

# **D.M.U. Mechanical (Supplement)**



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This publication is intended for students attending courses at C.M. & E.E. Training Units, and is a precis of the lectures given. Subsequently alterations **may be made and it entails** upon the person concerned to suitably up-date the **information**.

**SECTION 1F**  
**GENERAL INFORMATION**

**GENERAL DATA**

**Engine**

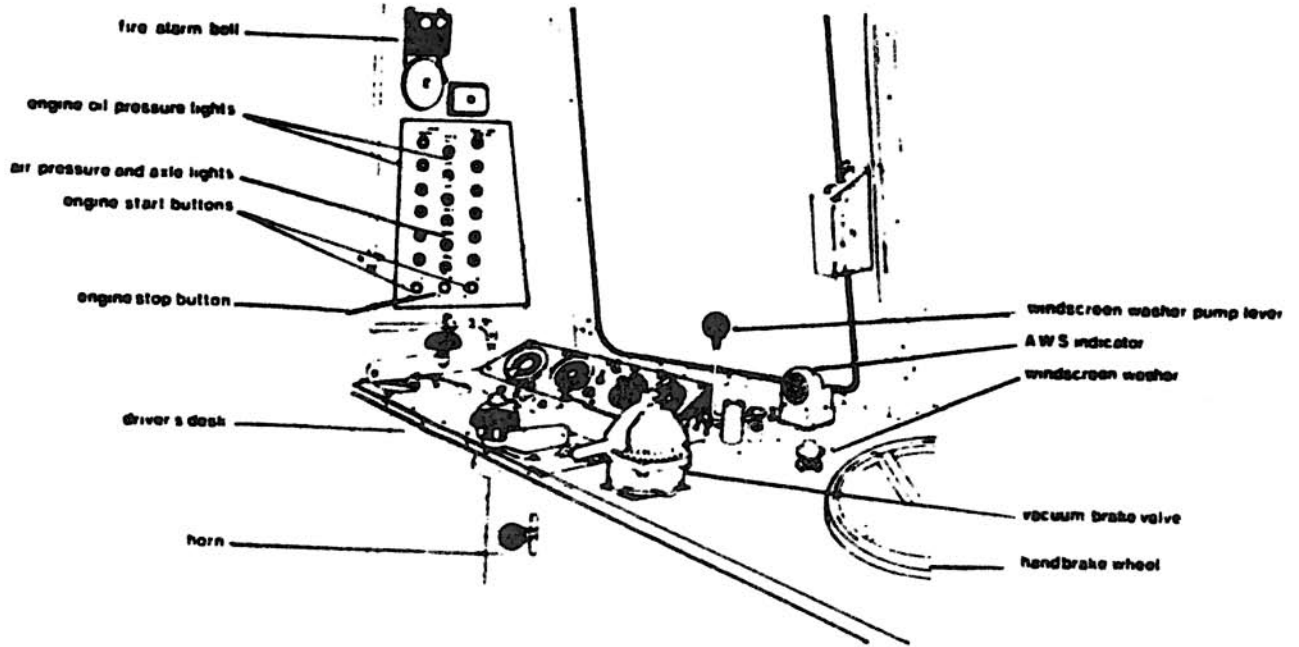
Type .....	Leyland 680 horizontal diesel engine
Number of cylinders .....	Six
Bore .....	127 mm (5.0 in)
Stroke .....	146 mm (5.75 in)
Displacement .....	11.1 litres (677 in <sup>3</sup> )
Compression ratio .....	16 : 1
Net installed hp (approximate) .....	107 kW (150 bhp) at 1800 rev/min
Firing order .....	1, 5, 3, 6, 2, 4
Rotation .....	Clockwise when viewed from timing case end
Oil capacity .....	32 litres (7 gal)
Maximum rated speed .....	1800 rev/min
Idling speed .....	<del>450</del> <sup>410</sup> to <del>470</del> <sup>430</sup> rev/min
Minimum oil pressure engine hot: idling ....	0,35 kgf/cm <sup>2</sup> (51bf/in <sup>2</sup> )
running speed .....	3,86 to 4,56 kgf/cm <sup>2</sup> (55 to 651bf/in <sup>2</sup> )



# driver's controls 1

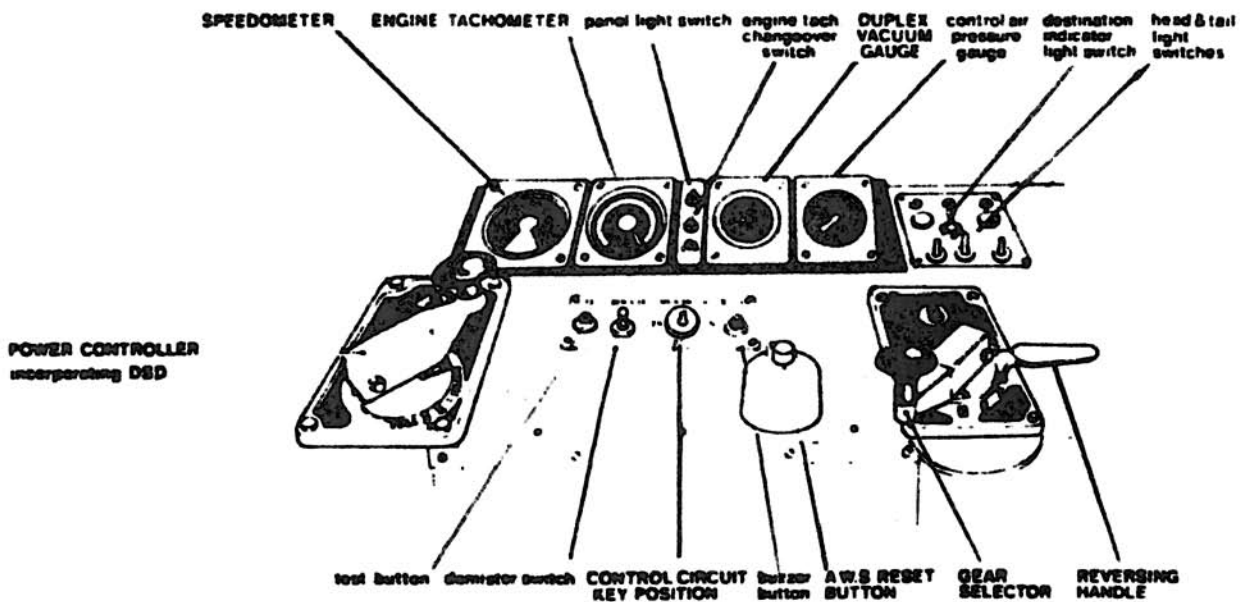
TYPICAL ARRANGEMENT

FIG 1



# driver's controls 2

FIG 2



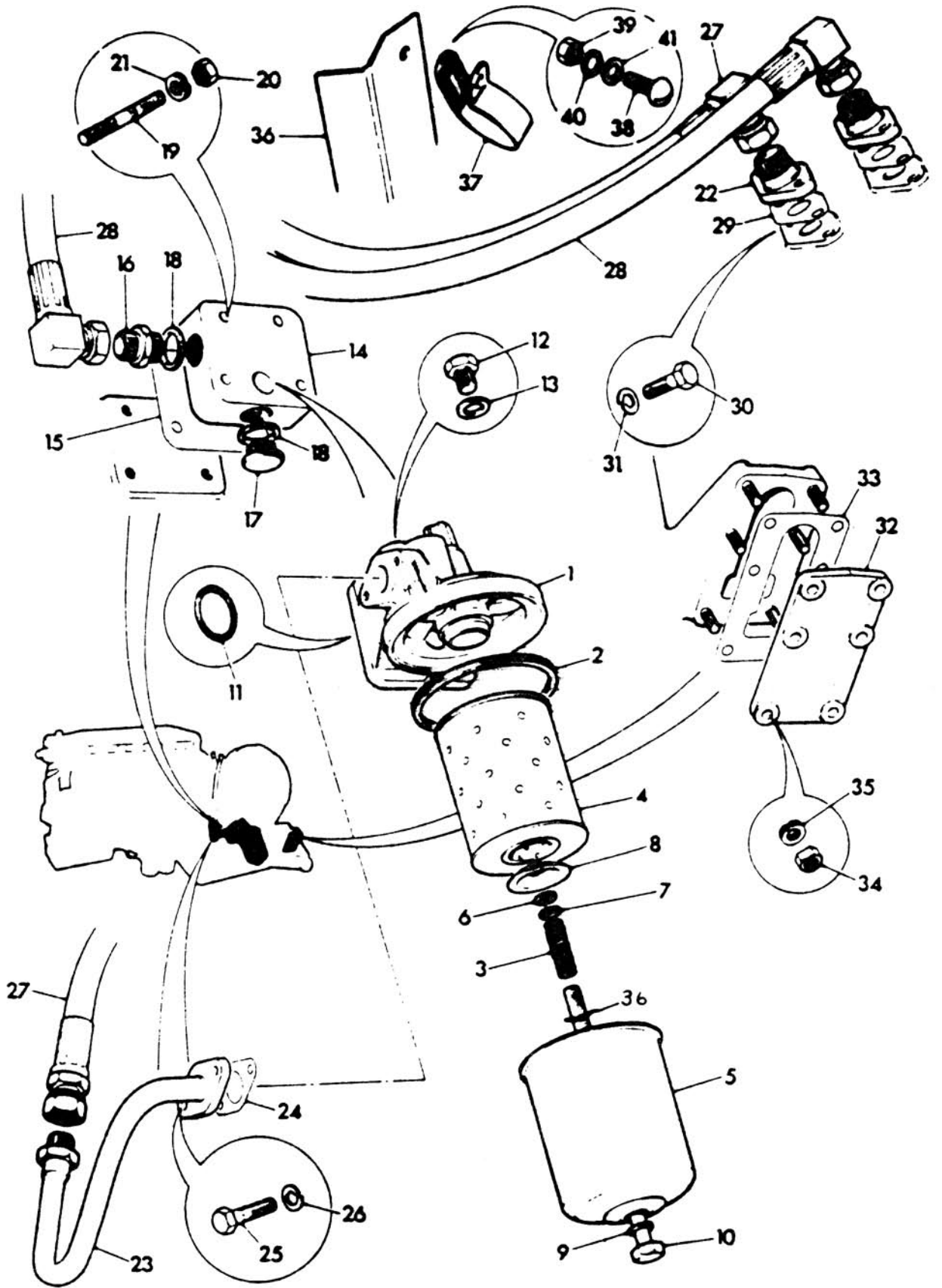
BR 33056/R.33056/2  
ISSUE 5



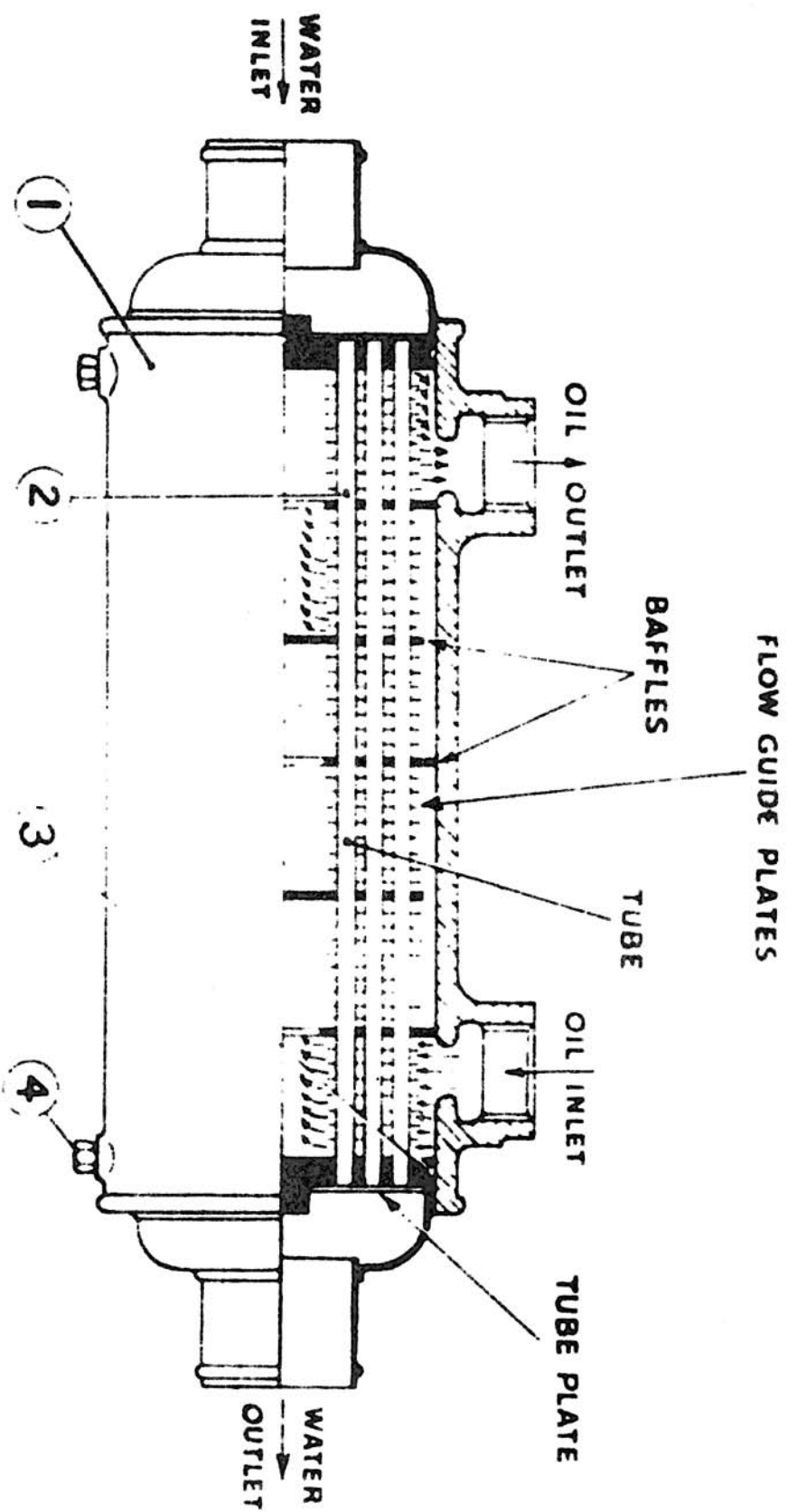
OIL FILTER  
EOF.71  
PL 200496

D529/A23

Illust. ref.	Part	Description	Quantity per unit
		Sub Group A.13	
		OIL FILTER UNIT EOF.71	
	10806031	FILTER oil assembly (bowl fixed by bolt from bottom of filter)	1
1	10806286	HEAD filter	1
2	10803469	SEAL	1
3	10806223	SPRING	1
4	10806225	ELEMENT (CROSLAND 654)	1
5	10806222	BOWL	1
6	569904	WASHER felt	1
7	569906	WASHER	1
8	10806224	SUPPORT element	1
9	10618757	SEAL	1
10	10806227	BOLT tie	1
11	CAL6004	O-RING filter to crankcase	1
12	802672	PLUG	1
13	802066	WASHER	1
14	10622493	BLOCK transfer	1
15	10622498	JOINT )	1
16	229723	BODY union ) For transfer	1
17	316308	ADAPTER ) block	1
18	185484	WASHER )	2



P057



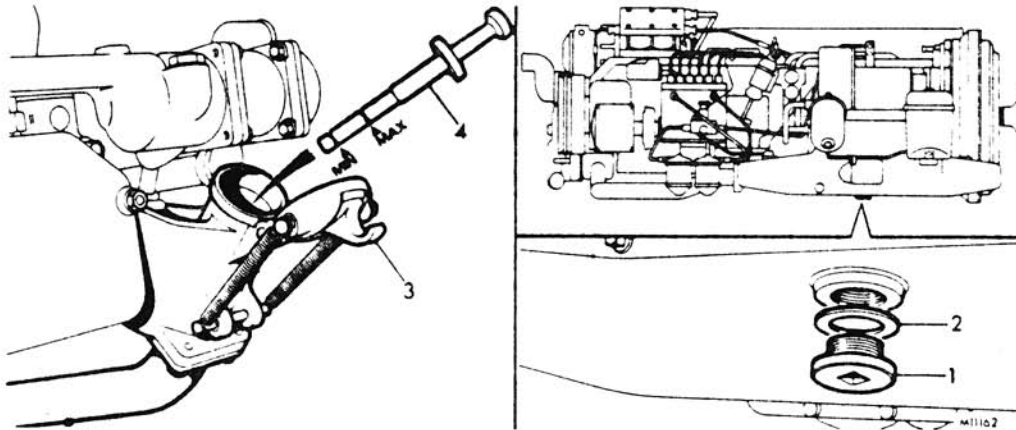
1	CYLINDER	PART NO C. 9 4 7 5
2	TUBE STACK	PART NO C. 9 4 8 1
3	SEALING RINGS	PART NO C. 8 8 7 8
4	RETAINING SCREWS	PART NO C. 8 9 1 5
	COMPLETE COOLER	PART NO C. 8 9 3 6

**SERCK** GUIDED FLOW OIL COOLER

4 2 8

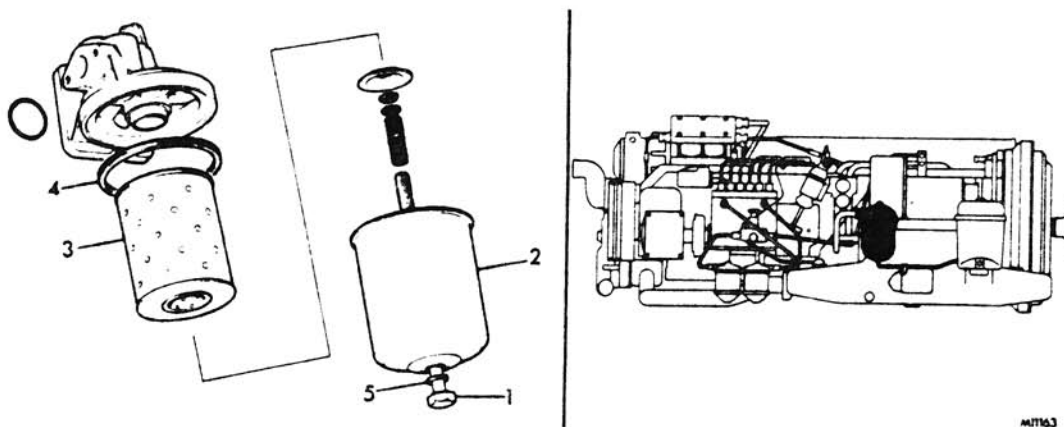


**WARNING:** To avoid possible serious injury to personnel or damage to the engine; the electrical supply MUST be isolated before any of the following maintenance operations are attempted.

