Leyland

SERVICE MANUAL

9.8 Litre OIL ENGINE

LEYLAND MOTORS LTD

3

CHAPTER 3F

ENGINE

EO. 600/10,15. 0848

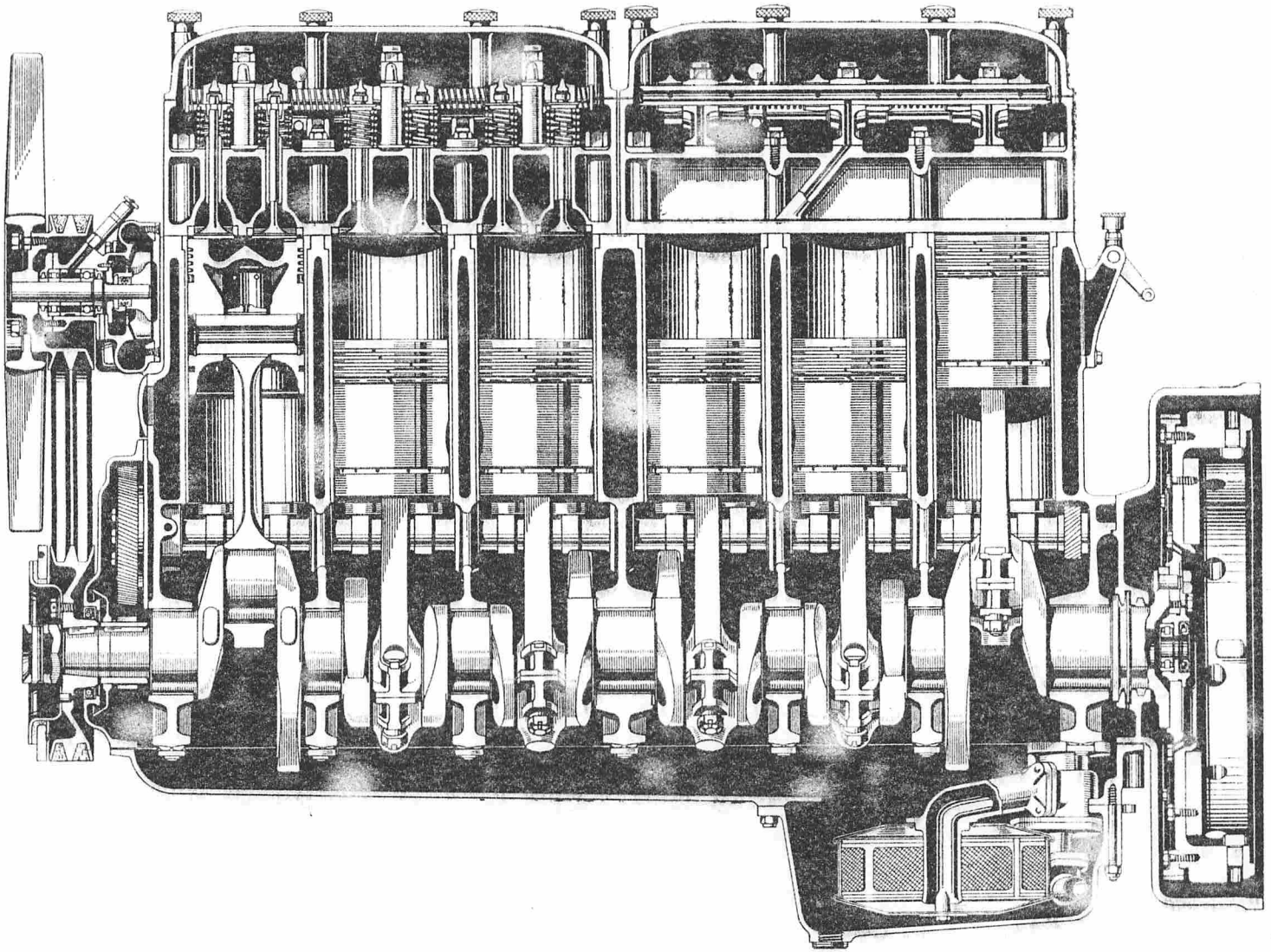


FIG. 1. SECTION THROUGH ENGINE

ENGINE

DATA

GENERAL

Known as	Leyland 9.8 litre oil engine.
Type	Six-cylinder, compression-ignition, direct injection, overhead valve, vertical, water-cooled.
Bore	4.8 in. (122 mm.).
Stroke	5.5 in. (139.7 mm.).
Cubic capacity	9.785 c.c. (597 cubic inches).
Maximum torque	410 lb./ft. (56.7 kg.m.) at 900 r.p.m.
Maximum b.h.p.	125 at 1,800 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. Initial diametral clearance between idler-gear and spindle, .0012 in. to .0022 in. Backlash between gears, .002 in. to .026 in.
Sump capacity	5 galls. (22.5 litres). Dry engine, 6 galls. (22.25 litres).
Oil pressure	60-70 lb. sq. in. (4.2 to 4.9 kg. sq. cm.) at 1,800 r.p.m. with warm engine. 25.30 lb. sq. in. (1.75 to 2.1 kg. sq. cm.) with engine idling.
Pump delivery	6 galls. (22.25 litres) per min. at 1,000 r.p.m.
Filter	Leyland, full-flow, cloth-type element.

CYLINDER HEADS

Type	Detachable, 2 per engine, each covering 3 cylinders.
Valve guide interference in head	.001 in. to .002 in.

ENGINE BLOCK

Type	Cylinders and crankcase in one-piece casting.
Liners	Pre-finished, dry, cast iron, push-fit, shoulder located.
Initial bore	4.8 in. +.001 in. −.000 in.
Reline when wear of liner bore exceeds ...	.020 in.

PISTON AND RINGS

Piston type	Aluminium alloy.
Initial piston clearances in cylinder bore ...	Top of skirt, .0068 in. to .0078 in. at 90° to gudgeon pin. Bottom of skirt, .005 in. to .006 in. in parallel to gudgeon pin.
Compression rings	
Top groove, fire ring	$\frac{1}{8}$ in. wide, 3° taper sides, unhardened, 22½° slot.
2nd, 3rd and 4th grooves	$\frac{1}{8}$ in. wide, 3° taper sides, hardened and tempered, 90° slot.
Scraper ring, 5th groove	$\frac{1}{4}$ in. wide, straight sides, slotted, 90° slot.
6th groove	No ring fitted.
Initial piston ring gap	.020 in. to .024 in. all rings.
Renew ring when gap exceeds	.040 in.
Renew rings when side clearance in groove exceeds	.015 in.

CONNECTING RODS AND GUDGEON PINS

Gudgeon pin	1⅜ in. dia. hollow, fully floating.
Pin retained by	Two circlips in piston.
Initial diametral clearance of pin in small-end bush (cold)	.00045 in. to .001 in.
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	Prefinished, 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.

CRANKSHAPT AND MAIN BEARINGS

Number of main bearings	Seven.
Type of bearing	Pre-finished, lead-bronze, steel shell. Bearings surface indium-coated.
Thrust taken on	Thrust washers at centre journal.
Centre journal initial end clearance	.004 in. to .010 in.

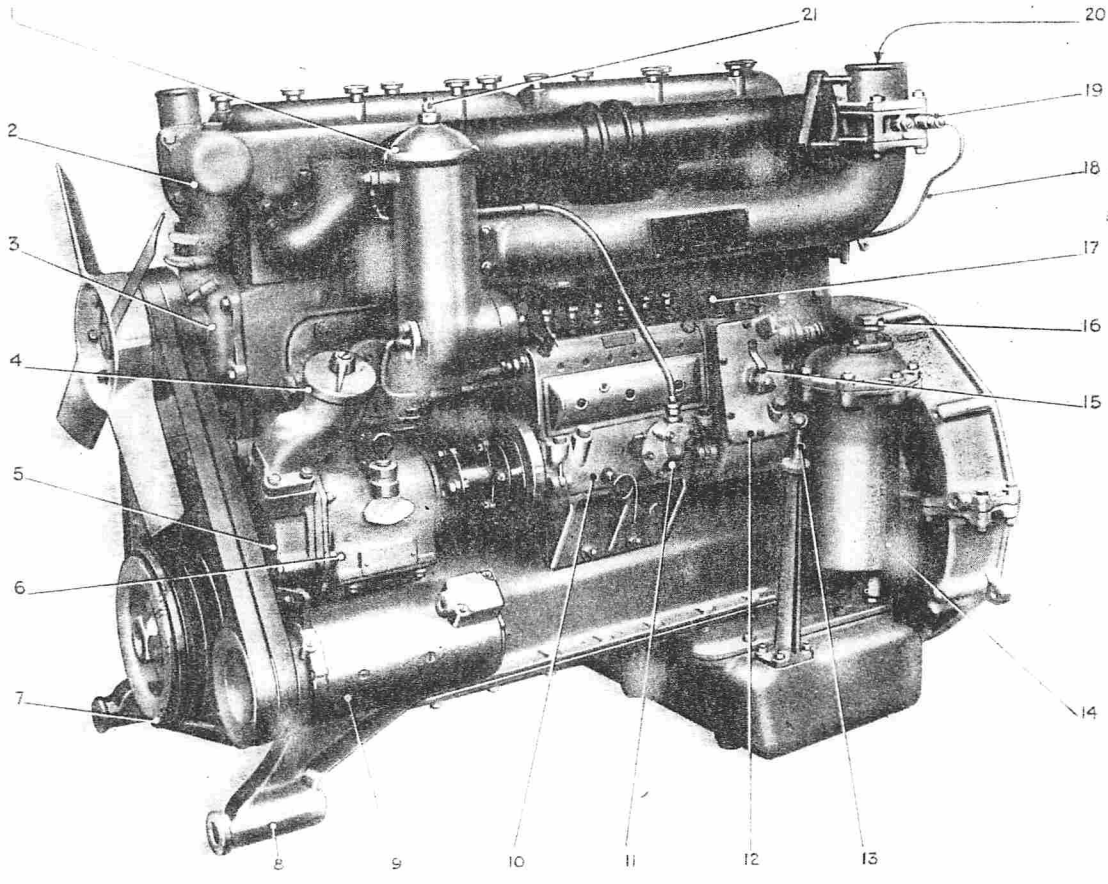


FIG. 2. LEFT-HAND VIEW OF ENGINE

1. Main Fuel Filter.
2. Water Manifold and Thermostat Housing.
3. Water Pump.
4. Engine Oil Filler.
5. Timing Case.
6. Compressor.
7. Crankshaft Damper.
8. Engine Suspension Bracket.
9. Dynamo.
10. Fuel Injection Pump.
11. Fuel Feed Pump.
12. Mechanical Governor Housing.
13. Engine Oil Dipstick.
14. Engine Oil Filter.
15. Engine Stop Control Lever.
16. Engine Oil Filter By-pass Valve
17. Excess Fuel Plunger.
18. Suction Pipe from Vacuum Governor.
19. Venturi Unit.
20. Air Intake from Oil Bath Filter.
21. Air Bleed Screw.

Renew thrust washers when end clearance exceeds	.014 in.
Oversize thrust washers available	1 set .010 in. thick (.005 in. each washer).
Journal diameter	3.4998 in. to 3.5005 in.
Crankpin diameter	2.9998 in. to 3.0005 in.
Regrind journals and crankpins	When .003 in. oval.

Do not grind sides of journals.

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.
Maximum run-out on shaft	.003 in. (total clock reading, .006 in.)
Maximum run-out between two adjacent bearings	.003 in.
Crankshaft damper	Rubber-bonded vibration damper at front of crankshaft.

CAMSHAFT

Number	One.
Type of drive	Single-helical gear.
Number of bearings	Seven.
Material	Front and rear—leaded 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.

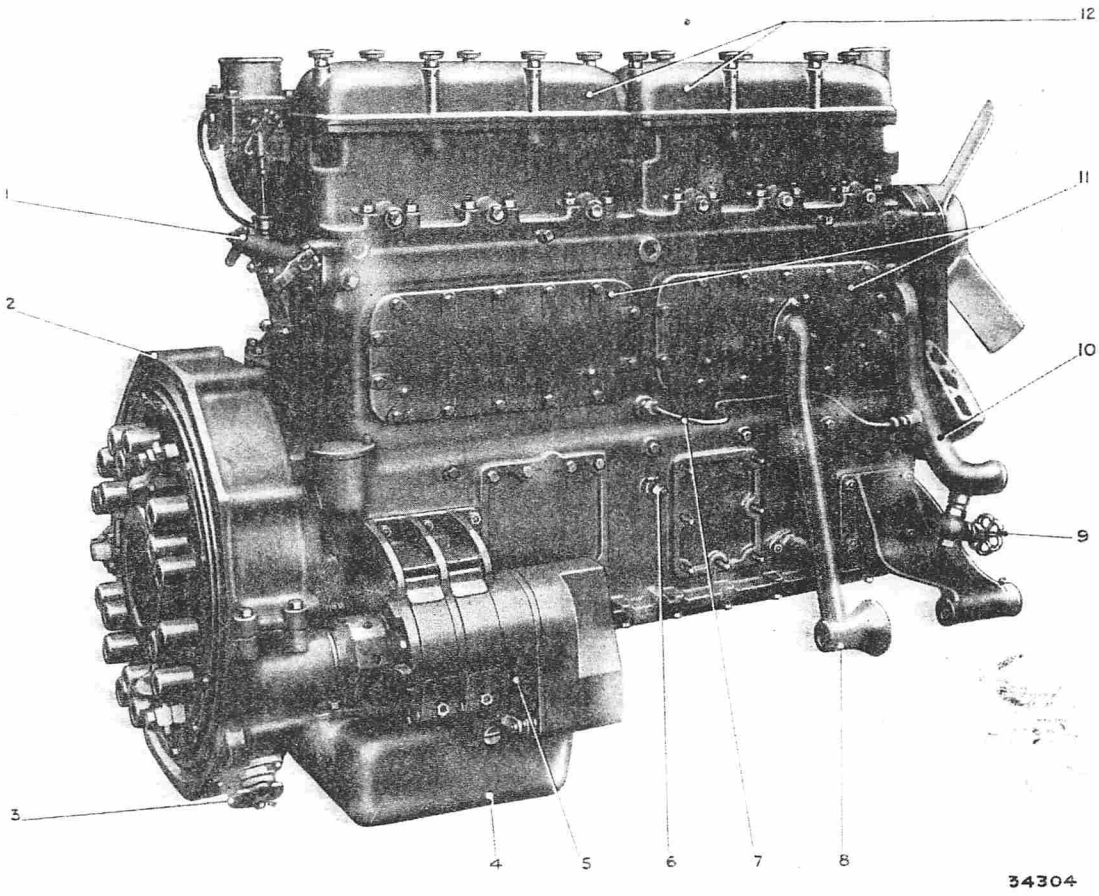


FIG. 3. RIGHT-HAND VIEW OF ENGINE

1. Accelerator Cross-shaft and Bracket.
2. Flywheel Housing.
3. Tuning Plunger.
4. Rear Sump Well.
5. Dynamo.
6. Tap to Oil Pressure Gauge.
7. Water Drain Pipe.
8. Engine Breather Pipe.
9. Water Drain Pipe.
10. Water Inlet Pipe.
11. Tappet Gallery Covers.
12. Cylinder Head Covers.

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	⅜ in.
Stem clearance in guide	
Inlet	.0005 in. to .00275 in.
Exhaust	.001 in. to .00325 in.
Valve head diameter	
Inlet	2.10 in.
Exhaust	1.80 in.
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. (61.1 kg.).
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. (15.94 kg.). Outer spring will compress to 1.5 in. under a load less than 74 lb. (33.74 kg.).
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 (43.7 mm.).
Inlet closes	50° after B.D.C.=8.61 in. on flywheel rim (218.7 mm.).
Exhaust opens	46° before B.D.C.=7.92 in. on flywheel rim (201.2 mm.).
Exhaust closes	14° after T.D.C.=2.41 in. on flywheel rim (61.2 mm.).

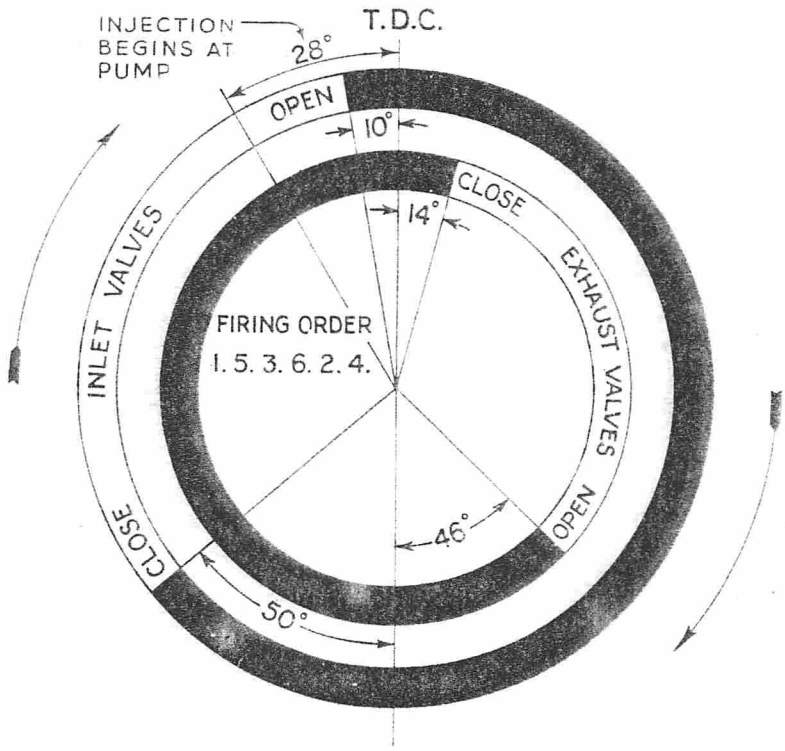


FIG. 4. VALVE TIMING DIAGRAM

FUEL SYSTEM

Capacity of fuel tank, Models:

EB/3R, EB/5L EH/1R, EH/2R, EH/9R EH/3L, EH/4L, EH/8L, EH/10L	55 galls. (250 litres).
EB/7R, EB/9L EH/13R, EH/14L	44 galls. (200 litres).
EB/11R, EB/13L	33 galls. (150 litres).
Fuel gauge	Simms magnetic type.
Control	Goods vehicles : stop tap and fuel filter combined, on left hand frame side, forward of fuel tank.
Main fuel filter	Leyland two-stage, with C.A.V. cloth element type and multi-gauze-and-felt element.

INJECTION PUMP

Make	C.A.V.
Type	BPE6B.
Number of deliveries	Six.
Plunger diameter	7.5 mm.
Cam lift	7.5 mm

Helix	Right hand.
Drive	Flexible, adjustable coupling, clockwise rotation, half engine speed, mounted in tandem with exhauster or compressor.
Timing	Injection begins at the injection pump, 28° before T.D.C.

GOVERNOR

Make	Leyland—C.A.V.
Type	BEP/LB.
Cutting-in speed	1,800 r.p.m. engine speed.
Runaway speed	1,900 r.p.m. engine speed.
Idling speed	300 350 r.p.m. engine speed.

FUEL FEED PUMP

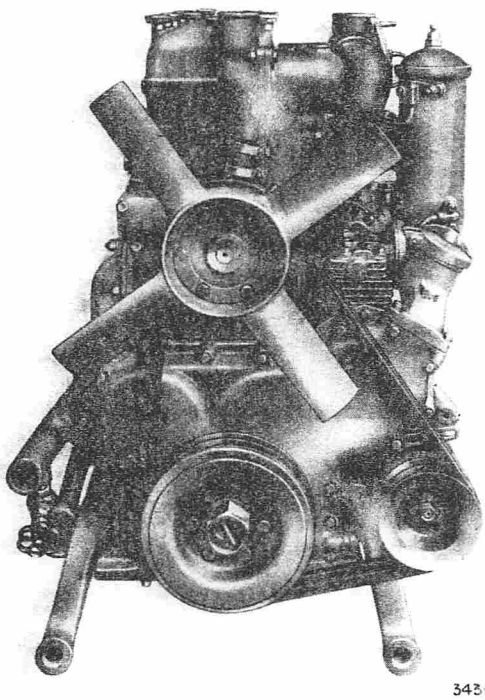
Make	C.A.V.
Type	DFP.
Pressure maintained	4/5 lb. per sq. in. (4.2 to 4.9 kg./sq. cm.).
Operation	Diaphragm, operated by arm in contact with eccentric on injection pump camshaft.

INJECTORS

Make	Leyland.
Type	N24.
Discharge pressure	140-145 atmospheres, 2,057 to 2,130 lb./sq. in. (144-150 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 five steps of .001 in. each.
Angle of spray	140°.
Valve spring free length	1 3/16 in.
Valve spring under load of 50 to 52 lb. (22.8 to to 23.7 kg.)	1.355 in.

AIR CLEANER

Make	Air maze.
Type	Two-stage oil bath, capacity 1 gallon.
Venturi	C.A.V., type BEP/KEG.
Bore of venturi	61 mm.



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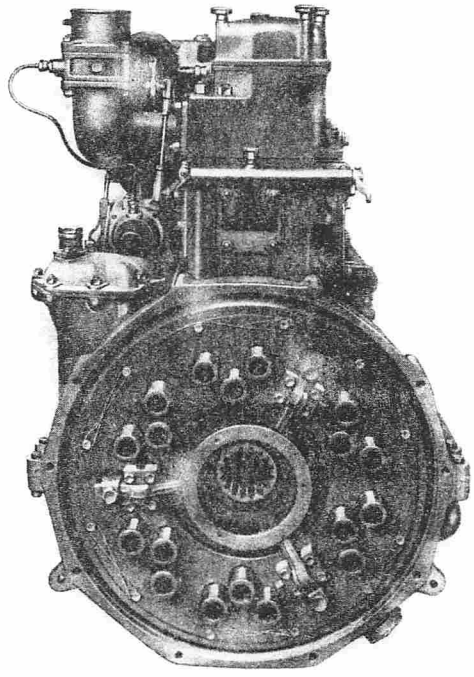

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FRONT AND REAR VIEW OF ENGINE

AIR COMPRESSOR

Make	Clayton Dewandre.
Types	PC GA58—independent sump and oil pump (sump capacity 1 pint), or PC GA66—pressure oil feed from engine.
Normal capacity	7 cu. ft. min. (1981 cc. min.) at 1,000 compressor r.p.m.
Backlash of coupling when in mesh with driving gear	.004 in. to .008 in.

DYNAMO DRIVE

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

COOLING SYSTEM

Controlled by thermostat	Thermostat opens at 185° F.
Water pump and fan drive	Belt driven from pulley on crankshaft at 1.43 × 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.

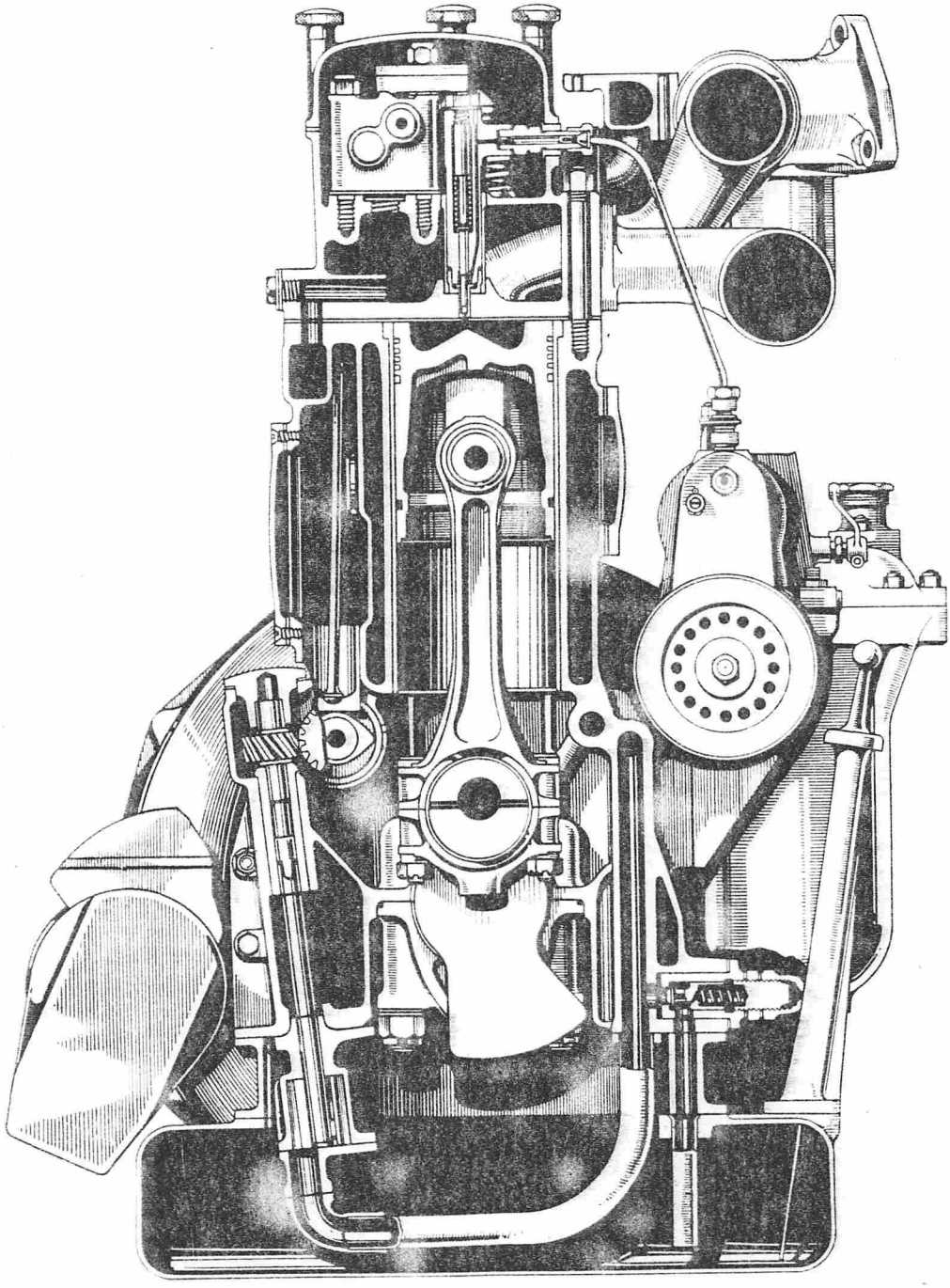


FIG. 5. CROSS-SECTION THROUGH ENGINE

CYLINDER HEADS AND MANIFOLDS

CYLINDER HEADS

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

To Remove and Replace Cylinder Heads

1. Drain the radiator and engine block. There are two arrangements of drain points.

   On the early production engines a tap is fitted at the rear left side of the engine block and connected by a copper pipe leading to a wheel-valve on the bottom water pipe at the front right-hand side. Open both tap and wheel-valve to drain the system.

   On later engines there is no tap on the engine block, and it is only necessary to open the wheel-valve to drain the system.

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. 6). 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. 17. First tighten down with a short spanner, then with a torsion spanner set at 155 to 160 lb. ft. (21.9 to 22 kg m.), see Fig. 9.

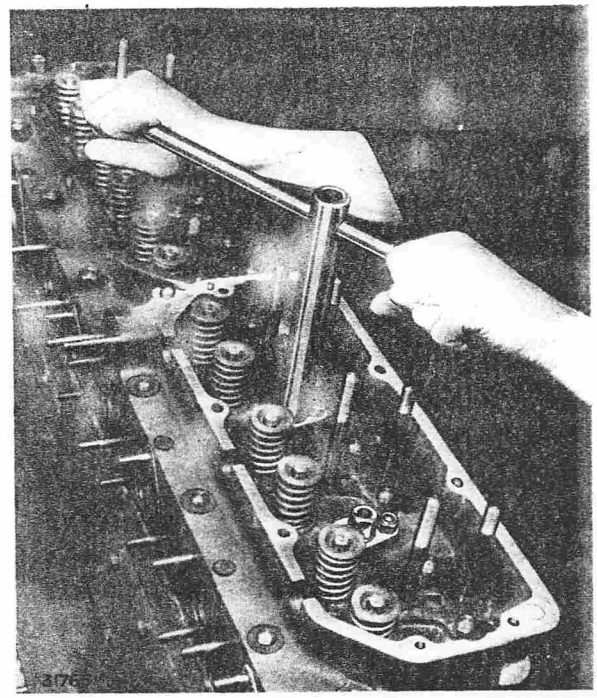


FIG. 6. TIGHTENING LIFTING NUTS

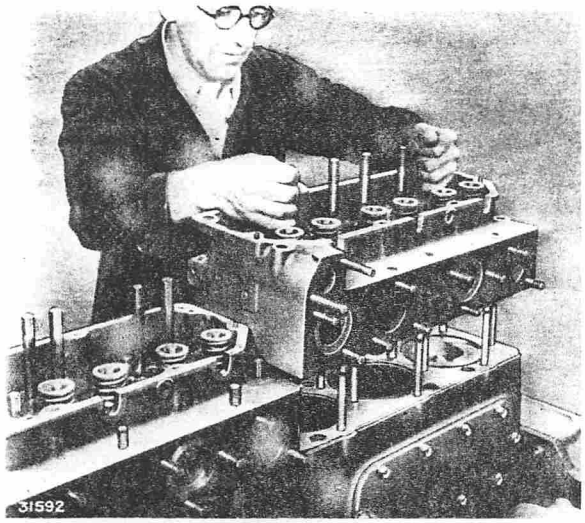


FIG. 7. FITTING CYLINDER HEAD

A torsion spanner set at 80 to 85 lb./ft. (11.0 to 11.7 kg/m.), should also be used for the ⅜ 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.

