

# Leyland



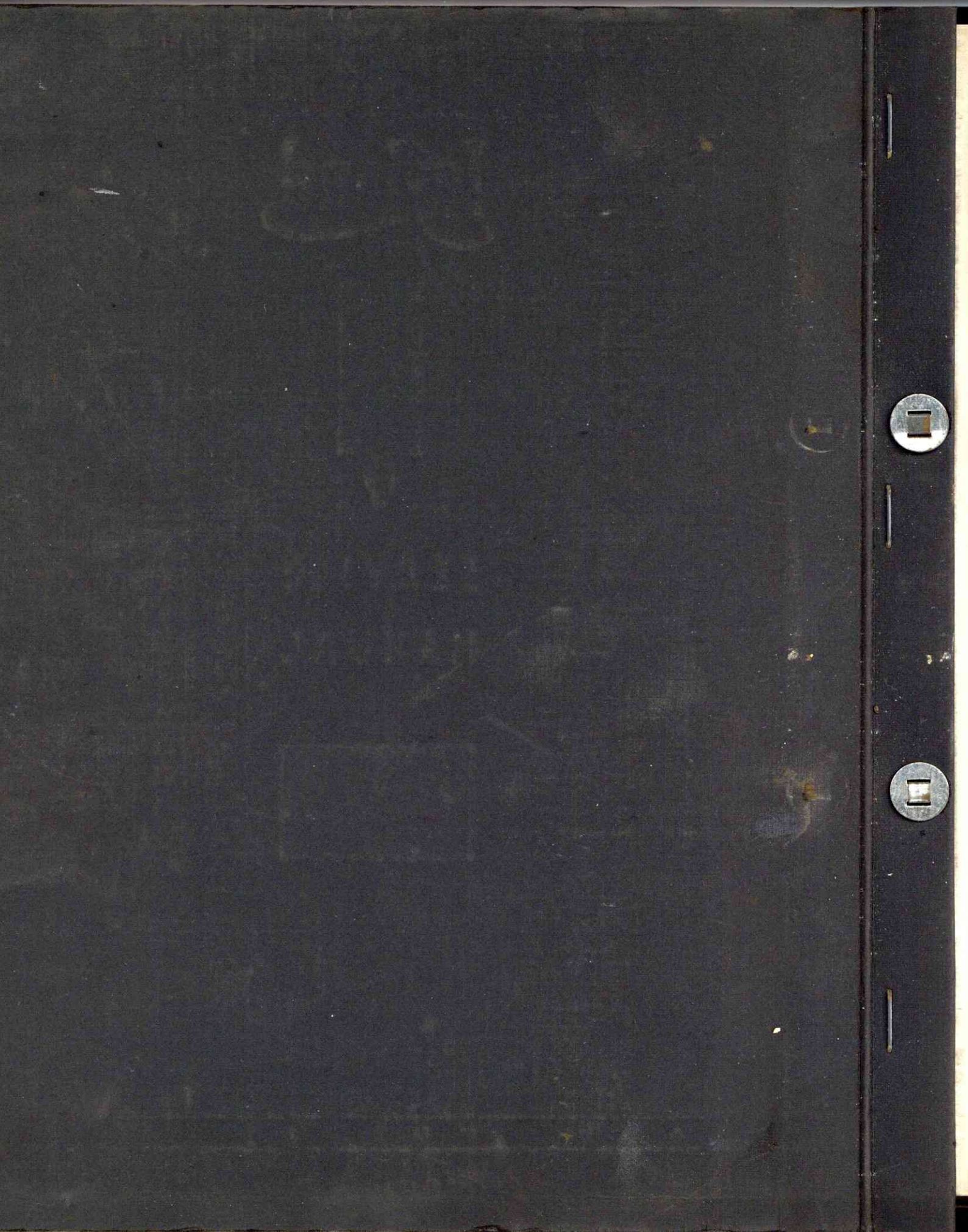
## SERVICE MANUAL

**0680**

**VERTICAL  
DIESEL  
ENGINE**

LEYLAND MOTORS LIMITED





**CHAPTER 3P**

**ENGINE**

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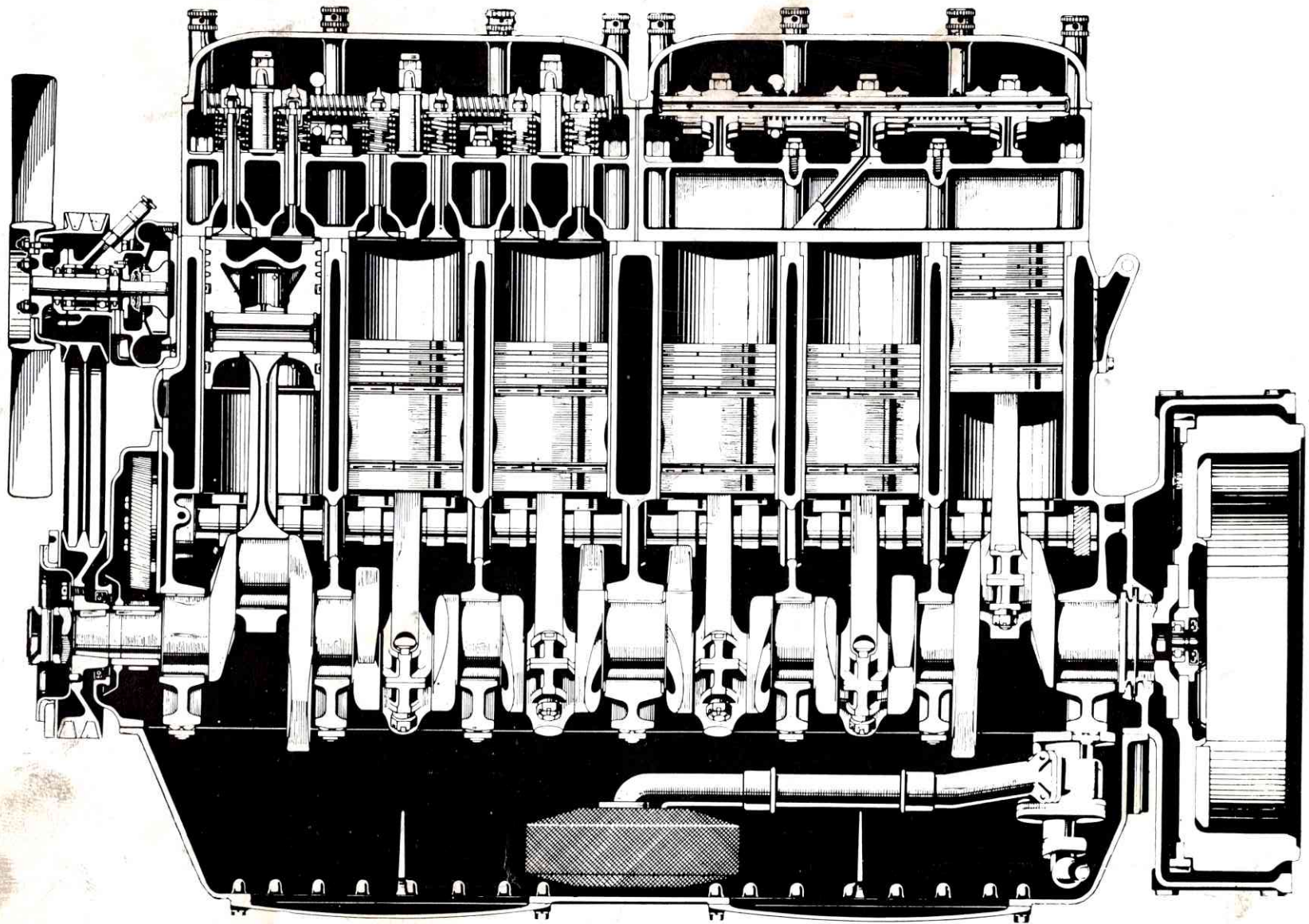


FIG. 1. SECTION THROUGH O680 ENGINE



**ENGINE****DATA****GENERAL**

|                   |     |     |     |     |     |   |
|-------------------|-----|-----|-----|-----|-----|---|
| Known as          | ... | ... | ... | ... | ... | Leyland 0680 Diesel engine (11.1 litres).   |
| Type              | ... | ... | ... | ... | ... | Six-cylinder, compression-ignition, direct injection, overhead valve, vertical, water-cooled. |
| Bore              | ... | ... | ... | ... | ... | 5.0 in. (127 mm.).  |
| Stroke            | ... | ... | ... | ... | ... | 5.75 in. (146 mm.)  |
| Cubic capacity    | ... | ... | ... | ... | ... | 677 cubic inches (11.1 litres).   |
| Maximum torque    | ... | ... | ... | ... | ... | 450 lb./ft. at 1,000 r.p.m. (62.1 kg./m.).  |
| Maximum b.h.p.    | ... | ... | ... | ... | ... | 154 at 2,000 r.p.m.   |
| Compression ratio | ... | ... | ... | ... | ... | 15.75 to 1.   |
| Firing order      | ... | ... | ... | ... | ... | 1, 5, 3, 6, 2, 4.   |

**LUBRICATION**

|               |     |     |     |     |     |  |
|---------------|-----|-----|-----|-----|-----|--|
| Type          | ... | ... | ... | ... | ... | Wet sump, gear-type pump.  |
| Pump data     | ... | ... | ... | ... | ... | Interference of pump gear on shaft, .0003 in. to .0013 in.<br>Initial diametral clearance between idler-gear and spindle, .0012 in. to .0022 in.<br>Backlash between gears, .022 in. to .026 in. |
| Sump capacity | ... | ... | ... | ... | ... | 7 gallons (31.8 litres).   |
| Oil pressure  | ... | ... | ... | ... | ... | 60 lb./sq. in. (4.2 kg./sq. cm.) at 1,000 r.p.m. or higher speeds, with warm engine.<br>Not below 5 lb./sq. in. (.35 kg./sq. cm.) with engine idling.  |
| Pump delivery | ... | ... | ... | ... | ... | 5 galls. per min. at 1,000 r.p.m. crankshaft speed.  |
| Filter        | ... | ... | ... | ... | ... | Leyland, full-flow, cloth-type filter element.   |







|  |  |
|--|--|
| Renew small-end bush when diametral clearance exceeds ... .. | .0025 in.  |
| Interference of small-end bush in connecting rod ... ..      | .00225 in. to .00425 in.   |
| Big-end bearing ... ..                                       | Pre-finished, lead-bronze, steel shell, bearing surface indium-coated. |
| Big-end initial diametral clearance ... ..                   | .0018 in. to .0037 in.   |
| Renew when diametral clearance exceeds ... ..                | .008 in.   |
| Undersize big-end bearings available ... ..                  | Pre-finished in five steps of .010 in. each.                           |

**Do not grind sides of crankpins.**

**CRANKSHAFT AND MAIN BEARINGS**

|  |  |
|--|--|
| Number of main bearings ... ..                         | Seven.   |
| Type of bearing ... ..                                 | Pre-finished, lead-bronze, steel-shell. Bearing surface indium-coated.   |
| Thrust taken on ... ..                                 | Thrust washers at centre journal.  |
| Centre journal initial end clearance ... ..            | .004 in. to .010 in.   |
| Renew thrust washers when end clearance exceeds ... .. | .014 in.   |
| Oversize thrust washers available ... ..               | 1 set .010 in. thick (.005 in. each washer).                             |
| Reground journals and crankpins ... ..                 | When .003 in. oval.  |
| Undersize main bearings available ... ..               | 5, in steps of .010 in. each.  |
| Main bearing initial diametral clearance ... ..        | .0020 in. to .0042 in.   |
| Renew when diametral clearance exceeds ... ..          | .009 in.   |
| Crankshaft damper ... ..                               | Viscous or rubber-bonded vibration damper fitted at front of crankshaft. |

With the crankshaft supported on front and rear journals the relative eccentricity of the centre main journal should not exceed ... .003 in. radius (total clock reading .006 in.)

The maximum eccentricity between two adjacent bearings should not exceed ... .. .003 in. total clock reading.



**TABLE OF CRANKSHAFT DIMENSIONS**

| TYPE             | PART NUMBER                         | CRANKPIN DIAMETER        | CRANKPIN WIDTH         | JOURNAL DIAMETER         | JOURNAL WIDTH |                        |                        |                        |
|------------------|-------------------------------------|--------------------------|------------------------|--------------------------|---------------|------------------------|------------------------|------------------------|
|                  |                                     |                          |                        |                          | FRONT         | CENTRE                 | REAR                   | OTHERS                 |
| Standard Service | Part Number as stamped on front web | 3.0005 in.<br>2.9998 in. | 2.203 in.<br>2.200 in. | 3.5005 in.<br>3.4998 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |
| 1st Service      | Part Number /S.1                    | 2.9905 in.<br>2.9898 in. | 2.203 in.<br>2.200 in. | 3.4905 in.<br>3.4898 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |
| 2nd Service      | „ /S.2                              | 2.9805 in.<br>2.9798 in. | 2.203 in.<br>2.200 in. | 3.4805 in.<br>3.4798 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |
| 3rd Service      | „ /S.3                              | 2.9705 in.<br>2.9698 in. | 2.203 in.<br>2.200 in. | 3.4705 in.<br>3.4698 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |
| 4th Service      | „ /S.4                              | 2.9605 in.<br>2.9598 in. | 2.203 in.<br>2.200 in. | 3.4605 in.<br>3.4598 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |
| 5th Service      | „ /S.5                              | 2.9505 in.<br>2.9498 in. | 2.203 in.<br>2.200 in. | 3.4505 in.<br>3.4498 in. | 2.000 in.     | 2.702 in.<br>2.700 in. | 2.705 in.<br>2.695 in. | 1.710 in.<br>1.700 in. |

**Note 1.**—When re-grinding crankpin and journals the sides must not be ground unless they have been damaged. If the location faces of the centre main bearing have been damaged, the width should be increased to 2.710 in./2.712 in., otherwise the dimension should remain unchanged.

**Note 2.**—The crankshaft should be re-nitrided at service sizes S.2 and S.4.

**CAMSHAFT**

|   |  |
|---|--|
| Number ... ..   | One.   |
| Type of drive ... ..  | Single-helical gear.                                       |
| Number of bearings ... ..   | Seven.   |
| Material ... ..   | Front and rear—lead-ed gunmetal ; intermediate—carobronze. |
| Thrust taken on ... ..  | Front bearing only.  |
| Interference fit of all bearings in engine block  | .0005 in. to .0025 in.                                     |
| Journal diameters ... ..  | 2.396 in. to 2.397 in.                                     |
| Initial diametral clearance in all bearings ...   | .004 in. to .0055 in.                                      |
| Renew bearings when clearance exceeds ...   | .010 in.   |
| Interference of oil pump drive on camshaft (where gear is not integral with camshaft) ... | .00125 in. to .00275 in.                                   |
| Initial dimension from nose to back of cam ...  | 1.995 in. to 2.005 in.                                     |
| Renew camshaft when this dimension is ...   | 1.983 in.  |

**TIMING GEARS**

|  |        |   |
|--|--------|---|
| Type   | ... .. | Hardened and ground single-helical gears. |
| Permissible backlash between each pair of gears              | ... .. | .002 in. to .004 in.                      |
| Idler gear initial diametral clearance between bush and gear | ... .. | .001 in. to .0035 in.                     |
| Diametral clearance between bush and idler spindle           | ... .. | .001 in. to .0035 in.                     |
| End float between thrust washers and idler gear              | ... .. | .004 in. to .0095 in.                     |
| Renew thrust washers when end clearance exceeds              | ... .. | .012 in.                                  |
| Interference fit of timing gear on crankshaft                | ... .. | .00075 in. to .00225 in.                  |

**VALVES**

|                     |        |  |
|---------------------|--------|--|
| Type                | ... .. | Overhead poppet, stellite-faced, hard chrome-plated stems. |
| Number per cylinder | ... .. | 1 inlet, 1 exhaust.  |
| Stem diameter       | ... .. | $\frac{1}{16}$ in.   |

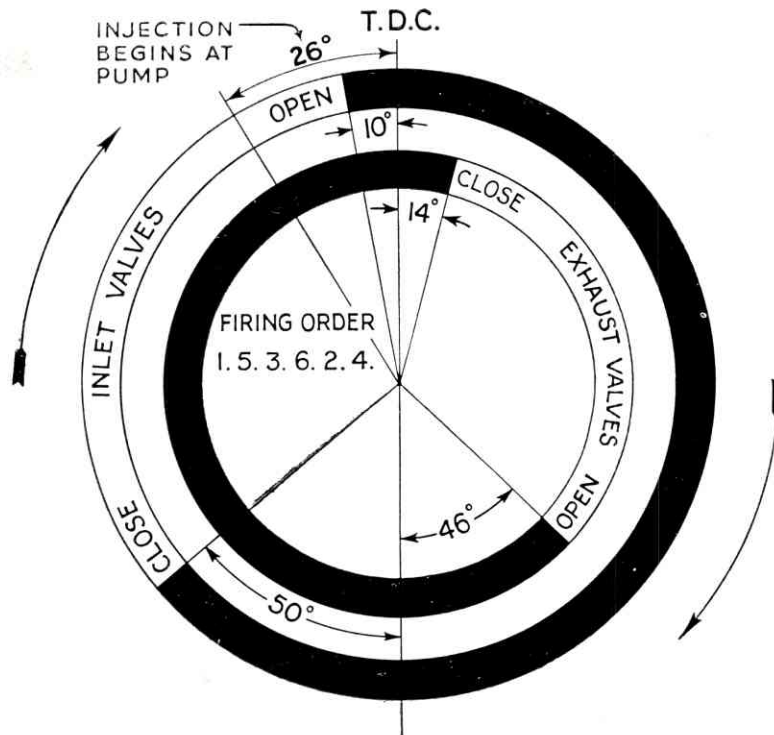


FIG. 2. VALVE TIMING DIAGRAM



|   |     |     |     |     |     |   |
|---|-----|-----|-----|-----|-----|---|
| Stem clearance in guide                                       |     |     |     |     |     |   |
| Inlet   | ... | ... | ... | ... | ... | .0005 in. to .00275 in.   |
| Exhaust   | ... | ... | ... | ... | ... | .001 in. to .00325 in.  |
| Valve head diameter   |     |     |     |     |     |   |
| Inlet   | ... | ... | ... | ... | ... | 2.20 in. (55.88 mm.)  |
| Exhaust   | ... | ... | ... | ... | ... | 1.90 in. (48.26 mm.)  |
| Angle of valve seat   | ... | ... | ... | ... | ... | 30°   |
| Angle of valve face   | ... | ... | ... | ... | ... | 29½°  |
| Valve lift  | ... | ... | ... | ... | ... | 0.5 in.   |
| Number of valve springs                                       | ... | ... | ... | ... | ... | Two per valve, concentric.  |
| Maximum spring pressure (valve open)                          | ... | ... | ... | ... | ... | 134 lb.   |
| Free length of spring   |     |     |     |     |     |   |
| Inner   | ... | ... | ... | ... | ... | 2.130 in.   |
| Outer   | ... | ... | ... | ... | ... | 2.50 in.  |
| Renew springs when  | ... | ... | ... | ... | ... | Inner spring will compress to 1.25 in. under a load less than 35 lb.<br>Outer spring will compress to 1.5 in. under a load less than 74 lb. |
| Initial diametral clearance of rocker shaft in rocker         |     |     |     |     |     |   |
| ...   | ... | ... | ... | ... | ... | .0005 in. to .00175 in.   |
| Renew rocker shaft bushes when diametral clearance exceeds    |     |     |     |     |     |   |
| ...   | ... | ... | ... | ... | ... | .003 in.  |
| Initial diametral clearance of tappet in engine block         |     |     |     |     |     |   |
| ...   | ... | ... | ... | ... | ... | .00175 in. to .00375 in.  |
| Renew tappet when diametral clearance in engine block exceeds |     |     |     |     |     |   |
| ...   | ... | ... | ... | ... | ... | .004 in.  |
| Tappet clearance  |     |     |     |     |     |   |
| Inlet   | ... | ... | ... | ... | ... | .020 in., engine cold.  |
| Exhaust   | ... | ... | ... | ... | ... | .020 in., engine cold.  |

**VALVE TIMING**

|                |     |     |     |     |     |   |
|----------------|-----|-----|-----|-----|-----|---|
| Inlet opens    | ... | ... | ... | ... | ... | 10° before T.D.C. = 1.72 in. on flywheel rim. |
| Inlet closes   | ... | ... | ... | ... | ... | 50° after B.D.C. = 8.61 in. on flywheel rim.  |
| Exhaust opens  | ... | ... | ... | ... | ... | 46° before B.D.C. = 7.92 in. on flywheel rim. |
| Exhaust closes | ... | ... | ... | ... | ... | 14° after T.D.C. = 2.41 in. on flywheel rim.  |

**FUEL SYSTEM**

Main fuel filter ... Leyland-C.A.V. cloth-sack and felt-pack type filter.

**INJECTION PUMP**

Make and type ... C.A.V. NL6E75/81  
 Number of deliveries ... Six.  
 Drive ... Flexible, adjustable coupling, clockwise rotation, half engine speed, mounted in tandem with compressor.  
 Timing ... Injection begins at the injection pump 26° before T.D.C. (see Fig. 2).

**GOVERNOR**

Make ... Leyland—C.A.V.  
 Cutting in speed ... 1,800 r.p.m. engine speed.  
 Runaway speed ... 2,000 r.p.m. engine speed.  
 Idling speed ... 300/350 r.p.m. engine speed.

**FUEL FEED PUMP**

Make and type ... C.A.V. DFP.  
 Pressure maintained ... C.A.V. type 4/5 lb. per sq. in (.28 to .35 kg./sq. cm.).

**INJECTORS**

Make ... Leyland.  
 Type ... N.35.  
 Discharge pressure ... 140-145 atmospheres, 2,057 to 2,130 lb./sq. in. (144 to 150 kg./sq. cm.)  
 Discharge pressure adjusting washer ... Available in ten steps of .010 in. each.  
 Needle valve lift ... .016 in. to .018 in.  
 Needle valve lift adjusting washers ... Available in six thicknesses, .0965 in., .0985 in., .1005 in., .1020 in., .1040 in., and .1060 in.  
 Angle of sprays ... 140°.  
 Valve spring free length ... 1 1/8 in.  
 Valve spring length under load of 50 to 52 lb ... 1.355 in.



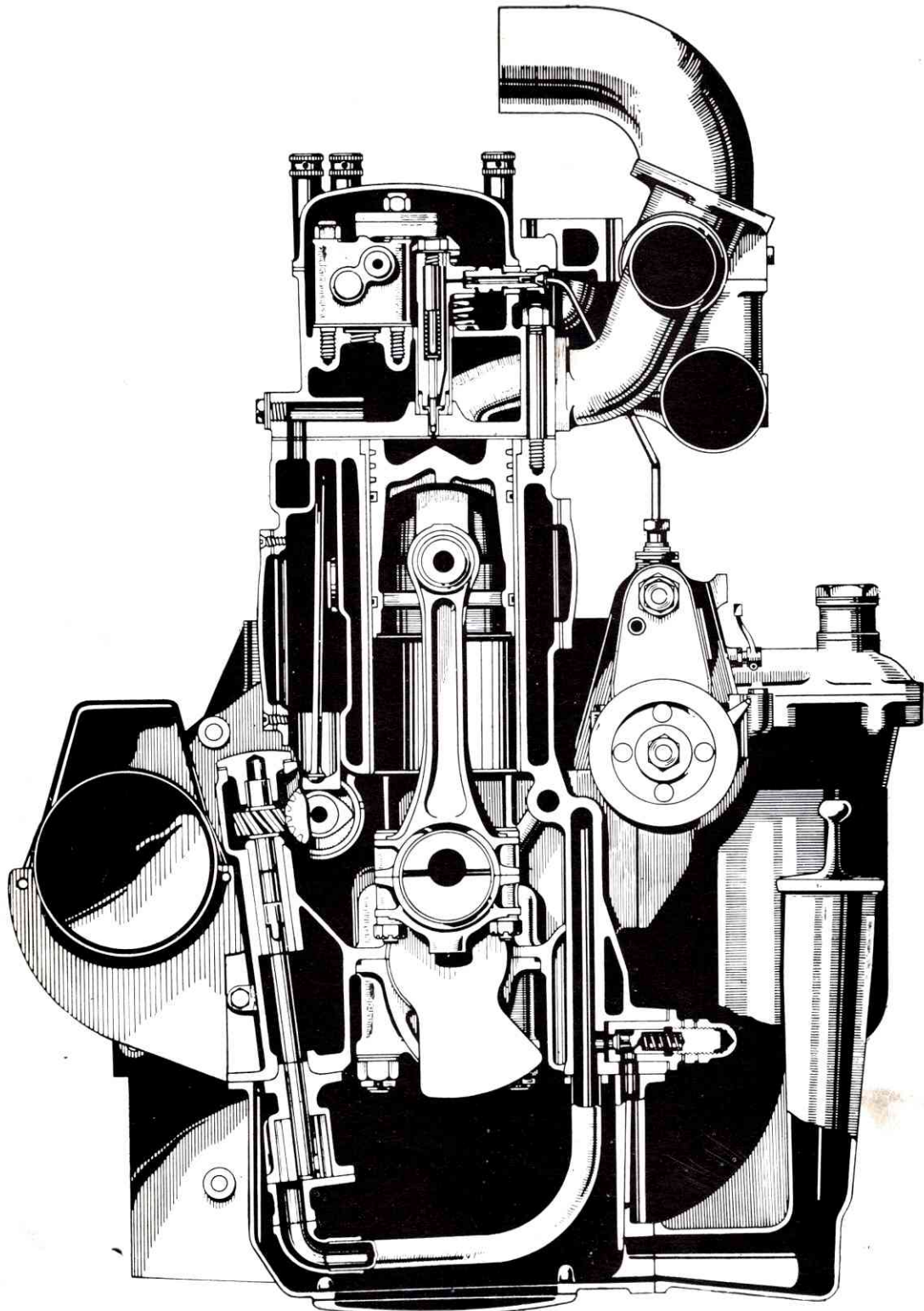


FIG. 3. CROSS-SECTION THROUGH O680 ENGINE

**DYNAMO DRIVE**

Drive ... .. Belt driven from pulley on crankshaft.  
 Rotation ... .. Clockwise.  
 Dynamo speed ... ..  $1.72 \times$  engine speed.  
 Interference fit of driving shaft in pulley bore .001 in. to .002 in.

**COOLING SYSTEM**

Controlled by thermostat ... .. Thermostat opens at  $185^{\circ}$  F.  
 Water pump and fan drive ... .. Belt driven from pulley on crankshaft at  $1.43 \times$  engine speed.  
 Interference fit of driving shaft in pulley bore .001 in. to .002 in.  
 Interference fit of driving shaft in impeller ... .. .0005 in. to .00175 in.

**AIR CLEANER**

Make ... .. Air-maze, heavy duty, two stage oil-bath, capacity 1 gallon.





## ENGINE LUBRICATION

### DESCRIPTION

Engine lubrication is on the wet sump system, the oil being circulated by a gear type two-stage oil pump.

The oil sump capacity is approx. 7 gallons as shown by the full mark on the dipstick. The oil should be changed every 200 to 250 hours run.

Oil is drawn from the sump, through the suction filter, and pressure fed by the pump through a full-flow cloth element filter into the main lubrication system, which is provided with an adjustable relief valve.

Oil is fed to the crankshaft main bearings, big end bearings, idler-gear and camshaft bearings through oilways drilled in the crankcase. The cylinder walls and gudgeon-pin bushes are lubricated by splash and intermittent spray from oilways drilled in the crankpins and connecting-rod big-ends.

The rocker gear is also lubricated by an intermittent feed from the second and fifth camshaft bearings via vertical oilways drilled in the engine-block and heads, up through the centre rocker shaft support bracket on each head, along the tubular rocker-shafts to the rocker levers.

Oil which escapes past the relief valve, spills back into the sump, via a short stand pipe below oil level to prevent aeration.

The sump suction filter should be removed and washed in paraffin every 1,000 hours run.

To remove the suction filter, drop the sump and remove the two setscrews securing the filter basket to the oil suction pipe.

The lead to the oil pressure gauge is taken from the oilway feeding the centre main bearing and is connected

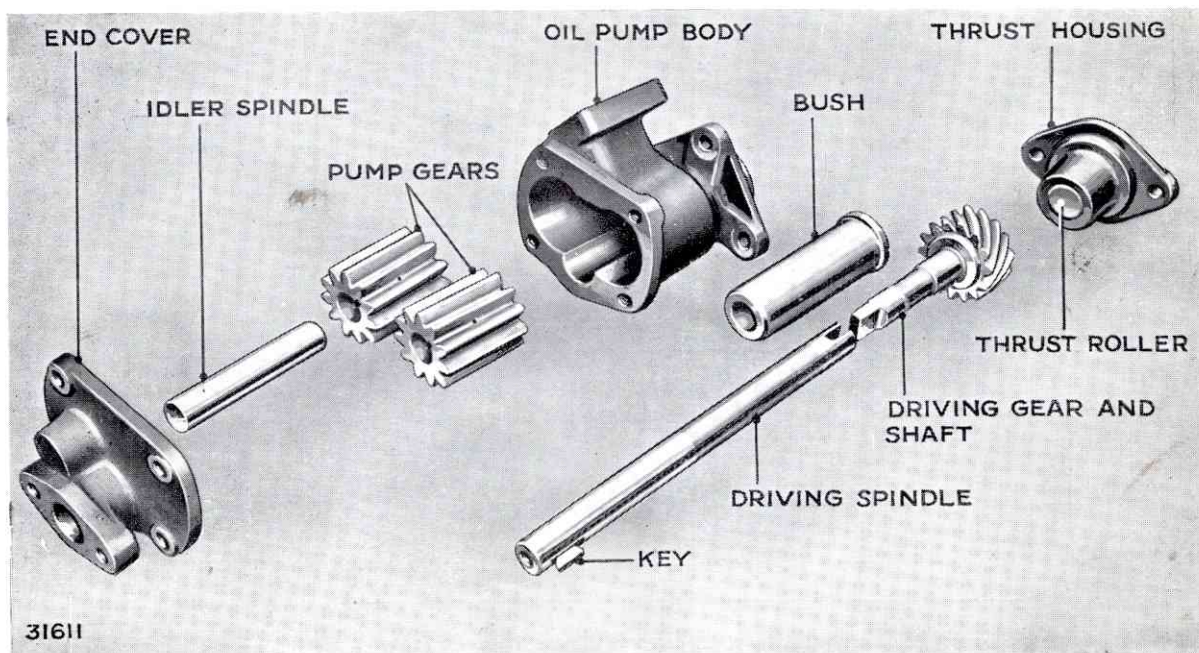


FIG. 4. OIL PUMP AND DRIVE DISMANTLED

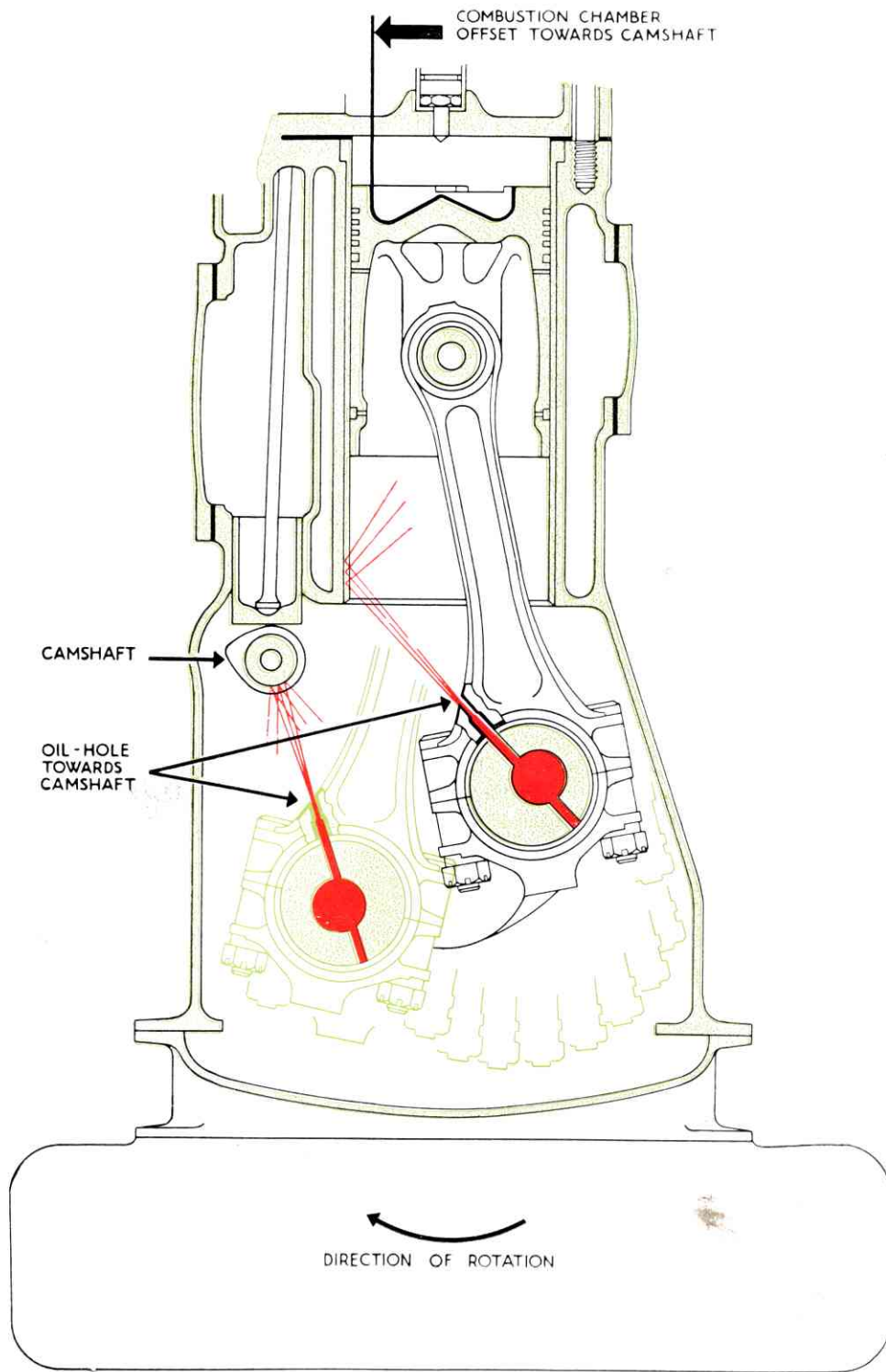


FIG. 5. CYLINDER-WALL LUBRICATION



to the gauge pipe through a tap on the left-hand side of the engine block. At all times the tap should remain open, but, in the event of a broken pipe or leaking gauge, the tap can be closed and serious loss of oil prevented.