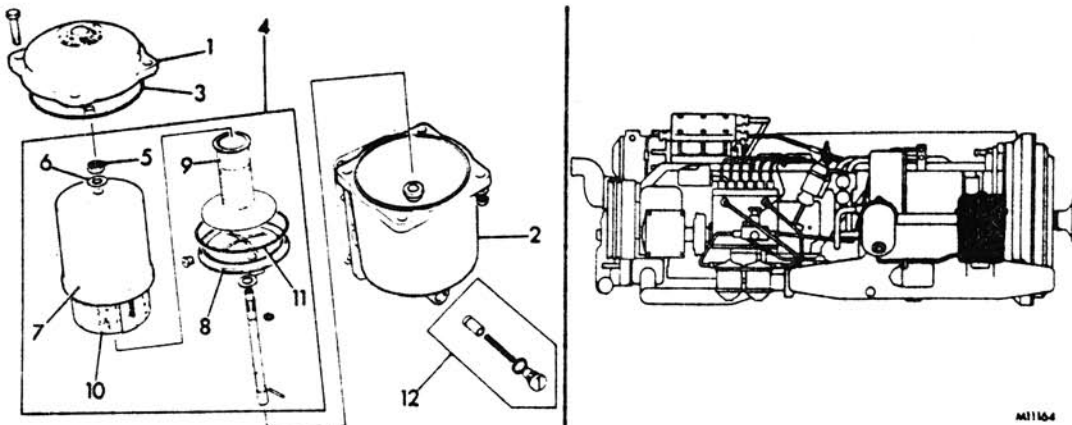


**Renewing the Engine Oil.** Position a suitable container beneath the engine sump. Remove the sump drain plug (1) complete with washer (2) and allow the engine oil to drain into the container; renew the oil filter elements (refer below) whilst the engine oil is draining. Clean and refit the sump drain plug and washer when drainage is complete. Release the filler cap (3) and fill with clean engine oil until the oil level registers up to the upper mark on the dipstick (4). Start the engine, but do NOT exceed the engine idling speed, and check that the oil pressure gauge registers pressure within 15 seconds. Check the sump drain plug and oil filters are free from leakages. Stop the engine and check that the oil level registers up to the upper mark on the dipstick (4).

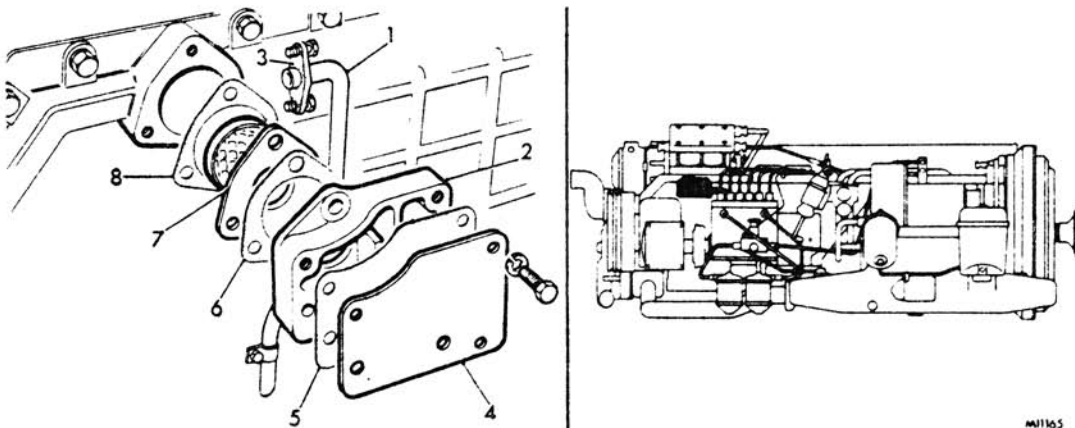
**NOTE:** From engine number 8160355 PTFE tape has been added to the sump drain plugs.



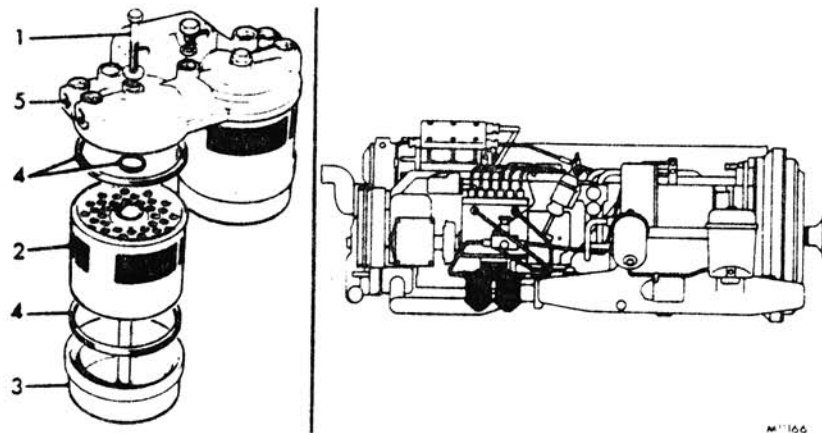
**Oil Filter Element, Full Flow Type.** To renew the filter element, remove the centre bolt (1) and detach the filter bowl (2). Extract and discard the filter element (3) and sealing rings (4 and 5). Wash all components in a suitable solvent and dry thoroughly. Reassemble the oil filter, using a new filter ring element and sealing rings. With the filter bowl correctly located on the filter head sealing ring, tighten the centre bolt to a torque of 27Nm (2,75 kgf m, 20 lbf ft); do not allow the filter bowl to rotate whilst tightening the centre bolt. Start the engine and check that the oil pressure gauge registers pressure within 30 seconds. Check the oil filter for oil leaks.



**Oil Filter Element, Centrifugal Type.** To renew the filter element, remove nuts, washers, setbolts and detach top cover (1) from filter body (2), discard O-ring (3). Withdraw rotor assembly (4) and invert to drain oil. Remove nut (5) washer (6) and separate rotor cap (7) from rotor body (8). Withdraw stand tube (9), discard filter element (10) and O-ring (11). Remove cut-off valve assembly (12) from filter body (2). Clean all components in a suitable solvent and dry thoroughly. Reassemble the oil filter, using a new filter element and sealing rings. Lightly tighten nut (5) on top of rotor assembly, do NOT over-tighten. Start the engine and check that the oil pressure gauge registers pressure within 30 seconds. Check the oil filter for oil leaks.

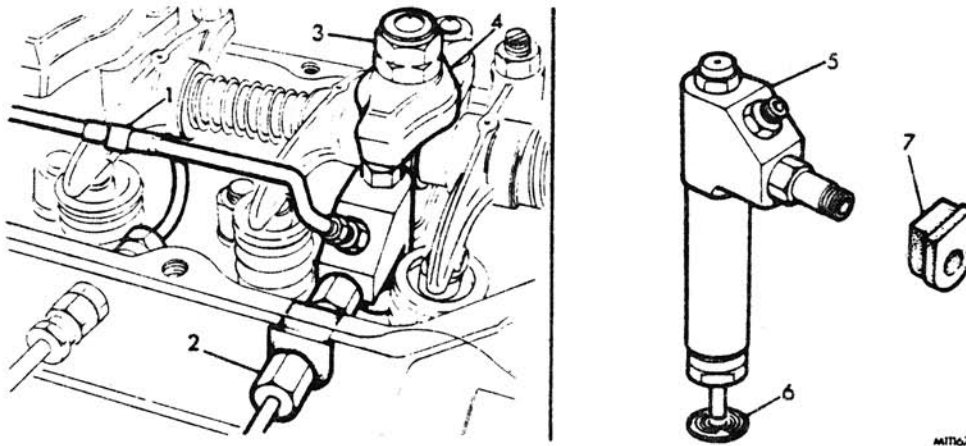


**Engine Breather.** Disconnect the breather pipe (1) from the baffle block (2), discard joint (3). Remove setscrews and detach cover plate (4), joint (5), baffle block (2) and joint (6). Withdraw air and oil separator (7) from inner sump, discard joint (8). Clean all components in a suitable solvent and dry thoroughly, clean all joint faces. Insert the air and oil separator (7) with a new joint into the inner sump. Assemble and refit the baffle block (2) and cover plate using new joints. Re-connect the breather pipe (1) to the baffle block (2) using a new joint.



**Fuel Filter Elements.** Position a suitable container beneath the fuel filter to prevent spillage. Remove the retaining bolt (1) and detach the filter element (2) and base (3). Separate the filter element from the base and discard the filter element and sealing rings (4). Clean the base and filter head (5) in a suitable solvent and dry thoroughly. Reassemble the filter using a new element and sealing rings, ensuring the element seats evenly against the filter head, tighten retaining bolt (1) to a torque figure of 8 to 11 Nm (0,82 to 1,10 kgf m, 6 to 8lbf ft). Repeat this procedure for the other filter element.

When both fuel filter elements have been renewed the fuel system should be bled as instructed on page 1-2F-7.



### Injectors

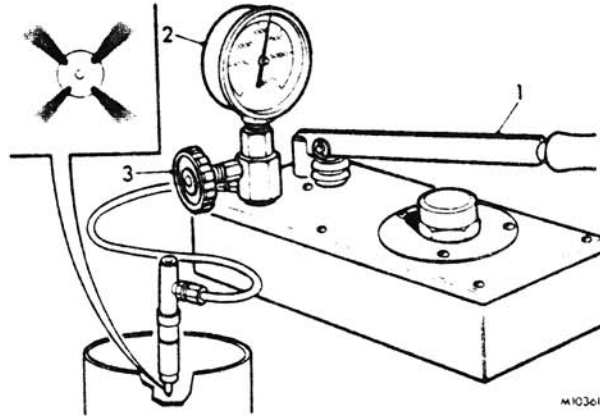
#### To Remove

Remove the rocker cover(s) and joint(s). Remove internal injector leak-off pipe (1). Disconnect high pressure injector pipe (2). Remove injector clamp nut (3) and clamp (4). Using service tool LC267708 and adaptor LC400115, extract the injector (5), discard sealing washer (6) and rubber seal (7). Using tool LC109C clean the injector seat.

**NOTE:** Do NOT attempt to dismantle a faulty injector as this requires the use of specialized equipment.

**To Refit**

Fit a new sealing washer and rubber seal to the injector. Position the injector in the injector housing, fit the clamp and tighten the clamp nut to a torque figure of 40,6 to 47,4 Nm (4,2 to 4,8kgf m, 30 to 35lbf ft). Reconnect the leak-off pipe and injector pipe, tighten pipe nuts to a torque figure of 20,3 to 27 Nm (2 to 2,7 kgfm, 15 to 20lbf ft). Refit rocker cover(s) and joint(s). Bleed fuel system, Page 1-2F-7.

**Testing Injectors**

To test the injectors suitable test equipment fitted with a lever-operated pump (1), pressure gauge (2) and pressure gauge check (shut-off) valve (3) will be required. This equipment should be used with Shell Calibration Fluid C, Esso Calibration Fluid IL 1838, Castrol Calibration Oil C or any other calibration fluid approved by Leyland Trucks Limited.

**⚠ DANGER:** When testing injectors ensure that the nozzle spray is shielded and directed away from the operator. Since the spray has a great penetrating force there must be no physical contact. Oil penetrating the skin will cause injury which will require immediate medical attention. Use suitable eye protection if the spray is exposed. The spray is highly inflammable and must not be exposed to a naked flame or any intense heat source.

Should an injector fail any of the following tests the defective injector must be renewed as instructed in Section 4F.

**Nozzle Opening Pressure Test**

Fill the test equipment with an approved calibration fluid and operate the pump lever several times to vent the pump system. Connect the injector to the test equipment, ensuring that the injector nozzle is directed away from the operator. With the check valve in the 'off' position, operate the pump lever several times to prime the injector. With the check valve in the 'on' position, operate the pump handle and observe the pressure gauge reading immediately the injector nozzle sprays; this reading should be as quoted in DATA, Section 4F.

**Nozzle Leakage Test**

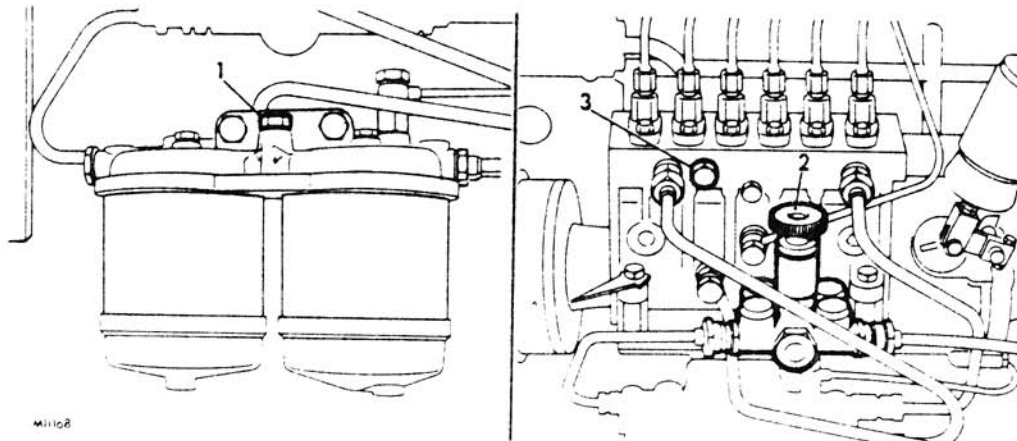
Dry the injector nozzle tip and, with the check valve in the 'on' position, build up the pressure to 10 atmospheres below the quoted nozzle opening pressure. The nozzle tip and bottom face must remain dry and there must be no tendency for the calibration fluid to collect or drip. Leakage from the nozzle tip is not permissible.

**Back Leakage Test**

With the check valve in the 'on' position, build up the pressure to 10 atmospheres below the quoted nozzle opening pressure and release the pump handle. The time/pressure drop should be 150 to 100 atmospheres within not less than 6 seconds and not exceeding 45 seconds. If the test results are not within the tolerances quoted, the injector is defective.

**Spray Form Test**

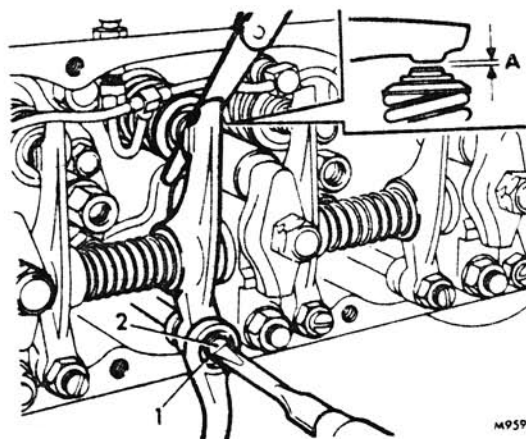
With the check valve in the 'off' position, operate the pump lever at 80 to 90 strokes per minute and observe the injector nozzle spray pattern. An atomized spray free from distortion, irregular streaks of unvaporized calibration fluid and hosing should be observed. Before removing the injector from the test equipment, ensure that the check valve is in the 'off' position to prevent damage to the pressure gauge.



**Fuel System Bleeding.** Air can enter the system if the fuel tank is allowed to become empty or if any part of the supply line from the fuel tank is disturbed during maintenance or repair. Before attempting to bleed the fuel system, ensure that there is an adequate fuel supply in the tank.

Position a suitable container beneath the filters. Release the fuel filter bleed screw (1), unscrew and operate the lift pump plunger (2) until air-free fuel is discharged; tighten the filter bleed screw to a torque figure of 18 to 20Nm (1,80 to 2,07kgf m, 13 to 15lbf ft). Release the fuel pump bleed screw (3), operate the lift pump plunger until air-free fuel is discharged and secure the lift pump plunger in position. Clean any fuel spillages from the engine and remove the container.

**NOTE:** The later types of fuel pump bleed screws have a valve incorporated in the screw, also a spill pipe fitted, this will prevent any fuel spillage on to the engine which could be a possible fire hazard.



**Valve Clearances.** Remove the rocker covers and joints. Check and adjust valve clearances (A) using the 'valves rocking method' with the engine in its normal direction of rotation.

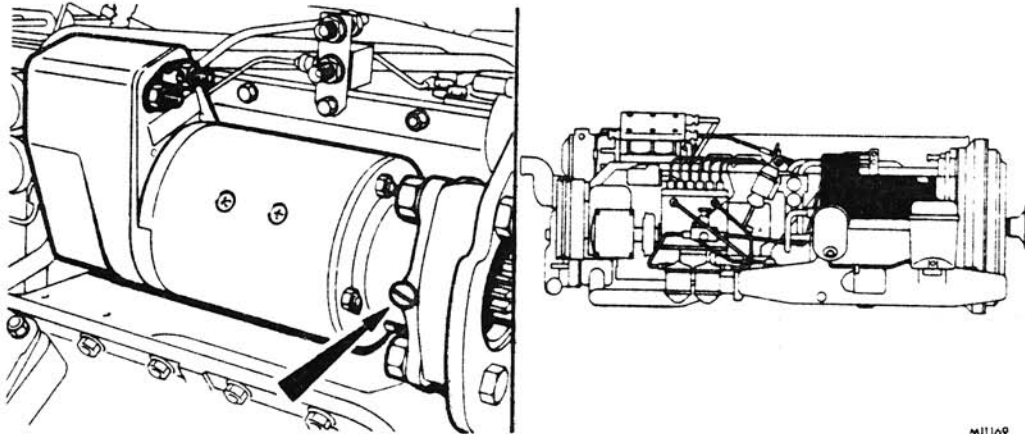
**NOTE:** The term 'valves rocking' is the position where the inlet valve is just opening, and the exhaust valve is just closing.

