DAVID BROWN

3-CYLINDER GASOLINE ENGINES

REPAIR MANUAL

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CONTENTS

SECTION	Page
Maintenance	2
Fuel System	6
Ignition System	13
Distributor	14
Lubrication System	16
Cooling System	20
Repair Operations	
Engine Tune	22
Decarbonising	23
Pistons and Connecting Rods	25
Crankshaft and Bearings	26
Timing Gears	27
Governor	30
Engine Removal	34
Dimensional Data	36
Summary of Design Changes	41
Approved Lubricants	42

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MAINTENANCE

Daily

Check engine oil level. Top up if necessary.

Check air cleaner. Remove filter bowl and examine the oil. In dusty conditions the air cleaner oil should be changed frequently, the detachable wire mesh element removed, washed in kerosene, and allowed to stand until all oil has drained off. (See note regarding air cleaner maintenance.)

If a paper element pre-cleaner is fitted, remove the cover and examine the element. If it is dirty, remove the element and tap it on the side to shake off dust. (Fig. 1.). **Do not attempt to wash a paper element.** Examine for any water, fuel or lubricating oil leaks.



Figure 1. PAPER ELEMENT PRE-CLEANER

Every 60 hours

Check engine oil level. Top up to the "full" mark on dipstick if required.

Check radiator water level and top up to within 1 in. (2·5 cm) from top if required. If the engine is hot, remove radiator cap slowly as the system is pressurised and may scald the hand if opened quickly.

Visually check the feed pump sediment bowl. Remove and clean if there is any accumulation of dirt or water.

Air Cleaner

Air Cleaner Oil: Air cleaner oil should be changed and the detachable wire mesh element removed and in dusty conditions washed frequently. The maximum dust deposit in the cleaner bowl should never be allowed to exceed $\frac{1}{4}$ in., checked after standing overnight, otherwise oil pullover into the induction manifold will take place, due to the raised oil level. This pullover is highly detrimental and must be prevented by adequate cleaner maintenance.

An SAE 30 grade of straight mineral oil is less susceptible to frothing, and usually cheaper, than the detergent oils used in the engine. In climates where the ambient temperature often exceeds 32° C (90° F) an SAE 50 grade oil may be used. Care should be taken not to overfill the bowl. Only fill to the level mark — not above or below it.

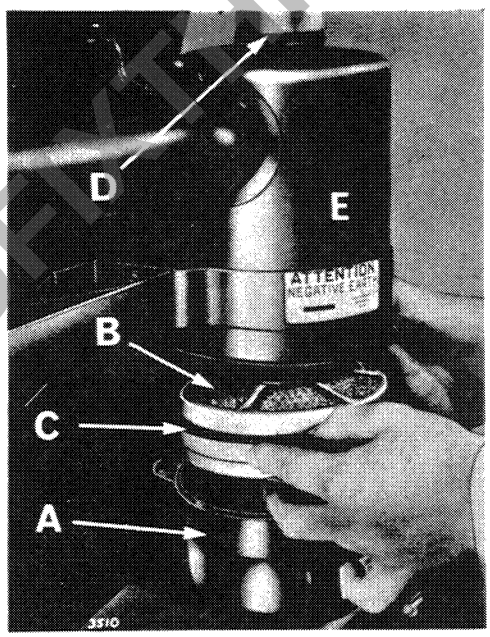


Figure 2. AIR CLEANER

A. Oil bowl **B.** Wire mesh **C.** Rubber sealing rings
D. Cleaner inlet pipe **E.** Cleaner body

Air Cleaner 'O' Rings: When assembling the air cleaner care should be taken to ensure that the 'O' rings between the cleaner body, lower element and oil bowl are correctly fitted to ensure an air-tight seal. The fit of these 'O' rings is particularly important, as the upper ring may be easily displaced when the oil bowl and lower element are being fitted. The 'O' ring should not be twisted and should fit securely on the small notched register on the lower edge of the air cleaner body. If the 'O' rings are damaged during assembly new rings must be fitted. (Fig. 2.)