Crankcase breathing is effected through holes drilled in the cylinder-head cover holding down bosses and vented to atmosphere from a venturi type breather attached to the front tappet gallery cover.

### Oil Pump

The oil pump is housed in the right-hand rear of the engine block and consists of spur gears, shaft driven from the camshaft by spiral gears. At the lower end of the camshaft driven-gear, a tongue transmits the drive to the pump spindle, on which is pressed a spur gear, the woodruff key being used only to position the oil hole supplying lubrication to the spiral gears and thrust face.

### OVERHAUL

#### To Remove the Oil Pump

1. Drop the sump and remove the suction filter. Disconnect the oil feed pipe from the crankcase bottom face.

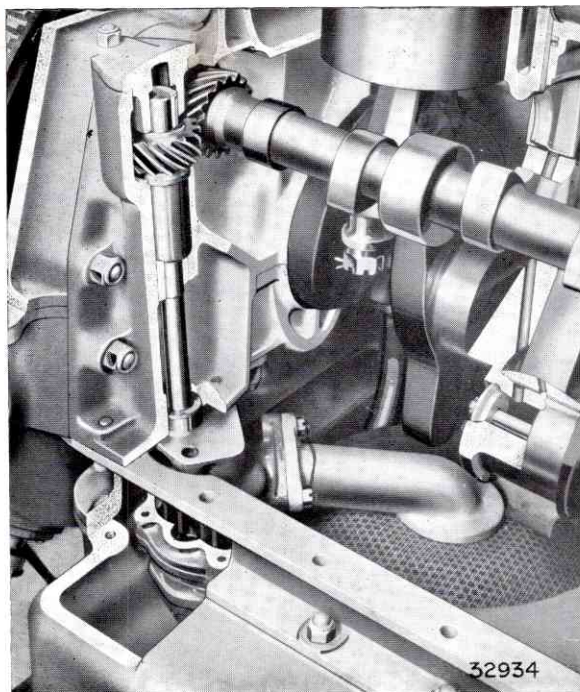


FIG. 6. OIL PUMP DRIVE FROM CAMSHAFT

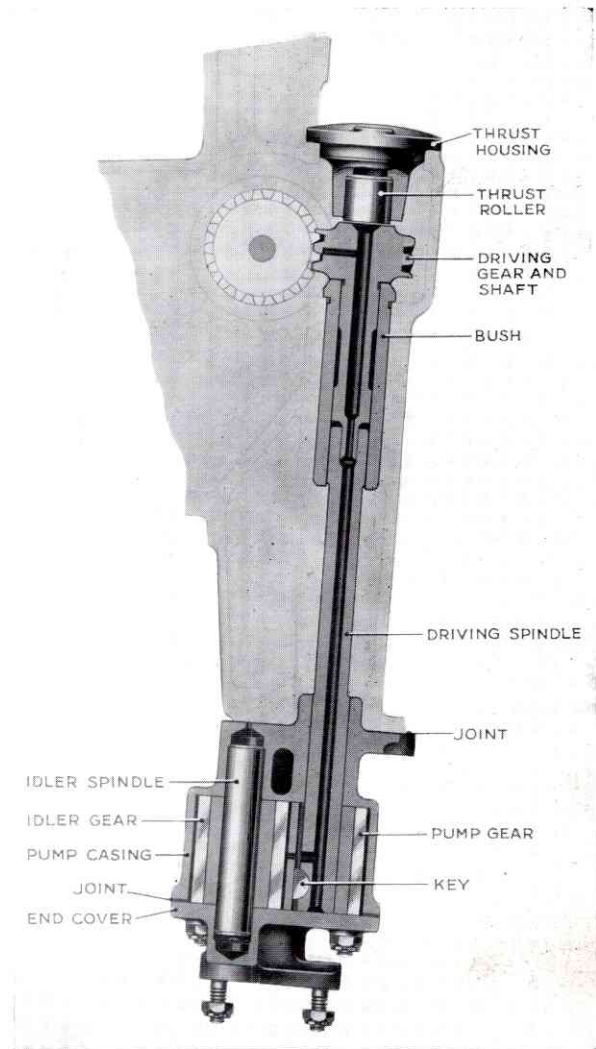


FIG. 7. OIL PUMP AND DRIVE

2. Remove the three nuts securing the pump body to the crankcase and withdraw the oil pump.

#### To Dismantle the Pump

1. Remove the oil pump end cover, and withdraw the gear and spindle.
2. All parts should be examined for wear and checked against the limits as laid down in the **Data**.
3. 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 (Fig. 9). Backlash between the two gears should be .004 in. to .008 in.



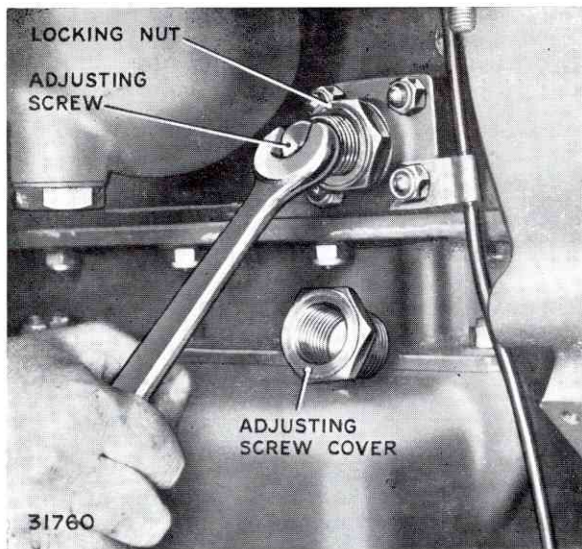


FIG. 8. ADJUSTING OIL RELIEF VALVE

### To Assemble and Refit Oil Pump

Reverse the operation for removing and dismantling oil pump. Ensure that an oil-tight joint is made between the pump end cover and casing.

### To Adjust the Relief Valve

The oil pressure relief valve (Figs. 8 and 10), mounted at the rear left-hand side of the engine block, consists simply of a spring-loaded valve, provided with an adjusting screw.



FIG. 9. FITTING OIL PUMP DRIVE GEAR AND THRUST HOUSING

To adjust the relief valve, remove the cover, slacken the lock-nut and turn the adjusting screw. Screw **in to increase** and **out to decrease** the pressure. Lock the screw and replace the cover after adjustment.

The valve should be adjusted to give 60 lb./sq. in. (4.2 kg./sq. cm.) at 1,000 r.p.m. or higher speeds, with warm engine.

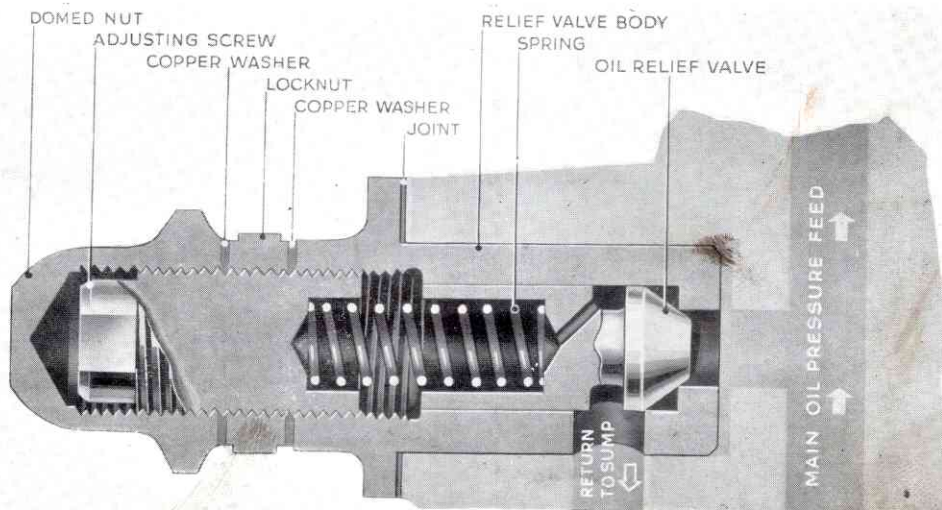


FIG. 10. OIL RELIEF VALVE



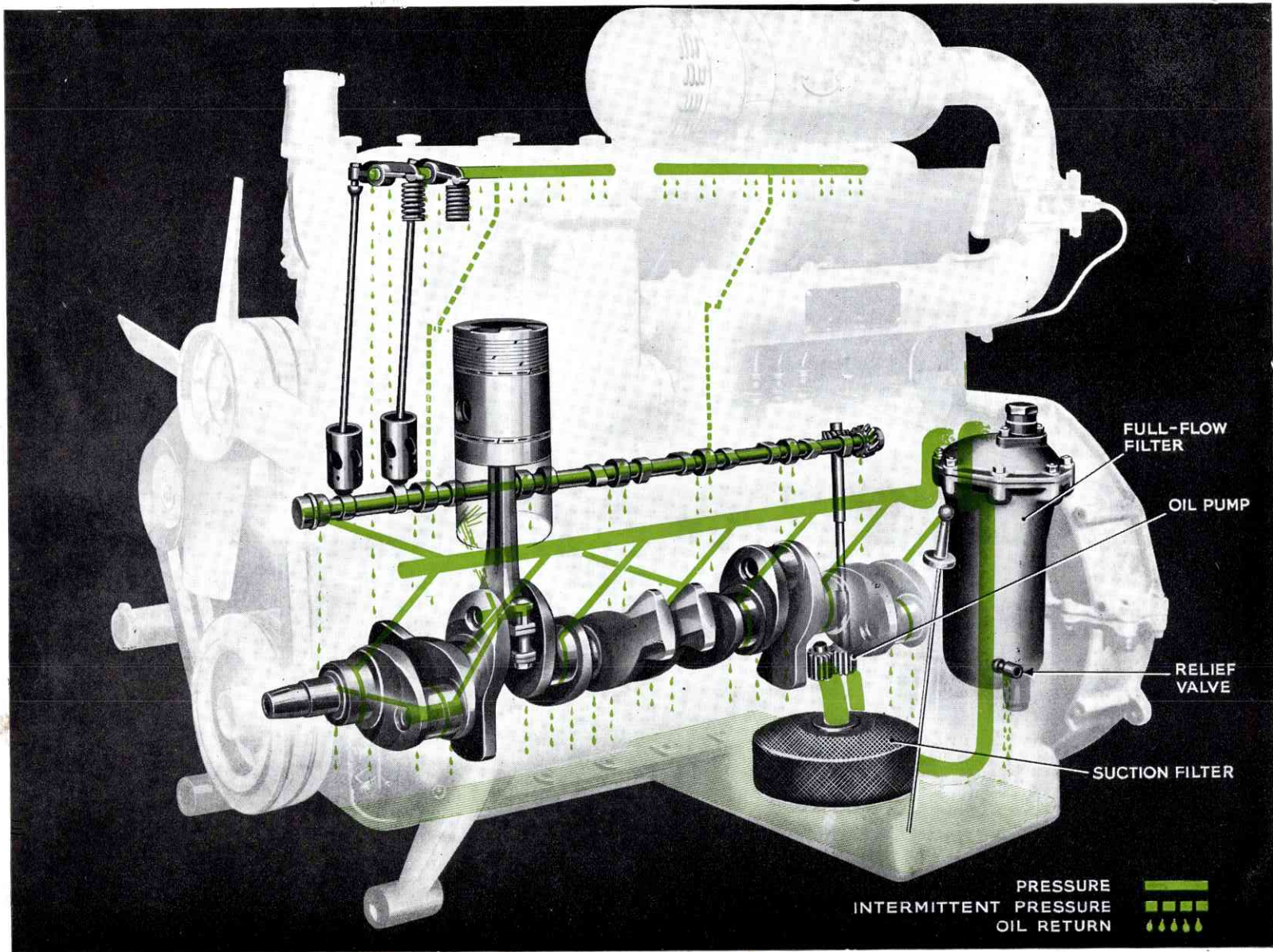


FIG. II. TYPICAL OIL-CIRCULATION DIAGRAM



**ENGINE OIL FILTER**

The engine oil filter is of the full-flow cloth element type, and is mounted at the left-hand rear of the engine-block. The oil is drawn from the sump and pressure-fed into the filter housing, where it is filtered and discharged into the main lubrication system. A by-pass valve, fitted in the top cover of the filter-housing, passes oil direct to the engine in the event of the filter element becoming choked.

The by-pass valve pressure is set before leaving the factory and should not be interfered with.

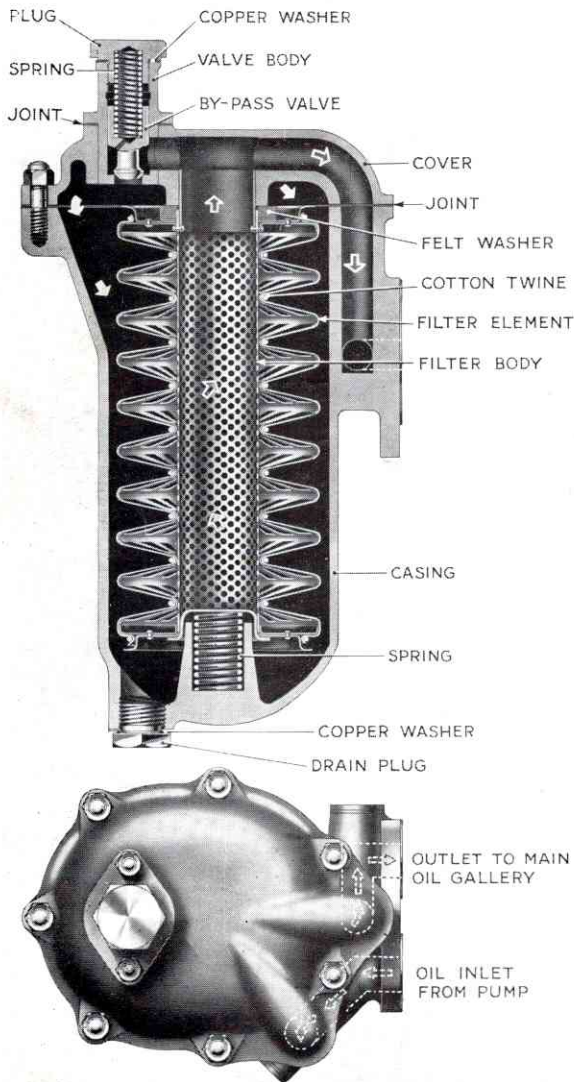


FIG. 12. THE OIL FILTER

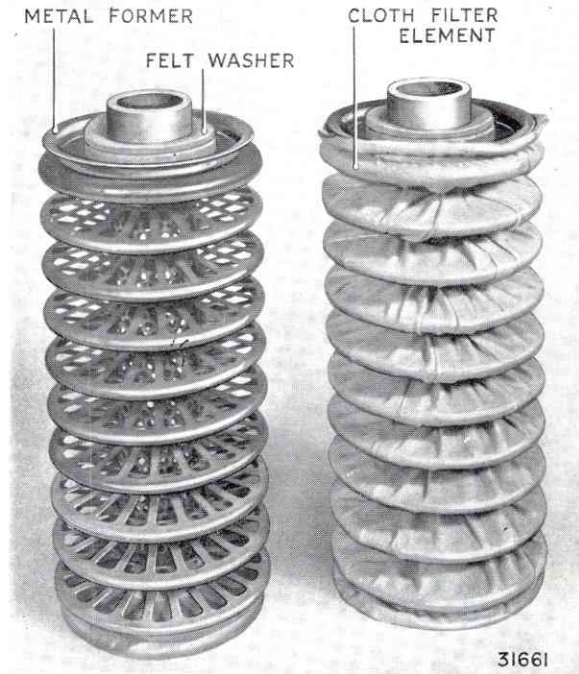


FIG. 13. OIL FILTER BODY AND BODY FITTED WITH CLOTH FILTERING ELEMENT

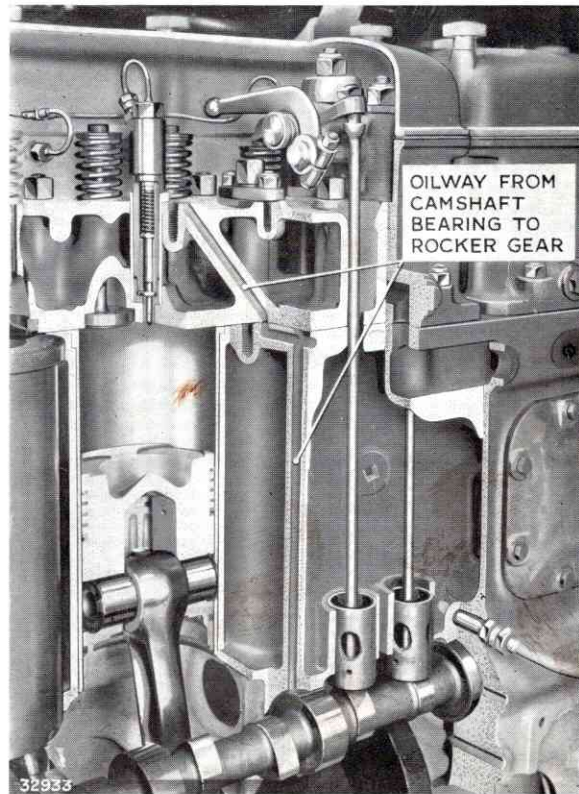


FIG. 14. ROCKER GEAR LUBRICATION

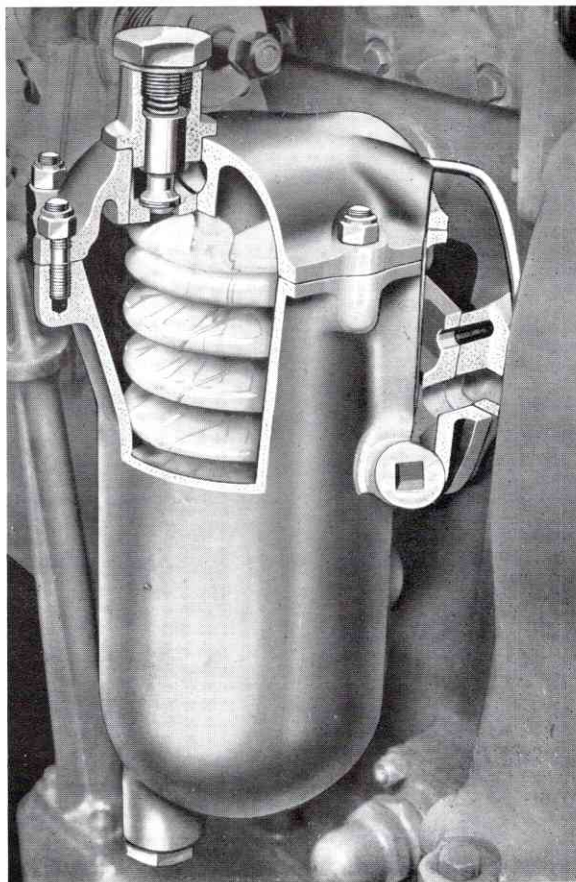


FIG. 15. CUT-AWAY SECTION OF OIL FILTER

The filter, a metal former covered by a sleeve-shaped filter-cloth secured with cotton twine, is designed to give maximum filtration area (Fig. 13).

To prevent vibration the filter is spring-loaded at the base (Fig. 12), and a felt washer at the top of the

filter prevents unfiltered oil passing into the main system.

The filter cloth should be changed every 200 to 250 hours run. A drain plug is provided in the bottom of the filter housing.



## THE CYLINDER HEADS AND MANIFOLDS

### CYLINDER HEADS

The two cylinder heads are interchangeable, each head covering three cylinders. The stellite-faced exhaust valve seats are shrunk into the heads.

#### To Remove and Replace Cylinder Heads

1. Drain the radiator and engine block by the tap fitted to the bottom of the water inlet pipe.
2. Drain and disconnect the main fuel filter.
3. Disconnect the inlet, exhaust and water manifolds and remove them from the heads.
4. Remove valve covers and uncouple and remove the fuel pipes.
5. Take off the nuts securing the rocker shaft brackets. Lift off the rocker assembly and withdraw the push rods.
6. Remove all cylinder head nuts and raise the heads by unscrewing the special lifting nuts (see Fig. 16). The two lifting nuts are provided for each of the heads to prevent damage to the gaskets when lifting. Both nuts should be screwed evenly as far as they will go, then lift the head off the studs. If the heads are tight on the studs, a further lift can be obtained by screwing long  $\frac{1}{2}$  in. B.S.F. bolts into the lifting nuts.
7. Before replacing the cylinder heads, wash out all water spaces. Clean all rust and carbon from the studs and engine block face. If this is left on, the heads may scrape some down and prevent a good bed being obtained when the nuts are tightened.
8. New gaskets should be fitted if the old ones are not in good condition. Gaskets must always be fitted so that the turnover reinforcement surrounding the cylinder bores is uppermost. **Do not use jointing compound on the gaskets.**
9. Lower each head on to the lifting-nut studs and screw down the nuts evenly a little at a time, keeping the heads parallel with the engine block.
10. To ensure freedom from distortion and gasket leaks, the cylinder head nuts must be tightened down evenly in a definite order, starting at the centre and working outwards, as shown in Fig. 26. First tighten down with a short spanner, then with a torsion spanner set at 150 to 160 lb./ft., see Fig. 19.

A torsion spanner set at 80 to 85 lb./ft., should also be used for the  $\frac{7}{16}$  in. dia., B.S.F. nuts along the right-hand of the cylinder-heads.

11. Replace push rods and fit rocker gear. Set inlet and exhaust valve clearances to .020 in. cold. Replace fuel pipes and manifolds.

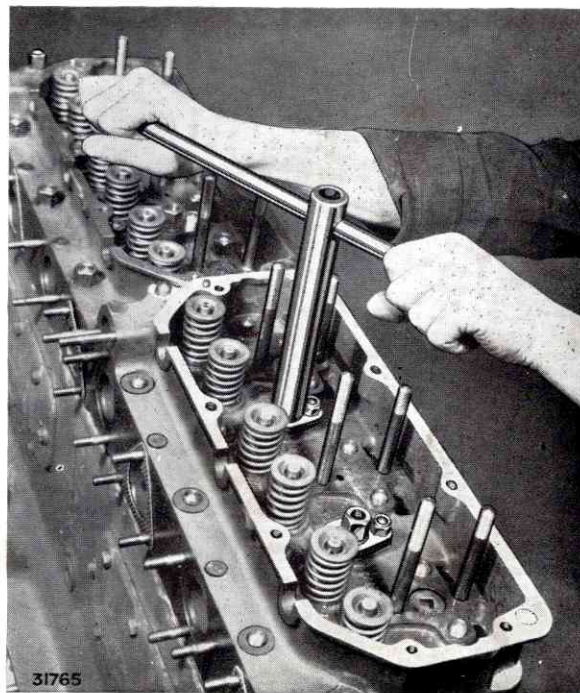


FIG. 16. TIGHTENING LIFTING NUTS



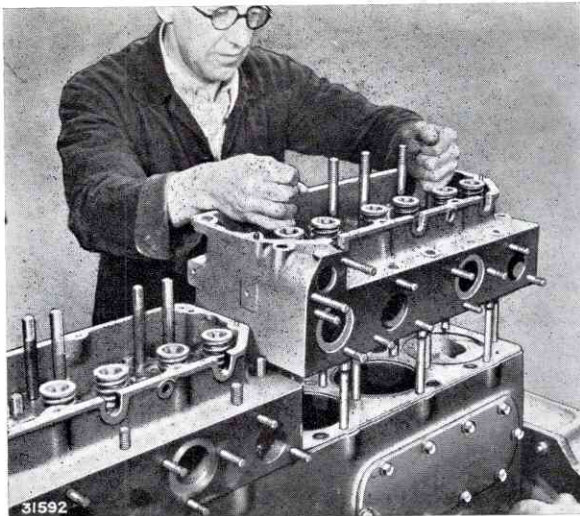


FIG. 17. FITTING CYLINDER HEAD

12. Do not over-tighten the exhaust manifold nuts.
13. Check tappet clearances after the engine has had a short run.

#### VALVES AND ROCKER GEAR

The rocker levers (Fig. 18) are bushed and carried on

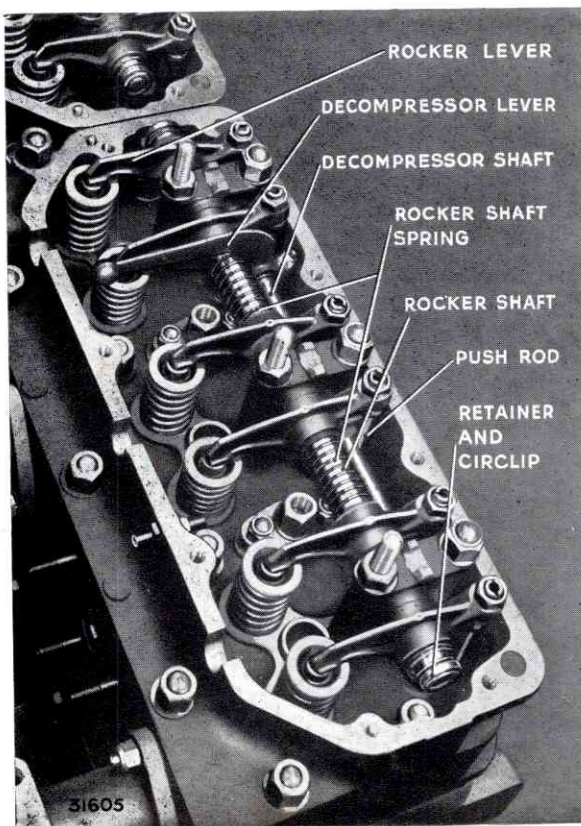


FIG. 18. THE ROCKER SHAFT ASSEMBLY

hollow shafts. Each shaft is held in position by three support brackets which also carry the decompressor shaft. The number one bracket on each head carries a spring-loaded plunger which comes into contact with a flat, formed on the decompressor shaft, and holds it in the **off** position.

An externally-operated decompressor mechanism is fitted to generating units. The movement (which is from right to left looking at the front of the engine) is carried out by a hand lever on the rear cylinder head cover, attached to an operating shaft which transmits the drive to the decompressor shaft by quadrants. A tongue transmits the drive to the operating shaft in the front cylinder head cover.

Lubrication is effected by an intermittent feed from the second and fifth camshaft bearings, via oilways drilled in the engine block and heads, up through the centre rocker-shaft support brackets, and along the rocker-shafts to the rocker levers.

The correct tappet clearance is .020 in. (cold) for both inlet and exhaust valves. When checking the clearances, make sure the tappets are on the backs of the cams. Turn the engine until the valve is fully open, then turn through one complete revolution to bring the tappet on the back of the cam.

Both valves are stellite-faced and have hard-chrome-plated stems. The valves can be distinguished by the difference in size across their heads, the exhaust being 1.90 in. dia., and the inlet 2.20 dia.

**When removing the valves and springs for inspection and refacing, it is important that subsequently they are replaced in their original position.**

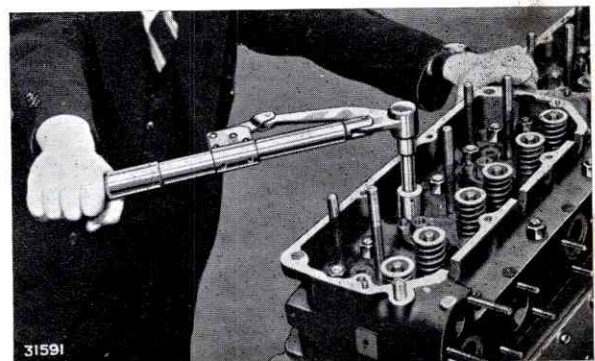


FIG. 19. TIGHTENING CYLINDER HEAD NUTS USING A TORSION SPANNER



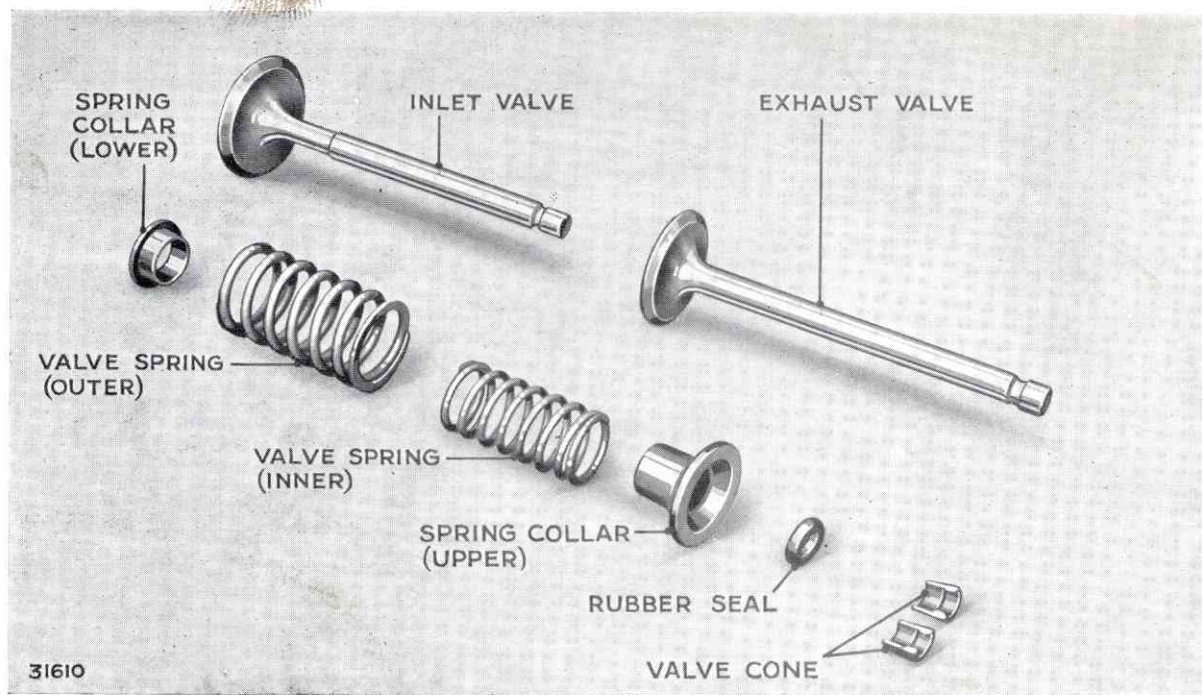


FIG. 20. VALVES AND SPRINGS

The valves and cylinder heads are numbered as shown in Fig. 24 to facilitate reassembly.

