



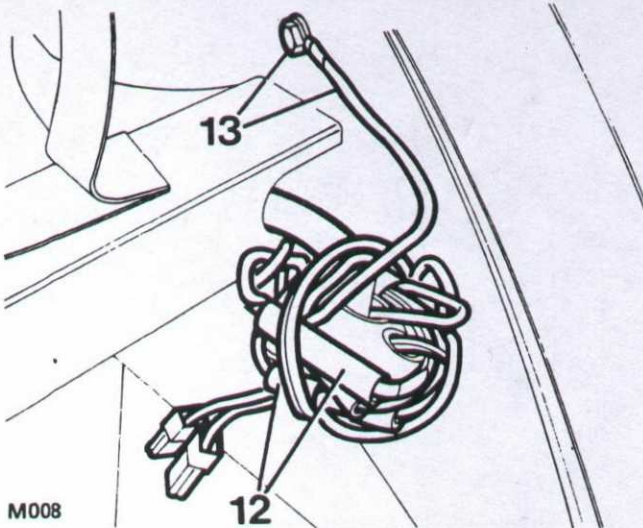
FX4S

INCLUDING FX4S PLUS
SUPPLEMENT

WORKSHOP MANUAL

Section 1

**2.5 LITRE DIESEL ENGINE
REMOVE & REFIT**



M008

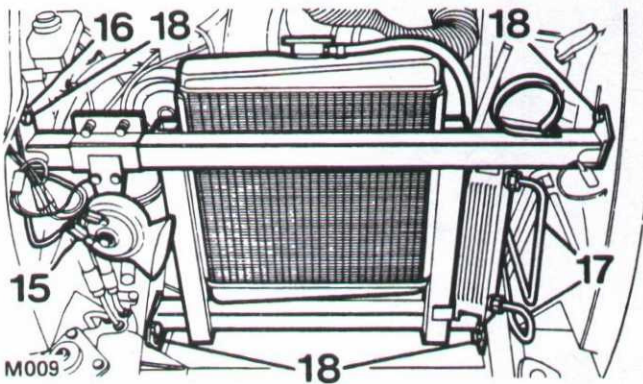
14 Pull wiring harness through radiator mounting frame.

15 Disconnect offside horn leads.

16 Remove earth lead from offside wheelarch.

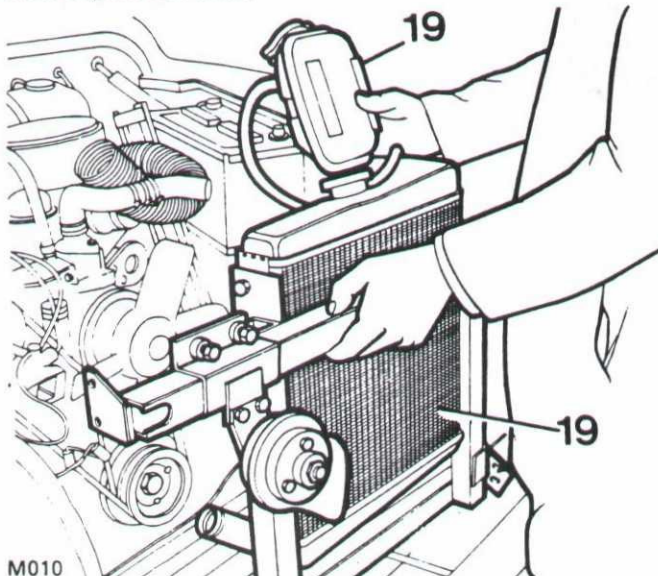
17 Disconnect oil cooler pipes (automatic vehicles only).

18 Remove six remaining bolts securing radiator mounting frame to wheel arches and chassis.



M009

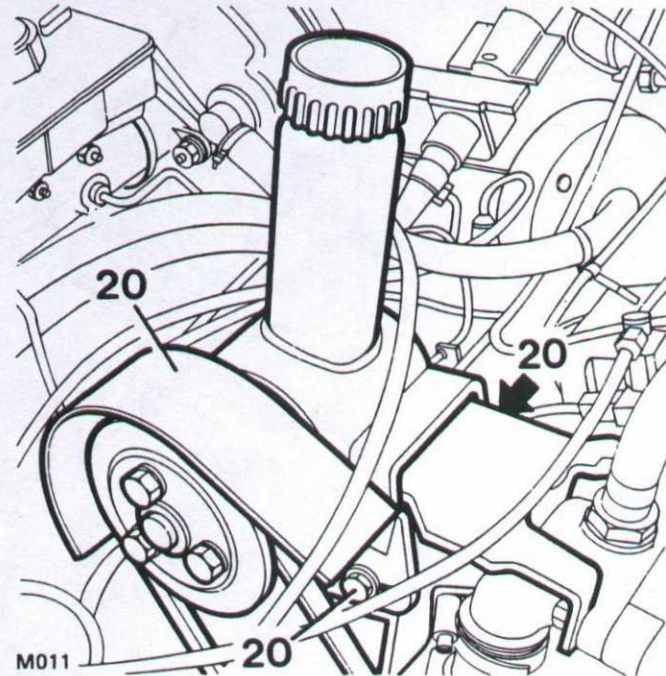
19 Lift out radiator and mounting frame complete with expansion tank.



M010

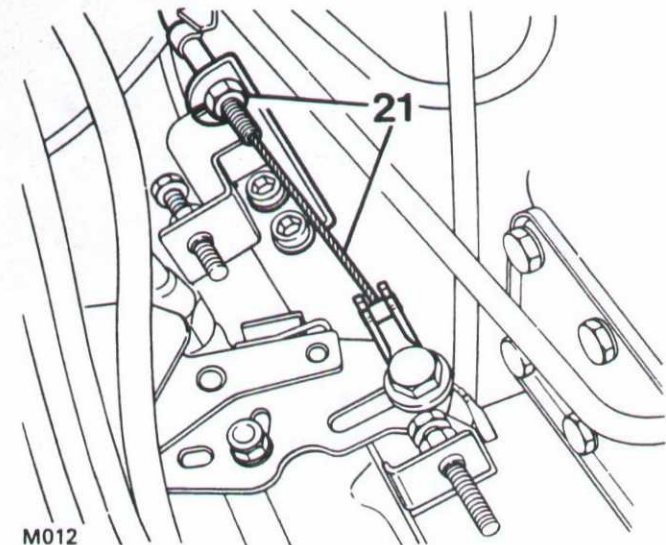
Note: On FX4S Plus models a new radiator mounting frame has been fitted, see page 8 for removal procedure.

20 Remove swivel bolt and adjuster bolt, detach power steering pump from mounting bracket and move to offside wing to facilitate engine removal.



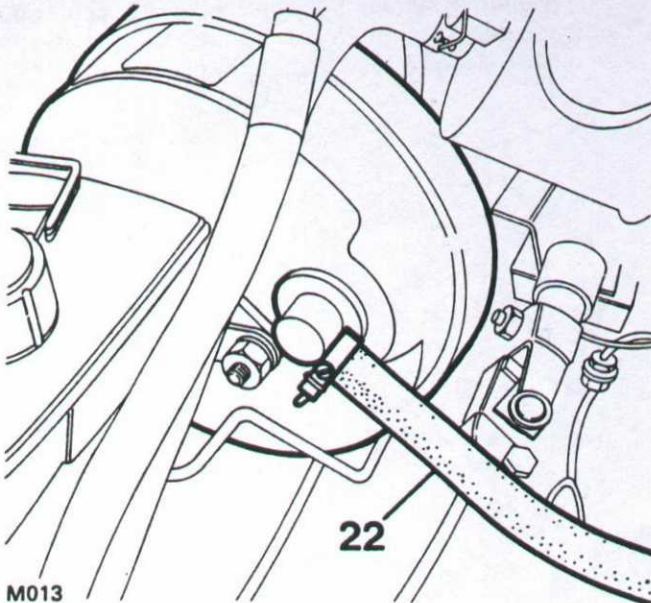
M011

21 Unscrew locknut and disconnect accelerator cable from injector pump (on automatic vehicles disconnect kick down cable from injector pump).



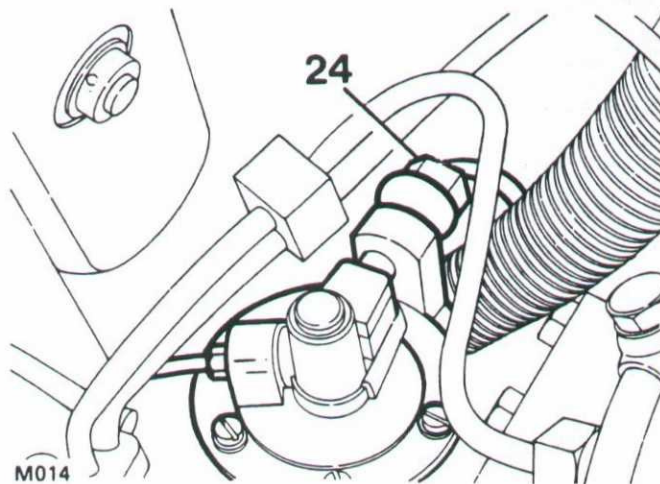
M012

22 Disconnect brake servo pipe.

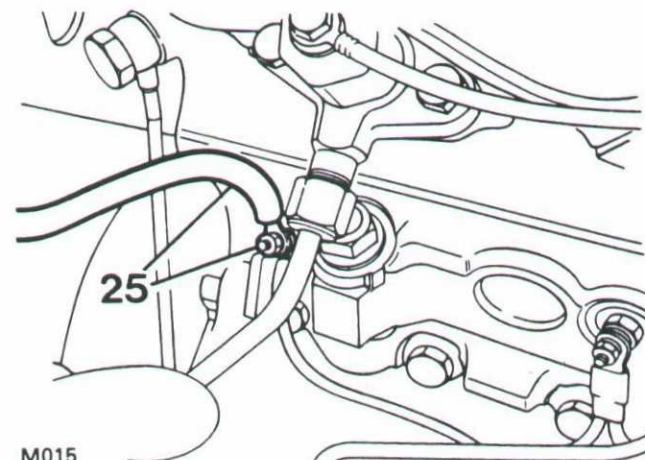


23 Disconnect oil pressure pipe from oil filter.

24 Unscrew fuel pipe from pump.

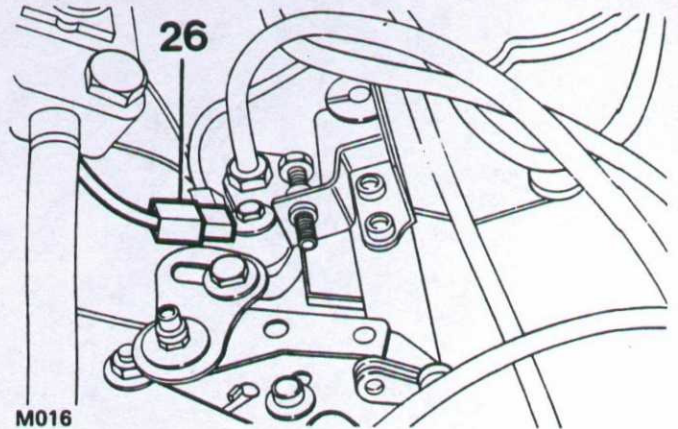


25 Unscrew retaining nut and remove main lead from glow plug.



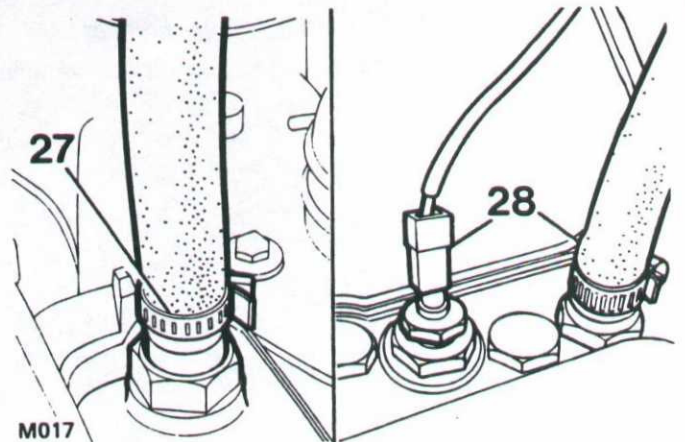
26 Disconnect lead from injector pump fuel cut off.

4



27 Disconnect heater pipe from thermostat housing.

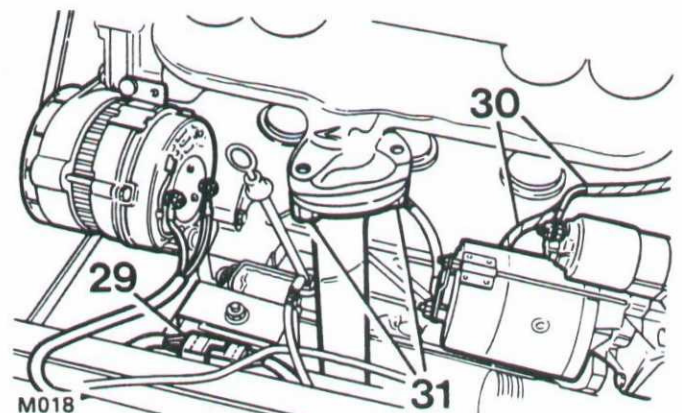
28 Disconnect heater pipe and temperature gauge sender unit lead at nearside rear of cylinder head.



29 Disconnect alternator harness plug.

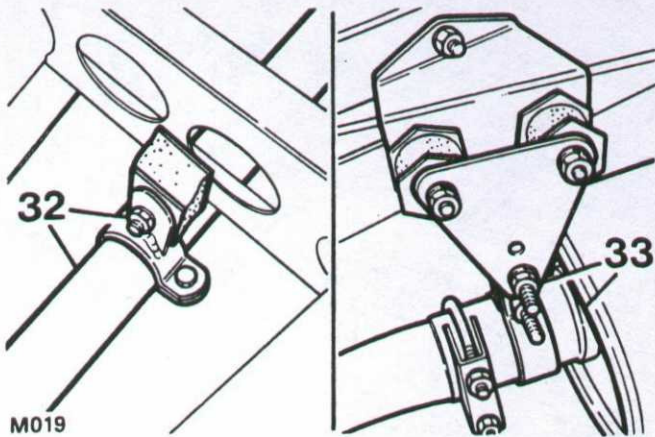
30 Disconnect starter motor leads from starter solenoid.

31 Unscrew retaining nuts and lower exhaust down pipe from manifold.

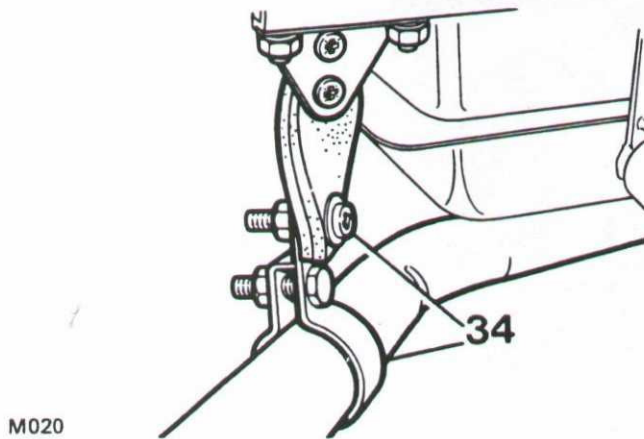


32 Remove single bolt and disconnect exhaust down pipe support bracket from chassis mounting.

33 Unscrew single bolt and disconnect exhaust silencer support bracket from chassis mounting.

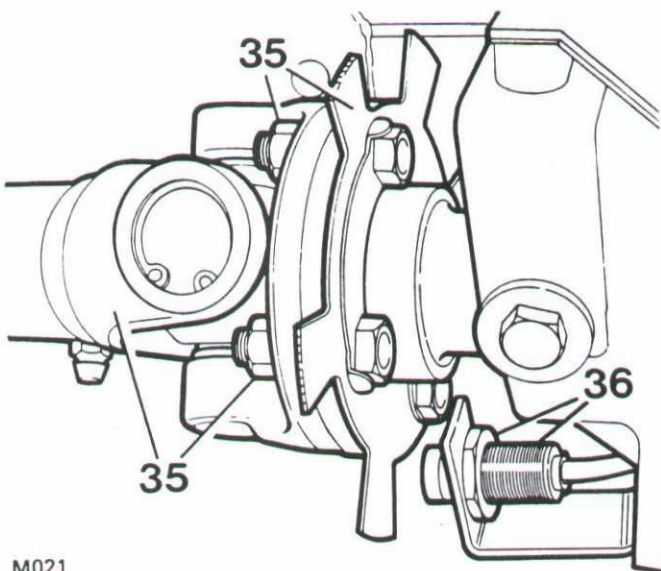


34 Remove single bolt and disconnect exhaust tail pipe support bracket from chassis mounting.



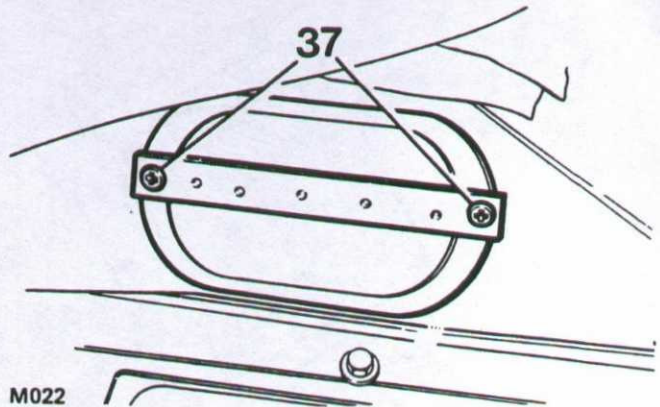
35 Remove retaining bolts and detach drive shaft from gearbox. Retain sensor plate.

36 Unscrew retaining nut and remove sensor switch from mounting bracket.



M021

37 Remove retaining screws and detach speedo cable access plate from inside the vehicle.

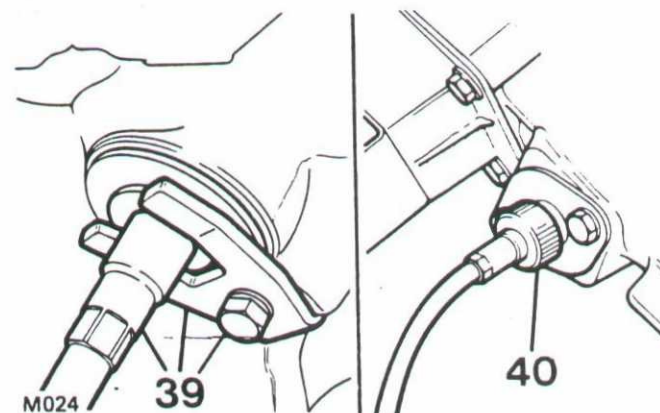
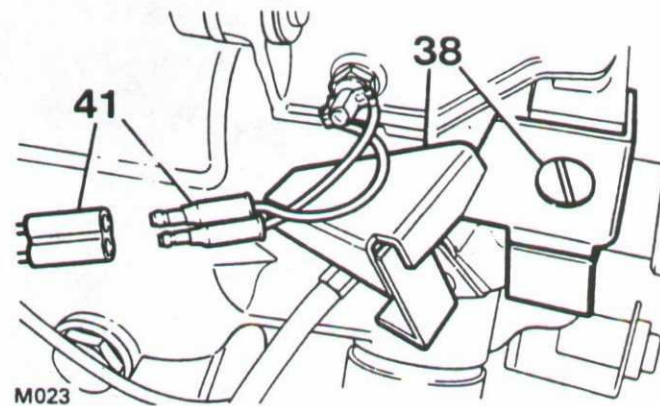


38 Unscrew single retaining screw and remove taxi meter lock bracket.

39 Remove bolt, detach retaining clamp and withdraw speedo cable.

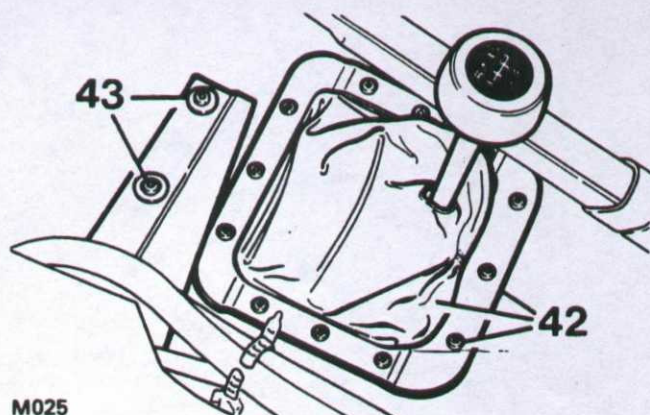
40 On automatic vehicles unscrew speedo cable from offside of gearbox.

41 Disconnect reverse light switch leads, if fitted.



42 Remove twelve screws and detach gear lever gaiter, complete with retaining plate.

43 Remove partition support bracket screws and fold back tunnel insulation to gain access to gear lever.

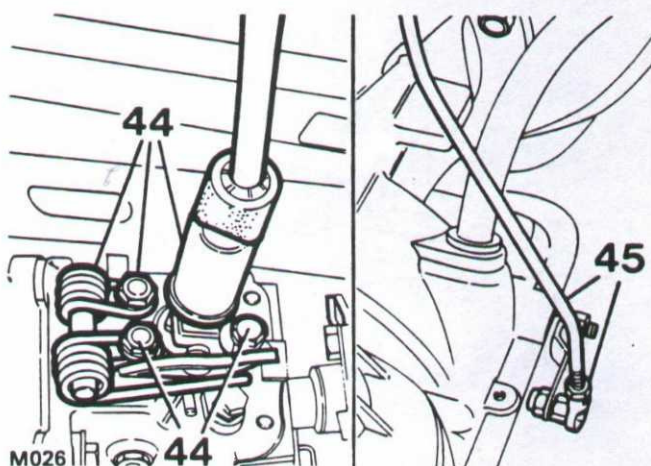


M025

44 Remove three bolts, detach retaining springs and withdraw gear lever.

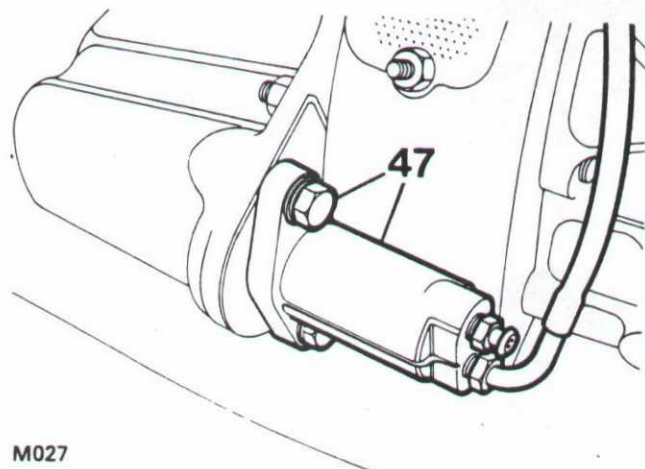
45 On automatic vehicles disconnect gear selector lever linkage from offside of gearbox.

46 Position engine lifting gear and secure chain hooks, or equipment to cylinder head eyelets.



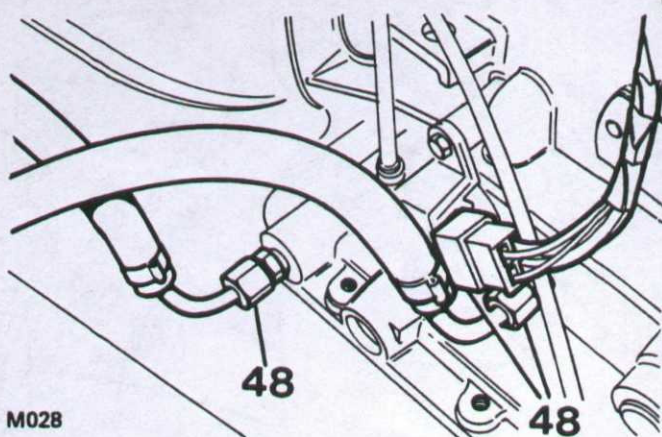
M026

47 Remove two bolts and withdraw clutch slave cylinder.



M027

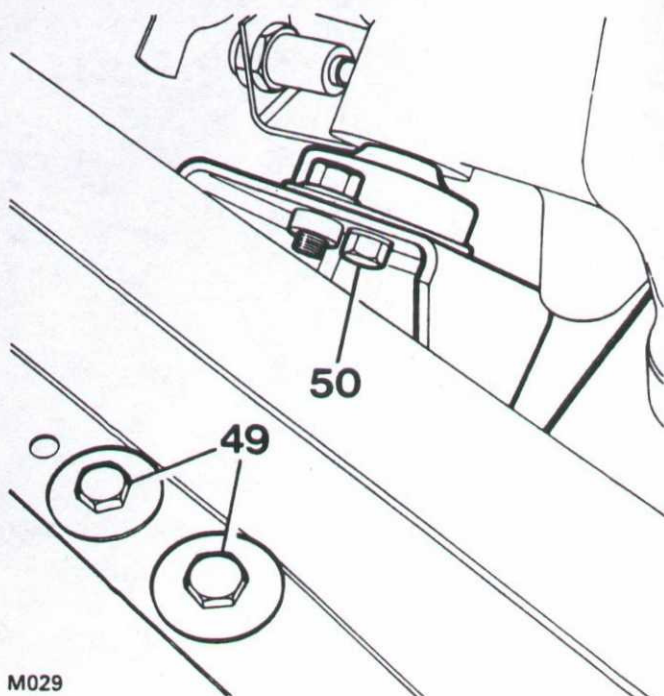
48 On automatic vehicles disconnect oil cooler pipes and inhibitor switch from gearbox.



M028

49 Remove four bolts and detach gearbox bearer.

50 Remove mounting rubber bolts from L.H. and R.H. side at rear of gearbox.

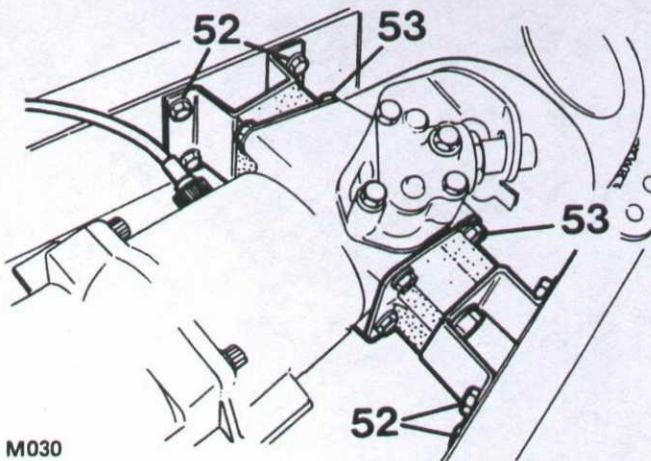


M029

51 On automatic vehicles remove snubber rubber bracket.

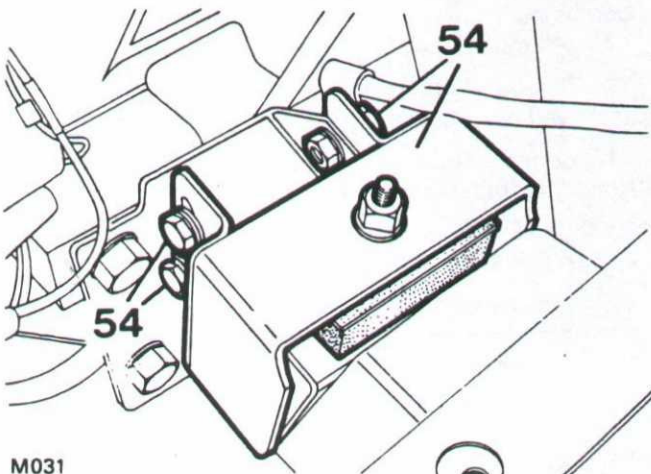
52 Remove four bolts from both sides and detach gearbox bearer brackets from chassis.

53 Remove gearbox mounting rubber bolts and detach both mountings, complete with bearer brackets and sensor bracket from the vehicle.



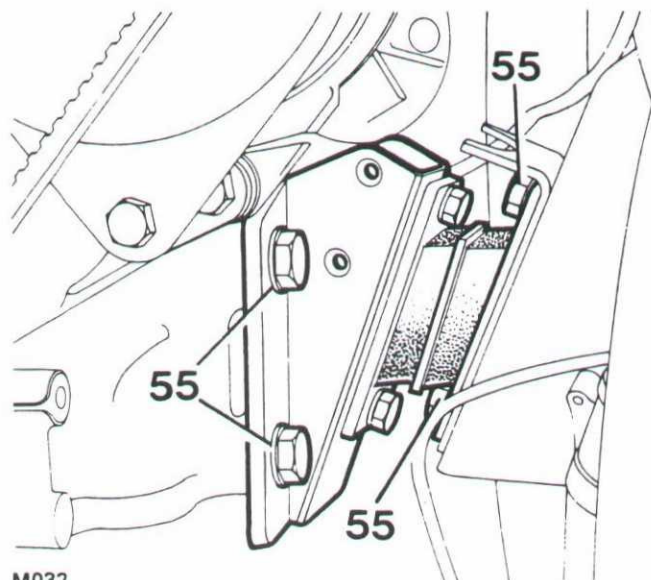
M030

54 Remove four bolts and detach L.H. engine anti-torque rubber bracket and engine earth lead. Repeat operation for R.H. side.



M031

55 Remove retaining bolts and detach L.H. engine mounting from engine and chassis. Repeat operation for R.H. side.



M032

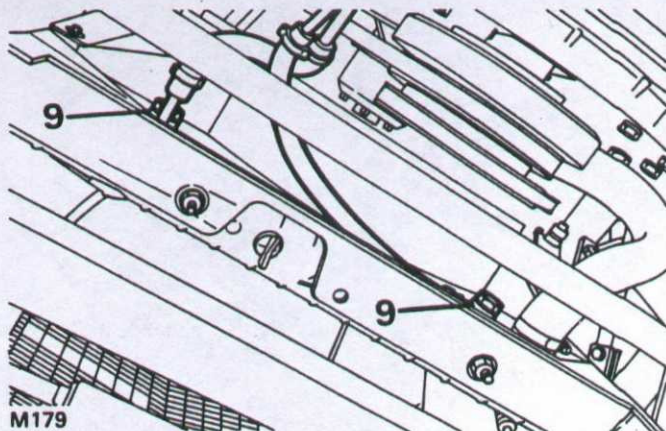
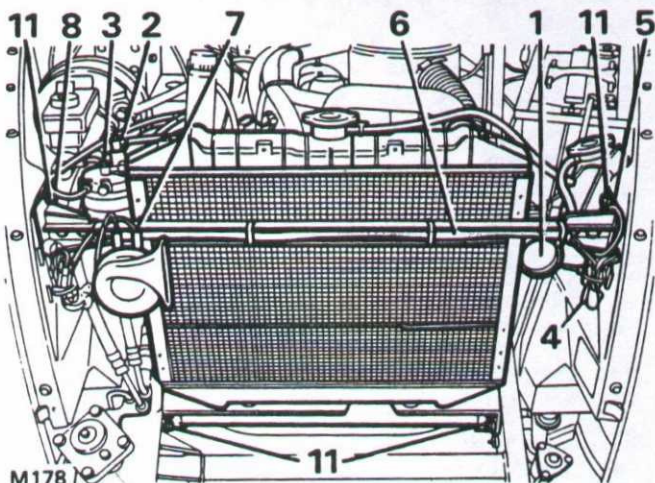
56 Remove engine and gearbox from vehicle.

Refit engine and gearbox

- 1** Refit engine mountings, anti-torque rubber Gasket and earth lead.
- 2** Refit sensor bracket, gearbox bearer bracket and gearbox mounting rubbers. On automatic vehicles refit snubber rubber.
- 3** On automatic vehicles reconnect oil cooler pipes and inhibitor switch at gearbox.
- 4** Refit clutch slave cylinder.
- 5** On automatic vehicles reconnect gear selector lever linkage.
- 6** Locate manual gear lever and refit retaining springs.
- 7** Replace tunnel insulation, secure partition and fit gear lever gaiter retaining plate.
- 8** Reconnect reverse light switch, if fitted, refit speedo cable, retaining clamp, taxi meter lock bracket and access plate.
- 9** Refit sensor switch and reconnect driveshaft, complete with sensor plate.
- 10** Refit exhaust mountings and exhaust down pipe to manifold.
- 11** Reconnect starter motor leads and alternator harness plug.
- 12** Reconnect heater pipes and temperature gauge sensor unit leads.
- 13** Reconnect injector pump fuel cut-off lead and main glow plug lead.
- 14** Reconnect fuel pump feed pipe, oil filter, and oil pressure pipe.
- 15** Reconnect brake servo pipe.
- 16** Reconnect accelerator cable at injector pump.
- 17** Refit power steering pump.
- 18** Refit radiator mounting frame, complete with expansion tank.
- 19** On automatic vehicles reconnect oil cooler pipes at radiator end.
- 20** Reconnect wiring harness and relevant leads.
- 21** Refit fuel filter to radiator mounting frame and reconnect fuel return pipe.
- 22** Refit air cleaner hose and radiator top hose.
- 23** Reconnect radiator bottom hose.
- 24** Refit bonnet, bonnet stay and windscreen washer tubes.
- 25** Refill cooling system.

Radiator mounting frame removal, FX4S Plus models

- 1 Pull air cleaner hose from support bracket on radiator mounting frame.
- 2 Disconnect fuel filter return pipe.
- 3 Remove two bolts and detach fuel filter from radiator mounting frame.
- 4 Disconnect headlamp, side light and horn wiring harness leads from nearside of vehicle.
- 5 Remove single bolt, accessible from inside nearside wheelarch, and detach earth lead.



- 6 Pull wiring harness from radiator mounting frame.
- 7 Disconnect offside horn leads.
- 8 Remove earth lead from offside wheelarch.
- 9 Disconnect oil cooler pipes at the base of the combined radiator/oil cooler, accessible from beneath the vehicle.
- 10 Remove four retaining screws, detach radiator fan cowl and position loosely over fan blades.
- 11 Remove six remaining bolts securing radiator mounting frame to wheel arches and chassis.
- 12 Lift out radiator / oil cooler and mounting frame complete with expansion tank.
- 13 Refit in reverse order.

At the time of going to print, the illustrations and text appearing in this workshop manual are representative of manufacture. Whilst retaining the basic features shown herein, the manufacturer reserves the right to make, at any time, and without necessarily updating this manual, any alterations considered convenient for improvement or for any other reason.

Whilst every effort is made to ensure the accuracy of the particulars contained herein, London Taxi International will not under any circumstances be held liable for any inaccuracies or the consequences thereof.



FX4S

INCLUDING FX4S PLUS

WORKSHOP MANUAL

Section 2

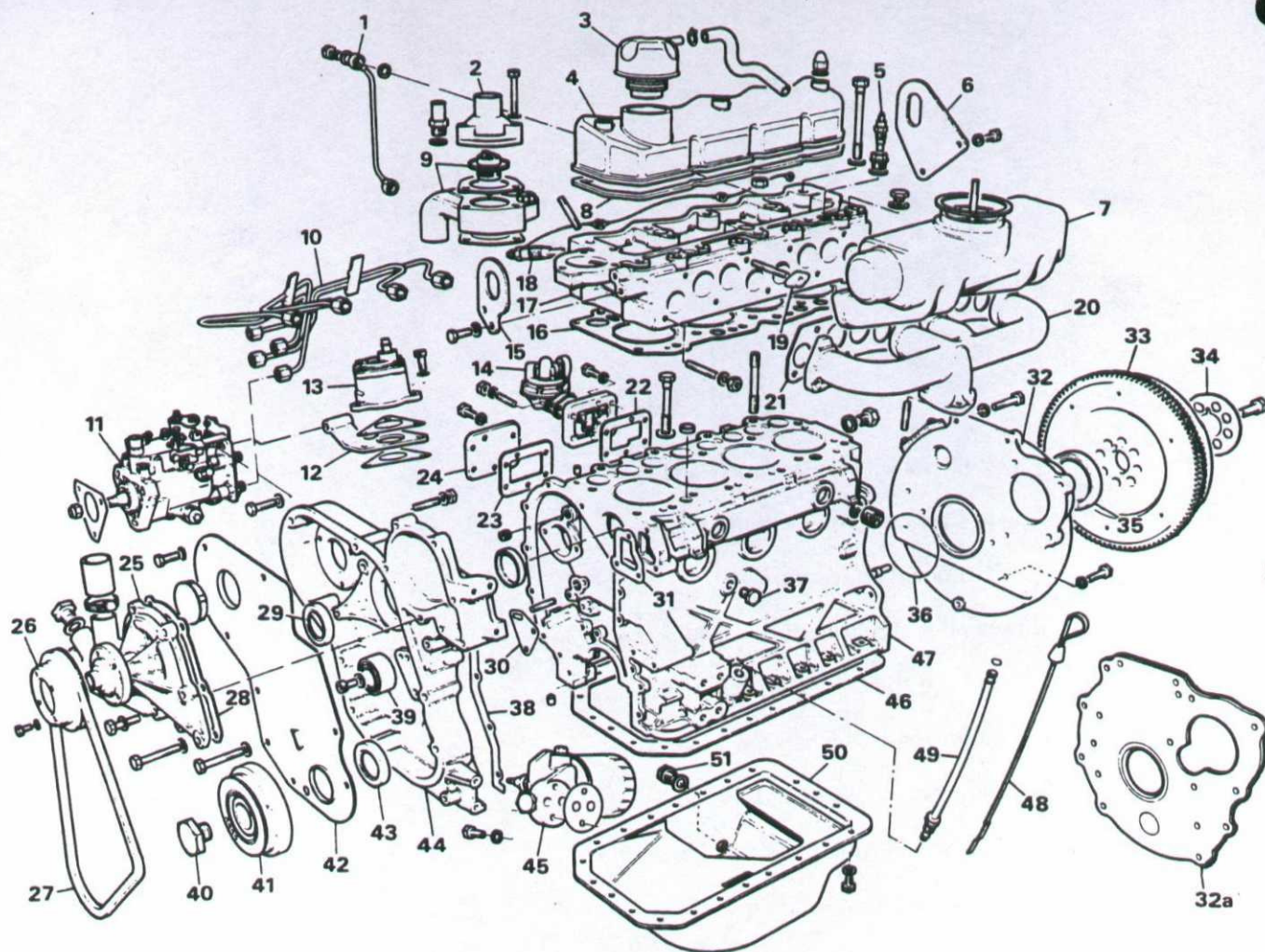
**2.5 LITRE DIESEL ENGINE
OVERHAUL**

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Key to Diesel Engine – External Parts	3
A. Gearbox Remove and Refit	4
B. Remove and Overhaul the Flywheel and Clutch	5
C. Remove and Overhaul Timing Belt and Pulleys	8
D. Remove and Overhaul Cylinder Head	15
E. Remove and Overhaul Oil Pump	29
F. Strip and Overhaul of Engine Block	31
Engine Data – Diesel (2.5 litre)	45

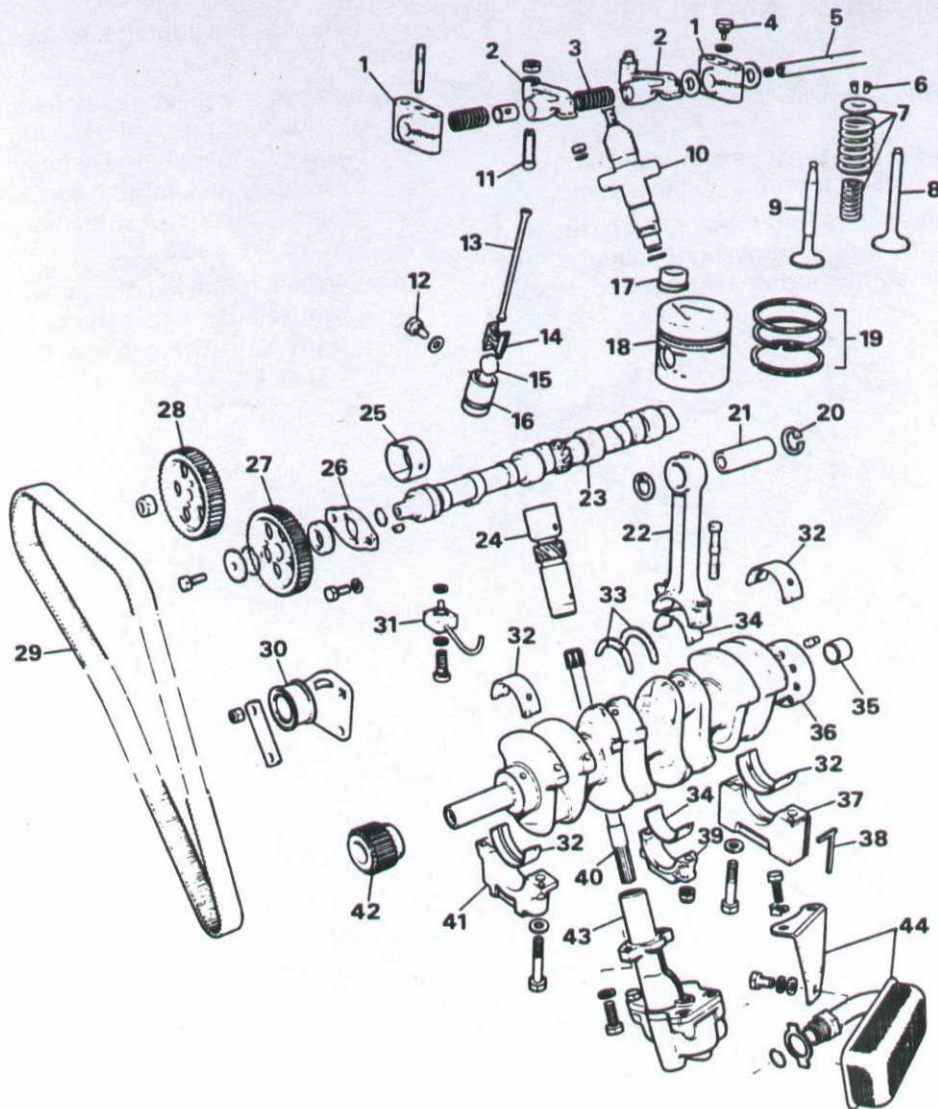
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Key to Diesel Engine – External Parts

- | | | | |
|----|------------------------------------|-----|-----------------------------------|
| 1 | Oil feed pipe | 27 | Fan belt |
| 2 | Thermostat cover | 28 | Water pump gasket |
| 3 | Engine oil filler/breather cap | 29 | Camshaft front cover oil seal |
| 4 | Rocker Cover | 30 | Joint washer |
| 5 | Coolant temperature thermocouple | 31 | Coolant gallery joint washer |
| 6 | Rear engine lifting bracket | 32 | Flywheel housing |
| 7 | Inlet manifold | 32a | Automatic gearbox adaptor plate |
| 8 | Rocker cover gasket | 33 | Flywheel |
| 9 | Thermostat and thermostat housing | 34 | Flywheel reinforcing plate |
| 10 | Injector pipes | 35 | Crankshaft oil seal |
| 11 | D.P.S. pump | 36 | 'O' ring |
| 12 | D.P.S. support bracket | 37 | Engine block drain plug |
| 13 | Vacuum pump | 38 | Front cover gasket |
| 14 | Fuel lift pump and rear side plate | 39 | Idler pulley – timing belt |
| 15 | Front engine lifting bracket | 40 | Crankshaft pulley bolt |
| 16 | Cylinder head gasket | 41 | Crankshaft pulley |
| 17 | Cylinder head | 42 | Front cover plate |
| 18 | Heater plugs | 43 | Front cover oil seal – crankshaft |
| 19 | Manifold retaining clamps | 44 | Front cover |
| 20 | Exhaust manifold | 45 | Oil filter assembly |
| 21 | Manifold gasket | 46 | Sump gasket |
| 22 | Rear side plate gasket | 47 | Engine block |
| 23 | Front side plate gasket | 48 | Dip stick |
| 24 | Front side plate | 49 | Dip stick tube |
| 25 | Water pump assembly | 50 | Sump |
| 26 | Fan pulley | 51 | Sump drain plug |



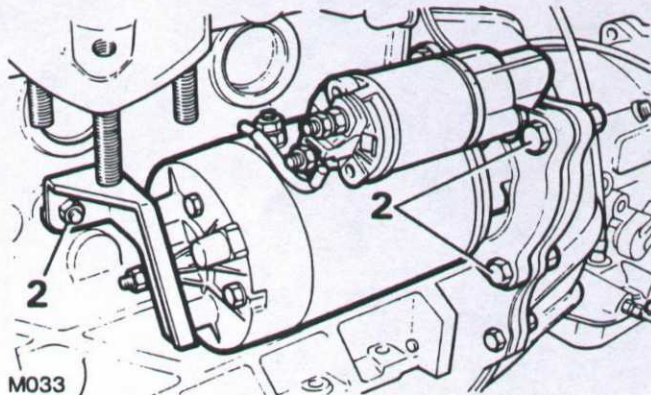
Key to Diesel Engine – Internal Parts

- | | | | |
|----|-----------------------------|----|---|
| 1 | Rocker shaft brackets | 23 | Camshaft |
| 2 | Rockers | 24 | Skew gear |
| 3 | Springs | 25 | Camshaft bearing |
| 4 | Rocker shaft locating screw | 26 | Thrust plate |
| 5 | Rocker shaft | 27 | Camshaft pulley |
| 6 | Cotter pins | 28 | D.P.S. pump pulley |
| 7 | Valve spring assembly | 29 | Timing belt |
| 8 | Inlet valve stem | 30 | Timing belt tension pulley |
| 9 | Exhaust valve stem | 31 | Oil jet tubes |
| 10 | Fuel injector assembly | 32 | Main bearing shells |
| 11 | Tappet adjustment screw | 33 | Thrust washers |
| 12 | Tappet guide securing screw | 34 | Connecting rod bearings |
| 13 | Push rod | 35 | Crankshaft end bush |
| 14 | Tappet slides | 36 | Crankshaft |
| 15 | Cam follower | 37 | No. 5 main bearing cap |
| 16 | Tappet guide | 38 | Cork seal |
| 17 | Hot plug | 39 | Connecting rod cap |
| 18 | Piston | 40 | Oil pump drive shaft |
| 19 | Piston rings | 41 | Main bearing cap |
| 20 | Circlips | 42 | Crankshaft pulley |
| 21 | Gudgeon pin | 43 | Oil pump assembly |
| 22 | Connecting rod | 44 | Oil pump strainer and retaining bracket |

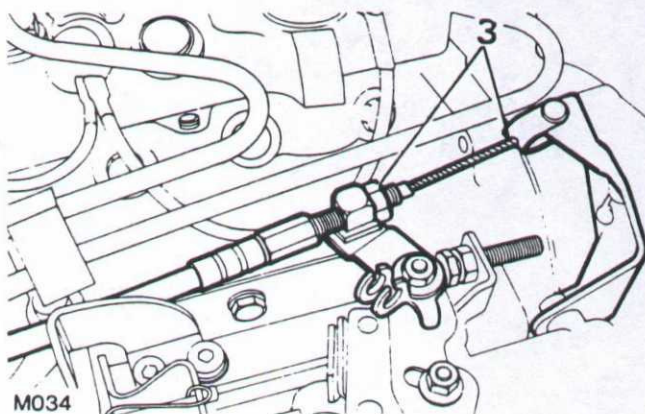
A. GEARBOX REMOVE AND REFIT

Gearbox removal

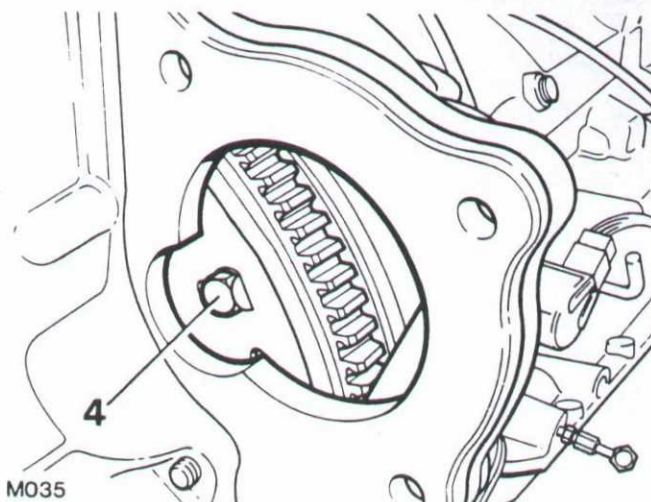
- 1 In the interests of safety and efficient working, secure the engine/gearbox onto a suitable stand.
- 2 Undo the three nuts and bolts, also the nut securing the starter motor retaining bracket to the block, remove the starter motor. (Automatic models only).



- 3 Disconnect the kick-down cable from the fuel injection pump (D.P.S.). (Automatic models only).



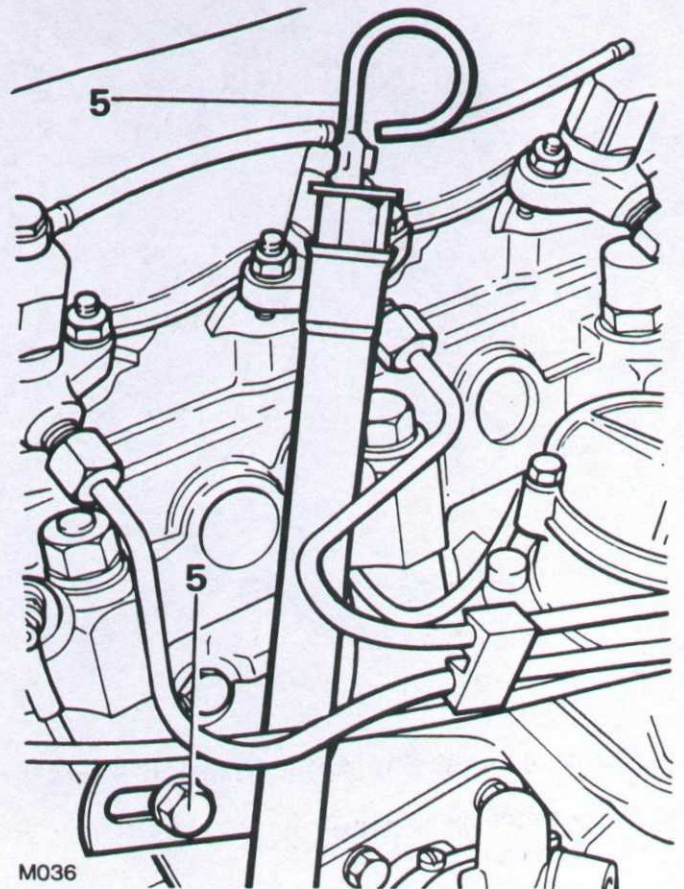
- 4 Remove the four bolts and tab washers securing the torque converter to the drive plate, through the starter motor aperture. (Automatic models only).



- 5 Remove the automatic gearbox dipstick/filter tube.

- 6 Remove the gearbox retaining bolts:
 - a) Holding the bell housing to the fly wheel housing (Manual models only).
 - b) Holding the torque converter housing to the adaptor plate. (Automatic models only) and remove the gearbox.

Note: When removing the automatic gearbox, take care to ensure that the torque converter comes away with the gearbox and is not left on the crankshaft spigot.



Refitting the gearbox

- 7 Refit the automatic or manual gearbox.
- 8 Refit the automatic gearbox dipstick/filler tube.
- 9 Through the starter motor aperture, locate and secure the torque converter to the drive plate. (Automatic model).
- 10 Reconnect the kick-down cable to the fuel injection pump, (D.P.S.). (Automatic models only).
- 11 Refit the starter motor to the adaptor plate. (Automatic models only).

B REMOVE AND OVERHAUL THE FLYWHEEL AND CLUTCH

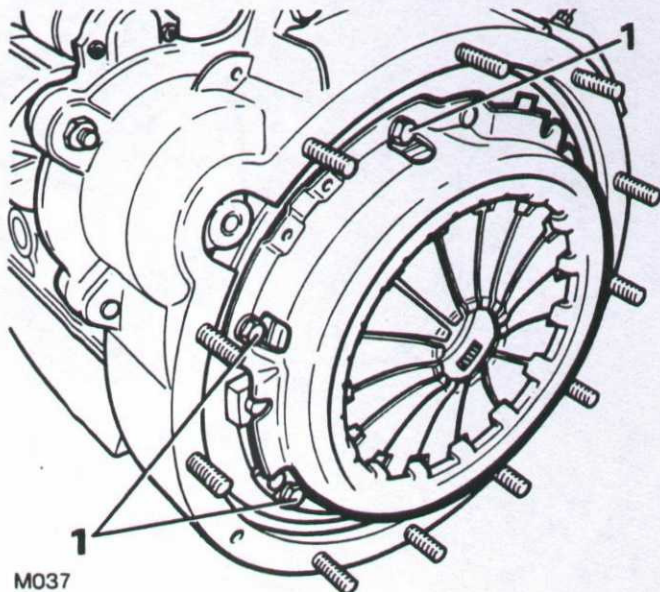
Special tools required

18G1344 Seal guide – rear main bearing.

R0605022 Clutch centralising tool.

