

DAVID BROWN

**FOUR-CYLINDER
DIESEL ENGINE**
(SERIES AD4/47)

REPAIR MANUAL

PUBLICATION TP 644

DAVID BROWN TRACTORS LIMITED
MELTHAM · YORKSHIRE · ENGLAND

June 1967

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Introduction

The engine fitted to 990 Agricultural Tractors is designated AD4/47 and is a four-cylinder unit of $3\frac{5}{8}$ in. bore and $4\frac{1}{2}$ in. stroke, fitted with wet cylinder sleeves. As the engine must have a flywheel suitable for the clutch (Livedrive or Non-Livedrive) the suffix A or B is included in the designation to indicate the type of flywheel fitted and therefore the tractor model on which the engine is used.

The engine fitted to 990 Industrial Tractors is designated ID4/47 and is basically identical to the AD4/47 engine, the only difference being that the ID4/47 engine is fitted with a flywheel suitable for the twin-plate clutch and has a splined coupling flange attached to the longer flywheel bolts.

Engine Designation and Tractor Models

<i>Engine Series</i>	<i>Tractor Model</i>	<i>Tractor Number</i>
AD4/47A	{ 990 Implematic Livedrive 990 Selectamatic Livedrive	440001 to 481999 482001 onwards
AD4/47B	{ 990 Implematic Non-Livedrive 990 Selectamatic Non-Livedrive	440001 to 481999 482001 onwards
ID4/47	990 Industrial Models	440001 onwards

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 diesel fuel, and allowed to stand until all fuel 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. **Do not attempt to wash a paper element.** Examine for any water, fuel or lubricating oil leaks.

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.

Oil in the induction manifold, which indicates oil pullover, can be easily checked through the ether plug aperture in the inlet manifold. This pullover will cause rapid engine wear 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.

Before assembling the air cleaner thoroughly clean the inside of the pre-cleaner and the inside of the pipe through the centre of the air cleaner. 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.

Paper Element Pre-cleaner

This is an alternative fitting to the centrifugal type pre-cleaner and incorporates a replaceable paper element. Frequency of attention depends on working conditions and in dusty climates the cover should be removed every few hours of use and the element examined. The element can be cleaned by tapping its side to shake off the loose dust. If the element becomes very dirty, or contaminated with oil or water, it should be renewed. **Do not attempt to wash an element.**

Every 125 Hours

Engine Oil: Drain the oil, while it is still warm, through the sump plug on the underside of the sump plate. Refill with approved oil to within the safe marks on the dipstick. For list of approved lubricants see Page 39. In dusty conditions clean or replace engine breather (see Engine Breather, Page 2).

Every 250 Hours

Engine Oil and Filter: Drain the oil when warm and remove filter bowl. Discard the old element and clean bowl out with clean diesel fuel, using a brush to make sure that the by-pass valve is perfectly clean. Fit a new element and check the sealing ring in the cylinder block groove; fit a new ring if it is damaged or distorted. Do not overtighten the bowl securing bolt — 10 lb ft (1.4 kg metres) is sufficient.

Refill the sump with new oil, start engine to fill the filter then recheck the oil level.

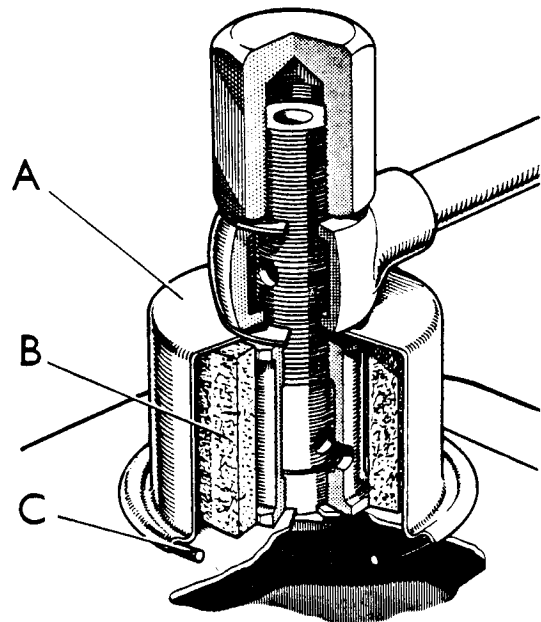


Figure 1. ENGINE BREATHER
A. Cover B. Element
C. Sealing ring

Engine Breather: Remove the domed nut from top and remove the pipe. Lift the cover off and remove breather element. Clean the top of rocker cover and fit a new element. Replace breather cover, ensuring that the 'O' ring is correctly located in the cover lip and replace pipe and nut. Failure to change the breather element could cause excessive pressure to build up in the crankcase with resulting oil leakage from the crankshaft seals. (Fig. 1.)

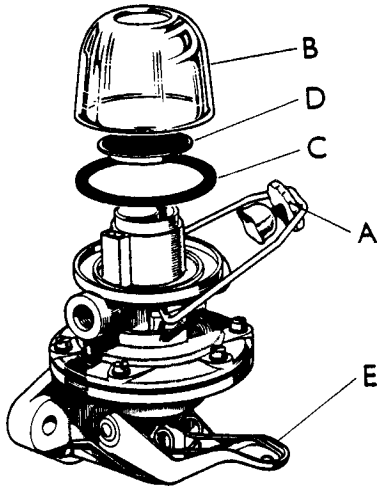


Figure 2. FUEL FEED PUMP SEDIMENT BOWL

- A. Bowl securing nut
- B. Sediment bowl
- C. Sealing ring
- D. Filter gauze
- E. Priming lever

Every 500 Hours

Remove sediment bowl and filter, as shown in Fig. 2, and wash in diesel fuel.

Injectors: Remove injectors for cleaning (see Page 7).

Procedure for removal of injectors:

1. Thoroughly clean off all external dirt.

2. Disconnect and remove leak-off pipe.
3. Disconnect high-pressure pipes at injector unions.
4. Slacken nuts holding down the injectors in stages, to prevent distortion.
5. Withdraw injectors carefully. Blank off inlet unions with caps. A protection sleeve should be fitted to nozzle tip.
6. Clean injector bores and remove copper washers. Plug the bores with clean rag to prevent dirt entering engine.