Using a 0,5mm (0.020in) feeler gauge, check the clearance (A) between the valve rocker arms and valve stems; the feeler gauge should be a sliding fit when the engine is cold. Check the clearance of each valve in the following sequences:

Check No. 1 valve with No. 11 valve fully open  
 Check No. 7 valve with No. 5 valve fully open  
 Check No. 9 valve with No. 3 valve fully open  
 Check No. 2 valve with No. 12 valve fully open  
 Check No. 5 valve with No. 7 valve fully open  
 Check No. 10 valve with No. 4 valve fully open

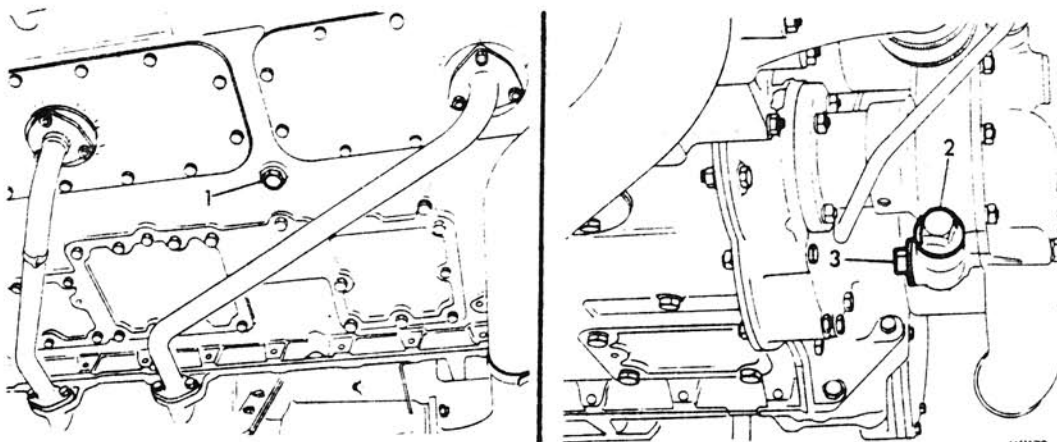
Check No. 12 valve with No. 2 valve fully open  
 Check No. 6 valve with No. 8 valve fully open  
 Check No. 4 valve with No. 10 valve fully open  
 Check No. 11 valve with No. 1 valve fully open  
 Check No. 8 valve with No. 6 valve fully open  
 Check No. 3 valve with No. 9 valve fully open

To adjust valve clearance slacken the locknut (1) and turn the adjusting screw (2) in the appropriate direction until the correct clearance is obtained. Hold the adjusting screw against rotation, tighten the locknut (1) to a torque figure of 20,3 to 27,1 Nm (2 to 2,7 kgfm, 15 to 20 lbf ft) and then re-check the valve clearance. On completion of checking and adjusting the valve clearances locate new joints and refit rocker covers.



M11169

**Starter Motor.** Using an oil can containing clean engine oil, apply 2 to 3 drops of oil to the starter motor wick lubricator at the point indicated.



M11170

### Draining the Cooling System

**WARNING:** Anti-freeze contains toxic chemicals which must NOT be swallowed or allowed to come into skin contact. Use impervious protective clothing and gloves when handling anti-freeze. In the event of slight skin contact rinse the affected area with water. If there is excessive skin contact or ingestion seek medical advice immediately.

## SECTION 1F

### Cooling System

#### GENERAL INFORMATION

#### DATA

##### Water Pump

Water pump drive . . . . .	Gear-driven from camshaft gear
Thermostat starts to open:	leading port . . . . . 77.5 to 79.5°C (172 to 175°F)
	trailing port . . . . . 81.5 to 83.5°C (179 to 182°F)
Thermostat fully open . . . . .	93.5° to 96°C (200 to 205°F)
Thermostat valve lift . . . . .	8,9 mm (0.31 in)

#### REMOVAL AND REFITMENT



**WARNING:** To avoid possible serious injury to personnel or damage to the engine, the electrical supply **MUST** be isolated before any of the following maintenance operations are attempted.

##### Water Outlet Pipe

###### To Remove

1. Drain cooling system.



**WARNING:** Anti-freeze contains toxic chemicals which must **NOT** be swallowed or allowed to come into skin contact. Use impervious protective clothing and gloves when handling anti-freeze.

In the event of slight skin contact, thoroughly rinse the affected area with water. If there is excessive skin contact or ingestion seek medical advice immediately.

2. Disconnect by-pass pipe from water pump end-cover to thermostat housing.
3. Remove setscrews, washers and detach water outlet pipe from cylinder head, discard joints.
4. Clean mating faces of pipe and cylinder head.

###### To Refit

1. Coat mating faces of pipe and cylinder head with a suitable jointing compound.
2. Position new joints on cylinder head, locate water outlet pipe and secure.

3. Reconnect by-pass pipe to thermostat housing elbow.
4. Refill cooling system.
5. Run engine check for leaks, rectify as necessary.

##### Water Pump

###### To Remove

1. Place a suitable container under the pump to collect any engine oil during pump removal.
2. Disconnect compressor return pipe from water by-pass pipe.
3. Disconnect by-pass pipe from pump end-cover.
4. Disconnect water delivery pipe from inlet elbow adaptor.
5. Remove nuts, washers and release inlet elbow from front engine mounting bracket, discard joint.
6. Remove nuts, washers and withdraw water pump from timing case, discard joint.
7. Detach inlet elbow and hose from water pump casing.
8. Clean all joint faces.

###### To Refit

Refitment is a reversal of the removal procedure. Coat mating face of timing case with a suitable jointing compound and fit a new joint. Refill cooling system, run engine and check for leaks, rectify as necessary.



# ENGINE

## Thermostat

### To Remove

1. Partially drain cooling system until the level is below the thermostat housing.
2. Disconnect pipe from water outlet elbow.
3. Disconnect by-pass pipe from thermostat housing.
4. Remove nuts, washers and release outlet elbow and thermostat housing from water outlet pipe, discard joint.
5. Withdraw thermostat from water outlet pipe.
6. Do NOT remove the small locating screw in the side of the outlet pipe.
7. Clean all joint faces.

### To Refit

Refitment is a reversal of the removal procedure ensuring;

- a. The slot on the outer rim of the thermostat engages with the locating screw in the water outlet pipe.
- b. Refit a new joint.
- c. Top-up cooling system, run engine and check for leaks, rectify as necessary.

## TESTING

### Thermostat

1. Remove thermostat and suspend in a container of water.
2. Heat water gradually, stirring continuously to ensure uniformity of temperature.
3. Measure water temperature and note that the valve should start to lift off its seat at temperatures shown in DATA.
4. Continue to heat water until the valve is fully open, refer to DATA for temperatures and valve lift.

If the thermostat does not operate as described above it should be replaced by a new unit as it is not adjustable or repairable.

## OVERHAUL

### Water Pump

Service tool: MS 155

### To Dismantle

1. Remove pump as previously described in this section.

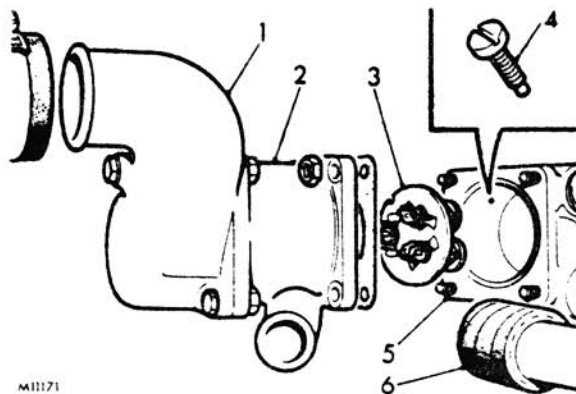


FIG. 1. THERMOSTAT HOUSING

- |                        |                   |
|------------------------|-------------------|
| 1. Water outlet elbow. | 3. Thermostat     |
| 2. Thermostat housing  | 4. Locating screw |
|                        | 5. By-pass hose   |
2. Suitably mark relative position of end cover with pump casing, remove nuts, washers and separate items, discard joint.
  3. Release tab washer from locknut and impeller, unscrew locknut from drive shaft.
  4. Using tool MS 155 with 3/8 in B.S.F. bolts of suitable length, withdraw impeller from shaft.
- NOTE:** Do NOT remove insert or O-ring from impeller bore unless worn or damaged, the insert and impeller are machined as a matched pair and should be renewed as a complete assembly as necessary.
5. Remove sealing gland from pump casing.
  6. Remove drive gear with a suitable extractor, retain distance piece which will become dislodged in the process.
  7. Release circlip and press the drive shaft assembly from pump casing.
- NOTE:** Before removing bearings observe their relative positions on the drive shaft.
8. Press roller bearing, distance pieces and ball bearing from drive shaft.
  9. Press or drift oil seal from pump casing.

### Inspection

1. Wash all components in a suitable solvent and blow dry with compressed air.
2. Check bearings for pitting or excessive wear; renew as necessary.
3. Examine the carbon sealing face of the gland; if scratched or damaged, this



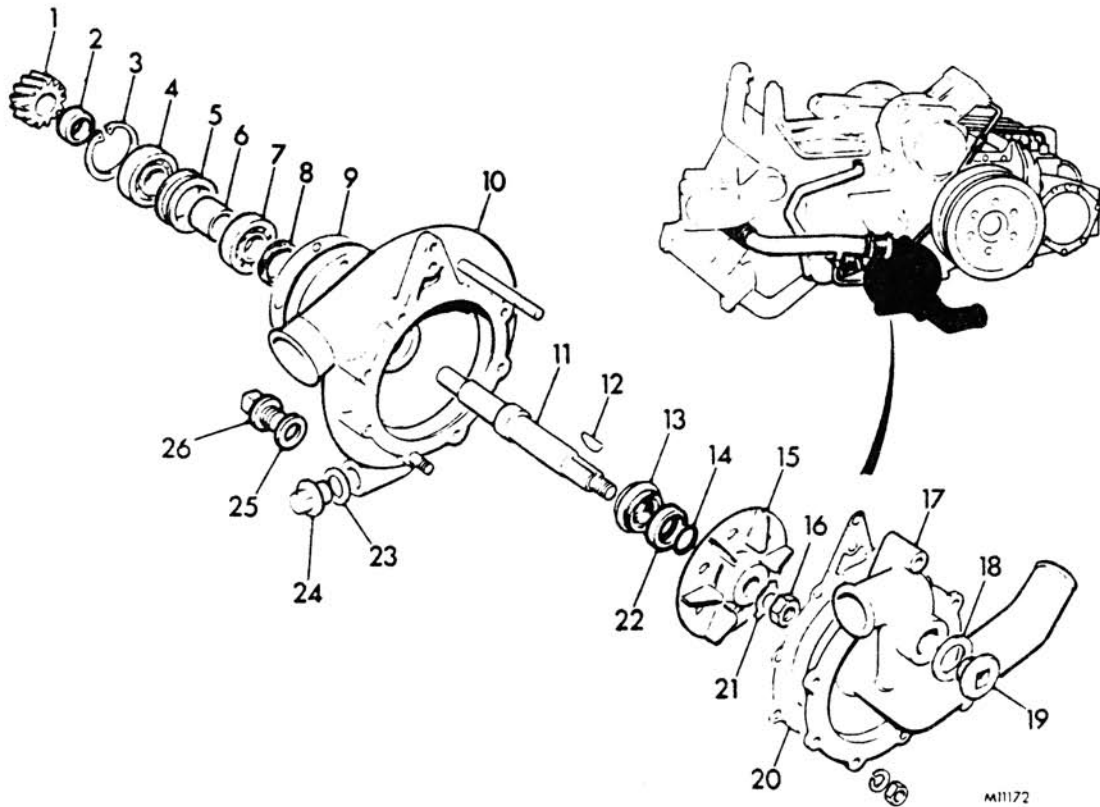


FIG. 2. EXPLODED VIEW OF WATER PUMP

1. Drive gear	8. Oil seal	15. Impeller	22. Insert
2. Distance piece	9. Joint	16. Nut	23. Sealing washer
3. Circlip	10. Pump casing	17. End cover	24. Drain plug
4. Roller bearing	11. Drive shaft	18. Sealing washer	25. Sealing washer
5. Outer distance piece	12. Key	19. Plug	26. Drain plug
6. Inner distance piece	13. Sealing gland	20. Joint	
7. Ball bearing	14. D-ring	21. Tab washer	

4. Check polished face of impeller insert; renew assembly as necessary.
5. Examine end cover and pump casing for cracks or damage.
6. Examine oil seal; discard if worn or damaged.

#### To Reassemble

1. Lightly smear bearings and oil seal with clean engine oil prior to reassembling.
2. Press oil seal in pump casing.
3. Press ball bearing, distance pieces and roller bearing on drive shaft, fit Woodruff key in shaft.
4. Press shaft assembly through oil seal; avoid damaging seal.
5. Fit circlip into groove in pump casing.
6. Locate small distance piece over drive shaft, press drive gear on the shaft.
7. Press sealing gland over shaft and into pump casing.
8. Refit impeller assembly on Woodruff key of drive shaft.
9. Fit tab washer and locknut, secure nut and bend tabs over flat of locknut and impeller cut-out.
10. Locate joint on casing studs, refit end cover to casing aligning the marks made prior to dismantling.
11. Fit washers and nuts, tighten evenly and securely.
12. Ensure drive gear will rotate without binding, rectify as necessary.



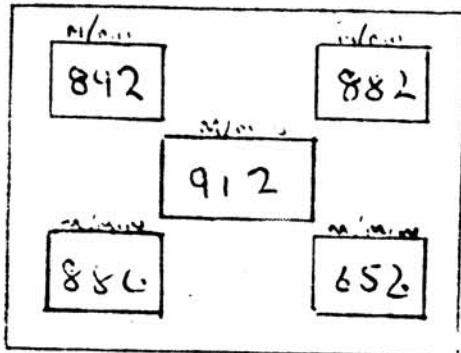
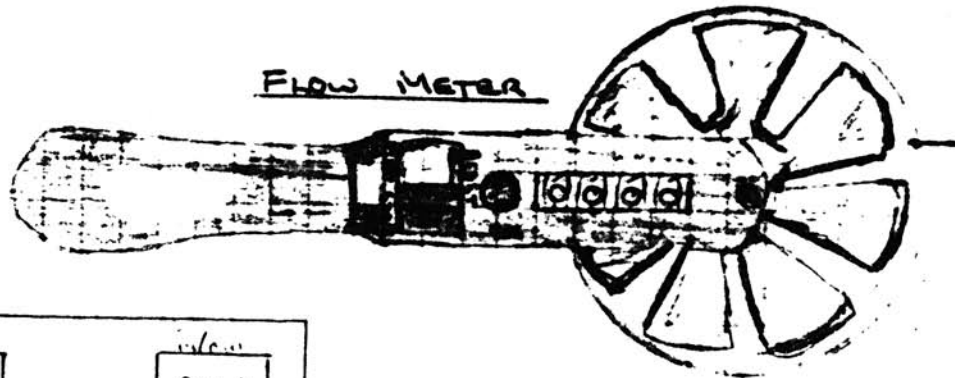
**CAUTION:**

- a. Do NOT attempt to remove the coolant filler cap whilst the engine is running or still hot.
- b. Do NOT attempt to fill/top-up a hot engine with cold coolant.

With the engine cool, remove the filler cap to release any pressure within the cooling system. Position suitable containers beneath the engine cylinder block drain plug (1), water pump drain plugs (2) and (3). Remove the drain plugs and allow the coolant to drain; insert a piece of wire into each drain aperture whilst the coolant is draining to clear any accumulated sediment.

**NOTE:** If the engine is to be left for a prolonged period without coolant, it is recommended that a notice to this effect is displayed in a conspicuous position. Leave all drain points open.

Flush out the system using clean water. When the system has been flushed, refit the drain plugs. Refill the cooling system with the correct clean water/anti-freeze or water/corrosion inhibitor solution to the correct level. Refit filler cap.



RAD 2 RADIATOR

ANY RADIATOR WHICH HAS AN AIR FLOW OF LESS THAN 675 M/HR AFTER CLEANING, MUST BE RECLEANED OR REPAIRD.

**OPERATION**

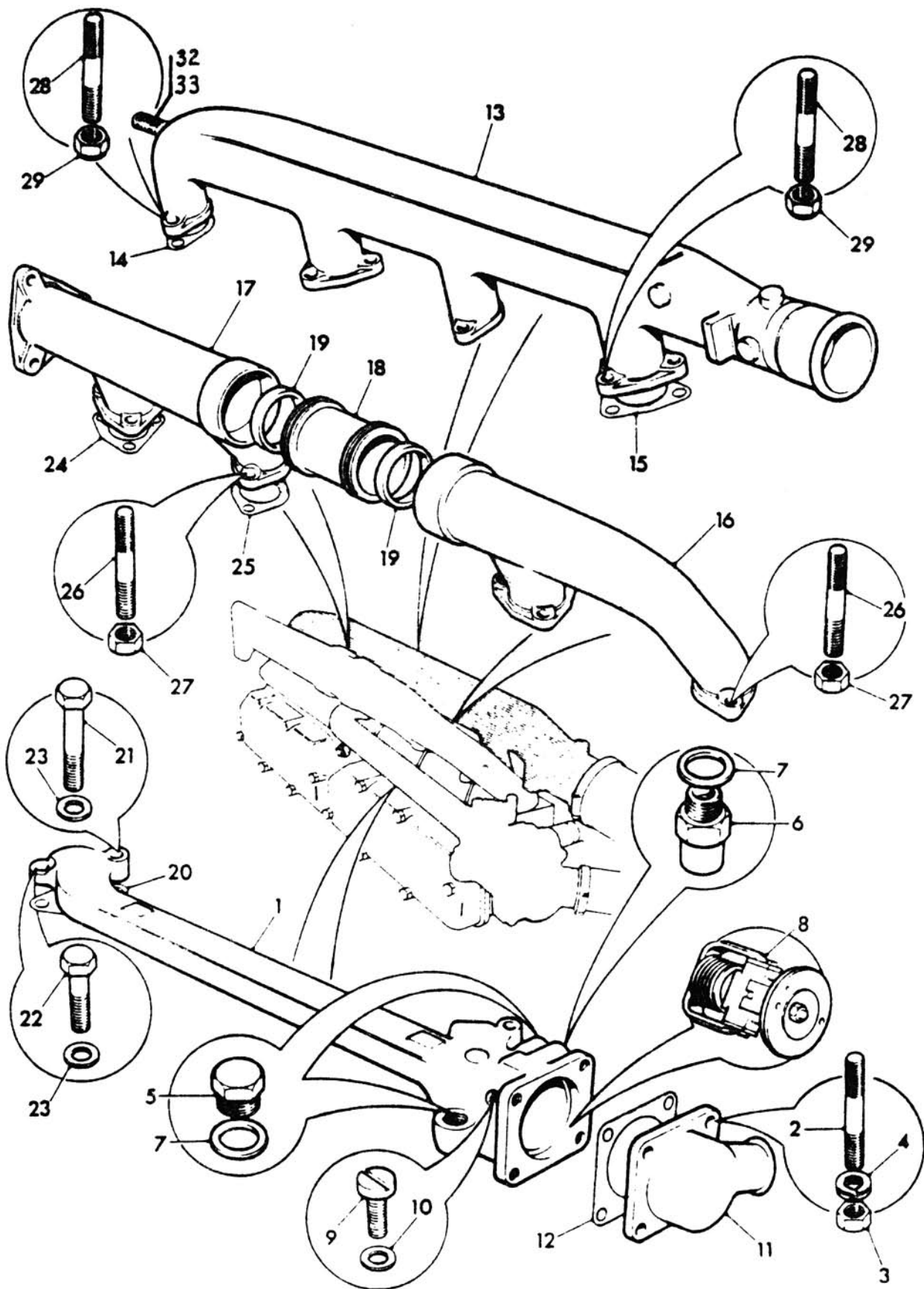
Start Engine and keep at Full RPM's for Air Flow Check

Set flow meter at zero.  
place flow meter on one of four positions on Radiator and time for one minute.