Paper Element Pre-cleaner

This is an alternative fitting to the centrifugal type pre-cleaner and incorporates a replaceable paper

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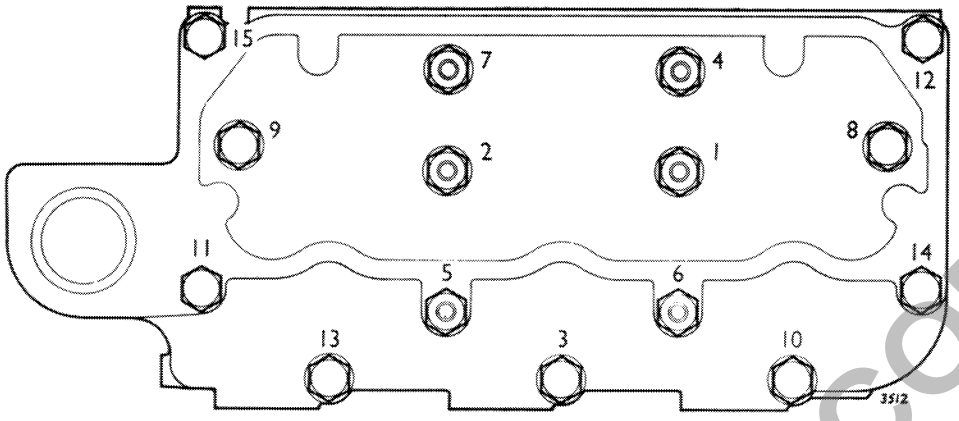


Figure 30. CYLINDER HEAD TIGHTENING SEQUENCE

Tighten the bolts and nuts in the order shown and in three stages of 30, 60 and finally 90 lb ft.

Removing the Pistons: The pistons cannot be removed through the sump when crankshaft is in position but can be withdrawn through the bores. Mark the pistons before removal and remove the connecting rod bolts, to prevent the bolt heads scoring the bore.

Gudgeon Pins: The fully floating gudgeon pins are retained by two circlips, one at each end of the pin, and to remove the gudgeon pin remove both circlips, then immerse piston in hot oil. This will cause piston to expand and allow the pin to be pushed out. Refit pin in same manner using hot oil, then replace circlips, ensuring that they are fully seated in their grooves. Mark the piston and connecting rod before removing the gudgeon pin: the gudgeon-pin hole is offset and the word "Front" stamped on the piston crown must be towards the front of the engine. (Fig. 31.)

Connecting Rods: The small end of connecting rod is bushed and this can be replaced if worn. Press out worn bush, using a suitable sized mandrel, and press in new bush, ensuring that oil hole in the bush is opposite hole in the end of connecting rod. Hone, or ream, new bush after fitting until gudgeon pin is a light push fit.

Connecting rods should always be checked for alignment whenever they are removed and especially if the piston skirt marking is not even. The easiest way of checking connecting rods is by means of a proprietary aligning tool such as is shown in Service Tool Leaflet B5, but if such a tool is not available, mandrels and 'V' blocks can be used.

Maximum out of parallel:	0·0005 in./in.
Maximum twist:	0·0005 in./in.

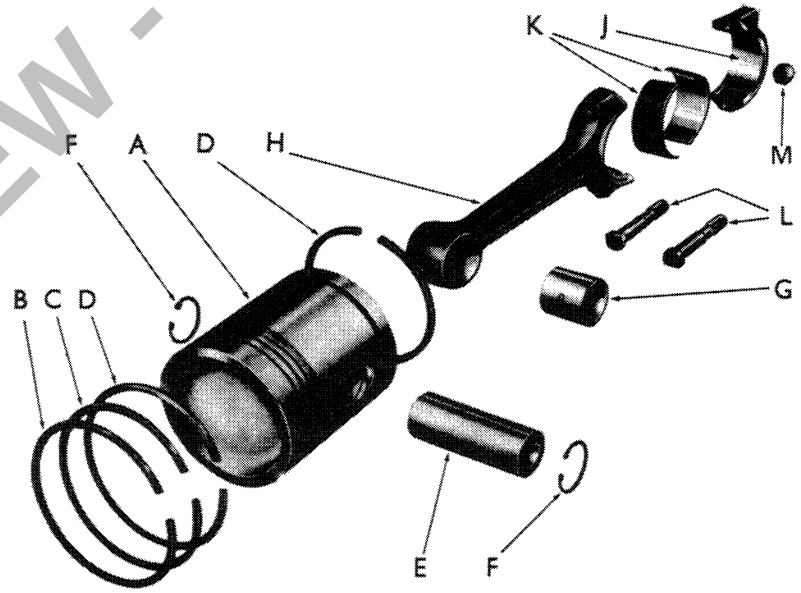


Figure 31. PISTON AND CONNECTING ROD

A. Piston
B. Chromed compression ring
C. Plain compression ring
D. Scraper rings
E. Gudgeon pin
F. Circlips
G. Bush – gudgeon pin
H. Connecting rod
J. Connecting rod cap
K. Big-end bearing shells
L. Connecting rod bolts
M. Self-locking nuts