Remove the clutch – manual models only

1 Evenly slacken and remove the six clutch retaining bolts and withdraw the clutch assembly and centre plate.



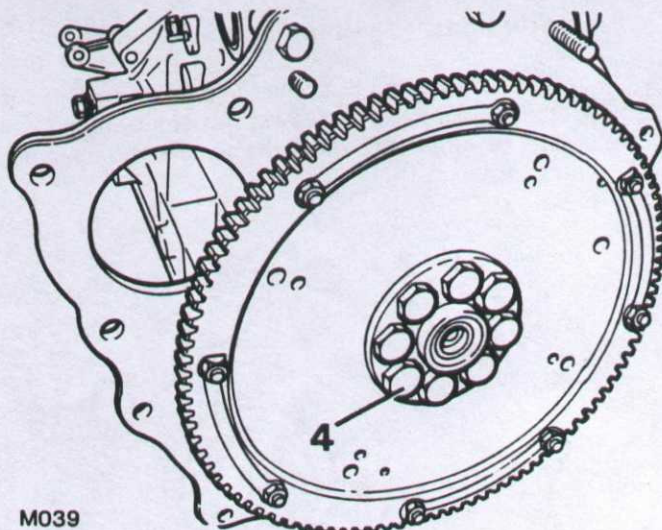
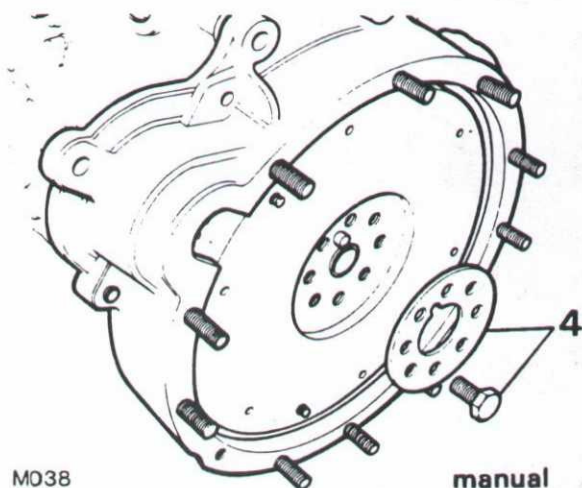
Remove the starter motor – manual models only

2 Undo the single nut and washer retaining the starter motor support bracket to the cylinder block.

3 Undo the bolt, nut and washer which retain the starter motor to the flywheel housing and carefully ease the motor away from the housing.

Remove the flywheel

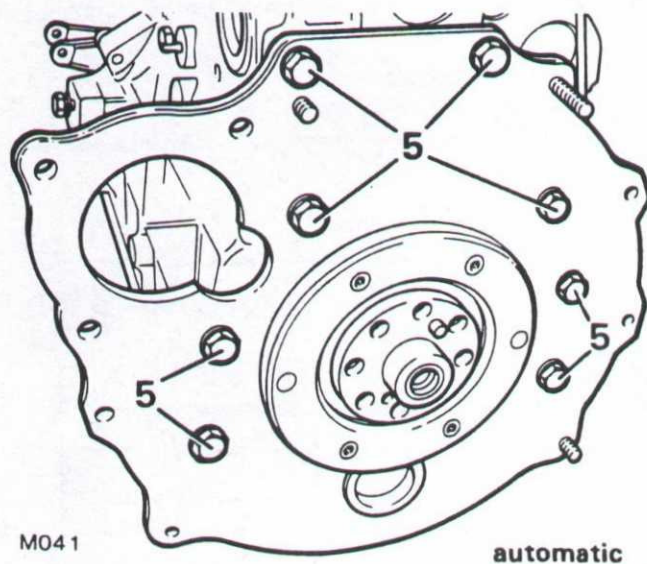
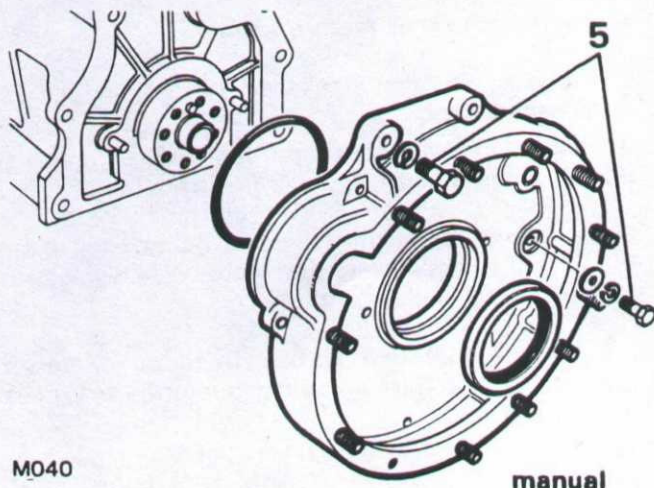
4 Remove the flywheel retaining bolts and withdraw the flywheel and reinforcing plate.



Remove the

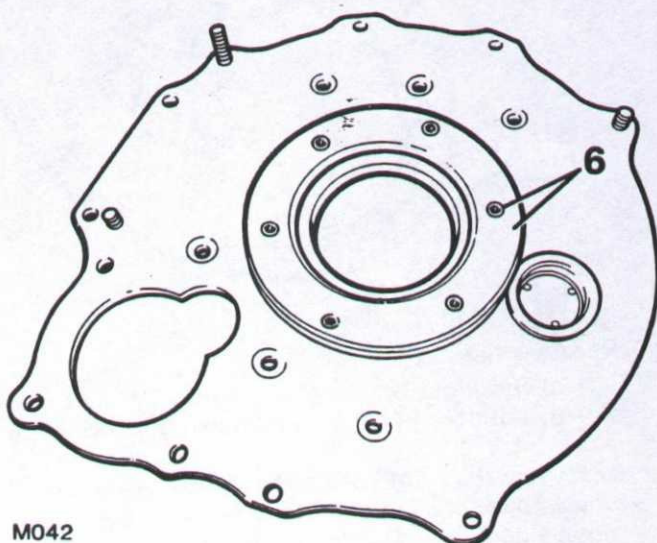
- a) flywheel housing – manual models only
- b) adaptor plate – automatic models only

5 Undo the eight bolts and washers holding the flywheel housing/adaptor plate to the cylinder block and remove complete with the main bearing oil seal.



Adaptor plate – automatic models only

6 The adaptor plate comes in two pieces, secured together by six "allen" screws; if there is any apparent damage to either part, undo the screws and replace the damaged part.



M042

Renewing the rear main oil seal

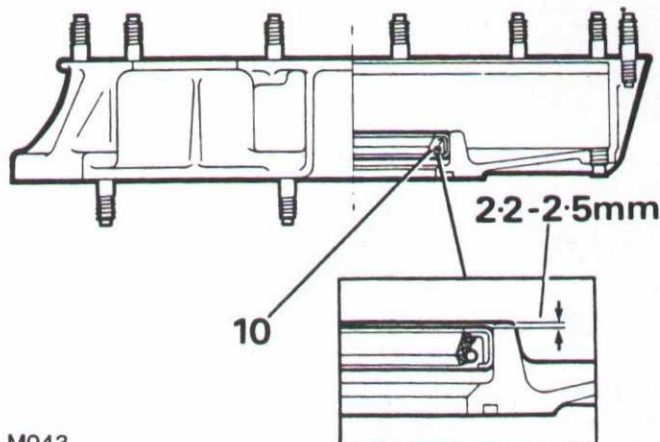
7 Check that the crankshaft oil seal journal is undamaged and clean.

8 Check the seal housing in the flywheel housing/adaptor plate is clean, dry and free from burrs.

Note: When fitting the new seal do not touch the seal lip and ensure that the outside diameter of the seal is clean and dry.

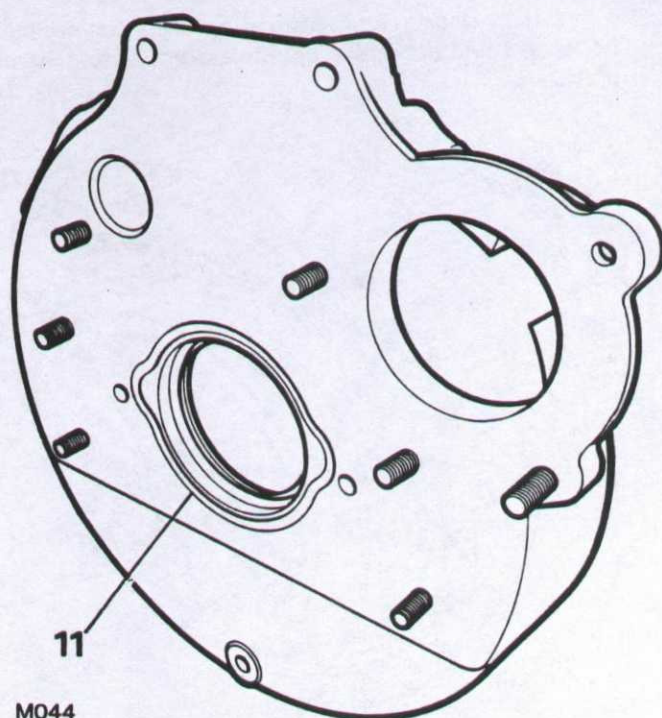
9 If a new crankshaft has been fitted, slowly press in the seal, lip side leading, squarely into the bottom of the housing.

10 If the original crankshaft is being used, press in to a depth of 2,2 to 2,5mm (0.080 to 0.081in) below the outer face of the seal housing. This is so that the new seal will not run in the same "track" as the original seal.



M043

11 Apply a bead of loctite 514 sealant to the rear face of the flywheel housing to the dimensions and configuration as illustrated. The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 5.5mm (0.216in) wide and 0.25mm (0.010in) thick.



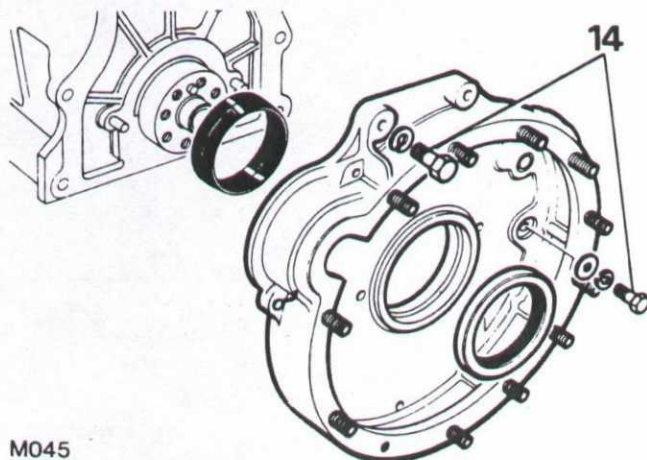
M044

Refit the flywheel housing/ adaptor plate

12 Examine the seal guide number 18G1344 and repair any damage which could destroy the seal lip.

13 Lubricate the outside diameter of the seal guide and the seal journal with concentrated "Oildag" in a 25% solution with clean engine oil.

14 Place the seal guide on the crankshaft flange and, using the two dowels protruding from the cylinder block rear face as a guide to ensure initial squareness. Fit the flywheel housing/adaptor plate and remove the seal guide. Secure the flywheel housing/adaptor plate, tightening evenly the eight retaining bolts to the specified torque. (40-50 Nm 30-36.8 1lb ft).



M045

Overhaul and refit the flywheel (manual models only)

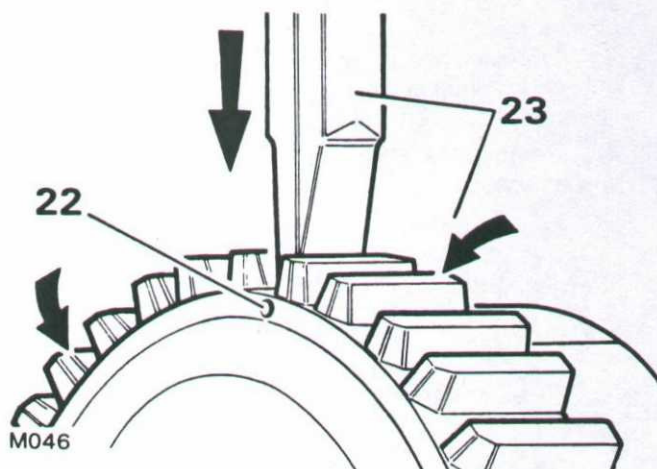
- 15 Inspect the flywheel clutch face and ring gear.
- 16 Wear or scores on the flywheel clutch face can be corrected by machining provided that the overall width of the flywheel is not reduced below 36,96mm (1.453ins).
- 17 Check that the flywheel has not been previously machined.
- 18 If the ring gear teeth are chipped or worn the gear can be renewed.

Replace the flywheel

- 19 Remove the clutch location dowels.
- 20 Machine the flywheel over the complete clutch face removing only the minimum material necessary to achieve a smooth flat surface parallel with the crankshaft mating face and within the previously stated width dimensions and fit new dowels.

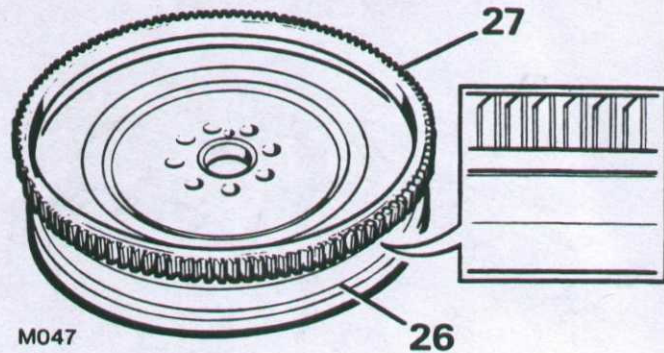
Renew the ring gear

- 21 Remove the eight nuts, bolts and tabwashers which hold the drive plate to the ring gear – Automatic models only.
- 22 Drill a 8.0mm ($\frac{5}{16}$ in) hole between the root of any two teeth and the inner diameter of the ring gear deep enough to weaken the ring. **Do not** allow the drill to enter the flywheel.
- 23 Secure the flywheel in a soft jawed vice and cover it with a cloth to protect one from personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.



- 24 Clean the flywheel removing any burrs which will prevent any part of the new ring gear seating properly.
- 25 Heat the new ring gear uniformly to between 225°C and 250°C but **do not** exceed the **higher** figure.
- 26 Place the flywheel, clutch face down, on a flat surface and locate the heated ring gear with the square edge of the teeth downward towards the flywheel clutch face and chamfered edge of the teeth uppermost.

- 27 Press the ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel. Allow the ring gear to cool naturally. **Do not** hasten the cooling process in any way.

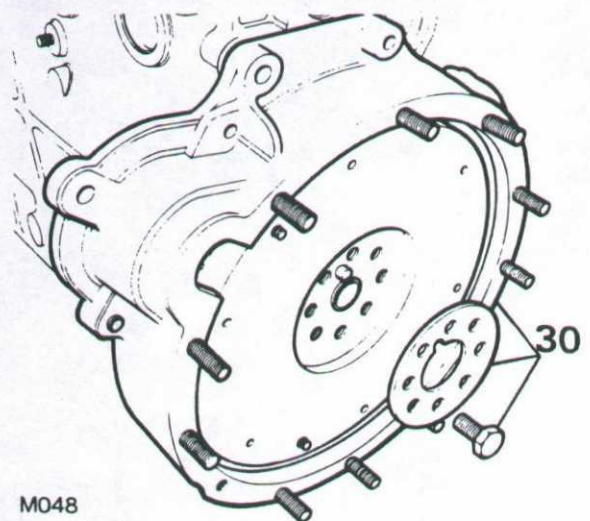


Fitting the flywheel

- 28 Examine the flywheel and crankshaft mating faces and remove any burrs or imperfections that could prevent the flywheel locating correctly. Check that the dowel is in position.
- 29 Refit the flywheel to the drive plate using the nuts, bolts and tab washers to prevent undoing – Automatic models only.

Note: The tabwashers are fitted so that the bolt heads are fixed together in pairs, and the nuts are fixed together in alternate pairs to the bolt heads.

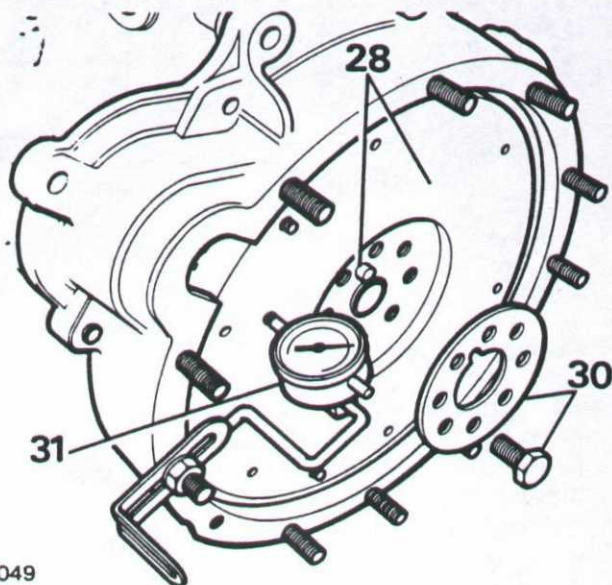
- 30 Offer up the flywheel to the crankshaft and secure with the reinforcing plate and retaining bolts. Evenly tighten the eight bolts to the specified torque (130-143Nm 96-105 lb ft).



- 31 To check the flywheel run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114mm (4.5ins).

32 Turn the flywheel, and check that the run-out does not exceed 0,05 to 0,07mm (0.002 to 0.003in). Should the run-out be excessive, remove the flywheel, and check again for any irregularities on the flywheel and crankshaft mating faces and dowel.

33 Repeat operations 30 and 31 to ensure correct run out.



M049

Fitting the clutch – manual models only

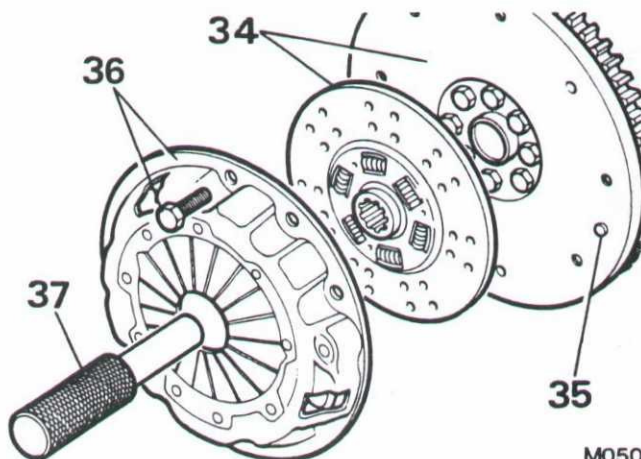
34 Clean the flywheel face and place the centre plate with the side marked "Flywheel side" towards the flywheel.

35 Fit the clutch assembly, locating it with the three dowels on the flywheel.

36 Loosely fasten the cover with the six bolts to the flywheel.

37 Centralise the centre plate using the special tool RO605022 or a slave primary shaft and tighten the six bolts evenly to the specified torque. (30-38Nm 22-28 lb ft).

38 Smear the splines of the centre plate with Molybdenum disulphide grease, such as Rocol MTS1000.



M050

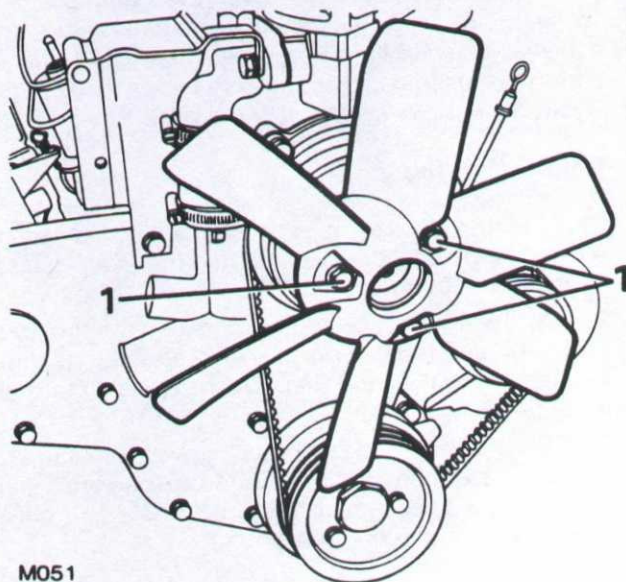
C. REMOVE AND OVERHAUL TIMING BELT AND PULLEYS

Special tools required

530102A Crankshaft nut spanner
18G1457/1 Distributor pump (D.P.S.) remover
18G1464/2/6 Crankshaft pulley remover
18G1456 Crankshaft oil seal replacer
18G1482 Camshaft oil seal replacer
18G1458 Distributor pump (D.P.S.) timing tool
18G1464/5 Button

Remove water pump

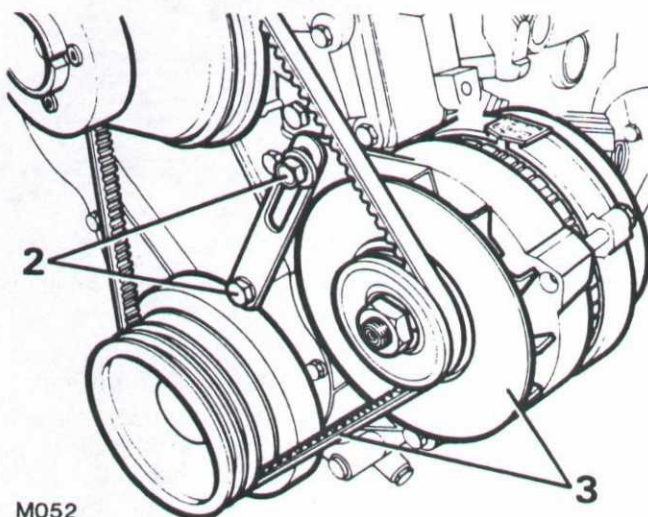
1 Undo the three retaining bolts and remove the fan blade.



M051

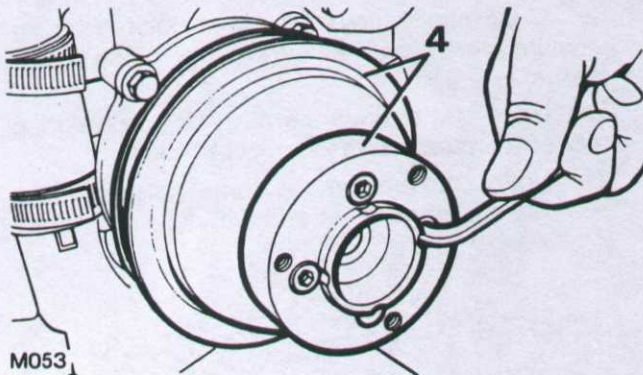
2 Loosen the alternator pivot bolt and the two alternator bracket fixing bolts; move the alternator inwards to slacken the belt.

3 Remove the drive belt, then remove the alternator and its associated bracket.

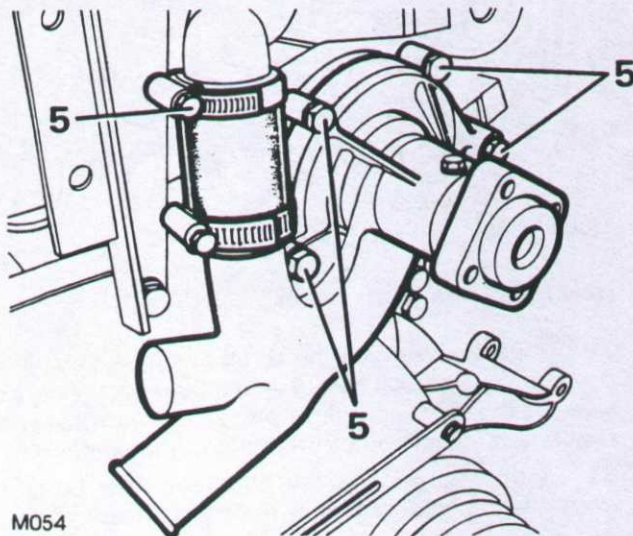


M052

4 Restraining the spacer undo the four "allen" screws and then remove the spacer and the water pump pulley.

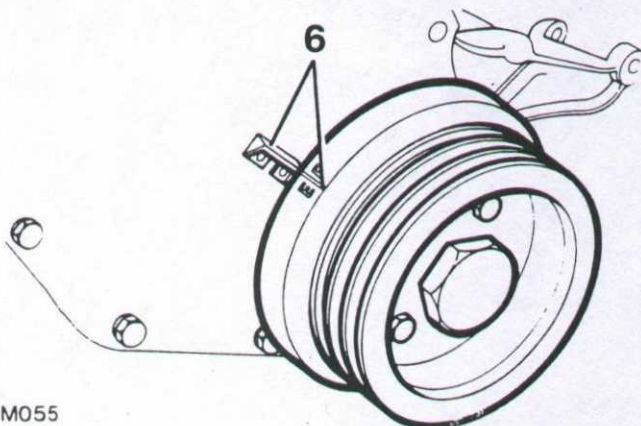


5 Slacken the by-pass hose top "jubilee" clip, then unscrew the seven retaining bolts, remove the water pump, housing and joint washer.



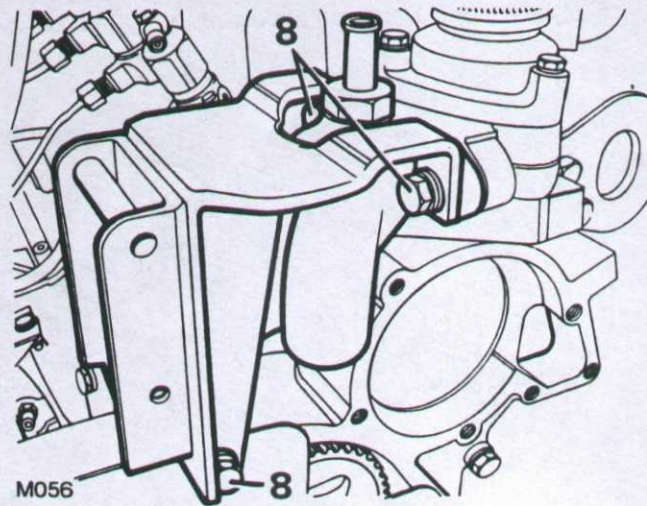
Remove the front cover

6 Rotate the crankshaft to bring the E/P mark on the pulley in line with the pointer on the front cover plate. Remove the oil filler cap and check that number one exhaust valve is fully open. Do not rotate the crankshaft again.

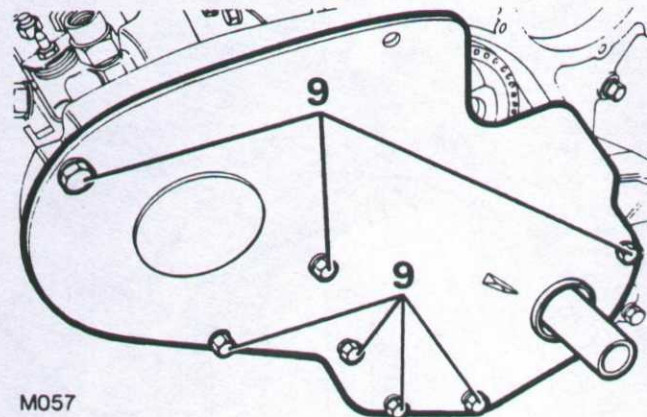


7 Remove the crankshaft pulley bolt and check that the E/P mark is still aligned with the pointer on the front cover plate and withdraw pulley, using special tool 530102A.

8 Remove the three bolts securing the power steering pump mounting bracket to the front cover and to the thermostat housing. Remove the mounting bracket and the water pump bypass casting.

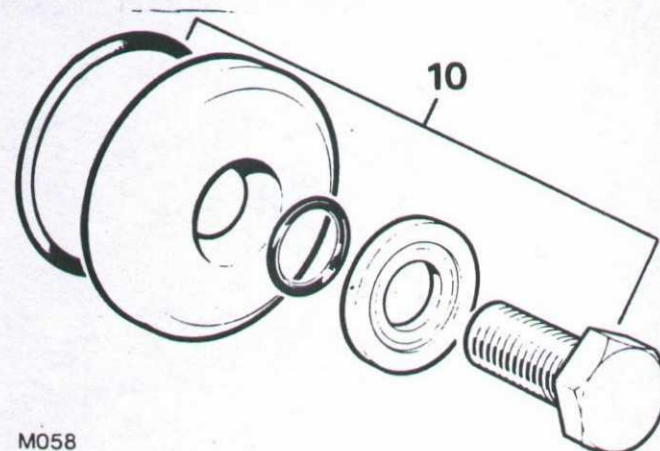


9 Undo the seven remaining bolts and remove the front cover.



Removing the timing belt and pulleys

10 Undo and remove the camshaft retaining bolt, special washer and 'O' rings.



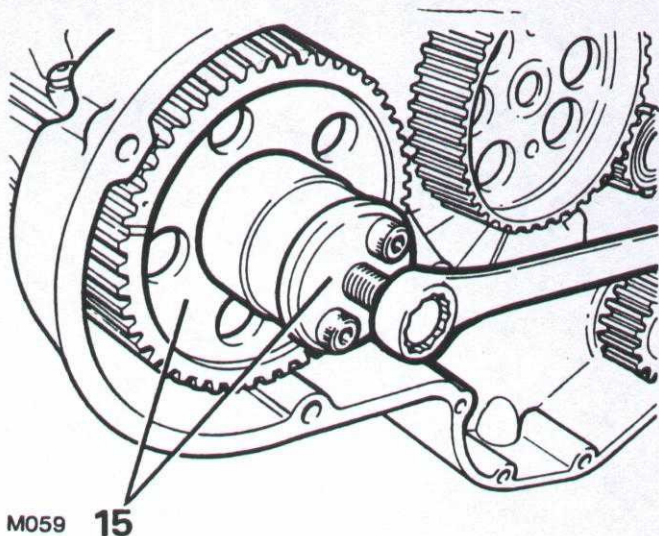
11 Undo and remove the distributor pump (D.P.S.) timing pulley nut.

12 Slacken the two belt tensioner assembly nuts and the idler pulley "allen" screw.

13 Remove the idler pulley and the timing belt.

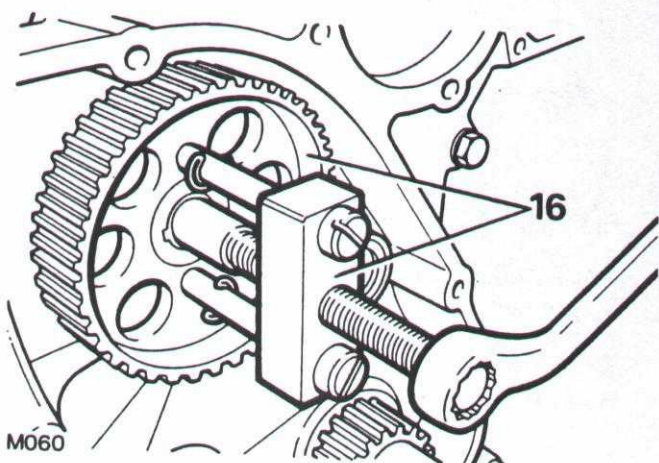
14 Remove the two belt tensioner assembly nuts and the assembler.

15 Using the centre part of special tool 18G1457/1 as illustrated, and withdraw the distributor pump (D.P.S.) pulley.



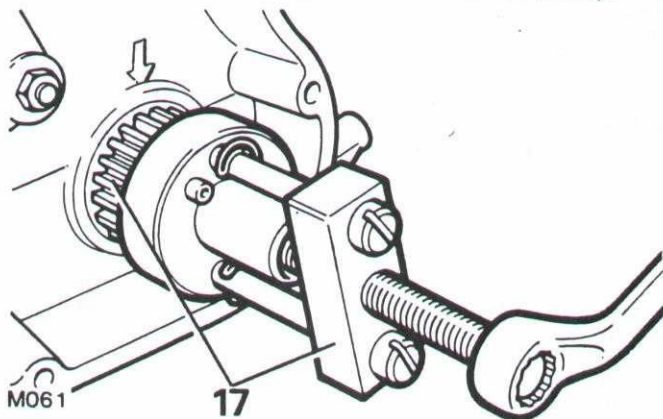
M059 15

16 Using the special puller tool 18G1464/2/6, as illustrated, withdraw the camshaft pulley.



M060

17 Using the special tool 18G1464/2 complete and button 18G1464/5 withdraw the crankshaft pulley.



M061

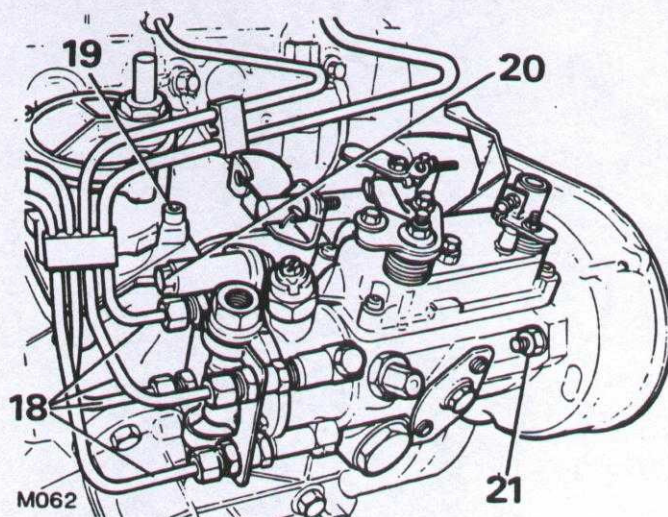
Removing the distributor pump (D.P.S.)

18 Remove the high and low pressure pipes from the D.P.S. pump and the injectors.

19 Undo and remove the three bolts retaining the vacuum pump and withdraw the pump and joint washer.

20 Undo and remove the nut and bolt securing the rear of the pump to the support bracket.

21 Undo and remove the three nuts retaining the pump to the front cover and withdraw the pump and joint washer.



M062

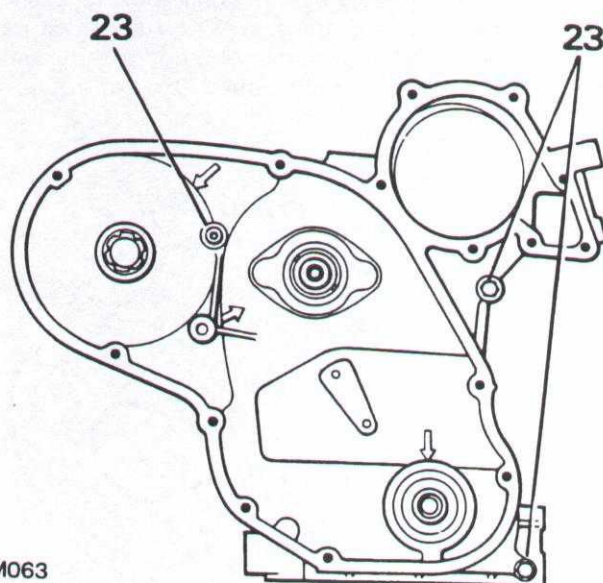
Removing the front cover

22 Undo and remove the three common sumps and cover bolts and slacken at least three bolts on both sides of the sump to relieve pressure on the cover and facilitate removal without damaging the sump joint.

23 Undo and remove the two remaining bolts and one "allen" screw retaining the front cover.

24 Remove the front cover taking care not to damage the sump gasket also remove the front cover gasket.

25 Remove the triangular joint washer and the water gallery joint washer from the cylinder block.



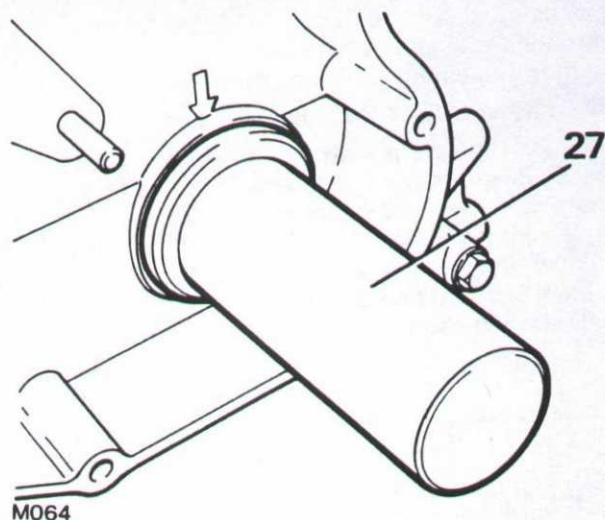
M063

Renewing front cover air seal

26 The oil seals in the front cover can be renewed with the cover flat on a work bench or with the cover in position on the cylinder block as shown in the following illustration.

Crankshaft seal

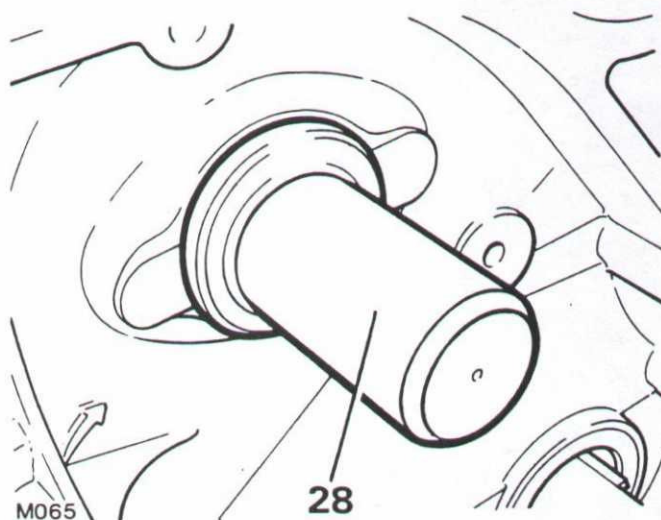
27 Carefully prise out the old seal and with the lip side leading drive in the new seal using special tool 18G145 until the seal is approximately 0,5mm (0.019in) below the inner face of the cover.



M064

Camshaft seal

28 Carefully prise out the old seal and drive in the new seal with the lip side leading until the seal is flush or approximately 1,0mm (0.039in) below the inner surface using the special tool 18G1482.

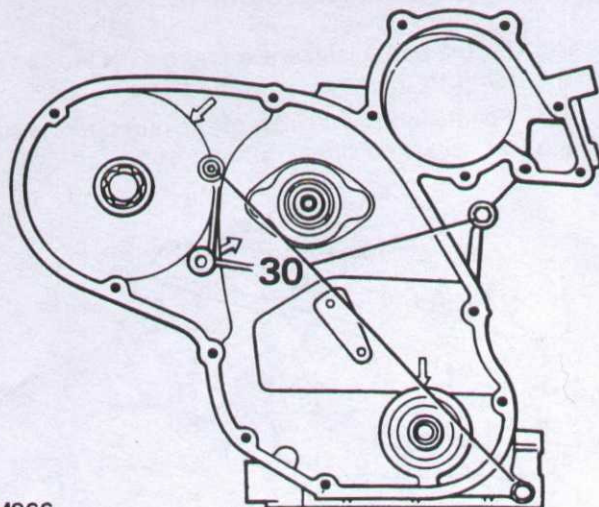


M065

Assembling the pulleys, timing belt and front cover

29 Fit new triangular cover joint washer and water gallery joint washer.

30 Fit and loosely secure the front cover to the block with the two bolts and one "allen" screw, referring to the chart for the location of the various bolt lengths.



M066

31 Fit the three common sump and front cover bolts and tighten these together with the cover bolts and the sump side bolts.

Overhaul and fitting of vacuum pump

32 Remove the four bolts securing the end plate and withdraw the end plate and "O" ring seal.

33 Tap the shaft-end of the rotor to remove it from the pump body.

34 Inspect the components for wear and damage and renew as necessary.

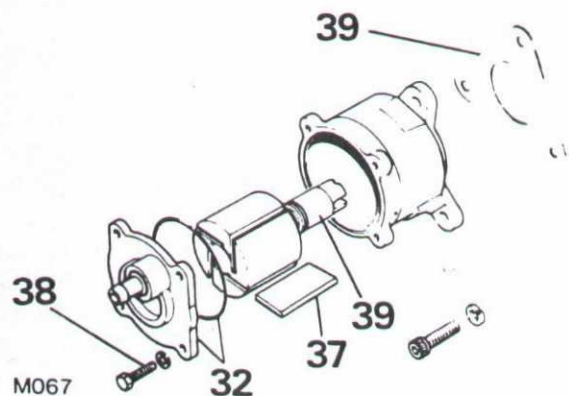
35 To check the rotor to body clearance, fit the rotor to the body and with feeler gauges, measure the clearance at the narrow point between the rotor and body. The correct clearance is 0,05mm (0.002in).

36 Check the clearance between the rotor and end plate by placing a straight edge across the body and with feeler gauges measure the clearance between the straight edge and the rotor. The correct clearance should be 0,10 to 0,12mm (0.004 to 0.005in).

37 Fit the rotor blades to the rotor with the radius outwards and insert the rotor into the body.

38 Place a new 'O' ring seal in position in the body groove and fit the end plate and secure with the four bolts tightening evenly.

39 Locate the distributor pump (D.P.S.) support bracket in position, then fit a new joint washer and finally insert the vacuum pump ensuring that the drive slot fits correctly over the coupling drive pin, secure with the three "allen" screws.

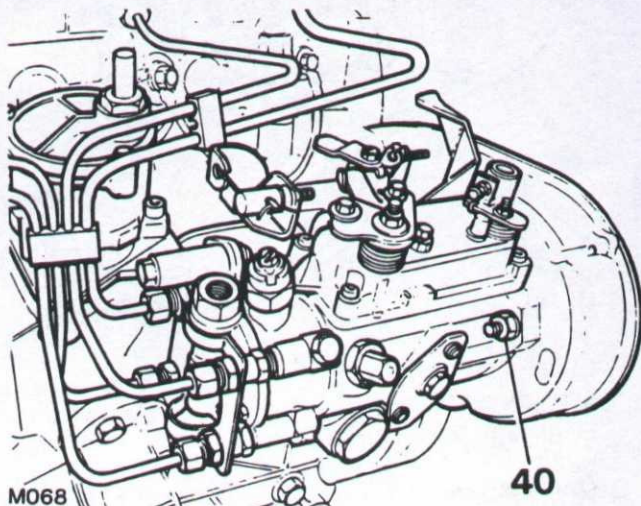


M067

Fitting the distributor pump (D.P.S.)

40 Fit the pump joint washer and then loosely secure the pump to the cover with the three nuts.

41 Secure loosely the rear of the pump to the support bracket using the single nut and bolt.



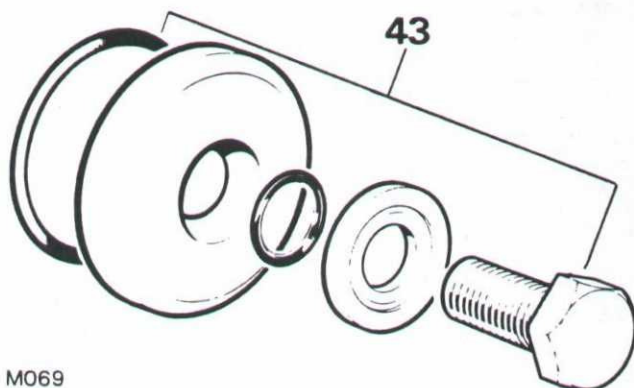
Fitting the crankshaft timing pulley

42 Taking care to ensure that the two keys are correctly located into the crankshaft, fit the pulley with the timing dot facing outwards, driving it into position using a suitable tube.

Fitting the camshaft pulley

43 Fit the pulley with the boss, facing towards the engine, and loosely fit the 'O' ring, special washer 'O' ring plain washer and bolt. **Do not** drive the pulley onto the camshaft, draw the pulley on using the slave 10mm diameter metric bolt and washer, after drawing the pulley on secure with the retaining bolt to finger tightness only.

Warning: Hitting or tapping the camshaft pulley onto the shaft will damage the tappet assemblies.



Fitting the distributor pump and idler pulleys

44 Fit the distributor pump pulley onto the pump taper and loosely secure, ensuring the dot on the pulley lines up with the arrow on the cover, with the nut.

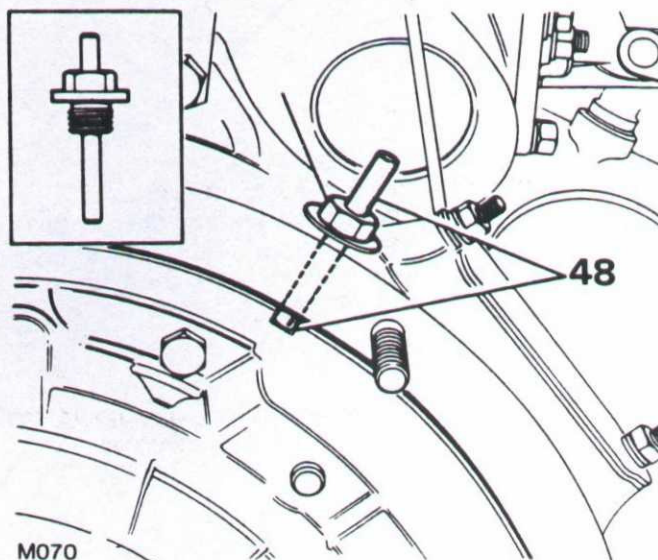
45 Fit the idler pulley securing it with the "allen" screw.

Timing the Distributor pump and valves (Manual only)

46 The distributor pump and valves are timed using the exhaust valve peak of number one cylinder. The exhaust peak position is determined by the relationships of a slot in the flywheel periphery and a plugged hole in the flywheel housing through which a probe is inserted to locate in the flywheel slot. A suitable probe tool can be manufactured using the existing plug and a 60mm (2.5in) length of 6,35mm (0.25in) diameter silver stem. Remove the plug from the flywheel housing and accurately determine the centre of the plug head and using a vertical drilling machine, drill a 6,35mm (0.25in) clearance hole through the length of the plug. The tool will be referred to in future as the E. P. Location Tool.

47 Fit the plug to the flywheel housing.

48 Turn the crankshaft in a clockwise direction until the E. P. slot in the flywheel is in line with the hole in the plug. Insert the silver steel rod through the hole until it locates in the flywheel slot. If the crankshaft is inadvertently turned beyond the E. P. slot do not turn it back but continue on round in a clockwise direction until the rod can be fully located in the flywheel.



49 Fit the timing belt tensioner assembly and loosely secure with the two nuts.

50 Turn the distributor pump pulley clockwise until the dot lines up exactly with the arrows in the front cover.

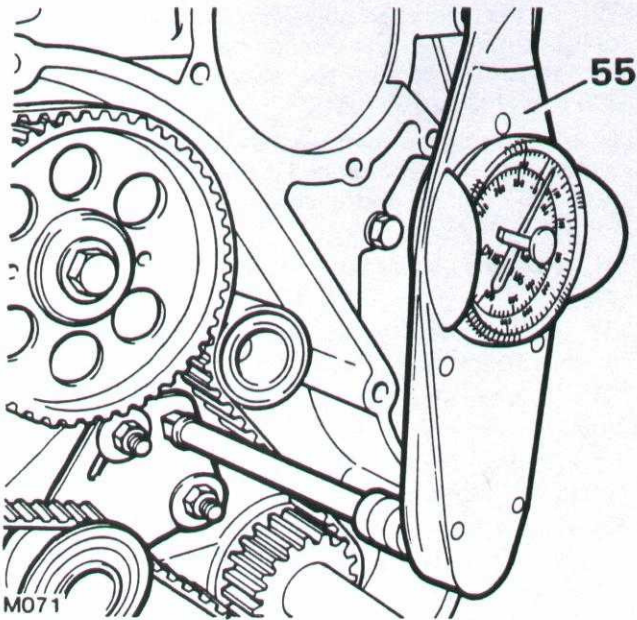
51 Similarly, turn the camshaft pulley clockwise so that the dot coincides exactly with the cast-on arrow.

52 Fit the timing belt over the crankshaft pulley and keeping the timing belt under tension, by hand, run the belt under the idler pulley and over the camshaft pulley. If the belt does not quite mate with the grooves, turn the pulley clockwise the necessary amount.

53 Feed the pulley around the distributor pump pulley ensuring the belt grooves mate up with the pulley. Keeping a firm grip on the belt pass it over the tensioner.

54 Withdraw the silver steel rod from the slot in the flywheel.

55 Using a direct scale read off torque wrench (Not a break-action torque wrench) adjust the belt tension by placing the drive peg into the square hole in the tensioner base plate. The tension should be from 10,5 Nm to 13 Nm (8 to 10lb ft). Once the belt tension has been achieved tighten the tension retaining nuts to 22 to 28 Nm (17 to 20lb ft).



56 Rotate the engine **two** complete revolutions.

57 Slacken the tensioner nuts.

58 Tension the belt again as described in instruction 43, and tighten the tensioner nuts to the specified torque 22 to 28 Nm (17 to 20lb ft).

Caution: The double tensioning procedure is imperative, otherwise the belt could fail resulting in serious engine damage.

59 Rotate the crankshaft until the steel rod can, once again be inserted into the flywheel slot.

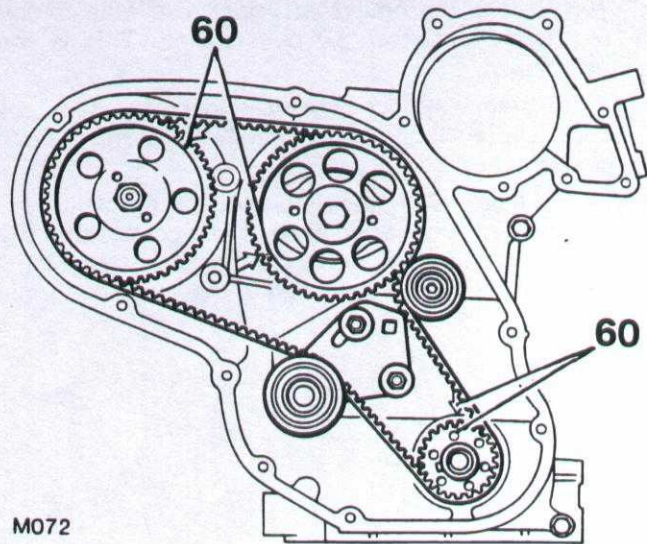
60 Check that the dots on the pump and camshaft pulley coincide exactly with their respective arrows. If there is any misalignment the procedure must be repeated.

61 Remove the plug from the side of the distributor pump, and insert gauge tool 18G1458 and if necessary rotate the pump body until the gauge can be fully inserted and screwed home indicating that the inner disc is centrally positioned with the hole.

62 Evenly tighten the three nuts securing the pump to the front cover and the single nut and bolt to the support bracket and reconnect the fuel injection pipes.

63 Remove the E. P. location tool and fit a new Plug – Part No. ERC7295 and the special tool and refit the plug.

64 Tighten the distributor pump timing pulley nut and the camshaft pulley retaining bolt to the specified torque 42-48 Nm (31 to 35.4 lb ft).



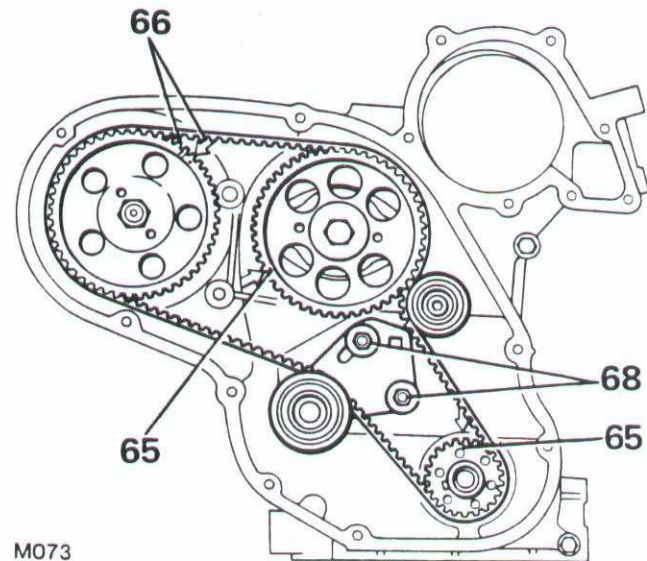
Valve timing – automatic only

65 Set the position of the crankshaft and camshaft so that the marks on both the pulleys align with the arrows on the front cover.

66 On the distributor pump pulley align the scribed line, adjacent to the “F” mark, with the arrow on the front cover.

67 Fit the timing belt, using only hand pressure to ease it onto the pulleys. First, fit it around the crankshaft pulley then run the belt under the idler pulley and over the camshaft pulley, always keeping it under tension. Finally feed the belt around the distributor pump pulley.

68 Refit the timing belt tensioner securing it loosely with the two retaining nuts and washers.

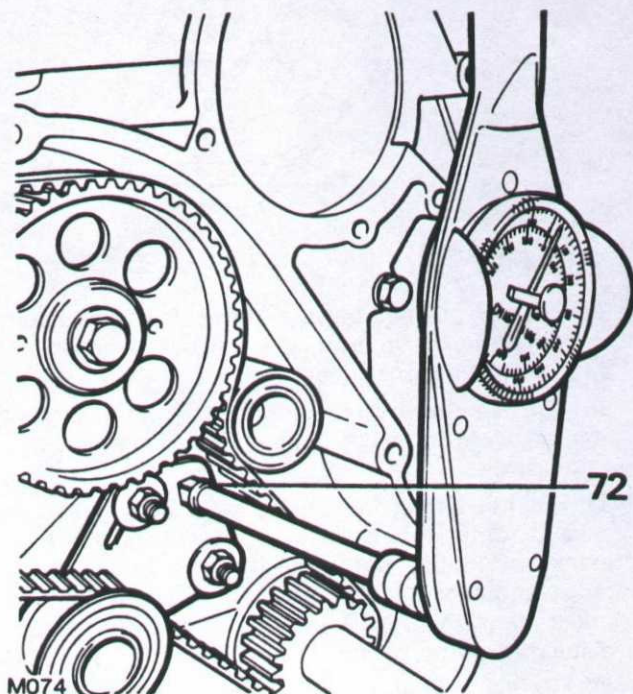


69 Using a direct scale read-off torque wrench (Not a break-action torque wrench) adjust the belt tension by placing the square peg into the square hole in the tensioner base. The belt tension should be from 10,5 to 13 Nm (8 to 10lb ft). Once the belt tension has been achieved tighten the tensioner retaining units to 22 to 28 Nm (17 to 20lb ft).

70 Rotate the crankshaft clockwise one complete revolution and reset the belt tension. **This is most important.**

71 Rotate the crankshaft clockwise one more complete revolution to check that the timing marks are correctly aligned.

72 If there is any misalignment the procedure must be repeated. Only when the timing is correct should the camshaft pulley bolt and distributor pulley retaining nut be loctited and fully tightened to the specified torque.



Fit the front cover plate, water pump and pulleys

76 Locate the front cover and retain with the seven bolts.

77 Fit the alternator pivot bracket onto the front cover and secure, finger tight only.

78 Refit the water pump bypass casting with a new joint washer to the thermostat housing, also the power steering pump mounting bracket and secure with three bolts.

79 Fit the crankshaft pulley, and secure with the pulley bolt ensuring that the threads have been coated with "loctite". Tighten to the specified torque. 260 to 280 Nm (192 to 206 lb ft).