When replacing injectors refit copper washers — new ones if old ones were damaged — and tighten the injector down evenly. Reconnect leak-off pipe and high-pressure pipes leaving the injector unions slack. Turn engine, with stop control in the "run" position and throttle lever full open, until all air is expelled from high-pressure pipes, then tighten the unions. Start engine and check for any leaks.

Valve Clearance

Remove valve rocker cover and check valve clearances when engine is cold. The valve clearance should be set cold to the dimensions on Page 33, Dimensional Data. The clearance between the tip of rocker arm and the end of valve stem should be checked with a feeler gauge as shown on Fig. 3 and adjusted, if necessary, to the correct clearance. Adjustment is made by slackening the locknut and turning the adjusting screw until correct clearance is obtained. When tightening the locknut hold adjusting screw firmly with a screwdriver, then recheck the clearance.

Relative position of valves is as follows:

No. 1 Cylinder (Front)		No. 2 Cylinder		No. 3 Cylinder		No. 4 Cylinder (Rear)	
Exhaust	Inlet	Inlet	Exhaust	Exhaust	Inlet	Inlet	Exhaust
No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8

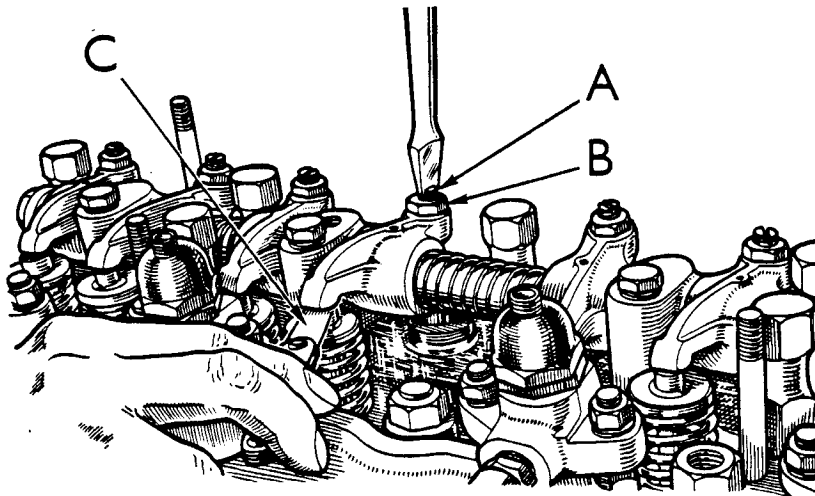


Figure 3. SETTING THE VALVE CLEARANCE

- A. Adjusting screw
- B. Locknut
- C. Feeler gauge

Valve adjustment is easier if carried out when the injectors have been removed for servicing as the engine can then be turned by means of the fan. If the injectors are not removed, or the holding-down nuts released, it will be necessary to use a box-spanner (Service Tool 960995) on the crankshaft nut to turn the engine.

To ensure the valve tappets are at the base of the cam, adjust the valves in the following order:

- Adjust No. 1 valve when No. 8 valve is fully open
- Adjust No. 6 valve when No. 3 valve is fully open
- Adjust No. 4 valve when No. 5 valve is fully open
- Adjust No. 2 valve when No. 7 valve is fully open
- Adjust No. 8 valve when No. 1 valve is fully open
- Adjust No. 3 valve when No. 6 valve is fully open
- Adjust No. 5 valve when No. 4 valve is fully open
- Adjust No. 7 valve when No. 2 valve is fully open

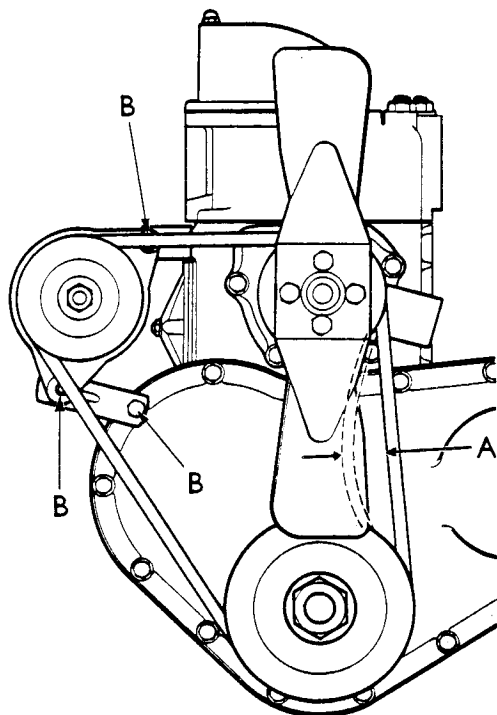


Figure 4. FAN BELT ADJUSTMENT
A. Deflection B. mounting bolts

Fan Belt

Check tension by deflecting belt midway between the fan and crankshaft pulleys. It should deflect approximately 1 in. (25 mm) and if necessary may be adjusted by releasing the three dynamo mounting bolts and swinging dynamo on the two upper bolts. Tighten lower bolt first, as this will hold dynamo in position whilst the upper bolts are tightened. Do not overtighten the belt. A taut belt will place excessive load on the dynamo and water pump bearings and cause rapid belt wear. If the belt has insufficient tension when dynamo has been adjusted so that the lower mounting bolt is at end of arm slot, the belt should be renewed. (Fig. 4.)

