24:1 (7 turns)	
Ratio - heavy duty ..	Variable		

Tightening Torques (standard gear)	Nm	Kgfm	lbf.ft
Drop arm lock nut	155 to 185	15,5 to 18,5	114 to 136
Rocker arm side cover	18,6 to 22,6	1,9 to 2,3	14 to 17
Rocker arm adjusting locknut	29,4 to 39,2	2,9 to 3,9	21 to 28
Steering worm shaft adjuster locknut	118 to 147	11,8 to 14,7	87 to 108
Steering column tube lower clamp	20 to 25	2,0 to 2,5	15 to 18
Steering wheel locknut	28 to 34	2,8 to 3,4	21 to 25
Drag and Track rod end castellated nuts	70 to 90	7,0 to 9,0	51 to 66
Steering box to body	54 to 64	5,4 to 6,4	40 to 47
Steering column tube upper column	13 to 16	1,3 to 1,6	9 to 11
Steering arm to spindle	55 to 63	5,5 to 6,3	40 to 46
Drag link and track rod clamp nuts	18 to 21	1,8 to 2,1	13 to 15
Rocker shaft side cover (heavy duty)	21 to 25	2,1 to 2,5	15 to 18
Steering shaft cover plate (heavy duty)	21 to 25	2,1 to 2,5	15 to 18

ENGINE 21C

(3,0 litre V6 engine)

Index

GENERAL DESCRIPTION

TRANSIT variants may be fitted with either a 2.4 litre Diesel engine or a range of petrol engines. The petrol engines are OHC/I-4 and OHV/I-4 engines. A 3,0 litre OHV/V6 engine is available as an S.V.O. (Special Vehicle Option)

OHC = overhead camshaft
OHV = overhead valves
I-4 = in-line engine - 4 cylinders

(This section deals solely with the 3,0 litre V6 petrol engine).

The other petrol engines are described in Section 21A and the Diesel engine is dealt with in Section 21B of this manual.

For simplification, the engines are only identified by a letter in the following description, as is the practice in other Workshop Manuals.

The chart below indicates which engines are fitted.

Engine Summary

Cubic capacity in litres	Compression ratio	Engine type	kW (HP)	Engine code on block	Identification in workshop manual
1,6*	LC	OHV/I-4	47 (63)	LIC	A
1,6	LC	OHC/I-4	48 (65)	LAT	B
2,0 Economy	LC	OHC/I-4	43 (58)	NUT	B
2,0	LC	OHC/I-4	57 (78)	NAT	B
2,0 (with auto. transmission)	LC	OHC/I-4	55 (75)	NAV	B
2,0 (variants with HD version)	LC	OHC/I-4	57 (78)	NAW	B
2,0 (with HD cooling)	LC	OHC/I-4	57 (78)	NAW	B
3,0	LC	OHV/V6	74 (100)	HX	F
2,4	Diesel	OHV/I-4	46 (62)	4AA	G

LC = low compression - suitable for 2 star/regular petrol
* = Great Britain

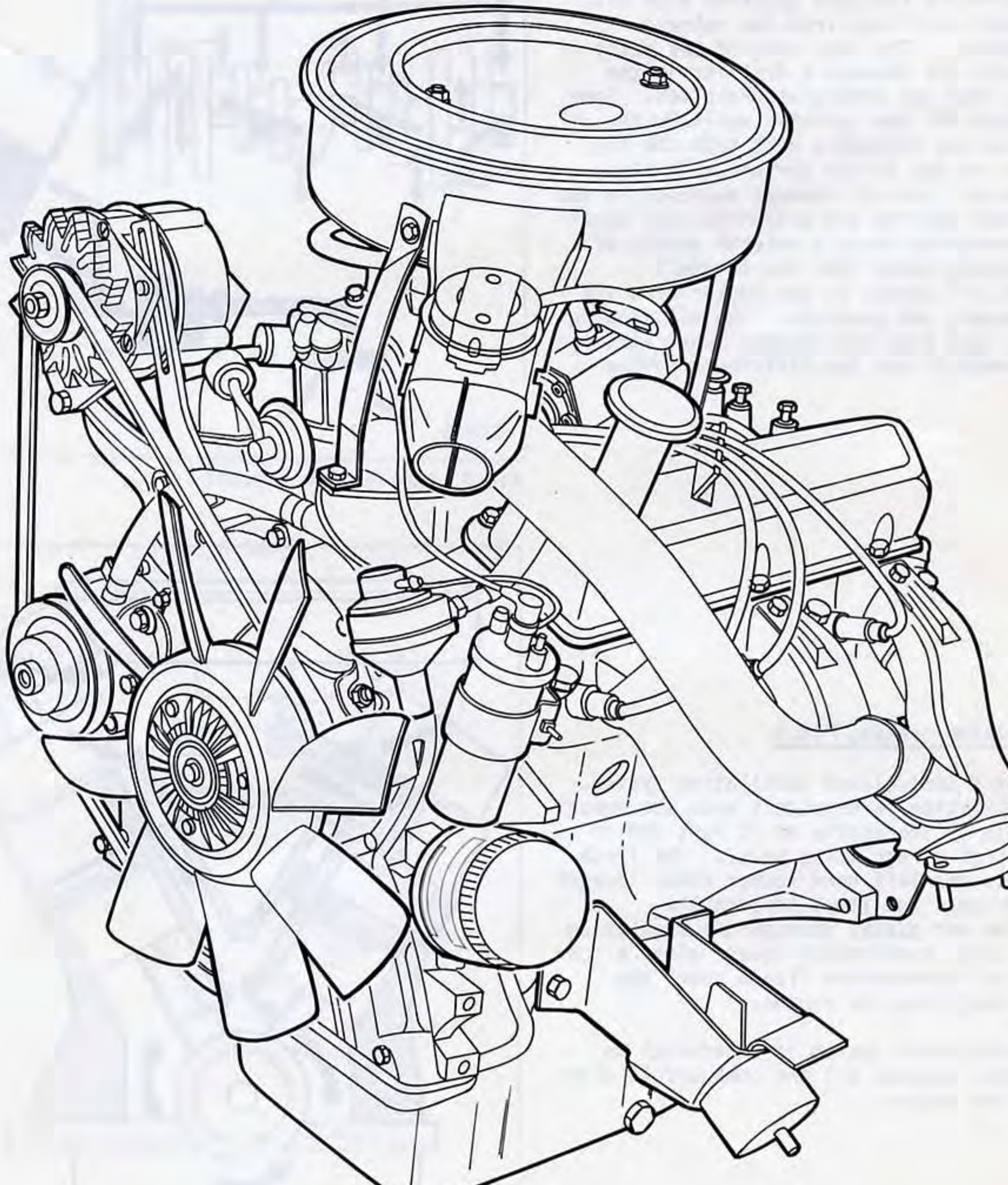
GENERAL DESCRIPTION (cont'd)

The 'F' engine is a 6-cylinder, 4-stroke petrol engine with the cylinder banks disposed in a V configuration at 60°. The overhead valves are operated by means of tappets, push-rods and rockers from a camshaft which is located in the centre of the block.

The cylinder heads are of the cross-flow type with combustion chambers inset into the piston crowns.

The gear driving the distributor and oil pump is located on the camshaft behind the front camshaft bearing.

An eccentric cam mounted in front of the camshaft gear drives the fuel pump which is mounted on the timing cover.



TR21-301

Fig.1. "F" engine.

GENERAL DESCRIPTION (cont'd)

Lubrication circuit, Fig.2

The engine has a pressurised lubrication circuit. The oil pump sucks up the oil in the sump through a gauze strainer and forces it through the full-flow oil filter. The oil pressure is regulated by a relief valve in the pump. From the centre of the oil filter, the oil passes along a connecting drilling to the main oil gallery which lies immediately below the camshaft. Crankshaft and camshaft bearings and the oil pressure switch are supplied with oil direct from the main oil gallery. The timing gears are lubricated through a splash port on the front of the block. The big-end bearing journals are each supplied with oil through diagonal drillings from the nearest crankshaft bearing. The rear side of the piston is splashed with oil through a drilling in the big-end every time the crankshaft revolves. Some of the oil wiped off the cylinder walls by the oil control ring passes through a port into the oil return channel to the piston pin which is also splashed with oil. An oil channel machined in the camshaft journal bearing and extending over about 160° of its periphery feeds a metered amount of oil to the tappets every time the camshaft revolves. The oil passes to the rocker arms via the hollow tappets and pushrods. The oil flowing back into the sump from the tappets lubricates the cams of the camshaft and the distributor drive gear.

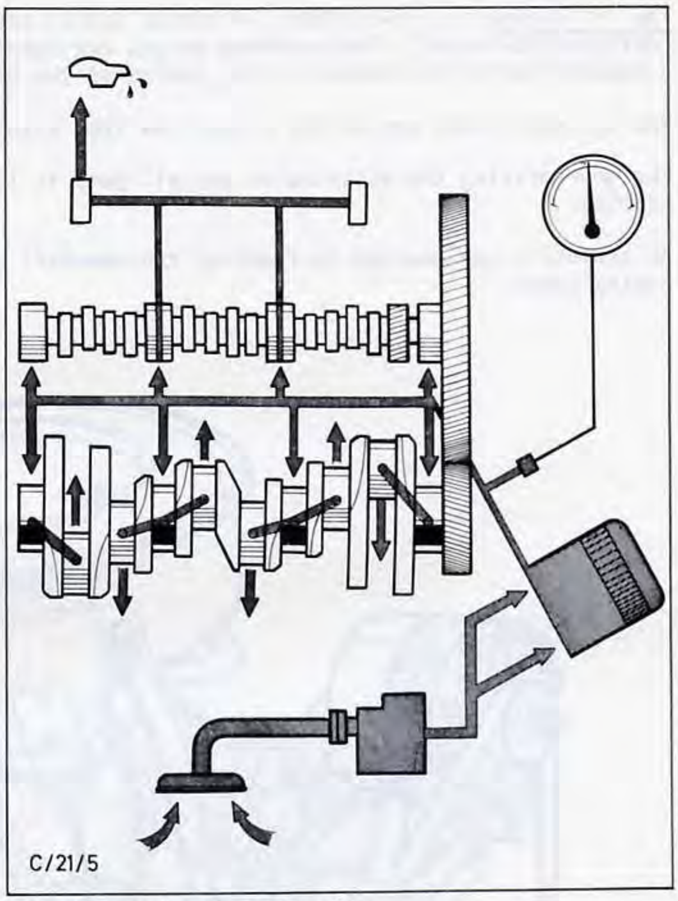


Fig.2. Lubrication circuit.

Closed ventilation system, Fig.3

The engine has a semi-closed ventilation system. Crankcase ventilation is dependent upon the amount of air drawn in by the engine as it runs and on the throughput of a regulating valve. The fresh air passes into the left hand rocker cover through the oil filler neck and flows through the crankcase. The air passes through the regulating valve in the right hand rocker cover, along a hose connected to an intermediate flange under the carburettor, back into the engine.

The engine ventilation system is beneficial to emission control because all the combustible gases are burnt in the engine.

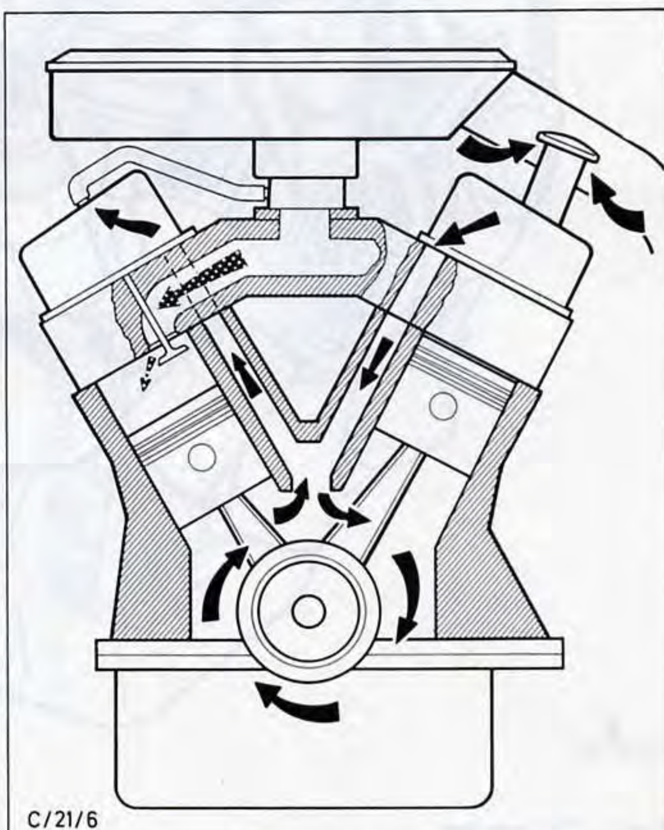


Fig.3. Closed engine ventilation system.

GENERAL DESCRIPTION (cont'd)

Engine identification code and engine serial numbers

In some countries it is a legal requirement that engines have an identification code and serial number, Fig.4 shows where the information is stamped in the engine. The letters and figures must be at least 6 mm high. Code and serial number must be stamped (e.g. on replacement engines) so as to be clearly identifiable by a testing authority.

The engine number consists of a two-digit code for the build year and month and a five-digit serial number. A five-pointed star is stamped before and after the complete seven-digit serial number.

The engine code indicates the cubic capacity and compression ratio of the engine.

Example:

H = 3,0 litres
X = LC (low compression)

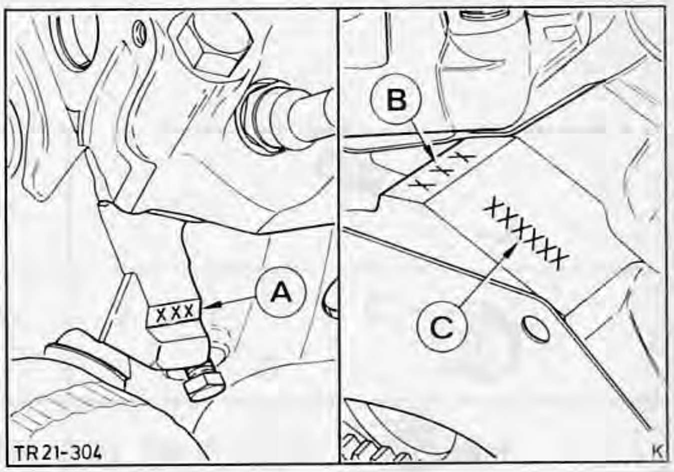


Fig.4. 'F' engine
A - engine code
B - build date
C - engine number

SERVICE ADJUSTMENTS AND CHECKS

When the oil level is checked, the vehicle must be standing on level ground and the engine must be warm. Wait a short time before making the check so that the oil distributed throughout the engine can return to the sump.

Withdraw dipstick, wipe with a non-fluffy rag, reinsert dipstick and withdraw it again (dipstick ring must face outwards). The oil film on the dipstick indicates the oil level in the sump which should lie between the two marks, Fig.5. The amount of oil needed to raise the level from the bottom to the top mark is 1,0 litre. When necessary top up through the oil filler using engine oil to the designated FORD specification.

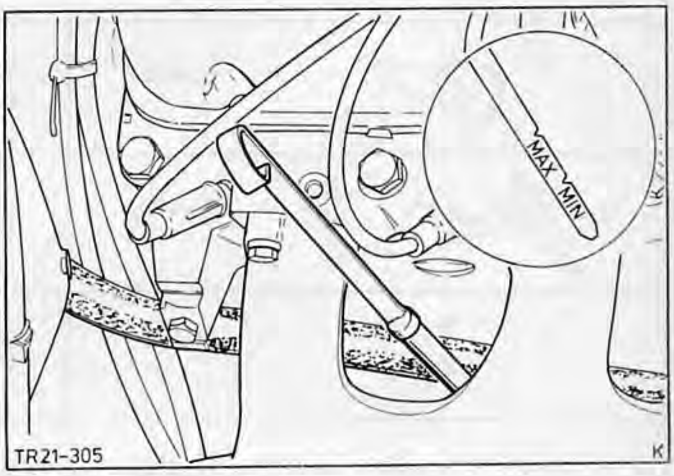


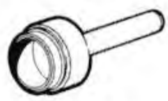
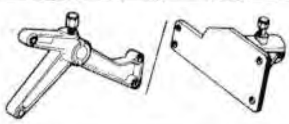
Fig.5. Oil dipstick.

Topping up is only needed when the oil level reaches the bottom mark. Do not let the oil level drop below this. Never top up beyond the top mark as the surplus oil will be wasted, i.e. oil consumption is increased.

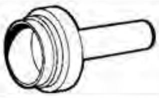
Engine oil and full-flow oil filter must be replaced every 10,000 km (6000 miles). Oil and filter replacement will be required at shorter intervals in severe operating conditions, e.g. lots of short trips, frequent cold starting, dusty roads.

If the specified engine oil is not used, increased wear or engine damage will inevitably result. The oil film will break up and parts under high thermal stresses will wear faster. Residues will collect in the sump and clog the oilways. In addition, poor quality oil does not protect against corrosion so rust will form on cylinder walls. After a fairly short time the engine will lose power and fuel and oil consumption will become unnecessarily high. Always use a branded oil complying with the FORD specification.

SPECIAL SERVICE TOOL RECOGNITION

	21-007	Valve stem oil seal installer
	21-011-B	Crankshaft rear oil seal replacerr (used when oil seal carrier is cut out)
	21-014	Piston pin installer
	21-023	Universal spindle (only used in conjunction with engine stand)
	21-030	Crankshaft rear oil seal installer (used when oil seal carrier is not cut out)
	21-032	Engine mounting bracket (only used in conjunction with 21-023)
	21-033	Engine mounting bracket (attachment for 21-032)
	21-036	Crankshaft needle bearing remover (flywheel bearing remover)
	21-042	Valve guide reamer
	21-044	Flywheel bearing replacer and clutch disc aligner

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

	21-047	Oil seal retainer cutter (seal carrier)
	21-056	Valve spring compressor
	21-059	Crankshaft front oil seal installer
	21-066	Inlet manifold wrench
	21-068	Engine lifting bracket
	21-096	Crankshaft rear oil seal extractor (used when oil seal carrier is cut out)

The existing valve spring compressor 21-056 must be ground down 4 mm at the point shown in Fig.6, to allow trouble-free working on Transit models when the V6 engine is installed.

This modified tool can still be used on other engines.

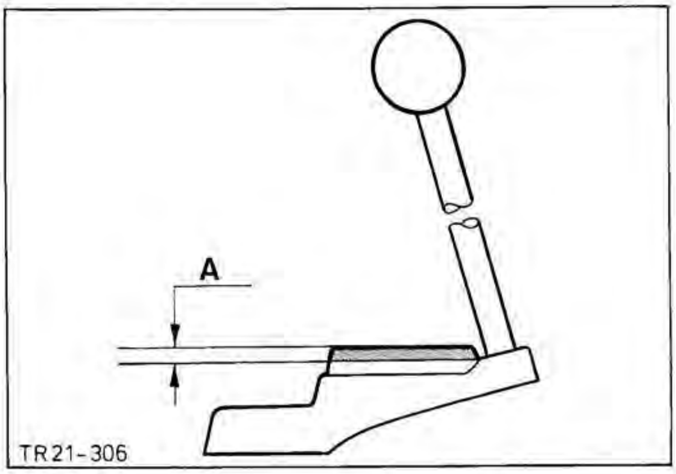


Fig.6. Rework valve spring compressor 21-056.
A - 4 mm

SERVICE AND REPAIR OPERATIONS CONTENT

ENGINE		Described in this Publication	Contained in operation	Also applicable to certain variants in the following model range:				
				FIESTA	ESCORT '81	TAUNUS/CORTINA '80	CAPRI '79	GRANADA '78
21 111	Engine - check compression	X		X	X	X	X	X
21 112	Oil pressure - check	X		X	X	X	X	X
21 132	Engine - remove and install	X						
21 134 8	Engine - dismantle and reassemble (engine removed)	X					X	
21 154	Sump - remove and install	-	21 332					
21 163	Cylinder head - remove and install (one)	X					X	
21 165 5	Cylinder head - replace (cylinder head removed)	X					X	
21 213	Valve clearances - adjust	X					X	
21 231 9	Valve seat - cut (one) (valve removed)	-	21 233 9	X	X	X	X	X
21 233 9	Valve guide - ream (one) (valve removed)	X		X	X	X	X	X
21 238	Seals - valve stem - replace (all)	X					X	
21 332	Timing gears - remove and install	X					X	
21 467	Seal - crankshaft front - replace	-	21 332				X	
21 468 4	Seal - crankshaft rear - replace (engine or transmission removed)	X		X		X	X	
21 505 5	Piston - replace (piston and connecting rod removed)	X		X	X	X	X	X

SERVICE AND REPAIR OPERATIONS

21 111 ENGINE - CHECK COMPRESSION

TESTING EQUIPMENT REQUIRED:

Conventional compression tester

NOTE: Differences in compression tester design and variations in starter motor speeds normally make it impossible to do more than check that the compression is the same in all the cylinders. The actual compression depends on a number of factors and can only be measured if certain preconditions exist.

The engine should be at normal operating temperature and valve clearances should be correctly adjusted.

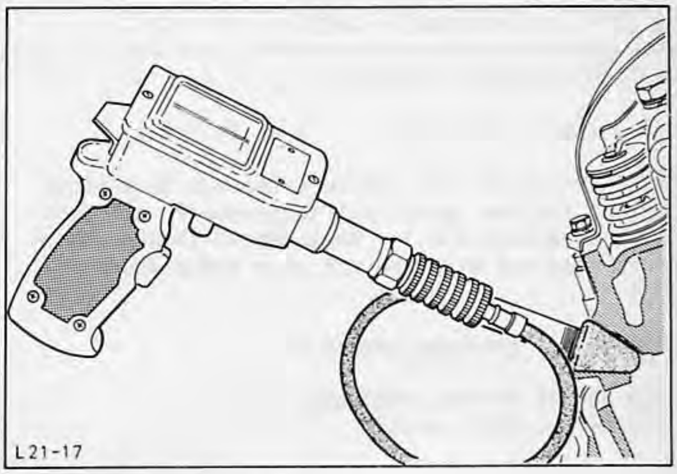


Fig.7. Compression tester.

To check

1. Disconnect low-tension lead from the coil (terminal 15).

2. Disconnect HT leads and remove spark plugs.

3. Insert graph paper in tester. Connect tester, pushing rubber seal firmly into the spark plug bore in cylinder no.1, Fig.7. Crank engine on starter with throttle fully opened until the needle on the tester stops rising.

4. Vent the tester, adjust graph paper for the next cylinder and repeat the procedure described in sub-operation 3 with all the other cylinders.

5. Refit spark plugs and tighten to specified torque. Reconnect the HT leads in the correct order, Fig.8.

6. Reconnect the low tension lead to the coil.

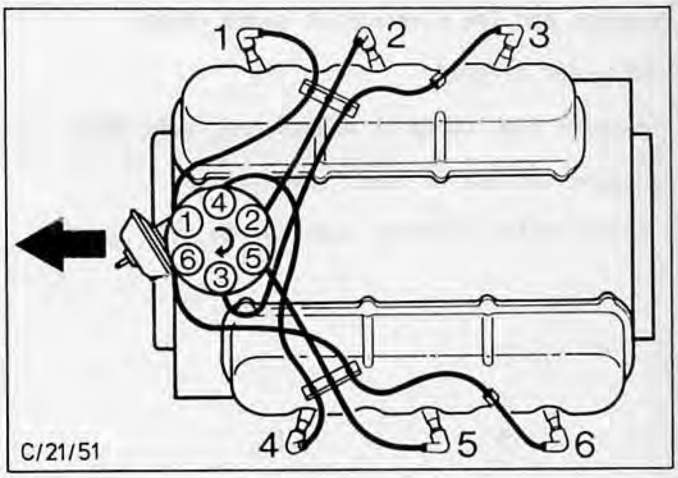


Fig.8. Arrangement of HT leads.

21 112 OIL PRESSURE - CHECK

TESTING EQUIPMENT REQUIRED:

Oil pressure test gauge

NOTE: The actual oil pressure depends on various factors (engine speed, oil temperature, oil pump rotor clearance etc.). Measurement should always be carried out with the oil at a temperature of 80°C.

Minimum oil pressure should be:

1,0 Bar at idling speed and
2,8 Bar at 2000 rev/min

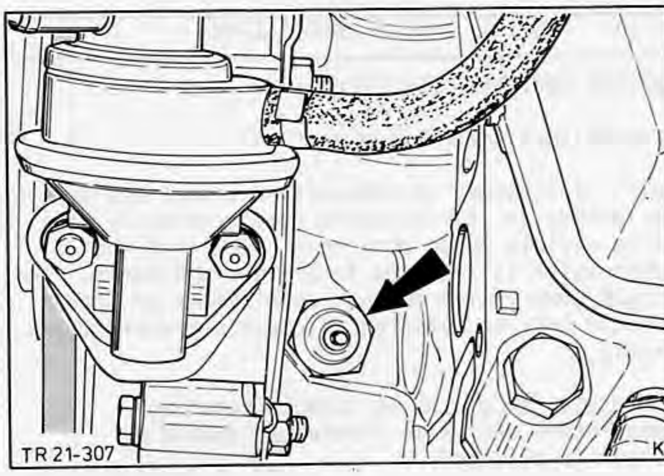


Fig.9. Oil pressure switch.

To measure oil pressure

1. Detach connecting lead from oil pressure switch and unscrew oil pressure switch, Fig.9.

2. Screw test gauge connector into bore for oil pressure switch - use adaptor as necessary.

3. Start engine and check oil pressure at idling speed and at 2000 rev/min.

4. Disconnect test gauge and connectors, refit oil pressure switch and reconnect lead.

If pressures are not as specified, first check the oil pump and relief valve, Fig.19, as the potential source of the fault.

The following faults can occur for instance:

Pressure too high at speeds above 2000 rev/min (approx. 5,5 Bar):

- Relief valve not opening due to dirt ingress.

Pressure too low over entire speed range:

- Strainer clogged.

- Suction pipe loose or broken, oil pump worn.

Pressure too low in lower speed range:

- Relief valve sticking open due to dirt ingress.

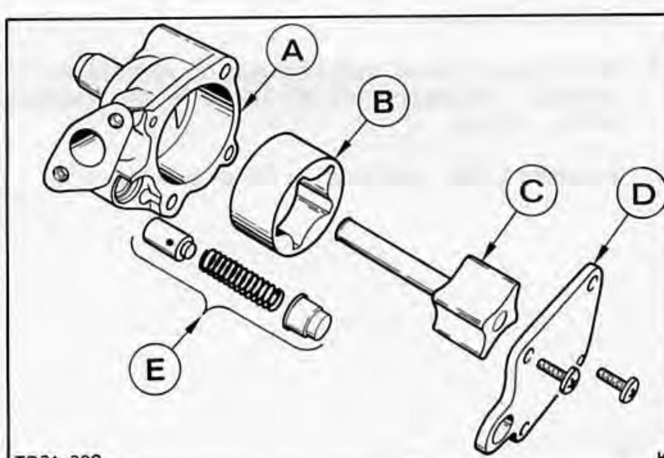


Fig.10. Oil pump dismantled.
A - Casing
B - Outer rotor
C - Inner rotor
D - Cover
E - Relief valve complete

21 134 ENGINE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Engine lifting bracket	21-068

To Remove

1. Disconnect battery earth strap.
2. Disconnect tube of screen washer system at T-piece and unscrew hood at the hinges (4 screws).
3. Detach hot air hose from preheater (1 screw), disconnect vacuum hose and remove air cleaner with brackets (3 screws).
4. Drain coolant into a collecting tray. Do this by detaching the bottom radiator hose from the water pump, Fig.11, and the top hose from the thermostat housing.
5. Unscrew connecting pipe to the overflow tank from the bodywork (2 screws), Fig.12.
6. Detach the bottom end of the radiator from the mountings on the crossmember (2 bolts).
7. Disconnect the hood release cable at the leg spring, Fig.13, and unscrew from the radiator grille panel.
8. Remove right and left hand headlamp units (2 screws in each case).

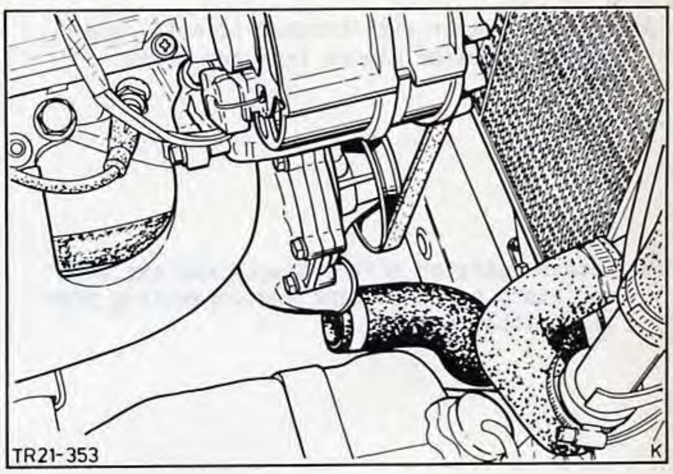


Fig.11. Bottom radiator hose disconnected.

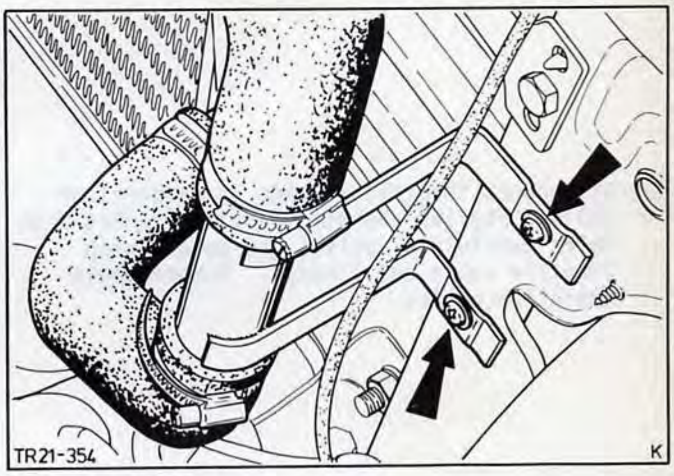


Fig.12. Connecting pipe to overflow tank.

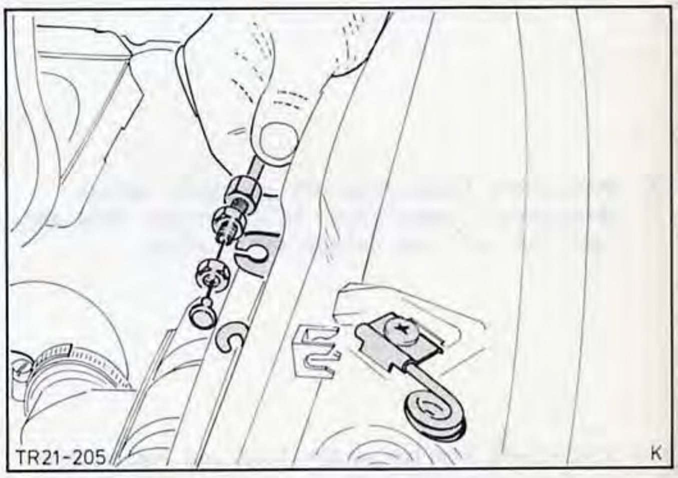


Fig.13. Remove hood release cable.

21 134

9. Release bumper with bracket (2 nuts) and detach the side pieces from the clips.

10. Remove radiator grille panel complete with radiator, overflow tank and connecting pipe (19 bolts), Fig.14.

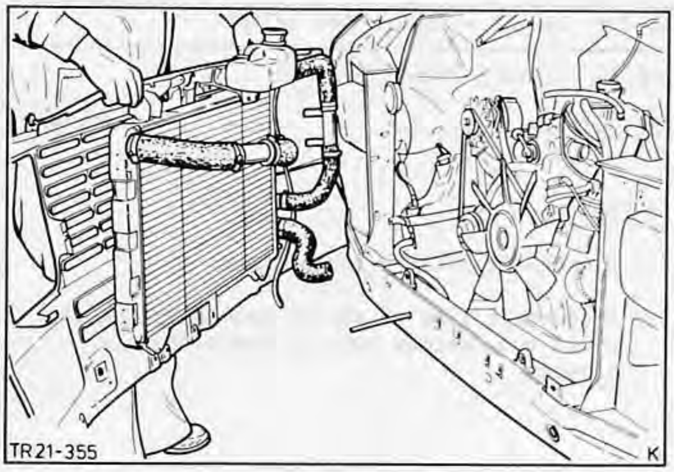


Fig.14. Remove radiator grille panel with radiator.

11. Detach hot water hoses of heater from bulkhead and inlet manifold connector, Fig.15.

12. Disconnect throttle linkage at carburettor (clip), Fig.16. Unbolt mounting bracket from inlet manifold (2 bolts) and detach with throttle cable and linkage. Remove choke operating cable.

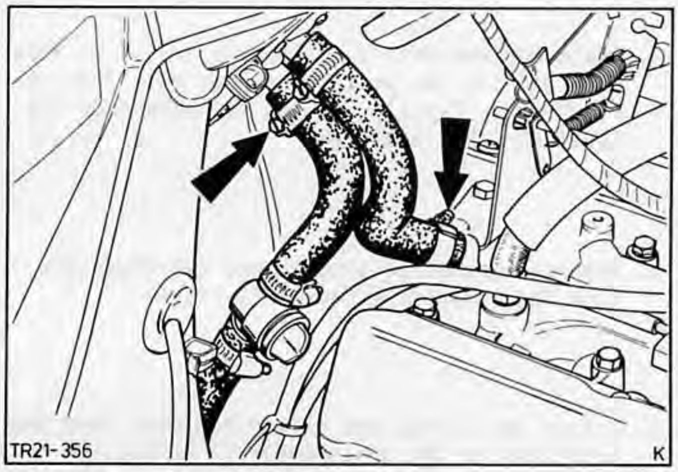


Fig.15. Remove hot water hoses.

13. Detach brake servo vacuum hose from connector on manifold and disconnect fuel line from the fuel pump.

14. Disconnect leads from oil pressure switch, alternator, temperature gauge sender unit and ignition coil and detach earth strap.

15. Disconnect starter motor lead and remove the starter motor (2 bolts).

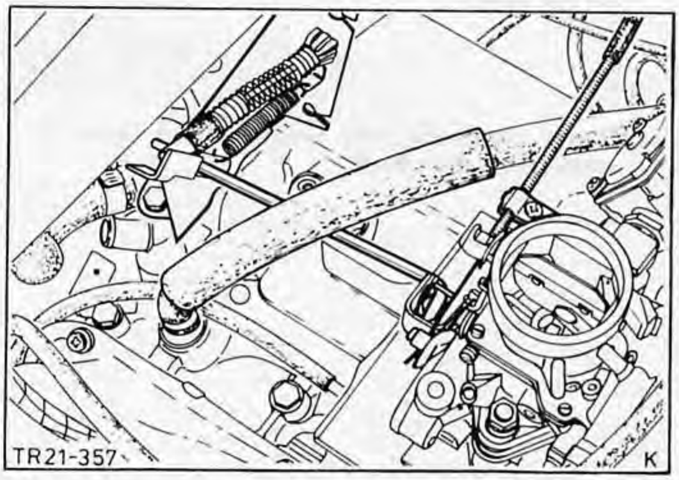


Fig.16. Disconnect throttle linkage.

16. Release the exhaust pipes from the exhaust manifolds (2 nuts in each case), Fig.17.

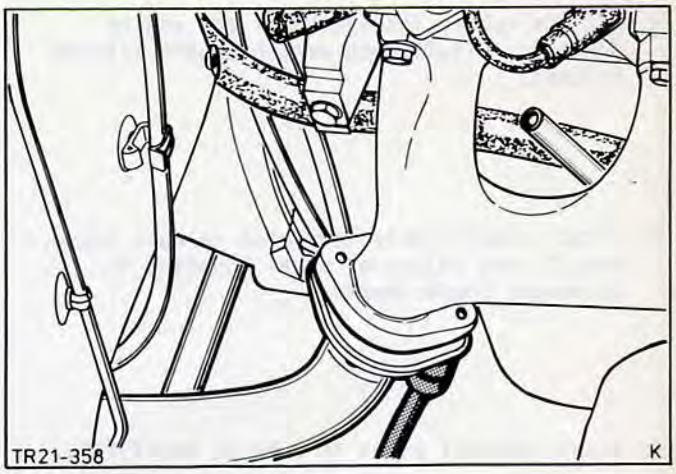


Fig.17. Release exhaust pipe.

17. Slacken clutch cable at pedal mounting in passenger compartment, Fig.18. Disconnect clutch cable from clutch release lever and draw out of the engine mounting.

18. Attach engine lifting bracket 21-068 to the engine, Fig.19. Undo the two rubber insulators from the engine mounting (2 nuts).

19. Remove clutch housing cover (4 clips) and disconnect the engine from the clutch housing flange (6 bolts).

20. Support the gearbox, draw engine forwards with the engine lifting bracket and then lift it out of the vehicle.

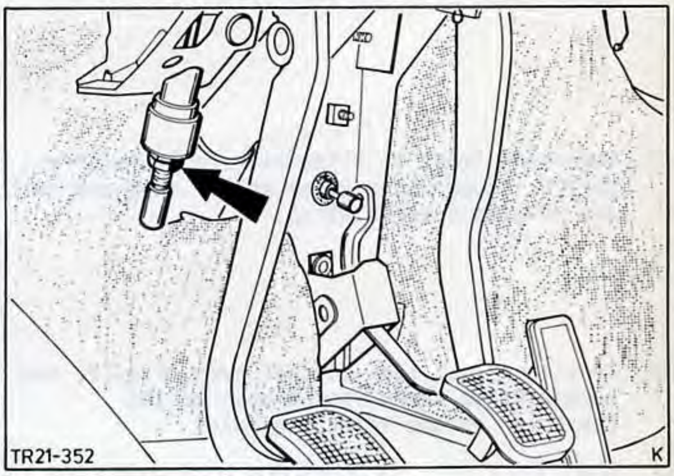


Fig.18. Slacken clutch cable.

To Install

21. Lower engine into the vehicle using engine lifting bracket 21-068. Slide engine onto the lightly greased transmission input shaft and attach to the clutch housing flange using 2 bolts partially tightened.

22. Insert all the flange bolts and tighten them evenly to the specified torque. Refit clutch housing cover.

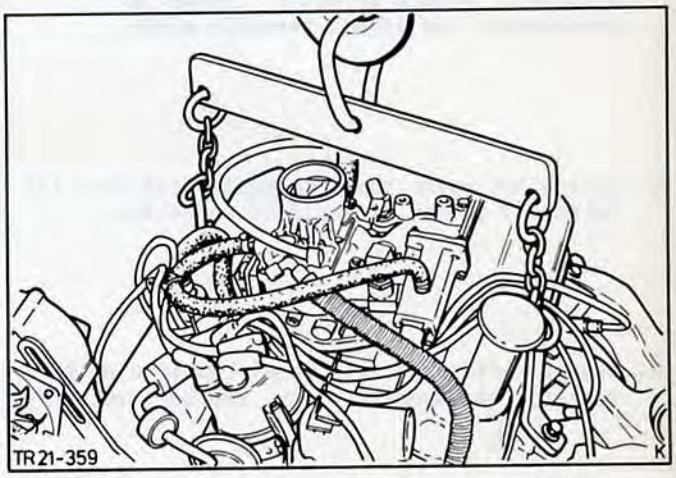


Fig.19. Attach engine lifting bracket.

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23. Fix the rubber insulators of the engine mounting, Fig.20, and detach engine lifting bracket.

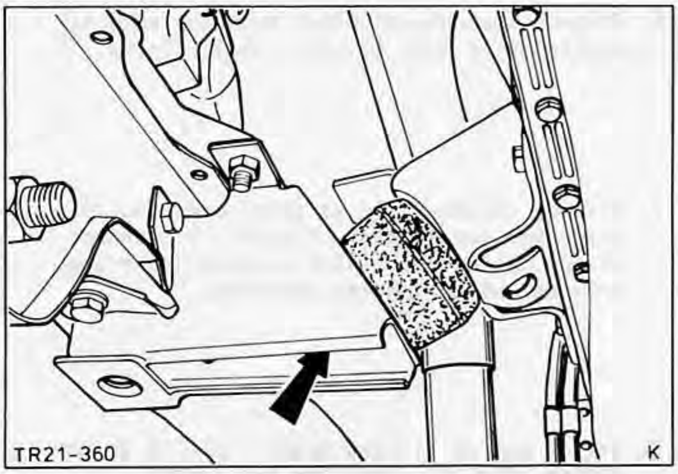

Fig.20. Rubber insulator of engine mounting.

24. Attach clutch cable to clutch release lever, Fig.21, and adjust at pedal mounting in passenger compartment.

25. Attach exhaust pipes to exhaust manifolds.

26. Install starter motor and connect starter motor lead.

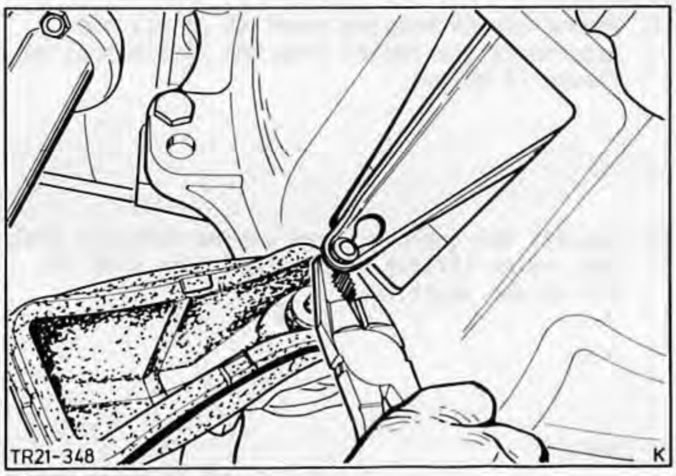

Fig.21. Attach clutch cable to release lever.

27. Reconnect leads to alternator, oil pressure switch, temperature gauge sender unit and coil and re-attach earth strap.

28. Re-attach fuel line to fuel pump, Fig.22, and secure brake servo vacuum hose to the connector on the inlet manifold.

29. Refit choke operating cable and adjust. Bolt throttle cable with mounting to inlet manifold. Attach throttle linkage to carburettor and adjust throttle cable.

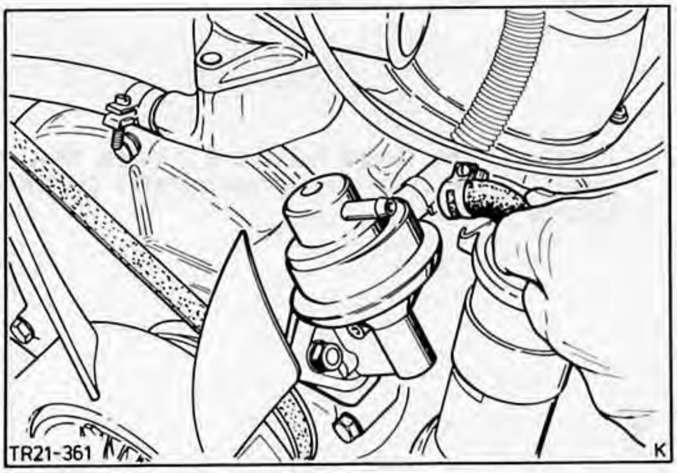

Fig.22. Attach fuel line.

30. Attach hot water hoses to heater radiator (in bulkhead) and inlet manifold connector.

31. Insert radiator grille panel complete with radiator and overflow tank, and bolt securely.

32. Fit bumper with bracket and secure side pieces.

33. Refit both headlamp units. (See operation 32 115) Attach hood release cable to leg spring and secure to radiator grille panel. Adjust hood release cable.

34. Secure bottom end of radiator in the mountings on the crossmember, Fig.23, and screw connecting pipe running to the overflow tank to the bodywork.

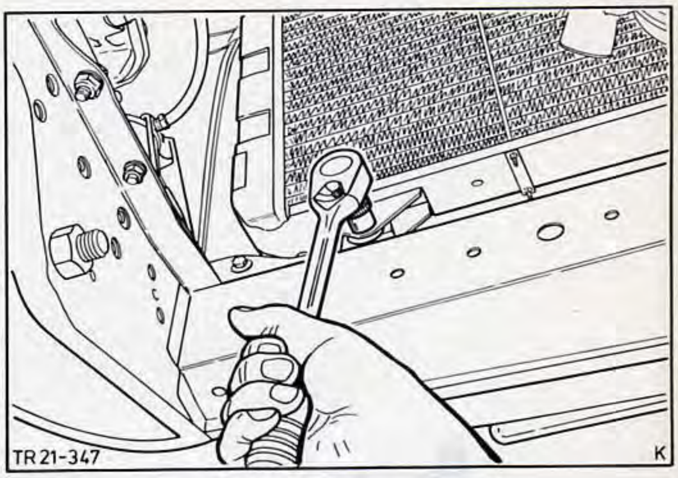

Fig.23. Secure bottom end of radiator.

35. Slide on top and bottom radiator hoses and tighten the hose clips, Fig.24. Pour in coolant. Check engine oil level and top up as necessary.

36. Refit hood and line up correctly. Fit tube of screen washer system onto the T-piece and secure.

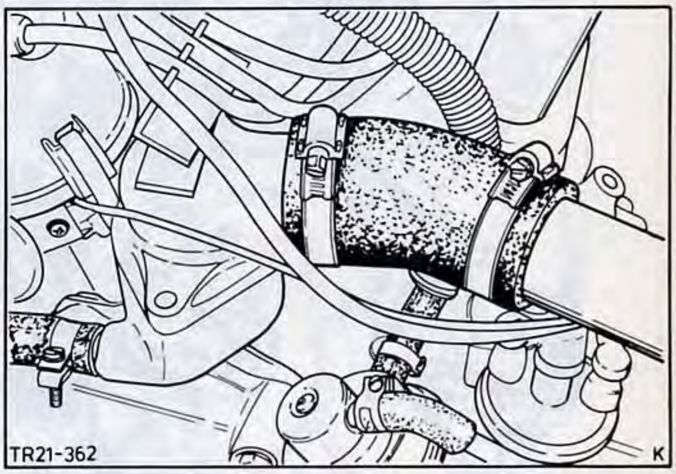

Fig.24. Fit top radiator hose.

37. Attach battery earth strap and carry out engine adjustments at normal operating temperature as specified. Set dwell angle, ignition timing, idling speed and CO-content.

38. Recheck coolant on reaching temperature needed to open the thermostat. Then refit air cleaner complete with vacuum and hot air hoses, Fig.25.

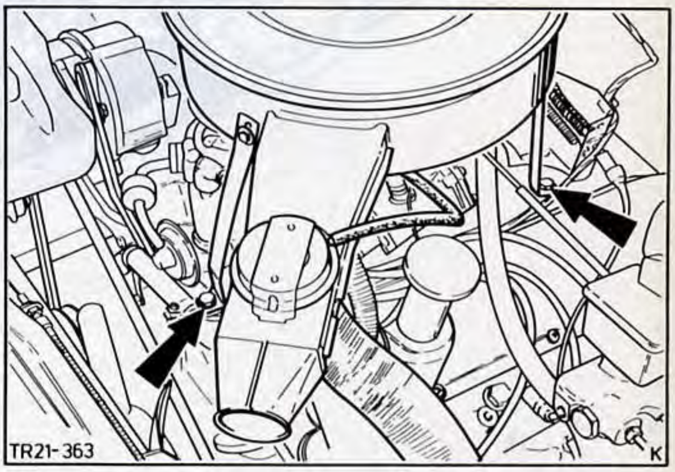

Fig.25. Fit air cleaner.

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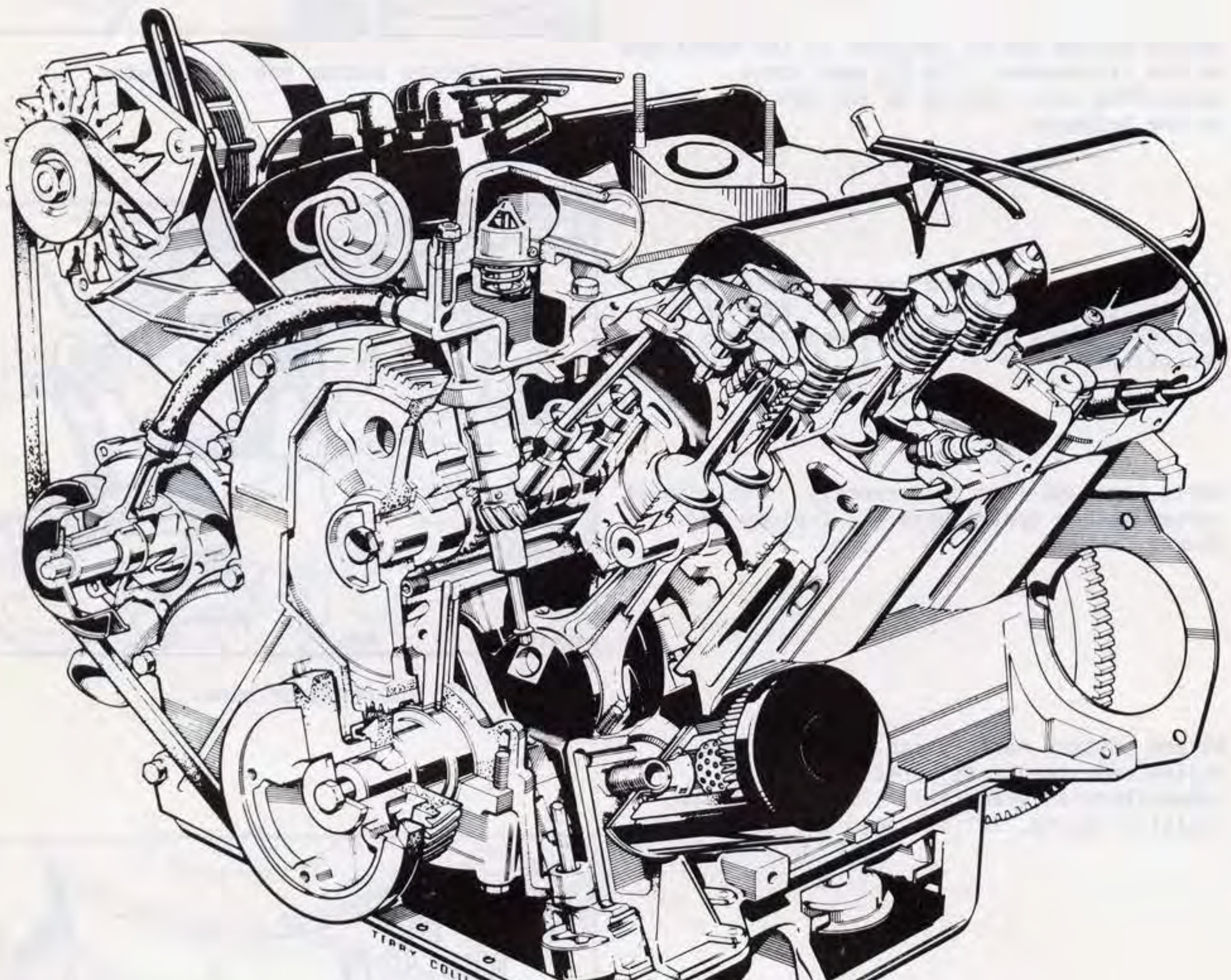

TR21-369

Fig.26. Sectional view of the 'F' engine.

21 134 8 ENGINE - DISMANTLE AND REASSEMBLE
(Engine removed)

SPECIAL SERVICE TOOLS REQUIRED:

Universal spindle	21-023
Crankshaft rear oil seal installer	21-030
Engine mounting bracket	21-032
Attachment for engine mounting bracket	21-033
Flywheel bearing remover	21-036
Flywheel bearing installer and clutch plate aligner.	21-044
Crankshaft front oil seal installer	21-059

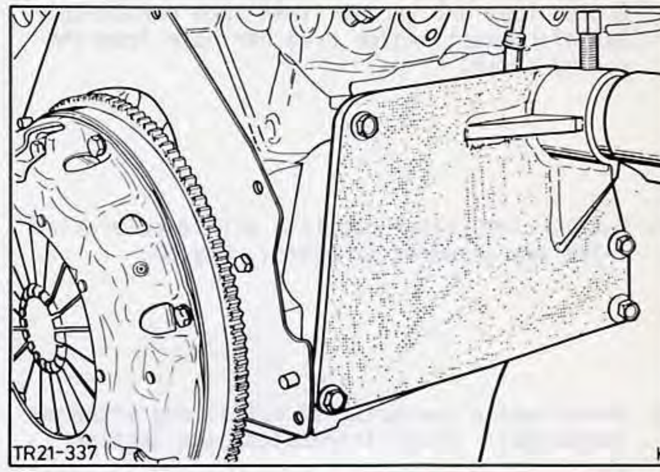

Fig.27. Engine mounting bracket.

To Dismantle

1. Detach right hand exhaust manifold (6 bolts) and secure the engine to the engine stand using universal spindle 21-023 and engine mounting bracket 21-032/-033, Fig.27.

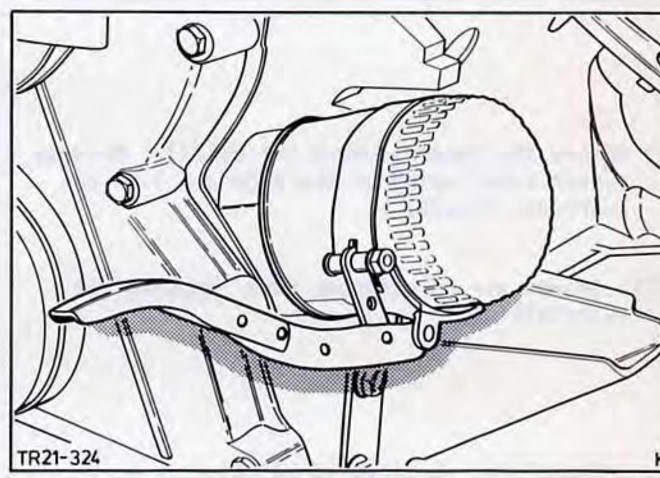

Fig.28. Unscrew oil filter with clamping tool.

2. Drain off engine oil. Unscrew oil filter with standard clamping tool, Fig.28, and withdraw oil dipstick.

3. Unbolt clutch pressure plate (6 bolts) with plate from the flywheel.

4. Remove alternator with bracket (4 bolts) and detach the drive belt. Undo centre fixing bolt and remove fan with coupling, Fig.29, and unbolt driving hub with belt pulley (4 bolts).

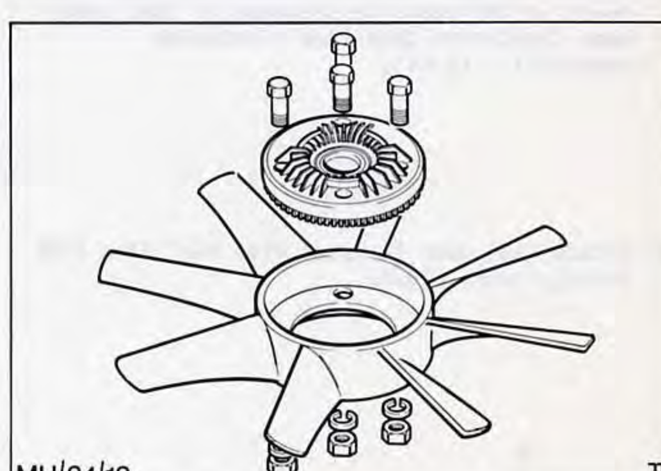

Fig.29. Fan and fluid coupling.

5. Detach spark plug connectors and remove distributor cap with HT leads. Remove spark plugs.

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6. Detach fuel and vacuum lines from carburettor and disconnect engine breather hose from the rocker cover.

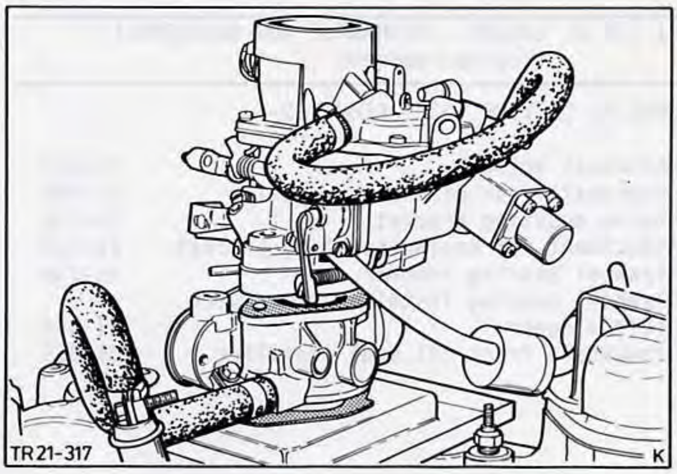

Fig.30. Remove carburettor.

7. Detach carburettor complete with deceleration valve and governor (2 bolts), Fig.30.

8. Remove water connector (2 bolts) and withdraw thermostat. Check thermostat, see Section 24.

9. Remove distributor (1 bolt) with vacuum line.

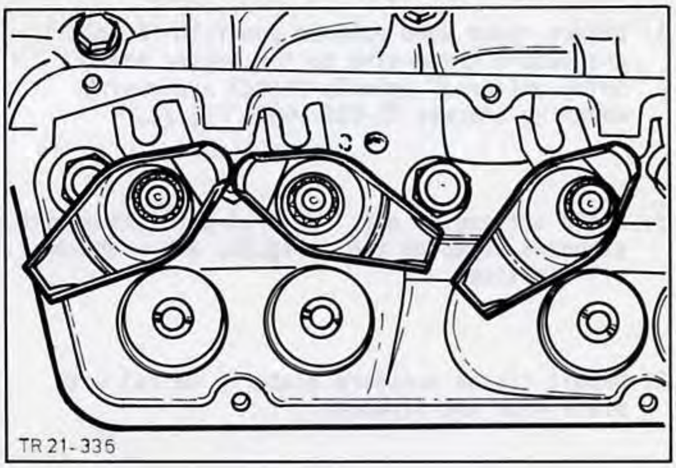

Fig.31. Rocker arms swung aside.

10. Remove the rocker covers (12 bolts). Release rocker arms, swing to the side and lift out pushrods, Fig.31.

NOTE: Do not mix up pushrods when removing and reinstalling.

11. Detach inlet manifold (8 bolts).

12. Remove cylinder heads, undoing cylinder head bolts in the opposite sequence to that used when tightening them (see tightening sequence), Fig.64).

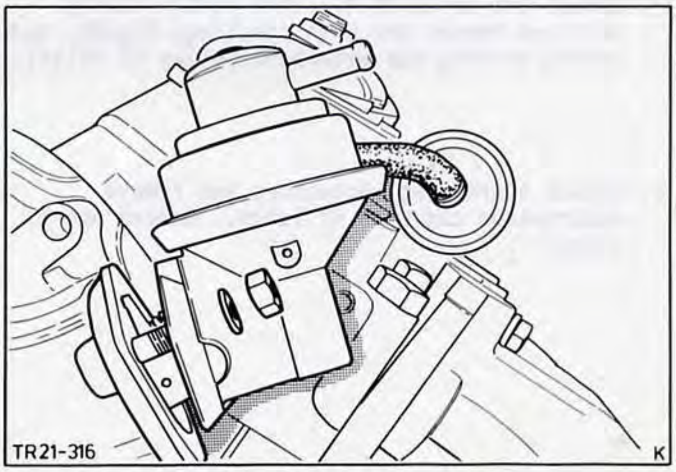

Fig.32. Remove fuel pump.

13. Detach fuel pump (2 nuts) with fuel line from timing cover, Fig.32.

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14. Remove sump from underneath, Fig.33, so that no oily sludge or metal particles get into the engine.

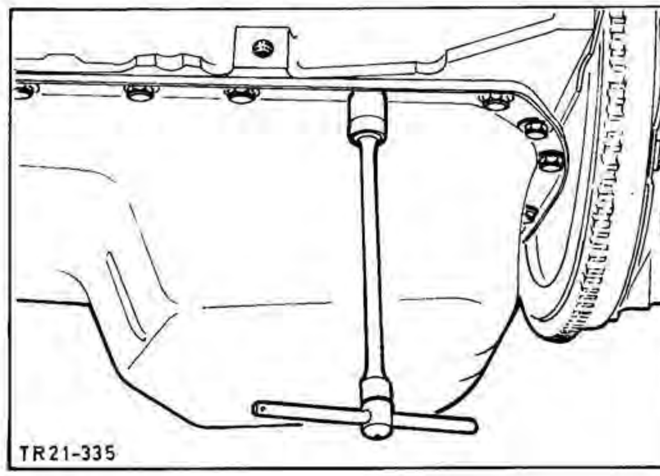

Fig.33. Unbolt sump.

15. Remove carbon deposits from the upper edges of the cylinders with a scraper, taking care not to touch the area over which the piston rings run.

NOTE: Make sure that the carbon does not get into the cylinders.

16. Position engine block vertically and press out valve tappets using a bent brass wire, Fig.34, having first placed a large oil drip tray underneath.

NOTE: Do not mix up tappets when removing and re-installing.

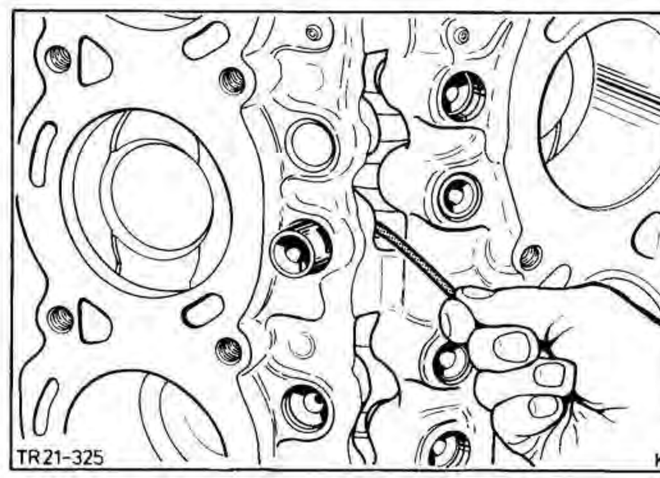

Fig.34. Press out valve tappets with a bent brass wire.

17. Detach crankshaft belt pulley (1 bolt) and timing cover (11 bolts).

18. Unbolt water pump from the engine block (7 bolts).

19. Remove camshaft gear (1 bolt) with eccentric disc and take off camshaft retaining plate (2 bolts. Withdraw camshaft with spacer ring.

20. Remove intermediate plate and its reinforcement.

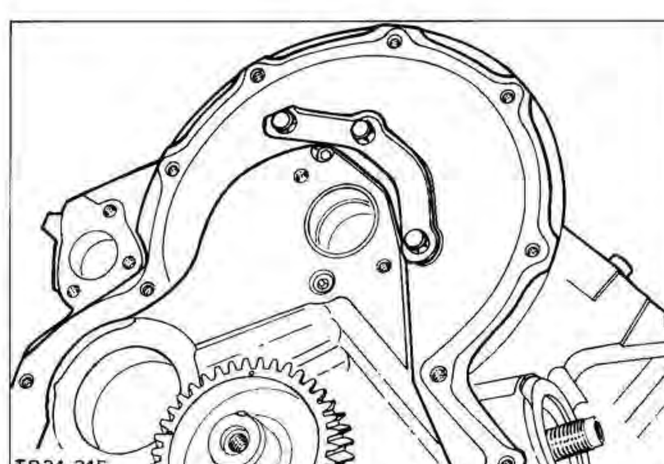

Fig.35. Intermediate plate reinforcement.

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21. Turn the engine further to catch any remaining (oil, loosened carbon or coolant).

22. Remove the oil pump complete with the suction pipe, Fig.36, (5 bolts) and lift out driveshaft.

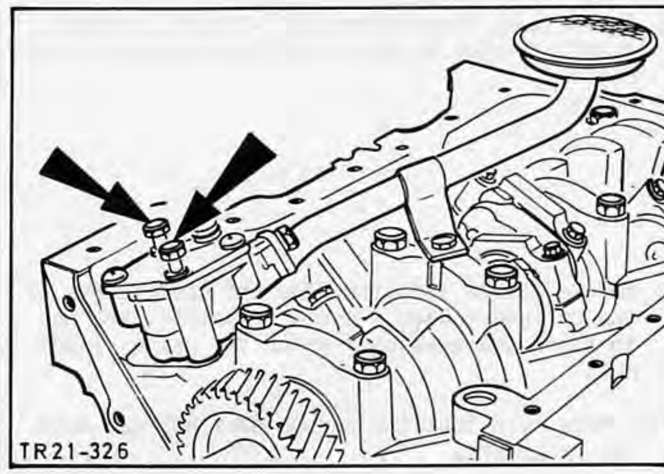

Fig.36. Oil pump with suction pipe.

23. Using special tool 21-036, draw pilot bearing out of the crankshaft, Fig.37.

24. Pull off crankshaft gear using a standard tool.

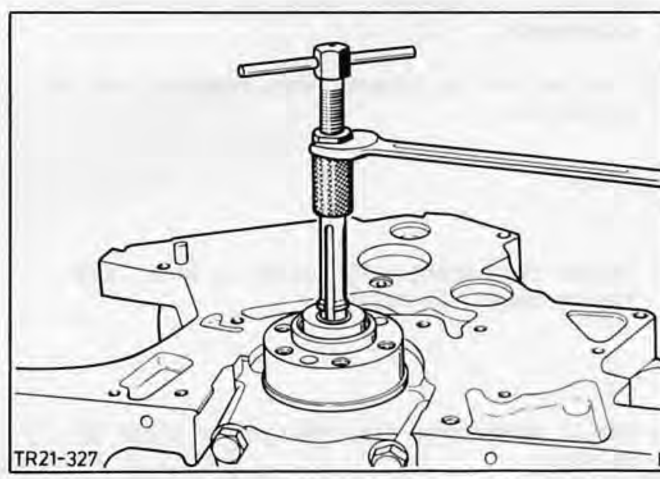

Fig.37. Withdraw pilot bearing with special tool 21-036.

25. Check that all the big end and main bearing caps are marked for refitting later, Fig.38.

26. Remove the big end bearing caps one at a time with the bearing shells. Press pistons together with connecting rods and bearing shells out of the block. If the bearing shells are to be taken out before the piston is removed, these should be marked according to the connecting rod to ensure correct location later.

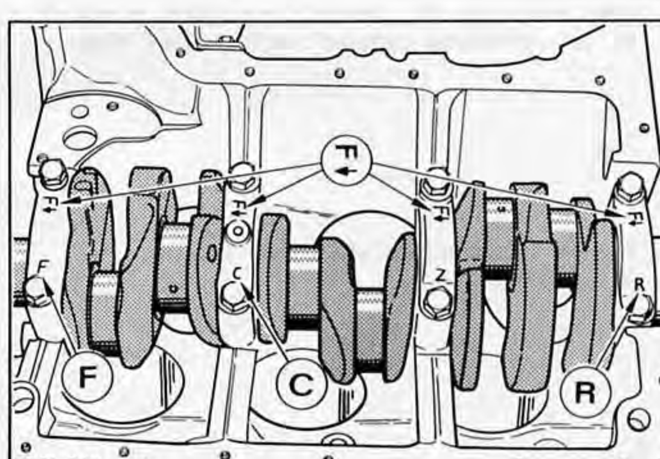

Fig.38. Markings on main bearing caps.

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27. Unbolt the flywheel (6 bolts).

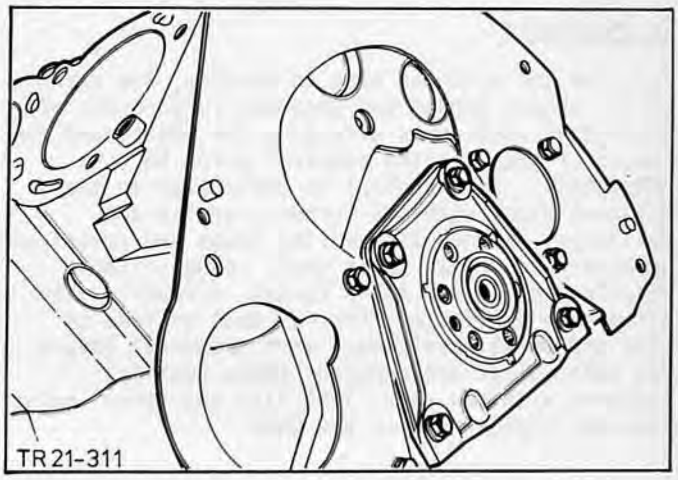

Fig.39. Oil seal carrier with intermediate plate.

28. Remove oil seal carrier (4 bolts) and intermediate plate (5 bolts) at rear of engine, Fig.39.

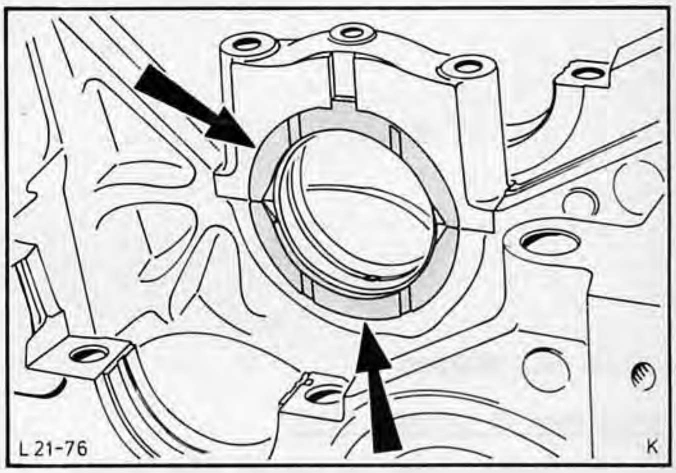

Fig.40. Thrust washer halves.

29. Remove main bearing caps with associated bearing shells. When removing the centre main bearing cap, note the position of the thrust washer halves and mark accordingly, Fig.40.

30. Lift the crankshaft out of the block. Remove the bearing shells and mark for refitting later as appropriate.

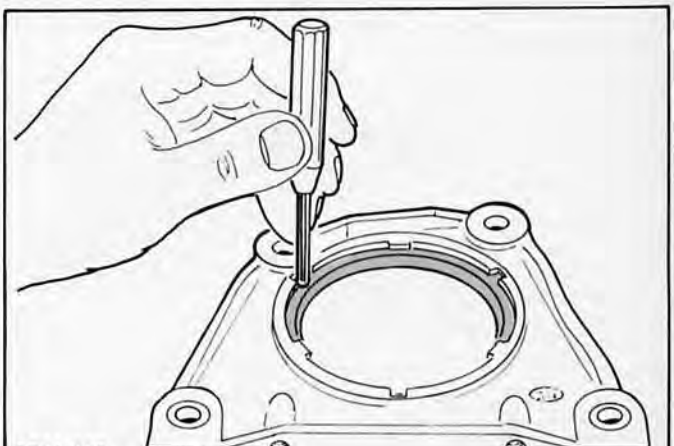

Fig.41. Drive oil seal out of the carrier.

31. Remove oil seals from timing cover and oil seal carrier using a drift, Fig.41.

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To reassemble

The time the unit has been in service, the extent of any engine damage and intended further use of individual components determine the degree and the nature of the cleaning required prior to reassembly. This applies in particular to the cylinder block with its corners, angles and drillings. Remove all sealing plugs and covers as necessary and clean their seats using suitable cleaning agents and tools (brush, scraper). The oilways in particular, Fig.42, must be free of dirt and metal particles. When press-fit covers and water plugs are removed, these must be replaced with new ones, just like any other seals, whenever engine repairs are made.

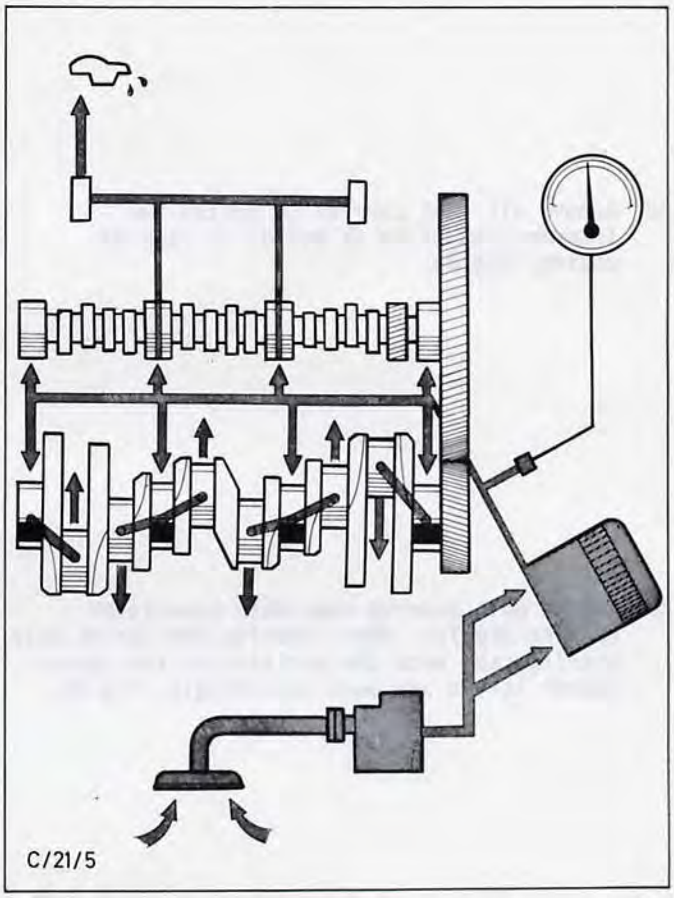

Fig.42. Lubrication circuit.

FITTING MAIN BEARINGS

Parent bore in cylinder block

When of standard size, the parent bore in the cylinder block is unmarked. With a 0,38 mm oversize bore, the bearing caps are marked with a white line, Fig.43.

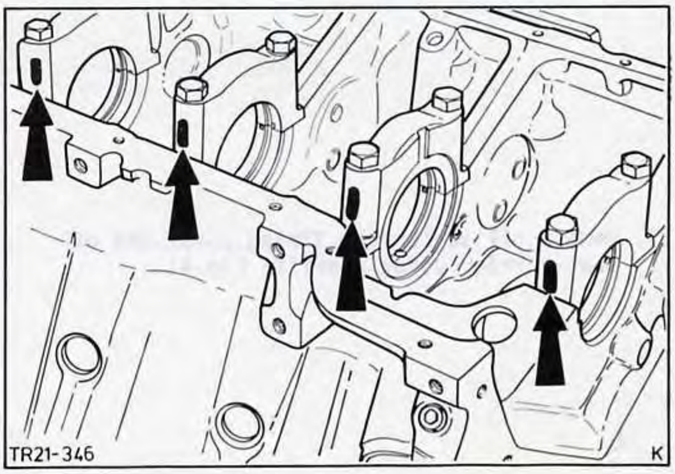

Fig.43. Colour markings on main bearing caps.

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Crankshaft main bearing journals

When of standard diameter, the crankshaft main bearing journals are unmarked. With 0,25 mm undersize journals, the crankshaft is marked with a green line on the first balance weight, Fig.44.

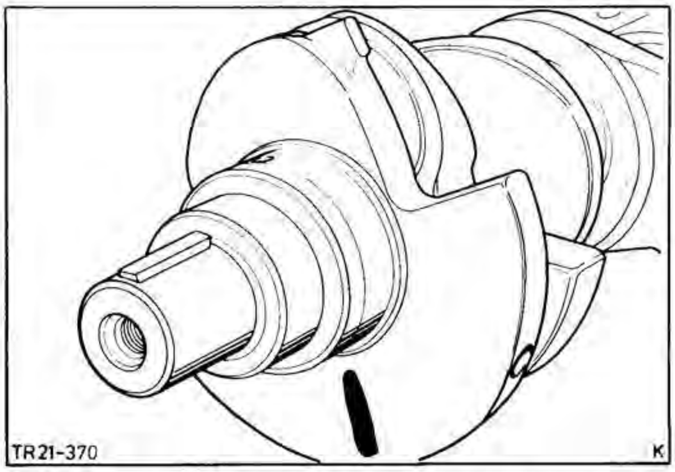

Fig.44. Colour marking on main bearing journal.

Crankshaft big-end bearing journals

When of standard diameter, the crankshaft big end bearing journals are also unmarked. With 0,25 mm undersize big end bearing journals, the crankshaft is marked with a green spot on the first web next to the journal, Fig.45.

Crankshafts with undersize main and big end bearing journals are marked with both the coloured line and the spot on the first web at the front end.

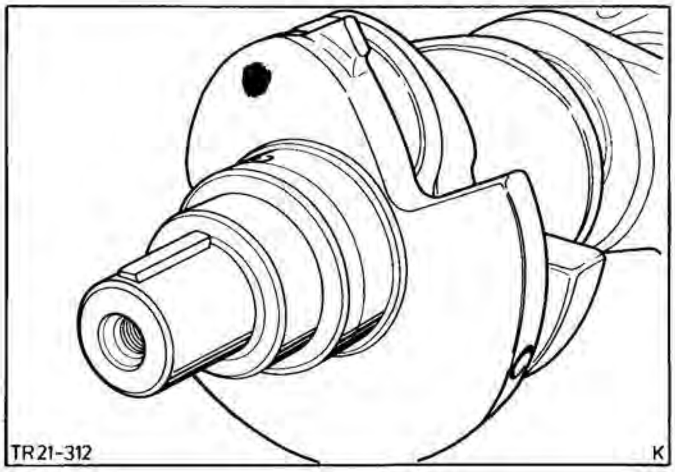

Fig.45. Colour marking on big end bearing journal.

Bearing shells

Standard sized main and big end bearing shells do not have any coloured markings. Oversize bearing shells have a corresponding inscription on the back (see parts microfilm). The green mark is made on the side on the outer edge, Fig.46.

Whenever new bearing shells are selected, always refer to the parts microfilm to check they are the right ones, and take measurements as well.

Bearing journals, bores and bearing shells must be measured individually to ensure compliance with the specified bearing tolerances (see Technical Data).

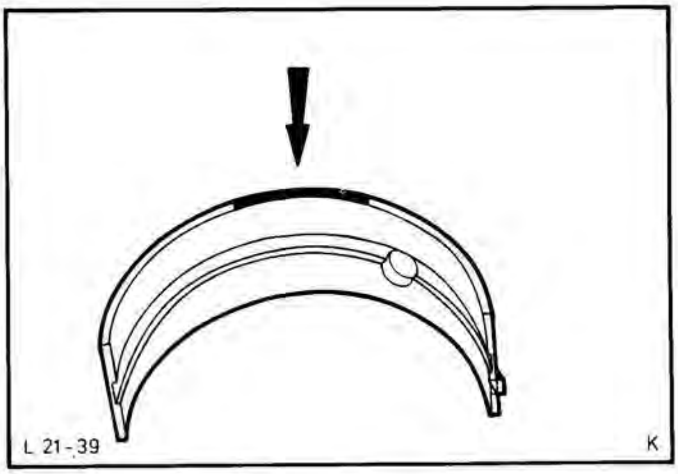

Fig.46. Bearing shell with coloured mark.

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Determining bearing clearance

Measurements of bearings (even with undersize crankshafts) can be eliminated and selection of the required bearing shells made easier if "PLASTIGAGE" (type Pg-1) made by:

PERFECT CIRCLE CORPORATION,
HAGERSTOWN, INDIANA/USA

is used.

"PLASTIGAGE" is the brand name of a precisely calibrated plastic filament.

Supplier: Federal German Republic
K.H. Ern/Motorenteile GmbH
Schinkelstr. 46-48
D-4000 Dusseldorf
Tel. 02 11/35 35 36

Supplier: U.K.
Norman Gaydon (International) Ltd
68 London Road
Southend on Sea
Essex SS1 1PG

Requirements for using "Plastigage"

a) Bearing must be dry and clean.

b) Crankshaft must not be turned during the measuring operation

c) Measurement should be made at point close to respective dead centre position

d) Do not seat bearing caps with hard blows

Place a length of this filament on crankshaft main bearing or big end bearing journal across the bearing, Fig.47, then fit main or big end bearing cap with bearing shell and tighten to specified torque. The plastic filament will be compressed more or less according to the bearing clearance. Remove bearing cap again.

Each main bearing must be measured individually without the other bearing caps being fitted.

The width of the compressed plastic filament can be measured on a scale printed in the PLASTIGAGE pack, Fig.47. The reading gives the bearing clearance.

Always use bolts in good condition when securing crankshaft bearing caps. Do not tighten these beyond the specified torque.

Measuring piston clearance

a) Fit main bearing caps without bearing shells and secure to specified torque.

b) Turn engine block through 180° and measure cylinder bores with standard measuring tool.

c) If diameter of cylinder bore is found to be too much for the existing piston size, the block must be overhauled or replaced. Fit cylinder block with new pistons corresponding to cylinder bore classification.

d) Before fitting the pistons, check the gaps of the piston rings, Fig.48. The indicated dimensions (see Technical Data) relate to the gauge ring used in production and cylinder measurements may exceed these by 0,15 mm.

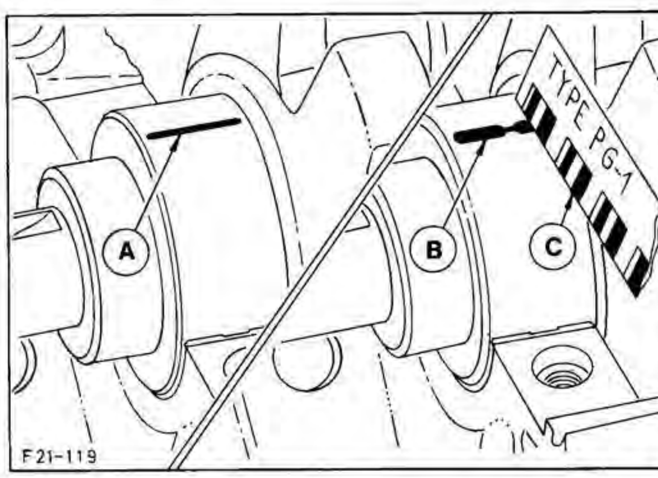

Fig.47. Measuring bearing clearance.
A - Calibrated plastic filament
B - Compressed plastic filament
C - Measuring scale

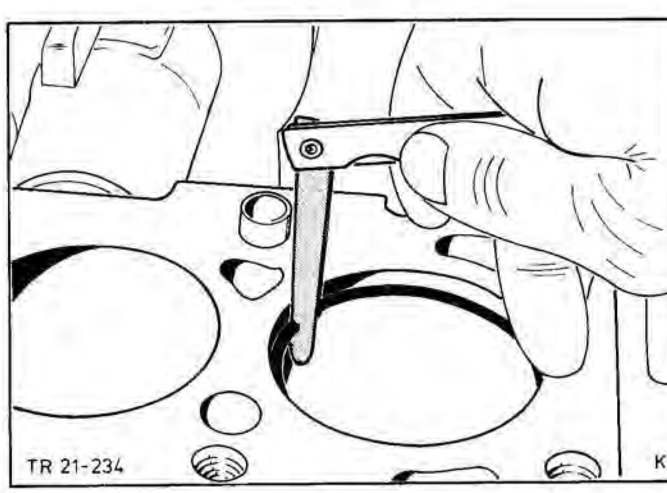

Fig.48. Check piston ring gaps.

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32. Press in oil seal of carrier using special tool 21-030 and oil seal of timing cover using special tool 21-059, Fig.49.

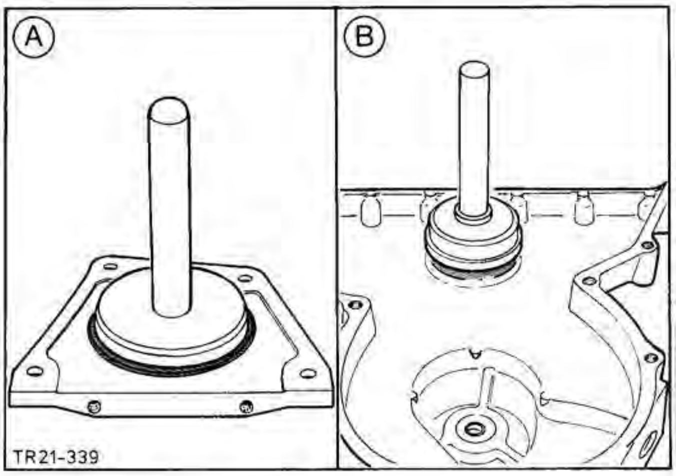

Fig.49. Fit oil seals.
A - rear oil seal carrier
B - timing cover

33. Press new pilot bearing into the crankshaft using special tool 21-044, Fig.50. Fit crankshaft gear together with belt pulley, washer and bolt.

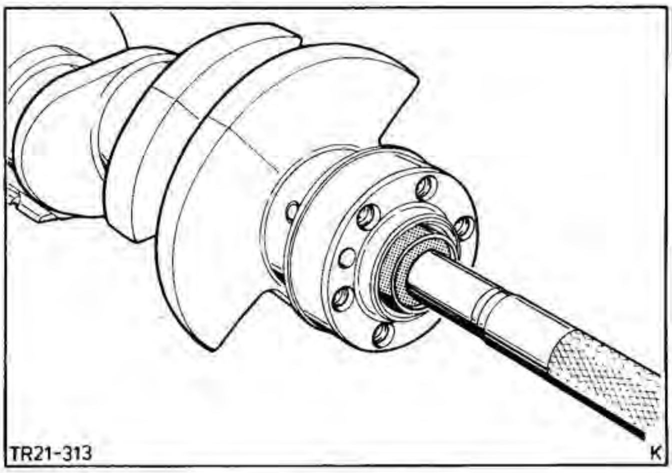

Fig.50. Press in pilot bearing.

34. Place main bearing shells dry in cylinder block, then moisten with engine oil and insert the crankshaft.

35. Fit main bearing caps complete with oiled bearing shells. Make sure that thrust washer halves are fitted in bearing providing axial guidance, Fig.51.

NOTE: The arrow on the main bearing caps must point towards the belt pulley.

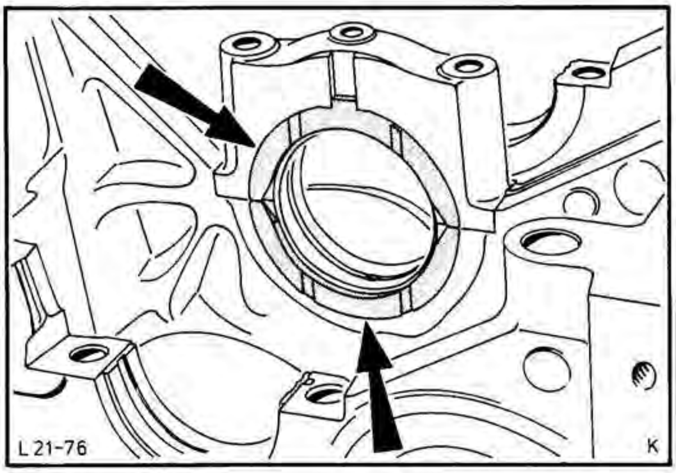

Fig.51. Thrust washer halves.

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36. Tighten bearing cap bolts evenly to the specified torque, Fig.52. Only tighten bolts fingertight on bearing providing axial guidance. First, press the crankshaft to the rear as far as it will go and then slide it slowly forwards as far as it will go and hold it in this position. Tighten bolts of bearing cap to specified torque in this position. (This procedure is required to ensure that the thrust washer halves bear uniformly).

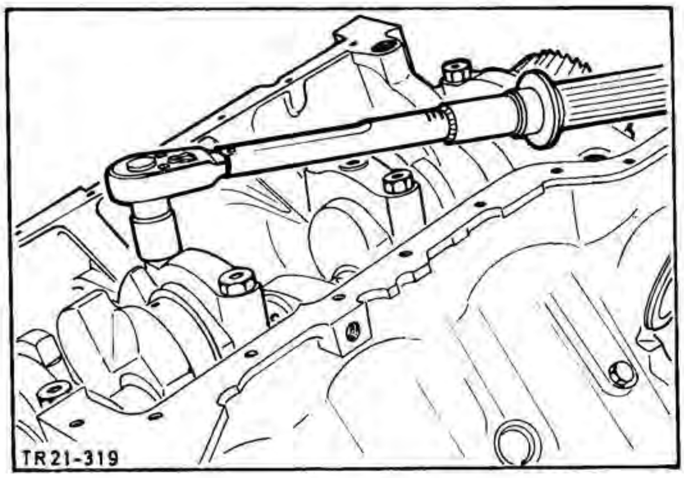

Fig.52. Torque main bearing cap bolts.

37. Check crankshaft end float with a dial indicator, Fig.53, (see Technical Data).

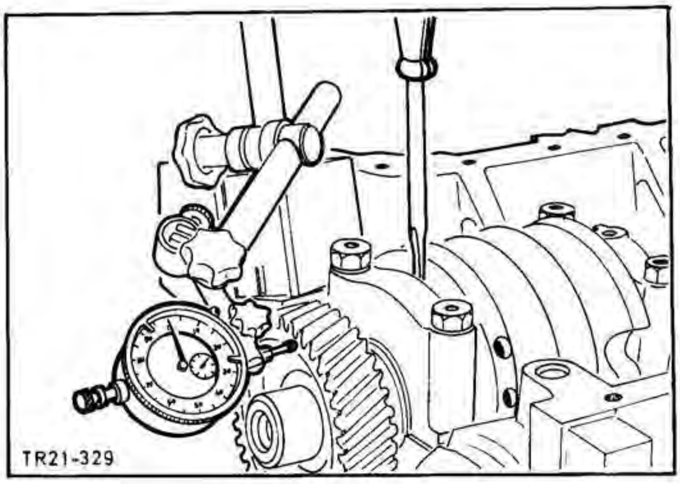

Fig.53. Check crankshaft end float.

38. Crank the engine and moisten camshaft bearings, camshaft and retaining plate with oil.

39. Install camshaft from front bearing end, Fig.54. Prior to fitting, slide spacer ring onto the camshaft with the chamfered side inwards and insert the parallel key. Screw the retaining plate in position. Tighten screws to specified torque.

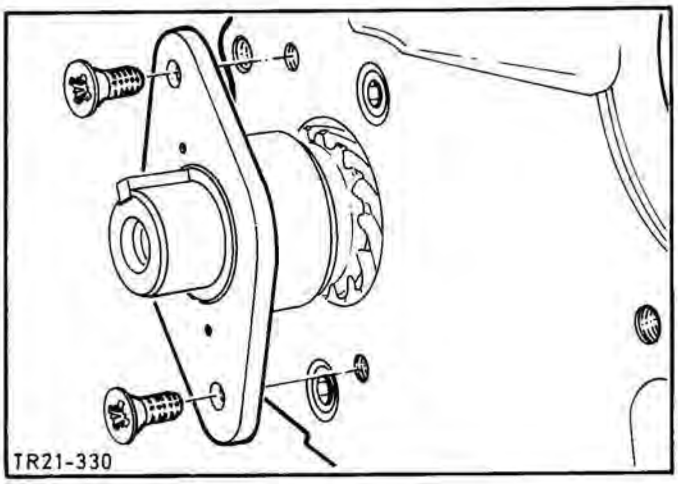

Fig.54. Install camshaft.

40. Coat outer periphery of front end of the cylinder block and the back of the front intermediate plate with sealing compound. Locate the gasket and fit the intermediate plate to the cylinder block with the reinforcement, only tightening finger-tight, Fig.55. Insert two further screws in the bottom holes in the intermediate plate for guidance. Remove these once the intermediate plate and reinforcement have been tightened down.

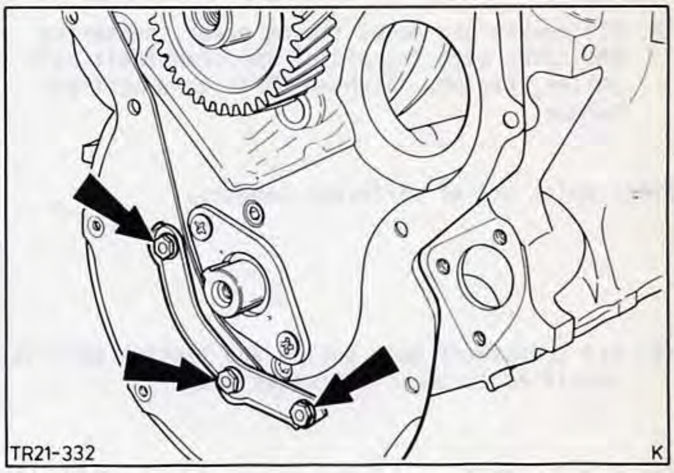

Fig.55. Intermediate plate reinforcement.

41. Slide on camshaft gear with the spot lined up on the mark on the crankshaft gear. (The slots for the keys must face one another.) Fit screw with eccentric disc and tighten to the specified torque.

NOTE: As the crankshaft gear carries two marks, make sure that camshaft gear is only fitted as shown in Fig.56.

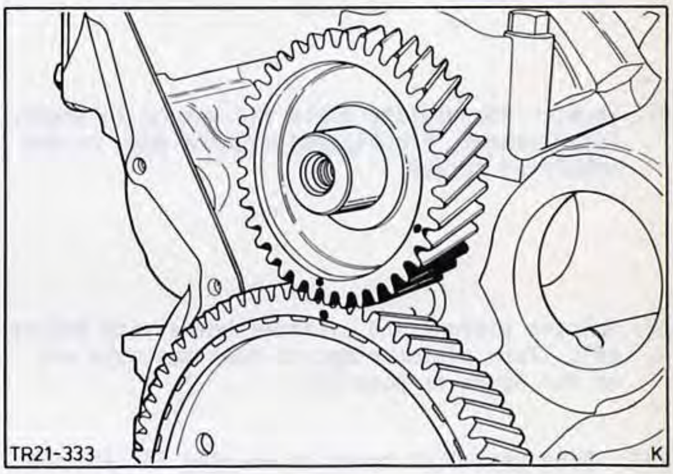

Fig.56. Spot marks on camshaft and crankshaft gears.

42. Check camshaft end float with a dial indicator, Fig.57, (see Technical Data).

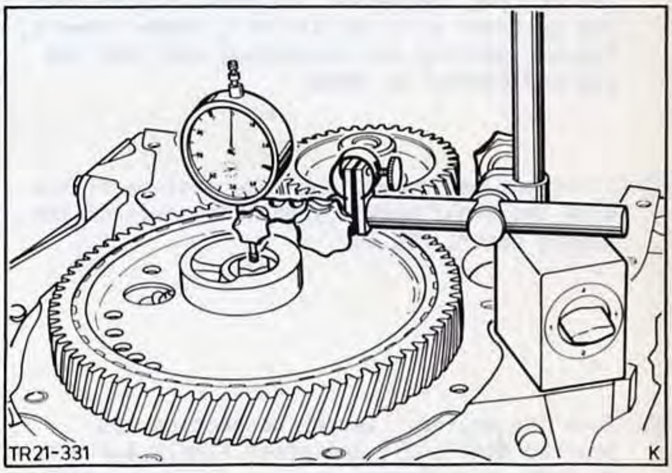

Fig.57. Check camshaft end float.

43. Coat outer periphery of mating face of timing cover and the front side of the intermediate plate with sealing compound.

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44. Fit gasket and mount timing cover, centering the cover with the aid of the crankshaft belt pulley, Fig.58. Tighten bolts to specified torque.

NOTE: Bolts are of different lengths.

45. Fit crankshaft belt pulley and tighten bolt to specified torque. Fit water pump.

46. Turn the engine. Fit rear oil seal carrier with new oil seal (sealing lip lightly oiled) and secure to specified torque.

47. Locate intermediate plate and secure in place. Fit flywheel, Fig.59, and tighten down to the specified torque.

48. Moisten pistons and cylinder bores with engine oil. Turn piston rings so that the gaps are as far apart as possible.

NOTE: Ring gaps must never be located in line one under the other - see Technical Data.

49. Compress the piston rings using a standard piston ring compressor and press piston into the cylinder with the aid of a hammer handle, Fig.60, guiding the connecting rod onto the big end journal by hand.

NOTE: Pistons and connecting rods must be fitted with the front markings pointing towards the timing cover, Fig.60.

50. Turn the engine. Insert connecting rod bearing shell, oil and press firmly against the big end journal.

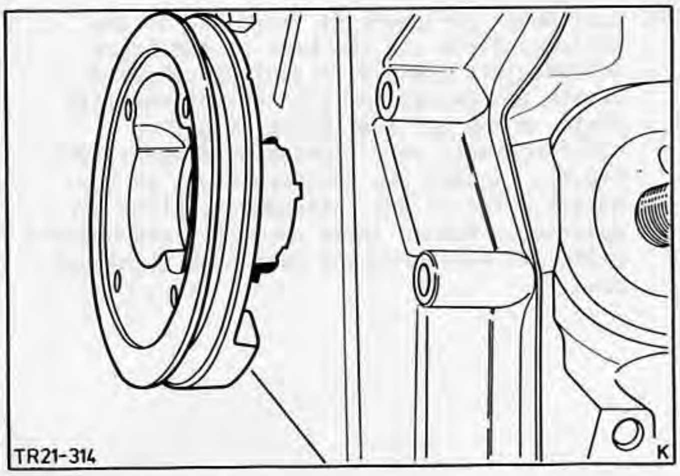

Fig.58. Centre timing cover with crankshaft belt pulley.

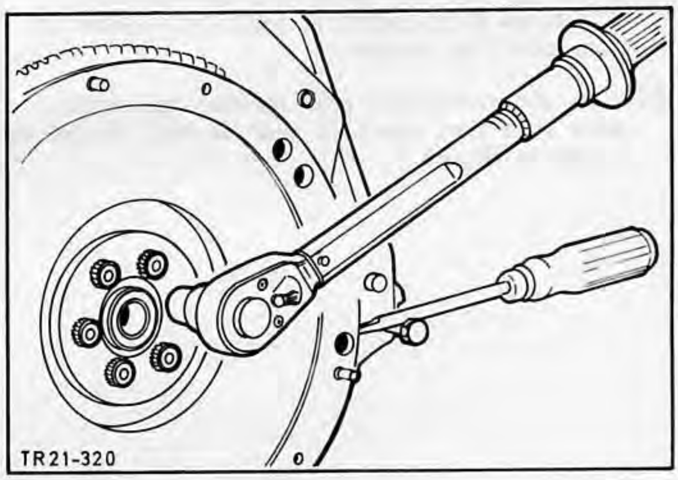

Fig.59. Fit flywheel.

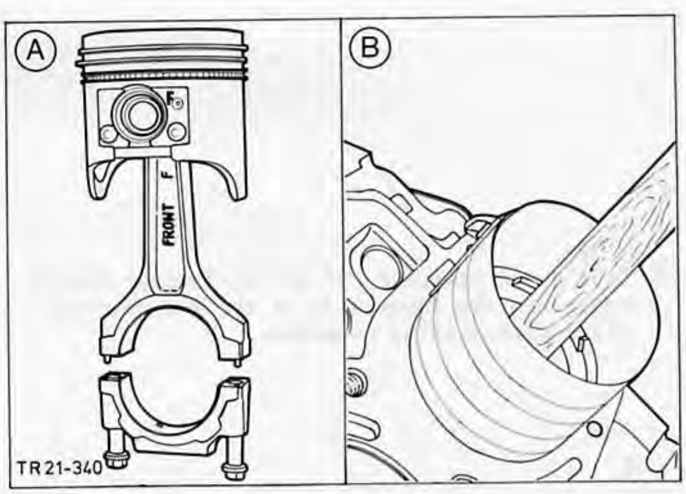

Fig.60. A - front marks on pistons and connecting rods
B - fit pistons using a ring compressor

21 134 8

51. Fit big end bearing cap complete with oiled bearing shell. Tighten bolts to the specified torque, Fig.61.

NOTE: Check that the connecting rod has enough end float on the big end journal.

52. Install oil pump complete with suction pipe and drive shaft, Fig.62. Tighten screws to specified torque.

NOTE: When using a new or overhauled oil pump, this must be turned over by hand and filled with engine oil before it is fitted.

53. Coat cylinder block mating surface with sealing compound at junction with timing cover and oil seal carrier and locate sump gaskets.

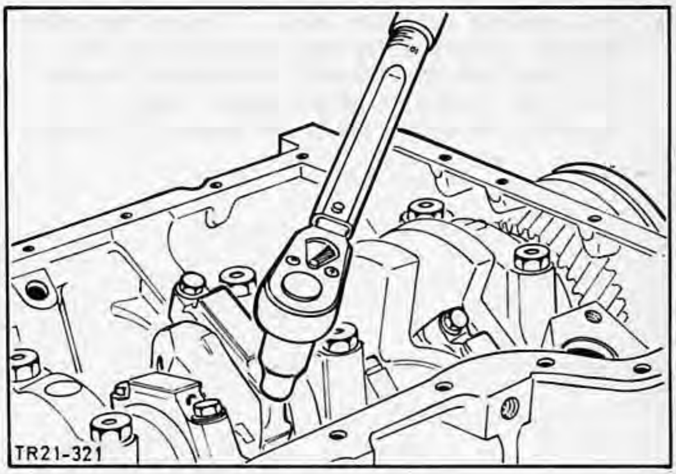

Fig.61. Torque bolts of big end bearing cap.

54. Fit sump and tighten bolts to specified torque.

55. Tighten oil drain plug to specified torque, fitting a new seal.

NOTE: A new seal must be used whenever the oil is changed or the oil drain plug is unscrewed.

56. Turn the engine. Lightly oil valve tappets and insert in the cylinder block.

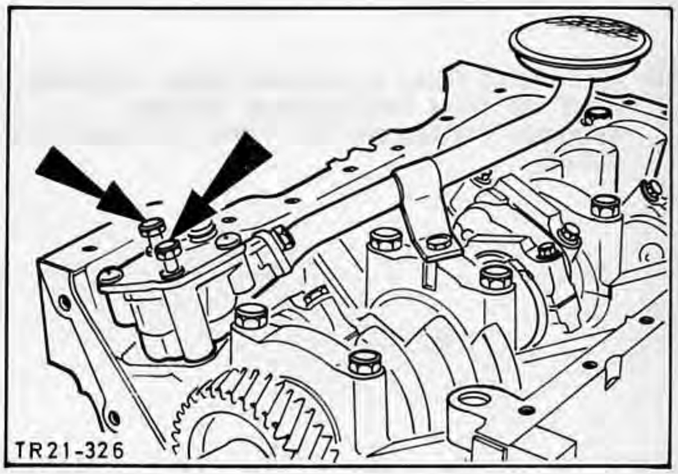

Fig.62. Oil pump complete with suction pipe.

57. Place cylinder head gasket over the guide sleeves on the cylinder block, Fig.63.

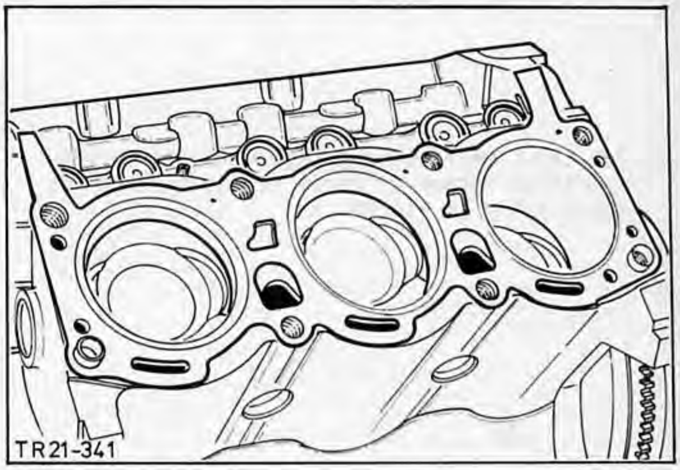

Fig.63. Cylinder head gasket in position.

21 134 8

58. Fit complete cylinder heads. Insert the bolts (having lightly oiled the underside of the bolt head and the thread) and tighten to the specified torque in three stages (see Technical Data) in the order shown in Fig.64.

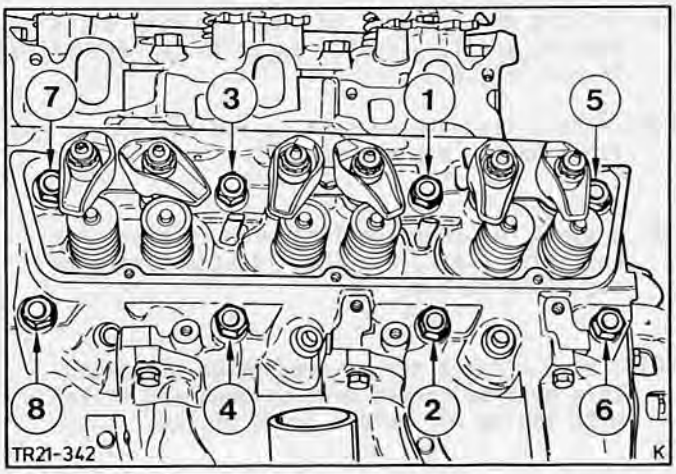

Fig.64. Tightening sequence - cylinder head bolts.

59. Coat mating faces on cylinder block, cylinder heads and inlet manifold with sealing compound, Fig.65, and fit a new inlet manifold gasket.

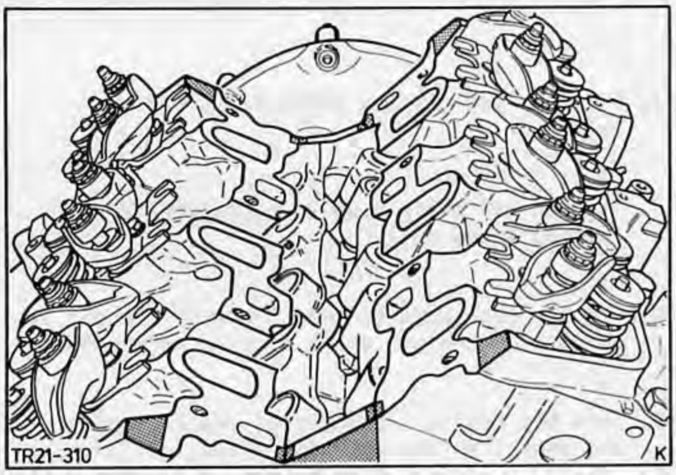

Fig.65. Coat mating faces with sealing compound.

60. Fit inlet manifold and tighten bolts to the specified torque in three stages as shown in the drawing in Fig.66.

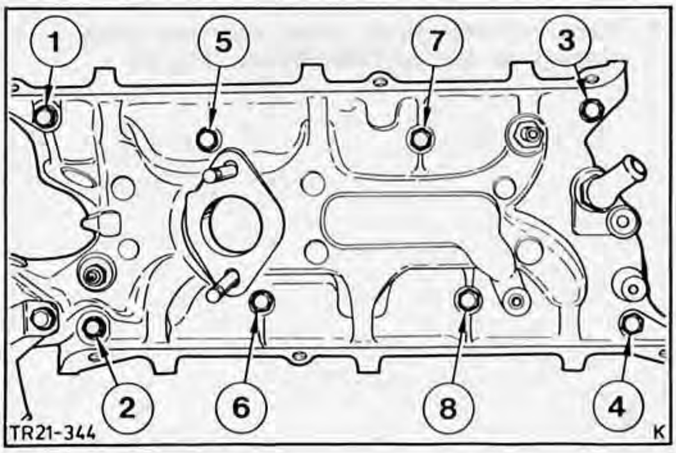

Fig.66. Tightening sequence - inlet manifold bolts.

21 134 8

61. Moisten push rods with engine oil at both ends and place in the push rod sockets. Locate the rocker arms on the push rods and do up adjusting nuts fingertight.

NOTE: Adjusting nuts should be replaced with new ones if they do not have an adequate clamping action.

62. Adjust valve clearances, see operation 21 213.

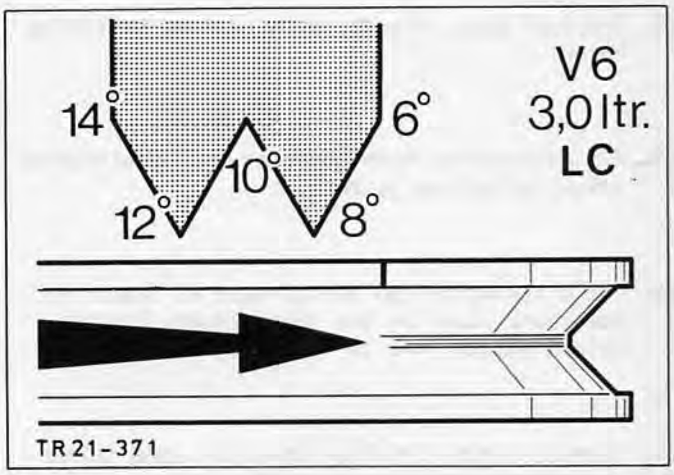

Fig.67. Timing marks.

63. Install distributor:
Position piston in cylinder 1 at 6° BTDC. The vacuum unit must face the front and the distributor rotor must point towards the no.1 break-contact in the distributor cap. Fit the distributor and secure in place, Figs.67 and 68.

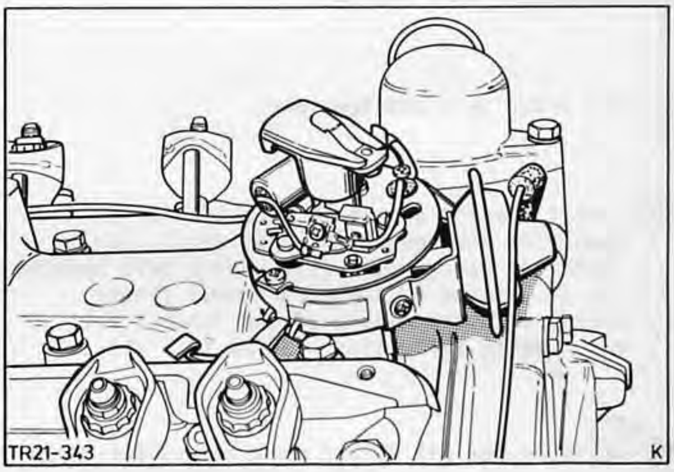

Fig.68. Position of distributor for installation.

64. Fit rocker covers using new gaskets. Insert spark plugs and tighten to specified torque.

65. Insert thermostat in inlet manifold, Fig.69, locate gasket and fit water connector.

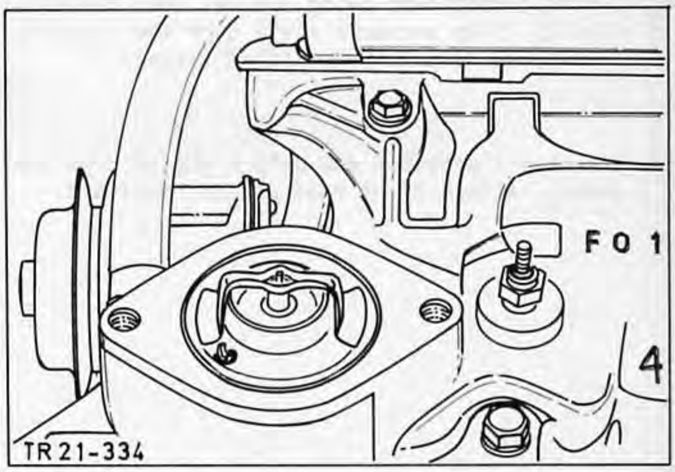

Fig.69. Position in which thermostat is installed.

21 134 8

66. Fit fuel pump, Fig.70, with gasket, on timing cover.

67. Fit carburettor with governor and deceleration valve, using new gaskets.

68. Fit distributor cap and connect HT leads to the spark plugs in the order shown, Fig.71. Attach vacuum line to carburettor.

69. Connect engine breather hose to rocker cover and attach fuel line to carburettor.

70. Bolt belt pulley in place together with driving hub and fit fan with coupling. Fit alternator with bracket.

71. Fit drive belt and tension.

NOTE: Belt tension should be checked with a measuring instrument (if available), see Technical Data. Otherwise, drive belt tension can be checked by applying normal finger pressure in the middle of the longest belt run. Total deflection - 13 mm (0,5 in)

72. Screw on new oil filter cartridge until the rubber seal makes contact with the casing, then tighten another 270°. Moisten rubber seal with engine oil before fitting.

73. Centre clutch disc using special tool 21-044, Fig.72. Slip pressure plate over the locating dowels and secure to specified torque.

74. Insert oil dipstick and detach engine from the stand. Attach right hand exhaust manifold.

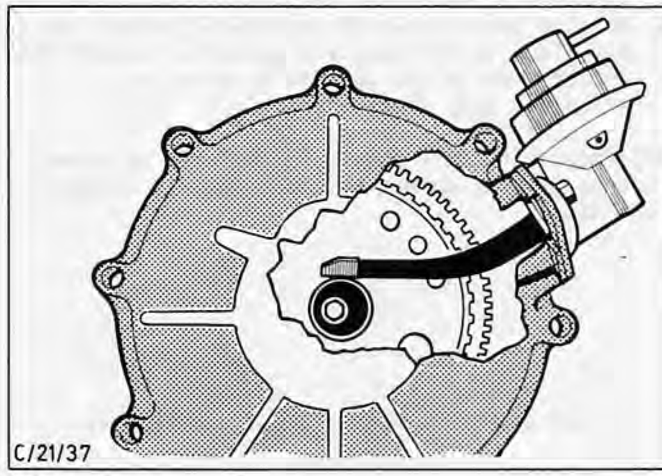

Fig.70. Fuel pump with drive.

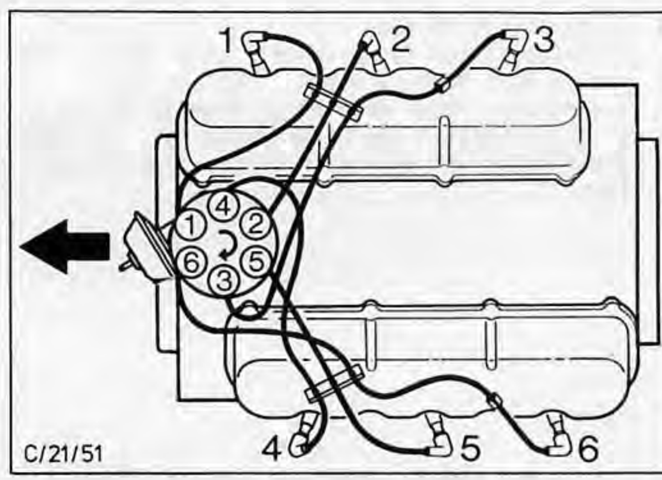

Fig.71. Arrangement of HT leads (firing order).

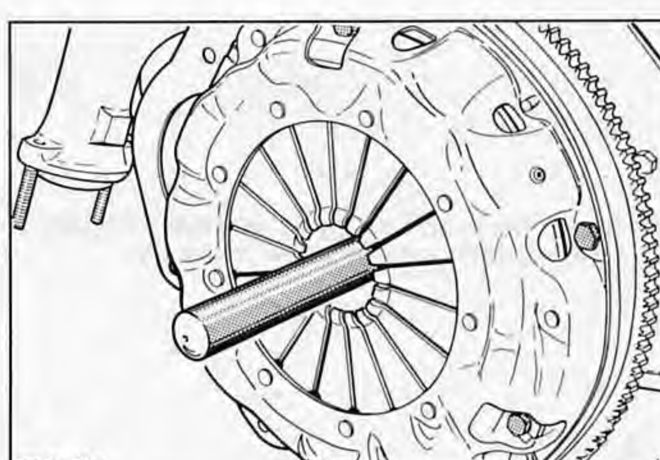

Fig.72. Centre clutch disc with special tool 21-044.

21 163 ENGINE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Inlet manifold wrench 21-066

To Remove

1. Disconnect battery earth strap.

2. Remove hot air hose from preheater (1 screw), detach vacuum hose and remove air cleaner with the brackets (3 bolts), Fig.73.

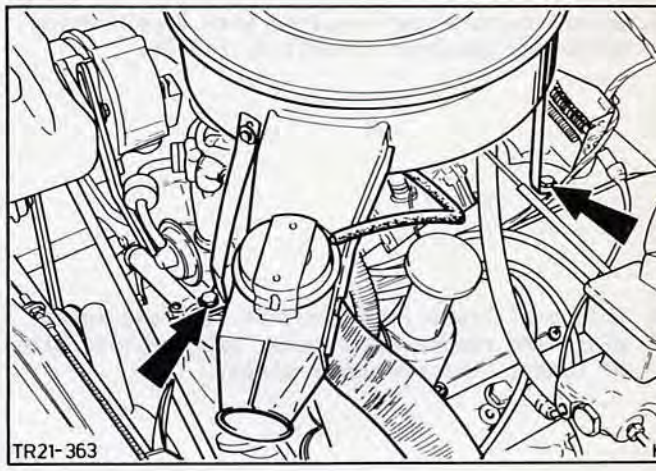

Fig.73. Remove air cleaner.

3. Drain coolant into a collecting tray by detaching bottom radiator hose from water pump, Fig.74, and top hose from thermostat water connector.

4. Detach heater hot water hoses from thermostat housing and connector on inlet manifold.

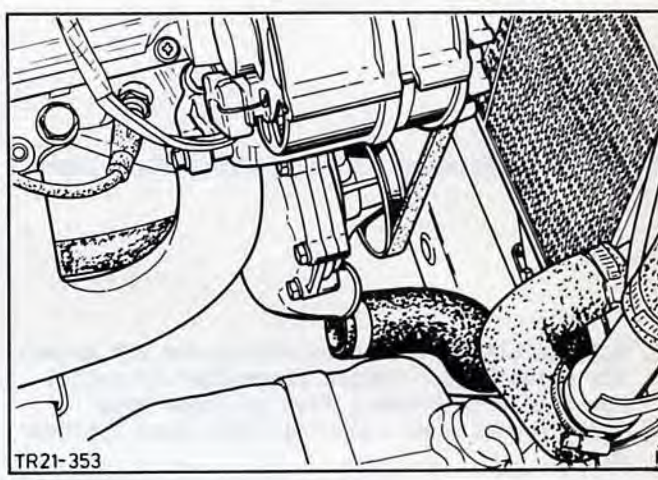

Fig.74. Bottom radiator hose detached.

5. Disconnect throttle linkage at carburettor (clip), Fig.75. Detach mounting bracket from inlet manifold (2 bolts) and remove with throttle cable and linkage. Remove choke operating cable.

6. Detach brake servo vacuum hose from the inlet manifold.

7. Detach fuel and vacuum lines from the carburettor and disconnect engine breather hose from rocker cover.

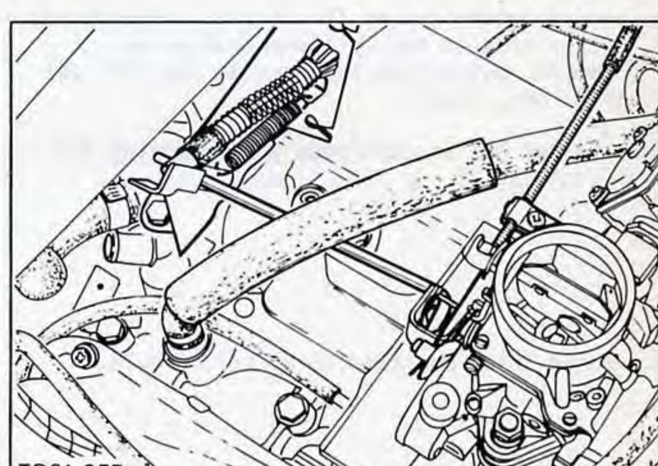

Fig.75. Disconnect throttle linkage.

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8. Remove carburettor complete with deceleration valve and governor (2 bolts), Fig.76.

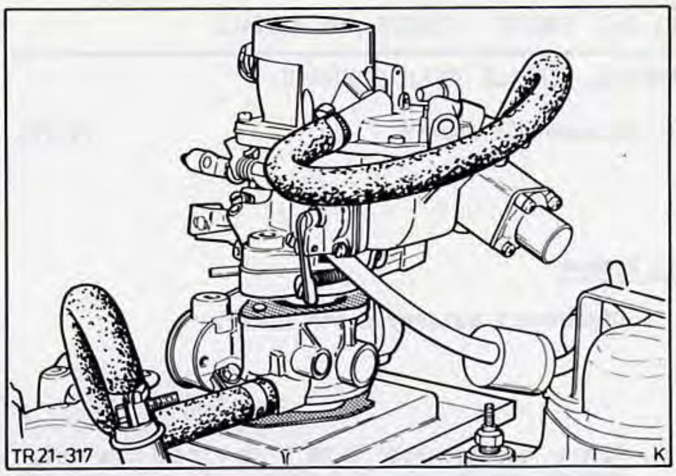

Fig.76. Remove carburettor.

9. Detach HT leads from ignition coil and spark plugs and remove distributor cap complete with HT leads. Unscrew spark plugs.

10. Disconnect leads from alternator, temperature gauge sender unit and coil.

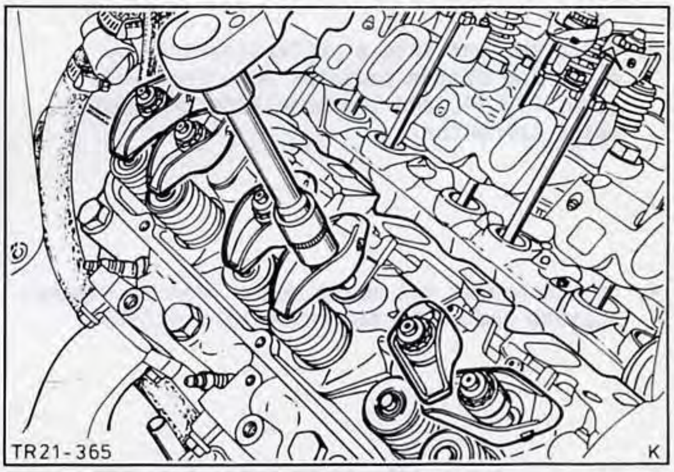

Fig.77. Release rocker arms and swing to one side.

11. Remove distributor (1 bolt) with vacuum line.

12. Release alternator on adjusting arm and detach the drive belt. Unbolt alternator (4 bolts) complete with bracket from cylinder head. (Only needed when removing right hand cylinder head).

13. Remove rocker covers (12 bolts). Release the rocker arms on the cylinder head to be removed, swing them to one side and lift out push rods, Fig.77.

NOTE: Do not mix up push rods when removing and installing.

14. Remove inlet manifold (8 bolts), Fig.78.

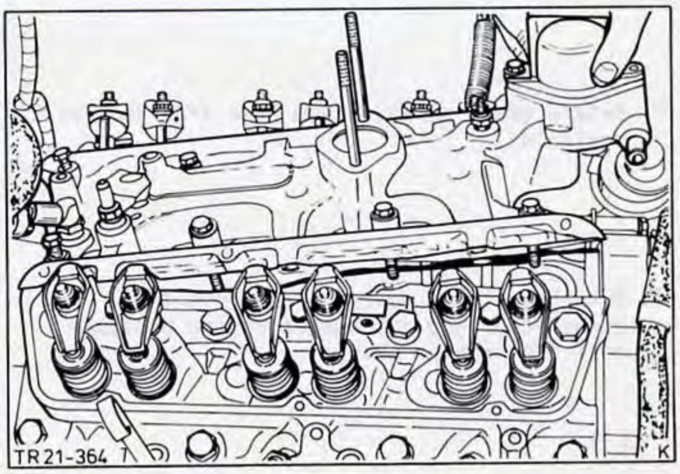

Fig.78. Remove inlet manifold.

21 163

15. Detach exhaust pipe from exhaust manifold (2 nuts).

16. Detach cylinder head, undoing cylinder head bolts in the reverse order so that used when tightening (see tightening sequence, Fig.80).

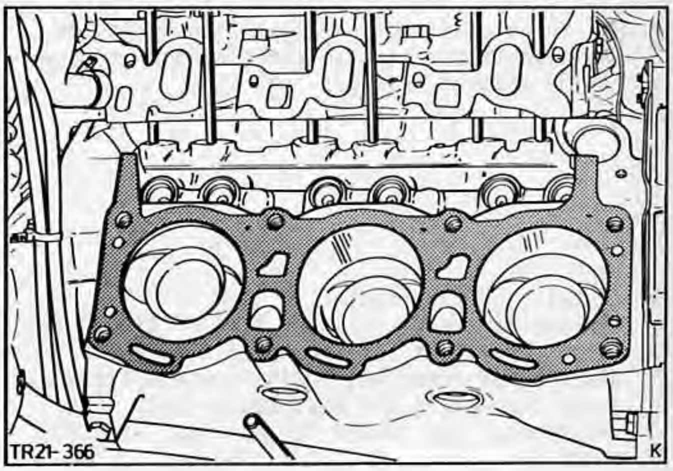

Fig.79. Locate cylinder head gasket.

To Install

17. Clean the mating surfaces (inlet manifold - cylinder heads - cylinder block) and locate new cylinder head gasket over the locating sleeves on the cylinder block, Fig.79.

NOTE: Cylinder head gaskets are marked "OBEN VORN" ("TOP FRONT").

18. Fit cylinder head in place, insert bolts (having lightly oiled underside of bolt head and thread) and tighten to the specified torque in three stages (see Technical Data) in the order shown in Fig.80.

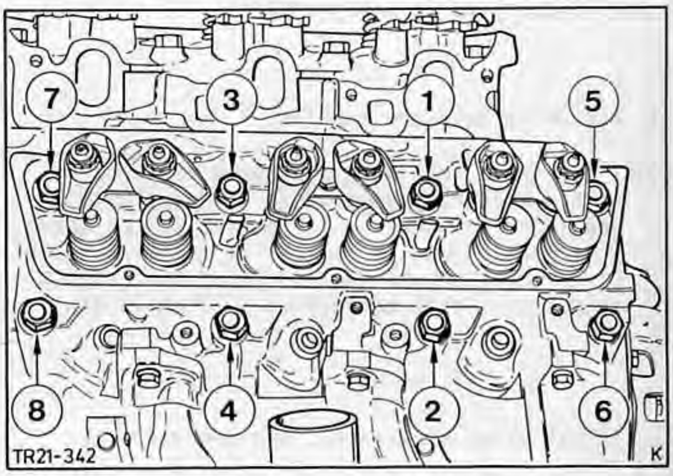

Fig.80. Tightening sequence - cylinder head bolts.

19. Attach exhaust pipe to the exhaust manifold.

20. Moisten push rods with engine oil at both ends and insert in the push rod sockets. Locate the rocker arms on the push rods and do up adjusting nuts fingertight.

NOTE: Adjusting nuts must be replaced with new ones if they do not have adequate clamping action.

21. Coat mating faces of cylinder block, cylinder heads and inlet manifold with sealing compound, Fig.81, and fit new inlet manifold gasket.

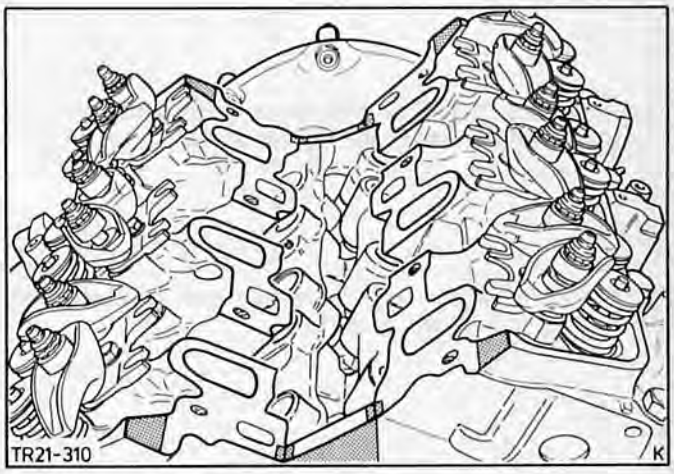

Fig.81. Coat mating faces with sealing compound.

21 163

22. Fit inlet manifold and tighten the bolts to the specified torque in three stages as shown in the diagram, Fig.82.

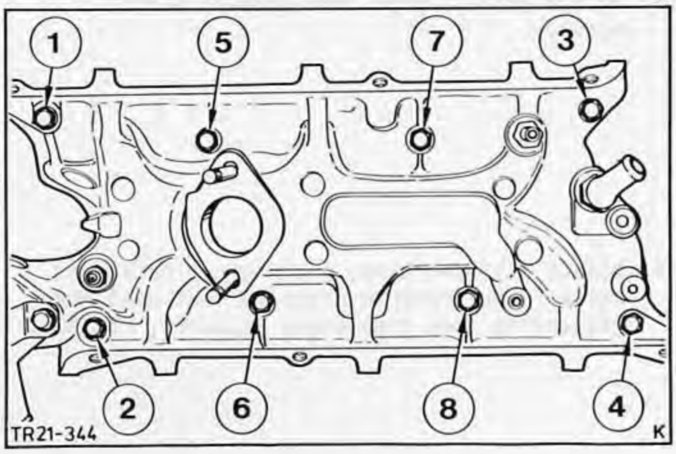

Fig.82. Tightening sequence - inlet manifold bolts.

23. Install the distributor:
Set the piston of cylinder 1 to 6° BTDC. The vacuum unit must face the front and the distributor rotor must point towards the No.1 break contact in the distributor cap. Fit distributor and secure in position, Figs.83 and 84.

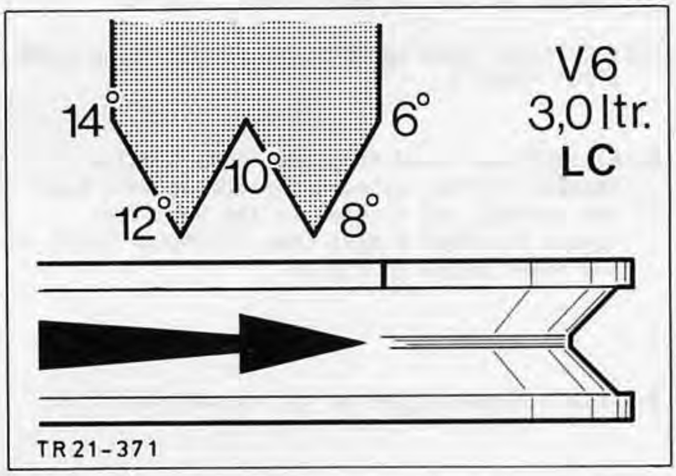

Fig.83. Timing marks.

24. Secure alternator with bracket to cyliinder head. (Only needed when the right hand cylinder head is being fitted).

25. Fit drive belt and tension.

NOTE: The drive belt tension should be checked with a measuring instrument (if available), see Technical Data. Alternatively, the drive belt tension can be checked by applying normal finger pressure in the middle of the longest belt run. Total deflection - 13 mm (0,4in).

26. Adjust valve clearances, see operation 21 213.

27. Fit rocker cover, using new gasket. Insert spark plugs and tighten to specified torque.

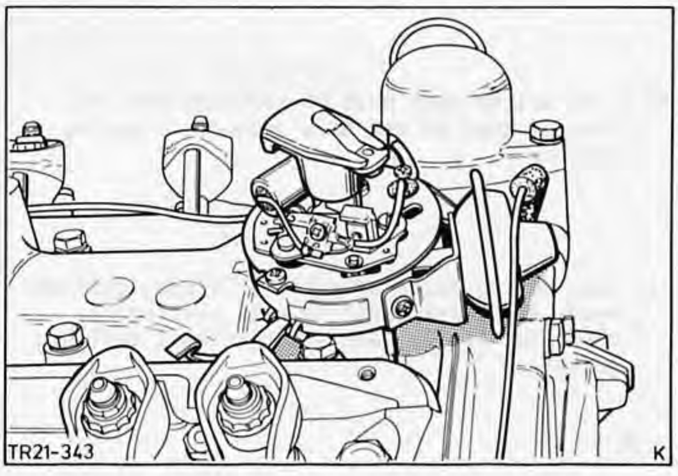

Fig.84. Position of distributor for installation.

28. Reconnect leads to alternator, temperature gauge sender unit and ignition coil.

29. Fit carburettor with governor and deceleration valve, using new gaskets.

30. Fit distributor cap and connect HT leads to spark plugs and coil in the sequence shown in Fig.85. Attach vacuum line to carburettor.

31. Connect engine breather hose to rocker cover and fuel line to carburettor.

32. Secure brake servo vacuum hose to connector on inlet manifold.

33. Fit choke operating cable and adjust. Secure throttle cable with mounting bracket to inlet manifold. Attach throttle linkage to carburettor, Fig.86, and adjust throttle cable.

34. Attach hot water hoses to thermostat housing and connector on inlet manifold.

35. Refit top and bottom radiator hoses and secure hose clips, Fig.87. Fill with coolant.

36. Reconnect battery earth strap and carry out engine adjustments at operating temperature as specified. Set dwell angle, ignition timing, idling speed and CO-content.

37. On completing the adjustments with the engine at normal operating temperature, detach the HT leads from the spark plugs and remove the rocker cover.

38. Retighten cylinder head and inlet manifold bolts to specified torque as indicated in Figs.80 and 82 (using Special Tool 21-066).

39. Fit rocker cover, reconnect HT leads and fit air cleaner.

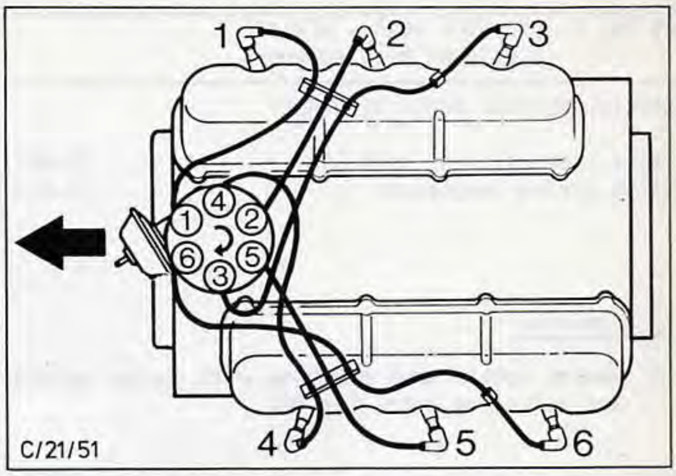

Fig.85. Arrangement of H.T. leads (firing order).

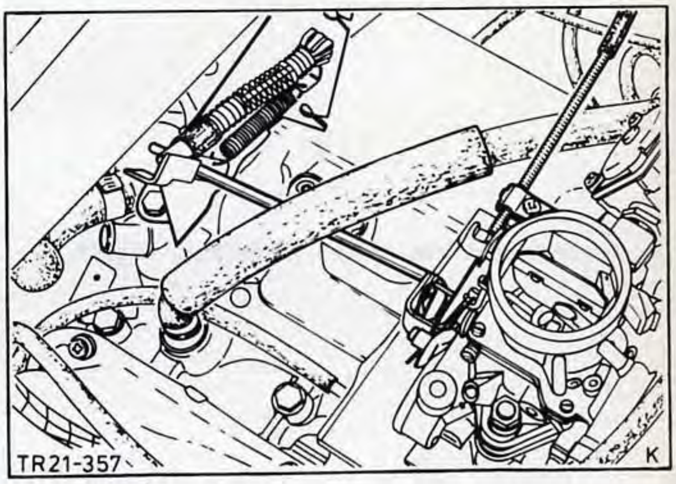

Fig.86. Connect throttle linkage

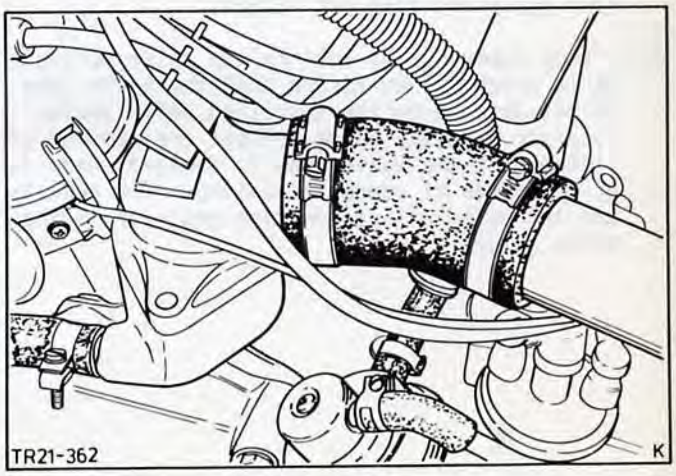

Fig.87. Fit top radiator hose

21 165 5 CYLINDER HEAD - REPLACE (Cylinder head removed)

SPECIAL SERVICE TOOLS REQUIRED:

Valve stem oil seal installer	21-007
Valve spring compressor	21-056

To Dismantle

1. Remove rocker arms complete with rocker guides and adjusting nuts, Fig.88.

NOTE: When existing rocker arms and rocker guides are to be used again, they must not be mixed up.

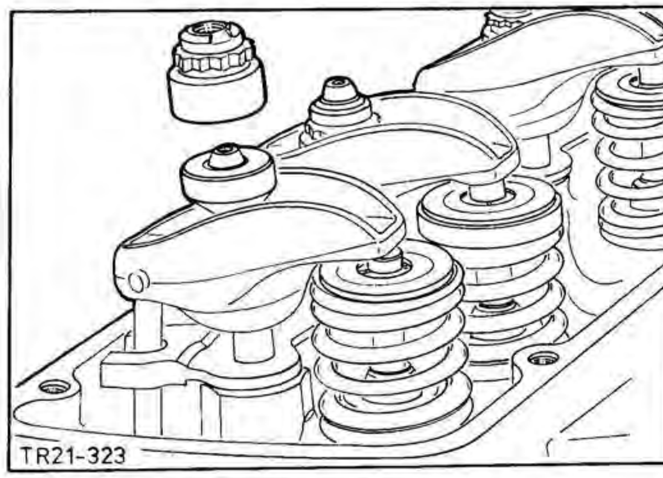

Fig.88. Rocker arm with rocker guide and adjusting nut.

2. Unscrew push rod guides (3 bolts), Fig.89.

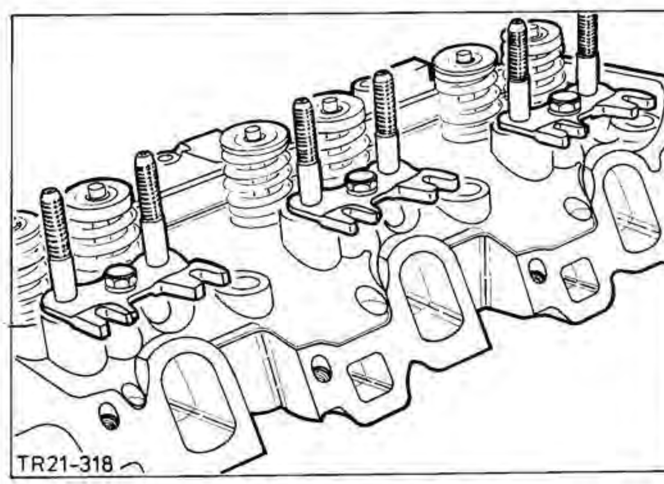

Fig.89. Push rod guide plates.

3. Remove valve springs and spring retainers with special tool 21-056, Fig.90. Remove valve stem seals and take out valves.

NOTE: When removing and fitting the valve springs, it is essential to ensure that the valve stem is not damaged by the depressed valve spring retainer when the valve collets are removed or fitted. If the valve stem is damaged there is no guarantee of adequate sealing. The results are increased oil consumption and wear in the valve guide.

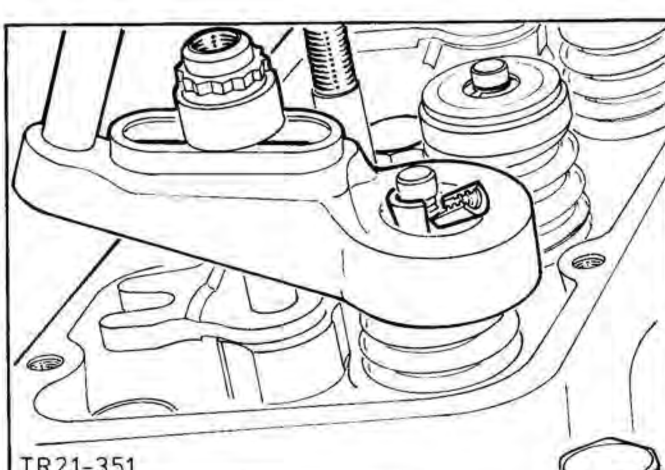

Fig.90. Removing valve springs with special tool 21-056.

21 165 5

To Assemble

NOTE: Before assembling the new cylinder head, any parts of the old cylinder head that are to be used again must be checked for wear and serviceability.

4. Lubricate the valve stems with hypoid oil SQM-2C9002-AA and insert the valves in the valve guides.

5. Mask the valve collet recesses with adhesive tape. Moisten the valve stem oil seals with oil and fit with special tool 21-007, Fig.91. Then remove the adhesive tape from the valve stem again.

NOTE: Use new valve stem seals whenever valves are removed and refitted. Valve collet recesses must be masked with adhesive tape to avoid damage to the oil seals.

6. Fit valve spring and spring retainer, compress using special tool 21-056 and insert valve collets, Fig.92.

   Make sure that the collets are correctly seated.

7. Install push rod guide plates and rocker arms complete with rocker guide and adjusting nut, Fig.93.

NOTE: Adjusting nuts must be replaced with new ones if they do not have adequate clamping action.

NOTE: When using old valves in the new cylinder head, the valve heads must be reground on a valve grinding machine prior to fitting. Then proceed as follows:

8. Grind in valves in cylinder head. Clean grinding paste residues from valves and valve seats and insert oiled valves. Continue as described in sub-operation 5 onwards.

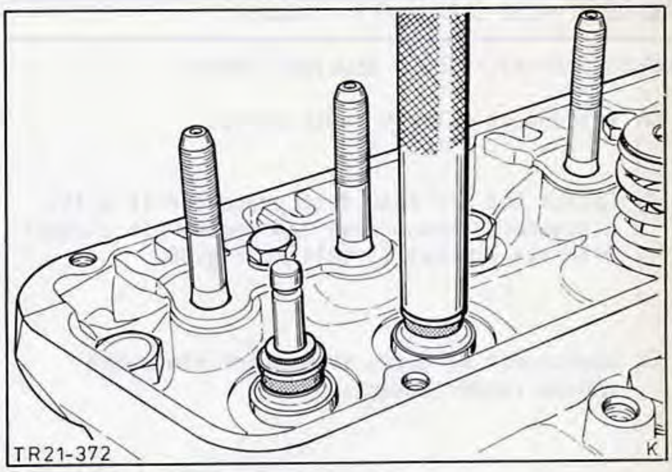

Fig.91. Fit valve stem oil seals.

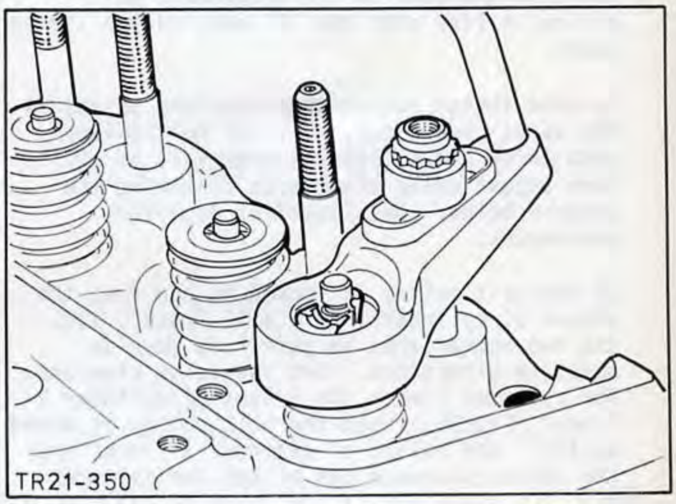

Fig.92. Fitting valve spring with special tool 21-056.

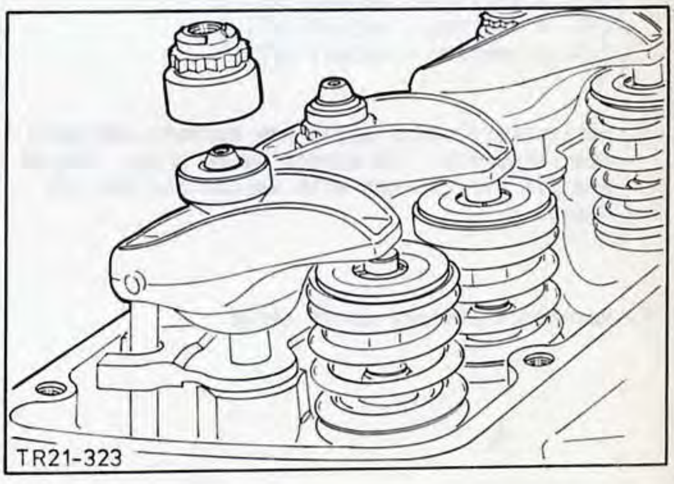

Fig.93. Rocker arm with rocker guide and adjusting nut.

21 213 VALVE CLEARANCES - ADJUST

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Disconnect battery earth strap.

2. Detach hot air hose from preheater (1 bolt), disconnect vacuum hose and remove air cleaner with its bracket (3 bolts), Fig.94.

3. Disconnect HT leads from spark plugs and remove rocker covers.

4. Crank engine solely in the normal direction of rotation during the valve clearance adjusting operation. To adjust the first valve, position the mark on the crankshaft belt pulley in line with the "O" mark on the timing cover.

   To make things easier when starting to adjust the valve clearances, mark the belt pulley with three chalk lines at intervals of 120°. Then adjust valve clearances following the pattern below. See Technical Data for clearances.

   If the belt pulley is rocked to and fro, the valves of cylinder 1 or 5 will "rock", i.e. the two rocker arms or push rods move in opposite directions. Set the valve clearance for cylinder 1 when the valves of cylinder 5 "rock", Fig.95. When the belt pulley is moved on 120°, the valves of cylinder 3 "rock" and the valve clearance can be set for cylinder 4.

   Cyl. 5 rocking - adjust cyl. 1
   Cyl. 3 rocking - adjust cyl. 4
   Cyl. 6 rocking - adjust cyl. 2
   Cyl. 1 rocking - adjust cyl. 5
   Cyl. 4 rocking - adjust cyl. 3
   Cyl. 2 rocking - adjust cyl. 6

5. Fit rocker covers using new gaskets and bolt down securely. Reconnect spark plugs, Fig.96 and fit air cleaner with vacuum and hot air hoses.

6. Reconnect battery earth strap.

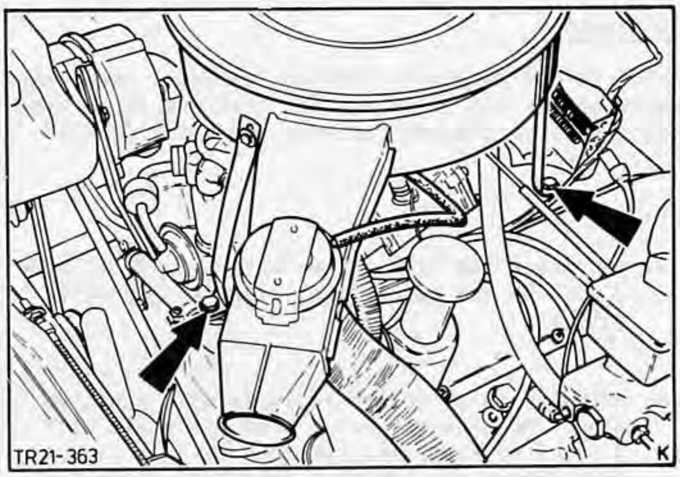

Fig.94. Remove air cleaner.

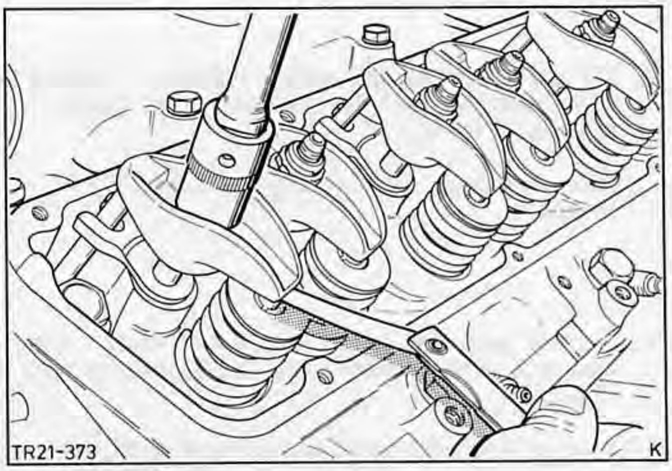

Fig.95. Adjust valve clearance.

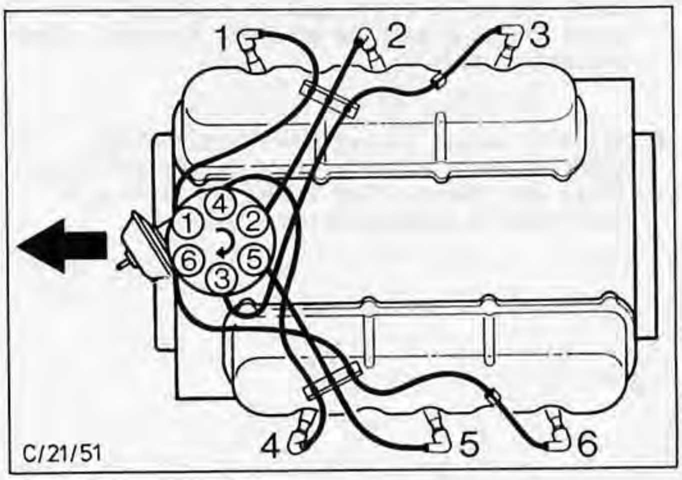

Fig.96. Arrangement of HT leads (firing order).

21 233 9 VALVE GUIDE - REAM
(Valve removed)

SPECIAL SERVICE TOOLS REQUIRED:

Valve guide reamer 21-042

1. Place valve in valve guide and check clearance by pressing sideways, Fig.97.

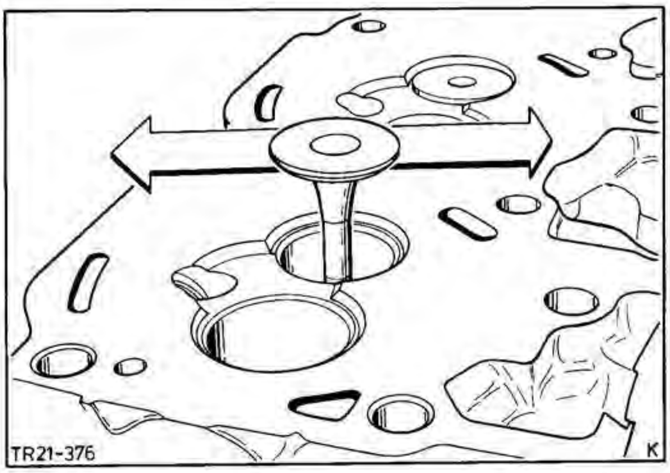

Fig.97. Check clearance in valve guide by pressing sideways.

2. Ream valve guide from the valve seat end using a suitable reamer, Fig.98. Use soluble oil or kerosene for lubrication.

NOTE: After a lengthy time in service, valve guides show signs of ovality. Consequently, reaming must always be done from the valve seat end.

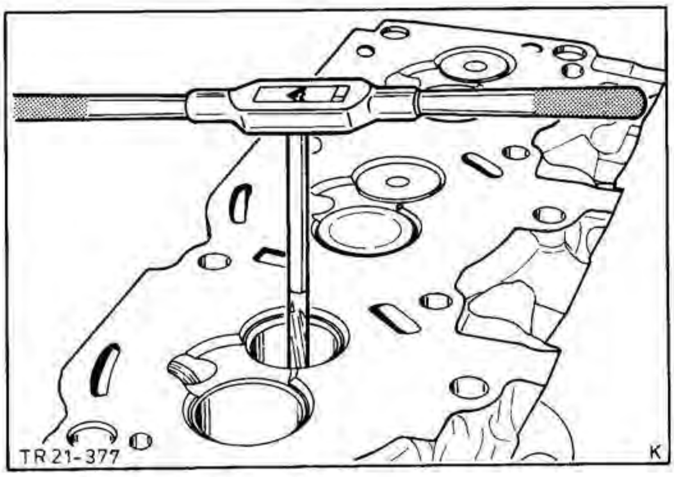

Fig.98. Ream valve guide.

3. Recut valve seat as specified (see Technical Data) using standard tool, Fig.99.

NOTE: Before the valve seat is recut, the valve guide must be checked and, if necessary, reamed.

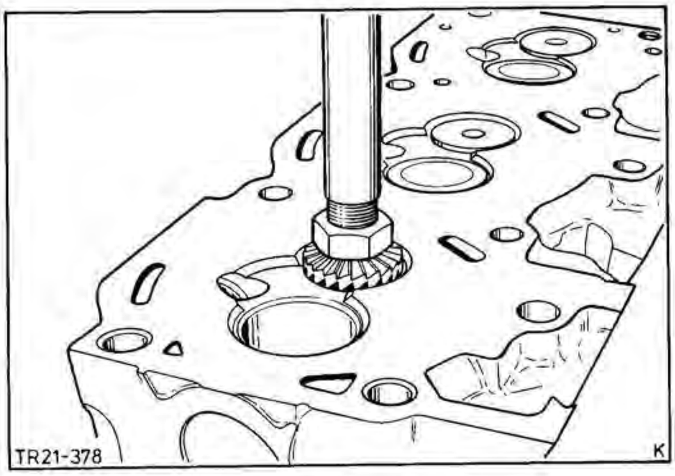

Fig.99. Recut valve seat.

21 238 SEALS - VALVE STEM - REPLACE

SPECIAL SERVICE TOOLS REQUIRED:

Valve stem oil seal installer	21-007
Valve spring compressor	21-056

To Remove

1. Disconnect battery earth strap.

2. Detach hot air hose from preheater (1 bolt), disconnect vacuum hose and remove air cleaner with its brackets (3 bolts).

3. Disconnect HT leads from coil and spark plugs and remove distributor cap with HT leads. Remove rocker covers (12 bolts).

4. Release alternator at adjusting arm and take off drive belt. Swing alternator to one side.

5. Remove rocker arms complete with rocker guides and adjusting nuts, Fig.100.

NOTE: Do not mix up rocker arms and rocker guides when removing and refitting.

NOTE: Valve stem oil seals can only be replaced when the piston of the cylinder in question is at TDC.

6. Secure special tool 21-056 to the cylinder head with a nut, Fig.101.

7. Press valve spring down with special tool 21-056 and remove valve collets, Fig.102. Release the valve spring and remove spring retainer, valve spring and oil seal.

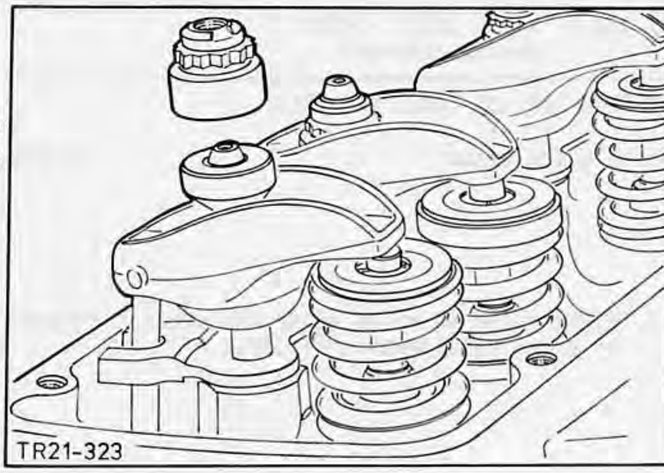

Fig.100. Rocker arm with rocker guide and adjusting nut.

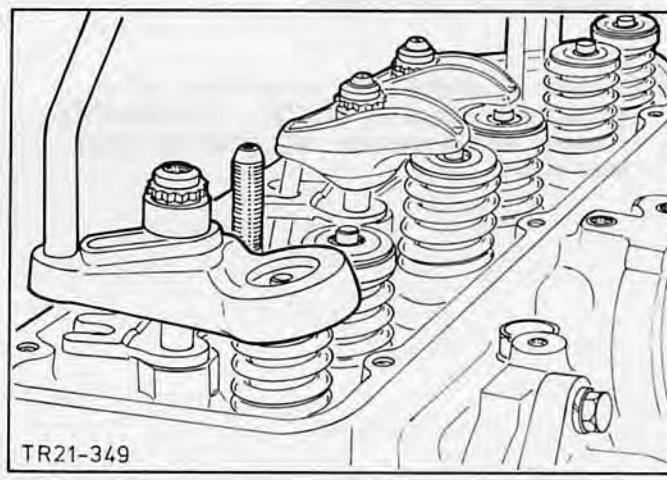

Fig.101. Fit special tool 21-056.

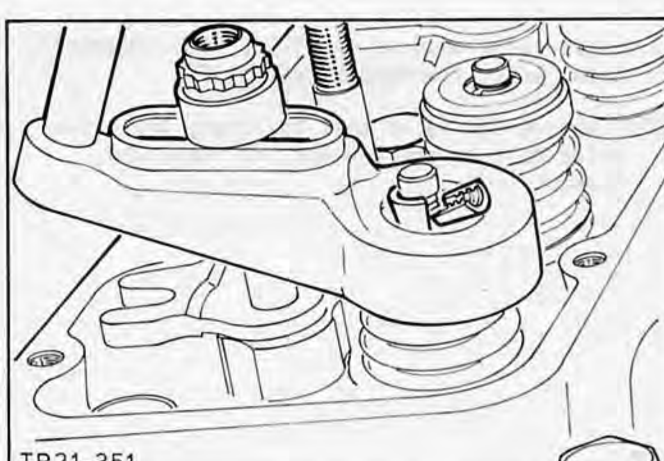

Fig.102. Remove valve collets.

21 238

To Install

8. Mask valve collet recesses with adhesive tape. Moisten oil seals with oil and fit using special tool 21-007, Fig.103. Then remove adhesive tape from valve stem.

NOTE: Always fit new valve stem oil seals whenever valves are removed and refitted. Mask valve collet recesses with adhesive tape to avoid damage to oil seals.

9. Fit valve spring and spring retainer, compress with special tool 21-056 and fit valve collets. Make sure that collets are seated correctly.

10. Position rocker arms and rocker guides on the push rods, Fig.104. fit adjusting nuts and check valve clearances (see operation 21 213).

NOTE: Adjusting nuts must be replaced with new ones if they do not have adequate clamping action.

11. Swing alternator back into position, fit drive belt and tension.

NOTE: Belt tension should be checked with a measuring instrument (if available), see Technical Data. Alternatively, belt tension can be checked by applying normal finger pressure in the middle of the longest belt run. Total deflection - 13 mm (0,5 in).

12. Fit rocker covers using new gaskets and tighten bolts evenly to specified torque.

13. Fit distributor cap and reconnect HT leads, Fig.105. Fit air cleaner and reconnect battery earth strap.

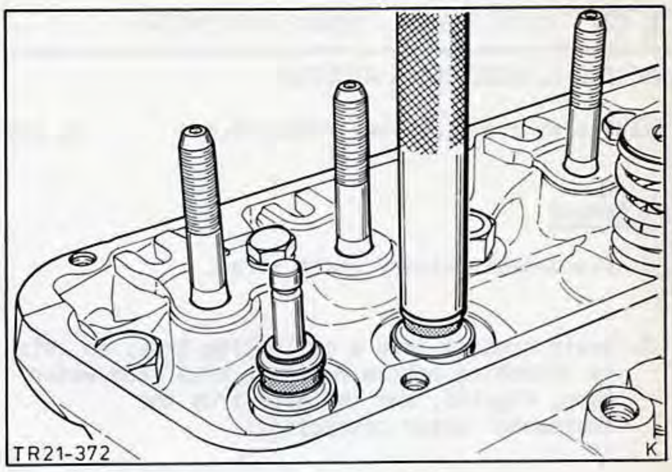

Fig.103. Fit valve stem oil seal.

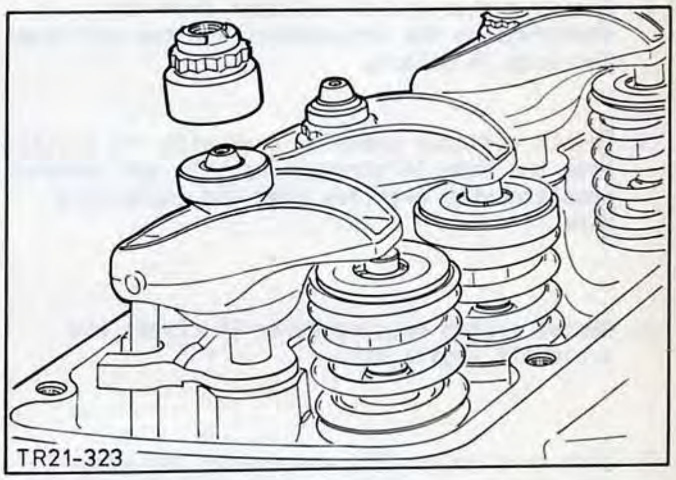

Fig.104. Fit rocker arms.

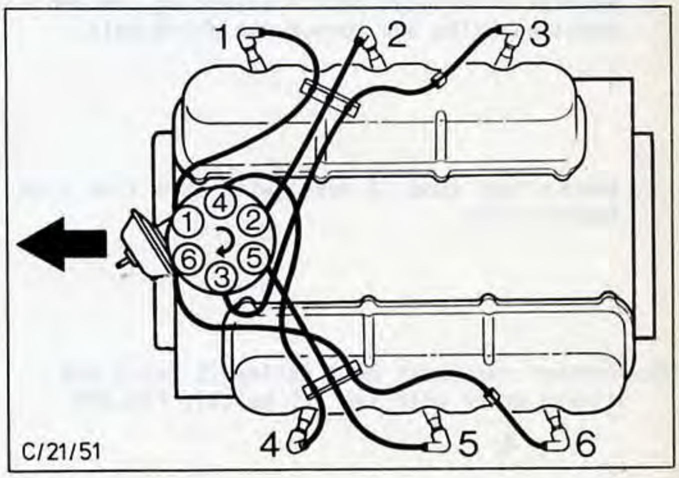

Fig.105. Arrangement of HT leads - (firing order).

21 332 TIMING GEARS - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Crankshaft front oil seal installer 21-059

To Remove

1. Disconnect battery earth strap.

2. Drain coolant into a collecting tray; do this by detaching bottom radiator hose from water pump, Fig.106, and top hose from the thermostat water connector.

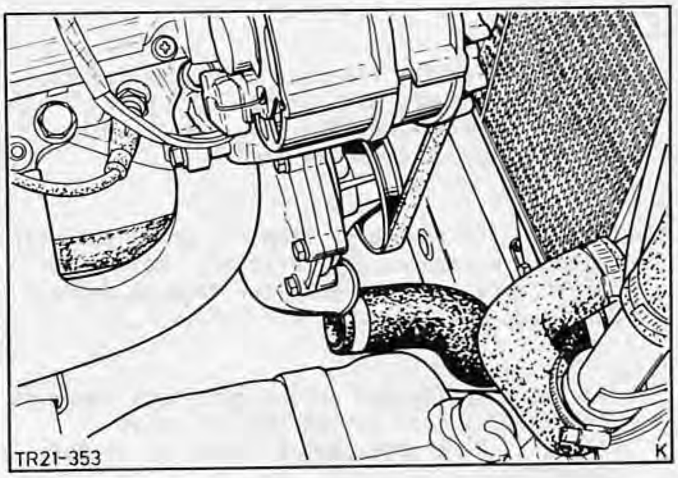

Fig.106. Bottom radiator hose detached.

3. Unscrew connecting pipe running to overflow tank from the body (2 screws), Fig.107.

4. Detach bottom end of radiator from its mountings on the crossmember and top end from the body (4 bolts).

5. Detach radiator overflow tank with its bracket from the body (4 screws) and lift out radiator complete with overflow tank and connecting pipe.

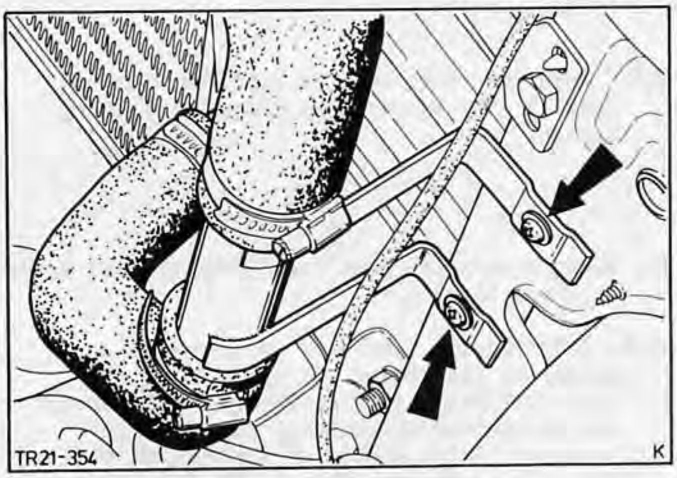

Fig.107. Connecting pipe to overflow tank.

6. Remove clutch housing cover (4 clips) and drain off engine oil.

7. Undo sump bolts (25) and detach the sump. If the sump is stuck fast, prise it off sideways using a screwdriver.

8. Release alternator on its adjusting arm and mounting bolts and remove the drive belt.

9. Remove fuel pump (2 nuts) with fuel line from timing cover.

10. Remove crankshaft belt pulley (1 bolt) and timing cover with fan (11 bolts), Fig.108.

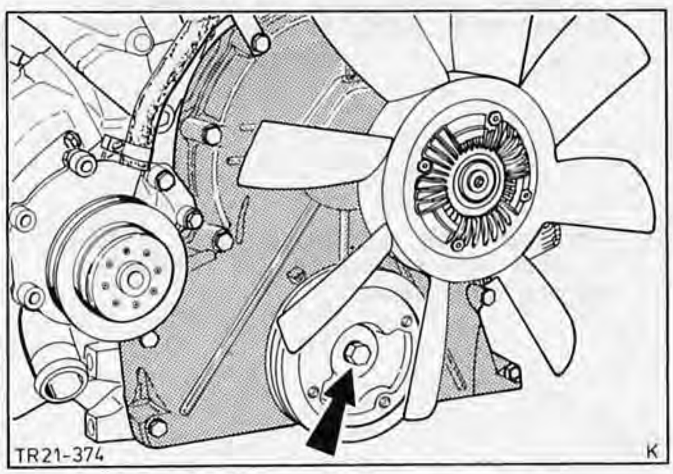

Fig.108. Remove crankshaft belt pulley.

11. Remove camshaft gear with eccentric disc (1 bolt).

12. Pull off crankshaft gear using a standard tool, Fig.109.

13. Drive oil seal out of the timing cover using a drift, Fig.110A.

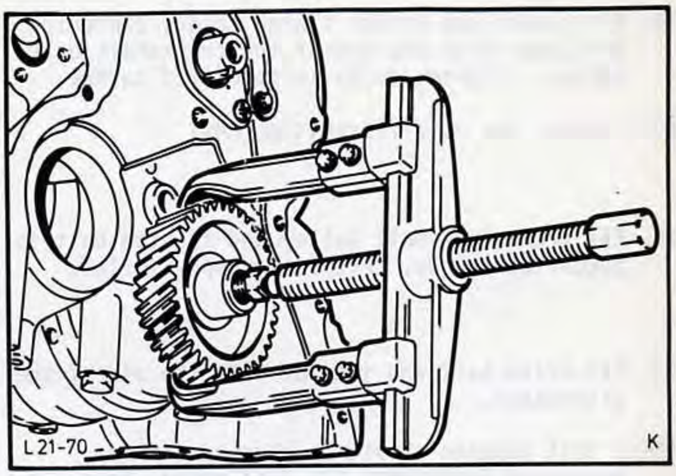

Fig.109. Pull off crankshaft gear.

To Install

14. Clean old gasket residues from the mating face of the timing cover and the intermediate plate.

15. Install a new oil seal in the timing cover with special tool 21-059, Fig.110B.

16. Line up crankshaft gear on the keyway and drive on part of the way using a plastic hammer. Pull on gear in conjunction with belt pulley, washer and bolt. Detach belt pulley again.

17. Slide on camshaft gear with the spot in line with the mark on the crankshaft gear. (Keyways must line up). Insert bolt with eccentric disc and tighten to specified torque.

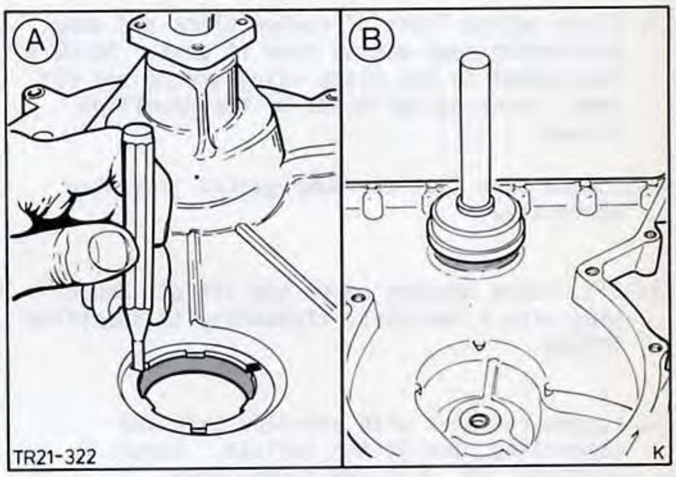

Fig.110. A - remove oil seal
B - install oil seal

NOTE: As the crankshaft gear has two marks, only fit camshaft gear as shown in Fig.111.

18. Check camshaft end float with a dial indicator (see Technical Data).

19. Coat outer periphery of timing cover mating face and front of intermediate plate with sealing compound.

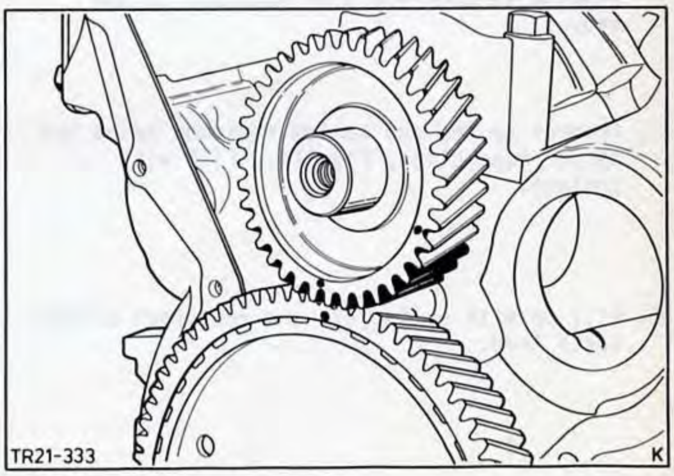

Fig.111. Spot marks on camshaft and crankshaft gears.

21 332

20. Fit gasket and attach timing cover, centering the cover with the aid of the crankshaft belt pulley. Tighten bolts to specified torque.

NOTE: Bolts are of different lengths.

21. Fit crankshaft belt pulley and tighten bolt to specified torque. Fit fuel pump, Fig.112.

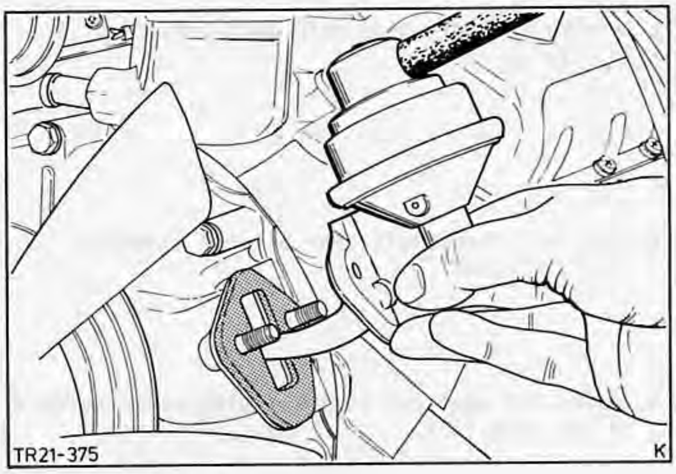

Fig.112. Fit fuel pump.

22. Fit drive belt and tension with the aid of the alternator.

NOTE: Belt tension should be checked with a measuring instrument (if available), see Technical Data. Alternatively, the belt tension can be checked by applying normal finger pressure in the middle of the longest belt run. Total deflection - 13mm (0,5 in).

23. Clean mating faces of engine block and sump. Straighten sump mating face if bent. Stick a new gasket to the block using grease and fit sump, securing the bolts to the specified torque.

NOTE: Make sure that the sump gasket is seated correctly.

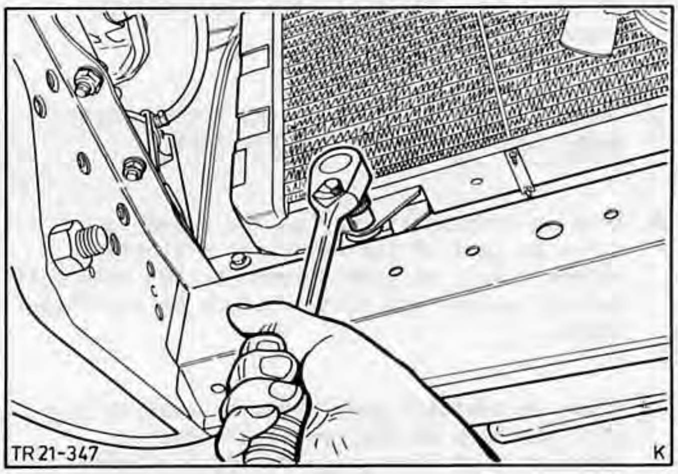

Fig.113. Secure bottom end of radiator.

24. Fit clutch housing cover and fit oil drain plug with a new seal, tightening to specified torque.

25. Locate radiator with overflow tank and connecting pipe in the vehicle. Screw overflow tank securely to the body

26. Bolt radiator securely in place at top and bottom, Fig.113, and attach connecting pipe running to overflow tank securely to the body.

27. Connect up top and bottom radiator hoses and secure hose clips, Fig.114. Fill with coolant.

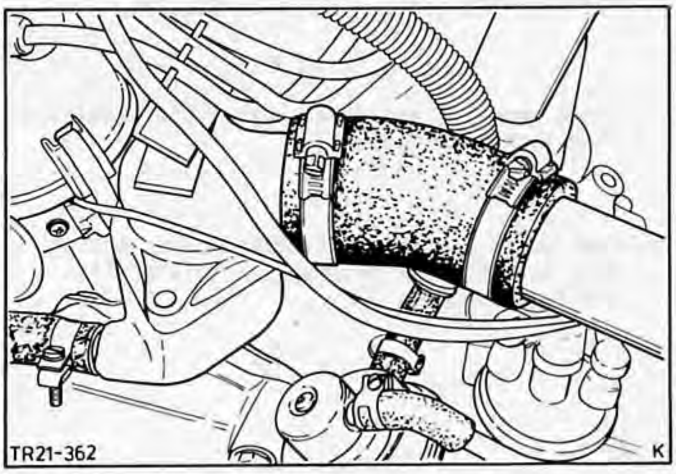

Fig.114. Fit top radiator hose.

28. Fill up with engine oil and reconnect battery earth lead.

21 468 4 SEAL - CRANKSHAFT REAR - REPLACE (Engine or transmission removed)

SPECIAL SERVICE TOOLS REQUIRED:

Crankshaft rear oil seal installer	21-011-B
Clutch plate locator	21-044
Crankshaft rear oil seal extractor	21-096

To Remove

1. Remove clutch pressure plate (6 bolts) with clutch disc from the flywheel.

2. Unbolt flywheel (6 bolts).

   The oil seal carrier must be cut out using special tool 21-047 (see operation 21 469 4) before the oil seal can be replaced.

3. Remove oil seal using special tool 21-096, Fig.115.

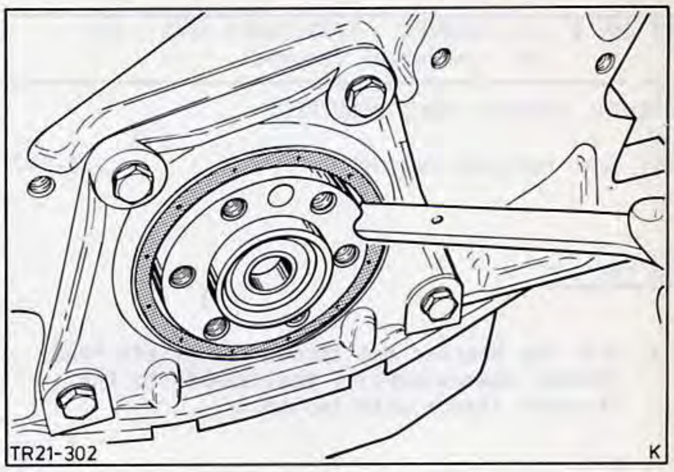

Fig.115. Remove oil seal.

To Install

4. Slide the new oil seal onto special tool 21-011-B as far as the stop (if necessary, turn the seal to obtain satisfactory seating). Moisten crankshaft with engine oil and fit the seal, Fig.116.

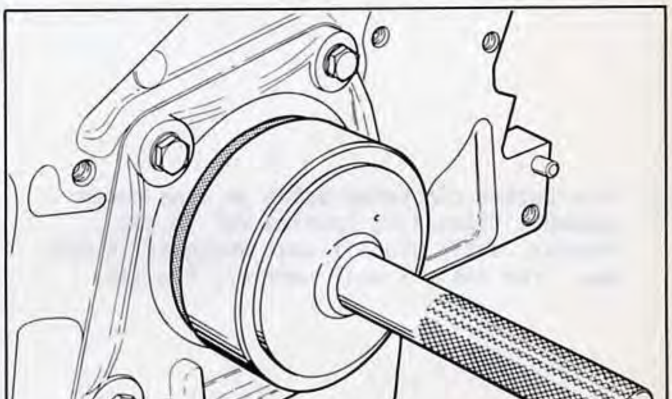

Fig.116. Install oil seal with special tool 21-011-B.

5. Clean crankshaft flange and flywheel contact area, fit flywheel and tighten bolts to specified torque.

6. Fit clutch pressure plate with clutch disc, centering clutch disc with special tool 21-044, Fig.117. Tighten clutch pressure plate bolts to specified torque.

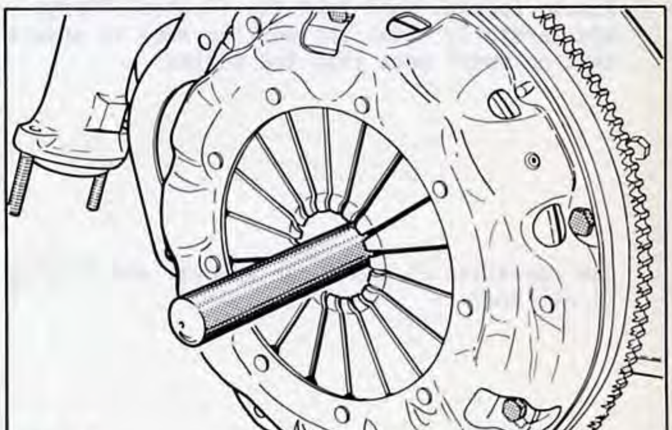

Fig.117. Centre clutch disc with special tool 21-044.

21 469 4 OIL CARRIER - CRANKSHAFT REAR - CUT OUT (Flywheel removed)

SPECIAL SERVICE TOOLS REQUIRED:

Oil seal retainer cutter	21-047

To cut out

1. With the knurled nut turned back (left-hand thread) attach special tool 21-047 to the flywheel flange with two bolts.

2. Turn cutter clockwise using an open ended spanner, tightening knurled nut in the process, until the oil seal abutment is cut away from the oil seal carrier, Fig.118.

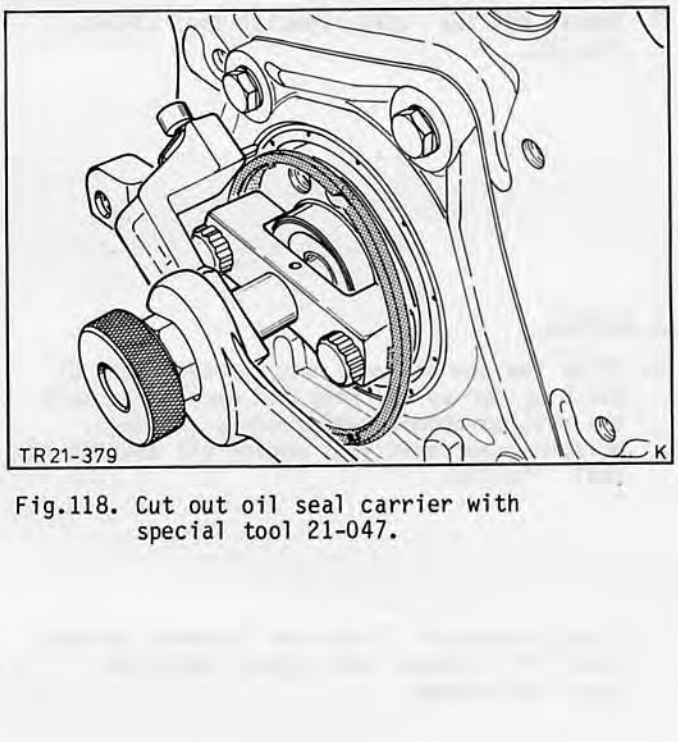

Fig.118. Cut out oil seal carrier with special tool 21-047.

3. Remove special tool from the flywheel flange and carefully clean the working area to ensure that no swarf gets into the engine.

See operation 21 468 4 for removal and fitting of oil seal.

21 505 5 PISTON - REPLACE
(Piston and connecting rod removed)

SPECIAL SERVICE TOOLS REQUIRED:

Piston pin installer 21-014

General

Piston and piston pin form a unit and can only be replaced together. Piston pin bores and piston pin diameters are graded with corresponding paint marks and must match one another. The paint marks take the form of spots and are located on the piston crown and the outer edge of the pin.

The procedure using the special tool described below must be followed exactly as the position of the piston pin cannot be changed once the connecting rod has cooled.

When a cylinder bore has to be enlarged 0,5 mm (0,20in) the remaining cylinder bores must be bored out by the same amount. Unequal bores would cause trouble because 0,5 mm (0,20 in) oversize could mean a piston weight increase of up to 10g.

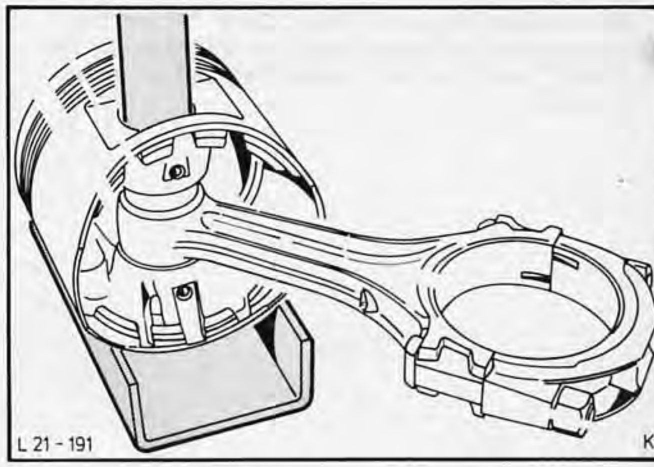

Fig.119. Drive out piston pin with a drift.

To Remove

1. Drive the piston pin out of the piston using a drift or a press, Fig.119.

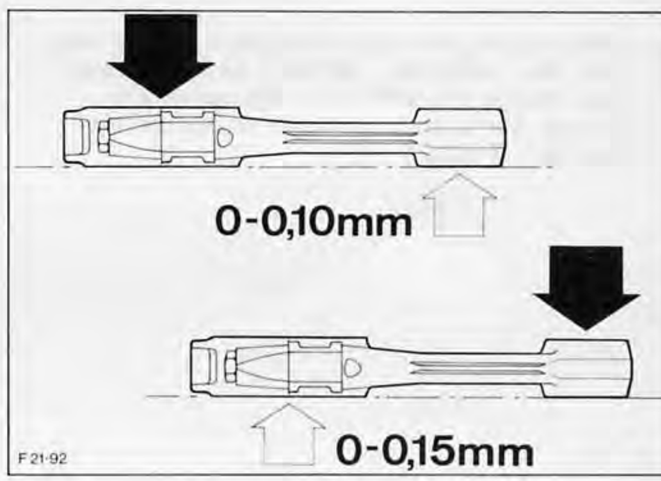

Fig.120. Max. deviation of connecting rod from alignment.

To Install

2. Measure up connecting rod on a surface plate using a feeler gauge. See Fig.120. for maximum deviation from alignment.

3. Clamp special tool 21-014 in the vice and retract guide pin fully, Fig.121.

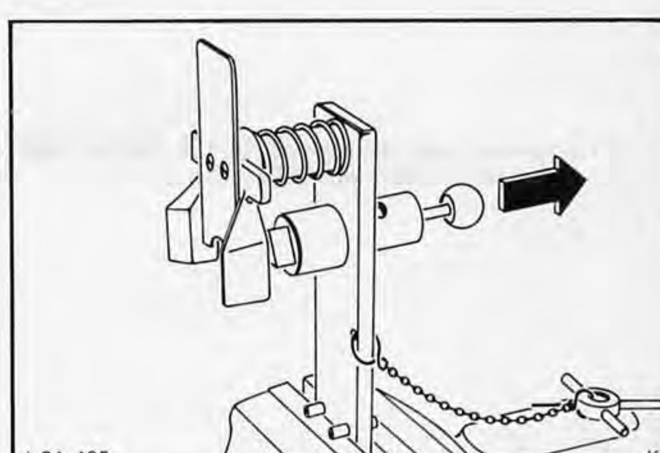

Fig.121. Installer 21-014.

21 505 5

4. When assembling, the front mark "F" on the piston must be positioned in relation to the "FRONT" mark on the connecting rod as shown, Fig.122.

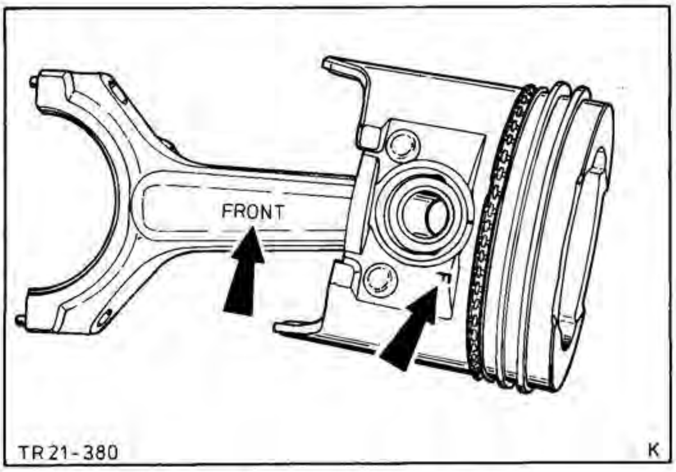

Fig.122. Relative positions of front marks.

5. Clamp piston with the front mark facing away from the installer. Moisten both pin bores with engine oil and slide the guide pin through the piston pin bore as far as the shoulder, Fig.123.

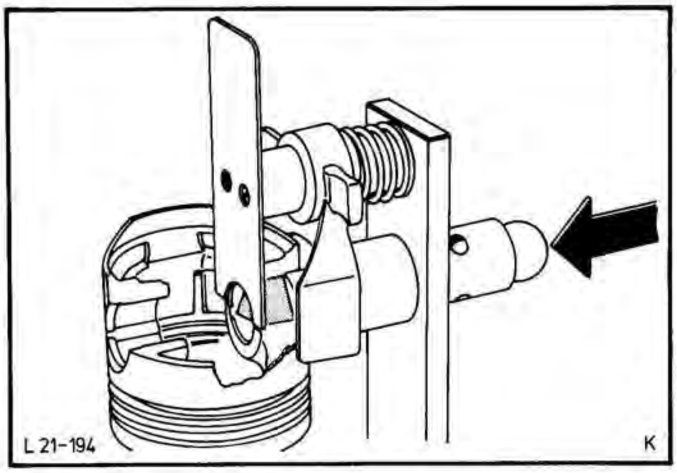

Fig.123. Slide guide pin through the pin bore as far as the stop.

6. Slide piston pin through up to the inside edge of the other piston pin bore, Fig.124.

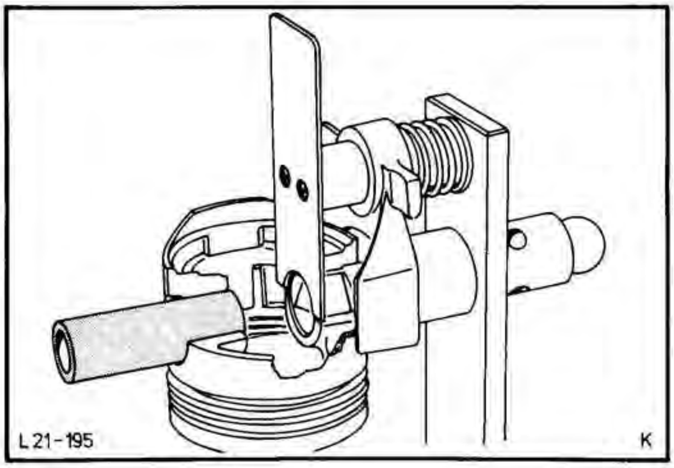

Fig.124. Insert piston pin.

21 505 5

7. Use the stop gauge marked "Essex", Fig.125.

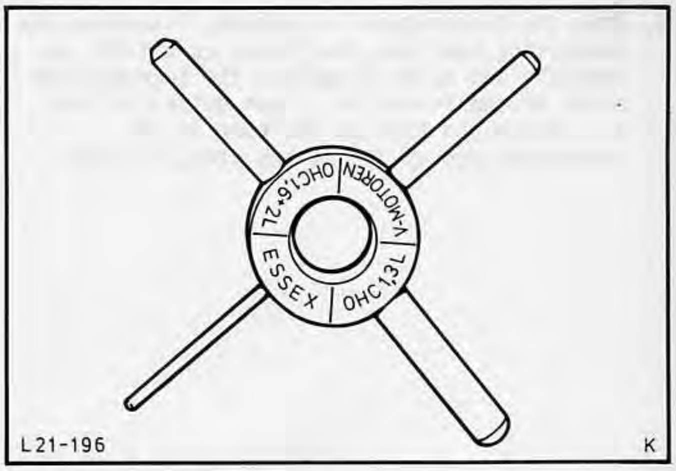

Fig.125. Installer stop gauge.

8. Slide stop gauge into the installer, Fig.126.

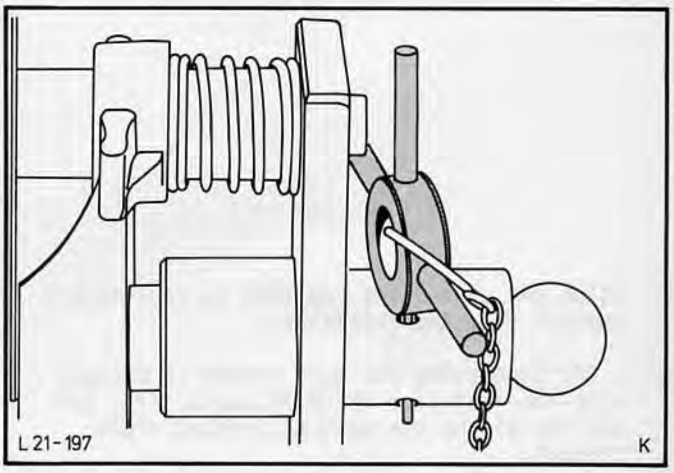

Fig.126. Fit stop gauge.

9. Heat connecting rod end using a hotplate, as shown in Fig.127, up to a temperature of 260° to 400°C. Mark piston pin bore with a thermochromatic coloured pencil (Faber-Castell 2815) before heating so that the temperature can be monitored. When the temperature reaches the figure indicated on the pencil cover, the mark on the pin bore of the connecting rod will change to the same colour as the pencil cover.

<u>Example</u>

If the pencil is green and the cover black, the indicated temperature of 280°C is reached when the green mark on the connecting rod pin bore changes to black.

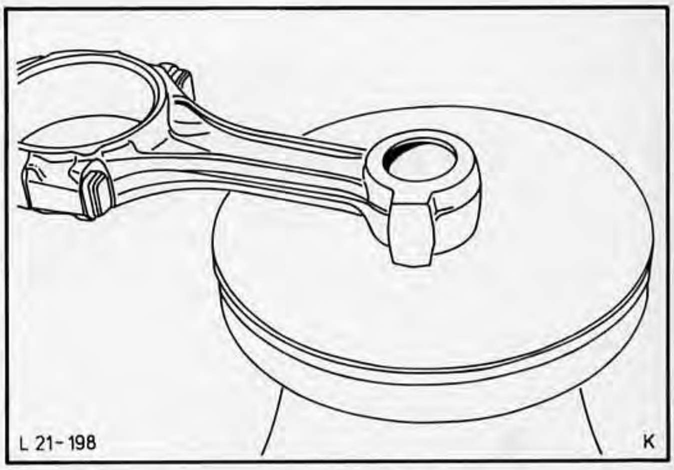

Fig.127. Heat pin bore in connecting rod.

21 505 5

10. When the temperature is reached, introduce the connecting rod into the piston as quickly as possible and hold it against the intermediate plate of the installer. Then quickly slide the piston pin through the bore in the connecting rod as far as the stop, Fig.128.

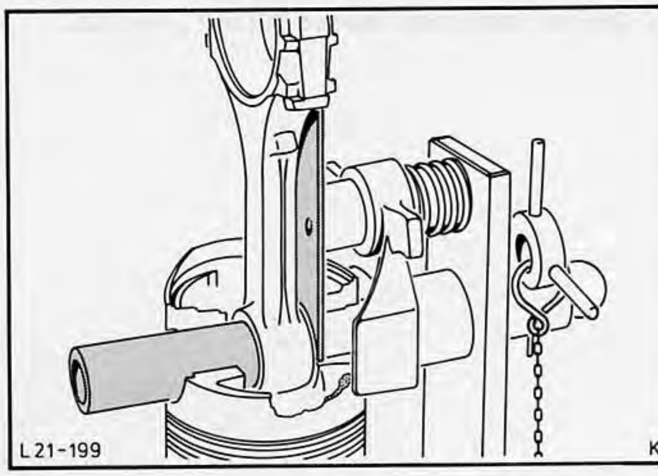

Fig.128. Slide piston pin through bore in connecting rod as far as stop.

11. Allow the connecting rod time to cool before removal from the installer.

NOTE: The connecting rod must remain in contact with the installer while it cools, Fig. 129, and the piston pin must be pressed right through.

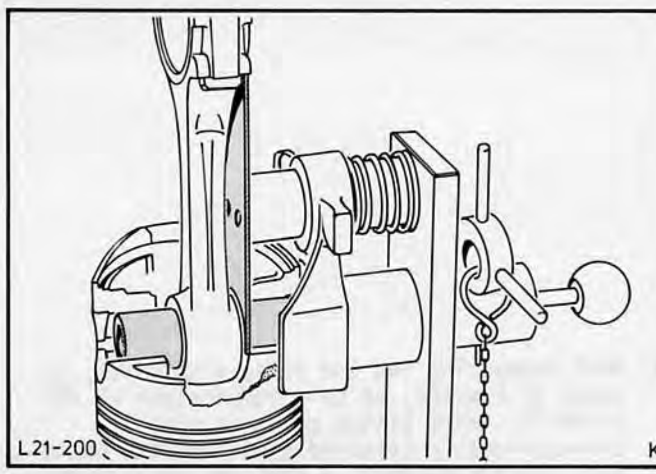

Fig.129. Connecting rod must remain in contact with installer.

TECHNICAL DATA

"F" engine (OHV/V6)

Engine - general		3,0 LC
Identification code		HX
Firing order		1-4-2-5-3-6
Bore	mm	93,67
Stroke	mm	72,415
Cubic capacity, effective	cc	2993
Cubic capacity, fiscal rating	cc	2945
Compression ratio		8,0 : 1
Compression pressure at starter motor speed	kgf/cm^2	8,84 - 10,84
Idling speed	rev/min	800 + 25
Power output - DIN	KW (HP)	74 (100)
at	rev/min	4300
Torque	Nm (kgf.m)	191 (95)
at	rev/min	3100
Cylinder block		
Cast mark		722F-6015-BA
Number of main bearings		4
Cylinder bore dim. - standard class A	mm	93,647 to 93,658
B	mm	93,658 to 93,668
C	mm	93,668 to 93,678
D	mm	93,678 to 93,688
oversize 0,381	mm	94,036 to 94,091
0,762	mm	94,315 to 94,447
1,143	mm	94,787 to 74,828
1,524	mm	95,178 to 95,209
Main bearings - parent bore diameter	mm	67,701 to 67,721
oversize	mm	68,082 to 68,102
Main bearing shell inside dia. (fitted) - standard	mm	63,542 to 63,580
undersize 0,25	mm	63,288 to 63,326
0,50	mm	63,034 to 63,072
0,75	mm	62,780 to 62,818
1,00	mm	62,526 to 62,564
Width of axial control bearing	mm	22,047 to 22,098
Crankshaft		
End float	mm	0,076 to 0,279
Main bearing journal dia. - standard	mm	63,515 to 63,536
undersize 0,254	mm	63,261 to 63,282
0,508	mm	63,007 to 63,028
0,762	mm	62,753 to 62,774
1,016	mm	62,499 to 62,520
Clearance, bearing shell - main bearing journal	mm	0,006 to 0,059
Thickness of thrust washer halves - standard	mm	2,311 to 2,362
oversize 0,0635	mm	2,375 to 2,426
0,1270	mm	2,438 to 2,489
0,1905	mm	2,502 to 2,553
0,2540	mm	2,565 to 2,616
Big end bearing journal dia. - standard	mm	60,355 to 60,376
undersize 0,254	mm	60,101 to 60,122
0,508	mm	59,847 to 59,868
0,762	mm	59,593 to 59,614
1,016	mm	59,339 to 59,360

TECHNICAL DATA - "F" engine (OHV/V6)

Camshaft

		3,0 LC
Number of camshaft bearings		4
Drive		gears
Cam lift - inlet	mm	7,205
- exhaust	mm	6,836
Cam length (heel to toe) - inlet	mm	34,701 to 34,930
- exhaust	mm	34,330 to 34,559
Thickness, camshaft retaining plate	mm	5,334 to 5,385
Thickness, spacer ring	mm	5,537 to 5,588
End float	mm	0,152 to 0,254
Backlash	mm	0,22 to 0,32
Camshaft bearing journal dia. - front	mm	47,592 to 47,612
- middle 1	mm	46,068 to 46,088
- middle 2	mm	44,544 to 44564
- rear	mm	44,163 to 44,183
Bearing clearance	mm	0,020 to 0,066
Bearing inner dia. - front	mm	47,633 to 47,658
- middle 1	mm	46,109 to 46,134
- middle 2	mm	44,585 to 44,610
- rear	mm	44,204 to 44,229

Pistons

Piston dia. - standard A	mm	93,600 to 93,610
B	mm	93,610 to 93,620
C	mm	93,620 to 93,630
D	mm	93,630 to 93,640
oversize 0,0635	mm	93,663 to 93,703
0,7620	mm	94,361 to 94,401
1,5240	mm	95,123 to 95,163
Clearance in bore	mm	0,038 to 0,058
Piston ring gap (fitted) - top ring	mm	0,381 to 0,508
- middle ring	mm	0,254 to 0,381
- bottom ring	mm	0,380 to 0,114
Ring gap position - top		Offset 150° from support ring gap
- middle		Offset 150° from support ring gap in opposite direction to top ring
- 3 piece oil control ring		
- intermediate ring, top		Offset 25 mm from support ring gap
- support ring		Opposite marked side of piston
- intermediate ring, bottom		Offset 25 mm from support ring gap in opposite direction to top intermediate ring

Piston pin

Pin dia. - red	mm	23,800 to 23,802
yellow	mm	23,802 to 23,805
blue	mm	23,805 to 23,807
Clearance in piston (floating)	mm	0,0076 to 0,0127
Interference in connecting rod	mm	0,0203 to 0,0381

Connecting rods

End float on shaft	mm	0,10 to 0,25
Bore dia. (excl. bearing shells) - big end	mm	64,033 to 64,054
- small end	mm	23,769 to 23,779
Internal bearing dia. (fitted) - standard	mm	60,382 to 60,420
- undersize 0,254	mm	60,128 to 60,166
0,508	mm	59,874 to 59,912
0,752	mm	59,620 to 59,658
1,016	mm	59,366 to 59,404
Big-end bearing journal/shell clearance	mm	0,006 to 0,064

TECHNICAL DATA - "F" engine (OHV/V6)

Cylinder head

		3,0 LC
Cast mark		722M-6090-FA
Valve seat angle		44°30'- 45°
Valve seat width - inlet	mm	1,15 - 1,7
- exhaust	mm	1,7 - 2,25
Valve stem bore - inlet and exhaust - standard	mm	7,907 - 7,938
- oversize 0,076	mm	7,983 - 8,014
0,382	mm	8,288 - 8,319

Valves

Valve stem dia. - inlet	mm	7,869 - 7,887
- exhaust	mm	7,846 - 7,864
Oversize valve stems	mm	0,076
		0,381
Clearance - valve stem guide - inlet	mm	0,020 - 0,068
- exhaust	mm	0,043 - 0,091
Valve head dia. - inlet	mm	40,944 - 41,199
- exhaust	mm	36,78 - 37,03

Valve springs

Free length	mm	47,955
Internal dia. of spring	mm	23,98 + 0,15
Total number of turns		6,5
Spring diameter	mm	4,27 + 0,025
Spring force - valve open	kgf	68 ∓ 3,4
- valve closed	kgf	31,75 ∓ 1,6

Valve timing

Inlet valve opens	29° BTDC
Inlet valve closes	67° ABDC
Exhaust valve opens	70° BTDC
Exhaust valve closes	14° ATDC

Valve clearances

Valve lift - inlet	mm	9,347
- exhaust	mm	8,611
Valve clearance - inlet	mm	0,29 - 0,34
- exhaust	mm	0,52 - 0,57

TECHNICAL DATA - "F" engine (OHV/V6)

		3,0 LC
Engine lubrication		
Oil type		HD oil (Ford Super engine oil)
Ford specification		SSM-2C9001-AA
Viscosity - below -12°C		SAE 5W-20
below 0°C		SAE 5W-30
-23°C to + 32°C		SAE 10W-30/40/50
over -12°C		SAE 20W-40-50
First fill capacity inc. filter	ltr	7,80
Oil change without filter renewal	ltr	6,75
Oil change with filter renewal	ltr	7,25
Min. oil pressure at - 750 rev/min	kgf/cm^2	1,0
- 2000 rev/min	kgf/cm^2	2,8
Relief valve opens at	kgf/cm^2	4,4 - 5,1
Oil pressure warning light comes on at	kgf/cm^2	0,3 - 0,5
Oil pump, rotor/housing clearance	mm	max. 0,304
Inner/outer rotor clearance	mm	max. 0,2
Rotor/mating face clearance	mm	max. 0,104

Tightening torques		Nm	(kgf.m)
Main bearing caps		74,3 to 81,0	(7,6 to 8,3)
Big end bearing caps		52,0 to 58,0	(5,3 to 5,8)
Crankshaft belt pulley		32,4 to 37,8	(3,3 to 3,8)
Camshaft gear		54,0 to 61,0	(5,5 to 6,2)
Flywheel		60,8 to 67,6	(6,2 to 6,9)
Timing cover		27,0 to 40,5	(2,8 to 4,2)
Oil pump/engine block		16,2 to 20,3	(1,8 to 2,0)
Oil pump cover		8,1 to 10,8	(0,8 to 1,1)
Sump		8,1 to 10,0	(0,8 to 1,1)
Cylinder head bolts	1)	to 10,0	(to 1,0)
	2)	30,0 to 50,0	(3,0 to 5,0)
- after waiting 10-20 minutes	3)	80,0 to 90,0	(8,0 to 9,0)
- after engine has warmed up (15 mins at 1000 rpm) retighten to	4)	110,0 to 115,0	(11,0 to 11,5)
Rocker cover		3,4 to 4,7	(0,3 to 0,4)
Inlet manifold	1)	4,0 to 8,0	(0,4 to 0,8)
	2)	8,0 to 15,0	(0,8 to 1,5)
	3)	18,0 to 22,0	(1,8 to 2,2)
- after engine has warmed up (15 mins at 1000 rpm) retighten to	4)	18,0 to 22,0	(1,8 to 2,2)
Oil drain plug		27,0 to 33,8	(2,8 to 3,5)
Oil pressure switch		12,0 to 15,0	(1,2 to 1,5)
Spark plugs		30,0 to 40,0	(3,0 to 4,0)
Exhaust manifold		16,0 to 20,0	(1,6 to 2,0)
Rear oil seal carrier		14,8 to 17,6	(1,5 to 1,7)
Carburettor		20,3 to 24,3	(2,0 to 2,5)
Fuel pump		16,0 to 20,0	(1,6 to 2,0)

WHEELS AND TYRES 11

GENERAL DESCRIPTION

Wheels

Three types of road wheel are available for the Transit model range.

Fig. 1A shows the $14 \times 5\frac{1}{2}$J pressed steel styled wheel as fitted to LCX (80 to 120 and 100L) variants. This wheel is available in two styles. The wheel is retained by conical wheel nuts covered by plastic nut caps, has a plastic centre cap, and on some variants has a bright metal trim ring.

Fig. 1B shows the $14 \times 5\frac{1}{2}$J pressed steel wheel with a twin offset and ventilated spider as fitted to LCY (130 to 190) variants. This wheel is retained by conical wheel nuts with left handed threads on left hand wheels and right handed threads on right hand wheels. On certain variants this wheel is fitted with a chrome plated cover. All the wheels on the LCY variants are of the same design.

Tyres

Radial ply tyres are fitted as standard equipment to all variants with a cross ply tyre as optional equipment on some variants.

Depending on model variant 185×SR14 Reinforced, 195×R14C (6PR), or 205×R14C (6PR) radial ply tyres are fitted as standard. The optional cross ply tyre is a 7.50×14 (6PR).

Details of tyre sizes together with the recommended inflation pressures for each variant are included in the Technical Data on Page 9.

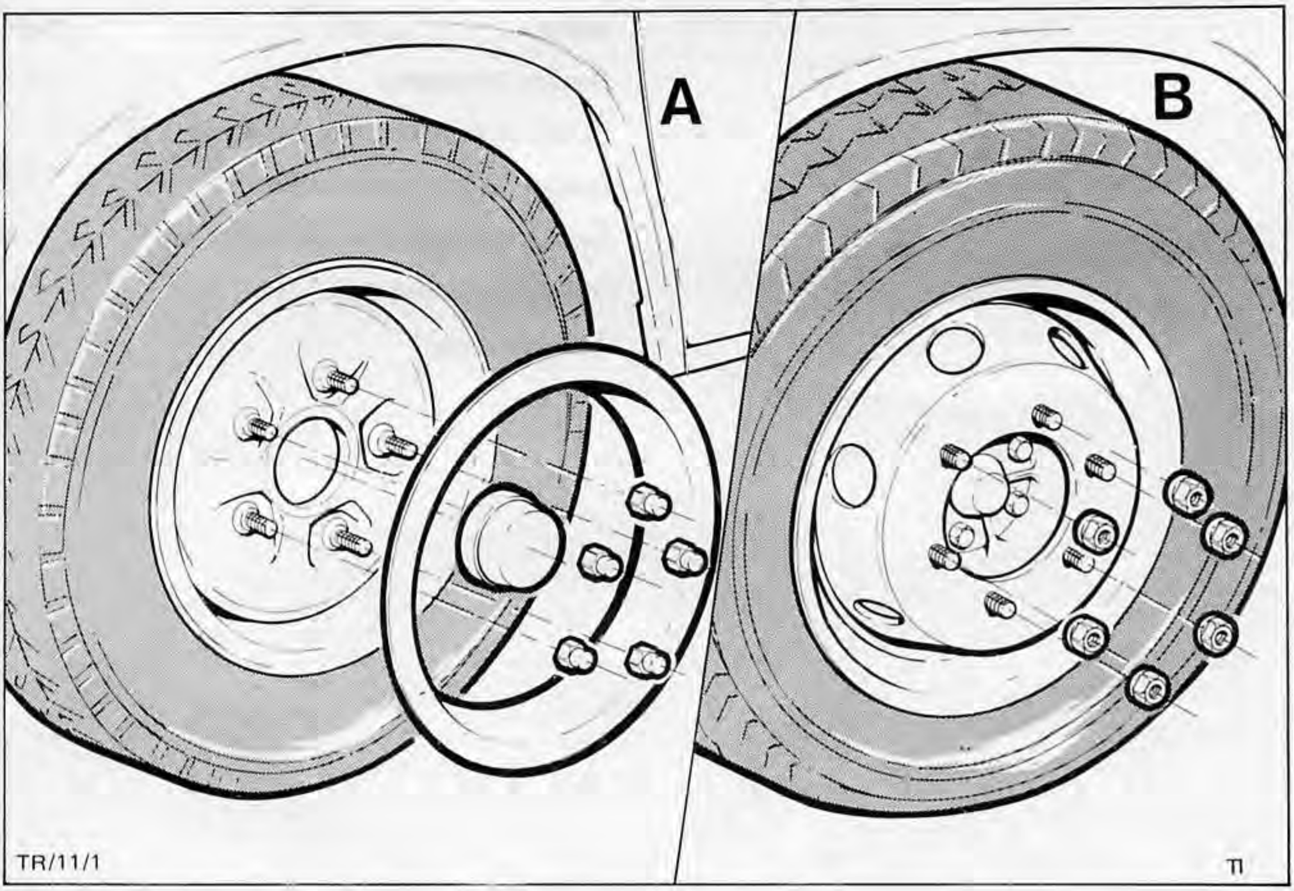

Fig. 1. Transit wheel types
A–Five stud variant wheel
B–Six stud variant wheel

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following items should be checked.

Tyre Pressures

The tyre pressures quoted under 'Technical Data' are 'cold' pressures. In this context, ambient temperature is considered 'cold' and the tyre is considered 'hot' after extended motoring at speed. Under certain extreme conditions of operation a tyre may require up to one hour before it can be considered 'cold', i.e. not warm to the touch as is usual after operation.

It is essential for safety that the recommended inflation pressures are always maintained.

Radial ply tyres may appear under-inflated at the correct recommended pressures shown in Technical Data. This is normal and they should never be inflated beyond the recommended pressures.

Tyre Wear

When tyre tread depth is less than 1 mm the tyre must be renewed (or earlier if required by local or national legislation).

If irregular wear is noticed, check the wheel bearings and steering/suspension joints for excess play. Also check the front suspension geometry and wheel balance.

In the later life of the tyres, it may be desirable to rebalance the wheels to compensate for tyre wear.

Wheel Nuts

Check the tightness of the wheel nuts. Refer to Technical Data.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
	No Special Service Tools Required.

JACKING THE VEHICLE

When undertaking repairs that involve jacking the vehicle it is important to ensure that only the correct jacking and support locations are used at all times. The following illustration shows the location points for positioning jacking equipment. Axle stands should always be fitted before working on a raised vehicle.

NOTE: The jack supplied with the vehicle is for emergency use only, e.g: changing a wheel at the roadside etc, and should **not** be used for general workshop applications.

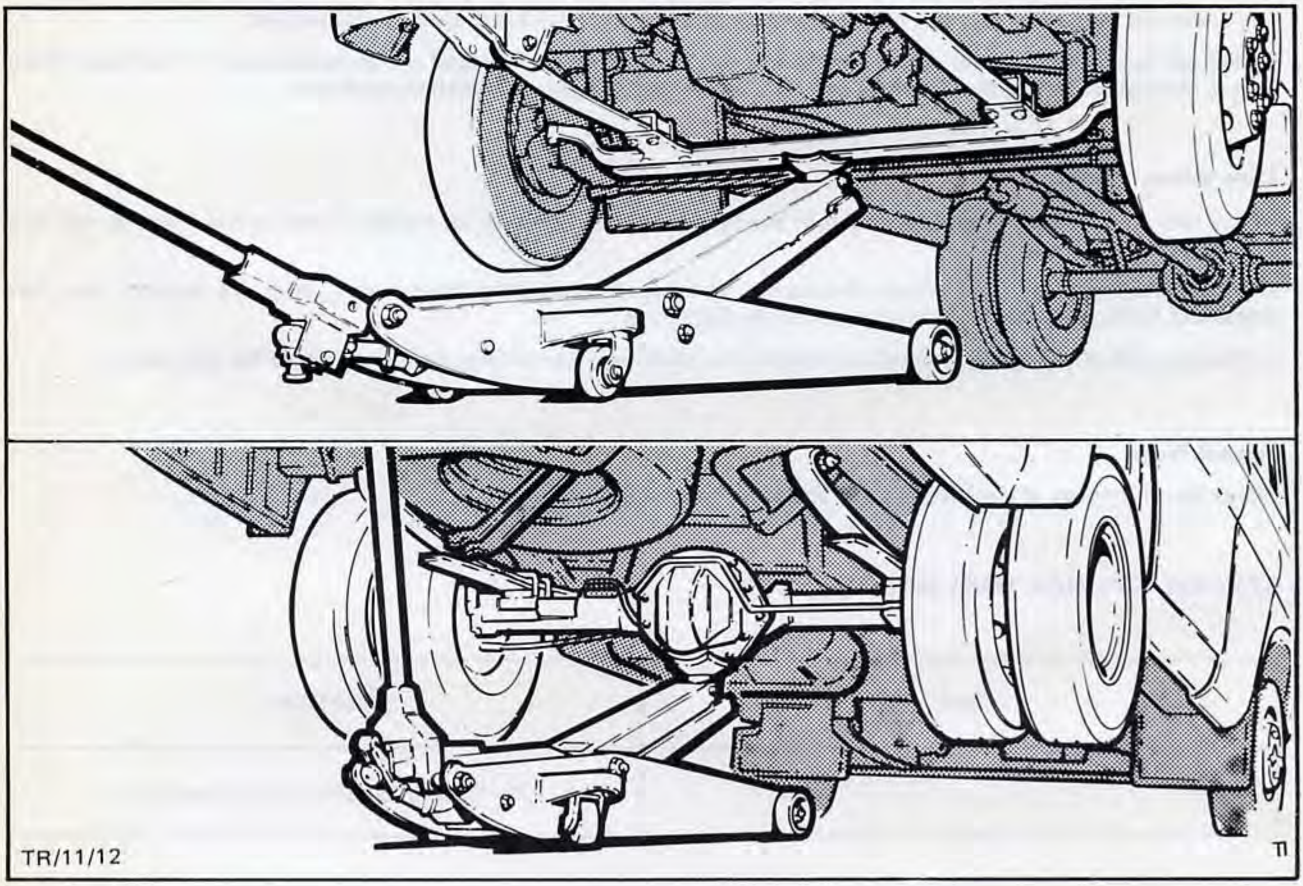

Fig. 2. Jacking locations

SERVICE AND REPAIR OPERATIONS – CONTENT

WHEELS AND TYRES		Described in this publication	Contained in Operation	Also applicable to certain variants in the following model range.					
				Fiesta	Escort '75 onwards	Taunus '76/ Cortina '77	Capri	Granada '78 onwards	Transit '77
11 122	Wheel assemblies – both front or both rear – balance (Includes static and dynamic balance)	X			X	X	X	X	X
11 211	Wheel assembly – remove and install	X			X	X	X	X	X
11 234 4	Wheel – replace	X			X	X	X	X	X
11 254 4	Tubeless tyre – replace	—	11 234 4		X	X	X	X	X

SERVICE AND REPAIR OPERATIONS

11 122 WHEEL ASSEMBLIES – BOTH FRONT OR BOTH REAR – BALANCE

Special Service Tools Required: None

It is important that the following is read and fully understood before commencing work on the vehicle. The method of balancing will vary for machines of different manufacture. For specific details refer to the equipment manufacturer's instructions.

Only FORD clip-on wheel weights should be used and it is recommended that these are located using a non-metallic hammer to avoid damaging the wheel.

A – Off the vehicle wheel balance – Front or Rear Wheels.

1. Remove wheel covers or nut covers, where applicable. Slacken wheel nuts securing wheels to be balanced. Jack up front, or rear of vehicle, as required, and fit chassis stands.

   NOTE: On six studded wheel variants, left hand wheels have left hand threaded nuts and right hand wheels have right hand threaded nuts.

2. Remove wheel to be balanced from vehicle. Remove centre cap, where applicable, and fit wheel to balance machine adaptor plate.

3. Locate wheel and hub assembly on balance machine positioning on spindle so that wheel rim just touches setting rod. Fig. 3. Lock wheel and hub adaptor onto spindle.

4. Remove bright metal trim ring if fitted, and remove any existing balance weights. Ensure tyre is inflated to correct pressure and that no large objects (e.g. stones) are wedged in tyre tread.

5. Spin-up wheel and balance in accordance with manufacturer's instructions.

6. Remove wheel from machine and refit onto vehicle. Refit trim ring and centre cap, where applicable.

   NOTE: On six studded wheel variants, left hand wheels have left hand threaded nuts and right hand wheels have right hand threaded nuts.

7. Remove chassis stands and lower vehicle to ground, finally tighten wheel nuts. Refit nut covers or wheel covers where applicable.

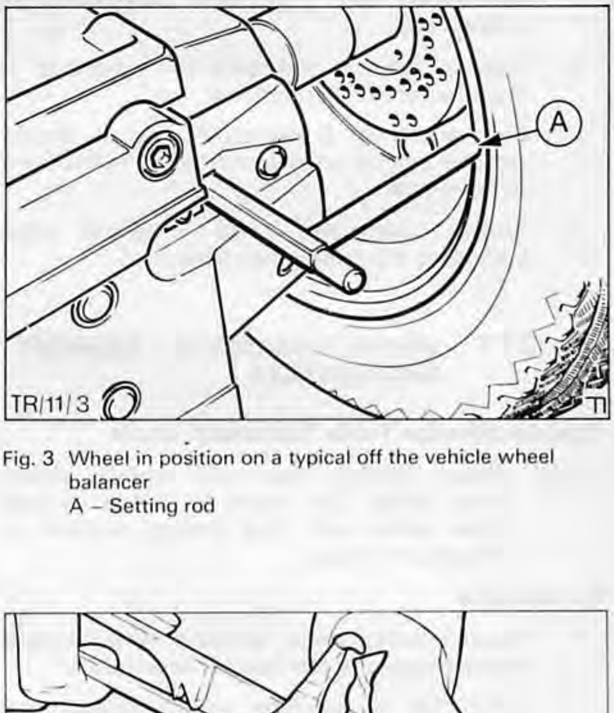

Fig. 3 Wheel in position on a typical off the vehicle wheel balancer
A – Setting rod

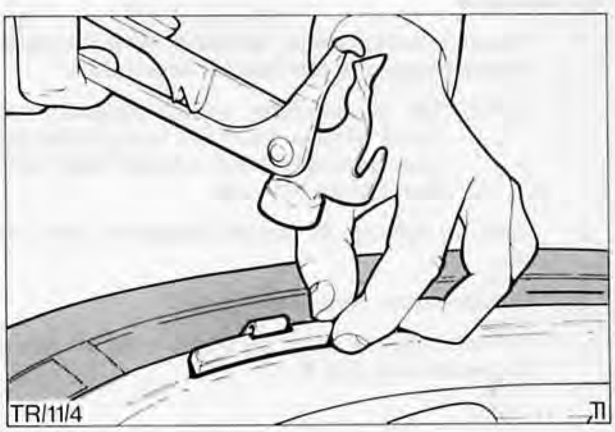

Fig. 4. Fixing balance weight to wheel rim

B – On the Vehicle – Front or Rear Wheels

1. Jack up front or rear of vehicle as required and fit chassis stands, leaving axle free.
2. Check wheel bearings, suspension joints, etc., for excess play and that tyres are correctly inflated.

   NOTE: It is impractical to balance the wheel successfully with incorrectly adjusted or worn wheel bearings.
3. For front wheels, position spin-up motor in correct position, relative to wheel to be balanced, Fig. 5.

   For rear wheels, vehicle engine should be used to drive wheels when balancing.
4. Remove trim ring, if fitted, any wheel weights present, and any large objects (e.g. stones) wedged in tyre tread.
5. Fit wheel adpator pick-up onto suspension in accordance with equipment manufacturer's instructions.
6. Spin-up wheel, and balance according to manufacturer's instructions.
7. Refit trim ring if applicable. Raise vehicle, remove stands. Lower vehicle to ground and remove jack.
8. Repeat operations 1 to 7 above when balancing the remaining wheels.

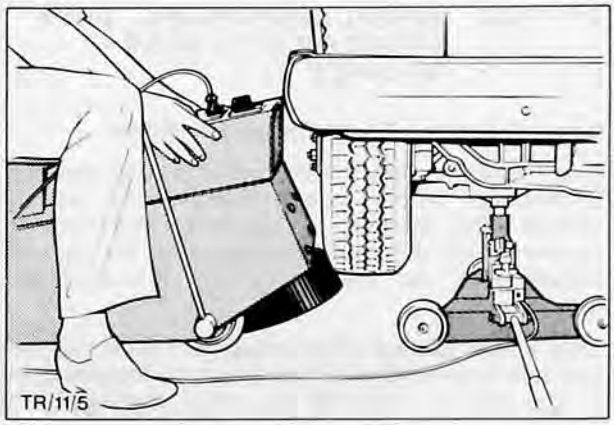

Fig. 5. Typical 'on car' balancer in position

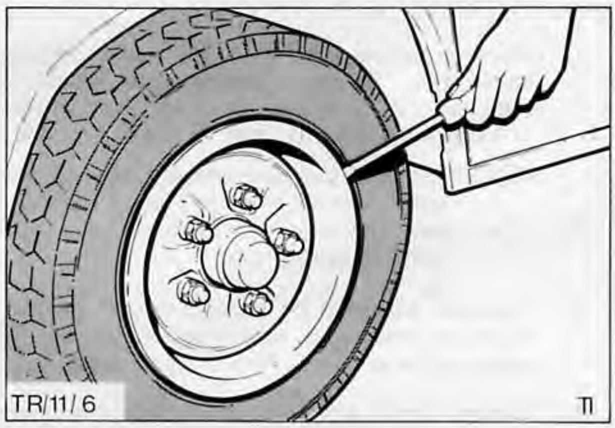

Fig. 6. Removing trim ring.

11 211 WHEEL ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: When refitting twin rear wheels ensure inner wheel tyre valve is visible through outer wheel and that mating surfaces of wheels are clean.

To Remove

1. Remove centre caps, nut caps, wheel covers, where fitted, and slacken off wheel nuts.

   NOTE: On six studded wheel variants, left hand wheels have left hand threaded nuts and right hand wheels have right hand threaded nuts.
2. Jack up vehicle, fit chassis stands at front or rear.
3. Remove nuts, remove wheel(s).

   If trim rings are fitted carefully prise off using a screwdriver, Fig. 6.

To Install

4. Refit wheel(s), fit nuts and semi-tighten.

   NOTE: On six studded wheel variants, left hand wheels have left hand threaded nuts and right hand wheels have right hand threaded nuts.
5. Jack up vehicle, remove chassis stands, and lower to ground.
6. Finally tighten wheel nuts and refit nut caps, wheel covers, and centre caps where applicable. Also fit trim rings where applicable.

11 234 4 WHEEL – REPLACE

(Wheel assembly removed)

GENERAL NOTES

(i) The type of equipment shown in this operation is of the 'semi-automatic' type using 'rim clamps' as compared with the type using a centre spigot to locate and retain the wheel.

(ii) Always lubricate tyre beads when removing and/or fitting tyre.

(iii) When tyres are being fitted to wheels, in order to avoid damge to the tyre bead they should be applied from the side of the wheel which has the narrowest ledge (i.e., distance from rim flange to edge of well).

When fitting a new tubeless tyre, a new snap-in valve should also be fitted. The valve is made to last the life of the tyre, but beyond that time fatigue of the valve body rubber is likely to impair the air seal at the rim hole.

(iv) When fitting Michelin radial ply tyres, always ensure that the red spot on the tyre wall is on the outside of the wheel.

Special Service Tools Required: None

1. Remove tyre valve core and break tyre bead, Fig. 7., on both sides of tyre.
2. Mount wheel assembly onto equipment.
3. Remove tyre from wheel equipment according to manufacturers instructions, Fig. 8. Cut off old valve assembly.
4. Remove wheel from equipment.
5. Place new wheel on equipment, Fig. 9, and ensure wheel clamps are fitted to wheel.

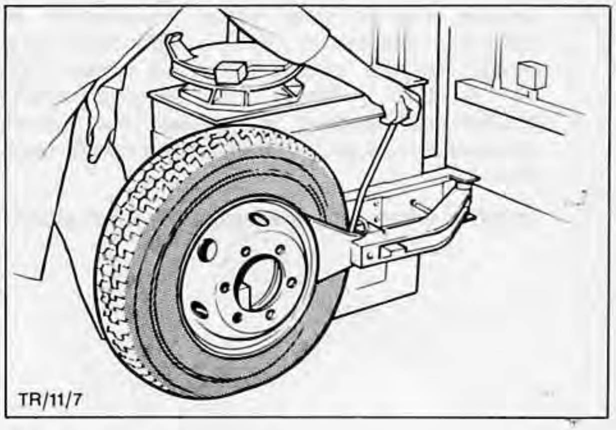
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Fig. 7. Breaking tyre beads

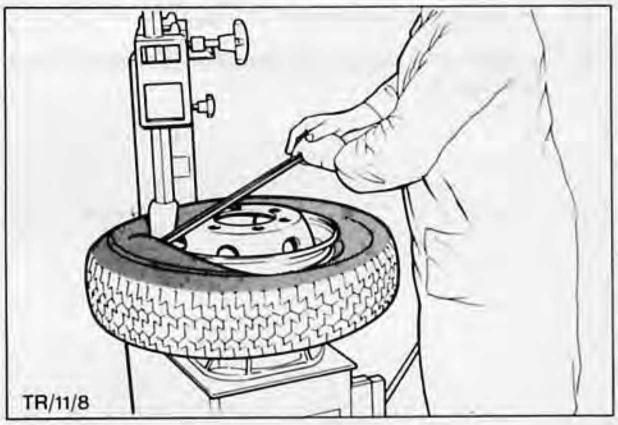
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Fig. 8. Removing tyre

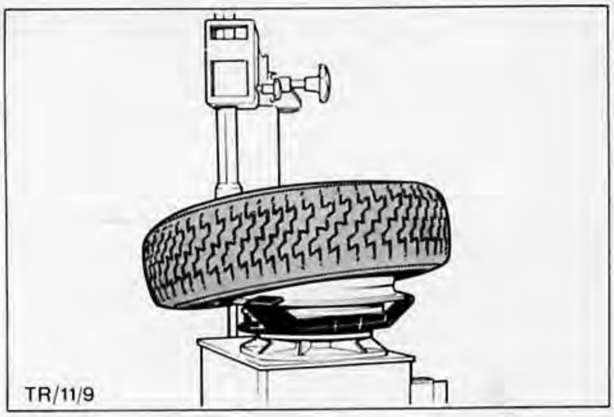
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Fig. 9. Wheel in position on equipment showing rim clamps

6. Locate and fit new valve ensuring it is correctly seated in wheel. Lubricate tyre beads, Fig. 10, and refit tyre to wheel, Fig. 11. As tyre is being fitted ensure 'fitted' portion of beading is guided into wheel channel to ensure remaining bead can fit over rim.
7. Remove wheel and tyre assembly from stand.

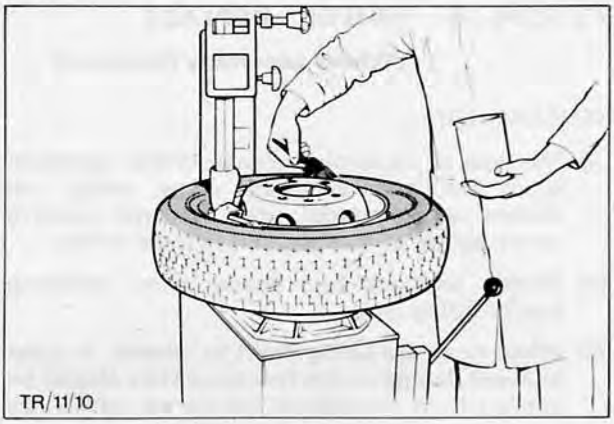


Fig. 10. Lubricate tyre beads before fitting tyre.

8. Fit new tyre valve core in valve.
9. Inflate tyre, adjust to specified pressure, refer to page 9.

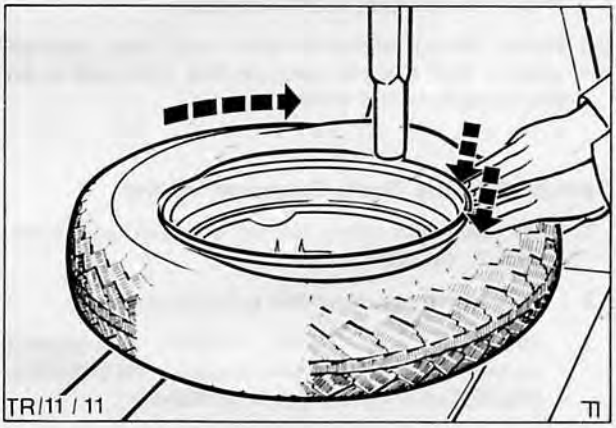


Fig. 11. Fitting tyre onto wheel.

TECHNICAL DATA

Recommended Tyre Pressures – (Cold) Bar or kgf/cm² (lbf/in²)*

Vehicle Type	Body Style	Tyre Size (Standard)	Pressure Front	Pressure Rear	Tyre Size (Optional)	Pressure Front	Pressure Rear
80 Petrol	Van or Combi	185×SR14R	2,5 (36)	2,9 (42)	7.50×14	2,0 (30)	2,0 (30)
80 Diesel	Van or Combi	185×SR14R	2,5 (36)	2,9 (42)	7.50×14	2,0 (30)	2,0 (30)
100 Petrol	Van	195×R14C	2,0 (30)	3,1 (45)			
100 Petrol	Combi	195×R14C	2,0 (30)	3,1 (45)	7.50×14	2,0 (30)	3,1 (45)
100 Petrol	S.C. Cab	195×R14C	2,0 (30)	3,1 (45)			
100 Petrol	D.C. Cab	195×R14C	2,0 (30)	3,1 (45)			
100 Petrol	Bus	185×SR14R	2,5 (36)	2,9 (42)			
100 Petrol	Bus	195×R14C	2,0 (30)	2,5 (36)			
100 Diesel	Van or Combi	195×R14C	2,5 (36)	3,1 (45)	7.50×14	2,5 (36)	3,1 (45)
100 Diesel	S.C. Cab	195×R14C	2,5 (36)	3,1 (45)	7.50×14	2,5 (36)	3,1 (45)
100 Diesel	D.C. Cab	195×R14C	2,5 (36)	3,1 (45)	7.50×14	2,5 (36)	3,1 (45)
115 Petrol	Bus	195×R14C	2,0 (30)	3,1 (45)	7.50×14	2,0 (30)	3,1 (45)
115 Diesel	Bus	195×R14C	2,5 (36)	3,1 (45)	7.50×14	2,5 (36)	3,1 (45)
120 Petrol	Van or Combi	205×R14C	1,6 (24)	2,9 (42)			
120 Petrol	S.C. Cab	205×R14C	1,6 (24)	2,9 (42)			
120 Petrol	D.C. Cab	205×R14C	1,6 (24)	2,9 (42)			
120 Petrol	Parcel Van	205×R14C	1,6 (24)	2,9 (42)			
120 Diesel	Van or Combi	205×R14C	2,0 (30)	2,9 (42)			
120 Diesel	S.C. Cab	205×R14C	2,0 (30)	2,9 (42)			
120 Diesel	D.C. Cab	205×R14C	2,0 (30)	2,9 (42)			
120 Diesel	Parcel Van	205×R14C	2,0 (30)	2,9 (42)			
100L Petrol	Van or Combi	195×R14C	2,0 (30)	3,1 (45)			
100L Petrol	S.C. Cab	195×R14C	2,0 (30)	3,1 (45)			
100L Diesel	Van or Combi	195×R14C	2,3 (34)	3,1 (45)			
100L Diesel	S.C. Cab	195×R14C	2,3 (34)	3,1 (45)			
130 Petrol	Van or Combi	185×SR14R	2,0 (30)	2,0 (30)	7.50×14	2,0 (30)	2,0 (30)
130 Petrol	S.C. Cab	185×SR14R	2,0 (30)	2,0 (30)	7.50×14	2,0 (30)	2,0 (30)
130 Petrol	D.C. Cab	185×SR14R	2,0 (30)	2,0 (30)	7.50×14	2,0 (30)	2,0 (30)
130 Petrol	Bus	185×SR14R	2,0 (30)	2,5 (36)	7.50×14	2,0 (30)	2,0 (30)
130 Diesel	Van or Combi	185×SR14R	2,9 (42)	2,0 (30)	7.50×14	2,5 (36)	2,0 (30)
130 Diesel	S.C. Cab	185×SR14R	2,9 (42)	2,0 (30)	7.50×14	2,5 (36)	2,0 (30)
130 Diesel	D.C. Cab	185×SR14R	2,9 (42)	2,0 (30)	7.50×14	2,5 (36)	2,0 (30)
130 Diesel	Bus	185×SR14R	2,9 (42)	2,0 (30)	7.50×14	2,5 (36)	2,0 (30)

*Bar and kgf/cm² are numerically the same value.

S.C. Cab – Single Chassis Cab Variant.

D.C. Cab – Double Chassis Cab Variant.

TECHNICAL DATA (cont'd)

Recommended Tyre Pressures – (Cold) Bar or kgf/cm² (lbf/in²)*

Vehicle Type	Body Style	Tyre Size (Standard)	Pressure Front	Pressure Rear	Tyre Size (Optional)	Pressure Front	Pressure Rear
160 Petrol	Van or Combi	185×SR14R	2,0 (30)	2,0 (30)	7.50×14	2,0 (30)	2,0 (30)
160 Petrol	S.C. Cab	185×SR14R	2,0 (30)	2,0 (30)	7.50×14	2,0 (30)	2,0 (30)
160 Petrol	Bus	185×SR14R	2,0 (30)	2,5 (36)	7.50×14	2,0 (30)	2,0 (30)
160 Diesel	Van or Combi	185×SR14R	2,9 (42)	2,5 (36)	7.50×14	2,5 (36)	2,0 (30)
160 Diesel	S.C. Cab	185×SR14R	2,9 (42)	2,5 (36)	7.50×14	2,5 (36)	2,0 (30)
160 Diesel	Bus	185×SR14R	2,9 (42)	2,5 (36)	7.50×14	2,5 (36)	2,0 (30)
175 Petrol	Van or Combi	185×SR14R	2,9 (42)	2,9 (42)			
175 Petrol	S.C. Cab	185×SR14R	2,9 (42)	2,9 (42)			
175 Petrol	Parcel Van	185×SR14R	2,9 (42)	2,9 (42)			
175 Diesel	Van or Combi	185×SR14R	2,9 (42)	2,9 (42)			
175 Diesel	S.C. Cab	185×SR14R	2,9 (42)	2,9 (42)			
175 Diesel	Parcel Van	185×SR14R	2,9 (42)	2,9 (42)			
190 Petrol	Van or Combi	195×R14C	2,0 (30)	2,6 (37)			
190 Petrol	S.C. Cab	195×R14C	2,0 (30)	2,6 (37)			
190 Petrol	D.C. Cab	195×R14C	2,0 (30)	2,6 (37)			
190 Diesel	Van or Combi	195×R14C	2,4 (35)	2,6 (37)			
190 Diesel	S.C. Cab	195×R14C	2,2 (33)	2,6 (37)			
190 Diesel	D.C. Cab	195×R14C	2,2 (33)	2,6 (37)			

*Bar and kgf/cm² are numerically the same value.