80 Locate a new joint washer in position and fit the water pump and housing. Fit the bolts in accordance with the diagram and evenly tighten to the specified torque.

81 Refit the bypass hose and secure with the "jubilee" clip.

82 Fit the water pump pulley and spacer, securing them with the four "allen" screws.

83 Refit the alternator to the pivot bracket and adjust bracket, ensuring finger tightness at this stage.

84 Replace the drive belt over the water pump pulley alternator and crankshaft pulleys.

85 Adjust the tension of the belt by moving the alternator in or out until correct. Tighten the three bolts to secure the tension.

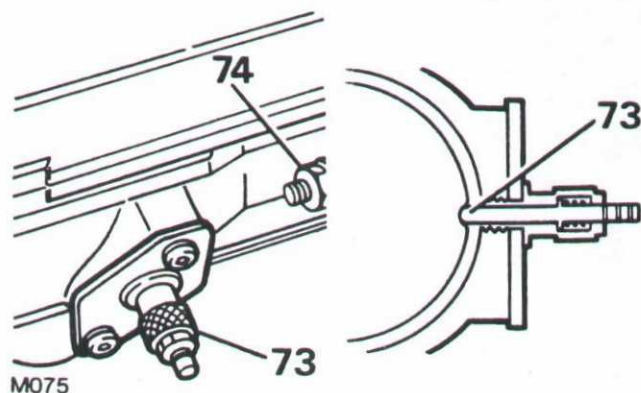
86 Fit the fan blade and secure with the three bolts.

Distributor pump timing automatic only

73 Remove the plug from the side of the pump and fit the special tool 18G1458. If necessary turn the pump body in either direction until the plunger in the tool locates fully in the timing recess, as illustrated, when the first mark on the plunger is flush with the body.

74 Tighten the distributor pump retaining nuts and rear support bracket nut and bolt and reconnect fuel injection pipes.

75 Remove the special tool and refit the plug.



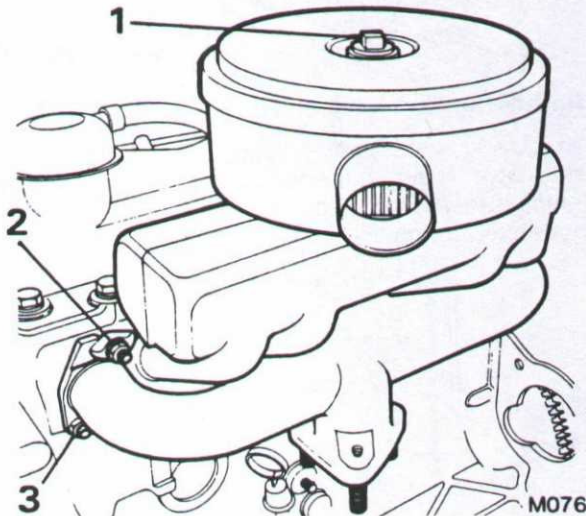
D. REMOVE AND OVERHAUL CYLINDER HEAD

Special tools required

- 274400 – Drift inlet valve guides
- 274401 – Drift exhaust valve guides
- 276102 – Valve spring compressor
- 600959 – Drift exhaust valve guide
- 601508 – Drift inlet valve guide
- MS621 – Seal cutter
- 530625 – Insert replacer

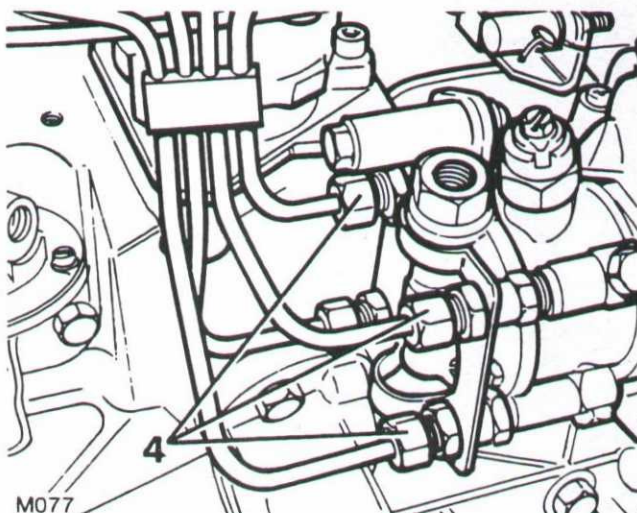
Remove the exhaust and inlet manifolds

- 1 Undo the square headed nut from the top of the air cleaner and remove the cleaner and seals.
- 2 Undo the manifold nuts, which hold the clamps retaining the inlet manifold, and remove.
- 3 Undo the remaining nuts and remove the exhaust manifold.

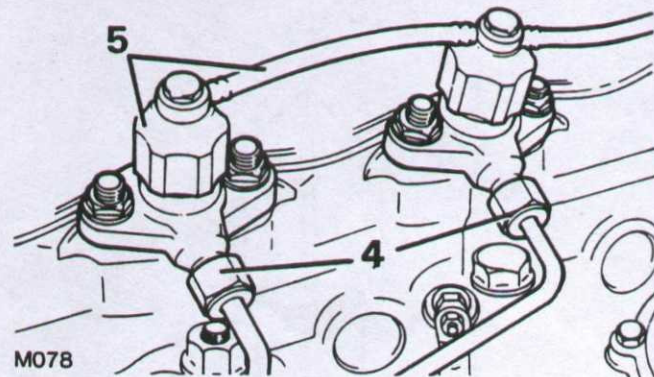


Removing the injectors, spill rail and oil feed pipe

- 4 Disconnect and remove the fuel injection pipes from the injectors and distributor pump (D.P.S.), then cover the injector parts to prevent ingress of foreign bodies.

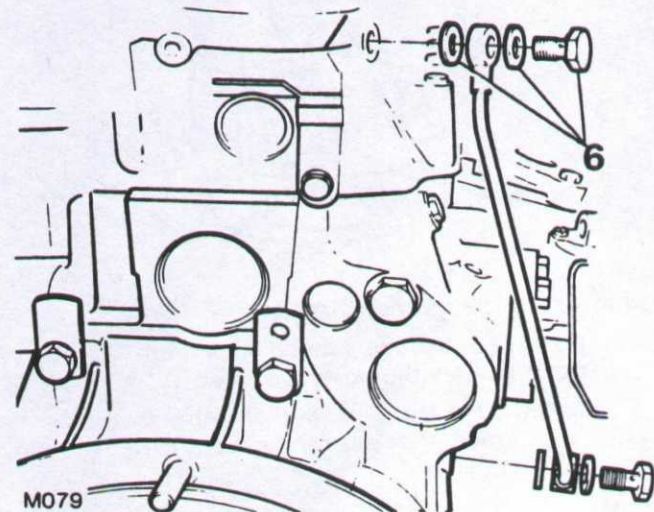


- 5 Remove the injectors complete with spill rail.



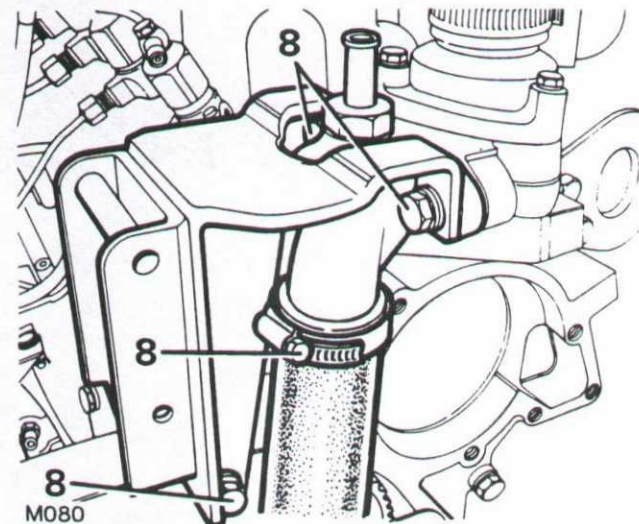
- 6 Undo the two banjo bolts and remove the cylinder head oil feed pipe at the rear of the engine.

- 7 Disconnect the heater plug electrical connections.

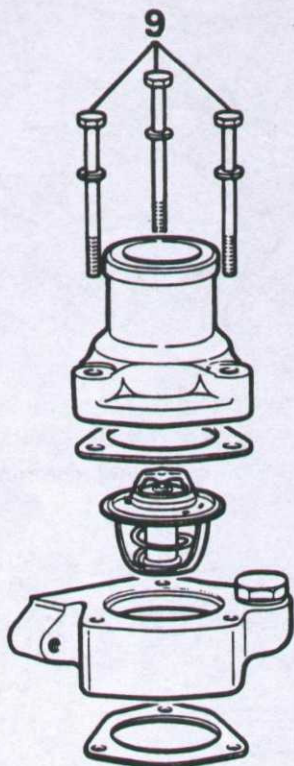


Removing the thermostat and housing

- 8 Slacken the "jubilee" clip holding the water bypass hose then undo the three bolts retaining the power steering mounting bracket and remove, including the elbow.



9 Undo the three bolts holding the thermostat cover and housing, remove the housing, cover and thermostat.

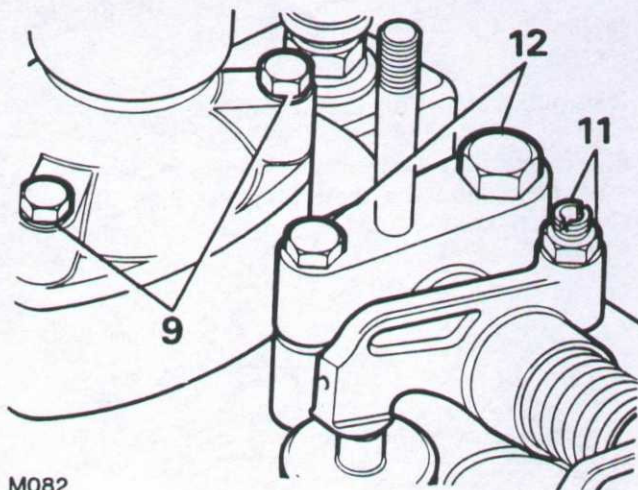


M081

Removing the cylinder head

10 Remove the three domed nuts from the rocker cover and remove the cover.

11 Slacken the tappet screw lock nuts then turn the adjusting screws to release them from the push rods.



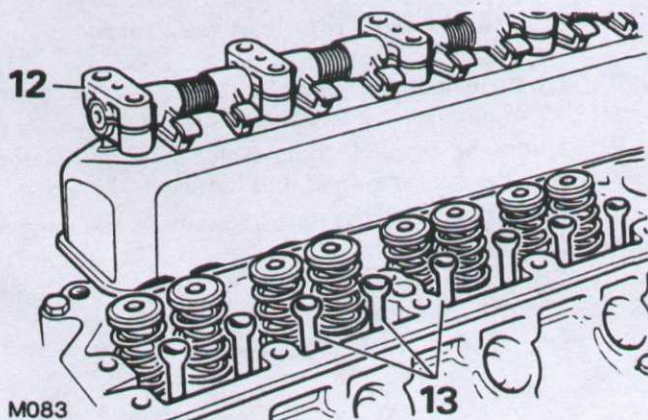
M082

12 Remove the rocker shaft retaining bolts, lift off the rocker shaft assembly, invert it and secure it to the rocker core studs to prevent the assembly from falling apart.

13 Withdraw the push rods and retain them in numerical order.

14 Evenly slacken the remaining cylinder head retaining bolt and lift off the cylinder head.

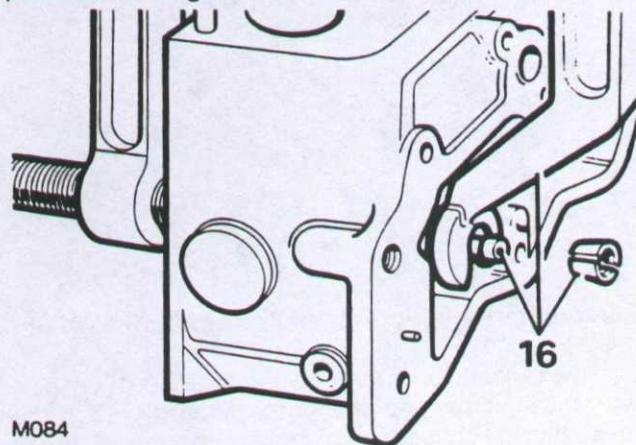
15 Remove the engine lifting brackets from the front and rear of the cylinder head.



M083

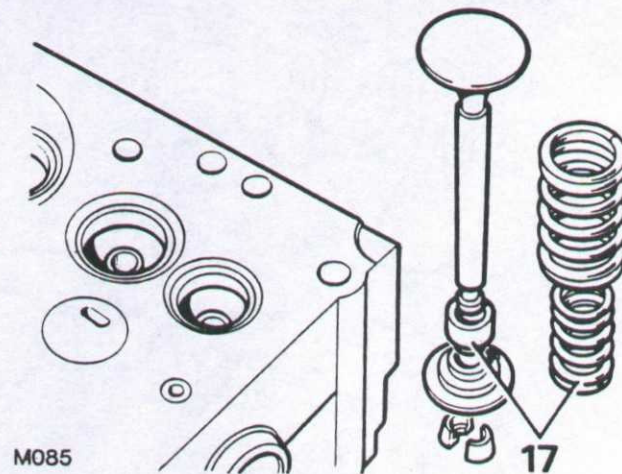
Removing the valve springs

16 Using valve spring compressor 276102 or a suitable alternator remove the valve and spring assemblies keeping them identified with their original locations for possible refitting.



M084

17 Discard the valve spring and valve guide oil seals. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.



M085

Examining the cylinder head

18 When carrying out normal top overhaul work on the cylinder head it is not necessary to remove either the injector shrouds or the hot plugs. Small surface cracks in the hot plug, extending from the opening to approximately 8,0mm (0.312in) in length can be ignored. However, if any severe cracks appear on the face of the hot plugs, before attempting to remove it, closely inspect the cylinder head for signs of cracks, particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant, and the cylinder head should be scrapped.

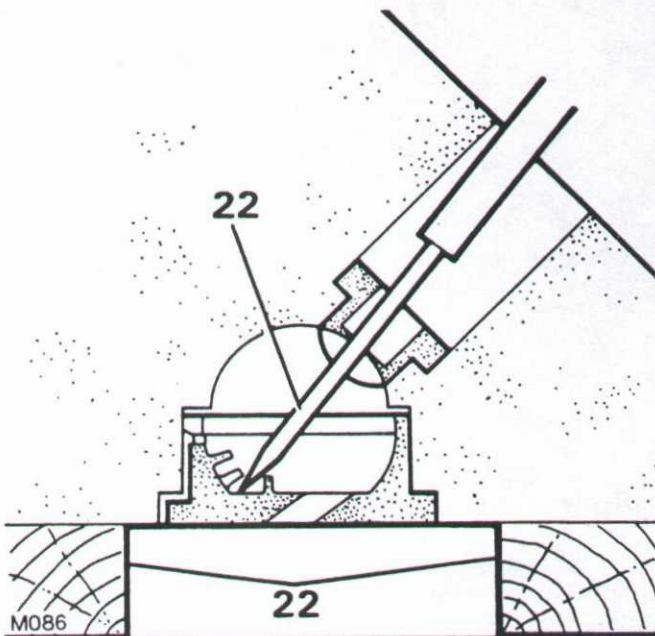
19 Examine the cylinder head for cracks and distortion.

20 Burnt, pitted and pocketed seats must be repaired.

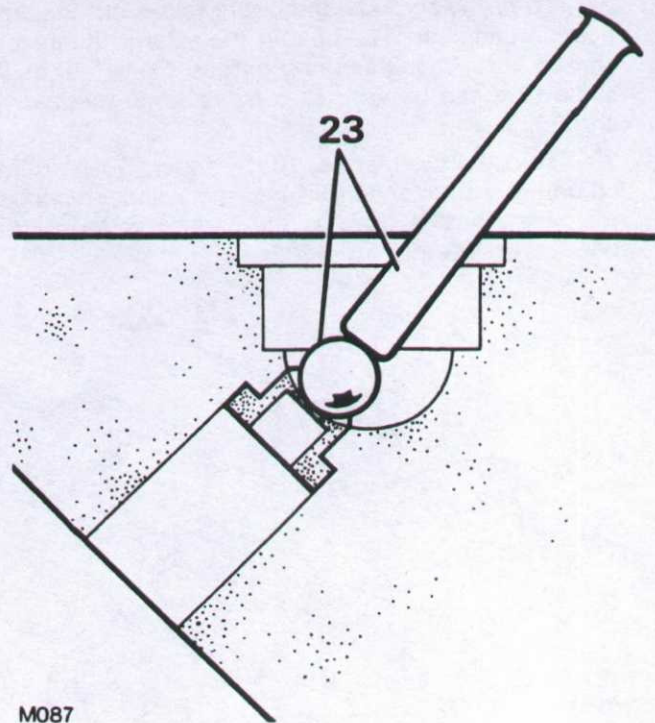
21 In addition, worn or damaged valve seats should be renewed.

Renewing the shrouds, hot plugs and push rod tubes

22 To remove a hot plug, support the cylinder head, face down on two pieces of timber. Insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed, a faulty hot plug cannot be restored and must be scrapped.



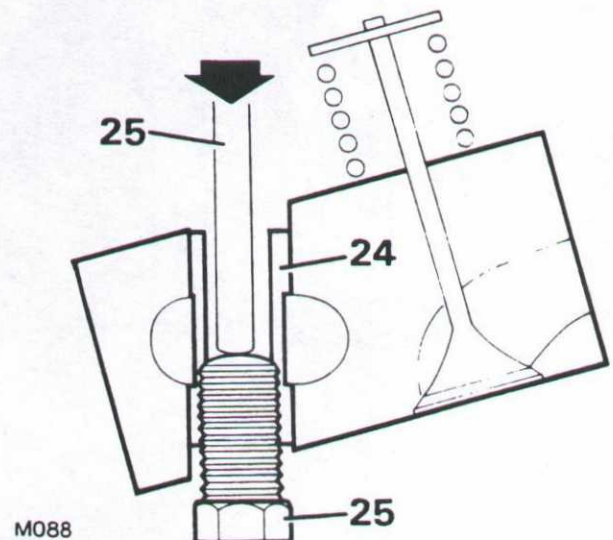
23 If the injector shroud is damaged, using a 13mm (0.51in) ball bearing drift the shroud out towards the injector bore.



Note: Whilst this is rarely necessary the procedure is nevertheless as follows:

24 Using an 8mm taper tap, cut a thread 30mm (1.18in) deep in the combustion face end of the tube to be removed.

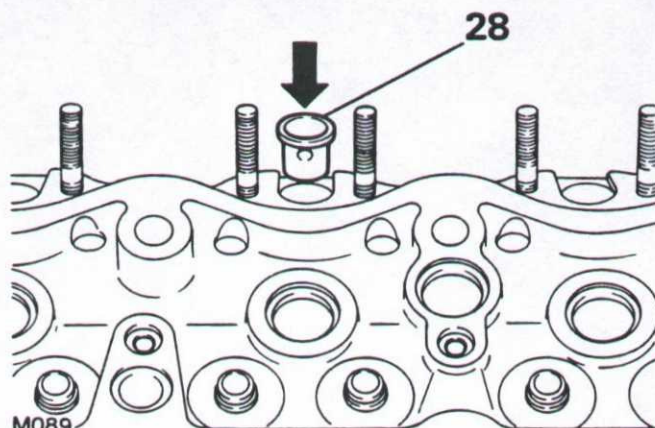
25 Screw an appropriate bolt into the tube and press out the tube as illustrated.



26 Smear both ends of a new tube with silicone rubber sealant and press it into the cylinder head.

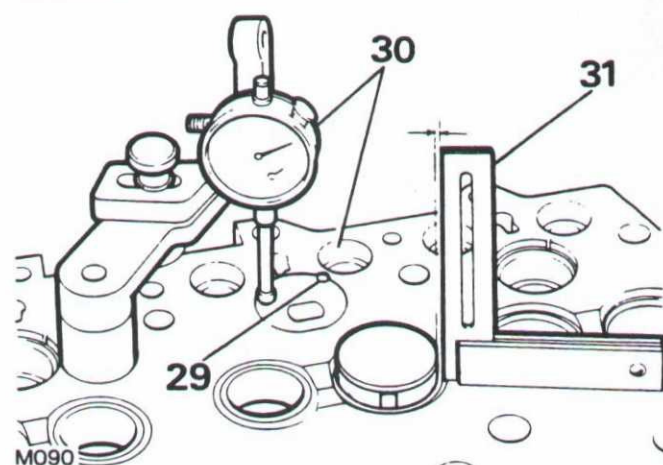
27 To fit the shrouds, thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only but at the same time can be used as a guide when refitting the shroud.

28 Turn the cylinder head face down. Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the cylinder head, and drift into position.



29 To fit the hot plugs use a hide-faced mallet and tap in, locating it with a new roll pin. If the hot plugs are loose in the cylinder head they may be retained with a little grease.

30 When fitted, the hot plugs must be checked with a dial test indicator to ensure that they do not protrude above the level of the cylinder head face more than 0,025mm (0.001in) and are not recessed below the level of the cylinder head for more than 0,005mm (0.002in).

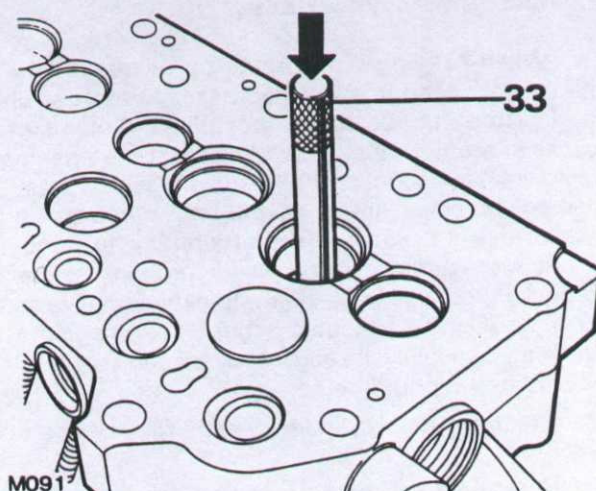


Renew the valve guides

31 Check the valve guides for wear by inserting a new valve in the appropriate guide 8mm (0.31in) above the seat. If movement across the head exceeds 0,15mm (0.006in) renew the guide.

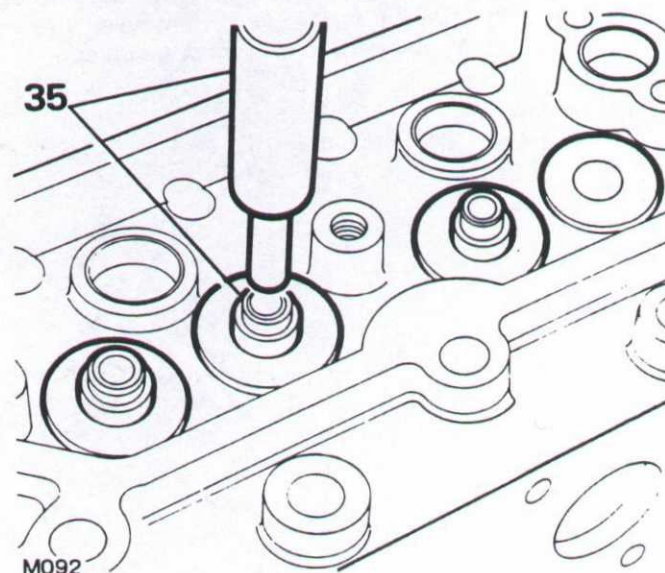
32 Support the cylinder head, combustion chamber uppermost pieces of timber of sufficient thickness to allow clearance for the valve guides to be driven out.

33 Using the special drifts 274400 for inlet guides and 27440 for exhaust guides, or suitable alternatives, drive out the old guides from the combustion face side.



34 Turn the cylinder head over so that the combustion chambers face downwards. Since the inlet and exhaust valve guides are dimensionally different it is important that the correct guides are fitted to the appropriate ports.

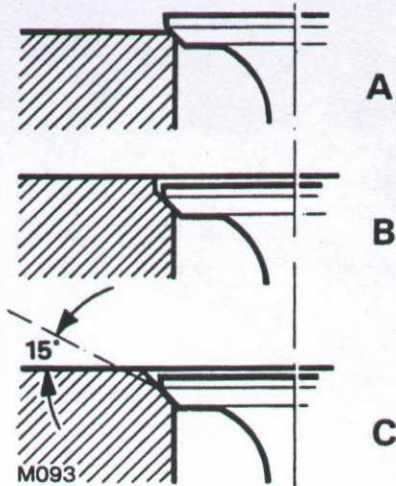
35 Lubricate the new guides with engine oil and using the special drifts 600959 for the exhaust and 601508 for the inlet valve guides or suitable alternatives, drive in the new guides until the shoulder is flush with the casting.



Replace cylinder head valve seats

36 Damaged or worn valve seats can be replaced provided they are not abnormally wide due to repeated refacing operation.

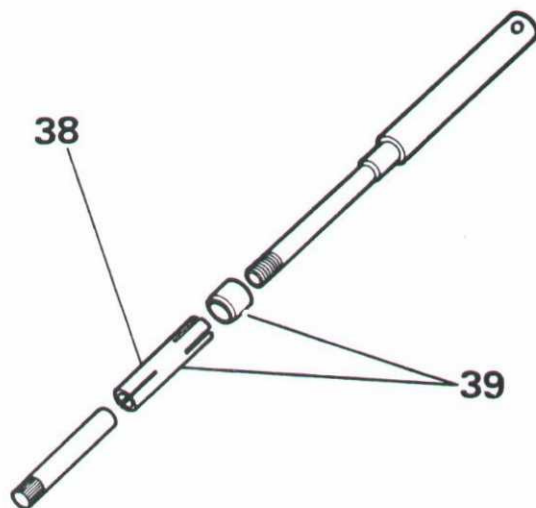
Note: After several truing-up or lapping-in operations valve seats may have an excessive width which can be reduced by obtaining special correction cutters which narrow the seat by removing metal from the top and bottom of the seat. A 60° cutter is recommended for bottom narrowing and 30° cutter for top narrowing.



37 The special set of hand tools recommended for refacing including expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with valve guides. The refacing tool has tungsten carbide cutters and can be used to cut a seat in a new exhaust seat insert.

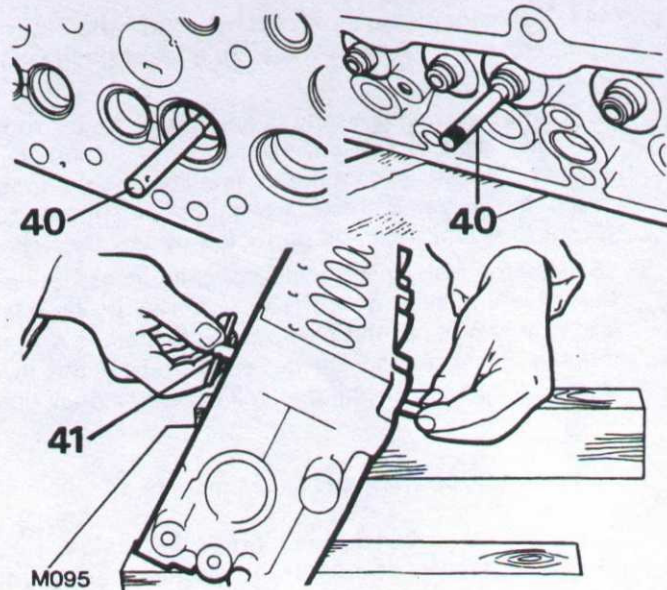
38 Select the correct expandable collet for the valve guide concerned i.e. 8mm (0.31in) for inlet guides and 8,5mm (0.33in) for exhaust guides.

39 Loosely assemble the collet, expander and nuts. Ensure that the chamfered end of the expander is towards the collet.

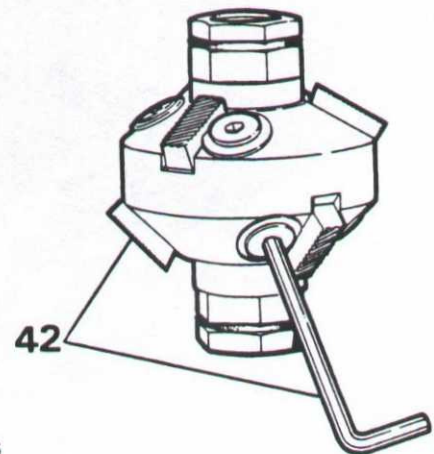


40 Insert the assembled pilot into the valve guide, from the combustion face side of the cylinder head, until the shoulder contacts the valve guide, and the whole of the collet is inside the valve guide.

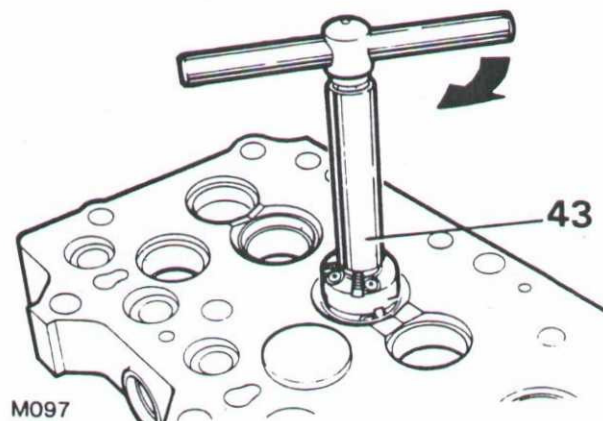
41 Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.



42 Use cutter MS621 and ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated. Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS76.



43 Fit the wrench to the cutter head and turn clockwise using only very light pressure. Continue cutting to approximately the centre of the existing seat.



44 To check the effectiveness of the cutting operation use engineers' "blue" or a feeler gauge made from cellophane.

45 Smear a small quantity of engineers' "blue" round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 12mm (0.472in) it can be corrected by tapping.

46 Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag, the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.

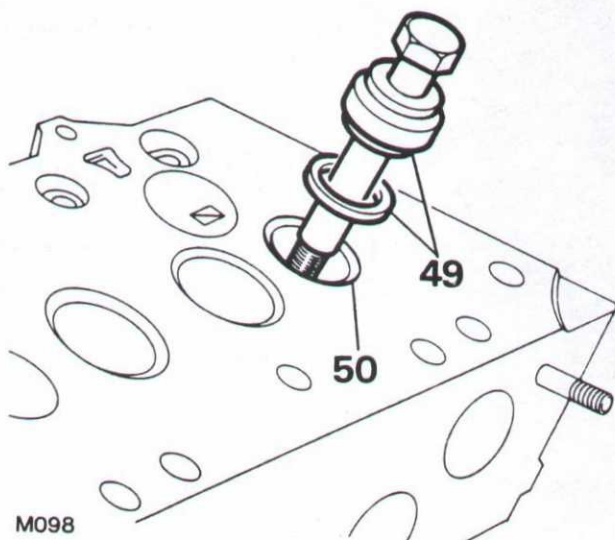
Renew inlet and exhaust seat inserts

47 Hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket.

48 Remove any burrs and swarf from the pocket. Failure to do so could cause the new insert to crack when being fitted.

49 Assemble the new exhaust insert to the replacer, special tool number 530625, so that the chamfered edge of the insert is leading. Using a suitable bolt and nut draw the insert into the cylinder head pocket.

50 Since no tool is available for the inlet seat, use a suitable adaptor to press-in the new seat. Cut a new 45° seat using cutter MS621.

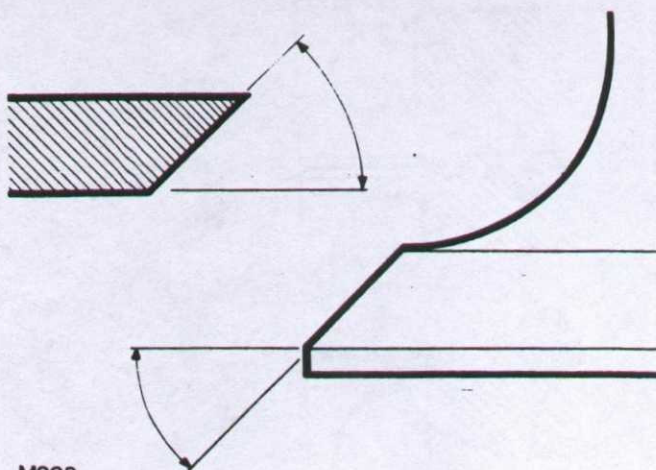


M098

Reface the valve seats

51 Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and the face concentric with the stem.

Inlet valve seat face	$45^\circ + \frac{1}{4}^\circ$
Exhaust valve seat face	$45^\circ + \frac{1}{4}^\circ$
Inlet valve seat face	$45^\circ - \frac{1}{4}^\circ$
Exhaust valve seat face	$45^\circ - \frac{1}{4}^\circ$



M099

Lap-in valves

52 Inspect the valves and discard any that are burnt, bent or distorted. Check the stems for wear by inserting a new guide. If wear is excessive, discard the valve. Valve faces that are pitted or ridged but otherwise serviceable may be refaced.

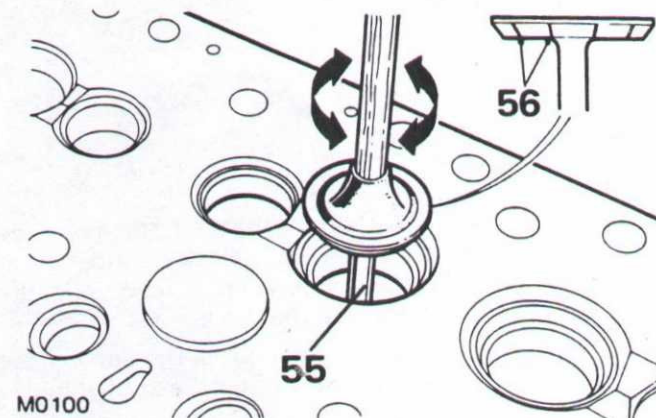
53 To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed.

54 Unless the faces to be lapped are in a poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil.

55 Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.

56 Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face. Place the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter turn a few times. If all the pencil lines are cut through no further lapping is required.

57 Wash all traces of grinding paste from the valves and cylinder head seats.



M0100

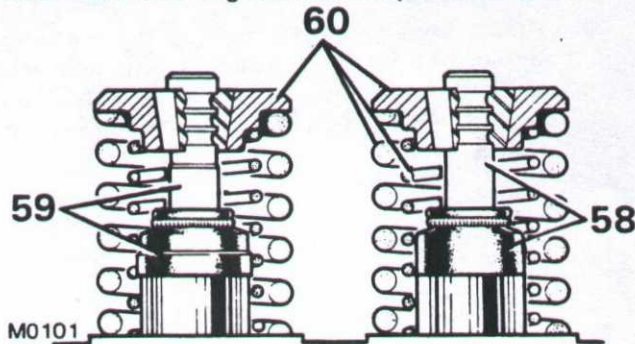
Assembling the valves to the cylinder head

58 Insert the inlet valves into the guides and fit new oil seals with the plain exterior. Ensure that the seal locates in the groove in the valve guide.

59 Insert the exhaust valves and fit the oil seals with the stepped exterior. They are larger than the inlet valve seals.

60 Fit the double valve spring and cup to each valve in turn and using valve spring compressor, 276102 or a suitable alternative secure the assembly with the multi-groove butting cutters.

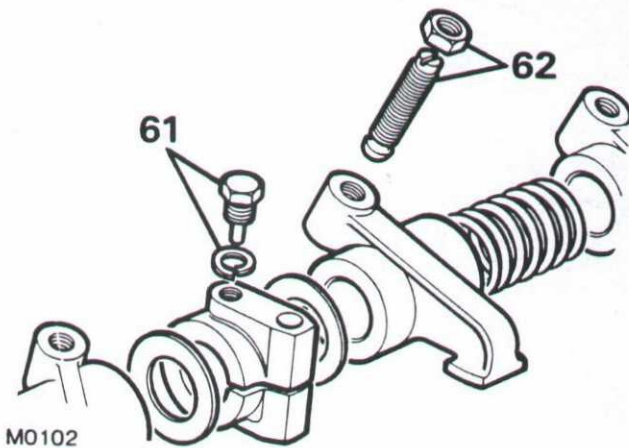
Note:- On later engines valve caps are fitted.



Overhaul the rocker shaft assembly

61 Remove the locating screw and washer from the number two rocker bracket and withdraw all the components from the rocker shaft.

62 Remove the locknuts and adjustment screws from the rockers.



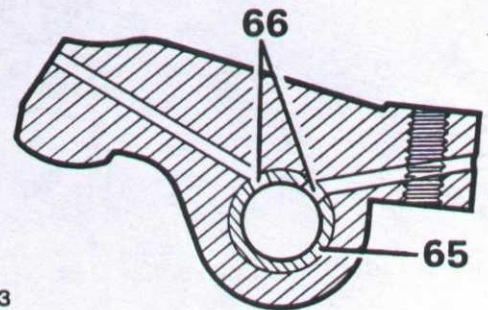
63 Examine the rocker shaft for wear and discard if the bearing surface is worn more than 0,025mm (0.001in)

64 Inspect the rockers and discard if the pads are worn. It is **not** permissible to grind pads in an attempt to reclaim the rockers.

65 Renew bushes if the clearance between shaft and bush is in excess of 0,101 to 0,127mm (0.004 to 0.005in).

66 Press in replacements ensuring that the pre-drilled oil holes in the rockers. The following cross-section of a rocker shows the oil drillings.

67 Using a $17/32$ " reamer, $13,5\text{mm} + 0,2\text{mm}$ (0.530in + 0.001in) finish the bushes and clear swarf from the oil holes.



M0103

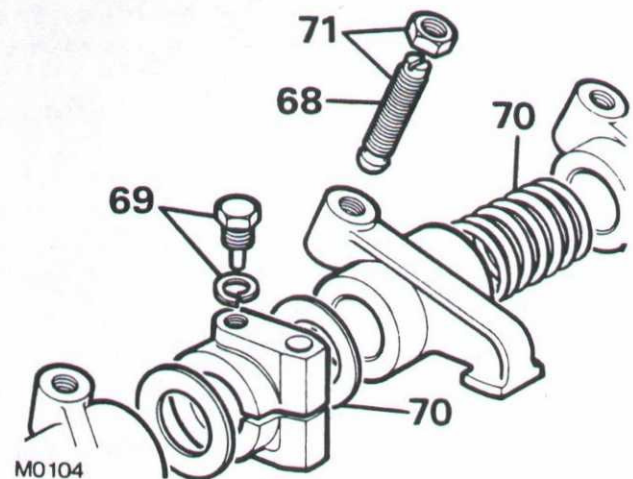
68 Examine the ball-end of the adjusting screws and discard any that are worn. Regrinding is **not** permissible. Check the threads for damage and that the oil relief drilling is clear.

69 Check that the oilways in the rocker shaft are clear and fit number two rocker shaft bracket to the shaft and retain with the locating screw and washer.

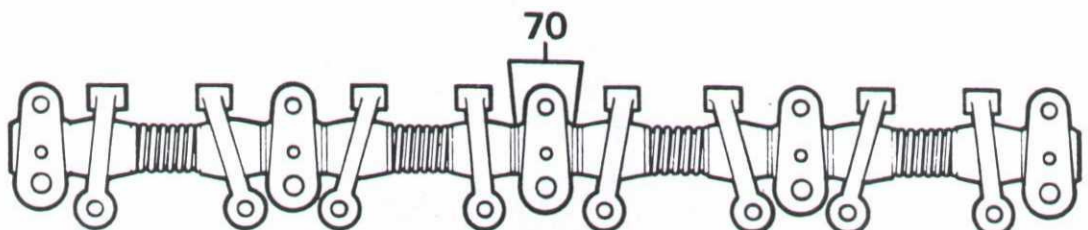
70 Using new spacers and springs, assemble the rockers and brackets to the shaft as illustrated, ensuring that the rockers move freely on the shaft.

Note: Double spacers are fitted each side of the centre pad.

71 Fit the tappet adjustment screws and lock nuts to the rockers.

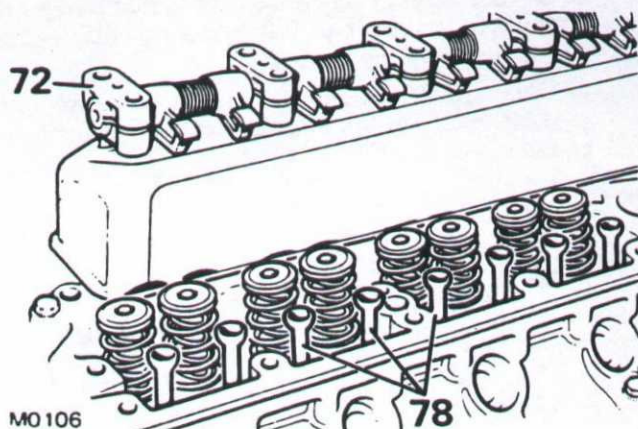


M0104



M0105

72 Invert the rocker assembly and locate it on the rocker cover to prevent it falling apart.



Fit the cylinder head and rocker shaft assembly

73 Clean the cylinder head and cylinder block mating faces. Position a new cylinder head gasket on the cylinder block with the word "Diesel" uppermost.

74 Fit the two engine lifting brackets to the cylinder head.

75 Lower the cylinder head onto the cylinder block using the two long bolts to facilitate accurate positioning of the head.

76 Fit the cylinder head retaining bolts except those also used to secure the rocker shaft and leave finger tight.

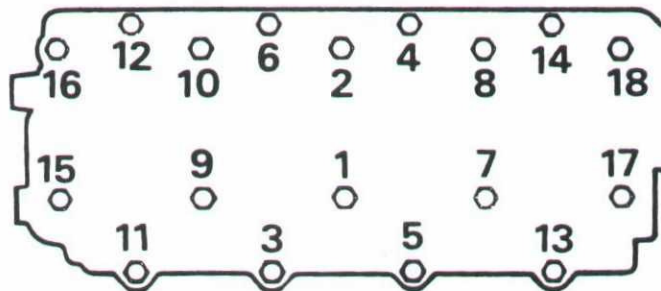
77 Renew any push rods that are bent or have worn or scored ball or socket ends.

78 Insert the push rods ensuring that the ball end locates properly in the spherical seat in the tappet.

79 Whilst holding the rocker shaft assembly together, lower it into position making sure that the hollow dowels locate properly in the cylinder head. Also ensure that the rocker adjusting screw ball end locates in the push rods.

80 Fit the rocker shaft large retaining bolts and leave finger tight.

81 Tighten the cylinder head retaining bolts, evenly, to the specified torque in the order as shown in the illustration.



MO107

82 Fit and tighten the rocker shaft, small bolts to the specified torque.

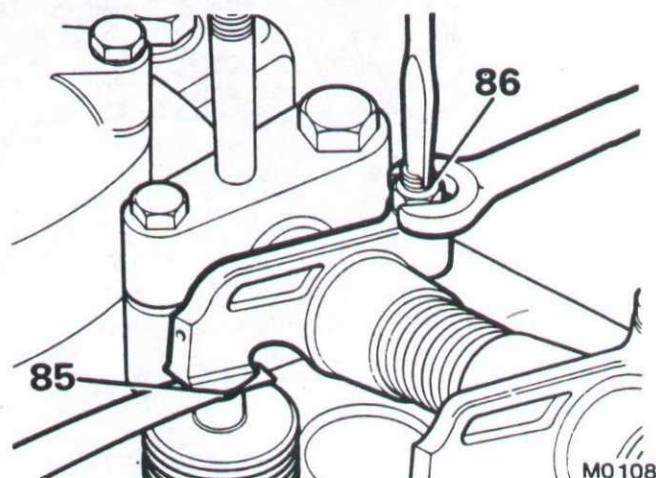
Adjust tappet clearances

83 If the crankshaft is rotated with excessive valve clearances it is possible that the push rods may become dislodged from the tappet seating and fracture the tappet slide. To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust the clearances.

84 Turn the engine over until number eight valve (counting from the front of the engine) is fully open.

85 Using a 0,25mm (0.010in) feeler gauge check the clearance between the valve tip and rocker pad of number one valve.

86 Adjust the clearance by slackening the lock nut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the lock nut.



87 Continue to check and adjust the remaining tappets in the following order.

Set N° 3 tappet with N° 6 valve fully open

Set N° 5 tappet with N° 4 valve fully open

Set N° 2 tappet with N° 7 valve fully open

Set N° 8 tappet with N° 1 valve fully open

Set N° 6 tappet with N° 3 valve fully open

Set N° 4 tappet with N° 5 valve fully open

Set N° 7 tappet with N° 2 valve fully open

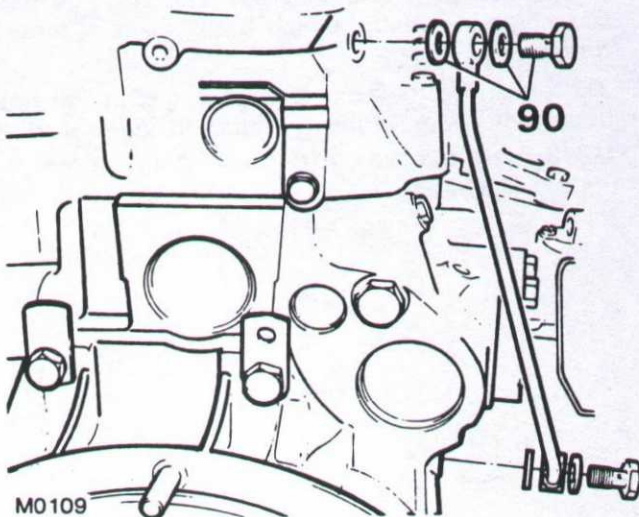
Fit the rocker cover

88 Using a new gasket, fit the rocker cover and secure with the three domed nuts and washers. Tighten evenly to the specified torque. **Do not** overtighten.

Fit the cylinder head oil feed pipe

89 Connect the oil feed pipe, for lubrication of the rocker shaft assembly, to the cylinder head.

90 Secure with the two banjo bolts and four joint washers.



Fit the thermostat and housing assembly

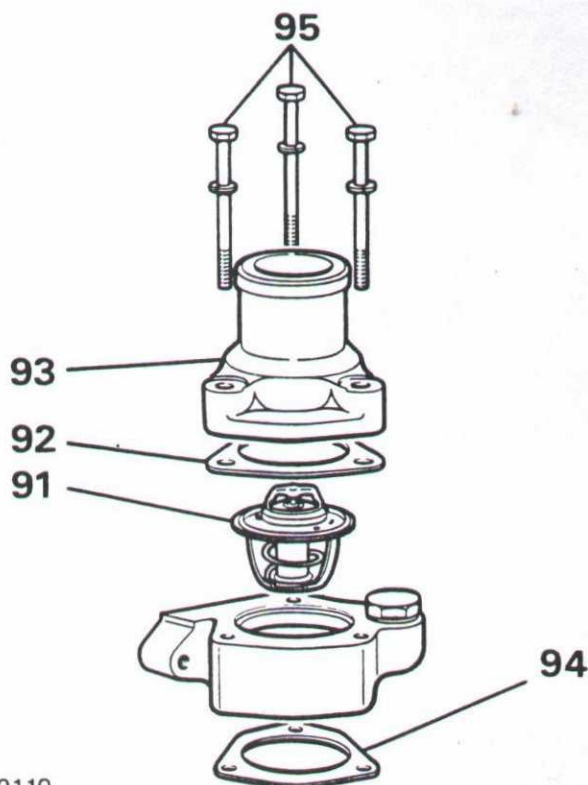
91 Insert the thermostat into its housing.

92 Place a new joint washer in position on the thermostat housing top face.

93 Fit the thermostat cover to the housing.

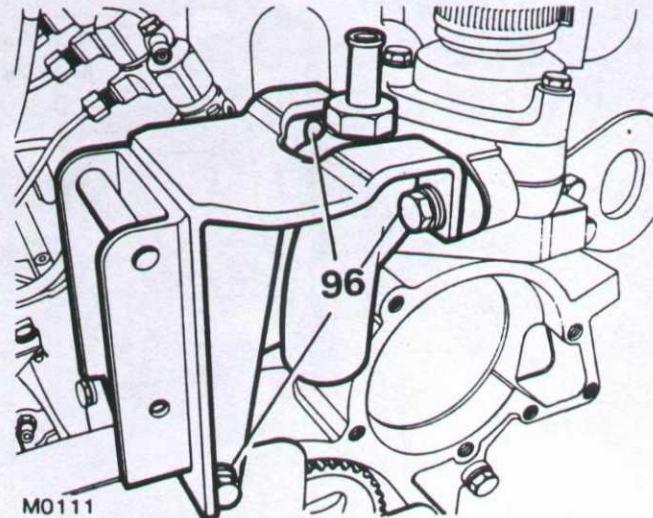
94 Place a new joint washer on the cylinder head.

95 Fit the complete assembly to the cylinder head using the three bolts and washers. Evenly tighten the bolts to the specified torque.



96 Locate the water bypass elbow with a new joint washer to the thermostat housing, also the power steering pump mounting bracket and secure with three bolts.

97 Refit the bypass hose and secure with the "jubilee" clip.



Clean, test and fit the heater plugs

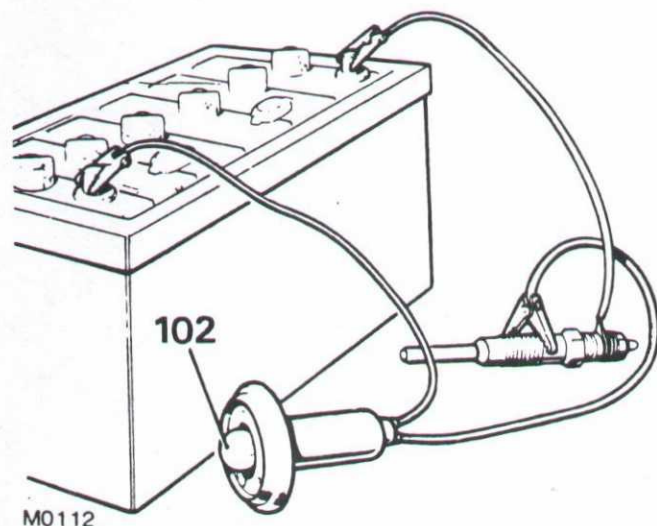
98 Remove the knurled terminal nuts from the heater plugs.

99 Detach the heater plug and washers.

100 Remove carbon from base of heater plugs to avoid the possibility of short circuiting of the element. **Do not sand blast.**

101 Examine the element for signs of fracture and deterioration and the seating for scores. Plugs with fractures or doubtful elements must be renewed. Where scoring of the seating may impair the seating, the plug should be renewed.

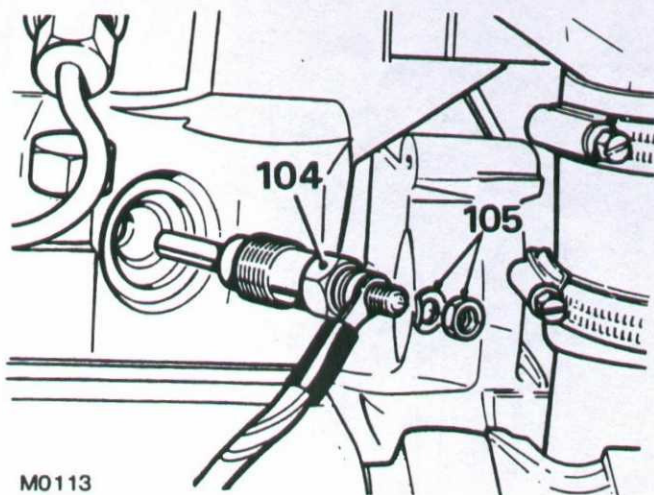
102 Test the plug internal circuit for continuity by connecting it in circuit with a 12 volt side lamp bulb and a 12 volt supply. If the bulb does not light an open circuit is indicated and the heater plug must be renewed.



103 Ensure that the terminals are clean and that the thread at the base of the plug is free from carbon.

104 Fit the heater plugs to the engine. Do not overtighten.

105 Fit the heater plug leads, washers and nuts.



M0113

Overhaul, test and refit fuel injectors

Service tools required

217483 or
18G109 or Injector nozzle testing and setting kit
Diesel tune III

278182 or
18G109B or Adaptor Pintaux Injector
Diesel tune 102

278181 or
18G109E Injector nozzle flushing tool

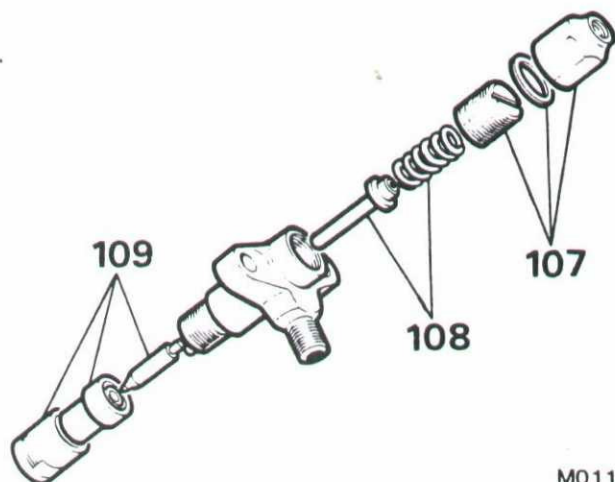
605002 or
18G1487 or Injector nozzle cleaning kit
FT9101

106 Disconnect the injectors from the fuel spill rail.

107 Remove the combined locknut and end cap, withdraw the sealing washer.

108 Unscrew the pressure adjusting screw and withdraw the pressure spring and valve spindle.

109 Unscrew the capnut and withdraw the nozzle valve and body.



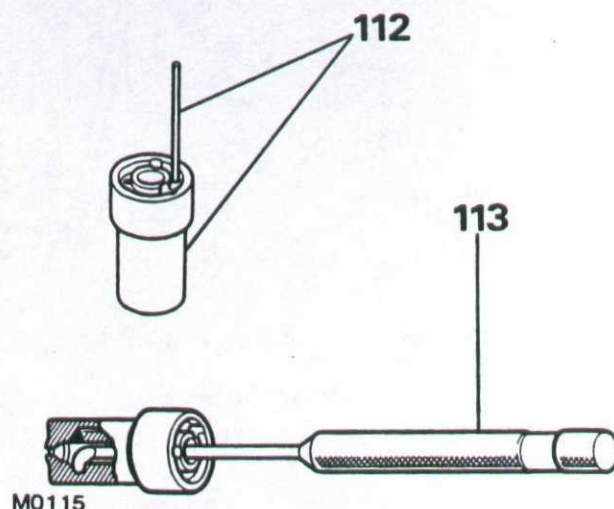
M0114

110 Soak the component parts of the assembly in Shell Calibration Fluid to loosen carbon deposits, but do not allow parts of any one assembly to be interchanged with those of another.