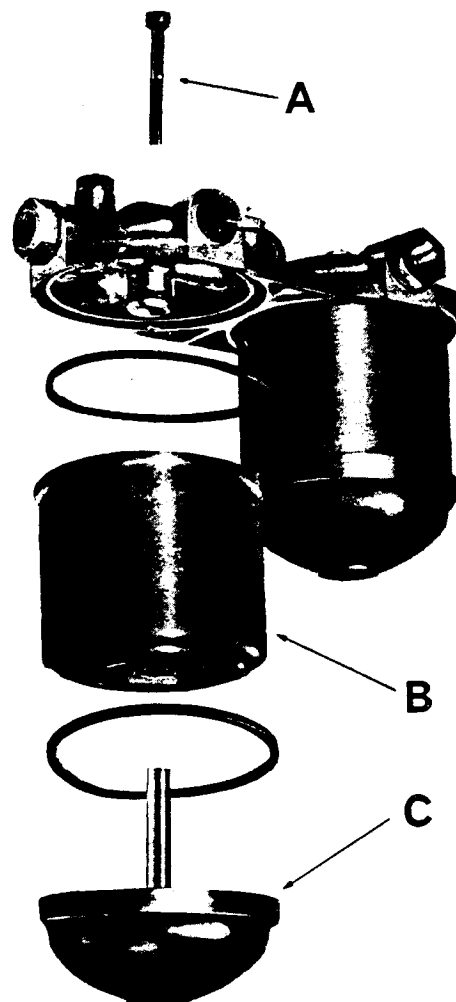


Figure 5. FUEL FILTER
A. Element securing bolt B. Element
C. Filter base

Fuel Filter

Fit a new element in the first fuel filter but do not disturb the second filter. Clean the outside of filter then remove the bolt securing base of first filter to filter head, whilst holding base and element with the other hand. Remove base and discard element. Flush out base and fit a new element, ensuring that it seats correctly on the sealing rings in base and head. Fit a new sealing washer on to the retaining bolt. Replace the bolt and tighten firmly, but not excessively.

Do not attempt to clean fuel filter elements and do not change elements from one filter to another.

Remove and flush out fuel feed pump sediment bowl. As the fuel pump is lower than the tank it will be necessary to turn fuel tap off or, if a fuel tap is not fitted, slacken outlet union on fuel tank, so that fuel will not siphon out. Clean filter gauze with an air blast, or wash in clean fuel. Replace gauze and bowl, ensuring that it seats correctly on the sealing ring. After refitting sediment bowl and tightening the tank outlet union, or turning on fuel tap, vent system to remove air. (See Page 5.) (Fig. 5.)

Water Pump

Apply high-melting-point grease sparingly to the pump grease nipple. A few strokes of the grease-gun are all that is required. Over-greasing will damage the seals and cause eventual bearing failure.

Dynamo

Remove small rubber plug from the centre of dynamo rear end-plate, inject a few drops of engine oil through the hole and replace the plug.

Every 1000 Hours

Engine Oil Pump: Drain the oil and remove sump cover. Remove setscrew attaching gauze to pump. Remove and clean the wire gauze with diesel oil. Do not use a cloth. Refit gauze, sump cover and plug; fill with correct oil (see Page 39).

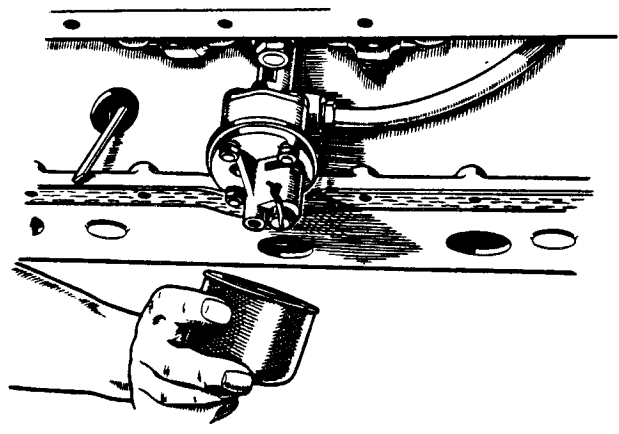


Figure 6. REMOVING THE OIL PUMP GAUZE FILTER

Fuel Filter: Using the same procedure as in 500 hours service, fit new elements in both first and second filters. Do not attempt to clean or interchange the filter elements.

FUEL SYSTEM

Introduction

A thoroughly clean fuel system is essential. Too much emphasis cannot be made on this point and the necessity for correct storage of fuel, proper attention to filter renewal, cleaning the exterior of the tractor before slackening any connections on the fuel system, and care when filling the fuel tank not to allow dirt to enter, must be impressed upon the user. Cotton waste or cloths must not in any circumstances be used in conjunction with fuel injection equipment.

Every care should also be exercised in the workshop. The bench used for servicing of fuel equipment should be situated in a well-lit and separate part of the workshop. If it is possible, an insulated dust-proof room should be provided in which the equipment can be permanently installed.

Some of the tools and test gear necessary for servicing injectors are shown in Category 'C' Tool Leaflets. The minimum essentials consist of the following: Two Safety Containers — one filled with petrol for soaking dirty nozzles and the other filled with test oil (see Page 40), or clean diesel fuel, for assembly of the cleaned components. A nozzle bench plate should be screwed to the bench with the jig end overhanging so that an injector can be located on it while the dome nut and lockwasher are slackened or tightened. A Nozzle Setting Outfit should also be securely bolted to the bench with a suitable canister to collect the spray and protect the operator against accidental contact with the spray.

The Flushing device used in conjunction with the Nozzle Setting Outfit is essential. The Nozzle Cleaning Kit (Fig. 13) includes a probing tool but not needles; correct diameter needles can be obtained separately as required. Although the above items are an essential minimum for injector servicing, more complex apparatus or additional items are available where the volume of work makes their purchase worthwhile.

Venting the System

Venting the system is necessary to remove air, as the system cannot operate correctly if air is present. If the system is allowed to run dry, or if any components are disturbed, venting should be carried out as follows:

1. Fill tank to a minimum of 2 gallons — 9 litres of fuel.
2. Clean sediment bowl and filter on lift pump before venting the system to prevent carry over of sludge or water, noting that if a fuel tap is not fitted it will be necessary to release the fuel tank outlet union to prevent fuel siphoning out. Ensure that no air is trapped in the bowl when refitting by filling it to the top with clean fuel.
3. Clean the outside of the fuel filters. Remove the plug G and slacken the connection H. Operate the feed pump priming lever and tighten in the order G then H as fuel appears at each point.