S.C. Cab = Single Chassis Cab Variant D.C. Cab = Double Chassis Cab Variant

NOTE: The tyre pressures shown above should be used when the tyre is cold, i.e., when approximately at ambient temperature, (not warm to the touch as is usual after operation). Always maintain the specified tyre pressures.

Tightening Torques	Nm	kgf.m	lbf.ft
Wheel nuts – Five studded wheel variants	**75 to 95**	**7,5 to 9,5**	**55 to 70**
Six studded wheel variants	**155 to 180**	**15,5 to 18,0**	**114 to 132**

BODY AND SHEET METAL 44

Index Page

GENERAL DESCRIPTION

The design of the Ford Transit places particular emphasis on ease of repair to meet the demands of the cost conscious operator. This ease of repair allows for extremely simple repair procedures and thus influences the economic efficiency of a vehicle just as much as mechanical repairs and routine maintenance costs.

To perform any sheet metal repair on FORD vehicles correctly it is imperative that genuine FORD replacement parts are fitted in accordance with the repair operations specified in the Workshop Manual, using suitable workshop equipment.

For some time the FORD Service Program has incorporated part panels as an effective method for repairing bodywork damage on all current FORD models. Depending on the type of damage involved, it used to be common practice to replace an entire sheet metal panel. Contemporary practice is, by means of a part panel repair, to replace only those parts which are actually damaged.

In addition to part panel repairs on non-load-bearing exterior panels, intensive research has also been done in developing part panel procedures for load-bearing sections of the body, with the result that replacement part panels suitable for repair are already identified during the development of a new body.

All instructions concerning the location of joint lines for part panels in load-bearing areas must be strictly adhered to. Basically, the joint lines for a particular vehicle are positioned to suit the shape and installation of the mechanical components fitted, such as engine, transmission, suspension, etc. Part panel repairs on accident damaged vehicles should therefore be limited to sections of the bodywork not affected by a possible reduction in strength and safety ensuing from the damage. This will ensure a satisfactory repair and adherence to the specified dimensions.

Provided repairs are correctly executed, all repair procedures using part panels will result in the same standards of strength and operational safety being maintained for a new vehicle. Numerous strength tests and extensive crash tests have proved that part panel repairs achieve equivalent standards as when complete panels are replaced. In addition, the conveniently placed joint lines for part panel repairs mean considerably lower costs and reduce labour times in comparison with whole panel replacement.

Body and sheet metal repairs to professional standards are achievable only by means of the necessary special tools. These include newly developed compressed air tools, such as air driven saws, etc., which reduce the amount of manual labour required of the panel beater and enable him to streamline the various tasks for an overall improvement in efficiency. A guide to the most frequently used bodywork tools is given in this section.

Each operation to replace damaged body and sheet metal components is marked with an operation number. The arrangement of this section and the operation numbers contained therein corresponds to the Labour Time Schedule. This ensures conformity between the repair instructions and the Labour Time Schedule.

In addition to part panel replacements, other cost and time-saving measures include straightening damaged sections of the vehicle following standard panel practice.

All body repairs described in this section have been carried out on a Transit body shell. The particular order of individual operations is based on the types of accident damage which most frequently occur and is intended as a general guide for the workshop.

All legislation regarding accident prevention requirements as well as other precautionary measures (see page 25) must be strictly observed.

GENERAL DESCRIPTION (cont'd)

Since bodywork repairs always involve welding components, it is recommended that sectional repairs (part panel replacement) only be carried out using MIG or spot-welding equipment (because of the major panel distortion caused by oxy-acetylene welding).

Body straightening operations should only be carried out cold. Spot-welded joints that are inaccessable with a spot welding gun are made by puddle welding, i.e. the spot-weld flange is drilled or punched and then welded with additional material.

To avoid damage to the alternator during MIG welding, the battery and alternator must always be disconnected.

CAUTION

Readily flammable overalls must not be worn during welding operations. In addition, fuel line, fuel tank and any other flammable materials must be removed if welding is to be carried out in their vicinity.

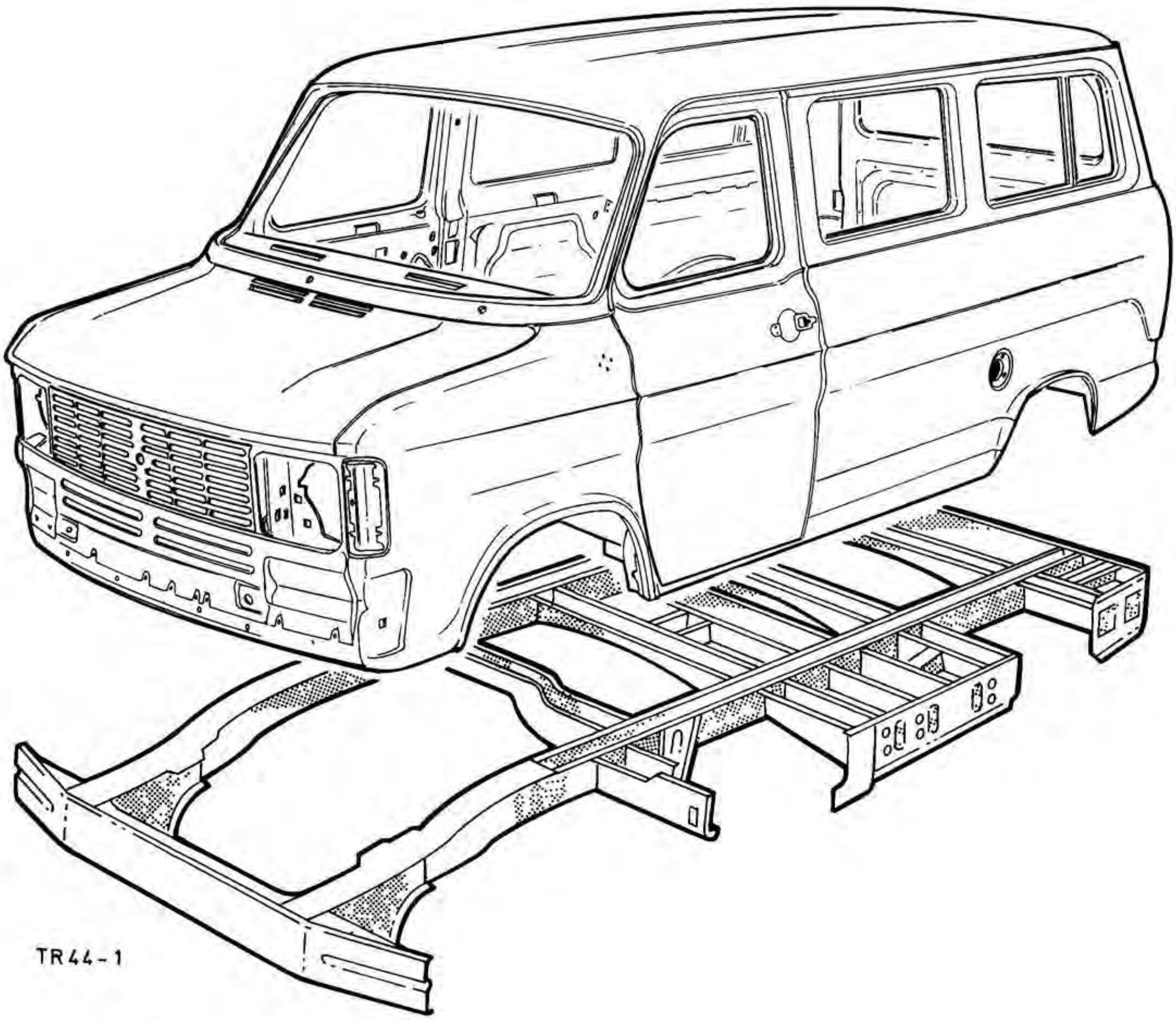


Fig.1. Body and chassis.

GENERAL DESCRIPTION (cont'd)

Safety body shell

The front and rear sections of the body incorporate impact-absorbing zones and these together with a rigid floor assembly produce a self-supporting safety body shell providing the vehicle occupants with so-called "passive" safety, Fig.1.

In a head-on collision with an immovable solid obstacle at 50 km/h (30 miles/h), the FORD TRANSIT safety passenger compartment is so constructed that the occupants have the best possible chance of survival if wearing seat belts.

The safety passenger compartment withstands this impact phase without notable distortion.

It is, therefore, of the utmost importance that the original strength and resistance to distortion be retained when repairs are carried out.

This can be achieved by replacing or straightening damaged parts.

When straightening damaged parts/members, use cold-rectification whenever possible. If cold-rectification is impossible, straightening can be made easier by application of heat - but not over 700°C.

When replacing welded parts, it is vitally important that the correct welding process and technique is used.

The parts shown in the following table are the ones primarily affected in accidents. The repair options with the corresponding repair operation numbers are also given, together with the importance of the parts concerned (i.e. load-bearing or not).

Part description	Repair option	Load-bearing	Operation No.
Apron (front)	Replace complete	Yes	44 234
Cross member (front) lower	Replace complete	Yes	44 274 4
Apron panel	Part panel repair	No	44 276 5
Side member	Part panel repair	Yes	44 281 5
Door entrance panel (front)	Replace complete	Yes	44 478 4
Side panel (front left)	Replace complete	No	44 517
Side panel (rear right)	Replace complete	No	44 518
Wheel house	Replace complete	Yes	44 534 4
Side sill	Replace complete	Yes	44 575 4
Rear panel	Replace complete	Yes	44 642
Cross member (rear)	Replace complete	Yes	44 674 4

GENERAL HINTS ON BODY REPAIRS

Welded Joints

With all-steel welded bodies, the structures which support the power unit, transmission and suspension, or their sub-frames, are welded to the body to form an integral unit. Each member, mounting, and even each external panel contributes to the overall strength of the vehicle and assists in giving protection to passengers in the event of an accident. It is therefore important that when a vehicle is repaired it is essential that each part satisfies its original strength condition.

Welding Method

1 - Gas fusion method (oxy-acetylene welding)

With this method metal sheets are welded together by fusion, with a hot oxy-acetylene flame, in conjunction with welding rod.

The disadvantage with oxy-acetylene welding is the high shrinkage stress and the consequential deformation.

2 - Spot welding

With electric resistance welding (spot welding), the area of contact is brought up to welding temperature by the electric current and fused together under local pressure. The disadvantage of spot welding is often the lack of accessibility for the electrode arms.

3 - MIG welding

The basis of this method is that an automatically fed welding wire (electrode) is fused at melting point under a protective gas screen. The weld fuses before the oxygen (air) can get in. Advantages of MIG welding are reduced shrinkage stress and deformation. Because of the minimal amount of heat generated during welding, adjacent heat-sensitive parts often need not be removed. In the automobile industry (both production and service) the use of MIG welding is being increased. This method offers the possibility of joining overlapping plates by puddle welding from one side.

Specific Pointers - spot welding

Of the welding methods described, spot welding is the one mostly used for bodywork repairs. To obtain satisfactory spot welded joints, attention should be paid to the following essential points:

- Closeness of contact between both (or a number of) plates or flanges.
- Thickness of metal (thinner sheet is the determining factor).
- Contact pressure of electrode arms.
  Only use welding equipment to British BS, DIN or equivalent standards. Where possible always use shortest welding arms (to ensure adequate contact pressure).
- Panels must be bright/clean (no rust, paint, grease or oil).
- Always apply standard weld-through, zinc rich primer before welding.
- Intensity of welding current.

GENERAL HINTS ON BODY REPAIRS (cont'd)

- Size (diameter) and spacing of spot welds.
  Spot weld diameter should be at least 3,6 mm in accordance with FORD Specification S72 GG IK-251 AA.

- The spacing between two spot welds should be 25 to 35 mm (if possible retain spacing used in production). In the cases of edges or flanges the centres of the welds should lie on the centre of the flange.

Procedure for welding sheets, particularly for part panel repairs.

- With internal sheet-metal parts "butt-welding" is permissible provided the metal thickness is not reduced by subsequent rubbing down.

- Butt welding is not acceptable for part panel repairs to apron panels since rubbing down the weld seam considerably reduces the thickness of the metal.

- With external sheet-metal parts both "lapped" as well as "butt" welds are permissible.

Testing

Welds must be shear-tested with the aid of a chisel or a screwdriver to ensure the weld has taken. This test should be conducted after dressing the repair.

The chisel is inserted between the welded plates at several points and moved to and fro gently (by hand). The spot welds are satisfactory if the welds do not crack during the test.

A weld is defective if any signs of burn-through, porosity or cracks are found.

Defective spot welds should be drilled out and the plates should be rewelded by MIG puddle welding.

The table overleaf shows spot weld sizes according to the thickness of the thinner plate in conformity with FORD Specification S72 GG 251 AA.

The minimum shear strength given in KN is given for the purpose of verifying weld quality or strength.

GENERAL HINTS ON BODY REPAIRS (cont'd)

Thickness of thinnest plate mm	Minimum spot weld diameter mm	Minimum shear strength KN
0,50 - 0,79	3,6	2,5
0,80 - 0,99	4,0	3,2
1,00 - 1,24	4,5	4,0
1,25 - 1,59	5,0	5,0
1,60 - 1,99	5,6	6,3
2,00 - 2,49	6,3	8,0

Checking Seat-Belt Mountings

When "B" and "C" pillars are replaced (see Fig.2) these should be checked thoroughly at several points after welding to make sure that the welds are of satisfactory quality (weld core diameter, spot-welding spacing and strength to FORD specification S72GG IK-251 AA).

With the lower belt anchorage points (floor assembly), adjoining plates within a radius of 100 mm should be checked, Fig.3.

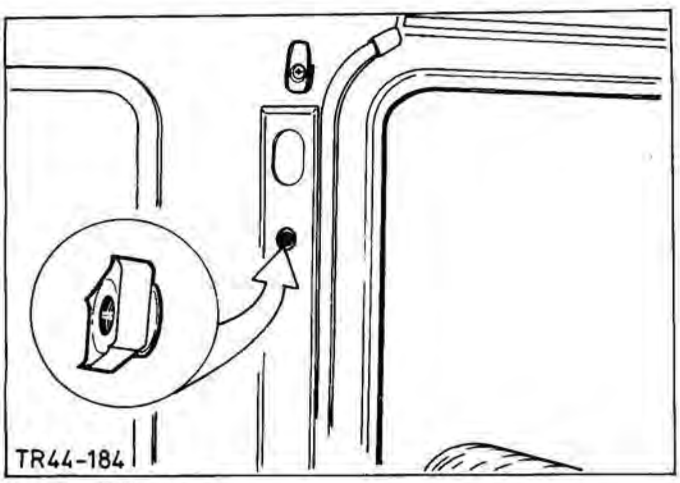


Fig.2. "B" pillar.

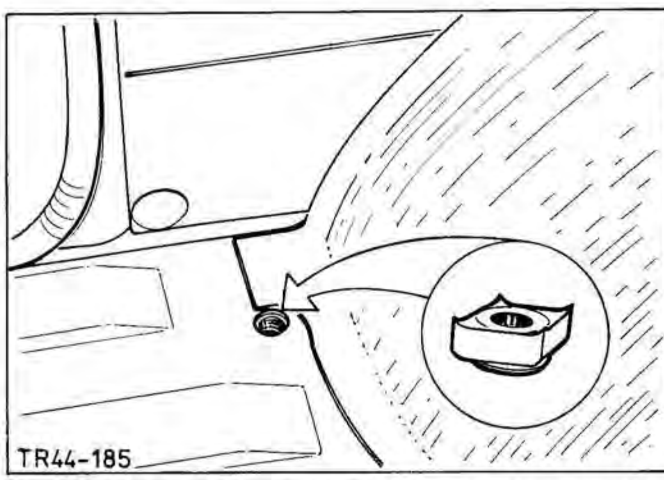


Fig.3. Lower belt anchorage point on floor panel.

Soldered Joints

Soldered joints are made with the aid of a metallic binding element - the solder - which is brought to melting point, this point being lower than that of the parts to be joined.

The joint faces must be cleaned carefully before soldering. Hard solder (melting point above 500°C) is suitable to cope with greater loadings.

The most widely used soldering process (in repair work) is flame-soldering. This is done with a soldering lamp or oxy-acetylene torch and requires flux.

Fig.4. overleaf shows the soldered locations on the vehicle.

GENERAL HINTS ON BODY REPAIRS (cont'd)

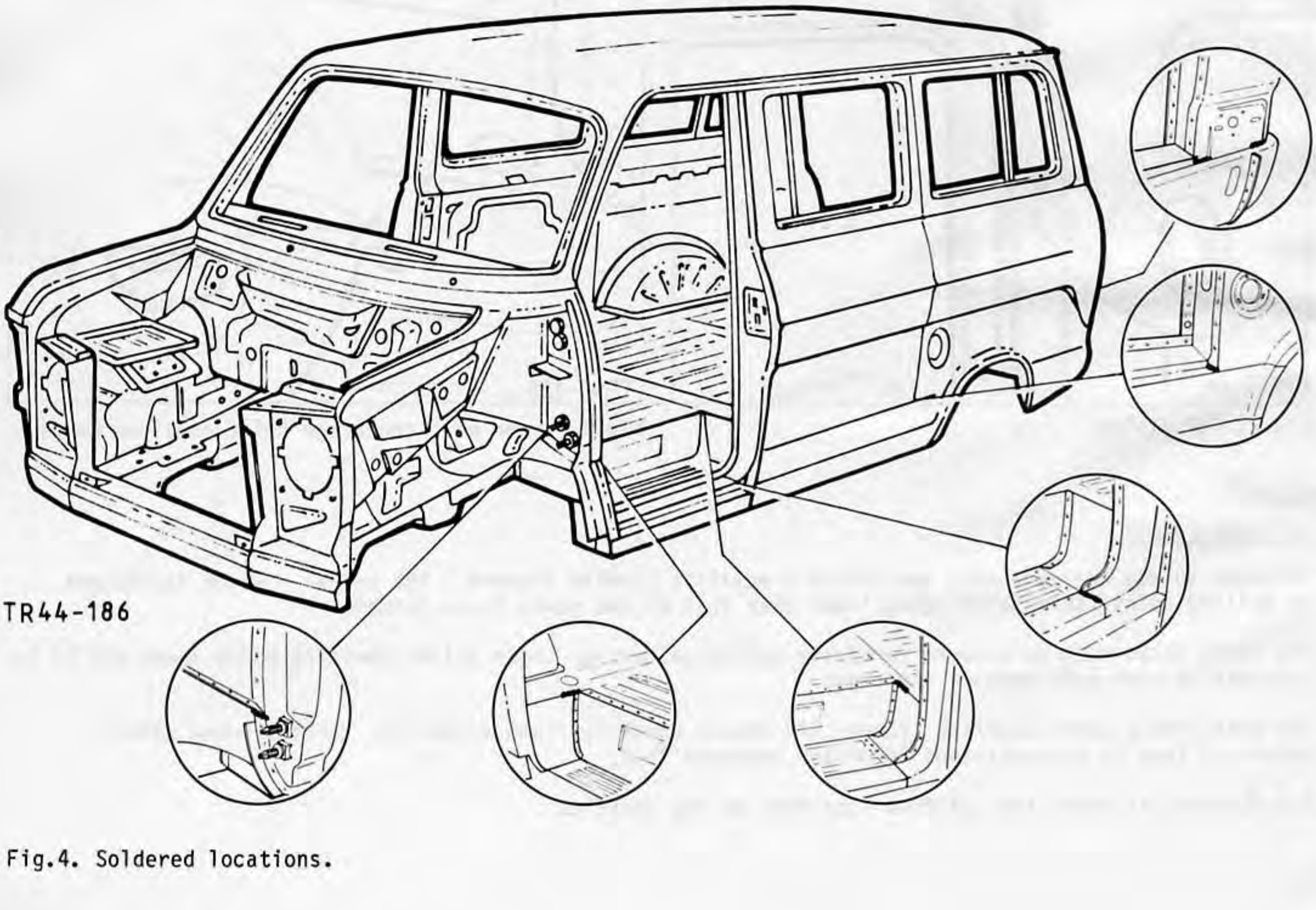


Fig.4. Soldered locations.

GENERAL HINTS ON BODY REPAIRS (cont'd)

Sealing and corrosion protection

The high level of quality achieved in the factory must be maintained after repairs.

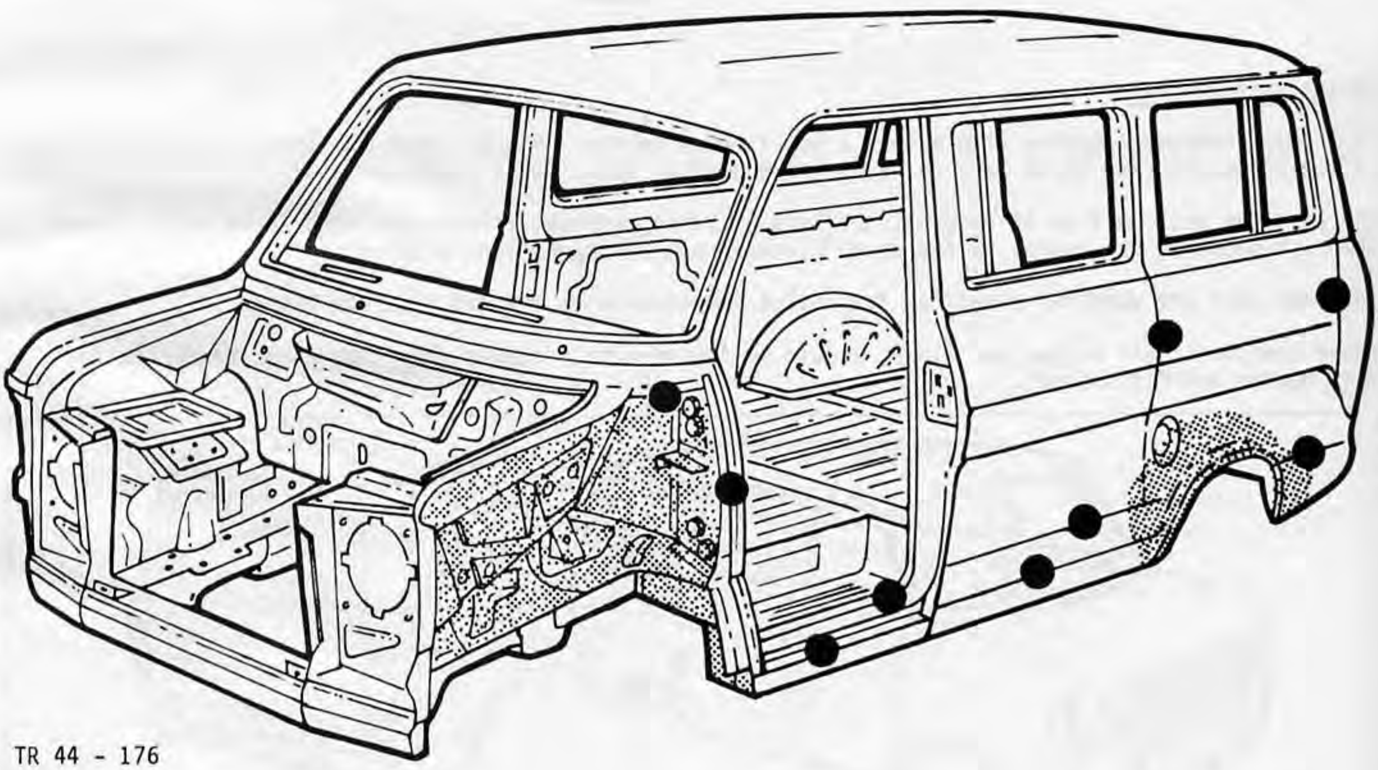
A decisive factor for adequate long-term protection is the use of:

- Corrosion-preventative primer
  FORD Specification SKM-99J 9588-A
- Zinc dust primer (weld-through)
  FORD specification SKM 6J 9569-A
- Metal joint sealant
  FORD Specification SM-4G 4650-A
- Multi-purpose adhesive
  FORD Specification SM-2G 4610-A
- Windscreen/rear window sealant
  FORD Specification SM-4G 4631-A
- Caulking compound
  FORD Specification SM-4G 4632-AB
- Air-drying sealing compound
  FORD Specification SKM 4G 9513-A
- Double-sided adhesive tape
  FORD Specification SKM 3G 9503-A
- Underseal
  FORD Specification SKM-5G 9500-A
- Wax underseal
  FORD Specification SKM-7C 9552-B
- Cavity rust-proofing wax
  FORD Specification SKM-7C 9550-A

These materials can only adhere properly and ensure long-term protection when applied on clean, dry surfaces.

Figs.5 and 6. show the most important parts and areas that must be treated with a particular material after the repair work.

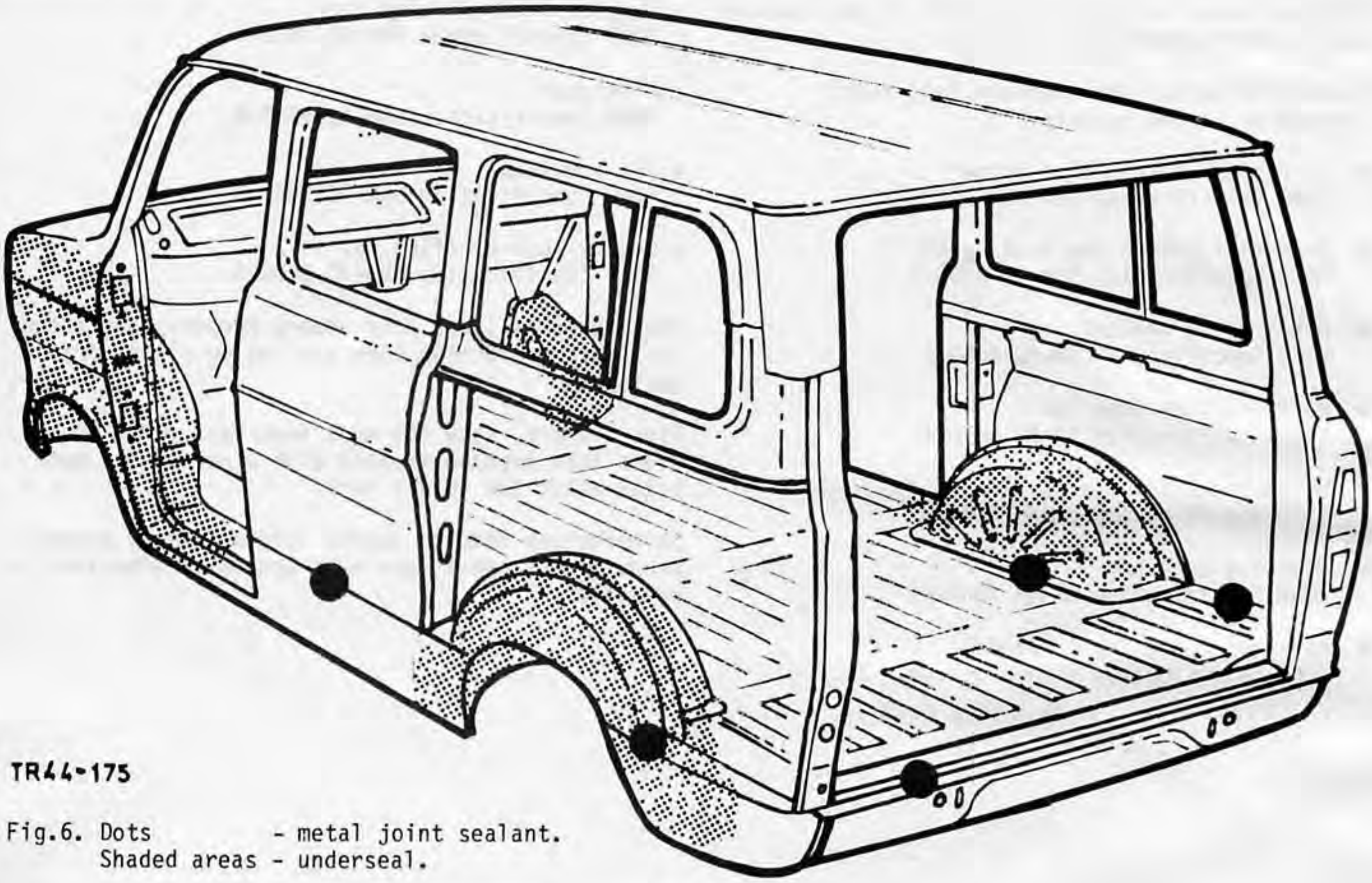
Satisfactory results depend upon extremely careful execution of operations with sealants, adhesives or primers.



TR 44 - 176

Fig.5. Dots - Metal joint sealant.
Shaded area - Underseal.

GENERAL HINTS ON BODY REPAIRS (cont'd)



TR44-175

Fig.6. Dots - metal joint sealant.
Shaded areas - underseal.

Cavity Rustproofing

Most major bodywork repairs also affect a wax-treated cavity. Fig.8. shows the areas treated with wax during production and these have to be re-treated after sheet metal repairs.

The cavities must be free of welding, drilling or other residues (clear with compressed air). Since the rust-proofing wax begins to run at 80°C, carry out all operations with extra care.

If steam jets are used for cleaning, the outlet temperature at the jet must not exceed 90°C.

After treatment, all holes, see Fig.7, should be sealed with a rubber plug (see Parts microfilm for Part Number and Finis Code).

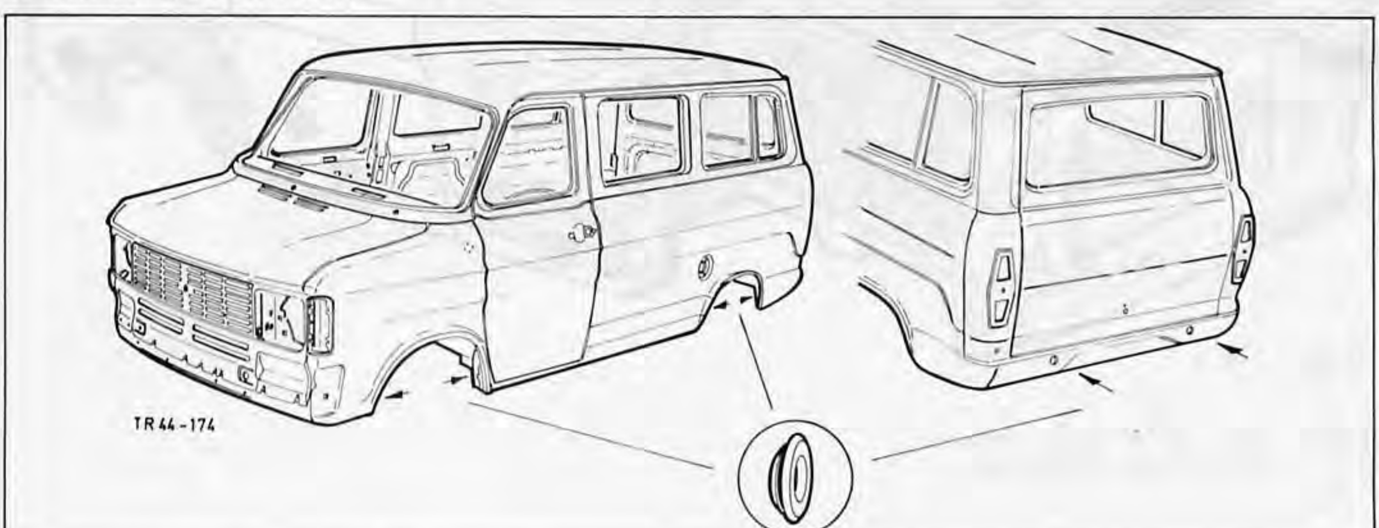


Fig.7. Location of rubber plugs.

GENERAL HINTS ON BODY REPAIRS (cont'd)

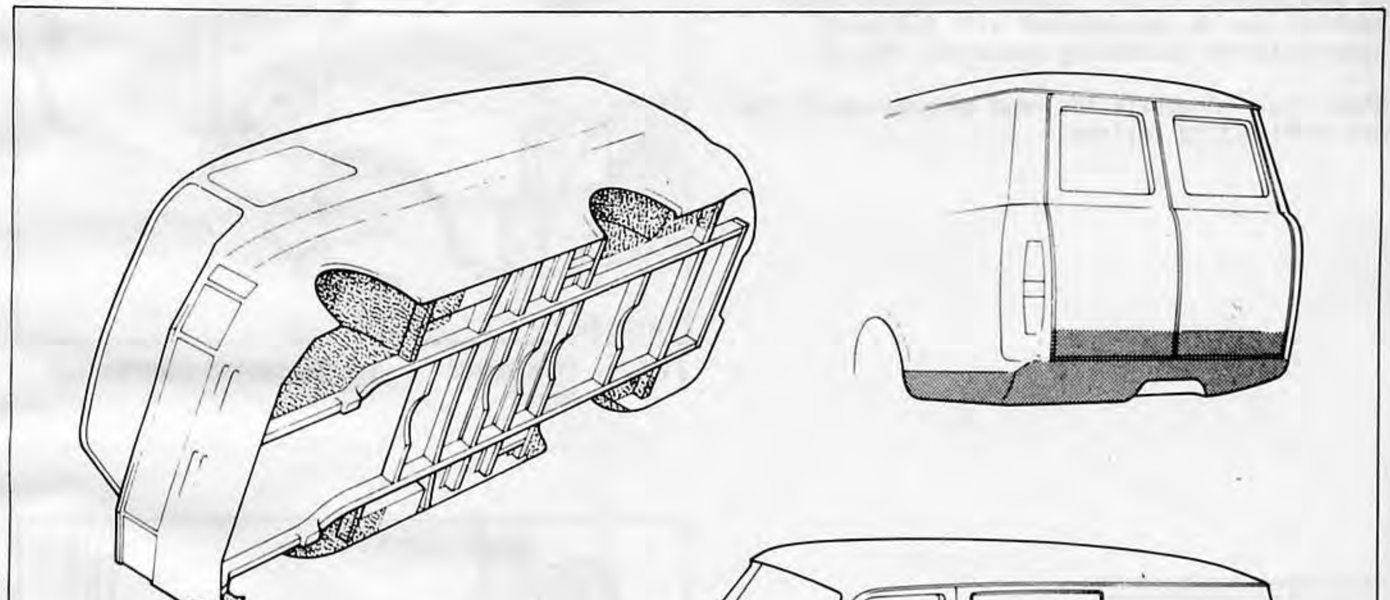


Fig.8. After a repair, the body must be treated with anti-corrosion agents (in the shaded areas) after painting. Thickness approx. 0,04 - 0,05 mm.
A - PVC underseal
B - Cavity rust-proofing wax

GENERAL HINTS ON BODY REPAIRS (cont'd)

Panel Rework

Depending on the type and extent of the damage, it may be preferable to repair rather than replace accessible skin panels, Fig.9.

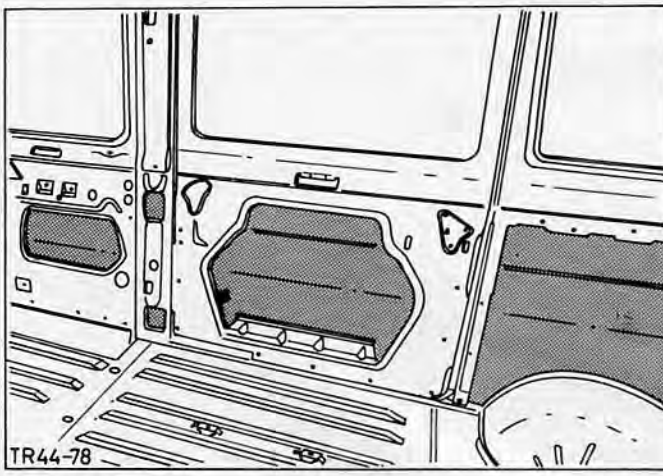


Fig.9. Access apertures for panel beating on side panel and door.

Straightening Operations

In many cases, bent or buckled panel and member sections can be straightened with hydraulic compression or stretching equipment, Fig.10.

These tools eliminate the need to renew parts that are difficult to replace.

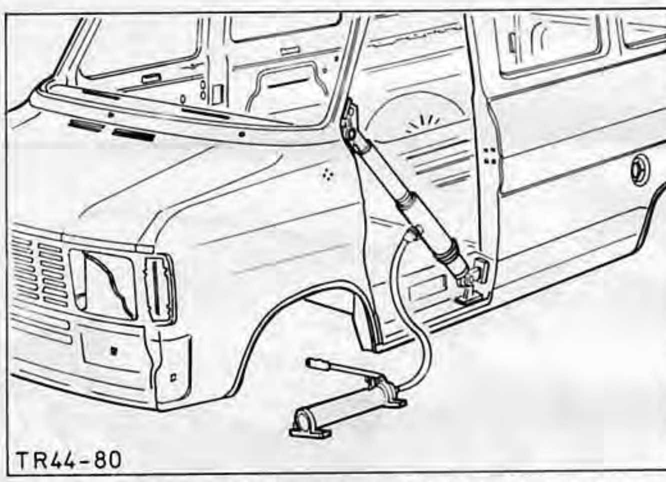


Fig.10. Straightening with hydraulic compression tool.

Part Panel Replacement

Part panel replacement in the damaged area may only be carried out on parts of the vehicle not subject to severe stresses.

For reasons of strength the cut locations recommended in the following operations must be used, Fig.11.

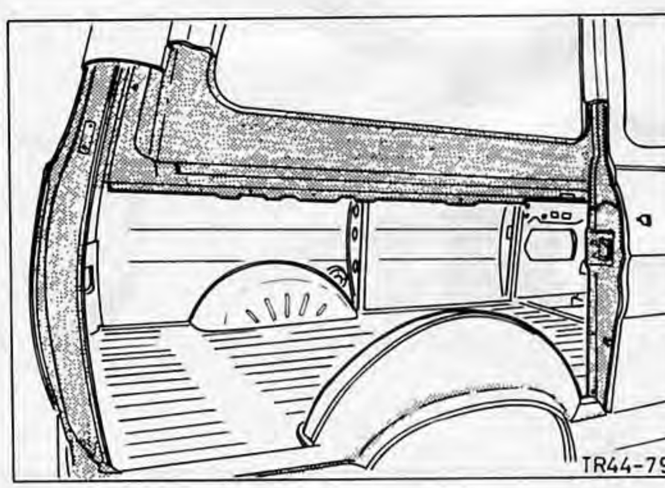


Fig.11. Recommended sectional repairs on side panel (rear).

GENERAL HINTS ON BODY REPAIRS (cont'd)

Complete Part Replacement

Where damage is extensive it is necessary to replace body panels complete as supplied. (For example - side panel, Fig.12.).

This is also the case if the damaged part conceals load carrying members or bracing, or if the part is double skinned and panel beating is impossible.

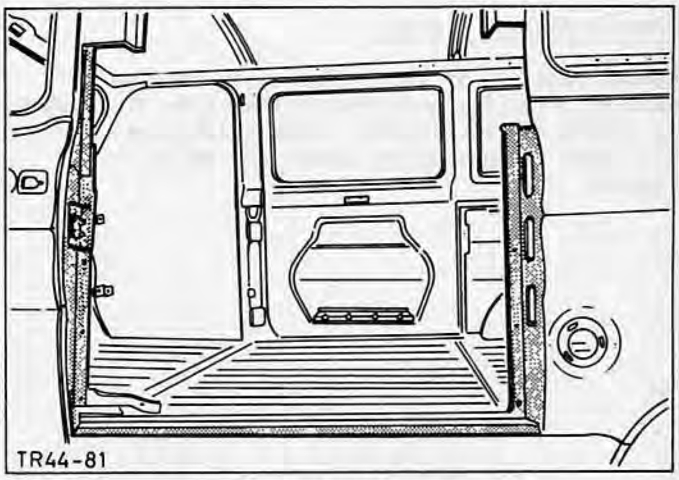


Fig.12. Side panel completely cut out.

OPERATIONAL SEQUENCE

Cut out damaged part

Using a compressed air cutting tool or hand chisel, cut out damaged part, Fig.13, taking care not to damage adjacent and underlying parts.

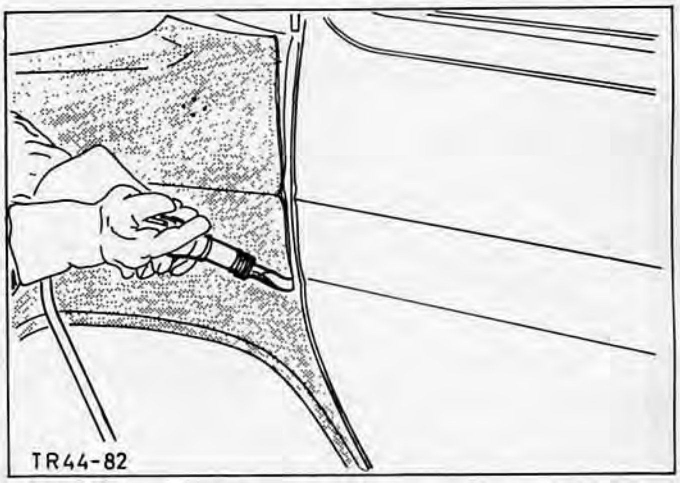


Fig.13. Cutting out fender with pneumatic power chisel.

Remove panel remnants from spot weld flange

Using a compressed air cutting tool or end cutting pliers remove panel remnants, Fig.14A. On overlapped panels it is advisable for spot welds to be drilled or punched, Fig.14B. Hard soldered points on adjoining panels should be heated and prised apart then cleaned with a wire brush while hot.

To prevent heat damage to upholstery and glass during cutting or welding operations, these items must always be protected.

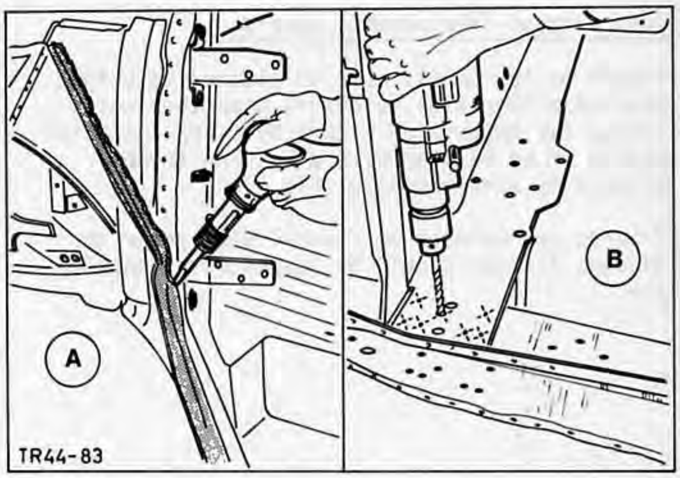


Fig.14. A - Remove panel remnants using pneumatic power chisel
B - Drill spot welds

BASIC OPERATIONAL SEQUENCE (cont'd)

Dress and align flanges

Remove remnants of spot welds using sanding machine, Fig.15., and dress either side of flanges to bright metal, Fig.16B. Then straighten distorted flanges using hammer and dolly, Fig.16A.

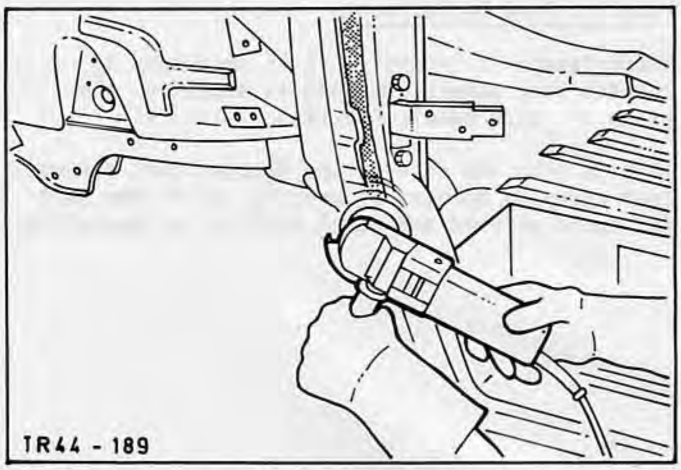


Fig.15. Removing weld remnants using sanding machine.

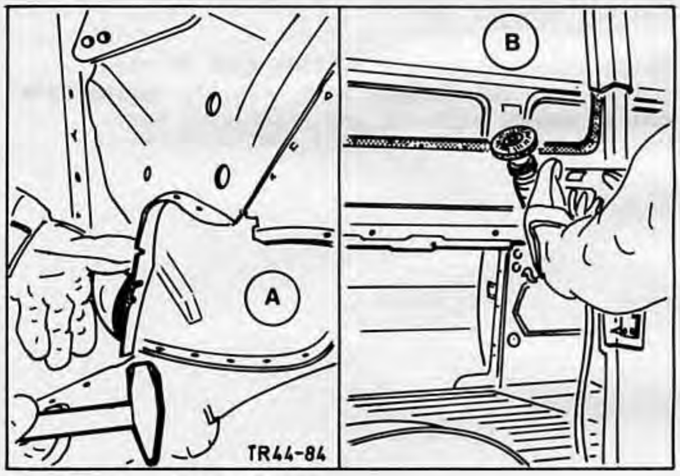


Fig.16. A - Align flange
B - Dress flange using wire brush

Dress flanges (replacement panels)

Flanges on new panels must be cleaned to bright metal on either side to ensure good spot welds. Flanges may be dressed either by using a sanding machine or by heating with a welding torch followed by wire-brushing, Fig.17.

If parts are painted on reverse side prior to fitting, flanges should be masked with adhesive tape.

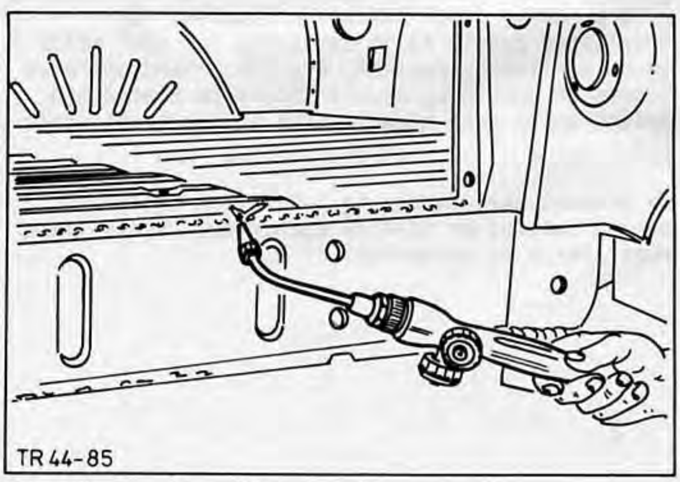


Fig.17. Burning off paint layer on flange.

BASIC OPERATIONAL PROCEDURE (cont'd)

Apply weld-through primer

In order to prevent corrosion at joints all contact faces of body and replacement parts should be coated with zinc rich weld-through primer, or anti-corrosion primer, Fig.18.

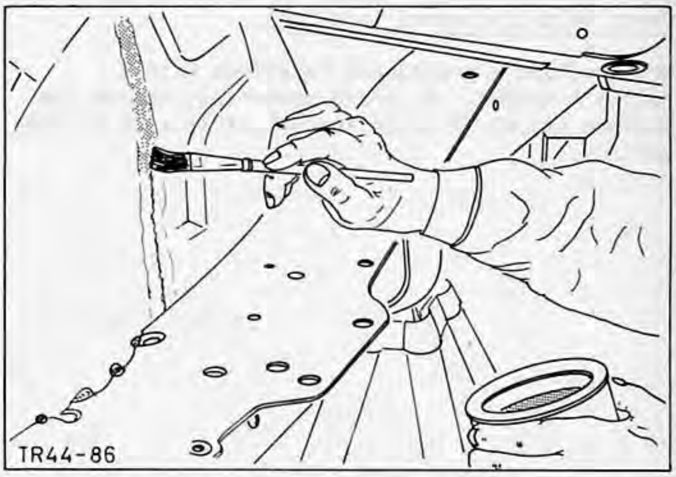


Fig.18. Apply zinc rich weld-through primer or anti-corrosion primer to contact faces of body and replacement part.

Align replacement part and secure with clamps

Make a joggle along cut edges on vehicles using crimping tool, Fig.19B. Position new part and align to contours of adjoining panels, Fig.19A. Ensure replacement panel is correctly aligned to body breaklines and natural breaks of adjacent panels.

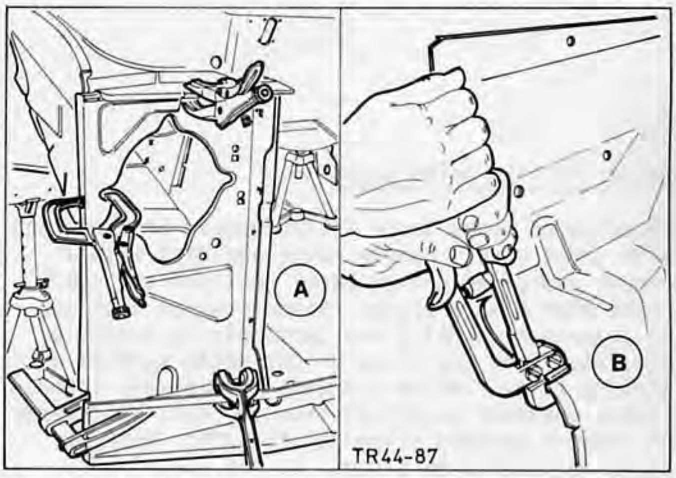


Fig.19. A - Position new part and clamp
B - Joggle edge on body using crimping tool (overlapping)

Spot weld, MIG weld or braze new part

The new part should be spot welded (wherever possible), Fig.20A. Electrode arms of different design are available for this purpose.

Ensure that welds are properly made through both flanges.

To avoid burning paint coat between panels, welding and brazing operations should be limited to locations where spot welding is not possible, Fig.20B.

Flammable materials must be removed from the welding area. Fire extinguishers must be immediately available whenever welding operations are carried out.

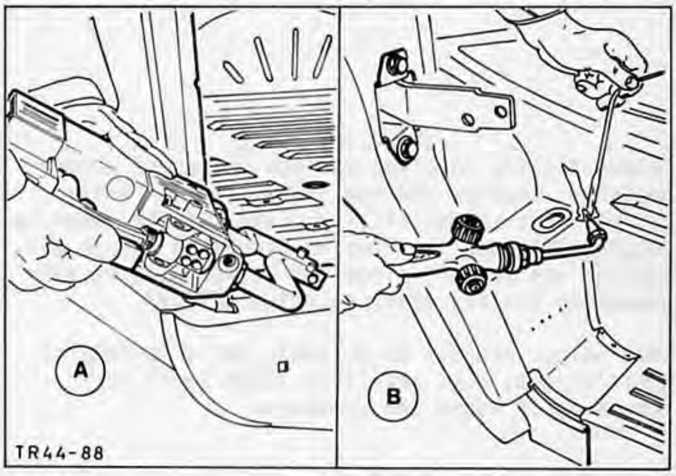


Fig.20. A - Spot weld new part
B - Braze new part

BASIC OPERATIONAL SEQUENCE (cont'd)

Dress welded/soldered locations

Dress welded and soldered locations with a suitable sander. To avoid weakening, remove the minimum amount of material compatible with a clean surface.

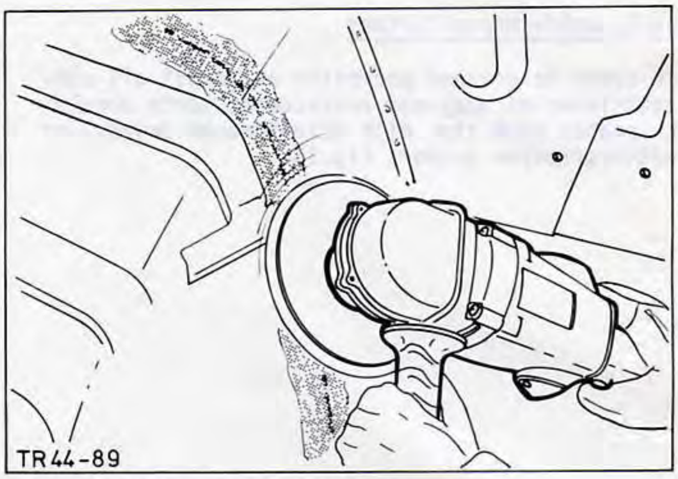


Fig.21. Dress welded locations.

Solder filling joint seams

Cleaning of seams to be filled should be conducted with great care. Remove paint and dirt with a sander and clean uneven panel sections and spot welds with a wire brush. Round brushes that can be powered by a drill are particularly suitable, Fig.22A. Coat the clean bright metal surface with tinning paste. While tinning, move burner (Bunsen burner whenever possible) from the outside inwards to prevent surface slipping, Fig.22B. Wipe off paste residues with a rag.

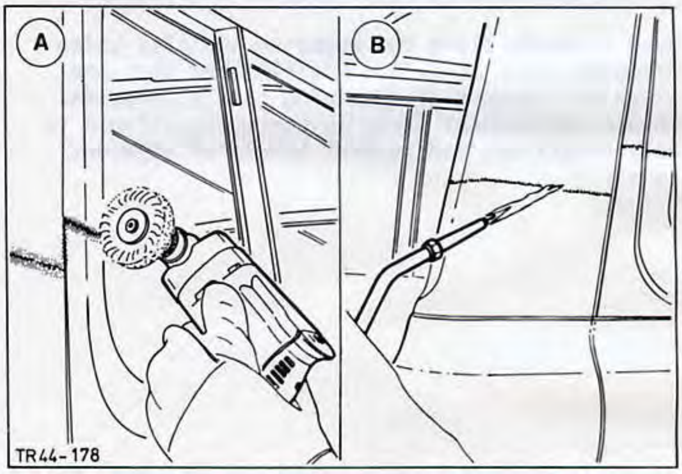


Fig.22. A - Clean seam with round steel wire brush
B - Tin seam

Solder-filling involves various shapes of wooden smoother, beeswax and bar solder (20%). While carrying out solder filling, care must be taken to ensure that material remains brushable and no air bubbles are formed, since the latter will usually appear as craters after painting, Fig.23.

This solder process is suitable for a variety of applications, e.g. levelling rough spots or treatment of edges and contours.

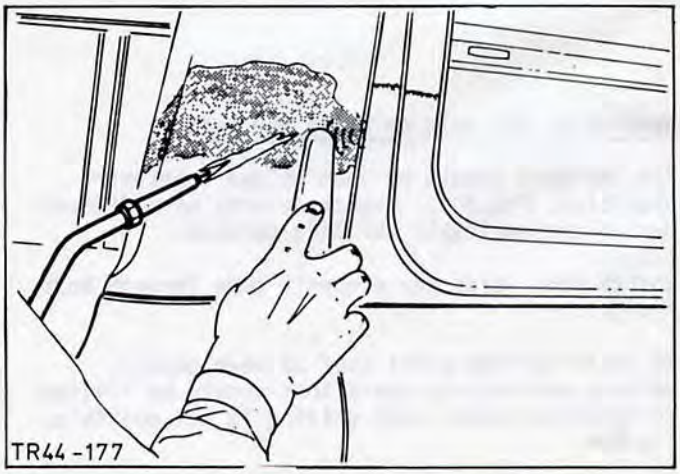


Fig.23. Solder-fill seam using a suitable smoother.

BASIC OPERATIONAL SEQUENCE (cont'd)

Machine soldered locations

Soldered locations can be machined in a variety of ways - by rotary sander, planing tools, orbital sander and powered mills, grindstones and grinding discs, Fig.24. While machining, make sure no localised distortion occurs.

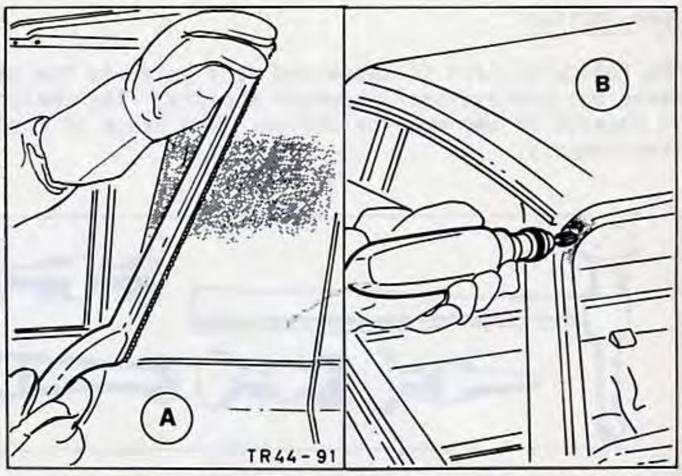


Fig.24. A - Using body file on a solder filled location.
B - Machining soldered location with circular miller.

Sealing seams and spot weld flanges

Prior to sealing, apply primer to seams and flanges.

A variety of materials are needed for sealing, ranging from low-viscosity compounds to solid sealing strips.

It is essential to apply the correct sealing materials; they are used in different ways; laid, brushed or sprayed, Fig.25.

On completing the sealing job in question, the repaired part of the body must always be checked for leaks (water test).

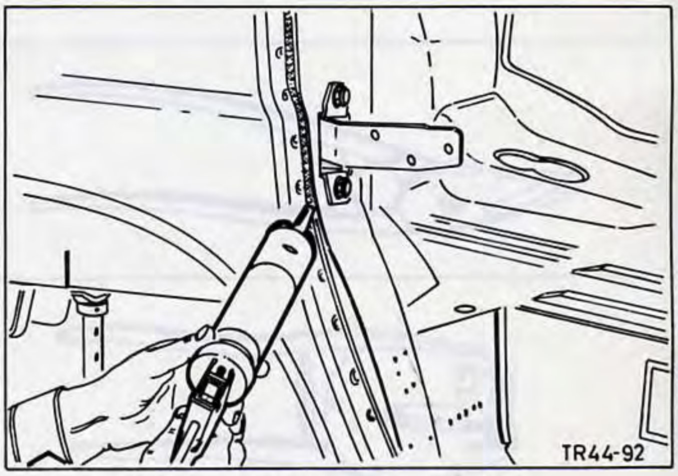


Fig.25. Applying joint sealing material.

After repair work, all new parts and part panel replacements must be brushed or sprayed with underseal from the reverse side, as in production. Fig.26.

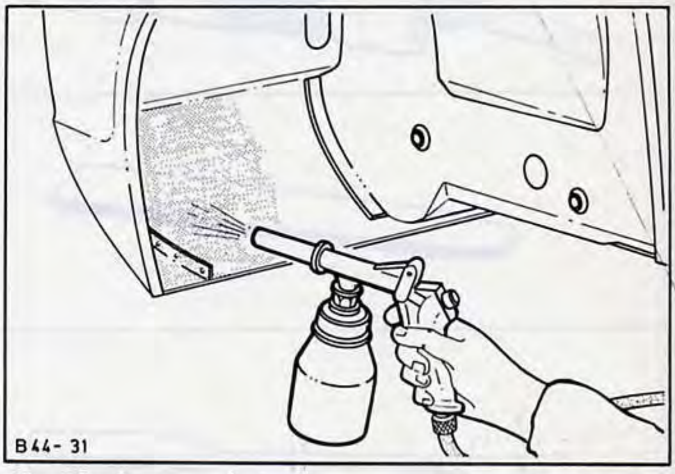
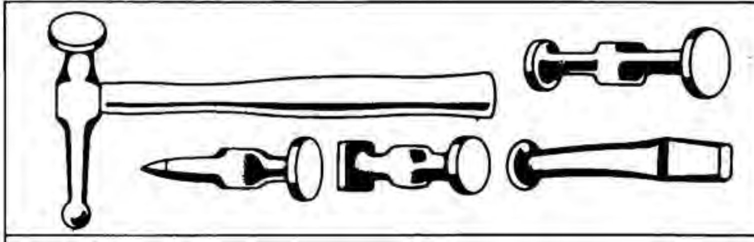
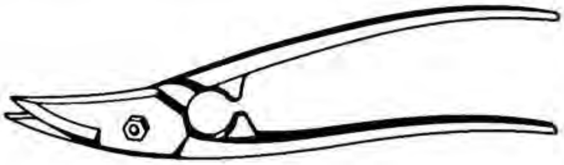
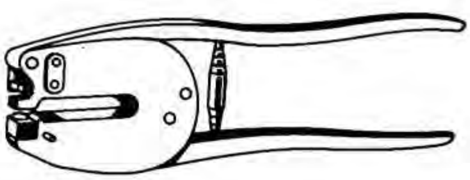
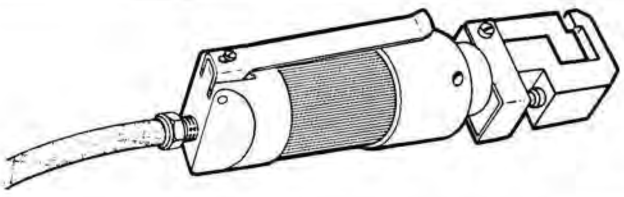


Fig.26. Spray underseal.

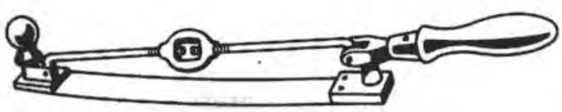
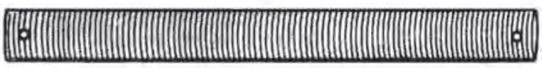
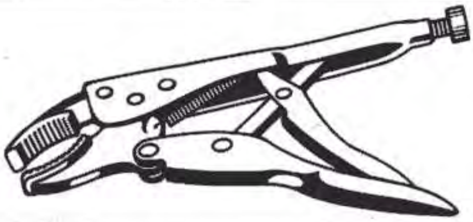
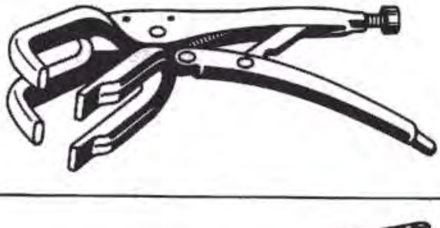
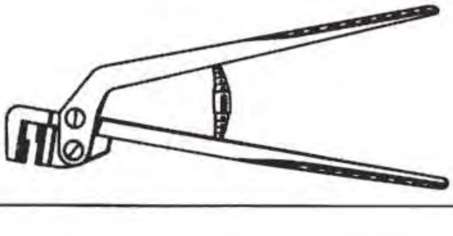
BODYWORK TOOLS AND EQUIPMENT

Introduction

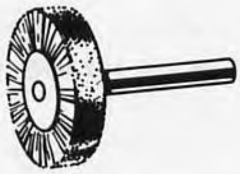
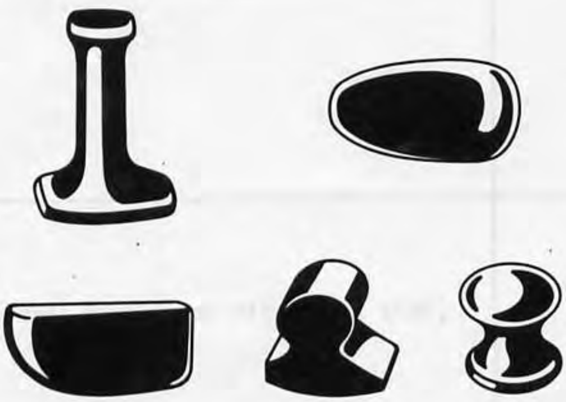
The following list is suggested as a guide to the basic bodywork tools and equipment required to carry out professional bodywork repairs. The choice of tools shown does not imply any recommendation in respect of any make or design. The range of tools may be expanded further according to individual requirements.

	Selection of hammers
	Plate shears, right
	Plate shears, left
	Hand punching tool (5mm dia.)
	Combination pneumatic punching and joggling tool
	Cold chisel
 TE 44 - 190	Triangular hardwood paddle

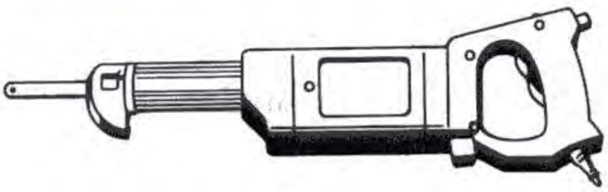
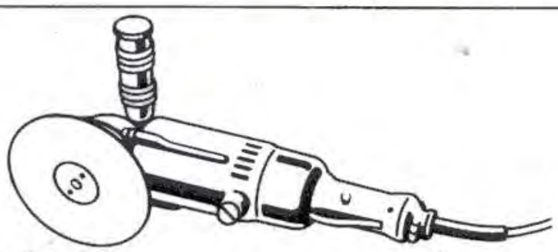
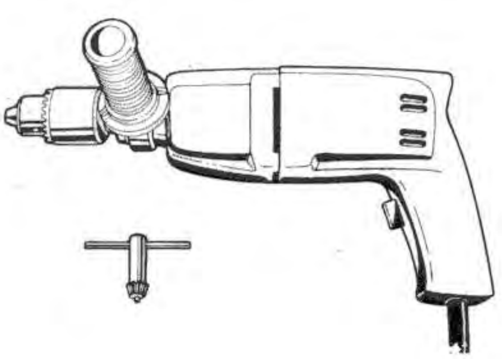
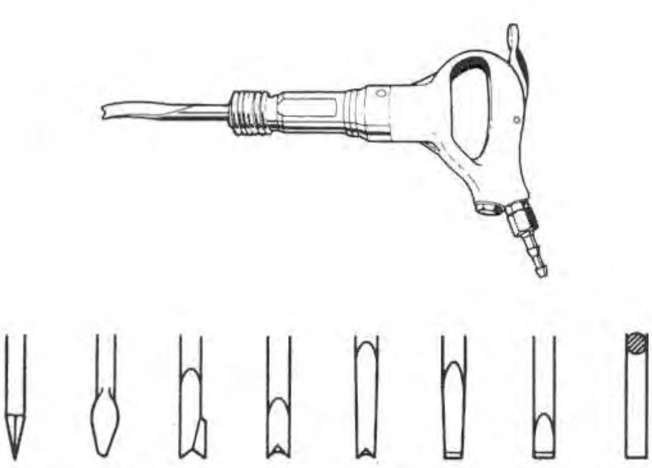
BODYWORK TOOLS AND EOUIPMENT (cont'd)

	Half round file - 250 mm (10 in)
	Adjustable file holder
	350 mm (14 in) body file
	Scriber
	Mole grips with open-ended jaws
	Weld clamps with curved jaws
	Weld clamps with straight and rectangular jaws
 F 44-23	Crimping tool

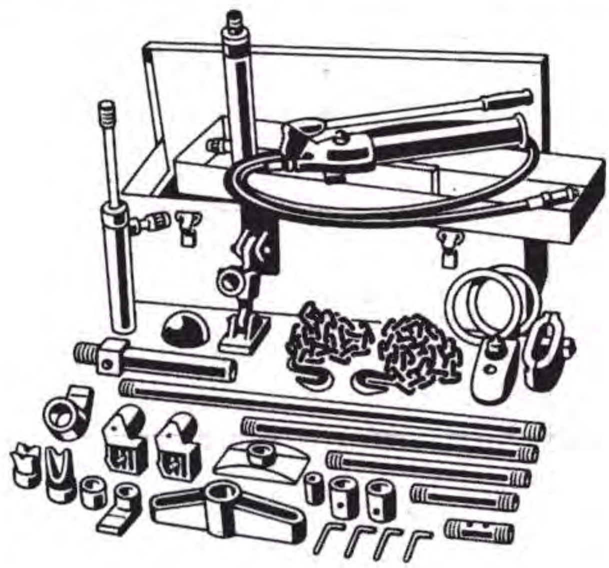
BODYWORK TOOLS AND EQUIPMENT (cont'd)

	Pincers
	Wire brush
	Rotary wire brush
	Various dollies
 F 44-24	Various spoons

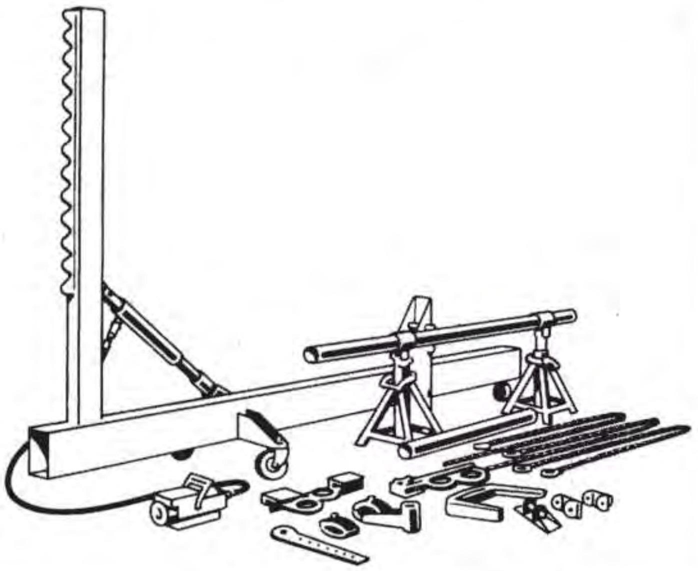
BODYWORK TOOLS AND EQUIPMENT (cont'd)

	Wooden mallet
	Pneumatic saw
	Grinding machine
	Drilling machine
 TE 44 - 191	Pneumatic chisel with 8 inserts

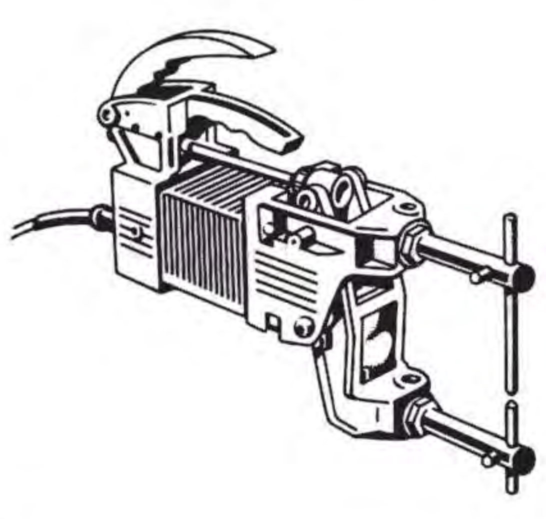
BODYWORK TOOLS AND EQUIPMENT (cont'd)



Hydraulic aligning equipment



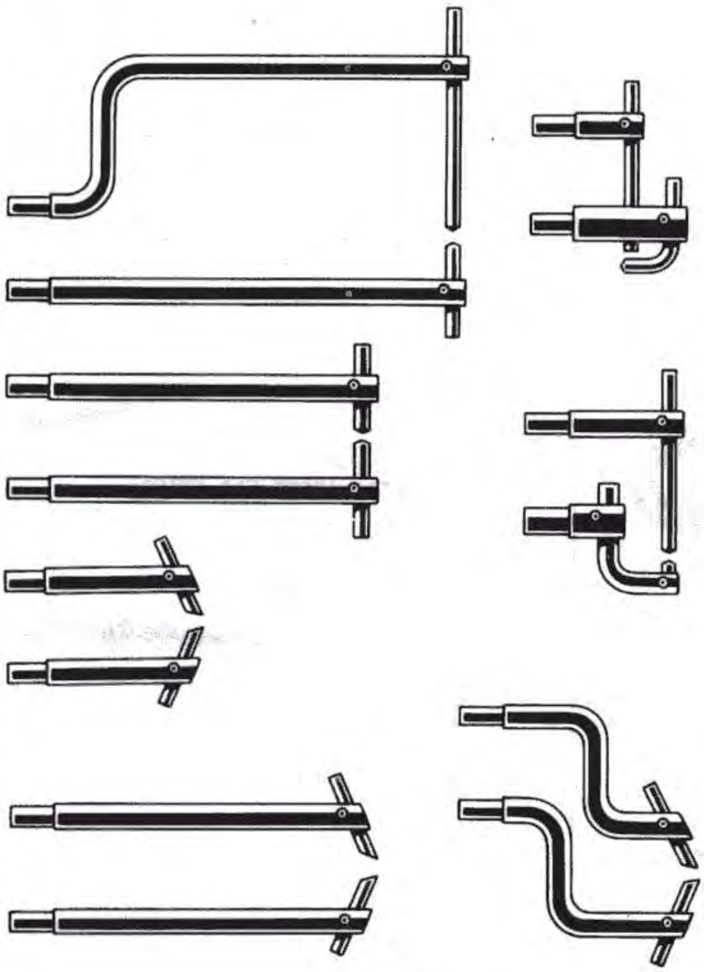
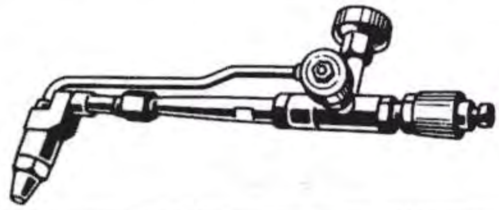
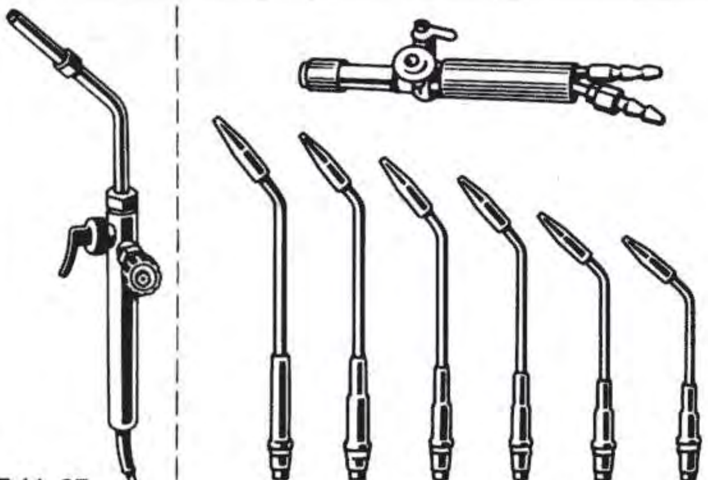
Hydraulic aligning equipment



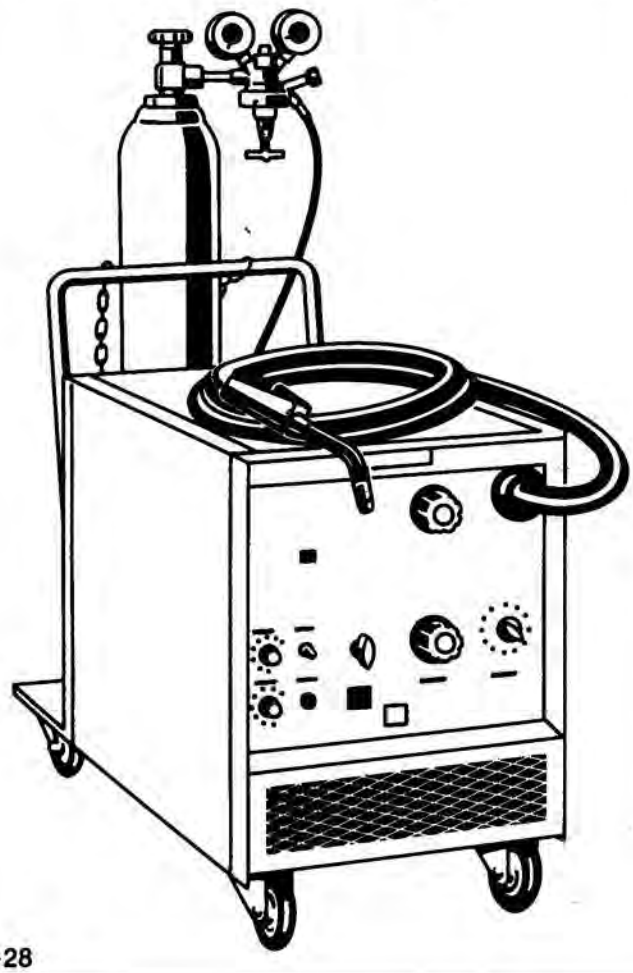
Spot welding gun

F 44-26

BODYWORK TOOLS AND EQUIPMENT (cont'd)

	Electrode arms of different shapes with electrodes
	Flame torch
 F 44-27	Oxy-acetylene welding equipment with 6 burner inserts

BODYWORK TOOLS AND EQUIPMENT (cont'd)



F 44-28

Metal Inert Gas (MIG) welding equipment

SPECIAL SERVICE TOOLS

	No special service tools required

OPERATIONAL SAFETY MEASURES

The following protective clothing and equipment must be provided for safety reasons:

- Protecting and welding goggles
- Chrome leather gloves
- Safety boots
- Ear protection (necessary for pneumatic hammer operations)
- Breathing mask (necessary for lead grinding operations)

SAFETY PRECAUTIONS AND LEGAL REQUIREMENTS

When exposed to intense heat from naked flames, certain rustproofing agents give off harmful vapours and gases. When subjected to heat the PVC underseal produces hydrochloric acid, and rigid polyurethane foam forms isocyanate. Wax underseal/cavity-sealant produces fumes which may be harmful if inhaled. The vapours and gases given off when various plastic materials melt may contain carbon monoxide, formaldehyde, nitrous fumes etc.

For personal and environmental protection at the place of work, the following instructions must be followed:

1. Even though there is no direct risk of fire, keep a fire extinguisher within easy reach.

2. If possible, the rustproofing agents applied in the area to be welded should be removed first. Rigid polyurethane foam can be removed using cutting tools, wax and underseal preferably with sanding discs or steel wire brushes. Wax or underseal can also be removed using a hot-air blower as used by the decorating trade when laying synthetic flooring.

3. If the rustproofing agents cannot be removed for reasons of space or accessibility, fumes and vapours must be extracted directly during welding operations. Exhaust extraction units with suction funnels attached to flexible hoses are most suitable for this purpose, Fig.27.

4. Welding operations should always be carried out in separate, well ventilated rooms. Always use breathing masks.

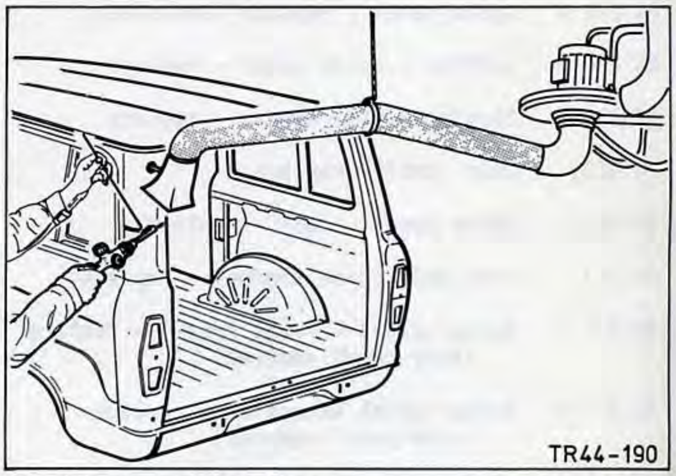


Fig.27. Fume extraction.

5. In the case of cavities filled with rigid foam, drill a hole on the side facing away from the operator so that vapours may escape.

IMPORTANT

The legal requirements applicable to individual countries - which may differ in some respects - must be observed.

NOISE PROTECTION REQUIREMENTS

During bodywork operations, e.g. cutting out sheet-metal parts with a parting-off grinder or pneumatic chisel, as well as the grinding and straightening of metal panels, a noise level of 85 - 90 dB(A) is usually reached or exceeded. Such noise can cause hearing damage and can increase risk of accidents e since it reduces operator perception.

In order to avoid subsequent injury (hardness of hearing and deafness due to noise come top of the list of occupational illnesses) ear protection should always be worn for such work.

Ear muffs or plugs are best suited for bodywork operations.

All noise areas inside the workshop should be clearly identified with signs etc. Further comprehensive notes and requirements are given in Accident Prevention Regulations available from Local Government authorities.

SERVICE AND REPAIR OPERATIONS CONTENT

BODY AND SHEET METAL		Described in Publication	Contained in Operation
44 214	Hood - replace	X	
44 224	Radiator grille panel - replace	X	
44 234	Panel Body Front - lower - replace	X	
44 253	Fender - front - replace (one)	X	
44 264 4	Headlamp mounting panel - replace	X	
44 271 4	Battery bracket - replace	X	
44 274 4	Crossmember - front - replace	X	
44 276 4	Apron panel - replace (one side)	X	
44 276 5	Section - apron panel - replace	X	
44 281 5	Section - side member - replace	X	
44 413	Door (cab) - replace	X	
44 415	Outer panel - door - replace	X	
44 453	Side door (with window) - replace	X	
44 476 4	Rocker panel - front (rear) - replace (side panel removed)	X	
44 477 4	Rocker panel extension - replace (side panel removed)	X	
44 478 4	Entrance step - front - replace (fender and door sill removed)	X	
44 517	Side panel with inside window panel - replace (front left)	X	
44 518	Side panel - rear right - replace	X	
44 534 4	Wheel house - replace	X	
44 574	Box corner - replace	X	
44 575 4	Door sill - replace	X	
44 642	Panel - back - replace	X	
44 674	Crossmember - rear - replace	X	
44 696	Fender - rear - remove and fit	X	
44 734	Tailgate - replace	X	

SERVICE AND REPAIR OPERATIONS

44 214 HOOD - REPLACE

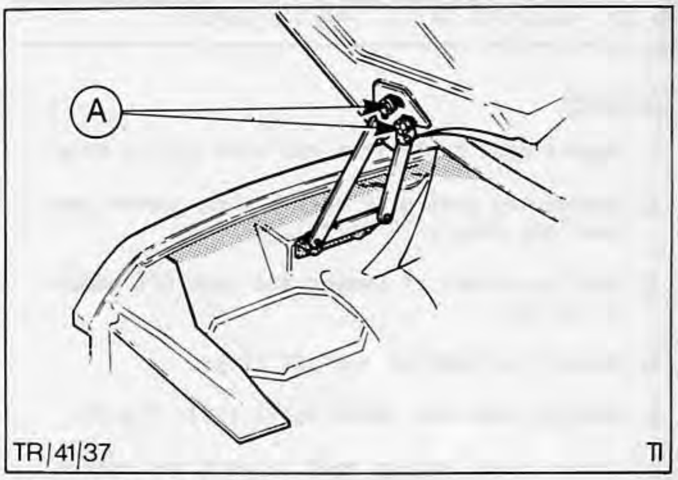


Fig.28. Hood hinge bolts.
A - Bolts and washers

To Remove

1. Detach tubes and windscreen washer jets from hood. Then remove tube retaining clips.
2. Detach lock striker and safety catch (1 bolt).
3. Remove hood (4 bolts), Fig.28. Use a cover to protect paintwork of cowl panel and fenders.
4. Replace hood support. Replace rubber grommet using a screwdriver.

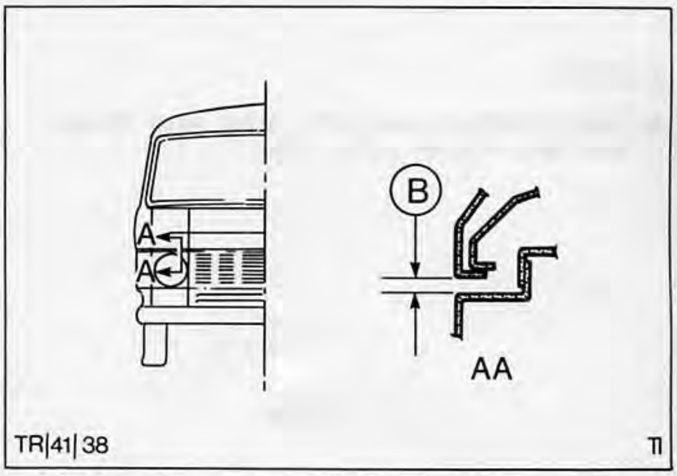


Fig.29. Hood alignment - underside of hood to radiator grille panel
B - 7,5 $\pm$ 1,5mm

To Install

5. Attach hood, leaving bolts finger-tight. Align hood so that clearance with adjacent body parts is even all round and hood top is flush with cowl panel and fenders, Fig.29. Tighten bolts with hood in this position and remove cover.
6. Fit safety catch and align it so that it engages correctly in the striker plate, Fig.30.
7. Fit lock striker and adjust. Set striker so that it engages fully in the leg spring of the hood lock and hood top is flush with the fenders.

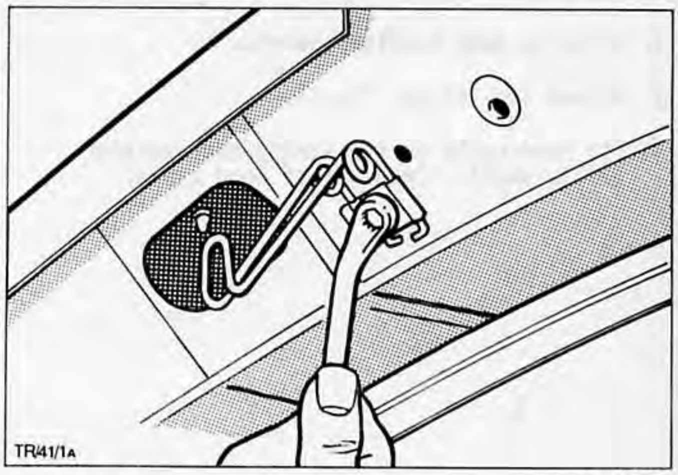


Fig.30. Fit hood safety catch.

8. Attach windscreen washer tube retaining clips and tubes as well as jets on hood.
9. Adjust windscreen washer jets.

44 224 RADIATOR GRILLE PANEL - REPLACE

To Remove

1. Remove hood cable from radiator grille panel.
2. Remove leg spring (1 bolt), then remove both headlamp panels (4 bolts).
3. Unclip corners of bumper and take off bumper (2 bolts).
4. Remove Ford emblem and all clips.
5. Unscrew radiator panel bolts (19), Fig.31.
6. Secure hood, detach hood support and remove rubber grommet.
7. Take off radiator grille panel, Fig.32.

Fig.31. Radiator grille panel bolts.

To Install

8. Insert bolts in new part, align with fenders and then tighten bolts (19).

Fig.32. Radiator grille panel removed.

9. Insert rubber grommet and attach hood support.
10. Fit bumper and clip on corners of bumper.
11. Screw on both headlamp panels.
12. Attach leg spring, Fig.33.
13. Fit hood cable on leg spring and radiator grille panel. Then adjust hood cable.

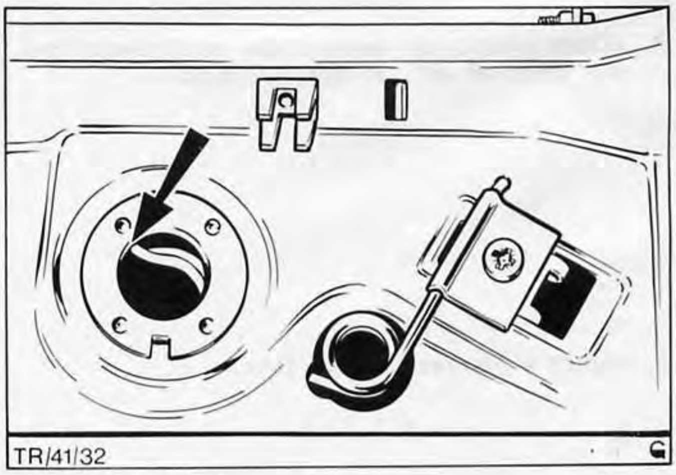


Fig.33. Attach leg spring.

44 234 PANEL - BODY FRONT LOWER - REPLACE

To Remove

1. Take off both headlamp panels (4 bolts).
2. Detach hood cable from leg spring.

Fig.34. Cut body front lower panel away from fender.

3. Unclip corners of bumper and take off bumper (2 bolts).
4. Take off radiator grille panel (19 bolts).

Fig.35. Cut out panel from crossmember.

5. Cut body front lower panel away from fenders, left and right, FIg.34.
6. Cut out body front lower panel from crossmember, Fig.35 and Fig.36.
7. Remove metal remnants.

Fig.36. View of front crossmember when body front lower panel removed.

8. Dress and align spot weld flanges, Fig.37.

9. Remove all metal remnants as far as possible between fenders and crossmember.

Fig.37. Dress spot weld flanges.

To Install

10. Dress spot weld flanges on new body front lower panel.

11. Shorten spot weld flanges right and left on new body front lower panel.

12. Coat spot weld flanges with weld-through primer.

13. Position new panel and fix with clamps, Fig. 38.

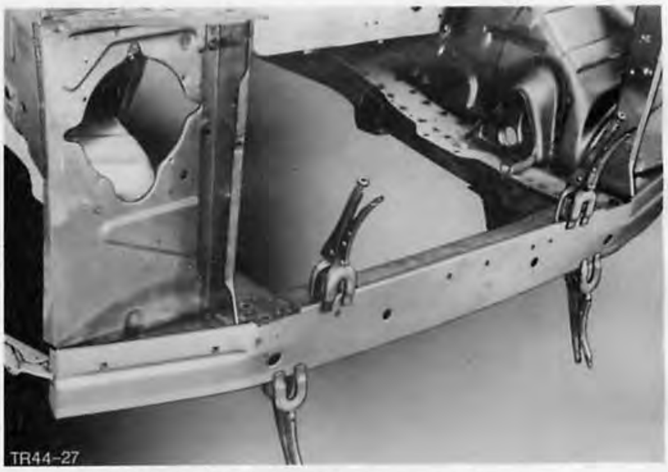


Fig.38. Fix new body front lower panel on crossmember with clamps.

14. Spot weld new body front lower panel, Fig.39.

15. Position radiator grille panel and bolt on.

16. Fit bumper, install hood cable and adjust.

17. Fit both headlamp panels.

Fig.39. Spot weld new body front lower panel onto crossmember.

44 253 FENDER - FRONT - REPLACE (one)

To Remove

1. Disconnect earth cable from battery.
2. Take off both headlamp panels (4 bolts).

Fig.40. Cut line of fender to be replaced.

3. Unclip corners of bumper and take off bumper (2 bolts).
4. Take off complete radiator grille panel (19 bolts).

Fig.41. Fender cut line in area of A pillar.

5. Remove headlamp and indicator (4 bolts) and remove hood bump rubber.
6. Remove bolt securing fender to apron panel. Mark fender cut line and cut out fender.
7. Cut fender at welded bracket connections and headlamp support panel.
8. Cut fender in area of apron panel, Fig.42.

Fig.42. Cut line in area of apron panel.

9. Cut fender in area of 'A' pillar and then take off, Fig.43.

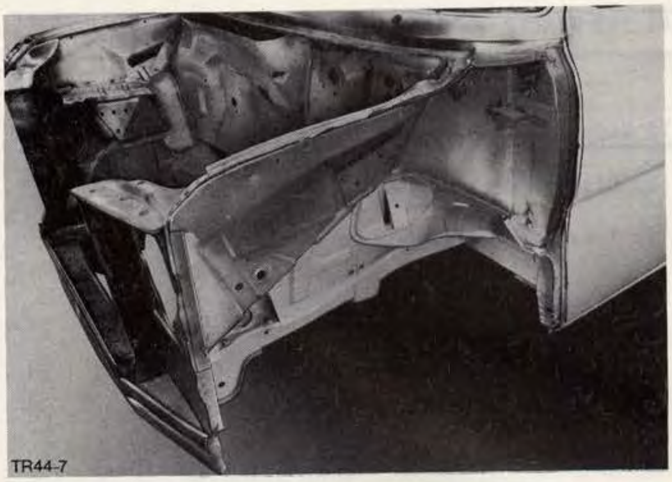


Fig.43. View of front quarter with fender cut out.

10. Remove metal remnants from spot weld flanges, Fig.44.

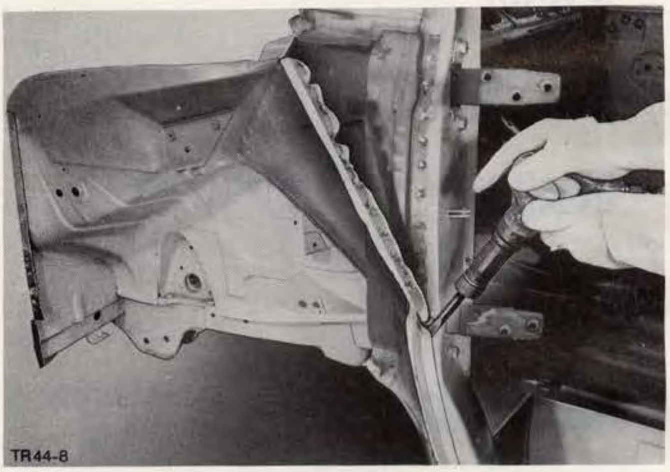


Fig.44. Remove metal remnants.

11. Dress spot weld flanges and straighten with hammer and dolly, Fig.45.

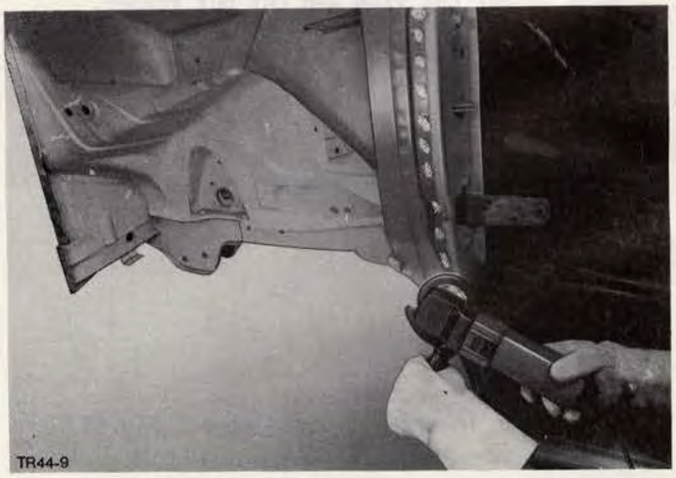


Fig.45. Dress spot weld flanges.

44 253

To Install

12. Punch spot weld flange for A pillar on new fender, Fig.46.

Fig.46. Punch spot weld flange for A pillar on new fender.

13. Coat contact faces of bodywork and fender with weld-through primer.

14. Adapt fender to corner of cowl panel, align with door and hood and fix with clamps, Fig.47.

Fig.47. Fix fender with clamps.

NOTE: Fender gap must be even all round from adjacent parts.

15. Fit fender bolt at corner of cowl panel.

16. Spot weld fender to apron panel and headlamp support panel, Fig.48.

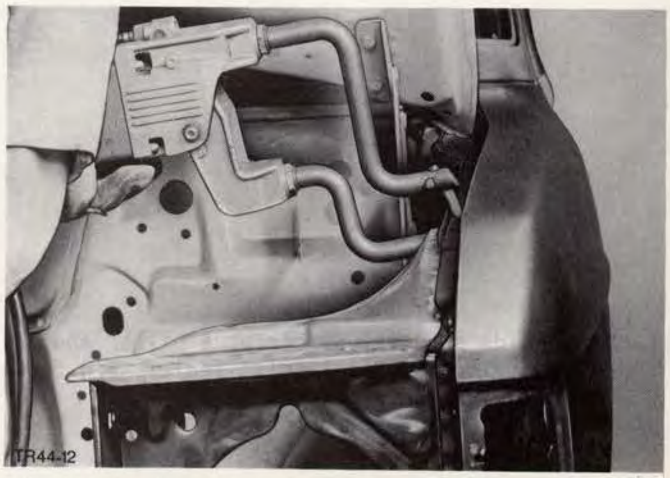


Fig.48. Spot weld fender in area of apron panel.

17. Remove door trim panel, pull off plastic door sheet, loosen bolts (6) and take door off the hinges, Fig.49.

Fig.49. Take off door, by loosening 6 hinge bolts.

18. Plug weld fender in area of A pillar, Fig.50.

Fig.50. Plug weld fender in area of A pillar.

19. Dress welds and seal fender at A pillar and apron panel using metal joint sealer, Fig.51. Then spray underseal on the inside.

Fig.51. Seal fender at A pillar and apron panel.

44 253

20. Fit door and position.

NOTE: Pay attention to gap between fender and door panel, Fig.52 and Fig.53.

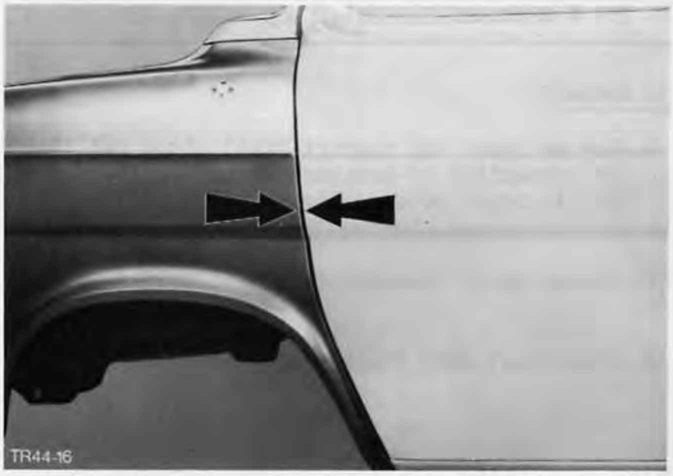


Fig.52. Gap between fender and door panel.

21. Fit plastic door sheet and door trim panel. Fit hood bump rubbers on fender.

22. Fit headlamp and indicator.

Fig.53. Gap between fender and hood.

23. Bolt radiator grille panel to bodywork, paying attention to gap between hood and fenders, Fig.54.

24. Bolt on both headlamp panels. Fit hood cable and adjust. Refit side mirror.

25. Connect battery earth cable.

Fig.54. Radiator grille panel fitted.

26. Adjust headlamps.

44 264 4 HEADLAMP SUPPORT PANEL - REPLACE

Fig.55. Cut lines for headlamp support plate.

To Remove

1. Cut out headlamp support panel along cut line at connection of crossmember and radiator grille panel holder, Fig.55.

2. Remove metal remnants from spot weld flanges.

3. Dress spot weld flanges and straighten.

To Install

4. Dress spot weld flanges on new headlamp support bracket and holder.

Fig.56. Fix headlamp support panel with clamps.

5. Coat contact faces of spot weld flanges with weld through primer.

6. Adapt new headlamp support panel to crossmember and apron panel and fix with clamps and cramp, Fig.56.

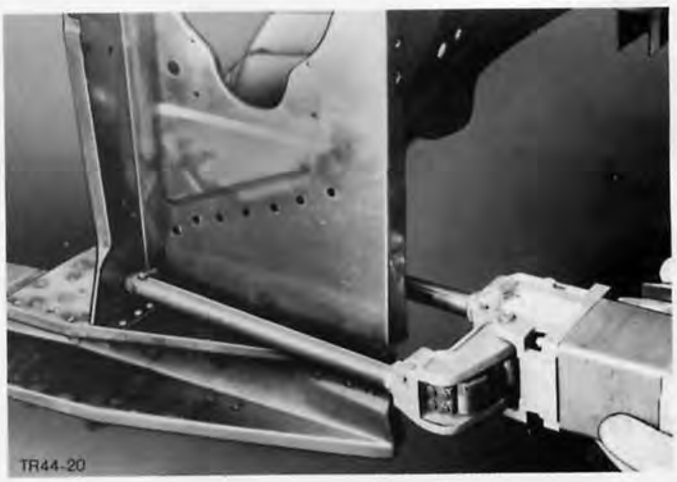


Fig.57. Spot weld headlamp support panel.

7. Spot weld headlamp support panel, Fig.57.

44 271 4 BATTERY BRACKET - REPLACE

Fig.58. Drill out weld points on battery bracket.

To remove

1. Drill out weld points in battery bracket and holder, Fig.58.

2. Cut off bracket with holder from apron panel.

3. Dress spot weld flanges and straighten.

To Install

4. Dress spot weld flanges on new bracket and holder.

5. Spot weld bracket and battery holder together. Then punch this part at apron panel connecting points.

6. Fit bracket with holder on apron panel and plug weld, Fig.59. Tack weld 25mm at rear of tray to apron.

7. Dress weld points.

Fig.59. Plug weld battery bracket with holder on apron panel.

44 274 4 CROSSMEMBER - FRONT - REPLACE

To Remove

1. Cut out front crossmember, first removing both bumper holders (4 bolts.), Fig.60.

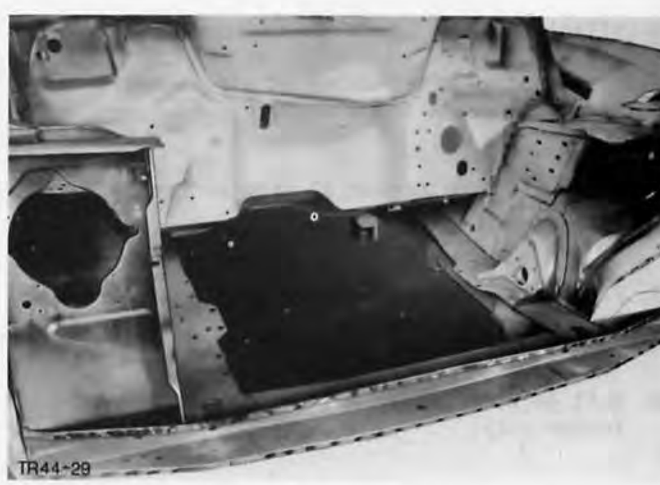


Fig.60. View of crossmember to be cut out.

2. Drill out spot weld connections between crossmember and side member, Fig.61 and disconnect fender stay.

3. Drill out headlamp support panels right and left at connection to crossmember.

4. Cut out crossmember completely.

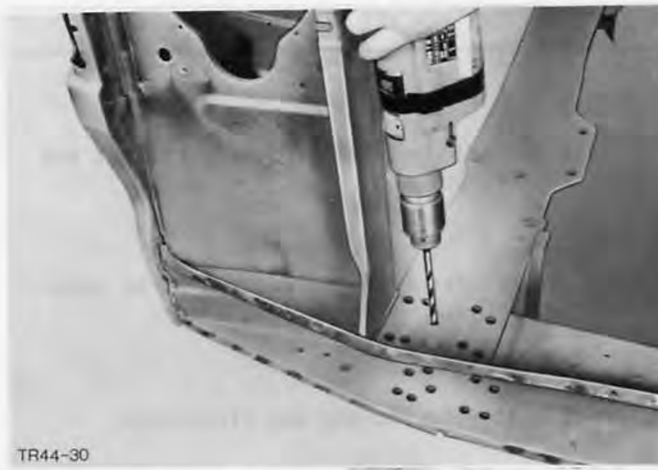


Fig.61. Drill out spot weld connection at right-hand side member.

5. Straighten spot weld flanges on side member and headlamp support panels with hammer and dolly.

6. Dress spot weld flanges on side members and headlamp support panels.

Fig.62. Fix crossmember at side members with clamps.

To Install

7. Position new crossmember at side members and fix with clamps and cramps, Fig.62.

8. Plug weld crossmember at side members, Fig.63.

9. Plug weld headlamp support panels right and left on crossmember.

10. Bolt on both bumper holders and reconnect fender stay.

Fig.63. Plug weld crossmember at side members.

44 276 4 APRON PANEL - REPLACE (one side)

To Remove

1. Drill out spot weld connections between apron panel and floor assembly, Figs.64 and 65.

NOTE: Remove cables, leads and rubber mats from vicinity of working area.

Fig.64. Drill out apron panel at outside connecting points.

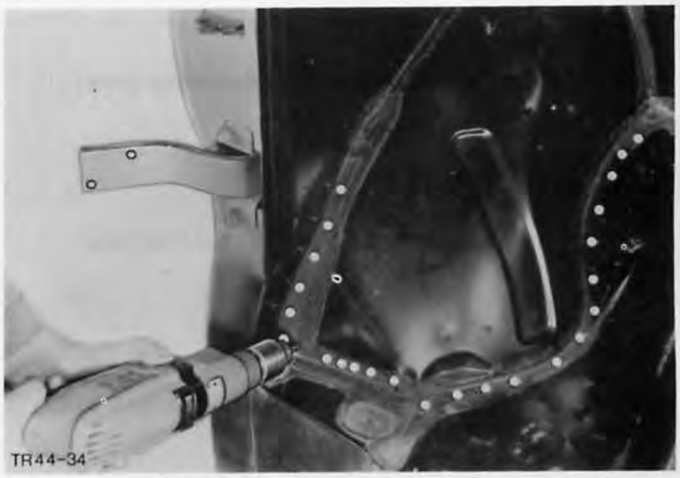


Fig.65. Drill out apron panel from passenger compartment.

2. Mark out cut line on apron panel to be cut out, Fig.66.

NOTE: With apron panel on left-hand side, remove steering box mounting bracket from side member (4 bolts).

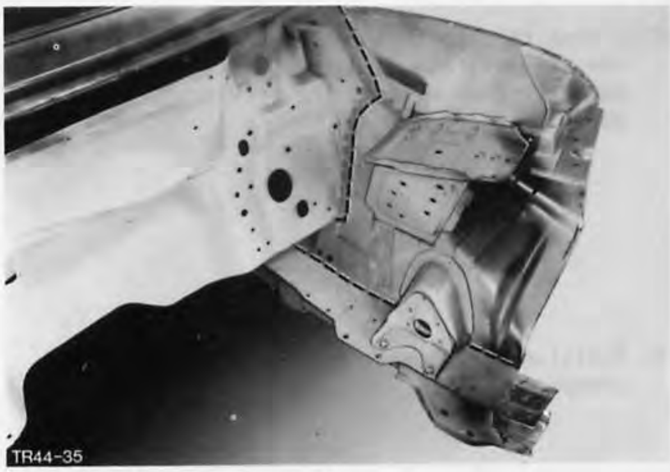


Fig.66. Mark apron panel cut line.

44 276 4

3. Cut out apron panel from side member, bulkhead and side panel, Fig.67.

4. Remove metal remnants from spot weld flanges.

5. Dress spot weld flanges, then straighten with hammer and dolly, Fig.68.

Fig.67. Cut out apron panel (steering box removed).

To Install

6. Dress spot weld flanges on new apron panel.

7. Punch apron panel in area of steering box mounting bracket.

8. Coat contact faces of spot weld flanges with weld-through primer.

Fig.68. Straighten spot weld flanges.

NOTE: When fitting the new apron panel, first fix the steering box mounting bracket on the side member. Then weld on the previously punched apron panel.

9. Position apron panel and fix with clamps and cramps, Fig.69.

Fig.69. Apron panel punched in area of steering box mounting bracket and fixed with clamps.

10. Spot weld apron panel on side member, Fig.70.

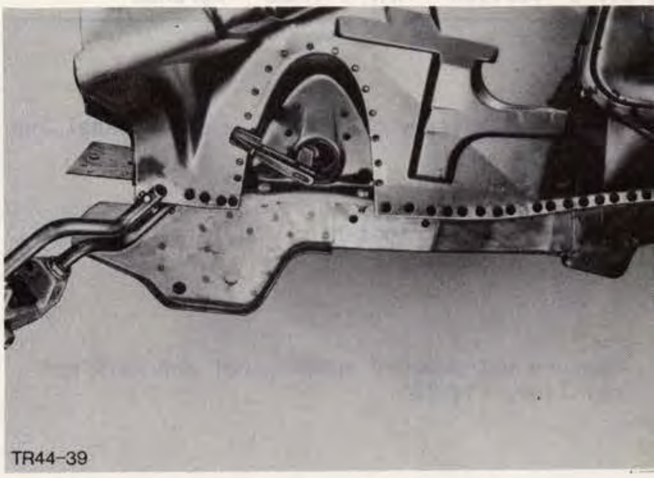


Fig.70. Spot weld apron panel at side member.

11. Weld apron panel on bulkhead and side panel, Fig.71.

Fig.71. Weld apron panel to side panel.

NOTE: Have fire extinguisher at hand due to fire risk.

12. Braze apron panel at the corners, Fig.72.

Fig.72. Braze apron panel at the corners.

13. Dress apron panel at weld locations.

14. Seal apron panel at joints with metal joint sealer and spray from the reverse side with underseal.

44 276 5 SECTION - APRON PANEL - REPLACE

To Remove

1. Drill out battery bracket from apron panel and remove.

NOTE: On diesel TRANSITS there is a battery bracket on the right-hand and left-hand side of the apron panel.

2. Measure out damaged apron panel and mark out cut line, Fig.73.

Fig.73. Cut line between side member and apron panel.

3. Cut off damaged apron panel section, Fig.74.

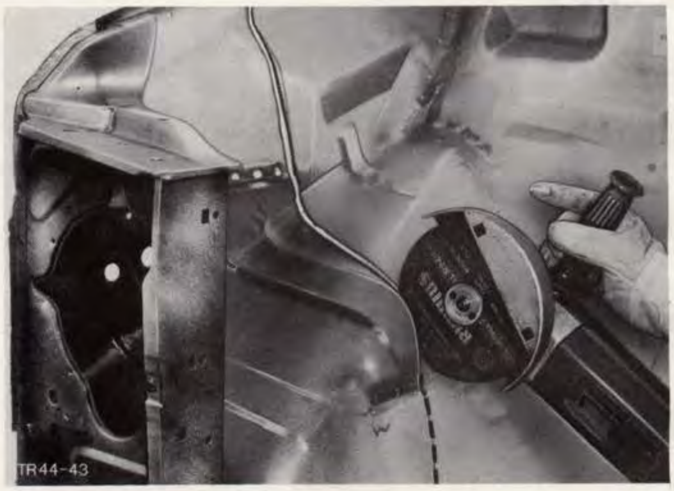


Fig.74. Cut apron panel section.

4. Remove metal remnants from spot weld flanges, Fig.75.

5. Deburr cut edges and remove underseal in area of cut.

6. Dress spot weld flanges and straighten.

Fig.75. Remove metal remnants.

7. Joggle remaining apron panel section with a joggling tool, Fig.76 and 77.

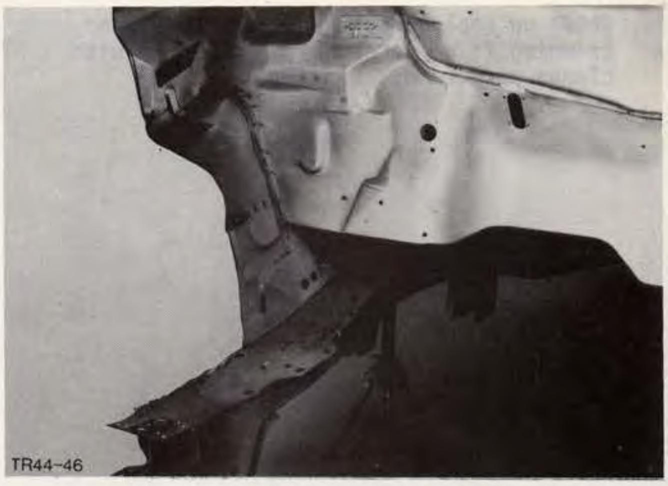


Fig.76. View of remaining apron panel section.

To Install

8. Measure up new apron panel section on the panel section cut out and mark new section, Fig.78. When measuring, allow 10 to 12 mm extra for overlap.

9. Cut off marked new apron panel, deburr and remove primer from contact faces of spot weld flanges on both sides.

Fig.77. Joggle apron panel.

10. Coat spot weld flanges with weld-through primer.

Fig.78. Mark new apron panel.

11. Offer up replacement apron panel section, trimming it as necessary, and secure with clamps and cramps, Fig.79.

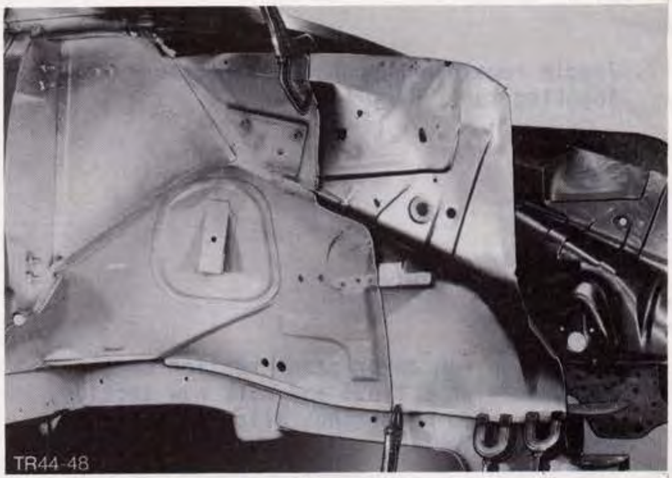


Fig.79. Secure new section with clamps.

12. Weld new apron panel section, Fig.80.

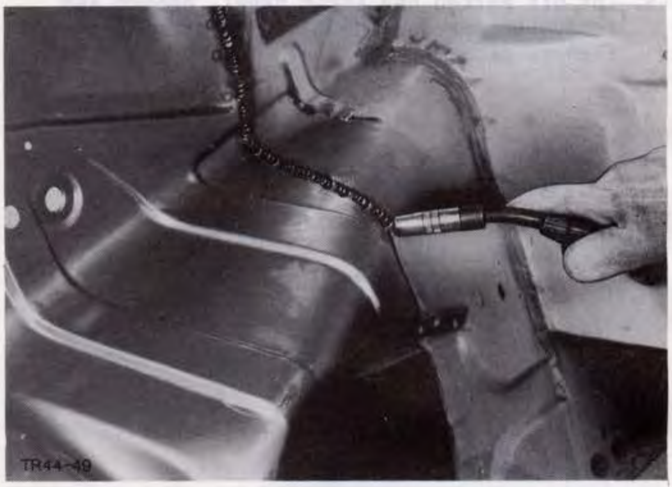


Fig.80. Weld new apron panel section.

13. Spot weld new apron panel section to side member and weld.

14. Dress welded zones and joint seam, Fig.81.

Fig.81. Dress joint seam.

44 276 5

15. Tin and solder-fill joint seam, Figs.82 and 83.

Fig.82. Coat joint seam with tinning paste.

16. Dress solder-filled locations on joint seal, Fig.84.

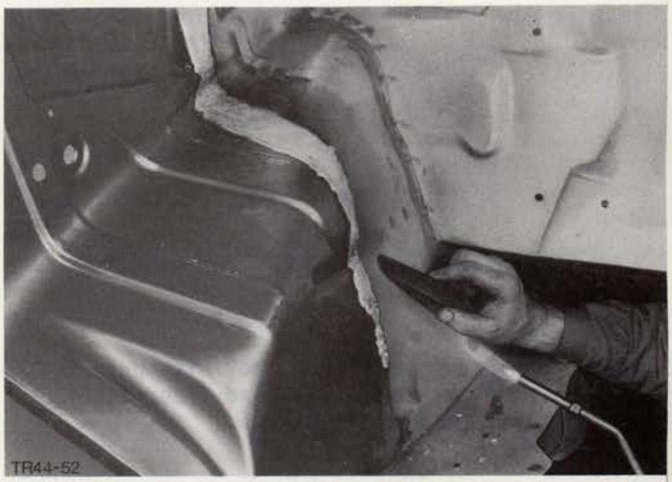


Fig.83. Solder-fill joint seam.

17. Seal apron panel at the joints with metal joint sealer and weld on battery bracket.

18. Spray underseal onto reverse side of apron panel.

Fig.84. Dress solder-filled locations.

44 281 5 SECTION - SIDE MEMBER - REPLACE

To Remove

1. Mark damaged side member at centre of threaded hole, Fig.85.

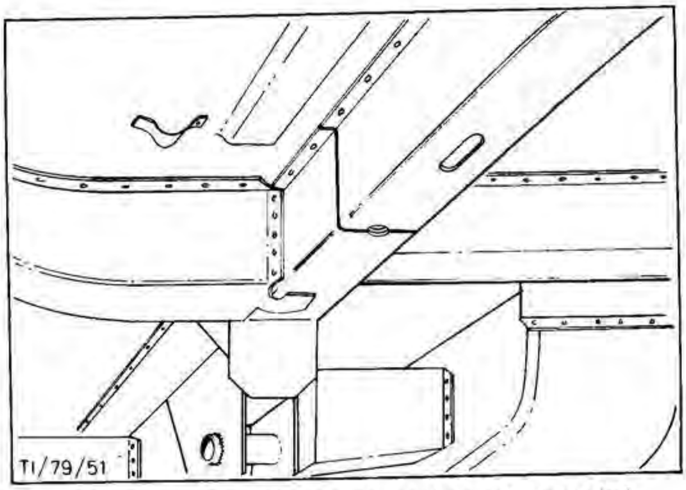


Fig.85. Mark side member at centre of threaded hole.

2. Drill out spot welds at front connection between floor panel and side member.

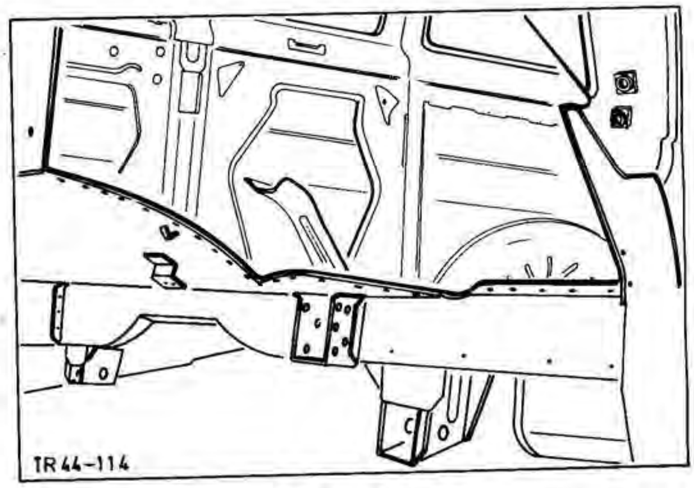


Fig.86. Side member cut out.

3. Cut side member at marked spot with grinding machine and on apron panel and floor panel with pneumatic chisel, Fig.86.

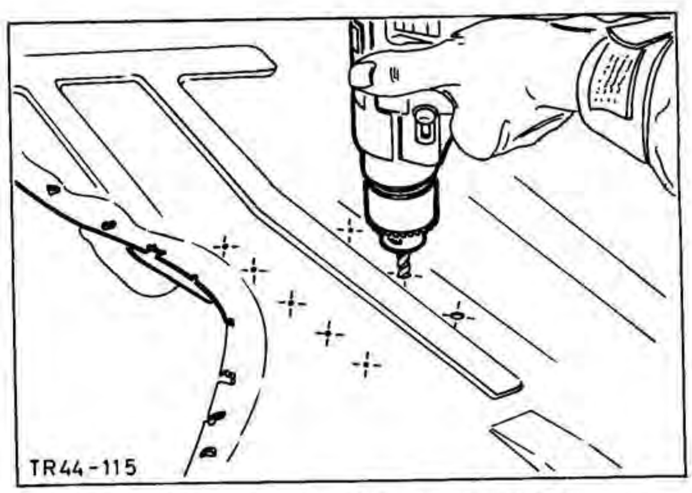


Fig.87. Drill out spot welds at connection between side member and floor panel.

4. Drill out spot welds at connection between side member and floor panel from passenger compartment,in area retaining plate with weld nut, Fig.87.

44 281 5

5. From passenger compartment, chisel open and bend up floor panel over side member, Fig.88.

6. Deburr cut edges and remove remains of retaining plate with weld nut from remaining side member section.

7. Mark holes on side member and drill out.

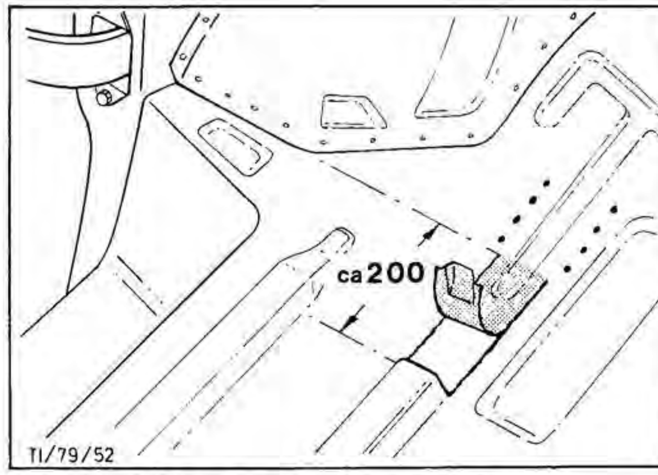


Fig.88. Drill out spot welds, chisel open and bend up floor panel.

<u>To Install</u>

8. Mark new side member at same point as shown in Fig.85 (centre of threaded hole).

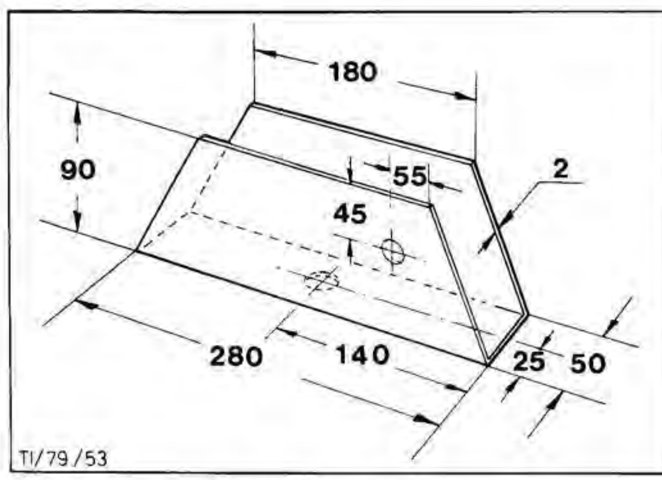


Fig.89. Make up internal shoe.

NOTE: Drill out the four spot welds on the retaining plate of the weld nut and remove plate. Keep for subsequent re-installation.

9. Cut new side member at marked location.

10. Make up internal shoe as per Fig.89.

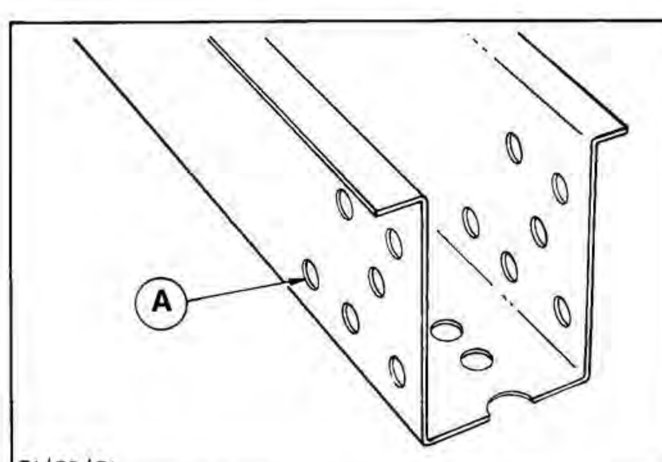


Fig.90. Drill hole on new side member section.
A - Holes

11. Drill 14 holes (12 mm dia.) on new side member section, Fig.90.

44 281 5

12. Insert internal shoe into new side member section and weld, Fig.91.

NOTE: For side members with additional reinforcement plate (diesel and HD version) the reinforcement plate must be welded in approx. 100 mm right and left before inserting the shoe, Fig.92.

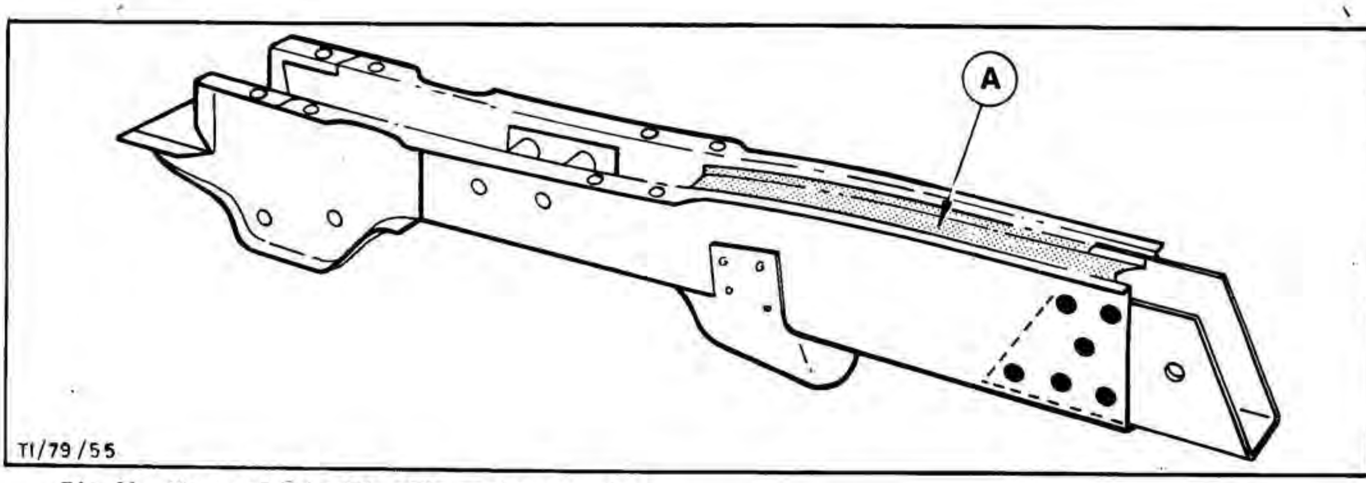


Fig.91. Shoe welded with side member section.
A - Reinforcement plate diesel and HD version

13. Weld shoe as well as weld nut retaining plate, Fig.92.

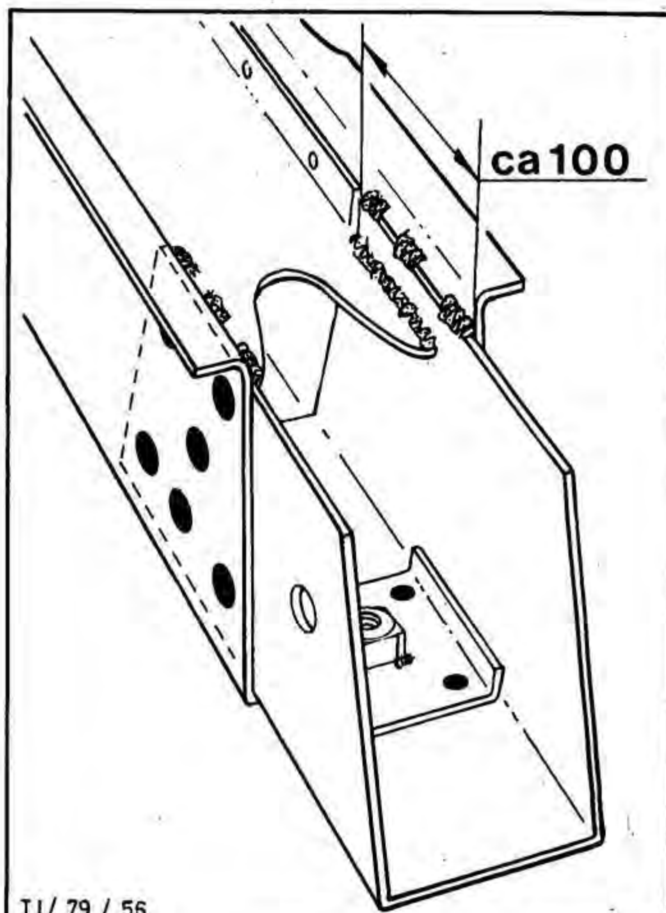


Fig.92. Weld locations on shoe and weld nut retaining plate.
Shoe welded in reinforcement plate approx. 100 mm right and left.

44 281 5

14. Drill 14 holes (12 mm dia.) on remaining side member section, Fig.93.

15. Place new cover plate on new side member section, clamp and spot weld.

16. Insert side member section with welded-on shoe into remaining side member section of body, Fig.93.

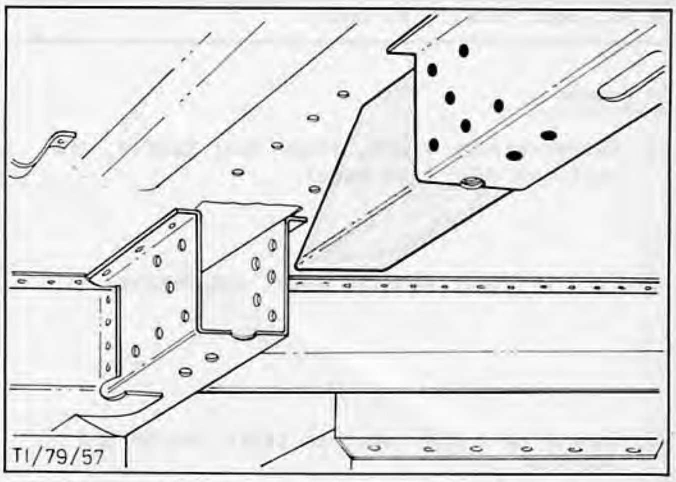
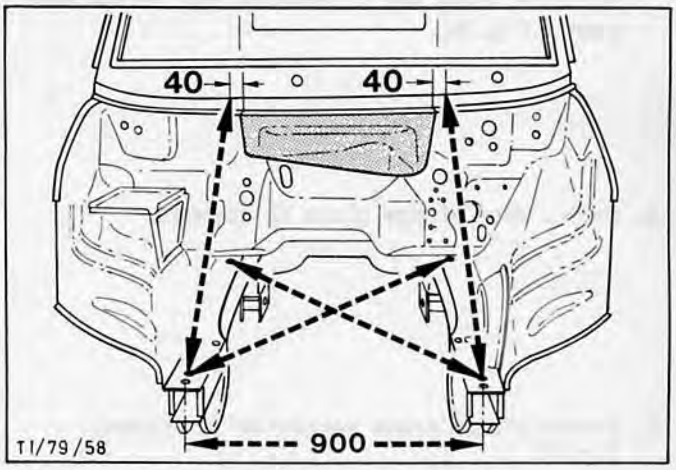


Fig.93. Drill holes in remaining section of side member and locate new section of side member.

17. Measure up side member section, Fig.94, bring into correct installation position and clamp.

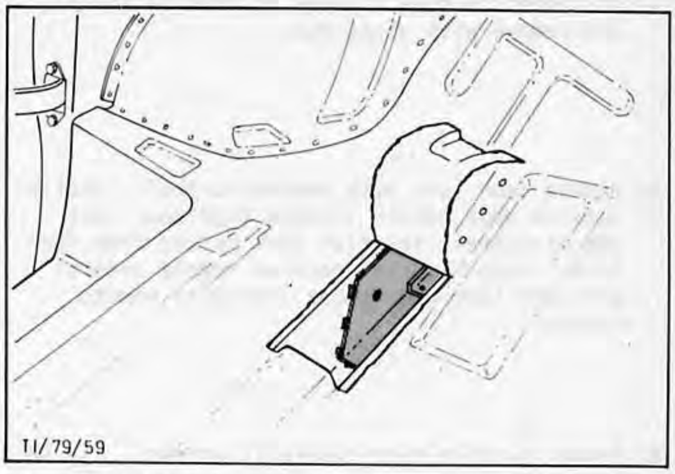


18. First, weld side member section alternately at the holes and then at the cut location.

Fig.94. Measure up side member section.

19. From the inside of the cab, weld the internal shoe through the opening in the floor panel, Fig.95.

20. Straighten chiselled-open sheet metal strip and bend back. Weld holes in floor panel to the side member and to cut edges of sheet metal strip.



21. Repaint repaired area in colour of vehicle.

Fig.95. Weld internal shoe in side member.

44 413 DOOR (CAB) - REPLACE

To Remove

1. Remove window crank, inner door handle, arm rest and door trim panel.

2. Pull off door plastic sheet and remove.

3. Remove belt rail weather strip inside and outside.

4. Remove quarter light, by removing 2 screws on the door frame and 1 screw on the inside door panel, Fig.96.

5. Remove door window glass (2 screws).

6. Remove window crank mechanism (6 screws). Fig.97.

7. Disconnect window channel at rear (1 screw), and remove with glass run.

8. Remove door lock with remote control. Unclip outside door handle linkage from door lock and disconnect interior lock button from door lock. Undo 3 screws each on remote control and door lock and remove lock with remote control.

9. Remove outside door handle (2 screws), Fig.98.

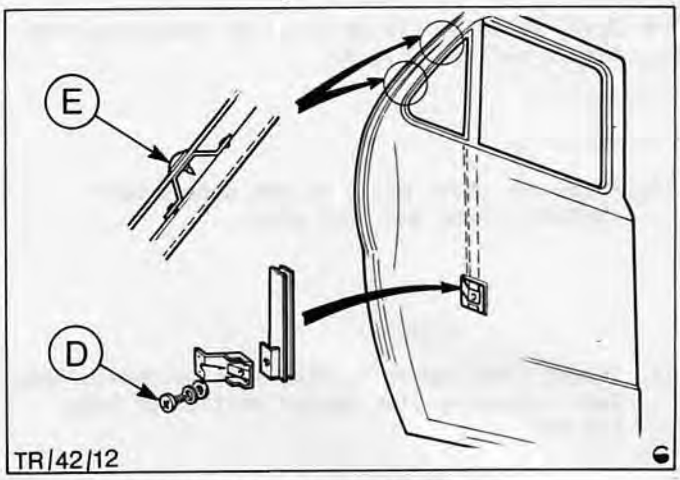


Fig.96. Remove door quarter light.
D - Mounting on inside door panel
E - Mounting on door window frame

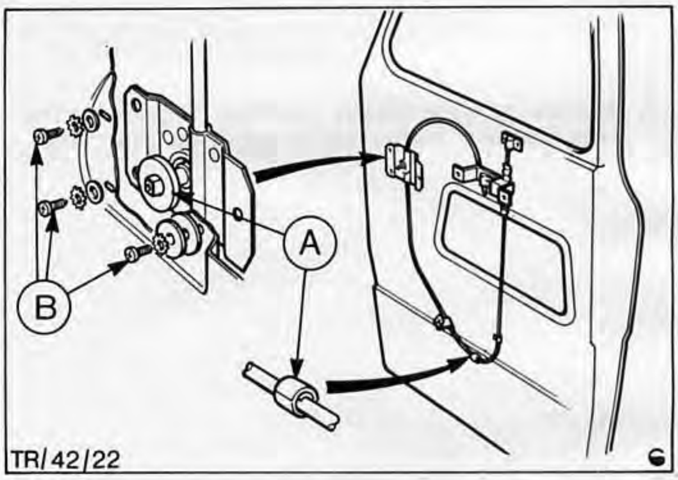


Fig.97. Remove crank mechanism.
A - Cushioning rubber
B - Crank mechanism plate fastening screws

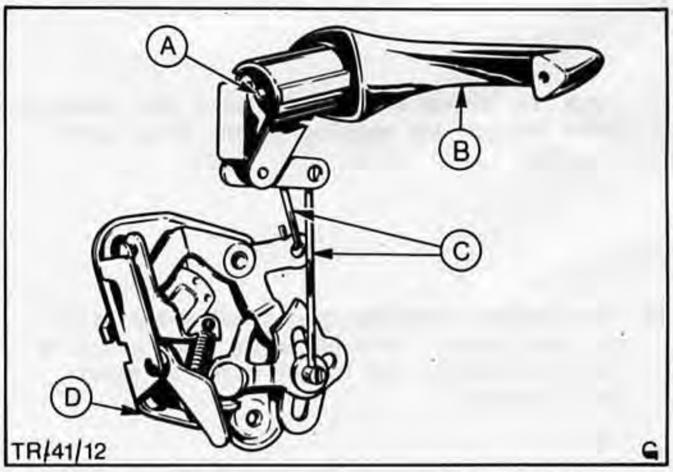


Fig.98. Outside door handle complete with lock.
A - Drive piece
B - Outside handle
C - Connecting rods
D - Lock

10. Remove pull-to grip, by drilling out 2 blind rivets.

11. Remove locking button grommet from door.

12. Remove check strap (2 screws), Fig.99.

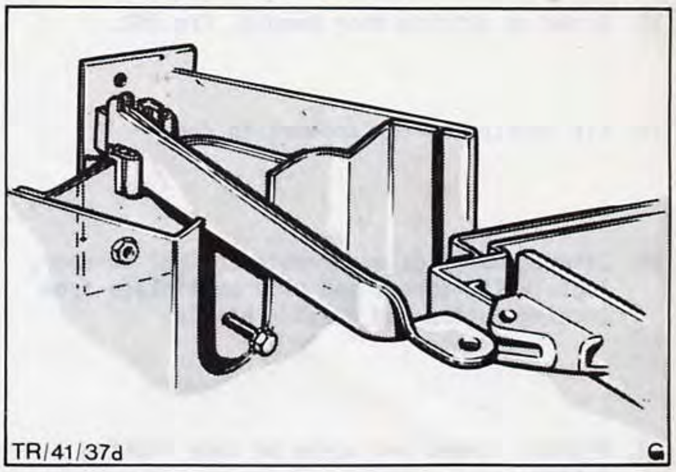


Fig.99. Remove pin and retaining ring connecting check strap mounting on A pillar.

13. Unscrew hinge bolts (6) and remove door, Fig.100.

14. Remove rubber door seal together with lower clips. Remove old adhesive remnants from flange.

Fig.100. Door hinge bolts.

To Install

15. Coat rubber door seal and door with adhesive and glue on rubber seal. Then attach clips from below.

16. Fit new friction pad between hinge and door and mount door on hinges and tighten with bolts. Then align.

NOTE: Pay attention to gap from side panel and fender.

17. Fit check strap and replace pin and retaining ring.

18. Insert pull-to grip in door and fix with blind rivets, Fig.101.

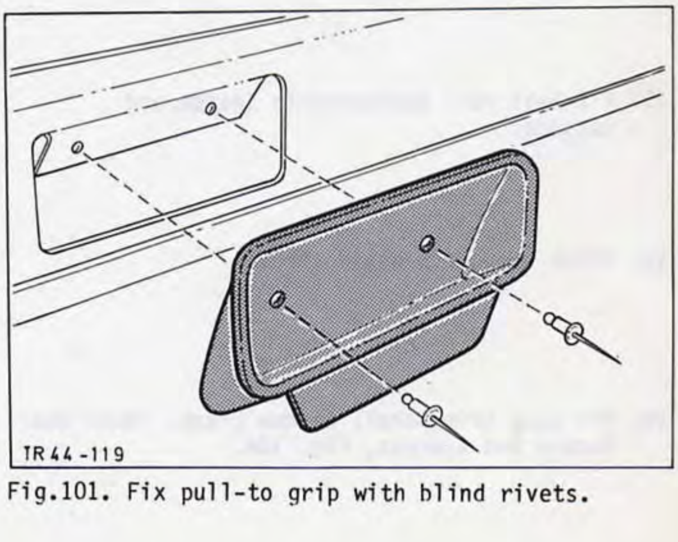


Fig.101. Fix pull-to grip with blind rivets.

44 413

19. Screw on outside door handle, Fig.102.

20. Fit locking button grommet to door.

21. Insert door lock and remote control in door, loosely fit screws and clip on linkage from locking button and outside handle.

22. Tighten screws and screw on door locking button.

23. Fit window channel and rubber glass run at rear.

24. Fit window guide, Fig.103.

25. Insert crank mechanism in door and screw in place.

26. Fit door window glass and quarter light with brace.

27. Fit belt rail weatherstrip inside and outside.

28. Stick on door plastic sheet.

29. Fit door trim panel, window crank, inner door handle and armrest, Fig. 104.

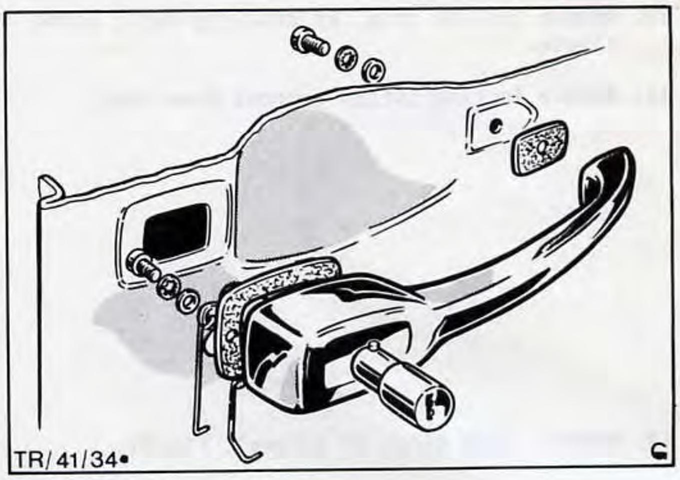


Fig.102. Fit outside door handle.

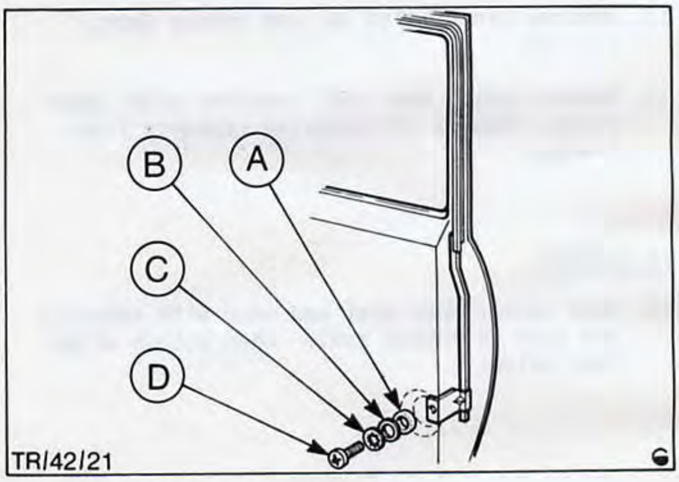


Fig.103. Guide rail and holder.
A - Fibre washer
B - Plain washer
C - Serrated washer
D - Screw

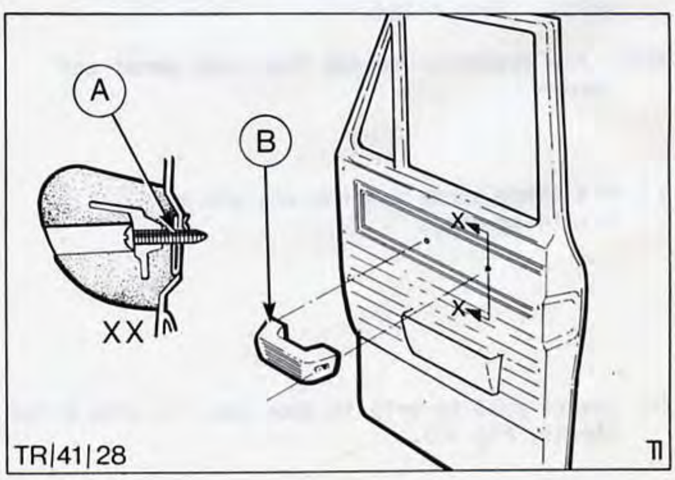


Fig.104. Door trim panel.
A - Fastening screw
B - Armrest

44 415 OUTER PANEL - DOOR - REPLACE

To Remove

1. Take off door trim panel.
2. Remove door plastic sheet and belt rail weatherstrip inside and outside.
3. Remove quarter light with brace, by removing screws on door frame and 1 screw on inside door panel.
4. Take out door window glass (2 screws) and window guide brace at rear (1 screw).

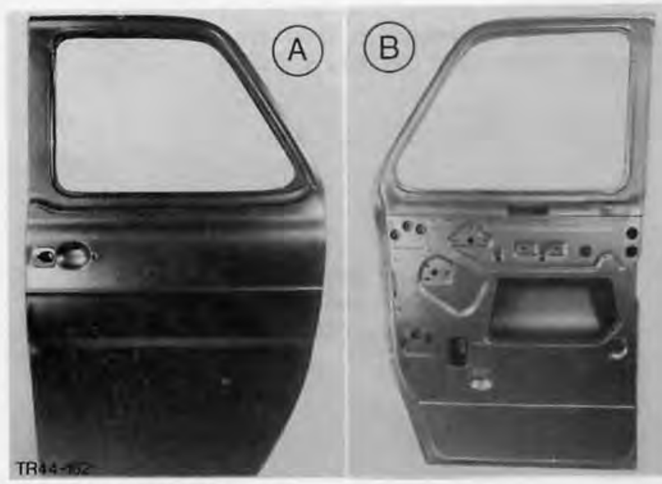


Fig.105. View of door.
A - Outer panel
B - Inner panel

5. Remove window guide and door lock (3 screws).
6. Remove outside door handle (2 screws).
7. Remove belt rail clips.
8. Remove door side mirror, if fitted, and door arrester.

Fig.106. Drill out inner door panel at window opening.

9. Loosen hinge bolts (6) on door and remove door, Fig.105.
10. Carefully remove rubber door seal.
11. Drill out spot welds on door inner panel flange at window opening, Fig.106.
12. Cut through door surround with parting-off grinder, Fig.107.

Fig.107. Cut through door surround.

13. Remove metal remnants from spot weld flanges with hammer and chisel, Fig.108.

14. Separate door outer panel from inner panel, by heating outer panel and removing from bonded connection to brace, Fig. 109.

Fig.108. Remove metal remnants from spot weld flanges.

15. Dress spot weld flanges on inner door panel and straighten, Fig.110.

To Install

16. Dress spot weld locations on new outer door panel.

Fig.109. Heat outer door panel and remove from bonded connection to brace.

17. Coat spot weld flanges with weld-through primer.

18. Apply metal adhesive to inner door panel brace.

Fig.110. Straighten spot weld flanges on inner door panel.

19. Position outer door panel and fix with clamps, Fig.111.

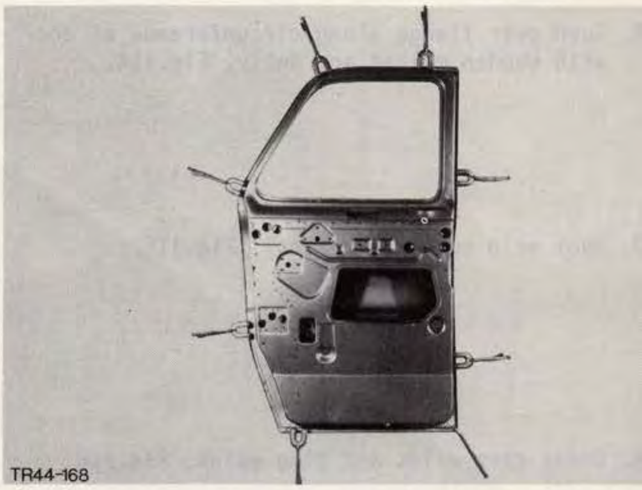


Fig.111. Fix door panel with clamps.

20. Tack (spot weld) outer door panel to inner panel, Fig.112.

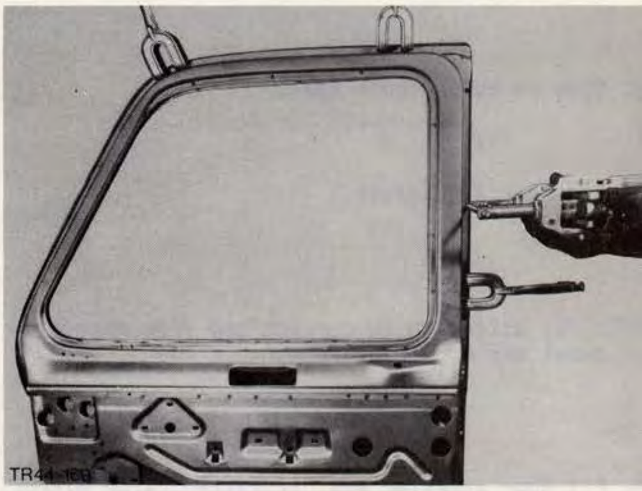


Fig.112. Tack on outer door panel.

21. Plug weld window opening flange and belt rail flange, Fig.113.

Fig.113. Plug weld window opening flange.

22. Turn over flange along circumference of door with wooden mallet and dolly, Fig.114.

23. Spot weld outer door panel, Fig.115.

24. Dress spot welds and plug welds, Fig.116.

25. Seal outer door panel at connection with inner panel using metal joint sealer.

26. Glue on rubber door seal.

27. Fit door and adjust.

NOTE: Pay attention to correct gap from rear side panel and B pillar.

28. Fit door arrester and, if fitted, side mirror.

29. Fit belt rail clips.

30. Fit outside door handle and door lock.

31. Fit window guide and window guide brace at rear.

32. Insert door window glass.

33. Fit quarter light and door weather strip inside and outside.

34. Fit door plastic sheet and door trim panel.

Fig.114. Turn over door flange edges.

Fig.115. Door outer panel spot welded on.

Fig.116. Dress welds.

44 453 SIDE DOOR (with window) - REPLACE

To Remove

1. Remove door trim panel, caps and clips, Fig.117.

2. Remove window control by unclipping linkage, removing 3 screws and taking out remote control.

3. Unclip door lock linkage, remove 3 screws and remove lock, Fig.118.

Fig.117. Take off door trim panel.

4. Remove outside door handle (2 screws).

5. Drill out 2 blind rivets on pull-to grip and take off grip.

6. Take out window glass and remove door arrester from B pillar.

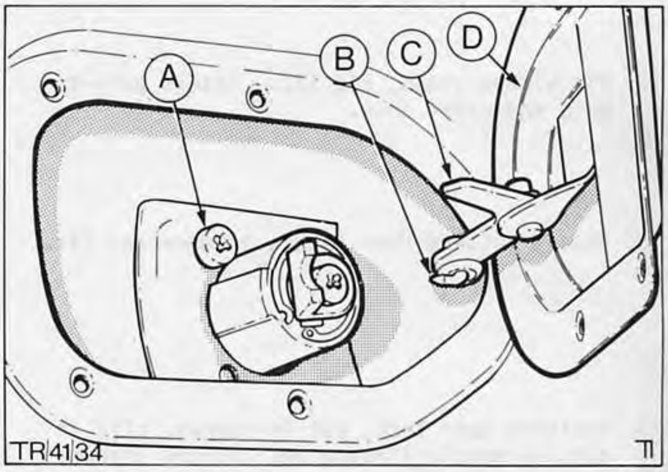


Fig.118. Door lock and outside handle striker.
A - Lock fastening screws
B - Striker
C - Control rod
D - Remote control plate

7. Remove screws (6) from hinges and take off door, Fig.119.

8. Remove rubber door seal with clips at bottom.

Fig.119. Side door hinge screws.

To Install

9. Coat rubber seal and door with adhesive and stick on rubber seal. Then fit clips from below.

10. Mount door on hinges, fit and adjust.

NOTE: Pay attention to correct gap from side panel at rear and B pillar, Fig.120.

Fig.120. Side door gap.

11. Screw door arrester onto B pillar

12. Fit window glass, Fig.121. Insert pull-to grip and rivet down.

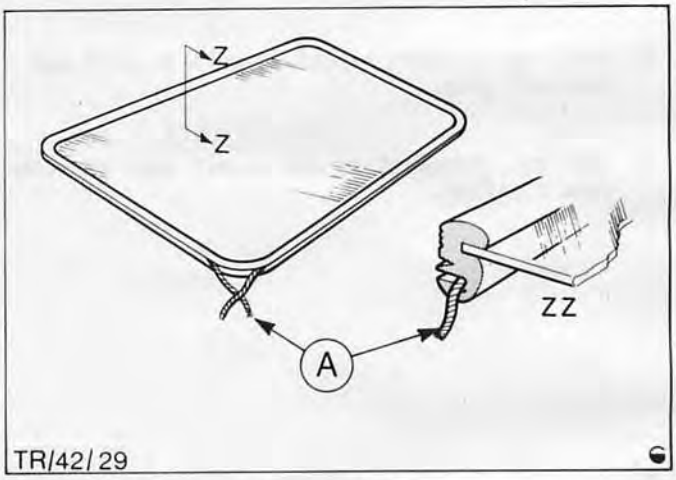


Fig.121. Glass, rubber seal and cord.
A - Cord

13. Insert outside door handle in door and fit.

14. Position door lock, put in screws, clip in outside handle linkage and tighten screws.

15. Position remote control, put in screws, clip in linkage on lock and tighten screws, Fig.122.

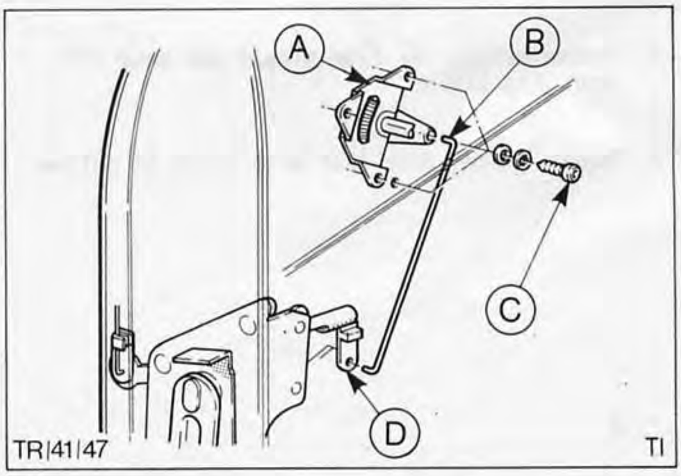


Fig.122. Side door remote control.
A - Remote control
B - Connecting rod
C - Screw and washer
D - Closing lever

16. Fit caps on inner door panel and fit door trim panel with clips.

44 476 4 ROCKER PANEL - FRONT - REPLACE
(Side panel removed)

To Remove

1. Mark out damaged rocker panel, Fig.123.

2. Cut out rocker panel completely at connection with floor panel, box corner, wheel house, side panel and apron, Fig.124.

3. Remove metal remnants from spot weld flanges, Fig.125.

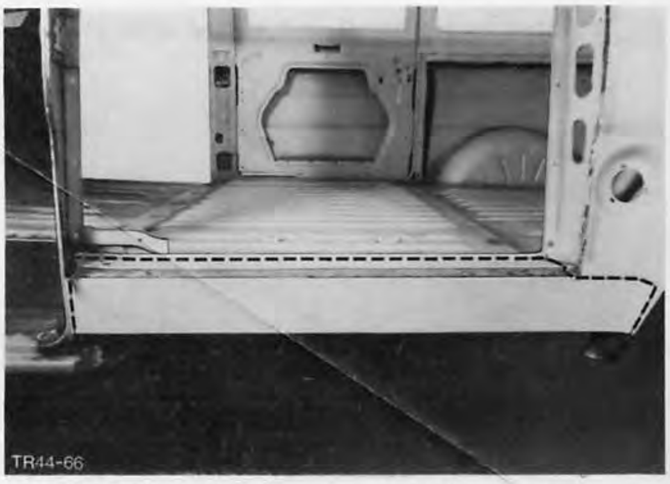


Fig.123. View of rocker panel to be cut out.

4. Dress spot weld flanges and straighten with hammer and dolly.

Fig.124. Cut out rocker panel.

To Install

5. Remove primer from weld flange contact faces of new rocker panel on both sides (dress).

6. Coat contact faces with weld-through primer.

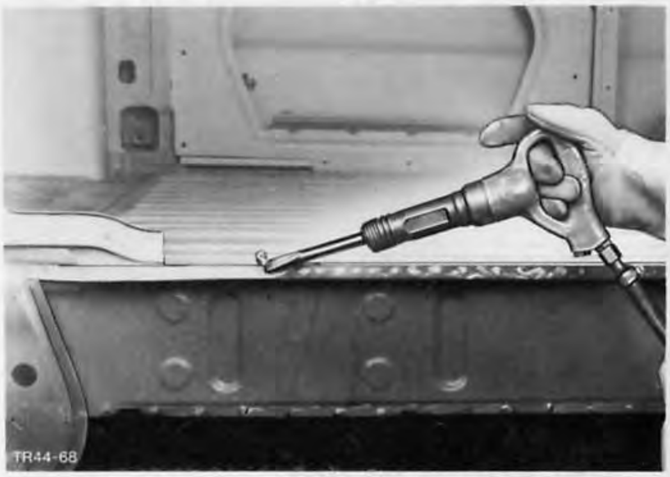


Fig.125. Remove metal remnants.

44 476 4

7. Position rocker panel and secure with clamps and cramps, Fig.126.

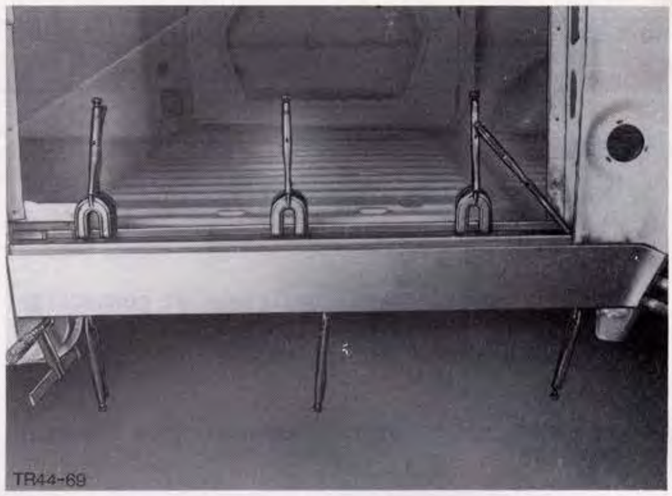


Fig.126. Position rocker panel and secure with clamps.

8. Spot weld rocker panel in upper and lower flange areas and wheel house, Fig.127.

Fig.127. Spot weld rocker panel.

9. Weld rocker panel at connection with B pillar and rear side panel, Fig.128.

10. Dress weld locations and seal rocker panel with metal joint sealer and replace rocker panel extension and strut.

Fig.128. Plug-weld rocker panel.

44 476 4 ROCKER PANEL - REAR - REPLACE
(Side panel removed)

To Remove

1. Cut out rocker panel at connection with floor panel, box corner, wheel house, side panel and apron, Fig.129.

2. Remove metal remnants from spot weld flanges.

3. Dress spot weld flanges and straighten.

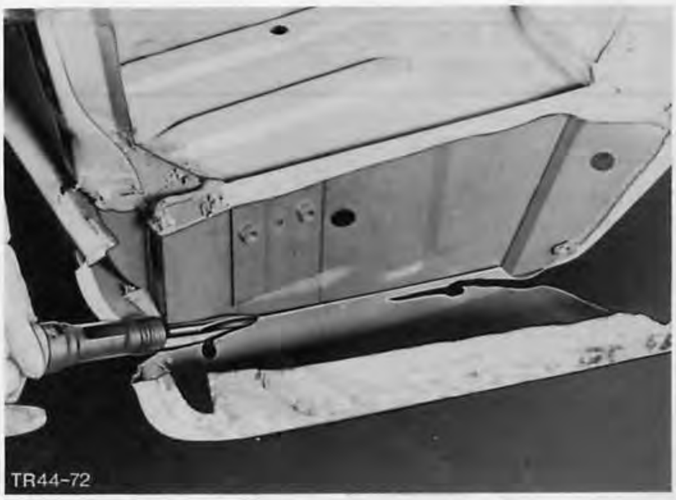


Fig.129. Cut out rear rocker panel.

To Install

4. Dress spot weld flanges on new rocker panel.

5. Coat contact faces of spot weld flanges with weld-through primer.

6. Position new rocker panel and secure with clamps, Fig.130.

Fig.130. Secure new rocker panel with clamps.

7. Spot weld/weld in new rocker panel at connection with floor panel, apron, side panel and wheel house, Fig.131.

8. Carefully seal rocker panel with metal joint sealer.

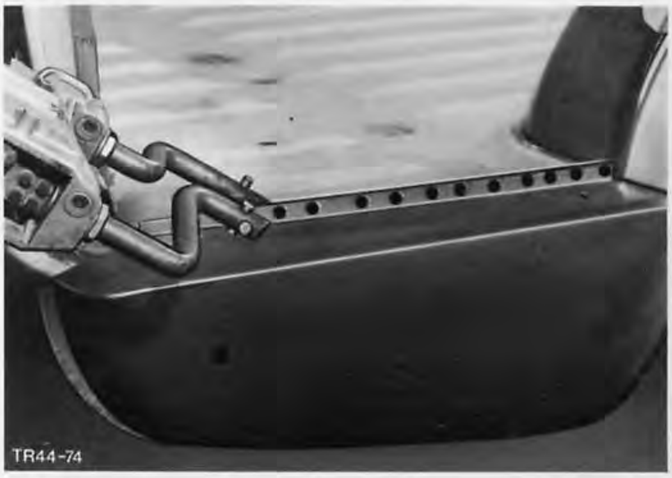


Fig.131. Spot weld rocker panel.

44 477 ROCKER PANEL EXTENSION - REPLACE
(Side panel removed)

To Remove

1. Cut out rocker panel extension at B pillar and wheel house, Fig.132.

2. Remove metal remnants from spot weld flanges, Fig.133.

3. Dress spot weld flanges.

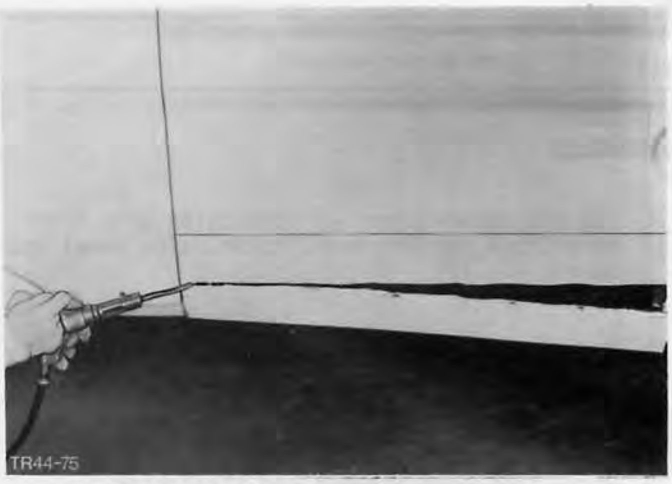


Fig.132. Cut out rocker panel extension.

To Install

4. Dress spot weld flanges on new rocker panel extension.

5. Punch new part at upper and lower spot weld flanges, Fig.134.

6. Coat spot weld flanges with weld-through primer.

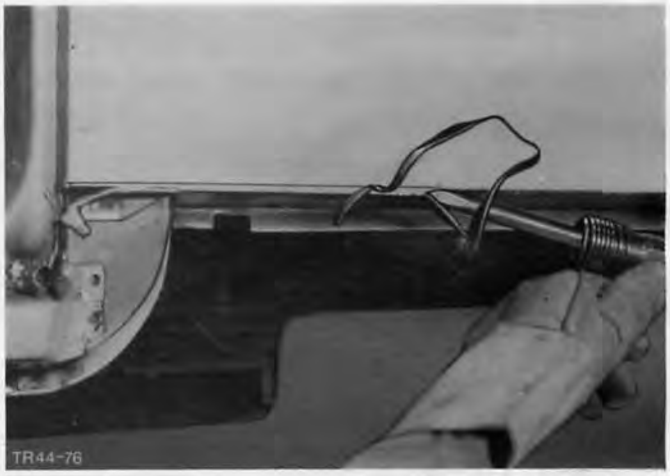


Fig.133. Remove metal remnants.

7. Position new rocker panel extension and secure with clamps.

8. Plug-weld rocker panel extension at upper and front spot weld flanges and weld-in at B pillar and wheel house and brace panel body rocker.

9. Seal rocker panel extension with metal joint sealer.

Fig.134. Punch new rocker panel extension at upper spot weld flange.

44 478 4 ENTRANCE STEP - FRONT - REPLACE
(Fender and door sill removed)

To Remove

1. Drill out all spot welds on entrance step, Fig.135.

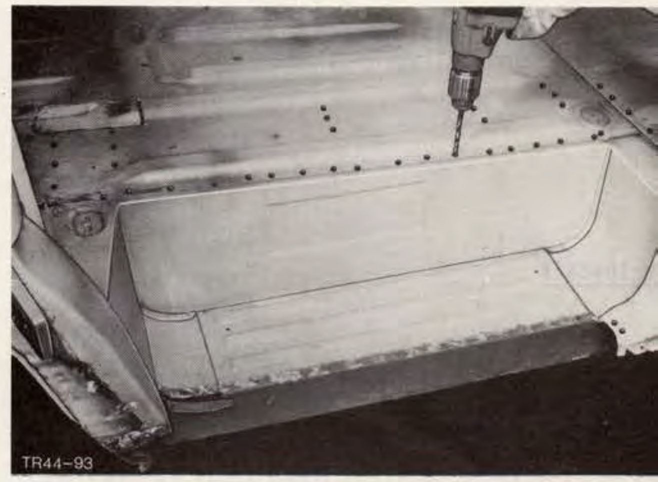


Fig.135. Drill out spot welds on entrance step

2. Cut out entrance step at A pillar, apron panel and floor panel, Fig.136.

3. Cut out entrance step at side member and B pillar, Fig.136.

Fig.136. Cut out entrance step.

4. Remove metal remnants from spot weld flanges, Fig.137.

5. Drill out metal remnants from A pillar reinforcement.

Fig.137. Metal remnants cut out from A pillar reinforcement.

44 478 4

6. Dress spot weld flanges and straighten with hammer and dolly, Fig.138.

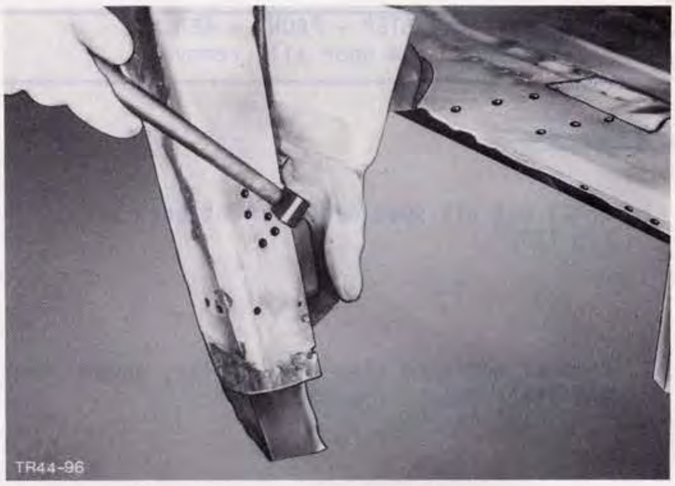


Fig.138. Straighten spot weld flanges.

To Install

7. Dress spot weld flanges on new entrance step at connection to B pillar and punch side member extension and B pillar at top, Fig.139.

8. Coat contact faces of spot weld flanges with weld-through primer.

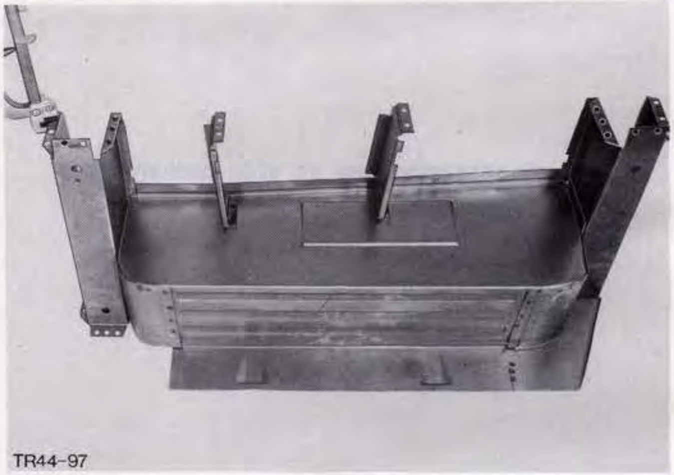


Fig.139. Punch new entrance step.

9. For a better fit, round off upper corners at connection to side member.

10. Position new entrance step and press in upwards with a jack or suitable tool. Then secure with clamps, Fig.140.

Fig.140. Press in new entrance step with jack and secure with clamps.

44 478 4

11. Plug weld entrance step at connection to floor panel, Fig.141.

12. Plug weld entrance step at A and B pillars and side member.

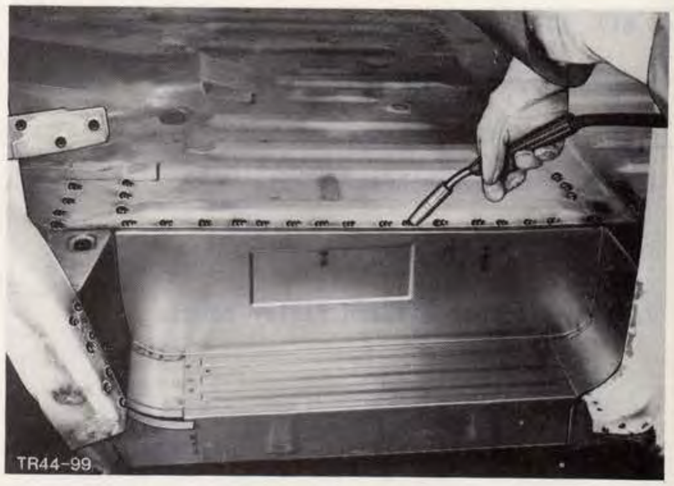


Fig.141. Plug weld entrance step at floor panel.

13. Spot weld entrance step at connection to B pillar at top and bottom, Fig.142.

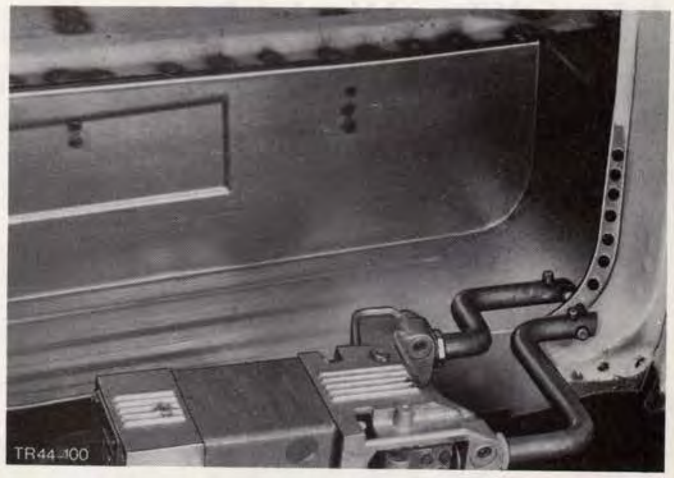


Fig.142. Spot weld entrance step at lower B pillar.

14. Braze corners of entrance step at floor panel, Fig.143.

15. Seal entrance step with metal joint sealer.

Fig.143. Braze corners of entrance step at floor panel.

44 517 SIDE PANEL WITH INSIDE WINDOW PANEL - REPLACE (front left)

To Remove

1. Remove seat benches.

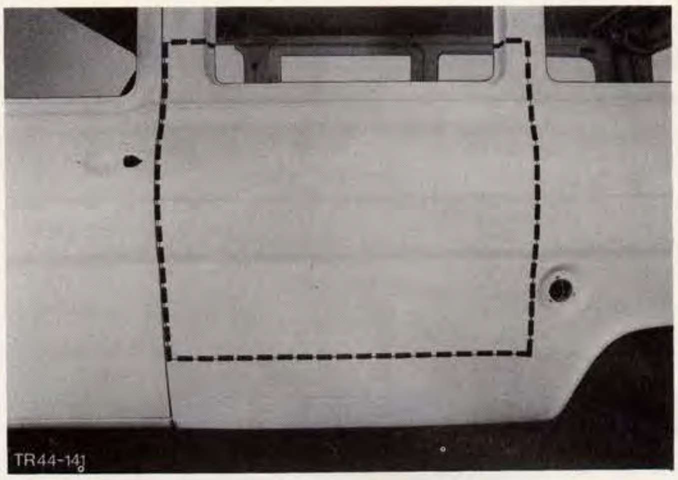


Fig.144. Mark out side panel cut lines.

2. Remove rubber mat and filler panel.

3. Remove seat belts and side trim panels.

4. Remove sliding and hinged windows.

Fig.145. Mark out inside window panel.

5. Mask front seats and windscreen.

6. Mark out cut line of side panel and inside window panel, Fig.144 and 145.

Fig.146. Cut side panel.

7. Cut side panel at B pillar and C pillar at top, and inside window panel at B pillar and connection to side panel at bottom using parting-off grinder, Fig.146.

8. Cut out side panel with pneumatic chisel, Fig.147 and 148.

Fig.147. Side panel and inside window panel cut out, view from outside.

9. Cut out inside window panel at connection to window flange using pneumatic chisel, Fig.148.

Fig.148. Side panel and inside window panel cut out, viewed from inside.

10. Remove metal remnants from spot weld flanges, Fig.149.

Fig.149. Remove metal remnants.

11. Dress spot weld flanges of side panel and straighten, Fig.150.

Fig.150. Dress side panel spot weld flange.

12. Dress spot weld flanges of inside window panel and straighten, Fig.151.

Fig.151. Dress inside window panel spot weld flange.

13. Deburr cut edges and joggle with joggling tool, Fig.152.

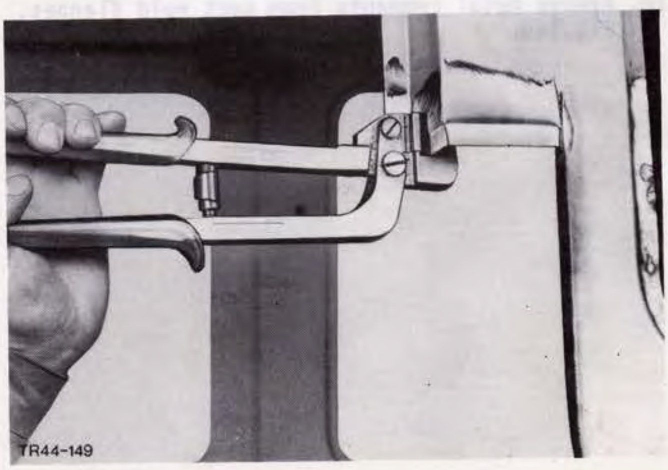


Fig.152. Joggle cut edges.

To Install

14. Measure side panel and inside window panel cut out on vehicle and transfer to new sections, Fig.153 and 154.

NOTE: Allow 10 - 12 mm extra for overlap.

Fig.153. Cut line marked out on new side panel.

15. Cut new sections and deburr.

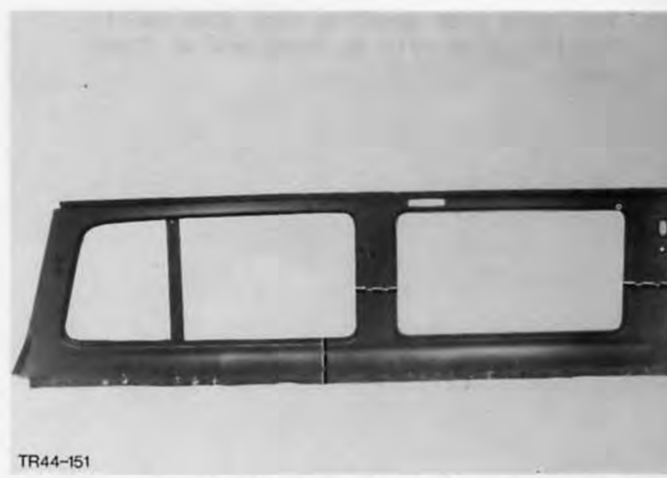


Fig.154. Cut line marked out on new inside window panel.

16. Dress spot weld flanges on new sections at connections to window opening and rear side panel.

17. Punch new side panel at front and bottom, Fig.155.

Fig.155. Punch side panel at front and bottom.

18. Coat contact faces of spot weld flanges with weld-through primer.

19. Position new side panel and secure with clamps and cramps, Fig.156.

NOTE: Pay attention to door gap and even transitions from panel to door.

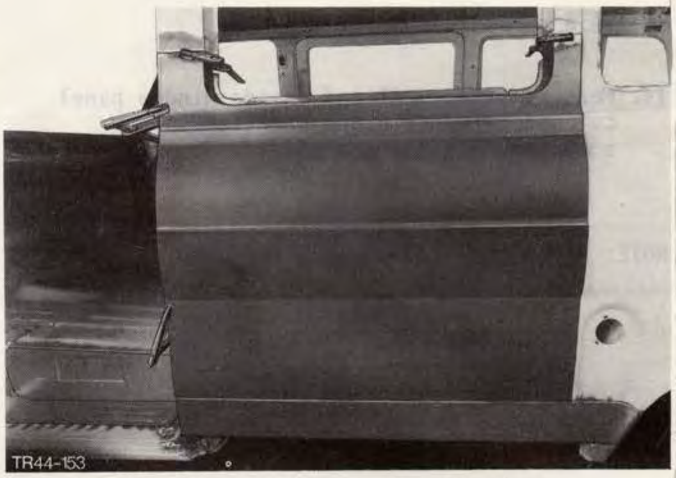


Fig.156. Secure new side panel with clamps.

20. Spot weld side panel to rear side panel, Fig.157, plug-weld at front and at floor panel.

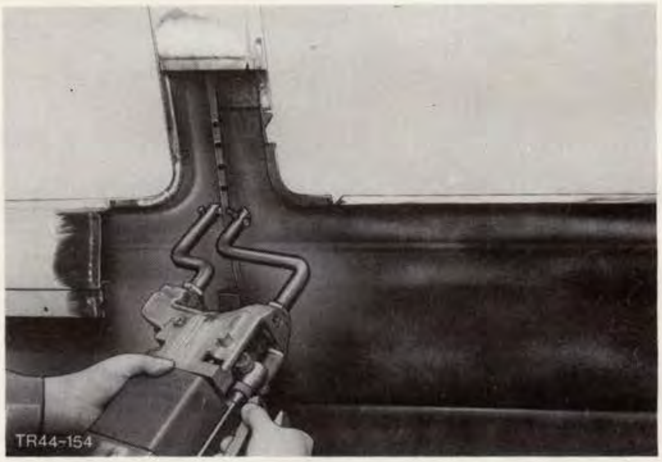


Fig.157. Spot weld front side panel to rear side panel (from inside).

21. Weld side panel at connection to B and C pillars, Fig.158.

Fig.158. Weld side panel at connection to B and C pillars.

22. Position new inside window panel and secure with clamps, Fig.159.

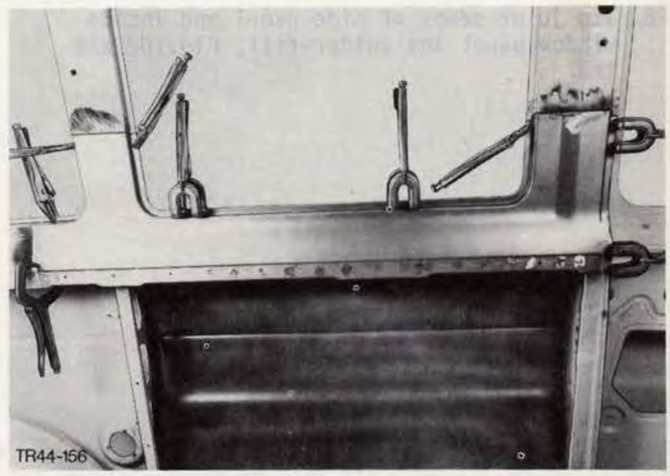


Fig.159. Secure new inside window panel with clamps.

23. Spot weld inside window panel at window guide and door, Fig.160.

Fig.160. Spot weld inside window panel to window guide.

24. Weld inside window panel at connection to B and C pillars, Fig.161.

25. Dress weld locations.

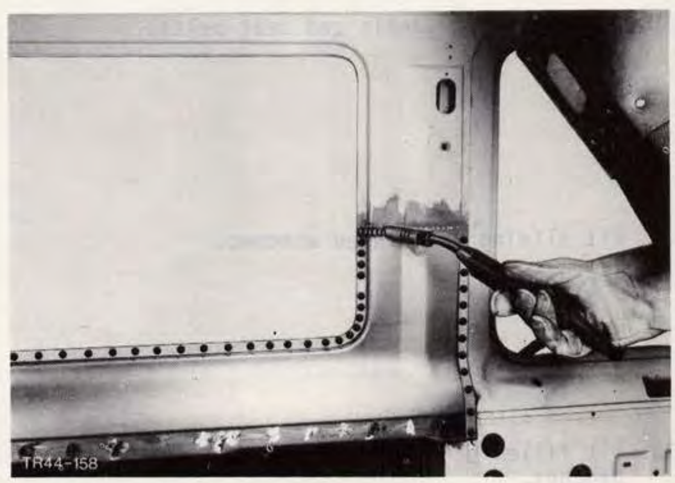


Fig.161. Weld inside window panel at connection to B pillar.

44 517

26. Tin joint seams of side panel and inside window panel and solder-fill, Fig.162 and 163.

Fig.162. Solder-fill side panel joint seam.

27. Dress solder-fill locations, Fig.164.

28. Seal all joint seams of side panel with metal joint sealer.

29. Remove masking from front seats and windscreen.

Fig.163. Solder-fill inside window panel joint seam.

30. Fit side trim panels and seat belts.

31. Fit sliding and hinged windows.

32. Fit filler panel, rubber mat and seat benches.

Fig.164. Dress solder-fill locations on inside window panel.

44 518 SIDE PANEL - REAR RIGHT - REPLACE

To Remove

1. Remove rear seat benches.

2. Remove rubber mat and filler panel.

3. Remove seat belts.

4. Remove side trim panels with cover plate.

5. Remove hinged and side windows.

6. Remove top box corner cover plate and cut out reinforcement plate at box corner.

7. Mark out side panel cut line, Fig.165.

8. Cut side panel at C pillar and D pillar at top with parting-off grinder.

9. Cut out side panel at connection to C pillar, rocker panel, box corner and wheel house, Fig.166 and 167.

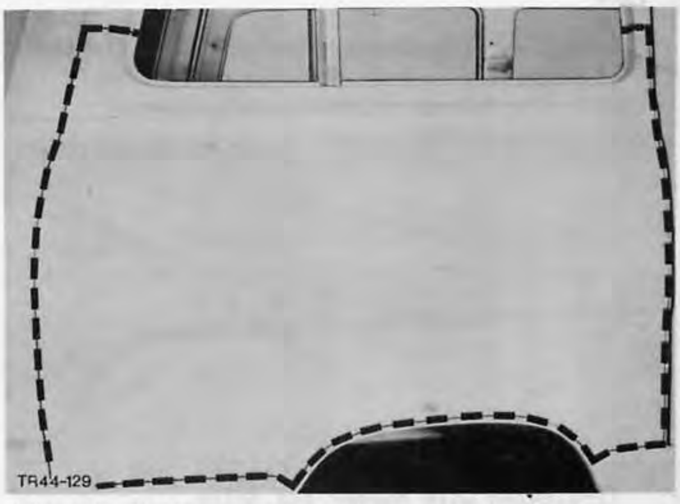


Fig.165. Mark out rear side panel cut line.

Fig.166. Cut out side panel.

Fig.167. View of side panel cut out.

10. Remove metal remnants from spot weld flanges, Fig.168.

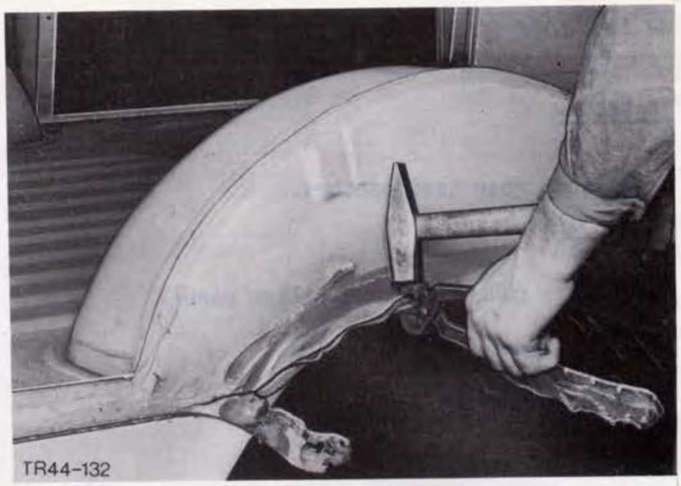


Fig.168. Remove metal remnants.

11. Dress spot weld flanges, Fig.169, and straighten with hammer and dolly.

12. Deburr cut edges and joggle with joggling tool.

Fig.169. Dress spot weld flanges.

To Install

13. Measure side panel cut out on vehicle and transfer to new side panel, Fig.170.

Fig.170. New side panel marked.

14. Cut new side panel and deburr cut edges.

15. Dress spot weld flanges of window opening, wheel house and connection to box corner on new side panel.

16. Punch spot weld flange at C pillar and at bottom in area of rocker panel, Fig.171.

Fig.171. Punch spot weld flanges.

17. Coat contact faces of spot weld flanges with weld-through primer.

Fig.172. Secure new side panel with clamps.

18. Position new side panel and secure with clamps and cramps, Fig.172.

NOTE: Transitions between side panel and adjoining sections must be even and flat.

19. Spot weld side panel at connection to box corner and window opening, Fig.173.

Fig.173. Spot weld side panel at connection to box corner.

20. Spot weld side panel at connection to wheel house, Fig.174.

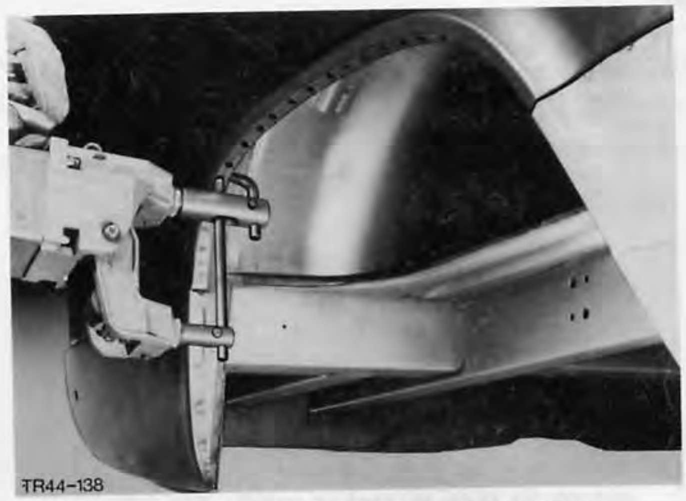


Fig.174. Spot weld side panel at connection to wheel house.

21. MIG weld side panel at connection to C pillar, rocker panel front and rear as well as joint seams, Fig.175.

22. Plug weld box corner reinforcement, Fig.176.

23. Dress all weld locations.

24. Tin joint seams and solder-fill.

Fig.175. MIG weld side panel joint seams.

25. Dress solder-fill locations and seal side panel with metal joint sealer.

26. Fit top box corner cover plate.

27. Fit hinged and side windows.

28. Fit side trim panels with cover plate and install seat belts.

29. Install filler plate, rubber mat and seat benches.

Fig.176. Plug weld box corner reinforcement.

44 534 4 WHEEL HOUSE - REPLACE

To Remove

1. Cut out wheel house along cut line, Fig.177.

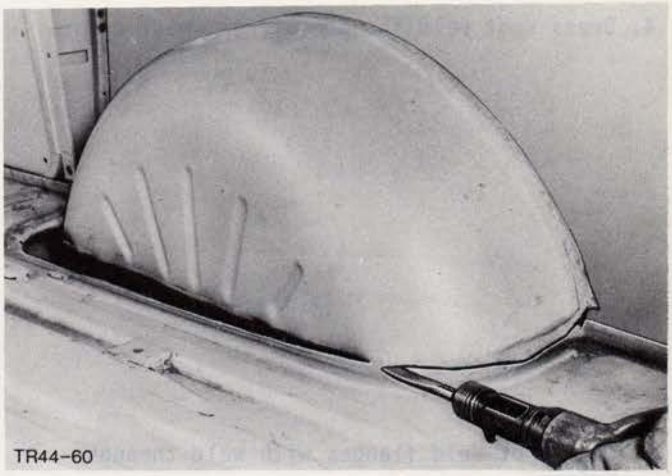


Fig.177. Cut out wheel house.

2. Remove metal remnants from spot weld flange, Fig.178.

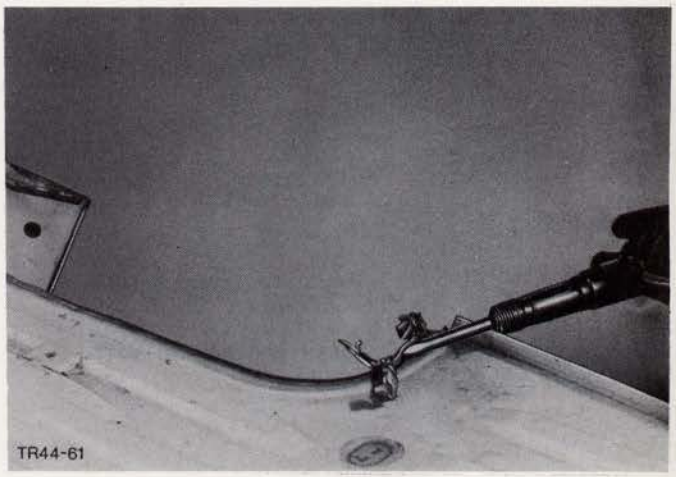


Fig.178. Remove metal remnants.

To Install

3. Dress spot weld flanges, Fig.179, and straighten.

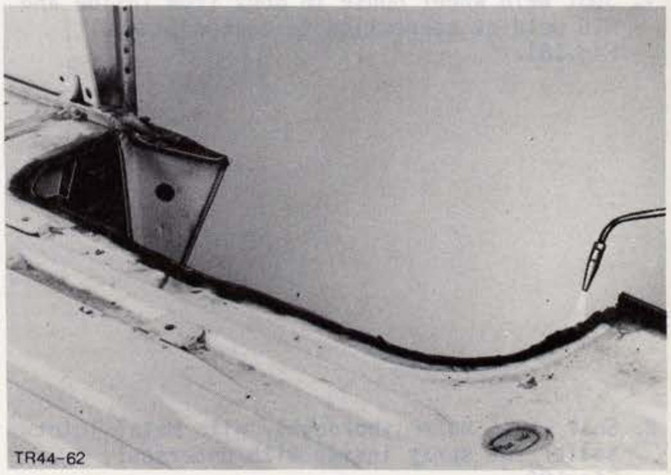


Fig.179. Burn paint off spot weld flange.

44 534 4

4. Dress spot weld flanges of new wheel house.

5. Coat spot weld flanges with weld-through primer.

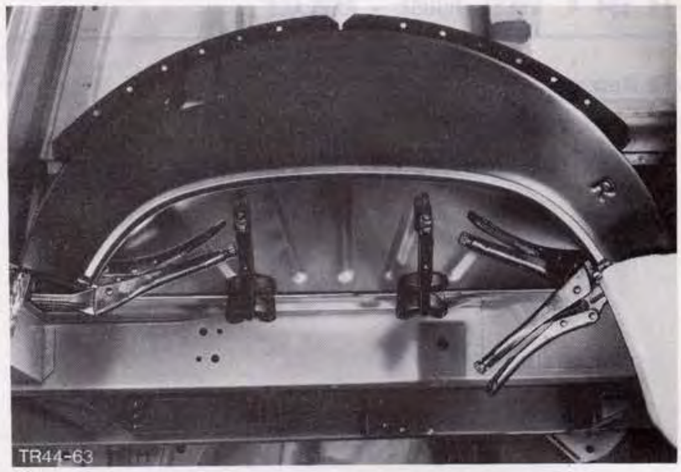


Fig.180. Secure wheel house with clamps.

6. Position new wheel house and secure with clamps, Fig.180.

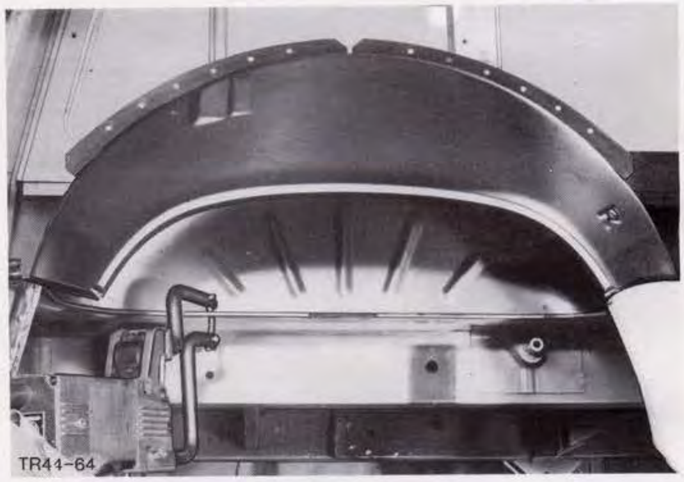


Fig.181. Spot weld wheel house.

7. Spot weld wheel house to body from inside and MIG weld at connection to rocker panel, Fig.181.

8. Seal wheel house thoroughly with metal joint sealer and spray inside with underseal, Fig.182.

Fig.182. Seal wheel house with metal joint sealer.

44 574 BOX CORNER - REPLACE

To Remove

1. Remove rear seat bench.

2. Remove rear side trim panel with cover plates.

3. Remove rear light.

4. Remove reflector/reversing light.

5. Unclip corner bumper.

6. Drill out pop rivets on rear entrance rail and take off rail.

7. Turn up rubber mat and, if necessary, remove filler plate.

8. Mark out box corner cut line, Fig.183, and cut at top with parting-off grinder. Then cut out box corner reinforcement with pneumatic chisel.

9. Cut out box corner at connection to side panel, rocker panel, D pillar and rear wall panel with pneumatic chisel, Fig.184.

10. Remove metal remnants, then dress spot weld flanges and straighten.

11. Deburr box corner cut edge and joggle with a joggling tool, Fig.185.

Fig.183. Box corner cut line.

Fig.184. Cut out box corner.

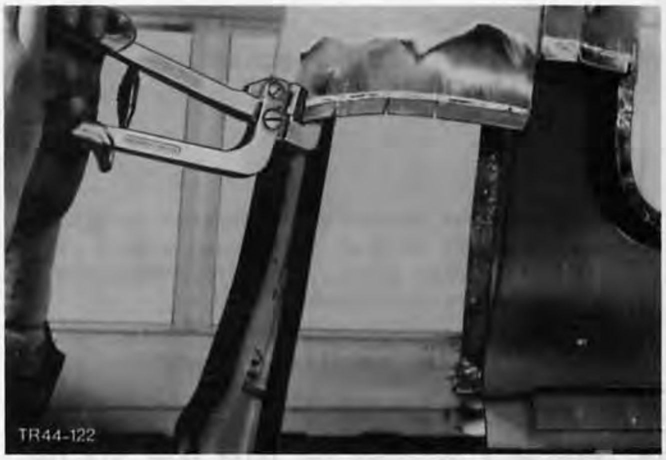


Fig.185. Joggle box corner.

To Install

12. Measure box corner cut out on vehicle and transfer to new section, Fig.186.

NOTE: Allow 10 - 12 mm extra for overlap.

13. Cut new box corner with parting-off grinder and deburr.

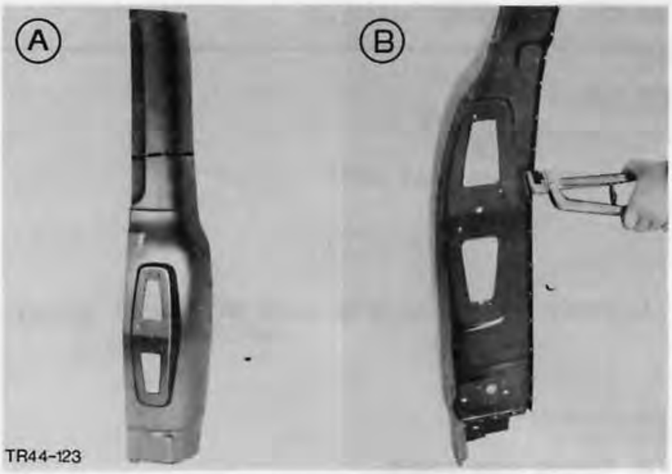


Fig.186. Mark new box corner and punch.
A - Box corner cut line
B - Punch spot weld flange

14. Dress spot weld flanges at connection to side wall on new box corner.

15. Punch new box corner at connection to D pillar and rocker panel, Fig.186.

16. Coat contact faces of spot weld flanges with weld-through primer.

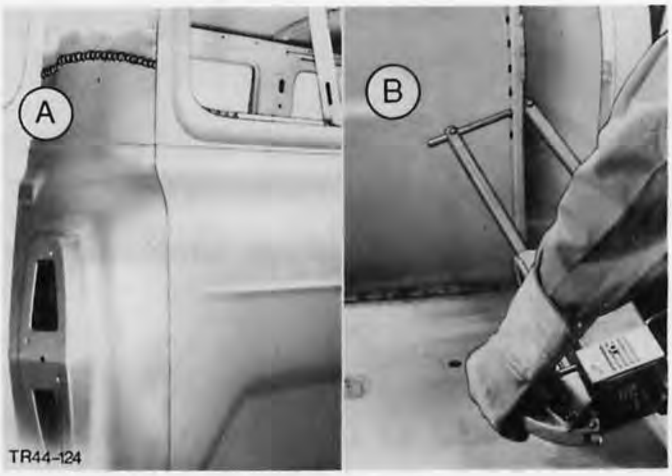


Fig.187. Weld in new box corner.

17. Position box corner and secure with clamps.

NOTE: Pay attention to door gap and even transition to side panel.

18. Spot weld box corner at connection to side panel and MIG weld at joint seam with D pillar and rear rocker panel, Fig.187. Then weld on box corner reinforcement.

19. Dress weld locations and joint seam, Fig.188.

Fig.188. Dress joint seam.

20. Tin box corner joint seam and solder-fill, Fig.189.

21. Dress solder-fill location, Fig.190 and 191.

22. Seal box corner with metal joint sealer.

23. Fit filler plate and lay rubber mat.

24. Fit entrance rail at rear and secure with blind rivets.

25. Clip corner bumper onto box corner.

26. Fit reflector/reversing light.

27. Fit rear light.

28. Fit side trim panel with cover plates.

29. Fit seat bench and secure.

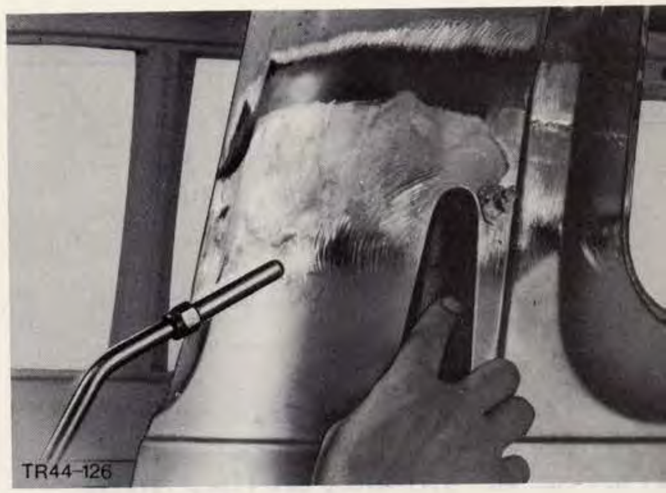
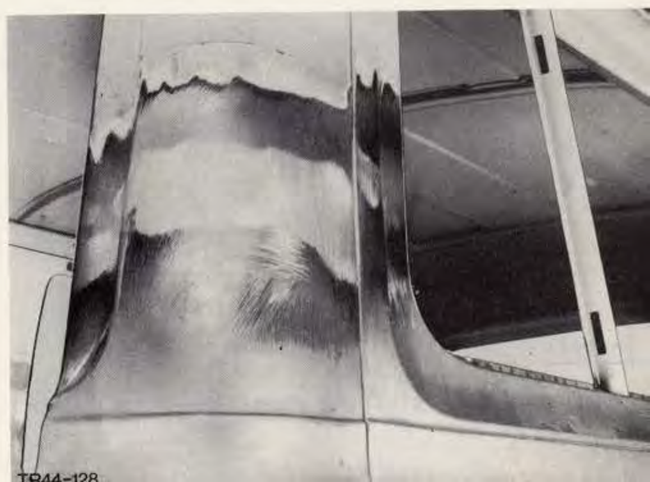


Fig.189. Solder-fill box corner.

Fig.190. Dress solder-fill location.



20. Tin box corner joint seam and solder-fill, Fig.189.

21. Dress solder-fill location, Fig.190 and 191.

22. Seal box corner with metal joint sealer.

23. Fit filler plate and lay rubber mat.

24. Fit entrance rail at rear and secure with blind rivets.

25. Clip corner bumper onto box corner.

26. Fit reflector/reversing light.

27. Fit rear light.

28. Fit side trim panel with cover plates.

29. Fit seat bench and secure.

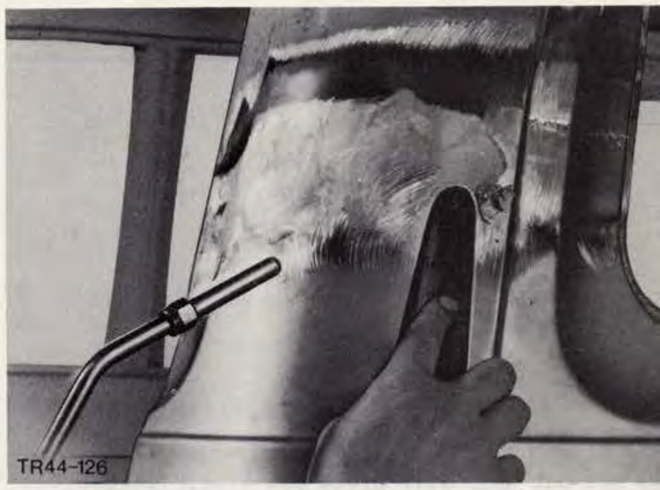


Fig.189. Solder-fill box corner.

Fig.190. Dress solder-fill location.

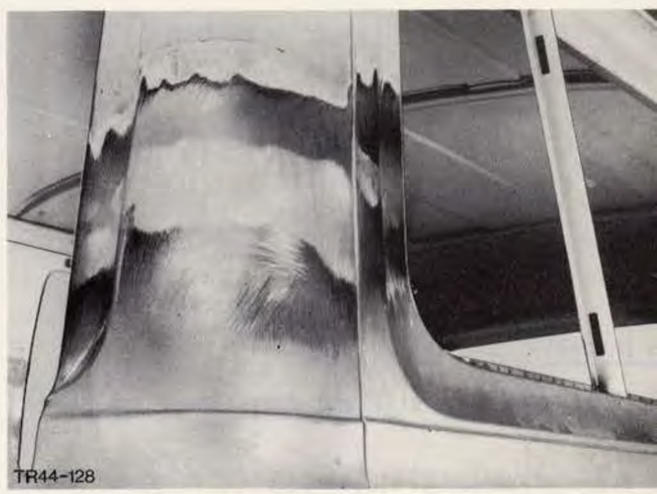


Fig.191. Finished solder-fill location.

44 575 4 DOOR SILL - REPLACE

To Remove

1. Mark out door sill cut line, Fig.192.

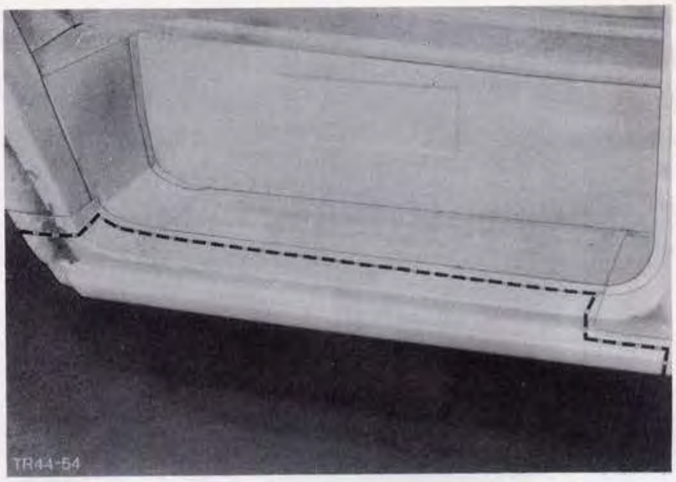


Fig.192. Door sill cut line.

2. Cut out door sill along cut line,Fig.193.

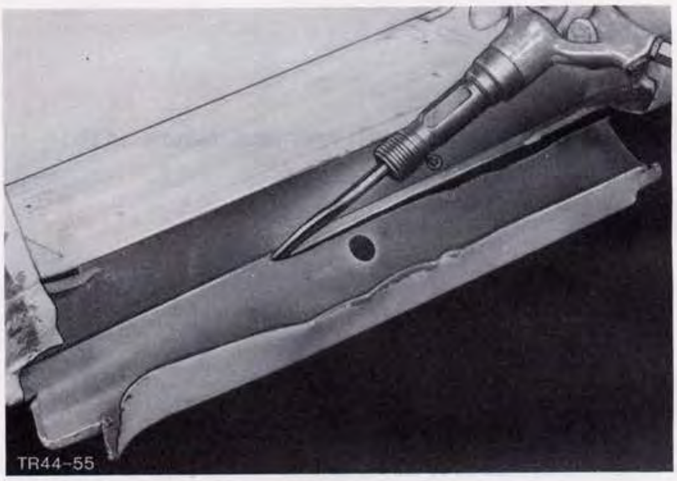


Fig.193. Cut out door sill.

3. Remove metal remnants from spot weld flanges on entrance step, Fig.194.

4. Dress spot weld flanges and straighten.

Fig.194. Remove metal remnants.

To Install

5. Punch new door sill and dress lower spot weld flange.

44 575 4

6. Coat spot weld flange on new door sill with weld-through primer.

Fig.195. Door sill punched and secured with clamps.

7. Position new door sill at entrance step and secure with clamps, Fig.195.

8. Spot weld door sill at lower flange and then plug weld at connection to entrance step at top, Fig.196.

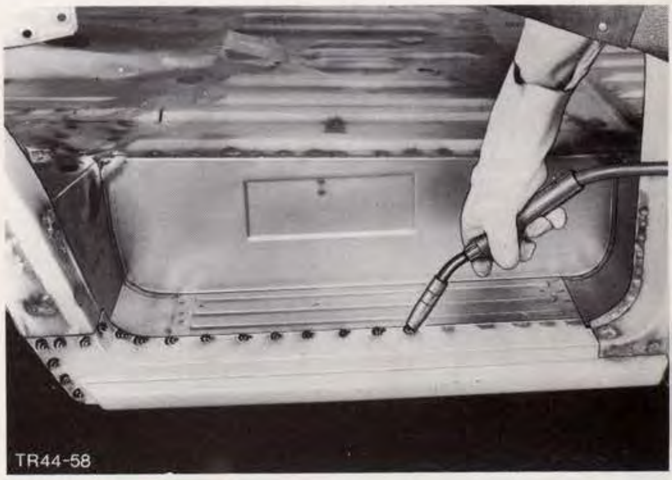


Fig.196. Plug weld door sill.

9. Braze door sill at corners, Fig.197.

10. Dress weld locations.

Fig.197. Braze door sill at corners.

11. Seal door sill with metal joint sealer.

44 642 PANEL - BACK - REPLACE

To Remove

1. Remove cover plates.

2. Remove reflector/reversing light.

3. Unclip corner bumpers.

4. Remove registration plate and registration plate light.

Fig.198. Mark out back panel cut line.

5. Drill out blind rivets from scuff plate.

Fig.199. Cut out back panel.

6. Remove door lock striker.

7. Mark back panel cut line, Fig.198, and cut out back panel at connection to floor panel, crossmember, rocker panels and D pillars, Fig.199.

8. Remove metal remnants from spot weld flanges.

Fig.200. Dress spot weld flanges.

9. Dress spot weld flanges and straighten, Fig.200.

To Remove

10. Dress new back panel at connection to rocker panels and crossmember. Punch at floor panel and D pillars.

11. Position back panel and secure with clamps, Fig.201.

12. Spot weld back panel onto rocker panels and crossmember, Fig.202.

Fig.201. Secure new back panel with clamps.

13. Plug weld back panel at floor panel and D pillars, Fig.203.

14. Fit door lock striker.

15. Secure entrance rail with blind rivets.

Fig.202. Spot weld new back panel.

16. Fit registration plate and lights.

17. Clip on corner bumpers.

18. Fit reflector/reversing light.

19. Fit cover plates.

Fig.203. Plug weld new back panel.

44 674 4 CROSSMEMBER - REAR - REPLACE

To Remove

1. Drill out spot welds at connection to floor panel.

2. Cut out rear crossmember at connection to floor panel, side members, reinforcements, D pillars and side panels, Fig.204 and 205.

Fig.204. Crossmember to be replaced.

3. Remove metal remnants from spot weld flanges, Fig.206.

Fig.205. Crossmember cut out.

4. Dress spot weld flanges and straighten.

To Install

5. Dress spot weld flanges on new crossmember at connection to side members, reinforcements and D pillars.

Fig.206. Metal remnants removed.

6. Position rear crossmember and secure with clamps and cramps, Fig.207.

Fig.207. Secure crossmember with clamps.

7. Spot weld crossmember at side members, reinforcements and D pillars, Fig.208.

Fig.208. Spot weld crossmember.

8. Plug weld crossmember to floor panel, Fig.209, and MIG weld to side panels.

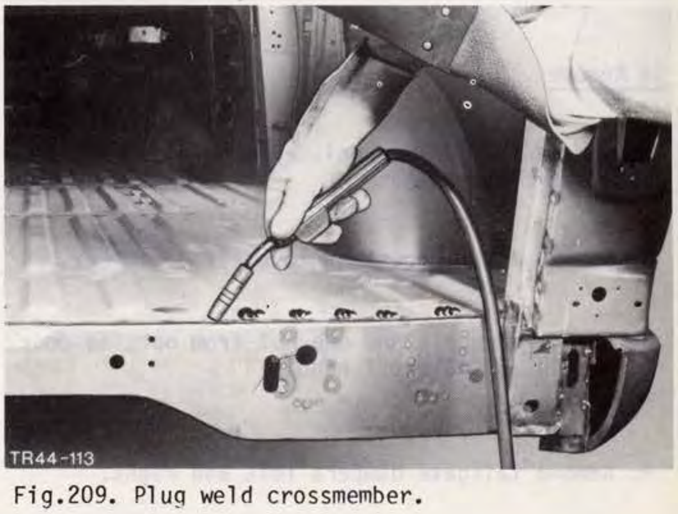


Fig.209. Plug weld crossmember.

9. Dress weld locations.

44 696 FENDER - REAR - REMOVE AND FIT

To Remove

1. Remove fender (7 bolts), Fig.210.
   Remove weatherstrip.

2. Clean contact face on body and clean weatherstrip, or replace.

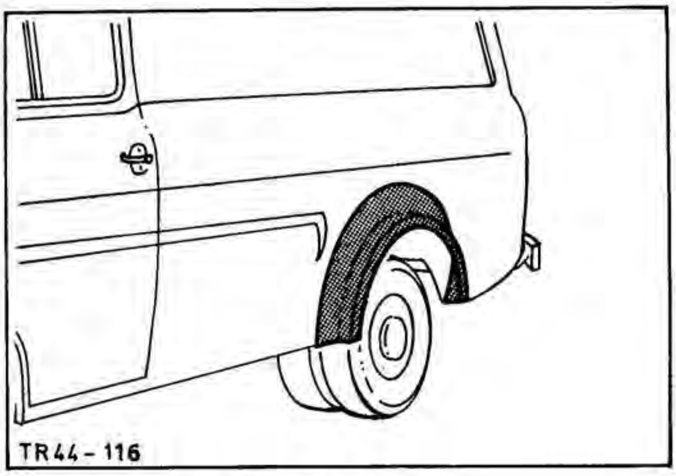


Fig.210. View of rear fender.

To Install

3. Position screws on underside fender flange and screw on loosely screws to side panel. Then slide weatherstrip between fender and side panel.

4. Tighten bolts from inside.

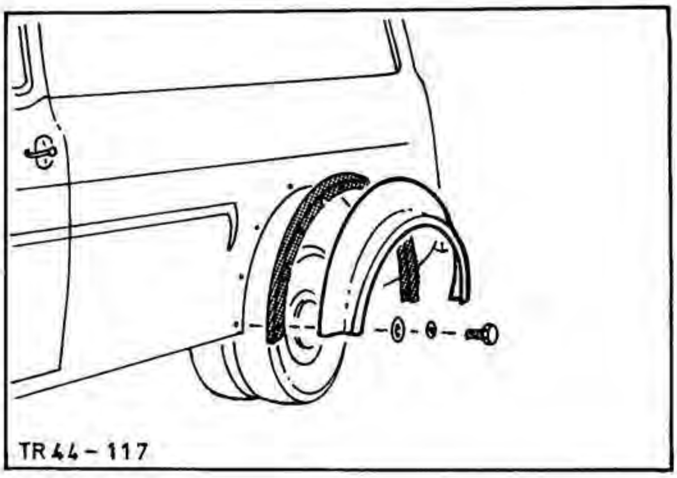


Fig.211. Individual parts of rear fender.

44 734 TAILGATE - REPLACE (Hinged at top)

To Remove

1. Remove door trim panel. Remove caps and clips from tailgate.

2. Remove five screws and take off door lock.

3. Remove one bolt and one nut from outside door handle and take off handle.

4. Remove tailgate dampers left and right.

5. Disconnect heated rear window lead and pull lead out of door. Then remove door glass.

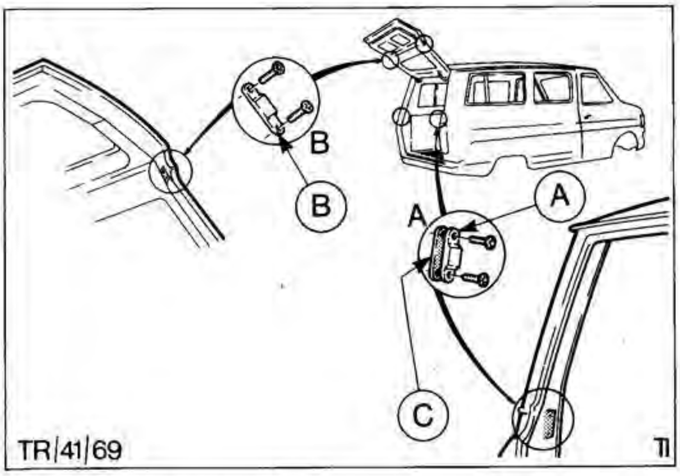


Fig.212. Tailgate dampers.
A - Pillar
B - Tailgate

44 734

6. Remove tailgate, by taking out 6 bolts on hinge, Fig.213.

7. Remove rubber door seal.

Fig.213. Remove tailgate hinge bolts.

To Install

8. Remove old adhesive from door flange.

9. Coat rubber door seal and door contact faces with adhesive and stick on rubber door seal.

10. Position tailgate, align and secure.

NOTE: Pay attention to even gap at box corners, Fig.214.

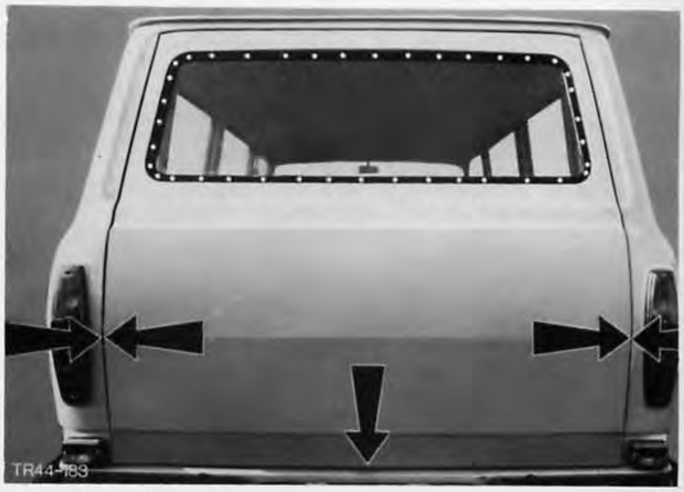


Fig.214. Tailgate gaps.

11. Mount door glass and insert heated rear window lead in door. Connect cable, Fig.215.

12. Fit tailgate dampers at left and right on door and adjust.

13. Fit door handle and door lock.

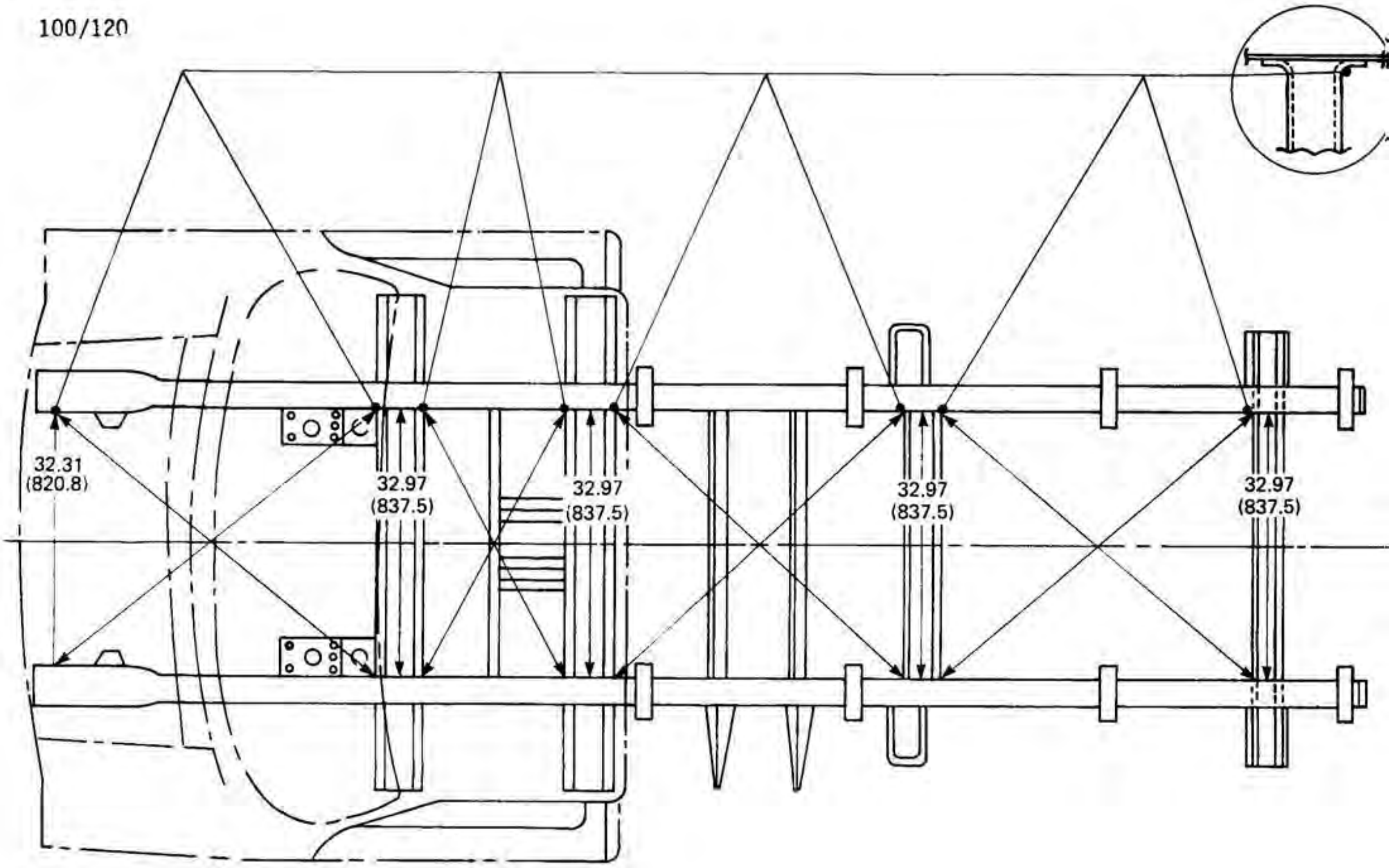
14. Insert caps and clips and fit door trim panel.

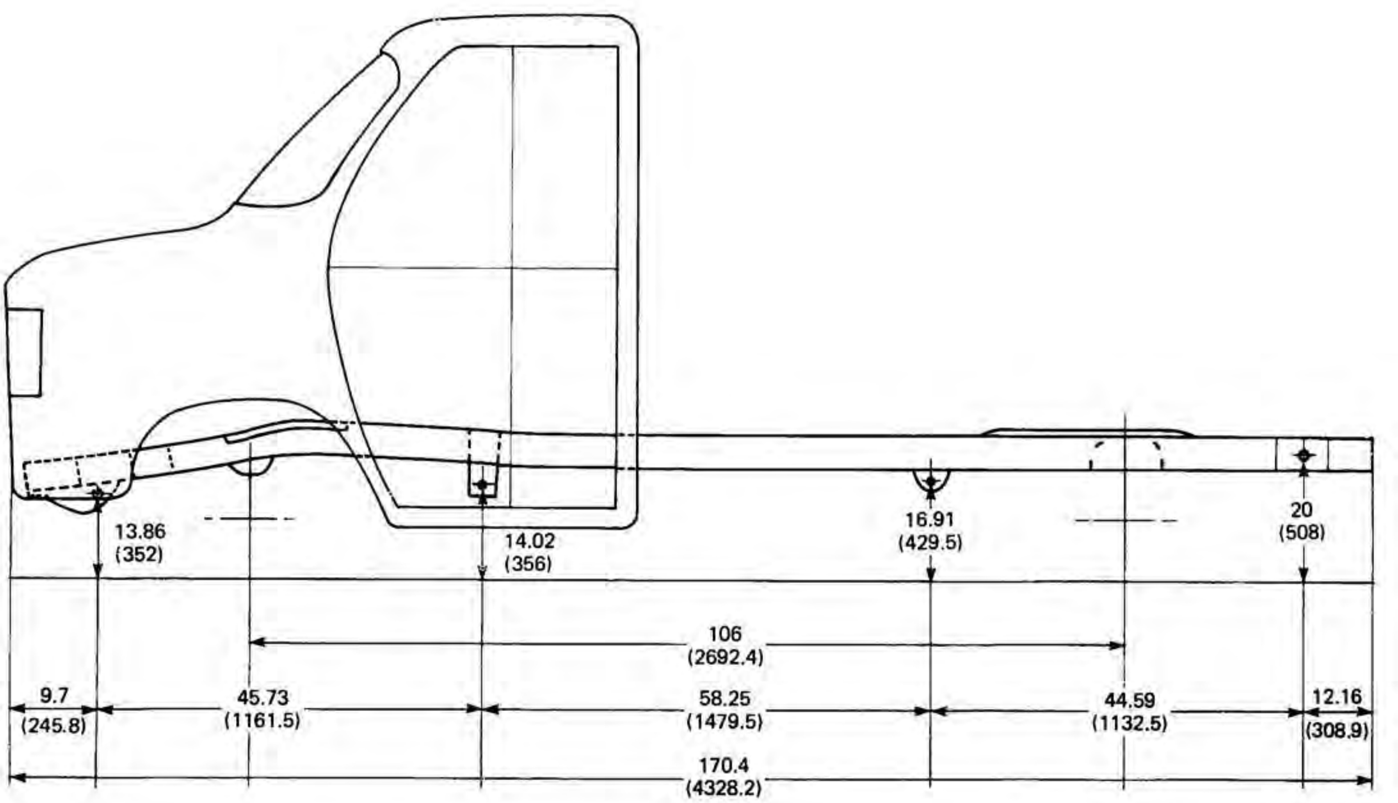
TR44-191

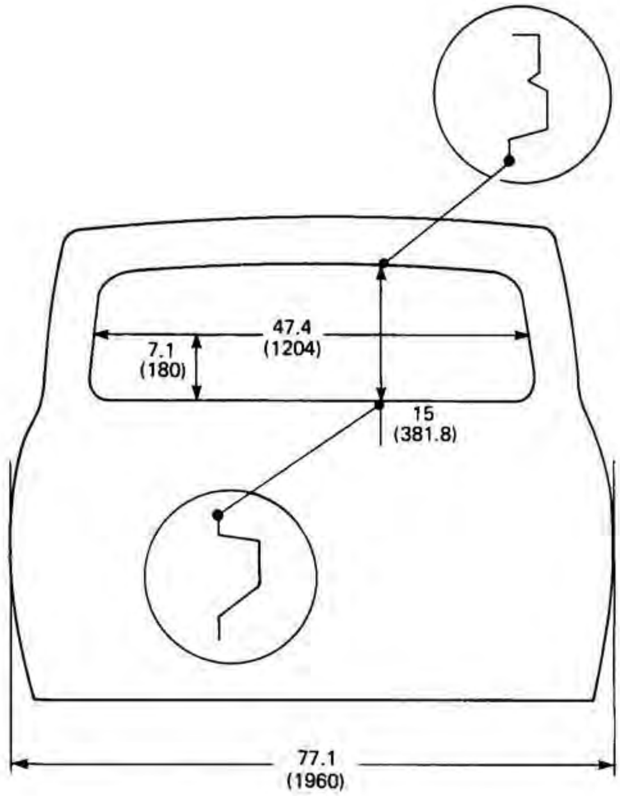
Fig.215. Connect cable to heated rear screen.