111 Brush away all external carbon deposits from component parts with a brass wire brush and return them to the fluid bath. Particular care must be exercised when cleaning the pintle and seat of nozzle valve to avoid scratching or scoring, which could result in spray distortion.

112 Clean the three oil feed passages in the nozzle body with a wire or drill of 1,5mm (0.062in) diameter.

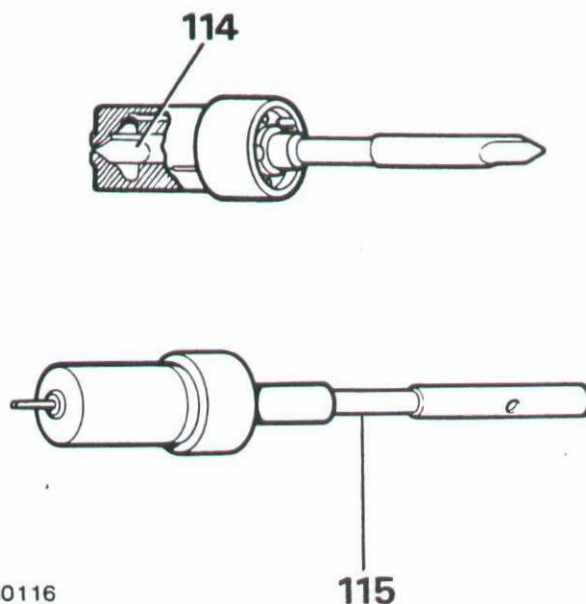
113 Remove the carbon from the annular recess with the tool illustrated.



M0115

114 Remove the carbon from the valve seat, using the appropriate tool with a rotary motion.

115 Select the appropriate size probe from the pocket of the cleaning kit and secure it in the pintle hole cleaner. Insert the probe into the bore of the nozzle valve body and allow the end to extend through the main fuel outlet, then turn in a rotary manner to remove the carbon.



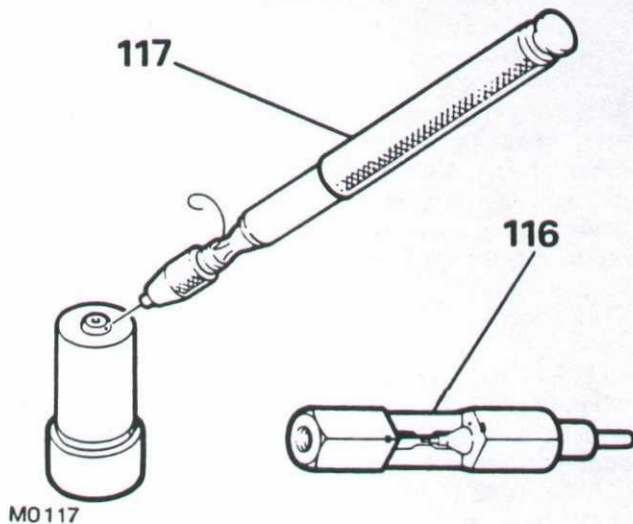
M0116

115

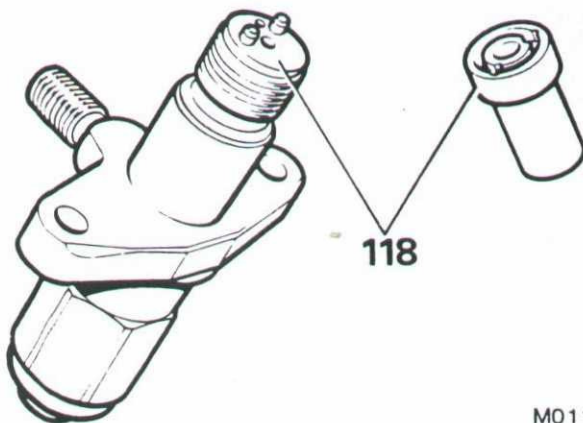
116 Carbon may be removed from the nozzle valve cone by inserting the valve into the tool illustrated and then rotating it alternately in a clockwise then anti-clockwise manner whilst pressing the valve inward. If the nozzle is blued or the seating has a dull circumferential ring indicating pitting or wear, the nozzle body and valve should be returned to a CAV Service Agent and replacement parts fitted. **Do not** attempt to lap nozzle valve to body. This process requires special equipment and training.

117 Clean the auxiliary spray hole using the special tool fitted with probing wire 0,20mm (0.008in) diameter.

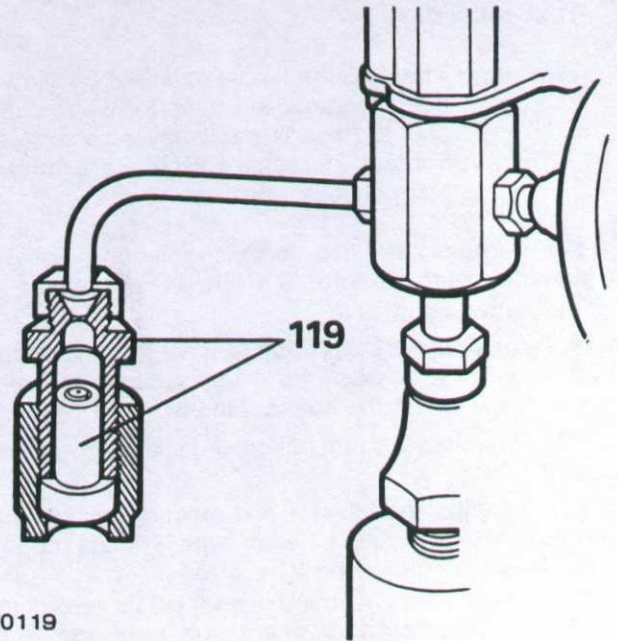
Note: Allow 1,5mm (0.062in) only to extend from the chuck and thus minimise the possibility of the wire bending or breaking while probing. Great care must be taken to prevent breakage of the wire in the hole.



118 Examine the pressure faces of the nozzle body and nozzle holder to ascertain their freedom from scoring and scratches. These surfaces must be perfectly smooth.



119 With the flushing tool secured to the nozzle testing outfit, fit the nozzle body (spray holes uppermost) to the flushing tool and pump test oil through vigorously. This flushing process is necessary for the removal of any tiny carbon particles which may have become lodged in the body after scraping and probing.



M0119

120 Fit the nozzle valve to nozzle and chest for freedom of movement.

121 Immerse the nozzle body and valve in the fluid bath and assembly whilst submerged.

122 Wash the remaining components and assemble the injector in the sequence illustrated during the dismantling.

123 Set the injection nozzle assembly in accordance with the following test procedure:

124 To check a nozzle assembly and to ensure that it is functioning correctly, a setting outfit, as illustrated, is essential. A bench covered with linoleum or non-ferrous sheet metal is most suitable for mounting the equipment; such a surface facilitates the cleanliness essential when checking nozzle parts. Between the bench and setting equipment a tray, also of non-ferrous metal, should be positioned to prevent spilt fuel spreading. Small containers may be attached to the bench to isolate the component parts of each assembly. These parts are carefully mated by the manufacturers and must **not** be interchanged. Lastly, a small bath with a cover, containing Shell Calibration Fluid for washing components, should be kept conveniently near.

125 The efficient operation of the injection nozzle assembly is dependent on four main conditions, as follows:

- i The nozzle valve must open at 135 Atmospheres.
- ii The rate of back leakage must be within 150 to 100 Atmospheres.
- iii Seat tightness must be sufficient to prevent leakage.
- iv Spray form must compare favourably with the illustrations.

126 Pressure setting, back leakage and seat tightness tests may be made by coupling the injection nozzle and holder assembly direct to the pressure feed pipe on the setting equipment, but an adaptor must be fitted between the pipe and injection nozzle and holder assembly when testing spray form. This adaptor, (CAV Y7044872) increases the pressure of fuel to injection nozzle and holder assembly sufficiently for the main and auxiliary spray form to be determined.

Test procedure

Warning: The injection nozzle must not be allowed to point towards the operator when spraying and the hands must never be allowed to contact the spray which has a force that can penetrate the flesh.

127 Remove the cap from the setting equipment container and fill with 0,8 litre (1.5 pints) of Shell Calibration Fluid.

128 Air vent the system by removing the vent screw, allow oil to flow freely for a few seconds and replace the screw whilst the flow continues.

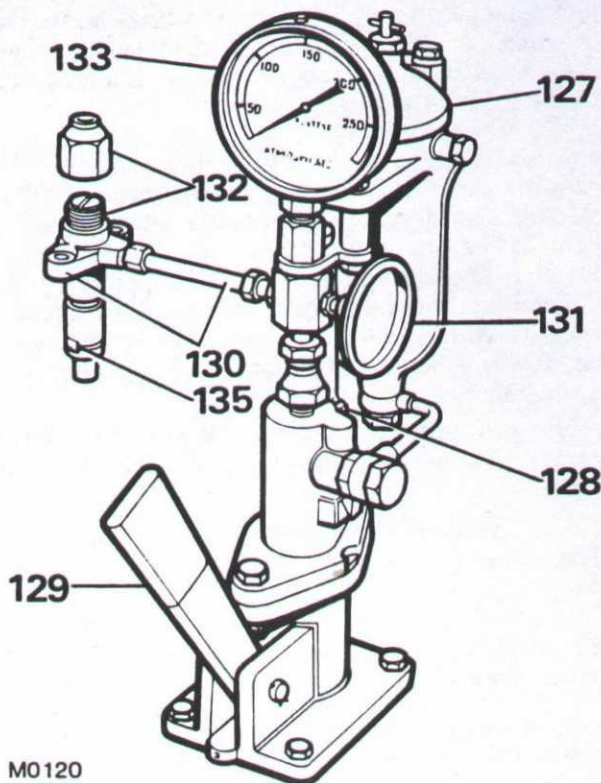
129 Operate the pump handle until fluid flows from the pipe.

130 Connect the injector and holder assembly to the pressure feed pipe with the nozzle pointing downwards. The length and bore of this pipe is important and replacement pipes must be approximately 75mm (2.9in) between the union nuts and of 3mm (0.118in) bore.

131 Close the check valve to keep the pressure gauge out of circuit and smartly operate the hand lever several times to expel all air from the system.

Leak back test

132 Adjustment is made by removing the combined end cap and lock nut from the nozzle holder, and turning the adjusting screw clockwise to increase and anti-clockwise to decrease the opening pressure.



M0120

133 Fit assembled injector to nozzle setting equipment and adjust to open at 160 to 170 atmospheres then pump up to just below this figure, release the handle to allow the needle of the gauge to fall naturally. Time the pressure drop from 150 atmospheres down to 100 atmospheres.

134 This should be not less than 5 seconds for the original nozzle and not less than 7 seconds if a new one is to be fitted, and not more than 36 seconds for either with oil temperature 10° to 21°C (50° to 70°F).

135 Check externally the top and bottom of nozzle cap nut and pressure pipe union nuts for signs of oil leakage. If leakage occurs at the nozzle cap nut, remove the nut and examine the pressure faces of nozzle holders and nozzle body (see item 1) for presence of foreign matter or surface scoring, before tightening further. A leakproof nozzle assembly with an excessive rate of pressure drop indicates a worn nozzle valve; the nozzle valve and nozzle body should be renewed.

Pressure setting

136 The selected operational opening pressures of the nozzle valve is 135 atmospheres. Readjust to this setting in the manner described in item 132.

Seal tightness

137 Wipe the bottom face of the injection nozzle dry and raise the pressure in the system to 125 atmospheres. A slight dampness on the bottom face is permissible, but blob formation or dripping indicates a badly seating valve in which case the assembly should be dismantled for further examination.

Spray form

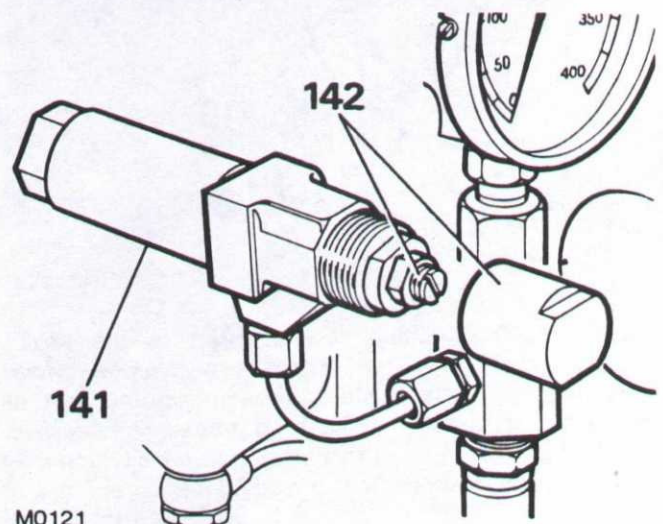
138 Fuel delivery to the injection nozzle assembly when testing spray form must be characteristically similar to fuel delivery under normal operating conditions and to effect these conditions an adaptor (CAV Y7044872) must be fitted between the injection nozzle assembly and the pressure pipe.

139 The adaptor differs mainly in the cap nut and nozzle valve from the ordinary type of injection nozzle and holder assembly as fitted to the engine; the nozzle valve has no pintle.

140 The cap nut is extended, bored and threaded to receive nozzle for testing.

141 Connect the adaptor assembly to the pressure pipe.

142 Remove the end cap and adjust the opening pressure of the nozzle valve to 220 atmospheres.

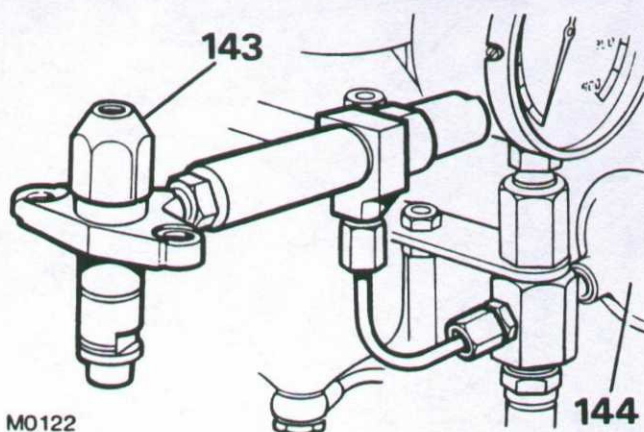


M0121

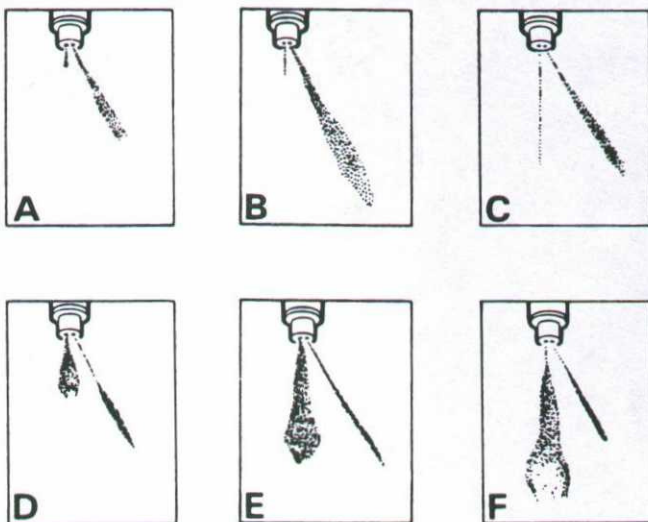
143 Screw the injection nozzle and holder assembly to be tested, into the adaptor.

144 With the check valve closed, operate the handle smartly to expel air from the system. The auxiliary spray form may be tested at 60 strokes per minute and the main spray at 140. Spray development from starting to running speed is illustrated, this illustration should be referred to and compared with the spray form of nozzles under test. Spray formation should be well formed and free from splits or distortion. A slight centre "core" can be disregarded. Observe the main spray through 360° to ensure a uniform spray.

145 When satisfactory, fit the combined locknut and end cap, connect the injectors to the fuel spill rail.



M0122



M0123

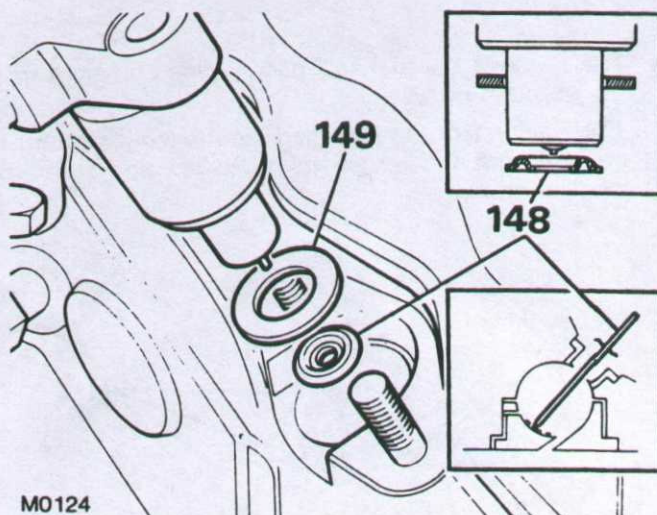
Fitting the fuel injectors

146 The steel sealing washer fitted below the injector nozzle is to ensure that the combustion does not take place around the nozzle body and cause it to overheat. A washer which has been used more than once, or an incorrectly fitted washer may cause the nozzle to overheat and result in that cylinder misfiring.

147 Ensure that the new washers are separated from each other and are clean.

148 Use a length of thin welding wire to guide one washer on into each port with the domed side toward the injector as illustrated. Ensure that only one washer is fitted to each port.

149 Lightly grease the copper washer into position on each injector before fitting to the cylinder head.

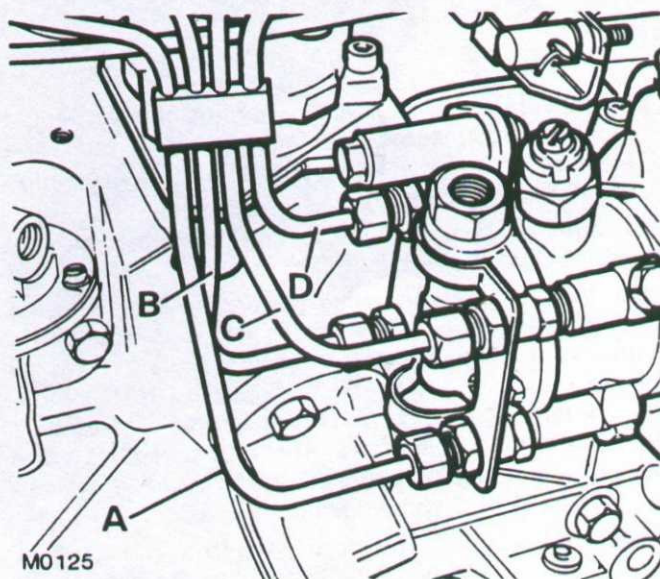


M0124

150 Fit the injector and evenly tighten the retaining nuts to the specified torque. Uneven or overtightening of the injector nozzle could distort the nozzle and cause misfiring when normal running temperature is reached.

151 Reconnect the injector pipes but do not over tighten the union nuts. Counting from the front of the engine connect the pipes as follows:

- A. To number 1 injector B. To number 2 injector
C. To number 3 injector D. To number 4 injector



M0125

Checking nozzle assemblies whilst engine is in situ

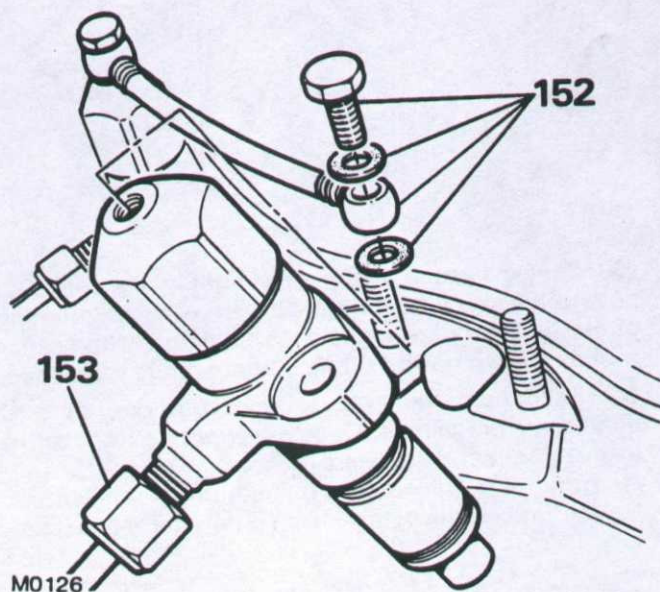
Warning: Do not allow the fuel spray to contact the person otherwise injury may result from skin penetration.

When an injection nozzle is considered to be the cause of irregular running and loss of power, a quick check may be made by loosening the fuel feed pipe union nut on each nozzle in turn whilst the engine is idling at approximately 1,000 rev/min. If the injection nozzle assembly being checked has been operating properly, there will be a distinct reduction in engine speed accompanied by obvious roughness, but a faulty injection nozzle may make little or no difference to the engine note when its fuel feed pipe is loosened.

Spray check

152 Remove the fuel spill gallery pipe complete from the injection nozzles.

153 Disconnect the fuel feed pipe (injection pump to nozzle) from the nozzle to be tested and from the injection pump.



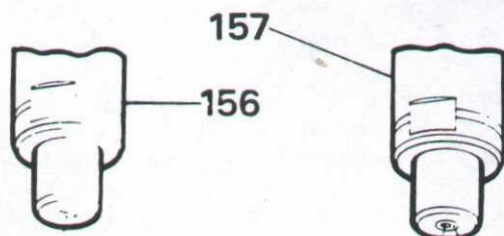
154 Release the fixings and withdraw the suspected injection nozzle assembly; reconnect the pipe and nozzle assembly to the injection pump in a position whereby fuel ejection may be observed.

155 Loosen the union nuts securing the remaining fuel pipes to injection nozzles.

156 Whilst the starter turns the engine over, observe the manner in which fuel issues from the nozzle and compare the spray form with the correct form as illustrated.

Very little fuel should issue from the main spray hole with the engine turning over at starter speed but a fine spray comparable to that illustrated should be ejected from the auxiliary spray hole.

157 If the ejected fuel is more in the form of a liquid jet issues from the main pintle hole, then the nozzle and holder assembly should be removed for overhaul and a replacement unit fitted.



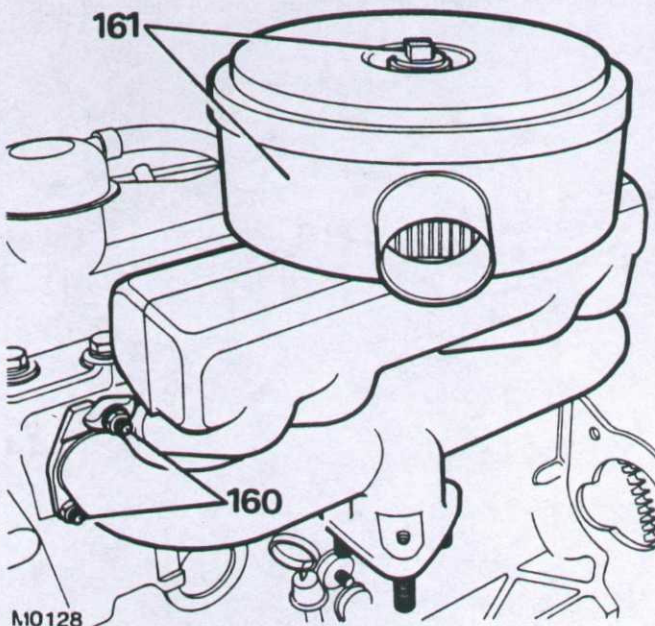
158 Refit the injectors and tighten the union nuts.

159 Connect the spill gallery pipe with the bolt and two washers.

Fit the air intake and exhaust manifolds

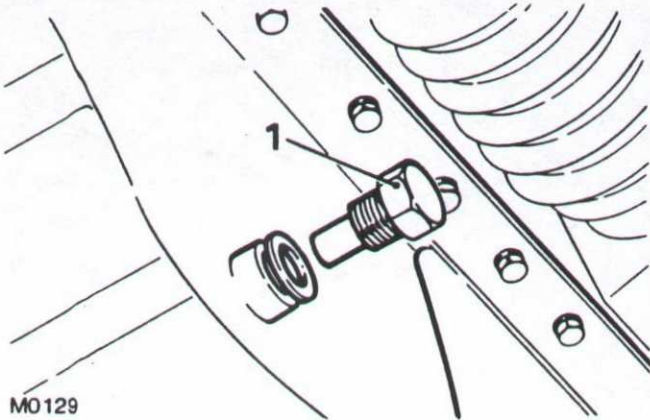
160 Using a new gasket fit the manifolds and secure with the retaining nuts and clamps. Evenly tighten to the specified torque.

161 Fit the air cleaner and seals and secure with the square headed nut to the top of the inlet manifold.



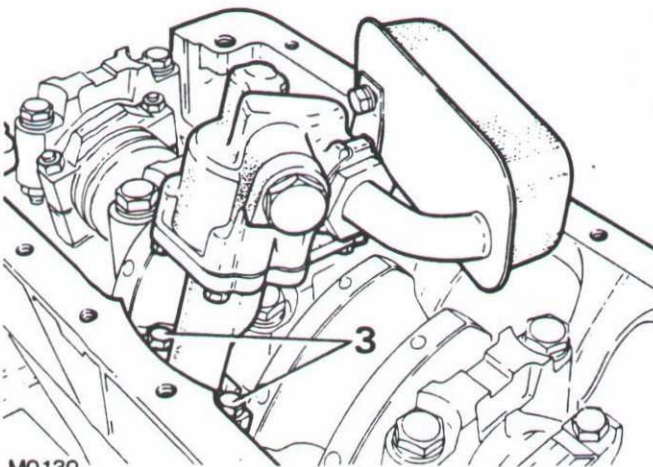
E. REMOVE AND OVERHAUL OIL PUMP

- 1 Remove the drain plug and drain the oil from the engine and sump into a suitable container.
- 2 Undo the bolts and washers and remove the sump and joint washer.



M0129

- 3 Bend back the lock washers and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.

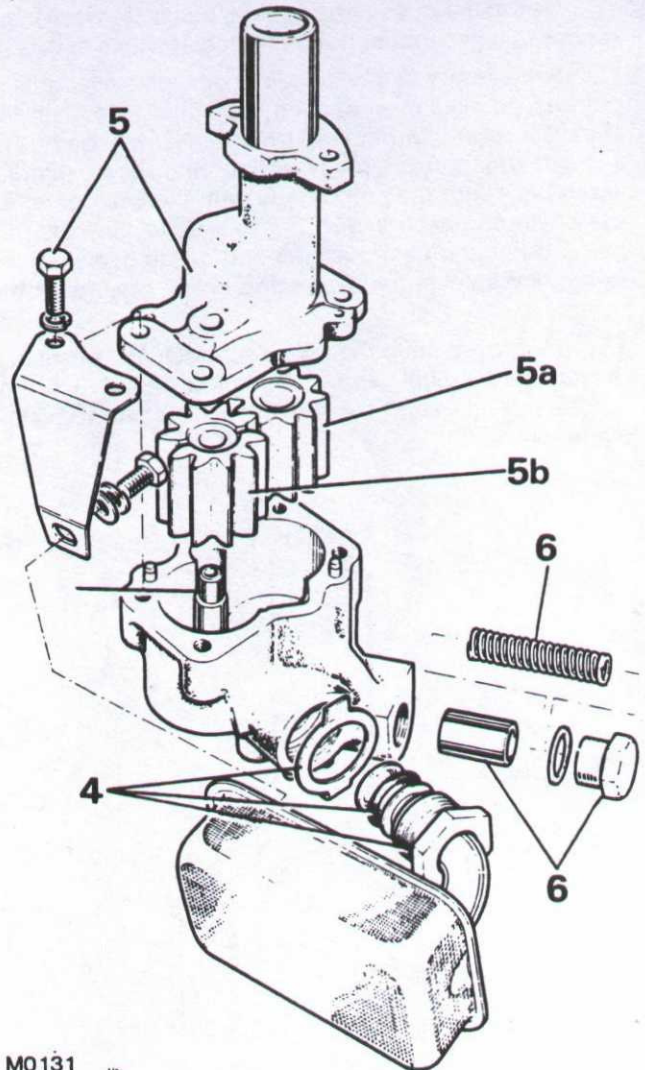


M0130

Dismantling the oil pump

- 4 Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
- 5 Remove the four bolts and washers and lift off the oil pump cover and lift out the driver and idler gears.
a) driver gear b) idler gear
- 6 Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring, plunger and ball.

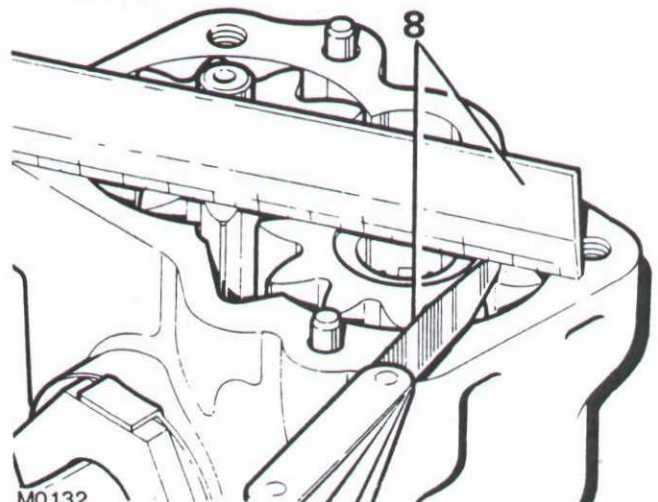
Note: Later pumps have ten toothed gears and no relief valve ball.



M0131

Overhaul the oil pump

- 7 Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:
- 8 Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated and using a feeler gauge, measure the clearance between the body and gears. The correct clearances are as follows.
- 9 Idler gear 0,07 to 0,15mm (0.003 to 0.006in).
- 10 Driver gear 0,05 to 0,12mm (0.002 to 0.005in).

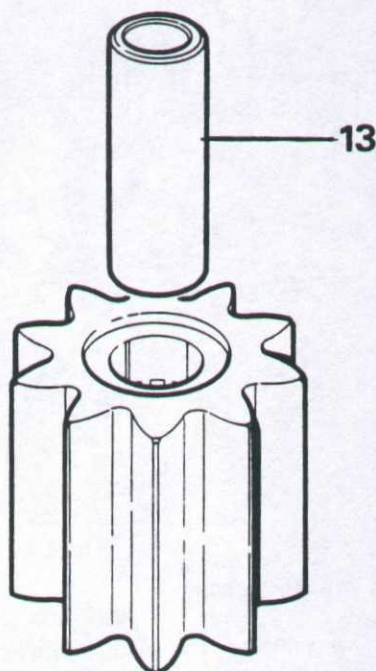


M0132

11 Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.

12 If necessary renew the idler gear spindle by drilling out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with the four bolts. Support the pump body and peer over the end of the new spindle. Remove the cover and gears and check security of the spindle.

13 If worn, remove the idler gear bush and press in a replacement. Drill the lubrication hole 3,17mm (0.125in) and ream the bush to 12,7mm (0.500in) diameter.

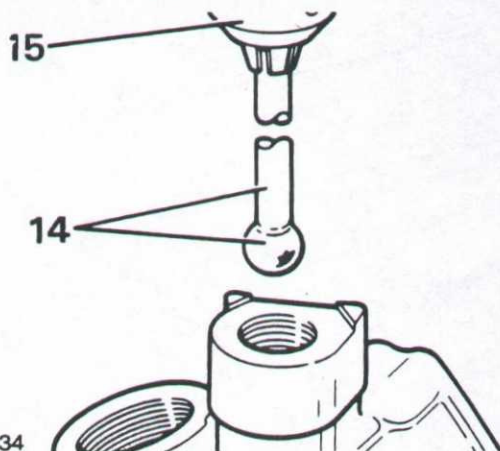


M0133

14 A scored ball valve seat can be restored by using a locally made lapping tool by silver soldering a new ball (part number 3748) onto a length of suitable tube.

15 Install the tube in a drill and lap-in using coarse grinder paste. Finally hand-lap the seat with fine paste using the same diabalo method as for lapping valves.

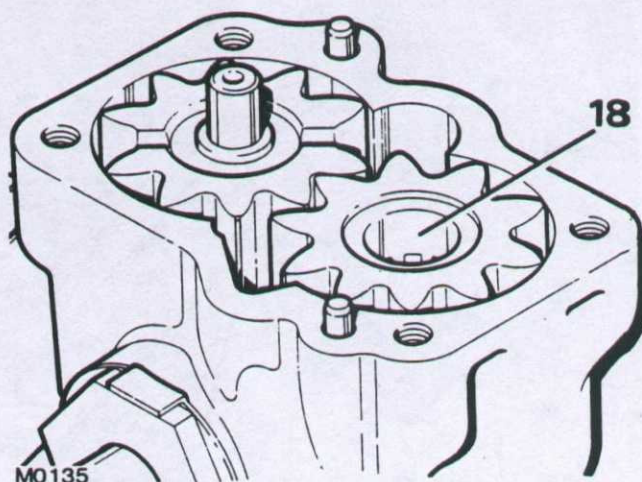
16 Thoroughly wash the pump body to remove all traces of grinding paste.



M0134

17 Fit the idler gear to the spindle.

18 Fit the driver gear with plain part of the bore uppermost. See illustration after instruction 10



19 Smear the joint face of the body with jointing compound and fit the cover over the dowels and the strainer bracket and secure with the four bolts and spring washers.

20 Hold relief valve bore vertically and insert the ball followed by the plunger with the ball seat end first. Fit the spring, sealing washer and plug.

21 Fit the oil strainer sealing ring to the pump body followed by the lock washer and strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab.

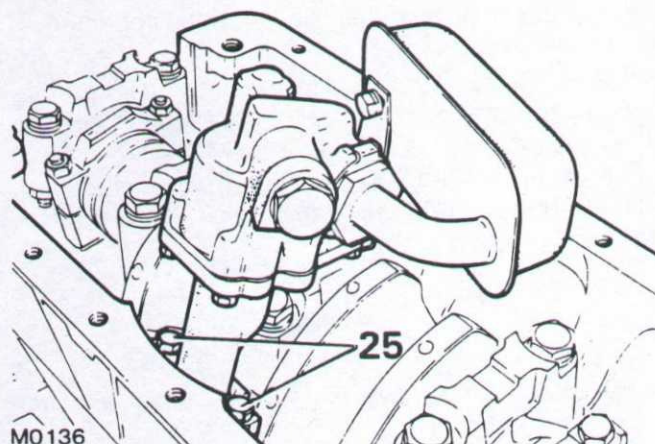
22 Secure the lower end of the bracket to the strainer with the single bolt, spring and plain washer.

Fit the oil pump and sump

23 Fit the longer splined end of the drive shaft into the oil pump.

24 Fit the oil pump and drive shaft to the crankcase, whilst revolving the shaft as necessary to engage the splines of the skew gear.

25 Using new lock washers, secure the pump to the crankcase tightening the bolts to the specified torque and bend over the lock tabs.



M0136

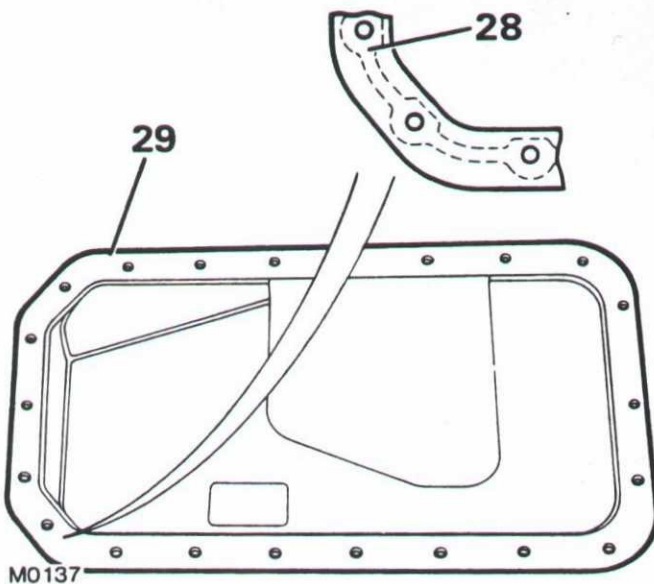
26 If necessary adjust the position of the strainer so that it is parallel to the sump baffle plate.

27 Clean the sump and cylinder block mating faces.

28 Apply a bead of RTV HYLOSILL 102 black approximately 7mm (0.27in) wide to the cylinder block or sump mating face.

29 Fit the sump within 30 minutes of applying sealant and secure with the bolts and tighten evenly to the specified torque.

Note: RTV Liquid Sealant is available under part number RTC 3254 from Land Rover Ltd.



F. STRIP AND OVERHAUL OF ENGINE BLOCK

Special tools required

270304 Cork seal guide

530101A Valve guide remover

1 Remove the flywheel and clutch. (Manual models only) or the flywheel and adaptor plate (Automatic models only) as stated in section B.

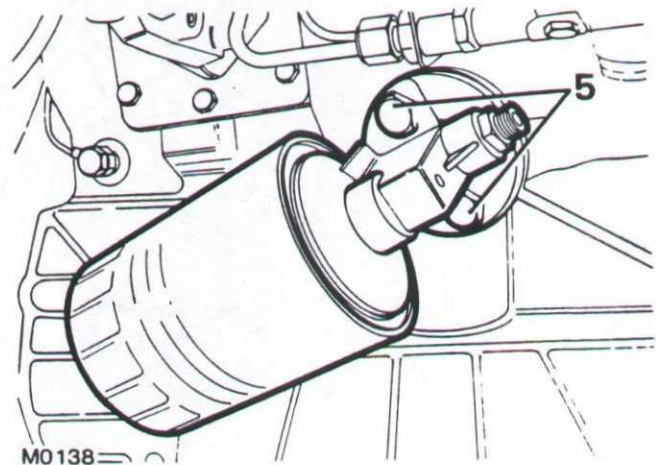
2 Remove the timing belt, pulleys and timing case as stated in section C.

3 Remove the cylinder head as stated in section D.

4 Remove the sump and oil pump as stated in section E.

Note: After the four preceding operations all that remains is the engine block and its associated parts.

5 Remove the two bolts and remove the oil filter assembly complete, unscrew the filter element and discard.



6 Undo the six bolts and withdraw the rear side plate complete with fuel pump (and bracket – Automatic models only).

7 Remove the dipstick, undo the engine block drain plug, allow any excess water to drain from the block.

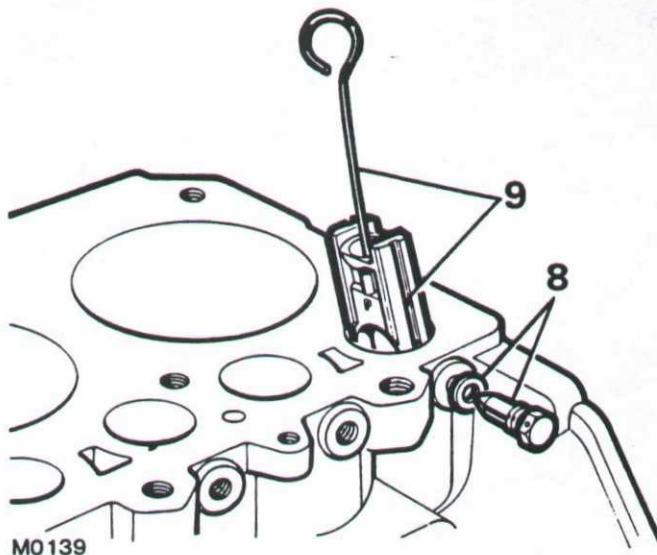
Remove the tappets, rollers and guides

8 Remove the eight tappet guide locating bolts from the right hand side of the engine.

Caution: Do not remove the tappet guides before the rollers otherwise the rollers may fall behind the camshaft.

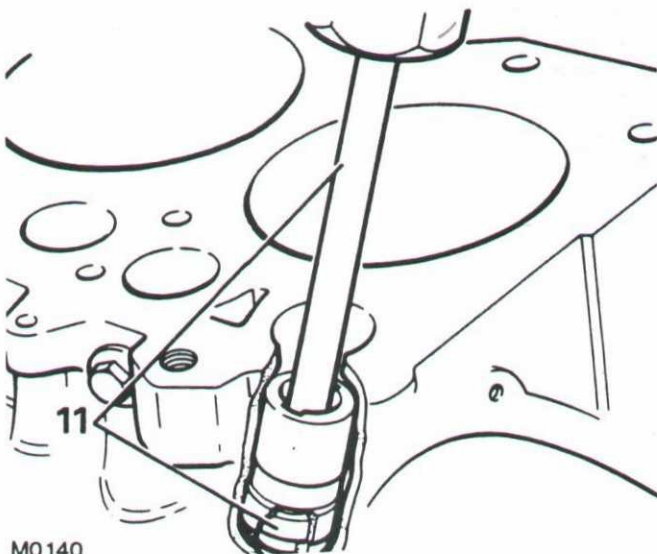
9 Using long nosed pliers or a suitable bent length of wire lift out the tappet slides and identify them with their respective guides for possible refitting.

10 Lift out the tappet rollers and mark the side facing the front of the engine for possible reassembly.



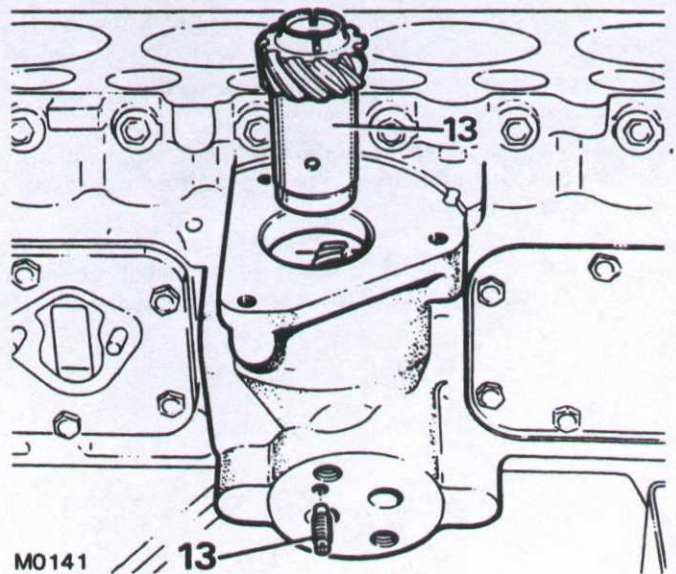
11 Lift out the tappet guides and retain with their respective slides and rollers. If the guides are difficult to remove use special tool 530101A.

12 Carefully examine all parts and discard any that are worn or damaged.



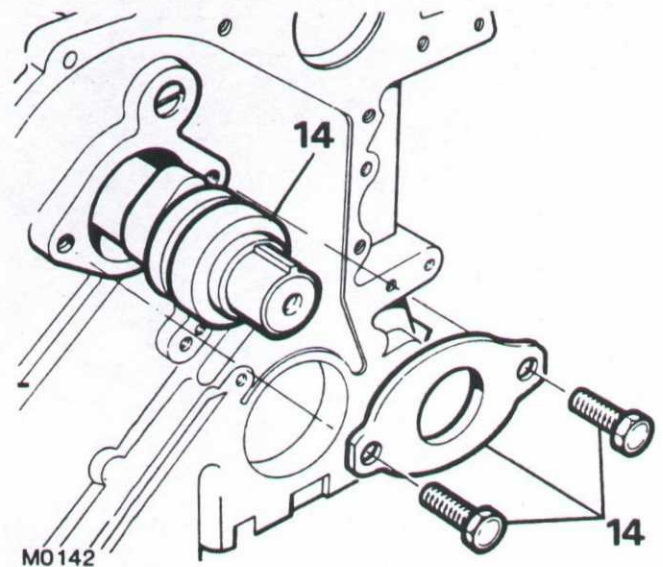
Remove the camshaft

13 Remove the skew gear bush retaining screw and lift out the skew gear bush assembly.



14 Since the camshaft sprocket has already been removed, remove the two bolts and the camshaft thrust plate and carefully withdraw the camshaft.

15 Inspect the camshaft and discard if any of the following visual defects are evident:-
Scored, worn, pitted or chipped cams. Worn, corroded and discoloured journals. Worn and chipped gear teeth.

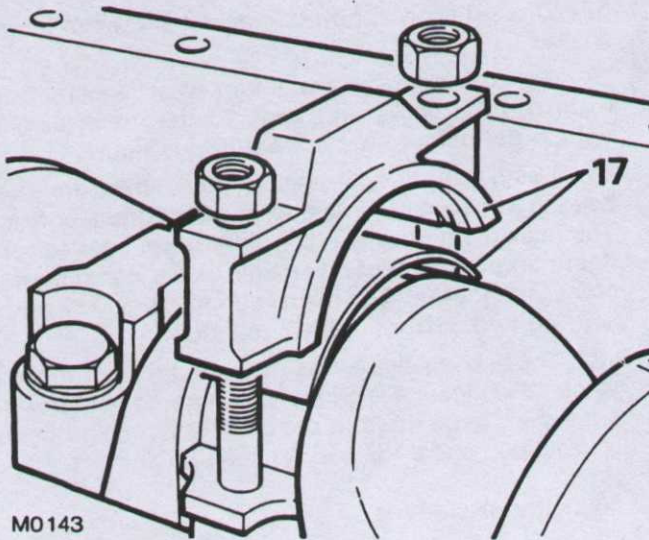


Remove the connecting rods and pistons

16 During the following instructions it is important that all components are kept in related sets and the pistons are identified with their respective bores.

17 Turn the crankshaft to bring the connecting rod caps to an accessible position and remove each cap and lower shells in turn. Note that the connecting rod caps are numbered one to four.

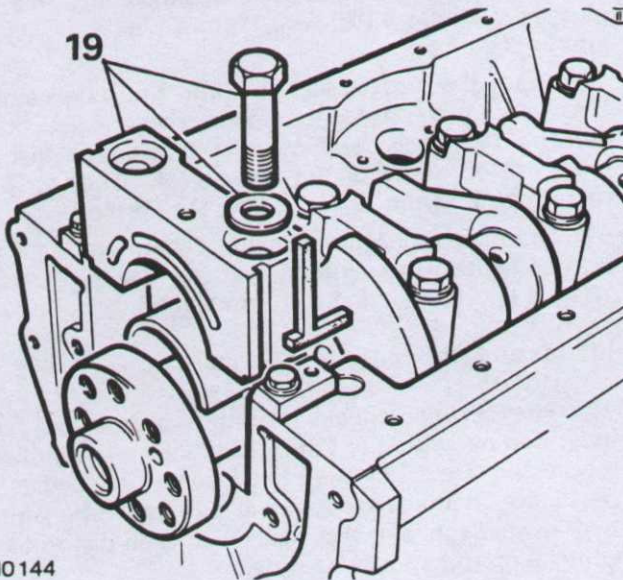
18 Push each piston assembly up the bore and withdraw from the cylinder block. Assemble the caps and shells to the connecting rods and place to one side for inspection with the cylinder block at a later stage.



M0143

Remove and inspect crankshaft

19 Undo the bolts and washers and remove the main bearing caps and shells and lift out the crankshaft. Collect the bearing shells from the bearing saddles and the thrush washers from the centre saddle.



M0144

20 Degrease the crankshaft and clear out the oilways, which can become clogged after long service.

21 Examine visually, the crankpins and main bearing journals for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth the continuing with more detailed examination.

22 With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows.

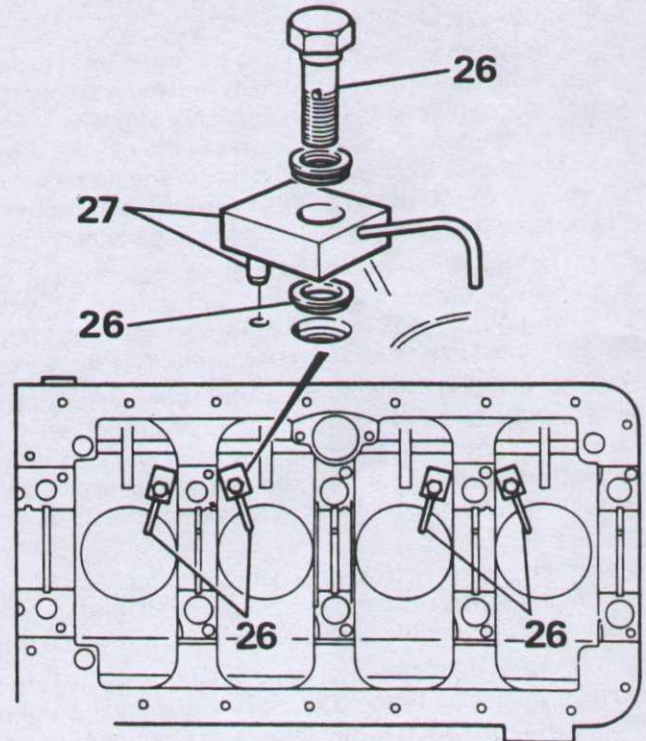
23 Ovality – Take two readings at right angles to each other at various intervals. The maximum ovality must not exceed 0,040mm (0.0015in)

24 Taper – Take two readings parallel to each other at both ends of the main bearings journal and crankpin. The maximum permissible taper must not exceed 0,025mm (0.001in).

25 To check for straightness, support the front and rear main bearing journals in "V" blocks and position a dial indicator to check the run out at the centre main bearing journal. Run out must not exceed 0,076mm (0.003in) taking into account any ovality in the centre journal. The overall allowable wear limit should not exceed 0,114mm (0.0045in) for main bearing journal and 0,088mm (0.0035in) for crankpins. A crankshaft worn beyond the limits of maximum taper, ovality and overall wear must be renewed. Regrinding of the journals is not permissible.

Removing the oil jet tubes

26 Undo the jet retaining bolts and remove the four oil jet tubes and washers.



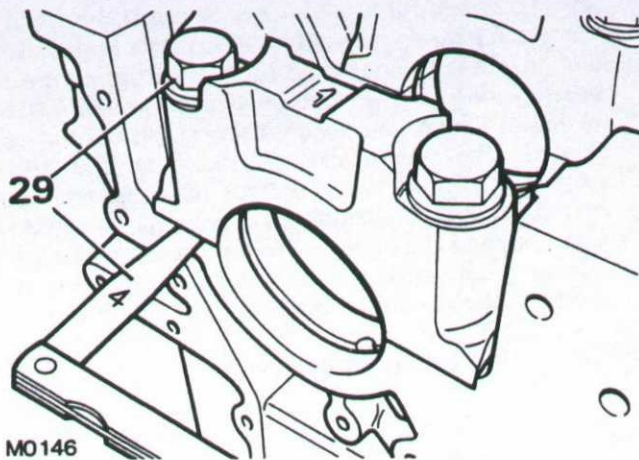
M0145

27 Clean the jet tubes ensuring that there is no blockage which will prevent the pistons and bores from being lubricated.

28 Remove the alternator mounting bracket from base of block.

Examine and overhaul the cylinder block

29 Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check the main bearing caps and saddles for distortion, fit the main bearing cap, without bearing shells, and tighten to the specified torque. Slacken and remove the bolt on one side of each bearing cap and check with a feeler gauge that no clearance exists at the joint face between the cap and saddle.



Inspect the cylinder bores

30 Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper.

31 Check the ovality of each bore by taking measurements at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50mm (1.97in) up from the bottom of the bore so that the overall ovality may be determined.

32 The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.

33 To establish maximum overall bore wear, take measurements at as many points possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

Maximum permissible ovality 0,127mm (0.005in)

Maximum permissible taper 0,254mm (0.010in)

Maximum permissible overall wear 0,177mm (0.007in)

34 If the figures stated previously are exceeded, the cylinders must be rebored or sleeved depending upon the general condition of the bores and amount of wear.

35 Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores afterwards to remove all traces of abrasive material.

Inspect the camshaft bearings

36 Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0,0508mm (0.002in) or, in any event, if they are scored or pitted. This work should only be entrusted to line boring specialists.

34

Check crankcase main bearings

37 Discard scored, pitted, cracked and worn bearing shells.

38 To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.

39 Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal. The main bearing running clearance is 0,018 to 0,061mm (0.0007 to 0.0024in).

40 The bearing clearances may also be determined by using "Plastigauge". Since this method requires the crankshaft to be fitted to the crankcase, the procedure is described under the sub section "Engine assembly".

Fit cylinder sleeves

41 Cylinder bores that cannot be rebored can be restored by fitting sleeves to enable standard size pistons to be fitted. Sleeving one cylinder only will distort the adjacent bore so sleeving must be carried out in pairs, i.e. 1 and 2 or 3 and 4.

42 Machine the cylinder bores to accept the sleeves to $94,425 + 0,012\text{mm}$ ($3.7175 + 0.0005\text{in}$). This will give the sleeve a 0,076 to 0,114mm (0.003 to 0.0045) interference fit.

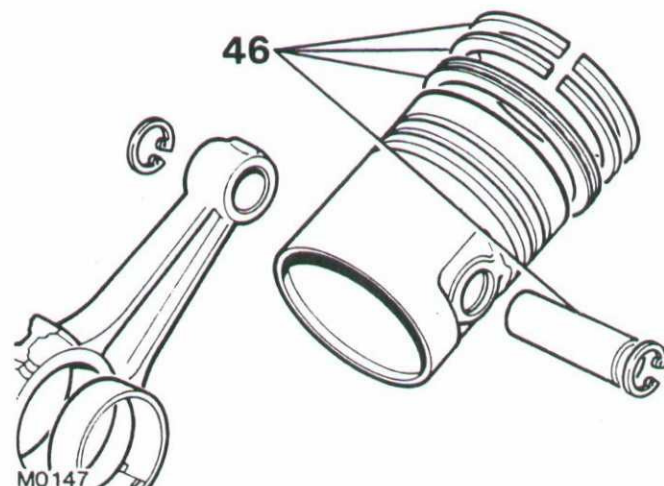
43 Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,54mm (0.1in) below the surface.