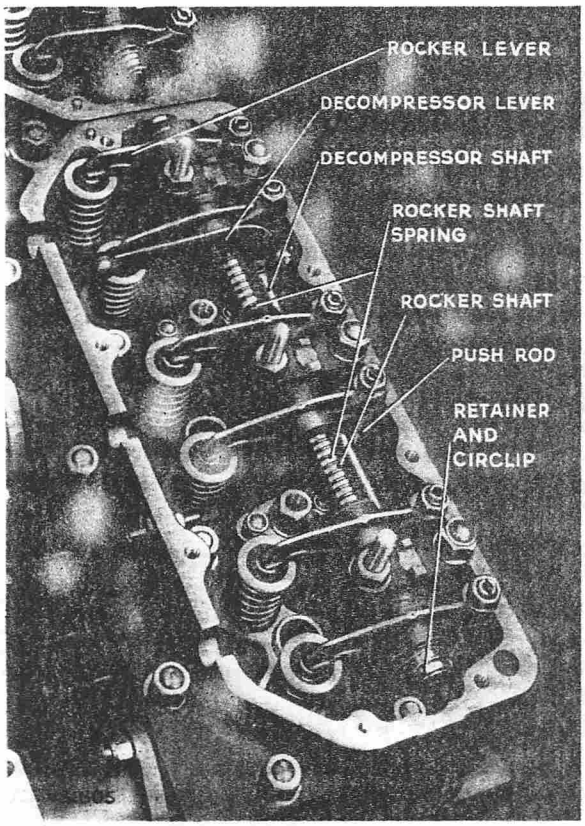


FIG. 8. VALVE GEAR

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 rocket levers (Fig. 8) are bushed and carried on 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, milled on the decompressor shaft, and holds it in the **off** position.

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 1.80 in. dia., and the inlet 2.10 in. dia. (Fig. 14).

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

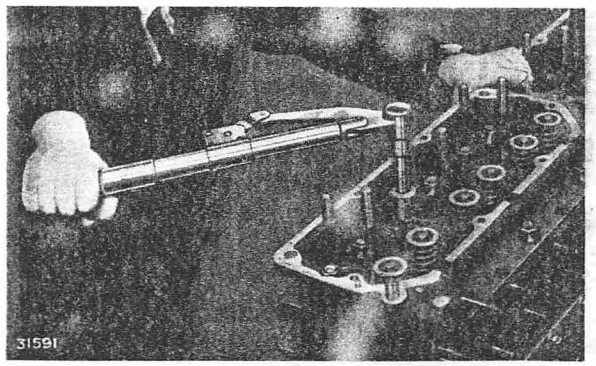


FIG. 9. TIGHTENING CYLINDER HEAD NUTS USING A TORSION SPANNER

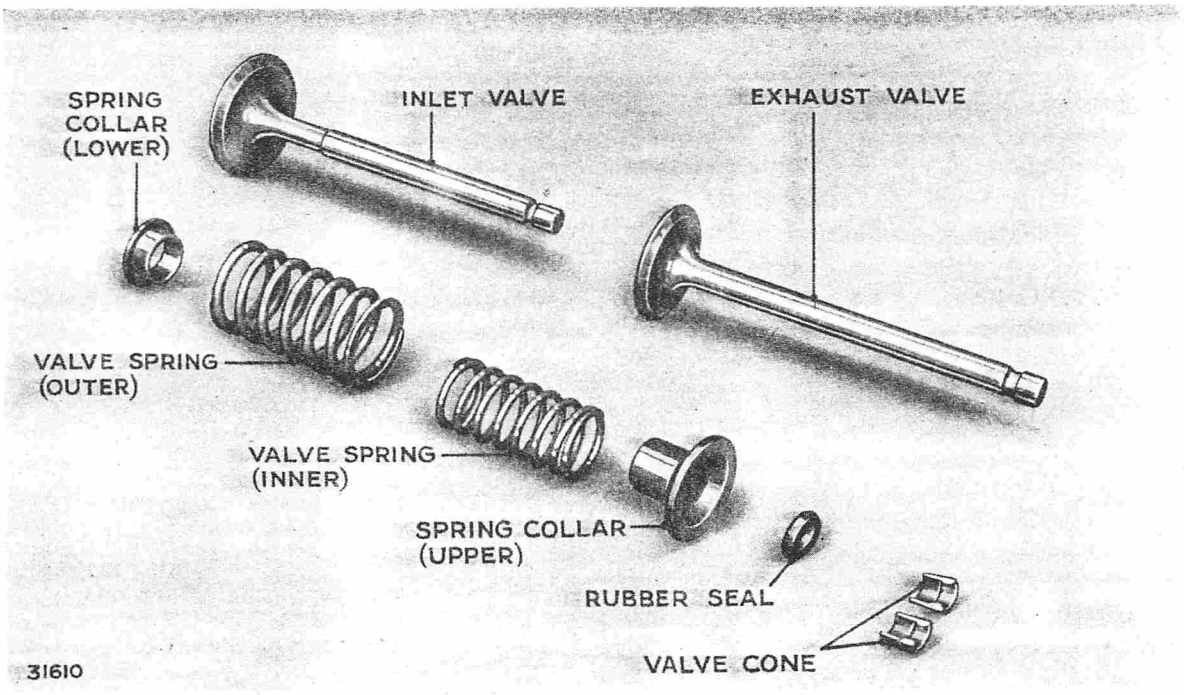


FIG. 10. VALVES AND SPRINGS

The valves and cylinder heads are numbered as shown in Fig. 15 to facilitate re-assembly.

To Remove and Replace Valves

1. Remove the cylinder head and place it face downwards on the bench.
2. Extract the split cone (Fig. 11) and remove the valve collar together with the rubber sealing ring and valve springs (Fig. 10).
3. The rubber sealing rings should be inspected and renewed if perished.
4. Check valve springs for length, see "**Data**"

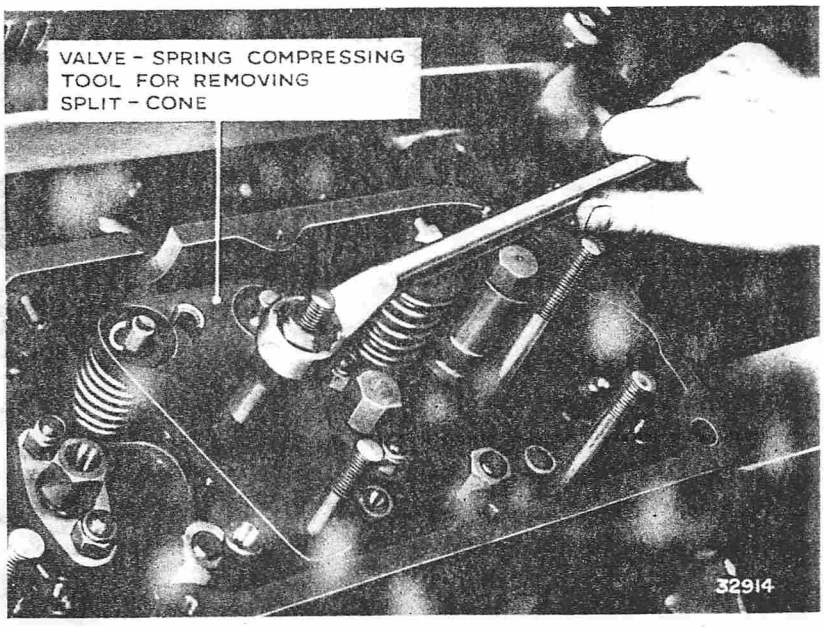


FIG. 11. VALVE SPRING COMPRESSING TOOL

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 valves 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. 14 for position of valve guide in head.

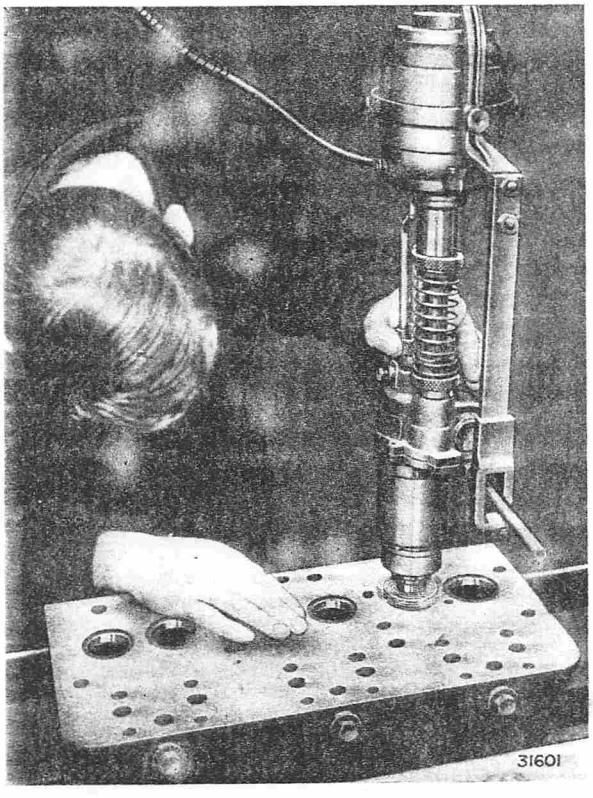


FIG. 12. GRINDING VALVE SEATS

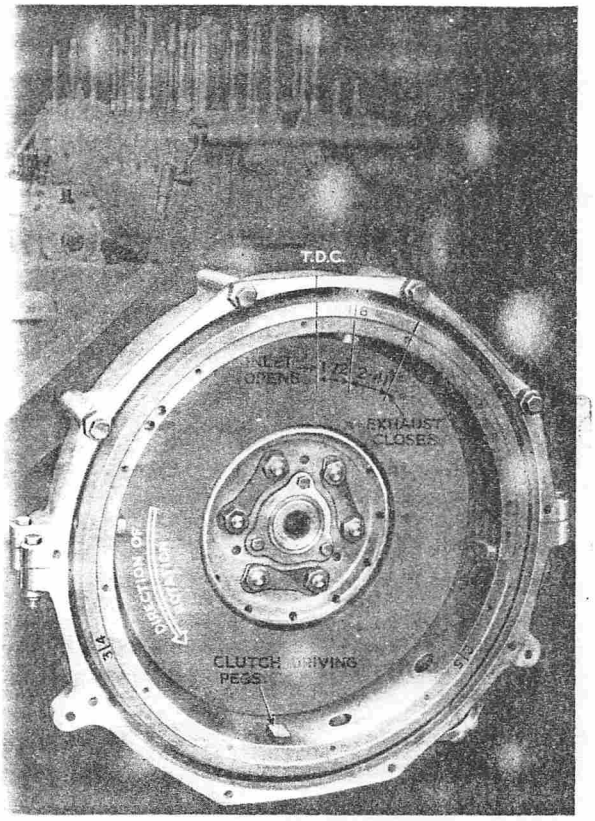


FIG. 13. VALVE TIMING MARKS ON FLYWHEEL

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° (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 on a valve-facing machine with the stone set at an angle of 29½°. **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.

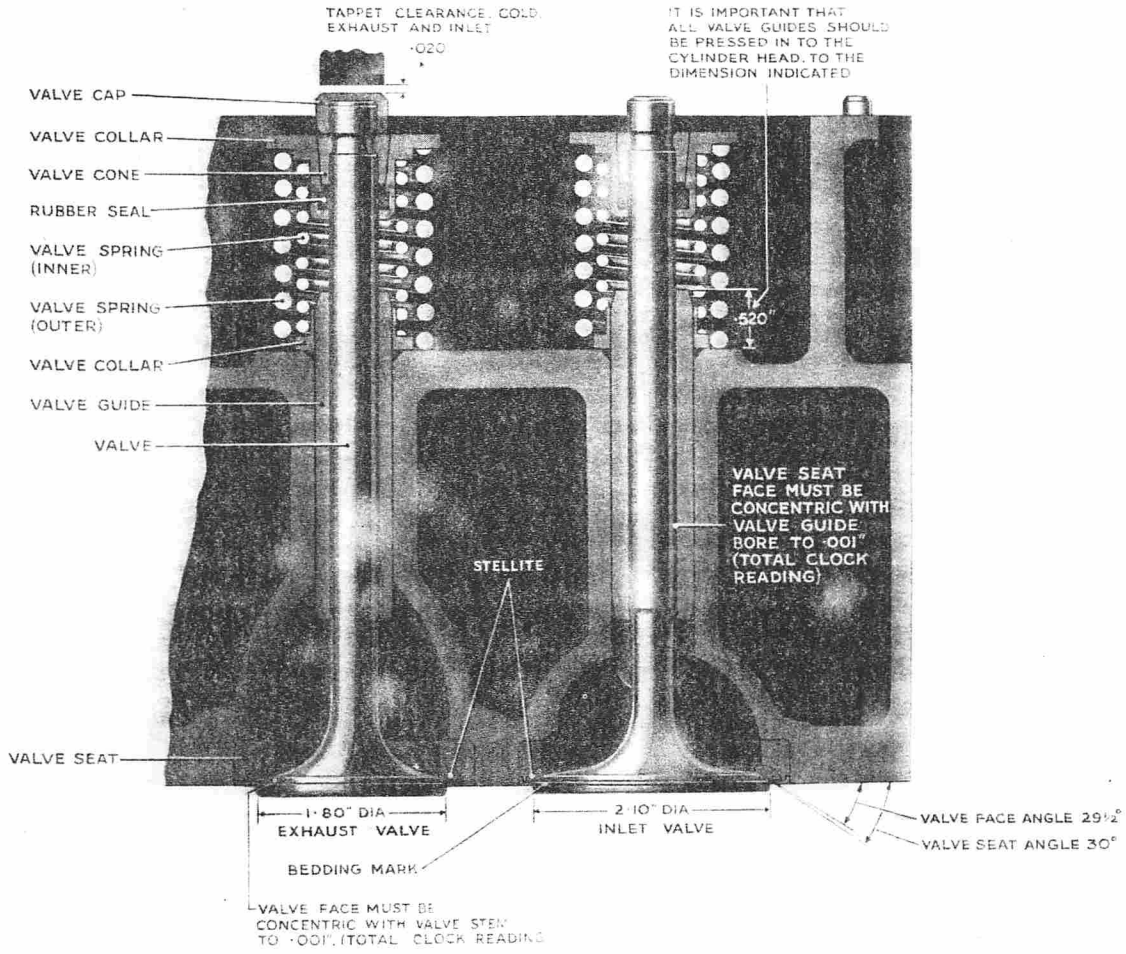


FIG. 14. VALVES AND SPRINGS IN POSITION

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 (Fig. 14).

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.

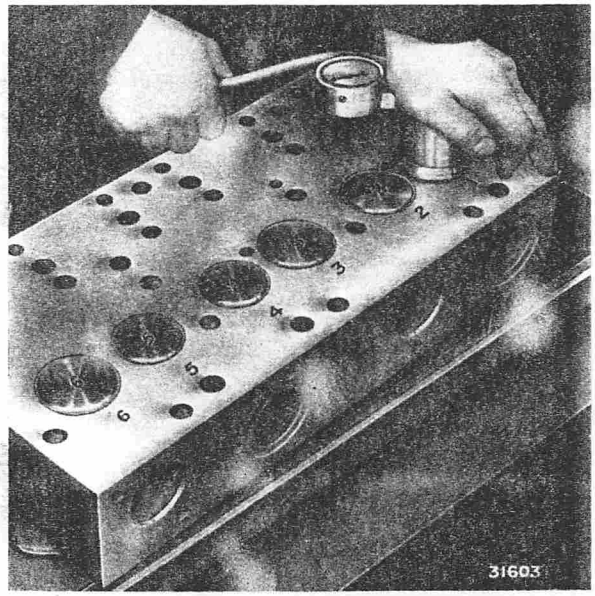


FIG. 15. TESTING GAS-TIGHTNESS OF VALVE ON ITS SEAT

VALVE TIMING

The valve timing is shown in Fig. 4, under "**Data.**"

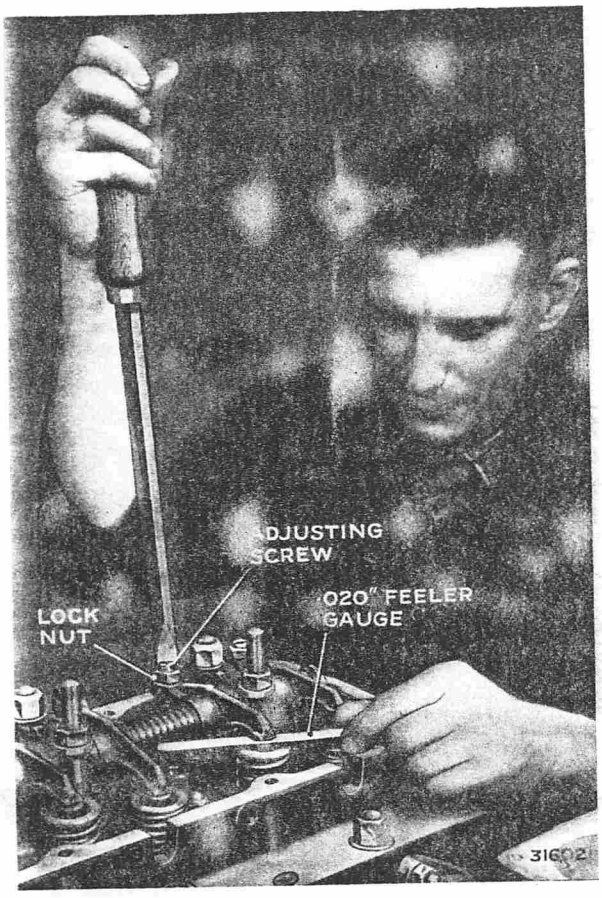


FIG. 16. ADJUSTING THE TAPPETS

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° 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. 13).

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 28° before T.D.C. of No. 1 piston (both valves closed). The plunger at lower right hand side of flywheel housing (Fig. 3), 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.

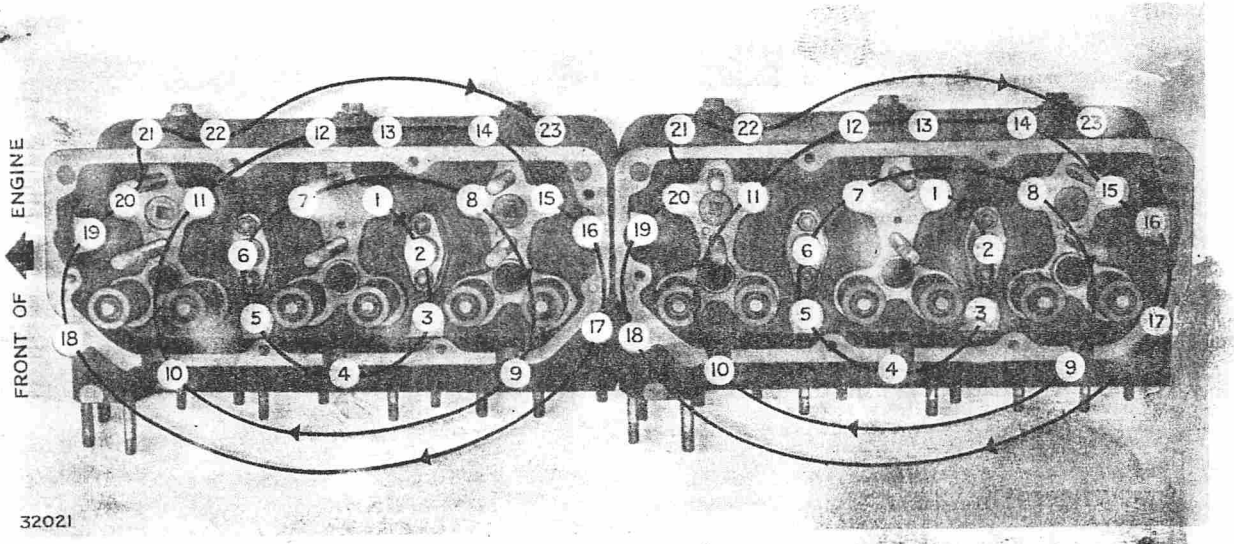


FIG. 17. CORRECT SEQUENCE OF TIGHTENING CYLINDER HEAD NUTS

FUEL SYSTEM

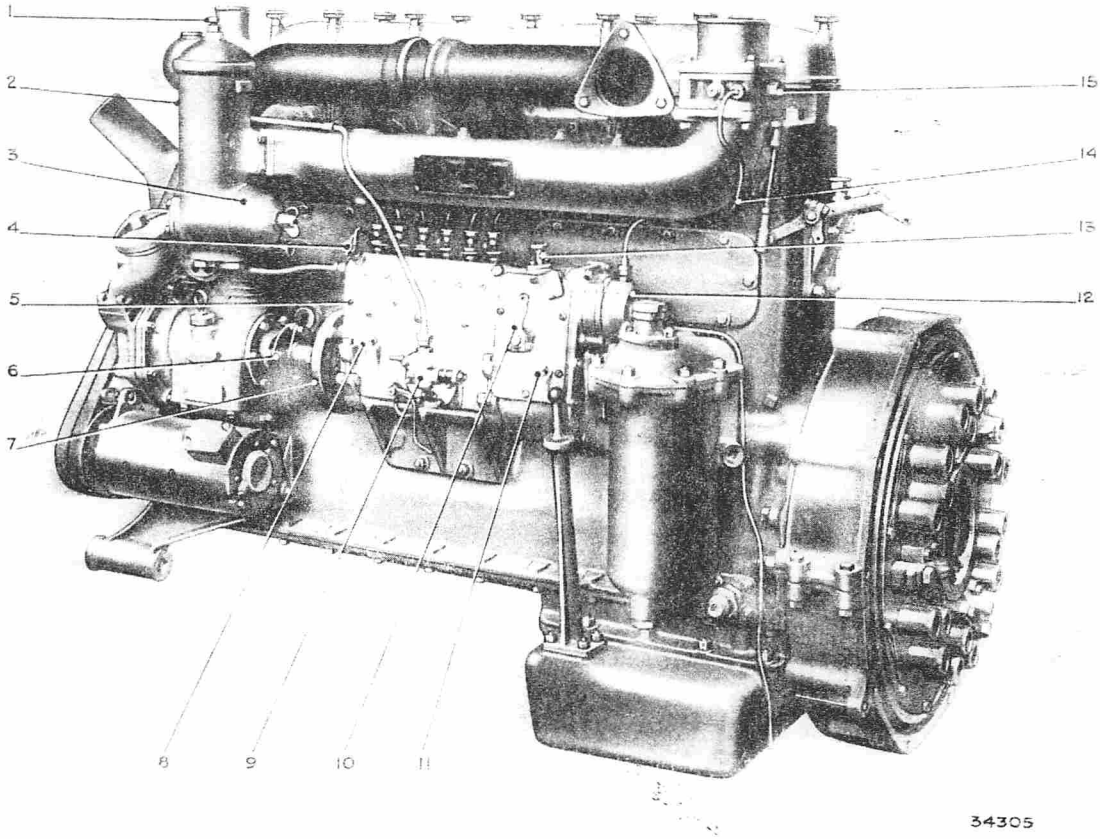


FIG. 18. FUEL SYSTEM AUXILIARIES

1. Air Bleed Screw.
2. Main Fuel Filter.
3. Secondary Fuel Filter.
4. Vent Block.
5. Fuel Injection Pump.
6. Injection Pump Coupling.
7. Injection Pump Flywheel.
8. Injection Pump Dipstick.
9. Fuel Feed Pump.
10. Engine Stop Control Lever.
11. Governor Housing Dipstick.
12. Pneumatic Governor Housing.
13. Excess Fuel Plunger.
14. Suction Pipe Governor to Venturi.
15. Venturi Unit.

DESCRIPTION

The fuel system consists of a single tank (Fig. 22), bracketed to the chassis frame. The fuel is raised through a combined **on-off** tap and primary filter (Fig. 20), by a small diaphragm-type feed pump, secured to the side of and driven from the injection pump. Fuel is delivered to the injection pump through the main fuel filter (Fig. 23) mounted on the front of the inlet manifold. The injection pump delivers fuel under high pressure through separate pipes to each injector. A leak-off pipe fitted to each injector is connected to a gallery pipe which discharges back into the filler neck of the fuel tank.

FUEL INJECTION PUMP

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 portions of the housing also contain the fuel suction chamber, delivery valve assemblies and delivery valve holders for connection to the injection feed pipes.

OVERHAUL

To Remove the Injection Pump

Immediately pipes are disconnected from the fuel pump, 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.
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. 19), 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.

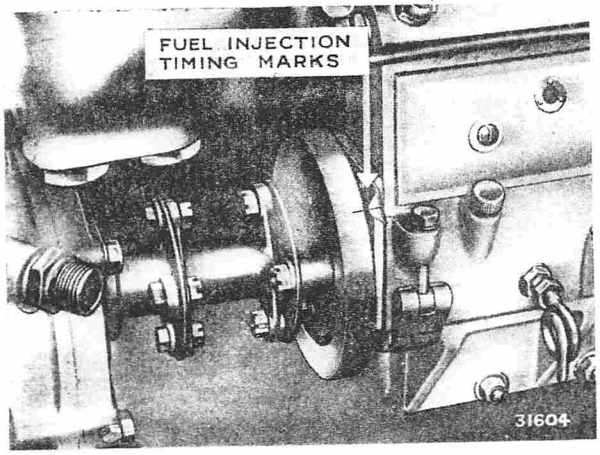


FIG. 19. INJECTION PUMP TIMING MARKS

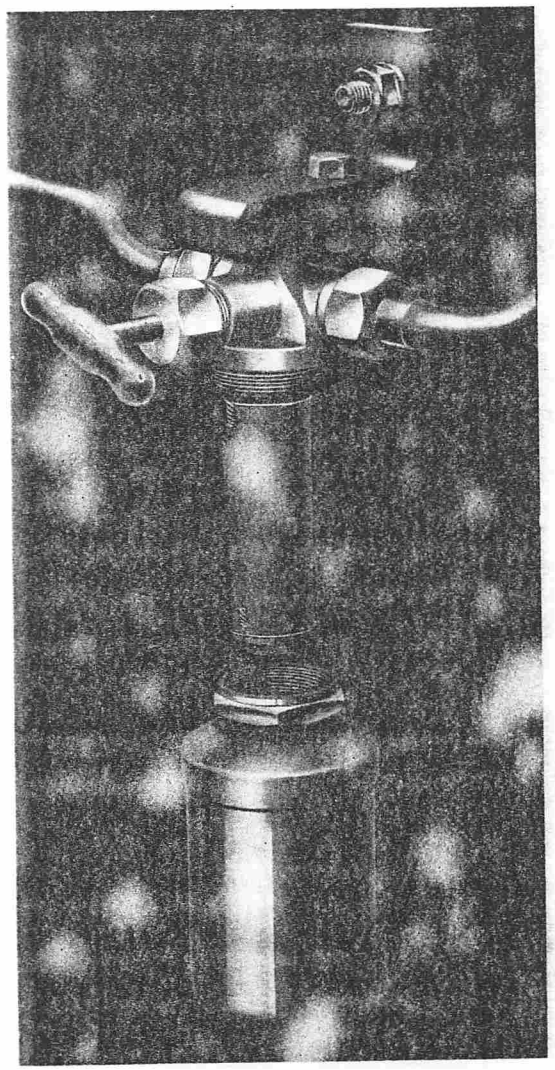


FIG. 20. FUEL TAP AND FILTER

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.