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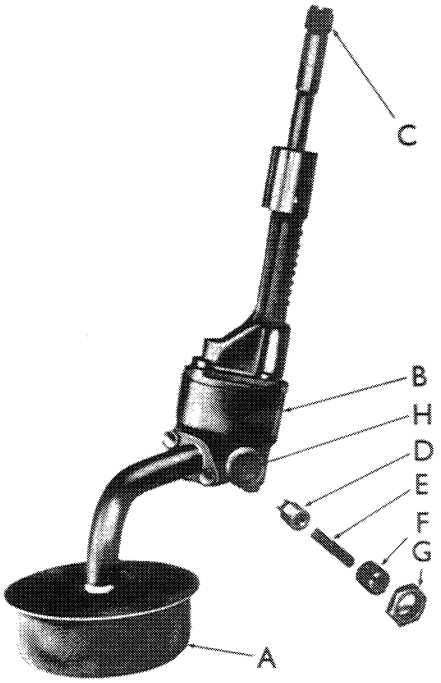


Figure 22. LUBRICATING OIL PUMP

A. Oil inlet screen **B.** Pump body **C.** Driveshaft
D. Relief valve plunger **E.** Spring **F.** Adjusting screw
G. Locknut **H.** Oil outlet connection

Oil Pump

The gear type oil pump is located in the engine sump and contains a relief valve which is set to open at 40 lb/sq in. (Fig. 22.)

To Remove the Pump

1. Drain engine oil and remove sump.
2. Disconnect outlet pipe from pump to cylinder block.
3. Release locknut and remove pump locating screw, which is situated on the side of block just below pump drive housing, and withdraw pump downwards.

The oil pump must be dismantled to check gear wear, gear end-float, and the condition of the upper bearing.

To Dismantle Pump

1. Remove the two setscrews and two bolts securing pump cover, noting that the two bolts are special locating bolts and must be fitted in their correct places when re-assembling.
2. Remove cover, complete with relief valve, and filter.
3. Check backlash between gears — this should be 0·020 to 0·026 in.
4. Remove driven gear and shaft.
5. Use a drift to force driving shaft from driving gear.
6. Check rotor and housing dimensions.
   Rotor width : 1·1865 – 1·1855 in.
   Housing depth : 1·1890 – 1·1875 in.

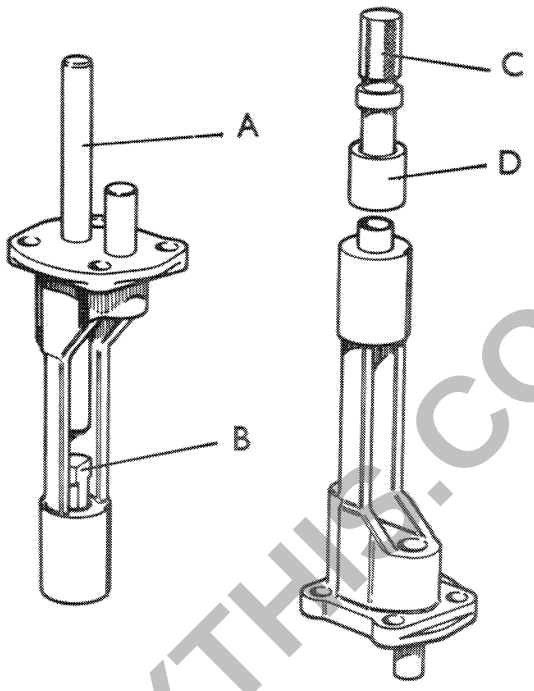


Figure 23. REPLACING OIL PUMP BRACKET BUSH (Using Service Tool 901701)

A. Long drift **B.** Pilot **C.** Replacer drift
D. Centraliser guide

   Rotor side clearance : 0·001 – 0·0035 in.
   If end-float is excessive but backlash is within limits and the gears are not worn, it is permissible to grind the face of the housing to reduce end-float. If the gears are damaged, both gears should be replaced. Never replace one gear only.
7. Check the upper bearing for wear.
   Bush internal diameter : 0·4905 – 0·4925 in.
   Shaft diameter : 0·4895 – 0·490 in.
   Clearance : 0·0005 – 0·003 in.