44 Bore and hone the sleeves to accommodate the pistons with the required clearances, see sub section "Piston and connecting rod inspection".

Piston and connecting rod inspection

45 The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebore and sleeved cylinder blocks. Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting rod should be noted.

46 Remove the piston rings and gudgeon pin from each piston and detach the connecting rod.



47 Original pistons: Decarbonise and degrease all components and carry out a visual examination of the pistons and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination as described in the next paragraph.

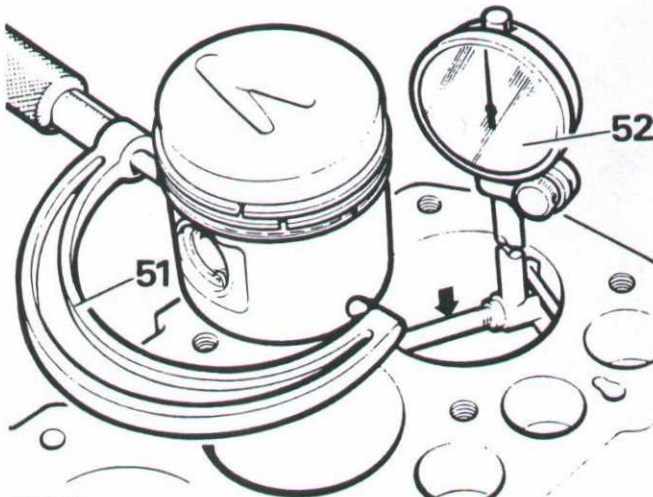
48 New pistons: Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Genuine "Land Rover" service standard size pistons are supplied 0,025mm (0.001in) oversize to allow for production tolerances on new engines.

49 When fitting new pistons to a standard size cylinder block the bores must be honed to accommodate the pistons with the correct clearances. In addition "Land Rover" pistons are available 0,50 and 1,01mm (0.019 and 0.039ins) oversize for fitting to rebored cylinder blocks.

50 Clearance limits for new standard size pistons in a standard cylinder bores measured at right angles to the gudgeon pin is 0,025 to 0,05mm (0.001 to 0.002in). When taking the following measurements the cylinder block and pistons must be at the same temperature to ensure accuracy.

51 Using a suitable micrometer measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.

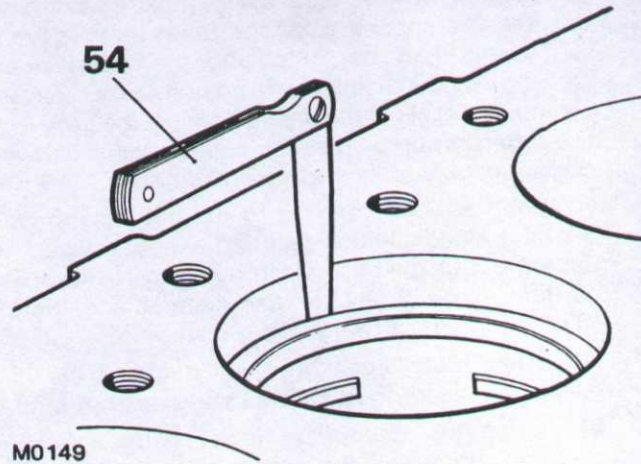
52 With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half way down and note the reading.



M0148

53 The clearance is determined by subtracting the piston diameter from the bore diameter.

54 If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized, feeler gauge down the thrust side of the bore and inserting the appropriate piston, "upside down", in the bore and position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore and stop at the tightest point and whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2,5kg (5.5lbs) is felt, the clearance is satisfactory.



M0149

Inspect the piston rings

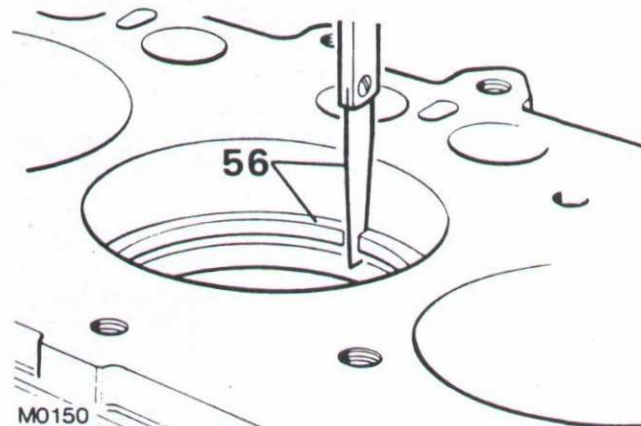
55 Normally when an engine is being overhauled the piston rings are discarded unless the pistons have been removed for a different purpose and the engine has only completed a small mileage. Before refitting the piston, the rings should be examined for wear and damage. In addition the rings must be checked for side clearance in the pistons and gap in the bores. The latter two checks must be made when fitting new rings to new and used pistons.

56 Check gap: When checking the ring gap in worn bores, but are nevertheless within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the bore at the lowest point of the piston travel. To ensure squareness of the ring, push the ring down the bore to the correct position with a piston. With newly machined bores, the ring may be inserted squarely into any position in the bore.

57 Using an appropriate feeler gauge check the gaps of all the rings, in turn, including the oil control ring assembly. The correct gaps are:

- a) Compression N° 1 (Top) 0,35 to 0,50mm (0.013 to 0.020in)
- b) Compression N° 2 (Middle) 0,25 to 0,38mm (0.010 to 0.015in)
- c) Oil control N° 3 (Bottom) 0,279 to 0,406mm (0.011 to 0.016in)

If any gap is less than that specified, remove the ring and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close up to within the specified limits when hot, an oversize ring should be fitted.



M0150

58 Check piston side clearance: It is important that the clearances are correct. Rings that are too tight will bind when hot, impairing the radial pressure causing possible load of compression. Excessive clearance will allow the rings to rock in the grooves and the resulting pumping action could cause excessive oil consumption and eventually broken rings.

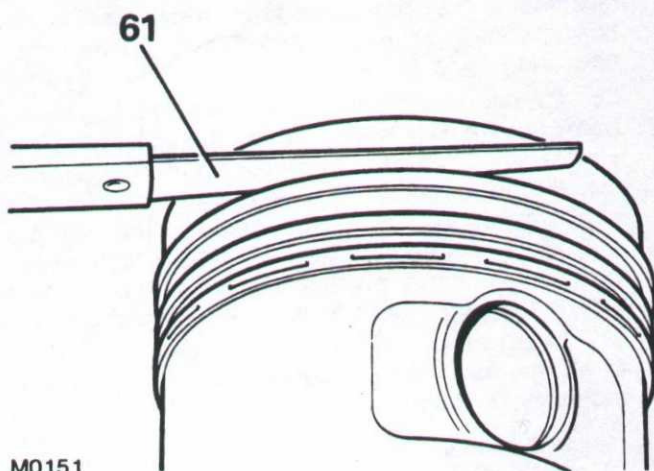
59 Fit the oil control ring to the bottom groove. Fit the unpolished compression ring with the word "Top" uppermost to the second groove. Insert the polished chrome ring with an internal chamfer and the word "Top" uppermost to the top groove.

60 After fitting each ring, roll it round the piston groove to ensure that it is free and does not bind.

61 Using an appropriate feeler gauge check the clearance between the rings and piston grooves. Clearances in excess of 0,102 to 0,152mm (0.004 to 0.006in) are unacceptable and the ring and/or the pistons should be removed.

Compression rings:- 0,064 to 0,11mm (0.0025 to 0.0045in)

Oil control ring:- 0,038 to 0,064mm (0.0015 to 0.0025in)



MO151

Inspect gudgeon pins

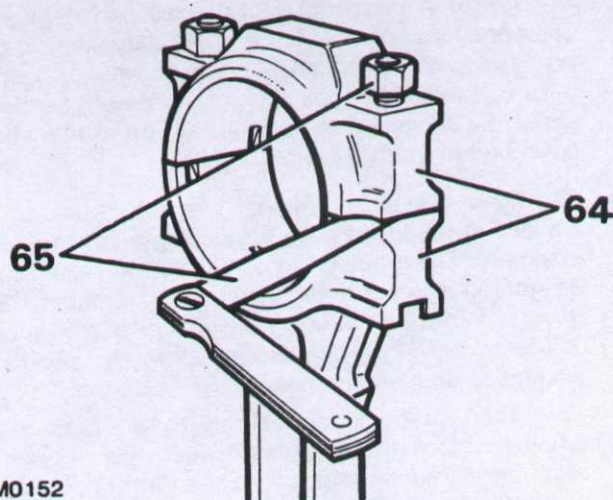
62 Check the gudgeon pin for wear, cracks, scores and overheating.

63 The gudgeon pin fit in the piston must be a tight push fit, at a temperature of 20°C (68°F). Check the gudgeon pin for ovality and taper using a micrometer.

Connecting rod inspection

64 Check the connecting rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting rod as denoted by the number stamped near the joint faces. This number/also indicates the crankshaft journal to which it must be fitted.

65 Tighten the nuts to the correct torque and release the nut on one side only. Check, with a feeler gauge, that no clearance exists between the joint faces. If there is a gap the connecting rod is distorted and should be renewed.



MO152

66 Use an accurate connecting rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127mm (0.005in).

67 Examine and check the small end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small end bush is 0,0196 to 0,008mm (0.00077 to 0.00014in).

68 When renewing a bush ensure that the oil hole in the bush lines up with the hole in the connecting rod. Finish the bush to the correct size and clearance.

69 Connecting rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewed. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Connecting rod bearing nip and clearance

70 New bearing halves are supplied with a protective coating and must be degreased before fitting.

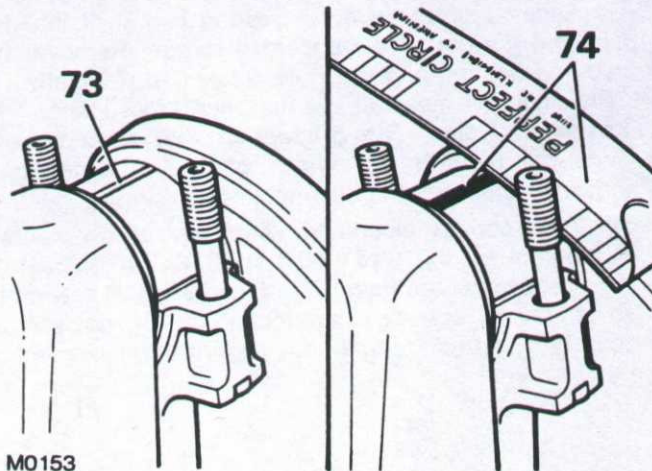
71 Fit the bearing halves to the connecting rod and cap and secure the assembly with the specified torque. Slacken the nut on one side only and check the clearance between the joint faces with a feeler gauge.

72 The clearance should be between 0,10 and 0,20mm (0.004 and 0.008in). The bearing nip can be adjusted by the selective assembly of the bearing shells which are available in slightly varying thicknesses. **Do not** file or machine the caps or rods to vary the bearing nip. Make a final check to prove the clearance by inserting a 0,063mm (0.0025in) shim paper between the crankpin and one half of the bearing and tightening to the specified torque. The connecting rod should resist rotation and move freely with the shim paper removed. As an alternative, the bearing clearances can be determined by using "Plastigauge" which consists of a thin piece of plastic material a few hundreds of a millimeter or thousands of an inch in diameter. When the material is flattened by being squeezed between the bearing and crankpin the width of the plastic is measured by a scale gauge which indicates the clearance.

73 Wipe any oil from the crankpins and place a piece of "Plastigauge" across the centre of the bearing in the connecting rod cap. Assemble the rod to the appropriate crankpin and tighten to the specified torque. Do not rotate the connecting rod or crankshaft during this operation.

74 Remove the connecting rod cap and bearing shell and using the scale supplied measure the flattened "Plastigauge" indicates the bearing clearance. The correct clearance with new or overhauled components is 0,019 to 0,063mm (0.0007 to 0.0025in).

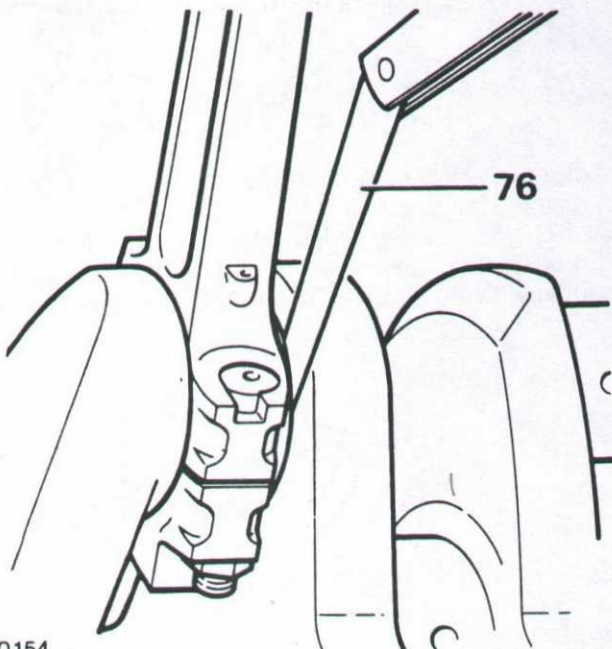
75 Wipe off the "Plastigauge" with an oily rag. Do not scrape off otherwise it may damage the crankpins.



M0153

Connecting rod end float

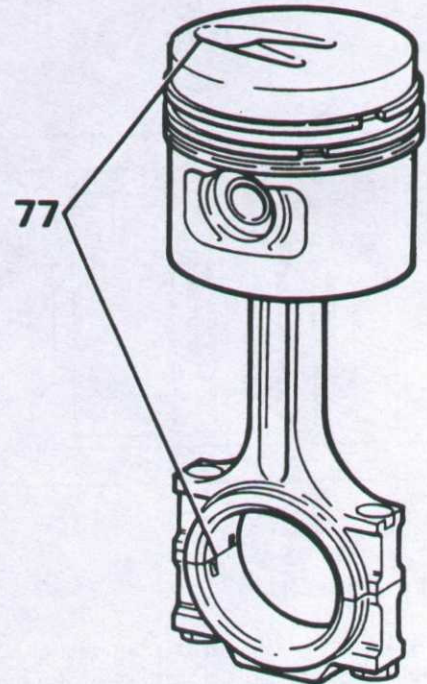
76 Fit the connecting rods complete with bearings to their respective crankpins. Move the connecting rod to one side and check the clearance, with a feeler, on the opposite side. The correct clearance is between 0,20 and 0,30mm (0.008 and 0.0012in).



M0154

77 The piston must be assembled with the point of the "V", on the piston crown, on the same side as the bearing shell location slots in the connecting rod.

78 Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.



M0155

Assemble jet tubes to cylinder block

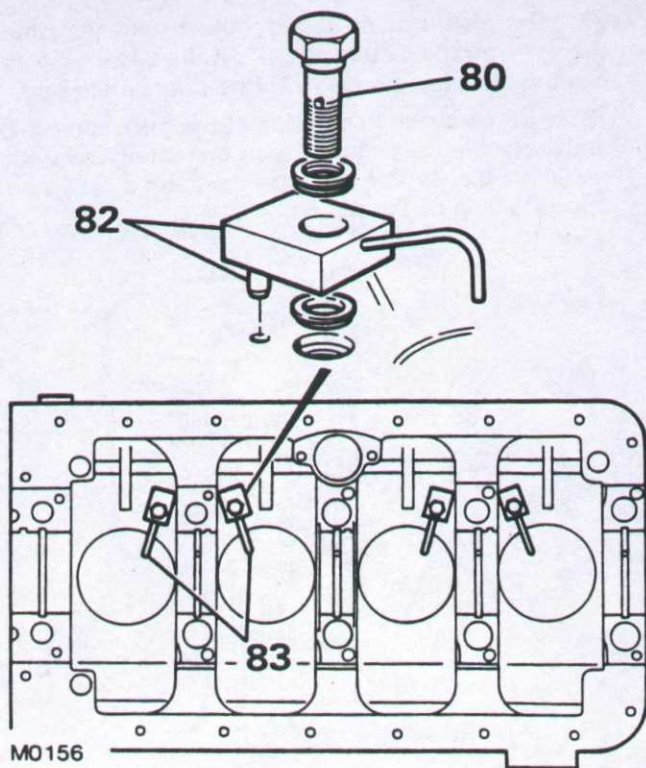
79 Oil jet tubes are fitted to lubricate the pistons and bores directly from the main oil gallery.

80 The jet tubes are "Handed" and can only be fitted one way. It is important to note that the jet retaining "bolt" contains a non-return valve and therefore on no account must an ordinary bolt be used.

81 Clean the recess in the cylinder block using an air line, if available, to remove any swarf.

82 Assemble and fit the jet tube assemblies as illustrated ensuring that the pegs locate in the holes in the cylinder block, and that the larger diameter washer fits under the bolt head.

83 Before tightening the retaining bolts ensure that the small squirt pipes do not foul the crankshaft or pistons. When the crankshaft and pistons have been fitted, slowly turn the crankshaft and check that no fouling occurs. Tighten the bolts to the specified torque.

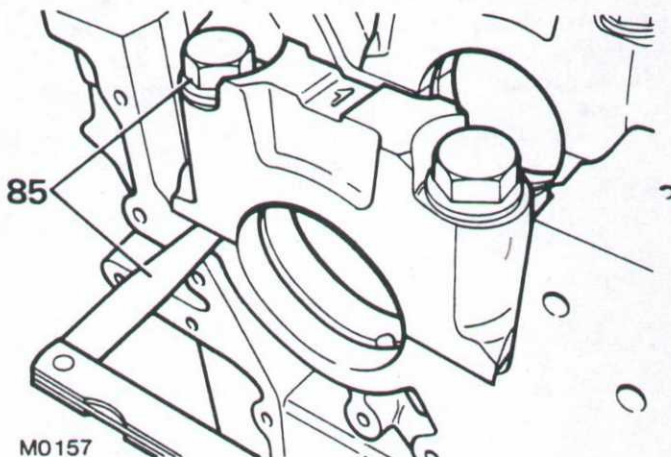


Fitting the crankshaft

84 Main bearing nip and clearance: New main bearing halves are supplied with a protective coating and must be degreased before fitting.

85 Fit the bearing halves in the crankcase saddles and cap and secure the caps to the crankcase and tighten to the specified torque. Slacken the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15mm (0.004 to 0.006in). The bearing nip can be adjusted by selective assembly of the bearing halves available in varying thicknesses. **Do not** file or machine the caps or saddles to achieve the correct clearance. Note that the rear main bearings are wider than the remaining four.

86 To make a final check that the clearance is correct, leave the bearing halves in the crankcase saddles and carefully lower the crankshaft into position.



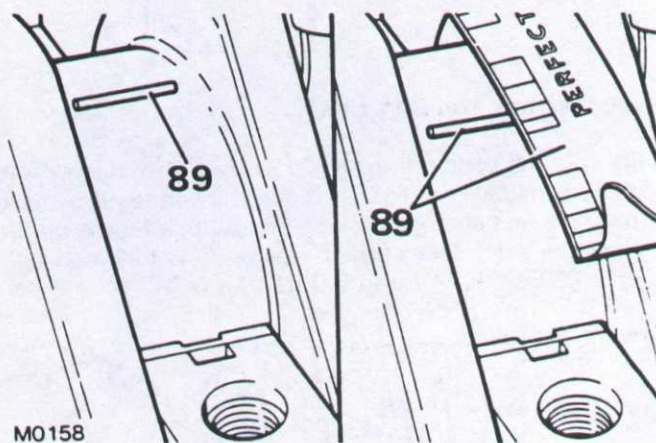
M0157

87 Check each bearing in turn by inserting a 0,063mm (0.0025in) shim paper between the bearing cap and crankshaft journal and tighten the bolts to the specified torque. If the clearance is correct, there should be a slight increase in the resistance to rotation of the crankshaft.

88 As an alternative "Plastigauge" may be used to check the clearance in the same manner as with the connecting rod bearings. This material may also be used to determine the amount of wear in used bearings and journals.

89 Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since "Plastigauge" is soluble in oil. Place a piece of "Plastigauge" across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the specified torque. Remove the cap and bearing and using the scale supplied with the "Plastigauge" measure the flattened "Plastigauge" at its widest point. The graduation that most closely corresponds with the width of the "Plastigauge" indicates the bearing clearance.

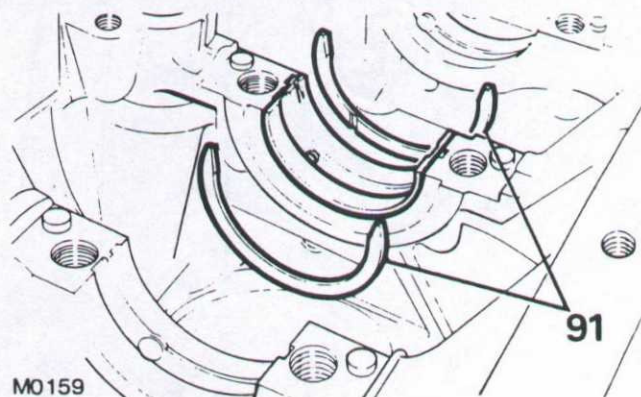
90 The correct clearance with new or overhauled components is 0,018 to 0,061mm (0.0007 to 0.0024in). If new bearings are being fitted use selective assembly to obtain the correct clearance. Wipe off, not scrape the "Plastigauge" with an oily rag from the journals or bearings.



M0158

Adjust crankshaft end float

91 Lift out the crankshaft and insert a standard size thrust washer both sides of the centre main bearing saddle with the grooves towards the crankshaft.

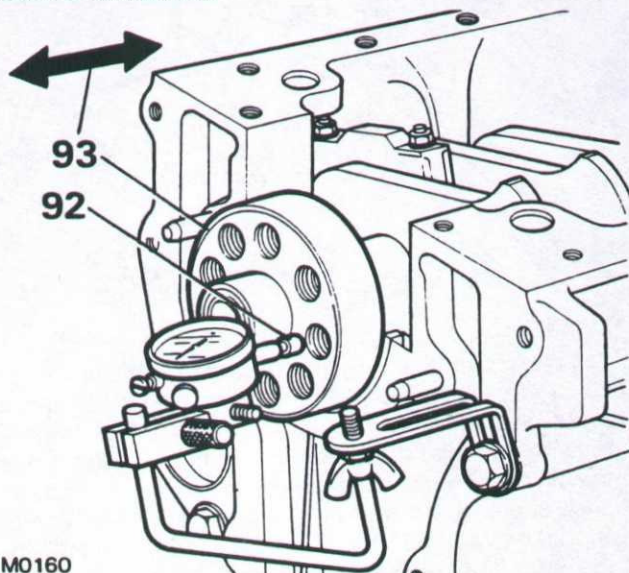


M0159

92 Place the crankshaft in position in the crankcase and mount a dial test indicator to read off the end of the crankshaft. A feeler gauge may be used instead of an indicator.

93 Determine the end float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite direction and note the indicator reading. Alternatively measure the clearance with a feeler gauge. The end float should be 0,05 to 0,15mm (0.002 to 0.006in).

94 If adjustment is required substitute with oversize thrust washer. Variation of thrust washer thickness at each side of crankshaft journal must not exceed 0,08mm (0.003in) to ensure that the crankshaft remains centralised.



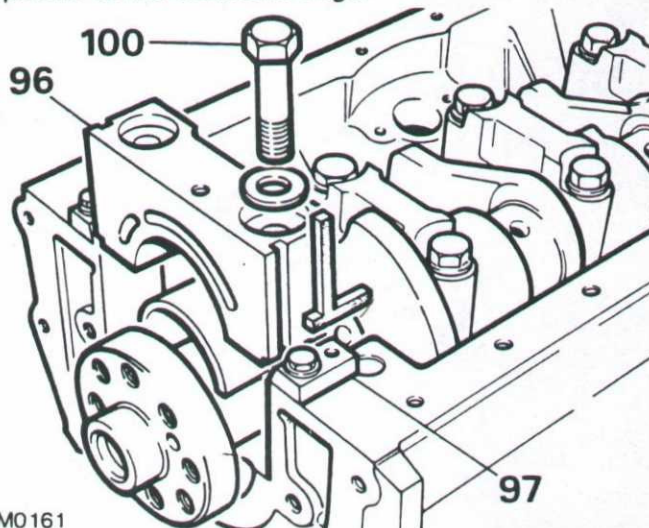
M0160

95 Lubricate the crankshaft main journals with clean engine oil and fit the appropriate bearing caps and lower shells to the crankcase with the exception of number five main bearing. Ensure that the caps locate properly over the dowels. Using new bolts and washers evenly tighten to the specified torque.

Fit rear main bearing cap

96 Ensure that number five main bearing cap is clean and free from old cork seal material.

97 Attach the cork seal guides, 270304, to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.

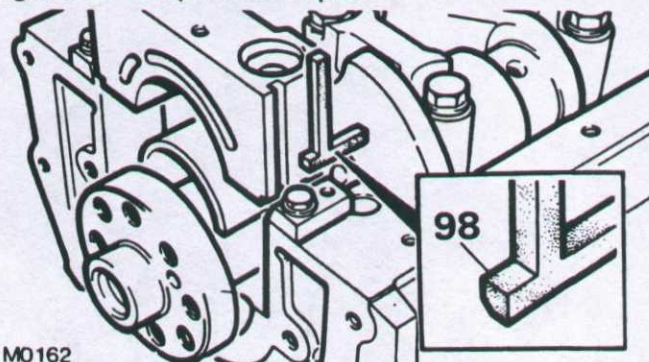


M0161

98 To prevent any cork seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the corks 0,40 to 0,80mm ($\frac{1}{64}$ to $\frac{1}{32}$ in) wide as illustrated.

99 Immerse the cork seals in engine oil and fit them to the bearing cap.

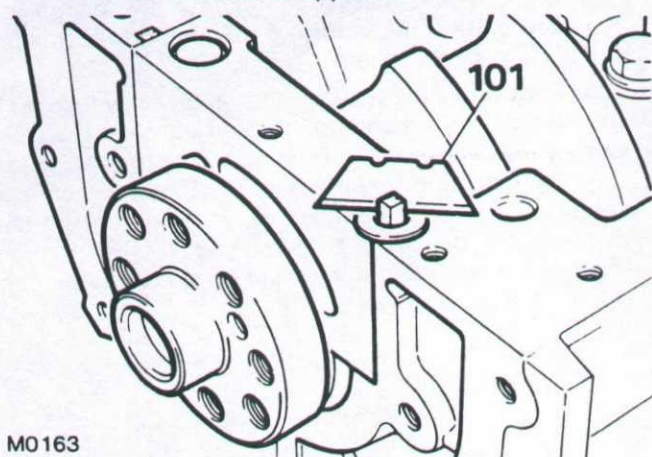
100 Fit the bearing cap and lower shell to the crankcase and secure with new bolts and washers and tighten to the specified torque.



M0162

101 To allow for shrinkage after fitting leave the cork seals standing proud of the crankcase sump face. If possible delay the fitting of the sump for approximately twelve hours and leave the seal protruding 2,40mm ($\frac{3}{32}$ in) and then place a 6,35mm ($\frac{1}{4}$ in) washer over the seal and cut off the surplus. If it is necessary to fit the sump immediately, trim the seals off leaving 0,80mm ($\frac{1}{32}$ in) proud, that is, the thickness of the above washer. Apply Hylomar SQ32M to the protruding end of the seals.

Note: On later models the cork seals have been deleted from the rear main leaning cap and replaced by "Hylosil 102" sealant. See page 47 for method of application.



M0163

Fit the connecting rods and pistons

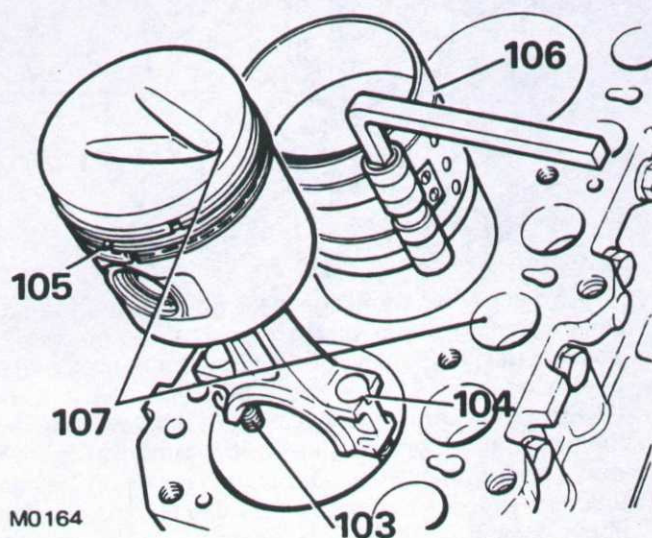
102 Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting rods.

103 When fitting the connecting rods and pistons ensure that the bolts do not foul and damage the crankpins. As a precaution it is recommended that rubber or soft plastic sleeves are placed over the threads.

104 The connecting rod bolts have eccentric heads which locate in a recess in the connecting rod. It is essential that the head of each new bolt is properly located before tightening.

105 Stagger the compression rings so that the gaps are equidistantly spaced round the piston but, so arranged, that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is in line with the gudgeon pin.

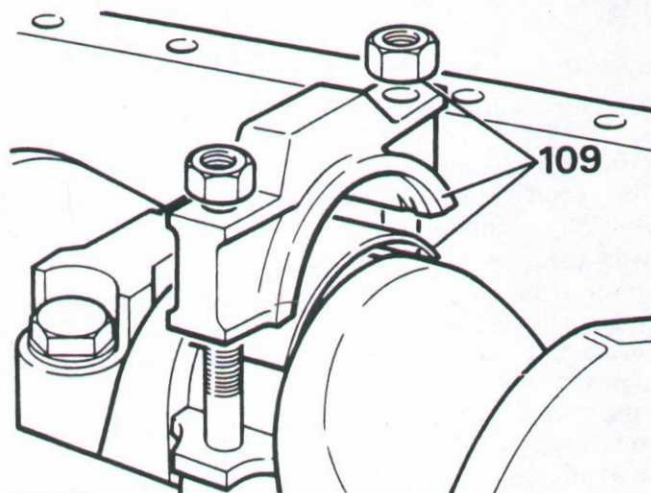
106 Lubricate the cylinder walls, piston rings and crankpins. Compress the piston rings with a suitable compressor tool and then carefully lower the connecting rod/piston assembly into the bore.



107 Ensure that the point of the arrow headed valve clearance indentation in the piston crown, must face the camshaft side of the engine.

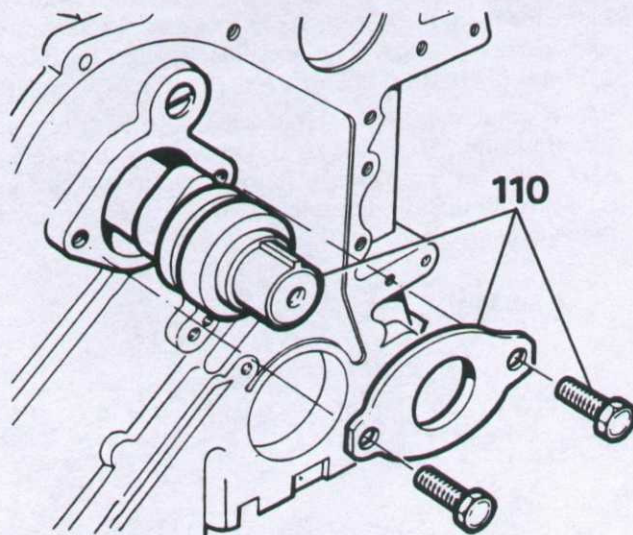
108 Using a soft mallet, sharply tap the piston into the bore so that the whole of the piston is just below the surface of the cylinder block.

109 Check that the bearing shell is properly located in the connecting rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten the new nuts to the specified torque. Repeat the previous instructions for fitting the remaining piston/connecting rod assemblies.



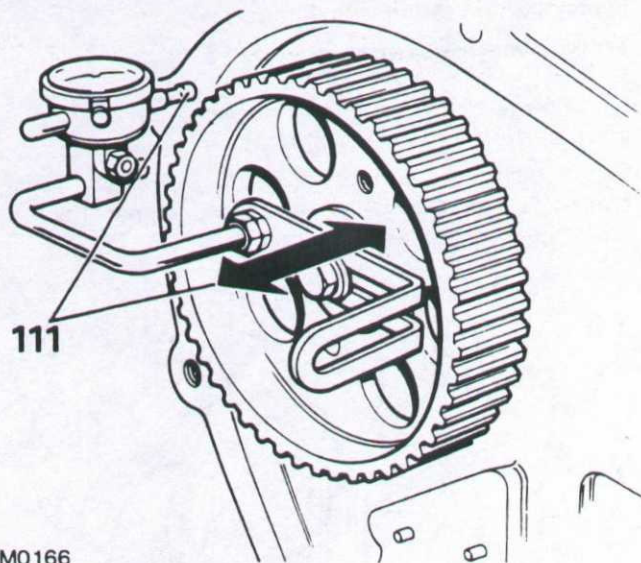
Fit the camshaft

110 Lubricate the camshaft bearings and with care, insert the camshaft into the cylinder block. Temporarily secure a new thrust plate with the two bolts.



111 To check the camshaft end float, fit the woodruff key and temporarily fit the camshaft pulley and mount a dial test indicator, as illustrated, so that the stylus rests in a loaded condition upon the machined face of the cylinder block. Zero the dial and move the camshaft back and forward and note the reading. The end float should be within 0,06 to 0,1 mm (0.0024 to 0.0005in). If the end float is outside of these limits, fit different thrust plates until the correct tolerance is achieved.

112 Remove the dial test indicator and camshaft pulley.



M0166

Fit the tappets, guides and rollers

113 If the same parts are being refitted ensure that they are returned to their original positions. Ensure that the tappet slides move freely in the guides.

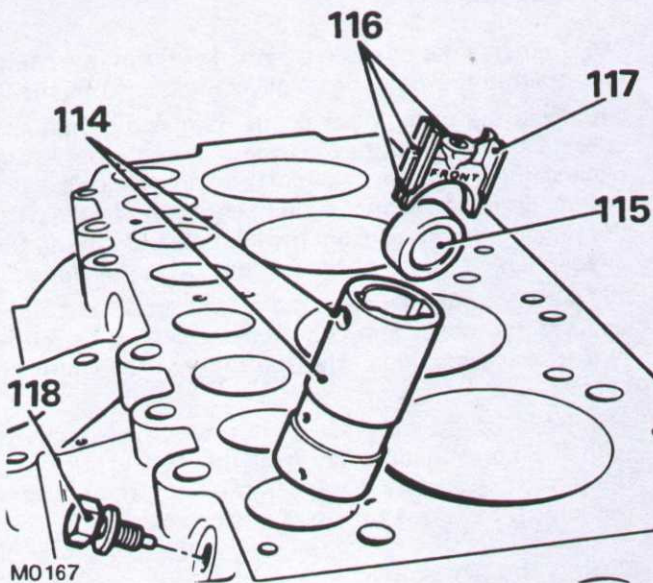
114 Insert the tappet guides into the cylinder block and align the locating screw holes.

115 Fit the tappet rollers ensuring that they are fitted in accordance with the marks made during removal. New rollers, however, may be fitted either way round.

116 Before fitting the tappet slides make sure the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod.

117 Insert the tappet slides with the word "Front" towards the front of the engine.

118 Secure the tappet guides with new Micro-encapsulated screws and tighten to the specified torque. Micro encapsulated screws should also be used on engines when the screws were originally wired for security.



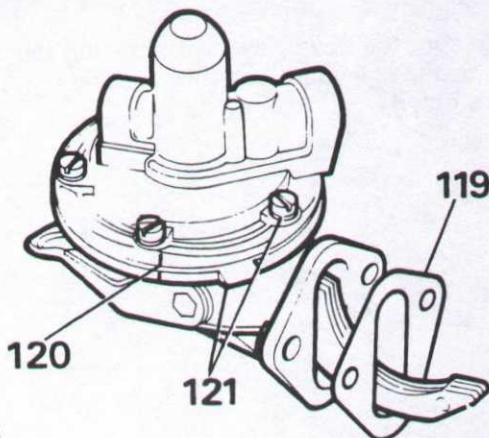
M0167

Overhaul and fitting of the fuel lift pump

119 Remove the fuel pump from the side cover and remove the joint washer.

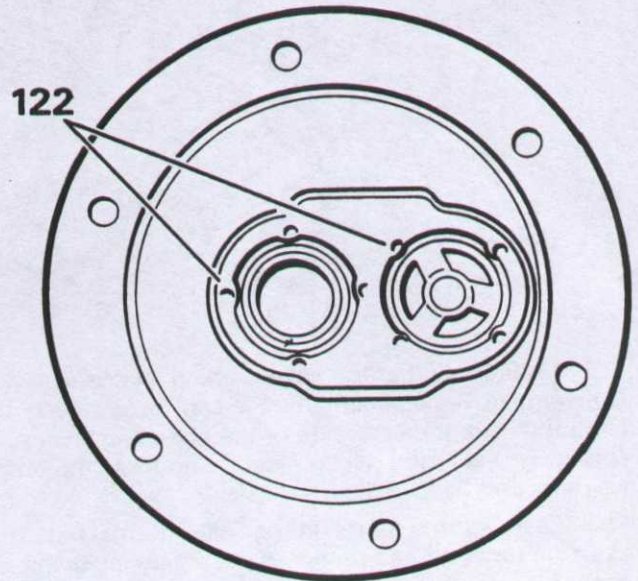
120 Mark the upper and lower halves of the pump casing to ensure correct alignment on reassembly.

121 Remove the top cover fixing screws, and while pressing the diaphragm tab against the pump body, lift the top cover clear.



M0168

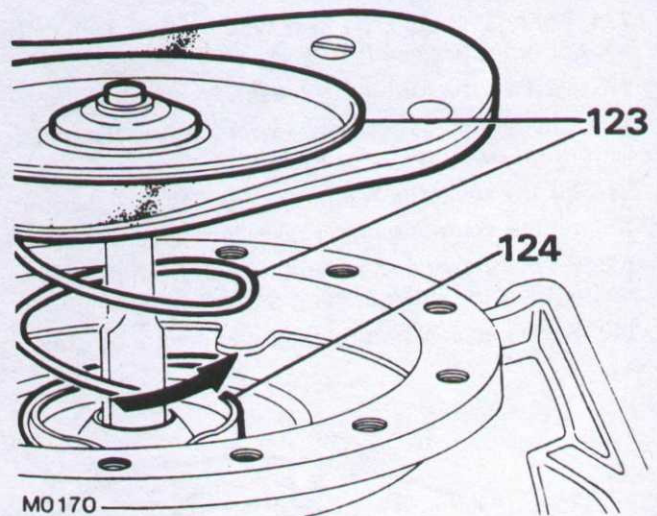
122 If necessary remove the valves by cutting away the retaining stakes with a scraper. Warm the top cover, note the position of the valves and withdraw them from the cover.



M0169

123 Turn, whilst pressing down the metal part of the diaphragm through 90° in either direction and withdraw the diaphragm and spring.

124 Unstake the oil seal housing and lever out the oil seal and retainer.



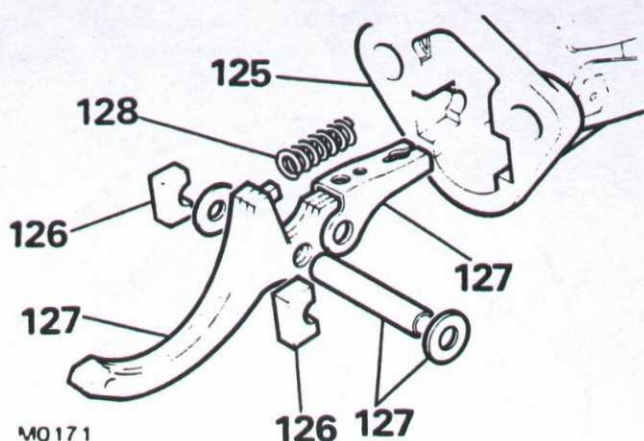
M0170

125 Using a small chisel, remove the staking from the rocker arm retainers.

126 Withdraw the retainers and rocker arm.

127 Withdraw the rocker arm pin and washers, detach the operating link.

128 Withdraw the rocker arm spring.



M0171

129 It is unlikely that the hand priming mechanism will ever require replacement, but it can be removed by filing the hexagon each side of the operating lever and springing the hand lever clear, withdraw the cork washers and hand rocker.

130 Clean all the parts in paraffin (Kerosene) and examine for wear and renew as necessary including all gaskets.

131 Sediment bowl filter disc must be free of damage and fit tightly around inlet neck of upper casing.

132 Renew the diaphragm assembly if any sign of hardening, cracking or porosity is present.

133 Only very slight wear should be tolerated at the rocker arm contact face, pivot pin, operating link and diaphragm pull rod slots.

134 Springs should be renewed ensuring that the correct types are used.

135 Test valves for air tightness, by suction.

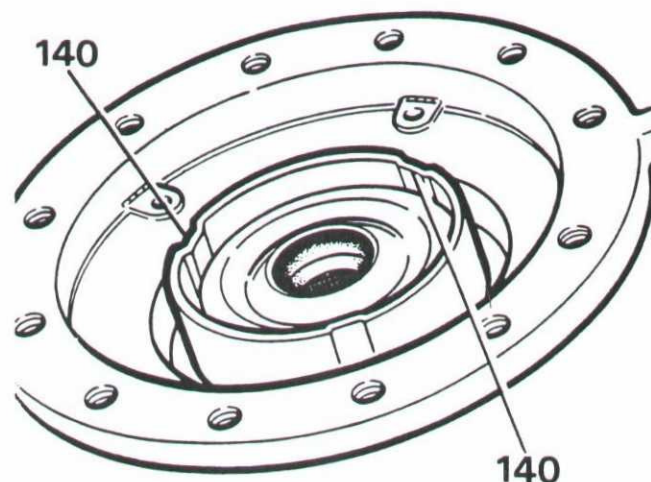
136 Check the upper and lower casing flanges for distortion, using a straight edge.

137 Fit the rocker arm spring.

138 Fit the operating link, rocker arm pin and washers.

139 Fit the rocker arm assembly to the pump body and secure with the retainers and stake.

140 Fit the oil seal and retainer and secure by staking.



M0172

141 To refit the diaphragm assembly, hold the pump body with the diaphragm return spring in position, and the rocker arm held outwards. Position the diaphragm over the spring with the flattened end of the pull rod in line with the slot in the operating link. Push the diaphragm inwards and turn to lock.

142 Fit the inlet and outlet valves and secure by staking.

143 Place the top cover assembly in position, aligning the mark made before dismantling. Fit the securing screws, but do not tighten at this stage; using hand priming lever, fully depress the diaphragm and fully tighten the securing screws. The diaphragm outer edges should be approximately flush with the outer edge of the pump joint faces when fitted.

144 Fit the filter gauge and sealing ring on pumps with a sediment bowl and fit the bowl and secure with the retaining clip. Ensure that the bowl and seal are located squarely. **Do not** overtighten the securing nut to prevent cracking of the bowl.

Test the fuel pump

145 Immerse the pump in a bath of paraffin (Kerosene) and operate the rocker arm several times to flush.

146 Hold the pump clear of the bath and continue to operate the rocker arm until the pump is empty, then place a finger over the inlet port and operate rocker arm several times. A distinct suction should be heard when the finger is removed from the inlet port, denoting that a reasonable degree of suction has been developed.

147 Place a finger over the outlet port and again operate the rocker arm. Air pressure should be felt for two to three seconds after the rocker movement has ceased.

148 Build up the air pressure in the pump again, and with the finger held firmly over the outlet, submerge the pump completely in the paraffin bath, then observe the joint face edges for signs of air leakage.

Fitting the lift pump

149 If the fuel pump was separated from the side cover, fit the pump to cover first using a new joint washer between the pump flange and rear cover, evenly tighten the retaining nuts.

150 Place a new cover plate joint washer in position and fit the cover and pump assembly to the cylinder block.

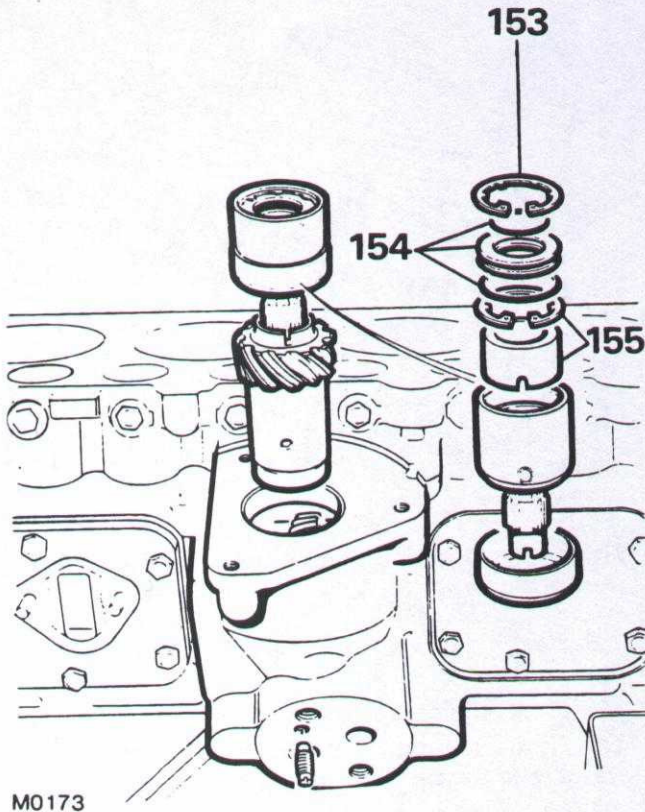
151 Ensure that the pump activating lever rides on top of the camshaft.

152 Secure the cover, evenly tightening the retaining bolts, to the cylinder block (and bracket – automatic models only).

Overhaul and fitting of the skew gear

Note: The coupling can be overhauled without separating it from skew gear.

- 153** With circlip pliers remove the retaining circlip.
- 154** Withdraw the seal collar and remove the inner and outer seals.
- 155** Remove the lower circlip and withdraw the sleeve.



156 Reassemble the coupling with any new parts that are necessary ensuring that the sleeve fits correctly over the lower cross-pin and secure with the circlip.

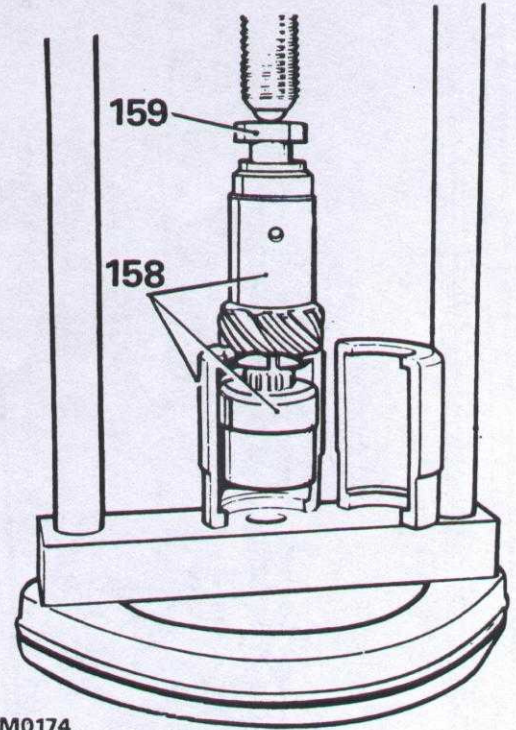
157 Lubricate and fit new seals to the collar and insert in the coupling and retain with the circlip. Make sure that the seals are properly located since damaged or misplaced seals could cause reduced engine oil pressure.

Renewing the skew gear coupling

Special tools required
MS47 Press
18G705-1A Collets

158 Position the skew gear and coupling assembly in a press and support it, as illustrated, with 18G705-1A or suitable metal bars.

159 Insert a suitable mandrel between the press ram and end of the coupling shaft and press out the coupling from the skew gear.

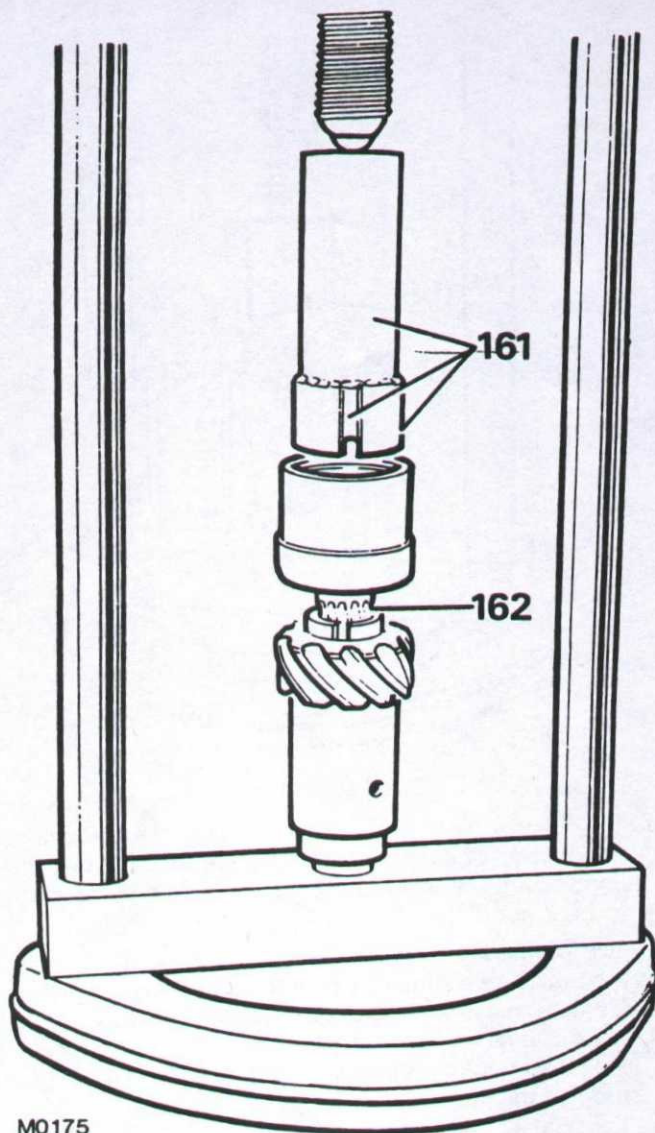


160 Dismantling the new coupling, as described previously. This is necessary, since in the assembled condition there is no suitable surface for the press tool to bear upon.

161 Dismantle the old coupling and use the sleeve to manufacture a suitable press tool. Use a round section file to increase the depth of the cross-pin slot so that it will not bear upon the cross-pin when used to press in the new coupling. Weld a suitable length of steel bar or tube to the sleeve to complete the tool.

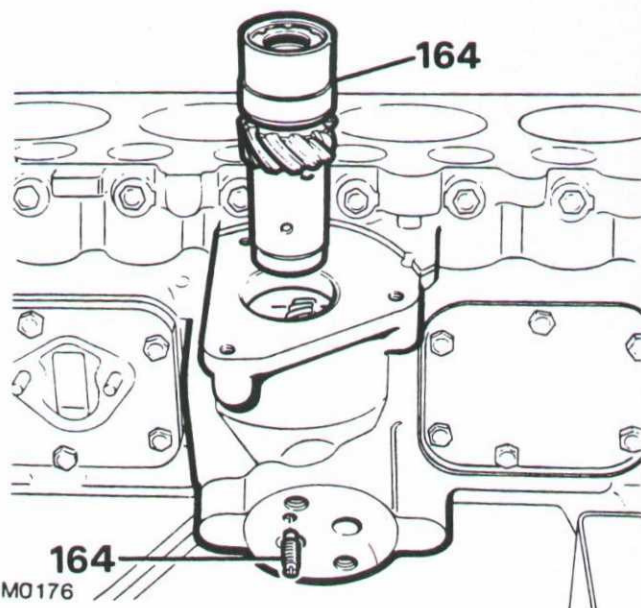
162 Fill the annular groove round the splines of the coupling with silicone rubber sealant.

163 Assemble the skew gear and coupling with the manufactured press tool in position inside the coupling and place under the press and slowly press in the new coupling. Clean off the surplus sealant and swarf from the internal splines of the skew gear.



M0175

164 Reassemble the new coupling as previously described. Lubricate and insert the skew gear assembly into mesh with the camshaft gear. Align the location hole in the bush and fit a new location screw into the cylinder block.



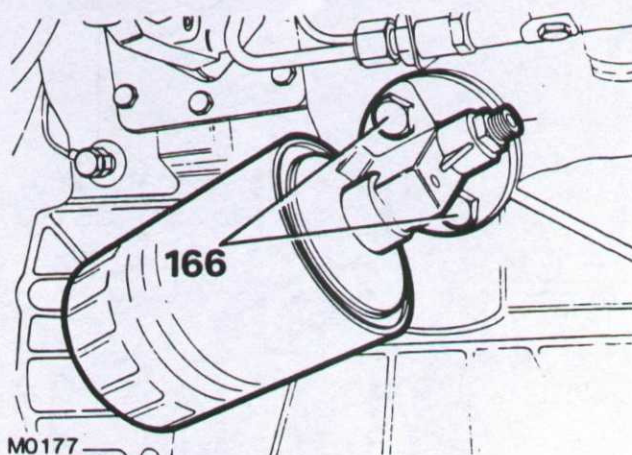
M0176

Fit oil filter and adaptor

165 Using a new joint washer fit the oil filter adaptor, ensuring that the retaining bolts pass through the two small round holes in the washer.

166 Tighten the two retaining bolts evenly to the specified torque.

167 Smear a little clean engine oil on the rubber washer of the new filter, then screw the filter on clockwise until the rubber sealing ring touches the machined face, then tighten a further half turn by hand only. Do not overtighten.



M0177

Fitting the dipstick, drain plug and alternator mounting bracket

168 Fit the dipstick retaining tube, securing the tube nut.

169 Fit the drain plug to the side of the cylinder block.

170 Fit the alternator bracket with the three bolts and washers to the base of the engine block.

171 Fit the oil pump and sump as stated in section E.

172 Fit the cylinder head as stated in section D.

173 Fit the timing case, pulleys and tuning belt as stated in section C.

174 Fit the flywheel and clutch (Manual models only) or the flywheel and adaptor plate (Automatic models only) as stated in section B.