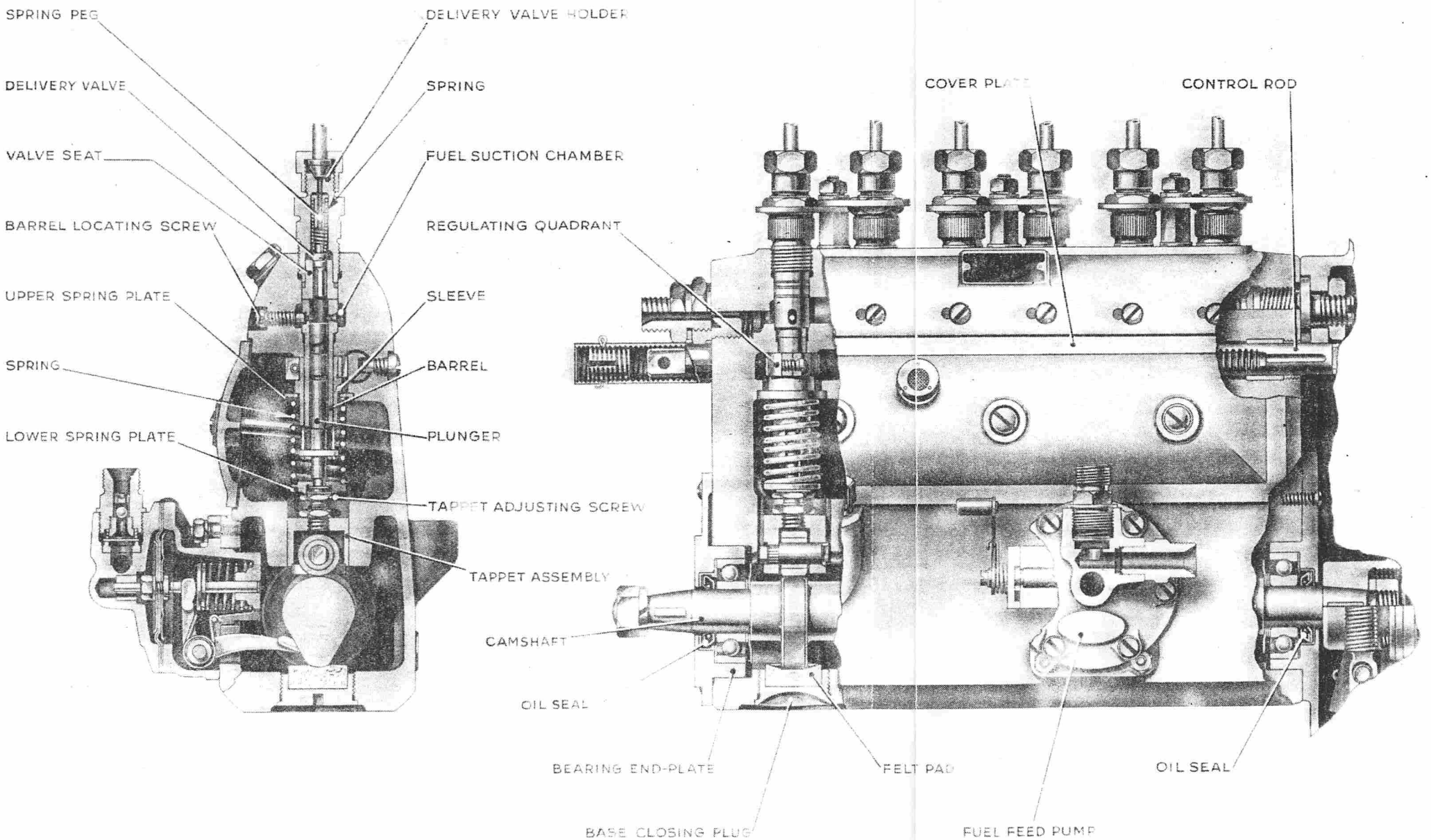


FIG. 21. THE FUEL INJECTION PUMP

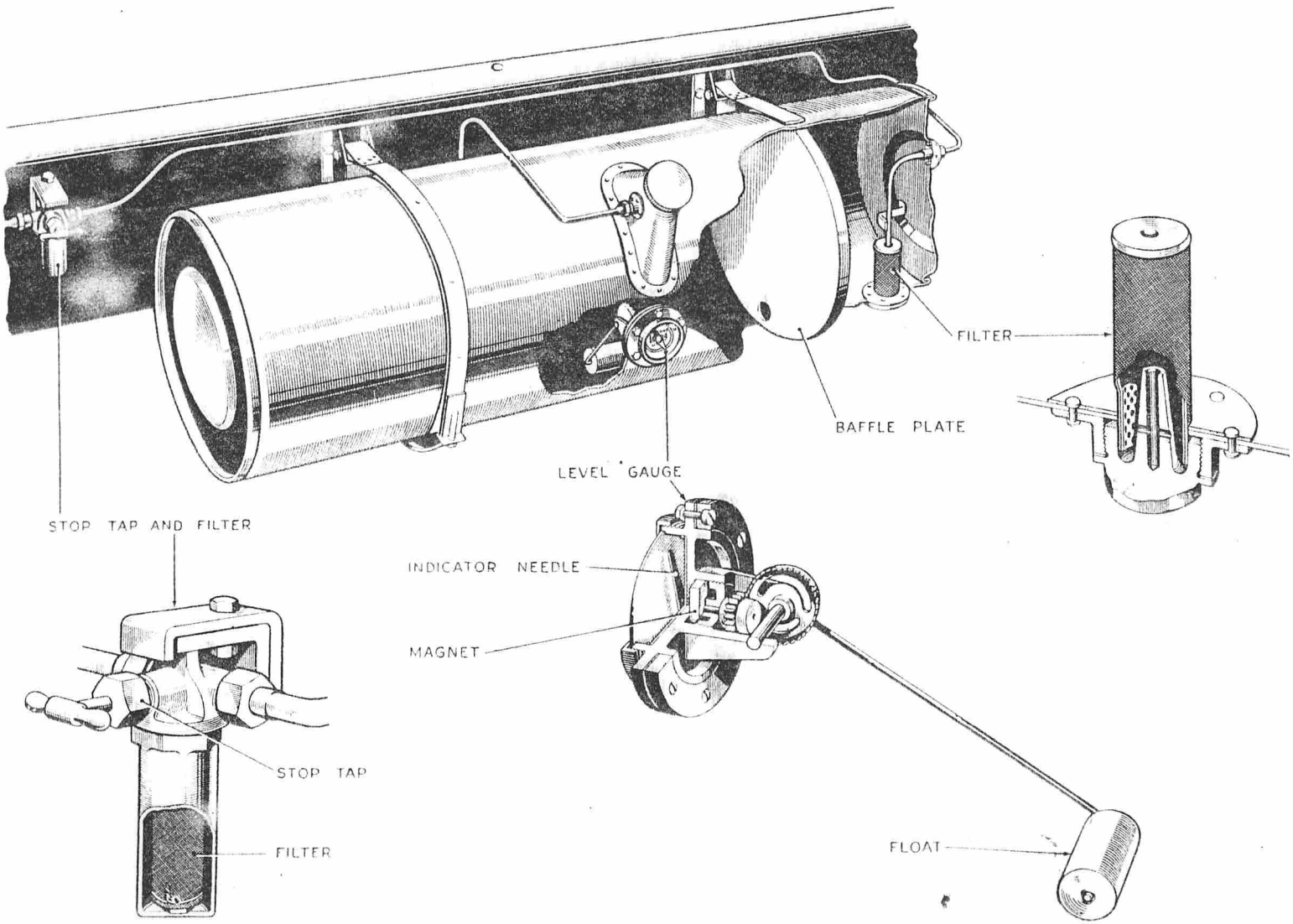


FIG. 22. FUEL TANK AND COMPONENTS

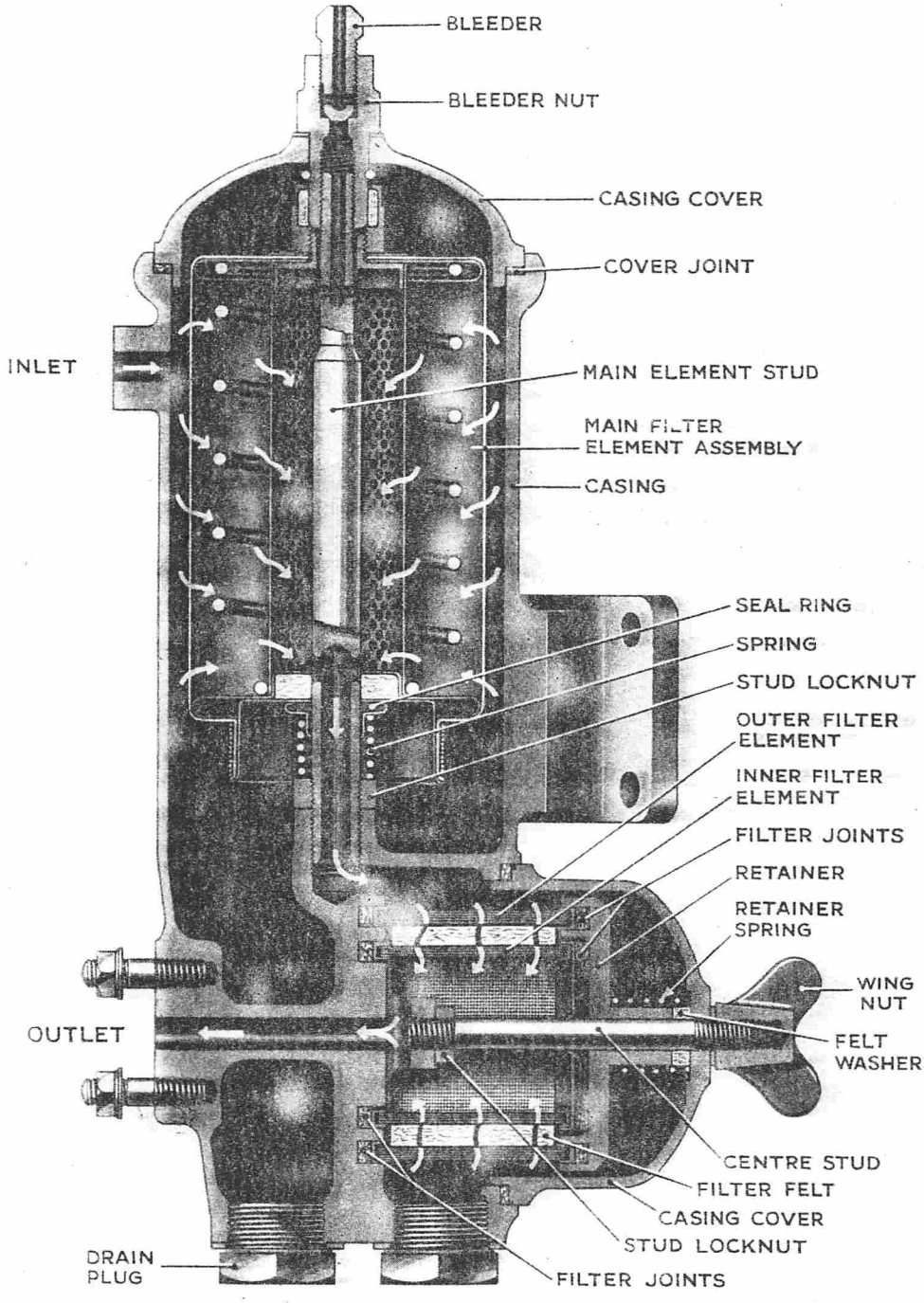
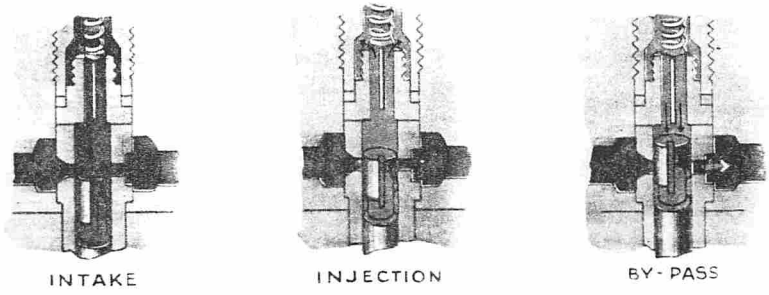
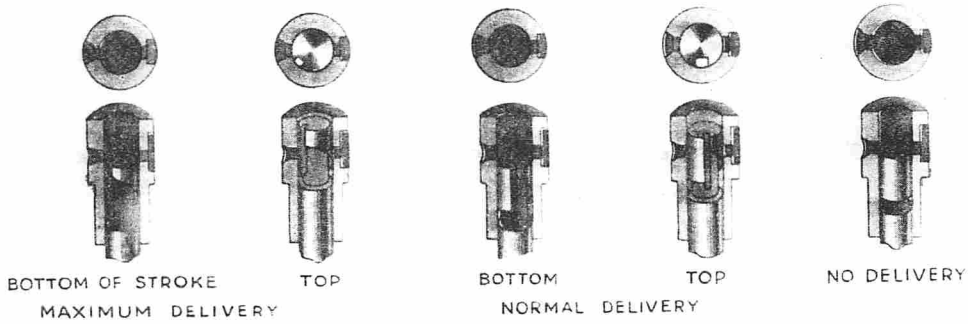


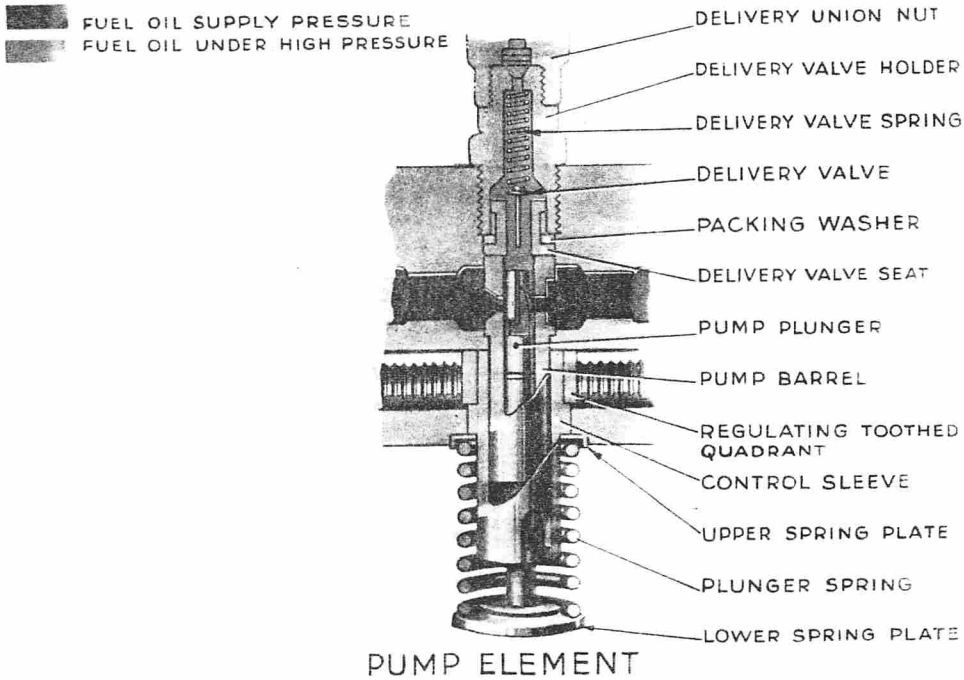
FIG. 23. THE MAIN FUEL FILTER



PRINCIPLE OF OPERATION



PRINCIPLE OF FUEL METERING



PUMP ELEMENT

FIG. 24. PRINCIPLE OF FUEL INJECTION

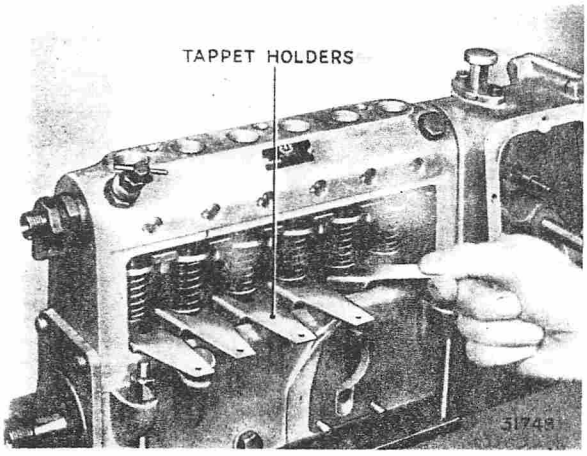


FIG. 25. FITTING TAPPET-LIFTING-PLATE

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 emergency 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.

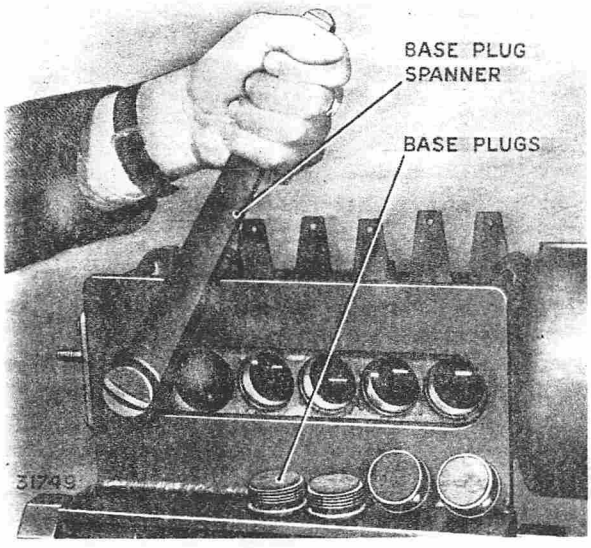


FIG. 26. REMOVING BASE-CLOSING PLUGS

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 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. 25).

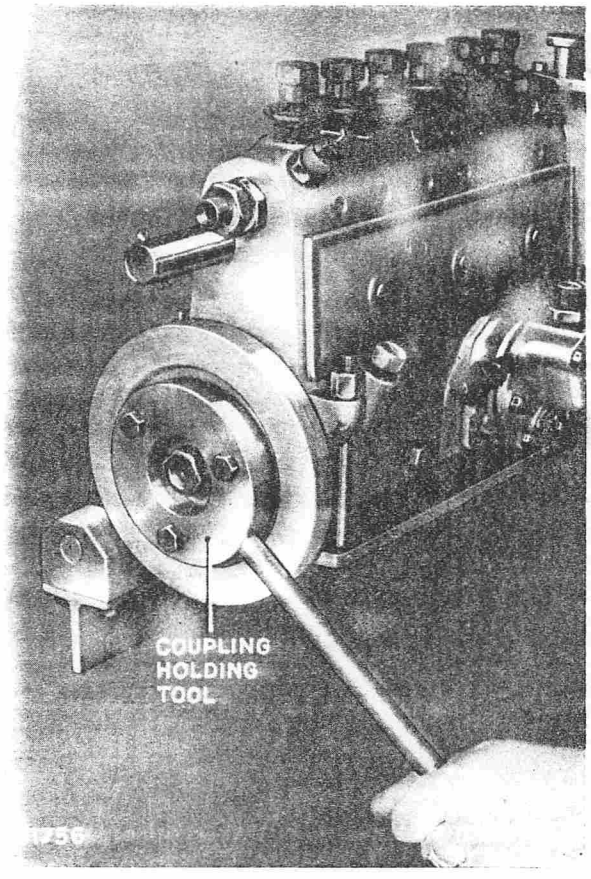


FIG. 27. HOLDING THE FUEL-PUMP FLYWHEEL

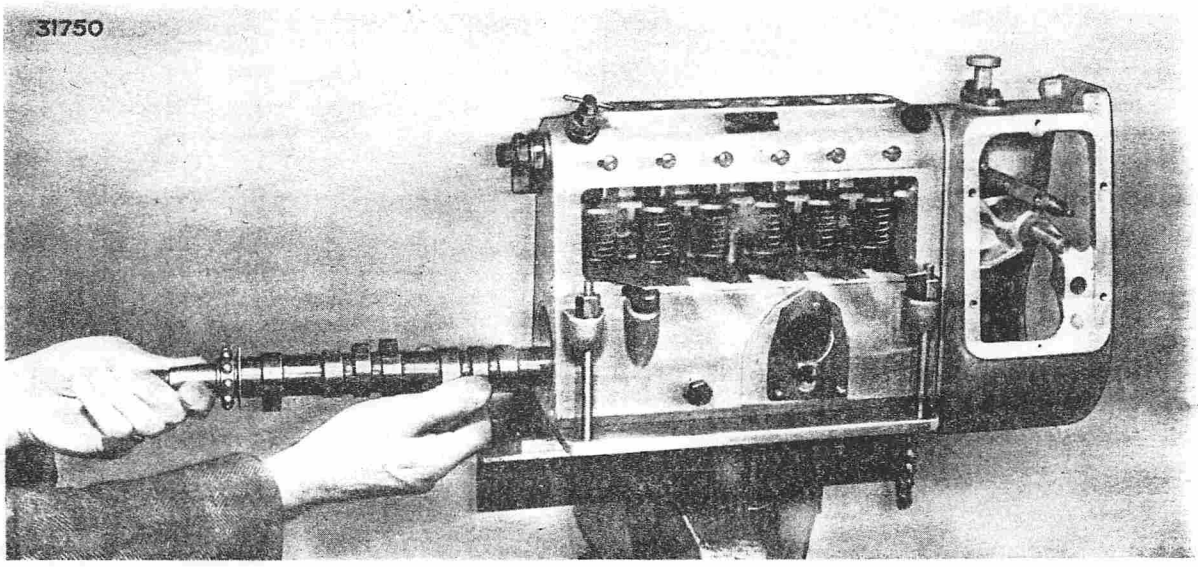


FIG. 28. REMOVING FUEL-PUMP CAMSHAFT

5. Unscrew the base closing plugs (Fig. 26).

6. Remove the injection pump flywheel, using the withdrawal and holding tool (Fig. 30.) 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. 28). 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. 36).

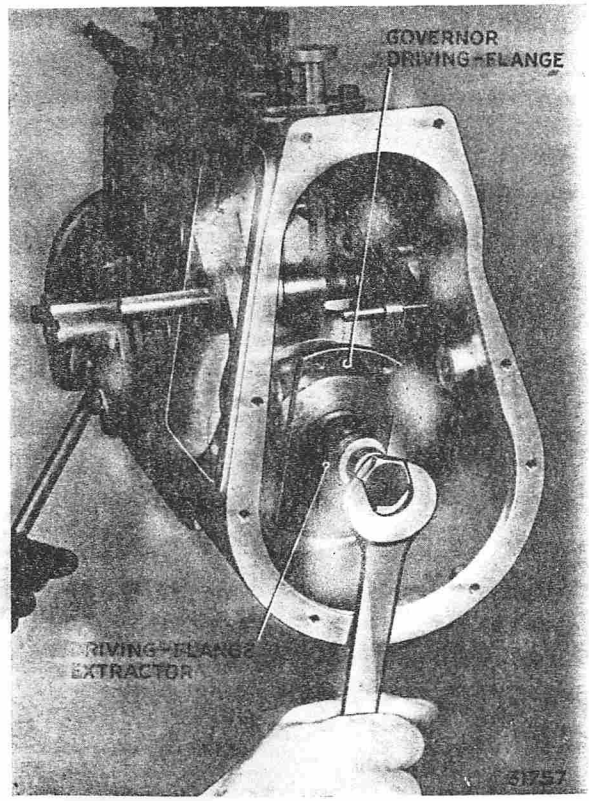


FIG. 29. REMOVING GOVERNOR DRIVING-FLANGE

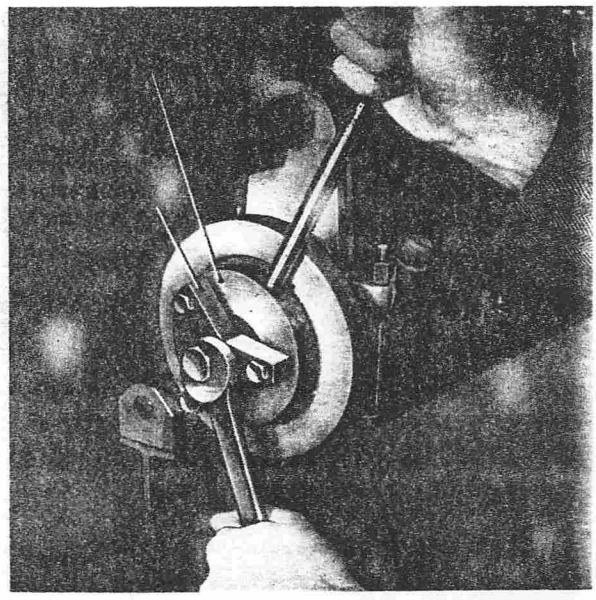


FIG. 30. REMOVING INJECTION-PUMP FLYWHEEL

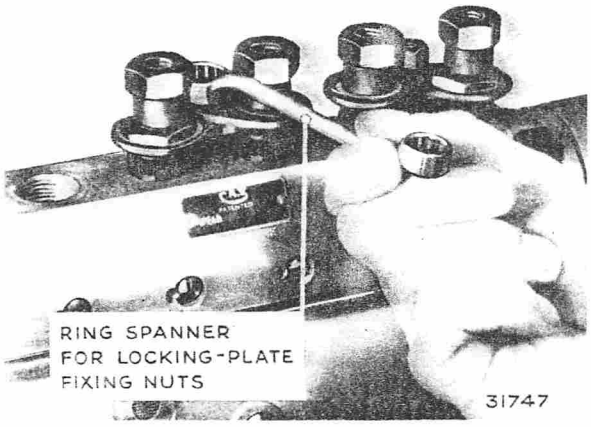


FIG. 31. REMOVING DELIVERY VALVE LOCKING-PLATES

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. 32).

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. 40).

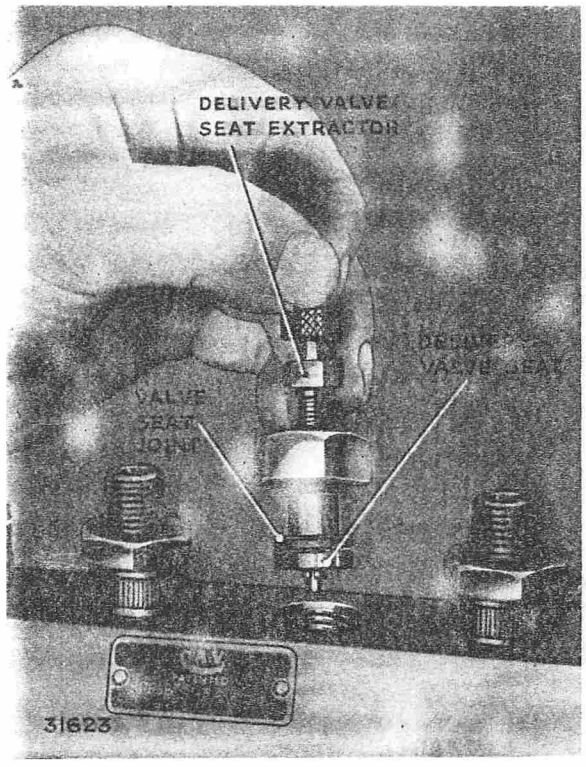


FIG. 32. REMOVING DELIVERY VALVE SEATING

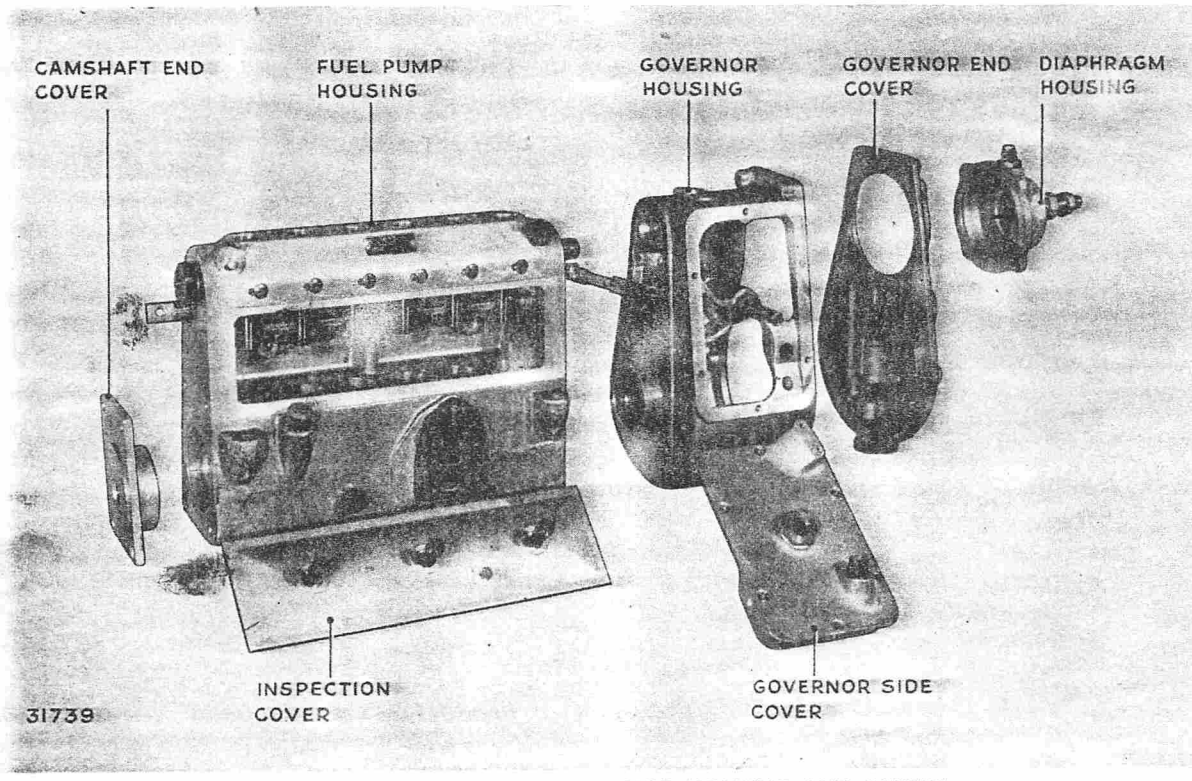


FIG. 33. INJECTION PUMP, GOVERNOR HOUSING AND COVERS

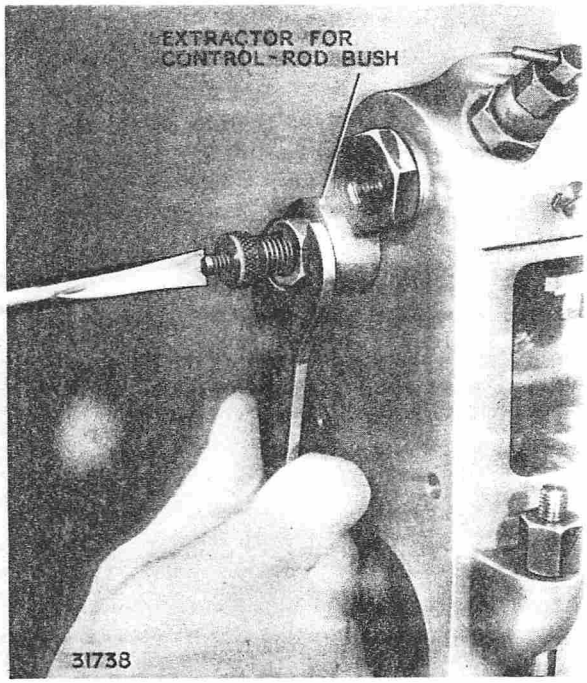


FIG. 34. REMOVING CONTROL ROD BUSHES

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. E.T.431, is required for removing the bushes (Fig. 34).
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. 35).
3. New bushes will have to be line reamed after fitting with C.A.V. Tool No. ET.109 ET.110 (Fig. 37).
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. 38).