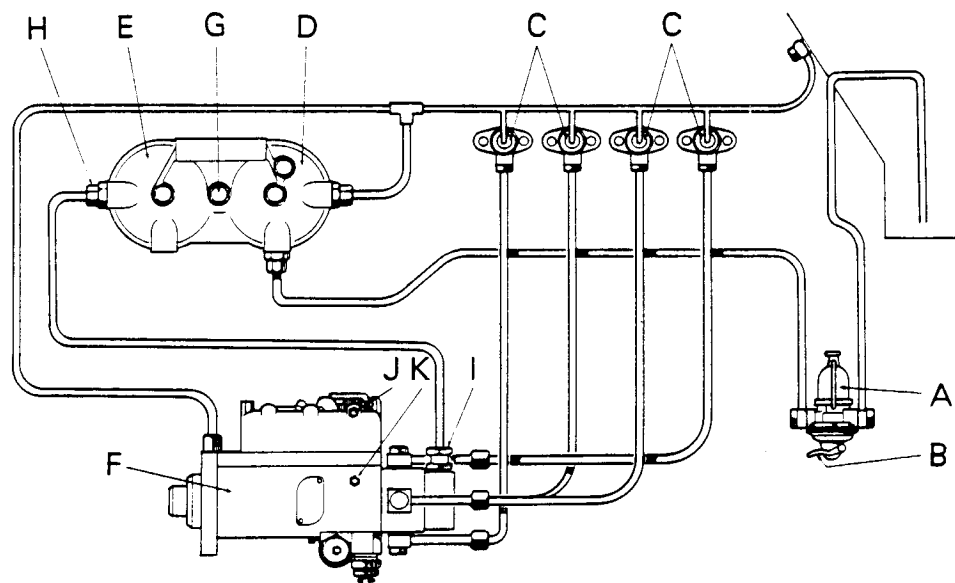


Figure 7. DIAGRAM OF FUEL SYSTEM

- | | | |
|-----------------------|----------------------------|---------------------|
| A. Fuel sediment bowl | B. Feed pump priming lever | C. Injectors |
| D. First fuel filter | E. Second fuel filter | F. Injection pump |
| G. Filter vent plug | H. Filter leak-off union | I. Pump inlet union |
| J. Pump vent plug | K. Pump vent plug | |

- Slacken the injection pump plug J and prime until all air is expelled then tighten the plug and repeat the operation with plug K.

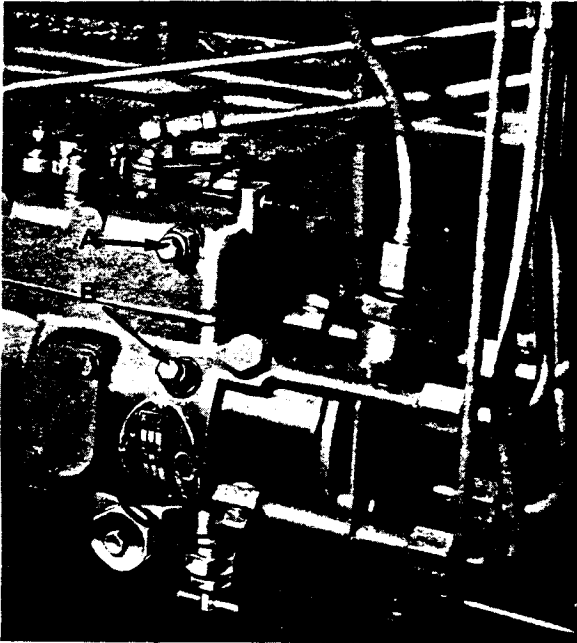


Figure 8. FUEL INJECTION PUMP VENT PLUGS

- Governor housing vent plug
- Pump barrel vent plug

- Slacken the union I and prime until free from air then tighten.
- Slacken the high-pressure pipes at the nozzle end then, with the engine stop control in the

“run” position and the throttle fully open, turn the engine with the starter until fuel is ejected. Tighten the pipe unions and operate the starter: the engine should then start.

- Having started the engine, check tightness of all the connections, check for any fuel leaks and wipe clean all spilt fuel.

Fuel Feed Pump

The fuel feed pump is mounted on the right-hand side of the engine crankcase and is actuated by a push rod from an eccentric formed on the camshaft.

To remove the fuel feed pump, disconnect fuel pipes at the pump and release the two bolts securing the pump to the engine crankcase. When the pump is removed the push rod may be withdrawn from crankcase.

Renewal of Diaphragm: Clean exterior of the pump and mark top and bottom halves so that they can be replaced in the same position. Remove six cheese-headed screws securing the upper half of the pump to the base and lift off the pump top.

Remove diaphragm complete with pull-rod by turning these through an angle of 90° which should release the pull-rod from the connecting link. Fit new diaphragm and pull-rod over the spring with the tab in the position shown in Fig. 10. Press the centre down until the “T” of pull-rod enters slot in connecting link and turn diaphragm through 90° as shown in Fig. 10 so that they lock together. The upper housing may then be replaced. Press priming lever and keep it pressed whilst the cheese-headed screws securing the housing are tightened. This ensures the diaphragm is not taut.

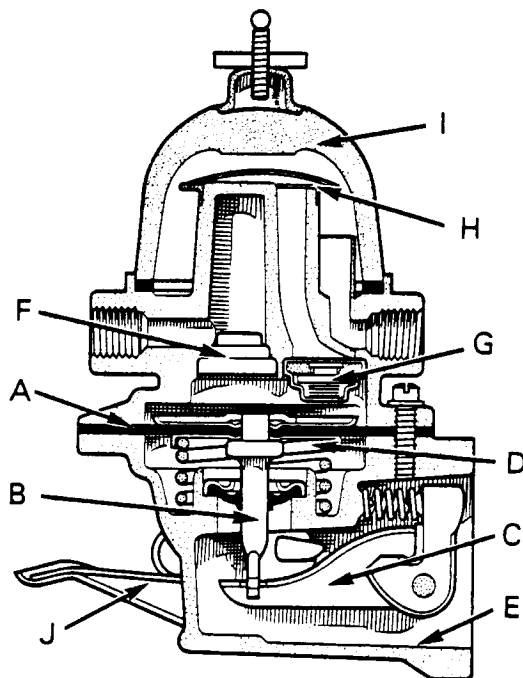


Figure 9. FUEL FEED PUMP

- Diaphragm
- Diaphragm pull-rod
- Connecting link
- Diaphragm spring
- Body
- Outlet valve
- Inlet valve
- Filter gauze
- Sediment bowl
- Hand primer