**To Remove and Replace Valves**

1. Remove the cylinder head and place it face downwards on the bench.
2. Extract the split cone (Fig. 21) and remove the

valve collar together with the rubber sealing ring and valve springs (Fig. 20).

3. The rubber sealing rings should be inspected and renewed if perished.
4. Check valve springs for length, see **Data**.

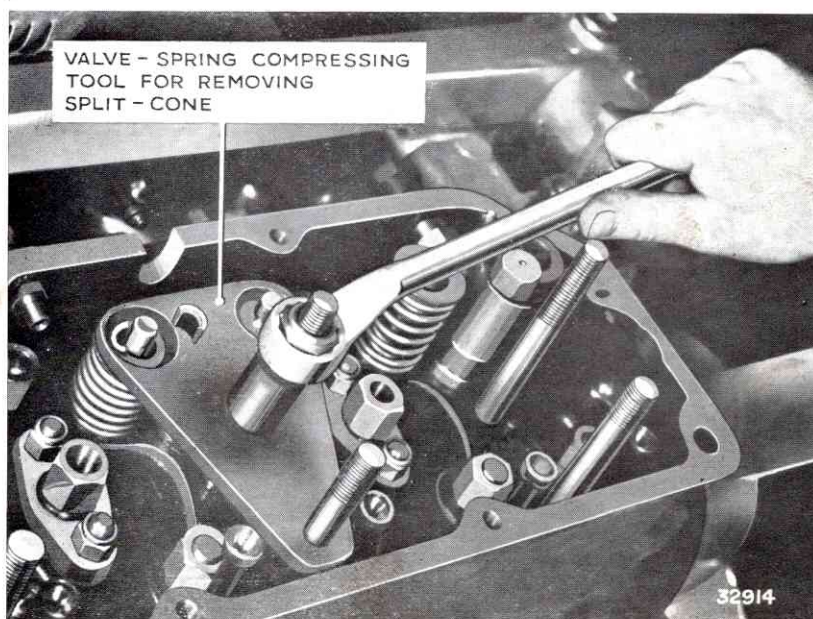


FIG. 21. VALVE SPRING COMPRESSING TOOL



## DECARBONISING, VALVE GUIDE RENEWAL AND VALVE GRINDING

### Decarbonising

Remove the heads and valves as previously described. Carefully scrape off the carbon deposit on the heads and pistons, but on no account must any form of abrasive be used. Do not disturb the ring of carbon at the top of the bore, as it will help to restrict the passage of oil into the combustion chamber if the bores are worn.

### Renewal of Valve Guides

1. Check the valve guides for stem clearances. If this is excessive, .010 in. or over, renew the guide. If the stem is worn, renew the valve. Always check the fit of a valve in the new guides. They must have .0005 in. to .00275 in. clearance for the inlet valve and .001 in. to .00325 in. clearance for the exhaust.
2. The valve guides are an interference fit in the heads and must be pressed in and out when replacements are necessary. See Fig. 23(a), for position of valve guide in head.



FIG. 22. GRINDING VALVE SEATS

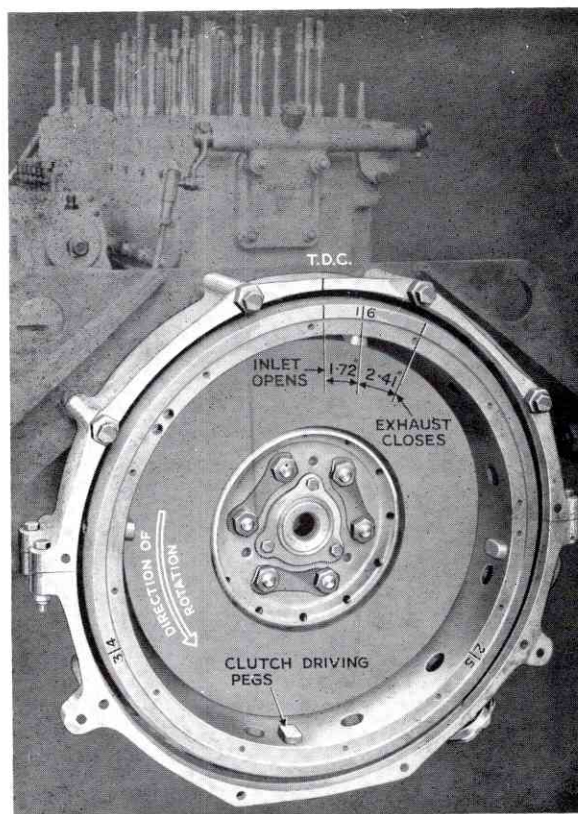


FIG. 23. VALVE TIMING MARKS ON FLYWHEEL

3. After fitting a new valve guide, always regrind the valve seat so that it is concentric with the guide.

### Valve Grinding

1. Examine the valve facings and seats. If the valve seats are at all pitted and require grinding, a special carborundum tool must be used. This must have a working face of  $30^\circ$  (the accuracy of this angle is important), and must be accurately positioned by a spindle located in the valve guide. The stone must be rotated at high speed. **The face of the seat should be concentric with the valve guide bore to within .001 in. (total clock reading).**
2. If the valves require refacing, this should be done in a valve-facing machine with the stone set at an angle of  $29\frac{1}{2}^\circ$ . **The valve facing must be concentric with the valve stem to within .001 in. (total clock reading).**
3. On no account must badly pitted valves and seats be lapped together, as this will cause excessively wide seats.



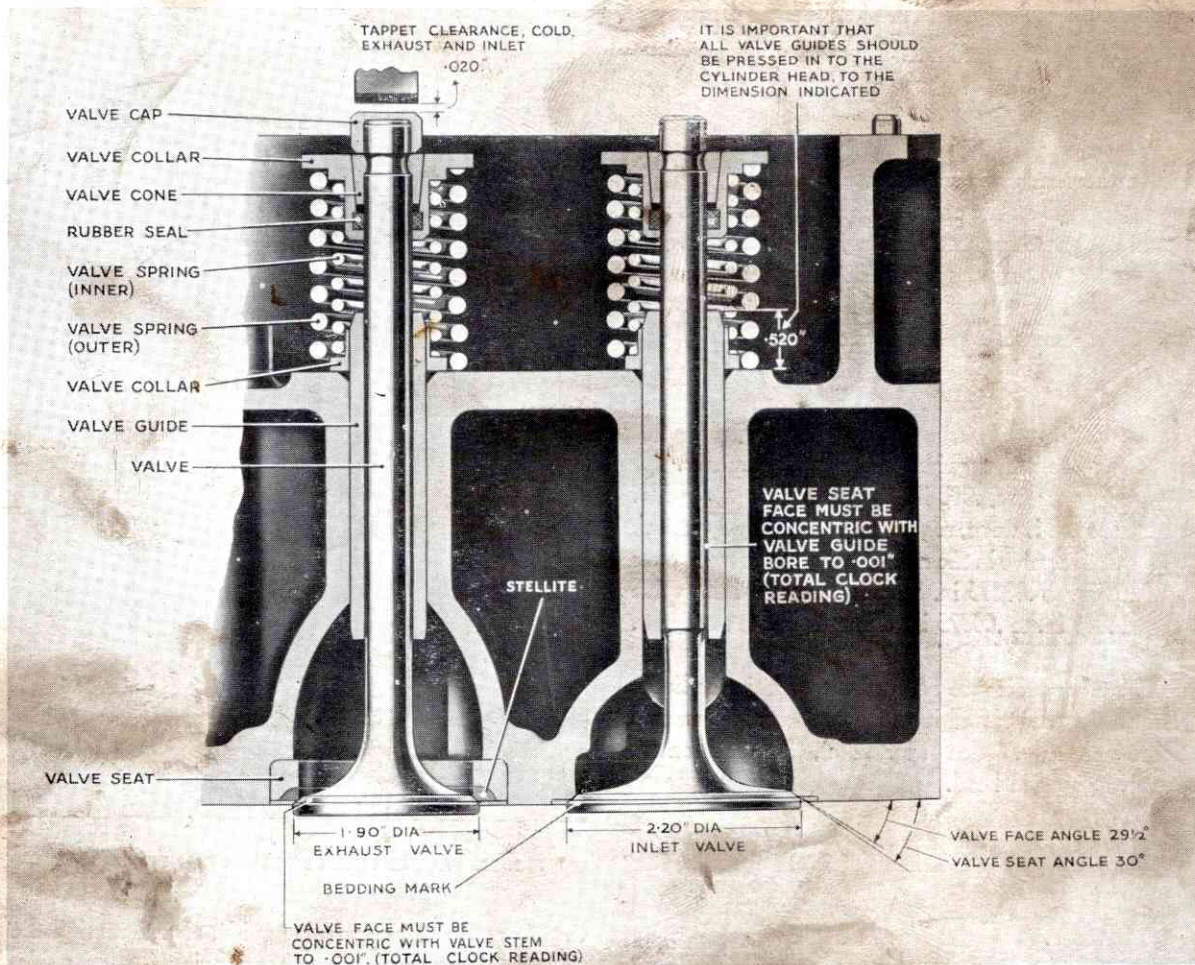


FIG. 23(a). VALVES AND SPRINGS IN POSITION

4. When the valves and seats have been re-cut, or when the valves and seats are in good condition, they should be lightly lapped together to give a perfect seating. The seating mark should be a thin line towards the top of the seat.
5. To lap in the valves, put a thin layer of fine grade carborundum paste on the valve seat and rotate the valve to and fro on the seat, occasionally lifting the valve off the seat. Do not rotate the valve through a complete revolution before lifting as this will groove the seat. All traces of grinding compound must be removed before assembly.

**VALVE TIMING**

The valve timing is shown in Fig. 2, under **Data**.

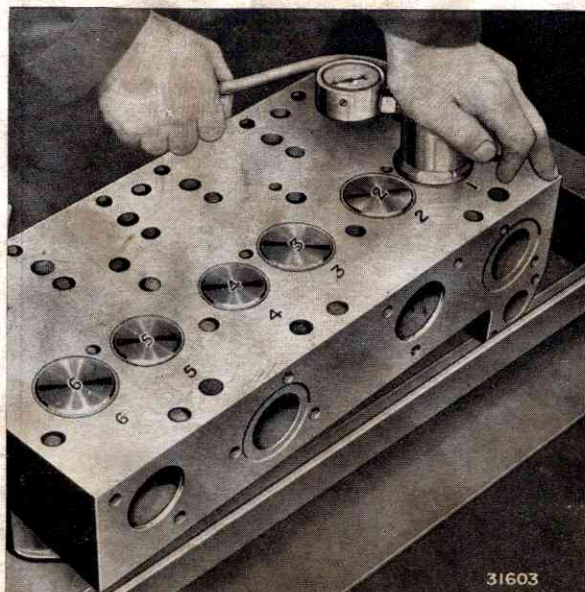


FIG. 24. TESTING GAS-TIGHTNESS OF VALVE ON ITS SEAT



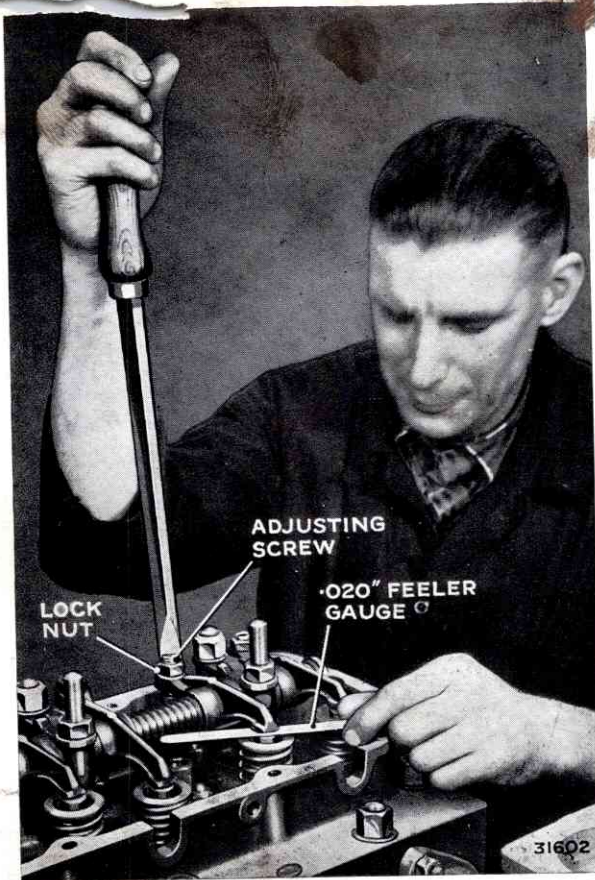


FIG. 25. ADJUSTING THE TAPPETS

### To Check Valve Timing

1. To check the valve timing, set the tappet clearances of No. 1 cylinder to .020 in. (cold).

2. Turn the engine until the timing-plunger engages in the flywheel, and No. 1 piston is on T.D.C. of the firing stroke, i.e., the fuel pump has just delivered. At this point the inlet and exhaust valves are closed. Mark the flywheel  $10^\circ$  before T.D.C. (1.72 in. (43.7 mm.) on flywheel rim).

3. Now turn the engine until the inlet valve of No. 1 cylinder just opens. To check when the inlet valve is just opening, hold the valve collar between thumb and forefinger and attempt to turn. When the valve lifts off its seat, the collar will turn. If the timing is correct, the piston should be 1.72 in. (43.7 mm.) before T.D.C. measured on the flywheel rim (Fig. 23).

### TIMING PLUNGER

This is fitted to facilitate finding T.D.C. for Nos. 1 and 6 pistons and also the fuel pump injection positions which is  $26^\circ$  before T.D.C. of No. 1 piston (both valves closed). The plunger at upper left-hand side of flywheel housing has three positions: **T.D.C.**, **INJ.** and **OFF**. To operate the plunger, lift and turn until the required position is shown, then turn the engine slowly until the plunger is felt to drop into the appropriate hole in the flywheel. **Never use the starter to turn the engine when using the plunger.**

Set the plunger in the off position when engine has been correctly timed.

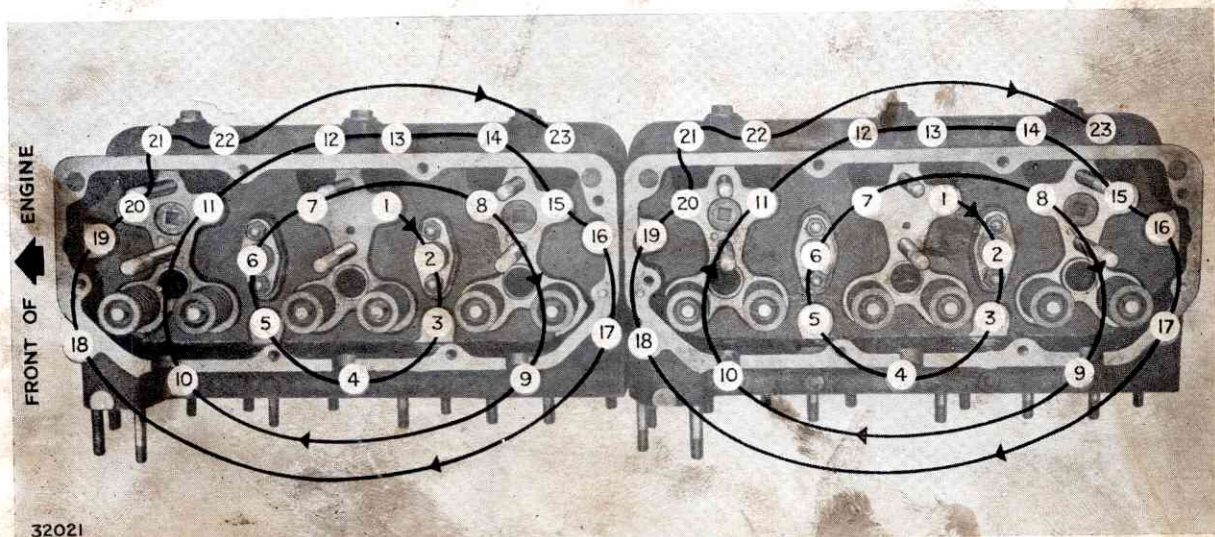
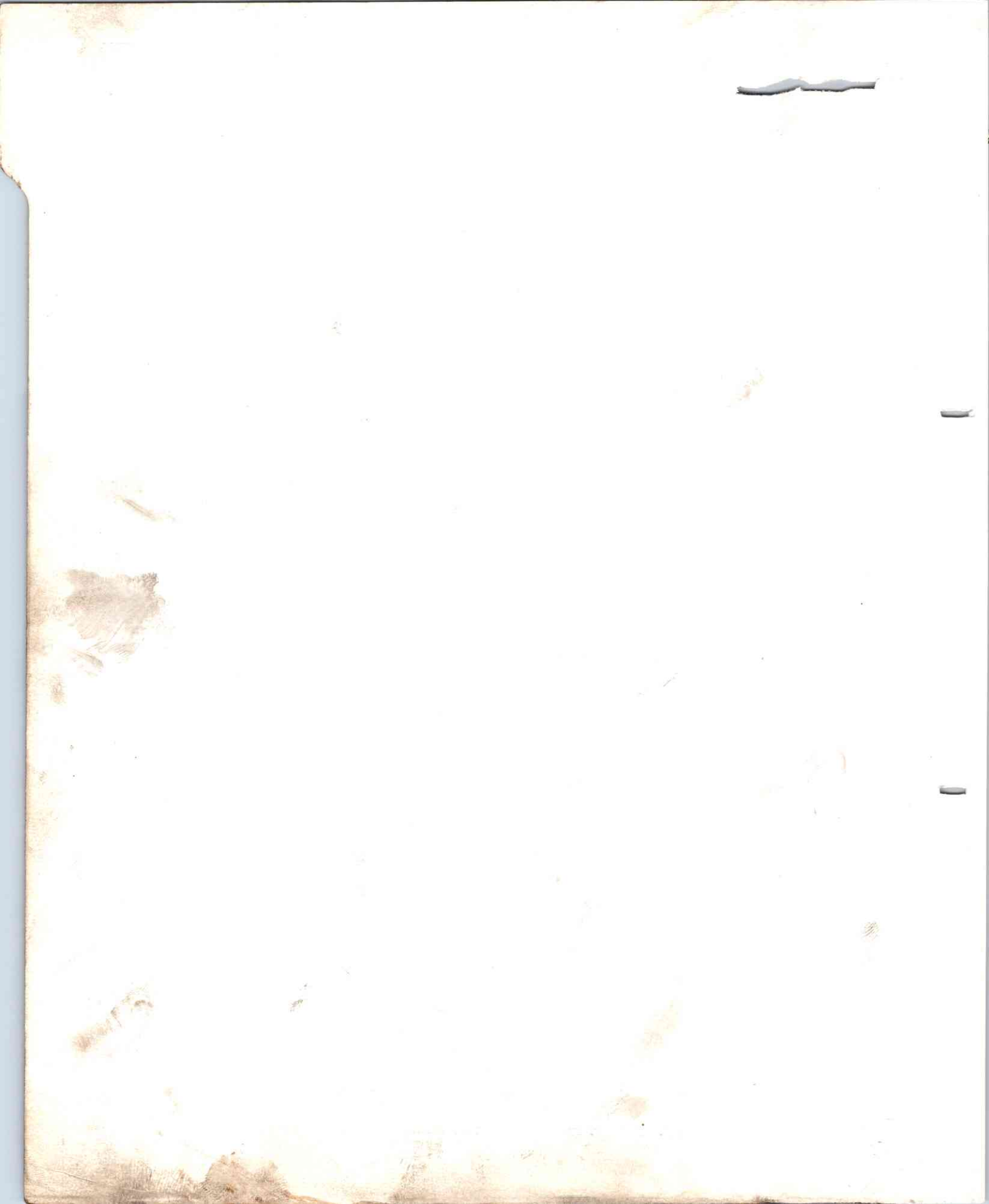


FIG. 26. CORRECT SEQUENCE OF TIGHTENING CYLINDER HEAD NUTS





## THE ENGINE BLOCK AND CAMSHAFT

### DESCRIPTION

The cylinders and crankcase are cast integral; the cylinders being fitted with dry push fit, cast iron liners, shoulder located.

The camshaft is carried in seven pressure lubricated bearings which are setscrew located on the lower offside of the engine block, the thrust being taken on the front bearing only. The drive is transmitted from the front of the crankshaft through helical gearing.

### OVERHAUL

#### To Remove Camshaft

1. Remove the rocker gear and extract the push rods.
2. Remove dynamo and driving belts.
3. Remove tappet gallery side covers and extract the tappets.
4. Remove vibration damper from pulley and then remove pulley with the special tool.
5. Disconnect the compressor oil feed pipe from the timing case side, and remove all securing bolts and setscrews from timing case.
6. Now remove timing case, taking care not to damage the oil seal housed in the bore surrounding the crankshaft end.
7. Remove the four setscrews and locking plates securing the gear to the camshaft and withdraw the gear, taking care to note the position of the timing mark on the gear in relation to the mark on the timing back plate when No. 1 piston is on T.D.C. of firing stroke (Fig. 28).
8. Remove the four setscrews fixing the camshaft thrust washer, and withdraw the camshaft (Fig. 29).
9. To remove the camshaft bearings, take out the locating setscrews and drive out the bearings with a suitable drift. The intermediate bearings are interchangeable.
10. To drive out the rear bearing, it is necessary to remove the clutch, flywheel and top half of flywheel housing.

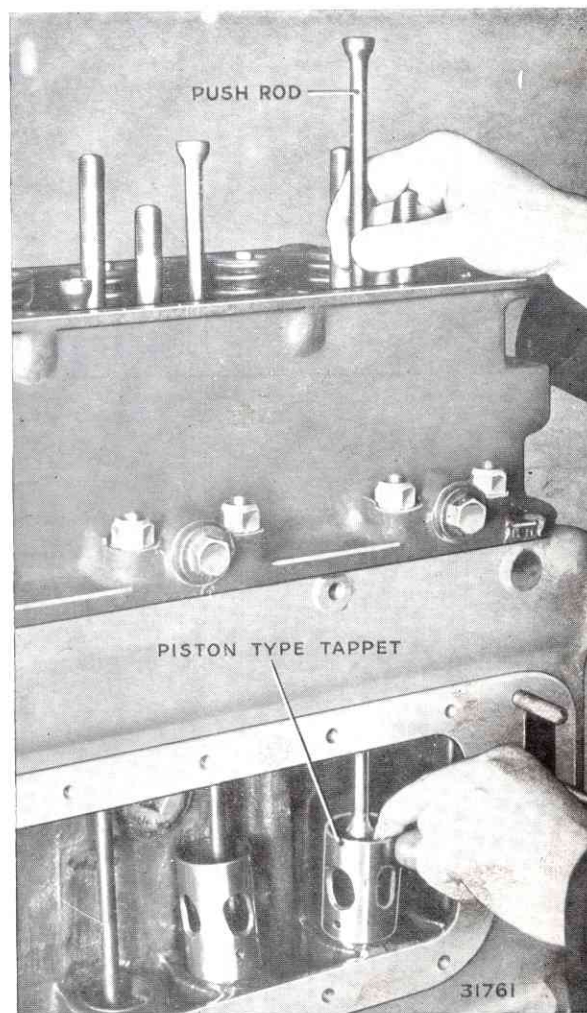


FIG. 27. REMOVING PUSH ROD AND TAPPET



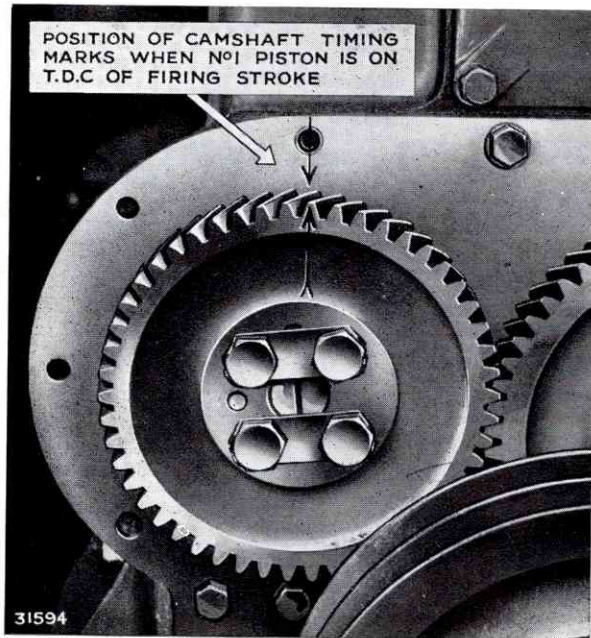


FIG. 28. CAMSHAFT TIMING MARKS

11. Check all bearings for wear and renew when diametral clearance exceeds .010 in. Normal end-play of the camshaft with the retaining plate tight up and adjusting shim in position is .004 in. If the end-play is .008 in. to .010 in., the shim should be removed.

### To Refit Camshaft

Refitting the camshaft is a reversal of the previous procedure.

**Take care that the bearings are not burred when replacing them.**

### To Time the Camshaft

1. Turn the engine until No. 1 piston is on T.D.C. of the firing stroke.
2. Fit the camshaft gear so that when the dowel hole in the gear locates on the dowel in the camshaft end, the arrows on the gear face and timing back plate are in line (Fig. 28), that is, 90° to the top face of the engine block.

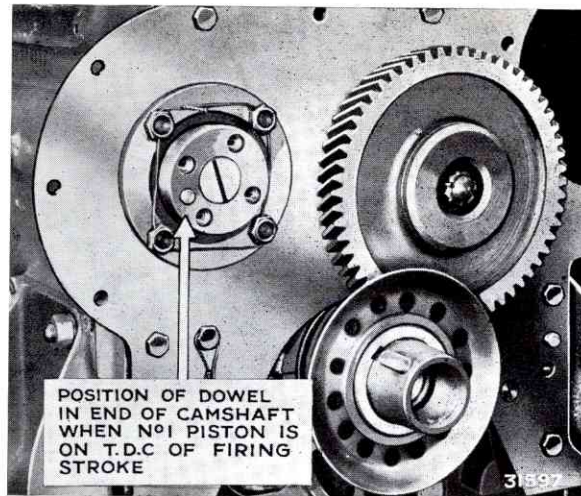


FIG. 29. GEAR LOCATING DOWEL IN CAMSHAFT END

3. Refit the locking plates and tighten the setscrews securely. Make sure that the locking plate tabs are turned over after the setscrews have been tightened.

### Cylinder Liners

At overhaul the liner bores should be measured and if the maximum diameter exceeds 5.0 in. + .020 in. at the top, new liners must be fitted.

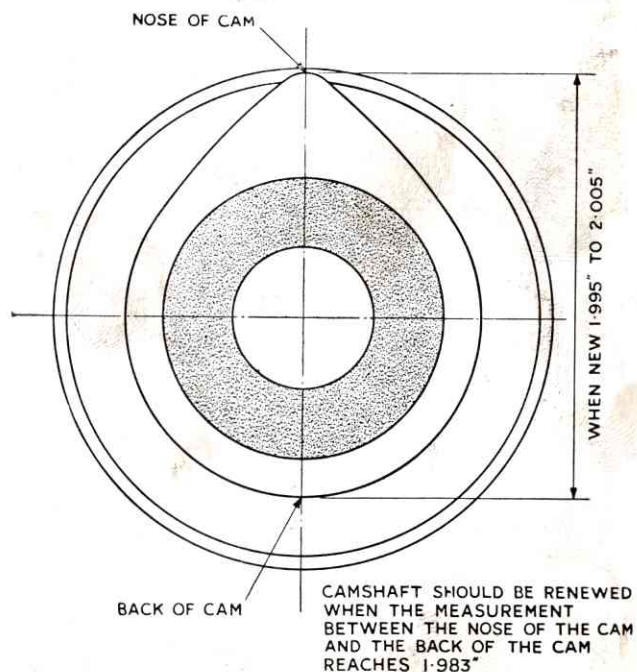


FIG. 30. CAM WEAR DIAGRAM

**To Remove and Insert Liners**

1. The cylinder liners are pre-finished ready for inserting in the engine-block. A special tool has been designed both to extract the old liner and to insert the new one in the block.

2. Before fitting new liners, thoroughly clean out the cylinder bores and lightly smear them with thin oil. This will facilitate removal of liners on subsequent occasions.

**Note:** Cylinder liners must not project more than .002 in. above the top face of the engine block.

**THE CONNECTING RODS AND PISTONS****DESCRIPTION**

The connecting rods are alloy steel stampings of exceptionally rigid design, drilled to provide intermittent oil spray for cylinder wall lubrication. The big ends have steel-shell type, lead-bronze bearings with the bearing surface indium-coated.

The small ends are bushed and the hollow gudgeon pins are located by circlips.

**OVERHAUL****To Remove Connecting Rods and Pistons**

The dimensions of the crankshaft are such that the pistons cannot be withdrawn from below; they can, however, be withdrawn through the cylinder bores.

Care should be taken not to scratch the bores when removing or replacing the connecting rod assemblies.