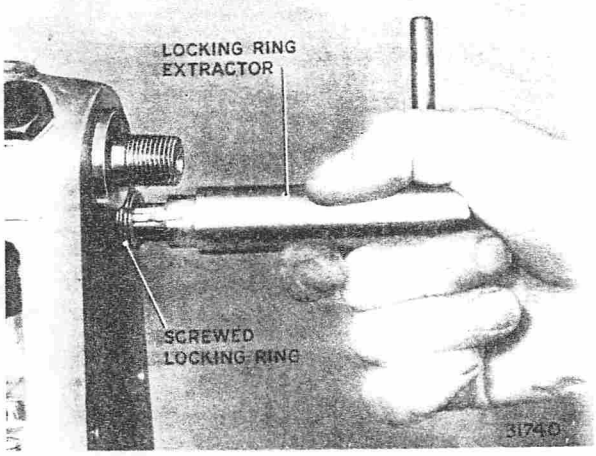


FIG. 35. REMOVING LOCKING RING

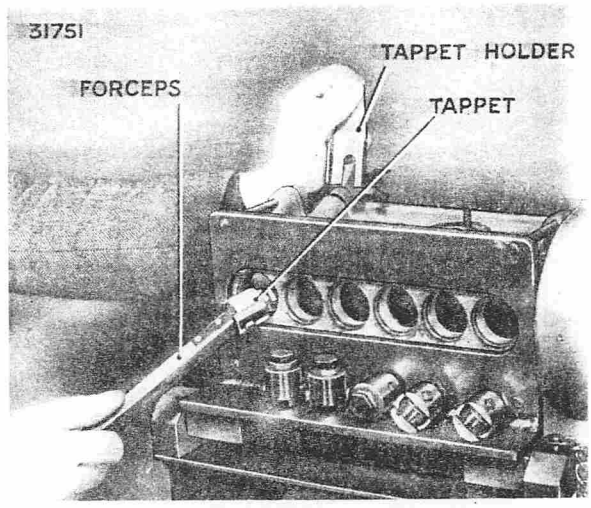


FIG. 36. REMOVING TAPPET ASSEMBLY

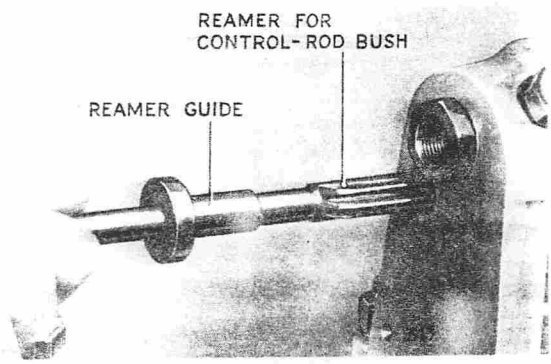


FIG. 37. REAMING CONTROL ROD BUSHES

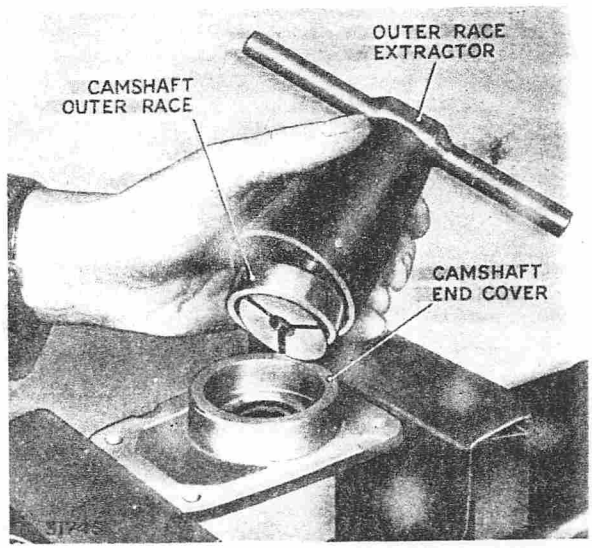


FIG. 38. REMOVING CAMSHAFT BEARING OUTER RACE

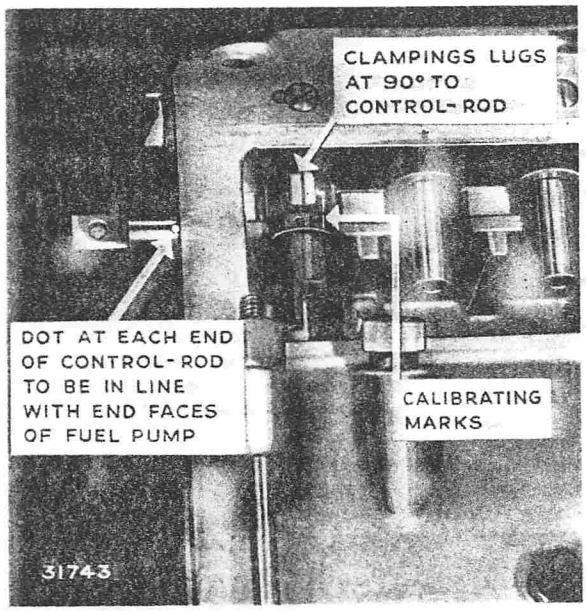


FIG. 39. SETTING CONTROL ROD

To Re-assemble 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.

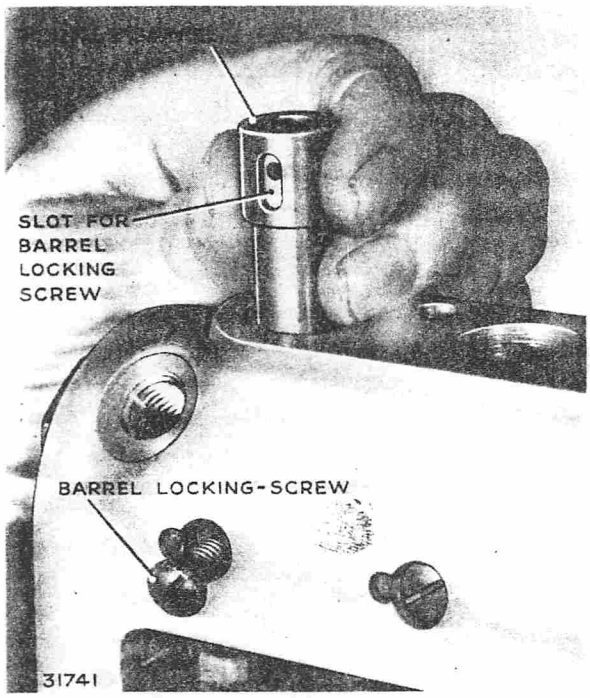


FIG. 40. REMOVING OR REPLACING PLUNGER BARREL

1. Fit the plunger barrel carefully, observing that the slot in it is opposite the hole for the locking screw (Fig. 40). 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 rotating movement of the barrel 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. 39).

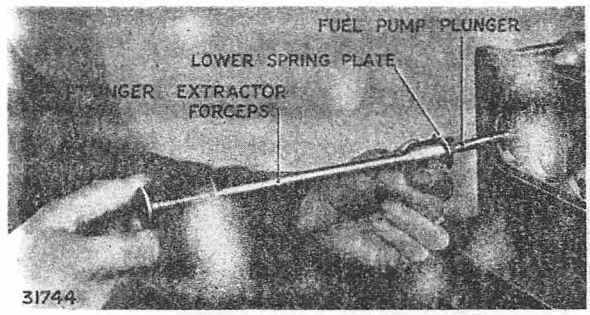


FIG. 41. REMOVING OR REPLACING PLUNGER

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. 39).

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. 41).

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.

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.

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 test injectors.

Readings to be taken at maximum fuel setting of 88 cu. mm. to 92 cu. mm. stroke at 600 r.p.m.—i.e., 17.6 to 18.4 c.c.'s 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. stroke.

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.

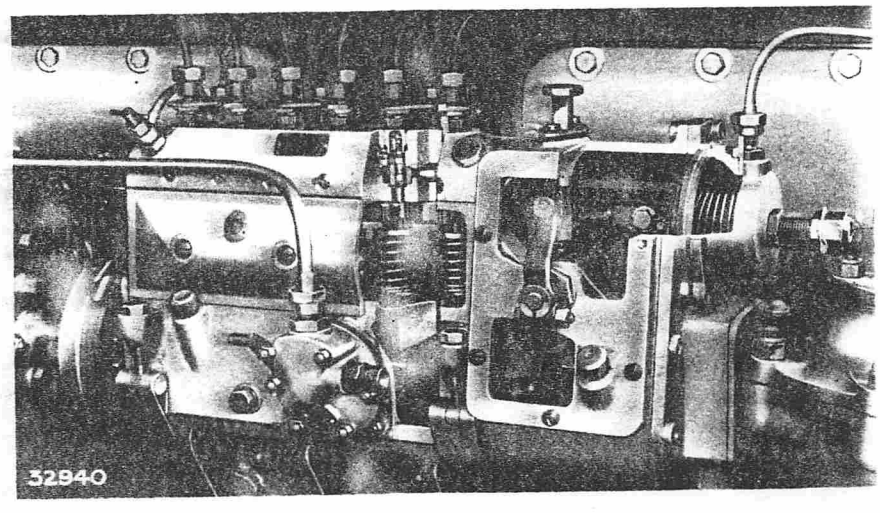


FIG. 42. INJECTION PUMP AND GOVERNOR

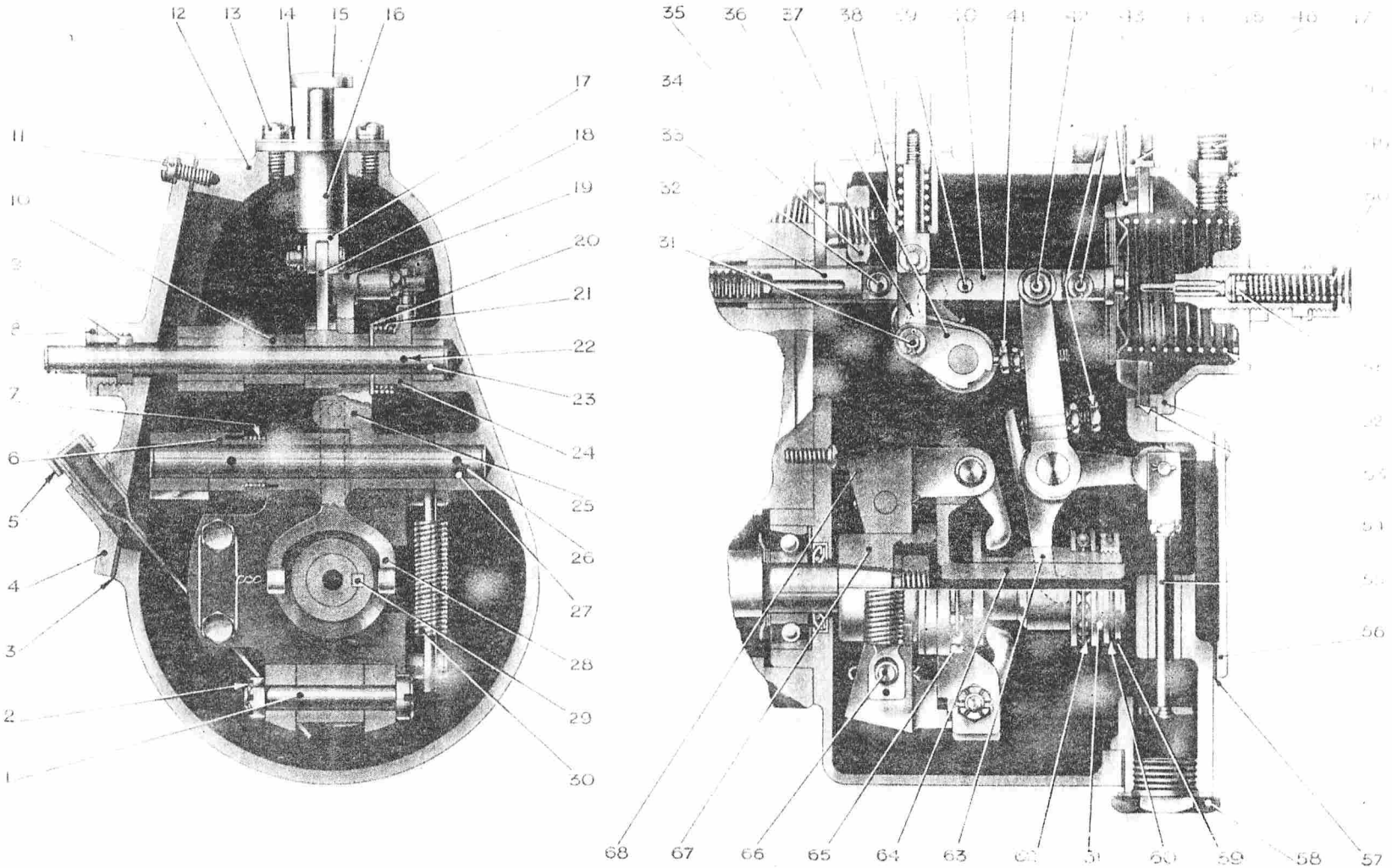


FIG. 32. SECTIONS THROUGH GOVERNOR

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

GOVERNOR

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 element which controls the idling and intermediate speeds of the engine. A flyweight governor controls the maximum speed of the engine.

The control rod is connected to a spring-loaded leather diaphragm which separates the main governor housing from the vacuum chamber. The control rod is held at full-load position by the spring. The vacuum chamber is in communication with a venturi unit, shown in Fig. 44, fixed over the air intake, by a copper pipe connection. The damper spring holds the control rod steady at idling speeds. When the damper valve lifts, however, due to the control rod touching it, air is drawn into the suction chamber. This helps to destroy the vacuum rapidly when the engine speed tends to increase, but as soon as the control rod moves forward, due to the decrease in vacuum, the valve shuts, thus restoring the vacuum, and engine speed decreases. This limits the movement of the control rod to a very small range, thus reducing any tendency of the engine to " hunt."

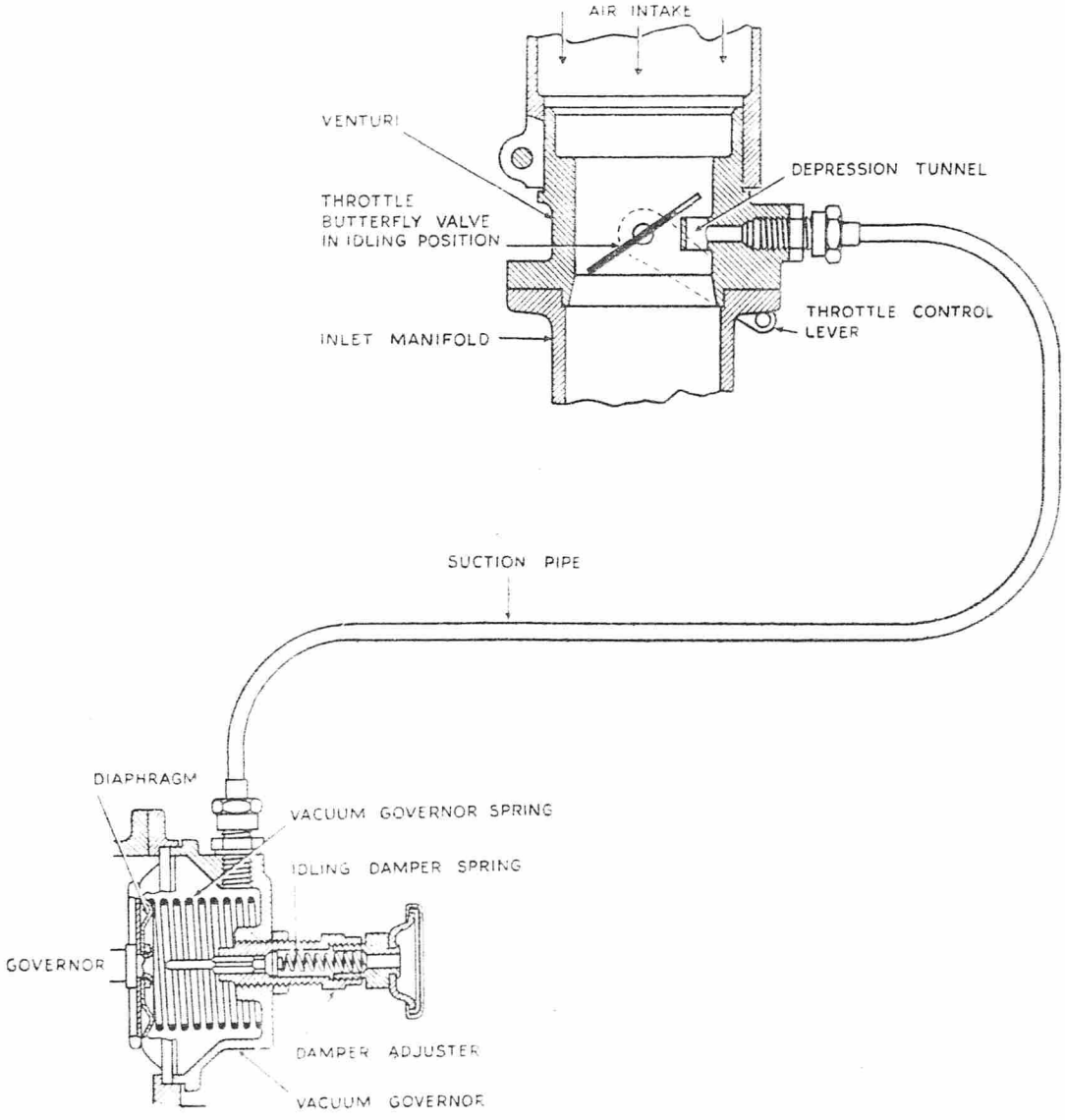


FIG. 44. DIAGRAM OF VACUUM GOVERNOR AND VENTURI CONNECTIONS

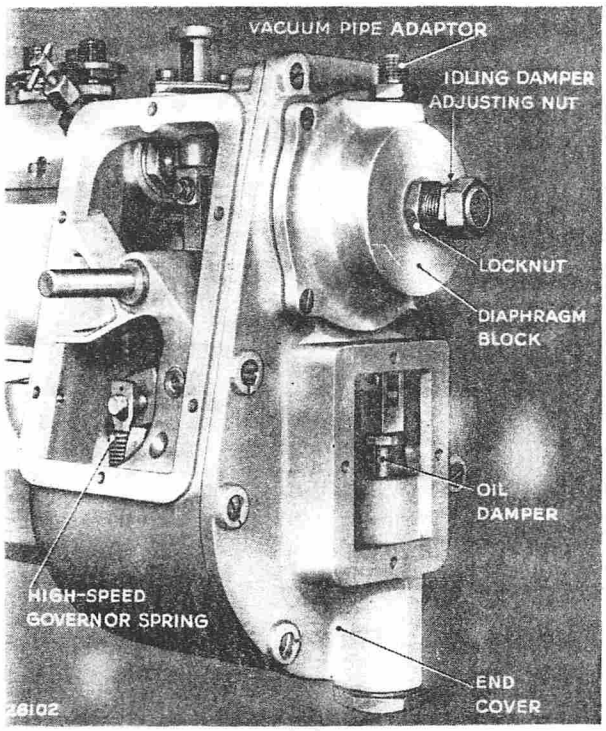


FIG. 45. GOVERNOR WITH SIDE COVER REMOVED

The vacuum in the suction chamber is determined by the extent to which the throttle is opened. As the throttle valve is opened a definite vacuum is created which exerts a pull on the diaphragm in opposition to the spring, so that the fuel pump control rod finds a balanced position.

At maximum speed, the flyweight governor comes into operation and moves the forked pickup lever into contact with the end of the lower adjusting screw on the operating lever, thereby moving the control rod back towards the closed position.

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. 46) and when operated returns the control rod back to the stop position.

Excess Fuel Control

Excess fuel for starting is provided for by a device shown in Fig. 46. Depressing the knob enables the full load adjusting screw carried on the operating lever to engage in the slot cut in the control rod stop, 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. 45), 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. 45), 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."

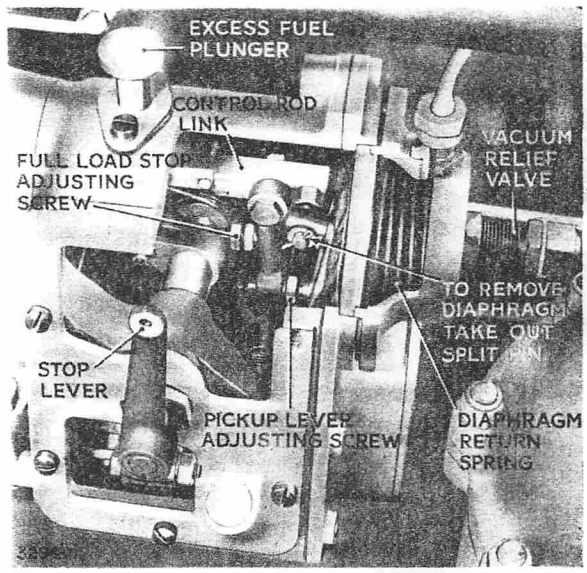


FIG. 46. GOVERNOR MECHANISM

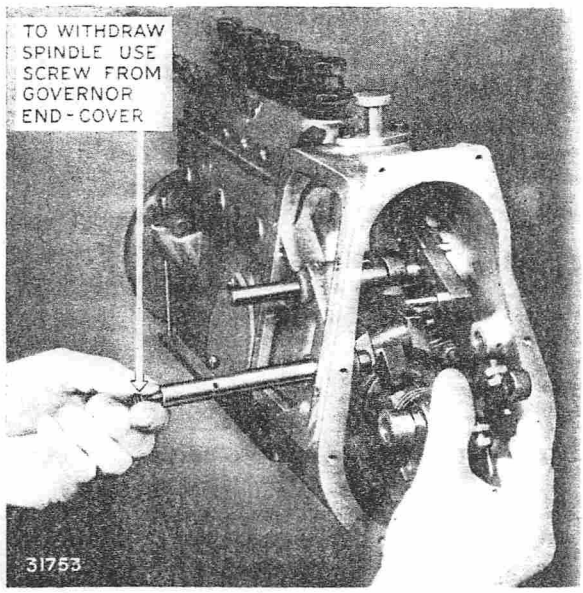


FIG. 47. REMOVING GOVERNOR LINKAGE SPINDLE

To Set High-Speed Governor

This should cut in at 1,800 r.p.m. engine speed and the runaway speed should not exceed 1,960 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.

When screwing **out** a spring eye, the spring must be gripped firmly near the end in a vice, otherwise the spring will lock the eye when an attempt is made to turn it. This procedure is not necessary when screwing an eye **in**

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. 46), securing the diaphragm to the control rod pin. Draw the rod to the full-off position and unhook the diaphragm.

4. Take out the split pins securing the pivot spindle (Fig. 50), screw a $\frac{1}{4}$ in. B.S.F. bolt into the tapped end and withdraw the spindle (Fig. 47). Remove the torsion spring and forked pick-up lever (Fig. 43).

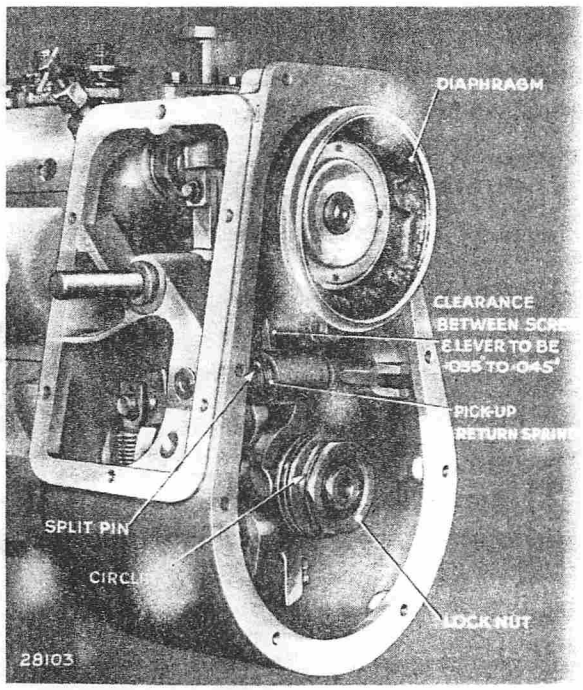


FIG. 48. GOVERNOR WITH COVERS REMOVED

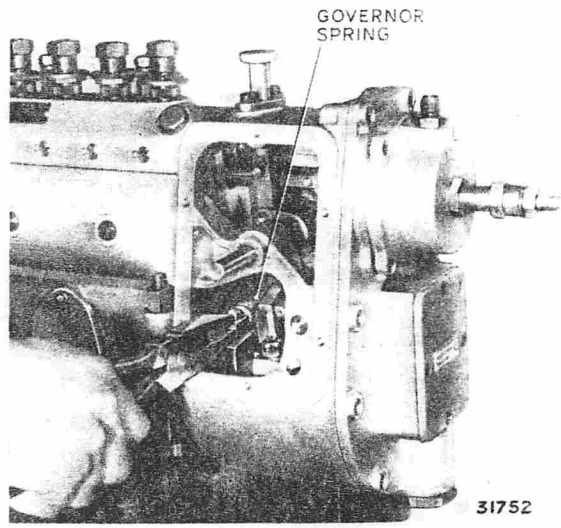


FIG. 49. RELEASING GOVERNOR SPRING

5. Release the governor springs (Fig. 49).

6. Remove the flyweight carrier bolts and withdraw the flyweights (Fig. 52).

7. Remove the four setscrews securing bracket (Fig. 52) to the driving centre and remove the bracket and sleeve.

8. Unscrew nut securing driving centre and using a special drawer (Fig. 29), remove the driving centre.

9. Remove the housing nut and setscrews (Fig. 43) 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.

FUEL FEED PUMP

The feed pump (Fig. 53) is of the variable-stroke-diaphragm type, driven directly by an eccentric on the injection pump camshaft. The pump is of ample capacity to ensure an adequate supply of fuel at all speeds.

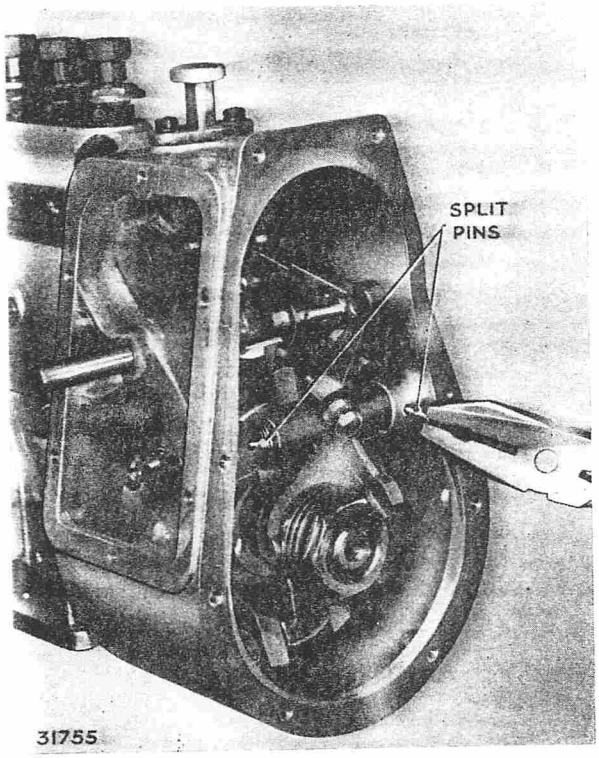


FIG. 50. REMOVING SPLIT PINS SECURING LINKAGE SPINDLE

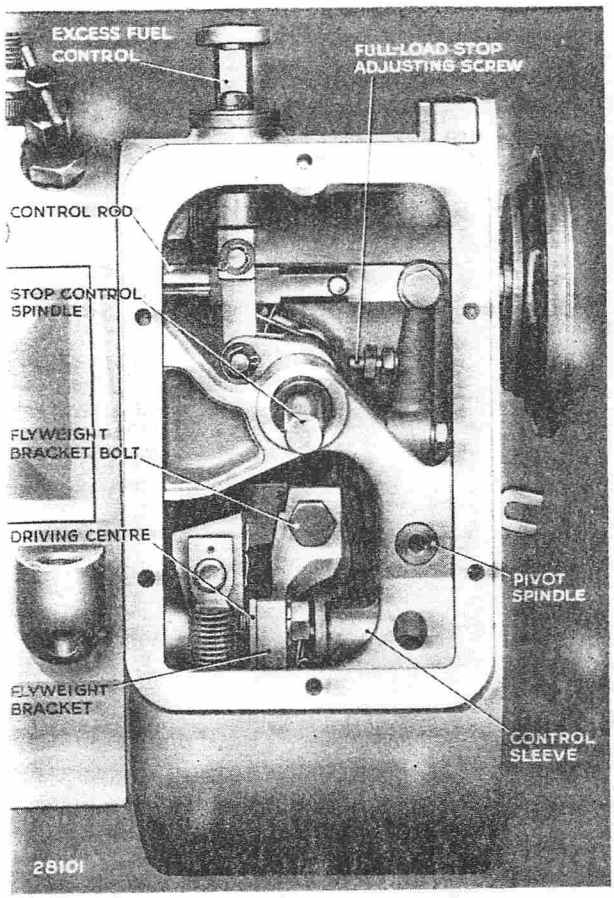


FIG. 51. EXCESS FUEL CONTROL AND FULL LOAD STOP

Operation

As the injection pump camshaft revolves, the eccentric pushes the rocker arm down ; this pulls the diaphragm, held between metal discs, inward against spring pressure thus creating a vacuum in the pump chamber.

Fuel enters the pump through the suction valve into the pump chamber. On the return stroke the return-spring pressure pushes the diaphragm outward, forcing fuel from the chamber through the pressure valve into the main fuel filter and so to the injection pump.

When the injection pump fuel gallery is full, a pressure is created in the pump chamber. This pressure will hold the diaphragm inward against the return-spring pressure, where it will remain inoperative until the pressure in the injection pump drops.

The small spring on the rocker arm is merely to keep the arm in constant contact with the eccentric to eliminate noise.

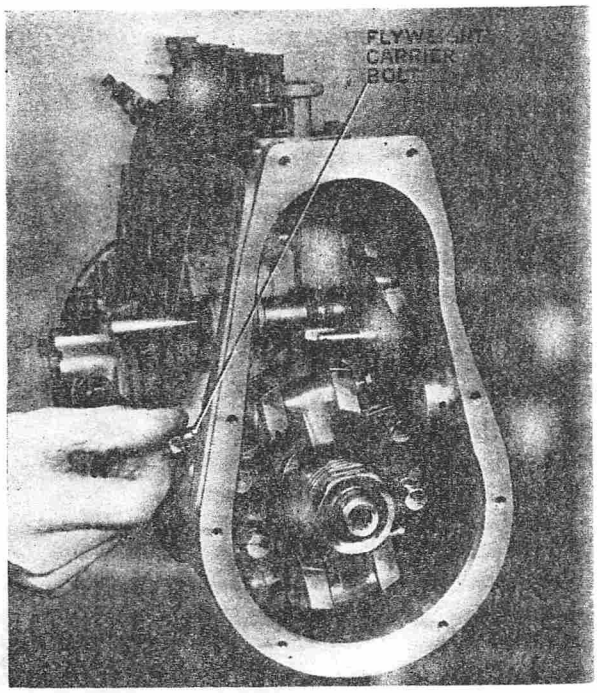


FIG. 52. REMOVING FLYWEIGHT CARRIER BOLT

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 both the main and primary filters are 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.

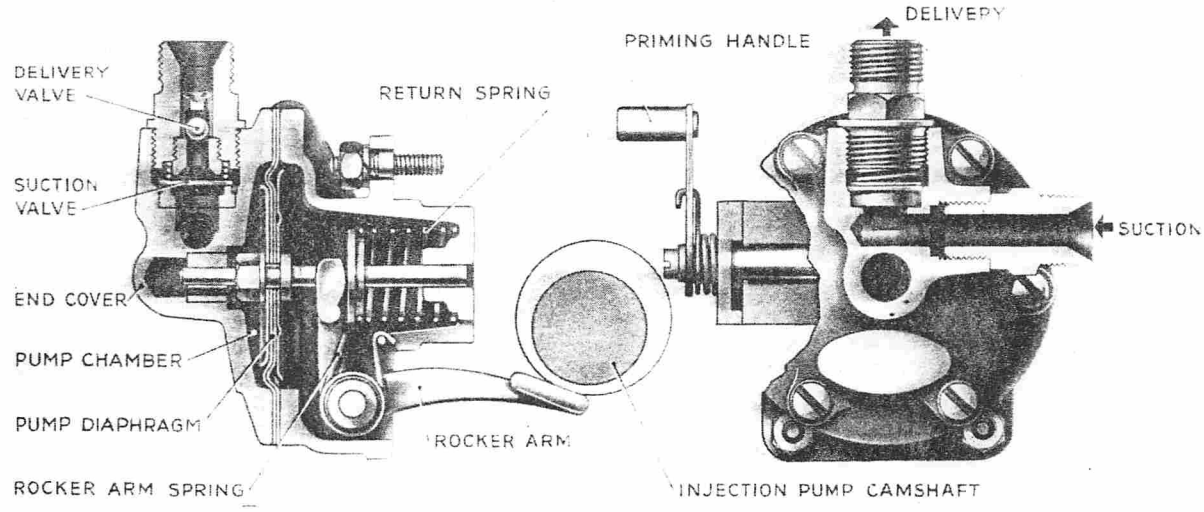


FIG. 53. THE FUEL FEED PUMP

INJECTORS

The fuel is delivered at high pressure to injectors (Fig. 54) 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.