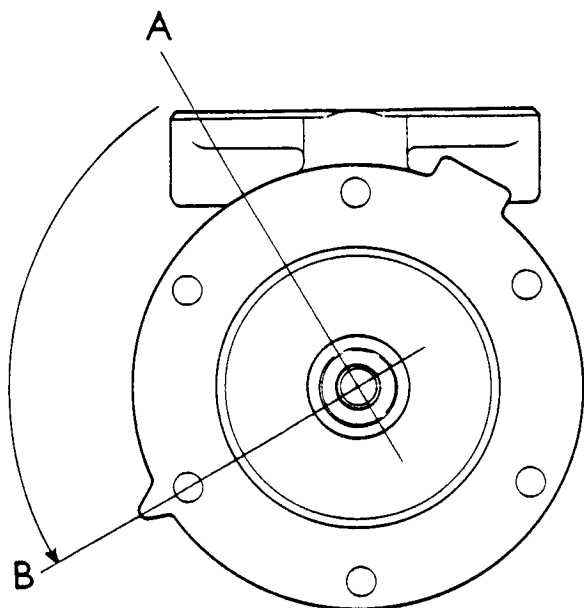


Figure 10. REFITTING FEED PUMP DIAPHRAGM

With the diaphragm tab at position A, fit the diaphragm on to the pump body until the pull-rod enters the link slot, then turn the diaphragm 90°, so that the tab is at position B, to lock the pull-rod in the link slot.

Injector Servicing

Nozzle Testing: The hand tester shown in Fig. 11 is adequate for testing and pressure setting injectors.

Attach the injector to the spray tester and place a canister round the nozzle to ensure that spray does not contact the body. The force of the spray is such that it will easily penetrate the skin, even through clothing. The resultant oil under the skin is very difficult to treat and can be a very uncomfortable wound. The canister will also help to condense the very fine spray which forms an objectionable atmosphere. If regular nozzle testing is contemplated a totally enclosed test chamber with exhaustor is advocated.

Pressure Test: With injector mounted in the test outfit, depress hand lever several times to fill the injector and expel any air. Depress lever very slowly and observe highest pressure reading that is obtained before needle on pressure gauge flicks. This is the pressure at which injection takes place. The correct pressure for new injectors is 185 atmospheres, and for used injectors 175 atmospheres.

If the pressure is incorrect but the nozzle is clean and otherwise satisfactory, it should be set to the correct figure as follows: Remove dome cap and slacken locknut, and using a large screwdriver in the pressure adjusting screw D (Fig. 12) adjust the pressure. Only a very small movement will be required unless the nozzle has only just been assembled and the pressure not previously set. When the screw has been adjusted, tighten locknut and recheck pressure.

Back Leakage Test: Operate hand pump until pressure is about 170 atmospheres. Release the handle quickly and measure, with a stop-watch, the

time taken between pressure gauge pointer passing the marks for 150 and 100 atmospheres as it gradually falls. For a satisfactory nozzle the time taken should be between 6 and 25 seconds.

Dry Seat Test: Carefully wipe nozzle dry. Build up pressure to 10 atmospheres below the injection pressure. Examine nozzle whilst under this pressure. It should be dry and free from leakage. If the nozzle is inadvertently caused to inject, the tip should be re-wiped dry and tested again.

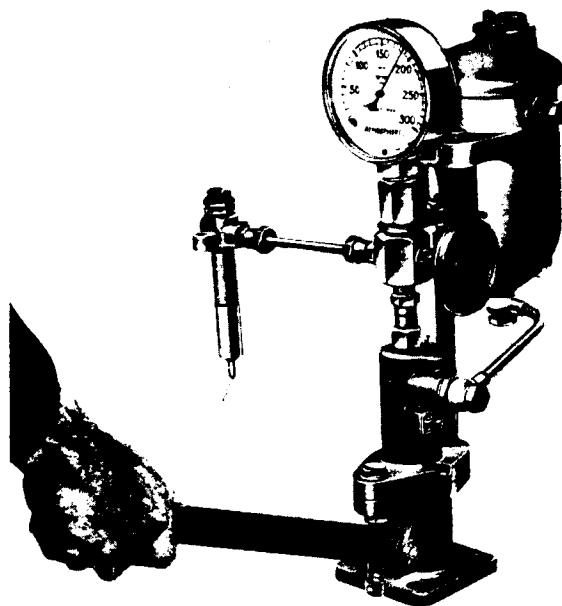


Figure 11. INJECTOR TESTING

Using Service Tool 7044/122FF

Atomisation Test: Isolate pressure gauge by closing valve. Apply eight quick jerks and examine the spray quality. The sprays should be free from coarse or solid streaks and the tip should remain dry. There should be four sprays equally spaced at an inclusive angle of 140°. They are offset 10° to allow for the tilt of the injector in the cylinder head.

Examine injector for signs of leakage at nozzle cap nut, spring adjusting nut, and copper sealing washers.

Nozzle Cleaning: If the injector fails to pass any of the above tests it must be dismantled, cleaned and retested. Note the spring pressure must be released before removing a nozzle. Unscrew the nozzle cap (Fig. 12), using a close-fitting spanner on the flats provided, and remove nozzle, noting that it will only fit in one position because of the locating dowels. Remove needle valve and place in petrol to soften the carbon. Examine nozzle and needle for damage, overheating or scratch marks on the lapped working surfaces. If excessive overheating has occurred, denoted by a dark blue colour of the needle, or if the seat or working surfaces are damaged, re-conditioning will be required and a new nozzle should be fitted.