ENGINE DATA — DIESEL (2.5 LITRE)

Number of cylinders.....	4	
Bore.....	90,49 mm	3.562 in
Stroke.....	97,0 mm	3.818 in
Valve operation.....	Overhead by push rods	
Crankshaft		
Main journal diameter.....	63,487 to 63,5 mm	2.499 to 2.5 in
Diametrical clearance.....	0,02 to 0,063 mm	0.008 to 0.0025 in
Crankpin journal diameter.....	58,72 to 58,733 mm	2.312 to 2.3128 in
Diametrical clearance.....	0,019 to 0,068 mm	0.0008 to 0.0027 in
End-float.....	0,05 to 0,015 mm	0.002 to 0.006 in
Adjustment.....	Selective thrust washers	
Thrust washers available.....	0,06 mm	0.0025 in
	0,12 mm	0.005 in
	0,18 mm	0.0075 in
	0,25 mm	0.010 in
Pistons		
Clearance in cylinder:		
Bottom of skirt.....	0,058 to 0,068 mm	0.0023 to 0.0027 in
Piston rings		
Number of rings.....	3 (2 compression, 1 oil control)	
Compression:		
Type: Top.....	Square friction edge, chrome plated	
Second.....	Bevelled friction edge, marked 'TOP' on upper side	
Fitted gap: Top.....	0,30 to 0,50 mm	0.012 to 0.020 in
Second.....	0,30 to 0,50 mm	0.012 to 0.020 in
Oil control		
Type.....	Expander and rails	
Fitted gap.....	0,33 to 1,40 mm	0.013 to 0.055 in
Gudgeon pins		
Type.....	Press fit in piston	
Clearance in connecting rod.....	0,002 to 0,020 mm	0.0001 to 0.0008 in
Camshaft marked S2		
End-float.....	0,06 to 0,13 mm	0.0035 to 0.0055 in
Valve lift: Inlet.....	9,85 mm	0.388 in
Exhaust.....	10,26 mm	0.404 in
Rocker gear		
Bush diameter, reamed in position.....	13,40 to 13,42 mm	0.530 to 0.531 in
Shaft clearance in bush.....	0,13 to 0,062 mm	0.0005 to 0.0025 in
Valves		
Seat angle.....	45°	
Head diameter: Inlet.....	39,16 to 39,36 mm	1.542 to 1.540 in
Exhaust.....	33,32 to 33,42 mm	1.312 to 1.316 in
Clearance in guide: Inlet.....	0,033 to 0,048	0.0013 to 0.0019 in
Exhaust.....	0,058 to 0.0073 mm	0.0023 to 0.0029 in
Valve springs		
Inner: Free length.....	42,67 mm	1.680 in
Load at fitted length.....	8.0 kg	17.7 lb
Outer: Free length.....	40,3 mm	1.587 in
Load at fitted length.....	21,0 kg	46.0 lb

FUEL SYSTEM — DIESEL 2.5 LITRE

Fuel lift pump	AC, mechanical	
Pressure range	0,35 to 0,56 kgf/cm ²	5 to 8 lbf/in ²
Fuel injection pump	Mechanically governed, distributor type C.A.V. model D.P.S. 8520A/300A; 3001A on later models.	
	C.A.V. Pintaux model 5385001	
Fuel injectors	B.D.N.O./SPC6209	
Nozzle size	135 atmospheres	
Operating pressure of nozzle valve		
Back leakage rate 150 to 100 atmospheres:		
New nozzle	7 seconds	
Start of injection	13° B.T.D.C.	
Valve timing		
Inlet valve: Opens	16° B.T.D.C.	
Closes	42° A.B.D.C.	
Exhaust valve: Opens	51° B.B.D.C.	
Closes	13° A.T.D.C.	
Peak opening of exhaust valve	109° B.T.D.C.	
Lubrication		
System pressure:		
Engine warm at 2000 rev/min	2,5 to 4,57 kgf/cm ²	35 to 65 lbf/in ²
Oil pump	Double gear	
Drive	Splined shaft from camshaft gear	
End-float: Steel gear	0,05 to 0,12 mm	0.002 to 0.005 in
Aluminium gear	0,07 to 0,15 mm	0.003 to 0.006 in
Radial clearance	0,02 to 0,10 mm	0.001 to 0.004 in
Backlash of gears	0,15 to 0,28 mm	0.006 to 0.012 in
Relief valve spring:		
Free length	67,82 mm	2.67 in
Fitted length	61,23 mm	2.45 in
Load at fitted length	2,58 kg	5.7 lb
Filter external disposable type	G.F.E 175	

ENGINE TUNING DATA

Engine — Diesel

Capacity	2495 cm ³	152.26 in ³
Compression ratio	21.0:1	
Firing order	1—3—4—2	
Idling speed	700 ± 50 rev/min	
Valve rocker clearance (cold)	0,25 mm	0.010 in
Timing marks:		
Exhaust valve E.P. = 109° B.T.D.C.	On engine flywheel and crankshaft pulley	
Injection timing 13° B.T.D.C.	On engine flywheel, crankshaft pulley and fuel injection pump flange	
Heater plugs		
Make/type	Micronova 465-10.	
Fuel injection pump		
Maximum speed setting (sealed)	4400 ± 80 engine rev/min	

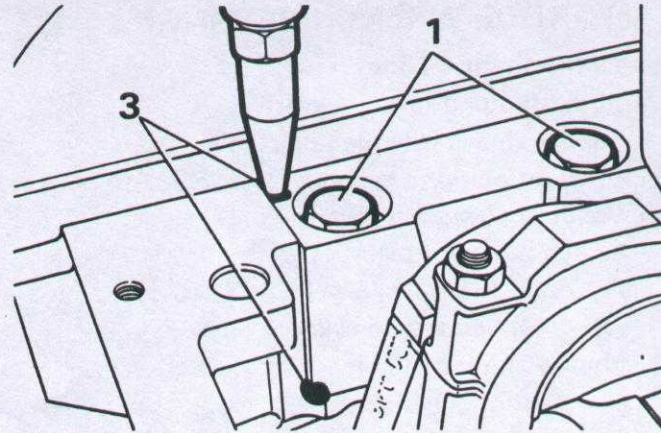
Rear main bearing cap sealing

A change has recently been introduced to the method of sealing the rear main bearing cap. Hitherto sealing was accomplished using "T" shaped cork packing strips one each side of the cap. Sealing is now achieved by injecting "Hylosil 102" (black) into the slots formally occupied by the packing strips. This material may also be used on all earlier engines where the caps were sealed with packing strips.

The method is as follows:-

1. With the sump removed, fit the main bearing cap and tighten the bolts to the correct torque, 130-136 Nm (96-100 lbf.ft).
2. Turn the crankshaft to bring numbers two and three pistons to Top Dead Centre so that the crankshaft webs will not obscure the bearing cap.
3. Using a suitable applicator, inject the sealant into the main bearing cap slot adjacent to the bearing cap bolt recess until it emerges from the upper end of the slot,
4. Repeat instruction 3 on the opposite side of the bearing cap.
5. Remove surplus sealant.

Note: When removing surplus sealant from the sump gasket face, ensure that the sealant is cleaned off level to the cylinder block machined face.



TORQUE WRENCH SETTINGS

Component/Fixing	lbf/ft	N.m.	Kgf/m
Fuel lift pump to side cover	15 - 20	20 - 28	2.1 - 2.7
Tappet sleeve retaining bolt	18 - 20	23 - 28	2.3 - 2.7
Vacuum pump to cylinder block	17 - 20	22 - 28	2.4 - 2.7
Vacuum pump top cover bolt	8	10.5	1
Clutch pressure plate	22 - 28	30 - 38	3.0 - 3.8
Flywheel to crankshaft bolt	96 - 105	130 - 143	13.3 - 14.5
Flywheel housing to cylinder block bolt	30 - 37	40 - 50	4.2 - 5.1
Engine sump pan bolt	11 - 15	15 - 20	1.5 - 2.0
Main bearing cap bolt	96 - 100	130 - 136	13.3 - 13.8
Big end bearing cap nut	27 - 30	37 - 41	3.7 - 4.1
Oil squirt jet bolt	10 - 14.5	14 - 20	1.4 - 2.0
Oil pump cover bolt	14.5 - 2.0	20 - 28	2.0 - 2.7
Oil pump to cylinder block bolt	17 - 20	22 - 28	2.4 - 2.7
Oil filter housing to cylinder block	30 - 37	40 - 50	4.2 - 5.1
Cylinder head oil feed pipe banjo bolt	15 - 18	20 - 25	2.0 - 2.5
Heater plug to cylinder head	15	20	2.0
Rocker cover nut	17 - 20	22 - 28	2.4 - 2.7
Cylinder head bolt	85 - 95	115 - 130	11.8 - 13.1
Rocker pedestal to cylinder head bolt	17 - 20	22 - 28	2.4 - 2.7
Rocker shaft securing bolt (in No. 2 pedestal)	15 - 19	20 - 27	2.0 - 2.6
Viscous fan coupling to water pump (Loctited, LEFT HAND thread)	30 - 37	40 - 50	4.2 - 5.1
Cooling fan to viscous coupling hub bolt	5.5 - 6.5	7 - 9	0.8 - 0.9
Water pump pulley bolt	17 - 20	22 - 28	2.4 - 2.7
Water pump to front cover bolt	17 - 20	22 - 28	2.4 - 2.7
Engine front cover to cylinder block bolt	17 - 20	22 - 28	2.4 - 2.7
Crankshaft pulley bolt	192 - 206	260 - 280	26.5 - 28.4
Camshaft timing gear bolt	30 - 37	40 - 50	4.2 - 5.1
Fuel injection pump timing gear nut	31 - 35	42 - 48	4.3 - 4.8
Timing belt idler pulley bolt	30 - 37	40 - 50	4.2 - 5.1
Timing belt tensioner nut	17 - 20	22 - 28	2.4 - 2.7
Camshaft thrust plate bolt	5.5 - 7	7 - 10	0.8 - 1.0
Engine side cover bolt	17 - 20	22 - 28	2.4 - 2.7
Injector securing nut	15 - 20	20 - 28	2.0 - 2.7
Timing belt tension	8 - 10	10.5 - 13	1 - 1.4



FX4S

INCLUDING FX4S PLUS

WORKSHOP MANUAL

Section 4

AUTOMATIC GEARBOX

PART I (GENERAL INFORMATION) TORQUE CONVERTER

Description

The torque converter is bolted to the drive plate attached to the crankshaft while the driven member is splined internally to accept the converter out-put shaft. The stator is mounted on a one-way sprag clutch, the hub of which is splined to a fixing on the oil pump housing.

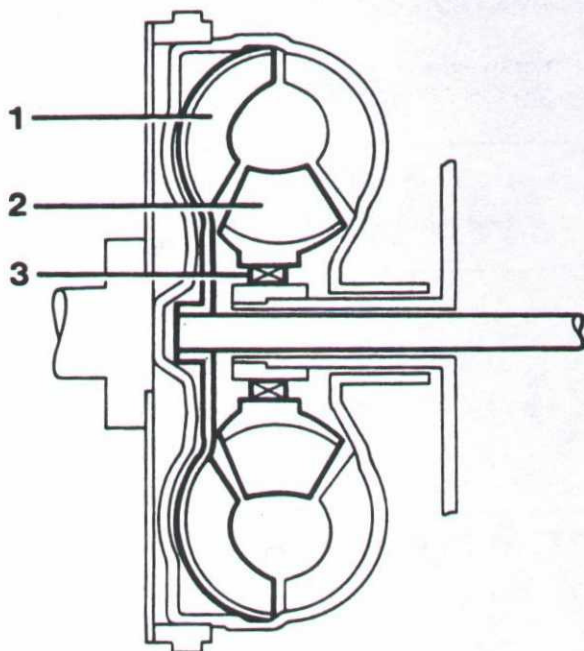
Oil is supplied to the torque converter under pressure and returns by way of the oil cooler to the transmission sump. The position of the oil cooler prevents the converter from draining whilst the vehicle is not operating. The secondary regulator valve maintains torque converter pressure.

Operation

With the car stationary and in gear, the driven member will be stationary. The driving member will, however, be turning with the engine. As engine speed is increased, oil will be thrown to the outside by centrifugal force. The vanes of the driving member then direct the oil flow against the outer vanes of the driven member with considerable force, causing it to rotate and drive the transmission.

After the oil has passed through the vanes of the driven member, it tends to be directed back against the inner vanes of the driving member contrary to engine rotation. To overcome this, the stator mounted between the driving and driven members on its one-way clutch changes the direction of the flow to clockwise, thus assisting the driving member to drive the car. This provides torque multiplication up to a maximum of approximately 2:1 (at stall).

As the vehicle moves away, the speed of the driven member approaches that of the driving member and the rate of flow through the vanes is reduced, resulting in less force being applied to the stator. With increased speed or reduction in load, the force with which the oil is thrown up against the back of the stator blades will increase and when a certain point is reached, the stator will free-wheel on its one-way clutch. This is known as coupling point. Torque multiplication now ceases and the unit operates as a fluid coupling with a torque multiplication ratio of 1:1



- 1. Turbine
- 2. Stator
- 3. One-way clutch

Fig. 1 - Sectional view of torque converter

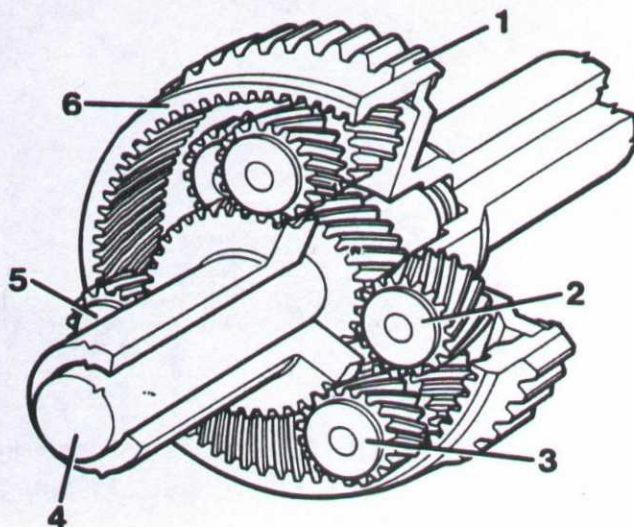
GEAR TRAIN ASSEMBLY

Operation

The planetary gear train consists of two sun gears, two sets of pinions, a pinion carrier and a ring gear. Helical involute tooth form is used throughout. Power enters the gear train via the sun gears.

In all forward gears power enters through the primary sun gears. In reverse, power enters through the secondary sun gear. Power leaves the gear train by the ring gear. The pinions are used to transmit power from the sun gears to the ring gear. In reverse, a single set of pinions is used which causes the ring gear to rotate in the opposite direction to the sun gear. In the forward gears, a double set of pinions is used to cause the ring gear to rotate in the same direction as the sun gear. The carrier locates the pinions in their positions relative to the sun gears and the ring gear (and also forms a reaction member for certain conditions). The various mechanical ratios of the gear set are obtained by the engagement of hydraulically operated multi-disc clutches and brake bands.

Fig. 2 shows the relationship of the various components of the gear train assembly with the exception of the planet carrier which is omitted so that the pinions can be seen.



- 1. Park Gear
- 2. Primary pinions (short)
- 3. Secondary pinions (long)
- 4. Primary sun gear
- 5. Secondary sun gear
- 6. Ring gear

Fig. 2 - Sectional view of gear train

A parking pawl engages with the external teeth of the ring gear to provide positive locking of the gear train in 'P'.

The two multi-disc clutches, the two bands and the 'sprag' type one-way clutch operate with the gear train to provide the three forward ratios, neutral and reverse. Engine braking occurs in all ratios except low gear in the 'D'.

MECHANICAL POWER FLOW

The following series of power flow tables indicate how the various ratios are brought into operation by the engagement of appropriate bands and clutches.

Selector Position	Ratio	Front Clutch	Front Band	Rear Clutch	Rear Band	One-way Clutch
P	—					
R	Reverse			•	•	
N	—					
D	Low	•				•
D	Inter	•	•			
D	High	•		•		
1	Low	•			•	
1	Inter	•	•			

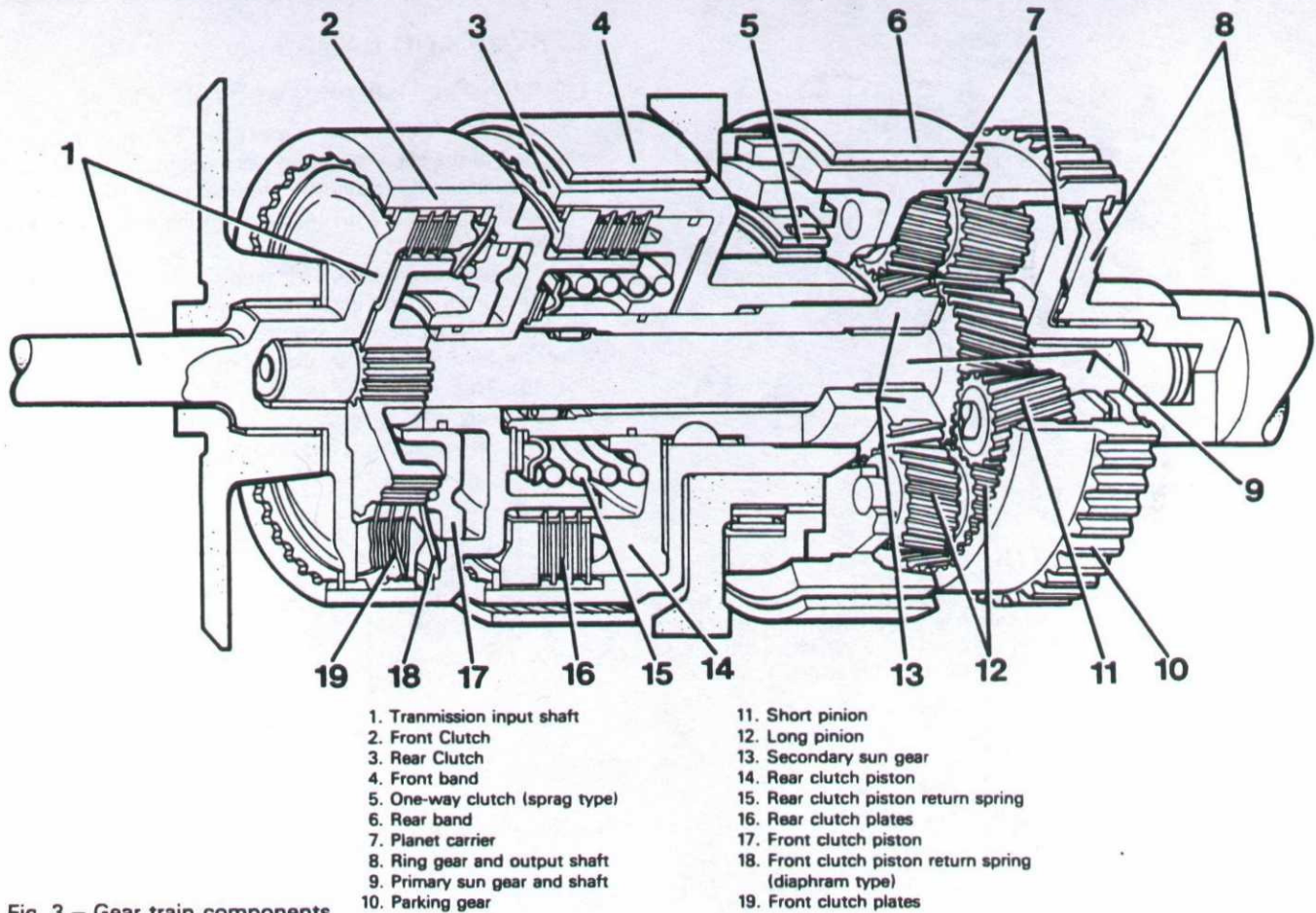


Fig. 3 - Gear train components

P-Park

The front and rear clutches are off, and no power is transmitted from the converter to the gear train. The front and rear bands are also released. For constructional reasons the rear band is applied as long as the engine is running.

Positive locking on the rear wheels is ensured by the engagement of the parking pawl with the teeth on the periphery of the ring gear.

R-Reverse 2·09:1

The rear clutch is applied, connecting the converter to the secondary sun gear. The rear band is applied holding the pinion carrier stationary. Power enters through the secondary sun gear. The long pinions cause the ring gear to rotate in the opposite direction to the sun gear. The primary sun gear and short pinions idle. The gear train provides a reduction in the reverse direction.

N-Neutral

All clutches and bands are released so no transmission of power is possible.

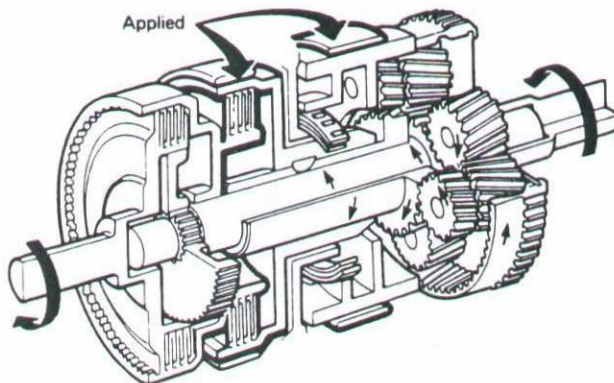


Fig. 4 - Reverse ratio power flow

D-Drive - Low Ratio 2·39:1

The front clutch is applied, connecting the converter to the primary sun gear. The one way clutch is in operation, preventing the pinion carrier from rotating anti-clockwise.

Power enters through the primary sun gear. The short and long pinions cause the ring gear to rotate in the same direction as the primary sun gear while the secondary sun gear idles. When the vehicle is coasting the one way clutch over-runs and the gear train free wheels.

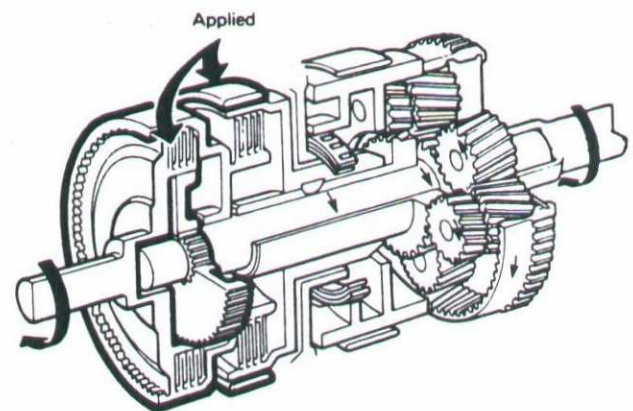


Fig. 5 - Low ratio D power flow

D-Drive - Intermediate Ratio 1·45:1

The front clutch is applied, connecting the converter to the primary sun gear. The front band is applied, holding the secondary sun gear stationary. Power flow through the gears is the same as in low ratio except that the planet carrier is made to rotate clockwise because the long pinions have to 'walk' around the held secondary sun gear. The speed imparted to the planet carrier increases the output shaft speed giving a ratio higher than previously i.e. intermediate ratio.

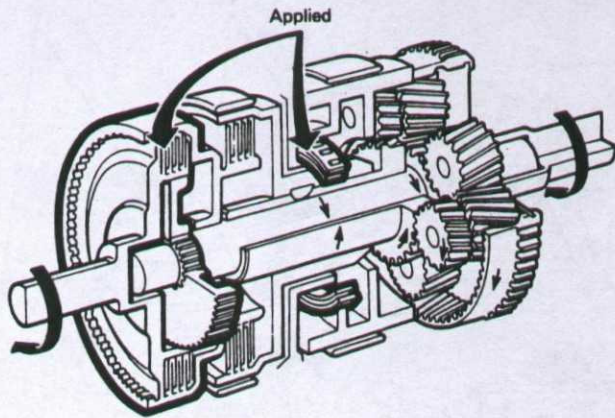


Fig. 6 - Intermediate ratio D power flow

D-Drive - Direct Ratio 1:1

The front clutch is applied, connecting the converter to the primary sun gear. The rear clutch is also applied, connecting the converter to the secondary sun gear. Thus sun gears are locked together and the gear set rotates as a unit providing a ratio of 1:1

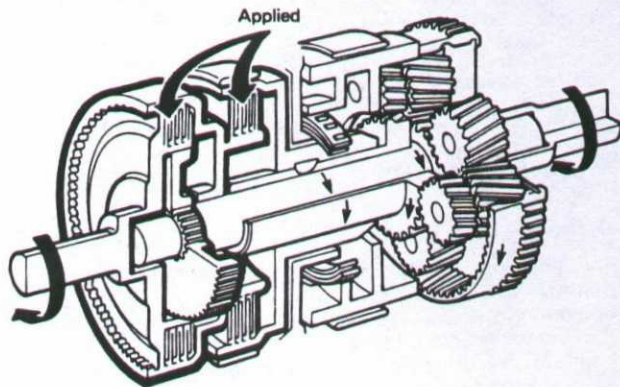


Fig. 7 - Direct ratio (D) power flow

L - Low Ratio

The mechanical operation of the gear train is the same as in D except that the rear band is applied to provide engine braking in low ratio. If this range is selected at high speed, direct gear ratio will be precluded and the transmission will hold intermediate ratio until the speed of the vehicle has reduced sufficiently to allow a 2-1 downshift to occur.

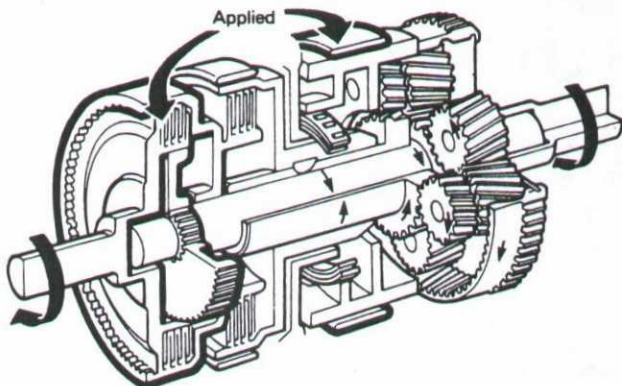


Fig. 8. Low ratio (L) power flow

SERVOS AND BANDS**Front Band and Servo - refer Fig. 9**

The front 'Flexwrap' type band (1) encircles a drum attached to the secondary sun gear assembly. One end of the band is anchored against the abutment (2). The other end of the band engages a strut (4) between the band and the servo actuating lever (5).

The front servo piston (6) exerts a force against the servo actuating lever which acts through the strut on to the end of the band. Under certain conditions, the servo is released by directing fluid pressure to the opposite side of the piston via line 15. This is the larger side of the servo piston and consequently a larger force can be produced. This, together with the release spring pressure will release the servo.

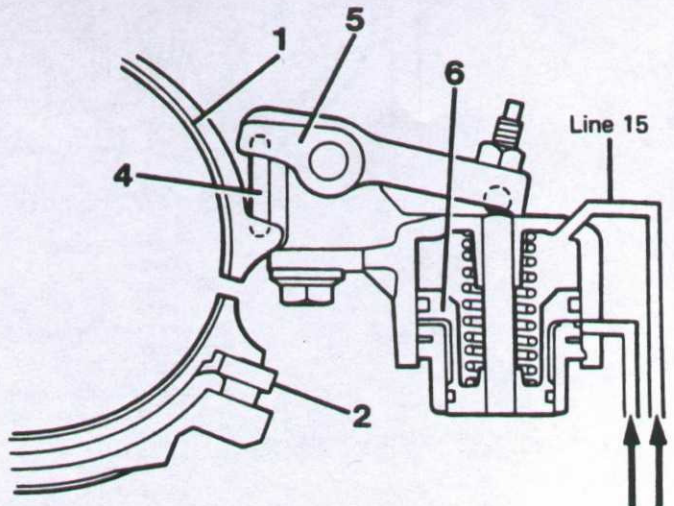


Fig. 9. Front band and servo

Rear Band and Servo - refer Fig. 10.

The rear band (1) encircles a drum formed on the planet carrier. One end of the band contacts the adjusting screw head (2) in the transmission housing. The other end of the band engages a strut (3) between the band and the servo actuating lever (4).

The band is applied by the application of fluid pressure from line 13 to the piston (5) and released by means of a 'hairpin' spring (6). Band clearance is adjusted by adjusting screw (7) and locknut (8).

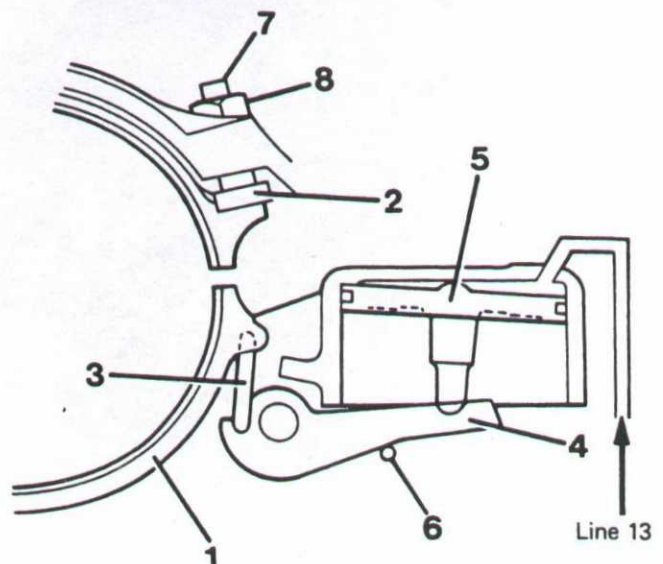


Fig. 10. Rear band and servo

PART 2

SERVICE INFORMATION

The greater majority of automatic transmission service jobs can be traced back to shift quality or shift pattern irregularities. By comparison purely mechanical failures are few and far between. If a major mechanical failure does occur, chances are it was caused by an abnormal shift condition. If minor shift problems are corrected early enough, most mechanical failures can be avoided. For this reason this procedure is designed to assist in the diagnosis and correction of shift problems.

The obvious things must be checked first — fluid and service adjustments. Identify the exact nature of the complaint by road-testing the transmission. Once the trouble has been narrowed down to one of the clutches or bands, faults that could cause that one band or clutch to malfunction can be investigated.

There are four important service adjustments in the transmission:-

- (1) Transmission Gearshift Control Linkage
- (2) Transmission Throttle Cable
- (3) Front Band
- (4) Rear Band

To ensure continued trouble-free operation, these four items should be adjusted at the recommended intervals shown in the vehicle Operation and Maintenance Schedule and the fluid level and cleanliness maintained.

The conclusion that the valve body has probably caused the trouble must not be hastily drawn just because of its complex operation and construction.

Experience has shown that most troubles start with neglected service adjustments or fluid. The great majority of transmission problems develop because one of the bands or clutches is not doing what it is supposed to when it is supposed to do it. If it is known what the bands and clutches are supposed to do in low, second, direct and reverse, the band or clutch which is not operating correctly can be found by diagnosis when road-testing the vehicle.

Fluid Level

The fluid level should be checked first on every transmission complaint. Many malfunctions, such as erratic shifting, can be traced to an incorrect fluid level. If the fluid level is low, the clutches and bands will not operate properly, while a high fluid level can result in foaming of the transmission fluid which will allow air to enter the hydraulic system and upset the operation of the control valves, band servos and clutch pistons.

Checking the Fluid Level

Stand the vehicle on level ground and apply the handbrake firmly. Start the engine from cold and, with the footbrake firmly applied, run the engine at idle speed for 2 to 3 minutes, passing selector lever through the complete range of positions two or three times and pausing for about 10 seconds in each, to ensure that the transmission is primed.

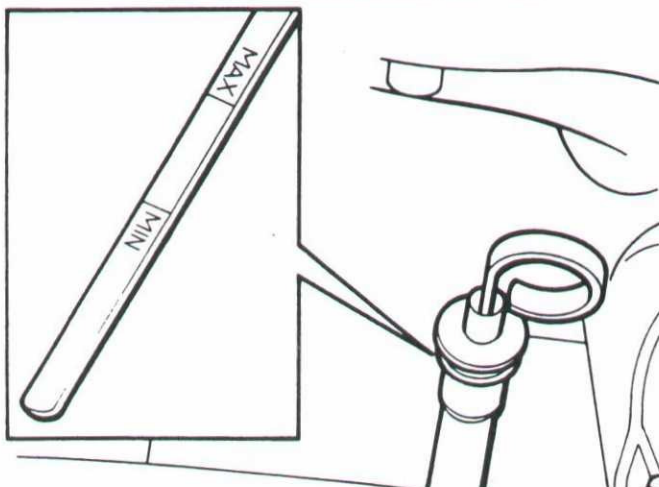


Fig. 11—Checking the fluid level

Select the 'P' (Park) position and keep the handbrake applied. Leave the engine running at idle speed. Remove the transmission dipstick and wipe it with a clean, non-fluffy cloth.

Switch off the engine. Immediately insert the dipstick all the way into the filler tube then withdraw it and check the fluid level. **THIS OPERATION MUST BE COMPLETED WITHIN 10 SECONDS OF ENGINE SWITCH OFF.**

Check the fluid level on the dipstick and if necessary, add fluid through the dipstick tube. **SEE SERVICE LUBRICANTS.**

Repeat instructions until the fluid level is correct. Do not overfill the gearbox. The difference between the max. and min. marks on the dipstick is approximately 1 pint (1.2 U.S. pints, 0.6 litre).

When checking the fluid level, note the condition of the fluid as some good clues to the probable cause or extent of the trouble can often be obtained from the condition of the fluid.

Fluid with Burnt Odour

Black or dark-coloured fluid, having a strong burnt smell, is caused by an overheated clutch, band or prolonged stalling.

By the time this condition becomes apparent, loose friction material from the deteriorating band or clutch has probably worked its way into the fluid passages in the transmission, causing valves to stick. Sticking valves may cause other friction elements to fail.

Milky-Appearing Fluid

If the fluid appears milky, it may be contaminated with water. This condition is not common, but it is possible.

Since the engine coolant attacks O-rings, seals, clutches and bands, a complete overhaul is necessary. If this condition is found, ensure that the reason for coolant leakage into the transmission fluid is rectified.

FX4S Plus

Check for a leak in the transmission oil cooler in the lower tank of the radiator by disconnecting the fluid lines and applying air pressure to the oil cooler connections, — **DO NOT EXCEED 15lb PER SQ. IN.** If a leak exists, air will bubble up through the coolant in the radiator.

This is a combined unit. If a leak occurs in the oil cooler section the complete radiator must be removed for repair/replacement.

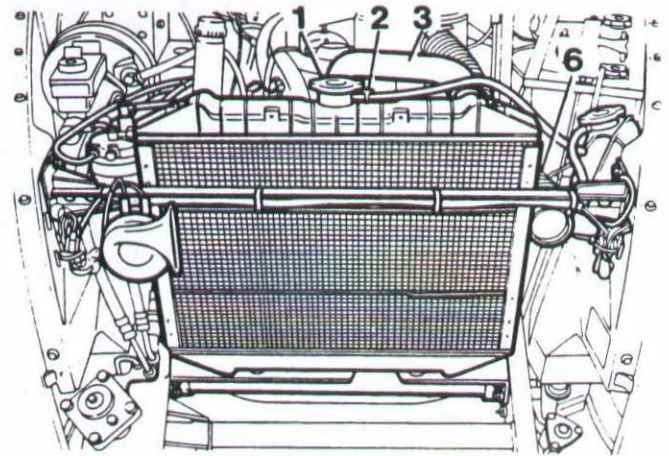


Fig. 12—Oil cooler FX4S plus

Removing

1. Remove radiator cap, unscrew drain tap and drain radiator.
2. Disconnect expansion tank hose at radiator.
3. Disconnect radiator top and bottom hoses.
4. Disconnect oil cooler pipes.
5. Remove fan cowl.
6. Remove air cleaner intake hose bracket.
7. Remove four fixings and carefully lift radiator oil cooler from mounting frame.

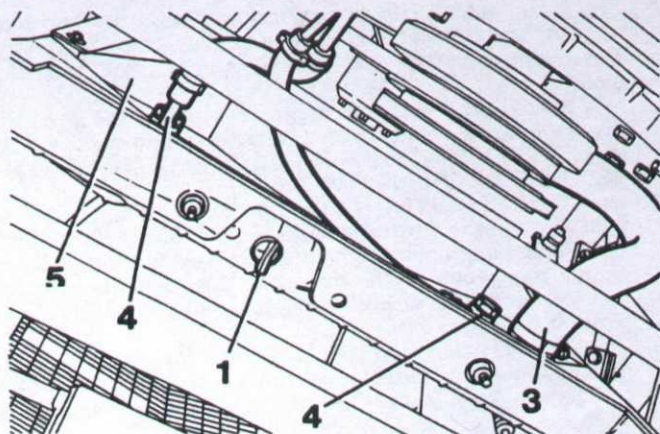
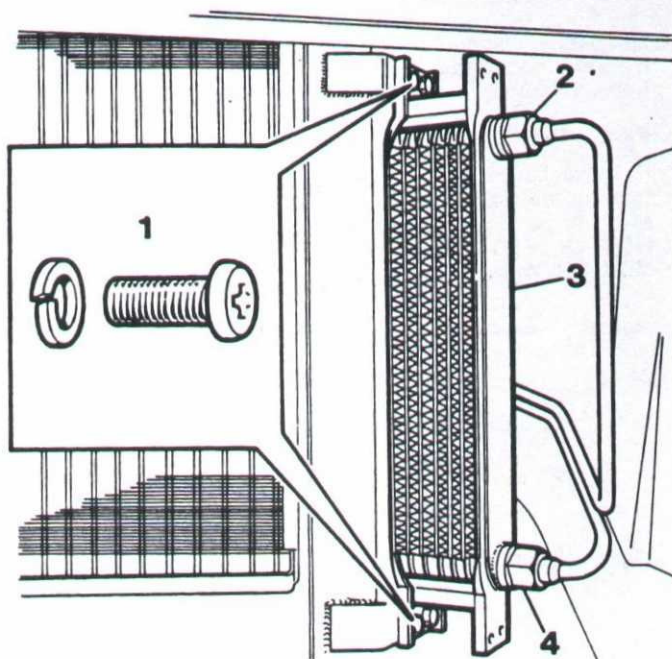


Fig. 13 - Oil cooler FX4S plus

Refitting

8. Reverse removal procedure ensuring the oil cooler pipe connections are tightened to the correct torque.

9. Top up the gear box using new transmission oil to the correct specification.

FX4S

- | | |
|--------------------------------|-------------------------|
| 1. Oil cooler retaining screws | 3. Oil cooler |
| 2. Upper pipe union nut | 4. Lower pipe union nut |

Fig. 14 - Oil cooler FX4S

Removing

- (1) Disconnect the battery.
- (2) Drain the cooler by disconnecting the lower pipe union nut.
- (3) Disconnect the oil cooler upper pipe union nut.
- (4) Remove the four retaining screws with spring washers and lift off the oil cooler.

Refitting

(5) Reverse the procedure tightening the oil cooler pipe union nuts to 9lbf ft (1-24 kgf m).

NOTE: If oil seepage occurs, further tightening of the pipe union nuts should only be carried out with the boss of the oil cooler connection held securely.

(6) Top up the gearbox using new Automatic Transmission oil is the correct specification.

Gearshift Control Linkage Adjustment Test

After checking the fluid level, take a moment to test the gearshift control linkage adjustment. With the engine running and the foot brake lightly applied, select "D" position and then the "N" position. Rev the engine. If there is a definite tendency for the car to move forward, with the transmission in neutral and the brakes released, check the gearshift control linkage adjustment.

Repeat the test by selecting "R" and then the "N" position. If the car definitely attempts to back up, the gearshift control linkage adjustment must be checked.

EXTERNAL OIL FILTER (WHEN APPLICABLE)

NOTE: THIS FILTER WAS DELETED FROM CHASSIS NUMBER 64305.

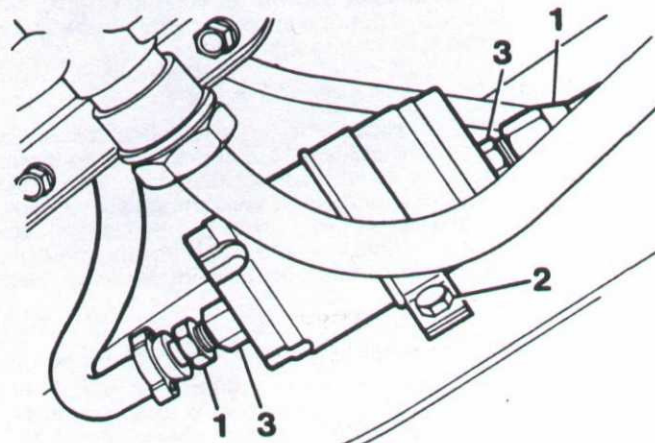
NOTE: The oil filter must be changed after the first 6,000 miles (10000 km) and subsequently only after a major gearbox failure or overhaul.

Removing

- (1) Unscrew the tube nuts at either end of the filter.
- (2) Remove the nut and bolt securing the filter mounting bracket to the chassis.
- (3) Detach the mounting bracket from the filter.

Refitting

- (4) Fit the mounting bracket to the new filter and attach the bracket to the chassis, tightening the nut and bolt finger tight.
- (5) Connect the pipes to the filter, holding the hexagons on the filter body securely while tightening the tube nuts.
- (6) Fully tighten the mounting bracket nut and bolt.
- (7) Top up the gearbox using new Automatic Transmission Fluid.
- (8) Check the filter connections for leaks.



- | | |
|----------------------------------|----------------------------|
| 1. Tube nuts | 3. Hexagons on filter body |
| 2. Mounting bracket nut and bolt | |

Fig. 15 - Oil filter

Being towed - automatic gearbox

Before being towed add an extra 3 pints (3.6 U.S. pints, 1.7 litres) to the transmission and move the selector lever to 'N'.

A vehicle fitted with automatic transmission must not be towed at speeds higher than 30 m.p.h. (48km/h) or for a distance greater than 30 miles (48km).

If the transmission is faulty, remove the propeller shaft or tow with the rear wheels lifted.

CAUTION: When the vehicle is being transported, 'P' must be selected; except if the vehicle is being carried as rail

freight, when 'N' must be selected. The handbrake must always be applied.

Towing - automatic gearbox

When towing another vehicle, always select 'L' before ascending or descending steep gradients. Driving in these conditions with 'D' selected can give rise to dangerous overheating of the transmission fluid.

DESCRIPTION

The automatic transmission incorporates a fluid torque converter coupling in place of the usual flywheel and clutch. The converter is coupled to a hydraulically operated planetary gearbox which provides three forward ratios and reverse. All forward ratios are automatically engaged in accordance with accelerator position and speed of the car.

Over-riding control with appropriate engine braking is available for the first and second gear ratios by manual selection of 'L'.

SELECTOR

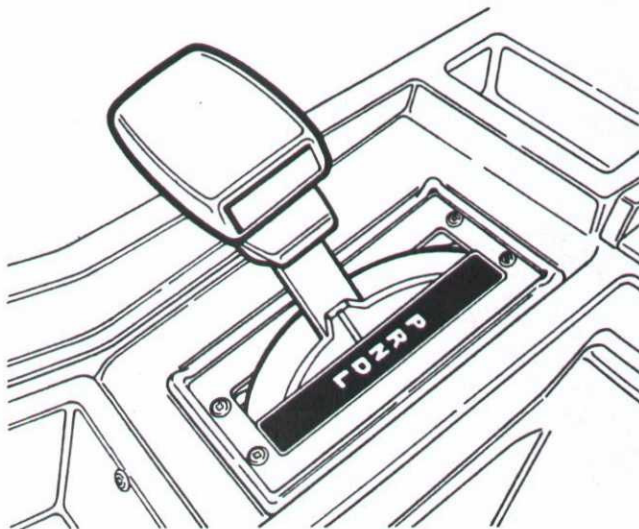


Fig. 16— Gear Selector

Parking pawl engagement check

Stand the car on a level surface. Switch off the engine, release the handbrake and move the selector level to 'P' (Park). Attempt to push the car backwards and forwards; the car should not move. Consult your Dealer if the car does move.

'P' (park)

In the park position no engine power is transmitted to the rear wheels. The gearbox is locked mechanically by a parking pawl engaging a gear on the driven shaft.

Use of the park position is recommended whenever the car is parked or when the engine is to be run for tuning or adjustment.

DO NOT select 'P' when the vehicle is moving.

'R' (reverse)

This position provides a reverse ratio with full engine braking. DO NOT select 'R' when the vehicle is moving forward.

'N' (neutral)

In the neutral position no engine power is transmitted to the rear wheels. The hand brake must be applied when the selector is at 'N' and the vehicle is at rest.

'D' drive

The position for all normal driving. This position covers a range of three ratios, all of which are engaged automatically and progressively up and down according to the vehicle speed and the position of the accelerator. Provided the vehicle speed is below a preset maximum, down-changes may be effected by fully depressing the accelerator past a detent mounted on the toeboard (kick-down).

'L' (lock-up)

Provides over-riding control for the first or second gear ratios with appropriate engine braking.

When starting from rest with the selector in 'L' the transmission starts in first gear and will remain locked in that gear irrespective of road speed and accelerator position. This gear provides maximum engine braking.

When the transmission is in the 'D' range the selection of 'L' will immediately give second gear ratio or first gear ratio at road speeds under 5 m.p.h. (8 km.p.h.), with engine braking. First gear may also be obtained by fully depressing the accelerator (kick-down at speeds of up to 12 m.p.h. (19.3 km.p.h.).

DRIVING PROCEDURE

A starter inhibitor switch embodied in the gearbox ensures that the starter will only operate when the selector is in the 'P' or 'N' position. With 'N' selected, apply the hand or foot brake before starting the engine.

NOTE.— Always select 'P' and apply the hand brake before attempting to start the engine when standing outside the vehicle, also when tuning or adjusting the engine.

PART 3 BORG WARNER AUTOMATIC TRANSMISSION MODEL 40

SPECIFICATION

TRANSMISSION GENERAL

Type Automatic 3 speed with torque converter
Torque Converter Diameter 242mm
Cooling Oil Cooler Radiator
Transmission Fluid "Dexron" II Automatic Transmission Fluid

GEAR RATIOS

1-Low 2.39:1
2-Second 1.45:1
D-Drive - Direct 1.00:1
R-Reverse 2.09:1

LINE PRESSURES

Idle 55-70 lbf/IN²
Idle plus 500 rev per min 75-95 lbf/IN²
Axle Ratio 3.909:1

SHIFT PATTERN

CONDITION	UPSHIFTS MPH		DOWNSHIFTS MPH		
	1-2	2-3	3-2	3-1	2-1
'D' SELECTED MINIMUM THROTTLE	8-13	10-15			
FORCED THROTTLE (KICK DOWN)	25-33	47-56	32-43	12-21	
'L' SELECTED FORCED THROTTLE (KICK DOWN)					

BELOW
11

CLUTCHES

Number of front clutch plates (steel) 4 "Flat"
Number of front clutch discs (friction) 5 "Flat"
Number of rear clutch plates (steel) 2 "Flat" and 3 "Dished"
Number of rear clutch discs (friction) 5 "Flat"

PART 4 TEST AND DIAGNOSIS

BAND AND CLUTCH APPLICATION CHART

LOW	LOW (Lock-up)	SECOND	DIRECT	REVERSE
FRONT CLUTCH	FRONT CLUTCH	FRONT CLUTCH	FRONT CLUTCH	REAR CLUTCH
OVER-RUNNING CLUTCH	(REAR) BAND	(FRONT) BAND	REAR CLUTCH	(REAR) BAND

Road Test

A road test takes time, but tackling a transmission problem without identifying the exact nature of the trouble does not save time on most transmission problems. Sometimes the nature of the complaint is obvious, however, more often than not it is hard to tell from the owner's account of his trouble just what he is complaining about.

Identify the Complaint

Find out exactly what the owner is complaining about by having the owner drive the vehicle so he can demonstrate the transmission fault.

Start with a Normal Transmission Performance

Before attempting to diagnose a condition on road test, the normal performance and shift qualities of that transmission must be fully understood and recognised.

If they are not, time should be taken to acquaint yourself with them by driving other vehicles that are correctly tuned and adjusted.

Road Test Procedure

Very little can be learnt about normal or abnormal automatic transmission operation by taking a short "joy ride", with the transmission in "D" range. All positions must be tried, accelerate and decelerate, compare shift quality under light, medium and heavy throttle and test kickdown and part throttle downshift performance.

It is most important to learn and visualise which band or clutch is being applied for each gear.

During the road test, concentrate your thoughts on what the clutches and bands are doing, rather than the control valves and hydraulic circuits.

Reference to the above "BAND AND CLUTCH APPLICATION CHART" will assist you when forming a mental picture of the internal functions of the transmission.

D Low

When the "D" position is selected, the transmission shifts into "Low" for good acceleration from a standing start. In this gear the front clutch is applied and the over-running clutch locks to obtain the first gear ratio. It must be remembered that the over-running clutch will transmit power on forward drive only.

It automatically releases on deceleration and no power is transmitted from the rear wheels to the engine. There is no engine braking and the vehicle coasts, refer Fig. 17.

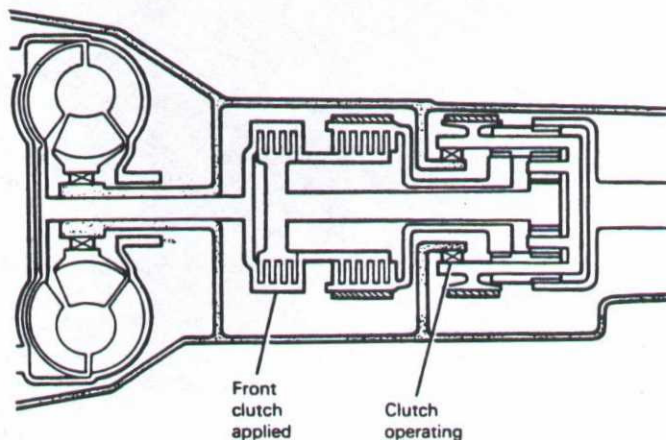


Fig. 17. — Elements applied in D low

L Low

When the L position is selected, the front clutch is applied just as it was in D — Low.

In addition, the rear band is applied, refer Fig. 18.

The REAR band is a "two-way" coupling, giving a low gear ratio for both acceleration and deceleration. That is, provides maximum engine braking whereas the over-running clutch provides no engine braking.

If the band should fail to apply, the over-running clutch would transmit the drive on acceleration giving a condition as in D low in the number L position. As with D low, there would not be any engine braking on deceleration. In addition, there would not be any power transmitted through the transmission with the reverse "R" position selected.

Since the low and reverse band provides a low gear ratio for both acceleration and deceleration, the reason for employing the over-running clutch to obtain low gear ratio in D low may cause some confusion. As band-to-band shifts are difficult to synchronize and are apt to be very harsh, the over-running clutch is utilized in D low to ensure smooth shifts between first and second. Also a closed throttle downshift to a low gear which provided maximum engine braking would be

abrupt and undesirable. This can be demonstrated by releasing the pressure from the throttle and selecting the L position at 15mph.

A noticeable jolt will be felt as the transmission downshifts into low gear. Part of the jolt is engine braking and part of it is from the low reverse band application.

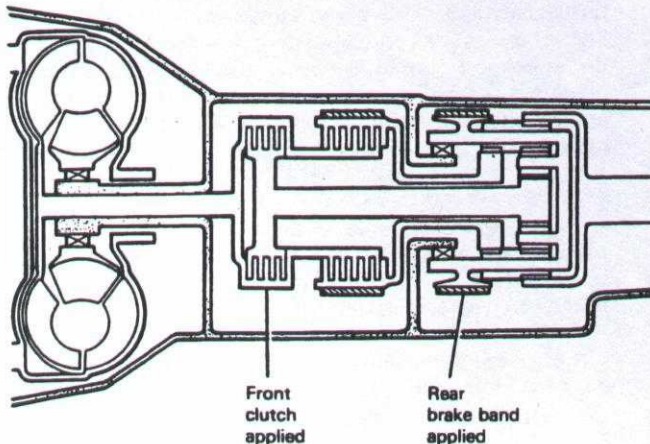


Fig. 18. - Elements applied in No. 1 position - low

To eliminate the harsh shifts between low and second, the over-running clutch acts as follows:

For smooth one-two upshifts, the over-running clutch simply over-runs as soon as the kickdown band is applied. The problem of timing or synchronising the upshift is eliminated. For smooth, closed throttle downshifts, the over-running clutch simply "coasts". The shift is very smooth and the over-running clutch stands by to pick up the load automatically when the driver chooses to accelerate/drive.

Front Clutch Slippage Test

Here is an example of how a working knowledge of bands and clutches can be applied to road test diagnosis.

If slippage exists in the low gear with the L position selected, as well as in D low, the trouble must be in the front clutch. The front clutch is the common drive element to both the D low and L low, refer Fig. 19.

Second Gear

In second, the front clutch and the front band are applied. If the transmission slips in second, but does not slip in D low, or direct, the trouble must be in the front band application, refer Fig. 20. At this point it will not be known whether the trouble is in the band itself or in the band apply circuit.

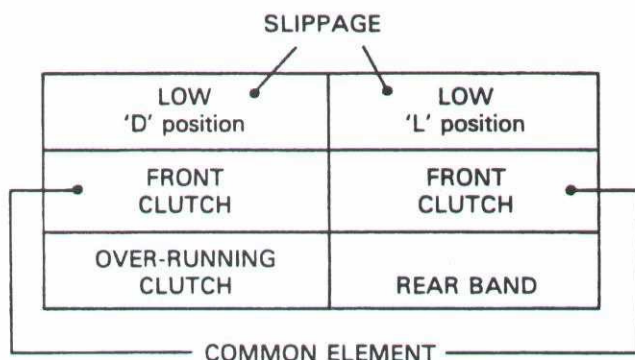


Fig. 19. - Diagnosis of front clutch slippage

However, the friction element at fault is known and investigations can start at this point ... starting with front band adjustment.

Reference to Fig. 20 will show that the slippage is not in the front clutch. Eliminating the friction elements that are not giving trouble speeds up the job of diagnosis and service.

NOTE: If the transmission shifts from low to direct, missing second completely, the front band is not applying.