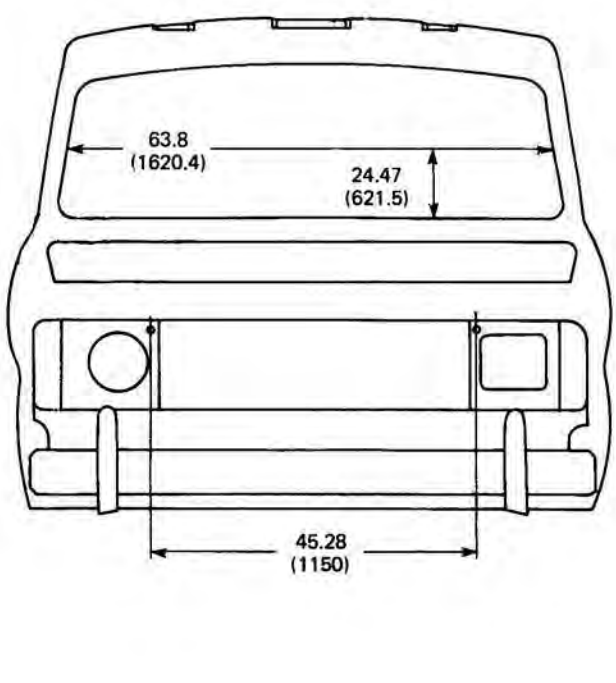
CHASSIS CAB

100/120







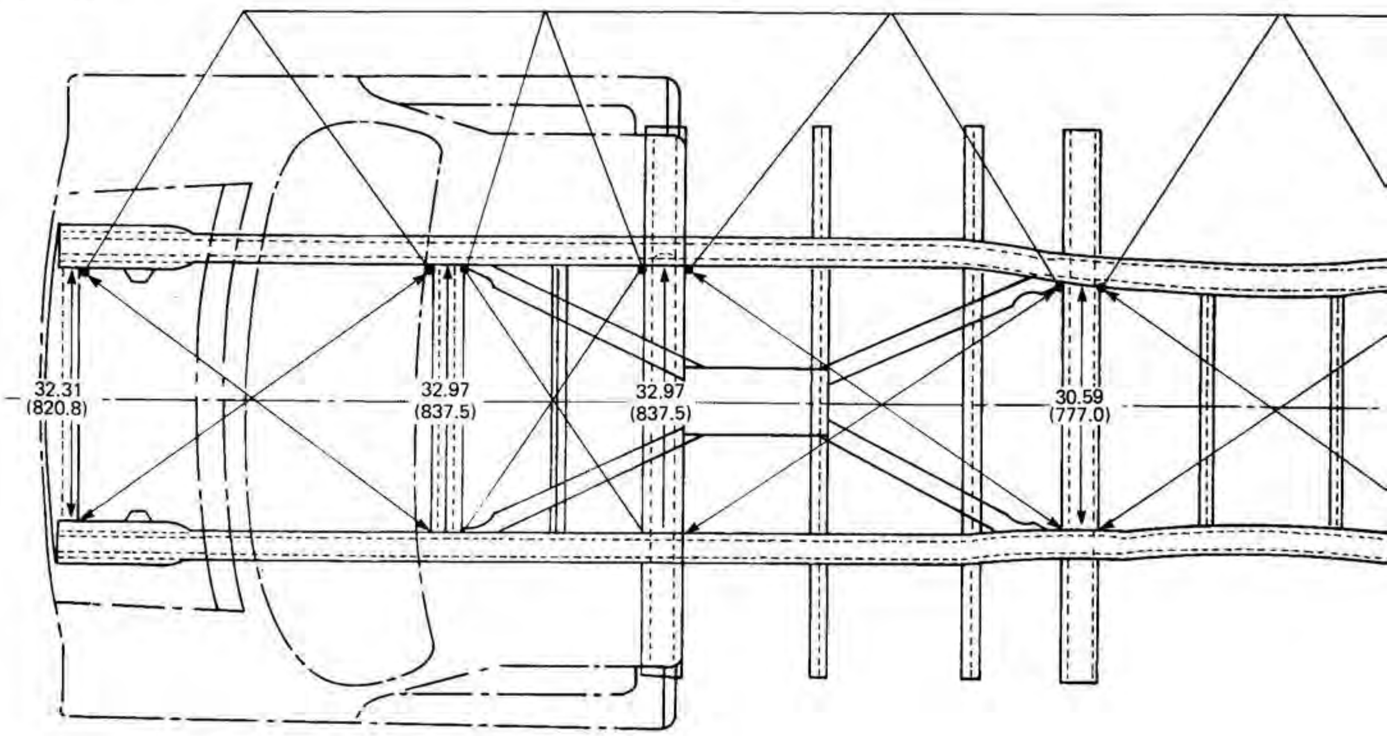


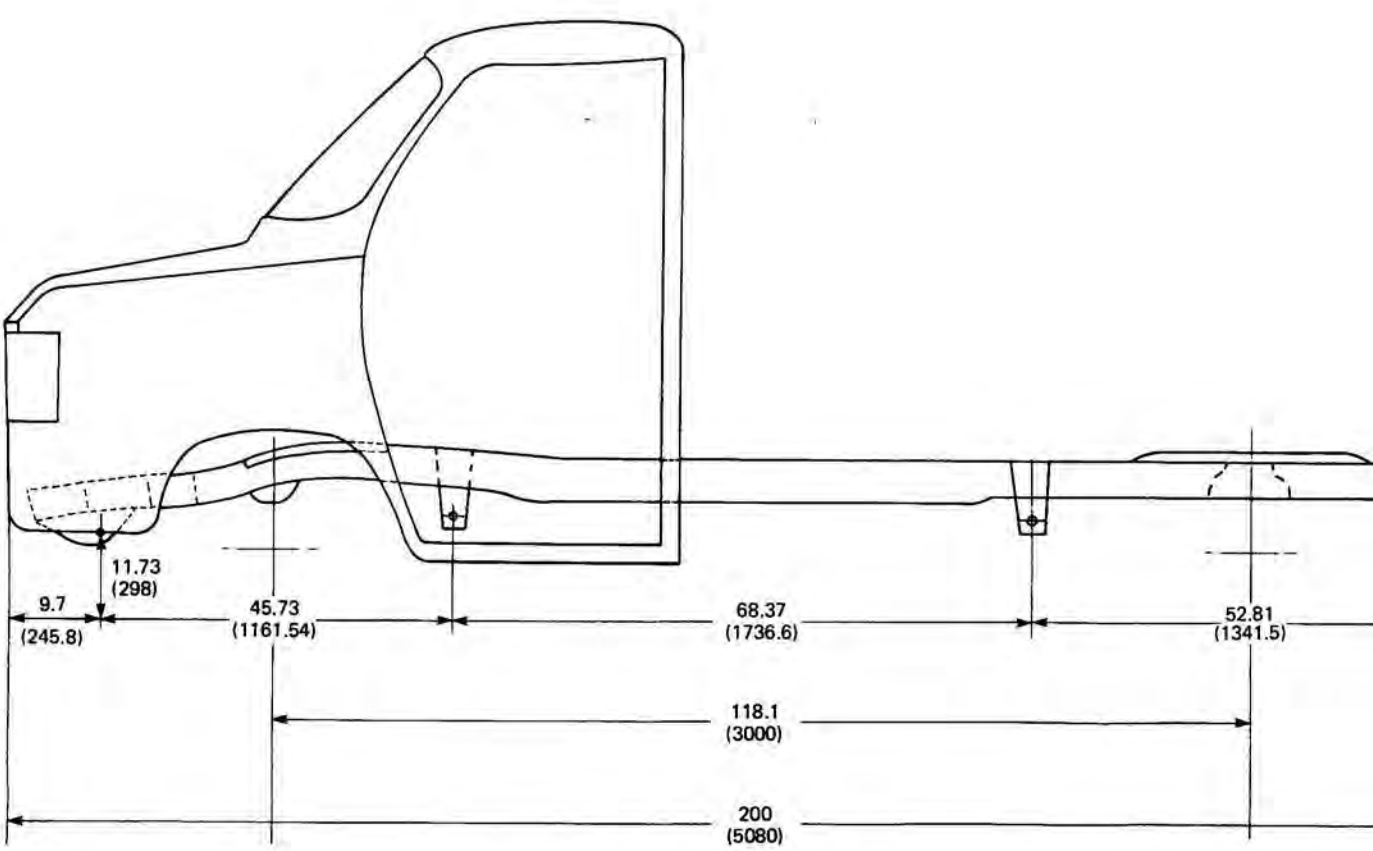
TR 44 – 192

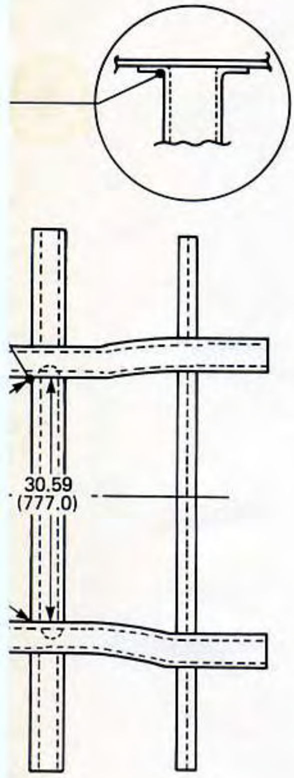
CHASSIS CAP

100L/130

160/190



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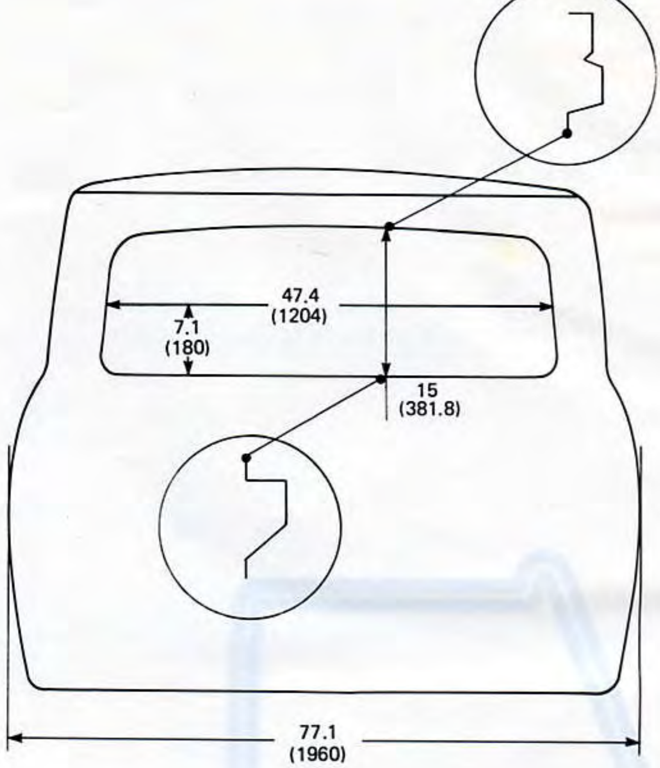
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15
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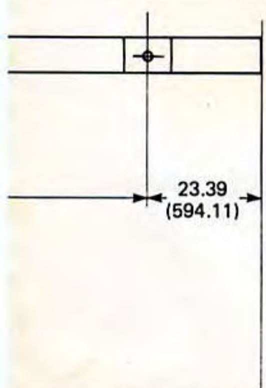
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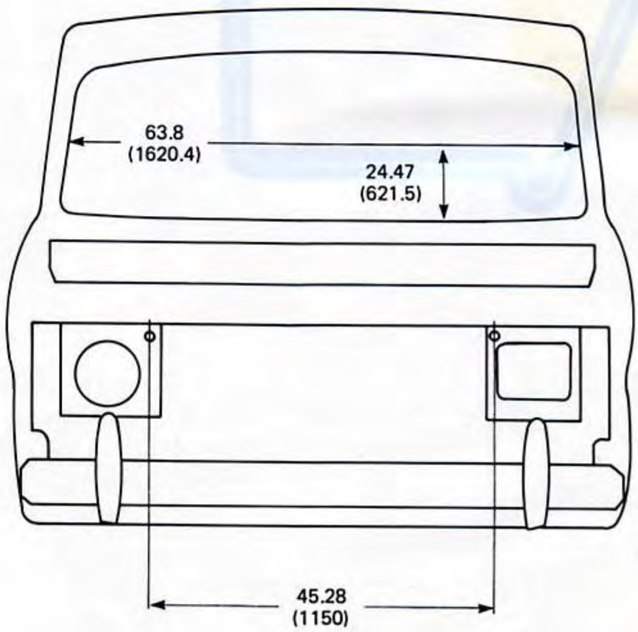
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TR 44 – 193

VAN/BUS/KOMBI

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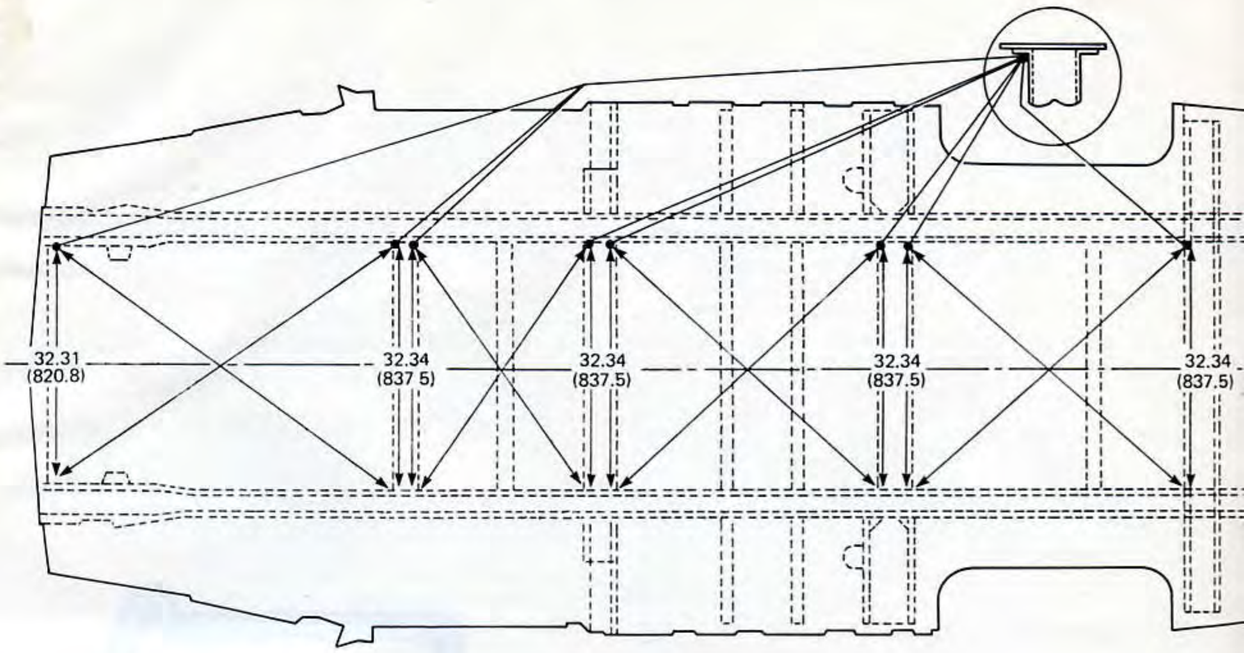
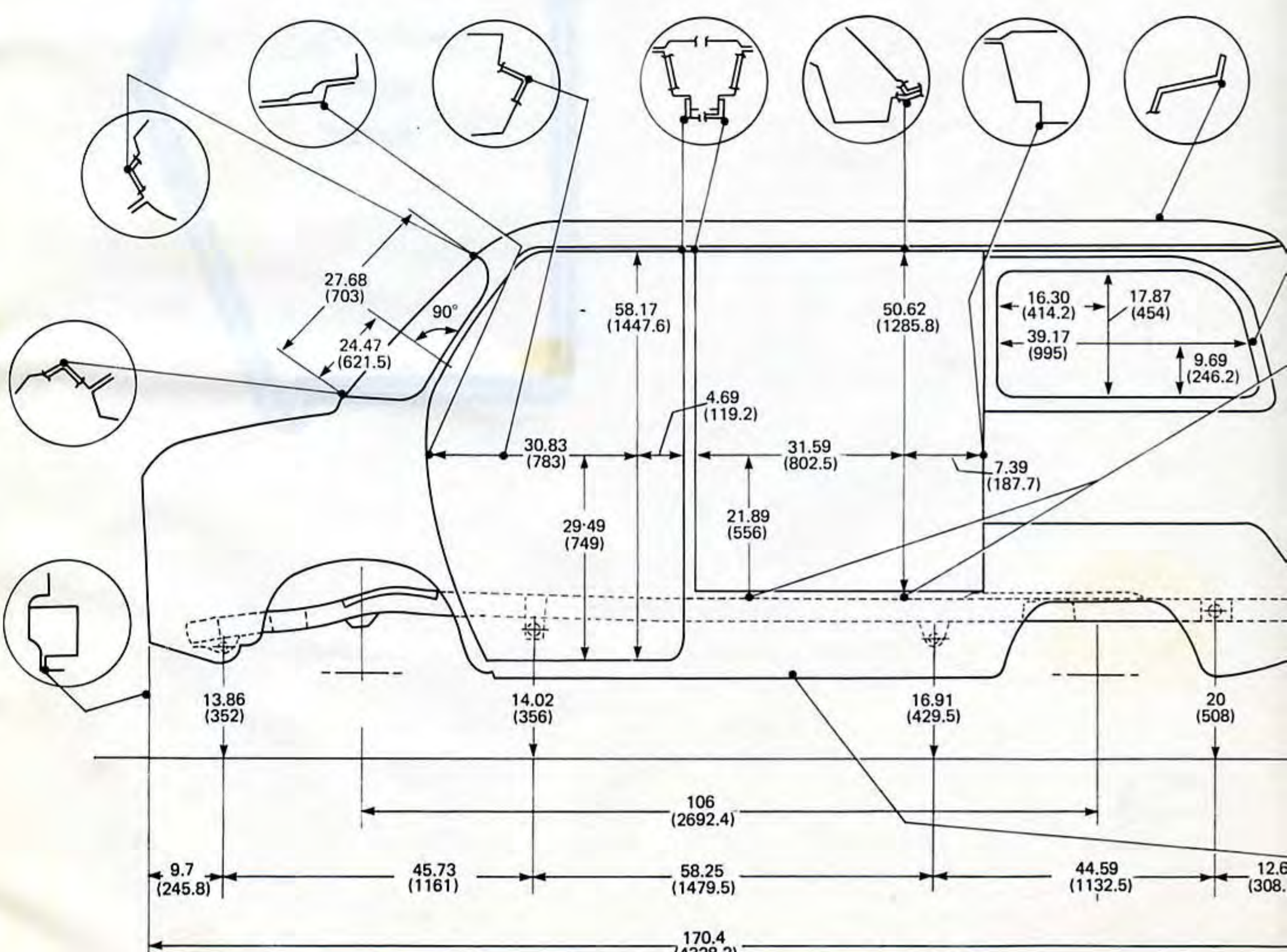
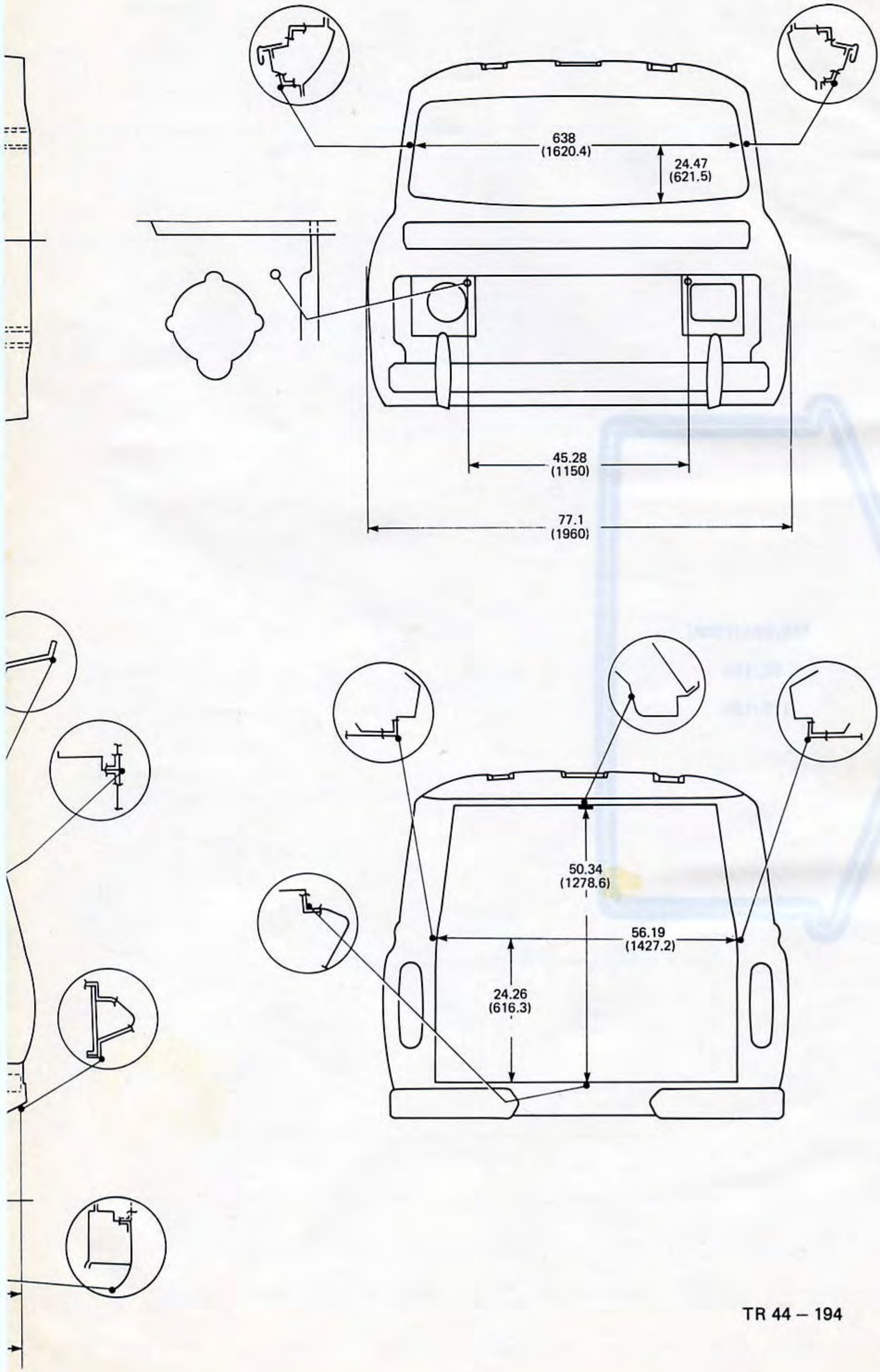
115/120



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(1427.2)
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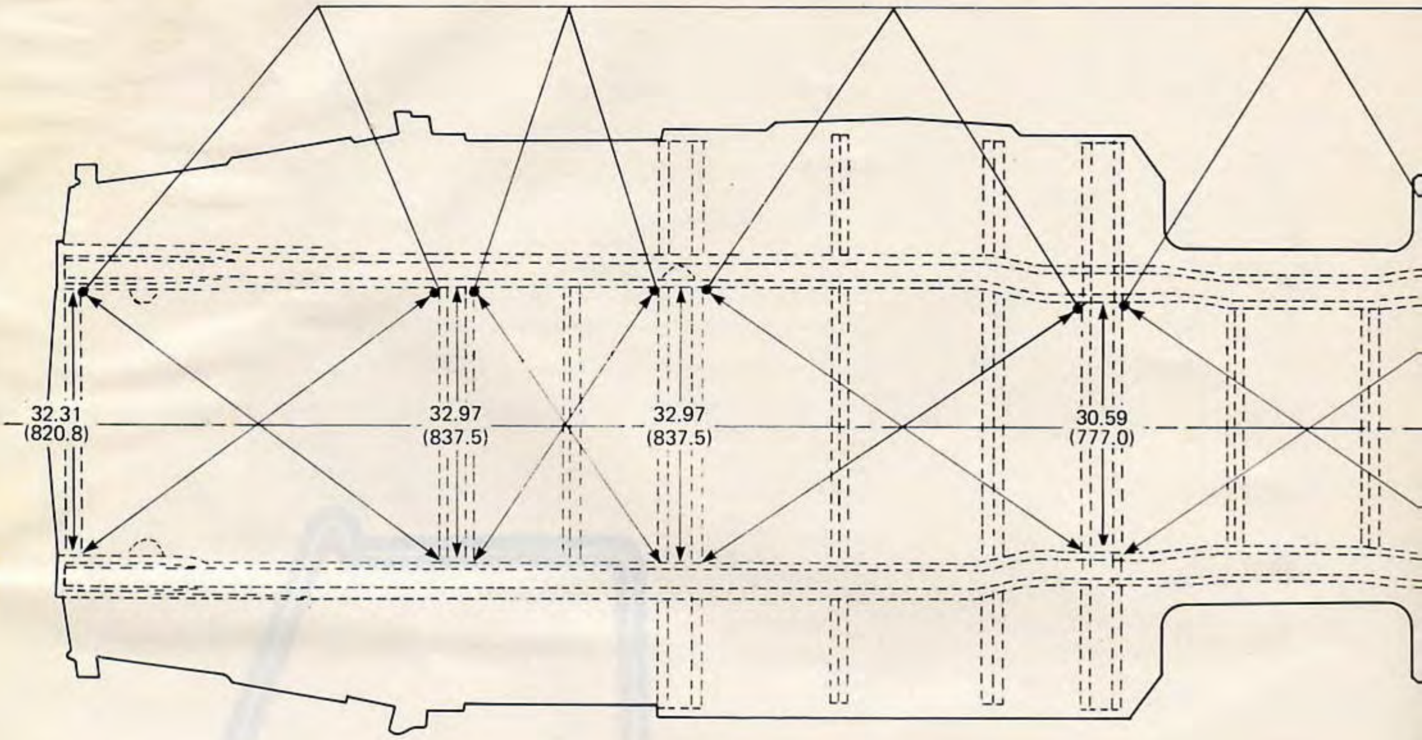
(616.3)

TR 44 — 194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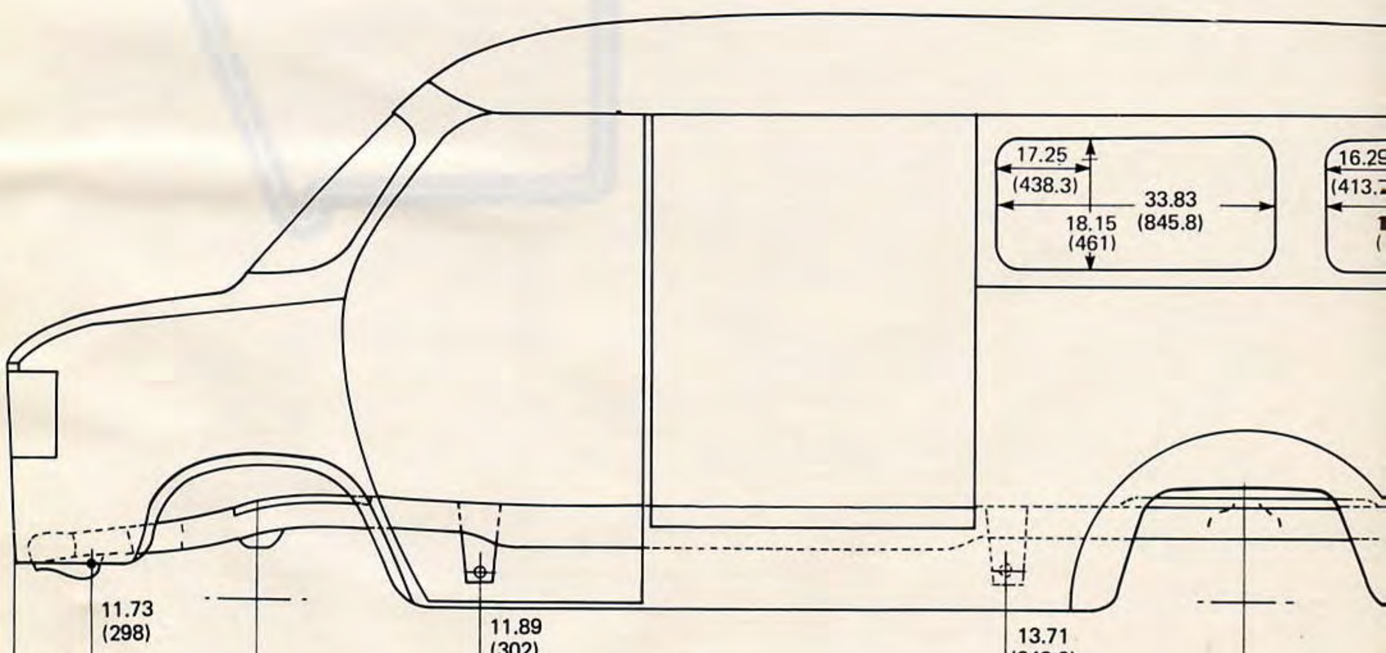
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(348.2)
9.7
(245.8)
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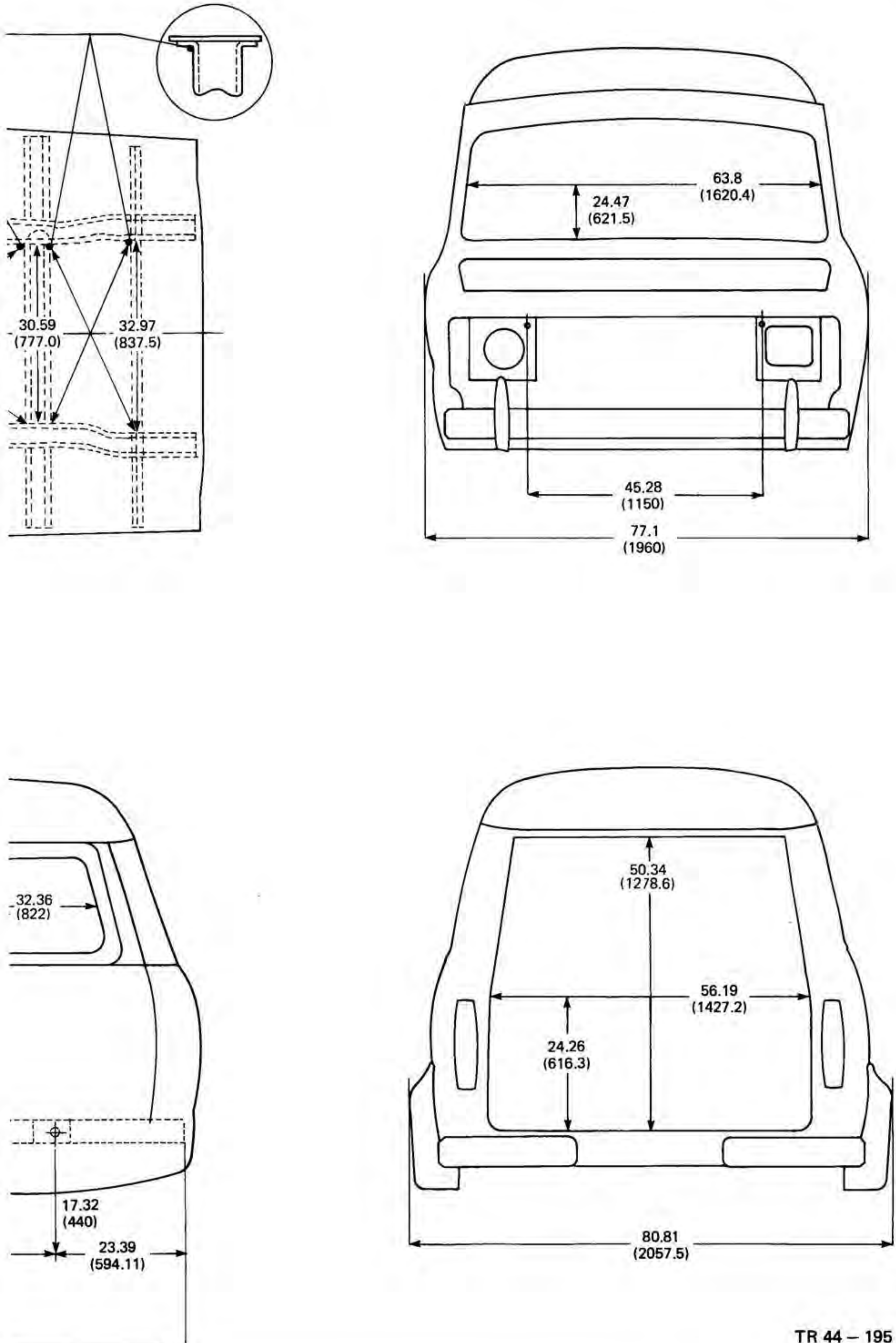
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(1278.6)
56.19
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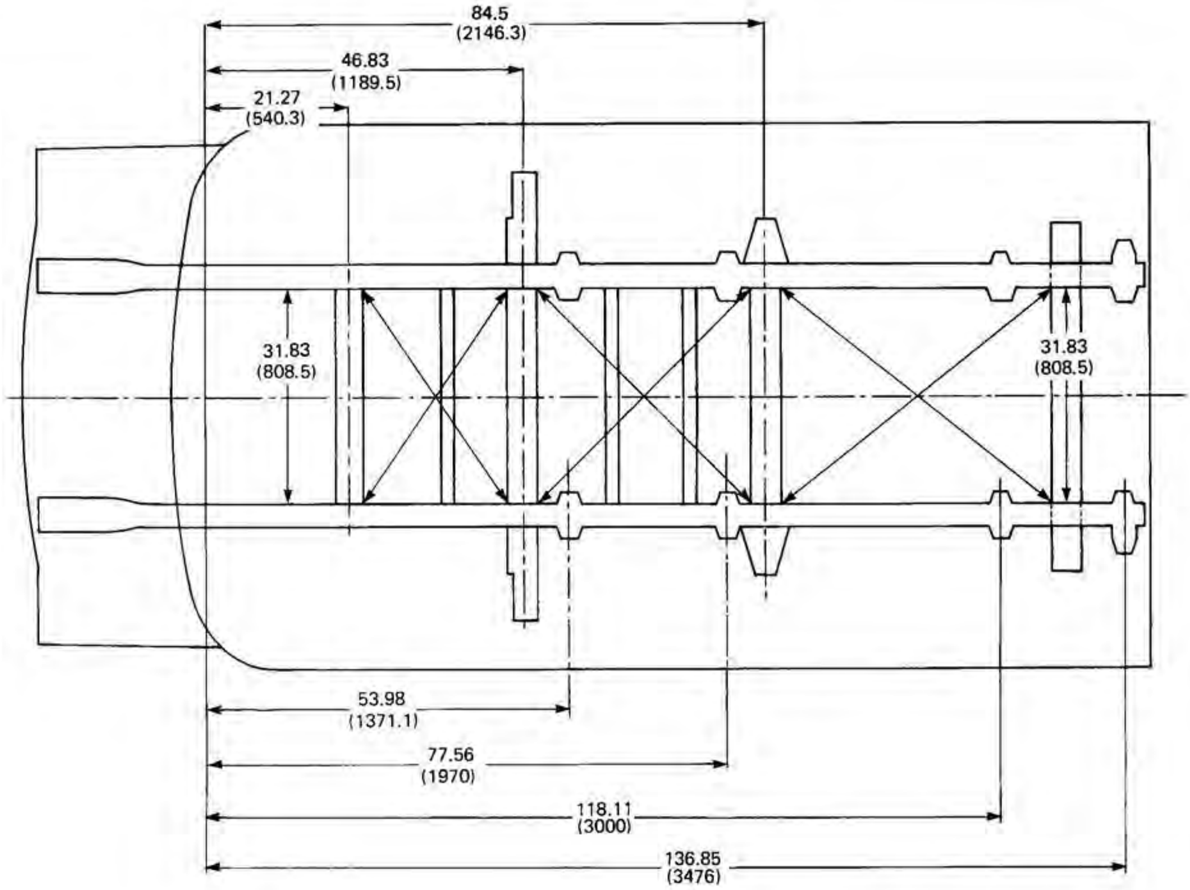
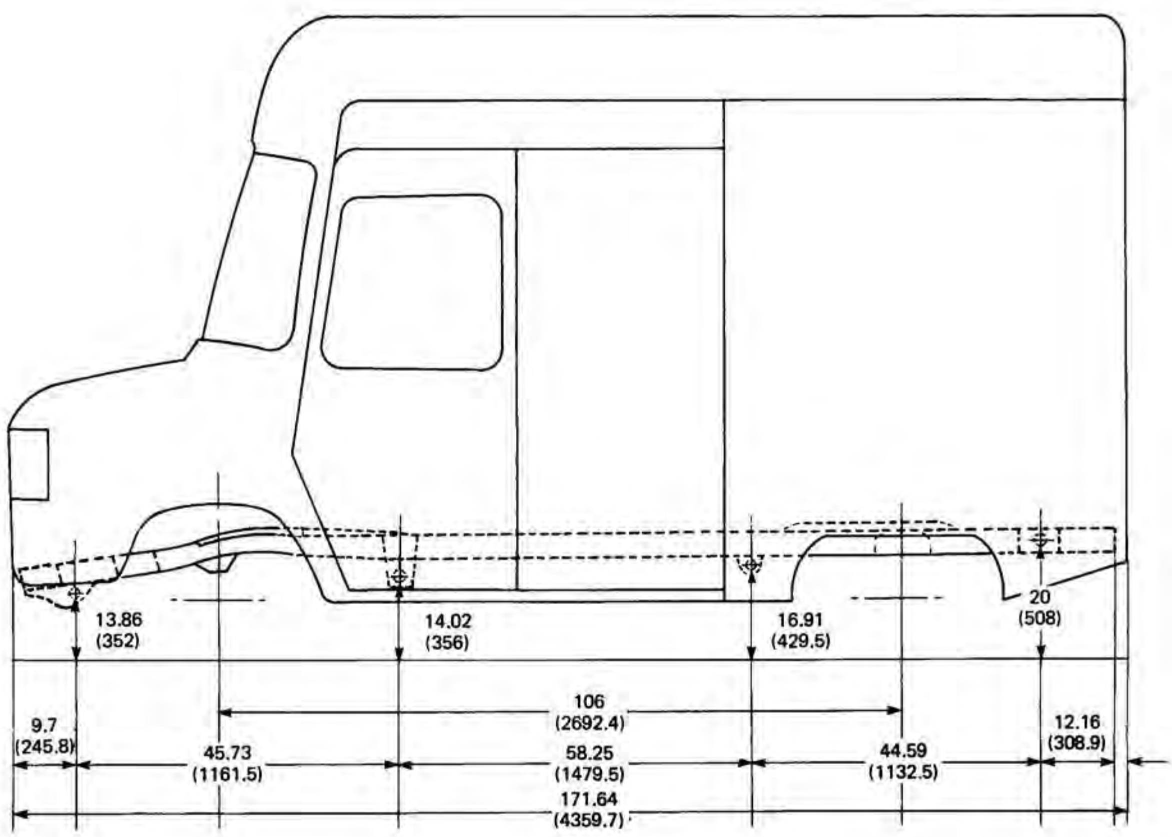
24.26
(616.3)
80.81
(2057.5)

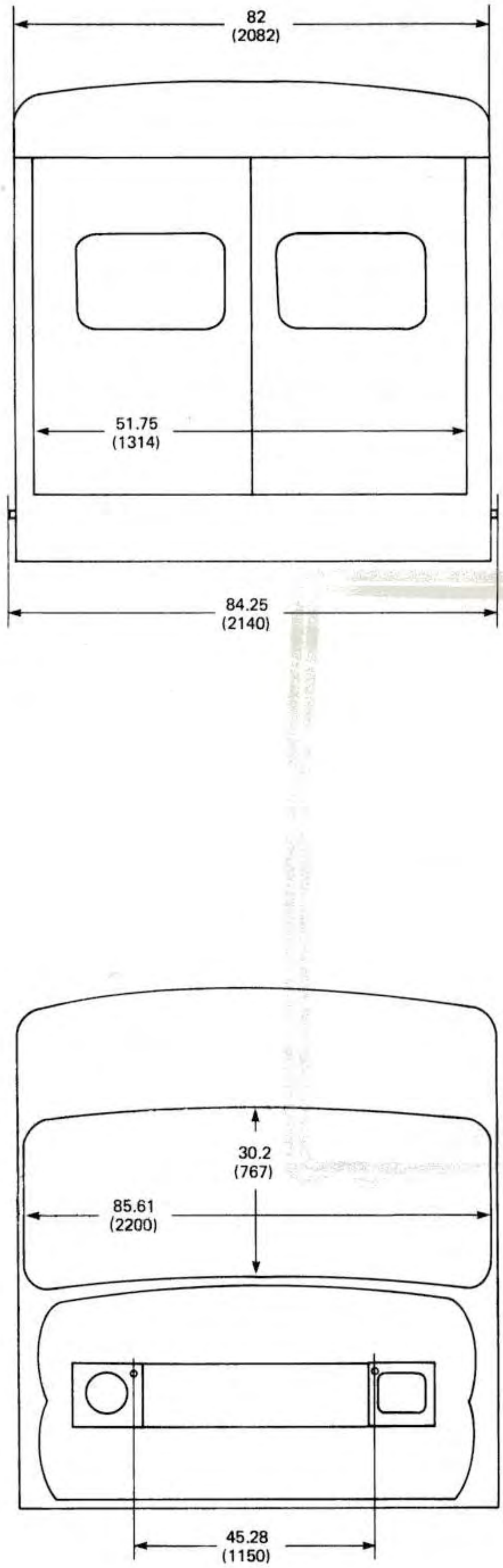
TR 44 – 195

PARCEL VAN

100/120







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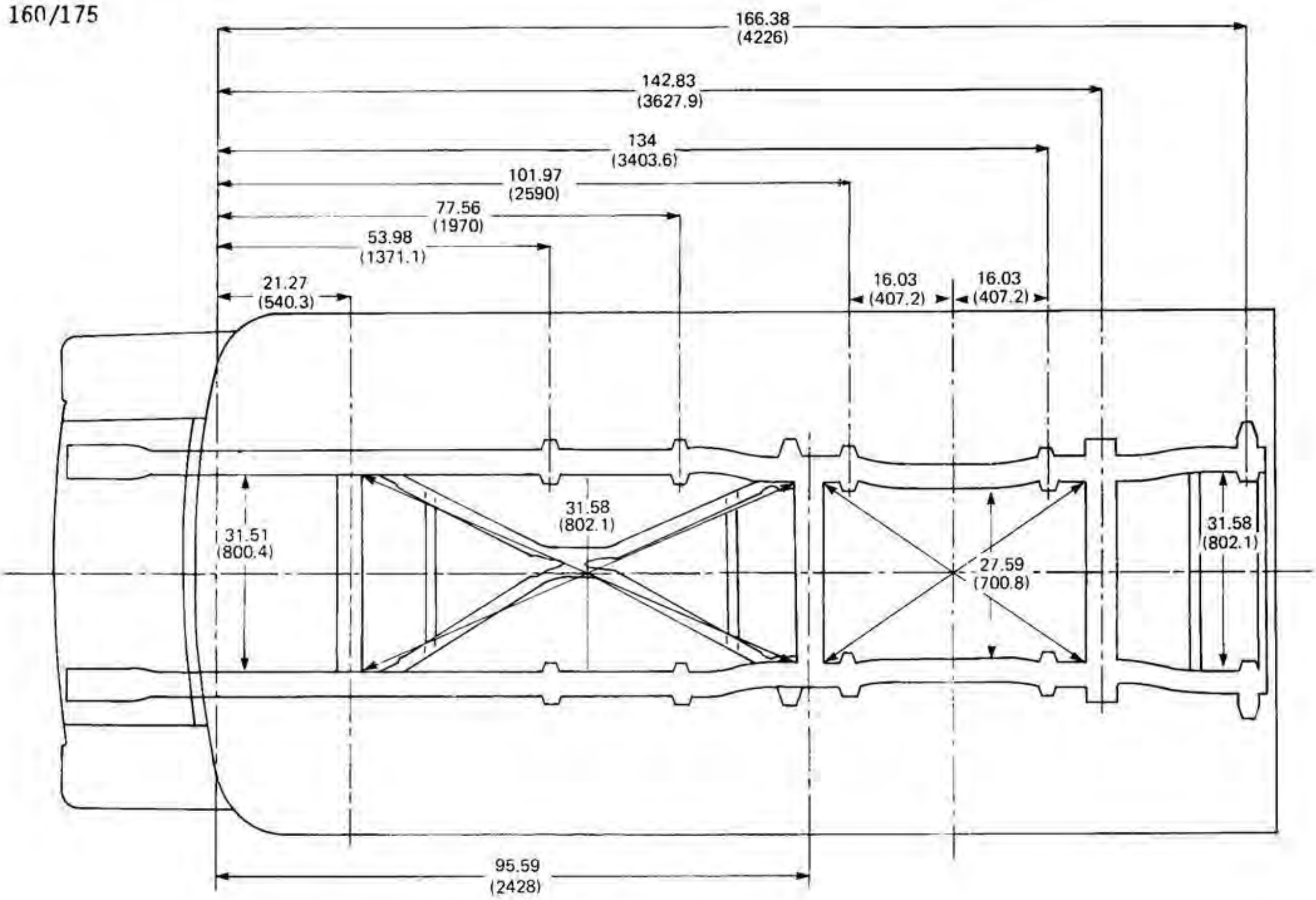
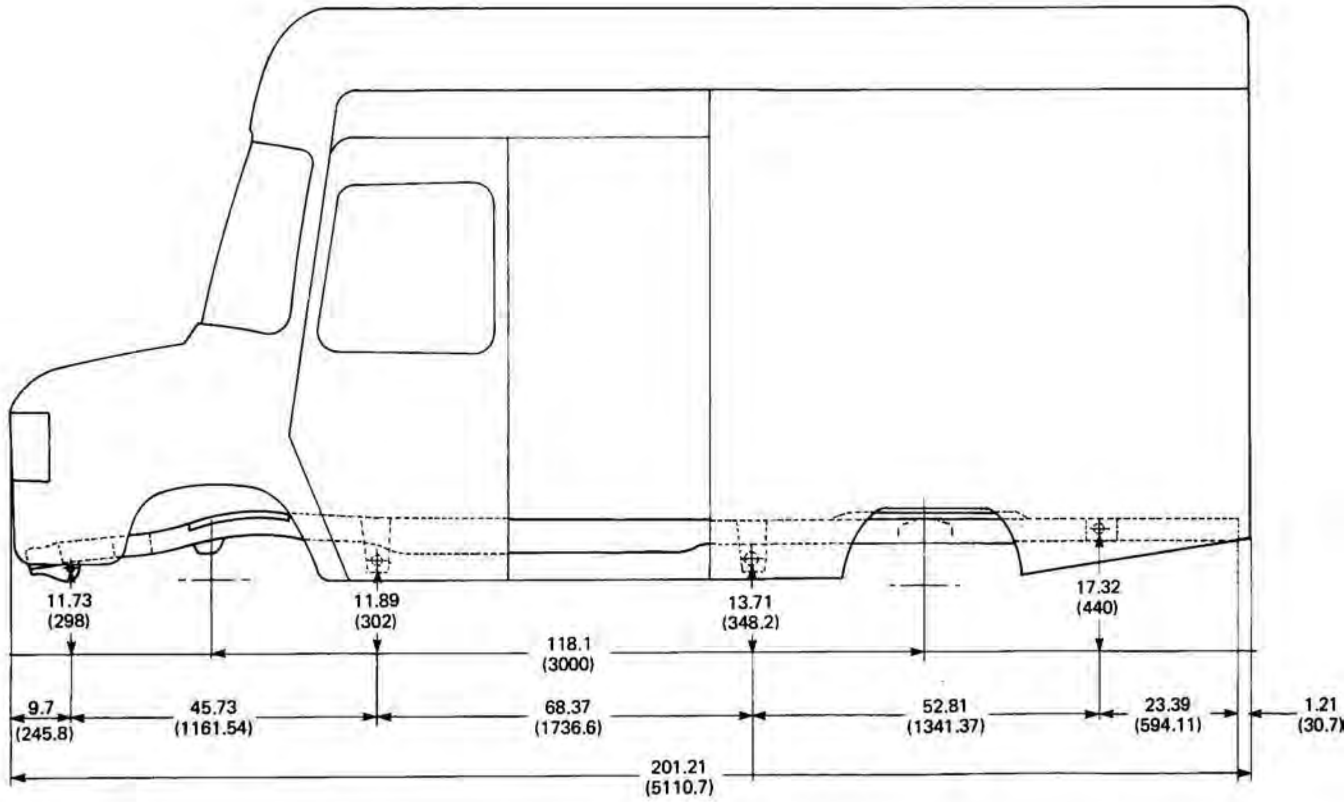
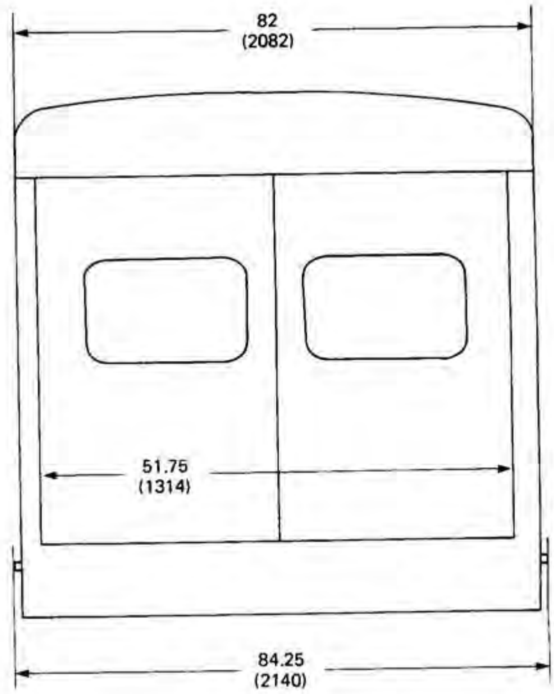
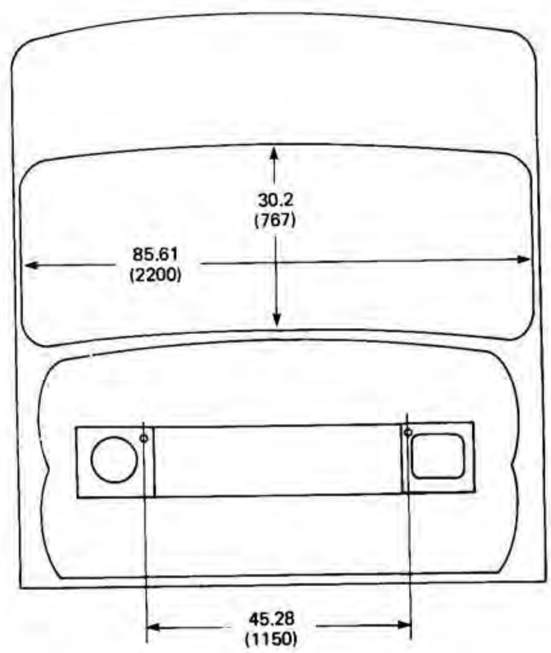
PARCEL VAN

160/175









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REPLACEMENT PARTS

Behind all FORD and MOTORCRAFT products are the vast resources of the worldwide FORD Parts Operations which can supply replacement parts made to the same exacting standards as the original factory fitted components.

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Reference in this publication to 'optional', 'special equipment', and 'where fitted' refer to alternative specifications for certain parts.

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BOSCH FUEL INJECTION SYSTEM 23C

Index **Page**

GENERAL DESCRIPTION

Fuel Circuit

The Bosch VE Fuel Injection Pump is a high pressure distributor type embodying a governor and timing device.

The system consists of a tank from which the fuel is drawn by a vane pump (integral part of fuel injection pump). Prior to entering the fuel injection pump the fuel passes through a hand primer and a fine mesh filter. The fine mesh filter ensures protection of the pump component parts as the fuel also acts as a lubricating agent.

The vane supply pump supplies a constant fuel quantity per revolution and produces a consistent pressure via the pressure regulating valve. The vane pump pressure regulation and the orifice in the excess flow valve produce a pressure in the pump which is proportional to pump speed. This feature is used to control the automatic injection advance unit. The majority of fuel conveyed flows through the pressure regulating valve and returns to the suction side of the supply pump. The remainder flows through the pump interior to be conveyed into the high pressure chamber or flows through the excess flow valve to the supply tank for cooling and removal of air. Prior to entering the tank the returning fuel passes through a one-way valve and the cold start reservoir.

In the fuel injection pump, high pressure chamber fuel is distributed to the injectors by the pump plunger which is actuated by the drive shaft. The cam plate and rollers in the cam roller ring cause a stroke movement in addition to the rotary movement.

The stroke produces feed at high pressure and the distribution of the injected quantity to the individual injector outlets is made through a metering slit in the distributor pump plunger. The port opening is controlled by the regulating collar opening the spill ports in the pump plunger.

The injector is a pintle type similar to that used on the Ford 2,4 litre diesel with Bosch Plunger Type Fuel Injection Pump. Fuel which leaks through the injector needle spindle/injector nozzle body clearance returns to the tank via the injector leak-off rail.

Mechanical Governor

The mechanical governor incorporated within the upper side of the Bosch VE distributor injection pump, is driven at a speed greater than the injection pump rotational speed by the pump drive shaft via damped gears on the governor weight cage and the main drive shaft. Rotating on the governor spindle is a sliding sleeve and four flyweights. The function of the flyweights is to control the axial sliding sleeve movement by centrifugal force determined by the rotational speed of the drive shaft and opposed by the governor springs.

When the engine is started and the pump has reached a predetermined speed the centrifugal weights push the sliding sleeve forwards on to the starting lever to overcome the weak starting spring. The starting lever actuates a tensioning lever which in turn moves the regulating collar on the pump plunger, thus fuel delivery is regulated.

The amount of pressure the governor sliding sleeve exerts on the tensioning lever via the starting lever and spring is balanced by the governor spring which is adjustable by an external governor control lever.

GENERAL DESCRIPTION (cont'd)

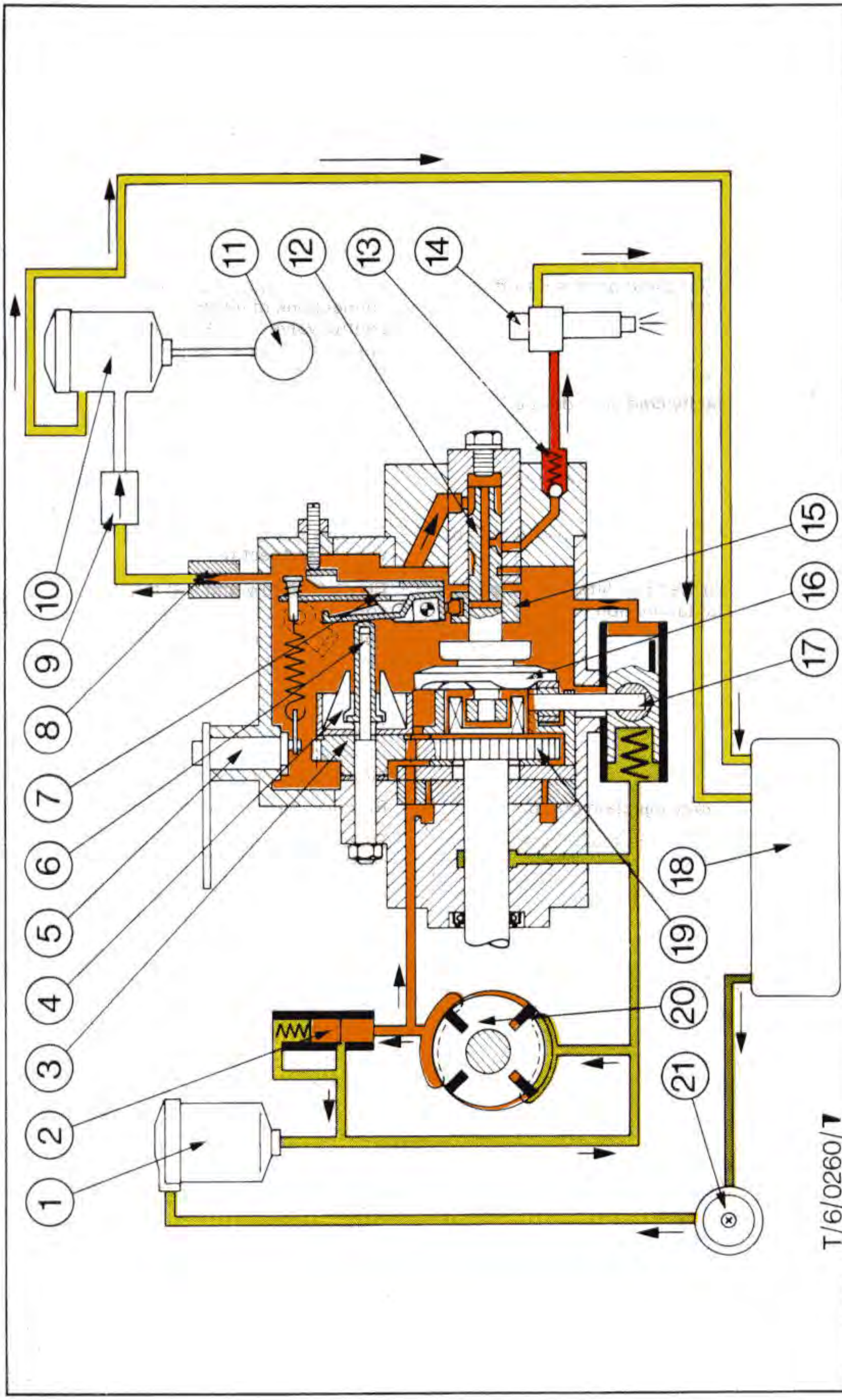


Fig. 1. Fuel Circuit

1. Fine mesh filter
2. Pressure regulating valve
3. Governor
4. Flyweight assembly
5. Control lever
6. Sliding sleeve
7. Lever assembly
8. Excess flow valve
9. One-way valve
10. Cold start reservoir
11. Heater plug
12. Distributor pump plunger
13. Delivery valve
14. Injector
15. Governor control sleeve
16. Camplate
17. Advance piston
18. Fuel tank
19. Governor drive
20. Vane pump
21. Hand prime

Inlet pressure to fuel injection pump

Return to tank

Internal pump pressure

Injection pressure

FAULT DIAGNOSIS

Introduction

The following fault diagnosis procedure has been devised to give a methodical guide when a fuel fault is not obvious. It is in no way an instruction which must be followed operation by operation. The mechanical condition of the engine, the vehicle history, circumstances and experience together with the following procedure will assist in an accurate diagnosis.

NOTE: Before any part of the fuel system is dismantled the surrounding area must be throughly cleaned.

Trouble Symptoms	Possible Causes	Remedy
Engine will not start or is difficult to start	Insufficient fuel in tank	Fill the fuel tank and bleed the system by filling the primary filter and fuel pump with clean fuel.
	Non operation of shut-off control	Clean and made good electrical connections of electrical shut-off control valve. Check solenoid operation. Check mechanical shut-off lever.
	Faulty cold start device	Check thermostart reservoir for correct supply to the heater plug/s. Check heater plug/s operation.
	Loose pump drive gear or timing slipped	Remove timing belt cover, check and adjust injection pump timing.
	Broken gear pump or timing belt	Remove pump or timing belt from vehicle and rectify.
	Choked fuel filter or fuel oil contamination	Check fuel flow and fuel tank condition.
		The fuel filter element must be changed at the regular intervals recommended.
		Check that the fuel system does not contain water. In sub-zero temperatures it is possible for wax crystals to separate from the fuel and cause a blockage in the fuel system.
	Faulty injection pump	Remove injection pump and rectify.
Engine starts then stops	Insufficient fuel in tank	Fill the fuel tank and bleed the system.
	Fuel starvation	Check that the fuel filter elements are not choked. Ensure that the fuel feed is operating correctly.
		Check all pipe unions and joints in the fuel system for tightness and effective sealing.
		Check that all pipes, including the fuel return pipe, permit unrestricted fuel flow.
		Check that the fuel tank vent is not blocked and there is no air in the system.
	Air starvation	Check and if necessary replace the air cleaner element.
		Check hoses for deterioration, kinks and splits.
		Check that valve clearances are correctly adjusted.

FAULT DIAGNOSIS (cont'd)

Trouble Symptoms	Possible Causes	Remedy
Engine starts then stops	Low idle speed	Check engine condition. Check that valve gear (push rods, valve springs, etc.) is operating correctly. Check that valve timing is correct. Check that all injectors are seated correctly and that a gas-tight seal is effected between the injectors and the cylinder head. Check the cylinder head gasket, valve seats, bores, pistons and rings for wear. Use a tachometer and set the idle speed (see specifications).
	Faulty stop control lead/lever	Check stop control lead/lever for tightness. Ensure the lead is in good condition and a constant flow is maintained.
Incorrect engine idling and maximum speeds	Air starvation	Check and if necessary replace air cleaner element.
	Fuel starvation	Check that there is no air in the system or water or foreign matter. Check that the fuel filter elements are not choked. Check all pipe unions and joints in the fuel system for tightness and effective sealing. Check that all pipes permit unrestricted fuel flow, and that, there is no dirt in the system.
	Accelerator linkage	Check accelerator linkage for wear and adjustment. Ensure that the fuel pump control lever is properly secured to the shaft.
	Fuel pump	Check that the control lever is tight on the throttle shaft. Ensure the linkage from the accelerator pedal will permit full throttle opening.
	Faulty injectors	Remove injectors and test.
	Check engine condition	Check that the engine valve gear (push rods, valves, valve springs, etc.) is operating correctly. Check for sticking valves, worn valve seats, damaged gaskets, worn bores, worn pistons, worn or sticking rings. Ensure injection timing is correct.
	Low maximum speed	Check maximum no-load speed (see specifications).
	Low idle speed	Use a tachometer and set the idle speed (see specifications).

FAULT DIAGNOSIS (cont'd)

Trouble Symptoms	Possible Causes	Remedy
Uneven running misfiring	Check valve clearances	Check that the valve clearances are adjusted correctly. Ensure that the engine valve gear is operating correctly, i.e. no valves are sticking, etc.
	Faulty injectors	Remove injectors, test and rectify as necessary. Check that the injector seatings in the cylinder head are gas-tight.
	Check engine mountings	Check that the engine mountings are secured correctly. Check for vibration being transmitted from some other loose or unbalanced part of the vehicle.
	Air in fuel system	Correct air leak.
	Check engine condition	Remove the radiator cap with engine at idling speed (cold) and check for gas leaks through the coolant. Check for a damaged cylinder head gasket. Check for valve seat damage and valves sticking. Check for worn pistons, sticking rings or worn bores.
Lack of power/poor fuel consumption		

Before checking the following possible causes ensure that:

1. The vehicle is not loaded in excess of its plated weight.
2. Tyre pressures are correct for load carried.
3. The clutch is not slipping.
4. The brakes are not binding.
5. The parking brake and drive line are in good working order.
6. The engine reaches its maximum no-load speed.
7. The fuel injection pump has not been tampered with and the seals are unbroken.
8. The density of the exhaust smoke is checked with engine warm and under load.
9. Check the accelerator cable and ensure that the throttle is opening fully.

Trouble Symptoms	Possible Causes	Remedy
	Air starvation	Check and if necessary replace air cleaner element. Check that the engine valve gear is operating correctly.
	Fuel starvation	Check that the fuel filter elements are not choked. Check that the fuel feed is operating correctly. Check all pipe unions and joints in the fuel system for tightness and effective sealing.

FAULT DIAGNOSIS (cont'd)

Trouble Symptons	Possible causes	Remedy
Lack of power/poor fuel consumption (cont'd)	Fuel starvation (cont'd)	Check that all pipes permit unrestricted fuel flow. Check that fuel tank vent is not blocked and that there is no air in the system.
	Engine	Check that the valve clearances are adjusted correctly.
	Exhaust system	Ensure exhaust system is free from internal obstruction.
	Accelerator linkage/cable	Check linkage for excessive wear.
		Check that the engine mounting bolts are tight. Check that when the accelerator pedal is fully depressed the pump control lever contacts the maximum speed screw.
	Stop control	Check that the stop control is operating correctly.
	Fuel injection equipment	Remove and test the injectors. If the fuel injection pump is suspected of being faulty, it must be removed and tested.
	Check engine condition	Remove radiator cap with engine at idling speed (cold) and check for internal gas leaks through coolant.
		Check for damaged cylinder head gasket.
		Check for worn or sticking rings, worn pistons or worn bores.

Excessive exhaust smoke

Note the colour of exhaust smoke, when the engine is on full load, in gear.

(a) White smoke	Denotes incorrect injection timing, low compression or water in the cylinders.
(b) Black smoke	Denotes incomplete combustion due to excess fuel or insufficient air being supplied to the cylinders, or faulty atomisation due to faulty injectors (accompanied by a heavy 'diesel knock').
(c) Blue smoke	Denotes that excessive engine oil is being burned due to faulty valves, valve stems, pistons, rings or bores, or faulty injectors causing a partially unburned fuel condition.

Before checking the following 'Possible Causes' ensure that:

1. The vehicle is not loaded in excess of its plated weight.
2. Tyre pressures are correct for load carried.
3. The brakes are not binding.
4. The clutch is not slipping.
5. The fuel injection pump has not been tampered with and that the seals are unbroken.

FAULT DIAGNOSIS (cont'd)

Trouble Symptoms	Possible Causes	Remedy
	6. The smoke condition only exists when the engine is thoroughly warm.	
	On Nos. 1, 2, 3, and 6 above, excessive smoke will be produced if the engine is subjected to gross over-loading, adverse conditions or incorrect gear use which will lower the engine speed.	
	Air starvation	Check and if necessary replace the air cleaner element. Check that valve clearances are correctly adjusted. Check that the engine valve gear is operating correctly.
	Fuel injection equipment	Remove injectors and test. Ensure that the specified type of injector is used. Check the injection timing. If the fuel injection pump is suspected of being faulty it must be removed to check the calibration.
Engine will not accelerate correctly	Air starvation	Check and if necessary replace the air cleaner element. Check that the engine valve gear is operating correctly and valves are set to the specified clearances.
Engine surge (with throttle in fixed position)	Fuel injectors	Remove injectors and test. Ensure that the specified type of nozzle and injector is used.
	Fuel injection pump linkage	Check accelerator linkage and lever for freedom of movement and excessive wear.
Slow engine die down	Blocked fuel return pipe	Check that the return fuel pipe from the fuel pump to the tank is clear.
	Fuel injection pump linkage	Check accelerator linkage and lever for freedom of movement and excessive wear.

SPECIAL SERVICE TOOLS

NOTE: The following Special Tools are only available through Bosch agents.

Bosch Tool No.	Tool Name
1 685 720 062	Pump adaptor
1 686 430 010 CA	Drive coupling tool
1 688 130 075	Gauge set
1 688 130 139	Measuring tool
KDEP 1086	Control valve remover/replacer
KDEP 1027	Bracing sleeve remover
1 687 233 012	Dial gauge
KDEP 2931	Indicator tool
1 683 458 019	Adaptor
1 688 010 011	Clamping bracket
1 683 391 074	Supply connector
1 683 385 011	Banjo connector
1 683 456 000	Hollow connector
1 683 385 016	Serrated connector
21 016	Timing peg
1 685 720 062	Adaptor flange
KDEP 2963	Mounting yoke
KDEP 1082	Governor shaft nut remover/replacer
KDEP 1080	Screw plug remover/replacer
KDEP 1086	Control valve remover/replacer
KDEP 1032	Base adaptor
1 687 233 012	Dial gauge
KDEP 1084	Register block

SERVICE AND REPAIR OPERATIONS – CONTENT

FUEL SYSTEM		Contain in this publication	Contained in Operation	Unique for Transit
23 142	Fuel system – bleed	X		X
23 412 2	Injection pump – calibrate (injection pump removed)	X		X
23 414	Injection pump – Remove and install	X		X
23 414 8	Injection pump – Overhaul (injection pump removed)	X		X

SERVICE AND REPAIR OPERATIONS

23 142 FUEL SYSTEM – BLEED

Special Service Tools Required: None

1. Raise the hood and secure with the stay.
2. Ensure that all fuel pipe connections are tight and there is sufficient fuel in the fuel tank.
3. Slacken the bleed screw on top of the fuel filter two or three turns.
4. Operate the hand primer (located on the fuel filter) by a 'press and release' motion until air bubbles cease and fuel flows freely from the bleed screw, securely tighten the bleed screw.
5. Switch on the ignition to actuate the stop control solenoid. Move the stop control lever in the start position and slacken the fuel outlet banjo.
Do not attempt to bleed the injection pump by slackening the hexagon headed bolts situated either side of the pump. This will displace governor components and damage the injection pump.
6. Operate the hand primer until air bubbles cease and fuel flows freely, securely tighten the banjo connection.

   NOTE: Do not attempt to bleed the fuel system by cranking the engine. The injection pump is lubricated by diesel fuel not engine oil. Serious damage may be incurred if the engine is cranked with a dry injection pump.
7. Wipe all surplus diesel oil from the fuel filter and injection pump.
8. Start the engine and check for fuel leaks.
9. Lower the hood and secure.

23 412 2 INJECTION PUMP – CALIBRATE (injection pump removed)

The following procedure details the calibrating procedure using a Bosch Test Stand Fig. 2. When using other test stands consult the test stand manufacturers instructions.

Special Service Tools Required:

Bracing sleeve remover	KDEP 1027
Control valve remover/ replacer	KDEP 1086
Indicator tool	KDEP 2931
Banjo connector	1 683 385 011
Serrated connector	1 683 385 016
Supply connector	1 683 391 074
Hollow connector	1 683 456 000
Adaptor	1 683 458 019
Pump adaptor	1 685 720 062
Drive coupling tool	1 686 430 010CA
Dial gauge	1 687 233 012
Clamping bracket	1 688 010 011
Gauge set	1 688 130 075
Measuring tool	1 688 130 139

1. Fit the pump adaptor flange Special Tool No. 1 685 720 062 to the test stand clamping bracket, Special Tool No. 1 688 010 011 securely tighten the clamp bolts.
2. Fit the drive coupling Special Tool No. 1 686 430 010 CA, to the pump drive shaft. Fit the lockwasher and securely tighten the nut.
3. Engage the drive coupling with the machine drive head. To eliminate play, pull the clamping bracket together with the fuel injection pump away from the drive slightly. Whilst applying this pressure securely tighten the clamping bracket to machine bed bolt.
4. Fit the gauge set to the machine bed (Special Tool No. 1 688 130 075).
5. Fit the machine supply pipe to the pump with connector, Special Tool No. 1 683 391 074.
6. Fit the manometer graduated 0 to 0,6 kgf/cm² to the supply pipe connector.
7. Fit the banjo (Special Tool No. 1 683 385 011) to the 0 to 16 kgf/cm² graduated manometer feed pipe.
8. Fit the manometer feed pipe to the fuel outlet connection. Retain in position with the hollow connector, Special Tool No. 1 683 456 000.
9. Fit the plastic hose to the serrated banjo, Special Tool No. 1 683 385 016.
10. Fit the return hose to the hollow connector. Retain the hose assembly with the pump outlet hollow bolt.

    NOTE: The injection pump must only be tested with the hollow bolt as fitted in production; use of any other bolt will result in incorrect calibration readings.

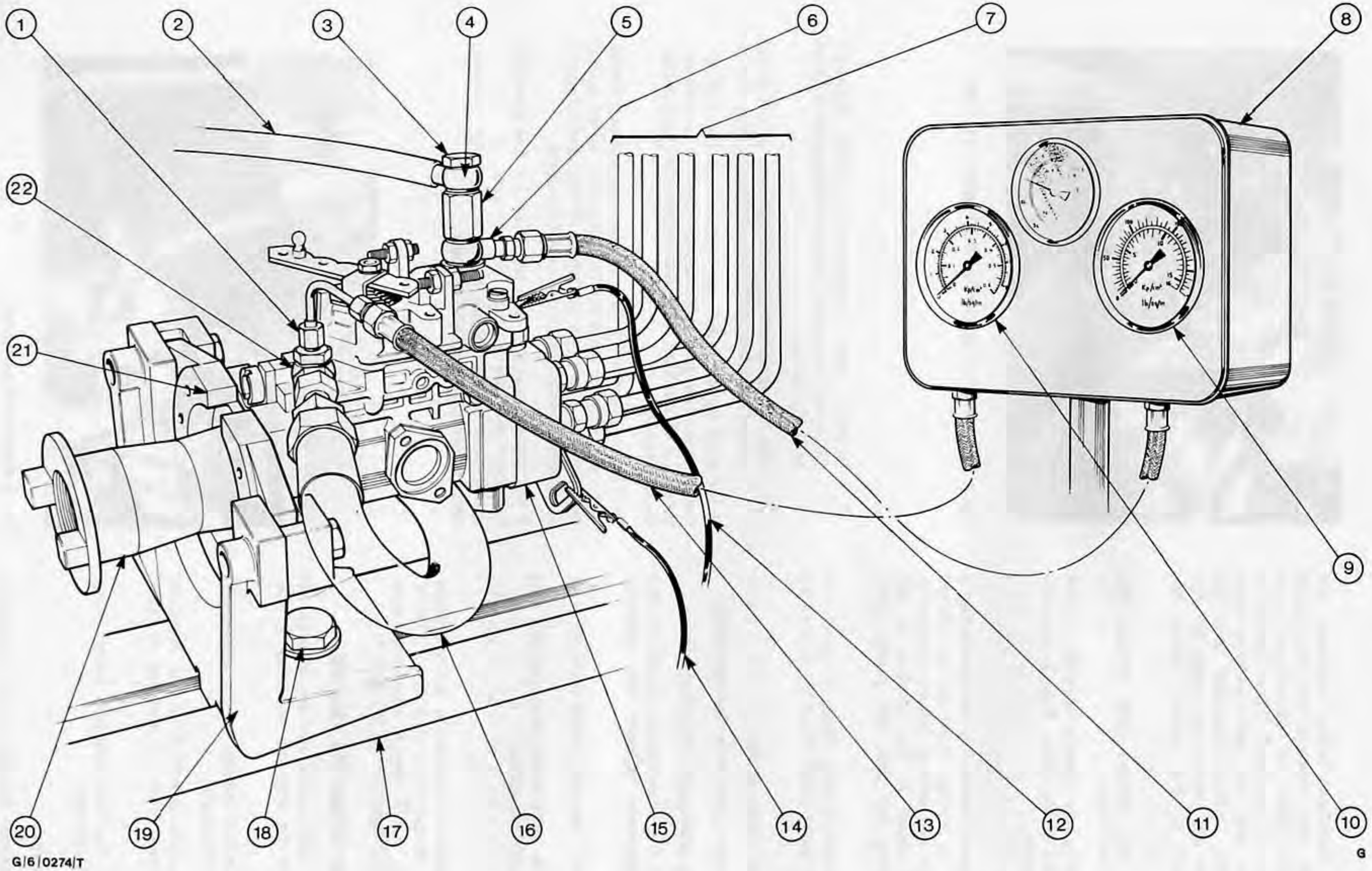


Fig. 2. Bosch Calibration Equipment

1. Supply connector, Special Tool No. 1 683 391 074
2. Plastic hose
3. Pump outlet hollow bolt
4. Serrated connector, Special Tool No. 1 683 385 016
5. Hollow connector, Special Tool No. 1 683 456 000
6. Manometer feed banjo connector, Special Tool No. 1 683 385 011
7. Injection tubes
8. Gauge set
9. Manometer graduated 0 to 16 kgf/cm²
10. Manometer graduated 0 to 0,6 kgf/cm²
11. Manometer supply pipe
12. Solenoid electrical supply
13. Manometer supply pipe
14. Solenoid electrical earth
15. Fuel injection pump
16. Test stand supply pipe
17. Machine bed
18. Clamp bolt
19. Clamping bracket, Special Tool No. 1 688 010 011
20. Drive coupling Special Tool No. 1 686 430 010 CA
21. Adaptor flange, Special Tool No. 1 685 720 062
22. Supply pipe banjo

23 412 2 (cont'd)

11. Fit the fuel injection tubes between the hydraulic head valve holders and the nozzle holder assembly (Note: All nozzles are to be set to 147 bar (147 kgf/cm²) (2091 lbf/in²). It is expedient to mark the fuel injection tubes relative to the letters stamped on the hydraulic head and route the tubes in the same sequence to the nozzle holder assemblies.
12. Remove the two screws and remove the timing device flat cover.
13. Fit the measuring tool Special Tool No. 1 688 130 139 to the pump body, Fig. 3, securely tighten the screws.

IMPORTANT NOTE:

The timing device travel measuring tool embodies a gauge and plunger. The plunger must not be entered in the advance piston end drilling, failure to observe this instruction will result in the bending of the plunger when aligning the tool and pump body screw holes.

14. Check the measuring tool 'Zero'. If correction is required the scale plate must be moved as follows:
    (a) Remove the outer circlip.
    (b) Slide the sight glass from the tool body.
    (c) Loosen the scale plate retaining screws.
    (d) Reposition the scale plate relative to the plunger, securely tighten the retaining screws.
    (e) Carefully refit the sight glass and circlip.
15. Fully retract the accelerator stop screws and disconnect the return spring.

Adjustments

For testing and adjustment purposes the specified test oil is used at a temperature of 313 to 318 °K (40 to 45 °C) (104 to 113 °F) and at a constant feed pressure of 0,2 bar (0,2 kgf/cm²) (2,85 lbf/in²).

Operating the pump to heat the Test Oil

1. Connect a 12 volt supply battery to shut off solenoid. Move the stop control lever to the start position.
2. Pull the accelerator linkage to the maximum fuel position and secure.
3. Set the feed pressure and drive the injection pump for approximately 10 minutes at rated speed.

IMPORTANT NOTE: The fuel injection pump must deliver fluid during this period.

Adjust full load delivery

1. Pull the accelerator linkage to the maximum fuel position and secure.

Fig. 3. Measuring Tool Special Tool No. 1 688 130 139

2. Release the adjustment screw locknut. Remove the screw, remove the spacer if fitted refit the screw.
3. Set the specified full load delivery at the given speed by rotating the adjustment screw, Fig. 4.

If full load delivery will not respond to the adjustment screw the governor may be 'cutting in' prematurely i.e. dimension 'MS' was incorrectly calculated during assembly.

NOTE: Ensure the 'O' ring on the adjustment screw does not emerge from the housing port when specified delivery has been obtained. If this does happen a shorter adjustment screw must be used.

If the adjustment screw is too short i.e. the specified full load delivery cannot be achieved or there is insufficient screw thread to fit the locknut a longer adjustment screw must be used.

Fig. 4. Adjust full load delivery

Set full load adjustment limits

To prevent unauthorised adjustment a spacer is fitted to the adjustment screw within the housing body.

4. Select a spacer that will allow the correct full load delivery but will only allow the adjustment screw to travel the maximum of $\frac{1}{3}$ of a turn further inwards, Fig. 5.
5. When the specified full load delivery is achieved and the correct spacer is fitted tighten the locknut to specifications.

Adjust the timing device travel and the supply pump pressure

1. Pull the accelerator linkage to the maximum fuel position and secure.
2. Via the centre screw bleed the measuring device, Special Tool No. 1688 130 139.
3. At the specified speed check the supply pump pressure and the timing device (advance piston) travel.

Adjust supply pump pressure

4. When the vent is pressed into the control valve, the supply pump pressure is increased and the timing device is thus advanced. Therefore to increase the supply pump pressure and advance the timing device carefully tap the control valve vent plug into the valve body.
5. If the supply pump pressure must be reduced the control valve vent plug must be drawn back.
6. Using Special Tool No. KDEP 1086 remove the control valve assembly from the pump body.
7. Enter the split nose of Special Tool No. KDEP 1027 into the control valve, Fig. 6.
8. Enter the central rod of Special Tool No. KDEP 1027 into the main tool body. Thus expand the tool nose and engage the valve bracing sleeve.
9. Hold the main tool firmly by the support arm, rotate the upper tool wheel and thus withdraw the bracing sleeve from the control valve.
10. Remove the valve plunger and spring.
11. Using a suitable mandrel press the control valve vent plug towards the valve upper face.
12. Replace the spring and valve plunger.
13. Using a suitable mandrel press a new bracing sleeve into the control valve body. When fitted the bracing sleeve must be flush with the end of the valve. The mandrel must insert the bracing sleeve without damage to either the sleeve or valve body i.e. no chips or burrs.
14. Fit two new 'O' rings to the valve body.

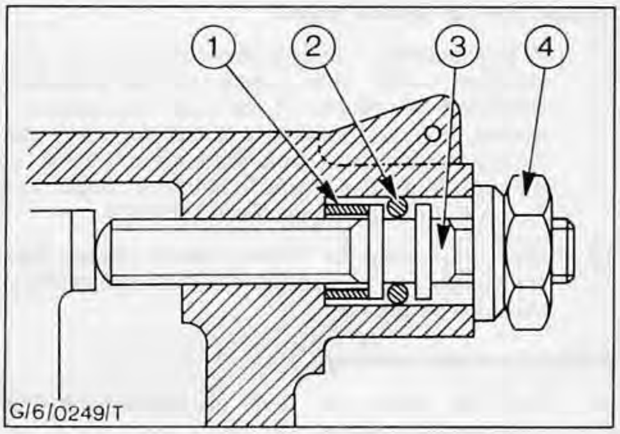


Fig. 5. Full load adjustment
1. Spacer
2. 'O' ring
3. Adjustment Screw
4. Lock nut

15. Using Special Tool No. KDEP 1086 fit the control valve to the pump housing, tighten to specifications.
16. The supply pump pressure may now be adjusted as detailed in operation number 4.

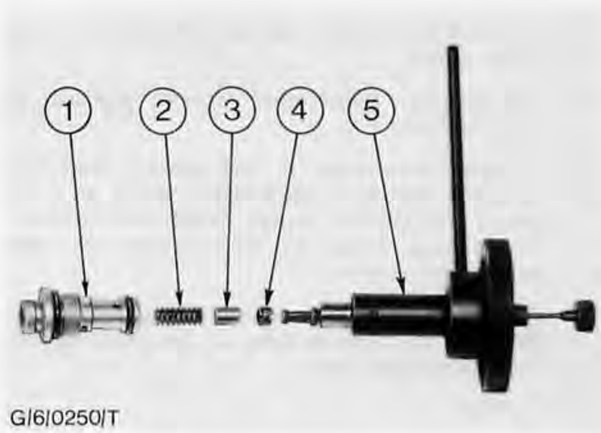


Fig. 6. Supply pump pressure control valve
1. Control valve
2. Valve spring
3. Valve plunger
4. Bracing sleeve
5. Special Tool no. KDEP 1027

23 412 2 (cont'd)

Adjust timing device travel

17. If the specified timing device travel is not attained when the supply pump pressure tolerance is utilized it can be changed by means of plain washers used to vary the spring preload. See specifications and 23 414 8 Fuel Injection Pump Overhaul (Injection Pump Removed). Operations 70 to 74.

18. After adjusting the timing device travel and the supply pump pressure the full load delivery must be rechecked.

Adjust low idle setting

1. Push the accelerator lever up against the idle speed adjustment screw, Fig. 7.
2. At the given speed set the specified idle delivery using the idle adjustment screw.
3. Measure the distance 'A' (see specifications). If the measured distance is not as specified the accelerator lever must be removed and rotated relative to the spindle.
4. Ensure the return spring, retaining bracket, lockwasher and nut are correctly repositioned. Tighten the nut to specifications.

Measure excess fuel for starting

1. At the specified speed check the fuel delivery. Note the speed at which the fuel delivery reading is taken must be approached from a lower speed i.e. do not exceed and then lower the r.p.m. to attain the specified speed.
2. If the excess fuel for starting value is not as specified, the dimension 'MS' (starting fuel) has been incorrectly calculated during assembly.

Adjust maximum speed setting

1. Push the accelerator linkage against the speed adjustment screw, Fig. 8.
2. Turn the speed adjustment screw inward until the specified amount of fuel is delivered at the given speed.
3. Tighten the adjustment screw locknut to specifications.
4. Measure dimension 'B' (adjustment distance) between the idle adjustment screw and the speed adjustment screw. Note: the accelerator linkage must be held against the idle adjustment screw.
5. If the measured dimension is not to specifications the wrong type of governor spring may have been fitted.

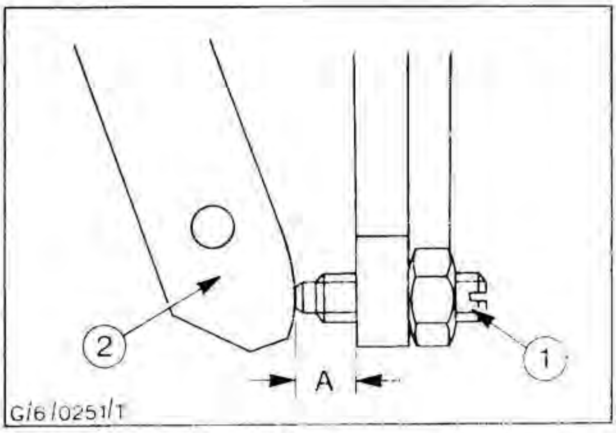


Fig. 7. Adjust low idle setting
1. Idle adjustment screw 2. Accelerator lever

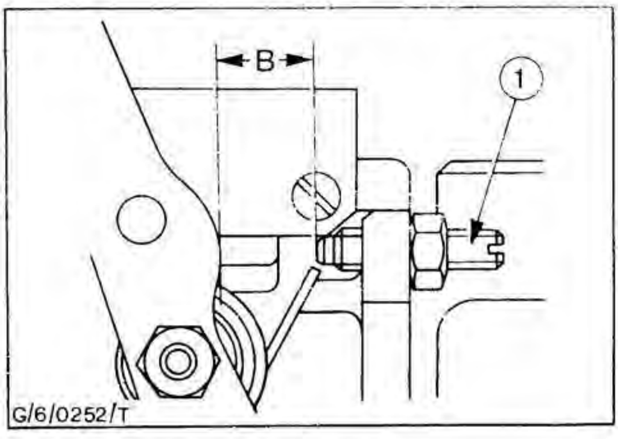


Fig. 8. Adjust maximum speed setting
1. Adjustment screw

Adjust timing, Fig. 9.

This procedure requires the pump flange to be fitted. The pump must therefore be temporarily removed from the test stand and held in a 'Soft Jaw' bench vice.

1. Fit the dial gauge Special Tool No. 1 687 233 012 to the indicator tool Special Tool No. KDEP 2931, securely tighten the allen screw clamp.
2. Fit the adaptor Special Tool No. 1 683 458 019 to the indicator tool, ensure the copper washer is correctly positioned, and securely tighten.
3. Push the adaptor plunger and ensure a dial indicator travel of 2 mm plus.
4. Remove the screw and copper washer from the central screw plug.
5. Fit the special tool assembly to the central screw plug. When fully tightened ensure the adaptor plunger has registered on the injection pump cam i.e. the dial gauge pointer has moved.

   NOTE: the dial indicator movement at this stage should not exceed approximately 0,05 mm. This dimension ensures a correct zero on the pump cam but allows sufficient unused movement for the cam lift readings.
6. Via the drive shaft nut rotate the pump in a clockwise direction (i.e. the direction of rotation in service).
7. Zero the dial indicator on the cam dwell prior to the plunger stroke for Number 1 cylinder i.e. the timing marks will be close to one another.
8. Continue to rotate the pump drive shaft and stop at the specified dial indicator reading.
9. Retain the pump in this position, loosen the adjustable timing marks align both marks and securely tighten the retaining screws.

Pre-stroke, Fig. 9.

10. Fit the spill pipe to the special tool assembly.
11. Via the drive shaft nut rotate the pump in a clockwise direction (i.e. the direction of rotation in Service).
12. Apply a test machine feed pressure of 20KN/m².
13. The flow from the spill pipe should 'cut off' at specified camlift, read from the dial indicator. An incorrect 'cut off' figure is corrected by changing the shim beneath the pump plunger i.e. dimension K was incorrectly calculated during assembly. If dimension K is checked and a revised shim is fitted beneath the plunger, dimension KF must also be checked as the two dimensions are inter related.
14. Remove the special tool.
15. Fit the screw and copper washer to the central screw plug tighten to specifications.

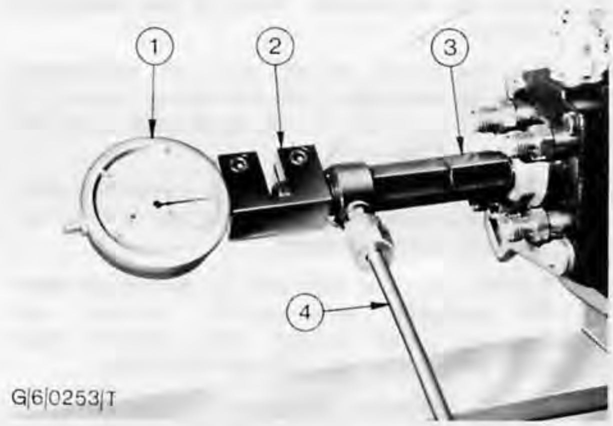


Fig. 9. Timing and pre-stroke adjustment
1. Dial guage Special Tool No. 1687 233 012
2. Indicator tool Special Tool No. KDEP 2931
3. Adaptor Special Tool No. 1683 458 019
4. Spill pipe

Testing

Test timing device travel and supply pump pressure

1. Push the accelerator lever up against the adjustment screw (maximum fuel position).
2. At the specified speeds check the supply pump pressures and the timing device travel.
3. Incorrect values must be rectified as previously detailed in **Adjust supply pump pressure** and **Adjust timing device travel.**

NOTE: Defects in the supply pump or in the valve affect both the supply pump pressure and the timing-device travel. Defects in the timing device (i.e. the wrong type of spring) affect the timing device travel only.

Test zero delivery (Stop) Electric solenoid type

1. Hold the accelerator lever in the maximum position.
2. Run the pump at 100 rpm, for **no longer than 30 seconds**, with no voltage applied to the stop solenoid. The pump should deliver no fuel to the injectors.
3. Connect a variable D.C. supply to the solenoid; positive supply to the solenoid spade terminal, negative supply to earth.
4. Run the pump at 100 rpm, for **no longer than 30 seconds**, and steadily increase the solenoid supply voltage. Fuel delivery must start before a supply voltage of 8 volts.
5. Reduce the supply voltage to 6 volts. Measure the fuel delivery over 100 shots, see specifications.
6. Increase speed to 1800 rpm measure the fuel delivery over 200 shots, see specifications.
7. Terminate electrical supply, fuel delivery should cease within 2 seconds.

Mechanical type

1. Hold the accelerator lever in the maximum position.
2. Run the pump at 100 rpm with stop control lever in the stop position. The pump should deliver no fuel to the injectors.
3. Allow the stop control lever to move towards the run position under the influence of the spiral return spring, i.e. do not assist the lever movement.
   Fuel delivery should start at the injectors within 2 seconds.
4. Measure the fuel delivery over 100 shots, see specification.
5. Increase speed to 1800 rpm and measure the fuel delivery over 100 shots, see specification.
6. Pull the control lever to the stop position, fuel delivery should cease within 2 seconds.

MEASURE THE OVERFLOW QUANTITY

1. Push the accelerator lever up against the adjustment screw (maximum fuel position).
2. Measure the overflow quantity of test oil returned using a suitable measuring glass, at the specified speed. Incorrect values must be rectified by checking (a) **Supply Pump Pressure,** and (b) that the outlet hollow bolt orifice is unobstructed.

NOTE: Outlet hollow bolts are matched to each individual fuel injection pump. The fitment of an incorrect bolt would therefore lead to incorrect pump operation.

Testing fuel delivery and breakaway characteristic

1. Measure the amounts of fuel delivered at the given speeds with the accelerator lever in the specified position.

   Incorrect values must be rectified by checking the **full load delivery.**
2. Remove the connections and thus disconnect the fuel injection pump from the manometers.
3. Remove the fuel injection tubes from the hydraulic head.
4. Remove the measuring tool from the timing device fit the cover and tighten the securing screws to specification.
5. Remove the pump/adaptor flange from the test stand.
6. Remove the pump from the adaptor.
7. Fit the pump flange, securely tighten the retaining bolts.
8. Fit the drive pulley to the pump drive shaft. Fit the lockwasher and nut, tighten the nut to specifications.

23 414 INJECTION PUMP – REMOVE AND INSTALL

Special Service Tools Required:

Timing peg 21 016

To remove the timing belt cover

1. Raise the hood and secure with the stay.
2. Drain the cooling system.
3. Disconnect the battery.
4. Remove the air cleaner assembly.
5. Disconnect the top hose at the radiator location.
6. Disconnect the expansion tank to hose mounting bracket, remove the hose and bracket assembly.
7. Fit the pump flange, securely tighten the retaining bolts.
8. Remove the radiator mounting bolts and rubber mountings, remove the radiator.
9. Slacken the vacuum pump drive belt jockey pulley and remove the drive belt.
10. Slacken the alternator mounting bolts and remove the alternator drive belt.
11. Remove the four fan retaining bolts and remove the fan, spacer and pulley.
12. Remove the screws securing the timing belt cover to the engine and remove the timing belt cover.

To remove the injection pump

13. Disconnect the throttle cable from the injection pump.
14. Disconnect the stop control lead/cable.
15. Remove the injection pump fuel feed and return pipes, fit dust caps. Retain the outlet banjo securing bolt in the injection pump protected by a suitable sleeve.
16. Remove the injector delivery pipes from the injectors and injection pump, fit dust caps.
17. Turn the engine to T.D.C. with No. 1 piston on compression stroke and locate the timing peg (Special Tool No. 21 016) through the hole in the camshaft gear and the engine front cover, Fig. 10.
18. Slacken the injection pump drive gear retaining bolts.
19. Slacken the timing belt tensioner retaining bolts, return the tensioner to the unloaded position, and securely tighten the tensioner retaining bolts, remove the timing belt from the injection pump drive gear.
20. Remove the previously slackened injection pump drive gear bolts, remove the plate and drive gear from the injection pump.
21. Remove the two bolts which secure the pump rear support bracket to the engine block, Fig. 11.

Fig. 10 Timing peg Special Tool No. 21 016

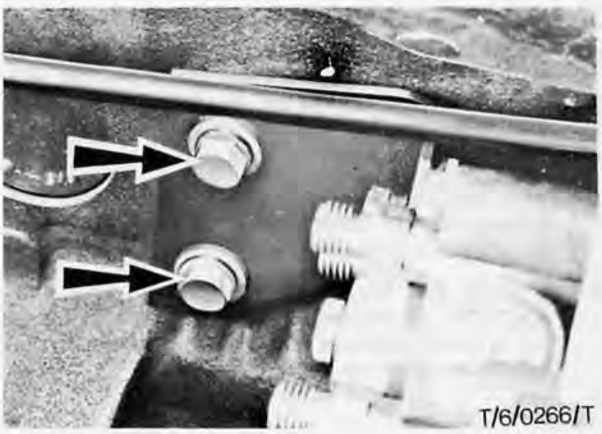


Fig. 11. Pump rear support bracket retaining bolts

23 414 (cont'd)

22. Slacken the engine block bracket to pump rear support bracket retaining nut.
23. Remove the remaining nuts and bolts and the throttle cable bracket retaining bolt from the pump mounting plate, remove the pump and mounting plate assembly from the vehicle, Fig. 12.
24. Remove the support bracket assembly from the rear of the injection pump.

Fig. 12. Pump and mounting plate, both removed from front cover

To install the injection pump

25. Clean all mating surfaces.
26. Fit the support bracket to the rear of the injection pump and secure but do not tighten the retaining nut.
27. Position the injection pump in the engine front cover and secure with the two nuts and bolts.
28. Replace the accelerator cable bracket and secure with the retaining bolts.
29. Fit the two lower pump mounting plate bolts.
30. Securely tighten the pump mounting plate retaining nuts and bolts.
31. Fit the pump rear support bracket to the engine block and secure with the two retaining bolts.
32. Securely tighten the engine bracket to pump rear support bracket nut.
33. Remove the dust caps, replace the injector delivery, fuel feed and return pipes, securely tighten, Fig. 13.

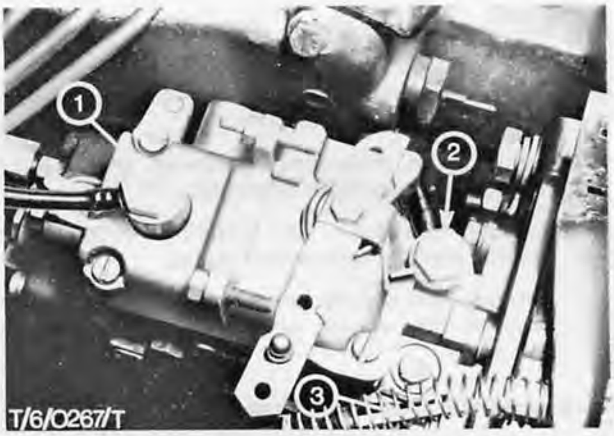


Fig. 13. Pump installation
1. Fuel return
2. Fuel feed
3. Accelerator cable

34. Assemble the drive gear ('FORD' stamped letter outermost) and plate to the injection pump, replace the retaining bolts but do not tighten. The bolt holes in the pump drive flange are arranged so the drive gear can only be located in one position.
35. Turn the injection pump drive gear until the timing pointer coincides with the TDC mark on the drive gear.
36. Ensure the timing peg (Special Tool No. 21 016) is located in the camshaft/engine front cover position and the crankshaft timing marks are aligned, Fig. 14.

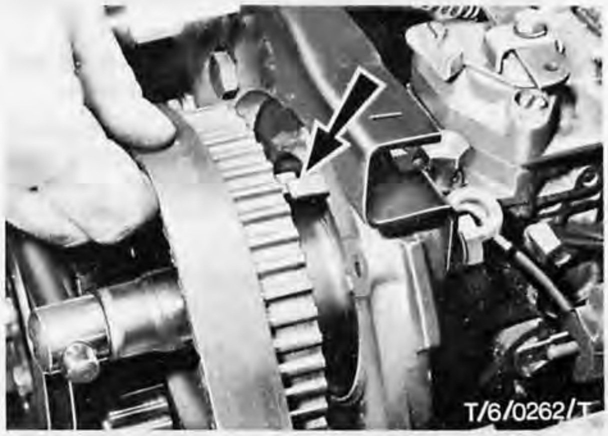


Fig. 14. Timing marks

37. Assemble the timing belt on the injection pump drive gear ensuring the timing marks do not move and the timing belt serrations are aligned with the gear teeth. If necessary move the drive gear in the pump using the slotted holes in the gear to allow the belt to mesh. It will be necessary to hold the injection pump gear in the TDC position whilst replacing the drive belt.

38. Securely tighten the drive gear retaining nuts.

39. Slacken the timing belt tensioner retaining bolts, actuate the tensioner mechanism by sharply depressing the longest span of the timing belt.

40. Securely tighten the tensioner retaining bolts and remove the timing peg (Special Tool No. 21 016) from the camshaft gear.

41. Rotate the crankshaft two revolutions in the normal rotational direction and recheck the injection pump timing, adjust if necessary by slackening the pump drive gear retaining nuts and moving the pump within the slotted holes in the drive gear. Securely tighten the gear retaining nuts.

42. Replace the stop control lead/cable and connect the throttle cable.

43. Bleed the fuel system as detailed in Operation No. 23 142.

To replace the timing belt cover

44. Replace the timing belt cover; fit and securely tighten the retaining screws.

45. Replace the fan pulley, spacer and fan assembly, securely tighten the four retaining bolts.

46. Replace the alternator drive belt and adjust via the alternator to the specified belt deflection measurement, securely tighten the alternator mounting bolts

47. Replace the vacuum pump drive belt and adjust via the jockey pulley to the specified belt deflection measurement, securely tighten the jockey pulley retaining nuts.

48. Replace the four radiator mounting rubbers and radiator, securely tighten the mounting bolts.

49. Fit the air return hose to the expansion tank, securely tighten the hose clip.

50. Replace the hose and bracket assembly to the expansion tank, securely tighten the hose clips and bracket retaining bolt.

51. Fit and securely tighten the top hose at the radiator location.

52. Replace the air cleaner assembly.

53. Refill the cooling system.

54. Connect the battery, start the engine, check for oil, fuel, and water leaks.

55. Lower the hood and secure.

23 414 8 FUEL INJECTION PUMP – OVERHAUL (Injection pump removed)

Special Service Tools Required:

Base adaptor	KDEP 1032
Screw plug remover/replacer	KDEP 1080
Governor shaft nut remover/ replacer	KDEP 1082
Register block	KDEP 1084
Control valve remover/replacer	KDEP 1086
Mounting yoke	KDEP 2963
Adaptor flange	1 685 720 062
Dial gauge	1 687 233 012

To Dismantle

1. Remove the drive shaft nut and washer.
2. Using a suitable puller remove the drive pulley.

   NOTE: When removing the drive pulley under no circumstances 'strike' the drive shaft as serious pump damage will result.
3. Remove the three bolts and remove the pump flange.
4. Fit the pump to the adaptor flange (Special Tool No. 1 685 720 062).
5. Fit the pump/adaptor to the mounting yoke (Special Tool No. KDEP 2963). Fit the yoke to support clamp or a suitable bench vice, Fig. 15.
6. Remove the screws and carefully lift off the housing cover, Fig. 16.
7. Unhook the **governor** spring from the retaining pin.
8. Remove the accelerator linkage centre nut and the spring retaining bracket.
9. Mark the accelerator linkage relative to the spindle, remove the linkage and return spring.
10. Remove the spindle and interior linkage from the housing cover.

Remove mechanical shut-off (if fitted)

11. Unhook mechanical shut-off return spring.
12. Remove shut-off lever retaining nut and lockwasher.
13. Remove outer lever, shim and seal.
14. Push the shaft into the housing cover and thus remove the shaft and inner linkage from the cover.

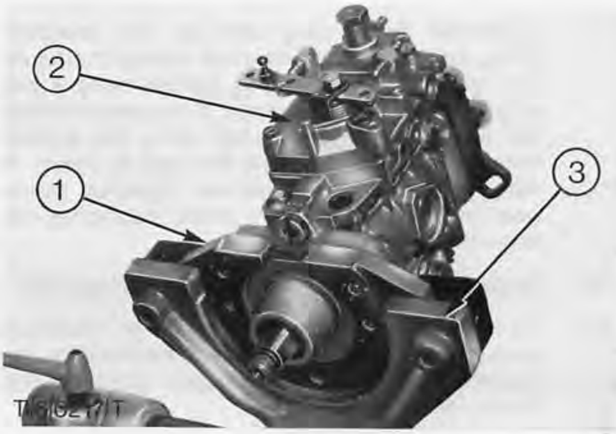


Fig. 15. Mounting the fuel pump
1. Adaptor Special Tool No. 1 685 720 062
2. Fuel injection pump
3. Mounting yoke Special Tool No. KDEP 2963

Fig. 16. Lift off the housing cover

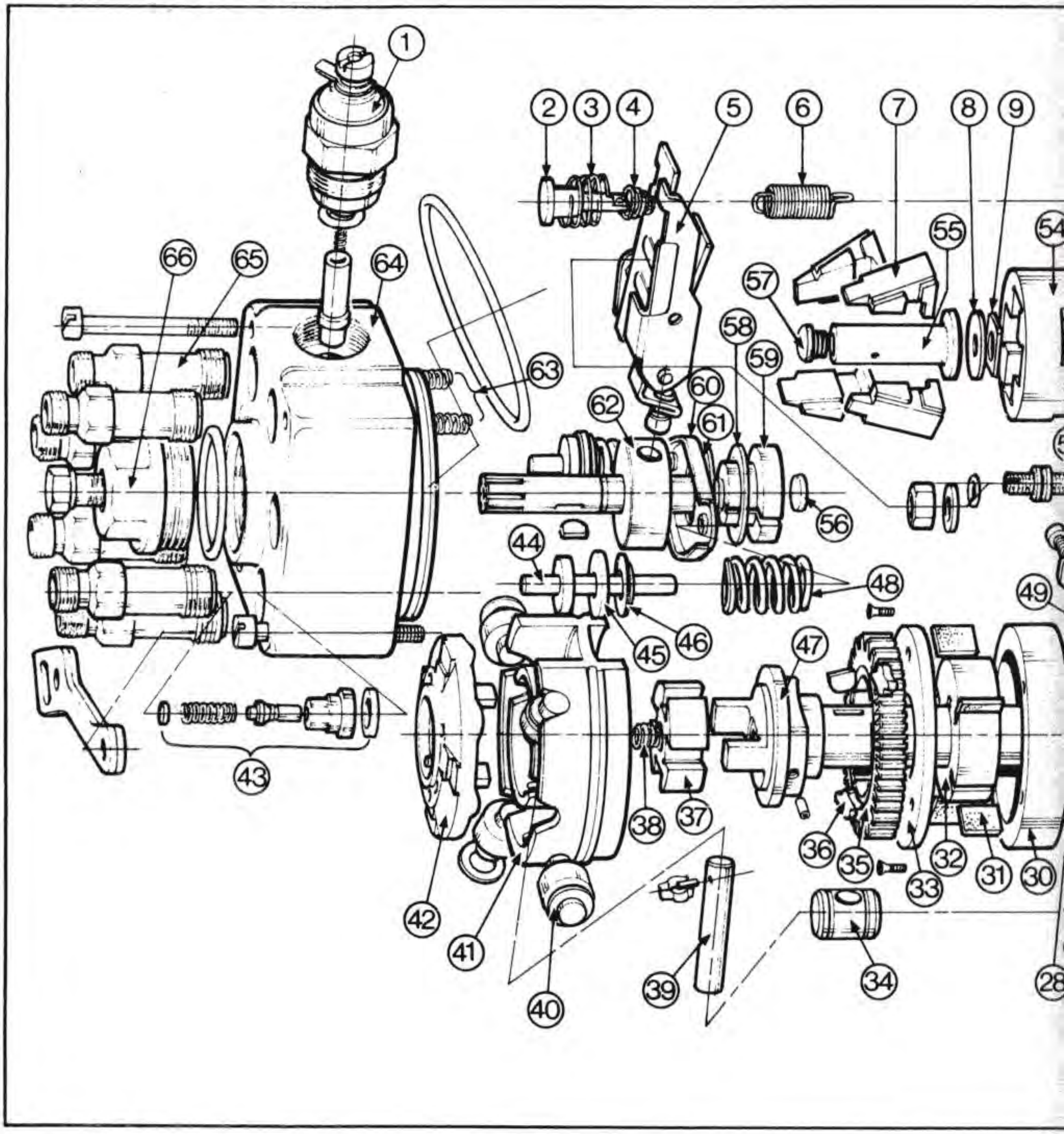
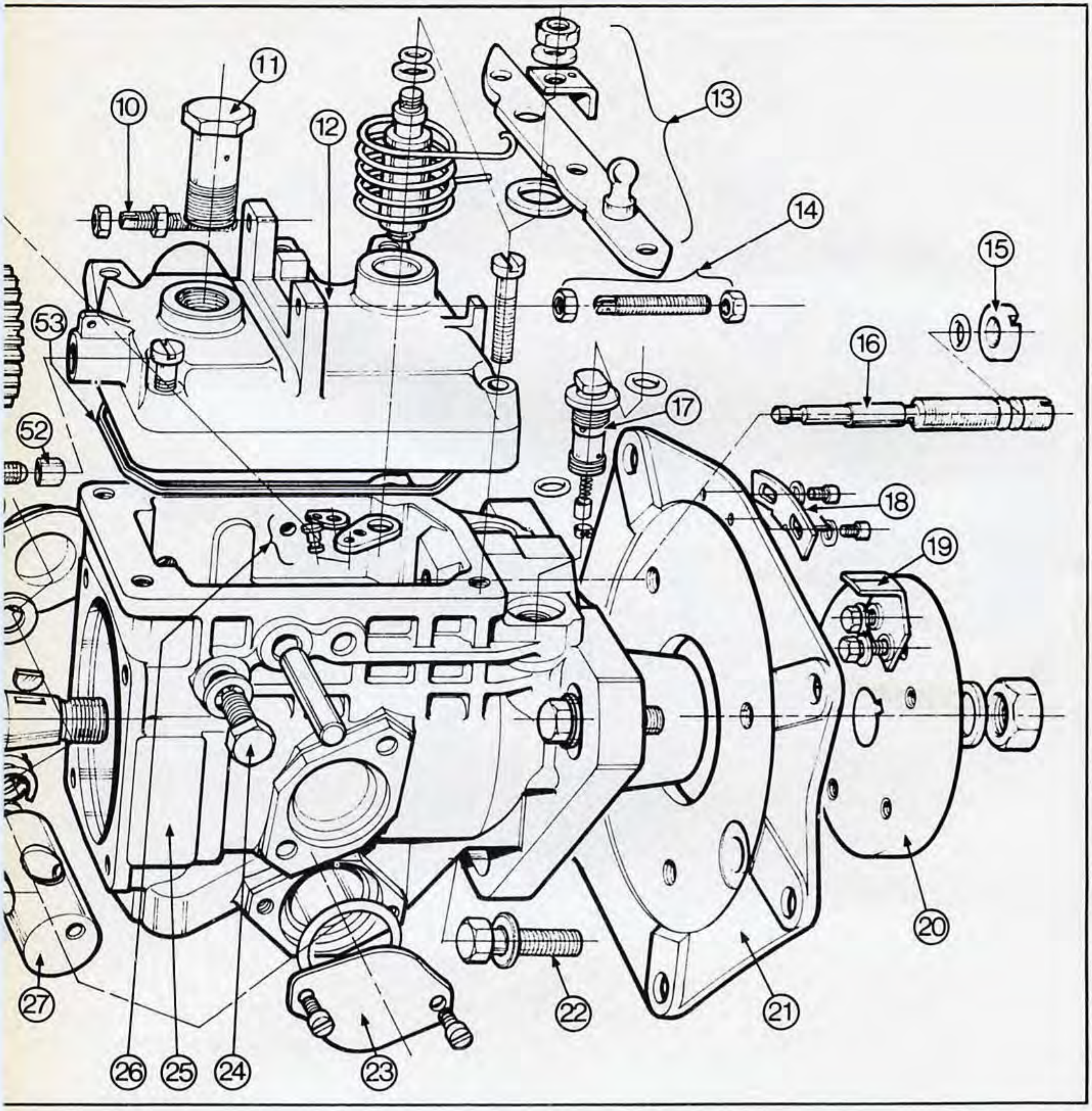


Fig. 17 Fuel Injection Pump

1. Solenoid
2. Retaining pin
3. Outer compression spring
4. Inner compression spring
5. Control lever assembly
6. Governor spring
7. Flyweight
8. Shim
9. Shim plate
10. Speed adjustment screw
11. Pump outlet hollow bolt
12. Housing cover
13. Accelerator lever assembly
14. Adjustment screw and locknuts
15. Governor shaft slotted nut
16. Governor shaft
17. Pressure control valve
18. Adjustable timing mark
19. Fixed timing mark
20. Drive pulley
21. Pump flange
22. Retaining bolt
23. Timing device flat cover
24. Control lever pivot bolt
25. Pump body
26. Accelerator interior linkage
27. Advance piston
28. Piston compression spring
29. Shim
30. Vane pump eccentric ring
31. Vane
32. Vane pump impellor
33. Vane pump retaining plate



34. Cross piece
35. Drive gear
36. Rubber buffer
37. Drive coupling
38. Camplate compression spring
39. Connecting shaft
40. Roller assembly
41. Cam roller ring
42. Camplate
43. Valve assembly
44. Spring carrier
45. Shim
46. Upper spring plate
47. Drive shaft
48. Plunger spring
49. Shim
50. Recess cover
51. Full load delivery adjustment screw
52. Spacer
53. Housing cover seal ring
54. Governor gauge
55. Sliding sleeve
56. Plunger base shim
57. Sliding sleeve nipple
58. Thrust washer
59. Pump plunger
60. Lower spring plate
61. Shim
62. Governor control sleeve
63. Compression springs
64. Hydraulic head
65. Valve holder
66. Screw plug

All models

15. Remove the retaining pin and helical compression springs from the tensioning lever, Fig. 18.

16. Position the pump vertically and using the socket part only of Special Tool No. KDEP 1082 slacken the governor shaft slotted nut.

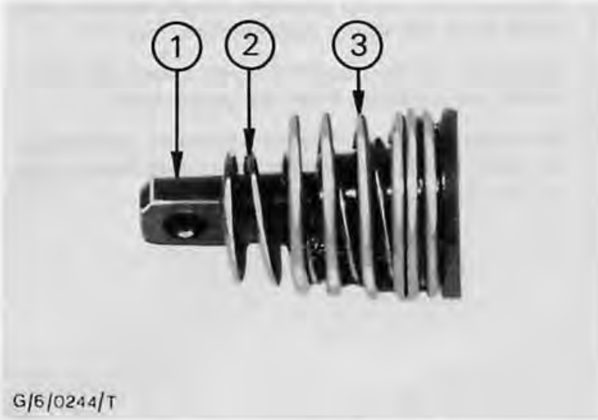


Fig. 18. 1. Retaining Pin 2. Inner compression spring 3. Outer compression spring

17. Unscrew the governor shaft, lift out the flyweight assembly, shims and shim plate, Fig. 19.

18. Remove the flyweights, spacer and sliding sleeve from the governor cage.

19. Using Special Tool No. KDEP 1080 remove the screw plug and 'O' ring.

20. Note the relative positions i.e. A, B, C, D and remove the delivery valve holders, shims, springs and the two valve components from the hydraulic head.

21. Remove the copper washers from the hydraulic head.

22. Remove the fuel shut-off solenoid if fitted.

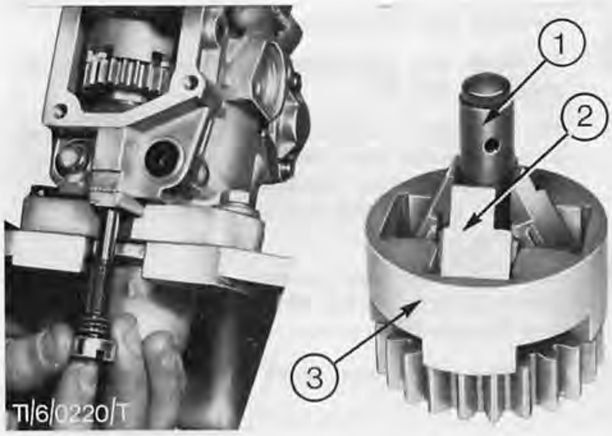


Fig. 19. Unscrew the governor shaft
1. Sliding sleeve
2. Flyweight
3. Governor cage

23. Remove the screws and remove the hydraulic head. During this operation care must be taken as once the hydraulic head is removed the compression springs, plunger springs, guides, shims, upper and lower spring plates are no longer positively retained, Fig. 20.

24. Lift out the pump plunger, governor control sleeve, springs and spring carrier assemblies.

NOTE: A shim is located beneath the plunger assembly.

25. Remove the spring and spring retainers.

26. Remove the shims and upper spring plates from the spring retainers.

27. Remove the governor central sleeve from the pump plunger.

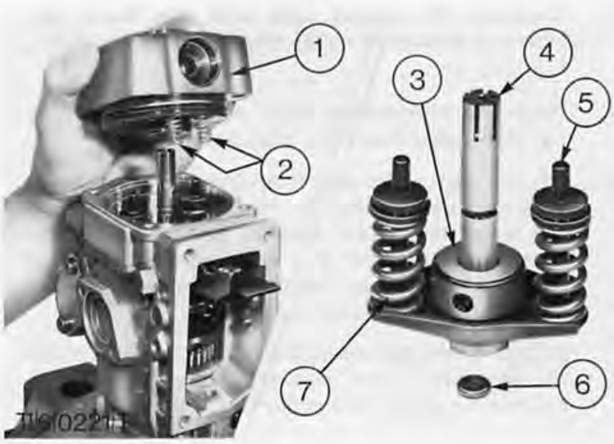


Fig. 20. Remove hydraulic head and pump plunger assembly
1. Hydraulic head
2. Compression springs
3. Governor control sleeve
4. Pump plunger
5. Spring carrier
6. Plunger base shim
7. Plunger spring

23 414 8 (cont'd)

28. Remove the pump plunger thrust washer and shim from the lower spring plate, Fig. 21.
29. Remove the two control lever assembly pivot bolts and washers from the pump body.
30. Remove the control lever assembly consisting of start lever, tensioning lever and correction lever from pump interior.

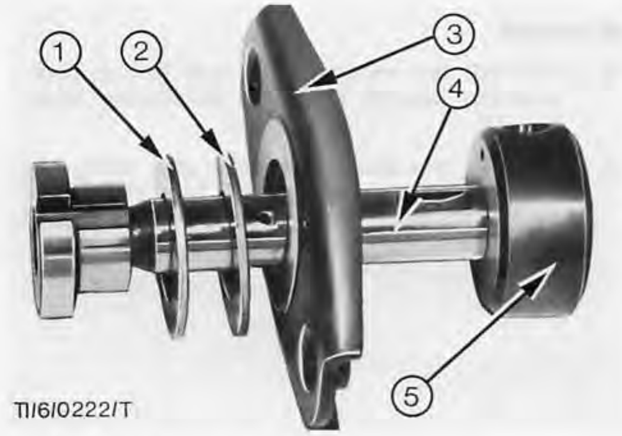


Fig. 21. Pump plunger assembly
1. Thrust washer
2. Shim
3. Lower spring plate
4. Pump plunger
5. Governor control sleeve

31. Remove the cam plate.
32. Remove the compression spring and drive coupling, Fig. 22.
33. Remove the two screws and remove the timing device flat cover (right hand side of pump body when viewed from the hydraulic head to pump body mating face). Discard the 'O' ring.
34. Remove the two screws and remove the timing device 'recess' cover. Remove the shim and compression spring. Discard the 'O' ring.
35. Remove the inner shim from the advance piston.

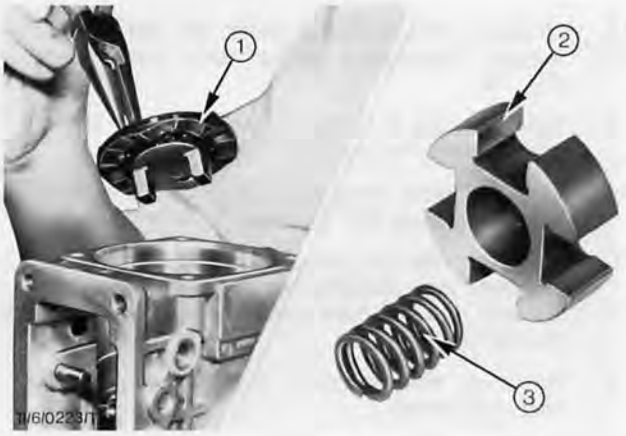


Fig. 22. 1. Camplate 2. Drive coupling 3. Compression spring

36. Remove the spring clip and pin from the advance piston to roller ring connecting shaft, Fig. 23.
37. Slide the connecting shaft into the roller ring i.e. disengage from the advance piston.
38. Lift the cam roller ring from the pump body. Caution. Each roller is machine matched to the inner and outer ring to ensure rotational flatness. Therefore if a roller is displaced it must be refitted to the correct (original) roller seats in the inner and outer ring.

    NOTE: when removed the cam roller ring must be protected by a suitable cover to prevent both dirt ingress and roller displacement.

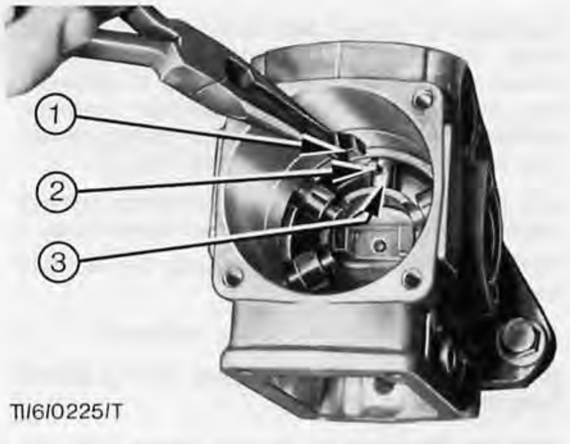


Fig. 23 1. Spring clip 2. Pin 3. Connecting shaft

39. Remove the advance piston and cross piece, Fig. 24.

Fig. 24. 1. Advance piston 2. Cross piece

40. Remove the drive shaft assembly. Remove the thrust washer, gear and rubber buffers, Fig. 25.

41. Remove the two screws and thus remove the vane pump retaining plate.

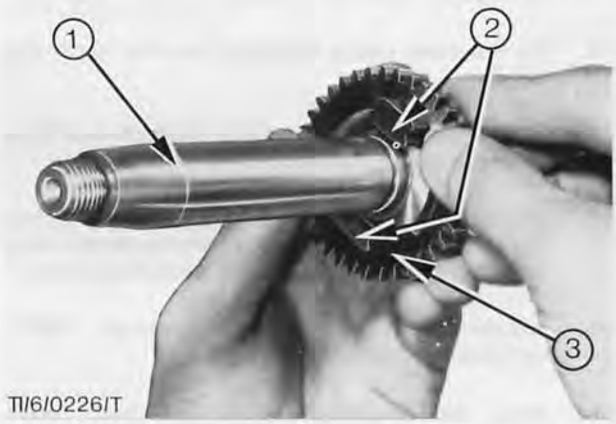


Fig. 25. Driveshaft assembly
1. Drive shaft
2. Rubber buffers
3. Drive gear

42. Position a suitable circular mandrel against the vane pump. The mandrel diameter must be large enough to cover the outer eccentric ring.

43. Invert the pump, gently tap the pump body with a rubber hammer. Thus remove the vane pump assembly supported upon the mandrel.

44. Using Special Tool No. KDEP 1086 remove the pressure control valve, Fig. 27.

45. Carefully remove the drive shaft oil seal from the pump body.

46. (a) Throughly clean all parts in clean diesel fuel oil or fuel oil substitute.
 (b) Discard all 'O' rings.
 (c) Replace all worn and damaged parts.
 (d) The control edges of the pump plunger must be sharp and the contact surfaces must not exhibit any running cracks/tracks.
 (e) The following assemblies are to be replaced as units.

Pump plunger and governor control sleeve; Cam roller ring and rollers; vane pump impeller, vanes and eccentric ring.

Fig. 26. Remove the vane pump

23 414 8 (cont'd)

To Reassemble

47. When assembling fuel pump components all parts including 'O' rings must be lubricated with fuel oil substitute.

    NOTE: The working surface and area must be clean when assembling the pump parts. The ingress of foreign particles will result in fuel pump/system failure.

48. Position the vane pump retaining plate, impeller vanes and eccentric ring on the removal mandrel as follows:

49. Place the retaining plate on the mandrel.

50. The two holes opposite each other in the eccentric ring are not equally spaced to the inner edge of the ring. The hole furthest from the inner edge must be positioned on the right when looking onto the assembled mandrel and retaining plate, Fig. 28.

51. Fit the vane pump impeller into the eccentric ring.

52. Fit the vanes to the impeller with convex face ends contacting the eccentric ring.

53. Introduce the assembled vane pump parts into the pump body, ensure the third eccentric ring hole is positioned towards the housing cover.

54. Rotate the pump housing through 180°, remove the mandrel.

55. Align the retaining plate holes with those machined in the eccentric ring.

56. Ensure the third hole (see sub operation 53) remains positioned towards the housing cover.

57. Fit and tighten the countersunk-head retaining screws to specifications.

58. Ensure the vane pump is free to rotate beneath the retaining plate.

59. If the spring pin (roll pin) has been removed a new pin must be pressed into the drive shaft to the dimension specified, Fig. 29. Remove any loose metal.

60. Push the gear wheel onto the drive shaft, the gear recess must face the drive coupling.

61. Press two new rubber buffers into the gear recesses.

62. Using a suitable grease fit the thrust washer and key to the drive shaft.

63. Using a suitable mandrel fit a new drive shaft oil seal to pump body.

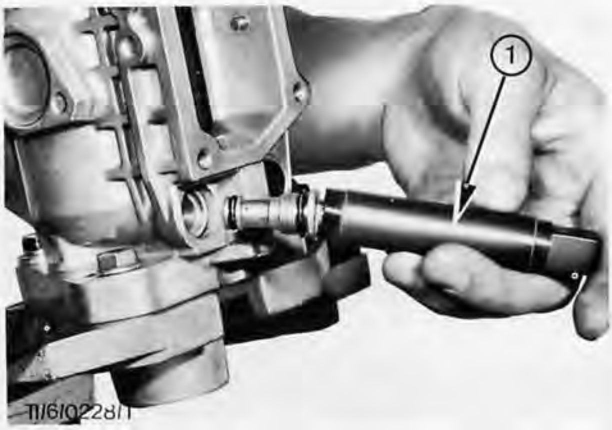


Fig. 27. Remove the pressure control valve
1. Special tool no KDEP 1086

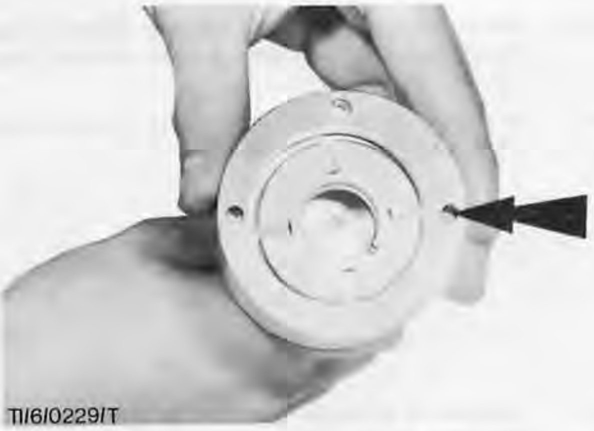


Fig. 28. Hole furthest from inner edge positioned on right when viewed from above

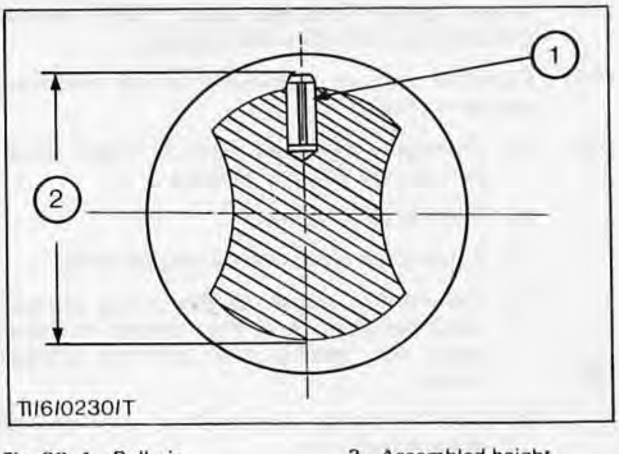


Fig. 29. 1. Roll pin 2. Assembled height (see specifications)

64. Protect the seal lip with a suitable assembly sleeve.

65. Position the pump body in the vertical plane and insert the assembled drive shaft.

66. Engage the drive shaft key with the vane pump impeller keyway, Fig. 30.

67. Prepare the cam roller ring. If despite all the precautions detailed in sub-operation 38, the relative roller positions are not known the height of the rollers assembled in the cam roller ring must be measured. The difference in assembled roller heights must not exceed 0,02 mm (0,0008 inches) when fitting rollers to the roller ring ensure the spring seat is positioned on the roller outer face, crown side towards the outer ring.

68. Fit the connecting shaft to the roller ring, position the cross bore vertically.

69. Carefully fit the cam roller ring to the pump body, ensure the connecting shaft points in the direction of the advance piston bore, Fig. 31.

70. Fit the cross piece and inner shim to the advance piston, retain in position with a suitable grease.

71. Fit the advance piston into the housing bore so that the compression spring recess is on the same side as the pump body return bore.

72. Engage the connecting shaft with the advance piston cross piece.

73. Fit the connecting shaft retaining pin, fit the spring clip.

74. Check the advance piston for freedom of movement.

75. Fit a new 'O' ring, fit and secure the timing device flat cover. Tighten the screws to specifications.

76. From the specification sheet determine the advance piston shim pack requirement.

77. Assemble the correct shim pack. Fit one shim to the advance piston, Fig. 32.

78. Fit the remaining shims to the cover recess.

79. Fit the compression spring.

80. Fit a new 'O' ring to the recess cover, fit and secure the cover. Tighten the screws to specifications.

NOTE: At least one shim must be fitted each side of the advance piston compression spring.

81. Assemble the pressure control valve with two new 'O' rings.

Fig. 30. Fit gear to shaft; recess to drive coupling

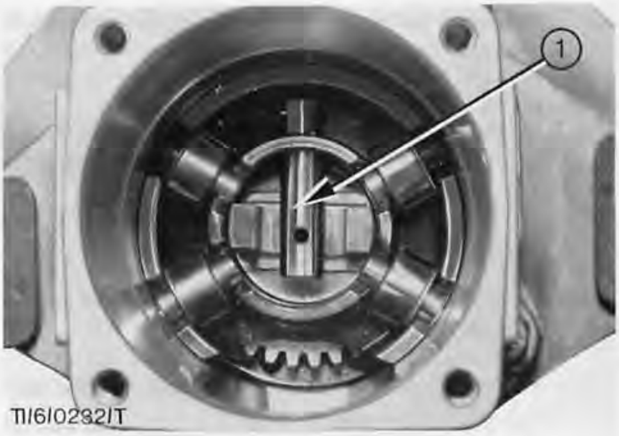


Fig. 31. Connecting shaft positioned towards advance piston

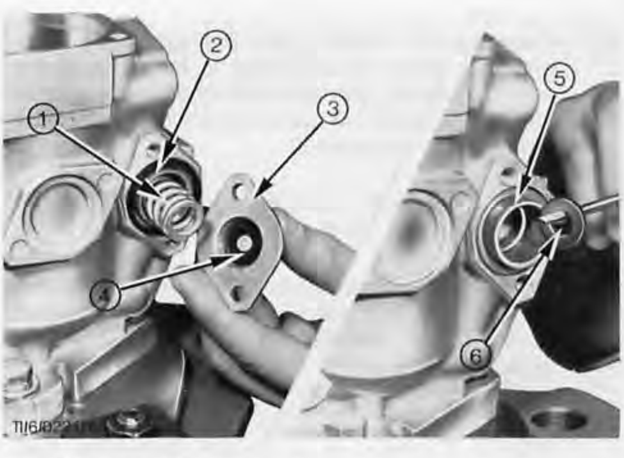


Fig. 32. Assemble advance piston
1. Compression spring
2. Advance piston
3. Recess cover
4. Recess cover shims
5. Advance piston
6. Advance piston shim

23 414 8 (cont'd)

82. Using Special Tool No. KDEP 1086 fit the pressure control valve to the pump body.

83. Fit the drive coupling into the cam roller ring, compression spring recess uppermost.

84. Fit the cam plate to the drive coupling.

NOTE: To ensure correct timing the cam plate drive pin must be aligned with the drive shaft key way. Incorrect alignment relative to the drive shaft will result in engine damage.

To determine the dimension 'KF' (plunger – spring stroke). The dimension 'KF' is the distance between the sealing surface on hydraulic head and the end face surface of the pump plunger.

85. Fit the base adaptor Special Tool No. KDEP 1032 to the dial indicator Special Tool No. 1 687 233 012, Fig. 33.

86. Using a suitable flat plate adjust the base adaptor to give a total plunger travel of 25 mm (indicated on the red hand).

87. Fit the spring guide pins to the hydraulic head, fit the upper spring plates to the pins, Fig. 34.

88. Fit the springs (no shims to be fitted) to the upper plate and pin assemblies.

89. Fit the thrust washer and shim to the pump plunger.

90. Fit the lower spring plate to the pump plunger.

91. Fit the plunger/lower spring plate assembly to the hydraulic head and assembled components.

92. Hold the hydraulic head in the horizontal position.

93. Push lightly against the plunger base, this pressure must be sufficient to hold the lower spring plate in contact with the compression springs. Under no circumstances must the springs be compressed.

94. Enter the dial indicator plunger into the hydraulic head via the screw plug aperture.

95. Compare the measured dimension (red figures on the dial indicator) with the normal value given in the specifications for 'KF', Fig. 35, equalise with shims fitted beneath the upper spring plates.

NOTE: If there is a choice between two different thicknesses of spacer, the thicker spacer is to be used. Do not fit two shims of the same dimension to the same guide pin.

Fig. 33. Dial indicator and base adaptor

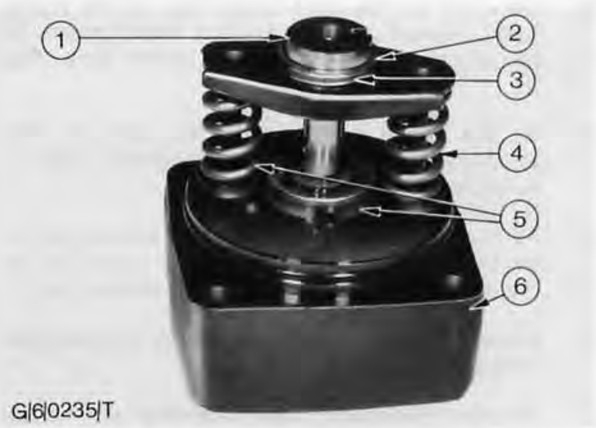


Fig. 34. Hydraulic head assembly
1. Pump plunger
2. Thrust washer
3. Shim
4. Spring
5. Spring and Governor control sleeve
6. Hydraulic head

Fig. 35. Measure the dimension 'KF'

96. Disassemble the hydraulic head.

To adjust the relative position of the diameter pump plunger (dimension 'K').

NOTE: For this adjustment the drive coupling compression spring must be removed.

97. Place any dry shim in the plunger base.

    IMPORTANT: use no adhesive agent i.e. grease.

98. Fit the plunger and shim to the cam plate. Ensure the cam plate drive pin engages with the plunger base slot.

99. Carefully without disturbing the assembled parts, fit the hydraulic head over the pump plunger. Fit the hydraulic head retaining screws and tighten to specifications.

100. Rotate the drive shaft and position at any BDC.

101. The dimension 'K' is the distance between the sealing surface of the end face of the hydraulic head and the end face of the pump plunger.

102. Measurement of 'K' is carried out in the same way as was the dimension 'KF' using the same Special Tools i.e. KDEP 1032 and 1 687 233 012 set at the nominal 25 mm (1,0 in), Fig. 36.

103. Compare the measured dimension (red figures on the dial indicator) with the nominal value given the specifications for 'K', equalise with shims fitted beneath the plunger base.

104. If the measured dimension is greater than the specified nominal value of 'K' a thicker shim needs to be inserted, whilst if the measured dimension is less than the nominal value of 'K' a thinner shim is required.

105. Finally check the dimension 'K' to ensure correct shim has been fitted.

106. Refit the coupling compression spring between the drive coupling and the cam plate.

    NOTE: To ensure correct pump timing the cam plate drive pin must be aligned with the drive shaft keyway. Incorrect alignment relative to the drive shaft will result in engine damage.

107. Check the ball stud of the control lever assembly in the governor control sleeve hole for freedom of movement.

108. Fit the thrust washer and shim to the pump plunger.

109. Fit the lower spring plate to the pump plunger.

110. Fit the governor control sleeve to the pump plunger, ground collar face upwards, Fig. 37.

Fig. 36. Measure the dimension 'K'

Fig. 37. Fit the control sleeve ground face uppermost

23 414 8 (cont'd)

111. Fit the plunger assembly with the calculated shim into the cam plate. Ensure the cam plate drive pin engages with the plunger base slot.

112. Place the helical compression springs on the lower spring seats.

113. Fit the control lever assembly to the pump body, fit the pivot bolts and washers. Tighten the bolts to specification.

114. Engage the control lever ball with governor control sleeve, Fig. 38.

115. Fit the guide pins, shims and upper spring seats to the hydraulic head. A suitable grease will help retain the spring components.

116. Using a suitable grease fit the control lever springs to the hydraulic head.

117. Fit 'O' ring to the hydraulic head.

118. Push the assembled hydraulic head into the pump housing so that the compression springs are aligned with the control lever assembly, Fig. 39. Particular care should be taken to ensure the guide pins are located in the guide holes of the lower spring seat when the hydraulic head is introduced and tightened. Incorrect assembly may result in the breaking of the lower spring seat. In addition ensure the ball stud of the control lever assembly is correctly located in the governor control sleeve.

119. Fit the hydraulic head retaining screws tighten to specification.

120. Fit and securely tighten the fuel solenoid shut-off, if fitted.

121. Stick the governor shims and shim plate in the pump housing with a suitable grease.

122. Assemble the governor i.e. flyweight, shim ring, sliding sleeve and blanking plug assembly.

    NOTE: The flyweights, if replaced must be renewed as a set of four.

123. Fit the governor assembly in the pump housing.

124. Fit a new 'O' ring to the governor shaft. Screw the shaft into the housing until the dimension 1,5 to 2,0 mm (0,059 to 0,079 inches) measured from the surface of the flange to the end of the governor shaft is attained, Fig. 40.

Fig. 38. Engage the control lever ball with the governor control sleeve

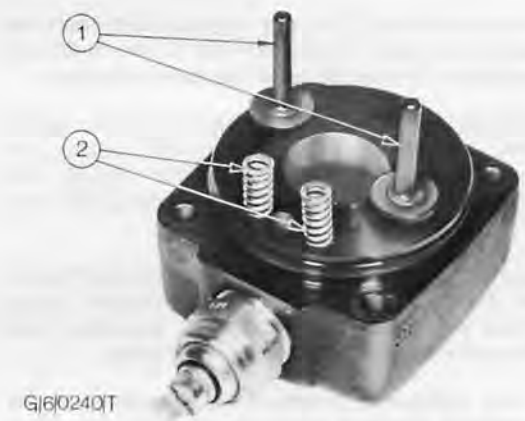


Fig. 39. 1. Spring guide pins 2. Compression springs

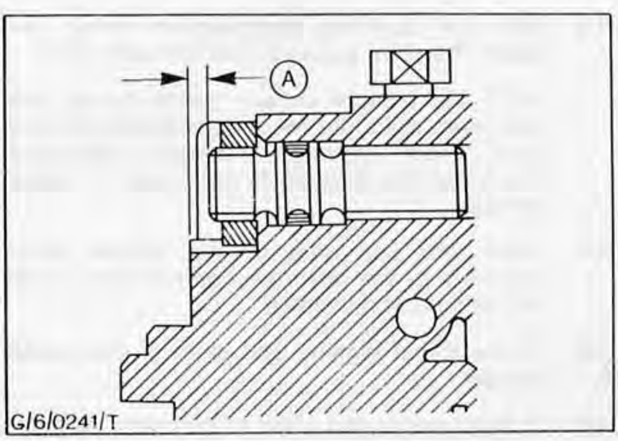


Fig. 40. Governor shaft dimension

125. Measure the axial play of the flyweight assembly with a feeler gauge, Fig. 41.

126. Adjust the axial play to specification by adjusting the shim pack.

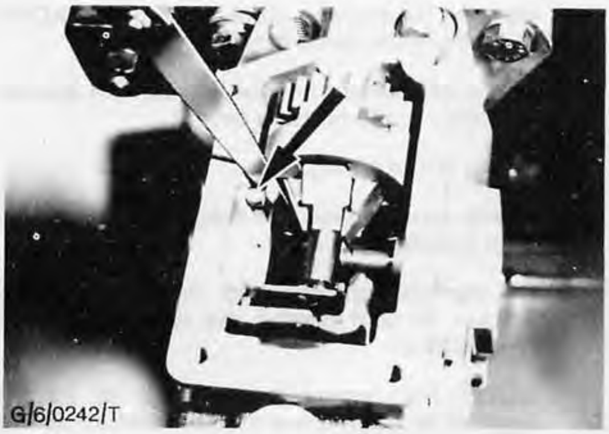


Fig. 41. Measure the flyweight axial play

127. Using Special Tool No. KDEP 1082 lock the governor shaft in position with the slotted round nut. Tighten to specifications, Fig. 42.

Fig. 42. Using Special Tool No. KDEP 1082 lock the governor shaft

To determine the dimension 'MS' (Starting Fuel).

128. Fit the register block Special Tool No. KDEP 1084 to the pump housing, machined surface towards the correction lever.

129. Push the tensioning lever against the pin stop.

130. Using feeler gauges measure the distance 'MS' i.e. the distance between the governor sliding sleeve plug and the starting lever which is up against the tensioning lever, compare the 'MS' value with the specications, Fig. 43.

131. The 'MS' dimension is corrected by removing the flyweight assembly. The sliding sleeve is then removed and the end plug driven from the sleeve with a suitable punch. A different end plug is then fitted with a longer or shorter nipple to obtain the specified 'MS' figure when assembled in the pump body.

Fig. 43. Measure the dimension 'MS'

23 414 8 (cont'd)

132. Remove the register block special tool KDEP 1084 from the pump housing.

133. Fit the accelerator interior linkage and spindle assembly to the housing cover.

134. Fit the return spring.

135. Fit the upper accelerator linkage to the spindle as previously marked.

136. Fit the spring/accelerator linkage retaining bracket, fit and tighten the retaining nut to specification.

NOTE: For testing purposes it is advantageous to leave the accelerator return spring unhooked from the accelerator linkage.

Install mechanical shut-off (if fitted)

137. Fit the washer to the mechanical shut-off inner linkage assembly.

138. Fit the shaft to the housing cover.

139. Fit the shim and seal.

140. Fit a spacer 27,7 mm (1,09 in) long between the inside edge of the housing cover and the interior shut-off lever.

141. Retain the shaft by holding the interior linkage against the spacer.

142. Fit the outer lever to the shaft so that the smallest possible gap exists between the shut-off lever and the housing cover.

143. Fit the lockwasher and nut, tighten the nut to specification.

144. Measure and note the outer lever to housing cover gap.

145. Insert a feeler guage of the previously noted dimension between the mechanical shut-off linkage and the housing cover, Fig. 44.

146. Adjust the threaded stop bolt to allow a horizontal stroke of 21,5 to 22,0 mm (0,846 to 0,866 in). Tighten the stop bolt locknut to specification, Fig. 45.

All models

147. Fit a new 'O' ring to the housing cover.

148. Hook the tension spring into the accelerator inner linkage so the opening in the spring is pointing downwards, Fig. 46.

149. Push the retaining pin with the helical compression springs through the hole in the tensioning lever and attach the tension spring.

NOTE: The retaining pin with helical compression springs are serviced as a unit.

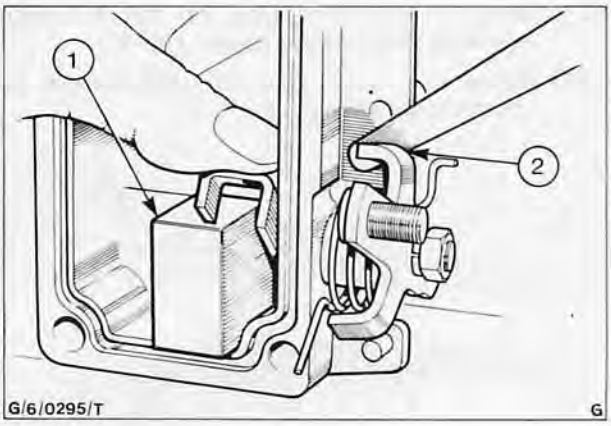


Fig. 44. Adjust Fuel Shut-Off
1. Spacer 2. Feeler gauge

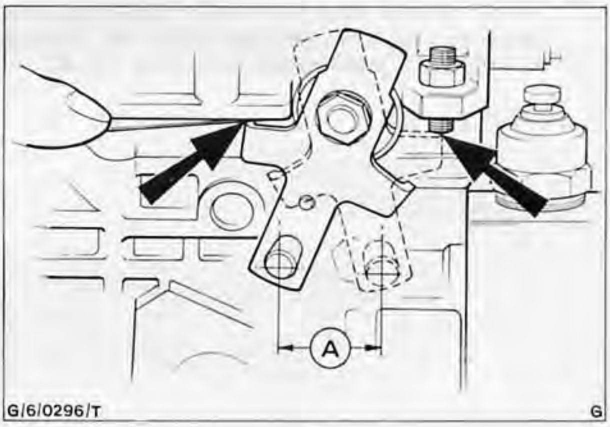


Fig. 45. Adjust Fuel Shut-Off Stroke between housing cover and adjustment bolt
A – Horizontal stroke

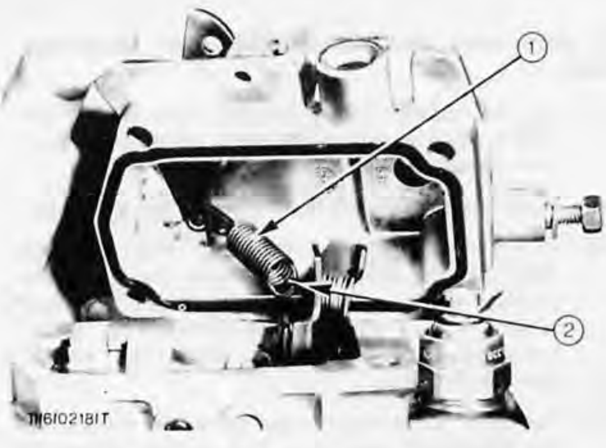


Fig. 46. Fit the tension spring:
1. Tension spring 2. Spring open end

150. Fit the housing cover, tighten the retaining screws to specification.
151. Fit new copper washers to the hydraulic head.
152. Assemble the valves i.e. shims, springs and two valve components, Fig. 47.
153. Fit the valve and valve holders in the correct positions i.e. A.B.C.D. tighten the valve holders to specifications.
154. Fit a new 'O' ring to the screw plug.
155. Using Special Tool No. KDEP 1080 fit and tighten the screw plug to specifications.

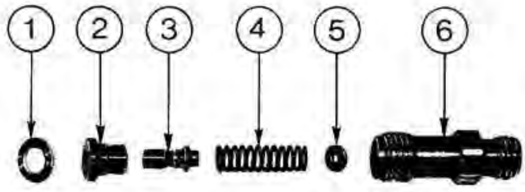


Fig. 47. Valve Assembly
1. Washer
2. Valve body
3. Valve plunger
4. Spring
5. Shim
6. Valve holder

FUEL INJECTION PUMP

Type	Distributor
Rotation	Clockwise from drive end
Timing	TDC
Pumping Element (Plunger)	
Plunger diameter	10,00 mm (0,39 in)
Return Spring	
Rate	72,5 N/mm (7,4 kgf/mm) (408 lbf/in)
Strength	32,5 kgf at 25,5 mm (71,6 lbf at 1 in)
Number of springs	2
Spill Ports	
Number of spill ports	2
Length	2 mm (0,08 in)
Width	2 mm (0,08 in)
Depth	0,5 to 1,5 mm (0,02 to 0,06 in)
Offset axially	0,2 mm (0,08 in)
Prestroke (spill cut off dial indicator reading	0,3 mm (0,012 in)
Cam	
Total cam lift	2,2 mm (0,09 in)
Camlift at spill	0,3 mm (0,012 in)
Camlift at timing mark	1,14 mm (0,045 in)
Delivery Valves	
Unloading	35 mm^3 (1,38 in^3)
Spring rate	4,8 N/mm (0,5 kgf/mm) (27 lbf/in)
Strength	4,25 kgf at 15,7 mm (9,3 lbf at 0,6 in)
Transfer Pump/Flow Control Valve	
Number of vanes	4
Number of orifices	2
Orifice diameter	2 mm (0,078 in)
Valve spring rate	15,3 N/mm (1,6 kgf/mm) (27 lbf/in)
Spring strength	0,77 kgf at 14,5 mm (1,7 lbf at 0,57 in)
Governor	
Type	Mechanical
Number of weights	4
Weight	10 grams (0,14 oz)
Spring rate	3 N/mm (0,3 kgf/mm) (16,9 lbf/in)
Spring strength	2,57 kgf at 39,3 mm (5,7 lbf at 1,55 in)
Gear Train	
Camshaft gear	37 teeth
Governor cage	23 teeth
Advance Unit	
Spring rate	31 N/mm (3,2 kgf/mm) (174 lbf/in)
Strength	2,5 kgf at 34,6 mm (5,5 lbf at 1,36 in)
Idle Spring	
Rate	0,45 N/mm (0,05 kgf/mm) (2,5 lbf/in)
Free length	8,65 mm (0,34 in)
Wire diameter	0,5 mm (0,02 in)
Idle Assist Spring	
Spring rate	0,8 N/mm (0,08 kgf/mm) (4,5 lbf/in)
Free length	8,3 mm (0,33 in)
Wire diameter	0,7 mm (0,03 in)
Roller Ring	
Height	31,75 to 31,8 mm (1,250 to 1,252 in)

Overhaul Specifications

Timing Device (Advance Piston)

		Part number (Bosch)
Nominal dimension	4,2 mm Max	
Shim sizes (Piston)	0,6 mm	1 460 100 612
(cover)	0,6 mm	1 460 100 612
	0,7 mm	1 460 100 613
	0,9 mm	1 460 100 614
	1,0 mm	1 460 100 615
	1,2 mm	1 460 100 616

Note: Piston shim 1 1460 100 612 must be fitted with at least one cover shim.

Dimension MS

		Part number (Bosch)
Nominal dimension	2,1±0,1 mm	
Nipple sizes	7,2 mm	1 463 120 338
	7,4 mm	1 463 120 339
	7,6 mm	1 463 120 340
	7,8 mm	1 463 120 341
	8,0 mm	1 463 120 342
	8,2 mm	1 463 120 343
	8,4 mm	1 463 120 344
	8,6 mm	1 463 120 345
	8,8 mm	1 463 120 346
	9,0 mm	1 463 120 347
	9,2 mm	1 463 120 348
	9,4 mm	1 463 120 349
	9,6 mm	1 463 120 350
	9,8 mm	1 463 120 351
	10,0 mm	1 463 120 352
	10,2 mm	1 463 120 353
	10,4 mm	1 463 120 354
	10,6 mm	1 463 120 355

Dimension K

		Part number (Bosch)
Nominal dimension	Not measured, hydraulic test.	
Shim sizes	1,90 mm	1 460 100 116
	1,92 mm	1 460 100 117
	1,94 mm	1 460 100 118
	↕ etc	↕ etc
	2,86 mm	1 460 100 164
	2,88 mm	1 460 100 165
	2,90 mm	1 460 100 166

Dimension KF

		Part number (Bosch)
Nominal dimension	5,8±0,1 mm	
Shim sizes	0,5 mm	1 460 100 312
	0,8 mm	1 460 100 313
	1,0 mm	1 460 100 314
	1,2 mm	1 460 100 315
	1,5 mm	1 460 100 316
	1,8 mm	1 460 100 317
	2,0 mm	1 460 100 318

Governor Weight Axial Play

		Part number (Bosch)
Nominal dimension	0,15 to 0,35 mm	
Shim sizes	1,05 mm	1 461 030 302
	1,10 mm	1 461 030 303

Governor Weight Axial Play (cont'd)		**Part number (Bosch)**
	1,25 mm	1 461 030 304
	1,45 mm	1 461 030 306
	1,60 mm	1 461 030 305
	1,65 mm	1 461 030 308
	1,80 mm	1 461 030 307
	1,85 mm	1 461 030 310
	2,00 mm	1 461 030 309
Full Load Adjustment Spacer		**Part number (Bosch)**
	2,0 mm	1 460 200 301
	2,2 mm	1 460 200 302
	2,4 mm	1 460 200 303
	2,6 mm	1 460 200 304
	2,8 mm	1 460 200 305
	3,0 mm	1 460 200 306
	3,2 mm	1 460 200 307
	3,4 mm	1 460 200 308
	3,6 mm	1 460 200 309
	3,8 mm	1 460 200 310
Lower Spring Plate Shim/washer		**Part number (Bosch)**
washer	one size	1 460 101 018
Shim	one size	1 460 101 022
Roll pin to drive shaft assembled height	37,3 to 37,9 mm (1,46 to 1,49 in)	

Calibration Specifications

Pre-adjust Full Load Delivery

Speed rpm 1750	Fuel delivery (cc/200 shots average of all lines)	
	Hartridge 1100	Bosch Machines
	7,5 ± 0,1 cc	8,0 ± 0,1 cc

Maximum line to line spread 0,8 cc/200 shots.

Adjust the Timing Device Travel and the Supply Pump Pressure

Speed rpm	Cam box pressure (KN/m²)	Advance unit piston travel (mm)
1600	595 ± 50	3,8 to 4,8

Figures apply to both Hartridge 1100 and Bosch test machine.

Adjust Low Idle Setting and Measure Excess Fuel for Starting

Test	Speed rpm	Speed lever position	Delivery cc/200 shots average of all lines		Maximum line to line spread cc/200 Shots
			Hartridge 1100	Bosch test machine	
Excess fuel	100	Maximum	13 to 20	13 to 20	2
Excess fuel	215	Maximum	13 to 20	13 to 20	2
Excess fuel	285	Maximum	Less than 13	Less than 13	2
Idle	300	Minimum	2,8 to 3,6	3,1 to 3,9	1

These tests to be carried out together to ensure excess fuel delivery does not affect idle.

Adjust Maximum Speed Setting

Speed rpm	Fuel delivery cc/200 shots average of all times	
	Hartridge 1100 machine	Bosch machines
2000	2,0 ± 0,2	2,6 ± 0,2

Note: Fuel deliveries shown are averages of all lines over 200 shots. Maximum line to line spread 0,8 cc/200 shots.

Overflow Quantity [This test to be carried out with a feed pressure of 0,242 Bar (0,245 kgf/cm²) (3,5 lb/in²)]

Speed rpm	Overflow Quantity litre/hour
500	18
1800	28

Fuel Delivery and Breakaway Characteristics

Speed rpm	Fuel delivery (cc/200 shots)	
	Hartridge 1100 machine	Bosch machine
1750	7,5 ± 0,4	8,0 ± 0,4
1250	As found at 1750 +0,2 to +0,7	As found at 1750 +0,7 to +1,2
800	As found at 1750 −0,9 to −0,3	As found at 1750 +0,2 to +0,7

Note: Fuel deliveries shown are averages of all lines over 200 shots.
Maximum line to line spread 0,8 cc/200 shots at stated speeds.

Accelerator Lever Adjustment Dimensions

Dimension A (lever position at idle)	10,2 ± 2,5 mm (0,40 ± 0,1 in)
Dimension B (lever to speed adjustment screw clearance)	10,3 ± 1,6 mm (0,41 ± 0,06 in)

Stop Control (Electric/Mechanical)

Fuel delivery @ 100 rpm	6,5 cc per 200 shots minimum (average of all lines)
Fuel delivery @ 1800 rpm	7,0 cc per 200 shots minimum (average of all lines)

Injector Specification

Nozzle type	DNOSD1930
Nozzle part No. (Bosch)	0 434 250 092
Nozzle opening pressure	145–153 Atmospheres
Nozzle rate	High flow
Injector part No. (Bosch)	0 423 287 049
Injector holder type	KB375A590/A
Injector holder part No. (Bosch)	0 431 201 036
Spring part No. (Bosch)	2 434 619 009

TIGHTENING TORQUES	**Nm**	**kgf/m**	**lbf/ft**
Control valve	8 to 9	0,8 to 0,9	5,9 to 6,6
Throttle stop screw locknut	5 to 6	0,5 to 0,6	3,7 to 4,4
Timing device cover retaining screws	6 to 8	0,6 to 0,8	4,4 to 5,9
Drive shaft nut	60	6,2	45
Control lever pivot bolt	10 to 13	1,0 to 1,3	7,4 to 9,6
Vane pump retaining screws	2 to 3	0,21 to 0,3	1,5 to 2,2
Hydraulic head retaining screw	11 to 13	1,1 to 1,3	8,1 to 9,6
Governor shaft lockring	25 to 30	2,5 to 3,1	18,4 to 22,1
Accelerator linkage retaining nut	5 to 10	0,5 to 1,0	3,7 to 7,4
Housing cover retaining screw	6 to 8	0,6 to 0,8	4,4 to 5,9
Screw plug	60 to 80	6,1 to 8,1	44,2 to 58,9
Solenoid valve	40 to 45	4,1 to 4,6	29,4 to 33,2
Bleed screws	8 to 10	0,8 to 1,0	5,9 to 7,4
Speed adjustment locknut	7 to 9	0,7 to 0,9	5,2 to 6,6
Inlet and outlet unions	20 to 25	2,0 to 2,5	14,7 to 18,4
Fuel filter bleed screw	8 to 10	0,8 to 1,0	5,2 to 6,6
Pump flange to front cover nuts and bolts	20,3 to 27	2,0 to 2,8	15 to 20
Injector delivery pipes	17,2 to 20,3	1,8 to 2,0	13 to 15
Valve holder	35 to 45	3,6 to 4,6	25,8 to 33,2
Pump drive gear retaining bolts	14,8 to 20,0	1,5 to 2,1	11 to 15
Timing belt cover screws	4,9 to 8,8	0,5 to 0,9	3,6 to 6,5
Alternator mounting bolts	9,5 to 14,9	1,0 to 1,5	7 to 11
Water pump pulley retaining bolts	19,0 to 24,3	1,9 to 2,5	14 to 18

C.A.V. DIESEL INJECTION SYSTEM 23B

Index **Page**

GENERAL DESCRIPTION

The C.A.V. injection system fitted on the 2,4 litre York diesel engine consists of a single acting injection pump, fuel lift pump, sediment and main fuel filters, injectors and a glow plug starting system. Basic idle speed is adjustable and should be checked and if necessary adjusted at the specified service intervals. Glow plugs should be changed at the specified intervals as detailed in the Service Voucher Book.

Pump timing is adjustable and a service procedure for this is detailed in Operation 23 414. The full throttle stop is set during engine final test and sealed to ensure unqualified persons do not overload the system.

To ensure that optimum performance, economy and exhaust emission-levels are maintained it is essential that the correct service repair and setting procedures are used in conjunction with the relevant specifications contained in the Technical Data Section.

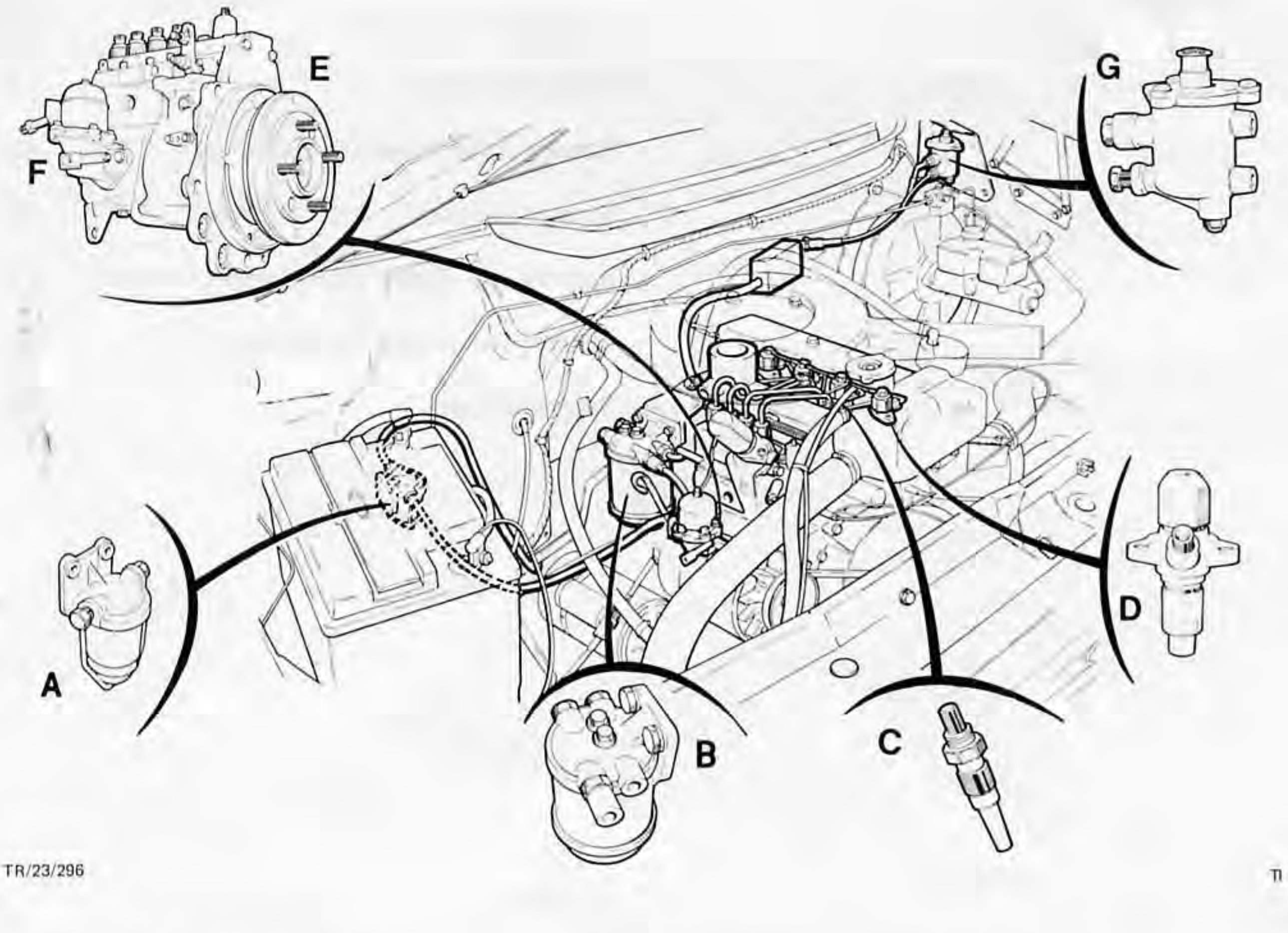


Fig. 1. C.A.V. Diesel injection system
Components that make up the diesel injection system are described individually on the following pages

A – Sediment filter
B – Main fuel filter
C – Glow plugs
D – Injectors
E – C.A.V. Injection pump
F – Fuel lift pump
G – Reservoir

GENERAL DESCRIPTION (cont'd)

Diesel Injection Pump. Fig. 2.

Two types of injection pumps are fitted on the Transit diesel variant, a Bosch rotary pump, which is covered in section 23C, and a C.A.V. Minimec pump which is described in this section (23B). The C.A.V. pump is of a jerk type design utilising a camshaft and four pumping elements.

The pump is located on the right hand side of the engine and is driven at half engine speed by a toothed drive belt, located behind the front cover of the engine. A governor located at the front of the pump is of a mechanical design utilising centrifugal weights. Fuel pressure is supplied from a lift pump mounted externally on the injection pump and driven by an eccentric cam on the pump camshaft. Stop control is by means of a cable connected to the stop lever which when operated moves the control rod into the no fuel position.

An excess fuel plunger is included in the pump and operated, when the engine is cold, by an externally mounted control solenoid.

Full details of how these individual systems operate are shown in the principle of operation section on page 4 onwards.

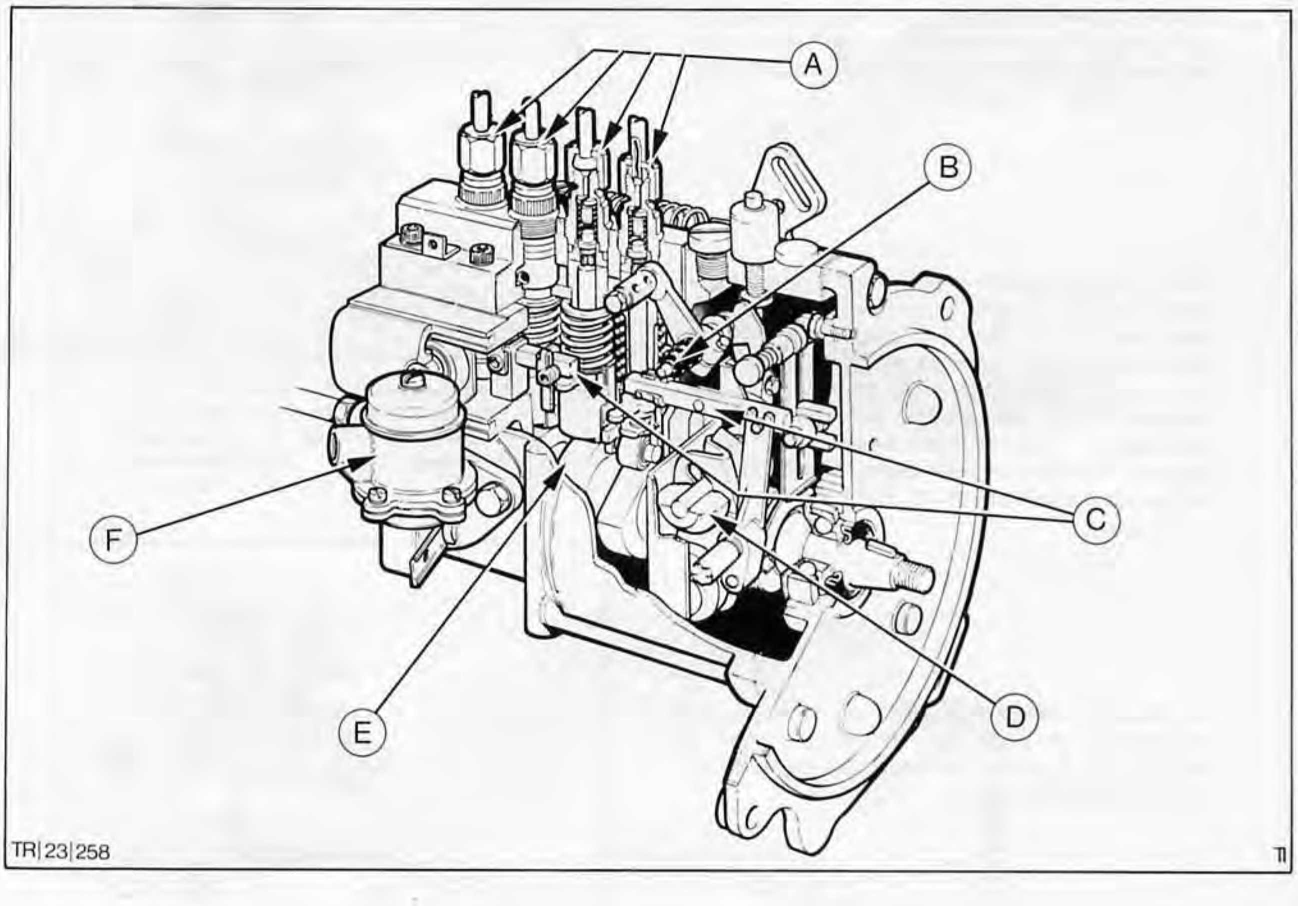


Fig. 2. C.A.V. Minimec diesel injection pump

A – Pumping elements
B – Excess fuel plunger
C – Control rod
D – Centrifugal weights
E – Camshaft
F – Fuel lift pump

PRINCIPLE OF OPERATION

Diesel Injection Pump

The injection pump is the heart of the diesel injection system and its most complicated component. For this reason the principle of operation of this unit is split into five sections:

A. Fuel lift pump

B. Pumping elements and camshaft

C. Excess fuel device

D. Governor

E. Auto-advance unit.

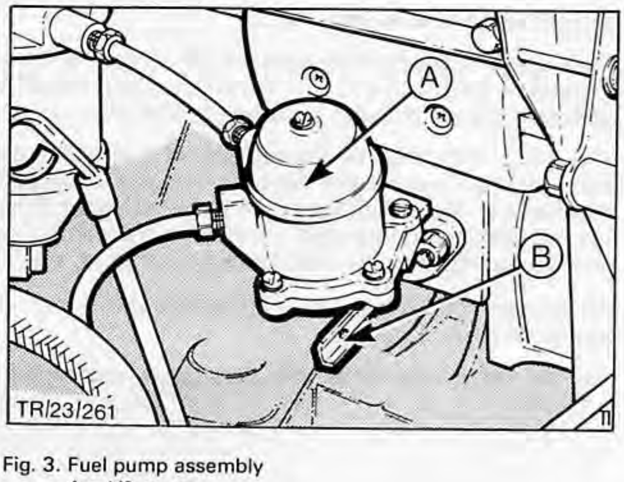


Fig. 3. Fuel pump assembly
A – Lift pump
B – Hand prime lever

A. Fuel Lift Pump, Fig. 3.

The lift pump is mounted on the side of the injection pump (Fig. 3) and is operated by a cam lobe. The pump is not a sealed unit and replacement parts such as a new diaphragm are available.

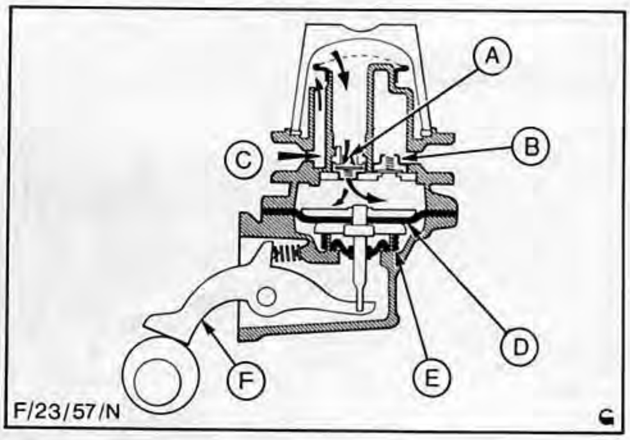


Fig. 4. Fuel pump assembly on first stroke
A – One way valve open
B – One way valve closed
C – Fuel flow
D – Diaphragm
E – Return spring
F – Rocker arm

The pump basically consists of a diaphragm, return spring, 2 one way valves, rocker arm and filter. The rocker arm at one end rests on an eccentric cam and the other is attached to the pump diaphragm. As the cam rotates through 180° the rocker arm will pull the diaphragm downwards against a spring tension resulting in fuel being drawn into the pump via a one way valve. Refer Fig. 4.

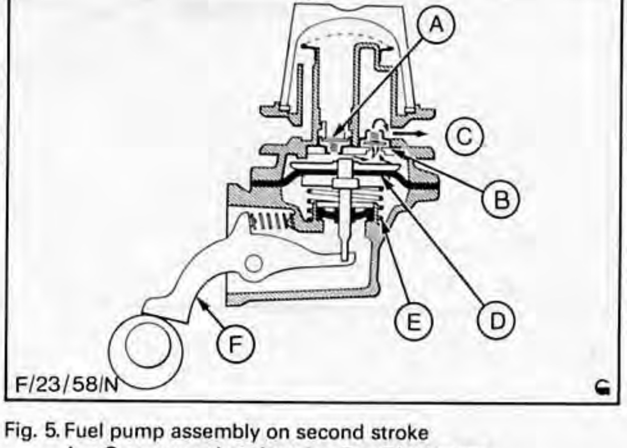


Fig. 5. Fuel pump assembly on second stroke
A – One way valve closed
B – One way valve open
C – Fuel flow
D – Diaphragm
E – Return spring
F – Rocker arm

As the cam completes 360° the return spring is allowed to push the diaphragm back so forcing the fuel out through the second one way valve. Refer Fig. 5.

An additional feature of the lift pump is a hand priming lever (Refer Fig. 3) which should be used when initially bleeding the fuel system.

PRINCIPLE OF OPERATION (cont'd)

B. Pumping Elements

The elements, one for each cylinder are mounted in the upper half of the pump, and are operated by the pump camshaft. Each element consists of a plunger and barrel assembly, delivery valve and a pressure control spring. There are four stages of element operation which are shown in Fig. 6.

Stage 'A' The plunger (E) is positioned on the back of the cam and is in its lowest position. The delivery valve (H) is held closed by the pressure control spring (G) and the inlet port (F) is open allowing fuel to enter and charge the element.

Stage 'B' As the cam turns the plunger is lifted which blocks the inlet port and pressurises the fuel charge. At this stage the fuel charge has not reached the required pressure to open the delivery valve against the control pressure spring.

Stage 'C' As the cam continues to turn, the fuel pressure in the element increases until at a pre-determined level, the pressure acting on the delivery valve overcomes the spring tension. At this point the fuel charge passes, at a high pressure from the element to the injector.

Stage 'D' When the plunger reaches the top of its stroke a helical slot which is connected to a central gallery in the plunger lines up with the return port and discharges the remaining fuel. Pressure immediately drops to lift pump pressure, the delivery valve closes and ends the injection cycle.

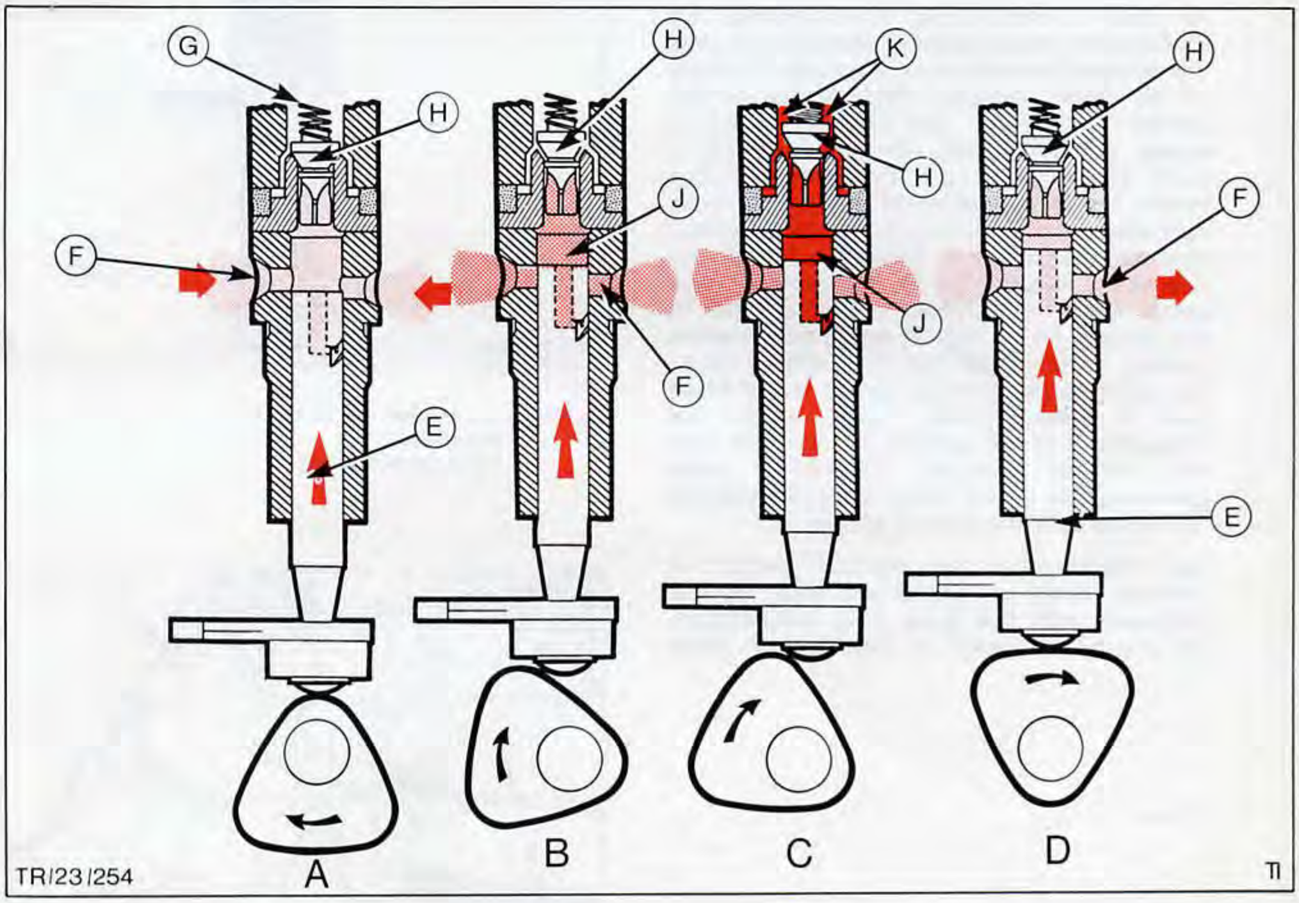


Fig. 6. Four stages of pumping element operation

Stage 'A'
E – Plunger at start of stroke
F – Inlet port open
G – Pressure control spring
H – Delivery valve closed

Stage 'B'
F – Inlet port closed
H – Delivery valve closed
J – Fuel charge

Stage 'C'
H – Delivery valve open
J – Fuel charge at injection pressure
K – Outlet port to injector open

Stage 'D'
E – Plunger at top of stroke
F – Return port open
H – Delivery valve closed

PRINCIPLE OF OPERATION (cont'd)

As shown on the previous page the effective end of the injection stroke is when the helical slot machined into the plunger reaches the return port, and discharges the remaining fuel charge.

The element in Fig. 7 shows the position of the plunger when the engine is idling. Note that the end of the effective stroke is achieved with only a small amount of upward movement of the plunger. This results in a small amount of fuel being passed to the injector.

By rotating the plunger the effective end of the stroke can be altered. Fig. 8 shows the element at full throttle with the helical slot shortened, resulting an a longer effective plunger stroke and an increased fuel supply to the injector.

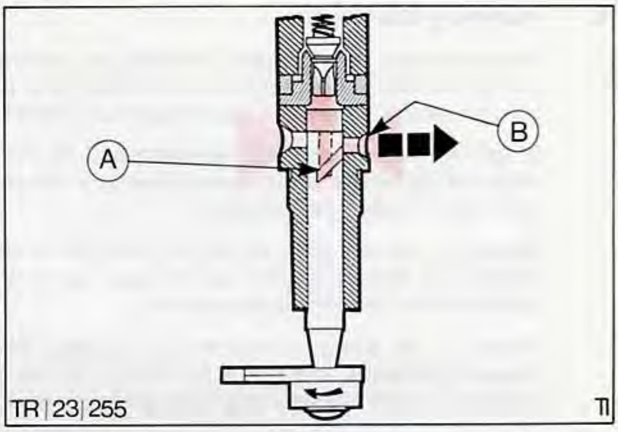


Fig. 7. Element positioned during engine idling
A – Machined helical slot
B – Outlet port

C. Excess Fuel System Fig. 9

To ensure good starting characteristics are achieved on cold engines an automatic excess fuel system is installed as a standard feature on all diesel variants. The purpose of the system is to allow the injection pump to supply additional fuel when the engine is being started from cold and to ensure that excess fuel is not delivered during 'hot' start operation, and normal running. The system consists of a plunger or button, located on the side of the injection pump, linkage within the pump, a control solenoid positioned next to the plunger ('A' in Fig. 9) and a temperature sensing switch fitted into the cylinder block. The temperature sensing switch is not fitted into a water gallery and senses the temperature of the cylinder block rather than the coolant mixture. Therefore, when removing this switch there is no requirement to drain or refill the cooling system.

For identification the thermal switch is coloured white or neutral and must not be confused with the glow plug temperature sensing switch which is described on page 15.

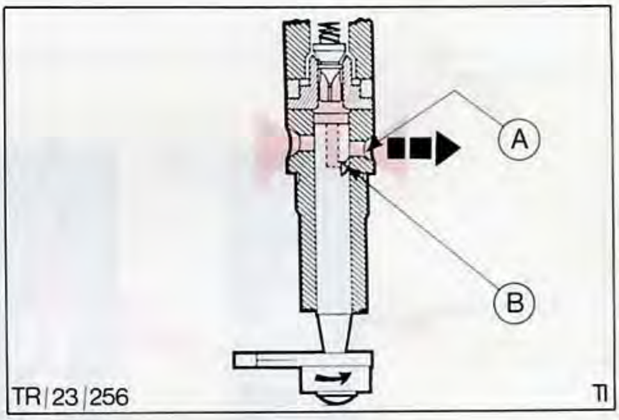


Fig. 8. Element position at full throttle
A – Outlet port
B – Machined helical slot

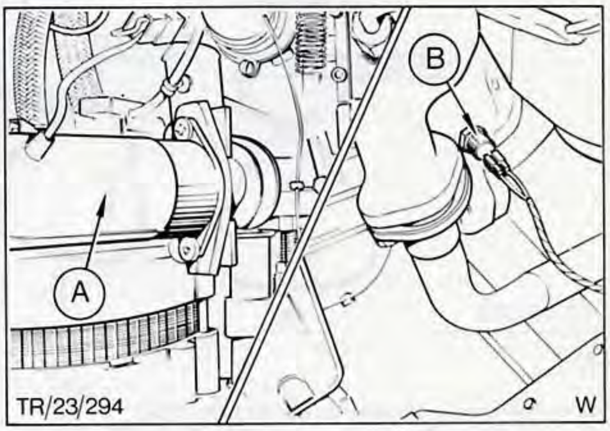


Fig. 9. Excess fuel system
A – Operating solenoid
B – Temperature sensing switch

PRINCIPLE OF OPERATION (cont'd)

Excess Fuel Plunger and Operating Linkage.

As already explained during normal operation fuel supply to the engine is increased by rotating the four injection pump elements. The elements are turned simultaneously by a control rod which moves backwards and forwards in response to either the governor or to the throttle pedal position.

During normal operation maximum movement of the control rod and therefore maximum fuel delivery to the engine is controlled by a stop bracket mounted at the end of the rod. Fig. 10, shows the situation when the engine is operating at full throttle with the control rod stop abutting the excess fuel stop. With the control rod in this position the air/fuel ratio will be correct to give maximum power from the engine.

During extreme cold start operations (at temperatures below 0 °C) the fuel supplied at full throttle will not be sufficient to readily start the engine. Under these conditions the excess fuel button is pushed inwards moving the shaft and excess stop bracket sideways, Fig. 11. This allows the control rod to override the normal stop position and results in the pump elements being turned past the full throttle position, supplying the engine with the increased amount of fuel required for cold start operation.

Control Components

Two control components are used in the excess fuel system, these are a operating solenoid, Fig. 12, and a temperature sensing switch. The solenoid operates the fuel button and the switch is designed to cut out the system during 'hot' start operation. The solenoid operates in two stages, firstly to push the excess fuel button into position and secondly to hold the button 'in' when the engine is being started. It is important to note that the solenoid is adjustable and if the unit is mal-adjusted it will quickly burn out. Full adjustment procedure is shown on the following page.

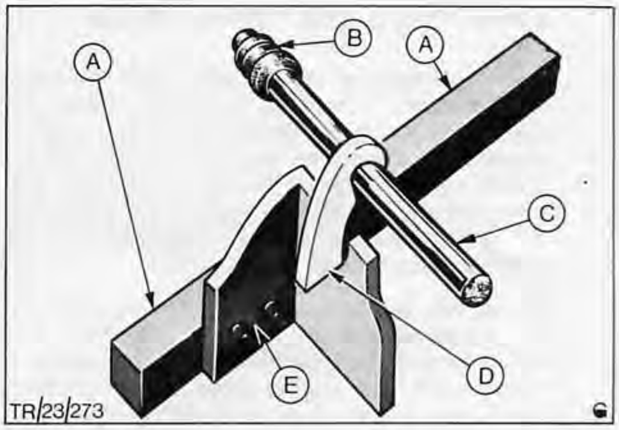


Fig. 10. Excess fuel device during normal full throttle operation
A – Control rod
B – Excess fuel button
C – Excess fuel shaft
D – Excess stop
E – Control rod stop

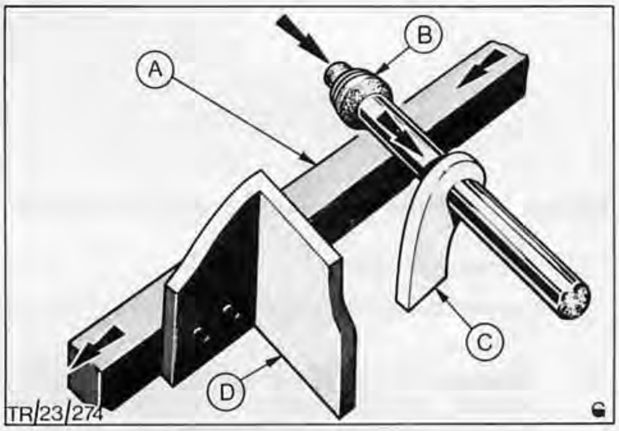


Fig. 11. Excess fuel device during cold start operation
A – Control rod moved back past normal stop
B – Excess button pushed in
C – Excess stop moved sideways
D – Control rod stop

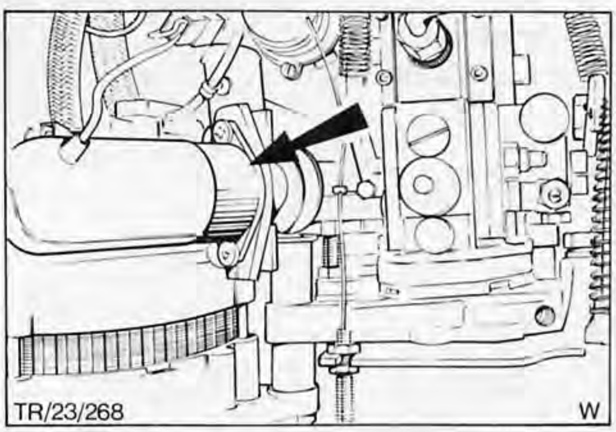


Fig. 12. Excess fuel operating solenoid

PRINCIPLE OF OPERATION (cont'd)

Excess Fuel Device – Wiring Circuit

When starting a cold engine with ambient temperatures below 0 °C power from the starter motor relay (live only during engine cranking) is fed to the excess fuel solenoid via the closed contacts of the thermal switch. The solenoid once energised pulls back, operating the control linkage, which in turn engages the pump excess button.

When the excess fuel button is fully engaged the pump control rod is allowed further back, fully opening the injection elements, which in turn supply the engine with additional fuel. Once the engine has started the governor, acting on the control rod, disengages the excess fuel device and so allows normal engine operation.

If the button fails to dis-engage the engine will run very roughly and at a low idle speed.

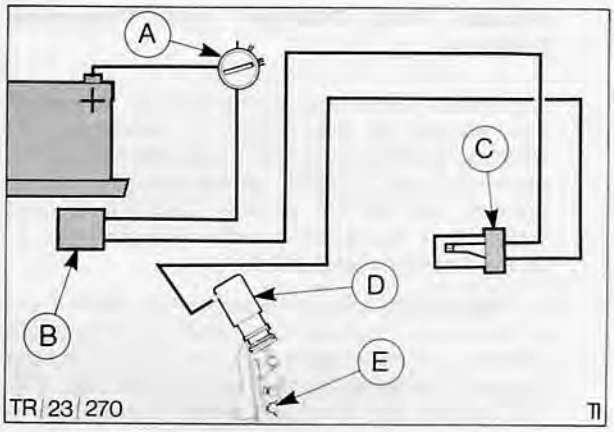


Fig. 13. Excess fuel System wiring circuit in operation (Simplified)
A – Ignition switch in start position
B – Starter motor relay energised
C – Thermal switch points closed
D – Fuel solenoid
E – Excess fuel button fully pushed in

Excess Fuel Solenoid – Adjustment procedure

1. Disconnect battery.
2. Loosen control rod adjusting clamp, ('C' in Fig. 14).
3. Position a wedge of wood between mounting bracket and fuel button operating lever, so that the fuel button is fully engaged.
4. Fully engage solenoid by pushing control rod (B) upwards as far as possible.
5. Secure control rod adjusting clamp and release wedge.
6. Ensure mechanism is free to return to the 'off' position.
7. Reconnect battery.

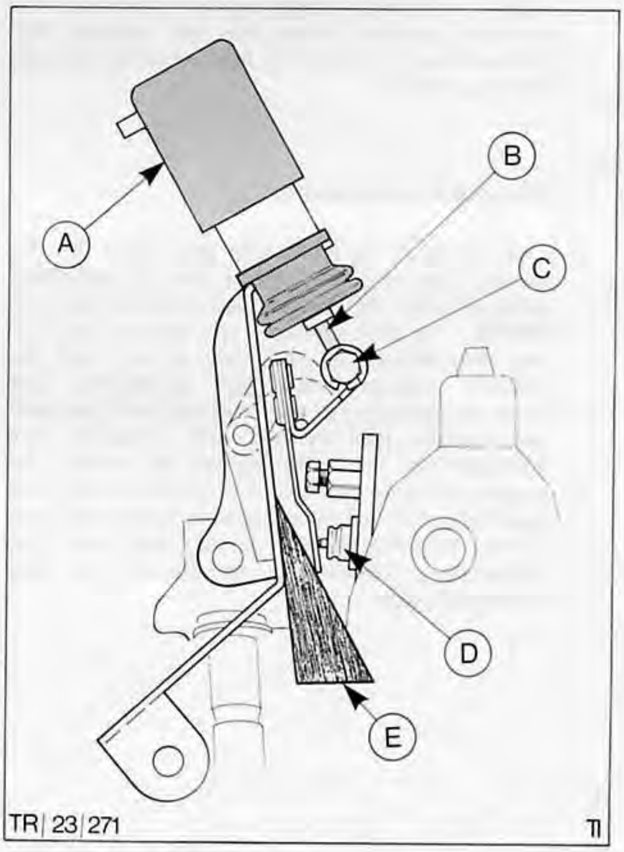


Fig. 14. Excess fuel solenoid adjustment
A – Solenoid
B – Control rod
C – Adjusting clamp
D – Excess fuel button
E – Adjustment wedge

PRINCIPLE OF OPERATION (cont'd)

D. Governor Control

In the diesel engine, idle adjustment by a stop screw to directly control the fuel delivery is not possible as the quantity of fuel required is very small and varies with ambient conditions and engine temperature. Any slight over adjustment or a change in ambient conditions would result in too much fuel being injected and the speed would rise. Also pumping efficiency improves as the speed rises so more fuel will be delivered and the engine speed could rise uncontrolably. Under adjustment would have the opposite effect and the engine would stall.

Limitations on maximum speed are imposed on the engine due to its heavy construction and also by the time required to deliver the fuel quickly enough to the engine for complete combustion. Incomplete combustion causes a smoky exhaust.

A Governor is incorporated to control both these extremes of speed, it also has a controlling effect on all intermediate speeds as well. This is termed a Variable Speed Governor and on the C.A.V. injection system is of the mechanical type.

The governor assembly is located at the front of the injection pump between the camshaft and auto-advance unit. It consists of two centrifugal weights, a weight carrier assembly, operating linkage and a control sleeve. The centrifugal weight carrier is bolted to the camshaft and the complete assembly including the two weights revolve at injection pump speed.

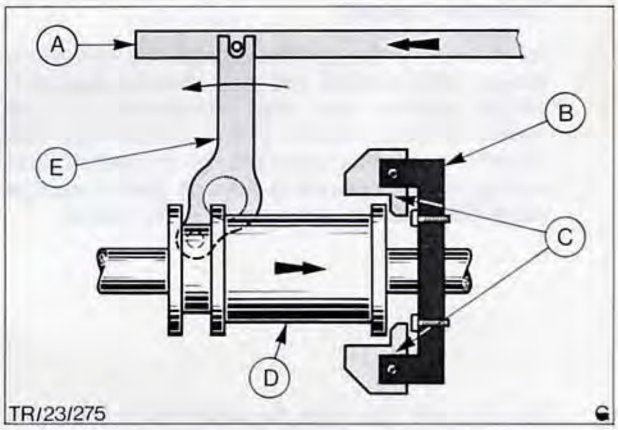


Fig. 15. Governor Assembly at full throttle and a low engine rpm (Side elevation)
A – Control rod
B – Weight carrier
C – Centrifugal weights
D – Control sleeve
E – Operating linkage

Fig. 15, shows the relative position of the governor components when the engine is at full throttle with a low engine speed. In this situation the two centrifugal weights are in their rest position applying a low force onto the control sleeve.

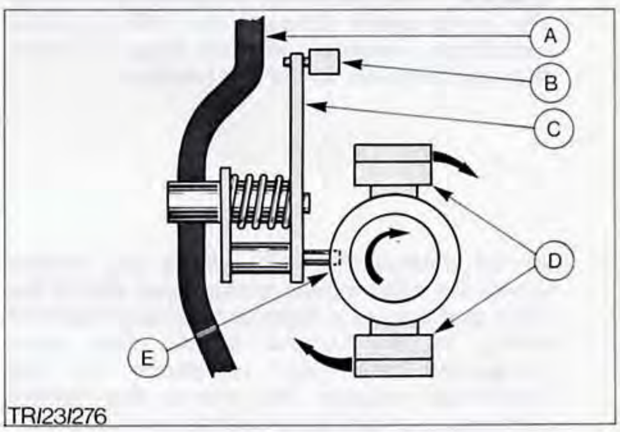


Fig. 16. Governor assembly (End elevation)
A – Pump casing
B – Control rod
C – Operating link
D – Centrifugal weights
E – Control sleeve

This allows the control sleeve and therefore the control rod to be positioned, by the throttle, in any location up to full throttle. (Throttle operation shown on the following page) Note that the control sleeve ('D' in Fig. 15) is located in its extreme right hand position.

PRINCIPLE OF OPERATION (cont'd)

As engine speed increases the centrifugal weights are thrown outwards (refer to Fig. 17) and due to their shape, force the control sleeve to the left. This movement is transferred, via the operating link, to the control rod which closes the four pumping elements.

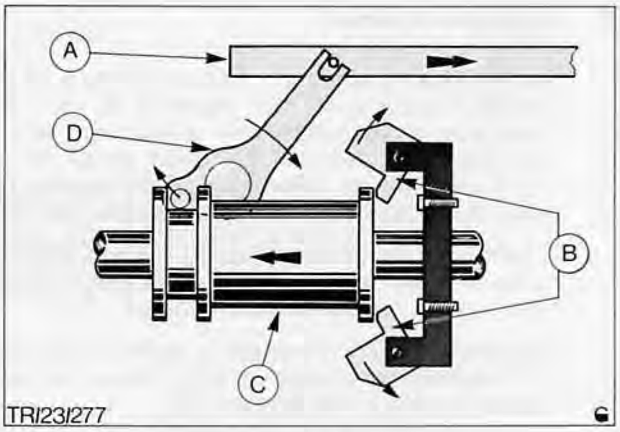


Fig. 17. Governor assembly at high engine rpm
A – Control rod
B – Centrifugal weights
C – Control sleeve
D – Operating linkage

Throttle Control

As shown on the previous page the operating sleeve and control rod are directly coupled, which means that any movement of the sleeve is transmitted to the control rod. The throttle assembly consists of a control leaf spring, roller, operating linkage and a wedge ramp fitted to the front cover of the pump.

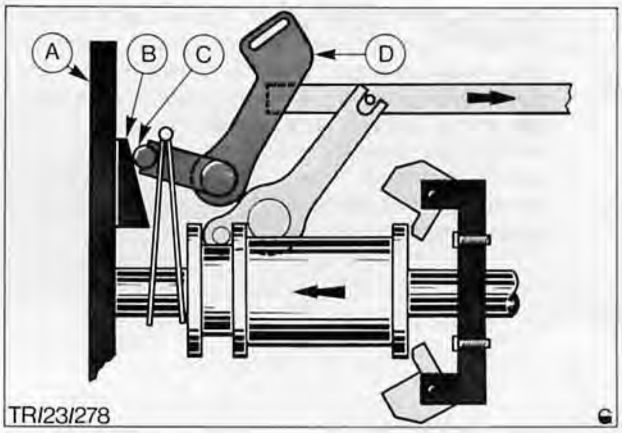


Fig. 18. Throttle and governor assembly during engine idling
A – Pump front cover
B – Wedge ramp
C – Roller
D – Throttle lever

The throttle operates by applying a force on the end of the control sleeve pushing against the action of the centrifugal weights. Fig. 18, shows the condition when the engine is at a low speed and the throttle pedal released (Engine idling). In this situation the roller is positioned at the lower end of the ramp applying a low force on the control leaf spring. The pump speed although low, still gives the centrifugal weights sufficient force to move the control sleeve to the idle position.

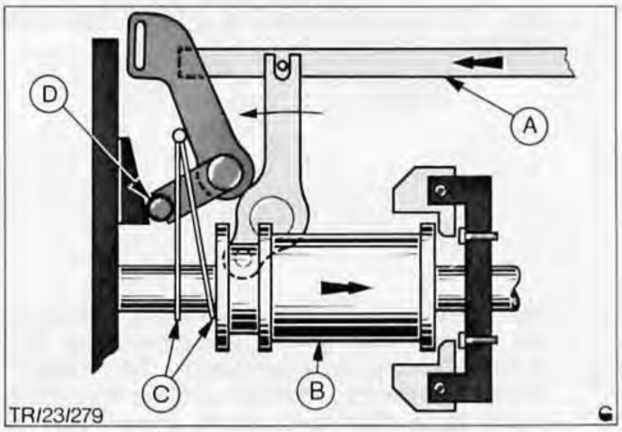


Fig. 19. Throttle and governor assembly during full throttle with a low engine rpm
A – Control rod (Full throttle)
B – Control sleeve
C – Leaf spring
D – Roller

At full throttle (Fig. 19) with a low engine speed the roller moves to the upper end of the ramp and applies a high force through the leaf spring to the control sleeve. This force overcomes the low resistance of the centrifugal weights and moves the control sleeve to the right. (Full throttle position).

PRINCIPLE OF OPERATION (cont'd)

As engine speed increases to a predetermined maximum speed, the force of the two centrifugal weights moves the control sleeve to the left closing the two leaf springs together. This results in the control rod being moved to the right and closing down the four pump elements.

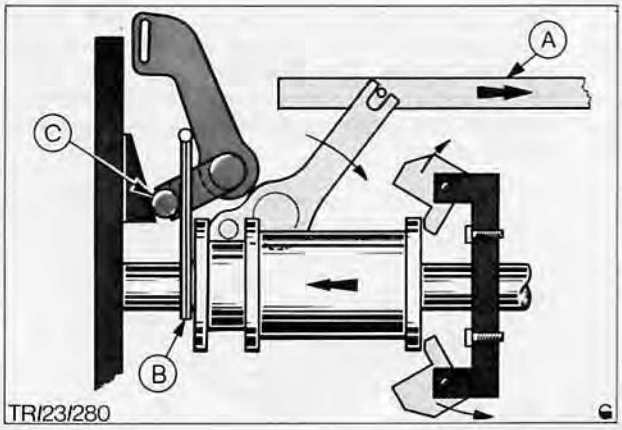


Fig. 20. Throttle and governor assembly during full throttle and high engine revs
A – Control rod
B – Leaf spring (Closed up)
C – Roller

E. Auto-Advance Unit

At low and medium engine speed the time allowed to inject the fuel into the cylinder is sufficient to ensure that fuel injection finishes at the correct point in the engine firing cycle. At high speed the time allowed to inject the fuel is radically reduced and if left uncontrolled could lead to an incomplete burn resulting in loss of power and a smokey exhaust.

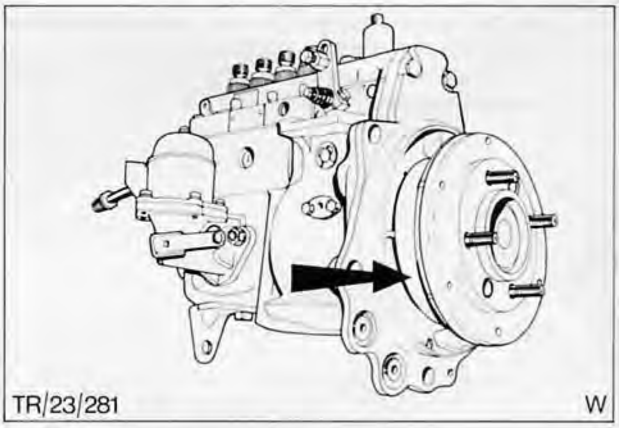


Fig. 21. Location of pump auto-advance unit

To overcome these problems an auto-advance unit is included in the pump to advance the start of injection delivery at high engine revs, thus ensuring that fuel injection is completed at the correct point in the firing cycle.

Located at the front of the injection pump (Fig. 21) the unit consists of 2 centrifugal weights ('C' in Fig. 22) control springs ('E') and advance sliders ('B').

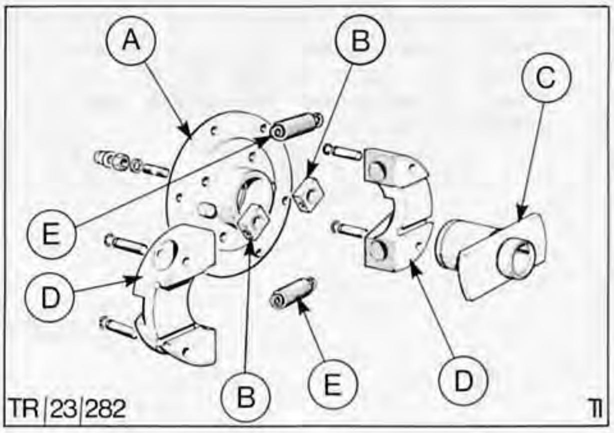


Fig. 22. Auto-advance unit (Exploded)
A – Drive flange
B – Advance slider
C – Centre sleeve
D – Centrifugal weights
E – Control springs

PRINCIPLE OF OPERATION (cont'd)

The outer flange is bolted to the belt drive gear and the inner sleeve is keyed to the camshaft. (Fig. 23.) Therefore, the drive path to the camshaft passes from the front flange, through the centrifugal weights and out the centre sleeve.

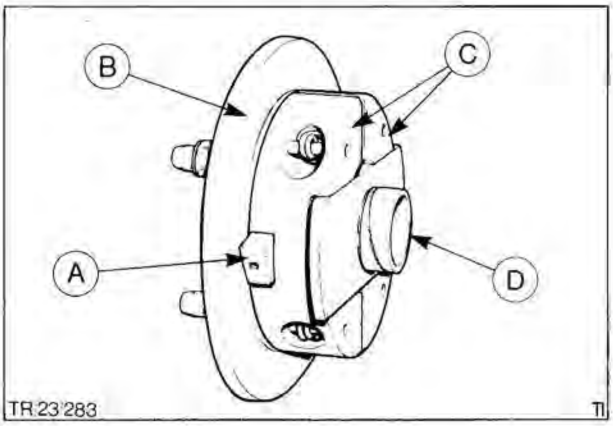


Fig. 23. Auto-advance unit
A – Advance slider
B – Front flange
C – Centrifugal weights
D – Centre output sleeve

At low engine speed the two springs hold the centrifugal weights together as shown in Fig. 24, and any advance is pre-set during initial installation of the pump. (11° B.T.D.C.)

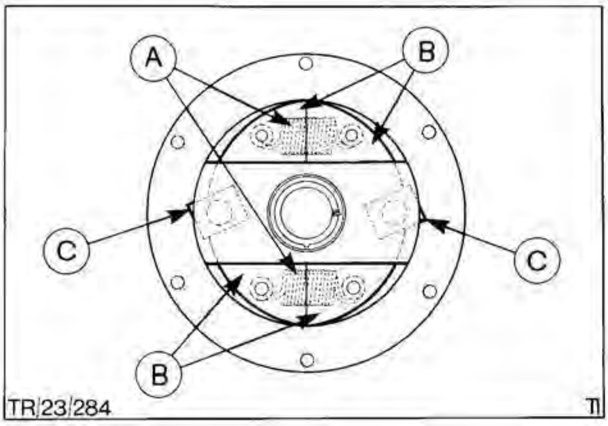


Fig. 24. Advance unit at low rpm (Zero advance)
A – Control springs
B – Centrifugal weights (held together)
C – Advance slider

As engine speed increases the weights are thrown outwards moving along the advance sliders. As shown in Fig. 25, this has the effect of advancing the output sleeve in relation to the front flange.

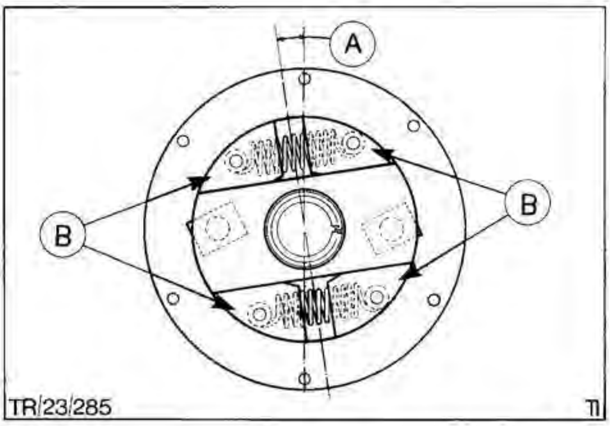


Fig. 25. Advance unit at high rpm (Maximum advance)
A – Degrees advance
B – Centrifugal weights thrown outwards

PRINCIPLE OF OPERATION (cont'd)

Sediment or Line Filter (Fig. 26)

The sediment or line filter is located on the right-hand wing panel beneath the battery. The purpose of the filter is to trap any large pieces of sediment before being passed to the main filter. The glass bowl should be removed and cleaned at the specified service interval.

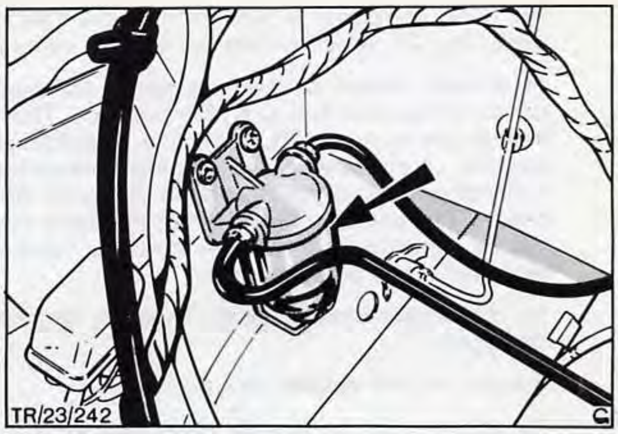


Fig. 26. Sediment or line filter

Main Fuel Filter

The main filter is bolted onto the engine in the location shown in Fig. 27, and includes a bleed bolt fitted into the upper housing. The filter is of a cartridge type which has to be renewed at the specified service interval. Details of this procedure are covered in Operation 23–545. The filter has a very fine mesh to ensure that all dirt and grit are removed from the fuel before it enters the pump where the dirt would cause damage to the accurately machined surfaces.

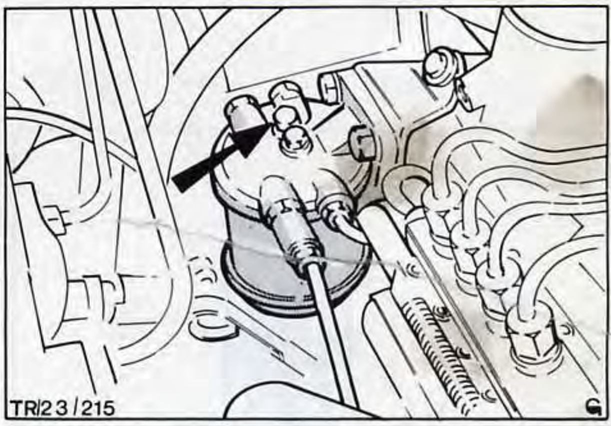


Fig. 27. Main fuel filter
Bleed bolt arrowed
(Air cleaner removed for clarity)

Injectors (Fig. 28)

The injectors are located down the left-hand side of the cylinder head and are held in position by 2 bolts. The type of injectors used are of the Pintle design (described overleaf) and operated by fuel pressure supplied from the pump.

The injectors carry out two functions, firstly to atomise the fuel into a fine mist during the power stroke, and secondly to ensure that fuel does not seep or drip into the cylinder during the other three strokes in the engine firing cycle. This type of injector does not carry out any metering or timing function, these operations being carried out by the injection pump.

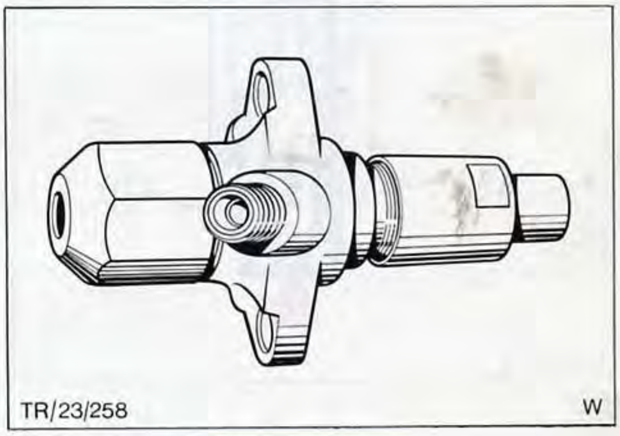


Fig. 28. Injector assembly

PRINCIPLE OF OPERATION (cont'd)

The basic components that make up the injectors, are a control spring, spindle, needle and nozzle body. (Refer Fig. 29, which shows the injector on its power stroke).

As already shown on previous pages the pump will supply the injectors at the correct time with the correct amount of fuel at a high pressure. This fuel enters the injector at point 'A' in Fig. 29, and due to its high pressure will lift the needle, and discharge into the cylinder. It is a combination of the shape and position of the needle and the high pressures that ensure the full atomization of the fuel. After the metered amount of fuel has been delivered the pressure will drop allowing the return spring to close the needle. The pressure figure when the valve starts to inject is called the needle opening pressure, which can be adjusted. This requires specialist tools and equipment which are usually only available in a fully equipped diesel pump room.

To disconnect injector pipes an open ring spanner should be used to ensure connections are not damaged.

Injector leak off system (See Fig. 30).

To ensure that the needle does not seize in its guide, these two components are lubricated by a controlled back leak of fuel up the needle guide, up past the spindle and return spring, and out through the leak off pipe back to the tank.

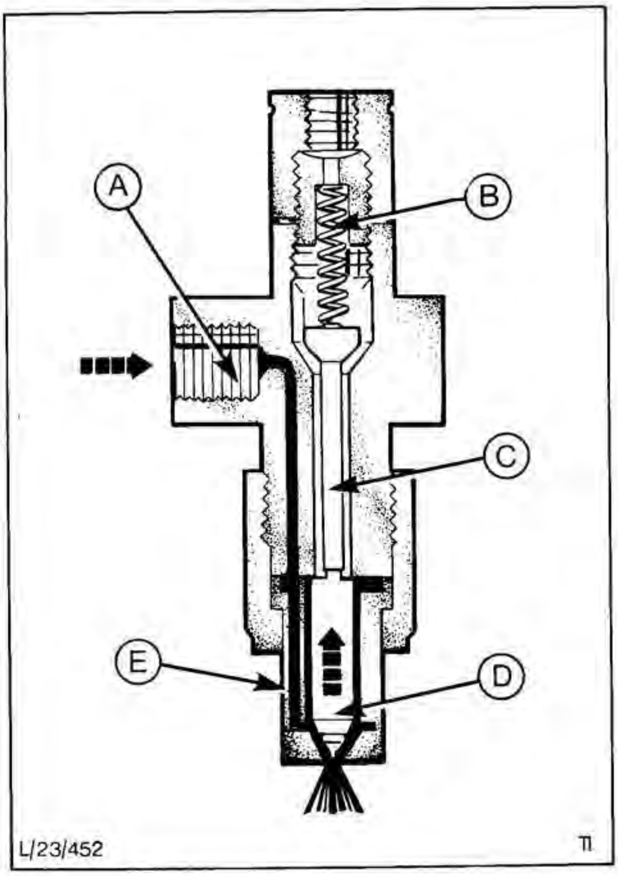


Fig. 29. Injector on the power stroke
A – Fuel inlet (high pressure)
B – Return spring
C – Spindle
D – Needle (raised)
E – Nozzle body

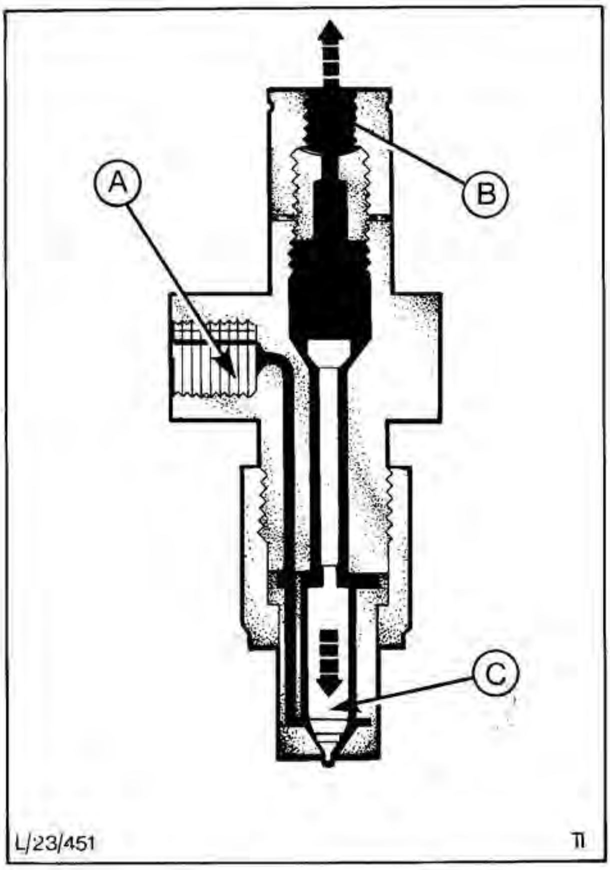


Fig. 30. Injector leak off system
A – Fuel inlet (low pressure)
B – Leak off connection
C – Needle (closed)

PRINCIPLE OF OPERATION (cont'd)

Glow Plug Starting Aid System

In addition to the excess fuel device a glow plug starting aid is fitted. The purpose of the plugs is to pre-heat the air in the pre-combination chamber before the engine is started. The heated air helps to atomize the fuel into a fine mist to ensure good starting characteristics are achieved. The Service life of the plugs are 45,000 km (30,000 miles) when they should be replaced. The procedures for this is detailed in Operation No. 23 772.

The glow plugs one for each cylinder are simple heater elements located in the cylinder head adjacent to each injector.

The No. 1 glow plug can be seen by inspecting the head, adjacent to the No. 1 injector, (Fig. 31), however the remaining 3 plugs are not visible unless the inlet manifold is removed.

Additional control components used in the system are a temperature sensing switch fitted into the cylinder head ('C' in Fig. 32) a time control unit 'A', and power relay 'B' fitted on the right-hand battery support panel, and a warning lamp. The time control unit controls the length of time that the plugs are allowed to operate and the switch cuts out plug operation on a hot engine.

Principle of Operation Refer Fig. 33

On a cold engine (at below approximately 40 °C) power from the ignition switch is fed to the time control unit and up through the warning lamp which lights up. The time control unit energises the relay via the closed contacts of the temperature switch, which in turn allows a heavy current to pass from the battery to the four glow plugs. After approximately 10 seconds at +10 °C or 20 seconds at −10 °C the time unit breaks part of the circuit, cutting off power to the warning lamp. At this point the engine can be started. During cranking the time control unit will still energise the relay enabling the plugs to pre-heat the air intake during the starting procedure. A safety feature of this system is that if the ignition is left in the 'ON' position and the engine is not cranked, the time control unit will cut off power to the relay after approximately 30 seconds.

If the engine fails to start the relay will be re-energised when the ignition is turned 'off' and then back 'on' again.

On a hot engine the contracts within the temperature switch will be open breaking any flow of current from the control unit to the relay.

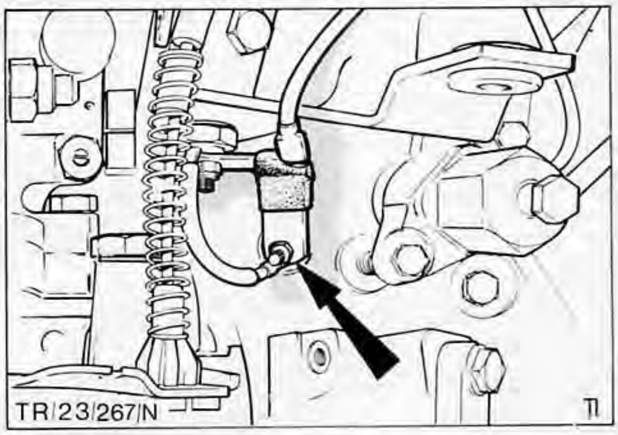


Fig. 31. No. 1 Glow plug positioned in cylinder head

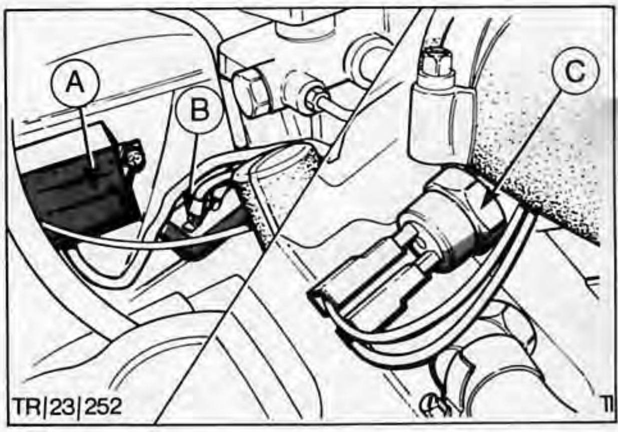


Fig. 32. Glow plug control components
A – Time control relay
B – Power relay
C – Coolant temperature sensor

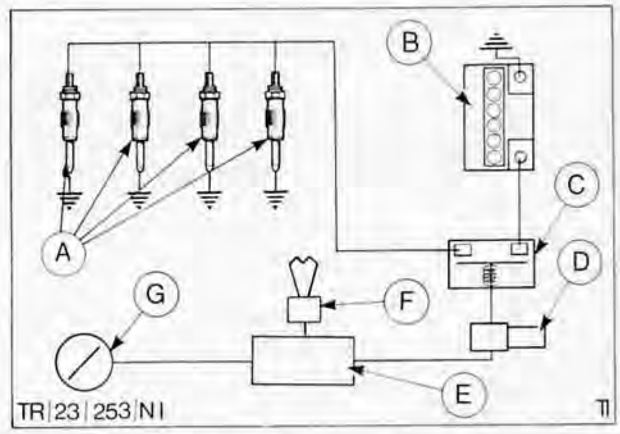


Fig. 33. Glow plugs wiring (Simplified)
A – Glow plugs
B – Battery
C – Power relay
D – Temperature sensing switch
E – Time control relay
F – Warning lamp
G – Ignition switch

DIAGNOSIS PROCEDURES

INTRODUCTION

The following procedures have been devised to assist in making the most accurate diagnosis of any fuel system problem with the least amount of trial and error work.

It will be found that, the diagnosis procedures detail the items to be checked and the manner of checking.

It is not intended to incorporate all the repair methods within the text, and whenever necessary, reference should be made to the appropriate section to establish the technical data and the method of carrying out each repair.

The fault diagnosis procedures are divided into seven categories which represent the most common categories of concern.

These are:

I. Engine will not start or is difficult to start.

II. Excessive exhaust smoke.

III. Engine starts and then stops.

IV. Uneven running/misfiring.

V. Lack of power/poor fuel consumption.

VI. Engine Surge (with throttle in fixed position).

VII. Engine 'Knock' (with incorrect fuel metering).

To make the most effective use of these diagnosis procedures, first test the vehicle to establish which category or categories you have to contend with. Having defined it as one of the general terms listed above simply refer to the relevant diagnosis chart and supplementary notes which follow each chart to establish the cause and the relevant remedy.

GENERAL NOTES

Requirements for Easy Starting:

An adequate quantity of properly atomised fuel delivered at the correct pressure, at the correct time, into the combustion chamber in which the compression of air has increased the temperature to readily ignite the fuel.

Requirements for Good Performance:

The most efficient generation of power is attained by the best possible combination of fuel and oxygen in the combustion chamber. Frictional losses throughout the vehicle must be kept to a minimum.

Requirements for Correct Speed Settings:

The specified idling and maximum no load speeds should be readily attained and held when the fuel pump control lever is in contact with the appropriate correctly set adjusting screw.

Requirements for Even Running:

All engine cylinders should give equal power output at evenly spaced intervals of the engine cycle at any given throttle opening and acceptable load. Engine mountings should hold the engine steady yet be sufficiently resilient to dampen normal engine vibration.

Requirements for Clean Exhaust:

If all the fuel and all the air in the combustion chamber were to be burnt this would be complete combustion. This ideal condition is approached but never realised in practice. However, no engine, if properly maintained and at its normal operating temperature, should emit more than a faint haze from the exhaust pipe.

Smoke is generated when combustion is unsatisfactory and therefore a proportion of the fuel is not doing useful work.

In the following notes it is assumed that the engine is in good condition and is therefore not burning excessive amounts of lubricating oil.

Black Smoke:

This consists of a large number of carbon particles which are produced when fuel is heated in 'oxygen lean regions' of the combustion chamber.

Blue Smoke:

This consists of large numbers of fuel oil particles of about 0,5 microns diameter or less.

These particles are condensed droplets of partially burnt or unburnt fuel which have passed through 'low temperature regions' of the combustion chamber, and may also be caused by burning lubricating oil caused by some mechanical defects.

White Smoke:

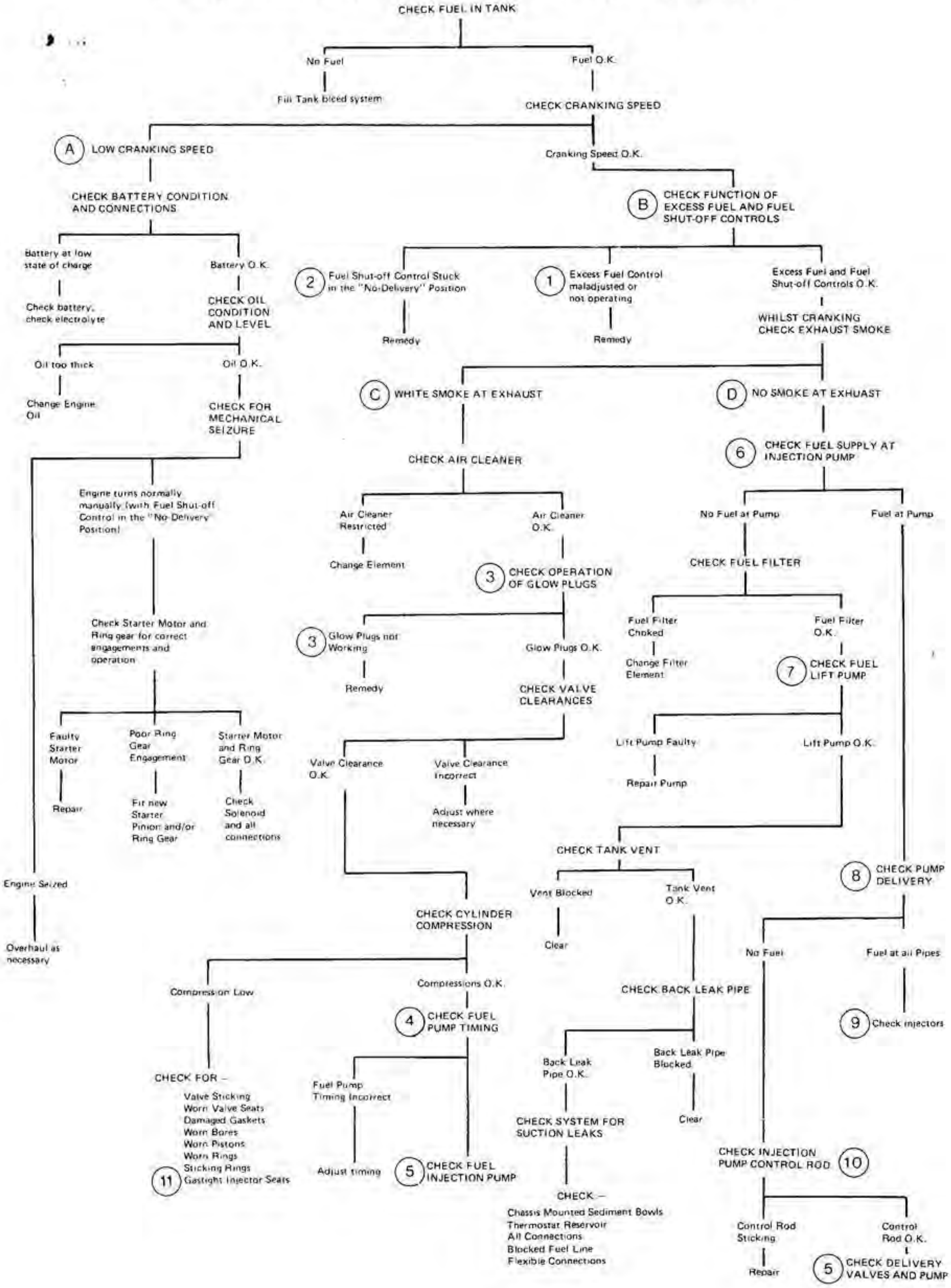
This consists of a large number of condensed droplets of partially burnt or unburnt fuel larger than about 1,0 micron diameter. To produce white smoke the fuel will have had more time to condense than for blue smoke, e.g. a cold engine running at light load and low speed could produce white smoke. Retarded injection timing would not give the fuel suitable conditions to burn correctly, and this can also produce white smoke.

It is important to realise that the majority of the items listed would not arise if the correct maintenance operations were carried out at the specified intervals.

Before any part of the fuel supply system is dismantled the surrounding area must be thoroughly cleaned. When the fuel system has been reassembled and all nuts tightened to the specified torque, it will be advisable to bleed the system to assist the self purge system.

DIAGNOSIS PROCEDURES (cont'd)

I ENGINE WILL NOT START OR IS DIFFICULT TO START



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DIAGNOSIS PROCEDURES (cont'd)

I. ENGINE WILL NOT START OR DIFFICULT TO START

Sympton 'A' Engine will not turn over at a sufficiently high speed.

For diagnosis information on this sympton reference should be made to either Section 36 (Batteries and Cables) Section 26 (Starter Motors) or Section 21 (Engines).

Item 'B' Excess fuel and fuel shut-off systems faulty.

1. Excess fuel control mal-adjusted – Full adjustment procedure shown on page 8.

   Excess fuel control inoperative – Operation of the excess fuel system can be checked by inspecting the solenoid, located on the excess pump button, which will be energised when the ignition is turned 'ON' at a cylinder temperature below 0 °C.

   At cylinder temperatures above 0 °C disconnect the cut out switch loom and fit a bridge between the two connections. Principle of Operation of the system is shown on page 6.

2. Fuel shut-off control. Check that when the ignition is turned 'ON' the shut-off motor and cable allows the stop control lever, on the pump, to return to the 'OFF' position.

Sympton 'C' White smoke at exhaust when the engine is being cranked – The white smoke proves that a fuel supply is being delivered to the engine.

3. Glow plug check procedure fully detailed in Operation 23 771. If all plugs fail to operate a voltmeter should be connected at the No. 1 glow plug terminal to ascertain if a voltage is available at the plug. If voltage is not available the wiring connections should be first checked and then the time control unit and relay checked by substitution. Principle of operation of the glow plug system is shown on page 15.

4. Check fuel pump timing – Full details of pump timing are shown in Operation 23 414.

5. If the injection pump is suspect the pump should be removed and overhauled by either C.A.V. or one of their authorised Agents.

Sympton 'D' No smoke at exhaust when the engine is being cranked – This would indicate that fuel is not being injected into the cylinder.

6. To check fuel delivery at the injection pump, disconnect the inlet pipe and crank engine.

7. To check lift pump disconnect the delivery connection and crank engine. If no fuel is delivered at this point the pump should be removed, dismantled and the diaphragm, lever and return spring checked for serviceability.

8. Check pump delivery by disconnecting the four injector pipes at the injectors and cranking engine.

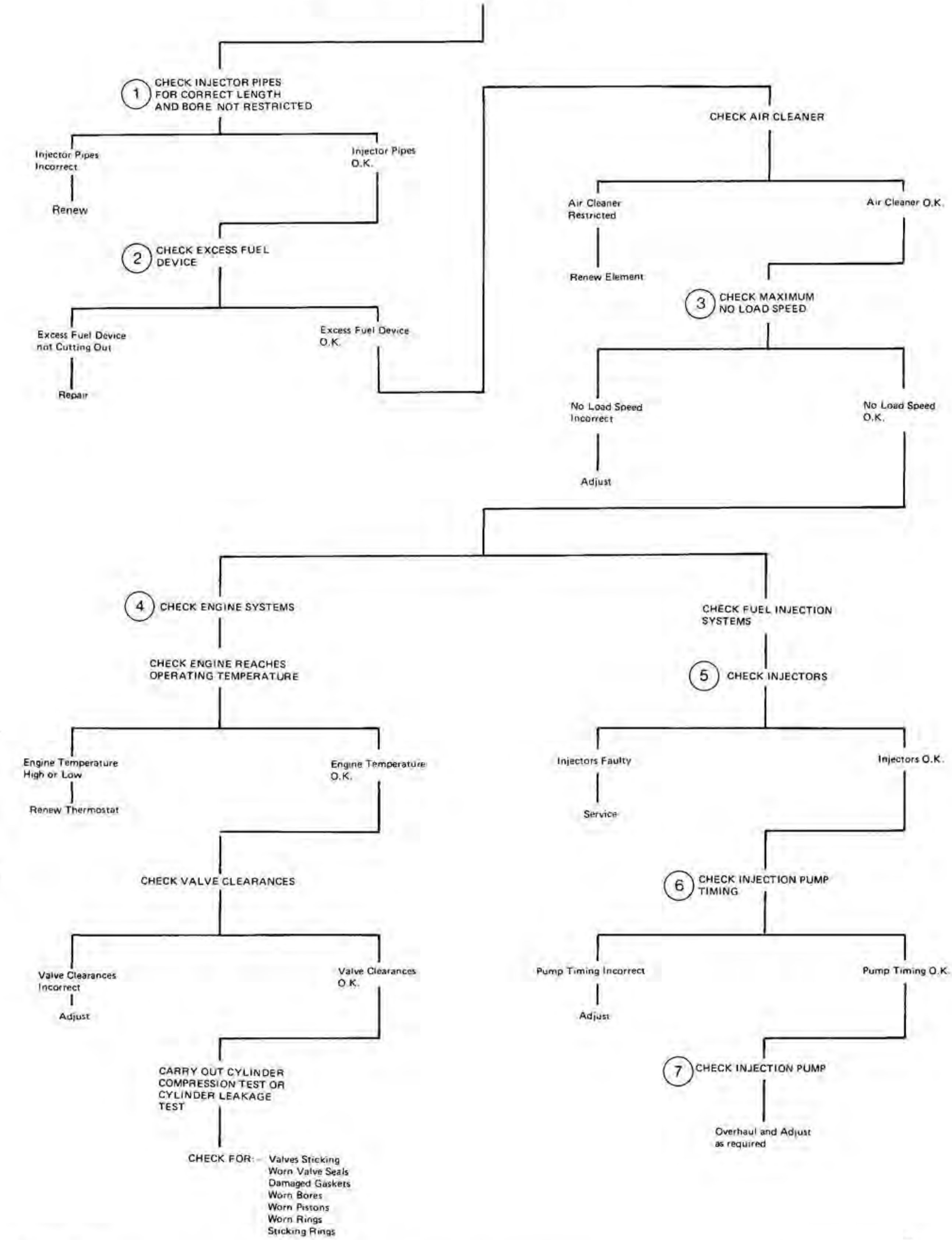
9. Injector check – Full details for checking and overhauling injectors are shown in Operation 23 454 8 on page 38.

10. Check injection pump control rod by removing the pump side cover, and moving the control rod backwards and forwards checking that the rod does not stick or bind.

11. Check that the injectors are a gas tight fit by inspecting the seals and replacing if required (Refer Operation 23 454) and ensuring the securing bolts are tightened to the specified torque.

DIAGNOSIS PROCEDURES (cont'd)

II EXCESSIVE EXHAUST SMOKE



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DIAGNOSIS PROCEDURES (cont'd)

II. EXCESSIVE EXHAUST SMOKE

CHART REFERENCE

1. Incorrect or damaged injection pipes can result in incorrect and unbalanced fuel distribution to the injectors. Check can be made visually.

2. Excess fuel device not cutting out – Visual inspection of the excess fuel button on the pump should confirm that the button has returned to its 'OFF' position. Also, if the button remains engaged the injection pump will baulk resulting in the engine running very rough and at a low idle speed. Principle of Operation for this system is shown on page 6.

3. Maximum no load speed – Procedure for this Operation is fully covered in Operation No. 23 413 on page 31.

   NOTE: The no load speed adjustment is sealed during pump manufacture and further adjustment must only be carried out by a C.A.V. Authorised Agent.

4. Engine systems – For further information and technical data for the engine operations reference should be made to the appropriate section in this Workshop Manual.

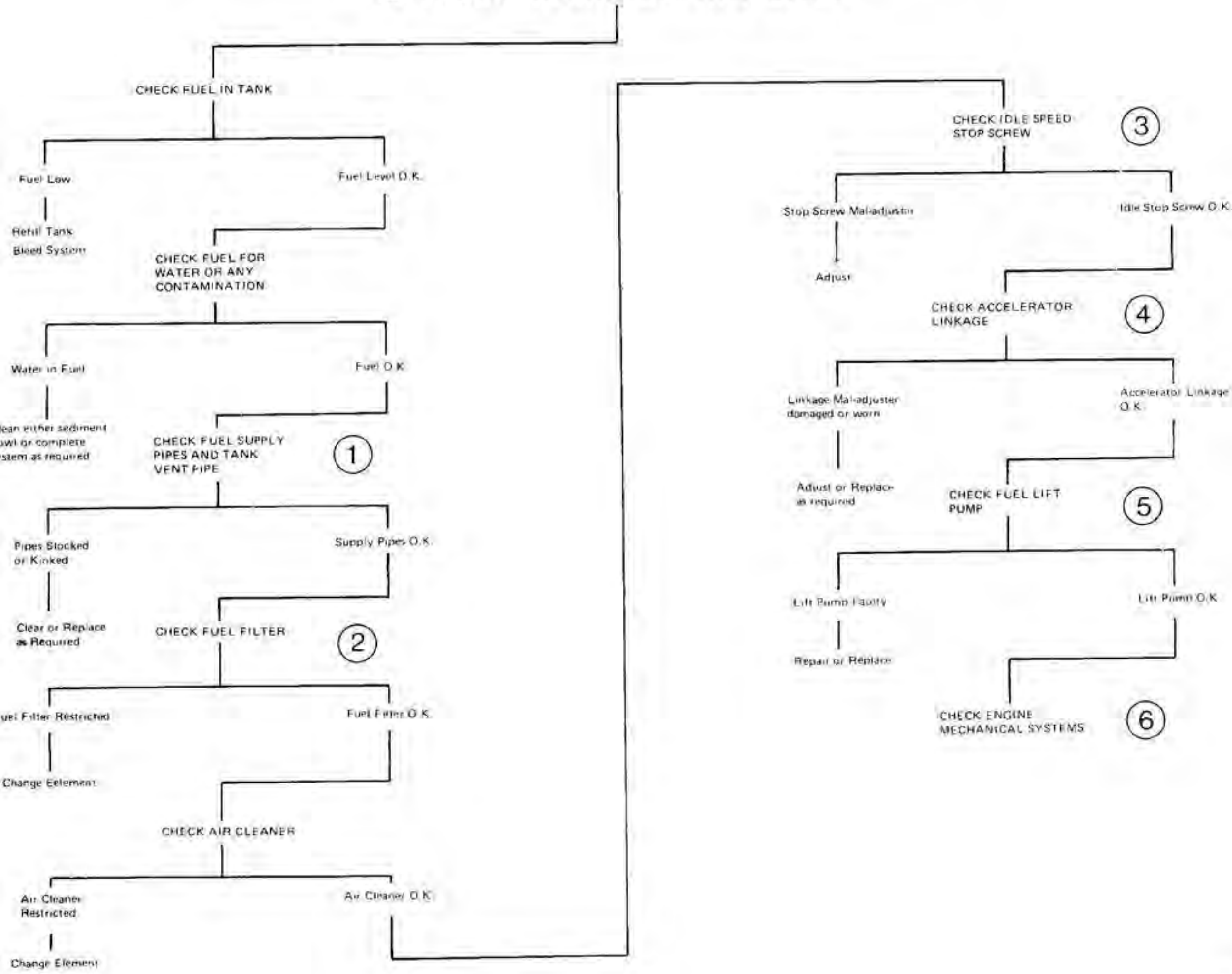
5. Injectors – Faulty injectors is one of the main causes of smoking exhausts and it is essential that they are serviced at regular intervals as laid out in the Service Voucher Book. The injectors should be checked for correct type, serviceable components and correct adjustment. Also, when injectors are removed ensure that the sealing washers are correctly fitted. Refer Operation No. 23 454 (Injector Remove and Install) and Operation No. 23 454 8 (Injector Overhaul).

6. Injection pump timing – Full details of pump timing check and adjustment are shown in Operation No. 23 414.

7. Injection pump – If the injection pump is faulty the pump should be removed and overhauled by either C.A.V. or one of their Authorised Agents.

DIAGNOSIS PROCEDURES (cont'd)

III ENGINE STARTS AND THEN STOPS



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III. ENGINE STARTS AND THEN STOPS

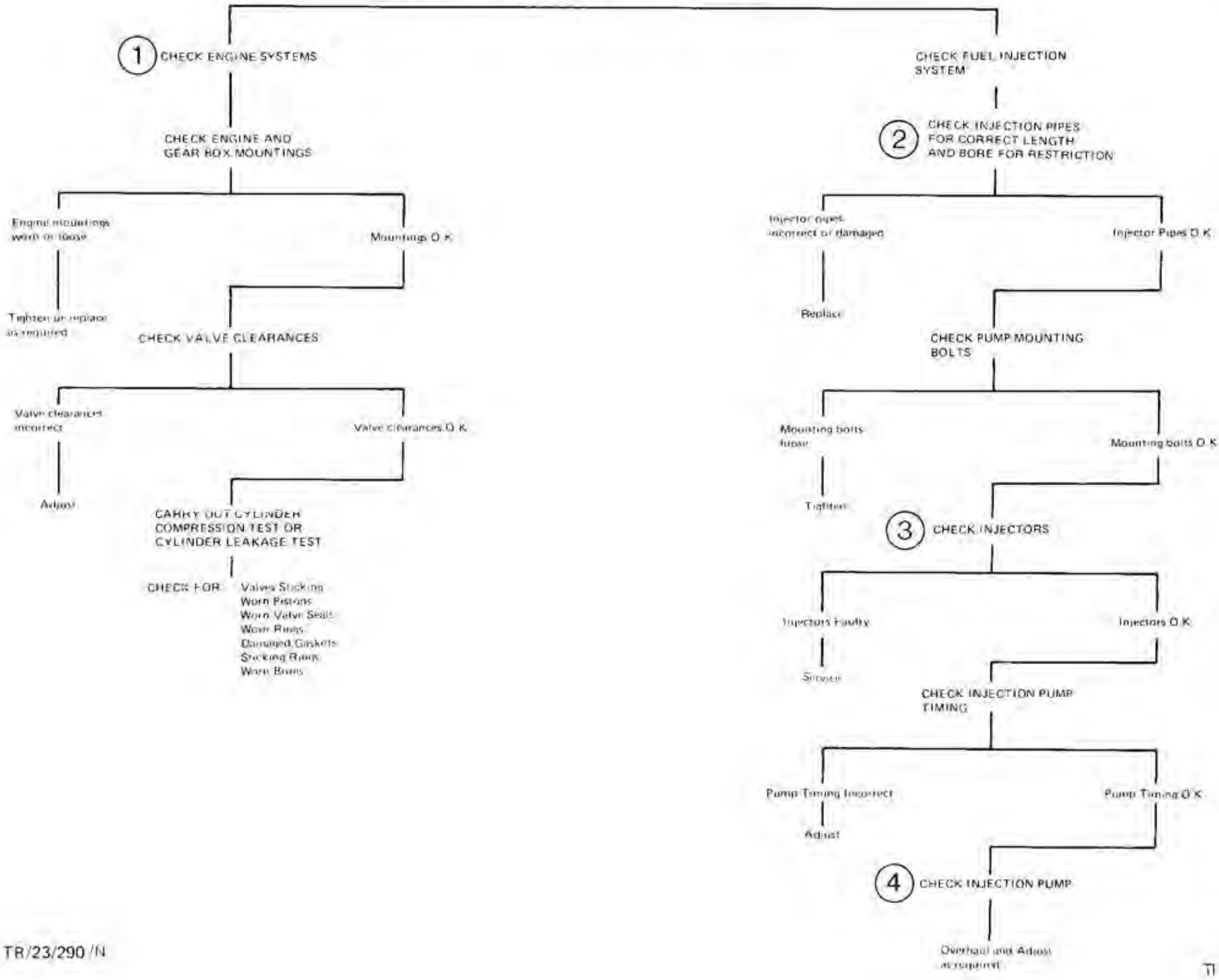
This is usually caused by fuel starvation as shown on above illustration.

CHART REFERENCE

1. Fuel supply and vent pipes – All pipes should be visually checked for damage or kinking and if still suspect the fuel supply pipe should be disconnected and blown through using an air line. If the tank vent pipe is blocked the engine will normally run for a considerable time before stopping and if at this time the filler cap was to be removed this would cure the problem. Also, check pipe unions for correct torque.
2. Fuel Filter – The fuel filter should be renewed at regular intervals as detailed in the Service Voucher Book. Refer Operation No. 23 545.
3. Idle Speed Stop Screw – This adjustment, should be checked to ensure that the idle speed is not to low as to cause a stall condition.
4. Accelerator Linkage – Linkage should be checked for correct adjustment, damage or worn components. Adjust or replace as required.
5. Fuel Lift Pump – To check pump disconnect delivery connection and crank engine. If no fuel is delivered the pump must be removed, dismantled and the components checked for serviceability. Overhaul or renew as required.
6. Check engine mechanical system – For further information reference should be made to the appropriate section in this Manual.

DIAGNOSIS PROCEDURES (cont'd)

IV UNEVEN RUNNING/MISFIRING



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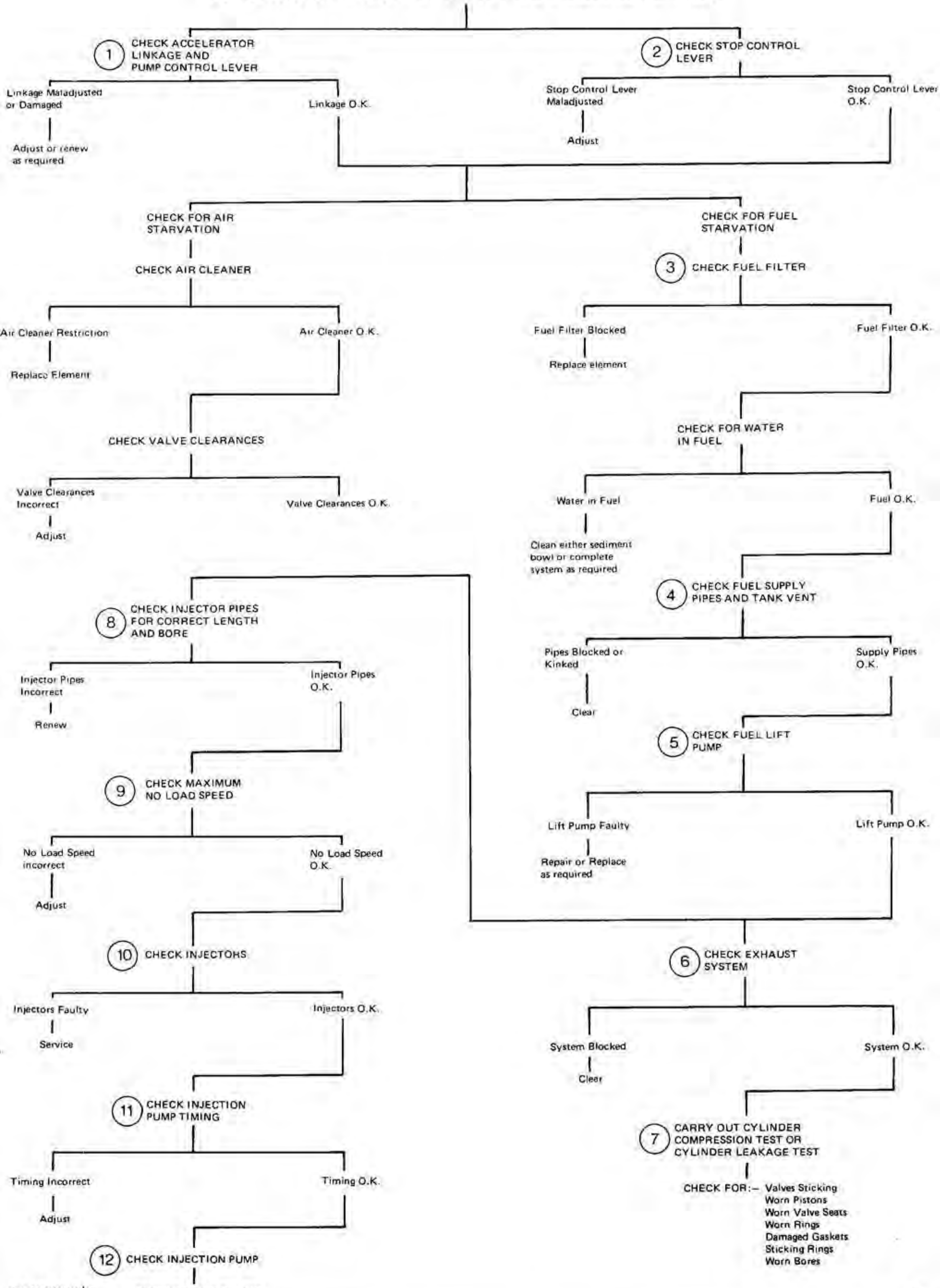
IV. UNEVEN RUNNING/MISFIRING

CHART REFERENCE

1. Check engine mechanical systems – For further information reference should be made to the appropriate section in this Manual.
2. Injector Pipes – Incorrect or damaged injection pipes can result in incorrect and unbalanced fuel distribution to the injectors. Checks can be made visually.
3. Injectors – To ensure a smooth drive is achieved it is essential that injectors are serviced at specified intervals as laid out in the Service Voucher Book. The injectors should be checked for correct type, serviceable components, and correct adjustment also when injectors are removed ensure that the sealing washers are correctly fitted. Refer Operation 23 454 (Injector Remove and Install) and Operation 23 454 8 (Injector Overhaul).
4. Injection Pump timing – Full procedure for pump timing check and adjustment are shown in Operation 23 414.
5. Injection Pump – If the injection pump is faulty the pump should be removed and overhauled by either C.A.V. or one of their Agents.