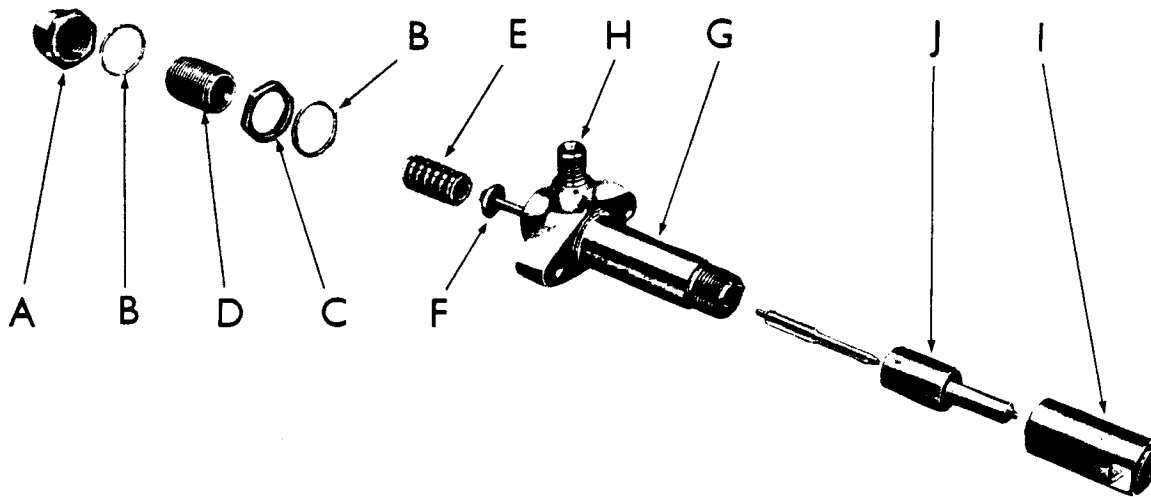


Figure 12. EXPLODED VIEW OF INJECTOR

- | | | | |
|-----------|-------------------|------------|--------------------------|
| A. Cap | B. Sealing washer | C. Locknut | D. Adjusting screw |
| E. Spring | F. Plunger | G. Holder | H. Fuel inlet connection |
| | I. Nozzle nut | J. Nozzle | |

If the nozzle is not damaged it should be cleaned using the special tools provided in the nozzle cleaning kit shown in Fig. 13 and Tool Leaflet C2. Firstly clean fuel oil channels and bores in the nozzle. Scrape carbon from valve seat with the brass scraper.

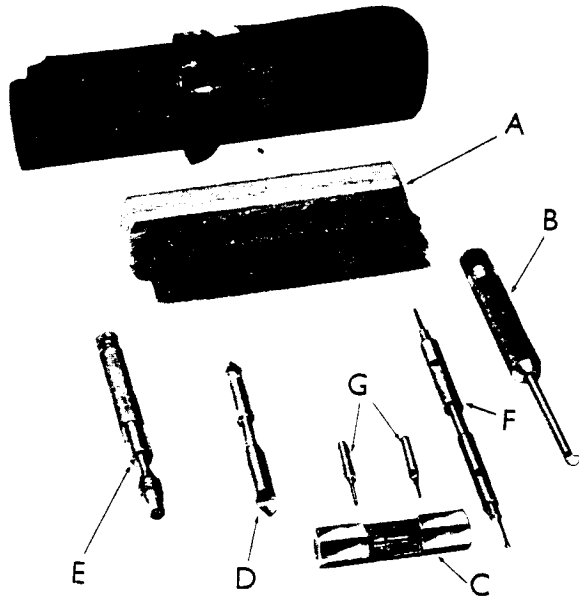


Figure 13. C.A.V. NOZZLE CLEANING KIT

- | | |
|--------------------------------|-------------------------------|
| A. Brass wire brush | B. Nozzle body groove scraper |
| C. Nozzle plunger cleaner | D. Nozzle body seat scraper |
| E. Holder—probing needle | F. *Pintle hole cleaner |
| G. *Probes—pintle hole cleaner | |

* Not required for D.B. nozzles.

Using the special groove scraper clear carbon deposits from oil gallery. Clean spray holes with probing tool fitted with a probing wire of the correct diameter.

If a wire is broken off in the hole it is often impos-

sible to remove it, and the nozzle is then useless. Great care should be exercised when using the probing wires. After clearing the holes scrape carbon from valve seat with the V-tipped brass tool. Next use the tool with the thin blade radiused at its tip to clean carbon out of the sac. After cleaning with the tools, the nozzle should be thoroughly cleaned with fuel. This should be done by placing the nozzle, without needle, in the reverse flushing attachment and connecting to the nozzle pressure tester in place of an injector. Operation of the tester will then thoroughly flush all particles of loose carbon from the nozzle.

With the brass wire brush, gently clean needle valve, paying particular attention to valve seat and needle tip. Brush carbon from nozzle stem and tip.

Reassembly: The needle valve should be fitted to nozzle whilst both are under the surface of clean fuel oil or test oil. Only in this way can dust be excluded from assembly. The needle should slide smoothly in the nozzle and this should be tried several times whilst under the surface of fluid. Needle and nozzle are assembled as a pair and under no account should they be interchanged.

The nozzle should then be assembled on to injector body. In order to avoid distorting needle or plunger the pressure on pressure spring should be released. Remove dome cap, slacken locknut and slacken pressure adjusting screw right back until there is no pressure on spring. Make sure that mating surfaces between nozzle and injector body are perfectly clean. Place nozzle on body with the dowels in correct engagement so that the two faces are in perfect contact, i.e., not held apart by spring pressure. Place the cap over nozzle and tighten adequately but not overtight. Retighten pressure adjusting screw and reset the pressure on spray tester. Test the spray, leak back, etc. If the injector is not required for immediate use it should be stored in a sealed plastic bag or similar container. (Fig. 14.)