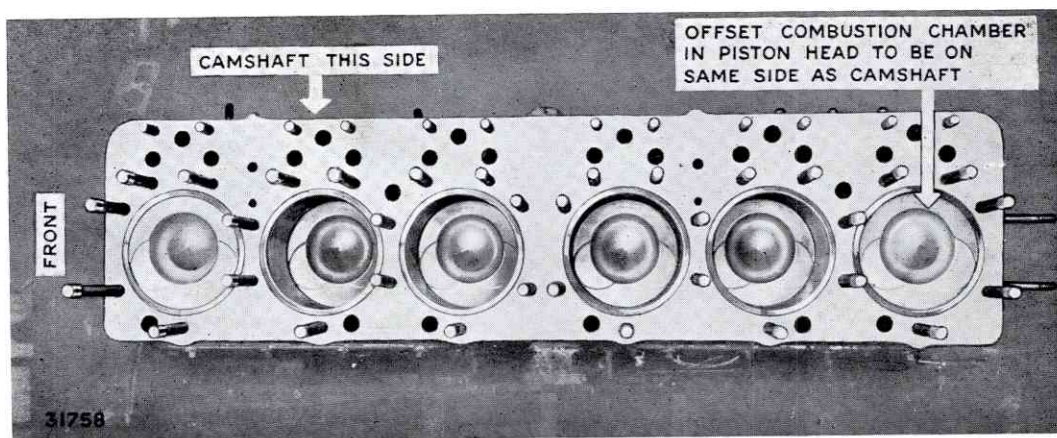


FIG. 31. POSITION OF OFFSET COMBUSTION CHAMBERS IN PISTON HEADS, IN RELATION TO THE CAMSHAFT



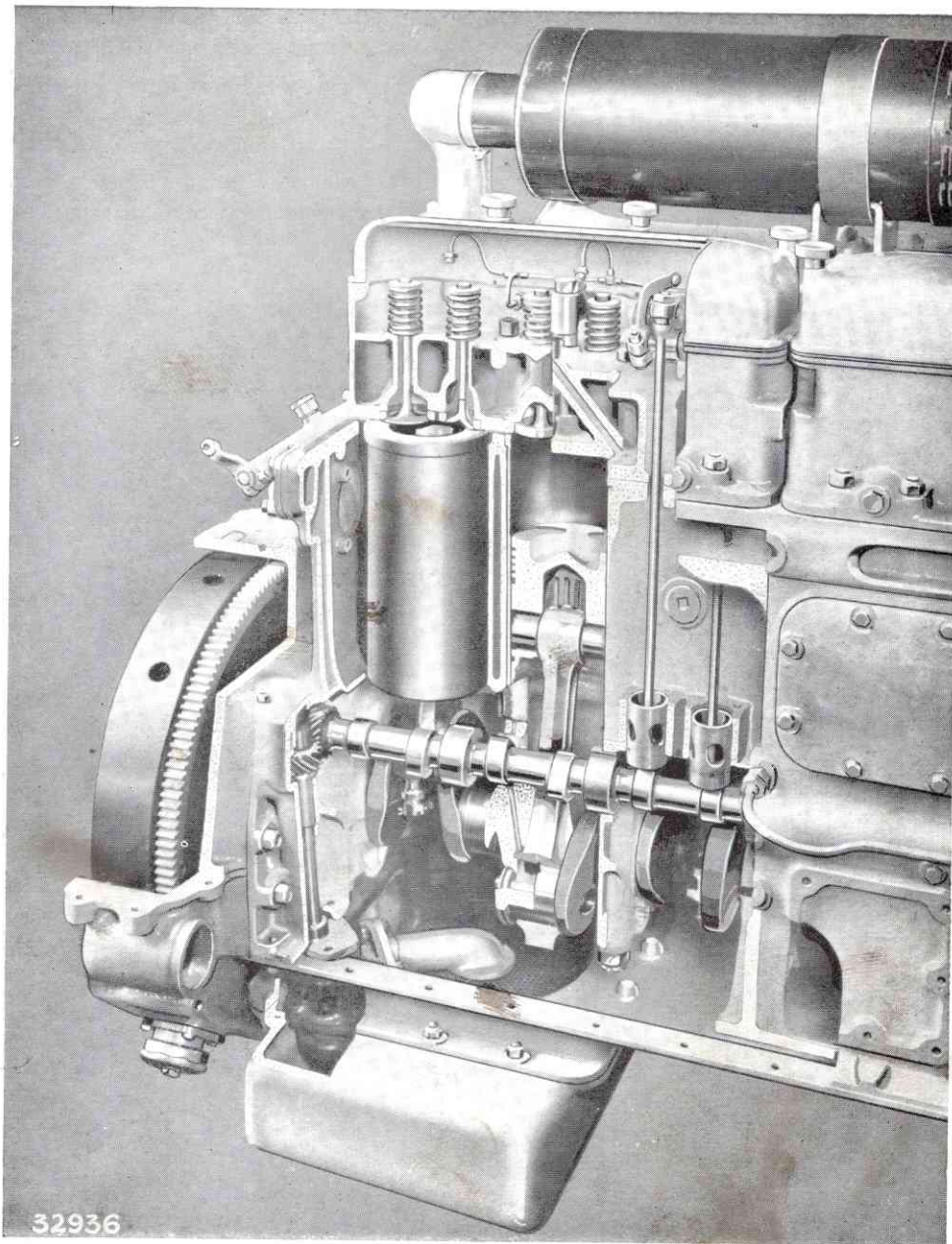


FIG. 32. TYPICAL CUT-AWAY SECTION OF REAR OF ENGINE

**To Separate Pistons from Connecting Rods**

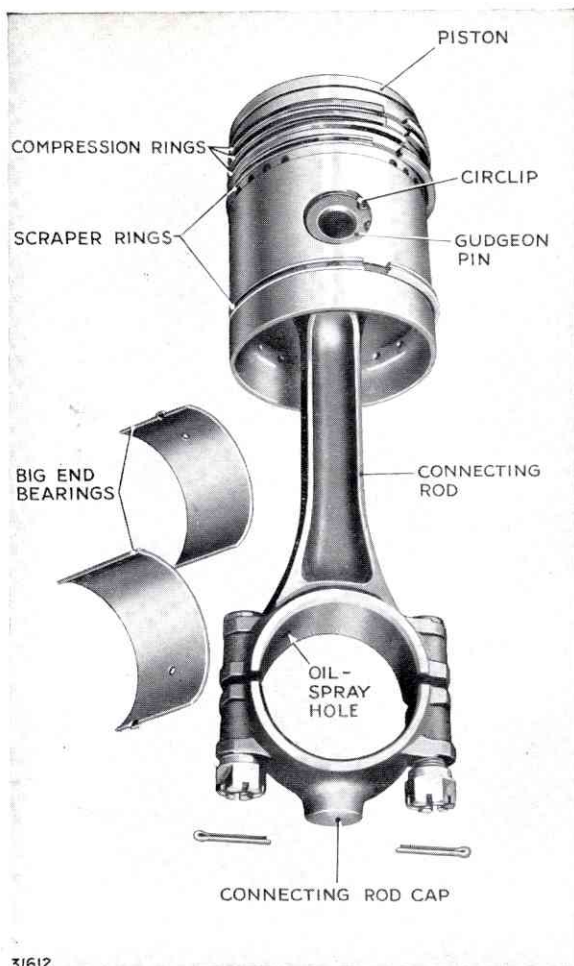
1. Remove the gudgeon pin circlips.
2. Heat the pistons in boiling water and tap or push the pin out while the piston is hot.

**Note:** The gudgeon pins must not be forced in or out of the pistons when cold. The pins are an interfer-

ence fit in the piston bosses when cold and an easy push-fit in the small-end bushes.

**To Assemble Piston and Connecting Rod**

1. Heat the pistons in boiling water or in an oven before the gudgeon pins are inserted. The oven temperature must not exceed 150° C.



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FIG. 33. CONNECTING ROD AND PISTON ASSEMBLY

2. Fit pistons to connecting rods with the offset combustion chamber in the piston heads on the same side as the oil spray hole in the connecting rod big end (Fig. 5).

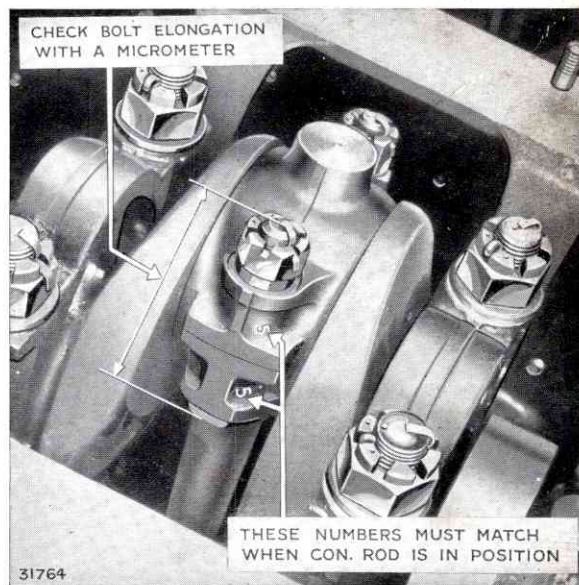
**To Fit Piston and Rings**

- |                  |                                   |
|------------------|-----------------------------------|
| 1st, 2nd and 3rd | Fit hardened wedge-section, com-  |
| grooves ...      | pression rings, 90° slot.         |
| 4th and 5th      |                                   |
| grooves ...      | Fit unhardened oil scraper rings. |

The initial piston ring gap is .020 in. to .027 in. Renew rings when side clearance in groove exceeds .015 in.

**To replace Connecting Rods and Pistons**

1. Wipe the crankpin and bearing surfaces with a clean rag and lightly smear with clean engine oil both crankpin and lead-bronze surface of bearing shells.
2. Fit the connecting rod assemblies with the offset combustion chamber in the piston heads and the oil spray hole in the big ends on the same side as the camshaft. (See Fig. 5).
3. The connecting rod bolts must be tightened to give an overall bolt elongation of .006 in. to .008 in. which must be measured with a micrometer (Fig. 34).
4. On no account must the nuts be slacked off to bring the pin holes into line. If the pin holes will not line up with the correct bolt elongation, the nut must be filed to bring the pin holes into line, care being taken to keep the faces true. Fit the split pins and slack off nuts just sufficiently to "nip" the split pins.



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FIG. 34. CONNECTING ROD IN POSITION



## THE CRANKSHAFT AND MAIN BEARINGS

### DESCRIPTION

The crankshaft is supported in seven lead-bronze, steel-shell, indium-coated, main bearings. The oil holes in the crankpins are drilled eccentrically to reduce centrifugal loading and also to act as sludge traps to protect the big-end bearings.

A labyrinth oil seal at the rear end of the crankshaft

prevents loss of oil from the lower half of the engine-block and a felt sealing ring fitted in the upper and lower halves of the flywheel housing prevents engine breathing (Fig. 36). A large diameter flywheel, fitted with a renewable cast iron clutch facing, is bolted to the crankshaft rear end flange. The bolt holes in the flange and flywheel are drilled out of pitch, so that the flywheel can only be mounted with the timing plunger holes in

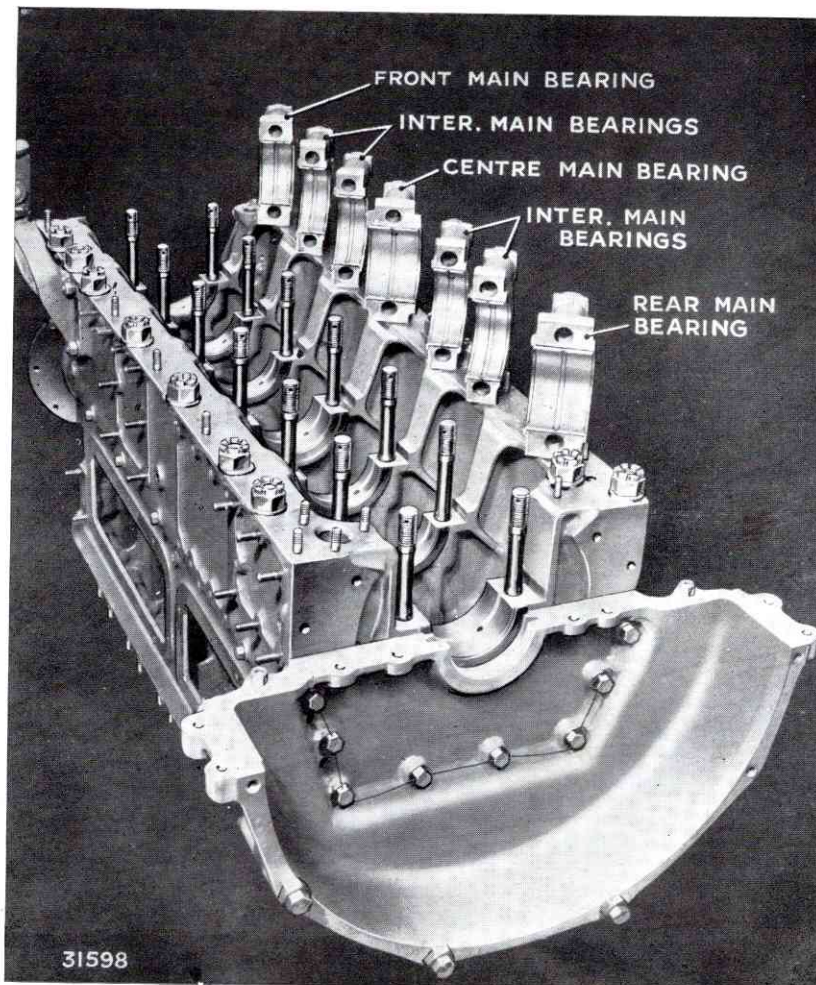


FIG. 35. ENGINE BLOCK AND MAIN BEARINGS

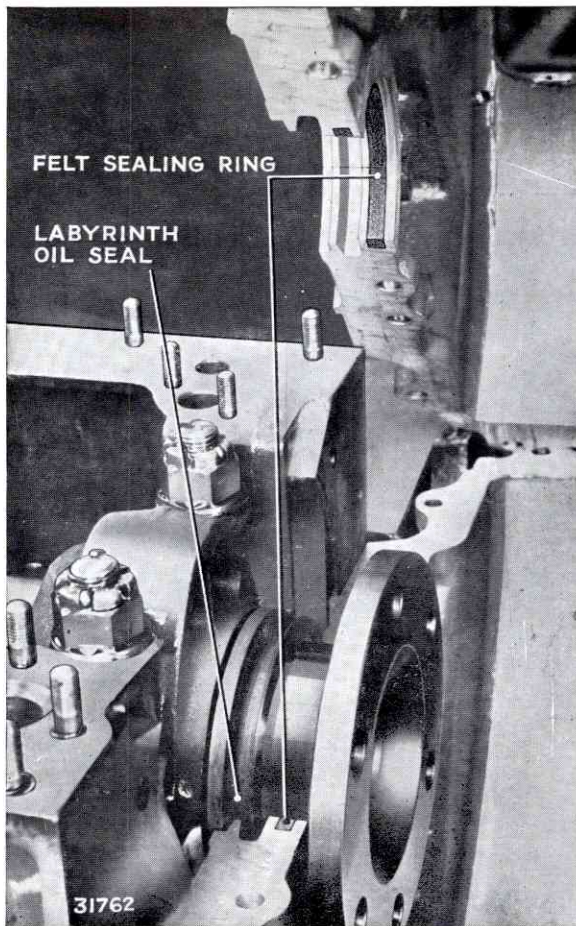


FIG. 36. LABYRINTH OIL SEAL

the flywheel rim, in correct relation to the throws of the crankshaft, for timing purposes.

The starter gear ring (Fig. 39) is spigoted and bolted to the flywheel so that its position can be changed as local wear takes place. It is reversible and can be turned completely over to obtain further service.

## OVERHAUL

### To Fit New Bearings and Thrust Washers

Normally by the time the main bearings require replacing, the crankshaft will need to be removed for regrinding, the instructions for these two latter operations being detailed in the sections headed **To Regrind the Crankshaft**.

However, if at any time one or more bearings should have to be renewed or removed for inspection, this can be done satisfactorily without the necessity of removing the engine from the vehicle.

1. Remove the sump and oil pump.
2. To renew or inspect an individual bearing only, take off the cap of the bearing in question.
3. Slacken all the remaining bearing cap nuts one or two turns to facilitate removal of the top halves of the bearings.
4. Remove the lower half of the bearing from the cap, push out the top half of the bearing by rotating it on the crankshaft.
5. Inspect the old bearing shells and if they require renewing insert a new half-bearing in the top and also fit a new half-bearing in the cap. If the old bearings are under size, replace by a new bearing of the same size.
6. Thrust washers can be renewed by the same method as described for the bearings. The bottom halves of the washers are tongue-located in the bearing caps and care must be taken to ensure that the tongues fit correctly in the caps.

### To Remove Crankshaft

1. Remove the engine from the vehicle.
2. Remove the cylinder heads, push-rods and tappets.
3. Invert the engine and remove the sump, oil pump, flywheel and connecting rod assemblies.

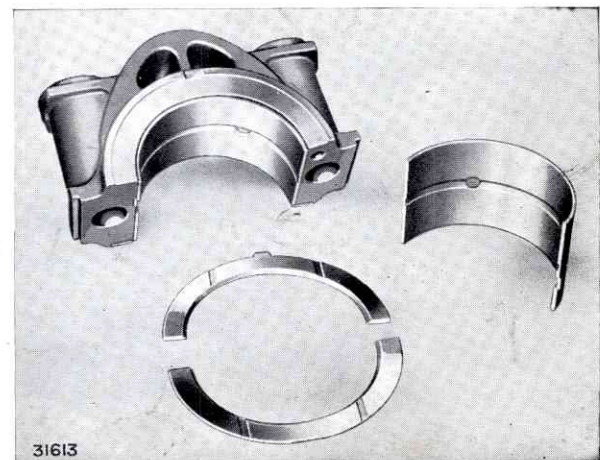


FIG. 37. CENTRE MAIN BEARING AND THRUST WASHERS



4. Remove bottom half of flywheel housing.
5. Withdraw driving pulley from end of crankshaft.
6. Disconnect the exhauster or compressor oil feed pipe, if fitted, from timing case side and remove timing case.
7. Remove main bearing caps, and lift out the crankshaft.

### To Replace the Crankshaft

Main bearing caps, bearings and nuts must be refitted in their original positions and to this end the caps are stamped with index marks A, B, C, etc., starting from the front of the engine. The caps are stamped on the front and a corresponding letter is stamped on the front of the crankcase web. When correctly assembled all marks must coincide.

1. Fit the top halves of the main bearings in their correct seatings ; check that the shells bed down correctly.
2. Flush out the crankshaft oil holes and smear the main bearing journals with clean engine oil.
3. Lower the crankshaft carefully into position, replace the main bearing caps in their correct positions, and tighten down, fitting the nuts to their original studs when possible. A torsion spanner set at 260 to 270 lb./ft. should be used to tighten the bearing cap nuts.

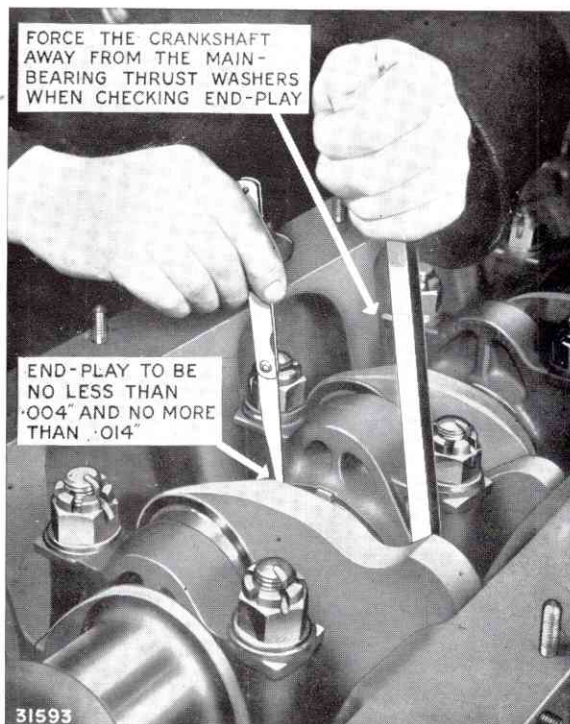


FIG. 38. CHECKING CRANKSHAFT END PLAY

4. Check the crankshaft end-play. This should not exceed .014 in.
5. Fill the crankshaft oilways with clean engine oil then fit the connecting rods with the oil spray hole in the big-end and the offset combustion chamber in the piston head, on the same side as the camshaft. The initial diametral big-end clearance should be .0018 in. to .0037 in. and should be renewed if it exceeds .008 in.

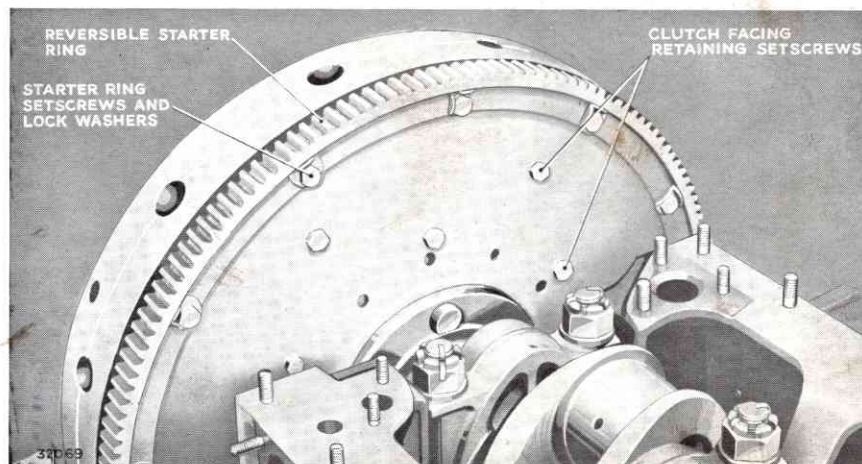


FIG. 39. REAR VIEW OF FLYWHEEL AND STARTER RING

### To Regrind the Crankshaft

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 to 2.710 in. to 2.712 in., otherwise the dimensions should remain at 2.700 in. to 2.702 in.

After grinding, support the crankshaft at the front and rear journals. Check the relative eccentricity of the centre main journal; this must not exceed .003 in. in radius—total run-out of .006 in. The permissible error between one bearing and its neighbour must not exceed .003 in. (total clock reading).

It is not permissible to straighten a crankshaft in a press.

The crankshaft should be re-nitrided at the second and fourth regrinds.

Check the main bearing diametral clearance. This should be within the limits of .0020 in. to .0042 in. when

new bearing shells are fitted. Bearings should be renewed when diametral clearance exceeds .009 in.

When refitting the flywheel to the crankshaft, check that the flywheel runs true with the crankshaft to within .004 in., as shown in Fig. 40.

### To Skim the Clutch Facing Plate

If the clutch facing plate is deformed it may be skimmed down. It is permissible to skim off .0313 in., after this figure is exceeded compensation must be made by fitting skim plates (.064 in. thick) between the clutch facing plate and flywheel. A maximum number of three skim plates may be fitted, if two or more are fitted the standard retaining setscrews must be replaced by setscrews .125 in. longer. It is not advisable to skim more than .100 in. from the clutch facing plate, but when considering the number of skim plates required it is important to allow for the amount skimmed from the clutch back plate.

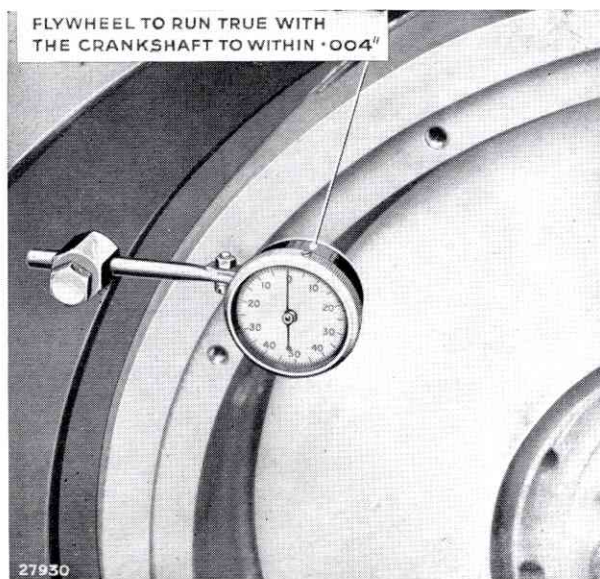


FIG. 40. CHECKING FLYWHEEL FOR RUNNING TRUE



## THE TIMING GEARS

### DESCRIPTION

The timing gears (Fig. 41) are single-helical hardened and ground gears, the drive to the camshaft and exhauster or compressor being transmitted from the timing gear on the crankshaft through an idler gear.

The gear on the crankshaft is an interference fit, the key being used only to locate the gear for timing purposes.

The idler gear, mounted on a spindle bolted to the engine block, runs on a floating bush, thrust being taken by two special washers (Fig. 42). The washers should be renewed when end float exceeds .012 in. To remove the idler gear it is only necessary to remove the split pin and nut from the end of the fixing bolt and withdraw the gear and spindle.

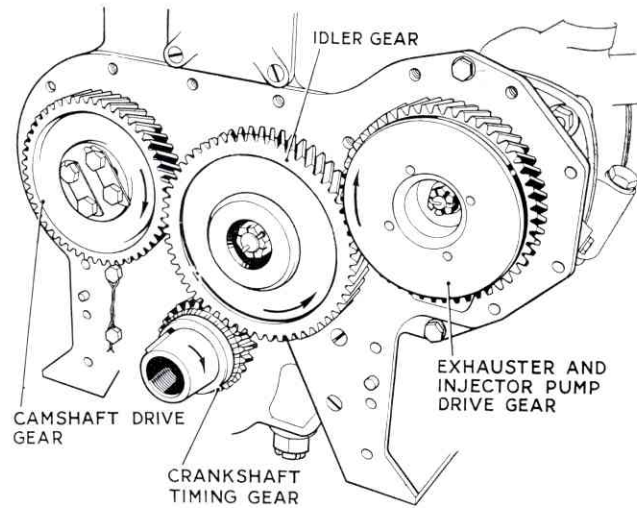


FIG. 41. THE TIMING GEARS

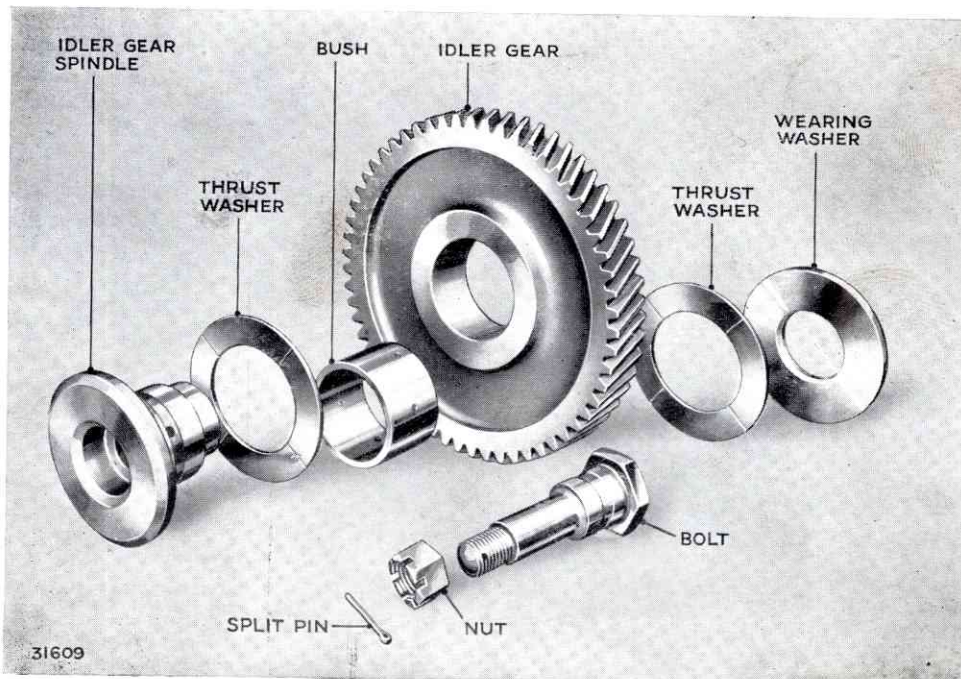


FIG. 42. IDLER GEAR DISMANTLED

The gear for the fuel-pump drive is carried on ball and roller bearings mounted in a housing attached to the compressor and bolted to the timing back plate.

**DISMANTLING FUEL INJECTION PUMP DRIVE GEAR**

1. Remove the two circlips behind the rear ball race.
2. Press the gear out of the housing and races. The

outer race of the roller bearing will remain in the housing. The four holes drilled in the face of the gear are to enable the inner-race of the roller bearing to be pressed or driven off the gear.

The two slots cut in the housing are to enable the roller outer-race and the ball race to be pressed out of the housing.



## THE COOLING SYSTEM

### DESCRIPTION

Water drawn by the pump from the bottom tank of the radiator is circulated through the block and heads, up through the water outlet manifold at the front end of each cylinder-head, and back to the top tank of the radiator.

A thermostat, fitted in the front end of the water outlet manifold (Fig. 43) enables the engine to reach the correct running temperature in the shortest possible time. The thermostat valve seals the outlet to the radiator while the water is cold, but allows it to circulate through the block and heads until the water temperature rises to 185° F., when the valve opens and brings the radiator into full operation.

### Draining the Cooling System

To drain the cooling system, open the tap fitted in the bottom of the water inlet pipe at the bottom of the radiator.

When draining the cooling system as a precaution against frost :

1. Park on level ground.

2. Open the drain tap.
3. Display a notice marked " No water in radiator " in a prominent position.
4. When all water has been drained off, close the drain tap.

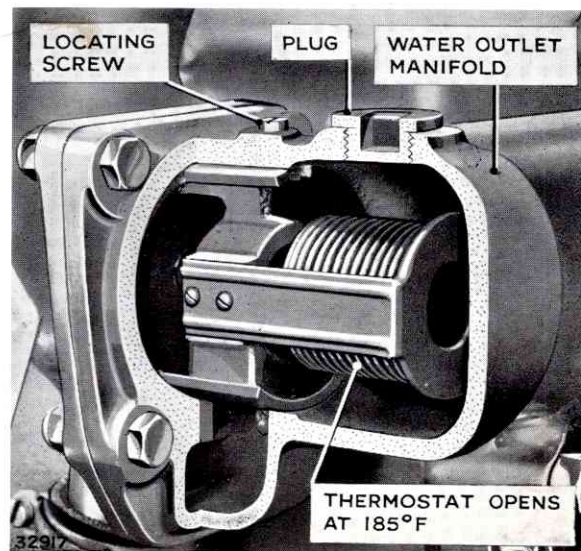


FIG. 43. THERMOSTAT IN POSITION

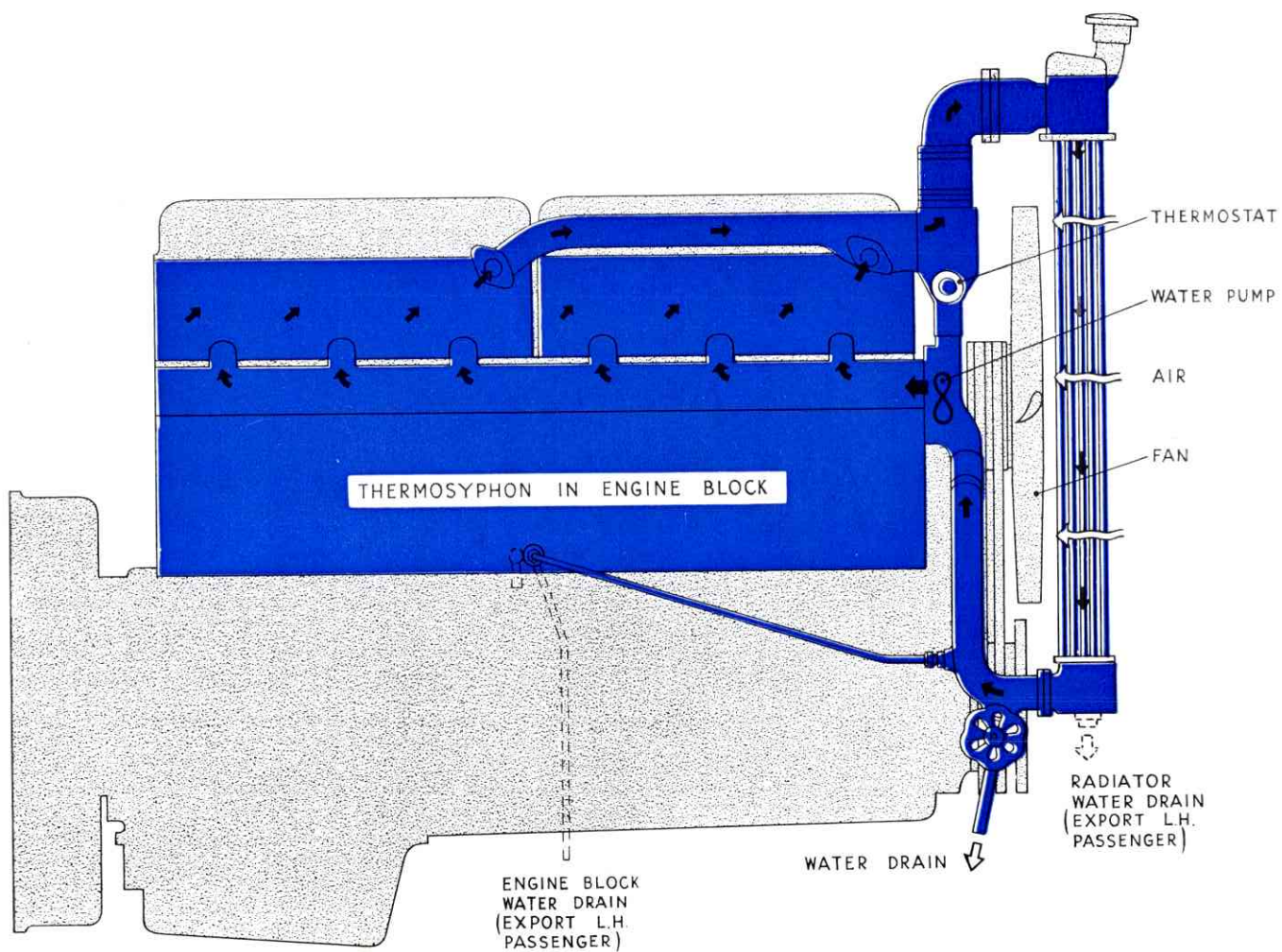


FIG. 44. WATER DRAIN AND CIRCULATION DIAGRAM



**WATER PUMP**

The impeller-type water-pump, mounted at the upper front end of the engine block, is driven from the crankshaft by pulley and twin belts. A spring-loaded, self-adjusting, carbon seal unit, carried on the driving shaft, completely isolates the impeller chamber from the ball and roller bearings. The bearings are lubricated through a limited-supply grease nipple on the pump housing ; loss of grease being prevented by felt washers.