DIAGNOSIS PROCEDURES (cont'd)

V LACK OF POWER/POOR FUEL CONSUMPTION



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DIAGNOSIS PROCEDURES (cont'd)

V. LACK OF POWER/POOR FUEL CONSUMPTION

CHART REFERENCE

1. Accelerator Linkage – Linkage should be checked for correct adjustment damage or worn components.

   Pump lever should be checked for correct operation and secure fit.

2. Stop Control Lever – With the ignition 'ON' the lever should be checked to ensure it has fully returned and does not affect pump control rod operation.

3. Fuel Filter – It is essential for correct operation to ensure that the fuel filter is renewed at the specified service intervals, as outlined in the service voucher book.

4. Fuel supply and vent pipes – All pipes should be checked for damage or kinking and if still suspect the supply pipes should be disconnected, and blown through using an air line.

5. Fuel lift pump – To check pump disconnect the delivery connection and crank engine. If no fuel is delivered the pump must be removed, dismantled, and the components checked for serviceability. Overhaul or renew as required.

6. Check exhaust system – Check exhaust system for internal obstruction, as any obstruction will create a high back pressure and reduce power output.

7. Check engine compression – For further information on engine operation and technical data, reference should be made to Section 21, (Engines).

8. Injector pipes – Incorrect or damaged pipes can result in incorrect and unbalanced fuel distribution to the injectors. Checks can be made visually.

9. Check maximum no-load speed – Procedure for the check is shown in Operation 25 413 on page 31.

   NOTE: The no-load speed adjustment is sealed during pump manufacture and further adjustment must only be carried out by C.A.V. or one of their authorised agents.

10. Injectors – To ensure peak performance and economy the injectors must be serviced at the specified intervals laid down in the Service Voucher Book.

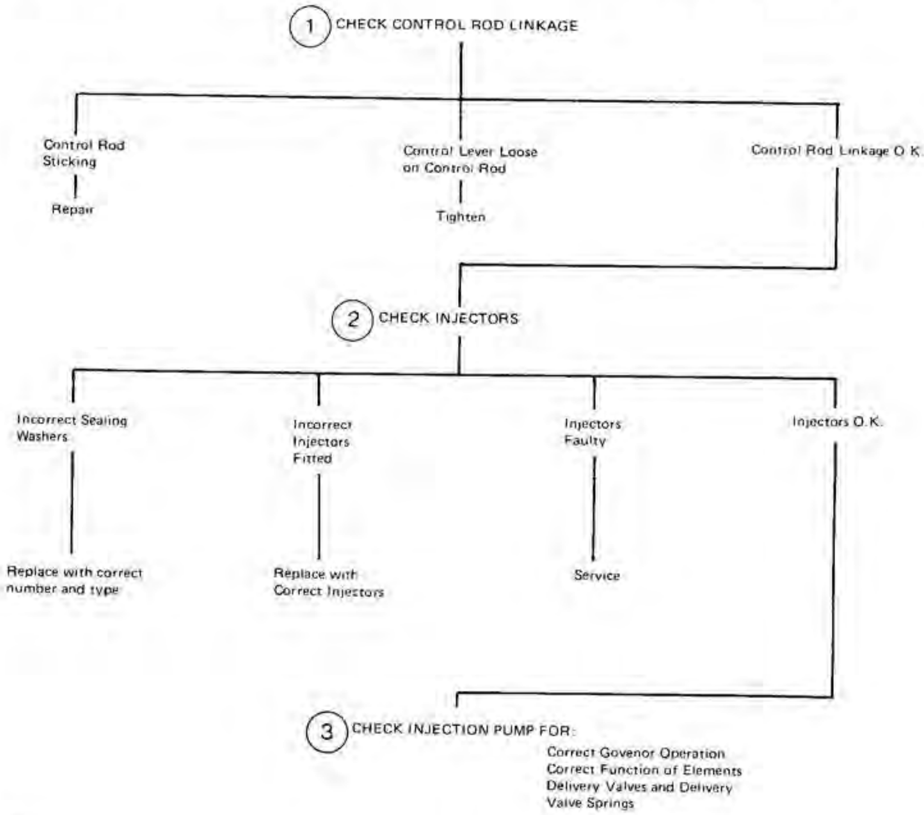
    The injectors should be checked for correct type, serviceable components and correct adjustment. Also when injectors are removed ensure that the sealing washers are correctly fitted. (Refer Operation 23 454 (Injector remove and install) and Operation No. 23 454 8 (Injector overhaul).

11. Injection pump timing – Full details of pump timing check and adjustment are shown in Operation 23 414.

12. Injection pump – If the injection pump is faulty the pump should be removed and overhauled by either C.A.V. or one of their authorised agents.

DIAGNOSIS PROCEDURES (cont'd)

VI ENGINE SURGE (WITH THROTTLE IN FIXED POSITION)



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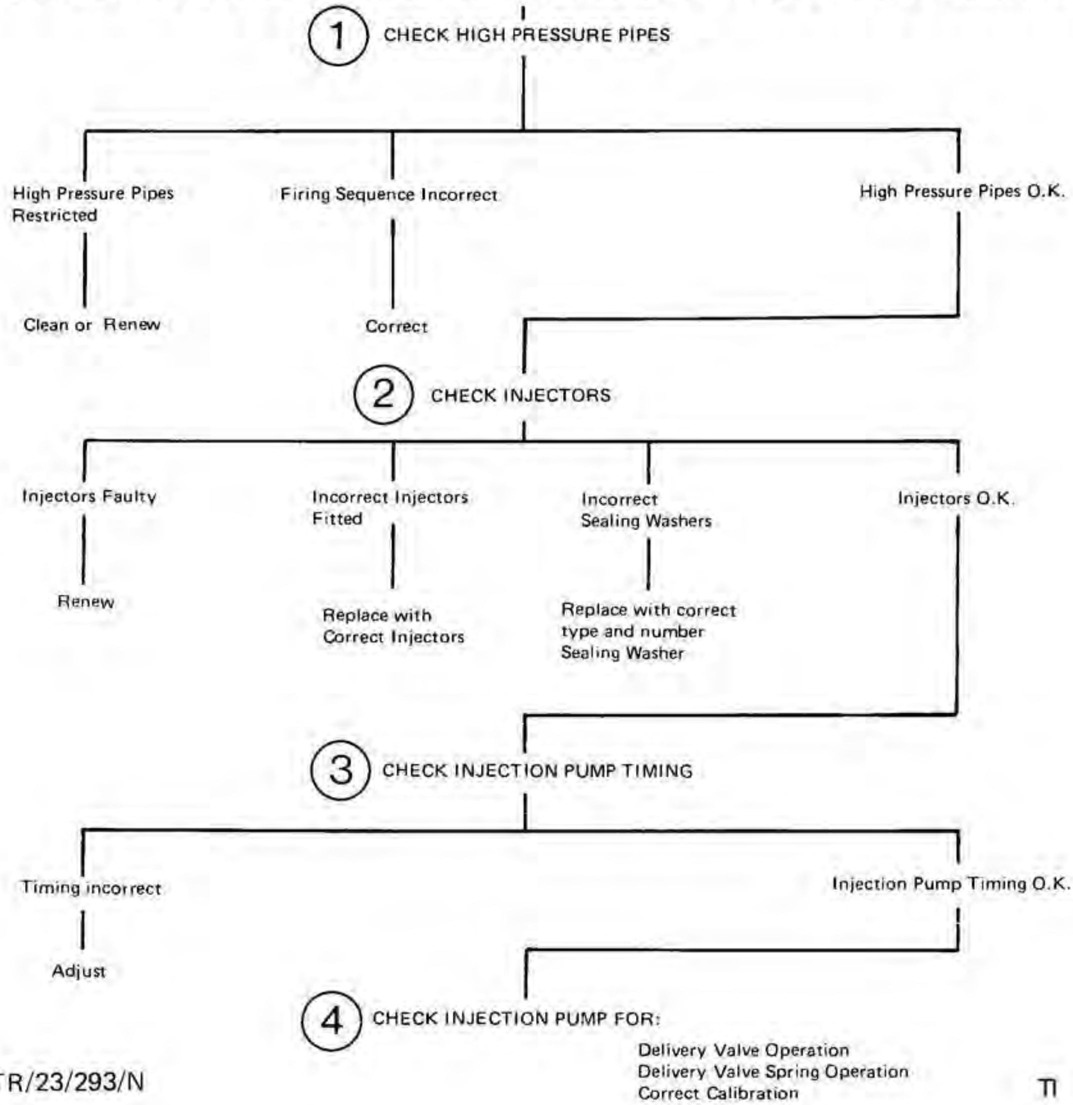
VI. ENGINE SURGE (WITH THROTTLE IN FIXED POSITION)

CHART REFERENCE

1. Check injection pump control rod by removing the pump side cover and moving the control rod backwards and forwards, checking that the rod does not stick or bind. Also ensure that the control lever is secure to the control rod.
2. Injectors – The injectors should be checked for correct type, serviceable components and correct adjustment. Also, when injectors are removed ensure that the sealing washers are correctly fitted. Refer Operation 23 454 (Injector Remove and Install) and Operation No. 23 454 8 (Injector overhaul).
3. Injection pump – If the injection pump is faulty the pump should be removed and overhauled by either C.A.V. or one of their Authorised agents.

DIAGNOSIS PROCEDURES (cont'd)

VII ENGINE KNOCK (WITH INCORRECT FUEL METERING)



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VII. ENGINE KNOCK (WITH INCORRECT FUEL METERING)

CHART REFERENCE

1. Check Injector Pipes – Incorrect or damaged injection pipes can result in incorrect and unbalanced fuel distribution to the injectors. Check can be made visually.
2. Injectors – The injectors should be checked for correct type, serviceable components and correct adjustment. Also when injectors are removed ensure that the correct number and type of sealing washers are fitted. Refer Operation 23 454 (Injector remove and install), and Operation 23 454 8 (Injector overhaul).
3. Injection pump timing – Full details of pump timing check and adjustment is shown in Operation 23 414.
4. Injection Pump – If the injection pump is faulty the pump should be removed and overhauled by either C.A.V. or one of their Authorised Agents.

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following items should be checked.

(a) Check and adjust idle speed.
Detailed in Operation 23 413.

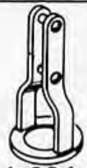
(b) Renew air filter element.
Detailed in Operation 23 184.

(c) Renew Diesel fuel filter.
Detailed in Operation 23 546.

(d) Check entire fuel system for evidence of leaks. If any are found they should be rectified immediately.

(e) Renew all four glow plugs.
Detailed in Operation 23 773.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 21-016	Camshaft gear alignment pin
 21-024	Valve spring compressor
 21-024-01	Valve spring compressor
 21-024-02	Valve spring compressor adaptor
 15-022	Dial gauge holding fixture
 15-046	Metric dial gauge

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SERVICE AND REPAIR OPERATIONS – CONTENT

DIESEL FUEL SYSTEM		Described in this publication	Contained in operation
23 142	Fuel system bleed	X	
23 174	Air cleaner assembly – remove and install	X	
23 184	Element – air cleaner – replace	X	
23 411	Injection pump – adjust timing		23 414
23 413	Engine idle speed – adjust	X	
23 414	Injection pump – remove and install	X	
23 414 4	Injection pump – remove and install (engine removed)		23 414
23 451 1	Injector – check (one) (injector removed)		23 454 8
23 454	Injector – remove and install (one)	X	
23 454 8	Injector – overhaul (one) (injector removed)	X	
23 455	Injectors – remove and install (all)		23 454
23 455	Injectors – remove and install (all) (air cleaner removed)		23 454
23 482	Pipe – injector delivery – remove and install (one)		23 483
23 483	Pipes – injector delivery – remove and install (all)	X	
23 485	Pipe – injector leak off – remove and install	X	
23 532	Fuel pump – clean	X	
23 534	Fuel pump – remove and install	X	
23 543	Filter – fuel line – clean	X	
23 544	Filter – fuel line – remove and install	X	
23 545	Fuel filter – remove and install	X	
23 546	Element – fuel filter – replace	X	
23 548	Fuel reservoir – remove and install	X	
23 588	Fuel line – fuel pump to fuel filter – remove and install	X	
23 592	Fuel line – fuel filter to injection pump – remove and install		23 588
23 594	Fuel line – fuel reservoir to fuel tank – remove and install		23 588
23 595	Fuel line – fuel reservoir to injection pump – remove and install		23 588
23 771	Glow plugs – check operation	X	
23 772	Glow plug – remove and install (one)		23 773
23 773	Glow plugs – remove and install (all)	X	
23 842	Cable – stop control – remove and install	X	

23 142 FUEL SYSTEM – BLEED

Special Service Tools Required: None

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Position drain tray beneath fuel filter and loosen filter bleed bolt by approximately half a turn, Fig. 34.
4. Using the hand priming lever (located on the lower half of the fuel lift pump, Fig. 35) bleed filter by pumping fuel through the bleed bolt until all air is removed. Tighten bleed bolt.
5. Bleed injection pump assembly by loosening bleed bolt on pump, Fig. 35, and manually pumping fuel through bleed bolt.
6. Tighten pump bleed bolt, and remove drain tray.
7. Reconnect battery.
8. Remove fender covers and close hood.

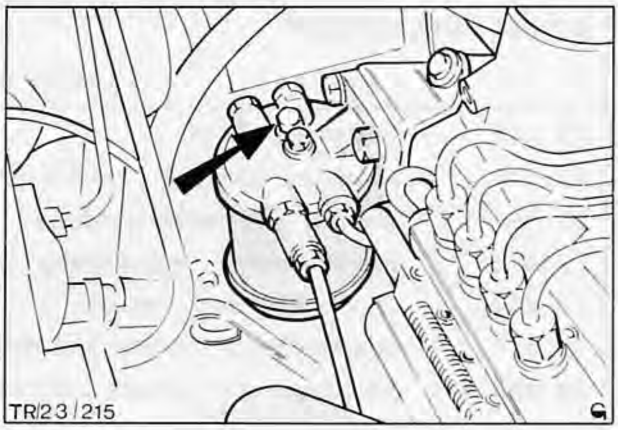


Fig. 34. Fuel filter bleed bolt
Air cleaner removed for clarity

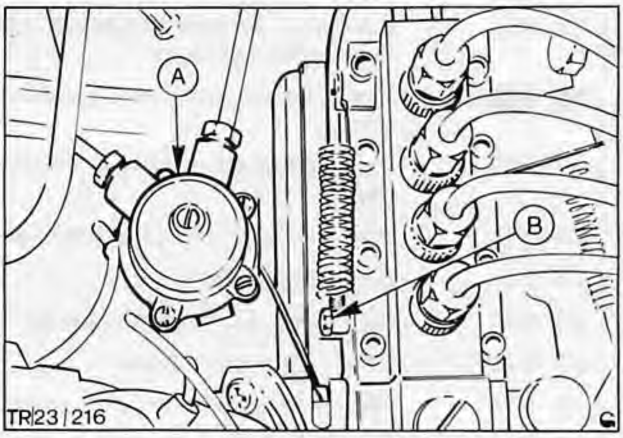


Fig. 35. Fuel injection pump
A – Fuel lift pump
B – Pump bleed bolt

23 174 AIR CLEANER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Remove centre wing bolt, one mounting stay bolt and detach cleaner assembly, Fig. 36.

To Install

4. Position cleaner assembly and secure with 2 bolts.
5. Reconnect battery.
6. Remove fender covers and close hood.

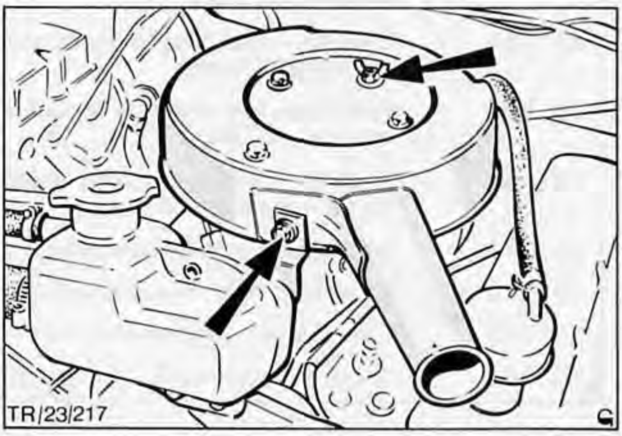


Fig. 36. Air cleaner securing bolts

23 184 ELEMENT – AIR CLEANER – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation 23 174.
4. Remove three bolts, split cleaner into two sections, and remove element, Fig. 37.

To Install

5. Using a new element re-assembly cleaner, and secure three bolts.
6. Refit air cleaner assembly.
7. Reconnect battery.
8. Remove fender covers and close hood.

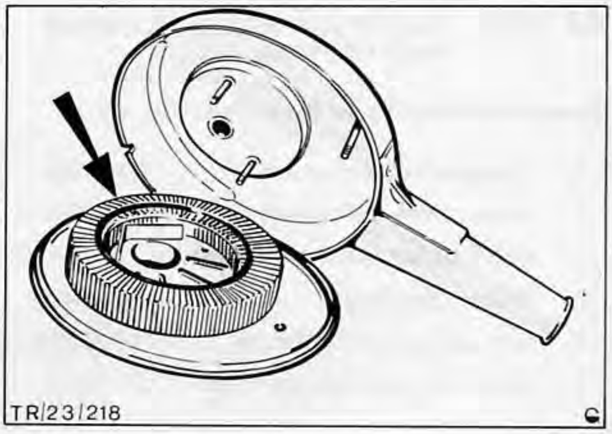


Fig. 37. Air cleaner element removal

23 413 ENGINE IDLE SPEED – ADJUST

Special Equipment Required: Tachometer

1. Open hood, and fit fender covers.
2. Run engine at full throttle and check maximum no-load speed. Do not hold throttle for longer than 5 seconds. An ideal type of tachometer is the strobe type, Fig. 38.
   NOTE: The maximum no-load adjustment is sealed and must only be adjusted by C.A.V. or one of their agents.

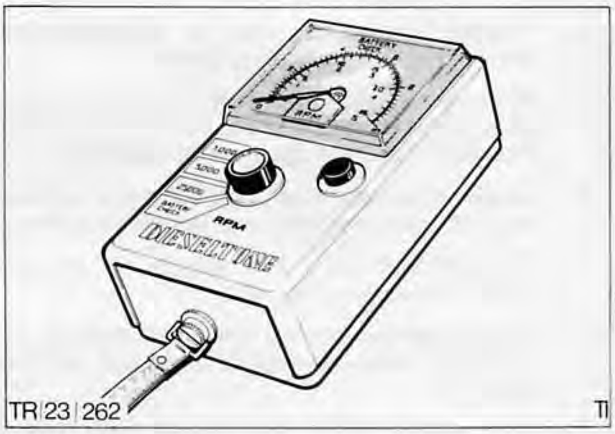


Fig. 38. Strobe type tachometer

3. Check and adjust idle speed by loosening the lock nut shown in Fig. 39, and screwing in or out the adjusting screw.
4. Remove fender covers and close hood.

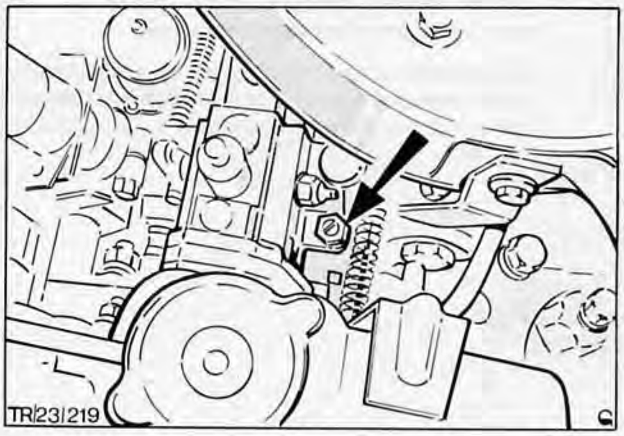


Fig. 39. Idle speed adjuster

23 414 INJECTION PUMP – REMOVE AND INSTALL

Special Service Tools Required: Fig. 40.

A.	Valve spring compressor	21–024
B.	Valve spring compressor adaptor	21–024–01
C.	Valve spring compressor adaptor	21–024–02
D.	Metric dial gauge	15–046
E.	Dial gauge holding fixture	15–022A
F.	Camshaft gear alignment pin	21–016

To Remove

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation 23 174.
4. Position drain tray and by disconnecting bottom hose drain cooling system.
5. Remove radiator and expansion tank complete with brackets and hoses. Detailed in Section 24 (cooling system).
6. Loosen alternator mounting bolts and remove fan belt from alternator and fan blade pulleys.
7. Remove four bolts and detach fan blades, pulley and spacer, Fig. 41.
8. Loosen vacuum pump drive belt adjuster (2 bolts), and detach vacuum pump belt and fan belt.
9. Remove five screws and detach front timing belt cover. A right angled cross-head screwdriver is a useful tool to remove screws.
10. Remove four injector supply pipes and fit dust caps to injectors and pump connections. NOTE: When disconnecting pipes at the pump remove the outer pipes first.
11. Disconnect stop control cable and accelerator cable, remove a single bolt, remove cable and bracket assembly and position clear of pump, Fig. 42.

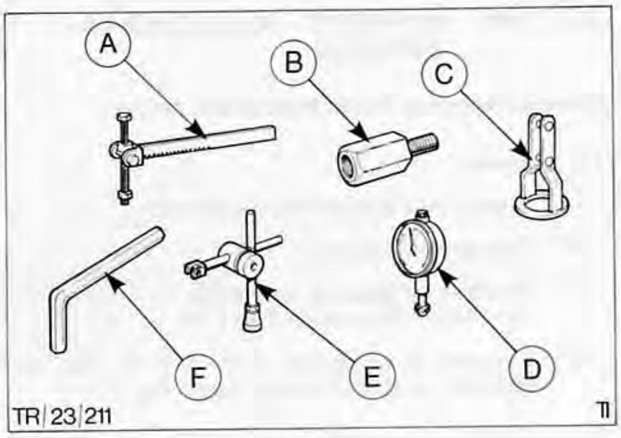


Fig. 40. Special tools requirement

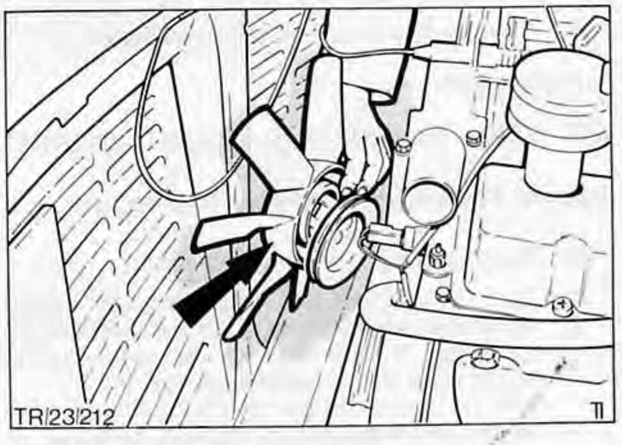


Fig. 41. Fan blade and pulley removed

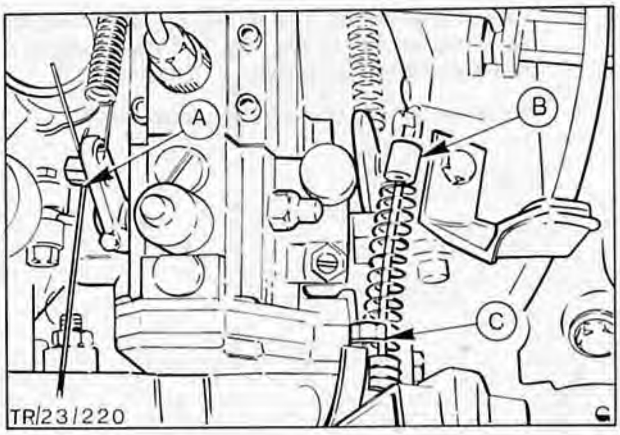


Fig. 42. Pump cable connections
A – Stop control cable
B – Accelerator cable
C – Cable bracket securing bolt

12. Disconnect fuel lift pump inlet and outlet pipes, and injection pump to filter pipe, Fig. 43.
13. Remove 2 bolts and detach fuel filter assembly, Fig. 43.

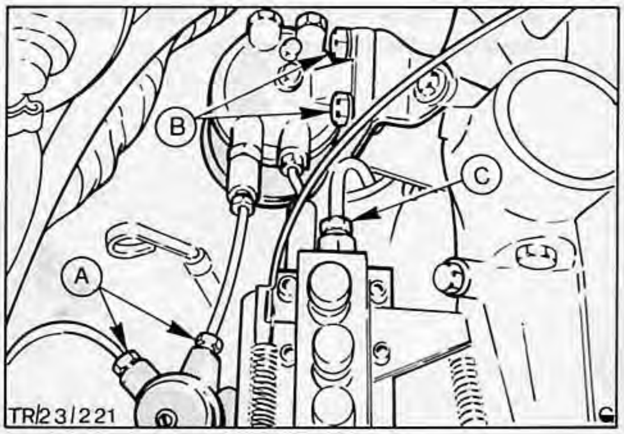


Fig. 43. Fuel filter assembly
A – Lift pump fuel connections
B – Filter securing bolts
C – Pump inlet connection

14. Using the timing marks on the crankshaft pulley and peg in the camshaft gear turn engine to T.D.C. No. 1, Fig. 44.

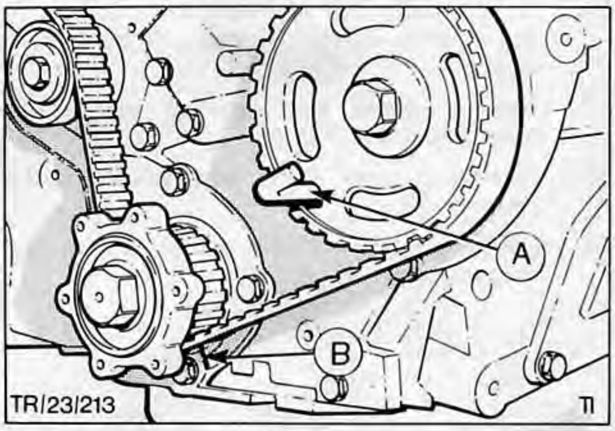


Fig. 44. Engine set on T.D.C. No. 1
(Crankshaft pulley removed for clarity)
A – Camshaft peg
B – Crankshaft T.D.C. marks

15. Loosen drive belt tensioner bolts swing tensioner away from belt and lock in this position, (Refer 'A' in Fig. 45).

    NOTE: The centre bolt does not have a captive nut and it may be necessary to hold the nut with a ring spanner from the rear (Refer 'B' in Fig. 45, which shows the nut when the pump is removed).
16. Remove drive belt from gears.

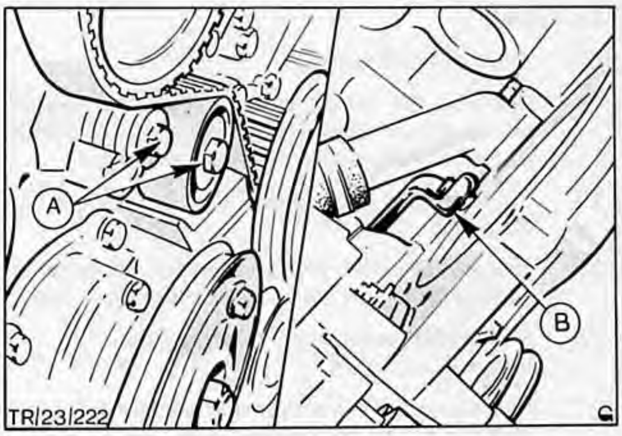
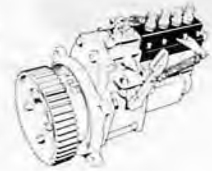


Fig. 45. Drive belt tensioner
A – Securing bolts viewed from the front
B – Securing nut viewed from the rear



17. Remove four nuts and carefully prise off injector pump drive gear, Fig. 46.

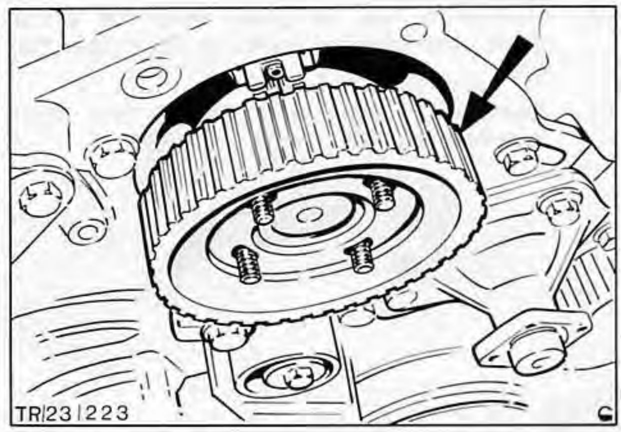


Fig. 46. Injection pump drive gear

18. On the front face remove 3 nuts and bolts and 2 bolts. Relative position of pump bolt locations shown in, Fig. 47.
19. Remove single bolt securing rear pump bracket to pump, Fig. 47.
20. Remove injector pump assembly from the rear, Fig. 48.
21. Hold drain tray beneath pump, remove fuel lift pump and drain pump.

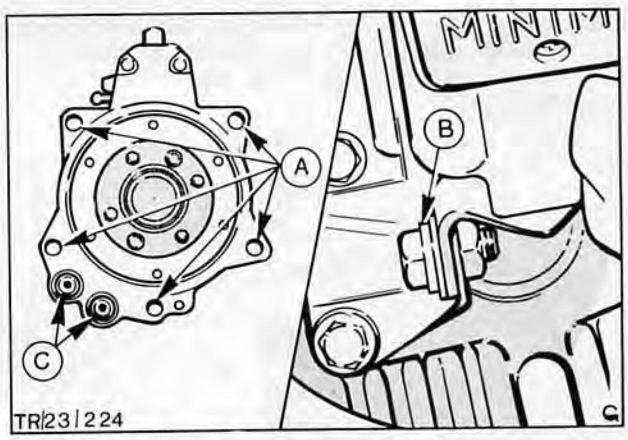


Fig. 47. Injection pump mounting point
A – Pump front face securing bolt holes
B – Pump rear mounting bolt
C – Injection pump oil seals

To Install

22. Clean fuel lift pump.
23. Remove the blanking plate from the fuel lift pump mounting aperture and pour 0,25 litres (0,5 pints) of engine oil into the pump.
24. Using a new gasket position and secure fuel lift pump.
25. Transfer throttle and accelerator cable return springs from the old to new injection pump.
26. Fit new 'O' seals to pump front face. Refer 'C' in, Fig. 47.
27. Place pump in position and secure front and rear mounting bolts, Fig. 47.

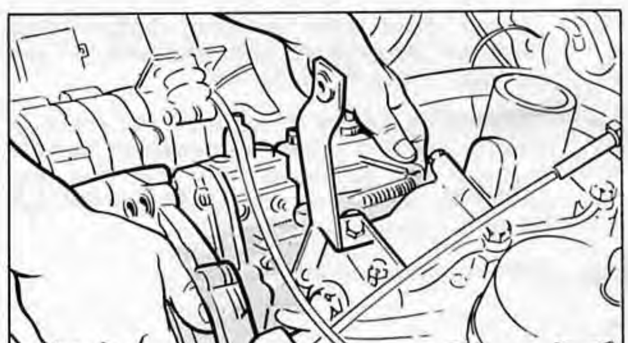
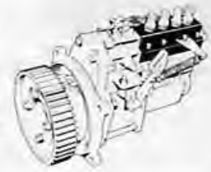


Fig. 48. Injection pump removal



28. Refit drive gear ensuring studs are in the centre of the elongated slots and loosely fit plate and four securing nuts, Fig. 49.

29. Ensure camshaft peg is still fitted and crankshaft lined up at T.D.C. Turn pump to the T.D.C. position as shown in Fig. 49, and refit drive belt.

30. Slacken belt tensioner actuate tensioner mechanism by sharply depressing the longest span of the belt and tighten retaining bolts, Fig. 45. Remove camshaft peg and rotate engine 2 revolutions to settle belt, refit T.D.C. peg.

31. Set engine to spill timing position as follows:

   A. Remove six screws and detach rocker cover.

   B. Loosen No. 1. exhaust valve adjuster screw clear of push rod. Slide rocker arm sideways, detach push rod and turn rocker arm through 90°, Fig. 50.

   C. Remove valve stem cap and using the valve spring compressor with suitable adaptors detach No. 1 exhaust valve spring, and valve stem seal. Allow valve to drop down onto piston.

   D. Mount dial gauge and adaptors using the rocker cover securing screw location and position gauge onto the valve stem, Fig. 51.

   E. Remove camshaft peg and using the gauge accurately set engine to T.D.C. Zero gauge. Turn engine backwards (anti-clockwise at the camshaft pulley) to a position where the piston has dropped 7 mm (seven complete revolutions on gauge).

   NOTE: Do not turn engine 360° as valve would drop into cylinder bore.

   F. Turn engine forward (clockwise at crankshaft) 6,01 mm and hold. At this position the front piston will be positioned 0,99 mm before top dead centre.

   IMPORTANT NOTE: If the final 0,99 mm position is passed the engine should be turned back to the 7 mm position sub operation (e) and sub operation (f) then repeated.

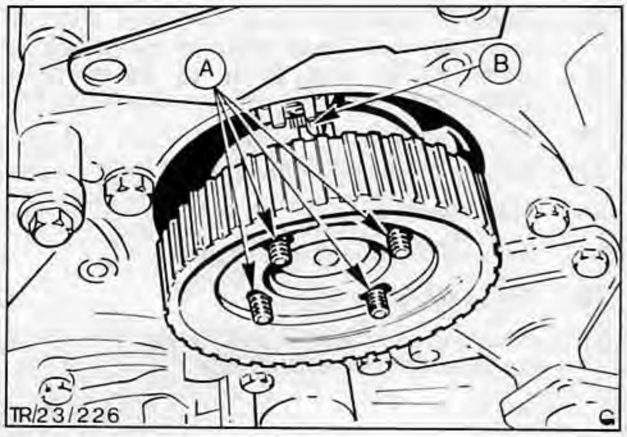


Fig. 49. Injection pump drive gear
A – Studs positioned in the centre of the slots
B – Pump set at approximately T.D.C.

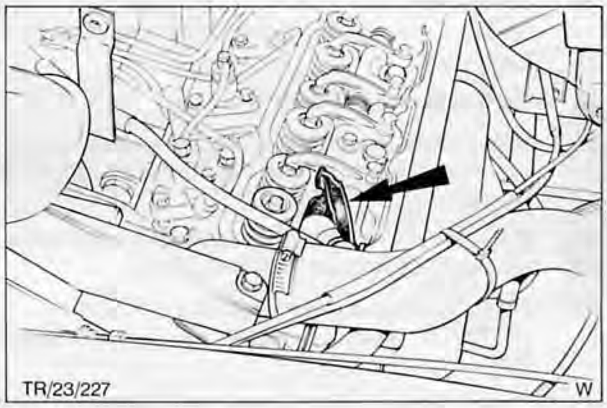


Fig. 50. Push rod removed and rocker arm turned through 90°

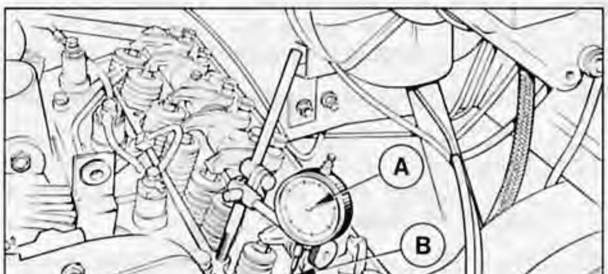
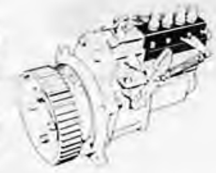


Fig. 51. Engine set at spill timing position
A – Metric dial gauge
B – Exhaust valve stem



32. Manually hold drive gear stationary and turn pump drive until peg holes on pump line up correctly. This can easily be achieved by using an 8 mm twist drill as shown, in Fig. 52.
33. Secure four pump drive securing nuts.
34. Turn engine to T.D.C.
35. Remove dial gauge and adaptors.
36. Refit valve stem seal.
37. Position valve spring and using the spring compressor refit valve collets.

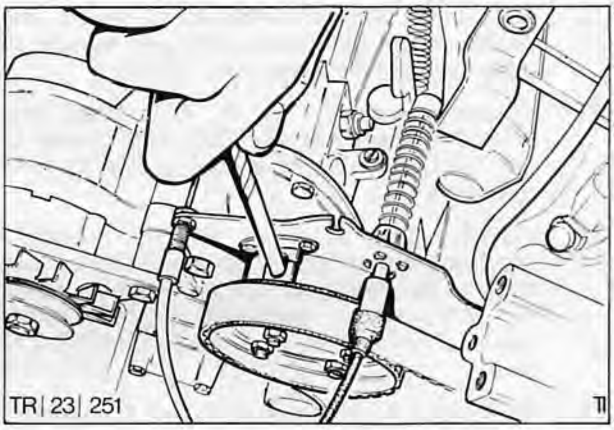


Fig. 52. Injector pump set at spill timing using an 8 mm twist drill to line-up hole

38. Refit valve cap (Fig. 53) and push rod, slide rocker arm in position and adjust valve clearance.
39. Refit rocker cover and secure.
40. Place filter assembly in position, and secure, reconnect fuel lines to lift pump and injector pump.
41. Position cable bracket, reconnect accelerator and stop control cables and adjust.
42. Place injector pipes in position and secure. NOTE: At injection pump secure outer pipes first.
43. Place timing belt cover in position, and secure cross-head screws.

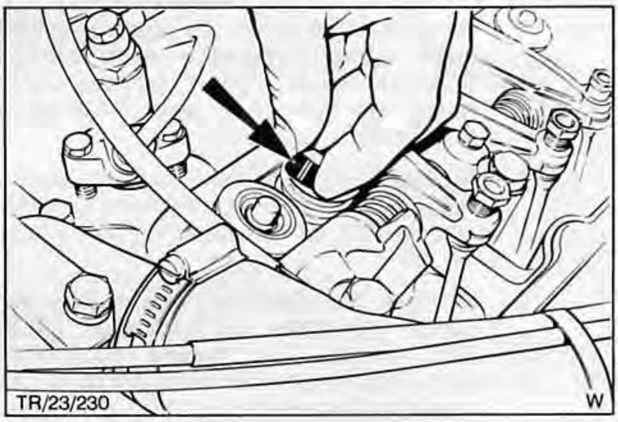


Fig. 53. Installation of valve stem cap

44. Position fan belt and vacuum pump drive belt. Adjust vacuum pump belt to give a 10 mm (0,4 in) free play on the longest span, Fig. 54.
45. Position and secure fan blades, pulley and spacer.
46. Locate fan belt, adjust to give a 10 mm (0,4 in) free play on the longest span and secure alternator.
47. Position radiator and expansion tank, secure all brackets and hoses.
48. Remove drain tray and refill cooling system with specified water anti-freeze solution.

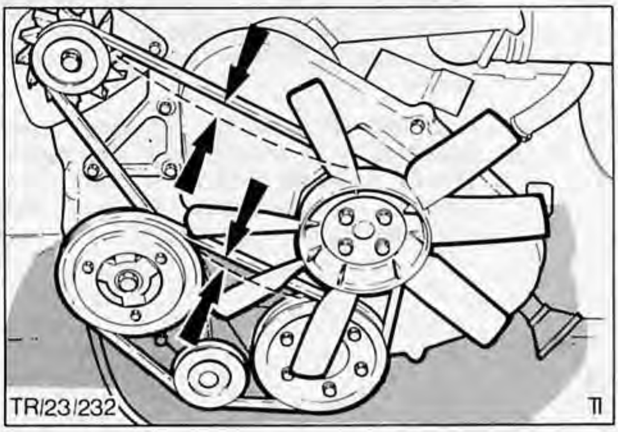


Fig. 54. Fan and drive belt adjustment

49. Bleed fuel filter and injection pump, Fig. 55. Detailed in Operation 23 142.
50. Refit air cleaner assembly.
51. Reconnect battery.
52. Start engine check for leaks and top up cooling system.
53. Remove fender covers and close hood.

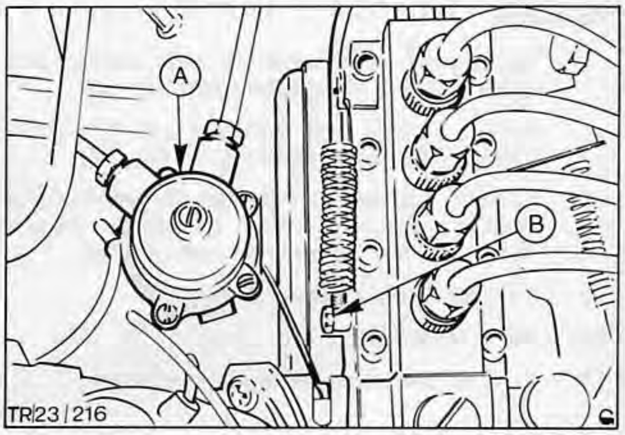


Fig. 55. Fuel injection pump
A – Fuel lift pump
B – Pump bleed bolt

23 454 INJECTOR – REMOVE AND INSTALL (ONE)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
4. Disconnect leak off pipe and fuel supply pipe, remove 2 bolts and detach injector, Fig. 56.

   NOTE: In some cases the heatshield 'D' in, Fig. 58. will come out with the injector. If this happens a new sealing washer 'E' must be fitted.

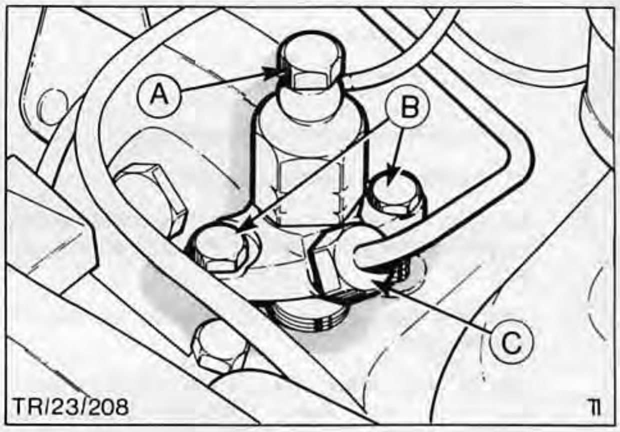


Fig. 56. No. 1 injector assembly
A – Injector leak off pipe
B – Securing bolts
C – Fuel supply pipe

5. Using an electricians screwdriver or scriber remove wave washer, Fig. 57.
6. Throughly clean, check, overhaul or renew injector as required.

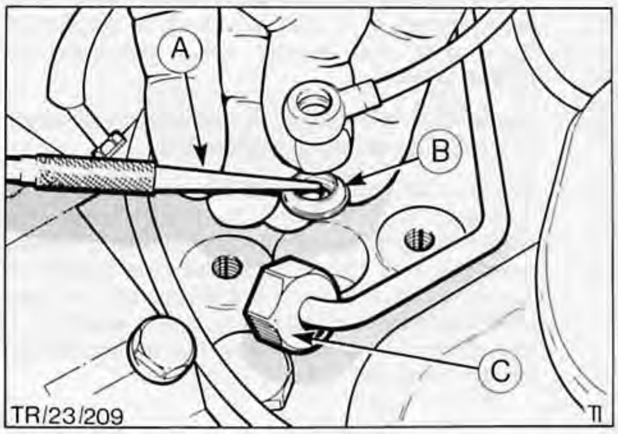


Fig. 57. Injector wave washer removal
A – Scriber
B – Wave washer
C – Injector union

To Install

7. Using new wave washers refit sealing and wave washers to cylinder head, Fig. 58.

   NOTE: Ensure that washers are fitted the correct way round, (Refer 'C' in Fig. 58).

8. Position and secure injectors tightening bolts evenly, and to the specified torque. Reconnect fuel supply and leak off pipe.

9. Refit air cleaner assembly.

10. Reconnect battery.

11. Remove fender covers and close hood.

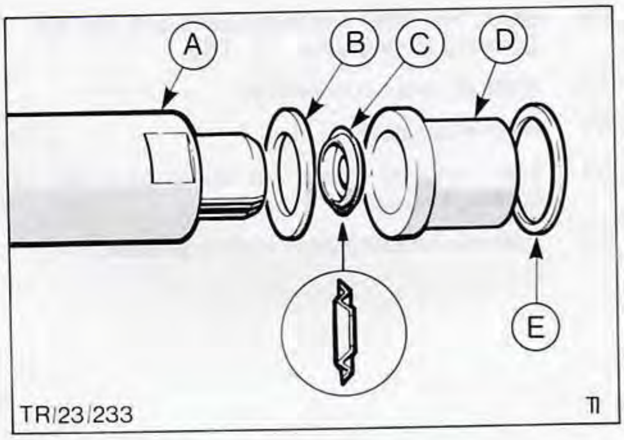


Fig. 58. Injector to head sealing washers
A – Injector
B – Sealing washer
C – Wavy washer
D – Heat shield
E – Sealing washer

23 454 8 INJECTOR – OVERHAUL (ONE) (Injector removed)

Special Service Equipment Required:

Injector test equipment.

Injector dismantling jig.

1. Thoroughly clean injector assembly.

2. Fit injector to a dismantling jig.

3. Remove injector cap nut, unscrew spring adjusting nut and remove injector spring and spindle.

4. Unscrew nozzle nut, and remove nozzle and needle valve.

   NOTE: As nozzles and needle valves are a selected fit, they should never be interchanged.

5. Wash all injector parts in clean fuel oil or substitute fuel oil and, using a soft brass wire brush, remove all carbon from nozzle and needle valve.

   Inspect all parts. If tip of needle is blued from overheating, or if seat is scored or damaged, the nozzle and needle valve are unfit for further service.

   Check that the spring is not broken or rusty and that the ends are perfectly square.

   Inspect all the components for wear or damage and check all joint faces for scratches or trapped foreign particles. Ensure needle is free to fall under its own weight in nozzle, when wet with substitute fuel oil, and falls freely from nozzle seat when inverted. If any components are faulty, the injector must be removed.

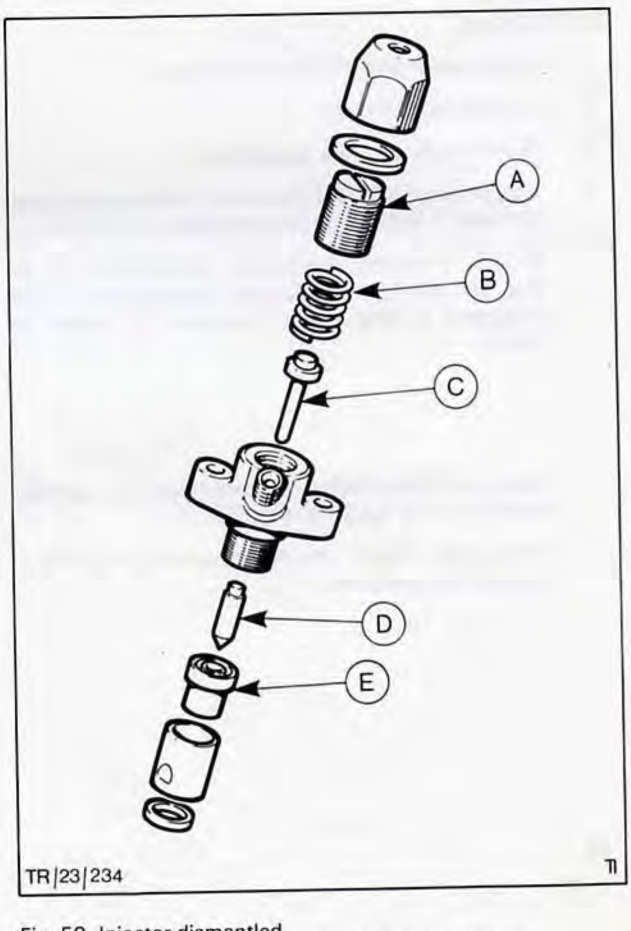


Fig. 59. Injector dismantled
A – Spring adjusting nut
B – Injector spring
C – Spindle
D – Needle valve
E – Nozzle

6. Using an injector cleaning kit remove all carbon from interior of nozzle.

   When a hard carbon deposit is formed, it may be softened by immersing nozzle in 'Acetone' for a short period. Up to half an hour is normally sufficient.

   WARNING: 'Acetone' is highly inflammable liquid it must not be brought near a naked flame and should be subject to the same handling precautions as petroleum spirit.

   IMPORTANT: Immediately the nozzle is removed from the fluid, it must be rinsed in clean fuel oil or substitute fuel oil to prevent corrosion on the finely-finished surfaces.

   Alternatively, the nozzle may be treated as follows:

   A. Dissolve 55 gm (2 oz) of caustic soda in 0,6 litre (1 pint) of water. Also add 14 gm ($\frac{1}{4}$ oz) of detergent.

   B. Place nozzle in the liquid and boil for a minimum period of 1 hour and not more than $1\frac{1}{2}$ hours.

      NOTE: The concentration of caustic soda must not exceed 15% and water should be added to replace that lost by evaporation.

      Should the concentration of caustic soda exceed 15% then the needle valve bore and joint face on the nozzle body may be roughened, making the injector unserviceable.

   C. Remove nozzles, after treatment, and wash in running water to remove all traces of caustic soda. After washing, immerse nozzles in a de-watering oil, then remove surplus oil by draining.

7. The carbon can now be easily removed with a wire brush and a standard pricker wire.

8. Flush out interior of the nozzle using a suitable reverse wash adaptor fitted to the injector testing machine. When all particles of carbon have been removed, enter needle valve into nozzle and ensure that it is quite free.

9. Re-assemble injector as follows: Fig. 59.

   NOTE: All injector parts should be assembled wet after rinsing in clean fuel or substitute fuel oil. Do not use rag to clean any of the internal parts.

   Fit nozzle and needle valve to the injector body. Screw on nozzle nut and tighten securely to specified torque.

   NOTE: It is essential that this figure is not exceeded otherwise serious distortion of the nozzle assembly may occur.

   Fit injector spindle, spring and spring adjusting nut. Screw down adjusting nut until pressure can be felt on spring.

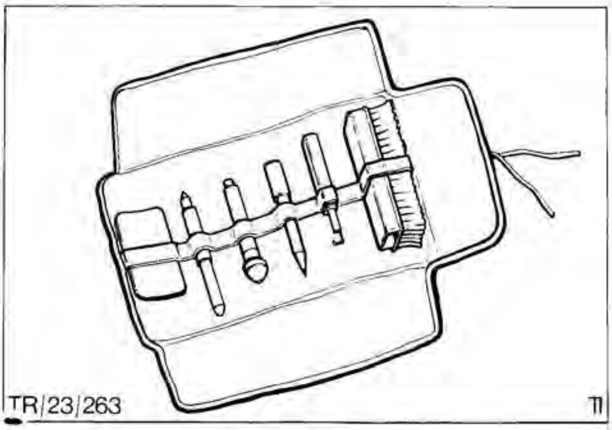


Fig. 60. Typical injector cleaning kit

10. Connect injector to test equipment.
11. Adjust opening pressure to 145 kg/cm² (145 atm) by screwing in or out adjuster nut, Fig. 61.
12. Fit injector cap, tighten and recheck nozzle opening pressure.
13. Fully test injector.

NOTE: If, after cleaning, the injector fails to pass these tests it should be replaced by a serviceable injector and the faulty one reconditioned. On no account should attempts be made to reclaim injector nozzles, and valves through hand-lapping with metal polish or any other abrasive.

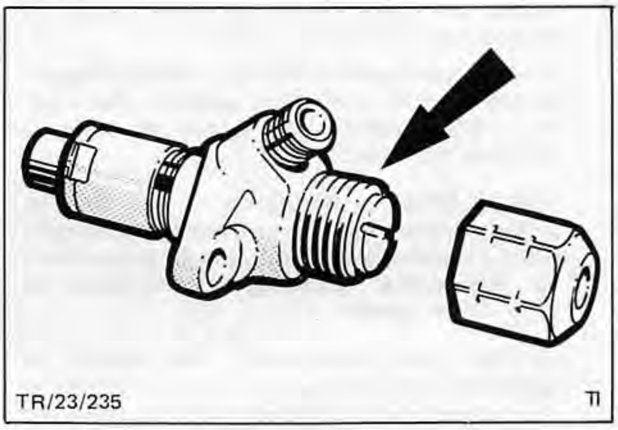


Fig. 61. Injector adjusting nut

Injector Testing

Care should be taken when testing injectors to ensure that the fuel spray does not come into contact with the hands of personnel operating the test equipment.

The characteristics of this pintle nozzle differ from the normal type in that the spray, with slow hand pumping, presents rather an inefficient appearance in comparison, and is inclined to be more 'ragged', 'wet' or 'soft' than with the normal four hole injector.

The nozzle can only be completely and satisfactorily tested with expensive and special stroboscopic equipment, but a good general test can be applied with a nozzle testing machine as follows:

A. Depress the Nozzle Testing Machine lever at about 20 strokes per minute, when a serviceable nozzle should emit a soft 'buzzing' noise, (possibly intermittent). Atomization will, however, appear to be streaky and generally unsatisfactory although, at the same time there should be no appreciable wetness at the orifice, Fig. 62.

B. Raise and maintain the pressure at 10 atmospheres below opening pressure for 10 seconds, when no fuel leakage should occur at the orifice.

C. It is difficult to obtain fuel 'atomization' with these nozzles on a normal testing machine, and the spray will always appear to be streaky. Fast operation of the lever (about 100 strokes per minute) should give a reasonable spray.

D. Check injector back leakage as follows:

Raise pressure to 100 atmospheres and measure the time taken for the pressure to drop to 75 atmospheres.

Refer Technical Data.

14. Remove injector from test equipment.

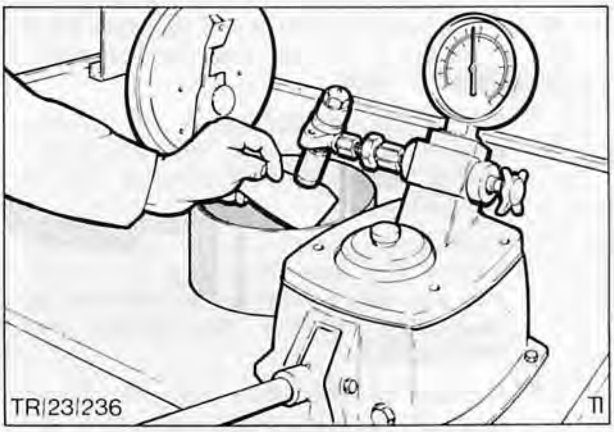


Fig. 62. Checking injector for leakage by using a piece of absorbent paper

23 483 PIPES INJECTOR DELIVERY – REMOVE AND INSTALL (All)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.

   Detailed in Operation 23 174.
4. Disconnect pipes at injector and pump and remove pipe assemblies.

   NOTE: When disconnect pipes at the pump remove outer pipes first, Fig. 63.
5. Remove clamps from pipe.

To Install

6. Loosely refit clamps to new pipes, place pipe assemblies in position and secure.

   Fully tighten pipe clamps.
7. Reconnect battery.
8. Start engine and check for leaks.
9. Refit air cleaner assembly.
10. Remove fender covers and close hood.

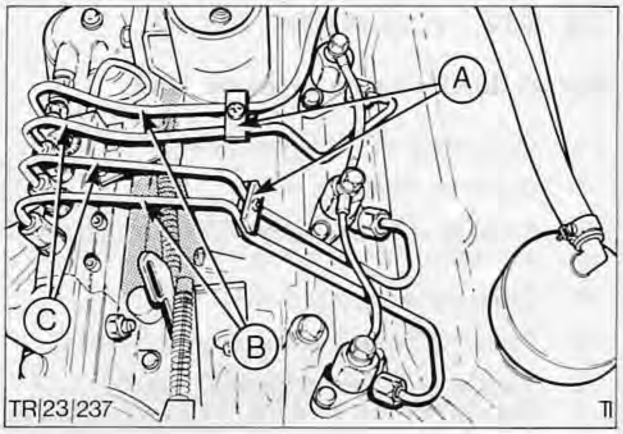


Fig. 63. Injection pipes in position
A – Pipe clamps
B – Outer injection pipes
C – Inner injection pipes

23 485 PIPE INJECTOR – LEAK OFF – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
   Detailed in Operation 23 174.
4. Disconnect leak off return pipe and pipe to injector connections. Remove pipe, Fig. 64.

   NOTE: Do not lose sealing washers.

To Install

5. Place pipe in position and reconnect to return pipe and injectors.

   NOTE: Ensure sealing washers are fitted to injector connection, Fig. 65.
6. Reconnect battery.
7. Start engine and check for leaks.
8. Refit air cleaner assembly.
9. Remove fender covers and close hood.

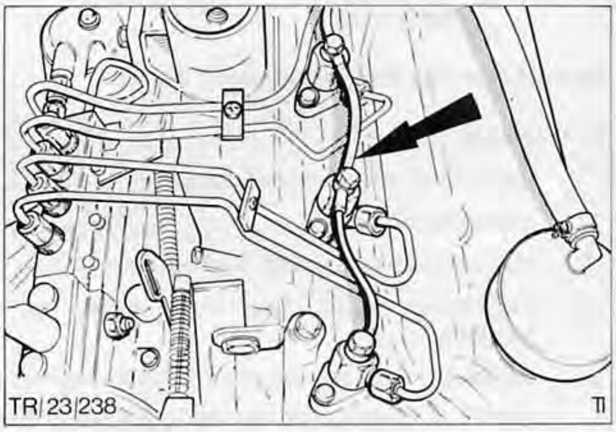


Fig. 64. Injector leak off pipe

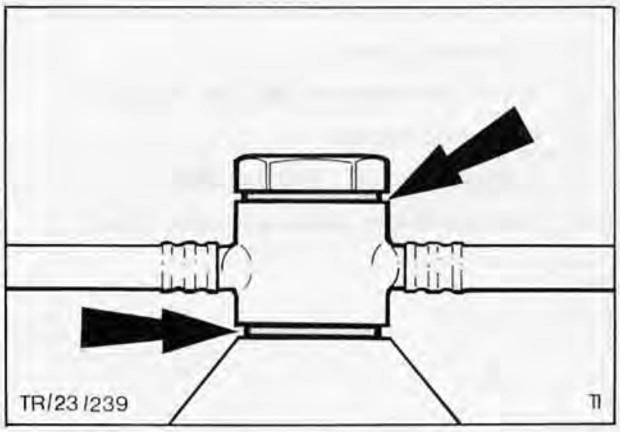


Fig. 65. Leak off pipe sealing washers

23 532 FUEL PUMP – CLEAN

Special Service Tools Required: None

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove a single screw, lift off pump cover and detach filter, Fig. 66.
4. Clean pump body and filter.
5. Position filter and pump cover and secure.
6. Bleed fuel system at the filter, Fig. 67. Detailed in Operation 23 142.
7. Reconnect battery.
8. Remove fender covers and close hood.

23 534 FUEL PUMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Place drain tray beneath fuel pump.
4. Disconnect pump inlet and outlet connections.
5. Remove 2 nuts and detach lift pump, Fig. 68.

   NOTE: A quantity of oil will drain from the injection pump when the lift pump is removed.

To Install

6. Clean pump gasket mating surfaces.
7. Using a new gasket refit and secure pump.
8. Reconnect pipes.
9. Bleed fuel system at the filter, Fig. 67.
10. Reconnect battery.
11. Start engine and check for leaks.
12. Remove fender covers and close hood.

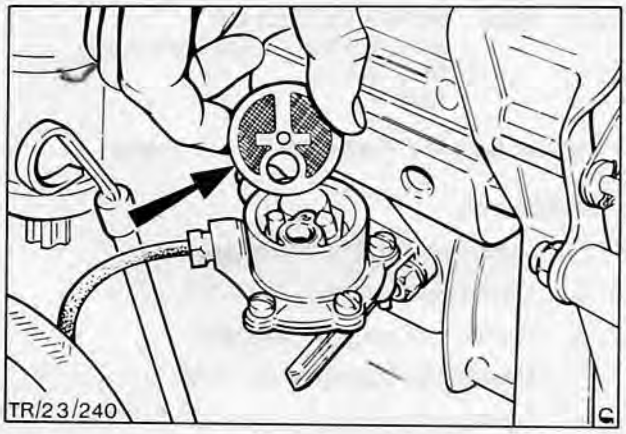


Fig. 66. Removal of pump filter

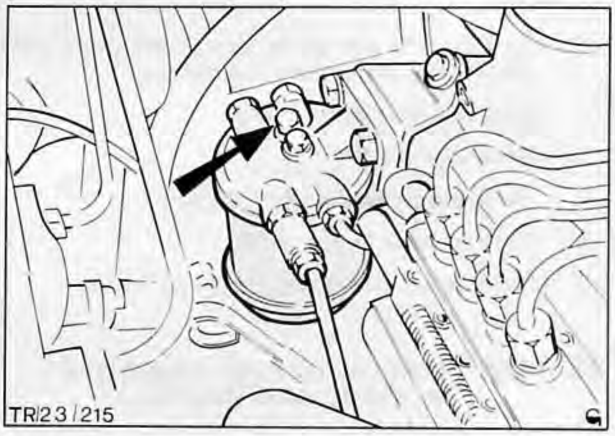


Fig. 67. Fuel filter bleed bolt
(Air cleaner removed for clarity)

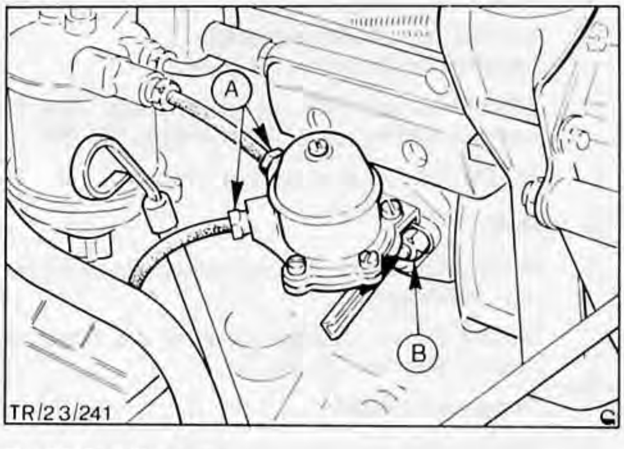
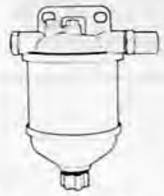


Fig. 68. Fuel lift pump
A – Pump fuel connection
B – Pump securing nut



23 543 FILTER – FUEL LINE – CLEAN

Special Service Tools Required: None

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Remove filter bowl, Fig. 69, drain and clean.
4. Check seal is correctly fitted and refit bowl.
5. Bleed fuel system at the filter.
   Detailed in Operation 23 142.
6. Reconnect battery.
7. Remove fender covers and close hood.

23 544 FILTER – FUEL LINE – REPLACE

Special Service Tools Required: None
To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect filter inlet and outlet pipe connections, Fig. 70.
4. Remove 2 screws and detach filter assembly.
5. Drain unit.

To Install

6. Place filter in position and secure.
7. Reconnect fuel pipes.
8. Bleed fuel system at the filter.
   Detailed in Operation 23 142.
9. Reconnect battery.
10. Remove fender covers and close hood.

23 545 FUEL FILTER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect filter inlet and outlet pipes.
4. Remove 2 bolts and detach filter assembly, Fig. 71.
5. Drain unit.

To Install

6. Place filter assembly into position and secure 2 bolts.
7. Reconnect fuel lines.
8. Bleed fuel system at the filter.
   Detailed in Operation 23 142.
9. Reconnect battery.
10. Remove fender covers and close hood.

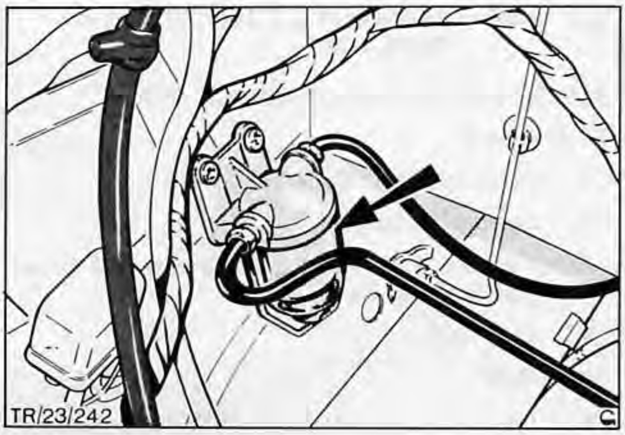


Fig. 69. Fuel line filter bowl

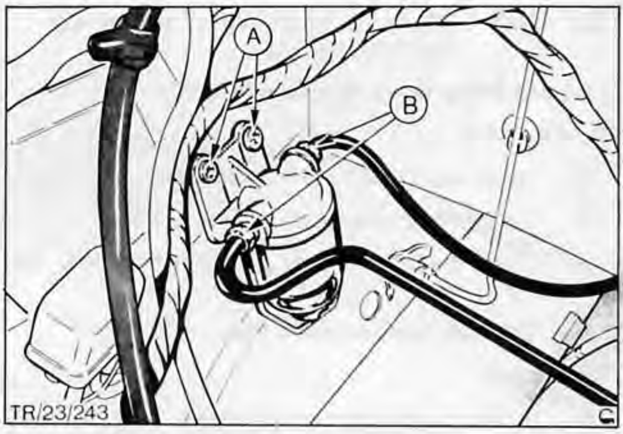


Fig. 70. Fuel line filter assembly
A – Filter securing screws
B – Filter fuel connections

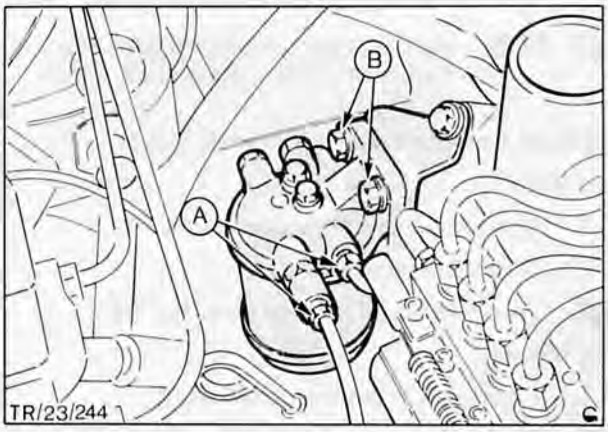
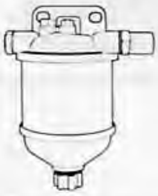


Fig. 71. Fuel filter assembly
(Air cleaner removed for clarity)
A – Filter fuel connections
B – Filter securing bolts



23 546 ELEMENT – FUEL FILTER – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove the centre securing bolt and detach element, Fig. 72.
4. Drain unit.

To Install

5. Place new element in position and secure.
6. Bleed fuel system at filter. Detailed in Operation 23 142.
7. Reconnect battery.
8. Remove fender covers and close hood.

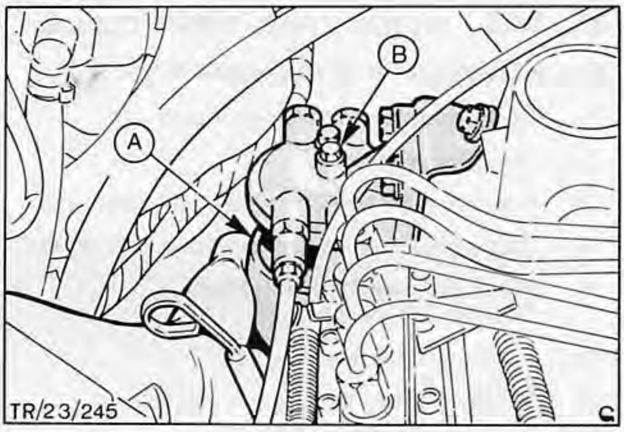


Fig. 72. Filter element removal
A – Filter element
B – Element securing bolt
(Air cleaner removed for clarity)

23 548 FUEL RESERVOIR – REMOVE AND INSTALL

Special Equipment Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect fuel inlet and outlet pipes, Fig. 73.
4. Remove two bolts and detach reservoir.

To Install

5. Place reservoir in position, secure and reconnect fuel pipes.

   NOTE: There is no requirement to bleed system.

6. Reconnect battery.
7. Remove fender covers and close hood.

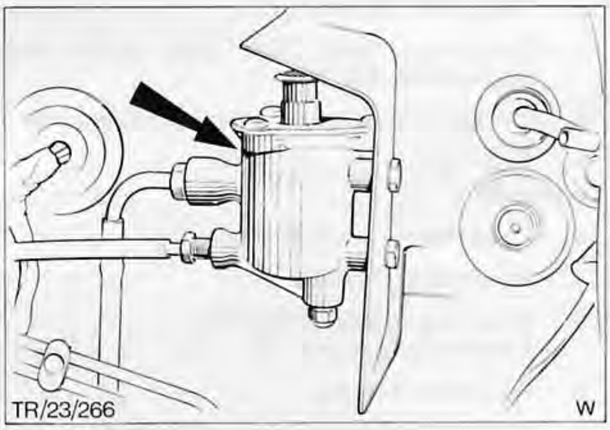


Fig. 73. Fuel reservoir assembly

23 588 FUEL LINE – FUEL PUMP TO FUEL FILTER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect and remove pipe, Fig. 74.

To Install

4. Place pipe in position and secure.
5. Bleed fuel system at fuel filter. Detailed in Operation 23 142.
6. Reconnect battery.
7. Remove fender covers and close hood.

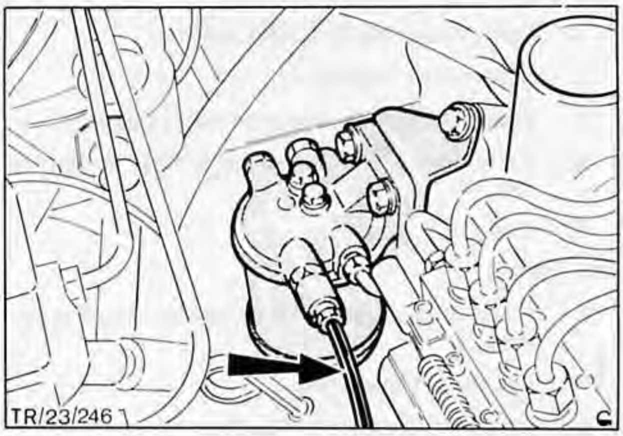


Fig. 74. Fuel pump to filter fuel line

23 771 GLOW PLUGS – CHECK OPERATION

Special Service Tools Required: None

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation 23 174.
4. Disconnect leak off pipe fuel supply pipe, remove 2 bolts and detach injector, Fig. 75.

   NOTE: In some cases the heat shield, 'D' in Fig. 77, will come out with the injector. If this happens a new sealing washer 'E' must be fitted.
5. Remove remaining three injectors.
6. Using an electricians screwdriver or scriber remove four injector wave washers, Fig. 76.
7. Reconnect battery.
8. Ensure engine is below 40 °C. If not disconnect wire from thermal switch (Fig. 32) and connect a bridge between the two connections.

   Turn ignition on and using a mirror look down each injector location. If the glow plugs are operating the plugs will light up the injector hole in the cylinder head.

   NOTE: The plugs will only heat up for approximately 30 seconds, after this the plugs should be allowed to cool and the check repeated.
9. Disconnect battery.
10. Using new wave washers refit sealing and wave washers to cylinder head, Fig. 77.

    NOTE: Ensure that washers are fitted the correct way round ('E' in Fig. 77).
11. Position and secure injectors, reconnect fuel and leak off pipes.

    Ensure sealing washers are fitted to leak off pipe.
12. Refit air cleaner assembly.
13. Reconnect battery.
14. Remove fender covers and close hood.

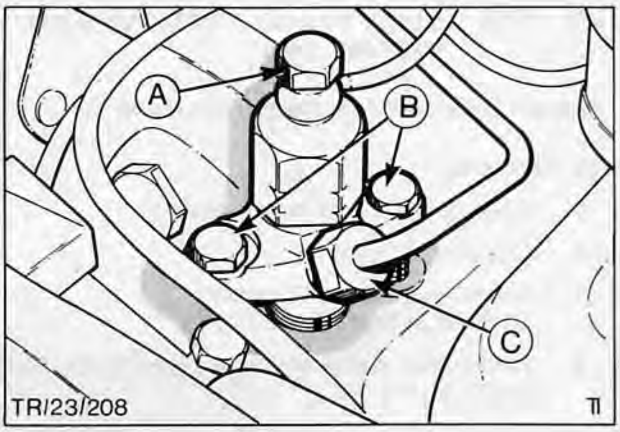


Fig. 75. No. 1 Injector assembly
A – Injector leak off pipe
B – Securing bolts
C – Fuel supply pipe

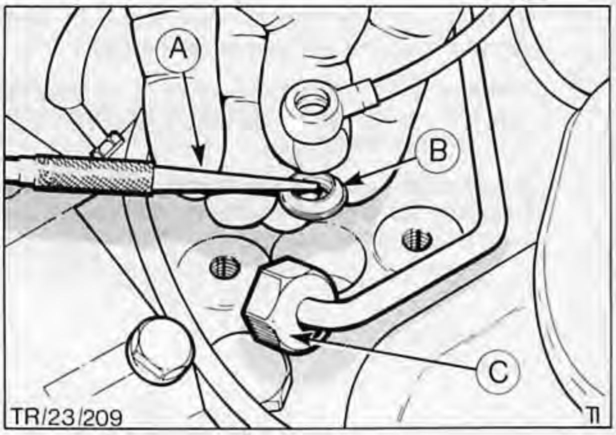


Fig. 76. Injector wave washer removal
A – Scriber
B – Wavy washer
C – Injector union

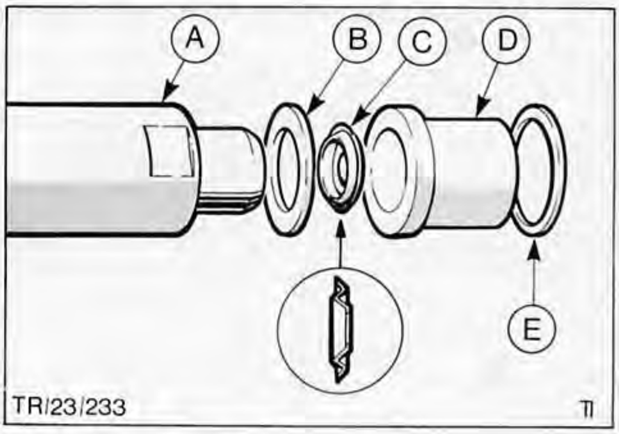


Fig. 77. Injector to head sealing washers
A – Injector
B – Sealing washer
C – Wave washer
D – Heat shield
E – Sealing washer

23 773 GLOW PLUGS – REMOVE AND INSTALL (All)

Special Service Tools Required: None

To Remove

1. Open hood, and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation 23 174.
4. Disconnect crankcase vent pipe on the inlet manifold, Fig. 78.

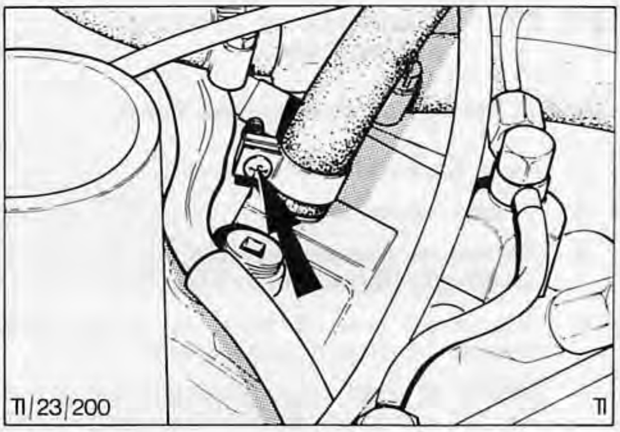


Fig. 78. Crankcase vent pipe on inlet manifold

5. Remove all four injector pipes and fit dust caps to injectors and pump connections.
6. Remove three fuel filter bracket to engine securing bolts, and position filter assembly clear of inlet manifold.
7. Disconnect glow plug loom connection. Location for this connection will be at the front of the inlet manifold, Fig. 79.

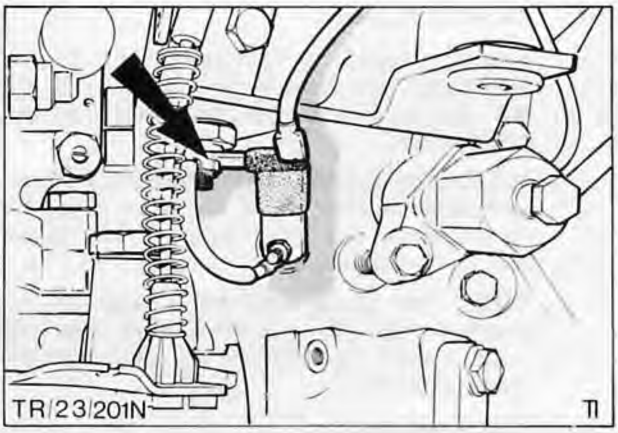


Fig. 79. Glow plug loom connection

8. Disconnect and remove throttle return spring, Fig. 80.

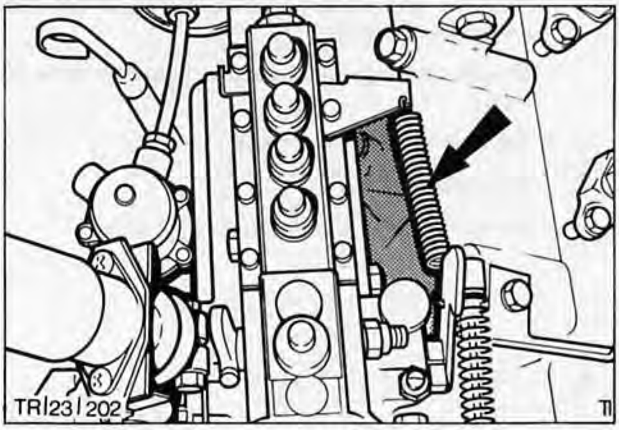


Fig. 80. Throttle return spring

9. Remove eight bolts securing inlet manifold to engine.

   NOTE: To remove the front lower securing bolts a long 13 mm ring spanner should be used as shown in Fig. 81.

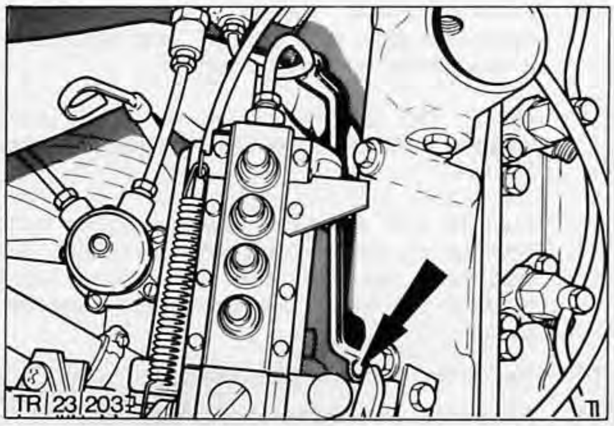


Fig. 81. Removal of front lower manifold securing bolt

10. Lift manifold clear of engine, disconnect glow plugs internal loom connection and remove manifold, Fig. 82.

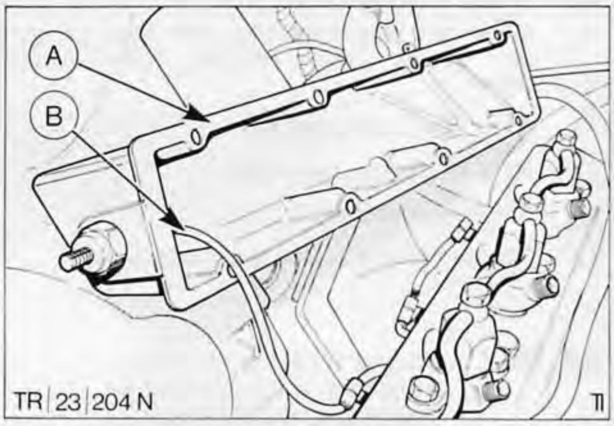


Fig. 82. Removal of inlet manifold
A – Inlet manifold
B – Glow plug loom connection

11. Using sockets disconnect and remove four glow plugs from cylinder head, Fig. 83.

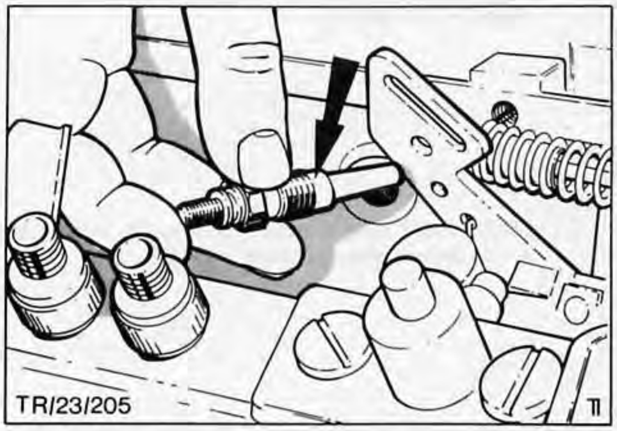


Fig. 83. Glow plug removal

To Install

12. Place plugs in position, secure and reconnect loom.

13. Clean manifold gasket mating surfaces, reconnect glow plug internal loom and using a new gasket refit inlet manifold.

    NOTE: The long bolt with the thick plain washer is fitted on the filter bracket location, Fig. 84.

    Also to refit the front lower securing bolt, both hands can be used, one positioning the bolt from the top, and the second hand holding the bolt from under the injection pump.

14. Reconnect throttle return spring.
15. Reconnect glow plug loom at manifold.
16. Position and secure filter assembly.
17. Remove dust caps and refit injector supply pipes.
18. Reconnect crankcase vent pipe.
19. Using a mirror look down the manifold air intake and check that the loom does not pass over the air cleaner securing bolt hole, Fig. 85.

    Relocate wire if possible.

20. Refit air cleaner assembly.
21. Reconnect battery.
22. Remove fender covers and close hood.

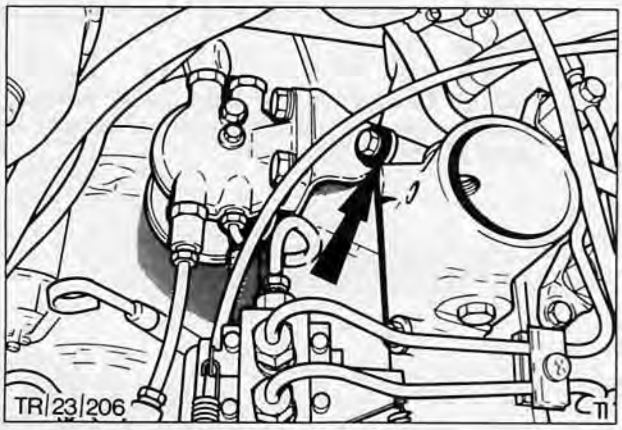


Fig. 84. Filter bracket securing bolt

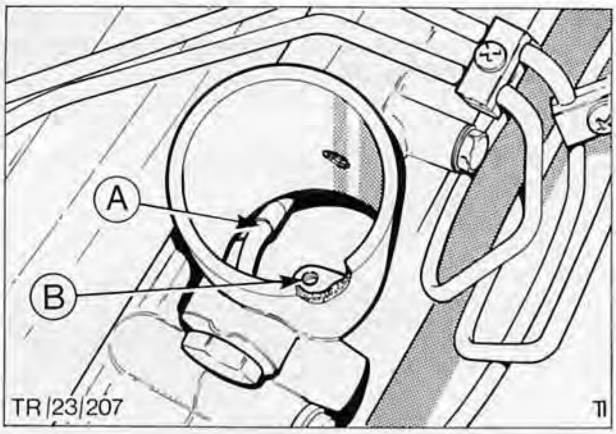


Fig. 85. Inlet manifold air intake
A – Glow plug internal loom
B – Air cleaner bolt hole

23 842 CABLE STOP CONTROL – REMOVE AND INSTALL (MANUAL CONTROL)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect inner cable from pump and outer cable from pump bracket, Fig. 86.

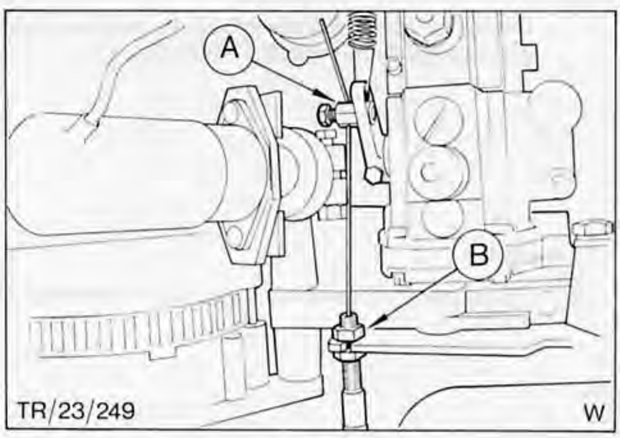
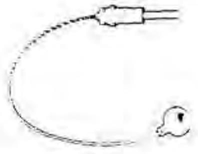


Fig. 86. Stop control cable
A – Inner cable clamp
B – Outer cable securing and adjusting position



4. Detach bulkhead to cable grommet.
5. Remove two screws and detach heater control panel, Fig. 87.
6. Remove outer cable to dash securing nut (17 mm).
7. Attach draw cord to cable and remove from inside vehicle.

To Install

8. Postion cable and remove draw cord.
9. Screw outer cable to dash.
10. Refit heater control panel, Fig. 87.
11. Reconnect cable to injection pump and adjust.

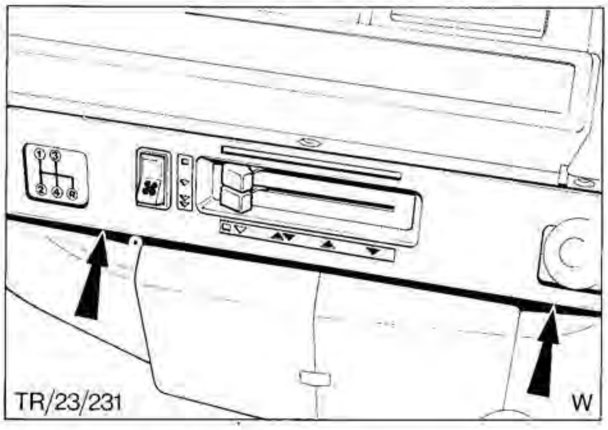


Fig. 87. Heater panel securing screws

23 842 CABLE STOP CONTROL – REMOVE AND INSTALL (AUTOMATIC CONTROL) '78 Model Year

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect inner cable from stop control motor by removing split pin.
4. Disconnect outer cable from motor bracket by prising out circlip, Fig. 88.
5. Disconnect inner cable from pump and outer cable from pump bracket, Fig. 89.
6. Detach cable assembly.

To Install

7. Place cable in position and loosely reconnect to pump.
8. Reconnect outer cable to stop motor bracket and refit retaining circlip, Fig. 88.

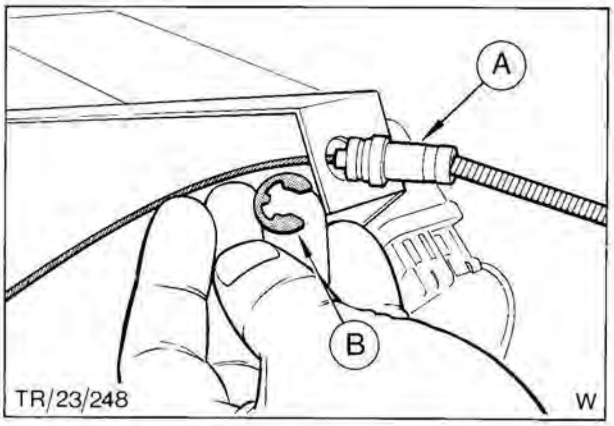


Fig. 88. Stop control cable removal
A – Outer cable
B – Securing circlip

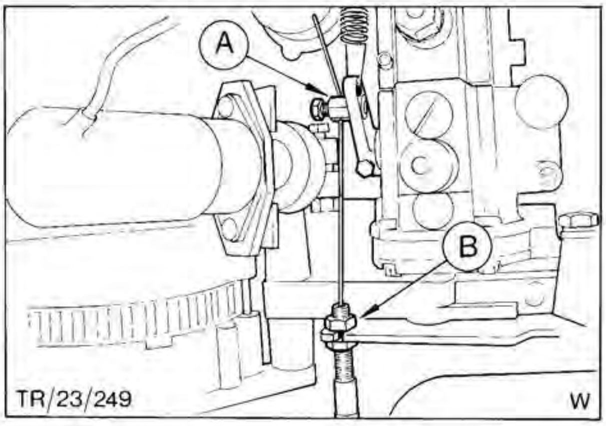
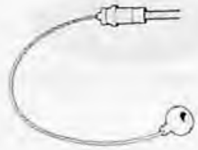


Fig. 89. Stop control cable
A – Inner cable clamp
B – Outer cable securing and adjusting position



STOP CONTROL CABLE

9. Reconnect inner cable to stop motor lever.

   NOTE: When connecting inner cable ensure plastic spacer washer is fitted, as shown in Fig. 90.

10. Reconnect battery and turn ignition 'ON'.
11. Adjust cable at the pump end so that no slack exists in the cable.
    Ensure pump stop lever is in the position shown in Fig. 89.
12. Check operation of stop control motor.
13. Remove fender covers and close hood.

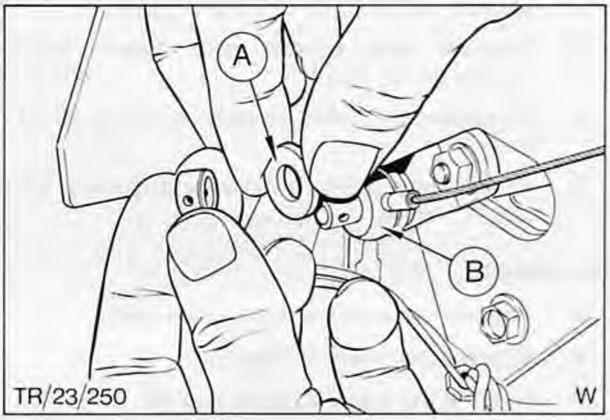


Fig. 90. Stop control cable
A – Plastic spacer washer
B – Inner cable

23 842 CABLE STOP CONTROL – REMOVE AND INSTALL (AUTOMATIC CONTROL) '79 Model Year

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect inner cable from stop control motor by removing a single cross head screw, Fig. 91.
4. Disconnect outer cable from motor bracket by compressing jaws of connector with a pair of pliers.
5. Disconnect inner cable from pump and outer cable from pump bracket, Fig. 92.
6. Detach cable assembly.

To Install

7. Place cable in position and connect to pump.
8. Clip outer cable to motor bracket and secure inner cable to stop control lever, Fig. 91.
9. Reconnect battery.
10. Check operation of stop control motor.
11. Remove fender cover and close hood.

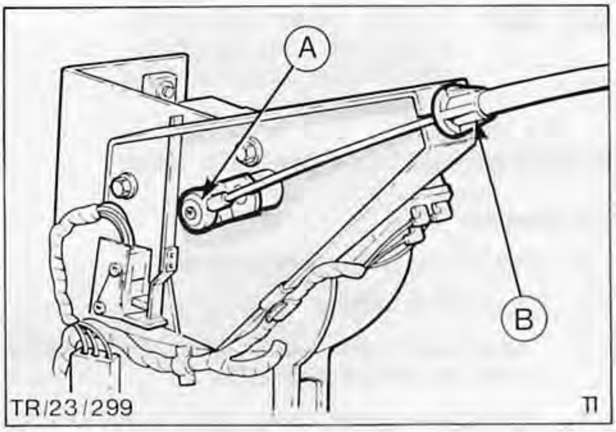


Fig. 91. Stop control cable. ('79 model year)
A – Inner cable connection
B – Outer cable connection

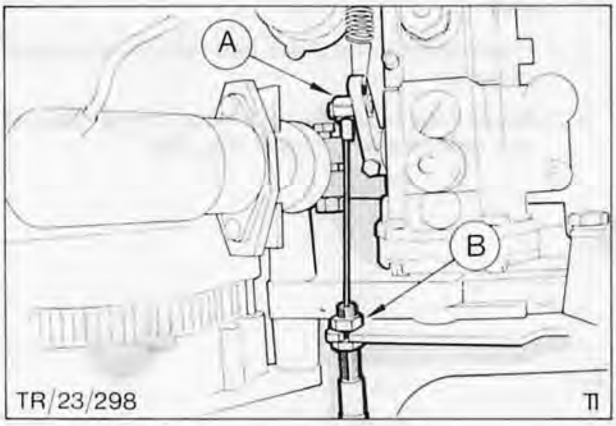


Fig. 92. Stop control cable
A – Inner cable clamp
B – Outer cable securing point and cable adjustment

TECHNICAL DATA

Fuel Injection Pump

Type	4 Element Jerk
Rotation (Viewed from the front)	Clockwise
Governor Type	Mechanical
Idle Speed	625 rpm ±25
Maximum 'No load' speed	4000 rpm ±30
Pump Timing	0,99 mm (11°) B.T.D.C.

Fuel Injectors

Type	Pintle
Plunger opening pressure	175 atmospheres
Back Leakage (time for pressure to drop from 100 to 75 atmospheres)	6 to 22 seconds
Needle seat leakage	Nozzle to be dry after operating the injector and after holding the pressure at 20 atmospheres below opening pressure for 10 seconds

Tightening Torques

Injector assembly securing bolts	1·5 to 2·0 kg.m (11 to 14·5 lb.ft.)
Injector Nozzle	6 to 8 kg.m (43 to 58 lb.ft.)

CHARGING SYSTEM 31

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GENERAL DESCRIPTION

The charging system basically comprises an alternator/regulator assembly which generates current to supply the vehicle electrical system and maintain the battery in a charged condition.

Two makes of alternator are used on the transit range, the models fitted are:

Lucas 15ACR, and 17–ACR.
Bosch K1–28A and K1–35A.

The alternator is mounted towards the front of the engine cylinder block and driven at approximately twice engine speed by the same drive belt as the water pump. The alternator is secured by two pivot bolts and a metal mounting strap which also provides a means of adjusting the drive belt tension.

All makes are machine sensed, meaning that a voltage regulator senses the output voltage and regulates this to a maximum of approximately 14 volts at all times. All models have integral voltage regulators, mounted at the rear of the unit.

When the alternator is not generating current, a warning lamp illuminates in the vehicle instrument cluster.

The alternator assembly basically comprises a fixed coil winding (stator), in an aluminium housing, in which rotates a shaft wound coil (rotor). The shaft is supported at each end by a ball race. Slip rings conduct current to and from the rotor field coils. Two carbon brushes bear against them. The diameter of the slip rings against which the brushes contact is small so that the surface speed is reduced to a minimum to minimise brush wear.

The alternator is cooled by a fan mounted at the front of the alternator, behind the belt pulley.

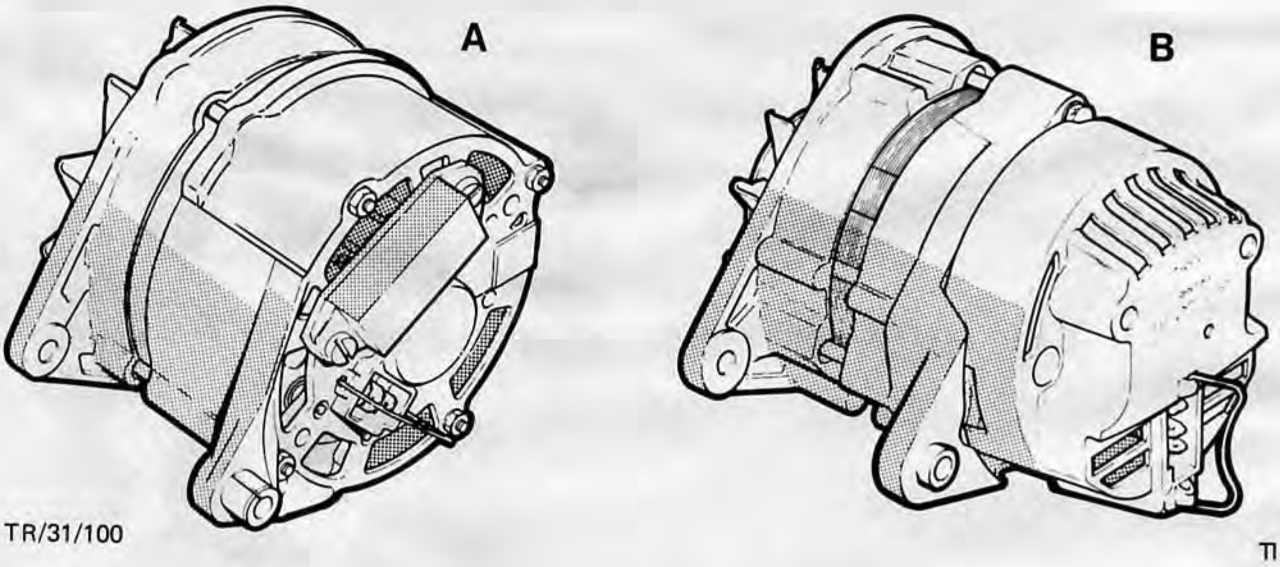


Fig 1. Two makes of alternator used on Transit
A – Bosch K1–28A and K1–35A alternator
B – Lucas 15 and 17 ACR alternator

GENERAL DESCRIPTION (cont'd)

The 12 volt lead acid battery is mounted on the side of the engine compartment and is part of a negative earth electrical system. Different capacities of battery may be fitted depending on territory/engine size. Each type has a translucent case through which the electrolyte level may be seen.

The battery electrolyte level should be maintained approximately 0,25 in (6 mm) above the battery plates otherwise negative plates not covered by electrolyte will oxidise quickly, rendering the cell useless.

If a battery is in a very low state of charge, the internal cell resistance will increase and terminal voltage on charge will also rise. As this terminal voltage approaches the voltage regulator settings, then immediate cut back of the charge rate occurs. In this case, the battery should be charged using a separate battery charger. See 'Technical Data' for notes on measuring battery charge, and charging the battery.

It is not necessary to disconnect battery cables before charging the battery but the following precautions must be observed.

1. Ensure charging is undertaken in a well ventilated room or garage, with the hood open.
2. The battery charger must be switched off before its leads are disconnected from the battery.
3. Never SMOKE OR IGNITE A NAKED FLAME near a battery which is being charged, as the charging process causes highly inflammable hydrogen gas to be given off.

The following precautions must be observed to avoid serious damage to the alternator, battery or vehicle wiring.

1. Always disconnect the battery earth cable before removing the alternator output lead as this is live at all times.
2. Do not disconnect battery cables while the engine is running.
3. When reconnecting the battery, or when using an additional battery as a starting aid, the battery live and earth cables MUST BE CONNECTED CORRECTLY, negative to negative and positive to positive. If the terminal connections are reversed, the alternator will be damaged.

PRINCIPLE OF OPERATION

The two makes of alternator work on a similar principle and generate alternating current (a.c) which is rectified by an internal diode system to direct current (d.c.) for distribution to the vehicle electrical system. The alternator produces alternating current by virtue of the magnetic field of the rotor moving relative to the stator. Current is supplied to and from the field coils via two carbon brushes.

The alternating current produced by the magnetic fields is converted within the rectifier pack to direct current. The voltage regulator is an electronic device which maintains the alternator output at a maximum voltage of approximately 14 volts.

When the battery is in a discharged condition the alternator automatically charges it to an approximate level of 14 volts. When this level is reached the demand on the alternator falls and current output is reduced accordingly. The regulator controls the charging rate by switching the rotor field current in and out as required.

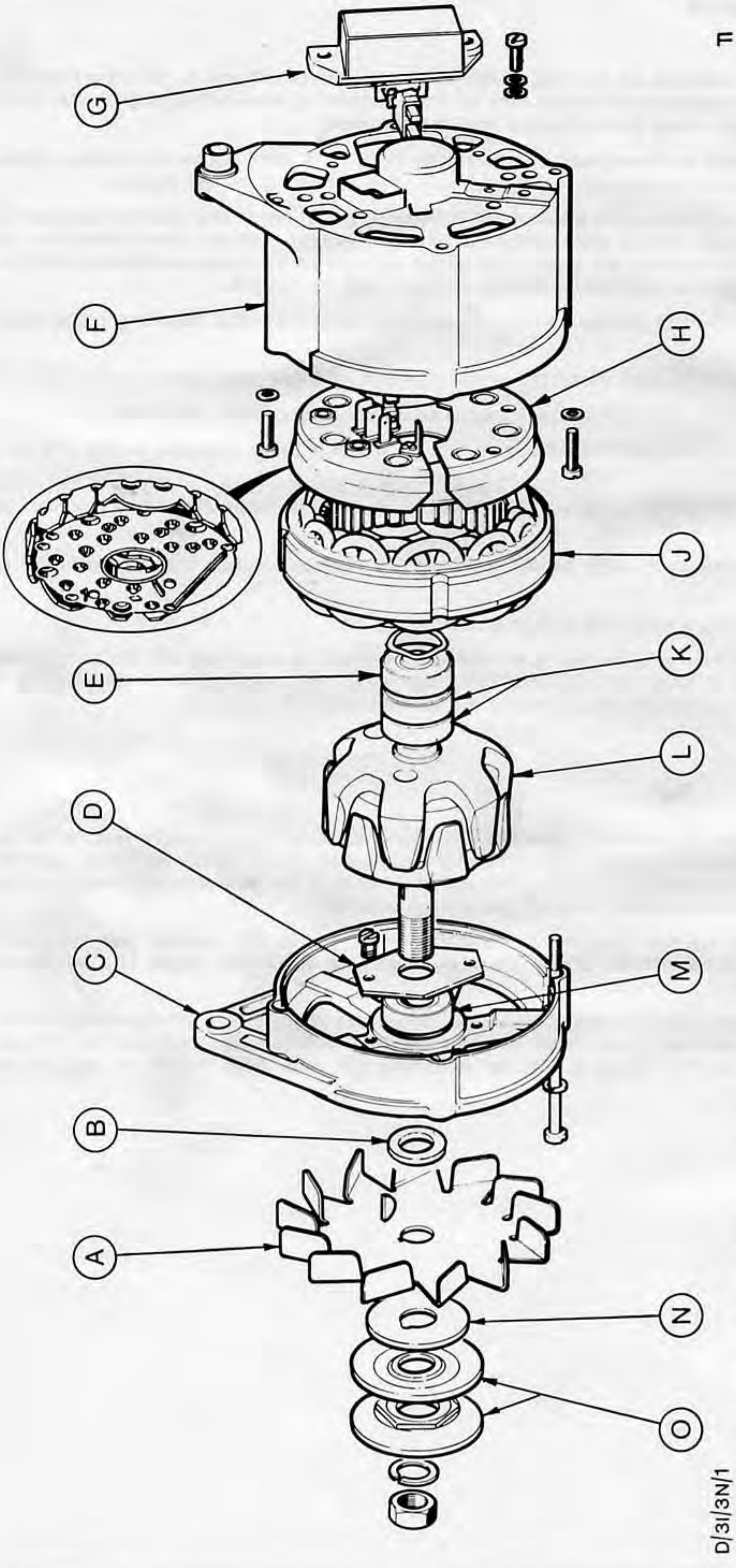


Fig. 2. Bosch K1-28A an K1-35A alternator

A – Fan
B – Spacer
C – Drive end housing
D – Thrust plate

E – Slip ring end bearing
F – Slip ring end housing
G – Brush box and regulator
H – Rectifier (diode) pack

J – Stator
K – Slip rings
L – Rotor
M – Drive end housing

N – Spacer
O – Pulley

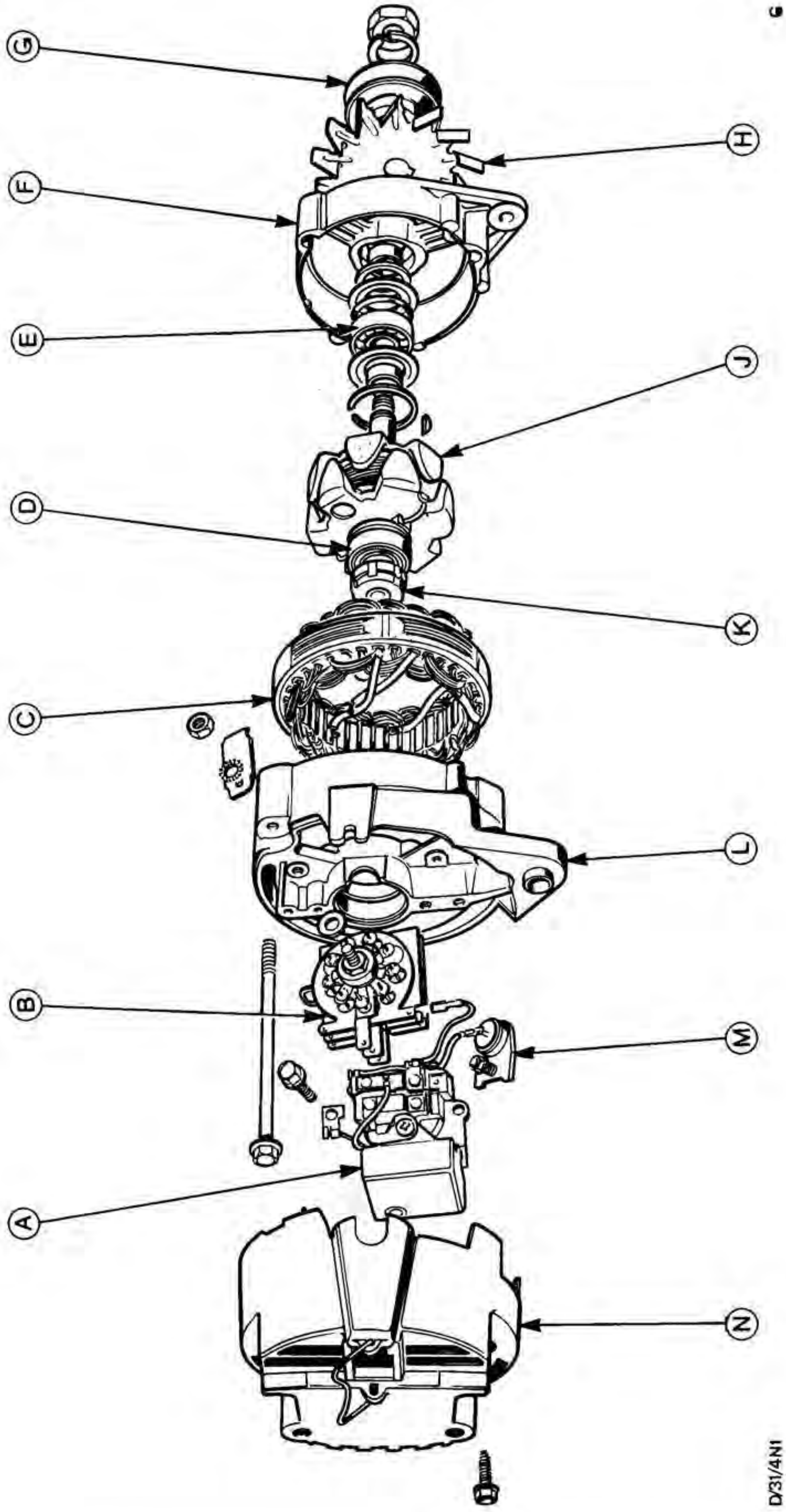


Fig. 3. Lucas 15 and 17ACR alternator

A – Regulator
B – Rectifier (diode) pack
C – Stator
D – Slip ring end bearing
E – Drive end bearing
F – Drive end housing
G – Pulley
H – Fan
J – Rotor
K – Slip ring
L – Slip ring end housing
M – Surge protection diode
N – End cover

SERVICE AJUSTMENTS AND CHECKS

At the specified service intervals the following items should be checked.

Fan Belt – Adjust

1. Slacken alternator adjusting arm clamp bolt and mounting bolts, Fig. 4.
2. Pivot alternator away from engine to tighten belt.

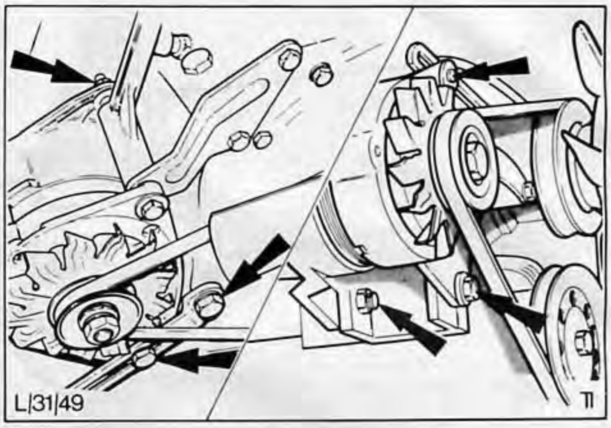


Fig. 4. Alternator mounting

3. Check that total free movement on longest span of belt is approximately 13 mm (0,5 in) applying normal fingertip pressure, Fig. 5.

   Alternatively, a belt tension gauge tool, similar to that shown in Fig. 5 can be used to measure the belt tension. For belt tensions refer to Technical Data.
4. Tighten alternator adjusting and mounting bolts.

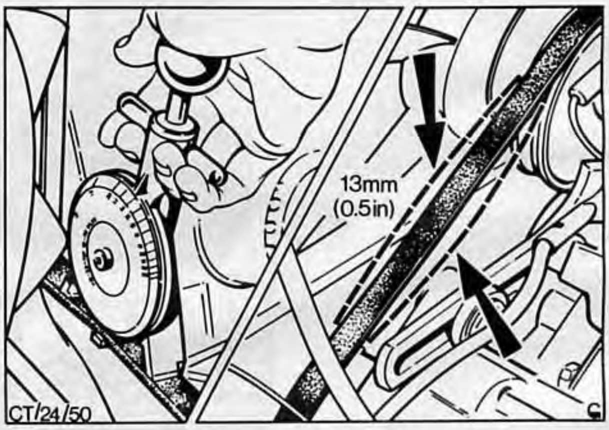


Fig. 5. Free movement measured on longest span

Battery

1. Check electrolyte level.
2. Check general condition and charge.
3. Grease battery terminals with petroleum jelly.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
	No special service tools required

SERVICE AND REPAIR OPERATIONS–CONTENT

CHARGING SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range: Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina '77	Granada '78
Battery									
31 211	Battery test	X		X	X	X	X	X	X
31 214	Battery – remove and install	X		X	X	X	X	X	X
Alternator Type 'A' (Bosch)									
31 411	Charging circuit – test	X		X	X	X	X	X	X
31 414	Alternator assembly – remove and install	X		X	X	X	X	X	X
31 414 8	Alternator assembly – overhaul (alternator removed)	X		X	X	X	X	X	X
31 474	Alternator brushes – replace	X		X	X	X	X	X	X
31 484	Pulley – alternator – remove and install	X		X	X	X	X	X	X
31 514	Regulator – remove and install	—	31 474	X	X	X	X	X	X
Alternator Type 'B' (Lucas)									
31 411	Charging circuit – test	X		X	X	X	X	X	X
31 414	Alternator assembly – remove and install	X		X	X	X	X	X	X
31 414 8	Alternator assembly – overhaul (alternator removed)	X		X	X	X	X	X	X
31 474	Alternator brushes –replace	X		X	X	X	X	X	X
31 484	Pulley – alternator – remove and install	X		X	X	X	X	X	X
31 514	Regulator – remove and install	X		X	X	X	X	X	X

SERVICE AND REPAIR OPERATIONS

31 211 BATTERY TEST

Special Equipment Required: None

1. Open hood, fit fender covers.
2. Clean battery and check condition using hydrometer and high rate discharge meter. Check the specific gravity of each cell in turn, Fig. 6. If the battery is fully charged it should be at least 1,275. When carrying out the high rate discharge test the voltage across the battery should be at least 8 volts. If it is less than this an internal battery fault is indicated.
3. Remove fender covers, close hood.

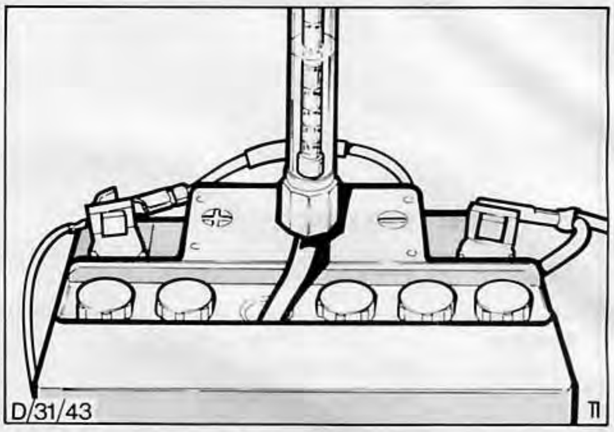


Fig. 6. Checking battery electrolyte specific gravity

31 214 BATTERY – REMOVE AND INSTALL

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery leads, earth lead first.
3. Remove battery clamp bolt, Fig. 7. clamp and battery.

To Install

4. Position battery in vehicle and secure with clamp.
5. Reconnect battery leads, positive lead first.
6. Cover terminals with industrial petroleum jelly.
7. Remove fender covers and close hood.

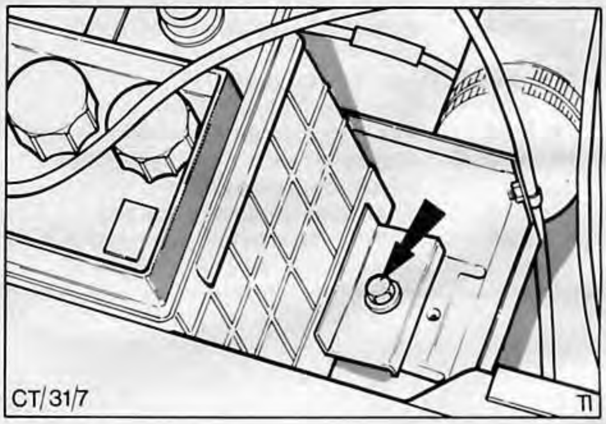


Fig. 7. Battery clamp bolt

31 411 CHARGING CIRCUIT – TEST – ALTERNATOR – TYPE 'A' (BOSCH)

Special Equipment Required:

Voltmeter.
Ammeter.

1. Open hood, fit fender covers.
2. Check fan belt tension, Fig. 8.

   There should be 13 mm (0,5 in) free movement mid-way along longest belt span.

   Alternatively, a belt tension gauge tool, similar to that shown in Fig. 5, can be used to measure the belt tension. For belt tensions refer to Technical Data.
3. Check battery condition.

   Refer to Operation No. 31–211.
4. Check charging circuit wiring continuity, Fig. 9.

   Remove the alternator multi-plug. Switch on ignition. Connect a 0–20 voltmeter, between a good earth and each of the multi-plug terminals, in turn. The voltmeter should read approximately battery voltage in all cases: a zero reading indicating an open circuit.
5. Connect output test circuit, Fig. 10.
6. Switch on headlamps, heater blower motor and heated backlight. Start engine and run it at 3000 rpm. Vary resistance to increase load current. Rated output should be reached without voltage dropping below 13 volt.
7. Switch off ignition, headlamps, heater blower motor and heated backlight and disconnect test circuit.

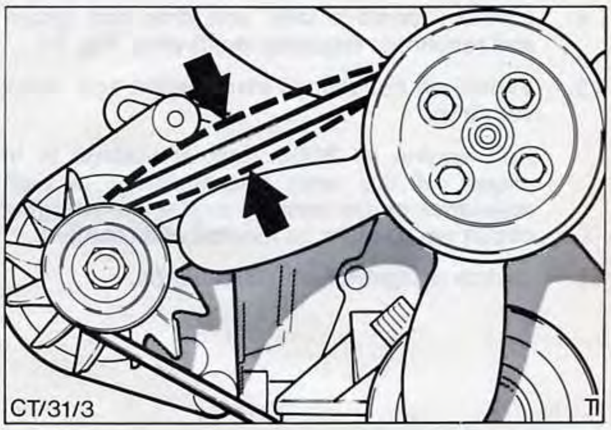


Fig. 8. Checking fan belt tension

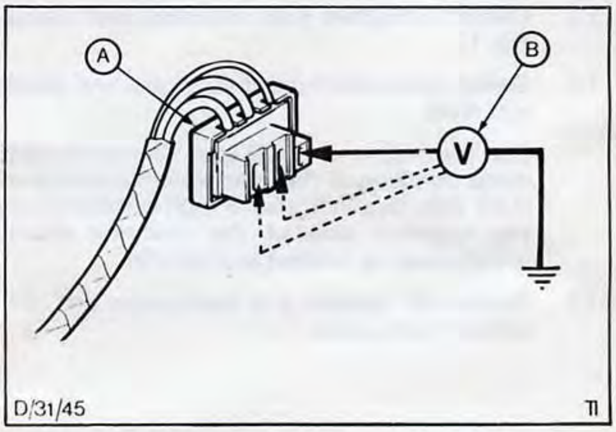


Fig. 9. Checking charging circuit wiring continuity
A – Multi-plug
B – Voltmeter

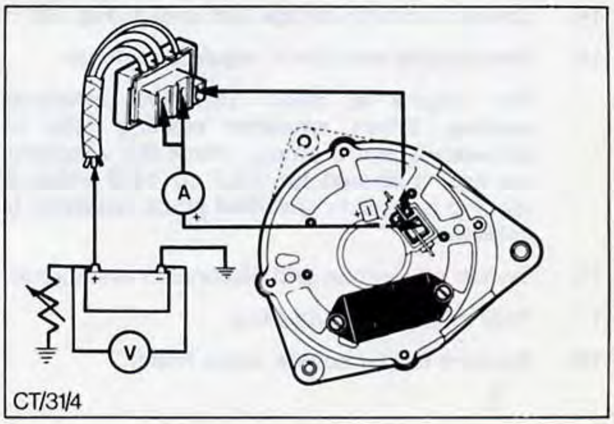


Fig. 10. Checking alternator output
A – Ammeter
V – Voltmeter
Resistor should be 30 amps. rating

8. Connect 'positive side' volt drop test circuit and reconnect regulator multi-plug, Fig. 11.
9. Switch on headlamps start engine and check volt drop.

   Run engine at 3000 rpm. If voltage is in excess of 0,5 volt, this indicates a high resistance on the positive side of the charging circuit which must be located and rectified.
10. Switch off ignition and headlamps.

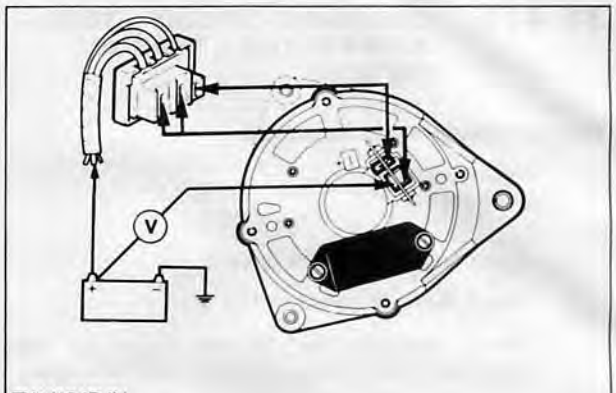


Fig. 11. Checking charging circuit volt drop 'positive side'

11. Connect 'negative side' volt drop test circuit, Fig. 12.
12. Switch on headlamps, start engine and check volt drop.

    Run the engine at 3000 rpm. Check the voltmeter reading. If the reading is in excess of 0,25 volt, this indicates a high resistance on the negative side of the charging circuit which must be located and rectified.
13. Switch off ignition and headlamps and disconnect test circuit.

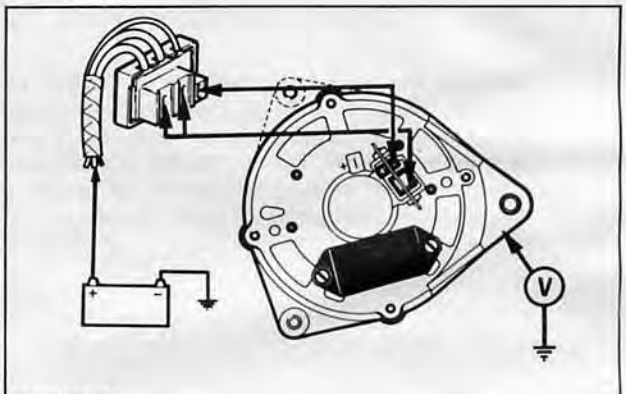


Fig. 12. Checking charging circuit volt drop 'negative side'

14. Connect control voltage test circuit, Fig. 13.
15. Start engine and check regulator voltage.

    Run engine at 2000 rpm note ammeter reading. When ammeter reading falls to between 3 and 5 amps., check the voltmeter reading, it should be 13,7 to 14,5 volts. If reading is outside specified limits regulator is defective.
16. Switch off ignition and disconnect test circuit.
17. Refit alternator multi-plug.
18. Remove fender covers, close hood.

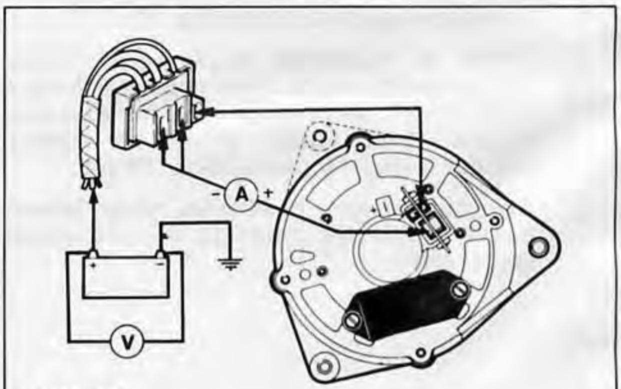


Fig. 13. Checking regulator control voltage

31 414 ALTERNATOR ASSEMBLY – REMOVE AND INSTALL – ALTERNATOR TYPE 'A' (BOSCH)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove multi-plug from rear of alternator.
4. Slacken alternator mounting bolts, Fig. 14, and tilt alternator towards engine.
5. Remove fan belt.
6. Remove alternator mounting bolts and remove alternator from vehicle.

To Install

7. Position alternator and retain with mounting bolts.
8. Fit fan belt and adjust, Fig. 15, tighten mounting bolts.

   Adjust fan belt tension to give 13 mm (0,5 in) of free movement mid-way along longest belt span.

   Alternatively, a belt tension gauge tool, similar to that shown in Fig. 5, can be used to measure belt tension. For belt tensions refer to Technical Data.
9. Refit alternator multi-plug.
10. Reconnect battery.
11. Remove fender covers, close hood.

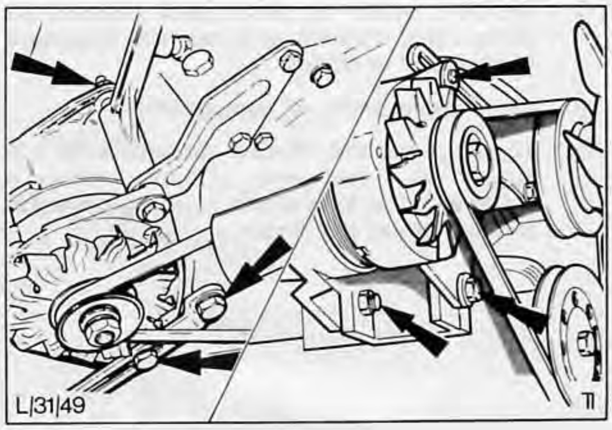


Fig. 14. Alternator securing bolts

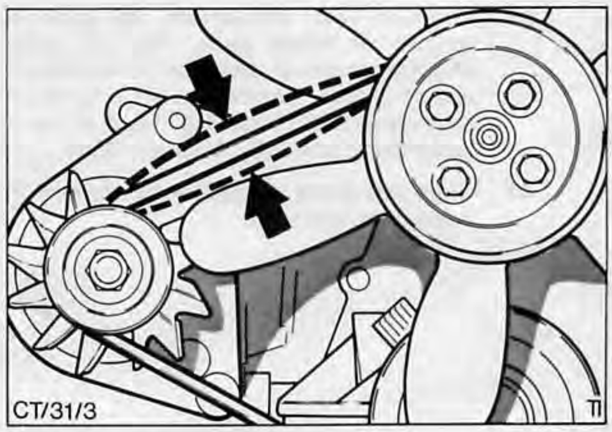


Fig. 15. Adjusting the fan belt tension

31 414 8 ALTERNATOR ASSEMBLY – OVERHAUL (ALTERNATOR REMOVED) – ALTERNATOR TYPE 'A' (BOSCH)

Special Equipment Required:

Press.

To Dismantle

1. Remove pulley retaining nut, washer, pulley, fan, spacer and woodruff key.
2. Remove brush box.
3. Remove through bolts and separate drive end housing and rotor from slip ring end housing.
4. Press out rotor from drive end housing.
5. Remove drive end bearing retainer and bearing.
6. Support slip ring end bearing with a large washer, incorporating a cut out to accommodate the rotor shaft, and press bearing from shaft, Fig. 16.
7. Remove rectifier (diode) pack retaining screws and lift out stator and rectifier (diode) pack.

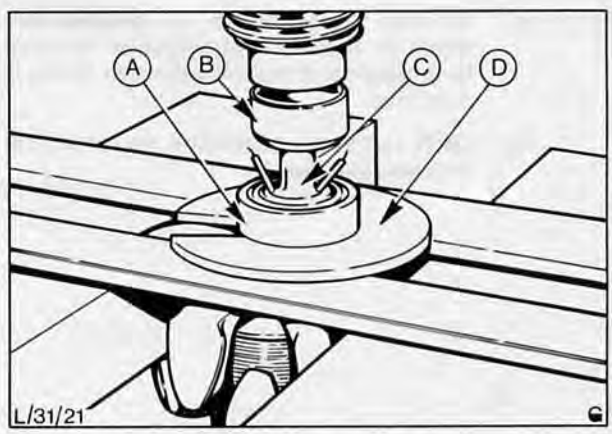


Fig. 16. Removing the slip ring end bearing

A – Bearing
B – Press
C – Suitable diameter mandrel
D – Washer

31 414 8 (cont'd)

8. Unsolder stator to diode pack connections using a pair of pliers, as a heat sink to reduce heat spread to diodes.
9. Clean and examine all components.
10. To check positive diodes, connect a 12 volt supply via a test lamp of approximately 5 watts wired to form a circuit when connected through one of the diodes.

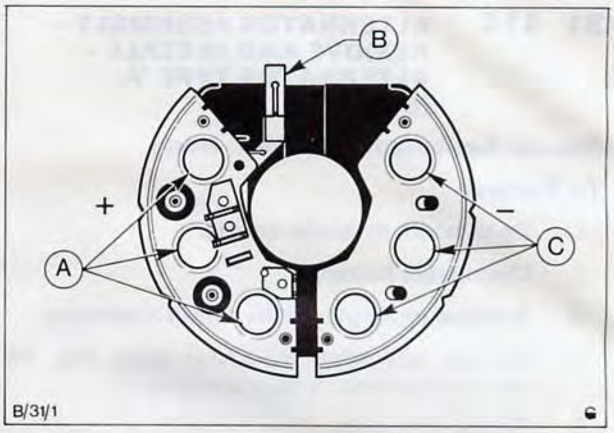


Fig. 17. A – Positive diodes
B – Brushbox terminal
C – Negative diodes

(a) Connect test equipment to positive section of diode pack, Fig. 17, with negative terminal attached to topside of one of diodes. Connect positive terminal to underside of diode, Fig. 18. If diode is functioning correctly, bulb will light.

(b) Carry out same procedure for remaining two positive diodes.

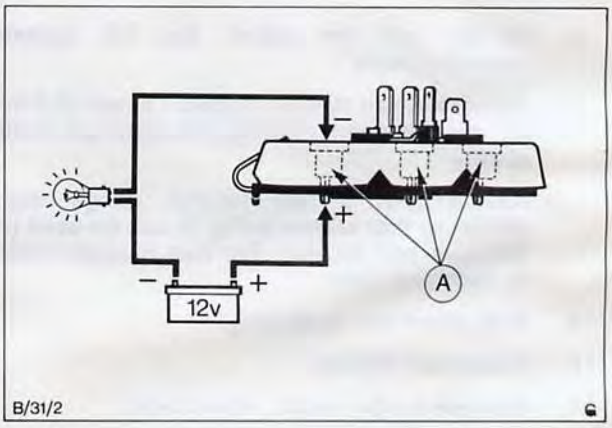


Fig. 18. A – Positive diodes

(c) Reverse the terminals, i.e. positive terminal to topside and negative terminal to underside. If bulb illuminates diode is defective.

(d) Carry out same procedure for remaining two positive diodes.

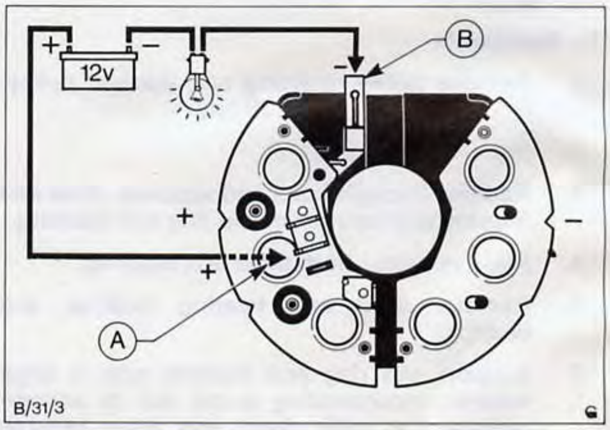


Fig. 19. A – Positive diodes
B – Brushbox terminal

11. To check field diodes, connect test equipment as shown in Fig. 20. With negative connection coupled to brush-box terminal and positive connection to diode, bulb will light if diode is operating correctly.

(a) Connect positive terminal to two remaining diodes in turn to test.

(b) Reverse terminals. If bulb illuminates, diode is defective.

(c) To check negative diodes.

Connect test equipment to negative section of diode pack, Fig. 17, with positive terminal attached to topside of one of diodes. Connect negative terminal to underside of diode, Fig. 20. If diode is functioning correctly bulb will light.

Carry out procedure for remaining two diodes.

(d) Reverse terminals,

If bulb illuminates diode is defective. Repeat process on remaining two diodes.

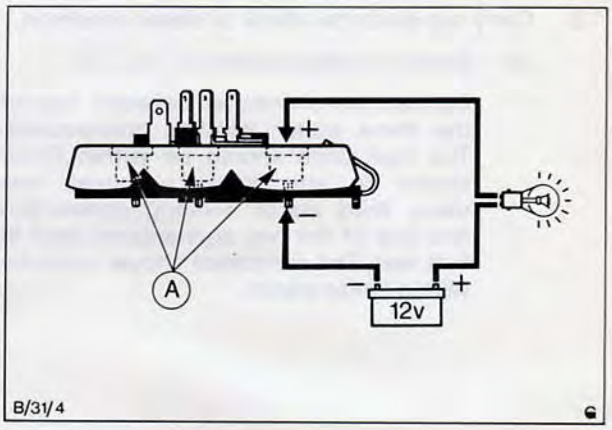


Fig. 20. A – Negative diodes

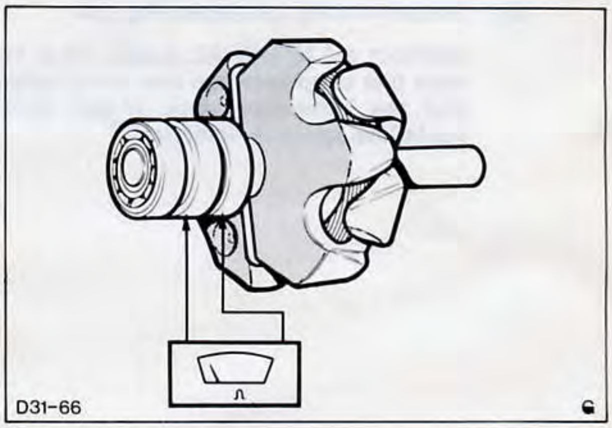


Fig. 21. Rotor winding continuity check

12. Carry out electrical check of rotor condition.

(a) Rotor winding continuity, Fig. 21.

Connect an ohm meter between the two slip ring contacts. For correct resistance figures refer to Technical Data Section.

(b) Rotor winding insulation, Fig. 22.

Connect a 110 volt AC supply via a 15 watt test lamp between one slip ring contact and one of the rotor poles. If test lamp illuminates, insulation is defective.

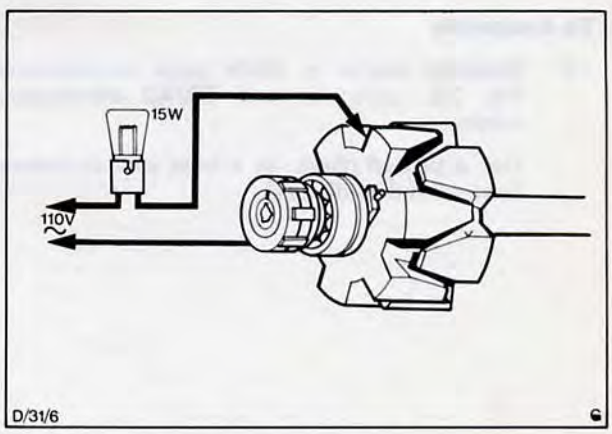


Fig. 22. Rotor winding insulation check

31 414 8 (cont'd)

13. Carry out electrical check of stator condition.

(a) Stator winding continuity, Fig. 23.

Connect an ohmmeter between two of the three stator winding connections. The resistance should be within limits shown in specification. Repeat test using third stator winding connection and one of the two connections used in first test. The resistance should again be within limits shown.

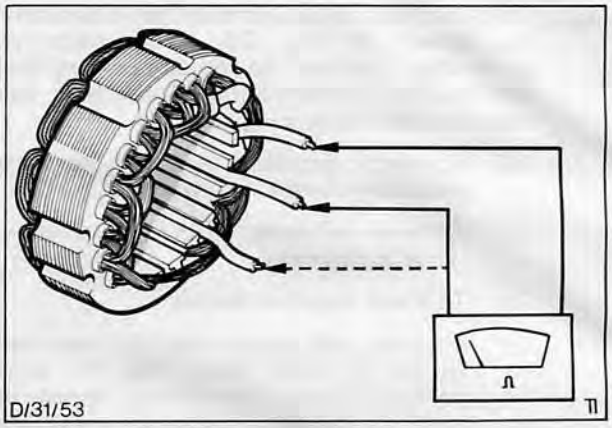


Fig. 23. Stator winding continuity check

(b) Stator winding insulation, Fig. 24.

Connect a 110 volt AC supply via a 15 watt test lamp between one stator cable and the lamination pack. If test lamp lights, insulation is defective.

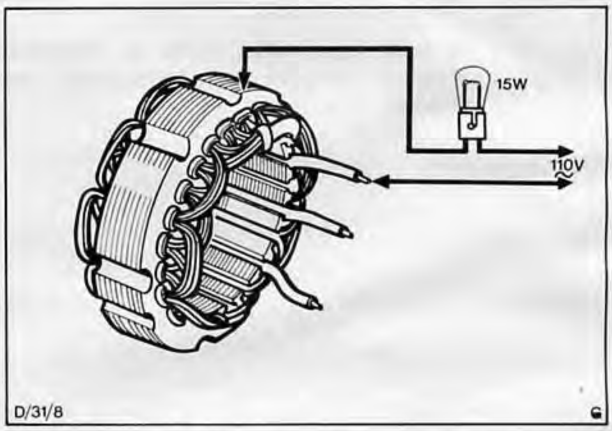


Fig. 24. Stator winding insulation check

To Assemble

14. Resolder stator to diode pack connections, Fig. 25. using only a 60/40 electricians solder.

Use a pair of pliers, as a heat sink to reduce heat spread to diodes.

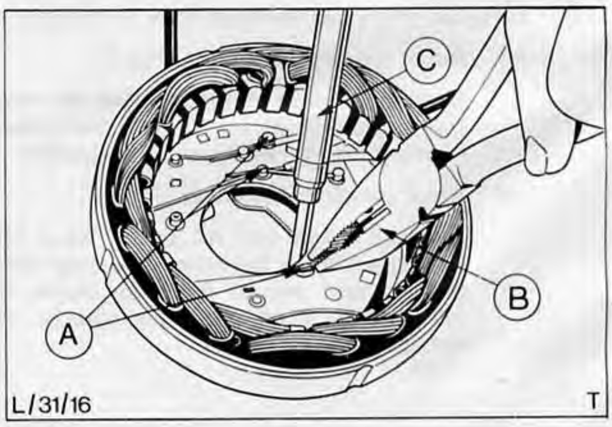


Fig. 25. Resoldering stator to diode pack connections

A – Stator connections
B – Pliers
C – Soldering iron

15. Position stator and diode pack in slip ring end housing and secure.
16. Press slip ring end bearing, onto rotor shaft Fig. 26.

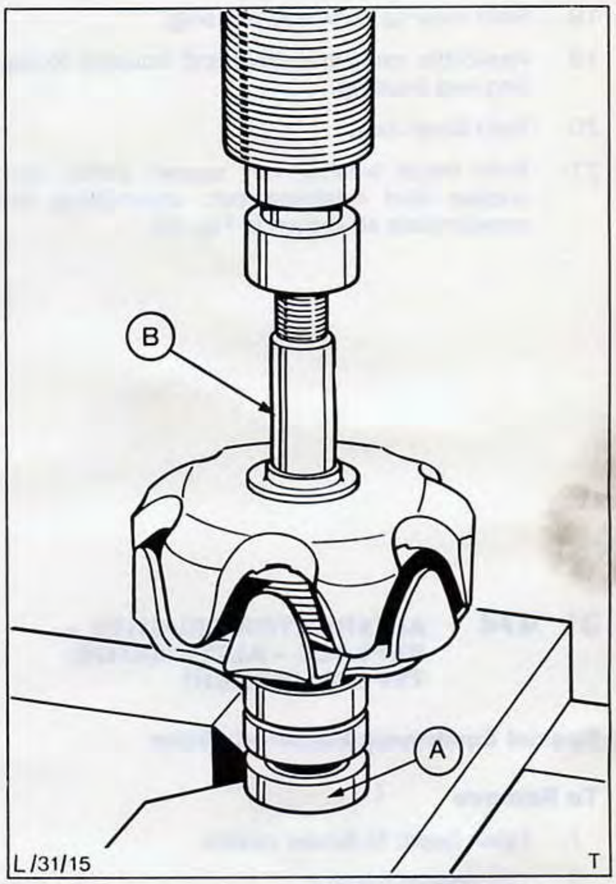


Fig. 26. Fitting the slip ring end bearing
A – Bearing B – Rotor shaft

17 Refit drive end bearing, into housing and secure with retainer plate. Assemble the bearing and retainer as shown in Fig. 27.

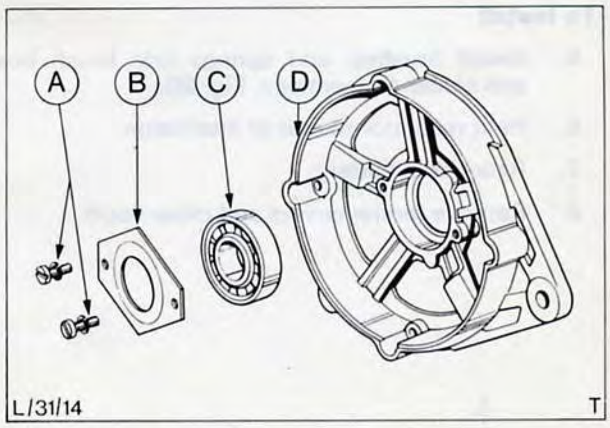


Fig. 27. Fitting the drive end bearing
A – Screws C – Drive end bearing
B – Retainer plate D – Drive end housing

18. Refit rotor to drive end housing.
19. Assemble rotor and drive end housing to slip ring end housing.
20. Refit brush box.
21. Refit thrust washer, fan, spacer, pulley, lock washer and retaining nut, assembling the components as shown in Fig. 28.

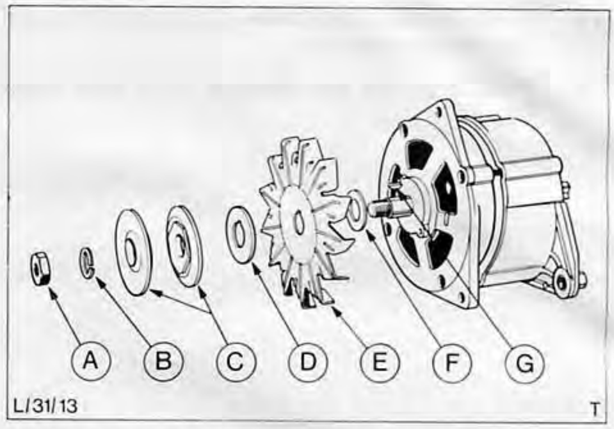


Fig. 28. Fan, pulley and associated components

A – Retaining nut D – Spacer
B – Lock washer E – Fan
C – Pulley F – Washer
G – Key

31 474 ALTERNATOR BRUSHES – REPLACE – ALTERNATOR TYPE 'A' (BOSCH)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove regulator retaining screws, Fig. 29, and withdraw regulator.
4. Unsolder brush wiring connections and remove brushes and springs.

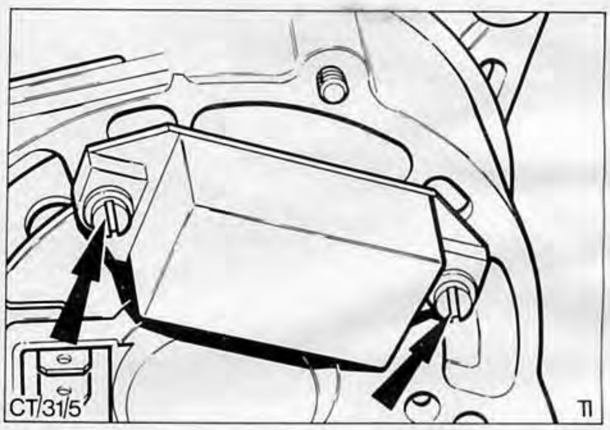


Fig. 29. Regulator retaining screws

To Install

5. Install brushes, and springs into brush box and solder connections, Fig. 30.
6. Refit regulator to rear of alternator.
7. Reconnect battery.
8. Remove fender covers and close hood.

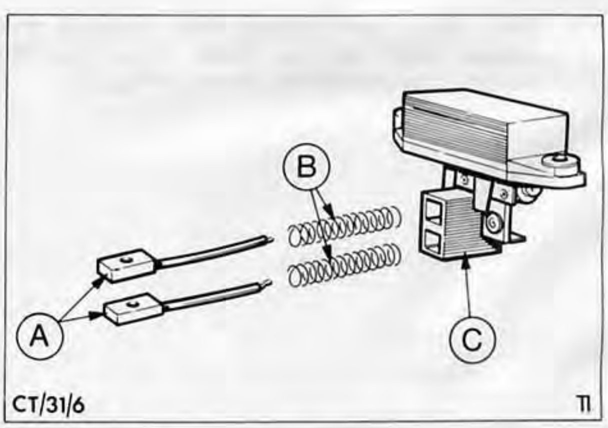


Fig. 30. Brush box exploded

A – Brushes C – Brush box
B – Springs

31 484 PULLEY – ALTERNATOR – REMOVE AND INSTALL ALTERNATOR TYPE 'A' (BOSCH)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Slacken alternator mounting bolts and remove fan belt.
4. Remove pulley retaining nut and pulley.

To Install

5. Fit pulley and secure.
6. Refit fan belt and adjust.

   Adjust fan belt tension to give 13 mm (0,5 in) of free movement mid-way along longest belt span.
7. Reconnect battery.
8. Remove fender covers and close hood.

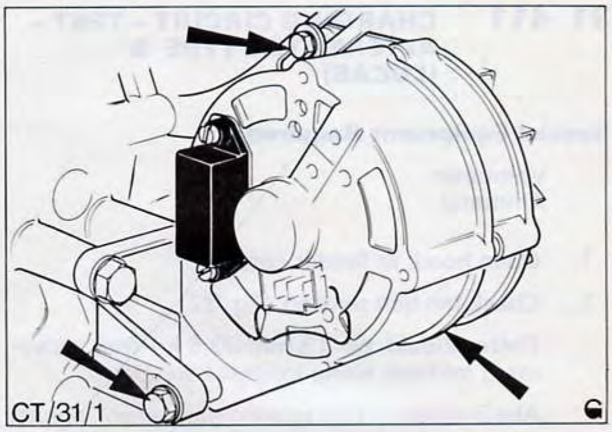


Fig. 31. Alternator mounting bolts

31 411 CHARGING CIRCUIT – TEST – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required:

Voltmeter
Ammeter

1. Open hood, fit fender covers.
2. Check fan belt tension, Fig. 32.

   There should be 13 mm (0,5 in) free movement midway along longest belt span.

   Alternatively a belt tension gauge tool, similar to that shown in Fig. 5, can be used to measure belt tension. For belt tensions refer to Technical Data.
3. Check battery condition.

   Refer to Operation No. 31–211.
4. Check charging circuit wiring continuity, Fig. 33.

   Remove alternator multi-plug. Switch on ignition. Connect a 0–20 voltmeter between a good earth and each multi-plug terminals in turn. The voltmeter should read approximately battery voltage in all cases; a zero reading indicating an open circuit.
5. Remove rear cover.

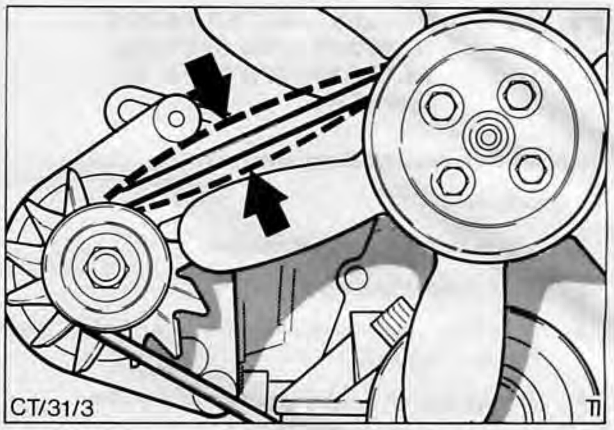


Fig. 32. Checking fan belt tension

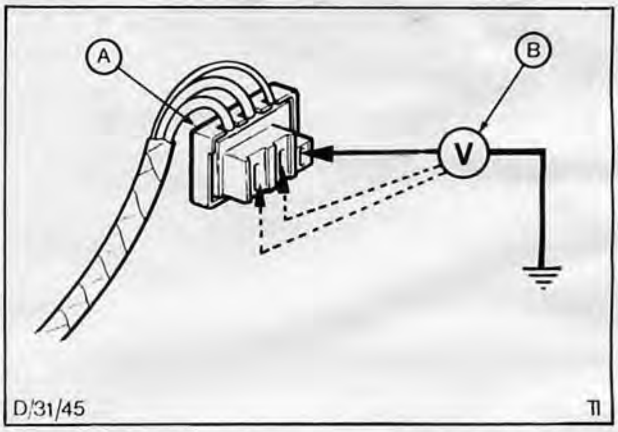


Fig. 33. Checking charging circuit wiring continuity
A – Multi-plug B – Voltmeter

6. Connect output test circuit, Fig. 34.
7. Switch on headlamps, heater blower motor and heated backlight.
8. Start engine and run it at 3000 rpm. Vary resistance to increase load current. Rated output should be reached without voltage dropping below 13 volts.
9. Switch off ignition, headlamps, heater blower motor and heated backlight.

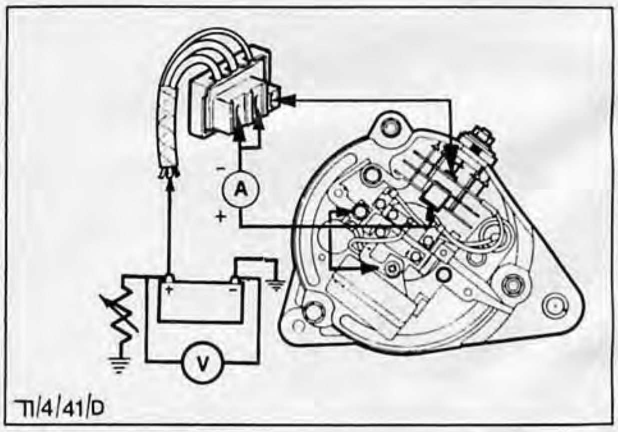


Fig. 34. Checking alternator output
A – Ammeter
V – Voltmeter
Resistor should be 30 amps. rating

10. Connect 'positive side' volt drop test circuit, Fig. 35.
11. Switch on headlamps start engine and check volt drop.

    Run engine at 3000 rpm.

    If voltage reading is in excess of 0,5 volt, this indicates a high resistance on the positive side of the charging circuit wiring which must be located and rectified.
12. Switch off ignition and headlamps.

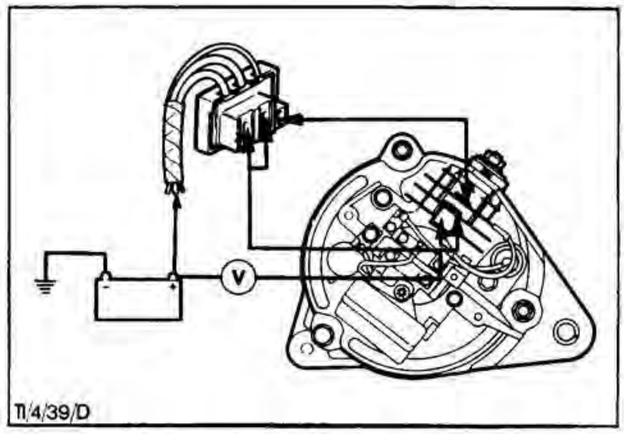


Fig. 35. Checking charging circuit volt drop 'positive side'
V – Voltmeter

13. Connect 'negative side' volt drop test circuit, Fig. 36.
14. Switch on headlamps, start engine and check volt drop.

    Run engine at 3000 rpm. Check voltmeter reading. If reading is in excess of 0,25 volt, this indicates a high resistance on the negative side of the charging circuit which must be located and rectified.
15. Switch off ignition and headlamps and disconnect test circuit.

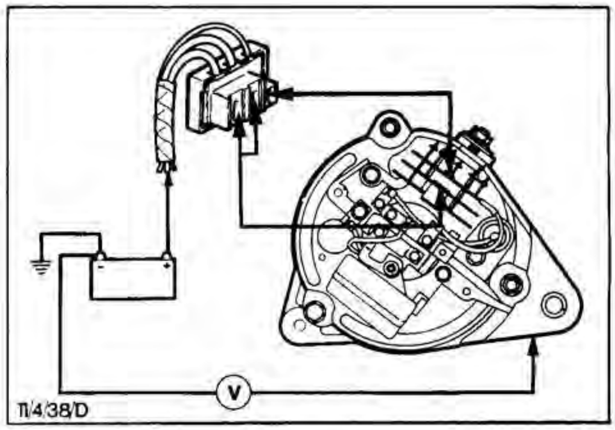


Fig. 36. Checking charging circuit volt drop 'negative side'
V – Voltmeter

16. Connect control voltage test circuit, Fig. 37.
17. Start engine and check control voltage.

    Run engine at 2000 rpm, note the ammeter reading. When the ammeter reading falls below 10 amps., check the voltmeter reading, it should be 13,7 to 14,5 volts. If reading is outside specified limits, the voltage regulator is defective.
18. Switch off ignition and disconnect test circuit.
19. Refit alternator rear cover and multi-plug.
20. Remove fender covers. Close hood.

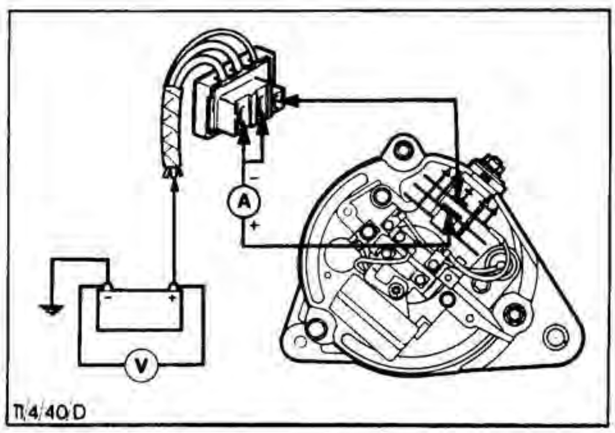


Fig. 37. Checking regulator control voltage
A – Ammeter
V – Voltmeter

31 414 ALTERNATOR ASSEMBLY – REMOVE AND INSTALL – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove multi-plug from rear of alternator.
4. Slacken alternator mounting bolts, Fig. 38, and tilt alternator towards engine.
5. Remove fan belt.
6. Remove alternator mounting bolts and remove alternator from vehicle.

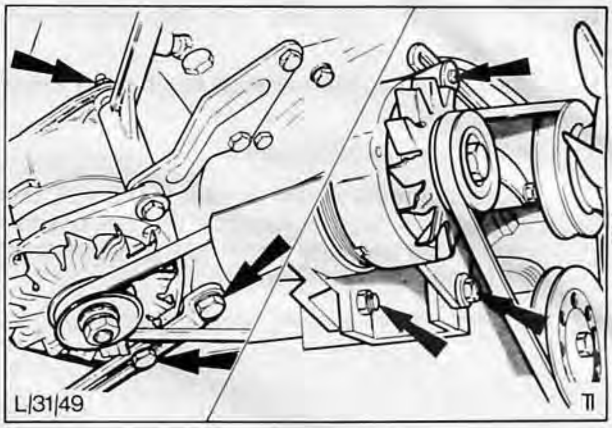


Fig. 38. Alternator mounting bolts

To Install

7. Position alternator and retain with mounting bolts.
8. Fit fan belt and adjust, tighten mounting bolts.

   Adjust the fan belt tension to give 13 mm (0,5 in) of free movement mid-way along the longest belt span, Fig. 39.

   Alternatively, a belt tension gauge tool, similar to that shown in Fig. 5, can be used to measure the belt tension. For belt tensions refer to Technical Data.
9. Refit alternator multi-plug.
10. Reconnect battery.
11. Remove fender covers, close hood.

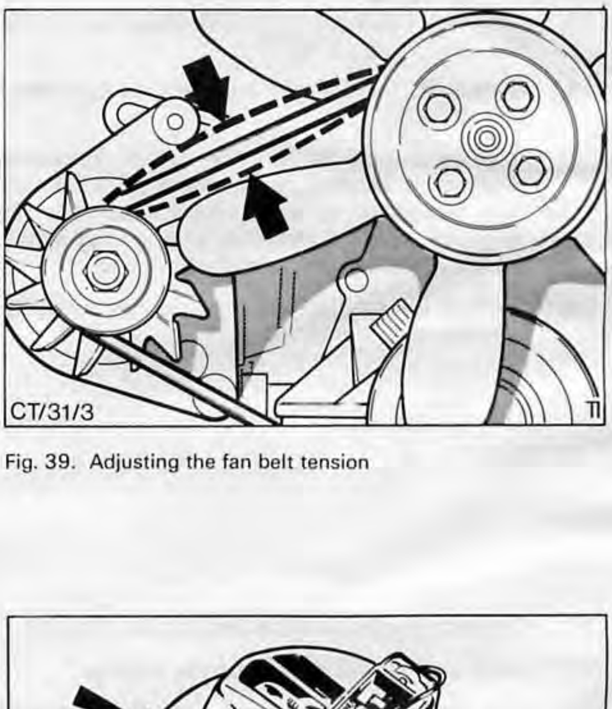


Fig. 39. Adjusting the fan belt tension

31 414 8 ALTERNATOR ASSEMBLY – OVERHAUL (ALTERNATOR REMOVED) – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required:

Test Lamp.

To Dismantle

1. Remove pulley, retaining nut, washer, fan, spacer and woodruff key.
2. Remove alternator rear cover, Fig. 40.
3. Remove regulator assembly.

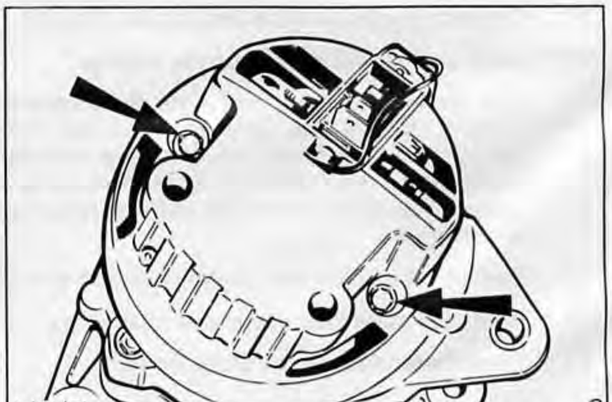


Fig. 40. Rear cover retaining screws. (18ACR shown)

4. Remove radio suppressor (if fitted).
5. Remove surge protection diode, 'A' in Fig. 41.
6. Remove brush box.
7. Unsolder stator connections, 'C' in Fig. 42, from rectifier (diode) pack 'A' loosen locknut and remove pack. When unsoldering the stator connections from the rectifier (diode) pack, use a pair of pliers 'B' as a heat sink to prevent the diode terminal pins and hence the diodes becoming excessively heated. Overheating can cause diode failure. Remove diode pack by removing securing nut.

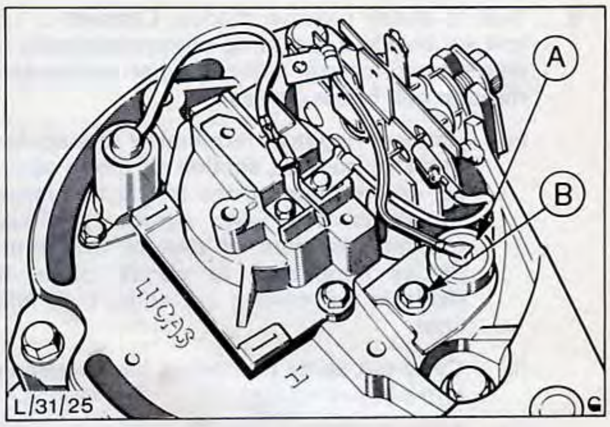


Fig. 41. Removing the surge protection diode (18ACR alternator)

A – Diode B – Retaining bolt

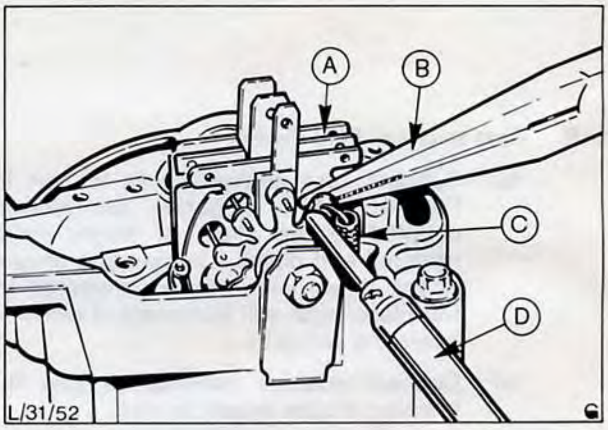


Fig. 42. Unsoldering the stator connections from the rectifier (diode) pack

A – Rectifier pack C – Stator connection
B – Pliers D – Soldering iron

NOTE: The Lucas 15 and 17 ACR alternators have separate positive and negative plates in the rectifier pack, and a star winding stator.

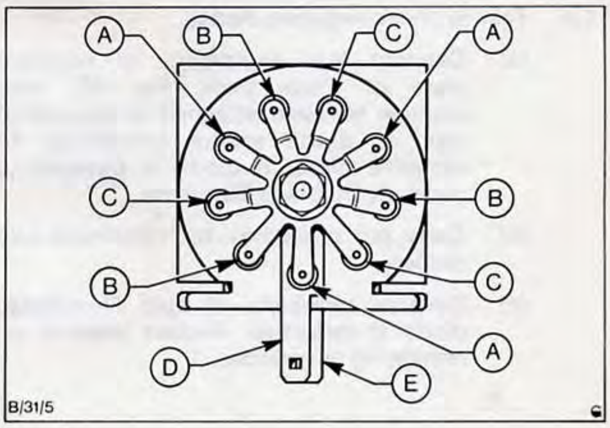


Fig. 43. Diode pack

A – Field diodes D – Field terminal
B – Positive diodes E – Positive terminal
C – Negative diodes

31 414 8 (cont'd)

8. Test to check positive diodes. Connect a 12 volt supply via a test lamp of approximately 5 watts wired to form a circuit when connected through one of the diodes.

   (a) Connect negative terminal of test equipment to positive section of diode pack, i.e. centre plate or one of the two large terminals, Fig. 44. Attach positive terminal to stem of one of the three diodes connected to centre plate. If diode is functioning correctly, bulb will light.

   (b) Carry out same procedure for remaining two positive diodes.

   (c) Reverse the terminals, i.e. positive terminal to diode stem and negative terminal to centre plate. If bulb illuminates diode is defective.

   (d) Carry out same procedure for remaining two positive diodes.

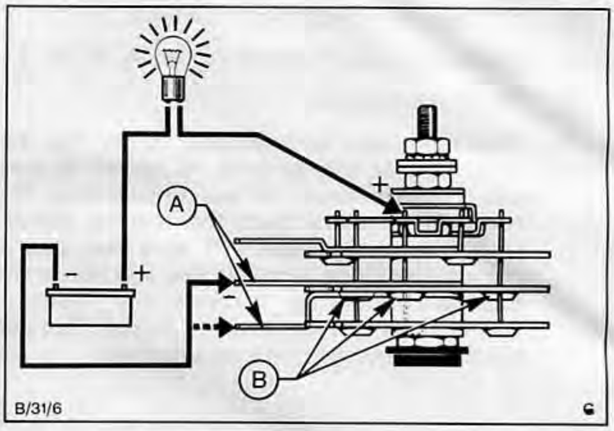


Fig. 44. A – Positive terminals
B – Positive diodes

9. Test to check field diodes.

   (a) Connect test equipment as shown in Fig. 45. With negative connection coupled to top plate, or single small terminal and positive connection to one of the three diode stems connected to top plate, bulb will illuminate if diode is operating correctly.

   (b) Connect positive terminal to two remaining diodes in turn to test.

   (c) Reverse terminals. If bulb illuminates diode is defective.

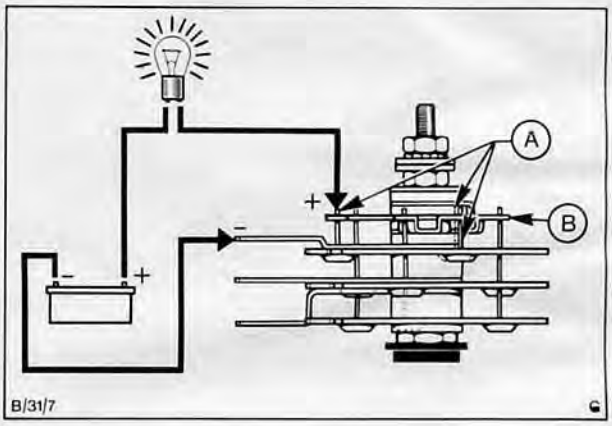


Fig. 45. A – Field diodes
B – Field plate

10. Test to check negative diodes.

   (a) Connect test equipment to negative plate of diode pack, Fig. 46, with positive terminal attached to topside of one of diode stems connected to negative plate. If diode is functioning correctly bulb will illuminate.

   (b) Carry out procedure for remaining two diodes.

   (c) Reverse terminals, If bulb illuminates diode is defective. Repeat process on remaining two diodes.

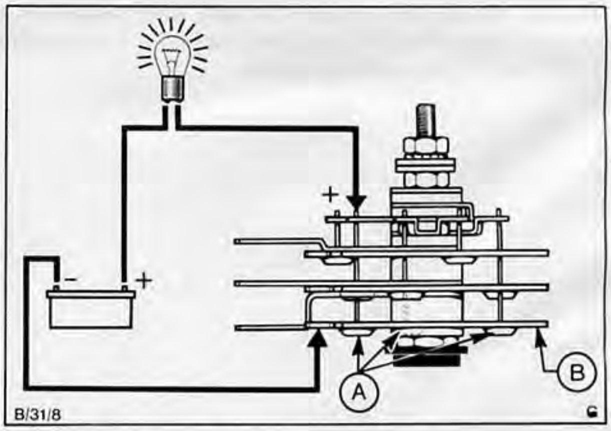


Fig. 46. A – Negative diodes
B – Negative plate

11. Remove through bolts, separate drive end and slip ring end housings and withdraw stator.
12. Unsolder wires from slip ring and remove slip ring from shaft.
13. Press out slip ring end bearing and rotor assembly from slip ring end housing.
14. Support slip ring end bearing with a large washer incorporating a cut-out to accommodate the rotor shaft, and press bearing from shaft, Fig. 47.

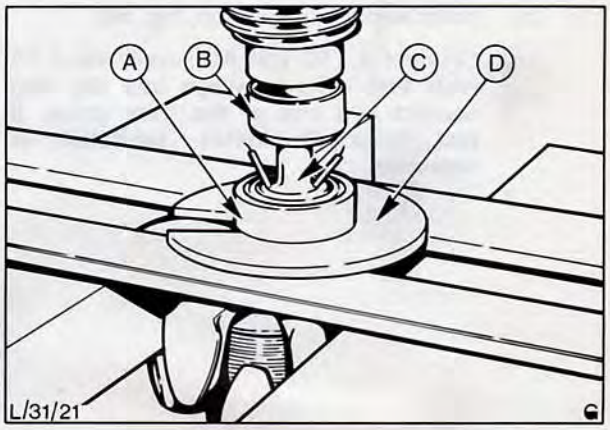


Fig. 47. Removing the slip ring end bearing from the rotor

A – Bearing
B – Press
C – Rotor shaft
D – Washer

15. To facilitate removing drive end bearing retaining circlip on alternator position housing under a press and apply a light pressure to the rear face of the bearing. This will release any pressure from bearing thrust washer against the circlip and at same time hold housing firmly, Fig. 48.
16. Remove thrust washer, drive end bearing and shim pack.
17. Clean and examine all components.

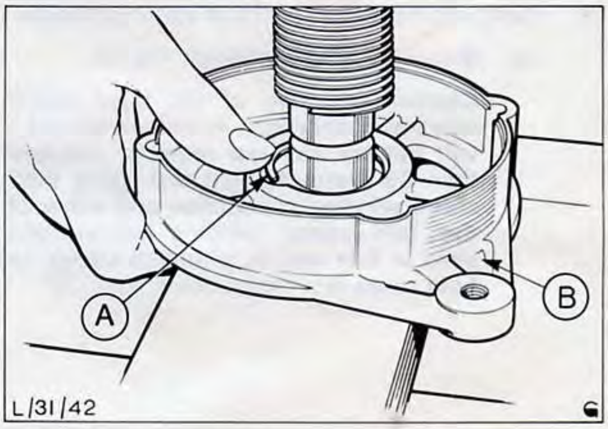


Fig. 48. Removing the drive end bearing retaining circlip

A – Circlip
B – Drive end housing

18. Carry out electrical checks of rotor condition.
    (a) Rotor winding continuity, Fig. 49.

    Connect an ohmmeter between the two slip ring contacts. For correct resistance figures refer to technical specification.

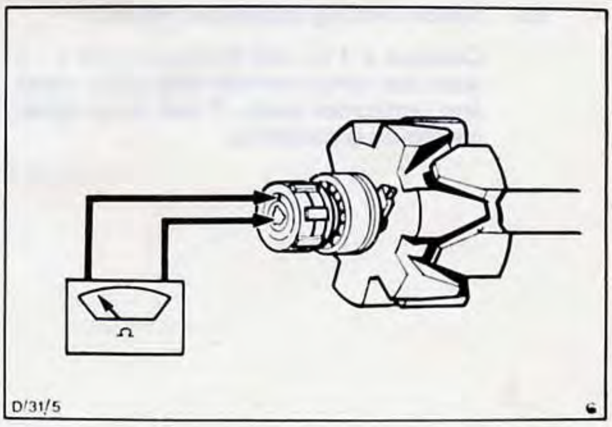


Fig. 49. Rotor winding continuity check

31 414 8 (cont'd)

(b) Rotor winding insulation, Fig. 50.

Connect a 110 volt AC supply via a 15 watt test lamp between one slip ring contact and one of the rotor poles. If test lamp illuminates, insulation is defective.

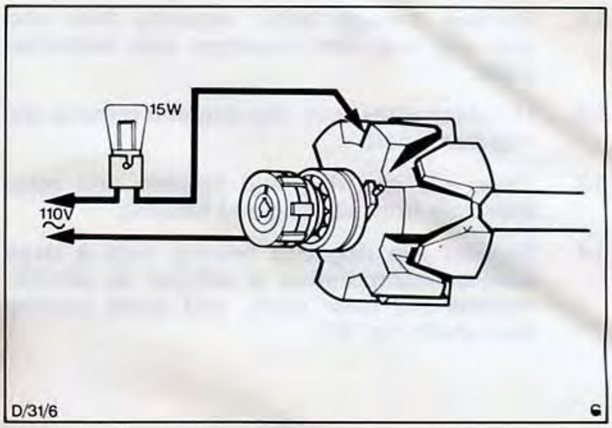


Fig. 50. Rotor winding insulation check

19. Carry out electrical checks of stator condition.

(a) Stator winding continuity, Fig. 51.

Connect any two of the three stator winding connections in series with a 12 volt battery and test lamp of not less than 36 watts. Repeat test using third stator winding connection and either of the two stator winding connections used in first test to complete circuit. In both cases test lamp should light.

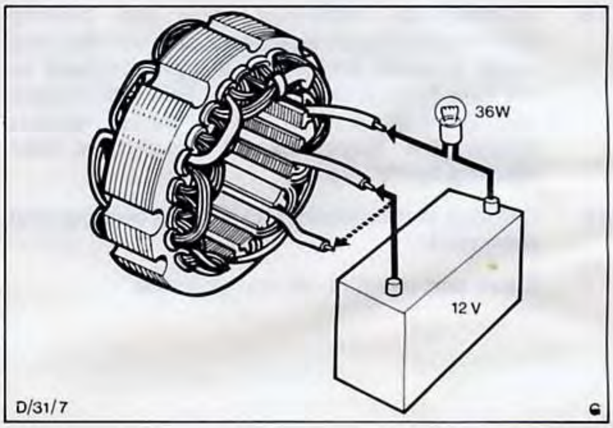


Fig. 51. Stator winding continuity check

(b) Stator winding insulation, Fig. 52.

Connect a 110 volt AC supply via a 15 watt test lamp between one stator cable and lamination pack. If test lamp lights, insulation is defective.

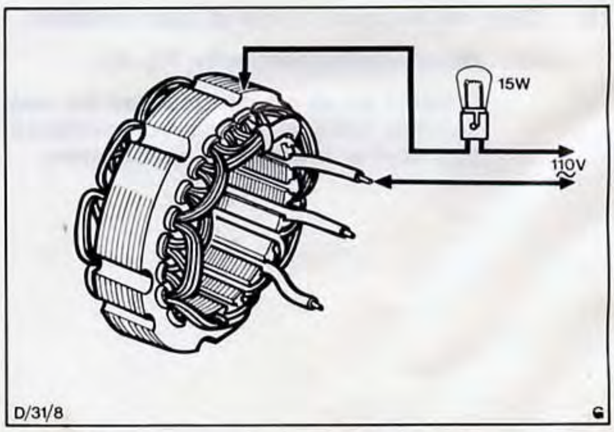


Fig. 52. Stator winding insulation check

To Assemble

20. Install drive end bearing shim pack, bearing and thrust washer.

    Assemble components as shown in Fig. 53.

    NOTE: If original bearing is being re-used pack bearing with high melting point grease.

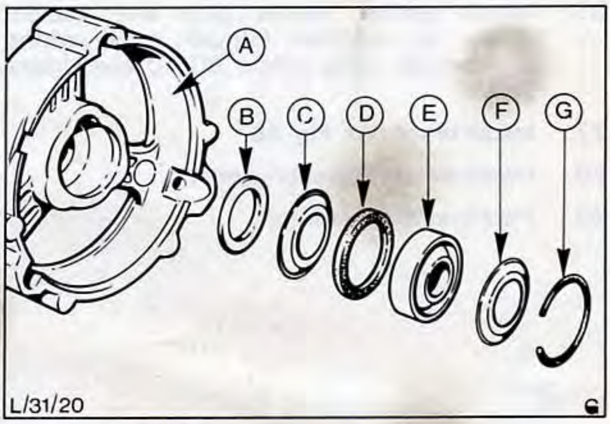


Fig. 53. Drive end bearing and associated components

A – Drive end housing
B – Felt ring
C – Thrust washer
D – 'O'-ring
E – Drive end bearing
F – Thrust washer
G – Circlip

21. Position housing under a press and apply light pressure to rear face of the bearing, Fig. 54. This will facilitate installing circlip by fully exposing circlip groove while holding housing firmly.

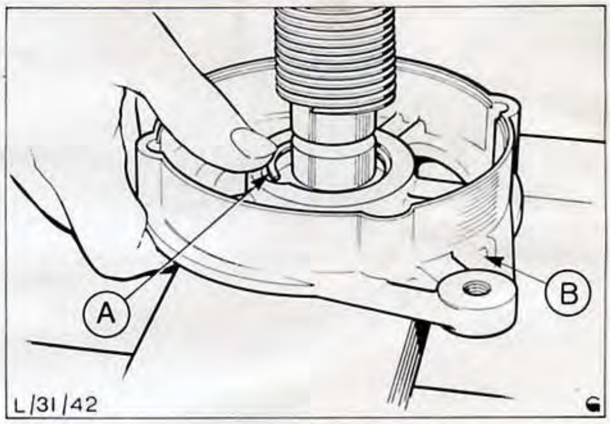


Fig. 54. Installing the drive end bearing retaining circlip

A – Circlip
B – Drive end housing

22. Ensure wires from rotor are correctly positioned in their grooves in rotor shaft and carefully press slip ring end bearing into position on rotor shaft.

    NOTE: If original bearing is being re-used then bearing should be repacked with high melting point grease.

23. Refit rotor assembly to slip ring end housing.

24. Position stator in slip ring end housing and assemble slip ring end and drive end housings. Pull together with through bolts.

25. Refit slip ring to rotor shaft and resolder slip ring connections, Fig. 55, using only a 60/40 electricians solder.

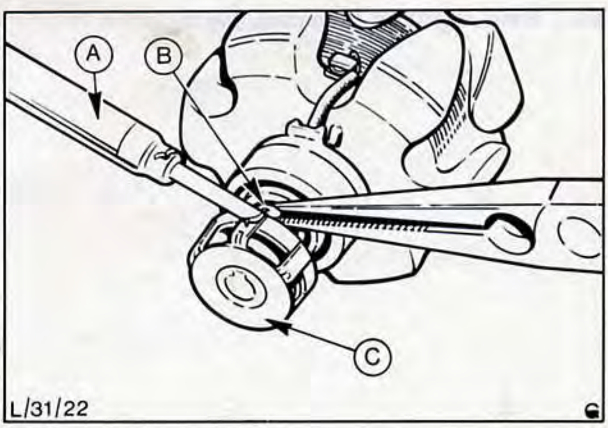


Fig. 55. Resoldering slip ring connections

A – Soldering iron
B – Slip ring connections
C – Slip ring

31 414 8 (cont'd)

26. Install rectifier (diode) pack and resolder stator to rectifier (diode) pack wiring connections using only a 60/40 electricians solder.
27. Install brush box, Fig. 56.
28. Install surge protection diode.
29. Install radio suppressor.

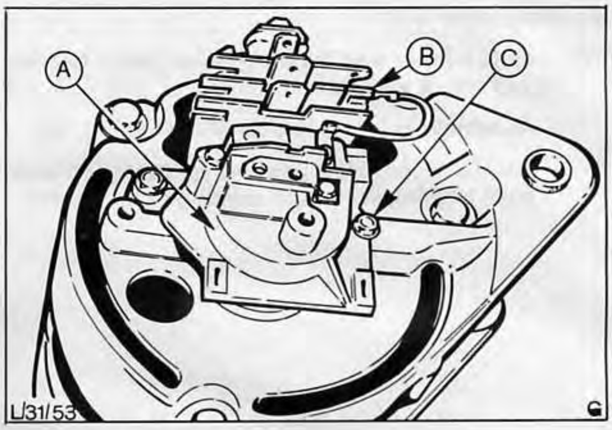


Fig. 56. Installing the brush box

A – Brush box
B – Brush box to rectifier connection
C – Brush box retaining screw

30. Refit regulator assembly, Fig 57.

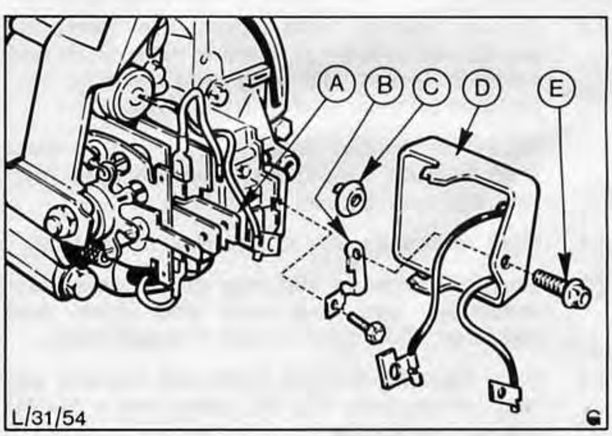


Fig. 57. Installing the regulator assembly

A – Brush box
B – Field link
C – Spacer
D – Regulator
E – Retaining screw

31. Refit rear cover.
32. Refit spacer, key, fan, pulley, washer and retaining nut, Fig. 58.

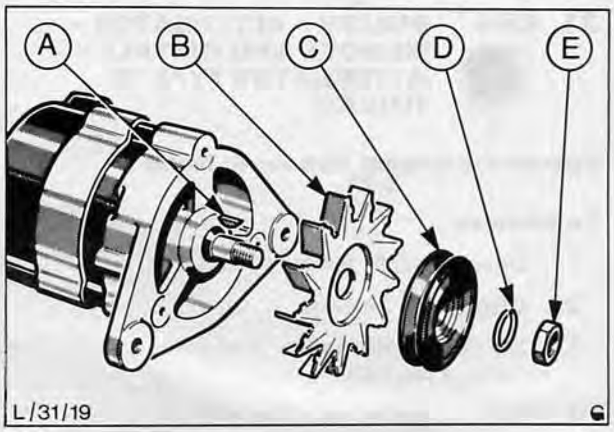


Fig. 58. Fan, pulley and associated components
A – Key
B – Fan
C – Pulley
D – Washer
E – Locknut

31 474 ALTERNATOR – BRUSHES – REPLACE – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove alternator multi-plug.
4. Remove alternator rear cover.
5. Remove brush retaining screws and withdraw brush assemblies from brush box, Fig. 59.

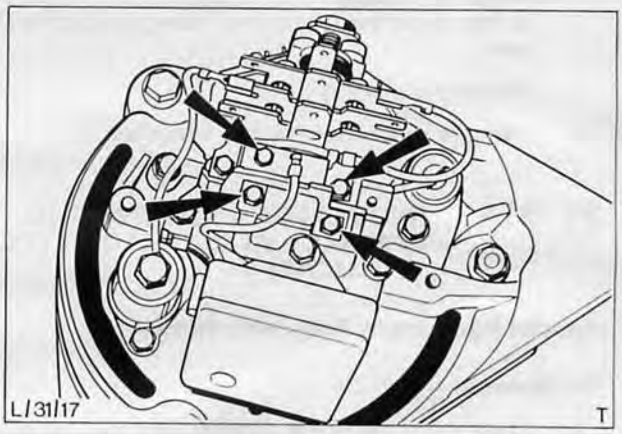


Fig. 59. Brush box retaining screws

To Install

6. Fit brush assemblies, 'B' in Fig. 60, into brush box 'A' and secure in position with retaining screws.
7. Refit alternator rear cover.
8. Refit alternator multi-plug.
9. Reconnect battery.
10. Remove fender covers, close hood.

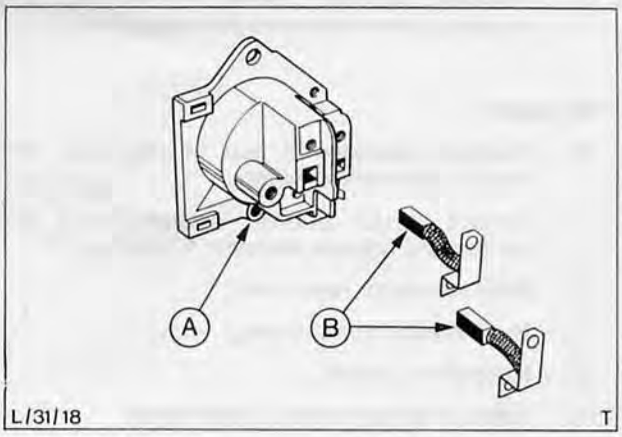


Fig. 60. A – Brush box B – Brushes

31 484 PULLEY – ALTERNATOR – REMOVE AND INSTALL – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Slacken alternator mounting bolts and remove fan belt.
4. Remove pulley retaining nut and pulley.

To Install

5. Fit pulley and secure.
6. Refit fan and adjust.

   Adjust fan belt tension to give 13 mm (0,5 in) of free movement mid-way along longest belt span.
7. Reconnect battery.
8. Remove fender covers and close hood.

31 514 REGULATOR – REMOVE AND INSTALL – ALTERNATOR TYPE 'B' (LUCAS)

Special Equipment Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove alternator multi-plug.
4. Remove alternator rear cover.
5. Remove regulator wiring connections and retaining screw and withdraw regulator.

To Install

6. Position regulator in rear of alternator and secure. Reconnect wiring.

   Ensure small plastic spacer, and the connecting link are correctly fitted, Fig. 61.
7. Refit alternator rear cover.
8. Refit alternator multi-plug.
9. Reconnect battery.
10. Remove fender covers, close hood.

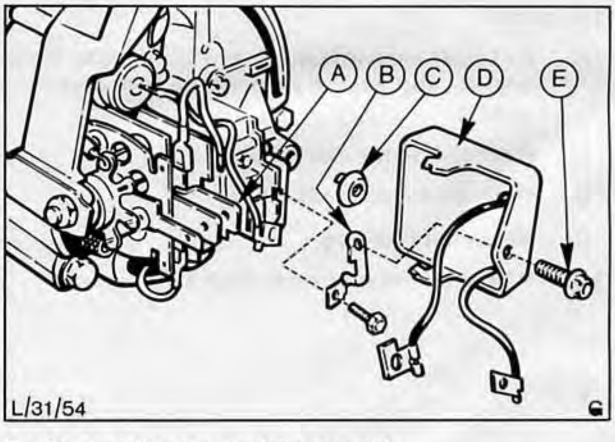


Fig. 61. Installing the regulator assembly

A – Brush box
B – Field link
C – Plastic spacer
D – Regulator
E – Retaining screw

TECHNICAL DATA

Battery

Type	Lead acid	
Voltage	12	
Capacity, amp. hours.	38	standard Kent
	44	standard OHC
	55	standard On all Heavy Duty, Petrol
	68	standard 2 used on Heavy Duty
Specific gravity charged	1,270 to 1,290 at a temperature of 25 °C	
	NOTE: For each 6 °C below this figure deduct 0,004 from the observed reading. For each 6 °C above this figure add 0,004 to the observed reading.	

When filling a dry battery with commercially available acid, a hydrometer should be used to ensure that the correct concentration of acid and water is obtained. If a hydrometer is not available, only a Technician who has had battery experience should fill the battery.

UNDER NO CIRCUMSTANCES ADD ACID TO A CHARGED BATTERY. WHEN ADDING ACID TO WATER IT SHOULD ALWAYS BE DONE SLOWLY, WATER SHOULD NEVER BE ADDED TO NEAT ACID.

BATTERY CHARGING

The following procedure should be used when charging a completely discharged battery.

1. Remove battery filler caps and check electrolyte level. Top up level with distilled water as necessary and refit filler caps.
2. Connect charger unit to battery as per the manufacturers instruction.
3. Adjust amp setting on charger to 0,01 of the battery's capacity, e.g. for a 38 amp hour battery set charger to 0,38 amp, and charge for 2 hours.
4. Following 2 hours charging, check specific gravity and voltage of battery.
   (a) If the battery has accepted the charge and voltage is **below** 14 volts, complete charging procedure with a setting of 0,05 of capacity, e.g. 1., 9 amps for a 38 amp hour battery.
   (b) If after 2 hours the battery has not accepted the charge and voltage is **above** 14 volts, continue to charge battery at 0,01 of capacity for a further 2 hours or until voltage is below 14 volts. Then charge battery at 0,05 of capacity for at least 20 hours to fully re-charge.

   NOTE: If after 4 hours at the low charge setting, the battery voltage is still above 14 volts then the battery is faulty.
5. Disconnect charger.

Batteries in storage, even on vehicles, must be charged at least once a month to prevent deterioration, although it should be noted that the **above** procedure is only suitable for charging completely discharged batteries.

When charging a partially discharged battery, the charger unit manufacturer's instructions should be followed.

It is not necessary to disconnect battery cables before charging the battery but the following precautions must be observed.

1. Ensure charging is undertaken in a well ventilated room or garage, with the hood open.
2. The battery charger must be switched off before its leads are disconnected from the battery.
3. Never SMOKE OR IGNITE A NAKED FLAME near a battery which is being charged, as the charging process causes highly inflammable hydrogen gas to be given off.

TECHNICAL DATA (cont'd)

Alternator (Type A) (BOSCH)

Type	**Bosch K1-28A**	**Bosch K1-35A**
Earth polarity	Negative	Negative
Nominal rated output at 13,5 volts and 6000 rpm	28 amp	35 amp
Max. continuous alternator speed (rpm)	15000	15000
Stator winding resistance, ohms per phase	0,2+0,01 −0	0,13+0,007 −0
Rotor winding resistance, ohms at 20 °C	4,0+0,4 −0	4,0+0,4 −0
Min. length of slip ring end brushes protruding from brush box in free position	5 mm (0,197 in)	5 mm (0,197 in)
Regulating voltage (Model AD1) at 4000 rpm and 3 to 7 amp load	13,7 to 14,5 volt	13,7 to 14,5 volt

Alternator (Type B) (LUCAS)

Type	**Lucas 15 ACR**	**Lucas 17 ACR**
Earth polarity	Negative	Negative
Nominal rated output at 13,5 volts and 6000 rpm	28 amp	35 amp
Max. continuous alternator speed (rpm)	15000	15000
Stator winding resistance, ohms per phase	0,198±0,01	0,133±0,007
Rotor winding resistance, ohms at 20 °C	3.27±5%	3.201±5%
Min. length of slip ring end brushes protruding from brush box in free position	5 mm (0,197 in)	5 mm (0,197 in)
Regulating voltage (Model 14 TR) at 4000 rpm and 3 to 7 amp load	14,2 to 14,6 volt	14,2 to 14,6 volt

Fan belt

Tension	20–25 kgf. (45–55 lbf.)

COOLING SYSTEM 24

Index

GENERAL DESCRIPTION

This section covers the removal and installation of the components that comprise the cooling system, and where necessary the overhaul of these components.

The three types of engine fitted in the Transit are the 'Kent' OHV in-line four cylinder, the OHC in-line four cylinder and the 'York' Diesel in-line four cylinder, all have similar cooling systems. These are pressurised impeller assisted thermo-syphon and incorporate a cooling radiator, water pump (water impeller), a thermostat and in most cases a heater radiator. Some variants have an additional circuit to operate the automatic choke.

The York Diesel variants use a cross-flow radiator for increased heat dissipation. A separate engine mounted remote radiator supply tank is used to maintain a constant coolant level, and water pressure at the water pump inlet. This pressure at the water pump is necessary to prevent cavitation within the pump. Cavitation is water pressure variation, (low pressure areas) within the pump which can cause increased wear of the impeller vains.

The OHV and OHC engine variants use the more conventional down-flow radiator with the bottom hose connected to the water pump.

All models contain a 25% solution of FORD anti-freeze, which contains a powerful corrosion inhibitor and should not be diluted. For certain territories because of the climate, anti-freeze is not required and the system is filled with a corrosion inhibitor at a concentration of 1 part inhibitor to 39 parts water.

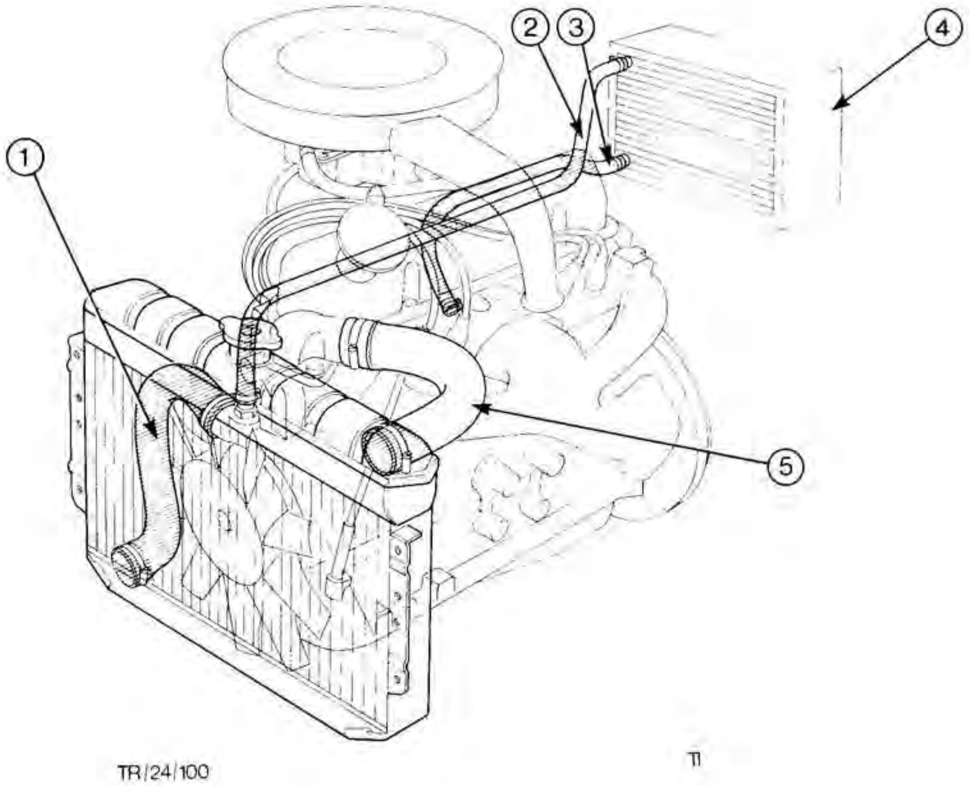


Fig. 1. Cooling system layout on OHV (Kent) engine variants.

1. Bottom hose
2. Heater outlet hose
3. Heater inlet hose
4. Heater matrix
5. Top hose

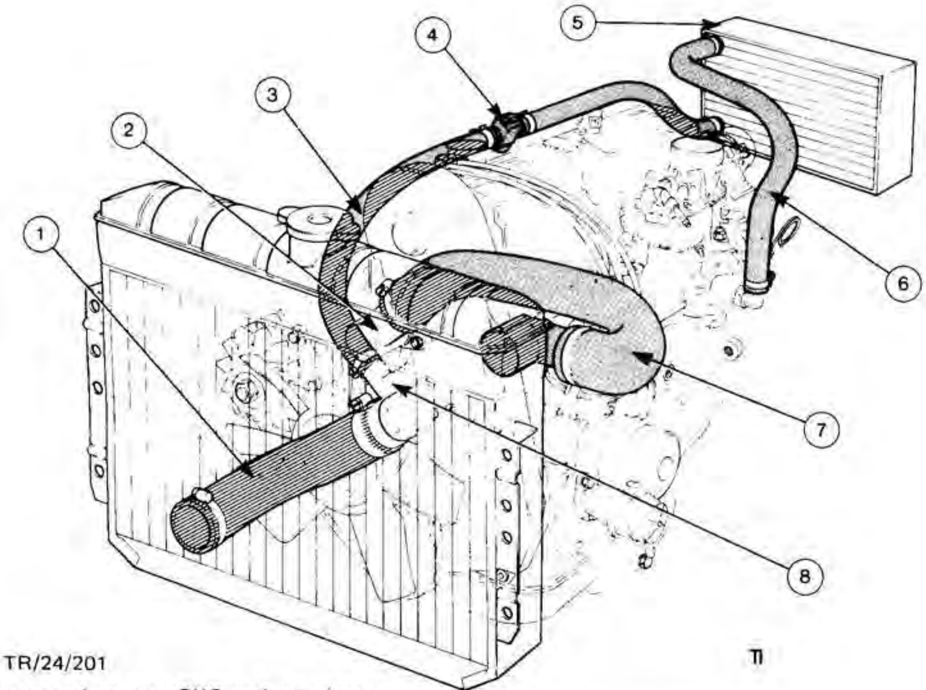


Fig. 2. Cooling system layout on OHC engine variants

1. Bottom hose
2. Thermostat housing
3. Heater inlet hose
4. Heater shut-off valve
5. Heater matrix
6. Heater outlet hose
7. Top hose
8. Water pump

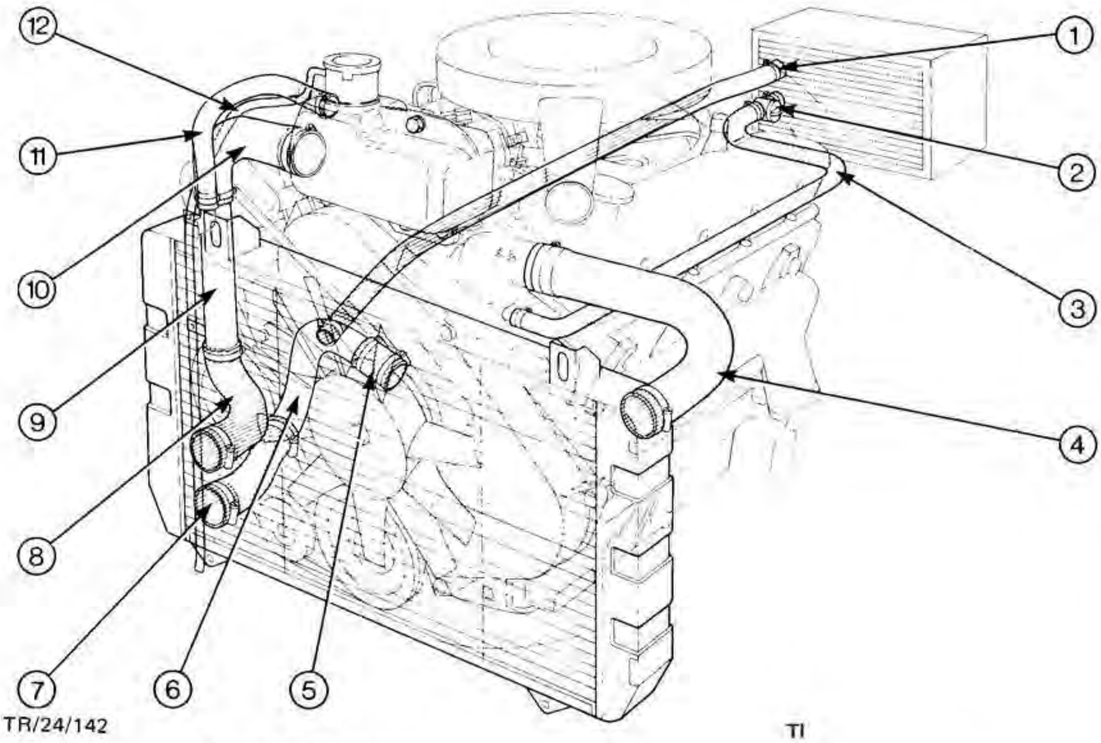


Fig. 3. Cooling system layout on Diesel engine variants

1. Hose – heater outlet
2. Heater shut-off valve
3. Hose – heater inlet
4. Top hose
5. Bottom hose – water pump to metal pipe
6. Bottom hose – metal pipe section
7. Bottom hose – metal pipe to radiator
8. Hose – radiator overflow – lower
9. Metal pipe – radiator overflow
10. Hose – radiator overflow – upper
11. Hose – radiator air bleed
12. Pipe – overflow to atmosphere

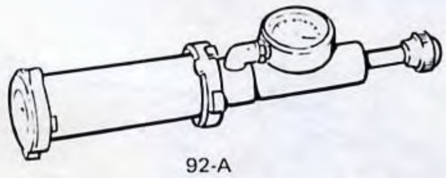
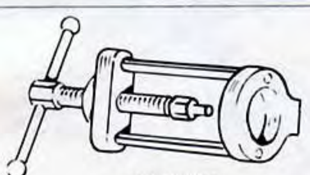
PRINCIPLE OF OPERATION

When the coolant is cold, the thermostat is in the closed position and the water flow is restricted to within the cylinder block, cylinder head, inlet manifold, heater, and where applicable, the automatic choke housing. An internal by-pass passage, (or hose on certain variants) allows circulation within the cylinder block and head during this period.

As the temperature increases the thermostat opens allowing the coolant to pass into the radiator. The coolant then flows through the radiator tubes and is cooled by air passing through the cooling fins assisted by the cooling fan. Coolant is then circulated from the base of the radiator up through the pump and into the cylinder block to complete the circuit.

Diesel variants have an expansion tank in addition to the radiator, this tank is secured to the engine at a level above the cross-flow radiator. Two hoses connect the remote supply tank to the radiator, one is a large bore hose which feeds the radiator as water is poured into the filler neck in the supply tank on initial filling and subsequent topping up. The other pipe is a small bore hose and is sited between the top of the radiator and the top of the supply tank. This hose is an air bleed to prevent air locks within the radiator. When topping up the cooling system the water level should not be allowed to cover the upper (small bore) pipe outlet.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 92-A	Cooling System pressure tester
 CPT-8000	Hand press main tool and thrust block adaptor
 P-8000-4B	Water pump overhaul kit adaptors used with CPT-8000

F/24/12/N1

SERVICE AND REPAIR OPERATIONS CONTENT – PART 'A'

COOLING SYSTEM		Described in this Publication	Contained in Operation
24 254	Radiator – Remove and Install	X	
24 404	Water Pump assembly – Remove and Install	X	
24 404 8	Water Pump assembly – Overhaul (water pump removed)	X	
24 454	Thermostat – Remove and Install	X	
24 604	Hose – radiator top – Replace	—	24 618
24 605	Hose – radiator bottom – Replace	—	24 618
24 607	Hose – expansion tank to radiator – Replace	X	
24 608	Hose – overflow, expansion tank to radiator – Replace	X	
24 618	Hoses – radiator – Replace (All)	X	
24 624	Hoses – water inlet connecting – Replace (all)	—	24 654
24 627	Hose – water pump connecting – Replace	—	24 628
24 628	Hose – Thermostat by-pass – Replace	X	
24 648	Hoses – engine – Replace (all)	—	24 654
24 654	Hoses – engine and radiator – Replace (all)	X	

SERVICE AND REPAIR OPERATIONS CONTENTS – PART 'B'

STARTING SYSTEM		Described in this Publication	Contained in operation	Also applicable to certain variants in the following model range.					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina '77	Granada '78
24 111	Cooling System – pressure text	X		X	X	X	X	X	X
24 122	Cooling System – Flush & Re-fill with cooling mixture	X		X	X	X	X	X	X
24 203	Fan Belt – Adjust	—	24 205						
24 205	Fan Belt – Replace (Includes adjust)	X		X	X	X	X	X	X
24 212	Fan – Remove and Install	X		X		X	X	X	
24 216	Pulley – Fan – Remove and Install	—	24 212						
24 254 4	Cooling System – Back flush (radiator removed)	X		X	X	X	X	X	X
24 451 1	Thermostat – Test (Thermostat removed)	X		X	X	X	X	X	X

SERVICE AND REPAIR OPERATIONS – PART 'A'

24 254 RADIATOR – REMOVE AND INSTALL (All variants except Diesel)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery. Remove radiator cap.

   NOTE: When removing cap rotate through approx. 90° to allow system to depressurise before fully removing cap.
3. Position clean drain tray below vehicle, disconnect bottom hose at radiator and allow to drain.
4. Disconnect top hose at radiator.
5. Remove four bolts and guide out radiator assembly, fig. 4.
6. With radiator removed, detach overflow pipe and clips.

To Install

7. Reassemble overflow pipe and clips to radiator.
8. Guide radiator into position in vehicle and secure using four bolts.
9. Reconnect top and bottom hoses to radiator.

   NOTE: First check hoses for cuts, splits etc, and renew if required.
10. Refill cooling system with specified anti-freeze or rust inhibitor water solution. Refit radiator cap.
11. Reconnect battery.
12. Run engine and check for leaks.
13. Check and top up coolant level as required.
14. Remove fender covers and close hood.

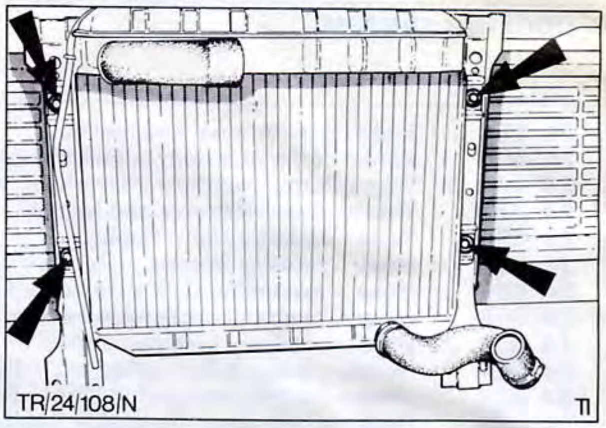


Fig. 4. Arrows show radiator mounting bolts. Viewed from engine compartment for clarity

24 254 RADIATOR – REMOVE AND INSTALL (Diesel variants)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers. Disconnect battery.
2. Remove cooling system filler cap located on expansion tank.

   NOTE: When removing cap rotate through approx. 90° to allow system to depressurise before fully removing cap.

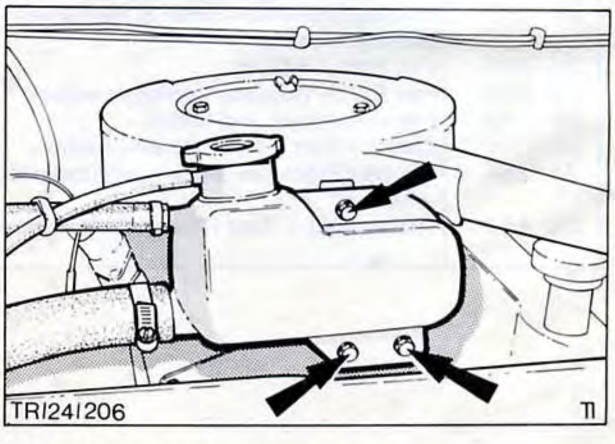


Fig. 5. Header tank showing securing bolts

PART 'A'

3. Position a clean drain tray below vehicle, disconnect bottom hose at radiator and allow to drain.

4. Disconnect top hose from radiator.

5. On variants that use an electro, ignition—controlled engine stop incorporating a metal cable, unclip engine stop-control cable from the two retaining clips on the front panel.
   On variants that use a manual, fascia mounted control incorporating a plastic coated cable, remove plastic clip that secures the cable to top hose.
   Unbolt expansion tank from retaining bracket. (Alternatively unbolt tank and bracket from engine).

6. Unbolt overflow pipe from inner fender panel, Fig. 8.

7. Remove two lower and two upper radiator mounting bolts, Fig. 6, noting which way rubber bushes are fitted. Guide radiator and expansion tank from vehicle.

To Install

8. Guide radiator and expansion tank into vehicle and secure using rubber bushes and bolts, Fig. 7.

9. Secure the overflow pipe to the inner fender panel with two bolts, Fig. 8.

10. Secure expansion tank to its brackets.

11. Reconnect top and bottom hoses to radiator and secure with clips.

12. Fit engine stop-control cable into its two clips, or in the case of plastic coated cable refit plastic strap retaining cable to top hose.

13. Refill cooling system with specified anti-freeze or rust inhibitor water solution. Refit radiator cap.

14. Reconnect battery, start and run engine and check for any leaks.

15. Check and top up coolant level as required.

16. Remove fender covers and close hood.

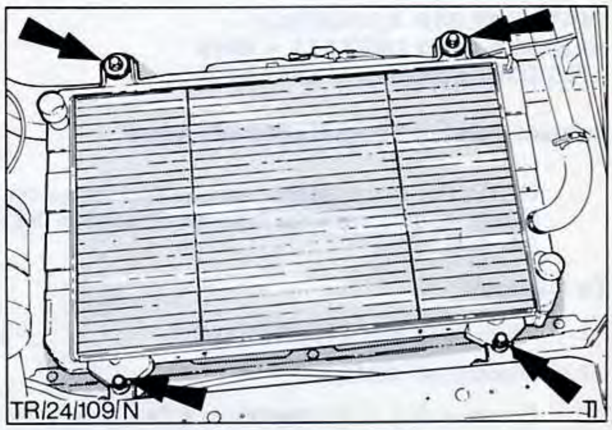


Fig. 6. Arrows depict radiator mountings
(Viewed from engine compartment for clarity)

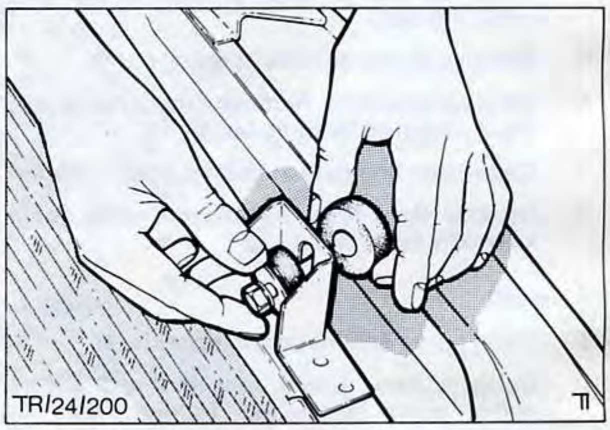


Fig. 7. Secure radiator ensuring bushes are positioned as shown

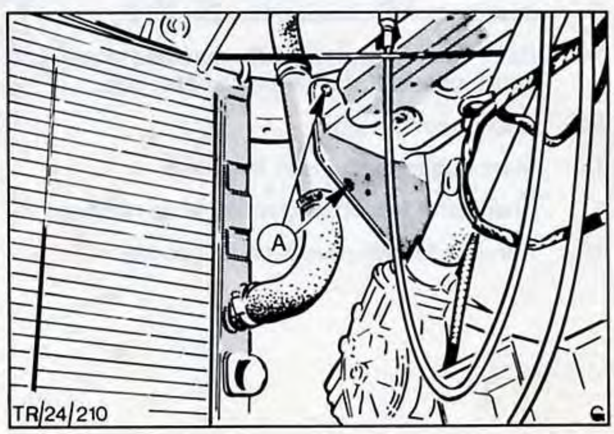


Fig. 8. A – Two securing bolts accessible from reverse side
(Viewed from engine compartment for clarity)

PART 'A'

WATER PUMP ASSEMBLY – REMOVE AND INSTALL – OHV AND OHC ENGINE VARIANTS

Special Service Tools Required: None

NOTE: For water pump remove and install on Diesel engine variants refer to Operation No. 24 628.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove fan belt, blades and fan pulley as detailed in Operation No. 24 212.
4. Position a clean drain tray below vehicle, disconnect bottom hose at radiator and allow to drain. Remove radiator cap taking care to rotate cap through approximately 90° to allow system to depressurise before fully removing cap.
5. Disconnect heater hose at water pump.
6. OHC variants only. Remove timing belt cover, Fig. 9. Secured by three bolts.
7. Disconnect and detach bottom hose at pump.
8. Remove three bolts and detach water pump assembly Figs. 10 and 11.

To Install

9. Clean pump and block mating surfaces.
10. Using a new gasket, position and secure water pump assembly. Tighten bolts to correct torque.
11. OHC variants only. Refit timing belt cover.
12. Reconnect heater hose and bottom hose to pump.
13. Refit fan pulley, blades and fan belt, as described in Operation No. 24 212.
14. Refill cooling system with specified water and anti-freeze solution. Refit radiator cap.
15. Reconnect battery.
16. Start engine and check for leaks.
17. Check and top up coolant level as required.
18. Remove fender covers and close hood.

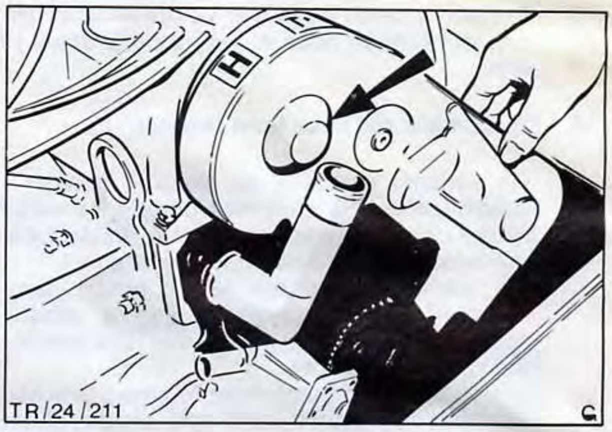


Fig. 9. Timing belt cover as fitted on all OHC variants

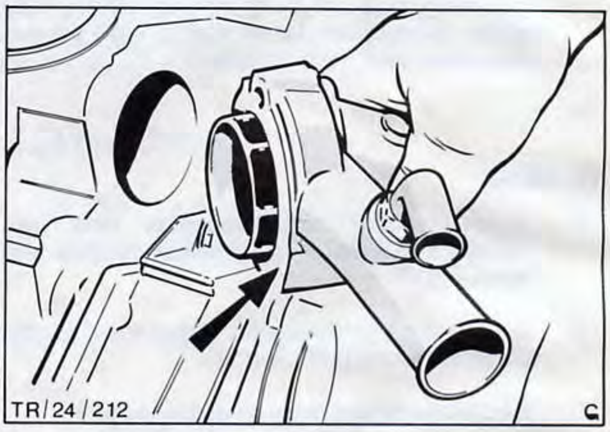


Fig. 10. Water pump removal (1.6 litre Kent variant)

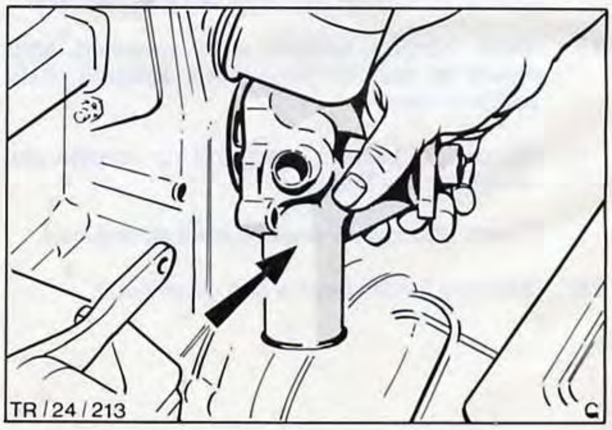


Fig. 11. Water pump removal (OHC variant)

PART 'A'

24 404 8 WATER PUMP ASSEMBLY – OVERHAUL (Water pump removed) OHV and OHC engine variants

Special Service Tools Required:

Split ring	P-8000-4B
Thrust block adaptors and Press	CPT-8000

To Overhaul

1. Withdraw pump pulley hub from shaft by supporting hub over a split ring 'C' in Fig. 12 mounted in a press 'A' in Fig. 12 and pressing shaft and pump assembly clear.

2. Support pump body on press and press out bearing shaft, seal and impeller as an assembly, from pump body, Fig. 12.

3. Support impeller over a split ring mounted in press, Fig. 13, taking care that impeller blades are clear of slots between two halves of split ring. Press shaft through impeller.

4. Slide pump seal from bearing shaft.

5. Support pump body on press, and applying pressure on outer ring of bearing, press bearing shaft into pump housing.

6. Using ring and thrust block adaptor, Fig. 14 press pump pulley hub onto front end of shaft until end of shaft projects 1,5 mm (0,06 in) from end of hub.

7. Push new seal over shaft and into counter-bore in water pump housing.

8. Press impeller onto shaft, Fig. 14, until a clearance of 0,8 mm (0,03 in) is obtained between impeller blades and housing face.

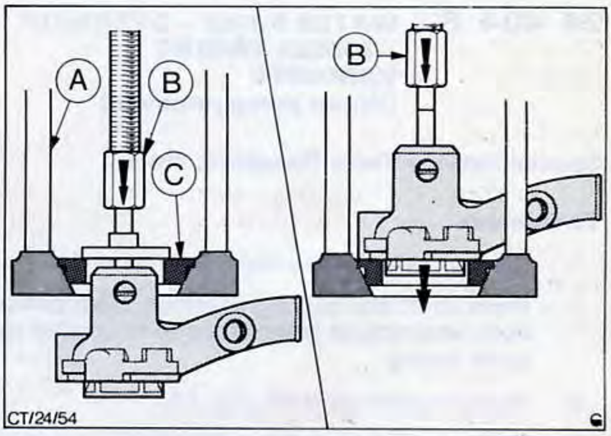


Fig. 12. Pressing pump pulley hub from shaft and bearing shaft assembly from pump body
A – Press
B – Thrust block adaptor
C – Split ring

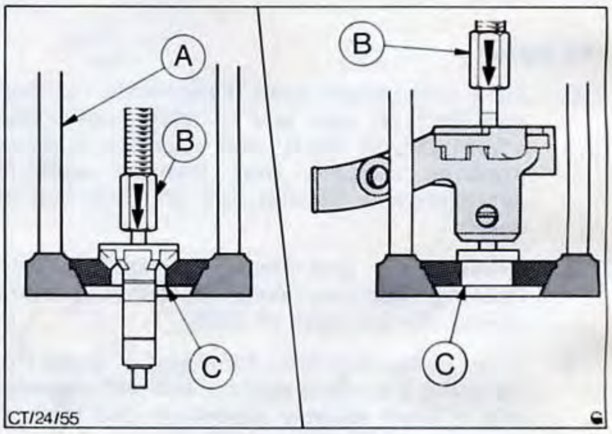


Fig. 13. Pressing impeller from bearing shaft assembly and pump pulley hub onto front end of shaft
A – Press
B – Thrust block adaptor
C – Split ring

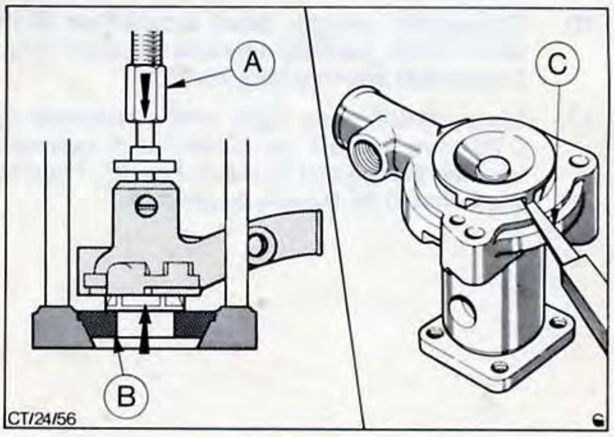


Fig. 14. Pressing impeller onto shaft and checking clearance with feeler gauges
A – Thrust block adaptor
B – Split ring
C – Feeler gauges

PART 'A'

24 404 8 WATER PUMP – OVERHAUL – DIESEL ENGINE VARIANTS (Water pump removed)

Special Service Tools Required: None

To Remove

1. Remove pulley hub using a suitable puller.
2. Press shaft and bearing assembly from pump body ensuring an even pressure is applied to outer casing.
3. Press impeller off shaft, Fig. 15.
4. Remove seal assembly and ceramic counter face and, if necessary, remove slinger bush from shaft.
5. Clean and inspect all parts.

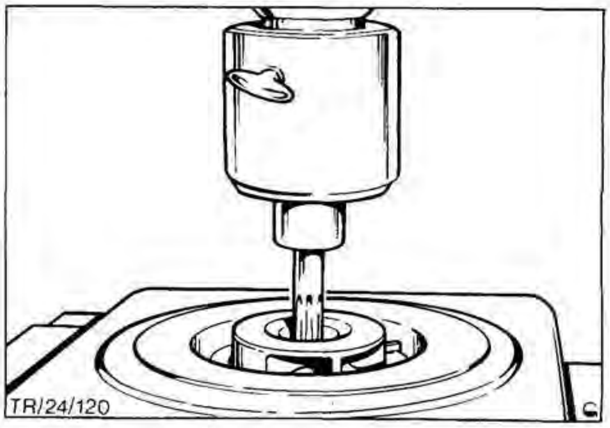


Fig. 15. Press impeller off shaft

To Install

6. Fit a new slinger bush if necessary (flanged end first) on rear end of shaft, supporting other end of shaft and using a suitable adaptor. Ensure that flanged end is approximately 13 mm (0,5 in) from end of shaft.
7. Press shaft and bearing assembly into housing, applying even pressure to outer casing. Do not press on shaft.
8. Press pulley hub onto front end of shaft Fig. 16 using a suitable adaptor and with impeller end of shaft suitably supported. End of shaft should be flush with end of pulley.
9. Press seal fully into housing. Press on flange ensuring that flange inner face is flush with housing face, spring facing uppermost and that 'plastic' face is not damaged and is clean.
10. Fit ceramic counter faced washer on shaft with rubber backing towards impeller face. Ensure that working face is clean.
11. Press impeller onto shaft until a clearance of 0,76 mm (0,030 in) is obtained between impeller blades and housing. Fig. 17. Front of shaft should be suitably supported.

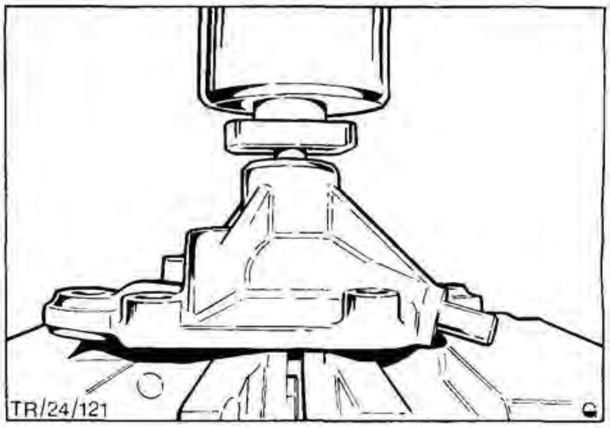


Fig. 16. Press pulley hub onto front end of shaft

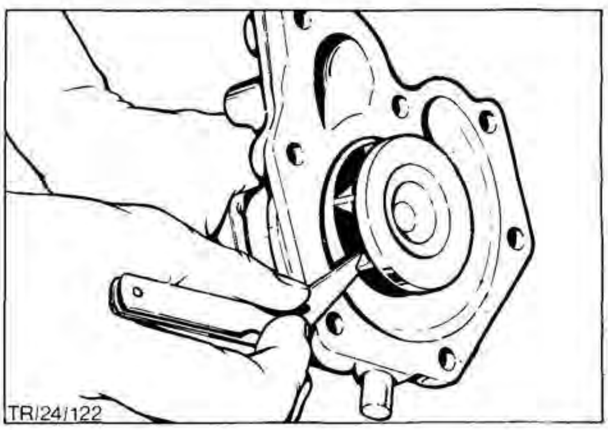


Fig. 17. Ensure a clearance of 0,76 mm (0,030 in) at point indicated

PART 'A'

24 454 THERMOSTAT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove radiator cap.

   NOTE: When removing cap rotate through approx. 90° to allow system to depressurise before fully removing cap.
3. Position a clean drain tray below vehicle, disconnect bottom hose at radiator and allow coolant to drain.
4. Slacken and remove top hose from thermostat housing.
5. Remove two thermostat housing bolts.

   NOTE: Bolts used on Diesel variants are of unequal lengths, Fig. 18.
6. Remove thermostat housing and thermostat, Figs. 19 and 20.

To Install

7. Ensure jointing faces of cylinder head and housing are clean and free from old gasket, sealer etc. Fit thermostat into locating groove in cylinder head aperture.
8. Refit thermostat housing using a new gasket and a small quantity of sealer. Secure housing with bolts and tighten to correct torque.
9. Refit top hose to thermostat housing and secure hose clamps.
10. Connect bottom hose to radiator, refill cooling system with specified anti-freeze or rust inhibitor water solution. Refit radiator cap.
11. Reconnect battery, start engine and check for any leaks.
12. Check and top up coolant level as required.
13. Remove fender covers and close hood.

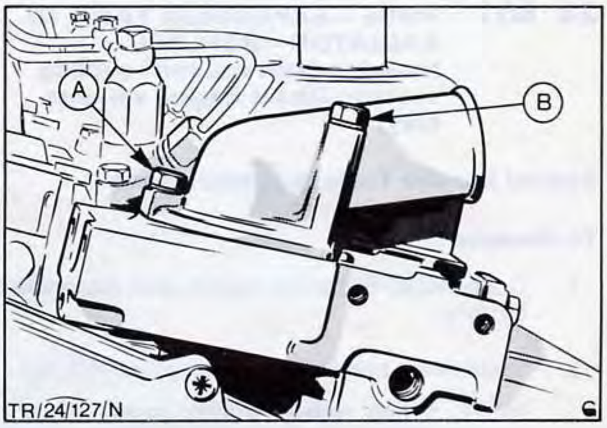


Fig. 18. Thermostat housing bolts (Diesel engine)
A – Short bolt
B – Long bolt

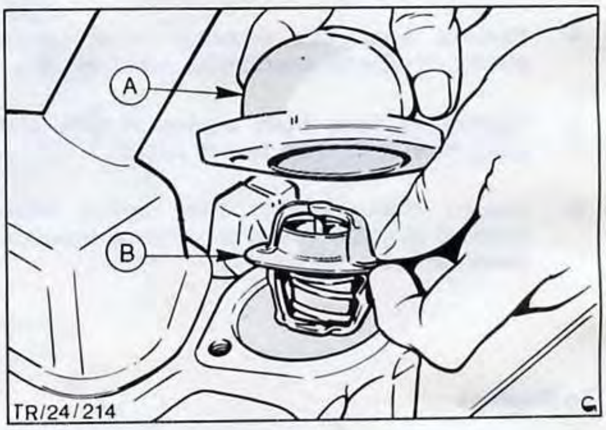


Fig. 19. Thermostat removal (Kent engine)
A – Thermostat housing
B – Thermostat

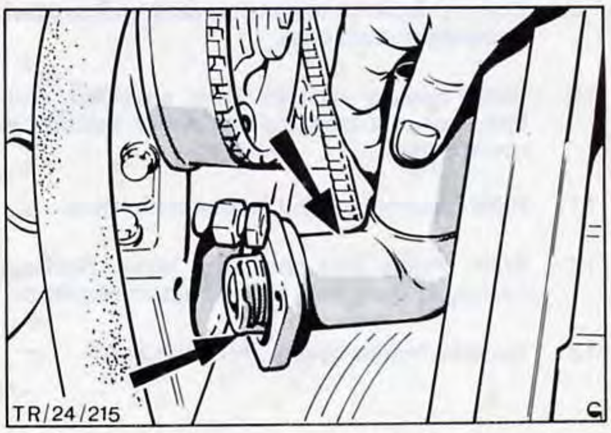


Fig. 20. Thermostat and housing removal (OHC engine)

PART 'A'

24 607 HOSE – EXPANSION TANK TO RADIATOR – REPLACE
Includes drain and refill cooling system (Diesel Engine variants only)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect battery and remove radiator cap.

   NOTE: When removing cap, rotate through approx. 90° to allow system to de-pressurise before fully removing cap.
3. Disconnect expansion tank-to-radiator hose from base of radiator and allow coolant to drain into a clean container.
4. Remove two bolts securing metal centre section of pipe to inner fender panel, Fig. 21.
5. Disconnect hose from expansion tank and guide hose assembly clear of vehicle.
6. Loosen clips securing two flexible hose sections to centre metal section and separate three parts, Fig. 22.

To Replace

7. Assemble new hose sections to metal pipe and secure with clips.
8. Align assembly into vehicle and locate with two bolts to inner fender cover. Tighten bolts.
9. Connect hose to expansion tank and radiator. Securely tighten clips.
10. Refill cooling system with specified anti-freeze or rust inhibitor and water solution to correct level.
11. Refit radiator cap and reconnect battery.
12. Start engine and check for leaks. Recheck cooling system level and top-up as required.
13. Remove fender covers and close hood.

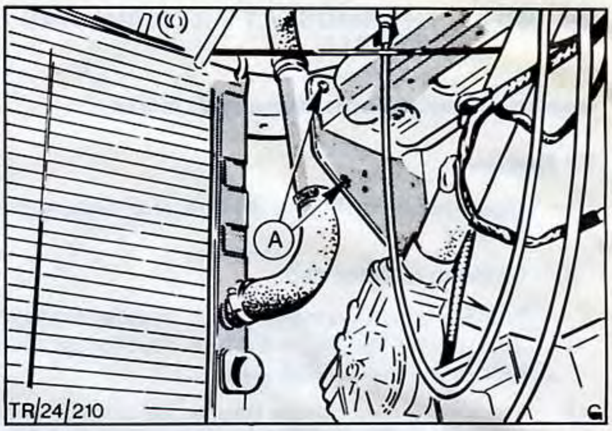


Fig. 21. Hose Removal
A – Two securing bolts accessable from reverse side (Viewed from engine compartment for clarity)

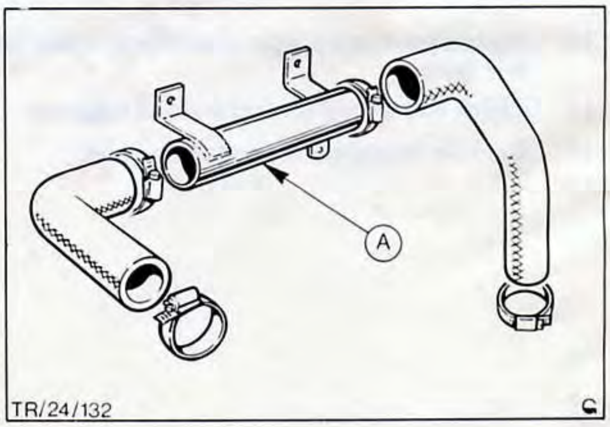


Fig. 22. Hose assembly in component form
A – Metal section

PART 'A'

24 608 HOSE – OVERFLOW (AIR BLEED) EXPANSION TANK TO RADIATOR – REPLACE

(Diesel engine variants only)

Special Service Tools Required: None

NOTE: There should be no necessity to drain the cooling systems as this hose is an air bleed hose only and does not contain coolant.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery and remove radiator cap.

   NOTE: When removing cap, rotate through approx. 90° to allow system to depressurise before fully removing cap.
3. Disconnect small plastic waste pipe from hose by releasing plastic retainer clips, (two) Fig. 23.
4. Disconnect expansion tank-to-radiator overflow hose from radiator by cutting hose clip with a pair of cutters.
5. Disconnect hose from expansion tank and remove, Fig. 23, by cutting through hose clip with a suitable pair of cutters.

To Replace

6. Place new clips to new hose.
7. Connect hose to expansion tank and radiator aperture. Securely tighten clips.
8. Refit radiator cap and reconnect battery.
9. Remove fender covers and close hood.

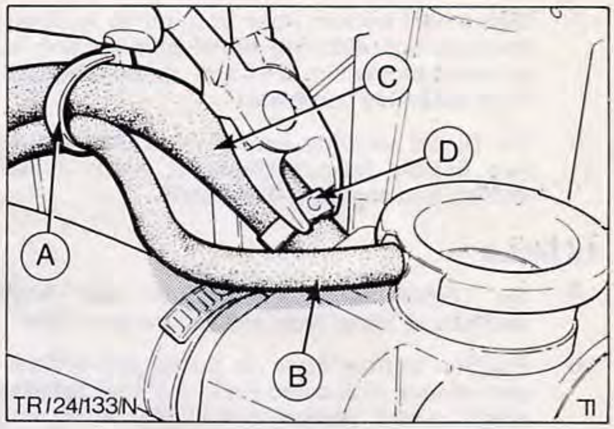


Fig. 23. Cutting non-reuseable clip from hose
A – Plastic retaining clip
B – Plastic pipe
C – Hose to be replaced
D – Disposable clip

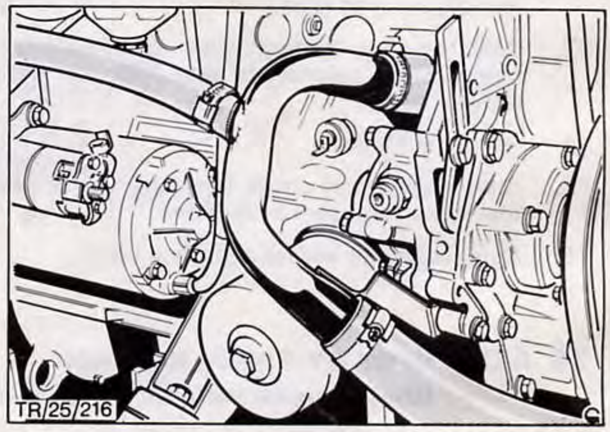


Fig. 24. Heater hose

24 618 HOSES, RADIATOR – REPLACE (ALL)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove radiator cap.

   NOTE: When removing cap, rotate through approx. 90° to allow system to depressurise before fully removing cap.
4. Position a clean drain tray below vehicle, disconnect bottom hose from radiator and allow to drain.
5. Disconnect top hose from radiator and thermostat housing and detach, Fig. 25.
6. On Diesel variants, disconnect heater outlet hose from centre metal section of pipe in bottom hose, Fig. 24.

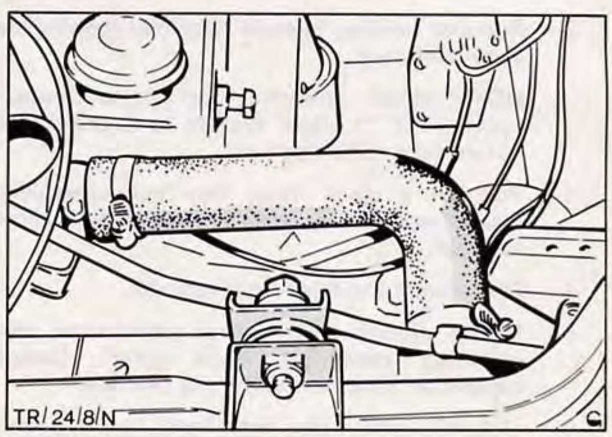


Fig. 25. Top hose on Diesel variants showing clips and location

PART 'A'

7. Disconnect bottom hose from pump location. Remove bolt securing metal pipe section to cylinder block Fig. 24, and detach bottom hose assembly complete.
8. On Diesel variants loosen clips that secure two flexible hose sections to centre metal section and separate three parts.

To Install

9. On Diesel variants assemble new hose sections to metal pipe and secure with clips.
10. Position bottom hose to pump and radiator and secure with clips. Refit bolt that secures metal centre section, to cylinder block and securely tighten.
11. On Diesel variants reconnect heater outlet hose to metal section of bottom hose and securely tighten clip.
12. Position top hose to thermostat and radiator and secure with clips.
13. Refill cooling system with specified anti-freeze water solution or rust inhibitor. Refit radiator cap.
14. Reconnect battery.
15. Start engine and check for leaks. Check and top-up coolant level as required.
16. Remove fender covers and close hood.

24 628 HOSE-BY-PASS – REPLACE (Diesel engine variants)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Remove cooling system filler cap located on expansion tank.

   NOTE: When removing cap rotate through approx. 90° to allow system to depressurise before fully removing cap.
3. Position a clean drain tray below vehicle, disconnect bottom hose at radiator and allow to drain.
4. Disconnect top hose from radiator.
5. Unclip engine stop-control cable from two retaining clips on front panel. Unbolt expansion tank from retaining bracket.
6. Unbolt overflow pipe from inner fender panel.
7. Remove two lower and two upper radiator mounting bolts, noting which way rubber bushes are fitted. Guide radiator and expansion tank from vehicle.

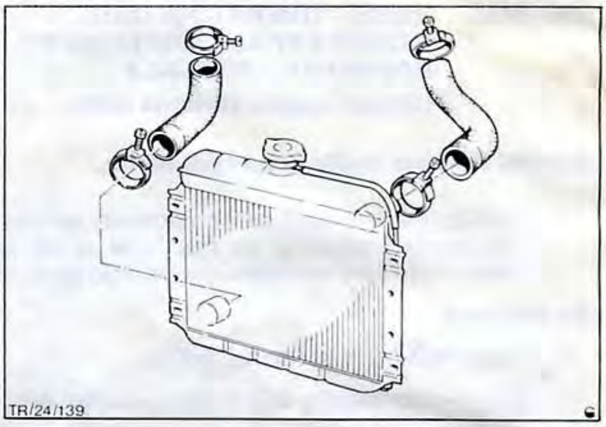


Fig. 26. Top and bottom hoses on OHC and OHV variants

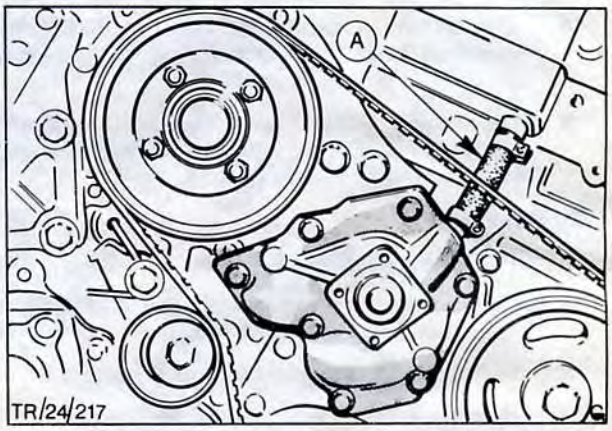


Fig. 27. Water pump assembly showing by-pass hose
A – By-pass hose

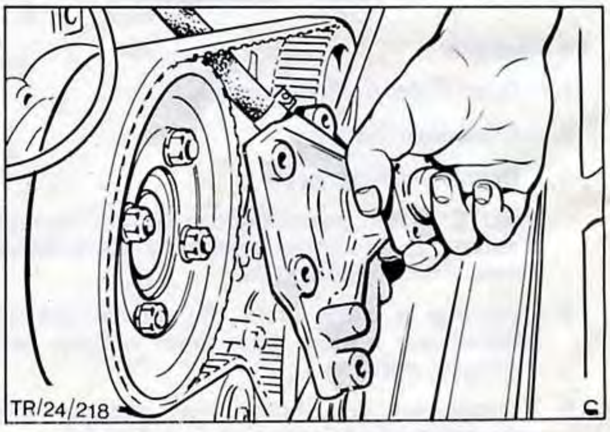


Fig. 28. Fitting the water pump assembly, (connect hose before positioning pump)

PART 'A'

8. Slacken off clamp nut on adjustable jockey pulley and remove auxiliary drive belt.

   Slacken off alternator mounting bolts and adjusting bolt. Tilt alternator towards engine and remove drive belt.

9. Remove four fan securing bolts and detach fan blade and pulley assembly.

10. Remove five retaining bolts securing timing belt cover to engine, guide cover over water pump shaft and lift clear of vehicle.

11. Slacken upper clamp securing by-pass hose to cylinder head. Remove seven bolts washers and spring washers securing water pump to front cover back plate and remove pump complete with by-pass hose.