If wear is excessive, remove the bush and replace using Service Tool 901701 as detailed below :

1. Slip special pilot bush B through slot in pump bracket to locate in drive shaft bush.
2. Stand pump bracket on a suitable hollow anvil or press base.
3. Place drift A in position.
4. Drive or press out pump bracket bush.
5. The driven rotor shaft may be removed using drift A. (Fig. 23.)

To replace the new bush :

1. Place new bush on the replacer drift C.
2. Push centraliser D over new bush and drift C until oil-hole in bush just shows at bottom edge of centraliser.
3. Start new bush in pump bracket and slide centraliser D up to pump bracket.
4. Stand the pump bracket on a flat anvil or press base; drive or press C until it butts firmly against D. The bush is now in its correct position in pump bracket.

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DIMENSIONAL DATA

Engine Details	4600 Tractor	3800 Tractor
Engine designation	355101	349101
Bore	$3\frac{15}{16}$ in	$3\frac{15}{16}$ in
Stroke	$4\frac{1}{2}$ in	4 in
Number of cylinders	3	3
Cubic capacity	164·4 cu in	146·1 cu in
Compression ratio	6·75 : 1	6·75 : 1
Fuel grade	U.S. regular gasoline, 92–93 octane	
Speed range	500 to 2,350 rev/min	
Maximum power at 2,200 engine rev/min	50 BHP	42 BHP
Maximum torque at 1,400 engine rev/min	140 lb ft	125 lb ft
Maximum PTO power at 2,200 engine rev/min	46 BHP	38 BHP
Maximum drawbar pull (ballasted)	6,000 lb	4,750 lb
Maximum drawbar horsepower	40	33

Tightening Torques

Big-end bearing nuts	50 lb ft
Camshaft gear bolt	40 lb ft
Crankshaft balance weight bolts	40 lb ft
Crankshaft pulley bolt	90 lb ft
Cylinder head nuts and bolts	90 lb ft
Cylinder head studs into block	25 lb ft
Flywheel housing to engine bolts	30 lb ft
Flywheel nuts	50 lb ft
Front extension to main frame bolts	120 lb ft
Fan blade bolts	25 lb ft
Main bearing cap bolts	120 lb ft
Main frame to engine bolts	30 lb ft
Main frame to flywheel housing bolts	50 lb ft
Oil filter bowl bolt	10 lb ft
Sump to main frame bolts	20 lb ft
Valve rocker adjusting nuts	14 lb ft

The following figures apply to bolts of standard material with either coarse (UNC) or fine (UNF) threads and may be used for all bolts and nuts not listed in the previous table.

Thread Diameter	Torque
$\frac{1}{4}$ in	7 lb ft
$\frac{15}{16}$ in	15 lb ft
$\frac{3}{8}$ in	25 lb ft
$\frac{7}{16}$ in	45 lb ft
$\frac{1}{2}$ in	65 lb ft
$\frac{5}{8}$ in	110 lb ft
$\frac{3}{4}$ in	140 lb ft

Capacities

	Imperial	U.S. Measure
Cooling system (4600)	18 pt	22 pt
Cooling system (3800)	15 pt	18 pt
Engine lubricating oil	11 pt	$6\frac{1}{2}$ pt
Steering-box oil	2 pt	$2\frac{1}{2}$ pt
Air cleaner oil bath	$1\frac{1}{4}$ pt	$1\frac{1}{2}$ pt
Transmission oil	5 gal	6 gal
Fuel tank (4600)	$11\frac{1}{2}$ gal	$13\frac{3}{4}$ gal
Fuel tank (3800)	8 gal	$9\frac{1}{2}$ gal

Wear Limits

The following figures are only intended to serve as a guide to determine when a component should be renewed :

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"progression" holes at the throttle edge. Half-size slow-running jets are unnecessary, as the volume control screw in the throttle barrel enables the strength of the mixture to be regulated.

Slow-running Air Bleed: The drilled hole 23 from the slow-running passage into the air intake, bleeds air to the circuit and serves also as an anti-syphon hole.