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 systems :

1. Pronounced knocking on one (or more) cylinders.
2. Complete or intermittent misfiring.
3. Smoky exhaust (black).
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.

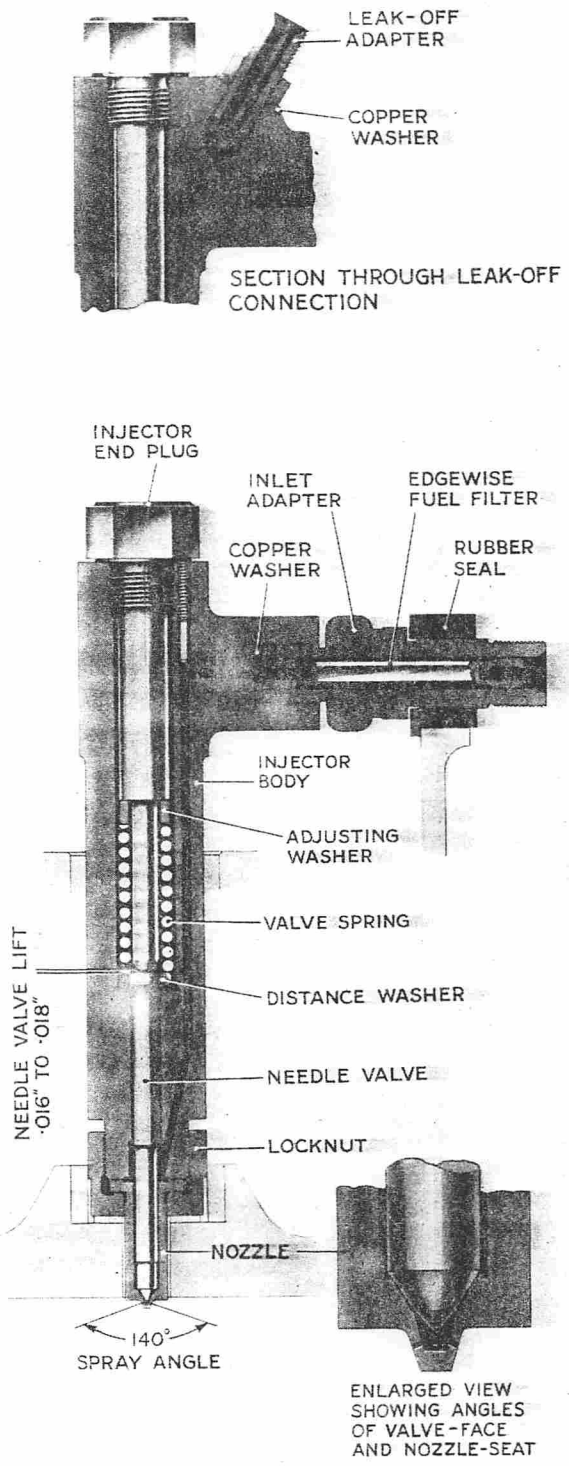


FIG. 54. THE INJECTOR UNIT

Faulty injection may be due to any of the following :

1. External carbon on nozzles.
2. Choked nozzle spray holes.
3. Loose nozzle locknut.
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 20 strokes per minute. 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 and depress the excess fuel plunger, then turn the engine with the starting handle and observe the spray.

When the injector is operating correctly, the spray from the nozzle spray holes should appear alike, of equal length and free from streaks or jets of undivided fuel (see Fig. 55). 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. Unscrew the locknut and remove the nozzle.
2. Remove the injector end plug and withdraw the valve spring, distance washer and needle valve. If

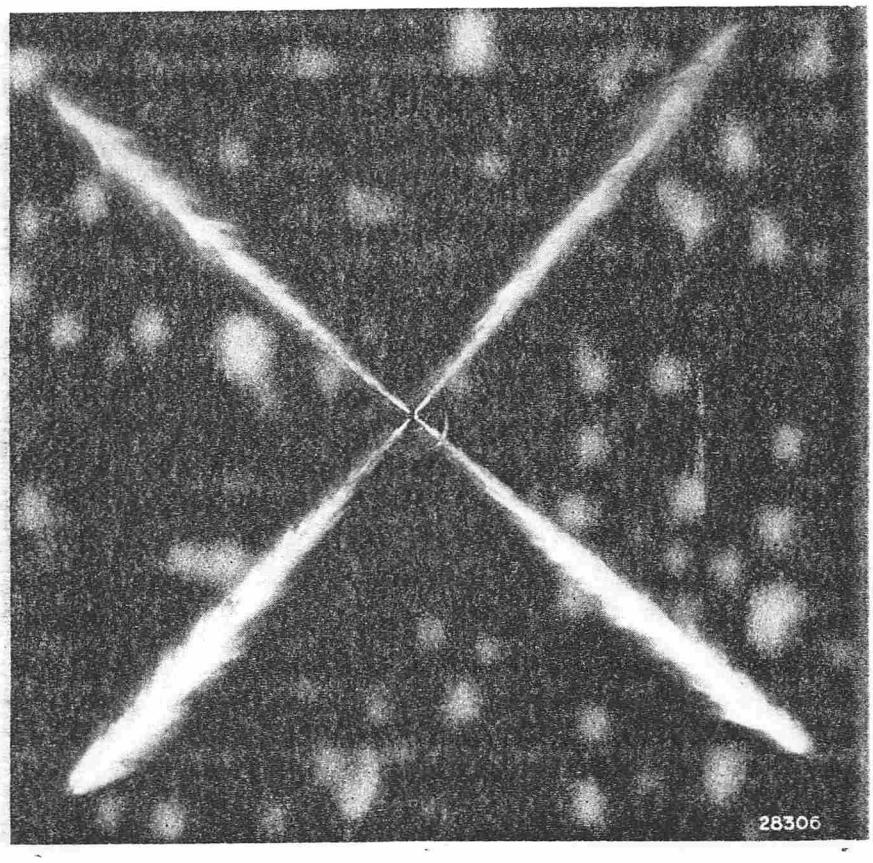


FIG. 55. INJECTOR SPRAY AS SEEN BY THE HIGH-SPEED CAMERA

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

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.

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 135 atmospheres. If the seat does not remain dry, repeat the lapping operations until such a condition is obtained.

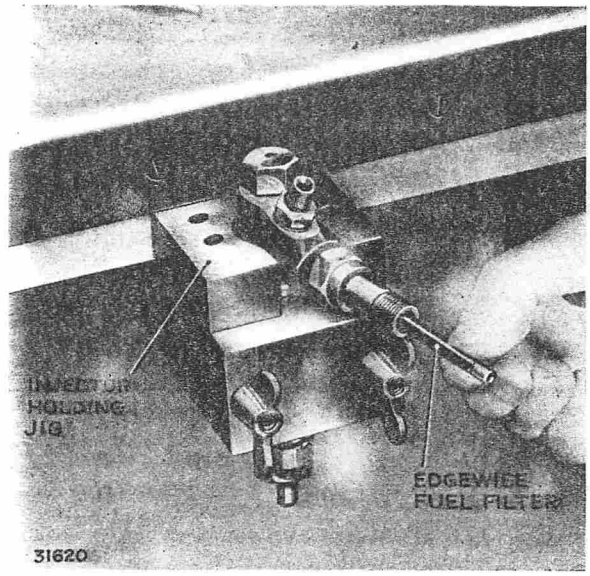


FIG. 56. FITTING THE EDGEWISE FILTER

To Re-assemble Injectors

1. Check that all the parts are perfectly clean and dry.

2. Fit the injector body in the holding jig (Fig. 56), so that the body is in an upright position.

3. Fit the nozzle and lock-nut, and screw up the lock-nut so that the nozzle can just be rotated with the fingers.

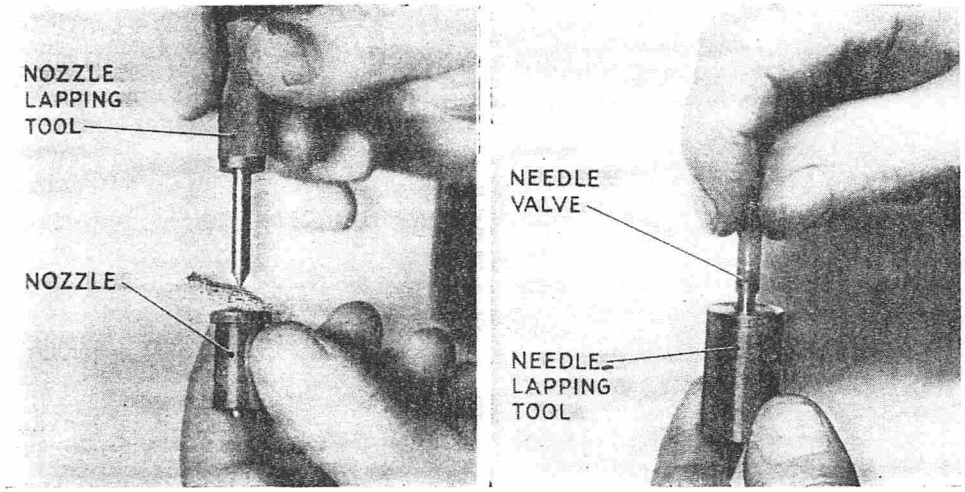


FIG. 57. LAPPING THE NEEDLE VALVE AND NOZZLE

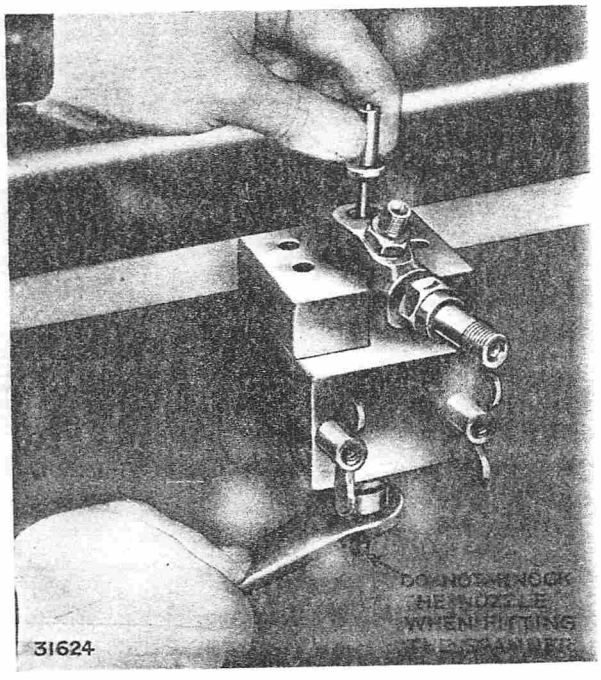


FIG. 58. TIGHTENING THE LOCK-NUT

4. Screw the 3 B.A. rod into the needle valve, 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 3 B.A. rod to bounce the needle valve rapidly on the nozzle seat. This is to ensure perfect centralisation of the nozzle and needle, without which the injector will not operate correctly. Finally, tighten the lock-nut with the ring spanner (Fig. 58), taking great care not to knock the nozzle when fitting the spanner.

6. When the lock-nut has been fully tightened, centralisation must be checked as follows :

   With the injector supported vertically in the holding jig, lift the needle valve off its seat, about $\frac{3}{4}$ in., then let it drop. The valve should strike the seat with a sharp metallic " click " and bounce about four times, otherwise the nozzle is not central and operation (5) must be repeated. If subsequent checks show no improvement, check the fit of the needle valve in the injector body.

7. Now assemble the distance washer, valve spring and 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.

1. Connect the injector to test pump ; expel all air from the pump.

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 (140 kg./sq. cm.) to 2,130 (150 kg./sq. cm.) lb./sq. in.).

3. The seat must remain dry with a sustained pressure of 135 atmospheres (1,984 (139.5 kg. sq. cm.) lb. sq. in.).

4. If the discharge pressure is not correct, check that the needle valve is free in the body ; if this is in order, then adjust the spring pressure by inserting a spring adjusting washer of a different thickness. Re-check the discharge pressure.

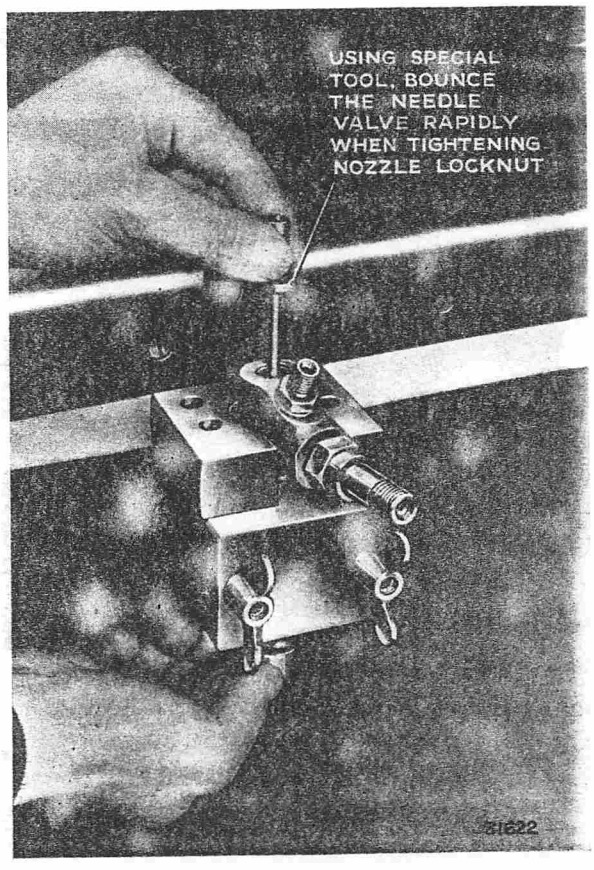


FIG. 59. CENTRALISING THE NEEDLE VALVE AND NOZZLE

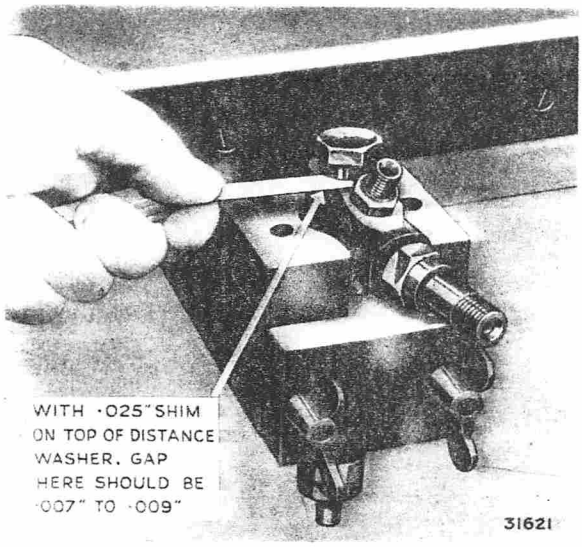


FIG. 60. CHECKING THE NEEDLE-VALVE LIFT

5. Check that the needle lift is between .016 in. and .018 in. To do this, remove the injector end plug and return spring. Insert a .025 in. thick shim on top of the distance washer and replace the end plug. Screw down the plug by hand and measure the gap between the end-plug and injector body (Fig. 60). If this gap is between .007 in. to .009 in., the needle lift is correct. If the gap is not correct, fit a different thickness of distance washer.

6. Check the time for the pressure to fall from 125 to 80 atmospheres (1,837 (129 kg. sq. cm.) to 1,176 (82 kg. sq. cm.) lb. sq. in.). The limits for rejection, using fuel oil are as follows (at room temperature 40° F. to 70° F.) :

New Injectors (not previously run in an engine) :

Upper limit 28 seconds.
Lower limit 12 seconds.

Used Injectors

Upper limit 20 seconds
Lower limit 7 seconds

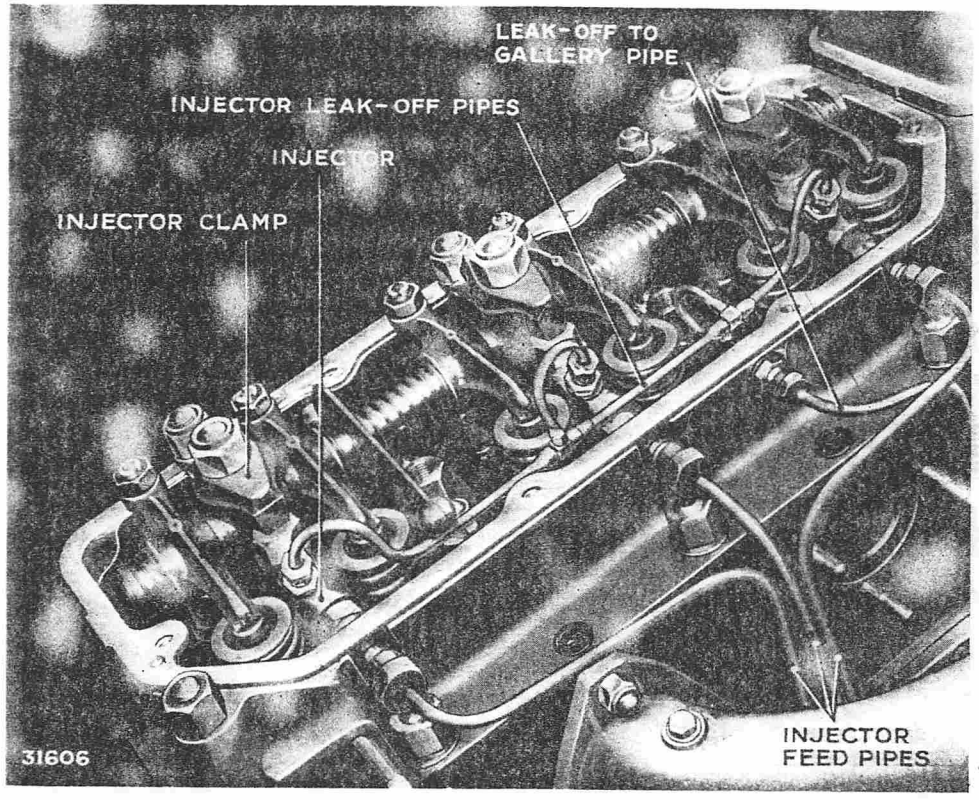


FIG. 61. INJECTORS AND LEAK-OFF PIPES IN POSITION IN CYLINDER HEAD

TO REMOVE AND REPLACE ENGINE AND GEARBOX

TO REMOVE ENGINE AND GEARBOX

1. Isolate the batteries by disconnecting at the terminals.

2. Drain the cooling system by operating the wheel valve at the front offside of the engine.

3. Remove the bonnet side covers and bonnet top, also the floor boards in the driver's cab.

4. Disconnect the radiator top-stay and the top and bottom water pipes at the flanged joints on the radiator.

5. Remove the bolts from the radiator mounting brackets on the front crossmember and remove the radiator.

6. Disconnect the starter motor cables and also the cable clip from the flywheel housing.

7. Remove the offside bonnet board and disconnect the oil pressure gauge pipe at the tap, on the side of the engine.

8. Disconnect the fuel feed pipe at the feed pump and remove the stop control cable from the governor.

9. Disconnect the fuel leak-off pipe at the rear near side of the engine.

10. Disconnect the air brake pipe line at the union at the rear of the engine.

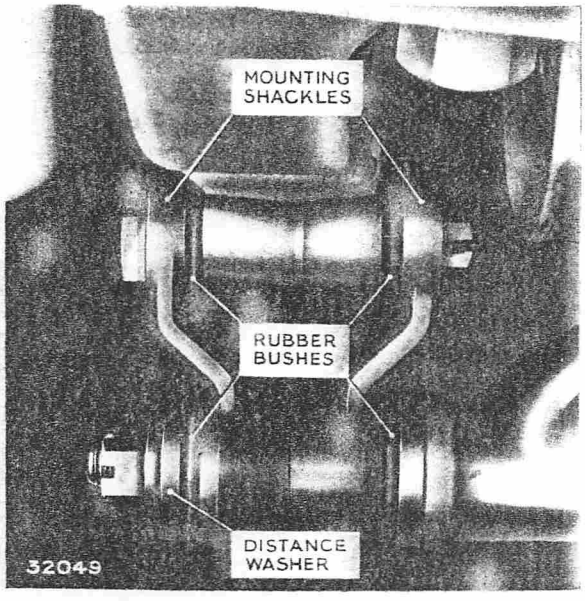
11. On vehicles with the compressor air-filter mounted on the dash under the bonnet near side, disconnect the air inlet pipe at the flexible connection.

12. Disconnect the accelerator control rod at the lever on the cross-shaft at the rear of the engine block.

13. Disconnect the dynamo cables and remove the forward near side bonnet board.

14. Break the air inlet hose connection at the venturi and remove the oil bath air filter and air intake trunk complete.

15. Remove the bolts connecting the propeller shaft and gearbox companion flange and slide the propeller shaft clear of the gearbox.



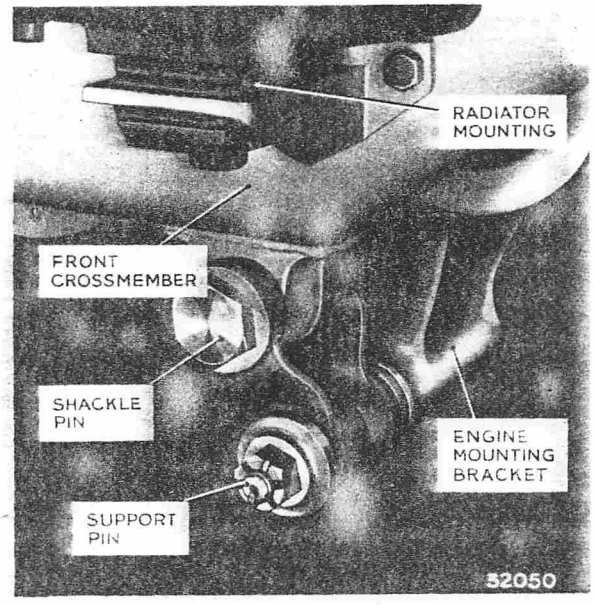


FIG. 63. ENGINE FRONT MOUNTING SHACKLES

16. Support the gearbox and remove the ten bolts securing the engine and gearbox through the banjo-crossmember (Fig. 64).

17. Disconnect the clutch operating rod at the ball end of the gearbox.

18. Remove the eight bolts, four each side securing the front crossmember to the frame side members.

19. Take the weight of the engine with a suitable crane before removing the two bolts securing the engine to the banjo crossmember (Fig. 64).

20. The engine can be manœuvred clear of the vehicle complete with front crossmember and without removing the front bumper.

21. It is advisable to leave the front bumper in position to keep the frame side members braced.

TO REPLACE ENGINE AND GEARBOX

The replacement of the engine and gearbox is a reversal of the procedure for removal.

There are certain points which must be watched to ensure the correct alignment and correct operation of the clutch :

1. Check that the clutch centre plate assembly is centralised before replacing gearbox. See **" Clutch "** chapters under **" To Re-assemble and Replace the Clutch").**

2. Do not strain the clutch centre plate assembly when meshing it with the clutch hub.

3. When the gearbox is finally replaced, check that the correct free travel on the clutch pedal is present. See **" Clutch "** chapter under **" Adjustment."**

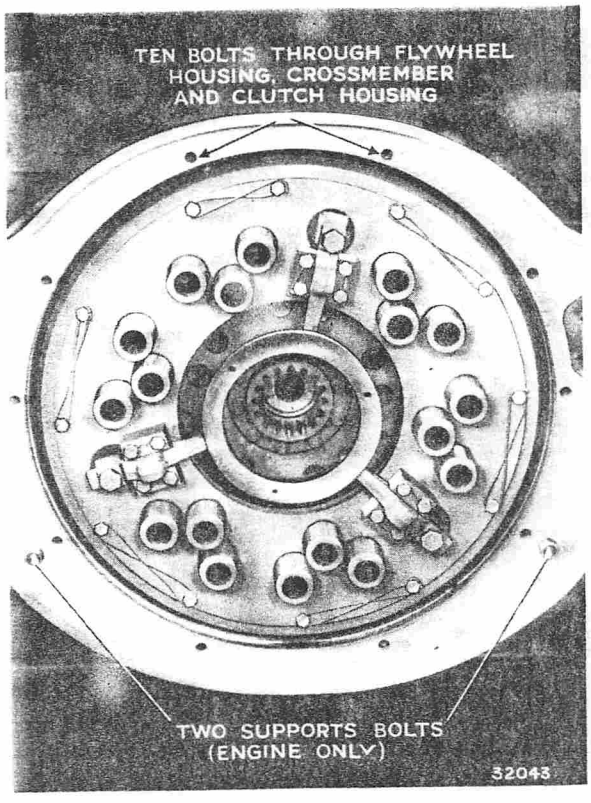


FIG. 64. ENGINE REAR MOUNTING

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 offside dynamo, and driving belts.
3. Remove the 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 exhauster 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.
8. Remove the four setscrews fixing the camshaft thrust washer, and withdraw the camshaft.

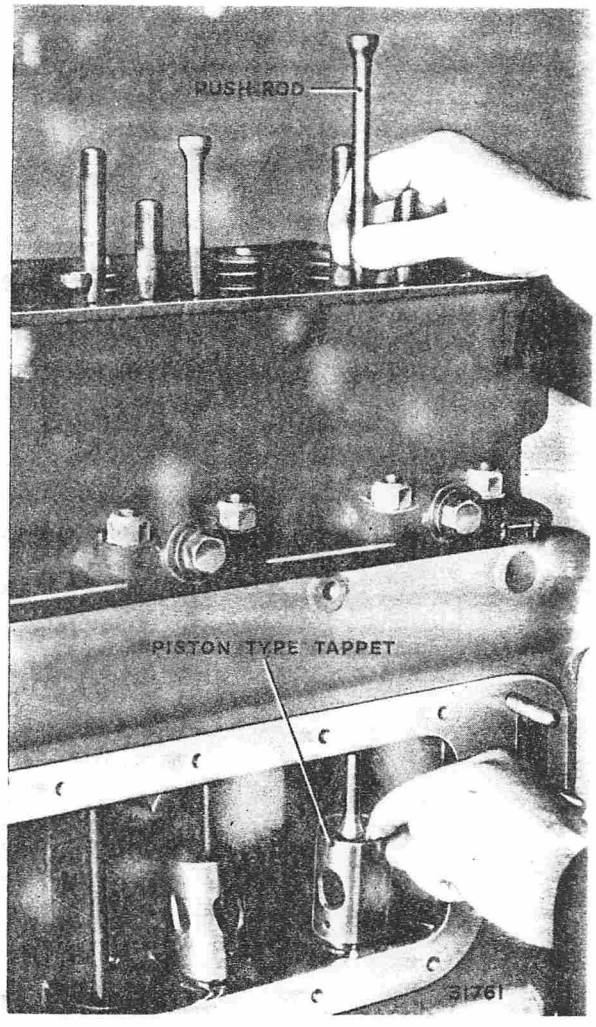


FIG. 65. REMOVING PUSH ROD AND TAPPET

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.

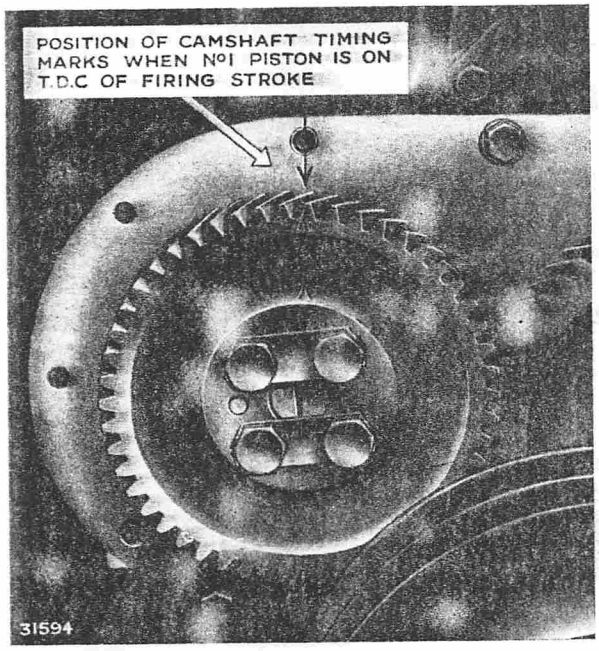


FIG. 66. CAMSHAFT TIMING MARKS

11. Check all bearings for wear and renew when diametrical 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. 66), that is, 90° to the top face of the engine block.

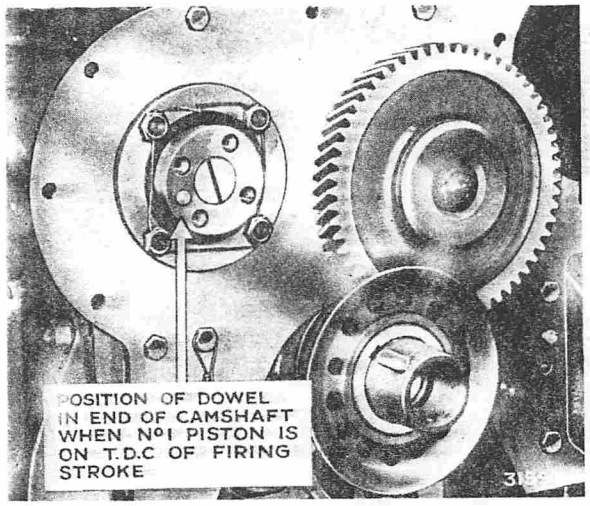


FIG. 67. GEAR LOCATING DOWEL IN CAMSHAFT END

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 4.8 in. + .020 in. at the top, new liners must be fitted.