**To Dismantle Water Pump**

1. Remove water-pump back plate.
2. Using the two  $\frac{5}{16}$  in. B.S.F. holes drilled in the end face of the impeller for fixing withdrawal tool, withdraw the impeller from the driving shaft.
3. Withdraw the carbon seal unit.
4. Remove inner cover and press the driving shaft out of the pulley and bearings, pressing from the pulley end of the shaft.
5. Remove outer cover and distance-piece, then press out bearings and retainer, pressing from impeller end of pump.

**Renewal of Carbon Gland Unit**

The carbon seal unit should not require attention for very long periods, but if at overhaul the rubber is damaged, or the carbon excessively worn, a new seal unit can be obtained from Leyland Service Department.

**To Reassemble Water Pump**

To reassemble the water pump, reverse the procedure for dismantling.

**NOTE :**

It is important that the driving shaft end and the impeller end face should be flush when in position, as this determines the correct spring pressure on the sealing face of the carbon gland. When pressing the impeller on the driving shaft, care should be taken that the tongue on the seal unit locates correctly in the driving slot cut in the impeller.

On later models a "Romet" type sealing member is fitted. The construction of this unit comprises a rubber case having a metal stiffener, a stainless steel loading spring and a sealing face of "Monum." The unit is a taper fit in the bearing housing end cover. A phosphor-bronze insert having lapped end faces is pressed into the hub of the impeller, the two sealing faces coming into contact when the impeller is pressed on to the pump spindle. A pressure of 10 to 15 lb. is exerted by the loading spring on the two sealing faces.

## THE FUEL INJECTORS

### DESCRIPTION

The fuel is delivered at high pressure to injectors (Fig. 45) which break up the fuel into a fine mist and distribute it in the combustion chamber. They also ensure a snap-start and finish to injection and prevent air from entering the pipe lines during the compression stroke.

The inlet adapter is provided with an "edgewise" type filter. From the filter, fuel is fed through a drilled

passage to the nozzle. When the required pressure is reached, the nozzle valve snaps open and allows fuel to be sprayed into the combustion chamber through four small, equally spaced holes in the nozzle tip. Although the needle valve is a very fine fit in its bearing in the injector body, a small quantity of fuel leaks past the valve stem and this is led away through a drilled passage in the injector body to a branch pipe and thence to the main leak-off gallery pipe (Fig. 47).

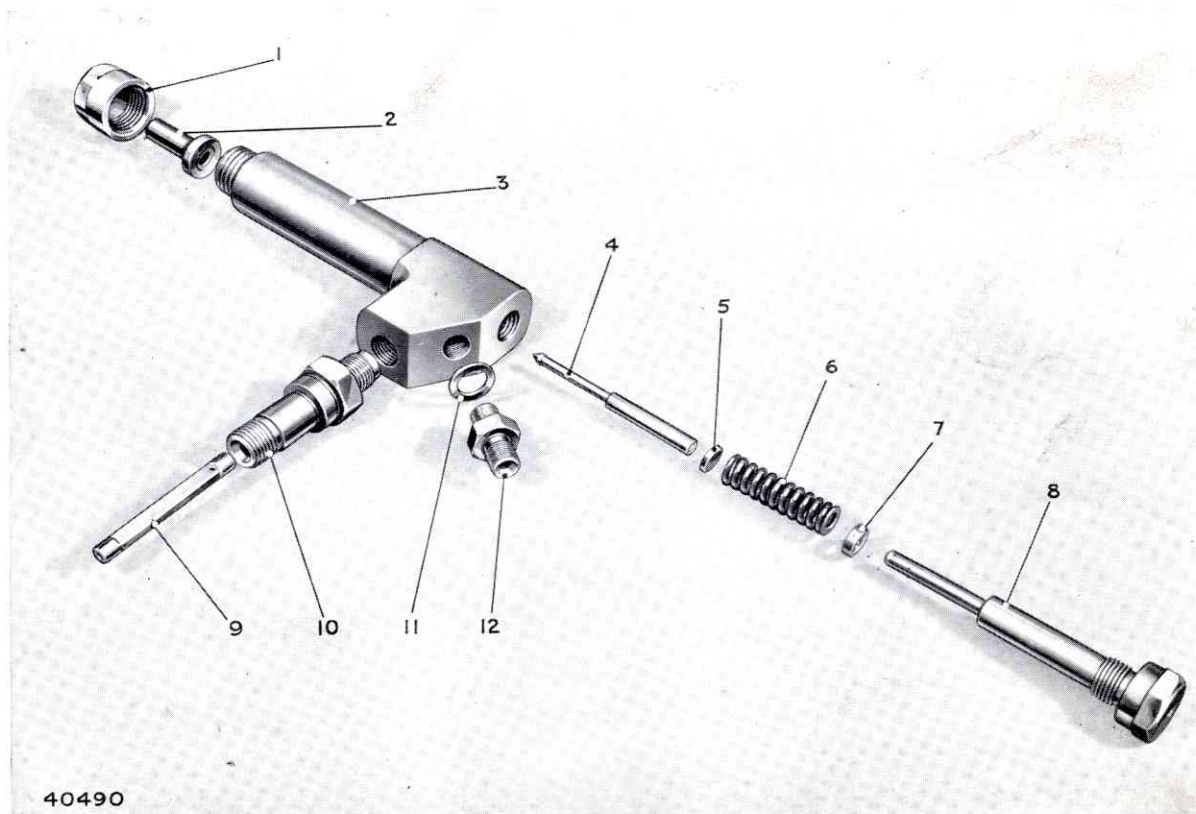


FIG. 45. EXPLODED VIEW OF INJECTOR UNIT

- |                   |   |                       |
|-------------------|---|-----------------------|
| 1. Locknut.       | 5. Needle valve lift distance washer.   | 8. End plug.          |
| 2. Nozzle.        | 6. Valve spring.                        | 9. Edgewise filter.   |
| 3. Injector body. | 7. Discharge pressure adjusting washer. | 10. Inlet adapter.    |
| 4. Needle valve.  |   | 11. Copper washer.    |
|                   |   | 12. Leak-off adapter. |

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FIG. 46. AN INJECTOR UNIT SECTIONED

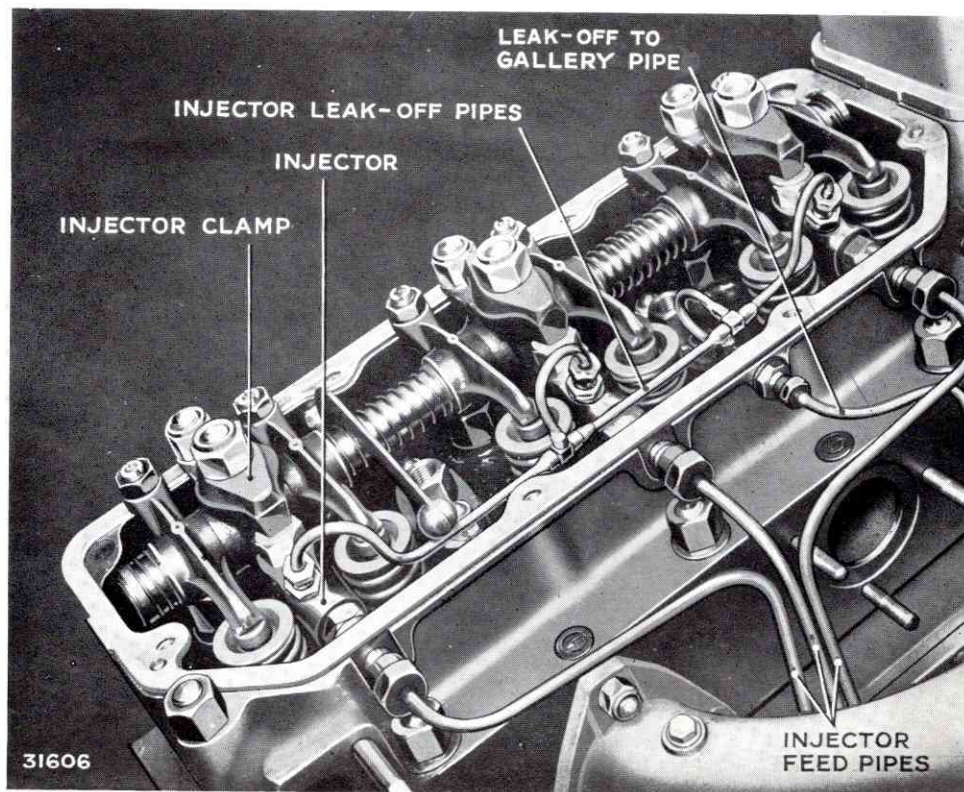


FIG. 47. INJECTORS AND LEAK-OFF PIPES IN POSITION IN CYLINDER HEAD

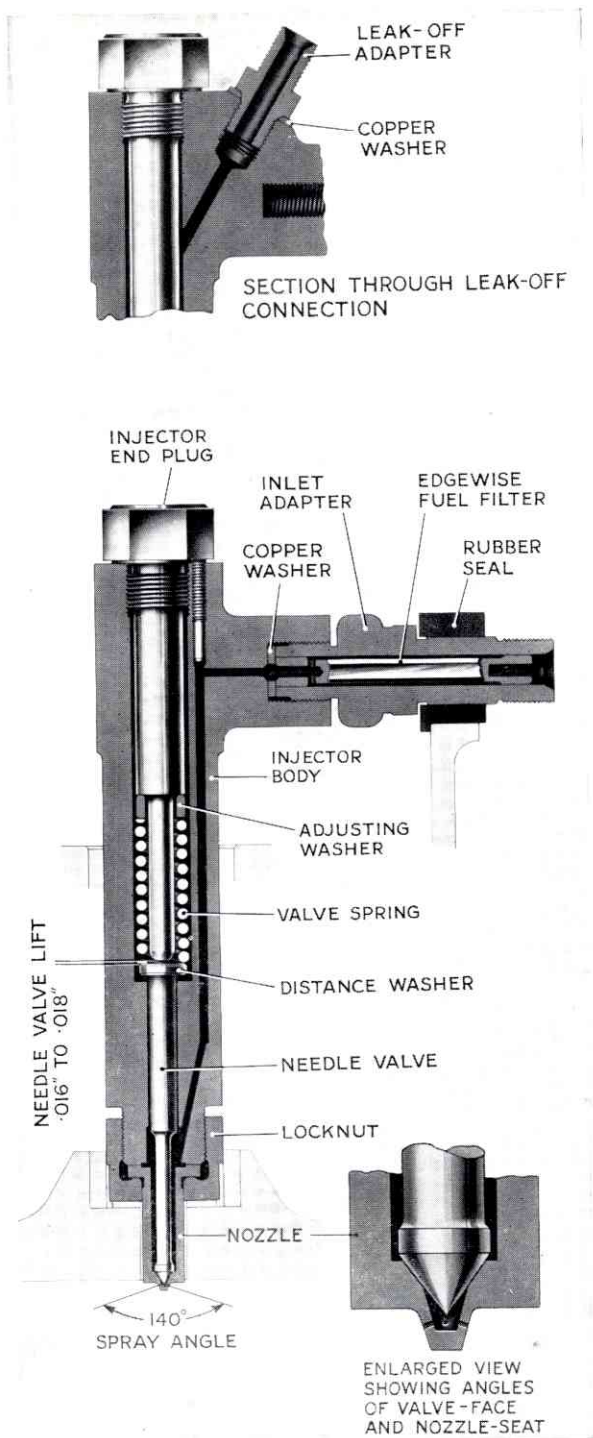


FIG. 48. THE INJECTOR UNIT

The injectors will give long periods of efficient service. Special equipment is required for reconditioning the injectors and special lapping tools are obtainable. If, however, no equipment is at hand, injectors should be returned to Leyland Service Department and a replacement set fitted.

### Diagnosis of Injector Trouble

Provided the fuel filters receive regular attention, thereby ensuring that only clean fuel is fed to the injectors, no attention is likely to be required for long periods. Any inefficiency can usually be detected by one of the following symptoms :

1. Pronounced knocking on one (or more) cylinders.
2. Complete or intermittent misfiring.
3. Smoky exhaust (black), injector discharging unvaporised fuel ; (blue), denotes a choked injector.
4. Increased fuel consumption.
5. Engine overheating.

To locate a faulty injector, slacken off the injector pipe union nut two or three turns and allow the fuel to leak past the threads while the engine is running slowly. This cuts out the injector and if no change in engine performance can be detected, it is reasonable to assume that the injector is faulty and should be removed for examination.

Faulty injection may be due to any of the following :

1. External carbon on nozzles.
2. Choked nozzle spray holes.
3. Loose nozzle lock-nut.
4. Dirt on the joint face between nozzle and body.
5. Dirt or carbon on needle valve seat.
6. Needle valve sticking in body.
7. Faulty valve spring adjustment.
8. Broken needle valve spring.
9. Cracked injector body.

### To Test Injectors

Connect the injector to an injector test pump, give the handle about ten strokes to expel all air, and observe the nature of the spray when pumping at about 2 strokes per second. If no test pump is available, connect the injector to the injection pump, so that the spray can



be observed. Slacken the unions on the remaining injectors to prevent unburnt fuel being sprayed into the cylinders. Decompress the engine. Turn the engine, and observe the spray.

When the injector is operating correctly, the spray from the nozzle spray holes should appear alike, and of equal length and free from streaks or jets of undivided fuel (Fig. 39).

A sharp, high-pitched, metallic squeak should be heard whilst the injector is spraying.

The nozzle tip must remain dry after fuel cut-off.

### OVERHAUL

#### To Dismantle and Clean Injectors

When dismantling injectors absolute cleanliness is essential. **Needle valves are not interchangeable**, care must be taken when dismantling to keep all parts with their original injectors.

1. Remove the injector end plug and withdraw the valve spring, discharge pressure adjusting washer,

needle valve lift distance washer and needle valve. If the needle valve is tight screw a piece of 3 BA screwed rod into the tapped bore of the needle valve and draw it out.

2. Remove the nozzle lock-nut and nozzle.
3. Wash the needle valve, nozzle and injector body in clean fuel oil. Both faces of the nozzle flange, the inner face of the lock-nut and face of the body should be bright and without trace of damage. They must bed perfectly to ensure a pressure-tight joint.
4. The stem of the needle valve must be free from high spots or scratches. If dirty or coked, clean with a fine brass wire brush.
5. Clean the nozzle seat thoroughly and clear the spray holes with a pricker. Brush through injector body bores and inlet adapter. Flush out the inlet port drilling and nozzle with fuel oil. Finally, rinse in clean white spirit before assembly.

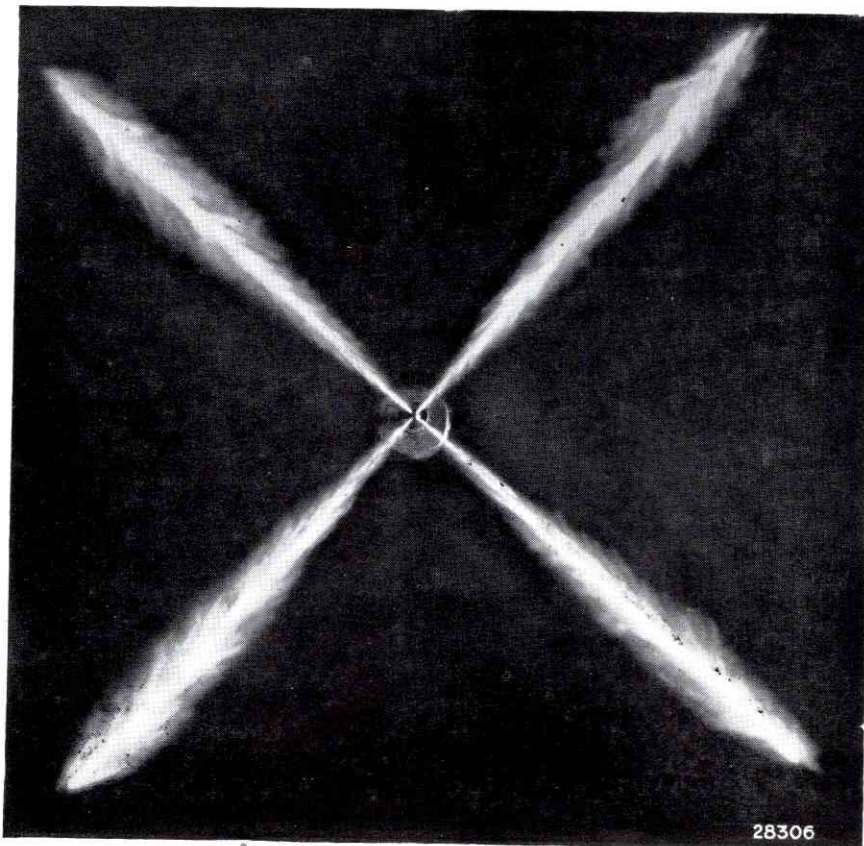


FIG 49. INJECTOR SPRAY AS SEEN BY THE HIGH-SPEED CAMERA



FIG. 50. PART SECTIONED VIEW OF INJECTOR UNIT

### To Re-lap Nozzle and Valve Seats

Use only the special fine grade lapping compound known as "2A.700.O.F." supplied by the Carborundum Co., Ltd., Trafford Park, Manchester, 17.

When lapping, only use **very** light pressure.

Never give the needle or nozzle lapping jigs more than a **few** twists at a time between each test.

Wash away every trace of lapping compound, assemble the injector and test for a dry seat with a sustained pressure of 125 atmospheres. 1,827 lb./sq. in. (129 kg./sq. cm.). If the seat does not remain dry, repeat the lapping operations until such a condition is obtained.

### Assembly and Test of Injectors

The most important point to check when assembling an injector unit is the correct alignment of the nozzle in relation to the bore in the injector body. If the alignment is not correct the unit will not function properly and failure will occur at very low mileages. The components should be thoroughly washed in white spirit or fuel oil and kept free from grit or dirt throughout the entire operation.

Fluffy material should not be used to wipe the components.

### To Reassemble Injectors

1. Check that all parts are perfectly clean and dry.
2. Fit the injector body in the jig (Fig. 51).
3. Fit the nozzle and lock-nut and screw up the lock-nut so that the nozzle can just be rotated with the fingers.
4. Screw the 3BA rod into the needle valve bore and insert the valve into the injector body.
5. Tighten the lock-nut slowly and carefully with the fingers, at the same time using the 3BA rod to bounce the needle valve rapidly on the nozzle seat (Fig. 53).

This ensures perfect centralisation of the nozzle and needle, without which the injector will not operate correctly. When the needle valve bounces freely on

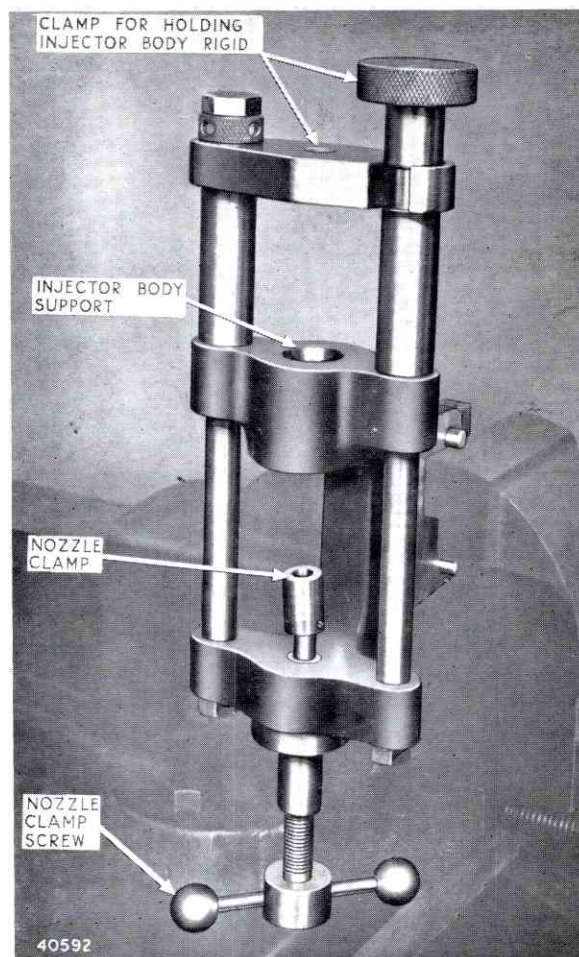


FIG. 51. NOZZLE AND NEEDLE ALIGNING JIG



its seat, tighten the jig clamp screw to hold the nozzle in position (Fig. 52) and finally tighten the lock-nut with the ring spanner (Fig. 56), taking great care not to knock the nozzle when fitting the spanner. When the lock-nut has been fully tightened a further and most important check that the needle valve operates freely, is the " Inverted Test " carried out as follows.

1. Remove the injector from the jig.
2. Hold the injector vertically in an inverted position. (Fig. 76).
3. With the needle valve attached to the screwed rod, insert the needle valve into the injector body and push it firmly on to the nozzle's seating.
4. Release the rod smartly for an instant, and check that the needle valve breaks cleanly from the nozzle seat without sticking or binding.

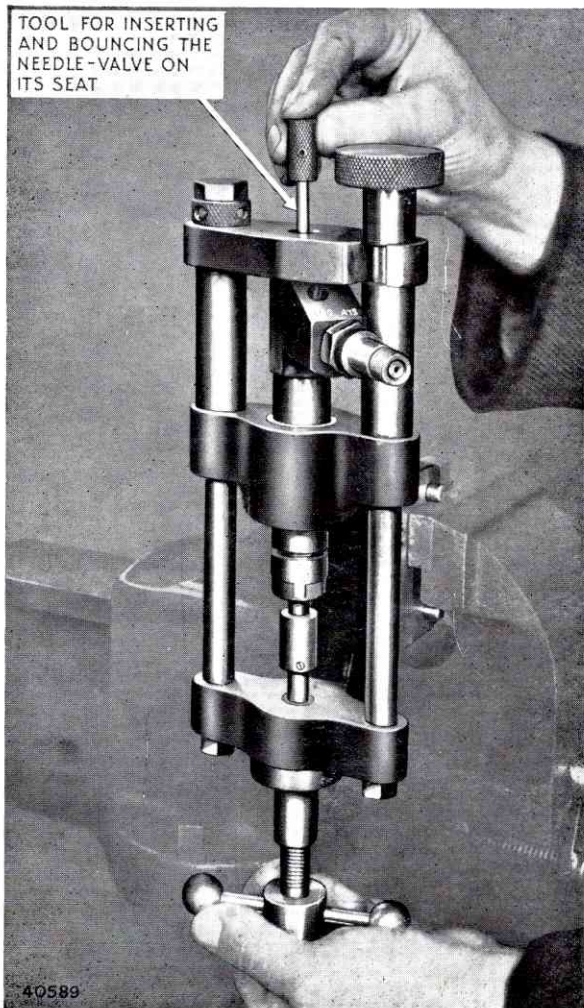


FIG. 52. CLAMPING THE NOZZLE AFTER CENTRALISING THE NEEDLE VALVE

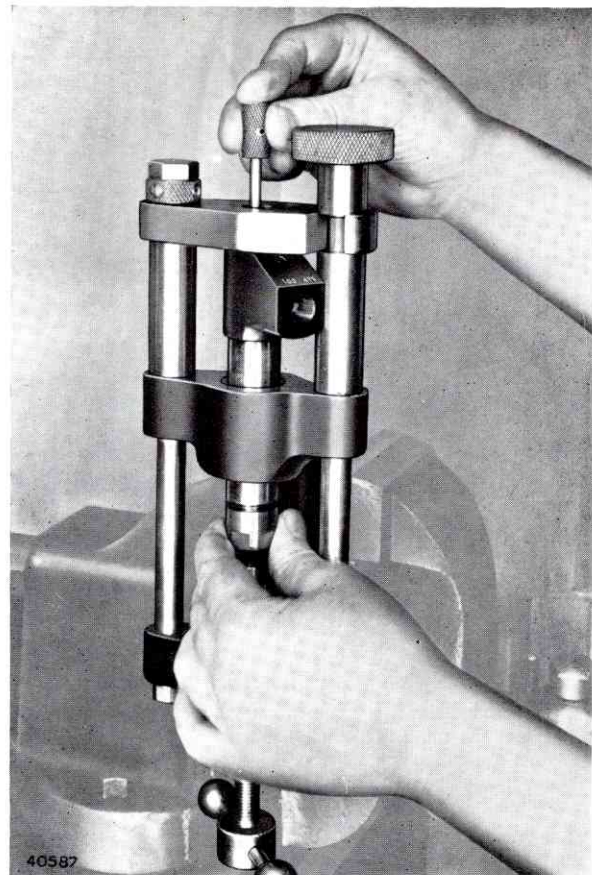


FIG. 53. BOUNCING THE NEEDLE VALVE ON ITS SEAT

Make this test with the needle valve in at least four different positions on the nozzle seat. If the needle valve sticks in any one position, then :

- (a) Check the needle valve slides freely in the injector body.
  - (b) Check that the end face of the injector body and the end face of the nozzle are clean and fit flush.
  - (c) After these checks, re-align the injector body and nozzle in the jig, and again carry out the " Inverted Test " until the condition described in paragraph 4 is obtained.
5. Now assemble the needle valve lift distance washer, valve spring and discharge pressure adjusting washer in the injector body and replace the injector end plug.

### To Check and Adjust Injectors

This can only be done successfully with a specially designed injector test pump (Fig. 55).

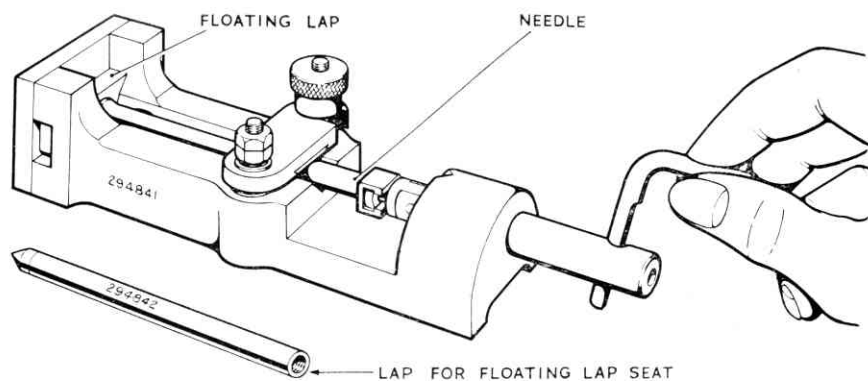


FIG. 54. INJECTOR NEEDLE LAPPING JIG

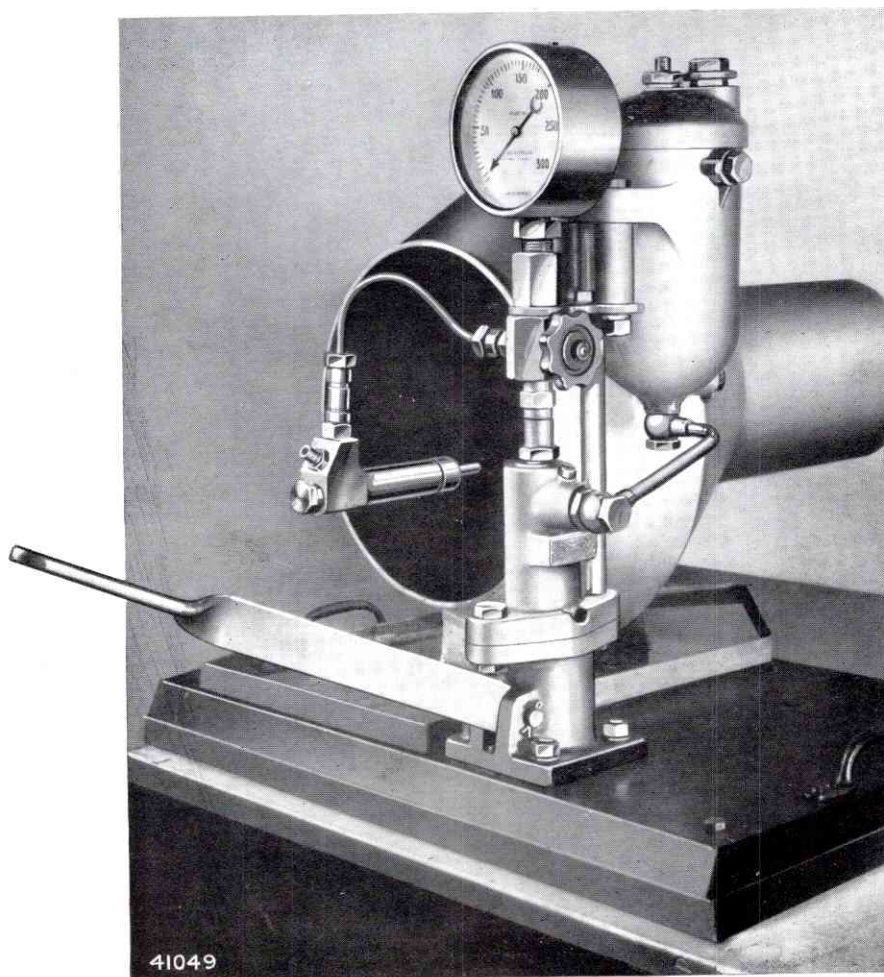


FIG. 55. INJECTOR UNIT TEST RIG



1. Connect the injector to the test pump ; expel all air from the pump by pumping the handle for about ten strokes.
2. Carefully note pressure at which spray breaks when the pump handle is operated. The correct pressure is between 140 and 145 atmospheres (2,057 to 2,130 lb./sq. in.) 144.6 to 149.7 kg./sq. cm.
3. The seat must remain dry with a sustained pressure of 125 atmospheres (1,837 lb./sq. in.), 129 kg./sq. cm.
4. If the discharge pressure is not correct, check that the needle is free in the body ; if this is in order adjust the spring pressure by inserting a discharge pressure adjusting washer of a different thickness (See **Data** under heading **Injectors**). Re-check the discharge pressure.

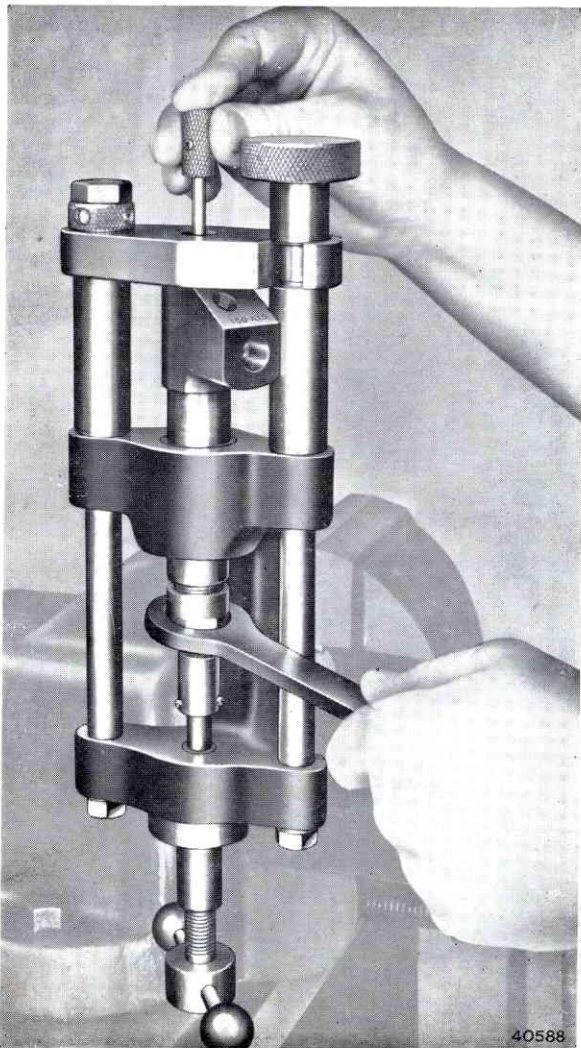


FIG. 56. TIGHTENING THE NOZZLE CLAMP NUT



FIG. 57. THE INVERTED TEST

5. Check that the needle lift is between .016 in. and .018 in. To do this remove the injector end plug and valve spring. Insert a .025 in. thick shim on top of the needle valve lift distance washer and replace the end plug. Screw down the plug by hand and measure the gap between the end plug and injector body, using a set of feeler gauges (Fig. 59).