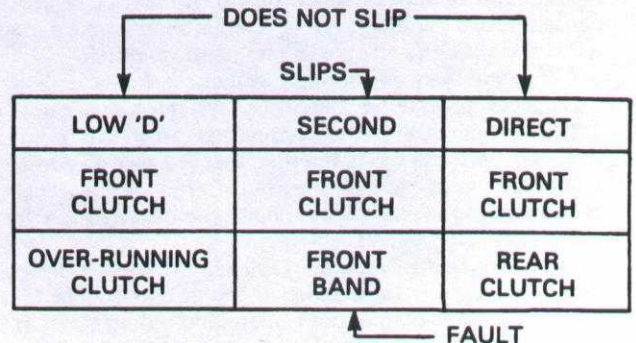


Fig. 20. - Diagnosis of front band slippage

Direct Drive

In direct drive the front clutch and rear clutch are both applied. The front clutch is applied in direct, second and low ... in all forward gears. Therefore, if slippage occurs in direct drive but not in second or low the front clutch can be considered satisfactory.

By the process of elimination the fault must be with the rear clutch, refer Fig. 21.

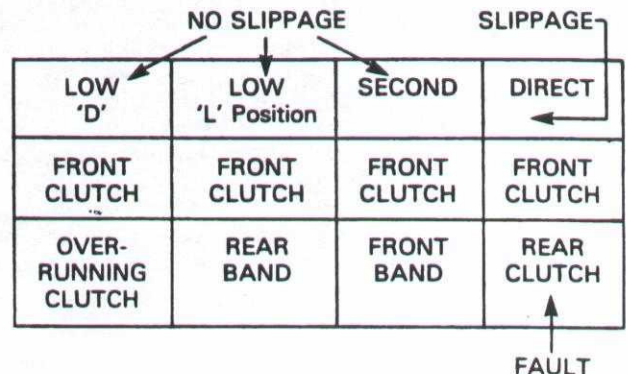


Fig. 21. - Diagnosis of rear clutch slippage

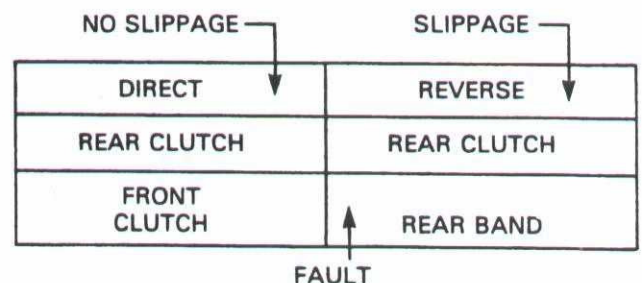


Fig. 22. - Diagnosis of reverse band slippage

Reverse Gear

In reverse gear, the rear clutch and the rear band are applied. The rear clutch is the friction member that is common to direct drive and reverse (refer Fig. 22). If there is slippage in reverse but no slippage in direct drive, the fault is most likely in the rear band application.

NOTE: If the rear band should fail to apply, no engine braking could be obtained with the transmission in the "LOW L" position. (Refer Paragraph headed L LOW).

Diagnosis by Elimination

The clutch and band application chart shown earlier is a simple but extremely useful aid to diagnosis. The examples and explanations shown in the foregoing paragraphs illustrate how fault diagnosis is simplified when it is known which bands and clutches are applied for each gear. It is not practical in a section of this size to try and cover every conceivable type of malfunction or shift quality problem. It must be realised that occasionally a condition will be encountered where a road test will not isolate the trouble to one band or clutch.

If more than one friction element is faulty or if friction material is preventing the valves in the valve body from operating correctly, the symptoms may be confusing. However, in these cases the road test will help to confirm the suspected fault when the burnt friction material was discovered in the transmission fluid; the transmission must be completely over-hauled.

On the other hand, removal of the transmission unnecessarily can be avoided if the exact trouble that the owner is complaining about is identified during the road test.

Engine Performance is very Important

The condition of the engine must not be over-looked, particularly on complaints relating to shift quality or performance. Idle speed and engine performance should be up to specifications as the shift pattern and shift quality of the transmission is tailored to normal engine performance.

The transmission **cannot** compensate for an engine which has become sluggish, it will automatically continue to carry out each shift as crisply as it should for a correctly tuned engine delivering full torque. The usual result being delayed or harsh shifts.

If the engine output is low, the driver has to open the throttle more to accelerate. Transmission throttle pressure will be too high in relation to actual engine torque, resulting in delayed, harsh shifts which resemble the trouble encountered when transmission throttle cable adjustment is advanced too much. **Under no circumstances should transmission throttle cable be adjusted to compensate for poor engine performance; correctly "tune" the engine.**

More than one shift quality complaint has been corrected by correcting engine performance and not touching the transmission.

Shift Speeds

The shift pattern summary chart as detailed in specifications summarises shift speeds for the transmission.

Reference to this chart should be made when conducting a road test. However, it is **permissible** for shift speeds to occur just **outside** the ranges, **as long as** the shift quality is good.

Speedometer error, abnormal vehicle loading and abnormal operating conditions also affect the shift points. However, if shift speeds are appreciably outside the specified range, transmission throttle cable adjustment may be incorrect.

Service Adjustments and Test

The road test will help pinpoint the trouble to one specified clutch or band. If the problem is traced to either the front band or the rear band, a band adjustment may be all that is needed to correct the complaint. However, if an adjustment appears to correct the complaint, ensure that a sample of the transmission fluid is checked for loose particles of band facing material before returning the vehicle to its owner.

Any evidence of deteriorating friction material necessitates a complete overhaul.

On complaints of poor shift quality, the gear shift control linkage adjustment and the transmission throttle cable adjustment must be checked. These two adjustments will correct many shift complaints and they are insurance against transmission troubles of a more serious nature.

Procedures for carrying out the following service adjustments and test necessary for diagnosing transmission faults are outlined in the Service Procedure.

1. Rear band adjustment.
2. Front band adjustment.
3. Transmission throttle cable adjustment.
4. Line pressure check.

Important Service Precautions

An automatic transmission is a complex assembly ... particularly the valve body. However, it is not necessary to know how every control valve and hydraulic circuit works to do an expert job of servicing the transmission. Accurate diagnosis will indicate what to concentrate on if disassembly and repair is necessary. It will also help to avoid unnecessary disassembly.

The Valve Body

The valve body is undoubtedly the one part of the transmission that technicians fear most, and because the valve body is complex and awe-inspiring many serviceable valve bodies are replaced unnecessarily.

Of course a new valve body will cure many shift problems but a thorough cleaning of the original valve body could also cure the shift problem.

NOTE: The most common cause of valve body trouble is dirt, not worn or damaged parts.

Valve Body Service Tips

There are three important points to remember when servicing the valve body.

1. Handle all parts gently.
2. Clean all parts thoroughly and keep them clean.
3. Assemble all parts correctly.

If the above cardinal rules of valve body service are observed and the service tips below are read, no trouble should be experienced.

Handle Parts Gently

Never clamp the valve body or any part of a body in a vice. Do not use force when removing or installing parts. The "fits" between valves and bores are close but they will go together easily if they are free from nicks and burrs and absolutely clean. Be careful not to drop any of the parts, especially the valves.

Clean Parts Thoroughly

Since dirt is the number one enemy of the valve body assembly, it stands to reason that a thorough cleaning is the number one cure. Many technicians prefer to clean the parts in a series of solvent-filled containers, beginning with a solvent that has been used considerably. In this container the largest deposits are removed. From there, the parts are immersed in containers having successively cleaner solvent. Finishing with a clean solvent, rinse. Dry the parts with clean, dry compressed air. Do not wipe parts with a cloth - lint will remain on the parts.

CONVERTER FAULT DIAGNOSIS

Torque converter faults can only be correctly determined when road test findings, transmission performance, engine condition, and stall test results have all been considered.

Slipping stator (stator free-wheel slipping)

- (1) Inability to pull away on steep gradients.
- (2) Poor acceleration from rest.
- (3) Stall test reading LOW.

Seized stator (stator free-wheel seized - unusual fault)

- (1) Reduced maximum speed in all gears, pronounced in top ratio.
- (2) Severe overheating of converter and transmission.
- (3) Stall test reading NORMAL.

Transmission slip (selected gear components slipping)

- (1) If the fault is apparent in both 'L' and 'R' it is usually due to low pressure.
- (2) If the fault is present in only one position a faulty component is the most likely cause.
- (3) Stall test reading HIGH.

STALL TEST

Stall speed is the maximum speed attainable at forced throttle (kick-down) with the converter turbine held stationary.

IMPORTANT – Duration of stall must not exceed 10 seconds.

- (1) Apply the hand brake and chock the wheels.
- (2) Run the engine until the normal operating temperature of the transmission is reached.
- (3) Check the transmission fluid level.
- (4) Apply the foot brake, select 'L' or 'R' (as required for test elimination), depress the accelerator pedal to the kick-down position for not more than 10 seconds and note the highest r.p.m. reading on the instrument.
- (5) Check the reading obtained against the following chart.

R.P.M.	Condition indicated
Under 1600	Slipping stator
1600 to 1800	NORMAL
Over 1800	Transmission slip

Noise

A whining or siren-like noise due to fluid flow is normal during stall operation with some converters; however, loud metallic noises from loose parts, or interference within the assembly, indicate a defective torque converter. To confirm that the noise originates within the converter, operate the vehicle at light throttle in "D" and "N" on a hoist and listen under the transmission converter housing.

PART 5

SERVICE PROCEDURE

ADJUSTMENTS**Front brake band**

- 1 Drain the gearbox, noting that a quantity of fluid will remain in the converter.
- 2 Remove the screws securing the gearbox oil pan and remove the pan.
- 3 Slacken the front servo adjusting screw locknut, move the servo lever outwards and place a spacer of .250 in. (6.35 mm.) thickness between the adjusting screw and the servo piston pin.
- 4 Using tool CBW 548 with a flexible adaptor CBW 548-2A tighten the adjusting screw to a torque of 10lb in (.115 kg. m)
- 5 Tighten the adjusting screw locknut to a torque figure of 15-20 lb. ft.
- 6 Refit the oil pan and fill gearbox with fluid to the correct level.

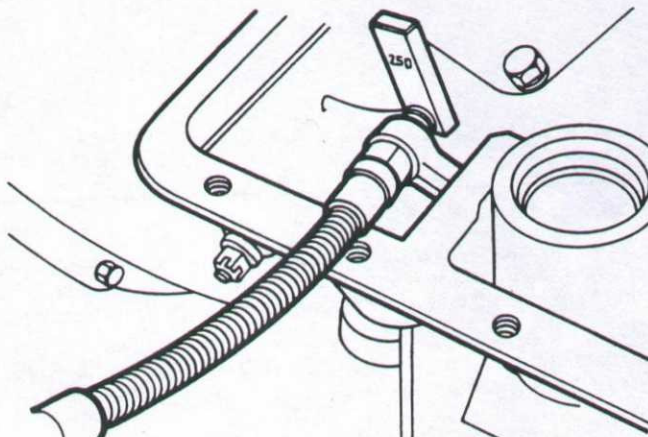


Fig. 23—Front brake band

Rear brake band

- 1 Slacken the locknut on the external adjusting screw.
- 2 Using a torque wrench tighten the adjusting screw to a torque of 10lb ft. (1.4kg. m.) then back off the screw three quarters of a turn.
- 3 Tighten the locknut to a torque figure of 25-30 lb. ft.

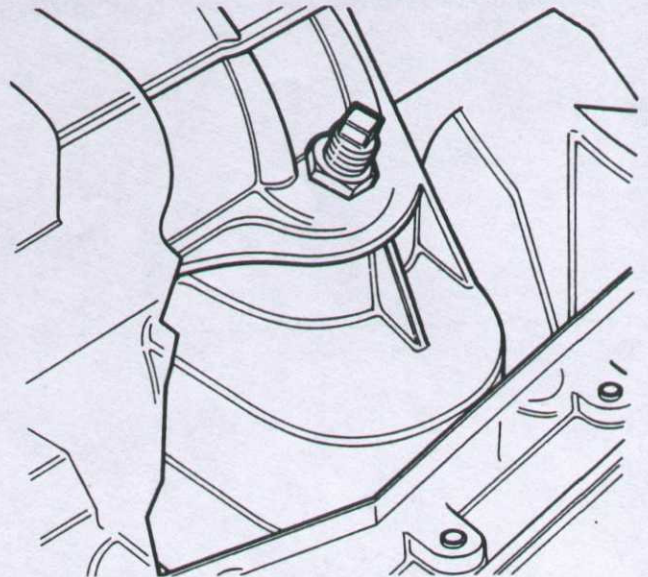


Fig. 24 — Rear brake band

Fluid Leaks

Leaks which may be repaired with the transmission in the vehicle are: transmission output shaft oil seal, extension housing gasket, speedometer and meterdrive gasket or 'O' ring, oil pan gasket and dip stick tube.

If oil is found inside the torque converter housing, determine whether it is transmission fluid or engine oil.

In either case the gearbox must be removed to replace the seals.

Transmission output shaft seal

- 1 Drive vehicle on to ramp.
- 2 Rear wheels need to be free to rotate propeller shaft.
- 3 Remove bolts and locktabs and disconnect propeller shaft from transmission flange.
- 4 Remove bolt securing flange to output shaft.
- 5 Prise out seal.
- 6 Fit new seal ensuring the seal is squarely located in the ext.
- 7 Replace flange and torque up bolt to torque figure.
- 8 Refit propeller shaft using new locktabs.

FRONT PUMP OIL SEAL

To replace the front pump seal the transmission must be removed from the vehicle.

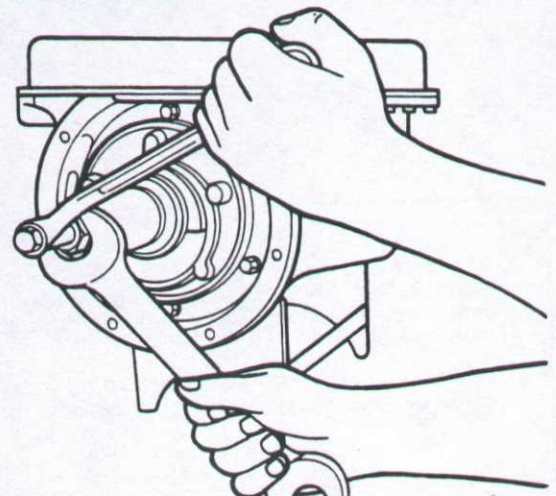


Fig. 25. — Removing pump oil seal

Replacement

The pump seal can be replaced without removing the pump assembly from the transmission case.

(1) Screw remover Tool CBW200 into seal, refer Fig. 1 then tighten screw portion of tool 18G389 to withdraw seal.

(2) To install a new seal, place a seal in opening of pump housing (lip side facing inward). Using Tool CBW202 drive seal into housing until tool bottoms, refer Fig. 2.

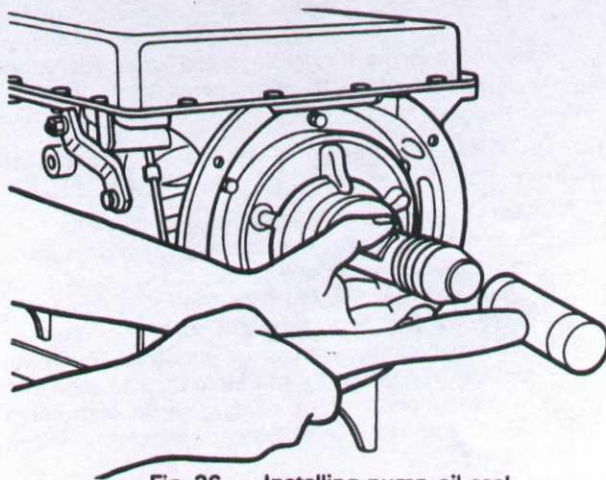


Fig. 26. — Installing pump oil seal

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FX4S

INCLUDING FX4S PLUS

WORKSHOP MANUAL

Section 8b

ELECTRICS

REAR DOOR SECURITY LOCKING SYSTEM

Introduction

When the electronic door security locking system is fitted the rear door locks are activated by the motion of the vehicle or the driver applying the footbrake.

If the ignition is switched on while the vehicle is stationary the fascia warning light will illuminate and the rear doors can be opened.

Note: On FX4S models a red warning light is fitted in the top right hand corner of the fascia, see 1 figure 1. On FX4S Plus models a key symbol is used and is located at the bottom centre of the warning lights, see 2 figure 2.

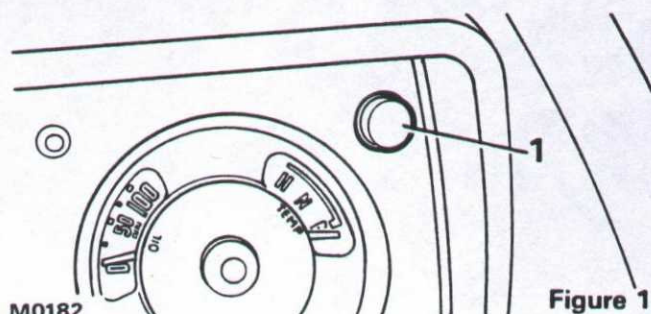


Figure 1

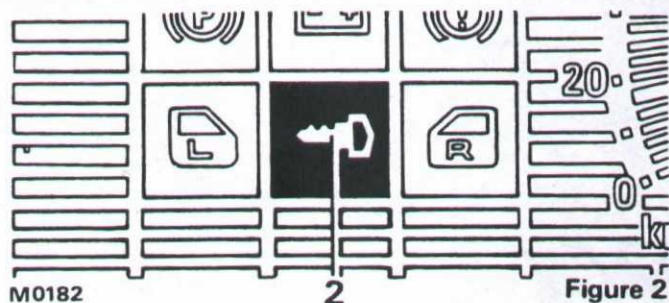


Figure 2

As soon as the footbrake is applied the locks will operate automatically, activated by separate relays through the brakelight switch circuit. The fascia warning light will extinguish and the doors will remain locked from the inside until the footbrake is released.

When the vehicle moves the rear doors will again lock automatically through the operation of the relays, this time activated by a proximity sensor located at the rear of the gearbox. The fascia warning light will extinguish and the doors will remain locked until the vehicle comes to rest. If the vehicle comes to rest without the footbrake being applied there will be a two second delay before the locks release.

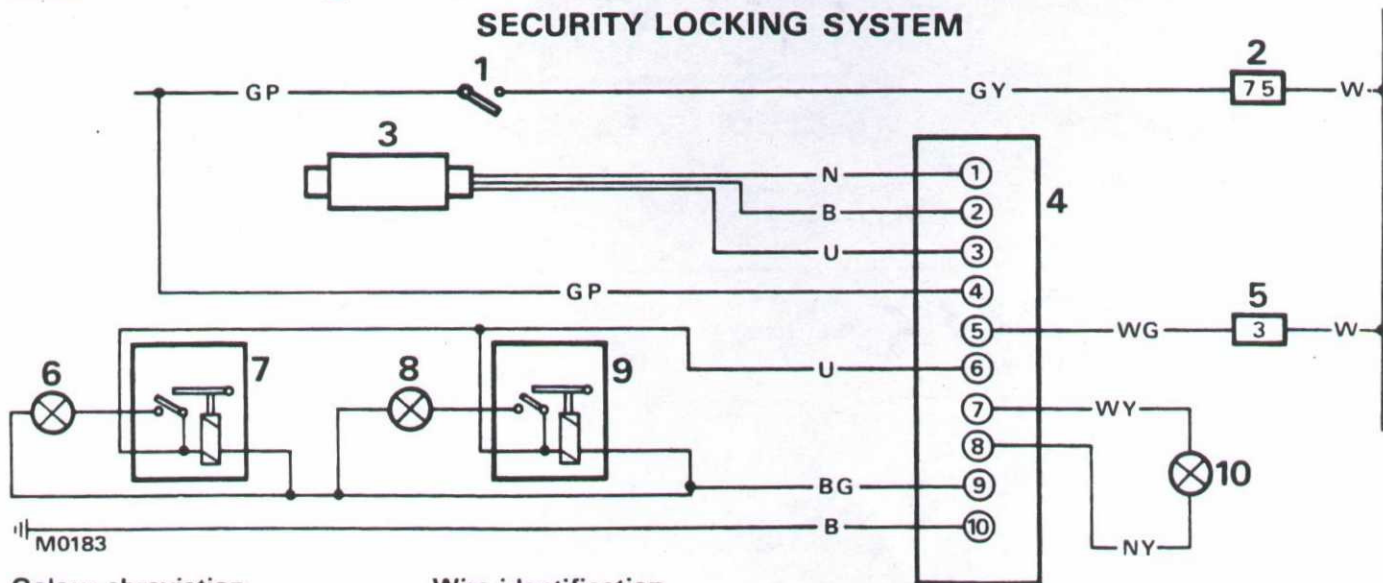
If the vehicle comes to rest with the footbrake applied the locks will not release until a few seconds after the handbrake is applied and the footbrake is released. The locks will release immediately the ignition is switched off.

When the automatic locks are activated, the rear doors can only be opened from the outside. In cases of emergency occupants can open a door by lowering the window and pressing the release button on the external handle.

When the red light, fitted on the rear of the door, extinguishes the door lock is released.

If at any time the fascia warning light illuminates when the vehicle is in motion this will indicate a fault in the door security locking system and must be investigated as soon as possible.

SECURITY LOCKING SYSTEM



Colour abbreviation

B - Black
G - Green
K - Pink
N - Brown
O - Orange
P - Purple
R - Red
S - Slate - Grey
U - Blue
W - White
Y - Yellow

Wire identification

First letter - Primary colour
Second Letter - Tracer colour
(Lighter shade preceded by L)

Key to wiring diagram

- | | |
|----------------------|--|
| 1 Brake light switch | 6 Warning light L.H. door |
| 2 7.5 amp fuse | 7 Relay (solenoid and microswitch) L.H. door |
| 3 Proximity sensor | 8 Warning light R.H. door |
| 4 Control box | 9 Relay (solenoid and microswitch) R.H. door |
| 5 3 amp fuse | 10 Fascia warning light |

Figure 3

Test 1 Fuses

Two fuses are used in the electrical circuit of the locking system, see items 2 and 5 figure 3. If the brake light circuit 7.5 amp fuse blows the fascia warning light will illuminate. However, if the 3 amp fuse in the main supply to the control box fails this will render the locking system completely inoperative and there for the warning light will not illuminate. Always check the fuses first before investigating other components in the system.

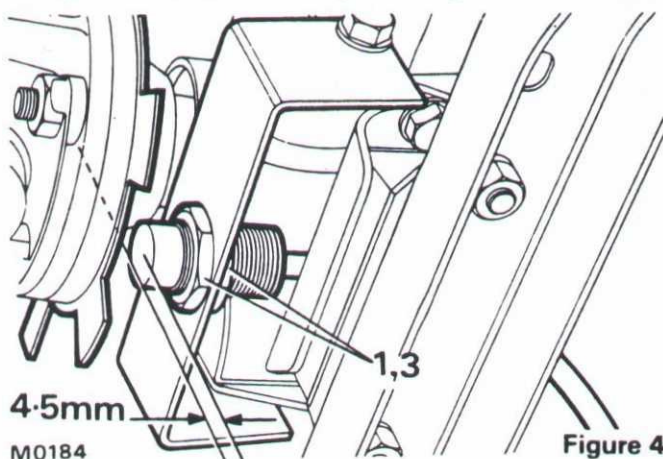
Note: On FX4S models the fuse covering the control box is situated behind the lower fascia board to the right of the ignition switch. The brake light fuse is fitted in the fuse box which is located on the right hand wing in the engine compartment.

The fuse box on the FX4S Plus models is fitted under the fascia above the brake pedal and the fuse ratings and positions are shown on a label on the back of the driver's sun visor.

Test 2 Proximity sensor adjustment

If the fascia warning light flickers or illuminates continuously when the vehicle is moving this could indicate that the proximity sensor is incorrectly positioned and should be adjusted as follows:-

1 Slacken the locknuts and set the face of the sensor square and parallel to the operating disc mounted on the gearbox/propshaft flange, see figure 4.



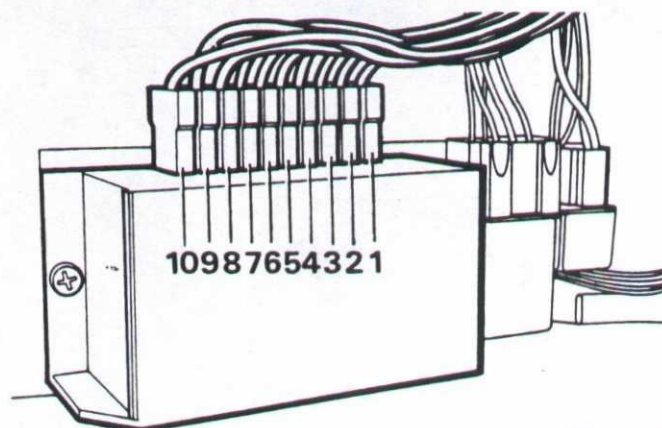
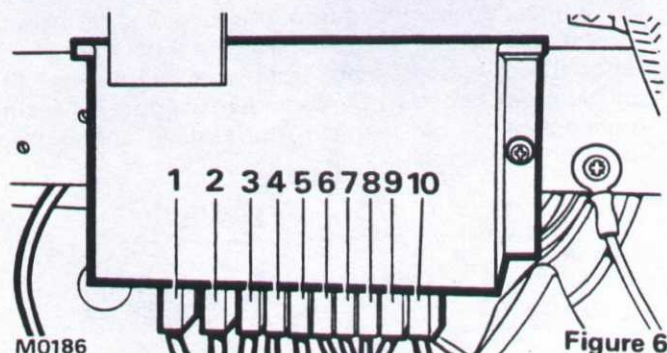
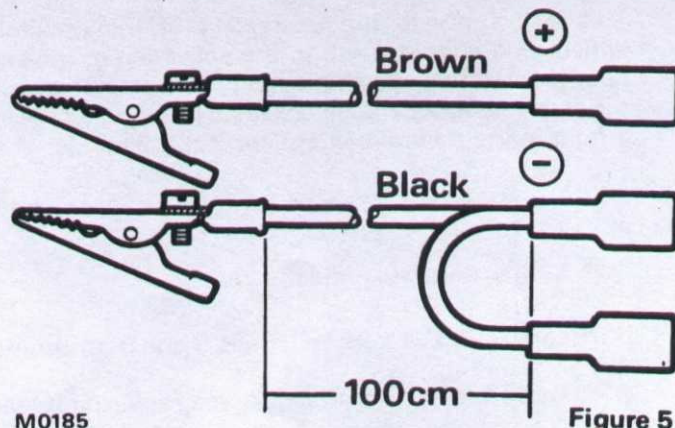
2 Adjust the clearance between sensor and disc to 4.5 mm on both FX4S and FX4S Plus models as shown in figure 4.

3 Retighten sensor locknuts and check locking system. If the fascia warning light still illuminates proceed to test 3.

Test 3 Proximity sensor

A test lead as shown in figure 5 is required for the following procedure, complete with a slave 12 volt battery.

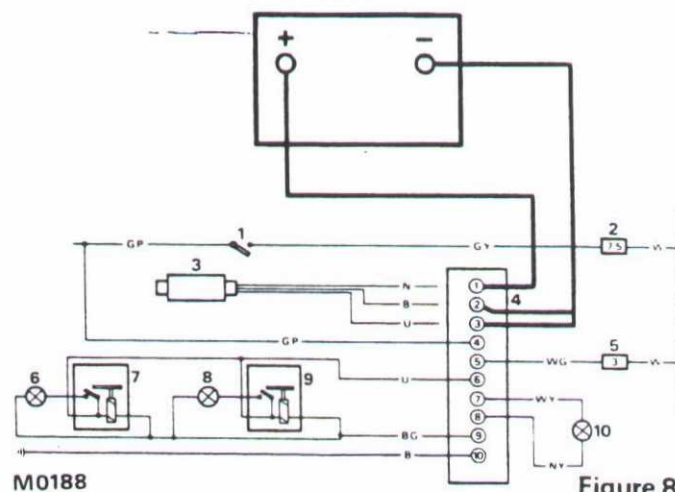
1 On FX4S models it will be necessary to remove the lower fascia board to gain access to the control box which is located on the right hand side, see figure 6. The control box on FX4S Plus models is fitted under the fascia below the left hand radio speaker, see figure 7. To facilitate access to the control box terminals, remove speaker grille.



2 Remove sensor connections 1, 2 and 3 from control box.

3 Using the test lead connect the positive lead to terminal 1 on the control box, see figure 8.

4 Connect negative lead to terminal 3 and fit second negative loop lead to terminal 2.



This will simulate the energising of the proximity sensor and should result in the activation of the rear door locks, thus indicating a faulty sensor. However, if the rear door locks are not activated this would suggest a fault in the control box or door lock solenoids.

Test 4 Rear door solenoids

- 1 Disconnect leads from terminals 6 and 9 on control box.
- 2 Remove rear door trim panel, see replacing a rear door relay, page 6.
- 3 Connect positive lead from the 12 volt slave battery to the blue coded wiring supply to the door solenoids and the negative lead from the battery to the black/green coded wiring as shown in figure 9. Making connection should result in the audible operation of both door solenoids.

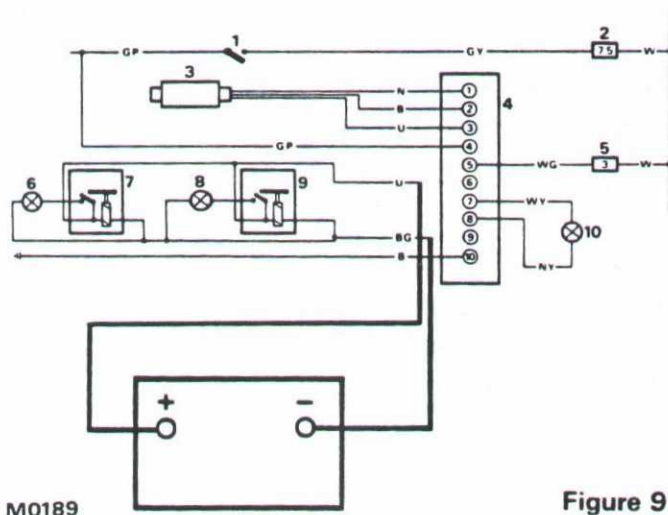


Figure 9

Test 5 Control box/door solenoids

- 1 Disconnect leads from terminals 6 and 9 on control box.
- 2 Connect a 12 volt test lamp across both terminals, see figure 10.
- 3 Switch on vehicle ignition and apply foot brake. The test lamp should illuminate.

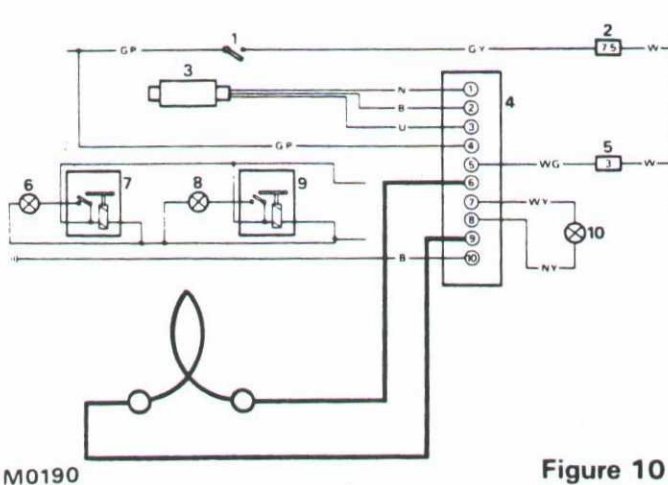


Figure 10

Test 6 Control box/brake light switch

- 1 Disconnect lead from terminal 4 on control box.
- 2 Connect positive lead from 12 volt slave battery to terminal 4 as shown in figure 11 and switch on vehicle ignition. This should simulate the operation of the brake light switch and activate the rear door locks.

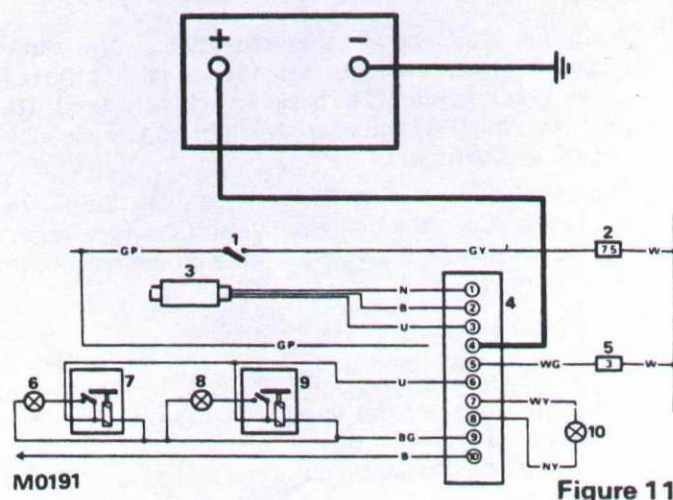


Figure 11

Test 7 Brake light switch and cable

- 1 Disconnect lead from terminal 4 on control box.
- 2 Connect a 12 volt test lamp between the lead and a suitable earth, see figure 12.
- 3 Switch on vehicle ignition and apply foot brake. Operation of the brake light switch should illuminate the test lamp. Failure to do so would indicate failure of the switch or a fault in the circuit cable.

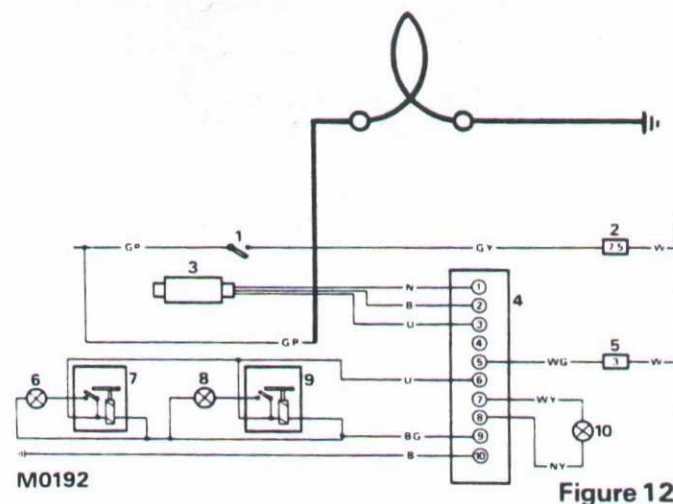
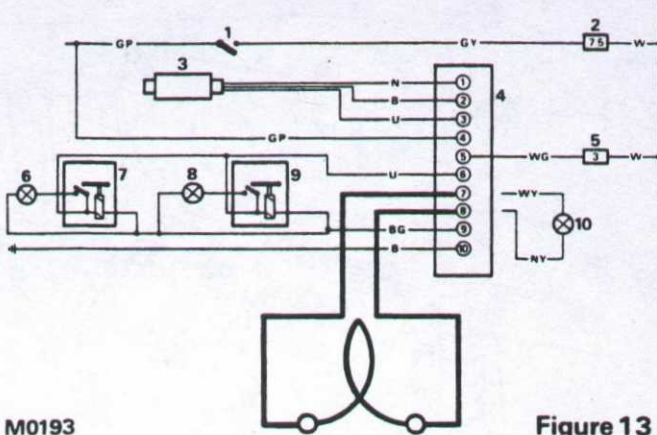


Figure 12

Test 8 Fascia warning light/control box

- 1 Disconnect leads from terminals 7 and 8 on control box.
- 2 Connect a 12 volt test lamp between the two terminals as shown in figure 13.
- 3 Switch on vehicle ignition and the test lamp should illuminate. Failure to illuminate would indicate a fault in the warning light/wiring circuit or control box.



M0193

Figure 13

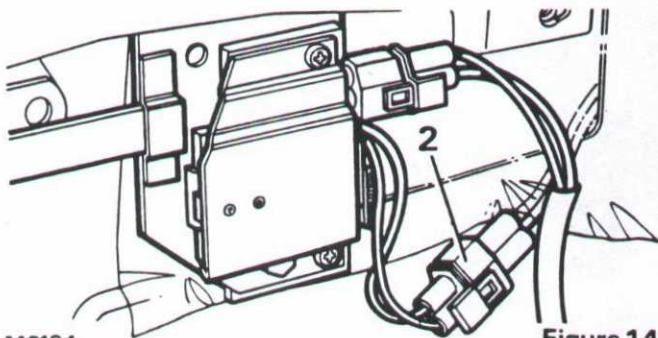
Test 9 Rear door microswitches/warning lights

The rear door microswitches, complete with the solenoids make up the combined relay that activate the door locks, and share the same supply from the control box.

The microswitches operate the warning lights mounted on both doors and inform the rear occupants that the doors are locked.

1 Switch on the vehicle ignition and apply the foot brake. This will energise the solenoids lock the doors and should illuminate the warning lights through the microswitches.

Failure to illuminate will indicate a failure in the microswitch or warning light bulb.

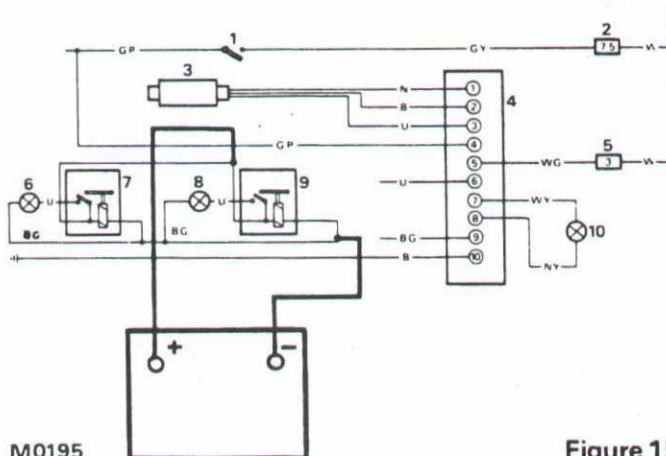


M0194

Figure 14

2 Disconnect the warning lamp lead as shown in figure 14.

3 Connect a 12 volt supply to the lamp harness, see figure 15. The warning lamp should illuminate thus indicating a microswitch failure.



M0195

Figure 15

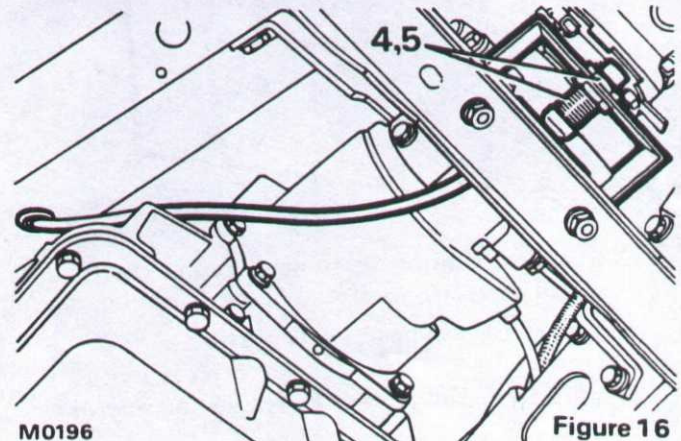
Note: The microswitch and solenoid can only be serviced as a combined relay, complete with mounting bracket.

Replacing proximity sensor

1 Disconnect terminals 1, 2 and 3 from control box.

2 Pull back carpet/matting, if fitted, and carefully release proximity sensor cable.

3 From under the vehicle remove rubber grommet and pull cable through grommet aperture. Figure 16 shows the grommet location for FX4S Plus vehicles. On FX4S vehicles cable entry is from the right hand side.



M0196

Figure 16

4 Unscrew locknut and withdraw proximity sensor from mounting bracket.

5 Fit new proximity sensor and adjust to correct setting, see test procedure 2, page 3.

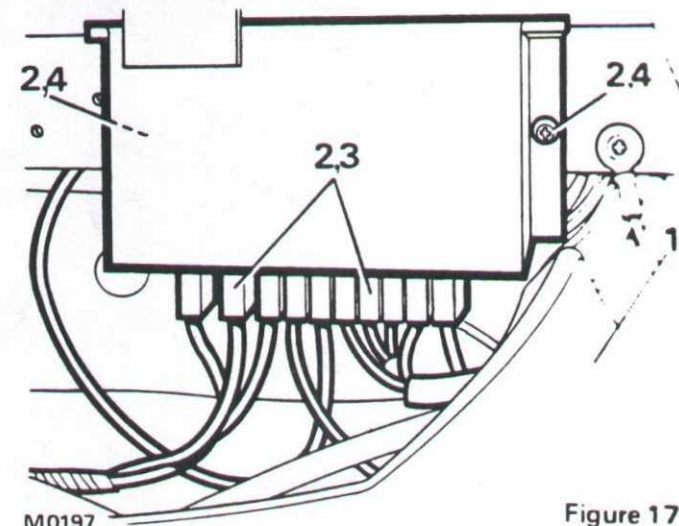
6 Reroute sensor cable, fit rubber grommet and reconnect terminals 1, 2 and 3 at control box.

Replacing control box

A FX4S

1 Remove lower fascia board.

2 Remove two retaining screws, detach control box from bulkhead and disconnect the ten terminals as shown in figure 17.



M0197

Figure 17

3 Reconnect terminals to new control box, ensuring they are correctly fitted, see figure 3, wiring diagram

4 Secure control box to bulkhead.

B FX4S Plus

1 Remove two retaining screws, carefully lower control box from under fascia, and disconnect the ten terminals, see figure 18.

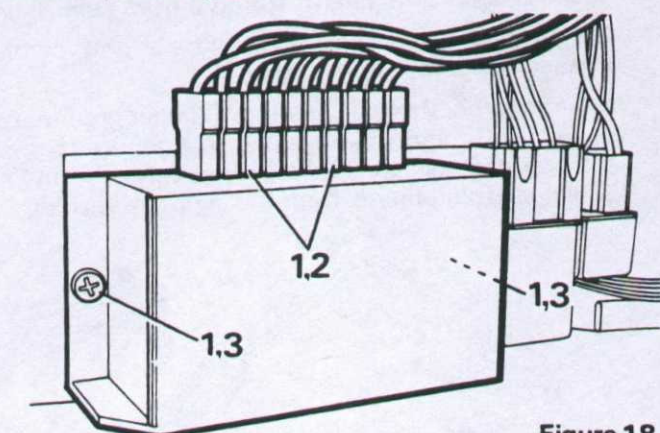


Figure 18

- 2 Reconnect terminals to new control box, ensuring they are correctly fitted, see figure 3, wiring diagram.
- 3 Secure control box to bulkhead.

Replacing rear door relay (solenoid and microswitch)

- 1 Detach checkstrap from door.
- 2 Carefully prise out end cappings, remove retaining screws and detach grab handle, see figure 19.
- 3 Remove door lock release handle cover, remove single screw and withdraw handle from its spindle.
- 4 Remove window lock escutcheon.
- 5 Remove door trim panel.

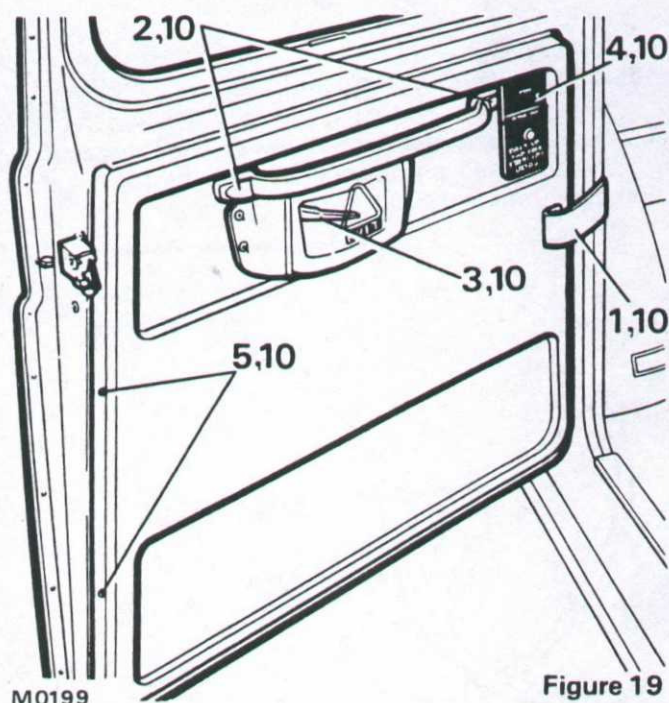


Figure 19

- 6 Peel back protective sheet and disconnect warning light lead plug and relay supply cable plug, see figure 20.
- 7 Slacken grab handle mounting bracket screws.

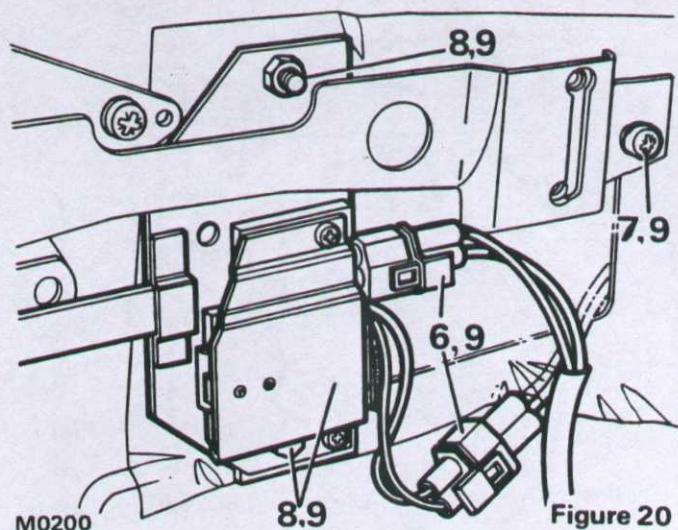


Figure 20

8 Remove top and bottom fixings, disengage relay mounting plate from retaining stud and door lock lever and lower assembly from door.

9 Fit new relay assembly, ensuring door lock lever is correctly engaged and reconnect solenoid and warning light plugs. Retighten mounting bracket screw.

10 Refit trim panel, door release handle, cover and grab handle window lock escutcheon and checkstrap.

Replacing rear door warning light

- 1 Remove door trim panel as previously described.
- 2 Disconnect warning light lead plug, see figure 21.
- 3 Peel back tape retaining warning light lead.

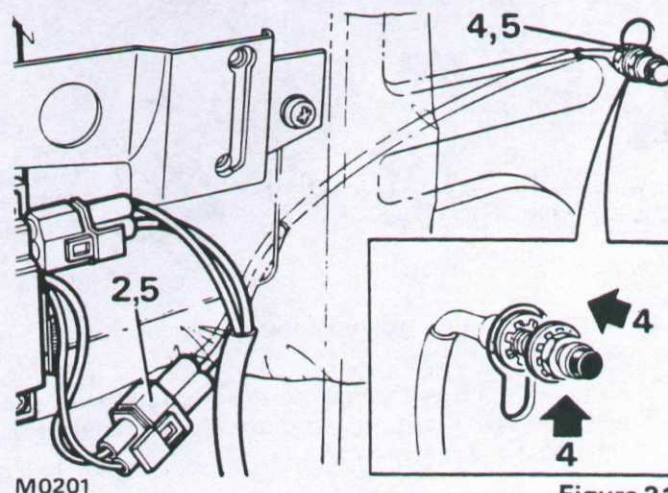


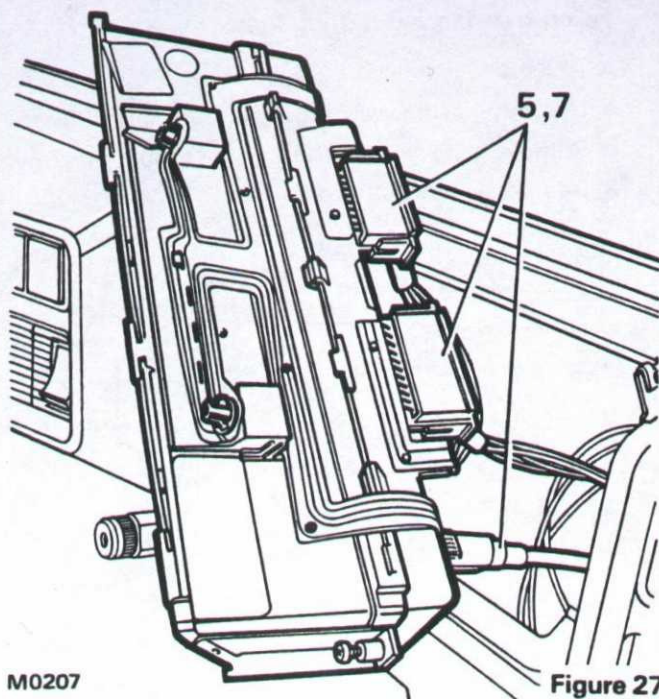
Figure 21

4 Support the warning light from inside the door panel, slacken the locknut and release the light inwards from the key hole slot.

5 Refit new warning light, connect wiring plug and replace door trim panel.

Replacing brake light switch

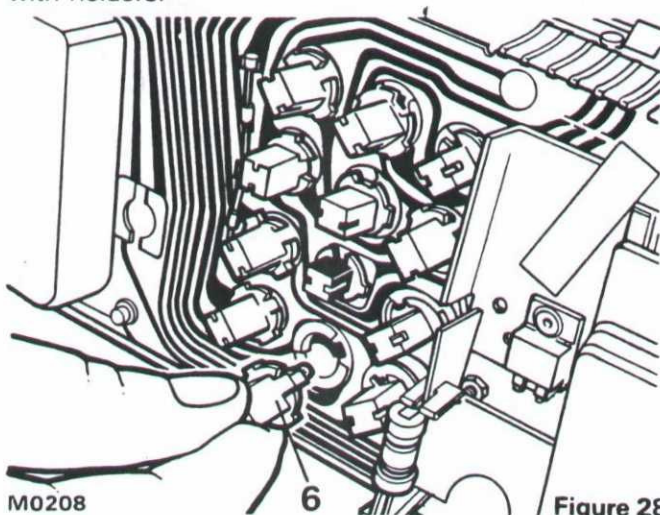
- 1 Remove two retaining bolts and carefully lift access plate from pedal box, see figure 22.
- Note:** The fuel cut off switch, as shown, is fitted in this position on FX4S Plus models only.



M0207

Figure 27

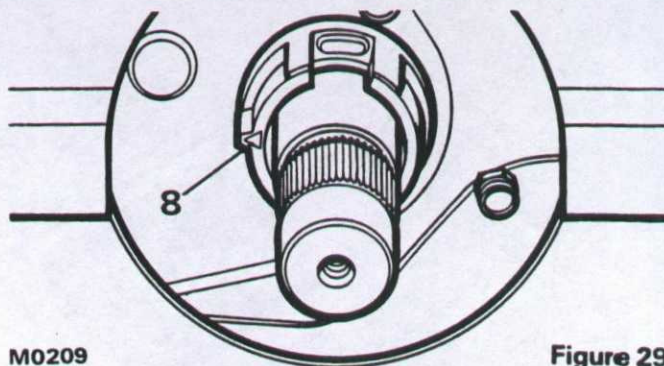
6 Remove fascia warning light bulb, see figure 28.
Note: Fascia warning light bulbs are serviced complete with holders.



M0208

Figure 28

7 Reconnect multi-plugs, speedo cable and refit fascia binnacle and cover.



M0209

Figure 29

8 Refit multi-switch assembly to steering column, ensuring that the blue self cancelling boss is correctly positioned, i.e with the arrow pointed to the left as shown in figure 29.

9 Refit top and bottom multi-switch covers, steering wheel and centre pad.

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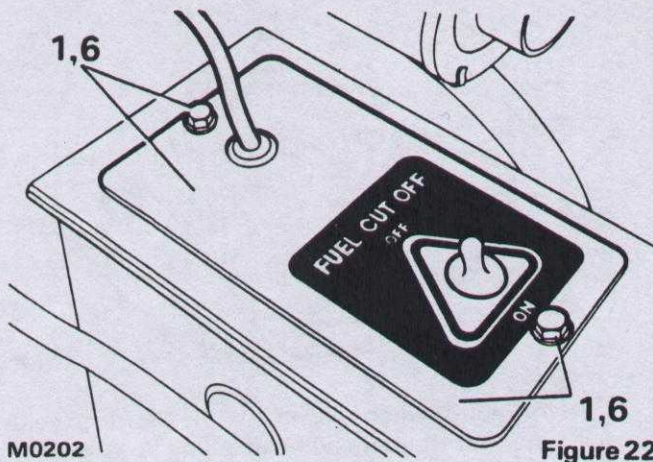


Figure 22

2 Unscrew locknut and remove brake light switch from mounting bracket.

3 Disconnect the two leads from the brake light switch, see figure 23.

4 Reconnect leads to new switch.

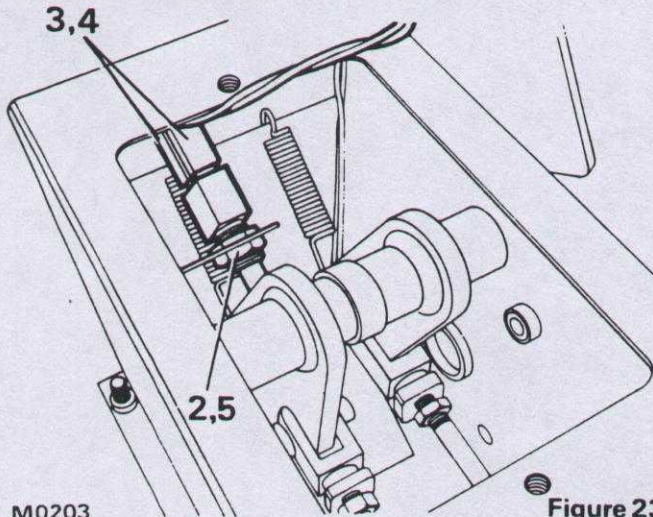


Figure 23

5 Fit new switch, secure loosely with locknuts and adjust as follows:-

- Position the switch so that the operating plunger abuts the brake pedal lever, see figure 24.
- Push the switch down so that the plunger depresses 3mm (0.125in) and tighten locknuts.
- Depress brake pedal and check that the switch plunger springs out to its full travel.
- Release brake pedal and recheck measurement of plunger depression as in (b).