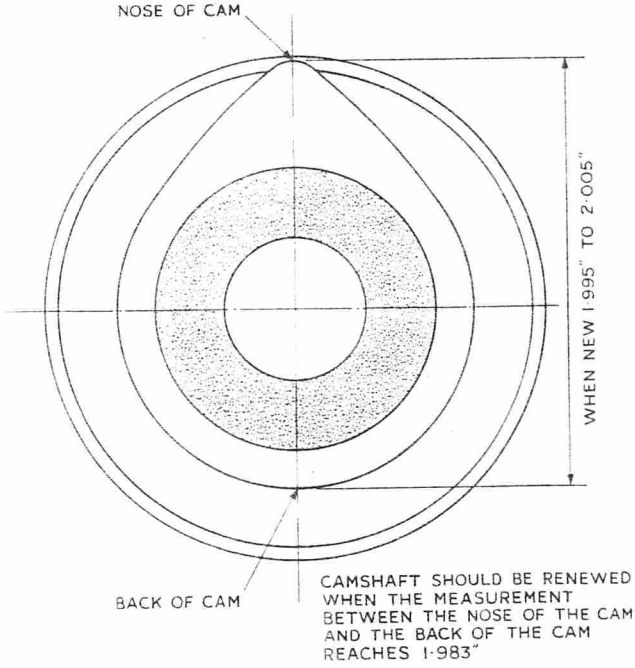


FIG. 68. CAM WEAR DIAGRAM

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

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.

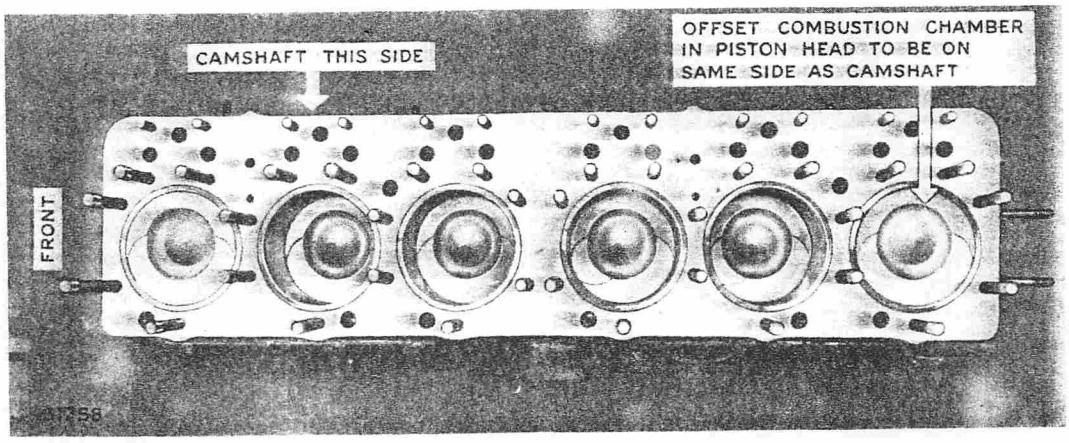


FIG. 69. POSITION OF OFFSET COMBUSTION CHAMBERS IN PISTON HEADS, IN RELATION TO THE CAMSHAFT

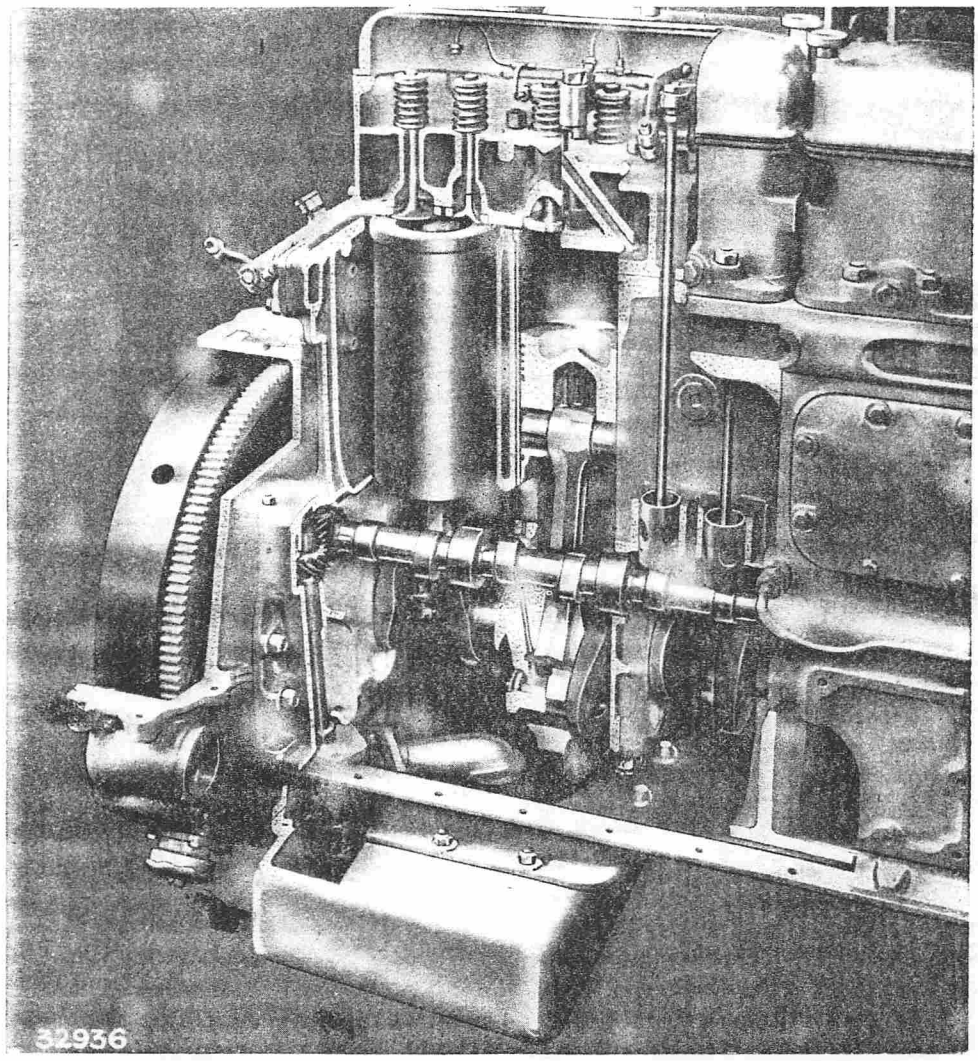


FIG. 70. CUT-AWAY SECTION OF REAR OF ENGINE

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 interference 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.

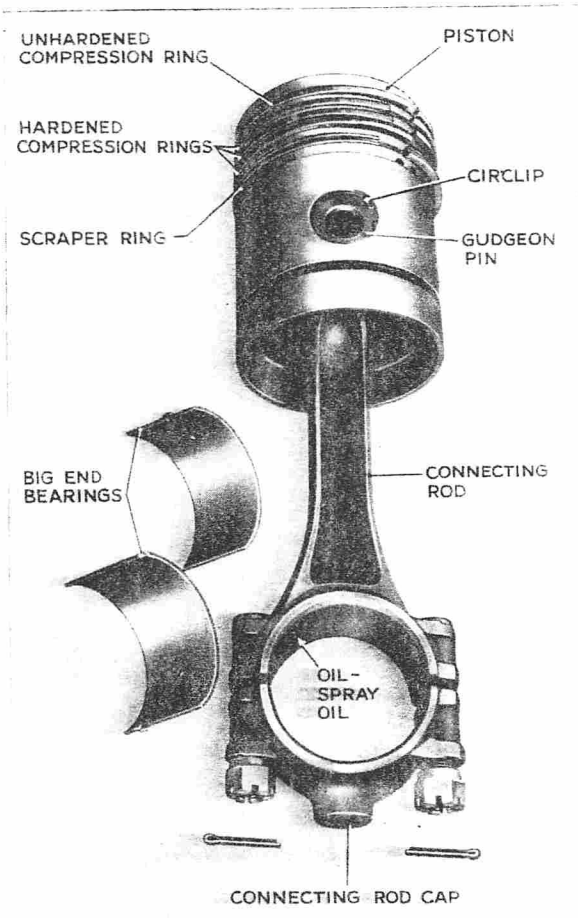


FIG. 71. CONNECTING ROD AND PISTON ASSEMBLY

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. 84).

To Fit Piston and Rings

Top groove ... Fit unhardened wedge-section fire-ring. This ring is slotted at an angle of 22½° for recognition purposes.

2nd, 3rd and 4th grooves ... ... Fit hardened compression rings. These are slotted at 90°.

5th groove ... Scraper ring, slotted, unhardened.

The initial piston ring gap is .020 in. to .024 in. Renew rings when gap exceeds .040 in. and 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. 84).

3. The connecting rod bolts must be tightened to within the limits 3.682 in. to 3.683 in., giving an overall bolt elongation of .006 in. to .008 in., which must be measured with a micrometer (Fig. 72).

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.

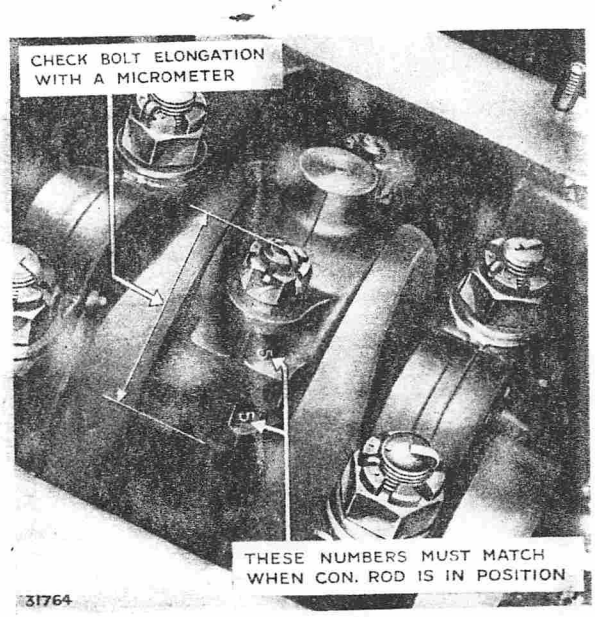


FIG. 72. CONNECTING ROD IN POSITION

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. 74). 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

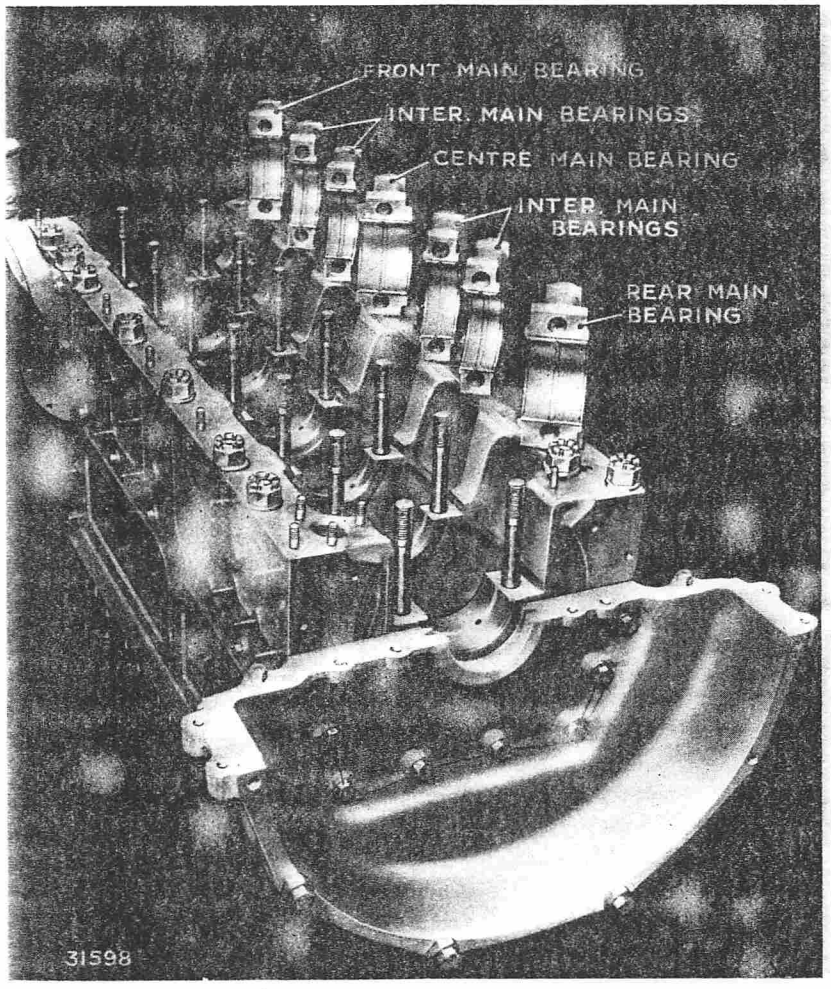


FIG. 73. ENGINE BLOCK AND MAIN BEARINGS

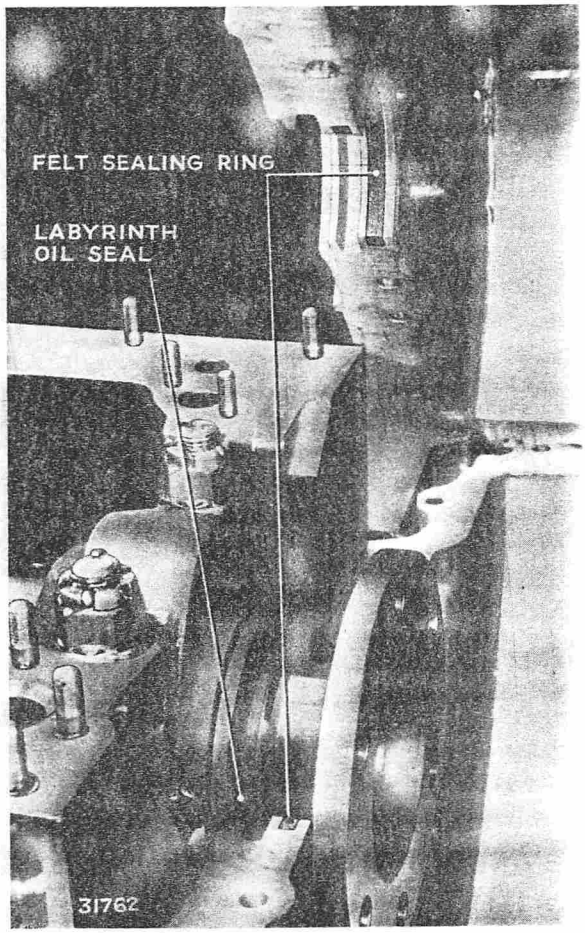


FIG. 74. LABYRINTH OIL SEAL

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

A rubber-bonded vibration damper is bolted to the pulley at the front end of the crankshaft.

The starter gear ring (Fig. 77) 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 instruction for these two latter operations being detailed in the sections preceding.

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.

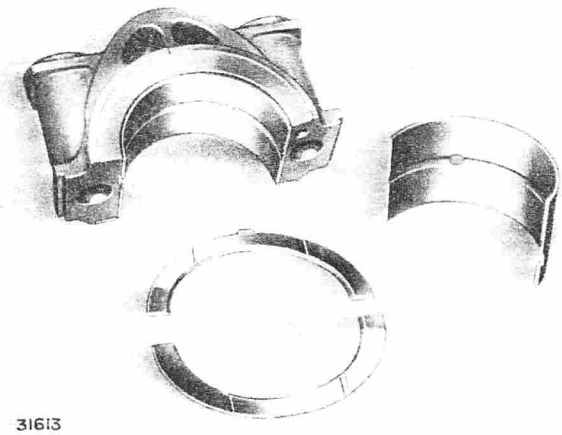


FIG. 75. CENTRE MAIN BEARING AND THRUST WASHERS

4. Remove bottom half of flywheel housing.

5. Withdraw driving pulley from end of crankshaft.

6. Disconnect the exhauster oil feed pipe 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.

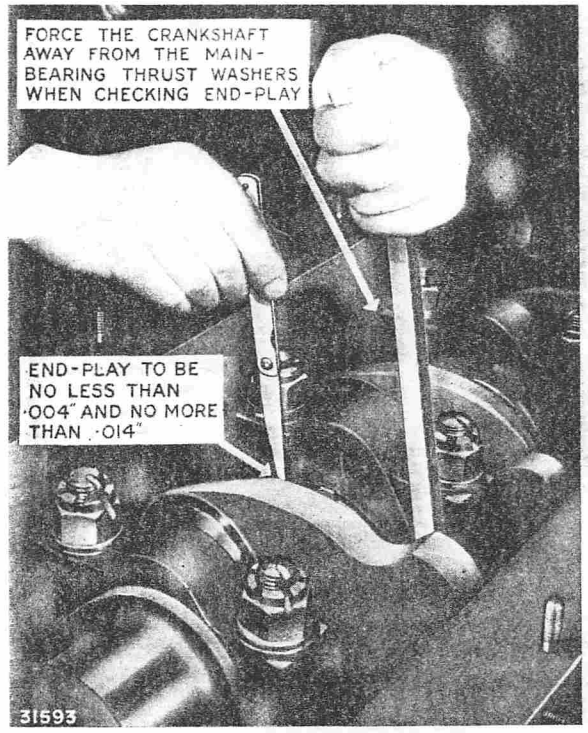


FIG. 76. CHECKING CRANKSHAFT END PLAY

4. Check the crankshaft end-play. This should not exceed .014 in. (Fig. 76).

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.

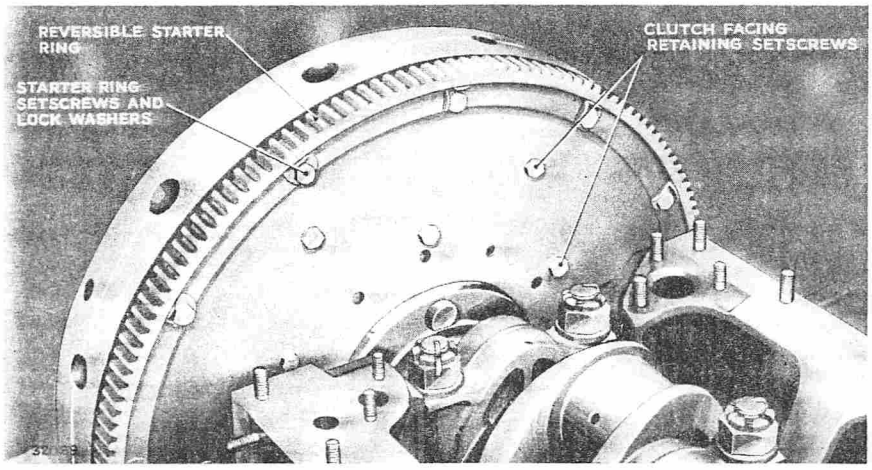


FIG. 77. REAR VIEW OF FLYWHEEL AND STARTER RING

To Regrind the Cranskhaft

The rate of wear of the crankshaft journals and crank pins is such that at least 200,000 miles can be expected before regrinding becomes necessary.

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 .006 in. in radius—total run-out of .012 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.

Check the main bearing diametral clearance. This should be within the limits .0020 in. to .0042 in. when new bearing shells are fitted. Bearings should be renewed when diametral clearance exceeds .009 in.

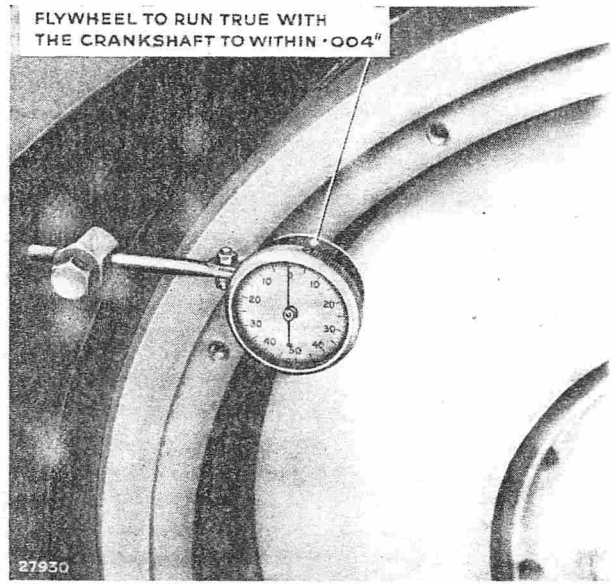


FIG. 78. CHECKING FLYWHEEL FOR RUNNING TRUE

When refitting the flywheel to the crankshaft, check that the flywheel runs true with the crankshaft to within .004 in., as shown in Fig. 78.

ENGINE LUBRICATION

DESCRIPTION

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

The oil sump capacity is approx. 5 gallons, as shown by the full mark on the dipstick. The oil should be changed every 5,000 miles.

Oil is drawn from the bottom sump well, 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 (Fig. 84).

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 bottom sump well, via a short standpipe below oil-level to prevent aeration.

The sump suction filter should be removed and washed in paraffin every 20,000 miles.

To remove the suction filter, it is only necessary to drop the bottom 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

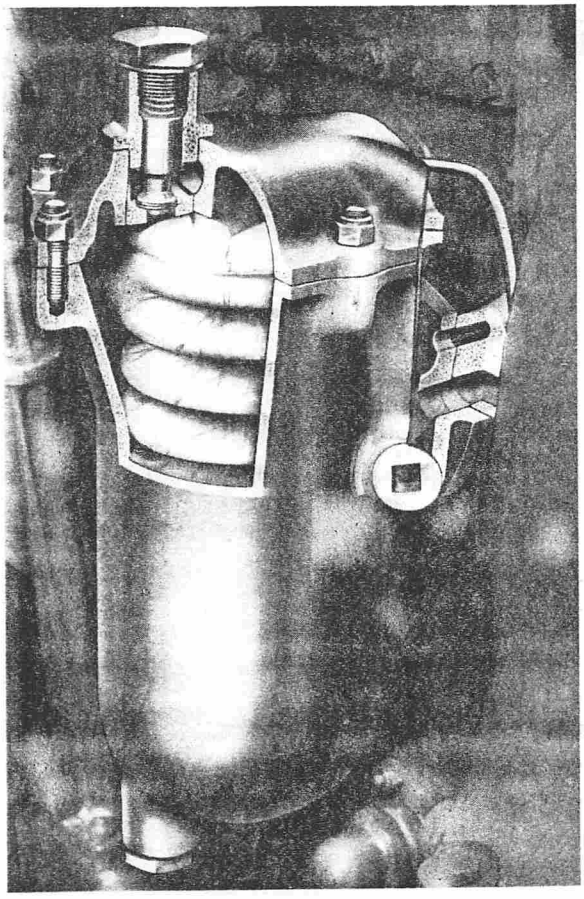


FIG. 79. CUT-AWAY SECTION OF OIL FILTER

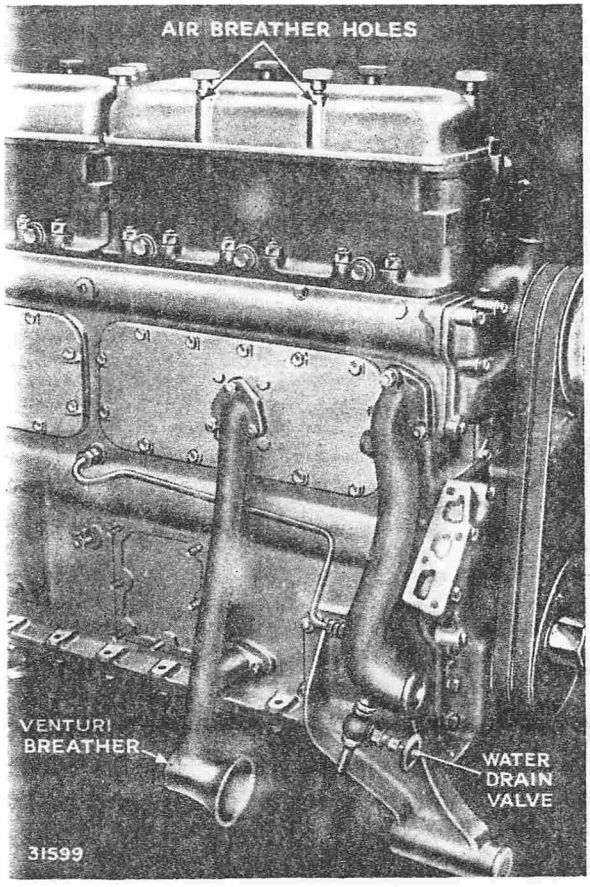


Fig. 80. ARRANGEMENT OF ENGINE BREATHING

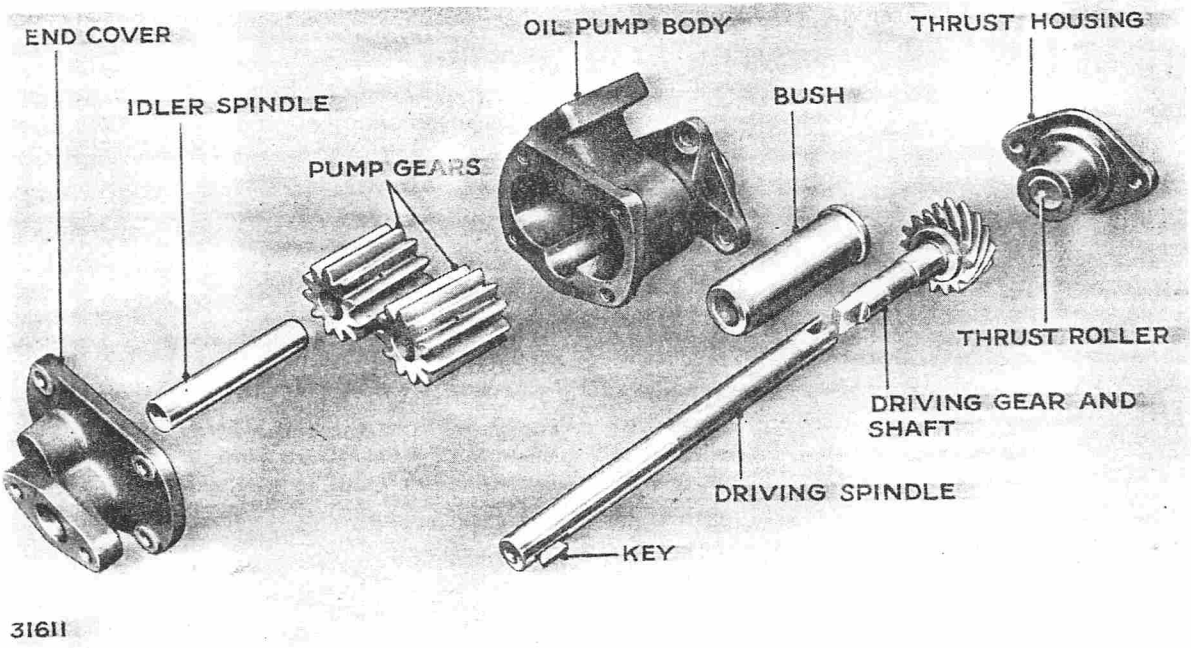


FIG. 81. OIL PUMP AND DRIVE DISMANTLED

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.

The engine-driven exhauster is fed independently by suction created in the exhauster. Oil, flung from the timing gears, collects in a well cast in the timing case and is drawn into the exhauster through a copper pipe connected to the timing case side.

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 galley cover (Fig. 80).

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 only used 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.

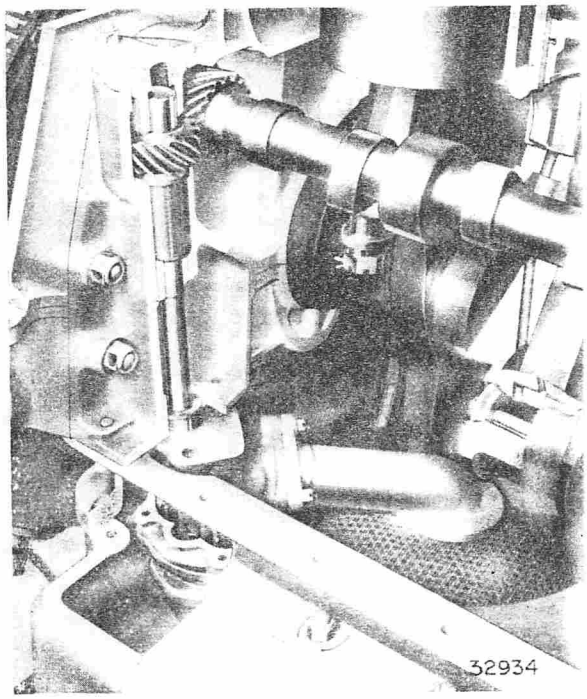


FIG. 82. OIL PUMP DRIVE FROM CAMSHAFT

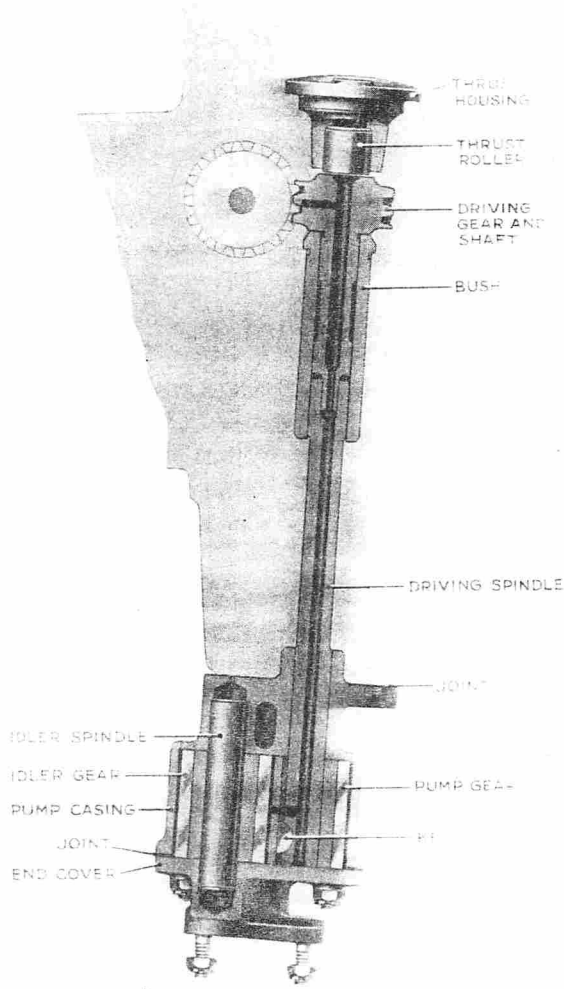


FIG. 83. OIL PUMP AND DRIVE

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. 87). Backlash between the two gears should be .004 in. to .008 in.