12. Slacken clamp securing hose to pump and detach hose.

To Install

13. Position hose on water pump outlet and securely tighten hose clip.

14. Ensure jointing faces of pump and backplate are clean and free from old gasket, sealer etc. Using a new gasket and sealer position pump on backplate, Fig. 28, loosely engaging by-pass hose on cylinder head outlet. Retaining bolts noting that lower bolt hole on pump is used in conjunction with a dowel bolt to ensure correct alignment of pump housing.

15. There is a small turning clearance between impeller and water pump housing, to ensure that this clearance is maintained pump assembly must be turned, clockwise within limits of bolt holes. Tighten bolts, in any sequence, to specified torque.

16. Ensure by-pass hose is not kinked or buckled, Fig. 29 and then tighten clamp at cylinder head end of hose.

    Position timing belt cover on engine and secure with five securing bolts.

    Refit fan, pulley and hub and secure with four bolts and spring washers. Tighten bolts to specified torque.

17. Refit fan belt over crankshaft, water pump and alternator pulleys. Adjust belt to correct tension, refer to technical data page for details. Fig. 30.

18. Refit auxiliary drive belt over crankshaft outer pulley, vacuum pump and jockey pulleys. Adjust jockey pulley to give correct belt tension when measured at mid-point of longest span.

19. Guide radiator and expansion tank into vehicle and secure using rubber bushes and bolts.

20. Secure overflow pipe to inner fender panel with two bolts.

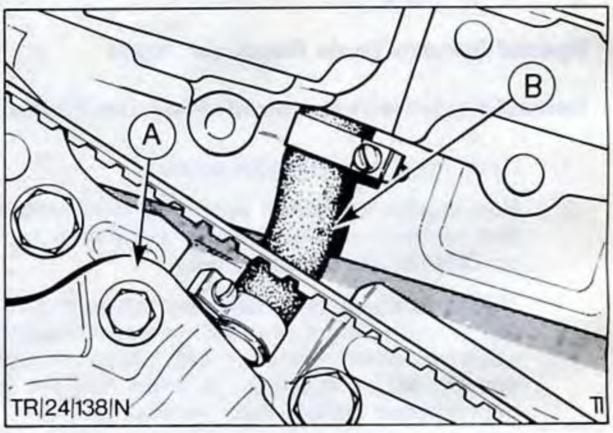


Fig. 29. A – Water pump
B – By-pass hose

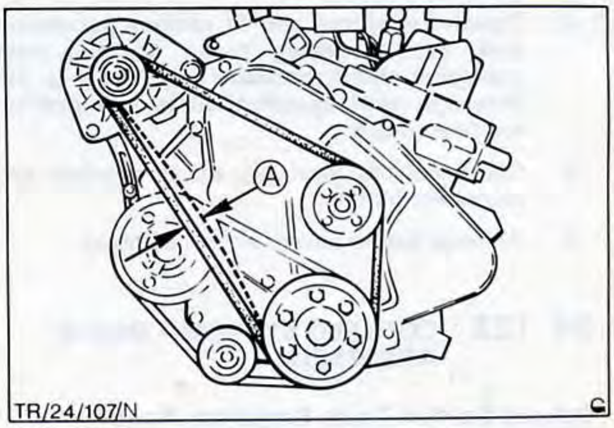


Fig. 30. Fan belt adjustment point 'A'
See technical data page for tension.

PART 'A'

21. Secure expansion tank to its bracket.
22. Reconnect top and bottom hoses to radiator and secure with clips.
23. Refit engine stop-control cable into its two clips.
24. Refill cooling system with specified anti-freeze or rust inhibitor water solution. Refit radiator cap.
25. Reconnect battery, start and run engine and check for any leaks.
26. Check and top up coolant level as required. Remove fender covers and close hood.

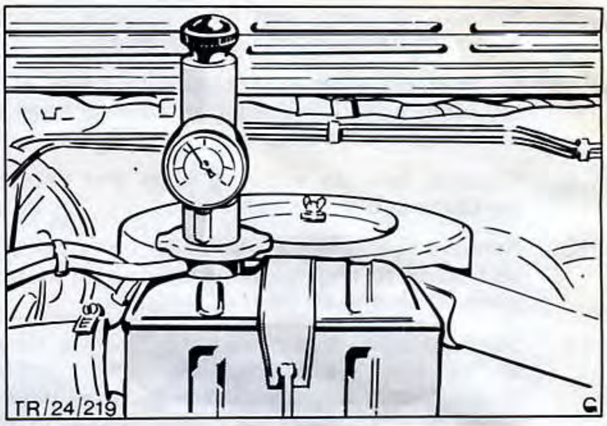


Fig. 31. Cooling system pressure test

PART 'B'

24 111 COOLING SYSTEM – PRESSURE TEST

Special Service Tools Required: None

Special Equipment Required: Pressure Tester

1. Open hood and fit fender covers.
2. Run engine to normal operating temperature and remove radiator cap, or expansion tank on Diesels, disconnect battery.

   NOTE: Adequately protect the cap, with thick rag or cloth before removal, to avoid possible scalding. When removing cap rotate through approx. 90° and pause to allow system to depressurise before fully removing cap.
3. Fit correct adaptor to pressure tester and clip in position onto filler neck, Fig. 31. Pump up cooling system to a maximum of 1,40 Bar (1,40 $kg.cm^2$) (20 $lb.in^2$) and hold for ten seconds. If pressure drops within this time inspect for leaks.
4. Transfer adaptors and fit radiator expansion tank cap to tester, pump up and note maximum steady pressure achieved, Fig. 32. Pressure relief specification is stamped on top face of cap.
5. Check coolant level, top up as required and reconnect battery.
6. Remove fender covers and close hood.

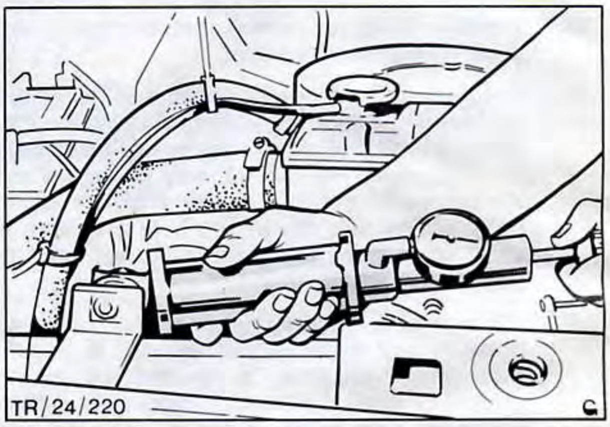


Fig. 32. Testing cap for correct pressure relief

24 122 COOLING SYSTEM – DRAIN AND REFILL

Special Service Tools Required: None

1. Open hood, fit fender covers.
2. Disconnect battery.
3. Remove radiator cap.

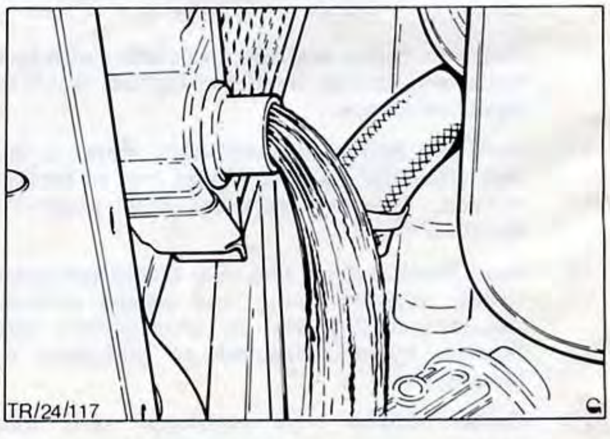


Fig. 33. Remove bottom hose and allow radiator to drain

PART 'B'

4. Position a clean drain tray below vehicle, open drain plug on engine block side, disconnect radiator bottom hose and allow system to drain, Fig. 33.

   NOTE: An anti-freeze solution has been used in the system and in certain territories a rust inhibitor. These solutions should be retained.

5. Close drain plug on engine block.
6. Refit bottom hose and secure.
7. Refill system with anti-freeze or rust inhibitor solution, refit radiator, or expansion tank cap.
8. Reconnect battery.
9. Run engine check for leaks. Top up system as necessary.
10. Remove fender covers, close hood.

24 205 FAN BELT – REPLACE (all variants except Diesel)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Loosen alternator adjusting and mounting bolts and detach fan belt.

   To detach fan belt, swing alternator towards engine and twist belt off alternator pulley, Fig. 34.

To Install

4. Place fan belt in position, adjust and tighten mounting bolts to correct torque.

   Adjust belt to correct tension, refer to technical data page for details, Fig. 34.

5. Reconnect battery.
6. Remove fender covers and close hood.

24 205 FAN BELT – REPLACE (Diesel variants)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Slacken off clamp nut on adjustable jockey pulley and remove auxiliary drive belt, Fig. 35.
3. Slacken off alternator mounting bolts and adjusting bolt. Tilt alternator towards engine and remove belt.

Fig. 34. Fan belt adjustment (Kent engine variant illustrated)

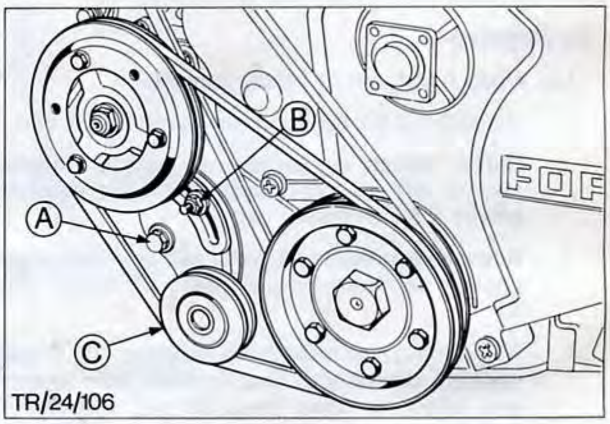


Fig. 35. Auxiliary belt adjustment
A – Jockey wheel pivot bolt
B – Adjuster nut
C – Jockey wheel

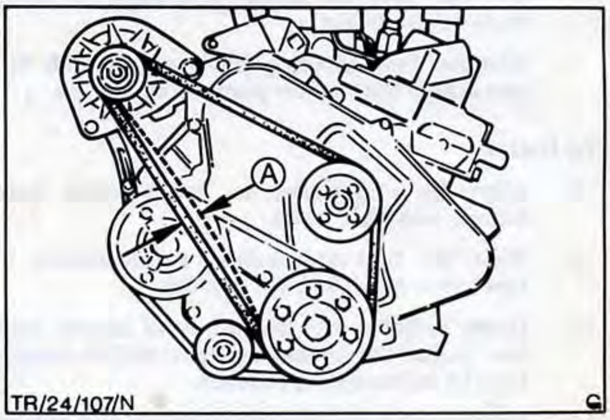


Fig. 36. Fan belt adjustment point 'A' see technical data page for tension

PART 'B'

To Install

4. Fit fan belt over crankshaft, water pump and alternator pulleys. Adjust belt to correct tension, refer to technical data page for details. Fig. 36.
5. Refit auxiliary drive belt over crankshaft outer pulley, vacuum pump and jockey pulleys. Adjust jockey pulley to give correct travel when checked at mid-point of longest span, Fig. 36.
6. Check tightness of alternator mounting bolts and belt, adjustment bolts. Reconnect battery, remove fender covers and close hood.

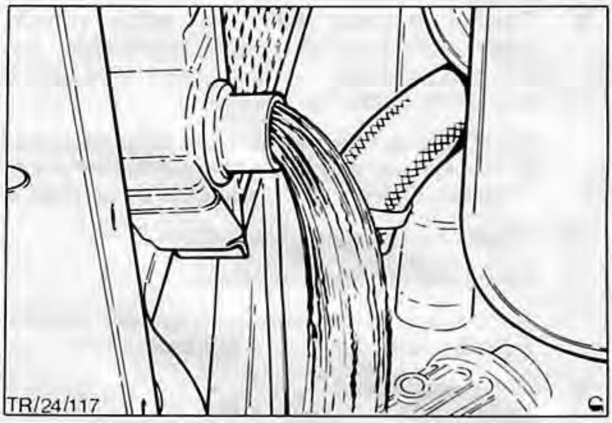


Fig. 37. Remove bottom hose and allow radiator to drain

24 212 FAN – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery and remove radiator cap.

   NOTE: When removing cap rotate through approx. 90° to allow system to depressurise before fully removing cap.
3. Remove bottom hose from radiator and allow coolant to drain into a clean container, Fig. 37.
4. Disconnect top hose from radiator. On Diesel variants disconnect header tank from engine and allow to hang free. Do not disconnect hoses.
5. Remove four radiator mounting bolts and guide radiator clear of vehicle.
6. Slacken alternator mounting bolts and remove fan belt. On Diesel variants unhook fan belt from fan pulley and allow to hang from other pulleys.
7. Remove four securing bolts and detach fan and pulley from water pump hub, Fig. 38.

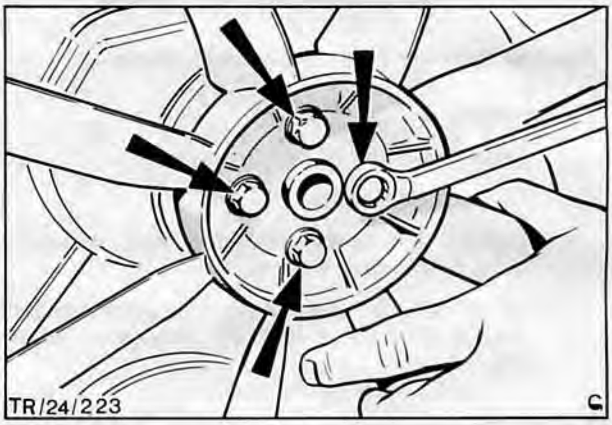


Fig. 38. Arrows depict four fan securing bolts

To Install

8. Align fan and pulley to water pump hub. Secure with four bolts.
9. Refit fan belt and adjust as described in Operation No. 24 205, Fig. 39.
10. Guide radiator into position and secure with four bolts. On Diesel variants secure supply tank to its mounting bracket.
11. Reconnect top and bottom hoses and secure clips.

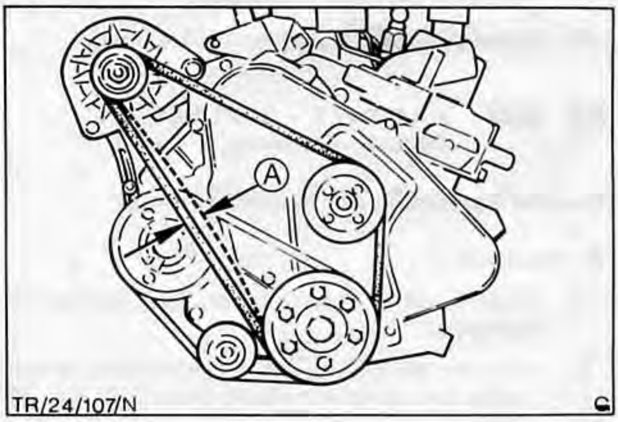


Fig. 39. Fan belt adjustment point 'A'
See technical data page for tension

PART 'B'

12. Refill cooling system with specified anti-freeze or rust inhibitor and water solution to correct level.
13. Refit radiator cap and reconnect battery.
14. Start engine and check for leaks.
15. Recheck cooling system level and top up as required.
16. Remove fender covers and close hood.

24 451 1 THERMOSTAT – TEST (Thermostat removed)

Special Service Tools Required: None

1. Suspend thermostat in water in a suitable container so that it does not touch sides of container, Fig. 40.
2. Gradually heat water, frequently checking temperature with an accurate thermometer. The thermometer must not touch container.
3. The thermostat should open at specified temperature. If it fails to function properly, do not attempt any adjustment, but replace with a new unit.

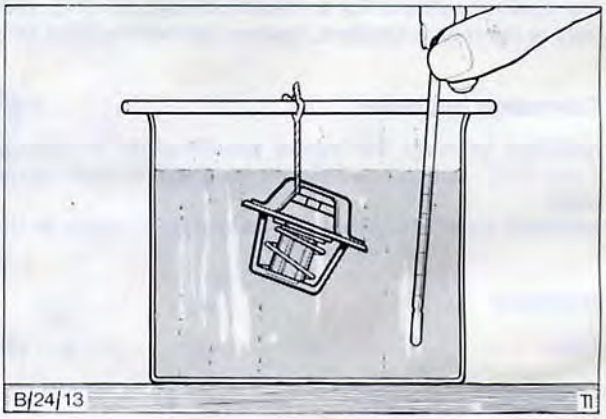


Fig. 40. Testing thermostat

24 254 4 COOLING SYSTEM – BACK FLUSH (Radiator removed)

1. Ensure radiator cap is in position, turn radiator upside down, position a high pressure water hose in the bottom hose location and back flush.
2. Remove thermostat housing and thermostat. Refer to Operation No. 24 454.
3. Position high pressure hose into engine via thermostat location and back flush engine, Fig. 41.
4. Using a new gasket refit thermostat and housing.

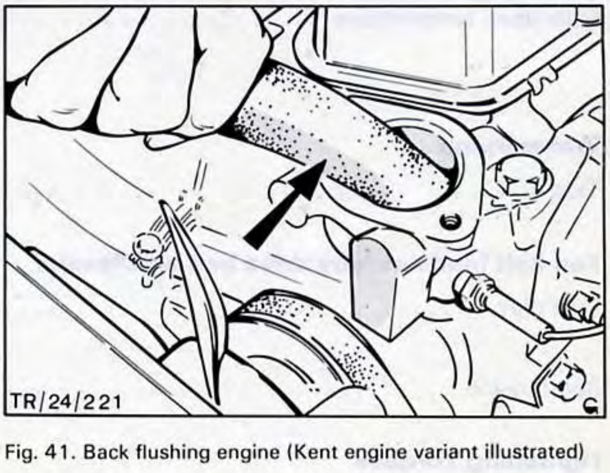


Fig. 41. Back flushing engine (Kent engine variant illustrated)

TECHNICAL DATA

Type .... Pressured, forced circulation

Capacity	**With heater**	**Without heater**
1.6 litre OHV (Kent)	6,0 litres (10,6 pints)	5,0 litres (8,8 pints)
1.6 litre OHC	8,2 litres (14,4 pints)	7,2 litres (12,6 pints)
2.0 litre OHC	8,2 litres (14,4 pints)	7,2 litres (12,6 pints)
2.4 litre York Diesel	10,6 litres (18,65 pints)	9,6 litres (16,9 pints)

Anti-freeze .... Ford Anti-freeze Plus; Part No. SSM-97B 9101-A

Concentration:

Specific Gravity (providing no other additive is in coolant)	Approximate Percentage of anti-freeze (by volume)	Remains fluid to		Solidifies at	
		°C	°F	°C	°F
1,042	25	−12	+10	−25	−20

A 25% concentration of Ford Anti-freeze Plus, which contains a powerful corrosion inhibitor, should remain in the cooling system for a maximum period of 2 years (regardless of climate) before being renewed. If water only is used as a coolant, severe corrosion could result.

Corrosion inhibitor ....Ford Specification SSM-97B 9100-A

Inhibitor to meet the above specification is manufactured by Ciba-Geigy Ltd., and is marketed as 'Inhibitor Type 71C', which is available on a world wide basis through the Head Office of the Ciba-Geigy group in your area.
Inhibitor type 71C should be mixed with water in the ratio of 1 part inhibitor to 39 parts water.

Radiator

Type .... Corrugated High Efficiency Fin on tube
Downflow on petrol engine variants
Crossflow on Diesel variants incorporating
a remote (engine mounted) header tank.

Pressure cap .... 0,9 Bar, 0,9 Kgf.cm², 13 lbf.in²

Thermostat

Type .... Wax
Opening temperature .... 82 to 92 °C (180 to 198 °F)
Fully open temperature .... 99 to 102 °C (210 to 216 °F)
(add ± 3 °C (5 °F) to above figures for used thermostats)

Water Pump

Type .... Centrifugal impellor (belt driven for crankshaft)

Fan Belt (and auxiliary drive belt on Diesels)

Free play .... 10 mm (0,4 in) or 245–343 Nm (25–35 kgf) (56–77 lbf ft) at mid-point of longest span of belt applying normal fingertip pressure

Belt tension .... 25 to 35 kgf (56 to 77 lbf)

Tightening Torques	**Nm**	**kgf.m**	**lbf.ft**
Fan blades	6,8 to 9,5	0,69 to 0,97	5 to 7
Water pump	6,8 to 9,5	0,69 to 0,97	5 to 7
Thermostat housing	16,3 to 20,3	1,66 to 2,07	12 to 15

DOORS, HOODS, LIDS AND SLIDING ROOF MECHANISM 41

GENERAL DESCRIPTION

The variety of vehicle options available on the Transit have resulted in complexity of door options and lock mechanisms.

This section details the repair procedures associated with the more common options of hinged and sliding cab doors, hinged and sliding side loading doors, and double rear doors and tailgate.

The hinged driver and passenger doors are each hung on two hinges secured to the body hinge pillar and the door inner frame. If necessary, adjustment to the position of the door within the aperture can be made on the hinges.

An interior trim panel covers the access hole to the door interior mechanisms; it can be detached by removing the window winder handle, the remote control handle, arm rest (where applicable), and pulling the trim panel away from the door inner panel.

The interior lock remote control handle and the window winder handle are each secured by a crosshead screw and shakeproof washer located centrally in the handle boss. The arm rest is secured by two crosshead screws.

Door pull handles are located on the top of the door inner panel and are secured by two crosshead screws and spring washers.

The door locks are of a semi-rotary cam type where an external cam, operating in conjunction with a striker plate secured to the door pillar, rotates to give two positions, thus providing a safety catch and a fully closed position.

The remote control operating rod is secured to the remote control mechanism by a spring clip.

Private locks are fitted to all the exterior doors. Operated by the ignition key, they are located in the centres of the exterior door handles and form the housing for the lock operating plungers.

An interior trim panel covers the access hole to the side loading door interior mechanisms, it can be detached by removing the door interior handle and pulling the trim panel away from the door inner panel.

The interior lock remote control handle and escutcheon plate is secured by a crosshead screw and shakeproof washer located centrally in the handle boss.

The external handle, door lock and remote mechanisms are similar to these used on the cab doors.

The rear doors, each hung on two hinges, are secured to the rear body side panel and the door outer frame.

Rear door opening is achieved by external and internal handles held to the door (external) by two screws and to the handle shaft (internal) by a screw and washer located in the centre of the handle boss. A private lock, operated by the ignition Key is located in the centre of the exterior handle boss.

SERVICE ADJUSTMENTS AND CHECKS

At the regular service intervals, all hood, door and tailgate hinges, door check straps, and all locks, should be checked for efficient operation. If considered necessary, oil should be carefully applied, taking care not to allow oil to contaminate interior trim, paintwork, etc. The hinge, door check strap and lock should then be operated several times to ensure smooth operation.

SPECIAL SERVICE TOOL RECOGNITION

Tool Number	Tool Name
 GTX 447	Torsion bar stress tool

TR/41/601 TI

SERVICE AND REPAIR OPERATIONS—CONTENT

DOORS, HOODS, LIDS AND SLIDING ROOF MECHANISM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina '77	Granada '78
41 213	Hood assembly – Adjust	X		X		X	X	X	X
41 214	Hood assembly – Remove and Install	X		X		X	X	X	X
41 218	Hood release cable – Adjust	X		X					
41 224	Cable – hood release – Remove and Install	X		X					
41 226	Lever assembly – hood release – Remove and Install		41 224			X	X	X	X
41 233	Spring – hood locking – Remove and Install	X		X					
41 235	Striker post – hood – Remove and Install	X		X		X	X	X	X
41 236	Safety catch – hood – Remove and Install	X		X					
41 238	Stay – hood – Remove and Install	X		X		X	X	X	X
41 253	Bump rubber – hood – Remove and Install	X		X		X	X	X	X
41 313	Door – Adjust	X		X					
41 314	Door assembly – Remove and Install	X		X					
41 333	Handle – door exterior – Remove and Install	X		X					
41 336 4	Barrel – door lock – Remove and Install	X		X					
41 352	Door lock assembly – Remove and Install	X		X					
41 355	Remote control assembly – door lock – Remove and Install	X		X					
41 356	Plate – door striker – Remove and Install	X		X		X	X	X	X
41 357	Rubber – door striker plate – Remove and Install	X		X		X	X	X	X
41 364	Spring – door check strap – Replace								
41 375	Weatherstrip – door aperture – Replace	X		X					
41 412	Side door assembly – Remove and Install		41 314						
41 423	Handle – side door exterior – Remove and Install		41 333						
41 432	Lock – side door – Remove and Install	X		X					
41 443	Weatherstrip – side door – Replace		41 375						
41 514	Door – sliding cab – Remove and Install	X		X					
41 516 4	Guide rod (lower) – sliding cab door – Remove and Install	X		X					
41 522	Handle – sliding cab door, exterior – Remove and Install	X		X					
41 526	Lock – sliding cab door – Remove and Install	X		X					
41 534 4	Weatherstrip – sliding cab door – front – Replace								
41 536 4	Weatherstrip – sliding cab door – rear – Replace		41 534 4						
41 554	Door – sliding side – Remove and Install	X		X					

SERVICE AND REPAIR OPERATIONS—CONTENT (cont'd)

DOORS, HOODS, LIDS AND SLIDING ROOF MECHANISM.		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina '77	Granada '78
41 562	Handle – sliding side door – exterior – Removal and Install			X					
41 574	Roller unit – sliding side door – Remove and Install		41–554						
41 575	Arm – sliding side door upper guide – Remove and Install			X					
41 594	Weatherstrip – sliding side door aperture – Remove and Install		41 375						
41 613	Rear door – Adjust		41 615						
41 615	Rear door – Remove and Install	X		X					
41 622	Handle – rear door – exterior – Remove and Install	X		X					
41 625	Barrel – rear door lock – Remove and Install	X							
41 634	Strap – rear door check – Remove and Install	X							
41 644	Weatherstrip – rear door aperture – Replace	X							
41 653	Tailgate assembly – Adjust	X		X					
41 654	Tailgate assembly – Remove and Install	X		X					
41 662	Handle – tailgate – exterior – Remove and Install		41 664						
41 664	Barrel – tailgate lock – Remove and Install	X		X					
41 666	Lock assembly – tailgate – Remove and Install	X		X					
41 674	Plate – tailgate striker – Remove and Install	X		X		X	X	X	X
41 683	Torsion bar – tailgate – Remove and Install	X		X					
41 694	Weatherstrip tailgate – Replace		41 375						

SERVICE AND REPAIR OPERATIONS

41 213 HOOD ASSEMBLY – ADJUST

Special Service Tools required: None

1. Slacken bolts securing underside of hood to hinges, Fig. 1.
2. Slacken locknuts and fully screw in adjustable bump stops on front crossmember.
3. Check gap between rear edge of hood and front edge of cowl panel, and between sides of hood and edges of fenders. Move hood as necessary on hinges to equalise gaps, retighten fixings.
4. Adjust front bump stops to flush front edges of hood with fenders. Tighten lock nuts.
5. Close hood, ensuring striker fully engages hood lock spring. Check visible clearance between underside of hood and crossmember. This should be 7,5$\pm$1,5 mm. Fig. 2. If necessary slacken striker locknut, screw striker, in or out, to achieve this setting. Hold striker in correct position then tighten locknut.

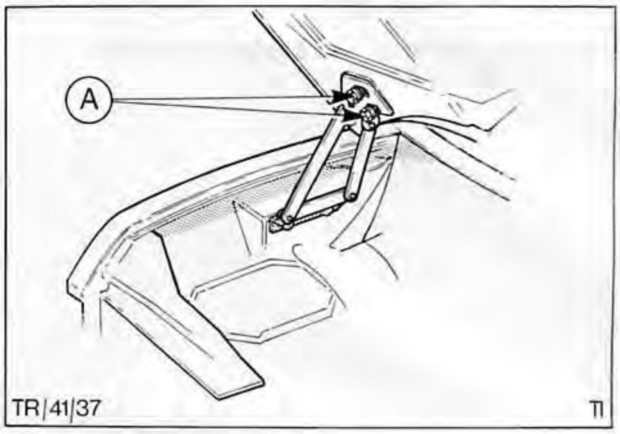


Fig. 1. Hood hinge bolts
A – Bolt and washer assemblies

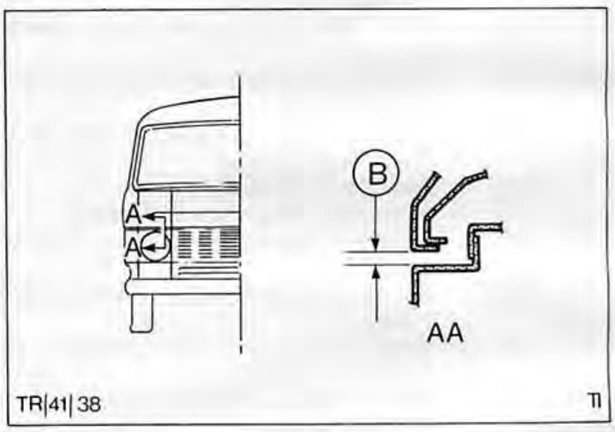


Fig. 2. Hood setting – underside of hood to crossmember clearance
B – 7,5$\pm$1,5 mm

41 214 HOOD ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, remove windscreen washer tubes, mark around hinges with a pen or pencil, Fig. 3, remove two bolts from each hinge and lift off hood.

To Install

2. Position hood on hinges and loosely retain with two bolts each side.
3. Align hinges to previously marked lines then tighten securing screws.
4. If necessary, adjust hood as described in Operation No. 41–213 then refit washer tubes.

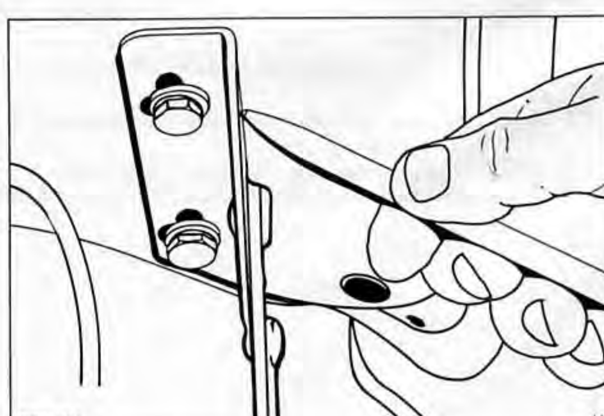


Fig. 3. Marking round hood hinges

41 223 HOOD RELEASE CABLE – ADJUST

1. Open hood, fit fender covers, slacken cable adjuster screws.
2. Pull cable until edge of hood lock spring contacts front face of hood lock sleeve, Fig. 4.
3. Hold cable in this position, tighten adjuster screws and re-check spring setting.
4. Close and release hood to check operation of lock. Hood should 'pop-up' freely, if not, this indicates striker post is out of alignment.

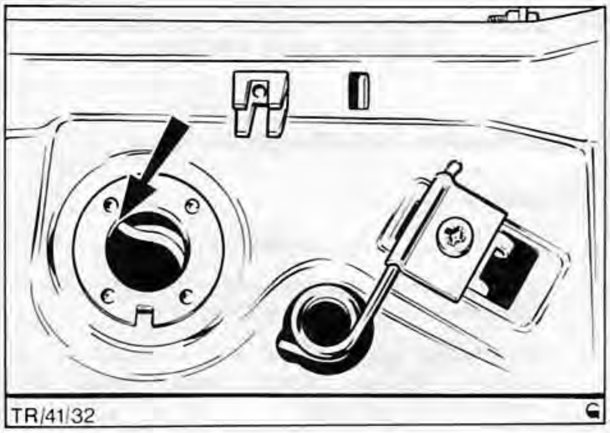


Fig. 4. Hood release spring adjustment: spring edge (arrowed) in contact with front face of sleeve

41 224 CABLE – HOOD RELEASE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, disconnect battery.
2. Slacken hood release cable and adjuster locknuts and unclip outer cable from fender apron and crossmember clips. Disconnect inner cable from hood release spring, then guide it through slot in adjuster bracket.
3. From inside passenger compartment disconnect handle pivot pin circlip and pull handle and cable assembly from handle bracket.
4. Pull cable through into passenger compartment and thence from vehicle.

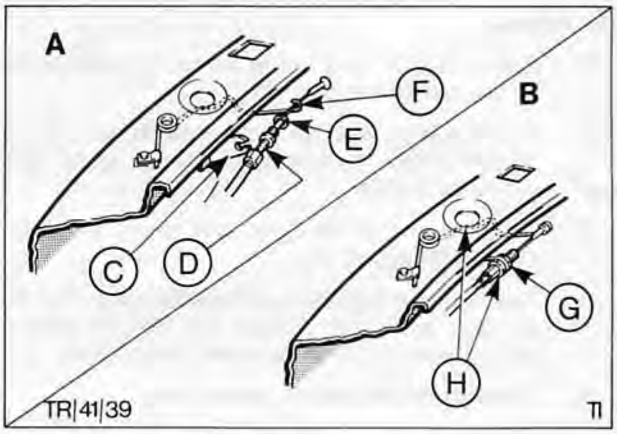


Fig. 5. Release cable to spring
A – Locating cable
B – Cable assembled
C – Adjuster bracket
D – Adjuster
E – Locknut
F – Spring
G – Locknut
H – Adjustment determins spring position

To Install

5. From passenger compartment insert cable through bulkhead into engine compartment and secure cable grommet in bulkhead.
6. Align cable and handle assembly on handle bracket and insert pivot pin. Secure pin with circlip.
7. Remove nut from cable adjuster and thread inner cable into striker release spring loop.
8. Hold outer cable and pull inner cable into spring loop to engage nipple. Insert inner cable into slotted hole in bracket. Release hold on outer cable to locate cable adjuster in slotted hole in bracket, Fig. 5.
9. Adjust cable, refer Operation No 41 223, sub operations 2 to 4.
10. Reconnect battery, remove fender covers.

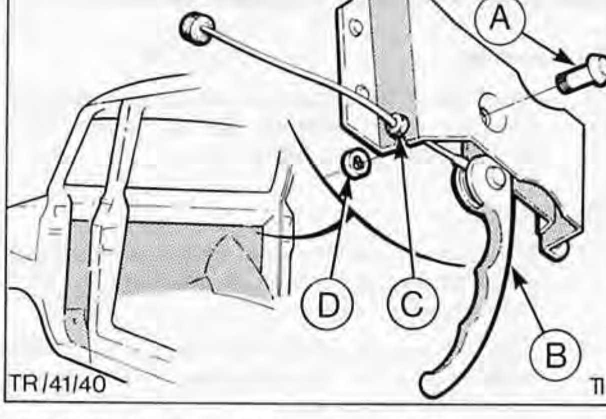


Fig. 6. Hood release cable handle assembly
A – Pivot Pin
B – Handle
C – Grommet
D – Circlip

41 233 SPRING – HOOD LOCKING – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers.
2. Slacken hood release cable adjuster, Fig. 7, disconnect cable from spring.
3. Disengage spring from slot in hood striker sleeve, slacken clamp plate screw and remove clamp plate.
4. Manoeuvre spring from crossmember.

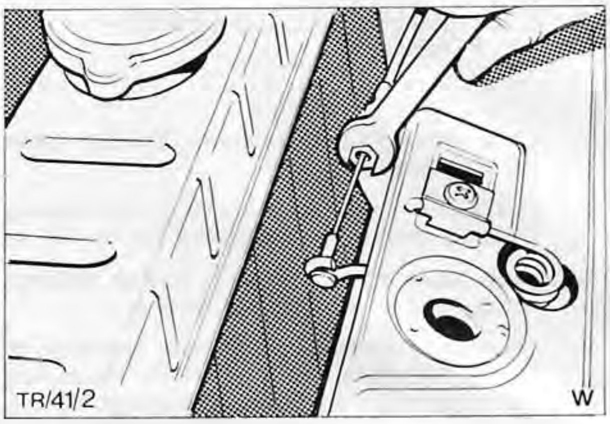


Fig. 7. Slackening hood release cable adjuster

To Install

5. Check that 'J' type nut is correctly installed in square cut out in crossmember.
6. Insert spring through hole next to sleeve in crossmember, secure with clamp plate and screw assembly.
7. Pull loop end of spring so that spring engages slot in striker sleeve.
8. Connect and adjust hood release cable Fig. 8, so that spring is seated on slot in striker sleeve, with all slack removed from cable.
9. Remove fender covers, close hood.

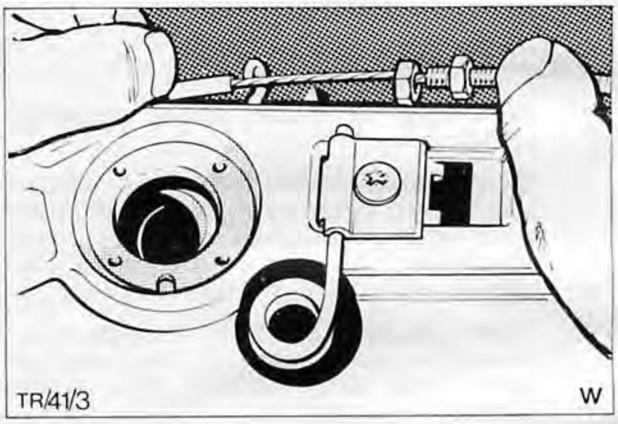


Fig. 8. Hood lock release cable to hood lock spring

41 235 STRIKER POST – HOOD – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, slacken locknut, unscrew and remove striker post from underside of hood, Fig. 9.

To Install

2. Fit washer over threaded end of striker post, insert striker in square nut (retained by hood inner panel).
3. Lower hood to check that striker is in line with sleeve in crossmember. If necessary raise hood and re-set.

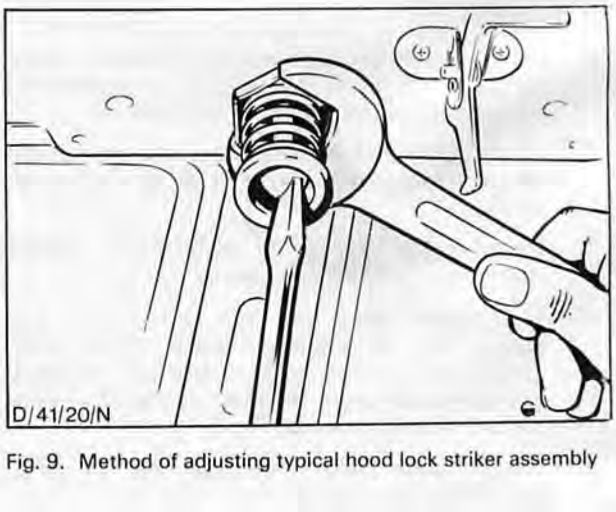


Fig. 9. Method of adjusting typical hood lock striker assembly

4. Close hood, ensuring striker, fully engages hood lock spring. Check visible clearance between underside of hood and cross-member. This should be 7,5 ± 1,5 mm. Fig. 10. If necessary screw striker in, or out, to achieve this setting.
5. Hold striker in correct position, then tighten locknut. Grease striker using lithium base grease.
6. Remove covers close hood.

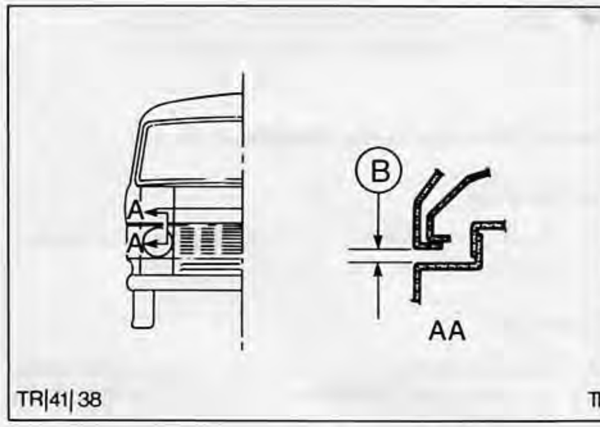


Fig. 10. Hood setting – underside of hood to grille panel
B – 7,5±1,5 mm

41 236 SAFETY CATCH – HOOD – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, remove bolt and clamp plate, detach safety catch from underside of hood, Fig. 11.

To Install

2. Position catch on underside of hood, secure with clamp plate, washer and bolt assembly.
3. Remove covers, check operation of catch.

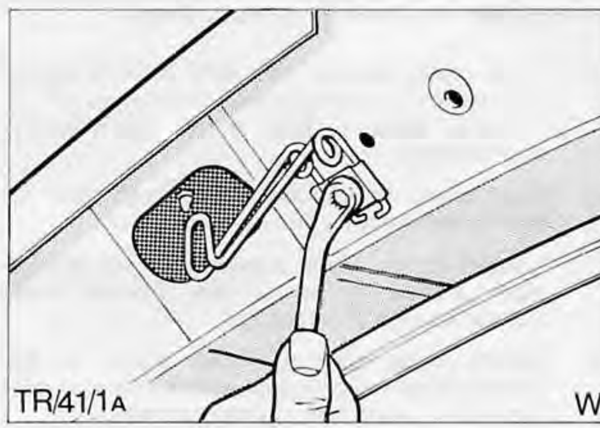


Fig. 11. Removing hood safety catch

41 238 STAY – HOOD – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open and securely prop hood, fit fender covers. Lift free end of hood stay from its retaining clip and manoeuvre fixed end from grommet on crossmember, Fig. 12.

To Install

2. Insert stay in grommet then locate free end in crossmember clip. Remove prop and covers, close hood.

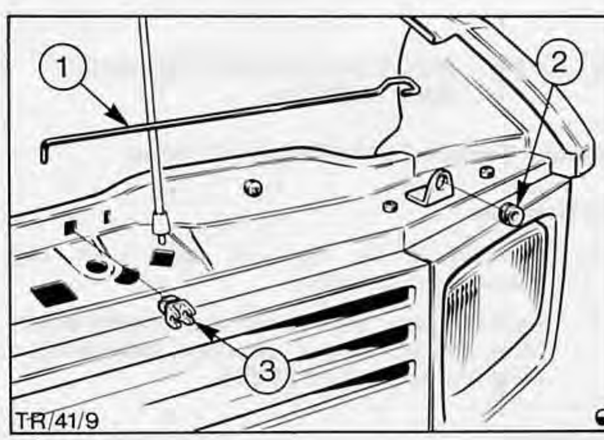


Fig. 12. Hood stay assembly
1 – Stay
2 – Grommet
3 – Clip

41 253 BUMP RUBBER – HOOD – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Pull bump rubber from its location in fender drain channel, Fig. 13.

To Install

2. Brush tapered end of bump rubber with soap solution and push into cut out in fender drain channel.

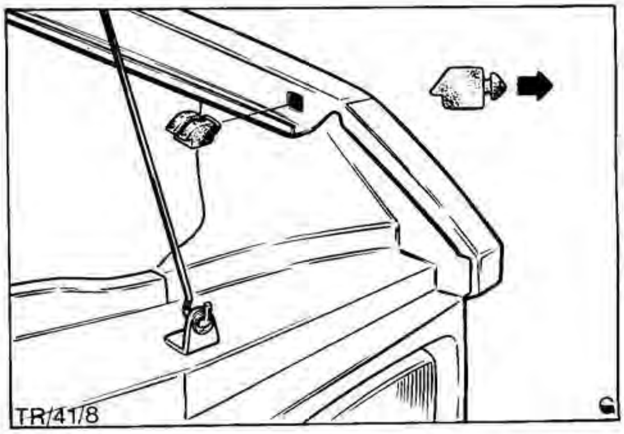


Fig. 13. Hood bump rubber assembly
Push tapered end of rubber into drain channel cut out

41 313 DOOR – ADJUST (Striker Plate Adjustment Only)

Special Service Tools Required: None

1. From inside vehicle, with door partially open, hold pencil on inner surface of door, so that it projects beyond lock edge, immediately above striker.
2. Hold pencil steady and slowly close door so that pencil marks a line on body pillar.
3. Loosen striker plate screws and set top of plate parallel to pencil line. Do not fully tighten screws at this stage.
4. Gently close door to move striker to its correct height. Open door, check striker is still parallel to pencil line, tighten screws.
5. Close door. Check door flushness to body contours. If necessary slacken screws and move striker outboard to align door and body. Avoid disturbing previously attained height setting.

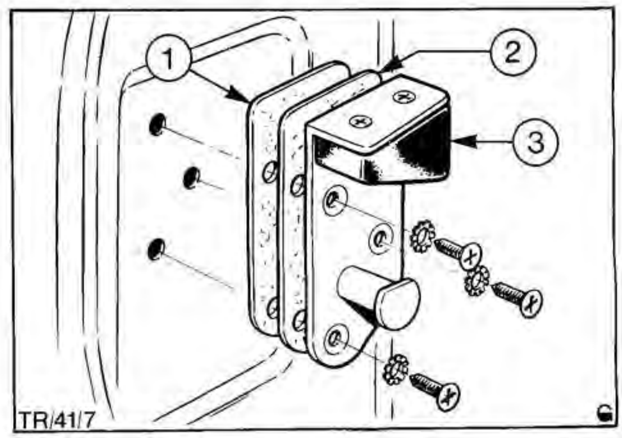


Fig. 14. Floor striker assembly
1 and 2 – Shim
3 – Plate

41 314 DOOR ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove circlip Fig. 15, and push out check strap clevis pin.
2. Remove door trim panel and plastic sheet. Mark around hinges on door then remove bolts and lift door off hinges.

To Install

3. Position door on hinges, insert bolt and washer assemblies and loosely secure door. Align door to previously made marks and tighten bolts.

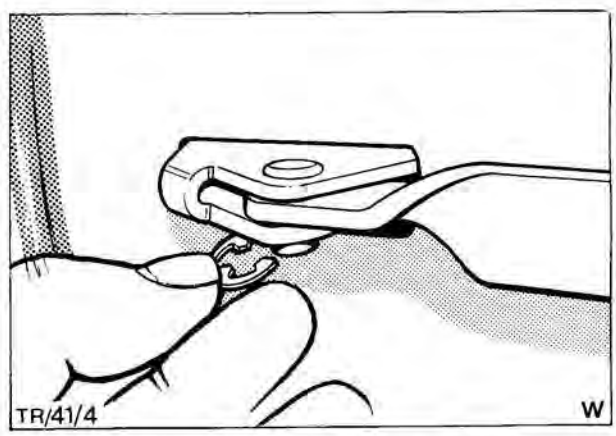


Fig. 15. Removing circlip from check strap clevis pin

4. Adjust door in frame, as necessary by moving door on hinges. Check door closing characteristics and flushness with bodyside, if necessary, adjust door striker plate.
5. Refit checkstrap clevis pin, circlip, door plastic sheet, and door trim panel.

41 333 DOOR EXTERIOR – REMOVE AND INSTALL

Special Service Tools Required:

To Remove

1. Remove door trim panel, and locally detach plastic sheet at exterior handle location.
2. Remove screw and washer assemblies securing door lock to shell.
3. Remove crosshead screws and washers securing handle to door (accessible through cut outs in door inner panel).
4. Unhook rods from lock. Turn handle until front end of handle is vertical, further turn handle towards front of vehicle, at same time guide handle rods through door cut out, Fig. 16.

To Install

5. With handle in vertical position insert rods through door cut out, and rotate handle into alignment.
6. Reconnect control rods, insert rubber gaskets between handle and door and secure handle to door with screw and washer assemblies.
7. Reposition lock on door shell and secure with screw and washer assemblies.
8. Refit plastic sheet and door trim panel.

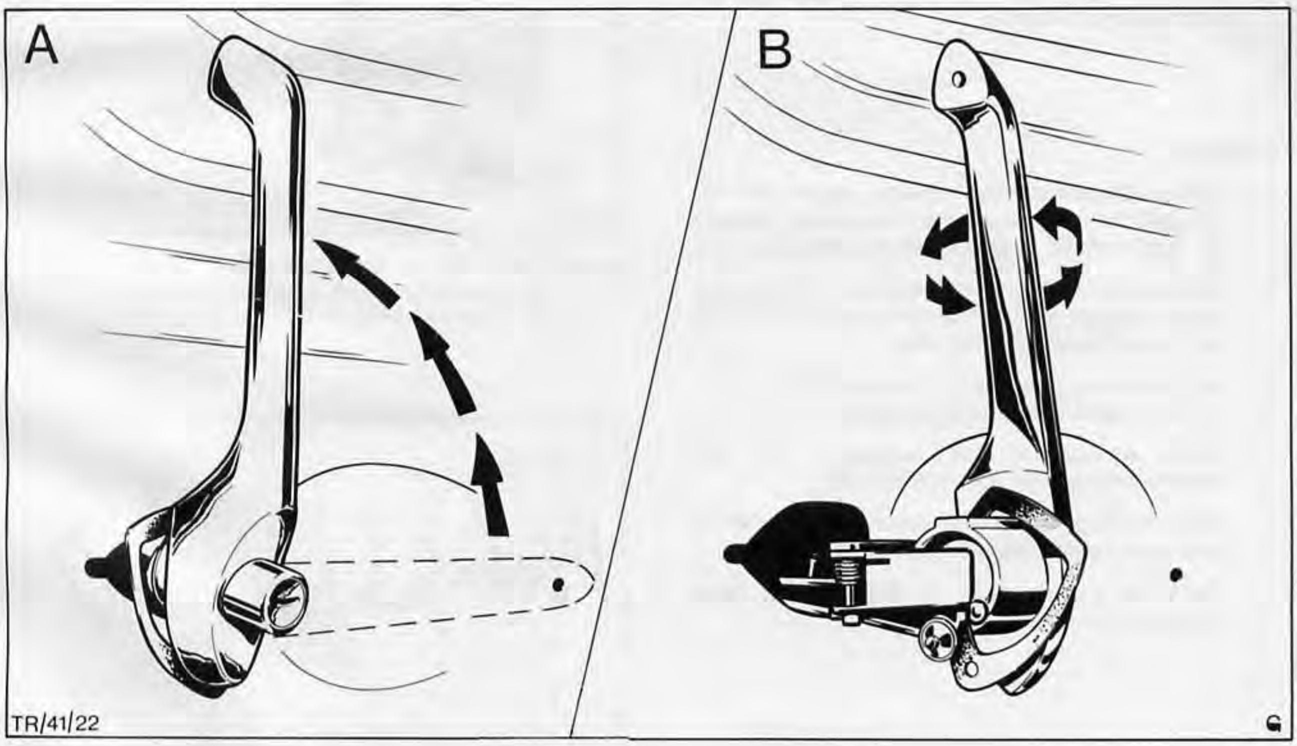


Fig. 16. Removing door exterior handle
A – Turn to vertical position
B – Twist towards front of vehicle

41 336 4 BARREL – DOOR LOCK – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: Where individual components have been itemised within this operation by a letter code without an accompanying Fig. No., they will automatically refer to Fig. 19.

To Remove

1. Unhook and remove short and long lock control rods from crank arm, 'C' in Fig. 18.
2. Tap out pivot pin retaining crank arm to handle, (N) detach crank arm (K) and return spring (M).
3. Remove circlip A retaining lock barrel housing in handle and withdraw lock barrel, lock plate, spring and housing assembly from handle, Fig. 19.
4. Withdraw spacer washers from lock housing and prise return spring (E) from lock barrel.
5. Remove 'O' ring seal (G) from groove on housing.
6. Drive out pin securing barrel in housing and withdraw lock barrel.

To Install

7. Slide lock barrel into housing, insert pin (O) through housing and barrel to secure. Locate 'O' ring seal (G) in groove on housing.
8. Slide return spring into housing so that spring tangs engage slot in housing and lock barrel, with both tangs in same slot.
9. Refit spacer washer on housing and insert housing assembly into door handle.
10. Insert spring (D) and lockplate (C) into handle and secure with circlip, (A).
11. Refit crank arm (K) and return spring (M) to door handle and secure with pivot pin.
12. Refit control rods 'C' in Fig. 18, to their respective locations.

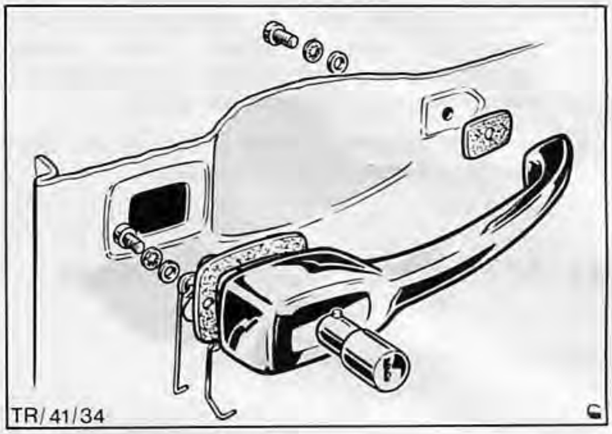


Fig. 17. Door exterior handle assembly

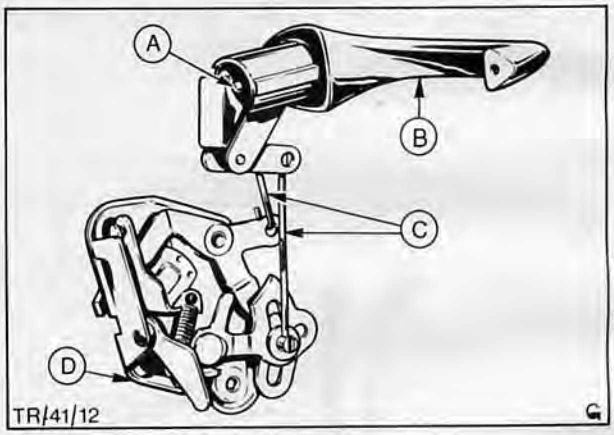


Fig. 18. Exterior handle and lock assembly
A – Operating plunger
B – Exterior handle
C – Control rods
D – Lock assembly

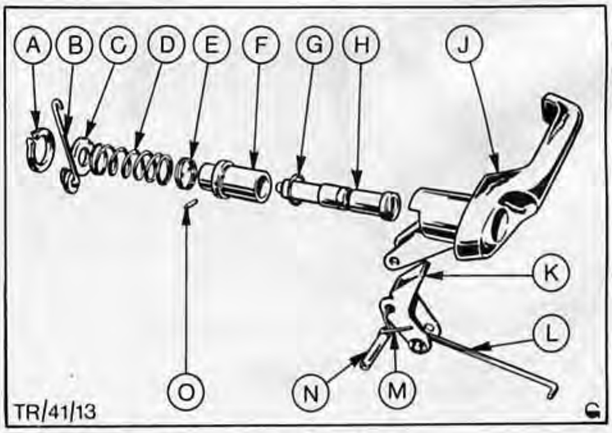


Fig. 19 Lock barrel assembly in door handle

A – Circlip
B – Control rod
C – Lockplate
D – Spring
E – Lock return spring
F – Lock barrel housing
G – Seal
H – Lock barrel
J – Handle
K – Crank arm
L – Control rod
M – Spring
N – Pin
O – Pin

41 352 DOOR LOCK ASSEMBLY – REMOVE AND INSTALL (Front Door)

Special Service Tools Required: None

To Remove

1. Remove door trim panel Fig. 20, and plastic sheet.
2. Remove screw, shakeproof, flat and fibre washer assemblies retaining remote handle assembly to door inner panel. Allow remote handle to hang down inside shell.
3. Unclip private lock rod exterior handle rods from lock levers.
4. Remove screw and shakeproof washer assemblies securing lock to door pillar and remove lock and remote control assembly from door.
5. Disconnect remote control rod link from lock.

To Install

6. If new lock is being fitted, assemble three clips and one bush to levers, as shown in Fig. 21.
7. Insert remote control rod Fig. 22, through appropriate lever on door lock.

NOTE: Check that anti-rattle pad Fig. 22D, is correctly located on rod, and that sealing washer Fig. 22C, is in place on remote handle shaft.

8. Pass lock/remote control assembly into shell. Connect exterior handle links to lock, allow lock to hang on links with remote handle hanging down in shell.
9. Secure lock to door pillar with screw and washer assemblies.
10. Connect private lock rod to lock, leave in locked position.
11. Secure remote handle to inner panel with screw and washer assemblies, ensure that lock connecting rod is not stressed, or touching inner panel.
12. Refit plastic sheet and door trim pad.

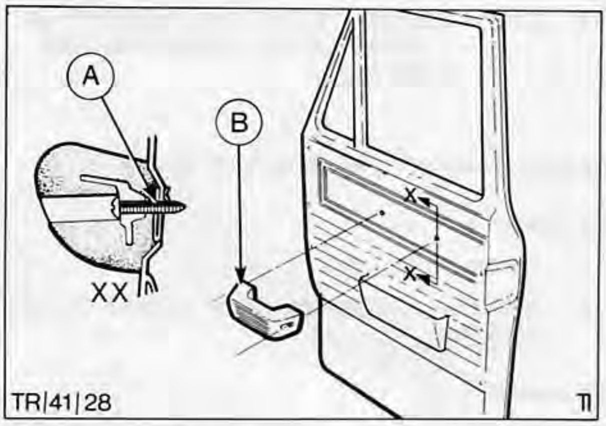


Fig. 20. Door trim panel
A – Arm rest retaining screws
B – Arm rest

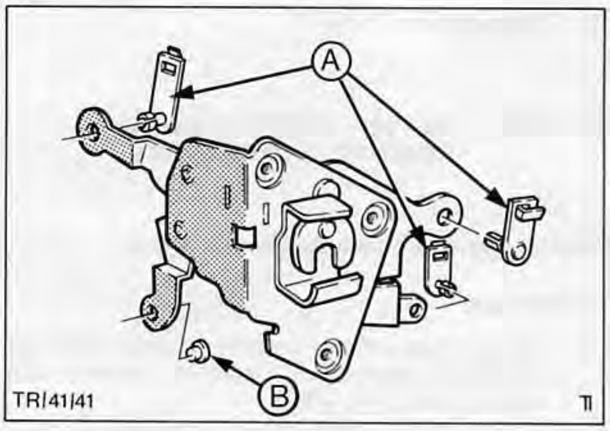


Fig. 21. Bush and clip assembly front door (hinged) lock
A – clips
B – bush

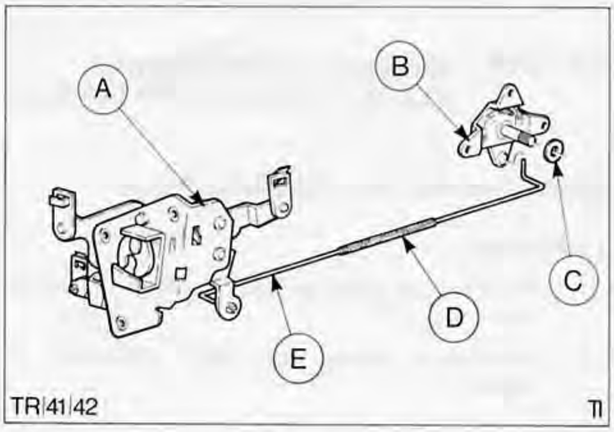


Fig. 22. Remote control and door lock assembly
A – door lock
B – remote control assembly
C – sealing washer
D – anti-rattle pad
E – connecting rod

41 355 REMOTE CONTROL ASSEMBLY – DOOR LOCK – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door lock.
2. Remove control link from remote handle assembly.

To Install

3. Insert vertical hook end of rod through grommet in remote handle lever. Ensure that anti-rattle pad is in place in approximate centre of rod.
4. Position sealing washer around remote handle shaft.
5. Replace door lock.

41 356 PLATE – DOOR STRIKER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open door, mark around striker plate to facilitate reassembly, remove screws and detach plate, Fig. 23.

To Install

2. Position plate within previously made marks insert screws (leave loose).
3. Adjust striker.

41 357 RUBBER – DOOR STRIKER PLATE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Prise rubber clear of retaining lugs on striker plate, Fig. 24.
2. Disengage nylon pad from underside of rubber.

To Install

3. Refit nylon pad to underside of rubber, Fig. 25.
4. Engage rubber with striker lugs and push to secure.

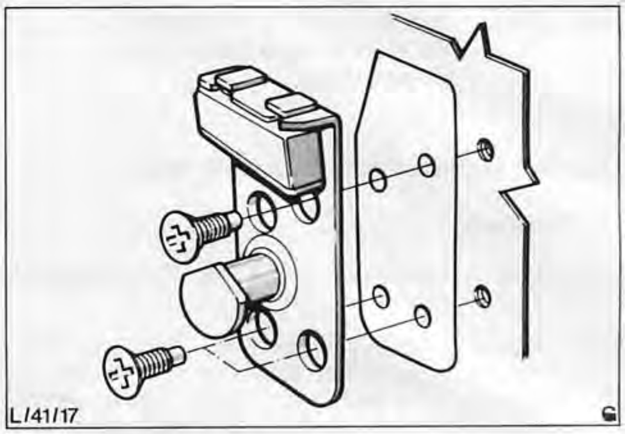


Fig. 23. Door striker plate assembly

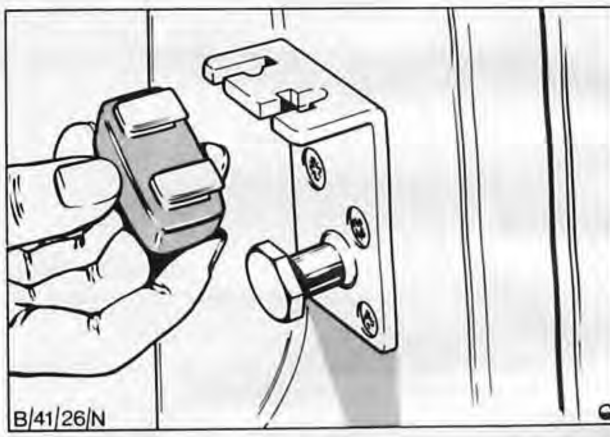


Fig. 24. Pull striker plate rubber from its location

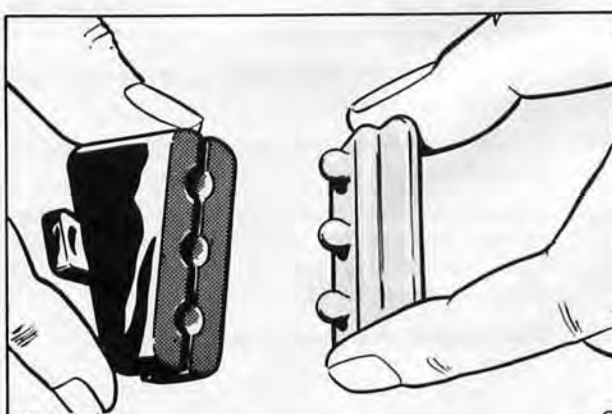


Fig. 25. Inserting nylon pad into striker plate rubber

41 364 DOOR CHECK STRAP – REMOVE AND INSTALL (Front Door)

Special Service Tools Required: None

To Remove

1. Remove door trim panel and locally pull back plastic sheet.
2. Remove two screw and washer assemblies securing check arm to door, Fig. 27.
3. Remove retainer and push clevis pin from 'A' pillar bracket.
4. Remove check arm from door shell.

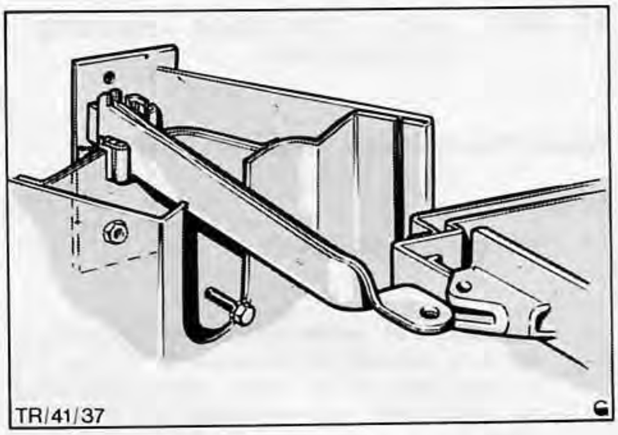


Fig. 26. Check arm screw locations (2) on door pillar

To Install

5. Insert check arm through aperture in door shell. Loosely secure to door with two screws and washer assemblies.
6. Using a suitable grease, grease tongue of check arm. Align hole in tongue with bracket on 'A' pillar, insert clevis pin and secure with retainer, Fig. 27.
7. Refit plastic sheet and door trim panel.

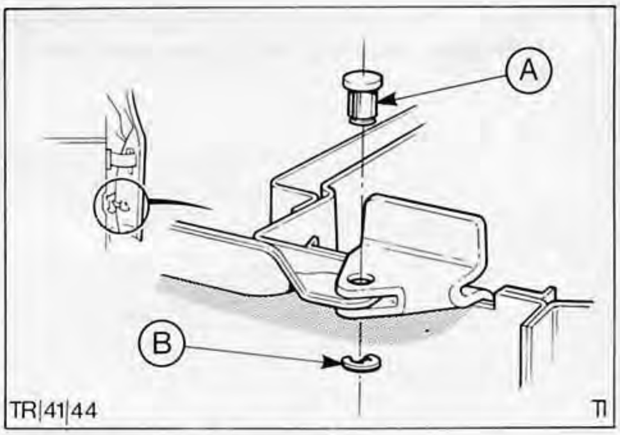


Fig. 27. Check arm clevis pin and retainer
A – Clevis pin
B – Circlip

41 375 WEATHERSTRIP – DOOR APERTURE – REPLACE

Special Service Tools Required: None

To Remove

1. Carefully pull weatherstrip from periphery of door inner panel.

To Install

2. Clean any old adhesive/debris from weatherstrip location on door inner panel.
3. Using adhesive to SQM-269101-A, or a suitable alternative, brush a film of adhesive around periphery of door inner panel in area of weatherstrip, Fig. 28 'B'.
4. Carefully press weatherstrip on to adhered area cut to length and butt joint ends.

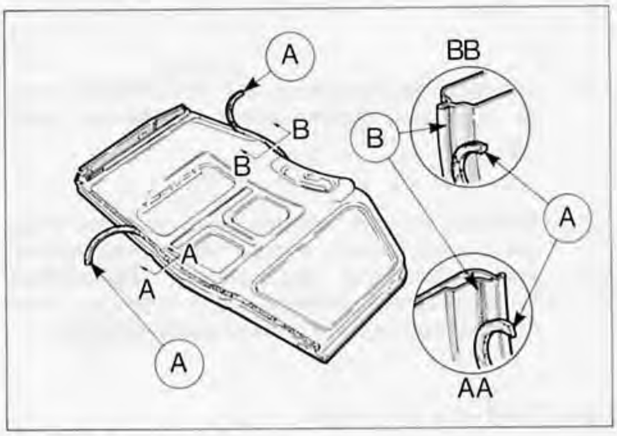


Fig. 28. Weatherstrip to door
A – Weatherstrip
B – Adhesive

41 432 LOCK – SIDE DOOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door trim panel.

2. Remove three screw and washer assemblies securing remote control plate 'D' in Fig. 29, to door inner panel. Lower plate within shell and disconnect remote control rod from lock lever.

3. Disconnect exterior handle rods from their door lock levers, Fig. 30.

4. Remove three screws and shakeproof washer assemblies securing lock to door and detach lock.

To Install

5. Position lock assembly on door pillar within door shell. Connect lock lever rod Fig. 31 'B', from outside handle to upper lever on lock assembly. Then insert and tighten three screw and washer assemblies to secure lock to door.

6. Connect lock release lever rod to release lever on door lock (lower lever) and secure with clip.

7. Position remote control plate to door inner panel and loosely secure with three screw, shakeproof and flat washer assemblies. Connect remote control rod to lock lever then fully tighten remote control plate screws.

8. Refit door trim panel.

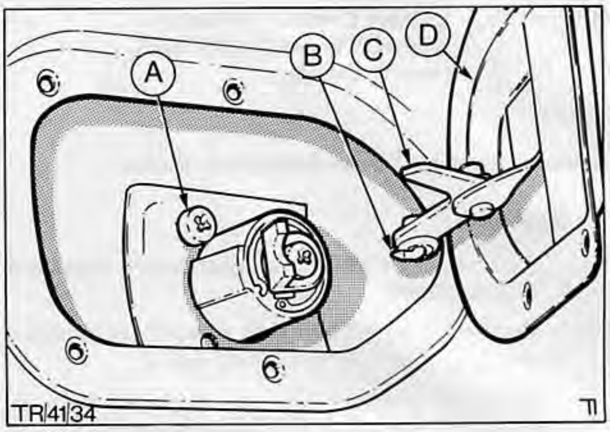


Fig. 29. Door lock assembly to door and exterior handle lock rod
A – Lock retaining screw C – Actuating arm
B – Lock rod D – Control plate

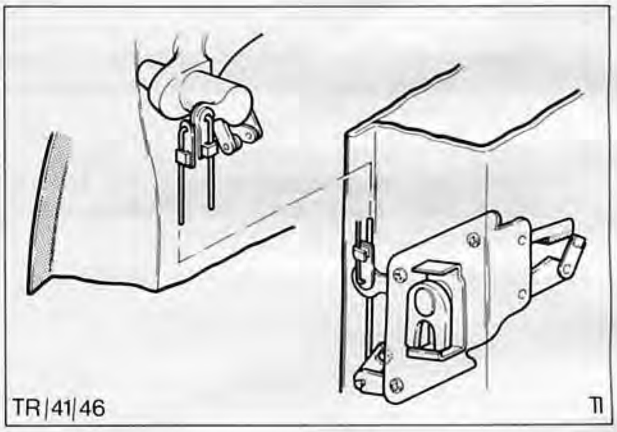


Fig. 30. Exterior handle release lever rod to release lever on lock

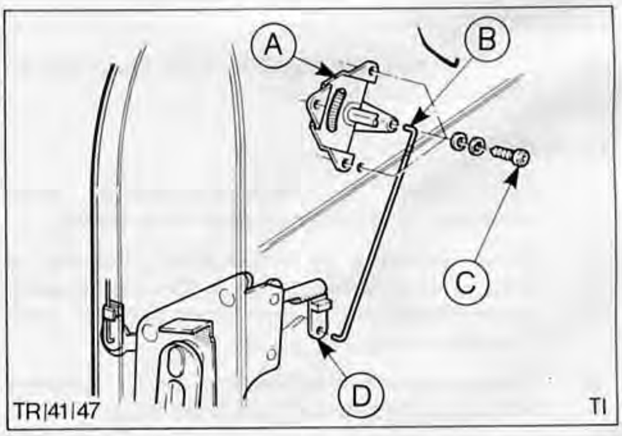


Fig. 31. Remote control assembly side door
A – Remote control C – Screw
B – Connecting rod D – Lock lever

41 514 DOOR – SLIDING CAB – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove nut and flat washer assemblies securing sliding door lower guides to body and detach guides, Fig. 32.

2. Remove screws securing upper interior brush seal to body and remove brush strip.

3. Remove retainer and packing strip screws from beneath front roller, then slacken nut and bolt assemblies securing front roller to door.

4. Slacken bolts securing upper rear roller bracket and cover to door, then remove single screw and detach cover. Slacken remaining bolts securing bracket to door.

5. Remove door by lifting upwards and outwards to disengage door rubbers from upper guide channel.

To Install

6. With door in open position lift door rollers into position on upper guide channel.

7. Fit rear roller cover to door by inserting between rear roller fixing bracket and door. Tighten roller bracket bolts, then fit remaining screw Fig. 34 'C' to secure cover Fig. 34 'B' to roller bracket.

8. Tighten nut and bolt assemblies retaining front roller to door. Then locate retainer and packing strip beneath front roller bracket and secure with two screws.

9. Align holes in brush seal with those in door frame and secure with four screws.

10. Locate lower guides in the lower guide channel and secure to door with four nut and flat washer assemblies.

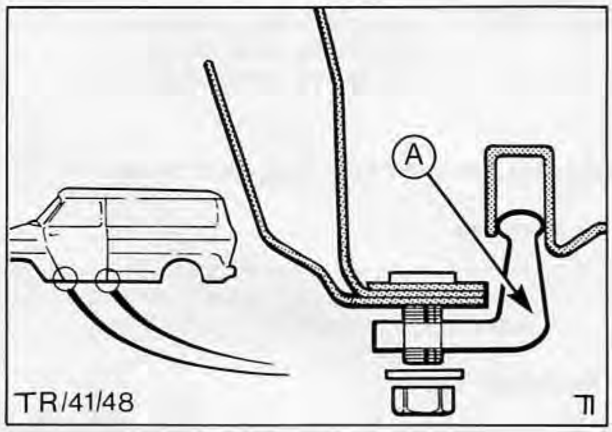


Fig. 32. Sliding cab door lower guides
A – Guide

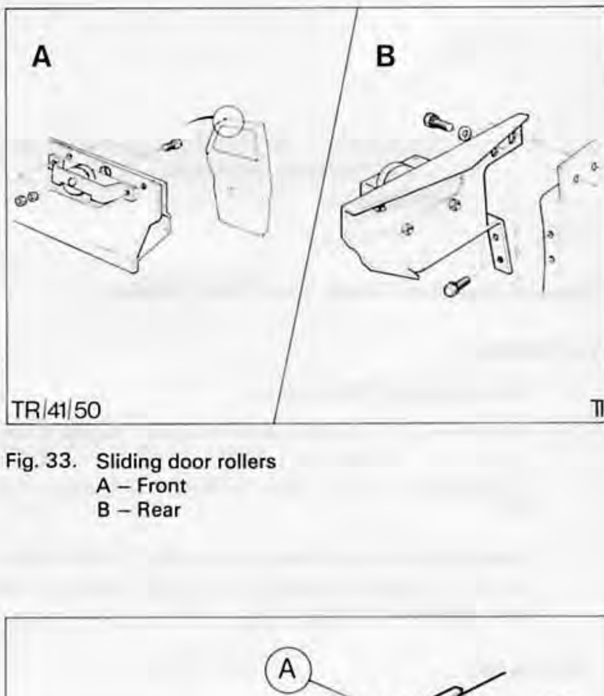


Fig. 33. Sliding door rollers
A – Front
B – Rear

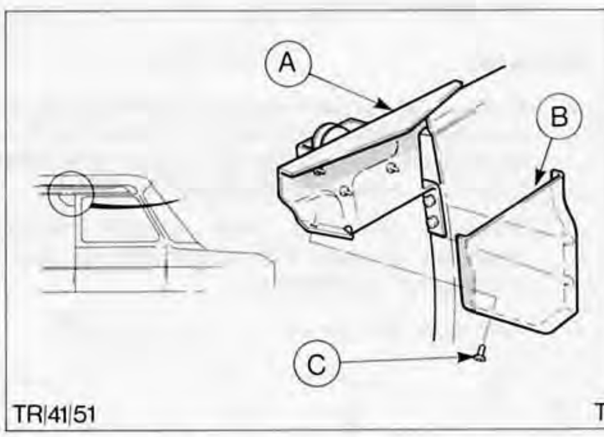


Fig. 34. Cover to sliding door rear roller
A – Rear roller
B – Cover
C – Screw

41 516 4 GUIDE RAIL (LOWER) SLIDING CAB DOOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove seven screw and flat washer assemblies securing guide rail and striker assembly to underbody, Fig. 35.

To Install

2. Position rail on underbody and loosely secure with screw and washer assemblies. Set guide rail inwards at front and outwards at rear then fully tighten bolts.

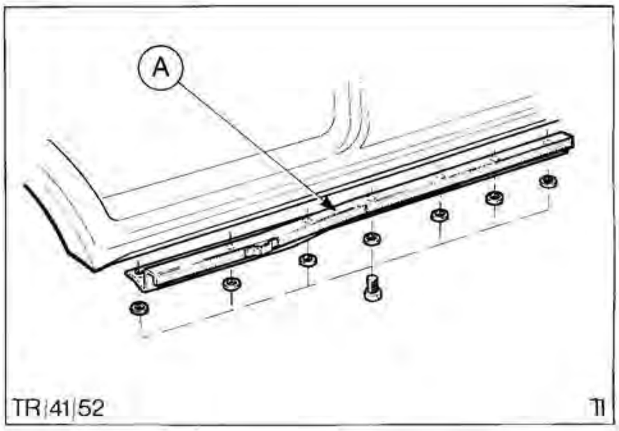


Fig. 35. Lower guide rail and striker assembly
A – Guide rail

41 522 HANDLE – SLIDING CAB DOOR – EXTERIOR REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door trim panel.
2. Remove six screws and washer assemblies securing lockplate and interior handle assembly to door and remove assembly, Fig. 36.
3. Remove three screw and washer assemblies securing exterior handle to door outer panel and detach handle.

To Install

4. Position upper and lower mounting pads on exterior handle and locate handle on door outer panel. Secure handle to door with three screw and washer assemblies, Fig. 37.
5. Position lockplate and interior handle assembly on door and secure with six screw and washer assemblies.
6. Refit door trim panel.

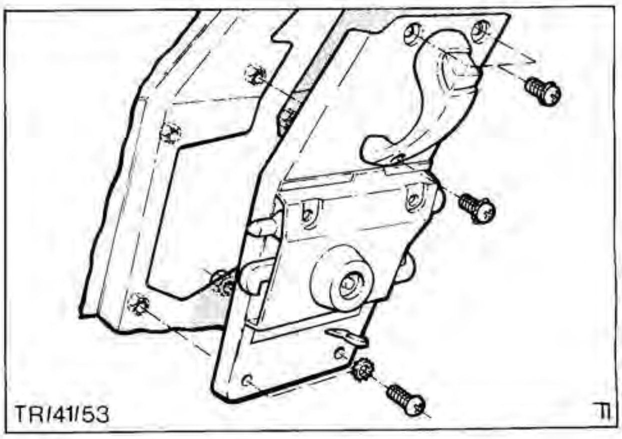


Fig. 36. Sliding lockplate and handle to door

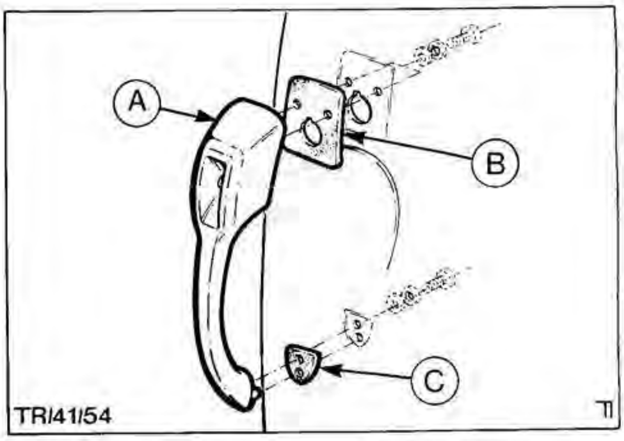


Fig. 37. Exterior handle and mounting pad assembly
A – Handle
B – Upper mounting pad
C – Lower mounting pad

41 526 LOCK – SLIDING CAB DOOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove interior handle and lockplate assembly.
2. Prise circlip Fig. 39 'B' off private lock lever pivot Fig. 39 'C' and disconnect interior release rod from pivot.
3. Drill out two pop rivets retaining lock assembly to lock plate and detach lock assembly.

To Install

4. Position lock assembly on lockplate and secure with two pop rivets, Fig. 38.
5. Place private lock lever in 'locked' position and adjust length of lock release rod Fig. 39 'A' until 0,040 in slip, or feeler gauge, just fits between end of lever and rod. Fit rod over lever pivot and secure with flat washer and circlip, Fig. 39 'B'.

41 534 4 WEATHERSTRIP – SLIDING CAB DOOR FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drill out 'pop' rivet from flanged retainer at lower end of front weatherstrip and detach retainer. Pull upper end retainer of weatherstrip, then pull weatherstrip off flange.

To Install

2. Position weatherstrip on flange, tap into place with mallet, and trim to length if required.
3. Fit flanged retainer over to lower end of weatherstrip and secure to body with 'pop' rivet, Fig. 40.
4. Fit upper retainer over flange and weatherstrip.

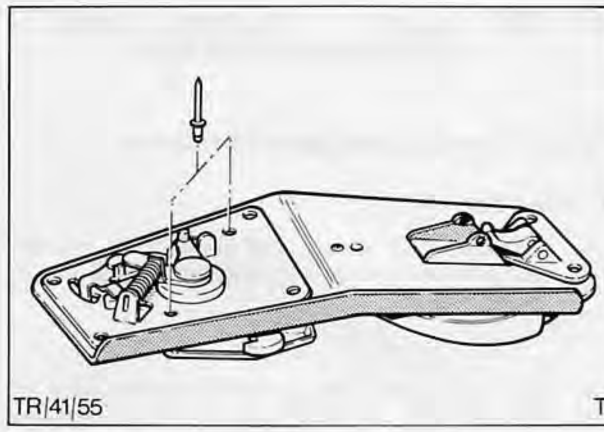


Fig. 38. 'Pop' rivet location, lock assembly to lockplate

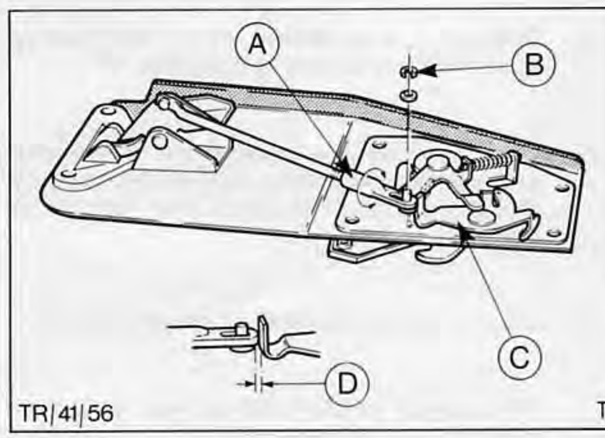


Fig. 39. Private lock lever and lock release rod adjustment. Private lock lever in 'locked' position
A – Adjuster
B – Circlip
C – Lock lever
D – 0,040 in clearance

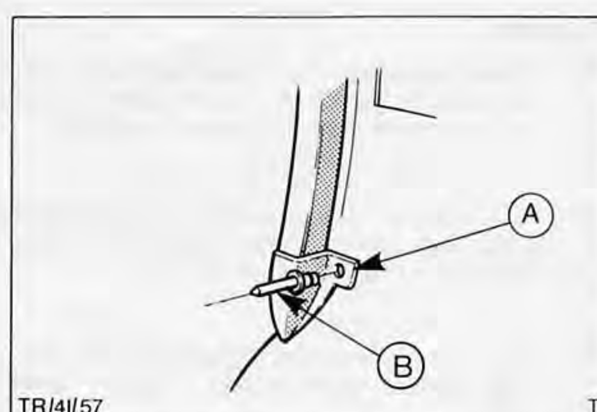


Fig. 40. Flanged retainer and 'pop' rivet (lower end front door aperture weatherstrip)
A – Flange
B – Pop rivet

41 554 DOOR – SLIDING SIDE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two screw and shakeproof washer assemblies and detach support from front 'B' pillar, Fig. 41.

2. Drill out 'pop' rivets securing upper guide rail shroud and cap and detach shroud and cap from rail, Fig. 42.

3. Remove screw and washer assembly securing shroud to upper guide arm.

4. Open door and remove circlip and washer from middle roller arm spindle, Fig. 43.

5. Close door, remove upper screw and washer and slacken lower screw and washer securing top guide arm. Prise guide arm from upper guide rail.

6. Slacken screws on lower guide arm, Fig. 45.

7. Lift door off middle roller spindle and guide roller out of guide rail.

To Install

8. Check that washer is in place on middle roller arm spindle Fig. 43 'B'. Locate roller in guide rail and mount door on roller arm spindle.

9. Push door to closed position, align bottom guide and tighten three screw and washer assemblies retaining guide to door.

10. Place top guide arm in upper guide rail, insert and tighten upper screw. Tighten lower screw.

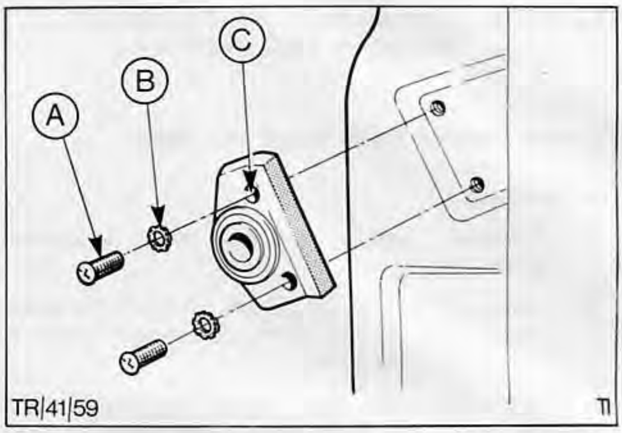


Fig. 41. Support (outer) assembly to 'B' pillar
A – Screw
B – Shakeproof Washer
C – Support

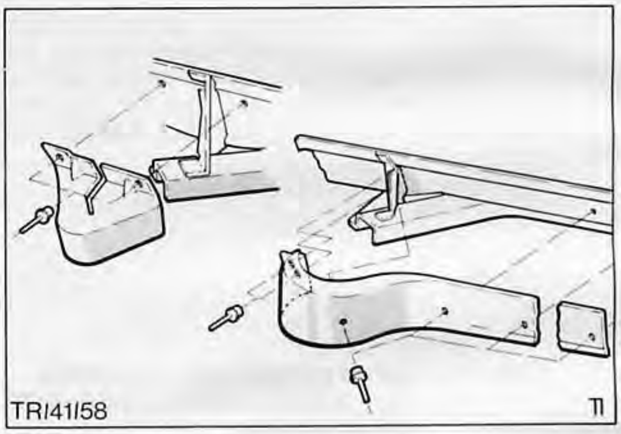


Fig. 42. Upper guide rail shroud and cap

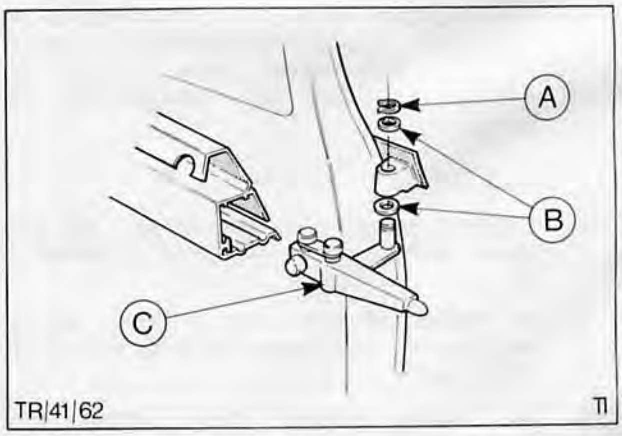


Fig. 43 Circlip and washer assembly middle roller arm spindle
A – Circlip
B – Washer
C – Roller arm

11. Open door and secure middle roller arm to door link with circlip and washer, Fig. 43.

12. Position shroud on upper guide arm and secure with screw and washer assembly, Fig. 44.

13. Position upper guide rail shroud and cap and secure with 'pop' rivets, Fig. 42.

14. Position outer support on 'B' pillar and secure with two screw and shakeproof assemblies, Fig. 41.

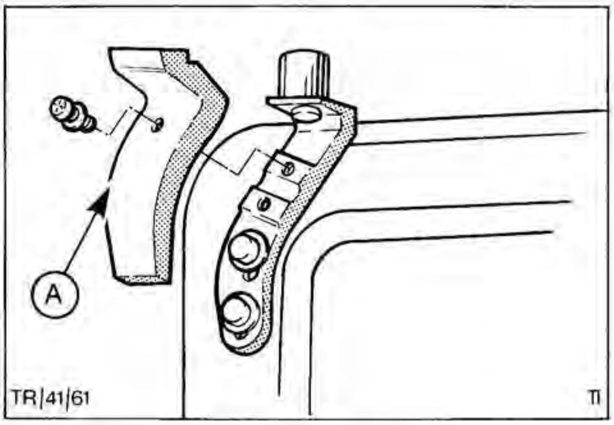


Fig. 44. Shroud assembly upper guide arm
A – Shroud

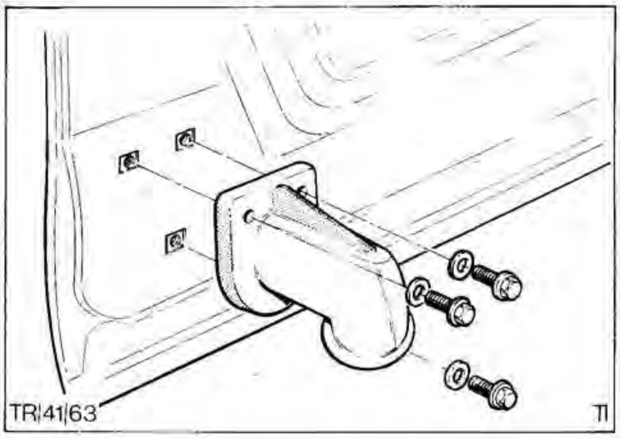


Fig. 45. Guide assembly sliding side door lower

41 562 HANDLE – SLIDING DOOR – EXTERIOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Pull circlip from handle lower spigot, Fig. 46 'D'.

2. Remove two screw and washer assemblies securing upper part of handle to door, Fig. 46 'A'.

3. Detach handle and mounting pads from door.

To Install

4. Locate mounting pads Fig. 46 'B', on upper and lower parts of handle.

5. Position handle on door, secure upper part with two screw and washer assemblies and lower part with circlip.

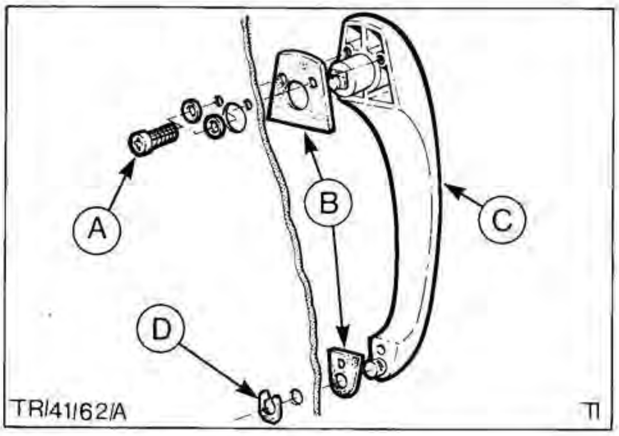


Fig. 46. Sliding door exterior handle assembly
A – Screw and washer C – Handle
B – Mounting pads D – Circlip

41 575 ARM – SLIDING DOOR UPPER GUIDE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove upper guide shroud, Fig. 47 'A'.
2. Remove upper screw, slacken lower screw and prise roller from upper guide.
3. Remove lower screw and detach arm and roller assembly. Lift roller off upper bolt shank on arm.

To Install

4. Assemble roller over upper bolt shank on arm.
5. Loosely secure arm to door with screw, spring and flat washer assembly.
6. Insert roller in upper guide then fit remaining screw and washer assembly. Tighten both screws.
7. Replace upper guide shroud.

41 594 WEATHERSTRIP – SLIDING SIDE DOOR APERTURE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Carefully pull weatherstrip from periphery of door aperture.

To Install

2. Clean door aperture of all traces of rubber/adhesive debris.
3. Apply masking tape around periphery of door aperture to protect body paintwork from excess adhesive.
4. Coat aperture periphery and weatherstrip with adhesive.
5. Locate weatherstrip in top left and right hand corners, then bottom corners, and finally press into place around the periphery of aperture. Firm weatherstrip into place with roller.

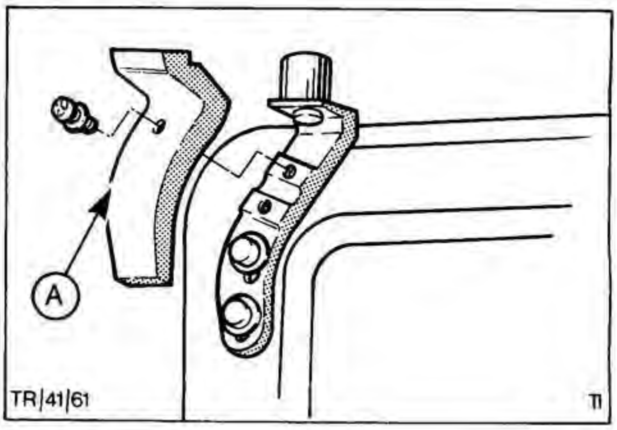


Fig. 47. Upper guide arm roller and shroud (A)

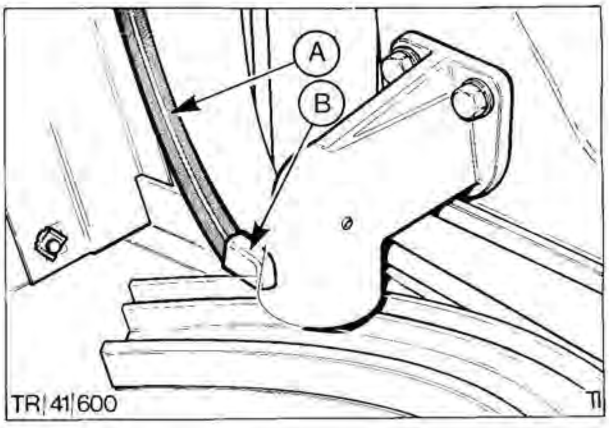


Fig. 48. Door aperture edging (A)
B – End cap

41 615 REAR DOOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove screw and washer assembly and detach shrouds (two each hinge) from hinges, Fig. 49.

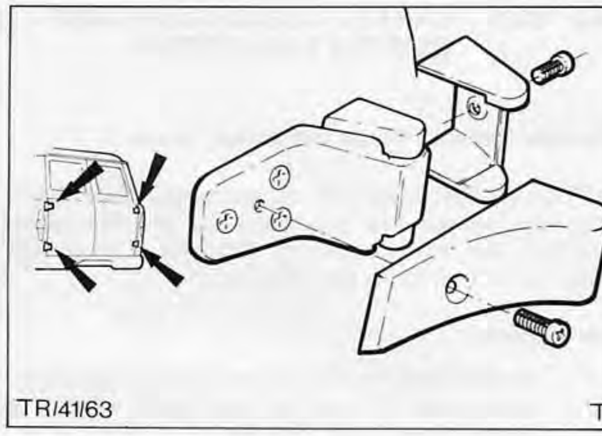


Fig. 49. Rear door hinge shrouds

2. Remove checkstrap (Op No 41 364)

3. Mark around hinge locations on door, remove screws Fig. 50, from hinges and lift off door.

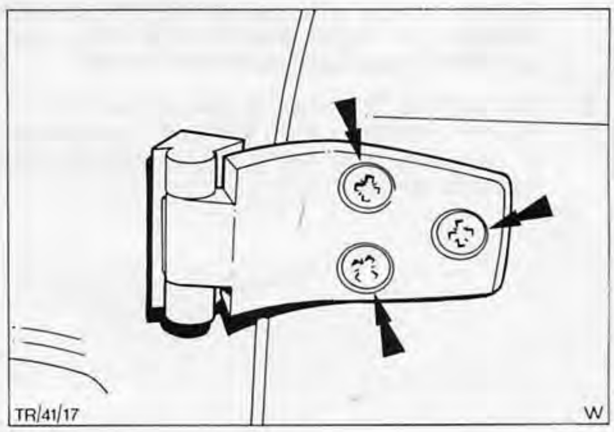


Fig. 50. Rear door hinge screws

To Install

4. Position door on hinges, align to previously made marks and loosely secure with screws.

5. Move door as necessary on hinges to obtain uniform clearance between horizontal and vertical edges of aperture. Tighten hinge screws. If necessary, slacken screws retaining upper and lower striker plates to roof and floor, and move strikers as required to flush door with remaining door.

6. Check alignment of door dovetails, if necessary, add or subtract shims (to a maximum of four) under male dovetail (RH door) to achieve satisfactory engagement of dovetails, Fig. 51.

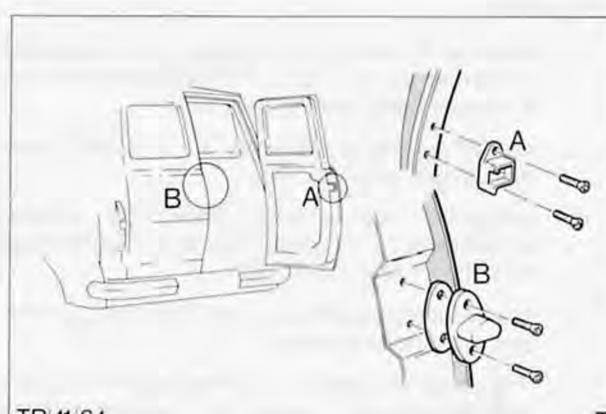


Fig. 51. Male and female dovetails rear
A – Female dovetail
B – Male dovetail

7. Replace check strap.

8. Refit hinge shrouds, and secure with retaining screws.

41 625 BARREL – REAR DOOR LOCK – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: Where individual components have been itemised within this operation by a letter code without an accompanying Fig. No, they will automatically refer to Fig. 54.

To Remove

1. Remove interior handle by unscrewing cross-head screw and washer from centre of handle boss (where fitted), Fig. 52.
2. Turn exterior handle to 'open' position and remove screws securing handle to door, Fig. 53.
3. Detach handle from door.
4. Remove circlip (C), spring (D) and spacer washers (K) from door handle boss and withdraw escutcheon plate from handle.
5. Tap out pin (B) securing square section rod (A) and withdraw rod. Similarly, tap out pin (F) securing lock barrel (J), in handle and withdraw barrel.

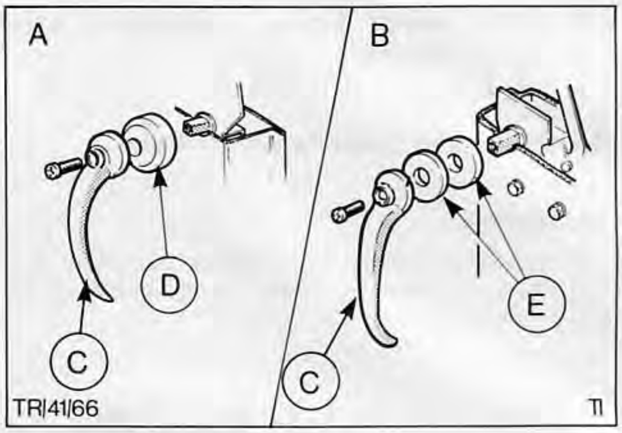


Fig. 52. Interior handle assemblies
A – Without trim panels D – Escutcheon
B – With trim panels E – Washers
C – Handle

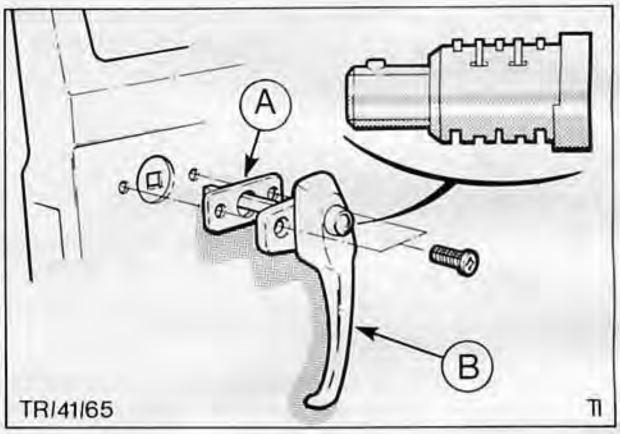


Fig. 53. Exterior handle and cylinder assembly
A – Mounting pad
B – Handle

To Install

6. Slide lock barrel into handle boss, ensuring operating pin on nose of barrel engages slot in handle boss locking peg, (G).
7. Locate square section rod (A), in handle boss and secure with pin, (B).
8. Assemble escutcheon plate, (E) spacer washers (K) and spring (D) into handle boss and secure with circlip (C).
9. Insert handle shaft into lock and secure with two crosshead screws.
10. Refit interior handle on exterior handle shaft and secure with screw and washer (where fitted).

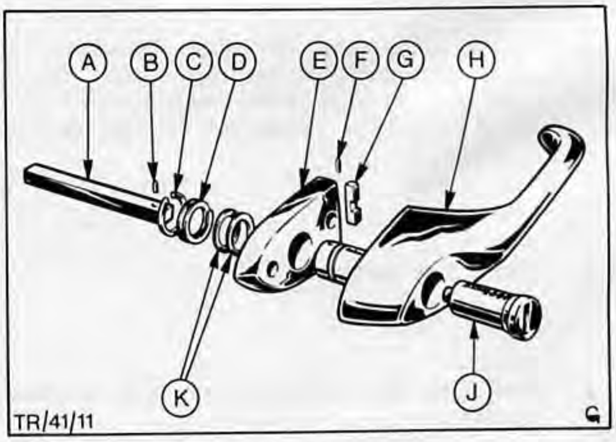


Fig. 54. Rear door exterior handle
A – Rod F – Pin
B – Pin G – Locking peg
C – Circlip H – Exterior handle
D – Spring washer J – Lock barrel
E – Escutcheon K – Spacers

41 634 STRAP – REAR DOOR CHECK – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open rear doors, remove tool bag (LH door only), remove trim panel.
2. Remove two retaining nuts and washer assemblies and detach check strap, Fig. 55.

To Install

(Van and Kombi)

3. Position check strap on door pillar, insert studs of strap through holes in pillar and secure to pillar with nut and washer assemblies.
4. Pass arm through aperture in rear door, ensuring roller is on reinforced area on door. Fully tighten nuts.

(Bus and Crewbus)

3. Locate check strap between outer and inner door panels, and through check aperture.
4. Close door sufficiently to locate studs of check strap through holes in door pillar. Secure with nuts and washers.
5. Where applicable, replace tool bag, refit trim panel.

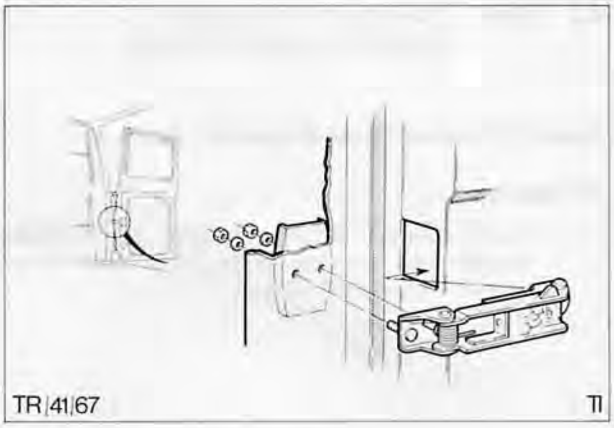


Fig. 55. Rear door check strap assembly

41 644 WEATHERSTRIP – REAR DOOR APERTURE – REPLACE

Special Service Tools Required: None

To Remove

1. Carefully pull weatherstrip from periphery of rear door inner panel, and door flanges.

To Install

2. Clean any old adhesive/rubber debris from weatherstrip location on door inner panel. Wipe area with methylated spirit/acetone mix.

To Install

3. Using adhesive to SQM–269101–A, or a similar alternative, brush coat a film of adhesive around periphery of door in area of weatherstrip and along door flange, Fig. 56 'A'.
4. Starting at left hand top corner carefully press weatherstrip on to coated areas round door periphery. Carefully cut weatherstrip to length as required and butt joint ends. Seal both joints with adhesive.
5. Similarly, secure weatherstrip to door flange (LH rear door).

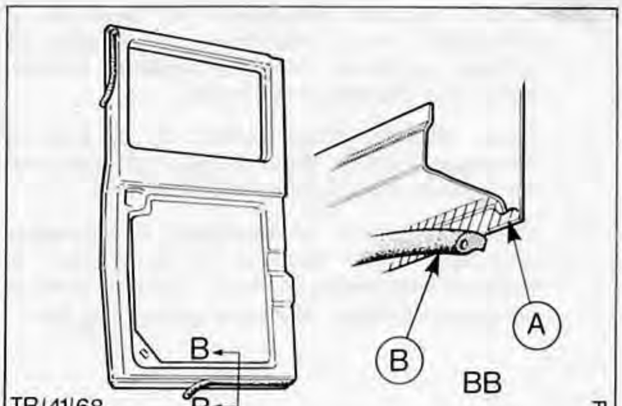


Fig. 56. Weatherstrip to door
A – Adhesive
B – Weatherstrip

41 654 TAILGATE ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Mark around tailgate hinges to facilitate reassembly, remove bolts from each hinge and lift tailgate off hinges.

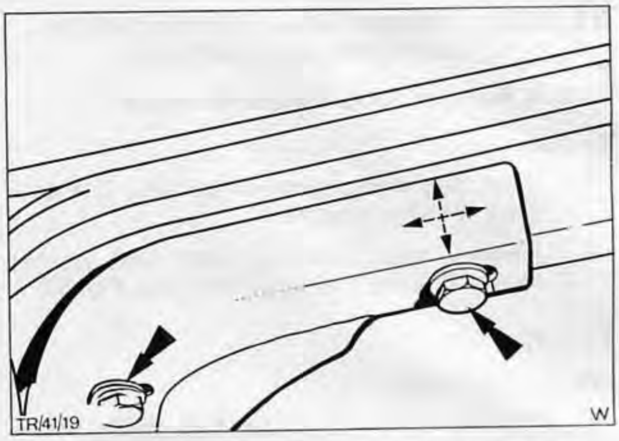


Fig. 57. Tailgate hinge bolts (arrowed) Broken arrows show area of movement within bolt hole

To Install

2. Position tailgate on hinges, loosely insert bolts and align hinges to previously made marks.
3. Slacken screws retaining bumpers on tailgate and tailgate aperture pillars.
4. Slacken screws retaining tailgate striker to load space floor, Fig. 58.

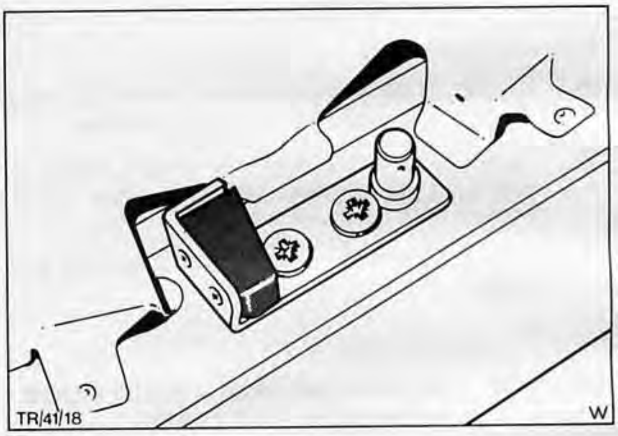


Fig. 58. Tailgate striker assembly

5. Check tailgate alignment in aperture if necessary move assembly on hinges to achieve uniform clearance around tailgate periphery. Tighten hinge bolts.
6. Close tailgate, move striker in, or out, as necessary to align lower edge of tailgate with back panel, then tighten striker screws.
7. Check alignment of bumpers, if necessary add pads under bumper on body pillar to achieve necessary contact. Tighten bumper screws on tailgate and body pillars, Fig. 59.

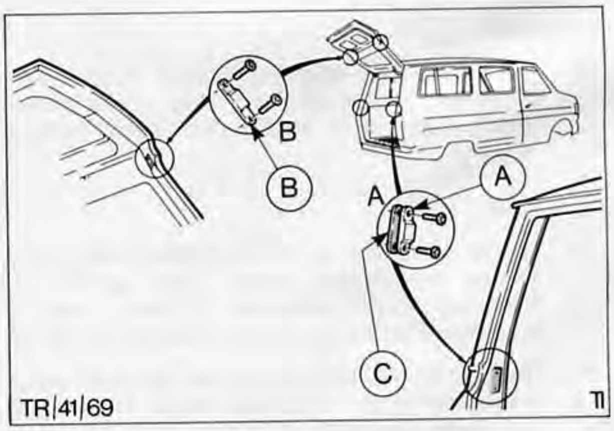


Fig. 59. Tailgate bumper assemblies
A – Bumber on body pillar
B – Bumber on tailgate
C – Pads

41 664 BARREL – TAILGATE LOCK – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open tailgate, remove tailgate trim panel. Remove single retaining screw and washer and detach lever from end of lock barrel.
2. Remove three screw and washer assemblies and lift handle and pad off tailgate.
3. Remove circlip and pull lock barrel from handle housing.

To Install

4. Insert lock barrel in handle housing and secure with circlip.
5. Position mounting pad on handle, locate handle on tailgate. Align holes in tailgate and handle insert and tighten screw and washer assemblies to secure.
6. Locate lever on end of lock barrel, secure with screw and washer.
7. Replace tailgate trim panel.

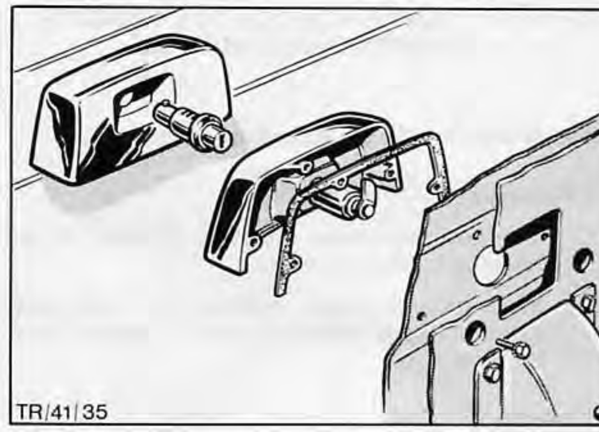


Fig. 60. Tailgate lock, lock barrel and handle assembly

41 666 LOCK ASSEMBLY – TAILGATE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove tailgate trim panel.
2. Remove bolt and spacer securing lock release lever to tailgate, Fig. 61.
3. Remove four screw and washer assemblies and detach lock from tailgate inner panel.

To Install

4. Insert release lever through aperture in tailgate inner panel, align holes in lock with those in tailgate, insert and tighten four screw and washer assemblies to secure.
5. Position spacer between lock release lever and tailgate, slide a further spacer over shoulder bolt insert and tighten bolt, through lever and spacer to secure lever to tailgate.
6. Refit tailgate trim panel.

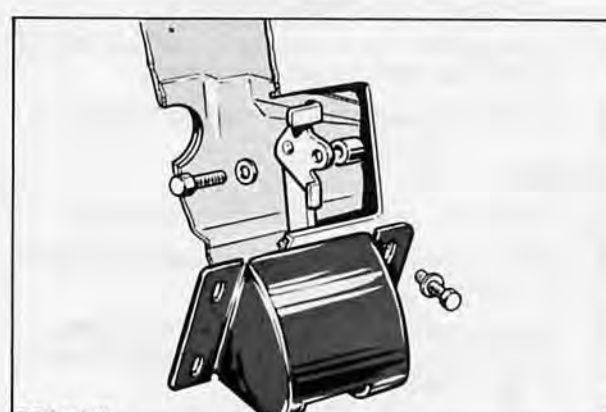


Fig. 61. Tailgate lock assembly

41 674 PLATE – TAILGATE STRIKER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Drill out pop rivets retaining tailgate striker cover to loadspace floor.
2. Mark around striker, remove torx bolts and external tooth washers and lift striker plate off floor.

To Install

3. Position striker on floor within previously marked lines. Insert and tighten torx bolt and washer assemblies.
4. Position tailgate striker cover to loadspace floor and secure with pop rivets, Fig. 62.

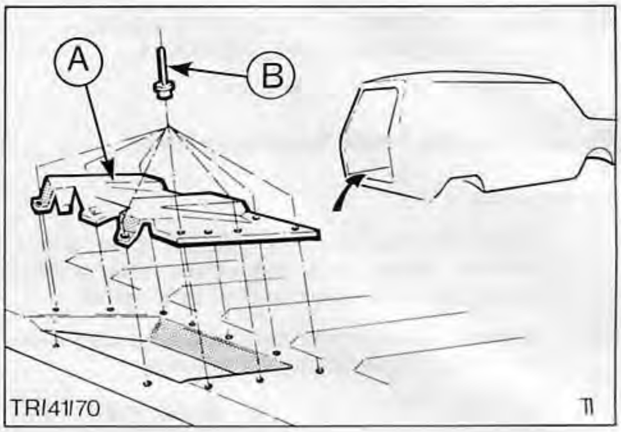


Fig. 62. Tailgate striker cover
A – Cover
B – Pop rivet

41 683 TORSION BAR – TAILGATE – REMOVE AND INSTALL

Special Service Tools Required: GTX 447

To Remove

1. Remove tailgate header bar trim panel.
2. Unscrew nuts securing 'T' retainer and counter plate assembly and detach the assembly.
3. Fit special tool No GTX 447 to 'U' end of torsion bar.
4. Push lever of tool forwards and, whilst supporting tailgate in 'Open' position, unhook torsion bar from hinge base plate.
5. At opposite hinge withdraw cranked end of torsion bar from its retaining sleeve.
6. Release 'U' end of torsion bar from hinge lug.

To Install

7. Engage 'U' end of torsion bar in hinge lug.
8. Slide cranked end of bar into retaining sleeve on opposite hinge.
9. Using special tool No GTX 447 on 'U' end of torsion bar, lever bar behind hook retainers on base plate.
10. Refit retainer counterplate and trim panel.

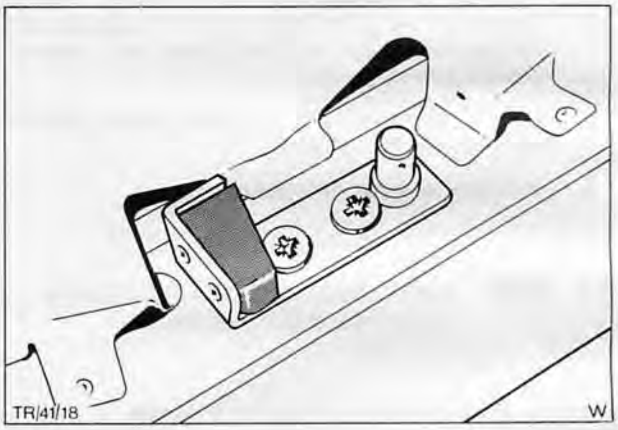


Fig. 63. Tailgate striker assembly

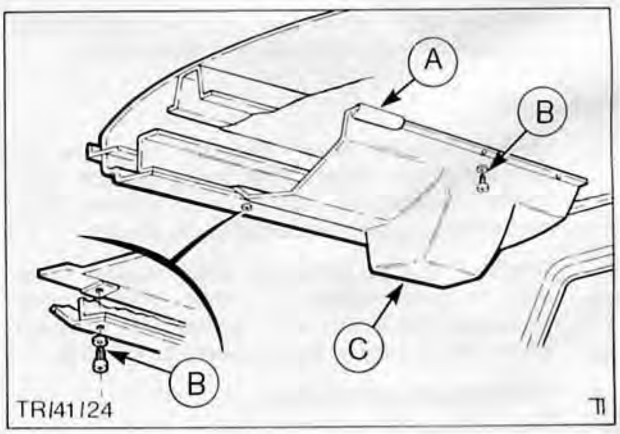


Fig. 64. Tailgate tension bar trim panel (C)
A – Anti-rattle pad
B – Screw and washer assembly

EXHAUST SYSTEM 25

Index	Page

GENERAL DESCRIPTION

Two basic designs of exhaust system are utilised on the $78\frac{1}{2}$ Transit range and each system can be adapted for all body variants, Figs. 1 and 2.

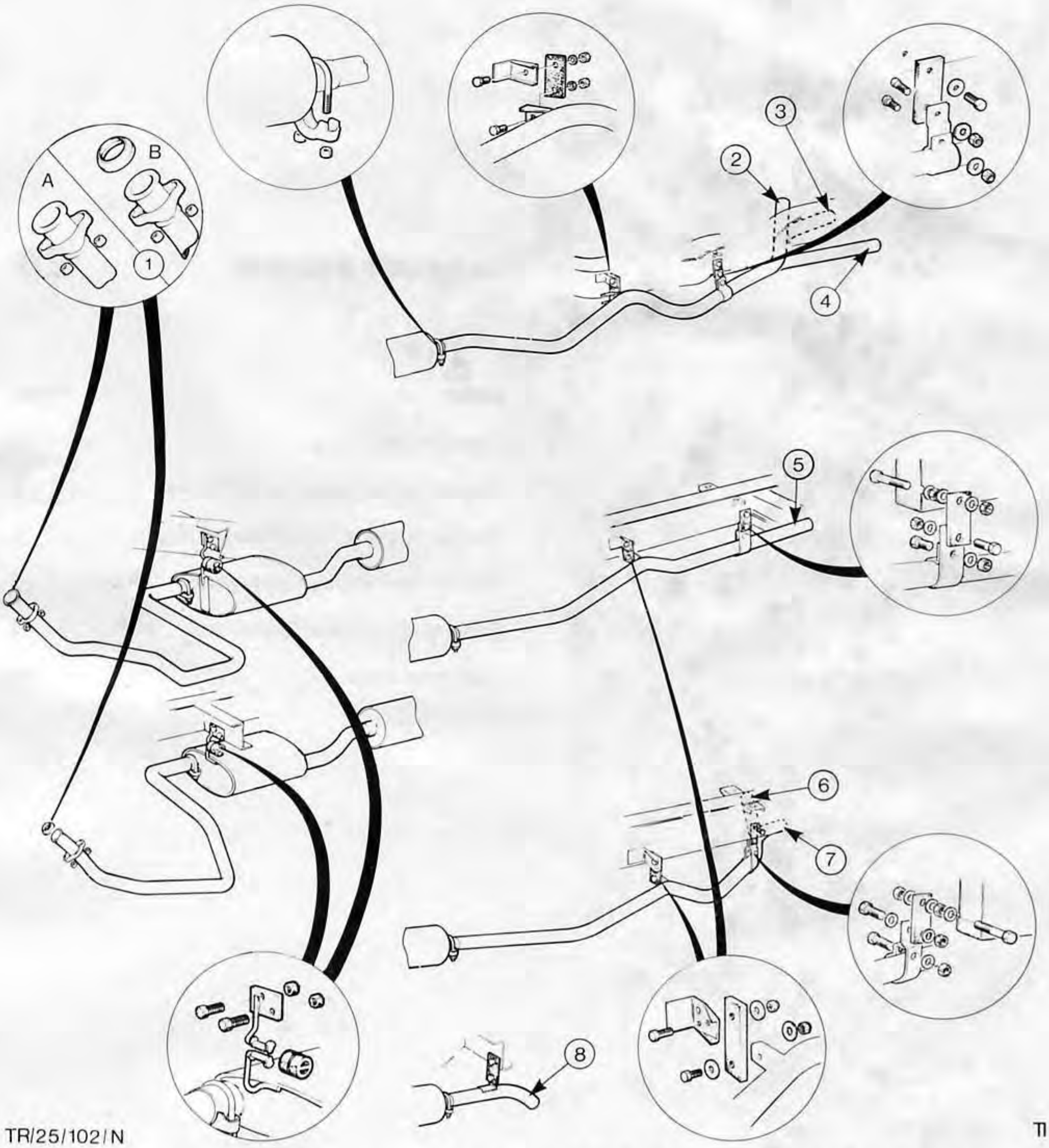


Fig. 1. Exhaust layout for Transit variants fitted with the 4 cylinder in-line OHV (Kent) engine and 4 cylinder Diesel (York) engine

1A Diesel (LCX and LCY)
1B Kent (LCX)
2 Parcel Delivery Van (Diesel LCY)
3 Van and Bus (Diesel LCY)
4 Chassis Cab (Diesel LCY) (Except UK)
5 Chassis Cab (Kent and Diesel LCX) (Except UK)
6 Parcel Delivery Van (Kent and Diesel LCX)
7 Van and Bus (Kent and Diesel LCX)
8 Chassis Cab (Kent and Diesel LCX and LCY) (UK only)

GENERAL DESCRIPTION (cont'd)

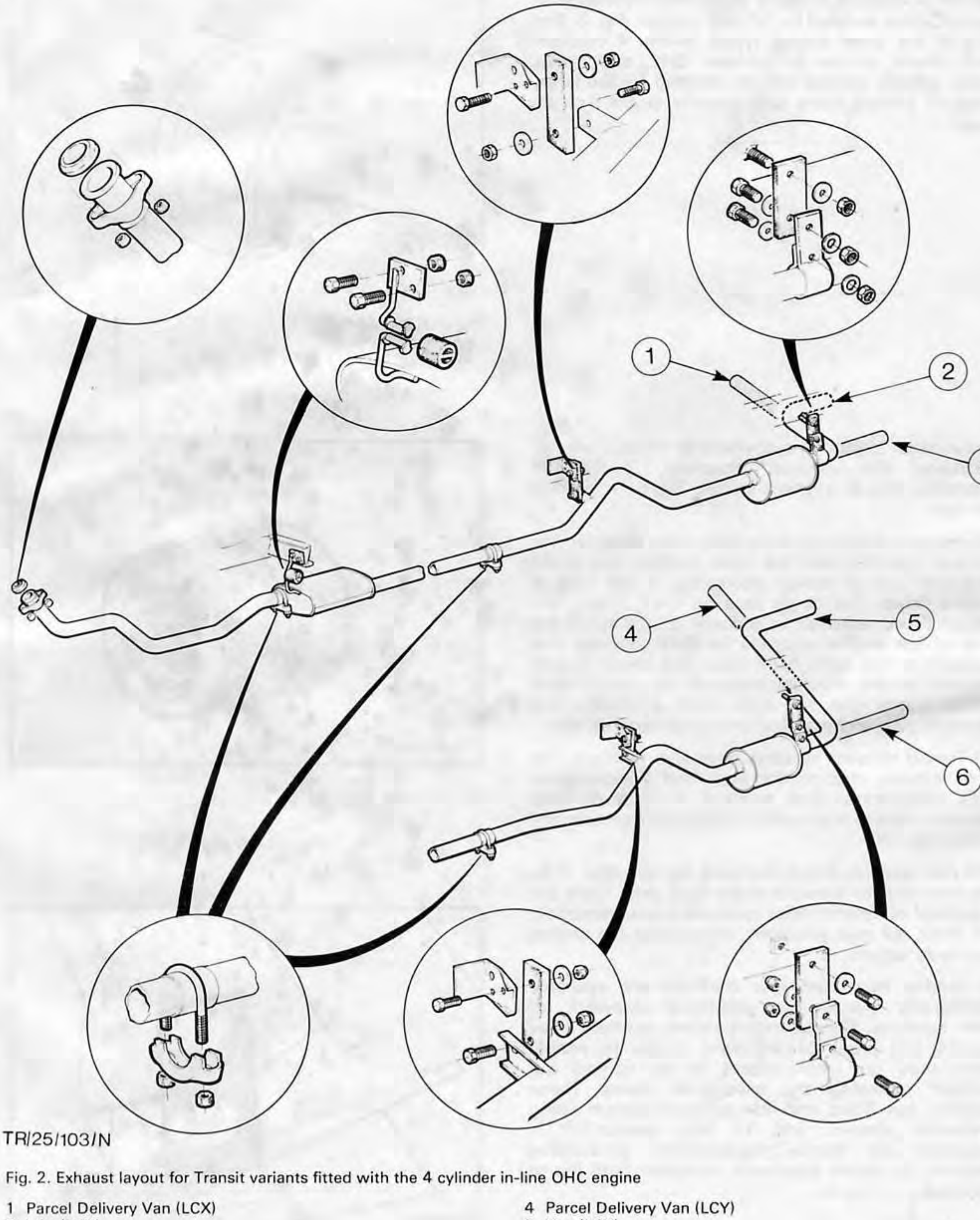


Fig. 2. Exhaust layout for Transit variants fitted with the 4 cylinder in-line OHC engine

1 Parcel Delivery Van (LCX)
2 Van (LCX)
3 Chassis Cab (LCX)
4 Parcel Delivery Van (LCY)
5 Van (LCY)
6 Chassis Cab (LCY)

GENERAL DESCRIPTION (cont'd)

The exhaust system on the Transit range consists of a series of exhaust sections assembled by means of sleeved joints secured by 'U' bolt clamps, Fig. 3. For each of the three engine types, in-line 4 cylinder OHV (Kent), in-line 4 cylinder OHC and Yorks Diesel, a basic system can be adopted for the large range of vehicle sizes and variants in the Transit range.

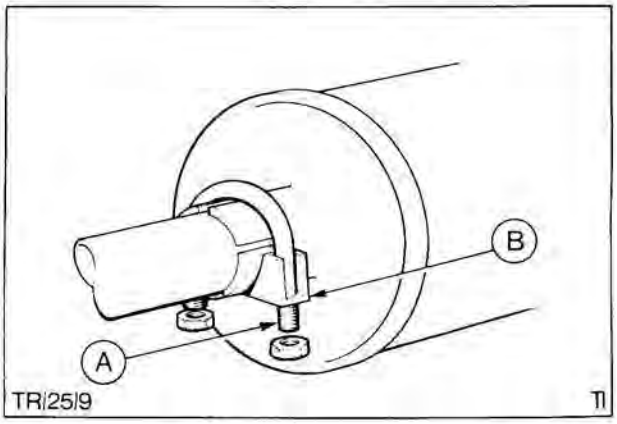


Fig. 3. 'U' bolt clamp
A – 'U' bolt
B – Clamp

The exhaust system is suspended at three locations, excluding the exhaust manifold, by rubber insulators, Fig. 4, support straps, Fig. 5, or bracket clamps

All systems employ a single down pipe between the exhaust manifold and the front muffler. This down pipe will vary in design according to the type of engine fitted. The down pipe on OHV (Kent) and Diesel (York) variants is secured to the left hand side of the engine whereas on OHC variants it is secured to the right hand side. The down pipe is secured to the exhaust manifold by means of a flange clamp and two nuts, with a sealing ring between pipe and manifold on petrol variants only.

All Transit exhaust systems have two mufflers. The front exhaust section, for Kent and York variants only, incorporates both mufflers whereas on OHC variants there is one muffler in the front section and one in the rear.

The rear section, which includes the tail pipe, joins the front section forward of the back axle. There are a number of different rear sections to accommodate the three tail pipe positions, throughout the engine and body ranges.

In service front and rear mufflers are available individually without the additional pipework for their sections. Service replacement mufflers have special end pipes of sufficient length to enable more than one replacement to be carried out without renewing the associated pipes. These mufflers are fitted into the exhaust system using connector sleeves and 'U' bolt clamps. It is important to follow replacement procedures carefully to obtain maximum utilization and life of all pipes.

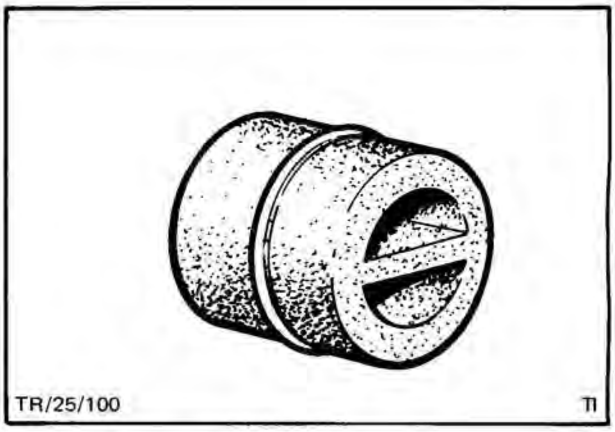


Fig. 4. Rubber insulator

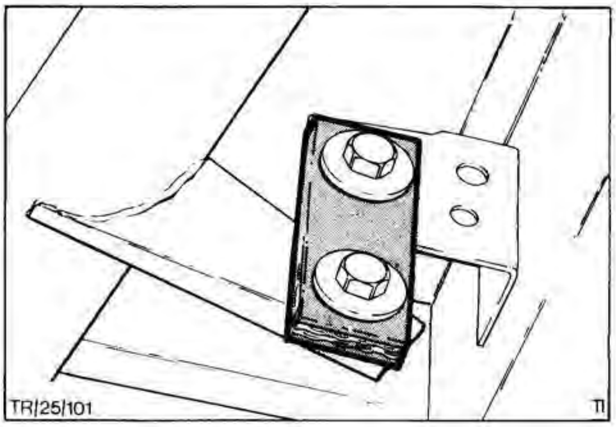


Fig. 5. Support strap

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals, the following items should be carefully checked.

1. **First service only – All engine variants.**

   Check the exhaust manifold and down pipe bolts and nuts for correct tightness.

2. Check for exhaust leaks.

   All exhaust system joints should be checked.

3. Visually check the entire exhaust system for signs of corrosion and damage.

4. Check alignment, condition and security of all exhaust hangers, brackets and rubber insulators.

SPECIAL SERVICE TOOL RECOGNITION

British Sourced	European Sourced	German Sourced	Tool Name
			No special service tools required.

SERVICE AND REPAIR OPERATIONS CONTENT

EXHAUST SYSTEM		Described in this publication	Contained in operation
25 204	Exhaust system – replace	X	
25 223	Muffler – front – replace	X	
25 243	Muffler – rear – replace	X	
25 261	Exhaust pipe – front left – replace	X	
25 263	Exhaust pipe – front right – replace	X	
25 293	Seal – manifold to exhaust pipe – replace	—	25 204
25 424	Support straps – exhaust mounting – replace (all)	X	
25 454	Bracket – exhaust mounting – remove and install	X	

SERVICE AND REPAIR OPERATIONS

25 204 EXHAUST SYSTEM – REPLACE (OHV and Diesel Engine Variants)

Special Service Tools Required: None

NOTE:

1. The exhaust system is suspended by rubber insulators and hangers, and by support straps with bracket clamps mounted to designated points on the chassis. The method of suspension may vary depending on body variant.
2. Apply some easing oil to all nuts, bolts, clamps and joints to be separated prior to working on vehicle. This will assist in freeing tight joints and hardware.

To Remove

1. Place vehicle on a ramp or over a pit, open hood and fit fender covers.
2. Remove 'U' bolt that secures rear pipe section to front muffler section.
3. Remove lower bolt from both support straps, Figs. 6 and 7. This allows free movement of the rear pipe.
4. Separate rear pipe section from front muffler section by twisting pipe in alternate directions and sliding clear of vehicle. Remove bracket clamp noting which way round it is fitted.

   NOTE: If necessary, separate sections by cutting, as complete system is being discarded.

   If it is desired to re-use the exhaust support bracket clamp, loosen nut and bolt and slide clamp from tail pipe.

5. Disconnect exhaust front down pipe from exhaust manifold by removing two nuts and allow down pipe free movement, Fig. 8. Remove sealing ring (where fitted) and retain.
6. Disconnect front muffler section from its support point by unhooking rubber insulator from hanger, Fig. 9. Guide exhaust clear of vehicle.
7. Remove 'U' bolt clamp that secures front down pipe to front muffler section. Separate down pipe and muffler, by cutting, if necessary as complete system is being discarded. Remove manifold clamp ring from down pipe.

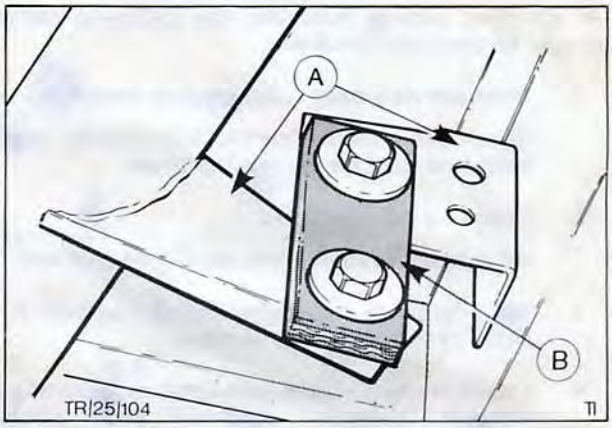


Fig. 6. Front support of rear tail pipe
A – Welded brackets
B – Support strap

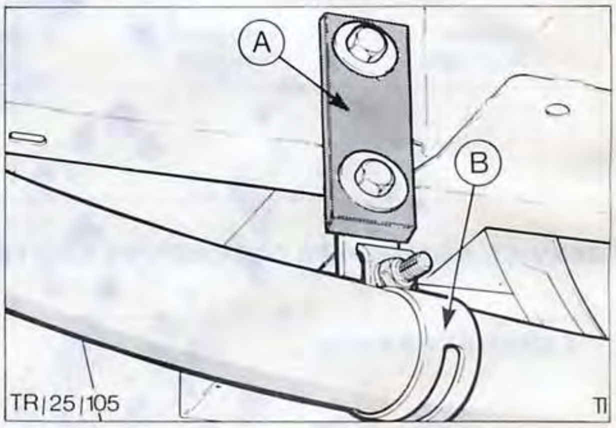


Fig. 7. Rear support of rear tail pipe
A – Support strap
B – Bracket clamp
Note: Bracket clamp is reversed for certain body variants

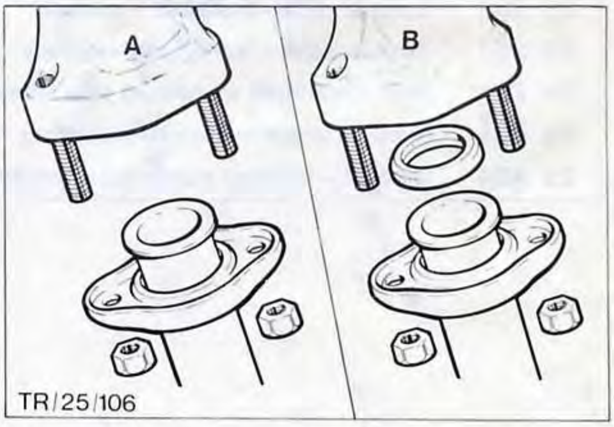


Fig. 8. Exhaust manifold front down pipe clamp
A – Diesel variants without sealing ring
B – Petrol variants with sealing ring

To Replace

8. Clean all contact surfaces of manifold, manifold clamp and, where fitted, sealing ring (only fitted to petrol variants) with emery cloth to remove any carbon build up. Examine all exhaust supports, bracket clamps, support straps and rubber insulator to see if they are suitable for re-use. Renew if necessary.

9. Slide manifold clamp ring onto the front down pipe and loosely fit tail pipe bracket clamp to rear pipe section.

   NOTE: Care must be taken to fit tail pipe bracket clamp correct way round for particular body variants, as noted in sub-operation 4.

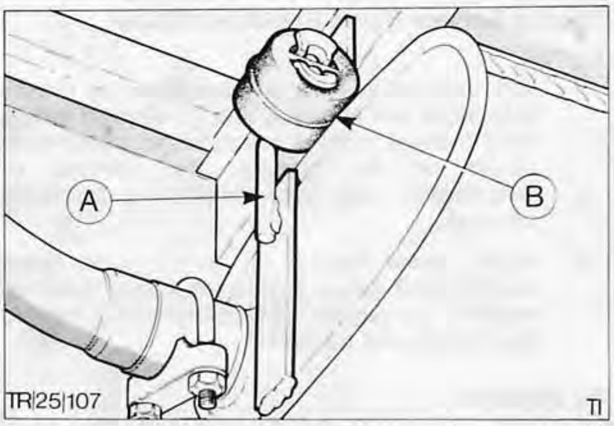


Fig. 9. Front mounting
A – Exhaust hanger
B – Rubber insulator

10. Connect front muffler section to front down pipe, using an exhaust sealer on the joint, to ensure a gas tight fit, Fig. 10.

11. Loosely secure the joint with 'U' bolt clamp. Position this combined section (front muffler section and down pipe) under the vehicle.

12. Suspend this section from the front rubber insulator and secure down pipe to manifold (on petrol variants insert manifold sealing ring). Do not fully tighten manifold clamp nuts at this stage.

13. Position rear section of pipe under vehicle and connect front and rear sections, using an exhaust sealer on the joint to ensure a gas tight fit.

14. Connect two remaining support straps but only loosely tighten the nuts and bolts.

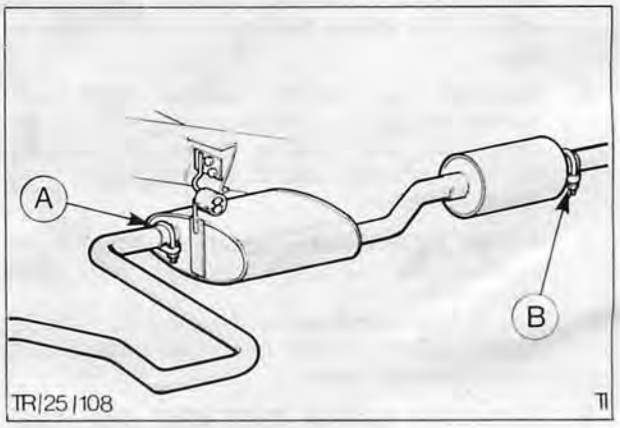


Fig. 10. Front muffler section
A – Join between front down pipe and front muffler
B – Join between front muffler and rear pipe section

15. Loosely secure joint between front and rear sections with 'U' bolt clamp, Fig. 11.

16. Align complete system ensuring there is no strain or slackness on exhaust insulator and support straps. Ensure that complete system does not touch the vehicle body or foul other components. Check that the down pipe is seating properly at manifold connection.

17. Securely tighten all 'U' bolt clamps, support and insulation strap fixings and the exhaust manifold clamp.

18. Start engine and check to ensure that there are no exhaust leaks.

19. Remove fender covers, close hood and remove vehicle from ramp or from over pit.

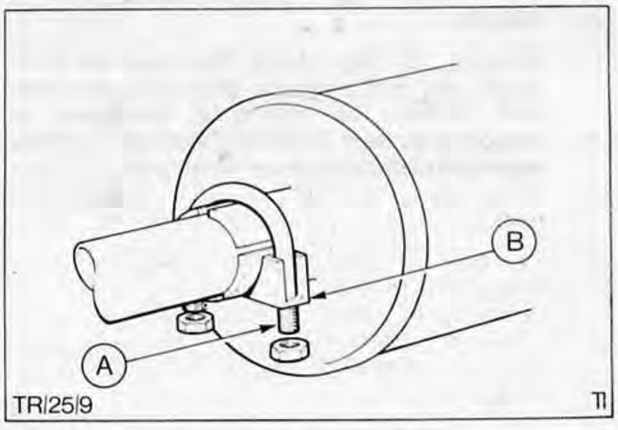


Fig. 11. Typical 'U' bolt clamp joint
A – 'U' bolt
B – Clamp

25 204 EXHAUST SYSTEM – REPLACE (OHC)

Special Service Tools Required: None

NOTE:

1. The exhaust system is suspended by rubber insulators and hangers, and by support straps with bracket clamps mounted to designated points on the chassis. The method of suspension may vary depending on body variants.
2. Apply some easing oil to all nuts, bolts clamps and joints to be separated prior to working on vehicle. This will assist in freeing tight joints and hardware.

To Remove

1. Place vehicle on a ramp or over a pit, open hood and fit fender covers, and disconnect the battery.
2. Remove 'U' bolt that secures rear muffler section to front muffler section.
3. Remove lower bolt from each of the support straps. This allows free movement of the rear pipe.
4. Separate rear muffler section from front muffler section by twisting pipe in alternate directions and sliding clear of vehicle. Remove bracket clamp noting which way round it is fitted.

   NOTE: If necessary, separate sections by cutting, as complete system is being discarded.
   If it is desired to re-use the exhaust support bracket clamp, loosen nut and bolt and slide clamp from tail pipe.
5. Disconnect exhaust front down pipe from exhaust manifold by removing two nuts and allow down pipe free movement. Remove manifold sealing ring, Fig. 12.
6. Disconnect front muffler section from its support point by unhooking rubber insulator from hanger, Fig. 13. Guide exhaust clear of vehicle.
7. Remove 'U' bolt clamp that secures front down pipe and mufflers. Separate down pipe and muffler, by cutting if necessary as complete system is being discarded. Remove manifold clamp ring from down pipe.

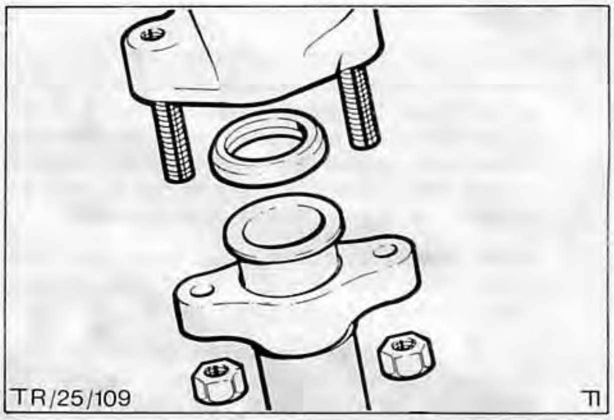


Fig. 12. Exhaust manifold/front down pipe clamping with sealing ring

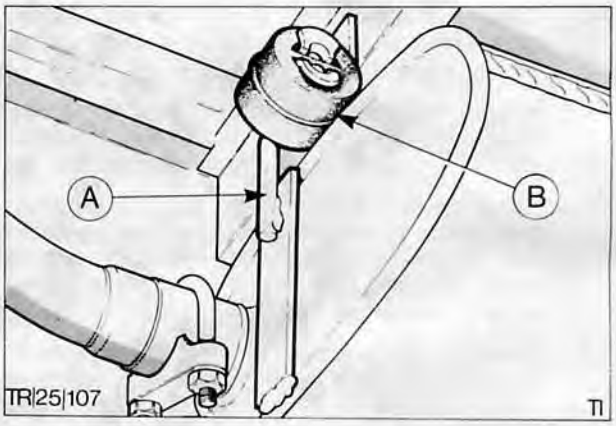


Fig. 13. Front mounting
A – Exhaust hanger
B – Rubber insulator

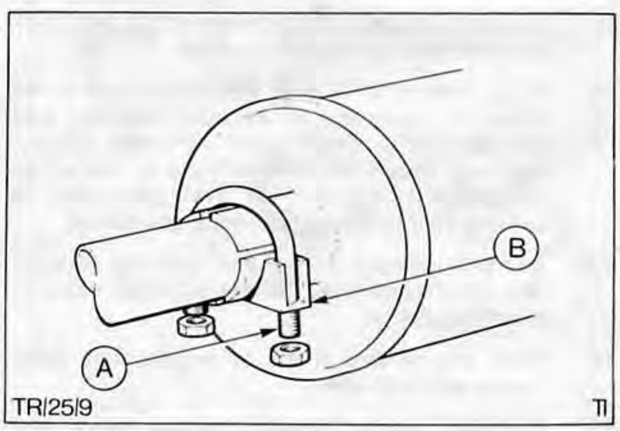


Fig. 14. Typical 'U' bolt clamp joint
A – 'U' bolt
B – Clamp

To Replace

8. All contact mating surfaces of manifold, manifold clamp and sealing ring must be cleaned with emery cloth to remove any carbon build up. Examine all exhaust supports, bracket clamps, support straps and rubber insulators to see if they are suitable for re-use.
   Renew if necessary.
9. Slide manifold clamp ring onto the front down pipe, and loosely fit tail pipe bracket clamp to rear pipe section.

   NOTE: Care must be taken to fit tail pipe bracket clamp correct way round for particular body variants, as noted in sub-operation 4.
10. Connect front muffler section to front down pipe, using an exhaust sealer on the join, to ensure a gas tight fit.
11. Loosely secure the joint with 'U' bolt clamp. Position this combined section, (front muffler section and down pipe), under the vehicle, Fig. 15.
12. Suspend this section from the front rubber insulator and secure down pipe to manifold remembering to insert manifold sealing ring. Do not fully tighten manifold clamp nuts at this stage.
13. Position rear section of pipe under vehicle and connect front and rear sections, using an exhaust sealer on the joint to ensure a gas tight fit.
14. Connect the two remaining support straps but only loosely tighten the nuts and bolts, Figs. 16 and 17.
15. Loosely secure joint between front and rear muffler sections with 'U' bolt clamp.
16. Align complete system ensuring there is no strain or slackness on exhaust insulator and support straps. Ensure that the complete system does not touch the vehicle body or foul other components. Check that the down pipe with the sealing ring is seating properly at the manifold connection.
17. Securely tighten all 'U' bolt clamps, support and insulation strap fixings and the exhaust manifold clamp.
18. Connect battery, start engine and check all joints for exhaust leakage.
19. Remove fender covers, close hood and remove vehicle from ramp or from over pit.

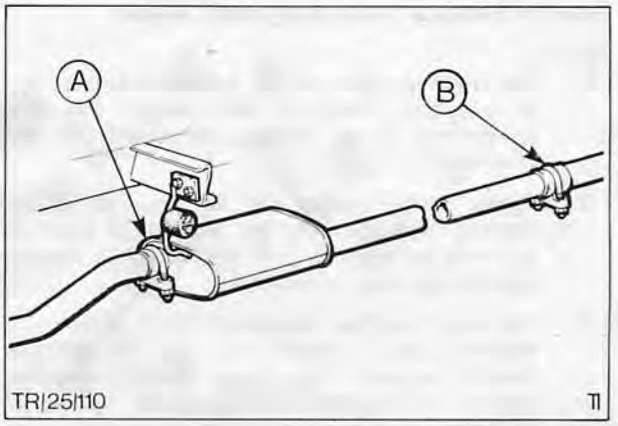


Fig. 15. Front muffler section
A – Join between front down pipe and front muffler
B – Join between front and rear muffler sections

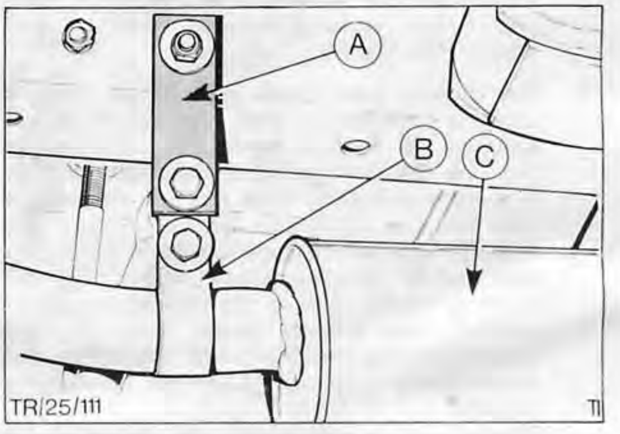


Fig. 16. Rear support of rear muffler section
A – Support strap
B – Bracket clamp
C – Rear muffler
NOTE: Bracket clamp is reversed for certain body variants

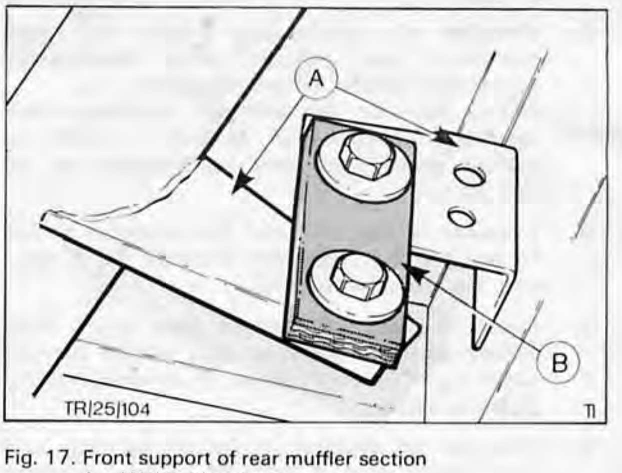


Fig. 17. Front support of rear muffler section
A – Welded brackets
B – Support Strap

25 223 MUFFLER – FRONT – REPLACE

Special Service Tools Required: None

NOTE:

1. The front muffler section is suspended by use of a rubber insulator and hanger, Fig. 18, connected to a bracket mounted on the chassis.
2. Apply some easing oil to all nuts, bolts, clamps and joints to be separated prior to working on vehicle. This will assist in freeing tight joints and hardware.
3. The front muffler section of OHC variants is available as a muffler only and on OHV and Diesel variants the front tandem muffler section is available as separate individual mufflers.

To Remove

1. Place vehicle on a ramp or over a pit.
2. Remove 'U' bolt clamp that secures front muffler section to front down pipe. On OHV and Diesel variants remove rear 'U' bolt clamp, B in Fig. 20.
3. Cut through front down pipe on all variants using a hacksaw at pipe change of section adjacent to muffler connection, arrowed in Fig. 18. On OHC variants cut through pipe immediately behind front muffler, arrowed in Fig. 19. On OHV and Diesel variants cut through connecting pipe between front and rear muffler at mid-point, arrowed in Fig. 20. If it is found that a service replacement muffler has already been fitted in the prescribed manner the pipes should be cut immediately outboard of the old connecting sleeves.
   These cutting operations are essential for removal of front muffler.
4. Unhook from rubber insulator, remove and discard old parts.

To Replace

5. Examine new parts and ensure that pipe diameters will match, using appropriate connector sleeves where necessary.
   NOTE: Service replacement mufflers have special end pipes of sufficient length to enable more than one replacement to be carried out.
6. Examine rubber insulator and support straps to ensure that they are suitable for further use. Renew if necessary.
7. Clean contact surfaces of pipe joints with emery cloth to remove any carbon or rust build up. Cut new pipes to enable mating pipes to align.
8. Chamfer all leading edges of existing and new pipes with a fine file. Apply a small amount of grease to assist sliding and use an exhaust sealer to ensure a gas tight fit on all joints.

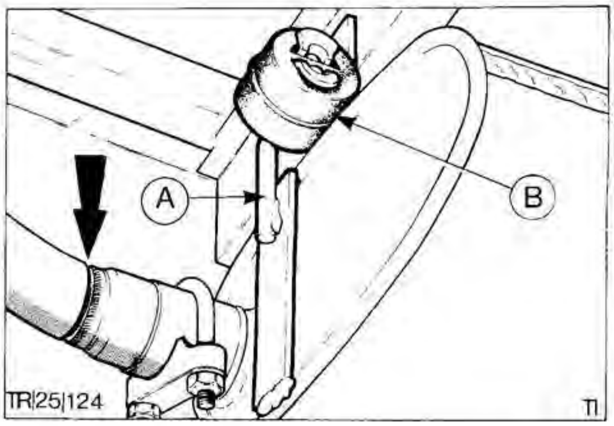


Fig. 18. Front mounting
A – Exhaust hanger
B – Rubber insulator
NOTE: Suitable cutting point arrowed, for all variants

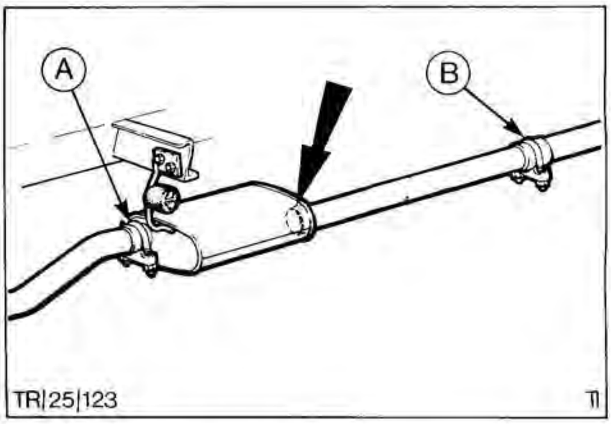


Fig. 19. Front muffler section of OHC variants
A – Join between front down pipe and front muffler
B – Join between front and rear muffler section
NOTE: Suitable cutting point arrowed

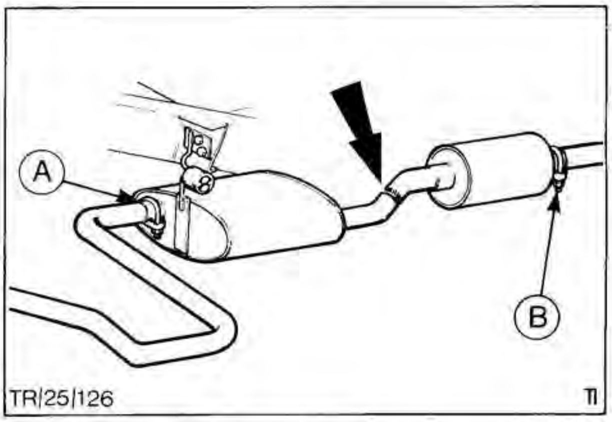


Fig. 20. Front muffler section of OHV and Diesel variants
A – Join between front down pipe and front muffler
B – Join between front muffler and rear pipe section
NOTE: Suitable cutting point arrowed

9. Align new section and connect to the front down pipe using sleeve connector. By twisting in alternative directions or by tapping with a soft mallet slide muffler far enough to enable rear muffler section to be connected. Connect rear pipe section using sleeve connector. Ensure correct alignment of new section to ensure that there is no fouling or any contact with body.
10. Suspend front muffler section from rubber insulator.
11. Fit 'U' bolt clamps to all joints and tighten securely.
12. Start engine and check all joints to ensure there are no exhaust leaks.
13. Remove vehicle from ramp or over a pit.

25 243 MUFFLER – REAR – REPLACE

Special Service Tools Required: None

NOTE:

1. The rear muffler section is suspended by use of support straps with bracket clamp mounted to designated points on the chassis. The method of suspension may vary depending on body variant.
2. Apply some easing oil to all nuts, bolts, clamps and joints to be separated prior to working on vehicle. This will assist in freeing tight joints and hardware.
3. The rear muffler section for OHC variants is available as a muffler only and on OHV and Diesel variants the front tandem muffler section is available as separate individual mufflers.

To Remove

1. Place vehicle on a ramp or over a pit.
2. Remove 'U' bolt clamp that secures rear muffler section to front muffler section on OHV and Diesel variants only.
3. Remove lower bolt from both support straps, OHC variants only. This allows free movement of the rear pipe, Figs. 16 and 17.
4. On OHV and Diesel variants cut pipe midway between front and rear mufflers, arrowed in Fig. 20. On OHC variants cut through pipe immediately in front of rear muffler, arrowed in Fig. 21. Cut through rear tail pipe immediately adjacent to rear muffler on all variants, Figs. 22 and 23.
   If it is found that a service replacement muffler has already been fitted in the prescribed manner the pipes should be cut immediately outboard of the old connecting sleeves.
   Remove bracket clamp noting which way round it is fitted, OHC variants only.
   NOTE: If it is desired to re-use the exhaust support bracket clamp, loosen nut and bolt and slide clamp from tail pipe.

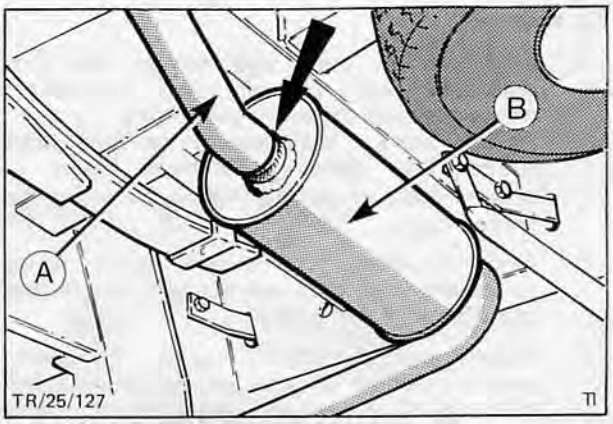


Fig. 21. Front cutting point of rear muffler section on OHC variants, (arrowed)
A – Front pipe of rear muffler section
B – Rear muffler

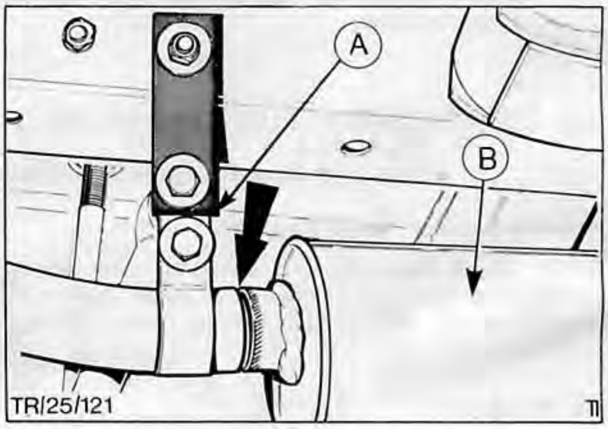


Fig. 22. Rear cutting point of rear muffler section on OHC variants, (arrowed)
A – Support strap/bracket clamp
B – Rear muffler

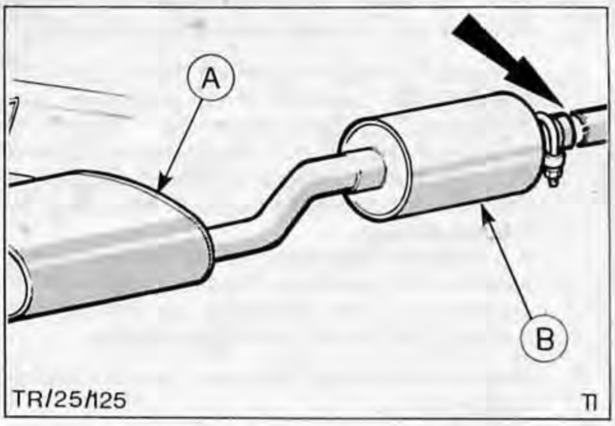


Fig. 23. Rear cutting point for rear muffler on OHV and Diesel variants, (arrowed)
A – Front muffler
B – Rear muffler

25 243 (cont'd)

To Replace

5. Examine new parts and ensure that pipe diameters will match, using appropriate connector sleeves, where necessary.
NOTE: Service replacement mufflers have special end pipes of sufficient length to enable more than one replacement to be carried out.

6. Examine rubber insulator and support straps to ensure that they are suitable for further use. Renew if necessary.

7. Clean contact surfaces of the pipe joints with emery cloth to remove any carbon or rust build up. Cut new and old pipe to enable mating pipes to align.

8. Chamfer all leading edges of existing pipes and the new pipes, with a fine file.

9. Apply small amount of grease to assist sliding of pipe connectors. Slide connectors onto existing pipes, far enough for new muffler section to align.

10. Align and secure new muffler section with connector sleeves, using an exhaust sealer on the joints to ensure a gas tight fit.

11. Connect the two support straps, OHC variants only, and fit 'U' bolt clamp to joints. Check system ensuring that there is no strain or slackness on the supports and that system is not touching the vehicle body at any point or fouling other components.

12. Tighten 'U' bolt clamps and support strap bolts securely. Start engine and check for exhaust leaks.

13. Remove vehicle from ramp or over a pit.

25 261 EXHAUST PIPE – FRONT, LEFT – REPLACE (OHV and Diesel Engine Variants)

Special Service Tools Required: None

NOTE: Apply some easing oil to all nuts, bolts, clamps and joints to be separated prior to working on vehicle, this will assist in freeing tight joints and hardware.

To Remove

1. Place vehicle on a ramp or over a pit, open hood, fit fender covers and disconnect battery.

2. Disconnect front down pipe from exhaust manifold and allow clamp ring to slide down pipe, to clear securing studs. On petrol variants only, remove sealing ring, Fig. 24.

3. Remove 'U' bolt clamp from down pipe/front muffler joint. Separate down pipe from front muffler, Fig. 25. If down pipe cannot be separated refit 'U' bolt clamp and cut pipe in front of muffler leaving sufficient old pipe to use connector sleeve to join new pipe to muffler section.
If it is found that a service replacement down pipe has already been fitted in the prescribed manner the pipe should be cut immediately outboard of the old connecting sleeve.

4. Remove front down pipe and detach manifold clamp ring.

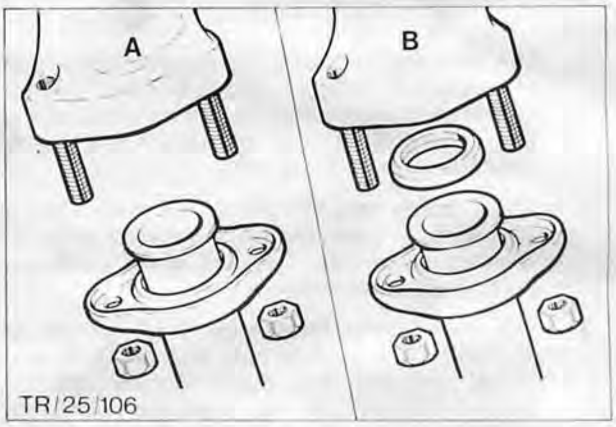


Fig. 24. Exhaust manifold front down pipe clamp
A – Diesel variants without sealing ring
B – Petrol variants with sealing ring

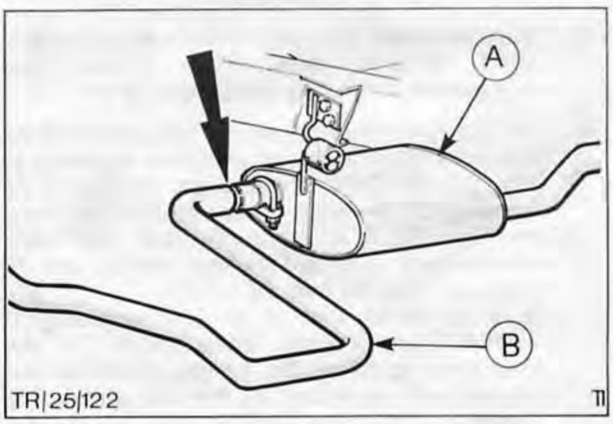


Fig. 25. Join between front muffler section and front down pipe
A – Front muffler
B – Down pipe
NOTE: Suitable cutting point arrowed

To Replace

5. Check that rubber insulator, supporting front muffler, is suitable for further use. Renew if necessary.
6. Clean contact surfaces of sealing ring (petrol variants only), manifold and manifold clamp ring with emery cloth to remove any carbon build up.
7. Chamfer leading edges of the front muffler and down pipe joint with fine file.
8. Apply a small amount of grease to the down pipe where it enters the front muffler section and some exhaust sealer on the joint, to ensure a gas tight fit.
9. Slide manifold clamp ring onto front down pipe. Align down pipe and assemble it to front muffler. When connector sleeve is used, cut and file new down pipe to align with old pipe and assemble it with connector to muffler section.

   Insert metal sealing ring (where applicable) between manifold and down pipe, align manifold clamp and assemble. Do not fully tighten at this stage.
10. Fit, but do not fully tighten, 'U' bolt clamps to new joints, Fig. 26.
11. Ensure correct seating of pipe at manifold connection. Securely tighten exhaust manifold clamp and 'U' bolt clamps.
12. Connect battery, start engine and check to ensure there are no exhaust leaks.
13. Remove fender covers and close hood. Remove vehicle from ramp or over pit.

25 263 EXHAUST PIPE – FRONT, RIGHT – REPLACE (OHC)

Special Service Tools Required: None

NOTE: Apply some easing oil to all nuts, bolts, clamps and joints to be separated prior to working on vehicle, this will assist in freeing tight joints and hardware.

To Remove

1. Place vehicle on a ramp or over a pit, open hood, fit fender covers and disconnect battery.
2. Disconnect front down pipe from exhaust manifold and allow clamp ring to slide down pipe to clear securing studs. Remove sealing ring, Fig. 27.
3. Remove 'U' bolt clamp from down pipe/front muffler joint. Separate down pipe from front muffler, Fig. 28. If down pipe cannot be separated refit 'U' bolt clamp and cut pipe in front of muffler leaving sufficient old pipe to use connector sleeve to join new pipe to muffler section.

   If it is found that a service replacement down pipe has already been fitted in the prescribed manner the pipe should be cut immediately outboard of the old connecting sleeve.
4. Remove front down pipe and remove manifold clamp ring.

To Replace

5. Check that rubber insulator supporting front muffler is suitable for further use. Renew if necessary.
6. Clean contact surfaces of sealing ring, manifold and manifold clamp ring with emery cloth to remove any carbon build-up.

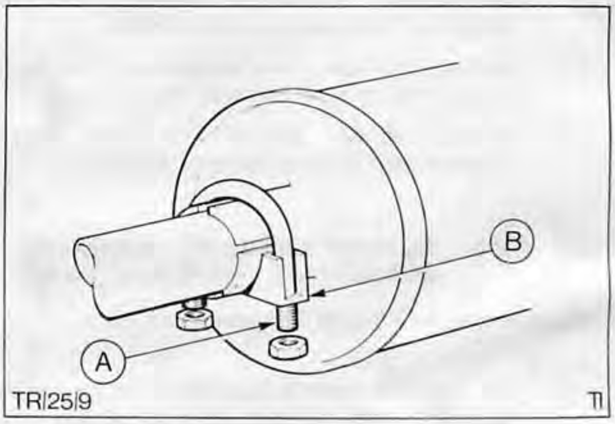


Fig. 26. Typical 'U' bolt clamp joint
A – 'U' bolt
B – Clamp

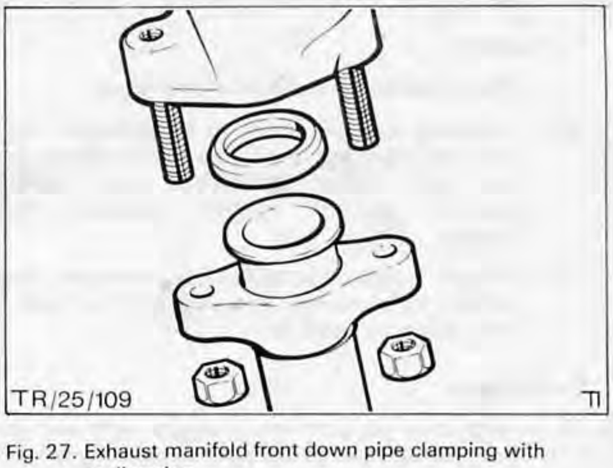


Fig. 27. Exhaust manifold front down pipe clamping with sealing ring

7. Chamfer leading edges of the front muffler and down pipe joint with a fine file.
8. Apply a small amount of grease to the down pipe, where it enters the front muffler section and use exhaust sealer on the joint, to ensure a gas tight fit.
9. Slide manifold clamp ring onto front down pipe. Align down pipe and assemble it to front muffler. When connector sleeve is used, cut and file new down pipe to align with old pipe and assemble it with connector to muffler section.

   Insert metal sealing ring between manifold and down pipe, align manifold clamp and assemble.
   Do not fully tighten at this stage.
10. Fit, but do not fully tighten, 'U' bolt clamps to all joints.
11. Ensure correct seating of pipe and manifold connection. Securely tighten exhaust manifold clamp and 'U' bolt clamps.
12. Connect battery, start engine and check to ensure there are no exhaust leaks.
13. Remove fender covers and close hood. Remove vehicle from ramp or over pit.

25 424 SUPPORT STRAPS – EXHAUST MOUNTING – REPLACE (ALL)

Special Service Tools Required: None

NOTE:
1. The exhaust system is suspended by rubber insulators and hangers, and by straps with bracket clamps mounted to designated points on the chassis. The method of suspension may vary depending on body variant.
2. To assist in dismantling support straps apply some easing oil to all nuts and bolts to be separated prior to working on vehicle.

To Remove

1. Place vehicle on a ramp or over a pit.
2. Separate support strap to be renewed from exhaust pipe by removing the securing nut and bolt. When renewing front muffler support, unhook rubber insulator from hanger.
3. Detach support strap/rubber insulator from vehicle by removing securing nut and bolt or unhooking as need be.

To Replace

4. Align new support strap, secure with nut and bolt. Remember to refit the relevant washers.

   If renewing rubber insulator, Fig. 29, hook insulator onto chassis bracket.

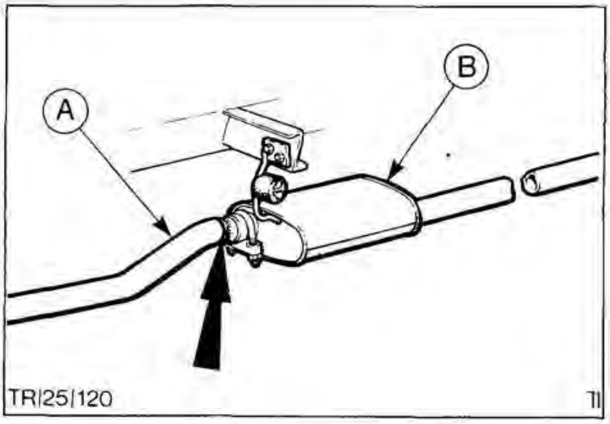


Fig. 28. Join between front muffler section and front down pipe
A – Front down pipe
B – Front muffler section
NOTE: Suitable cutting point arrowed

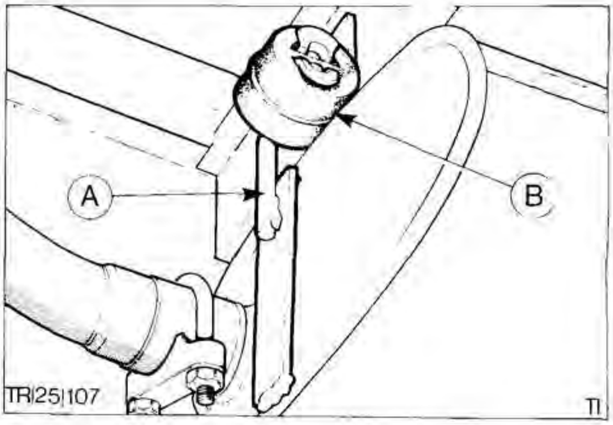


Fig. 29. Front mounting
A – Exhaust hanger
B – Rubber insulator

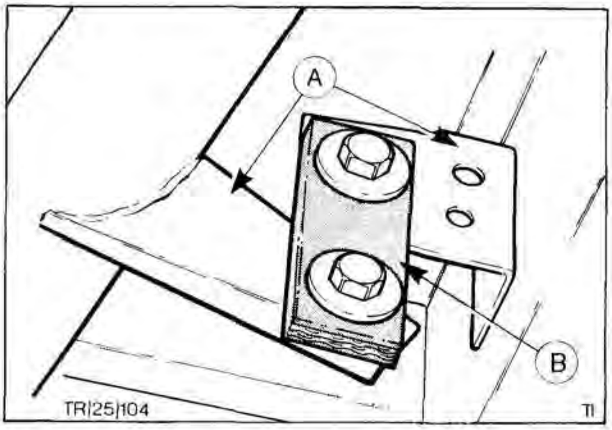


Fig. 30. Front support of rear tail pipe
A – Welded brackets
B – Support strap

5. Align exhaust hanger to support strap. Position and secure support to exhaust with nut and bolts, remembering to refit any washers, Fig. 30 and 31. For rubber insulator, align and reconnect by hooking it on the hanger.
6. Ensure that there is no undue strain or slackness of the support strap/rubber insulator and that they are hanging vertically.
7. Repeat the above operations 2 to 6 for the remaining two exhaust supports.
8. Check to see that the system is not fouling or touching the underbody or other components.
9. Remove vehicle from ramp or from over a pit

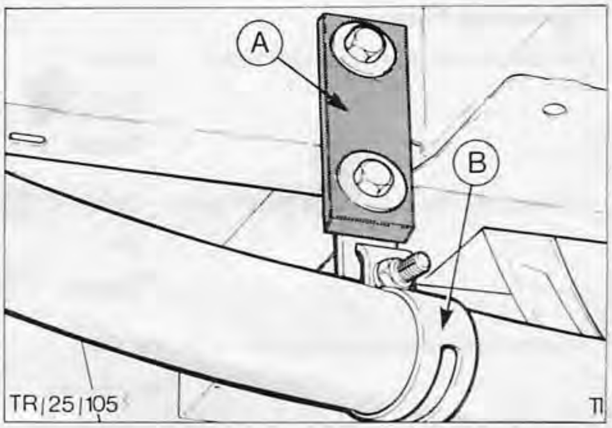


Fig. 31. Rear support of rear tail pipe (OHV/Diesel variant illustrated)
A – Support strap
B – Bracket clamp

25 454 BRACKET – EXHAUST MOUNTING – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: To assist in dismantling the exhaust mounting bracket/support strap apply some easing oil to all nuts and bolts to be separated prior to working on vehicle.

To Remove

1. Place vehicle on a ramp or over a pit.
2. Separate support strap from exhaust mounting bracket by removing the securing nut and bolt, Figs. 32 and 33.
3. Loosen nut and bolt that secures bracket to exhaust pipe.
4. Slide bracket from exhaust pipe.

   NOTE: It is important to note which way round the bracket is mounted.

To Install

5. Clean bracket with wire brush to remove surface rust and dirt.
6. Slide bracket, correct way round as noted in sub operation 4, onto the pipe to align with the support strap.
7. Clamp bracket in vertical position, but do not fully tighten nut and bolt.
8. Connect support strap and fully tighten nut and bolt connecting this assembly.
9. Check that there is no strain or slackness on the support strap and that there is no fouling of pipe and bracket.
10. Fully tighten all nuts and bolts.
11. Remove vehicle from ramp or over a pit.

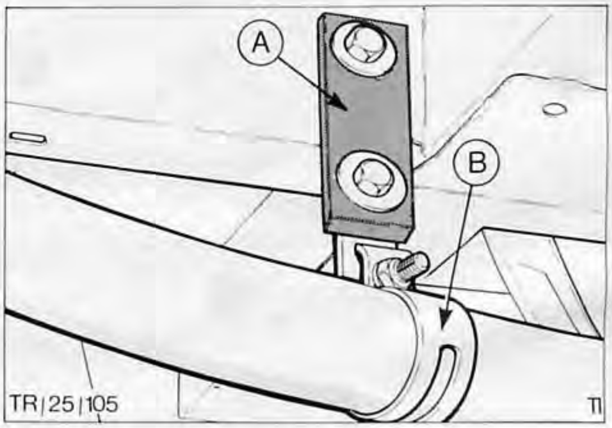


Fig. 32. Rear support of rear tail pipe on OHV and Diesel variants
A – Support strap
B – Bracket clamp
NOTE: Bracket clamp is reversed for certain variants

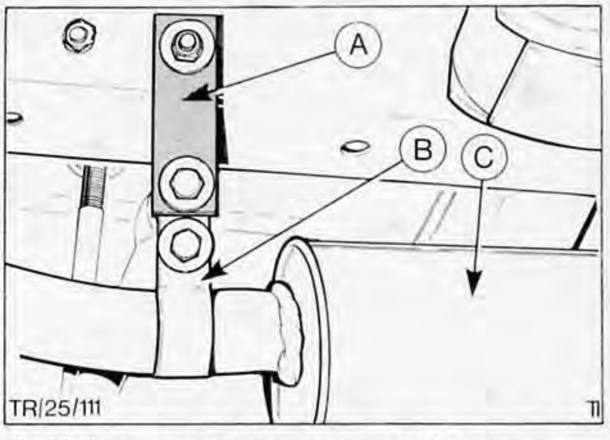


Fig. 33. Rear support of rear muffler section OHC variants
A – Support strap
B – Bracket clamp
C – Rear muffler
NOTE: Bracket clamp is reversed for certain variants

TECHNICAL DATA

Tightening Torques		**Nm**	**kgf.m**	**lbf.ft**
Exhaust manifold to cylinder head	OHV	21 – 25	2,1 – 2,5	15,5 – 18,4
	OHC	21 – 25	2,1 – 2,5	15,5 – 18,4
	Diesel	41 – 51	4,1 – 5,1	30,2 – 37,6
Exhaust manifold to front down pipe –	OHV	21 – 26	2,1 – 2,6	15,5 – 19,2
	OHC	35 – 40	3,5 – 4,0	25,8 – 29,5
	Diesel	21 – 26	2,1 – 2,6	15,5 – 19,2
Rubber Insulator retaining bolt with	M8 nuts	8 – 10	0,8 – 1,0	5,9 – 7,4
	M10 nuts	14 – 17	1,4 – 1,7	10,3 – 12,5
Exhaust brackets – retaining nuts/bolts		8 – 10	0,8 – 1,0	5,9 – 7,4

EXTERIOR LIGHTS, DIRECTION INDICATORS, HORN AND WINDSCREEN WIPERS

32

Index **Page**

GENERAL DESCRIPTION

Exterior Lights and Direction Indicators

The Ford Transit is equipped with either round or square headlamps. Four types of headlamps are available, depending on model variant. These are a round 40/45 watt sealed beam unit, round semi-sealed unit with a 40/45 watt tungsten bulb, and a square semi-sealed unit with a 55/60 watt halogen bulb. The bulbs are retained and protected in each headlamp by a bulb retainer and multi-plug. Sidelamp bulbs are fitted to each headlamp unit.

The headlamp alignment is obtained by tilting the complete headlamp unit, by means of two screws. These screws are accessible from outside the vehicle, after removal of the headlamp surround on square headlamp variants.

The front direction indicator lamps are separate from the headlamps, and are retained by means of screws in the front fenders. The bulbs are mounted in a bulb holder and are accessible after removal of the direction indicator lamp unit.

The rear exterior light clusters consist of tail and stop lights and direction indicators. These bulbs are mounted in the lamp unit, and are accessible from outside the vehicle after removal of the lamp lens. Below the rear lamp units are either red reflectors or combined back-up lamps and red reflectors.

Two single bulb lamp units are located in the rear panel and illuminate the number plate.

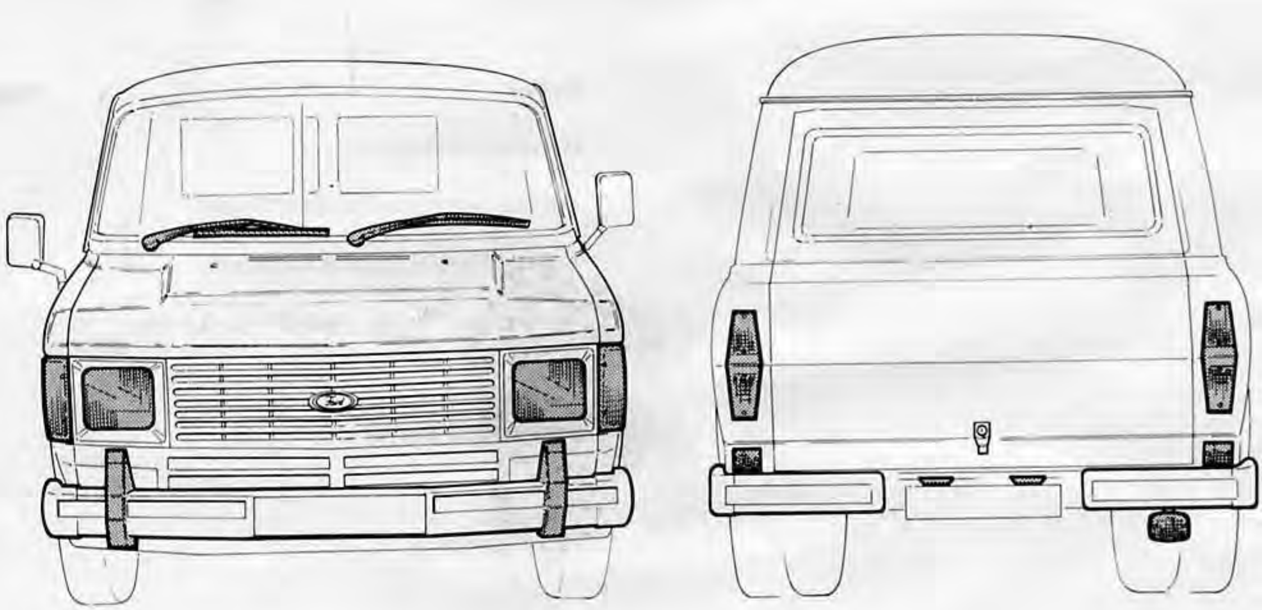


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Fig. 1. Front and rear components highlighted

GENERAL DESCRIPTION

Horn, Windscreen wiper/washers and Headlamp washers

Audible warning is provided by single or dual horns mounted forward of the radiator. Access to these is from within the engine compartment.

The front windscreen wiper motor is located in the passenger compartment and is coupled directly to the wiper linkage. The motor is a two speed self parking unit and is operated by a lever type switch mounted on the steering column.

An electrically operated pump supplies water to the windscreen washer system. The reservoir for the windscreen is mounted in the engine compartment.

Certain variants are equipped with headlamp washers. The system utilises a high pressure, single speed pump which draws water from the windscreen washer reservoir and pumps the water through large bore piping to two adjustable jets. One jet is mounted in each bumper overrider and is set to provide complete coverage of each headlamp lens with a high pressure jet of water. The jets are an integral part of the overriders.

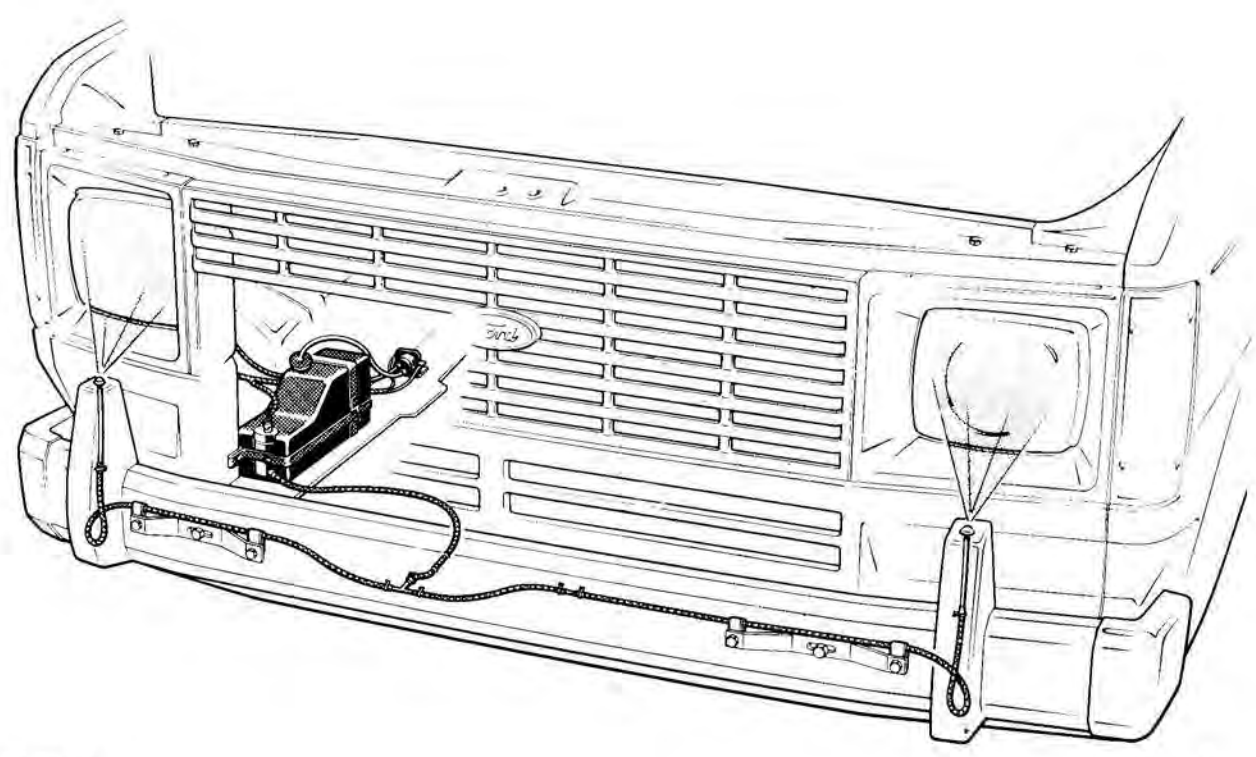

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Fig. 2. Headlamp washer system

GENERAL NOTE

The glass envelope of the headlamp bulb must not be touched with the fingers. If it is accidentally touched, the glass should be washed with methylated spirits and dried with a soft, dust-free cloth. The headlamp reflector must not be marked or touched.

The majority of the operations contained in this section entail disconnection of the battery for safety. If the battery has been disconnected, and the vehicle is equipped with a clock, the clock should be reset to the correct time on completion of the operation.

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following items should be checked:

Headlamp Alignment

1. Check and if necessary adjust the headlamp alignment at the specified service intervals or whenever the headlamp has been disturbed.
2. If proprietary beam setting equipment is not available, the procedure and alignment charts in this section should be used.

Headlamp and Screen Washers

1. Check correct operation. Ensure all nozzles are not blocked by foreign matter.
2. Check alignment of nozzles and adjust if necessary.

Lights, Horn and Wipers

1. Ensure that all exterior lights, horn and wipers are operating correctly, also that the wiper blades are in good order and 'park' correctly.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 32-002	Headlamp washer jet aligner

D/32/95

SERVICE AND REPAIR OPERATIONS CONTENT – PART 'A'

EXTERIOR LIGHTS, DIRECTION INDICATORS, HORN AND WINDSCREEN WIPERS		Described in this Publication	Contained in Operation	Unique to 78 Transit
32 113	Headlamps – align	X		X
32 115	Headlamp assembly – remove and install	X		X
32 127 4	Housing – headlamp – remove and install	X		X
32 143	Lens and reflector assembly – headlamp – replace	—	32 115	X
32 147	Bulb – headlamp – replace	X		X
32 207	Bulb – sidelamp – replace	X		X
32 225	Indicator assembly – front – remove and install	X		X
32 237	Bulb – front indicator – replace	X		X
32 335	Lamp – back-up – remove and install	X		X
32 347	Bulb – back-up lamp – replace	X		X
32 524	Motor – windscreen wiper – remove and install	X		X
32 554	Linkage – windscreen wiper – remove and install	—	32 524	X
32 563	Pivot shaft – replace	X		X
32 678	Nozzles – headlamp washer – remove and install	X		X
32 882	Motor – engine stop control – remove and install	X		X

SERVICE AND REPAIR OPERATIONS CONTENT – PART 'B'

EXTERIOR LIGHTS, DIRECTION INDICATORS, HORN AND WINDSCREEN WIPERS		Described in this publication	Also applicable to certain variants in the following model range						
			Contained in Operation	Transit '77	Fiesta	Escort '75 onwards	Capri II	Taunus '76 Cortina '77	Granada '78 onwards
32 305	Lamp assembly – rear – remove and install	X		X					
32 313	Lens – rear lamp – replace		32 305	X					
32 317	Bulb – rear – lamp – replace		32 305	X					
32 351	Fog lamp – rear – remove and install	X		X		X	X	X	
32 353	Bulb – fog lamp – rear – replace	X		X		X	X	X	
32 365	Lamp assembly – licence plate – remove and install	X		X					
32 377	Bulb – licence plate lamp – replace	X		X					
32 394	Reflector assembly – replace	X		X					
32 584	Blades – windscreen wiper – replace	—	32 586	X	X	X	X	X	X
32 586	Rubber – windscreen wiper blades – replace (both)	X		X	X	X	X	X	X
32 622	Reservoir – windscreen washer – replace	X		X					
32 624	Pump – windscreen washer – remove and install	X		X					
32 624	Pump – headlamp washer – remove and install	—	32 622						
32 634	Nozzles – windscreen washer – replace	X							
32 638	Hoses – windscreen washer – replace	X		X					
32 815	Horn – remove and install	X		X					

SERVICE AND REPAIR OPERATIONS – PART 'A'

32 113 HEADLAMPS – ALIGN

Where possible, headlamps should be aligned using proprietary beam setting equipment using specifications shown in the diagrams, and in accordance with equipment manufacturer's instructions.

Where beam setting equipment is not available, a suitable aiming board may be used as detailed in the following operation.

1. Position vehicle on level ground 10 metres (33 feet) in front of a suitable aiming board (a white board marked with vertical and horizontal lines, as shown below, Fig. 3 and placed in a suitably darkened area is recommended).
2. Ensure vehicle is unladen and tyre pressures are correct. Adjust if necessary.
3. Bounce vehicle to settle suspension.
4. Mark centre point of front and rear windows with wax crayon. On vehicles with hinged rear door, open one door and use the edge of the remaining closed door as a centre line.
5. Position board in front of vehicle such that vertical centre line and marks on windows are in line when viewed through rear window.
6. Raise or lower board so that horizontal line is at height 'H'-X from the ground, Fig. 3.
7. Switch on dipped beam headlamps.
8. Cover left-hand headlamp.
9. Adjust horizontal alignment of right-hand headlamp so that intersection of horizontal and angled light pattern, C, Fig. 3 coincides with vertical line on aiming board.

   NOTE: On vehicles with square headlamps, it will be necessary to remove the lamp surround screws and lamp surround to gain access to adjustment screws.
10. Adjust vertical alignment so that light/dark boundary of beam pattern B, Fig. 3 coincides with dotted line on aiming board.
11. Cover right-hand headlamp and repeat operations 9 and 10 for left-hand headlamp.
12. Switch off headlamps.
13. Replace lamp surround and secure with screws if removed in sub-operation 9. Clean crayon marks from windows.

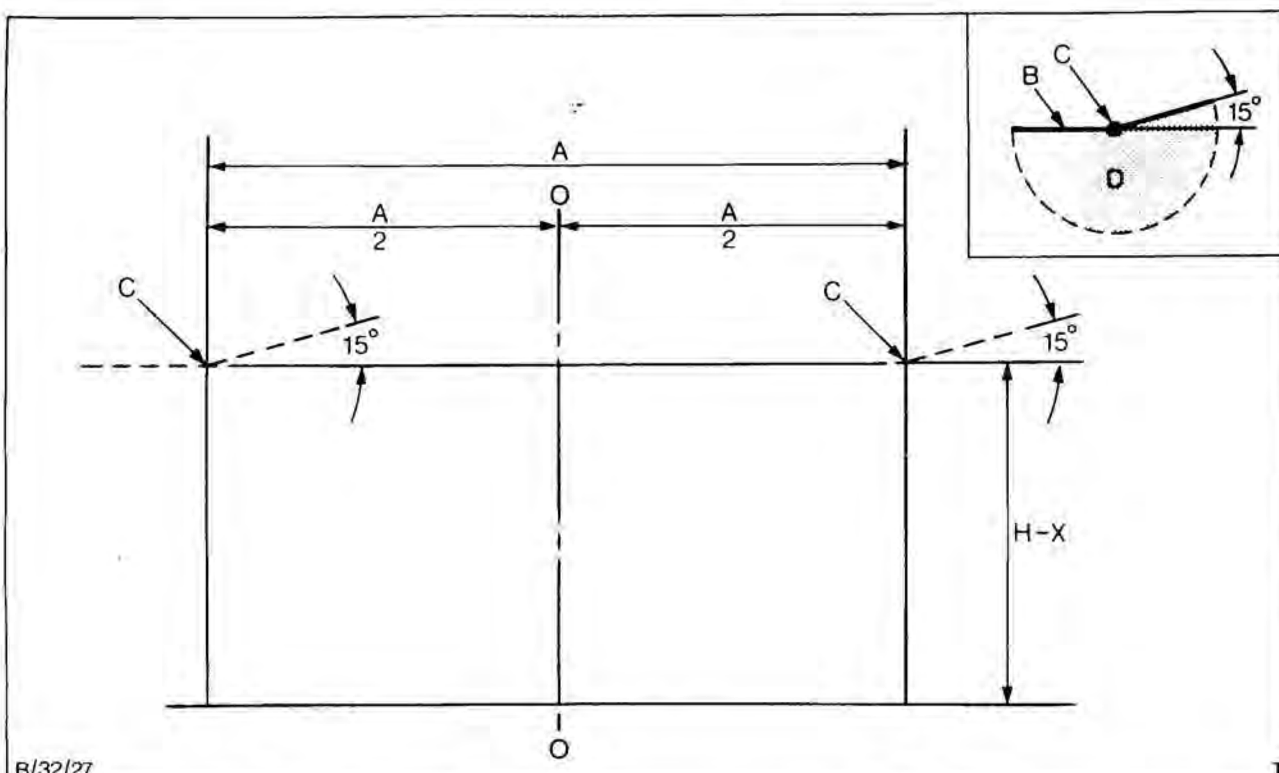


Fig. 3. Headlamp Alignment Chart (left-hand drive shown)

For right-hand drive vehicles, the 15° beam inclination line should be transposed from right to left

A – Distance between headlamp centres
B – Light/dark boundary
C – Beam centre dipped
D – Dipped beam pattern
H – Height from ground to centre of headlamps
X – 10,0 cm (4,0 in)

PART 'A'

32 115 HEADLAMP ASSEMBLY – REMOVE AND INSTALL (ONE)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Remove two screws securing headlamp surround to vehicle, Fig. 4 and remove surround.
3. Remove screw(s) securing headlamp to vehicle, Fig. 5 and withdraw lamp from vehicle. On variants with sealed beam headlamps remove headlamp bezel.
4. On sealed beam headlamp units disconnect multi-plug from rear of headlamp unit.
5. On headlamps with separate bulbs, turn bulb holder anti-clockwise and remove bulb and holder or release spring clip and remove bulb.

   NOTE: Do not touch bulb glass, refer to note on page 32–4.
6. Withdraw sidelamp bulb and holder assembly from rear of headlamp unit.

To Install

7. Refit sidelamp bulb and holder assembly into rear of headlamp unit.
8. On headlamps with separate bulbs refit bulb and holder assembly by inserting assembly and turning clockwise to secure or refit bulb and secure with spring clip.
9. Reconnect multi-plug, Fig. 6.
10. Locate headlamp in aperture and secure with screws. On sealed beam headlamps refit bezel on to headlamp and secure with screws. Reconnect battery.
11. Align headlamps, refer to Operation No. 32 113.
12. Refit headlamp surround and secure with two screws.
13. Remove fender covers, and close hood.

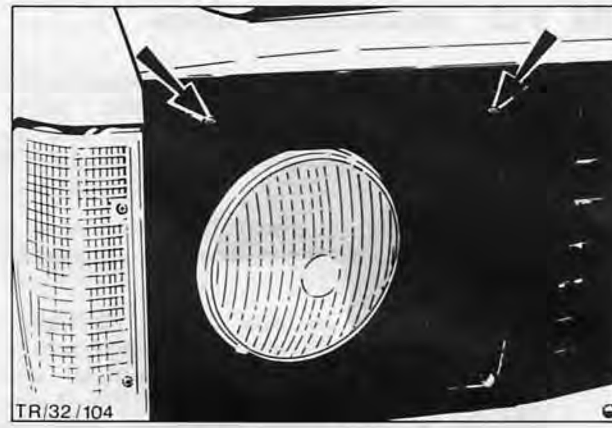


Fig. 4. Headlamp surround securing screws

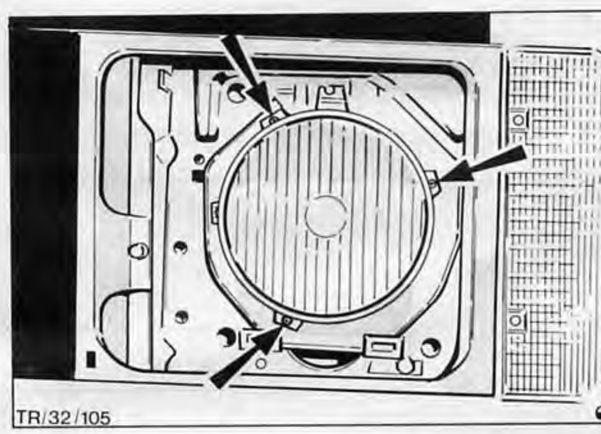


Fig. 5. Headlamp mounting screws

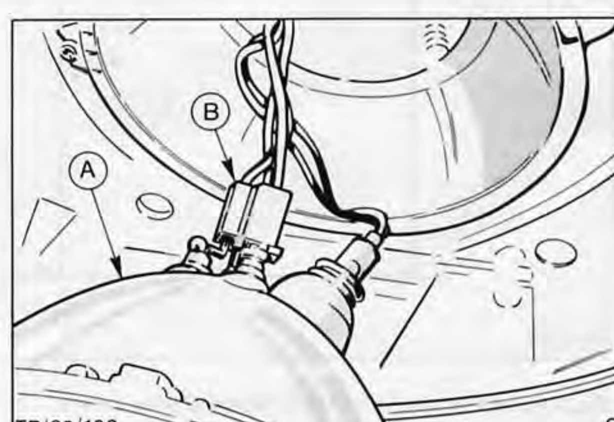


Fig. 6. A – Headlamp
B – Multi-plug

PART 'A'

32 127 4 HOUSING – HEADLAMP – REMOVE AND INSTALL (HEADLAMP REMOVED)

Special Service Tools Required: None

To Remove

1. Remove four screws Fig. 7 securing headlamp housing to front body panel.
2. Remove housing from vehicle.

To Install

3. Refit housing to vehicle.
4. Secure housing with four screws.

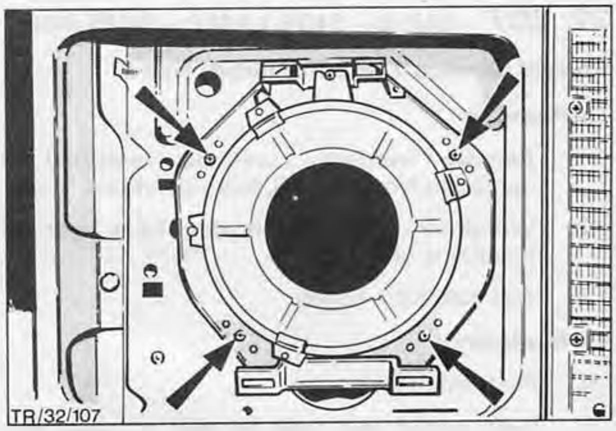


Fig. 7. Housing securing screws

32 147 BULB – HEADLAMP – REPLACE

Special Service Tools Required: None

NOTE: Do not touch bulb glass, refer to note on Page 32-4.

To Remove

1. Remove headlamp unit as described in Operation No. 32 115, sub-operations 1 to 3.
2. On semi-sealed headlamps release spring clip and remove bulb from rear of headlamp unit, Fig. 8.

   On Halogen headlamps hold bulb base without touching glass, and disconnect multi-plug and retainer. Remove bulb from lamp, Fig. 9.

To Replace

3. On semi-sealed headlamps fit bulb to headlamp and fit spring clip to bulb to secure bulb.

   On Halogen headlamps fit bulb to headlamp and fit retainer and multi-plug to bulb terminals to secure bulb.
4. Refit headlamp unit as described in operation No. 32 115, sub-operations 9 to 11.
5. Refit headlamp surround and secure with two screws.
6. Remove fender covers, and close hood.

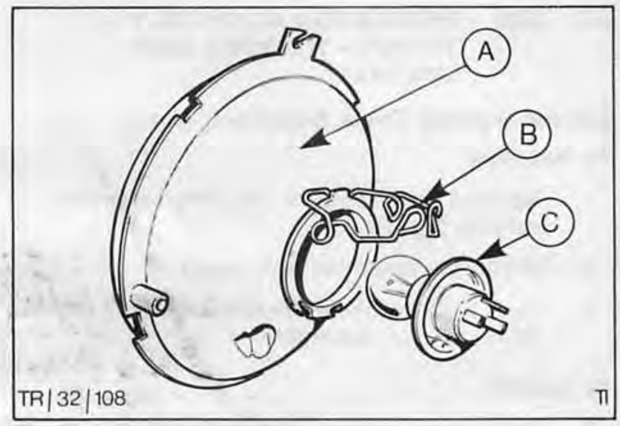


Fig. 8. A – Lamp unit
B – Spring clip
C – Bulb

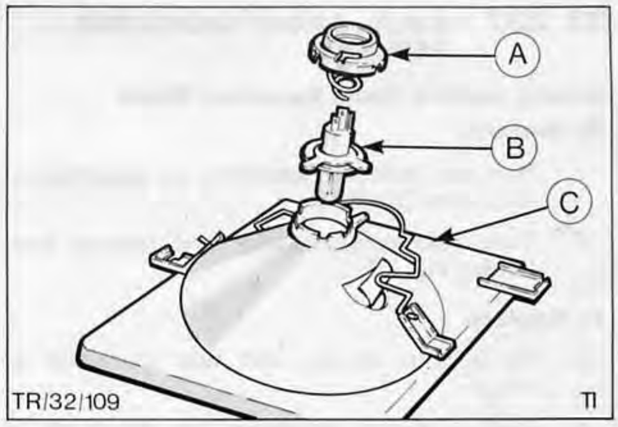


Fig. 9. A – Retainer
B – Bulb
C – Headlamp unit

PART 'A'

32 207 BULB – SIDE LAMP – REPLACE

Special Service Tools Required: None

To Remove

1. Remove headlamp unit as described in operation No. 32 115, sub-operations 1—3.
2. Withdraw bulb and holder from rear of headlamp unit, Fig. 10.
3. Pull bulb from holder.

To Replace

4. Push bulb into holder.
5. Refit holder and bulb to rear of headlamp unit.
6. Replace headlamp unit as described in Operation No. 32 115, sub-operations 10, 12 and 13.

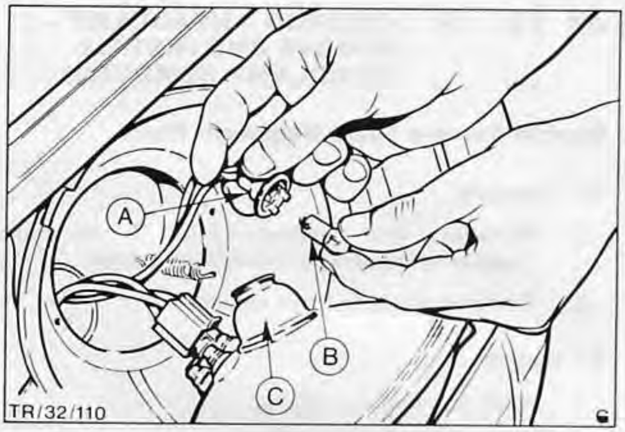


Fig. 10. A – Bulb holder
B – Bulb
C – Headlamp

32 225 INDICATOR ASSEMBLY – FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove four screws securing assembly to vehicle, Fig. 11.
2. Withdraw assembly from aperture.
3. Turn bulb holder anti-clockwise and remove from indicator assembly.

To Install

4. Refit bulb holder and turn clockwise to secure.
5. Install lamp assembly into aperture.
6. Secure with four screws.

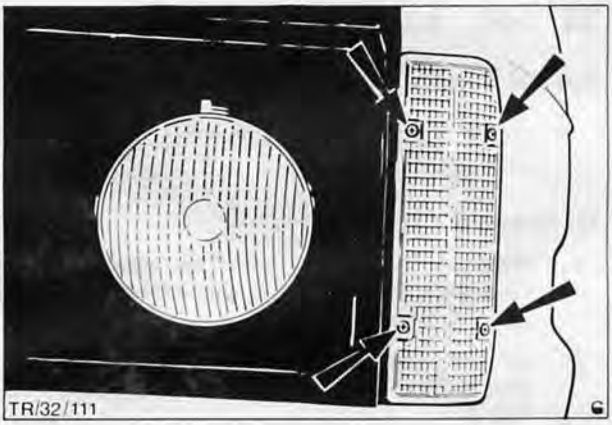


Fig. 11. Indicator assembly mounting screws

32 237 BULB – FRONT INDICATOR – REPLACE

Special Service Tools Required: None

To Remove

1. Remove indicator assembly as described in Operation 32 225.
2. Turn bulb anti-clockwise and remove from holder, Fig. 12.

To Replace

3. Fit bulb to holder and turn clockwise to secure.
4. Refit indicator assembly as described in Operation 32 225.

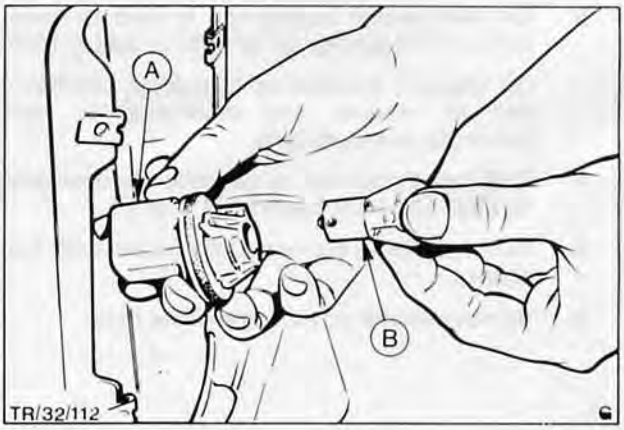


Fig. 12. A – Bulb holder
B – Indicator bulb

PART 'A'

32 335 LAMP – BACK-UP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood fit fender covers, and disconnect battery.
2. Remove two screws securing lamp lens to lamp.
3. Remove lens and unclip bulb from lamp unit, Fig. 13.
4. Remove screws securing lamp to vehicle and remove lamp, Fig. 15.
5. Disconnect lamp connection cable from wiring loom.

To Install

6. Reconnect cable to wiring loom.
7. Refit lamp to vehicle, secure with screws, ensure earth lead is fitted under mounting screw, Fig. 14.
8. Refit bulb, bulb is festoon type.
9. Refit lens and secure with screws.
10. Reconnect battery.
11. Remove fender covers and close hood. Test operation of lamp.

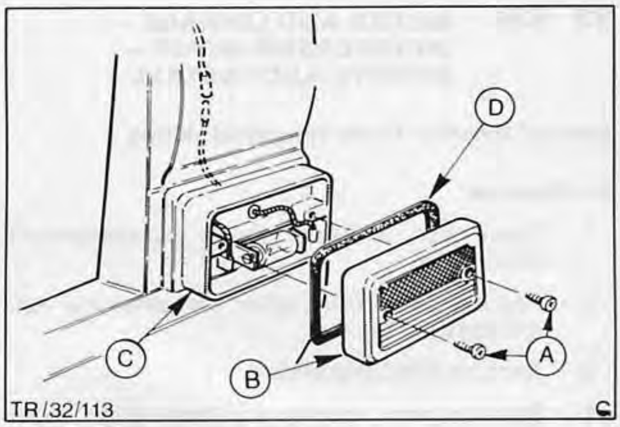


Fig. 13. A – Screws B – Lens C – Lamp D – Gasket

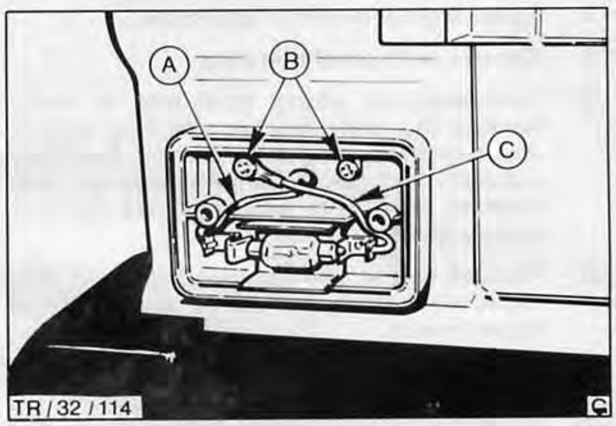


Fig. 14. A – Feed wire
B – Screws
C – Earth wire

32 347 BULB BACK-UP LAMP – REPLACE

Special Service Tools Required: None

To Remove

1. Remove two screws securing lamp lens to lamp, Fig. 13.
2. Remove lens.
3. Remove bulb, Fig. 15 from lamp unit.

To Replace

4. Fit new festoon type bulb.
5. Refit lens and secure with two screws.
6. Test operation of bulb.

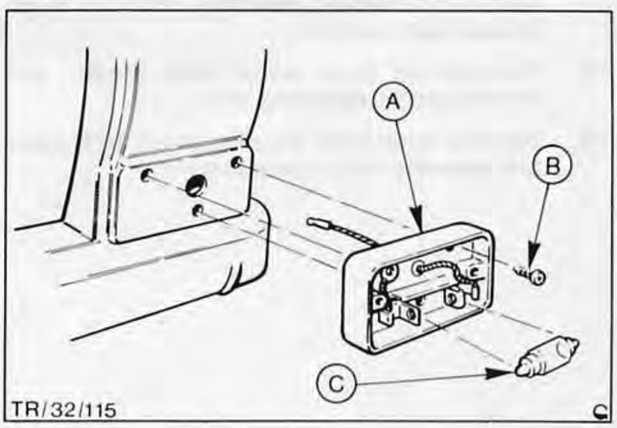


Fig. 15. A – Lamp
B – Screw
C – Bulb

PART 'A'

32 524 MOTOR AND LINKAGE – WINDSCREEN WIPER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove cover from wiper arm retaining nut, and remove nut.
3. Remove arms and blades.
4. Remove nuts, spacers and seals from wiper pivot shafts.
5. Remove radio control knobs if applicable, Fig. 16.
6. Turn screws on facia panel through 90° and remove panel.
7. Remove glove box lid, if applicable.
8. Remove facia panel trim strip.
9. Disconnect all wiring from rear of radio. Remove four radio bracket mounting screws, and withdraw radio and bracket assembly complete from fascia. Remove passenger side fresh air hose, from face level vent. Remove screws securing speaker to facia.
10. Remove two screws securing passenger side fascia vent duct, and lower duct clear of wiper linkage.
11. Disconnect multi-plug at wiper motor.
12. Remove motor securing screw, Fig. 17 and lower linkage and motor until pivot shafts are clear of the cowl panel.
13. Lever linkage from motor operating arm.
14. Remove two bolts securing motor, and bracket assembly to linkage, Fig. 18. Remove motor and bracket assembly. Remove wiper linkage from vehicle.
15. Remove nut from motor drive spindle and remove motor operating arm.
16. Remove three bolts securing motor to bracket and separate motor from bracket.

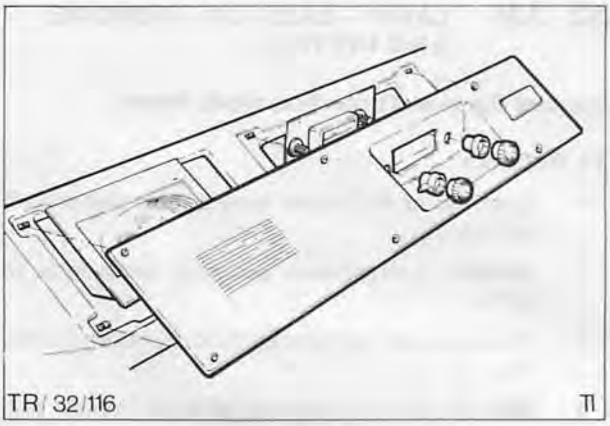


Fig. 16. Removing facia panel and radio control knobs

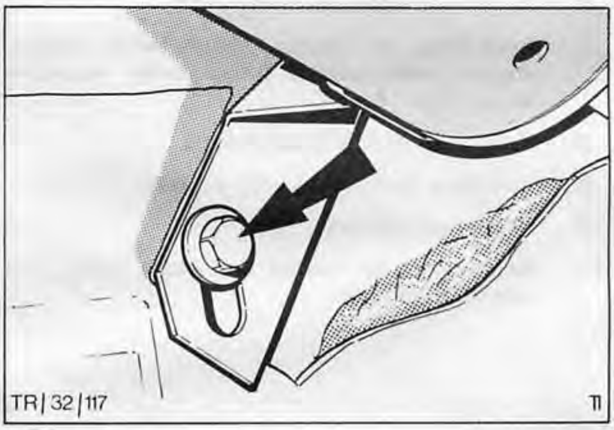


Fig. 17. Motor securing screw

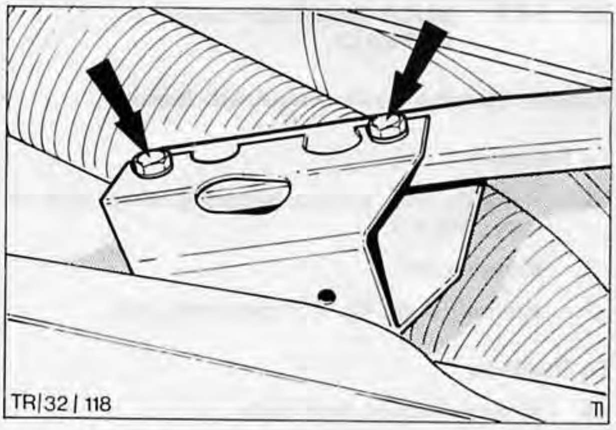


Fig. 18. Motor to linkage bolts

PART 'A'

To Install

17. Refit motor to bracket and secure with three bolts.

18. Refit motor operating arm to drive spindle and secure with nut. Ensure groove in spindle engages with spline in arm.

19. Refit linkage to vehicle and refit motor and bracket to linkage.

20. Reconnect motor operating arm to linkage.

21. Insert wiper motor and linkage assembly into position ensuring wiper spindles are correctly located in their holes. Do not secure motor at this stage.

    Fit rubber seals, spacers and spindle nuts to wiper spindles. Secure motor with screw.

22. Reconnect wiring to motor.

23. Refit facia vent duct and secure with two screws. Refit fresh air hose.

24. Refit radio and bracket assembly, and secure with 2 screws. Reconnect wiring to rear of radio. Refit speaker and secure with screws.

25. Refit facia panel trim strip.

26. Refit glove box lid, if applicable.

27. Refit facia panel and turn screws through 90° to secure.

28. Refit radio control knobs.

29. Refit arms and blades. Refit washer and nut and nut cover.

30. Reconnect battery, remove fender covers and close hood.

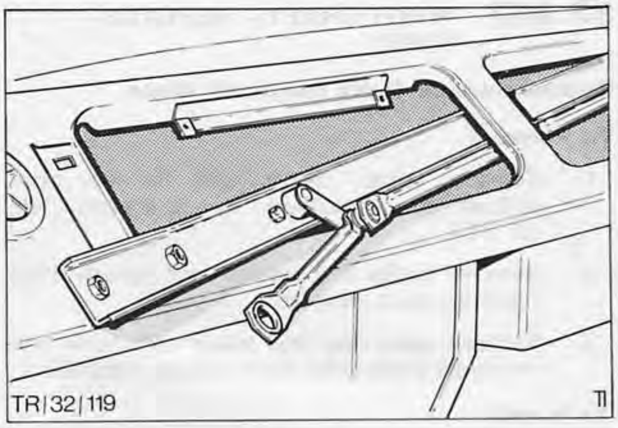


Fig. 19. Removing linkage through facia

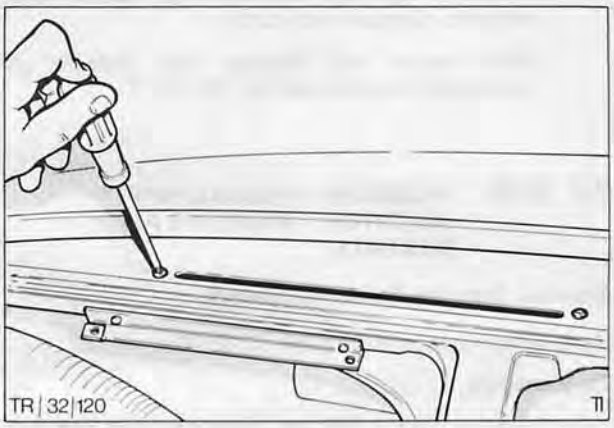


Fig. 20. Facia vent duct securing screw

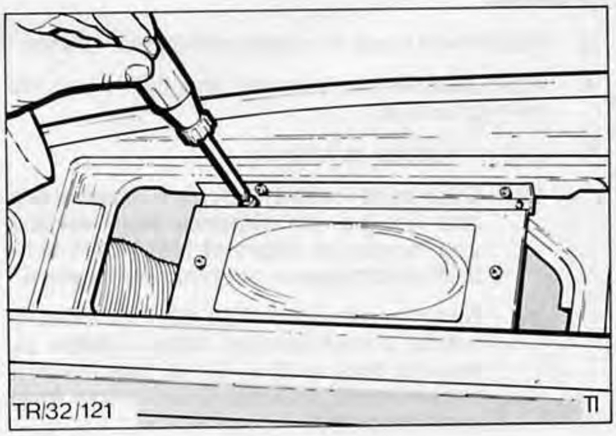


Fig. 21. Radio speaker securing screws

PART 'A'

32 563 PIVOT SHAFT – REPLACE – (ONE)

Special Service Tools Required: None

To Remove

1. Remove wiper motor and linkage from vehicle as described in operation No. 32 524.
2. Remove circlip and washer and detach drive link from pivot shaft arm.
3. Remove snap ring and wiper arm cone and withdraw pivot shaft from linkage assembly.

To Install

4. Assemble pivot shaft to linkage assembly.
5. Refit wiper arm cone and fit new snap ring ensuring it seats in groove in shaft.
6. Reconnect pivot shaft arm to drive link ensuring correct position of bush and washers. Secure with circlip.
7. Refit motor and linkage into vehicle as described in operation No. 32 524.

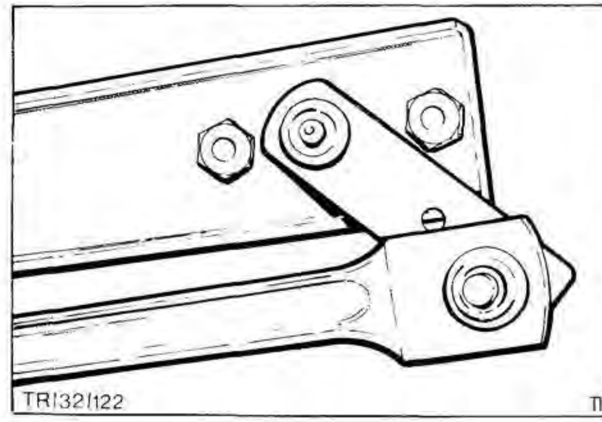


Fig. 22. Pivot shaft

32 678 NOZZLES – HEADLAMP WASHER – REMOVE AND INSTALL

Special Service Tools Required:

Headlamp washer jet aligner 32-002

To Remove

1. Loosen clamp bolt on overrider and remove overrider from bumper, Fig. 23.
2. Loosen hose clamp securing hose to nozzle overrider and remove hose from overrider, Fig. 24.

To Install

3. Reconnect hose to nozzle and tighten clamp.
4. Refit overrider to bumper and tighten clamp bolt to secure.
5. Adjust nozzles as follows:
   (a) Determine centre of lens by measuring and halving the distance from vertical and horizontal edges of lens. Mark spot with a soft crayon or chinagraph pencil.
   (b) Insert service tool 32-002 into slots in nozzle circumference. Adjust nozzle by moving tool so that tip of tool touches crayon mark on lens. Clean marks from headlamp lens.
   (c) Repeat above procedure for remaining nozzle.

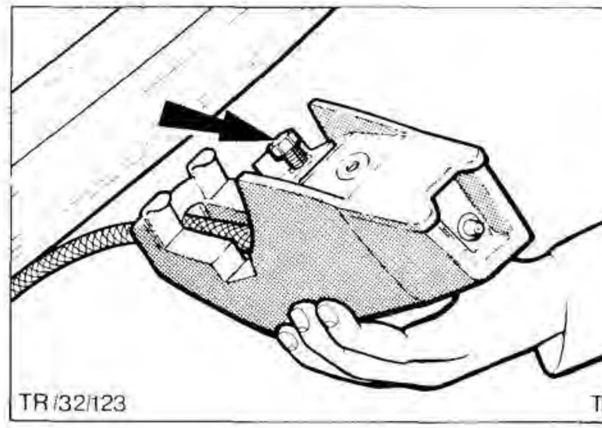


Fig. 23. Removing overrider. Clamp bolt arrowed

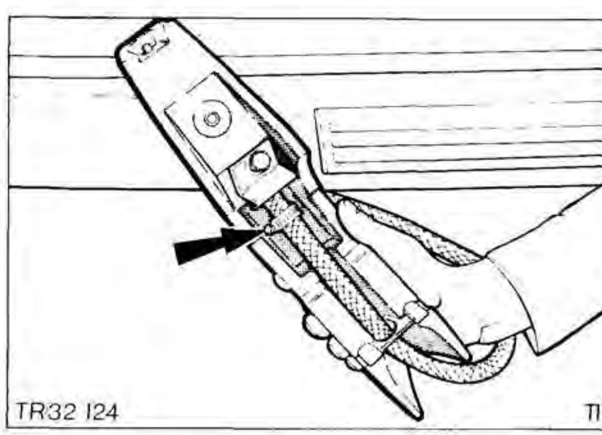


Fig. 24. Hose to nozzle joint

PART 'A'

32 882 MOTOR – ENGINE STOP CONTROL – REMOVE AND INSTALL

Special Service Tools Required: None

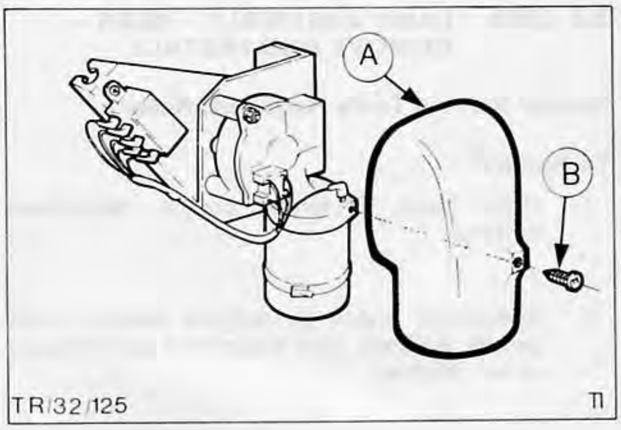


Fig. 25. A – Motor cover
B – Screw

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove motor cover securing screw and remove cover, Fig. 25.
3. Disconnect wiring from motor.
4. Remove nut and washer securing motor operating arm to motor and remove arm from motor, Fig. 26.
5. Remove three bolts securing motor to bracket and remove motor.

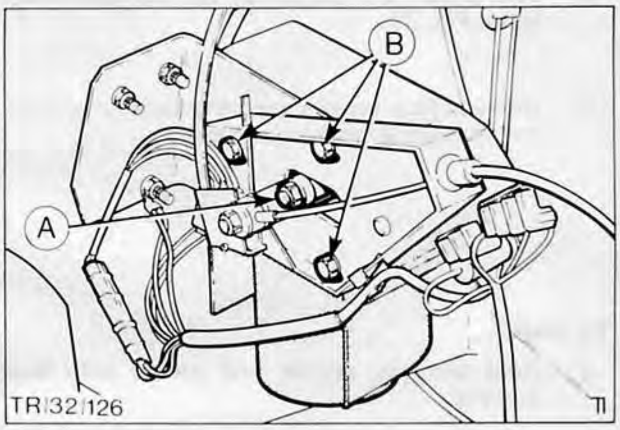


Fig. 26. A – Motor operating arm
B – Motor securing bolts

To Install

6. Refit motor to bracket and secure with five bolts.
7. Refit operating arm to motor and secure with washer and nut.
8. Reconnect wiring to motor.
9. Refit motor cover and secure with screw, Fig. 25.
10. Reconnect battery. Test operation of motor.
11. Remove fender covers and close hood.

SERVICE AND REPAIR OPERATIONS – PART 'B'

32 305 LAMP ASSEMBLY – REAR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, disconnect battery.
2. Open rear doors or tailgate remove trim panels, if fitted, and disconnect connections at rear of lamp.
3. Remove four screws securing lens to lamp and remove lens from lamp. Remove lens gasket from lamp, Fig. 27.
4. Turn bulbs anti-clockwise and remove from lamp, Fig. 28.
5. Remove four screws securing lamp to vehicle and remove lamp from vehicle.

To Install

6. Refit lamp to vehicle and secure with four screws.
7. Refit bulbs and turn clockwise to secure.
8. Refit gasket and lens, secure lens with screws.
9. Reconnect electrical connections at rear of lamp. Refit trim panels if removed in sub-operation 2.
10. Reconnect battery, remove fender covers, and close hood.

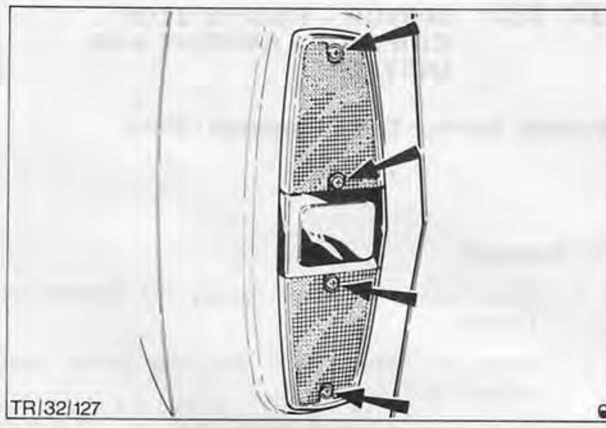


Fig. 27. Lamp lens securing screws

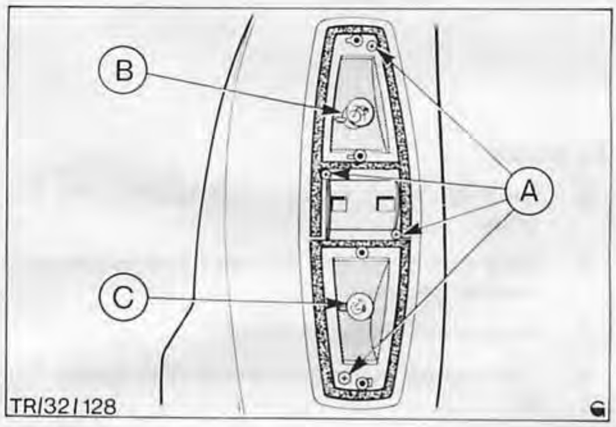


Fig. 28. A – Lamp securing screws
B – Indicator lamp
C – Stop/tail lamp

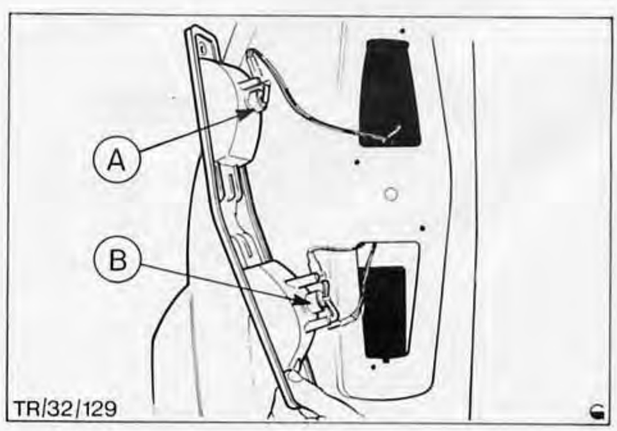


Fig. 29. Rear lamp wiring
A – Indicator
B – Stop/tail lamp

PART 'B'

32 351 FOG LAMP – REAR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood fit fender covers, and disconnect battery.
2. Disconnect wiring from rear of lamp.
3. Remove mounting nut, Fig. 30 and serrated washer and remove lamp from vehicle.

To Install

4. Refit lamp to vehicle and secure with serrated washer and mounting nut.
5. Reconnect wiring to rear of lamp.
6. Reconnect battery.
7. Remove fender covers and close hood. Test operation of lamp.

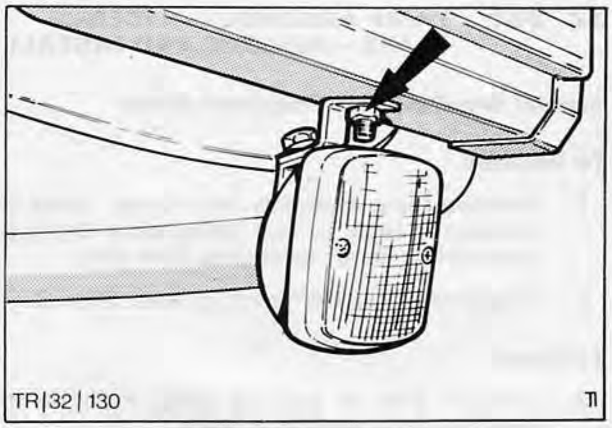


Fig. 30. Lamp securing nut

32 353 BULB – FOG LAMP – REAR – REPLACE

Special Service Tools Required: None

To Remove

1. Remove two screws securing fog lamp lens to lamp, Fig. 31.
2. Turn bulb to remove from lamp.

To Replace

3. Fit new bulb. Bulb is bayonet type.
4. Refit lamp lens and secure with two screws.
5. Test operation of bulb.

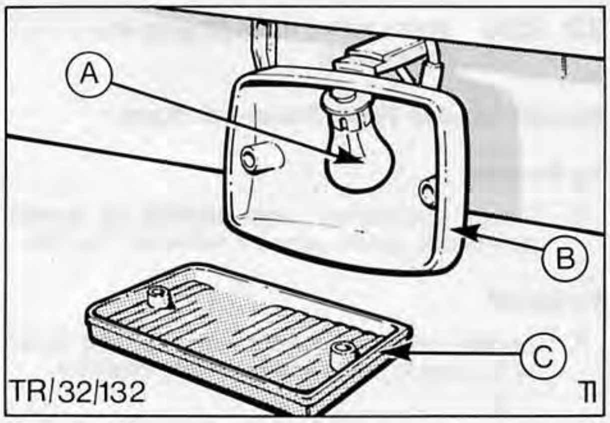


Fig. 31. A – Bulb
B – Lamp
C – Lens

PART 'B'

32 365 LAMP ASSEMBLY – LICENCE PLATE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove lamp assembly from body. Lamp is secured to body by two spring clips. Using a screwdriver gently lever lamp from body.
2. Disconnect bulb from back of lamp. Fig. 32.

To Install

3. Connect bulb to back of lamp. Press lamp assembly into position in body.
4. Reconnect battery and check operation of lamp.

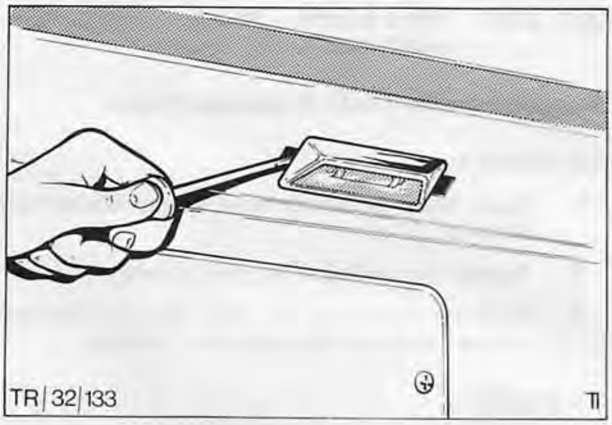


Fig. 32. Levering lamp from body

32 377 BULB – LICENCE PLATE LAMP – REPLACE

Special Service Tools Required: None

To Remove

1. Remove lamp assembly from body. Lamp is secured to body by two spring clips. Using screwdriver gently lever lamp from body.
2. Remove bulb holder Fig. 33.
3. Remove bulb (bayonet type).

To Replace

4. Fit new bulb.
5. Refit bulb holder.
6. Fit lamp assembly to body and check operation of light.

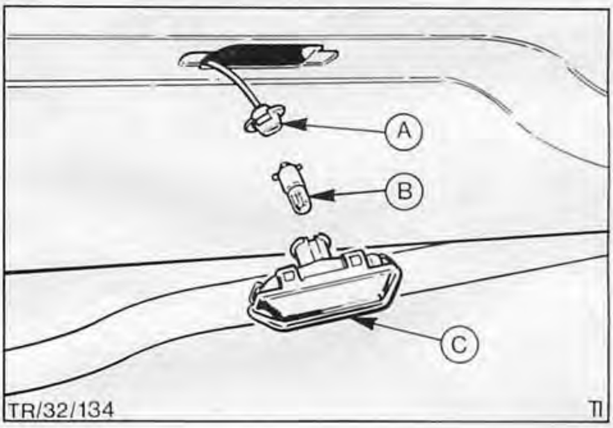


Fig. 33. A – Bulb holder
B – Bulb
C – Lamp

32 394 REFLECTOR ASSEMBLY – REPLACE

Special Service Tools Required: None

To Remove

1. Using screwdriver, and packing to protect paintwork, gently prise off reflector, Fig. 34.

To Install

2. Locate reflector correct way up and insert with pegs in holes and push into position.

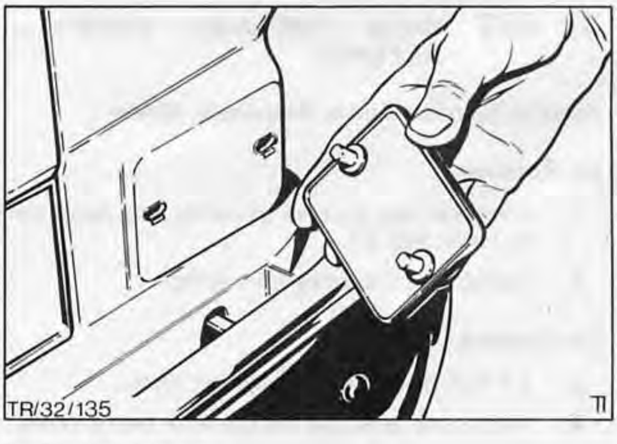


Fig. 34. Rear reflector

PART 'B'

32 586 RUBBER – WINDSCREEN WIPER BLADES – REPLACE (BOTH)

Special Service Tools Required: None

To Remove

1. Lift wiper arm away from windscreen through 90°. Turn wiper blade to a position 90° from wiper arm.
2. Depress spring clip and slide blade down wiper arm to clear arm hook, Fig. 35. Slide blade up arm and clear of arm hook.
3. Remove two metal inserts from within wiper rubber and unhook wiper rubber from blade.

To Replace

4. Hook new rubber onto wiper blade and slide metal inserts along channels in wiper rubber. Ensure 'cut-outs' in inserts face inwards Fig. 36.
5. Slide wiper blade onto arm and clip into position.
6. Check operation.
7. Repeat sub-operations 1 to 6 for second blade.

32 622 RESERVOIR – WINDSCREEN WASHER – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: Where fitted this reservoir also supplies the headlamp washer.

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Drain or syphon fluid from reservoir.
3. Disconnect supply pipe from pump where fitted to reservoir, Fig. 37.
4. Disconnect wiring loom from pump.
5. Unhook clamping straps and remove reservoir.
6. Remove pump where fitted to reservoir.

To Install

7. Install pump, where applicable.
8. Refit reservoir and secure with clamping straps.
9. Reconnect wiring loom and hose to pump, where applicable.
10. Refill reservoir.
11. Reconnect battery.
12. Remove fender covers and close hood. Test operation of washers.

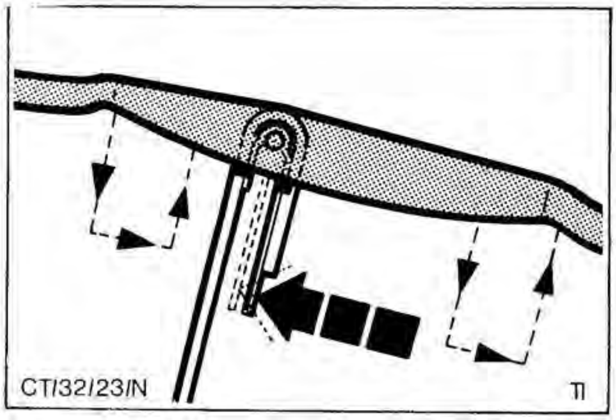


Fig. 35. Removing wiper blade

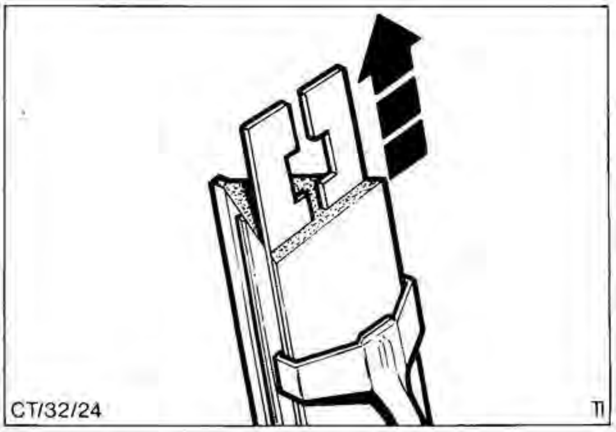


Fig. 36. Cut-outs to face inwards

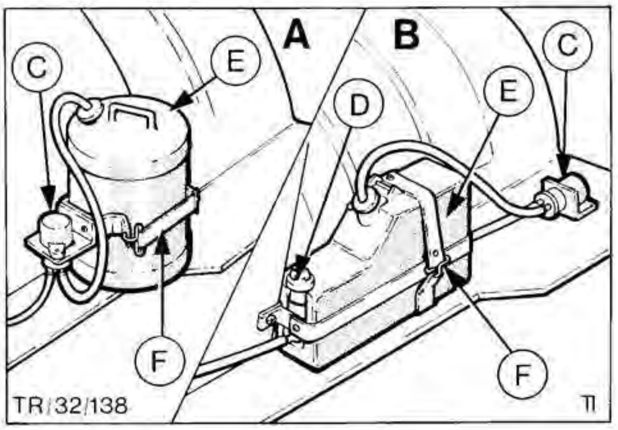


Fig. 37. A – Windscreen washer system
B – Headlamp washer system
C – Windscreen washer pump
D – Headlamp washer pump
E – Reservoir
F – Clamping strap

PART 'B'

32 624 PUMP – WINDSCREEN WASHER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect hoses and wiring from pump, Figs. 38 or 39.
3. Remove retaining screws and detach pump.