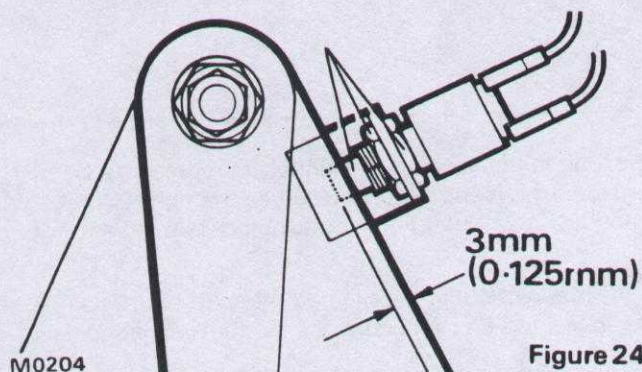


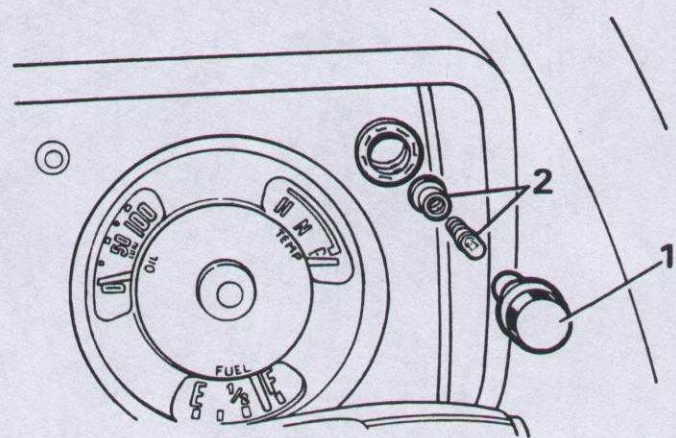
Figure 24

6 Refit pedal box access plate.

To replace fascia warning light

A FX4S

- Unscrew fascia warning light, see figure 25.
- Remove bulb holder and unscrew bulb as shown.
- Replace in reverse order.

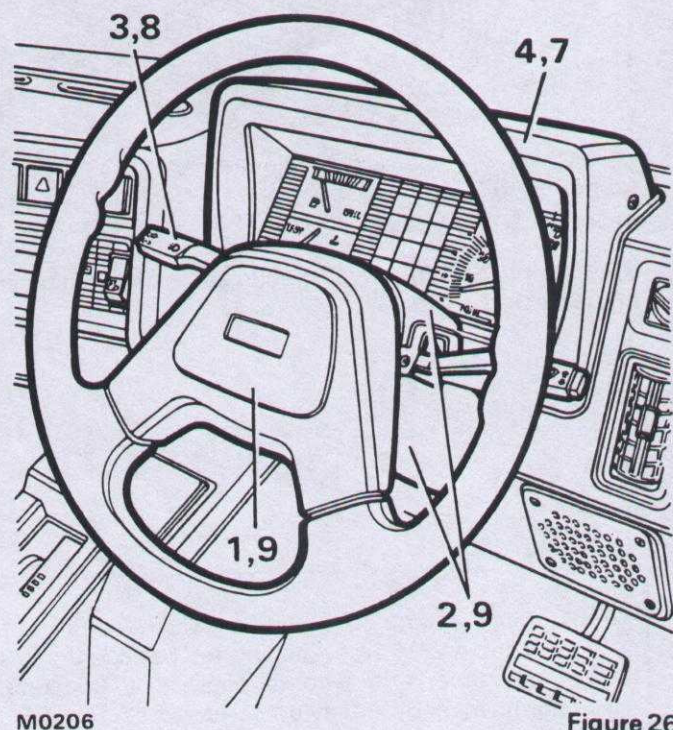


M0205

Figure 25

B FX4S Plus

- Prise out centre pad, unscrew retaining bolt, and remove, steering wheel, see figure 26.
- Remove top and bottom multi-switch covers.
- Remove multi-switch assembly from steering column.
- Remove instrument binnacle cover.



M0206

Figure 26

5 Remove instrument binnacle and disconnect multi-plugs and speedo cable, see figure 27.



FX4S

INCLUDING FX4S PLUS

WORKSHOP MANUAL

Section 8c

ELECTRICS

**MICRONOVA CONTROLLER
AND HEATER PLUGS**

Introduction

The type 583 Micronova Controller is an electrical unit designed to assist cold starting of a diesel engine using Micronova 465-10 heater plugs, one per cylinder, wired in parallel, and is fitted to FX4S and FX4S Plus models. Figure 1 illustrates the system layout.

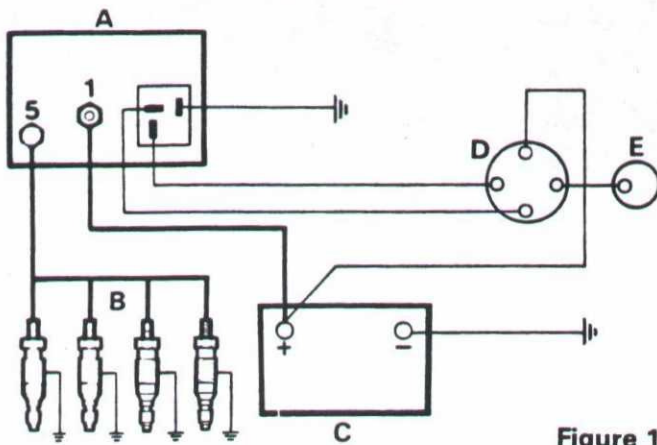


Figure 1

M0212

- A Micronova controller
- B Heater plugs
- C 12 volt supply
- D Ignition switch
- E Starter solenoid

Cable	Current	Total cable volt drop 0.25V MAX
—	1A MAX	
—	60A Nominal	

A short 'preheat' is provided, up to a maximum of three seconds, every time the ignition switch is moved from off to run to reduce engine cranking time. In addition to operating during engine cranking the system is designed to continue in operation for a maximum of thirteen seconds after cranking ceases, this is referred to as 'postheat'.

The controller has an integral thermistor control that limits 'postheat' when the engine compartment temperature exceeds approximately 12.5°C. The temperature may vary slightly above or below this figure. With a fully charged battery, during the 'preheat' period, a clicking will be heard from the controller. This is perfectly normal as the controller relay is pulsing to limit the power to the Micronova heater plugs.

The pulsing (clicking) is more evident during the 'postheat' period, firstly because of the longer operating period and secondly when the engine has started, the alternator will be charging, so raising the system voltage to a level where pulsing is required to control the power.

If starting problems are experienced, especially in cold weather, the earthing leads and Micronova components in the starting system should be checked as follows:-

Earth lead/ Supply cable.

A poorly located, disconnected or even a loose earth lead can cause an excessive resistance within the control unit resulting in a voltage drop when the four heater plugs are energised.

1. The earth lead from the control unit should be securely attached to the rear of the cylinder head, as illustrated in Figure 2, for both FX4S and FX4S Plus models.

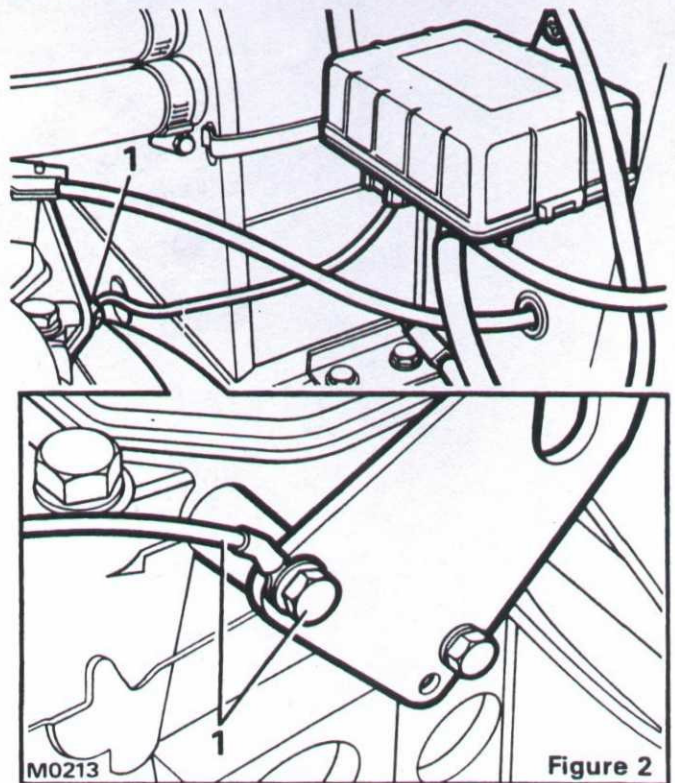
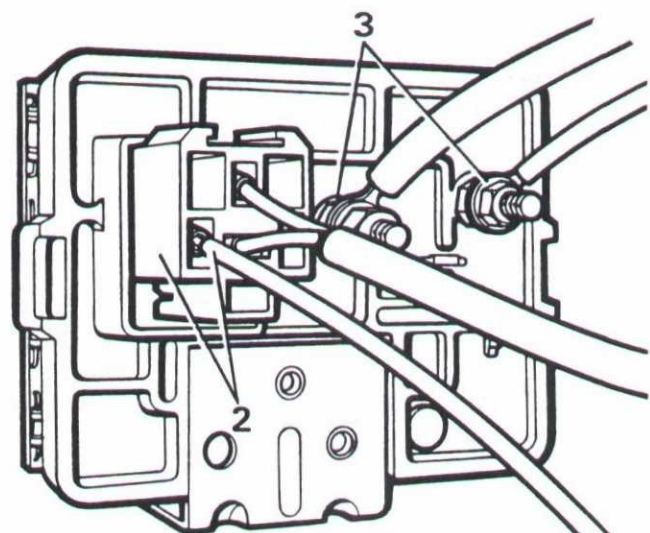


Figure 2

2. Check that the earth lead lark is securely located in the multi-plug under the base of the control unit, see Figure 3, and the multi-plug itself is pushed firmly onto the terminal blades.

3. Check that the 12 volt supply cable and ignition switch leads are securely attached.



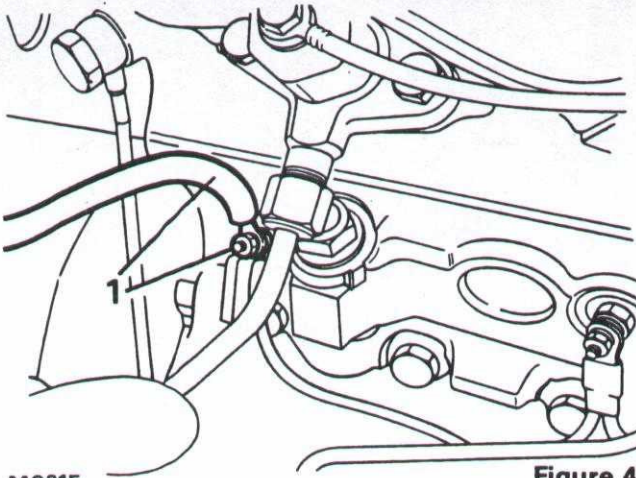
M0214

Figure 3

Heater plugs.

First check that the Micronova heater plugs are securely installed in the cylinder head (tightening torque of 20Nm (15 lb ft)).

1. Disconnect the main supply cable to the glow plug, see Figure 4.



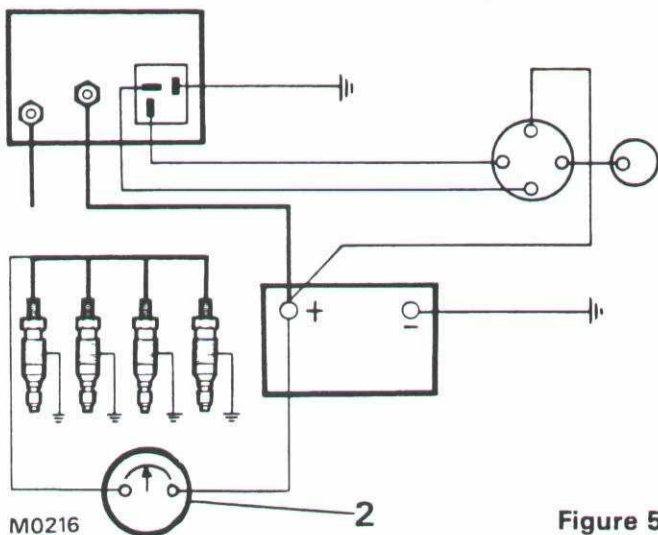
M0215

Figure 4

2. Connect a suitable ammeter to the vehicle battery positive terminal and the negative lead to the heater plug, see Figure 5. An immediate reading of approximately 100 amps should be obtained indicating that all four heater plugs (approx. 25 amps each) are operating correctly. It should be noted that the ammeter reading will fall immediately the plugs begin to heat up.

If a reading appreciably below 100 amps is recorded this would indicate a fault i.e. a short circuit in one or more of the heater plugs. This can be confirmed by disconnecting the supply cable between the heater plugs and testing them individually.

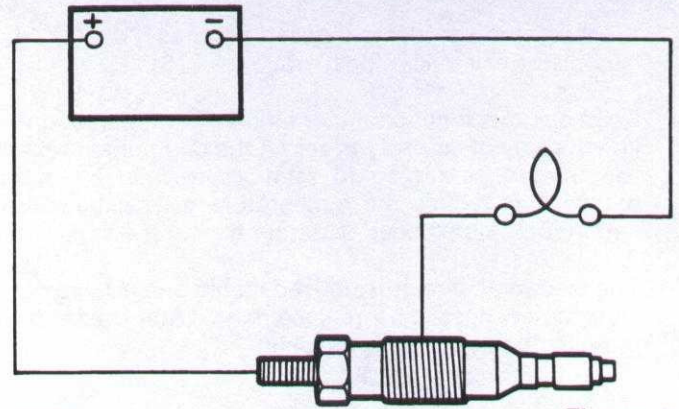
Note: DO NOT keep the test circuit connected for more than three seconds as a possible overheat of the heater plugs could occur.



M0216

Figure 5

3. If a suitable ammeter is not available each plug can be removed and first checked visually.
4. Remove carbon from base of heater plug to avoid the possibility of short circuiting of the element. **DO NOT** sand blast.
5. Examine the element for signs of fracture and deterioration and the seating for scores.
6. Test the plug internal circuit for continuity by connecting it in circuit with a 12 volt supply and test lamp as shown in Figure 6. If the bulb fails to illuminate an open circuit is indicated and the heater plug must be replaced.



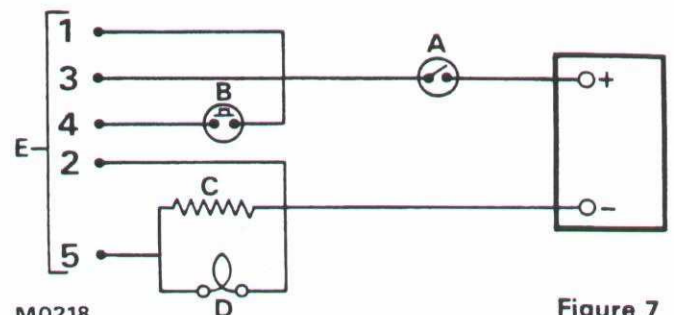
M0217

Figure 6

7. When refitting a new plug /s it should be installed in the cylinder head with a high temperature (1,000°C) anti-seize compound to the cone seat and thread, and tightened to the correct torque.

Micronova Controller.

The circuit diagram, Figure 7, shows a simple means of testing the controller. **A** simulates the ignition switch and **B** simulates the crank (start) position of the switch. The 22 ohm 25 watt resistance **C** simulates a Micronova heater plug in circuit and the indicator / warning lamp **D** shows the 'on' periods.



M0218

Figure 7

E Terminal Identification

1. Using a 12 volt supply connect the controller to the test circuit.
2. Operate the ignition switch **A** and the indicator lamp should illuminate. If the voltage is high enough, the warning lamp will flash and the relay in the controller will pulse up to three seconds during the pre-heat period.
3. Press the crank (start) button **B** for a minimum of two seconds and the warning lamp should illuminate continuously.
4. Release the crank button **B**, and, provided the ambient temperature is below 12.5°C the controller will begin the 'postheat' period. If the system voltage is high enough, the warning lamp will flash, indicating pulsing.

A controller that performs as described can be deemed satisfactory.

If the ambient temperature exceeds 12.5°C the thermistor will inhibit 'postheat'.

To check this function under high ambient conditions a liberal spray of aerosol freezer on the component side of the printed circuit board (aim approximately in the middle) will reduce the temperature of the thermistor and induce a 'postheat' situation during the test.

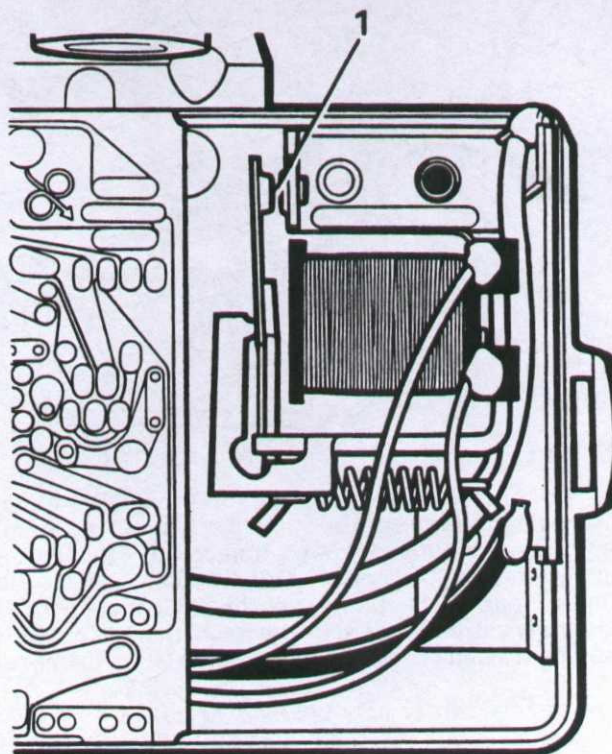
The electronic circuit is not repairable and a faulty unit must be serviced by a replacement. Light dressing of the relay contacts is permissible.

Relay contact condition.

It is recommended that the condition of the relay contacts, see 1 Figure 8, are checked at least every six months for normal operating conditions. Normal 'pitting and piling' is to be expected and the contacts can be dressed with a fine file.

Severe 'pitting and piling' can be caused by inadequate earthing between the engine and chassis of the vehicle.

Burnt out or 'spattered' contacts can be caused by a displaced supply cable to a heater plug earthing on the engine, or a dead short circuit plug or plugs.



M0219

Figure 8

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EXAS PLUS

WORKSHOP MANUAL

Section 10

BODY

INTERIOR TRIM - DRIVERS CAB

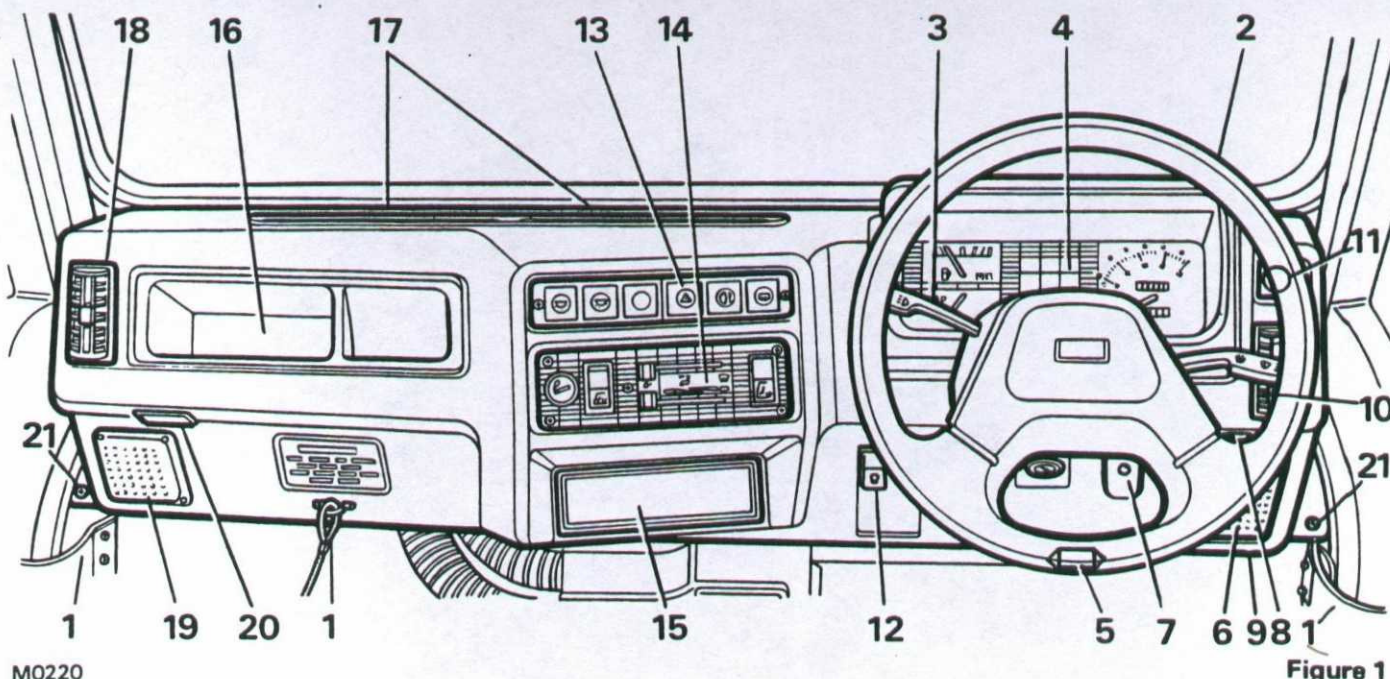


Figure 1

M0220

Fascia Panel

The fascia panel comprises a single ABS plastic moulding that accommodates the instrument binnacle, electrical components and heater controls. Individual components can be serviced or replaced without disturbing the fascia fixings. However, if structural damage has occurred around the bulkhead area it will be necessary to remove the complete fascia moulding to facilitate repair operations.

It is important that the correct procedure is adopted to prevent possible damage to ancillary components, therefore first read the summary of the removal sequence, shown in Figure 1, as follows:-

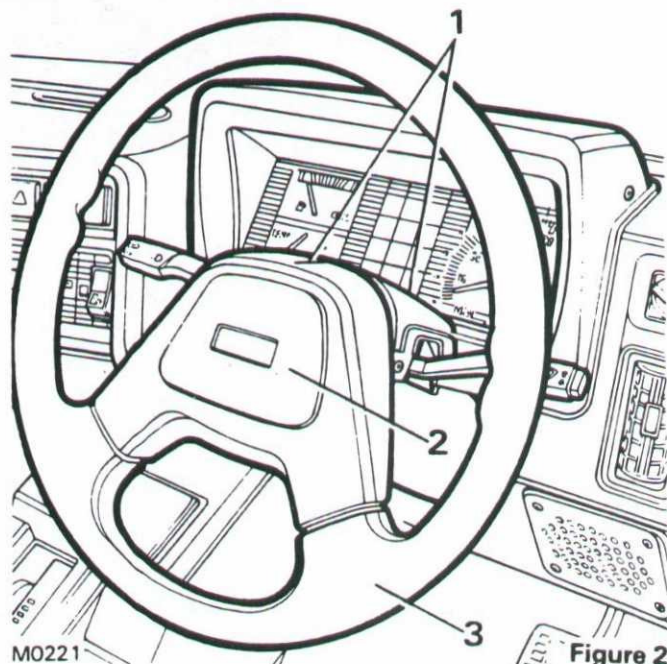
1. After disconnecting battery, remove door checkstraps.
2. Remove steering wheel.
3. Remove multi-switch assembly from steering column.
4. Remove instrument binnacle
5. Disconnect wiper motor relay wiring plug.
6. Remove R.H. radio speaker grille.
7. Remove hazard warning relay.
8. Disconnect R.H. footwell lamp leads.
9. Remove fuse box.
10. Remove R.H. fresh air vent hose.
11. Disconnect dimmer switch wires.
12. Disconnect 'taxi hire' switch plug.
13. Remove fascia switch panel.
14. Remove heater control panel.
15. Remove radio, if fitted.
16. Remove glove box.
17. Remove windscreen vent hoses.
18. Remove L.H. fresh air vent hose.
19. Remove L.H. radio speaker/grille.

20. Disconnect L.H. footwell lamp leads.

21. Remove fascia panel fixings.

Detailed instructions on how to remove the fascia moulding are contained in the following pages.

Remove steering wheel

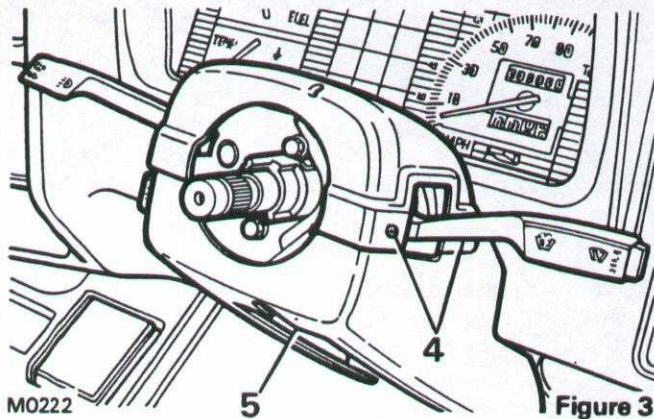


M0221

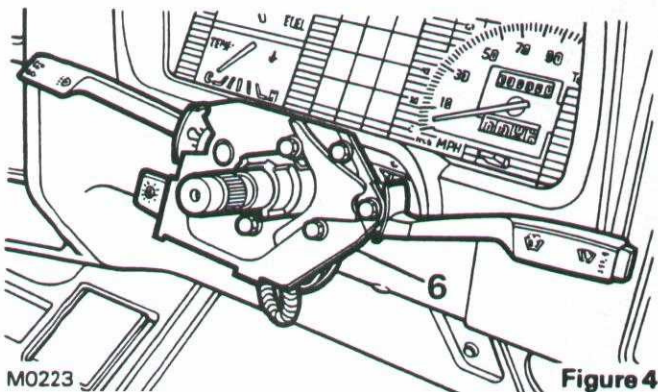
Figure 2

1. Chalk a mark on the steering wheel boss and multi-switch cover to ensure correct alignment in the refitting procedure, see Figure 2.
2. Carefully prise out centre pad and unscrew retaining nut.
3. Remove steering wheel from splined column.

Remove multi-switch assembly

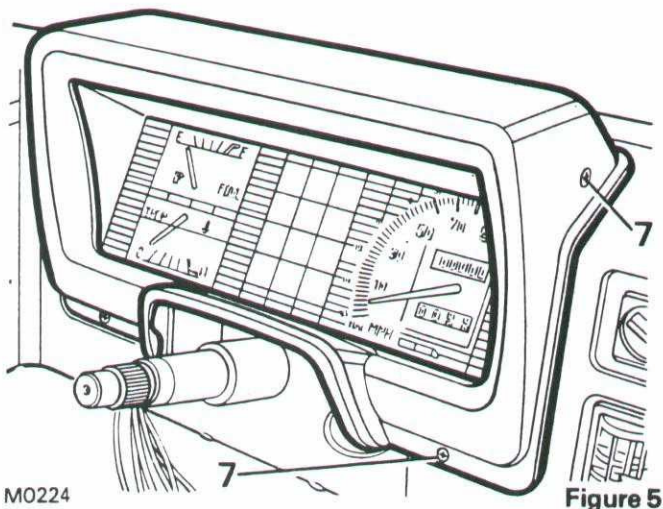


4. Remove four screws and remove top cover from multi-switch, see Figure 3.
5. Remove single screw and remove bottom cover.

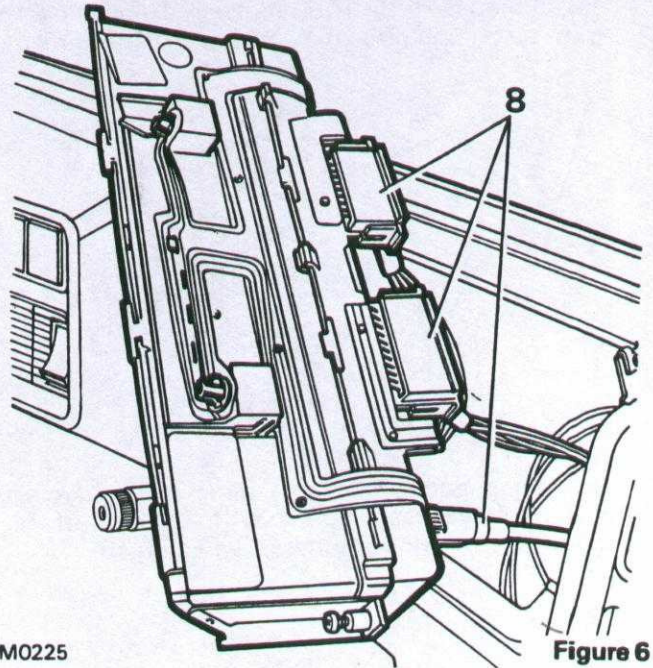


6. Slacken clamping screw and remove multi-switch from steering column, see Figure 4. The wiring plugs have to be disconnected after the instrument binnacle is detached from the fascia.

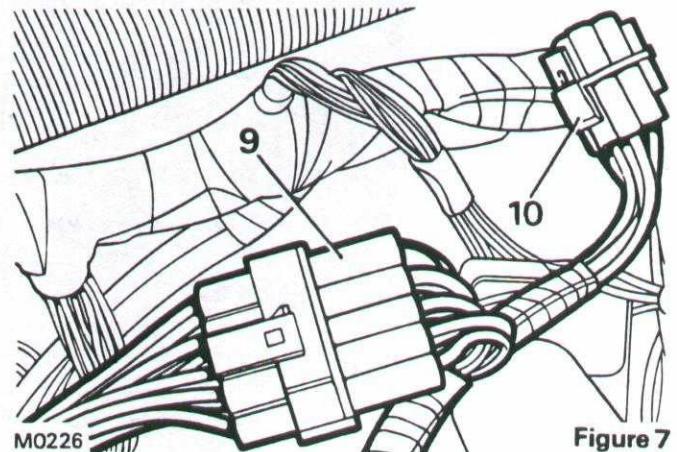
Remove instrument binnacle



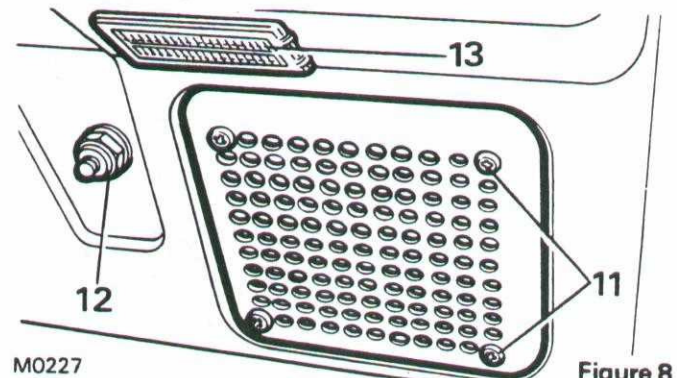
7. Remove four retaining screws and left binnacle cover from fascia, see Figure 5.



8. Remove fixing screws, pull binnacle forward from fascia location and disconnect multi-plugs and speedo cable, see Figure 6.

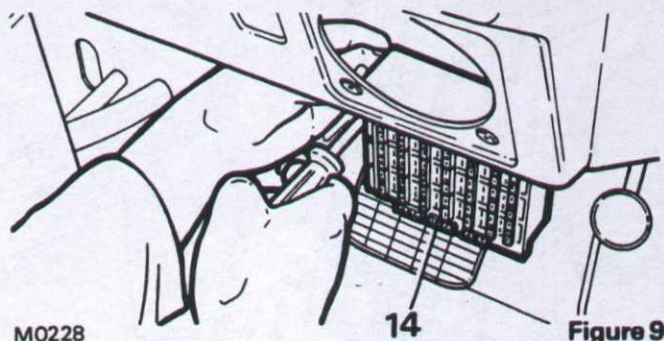


9. Disconnect multi-switch wiring plug, see Figure 7.
10. Disconnect wiring plug from wiper motor control relay, see Figure 8.

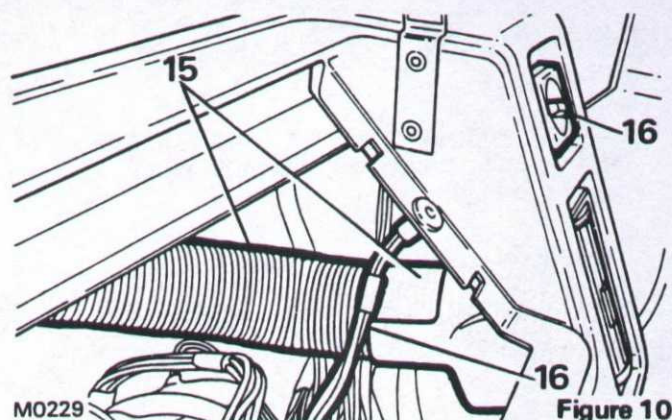


11. Remove four retaining screws and withdraw radio speaker grille, see Figure 8, and disconnect speaker wires if radio is fitted.
12. Remove single bolt and detach hazard warning relay from rear of fascia, see Figure 8.

13. Carefully prise R.H. footwell illumination lamps from fascia and disconnect wiring leads. Refit lamp.

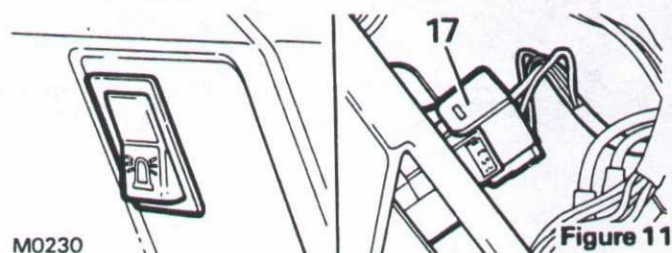


14. Hinge down fuse box, remove hinge retaining screws and detach fuse box from rear of fascia complete with wiring harness, see Figure 9.

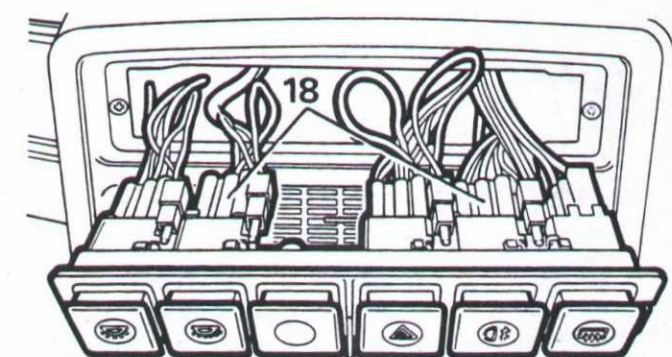


15. Remove R.H. fresh air vent boot, complete with hose, see Figure 10.

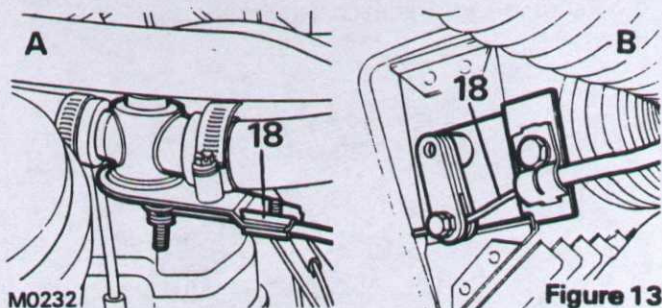
16. Disconnect dimmer switch leads.



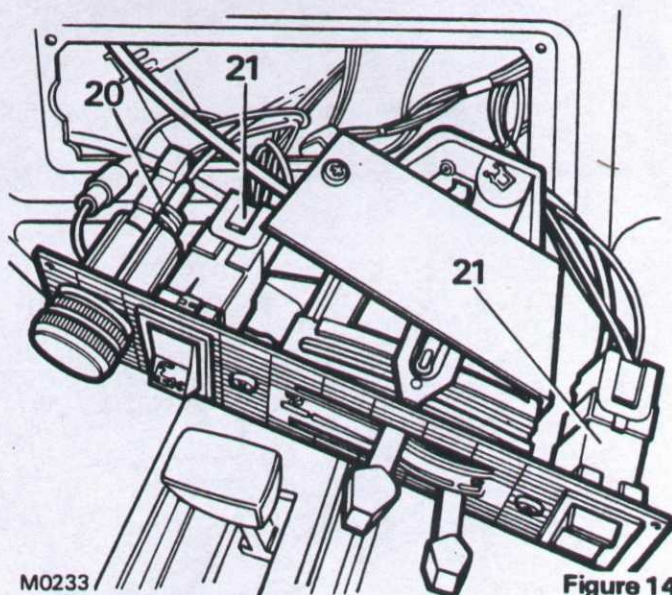
17. Disconnect 'taxi hire' switch wiring plug, see Figure 11.



18. Remove retaining screws, pull fascia switch panel forward and disconnect wiring plugs, see Figure 12.



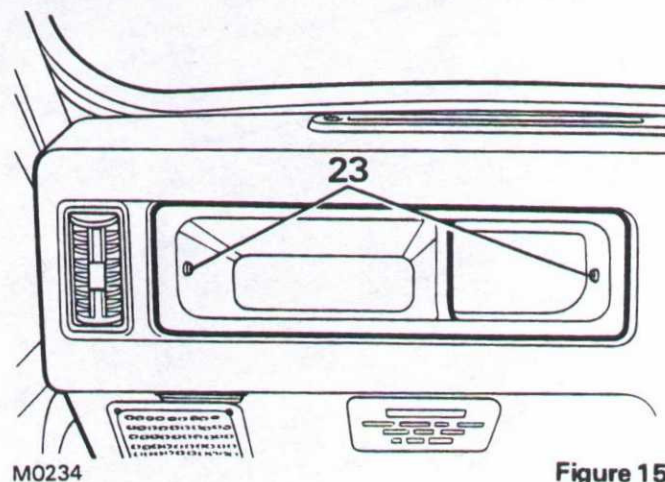
19. Disconnect heater control cables from water valve A in the engine compartment and at vent control B in the L.H. footwell, see Figure 13.



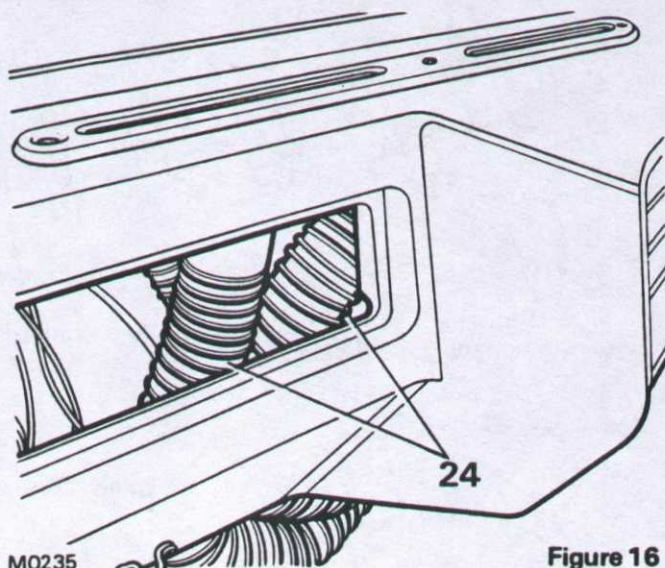
20. Remove four retaining screws, pull heater control panel forward and disconnect cigar lighter lead, see Figure 14.

21. Disconnect driver and passenger fan heater switch plugs and remove heater control panel, complete with control cables.

22. Remove radio, if fitted. Refer to manufacturers instructions.



23. Remove retaining screws and withdraw glove box from fascia, see Figure 15.

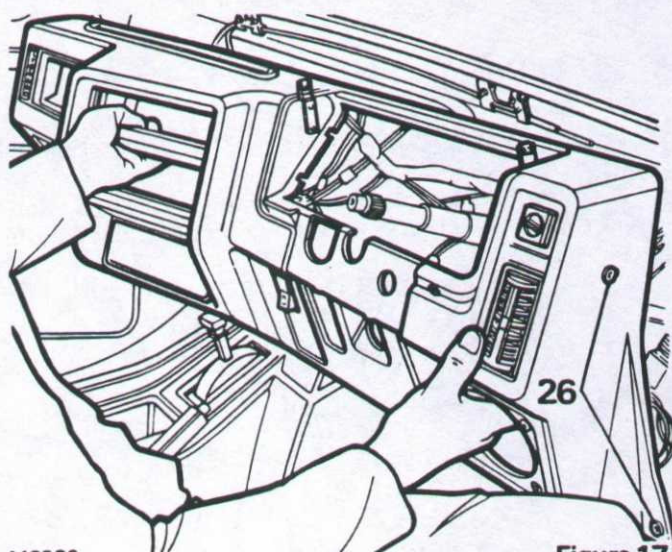


M0235

Figure 16

24. Disconnect windscreen de-mist vent hoses through glove box aperture, see Figure 16.

25. Remove L.H. fresh air vent boot complete with hose, footwell illumination lamp and radio speaker grille as for R.H. side.



M0236

Figure 17

26. Carefully prise off four finishing caps, two either side, remove retaining screws and withdraw fascia panel from bulkhead as shown in Figure 17.

Refit fascia panel

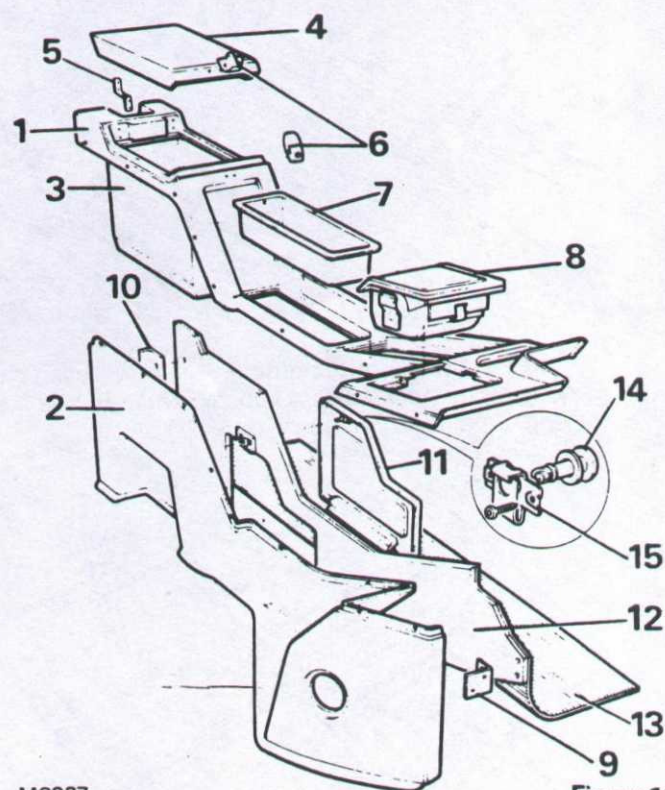
1. Refit fascia panel to bulkhead and secure with retaining screws and cappings. To facilitate following operations pull wiring leads etc of ancillary components through relevant fascia apertures.

2. Reconnect L.H. footwell illumination lamp leads.
3. Refit radio speaker/grille.
4. Reconnect fresh air vent hose.
5. Reconnect windscreen de-mist vent hoses.
6. Refit glove box.
7. Refit radio, if applicable.
8. Refit heater control panel.
9. Refit fascia switch panel.

10. Reconnect 'taxi hire' switch plug.
11. Reconnect dimmer switch leads.
12. Reconnect R.H. fresh air vent hose.
13. Refit fuse box.
14. Reconnect footwell illumination lamp leads.
15. Refit hazard warning relay.
16. Refit R.H. radio speaker/grille.
17. Refit instrument binnacle.
18. Refit multi-switch assembly to steering column. Ensure the self cancelling boss is correctly positioned, i.e. with the arrows pointing to the left.
19. Refit steering wheel.
20. Refit door checkstraps and reconnect battery.

Centre Console (Automatic vehicles)

The centre console comprises three main panels R.H. plastic moulding. L.H. board, complete with carpet or matting and a top plastic moulding that also houses a storage box, see Figure 18. Individual components housed within the centre console such as the drivers ashtray or storage box lid can be serviced without disturbing the console fixings.

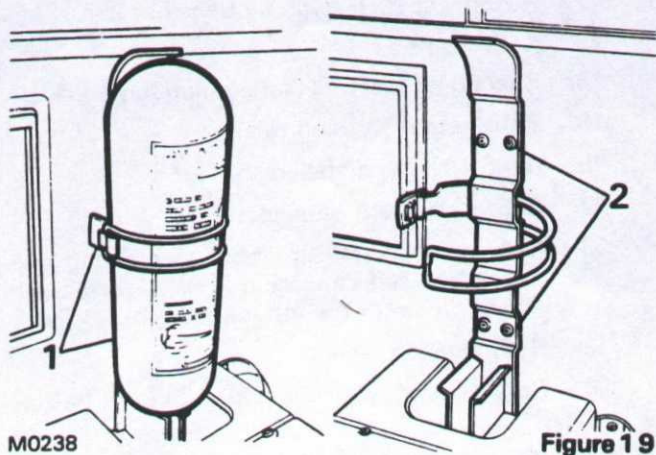


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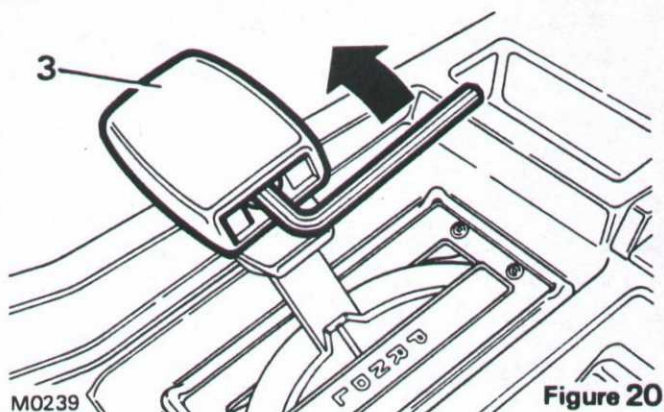
Figure 18

- | | |
|-------------------|-----------------------|
| 1 Top panel | 9 Mounting bracket |
| 2 Side panel R.H. | 10 Mounting bracket |
| 3 Storage box | 11 Access panel |
| 4 Storage box lid | 12 Side panel L.H. |
| 5 Hinge, lid | 13 Cover, side panel |
| 6 Lock and catch | 14 Stud, access panel |
| 7 Moulded tray | 15 Receptacle, stud |
| 8 Ash tray | |

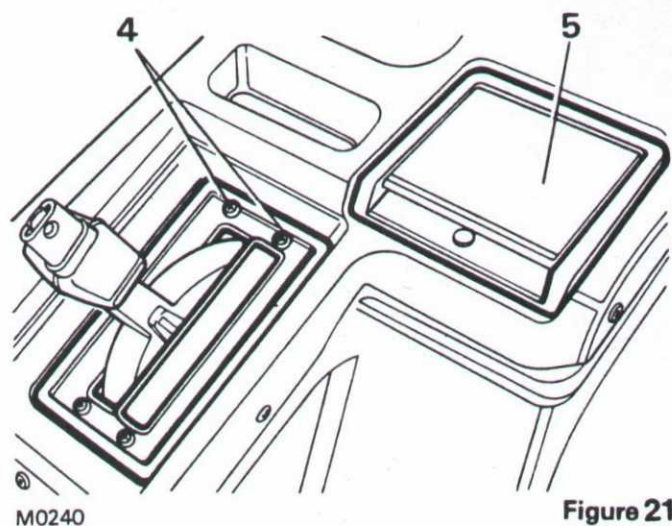
Remove top panel



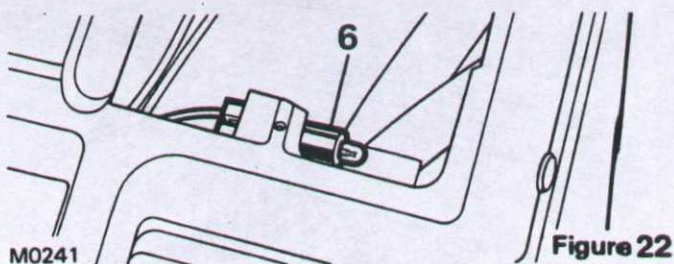
1. Release clamp and remove fire extinguisher from mounting bracket, see Figure 19.
2. Remove four retaining screws and detach mounting bracket from division panel, see Figure 19.



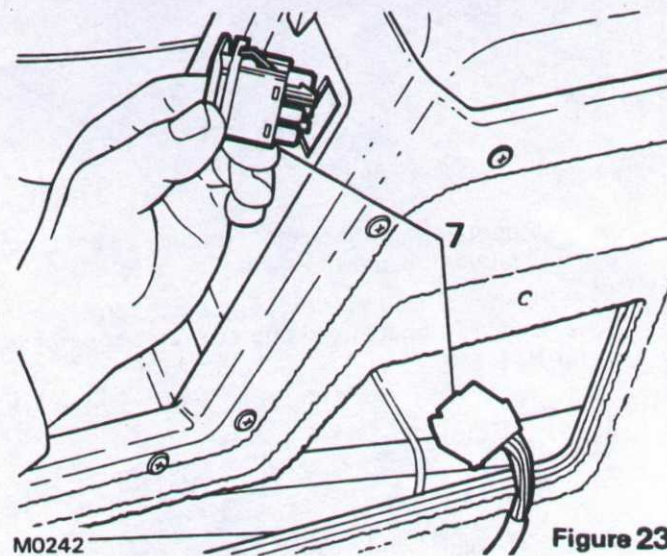
3. Carefully prise out capping, unscrew allen key type bolt from gear lever knob. Withdraw bolt and remove gear lever knob, see Figure 20.



4. Remove four screws and detach gear lever plate, see Figure 21.
5. Raise ash tray cover and remove complete assembly from centre console, see Figure 21.



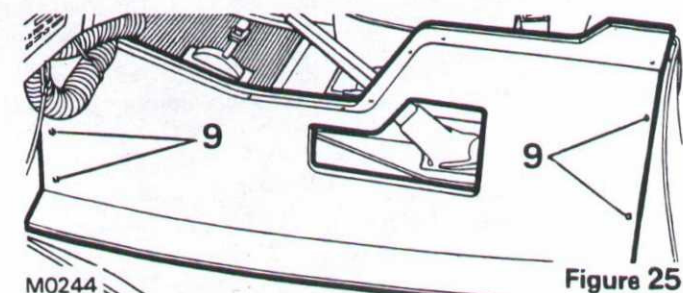
6. Disconnect ash tray illumination bulb holder from centre console, see Figure 22.



7. Remove L.H. access panel, push through window lift motor switch and detach wiring plug, see Figure 23.



8. Remove retaining screws and lift top console from the rear to clear fascia and gear lever as shown in Figure 24. The R.H. centre console panel is now loose and can be removed.



9. Peel back carpet/matting, remove four retaining screws and lift out L.H. console panel, see Figure 25.
10. Refit in reverse order.

Roof Console

The roof console houses the drivers cab interior lamp and a digital clock, and both of these can be serviced without detaching the console from the headlining. However, it will be necessary to remove the console to gain access to the 'taxi for hire' sign illumination bulb on to remove the headlining.

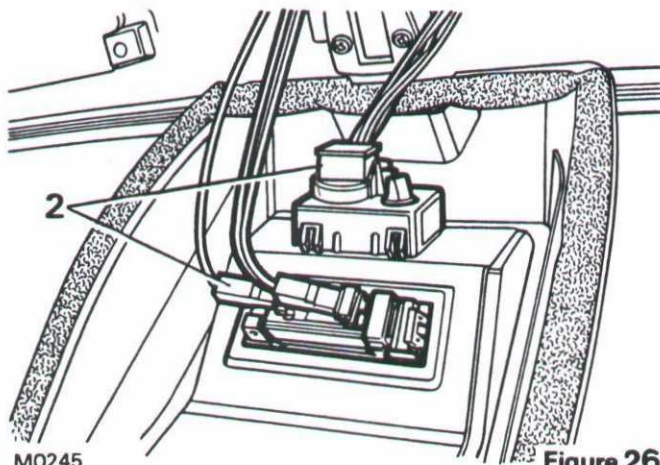


Figure 26

1. Remove two retaining screws, detach console from front mounting bracket and swing down as shown in Figure 26.
2. Disconnect wiring plug from digital clock and leads from interior lamp and remove roof console.
3. Replace in reverse order.

Roof Headlining (Drivers Cab)

The headlining comprises a single moulded panel and would normally only be removed if structural damage had occurred.

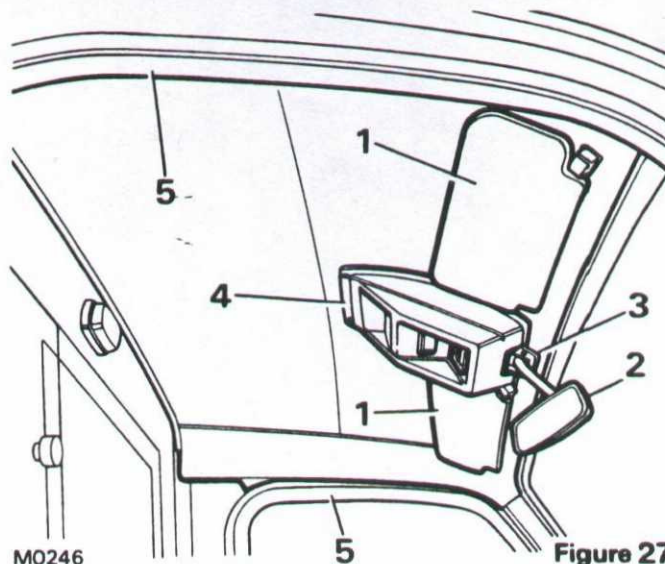


Figure 27

1. Remove retaining screws and detach both sun visors, see Figure 27.
2. Remove rear view mirror, complete with stem from retaining bracket.
3. Remove two screws and detach bracket.
4. Remove roof console as previously described.
5. Remove door aperture seals.
6. Carefully break the adhesive securing the headlining panel on both sides, pull the headlining forward to clear the division panel and remove from the vehicle.
7. Replace in reverse order ensuring the correct adhesive is used on both sides of the headlining panel.

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