To Assemble and Refit Oil Pump

Reverse the operation for removing and dismantling oil

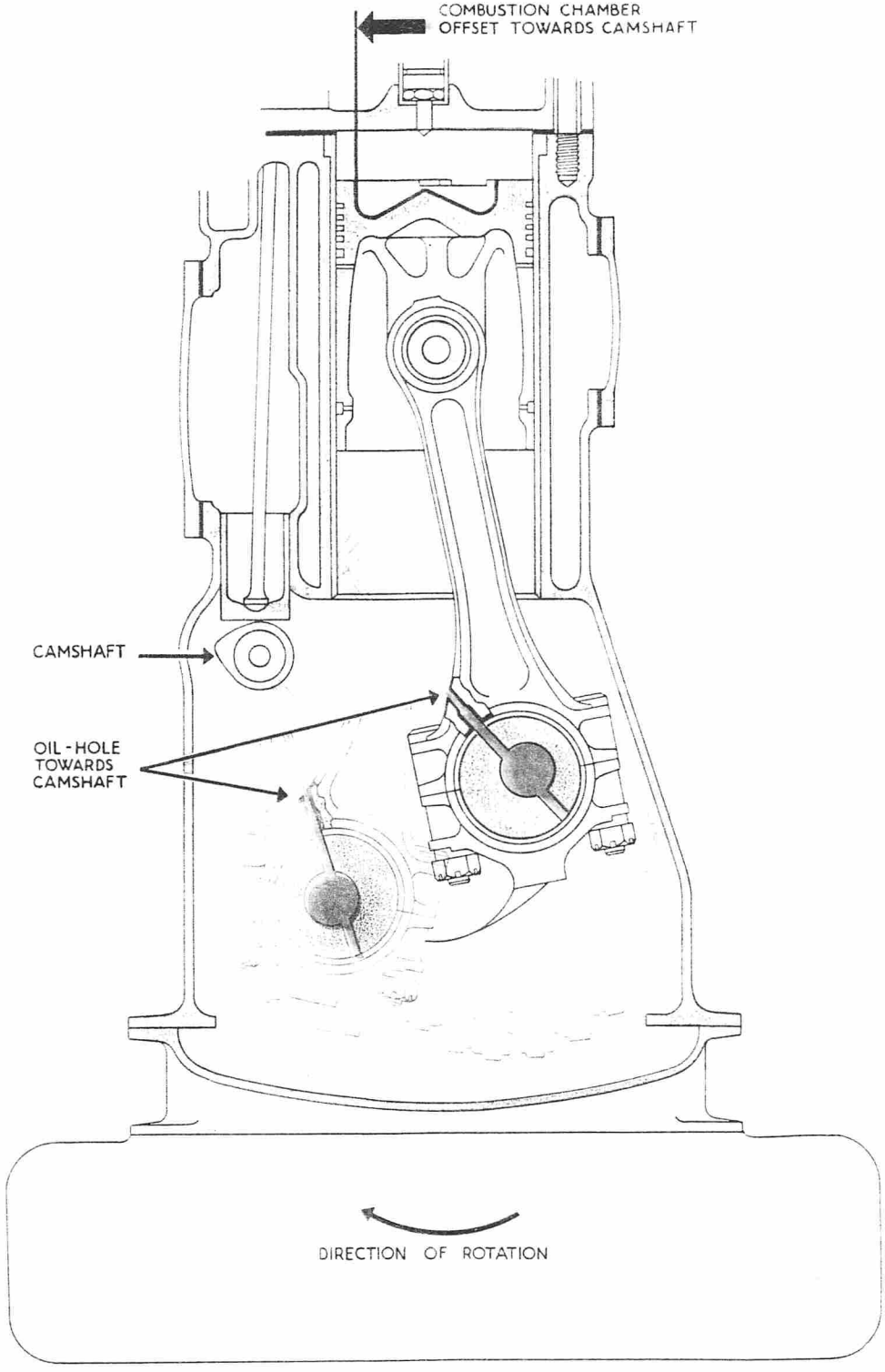


FIG. 84. CYLINDER-WALL LUBRICATION

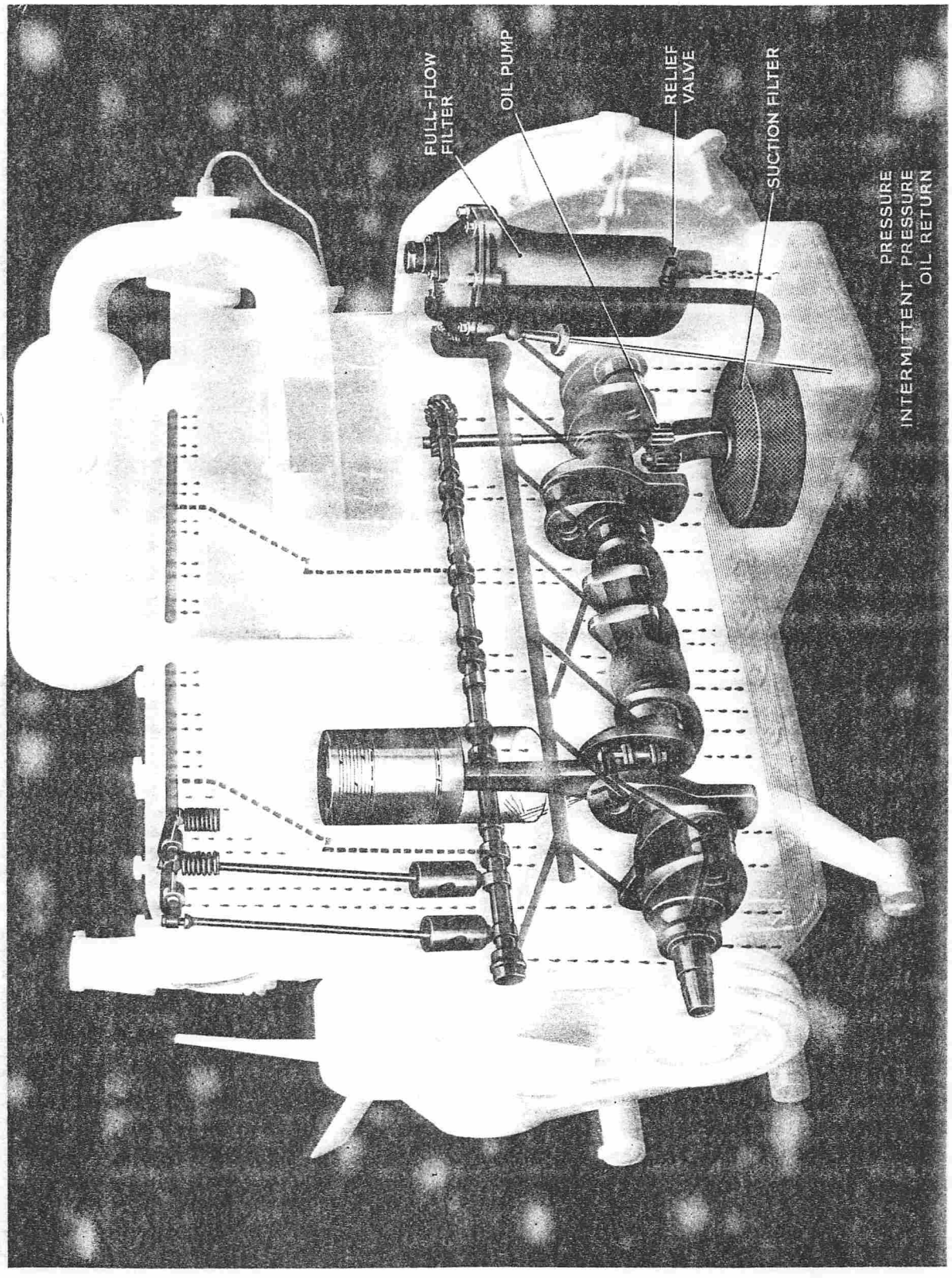


FIG. 85. OIL-CIRCULATION DIAGRAM

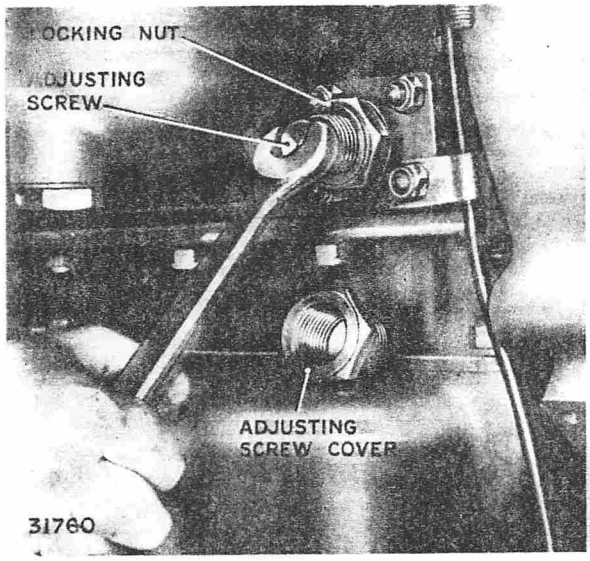


FIG. 86. ADJUSTING OIL RELIEF VALVE

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 (Fig. 88) mounted at the rear left-hand side of the engine-block consists simply of a spring-loaded valve, provided with an adjusting screw.

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.

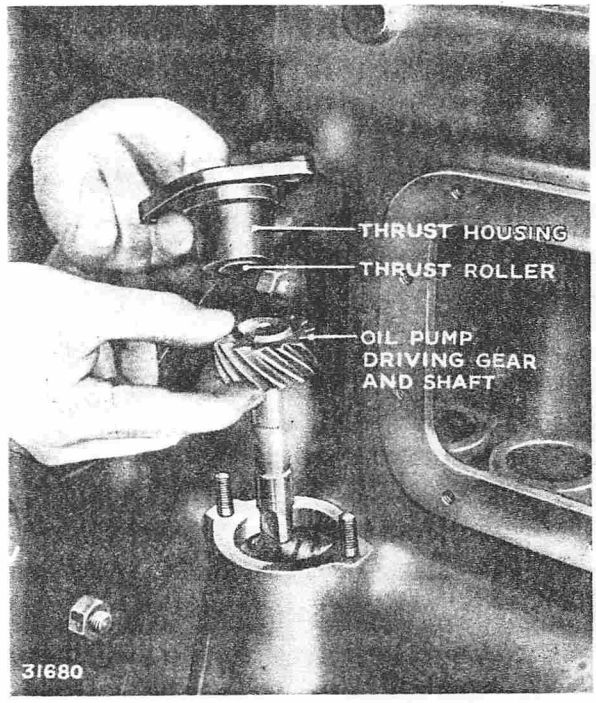


FIG. 87. FITTING OIL PUMP DRIVE GEAR AND THRUST HOUSING

The valve should be adjusted to give a maximum pressure of 60 to 70 lb./sq. in. (4.2 to 4.9 kg. sq. cm.) with a warm engine running at full throttle.

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 bottom sump well and pressure-fed into the filter housing, where it is filtered

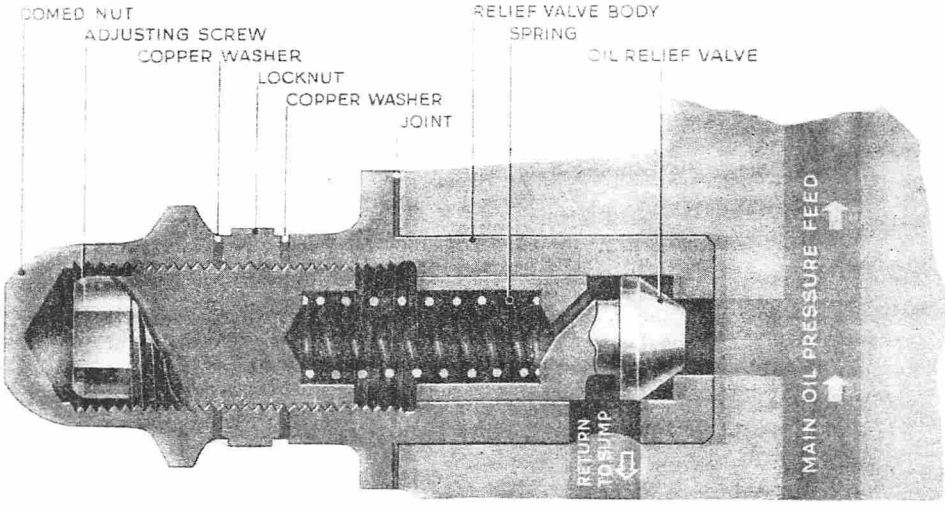


FIG. 88. OIL RELIEF VALVE

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.

The filter, a metal former covered by a sleeve-shaped filter-cloth secured with cotton twine, is designed to give maximum filtration area (Fig. 91).

To prevent vibration the filter is spring loaded at the base (Fig. 89), 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 5,000 miles. A drain plug is provided in the bottom of the filter housing.

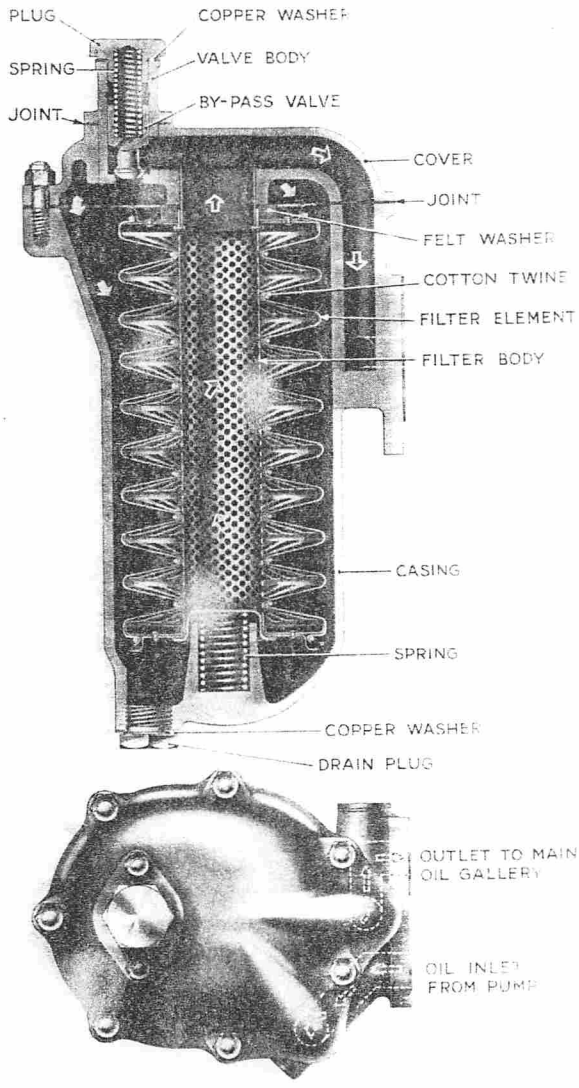


FIG. 89. THE OIL FILTER

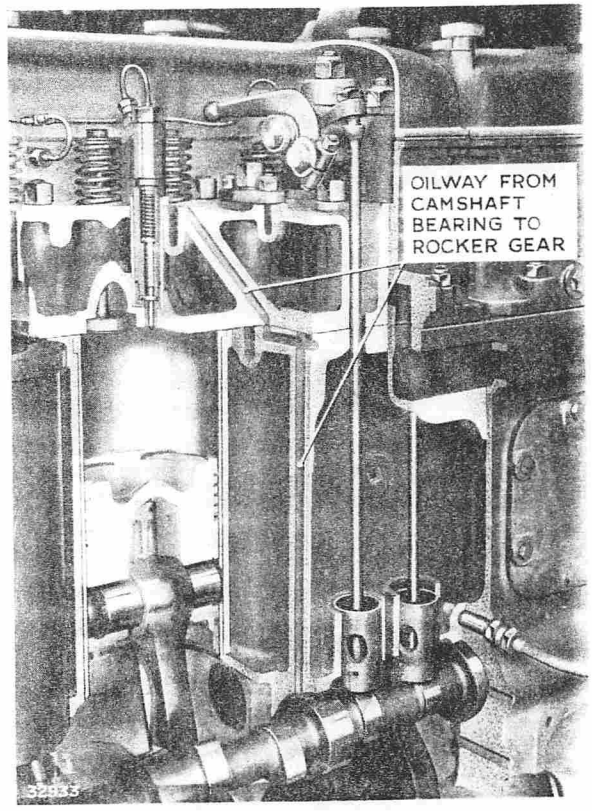


FIG. 90. ROCKER GEAR LUBRICATION

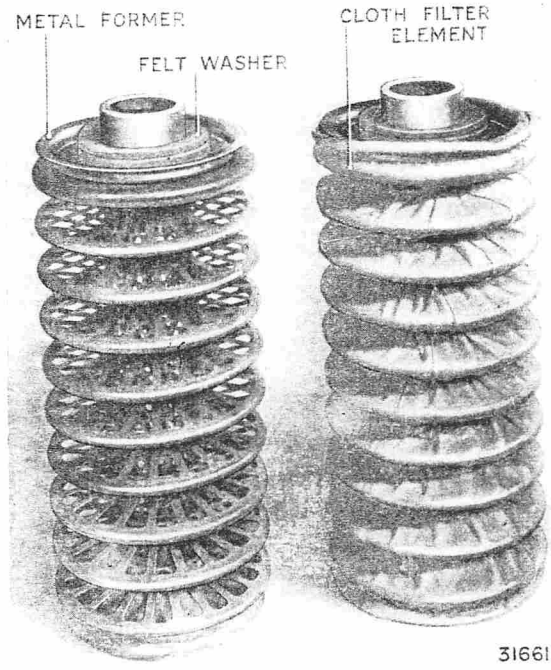


FIG. 91. OIL FILTER BODY AND ELEMENT

TIMING GEARS

DESCRIPTION

The timing gears (Fig. 92) are single-helical hardened and ground gears, the drive to the camshaft and exhauster 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. 93). 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.

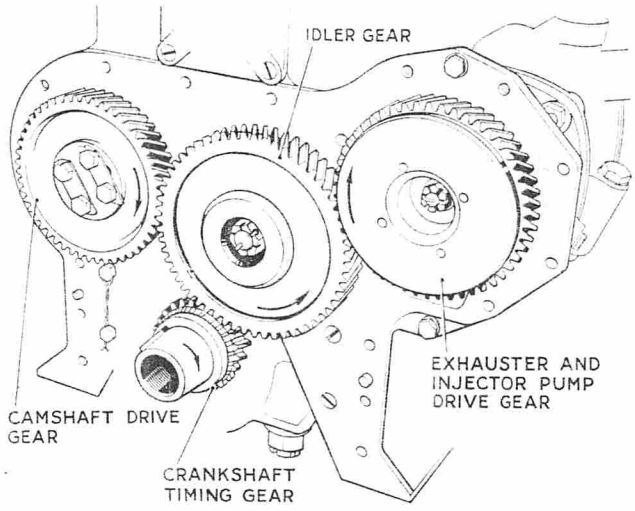


FIG. 92. THE TIMING GEARS

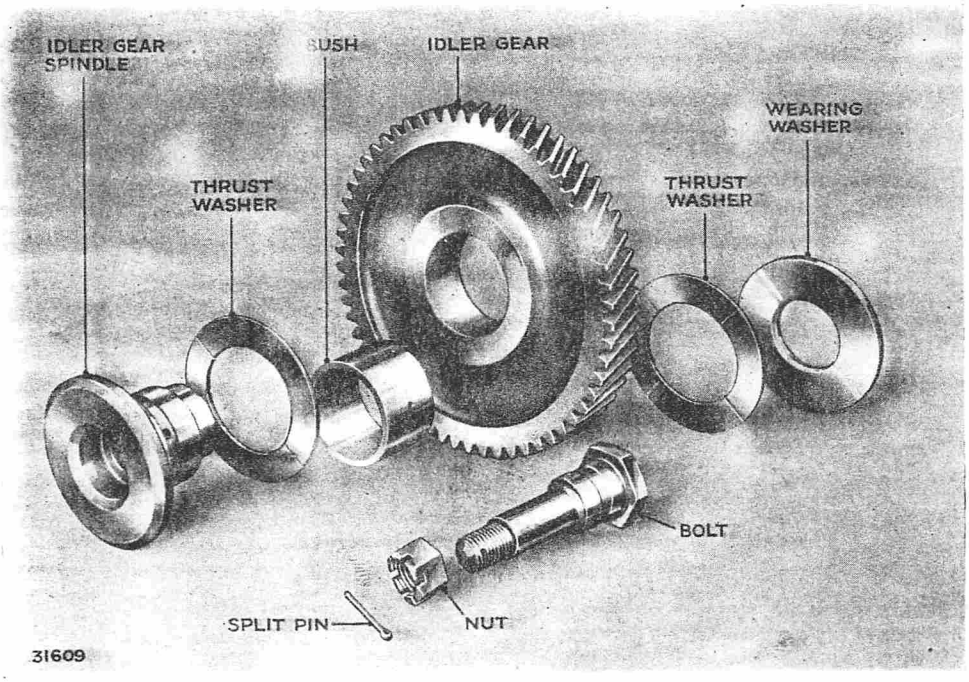


FIG. 93. IDLER GEAR DISMANTLED

The gear for compressor and injection pump drive is carried on ball and roller bearings mounted in a housing bolted to the timing back plate (Fig. 94). Internally cut gear teeth integral with the compressor drive gear, mesh with a small mating gear on the compressor drive shaft, thereby transmitting the drive to the compressor and through a flexible coupling to the injection pump.

DISMANTLING COMPRESSOR 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.

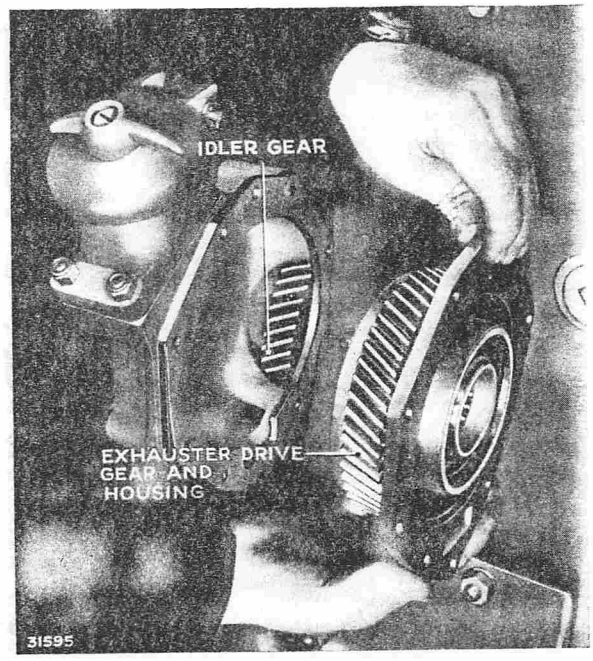


FIG. 94. REMOVING COMPRESSOR DRIVE GEAR

AIR COMPRESSOR

DESCRIPTION

The two alternative types of compressor, shown in Figs. 95 and 96, are substantially the same, the main differences, being the method of lubrication and the air inlet.

Both types have monobloc blocks and crankcases with detachable heads and sumps. The valves are discs held in cavities in the cylinder heads and are spring loaded.

Separate inlet and delivery valves are provided for each cylinder. The delivery valves are removable through plugs in the head for inspection and carbon removal. The inlet valves cannot be inspected without head removal.

The air inlet on type PC/GA58 is through a felt filter directly mounted on the head, as shown in Fig. 96.

The air inlet on type PC/AG66 is a manifold piped to a felt filter (Figs. 97 and 98), which is mounted on the front dash.

Both types of compressors are flange-mounted to the timing backplate of the engine and driven by a gear meshing with the timing idler gear. The fuel injection pump is driven in tandem with and from the back of the compressor, as shown in Fig. 2. The speed of the drive is always half engine r.p.m.

On type PC/GA58 lubrication is provided by an oil pump driven from an eccentric on the crankshaft, drawing oil from the sump. The oil is pressure-fed to the big-end bearings through oilways in the crankshaft. The gudgeon pins, pistons and crankshaft journal bearings are lubricated by splash. The reciprocating oil pump has ball valves in the body and plunger with a plate relief valve incorporated in the pump body.

A filler and dipstick are provided for maintaining oil level.

On type PC/GA66 lubrication is provided by a pressure-feed from the main engine lubrication system. The oil

is led through the oil-feed gland to oilways in the crankshaft and then to the big-end bearings. The gudgeon pins, piston and crankshaft journal bearings are lubricated by splash. Surplus oil returns through the spill-port in the mounting-end cover to the engine timing case.

LUBRICATION

Type PC/GA58 (Fig. 96)

Inspect the oil level daily. Top up as required, changing oil every 5,000 miles.

Type PC/GA66 (Fig. 95)

No daily inspection necessary. Drain completely when engine oil is changed every 5,000 miles.

For the specification of the oil, see "**Lubrication**" chapter.

MAINTENANCE

The delivery valves and springs should be removed every 10,000 miles and any carbon deposit removed. If the valves become ridged or distorted they should be replaced.

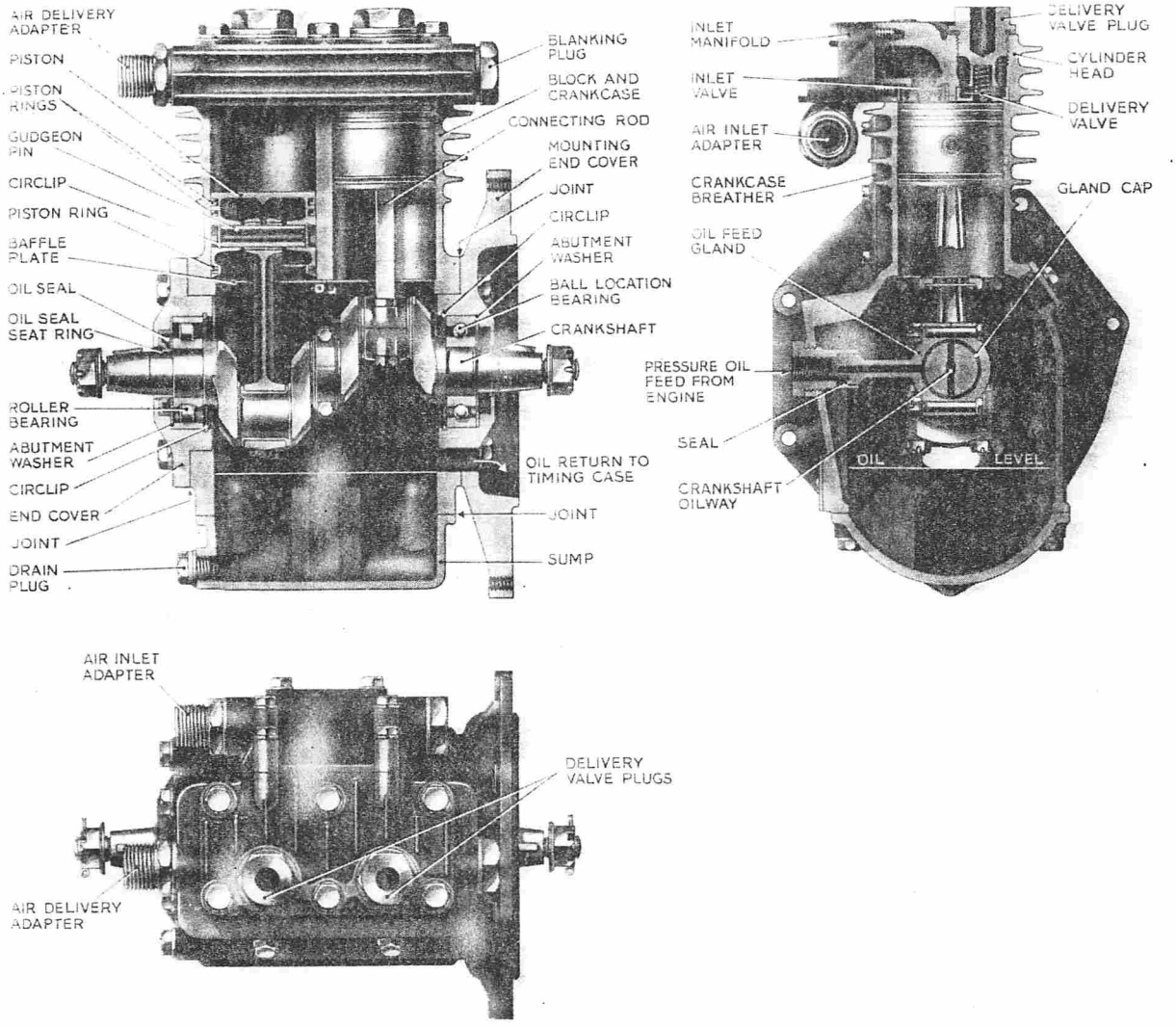


FIG. 95. SECTION THROUGH COMPRESSOR, TYPE PC/GA66

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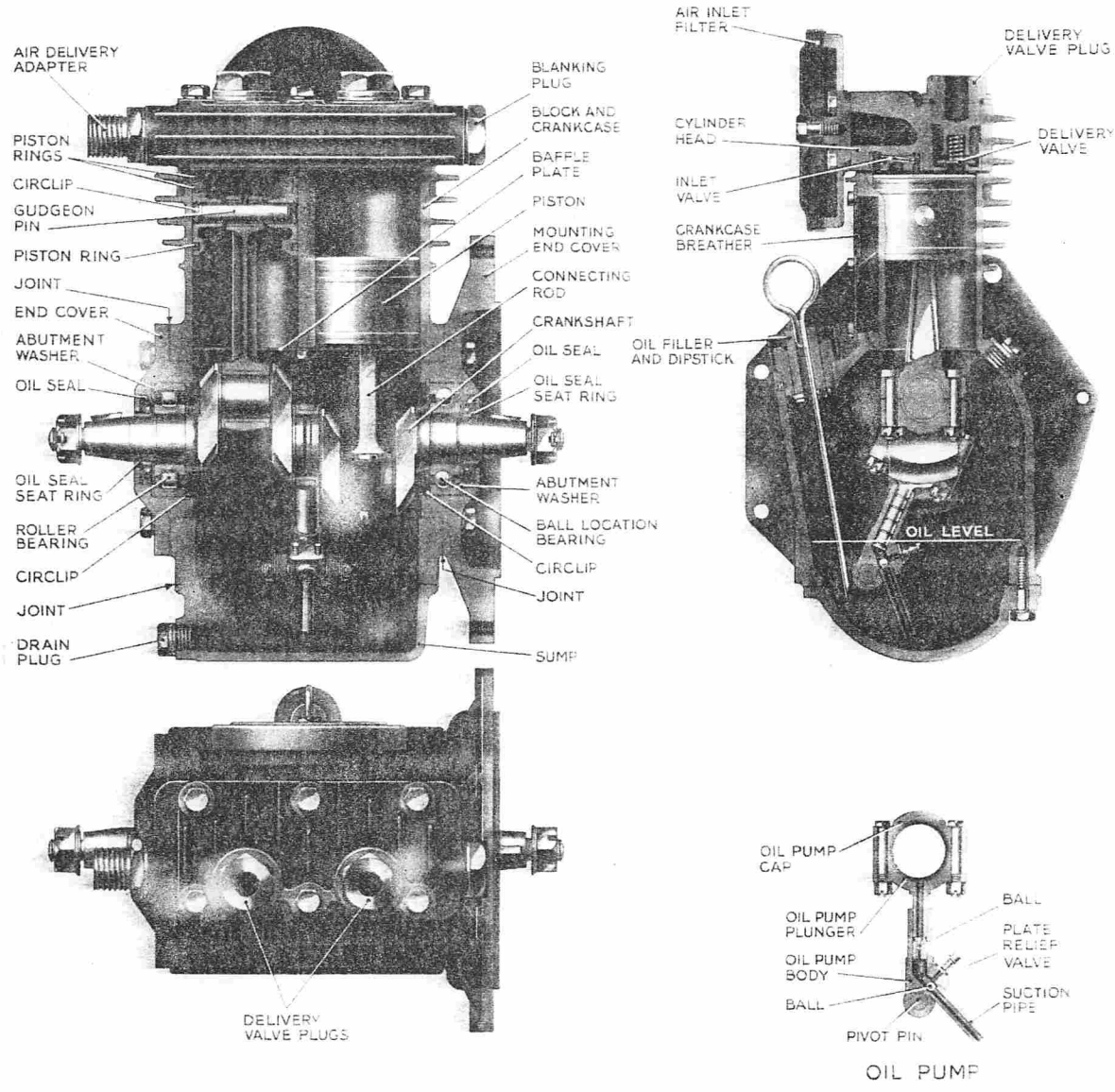


FIG. 96. SECTION THROUGH COMPRESSOR, TYPE PC GA58

Inspect the whole air pressure system periodically for leaks in pipes, valves and cylinders. Leaks result in the compressor overheating.