Ventilation Orifice 29: At part throttle operation when manifold depression is high the diaphragm 30 will be off its seating to open the orifice under the metal insert of the diaphragm and admit air from the channel 33. The ventilation orifice will then control the degree of air bleeding to the compensating jet, also to the cross channels drilled into the main passage of the emulsion block, just above the main jet.

At full throttle or when manifold depression is low the air bleed through the ventilation screw is limited by the air having to pass through the small full throttle air bleed orifice 32, as the diaphragm 30 will be closed on its seating by the spring 31.

Increasing the air bleeding by fitting a larger ventilation screw will weaken the mixture by reducing the depression on the main and compensating jets.

By variation to the ventilation screw, it is possible to alter the mixture ratio between low and high speeds at part and full throttles.

Any alteration to the size of the screw will affect the mixture strength over the whole speed range, but will have a greater influence at high speeds, when the depression in the waist of the choke tube is at its maximum.

Interconnection for Cold Starting: The degree of throttle opening when the strangler is closed is preset by the length and set of the rod 1. The only way to alter this is to set or bend the interconnection rod.

Fuel Level: This is set at the factory 15·5 mm down from the top edge of the floatchamber.

It should be explained that this level is that which should result when the top half carrying the float is in position on the carburetter, and the float is holding the needle closed against the pressure in the fuel line. When the top half is taken off and the float is lifted out of the chamber the level will fall.

To check the level remove the top half and leaving the float in position reverse the cover so that the float arm closes the needle, then measure from the face of the gasket to the highest point of the float, which should be 32–33 mm.

The level can be altered by bending carefully the tag on the float arm that contacts the end of the needle or an easier method is to vary the thickness of the washer under the needle seating; a thicker or an additional washer lowers the level.

Needle Valves and Seatings: These are calibrated in millimeters, the size being stamped on one of the flats of the hexagon. This size depends on the fuel pump pressure and the capacity and power of the engine.

General: In any investigation of suspected faulty carburation, first of all check through the instrument to ensure the specification, which includes choke tube, jet and air bleed sizes, is correct for the particular application. (See Page 36.)

Whilst it is important to ensure that jets have the right numbers stamped on them, the possibility should not be overlooked that a jet may have been tampered with, or careless cleaning has affected the flow of fuel or air through a jet or air bleed. If, therefore there is any indication that any of these have been interfered with, a new part of the correct size should be fitted.

Difficult Starting from Cold: Make sure there is fuel in the floatchamber, and that fuel from the pump flows through the needle seating within a few seconds of rotating the engine by the starter, or by operation of the hand primer on the fuel pump.

Cases are encountered where sediment or gum cause the needle to stick on its seating, thus preventing the entry of fresh fuel when attempting to start. This will explain difficult starting, as fuel in the floatchamber when the engine is switched off may have evaporated after standing for several hours.

If a sticking needle is suspected, remove the top half and operate the needle with the finger. Any tendency for the needle to remain closed can usually be overcome by rinsing the needle and seating in methylated spirit. This will dissolve sediment or gum deposit.

Ensure that the strangler flap in the air intake closes completely when the choke control is operated. From examination of the choke control on the carburetter it will be seen there is no mechanical connection between the strangler control wire and the spindle on which the strangler flap is fitted.

Movement of a cam lever on the side of the air intake permits the spring loading of the strangler spindle and arm to close the flap in the air intake: therefore undue friction by reason of a bent strangler spindle, carboned-up bearings or a broken spring would explain non-closure of the flap when the choke control is out. Removal of the air-cleaner connection will enable this to be checked.

The interconnection between the strangler lever and the throttle should ensure that the latter opens beyond the normal slow-running position, when the strangler is fully closed.

Difficult Starting When Engine is Hot: This trouble is caused by an over-rich mixture and can be a source of annoyance, particularly in hot climates.

If this fault is experienced, first ensure that the needle and seating fitted is of the correct size. Having cleaned the assembly replace it with the correct washer, ensuring it is screwed tightly in position.

Examine the float to ensure it is not damaged or bent. See it moves freely on the axle-pin.

A new needle and seating of the size specified will eliminate the possibility of the assembly being worn and no longer able to withstand normal fuel pump pressure.

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tension lead hole through the body must now be towards the cylinder block) and connect a timing light to the contact-breaker terminal (or leaf spring and earth). (Fig. 18.)