To Install

4. Position pump in engine compartment and secure with screws.
5. Reconnect hoses and wiring.
6. Reconnect battery.
7. Check operation of pump.
8. Remove fender covers and close hood.

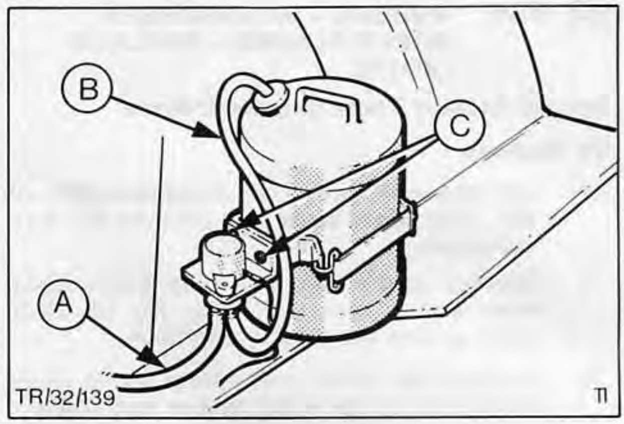


Fig. 38. A – Hose to screen
B – Hose to reservoir
C – Mounting screws

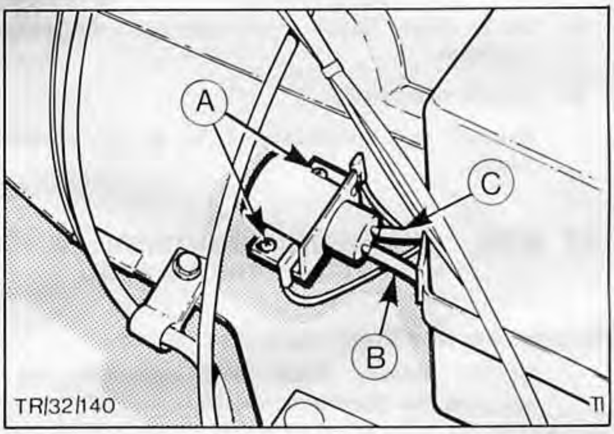


Fig. 39. A – Mounting screws
B – Hose to reservoir
C – Hose to screen

32 634 NOZZLES – WINDSCREEN WASHER – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect plastic hose from nozzles, depress clips and press out nozzles from hood, Fig. 40.

To Install

3. Press nozzles into apertures in hood and reconnect plastic hoses.
4. Check operation and adjustment of windscreen washers.
5. Reconnect battery, remove fender covers and close hood.

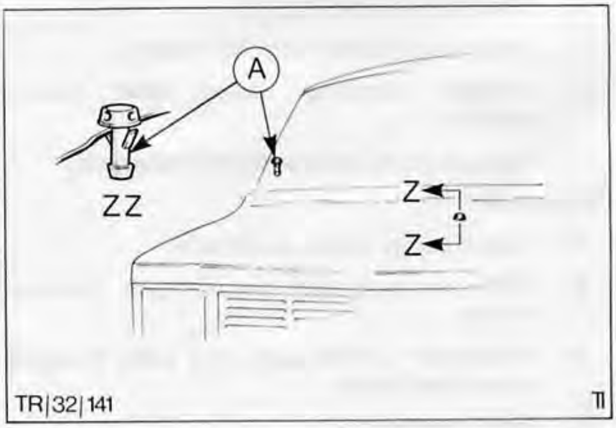


Fig. 40. A – Nozzle

PART 'B'

32 638 HOSES – WINDSCREEN WASHER – REPLACE (ALL)

Special Service Tools Required: None

To Remove

1. Open hood fit fender covers and disconnect battery.
2. Disconnect and remove all windscreen washer hoses noting locations routing and fixings, Fig. 41.

To Install

3. Cut new hoses using existing hoses to gauge correct lengths.
4. Connect all new hoses.
5. Reconnect battery.
6. Check operation of washer system.
7. Remove fender covers and close hood.

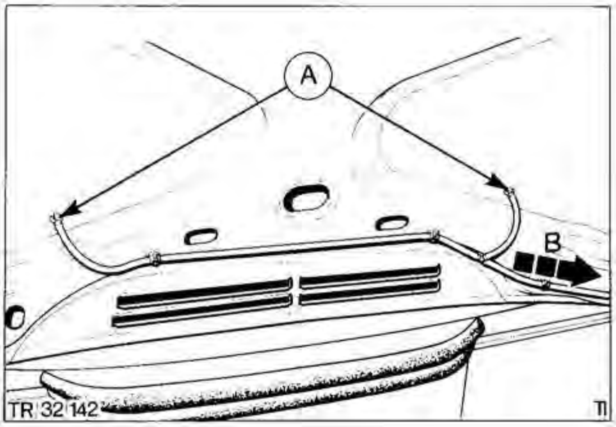


Fig. 41. A – Nozzles
B – To pump and reservoir

32 815 HORN – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect horn wiring, Fig. 42.
3. Remove retaining bolt and washer and detach horn.

To Install

4. Fit horn and secure with retaining bolt and washer.
5. Reconnect horn wiring.
6. Reconnect battery.
7. Check operation of horn.
8. Remove fender covers and close hood.

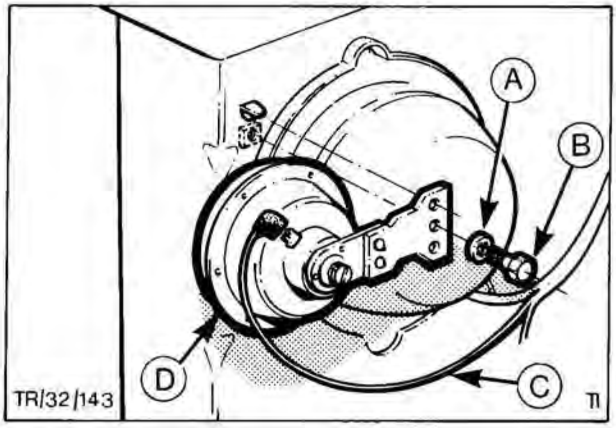


Fig. 42. A – Washer
B – Retaining bolt
C – Wiring
D – Horn

TECHNICAL DATA

Exterior Lights

Headlamp type	see page 32 – 2
Headlamp alignment	see page 32 – 7
Headlamp washer alignment	see page 32 – 14

Bulb Chart

Lamp designation	Quantity	Wattage	Fitting
Headlamp – circular – sealed beam	2	40/45	—
Headlamp – circular – semi-sealed – tungsten	2	40/45	Bayonet
Headlamp – square – semi-sealed – halogen	2	55/60	Bayonet
Park/side lamps	2	4	Bayonet
Direction indicators (front)	2	21	Bayonet
Direction indicators (rear)	2	21	Bayonet
Tail lamps	2	5	Bayonet
Stop lamps	2	21/5	Bayonet
Licence plate lamps	2	4 or 5	Bayonet
Back-up lamp	2	21	Festoon
Rear Fog Lamp	1	21	Bayonet

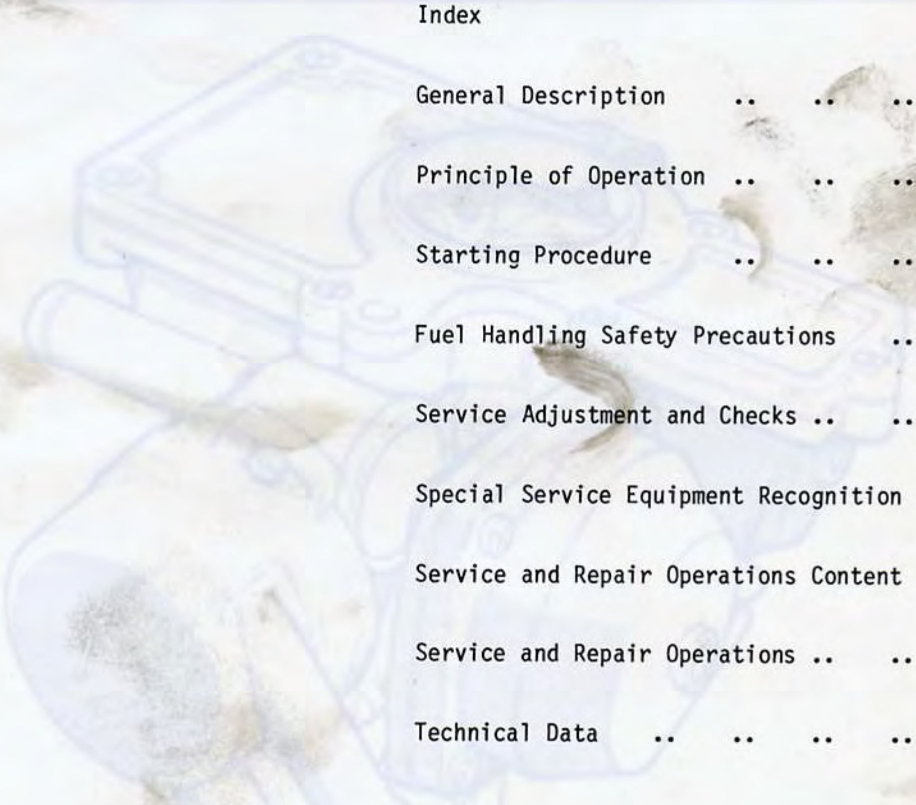
Windshield Wipers

Motor – (front) – type	Two-speed electric, self parking

Washers

Windscreen	Electric pump either 2,0 or 8,0 litre reservoir
Headlamps	High pressure pump, sharing 8,0 litre reservoir with windscreen washer system.

Fuel System (Ford VV Carburettor) 23V



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GENERAL DESCRIPTION

FORD V.V.
CARBURETTOR

The basic carburettor design used by Ford Motor Co. in recent years has been of the fixed venturi type, utilising a fixed size main jet system. This type of carburettor has proven highly successful in meeting the requirements for good performance and acceptable fuel consumption.

During the last decade an additional requirement has been introduced, namely the need to reduce atmospheric pollution and Governments throughout the world have passed legislation stating that the internal combustion engine must meet specific standards of low pollution (emission) levels. Compliance with legislation laid down by European governments has been achieved in the 1970's by developing the Ford fixed venturi carburettor. For example during 1975 a new design idle system known as the 'Sonic' or 'By-pass' idle system, was introduced onto the Ford carburettor to ensure that Ford engines met the 1976 increased severity emission legislation without any detrimental effect on drive charactoristics.

As time passes emission legislation in Europe will become more strict and to ensure Ford engines meet these strict emission levels a completely new carburettor has been designed and developed for the 1980's.

The Ford Variable Venturi unit is this carburettor and will progressively be fitted on all Transit (1V) variants (except the 2,0 litre heavy duty) starting from May 1980.

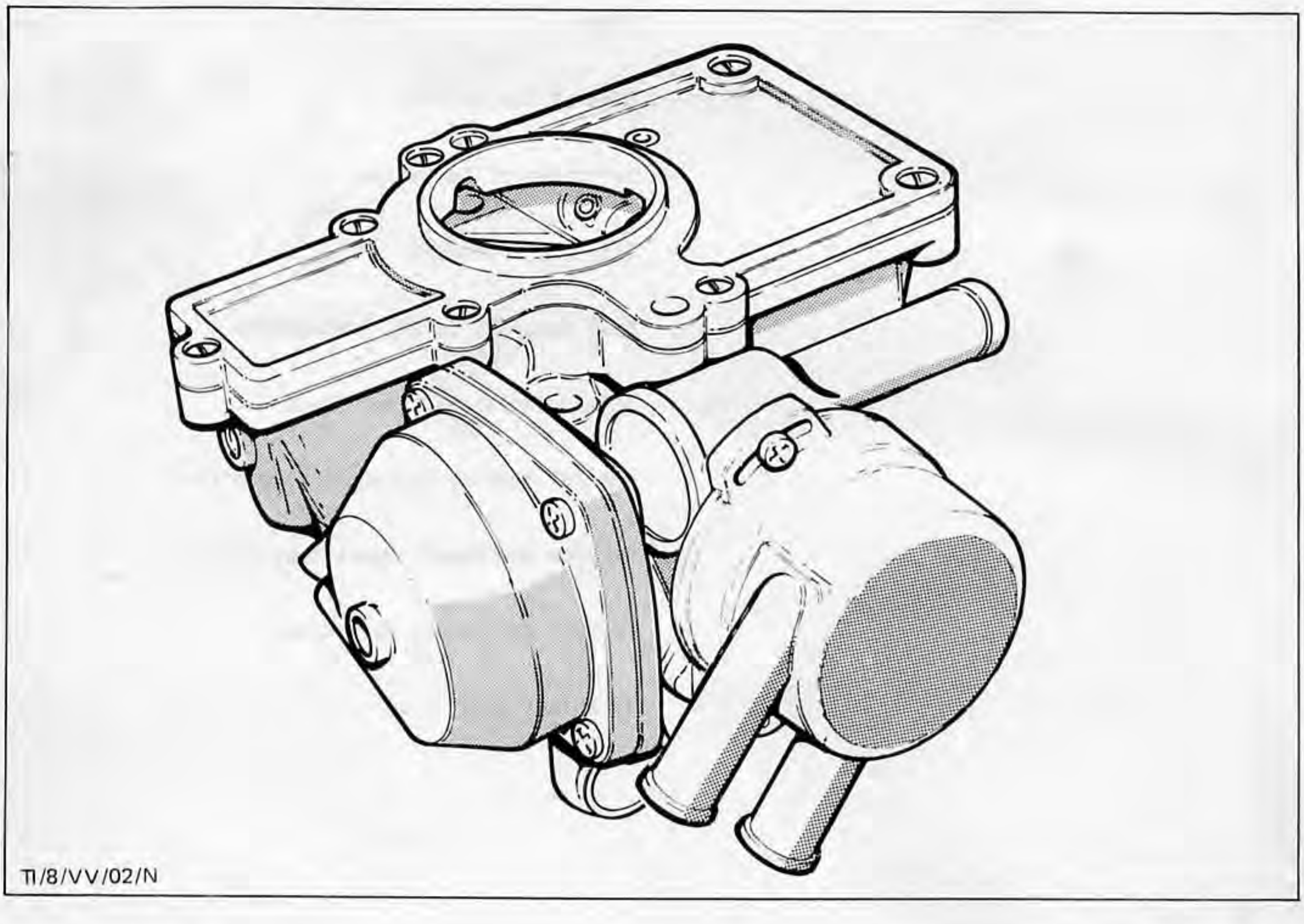


Fig.1. The Ford Variable Venturi Carburettor.

GENERAL DESCRIPTION (cont'd)

FORD V.V
CARBURETTO

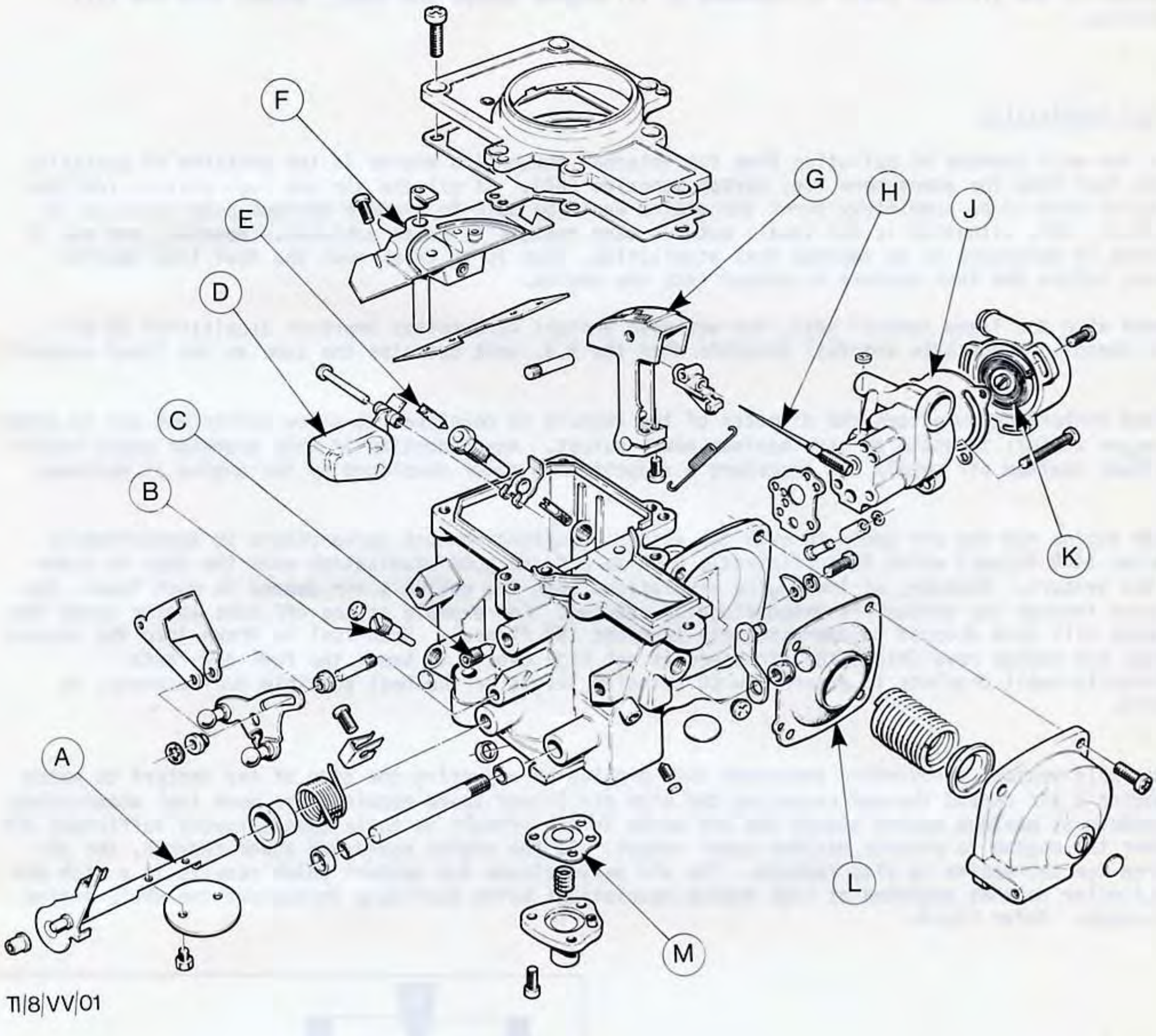


Fig.2. Exploded view of V.V. carburettor.
A - Throttle spindle
B - Mixture screw
C - By-pass leak adjuster
D - Float
E - Needle valve
F - Main jet body
G - Air valve
H - Metering rod
J - Choke assembly
K - Bi-metal coil
L - Vacuum diaphragm
M - Accelerator pump diaphragm

GENERAL DESCRIPTION (cont'd)

FORD V.V. CARBURETTOR

When compared with the fixed venturi carburettor the variable venturi unit improves emissions, fuel economy and general engine performance for two main reasons;

1) Fuel atomisation (the mixing of fuel into the air stream) is improved, especially at low engine speeds and loads, and

2) Control of the air/fuel ratio is improved at all engine speeds and loads, except idle and full throttle.

1) Fuel Atomisation

One of the main sources of pollution from the internal combustion engine is the emission of partially unburnt fuel into the atmosphere i.e. carbon monoxide (CO). If all the air and fuel mixture fed into the engine were to be completely burnt the engine would be able to produce maximum power with no CO emissions. This situation is the ideal, but for many reasons is never achieved. However, one way of improving CO emissions is to improve fuel atomisation, that is to break down the fuel into smaller droplets before the fuel mixture is passed into the engine.

Compared with the fixed venturi unit, the variable venturi carburettor improves atomisation at all engine speeds, except idle and full throttle when the V.V. unit operates the same as the fixed venturi unit.

On fixed venturi carburettors the diameter of the venturi is developed to allow sufficient air to enter the engine at full throttle to give maximum power output. Any reduction in this diameter would result in a lower maximum air supply and therefore a reduction in power developed by the engine at maximum rpm.

At high engine rpm the air speed through the venturi on fixed venturi carburettors is approximately 120 m/sec (400 ft/sec) which is sufficiently high to achieve good atomisation when the fuel is drawn into the venturi. However, at low engine revolutions when the engine's air demand is much lower, the air speed through the venturi is proportionally reduced. For example at the off idle engine speed the air speed will have dropped to approximately 12 m/sec (40 ft/sec). When fuel is drawn into the venturi at these low engine revolutions the air speed is not high enough to break the fuel down into sufficiently small droplets to ensure low CO emission levels or the best possible fuel economy, is achieved.

The variable venturi carburettor overcomes this problem by adjusting the size of the venturi to match the engine's air demand thereby retaining the high air intake speed required for good fuel atomisation. For example at maximum engine speeds the air valve in the venturi is fully open allowing sufficient air to enter the engine to produce maximum power output. As the engine speed and power reduces, the air required for the engine is also reduced. The air valve closes the venturi which results in a high air speed similar to that achieved at high engine revolutions being available throughout the whole engine speed range. Refer Fig.4.

Fig.3, shows the fixed venturi carburettor at a low engine rpm and load with fuel being drawn into the air stream, flowing at a speed of approximately 12 m/sec (40 ft/sec).

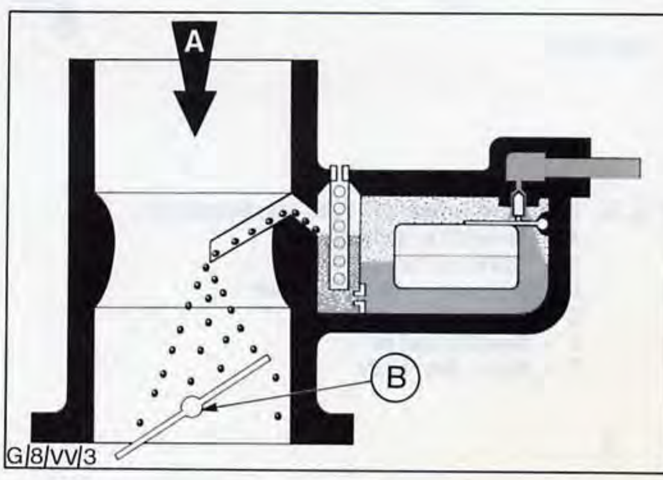


Fig.3. Fixed venturi carburettor at low engine rpm and load.
A - Air Intake
B - Throttle plate

GENERAL DESCRIPTION (cont'd)

FORD V.V.
CARBURETTOR

Fuel Atomisation (cont'd)

Fig.4, shows the variable venturi carburettor also in the low engine rpm situation. Note that the air valve has reduced the size of the venturi resulting in a much higher air speed, in the region of 90 m/sec (300 ft/sec) compared with the fixed choke unit which as we have shown only achieves an air speed of approximately 12 m/sec (40 ft/sec).

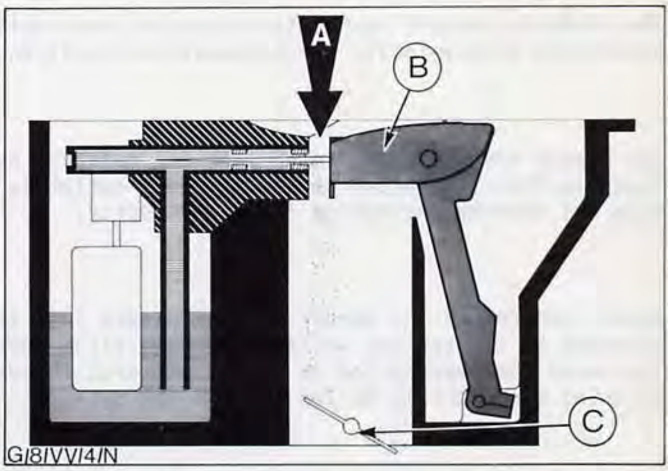


Fig.4. Variable Venturi Carburettor at low engine rpm and load.
A - Air intake
B - Air valve (almost closed)
C - Throttle plate

It can therefore be seen that at all cruise engine speeds (up to approximately 4000 rpm except idle) fuel atomisation and therefore CO emissions are vastly improved on the variable venturi carburettor.

In addition to the reduction in emission levels the improved quality fuel atomisation allows the engine to be operated on a leaner air/fuel ratio without any loss of power. This results in an overall improvement in fuel consumption.

2) Air/Fuel Ratio Control (Main Jet System)

Control of the air supply on both types of carburettor is achieved by a throttle butterfly plate mounted in the venturi. It is in the method of controlling the fuel that the two types of carburettors differ. On the fixed venturi unit the main system does not discharge until the throttle plate is open and the increased air flow creates sufficient vacuum to pull fuel through the main nozzle.

It is difficult to achieve a smooth transition from the idle to the main system and at the point where the main jet system comes into operation, fuel atomisation is poor with large droplets of fuel being fed into the engine. To ensure a good drive condition is achieved during this period the mixture strength is richened to compensate for the poor fuel atomisation.

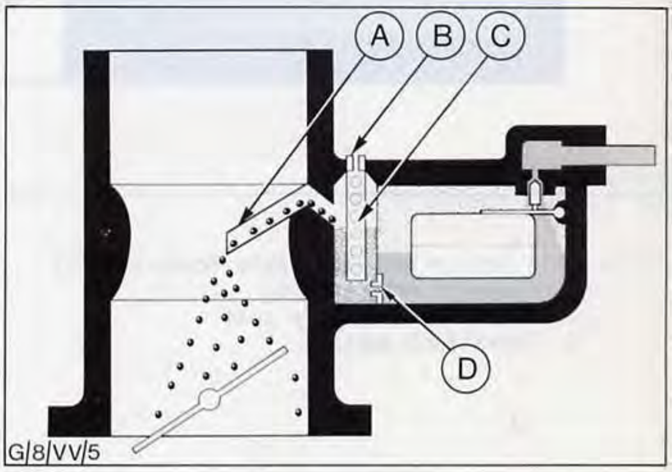


Fig.5. Main jet system. (Fixed venturi unit)
A - Main fuel outlet
B - Air bleed
C - Emulsion tube
D - Main jet

GENERAL DESCRIPTION (cont'd)

FORD V.V.
CARBURETTOR

The variable venturi carburettor does not have this disadvantage because the main jet system with its associated high velocity is in operation at all engine speeds and loads. Refer Fig.6.

The reason fuel is drawn in through the main jet system on V.V. carburettors at low engine speeds and loads is that the vacuum at the main jet outlet is high, due to the air valve reducing the venturi size and thereby increasing the air velocity.

Actual control of the amount of fuel passed into the engine is achieved by a tapered metering rod attached to the venturi valve, which can slide through the main jet. As the engine's fuel demand is increased the tapered rod is pulled outwards through the main jet so increasing the main jet size allowing more fuel to be fed through the system.

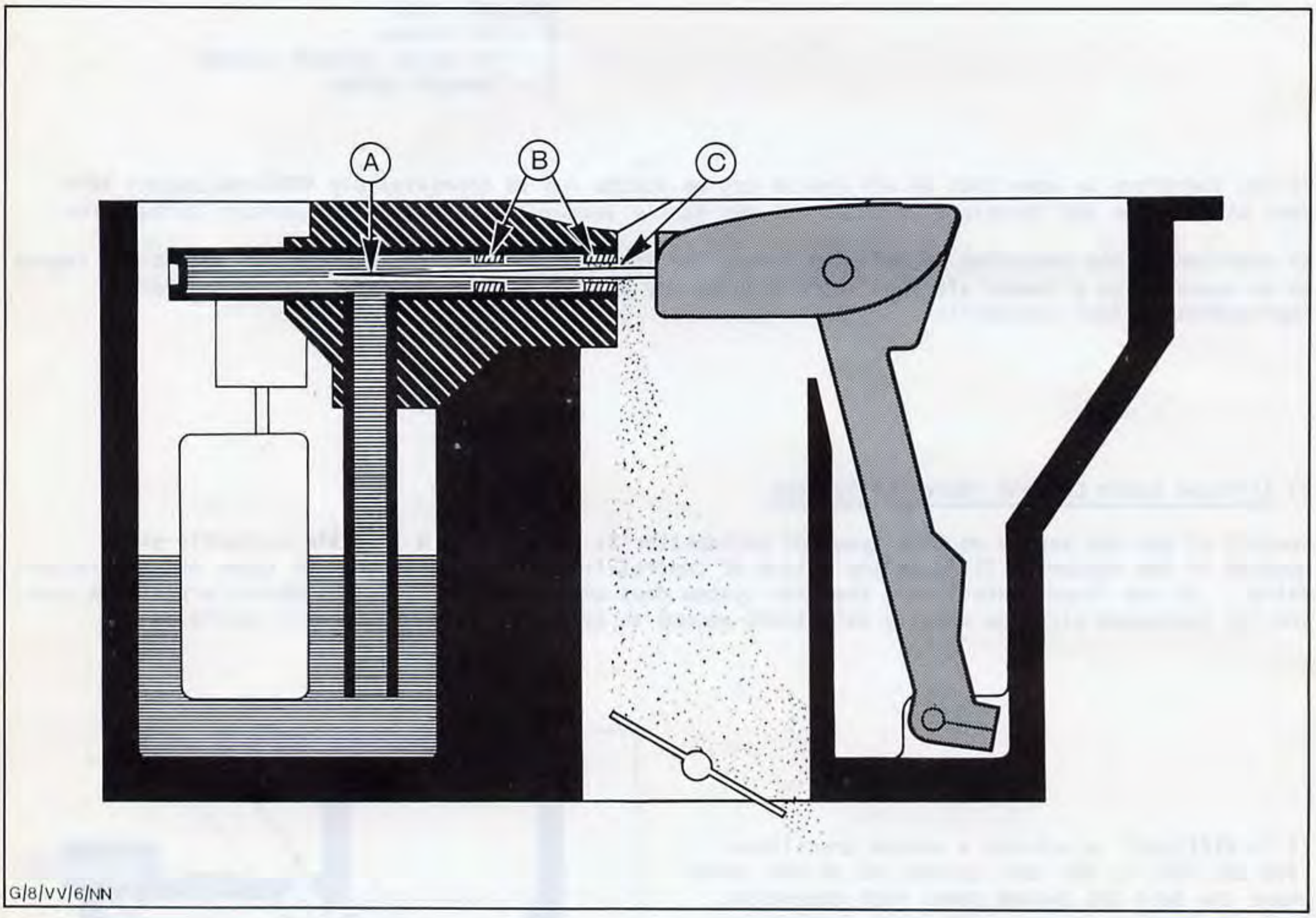


Fig.6. Main jet system. (Variable Venturi Unit)
A - Tapered metering rod
B - Main and secondary jets
C - Main fuel outlet

PRINCIPLE OF OPERATION

FORD V.V. CARBURETTOR

Although the carburettor looks, and is in fact a sophisticated piece of equipment, it is basically only a series of simple systems. To help in explaining the operation of the V.V. carburettor the principle of operation section has been split into 9 parts covering each system. The individual systems are listed below with the appropriate page number shown alongside for ease of reference.

a) <u>Fuel Input System</u>

Control of the fuel input is achieved by the same method as that used on the Ford fixed venturi carburettor. The system consists of an intake filter "A" in Fig.7, located in the input tube, a needle valve "B" and float "D" located in the float chamber.

As the fuel level in the float chamber drops the needle valve is opened allowing fuel, at lift pump pressure, to pass into the float chamber. As the level rises the float closes the valve and stops any further flow of fuel.

The float level on variable venturi carburettors is not adjustable as small variations in fuel level have no effect on carburettor performance.

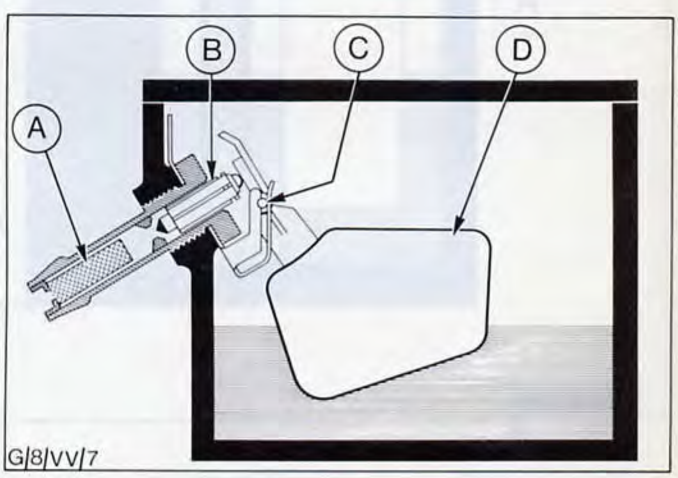


Fig.7. Fuel input system.
A - Inlet filter
B - Needle valve
C - Float pivot
D - Float

Fuel Input System (cont'd)

The needle valve has an override system which consists of a light spring, built into the valve, and a ball. The purpose of the system is to ensure that a steady force is exerted on the needle against the valve seat over a range of float travel. This reduces needle chattering caused by engine and vehicle vibration which would otherwise lead to an unacceptable rise in fuel level.

The leading end of the valve is 'Viton' coated, this is a thin rubberised coating applied to ensure a good seal is achieved between the valve and valve body.

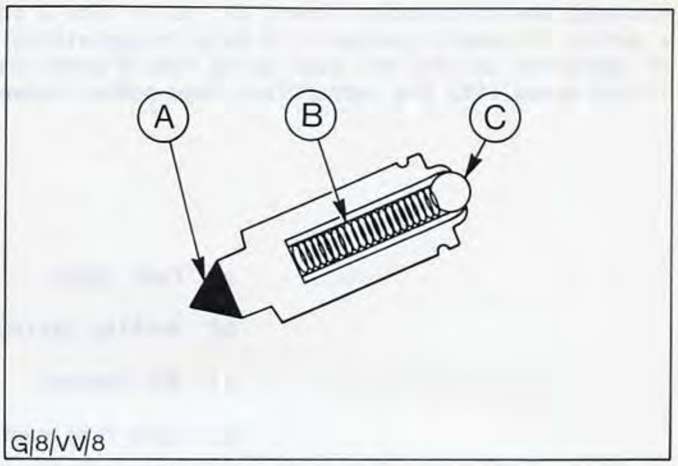


Fig.8. Needle valve assembly.
A - Lead end 'Viton' coated
B - Spring
C - Ball

b) Float Chamber Vent System

In countries where emission levels are strict it is not possible to allow petrol vapour, concentrated in the float chamber, to be emitted directly to atmosphere. The V.V. carburettor has therefore been designed with a closed or internal vent system. This has been achieved by venting the petrol vapour from the float chamber, through a drilling in the main jet body and into the carburettor air inlet. Refer Fig.9.

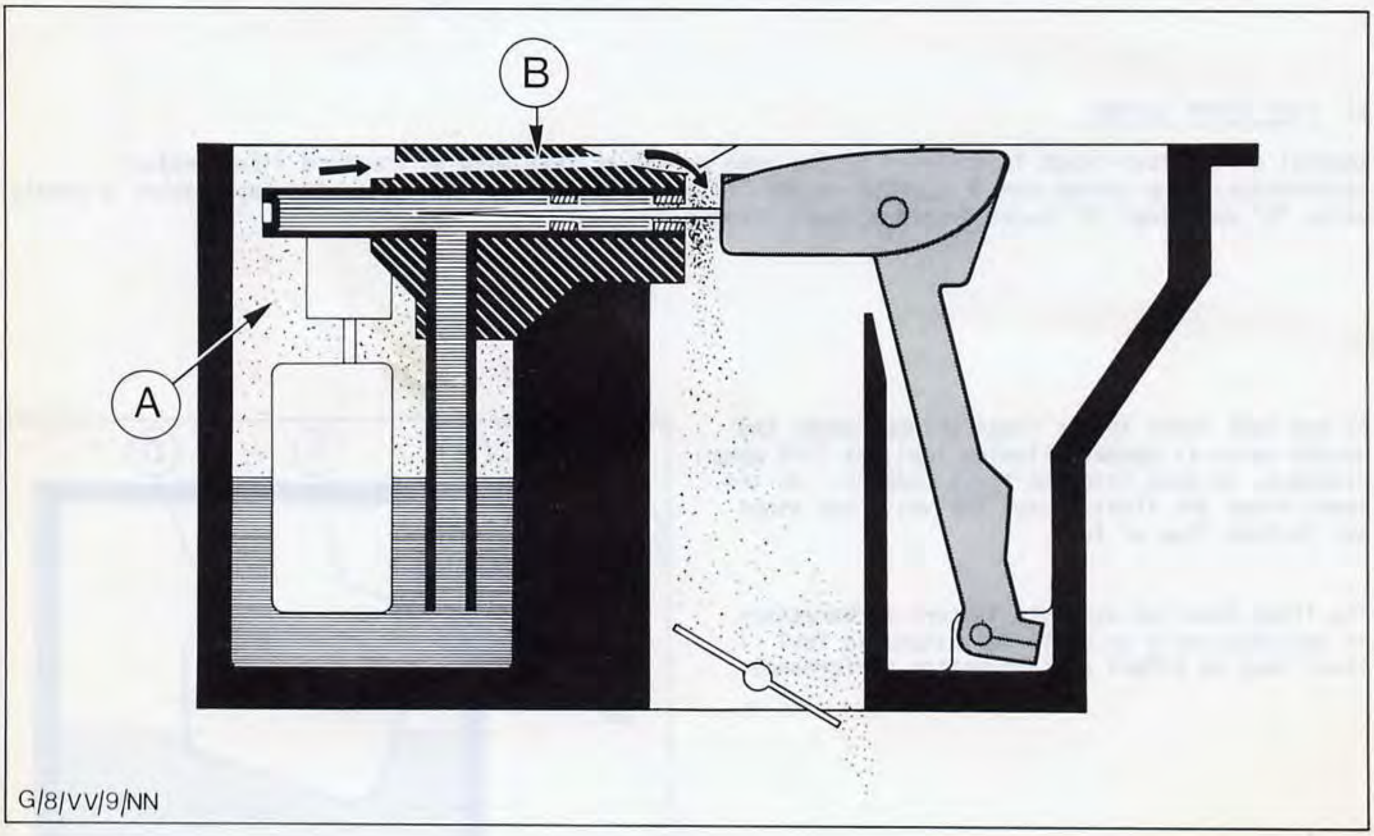


Fig.9. Float chamber vent system.
A - Fuel vapour
B - Vent gallery

PRINCIPLE OF OPERATION (cont'd)

FORD V.V. CARBURETTOR

c) Air Control

As shown in the General Description section, the main advantage of the V.V. carburettor is its ability to create a high air intake speed and therefore good quality fuel atomisation at low engine speeds and loads. This is achieved by the air valve which opens or closes the size of the venturi to respond to the engine's air demand. The air valve is operated by a diaphragm which is controlled by vacuum, sourced from a point in the venturi between the air valve and throttle butterfly. This depression created in the venturi is known as the control vacuum. The air valve and vacuum diaphragm are directly coupled which means that any movement of the diaphragm is directly transfered through levers to the air valve. See Fig.10.

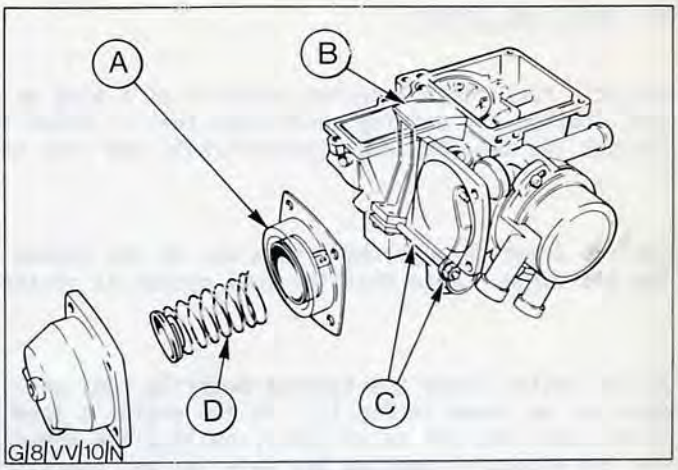


Fig.10. Air control system.
A - Vacuum diaphragm
B - Air valve
C - Operating linkage
D - Diaphragm return spring

At idle when the engine air requirements are low the air valve is held in its rest position by the diaphragm return spring. See Fig.11. This results in a high air speed over the main jet outlet, but because the throttle plate is closed the control vacuum is comparatively low. As the throttle plate is opened the engine's air demand rises and the control vacuum in the venturi increases. This control vacuum is fed to the diaphragm which pulls back, against a spring load, and opens the air valve until a balance between the forces of the control spring and the control vacuum are equal.

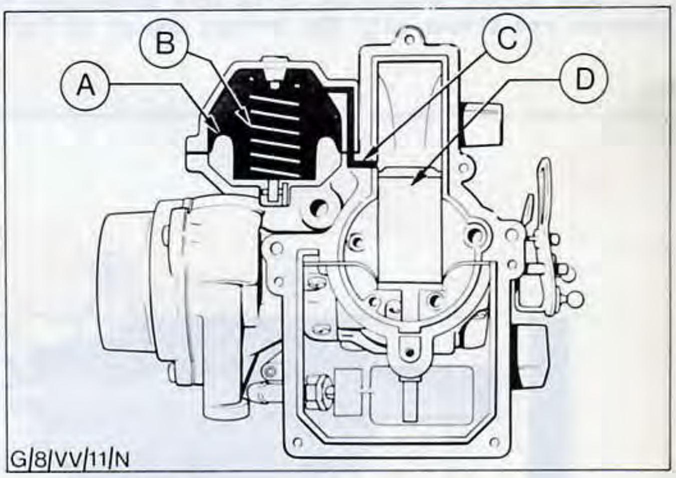


Fig.11. Air/Vacuum control system at idle.
A - Vacuum diaphragm
B - Return spring
C - Control vacuum source
D - Air valve (closed)

As the throttle is further opened the air valve will also open further until again the two opposing forces of the control spring and control vacuum are equal.

This balancing of the two opposing forces continues throughout the whole speed range up to maximum air valve opening. See Fig.12.

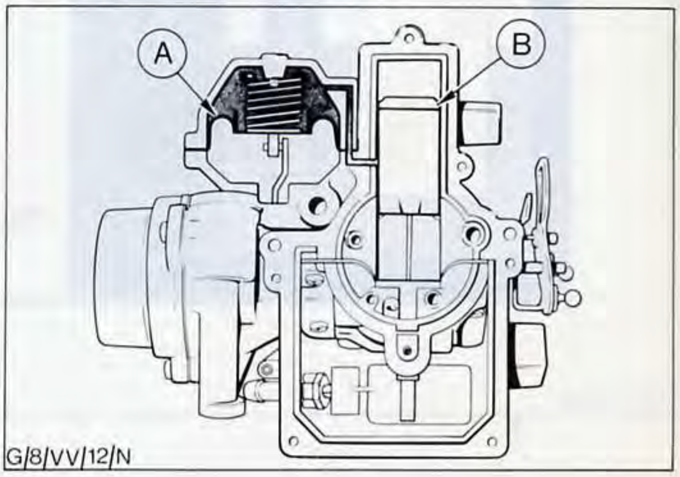


Fig.12. Air/Vacuum control system at full throttle.
A - Vacuum diaphragm
B - Air valve (fully open)

d) Main Fuel Control

The main fuel control system consists of a pick up tube, main and secondary jets and a tapered metering rod. During all driving conditions fuel is drawn from the float chamber, up the pick up tube, metered through the two jets and tapered needle and into the engine.

Fuel is drawn through the system due to the vacuum created in the venturi between the main jet body and the air valve. Note that the fuel outlet is located opposite the air valve.

At low engine loads the tapered metering rod, which is attached to the air valve, almost closes the main jet as shown in Fig.13. As the engine's load increases so does the engine's air requirements and in response the air valve opens, pulling the tapered needle through the main and secondary jets. This has the effect of opening the main jet and therefore allowing additional fuel to be supplied to the engine.

The contour of the taper on the metering rod controls the amount of fuel supplied to the engine. Therefore during production it is very accurately machined to ensure that at any given engine load the metering rod allows only the correct amount of fuel to pass into the engine.

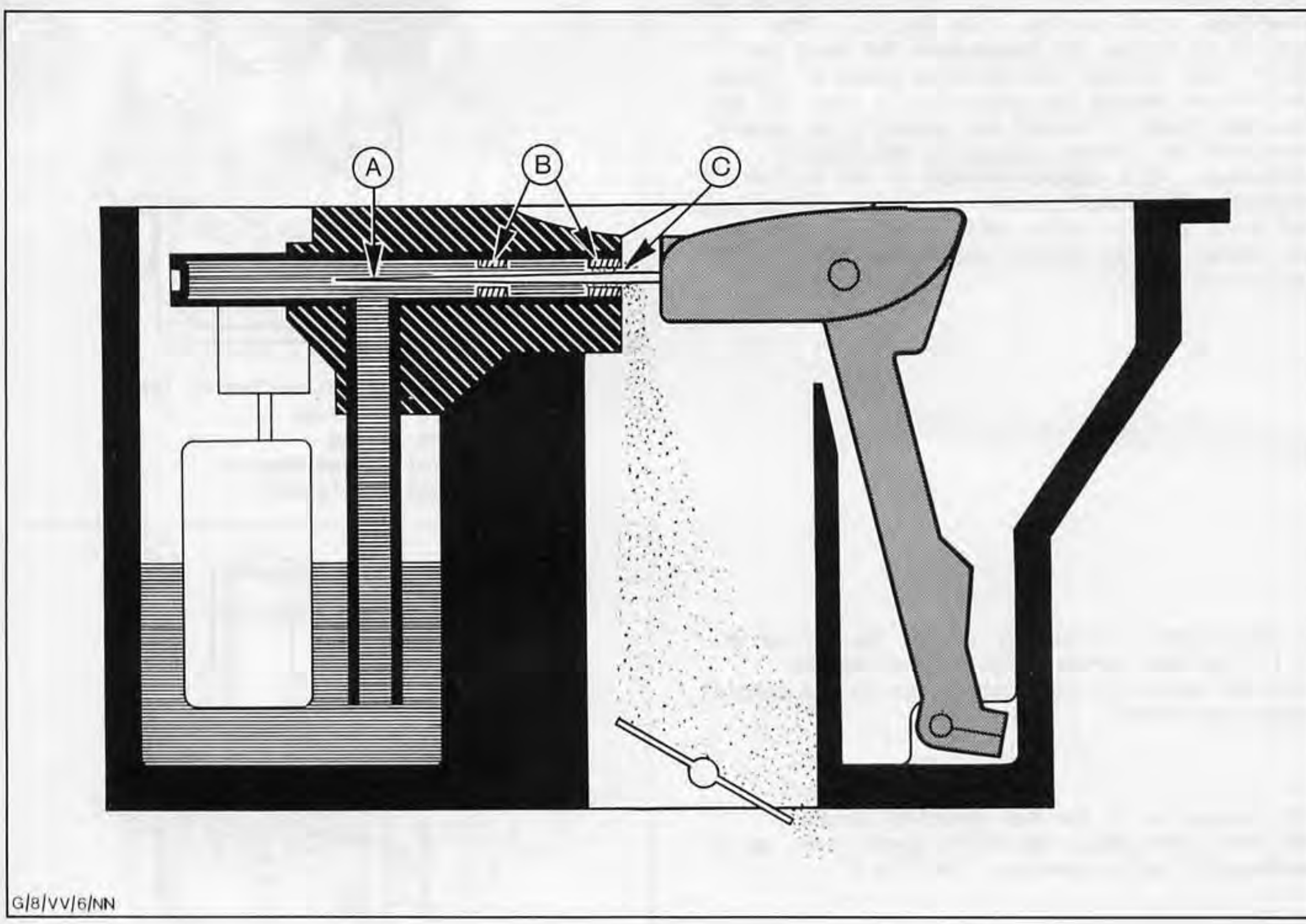


Fig.13. Main jet system.
A - Tapered needle valve
B - Main and secondary jets
C - Main fuel outlet

e) Idle System

The sonic idle system that was built into the Ford fixed venturi carburettor for 1976 to 1978 engines has been so successful in meeting idle emission levels that the same basic system has been built into the V.V. unit. The system achieves extremely low emission levels, at idle, because fuel is atomised in an air stream flowing at super-sonic velocity which produces a shock wave. On V.V. carburettors 70% of the idle fuel mixture is supplied through the sonic idle system, the remaining 30% being drawn from the main system. This proportioning has been found to give optimum idle quality with an idle CO that remains stable with temperature changes.

With the exception of the air bleed, "C" in Fig.14, all the air used by the engine at idle is drawn past the venturi and main jets. It then splits into two streams, one passes the throttle plate and the other passes round the sonic idle system where more fuel is added. The quantity passing the throttle plate can be varied to provide idle speed adjustment. The small opening of the throttle plate also prevents the butterfly becoming siezed in the bore as the carburettor body contracts during the cooling period after engine switch off.

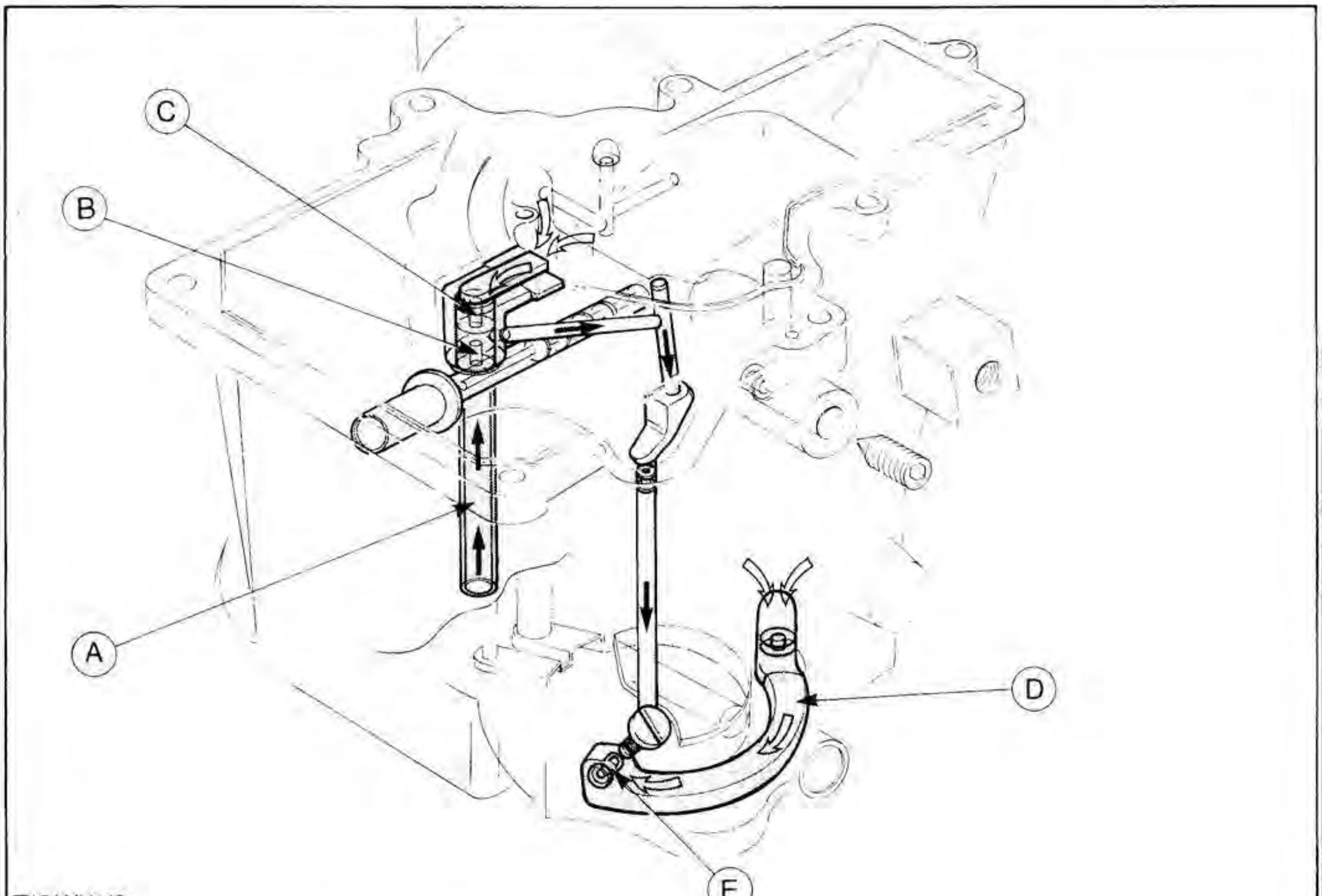


Fig.14. Idle System.

A - Main pick up tube
B - Idle fuel jet
C - Idle air jet
D - By-pass gallery
E - Sonic discharge tube

PRINCIPLE OF OPERATION (cont'd)

FORD V.V. CARBURETTOR

Idle System (cont'd)

Fuel supply for the idle system is sourced from the main pick up tube, metered through the idle jet, refer "B" in Fig.15, and mixed with air from an air bleed fitted into the main jet body. Refer "C" in Fig.15. The rich air/fuel mixture is then drawn through internal galleries down to the mixture control screw which regulates the amount of fuel to be fed into the engine from the idle system. The fuel mixture is then atomised with air drawn through the by-pass idle channel and fed into the engine through the sonic discharge tube.

Because of the high pressure difference that exists across the discharge tube the air is accelerated to a high speed (approximately 365 m/sec, 1200 ft/sec) and forms shock waves. The fuel is atomised when the droplets pass through these shock waves and is then fed directly into the inlet manifold below the throttle plate.

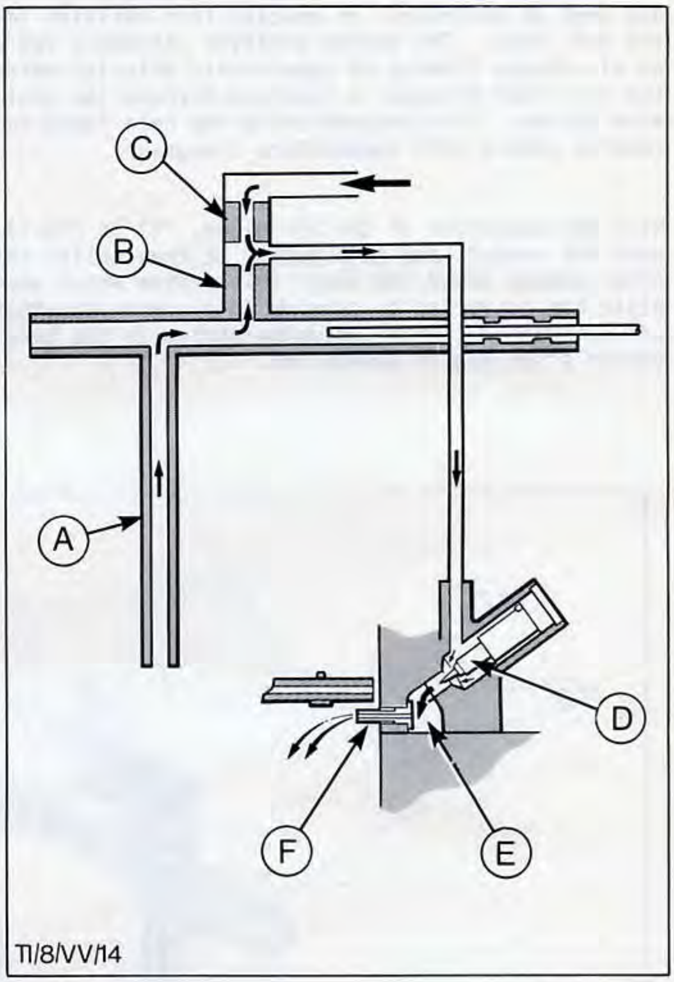


Fig.15. Idle system. (schematic)

A - Main pick up tube
B - Idle fuel jet
C - Idle air bleed jet
D - Mixture screw
E - Air by-pass channel
F - Sonic discharge tube

f) Throttle Operation

The same basic size of V.V. carburettor is used for all (IV) engine variants, therefore it can be seen that the throttle bore has to be sufficiently large to pass the air requirements for the larger engines to meet its power needs. However on the smaller engines maximum air requirements can be achieved with only 75% of throttle. This could make initial opening very sensitive giving poor driveability.
To overcome this the throttle linkage has been made progressive, see Fig.16, with a cam and roller mechanism so that a large initial throttle pedal movement will only give a small throttle plate opening. As the full pedal travel is approached the throttle plate movement is very rapid.

This gives a better feel on all engine sizes for slow speed traffic crawl, aiding economy and in addition giving good engine response throughout the full range of pedal travel on the smaller engines.

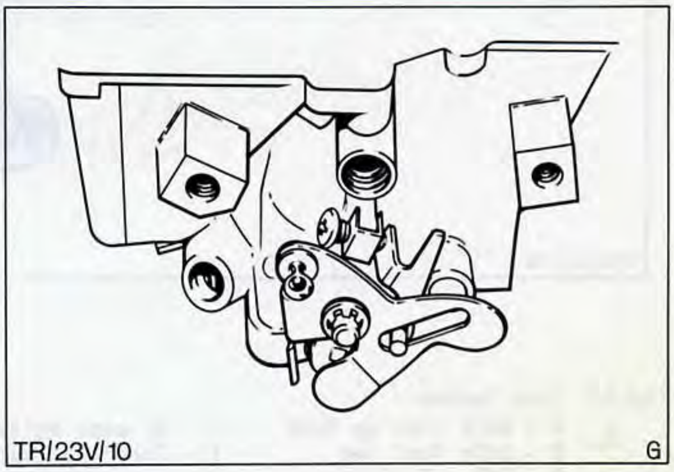


Fig.16. Progressive throttle system.

g) Accelerator Pump

The fuel and air supply systems, previously described, operate completely successfully during steady state or cruise conditions. However, during transient conditions i.e. when the throttle pedal is moved to accelerate, the manifold vacuum drops and there is a time lag before a stable fuel/air balance condition is re-established in the inlet manifold. If no compensation were to be made for this time lag a flat spot or hesitation would result.

The Variable Venturi carburettor has two systems to compensate for the time lag. One is a restrictor fitted in the air passage between the control diaphragm and the control vacuum area. This causes the valve opening to react slowly to an increase in air flow causing a momentary higher vacuum at the main jet because of the increased air velocity. The higher vacuum results in an increased fuel flow.

The first system compensates for all but very large reductions in manifold vacuum. For these relatively large amounts of fuel are required. To deliver this extra fuel an accelerator pump system is fitted to the carburettor. See Fig.17.

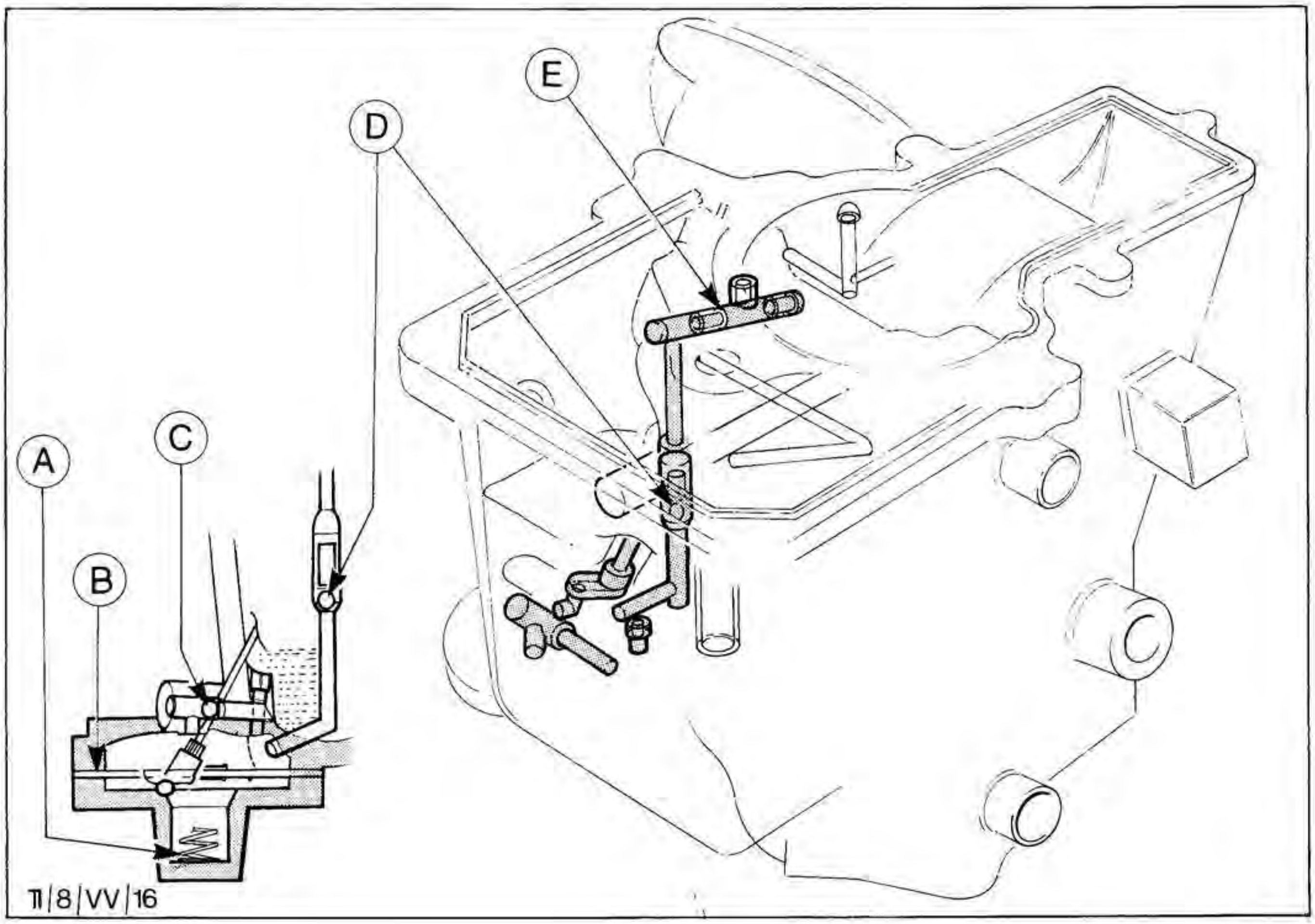


Fig.17. Accelerator pump system.
A - Return Spring
B - Diaphragm
C - Intake one way valve
D - Outlet one way valve
E - Pump jet

PRINCIPLE OF OPERATION (cont'd)

Accelerator Pump (cont'd)

Unlike the accelerator pump fitted on fixed venturi units the V.V. pump is vacuum controlled.

The system senses the fall in manifold vacuum and injects fuel directly into the venturi enriching the mixture so minimising any hestitation.
Under normal operating conditions a vacuum, obtained from beneath the throttle plate, is available at the pump and pulls a diaphragm back against a spring load. This in turn draws fuel, through internal galleries, from the float chamber. In this situation the inlet one way valve, "F" in Fig.18, in the pump is open and the outlet one way valve "C" is closed.

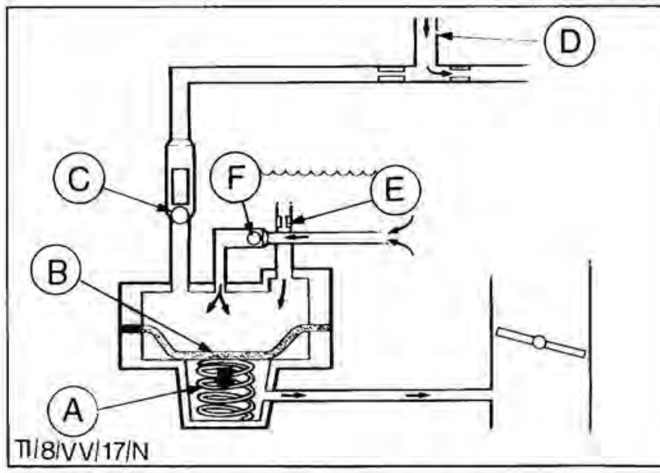


Fig.18. Accelerator pump system - Inlet.
A - Return spring (Compressed)
B - Diaphragm
C - One way valve
D - Vacuum break air hole
E - Back bleed
F - One way valve

When the vehicle is accelerated the vacuum signal beneath the throttle plate drops rapidly which results in the return spring pushing the diaphragm back to its rest position. The fuel reserve that was initially drawn into the pump is then injected through internal galleries past the outlet one way valve and into the venturi. See Fig.19.

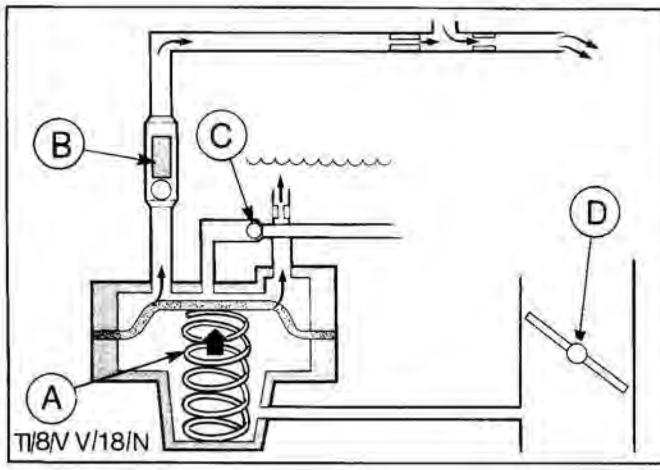


Fig.19. Accelerator pump system - Outlet. (schematic)
A - Return spring (extended)
B - Outlet one way valve (open)
C - Inlet one way valve (closed)
D - Throttle plate (open)

As shown in Fig.18, the system also includes a back bleed "E" located in the pump and a vacuum break air hole "D" located at the fuel outlet.

Pump Back Bleed

During prolonged idle such as that experienced during traffic congestion the air temperature under the hood will rise considerably. This has the effect of boiling or gassing the fuel contained in the accelerator pump reservoir, resulting in ineffective operation when the pump is next used. Also the fuel vapour created in the pump would seep into the system and so richen the idle air/fuel mixture by discharging fuel from the pump jet. The back bleed overcomes this condition by allowing vapour to bleed back into the float chamber and so allowing cooler fuel to feed into the pump.

Vacuum Break Air Hole

During normal operation the air speed and therefore the vacuum at the fuel outlet is high. This vacuum during high speed operation would be strong enough to pull fuel through the accelerator pump system. The vacuum break air hole "D" in Fig.18, is included to overcome this condition by allowing air to bleed into the pump outlet pipe and so lowering the vacuum created at the accelerator pump jet. Note that the bleed hole is located on the outlet side of the pump jet.

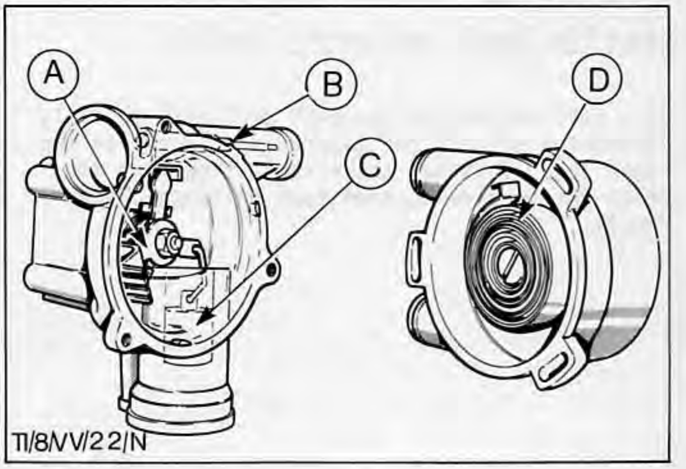
PRINCIPLE OF OPERATION (cont'd)

FORD V.V. CARBURETTOR

h) Choke Operation

Due to the variable venturi principle it is not practical to install a choke plate into the venturi. Therefore, all V.V. units irrespective of the vehicle model will have a fully automatic choke system.

The only similarity between the V.V. choke and fixed venturi auto-choke systems is the method of controlling the unit. This is achieved by using a conventional bi-metal coil which reacts to the temperature of the coolant supplied from the water pump via the inlet manifold.



The actual choke system operates like a miniature carburettor utilising a variable needle jet and a variable air supply.

Fig.20. Auto-choke assembly.
A - Operating linkage
B - Needle valve
C - Pull down piston
D - Bi-metal coil

The system consists of a bi-metal coil, 'D' in Fig.20, a tapered needle valve 'B', operating linkage and a vacuum operated pull down piston 'C'. The principle of operation for the choke system is split into three parts; the fuel supply, the air supply and the choke pull down system.

1 - Choke Fuel Supply and Control

According to model, fuel supply to the choke is either sourced from the main pick up tube or from a separate choke supply tube. Fuel is then fed through internal galleries in the main jet body and into the tapered needle valve in the choke housing. Because the needle valve is tapered it has the ability to vary the fuel fed through the choke system to match the engine's requirements. On carburettors with a separate choke tube the fuel is partially emulsified at source by air being drawn into the upper section of the supply tube.
Fig.21, shown below also details the air/fuel mixing point, air intake and mixture outlet.

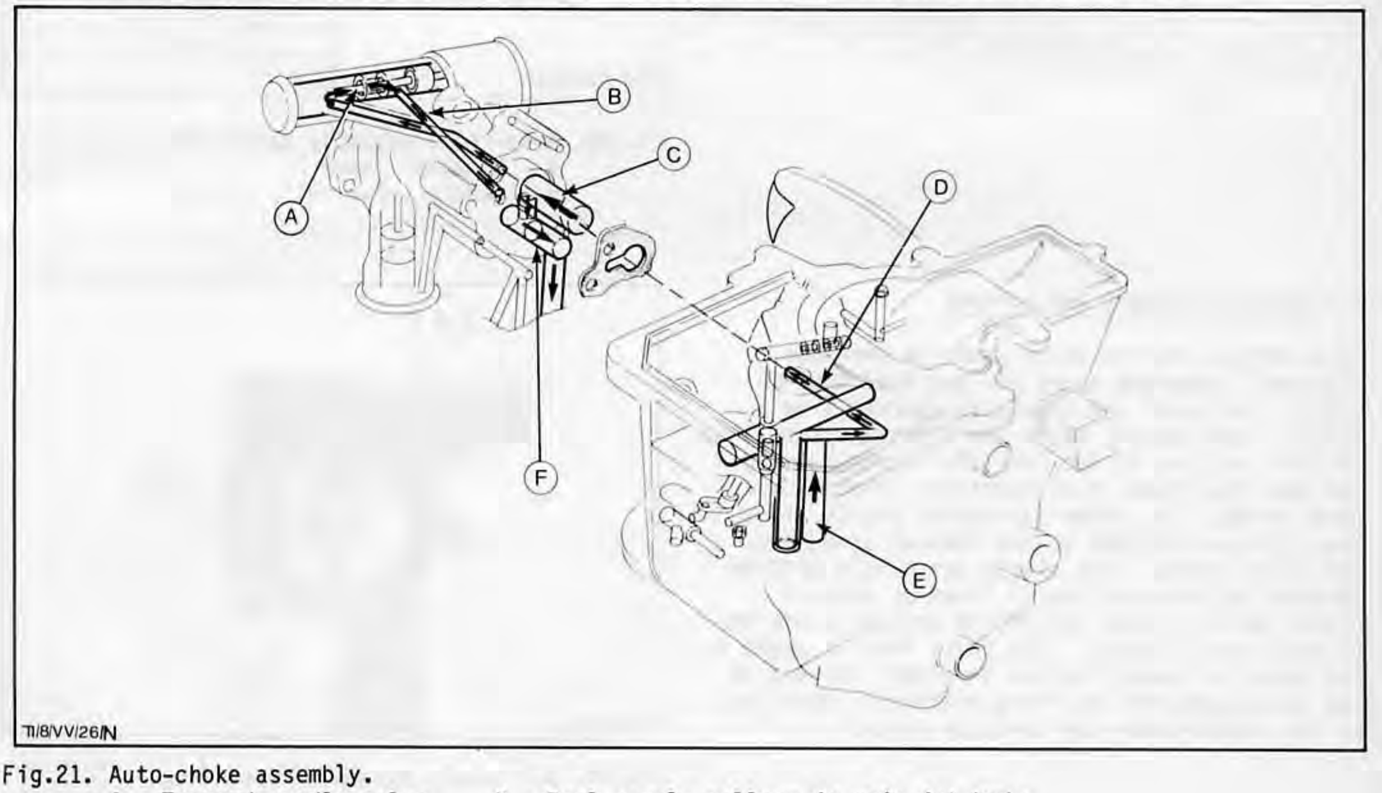


Fig.21. Auto-choke assembly.
A - Tapered needle valve
B - Fuel output gallery
C - Air intake and mixing point
D - Fuel supply gallery in main jet body
E - Choke fuel pick up tube
F - Mixture outlet

PRINCIPLE OF OPERATION (cont'd)

FORD V.V. CARBURETTOR

Choke Fuel Supply and Control (cont'd)

On a cold engine the bi-metal coil will be fully contracted pulling the tapered needle out of the choke jet. This has the effect of opening the choke jet to give maximum fuel delivery. See Fig.22.

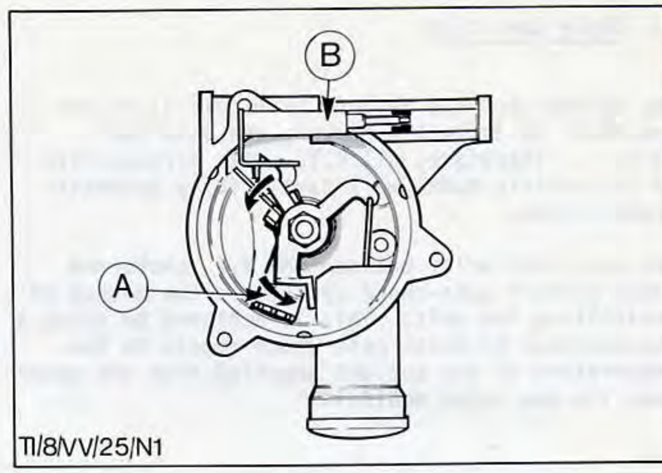


Fig.22. Auto choke fully operational.
A - Bi-metal lever
B - Needle valve fully open

As the bi-metal coil warms up it expands and closes the needle valve so reducing the amount of fuel fed into the sytem. This continues until the bi-metal coil fully closes the needle valve as shown in Fig.23.

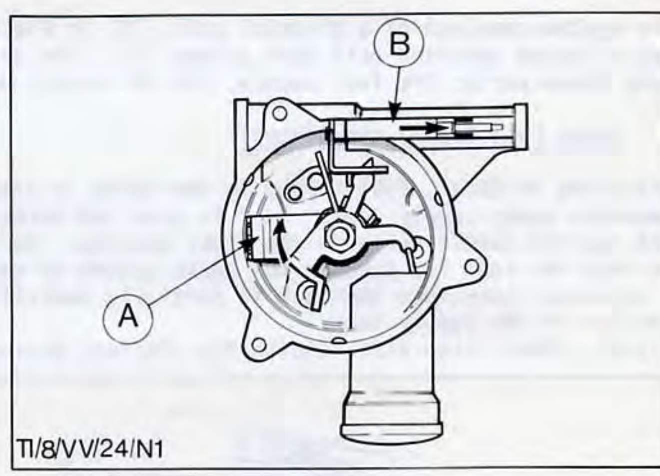


Fig.23. Auto-choke assembly closed down.
A - Bi-metal lever
B - Needle valve fully closed

2 - Choke Air Supply and Control

Cold engines require extra power to overcome friction, therefore extra air and fuel must be added. The choke air supply is sourced from a point in the venturi above the throttle plate, the air/fuel mixture is fed into the engine beneath the throttle plate, thus forming a throttle by-pass system. The choke air valve, Fig.24, is a brass sleeve attached to the central spindle of the choke levers. The sleeve has a hole drilled through the side wall which lines up with an outlet gallery, when the engine and therefore the bi-metal coil is cold. The choke fuel is added to the choke air supply before it enters the end of the sleeve and the resulting mixture is supplied to the engine below the throttle plate.

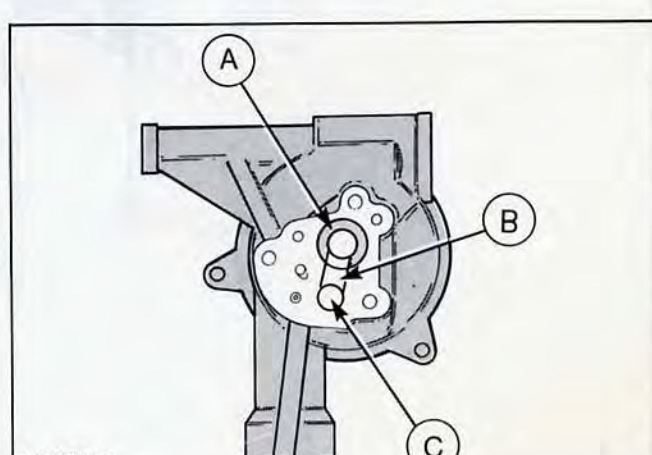


Fig.24. Air supply system in operation.
A - Brass sleeve attached to central shaft and lined up with outlet gallery
B - Outlet gallery
C - Air fuel outlet

Choke Air Supply and Control (cont'd)

As the bi-metal coil starts to heat up and expands it turns the central shaft and therefore the control sleeve thus restricting mixture flow through the system. As with the fuel supply the bi-metal expansion progressively rotates the sleeve until it fully blocks the outlet gallery. Refer Fig.25.

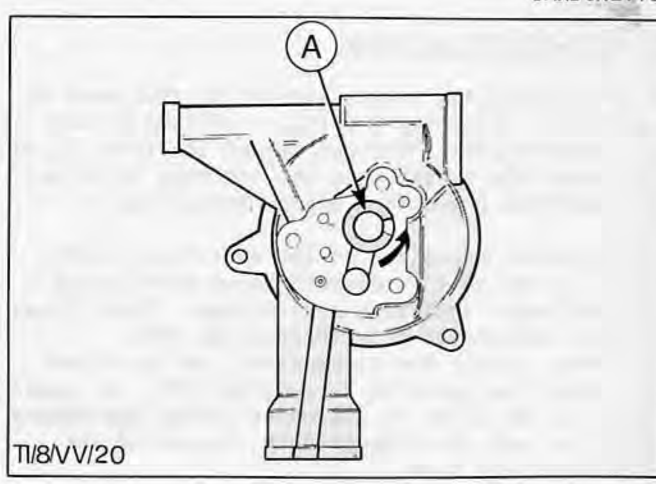


Fig.25. Air supply system closed down.
A - Brass sleeve blocking outlet gallery

3 - Choke Pull Down System Fig.26.

When operating a cold engine at a light load or cruise condition it is not necessary to have such a rich mixture as that required during acceleration or heavy load. The choke therefore has been equipped with a pull down system which pulls the choke off during engine cruise conditions. This system improves emission levels and fuel economy during engine warm up.
The system consists of a vacuum piston connected through levers to the central choke spindle. The piston is vacuum operated from a source in the venturi beneath the throttle plate. During acceleration when the throttle plate is open the vacuum signal beneath the plate and also at the pull down piston is low. Therefore, during acceleration the system has no effect on choke operation. As the cold engine returns to a steady state or idle condition the vacuum signal increases pulling the piston downwards. Once the torque of the bi-metal coil is overcome the piston will pull the needle valve closed and also close down the choke mixture supply.

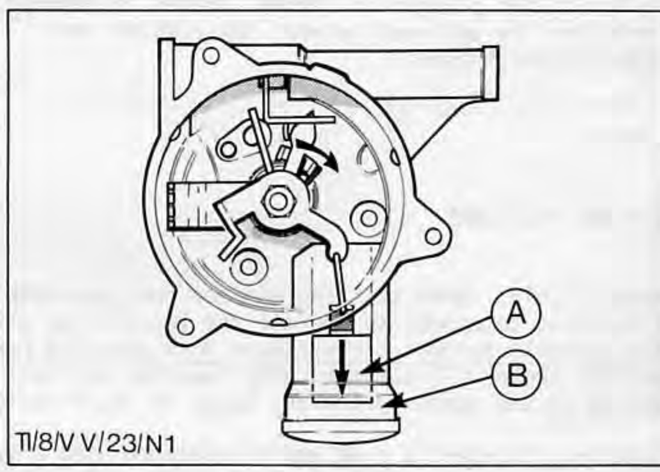


Fig.26. Choke pull down system.
A - Piston pulled down, closing choke
B - High vacuum

Working together the individual choke systems ensure that sufficient additional air/fuel mixture is supplied to the engine to suit the specific operating condition. Also, the system is designed to shut down progressively as the engine warms-up and thus avoids exessively high engine speeds normally associated with auto-choke systems.

PRINCIPLE OF OPERATION (cont'd)

j) Anti-Dieselling Valve

An anti-dieselling valve, similar to that used on some Ford fixed venturi units, is fitted on most V.V. carburettors. The purpose of the valve is to block the idle system when the ignition is turned OFF therefore preventing engine dieselling.

During normal operation of the vehicle a 7 volt supply is fed to the solenoid valve which holds back a plunger against a spring load. This allows air/fuel mixture to flow through the idle galleries, within the carburettor, in the normal way. When the ignition is switched OFF, the power supply to the valve is cut which allows the return spring to push the plunger into the end of the sonic discharge tube.

This results in the air/fuel mixture flow, in the sonic idle system, being blocked the instant the ignition is turned OFF and so preventing the engine from dieselling.

The tip of the plunger is 'Viton' coated to ensure a good seal is achieved between the plunger and sonic discharge tube.

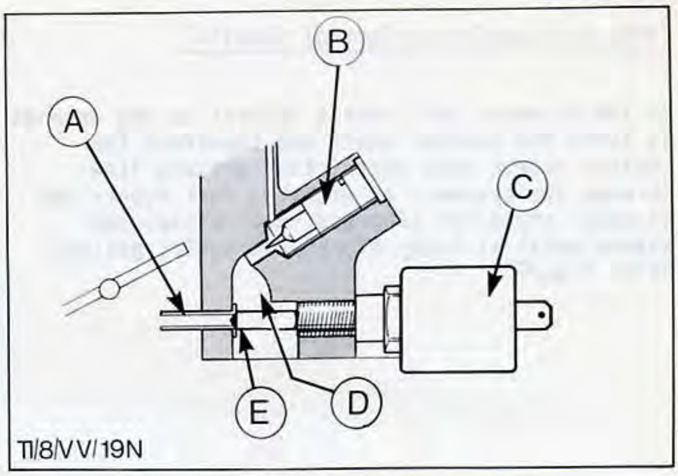


Fig.27. Anti-dieselling valve system.
A - Sonic discharge tube
B - Mixture screw
C - Anti-dieselling valve
D - By-pass air channel
E - 'Viton' coated tip

STARTING PROCEDURE

Engine - Cold: When starting engines equipped with fixed venturi carburettors, with automatic chokes, it is first necessary to operate the throttle to allow the choke plate/s to close. On engines equipped with variable venturi carburettors this starting procedure is not required because as an engine cools the V.V. choke will automatically function and will be fully operational on a cold engine. Full details of the choke system are shown in the Principle of Operation section.

Therefore, to start a cold engine equipped with a variable venturi carburetor all that is required is to crank the engine until it starts. It is important that during cranking the throttle is NOT pumped as this will upset the choke operation and cause a poor start condition.

If the engine does not start within ten seconds, return key to position 1, pause and repeat cranking. If the engine does not start after two attempts, wait ten seconds and proceed as described in "starting a flooded engine".

Engine - Warm: Slowly depress the throttle pedal to the half way position and hold, crank engine until it starts. If engine fails to start after three attempts and the engine is hot, proceed as described below.

Starting a Flooded Engine: If the engine has been cranked several times without starting, the cylinders may be flooded with unburnt fuel. Should this occur, press the throttle slowly to the floor and hold in this position while cranking the engine. When the engine starts release throttle gradually as the engine speed increases.

IMPORTANT NOTE: When the engine is first started from cold the fast idle speed will not be as high as that experienced on fixed choke carburettors. On initial start the engine will operate at approximately 900 rev/min, will increase to approximately 1200 during the first stages of warm up and finally drop to normal idle speeds when the engine reaches operating temperatures.

FUEL (PETROLEUM SPIRIT) HANDLING SAFETY PRECAUTIONS

FORD V.V. CARBURETTOR

When carrying out repairs to vehicle fuel systems it is easy to become complacent about handling fuel, particularly in relation to draining fuel tanks. The risks involved should not be under estimated. The following information provides the basic precautions which must be taken if fuel is to be handled safely and also points out some other areas of risk that must not be overlooked.

1. Disconnect the battery when carrying out any work on fuel systems.
2. Always empty fuel tanks in the open, preferably in a designated no-smoking area. If this is not possible, portable warning notices should be positioned around the vehicle when carrying out the draining operation.
3. Always have a suitable fire extinguisher close at hand.
4. Empty the tank using suitable pumping equipment, not by disconnecting the fuel line from the sender unit.
5. Ensure there are no naked lights or other ignition sources (i.e. welding equipment) within 7 metres (20 feet) of the vehicle, before commencing the emptying process.
6. Do not empty the tank over an inspection pit. Petrol vapour is heavier than air and will remain in a pit for several hours. This also applies when cleaning carburettor float bowls or fuel pumps as small amounts of petrol can produce sufficient vapour to constitute a possible source of risk.
7. Empty the fuel into a closed, clearly marked container. There are containers on the market which are specifically suited to this purpose incorporating such devices as a flame arrestor and a pressure vented cap.
8. Having removed the fuel, do not leave it standing in the workshop. Petrol should only be kept in a store which meets with the approval of local by-laws.
9. When the fuel has been drained from the tank, the tank will still contain petrol vapour. In this state it is in an even more hazardous condition, and the precautions regarding naked lights and other ignition sources should be maintained with the utmost care.
10. On many vehicles the fuel line is connected to the fuel tank outlet pipe by spring steel band clips to ensure a leak proof joint. These clips should be released before the fuel line is disconnected or the tank sender unit is removed. By observing this procedure, any sparks which may be generated when removing the clips cannot ignite residual petrol fumes in the fuel tank.
11. In no circumstances should any repair involving the application of heat be attempted on any fuel tank, without first rendering the tank safe. There are two main methods of rendering the tank safe:

    (a) Steaming Out.

    The filler cap and the tank sender unit must be removed and the tank emptied as completely as possible before steaming out. The tank should then be steamed for at least two hours with low pressure steam. Position the tank so that the condensate can drain away freely, thus ensuring that sediment and sludge, not volatilised by the steam, are washed out during the steaming process.

    (b) Boiling Out

    Again the filler cap and the tank sender unit must be removed and the tank emptied. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling as well as surrounding the tank. Boil the tank for at least two hours.

    In addition, no person should be allowed to work on petrol or any fuel tank repairs without having the special training necessary.

12. As an added precaution fuel tanks should have a PETROL (GASOLINE) VAPOUR warning label attached to them as soon as they are removed from the vehicle. After steaming or boiling out a signed and dated label to this effect should be attached to the tank.

SERVICE ADJUSTMENTS AND CHECKS

FORD V.V. CARBURETTOR

In total there are five adjustments possible on the V.V. carburettor, however only two are required during normal routine servicing. These are the idle speed and fuel mixture settings. The three other adjustments will only be required when the choke is repaired or when the carburettor is overhauled. They are fully explained in Operation No. 23 214 'Metering rod adjust' and Operation No. 23 274 'Choke adjust'.

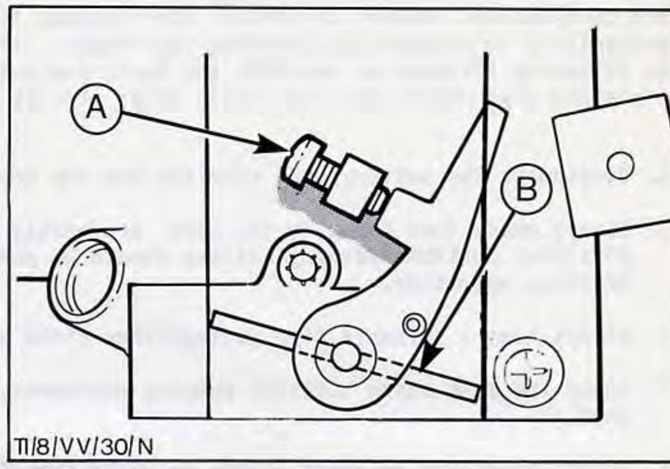


Fig.28. Engine idle speed adjustment.
A - Throttle stop screw
B - Throttle plate

Idle speed adjustment is achieved by exactly the same method as that used on the Ford fixed venturi unit, utilising a throttle stop screw Fig.28, to control engine speed and a mixture screw Fig.29, to control fuel delivery.

On all V.V. units the mixture screw will be tamperproofed to minimise indiscriminate adjustment of the idle mixture. The screw is sealed by a plastic plug which has to be destroyed to gain access to the screw.

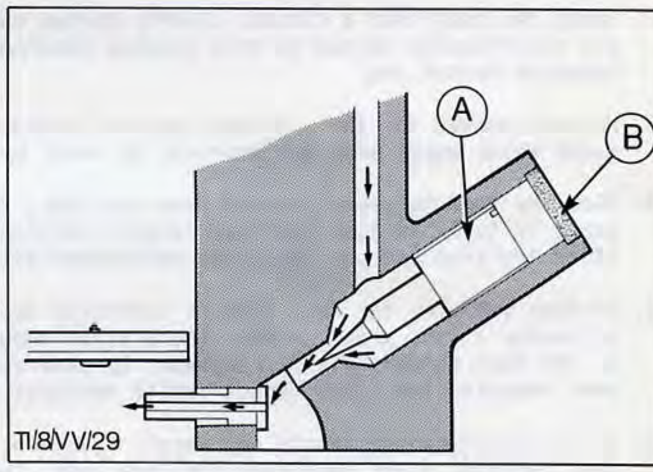


Fig.29. Fuel mixture or CO adjustment.
A - Mixture screw
B - Tamperproof plug

Adjustment of the throttle stop screw controls the engine's idle speed by opening the throttle plate, to increase speed, or closing the plate to reduce speed. Refer Fig.28.

The mixture screw is a tapered needle jet which when screwed in will reduce the flow of fuel through the system and so weaken the mixture. Unscrewing will have the opposite effect which richens the idle mixture. Refer Fig.29.

A full detailed procedure for adjusting the idle speed and mixture setting is covered in Operation No. 23 213. Both adjustment screws are shown in Fig.30.

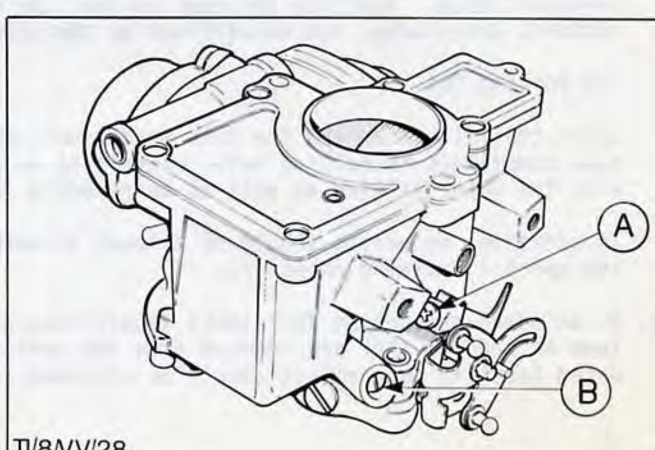


Fig.30. Variable Venturi carburettor.
A - Idle speed adjusting screw
B - Mixture adjusting screw (Tamper-proof plug removed for clarity)

In addition to the idle adjustment during normal routine servicing the entire fuel system should be checked for evidence of leaks. If any are found they should be rectified immediately.

SPECIAL SERVICE EQUIPMENT RECOGNITION

FORD V.V.
CARBURETTOR

To carry out adjustments on variable venturi carburettors two separate pieces of equipment are required. These are:

a) Engine Tachometer Fig.31.

The tachometer is required for checking normal idle speeds and in most cases will be readily available in the workshop.

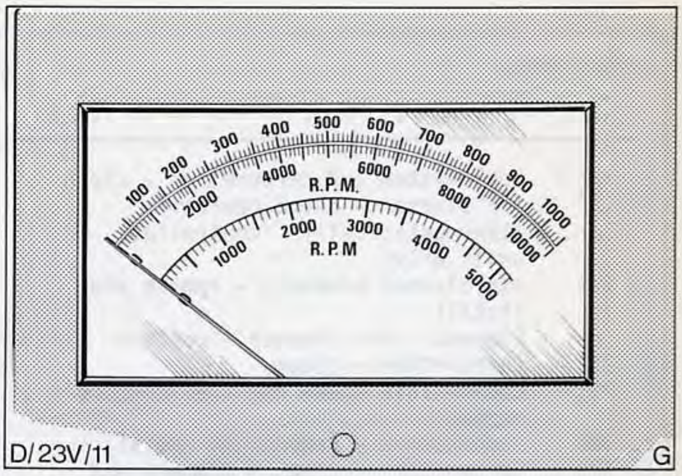


Fig.31. Typical engine tachometer or rpm meter.

b) Exhaust Gas Analyser Fig.32.

This equipment is used to check the mixture strength at normal idle during routine servicing. To ensure that the carburettor is adjusted correctly the equipment must be calibrated in % CO rather than the rich and lean calibrations which were used on older gas analysing equipment.

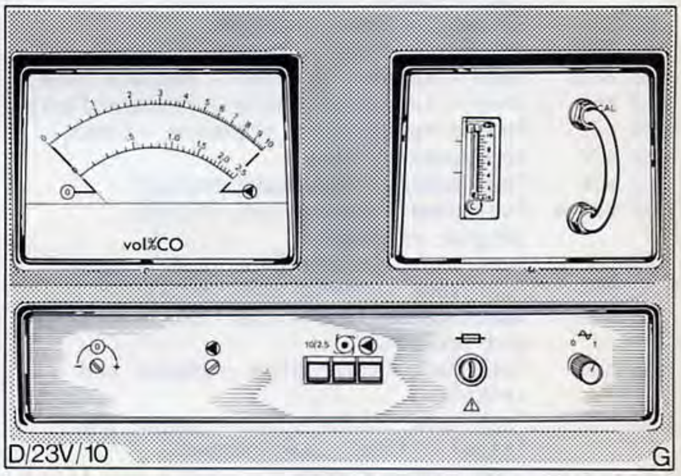


Fig.32. Exhaust gas analyser calibrated in %CO.

SERVICE AND REPAIR OPERATIONS - CONTENT

FORD V.V. CARBURETTOR

FUEL SYSTEM		Described in this publication	Contained in Operation	Contained in Section 23
23 122	Fuel system and carburettor - clean		23 212	X
23 172	Air cleaner - check operation (thermostatically - controlled units only)	X		
23 174	Air cleaner assembly - remove and install	X		
23 184	Element - air cleaner - replace	X		
23 212	Carburettor - clean	X		
23 213	Engine idle speed and fuel mixture - adjust	X		
23 224	Carburettor - remove and install	X		
23 224 6	Carburettor - clean - inspect and adjust (carburettor removed)	X		
23 242	Carburettor - main metering rod - replace	X		
23 244	Needle valve - replace	X		
23 264	Carburettor control diaphragm - remove and install	X		
23 274	Automatic choke - adjust	X		
23 276	Automatic choke - remove and install	X		
23 283	Hose - automatic choke - replace (one)			X
23 284	Hose - automatic choke - replace (both)			X
23 531	Fuel pump delivery pressure - check			X
23 532	Fuel pump - clean			X
23 534	Fuel pump - remove and install			X
23 534 4	Fuel pump - remove and install (engine removed)			X
23 552 2	Fuel tank - clean (fuel tank removed)			X
23 554	Fuel tank - remove and install			X
23 558	Ventilation tube - fuel tank - remove and install			X
23 572	Fuel tank filler pipe - remove and - install			X
23 572 4	Fuel tank filler pipe - remove and - install (fuel tank removed)		23 572	
23 581 2	Fuel line - clean			X
23 583	Fuel line - fuel tank to pump - remove and install			X
23 587	Fuel line - fuel pump to carburettor - remove and install			X
23 594	Fuel line - fuel return - carburettor to fuel tank - remove and install			X
23 598	Hose - fuel line connecting - replace (one)			X
23 811	Linkage - accelerator - adjust	X		
23 822	Pedal - accelerator - remove and install			X
23 824	Accelerator shaft - remove and install			X
23 826	Cable - accelerator - remove and install			X

23 172 AIR CLEANER - CHECK OPERATION (Thermostatically Controlled Units Only)

SPECIAL EQUIPMENT REQUIRED:
Vacuum Pump

1. Open hood and fit fender covers.

2. Note position of air cleaner flap. With engine stationary the flap should be fully closed, Fig.33.

NOTE: Flap position can be viewed through the main intake spout.

3. Start engine and note operation of air control flap. At idle flap should fully open and hold open to allow warm air from exhaust manifold to enter air cleaner. Fig.34.

NOTE: It is essential that this test is carried out on a cold engine, i.e. with engine cooled sufficiently for the ambient temperature around the exhaust manifold to be below heat sensor value (25° C) (77° F). This is to ensure that the heat sensor unit allows full vacuum to be available at the diaphragm unit. If the flap operates as described above, cleaner is functioning correctly.

If flap remains closed when engine is started the diaphragm unit and heat sensor unit should be tested as follows to determine which unit is faulty.

4. Check vacuum lines for leaks and renew if suspect.

5. Disconnect diaphragm to heat sensor pipe at the heat sensor and connect vacuum pump to diaphragm, Fig.35.

6. Pump vacuum up to 100 mm (14 in) of mercury and hold. If diaphragm now operates and control flap opens this indicates that heat sensor is at fault and should be renewed.

If flap remains closed throughout this test, either diaphragm or control flap is faulty. If visual inspection confirms that control flap is free to operate then a fault in the diaphragm is indicated and this should be renewed.

IMPORTANT NOTE: When installing an air cleaner, ensure that the vacuum pipe fully locates onto inlet manifold take off pipe.

7. Disconnect vacuum pump and reconnect pipe.

8. Remove fender covers and close hood.

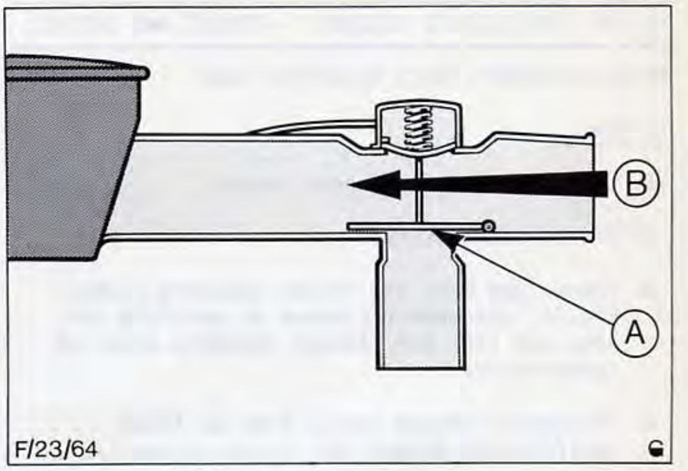


Fig.33. Air cleaner spout.
A - Control flap shutting of flow from manifold
B - Main air flow

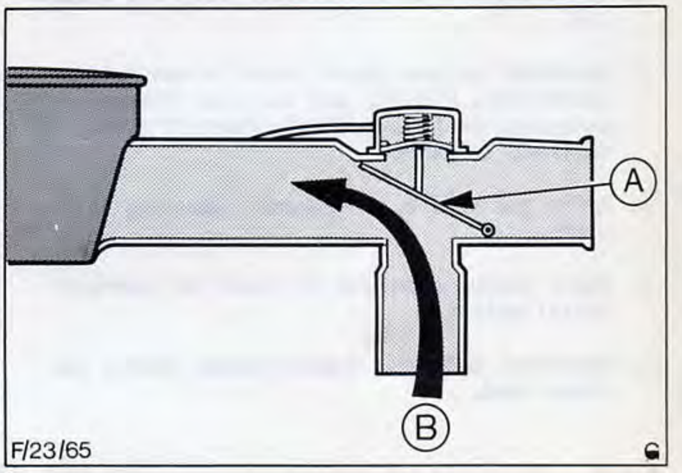


Fig.34. Air cleaner spout.
A - Control flap held open restricting main air flow
B - Air flow from manifold

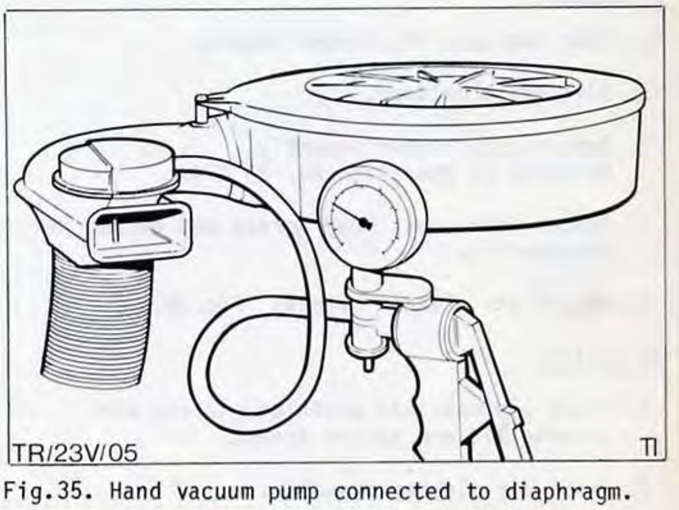


Fig.35. Hand vacuum pump connected to diaphragm.

23 174 AIR CLEANER ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove one bolt and loosen securing clamp, Fig.36, disconnect cleaner to manifold air hose and lift air cleaner assembly clear of carburettor.
4. Disconnect vacuum supply pipe at inlet manifold and detach air cleaner assembly.
5. Remove air cleaner element.
   Detailed in Operation No. 23 184.

To Install

6. Refit element to air cleaner body and secure lid.
7. Reconnect vacuum supply pipe to manifold connection, Fig.37, and position cleaner ensuring air hose connects correctly on manifold location.
8. Refit and secure air cleaner securing bolt and clamp.
9. Check vacuum pipe and air hose for correct installation.
10. Reconnect battery, remove fender covers and close hood.

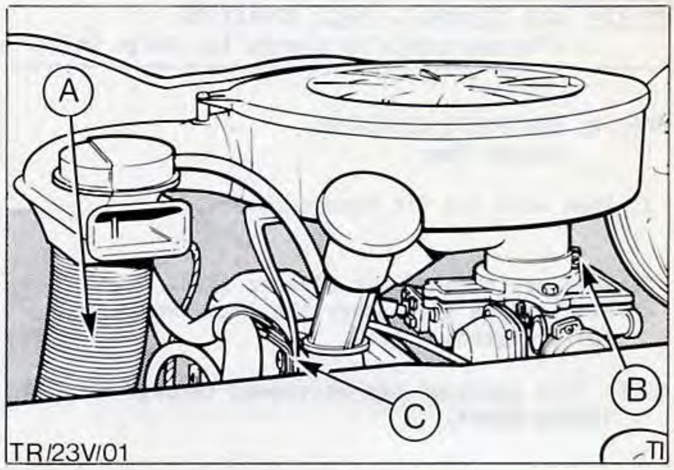


Fig.36. Air cleaner assembly.
A - Cleaner to manifold air hose
B - Cleaner to carburettor clamp
C - Cleaner securing bolt

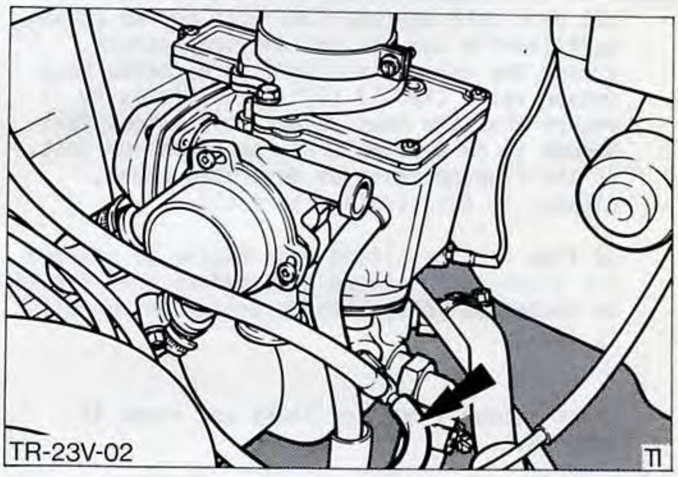


Fig.37. Air cleaner vacuum supply hose connection.

23 184 ELEMENT - AIR CLEANER - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
   Detailed in Operation No. 23 174.
4. Remove four cross head screws and detach air cleaner lid.
5. Remove air cleaner element, Fig.38.

To Install

6. Place element into position, locate air cleaner lid and secure screws.
7. Refit air cleaner assembly.
8. Reconnect battery.
9. Remove fender covers and close hood.

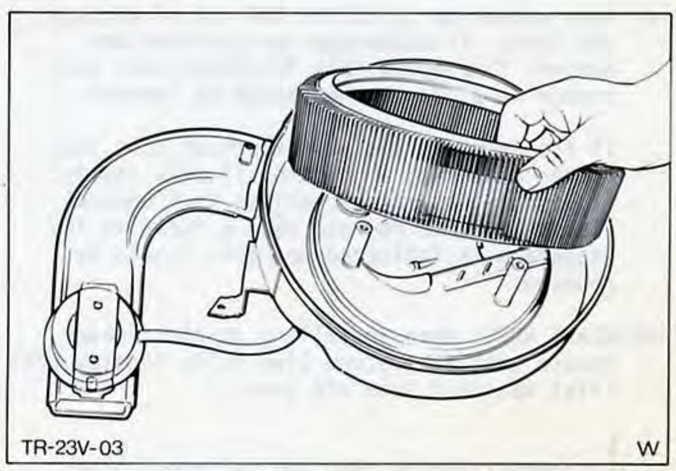


Fig.38. Air cleaner element removal.

23 212 CARBURETTOR - CLEAN

SPECIAL EQUIPMENT REQUIRED:

CO Meter
RPM Meter

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Remove air cleaner assembly, Fig.39.
   Detailed in Operation No. 23 174.

4. Clean carburettor exterior.

5. Remove two bolts and detach carburettor to air cleaner mounting adaptor, Fig.40.

6. Remove seven screws and detach carburettor top cover, Fig.40.

7. Using a piece of absorbent cloth soak out fuel from float chamber.

8. Using an air line, clean carburettor float chamber.

IMPORTANT: Ensure air pressure is NOT directed into accelerator pump air bleed, air valve vent or pump outlet, Fig.41, as this will result in diaphragm damage.

9. Position upper gasket and top cover and secure.

10. Position and secure air cleaner to carburettor mounting adaptor.

11. Refit air cleaner assembly.

12. Reconnect battery.

13. Check and adjust engine idle speed and fuel mixture setting.
    Detailed in Operation No. 23 213.

14. Remove fender covers and close hood.

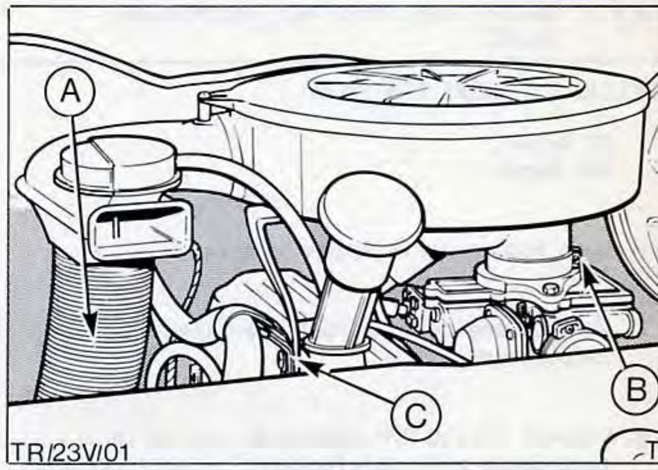


Fig.39. Air cleaner assembly.
A - Cleaner to manifold air hose
B - Air cleaner to carburettor clamp
C - Air cleaner securing bolt

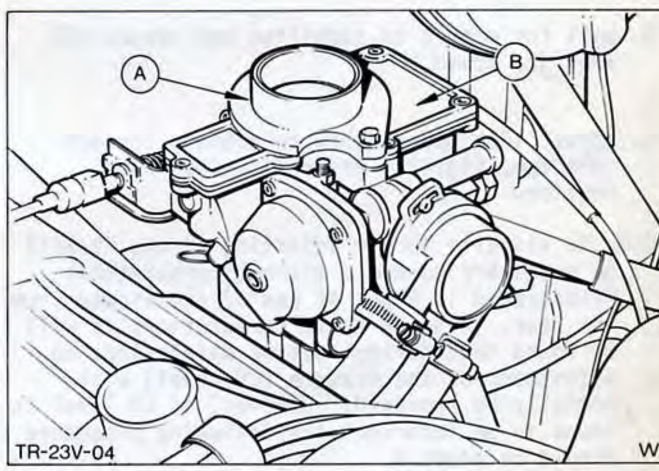


Fig.40. Air cleaner mounting adaptor removal.
A - Air cleaner adaptor
B - Carburettor top cover

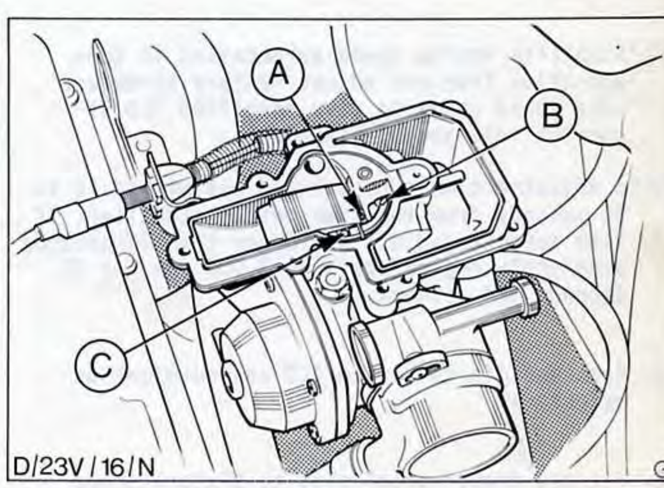


Fig.41. V.V. carburettor with top cover removed.
A - Accelerator pump outlet
B - Accelerator pump air bleed
C - Air valve diaphragm vent

23 213 ENGINE IDLE SPEED AND FUEL MIXTURE - ADJUST

SPECIAL EQUIPMENT REQUIRED:

CO Meter
RPM Meter

1. Open hood and fit fender covers.
2. Warm up engine to normal operating temperature.
3. Connect CO and RPM meters to engine in accordance with manufacturer's instructions.
4. Stabilise engine by running at 3,000 rpm for approximately 30 seconds and allow engine to idle.
5. Wait for meters to stabilise and record %CO and idle speed.
6. Adjust idle speed screw to achieve correct idle rpm, Fig.42. Refer Technical Data section.

NOTE To visually locate adjusting screws it will be necessary to use a mirror, carburettors illustrated in Figs, 42 and 43 are viewed from the rear. Also on these carburettors it will be found that during routine maintenance no adjustment of the mixture (CO level) will normally be required. However, if CO level is found to be incorrect the following procedure should be adopted.

7. Using a thin bladed screwdriver carefully prise out mixture screw tamper-proof plug, Fig.43.
8. Stabilise engine speed as detailed in sub-operation four and adjust mixture screw and idle speed screw to give specified %CO at correct idle speed, Fig.44.

NOTE: Adjustment must be carried out within 10 to 30 seconds from the time meters stabilise. If time taken to adjust is longer than 30 seconds accelerate engine again to 3,000 rpm for 30 seconds and recheck.

9. Recheck idle speed and %CO and readjust as necessary.
10. Fit new tamper-proof plug to mixture screw housing.
11. Remove fender covers and close hood.

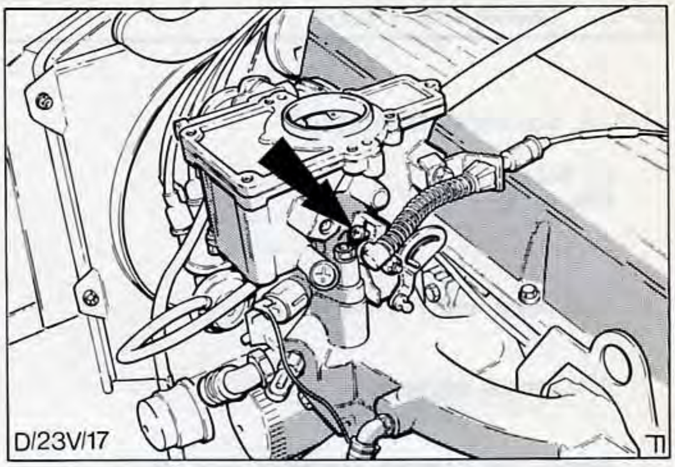


Fig.42. Variable Venturi carburettor, idle speed adjusting screw.
(Air cleaner removed for clarity but must be fitted during idle adjustment)

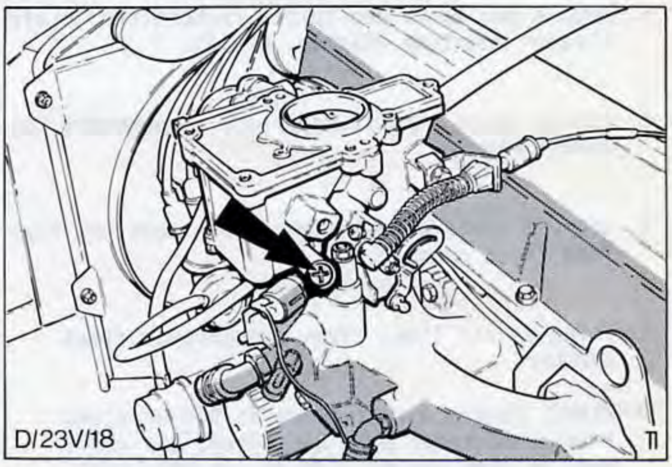


Fig.43. Mixture screw tamper-proof plug.
(Air cleaner removed for clarity)

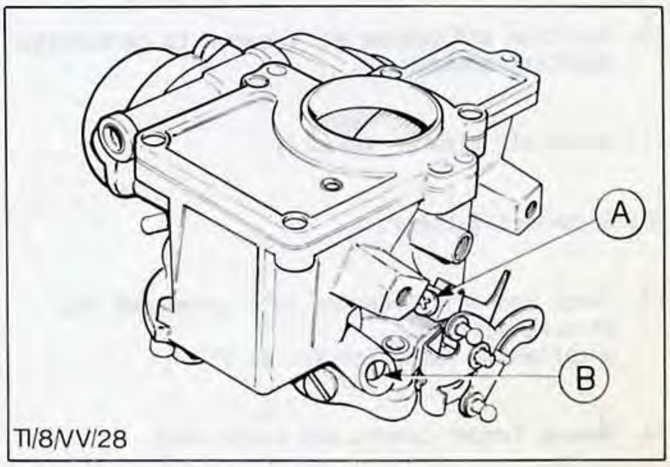


Fig.44. Idle adjusting screws.
A - Idle speed adjusting screw
B - Idle mixture adjusting screw

23 224 CARBURETTOR - REMOVE AND INSTALL

SPECIAL EQUIPMENT REQUIRED:

CO Meter
RPM Meter

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
Detailed in Operation No. 23 174.
4. Disconnect both auto-choke hoses at carburettor. 'B' in Fig.45.

IMPORTANT: Before disconnecting hoses ensure that cooling system is not pressurized (by removing radiator cap and refitting) and that radiator cap is in position.
Position disconnected hoses with ends facing upwards, this will minimise amount of coolant lost.

5. Disconnect anti-dieselling valve wire.
6. Disconnect carburettor to distributor vacuum pipe.
7. Disconnect throttle linkage.
8. Disconnect fuel feed pipe at carburettor.

IMPORTANT: If a crimped type hose clamp is fitted it must be cut free and replaced with a screw and nut type clamp, Fig.46.

9. Remove two nuts and washers and detach carburettor assembly, Fig.47.

To Install

10. Transfer air cleaner mounting adaptor to new carburettor and clean gasket faces.
11. Place carburettor into position with a new gasket and secure.
12. Reconnect distributor vacuum supply pipe.
13. Reconnect fuel feed pipe.
Refer Fig.46 and sub-operation eight.
14. Reconnect throttle linkage.
15. Reconnect anti-dieselling valve.
16. Reconnect both auto-choke hoses.
17. Refit air cleaner assembly, top up cooling system if required and reconnect battery.
18. Check and adjust engine idle speed and fuel mixture setting.
Detailed in Operation No. 23 213.
19. Remove fender covers and close hood.

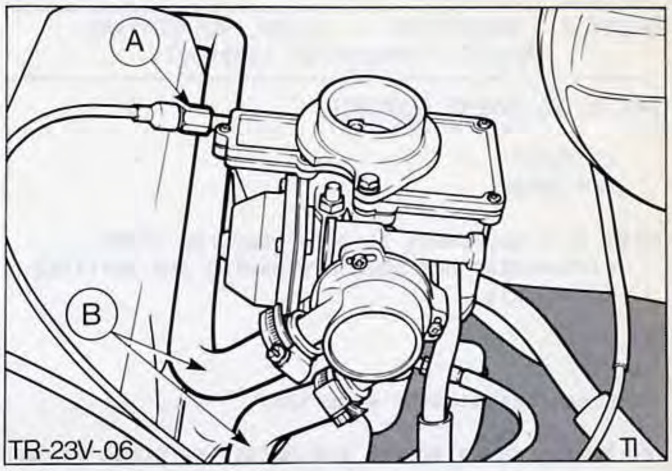


Fig.45. Components to be disconnected before removing carburettor.
A - Throttle linkage
B - Choke hoses

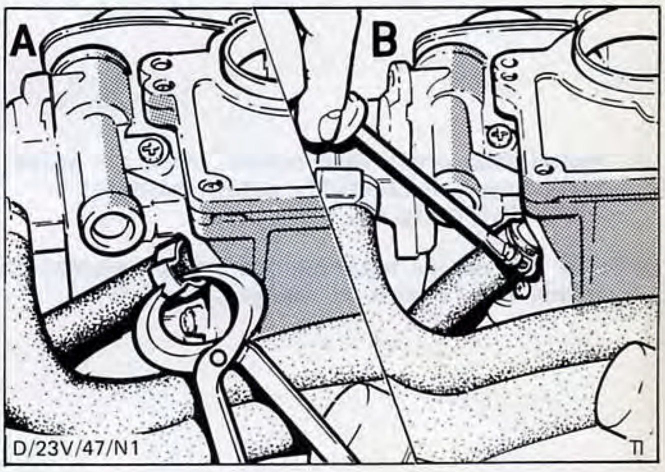


Fig.46. Disconnecting and reconnecting fuel supply pipe.
A - Crimped type hose clamp
B - Screw and nut type hose clamp

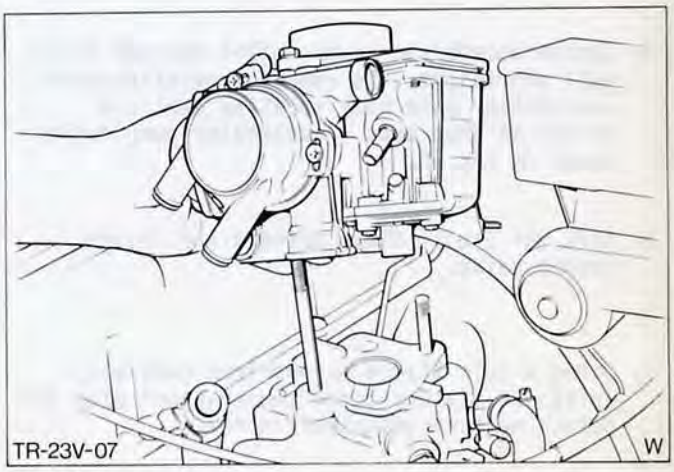


Fig.47. Carburettor removal.

23 224 6 CARBURETTOR - CLEAN, INSPECT AND ADJUST (Carburettor removed)

SPECIAL EQUIPMENT REQUIRED:

CO Meter
RPM Meter

NOTE: This equipment is only required after carburettor has been overhauled and refitted to vehicle.

1. Clean carburettor exterior.
2. Remove seven screws and detach carburettor top cover and gasket, Fig.48.
3. If required drain fuel float chamber.

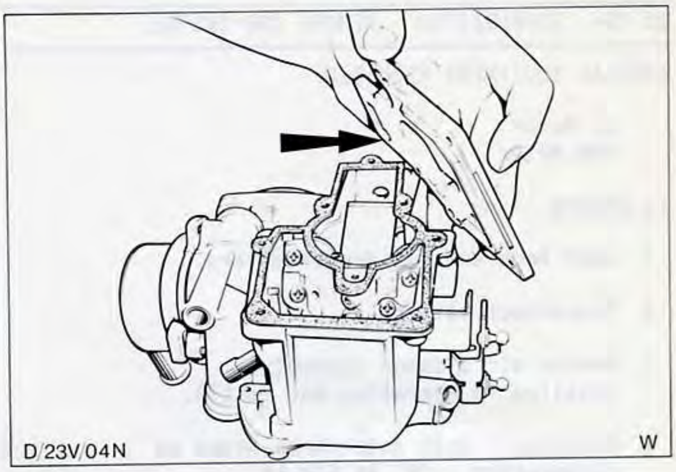


Fig.48. Carburettor top cover removal.

4. Remove four cross head screws, hold air valve fully open and carefully detach main jet body. Refer Fig.49.

NOTE: Do not remove metering rod unless inspection proves rod is worn or damaged.

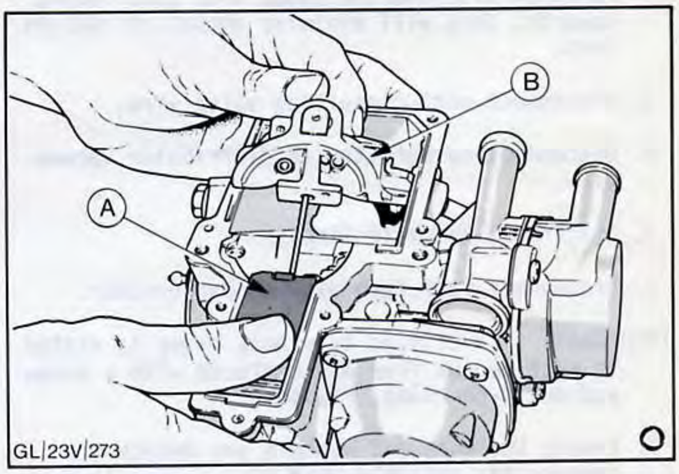


Fig.49. Main jet body removal.
A - Air valve held fully open
B - Main jet body

5. Remove accelerator pump outlet one-way valve ball and weight. To remove carefully invert carburettor main body to allow ball and weight to drop out. Accelerator pump outlet shown in Fig.50.
6. Lift out float, float spindle and intake needle valve.
7. Using a thin bladed screwdriver carefully prise out mixture screw tamper-proof plug and detach mixture adjustment screw.

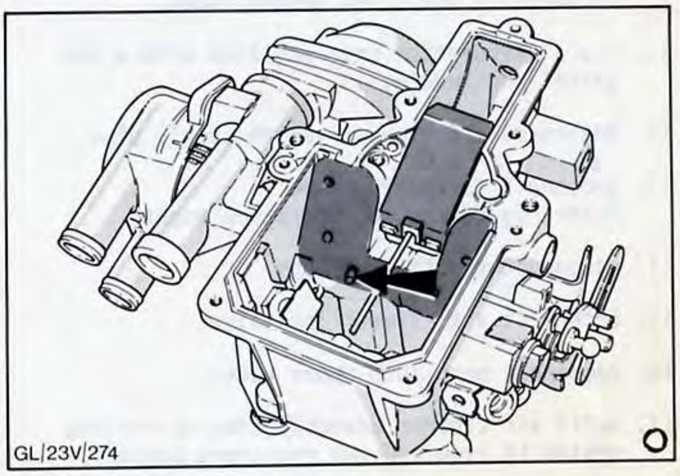


Fig.50. Accelerator pump outlet.

8. Remove four cross head screws and detach vacuum diaphragm housing, return spring and spring seat. Remove circlip and detach diaphragm, Fig.51.
   Take care return spring or circlip is not lost.

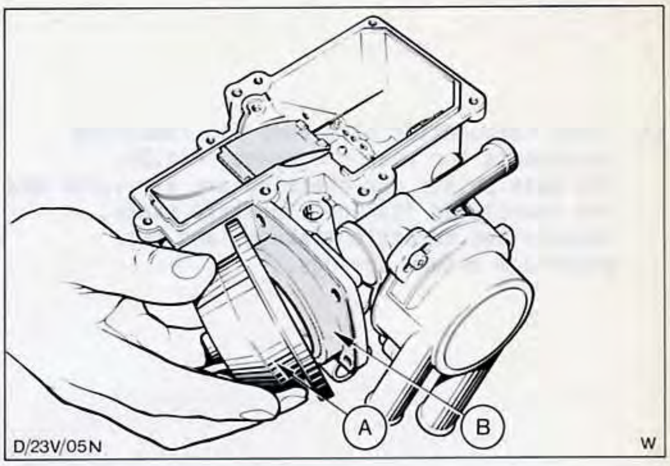


Fig.51. Vacuum diaphragm removal.
A - Housing
B - Vacuum diaphragm

9. Invert carburettor, remove three cross head screws and detach accelerator pump diaphragm, also taking care return spring is not lost, Fig.52.

10. Clean carburettor float chamber, main jet body and jet drillings.

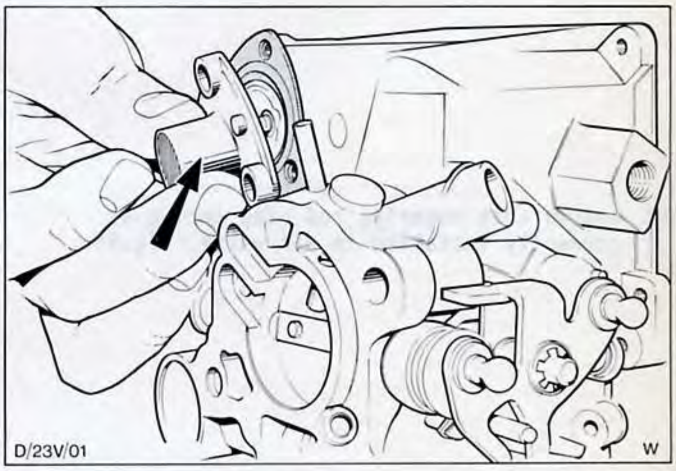


Fig.52. Accelerator pump housing removal.

11. Inspect carburettor components.
    Some of the items for inspection are shown in Fig.53.
    Float should be checked for leaks, diaphragm and gasket checked for splitting and metering rod, needle valve and jet body checked for wear or damage.

NOTE: Ensure main jet in the main jet body is closely checked for wear, e.g. Ovality.

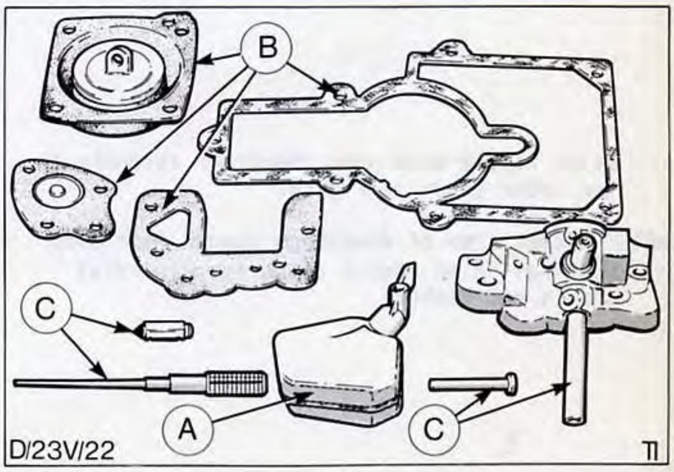


Fig.53. Carburettor components to be checked.
A - Checked for leaks
B - Checked for splits
C - Checked for wear or damage

12. Check carburettor main body and remaining components for wear or damage, Fig.54. The main points for checking are air valve and its associated linkage, throttle plate, spindle and throttle linkage, and two diaphragm return springs.

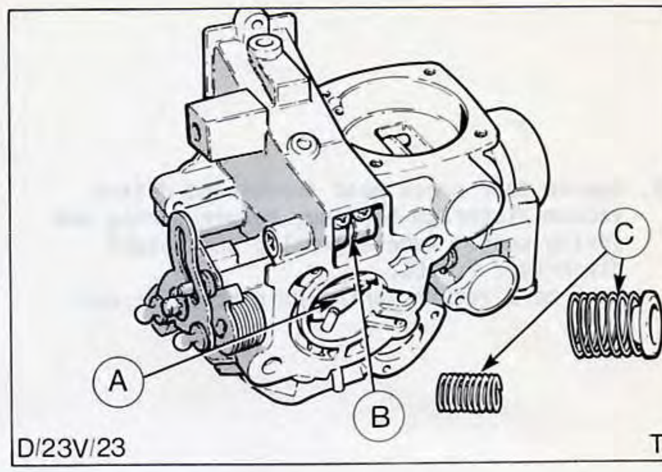


Fig.54. Items to be checked on carburettor main body.
A - Throttle spindle and linkage
B - Air valve and associated linkage
C - Diaphragm return springs

13. Ensure that metering rod bias spring is correctly installed to air valve, Fig.55.

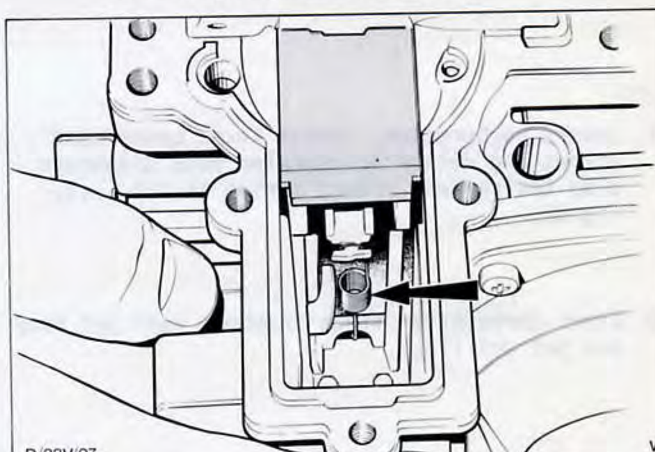


Fig.55. Metering rod bias spring correctly positioned on air valve.

14. Refit accelerator pump diaphragm assembly in the order shown in Fig.56.

NOTE: Gasket side of diaphragm should face pump housing. Also ensure diaphragm lies flat and is not kinked.

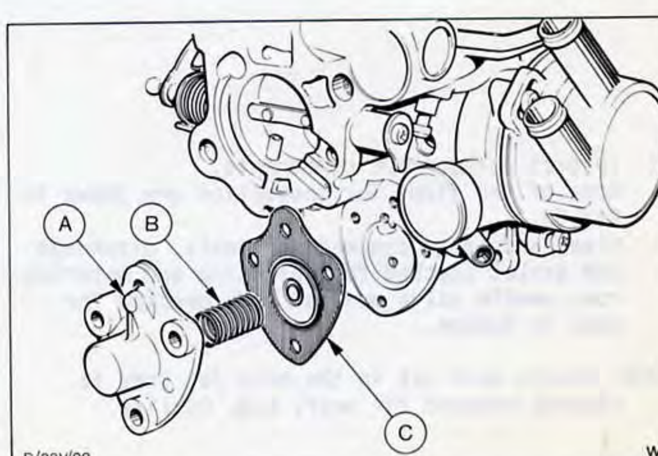


Fig.56. Accelerator pump assembly.
A - Housing
B - Return spring
C - Diaphragm

15. Connect control diaphragm to operating linkage, reconnect circlip and refit diaphragm housing and spring assembly, Fig.57. Secure with four cross head screws.

NOTE: Ensure that vacuum hole in diaphragm aligns with supply gallery in both carburettor body, 'D' in Fig.57, and housing. Also ensure diaphragm lies flat and is not kinked, by holding air valve open whilst locating and tightening diaphragm cover.

16. Refit mixture adjusting screw, fully screw in and screw out three full turns. This will position screw in the approximate idle running location.

NOTE: When fitting mixture screw do not overtighten as this can cause damage to the finely machined surfaces.

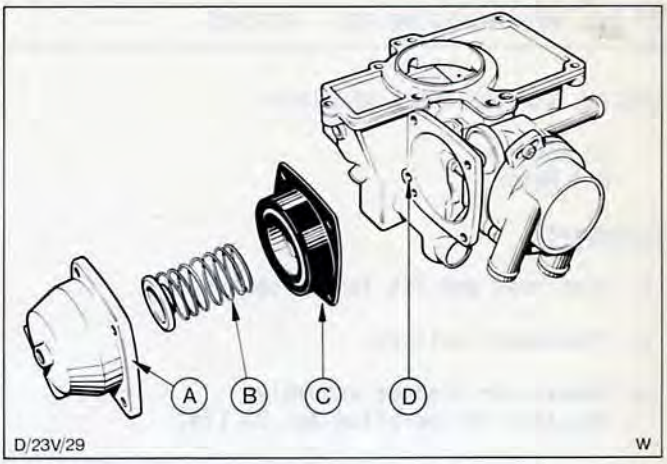


Fig.57. Control vacuum diaphragm assembly.
A - Diaphragm housing
B - Return spring
C - Diaphragm
D - Vacuum supply gallery

17. Refit needle valve, float and float pin.

NOTE: Refit needle valve so that spring loaded ball on valve will be in contact with float once petrol is fed into carburettor, Fig.58.

18. Refit accelerator pump ball and weight into discharge passage.

NOTE: Fit ball first and then position weight on top. Fig.58, shows location of discharge passage.

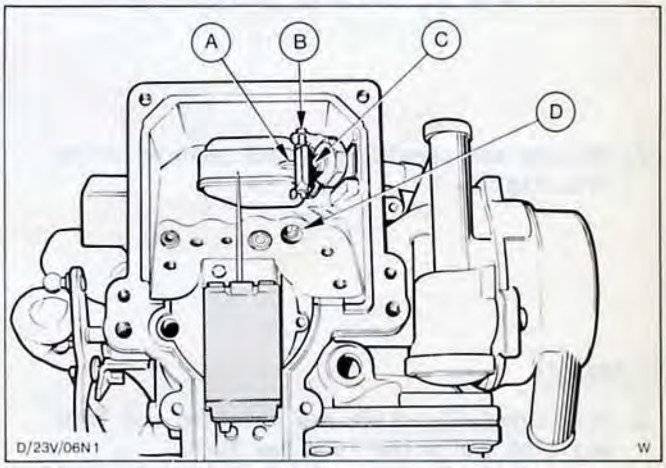


Fig.58. Needle valve installation.
A - Float
B - Float pin
C - Needle valve
D - Accelerator pump discharge passage

19. Hold air valve fully open and using a new gasket carefully position and loosely secure main jet body.

Using a straight edge adjust main jet body so that two alignment flanges 'A' in Fig.59, are flush with top face of carburettor main body.

20. Adjust main metering rod as detailed in Operation No. 23 242 shown on the following page.

NOTE: Only carry out this operation if rod adjustment is suspect.

21. Using a new gasket refit carburettor top cover.

Once carburettor has been installed to vehicle engine idle speed and mixture adjustment must be carried out.

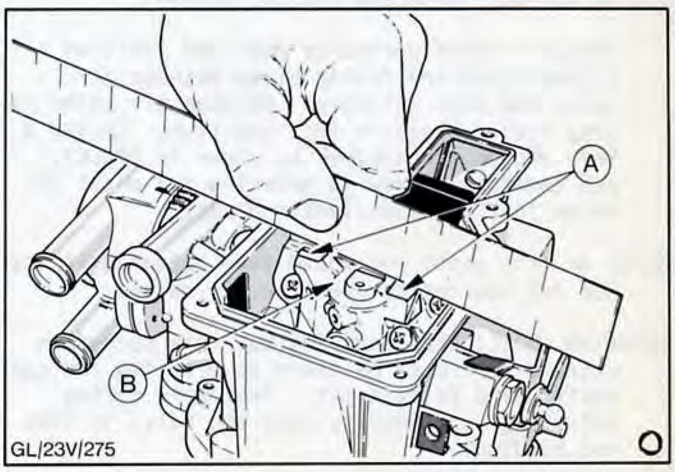


Fig.59. Main jet body adjustment.
A - Alignment flanges
B - Main jet body

23 242 MAIN METERING ROD - REPLACE

SPECIAL SERVICE TOOLS REQUIRED:

CO Meter
RPM Meter

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly. Detailed in Operation No. 23 174.
4. Remove seven screws and detach carburettor top cover.
5. From inside carburettor tap out metering rod tamper-proof plug.
6. Unclip metering rod bias spring, Fig.60.
7. Unscrew and carefully detach main metering rod, Fig.61.

To Install

8. Very carefully slide new metering rod into position and screw in a few turns.
9. Clip metering rod bias spring into position as shown in Fig.60.
10. Adjust main metering rod as follows.

Hold air valve partially open and position a 0,03mm (0,001in) feeler blade between air valve and main jet body. Release air valve to trap feeler blade in this position. Locate a thin bladed screwdriver as shown in Fig.62, and carefully screw in metering rod until air valve just releases feeler blade.

NOTE: At this point rod would have bottomed in its jet and started to open the air valve.

IMPORTANT NOTE: When carrying out this operation extreme care must be taken as metering rod can easily bind in main jet. Therefore during adjustment continually open air valve to stop rod binding.

From this point unscrew metering rod the exact amount of turns as detailed in the Technical Data section.

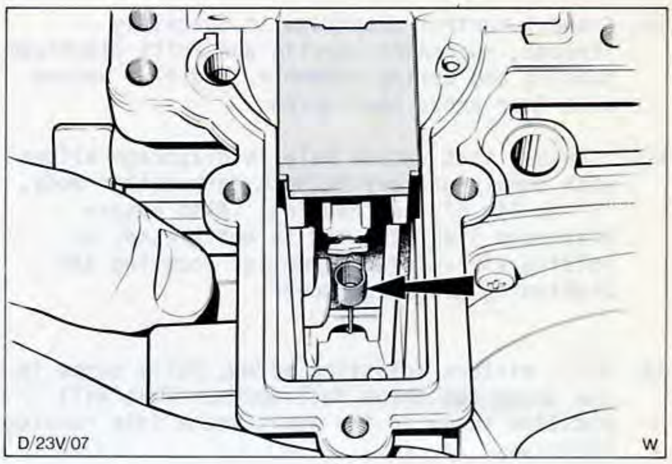


Fig.60. Metering rod bias spring fitted to air valve.

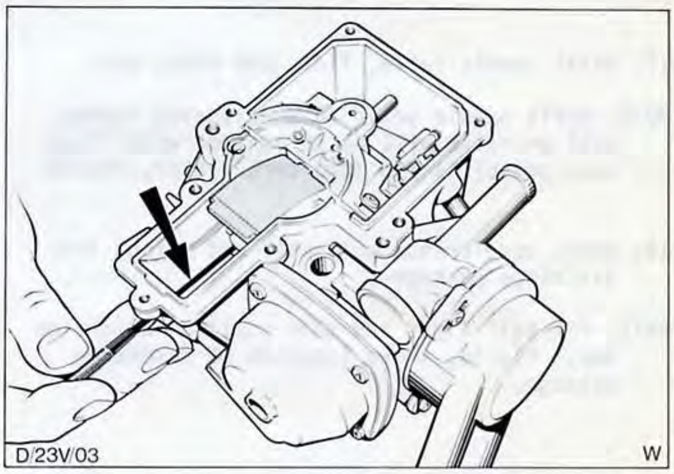


Fig.61. Main metering rod removal.

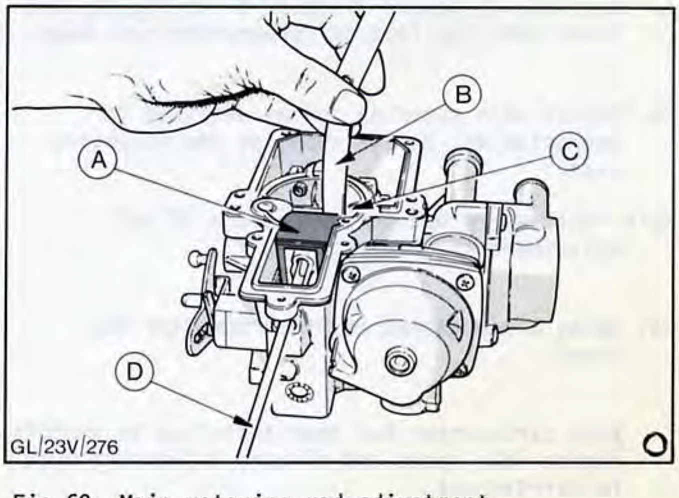


Fig.62. Main metering rod adjustment.
A - Air valve
B - Feeler blade
C - Main jet body
D - Screwdriver

11. Fit new tamper-proof plug in hole in venturi through which metering rod was installed. Refer Fig.63.

12. Using a new gasket refit carburettor top cover.

13. Refit air cleaner assembly.

14. Reconnect battery.

15. Check and adjust engine idle speed and fuel mixture setting.
Detailed in Operation No 23 213.

16. Remove fender covers and close hood.

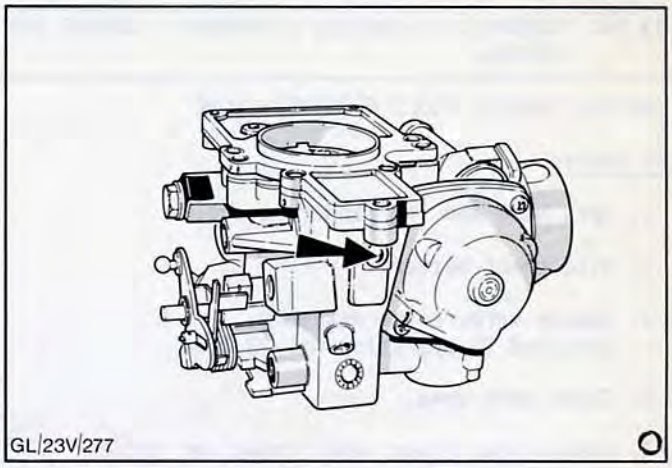


Fig.63. Main metering rod tamperproof plug.

23 244 NEEDLE VALVE - REPLACE

SPECIAL SERVICE EQUIPMENT REQUIRED:

CO Meter
RPM Meter

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Remove air cleaner assembly.
Detailed in Operation No. 23 174.

4. Remove seven screws and detach carburettor top cover.

5. Unclip float pin and position float clear of needle valve. Fig.64.

NOTE: It is not possible at this stage to completely remove float.

6. Using long nosed pliers remove needle valve.

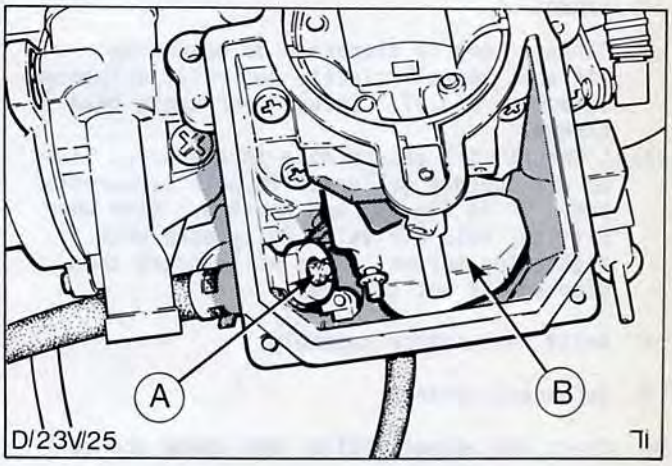


Fig.64. Needle valve removal.
A - Needle valve
B - Float

To Install

7. Position needle valve, float and float pin.

NOTE: Refit needle valve so that spring loaded ball on valve will be in contact with float when petrol is fed into carburettor, Fig.65.

8. Refit carburettor top cover.

9. Refit air cleaner assembly.

10. Reconnect battery.

11. Check and adjust engine idle speed and fuel mixture setting.
Detailed in Operation No. 23 213.

12. Remove fender covers and close hood.

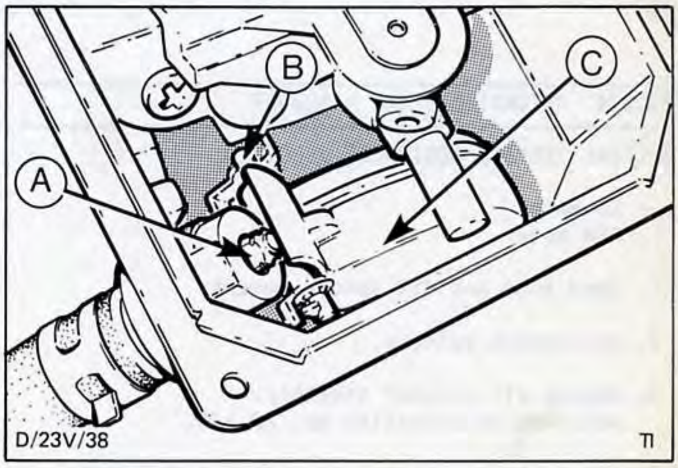


Fig.65. Needle valve installed.
A - Needle valve
B - Float pin
C - Float

23 264 CARBURETTOR CONTROL DIAPHRAGM - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove carburettor assembly.
   Detailed in Operation No. 23 224.
4. Clean work area.
5. Remove four cross head screws and detach diaphragm housing, Fig.66.
6. Remove circlip and detach control diaphragm from control lever.

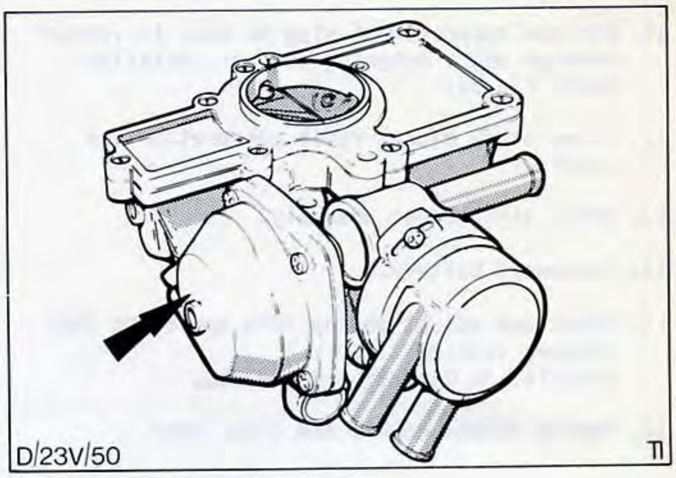


Fig.66. Diaphragm housing.

To Install

7. Connect control diaphragm to operating linkage, install circlip and refit diaphragm assembly, Fig.67. Secure four cross head screws.

NOTE: Ensure that vacuum hole in diaphragm lines up with supply galleries in both carburettor body 'D' in Fig.67, and housing. Also when fitting, hold air valve fully open when tightening screws. This will ensure that diaphagm is not trapped.

8. Refit carburettor assembly.
9. Reconnect battery.
10. Check and adjust engine idle speed and fuel mixture setting.
11. Remove fender covers and close hood.

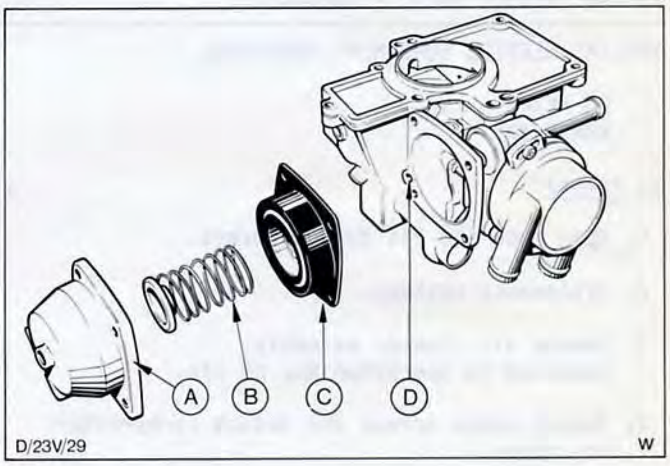


Fig.67. Control vacuum diaphragm assembly.
A - Diaphragm housing
B - return spring
C - Diaphragm
D - Vacuum supply gallery

23 274 AUTOMATIC CHOKE - ADJUST

SPECIAL SERVICE EQUIPMENT REQUIRED:

CO Meter
RPM Meter

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
   Detailed in Operation No. 23 174.
4. Remove three cross head screws and detach choke bi-metal coil housing, position clear of choke, Fig.68.

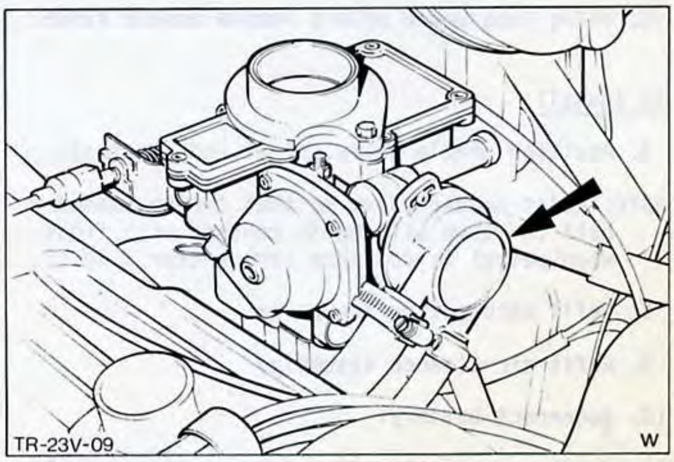


Fig.68. Auto-choke bi-metal coil housing.

5. Check and adjust choke gauging as follows:

NOTE: This adjustment controls the air/fuel mixture or ratio, that is fed into engine when choke is in operation.

i) Using a thin bladed screwdriver carefully prise out tamper-proof plug. Plug location shown in Fig.69.

ii) By looking down hole where tamper proof plug was fitted, Fig.69, turn choke operating lever until drilling in central shaft lines up with hole in carburettor housing.

iii) Position a specified twist drill shank into hole ensuring drill fully locates into choke central shaft, Fig.70. Refer Technical Data section.

iv) Loosen central nut that secures choke linkage to choke shaft, 'C' in Fig.70.

v) With drill in position turn choke lever fully clockwise up to its stop and tighten centre securing nut.

NOTE: Do not overtighten securing nut.

vi) Remove twist drill.

NOTE: Do not fit tamper-proof plug at this stage. Also if after assembly choke does not function it is possible that centre shaft is 180° out.

6. Check and adjust choke pull down/fast idle setting as follows:

This adjustment ensures that the vacuum pull down system, which controls fast idle, is operating correctly. A description of how the system operates is shown on page 17.

i) Position a twist drill in the location shown in Fig.71, and using a small pair of pliers bend back pull down operating lever to a position also shown in Fig.71. This sub-operation is necessary to ensure that the lever does not restrict movement of vacuum piston which could make it impossible to set choke in the correct pull down/fast idle position. The drill is required to ensure linkage is not damaged when the pull down lever is bent back. Once lever is bent back remove twist drill.

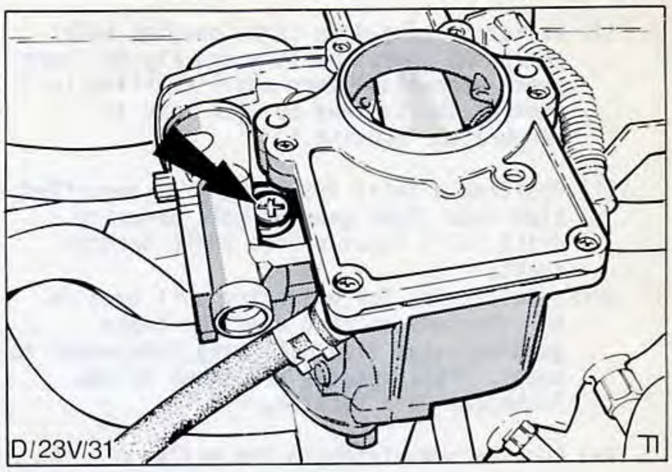


Fig.69. Choke gauging adjustment tamper-proof plug.

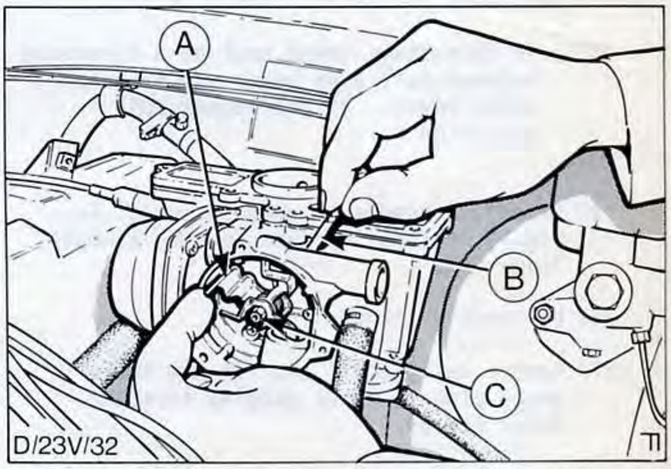


Fig.70. Choke gauging adjustment.
A - Operating lever held fully clockwise
B - Twist drill held fully in position
C - Nut that secures linkage to central shaft

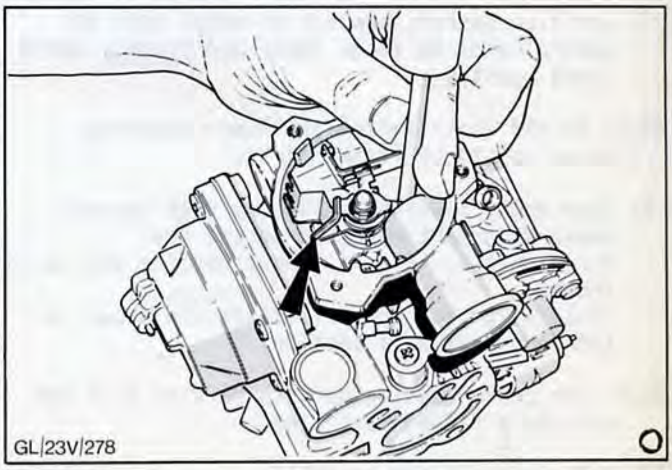


Fig.71. Pull down lever bent back to ensure that correct fast idle position can be achieved.

ii) Whilst looking down choke gauging hole, refer sub-operation five and Fig.69, turn choke operating lever until drilling in central shaft lines up with hole in carburettor housing.

iii) Position a twist drill shank of specified size into choke gauging hole ensuring drill fully locates into choke central shaft.

NOTE: Drill size for adjusting pull down is NOT the same as that used for choke gauging, also size will vary from model to model. Full details are shown in the Technical Data section.

iv) Push vacuum piston to the bottom of its travel and hold choke lever fully clockwise. Refer Fig.72.

This sub-operation locates choke assembly into the pull down/fast idle checking position.

NOTE: At this stage there must be a clearance between pull down lever and bi-metal choke lever. If not repeat sub-operation i.

v) To adjust bend pull down lever 'C' in Fig.73, so that it just touches bi-metal lever 'A'.

vi) Re-check setting.

vii) Remove twist drill and fit new tamper-proof plug to choke gauging location. Refer Fig.69.

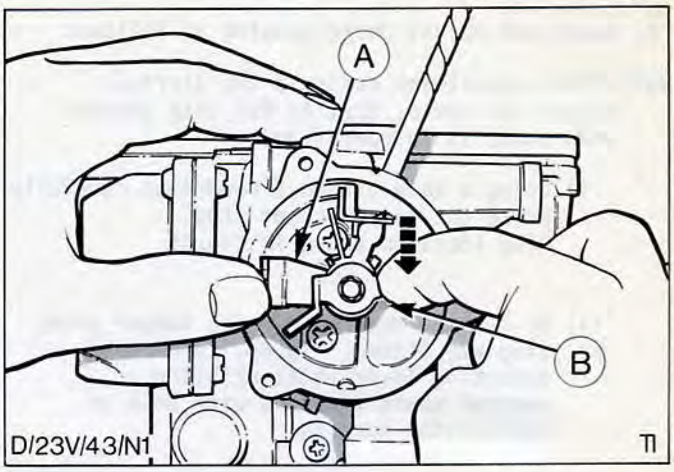


Fig.72. Choke held at pull down/fast idle setting.
A - Bi-metal lever held fully clockwise
B - Vacuum piston pushed downwards to the bottom of its travel

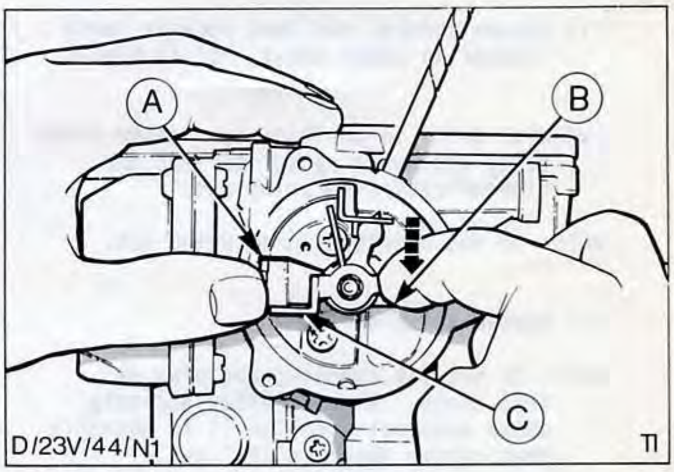


Fig.73. Choke held and correctly adjusted.
A - Bi-metal lever held fully clockwise
B - Vacuum piston pushed fully downwards
C - Pull down lever just touching bi-metal lever

7. Position gasket, connect bi-metal coil to central slot on choke lever and loosely refit choke housing.

NOTE: To aid installation the lower securing screw should be fitted first.

8. Turn choke housing to line up with correct choke alignment mark and secure the three screws. Fig.74, shows housing set up on index.
Choke alignment specifications are shown in the Technical Data section.

NOTE: The choke housing mark to be used is a saw cut not a raised cast line.

9. Refit air cleaner assembly.

10. Reconnect battery.

11. Remove fender covers and close hood.

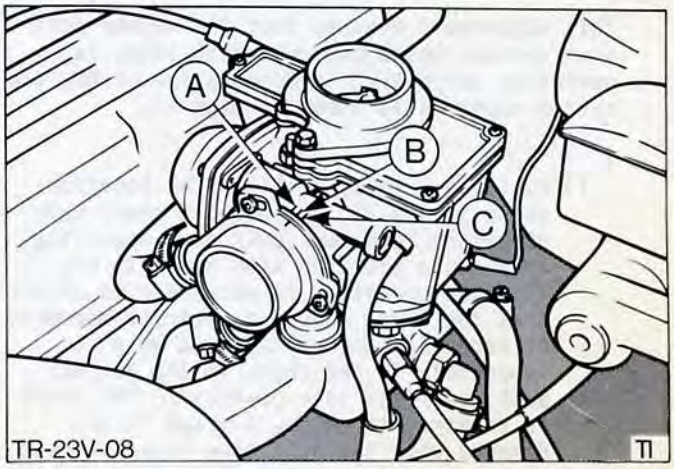


Fig.74. Choke housing alignment.
A - Rich setting
B - Index mark
C - Lean setting

23 276 AUTOMATIC CHOKE REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

CO Meter
RPM Meter

To Remove

1. Open hood, fit fender covers and disconnect battery.

2. Remove air cleaner assembly.

3. Disconnect both auto-choke hoses at carburettor.

IMPORTANT: Before disconnecting hoses ensure that cooling system is not pressurized (by removing radiator cap and refitting) and that radiator cap is in position.
Position disconnected hoses with ends facing upwards, this will minimise amount of coolant lost.

4. Remove three cross head screws and detach choke bi-metal coil housing, Fig.75.

5. Remove a further three screws and detach choke assembly, Fig.76.

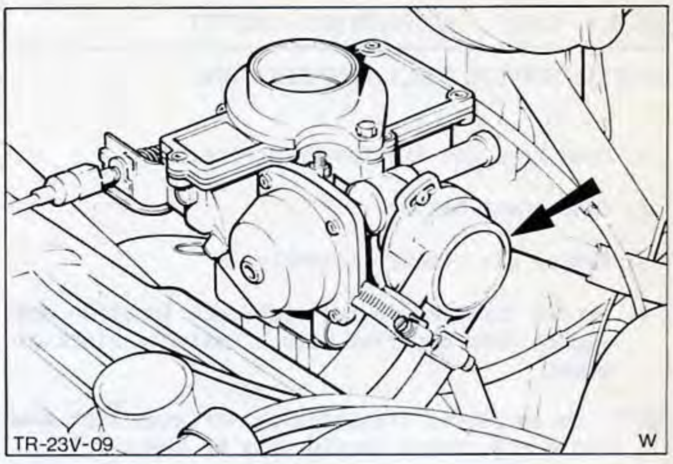


Fig.75. Auto-choke assembly.

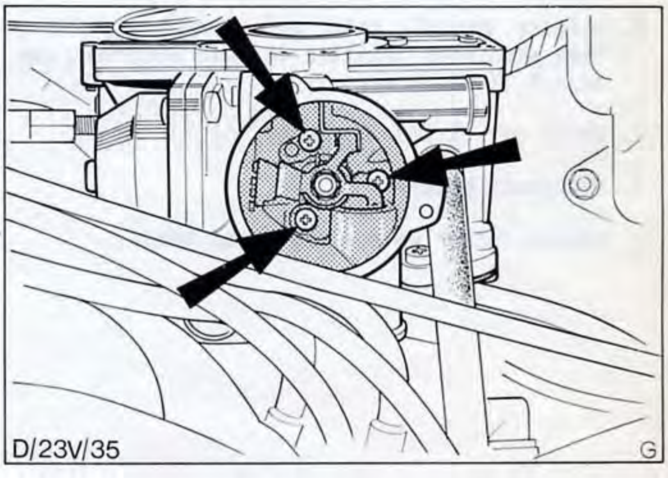


Fig.76. Choke assembly securing screws.

To Install

6. On new choke, threads in bi-metal housing securing holes are not formed, therefore before fitting assembly tap threads using existing securing screws which are thread forming.

NOTE: Under no circumstances should threads be cut using standard taps, always use the thread forming screws.

7. Also before fitting new choke assembly check unit for binding or sticking and that linkage is not damaged.

8. Using a new gasket place choke assembly into position and secure.

9. Position gasket, connect bi-metal coil to central slot on choke lever and loosely refit choke housing.

NOTE: To aid installation lower securing screw should be fitted first.

10. Turn choke housing to line up with specified choke alignment mark and secure three screws. Fig.77, shows housing set up on index.

NOTE: Choke housing mark to be used is a saw cut not a raised cast line.

11. Reconnect choke hoses to choke bi-metal coil housing.

12. Refit air cleaner assembly, reconnect battery, remove fender covers and close hood.

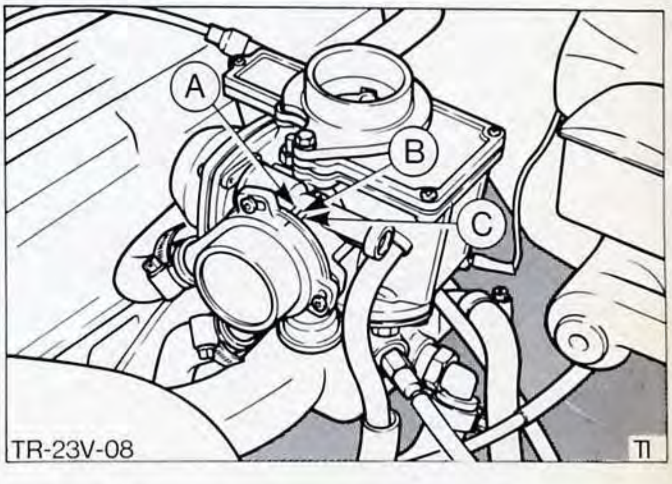


Fig.77. Choke housing alignment.
A - Rich setting
B - Index mark
C - Lean setting

23 811 CABLE - ACCELERATOR - ADJUST

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Remove air cleaner assembly.
4. Locate throttle in the wide open location and jam in this position with a suitable block of wood.

NOTE: On automatic transmission variants kick down cable adjustment should also be checked to ensure it does not prevent wide open throttle being achieved.

5. Wind back adjusting sleeve to a point where carburettor linkage is just in the fully open position, Fig.78.
6. Release throttle pedal and re-apply, checking that wide open throttle is just achieved, re-adjust if required.
7. Refit air cleaner assembly.
8. Reconnect battery.
9. Remove fender covers and close hood.

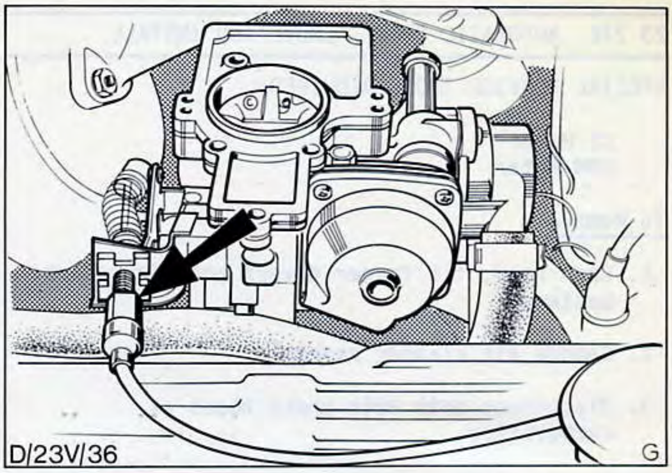


Fig.78. Accelerator cable adjusting sleeve.

TECHNICAL DATA

FORD V.V. CARBURETTOR

Carburettor Part No.	- 1.6 OHC	79HF-9510-KHC
	- 2.0 OHC Manual Transmission	79HF-9510-KNA
	- 2.0 OHC Automatic Transmission ..	79HF-9510-KKC

Idle Setting

Idle Speed	800 rpm $\pm$ 50 rpm
Idle Mixture All OHC	1.0% CO $\pm$ 0.5%

Main Metering Rod

Code No.	1600 OHC	FBM
	2000 OHC Manual Transmission	FCS
	2000 OHC Automatic Transmission	FBZ

Metering Rod adjustment

Rod backed off by;	1600 OHC	2,50 Turns.
	2000 OHC Manual	2,00 Turns.
	2000 OHC Automatic..	2,25 Turns.

Choke System

	1.6 OHC	2.0 Manual	2.0 Automatic
Choke gauging (Twist drill)	3,4 mm (0,135 in)	3,4 mm (0,135 in)	3,4 mm (0,135 in)
Choke fast idle/pull down (Twist drill) .. (Choke lever held fully)	4.0 mm (0,158 in) CLOCKWISE	4,0 mm (0,158 in) CLOCKWISE	4,0 mm (0,158 in) CLOCKWISE
Choke housing alignment	On Index	On Index	On Index

HEATING AND VENTILATION 34

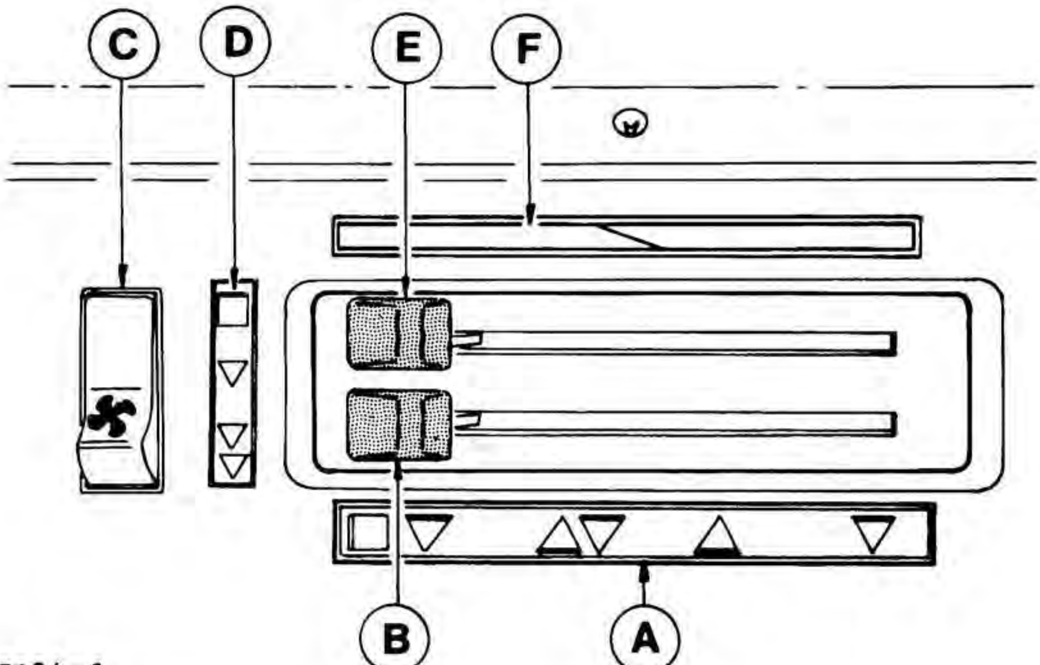
Index **Page**

GENERAL DESCRIPTION

The heater housing, containing blower and heater radiator, is located inside the vehicle under the instrument panel. Hoses connect the heater to the face-level aeroflow vents and demister nozzles.

The Transit is fitted with a two-speed blower which is operated by a rocker switch on the instrument panel.

Air leaving the heater assembly may be adjusted for temperature and air flow direction by sliding control levers in the instrument panel, which in turn actuate flap valves in the heater housing, Fig. 1.



TR34-1

Fig. 1.
A – Symbols—air distribution
B – Air distribution lever
C – Blower switch
D – Symbols—blower operation
E – Temperature control lever
F – Symbols—temperature control

PRINCIPLE OF OPERATION

The air required for heating passes through the heater radiator which is mounted in the heater housing. The heater radiator is similar in construction to the main engine radiator and is supplied with hot coolant from the engine cooling system. Heat contained in the coolant is conducted through the radiator core, via the fins, to the air stream which warms the vehicle interior. The temperature and distribution of the air is regulated by flap valves in the heater housing.

Operating the temperature control lever (upper lever), Fig. 2, actuates the temperature regulating flap valve by means of a bowden cable to control the mixing of ambient, cold air with the warm air flow from the heater radiator.

This enables the temperature to be adjusted to suit individual requirements.

The heater may be 'switched off' completely by means of a water valve fitted in the engine compartment. When the valve is closed the heater radiator is isolated from coolant circulation.

By operating the air distribution control lever (lower lever), Fig. 2, which is connected to the air distribution flap valve by a bowden cable, the air flow is directed to the footwell and/or demister nozzles, depending on the position of the lever.

The heater assembly is designed so that the aeroflow vents can only be supplied with cold air, independent of the lever positions, Fig. 5.

To ensure an adequate flow of air even when the vehicle is travelling slowly, a two-speed electrically driven blower fan is fitted in the heater housing, Fig. 3.

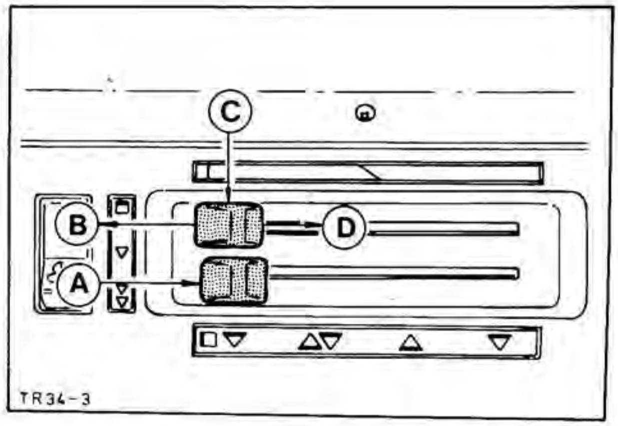


Fig. 2 A – Air distribution lever
B – Warm
C – Temperature control lever
D – Cold

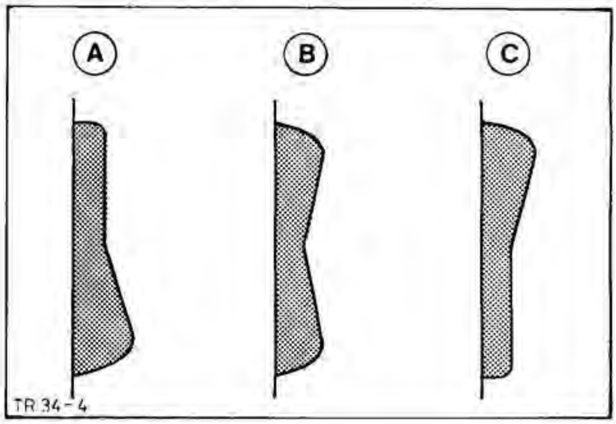


Fig. 3. A – Blower—off
B – Blower on—slow speed
C – Blower on—fast speed

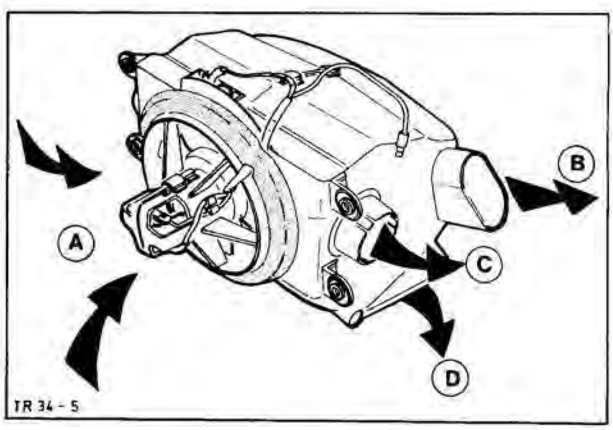


Fig. 4. A – Ambient air
B – Air flow to aeroflow vents
C – Air flow to demister nozzles
D – Footwell

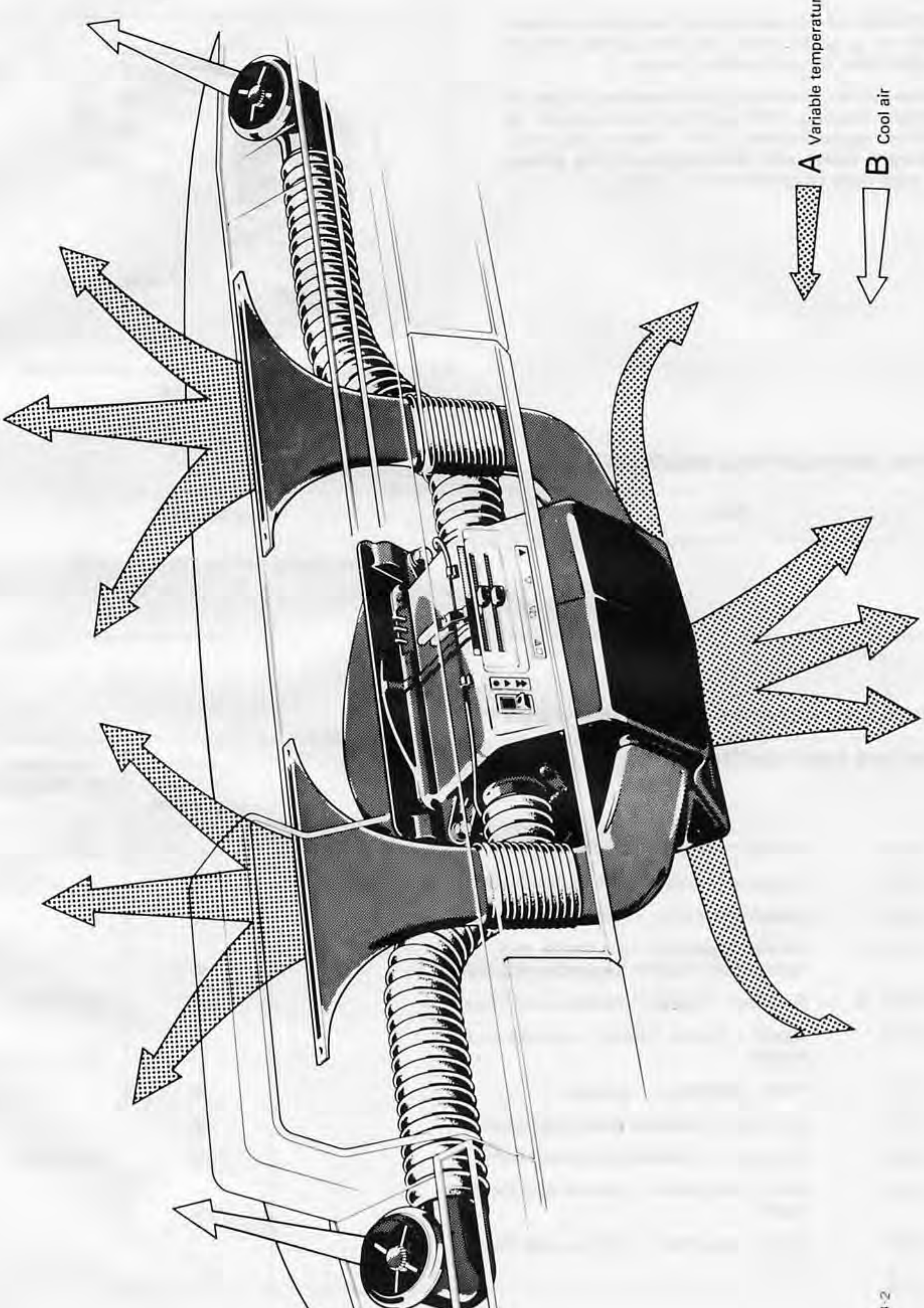


Fig. 5.

SERVICE ADJUSTMENTS AND CHECKS

The efficiency of the heating and ventilation system depends to a great extent on the correct fitment and adjustment of the bowden cables.

Therefore, when connecting the bowden cables to the heater housing, both control levers should be positioned approximately 2 mm before the stop. **The levers must not abut against the stops.** Fig. 6 (also refer to operation 34 314).

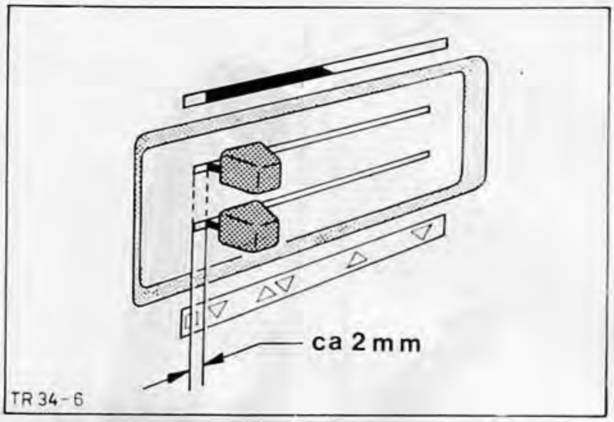


Fig. 6. Before connecting bowden cables position control levers approx 2 mm before stop

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
	No special service tools required

SERVICE AND REPAIR OPERATIONS — CONTENT

HEATING AND VENTILATION		described in this publication	contained in operation
34 313	Heater controls – adjust	—	34 314
34 314	Heater controls – remove and install	X	
34 354	Heater assembly – remove and install	X	
34 354 8	Heater assembly – dismantle and reassemble (heater assembly removed)	X	
34 364 4	Radiator – heater – remove and install	—	34 354 8
34 374	Motor – heater blower – remove and install	—	34 354 8
34 474	Hose – demister – replace	X	
34 483	Demister – remove and install (right)	X	
34 484	Demister – remove and install (left)	—	34 483
34 487	Vent – face level – remove and install (right)	X	
34 488	Vent – face level – remove and install (left)	—	34 487

SERVICE AND REPAIR OPERATIONS

34 314 HEATER CONTROLS – REMOVE AND INSTALL

To Remove

1. Remove heater control panel bezel from beneath instrument panel (2 screws), Fig. 7.

   Disconnect cables from the blower switch and symbol illumination.

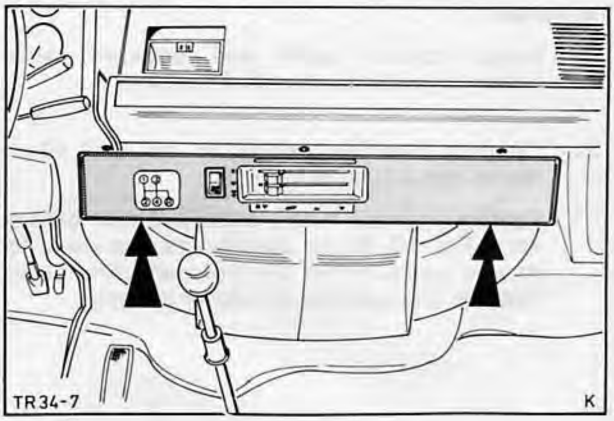


Fig. 7. Remove bezel from instrument panel

2. Detach bowden cables from heater housing (2 screws) and unhook cables from air flap valve levers, Fig. 8.

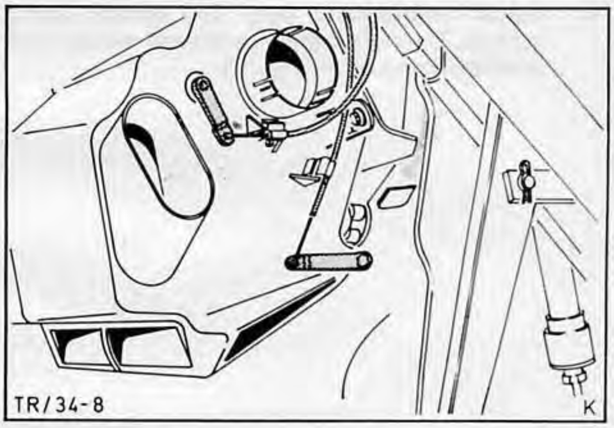


Fig. 8. Detach bowden cables from heater housing and air flap valve levers

3. Remove heater control panel (2 screws), Fig. 9, from instrument panel and withdraw complete with bowden cables.

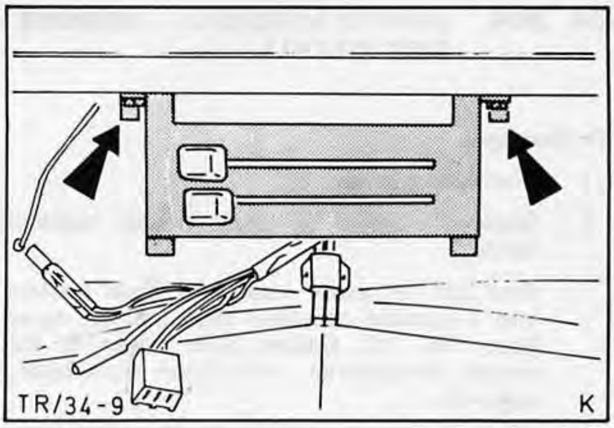


Fig. 9. Remove heater control panel

34 314 (cont'd)

To Install

4. Install control panel and bowden cable assembly and secure with 2 screws.

5. Connect bowden cables to air flap valve levers and adjust as follows:

   Position control levers approx. 2 mm before stop, Fig. 10. Move appropriate flap valve to its end position and clip bowden cable outer cover in this position on heater housing.

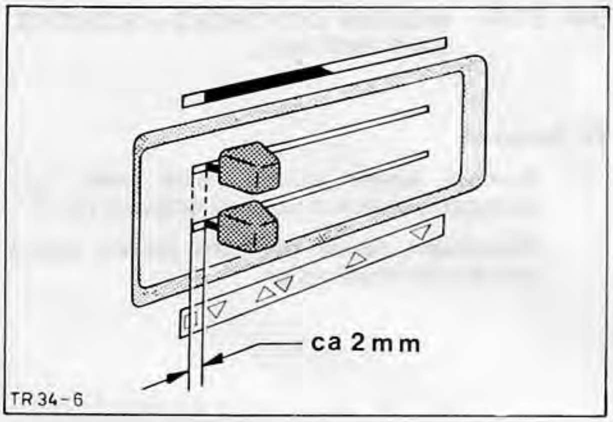


Fig. 10. Position control lever approx. 2 mm before stop

6. Install control panel bezel and secure with 2 screws. Connect cables to blower switch and symbol illumination, Fig. 11.

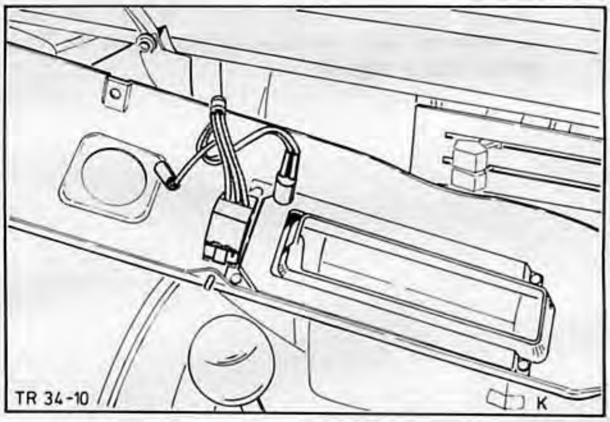


Fig. 11. Connect cables to switch and illumination

34 354 HEATER ASSEMBLY – REMOVE AND INSTALL

To Remove

1. Disconnect battery.
2. Slacken clamps on both heater radiator hoses.

   First pull off lower hose and drain coolant into a suitable container then pull off upper hose, Fig. 12. Secure both hoses in the engine compartment with open ends facing upwards.

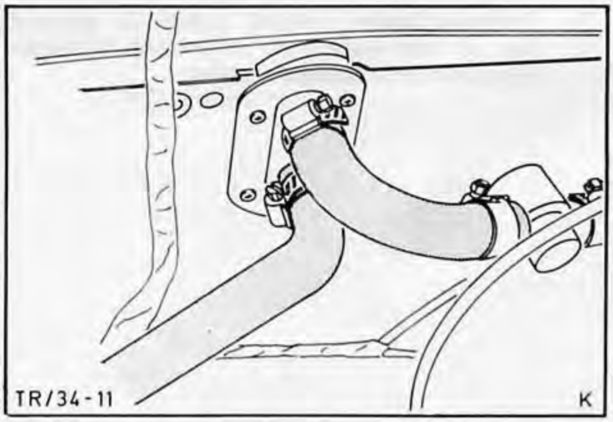


Fig. 12. Disconnect hoses from heater radiator

34 354 (cont'd)

3. Remove cover plate and gasket from bulkhead (4 screws), Fig. 13.

4. Remove heater control panel bezel from underneath the instrument panel (2 screws) and disconnect cables from the blower switch and symbol illumination.

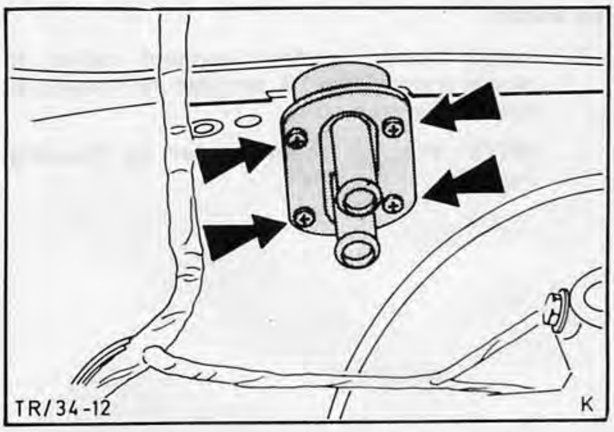


Fig. 13. Remove cover plate and gasket from bulkhead

5. Pull of air hoses (4 off) from heater housing, Fig. 14. Detach bowden cables from heater housing (2 screws) and unhook cables from air flap valve levers.

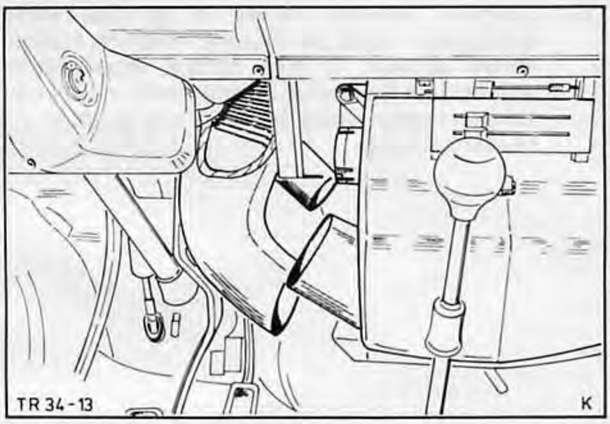


Fig. 14. Disconnect air hoses from heater housing

6. Detach heater housing from bulkhead (4 bolts), Fig. 15, pull away slightly and disconnect cables from blower motor. Withdraw heater assembly and remove from vehicle.

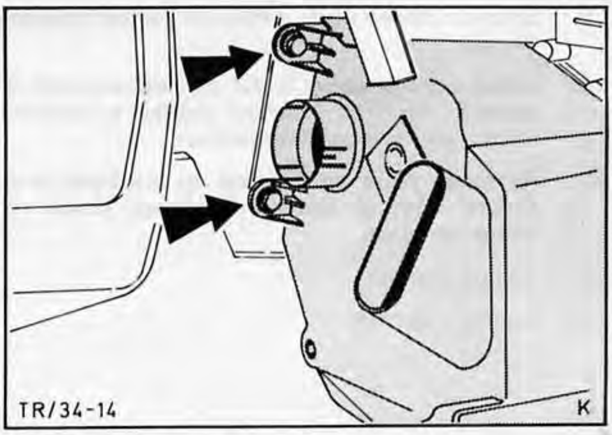


Fig. 15. Detach heater housing from bulkhead

34 354 (cont'd)

To Install

7. Install heater housing, connect cables to blower motor, Fig. 16, and secure housing to bulkhead with 4 bolts.

   NOTE: Position foam gasket on housing, Fig. 17.

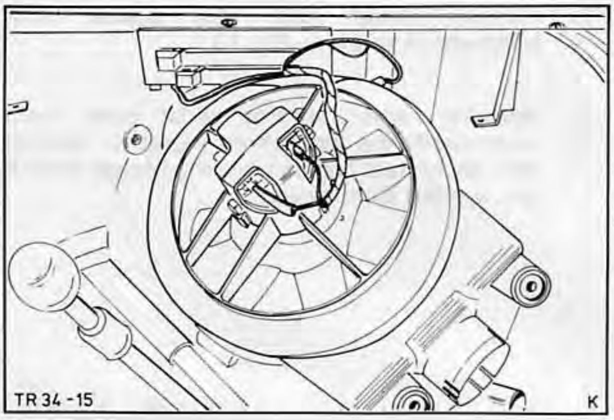


Fig. 16. Connect cables to blower motor

8. Connect bowden cables to air flap valve levers and adjust as follows: Position control levers approx. 2 mm before stop. Move appropriate flap valve to end position and clip bowden cable outer cover in this position on heater housing.

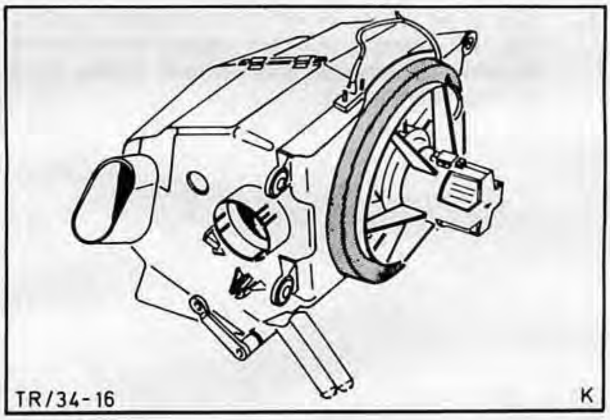


Fig. 17. Position foam gasket on housing

9. Slide air hoses on to necks on heater housing (4 off).
10. Install control panel bezel and secure with 2 screws, Fig. 18. Connect cables to blower switch and symbol illumination.
11. Fit cover plate and gasket to bulkhead and secure with 4 screws. Connect hoses to heater radiator.
12. Top up coolant.
13. Connect battery.

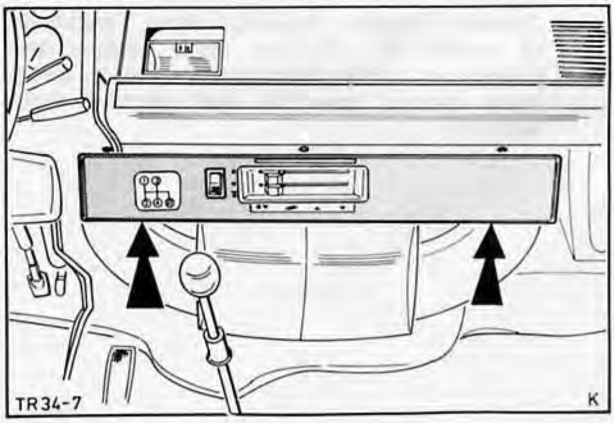


Fig. 18. Install control panel bezel

34 354 8 HEATER ASSEMBLY – DISMANTLE AND REASSEMBLE (Heater assembly removed)

To Dismantle

1. Remove foam gasket from blower flange, Fig. 19, and separate heater assembly halves (10 clips), Fig. 20.

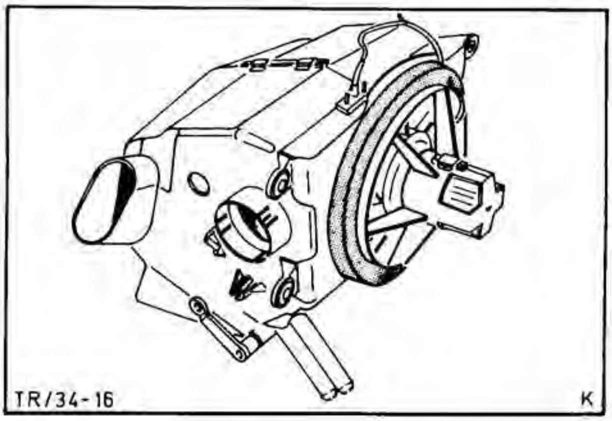


Fig. 19. Remove foam gasket from blower flange

2. Remove blower motor and air flap valves from housings, Fig. 21.

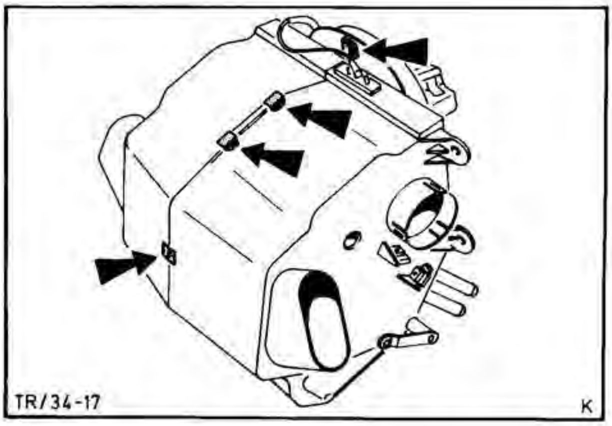


Fig. 20. Separate heater assembly halves

3. Remove heater radiator from housing.

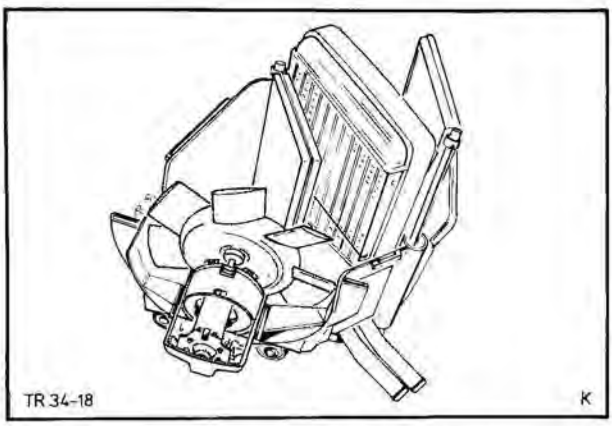


Fig. 21. Remove blower motor and air flap valves from housings

34 354 8 (cont'd)

To Reassemble

4. Install heater radiator in housing, renewing foam gasket if necessary, Figs. 22 and 23.

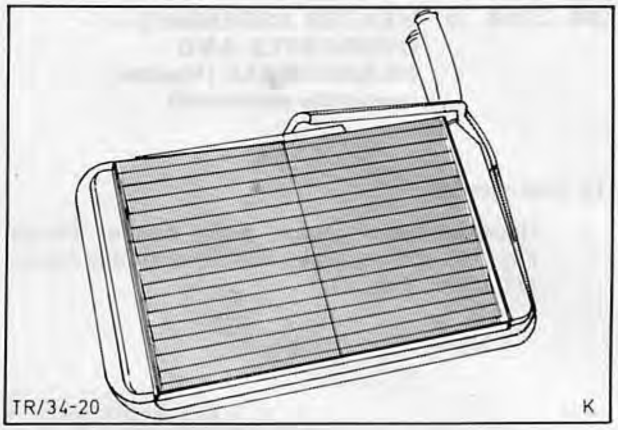


Fig. 22. Renew foam gasket, if necessary

5. Assemble air flap valves and blower motor to housings. Assemble housing halves and secure with 10 clips, Fig. 24.

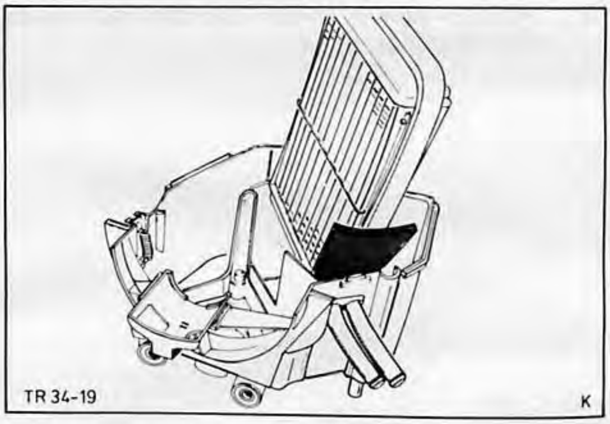


Fig. 23. Install heater radiator in housing

6. Position foam gasket around blower flange on heater housing.

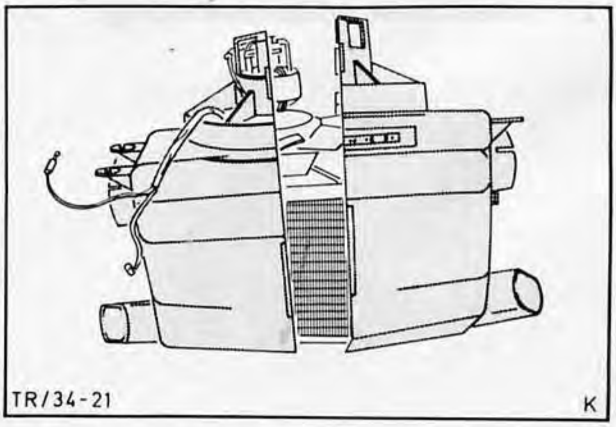


Fig. 24. Assemble housing halves

34 474 HOSE – DEMISTER REMOVE AND INSTALL

To Remove

1. Pull demister hose off heater housing and demister nozzle, Fig. 25.

To Install

2. First push demister hose over demister nozzle then on to neck on heater housing.

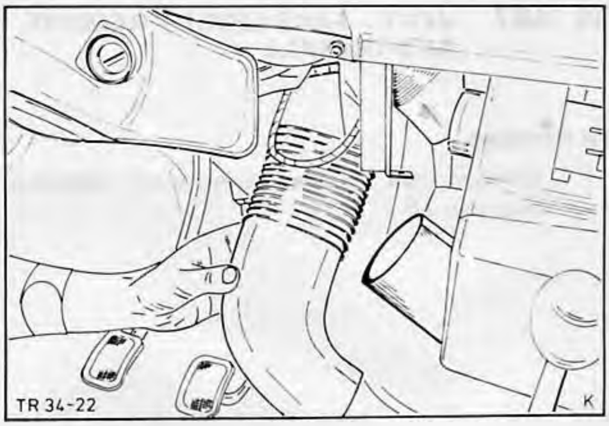


Fig. 25. Withdraw demister hose

34 483 DEMISTER – REMOVE AND INSTALL

To Remove

1. Remove demister nozzle (2 screws), Fig. 26, and withdraw complete with hose.

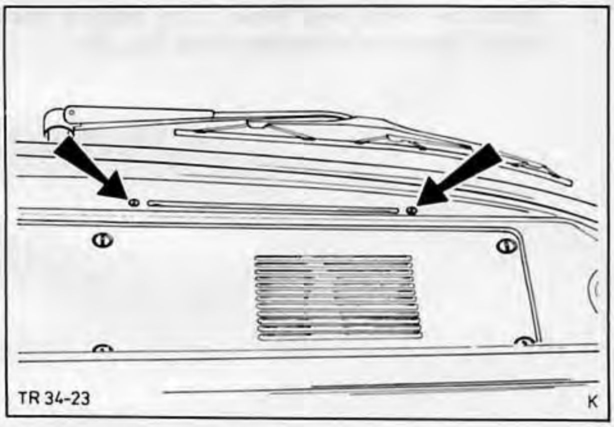


Fig. 26. Remove demister nozzle

2. Pull the demister nozzle off the hose, Fig. 27.

To Install

3. Push demister nozzle on to hose.
4. Install demister nozzle and hose assembly and secure with two screws.

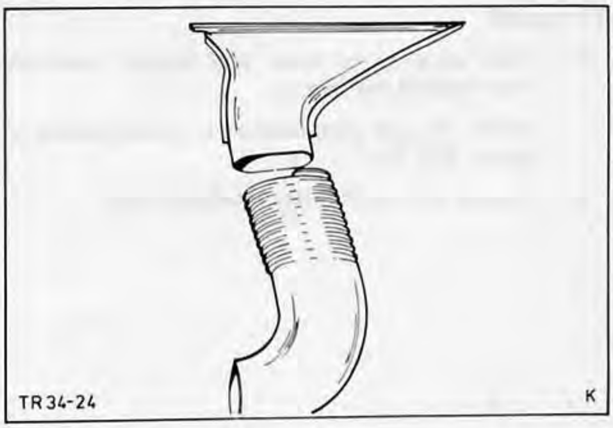


Fig. 27. Pull nozzle off hose

34 487 VENT – FACE LEVEL – REMOVE AND INSTALL

To Remove

1. Remove vent by unscrewing outer retaining ring, Fig. 28.

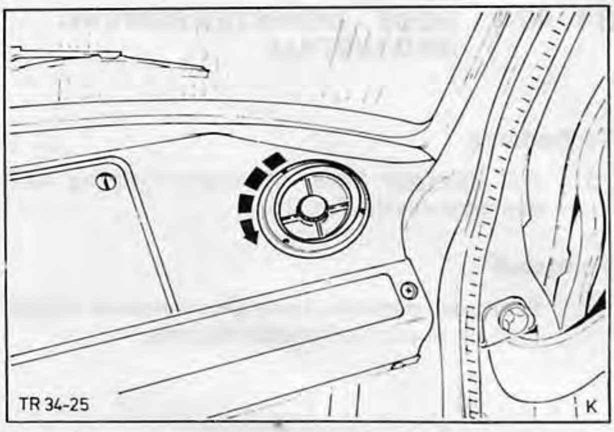


Fig. 28. Remove face level vent

2. Withdraw vent and hose from behind the fascia. Separate vent from hose, Fig. 29.

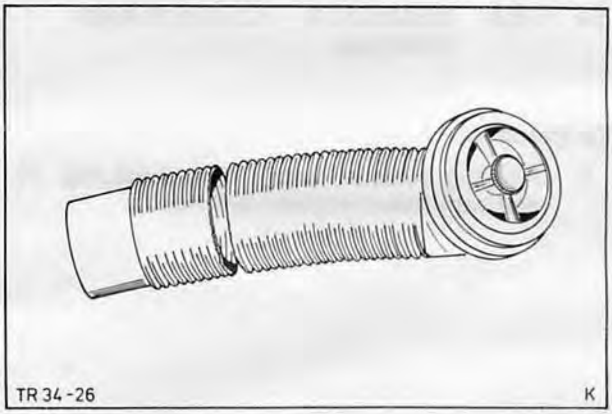


Fig. 29. Remove vent and hose assembly

To Install

3. Push vent on to hose and install assembly from behind the fascia.

   NOTE: Ensure vent locates in guide groove in fascia, Fig. 30.

4. Secure vent with outer retaining ring.

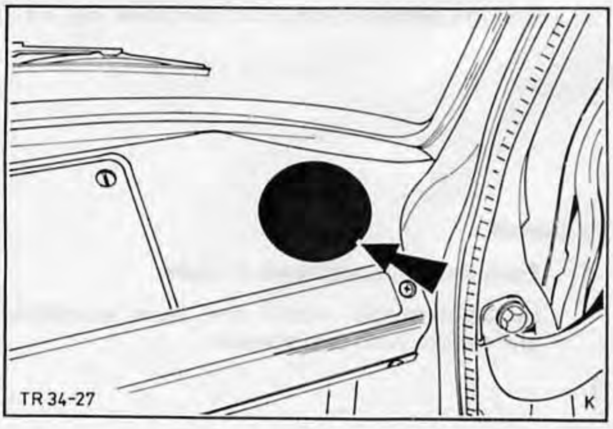


Fig. 30. Guide groove in fascia

Heating & Ventilation 34

Index Page

GENERAL DESCRIPTION

All TRANSIT variants built since August '82 (Build Code CP) are equipped with a new heating installation.

The 4-part heater casing accommodating the blower and the heater radiator is located inside the vehicle under the instrument panel. The heater is attached to the vent and demister nozzles by means of hoses.

The two-speed blower is operated by a rocker switch on the facia.

The temperature and distribution of the incoming air can be regulated by means of adjustable control levers. Depending on the setting of the air valves in the heater casing, warm or cold air flows into the interior or to the windows, Fig.1.

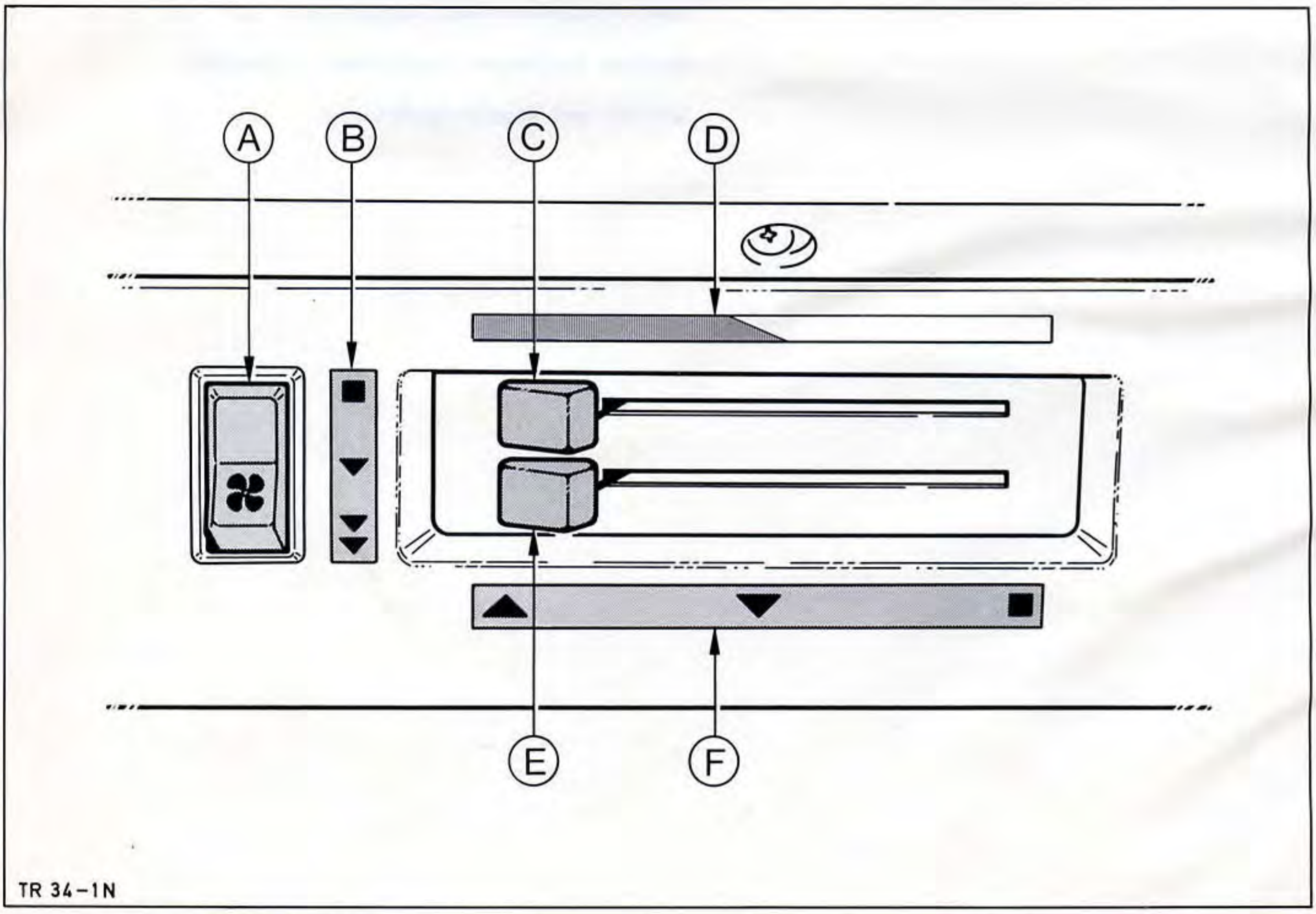


Fig.1. Heater blower controls.
A - Blower switch
B - Blower symbols
C - Temperature control lever
D - Temperature control symbol
E - Air distribution lever
F - Air distribution symbols

PRINCIPLE OF OPERATION

The air needed for the heater passes through the heater radiator in the heater casing. The heater radiator is of similar design to the radiator of the engine cooling system. Hot coolant flows through the heater radiator. The heat contained in the coolant is conducted through the radiator core, by means of cooling fins, to the stream of air flowing into the interior of the vehicle, i.e. heat exchange takes place between the coolant and the air (hence the name heater exchanger).

The temperature and distribution of the heating - or cooling - air are regulated by air valves in the heater casing. The upper - temperature control - lever, Fig.2, operates the temperature regulating valve by means of a Bowden cable to mix two streams of air. One of these comes straight from the outside (and is cold) while the other is directed through the heater radiator (and is warm). This allows adjustment of the temperature as required.

The lower - air distribution - lever, Fig.2, operates the air distribution valve by means of a Bowden cable to distribute the air to the footwells and the demister nozzles, depending on the lever setting. The heating system is designed so that warm or cold air can be directed to the vent nozzles, depending on the setting of the air distribution lever, Fig.5.

A two-speed electric blower is also provided in the heater casing so that an adequate flow of air can be achieved, even when moving slowly, Figs 3 and 4.

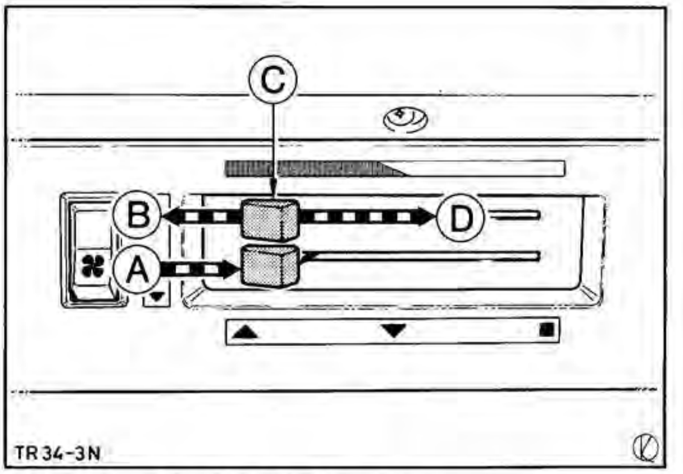


Fig.2. A - Air distribution lever
B - Warm
C - Temperature regulating lever
D - Cold

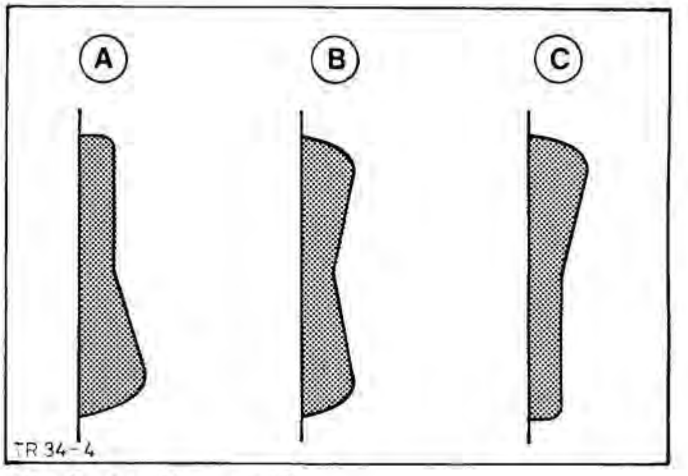


Fig.3. A - Blower off
B - Blower speed I
C - Blower speed II

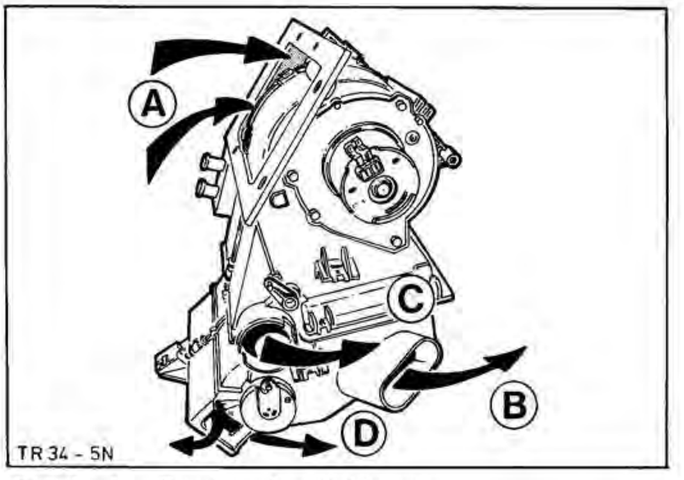


Fig.4. A - Supply of outside air
B - To the demister nozzles
C - To the vents nozzles
D - To the footwells

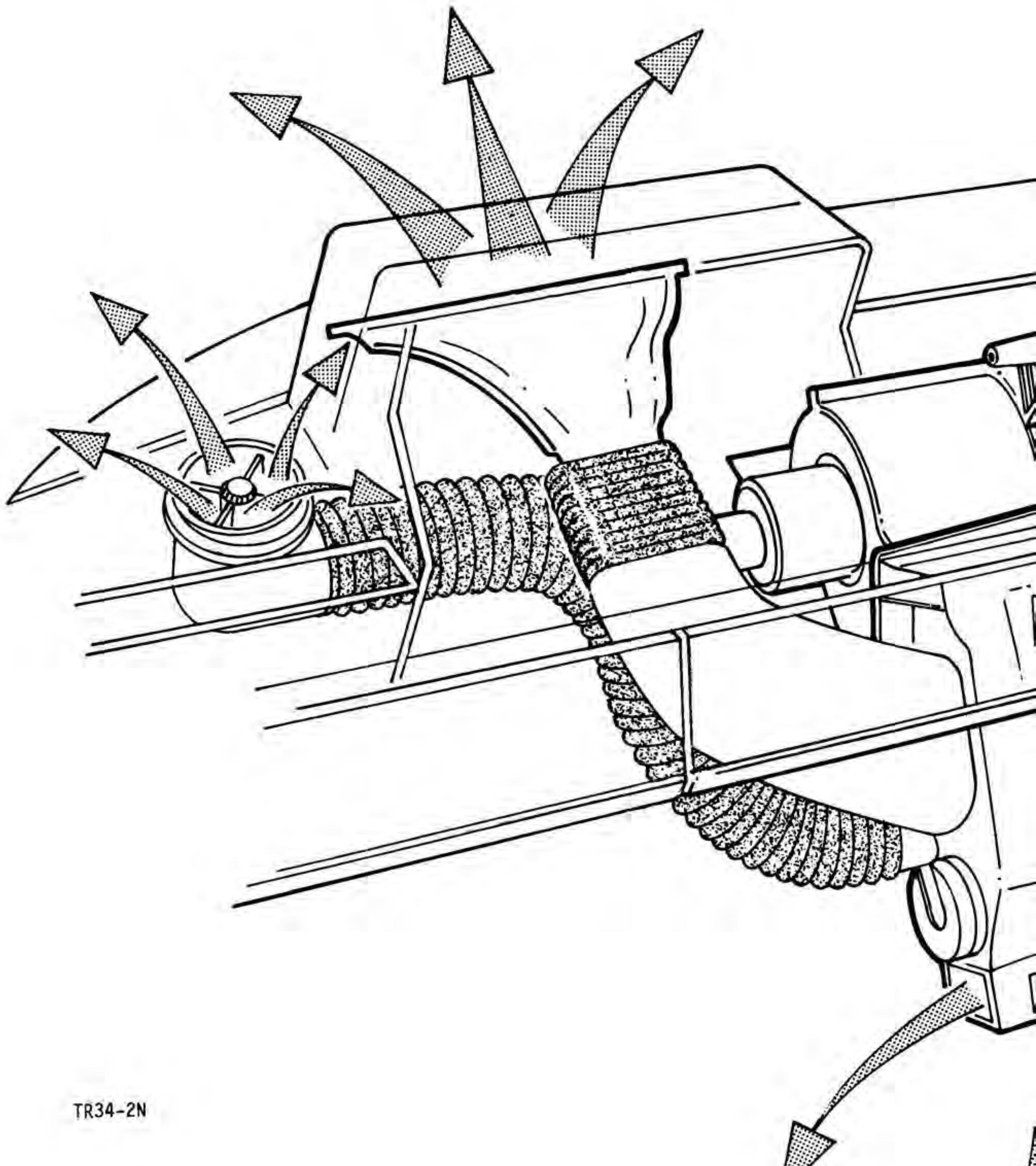
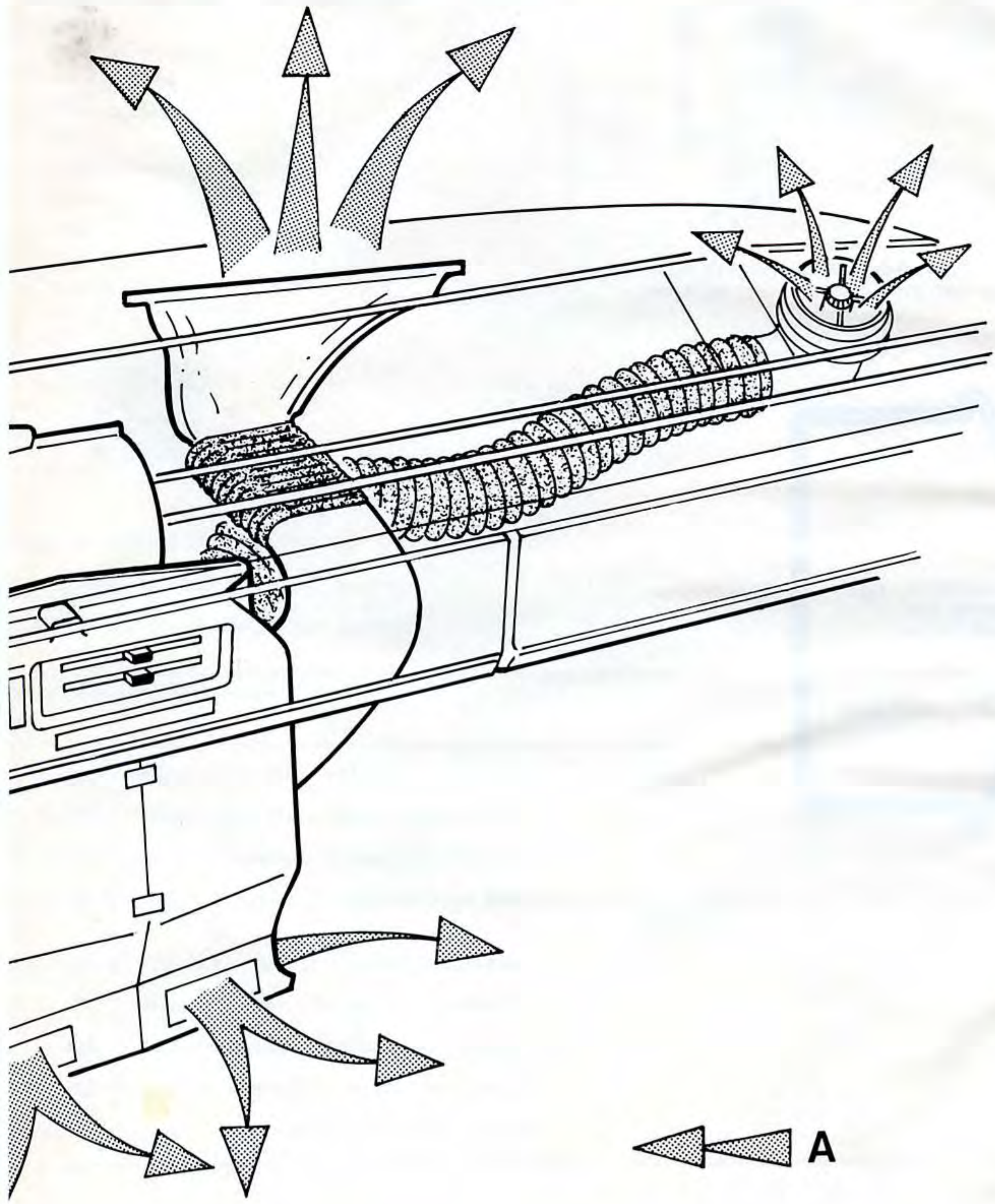


Fig.5. Diagrammatic view showing air distribution.
A - Cold/warm air depending on setting of air distribution lever.


A

SERVICE CHECKS AND ADJUSTMENTS

The efficiency of the heater and ventilation is also largely dependent on correct adjustment and fitting of the Bowden cables. Consequently, when attaching the Bowden cables to the heater casing, the two control levers must not be on their stops but approx 2 mm away from them, Fig.6.

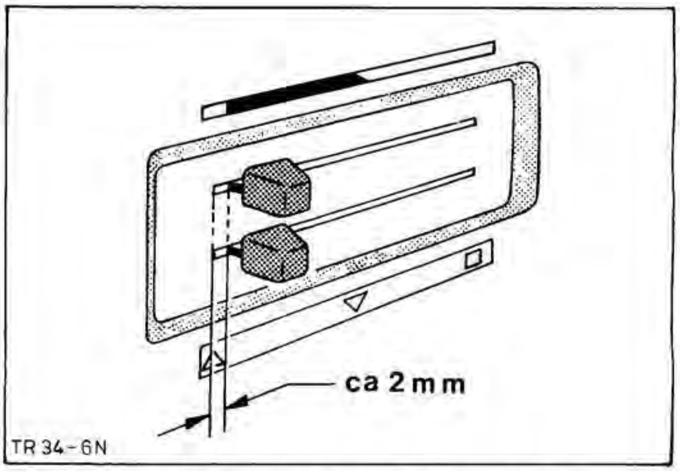


Fig.6. When fitting Bowden cable, control lever must be approx 2 mm before the stop.

SPECIAL SERVICE TOOL RECOGNITION

No special service tools are required:

SERVICE AND REPAIR OPERATIONS CONTENTS

Heating and Ventilation		Described	Contained in operation
34 313	Heater controls - Adjust	-	34 354
34 314	Heater controls - Remove and Install	-	34 354
34 354	Heater assembly - Remove and Install	X	
34 354 8	Heater asssembly - Dismantle and Reassemble (Heater Assembly Removed)	X	
34 364 4	Radiator - Heater - Remove and Install	X	
34 374	Motor - Heater - Remove and Install	X	
34 474	Hose - Demister - Remove and Install (left)	X	34 484
34 483	Nozzle - Demister - Remove and Install	X	
34 487	Vent - Face Level - Remove and Install	X	

SERVICE AND REPAIR OPERATIONS

34 354 HEATER ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect battery earth lead.

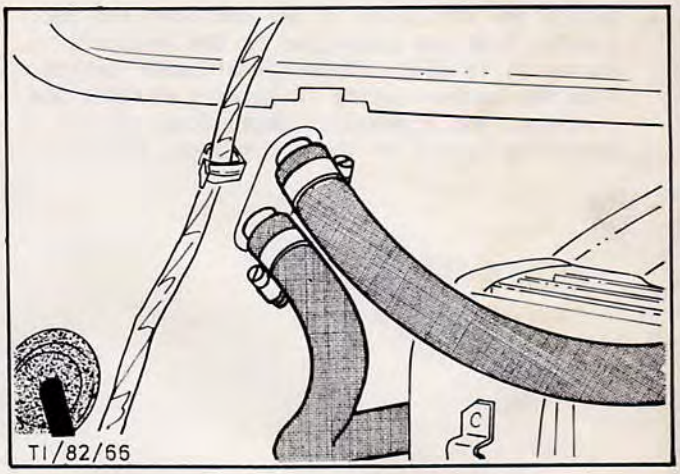


Fig.7. Detach hot water hose from heater radiator.

2. Position a tray under the vehicle to catch the coolant. Detach the hot water hoses from the heater radiator connector, Fig.7. Secure hoses in the engine compartment with their ends raised.

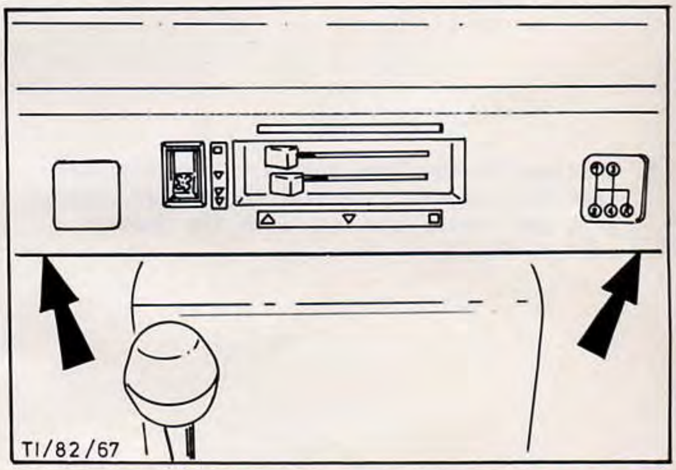


Fig.8. Detach bezel from the facia panel - retaining screws arrowed.

3. Detach bezel of heater control unit under the facia panel (2 crosshead screws), Fig.8.

   Pull out symbol illuminating bulb and holder. Pull multi-plug off the blower switch, Fig.9.

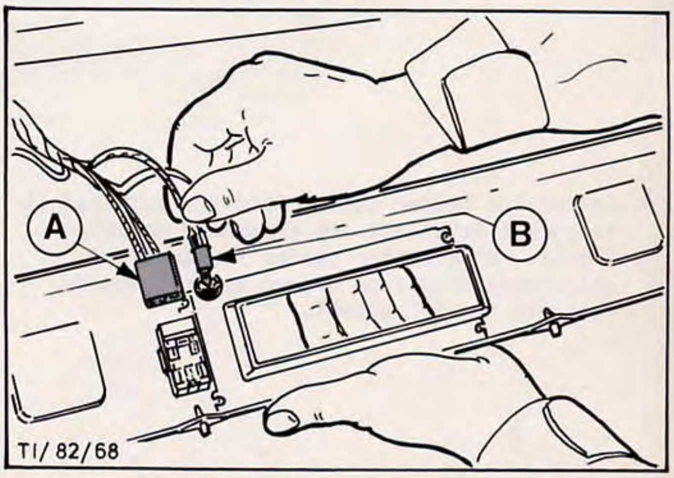


Fig.9. Pull off blower switch multi-plug, A, and detach symbol illuminating bulb and holder, B.

To Install

7. Locate the heater assembly in the vehicle, Fig.13. Connect plug of blower motor, Fig.14, and secure the heater casing to the bulkhead with 5 bolts.

NOTE: First locate the gasket over the heater radiator connector and glue a new foam gasket (when damaged) on the upper part of the heater casing.

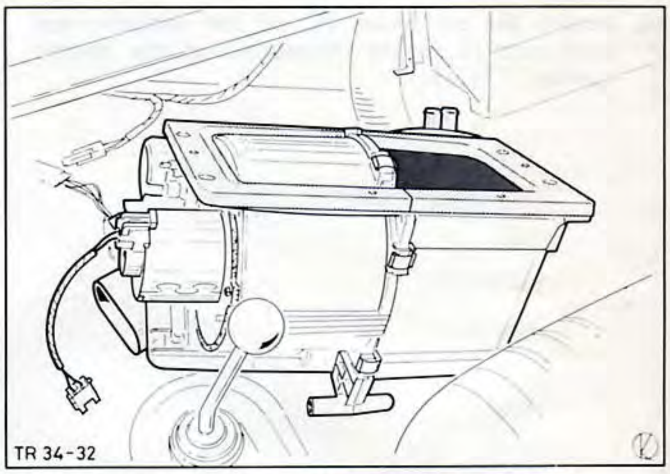


Fig.13. Locate heater assembly in vehicle.

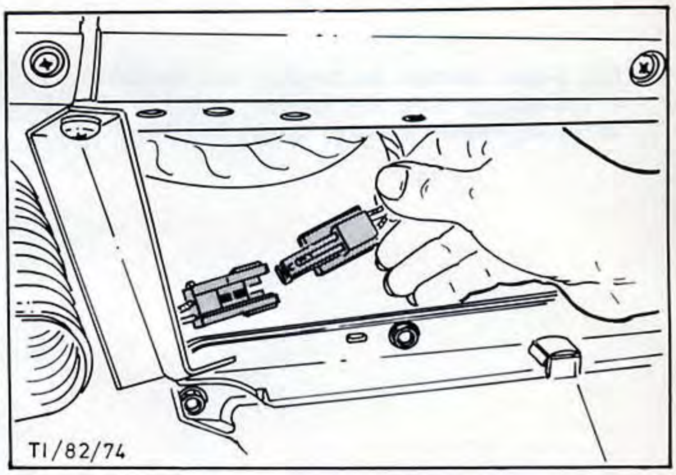


Fig.14. Attach plug to blower motor.

8. Fit heater control unit complete with Bowden cables on the facia panel and secure with the 2 (TX40) Torx screws.

9. Attach and Bowden cables to the air valve levers and then adjust as follows: Position the control lever approx 2 mm before the stop, Fig.15, and secure the slotted retainer that holds the Bowden cable sheath so that the air valve in question is in its extreme position.

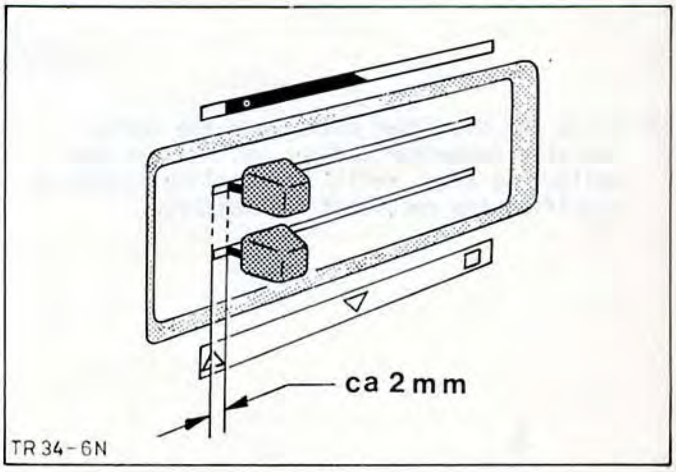


Fig.15. Position control lever approx 2 mm before the stop.

10. Attach the air hoses (4) of the demister and vent nozzles to the connectors on the heater casing, Fig.16.

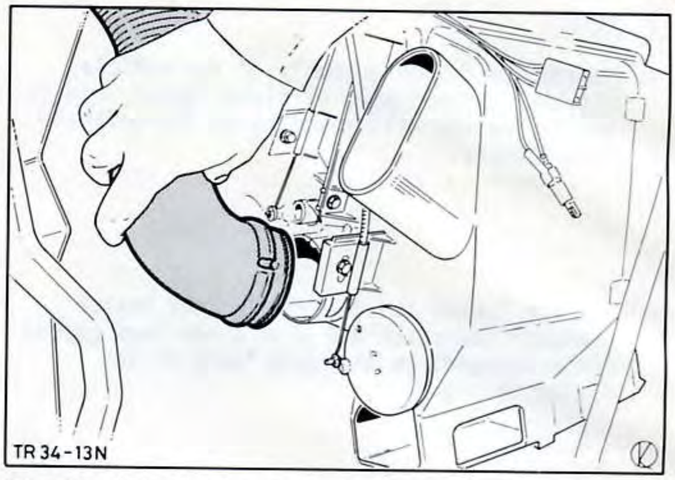


Fig.16. Attach air hoses to heater casing.

11. Fit blower switch multi-plug and symbol illuminating bulb and holder, Fig.17. Mount bezel of heater control unit, Fig.18.

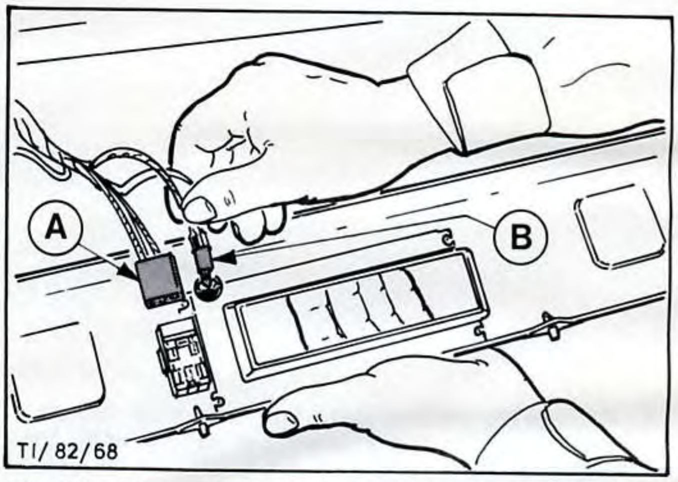


Fig.17. Fit multi-plug, A, and symbol light, B, to bezel of heater control unit.

12. Slide the hot water hoses onto the heater radiator connector and secure. Remove the collecting tray, refill the cooling system as specified and reconnect the battery.