The air inlet filter, whether the mushroom type on the PC GA58 or the independent type on the PC GA66 compressor, should be periodically dismantled, washed in petrol and dried.

The frequency of cleaning is solely dependent on the operating conditions. A sound rule is to clean the compressor filter at the same time as the main engine air filter.

OVERHAUL

To Remove and Replace the Compressor

1. Disconnect all injection pump pipe connections.
2. Disconnect all pipe connections to the compressor.
3. Remove the two setscrews securing the flexible coupling to the injection pump flywheel. Remove the injection pump.
4. Remove the setscrews securing the compressor to the timing backplate. Withdraw the compressor.

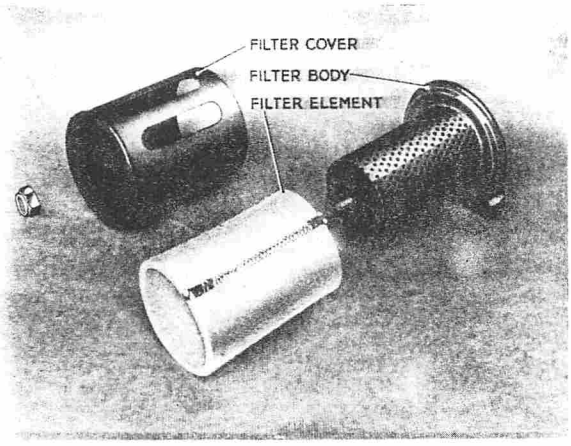


FIG. 97. COMPRESSOR AIR FILTER DISMANTLED

To replace the compressor, reverse the above procedure.

Warning : The coupling between compressor and injection pump must be assembled with at least $\frac{1}{32}$ in. float in an axial direction. Failure to obtain this condition will cause excessive ball-bearing journal wear in the compressor and injection pump. When finally replaced, check the injection pump timing. See **"To Replace the Injection Pump"** under **"Fuel System,"** for injection pump timing.

To Dismantle the Compressor

1. Drain off the sump oil.
2. Remove the cylinder head complete.
3. Remove the oil sump.
4. Remove connecting rod caps (mark the rods and caps before removal).
5. Remove oil gland cap from crankshaft centre journal.
6. Remove baffle plates and withdraw pistons and connecting rods through top of the cylinder bore.
7. Remove setscrews from the mounting end cover and withdraw the cover and crankshaft complete.

To Re-assemble the Compressor

1. Insert connecting rods and pistons through top of cylinder bore

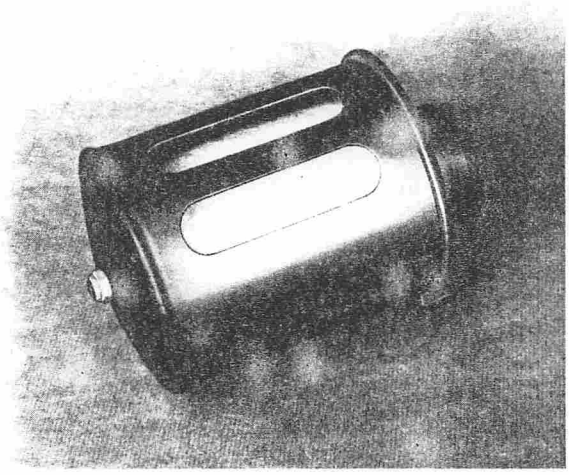


FIG. 98. AIR FILTER ASSEMBLY

2. Fit baffle plates and wire up the bolts.
3. Fit the crankshaft and end covers. Take care not to damage the oil seals.
4. Fit connecting rod caps and fit oil gland cap to central journal of crankshaft.
5. Fit oil pump plunger to pump body (type PC/GA58) and bolt up the sump (Fig. 96).
6. On type PC/GA66 having pressure oil feed from main engine, fit the seal housing to compressor crankcase side taking care not to damage the oil seal when locating the oil-feed gland from the centre journal of the crankshaft (Fig. 95).
7. Refit the cylinder head, using new gasket.

To Dismantle the Cylinder Head

Remove

1. Inlet manifold.
2. Valve caps and springs.
3. Delivery valve sleeve (special tool required).
4. Delivery valve, spring and seat. (For seat removal a special tool is required).

5. Inlet valve, spring keeper and spring.

6. To remove inlet valve seat, insert a piece of brass bar ¾ in. dia. × .4 in. long on to the valve seat, replace the valve cap and screw down until the seat falls away.

7. During a general overhaul it is advisable to fit new delivery valve discs and springs.

4. Re-assembly of the cylinder head is a reversal of the above procedure.

9. Fit a new gasket when re-fitting the cylinder head.

Inspection of Individual Parts

1. Delivery valves should be renewed if they have become ridged or distorted. It is advisable to renew the springs as well.

2. The delivery valves can be removed and relapped if necessary.

3. Check crankshaft ball and roller bearings, and oil seals. See **"General Notes on Overhauling,"** in **" General Instructions."**

4. Inspect connecting rod bearings. It should not be possible to insert thicker than a .003 in. feeler between crankpin and journal shoulder or .003 in. between oil pump gland and centre journal shoulder.

5. In the event of a connecting rod bearing having to be re-metalled, it is important to maintain the correct rod lengths at 3.652 in. to 3.648 in. centres.

6. Check cylinder bore for wear. The initial dimensions are within the limits 2.125 in. to 2.1255 in. dia. Wear is permissible up to .005 in., but new piston rings should be fitted at this stage. If greater wear has occurred, rebore, fit liners and bore out to the initial dimensions and fit new piston assemblies.

7. When fitting new liners to cylinders for the first time, bore the cylinder to the dimensions 2.250 in. to 2.2505 in. dia., press in new liners and finally bore in position to the initial dimensions 2.125 in. to 2.1255 in. dia.

8. Standard clearances for cast-iron pistons are .001 in. to .0025 in.

9. Piston and scraper ring gaps should be between .003 in. to .006 in. for butt-jointed rings and .002 in. to .004 in. for scarf-jointed rings. Both types can be used.

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. 98) 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

There are two arrangements of drain points.

On early production engines a tap is fitted at the rear left-hand side of the engine-block and connected by a copper pipe leading to a wheel-valve on the bottom water pipe at the front right-hand side. On these engines, open both the tap and the wheel-valve to drain the system.

On later engines there is no tap on the engine-block, and it is only necessary to open the wheel-valve to drain the system.

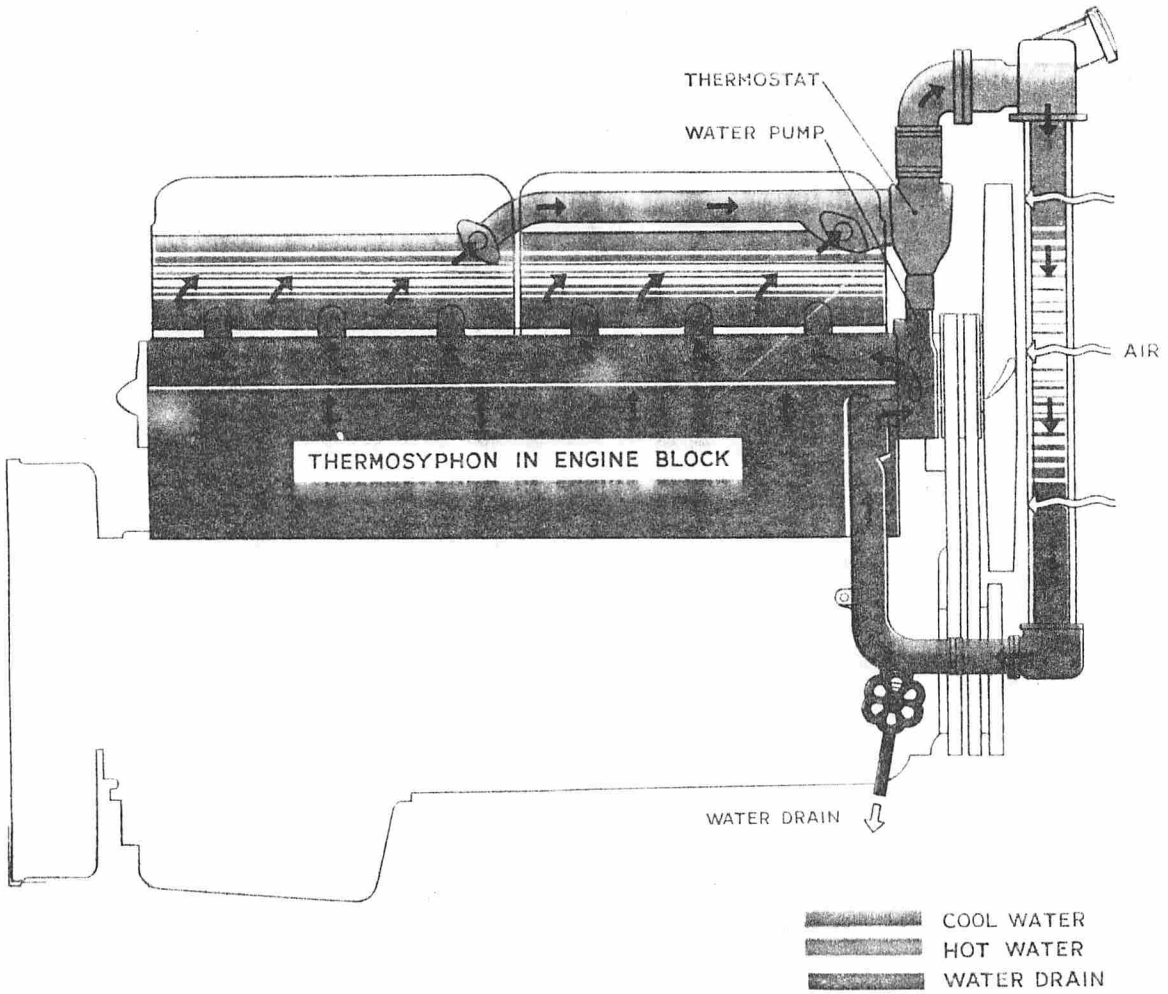


FIG. 99. WATER CIRCULATION DIAGRAM

When draining the cooling system as a precaution against frost :

1. Park the vehicle on level ground.

2. Open the wheel-valve (and tap if fitted).

3. Display a notice marked " No water in radiator " in a prominent position on the vehicle.

4. When all water has been drained off, close the wheel-valve (and tap if fitted).

RADIATOR

The radiator is carried on special rubber bushes and mounted on support brackets attached to the front crossmember. Both top and bottom tanks and side standards can be removed without disturbing the cooling tubes. The frontal area and water capacity are such that efficient cooling is obtained under all normal conditions. The top tank is a sheet brass pressing and the bottom tank is a gun-metal casting ; this prevents ' furring " up in districts where hard water is prevalent.

To Remove Radiator

1. Drain the system by operating the wheel-valve (and tap if fitted).

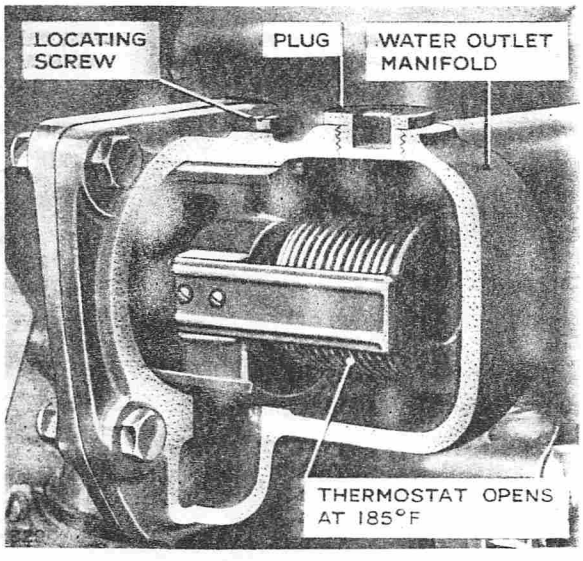


FIG. 100. THERMOSTAT IN POSITION

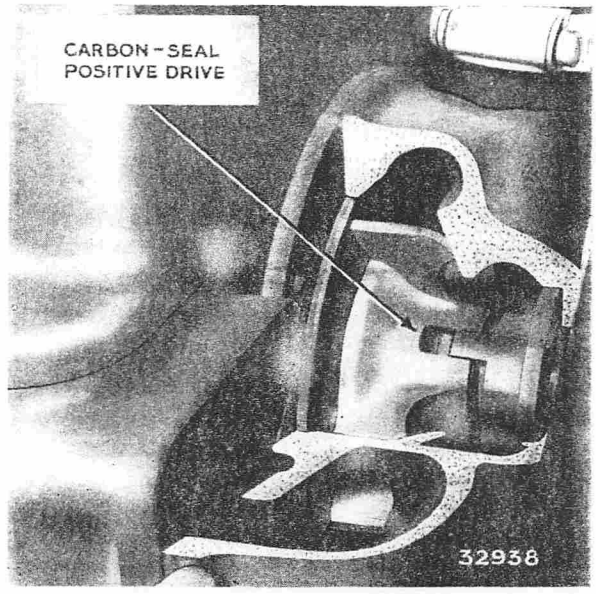


FIG. 101. WATER-PUMP CARBON-SEAL POSITIVE DRIVE

2. Disconnect the top and bottom water pipes at the flanged joints on the radiator.

3. Disconnect the top radiator-stay and remove the pinch-bolts from the support brackets on the front crossmember.

4. Take the weight of the radiator and draw it off square with the mounting brackets.

Overhaul of Radiator

During the annual overhaul the radiator should be thoroughly cleaned internally. If hard water has been used, the top and bottom tanks should be removed and any deposit in the tubes loosened by passing a rod down each tube.

When refitting the tanks, use new joints obtained from Leyland Motors Service Department and paint with red lead before fitting.

To Replace Damaged Tubes

1. To remove a damaged tube, unscrew both top and bottom gland nuts and push the tube up far enough to free the bottom end, then pull out the top end.

2. The old ferrules should be removed and the cavities cleaned out.

3. Fit the new ferrules and replace gland nuts ; these should be only just finger-tight whilst inserting the tube.

4. Insert the tube ; rotating the tube will assist the operation.

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 (Fig. 2). A spring-loaded, self-adjusting, carbon seal unit (Fig. 102), 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 $\frac{1}{16}$ 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.

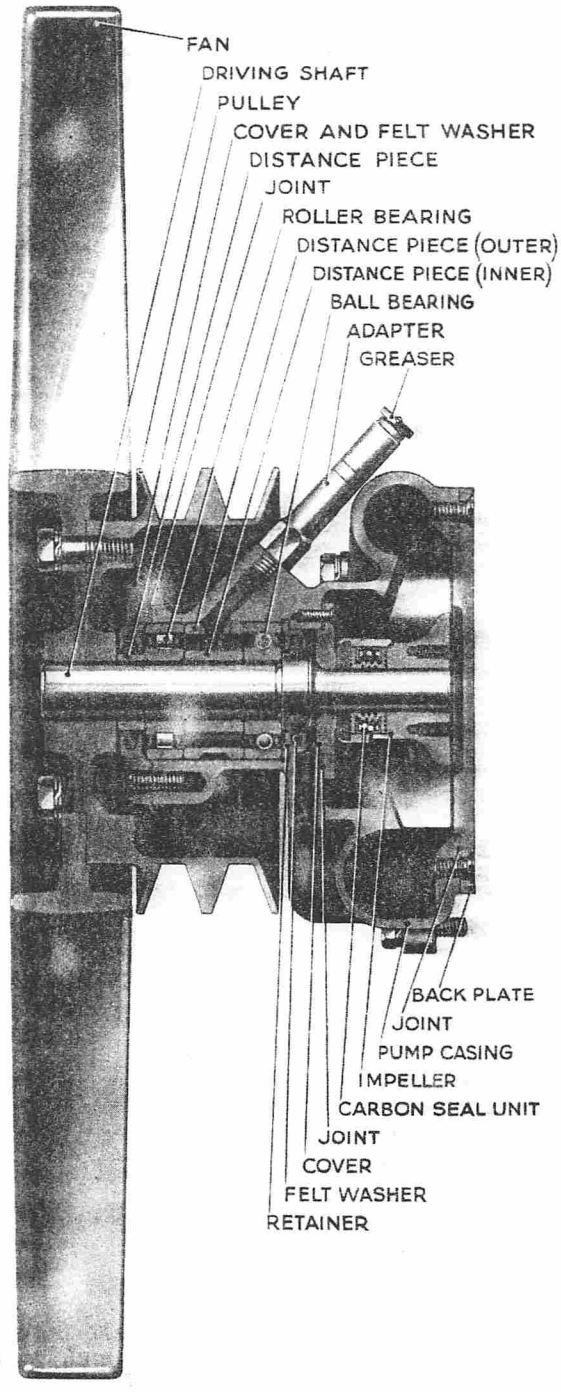


FIG. 102. SECTION THROUGH THE WATER PUMP.

To Re-assemble Water Pump

To re-assemble 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 (Fig. 101).

AIR CLEANER

DESCRIPTION

The oil-bath type cleaner filters the air in two stages. First, by reversal of air flow and impingement upon the surface of the oil, and secondly, by passing the oil-laden air through a screen or element.

Fig. 104 shows the action of the cleaner through the whole speed range of the engine, that is from 0—1,800 r.p.m.

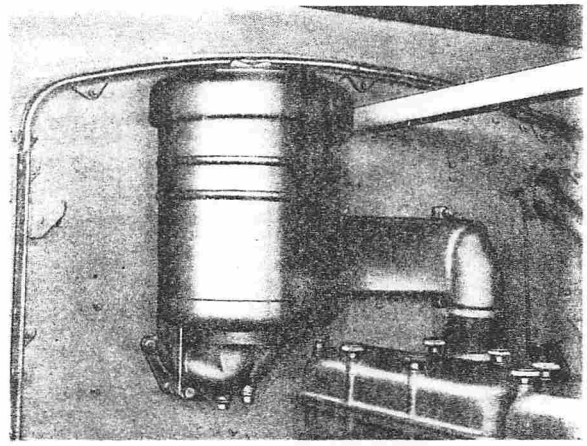


FIG. 103. AIR CLEANER IN POSITION

OPERATION

"No Air Flow"

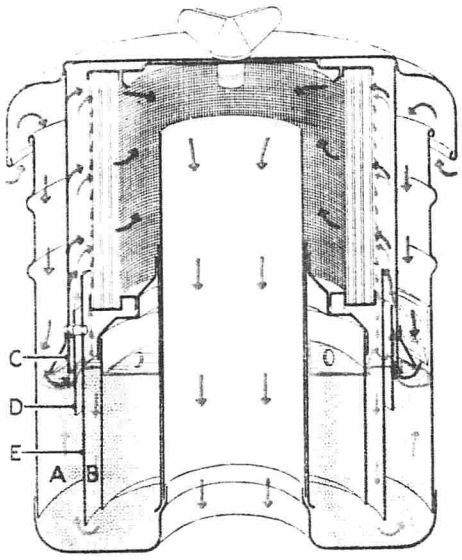
The oil levels shown in Chambers A and B are maintained only when no air is passing through the cleaner.

"Idling"

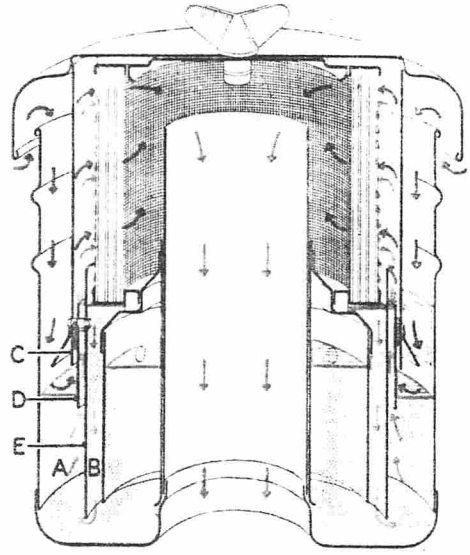
At this speed the air flow is comparatively low, but it is sufficient to lower the oil level in Chamber A with a consequent rise behind Baffle D and in Chamber B. The effect of Baffle D is to separate the high and low pressure chambers and to create a sufficiently high velocity in the passage between Baffles C and D to allow oil to be picked up from the free surface and be delivered to the filtering element. From this element the oil sludge drains back into Chamber B at all speeds.

"Quarter-Throttle"

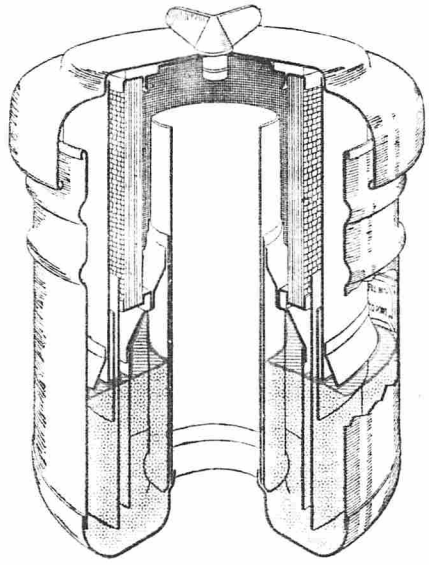
At this speed the increase in air flow lowers the oil level in Chamber A still further, with a consequent rise



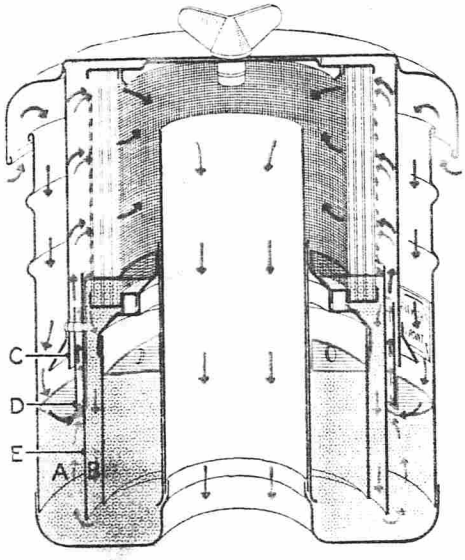
IDLING



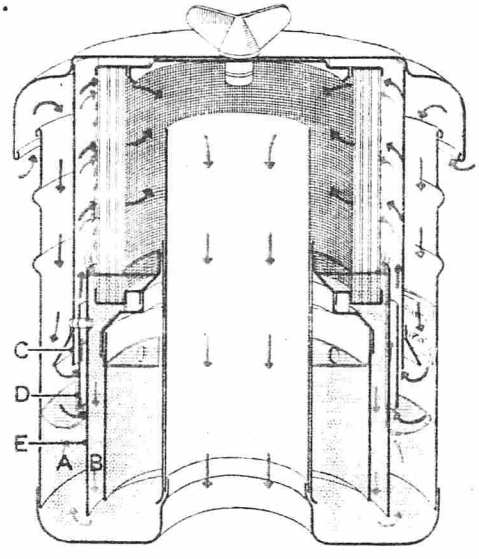
¼ THROTTLE.



NO AIR FLOW.



½ THROTTLE.



¾ TO FULL THROTTLE.

behind Baffle D until it commences to spill over the upper edge of the baffle and meet the rising air flow. The air now picks up oil to a decreasing extent from the free surface in Chamber A and to an increasing extent from the stream flowing down the outer surface of Baffle D. The oil saturated air then passes to the filtering element.

"Half-Throttle"

The increase in air flow at this speed is sufficient to lower the oil level in Chamber A still further so as to uncover the lower edge of Baffle D. The flow of oil down the outer surface of Baffle D ceases as the oil level rises further inside Chamber B. The pick-up of oil now occurs in the narrow gap between the free surface and the lower edge of Baffle D. The oil saturated air then passes to the filtering element.

"Three-Quarter to Full Throttle"

As the air flow increases in the upper speed range of the engine, the oil level in Chamber A is lowered further causing the oil level in Chamber B to rise and ultimately spill over and run down the outside of Baffle E, meeting the rising air flow. This causes the air to pick up oil to a decreasing extent from the free surface in Chamber A and to an increasing extent from the oil spill-over from Baffle E before passing to the filtering element.

OVERHAUL

Cleaning

To clean, unscrew the clamp bolt and lift off the cover and baffle assembly. (See Fig. 105.) Lift cleaner bowl bodily off the air-intake elbow to a suitable place for cleaning. Remove the element and wash it thoroughly in petrol or paraffin. Fuel oil must be used **only** in an emergency. Clean the cover and baffle assembly, element support and bowl thoroughly in fuel oil. Examine the element carefully for punctures or any damage which may affect its filtering capacity. Inspect the rest of the cleaner components for deformed baffles or a leaking bowl. Re-assemble the cleaner and refill with oil to the point of the arrow on the oil level indicator inside the bowl. (Fig. 105.) Replace the cleaner on the air-intake elbow.

Fit cover and baffle assembly and tighten down the clamp bolt finger tight. Do not use a wrench or any similar tool to tighten this bolt.

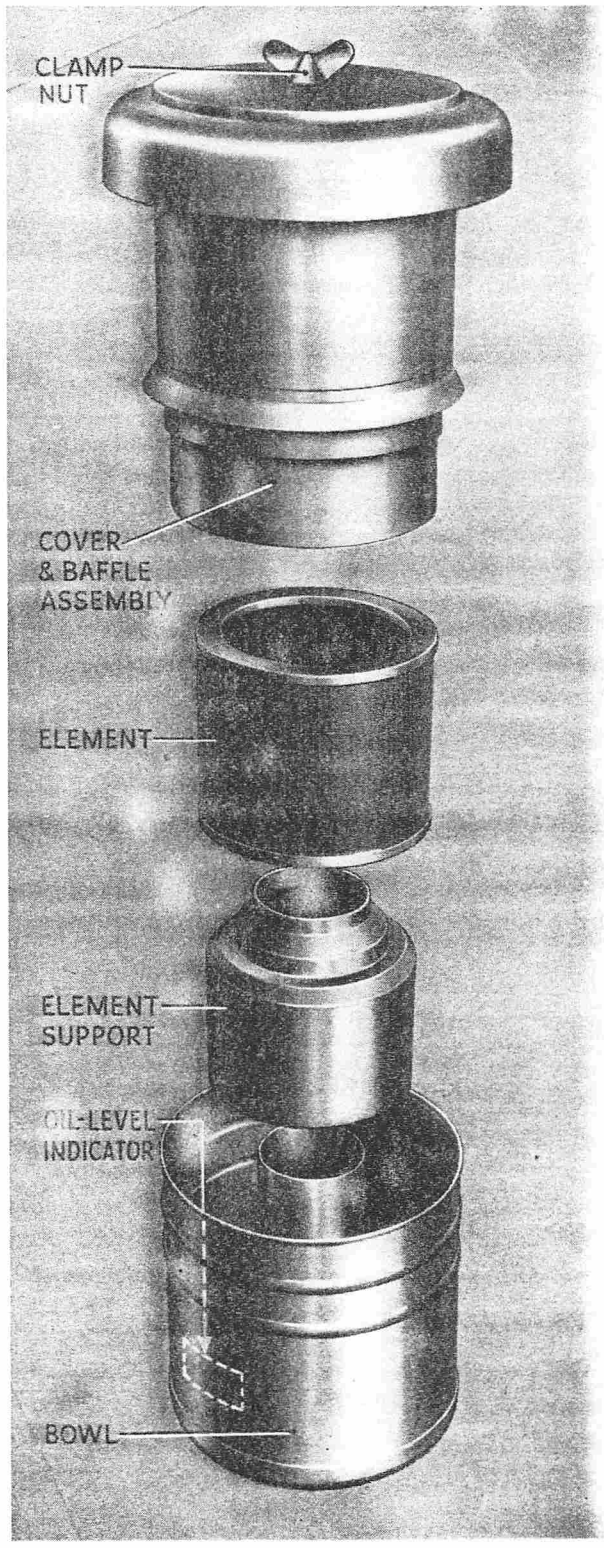


FIG. 105. THE OIL-BATH AIR FILTER