If this gap is between .007 in. and .009 in., the needle lift is correct. If the gap is not correct, fit a different thickness of distance washer and re-check (see **Data** under heading **Injectors**), when a needle valve lift distance washer of the correct thickness has been obtained, remove the .025 in. thick shim and assemble the injector for test.

6. Check the time for the pressure to fall from 90 to 40 atmospheres (1,323 to 588 lb./sq. in., 93 to 41.4 kg./sq. cm.). The limits for rejection are as follows (at room temperature 40°F. to 70°F.) :

Using fuel oil ... .. 4½ to 14 secs.

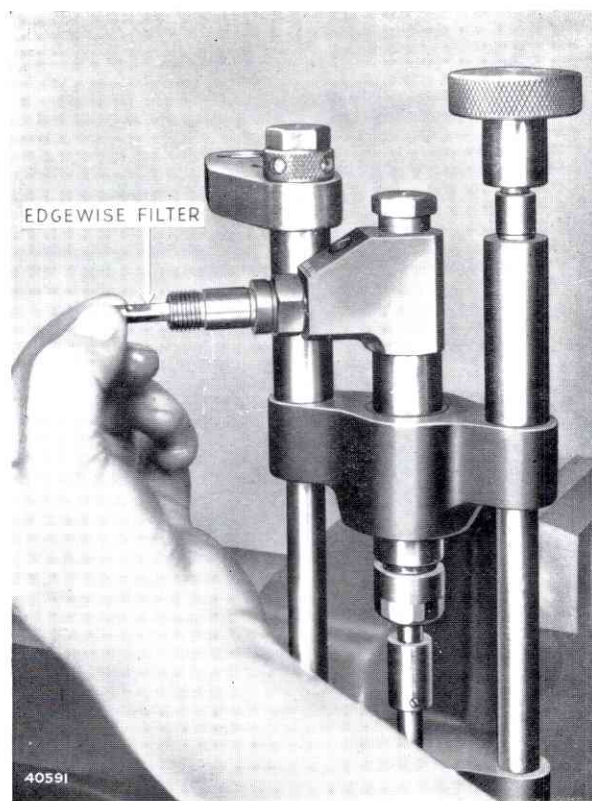


FIG 58 FITTING THE EDGEWISE FUEL FILTER

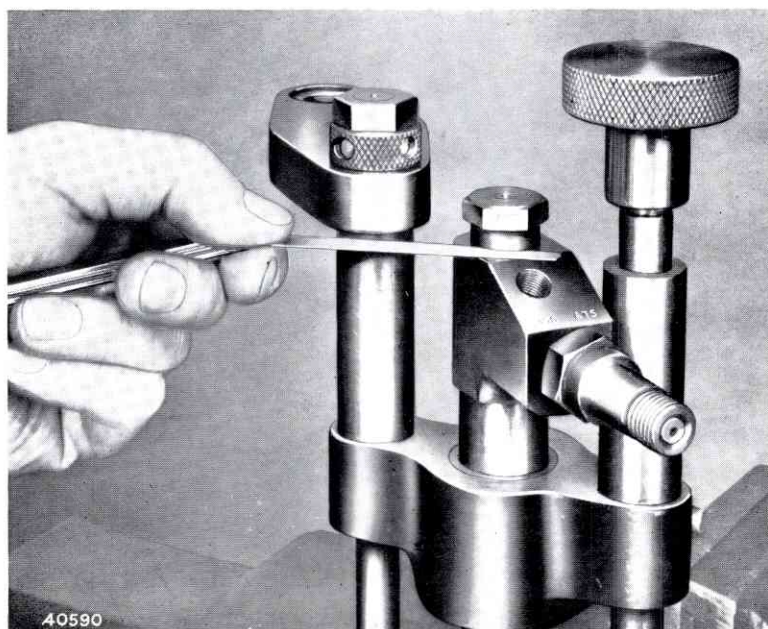
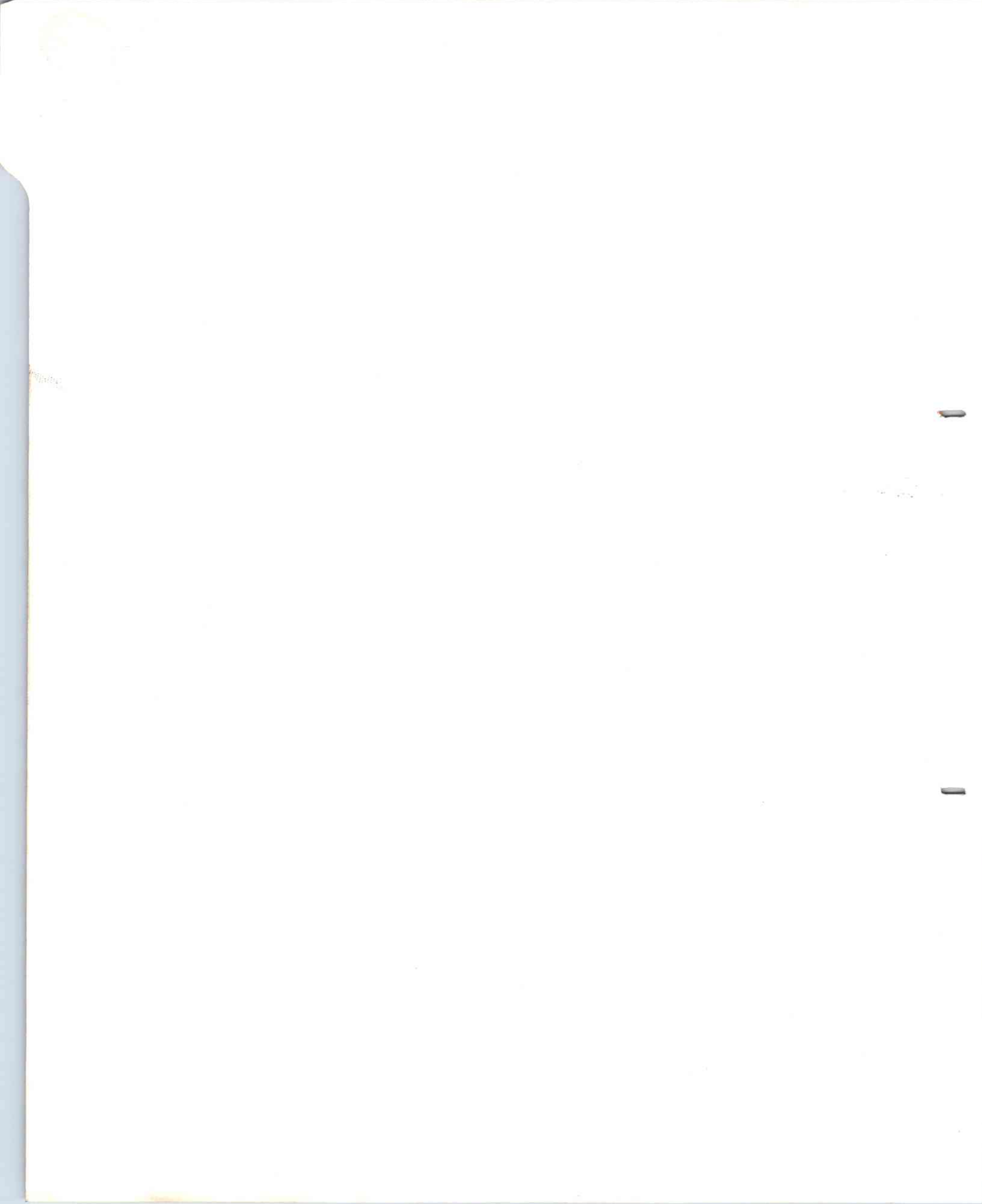


FIG. 59. CHECKING THE NEEDLE VALVE LIFT





## THE FUEL INJECTION PUMP AND GOVERNOR

### C.A.V. TYPE

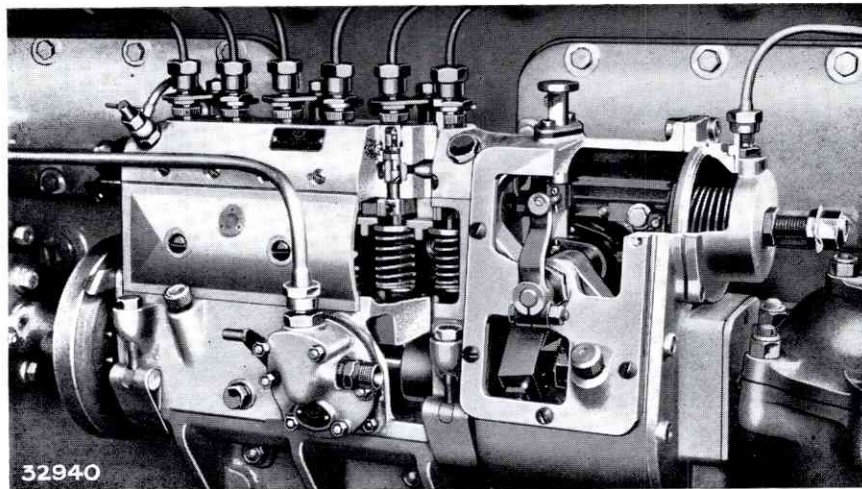


FIG. 60. THE C.A.V. INJECTION PUMP AND GOVERNOR

#### DESCRIPTION

The fuel injection pump is of the constant-stroke cam-actuated, lapped-plunger type. The pump consists of a body with camshaft compartment at the bottom whilst in the middle and upper portions of the pump housing are located the plunger and barrel assemblies, metering control sleeves with regulating toothed quadrants, plunger springs and control rod. The upper portion of the housing also contains the fuel chamber, delivery valve assemblies and delivery valve holders for connection to the injection feed pipes.

#### OVERHAUL

##### To Remove the Injection Pump

Immediately the pipes are disconnected from the delivery valve holders the ends of the pipes and unions on the pump must be covered with clean rag or caps. **No dirt must be allowed to fall into the injection pump.**

1. Uncouple the pipe from the governor to the venturi.
2. Disconnect the stop control.



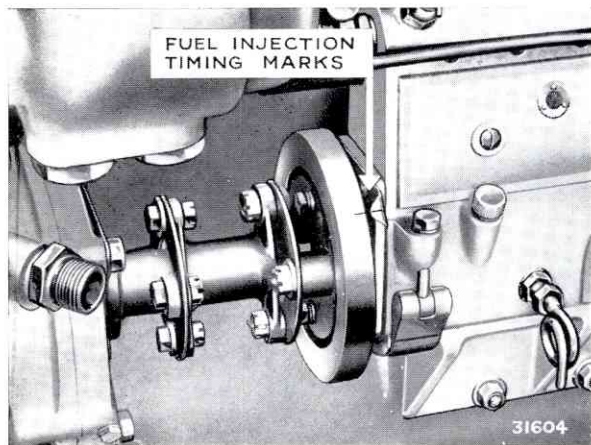


FIG. 61. INJECTION PUMP TIMING MARKS

3. Uncouple the pipe from main filter to pump and the suction and delivery pipes to the fuel feed pump.
4. Disconnect the delivery pipes to the injectors.
5. Set the engine to No. 1 pump injecting and remove the setscrews connecting the flexible coupling to the pump flywheel. The flywheel must not be removed from the injection pump camshaft.
6. Disconnect the fixing straps and remove the pump.

### To Replace the Injection Pump

1. Set the engine to the **INJ.** mark of the timing plunger, so that No. 1 cylinder is on **compression stroke**.
2. Turn the pump camshaft until the mark on the flywheel is in line with the pointer on the pump body (Fig. 80), insert setscrews connecting flexible coupling to flywheel and tighten securely.
3. In the event of a replacement pump having to be fitted, set the engine to the **INJ.** mark as in paragraph 1.
4. Couple up the main feed pipes, but only the delivery pipe to No. 1 injector.
5. Prime the pump by opening vent cock and also prime through to No. 1 injector.
6. Now turn the pump flywheel clockwise, until resistance becomes solid. At this point No. 1 injector starts injecting fuel.

7. Insert setscrews and connect flexible coupling to pump flywheel
8. Mark flywheel opposite timing pointer on pump body to facilitate replacement of pump should subsequent removal become necessary (Fig. 61).

### To Dismantle Injection Pump

In the event of the injection pump being faulty in service, it should normally be removed complete and replaced by a spare pump, the faulty unit being dispatched to the nearest Leyland Service Depot. As a replacement pump may not always be available, details whereby repairs can be carried out are given in the following paragraphs.

**Warning :** Strict cleanliness must be observed when preparing to dismantle fuel injection pumps, care being taken that all filings, dust, dirt and grit, etc., have been removed from the bench on which work is to be done. The bench should then be covered with clean grease-proof paper and a number of clean containers provided for the various parts removed. It is also an advantage to have a supply of clean, fresh fuel oil for washing these parts.

The various parts of one pumping element should never be interchanged with another, particularly the barrel, pump plunger, delivery valve and seating. To keep the six elements isolated they should be placed in separate containers.

The surfaces of these parts must never at any time be touched with a file, scraper, or other hard tool or any abrasive compound.

Procedure is as follows, the components being removed in the sequence given :—

1. Remove the fuel feed pump by unscrewing the fixing screws.
2. Remove the inspection cover-plate and dipstick.
3. Remove the governor (see **To Remove Governor**).
4. Rotate the camshaft to bring each tappet assembly to its top dead centre position and insert the tappet holder under the head of the tappet adjusting screw (Fig. 81).
5. Unscrew the base closing plugs (Fig. 64).



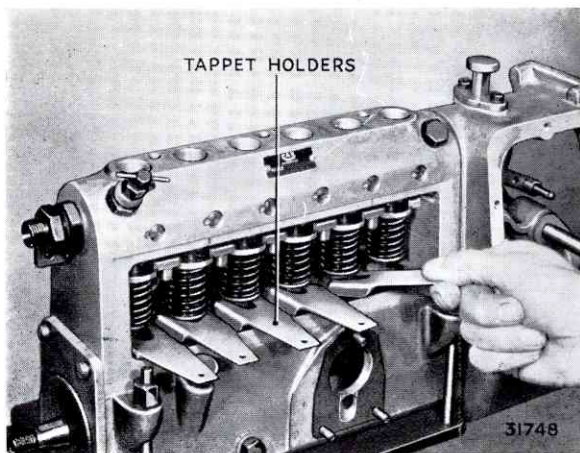


FIG. 62. FITTING TAPPET-LIFTING PLATE

6. Remove the injection pump flywheel using the withdrawal and holding tool (Fig. 63). The removal of the flywheel from the tapered end of the camshaft must never be done by the use of a hammer or drift.
7. Remove the bearing end plate and withdraw the camshaft (Fig. 76). The camshaft has a chisel mark at the driving end to ensure that it is replaced correctly.
8. Push up the tappet assembly until it is possible to withdraw the tappet holder, after which the tappet assembly, lower spring plate, plunger spring, upper spring plate and plunger can be withdrawn through the base (Fig. 69).

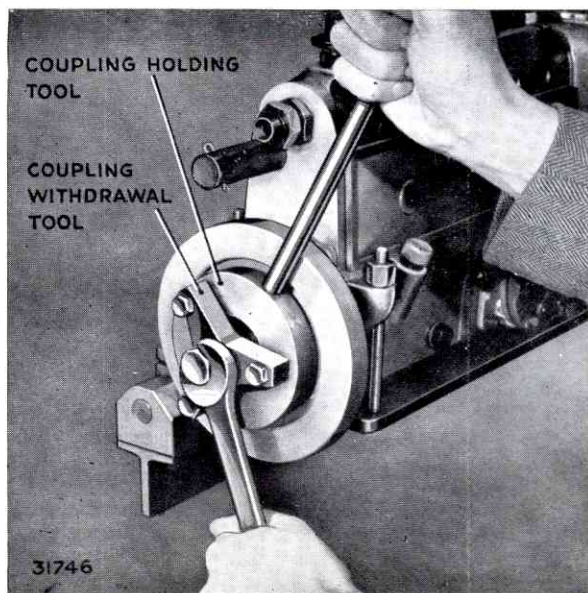


FIG. 63. REMOVING INJECTION-PUMP FLYWHEEL

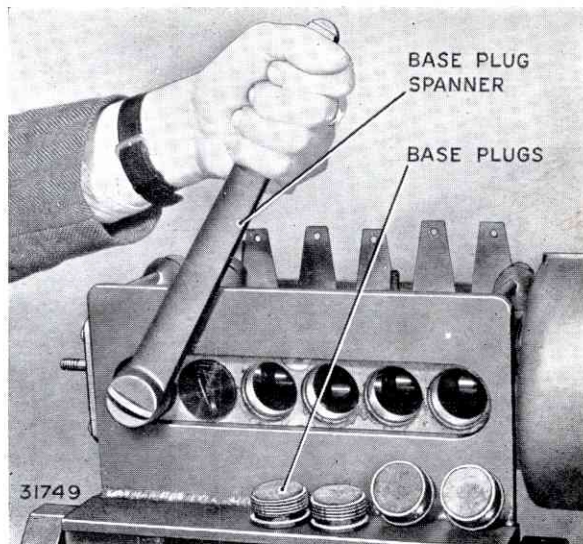


FIG. 64. REMOVING BASE-CLOSING PLUGS

9. Unscrew delivery valve holder, withdraw spring, spring peg, and delivery valve. The valve seating and its joint can now be removed by the extractor tool (Fig. 65).
10. To remove the pump barrel, unscrew the locking screw situated above the inspection cover-plate and push the barrel from below with a fibre or soft brass drift (Fig. 74).

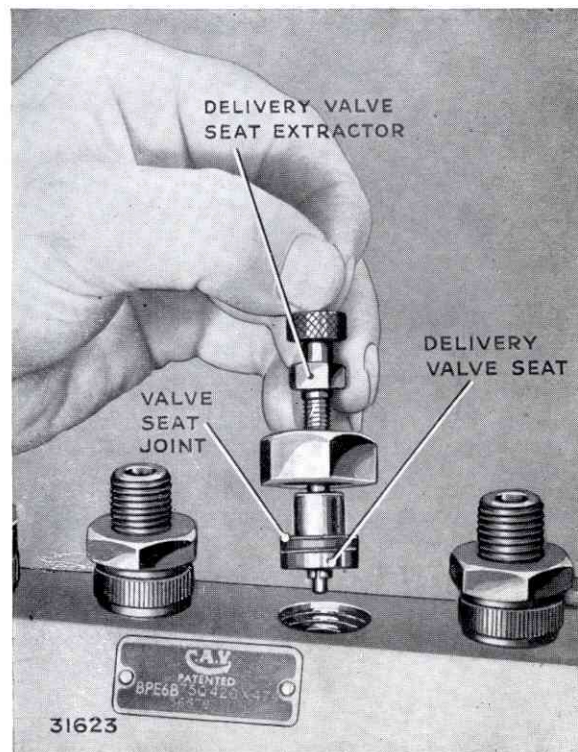
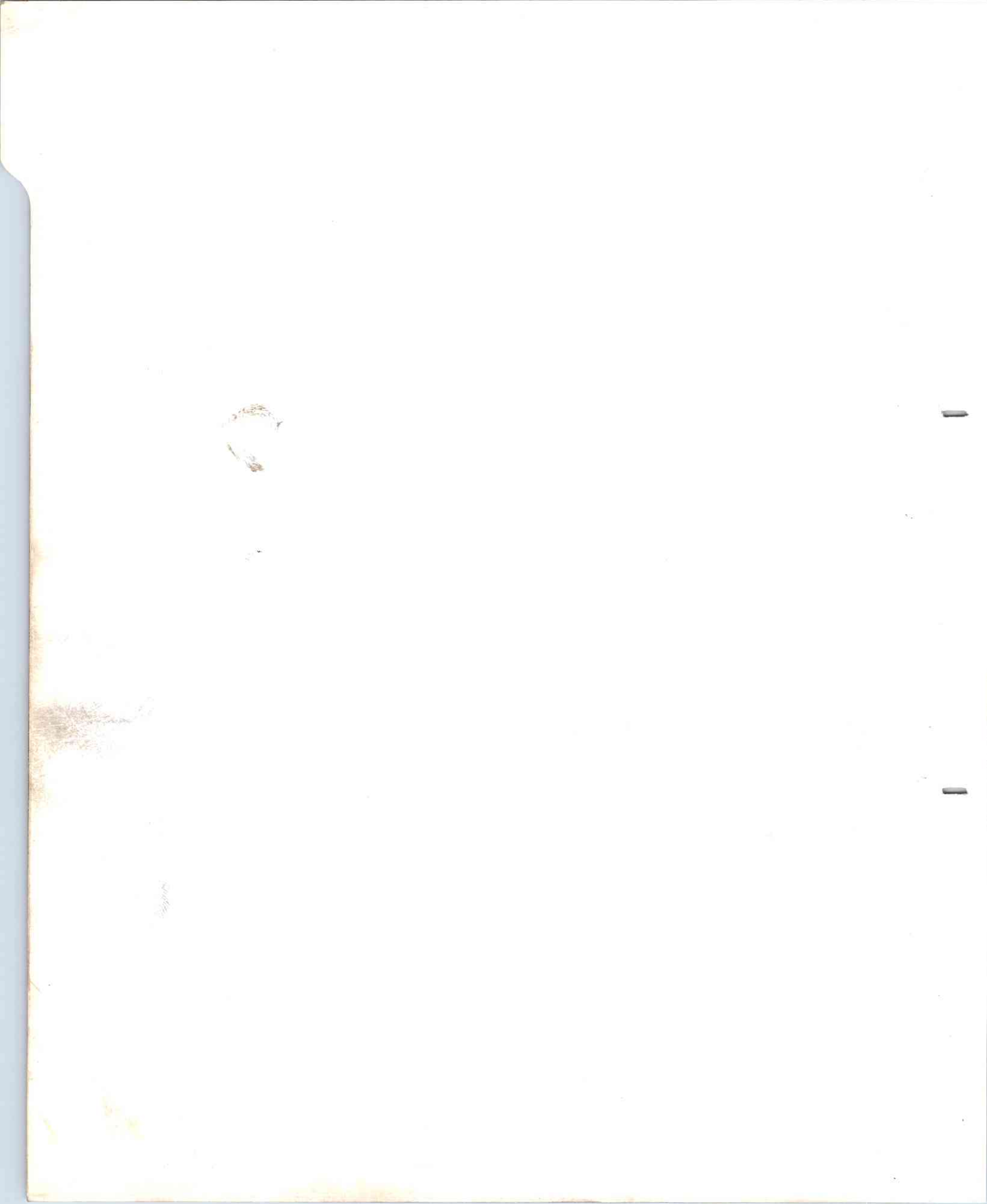


FIG. 65. REMOVING DELIVERY VALVE SEATING





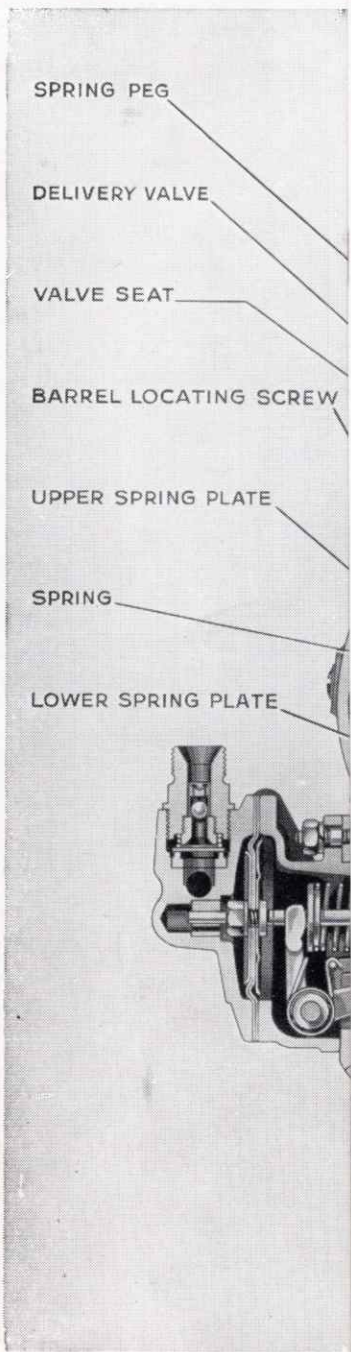


FIG. 66. THE C.A.V. FUEL INJECTION PUMP WITH FUEL FEED PUMP



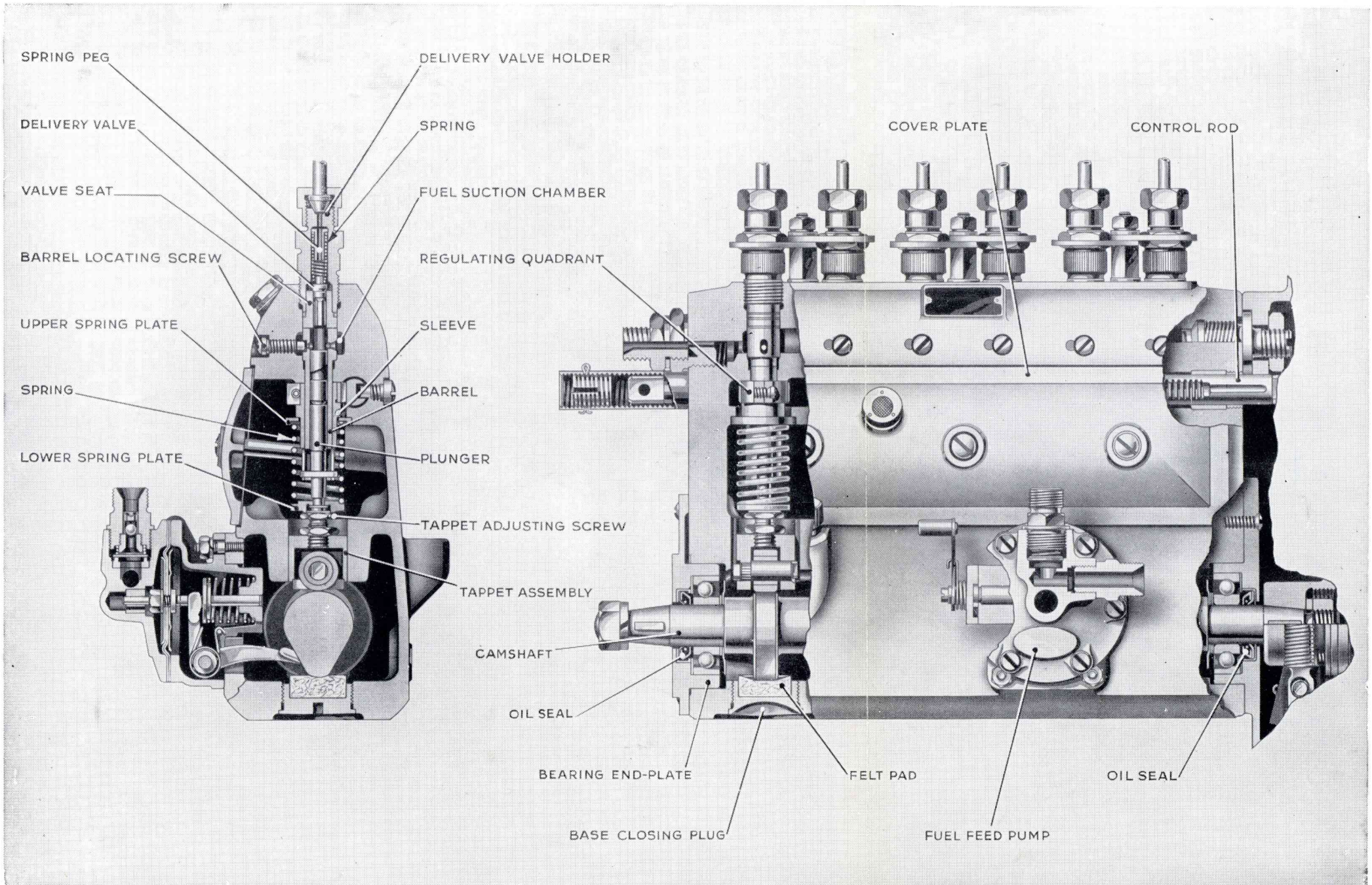


FIG. 66. THE C.A.V. FUEL INJECTION PUMP WITH FUEL FEED PUMP



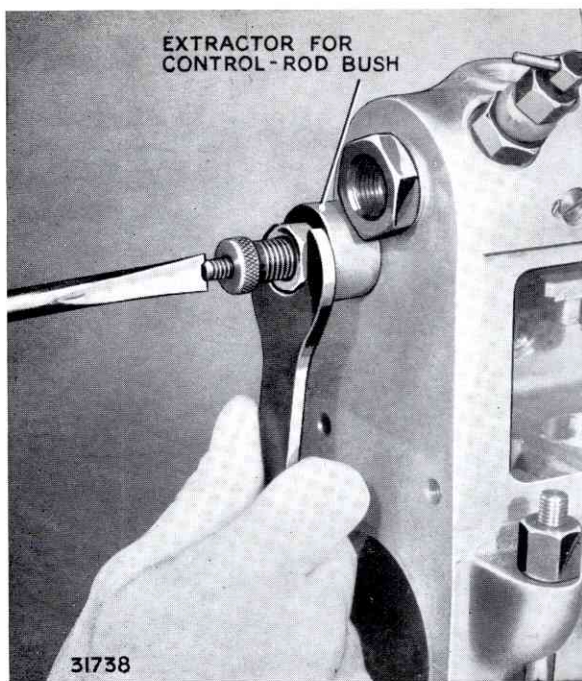


FIG. 67. REMOVING CONTROL ROD BUSHES

**To Renew the Control Rod Bushes**

1. If the control rod bushes are worn and need renewing, a special extractor tool, C.A.V. No. ET.431 is required for removing the bushes (Fig. 67).
2. To remove the locking ring holding the rear control rod bush in position in the pump housing, use C.A.V. Tool No. ET.031 (Fig. 68).
3. New bushes will have to be line reamed after fitting with C.A.V. Tool No. ET.109 ET.110 (Fig. 70).
4. To remove the camshaft bearing outer race from the end cover and governor housing, use extractor tool C.A.V. No. ET.026B (Fig. 71).