It is essential that the copper washer be used under

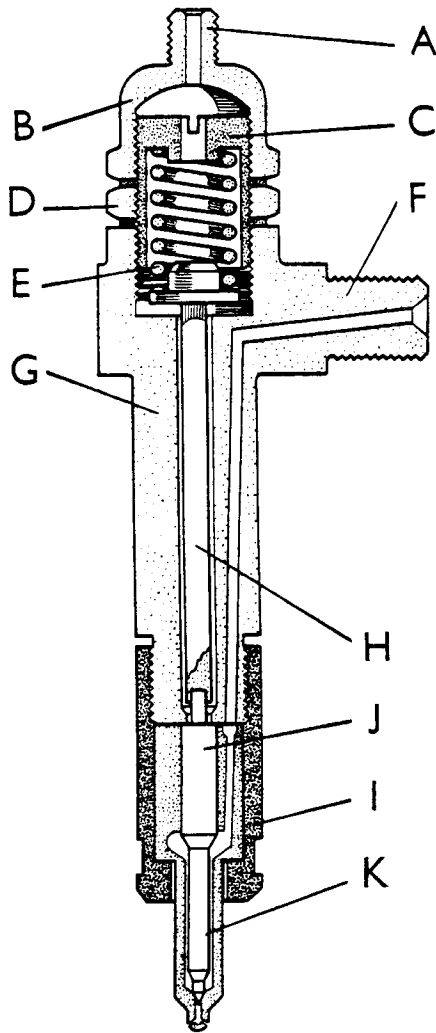


Figure 14. SECTIONED INJECTOR

- | | | |
|------------------------|------------|--------------------------|
| A. Leak-off connection | B. Cap | C. Adjusting screw |
| D. Locknut | E. Spring | F. Fuel inlet connection |
| G. Holder | H. Plunger | I. Nozzle nut |
| | J. Needle | K. Nozzle |

injector when refitting to engine. Check that the seat in head is clean and that the old washer has not been left in the recess. The use of two washers will raise nozzle tip so that the spray impinges on cylinder head. This causes a loss of efficiency and excessive exhaust smoke.

Injection Pump

The injection pump is attached by three studs on the engine carrier plate, and the pump mounting holes are slotted to permit pump body to be turned for injection timing adjustment. To assist in obtaining the correct timing position the pump flange is marked with a groove and when the timing is set during assembly a mark is made on the carrier flange in line with the mark on pump. Any pump can thus be fitted and the original timing obtained by placing the two marks in alignment. (See Fig. 15.)

The pump is driven from the camshaft by means of an intermediate gear and correct timing of the injection pump can only be obtained if all the timing gears are meshed correctly (see Fig. 44).

Removing the Pump

1. Disconnect all fuel pipes from pump.
2. Disconnect throttle and stop control cables from pump.
3. Check that timing-mark on pump drive housing is visible. If not, scribe a new line in line with the mark on pump.
4. Unscrew holding-down nuts on pump flange.
5. Lift pump away from housing. The quill shaft will probably remain in the pump and should be withdrawn and retained until required.

Refitting the Pump

1. Before refitting the pump check the position of the master spline in the driving gear then fit the quill shaft into the pump (chamfered end of shaft towards pump) and turn the pump so that the master spline on the quill shaft is in line with the gear spline.
2. Fit pump to housing.
3. Rotate pump body until timing marks line up (see Fig. 15) and tighten the three holding nuts.
4. Reconnect all fuel pipes and control cables. Vent fuel system (see Page 5).

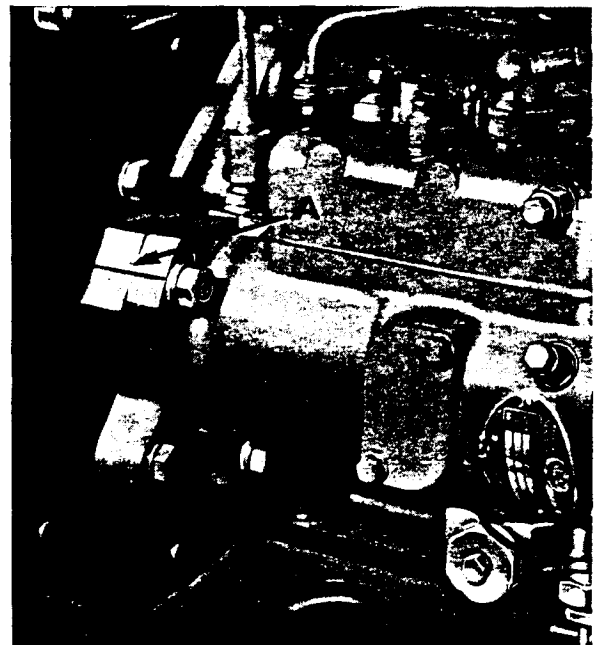


Figure 15. INJECTION PUMP TIMING-MARKS

- A. Pump body mark aligned with engine flange

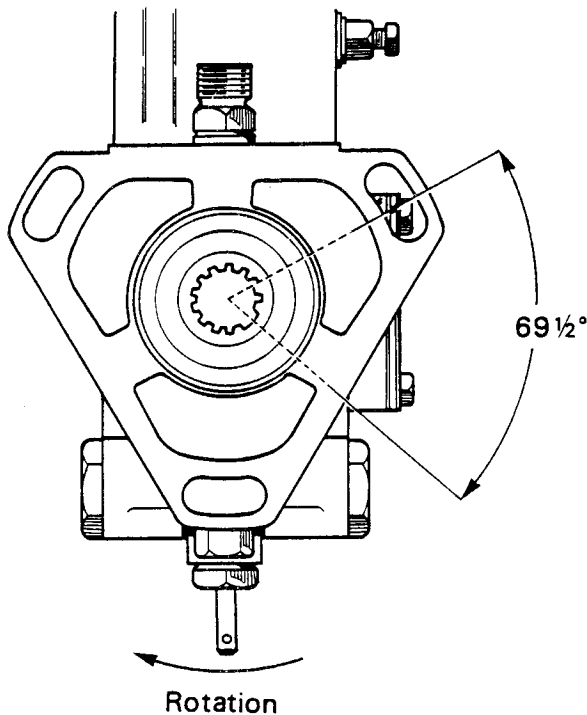


Figure 16. SETTING THE INJECTION PUMP

Retiming the Injection Pump

If the timing-line on pump becomes obliterated the pump can be retimed to the engine as follows:

1. Attach stirrup pipe, Service Tool CAV 7144/262, to Nos. 1 and 4 injector pipe connections and connect the pipe to an injector tester. Set the pump so that the master spline is towards the top of the pump then operate the tester handle to build up a pressure of 30 atmospheres.
2. Fit Service Tool CAV 7144/112U on to the pump quill shaft and turn the pump until it becomes rigid. This will be the point at which injection commences on No. 1 cylinder.
3. Measure $69\frac{1}{2}^\circ$ from the blank spline by means of the scale on the tool and mark the pump flange (Fig. 16).
4. Remove the tool, disconnect the tester and refit the pump on the engine, aligning the timing-marks before tightening the mounting nuts.