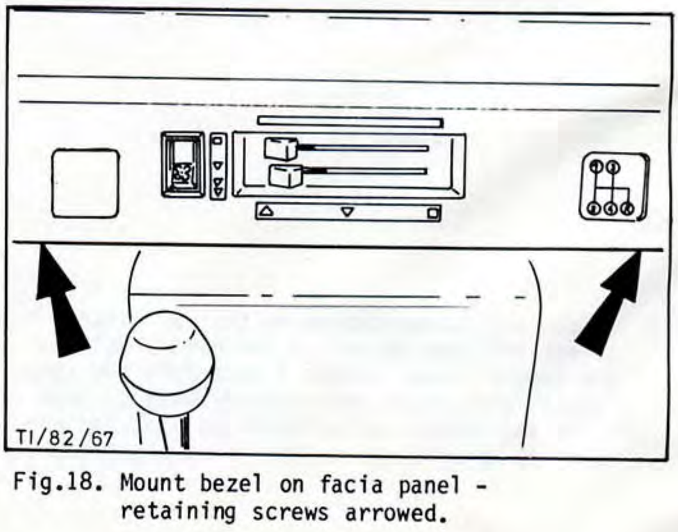


Fig.18. Mount bezel on facia panel - retaining screws arrowed.

34 354 8 HEATER ASSEMBLY - DISMANTLE AND REASSEMBLE (Heater Assembly Removed)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Dismantle

1. Separate the lower part of the casing from the upper part (8 screws), Fig.19.

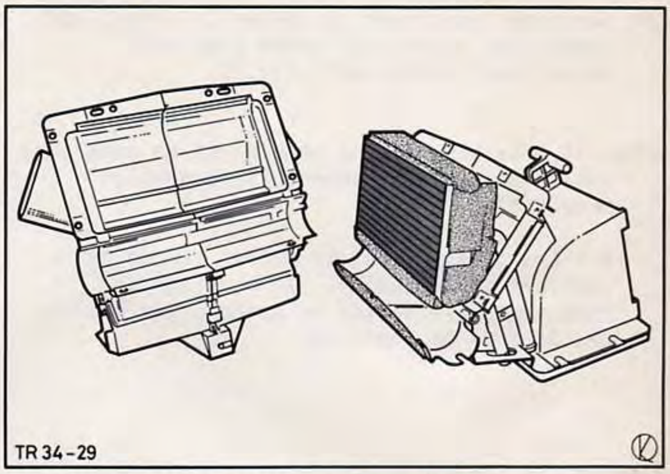


Fig.19. Separate casing halves (lower part from upper part).

2. Remove the electric motor from the heater casing (3 screws), Fig.20.

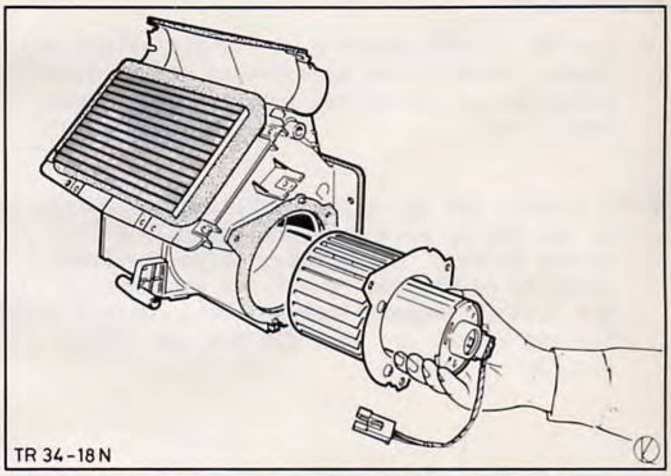


Fig.20. Withdraw electric motor from heater casing.

3. Withdraw the heater radiator from the casing, having first removed 1 screw from the bracket between the connectors.

4. Cut foam gasket of upper part of casing with a knife in the area of the casing halves, Fig.21. Remove the seven clips, separate upper part of casing and remove the air valve from the casing half in question.

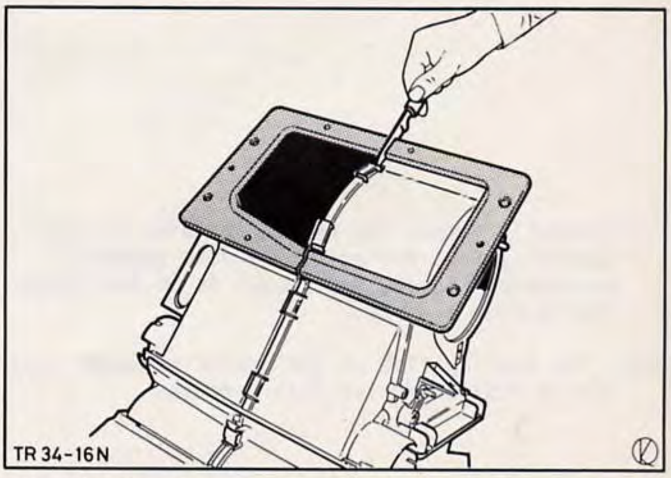


Fig.21. Cut foam gasket with a knife in area of casing halves.

34 354 8

5. Separate lower part of casing (6 clips) and remove the second air valve from the associated casing half, Fig.22.

NOTE: If possible, casing should not be separated unless heater was incorrectly assembled previously.

The bearings of the air valves cannot be replaced individually. If bearings or components are faulty or broken, the entire casing must be replaced.

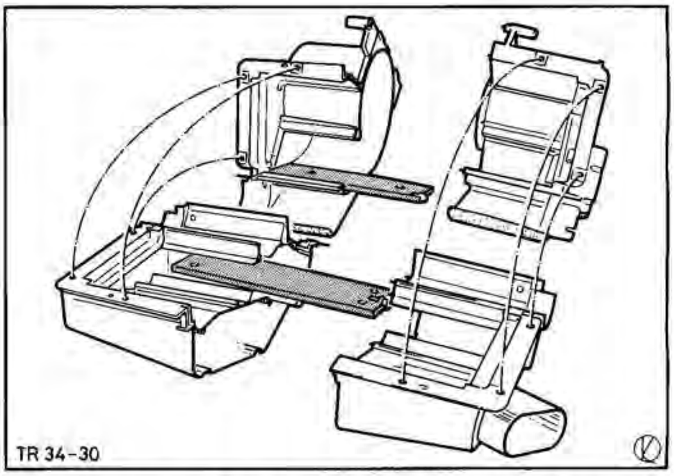

TR 34-30

Fig.22. Assemble casing halves and air valves.

To Reassemble

6. Fit the plastic bearing to the air valves and insert these in the appropriate casing halves, bring the casing halves together and secure with clips.

NOTE: Install the air valve operating mechanisms in the heater casing before assembling the casing halves. To do this, align the broad toothing on the cog cover with the opening in the toothed segment (makes direct contact with the air valve) and then fit the cog cover, Fig.23.

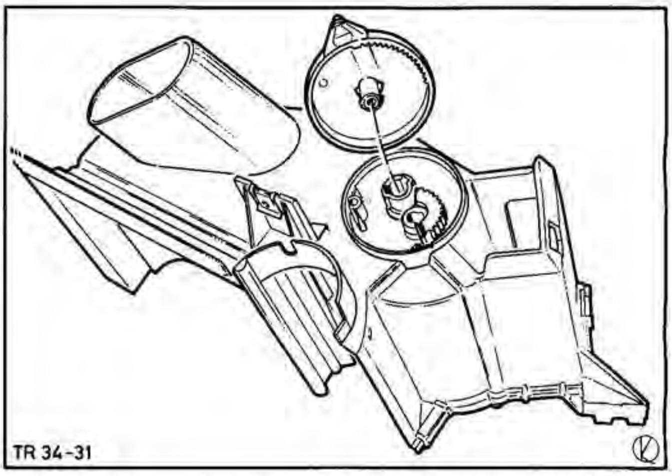

TR 34-31

Fig.23. Assemble air valve operating mechanism.

7. Carefully insert the heater radiator in the heater casing, replacing the foam gasket if necessary, Fig.24, and secure it to the heater casing with a screw.

NOTE: The cooling fins on the heater radiator must not be damaged during this process.

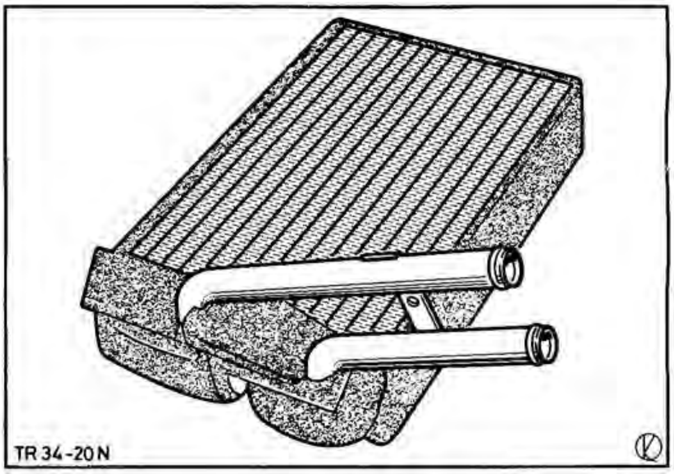

TR 34-20N

Fig.24. Heater radiator with foam gasket.

34 354 8

8. Screw the lower and upper parts of the casing together (8 screws), Fig.25.

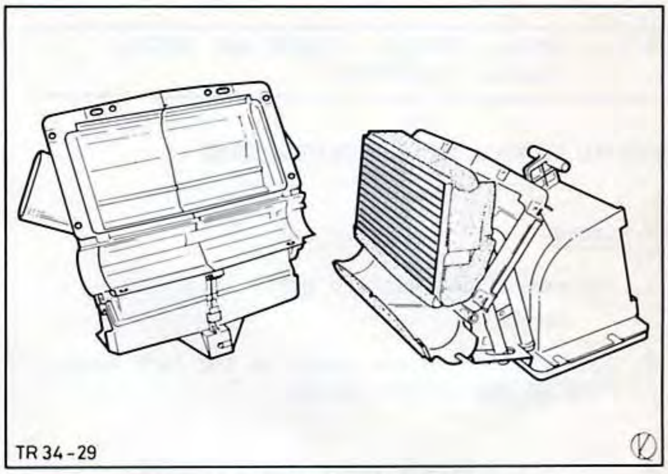


Fig.25. Screw casing lower and upper parts together.

9. Position gasket on heater casing, slide the electric motor with the fan into the casing and secure with three screws, Fig.26.

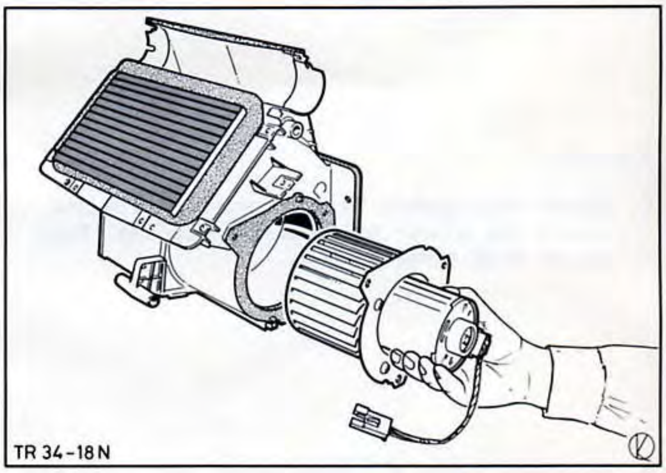


Fig.26. Insert the electric motor in the heater casing.

10. Stick a new foam gasket to the heater casing, Fig.27.

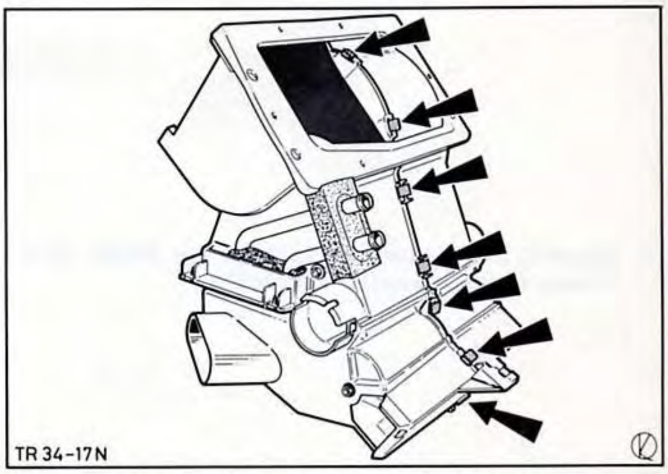


Fig.27. Heater fully assembled - foam gasket stuck in place. Retaining clips arrowed.

34 374 MOTOR - HEATER - REMOVE AND INSTALL (Heater Installed)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Disconnect the battery earth lead.

2. Detach both the air hoses on the left hand side of the heater casing.

3. Disconnect blower motor plug, Fig.28.

4. Undo the three retaining screws and withdraw the blower motor from the heater casing sideways, Figs. 29 and 30.

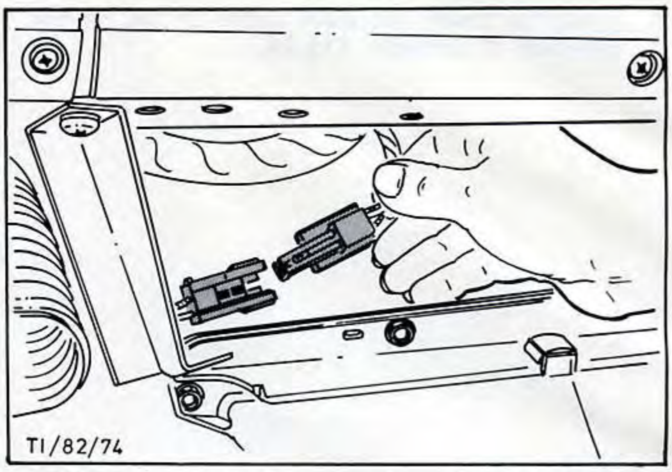


Fig.28. Disconnect blower motor plug (bezel of heater control unit removed for clarity).

To Install

5. Attach foam gasket to the heater casing and insert the blower motor in the opening, then secure with three screws.

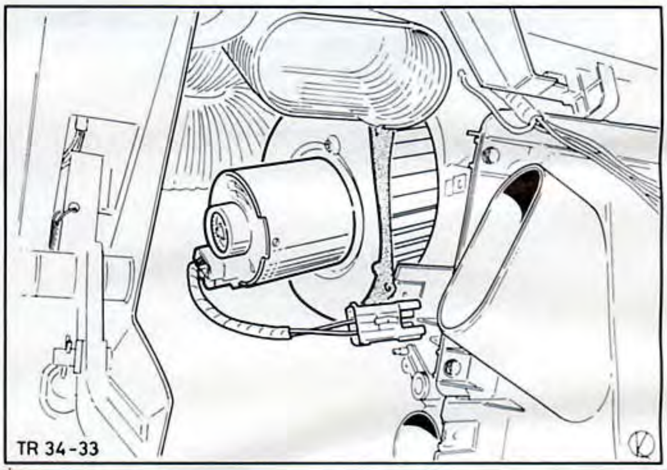


Fig.29. Draw heater blower motor out of the heater casing.

6. Reconnect cable of blower motor and refit the two air hoses.

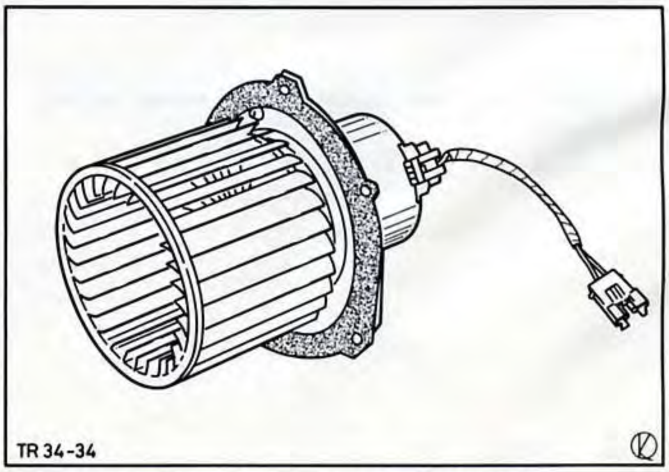


Fig.30. Blower motor removed - foam gasket shown shaded.

7. Connect the battery earth lead and check that blower motor operates correctly.

34 474 HOSE - DEMISTER - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Detach demister air hose from the heater casing and the demister nozzle and withdraw hose, Fig.31.

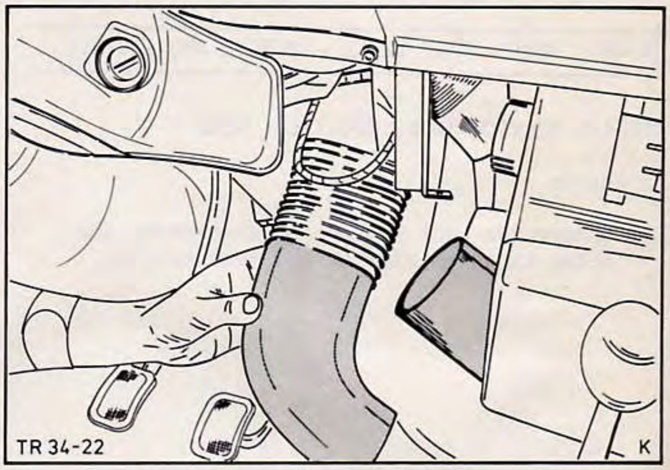


Fig.31. Detach demister hose.

To Install

2. Attach hose, first to demister nozzle and then to heater casing.

34 483 NOZZLE - DEMISTER - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove the two crosshead screws, Fig.32, and withdraw the nozzle complete with the hose.

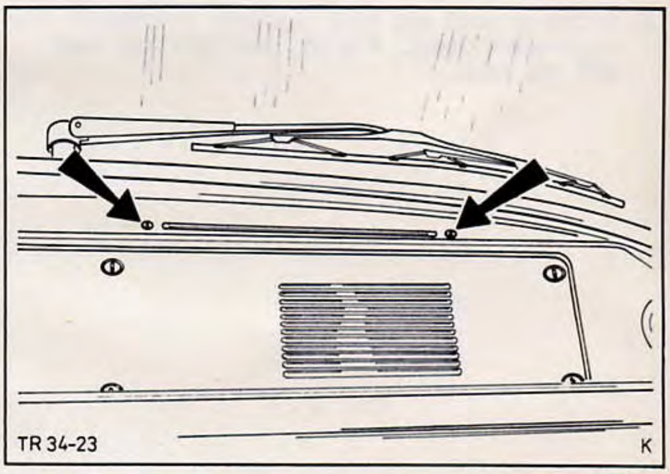


Fig.32. Remove demister nozzle.

2. Detach the demister nozzle from the hose, Fig.33.

To Install

3. Attach the nozzle to the hose.

4. Secure demister nozzle complete with the hose (2 screws).

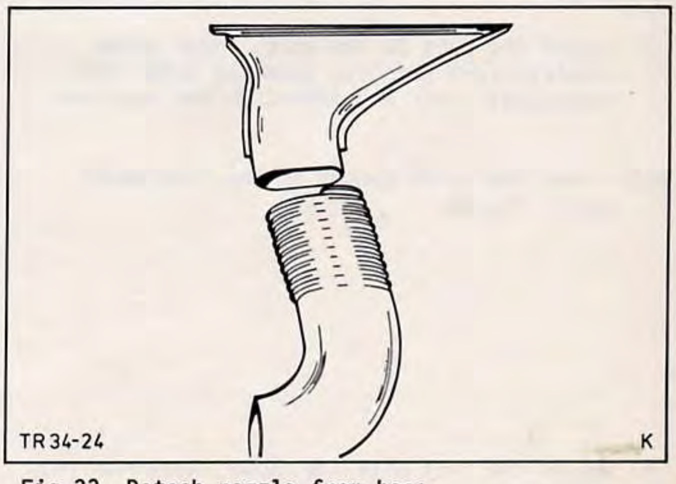


Fig.33. Detach nozzle from hose.

34 487 VENT - FACE LEVEL - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Remove the vent Fig.34, by unscrewing the outer threaded ring on the vent nozzle.

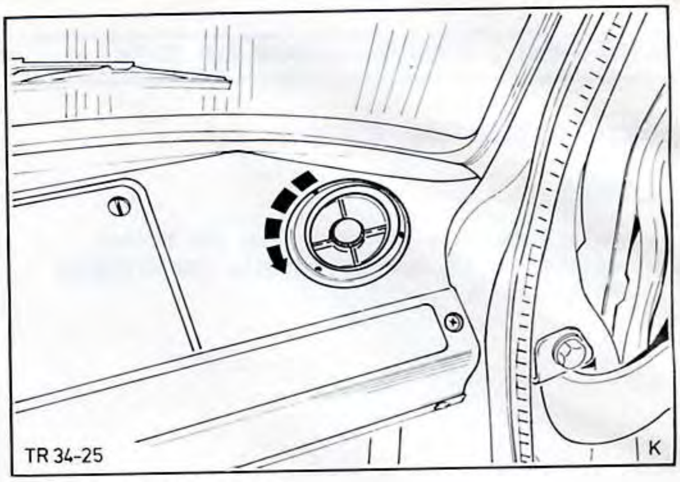


Fig.34. Remove vent.

2. Withdraw vent and hose complete underneath the instrument panel, Fig.35, and pull the vent off the hose.

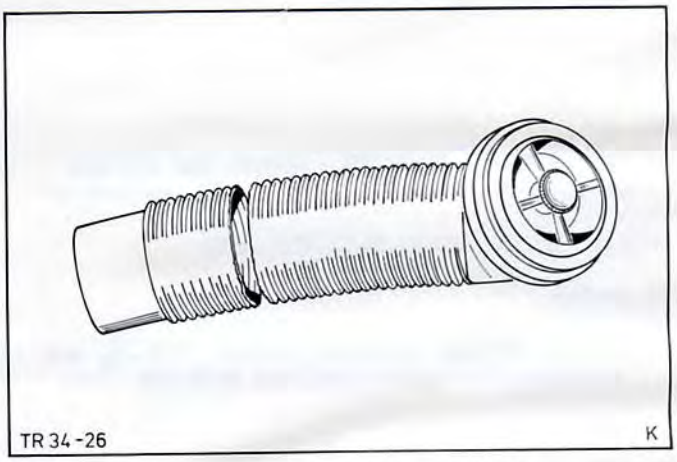


Fig.35. Withdraw vent and hose complete.

To Install

3. Attach the vent to the hose. Then guide complete vent and hose assembly under the instrument panel and insert in the aperture.

NOTE: Note the guide groove in the instrument panel, Fig.36.

4. Secure the vent with the outer threaded ring.

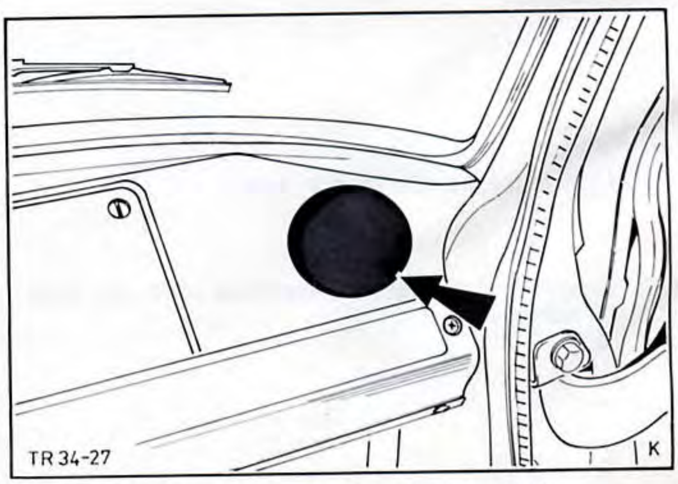


Fig.36. Guide groove in instrument panel.

INTERIOR LIGHTS, INSTRUMENTS, INSTRUMENT PANEL CONTROLS AND SENDER UNITS

33

Index — **Page**

GENERAL DESCRIPTION

Facia Panel and Instrument Cluster

The Transit Facia panel contains the instrument cluster, driver operated controls and switches, and the heating and ventilation controls.

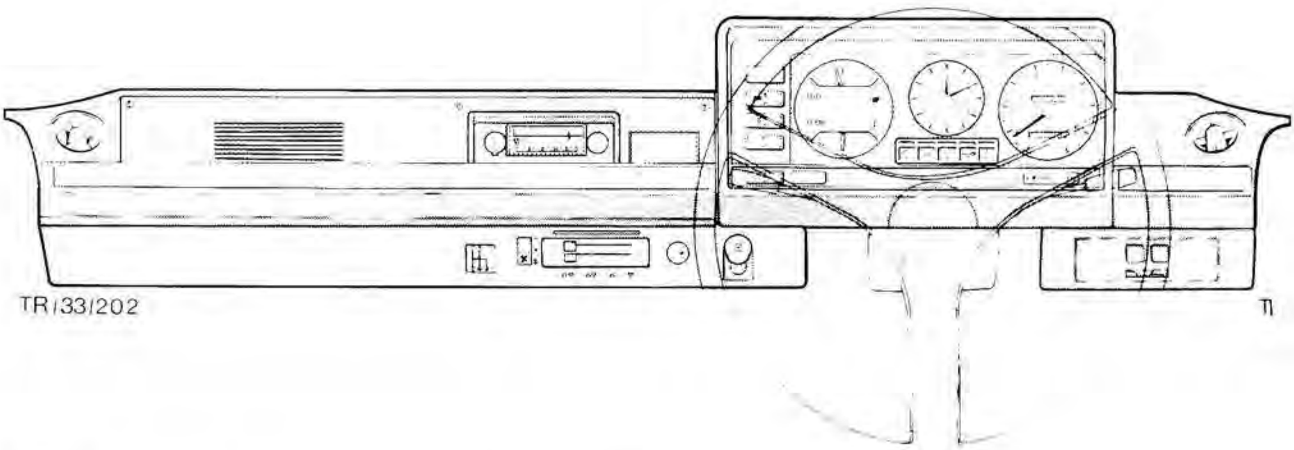
The instrument cluster is based on the award winning 'R' module first fitted to the Taunus/Cortina range. Three basic types of clusters are available.

Fig. 1A. This cluster is available on custom cab variants and available as an option on Base variants. It comprises of two large circular instruments, the large instruments being a speedometer, and a combined fuel level and engine coolant temperature indicator. A clock is fitted and located above the warning lights and between the two large instruments. The fascia is trimmed in a simulated wood effect.

A further cluster is available on Base variants and has two large circular instruments. These are a speedometer and a combined fuel level and engine coolant temperature indicator.

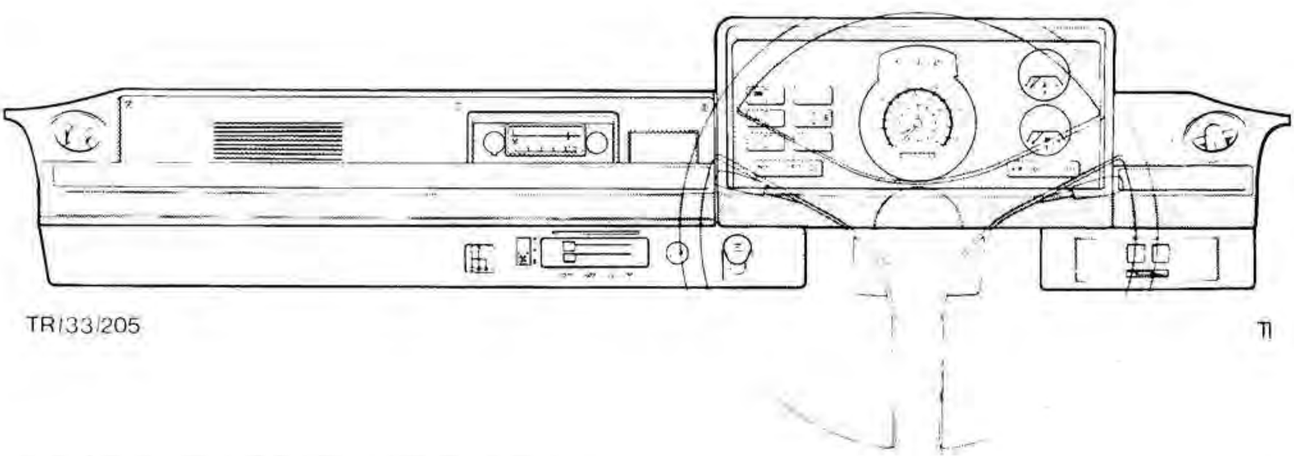
Fig. 1B. This facia is for vehicles fitted with a tachograph. Where the tachograph is fitted the fuel level and coolant temperature indicators are individually housed within the facia panel adjacent to the tachograph.

All instruments clusters have two rows of warning lights giving visual warning of direction indicators, low brake fluid level, headlamp main beam, and ignition. On Diesel variants 'pre-heat' and low vacuum warning lights are included in the warning light panels.



TR/33/202 TI

Fig. 1A. Petrol engined Custom variants with optional radio fitted



TR/33/205 TI

Fig. 1B. Diesel engined variants with optional radio fitted

GENERAL DESCRIPTION (cont'd)

Facia Mounted Controls

The heater controls are sited in the lower facia panel and are of the sliding type. The control positions are illuminated when the parking/driving lights are switched on.

Rocker type switches are provided for rear fog lamp (where fitted), front fog or driving lamps, (where fitted) hazard warning, and interior lamp.

Where a cigarette lighter is fitted, it will be located adjacent to the heater controls.

Steering Column Mounted Controls

Three multi-function switches are mounted on the steering column.

The left-hand switch controls the direction indicators, horn operation and headlamp dip/main beam and headlamp 'flash' controls.

The right-hand switch closest to the driver controls the two-speed windscreen wipers, windscreen and headlamp washers, (where fitted) and 'ON' – 'OFF' switch for the wiper delay circuit. The other right-hand switch controls the operation of the side lamps and headlamps.

Relays

Many of the wiring circuits require the use of relays within their circuitary. These relays are sighted in two basic locations.

The automatic transmission inhibitor relay, and glo-plug relay (where fitted), are attached to the battery tray, within the engine compartment.

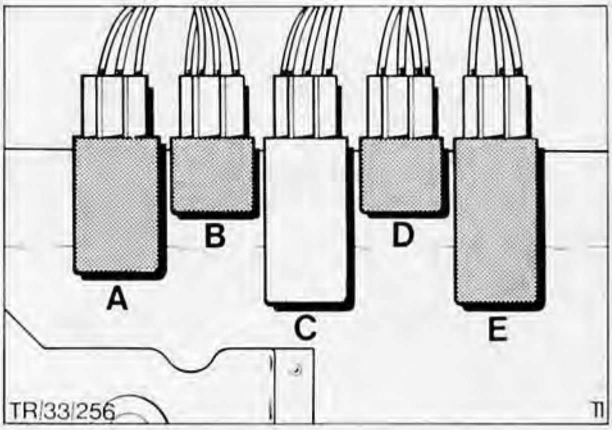
Other relays are located under the facia panel adjacent to the hood release, and clip onto the side cowl panel. Up to five relays are located as shown in Fig. 2 below.

Tachographs

To comply with legislation, certain territories require tachographs to be fitted to certain classes of vehicles within the Transit range. The variants effected are the Bus, Crewbus and Kombi models with a seating capacity (including the driver) greater than nine.

The tachograph is a 'black box' item with in-built seals to prevent unauthorised tampering. In the event of a defect occuring it should be returned to an authorised Ford dealer, or an approved repairing agent. Attempts to effect a repair by unauthorised agents, and the resultant damage to seals could result in infringements of legislation appertaining to tachographs and their operation.

Fig. 2. Relay positions and functions
- A – Intermitant windscreen wiper relay
- B – Headlamp wash relay
- C – Headlamp wash circuit control relay
- D – Heated rear screen relay
- E – Direction indicator/hazard flasher relay



PRINCIPLE OF OPERATION

Two types of tachograph will be encountered, they are:

1. 24 hours, single driver, which contains one record chart.
2. 24 hours, dual driver, which contains two record charts, one for each driver.

Territories which have tachograph legislation, require that the tachograph system is sealed, which limits the repair operations that an owner/Operator or Dealer can do, to relatively minor items. All major repairs to a tachograph should be carried out by an authorised agent.

DRIVER RECORD CHARTS

The following information, regarding driver record charts, should be considered by Dealers and Owner/Operators.

1. When a tachograph is fitted as original equipment, it is fitted with the appropriate paper charts, ready for operational use. Due to the current situation regarding tachograph legislation, i.e. certain territories have legislation, others do not, it is possible that some Owner/Operators will leave the original chart in place. Where a chart is left in place for too long, the stylii will eventually wear through the chart, and damage to the stylii and tachograph will result. This can also happen when vehicles are stored with the battery connected.

   For this reason it is important that Owner/Operators are made aware of this situation, and make regular chart changes.

   In instances where the normal paper chart will not be used, the Owner/Operator should be made aware that a plastic or 'blind', chart is available. The 'blind' charts have a much longer life than the normal paper charts, and should only be used in territories where tachograph legislation is not fully implemented.

2. It is essential that record charts are always fitted into a tachograph during its operation. On certain types of tachograph, a 'fault' light will registar on the face of the instrument if the card(s) are not inserted.

   Other types of tachographs do not have a warning light but serious damage to the stylii can result if a chart is not in place. It is therefore, important that a physical check is made using the chart illumination light and the chart viewing window, or by actually opening the front of the instrument itself.

PRINCIPLE OF OPERATION (cont'd)

INSERTION OF RECORD CHARTS

24 Hours, Single Driver

1. Check that the time shown on the tachograph clock is correct.
2. Open the front of the tachograph (this should only be done with the vehicle stationary). If the tachograph clock shows an incorrect time, it should be adjusted by rotating the clock setting wheel, shown in Fig. 3.

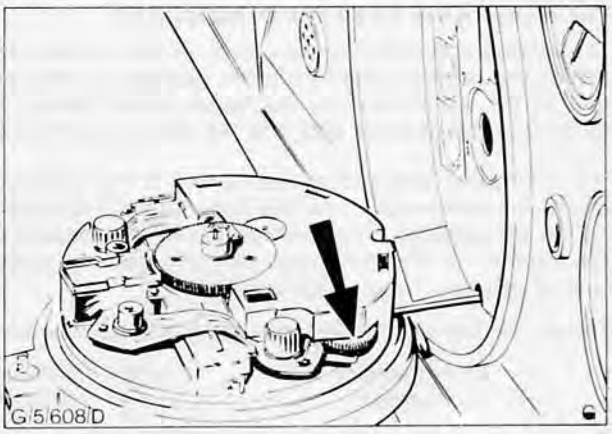


Fig. 3. Clock setting wheel (arrowed)

3. Lift the chart clamping lever, (where applicable), and place the chart over the centre boss.
4. On tachographs that use chart clamps, press the clamping lever down to retain the chart.
5. Close the tachograph.

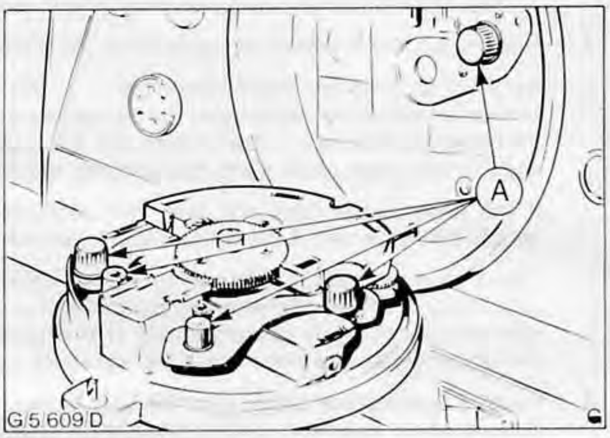


Fig. 4. Insertion of record chart (single driver)
A – Bulb locations

24 Hours, Dual Driver

1. Check that the time shown on the tachograph clock is correct.
2. Open the front of the tachograph (this should only be done with the vehicle stationary). If the tachograph clock shows an incorrect time, it should be adjusted by rotating the knurled wheel, 'E' in Fig. 5 in either direction.
3. Lift up the chart table, 'C' in Fig. 5.
4. Insert the chart for the non-driving crew member.
5. Press down the chart table until it snaps into position.
6. Place the driver's chart on the chart table.

   NOTE: 1. Both charts must be inserted with the green side uppermost.

   2. Two charts must always be in the tachograph, even when there is only one crew member.

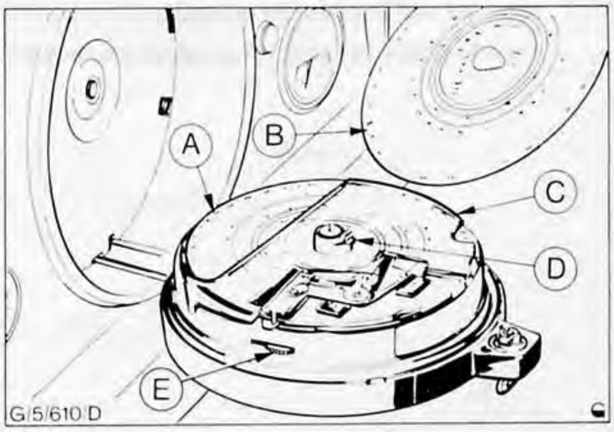


Fig. 5. Insertion of record chart (dual driver)
A – Non-driver's chart
B – Driver's chart
C – Chart table
D – Chart retaining clips
E – Clock setting wheel

PRINCIPLE OF OPERATION (cont'd)

TACHOGRAPH SYSTEM DIAGNOSIS

The tachograph is driven via a one, or two, piece heavy duty cable from the gearbox. In the case of two piece cables the drive is taken from the gearbox to the calibration unit by the lower cable and from the calibration unit to the tachograph by the upper cable. Where a one piece cable is used the calibration unit is screwed direct into the gearbox side and the cable runs from the calibration unit direct to the tachograph.

The calibration unit is mounted in one of three positions; (1) On the right-hand side of the bulkhead at a point where the bulkhead forms the floor pan. (2) On the right-hand chassis member in the engine compartment. (3) On the gearbox. The calibration unit is a sealed unit and should only be repaired by an authorised agent. The location of the calibration unit, and consequently the use of one or two piece cables, is dependent on the type of gearbox fitted to the vehicle.

Should the tachograph fail to register when the vehicle is driven, a fault is indicated in either;

(a) drive cable(s)
(b) tachograph
(c) calibration unit
(d) drive cable gear (in gearbox)

A check should first be made to establish whether or not the drive cable(s) are damaged.

NOTE: 1. The following procedure is for a 'two-cable' system. The same principles can be applied when diagnosing faults on a single cable variant.

2. Vehicles operating in territories where full tachograph legislation is in force will have seals applied at the cable ends. The following procedure necessitates disturbing these seals (if fitted). It is therefore important that these seals are renewed before the vehicle is returned to service.

1. Disconnect the lower drive cable from the calibration unit.

2. Attempt to turn the inner lower cable. If the inner cable turns, this indicates that either the cable is broken or the drive cable gear (in the gearbox) is damaged. In this instance, disconnect the drive cable from the gearbox and inspect both the drive gear and the cable. Ensure that either or both the square ends of the inner cable have not become rounded.

   If the inner cable does not turn, this indicates that the cable is probably satisfactory, but this cable should be inspected if the following procedures do not identify the malfunction.

3. Check that the calibration unit functions smoothly, by inserting a screwdriver blade, in the forked end and rotating. If the operation of the calibration unit is stiff, or if tight spots are evident repeat this check with the upper cable disconnected. If the calibration unit now operates smoothly a fault is indicated in the upper cable and this should be replaced.

4. Insert a screwdriver blade into the end of the inner upper cable. Spin the cable anti-clockwise and with the aid of an assistant, detect whether or not the tachograph registers. If there is no movement either the upper drive cable is broken, or the tachograph unit is faulty.

   Disconnect the drive cable from the rear of tachograph, and inspect both ends of the cable. If broken or damaged, replace.

   If the drive cable is satisfactory, a fault is indicated within the tachograph. In this instance, remove the tachograph from the vehicle and return it to an authorised agent. Refer to Operation No. 33–274 for removal and installation procedure.

   Should either, or both, drive cables be broken, refer to Operation No. 33–376 to effect a replacement.

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following items should be checked to ensure correct function.

1. Operation of all interior lights including facia panel lights and automatic transmission lever quadrant light where fitted.
2. Operation of warning lights including brake warning light where fitted.
3. All switches and controls, (to include heated rear window switch where fitted).
4. Speedometer or tachograph operation, which should be checked either by road or roller test.

BULB REPLACEMENT

24 Hours, Single Driver

1. With the vehicle stationary, open the front of the tachograph.
2. Remove the failed bulb and holder, by twisting anti-clockwise.
3. Pull the failed bulb from the holder and replace with a new one.
4. Fit the new bulb and holder.
5. Close the tachograph and check the operation of the bulb.

24 Hours, Dual Driver

1. With the vehicle stationary, open the front of the tachograph.
2. Lift-up the bulb contact, remove the failed bulb by rotating, remove the bulb. Alternatively the bulb can be removed by pressing a small amount of plasticine onto the bulb contact, and lifting the bulb from its socket.
3. Fit a new bulb and retain the bulb contact.
4. Close the tachograph and check the operation of the bulb.

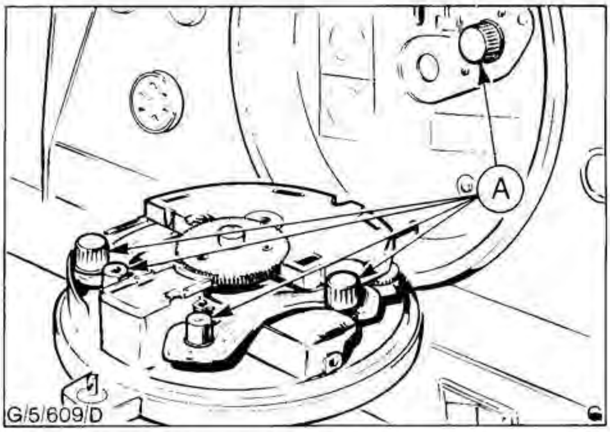


Fig. 6. A – Bulb holders and their locations

SPECIAL SERVICE TOOL RECOGNITION EUROPEAN SOURCED

Tool	Tool Name
23–009	Fuel tank sender unit lock ring wrench

SERVICE AND REPAIR OPERATIONS – CONTENT 'A'

INTERIOR LIGHTS, INSTRUMENTS INSTRUMENT PANEL CONTROLS AND SENDER UNITS		Described in this Publication	Contained in Operation	Unique to Transit
33 128	Bulb – Heater control illuminating lamp – Replace	X		X
33 139	Bulb – Brake fluid warning – Replace	X		X
33 152	Lamp – Engine compartment – Remove and Install	X		X
33 154	Bulb – Engine Compartment lamp – Replace	—	33 154	X
33 214	Instrument cluster assembly – Remove and Install	X		X
33 228 4	Bulb instrument cluster – Replace (Instrument cluster removed)	—		X
33 244	Regulator – Instrument voltage – Remove and Install (variants with a tachograph)	X		X
33 274	Tachograph assembly – Remove and install	X		X
33 275	Bulb – Tachograph illumination – Replace – (One)	X		X
33 276	Cable – Tachograph – Remove and Install	X		X
33 284	Gauge – Fuel – Remove and Install (variants with a tachograph)	—	33 244	X
33 286	Sender unit – Fuel tank – Remove and Install	—	23 554	X
33 304	Gauge – Temperature – Remove and Install (variants with tachograph)	X		X
33 307	Sender Unit – Vacuum warning light – Remove and Install	X		X
33 384	Cigarette lighter assembly – Remove and Install	X		X
33 512	Switch – Ignition – Remove and Install	X		X
33 514	Switch – Light – Remove and Install	X		X
33 522	Switch – Direction indicator – Remove and Install	X		X
33 542	Switch – Windscreen wiper – Remove and Install	—	33 522	X
33 557	Switch – Rear fog lamp – Remove and install	—	33 522	X
33 575	Switch – Temperature sensing – Excess fuel – Remove and Install	X		X
33 576	Switch – Engine stop control motor – Remove and Install	X		X
33 601	Timer switch – Glow-plug operating – Remove and Install	X		X
33 602	Switch – Temperature sensing – Glow-plug control – Remove and Install	X		X
33 713	Relay – Headlamp washer system – Remove and Install	—	33 722	X
33 715	Relay – Windscreen wipers – Remove and Install	—	33 722	X
33 722	Relay – Indicator flasher – Remove and Install	X		X
33 724	Relay – Inhibitor switch – Remove and Install	X		X
33 726	Relay – Heated rear screen – Remove and Install	—	33 722	X
33 727	Relay – Glow-plug – Remove and Install	X		X
33 757	Solenoid – Excess fuel operating – Remove and Install	X		X
33 762	Relay – Engine stop control – Remove and Install	X		X

SERVICE AND REPAIR OPERATIONS – CONTENT 'B'

INTERIOR LIGHTS, INSTRUMENTS, INSTRUMENT PANEL CONTROLS AND SENDER UNITS		Described in this Publication	Contained in Operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina '77	Granada '78
33 112	Lamp – Interior – Remove and Install – (One)	X		X	X	X	X	X	X
33 114	Bulb – Interior Lamp – Replace – (One)	—	33 112	X	X	X	X	X	X
33 134	Bulb – Quadrant lamp – Replace	X		—	—	X	X	X	X
33 139	Bulb – Brake fluid warning – Replace	X		X	X	X	X	X	X
33 144	Bulb – Warning Light – Heated rear window – Replace	X		X	X	X	X	X	X
33 146	Bulb – Hazard warning – Replace	X		X	X	X	X	X	X
33 224 4	Printed circuit – Instrument cluster – Remove and Install (instrument cluster removed)	X		—	X	X	X	X	X
33 226 4	Glass – Instrument cluster – Replace (instrument cluster removal)	X		—	X	X	X	X	X
33 244 4	Regulator – Instrument voltage – Remove and Install (instrument cluster removed) (variants with standard facia)	—	33 224 4	—	X	X	X	X	X
33 254	Head – Speedometer – Remove and Install	X		—	X	X	X	X	X
33 256	Cable – Speedometer – Inner and outer – Remove and Install	X							
33 284	Gauge – Fuel – Remove and Install (variants with standard facia)	X		—	X	X	X	X	X
33 304	Gauge – Temperature – Remove and Install (instrument cluster removed) (variants with standard facia)	—	33 284	—	X	X	X	X	X
33 306	Sender unit – Temperature – Remove and Install	X		X	X	X	X	X	X
33 374	Clock – Remove and Install	X		—	—	—	—	X	X
33 384	Cigarette lighter – Replace	X		—	X	X	X	X	X
33 386	Bulb – Cigarette lighter – Replace	—	33 384	—	X	X	X	X	X
33 513	Lock barrel – Ignition switch – Remove and Install	X		X	X	X	X	X	X
33 524	Switch – Courtesy light – Remove and Install	X		—	X	X	X	X	X
33 528	Switch – Back up lamp – Remove and Install	X		—	—	X	X	X	X
33 548	Switch – Stop light – Remove and Install	X		X	X	X	X	X	X
33 554	Switch – Oil pressure warning light – Replace	X		X	X	X	X	X	X
33 557	Switch – Fog lamp rear – Remove and Install	X		X	X	X	X	X	X
33 558	Switch – Hazard warning – Remove and Install	—	33 146	X	X	X	X	X	X
33 572	Switch – Heated rear window – Remove and Install	—	33 144	X	X	X	X	X	X
33 574	Switch – Heater motor – Remove and Install	X		X	X	X	X	X	X

SERVICE AND REPAIR OPERATIONS – CONTENT A

33 128 BULB – HEATER CONTROL ILLUMINATION PANEL REPLACE

Special Service Tools Required: None

To Remove

1. Ensure vehicle parking lights are turned off.
2. Remove facia trim panel by releasing six screw clips, Fig. 7.

   NOTE: If vehicle is fitted with a radio, first remove radio knobs and radio surround bezel.
3. Reach behind heater controls, unplug bulb and socket from heater panel and remove wedge-type bulb, Fig. 8.

To Replace

4. Fit new bulb, reconnect bulb and socket into heater facia.
5. Position facia panel, align six screw clips, and secure by rotating clips through 90°.

   If vehicle is fitted with a radio, position radio surround and fit radio knobs.
6. Test operation of bulb.

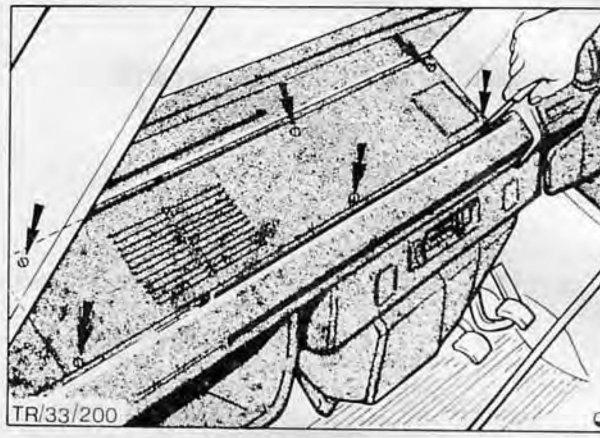


Fig. 7. Release facia trim panel by rotating six screws (arrowed) through 90°

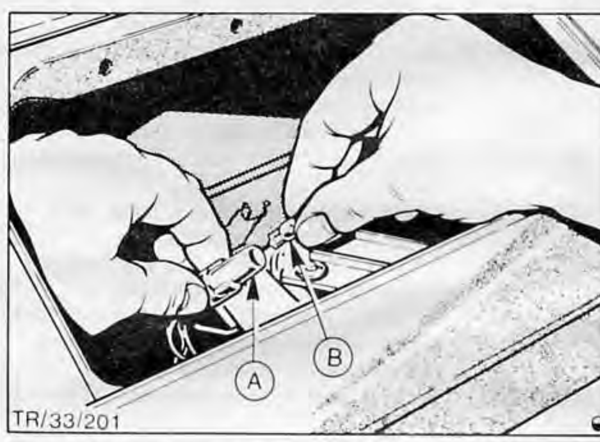


Fig. 8. Heater control light
A – Light socket
B – Bulb

33 139 BULB – BRAKE FLUID WARNING – REPLACE

Special Service Tools Required: None

To Remove

1. Ensure vehicle ignition is switched off.
2. Using a soft cloth or a wad of paper, cover instrument cluster bezel area immediately below switch location.
3. Using a small electrical screwdriver, pivoting on protective material, prise warning light panel from its bezel location, Fig. 9.

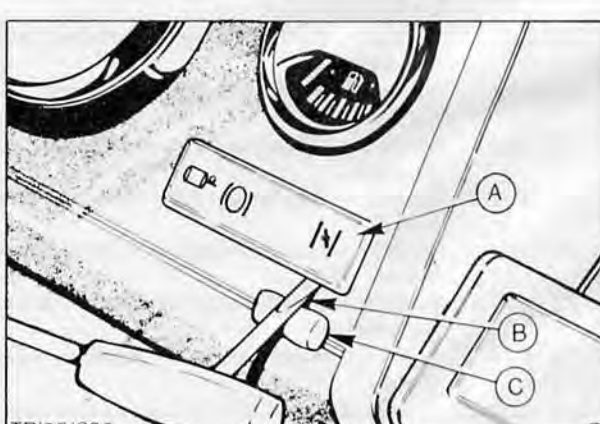


Fig. 9. Removing warning lamp panel
A – Warning lamp panel
B – Screwdriver
C – Protective wad

PART 'A'

4. Unplug applicable bulb socket and remove wedge-type bulb, Fig. 10.

To Replace

5. Fit new bulb and plug socket into warning light panel.
6. Align warning lamp panel with bezel aperture and clip into position.

Fig. 10. Unplug warning lamp body complete with bulbs

33 152 LAMP – ENGINE COMPARTMENT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Unplug bayonet-type bulb from its socket, Fig. 11.
3. Disconnect wire from engine compartment loom, and unthread from hood panel strengthening struts.
4. Unscrew single retaining screw and detach lamp body.

To Install

5. Position lamp to hood panel, Fig. 12, and secure with single retaining screw.
6. Thread wire behind hood panel strengthening struts and connect to loom.
7. Plug bulb in its socket.
8. Reconnect battery, remove fender covers and close hood.

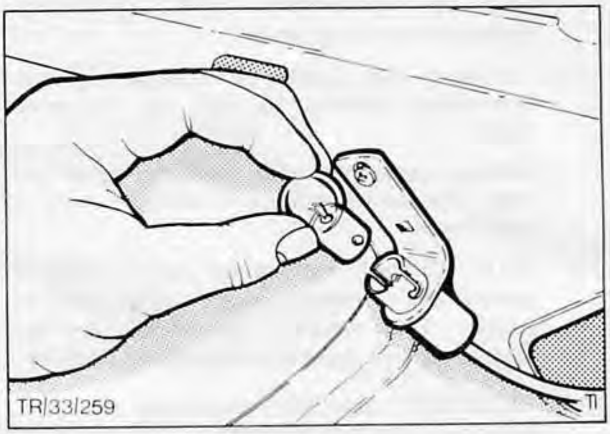


Fig. 11. Removing bulb

33 214 INSTRUMENT CLUSTER ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Unscrew single retaining screw and remove steering column upper shroud.
3. Remove two securing screws and lift instrument housing shroud from its location, on facia panel.

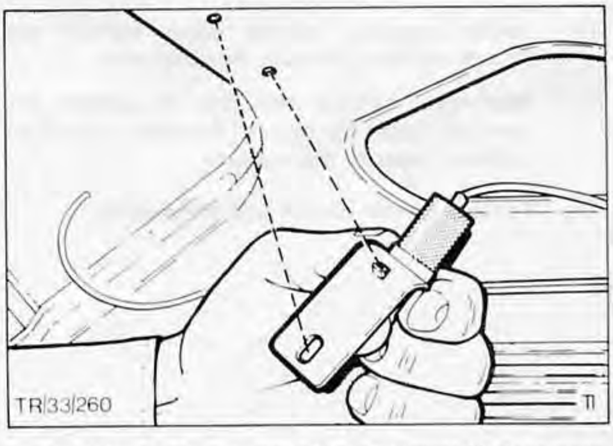


Fig. 12. Align locating peg in hole and elongated hole to screw hole

PART 'A'

4. Unscrew four instrument housing securing screws, and lift instrument housing to separate from facia panel.
5. Disconnect auxiliary switches from main loom at multi-plugs located at back of switches, Fig. 13.
6. Where applicable unplug warning lights from their sockets in auxiliary warning light panel.
7. Disconnect two multi-plugs where they connect to instrument cluster, Fig. 14.
8. Disconnect speedometer drive cable by depressing outer sleeve and releasing retaining peg, Fig. 15. Guide instrument cluster housing, complete with switches and auxiliary warning light panel (where applicable) clear of facia panel.

To Install

9. Approximately position instrument cluster housing assembly and reconnect speedometer drive cable.
10. Connect two loom multi-plugs to their respective sockets in rear of instrument cluster.
11. Where applicable plug warning lights into their respective sockets in auxiliary warning light panel.

    NOTE: The bulb sockets are colour coded to correspond to matching paint spots on lamp bodies. This ensures that bulbs are not accidentally plugged into the wrong sockets.
12. Reconnect auxiliary switches to their respective loom multi-plugs.
13. Align instrument housing assembly to facia panel and secure with four cross-head screws.
14. Position instrument housing shroud and secure with two cross-head screws.
15. Locate steering column upper shroud and secure with single cross-head screws.
16. Reconnect battery and test all gauges and warning lights for correct function. If a clock is fitted, reset to correct time.
17. Remove fender covers and close hood.

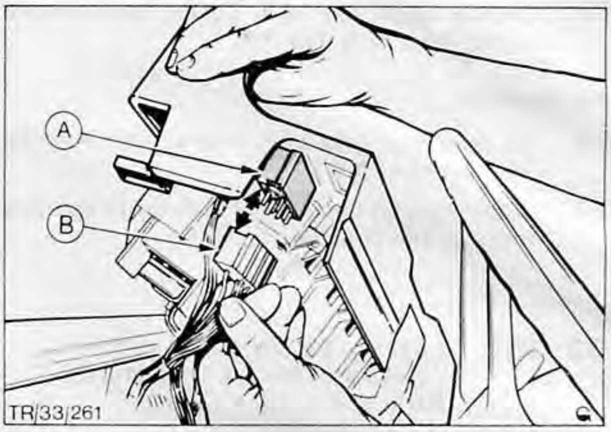


Fig. 13. Disconnecting switches
A – Switch
B – Multi-plug

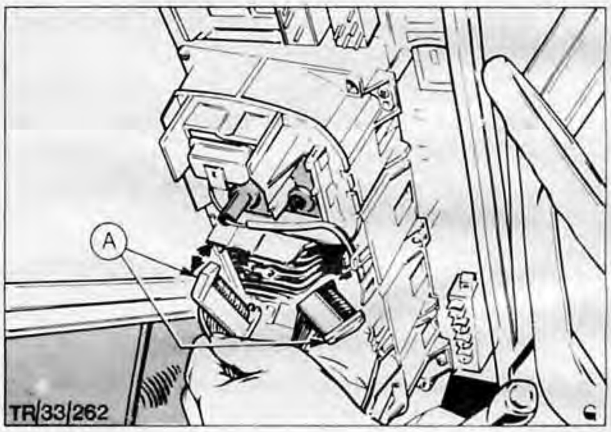


Fig. 14. Disconnecting multi-plugs
A – Two multi-plugs

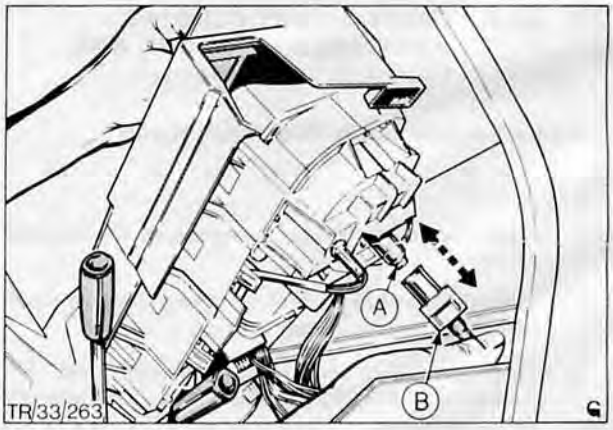


Fig. 15. Disconnecting speedo cable
A – Speedometer
B – Retaining peg (sleeve)

PART 'A'

33 214 INSTRUMENT CLUSTER ASSEMBLY – REMOVE AND INSTALL (Variants fitted with a tachograph)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Unscrew single retaining screw and remove steering column upper shroud.
3. Remove two securing screws, Fig. 14, and lift instrument housing shroud from its location, on facia panel.
4. Unscrew four instrument housing securing screws, Fig. 15, and lift instrument housing to separate from facia panel.
5. Disconnect auxiliary switches from main loom at multi-plugs located at back of switches.
6. Unplug warning lights from their sockets in warning light panels.
7. Disconnect three wires and illumination bulb/socket from fuel gauge.
8. Disconnect two wires from voltage regulator.
9. Disconnect two wires and illumination bulb/socket from temperature gauge.
10. Guide instrument cluster housing, complete with switches, warning light bodies and auxiliary instruments, clear of facia panel, Fig. 18.

To Install

11. Approximately position instrument housing assembly and reconnect three fuel gauge wires and illumination bulb/socket.
12. Reconnect two wires to voltage regulator.
13. Reconnect two temperature gauge wires and illumination bulb/socket.
14. Plug warning lights into their respective sockets in warning lamp cluster.

    NOTE: The bulb sockets are different colours to correspond to matching paint spots on lamp bodies. This ensures that bulbs are not accidentally plugged into the wrong sockets.
15. Connect auxiliary switches to their respective multi-plugs on main loom.
16. Align instrument housing assembly to facia panel and secure with four cross-head screws.
17. Position instrument housing shroud and secure with two cross-head screws.
18. Locate steering column upper shroud and secure with single cross-head screw.
19. Reconnect battery and test all gauges and warning lights for correct function.
20. Remove fender covers and close hood.

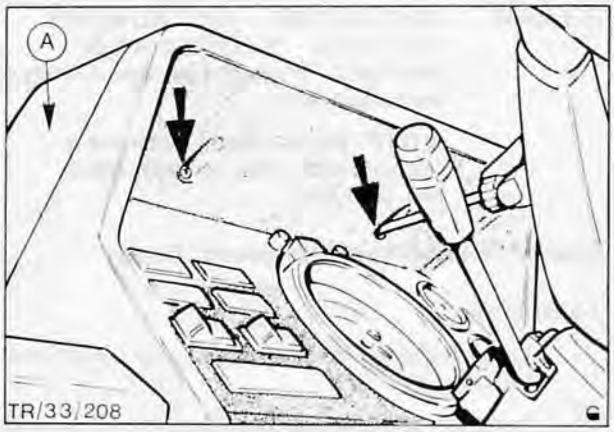


Fig. 16. Removing housing shroud. Retaining screws arrowed
A – Shroud

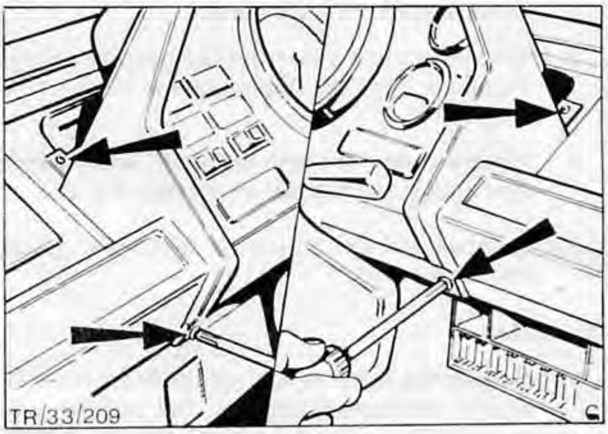


Fig. 17. Instrument housing removal
Securing screws are arrowed

Fig. 18. Guide housing assembly from facia panel

PART 'A'

33 244 REGULATOR – INSTRUMENT VOLTAGE – REMOVE AND INSTALL (Variants equiped with a tachograph)

NOTE: For variants without a tachograph refer to Operation No. 33–224

Special Service Tools Required: None

To Remove

1. Open hood fit fender covers and disconnect battery.
2. Unscrew single cross-head screw and remove upper steering column shroud.
3. Unscrew and detach instrument cluster shroud.
4. Unscrew four instrument housing securing screws and carefully lift instrument housing to separate from facia panel.
5. Disconnect wires from fuel gauge and voltage regulator, Fig. 19. Unplug gauge illumination socket.
6. Unscrew two knurled fasteners and remove fuel gauge and bracket from facia, Fig. 20.
7. Remove voltage regulator from fuel gauge retaining bracket.

To Install

8. Secure regulator to fuel gauge bracket using screw, shakeproof washer, flat washer and nut, Fig. 21.
9. Assemble gauge in facia and secure with bracket and two knurled fasteners.
10. Reconnect two wires to voltage regulator and three wires to fuel gauge. Plug in fuel gauge illumination socket.
11. Align instrument housing assembly and secure with four cross-head screws.
12. Position instrument housing shroud and secure with two screws.
13. Position steering column upper shroud and secure with single screw.
14. Reconnect battery, remove fender covers and close hood.

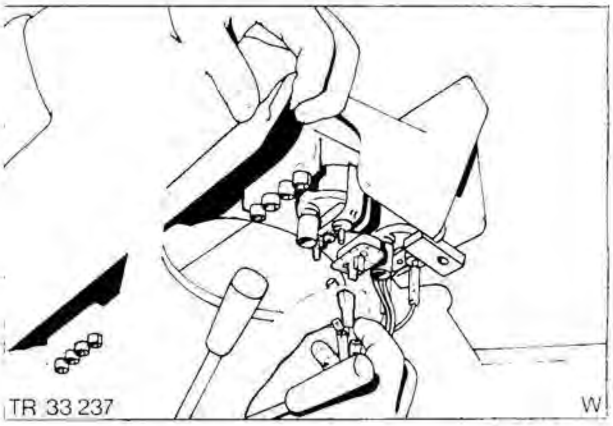


Fig. 19. Disconnecting wires from fuel gauge and regulator

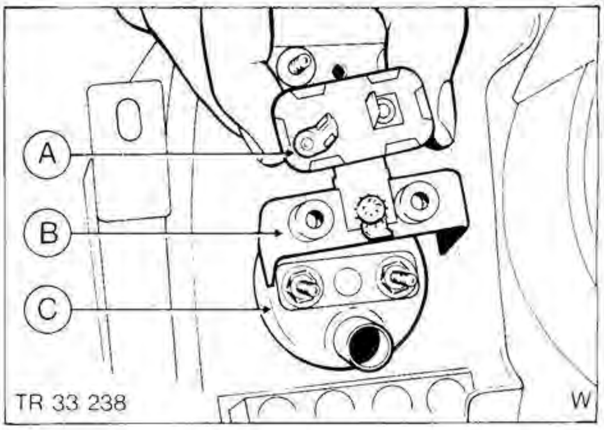


Fig. 20. Removing regulator
A – Regulator
B – Fuel gauge bracket
C – Fuel gauge

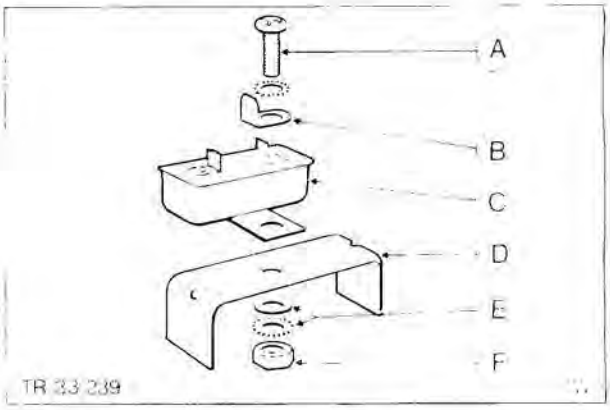


Fig. 21. Assembling regulator
A – Securing screw
B – Earth terminal
C – Regulator
D – Bracket
E – Flat and shakeproof washers
F – Securing nut

PART 'A'

33 274 TACHOGRAPH ASSEMBLY – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: Vehicles operating in territories where full tachograph legislation is in force will have seals applied at the drive cable ends. The following procedure necessitates disturbing these seals (if fitted). It is therefore, important that these seals are renewed before the vehicle is returned to service.

To Remove

1. Remove instrument cluster housing from facia panel as described in Operation No. 33–214 Sub Operations 1 to 11.
2. Unscrew four cross-head screws securing tachograph and bracket to facia panel, Fig. 22.
3. Disconnect tachograph loom at multi-plug, Fig. 23.
4. Disconnect drive cable by removing seal (where applicable), releasing collar securing key, Fig. 24, and twisting cable retaining collar anti-clockwise. Lift tachograph and bracket assembly clear of facia.

To Install

5. Connect drive cable to tachograph and lock cable retaining collar in position using collar securing key. Renew seal (where applicable).
6. Align tachograph bracket to facia panel, and secure with four cross-head screws.
7. Connect tachograph loom at multi-connector.
8. Refit instrument housing cluster to facia as described in Operation No. 33–214, Sub Operations 12 to 20.

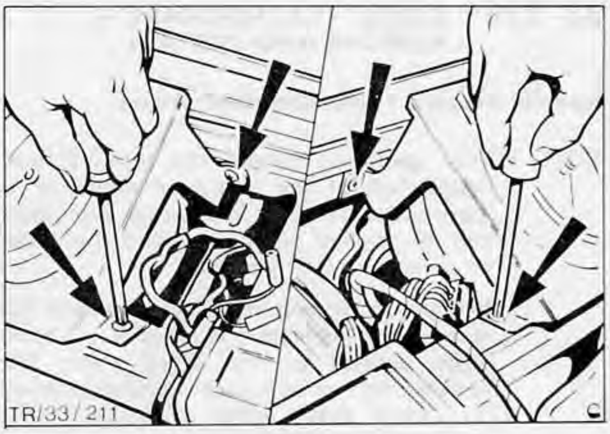


Fig. 22. Removing securing screws
Four screws are arrowed

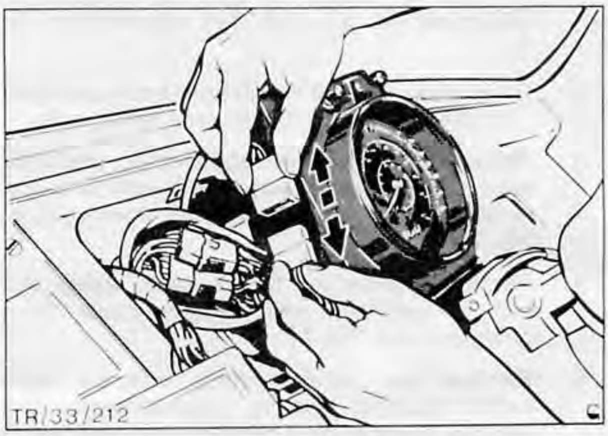


Fig. 23. Disconnect tachograph electrics at multi-plug

33 275 BULB – TACHOGRAPH ILLUMINATION – REPLACE ONE

For details on the replacement of tachograph bulbs refer to Service Adjustments and Checks on page 7.

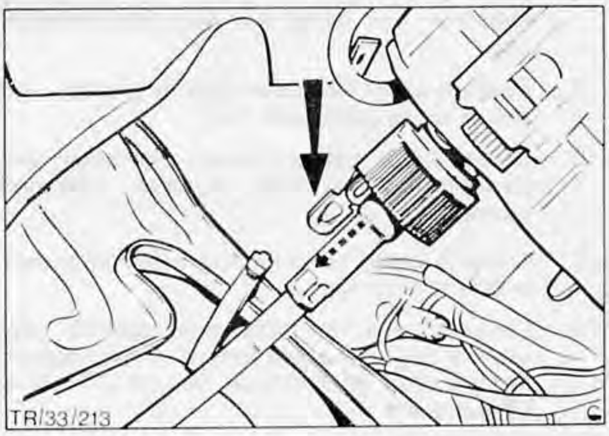


Fig. 24. Release drive cable securing collar locking key
(Key shown in 'out' position)

PART 'A'

33 276 CABLE – TACHOGRAPH – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: 1. This operation covers the removal and installation of the complete cable for a 'two-cable' system. The same principals can be applied when replacing the cable on a 'single cable' variant.

2. Vehicles operating in territories where full tachograph legislation is in force will have seals applied at the cable ends. The following procedure necessitates disturbing these seals (if fitted). It is therefore, important that these seals are renewed before the vehicle is returned to service.

To Remove

1. Remove tachograph assembly as described in Operation No. 33–274, Sub Operations 1 to 4.
2. Guide drive cable through bulk-head aperture. Remove seal (where fitted) (see note two).
3. Remove seal (where applicable), unscrew drive cable retaining nut at reduction box and remove upper section of cable from vehicle, Fig. 26.
4. Remove seal (where fitted), cable clamp and bolt at gearbox and remove cable from gearbox drive, Fig. 27.
5. Remove seal (where fitted), unscrew drive cable retaining nut at reduction box and remove lower section of cable from vehicle.

   NOTE: Lower drive cable retaining nut at reduction box has a left-hand thread.

To Install

6. Align lower section of cable and connect to reduction box using the left-hand threaded nut.
7. Position cable into drive gear in gearbox and secure using clamp and bolt.
8. Guide upper cable through bulkhead and position behind facia. Position bulkhead grommet.
9. Connect cable to reduction box and secure with retaining nut.
10. Connect cable to tachometer and fit new seals at appointed locations. Refit tachograph as described in Operation No. 33–274, Sub Operations 5 to 8.

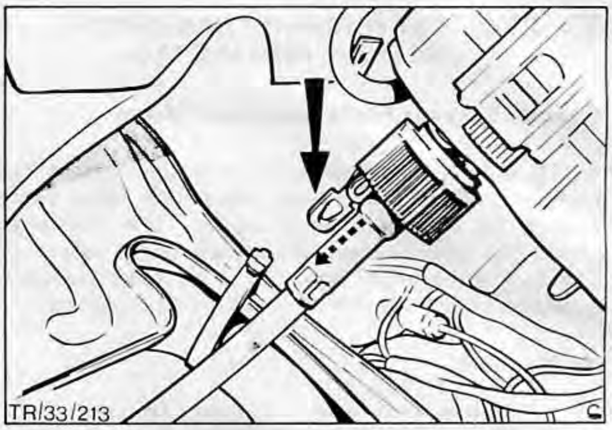


Fig. 25. Release drive cable collar securing key
(Key shown in 'out' position)

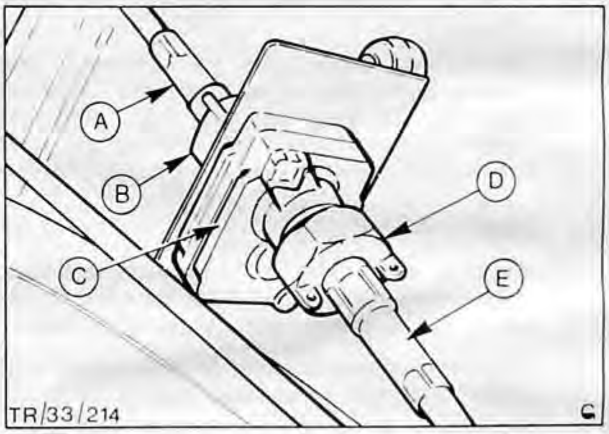


Fig. 26. Calibration box and cables
A – Upper cable
B – Cable retaining nut (right-hand thread)
C – Calibration box
D – Cable retaining nut (left-hand thread)
E – Lower cable

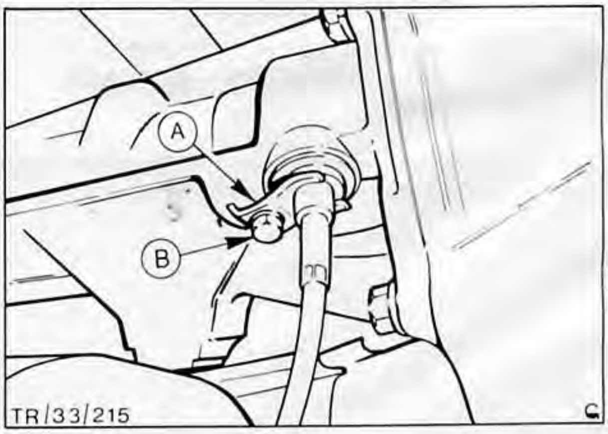


Fig. 27. Cable at gearbox end
A – Cable clamp
B – Securing bolt

PART 'A'

33 304 GAUGE – TEMPERATURE – REMOVE AND INSTALL (Variants fitted with a tachograph)

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Unscrew single retaining screw and remove steering column upper shroud.
3. Remove two securing screws and lift instrument housing shroud from its location on facia panel.
4. Disconnect two temperature gauge wires and illumination bulb/socket.
5. Remove two knurled fasteners, detach gauge retaining bracket and guide gauge from facia panel.

To Install

6. Align gauge in facia aperture and secure by fitting retaining bracket and two knurled fasteners. Fig. 28.
7. Reconnect illumination bulb/socket and two gauge wires. Fig. 29.
8. Position instrument housing shroud on facia and secure with two cross-head screws.
9. Align upper steering column shroud and secure with single cross-head screw.
10. Connect battery, remove fender covers, and close hood.

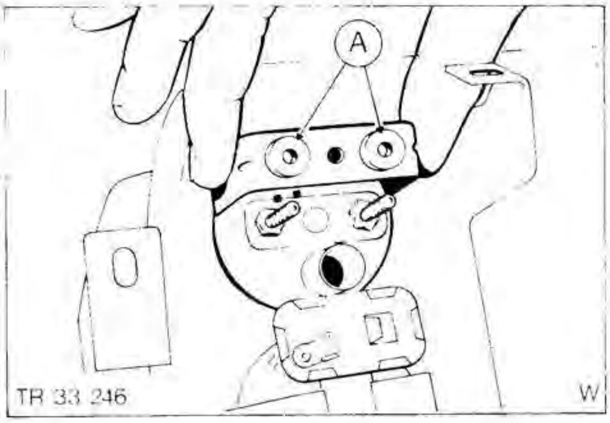


Fig. 28. Aligning guage securing bracket. Ensure plastic insulators 'A' are correctly positioned and not damaged

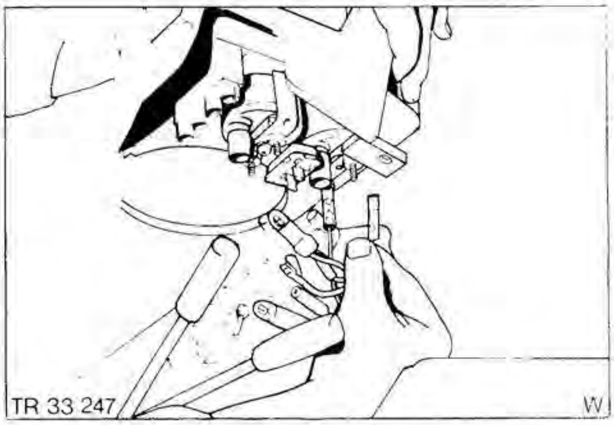


Fig. 29. Connecting wires to guage

33 307 SENDER UNIT – VACUUM WARNING LIGHT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect lead from sender unit.
3. Unscrew sender unit from servo unit. Fig. 30.

To Install

4. Screw sender unit into aperture in servo.
5. Connect wire to sender unit.
6. Reconnect battery, remove fender covers, and close hood.

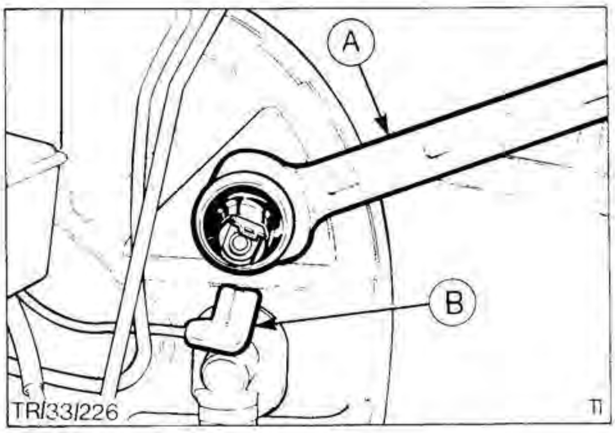


Fig. 30. Unscrew sender unit
A Spanner
B Loom connector

PART 'A'

33 512 SWITCH – IGNITION – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove single retaining screw, and detach steering column upper shroud.
3. Remove two screws and detach both lower steering column shrouds, Fig. 31.

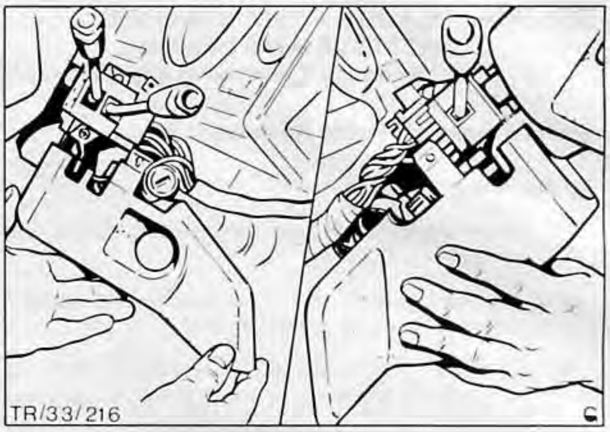


Fig. 31. Removing two lower steering column shrouds

4. Remove two bolts that secure steering column assembly to facia panel. Allow steering column to rest in a lowered position.
5. Using a suitable drift, (e.g. small chisel or pin punch), and a hammer tap out two 'shear' bolts securing ignition switch to steering column, Fig. 33.
6. Disconnect switch assembly from main loom at multi-plug.

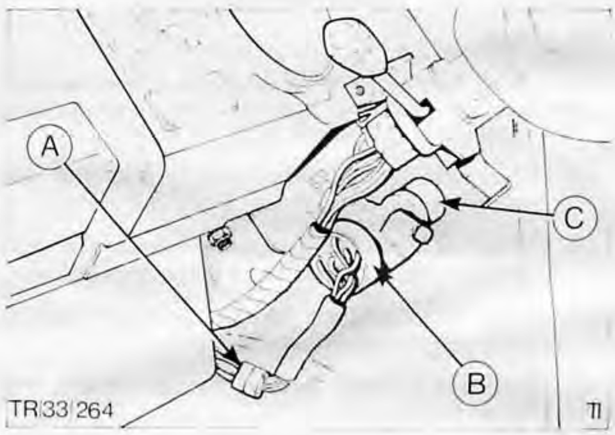


Fig. 32. Switch assembly
A – Loom multi-plug
B – Ignition switch
C – Lock barrel

To Install

7. Connect ignition switch to loom at multi-plug, Fig. 32.
8. Position switch assembly on steering column ensuring that lock part engages with steering column cut-out. Secure with two new 'Shear' bolts. Check function of lock, then tighten bolts until heads shear off.
9. Reposition steering column and secure to facia with two bolts.
10. Align left and right-hand lower sections of steering column shrouds and secure with two cross-head screws.
11. Align steering column upper shroud and secure with single cross-head screw.
12. Reconnect battery, remove fender covers and close hood.

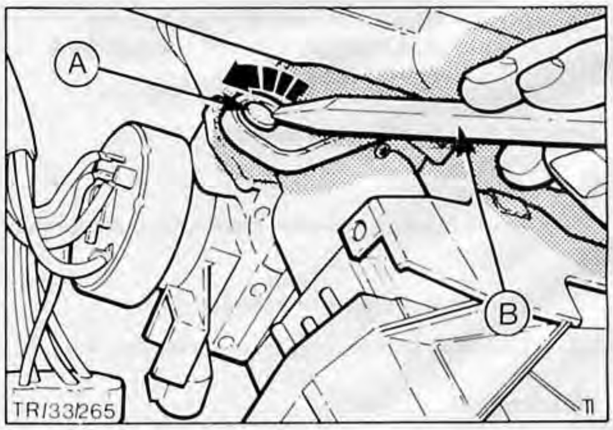


Fig. 33. Chiselling-out shear bolts to release lock
A – Shear bolt
B – Chisel

PART 'A'

33 514 SWITCH – LIGHT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Unscrew three retaining screws and remove five steering column shroud sections.
3. Remove two cross-head screws and separate direction indicator switch, light/windscreen wiper switch and steering column shroud bracket from around steering column.
4. Unplug light/windscreen wiper switch from loom, Fig. 34.

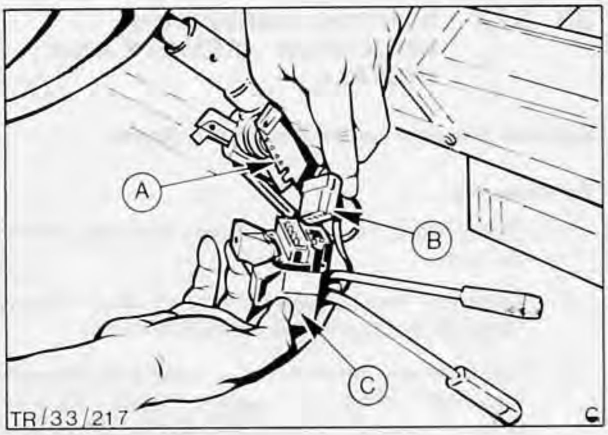


Fig. 34. Disconnecting switch
A – Multi-plug to wiper switch
B – Multi-plug to light switch
C – Switch

To Install

5. Plug switch into loom multi-plugs.
6. Align indicator switch, steering column shroud bracket, and light/windscreen wiper switch around steering column, Fig. 35, and secure with two cross-head screws.

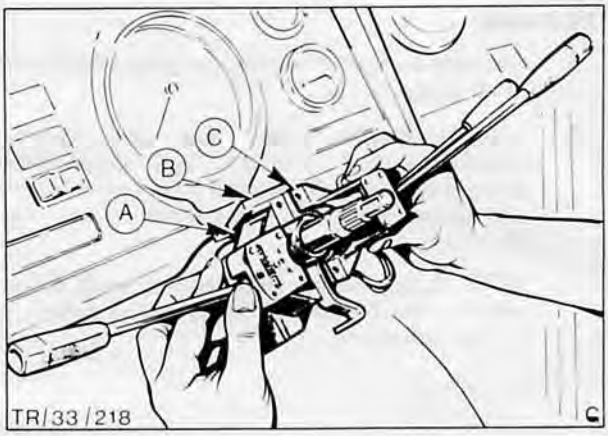


Fig. 35. Aligning switches to column
A – Multi-function switch
B – Shroud bracket
C – Wiper/light switch
NOTE: Steering wheel removed for clarity

NOTE: Lower screw also retains earth wires, which must be connected to screw before it is fully tightened, Fig. 36.

7. Align left and right-hand steering column lower shrouds and secure with four cross-head screws.
8. Align steering column upper shroud and secure with single cross-head screw.
9. Reconnect battery, remove fender covers and close hood.

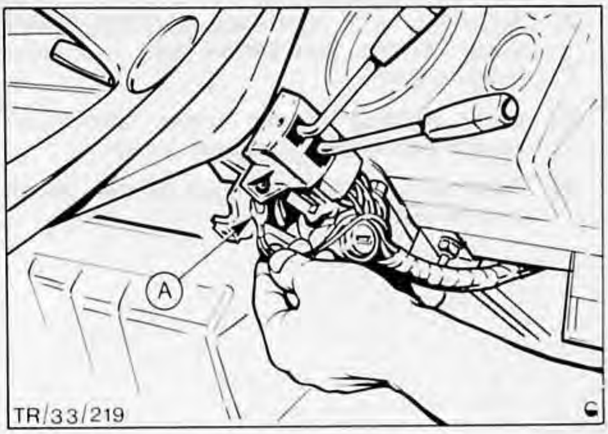


Fig. 36. Connecting earth lead
A – Earth lead

PART 'A'

33 522 SWITCH – DIRECTION INDICATOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Unscrew five retaining screws and remove three steering column shroud sections.
3. Remove two cross-head screws and separate direction indicator switch from steering column shroud bracket and light/windscreen wiper switch.
4. Unplug indicator switch from two loom plugs, Fig. 37.

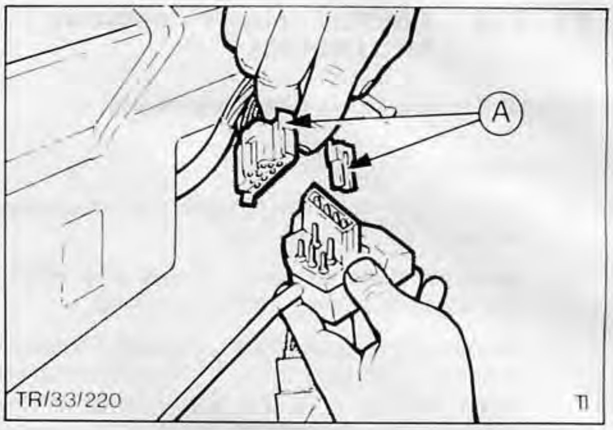


Fig. 37 Disconnecting switch
A – Two multi-plugs

To Install

5. Connect indicator switch to loom with two multi-plugs.
6. Align indicator switch, Fig. 38, steering column shroud bracket, and windscreen wiper/light switch around steering column and secure with two cross-head screws, Fig. 39.

   NOTE: Lower screw also retains earth wires, which must be connected to screw before it is fully tightened.

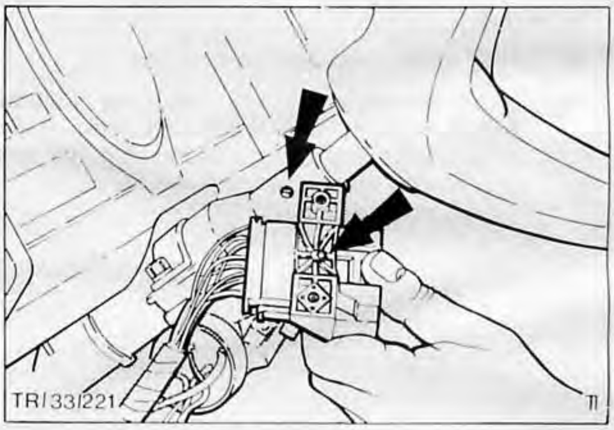


Fig. 38. Peg (arrowed) on switch locates in hole in steering column (arrowed)

7. Align left and right-hand steering column lower shrouds and secure with four cross-head screws.
8. Align steering column upper shroud and secure with single cross-head screw.
9. Reconnect battery, remove fender covers, and close hood.

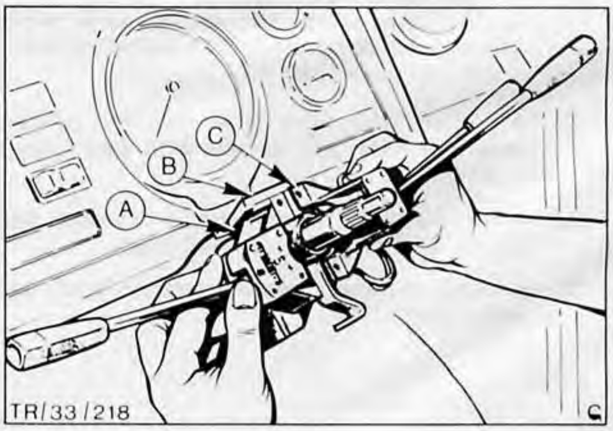


Fig. 39 Aligning switches to column
A Multi-function switch
B Shroud bracket
C Wiper/light switch
NOTE: Steering wheel removed for clarity

PART 'A'

33 575 SWITCH – TEMPERATURE SENSING – EXCESS FUEL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect loom and unscrew switch from cylinger block, Fig. 40.

   NOTE: The switch is not fitted into a water gallery, therefore there is no requirement to drain cooling system.

To Install

4. Fit switch into cylinder, tighten and reconnect loom.
5. Reconnect battery.
6. Remove fender covers and close hood.

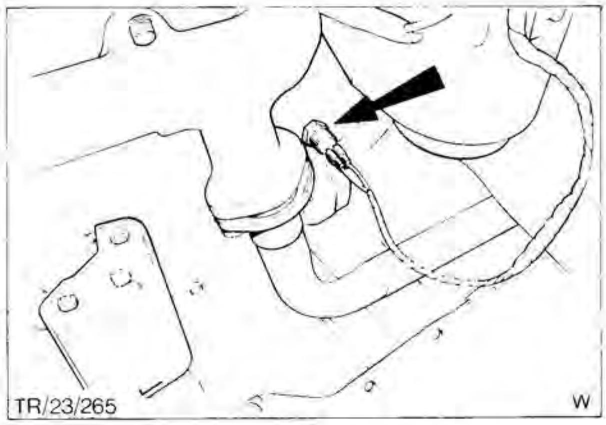


Fig. 40. Excess fuel temperature sensing switch

33 576 SWITCH – ENGINE STOP CONTROL MOTOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove engine stop control motor as described in Operation No. 32–882, Sub Operations 2–4.
3. Remove two screws, nuts and spring washers and plastic dirt guard and detach switch from mounting bracket, Fig. 40A.
4. Disconnect switch from loom at multi-plug, Fig. 41.

To Install

5. Connect switch to loom at multi-plug.
6. Align switch and dirt guard to mounting bracket and secure with two screws, spring washers and nuts.

   NOTE: Care should be taken not to over-tighten screws as this could crack plastic switch body.

7. Refit engine stop control motor as described in Operation No. 32–882, Sub Operations 5 and 6.
8. Reconnect battery, remove fender covers and close hood.

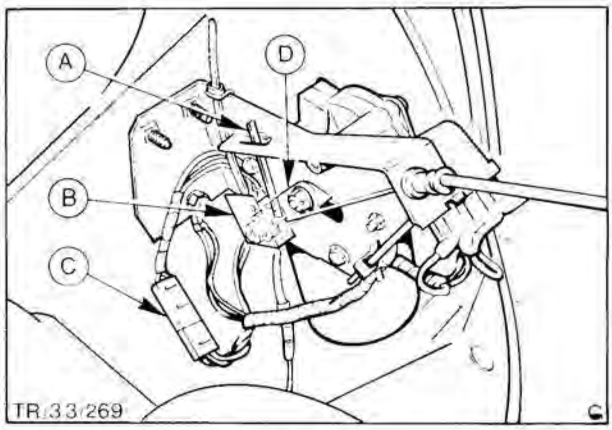


Fig. 40A. Detaching switch from mounting bracket
A – Switch operating lever
B – Plastic dirt guard
C – Loom plug
D – Actuating arm

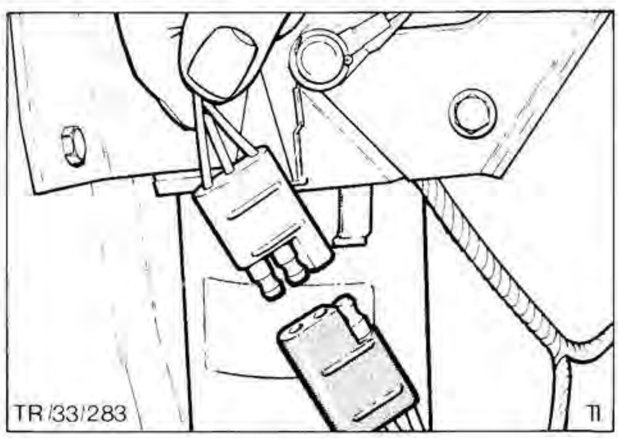


Fig. 41. Disconnecting loom plug

PART 'A'

33 601 TIMER – GLOW-PLUG – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove two securing screws and detach timer and protective shield from battery tray, Fig. 42.
3. Disconnect timer from loom.

To Install

4. Connect timer to loom with multi-plug.
5. Secure timer and protective shield to battery tray with two screws.
6. Re-connect battery remove fender covers and close hood.

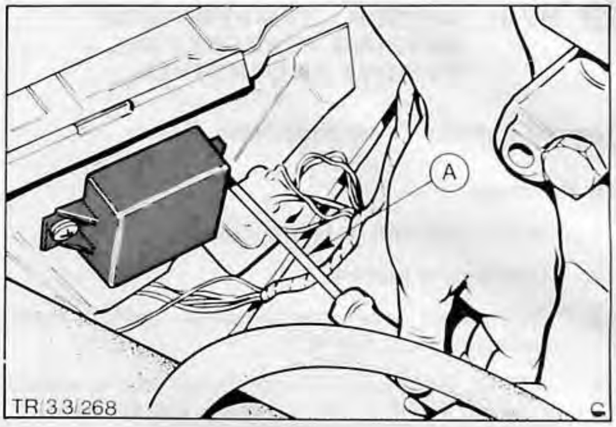


Fig. 42. Removing timer
A – Screwdriver

33 602 SWITCH – TEMPERATURE SENSING – GLOW-PLUG CONTROL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect loom and unscrew switch from cylinder head, Fig. 42A.

   NOTE: The switch is not fitted into a water gallery, therefore there is no requirement to drain the cooling system.

To Install

4. Fit switch into head, secure and reconnect loom.
5. Reconnect battery.
6. Remove fender covers and close hood.

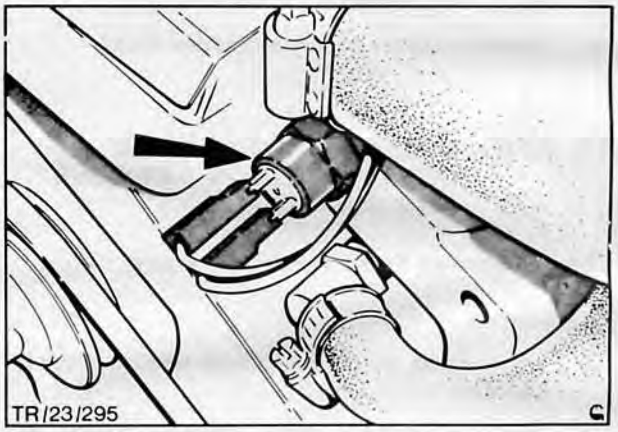


Fig. 42A. Glow Plug temperature sensing switch

PART 'A'

33 722 RELAY – INDICATOR FLASHER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Unclip relay from its location under facia panel, above hood release, Figs. 44 and 45.
3. Unplug relay from loom.

To Install

4. Plug relay onto loom multi-plug.
5. Clip relay to side panel under facia.
6. Reconnect battery, remove fender covers and close hood.

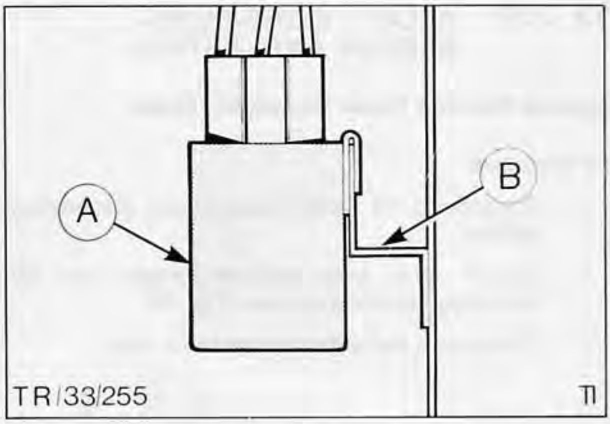


Fig. 43. Relay mounting
A – Relay
B – Cowl side panel

33 724 RELAY – INHIBITOR SWITCH – AUTOMATIC TRANSMISSION – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Detach relay from its location on underside of battery tray by removing single cross head screw.
3. Disconnect relay from loom.

To Install

4. Connect relay to loom.
5. Secure relay in position on battery tray using retaining screw.
6. Reconnect battery, remove fender covers, and close hood.

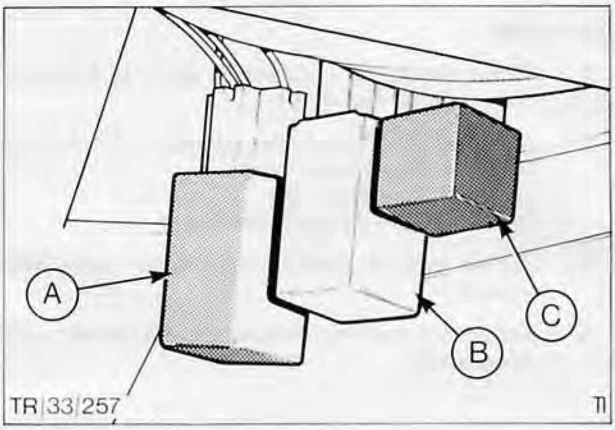


Fig. 44. Relay location
A – Direction indicator/Hazard flasher
B – Intermittent wiper relay
C – Heated rear screen relay (where relay fitted)

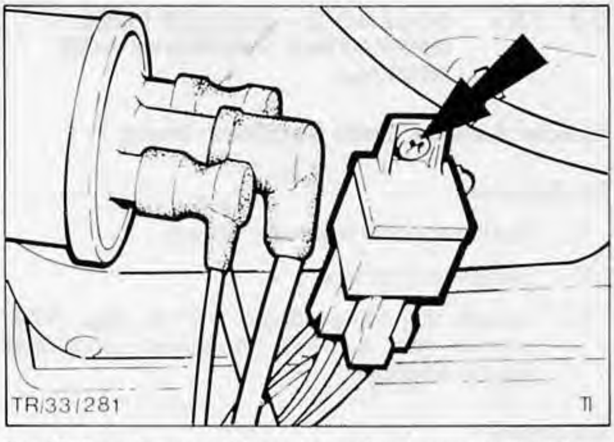


Fig. 45. Relay is secured by one cross head screw (arrowed)

PART 'A'

33 727 RELAY – GLOW-PLUG – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Detach relay from vehicle battery tray by removing securing screws, Fig. 46.
3. Disconnect individual wires from relay.

Fig. 46. The glow-plug relay location

To Install

4. Wires should be connect to relay as follows; (also refer to Fig. 47).

   Terminal 85 – Two brown wires
   Terminal 86 – Green wire
   Terminal 30 – Red wire
   Terminal G – Black/Brown wire
5. Secure relay in position on vehicle using two screws.
6. Reconnect battery, remove fender covers and close hood.

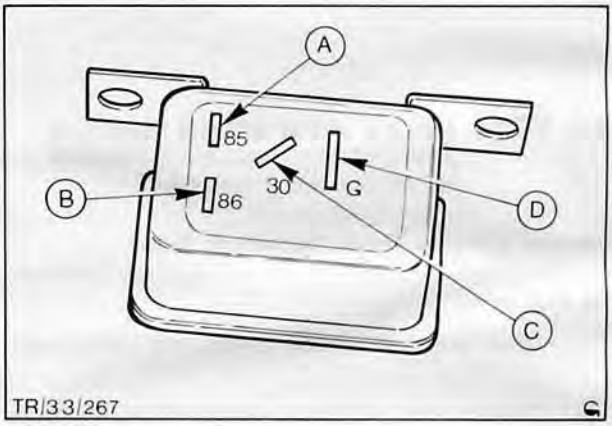


Fig. 47. Glow-plug relay connections
A – Twin brown C – Red
B – Green D – Black/Brown

33 757 SOLENOID – EXCESS FUEL OPERATING – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Loosen adjusting clamp, 'C' in Fig. 47A, remove two screws, disconnect loom and detach solenoid.

To Install

4. Place solenoid in position and secure two screws.

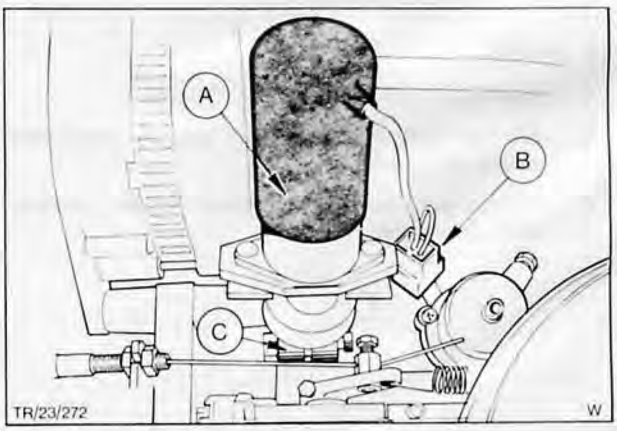


Fig. 47A. Excess fuel operating solenoid
A – Solenoid
B – Loom connection
C – Adjusting clamp

PART 'A'

5. Adjust solenoid control rod as follows, Fig. 47B.
   (a) Position a wedge of wood between mounting bracket and fuel button operating level, so excess fuel button is FULLY ENGAGED.
   (b) Fully engage solenoid by pushing control rod 'B' in Fig. 47B, upwards as far as possible.
   (c) Secure the control rod adjusting clamp and release wedge.
6. Reconnect loom to switch.
7. Ensure linkage is free to return to 'off' position.
8. Reconnect battery.
9. Remove fender covers and close hood.

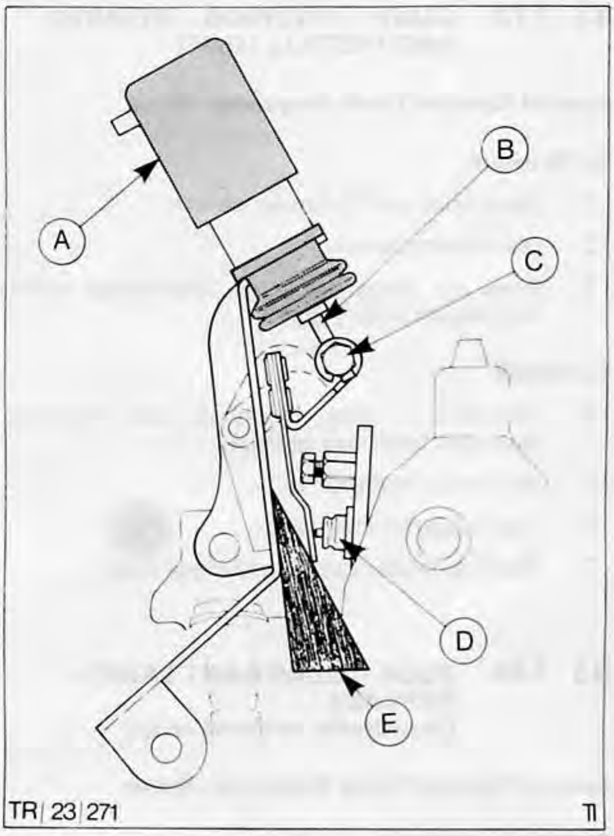


Fig. 47B. Excess fuel solenoid adjustment
A – Solenoid
B – Control rod
C – Adjusting clamp
D – Excess fuel button
E – Adjustment wedge

33 762 RELAY – ENGINE STOP CONTROL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect wiring loom spade connectors from relay.
3. Remove two relay securing screws, nuts, flat and shakeproof washers, and detach relay from bracket assembly.

To Install

4. Position relay on bracket and secure with two screws, nuts, flat and shakeproof washers.
5. Reconnect loom spade connectors to relay as follows, (also refer to Fig. 48).

   A – Black
   B – Brown
   C – Green
   D – Blue
   E – Yellow

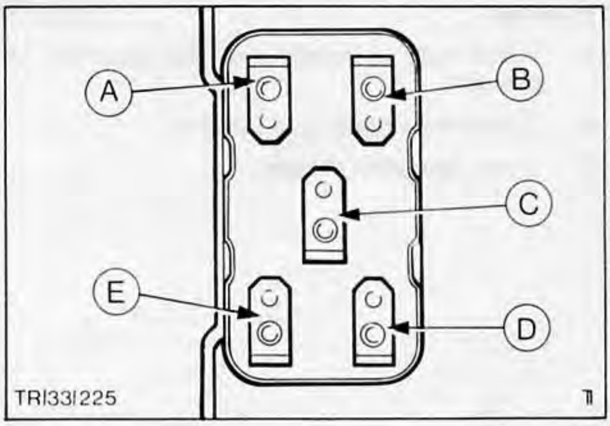


Fig. 48. Relay connections
A – Black
B – Brown
C – Green
D – Blue
E – Yellow

SERVICE AND REPAIR OPERATIONS – CONTENT 'B'

33 112 LAMP – INTERIOR – REMOVE AND INSTALL (ONE)

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Prise out lamp assembly, disconnect loom and detach bulb, Fig. 49.

To Install

4. Refit bulb to lamp, reconnect loom and clip assembly back into position.
5. Reconnect battery.
6. Check operation of lamp.
7. Remove fender covers and close hood.

Fig. 49. Interior lamp removal

33 134 BULB – QUADRANT LAMP – REPLACE (Automatic variants only)

Special Service Tools Required: None

To Remove

1. Unclip selector housing and lift clear of selector mechanism, Fig. 50.
2. Slide out bulb holder from base of selector lever and detach bulb from holder, Fig. 51.

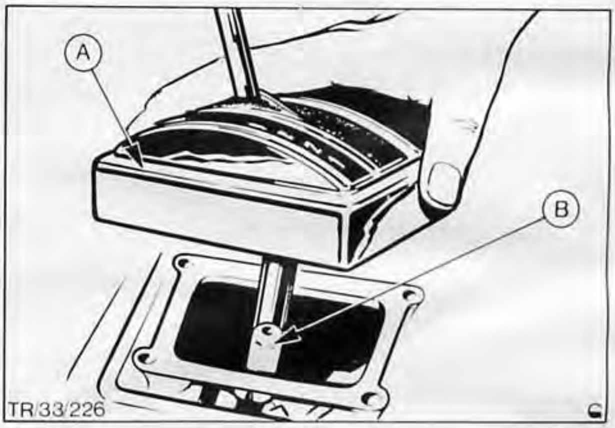


Fig. 50. Removal of selector housing
A – Selector housing
B – Quadrant lamp

To Install

3. Install bulb to holder and clip assembly in position.
4. Clip selector housing in position.
5. Check operation of bulb.

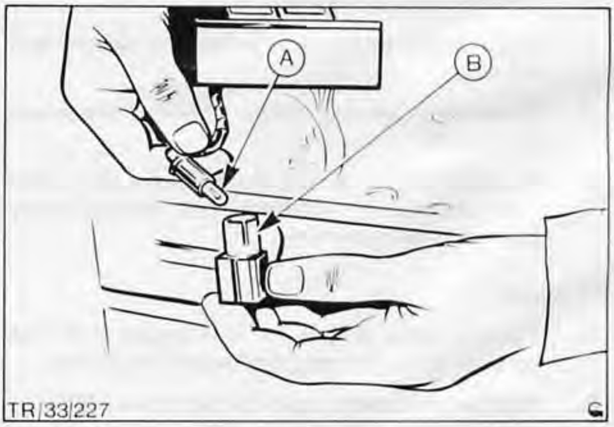


Fig. 51. Removal of quadrant bulb
A – Quadrant bulb
B – Quadrant bulb housing

PART 'B'

33 144 BULB – HEATED REAR WINDOW WARNING LIGHT – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood fit fender covers and disconnect battery.
2. Using a soft cloth or a wad of paper, cover instrument cluster bezel area immediately below switch location.
3. Using a small electrical screwdriver, pivoting on protective material, prise switch from its bezel location, Fig. 52.
4. Detach multi-plug and bulb and remove switch. Unplug bulb, Fig. 53.

   NOTE: Bulb is push fit into socket, do not twist to remove.

To Replace

5. Fit new bulb into holder.
6. Insert bulb holder into switch body, Fig. 53, connect loom connectors to rear of switch.
7. Position switch in bezel aperture and push home to secure.
8. Reconnect battery, and check switch for correct function. Remove fender covers and close hood.

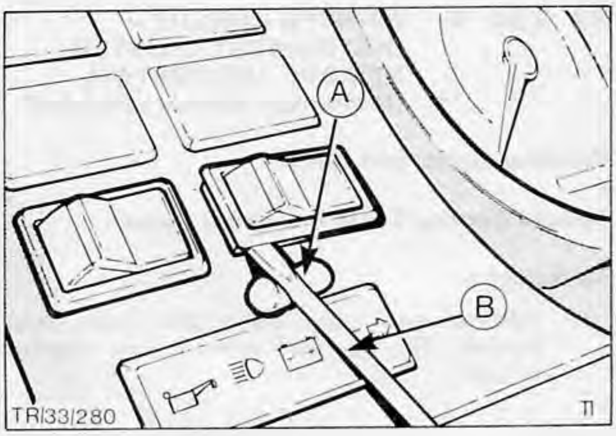


Fig. 52. Removing switch
A – Protective material
B – Screwdriver

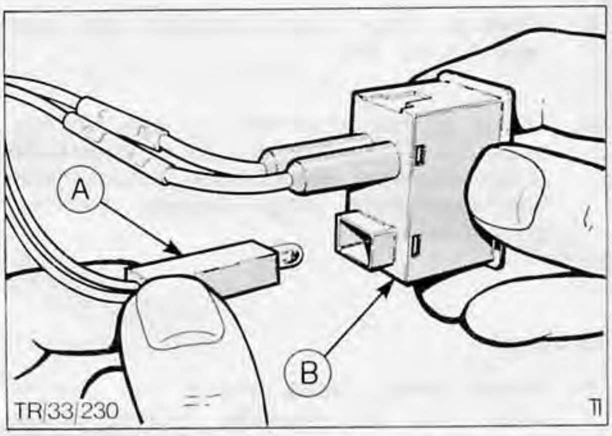


Fig. 53. Removing bulb and holder
A – Bulb holder
B – Switch body

33 146 BULB – HAZARD WARNING – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers, and disconnect battery.
2. Using a soft cloth or a wad of paper, cover instrument cluster bezel area immediately below switch location, Fig. 54.
3. Using a small electrical screwdriver, pivoting on protective material, prise switch from its bezel location.
4. Detach multi-plug and remove switch.
5. Carefully prise bulb holder and bulb from rear of switch, Fig. 53. Pull bulb out of socket.

   NOTE: Bulb is a push fit into socket, do not twist to remove.

To Replace

6. Fit new bulb into holder.
7. Insert bulb holder in switch body, connect loom multi-plug to rear of switch.
8. Position switch in bezel aperture and push home to secure.
9. Reconnect battery and check switch for correct function. Remove fender covers and close hood.

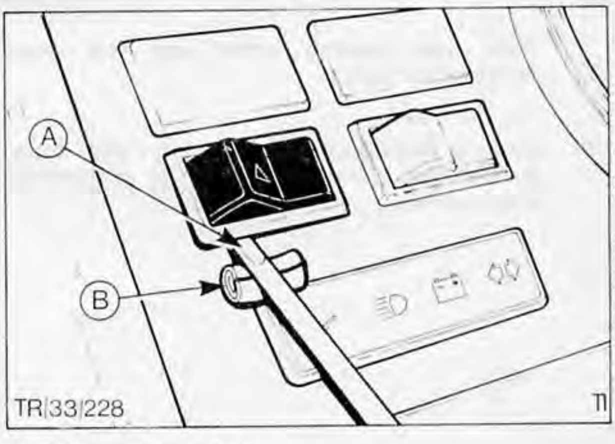


Fig. 54. Removing switch
A – Screwdriver
B – Protecting wadding

PART 'B'

33 224 4 PRINTED CIRCUIT – INSTRUMENT CLUSTER – REMOVE AND INSTALL (Instrument cluster removed)

Warning Lights and Clock

Special Service Tools Required: None

To Remove

1. Remove two clock illumination bulbs and holders, Fig. 55. Also remove five warning lamps.

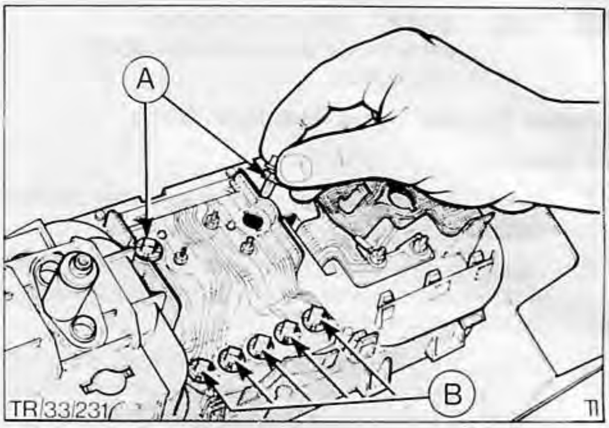


Fig. 55. Removing bulbs
A – Illuminating bulbs
B – Warning lights

2. Slacken off, but do not remove four screws securing fuel/temperature gauge housing and four screws securing speedometer housing to instrument cluster body.

3. Unscrew three clock retaining nuts and washers, Fig. 56.

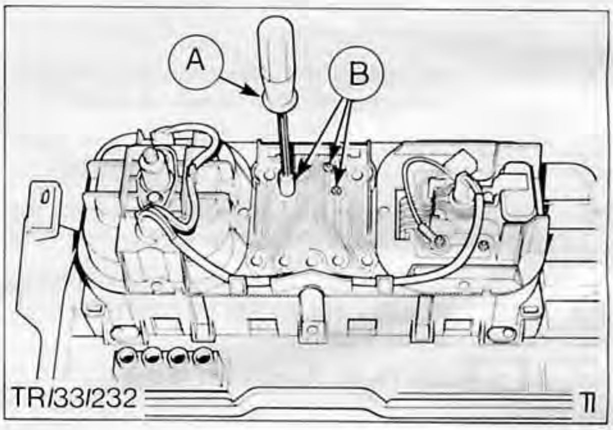


Fig. 56. Removing clock retaining nuts
A – Socket spanner
B – Securing nuts

4. Unpeg printed circuit from its four locating pegs, Fig. 57, carefully untucking circuit from under edges of speedometer housing and fuel/temperature gauge housing. Remove printed circuit.

To Install

5. Locate printed circuit onto its four locating pegs, Fig. 57, carefully tucking circuit underneath speedometer housing and fuel/temperature gauge housing where printed circuit overlaps housings.

6. Secure clock with three nuts and washers.

7. Refit five warning lamps and two clock illumination lamps.

8. Secure speedometer housing and fuel/temperature gauge housing by tightening eight screws.

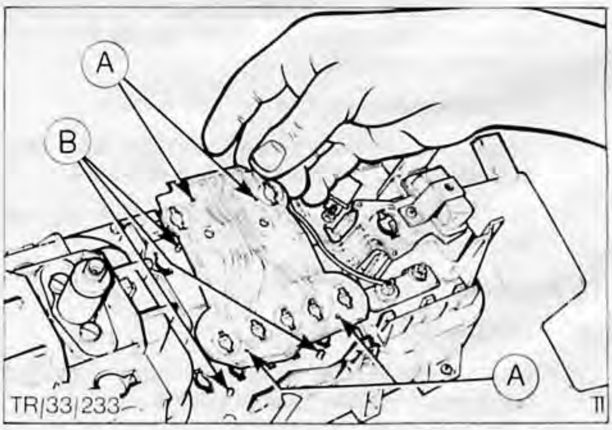


Fig. 57. Locating printed circuit
A – Locating holes
B – Locating pegs (three of the four pegs shown, fourth peg obscured)

PART 'B'

33 226 4 GLASS – INSTRUMENT CLUSTER – REPLACE

Special Service Tools Required: None

To Remove

1. Remove instrument cluster housing assembly as described in Operation No. 33–214, Sub-Operations 1 to 8.

2. Remove instrument cluster assembly from bezel surround by removing six screws.

3. On variants fitted with a clock mounted in instrument cluster unscrew the clock adjuster knob and remove, Fig. 58.

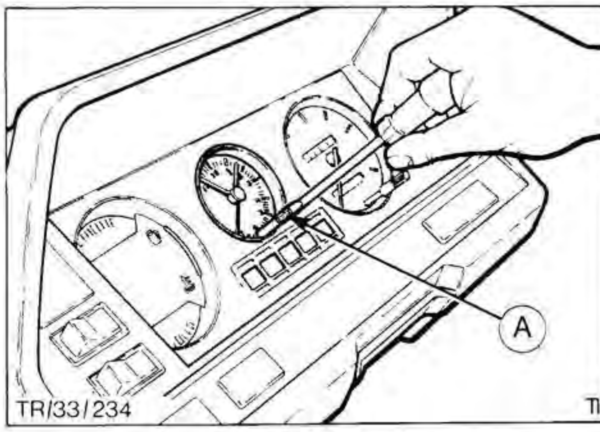


Fig. 58. Removing clock knob (where fitted)
A – Knob

4. Remove two cross-head screws, securing glass to upper edge of instrument cluster, Fig. 59.

5. Prise two clips off lower edge lugs and lift glass from cluster body.

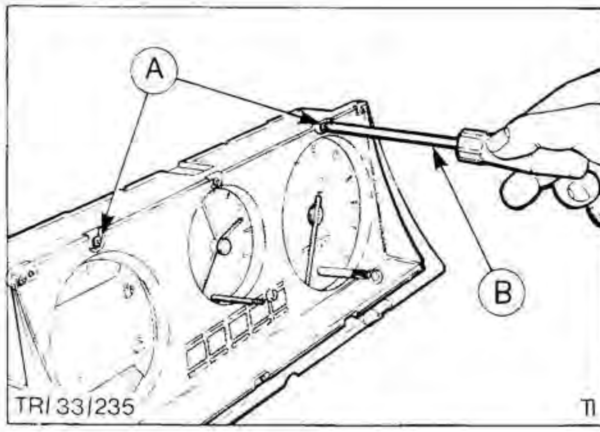


Fig. 59. Removing glass securing screws
A – Screws
B – Screwdriver

To Install

6. Replace glass positioning it on cluster housing so two locating pegs on upper corners of cluster body insert through glass. Fig. 60. Locate lugs on lower edge of glass so that they engage cut-outs in housing body.

7. Secure glass to housing body with two cross-head screws along upper edge, Fig. 59, and press on two clips on lower edge.

   If a clock is fitted in instrument cluster locate clock adjustment knob and secure with screws.

8. Replace instrument cluster assembly to bezel and secure with six screws.

9. Refit instrument cluster and panel to vehicle, as described in Operation No. 33–214, Sub Operation 9 to 17.

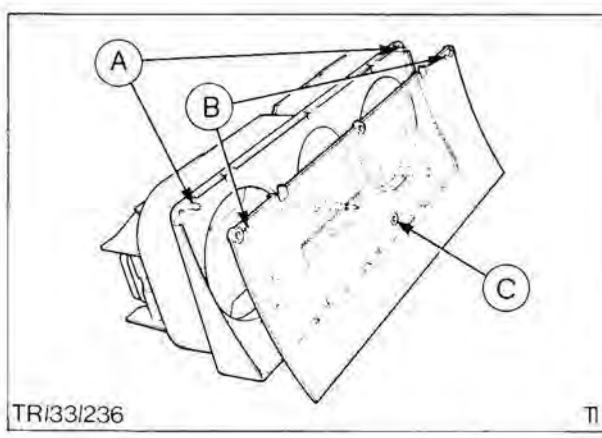


Fig. 60. Aligning glass
A – Locating pegs
B – Locating holes
C – Hole for clock shaft (where fitted)

PART 'B'

33 254 HEAD – SPEEDOMETER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 1 to 8.

2. Remove four cross-head screws securing speedometer head and housing to instrument cluster body.

3. Disconnect two speedometer illumination bulbs and holders. Unclip wiring loom from speedometer housing, Fig. 51.

4. Unscrew two slot headed screws retaining speedometer unit to housing, Fig. 62, Remove speedometer unit, gasket and two grommets

To Install

5. Position gasket and speedometer head to housing and secure in position with two slot headed screws and grommets, Fig. 62.

6. Align speedometer and housing to instrument cluster body, Fig. 63, and secure using four cross-head screws.

7. Reconnect speedometer illumination bulbs and holders, clip wiring loom back into position.

8. Refit instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 9 to 17.

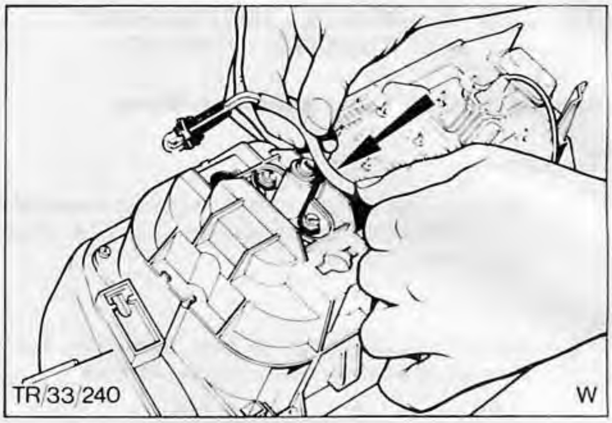


Fig. 61. Unclipping loom from housing. Clip position arrowed

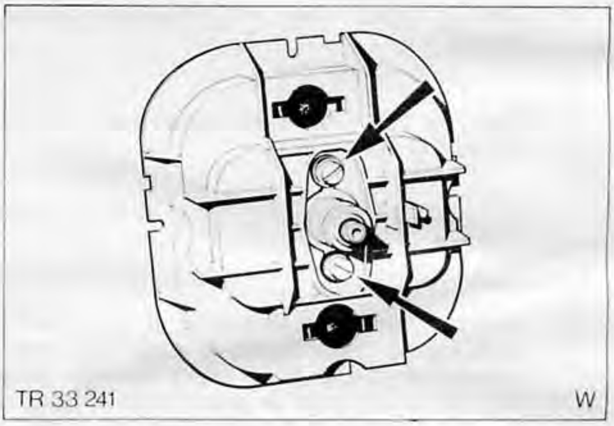


Fig. 62. Speedo unit to housing screws (arrowed)

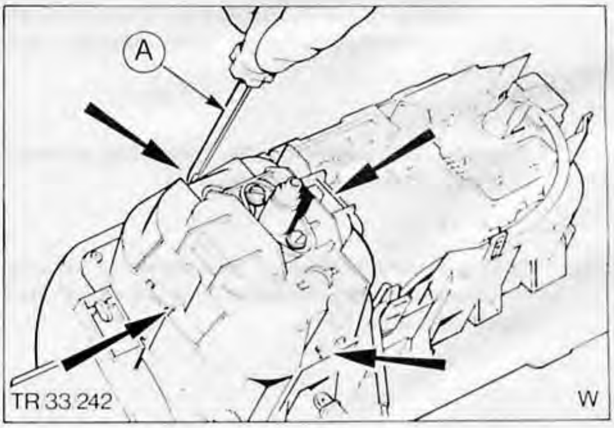


Fig. 63. Securing speedo housing
A – Screwdriver
Screw locations arrowed

PART 'B'

33 256 CABLE – SPEEDOMETER INNER AND OUTER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 1 to 8.

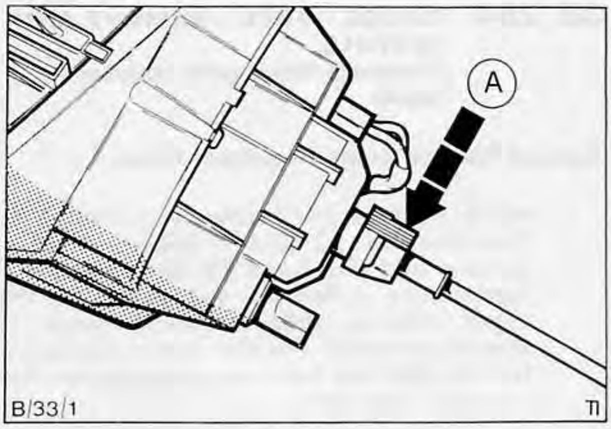


Fig. 64. Disconnect speedo by depressing grooved section in direction of arrow 'A'

2. Jack up front of vehicle and fit axle stands.

   Remove bolt and spring washer securing cable retaining clamp to gearbox, remove clamp and speedometer drive cable from gearbox, Fig. 65.

   Pull cable through bulkhead panel and remove from engine compartment.

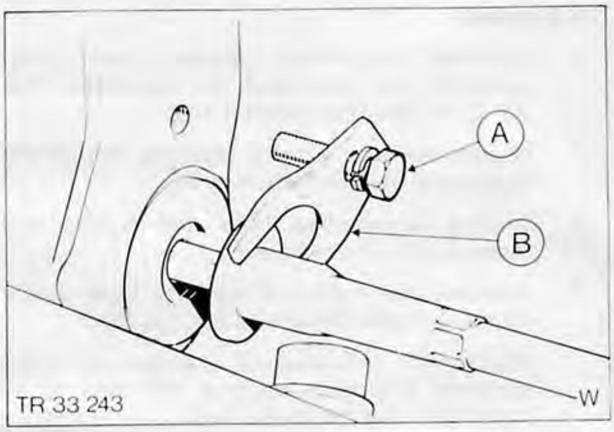


Fig. 65. Disconnecting speedo cable
A – Securing bolt
B – Clamp

To Install

Insert cable through bulkhead aperture and fit grommet into its dash panel location. Feed cable through dash panel aperture until colour band on cable coincides with grommet.

Route cable to extension housing and locate cable in gearbox housing driven gear. Assemble spring washer and clamp to bolt, locate fork of clamp over speedometer cable casing and secure. Tighten bolt to 6,9 to 9,8 Nm (0,7 to 1,0 kgm) (5 to 7 lbf.ft)

Remove axle stands and lower vehicle to ground.

Refit instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 9 to 17.

PART 'B'

33 284 GAUGE – FUEL – REMOVE AND INSTALL (Variants fitted with standard facia)

Special Service Tools Required: None

NOTE: Removal and installation procedure for Operation No. 33–284 – Gauge – Fuel – Remove and Install and 33–304 – Gauge – Temperature – Remove and Install, are the same, differing only in which gauge is actually removed. For this reason Operation No. 33–304 has been incorporated into this operation (33–284).

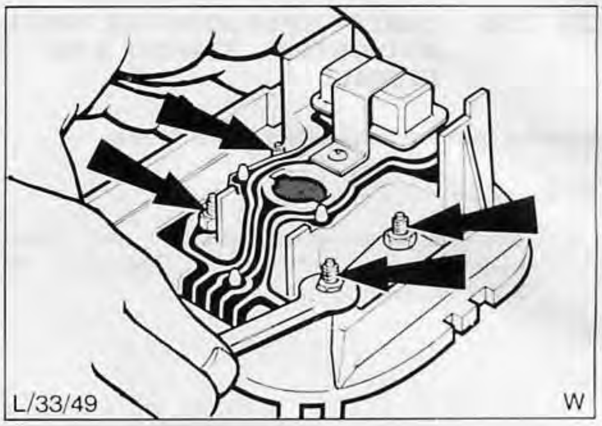


Fig. 66. Location of fuel and temperature gauge securing nuts

To Remove

1. Remove instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 1 to 8.
2. Disconnect four screws securing instrument housing to cluster body, Fig. 66.
3. Unplug illumination bulb and holder and remove instrument housing.
4. Remove two nuts and washers from gauge retaining studs, detach gauge, Fig. 67.

   NOTE: If temperature gauge is being removed a plastic insulator also has to be detached from the lower stud.

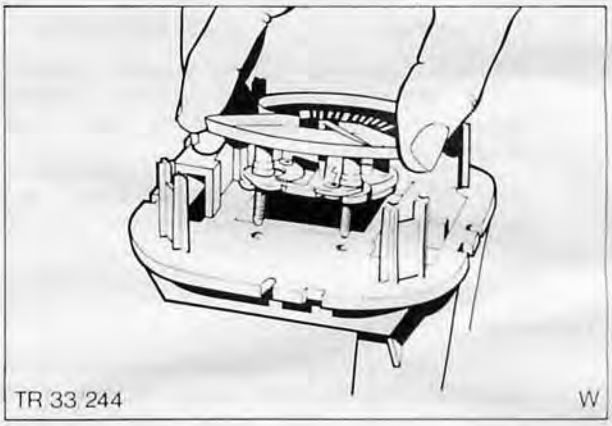


Fig. 67 Removing gauge from housing. Take care not to mark gauge face

To Install

5. Position gauge in its housing and secure with two washers and nuts, Fig. 68.

   NOTE: Lower stud on temperature gauge also has a plastic insulation washer which must be fitted first.

6. Locate instrument housing onto cluster housing assembly and secure with four screws.
7. Plug in illumination bulb and holder.
8. Replace instrument cluster and panel assembly into vehicle as described in Operation No. 33–214, Sub Operations 9 to 17.

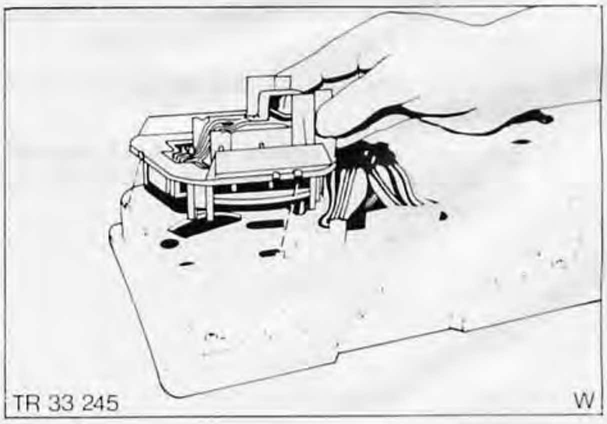


Fig. 68. Aligning instrument housing to main cluster body

PART 'B'

33 306 SENDER UNIT – TEMPERATURE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.

2. Remove radiator cap.

   NOTE: When removing cap rotate through approximately 90° to allow system to depressurise before fully removing cap.

3. Place a clean drain tray below vehicle, disconnect bottom hose at the radiator and allow to drain.

4. Disconnect wire at sender unit, and unscrew sender unit from cylinder head.

To Install

5. Screw sender unit into cylinder head. Connect wire.

6. Connect bottom hose to radiator. Refill cooling system with specified anti-freeze, or rust inhibitor, and water solution. Refit radiator cap.

7. Reconnect battery, run engine, check and top up coolant level as required.

8. Remove fender covers, and close hood.

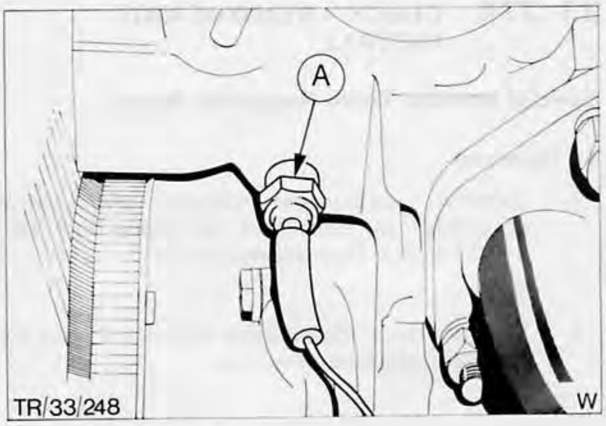


Fig. 69. Sender unit on OHV variants
A – Sender unit

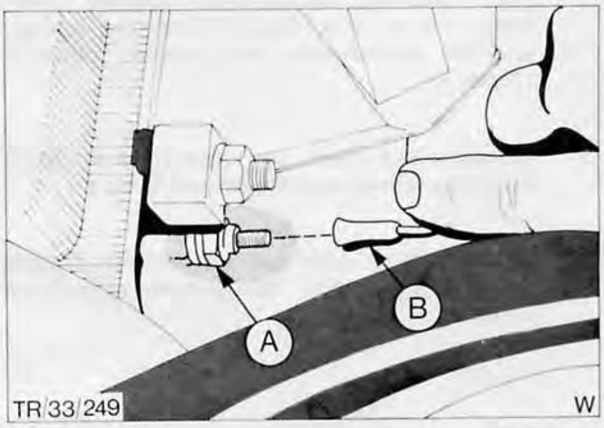


Fig. 70. Sender unit on OHC variants
A – Sender unit
B – Loom connector

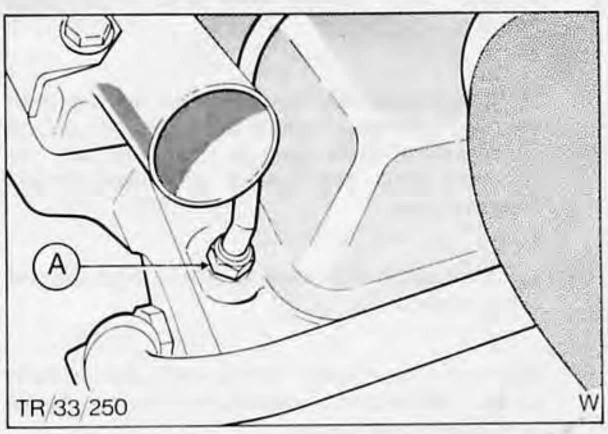


Fig. 71. Sender unit on diesel variants
A – Sender unit
NOTE: Top hose removed for clarity

PART 'B'

33 374 CLOCK – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove instrument cluster and panel assembly as described in Operation No. 33–214, Sub Operations 1 to 8.

2. Remove three illumination bulbs and sockets and their associated wiring.

3. Unscrew clock adjuster knob securing screw and remove knob, Fig. 72.

4. Unscrew four cross-head screws securing speedometer housing and lift speedometer clear. Likewise remove four housing cross-head screws from fuel/temperature gauges and lift instruments and housing clear of cluster.

5. Remove four clock and warning light plate retaining screws and lift assembly clear.

6. Remove three nuts and washers from clock retaining stubs, Fig. 73. Remove clock from plate.

To Install

7. Align clock in plate and secure with three nuts and washers.

8. Refit clock and warning light assembly into position and secure with four cross-head screws.

9. Refit speedometer housing and secure with four cross-head screws. Likewise locate fuel/temperature gauge housing on its location pegs and secure with four cross-head screws.

10. Locate clock adjustering knob and secure with screws.

11. Replace the three instrument illumination bulbs, holders and associated wiring. Twist bulb holders to secure.

12. Replace instrument cluster and panel assembly in vehicle as described in Operation No. 33–214, Sub Operations 9 to 17.

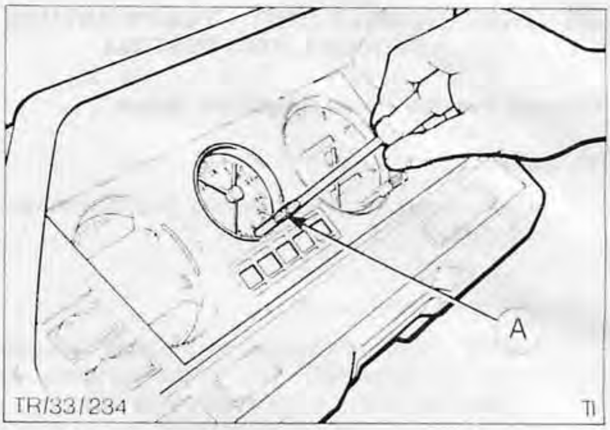


Fig. 72 Removing clock knob
A Knob

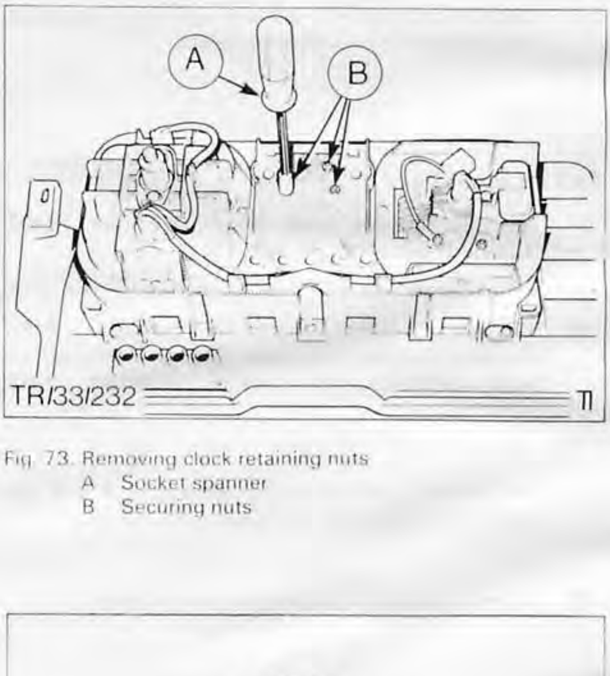


Fig. 73. Removing clock retaining nuts
A Socket spanner
B Securing nuts

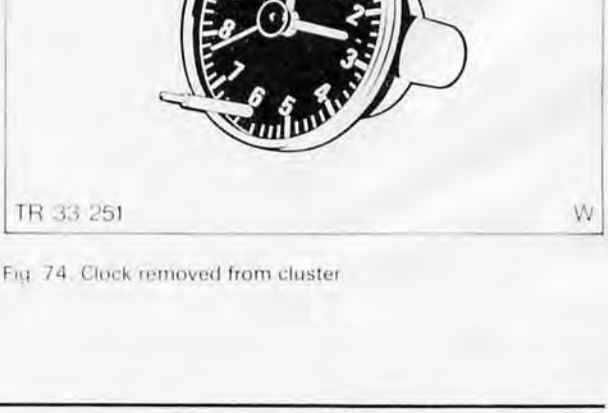


Fig. 74. Clock removed from cluster

PART 'B'

33 384 CIGARETTE LIGHTER – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Remove facia trim panel by releasing six screw clips.

   NOTE: If vehicle is fitted with a radio first remove radio knobs and radio surround bezel.
3. Remove cigarette lighter assembly by pulling out element, disconnecting feed wire, earthwire and illumination bulb. Push collar against spring tension and twist in an anti-clockwise direction.

To Install

4. Refit assembly in order shown in Fig. 75.
5. Reconnect insulated feed wire, earth wire and illumination bulb. Refit element.
6. Align facia panel and secure by rotating clips through 90°.

   NOTE: If vehicle is fitted with a radio, position radio surround bezel and refit radio knobs.
7. Reconnect battery, remove fender covers and close hood.

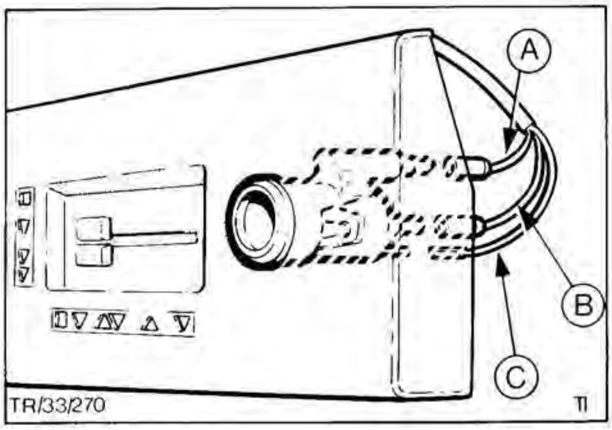


Fig. 75. Cigarette lighter wiring
A – Illumination bulb feed wire
B – Main feed wire (red)
C – Earth wire (brown)

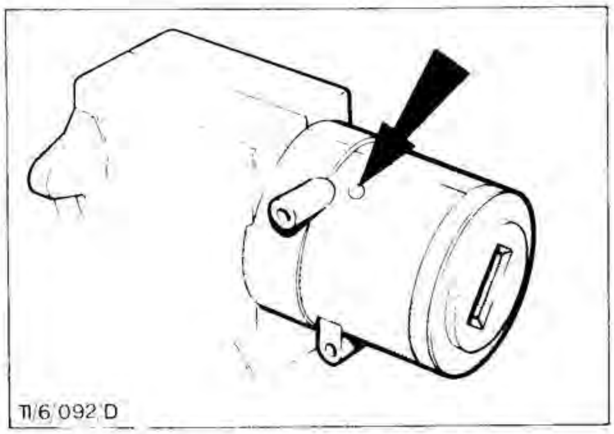


Fig. 76. Key cylinder leaf spring access hole

33 513 LOCK BARREL – IGNITION SWITCH – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender cover, and disconnect battery.
2. Remove upper and lower steering column shrouds by removing five cross-head screws.
3. Insert key into ignition switch and turn to position '1' (accessory). This has the effect of aligning key barrel retaining circlip and keyway register in the housing.
4. Using a suitable tool, such as a scriber, depress key cylinder leaf spring through access hole, Fig. 76, provided in lock housing, whilst pulling on key until key cylinder and lock barrel are withdrawn.

   NOTE: Slight clockwise and anti-clockwise movements of the key may be necessary in order to align key barrel and lock housing drive cam, hence allowing removal of cylinder and barrel.

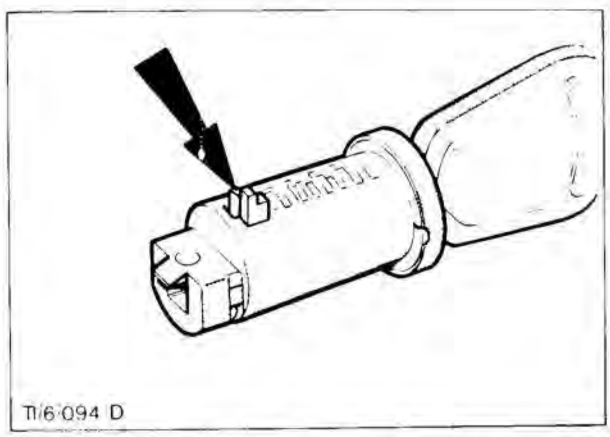


Fig. 77. Key barrel with key fully inserted showing securing ward

PART 'B'

5. Insert key fully into key barrel and remove retaining circlip. Ensure circlip location on lock barrel is undamaged otherwise location of circlip may be affected on reassembly.

6. Withdraw key approximately 5 mm (0,2 in). This causes an additional securing ward, Fig. 74, which acts on key cylinder chamfer, to be brought flush to barrel.

7. Key barrel may now be removed from cylinder.

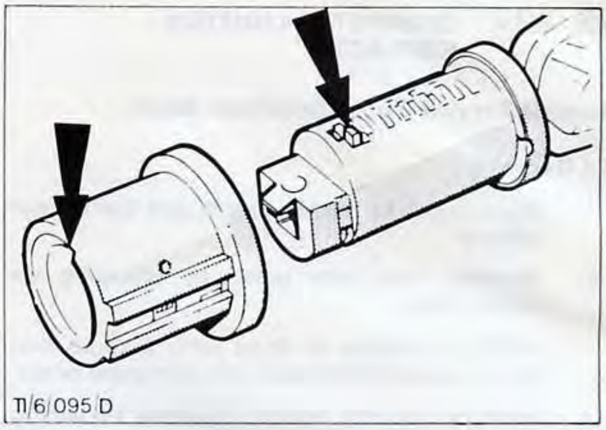


Fig. 78. Assembly of barrel into key cylinder

To Install

8. Insert key fully into barrel, and withdraw key approximately 5 mm (0,2 in) to bring additional ward, Fig. 77, flush with barrel.

9. With reference to Fig. 78, insert barrel into cylinder. Barrel can only be fitted in one position, and this allows securing ward to operate on key cylinder chamfer.

10. With key fully inserted, check that key and barrel may be turned from position 'O' to position 'III'.

11. Turn key to accessory ('I') position, and fit retaining circlip. The open 'jaws' of circlip must align with keyway register on cylinder, see Fig. 79.

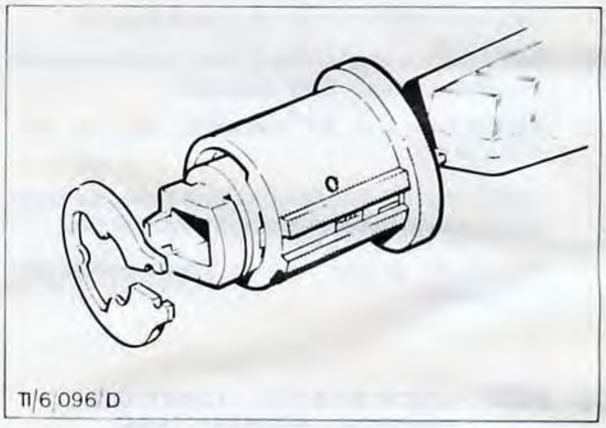


Fig. 79. Fitting retaining circlip

12. With reference to Fig. 80 insert cylinder assembly into housing. Ensure cylinder is pushed fully into housing, and leaf spring locates into undercut slot in housing.

13. As in removal operation, slight clockwise and anti-clockwise, movements of the key may be necessary to achieve correct alignment of key barrel and lock housing drive cam.

14. Check operation of lock assembly in all positions and if satisfactory, return the key to position 'O' and remove the key.

15. Refit the steering column upper and lower shrouds, secure with five cross-head screws.

16. Reconnect battery, remove fender cover, and close hood.

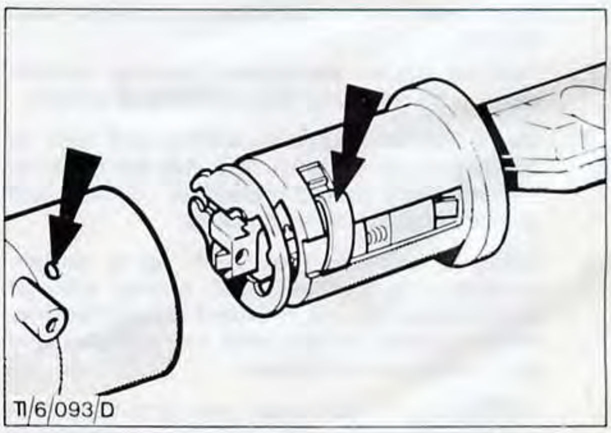


Fig. 80. Housing and cylinder in correct alignment prior to assembly

PART 'B'

33 524 SWITCH – COURTESY LIGHT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender cover and disconnect battery.
2. Remove securing screw and pull out switch, Fig. 81, pull loom out from door pillar and disconnect loom. Before disconnecting ensure loom is pulled well clear of pillar.

Fig. 81. Courtesy light switch
A – Securing screw

To Install

3. Reconnect loom, feed loom back into door pillar and fit switch in position, secure with cross-head screw.
4. Reconnect battery and check switch for correct function. Remove fender cover and close hood.

33 528 SWITCH – BACK UP LAMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood and fit fender covers.
2. Jack up front end of vehicle and fit axle stands.
3. Disconnect loom and unscrew switch which is located in gearbox extension housing, Fig. 82.

To Install

4. Refit switch and reconnect loom. Ensure loom is well clear of exhaust and does not foul transmission.
5. Check operation of switch.
6. Remove stands and lower vehicle to ground.
7. Remove fender covers and close hood.

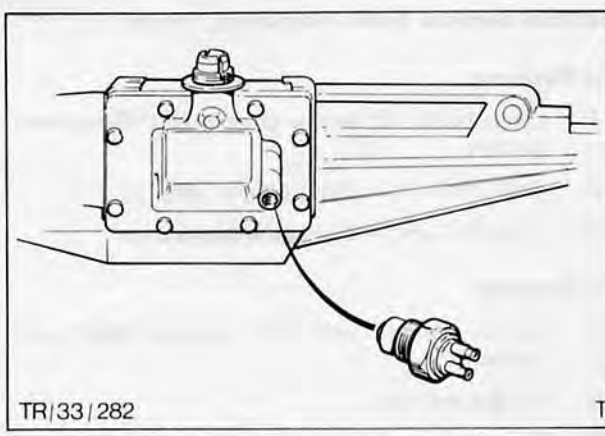


Fig. 82. Location of switch

PART 'B'

33 548 SWITCH – STOP LIGHT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Slacken and remove lock nut securing stop lamp switch to pedal box assembly.
3. Remove switch from pedal box assembly and disconnect two wires.

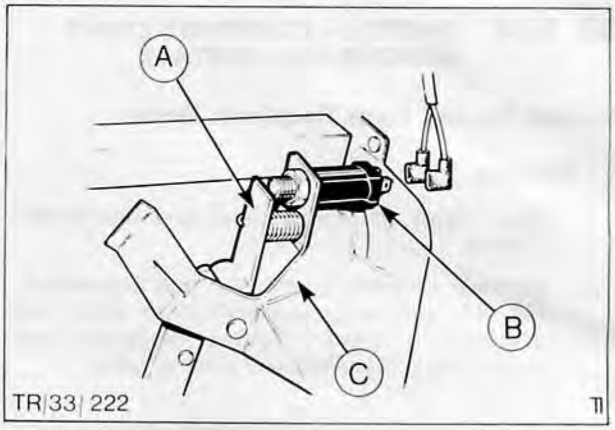


Fig. 83. Stop light switch
A – Brake pedal
B – Stop light switch
C – Pedal box

To Install

4. Connect switch to two wires.
5. Align switch in pedal box and retain with lock nut.
6. Adjust switch so it operates within first inch of pedal travel. Tighten lock nut.
7. Reconnect battery, remove fender covers and close hood.

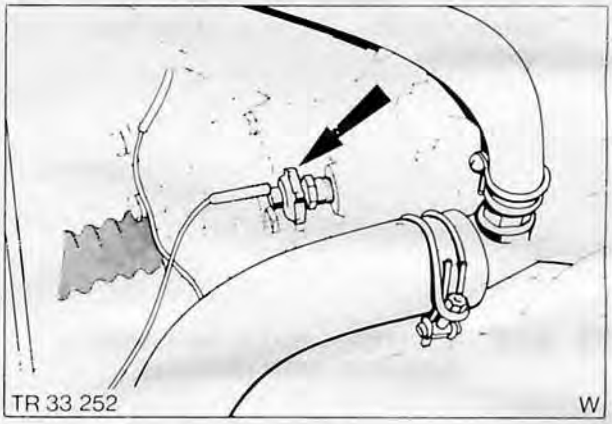


Fig. 84. Oil pressure switch, OHV variants
A – Switch

33 554 SWITCH – OIL PRESSURE WARNING LIGHT – REPLACE

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Disconnect wire from sender unit.
3. Unscrew unit from engine block.

To Replace

4. Screw sender unit into engine block and tighten.
5. Reconnect wire.
6. Reconnect battery, remove fender covers and close hood.

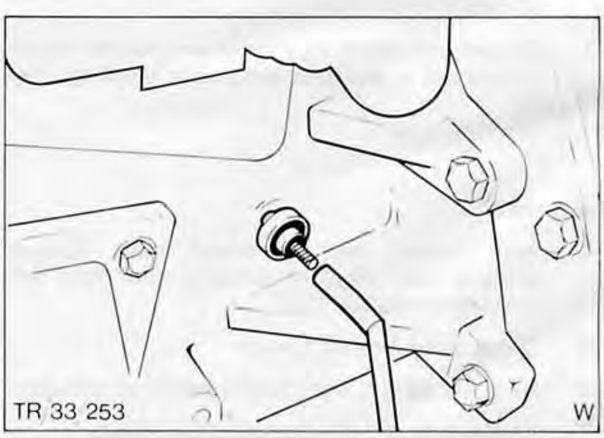


Fig. 85. Oil pressure switch, OHC variants

PART 'B'

33 557 SWITCH – REAR FOG LAMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Using a soft cloth or a wad of paper, cover facia panel area immediately below switch location.
3. Using a small electrical screwdriver, pivoting on protective material, prise switch from its bezel location, Fig. 86.
4. Detach multi-plug and remove switch.

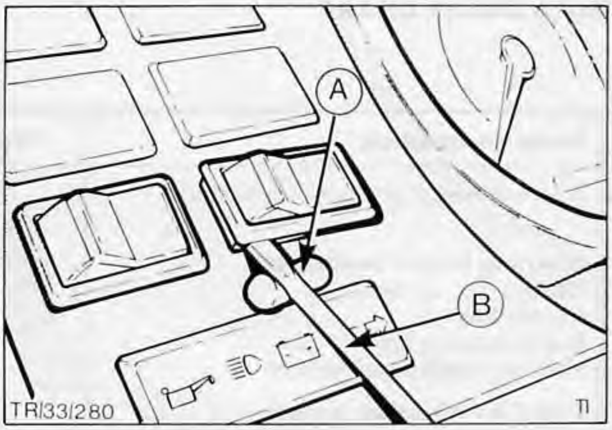


Fig. 86. Lever switch from panel
A – Protective wad
B – Screwdriver

To Install

5. Connect loom multi-plug to rear of switch, Fig. 88.
6. Position switch in facia and push home to secure.
7. Reconnect battery, remove fender covers, and close hood.

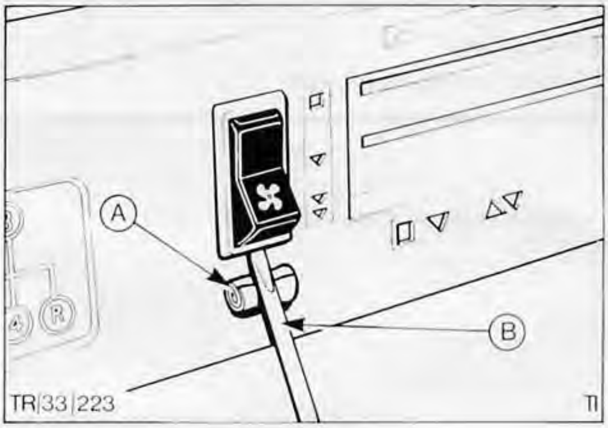


Fig. 87. Lever switch from panel
A – Protective wad
B – Screwdriver

33 574 SWITCH – HEATER MOTOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Using a soft cloth or a wad of paper, cover heater control panel area immediately below switch location.
3. Using a small electrical screwdriver, pivoting on protective material, prise switch from its bezel location, Fig. 87.
4. Detach multi-plug and remove switch.

To Install

5. Connect loom multi-plug to rear of switch.
6. Position switch in facia and push home to secure.
7. Reconnect battery, remove fender covers, and close hood.

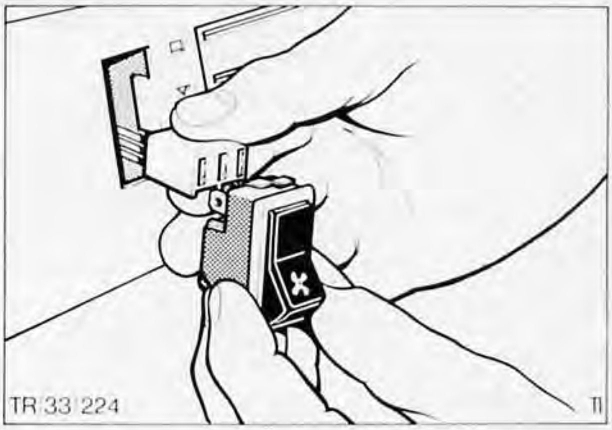


Fig. 88. Align switch to multi-plug and connect

TECHNICAL DATA

BULB USAGE CHART

Lamp designation	Wattage	Fitting	Remarks
Warning lamps (instrument cluster)	1,3	Glass socket Glass socket	Standard facia Tachograph variants
Warning lamps (switches)			
Heated rear window	1,3	Glass socket	Where fitted
Hazard flasher	1,3	Glass socket	
Brake warning light	1,3	Glass socket	Where fitted
Rear fog lamp warning light	1,3	Glass socket	Where fitted
Panel illumination lamps	2,6 2,0	Glass socket Bayonet	Standard facia Tachograph variants
Clock illumination light	2,6	Glass socket	Where fitted
Heater control illumination light	2,0	Glass socket	
Automatic trans. selector quadrant light	1,4	Bayonet	Where fitted
Cigarette lighter illumination light	1,4	Bayonet	Where fitted
Interior light	5,0	Bayonet/festoon	
Engine compartment light	5,0	Bayonet	Where fitted

Heated rear window relay fuse 16 amps

STARTING SYSTEM 26

Index **Page**

GENERAL DESCRIPTION

Vehicles within the Transit range are fitted with inertia or pre-engaged starter motors of either Lucas or Bosch manufacture. The starter motors are basically of a conventional series wound, four pole, four brush design and are fully serviceable.

The standard equipment Lucas starter motor is the M35J inertia or pre-engaged the 5M90 for diesel, with optional heavy-duty M50G or 2M100 being available where required.

On vehicles with a Bosch starter motor a 0.7PS, 0.8PS, 1.1PS or 3.3PS type will be fitted dependant on engine and transmission specification. Irrespective of make or model all pre-engaged starter motors have an integral solenoid. The solenoid should not be dismantled and is only serviced as an assembly. All types have pinions which engage with a ring gear during starting. The ring gear is located on the outside of the flywheel, or, in the case of vehicles fitted with automatic transmission, on the circumference of a separate drive plate assembly.

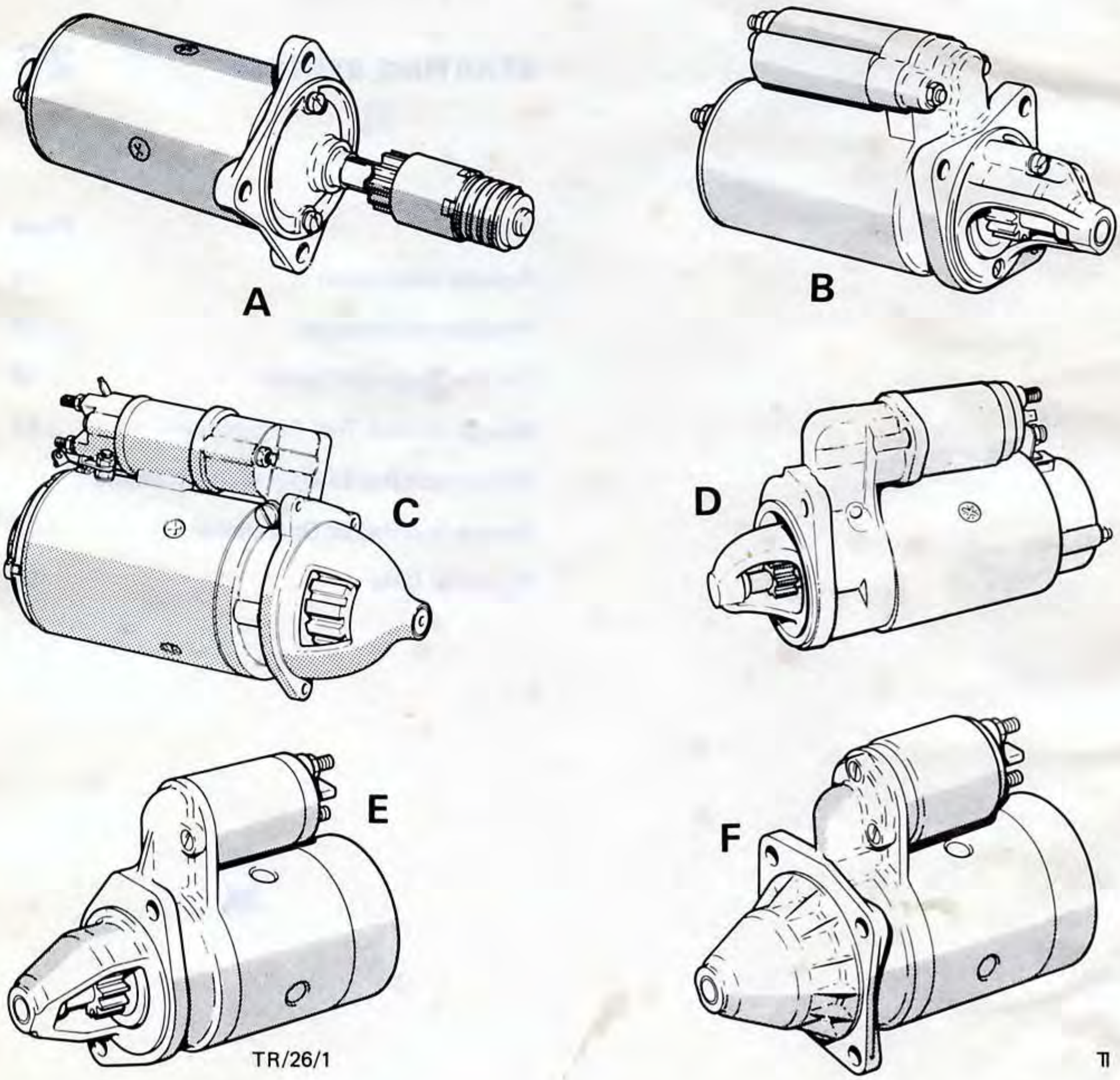


Fig. 1. Starter motors
A – Lucas M35J inertia motor
B – Lucas 5M90 motor
C – Lucas M50G motor
D – Lucas 2M100 motor
E – Bosch 0.7 and 0.8PS motor
F – Bosch 1.1 and 3.3PS motor

GENERAL DESCRIPTION (cont'd)

LUCAS M35J (Inertia)

The M35J starter motor is a series wound, four pole, four brush unit, and is mounted to the clutch housing by three bolts.

A face-type commutator assembly is moulded onto the armature.

The brushgear assembly is fully insulated and comprises wedge-shaped brushes actuated by coil springs located in a plastic brushbox moulding which is rivetted to the commutator end plate. The brushes have a keyway to ensure correct location and the springs are held captive in the brushbox moulding.

The continuously wound field winding has no interconnecting joints. One end is earthed to the main casing (yoke) by a rivetted connection, while the other end is connected to two of the four brushes. The remaining pair of brushes are connected to the main feed terminal.

The main casing (yoke) of the starter motor has two independently fixed end plates. The commutator end plate screws locate in the main body itself, whilst the 'drive' end plate screws locate in tapped holes provided in the pole pieces. Access to the brushes is gained by removing the commutator end plate.

The drive pinion, which runs on a screwed sleeve (with an internal spline), and the powerful cushion spring, are retained on the commutator shaft by a 'C' clip.

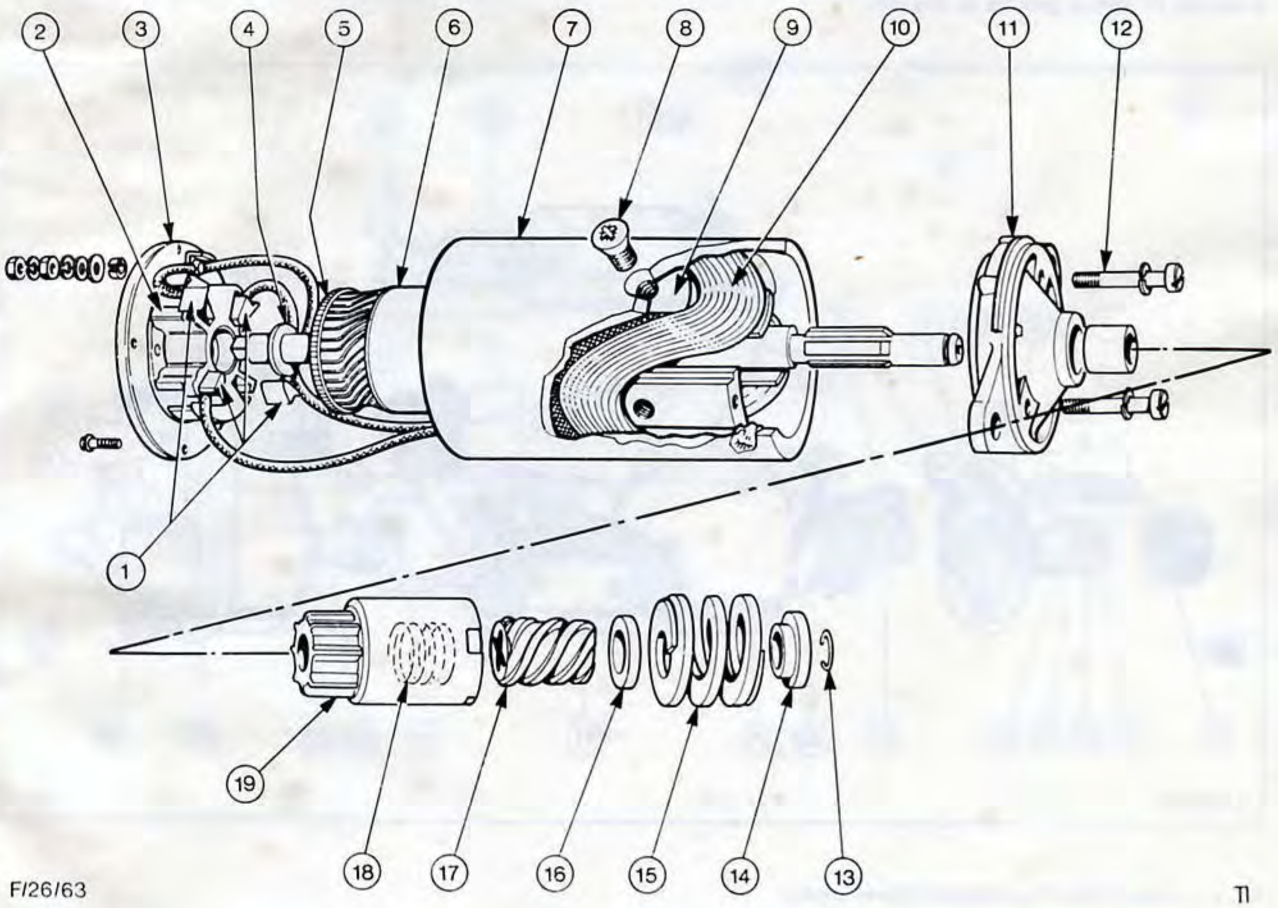


Fig. 2. Lucas M35J (inertia) starter motor

1. Brushes
2. Brushbox moulding
3. Commutator end plate
4. Thrust washer
5. Commutator
6. Armature
7. Main casing (yoke)
8. Pole piece retaining screw
9. Pole piece
10. Field winding
11. Drive end plate
12. Drive end plate retaining screws
13. 'C' clip
14. Spring cup
15. Cushion spring
16. Cushion washer
17. Screwed sleeve
18. Anti-drift spring
19. Drive pinion

GENERAL DESCRIPTION (cont'd)

Lucas 5M90 Pre-Engaged Starter Motors

This starter motor is a four pole, four brush motor with a series wound field and a solenoid operated roller clutch drive, Fig. 3, item 24.

The starter motor has a face-type moulded commutator assembly on the end-face of the armature. A fully-insulated brushgear assembly comprises wedge-shaped brushes and coil springs assembled into a plastic brushbox moulding which is riveted to the commutator end plate. The brushes are provided with a keyway to ensure correct fitting, and the springs are held captive in the brushbox moulding.

The field-winding is continuously wound and has no interconnecting joints. One end is earthed to the yoke by a soldered connection, while the other end terminates at one pair of brushes. The remaining pair of brushes are connected to the main feed terminal. The main casing (yoke) of the starter motor has an independently secured plate at the commutator end and an independently secured drive end housing. The commutator end plate screws locate in the main body itself whilst the drive end housing screws locate in tapped holes provided in the pole pieces. Access to the brushes is gained by removing the commutator end plate.

Armature end-float is controlled at the commutator end by a thrust plate and required number of packing shims, which are assembled on the armature shaft extension. The parts are retained by a star clip secured on the end of the shaft.

The position of the actuating lever in the drive-end housing is pre-set and cannot be altered. This eliminates setting the pinion position to obtain the correct operation of the actuating solenoid. The lever swivels on a non-adjustable pivot pin which is retained in the drive-end housing by a special type of retaining ring which is a spring fit into a groove in the pin.

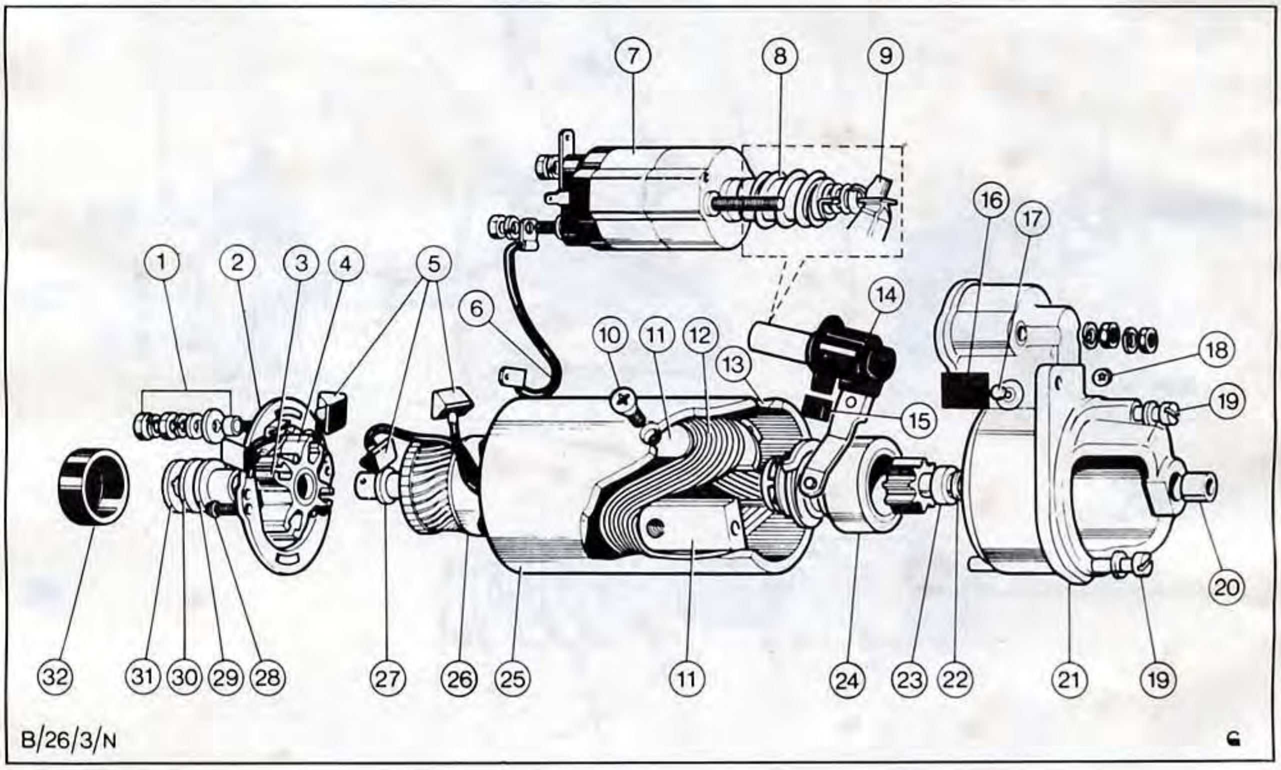


Fig. 3. Lucas 5M90 (Pre-Engaged) Starter motor

1. Terminal nuts and washers
2. Commutator end cap
3. Brush housing
4. Brush springs
5. Brushes
6. Connector link, solenoid to starter
7. Solenoid unit
8. Return spring
9. Engagement lever
10. Pole screw
11. Pole shoe
12. Field coils
13. Field to earth connection
14. Rubber seal
15. Rubber dust pad
16. Rubber dust cover
17. Pivot pin
18. Retaining clip
19. Housing retaining screws (2)
20. Bearing bush
21. Drive end housing
22. 'C' clip
23. Thrust collar
24. Drive assembly
25. Main casing (yoke)
26. Armature
27. Thrust washer
28. Commutator end plate retaining screws (2)
29. Bearing bush
30. Thrust plate
31. Star clip
32. Dust cover

GENERAL DESCRIPTION (cont'd)

Lucas M50G Pre-engaged Motor

This starter motor is a four pole, four brush motor with a series wound field and a solenoid operated roller clutch drive, Fig. 4. item 19.

A radial commutator assembly is moulded to the armature. The brush gear assembly has two fully insulated positive brushes, connected to the main terminal via a split field winding. The remaining pair of brushes are connected direct to earth on the metal brush plate.

The main casing (yoke) houses the four pole pieces and the field windings. The commutator end housing and the drive-end housing are fixed to the main casing by common through bolts or studs, nuts and washers.

Armature shaft end-float is controlled at the commutator end by a steel thrust washer and fibre washer which are assembled on the armature shaft extension.

The position of the actuating lever in the drive-end housing is pre-set and cannot be altered. This eliminates setting the pinion position to obtain the correct operation of the actuating solenoid. The lever swivels on a non-adjustable pivot pin which is retained in the drive-end housing.

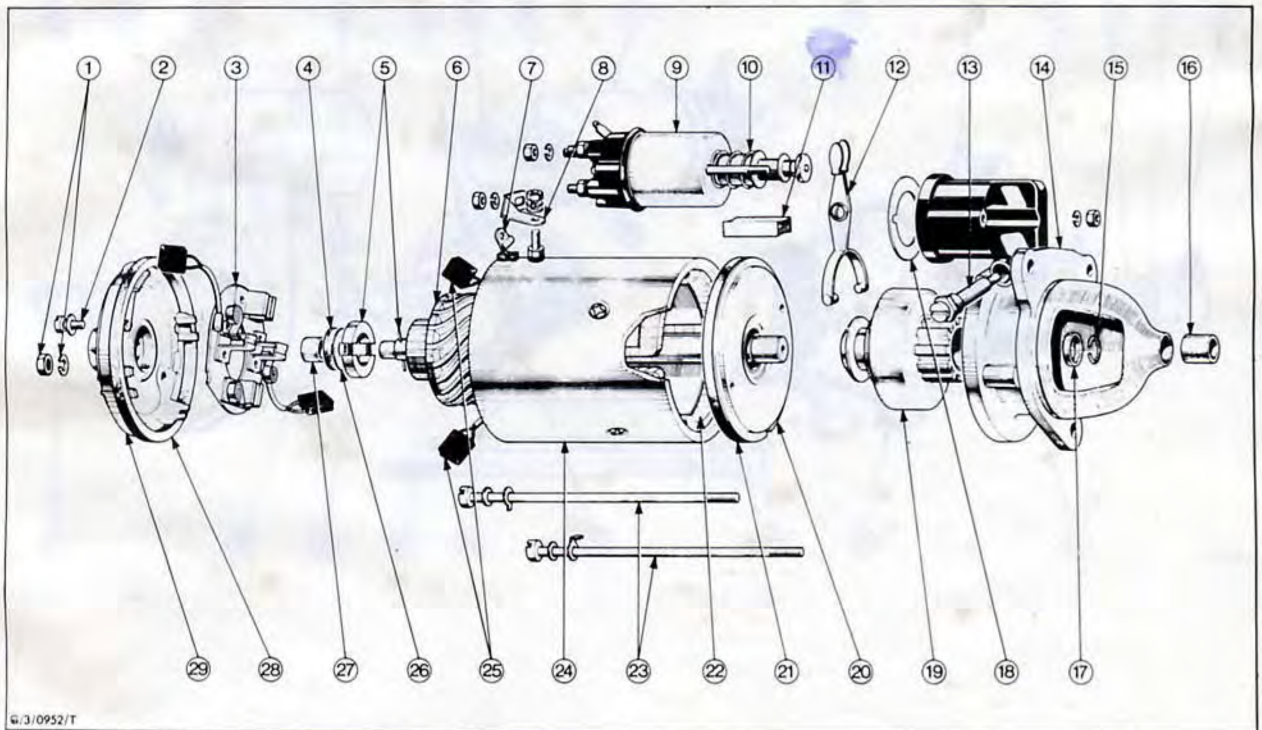


Fig. 4. Lucas M50G (Pre-engaged) Starter motor

1. Nut and spring washer
2. Bolt
3. Brush gear assembly
4. Fibre washer
5. Brake shoes and cross peg
6. Armature
7. Flexible link
8. Copper link
9. Solenoid unit
10. Return spring
11. Sealing grommet
12. Engagement lever
13. Eccentric pivot pin
14. Drive end fixing bracket
15. 'C' clip
16. Bearing bush
17. Thrust collar
18. Gasket
19. Drive assembly
20. Intermediate bracket
21. Sealing ring
22. Field coils
23. Through bolts
24. Yoke
25. Insulated brushes (field coils)
26. Steel thrust washer
27. Bearing bush
28. Sealing ring
29. Commutator end bracket

GENERAL DESCRIPTION (cont'd)

Lucas 2M100 Pre-Engaged Starter Motor

This starter motor is a four pole, four brush motor with a series wound field and a solenoid operated roller clutch drive.

The starter motor has a face-type moulded commutator assembly on the end-face of the armature. A fully-insulated brushgear assembly comprises wedge-shaped brushes and coil springs assembled into a plastic brushbox moulding which is riveted to the commutator end housing. The brushes are provided with a keyway to ensure correct fitting, and the springs are held captive in the brushbox moulding.

The field-winding is continuously wound and has no interconnecting joints. One end is earthed to the yoke by a soldered connection, while the other end terminates at one pair of brushes. The remaining pair of brushes are connected to the main feed terminal.

Access to the brushes is gained by removing the commutator end housing.

Armature end-float is controlled at the commutator end by a thrust clip which is assembled on the armature shaft extension.

The position of the actuating lever in the drive-end housing is pre-set and cannot be altered. This eliminates setting the pinion position to obtain the correct operation of the actuating solenoid. The lever swivels on a non-adjustable pivot pin.

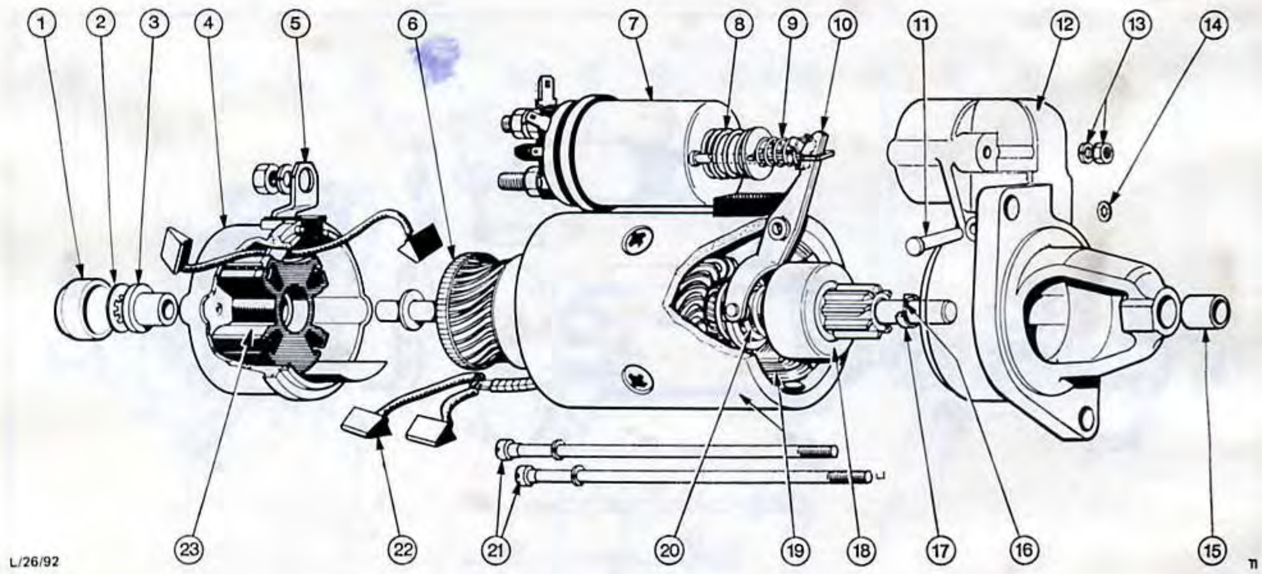


Fig. 5. Lucas 2M100 (Pre-engaged) Starter motor

1. Rubber cover
2. Spire retaining clip
3. Commutator end housing bush
4. Commutator end housing
5. Starter terminal link
6. Armature
7. Solenoid
8. Return spring
9. Lost motion spring
10. Actuating lever
11. Actuating lever pivot pin
12. Drive-end bracket
13. Solenoid securing nut and washer
14. Retaining clip
15. Drive-end bracket bush
16. 'C' clips
17. Thrust collar
18. Pinion gear assembly
19. Pole shoe and yoke assembly
20. Spacing spring
21. Through bolts
22. Brush
23. Brush box assembly

GENERAL DESCRIPTION (cont'd)

BOSCH – all models

The Bosch starter motors are series wound, four pole, four bush units having an integral solenoid and a roller clutch drive.

A radial commutator assembly is moulded to the armature.

The brushgear assembly has two fully insulated positive brushes connected to the main feed terminal via a split field winding. The remaining pair of brushes are connected direct to earth on the metal brushplate.

The main casing (yoke) houses the 4 pole pieces and the field windings. The commutator end housing and the drive end housing are fixed to the main casing by common through bolts or studs, nuts and washers.

Armature shaft end-float is controlled at the commutator end by shim washers which are retained by a 'C' clip on the armature shaft.

The drive pinion is actuated by a solenoid bolted to the drive-end housing. An actuating lever with a fork at one end transmits the solenoid movement to the pinion during the starting operation. The position of the actuating lever is pre-set and requires no adjustment. The pivot pin is a nut and bolt assembly.

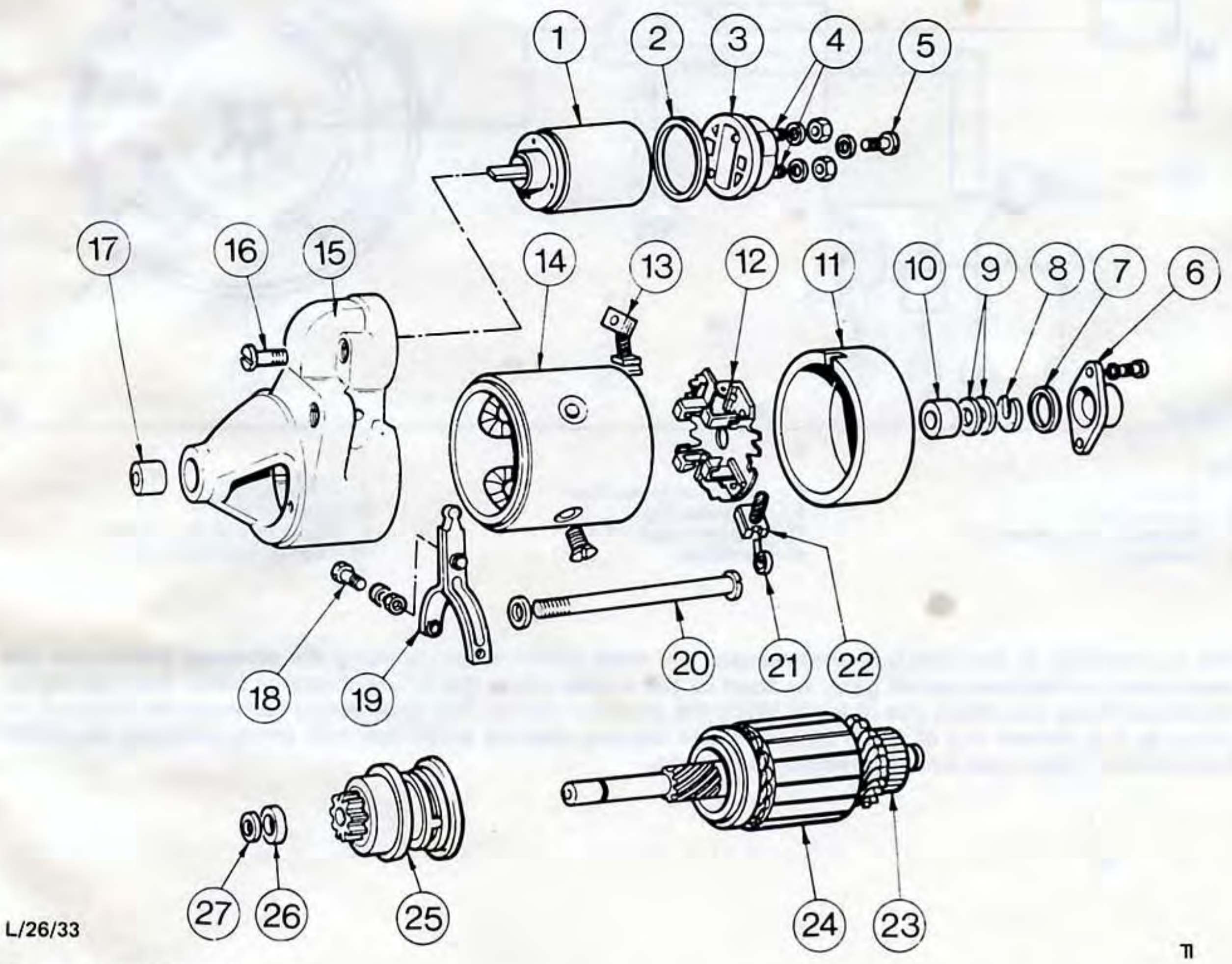


Fig. 6. Bosch starter motor

1. Solenoid body
2. Gasket
3. Switch contacts and cover
4. Terminals (main)
5. Retaining screw
6. End cover
7. Seal
8. 'C' clip
9. Shim washer
10. Bearing bush
11. Commutator end housing
12. Brushbox assembly
13. Manifold winding braiding
14. Main casing (yoke)
15. Drive-end housing
16. Solenoid retaining screw
17. Bearing bush
18. Pivot screw
19. Actuating lever
20. Through bolt
21. Brush spring
22. Brush
23. Commutator
24. Armature.
25. Drive pinion and roller clutch assembly
26. Bearing bush
27. Thrust washer

PRINCIPLE OF OPERATION

INERTIA STARTER

On turning the ignition switch, 'B' in Fig. 7, current is supplied to terminal 'L', which energises the solenoid and closes the main contacts 'C'. This allows battery current to flow direct to the starter motor, 'G'. The current enters the motor at the main terminal 'E', and passes through the armature windings via brushes to the field windings. The magnetic fields created in both windings cause the starter to rotate. The field coils connected to earth complete the circuit.

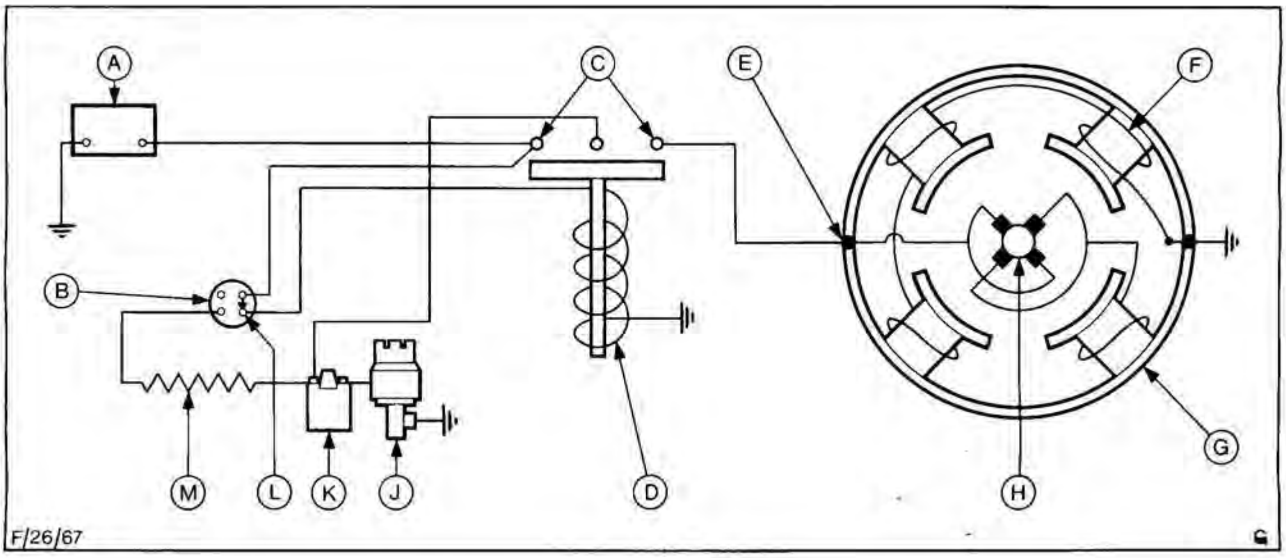


Fig. 7.

A – Battery
B – Ignition switch
C – Solenoid main contacts
D – Solenoid
E – Starter main terminal
F – Field winding
G – Starter motor
H – Armature
J – Distributor
K – Ignition coil
L – Ignition switch terminal
M – Ballast resistor circuit

The acceleration of the armature shaft causes the drive pinion to move along the screwed sleeve and into mesh with the flywheel rear of gear. As soon as the engine starts the flywheel rotates faster than the starter motor and flings the pinion out of mesh along the screwed sleeve. The large spring cushions the shock of the pinion as it is thrown out of mesh by the engine starting and the small anti-drift spring prevents the pinion from vibrating into mesh once the engine is running.

PRINCIPLE OF OPERATION

PRE-ENGAGED STARTER (Bosch shown)

The solenoid circuit is designed to ensure that the armature shaft does not revolve until the drive pinion is fully engaged with the ring gear.

Fig. 8. shows the pre-engaged starter circuit with the start switch in the 'start' position.

The solenoid has two windings: a 'closing winding', '10' required to push the starting pinion into mesh with the ring gear and a 'hold on winding', '9' required to maintain the pinion in mesh with the flywheel during engine cranking. The high resistance 'hold on winding' is earthed directly by means of a connection to the solenoid but a low resistance 'closing winding' is earthed through the starter motor itself.

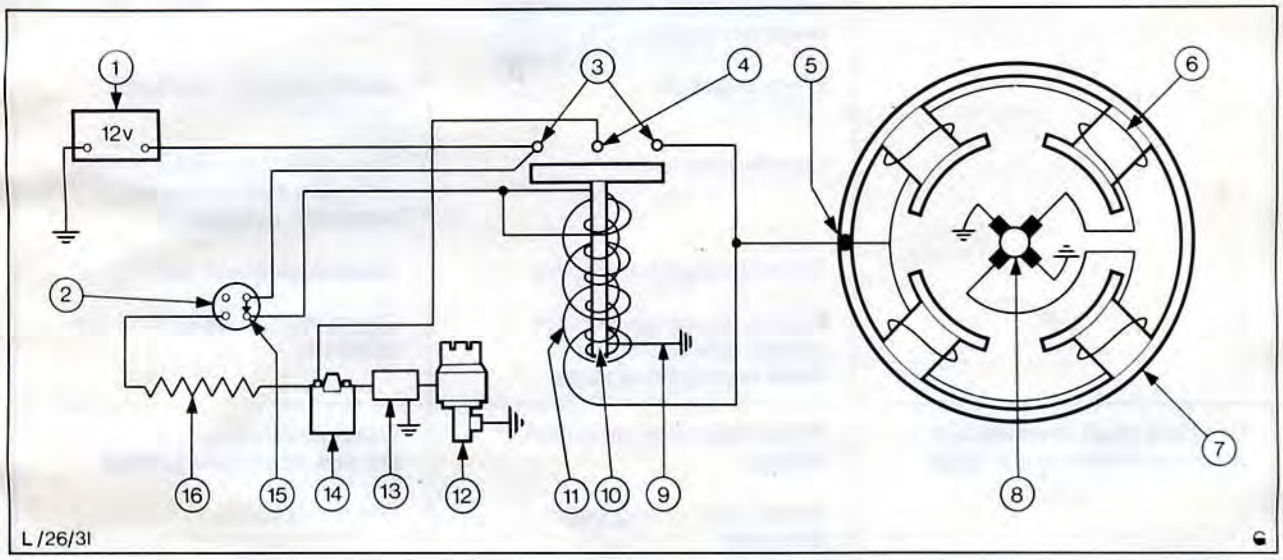


Fig. 8. (Four brush motor shown)

1. Battery
2. Ignition switch
3. Solenoid main contacts
4. Terminal (feed to coil)
5. Starter main terminal
6. Field winding
7. Starter motor
8. Armature
9. Hold onwinding
10. Solenoid armature
11. Closing winding
12. Distributor
13. Ignition control module*
14. Ignition coil
15. Ignition switch terminal
16. Ballast resistor circuit

*Used in conjunction with breakerless (transistorized) ignition and only available on V6 variants.

While the ignition switch is in the start position, current is applied to the two solenoid windings '9' and '10' The combined magnetic field of the windings pulls the solenoid core into the centre of the windings where the field is strongest.

This causes the pinion to engage the flywheel and simultaneously the main contacts '3' are bridged. As soon as this happens the voltage at each side of the closing coil is equal and current flow through the closing coil ceases. Current continues to flow in the holding coil only, and the magnetic field is sufficient to hold the pinion in mesh.

With the main terminals bridged, current flows direct to the starter motor, through the field winding and via brushes to the armature winding. The other two brushes connected to earth complete the circuit. The magnetic fields created in the field and armature windings cause the starter to rotate.

A small terminal '4' allows current to flow from the solenoid to the ignition coil '14' thus by-passing the ignition ballast resistor circuit '16'.

As soon as the ignition switch is released the 'hold on winding' de-magnetises and the spring loaded core returns to its 'rest' position, pulling the pinion out of mesh and at the same time disconnecting the current supply to the motor itself. The 'by-pass' feed from '4' is also disconnected at this moment and current for the ignition is drawn during normal running from the ignition switch through the ballast resistor circuit '16'.

TROUBLE DIAGNOSIS GUIDE – STARTER MOTOR

Trouble	Possible Causes	Corrections
Armature shaft does not revolve or revolves too slowly when starter is switched on	Discharged battery	Charge battery and check it
	Battery terminals loose or oxidized. Poor earth connection	Tighten battery terminals, clean terminals and apply acid-resistant grease Check earth
	Starter terminals or brushes have ground short-circuit	Eliminate ground short-circuit
	Brushes do not contact commutator, jammed in their guides, are worn, broken, oily or dirty	Check brushes, clean or replace them. Check guides
	Worn bearings	Check bearings, replace if necessary
	Commutator worn	Turn down commutator on a lathe. **Do not undercut between segments**
	Solenoid switch defective	Replace solenoid switch
	Too much voltage drop in cables, cables defective, cable connections loose	Check starter cables and connections
Armature shaft revolves but pinion gear does not engage	Pinion gear dirty on pinion sleeve	Clean pinion gear and sleeve **Do not apply oil/grease**
	Pinion gear or ring gear damaged	File down burrs
Armature shaft revolves until pinion gear engages positively, then comes to a stop	Battery not sufficiently charged	Charge battery
	Insufficient pressure on brushes	Check brushes: clean or replace them
	Brush springs weak	Replace brush springs
	Solenoid switch defective	Replace solenoid switch
	Excessive voltage drop in cables	Check starter cables and connections
Starter continues operating after ignition key has been released	Ignition switch does not cut out Solenoid relay or switch sticks	Immediately loosen starter cable from battery or starter, replace solenoid relay or ignition switch
Pinion does not disengage after engine starts	Pinion gear or flywheel ring gear dirty or defective	Carefully remove any burrs Clean components
	Retracting spring weak or broken	Replace retracting spring
	Faulty ignition/start switch	

SPECIAL SERVICE TOOL RECOGNITION

Tool Number	Tool Name
 CP-9504	Pole-piece screwdriver
 CP-9509	Pole-piece expander

CT/26/54

SERVICE AND REPAIR OPERATIONS – CONTENTS

STARTING SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus 76 Cortina 77	Granada '78
26 111	Starting system – test	X	—	X	X	X	X	X	X
26 204	Starter motor assembly – remove and install	X	—	X	X	X	X	X	X
26 204 8	Starter motor – overhaul	X	—	X	X	X	X	X	X
26 234 4	Starter motor drive components – remove and install	—	26 204 8	X	X	X	X	X	X
26 274 4	Starter motor brushes – remove and install	—	26 204 8	X	X	X	X	X	X
26 304	Solenoid – starter motor – remove and install (inertia starters)	—	26 204 8	X	X	X	X	X	X
26 304 4	Solenoid – starter motor – remove and install (Starter motor removed – pre-engaged starters)	—	26 204 8	X	X	X	X	X	X

SERVICE AND REPAIR OPERATIONS

26 111 STARTER MOTOR AND STARTING SYSTEM – TEST (inertia motor)

Check that the battery is in an acceptable condition for the purpose of the tests (fully charged with a hydrometer reading 1,270–1,290 S.G.). IF NOT SATISFACTORY, REPLACE WITH A BATTERY KNOWN TO BE FULLY CHARGED AND IN GOOD CONDITION.

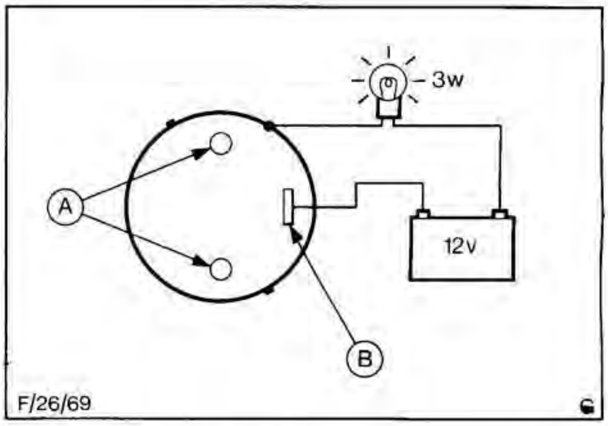


Fig. 9. Solenoid winding check
A – Main terminals
B – Spade terminal

Test 1. Starter Solenoid Unit – Check

A. Disconnect battery earth cable. Remove both cables from solenoid, 'A' in Fig. 9. Check continuity of solenoid windings by connecting a test lamp circuit comprising a 12 volt battery and low wattage (1–3 watts) bulb between the spade terminal and the solenoid body. The lamp should light.

B. With both solenoid cables still disconnected, connect a new test circuit, Fig. 10, this time with a high wattage (18–21 watts) bulb, between the solenoid main terminals. Energise the solenoid by applying 12 volts between the spade terminal and a good earthing point on the solenoid body. The solenoid should be heard to operate and the test bulb should light fully indicating closure of the solenoid contacts.

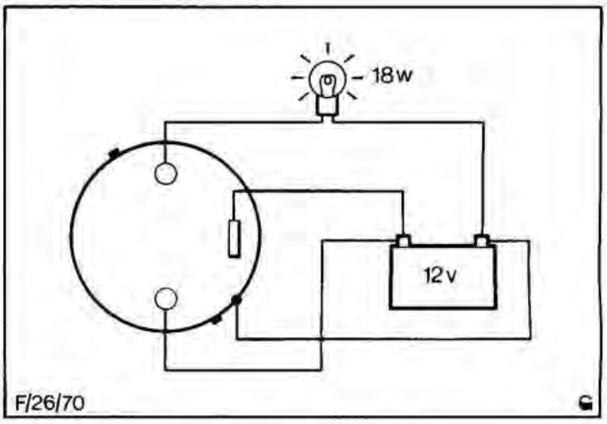


Fig. 10. Solenoid operation check

Test 2. Voltage check at battery terminals (on load)

Connect a voltmeter directly between battery terminals, Fig. 11.

Operate starter with ignition off, i.e. disconnect positive terminal on ignition coil. Reading on voltmeter should not be less than 10,5 volts.

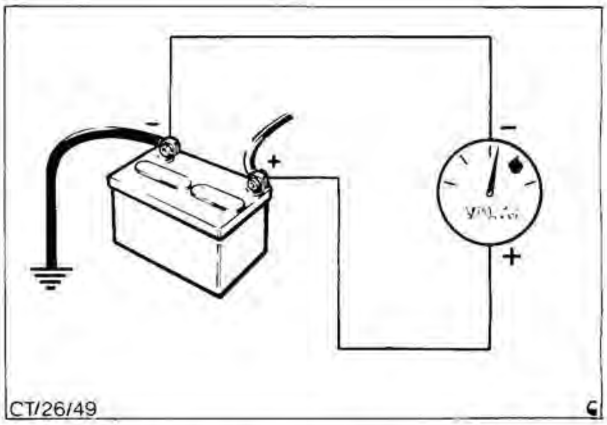


Fig. 11 Testing load on battery terminal

SERVICE AND REPAIR OPERATIONS

26 111 STARTER MOTOR AND STARTING SYSTEM – TEST (Pre-engaged motor)

Check that the battery is in an acceptable condition for the purpose of the tests (fully charged with a hydrometer reading 1,270–1,290 S.G.). If not satisfactory, replace with a battery known to be fully charged and in good condition.

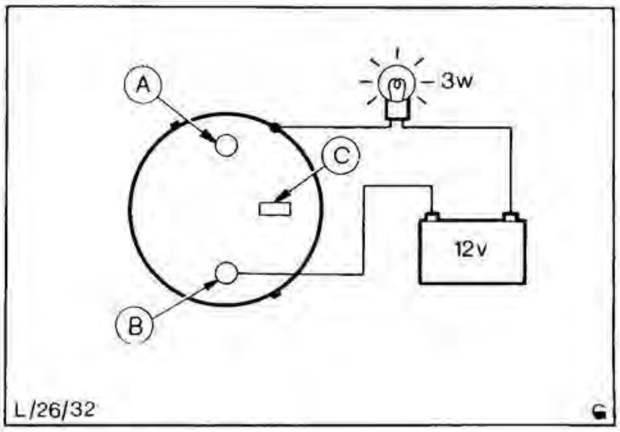


Fig. 12A. Solenoid winding check
A – Battery Terminal
B – Feed Terminal
C – Spade Terminal

Test 1. Starter Solenoid Unit – Check

A. Disconnect battery earth cable. Remove both cables from solenoid. Check continuity of solenoid windings by connecting a test lamp circuit comprising a 12 volt battery and low wattage (1–3 watts) bulb between starter feed terminal and solenoid body. The lamp should light, Fig. 8.

B. With both solenoid cables still disconnected, connect a new test circuit, Fig. 12B, this time with a high wattage (18–21 watts) bulb, switched by solenoid main terminals. Energise solenoid by applying 12 volts between spade terminal and starter feed terminal. The solenoid should be heard to operate and test bulb should light fully indicating closure of solenoid contacts.

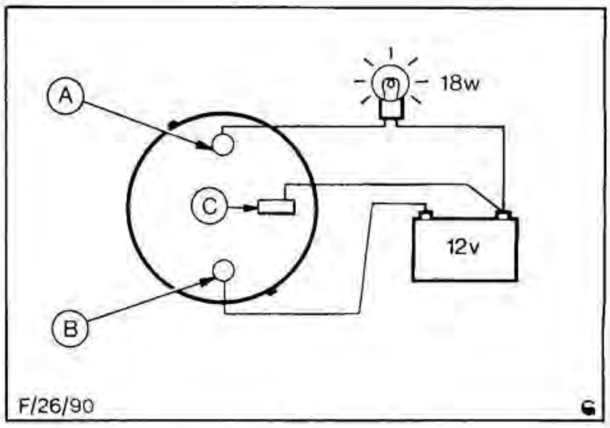


Fig. 12B. Solenoid continuity check
A – Battery Terminal
B – Feed Terminal
C – Spade Terminal

Test 2. Voltage check at battery terminals (on load)

Connect a voltmeter directly between battery terminals, Fig. 12C.

Operate starter with ignition off, i.e. disconnect positive terminal on ignition coil. Reading on voltmeter should not be less than 10,5 volts.

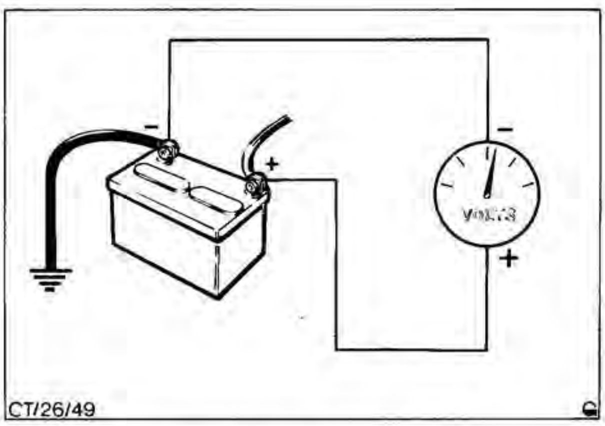


Fig. 12C. Testing load on battery terminal

26 111 (cont'd)

Test 3. Voltage Check at Starter Main Terminal (on load)

Connect a voltmeter between the starter main terminal and the body of the starter, Fig. 13.

Operate starter with ignition off. A reading of not more than 0,5 volts lower than the readings obtained at the battery should be registered. IF A GREATER VOLTAGE DROP IS PRESENT THEN THE CIRCUIT BETWEEN THE BATTERY AND STARTER TERMINAL MUST BE EXAMINED.

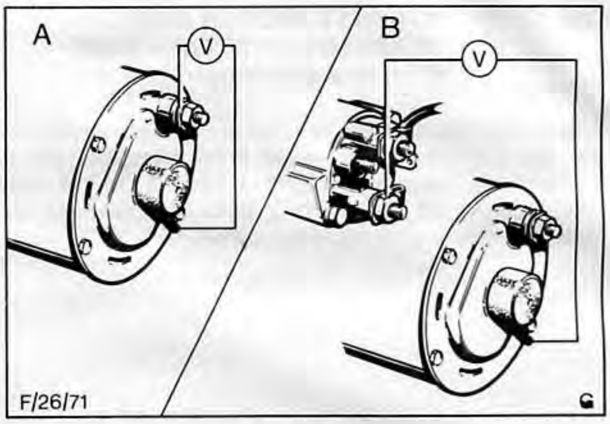


Fig. 13. Main terminal voltage check
A – Inertia starter motor
B – Pre-engaged starter motor

Test 4. Voltage Drop in Main Insulated Line (on load)

Connect a voltmeter between the battery positive terminal and the starter motor main feed terminal, Fig. 14.

Operate starter with ignition off, for two or three seconds checking meter readings. Battery voltage should be indicated first and then drop to a value less than 0,5 volts. READINGS ABOVE THIS VALUE INDICATE A HIGH RESISTANCE IN THE LINE, PROCEED TO TEST 5. IF THE READING IS LESS THAN 0,5 VOLTS, PROCEED TO TEST 6.

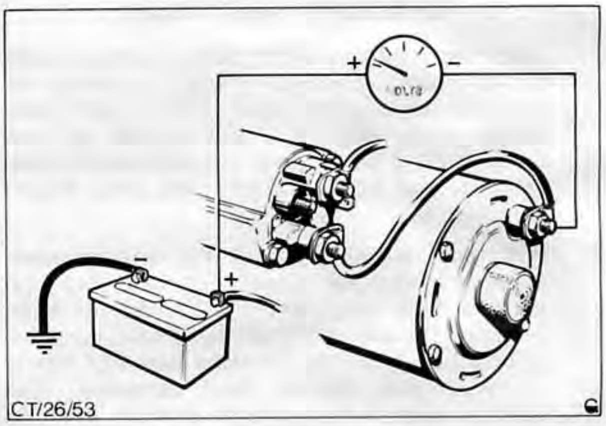


Fig. 14. Testing voltage drop in main wiring

Test 5. Voltage Drop across Starter (Solenoid) Switch

Connect a voltmeter between the two main terminal stud connections, Fig. 15.

Operate the starter for two or three seconds with the ignition off and note the meter readings.

Battery voltage should be indicated first and then a volt drop to a value less than 0,5 volts, Fig. 15 IF NOT, CHECK FOR FAULTY SWITCH OR CONNECTIONS, IF THE READING IS O.K., THEN ANY HIGH RESISTANCE CAN BE DUE TO EITHER A LOOSE OR CORRODED TERMINAL.

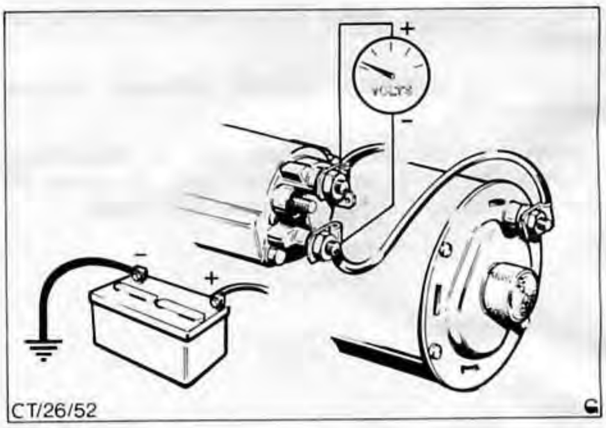


Fig. 15. Testing voltage drop across starter solenoid switch

Test 6. Voltage Drop Check on Earth Line (on load)

Connect a voltmeter between the battery negative (earth) terminal and the starter motor main casing, Fig. 16.

With the ignition off, operate starter for two or three seconds. If the earth line is satisfactory the reading should be less than 0,4 volts. A reading of 0,5 volts or more indicates a high resistance which is somewhere in the earth return side of the circuit.

Test 7. Battery Earth Connection – Check

A high reading in Test 6. can be due to a dirty or loose connection in the battery earth cable either at the battery or at the points where the cable is fastened to the engine block. (a) Check to ensure that all connections are clean and tight:

Clean and re-tighten where necessary and again carry out Test 6.

26 204 STARTER MOTOR – REMOVE AND INSTALL

To remove

1. Open hood, fit fender covers.
2. Disconnect the negative (–) i.e. earth cable from the battery.
3. On pre-engaged starters disconnect the Lucas solenoid terminal.
4. Disconnect the positive (+) main starter feed cable from the starter motor terminal (starter motor type M35J) or the solenoid on the pre-engaged types.
5. Unscrew the starter motor mounting bolts simultaneously releasing the starter motor earth cable.
   NOTE: The earth cable is attached to a starter mounting bolt with the exception of the M50G type starter which has an earth terminal.

To Install

NOTE: Before installing the starter motor, check the flywheel ring gear for excessive wear or damage. Clean the contact surfaces.

6. Install the starter motor and secure it with the mounting screws.
   One mounting screw is used to attach the starter earth cable on all starters except starter motor type M50G.
7. Connect the starter positive cable to the starter terminal (inertia) or the solenoid terminal (pre-engaged). On starter motor type M50G connect the earth cable to the terminal on the commutator end cover.
8. Connect the battery negative (–) earth cable.
9. Remove fender covers, close hood.

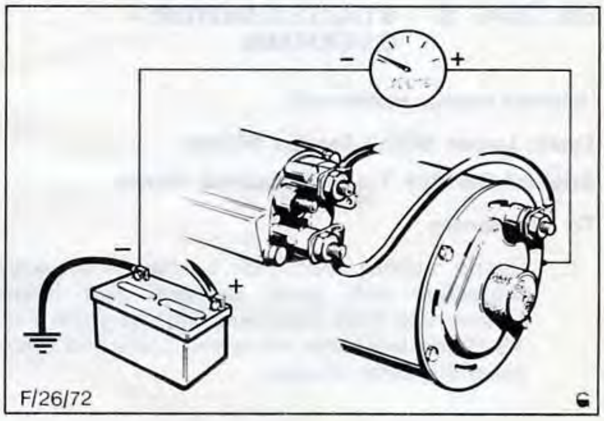


Fig. 16 Testing voltage drop in earth line

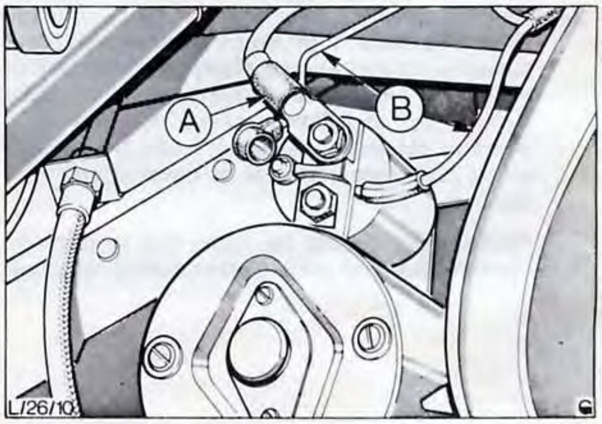


Fig. 17. Electrical connections on pre-engaged starter
A – Main feed cable
B – Loom wires

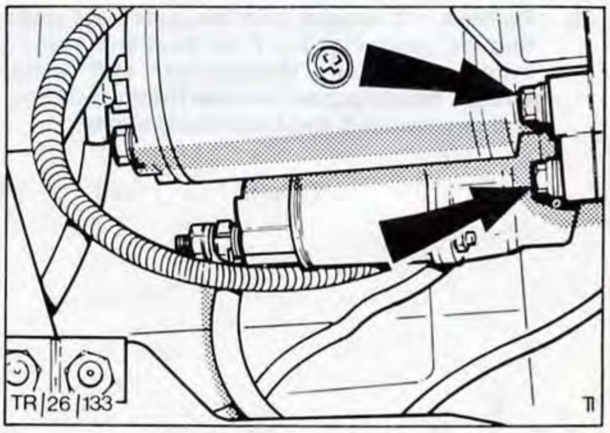


Fig. 18. Starter motor securing bolts

LUCAS

26 204 8 STARTER MOTOR – OVERHAUL

(Starter motor removed)

Type: Lucas M35J Inertia Motor

Special Service Tools Required: None

To Dismantle

1. Clamp starter motor in a vice fitted with protective soft jaws. Remove two fixing screws that hold drive-end plate to yoke, Fig. 19 Guide armature, drive-end plate and drive assembly clear of yoke.

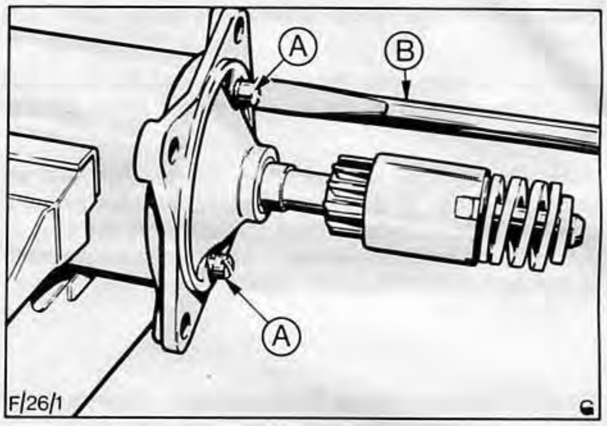


Fig. 19. Removing drive-end plate
A – Fixing screws
B – Screwdriver

2. Remove plastic cover from end of armature shaft. Remove four commutator end plate securing screws and carefully tap plate free of yoke. Lift commutator plate clear of yoke sufficiently to allow access to two field winding brushes, disconnect two brushes to allow complete removal of commutator end plate, Fig. 20.

   NOTE: Care should be taken not to damage commutator end plate gasket during removal.

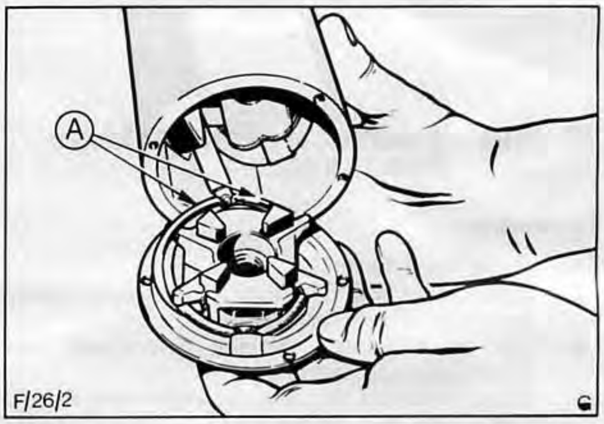


Fig. 20. Lift commutator plate clear of yoke sufficiently to allow access to both field winding brushes
A – Two field winding brushes

3. Remove nut, washer and insulator from main terminal stud, Fig. 21. Push stud and second insulator through commutator end plate, unhook two attached brushes from brush box, and remove stud and brushes complete.

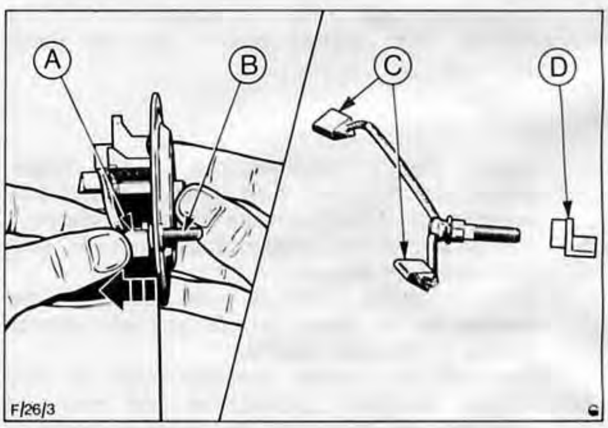


Fig. 21. Removing brushes
A – Insulator
B – Terminal stud
C – Brushes
D – Insulator

LUCAS

4. To remove brush box drill out two rivets securing brush box to commutator end plate and remove brush box and gasket.

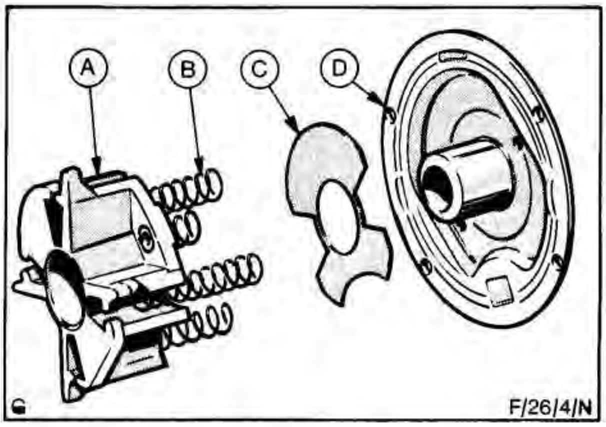


Fig. 22. Brush box and commutator end plate
A – Brush box
B – Brush springs
C – Insulation gasket
D – Commutator end plate

5. Using a suitable adaptor in a press, Fig. 23, remove drive pinion assembly by compressing spring and removing 'C' clip from armature shaft. Remove main drive pinion assembly from armature shaft.

6. Separate drive-end plate and armature by guiding armature shaft free of end plate.

7. Checking components.

   After dismantling motor, examine components for wear or damage and replace as necessary.

A. Brushgear

   Check for sticking brushes. If necessary, clean brushes and brush box moulding with a petrol-moistened cloth.
   Check brushes for wear. Brushes worn to approximately 8 mm (0,32 in) should be renewed, as a set.

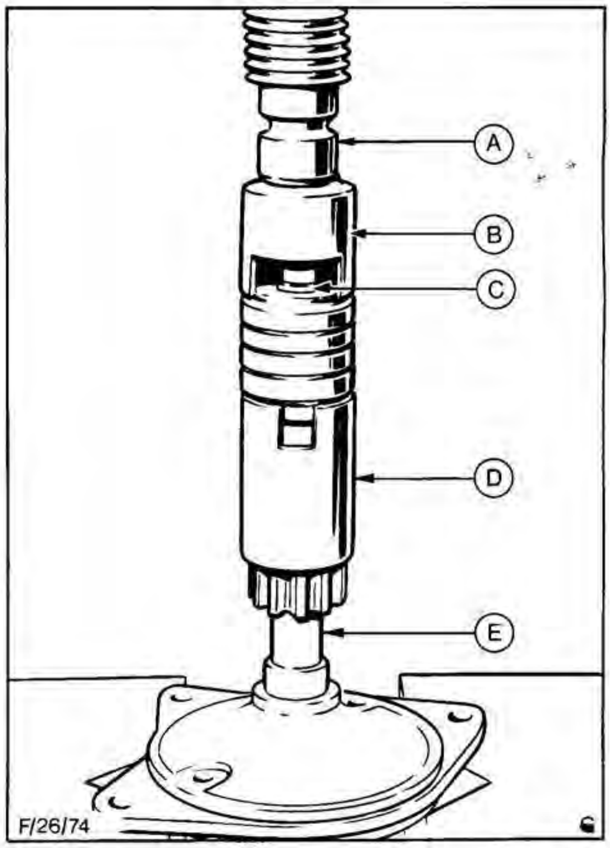


Fig. 23. Removing drive pinion
A – Press spindle
B – Adaptor
C – 'C' clip
D – Drive pinion
E – Armature shaft

26 204 8 (cont'd)

Two of the brushes are serviced complete with commutator end plate terminal but field winding brushes will need soldering to original brush-leads, which should be cut about 6 mm (0,25 in) from field winding conductor. Note arrangement of short and long brush-leads (see Fig. 24) and ensure a perfect soldered joint to maintain the correct length.

Check brush spring pressure, renew if suspect. Spring pressure should be 7.80 N (28 ozf or 0.8 kgf) approximately.

NOTE: Brush springs are not serviced individually. If an incorrect spring pressure reading is obtained, brush box assembly should be renewed.

Check insulation between brush springs and terminal post by connecting a 110 volts a.c. 15-watt test lamp, between a clean unpainted part of end plate and each of springs in turn and then between end plate and terminal post. Test lamp should not light, Fig. 25.

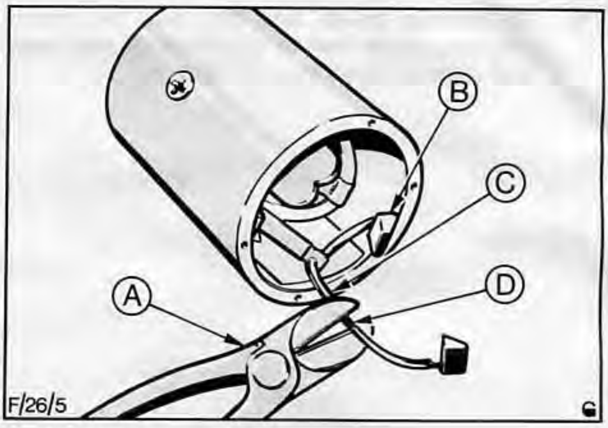


Fig. 24. Cutting brush leads
A – Wire cutters
B – Short brush lead
C – Long brush lead
D – Cut 6 mm (0.25 in) from conductor

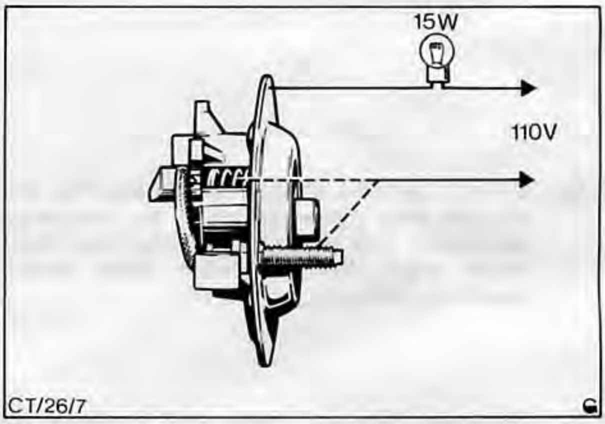


Fig. 25. Checking brush spring insulation

B. Armature

Face of commutator should be clean and free from burnt spots. Clean commutator with a petrol-moistened cloth and, if necessary, use fine glass paper to remove burnt spots.

NOTE: This should be done prior to cleaning with petrol-moistened cloth. Do not use emery cloth.

NOTE: If it is considered necessary to skim the commutator, the minimum thickness must never be below 2 mm (0,080 in).

Skimming operation should be followed by polishing commutator surface with fine glass paper, then wipe clean with a petrol-moistened cloth.

DO NOT UNDER-CUT THE INSULATION SLOTS.

Armature insulation can be checked by connecting a 110 V a.c. 15-watt test lamp between a commutator and shaft. Lamp should not light, see Fig. 26.

Short-circuited armature windings can normally only be detected by the use of specialised armature testing equipment. If this equipment is not available, the only alternative is to check the armature by substitution.

If armature laminations have been in contact with pole pieces, armature bearings are probably excessively worn. First check that pole pieces are tight and that armature runs true in a lathe. Then if necessary renew armature bearings, refer to sub op. 7 'D'.

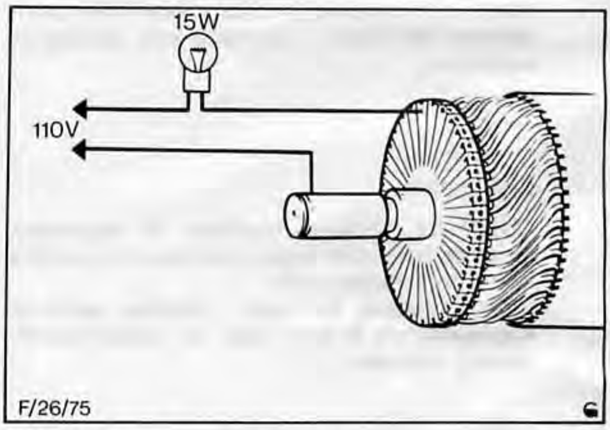


Fig. 26. Testing armature insulation

C. Yoke and Field Winding Assembly

Inspect field winding in-situ for obvious signs of a fault. A visual indication of a breakdown in field winding insulation will eliminate need for testing and field winding must be renewed.

Providing field winding insulation appears to be satisfactory, and providing starter has been sufficiently dismantled to enable earthed-end of field winding to be inspected, check continuity between field winding brushes and flexible link connection to yoke, Fig. 27. Check for a firmly rivetted connection between flexible link and yoke.

If there are no obvious signs of a field winding fault, disconnect earthed-end of field winding to enable a positive field winding insulation test to be carried out.

After disconnecting earthed-end of field winding at yoke (not the hot-pressed joint between field winding and flexible link), carry out a positive test of field winding insulation by connecting a 110 volts a.c. 15-watt test lamp between disconnected end of winding and a clean unpainted part of yoke. Test lamp should not light. Ensure neither of the brushes or bare part of their leads are contacting yoke during test.

A field winding continuity test is unnecessary in the case of full-dismantling, where it is possible to inspect joints at both ends of field winding.

Field winding replacement.

Disconnect earthed-end of winding at yoke by drilling out riveted connection. Alternatively, end of rivet can either be filed or ground away and rivet then tapped from yoke.

Slacken four pole-piece retaining screws. Remove two of these screws from a diametrically opposite pair of pole-pieces and remove pole-pieces from yoke. Providing remaining pair of pole pieces are sufficiently slackened, field winding can be slid out from beneath shoulders of in-situ pole-pieces and withdrawn from yoke.

When working on Lucas starter motors special tools CP9504 and CP9509 can be used to assist in pole piece/field winding replacement as shown in Fig. 28.

Clean yoke and insulating piece which separates field winding brush-joint from yoke. Loosely fit new field winding and two pole-pieces in yoke and position insulation piece between brush-joint and yoke. Tighten the pole-piece screws evenly to a torque of 40.70 Nm (30 lbf.ft) and make a good riveted connection between earth-end of winding and yoke.

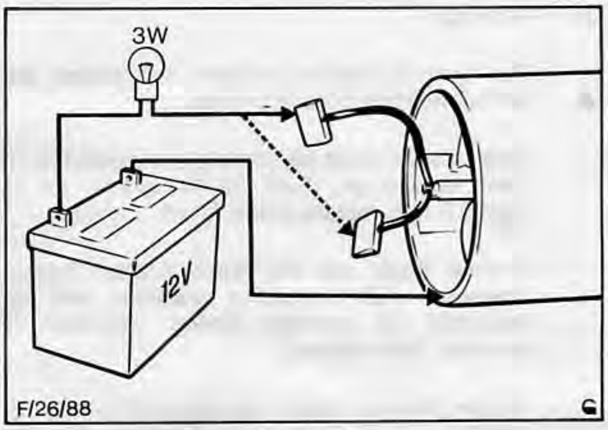


Fig. 27. Testing field winding continuity

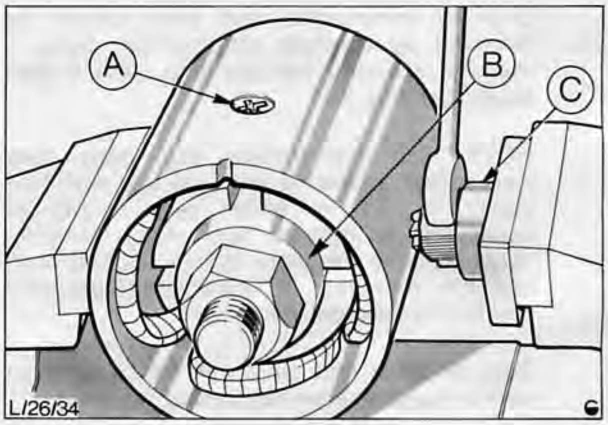


Fig. 28. Removing pole screws
A – Pole screw
B – Pole piece expander (CP9509)
C – Pole piece screwdrive (CP9504)

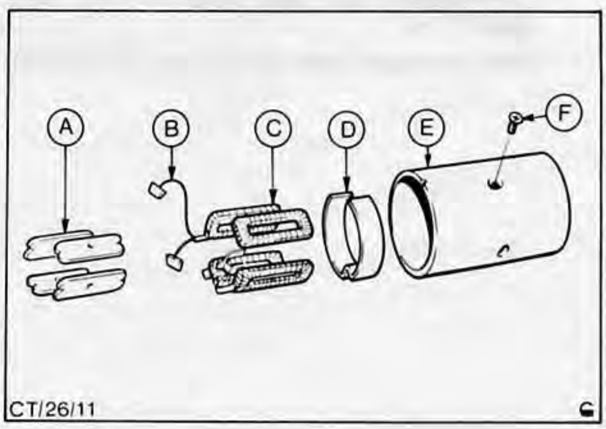


Fig. 29. Yoke assembly
A – Pole pieces D – Insulator
B – Field brushes E – Yoke
C – Field windings F – Pole Screw

26 204 8 (cont'd)

D. Bearings

The bearing bushes in both end plates are self-lubricating porous bronze.

New bushes must be completely immersed in clean engine oil, (SAE 30/40 grade) for at least 20 min. before being fitted.

Bushes must not be reamed after fitting, otherwise self-lubricating qualities will be impaired (A special fitting mandrel is required, refer below).

Renew bushes when excessive side-play of armature shaft is evident. Fouling of pole-pieces by armature, or inefficient operation of starter, is likely to occur when inner diameter of bushes exceeds following dimensions: commutator end plate bush 11,20 mm (0,44 in) drive end plate bush 19,15 mm (0,75 in).

Bush in commutator end plate should be removed by carefully tapping out, using a mandrel ensuring that the end plate is well supported, Fig. 30.

NOTE: The commutator end plate may incorporate a bearing felt seal and retaining plate, Fig. 31, in which case it will be necessary to remove two rivets securing these parts to the plate, before bearing bush can be renewed. A service replacement bearing kit, includes new rivets.

Bush in drive end plate can be tapped out with a mandrel, after supporting the plate.

New bushes should preferably be pressed into position, but alternatively can be tapped into position, using a shouldered mandrel with fitting pin dimension polished to the following diameters:

Commutator end plate bush 11,117 mm (0,4377 in).

Drive end plate bush 19,042 mm (0,7497 in).

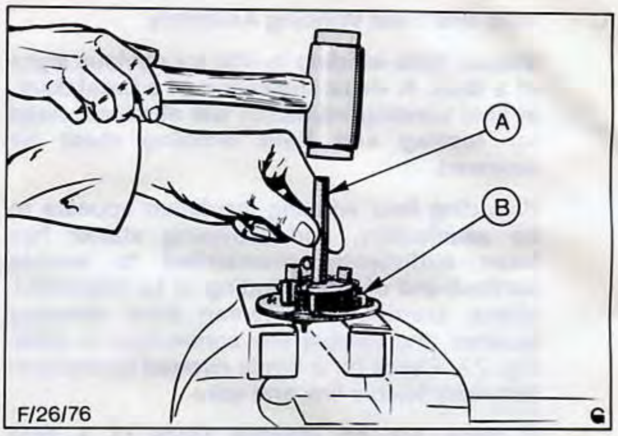


Fig. 30. Removing commutator end bearing bush
A – Mandrel
B – Commutator end plate

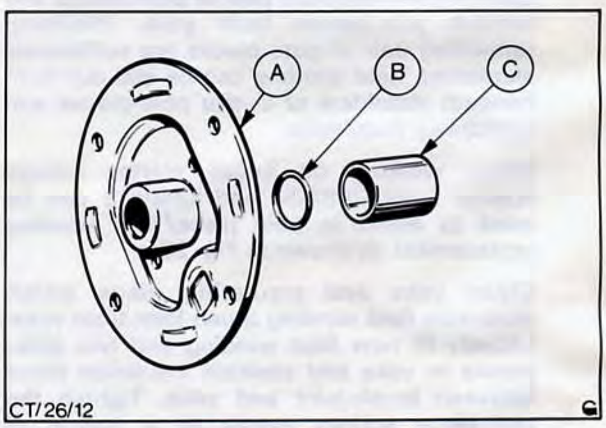


Fig. 31. End plate assembly
A – Commutator end plate
B – Felt seal
C – Bearing

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To Assemble

8. Slide drive end plate onto armature shaft. Assemble drive pinion assembly to armature shaft. Replace main cushion spring and spring cup, compress spring and fit 'C' clip.
9. Position brush box gasket on commutator end plate, align brush box into position on gasket, Fig. 32, and rivet brush box to commutator end plate.

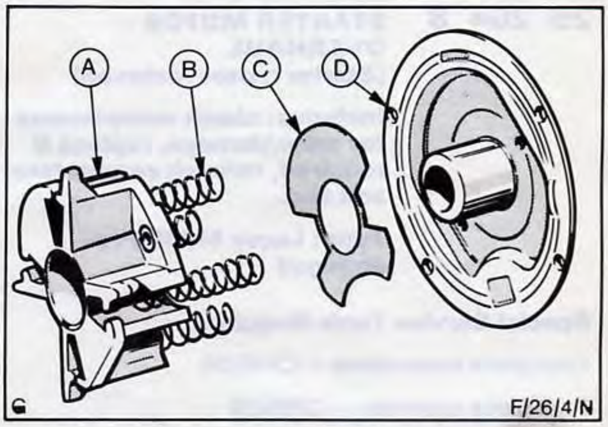


Fig. 32. Brush box and commutator end plate
A – Brush box
B – Brush spring
C – Insulator gasket
D – Commutator end plate

10. Fit main terminal stud and insulator bush through aperture in commutator end plate. Secure stud with second insulator, washer and nut. Fit two brushes, that are attached to stud, into their respective channels in brush box, Fig. 33.
11. Place two field winding brushes in their respective channels in brush box, Fig. 33, align commutator end plate to yoke and secure plate with four screws. Clip plastic cap onto commutator end plate.

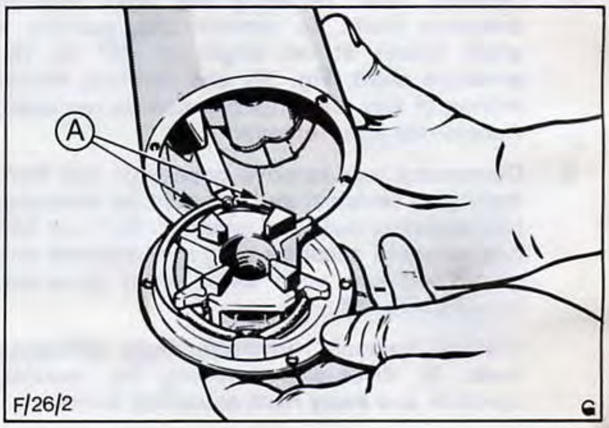


Fig. 33. Position brushes as shown
A – Brush-to-field-winding leads

12. Guide armature assembly through yoke so that armature shaft slides into bush in commutator end plate. Match alignment notches in yoke and drive end plate, Fig. 34. Secure end plate to yoke with two fixing screws.