Subtract number from 9999 eg 
$$\begin{array}{r} 9999 \\ 9117 \\ \hline 882 \end{array}$$

Report on flow each position (see Diagram)  
Repeat exercise on other Radiator





SECTION 2F

Cylinder Head

GENERAL INFORMATION

DATA

Cylinder Head

Depth of cylinder head . . . . . 141,96 to 142,29 mm (5.598 to 5.602 in)  
 Maximum permissible distortion . . . . . 0,02 mm per 250 mm (0.001 in per foot)  
 Minimum depth after refacing . . . . . 141,68 mm (5.578 in)

Rockers

Initial clearance of rocker lever on rocker shaft . . . . . 0,013 to 0,044 mm (0.0005 to 0.00175 in)  
 Renew rocker shaft bush when clearance exceeds . . . . . 0,076 mm (0.003 in)

Valves

Gas tightness test of valve on seat . . . . . 0,7 kgf/cm<sup>2</sup> (10 lbf/in<sup>2</sup>) for 5 seconds  
 Valve face angle . . . . . 30°  
 Valve head diameter: inlet . . . . . 55,75 to 56 mm (2.195 to 2.205 in)  
                                     exhaust . . . . . 48,13 to 48,38 mm (1.895 to 1.905 in)  
 Valve stem diameter: inlet . . . . . 11,030 to 11,043 mm (0.43425 to 0.43475 in)  
                                     exhaust . . . . . 10,992 to 11,004 mm (0.43275 to 0.43325 in)  
 Minimum permissible valve head thickness . . . . . 1,587 mm (0.0625 in)  
 Clearance fit of valve stem in guide: Inlet . . . . . 0,063 to 0,095 mm (0.0025 to 0.00375 in)  
   Exhaust . . . . . 0,102 to 0,133 mm (0.004 to 0.00525 in)  
 Maximum permissible stem clearance in valve guide . . . . . 0,254 mm (0.010 in)  
 Valve head protrusion from cylinder head pressure face . . . . . 1,067 to 2,032 mm (0.042 to 0.080 in)  
 Valve lift . . . . . 12,70 mm (0.50 in)  
 Valve (tappet) clearance, cold . . . . . 0,5 mm (0.020 in)

Valve Guides

Guide protrusion . . . . . 13,208 mm (0.520 in)

Valve Seats

Desirable width (measured along sloping face) . . . . . 3,6 mm (0.142 in)  
 Seat angle . . . . . 30°  
 Outside diameter of service valve insert (press fit):  
   Inlet . . . . . 59,30 to 59,32 mm (2.3350 to 2.3355 in)  
   Exhaust . . . . . 55,996 to 56,004 mm (2.2044 to 2.2049 in)

**Valve Springs**

Free length: inner ..... 52,07 mm (2.05 in)  
 outer ..... 61,2 mm (2.41 in)

Renew when spring compresses to: inner ..... 31 mm (1.23 in) at less than 25.4 kg (56 lb)  
 outer ..... 37,6 mm (1.48 in) at less than 49 kg (108 lb)

**Torque Tightening Figures**

Nm                      kgf m                      lbf ft

**IMPORTANT:** Check torque wrenches at regular intervals to ensure correct settings are being maintained.

Cylinder head nuts: 7/16 in B.S.F.	stage 1 .....	27	2,7	20
	stage 2 .....	67,8	7	50
	final .....	88 to 95	9 to 9,6	65 to 70
9/16 in B.S.F.	stage 1 .....	54,2	5,5	90
	stage 2 .....	135,5	13,8	100
	final .....	183 to 190	18,6 to 19,3	135 to 140
Exhaust manifold nuts .....	34	3,4	25	
Injector clamp nuts .....	24,4 to 29,8	2,5 to 3	18 to 22	
Rocker shaft nuts .....	54,2	5,5	40	
Injector leak-off pipe nuts .....	20,3 to 27	2 to 2,7	15 to 20	
Injector pipe nuts .....	20,3 to 27	2 to 2,7	15 to 20	
Tappet adjuster locknut .....	20,3 to 27	2 to 2,7	15 to 20	

3. Refit nuts and tighten in the sequence shown in Fig. 1 refer to DATA for torque figures.
4. Install push-rods as originally fitted and locate valve caps on valve stems; ensure that the caps are free on the stems.
5. Refit new joints, locate rocker shaft on dowels and secure; refer to DATA for torque figure.
6. Fit new injector seating washers, refit injectors and clamps, tighten clamp nuts to the torque figure quoted in DATA.
7. Check and adjust valve clearances as necessary; see page 2-2F-5.
8. Refit adaptors and internal injector leak-off pipes; tighten pipe nuts to the torque figure quoted in DATA.
9. Reconnect fuel injector pipes and external leak-off pipes; tighten pipe nuts to the torque figure quoted in DATA.
10. Reconnect oil filler mounting bracket and pipe to cylinder head.
11. Position new joints on cylinder head, locate inlet/exhaust manifolds and secure.
12. Using new joints, refit water outlet pipe.
13. Reconnect pipe to water outlet elbow.
14. Reconnect by-pass pipe to thermostat housing.
15. Reconnect air delivery pipe to inlet manifold.
16. Refill cooling system.
17. Bleed the fuel system, see Section 4F.
18. Check engine oil level, top-up as necessary.
19. Reconnect electrical supply, run engine and ensure that oil flows to the rocker levers; stop engine.
20. Check for oil/water leaks, rectify as necessary.
21. Refit new joints and rocker covers.

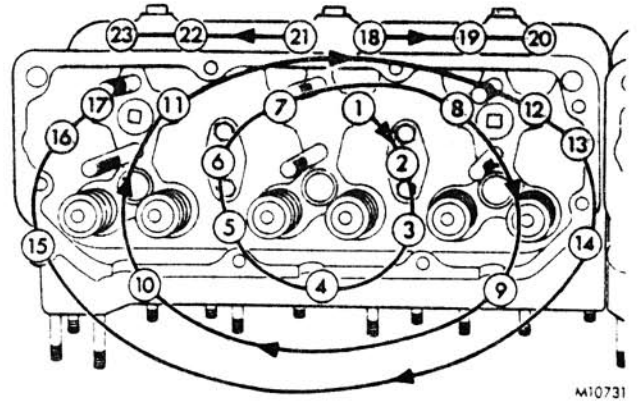


FIG. 1. CYLINDER HEAD NUT TIGHTENING SEQUENCE

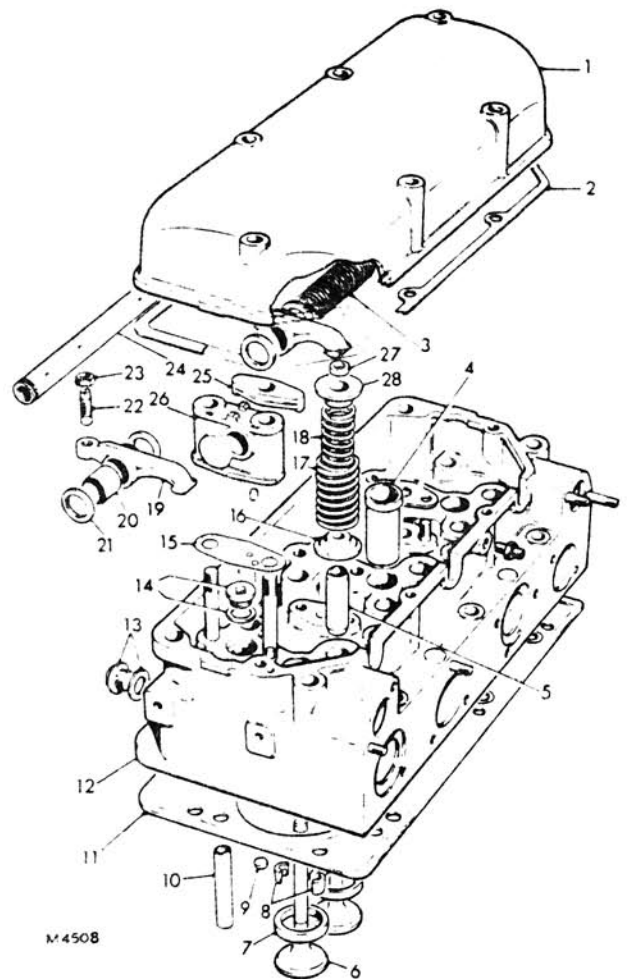


FIG. 2. EXPLODED VIEW OF CYLINDER HEAD

**IMPORTANT:** The cylinder head nuts MUST be re-torqued after the engine has covered 100 to 600 km (500 to 1000 miles) by adopting the following procedures:

- a. Run the engine and attain its normal operating temperature.
- b. Slacken-off the cylinder head nuts by approximately one flat.
- c. Re-tighten nuts see Fig. 1 for sequence and DATA for the final torque figures.

1. Rocker cover	15. Joint
2. Gasket	16. Lower spring collar
3. Rocker spring	17. Outer spring
4. Inject x sleeve	18. Inner spring
5. Valve guide	19. Rocker lever
6. Valve	20. Rocker lever bush
7. Valve seat	21. Thrust washer
8. Split cone	22. Adjusting screws
9. Valve cap	23. Nut
10. Liner	24. Rocker shaft
11. Cylinder head gasket	25. Injector clamp
12. Cylinder head	26. Rocker bracket
13. Plug and washer	27. Valve stem seal
14. Plug and washer	28. Upper spring collar

**Valve Springs (in situ)**

Service tools: LC6118, LC6118-3, LC6118-6

**To Remove**

1. Remove rocker shaft assembly; see page 2-3F-3.
2. Turn engine until piston of associated cylinder is on T.D.C.
3. Remove valve caps.
4. Remove push-rods.
5. Assemble adaptor LC6118-3 and LC 6118-6 to tool LC 6118.
6. Fit tool to rocker stud and adjust to suit valve spring.
7. Compress valve springs and remove split collets.
8. Remove springs and spring caps.

**To Refit**

Refitment is a reversal of the removal procedure.

**ADJUSTMENT**

**Valve Clearances**

**To Check and Adjust**

1. Remove rocker covers and joints.
2. Check clearance between valve rocker arms and valve stems with a 0,508 mm (0.020 in) feeler gauge.

The gauge should be a sliding fit when the engine is cold. Check clearance of each valve in the following sequence:

Check No. 1 valve with No.11 valve fully open.

"	"	7	"	"	5	"	"	"
"	"	9	"	"	3	"	"	"
"	"	2	"	"	12	"	"	"
"	"	5	"	"	7	"	"	"
"	"	10	"	"	4	"	"	"
"	"	12	"	"	2	"	"	"
"	"	6	"	"	8	"	"	"
"	"	4	"	"	10	"	"	"
"	"	11	"	"	1	"	"	"
"	"	8	"	"	6	"	"	"
"	"	3	"	"	9	"	"	"

3. If gap requires adjustment, slacken locknut and turn adjusting screw in required direction to obtain correct clearance, hold screw and tighten locknut to the torque figure quoted in DATA.

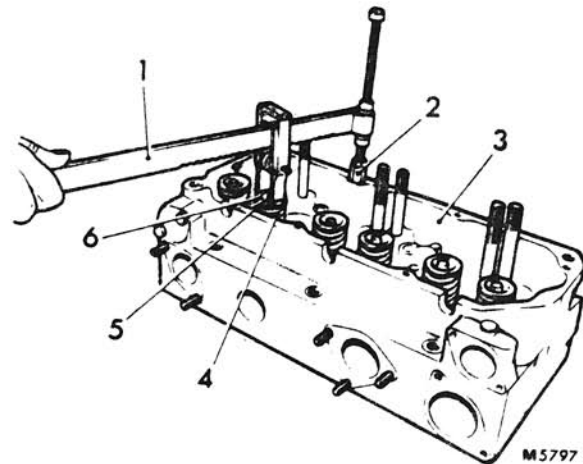


FIG. 3. VALVE SPRING COMPRESSOR

- |    |                  |    |               |
|----|------------------|----|---------------|
| 1. | Compression tool | 4. | Valve spring  |
| 2. | Adaptor          | 5. | Valve         |
| 3. | Cylinder head    | 6. | Spring collar |

4. Refit rocker covers and joints.
5. Reconnect electrical supply.

**OVERHAUL**

**Cylinder Head**

Service tools: LC6118, LC6118-3, LC6118-6, MS76, MS 150-11, MS655, LC325, LC245-259

**To Dismantle**

**Rocker Shaft**

1. Remove rocker shaft assembly; see page 2-3F-3.
2. Remove circlips and washers from each end of shaft, then remove springs, rocker levers and brackets from shaft, noting their position on the shaft.
3. Remove blanking washers from each end of shaft.

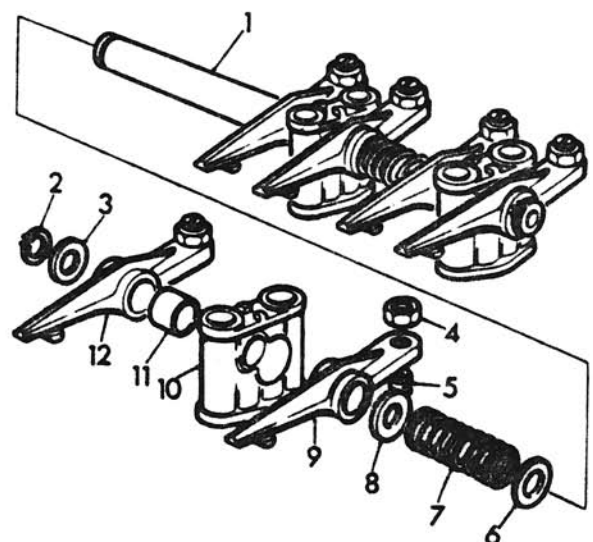


FIG. 4. ROCKER SHAFT ASSEMBLY

- |    |         |    |          |     |                |
|----|---------|----|----------|-----|----------------|
| 1. | Shaft   | 5. | Adjuster | 9.  | Rocker Bracket |
| 2. | Circlip | 6. | Washer   | 10. | Bearing        |
| 3. | Washer  | 7. | Spring   | 11. | Rocker         |
| 4. | Locknut | 8. | Washer   | 12. | Rocker         |

## REMOVAL AND REFITMENT

### Rocker Shaft Assembly

Service tools: LC267708, LC109C

#### To Remove

**WARNING:** To avoid possible serious injury to personnel or damage to the engine, the electrical supply MUST be isolated before any of the following maintenance operations are attempted.

1. Disconnect fuel injector pipes.
2. Remove rocker covers and joints.
3. Remove internal injector fuel leak-off pipes.
4. Remove nuts, injector clamps and withdraw injectors.
5. Gradually and evenly remove the rocker shaft retaining nuts, withdraw rocker shaft; discard joints.
6. Using tool LC109C, clean the injector seats.

#### To Refit

1. Refit new joints, locate rocker shaft assembly on dowels and tighten nuts to the torque figure quoted in DATA.
2. Refit new injector seating washers and locate injectors in bores.
3. Refit injector clamps and tighten nuts to the torque figure quoted in DATA.
4. Check and adjust valve clearances as described in this Section.
5. Refit internal injector fuel leak-off pipes and reconnect fuel injector pipes; tighten pipe nuts to the torque figure quoted in DATA.
6. Bleed the fuel system; see Section 4F.
7. Reconnect electrical supply, start the engine and ensure that oil flows to the rocker levers; stop engine.
8. Refit new joints and rocker covers.

### Cylinder Head

Service tools: LC267708, LC109C

#### To Remove

1. Drain cooling system.

2. Disconnect air delivery pipe from compressor to inlet manifold.
3. Disconnect by-pass pipe from water pump end-cover to thermostat housing.
4. Disconnect pipe from water outlet elbow.
5. Remove setscrews, washers and detach water outlet pipe from cylinder head, discard joints.
6. Remove nuts and detach inlet and exhaust manifolds, discard joints.

**NOTE:** Immediately the fuel pipes are disconnected, the pipes and adaptors MUST be plugged to prevent the ingress of foreign matter entering the fuel system.

7. Disconnect fuel injector pipes and external leak-off pipes.
8. Detach oil filler mounting bracket and filler pipe assembly from cylinder head.
9. Remove rocker cover(s) and joint(s).
10. Remove internal injector leak-off pipes and adaptors.
11. Remove nuts, injector clamps and withdraw injectors.
12. Gradually and evenly remove the rocker shaft retaining nuts, withdraw rocker shaft assembly; discard joints.
13. Remove valve caps from valve stems.
14. Note positions of push-rods, then withdraw from engine.
15. Remove nuts and withdraw cylinder head(s) from studs; discard gaskets.
16. Withdraw ferrules and O-rings from crankcase.
17. Thoroughly clean all mating surfaces, remove any carbon deposits from valves and piston crowns.
18. Using tool LC109C, clean the injector seats.

#### To Refit

1. Locate new ferrules and O-rings in the crankcase.

**NOTE:** Unless specified by the engine manufacturer (Leyland Trucks Limited), jointing compound or paste must NOT be used when refitting new cylinder head gaskets. The head and crankcase must be oil-free, clean and dry; gaskets are marked 'TOP' to ensure correct positioning.

2. Position new gaskets on studs, locate cylinder head on studs and carefully slide into position.



2. Remove socket-head screws and detach pulley and damper from driving flange dowels.
3. Bend back tab washer, remove bolt and using service tool MS 65 with adaptors LC 65-3 and LC 65-10, withdraw the driving flange from crankshaft.
4. Remove oil seal from the timing gear case.

#### To Refit

1. Refit a new oil seal into timing gear case.
2. Refit driving flange through oil seal and locate on crankshaft key.
3. Refit tab washer, bolt and tighten bolt to the torque figure quoted in DATA; bend tab washer over flat on bolt and through hole in flange.
4. Locate crankshaft damper and driving coupling on dowels; secure with socket-head screws.
5. Remove container, top-up oil level as necessary.

#### Timing Gear Case

Service tools: MS 65, LC 65-3, LC 65-10

#### To Remove

1. Remove engine sump and front crankshaft oil seal as detailed in this Section.
2. Remove compressor return pipe from water by-pass pipe.
3. Remove water pump, see Section 1F, Group 2.
4. Remove compressor, see Section 5F.
5. Remove nuts, washers and setbolt, detach front support bracket from crankcase, discard joint.

**NOTE:** Ensure that the copper washers are retained on the two upper mounting studs.

6. Remove tachometer from timing case; discard joint.
7. Suitably identify relative positions of setscrews for subsequent refitment.
8. Remove timing case from dowels on backplate; discard joint.
9. Remove oil seal from timing case.
10. Clean all joint faces.

#### To Refit

1. Press a new oil seal into timing case.
2. Position a new joint on backplate, refit timing case and secure.
3. Position a new joint on timing case, refit tachometer.
4. Refit compressor; see Section 5F.
5. Refit a new joint on crankcase coated with a suitable jointing compound, locate front support bracket on studs and secure.
6. Refit water pump; see Section 1F, Group 2.
7. Reconnect compressor water return pipe.
8. Refit engine sump and front crankshaft oil seal as detailed in this Section.
9. Refill cooling system; see Group 1.
10. Refill lubrication system.
11. Reconnect electrical supply, run engine and check for leaks; rectify as necessary.