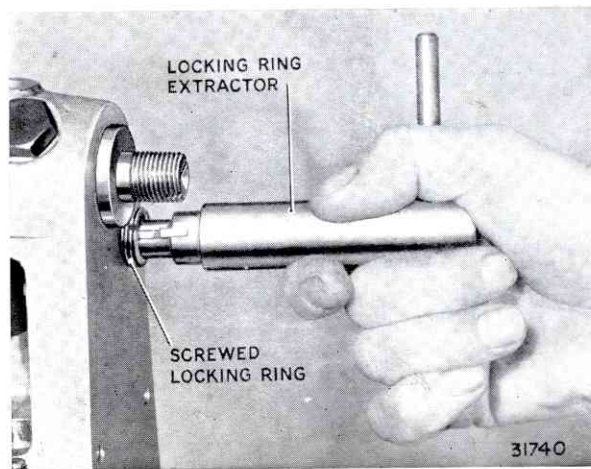


FIG. 68. REMOVING LOCKING RING

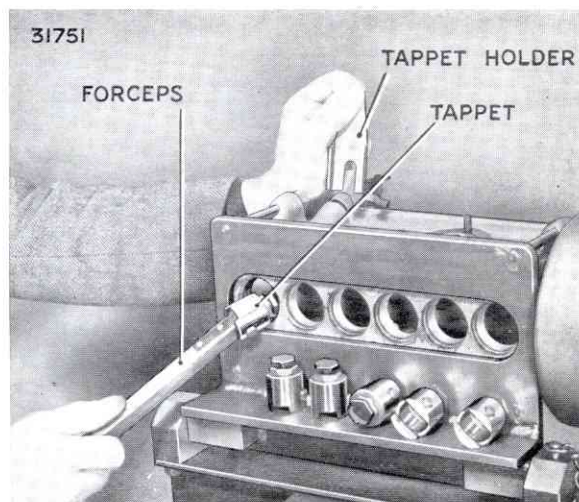


FIG. 69. REMOVING TAPPET ASSEMBLY

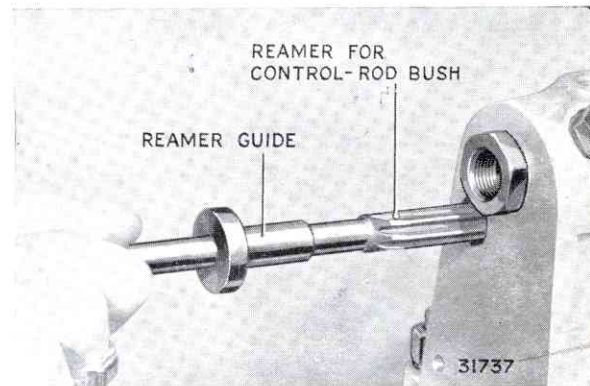


FIG. 70. REAMING CONTROL ROD BUSHES

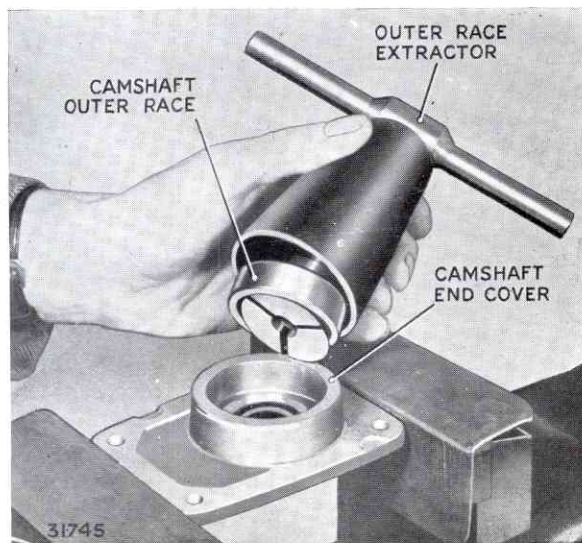
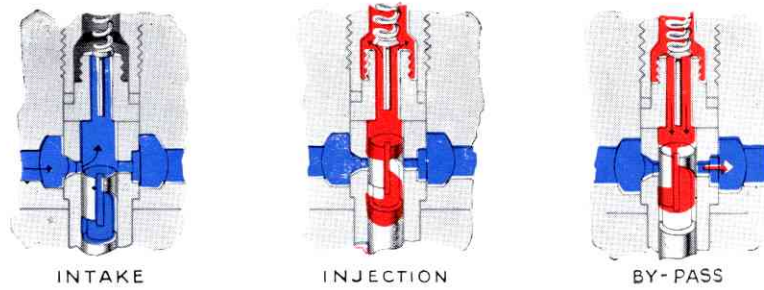
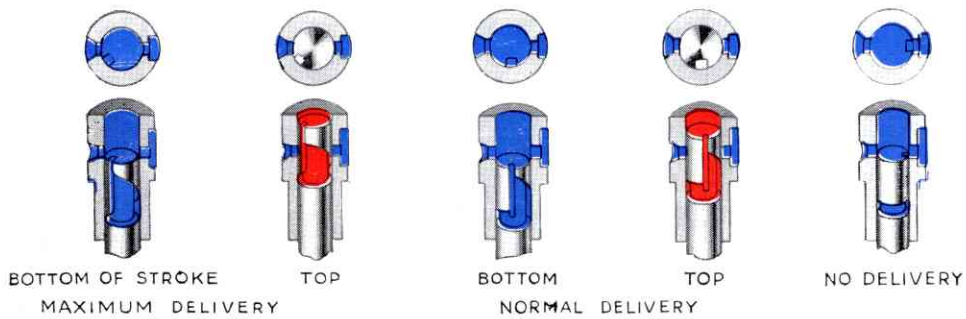


FIG. 71. REMOVING CAMSHAFT BEARING OUTER RACE



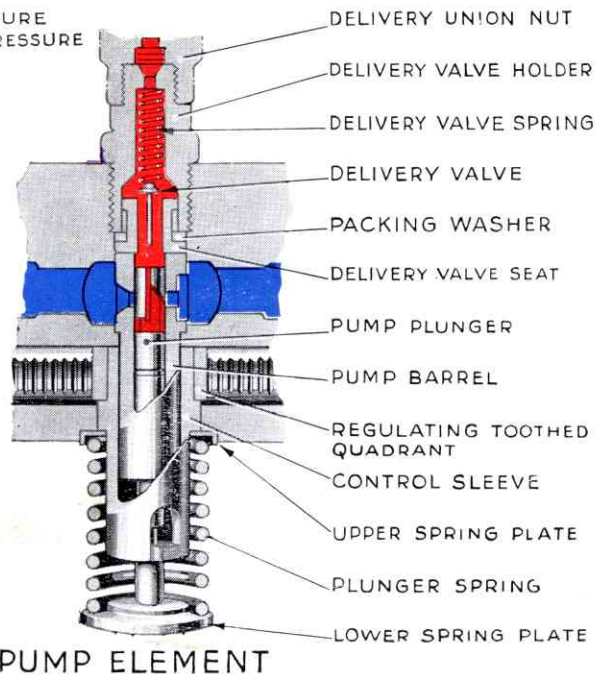


PRINCIPLE OF OPERATION



PRINCIPLE OF FUEL METERING

■ FUEL OIL SUPPLY PRESSURE  
■ FUEL OIL UNDER HIGH PRESSURE



PUMP ELEMENT

FIG. 72. THE PRINCIPLE OF FUEL INJECTION

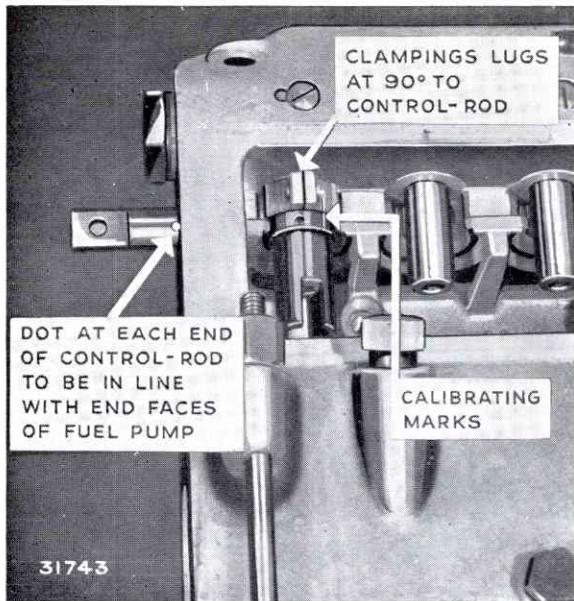


FIG. 73. SETTING CONTROL ROD

### To Reassemble Injection Pump

Care must be taken that all joints and other parts are entirely clean. The cleaning operation should be :

- i. Rinse in clean fuel oil.
- ii. Bring together without the use of cotton waste, rags, or wipers of any kind.

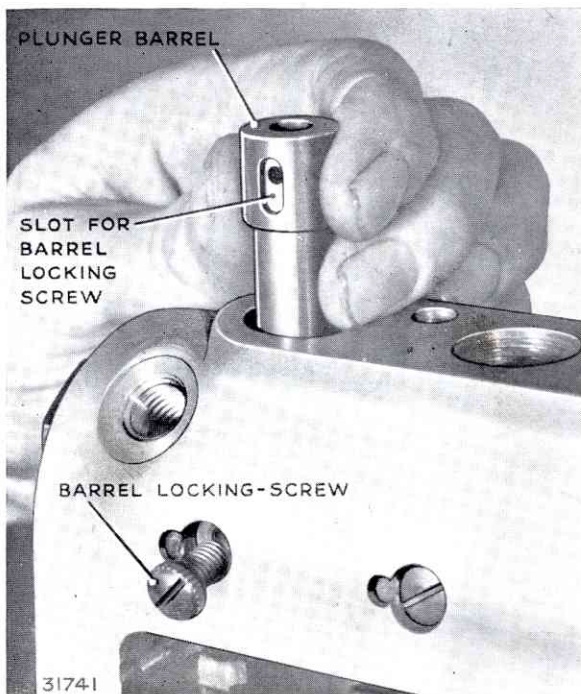


FIG. 74. REMOVING OR REPLACING PLUNGER BARREL

1. Fit the plunger barrel carefully, observing that the slot in it is opposite the hole for the locking screw (Fig. 74). Carefully screw in the locking screw, with new joint, until it locates with the slotted recess in the barrel, when it can be tightened. If correctly engaged, it will prevent the barrel from rotating whilst permitting a limited vertical movement.
2. Fit the delivery valve seatings with new joints and insert the valves.
3. Replace the delivery valve springs and pegs. Screw on valve holders and fit locking plates.
4. Assemble control rod in the pump casing and set it in the middle position. The dot at each end of the control rod should be set so that it is in line with the outer face of the pump body (Fig. 73).

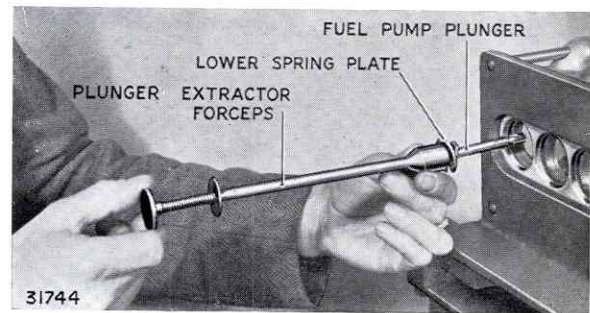


FIG. 75. REMOVING OR REPLACING PLUNGER

5. Assemble regulating quadrants and sleeves, together with the upper spring plates on the plunger barrels. Calibration marks on quadrants and sleeves must coincide.
6. With the control rod in the central position, quadrants should be meshed so that their clamping lugs are at 90° to the control rod and in line with the barrel locking screws (Fig. 73).
7. Slide the plunger springs into location with top spring plates.
8. Fit lower spring plates on to the plungers and insert the plungers into the barrels through the base plug holes, using C.A.V. Tool No. ET.569 (Fig. 75).
9. It is essential that the chisel marks on the plunger lugs coincide with the chisel marks at the base of the regulating sleeve guide slots.



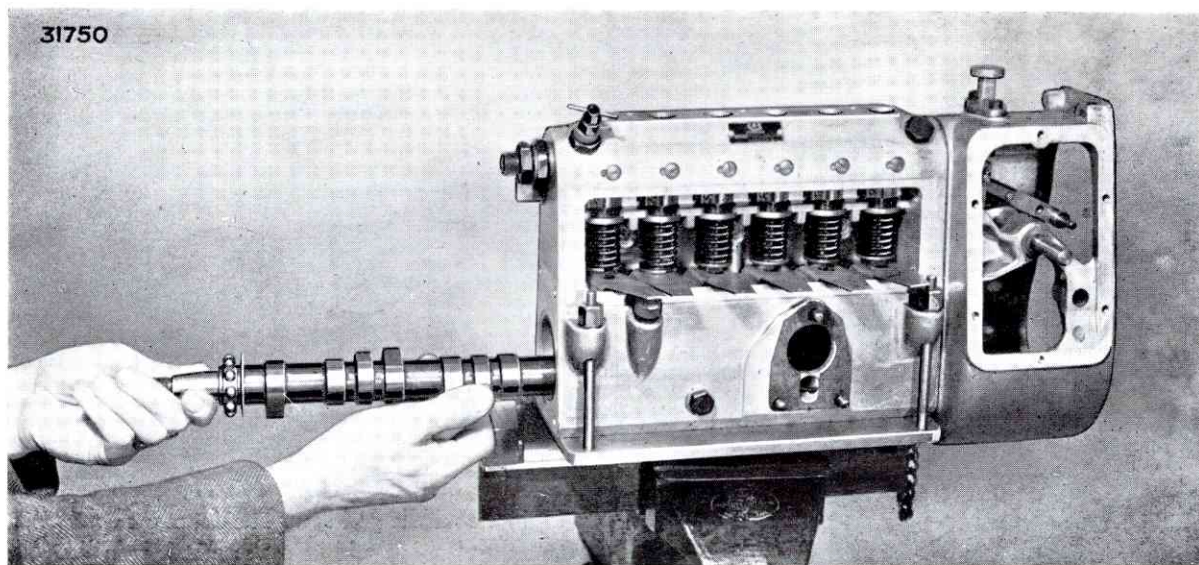


FIG. 76. REMOVING FUEL-PUMP CAMSHAFT

10. Insert tappet assemblies and press against each spring until the tappet holders can be inserted under the heads of the tappet adjusting screws.
11. Fit the camshaft and its bearings in the pump housing, taking care that the mark on the shaft is fitted to the correct end of the pump body. Check the end-play, and if the movement measured does not lie between .1 mm. to .2 mm., remove one bearing end-plate and insert shims as required between oil thrower and bearing.
12. Refit the base closing plugs and securely tighten. Rotate camshaft and remove tappet holders in correct sequence, but only when their corresponding cams reach top dead centre.

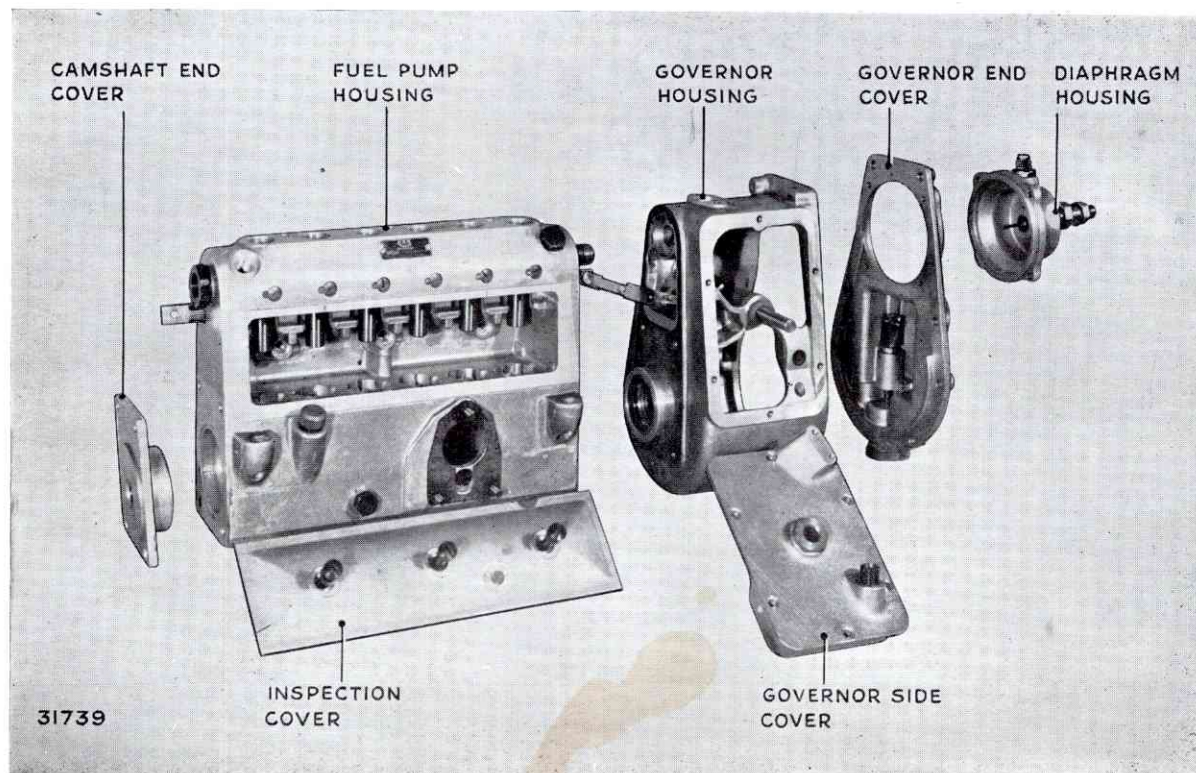


FIG. 77. INJECTION PUMP, GOVERNOR HOUSING AND COVERS



13. Examine each tappet screw locknut and tighten if necessary. If a tappet adjusting nut is found loose, or is renewed, it is advisable to retime the complete unit, but as a temporary measure it can be adjusted and locked so that the distance between the screw head and locknut is uniform with the remaining tappet assemblies.
14. Care must be taken that plungers do not hit delivery valve seatings at peak of cam lift. If a tappet has been readjusted test clearance between plunger top at cam T.D.C. and base of delivery valve seating by inserting a screwdriver gently below head of tappet adjusting screw and lifting plunger. The resultant movement should give a play of .3 mm. to .5 mm. On no account must a screwdriver be used in this position for any other purpose.
15. Replace the governor (see **To Replace Governor Assembly**).
16. Refit fuel feed pump.

#### To Re-calibrate the Pump (Governor attached).

Calibration should be carried out on a power-driven test rig, using gravity feed and master, pintle-type, test injectors.

Readings to be taken at maximum fuel setting of 88 cu. mm. to 92 cu. mm. per stroke per plunger at 600 r.p.m., that is, 17.6 to 18.4 c.c.'s per plunger per 200 strokes.

Maximum variation of delivery of all elements :

|     |                         |  |
|-----|-------------------------|--|
| .7  | c.c. per 200 strokes at | 300 r.p.m.   |
| .7  | " " " "                 | 600 r.p.m.   |
| .7  | " " " "                 | 900 r.p.m.   |
| 1.0 | " " " "                 | idling speed of 200 r.p.m.   |
|     |                         | with fuel setting of 16 cu. mm. to 20 cu. mm. per stroke, that is, 3 c.c.'s to 4 c.c.'s per plunger per 200 strokes. |

Make sure that the locknut on the full load stopscrew has been fully tightened and the clearance between the screw on the lower part of the lever and the governor thrust arm is .035 in. to .045 in.

#### THE GOVERNOR—C.A.V. TYPE BEP/LB (Page 80).

The Leyland-C.A.V. combined vacuum and mechanical governor is housed in a casing at the rear end of the injection pump. The governor consists of a vacuum-

operated spring-loaded leather diaphragm which controls the idling and intermediate speeds of the engine. A flyweight governor controls the maximum speed of the engine.

The diaphragm separates the main governor-housing from the vacuum chamber and is in communication by pipe connection with a venturi throttle valve unit which is fitted over the air intake (Fig. 79).

An idling damper (Fig. 80) fitted in the rear end of the diaphragm housing holds the engine revs. steady at idling speed.

The governor housing also carries an excess fuel device which is used for cold starting, and the engine stop-control mechanism (Fig. 80).

#### Operation of Vacuum Governor

When the engine is stationary the diaphragm and control rod are held in the full-load position by the diaphragm return spring (52) (Fig. 80).

The vacuum in the suction chamber is determined by the extent to which the throttle valve is opened and the speed of the engine.

When the engine is idling, the butterfly valve in the venturi, operated by the accelerator pedal, is almost closed, and a high vacuum is created in the diaphragm block. The diaphragm, drawn by the suction, moves the control rod towards the stop position, but in doing so the control rod end comes into contact with the spring-

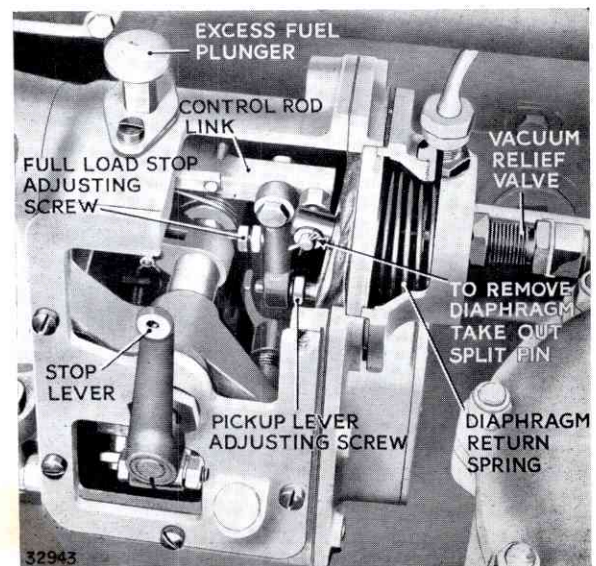


FIG. 78. GOVERNOR MECHANISM



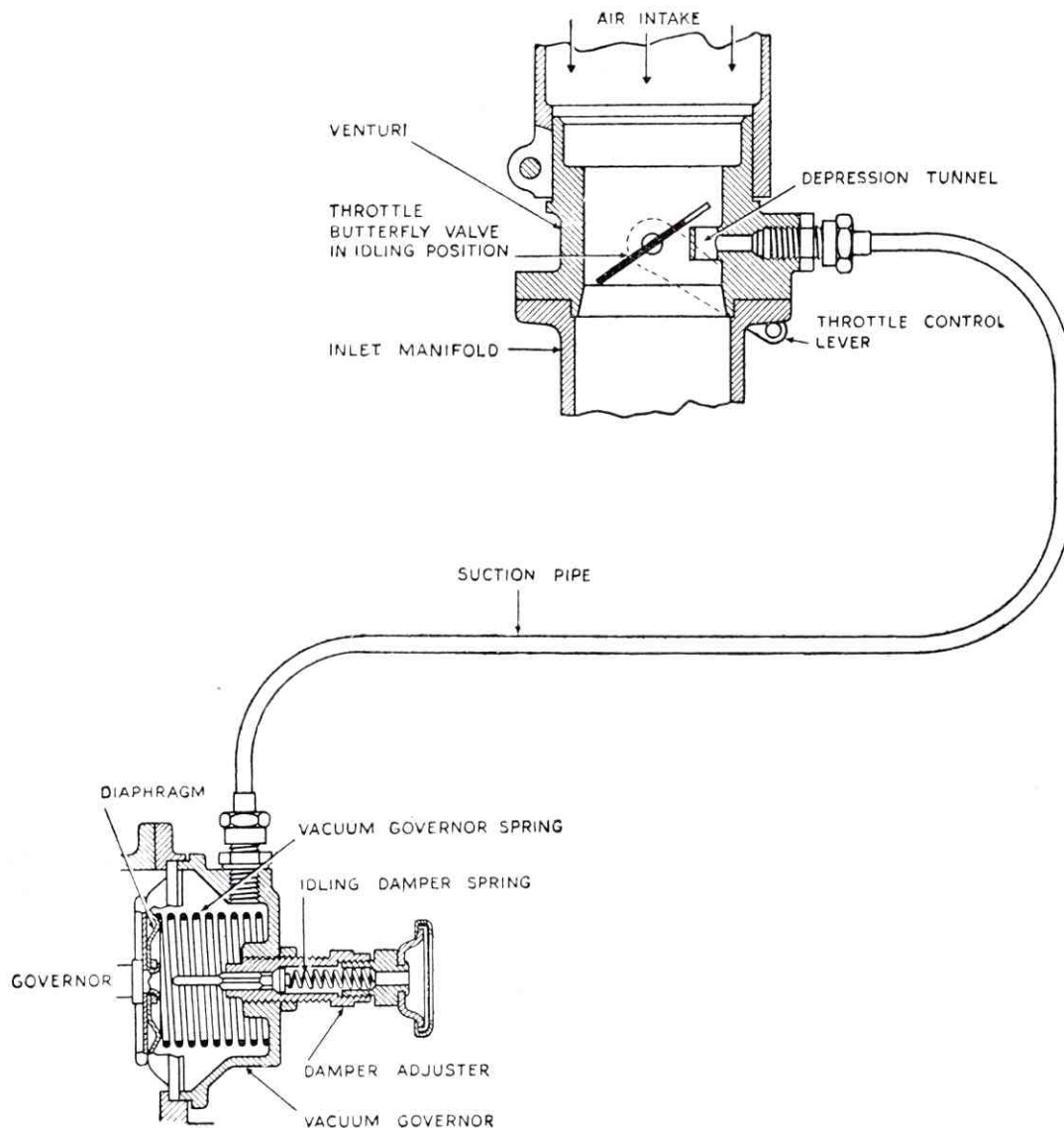


FIG. 79. DIAGRAM OF VACUUM GOVERNOR AND VENTURI CONNECTIONS

loaded damper valve, lifting the valve off its seat and allowing air at atmospheric pressure to be drawn through the damper valve body into the diaphragm housing. This tends to destroy the vacuum in the chamber and allows the control rod to move towards the full-load position under pressure of the diaphragm spring, causing the engine revs. to increase. As soon as the control rod moves forward, however, the damper valve closes, thus restoring the vacuum and the engine revs. decrease. This limits the movement of the control rod to a very small range, thus reducing any tendency of the engine to "hunt." Correct adjustment of the butterfly idling stop and the idling damper creates a balance giving steady idling.

When the accelerator pedal is depressed the butterfly valve is opened, the engine speed increases beyond idling speed and the vacuum in the diaphragm housing falls, thereby allowing the diaphragm under the pressure of its return spring to move the control rod towards the full-load position. As the engine speed and thus the air velocity in the venturi increases, so does the vacuum rise, controlling the movement of the diaphragm and control rod in the intermediate speed range.

**Operation of Mechanical Governor**

At maximum speed the mechanical flyweight governor comes into play and as the weights (68) (Fig. 80) move

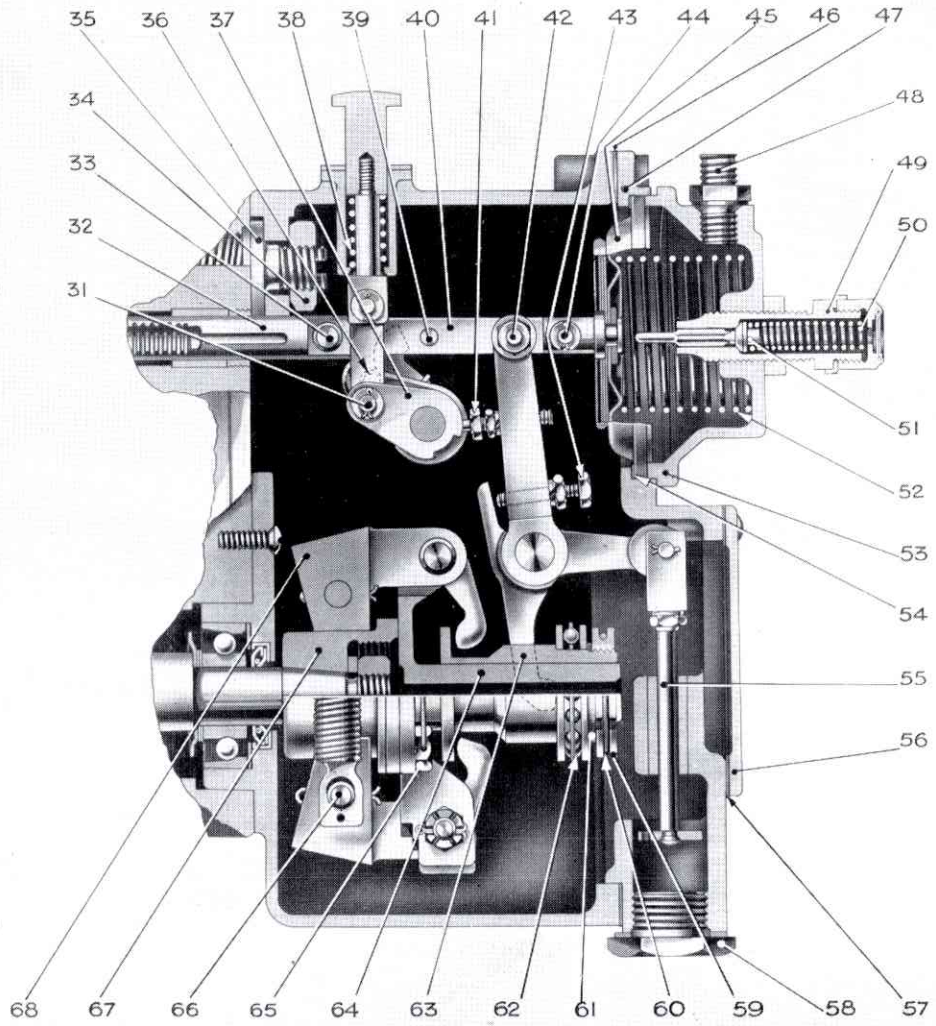
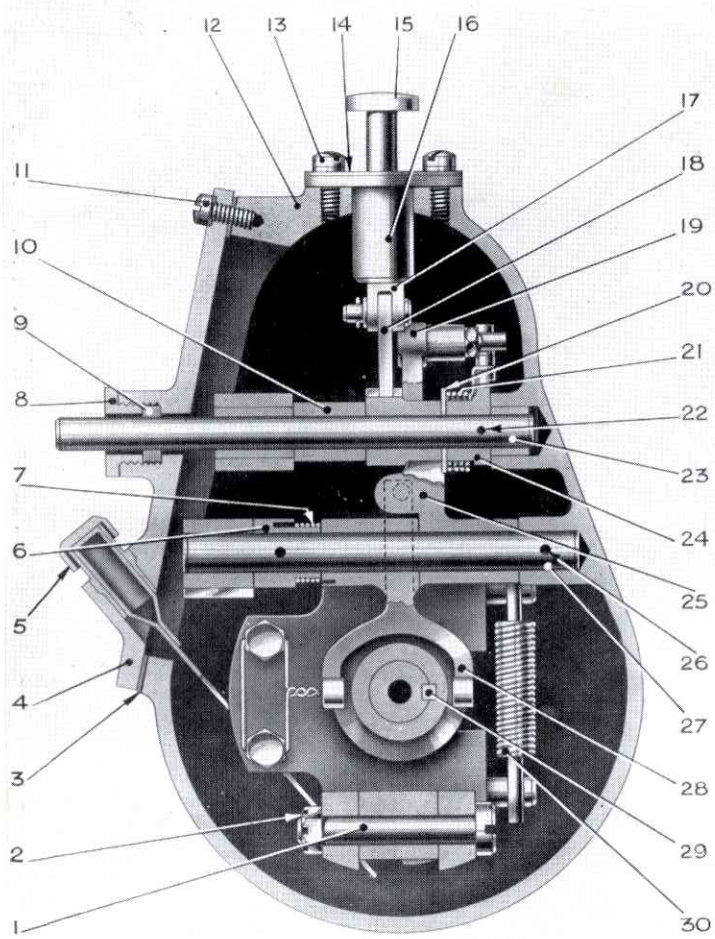


FIG. 80. SECTIONS THROUGH GOVERNOR—C.A.V. TYPE BEP/LB

- |                            |                                 |                                 |                             |                      |
|----------------------------|---------------------------------|---------------------------------|-----------------------------|----------------------|
| 1. Weight Carrier Bolt.    | 15. Excess Fuel Plunger Knob.   | 29. Weight Carrier Key.         | 42. Screwed Pin             | 55. Oil Damper.      |
| 2. Slotted Nut.            | 16. Excess Fuel Plunger Barrel. | 30. Weight Spring Assembly.     | 43. Pick-up Lever Adjusting | 56. End Plate.       |
| 3. Joint.                  | 17. Excess Fuel Plunger Link    | 31. Pivot Pin.                  | 44. Screwed Pivot Pin.      | 57. Joint.           |
| 4. Inspection Cover.       | 18. Excess Fuel Plunger Shaft.  | 32. Control Rod.                | 45. Diaphragm.              | 58. Base Plug.       |
| 5. Dipstick.               | 19. Operating Lever.            | 33. Pivot Pin.                  | 46. Joint.                  | 59. Sleeve Nut.      |
| 6. Torsion Spring Carrier. | 20. Retaining Washer.           | 34. Housing Nut.                | 47. Governor End Housing    | 60. Locking Circlip. |
| 7. Torsion Spring          | 21. Torsion Spring.             | 35. Housing Stud.               | 48. Adaptor.                | 61. Seeger Circlip.  |
| 8. Gland Plug.             | 22. Taper Pin.                  | 36. Stop Peg.                   | 49. Damper Valve Body.      | 62. Thrust Race.     |
| 9. Felt Washer.            | 23. Long Shaft.                 | 37. Control Rod Stop.           | 50. Damper Valve Spring.    | 63. Sleeve.          |
| 10. Distance Piece.        | 24. Stop Lever.                 | 38. Excess Fuel Plunger Spring. | 51. Damper Valve.           | 64. Weight Carrier.  |
| 11. Screw.                 | 25. Operating Lever.            | 39. Threaded Peg.               | 52. Main Spring.            | 65. Bolt.            |
| 12. Governor Casing.       | 26. Split Pin.                  | 40. Link.                       | 53. Diaphragm Housing.      | 66. Pin.             |
| 13. Screw.                 | 27. Short Shaft                 | 41. Full Load Stop Adjusting    | 54. Screw                   | 67. Driving Centre.  |
| 14. Guide Plate.           | 28. Pick-up Lever.              | 42. Screwed Pin                 |                             | 68. Flyweight.       |

450



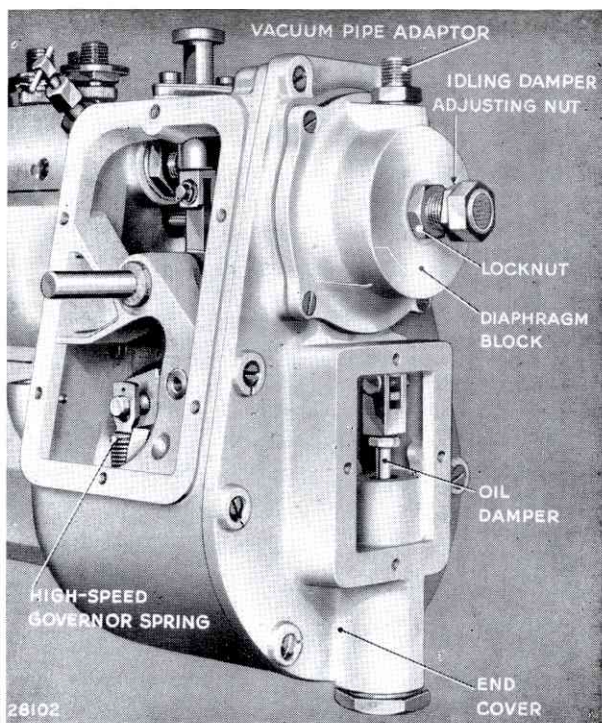


FIG. 81. THE GOVERNOR HOUSING

outward against the pull of their retaining springs (30), the arms of the weights make contact with the flange of sleeve (63), causing the sleeve to slide inwards on the weight carrier (64). This brings the thrust race (62) on the end of the sleeve (63) to bear against the forked lever (28), causing the tail of the forked lever to make contact with adjusting screw (43) on lever (25).