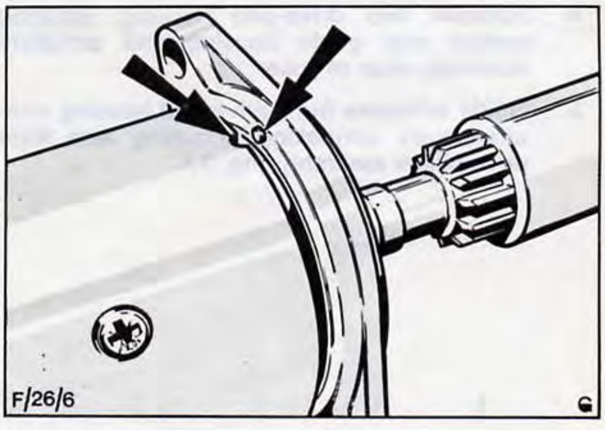


Fig. 34. Align location notches

26 204 8 STARTER MOTOR – OVERHAUL (Starter motor removed)

Includes: check components for wear/damage, replace if required, refinish commutator and test.

Type: Lucas 5M90 Pre-engaged

Special Service Tools Required:

Pole-piece screwdriver – CP9504

Pole-piece expander – CP9509

To Dismantle

1. Clamp starter motor in a vice fitted with protective soft jaws. Remove plastic cap from commutator end plate.

2. Remove 'star' retaining clip from end of armature shaft. To remove clip, position a small chisel at an angle of 45° to the armature shaft, Fig. 35, and carefully distort prongs of star clip until clip can be removed, discard clip after removal.

3. Disconnect and remove connector link from main feed terminal and solenoid by removing two retaining nuts and washers. Remove two two solenoid securing nuts and washers and guide solenoid yoke away from drive-end housing, Fig. 36.

   Unhook solenoid armature from actuating lever in drive-end housing by moving upwards and away from actuating lever.

4. Remove two drive-end housing securing screws and guide housing and armature assembly clear of yoke.

5. Guide armature from drive-end housing simultaneously unhooking actuating arm from drive pinion assembly, Fig. 37.

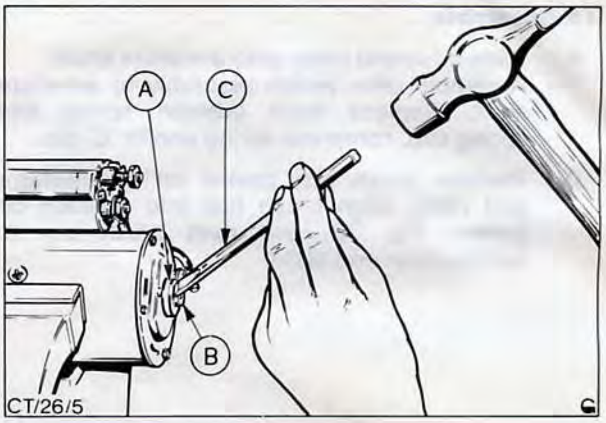


Fig. 35. Removing star retaining clip
A – Star washer
B – Armature shaft
C – Chisel

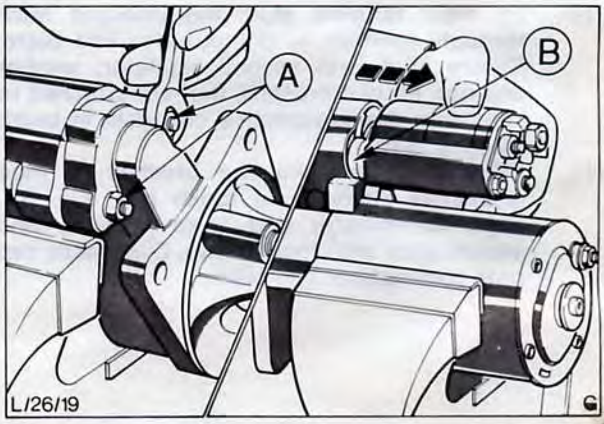


Fig. 36. Unhook solenoid from actuating arm as solenoid is removed
A – Solenoid securing studs
B – Rubber seal

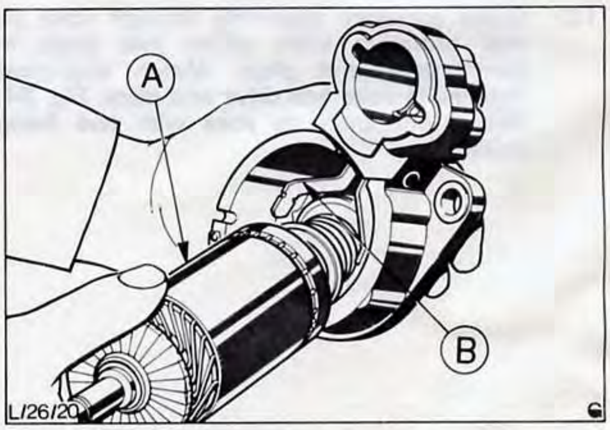


Fig. 37. Unhook armature from actuating arm as armature is guided clear of drive-end housing
A – Armature
B – Actuating arm

6. Remove rubber block and neoprene seal/ sleeve from drive-end housing, Fig. 38.

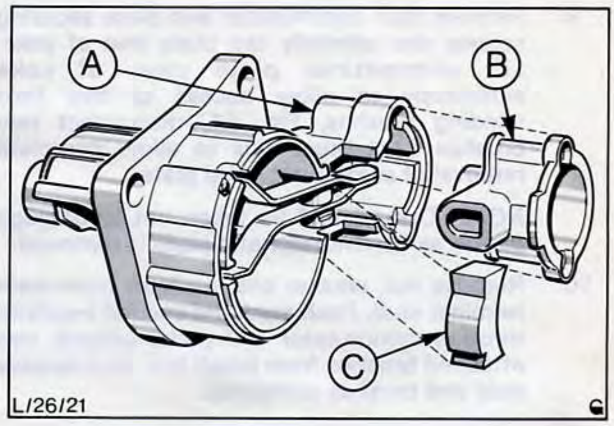


Fig. 38. Positions of seals
A – Drive-end housing
B – Neoprene seal/sleeve
C – Rubber block

7. Drive actuating arm pivot pin from drive-end housing, Fig. 39. The pin retaining star clip will distort under pressure and allow removal of pin.

   Discard star clip and remove actuating arm from housing.

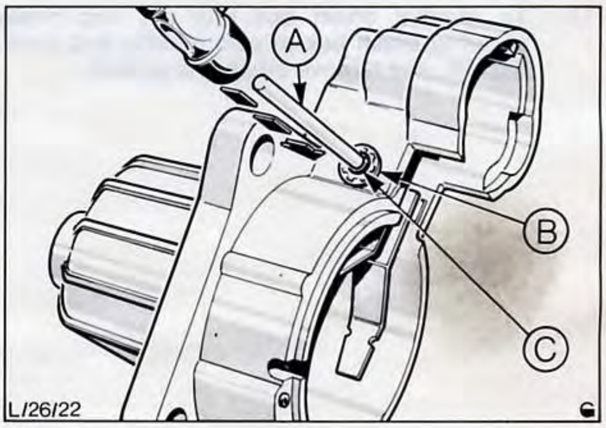


Fig. 39. Removing pivot pin
A – Small metal drift
B – Star clip
C – Pivot pin

8. To remove drive pinion assembly from armature shaft, use a suitably dimensioned tube to separate thrust collar from 'C' clip, Fig. 40.

   Remove 'C' clip from its groove and slide thrust collar and drive pinion assembly off armature shaft.

   NOTE: Do not grip the one-way clutch in a vice whilst carrying out this operation as it will be damaged.

   The drive pinion and clutch are serviced as a complete unit as repairs to the unit are impractical.

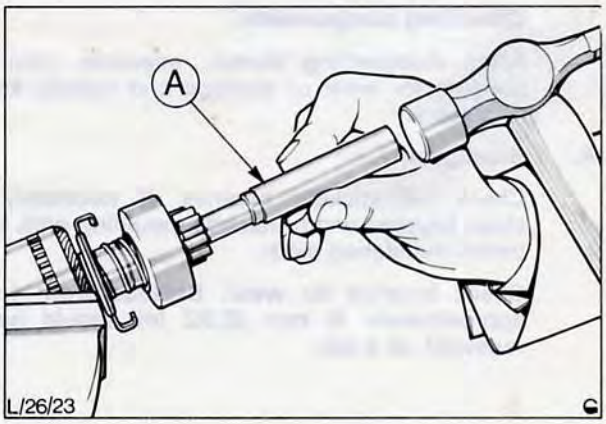


Fig. 40. Slide thrust collar down armature shaft using a suitably dimensioned tube, 'A'

26 204 8 (cont'd)

9. Remove four commutator end plate securing screws and carefully tap plate free of yoke. Lift commutator plate clear of yoke sufficiently to allow access to two field winding brushes, Fig. 41, disconnect two brushes from brush box to allow complete removal of commutator end plate.

   NOTE: Care should be taken not to damage gasket as commutator end plate is removed.

10. Remove nut, washer and insulator from main terminal stud. Push stud and second insulator through commutator end plate, unhook two attached brushes from brush box, and remove stud and brushes complete.

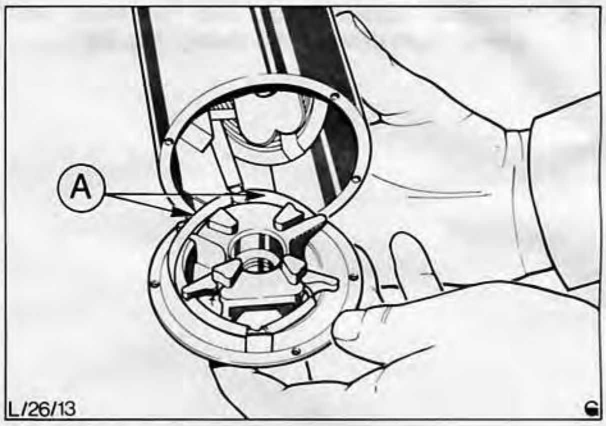


Fig. 41. A – Field winding brushes

11. To remove brush box drill out two rivets securing brush box to commutator end plate, Fig. 42, and remove brush and gasket.

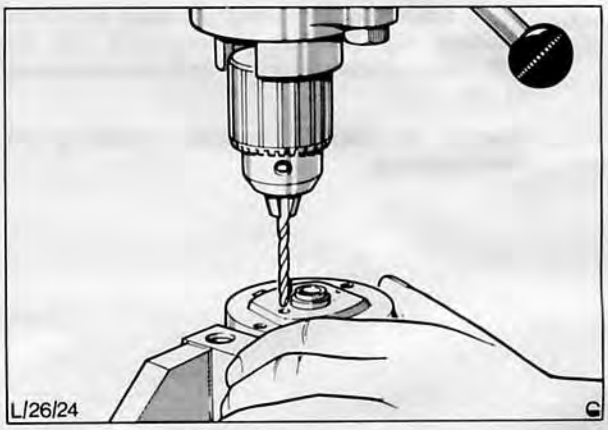


Fig. 42. Drilling out brush box securing rivets

12. **Checking components**

    After dismantling motor, examine components for wear or damage and replace as necessary.

A. Brushgear

   Check for sticking brushes. If necessary, clean brushes and brush box moulding with a petrol-moistened cloth.

   Check brushes for wear. Brushes worn to approximately 8 mm (0,32 in) should be renewed, as a set.

Two of the brushes are serviced complete with commutator end plate terminal but field winding brushes will need soldering to original brush-leads, which should be cut about 6 mm (0,25 in) from field winding conductor. Note arrangement of short and long brush-leads, Fig. 43, and ensure a perfect soldered joint to maintain the correct length.

Check brush spring pressure, renew if suspect. Spring pressure should be 7,80 N (28 oz.f or 0,8 kg.f) approximately.

NOTE: Brush springs are not serviced individually. If an incorrect spring pressure reading is obtained, brush box assembly should be renewed.

Check insulation between brush springs and terminal post by connecting a 110 volts a.c. 15-watt test lamp, between a clean unpainted part of end plate and each of springs in turn and then between end plate and terminal post. Test lamp should not light, Fig. 44.

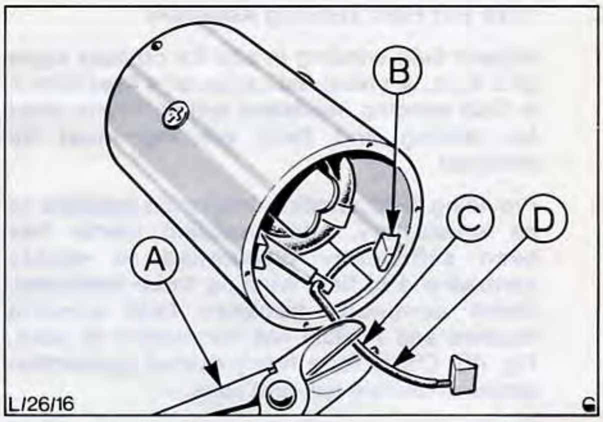


Fig. 43. Cutting long brush lead
A – Wire cutters
B – Short brush lead
C – Cut 6 mm (0,25 in) from conductor
D – Long brush lead

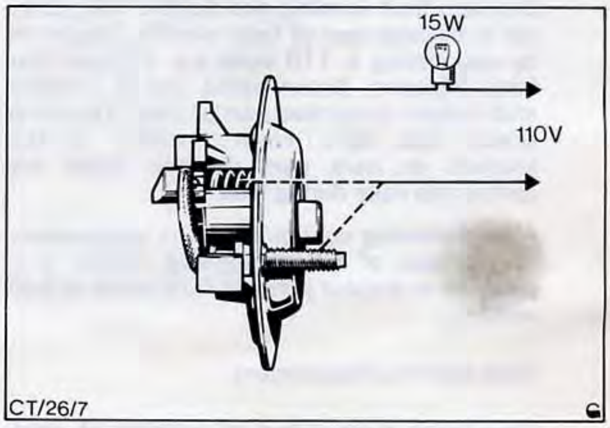


Fig. 44. Checking brush spring insulation

B. Armature

Face of commutator should be clean and free from burnt spots. If necessary remove any burnt spots using fine glass paper. (Do not use emery cloth), and then clean commutator with a petrol-moistened cloth.

If it is considered necessary to skim the commutator, the minimum thickness must never be below 2 mm (0,080 in).

Skimming operation should be followed by polishing commutator surface with fine glass paper, then wipe clean with a petrol-moistened cloth.

DO NOT UNDER-CUT THE INSULATION SLOTS.

Armature insulation can be checked by connecting a 110 volts a.c. 15-watt test lamp between a commutator segment and shaft. Lamp should not light, see Fig. 45.

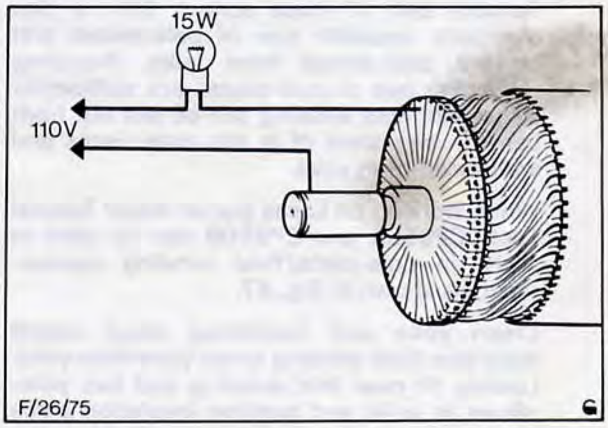


Fig. 45. Testing armature insulation

Short-circuited armature windings can normally only be detected by the use of specialised armature testing equipment. If this equipment is not available, the only alternative is to check the armature by substitution.

If armature laminations have been in contact with pole-pieces armature bearings are probably excessively worn. First check that pole-pieces are tight and that armature runs true in a lathe.

Then, if necessary, renew armature bearings refer to sub-operation 'D' on page 27.

26 204 8 (cont'd)

C. Yoke and Field Winding Assembly

Inspect field winding *in situ* for obvious signs of a fault. A visual indication of a breakdown in field winding insulation will eliminate need for testing and field winding must be renewed.

Providing field winding insulation appears to be satisfactory, and providing starter has been sufficiently dismantled to enable earthed-end of field winding to be inspected, check continuity between field winding brushes and flexible link connection to yoke, Fig. 46. Check for a firmly riveted connection between flexible link and yoke.

If there are no obvious signs of a field winding fault, disconnect earthed-end of field winding to enable a positive field winding insulation test to be carried out.

After disconnecting earthed-end of field winding at yoke (not the hot-pressed joint between field winding and flexible link), carry out a positive test of field winding insulation by connecting a 110 volts a.c. 15-watt test lamp between disconnected end of winding and a clean unpainted part of yoke. The lamp should not light. Ensure neither of the brushes or bare part of their leads are contacting yoke during test.

A field winding continuity test is unnecessary in the case of full-dismantling, where it is possible to inspect joints at both ends of field winding.

Field winding replacement

Disconnect earthed-end of winding at yoke by drilling out riveted connection. Alternatively, end of rivet can either be filed or ground away and rivet then tapped from yoke.

Slacken four pole-piece retaining screws. Remove two of these screws from a diametrically opposite pair of pole-pieces and remove pole-pieces from yoke. Providing remaining pair of pole-pieces are sufficiently slackened, field winding can be slid out from beneath shoulders of *in situ* pole-pieces and withdrawn from yoke.

When working on Lucas starter motor Special Tools CP9504 and CP9509 can be used to assist in pole-piece/field winding replacement, as shown in Fig. 47.

Clean yoke and insulating piece which separates field winding brush-joint from yoke. Loosely fit new field winding and two pole-pieces in yoke and position insulation piece between brush-joint and yoke. Tighten the pole-piece screws evenly to a torque of 40,70 Nm (30 lbf.ft) and make a good riveted connection between earth-end of winding and yoke.

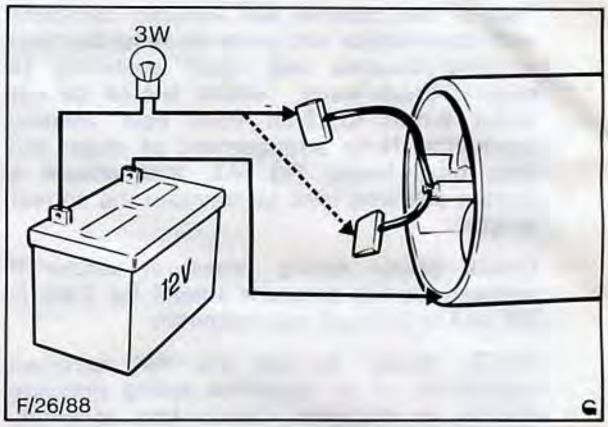


Fig. 46. Testing field winding continuity

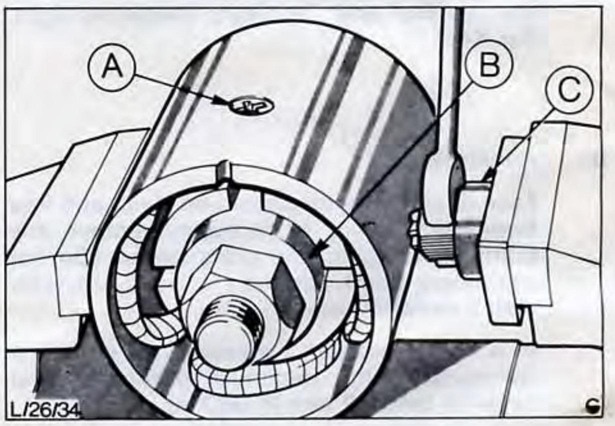


Fig. 47. Removing pole screws
A – Pole screw
B – Pole-piece expander (CP9509)
C – Pole-piece screwdriver (CP9504)

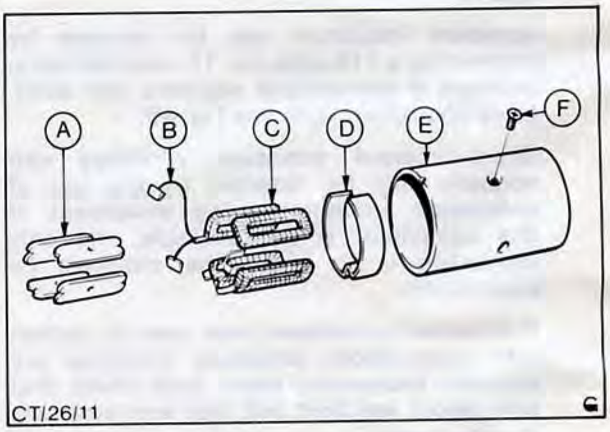


Fig. 48. Yoke assembly
A – Pole-pieces
B – Field brushes
C – Field windings
D – Insulator
E – Yoke
F – Pole screw

D. Bearings

The bearing brushes in both end plates are self-lubricating porous bronze.

New bushes must be completely immersed in clean engine oil, (SAE 30/40 grade) for at least 20 min. before being fitted.

Bushes must not be reamed after fitting, otherwise self-lubricating qualities will be impaired. (A special fitting mandrel is required, refer to last paragraph.)

Renew bushes when excessive side-play of armature shaft is evident. Fouling of pole-pieces by armature, or inefficient operation of starter, is likely to occur when inner diameter of bushes exceeds following dimensions: commutator end plate bush 11,20 mm (0,44 in); drive end plate bush 19,15 mm (0,75 in).

Bush in commutator end plate should be removed by carefully tapping out, using a mandrel ensuring that the end plate is well supported, Fig. 49.

NOTE: The commutator end plate may incorporate a bearing felt seal and retaining plate, Fig. 50. in which case it will be necessary to remove two rivets securing these parts to the plate, before bearing bush can be renewed. A service replacement bearing kit includes new rivets.

Bush in drive end plate can be tapped out with a mandrel, after supporting the plate.

New bushes should preferably be pressed into position, but alternatively can be tapped into position, using a shouldered mandrel with fitting pin dimension polished to the following diameters:

Commutator end plate bush 11,117 mm (0,4377 in).

Drive end plate bush 19,042 mm (0,7497 in).

To Assemble

13. Position brush box gasket on commutator end plate, align brush box into position on gasket, rivet brush box to commutator end plate.

14. Fit main terminal stud and insulator bush through aperture in commutator end plate.

    Secure stud with second insulator, washer and nut, Fig. 51. Fit two brushes, that are attached to stud, into their respective channels in brush box.

15. Place two field winding brushes in their respective channels in brush box, align commutator end plate to yoke and secure plate with four screws.

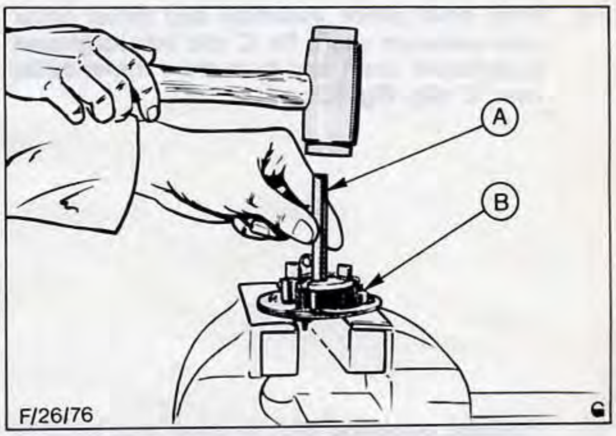


Fig. 49. Removing commutator end bearing bush
A – Mandrel
B – Commutator end plate

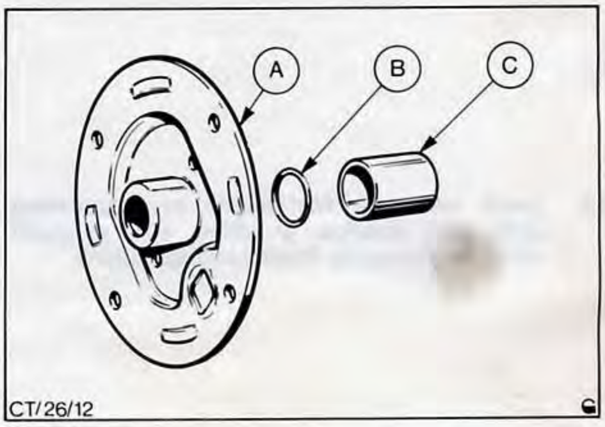


Fig. 50. End plate assembly
A – Commutator end plate
B – Felt seal
C – Bearing

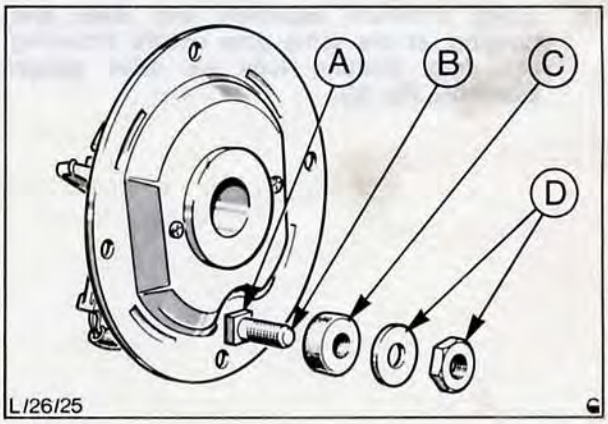


Fig. 51. Insulator assembly
A – First insulator
B – Terminal stud
C – Second insulator
D – Nut and washer

26 204 8 (cont'd)

16. Slide drive pinion assembly and thrust collar onto armature shaft. Fit 'C' clip into its groove in armature shaft and then draw thrust collar over 'C' clip, Fig. 52.

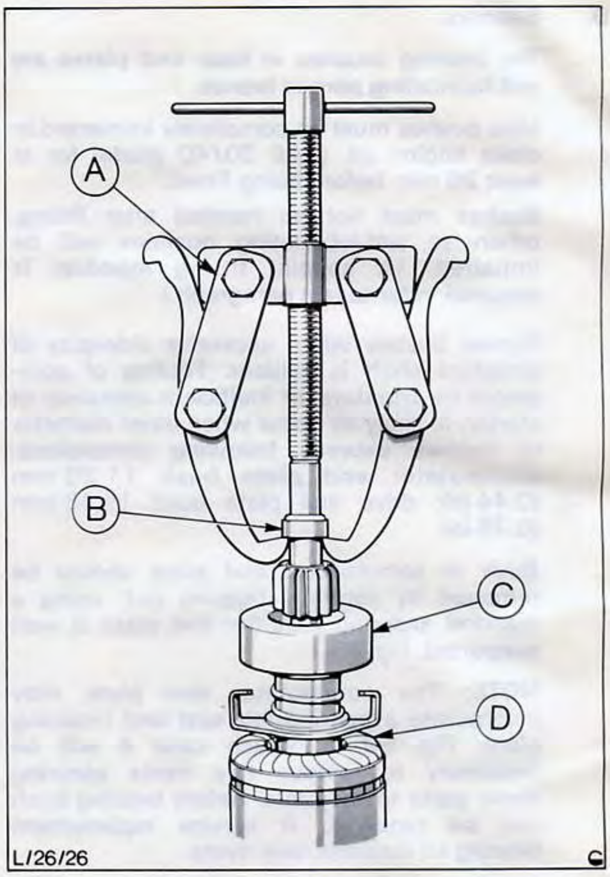


Fig. 52. A – Standard two-leg puller
B – Thrust collar
C – Drive pinion assembly
D – Armature

17. Position actuating arm in drive end housing and locate with pivot pin. Retain pivot pin with a new star clip.

18. Hook neoprene seal/sleeve over actuating arm and position in drive end solenoid mounting housing. Position rubber block.

19. Guide armature assembly into drive end housing, at the same time couple actuating arm into locating lugs on drive pinion assembly, Fig. 53.

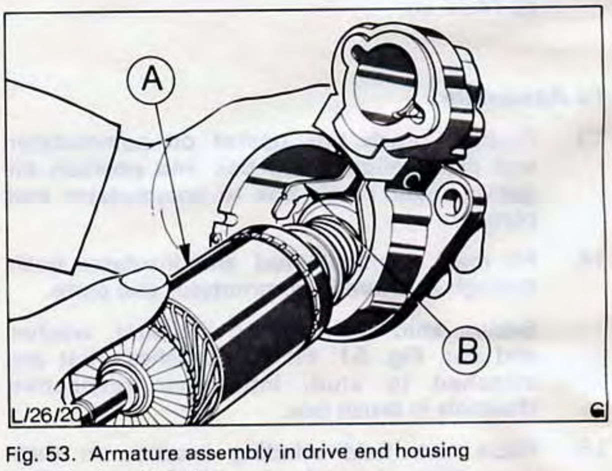


Fig. 53. Armature assembly in drive end housing
A – Armature
B – Actuating arm

20. Guide armature and drive end housing assembly through yoke and align armature shaft with commutator plate end bush.

21. Match alignment notches in yoke and drive end housing, Fig. 54, and secure yoke and housing with two fixing screws.

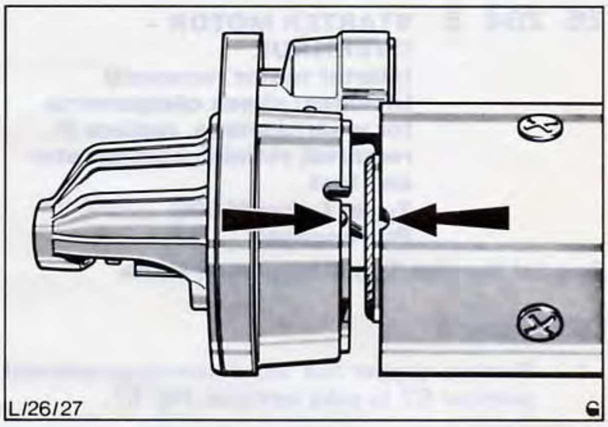


Fig. 54. Match alignment notches

22. Fit a new star clip onto end of armature shaft, Fig. 55.

NOTE: Ensure that star clip is pressed home firmly to eliminate any end-float in the armature. Refit plastic cap over star clip and armature shaft end.

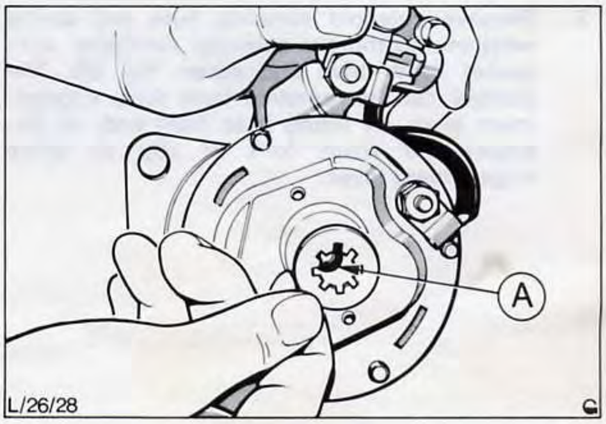


Fig. 55. Fit new star clip onto armature shaft
A – Armature shaft

23. Locate solenoid armature onto actuating arm. Guide solenoid yoke over solenoid armature, locate yoke securing studs through drive end housing and secure with two nuts and washers.

24. Refit connector link between solenoid and main feed terminal and secure with nuts and washers, Fig. 56.

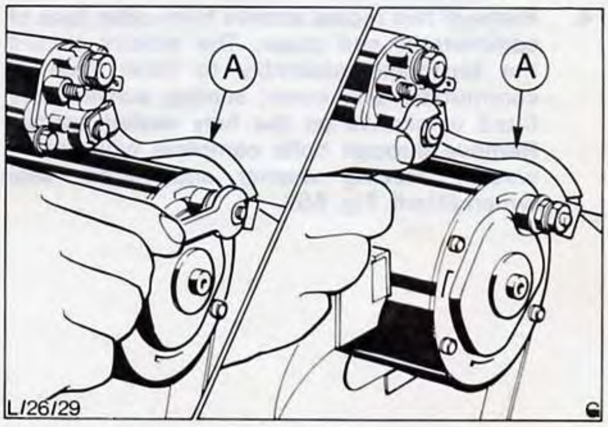


Fig. 56. Secure 'A', connector link, to solenoid and main terminal

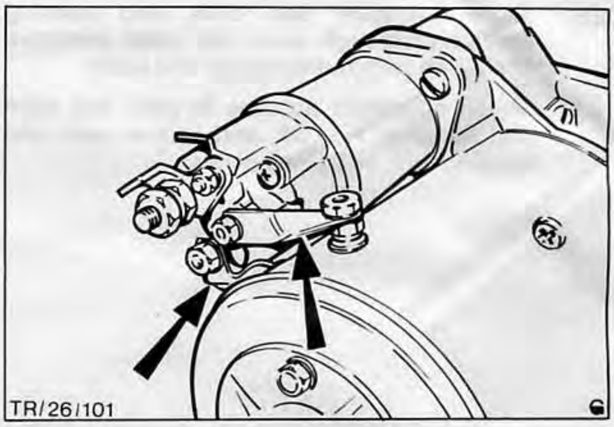
26 204 8 STARTER MOTOR – OVERHAUL

(starter motor removed)
Includes: check components for wear/damage, replace if required, refinish commutator and test
Type: Lucas M50G
Pre-engaged

Special Service Tools Required: None

To Dismantle

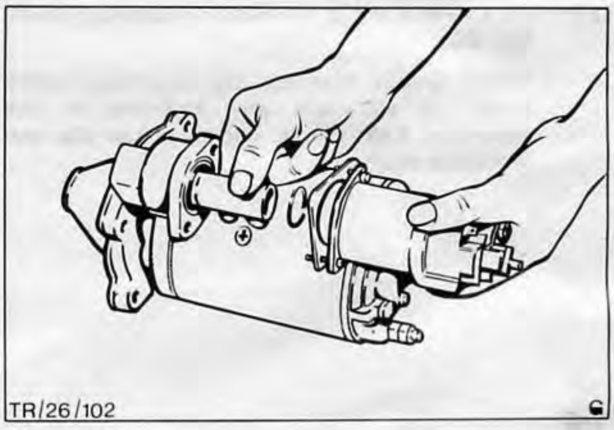
1. Remove copper link which connects solenoid terminal S2 to yoke terminal, Fig. 57.
2. Disconnect flexible link connecting solenoid terminal S1 to indexing field coil inside yoke.



TR/26/101

Fig. 57. Solenoid terminal to yoke terminal copper link

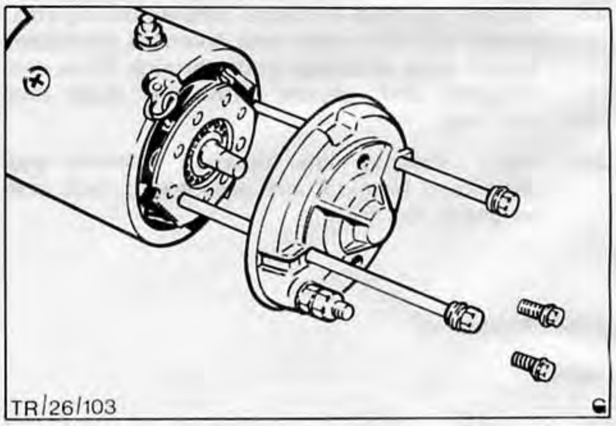
3. Remove solenoid securing nuts and spring washers. Withdraw solenoid complete with gasket from drive end cover, Fig. 58. The plunger can be removed from drive engagement lever, by lifting it at front end, to disengage it from fork at top of drive engagement lever.



TR/26/102

Fig. 58. Withdrawing solenoid from drive end cover

4. Remove two recess screws from outer face of commutator end cover. The screws secure the brushgear assembly to inner face of commutator end cover; sealing washers are fitted to screws on the fully sealed starter. Remove through bolts complete with spring washer, locking washer and rubber seal (when fitted), Fig. 59.



TR/26/103

Fig. 59. Commutator end cover, recess screws and through bolts

5. Remove foam rubber block which is wedged between drive end cover solenoid mount and yoke, Fig. 60.

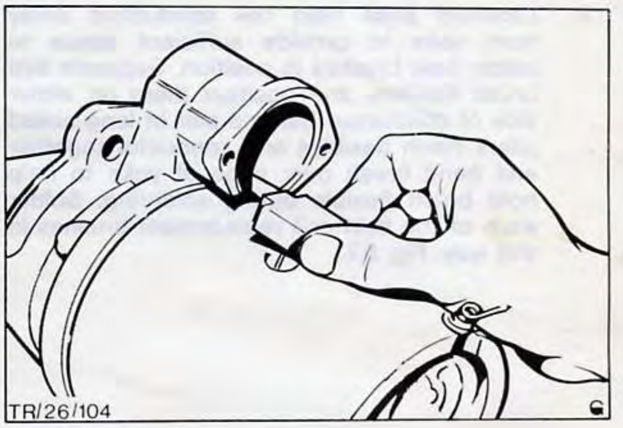


Fig. 60. Removing foam rubber block

6. Using a wire hook pull back brush springs and slide brushes out of their holders. Remove yoke from drive end cover and armature. To renew earthed brushes place a hot soldering iron on rolled over contact holding brush flexible joint. When solder is molten, using a small screwdriver, prise up metal suffiently to allow removal of old brush lead. Insert new brush lead and solder it in place, Fig. 61.

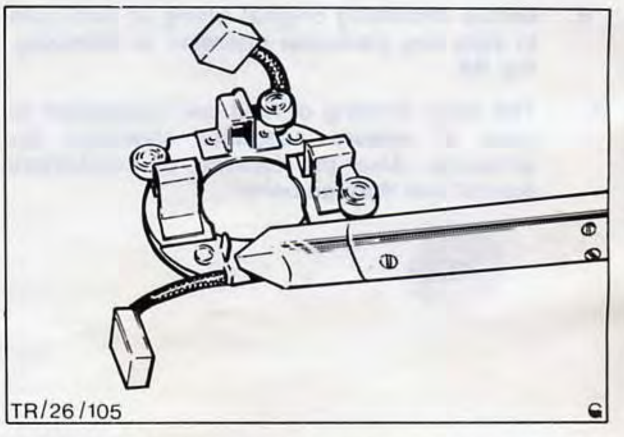


Fig. 61. Using soldering iron to solder new brush lead into place

7. Cut worn field coil brushes as near as possible to field coil conductor, Fig. 62.

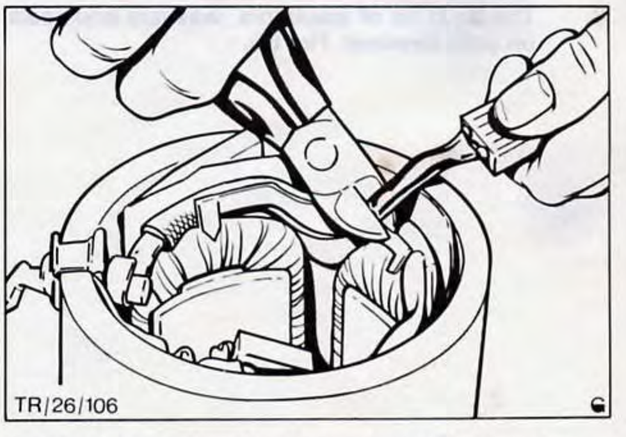


Fig. 62. Cutting field coil brush away from field coil conductor

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8. Carefully prise field coil conductors away from yoke to provide sufficient space to solder new brushes in position. Separate two brush flexibles and position them on either side of conductor. Using a pair of long nosed pliers pinch flexibles and conductor together and bend brush over edge of yoke to help hold brush flexible during soldering. Solder each of the field coil replacement brushes in this way. Fig. 63.

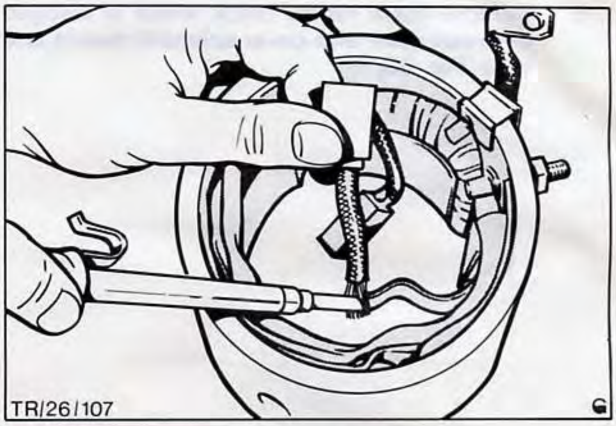

Fig. 63. Soldering field coil brush into position

9. Before disturbing original fitting of field coils in yoke pay particular attention to following, Fig. 64.

A. The close forming of field coil conductors to yoke to ensure adequate clearance for armature. Also the forming of conductors around two through bolts.

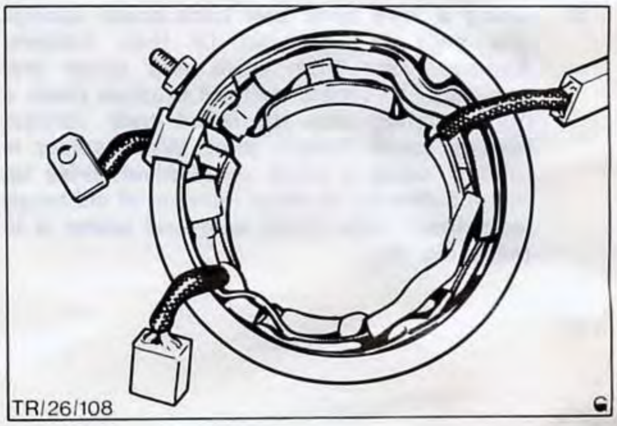

Fig. 64. Yoke assembly

B. The build up of insulators, washers and seals on yoke terminal, Fig. 65.

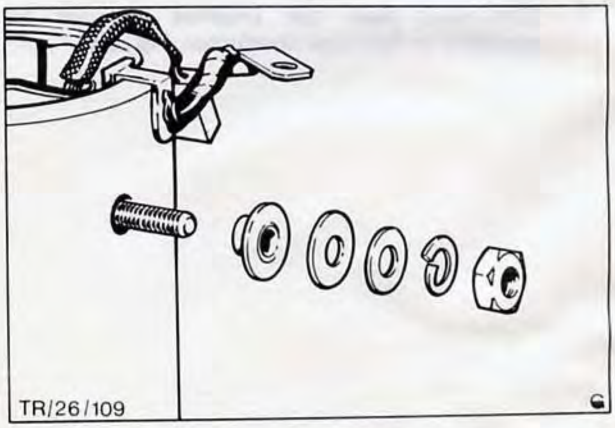

Fig. 65. Yoke terminal washer and seal assembly

C. A minimum clearance of 10,3 mm (0,4 in) between the edge of the field coil assembly and the end face of the yoke, Fig. 66.

D. The position of the insulators between the yoke and the field coil conductors.
If the above points are observed the replacement of field coil assemblies will be straightforward and uncomplicated.
To remove old field coils insert pole piece expander tool and unlock pole piece retaining screws using screwdriver. Replace field coils loosely in yoke, insert yoke terminal and loosely fit new pole piece retaining screws to locate pole pieces. Position new insulators between yoke and field coil conductors. Insert pole piece expander and using pole piece screwdriver tighten screws to a torque of 28 Nm 2,8 kgf.m (20 lbf.ft). The yoke terminal fixing nut should be torqued to 3 Nm 0,3 kgf.m (2.0 lbf.ft).

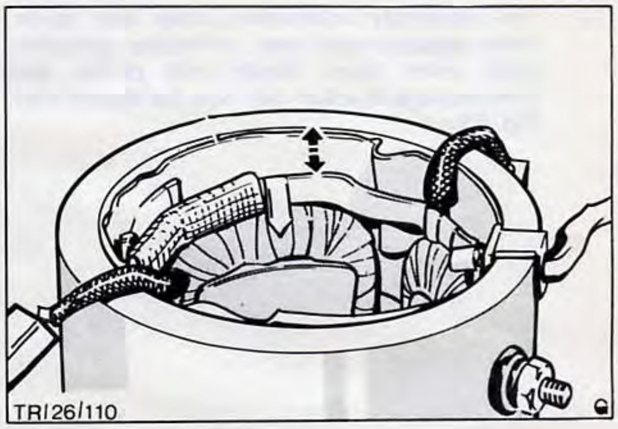

Fig. 66. Arrows indicate minimum clearance to be between edge of field coil and end face of yoke

10. The sealing ring between yoke and intermediate bracket should be removed, from its retaining groove in bracket, Fig. 67.

Fig. 67. Removing sealing ring

11. Unscrew eccentric pivot pin from side of drive end cover, Fig. 68.

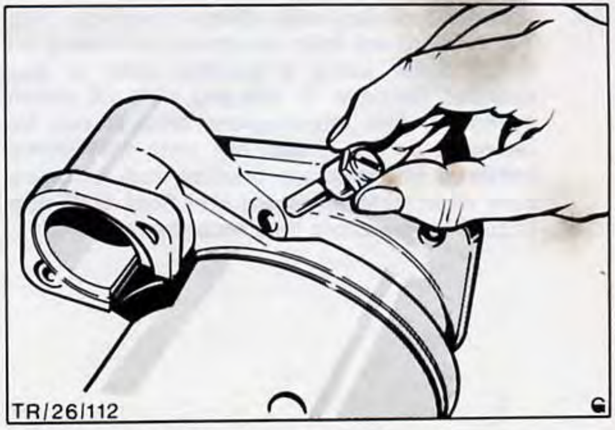

Fig. 68. Removing the eccentric pivot pin

26 204 8 (cont'd)

12. The assembly comprising drive end cover, drive engagement lever, armature complete with roller drive clutch and pinion and intermediate bracket can now be dismantled, Fig. 69.

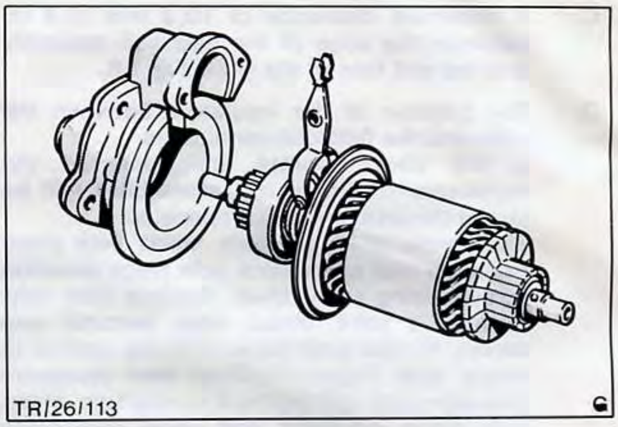

Fig. 69. Starter motor assembly

13. On fully sealed version, separation of drive end cover and intermediate bracket will reveal two small sealing washers, which locate in counterbores of through bolt holes in drive end cover. A further washer will be found on locating dowel in drive end cover. Ensure these washers are not mislaid.

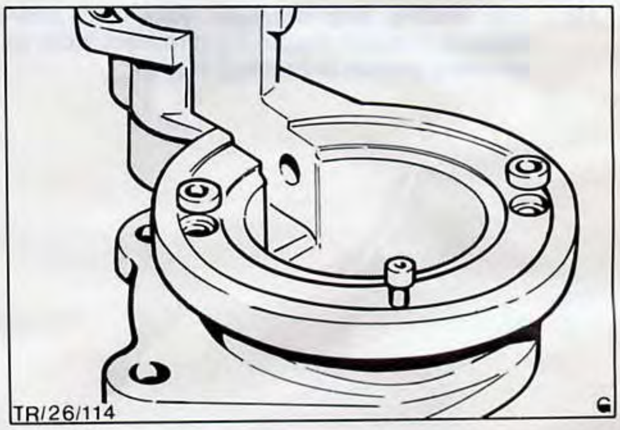

Fig. 70. Drive end cover

14. The drive pinion/roller clutch assembly, Fig. 71, is removed from armature by driving off thrust collar using a suitable tube or box spanner. Remove 'C' clip and slide off pinion assembly. The intermediate bracket can be removed at this stage, but note that shims between intermediate bracket and armature core determine armature end float 0,63 mm (0,025 in) therefore they must be retained.

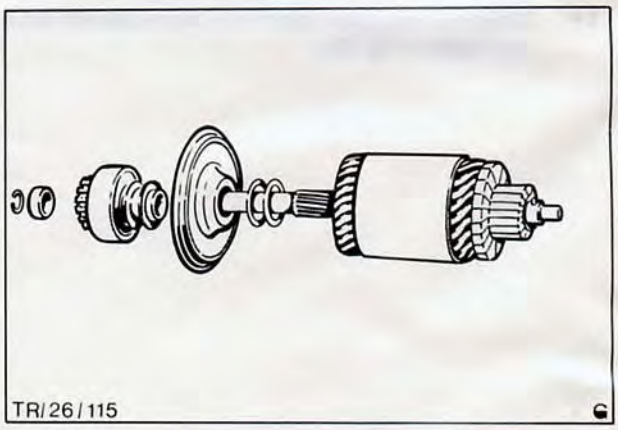

Fig. 71. Drive pinion/roller clutch assembly shown away from armature

Starter motor components test

Check condition of the armature windings and insulation as described for starter motor type A.
Due to very low resistance of field coils and method of interconnecting conductors, continuity of field coils and presence of a short-circuit between windings can only be determined by using special equipment. The field coils should be visually inspected *in situ* for signs of obvious faults. Check various joints of field coil assembly and look for discolouration of winding insulation tape, which could indicate short-circuit windings.
A suspected fault in field coil assembly is best checked by substitution.
The brush gear insulation check should be carried out as described for starter motor type A. Only two insulated brush holders need be tested for isolation from brush plate.
Check starter solenoid for satisfactory closing of first and second stage contacts associated with terminals S1 and S2. Disconnect terminal S1 and apply a 12 volt battery supply between solenoid 'Lucar' terminal and earth (starter motor body).
Using an ohmmeter or battery operated test lamp connect one lead to solenoid main terminal (the largest one) and connect other lead alternately to terminals S1 and S2. If a zero reading shows on ohmmeter, or test lamp lights the solenoid contacts are satisfactory.
If the fault lies in the solenoid coils the solenoid plunger will either fail to pull in, or hammer in and out. If the plunger pulls in but the main terminal to S1 or S2 contact is not made then the solenoid contacts are at fault. These can be changed as described in the overhaul.

15. If tests indicate that solenoid contacts are faulty it is possible to renew them without replacing the whole solenoid unit.
    Remove two screws securing terminal and base assembly to solenoid body. Apply a hot soldering iron alternately to each of the two soldered connections and wait for solder to run free. Shake most of the melted solder out of the joints by tapping solenoid terminal ends down on work bench. Carefully clamp solenoid body in a vice and, while continually pulling on the moulded cover, apply soldering iron alternately to two soldered connections until terminal and base assembly is freed. When re-making soldered connections, avoid dry soldered joints by ensuring that parts are clean and adequately heated before applying solder. Tighten terminal and base assembly fixing screws to a torque of 3 Nm 0,3 kgf.m (1.8 lb.ft).

16. Examine surface of the commutator, Fig. 72, it should be clean and free from burnt spots. If necessary restore surface with fine glass paper followed by wiping and a petrol moistened cloth. The commutator may be skimmed to a maximum depth of 1,5 to 3,0 mm (0,060 to 0,120 in) on the dia. before a replacement armature become necessary. After skimming, the surface should be polished as mentioned above. **The insulation slots must not be under cut.**

    If there are signs of thrown solder or the conductors have lifted the motor has probably been overspeeding. Check operation of roller clutch drive. It should rotate smoothly in one direction and provide instantaneous take-up in the other. If the clutch shows any sign of malfunction it will have to be replaced complete with pinion as an assembly.

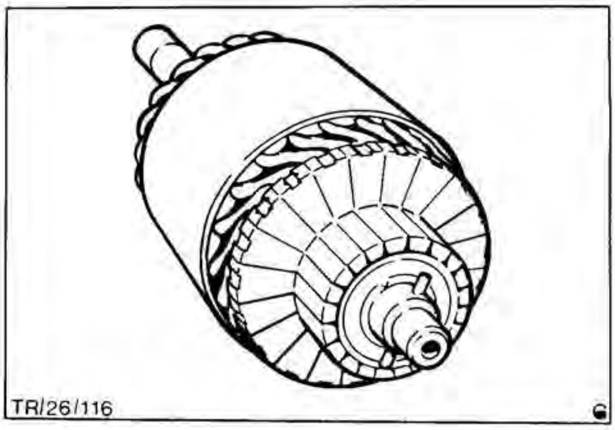

Fig. 72. Commutator

26 204 8 (cont'd)

17. If the armature fouls the pole shoes it indicates worn bearings, loose pole shoes or the armature shaft is distorted. Check the armature in a lathe. If it is distorted it must be renewed.
If the armature is satisfactory the bearings in the drive end cover, intermediate plate and commutator end cover must be renewed. All three bearings are self lubricating porous bronze bushes, Fig. 73. New bushes should be allowed to stand in clean engine oil for 24 hours at room temperature before fitting. Alternatively the time may be reduced to 2 hours if the oil is heated to 100 °C and allowed to cool before removal. Bushes must not be reamed after fitting.
The commutator end cover bush should be replaced when its diameter exceeds 12,82 mm (0,505 in). It can best be removed by inserting 14,30 mm (0,563 in) thread tap. Then withdraw the thread tap and the bush will be drawn out. The bushes in the drive end cover and intermediate bracket can be removed by conventional press techniques.
All three replacement bushes should be pressed or driven into position in their respective housings using a shouldered polished mandrel dimensioned as follows:
Commutator end cover bush
12,712 mm (0,5005 in)
Intermediate bracket bush
31,054 mm (1,1226 in)
Drive end cover bush
17,030 mm (0,6705 in)

18. Fit the intermediate bracket and drive assembly to the armature, ensure that the shims are fitted between the armature core and intermediate bracket. Fit the thrust collar and 'C' clip.

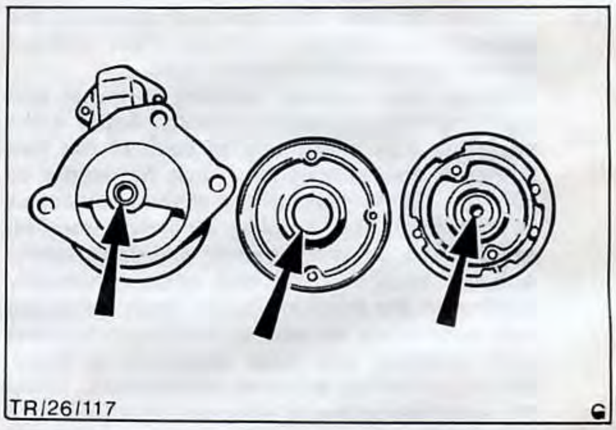

Fig. 73. Commutator end cover, Intermediate bracket and drive end cover bushes

19. Fit the three rubber seals to the drive end cover and locate the drive engagement lever in its groove in the clutch assembly. Slide the drive end of the armature into the drive end cover, locate the dowel pin in the drive end cover into the hole in the intermediate bracket.

20. Slide the yoke over the armature onto the drive end cover/intermediate plate assembly, Fig. 74. Locate the dowel and check for sufficient clearance between armature and field coil conductors, particularly at through bolt entry points.

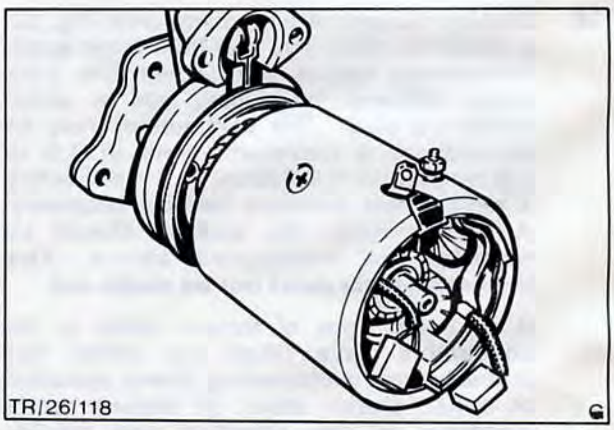

Fig. 74. Locating yoke over the armature

21. Commence re-assembly of brush plate. Slide earth brushes into their holder and wedge the springs against sides of the brushes, Fig. 75.

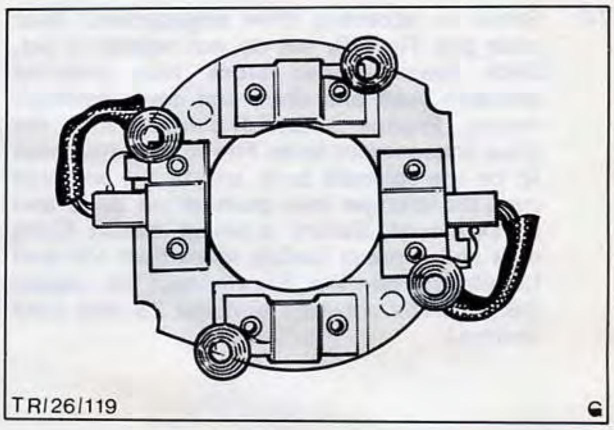

Fig. 75. Brush plate assembly

22. Examine brake and thrust washers in commutator end cover. If they are in order reassemble them as shown, Fig. 76.

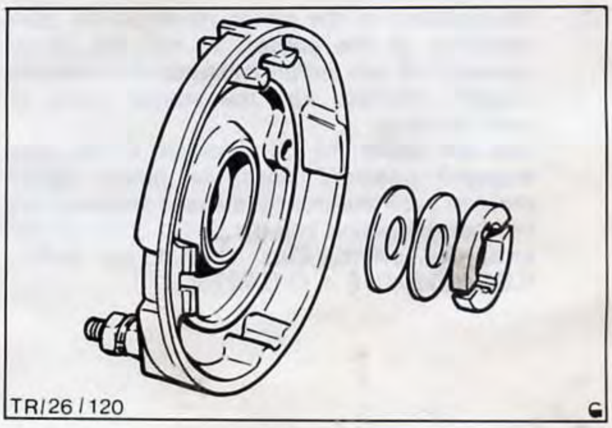

Fig. 76. Commutator end cover

23. Bring brush holder assembly near the yoke and fit the two insulated field coil brushes. Fit rubber seal on commutator end cover. Push the brushes through their holders against commutator face, Fig. 77, the brush springs will slip into position behind brushes. Ensure that springs are correctly aligned, and that all brush leads are suitably positioned to allow end cover to be fitted. Align the cross peg on the armature with end cover brake *slots* and fit end cover onto yoke taking care to line up dowel pin. Fit through bolts after the brush plate to end cover bolts are fitted.

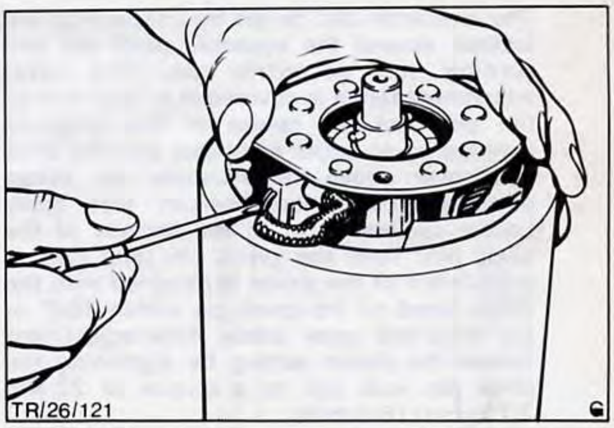

Fig. 77. Pushing brushes through holders

26 204 8 (cont'd)

24. Screw in eccentric drive engagement lever pivot pin, Fig. 78, but do not tighten it yet. Slide foam rubber block into position between yoke and drive end cover solenoid mount. Engage solenoid plunger with the drive engagement lever. Fit return spring onto lip on the solenoid body and fit the solenoid over the plunger into position on drive end cover mount. Secure solenoid mount fixing nuts and connect flexible index field coil lead to solenoid terminal S1. Connect the copper link between solenoid terminal 2S and yoke terminal.

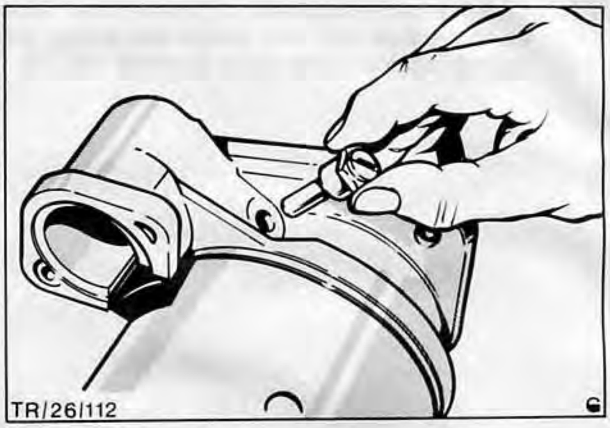

Fig. 78. Eccentric drive lever pivot pin

25. The position of the pinion must be set after assembly of the starter. To set the pinion connect a 6 volt supply between the solenoid ('Lucar') terminal and the starter frame or earth terminal.
This will move the drive foward to the fully engaged position. With the pinion lightly pressed back measure the space between the front of the pinion and the thrust collar on the armature shaft. This should be 0,40–0,63 mm (0,015 in to 0.025 in).

The clearance can be set by unscrewing the locknut around the eccentric pivot pin and turning the eccentric pin. The total adjustment range is covered in a 180° turn of the pin, and the centre of this range is denoted by an arrow head cast into the drive end cover above the eccentric pin. When adjusting the pinion position first apply Loctite (Screw Lock) to the threads of the pivot pin. Turn the pivot pin until correct adjustment of the pinion is obtained with the arrow head on the pivot pin within 180° of the drive end cover arrow. After adjustment secure the pinion setting by tightening the pivot pin lock nut to a torque of 22 Nm 2,2 kgf.m (16.0 lbf.ft).

26 204 8 STARTER MOTOR – OVERHAUL

(starter motor removed)
(includes: check components for wear/damage, replace if required refinish commutator, test)
Type: Lucas 2M100
Pre-engaged

Special Service Tools Required:

Pole-Piece screwdriver	CP9504
Pole-Piece expander	CP9509

1. Clamp starter motor in vice fitted with protective soft jaws. Remove nut and washer securing starter terminal to solenoid terminal marked STA, Fig. 79.

2. Remove solenoid nuts and washers securing body to drive end cover. The solenoid body can then be removed leaving plunger hooked to actuating lever. Unhook plunger by pushing in and lifting front upwards, Fig. 80.

3. To remove commutator end housing the spire retaining clip fitted over end of armature shaft must be removed. Ensure that a replacement clip is available, as only satisfactory way of removing clip is to break clip's claws which grip shaft, with a sharp chisel. After removing clip unscrew 'through' bolts, commutator end housing can then be withdrawn far enough to allow removal of two field coil brushes, Fig. 81.

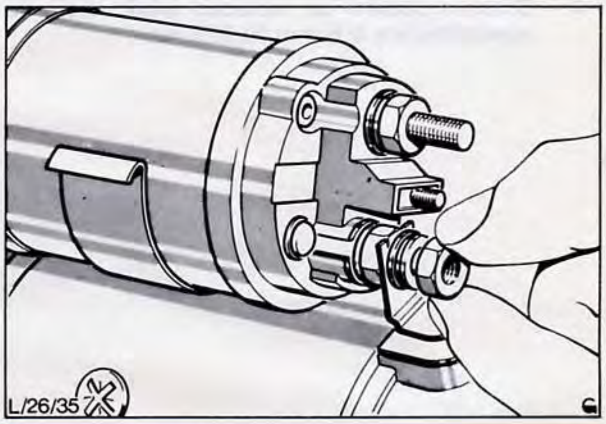

Fig. 79. Disconnecting starter terminal

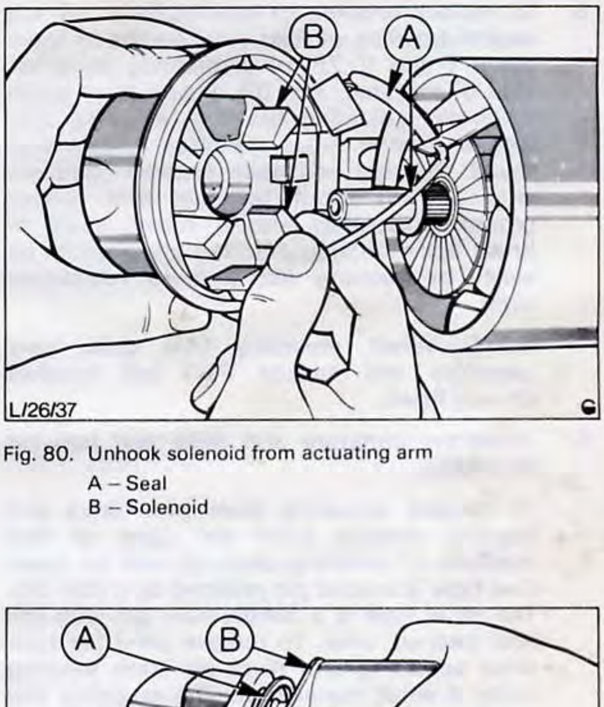

Fig. 80. Unhook solenoid from actuating arm
A – Seal
B – Solenoid

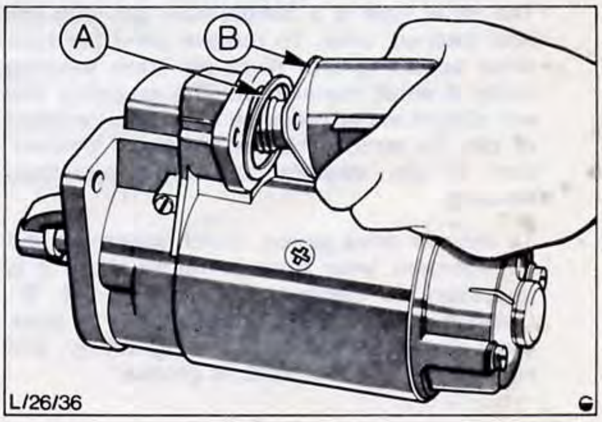

Fig. 81. Disconnecting two field brushes
A – Field coil brushes
B – Terminal brushes

26 204 8 (cont'd)

4. Brushes should be replaced when worn to approximately 9,5 mm (0,375 in).

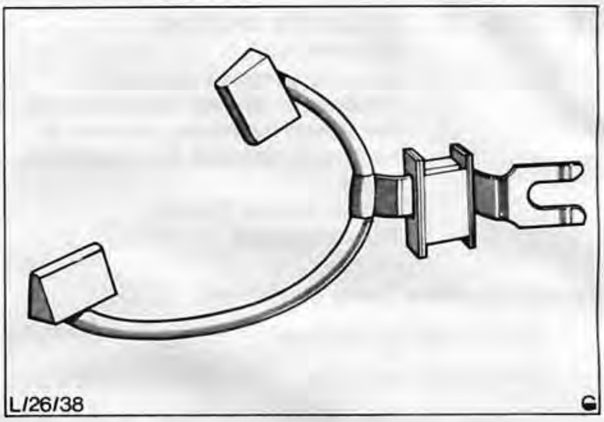

Fig. 82. Terminal brushes
NOTE: Long and Short braiding

5. To replace brushes on existing field coil, cut copper braiding of field coil brushes to leave about 6 mm (0,25 in) of braiding on either side of terminal, Fig. 83, Solder new brush leads to remaining braiding, ensuring that long and short leads are fitted correct way round. Replace end plate brushes complete with a new input terminal and rubber grommet. Brushes should move freely in brush box moulding. Sticking brushes can be eased by cleaning with a petrol moistened cloth.

   NOTE: When replacing field coils, new assembly will include field coil brushes already fitted.

6. Withdraw armature and drive end housing from yoke.

   To remove actuating lever from drive end housing remove pivot pin. One of two methods of retaining pivot pin will be used. One type is a solid pin retained by a star clip. The other type is a hollow bore pin with the end 'peaned' over. To remove solid pin type drive actuating arm pivot pin from housing using a small metal drift. The retaining clip will distort under pressure and allow removal of pin. To remove hollow pin bend 'peaned' part of pin straight and drive pin from housing.

7. To remove drive pinion, clutch assembly and engagement lever from armature shaft, it is necessary to remove 'C' clip, Fig. 84 'B'. Using a suitable sized box spanner or tube, drive 'C' clip off thrust collar, Fig. 84 'A', and remove thrust collar from its groove.

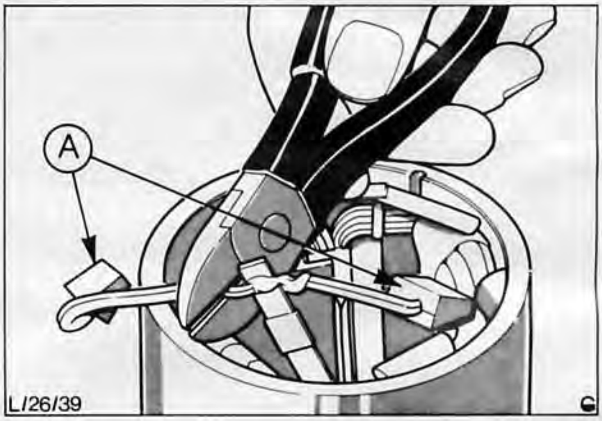

Fig. 83. Be sure to cut braiding in correct place
A – Field coil brushes

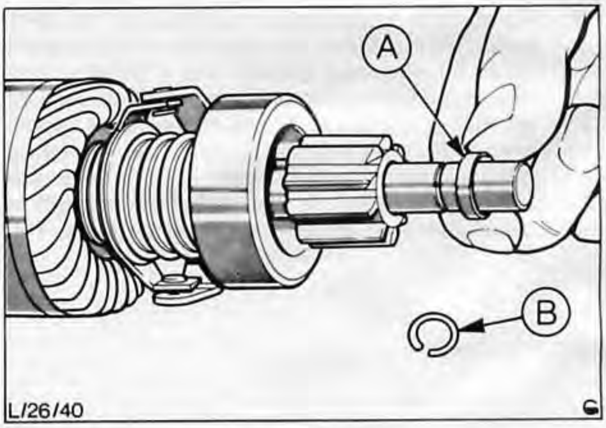

Fig. 84. Removal of 'C' clip when removing drive pinion
A – Thrust collar
B – 'C' clip

8. Slide complete assembly off armature shaft. There will normally be no need to separate actuating lever from clutch and pinion, as all items are serviced as an assembly. Correct build up of assembly is illustrated, Fig. 85.

Starter motor components test

All starter motor components are tested as for starter motor M90, but with addition of drive engagement solenoid.

If a faulty solenoid is suspected it can be tested either by by-passing solenoid with a suitable piece of jumper cable, or substituted with one that is known to be in good order.

When current is applied to solenoid 'Lucar' terminal drive pinion should be pulled sharply forward to 'in-mesh' position. If this happens, but starter motor does not develop cranking torque, then problem may be burnt or pitted solenoid contacts. These can be changed without replacing whole unit as described in overhaul procedure.

Complete failure of solenoid to operate or hammering in and out of engagement, could be the result of solenoid coil failure. If this occurs it will be necessary to replace solenoid unit completely.

9. Face of armature commutator should be clean and free from burnt spots. Surface marks can be removed using a flat pad of very fine glass paper, followed by wiping with a petrol moistened cloth. Where commutator is worn, surface may be skimmed to a maximum depth of 3,5 mm (0,140 in), the minimum cut consistent with a clean flat surface should be taken. After skimming, polish surface with very fine glass paper and wipe with a petrol moistened cloth.

   If armature shows signs of thrown solder or lifting conductors, overspeeding may have taken place. Check that roller clutch, which is part of pinion assembly is free to rotate smoothly in one direction and provides instantaneous take up in other direction. Clutch is serviced as a complete assembly with pinion, if it is faulty.

10. If armature laminations have been touching pole shoes, bearings in drive end cover and commutator end cover are probably worn. Check that pole shoes are tight, and that armature is running true and not distorted. Should armature be out of true it will have to be replaced.

11. Armature bearings fitted in commutator end cover and drive end cover are self lubricating porous bronze bushes. Worn bushes can be pressed out and replacement bushes pressed into position using a shouldered, polished mandrel with dimensions as follows: Commutator end cover bush 11,117 mm (0,4377 in).

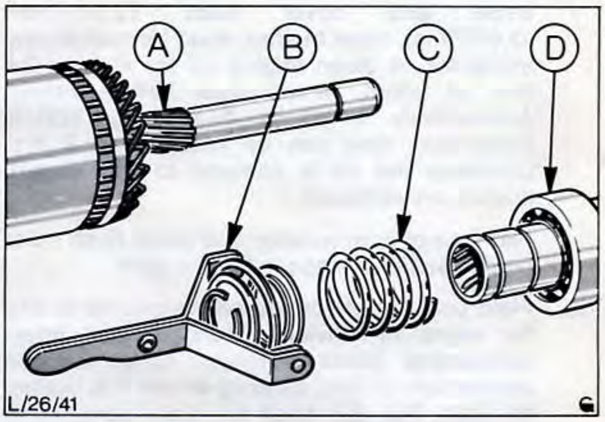

Fig. 85. Actuating lever assembly
A – Armature
B – Actuating arm (fork)
C – Shock spring
D – Pinion and roller clutch assembly

26 204 8 (cont'd)

Drive end cover bush 12,011 mm (0,4729 in). New bushes must be completely immersed in clean engine oil for at least 24 hrs. at room temperature before fitting. Alternatively if oil is heated to 100 °C immersion time can be reduced to 2 hrs. providing the oil is allowed to cool before bushes are removed.

Flat face of commutator end cover bush must be pressed home against cover face.

12. Field coils should be visually inspected *in situ* for signs of obvious faults. Check interconnecting joints between coils, earthed connection of field winding where it is riveted to yoke, Fig. 87. Look for discolouration of winding insulation tape which could indicate short circuit windings or a short between winding and yoke. If there are no obvious signs of a fault, field coils should be tested as laid out in test procedure. (Starter motor type 5M90.) To change field coils remove rivet which attaches field coil earth lead to yoke. Insert pole shoe expander, Special Tool No. CP9509, and remove pole shoe screws, using pole-piece screwdriver Special Tool No. CP9504, Fig. 88. Wipe clean inside of yoke and insulating pieces in which through bolts locate.

    Loosely fit new field coil assemblies and pole shoes into yoke, with threads of new pole shoe fixing screws partially engaged. Through bolt insulating pieces should now be inserted into yoke, by sliding shoulders of insulator pieces between field coils and yoke in a position 180° apart and 90° each side of field coil brush connection point. Expand pole shoes using expander Special Tool No. CP9509, and tighten pole piece screws with pole piece screwdriver to a torque of 40 Nm (30 lbf.ft). Rivet field winding earth tab to yoke to make a good connection.

13. To renew solenoid contacts remove two screws securing terminal and base to solenoid body. Apply a soldering iron alternately to each of two terminal connections and wait for solder to run free, then shake most of the solder out of joints by tapping two solenoid terminal ends down sharply on bench. Clamp solenoid body terminals uppermost, apply a constant pull on moulded cover and heat two soldered connections alternately, until terminal and base assembly is freed. Fit new base assembly complete with contacts, resolder two connections and tighten terminal and base assembly fixing screws to a torque of 3 Nm 0,3 kgf.m (1,8 lb.ft).

14. To reassemble starter bring commutator end plate complete with starter terminal brushes close to yoke, to allow field coil brushes to be fitted in brushbox. Position brushwires correctly so that they are free to move with brushes and push commutator end plate into position on yoke.

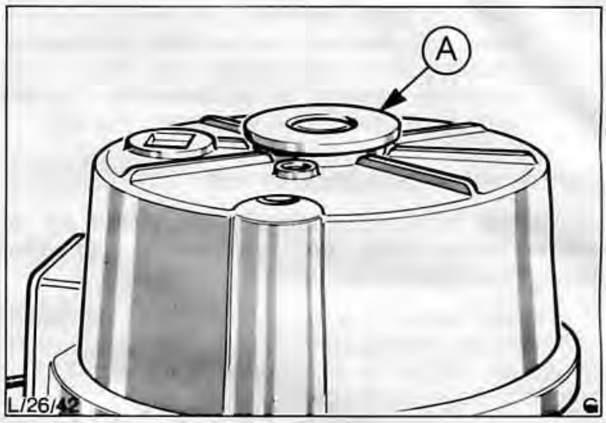

Fig. 86. Commutator end housing showing bearing – 'A'

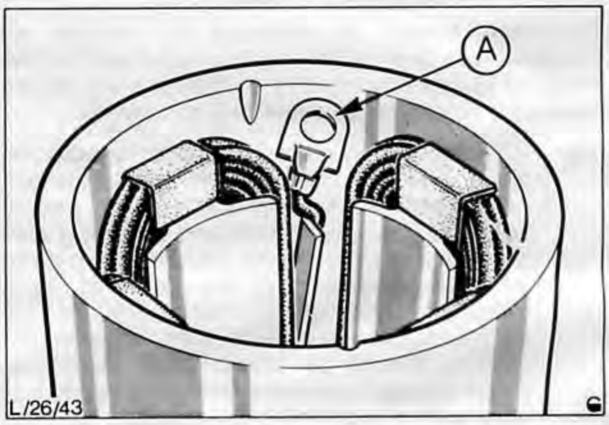

Fig. 87. Check rivet for good connection
A – Rivet

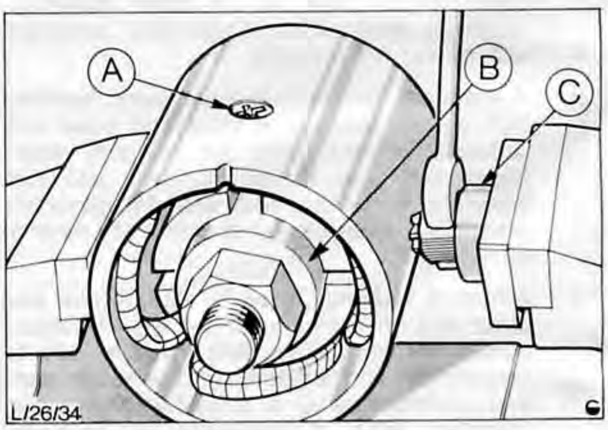

Fig. 88. Removing pole screws
A – Pole screw
B – Pole piece expander (CP9509)
C – Pole piece screwdriver (CP9504)

15. Fit pinion gear assembly onto armature shaft with pinion teeth furthest from armature windings, Fig. 89. Slide thrust collar over shaft and then drive 'C' clip onto shaft and into its groove, with a suitable size tube. Draw thrust collar over 'C' clip using a suitable puller. For completed assembly see Fig. 89.

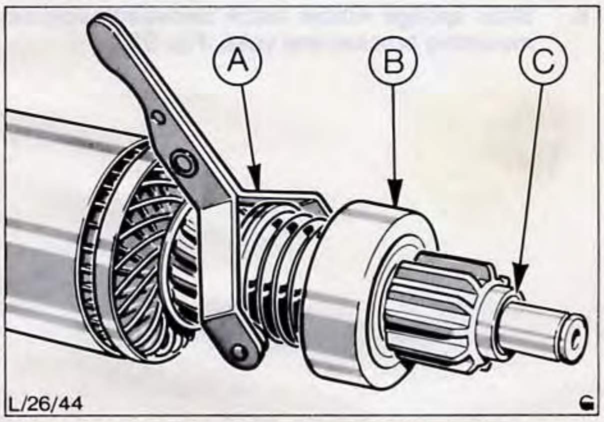

Fig. 89. Actuating fork – 'A', pinion/Clutch assembly – 'B' and thrust collar/'C' clip – 'C' in assembled position

16. Fit thrust washer, Fig. 90, on commutator end of armature shaft and slide armature through yoke into commutator end plate. Drive new spire retaining clip over armature shaft far enough to hold shaft.

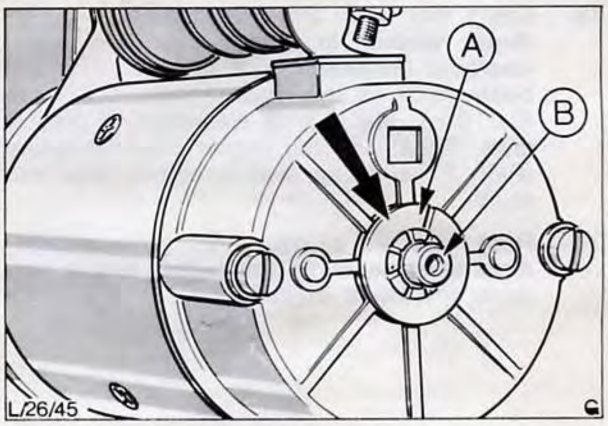

Fig. 90. Thrust washer location
A – Thrust washer
B – Armature shaft

17. Fit drive end housing to yoke, Fig. 91, ensuring that solenoid mount is in line with starter terminal and secure it with through bolts. Fit actuating lever pivot pin and drive on new retaining clip. Alternatively 'pean' over end of new hollow pin.

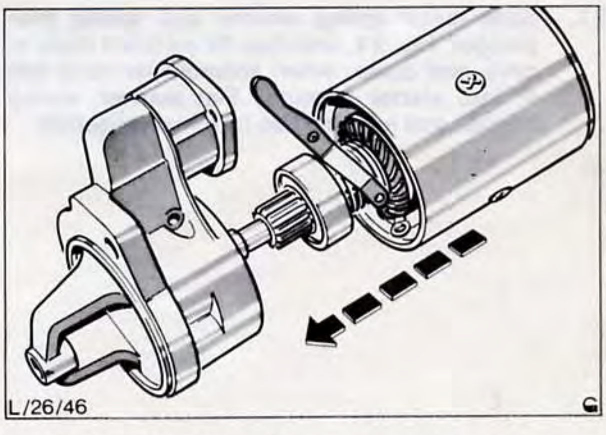

Fig. 91. Assemble drive end housing to armature and yoke assemblies

26 204 8 (cont'd)

18. Slide sponge rubber block between solenoid mounting bracket and yoke, Fig. 92.

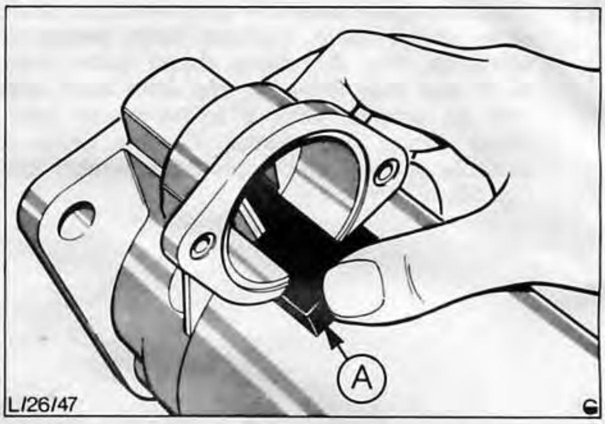

Fig. 92. Rubber block location between solenoid mounting bracket and yoke
A – Rubber block

19. Check that when armature is pushed against thrust washer in commutator end plate, clearance between 'Spire' retaining ring and bush face is no more than 0,25 mm (0,010 in). Fig. 93. If clearance is greater drive 'Spire' ring clip further down armature shaft. Fit end cap seal to commutator end cover.

20. Hook solenoid plunger onto drive engagement lever ensuring that rubber seal is correctly positioned on plunger.

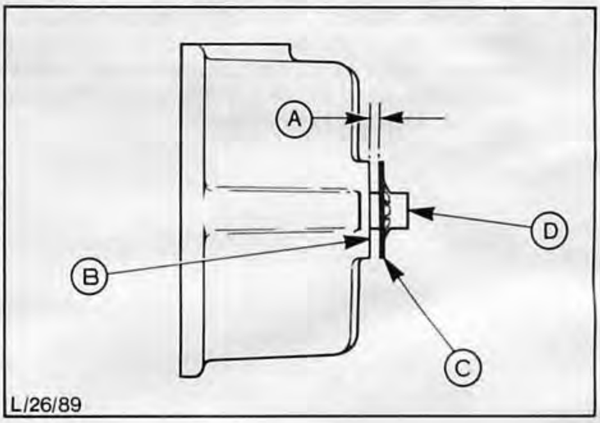

Fig. 93. Commutator end cover
A – Ensure clearance is no more than 0,25 mm (0,010 in)
B – Bearing face
C – Thrust washer
D – Armature shaft

21. Slide metal spring retainer and spring over plunger, Fig. 94, and then fit solenoid body to drive end cover, when solenoid terminal will fit into starter terminal. Flat washer, spring washer and nut, secures terminals together.

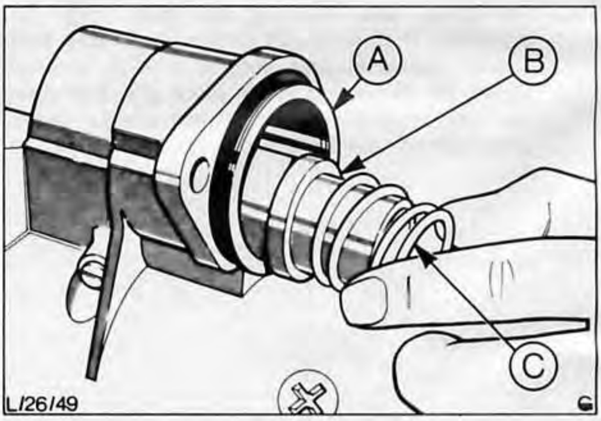

Fig. 94. Assembly of spring retainer
A – Rubber seal
B – Metal spring retainer
C – Spring

26 204 8 STARTER MOTOR – OVERHAUL

(starter motor removed)
includes: check components for wear/damage, replace if required, refinish commutator and test
Type: Bosch – All models

Special Service Tools Required: None

To Dismantle

1. **All types**

   Clamp starter motor in a vice fitted with protective soft jaws. Remove nut and washer securing field winding cable to solenoid, unhook cable from stud.

2. **OHC engines only**

   Remove three solenoid securing screws, Fig. 95, 'B', and guide solenoid yoke away from drive end housing and solenoid armature, Fig. 96. Unhook solenoid armature from actuating lever, Fig. 96.

   NOTE: Solenoid is a complete unit and contains armature, Fig. 97, therefore armature is not removed as a separate item.

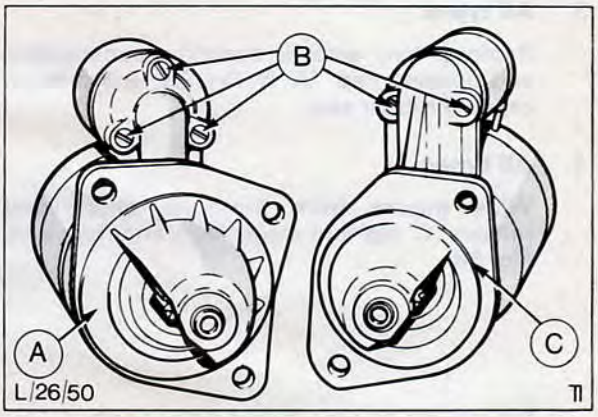

Fig. 95. Starter motors
A – Starter motor fitted to OHC engines
B – Solenoid securing screws

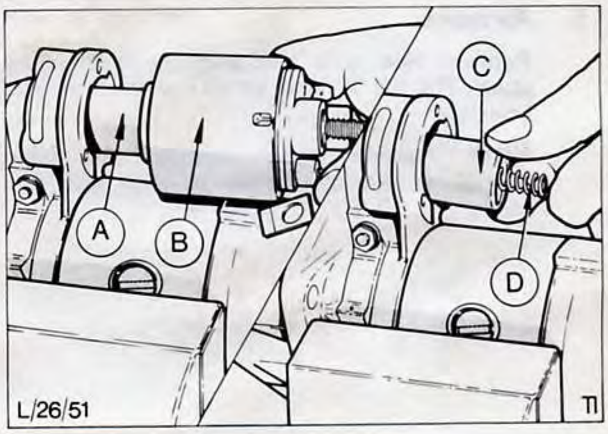

Fig. 96. Solenoid assembly
A – Solenoid armature
B – Solenoid yoke
C – Solenoid armature
D – Solenoid armature return spring

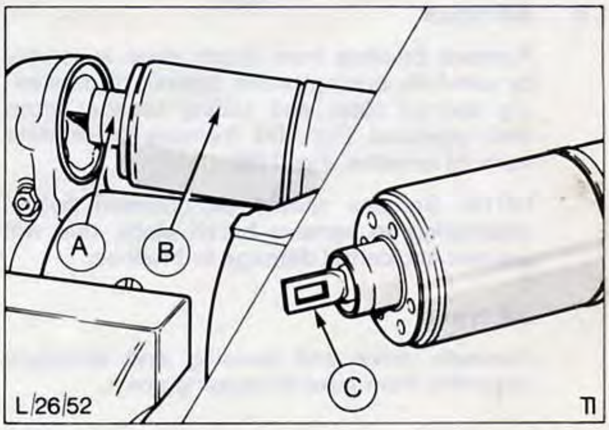

Fig. 97. Solenoid assembly
A – Solenoid armature
B – Solenoid yoke
C – Armature 'hook' which locates over actuating arm

26 204 8 (cont'd)

3. **All types**

   Remove two screws securing commutator end housing cap, 'A' in Fig. 98, and remove cap and rubber seal.

4. **All types**

   Wipe grease from armature shaft, and remove 'C' clip and shims from armature end, Fig. 98.

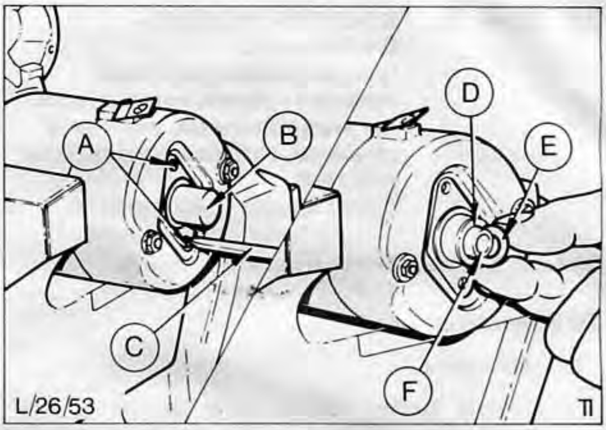

Fig. 98. Commutator end housing
A – Securing screws
B – Housing cap
C – Screwdriver
D – Shims
E – 'C' clip
F – Armature shaft

5. **All types**

   Remove two nuts and washers from fixing studs, Fig. 99 'A', and lift off commutator end housing.

   NOTE: Certain Bosch motors use fixing screws as an alternative to the nuts and studs, Fig. 99 'B'.

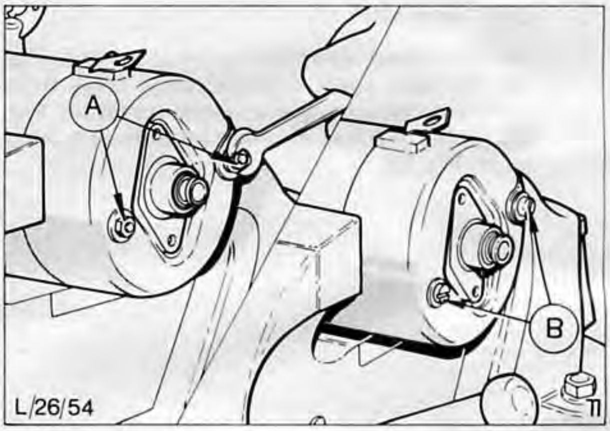

Fig. 99. Commutator end housing
A – Starter – using nuts and washers
B – Starter – using screws

6. **All types**

   Remove brushes from brush plate assembly by carefully prising brush retaining/ tensioning springs clear and sliding brushes from their locations, Fig. 100. Remove brush plate from its location, Fig. 100.

   NOTE: Brushes should be released before attempting to remove brush plate, this will prevent accidental damage to brushes.

7. **All types**

   Separate drive end housing and armature assembly from yoke by tapping apart.

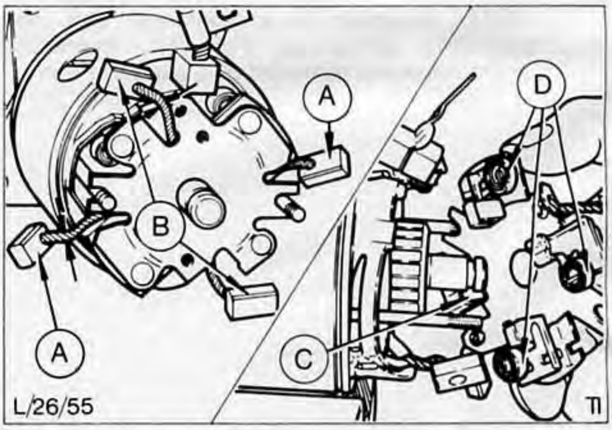

Fig. 100. Brush assembly
A – Field brushes
B – Terminal brushes
C – Brush plate
D – Brush retaining springs

8. **OHC engines only**

Remove rubber insert from drive end housing, Fig. 101. Remove actuating arm pivot retaining nut and slide pivot pin (screw) from housing. Fig. 101.

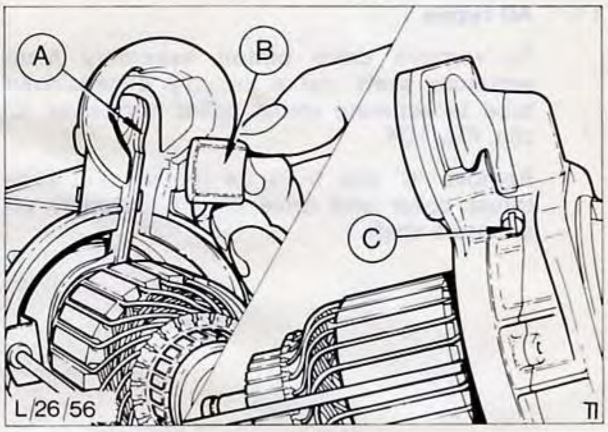

Fig. 101. Rubber insert and pivot pin
A – Actuating arm
B – Rubber insert
C – Pivot pin (screw)

9. **All types**

On starter motors that use fixing studs to secure motor components together, Fig. 102, remove studs to release drive pinion clutch stop bracket.

On starter motors that use fixing screws the screws were removed in sub-operation 5.

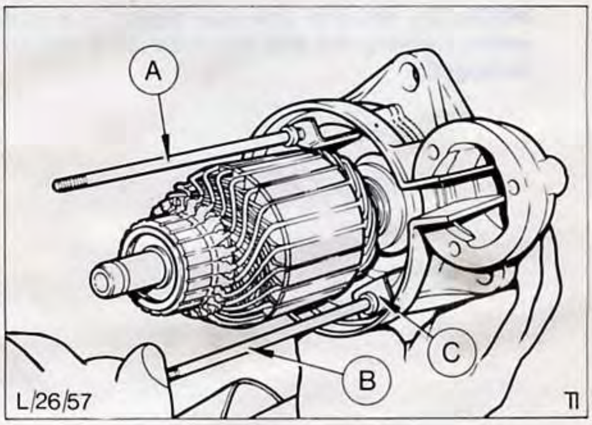

Fig. 102. A and B – Fixing studs
C – Clutch stop bracket

10. **OHC engines only**

Withdraw armature assembly, complete with actuating arm, from drive end housing. Unhook actuating arm from drive pinion flange, Fig. 103.

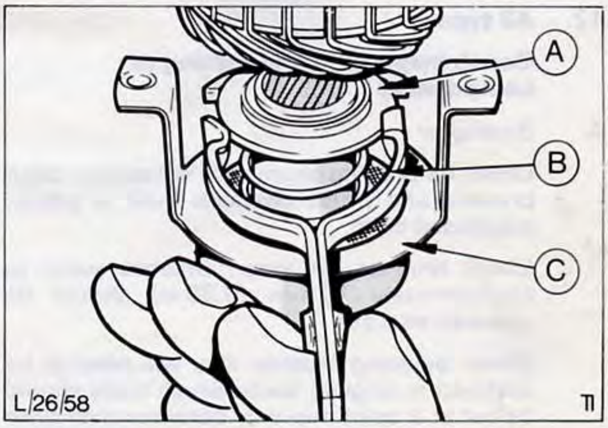

Fig. 103. Clean actuating arm assembly
A – Actuating arm locating flange
B – Actuating arm
C – Clutch stop bracket

26 204 8 (cont'd)

11. **All types**

To remove drive pinion assembly from armature shaft use a suitably dimensioned tube to separate thrust collar from over 'C' clip, Fig. 104.

Remove 'C' clip from its groove and slide thrust collar and drive pinion assembly off armature shaft.

NOTE: Do not grip one-way clutch in a vice whilst carrying out this operation as it will be damaged.

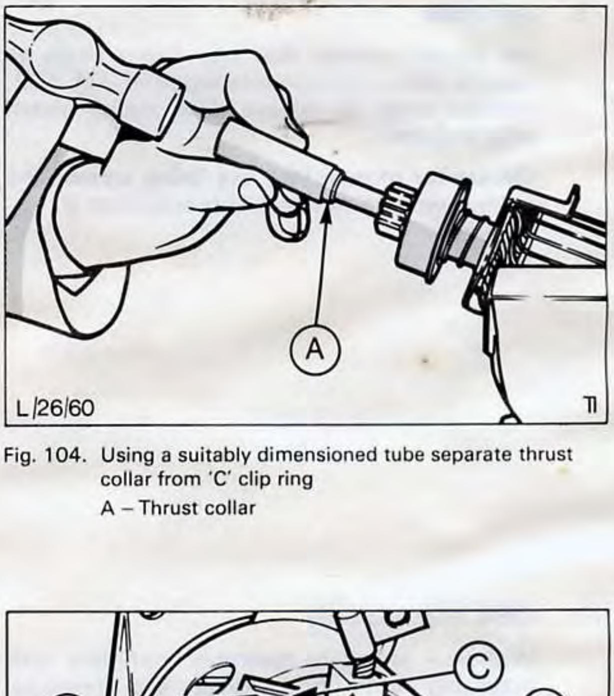

Fig. 104. Using a suitably dimensioned tube separate thrust collar from 'C' clip ring
A – Thrust collar

12. **All types**

Bench inspection and testing of components

A. Brushgear

Check for sticking brushes. If necessary, clean brushes and brush channels with a petrol-moistened cloth.

Check brushes for wear. Brushes worn to approximately 10 mm (0,39 in) should be renewed as a set.

When replacing brushes they will need to be soldered to original leads. Brush leads should be cut at a point mid-way between their base and brush, Fig. 105. Ensure a good soldered joint between wires.

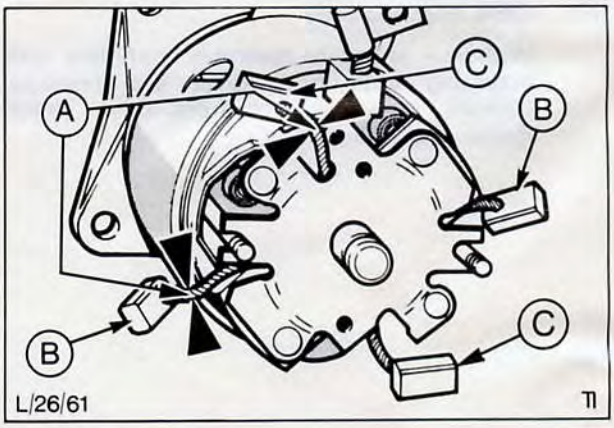

Fig. 105. Brushgear
A – Cut leads mid-way in their length
B – Field brushes
C – Terminal brushes

B. Armature

Figs. 106 and 107 show armature and two types of drive pinion assembly and clutch stops.

Fig. 106 shows assembly where clutch stop is integral part of armature. This type is used where starter components (drive end housing, yoke and commutator housing) are secured with 'through' fixing screws.

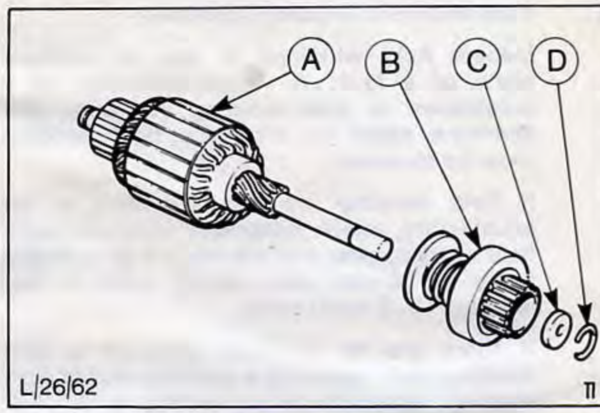

Fig. 106. Armature assembly
A – Clutch stop
B – Drive pinion and clutch assembly
C – Thrust collar
D – 'C' clip

Fig. 107 shows assembly where clutch stop is a separate bracket and is located, and secured, by the two fixing studs, Fig. 102.

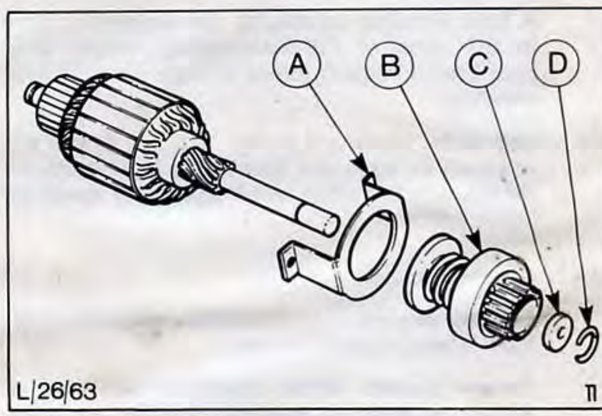

Fig. 107. Armature assembly
A – Clutch stop bracket
B – Drive pinion and clutch assembly
C – Thrust collar
D – 'C' clip

Face of commutator should be clean and free from burnt spots. If necessary remove any burnt spots using fine glass paper. (Do not use emery cloth), and then clean commutator with a petrol-moistened cloth.

If it is necessary to skim commutator the minimum permissible diameter to which the armature commutator can be skimmed is 33,5 mm (1,32 in).

Skimming operation should be followed by polishing commutator surface with fine glass paper, then wipe clean with a petrol-moistened cloth.

DO NOT UNDER-CUT THE INSULATION SLOTS.

Armature insulation can be checked by connecting a 110 volts a.c. 15-watt test lamp between a commutator segment and shaft. Lamp should not light, Fig. 108.

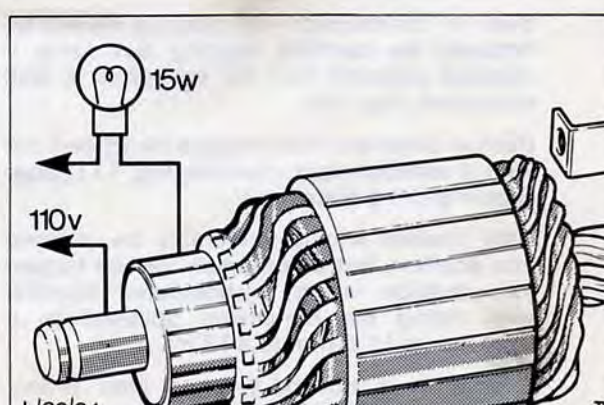

Fig. 108. Armature insulation test

Short-circuited armature windings can only be detected by the use of specialised armature testing equipment. If this equipment is not available, the only alternative is to check the armature by substitution.

If armature laminations have been in contact with pole-pieces armature bearings are probably excessively worn. First check that pole-pieces are tight and that armature runs true in a lathe. Then, if necessary, renew armature bearings.

26 204 8 (cont'd)

C. Yoke and Field Winding Assembly

Inspect field windings *in situ* for obvious signs of a fault. A visual indication of a breakdown in field winding insulation will eliminate need for testing a field winding must be renewed.

If field winding insulation appears to be satisfactory, check continuity between each field winding post and the main feed terminal using a 12-volt test circuit, with a low wattage (1–3 watt) lamp.

If there are no obvious signs of a field winding fault, carry out a positive test of field winding insulation by connecting a 110 volt a.c. 15-watt test lamp between each field winding brush in turn, and a clean unpainted part of yoke, Fig. 109.

Test lamp should not light. Ensure neither of brushes or bare part of their leads are contracting yoke during test.

A field winding continuity test is unnecessary in the case of full-dismantling, where it is possible to inspect joints at both ends of field winding.

The field windings, poles and yoke are not serviced as separate items. If a fault is traced to the windings the yoke assembly must be replaced.

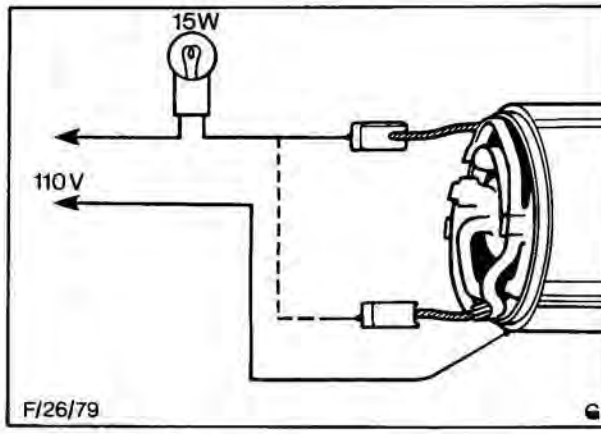

Fig. 109. Testing field winding continuity.

D. Bearing bushes

Bearing bushes in both end housings are self-lubricating porous bronze.

Renew bushes when excessive side-play of armature shaft is evident. Fouling of pole-pieces by armature, or inefficient operation of starter, is likely to occur if commutator bushes are excessively worn. Maximum permissible armature side play is 0,05 to 0,30 mm (0,002 to 0,012 in) before bushes need renewing.

Bush in commutator end housing should be removed by carefully tapping out using a mandrel ensuring that the end plate is well supported, Fig. 110.

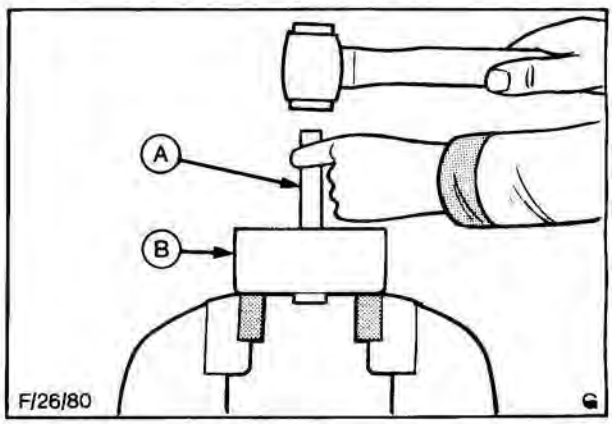

Fig. 110. Removing commutator housing bush
A – Suitably-sized mandrel
B – Housing

Bush in drive end housing can be tapped out with a suitably-sized mandrel, Fig. 111, after supporting the plate.

New bushes should preferably be pressed into position, but alternatively can be tapped into position, using a shouldered mandrel with fitting pin dimension polished to a diameter of 11,0 mm (0,433 in).

Bushes must not be reamed after fitting, otherwise self-lubricating qualities will be impaired.

NOTE: New bushes must be completely immersed in clean engine oil (SAE 30/40 grade) for at least 20 mins. before being fitted.

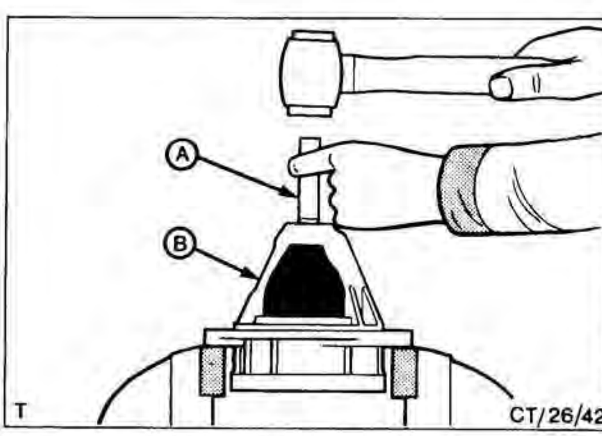

Fig. 111. Removing drive end housing bush
A – Suitably-sized mandrel
B – Housing

To Assemble

13. **All types**

Slide drive pinion assembly and thrust collar onto armature shaft. Fit 'C' clip into its groove in armature shaft and then draw thrust collar over 'C' clip.

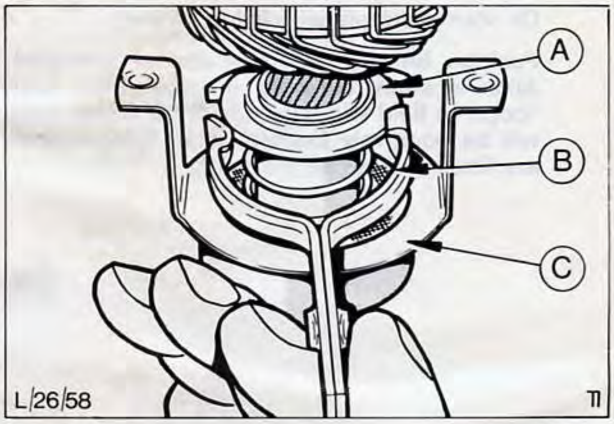

Fig. 112. Actuating arm assembly
A – Actuating arm locating flange
B – Actuating arm
C – Clutch stop bracket

OHC engines only

Connect actuating arm onto drive pinion flange, Fig. 112. Align armature and actuating arm to drive end housing and couple up components. Fit actuating arm pin and secure with retaining nut.

14. **All types**

On starter motors that use fixing studs and nuts to secure components instead of fixing screws, align clutch retaining bracket, Fig. 113, and screw home two fixing studs so that they retain clutch bracket, Fig. 113.

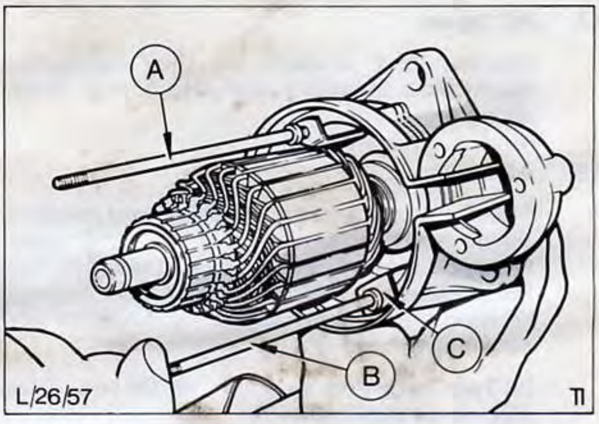

Fig. 113. Clutch stop bracket location
A and B – Fixing studs
C – Clutch stop bracket

15. **All types**

Refit rubber insert into drive end housing.

16. **All types**

Guide yoke over armature and abut to drive end housing and tap home.

On starter motors with fixing studs:

Position brush plate over end of armature. Locate studs in alignment 'cut-outs' in brush plate to ensure correct positioning of brush plate, Fig. 114.

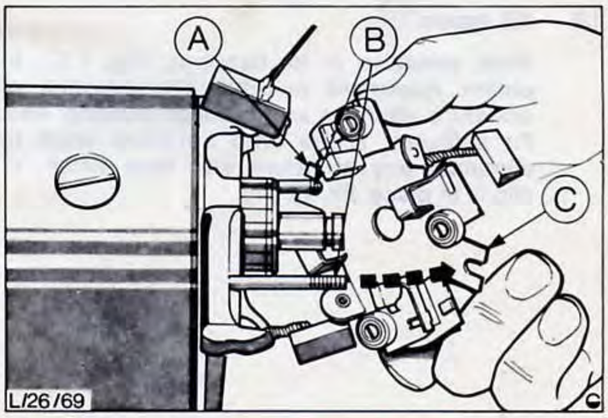

Fig. 114. Brush plate
A and C – Alignment lugs
B – Fixing studs

26 204 8 (cont'd)

On starter motors with fixing screws:

Position brush plate over end of armature. Align location 'cut-outs' in brush plate with 'loops' in field windings, Fig. 115. Brush plate will be positively located when fixing screws are fitted in sub-operation 19.

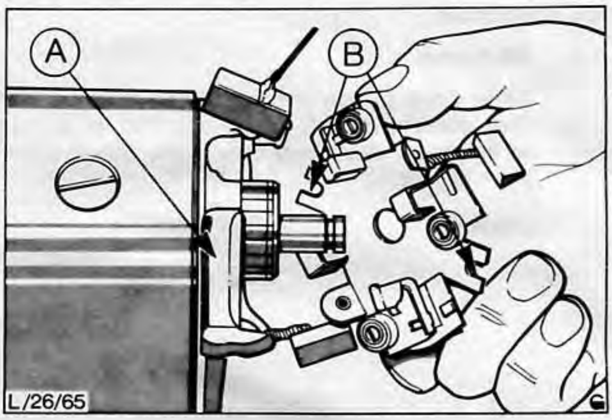

Fig. 115. Positioning brush plate
A – Field winding loops
B – Location cut-outs

17. **All types**

Position four brushes in their respective brush-plate locations and retain with brush springs.

18. **All types**

Guide commutator end housing into position, sliding rubber insulator into commutator housing 'cut-out', Fig. 116, and locating two fixing studs, (where applicable) through housing stud holes. Secure commutator end housing with either:

(a) Two nuts and washers, or (b) two fixing screws, as applicable.

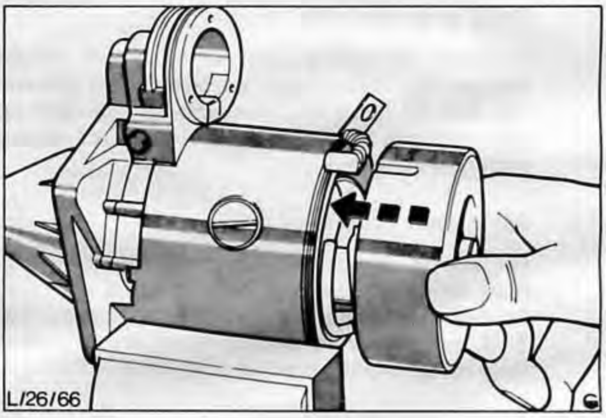

Fig. 116. Guide rubber insulator into cut-out in commutator end housing

19. **All types**

Slide armature in its bearings, Fig. 117, to obtain maximum possible protuberance of armature shaft at commutator bearing end. Fit sufficient shims onto armature shaft to eliminate any armature end float when 'C' clip is in place. Fit 'C' clip.

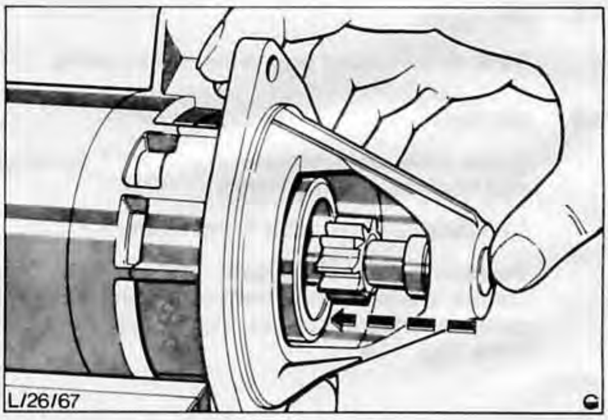

Fig. 117. Slide armature in its bearings

20. **All types**

Place bearing cap seal in position on commutator housing, smear a small quantity of lithium based grease onto end of armature shaft and refit bearing cap, securing with two screws, Fig. 118.

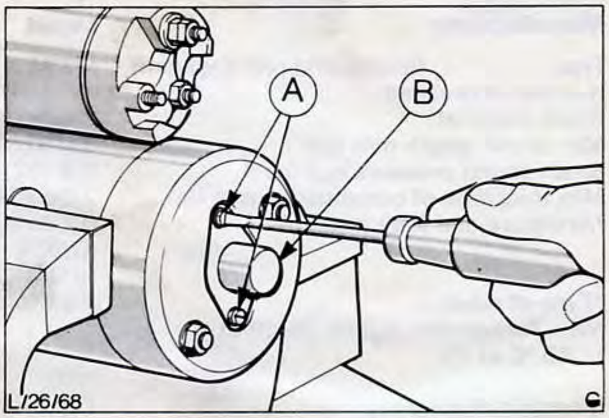

Fig. 118. Refitting bearing cap
A – Bearing cap screws
B – Bearing cap

21. **OHC engines only**

Smear lithium based grease onto solenoid armature hook and then locate hook onto actuating arm in drive end housing. Ensure solenoid armature return spring is correctly positioned and then guide solenoid yoke over armature, Fig. 119. Align yoke with drive end housing and retain with three securing screws.

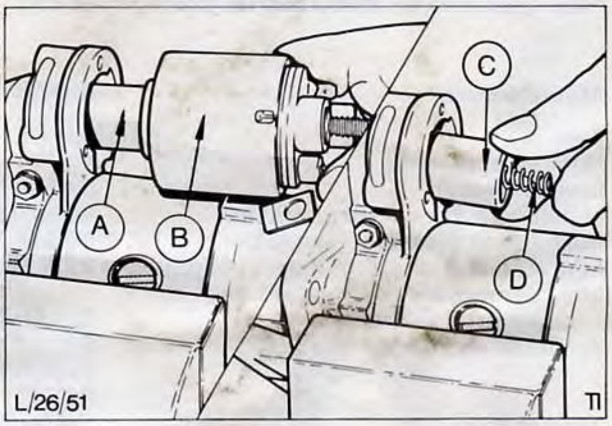

Fig. 119. Aligning solenoid yoke
A – Solenoid armature
B – Solenoid yoke
C – Solenoid armature
D – Armature return spring

22. Reconnect field wire onto secondary terminal and secure with nut and washer.

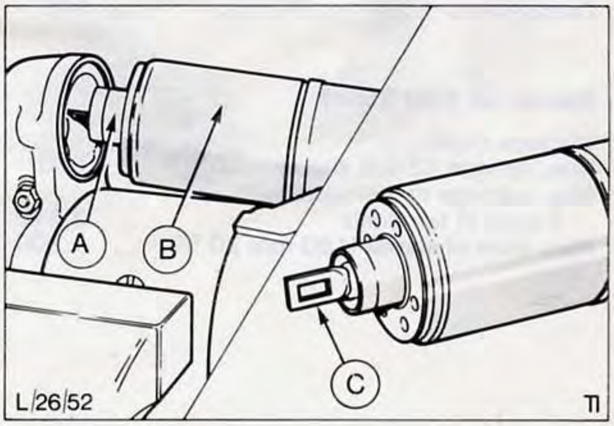

Fig. 120. Aligning solenoid assembly
A – Solenoid armature
B – Solenoid yoke
C – Armature hook which locates over actuating arm

TECHNICAL DATA

Manufacturer	Lucas			
Type .. (inertia and pre-engaged)	M35J	5M90	M50	2M100
Number of brushes	4	4	4	4
Brush material	Copper sinter	Copper sinter	Copper sinter	Copper sinter
Min. brush length mm (in)	8,0 (0,3)	8,0 (0,3)	12,0 (0,4)	9,5 (0,37)
Brush spring pressure kg.f (oz.f) ..	0,9 (32)	0,9 (32)	1,8 (62)	0,9 (32)
Min. thickness of commutator mm (in) ..	2,05 (0,08)	2,05 (0,08)	38 (1,5)	3,8 (0,15)
*Armature end float mm (in)	0,1 to 0,3 (0,004 to 0,010)	0,1 to 0,3 (0,004 to 0,010)	0,6 (0,025) max.	0,3 (0,010)
*Type of drive	Solenoid	Solenoid	Solenoid	Solenoid
Max. Torque Nm (kgf.m) (lbf.ft) at 20 °C at 7V	9,5 (0,97) (7,0)	10,8 (1,10) (8,0)	45,4 (4,6) (33,5)	18,93
Direction of rotation	Clockwise	Clockwise	Clockwise	Clockwise
Voltage	12	12	12	12
Max. current draw (amps) at 7V ..	(370) (365) Inertia (390) Pre-engaged	(370)	(1160) at 5 Volts	(480)

*Not applicable on M35J **inertia** starter models.

Manufacturer	Bosch			
Type	0,7 PS	0,8 PS	1,1 PS	3,3 PS
Number of brushes	4	4	4	4
Brush material	Carbon Y-31	Carbon Y-31	Carbon Y26×28	Carbon
Min. length of brushes – mm (in) ..	10 (0,39)	10 (0,39)	10 (0,39)	15,5 (0,6)
Bush spring pressure – gm (oz) ..	900 to 1,300	900 to 1,300	31 to 45	35 to 46
Min. diameter of commutator – mm (in)	32,8 (1,29)	32,8 (1,29)	32,8 (1,29)	32,8 (1,29)
Max. permissible out of round on commutator – mm (in)	0,3 (0,012)	0,3 (0,012)	0,3 (0,012)	0,3 (0,012)
Armature end float – mm (in)	0,1 to 0,3 (0,004 to 0,012)	0,1 to 0,3 (0,004 to 0,012)	0,1 to 0,3 (0,004 to 0,012)	0,1 to 0,3 (0,004 to 0,012)
Type of drive	Solenoid	Solenoid	Solenoid	Solenoid
Number of pinion gear teeth	10	10	9	12
Number of flywheel ring gear teeth ..	138	138	138	—
Max. torque (mkg) at 20 °C	1,1	1,1	1,1	—
Direction of rotation	Clockwise	Clockwise	Clockwise	Clockwise
Max. current draw watts (amps) ..	4,560 (380)	4,080 (340)	—	1,400 (117)
Voltage	12	12	12	12
Output watts	515	515		

Starter on Test Stand

Wattage draw:				
Max. no load 12 volt supply	540	540	720	—
Max. wattage draw locked with 7 volts at terminals	2,310	2,310	3,500	—
Max. draw of starter (180 rpm 20 °C) ..	1,200	1,200	1,200	—

INTERIOR AND EXTERIOR TRIM, SEATS 43

Index	**Page**

GENERAL DESCRIPTION

Easily removable plastic end caps are provided on the front and rear bumpers, to reduce replacement costs in the event of accident damage.

Door trim coverings can be either grained hardboard or PVC finish depending on trim levels. Either level of trim panel incorporates window regulator and interior release handles. Where a higher trim level is specified door armrests are screwed through the trim panel into the door inner panel. All doors incorporate a pull handle 'Pop' riveted to the door inner panel.

Front bucket seats are provided for the driver with either a dual, or single, seat available for the cab passenger. Rearward vision is via a windscreen header bar-mounted interior mirror together with external mirrors mounted on either the doors or fenders.

SERVICE ADJUSTMENT AND CHECKS

None required.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
	No Special Service Tools Required

SERVICE AND REPAIR OPERATIONS – CONTENT

INTERIOR AND EXTERIOR TRIM, SEATS		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina	Granada '78
43 236	Emblem – Radiator grille – Remove and install	X							
43 263	Bezel – Headlamp – Remove and install	X		X					
43 323	Mirror – Front fender – Remove and install	X							
43 364	Mirror – Door – Remove and Install		42 323						
43 412	Bumper assemblies – Front and rear – Remove and install		43 423/445						
43 423	Bumper assembly – Front – Remove and install	X							
43 445	Bumper – Rear quarter – Remove and install	X							
43 464 4	Bracket – Bumper – Remove and install		43 423/445						
43 612	Headlining – Replace	X							
43 633	Sun visor – Remove and install	X		X	X	X	X	X	X
43 636	Mirror – Interior – Remove and install	X		X					
43 644	Crash padding – Fascia – Remove and install	X							
43 655	Handle – Passenger assist – Remove and install	X							
43 662	Lid – Glove compartment – Remove and install		43 668						
43 666	Lock – Glove compartment – Remove and install		43 668						
43 668	Glove – Compartment assembly – Remove and install	X							
43 684	Shelf – Front parcel – Remove and install		43 668						
43 712	Panel – Door trim – Remove and install	X							
43 714	Handle – Door remote control – Remove and install	X							
43 716	Handle – Door window regulator – Remove and install	X	X	X	X	X	X	X	X
43 737	Arm rest – Remove and install	X	X	X	X	X	X	X	X
43 744	Panel – Tailgate trim – Remove and install	X							
43 751	Seat assembly – Front bucket – Remove and install	X	X	X	X	X	X	X	X
43 755 4	Slide – Front seat – Replace	X	X	X	X	X	X	X	X
43 872	Panel – Partition – Remove and install	X							
43 874	Half panel – Partition – Remove and install	X							

SERVICE AND REPAIR OPERATIONS

43 236 EMBLEM – RADIATOR GRILLE – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Open hood. From behind grille panel, prise two push-fix clips from emblem studs and detach emblem from grille.

To Install

2. Insert studs of emblem through holes in grille panel and secure from behind grille with two push-fix clips. Close hood.

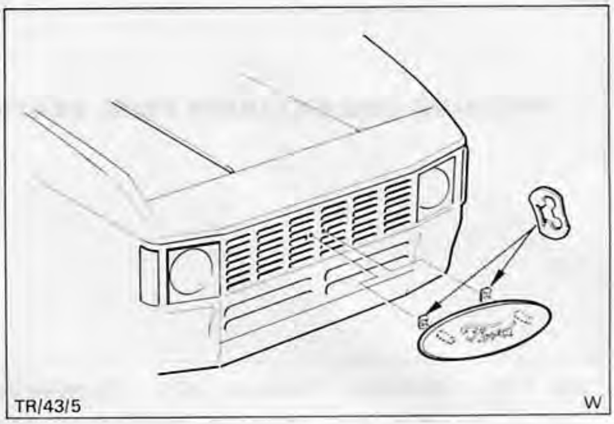

Fig. 1. Emblem assembly to radiator grille

43 263 BEZEL – HEADLAMP – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove:

1. Open hood. Remove two screw and flat washer assemblies from top edge of bezel. Lift bezel upwards and outwards to disengage lower fixing lugs from body slots.

To Install

2. Locate lugs on bottom edge of bezel into slots in radiator grille panel. Align bezel around headlamp and secure top edge to crossmember with two screw and flat washer assemblies. Close hood.

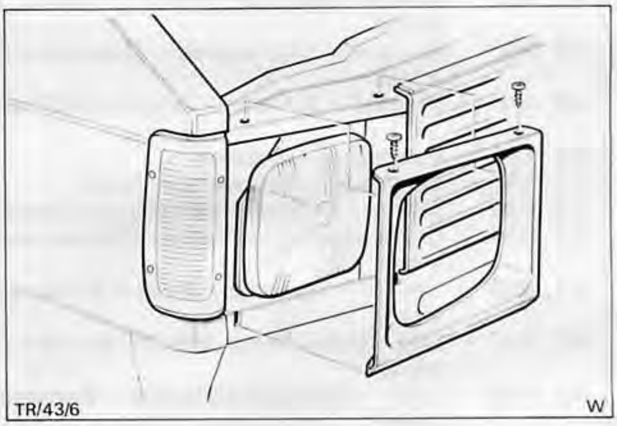

Fig. 2. Headlamp bezel assembly

43 323 MIRROR – FRONT FENDER – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two screws and detach cover from base of mirror arm.
2. Remove two further screws, exposed by removal of cover, securing arm to fender and detach arm and mounting pad.

To Install

3. Position pad on fender. Locate mirror arm on pad, insert screws through arm and pad to secure.
4. Refit cover on arm, secure with two screws.

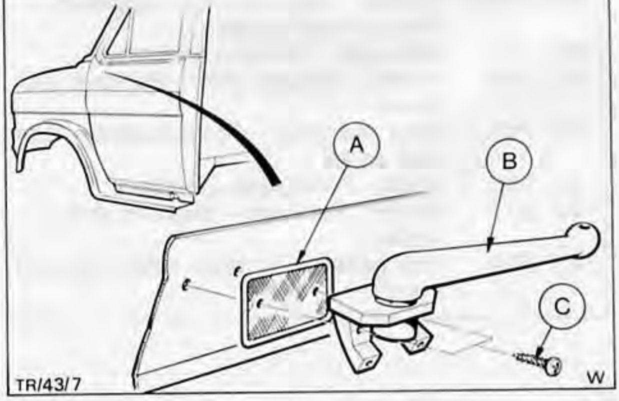

Fig. 3. Mirror, arm and cover assembly front door
A – Mounting pad
B – Arm
C – Screw

43 423 BUMPER ASSEMBLY – FRONT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Carefully pull bumper end cap away from fender to disengage clip. With end cap clear of fender clip, pull cap away from end of bumper to disengage bumper clips.
2. Locate and remove two nut and washer assemblies retaining bumper bars to side member mounting brackets. (Inside engine compartment.)
3. Pull bumper off front body panel. If required remove four nuts bolt and washer assemblies and detach mounting brackets from bar.

To Install

4. Insert a bumper bar bolt and washer assembly through each of four holes in bumper bar.
5. Locate brackets over bolts and secure with further nuts, flat and shakeproof washer assemblies.
6. Insert mounting bracket studs through holes in front body into brackets on side member. Align bumper across front body panel and tighten nut, flat and shakeproof washer assemblies to secure.
7. Check that retainer is correctly aligned in fender. Engage end cap with bumper bar, push firmly into place, then press into retainer on fender to secure.

   NOTE: Where bumper pads are fitted, these may be removed by prising off bar, and replaced by rubber malleting into place.

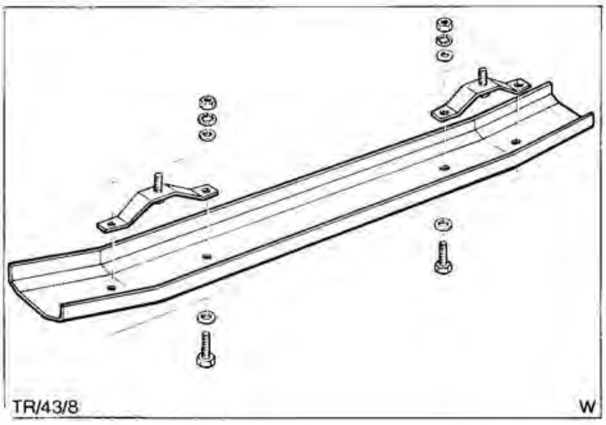

Fig. 4. Front bumper mounting bracket assembly to bumper bar

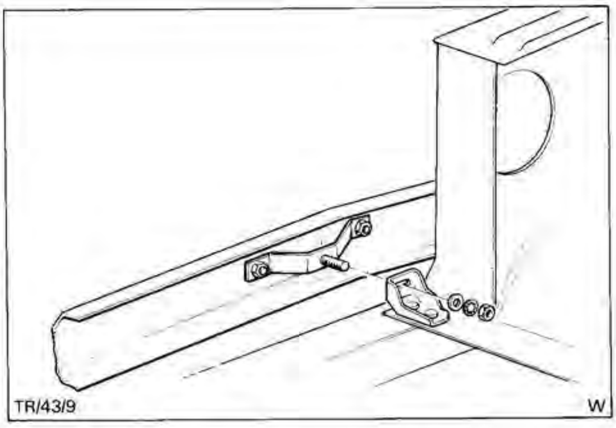

Fig. 5. Front bumper mounting brackets on body

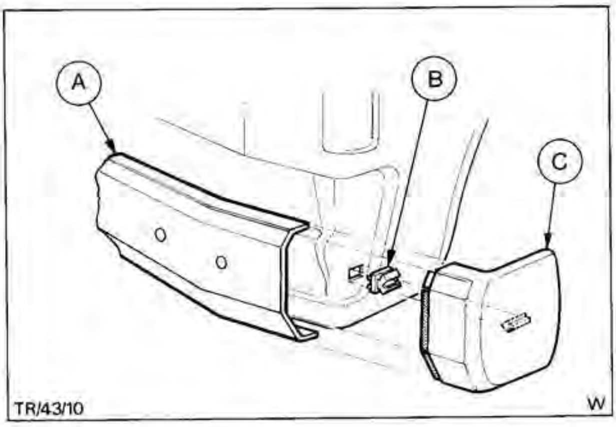

Fig. 6. Front bumper end cap fixings
A – Bumper bar
B – Retainer
C – End cap

43 445 BUMPER – REAR QUARTER – REMOVE AND INSTALL (ONE)

Special Service Tools Required: None

To Remove

1. Carefully pull bumper end cap away from bodyside panel to disengage clip. With end cap clear of side panel, pull cap away from end of bumper to disengage bumper clips.
2. From underneath vehicle remove bolt and washer assemblies securing bumper mounting bars to underbody. Note that for LH bumpers the assembly also retains the towing hook.
3. Pull bumper off back panel.
4. Where fitted, remove screw, nut and washer assemblies retaining fog lamp bracket, and rivets securing rear bumper inner caps.
5. Remove bolt and washer assemblies securing mounting bars and detach bars from bumper.

To Install

6. Position mounting bars on bumper bar and secure with a nut, bolt, flat washer (2) and shakeproof washer assembly for each bar.
7. Where required, refit fog lamp bracket and inner caps.
8. Insert mounting bars through elongated holes in back panel and secure bars to underbody with towing hook located on inboard bar, Fig. 9.
9. Check that retainer is correctly aligned in body side panel. Engage end cap with bumper bar, push firmly into place, then press into bodyside panel to secure.

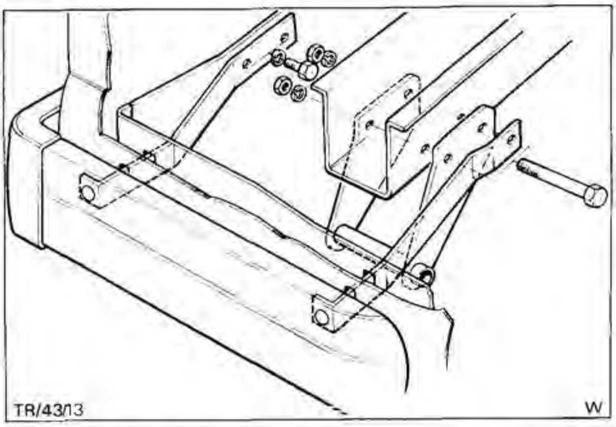

Fig. 7. Bumper bar and towing hook assembly to underbody

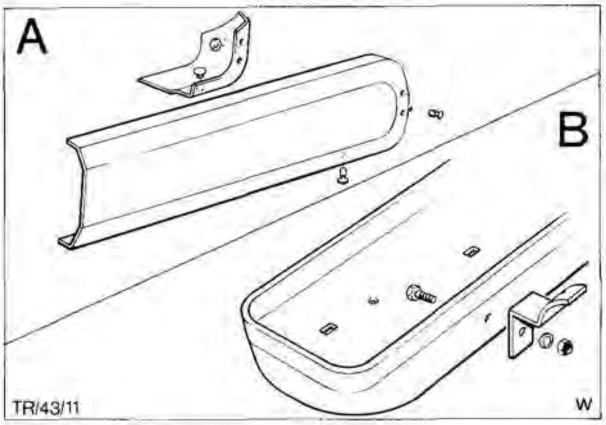

Fig. 8. Bumper bar fittings
A – Inner cap assembly
B – Fog lamp bracket

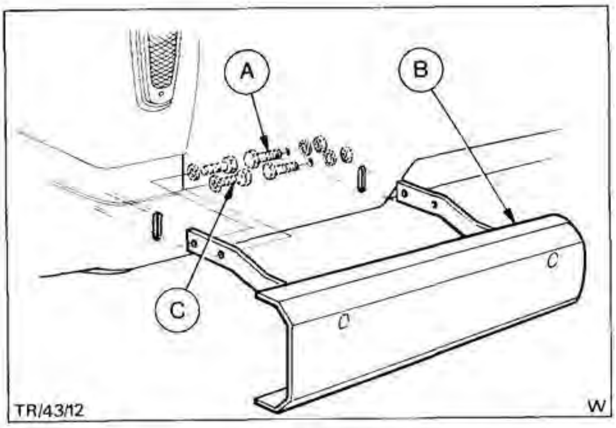

Fig. 9. Rear bumper mounting bracket assembly to body
A – Screw and washer assembly (inboard bar)
B – Bumper bar
C – Screw and washer assembly (outboard bar)

43 612 HEADLINING – REPLACE (¾ Length)

Special Service Tools Required: None

To Remove

1. Remove screw and washer assembly securing rear moulding retainer to roof side rail (RH and LH sides) and detach retainer.
2. Similarly, remove screw and washer from rear end, and push-in rivet from front end, of front moulding retainer (LH and RH side).
3. Carefully prise roof panel side trim moulding off roof side flanges.
4. Remove nine screw and washer assemblies securing rear roof panel to roof bar and eleven screw and washer assemblies securing each of two roof panel retainers to roof bows. Detach retainers.
5. **Slacken** screws securing roof panels to side rails and spring panels off screws, working from the rear of the vehicle forwards.

To Install

6. Check that roof panel anti-rattle felts are securely adhered to roof surface.
7. Renew adhesive foam strip SKM 3G9506 A, across front header bar, if required.

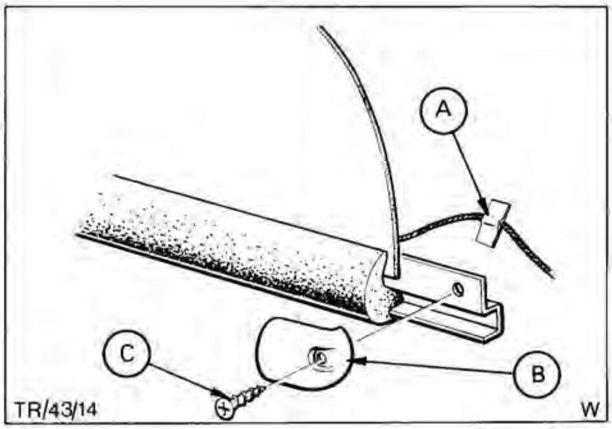

Fig. 10. Rear moulding retainer assembly
A – Retaining clip (electrical loom)
B – Retainer
C – Screw

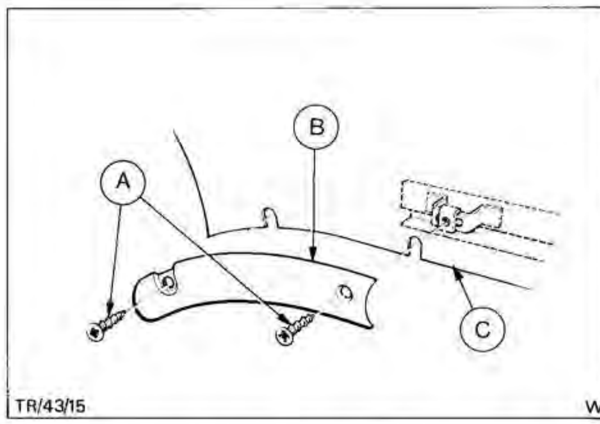

Fig. 11. Front moulding retainer assembly
A – Screws
B – Moulding
C – Roof panel

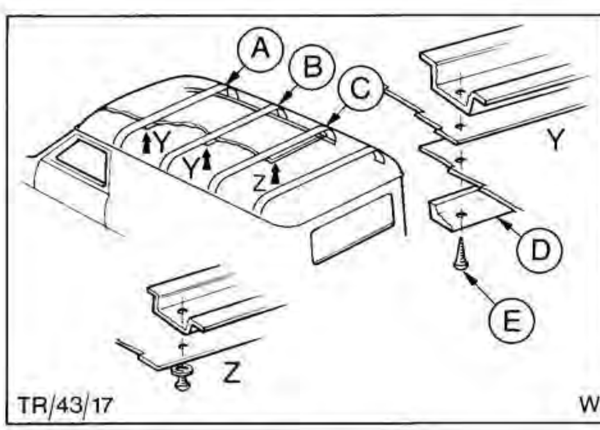

Fig. 12. Roof panels on roof bows
A – 1st bow (11 screws)
B – 2nd bow (11 screws)
C – 3rd bow (nine screws, no retainer)
D – Retainer
E – Screw

8. Check that 'U' nuts and screws are correctly located in body side rails. Screws should be loosely secured so that approximately 3 to 4 threads only engage 'U' nuts.
9. Assemble roof panels to roof bows (2 man operation). Locate panel onto side tail screws (RHS) while 2nd operator supports panel. To locate panel over LHS rail screws depress panel downwards in centre while 1st operator again locates panel over side tail screws.
10. Repeat for 2nd and 3rd panels, do not tighten screws.
11. Refit retainers across panels at 1st and 2nd roof bows and screw through rear edge of 3rd panel into roof bow.
12. Tighten all side rail screws.
13. Locate side trim moulding on side tails, starting at 3rd roof bow, work forward to 'A' pillar using rubber mallet to assemble moulding to flange.
14. Refit front and rear moulding retainers.

43 612 HEADLINING – REPLACE (FULL LENGTH)

Special Service Tools Required: None

To Remove

1. Remove following components:
   - Windscreen
   - Door flange weatherstrips
   - Interior mirror
   - Interior light
   - Sun visors
   - Tailgate hinge trim panel
2. Remove harpoon clips from aperture flanges, pull headlining off flanges.
3. Further pull headlining from side rail retainers, detach listing supports from their respective sleeves and remove headlining from vehicle.

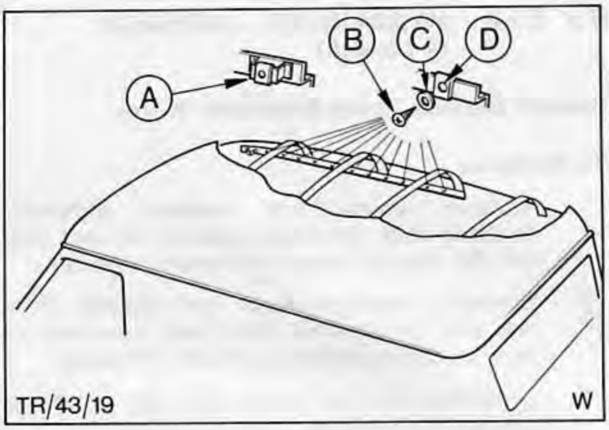

Fig. 13. Screw and washer assembly into side rails
A – Retainer bracket (one only, front)
B – Screw
C – Washer
D – 'U' nut

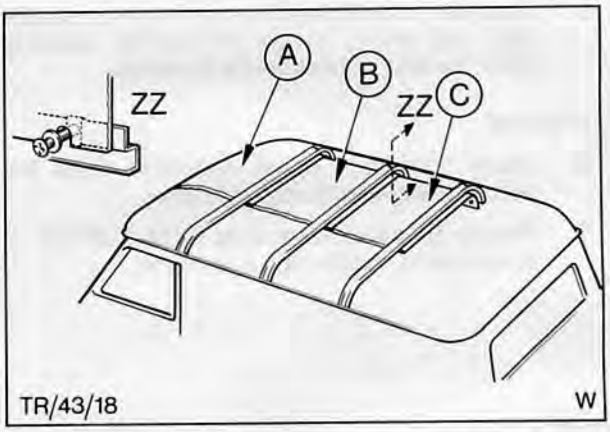

Fig. 14. Roof panel assembly on roof bow and side rail screws
A – 1st panel
B – Second panel
C – Third panel

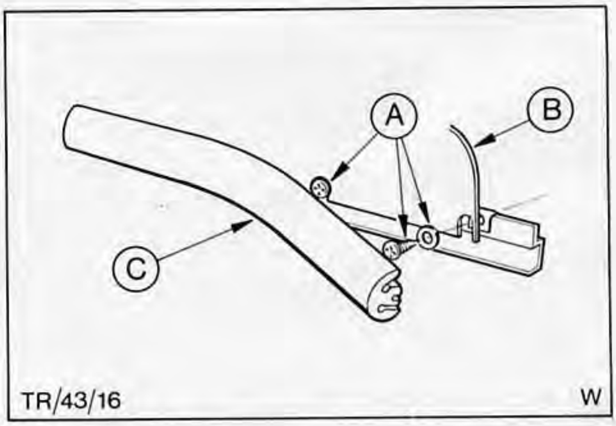

Fig. 15. Roof panel side trim moulding assembly
A – Screw and washer assembly, roof panel
B – Roof panel
C – Side trim moulding

To Install. (Full headlining)

4. Check that listing wire anti-rattle felts are correctly adhered to roof panel, if necessary refit felts using adhesive SM2G 4606 A, or similar.
5. Fit listing supports to headlining (supports numbered 1 to 9, from front of vehicle). Dust supports with French chalk before insertion into headlining seams.
6. Check that listing support sleeves are correctly located in retainers along roof side rail reinforcement.
7. Locate headlining in vehicle, working from front to rear engage listing supports in support sleeves RH and LH roof side rails. Centralise headlining at each seam.
8. Brush adhesive onto windscreen aperture flange and roof header bar. Offer headlining to prepared area, to transfer film of adhesive to material. Pull headlining off aperture and allow adhesive to gel.
9. Working from rear of vehicle forwards, tuck material under body headlining retainer to a point at door opening finish strip flange. Cut material carefully at this point to allow a wrap-around condition at flange.
10. Apply adhesive GESM 2G56A, or similar, to door opening flange.
11. Pull headlining taut and adhere to header and aperture flanges. Clamp in position while assembling harpoon type clamps to finally secure headlining to flanges.
12. Trim excess material, adhere material to door opening flange finishing at 'A' pillar as shown 'A' Fig. 18. Clip at corner as shown 'B' Fig. 18.

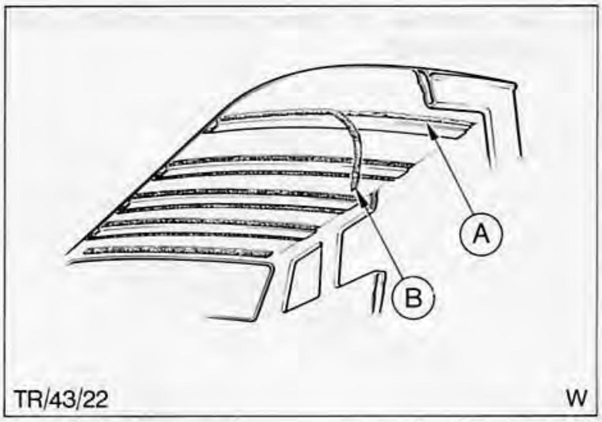

Fig. 16. Listing wire anti-rattle felts
A – Adhesive
B – Felt

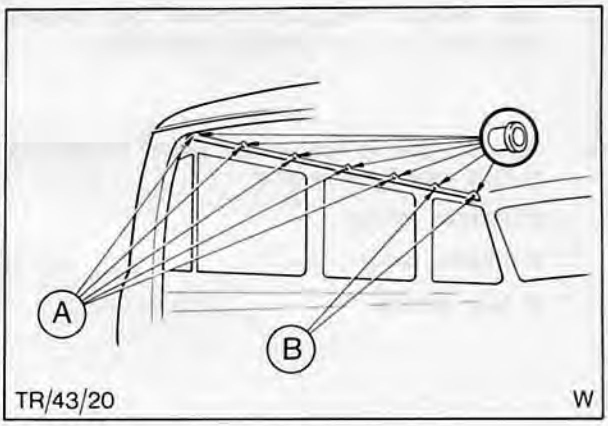

Fig. 17. Listing support sleeves
A and B – Full headlining
B – Cab headlining

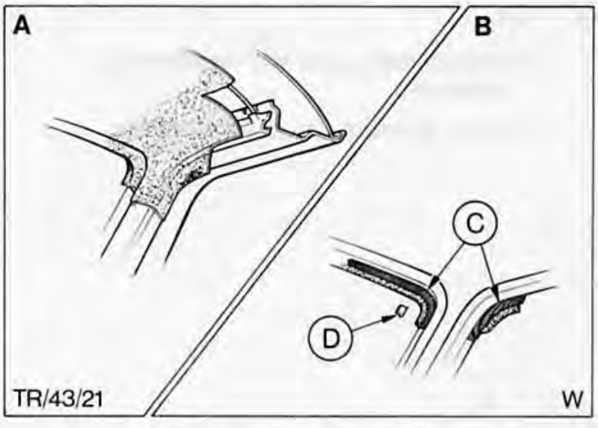

Fig. 18. Headlining at windscreen and door apertures
C – 'A' pillar finish, door opening
D – Edge clip

13. Cut material at interior lamp location, pull wires through.

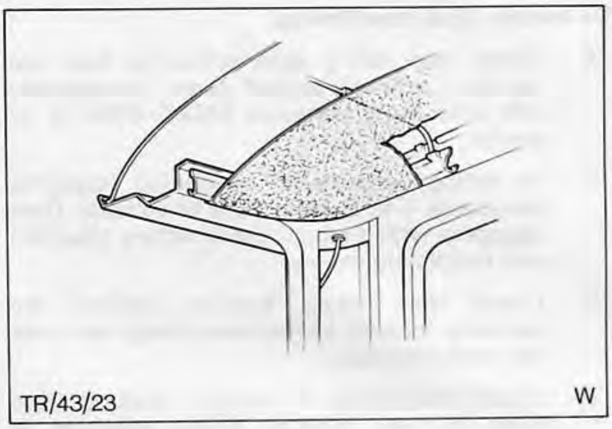

Fig. 19. Finish condition of headlining around rear of vehicle with double doors

14. Refit tailgate hinge trim panel and secure with ten screw and washer assemblies.

15. Feel for holes in header bar, pierce headlining at hole location and refit:

- Interior mirror
- Interior lamp
- Sun visor(s)

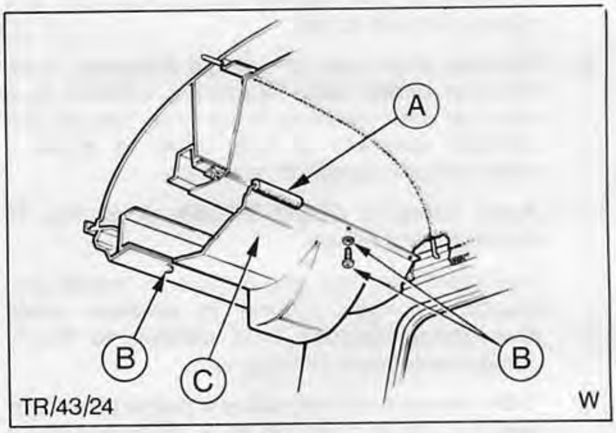

Fig. 20. Tailgate torsion bar trim panel assemble (LCY)
A – Weatherstrip 1340 mm long used only when full headlining is not fitted
B – Screw and washer assembly
C – Panel

16. Refit:

- Windscreen glass and weatherstrip assembly
- Door aperture flange weatherstrip

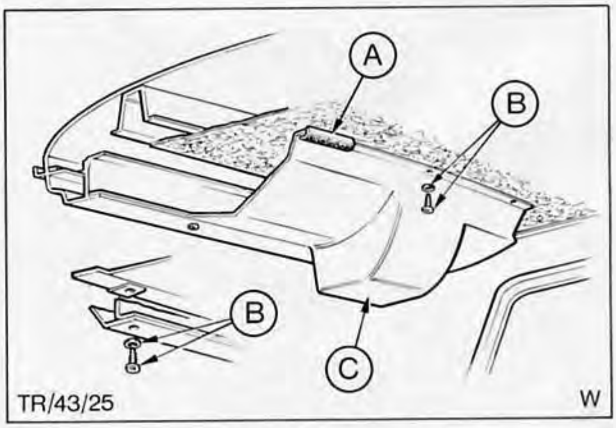

Fig. 21. Tailgate torsion bar trim panel (LCX)
A – Panel
B – Screw and washer assembly
C – Weatherstrip used only when full headlining is not fitted

43 633 SUN VISOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove single screw securing each sun visor bracket to roof header bar and detach visor assembly.

To Install

2. Position sun visor on header bar, align holes, insert and tighten screws to secure.

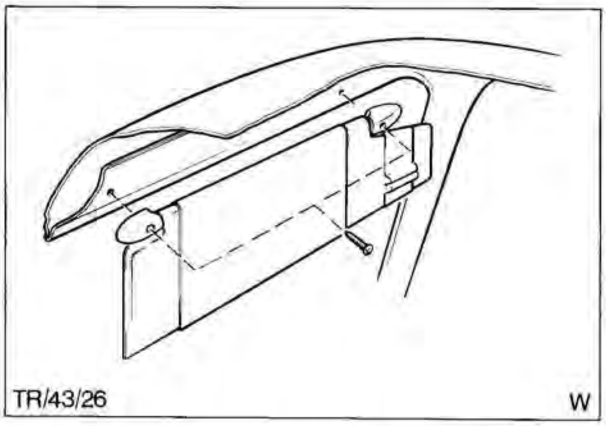

Fig. 22. Sun visor assembly to roof header bar

43 636 MIRROR – INTERIOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two screws securing mirror arm to roof header bar and detach mirror and arm assembly.

To Install

2. Position mirror and arm assembly on header bar, align holes, insert and tighten two screws to secure.

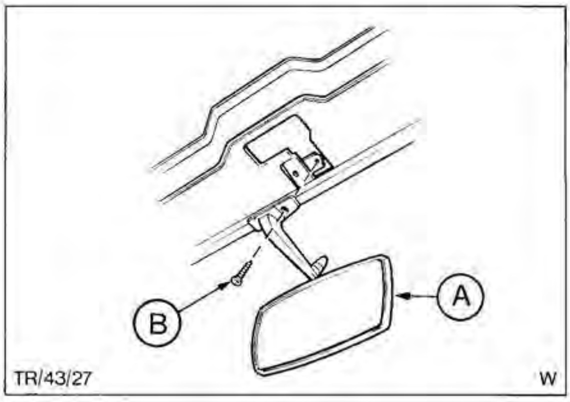

Fig. 23. Mirror and arm assembly to header bar
A – Mirror
B – Screw

43 644 CRASH PADDING – FASCIA – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Turn dzus fasteners securing instrument panel cover(s) and lift cover(s) off instrument panel.
2. Remove screws from pad, Fig. 24, and lift pad off instrument panel.

To Install

3. Position pad on instrument panel and secure with screws.
4. Replace cover(s) on instrument panel and secure with dzus fasteners.

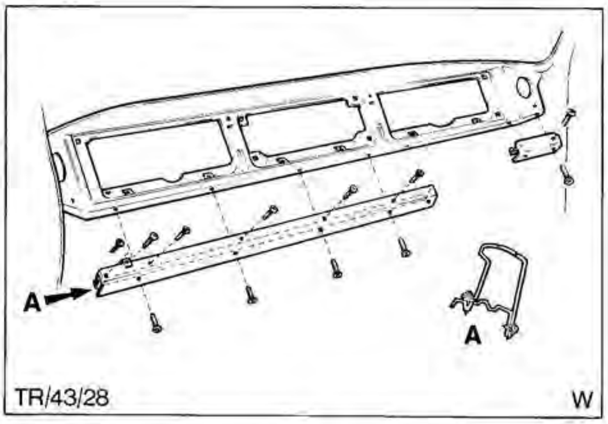

Fig. 24. Crash pad assembly to body
View arrow 'A' shows section through pad on instrument panel

43 655 HANDLE – PASSENGER ASSIST – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two screws securing retainer and passenger assist strap to 'B' pillar and detach strap.

To Install

2. Position strap on 'B' pillar. Locate retainer over strap and secure assembly to 'B' pillar with two screws.

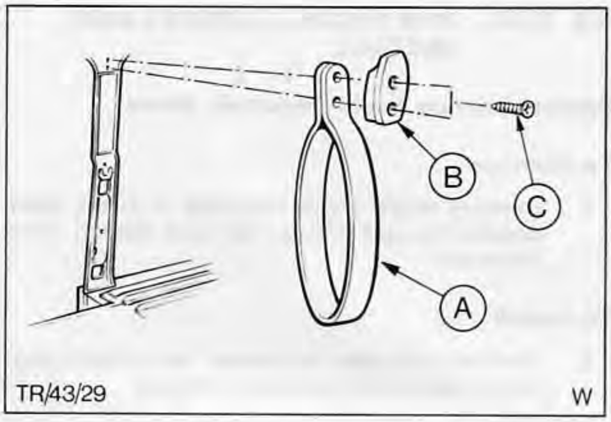

Fig. 25. Passenger assist strap assembly to 'B' pillar
A – Strap
B – Retainer
C – Screw

43 662 LID-GLOVE COMPARTMENT – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two screw and washer assemblies securing glove box striker through box to instrument panel lower.
2. Unscrew and remove two screws securing lower end of glove box/package tray to dash panel support bracket.
3. Remove four further screws from top flange of glove box/package tray and detach assembly from instrument panel.
4. Prise clips from pivots on side arms of lid, spring arms clear of glove box/package tray and detach lid.
5. Remove two screws and detach catch from lid.

To Install

6. Position catch on top centre of lid and secure with two screws.
7. Assemble lid to glove box/package tray by locating side arms of lid into sides of box and secure by assembling clips onto pivots.
8. Secure upper flange of glove box/tray to underside of instrument panel lower.
9. Further secure bottom of glove box/tray to dash panel bracket with two screws.
10. Position striker on top flange of glove box/tray and secure with two screws.

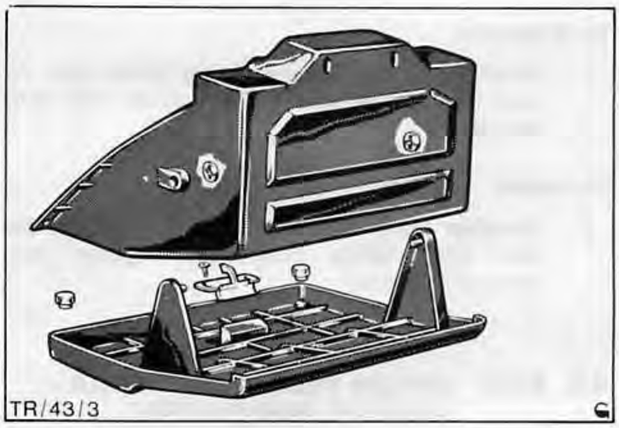

Fig. 26. Glove box lid assembly to glove box/package tray

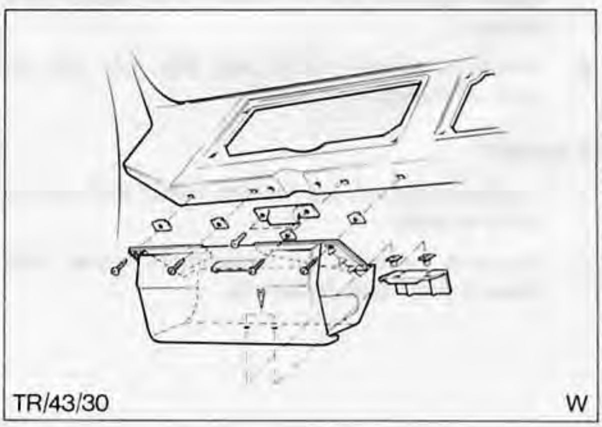

Fig. 27. Glove box/package tray to instrument panel lower

43 712 PANEL – DOOR TRIM – REMOVE AND INSTALL

Special Service Tools Required: None

NOTE: Trim panels may be fitted to the hinged front, side loading and rear doors, and to the sliding front and side loading doors. Trim panels may be either painted hardboard, with visible clips or PVC covered, with the PVC finish concealing the retaining clips.

To Remove

1. Remove door remote control handle Operation No. 43–714.
2. Door window regulator (where fitted) Operation No. 43–716.
3. Door armrest (where fitted) Operation No. 43–737.
4. Prise clips from their locations, lift trim panel from door. Use tool, dimensioned in Fig. 28, to lift PVC finish panel clips from their locations.

To Install

5. Check that clip plugs are correctly located in door inner panel (painted hardboard panels).
6. Position trim panel on door, if necessary engage top edge of panel under horizontal retainer on door inner panel.
7. Align holes in panel with plugs (hardboard panel), or clips in panel with holes in door inner panel (PVC finish panels), and push in clips to secure.
8. Refit, as required, door armrest, window regulator and remote control handles.

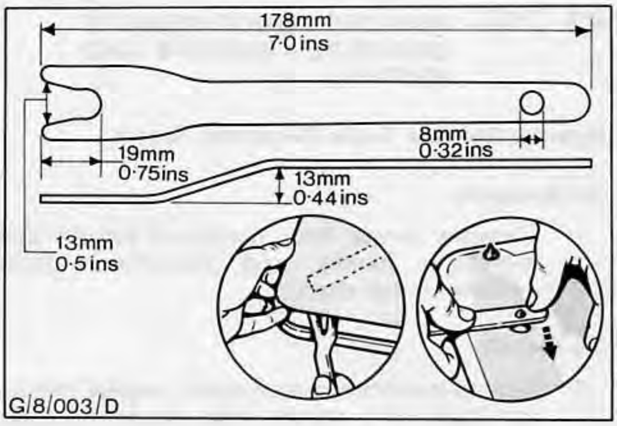

Fig. 28. Door trim clip removal tool (PVC finish panels)

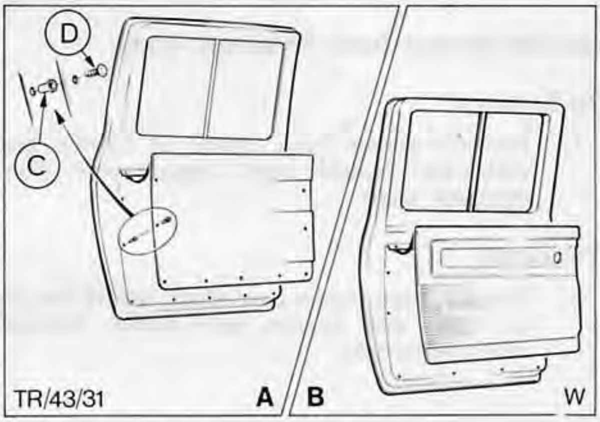

Fig. 29. Hinged side loading door trim panel
A – Painted hardboard, visible clips
B – PVC, concealed clips
C – Clip
D – Plug

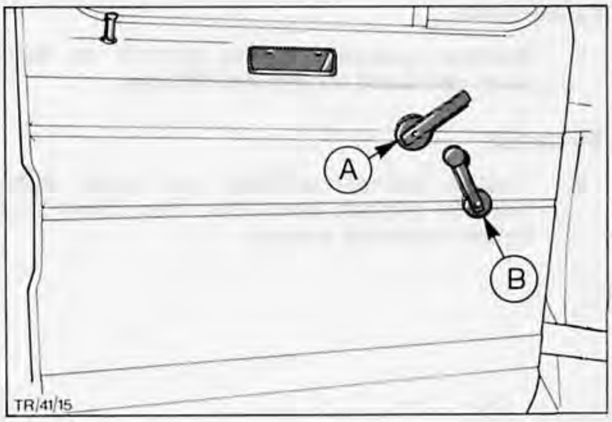

Fig. 30. Front door trim panel, PVC finish
A – Remote control handle
B – Window regulator handle

43 714 HANDLE – DOOR REMOTE CONTROL – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove screw from centre of handle and withdraw handle and escutcheon from remote control shaft.

To Install

2. Locate escutcheon over shaft, engage handle on shaft and secure with screw through centre of handle.

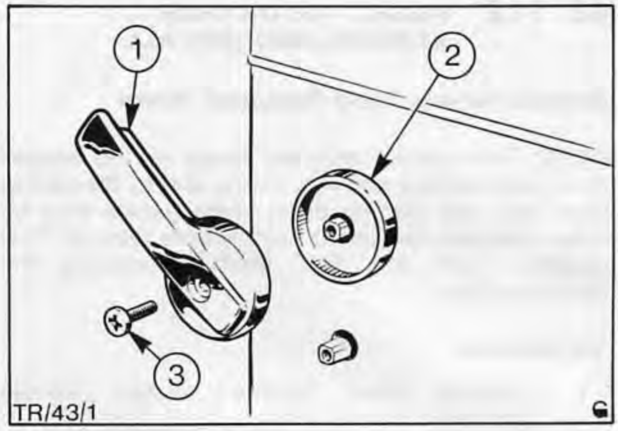

Fig. 31. Remote control handle assembly
1 – Handle
2 – Escutcheon
3 – Screw

43 716 HANDLE – DOOR WINDOW REGULATOR – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove screw from centre of handle and withdraw handle and escutcheon from regulator shaft.

To Install

2. Position escutcheon over shaft, locate handle on shaft and secure with screw through centre of handle.

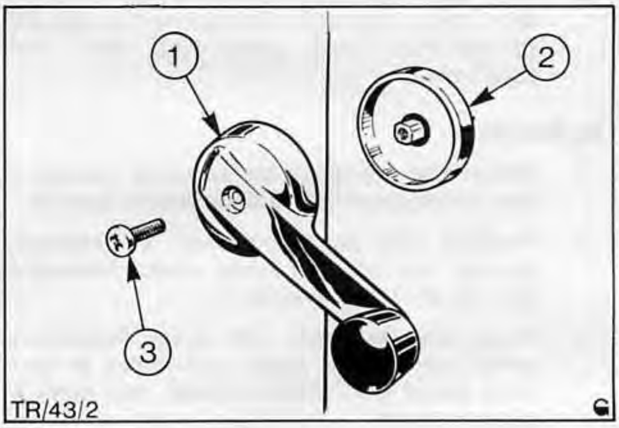

Fig. 32. Door window regulator assembly
1 – Handle
2 – Escutcheon
3 – Screw

43 737 ARM REST – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove screws securing armrest to door inner panel and lift armrest off door.

To Install

2. Position armrest on door trim panel, align holes in armrest and door, then insert and tighten retaining screws.

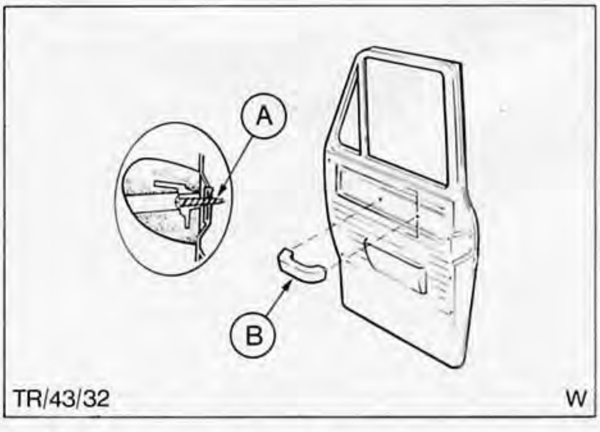

Fig. 33. Armrest assembly to door
A – Screw and armrest sectioned
B – Armrest

43 744 PANEL – TAILGATE TRIM – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Prise seventeen pins from periphery of trim panel and lift panel off tailgate inner panel.

To Install

2. Check that plugs are correctly located in tailgate inner panel. Position trim panel on tailgate, align holes in panel with plugs and push in trim pins to secure.

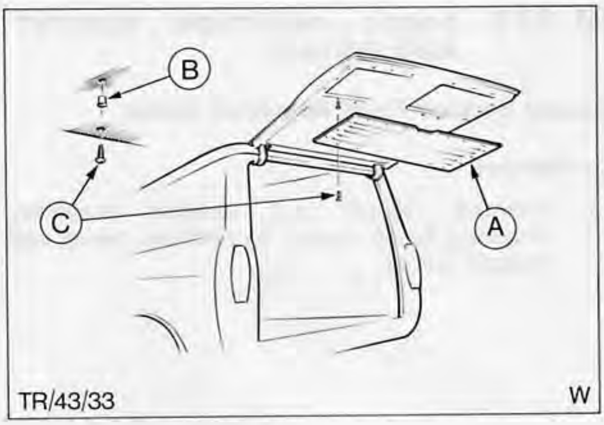

Fig. 34. Trim panel, tailgate
A – Panel
B – Plug
C – Clip

43 751 SEAT ASSEMBLY – FRONT BUCKET – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove three bolt and washer assemblies retaining each seat slide to floor and lift seat from cab.

To Install

2. Position seat in cab, align holes in guides and floor pan, insert and tighten three bolt, flat and lock washer assemblies to secure each slide to floor.

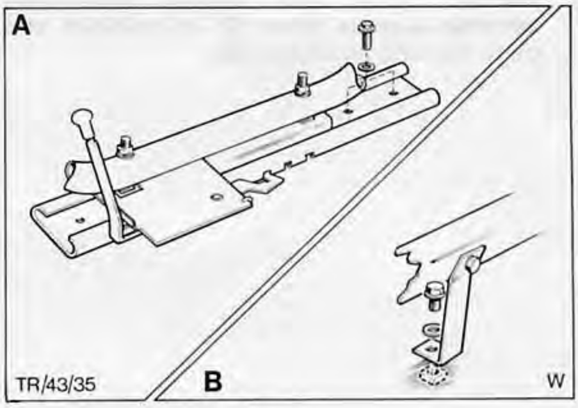

Fig. 35. Front seat to floor pan
A – Seat slide assembly (driver seat)
B – Fixed passenger seat fixing bracket

43 755 4 SLIDE – FRONT SEAT – REPLACE (SEAT REMOVED)

Special Service Tools Required: None

To Remove

1. Remove nut and washer assemblies securing slide studs to seat frame.

To Install

2. Insert seat slide studs through their respective holes in seat frame and secure with nut and washer assemblies.

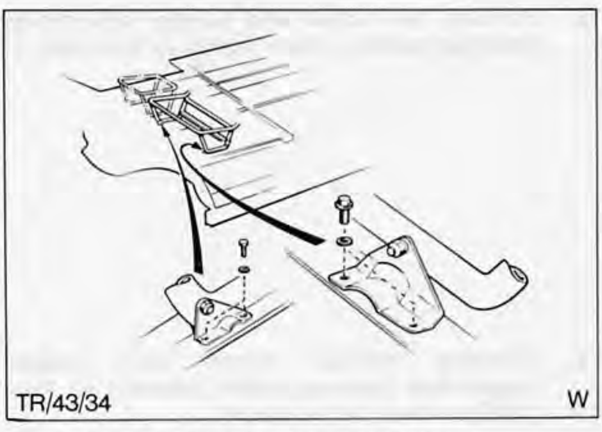

Fig. 36. Front passenger seat (dual) to floor pan

43 872 PANEL – PARTITION – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove screw and washer assembly securing bump rubber to partition panel and detach rubber.

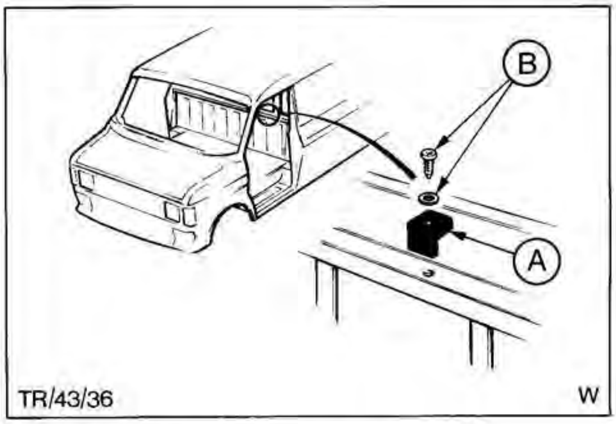

Fig. 37. Partition panel bump rubber
A – Bump rubber
B – Screw and washer

2. Remove screw and washer assemblies securing support tubes (2) to partition and body side and remove tubes.

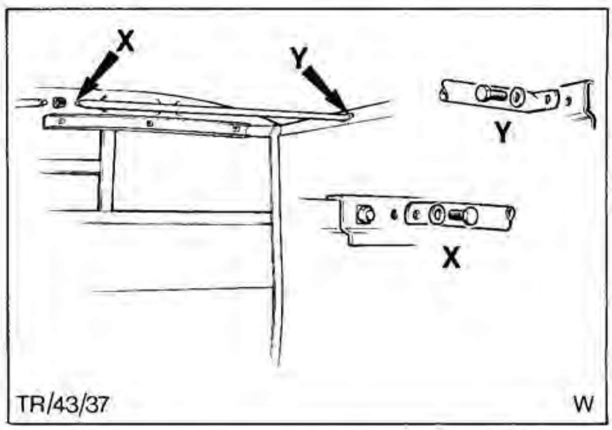

Fig. 38. Body partition support tubes (reinforced bulkhead)

3. Remove ten screw and washer assemblies securing partition lower flange to floor pan.

4. Similarly remove screw and washer assemblies securing outer brackets to floor pan (non-seat belt variants).

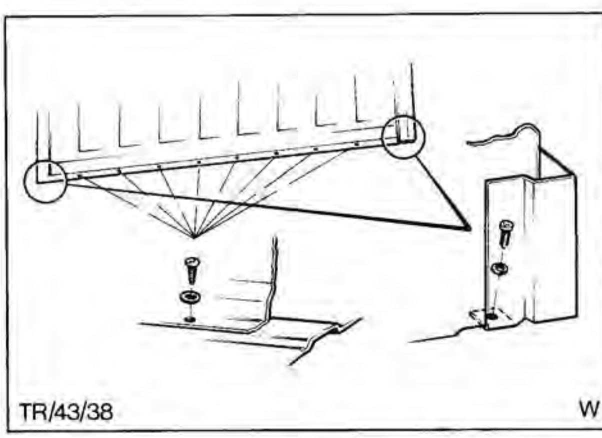

Fig. 39. Body partition lower flange assembly to floor pan

5. Remove screw and washer assembly securing partition and retainer into side retainers at top corners (RH and LH side).

6. Remove six screw and washer assemblies securing two reinforcement plates (LCX) to upper bulkhead, or one full width reinforcement plate (LCY) to bulkhead and detach plate(s).

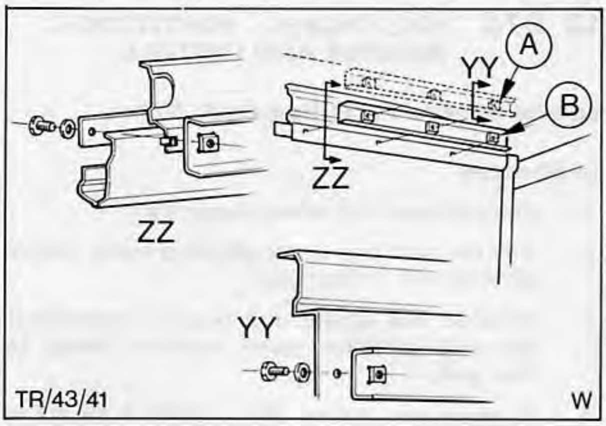

Fig. 40. Reinforcement plates to upper bulkhead
A – YY – LCY variants
B – ZZ – LCX variants

7. Remove upper and lower side reinforcement plate screws retaining partition panel to side retainers. Remove reinforcement plates.
8. Remove front seats and belts.
9. Remove partition panel from vehicle.

To Install

10. Check that special nuts in side and upper retainers are correctly located, and that sealing strips are in good condition. If necessary, renew strips.

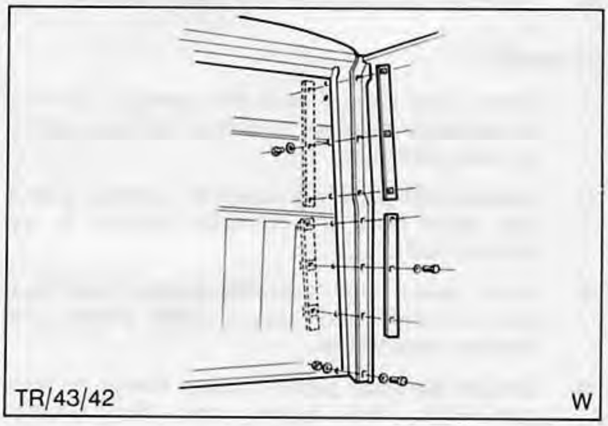

Fig. 41. Reinforcement plates to side bulkhead

11. Brush apply adhesive to upper edge of partition panel, and assemble upper sealing strip to panel, aligning holes in strip with those in panel.
12. Locate partition panel in vehicle

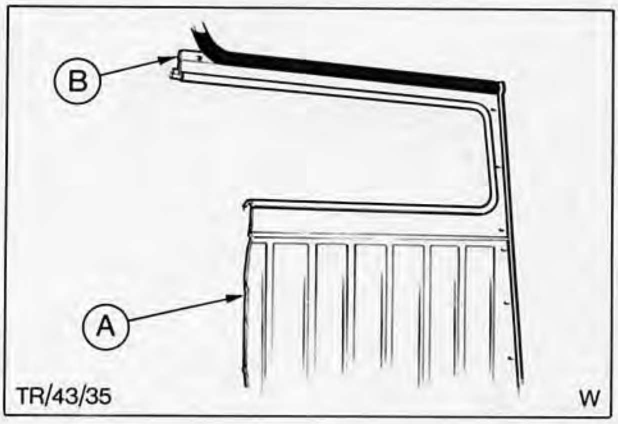

Fig. 42. Sealing strip to partition panel upper edge
A – Panel
B – Upper edge

43 874 HALF PANEL – PARTITION – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove seat and relevant seat belt.
2. Drill out two pop rivets securing lower end of partition rail to floor pan.
3. Remove five screw and washer assemblies securing partition panel bottom flange to floor pan.
4. Remove two screw and washer assemblies securing partition panel rail to roof bow bracket.
5. Similarly remove seven screw and washer assemblies securing panel to body side retainer.
6. Remove half partition panel from vehicle.

To Install

7. Check that special nuts are correctly located in bodyside retainer, and that retainer seal is in good condition.
8. Locate half partition panel in vehicle. Check that spire nuts are correctly located in top sides of rail.
9. Align panel with bodyside retainer and roof bow bracket and secure with screw and washer assemblies.
10. Secure partition panel bottom flange to floor pan with five screw and flat washer assemblies.
11. Pop rivet lower flange of partition rail to floor pan.

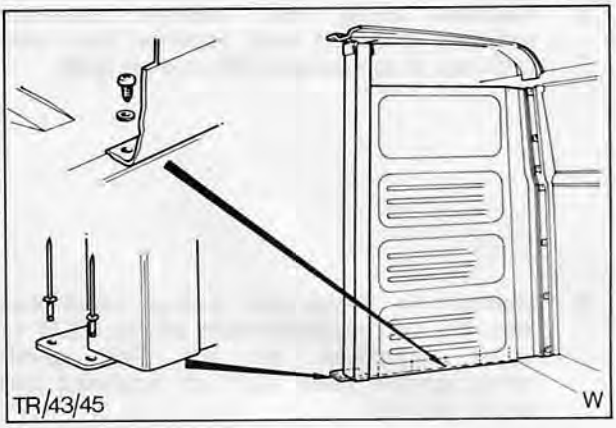

Fig. 43. Partition panel rail and bottom flange assembly to floor pan

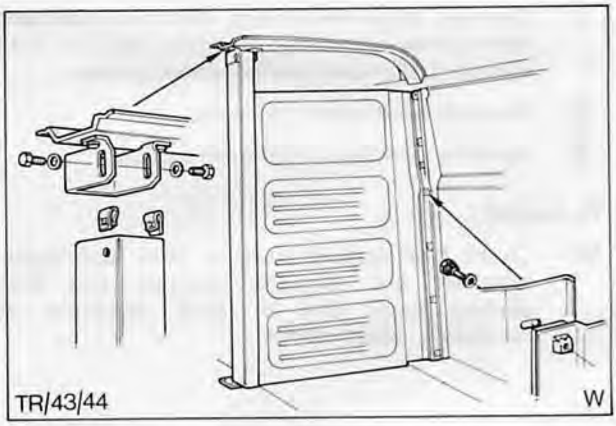

Fig. 44. Partition panel and rail assembly to roof bow bracket and bodyside retainer

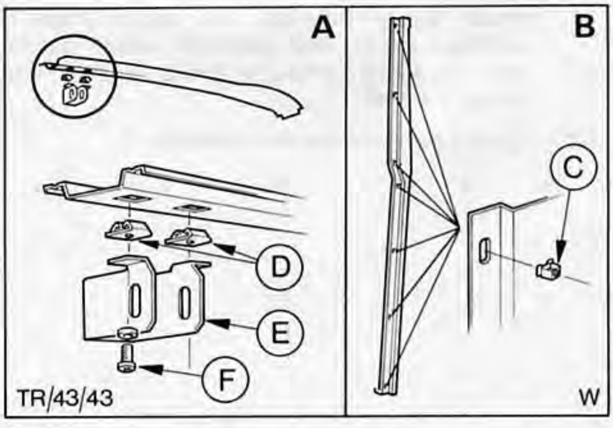

Fig. 45. A – Bracket assembly to roof bow
B – Retainer to bodyside
C – Special nut
D – Special nut
E – Bracket
F – Screw and washer

12. Align partition panel to side retainers and secure to side retainers with reinforcing plates (upper and lower) and six screw and washer assemblies (three each plate). Finally, insert and tighten further screw and washer at bottom corners.
13. Similarly, secure partition panel to roof retainer across upper edge with one, or two reinforcement plates (depending on model variant).
14. Insert and tighten a further screw and washer assembly at each top corner.

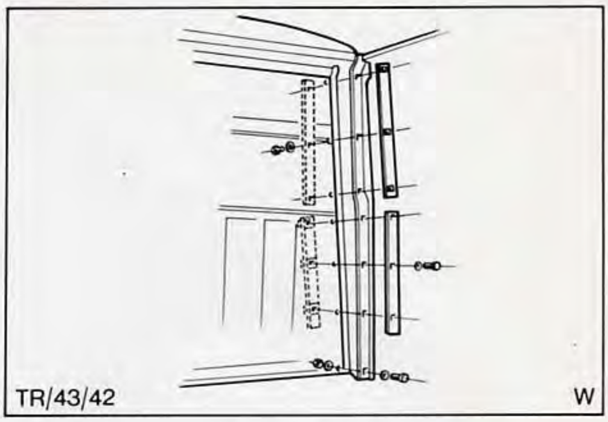

Fig. 46. Reinforcement plates to side bulkhead

15. Secure outer brackets on partition to floor pan with single screw and washer assembly (when seat belts are not fitted).
16. Refit ten screw and flat washer assemblies securing partition panel lower flange to floor pan.
17. Position and secure body partition support tubes to partition panel and body side.

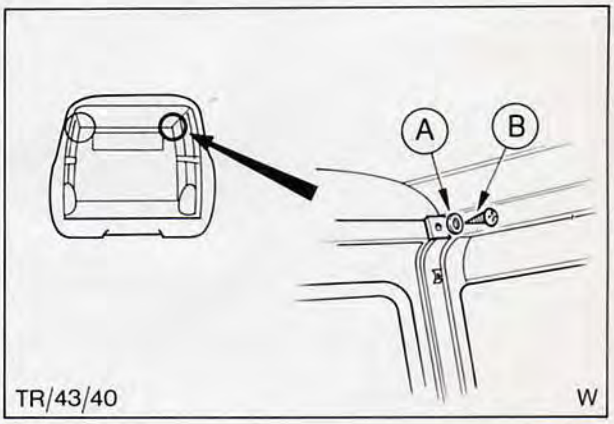

Fig. 47. Top corner screw and washer assembly
A – Washer
B – Screw

18. Locate bump rubber on partition panel and secure with screw and washer assembly.
19. Refit seat and seat belt.

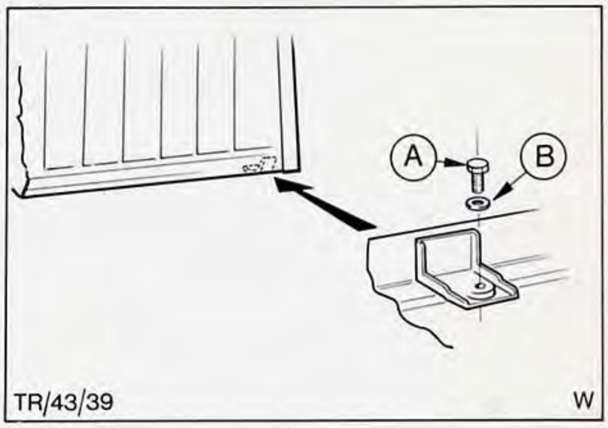

Fig. 48. Outer bracket assembly to floor pan
A – Bolt
B – Washer

WINDOWS AND OPERATING MECHANISM

42

GENERAL DESCRIPTION

Toughened safety glass is flexibly mounted to all window apertures, excepting the windscreen via groove weatherstrip assemblies. A laminated windscreen is available as optional equipment on all models. This type of screen consists of a layer of clear plastic sandwiched between two layers glass. When struck with sufficient force the screen does not shatter but only cracks, allowing virtually unimpeded vision.

The driver and passenger hinged door windows may be raised, or lowered, by means of one piece cable-type regulator mechanism. These mechanisms are retained to the door inner panel with screws and are bolted to the window glass bracket. The door window glass slides in lined channelling in the window frame and door shell.

Opening quarter vent windows pivoting within a separate framework, are available as an option with hinged front doors in instances where the opening quarter window options is not taken up, fixed triangular, glass pieces are located between the window vertical channel and the window frame.

The glass used with the sliding cab door is one piece fixed, and one piece sliding. The sliding glass is locked by a spring loaded catch mounted on the door frame.

Side windows, Rear Door windows and Tailgate windows are all fixed and are retained in their various apertures by conventional rubber weatherstrips.

Opening rear quarter windows are available as an option. These are hinged at their leading edge and operated by an over centre catch, bolted through the glass and held to the rear pillar by two screws.

SERVICE ADJUSTMENTS AND CHECKS

None required

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
	None required.

G/7/079/D

SERVICE AND REPAIR OPERATIONS – CONTENT

WINDOWS AND OPERATING MECHANISM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range					
				Transit '77	Fiesta	Escort '75 onwards	Capri	Taunus '76 Cortina	Granada '78
42 114	Windscreen – Remove and Install	X		X	X	X	X	X	X
42 115	Windscreen – Replace		42 114						
42 214	Glass – Door quarter window fixed – Remove and Install								
42 254	Opening quarter window assembly – Remove and Install		42 214						
42 254 8	Opening quarter window – Dismantle and Reassemble	X		X					
42 255	Glass – Opening door quarter window – Remove and Install		42 254 8						
42 272	Catch – Door quarter window – Replace		42 254 8						
42 314	Glass – Door window – Remove and Install	X		X					
42 314 4	Bracket – Door window glass to regulator – Remove and Install	X		X					
42 334 4	Runs – Door window – Replace	X		X					
42 338	Regulator assembly – Door window – Remove and Install	X		X					
42 364	Glass and frame assembly – Sliding window – Remove and Install	X		X					
42 414	Glass – Side window – Remove and Install	X		X					
42 464	Glass – Partition panel – Replace	X		X					
42 514	Glass – Fixed rear quarter window – Remove and Install		42 414						
42 534	Opening rear quarter window assembly – Remove and Install		42 536						
42 536	Glass – Opening rear quarter window – Remove and Install	X		X					
42 544	Catch – Opening rear quarter window – Remove and Install		42 536						
42 546	Weatherstrip – Opening rear quarter window – Remove and Install	X		X					
42 634	Glass – Rear door window – Remove and Install	X		X					
42 554	Glass – Tailgate window – Remove and Install		42 414						

SERVICE AND REPAIR OPERATIONS

42 114 WINDSCREEN – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Cover hood and cowl with cloth to prevent accidental damage.
2. Remove windscreen wiper arms and blades.
3. Using a lipping tool from inside car, push weatherstrip lip under top and sides of aperture flange. Push out weatherstrip and glass as an assembly.
4. Remove weatherstrip.
5. Clean aperture and weatherstrip. Check aperture flanges for buckles and distortion. Dress, if necessary.

To Install

6. Fit weatherstrip to glass and fit length of cord in the rubber to body groove of weatherstrip so that cord ends emerge at bottom corner. Allow a crossover of cord ends of approximately 150 mm (6,0 in). If draw cord is passed through short length of metal tube and tube then used to separate weatherstrip lips insertion of cord may be simplified by drawing tube around periphery of weatherstrip. To assist in retaining weatherstrip to glass short lengths of masking tape may be stuck over weatherstrip and secured to both sides of glass. Seal rubber to glass location.
7. Using PVC foam tape (SQM 3G9505A. 9,0×6,0 mm) remove backing paper and apply tape to exterior horizontal flanges of windscreen aperture.
8. Offer glass and weatherstrip assembly to body aperture. Push assembly up until groove in weatherstrip engages top transverse flange of body aperture. Ensure that draw cord ends are inside passenger compartment and push window firmly in at base. From inside vehicle commence pulling one end of drawcord from weatherstrip groove. As cord is withdrawn apply pressure to glass from outside, either by hand or rubber mallet, in immediate vicinity of cord. When top centre of window is reached repeat procedure with other end of cord. Remove masking tape as installation proceeds.
9. Refit windscreen wiper arms and blades.
10. Remove cowl covering.

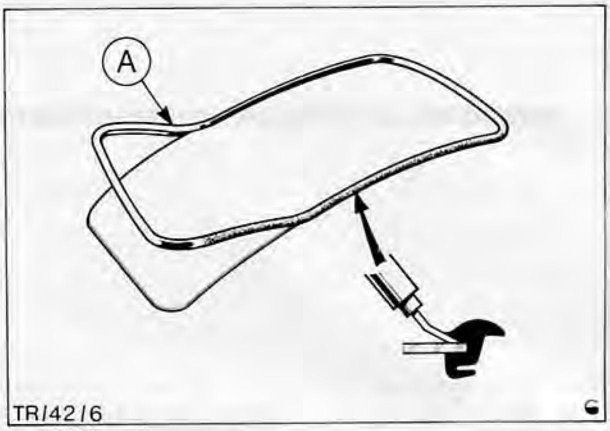

Fig. 1. Weatherstrip (A) to windscreen assembly

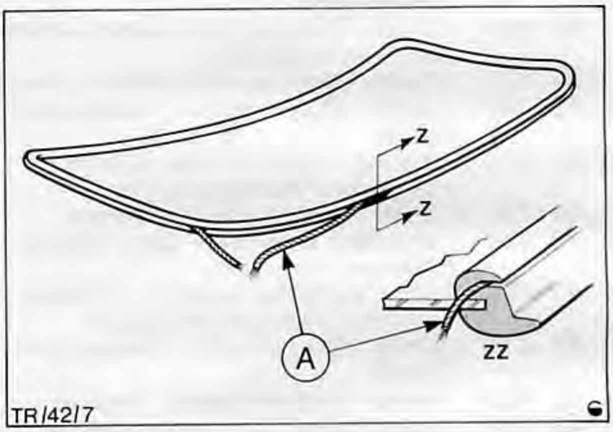

Fig. 2. Windscreen drawcord (A) inserted

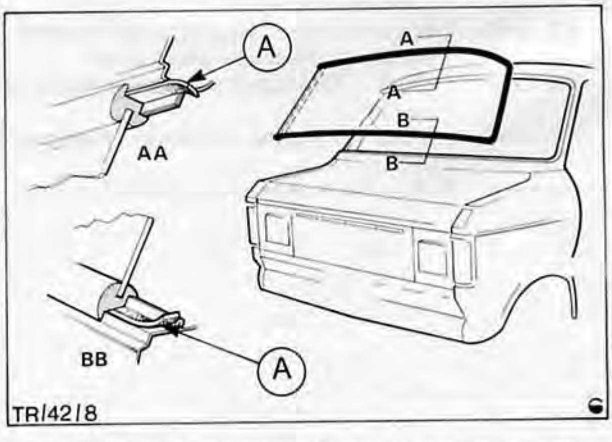

Fig. 3. PVC foam tape locations (A) on windscreen aperture

42 214 GLASS – DOOR QUARTER WINDOW – FIXED – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door trim panel.
2. Pull down plastic sheet as necessary to gain access to quarter window glass fixings.
3. Peel back adhered section of door belt weatherstrips from vent window channelling and remove inner and outer door belt weatherstrips from door.
4. Remove screw and flat washer assembly retaining quarter window channelling to door inner panel.
5. Similarly remove two screw, lock and flat washer assemblies securing quarter window frame to door window frame. Remove quarter window and frame assembly from door shell.
6. Drill out two pop rivets securing top of quarter window frame and two tubular rivets securing lower end of frame to dividing bar.
7. Separate frame and glass from dividing bar and then glass from frame.
8. Remove weatherstrip from glass.

To Install

9. Assemble weatherstrip around perimeter of glass.
10. Brush soap solution onto weatherstrip and locate glass and weatherstrip assembly into channelling of frame. Tap firmly into place using a rubber mallet.

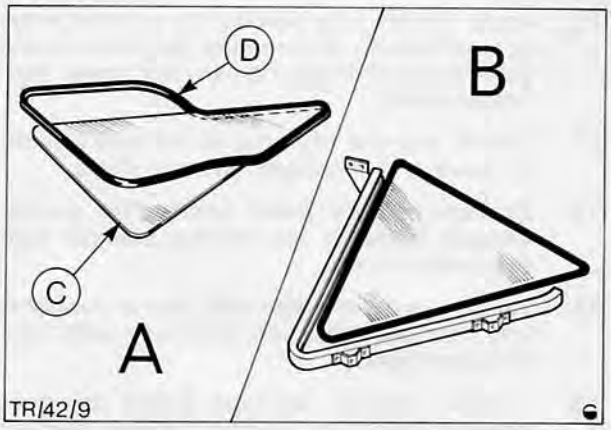

Fig. 4. Glass and weatherstrip assembly
A – Glass (C) and weatherstrip (D)
B – Glass/weatherstrip to frame

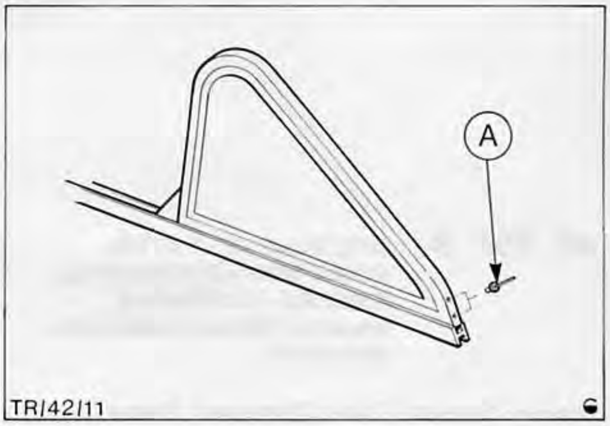

Fig. 5. Pop rivet (A) assembly quarter window frame (top)

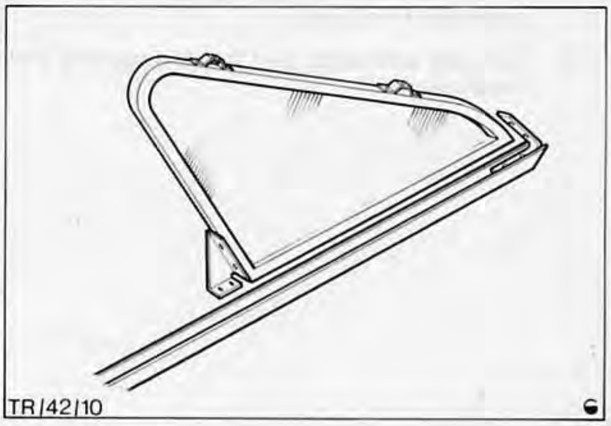

Fig. 6. Glass and frame assembly to dividing bar

11. Apply further soap solution to exposed edge of weatherstrip and engage glass and frame assembly in dividing channel, tap 'home' with rubber mallet.
12. Secure top end of frame to cranked bracket on dividing channel with two pop rivets.
13. Similarly, secure lower bracket on quarter window frame to the dividing channel with two tubular rivets.
14. Insert quarter window and frame assembly into door shell and into alignment with door window frame.
15. Secure quarter window frame to door window frame and quarter window dividing channel to door inner panel with screw and washer assemblies.
16. Refit door belt weatherstrips, adhering overlap sections to quarter window assembly.
17. Refit plastic sheet and door trim panel.

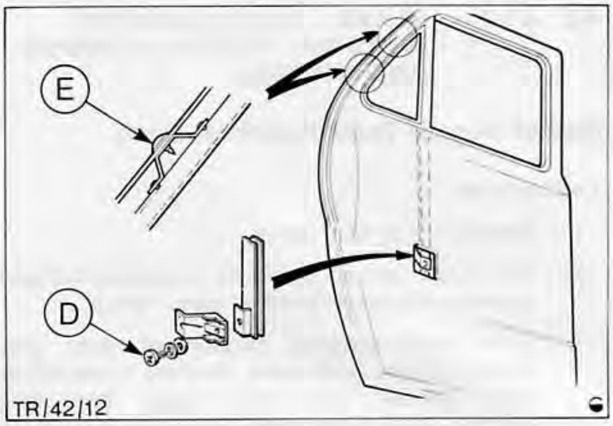

Fig. 7. Door quarter window frame fixing to door
E – Fixing at door window frame
D – Fixing at door inner panel

42 254 8 OPENING QUARTER WINDOW – DISMANTLE AND RE-ASSEMBLE (quarter window assembly removed)

Special Service Tools Required: None

1. Slacken and remove screw securing clip on lower pivot.
2. Carefully drill out end of special shouldered rivet retaining glass and frame to upper pivot. Remove rivet, cover, spacer and insert assembly from pivot.
3. Carefully pull glass and frame assembly from lower pivot.

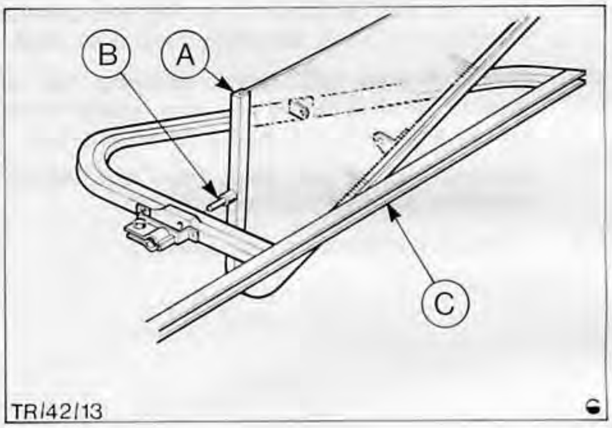

Fig. 8. Lower pivot clamp
A – Glass and frame
B – Lower pivot
C – Quarter window frame

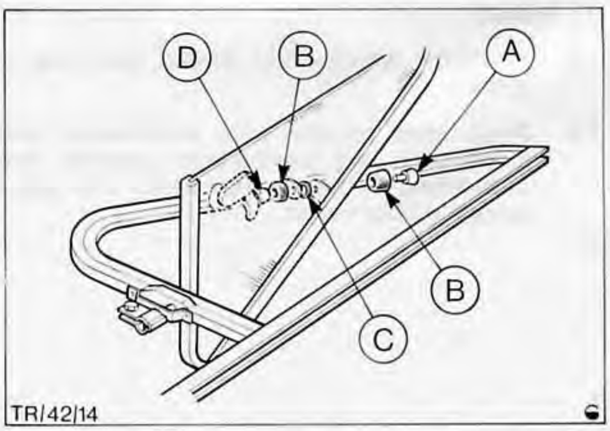

Fig. 9. Spacer and insert assembly, upper pivot
A – Shoulder rivet
B – Cover
C – Spacer
D – Insert

4. If required fully remove screw securing clip to lower pivot and detach clip.
5. Drill out rivets securing weatherstrip along dividing bar, and remove weatherstrip from dividing bar and frame assembly.
6. Carefully support glass and frame assembly and tap out pin from handle. Pull handle and washer off shaft.

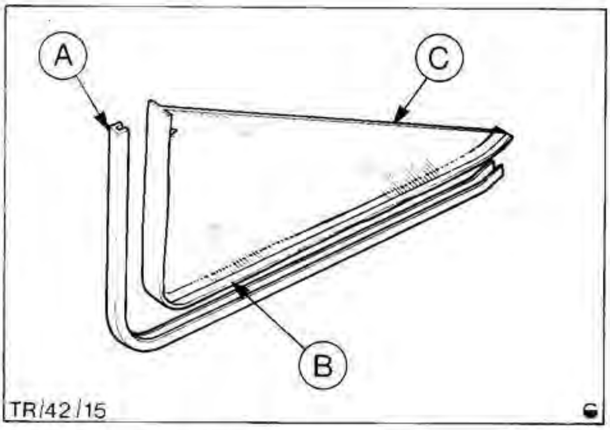

Fig. 10. Glass and seal assembly to frame
A – Frame
B – Seal
C – Glass

7. With handle removed, unscrew shaft nut and separate shaft, nut and washer assembly.
8. If a new glass is being fitted, press a strip of glazing and sealing mastic into 'U' channel of glass frame. Push glass edge into channel and tap with rubber mallet to secure. Clean excess sealer from both sides of frame.

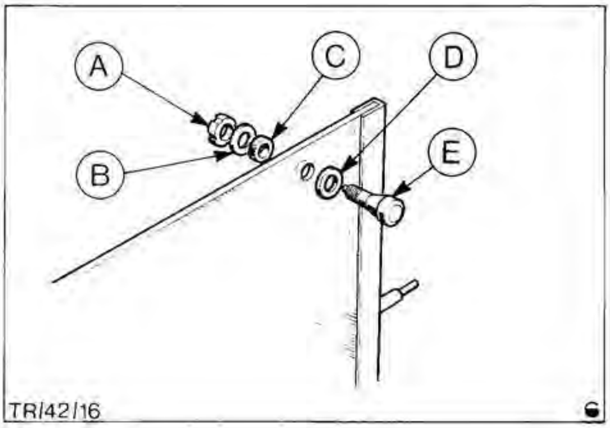

Fig. 11. Handle shaft assembly to glass

9. Assemble a sealing washer on to handle shaft, insert shaft through hole in glass and assemble a further sealing washer, flat washer, lock washer and nut onto shaft. Tighten nut to secure assembly.
10. Grease remaining length of handle shaft then assemble flat washer and handle onto shaft. Secure handle by inserting pin, ensure locking face of handle is parallel to glass face.
11. Brush soap solution on to weatherstrip and fit weatherstrip to dividing channel and frame assembly. Complete assembly to dividing channel with four 'pop' rivets.

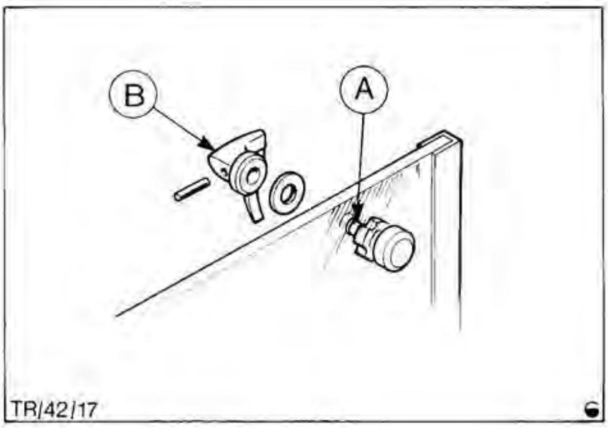

Fig. 12. Handle assembly to shaft

12. If required, assemble clip to lower pivot bracket on dividing channel and frame assembly, loosely retain with screw.

13. Grease lower pivot pin on glass and frame assembly and insert pin into lower pivot on dividing channel and frame assembly.

14. Insert a spacer between upper pivot lugs and secure lugs with rivet. Tighten screw on lower pivot clip.

    NOTE: For Ford Germany built vehicles upper pivot assembly consists of: shoulder rivet, cover, spacer, cover and insert. (Fig. 9.)

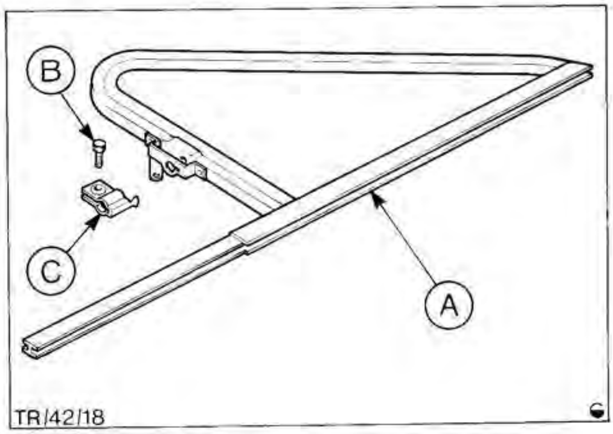

Fig. 13. Clip assembly to lower pivot
A – Quarter window frame
B – Screw
C – Clip

42 314 GLASS – DOOR WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door trim panel see Operation No. 43–712.
2. Peel plastic sheet clear of door inner panel apertures.
3. Remove vent window assembly.
4. Remove inner and outer door belt weatherstrips.
5. Raise glass sufficiently to give access to regulator plate screws through cut-out. Remove screws and withdraw glass via window aperture.

To Install

6. Insert glass in door shell and secure to regulator plate with two screws. Raise and lower glass to check function before finally tightening screws.
7. Refit inner and outer door belt weatherstrips.
8. Refit plastic sheet and door trim panel.

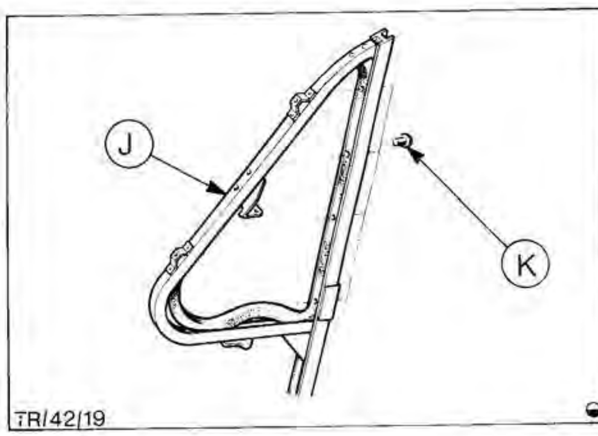

Fig. 14. Rivet assembly, quarter window weatherstrip to dividing bar
J – Quarter window channel
K – Rivet

42 314 4 BRACKET—DOOR WINDOW GLASS TO REGULATOR – REMOVE AND INSTALL (door window glass removed)

Special Service Tools Required: None

1. Carefully tap bracket off glass.

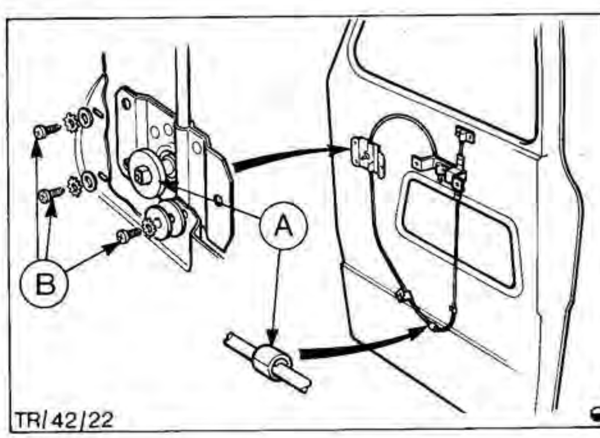

Fig. 15. Regulator plate assembly to door
A – Anti rattle pads
B – Regulator plate screws

To Install

2. Position weatherstrip along bottom edge of glass, aligning ends of weatherstrip with ends of glass.
3. Seat glass and weatherstrip assembly into 'U' channel of bracket and tap into place with rubber mallet.

42 334 4 RUNS – DOOR WINDOW – REPLACE (door glass removed)

Special Service Tools Required: None

To Remove

1. Remove screw and washer assembly securing door run assembly retainer to inner panel.
2. Carefully pull retainer and door glass run from channel in door frame.

To Install

3. Assemble retainer to door glass run then locate retainer and run assembly into channel in door frame.
4. Align retainer into position on door inner panel and secure with screw, lock, flat and fibre washer assembly, Fig. 17. Slide retainer towards door lock before finally tightening screw.

42 338 REGULATOR ASSEMBLY – DOOR WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove door trim panel and plastic sheet.
2. Support door window and remove screw and washer assemblies securing glass bracket to regulator plate. Lower glass to bottom of door shell.

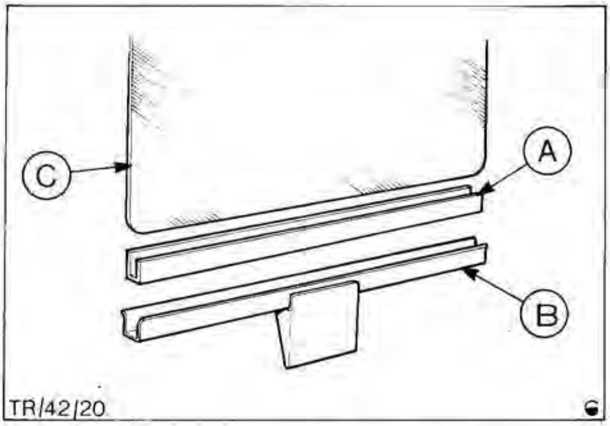

Fig. 16. Glass and bracket assembly door window
A – Weatherstrip
B – Channel
C – Glass

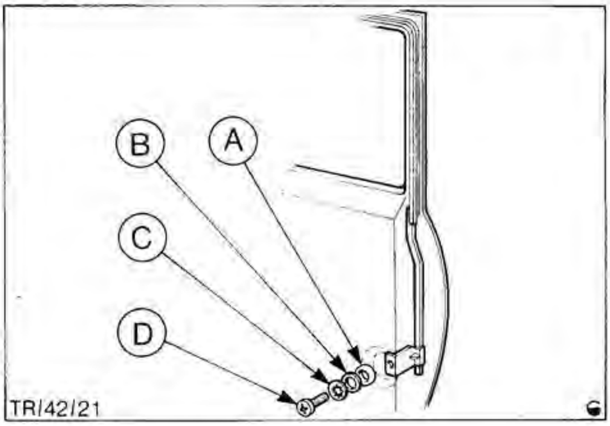

Fig. 17. Door glass run and retainer assembly to door inner panel
A – Fibre washer
B – Flat washer
C – Lock washer
D – Screw

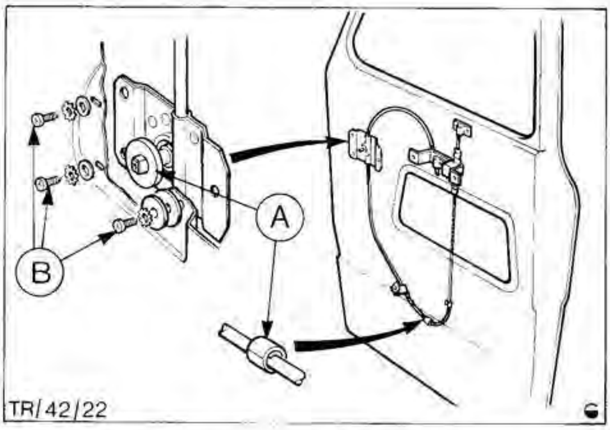

Fig. 18. Regulator plate assembly to door
A – Anti rattle pads
B – Regulator plate screws

3. Remove screw and washer assemblies securing remote handle assembly to door inner panel.
4. Remove screw and washer assembly securing regulator cable lower fixing bracket to door inner panel.
5. Similarly, remove two screw and washer assemblies securing cable upper bracket, and a further three screw and washer assemblies securing the regulator plate.
6. Remove screw securing lower end of quarter window dividing channel, push channel to one side and withdraw regulator from door shell.

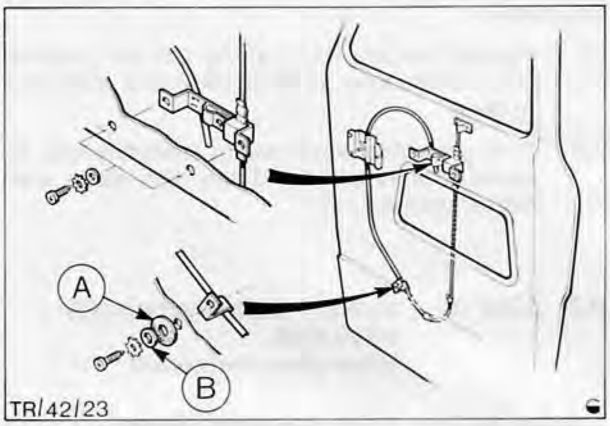

Fig. 19. Regulator upper and lower fixing brackets

To Install

7. Locate regulator assembly within door shell in approximately its final alignment.
8. Re-align quarter window dividing channel and secure with screw and washer.
9. Position an anti-rattle pad over regulator shaft plate so that it is positioned between plate and inner panel. Similarly check that a further anti-rattle pad is in place around cable at extreme lower bend of cable run.

10. Secure regulator plate to door with two screws, flat and shake-proof washers on front holes of plate, and a screw large flat, and large fibre washer on rear hole.
11. Similarly, insert and tighten two screw and shake-proof washers to secure upper cable bracket to door inner panel.
12. Finally, insert and tighten screw, shake-proof washer, large flat and large fibre washers to secure lower bracket to inner panel.

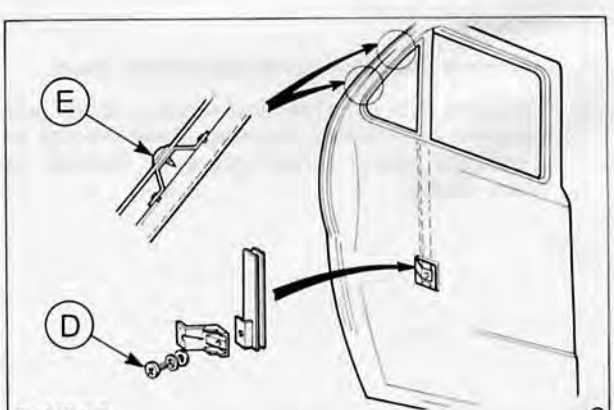

Fig. 20. Door quarter window frame fixing to door

13. Wind regulator as necessary to bring door glass bracket into view in door aperture. Raise glass and secure to bracket with two screw and washer assemblies.
14. Refit plastic sheet and door trim panel.

42 364 GLASS AND FRAME ASSEMBLY – SLIDING WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Using a lipping tool, push weatherstrip lip under top and sides of aperture flange. From inside cab push out weatherstrip, frame and glass as an assembly.

2. Carefully prise fillers from upper and lower sections of weatherstrip, immediately to rear of fixed glass.
3. Carefully prise sliding glass and handle assembly from weatherstrip and frame.
4. Similarly remove fixed glass.
5. If necessary, remove weatherstrip by pulling glass runs from upper and lower horizontal sections of weatherstrip and then pulling weatherstrip from frame.

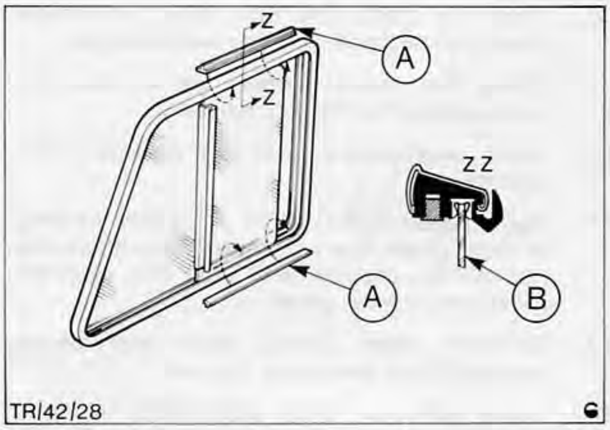

Fig. 21. Filler location sliding window assembly
A – Filler
B – Glass

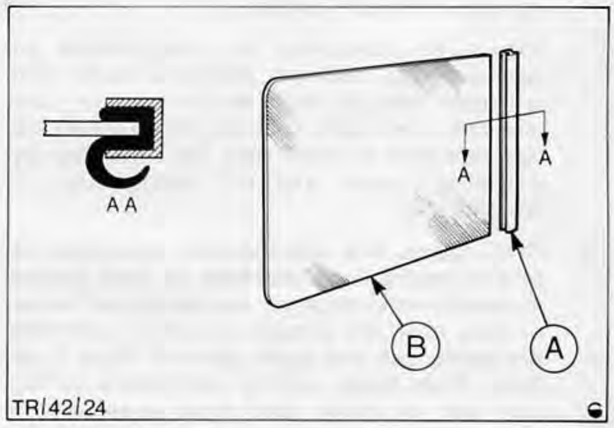

Fig. 22. Weatherstrip to rear vertical edge of glass
A – Weatherstrip
B – Glass

To Install

6. If new fixed glass is being fitted, brush soap solution along rear vertical edge of glass then tap fixed glass weatherstrip into place on vertical edge, using rubber mallet.
7. If new sliding glass is being fitted, lay a length of sealing and glazing strip into 'U' channel of sliding glass handle and tap glass into channel using a rubber mallet. Trim off excess glazing strip.

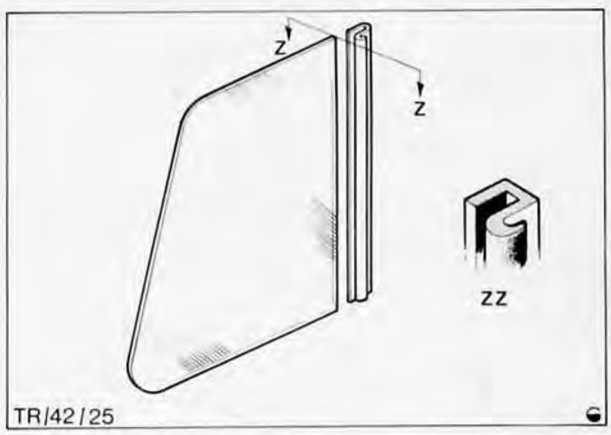

Fig. 23. Fixed glass weatherstrip assembly

8. Assemble glass runs into upper and lower horizontal sections of frame weatherstrip.
9. Check that rubber buffers are in place on lower edge of frame 'U' channel.
10. Insert weatherstrip and run assembly into channel.
11. Apply sealer SM4G 4631 A. to weatherstrip at fixed glass location. Insert fixed glass into appropriate channel and slide into position. Clean sealer from glass.
12. Similarly insert sliding glass and handle assembly into remaining channel.
13. Using adhesive, GES M2G 4502 A, or a suitable alternative, coat underside of each filler with a film of adhesive. Press fillers into fixed glass channels (upper and lower) immediately to rear of fixed glass.
14. Fit length of cord in the rubber to body groove of weatherstrip so that cord ends emerge at bottom centre.

    Allow a crossover of cord ends of approximately 150 mm (6,0 in) If draw cord is passed through short length of metal tube and tube then used to separate weatherstrip lips insertion of cord may be simplified by drawing tube around periphery of weatherstrip.
15. Offer glass and weatherstrip assembly to body aperture Push assembly up until groove in weatherstrip engages top horizontal flange of body aperture. Ensure that draw cord ends are inside cab and push window firmly in at base. From inside vehicle commence pulling one end of draw cord from weatherstrip groove. As cord is withdrawn apply pressure to glass from outside either by hand or rubber mallet, in immediate vicinity of cord.

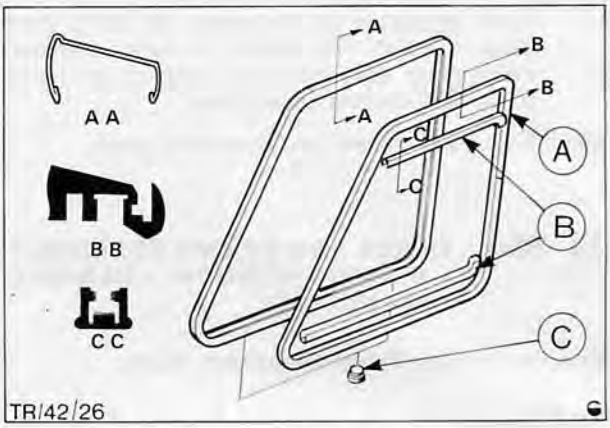

Fig. 24. Sliding window frame and weatherstrip assembly
A – Weatherstrip
B – Glass runs
C – Buffers

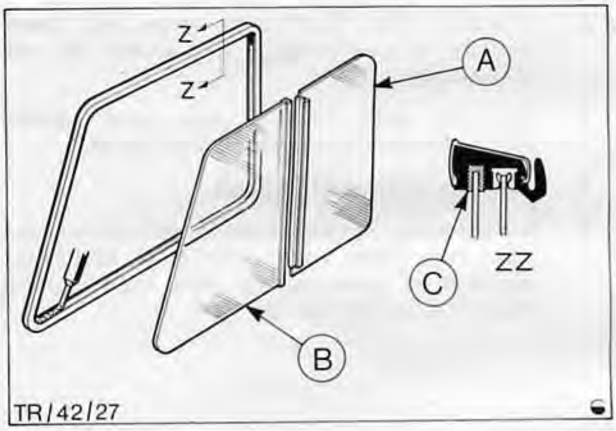

Fig. 25. Sliding window glass assembly
A – Sealer
B – Fixed glass
C – Sliding glass and handle

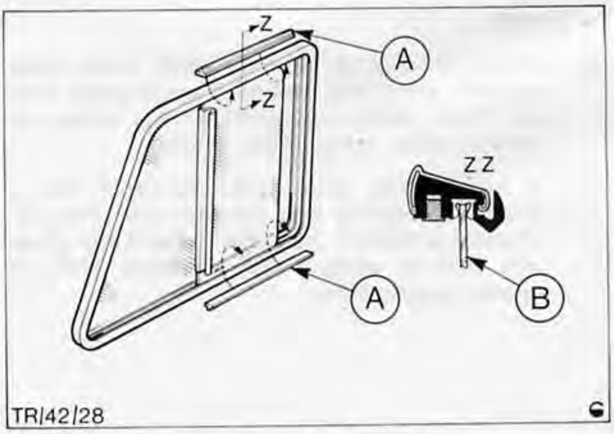

Fig. 26. Filler location in glass and frame assembly
A – Filler
B – Glass

42 414 GLASS – SIDE WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. From inside vehicle, using a lipping tool, push upper horizontal edge of weatherstrip under window aperture flange.
2. When approximately two thirds of weatherstrip is under flange, push glass and weatherstrip out of aperture as an assembly.
3. Carefully remove weatherstrip from glass.

To Install

4 If window glass is being replaced due to accident damage, ensure that aperture is dimensionally correct, flange height (13 mm nominal) is as specified and that flange is free from buckles and distortion. Carefully clean any shattered glass from the weatherstrip grooves and scrape any sealer from rubber weatherstrip, or body aperture flange.

5. Fit weatherstrip to glass, and fit length of cord in the rubber to body groove of weather strip so that cord ends emerge at bottom corner.
6. Allow a crossover of cord ends of approximately 1500 mm (6,0 in). If draw cord is passed through short length of metal tube and tube then used to separate weatherstrip lips insertion of cord may be simplified by drawing tube around periphery of weatherstrip Fig. 27.
7. Seal weatherstrip to glass, location.
8. Using SQM 3G9S05-A PVC foam tape (9,0×6,0 mm) remove backing paper from tape and apply to horizontal flange of window aperture.
9. Offer glass and weatherstrip assembly to body aperture. Push assembly up until groove in weatherstrip engages top transverse flange of body aperture. Ensure that draw cord ends are inside passenger compartment and push window firmly in at base. From inside vehicle commence pulling one end of draw cord from weatherstrip groove. As cord is withdrawn apply pressure to glass from outside either by hand or rubber mallet, in immediate vicinity of cord.

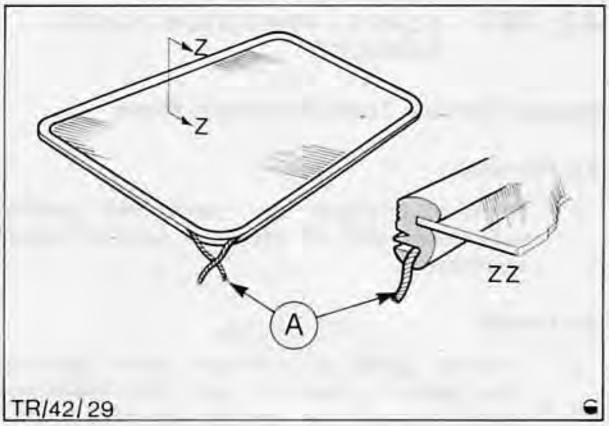

Fig. 27. Glass, weatherstrip and drawcord assembly
A – Cord

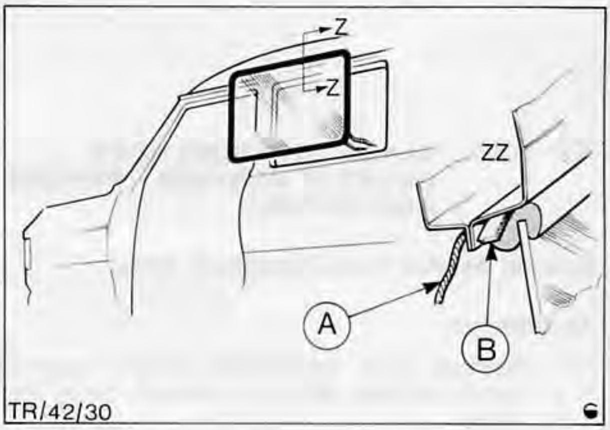

Fig. 28. Foam tape location on fixed window
A – Cord
B – Foam tape

42 464 GLASS – PARTITION PANEL – REPLACE

Special Service Tools Required: None

To Remove

1. Remove fourteen nut, bolt and washer assemblies and lift glass off partition panel aperture.

To Install

2. Position glass on partition panel aperture, align holes in glass and panel then insert and tighten nut bolt and washer assemlies.

   NOTE: Some locations may have the partition panel glass retained by a weatherstrip assembly. For this type of assembly proceed as for Operation No. 42–414 but exclude sealing operations.

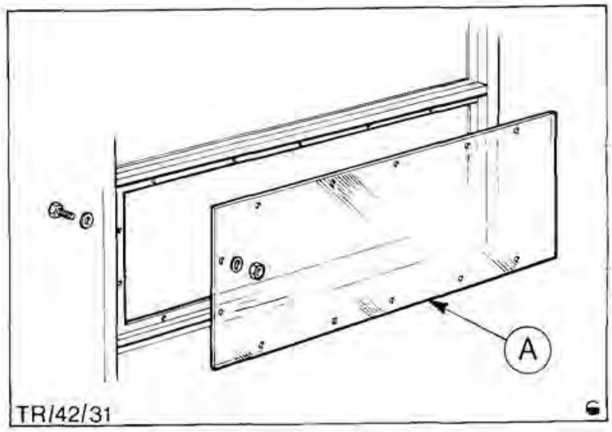

Fig. 29. Partition panel glass assembly
A – Glass

42 536 GLASS – OPENING REAR QUARTER WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove two cross-head screws securing catch to body pillar and detach catch from pillar.

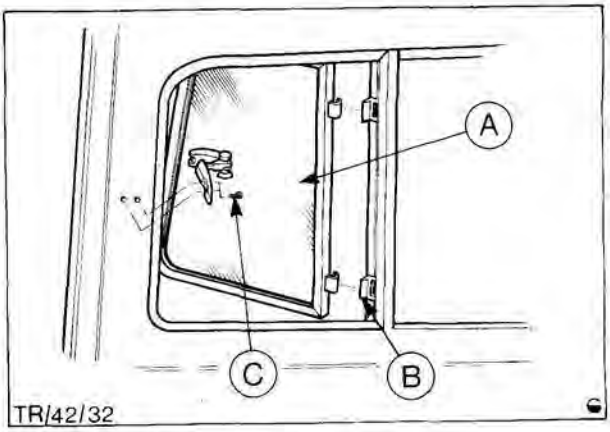

Fig. 30. Rear quarter window assembly
A – Glass
B – Hinge rubber
C – Screw

2. Using a screwdriver blade, wrapped in cloth, inserted between glass and window aperture carefully lever glass and frame assembly rear wards to disengage hinges from hinge rubbers. Lift glass and frame assembly off vehicle when hinges clear rubbers.
3. Unscrew headless screw pin securing catch to glass bracket and detach catch from glass.
4. Removal of headless screw pin and catch exposes cross-head screw retaining bracket to glass. Remove screw, nut and grommet assembly and detach bracket from glass.

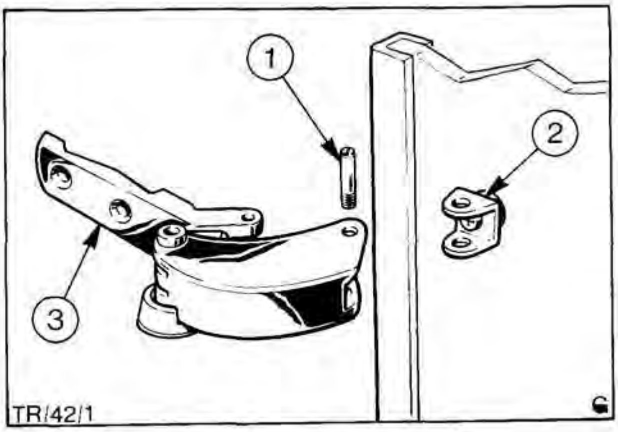

Fig. 31. Catch assembly to glass bracket
1 – Headless pin, 2 – Bracket; 3 – Catch

5. Remove cross-head screws, two each end, securing vertical section of frame to curved section. Lift vertical section off glass and remove sealing strip.
6. Pull glass and sealing strip from curved section of frame.

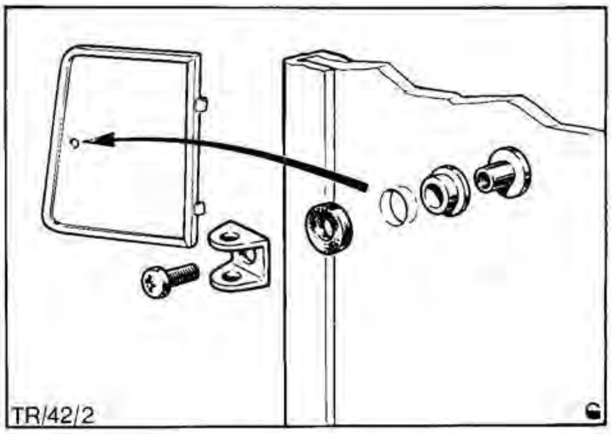

Fig. 32. Catch bracket assembly on glass

To Install

7. Assemble a strip of glazing and sealing mastic to curved edge of glass. Tap glass and seal assembly into curved section of frame.
8. Assemble a strip of sealing mastic to unframed edge of glass, then locate vertical section of frame on glass edge and secure to curved section with four cross-head screws. Trim off excess sealer.
9. Assemble two 'top hat' grommets into catch hole in glass. Position bracket on glass (with slot to top) and secure bracket with screw and nut inserted through grommets.

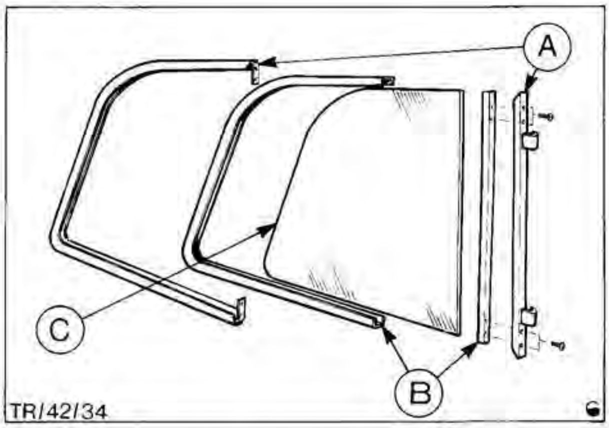

Fig. 33. Frame and sealing, vertical glass edge
A – Frame
B – Glazing and sealing mastic
C – Glass

10. Position catch on bracket, and insert and tighten headless screw to secure.
11. Lubricate pillar hinge rubbers with soap solution then push hinge pivot on glass frame into pillar rubbers, so that glass and frame pivot towards inside of vehicle.
12. Align holes in catch with those in pillar and insert and secure screws.

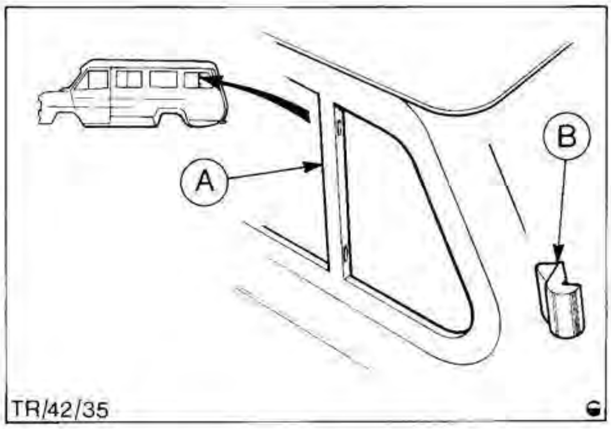

Fig. 34. Opening quarter window hinge pivot rubbers
A – Pillar
B – Hinge pivot rubbers

42 546 WEATHERSTRIP – OPENING REAR QUARTER WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. Remove opening rear quarter window glass and frame assembly, see Operation No. 42 534.
2. Pull weatherstrip and foam tape from flange.

To Install

3. Clean aperture flange, check for buckling and distortion, dress if necessary.
4. Remove backing from PVC foam tape and apply tape to horizontal flanges of window aperture.
5. Press weatherstrip onto flange, ensuring that it is uniformly and securely seated.
6. Refit opening rear quarter window glass and frame assembly.

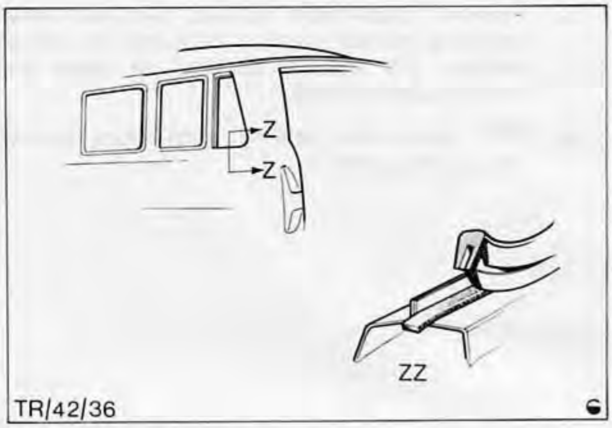

Fig. 35. Quarter window weatherstrip assembly on aperture flange

42 634 GLASS – REAR DOOR WINDOW – REMOVE AND INSTALL

Special Service Tools Required: None

To Remove

1. From inside vehicle, using a lipping tool, push upper horizontal edge of weatherstrip under window aperture flange. When approximately two-thirds of weatherstrip is under flange, push out glass and weatherstrip as an assembly. Remove weatherstrip from glass.

To Install

2. Check weatherstrip flange for buckles and distortion, dress if necessary.
3. Apply PVC foam tape to horizontal flanges of aperture.
4. Fit a new weatherstrip to glass, insert a draw cord and fit glass and weatherstrip to window aperture.
5. Seal glass and rubber once window is installed.

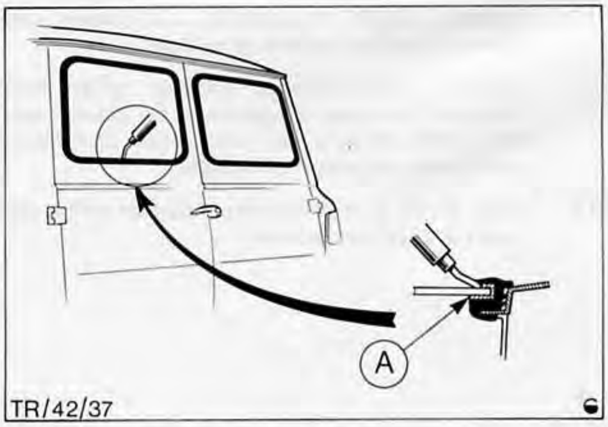

Fig. 36. Sealing rear door glass to rubber
A – Sealer