#### Timing Gear Backplate

#### To Remove

1. Remove timing gear case as previously described.

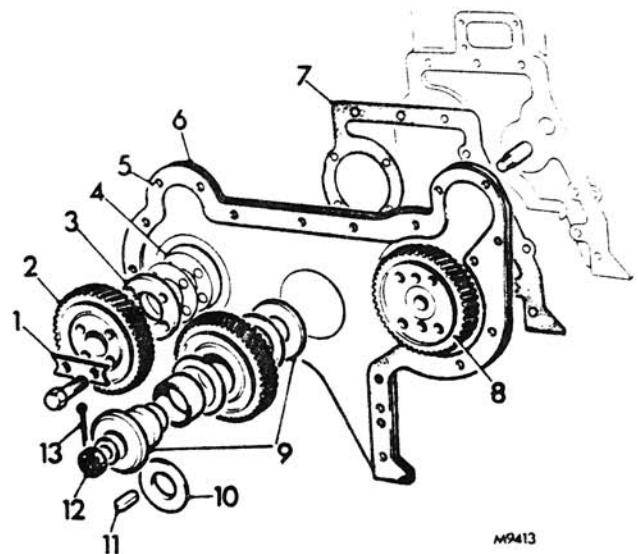


FIG. 2. TIMING GEAR BACKPLATE

- |                                   |                          |
|-----------------------------------|--------------------------|
| 1. Lockplate                      | 7. Joint                 |
| 2. Camshaft gear                  | 8. Compressor drive gear |
| 3. Thrust washer                  | 9. Idler gear assembly   |
| 4. Shim                           | 10. Oil flinger          |
| 5. Joint                          | 11. Key                  |
| 6. Timing gear backplate, typical | 12. Nut                  |
|                                   | 13. Split pin            |

2. Remove rocker shaft assemblies; see Section 2F.
3. Set engine until No. 1 piston is on 'T.D.C.' by turning the engine in its normal direction of rotation and aligning the pointer on the engine rear mounting plate with the mark 'T.D.C.' stamped on the flywheel, Fig. 3. The timing mark on the camshaft gear must also be aligned with the mark on the timing backplate as shown in Fig. 4.
4. Remove oil flinger and key from crankshaft.
5. Remove split pin, castellated nut and idler gear assembly.
6. Bend back lockplate tabs, remove setbolts and withdraw camshaft gear from its dowelled location.
7. Remove setbolts and withdraw thrust washer and shims from backplate.
8. Remove timing gear backplate from dowels; discard joint.
9. Clean joint faces.

**To Refit**

1. Position a new joint on crankcase, refit and secure backplate.
2. Refit original shims, thrust washer and setbolts to backplate. Position a dial-test indicator on the end of the camshaft, check end-float is within the limits quoted in DATA; adjust shim pack as necessary.
3. Fit camshaft drive gear onto dowelled location on end of camshaft. Ensure to align mark on gear with mark on backplate. Fit setbolts and lockplates; do NOT tighten at this stage.
4. Check that engine is set on 'No. 1 T.D.C.'
5. Locate idler gear assembly onto spindle, fit castellated nut and secure with split pin.
6. Fit oil flinger and key to end of crankshaft.
7. Tighten camshaft gear, setbolts, bend lockplate tabs over bolt heads.
8. Rotate the engine anti-clockwise, until the timing pointer on the rear engine mounting plate is just past the mark 'INJ' on the flywheel. Rotate the engine clockwise and align the pointer with 'INJ' on the flywheel is in line with the pointer; adjust as necessary.

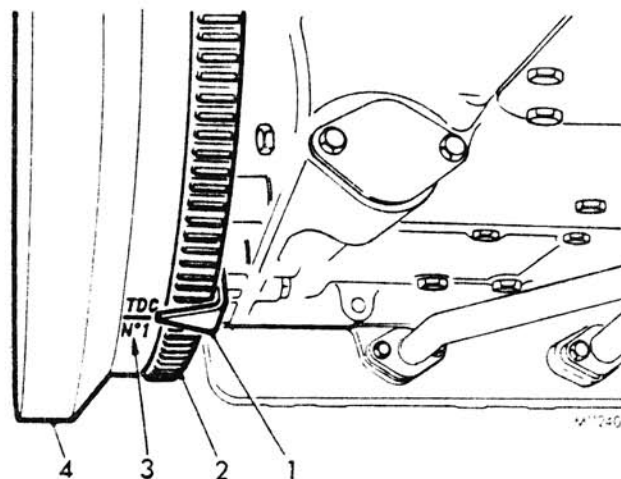


FIG. 3. FLYWHEEL TIMING POINTER

- |                   |                 |
|-------------------|-----------------|
| 1. Timing pointer | 3. Timing marks |
| 2. Starter ring   | 4. Flywheel     |

9. Fit rocker shaft assembly; see Section 2F.
10. Refit timing gear case as described in this Section.

**Camshaft**

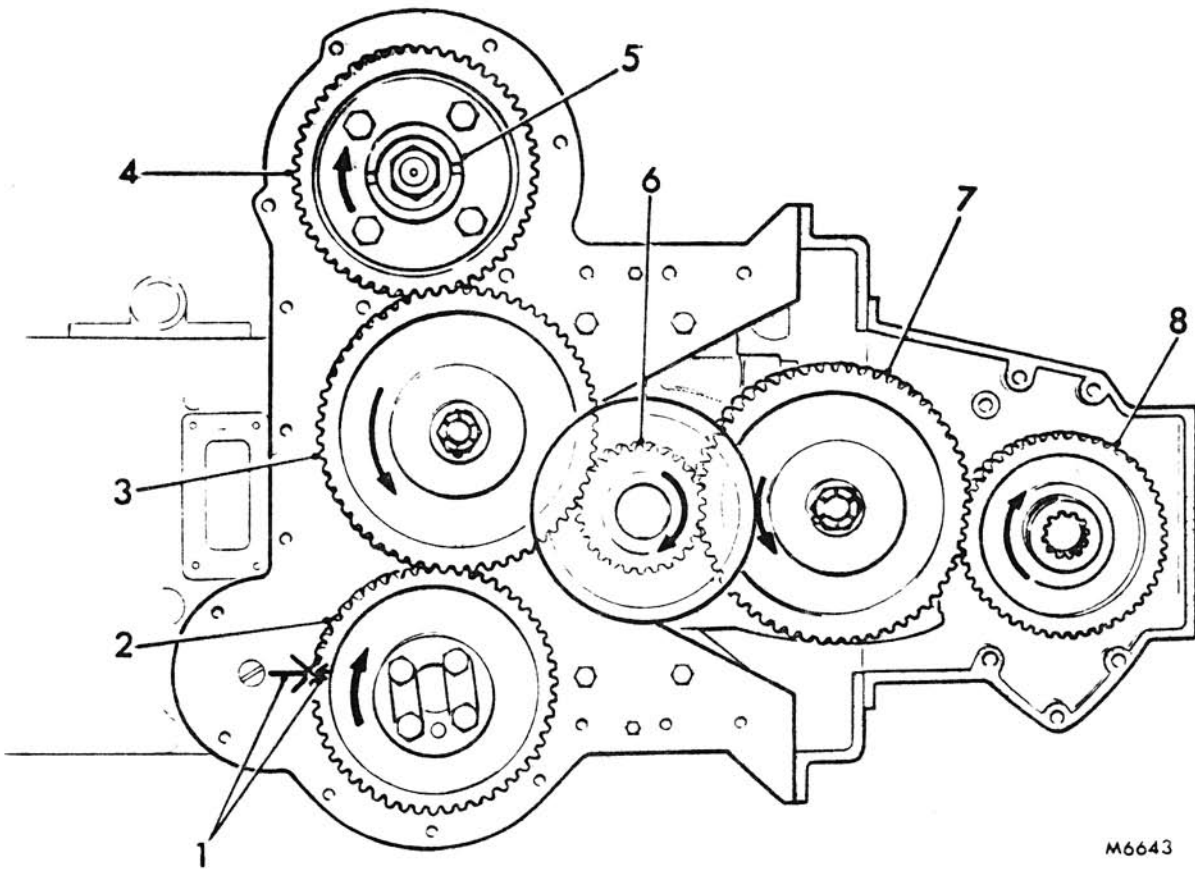
**To Remove**

1. Remove timing gear case; see page 2-3F-8.
2. Remove rocker shaft assemblies; see Section 2F.
3. Remove tappets/cam followers; see page 2-3F-5.
4. Set engine until No. 1 piston is on 'T.D.C.' by turning the engine in its normal direction of rotation and aligning the pointer on the engine rear mounting plate with the mark 'T.D.C.' stamped on the flywheel. The timing mark on the camshaft gear must also be aligned with the mark on the timing back plate, as shown in Fig. 4.
5. Bend back lockplate tabs, remove setbolts and withdraw camshaft gear from its dowelled location.
6. Remove setbolts and withdraw thrust washer and shim(s) from end of camshaft/timing backplate.
7. Withdraw camshaft.

**NOTE:** The camshaft should be renewed when the difference between base circle diameter and nose dimension is less than 9mm (0.385in), Fig. 5.

8. Check the camshaft bearings and tappets for wear, see DATA for tolerances.





M6643

FIG. 4. TIMING GEARS SHOWING CAMSHAFT TIMING MARKS

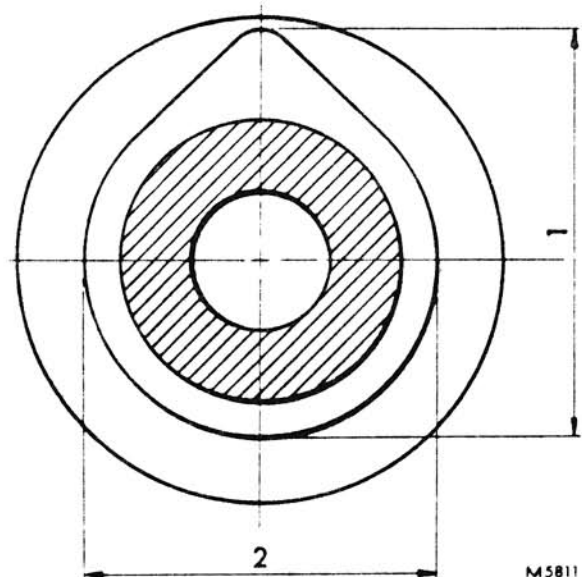
- |    |                       |    |                          |
|----|-----------------------|----|--------------------------|
| 1. | Timing marks          | 5. | Tachometer drive adaptor |
| 2. | Camshaft gear         | 6. | Crankshaft gear          |
| 3. | Idler gear            | 7. | Idler gear               |
| 4. | Compressor drive gear | 8. | Fuel pump drive gear     |

9. The camshaft bearings are held in position with locating screws through the underside of the crankcase and into the bearings.
10. If the bearings require renewal, release screws and drive out the bearings with a suitable drift. The intermediate bearings are interchangeable.

**NOTE:** To remove the rear bearing the fluid coupling and flywheel must be removed see relevant sections of this Group.

**To Refit**

1. Refit new bearings if removed, secure with locating screws.
2. Refit camshaft.



M5811

FIG. 5. CAM WEAR DIAGRAM

1. Cam lift dimension
2. Base circle diameter

3. Refit original shims and thrust washer on camshaft, locate setbolts through washer/shims and secure to backplate.
4. Check that camshaft end-float is within limits quoted in DATA. Adjust shimming as required.
5. Set engine on 'No. 1 T.D.C.' as detailed on page 2-3F-9.
6. Fit No. 6 cylinder tappets/cam followers and push-rods.
7. Turn camshaft until No. 6 cylinder push-rods are rocking.
8. Fit camshaft gear onto dowelled location on end of camshaft. Ensure that mark on gear is in line with mark on backplate, see Fig. 4.

**NOTE:** The timing marks on the gear and backplate will only be aligned when the camshaft gear is completely in mesh.

9. Refit lockplates and setbolts do NOT tighten at this stage.
10. Check that timing mark on fuel pump flywheel is just past injection, 12mm (0.5 in) approximately.
11. Tighten camshaft gear setbolts, bend lockplate tabs over bolt heads.
12. Rotate the engine anti-clockwise and align the pointer on the engine rear mounting plate with the mark 'INJ'. Check that the mark on the fuel pump flywheel is aligned with the pointer; adjust fuel pump timing as necessary; see Section 4F.
13. Refit remaining tappets/cam followers and push-rods.
14. Refit rocker shaft assemblies; see Section 2F.
15. Refit timing gear case as described in this Section.

**NOTE:** In the event of a new camshaft gear being fitted an arrow must be electrically etched on the gear in exactly the same position as that marked on the original.

### Idler Gear(s)

#### To Remove

1. Remove timing case, see page 2-3F-8.
2. Set engine on 'T.D.C.' and ensure it does not rotate during removal of the idler gear(s).

3. Remove split pin, nut and withdraw idler gear complete with spindle, floating bush, thrust washers and plain washers.

#### To Refit

Refitment is the reversal of the removal procedure ensuring that the flat machined on the bolt coincides with the oil feed hole in the spindle.

### Connecting Rod Big-End Bearings

#### To Remove

1. Remove injectors; see Section 5F.
2. Remove oil sump, see page 2-3F-5.
3. Turn engine to bring two connecting rods to bottom dead centre.
4. Remove bearing caps and shells.
5. Slide pistons and connecting rods up bores, then remove bearing upper shells.

#### To Refit

1. Fit new bearing upper shells, lubricate bearing surfaces with clean engine oil, then pull connecting rods and pistons down onto crankshaft.
2. Fit bearing shells into caps, lubricate bearings with clean engine oil, then align numbers stamped on bearing caps with numbers stamped on connecting rods.
3. Tighten cap nuts and bolts until an extension of 0,152 to 0,203 mm (0.006 to 0.008 in) is recorded. This will probably take place in the torque figure range shown in DATA, but these figures must be used for reference only.
4. If necessary, tighten nuts further to bring centre punch slot in line with split pin hole and fit split pin.

**NOTE:** Nut on fuel side of connecting rod has a centre punch mark on one of its sides.

5. Repeat operations 3 of removal to 4 of refitment for remainder of bearings.
6. Fit oil sump; see page 2-3F-5.
7. Fit injectors; see Section 4F.
8. Bleed fuel system; see Section 4F.

**ENGINE**

**To Reassemble**

1. Fit new circlip to piston.
2. Heat piston in boiling water, fit gudgeon pin to piston and connecting rod.

**NOTE:** Piston must be fitted to connecting rod with stamping 'camshaft side' to side of connecting rod with cut-out for bearing shell tongue.

3. Fit second new circlip to piston.
4. Repeat items 1 to 3 for remaining piston and rod assemblies.
5. Using a suitable tool, fit piston rings in the following sequence:

Slotted scraper - 4th groove.

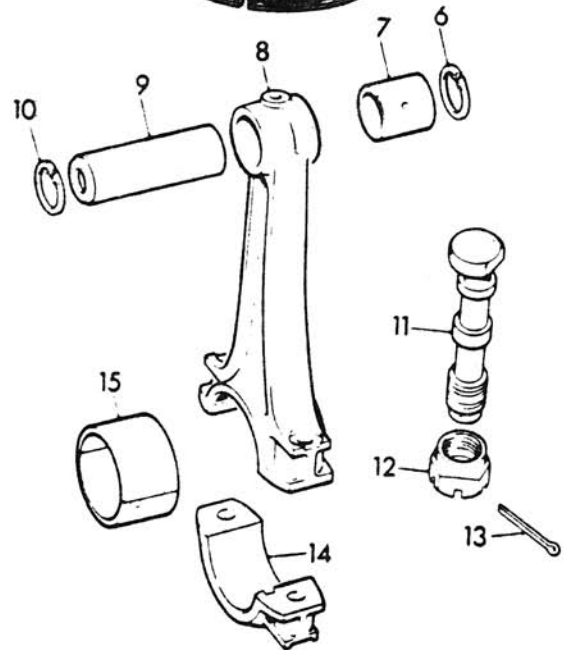
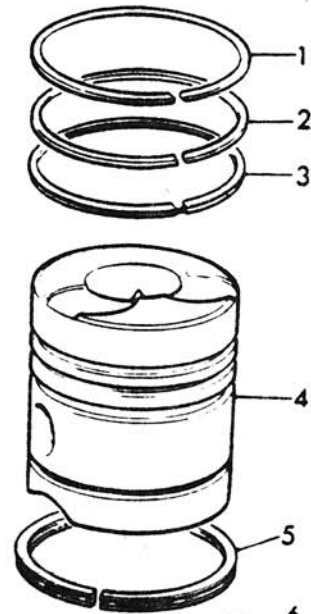
Spring loaded scraper - 3rd groove

**NOTE:** Stepped compression rings fitted in 2nd and top grooves are marked 'TOP' to indicate correct positioning.

Stepped compression, tapered sides -top groove.

6. Space piston ring gaps 120° apart.

2. Press spindle in pump body and fit idler gear on spindle.
3. Insert driving gear/shaft assembly in pump body, refit joint and end cover.



**Oil Pump**

**To Dismantle, Fig. 17**

1. Remove suction pipe assembly and delivery pipe from pump body, discard joints.
2. Place pump in a vice equipped with soft jaws.
3. Mark position of end-cover to body.
4. Remove setscrews and detach end-cover; discard joint.
5. Withdraw driving gear/shaft assembly, release gear from key.
6. Withdraw idler gear from spindle.
7. Press spindle from pump body.
8. Examine all components for wear or damage; see DATA.