6. Switch the ignition on and note that the timing light is out. Rotate the distributor body slowly in a clockwise direction until the timing light illuminates (this shows that the points have just opened) then tighten the clamp bolt to lock distributor body in position.
7. Turn engine for two revolutions then check that the light illuminates just as the pointer engages in the flywheel indentation.

Ignition Coil: The coil is an oil-filled and sealed unit. The only maintenance required is keeping the connections clean and tight. If a coil is suspected of faulty operation remove it and temporarily connect a new coil: negative terminal to the distributor and positive terminal to the ignition. If the original coil is defective the new coil will correct the fault.

LUBRICATION SYSTEM

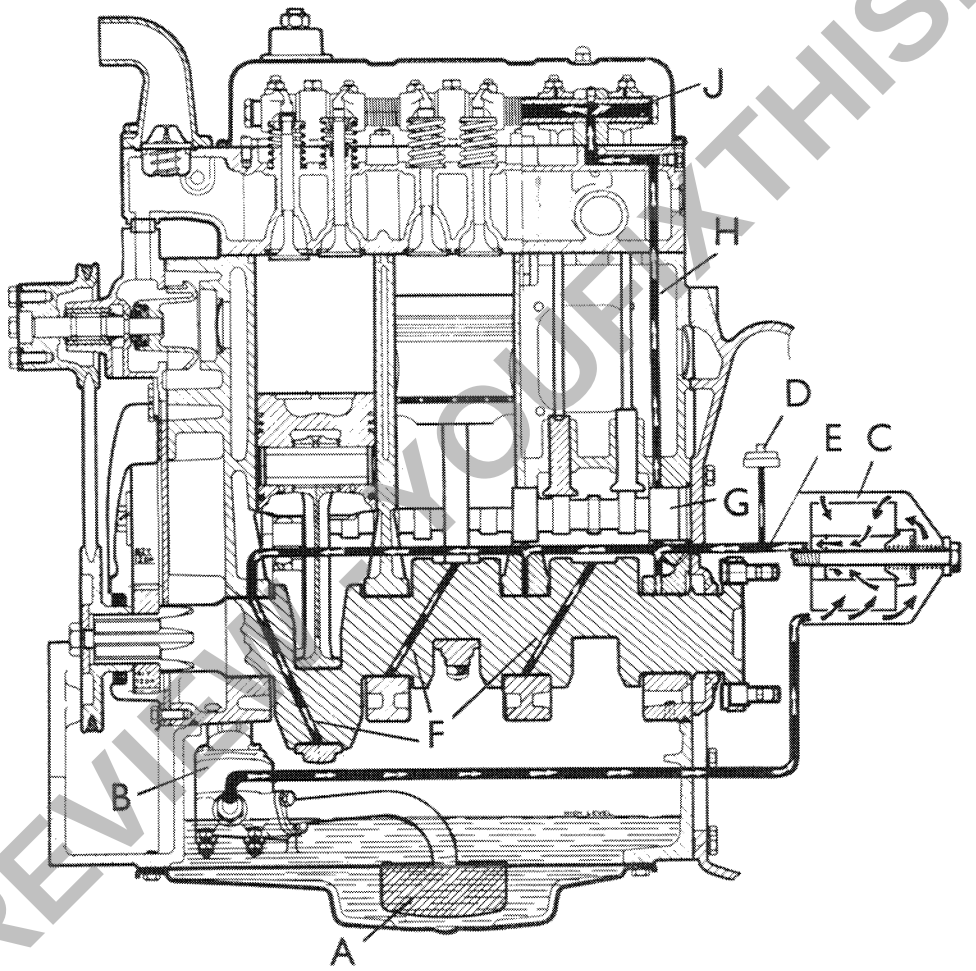


Figure 19. DIAGRAM OF LUBRICATION SYSTEM

A. Pump inlet screen **B.** Oil pump **C.** Filter **D.** Warning light switch
E. Oil gallery **F.** Crankshaft oil passage **G.** Camshaft rear bearing
H. Valve gear feed **J.** Rocker shaft

Engine Lubrication

Oil is drawn from the sump by the gear-driven rotary oil pump and delivered under pressure to the oil filter. After filtration the oil passes to the main oil gallery in the cylinder block and so, via oilways in the block webs, to the crankshaft main journals and then on, through further oilways in the cylinder block, to pressure lubricate the camshaft bearings. The big-end bearings are lubricated by drillings in the crankshaft webs. (Fig. 19.)

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