The lever being connected to link (40) and the fact that the tail of forked lever (28) is bearing against adjusting screw (43) prevents the control rod from reaching its full load position, thereby governing the speed of the engine to a maximum of 2,000 r.p.m.

### Stop Control

The engine can be stopped by operating the stop control mounted on the engine side cover at the rear left hand side of the driver.

The cable control is connected to the stop lever (Fig. 78), and when operated moves the control rod to the fuel cut-off position, thereby stopping the engine.

### Excess Fuel Control

Excess fuel for cold starting is provided for by a device shown in Fig. 80. Depressing the knob and spring (38) enables the full load adjusting screw (41) carried on the operating lever to engage in the slot cut in the

control rod stop (37), thus permitting the pump control rod to move further open. Once the engine has started, the pump control rod is moved back by the diaphragm, allowing the plunger to return to its normal position.

### MAINTENANCE

#### To Test Condition of Idling Diaphragm

1. Move the control rod to the stop position by operating the stop lever.
2. Plug the vacuum pipe adapter (Fig. 81), with finger and release the stop lever. The control rod should not return to the open position. If it should do so, the leakage may be due to the following causes :
  - i. Porous diaphragm.
  - ii. Leaking diaphragm joint.
  - iii. Leaking idler damper valve.

#### To Set Idling Controls

This is done with the engine running :

1. Screw out the idling damper (Fig. 81), so that it is clear of the diaphragm when the engine is idling.
2. Adjust the idling stop on the venturi so that the butterfly valve is set to give an idling speed of 300/350 r.p.m.
3. The idling damper must now be screwed in to eliminate "hunting." This adjustment is so extremely critical that a fraction of a turn of the adjusting nut from the pre-determined position will cause "hunting."



FIG. 82. REMOVING GOVERNOR LINKAGE



### To Set High-Speed Governor

This should cut in at 2,000 r.p.m. engine speed and the runaway speed should not exceed 2,160 r.p.m. engine speed.

When checking the governor on a test rig, an allowance of 75 r.p.m. (pump speed) should be made for the effect of the vacuum diaphragm not being in action ; therefore, the governor should be set to cut in at 975 pump r.p.m.

If each eye of the governor springs is given a quarter-turn, the cutting-in speed will be altered by approximately 25 pump r.p.m.

### OVERHAUL

#### To Remove Governor Assembly

1. Remove the diaphragm block ; press against the cover while removing the setscrews, as there is a strong spring underneath.
2. Remove the stop lever and dipstick, then remove the side cover and end cover. The oil damper will come away with the end cover.
3. Remove the split pin (Fig. 78), securing the diaphragm to the control rod pin. Draw the rod to the full-off position and unhook the diaphragm.

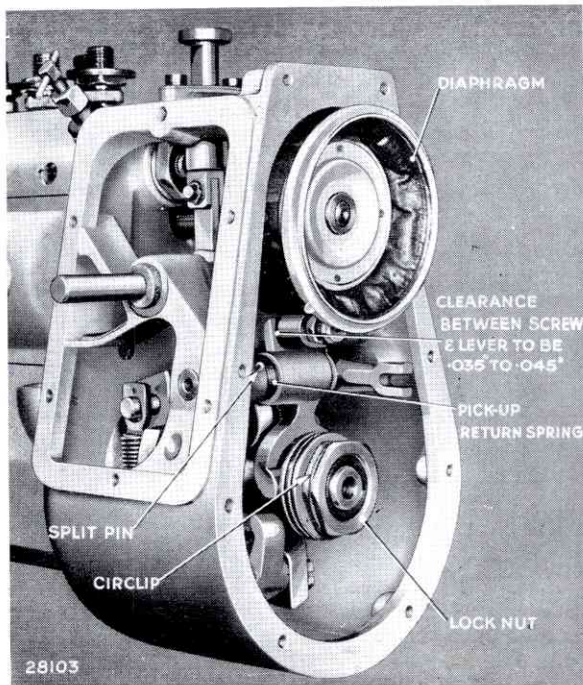


FIG. 83. GOVERNOR WITH COVERS REMOVED

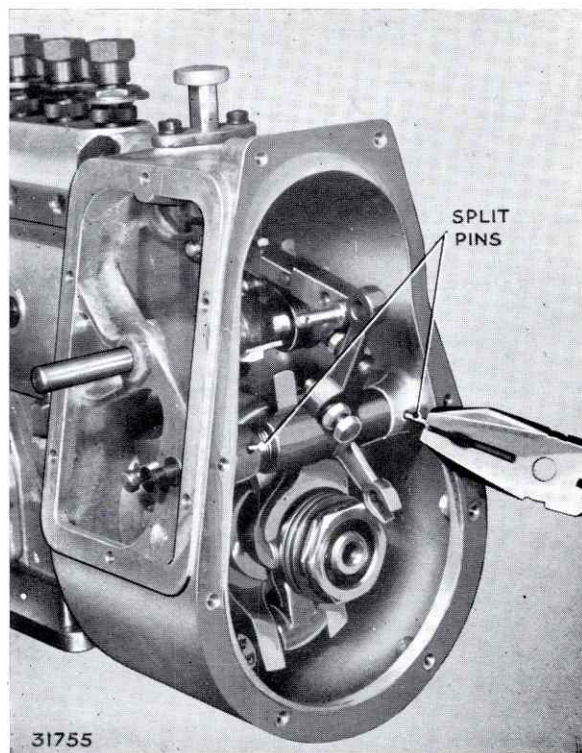


FIG. 84. REMOVING SPLIT PINS SECURING LINKAGE SPINDLE

4. Take out the split pins securing the pivot spindle (Fig. 84), screw a 1/4 in. B.S.F. bolt into the tapped end and withdraw the spindle (Fig. 82). Remove the torsion spring and forked pickup lever (Fig. 83).

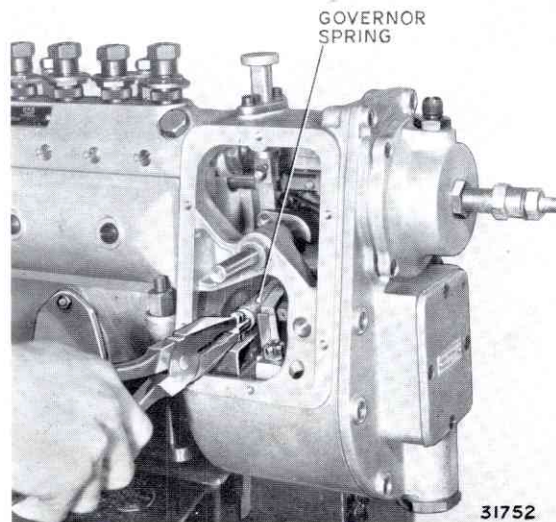


FIG. 85. RELEASING GOVERNOR SPRING



5. Release the governor springs (Fig. 85).
6. Remove the flyweight carrier bolts and withdraw the flyweights (Fig. 86).

**Note:** On later injection pump governors. To remove the flyweights, remove the flyweight pivot pin retaining brackets and withdraw the pivot pins.

7. Remove the four setscrews securing bracket (Fig. 85) to the driving centre and remove the bracket and sleeve.
8. Unscrew nut securing driving centre and using a special drawer (Fig. 87), remove the driving centre.
9. Remove the housing nut and set-screws (Fig. 80), securing the governor casing to the injection pump housing and remove the casing.

### To Replace Governor Assembly

Reverse the sequence of operations for **Removing Governor**.

**Note:** The flyweight bracket and driving centre are both meshed on initial assembly and they must be replaced so that the marks coincide.

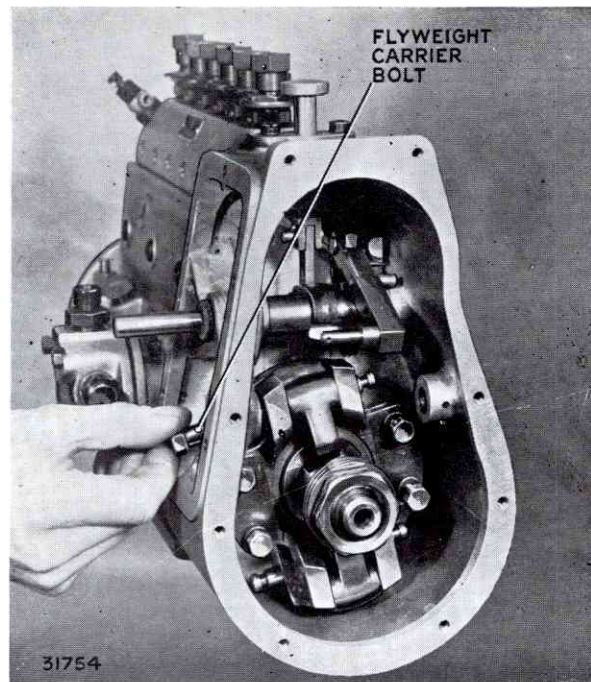


FIG. 86. REMOVING FLYWEIGHT CARRIER BOLT

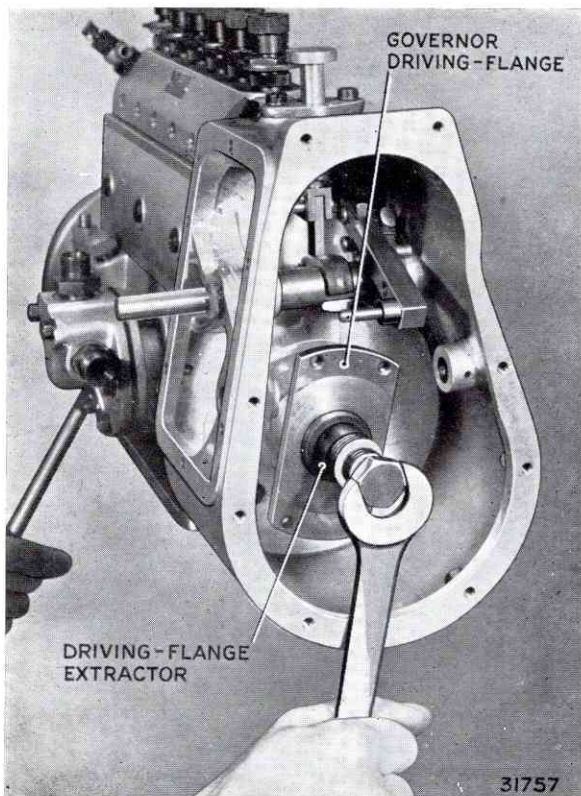


FIG. 87. REMOVING GOVERNOR DRAWING FLANGE

## GOVERNOR—C.A.V. TYPE BRV

### PRINCIPLES OF OPERATION

The Principle of the C.A.V. variable range speed governor is, that any speed between idling and maximum can be pre-set by means of an operating lever and automatically maintained by a governing device consisting of a flyweight governor.

Since the speed of an oil engine depends upon the quantity of fuel delivered and the load, the governing of the engine speed is effected by regulating the quantity of fuel delivered by the injection pump. For this purpose C.A.V. injection pumps are fitted with a fuel delivery control rod with a movement ranging from zero to maximum.

The control rod can be moved either by operating the lever, or independently by the automatic governor, in fact, both the selecting and governing medium can operate on the control rod simultaneously.

The C.A.V. type BRV variable range speed governor for injection pumps, is a centrifugal governor which

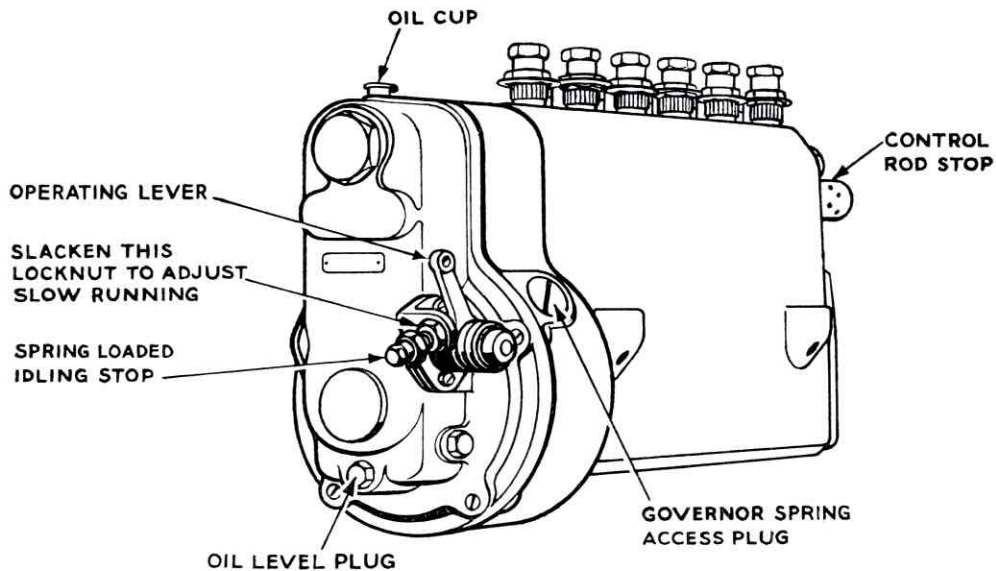


FIG. 88 INJECTION PUMP AND GOVERNOR

maintains all speeds between idling and maximum, irrespective of the load. Its fundamental characteristic is the sub-dividing of the governing device into the actual governor with flyweights and linkage, and an operating lever with an equalising spring as a selective medium enabling any desired speed to be pre-set. Therefore, every position of the operating lever gives a certain definite speed during operation, except when the engine is either excessively loaded, or the load is suddenly removed.

The obvious consequence of the advance adjustment of the speed by the operating lever, is that the centrifugal governor does not overtake this speed simultaneously. This enables the resistance when speeding up to be overcome quickly, for whilst the control rod can be immediately moved to full delivery by the operating lever, the quantity of fuel delivered is gradually altered by the governor only with increasing speed.

The twofold influence on the control rod (both deliberately by the operating lever and automatically by the centrifugal forces) necessitates a superimposing of the adjusting movements. It is characterised by the centrifugal force of the governor acting on the control rod via a two-armed floating lever, the axis of which can be deliberately displaced by moving the operating lever. This means that the primary position of the control rod is dependent on the position of the floating lever axis, and that the floating lever executes oscillating movements around this axis, the extent and direction of which are governed by the fluctuations in load occurring.

**ADJUSTMENT**

**1. Adjusting the Pump to the Engine.**

The quantity of fuel delivered by the pump is dependent upon the position of the control rod, the travel of which, in the direction of " Full Delivery " is limited by the stop, Fig. 8. This stop is adjusted in the following manner :

- (a) Run the engine with the operating lever disconnected from the speed control linkage and with the control rod on full delivery, and injection advance in its most favourable position, until the engine develops its full power at the prescribed speed, without smoke.
- (b) With the aid of a hooked piece of wire, release the spring disc, Fig. 89, from the sleeve, then remove the split pin. Screw the adjusting

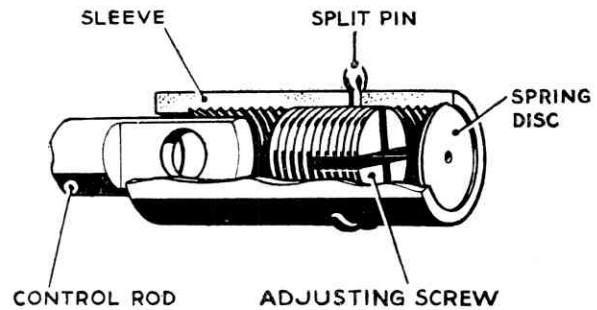


FIG. 89 CONTROL ROD STOP



screw into the sleeve until it touches the control rod (provided conditions are as under (a)), in this position secure the screw by the split pin and replace the spring disc. If at full load, the engine speed deviates slightly from the prescribed speed, the governor springs must be re-adjusted, see **Re-adjusting the Governor Springs.**

If the maximum speed is to be greatly altered, a new set of springs must be fitted, see **Exchanging the Governor Springs.**

- (c) Connect the operating lever, Fig. 88, to the engine speed control linkage.

## 2. Re-adjusting the Governor Springs.

The maximum speed of the engine can be adjusted within narrow limits, as follows :

- (a) Remove the access plug, Fig. 88, from the governor housing.
- (b) Rotate pump shaft until the governor spring adjusting nut is accessible.
- (c) According to whether it is required to decrease or increase the spring tension turn the adjusting nut either to the left or to the right, only half a turn at a time on each weight, as only in these positions will it engage in its locking device.

The nut must not pass the position in which its face is flush with the end of the bolt.

## 3. Exchanging the Governor Springs.

When exchanging the governor springs for a different set, the adjusting nut must be entirely removed, and care should be taken that each spring has the same tension on each weight, i.e. that the nuts are in identical positions on their bolts.

## 4. To Adjust the Slow Running Position.

Fig. 88 shows the spring-loaded idling stop. The governor operating lever is against this stop when idling speed can be set by screwing this stop in or out the required amount.

Moving the operating lever against the spring-loading of this stop will move the pump control rod to the " No Delivery " position, thereby stopping the engine. When the lever is released it will return automatically under spring pressure to the idling position.

## LUBRICATION

Before placing the governor in service, raise the oil cup lid, see Fig. 88, and fill up with .25 pint (142 cc.) of engine oil. A further .125 pint (71 cc.) should be added after every 100 hours run. The level plug shown in Fig. 88 should be removed at each topping up, so that overfilling does not occur.

## THE FUEL SYSTEM

### DESCRIPTION

The fuel is raised by a small diaphragm-type lift pump which is secured to the side of the injection pump and driven by an eccentric formed on the injection pump camshaft. Fuel is delivered to the injection pump through the main fuel filter (Fig. 90), and a leak-off pipe fitted to each injector is connected to a gallery pipe which discharges back into the filler neck of the main tank. Air-bleed points enable the system to be kept free from air locks.

### Overhaul

If trouble occurs in the fuel supply to the injection pump, the following checks should be made before attempting any repairs to the pump :

1. Make sure the fuel pipes are not blocked.
2. Check that the main filter is clean.
3. Examine for leaks on the suction side of the pump.
4. Examine the valves and, if defective, renew.

If the pump still fails to operate satisfactorily, dismantle and check for the following :

1. Broken diaphragm return spring.
2. Diaphragm retaining-nut loose.

3. Punctured or worn-out diaphragm.
4. Leakage at diaphragm flange.
5. Broken rocker arm.

### MAIN FUEL FILTER

#### Description

The fuel filter unit consists of a die-cast body and cap housing a double filtering element and fitted with a gravity air-vent-valve, see Fig. 90. The filtering element, known as the "Pack-and-Sack" type, is made up of fifteen square felt pads, assembled thick and thin alternately (18) and (19), on a perforated support tube.

The outer element (16) is a finely woven cloth, pleated to a cylindrical form over a support spring (17) and secured by cotton twist (21) at the bottom of the metal former. A handle fitted at the top of the filtering element facilitates the removal of the element for maintenance purposes. The gravity vent-valve fitted to the side of the filter body acts as a constant air bleed, allowing aerated fuel to be expelled automatically from the filter chamber and thereby preventing the possibility of air locks forming in the fuel system. No maintenance is required on the vent valve.

Fuel entering the filter chamber through pipe connection (29) passes through the cloth outer filter and then through the felt pack to the centre tube where it enters the drilled passage in the centre bolt (20) and is fed to the injection pump through a pipe connected to outlet adapter (25).



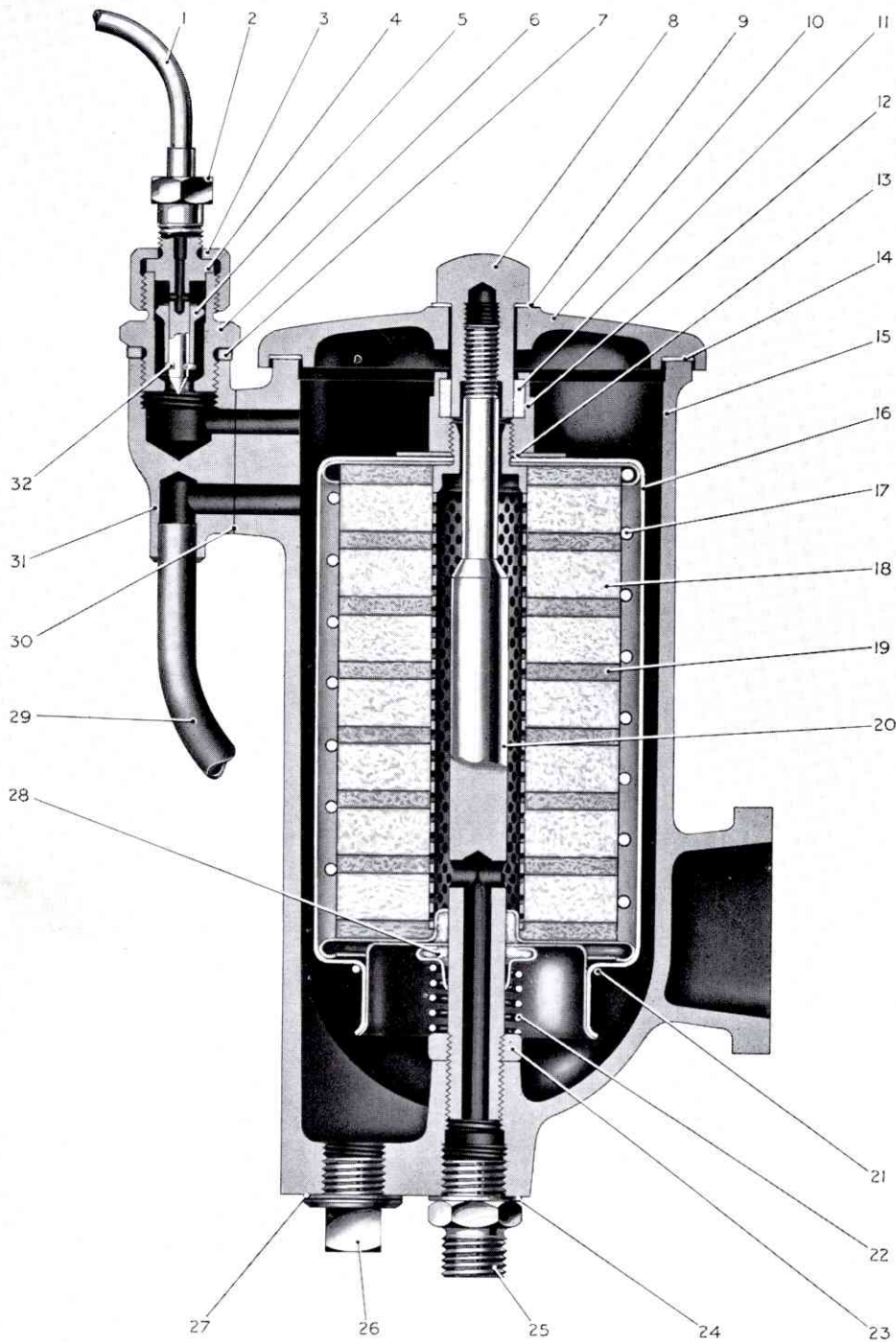


FIG. 90. SECTION THROUGH MAIN FUEL FILTER

- |                              |                              |                               |                            |
|------------------------------|------------------------------|-------------------------------|----------------------------|
| 1. Bleeder Pipe.             | 10. Cover for Filter Casing. | 19. Filter Element (thin).    | 25. Outlet Pipe Adapter    |
| 2. Union Nut.                | 11. Seal.                    | 20. Centre Bolt and Outlet    | 26. Drain Plug.            |
| 3. Vent Valve Retaining Nut. | 12. Nut.                     | Gallery.                      | 27. Washer for Drain Plug. |
| 4. Valve Pillar.             | 13. Washer.                  | 21. Cotton Twine for Securing | 28. Bush.                  |
| 5. Valve.                    | 14. Joint for Filter Cover   | Cloth Filter.                 | 29. Fuel Inlet Pipe.       |
| 6. Adapter.                  | 15. Filter Casing.           | 22. Support Spring.           | 30. Joint.                 |
| 7. Washer for Adapter.       | 16. Cloth Filter.            | 23. Locknut for Centre Bolt.  | 31. Pipe Connection and    |
| 8. Filter Cover Unit.        | 17. Spring.                  | 24. Washer for Outlet         | Vent Valve Carrier.        |
| 9. Washer for Cover Nut.     | 18. Filter Element (thick).  | Adapter                       | 32. Split Pin.             |

**DISMANTLING THE FILTER ELEMENT**

After removing the filter element from the housing, remove nut (12), and washer (13), then untie the twine securing the filter cloth to the metal former and strip off the cloth.

To remove the felt pads, lift off the top plate and support spring (17), the pads can then be taken off the perforated support tube.

Reassembly is a reversal of the above, but the following should be noted :

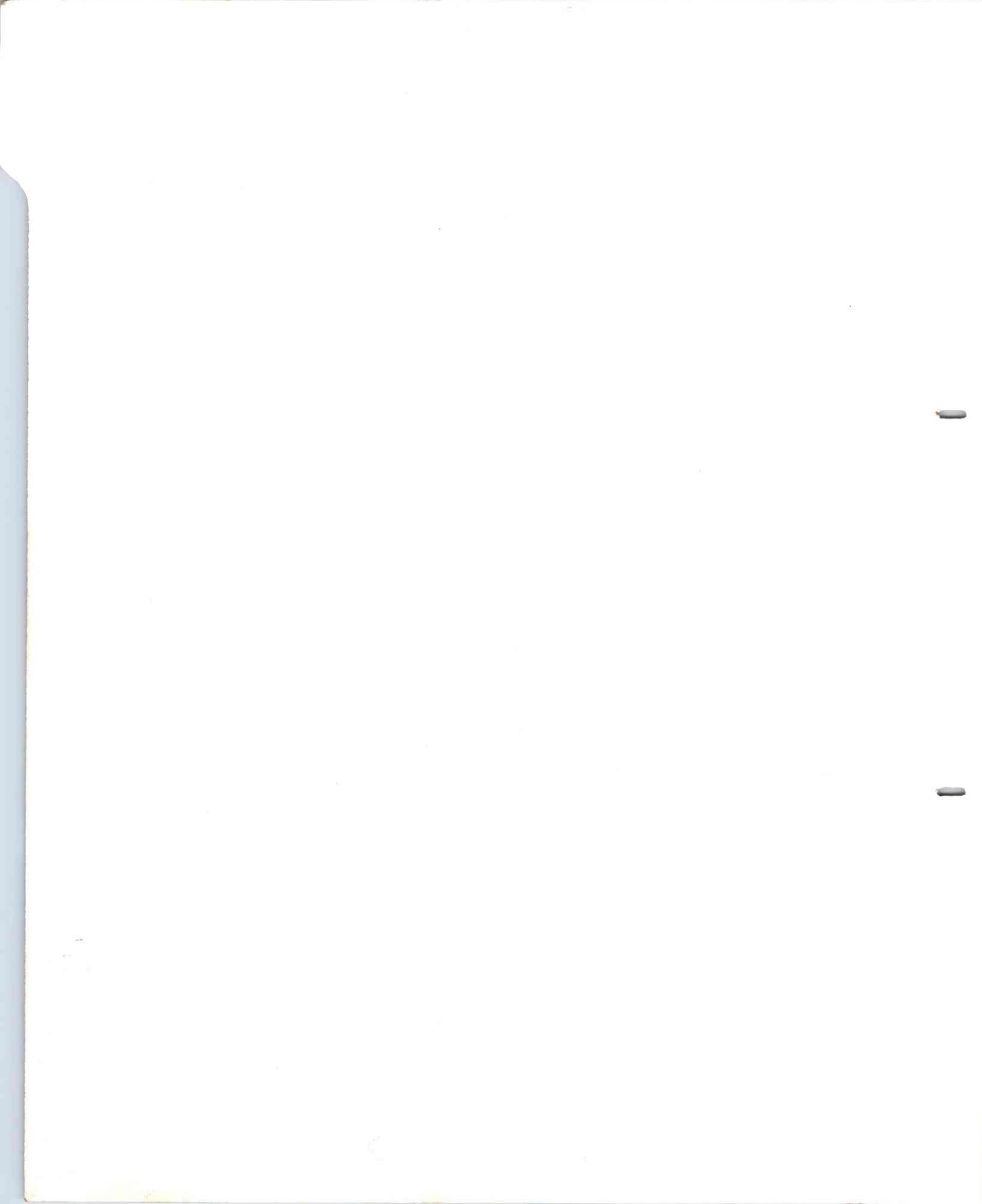
When rebuilding the felt pack start with a thin felt, then a thick and thin felt alternately, using a total of seven thick and eight thin.

**To Renew Cloth and Felt**

The cloth filter should be examined approximately once a week for punctures or excess dirt and renewed if necessary. The filter cloth supplied by Leyland and C.A.V. service depots for this purpose is a special weave found by test to possess the maximum filtration qualities.

Providing the cloth is changed regularly the felt element should only require renewal when the engine is down for major overhaul. It is advisable when changing the filter cloth to clean the felt element. This is best done by applying compressed air to the support pipe, after suitably sealing the ends, so that the air passes from the inside to the outside of the pads. This should be done immersed in clean petrol or paraffin. It is not sufficient merely to rinse the felt pack or brush it in fuel oil, as this may cause dirt removed to settle on the inside and subsequently pass into the injection system when the filter is replaced on the engine.





Topbolte 150-160 lb/ft.

" " 80-85 " " "

PLEJL Stænger 150-180 lb/ft

forlængelse af bolte. 0,15-0,20 m

Gærkasse Type G.B. 117

Blis til gærkasse Spirax EP 90  
ialt 6 liter

Handtyr spandes med 260-270 lb/ft



# Leyland



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