FIG. 15. CONNECTING ROD AND PISTON

- |                               |                 |
|-------------------------------|-----------------|
| 1. Compression ring           | 9. Gudgeon pin  |
| 2. Compression ring           | 10. Circlip     |
| 3. Spring loaded scraper ring | 11. Bolt        |
| 4. Piston                     | 12. Nut         |
| 5. Scraper ring               | 13. Split pin   |
| 6. Circlip                    | 14. Bearing cap |
| 7. Bush                       | 15. Bearings    |
| 8. Connecting rod             |                 |

**To Reassemble**

1. Refit key in driving shaft and press driving gear on shaft.

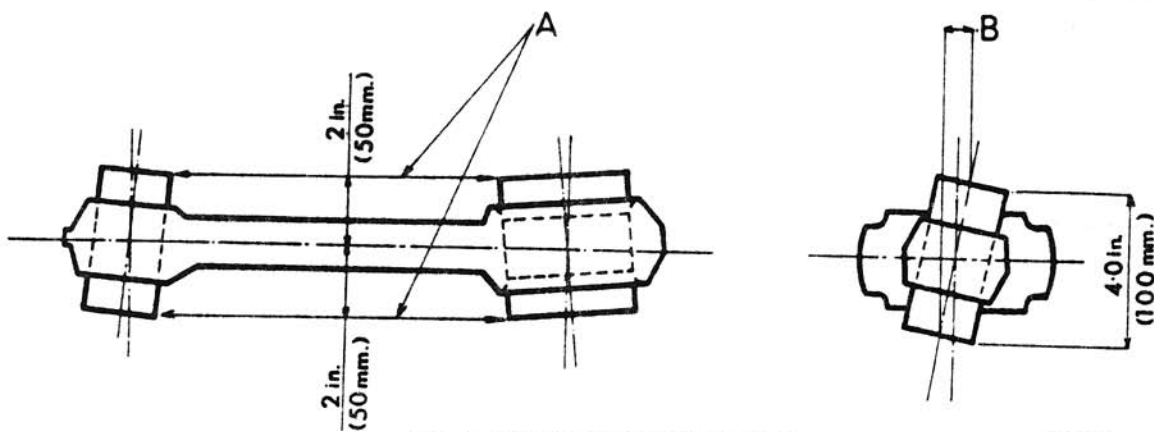


FIG. 16. CONNECTING ROD ALIGNMENT

M1176

Difference between dimension at A not to exceed 0,025 mm (0.001 in)

Dimension at B not to exceed 0,05 mm (0.002 in) in this or opposite plane

4. Locate new joints, reconnect suction pipe assembly and delivery pipe to pump body.

After grinding, support the crankshaft at the front and rear journals. Check the relative eccentricity of the centre main journal; this must not exceed 0,0762 mm (0.003 in) in radius - total run-out of 0,1524 mm (0.006 in).

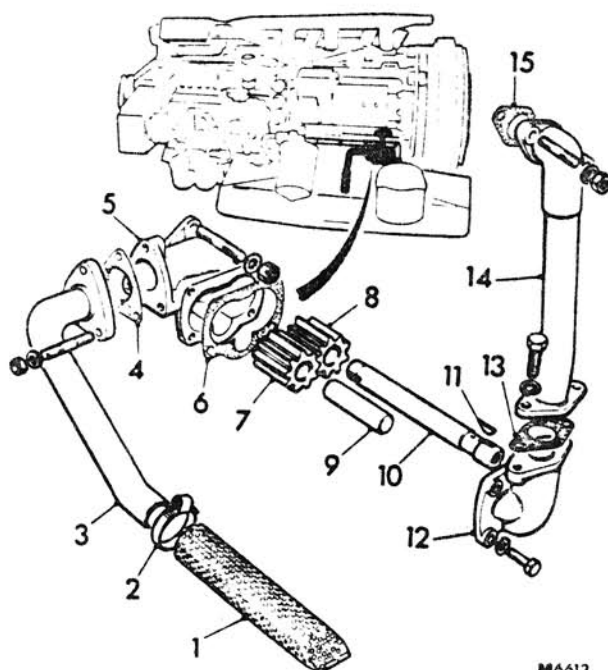
### Driving Gear, Fig. 18

To inspect the oil pump driving gear remove the thrust housing on the rear right-hand-side of the engine block and withdraw the gear by screwing a 5/16 in B.S.F. bolt of suitable length into the gear.

If it is found necessary to renew the driving gear bush in the engine block ensure that the oil hole in the bush flange is directed towards the gear on the camshaft

### Relief Valve

The oil pressure relief valve is set at initial engine test and should require no further adjustment.



M6613

FIG. 17. EXPLODED VIEW OF OIL PUMP

### Crankshaft

#### To Regrind

When regrinding journals and crankpins, the end faces must NOT be ground. If the location faces of the centre bearing have been damaged, the width should be increased from 68,834 to 68,885 mm (2.710 to 2.712 in), otherwise the dimensions should remain at 68,580 to 68,631 mm (2.700 to 2.702 in).

- |    |                |     |                     |
|----|----------------|-----|---------------------|
| 1. | Suction filter | 8.  | Driving gear        |
| 2. | Hose clip      | 9.  | Spindle, idler gear |
| 3. | Suction pipe   | 10. | Driving shaft       |
| 4. | Joint          | 11. | Key                 |
| 5. | Oil pump body  | 12. | Oil pump cover      |
| 6. | Joint          | 13. | Joint               |
| 7. | Idler gear     | 14. | Delivery pipe       |
|    |                | 15. | Joint               |

## REMOVAL AND REFITMENT

## Fuel Injection Pump

Service tools: MS 55, LC 55-3

## To Remove

**NOTE:** Immediately the pipes are disconnected, the ends together with the unions on the pump and filters must be protected against the ingress of foreign matter.

**WARNING:** To avoid possible serious injury to personnel or damage to the engine, the electrical supply **MUST** be isolated before any of the following maintenance operations are attempted.

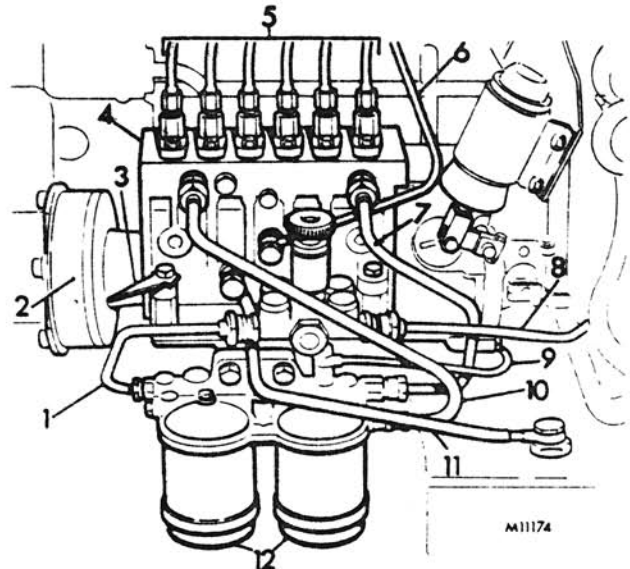


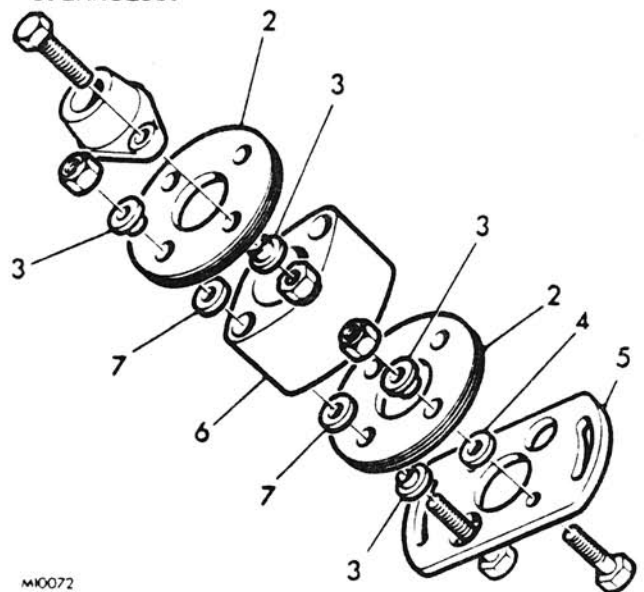
FIG. 1. FUEL INJECTION PUMP

1. Fuel pipe, filter to lift pump	7. Fuel bleed pipe
2. Fuel pump flywheel	8. Fuel inlet pipe
3. Timing pointer	9. Filter leak-off pipe
4. Fuel pump	10. Fuel feed pipe
5. Fuel injector pipes	11. Oil drain pipe
6. Oil feed pipe	12. Fuel filters

**NOTE:** Should the coupling assembly need to be dismantled, the relative positions of the plates, sleeves and washers must be observed, see Fig. 2.

1. Place a suitable container beneath the pump.
2. Set engine in injection position on No. 1 cylinder by turning the engine in its normal direction of rotation and aligning the pointer on the engine rear mounting plate with the mark 'INJ' stamped on the flywheel housing. Check that the timing pointer is aligned with the mark on the fuel pump flywheel.
3. Disconnect fuel pump injector pipes and release clamps from engine.
4. Disconnect fuel pipe from lift pump to filter.
5. Disconnect oil drain pipe from fuel pump and move pipe clear.
6. Disconnect fuel feed pipe from filter to pump.
7. Disconnect fuel inlet pipe from lift pump.
8. Disconnect fuel bleed pipe from pump to filter.
9. Disconnect oil feed pipe from pump.
10. Disconnect leak-off pipe from fuel filter.
11. Disconnect stop solenoid linkage from fuel pump lever, release return spring from rear of pump.
12. Remove setscrews and disconnect drive coupling adjusting plate from fuel pump flywheel.
13. Remove setscrews, washers and detach fuel pump from mounting bracket, noting that the timing pointer fits on the front left-hand side setscrew, on the latest type of fuel pump the timing pointer is secured to the left hand-side of the pump.

14. Remove nut and washer securing flywheel to pump; using tool MS 55 with adaptor LC 55-3 withdraw flywheel from fuel pump, retain key if dislodged.
15. Check driving plates, coupling, adjusting plates and sleeves for cracks or damage; renew as necessary.
16. Clean any excess fuel from pump and crankcase.



MK0072

FIG. 2. FUEL PUMP COUPLING ASSEMBLY

1. Coupling flange	5. Adjusting plate
2. Driving plates	6. Coupling
3. Sleeve	7. Special washer
4. Plain washer	

**To Refit**

1. Refit and secure flywheel to fuel pump with nut and washer.
2. Refit and secure drive coupling to housing, if previously removed.
3. Locate fuel pump on mounting bracket with the pump flywheel in light contact with the coupling assembly. Do NOT end-load the coupling.
4. Refit pump mounting setscrews, ensuring that the timing pointer is attached to the front left-hand-side setscrew; lightly tighten setscrews.

**NOTE:** During the setting procedure do NOT reconnect the fuel injector pipes.

5. Using feeler gauges, check clearance between coupling plates and pump flywheel at four diametrically opposed points; rotate engine through 180° in its normal direction of rotation and re-check clearance.
6. When a light, even contact is achieved in all positions as checked above, set pump timing as detailed below, reconnect pipes and tighten pump mounting bolts.
7. If the side clearances of the pump are not equal, slacken securing setscrews and move pump as necessary to attain the correct alignment as checked in paragraph 5.

**NOTE:** Should any adjustments be made to the position of the pump it will be necessary to re-check using the above procedure.

8. When an equal gap between the pump flywheel and coupling is achieved, move the pump towards the drive housing until the gap just closes.
9. Check the engine is set on '1NJ', with No. 1 cylinder on the firing stroke, then rotate the pump flywheel until the timing mark is aligned with the pointer, fit setscrews, washers and secure adjusting plate to pump flywheel.
10. Refit fuel filter assembly to fuel pump mounting bracket, secure with setscrews.
11. Reconnect stop solenoid to fuel pump lever and spring to rear of pump, see Page 2-4F-5 for setting procedure.
12. Reconnect fuel filter leak-off pipe.
13. Reconnect fuel bleed pipe.
14. Reconnect oil feed pipe.

15. Reconnect fuel inlet pipe to lift pump.
16. Reconnect fuel feed pipe from filter to pump.
17. Reconnect oil drain pipe to pump.
18. Reconnect fuel pipe from lift pump to filter.
19. Reconnect fuel pump injector pipes, tighten pipe nuts to the torque figure quoted in DATA, secure clamps.
20. Bleed fuel system as described on page 2-4F-4.
21. Reconnect electrical supply.
22. Remove container from beneath pump.
23. Run engine and check for leaks, also stop solenoid operation; rectify as necessary.
24. Re-check fuel pump timing as follows:
  - a. Rotate engine in its normal direction of rotation until the mark on the pump flywheel aligns with the pointer, with No. 1 cylinder on the firing stroke.
  - b. Slacken fuel pump adjusting plate setscrews.
  - c. Move fuel pump flywheel in opposite direction of rotation, then rotate in the normal direction until slight resistance to further movement is reached.
  - d. Re-align timing pointer with mark and secure setscrews.
  - e. Reconnect electrical supply on completion of adjustment.

**Fuel Lift Pump****To Remove**

1. Disconnect fuel pipes from lift pump.
2. Disconnect fuel feed pipe from pump, move pipe clear of lift pump.
3. Disconnect oil return pipe from pump, move pipe clear.
4. Remove nuts, washers and withdraw lift pump; discard joint.
5. Place a suitable cloth over aperture to prevent the ingress of foreign matter.

**To Refit**

Refitment is a reversal of the removal procedure, observing the following points:

1. Clean mating faces and fit a new joint.
2. Bleed fuel system.





## Injector

Service tools: LC 267708, LC 400115, LC 109C

### To Remove

1. Place a suitable container under rocker cover.
2. Remove rocker cover(s) and joint(s).
3. Remove internal injector leak-off pipes.
4. Disconnect injector pipe.
5. Remove injector clamp, nut and clamp.
6. Remove the injector end-plug and screw the adaptor into the injector body. Position the extractor with the longest leg resting on the edge of the valve cover and the shortest leg on the rocker bracket.
7. Screw the withdrawal screw into the adaptor and withdraw the injector by screwing down the nut on top of the tool.
8. Remove injector seating washer and rubber seal.
9. Remove tool from injector, refit the end-plug and tighten plug to the torque figure quoted in DATA.
10. Using tool LC109C, clean injector seat.

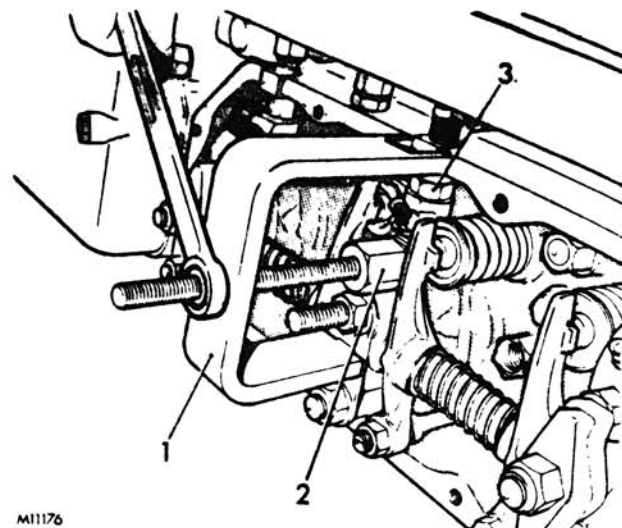


FIG. 3. INJECTOR EXTRACTOR LC 267708

- |              |            |             |
|--------------|------------|-------------|
| 1. Extractor | 2. Adaptor | 3. Injector |
|--------------|------------|-------------|

2. Unscrew priming plunger on lift pump.
3. Release bleed screw on fuel filter.
4. Operate hand primer until air-free fuel flows from the filter; tighten bleed screw, refer to DATA for torque figure.
5. Release bleed screw on fuel pump.
6. Operate hand primer until air-free fuel flows from the pump; tighten bleed screw.
7. Secure plunger on lift pump.
8. Clean any excess fuel from pump and filter.

**NOTE:** The later types of fuel pump bleed screws will have a valve incorporated in the screw also a spill pipe will be fitted, this will prevent any fuel spillage on to the engine which could be a possible fire hazard.

9. Reconnect electrical supply.
10. Remove container.

**IMPORTANT:** Further information and overhaul instructions for fuel injection equipment can be obtained from the maker's local agents (CAV/Simms) or from:

CAV & Simms Service  
CAV Limited  
P.O. Box 36  
Warple Way  
LONDON W3 7SS

or Friedmann and Maier.

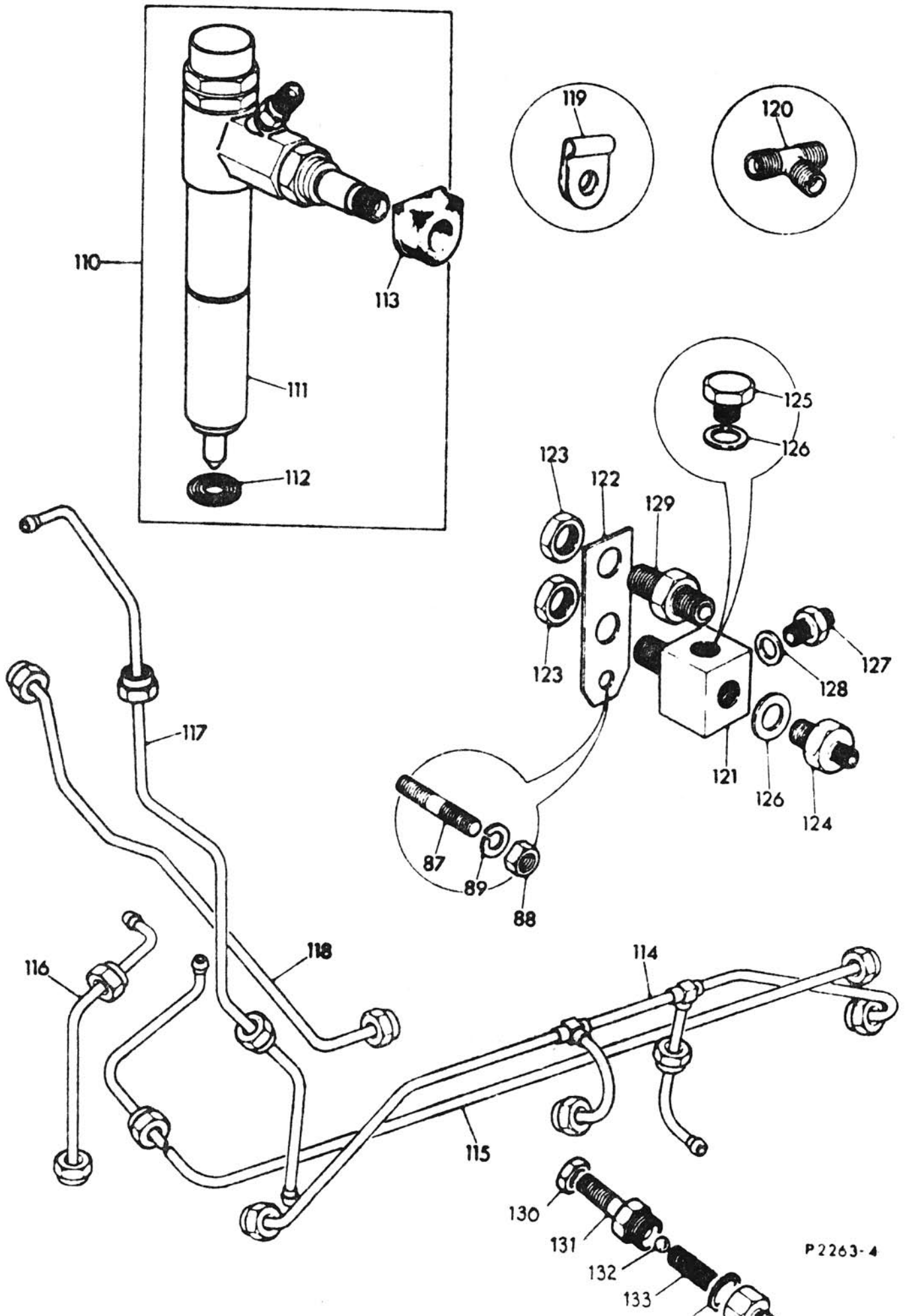
### To Refit

1. Refit new seating washer to bottom of injector.
2. Refit rubber seal to injector.
3. Refit injector.
4. Refit injector clamp and nut, tighten nut to the torque figure quoted in DATA.
5. Refit fuel leak-off pipes and reconnect injector pipe, tighten pipe nuts to the torque figure quoted in DATA.
6. Bleed fuel system.
7. Refit rocker cover(s) and joint(s).
8. Reconnect electrical supply.
9. Remove container.

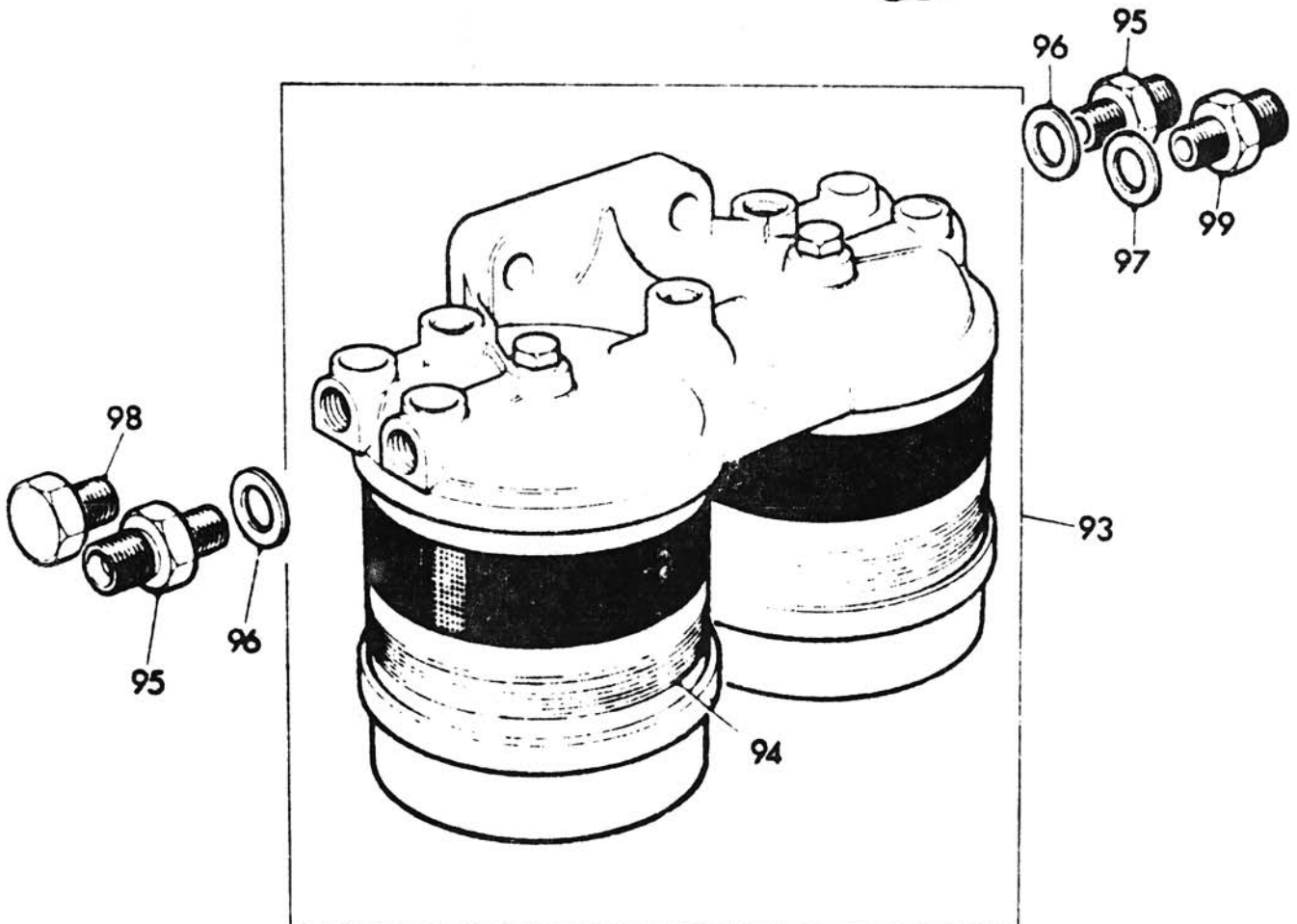
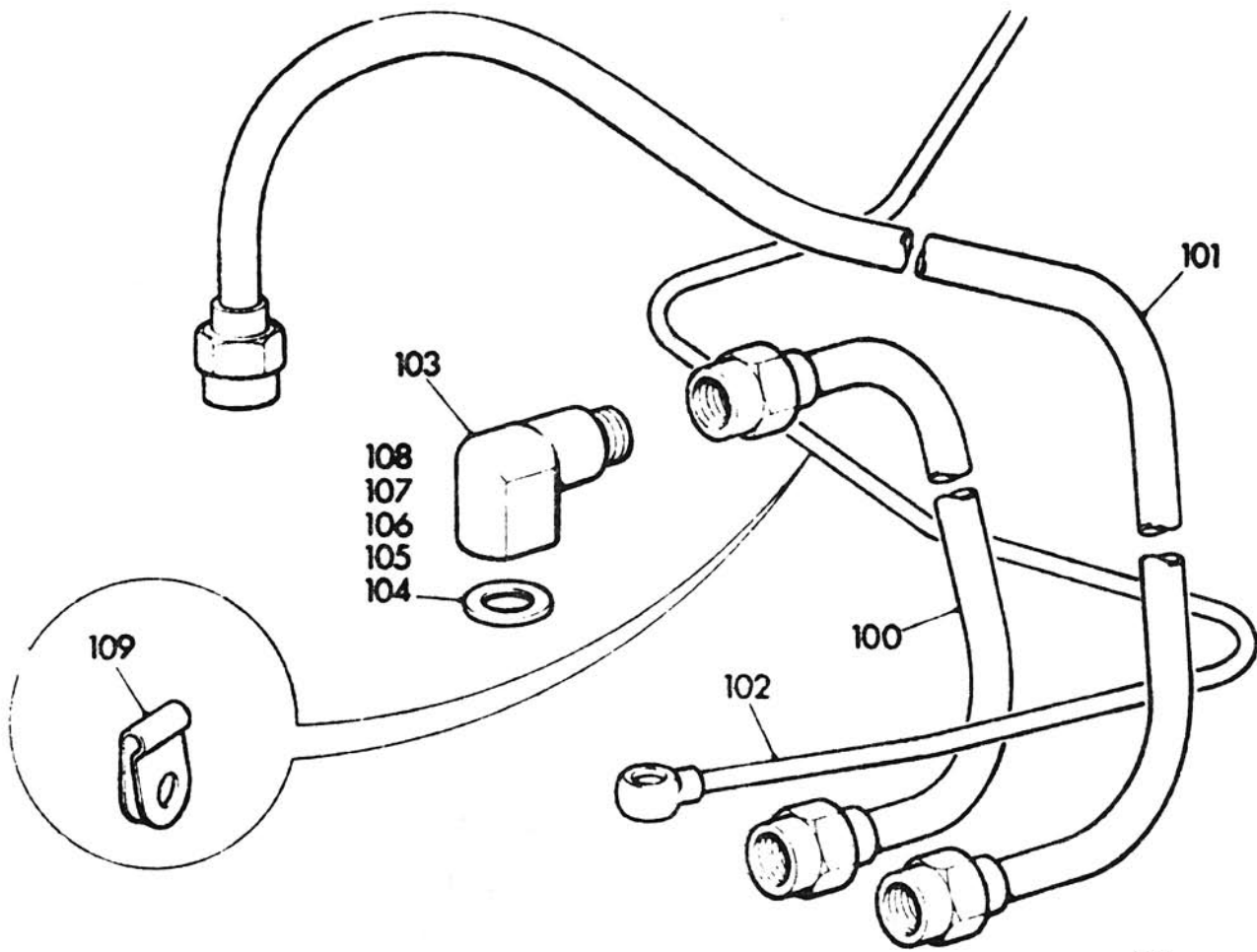
## Fuel System

### To Bleed, Fig. 4.

1. Place a suitable container beneath fuel pump.



P2263-4



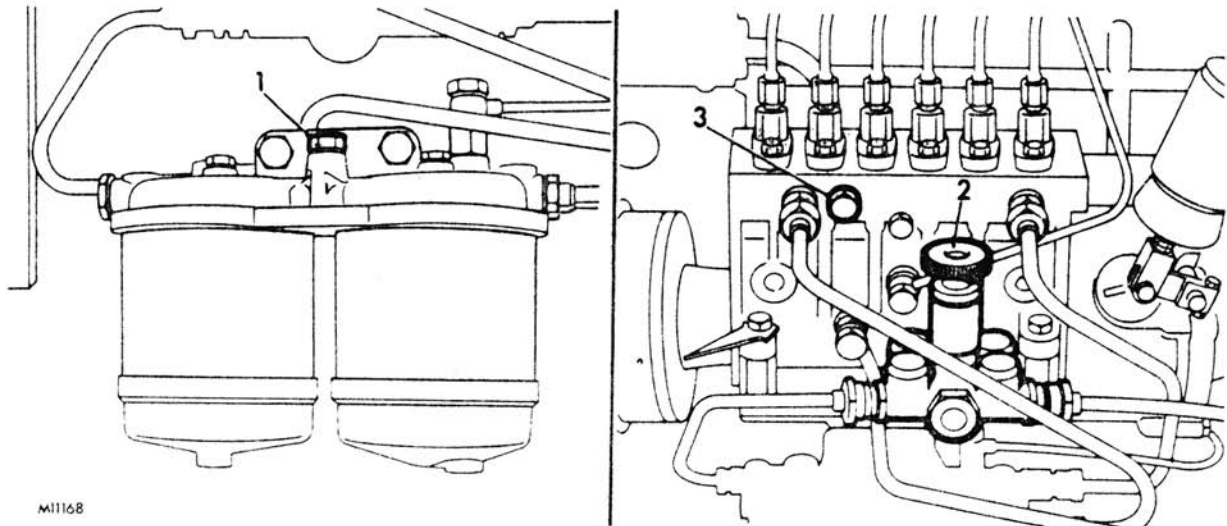


FIG. 4. FUEL BLEED POINTS

1. Filter bleed screw                      2. Lift pump plunger                      3. Fuel pump bleed screw

Quote engine and fuel pump serial number and type on application.

Main U.K. Agents:  
D. C. Woodhead  
Pudsey  
Leeds  
Tel. Leeds 572275

**NOTE:** The solenoid should now be bottoming in both the 'RUN' and 'STOP' positions; under no circumstances must the stop mechanism bottom in the fuel pump governor. This can be observed by operating the stop control manually and listening for an audible click with the engine stopped.

### Engine Stop Solenoid

#### To Remove

1. Peel back rubber cover, note positions of electrical connections, then disconnect.
2. Release split pin, withdraw clevis pin and disconnect solenoid operating lever from fuel pump stop lever.
3. Remove setscrews, washers and detach solenoid from mounting bracket.

#### To Refit

1. Slacken stop lever clamp screw so that the lever can rotate freely on the shaft.
2. Refit solenoid to mounting bracket and reconnect operating rod to fuel pump stop lever.
3. Pull the solenoid operating rod to its normal 'RUN' position, bottoming inside the solenoid, hold in this position and secure clamp screw.
4. Unscrew locknuts on solenoid operating rod and shorten linkage one-half turn, turn screw clockwise to shorten distance, secure locknuts.

5. Reconnect electrical connections and refit rubber cover.
6. Reconnect electrical supply.
7. Run engine and test operation of solenoid; adjust as necessary.

**CAUTION:** Incorrect adjustment of the solenoid could result in damage to the fuel pump governor mechanism.

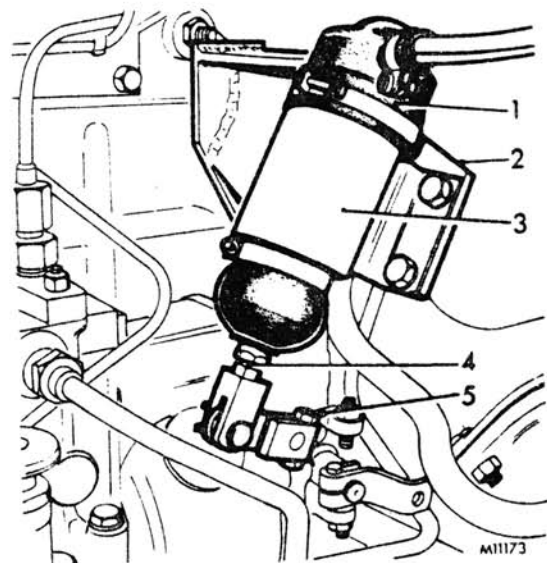


FIG. 5. ENGINE STOP SOLENOID

1. Solenoid terminals                      4. Operating rod  
2. Mounting bracket                      5. Stop lever clamp screw  
3. Solenoid

2-4F-5

## SECTION 5F

## Ancillaries

## AIR COMPRESSOR

## Diagnostic Testing

If the compressor fails to maintain adequate pressure, certain tests can be carried out to ascertain which part of the compressor is malfunctioning. Possible causes are as follows:

1. Excessive carbon in the compressor cylinder head or delivery line.
2. Excessive wear in cylinders or piston rings.
3. Worn inlet or delivery valves and seats.
4. Broken or weak valve springs.
5. Air leakage in system.
6. Defective unloader valve.

## Operating Tests

1. Release all air pressure from the system and remove the delivery port pipe connection
2. Run the engine for a short time to warm the compressor up and clear any collected oil.
3. Hold a sheet of white card 50 mm (2 in) from the delivery port for 10 seconds and a light mist of oil should be apparent, indicating correct lubrication is taking place. The formation of a large patch of oil will indicate wear in the cylinder bores or piston assemblies.
4. If the oil carry-over test is negative, remove the compressor cylinder head and connect a separate air line of 7,03 kgf/cm<sup>2</sup> (100 lbf/in<sup>2</sup>) to the delivery port. An excessive amount of escaping air indicates a defective delivery valve, spring or valve seat.

## REMOVAL AND REFITMENT

## Compressor Cylinder Head

## To Remove

1. Release air pressure from system and partially drain cooling system until level is below compressor.
2. Disconnect the air and water pipes from the cylinder head. Protect each bore against the ingress of foreign matter.

**NOTE:** The cylinder liners should be held in position whilst removing the cylinder head to avoid breaking the crankcase seal.

3. Remove the cylinder head nuts and tap the cylinder head to break the joint and detach the cylinder head from the compressor.

## To Refit

1. Ensure that the valves are not seized and that they are held centrally on their seats by the valve springs.
2. Renew each ring joint between the cylinders and cylinder head.
3. Fit the cylinder head and torque tighten the cylinder head nuts evenly to 21,6 Nm (2,2 kgf m, 16 lbf ft).
4. Connect the air and water pipes to the cylinder head.
5. Refill the cooling system to the correct level.

## Compressor

## To Remove

1. Release air pressure from the system and partially drain cooling system until level is below compressor.
2. Disconnect and remove air inlet and outlet pipes.
3. Disconnect water inlet and outlet pipes.
4. Disconnect oil feed pipe compressor to crankcase.
5. Remove setbolts, nuts, support weight and remove compressor from its location, discard joint.

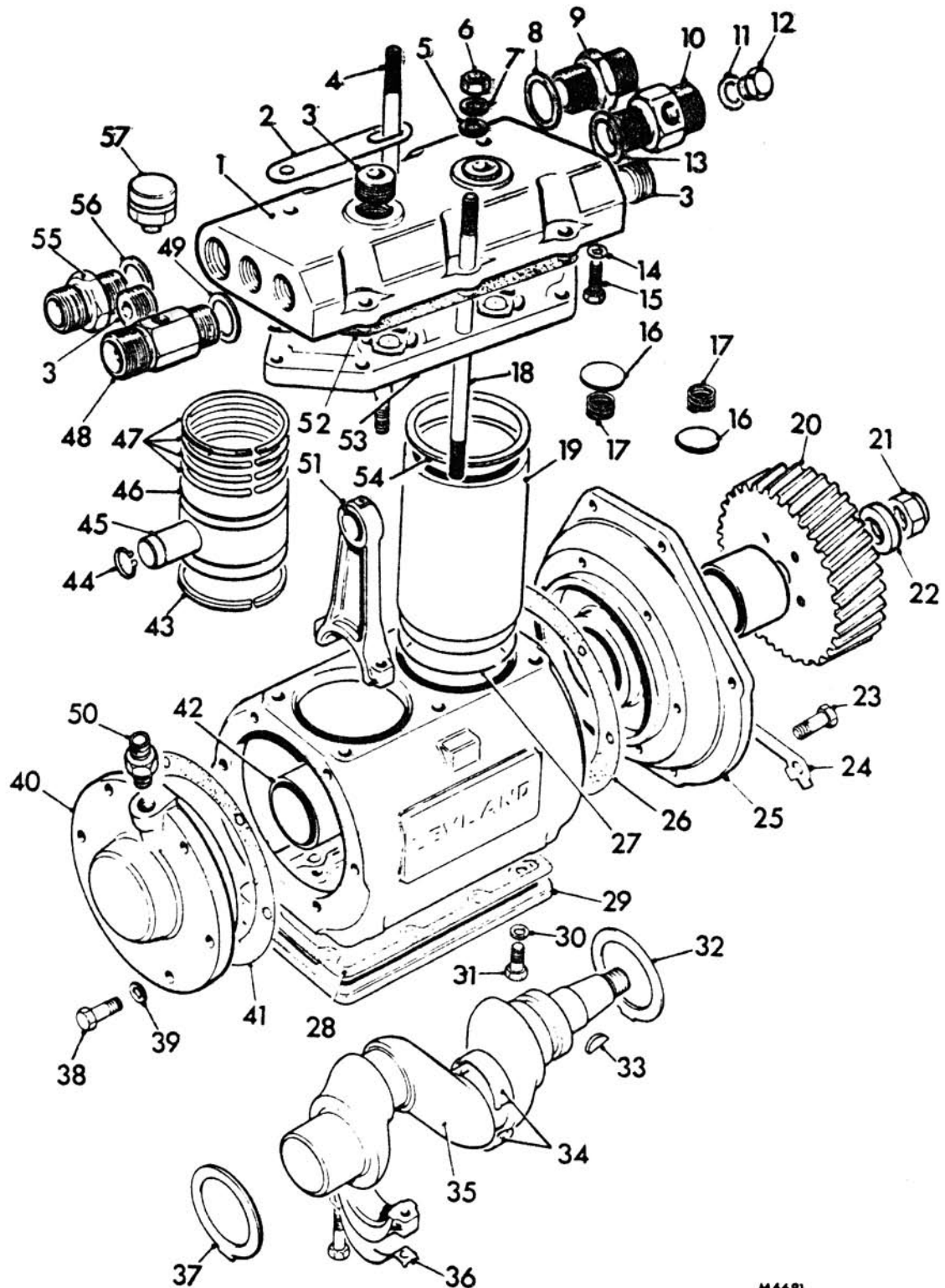
## To Refit

Refitment is a reversal of the removal procedure, observing the following points:

1. Fit a new joint coated with a suitable jointing compound.
2. Ensure that the tongue on the tachometer locates in the slot(s) in the compressor drive adaptor.
3. Top-up cooling system.

## OVERHAUL

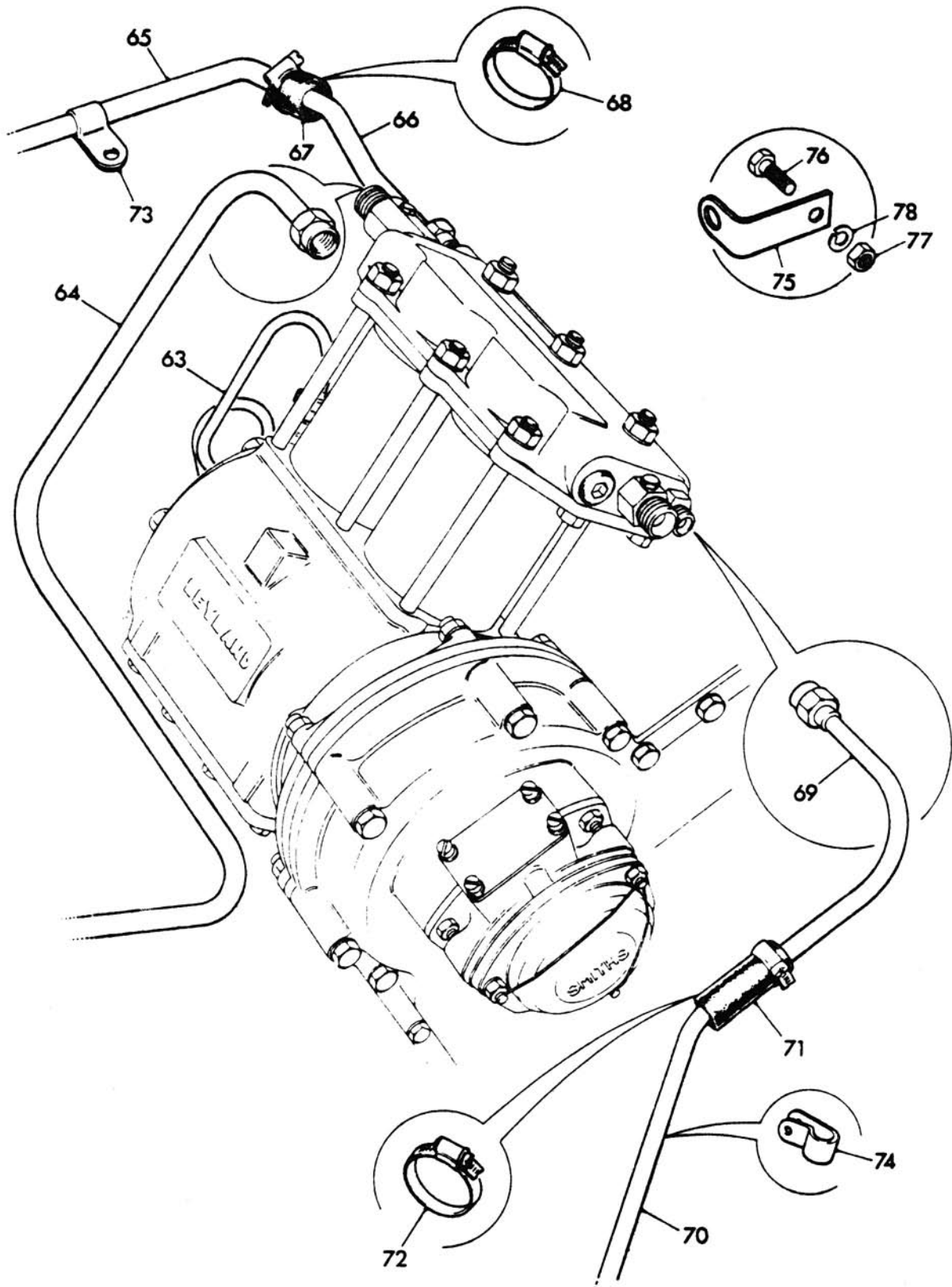
The manufacturers recommended overhaul period for the cylinder head is every year or 80 000 km (50 000 miles) and the complete compressor, every two years or 240 000 km (150 000 miles).



M6681

FIG. 1. EXPLODED VIEW OF COMPRESSOR

- |                               |                     |                    |                                |
|-------------------------------|---------------------|--------------------|--------------------------------|
| 1. Cylinder head (upper half) | 15. Bolt            | 29. Base plate     | 43. Ring (scraper)             |
| 2. Nameplate                  | 16. Valve disc      | 30. Spring washer  | 44. Circlip                    |
| 3. Plug                       | 17. Valve spring    | 31. Bolt           | 45. Gudgeon pin                |
| 4. Stud                       | 18. Stud            | 32. Thrust washer  | 46. Piston                     |
| 5. Plain washer               | 19. Cylinder        | 33. Key            | 47. Ring (compression)         |
| 6. Nut                        | 20. Drive gear      | 34. Bearing shells | 48. Adaptor                    |
| 7. Spring washer              | 21. Nut             | 35. Crankshaft     | 49. Sealing washer             |
| 8. Sealing washer             | 22. Washer          | 36. Locking strap  | 50. Adaptor                    |
| 9. Adaptor                    | 23. Bolt            | 37. Thrust washer  | 51. Connecting rod             |
| 10. Adaptor                   | 24. Locking strap   | 38. Bolt           | 52. Joint                      |
| 11. Sealing washer            | 25. Drive-end cover | 39. Spring washer  | 53. Cylinder head (lower half) |
| 12. Plug                      | 26. Joint           | 40. Rear end cover | 54. Sealing ring               |
| 13. Sealing washer            | 27. Sealing ring    | 41. Joint          | 55. Adaptor                    |
| 14. Spring washer             | 28. Joint           | 42. Bush           | 56. Sealing washer             |
|                               |                     |                    | 57. Safety valve               |



P2262-2\*

Before overhaul, a major repair kit, new cylinders and piston rings must be obtained.

#### To Dismantle, Fig. 1

1. Mark a line on the cylinder head, end-covers and crankcase for reassembly purposes.
2. Progressively slacken and remove the six cylinder head retaining nuts and spring washers. Lift off the cylinder head and remove and discard the sealing joints.
3. Separate the cylinder head by removing the four retaining screws and remove the valve assemblies. Reface the valve seats if showing signs of pitting.
4. Withdraw and discard the cylinders from the crankcase and remove and discard the O-ring seals.
5. Remove the sump cover plate and joint.
6. Mark the big-end bearing caps to ensure correct reassembly. Release tabs of locking straps and remove connecting rod bolts and caps. Withdraw connecting rod and piston assemblies from the crankcase.
7. Remove four setscrews and detach drive adaptor from the compressor gear.
8. Release nut, washer from the end of the crankshaft and remove compressor drive gear.
9. Release locking tabs, remove setscrews and detach drive end cover.
10. Remove the crankcase end cover and withdraw the crankshaft, retain thrust washers.
11. Remove and discard piston rings from pistons. Release one circlip from each piston and press out the gudgeon pins.

#### Inspection

1. Remove completely all traces of old jointing from mating faces, loosen any carbon or other foreign matter present on any of the component parts.
2. Check oilways in the crankshaft and end cover to ensure that they are free from obstruction.
3. Thoroughly wash all parts and flush all oilways in a suitable cleaning solvent, then dry with compressed air.
4. Examine pistons for excessive wear, scores, cracks or damage of any kind. Renew as necessary.
5. Test gudgeon pin clearance in small-end bush, limit 0,038 mm (0.0015 in).

6. Inspect connecting rods for cracks and damage; renew as necessary.
7. Check crankshaft journals for excessive wear. If badly scored or more than 0,038 mm (0.0015 in) oval, the crankshaft should be renewed.
8. It is recommended that new shell bearings be fitted to ensure complete serviceability.
9. Examine crankshaft plain bearings for wear or distortion; renew as necessary.
10. Examine the crankcase, base plate and end covers for cracks or damage.
11. Check bushes in end-covers; renew as necessary.

#### To Reassemble, Fig. 1

1. If a new small-end bush has to be fitted, mark the piston and connecting rod for reassembly purposes. Drill the oil hole through the bush from the top of the connecting rod before reaming.
2. Place the lower half of the cylinder head on a flat surface and fit a new joint. Position the valve discs and springs and carefully place the upper half of the cylinder head over the valve assemblies and press down until both halves of the head are correctly located. Ensure the valves are not trapped between the mating faces of the cylinder head. Insert the four securing screws from the underside of the head and tighten to a torque of 9,5 Nm (0,96 kgf m, 7 lbf ft).
3. Refit thrust washers to crankshaft with white metal face towards the crankshaft. Insert crankshaft into crankcase and refit end covers ensuring new joints are fitted. Check crankshaft end-float is within 0,076 to 0,558 mm (0.003 to 0.022 in). Renew thrust washers as necessary.
4. Fit each gudgeon pin to its piston and connecting rod assembly and secure with circlips.
5. Fit the new piston rings, ensuring that the compression rings are fitted with the word 'TOP' facing upwards to the piston crown. Space each piston ring approximately 120° to each other. Avoid positioning the gaps in line to the ends of the gudgeon pin.
6. With the big-end bearing shells located correctly in their respective rod and cap housings, assemble connecting rods on crankshaft journals as originally fitted.





7. Using new locking straps, fit and tighten evenly the connecting rod bolts to a torque figure of 13,5 to 16,2 Nm (1,40 to 1,66 kgf m, 10 to 12 lbf ft). Bend up tabs of locking straps.
8. Renew the sealing rings and slide cylinder over its piston assembly and into the crankcase.
9. Pass the new cylinders carefully over pistons, then insert the ends into top of the crankcase.
10. Place new joints on cylinders and correctly position cylinder head on the studs.
11. Fit plain and spring washers followed by securing nuts, and tighten nuts progressively to a torque setting of 21,6 Nm (2,2 kgf m, 16 lbf ft).
12. Invert compressor and apply clean engine oil over crankshaft and cylinder walls.
13. Refit base cover plate using a new joint. Tighten setscrews to a torque of 13,5 Nm (1,4 kgf m, 10 lbf ft).
14. Refit compressor drive gear, secure with nut and washer.
15. Fit drive adaptor to compressor gear, secure with the four setscrews and washers.



FLUID FLYWHEEL  
R/FF.2  
PL 30089

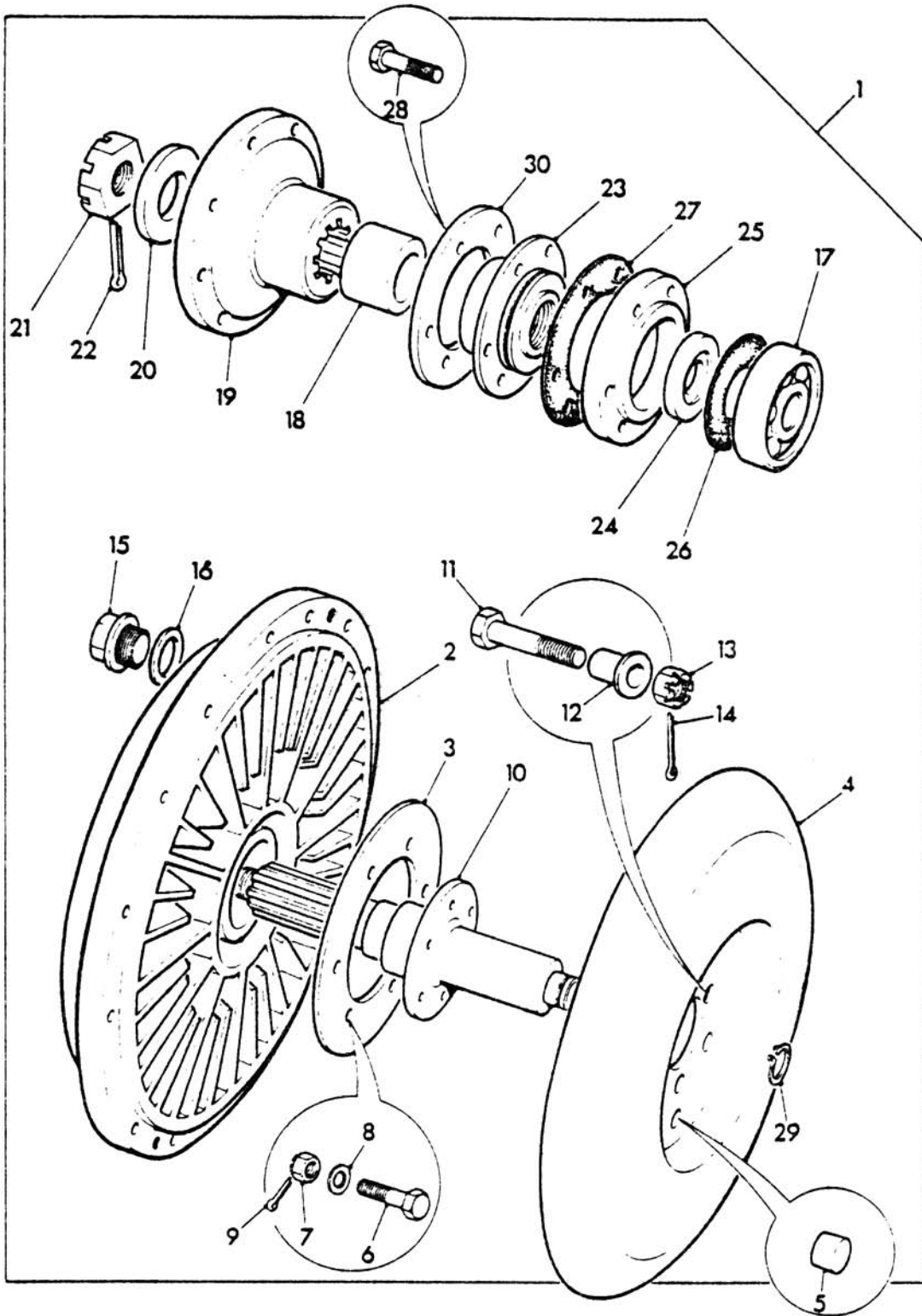
D531/B02

Illust. ref.	Part	Description	Quantity per unit
		Sub Group A.31	
		FLUID FLYWHEEL UNIT R/FF.2	
1	533943	FLYWHEEL assembly	1
2	351274	CASING rear	1
3	535478	PLATE baffle	1
4	580053	RUNNER	1
5	10898459	PLUG runner balance	as reqd
6	281959	BOLT 5/16" B.S.F. )	6
7	NL405061	NUT 5/16" slotted ) Baffle plate	6
8	WA108051	WASHER 5/16" ) to runner	6
9	PS604080	SPLIT PIN )	6
10	521694	SHAFT runner	1
11	282712	BOLT )	6
12	282711	FERRULE ) Runner to	6
13	NL406061	NUT 3/8" slotted ) runner shaft	6
14	PS604080	SPLIT PIN )	6
15	282713	PLUG	4
16	282714	WASHER	4
17	134493	BEARING ball	1
18	521688	DISTANCE PIECE	1
19	521604	FLANGE coupling	1
20	521687	WASHER for coupling flange	1
21	521686	NUT 1.1/8" slotted	1
22	PS612150	SPLIT PIN 3/16" x 2.1/4"	1
23	521689	SEAL oil	1
24	ABU4506	WASHER rubbing	1
25	521690	RING spacing oil seal	1
26	521691	JOINT ring	1
27	521747	JOINT oil seal	1
28	243562	SETSCREW 5/16" B.S.F. oil seal casing	6
29	221809	CIRCLIP for spigot bearing	1
30	586069	STIFFENER ring	1

TP/LE/1081\*

Always quote Chassis No. when ordering parts

A31.3



P2268

LEYLAND 680/1595 ENGINES - FITTING OF C.A.V. HEAVY DUTY INJECTORS

In future 680/1595 engines will be fitted with heavy duty injectors. These inject at 235 atmospheres. On No. 6 examinations and above the injectors are to be changed for the heavy duty type, which are painted green. The old injectors, painted yellow, are to be returned to B.R.E.L. Swindon Works. Where the injector clamp stud is less than  $4\frac{1}{2}$ " (115mm.) long, from the face of the head to the end of the thread, it must be renewed before the green injector can be fitted. Remember to fit new "Nylor" nuts on injector clamp studs. This is particularly important where heavy duty injectors are fitted since the nut will be very near the end of the stud. "Green" and "yellow" injectors must not be mixed on the same engine.

"Green" injectors must not be fitted to 680/1 engines.

BRITISH RAILWAYS - WESTERN REGION

STANDARD INSTRUCTION FOR THE REPAIR OR

MAINTENANCE OF DIESEL LOCOMOTIVES AND MULTIPLE UNITS

Incorporates B.R. Engineering Instruction No. MD/266 Issue 3	W.R. Standing Order No. <b>2/B/104</b>	
Supersedes  W.R. Standing Order No. 2/B/104 dated 26.4.77	Issue 2	
	Date :	19 SEP 1977
Units Applicable :-  All Diesel Multiple Unit Power Cars with Leyland 680 Series engines.	Vehicle Serial Nos :-  Various	

IDENTIFICATION OF INJECTORS - LEYLAND 680 SERIES ENGINES

Whilst the bodies of injectors for Leyland 680/1 (Existing) and 680/1595 (New) series engines are interchangeable, it is important that the correct nozzles are fitted for the engine specification.

For reference, the following table shows which injectors shall be fitted to the various types of Leyland 680 engines.

ITEM	CAV PART NO.	B.R. CAT NO.	ENGINE TYPE
Holder	52466	-	680/1
	(Type BKHL 97S 5006/b)		680/1595
Nozzle	Type BDLL 140S 6205/A	15/77005	680/1
"	Type BDLL 140S 6306	15/1287	680/1595
Injector Complete	5246605	15/77004	680/1
"	5246607	15/1287	680/1595

In order to clearly differentiate the injector assemblies, all injectors built to B.R. Cat No. 15/1287 will be identified by the injector body painted yellow.

Injectors built to B.R. Cat No. 15/77004 will be free of any yellow paint on the body.

for CHIEF MECHANICAL & ELECTRICAL ENGINEER - PADDINGTON

*M. P. Lawton*