Fuel Setting

Once the fuel setting has been set for an engine it is most unlikely that it requires adjustment. If adjustment is required then the pump should be removed from the engine and tested for delivery on a Hartridge Test Bench. For details of injection pump fuel setting see Page 34.

Injection Pump Controls

The front lever on injection pump operates the fuel cut-off to stop the engine. The rear lever operates the governor to give required engine speed and is fitted with two adjustable stops. The front stop is for setting idling speed and this should be set so that the engine runs at 650–700 rev/min with throttle lever in shut-off position. The rear stop is for setting maximum speed and should be set at : 2350 rev/min no load to give 2200 rev/min full load.

Fuel Filters

The double fuel filter mounted on the left-hand side of the engine contains two replaceable paper elements. These are connected in series, so that all fuel must pass through both elements before it is fed to the injection pump. Always wipe the outside of filter clean before removing the elements and fit new elements at the time specified. New elements should also be fitted whenever a new, or reconditioned, fuel injection pump is fitted. Do not attempt to clean elements and do not change elements from one filter to another.

Fuel Tank Removal

The easiest way of removing the fuel tank is to remove the tank complete with instrument panel, then remove instrument panel from tank.

First drain tank by unscrewing union nut on fuel tap outlet and allowing fuel to flow by gravity into a suitable, **clean** container. If tractor is not fitted with a fuel tap, remove union from fuel feed pump inlet and allow the fuel to siphon through pipe into a suitable, clean container. Do not release the union at the tank end of pipe as this will allow air into pipe and prevent the siphon action from taking place. Disconnect tractor meter drive cable and wiring. Some of the wires are fitted with snap connectors, but others, such as oil warning switch wire, will have to be disconnected at their terminals.

Remove fuel tank mounting bolts and fuel cut-off control-rod spring bracket, unscrew fuel outlet and leak-off pipes from tank and lift tank assembly from its support.

Replace the tank in reverse order of removal ensuring that seating pads are in position and wires are replaced in their correct connectors.

STARTING AIDS

For use in cold weather

Manual retard device on injection pump: The wing-nut on the under-side of pump should be screwed in **before** trying to start engine. As soon as engine is running the wing-nut must be screwed out, otherwise erratic running with black exhaust smoke and loss of power will occur. Do not screw manual retard nut in immediately after an unsuccessful attempt to start engine. If you attempt to start engine prior to screwing in manual retard, wait 15 to 20 seconds to allow pressure inside

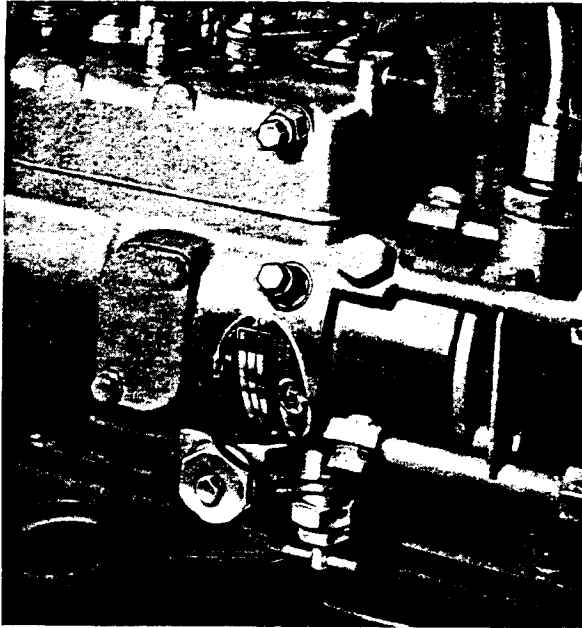


Figure 17. INJECTION PUMP RETARD CONTROL
A. Wing nut

pump to fall; otherwise pump will be locked in the advanced position and engine will not start. It is advisable to screw the wing-nut in **before** attempting to start engine. (Fig. 17.)

For use in sub-zero temperatures

Ether plug: In the inlet manifold there is a plastic plug with a felt pad on the end. Unscrew plug and dip felt pad into ether or a proprietary starting fluid, replace plug in manifold and start engine immediately. (Fig. 18.)

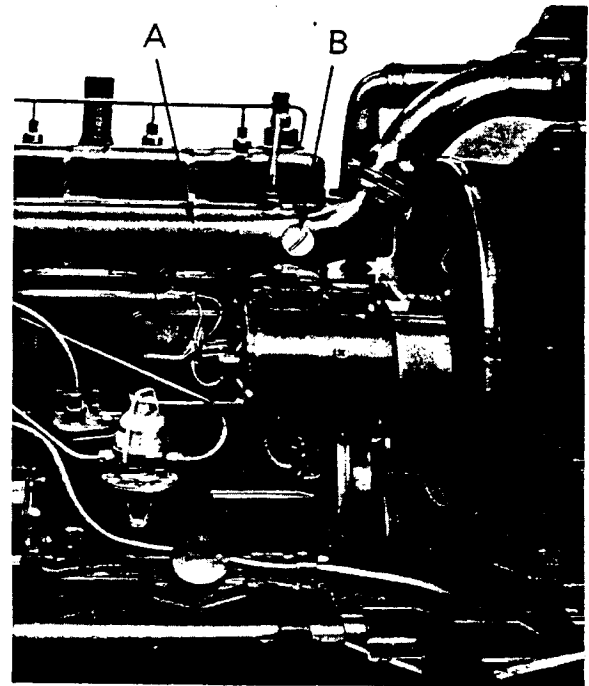


Figure 18. ETHER STARTING PLUG
A. Inlet manifold B. Plug

Warning

Serious damage can be caused to an engine by the use of an excessive amount of ether. The plug should be removed, the felt soaked in ether and then replaced. **Ether in excess of the quantity absorbed by the felt must not be added.**

It must be noted that other aids do exist, namely that correct oil should be used (see Page 39) and the battery should be kept charged by running the engine for adequate periods of time.

LUBRICATION SYSTEM

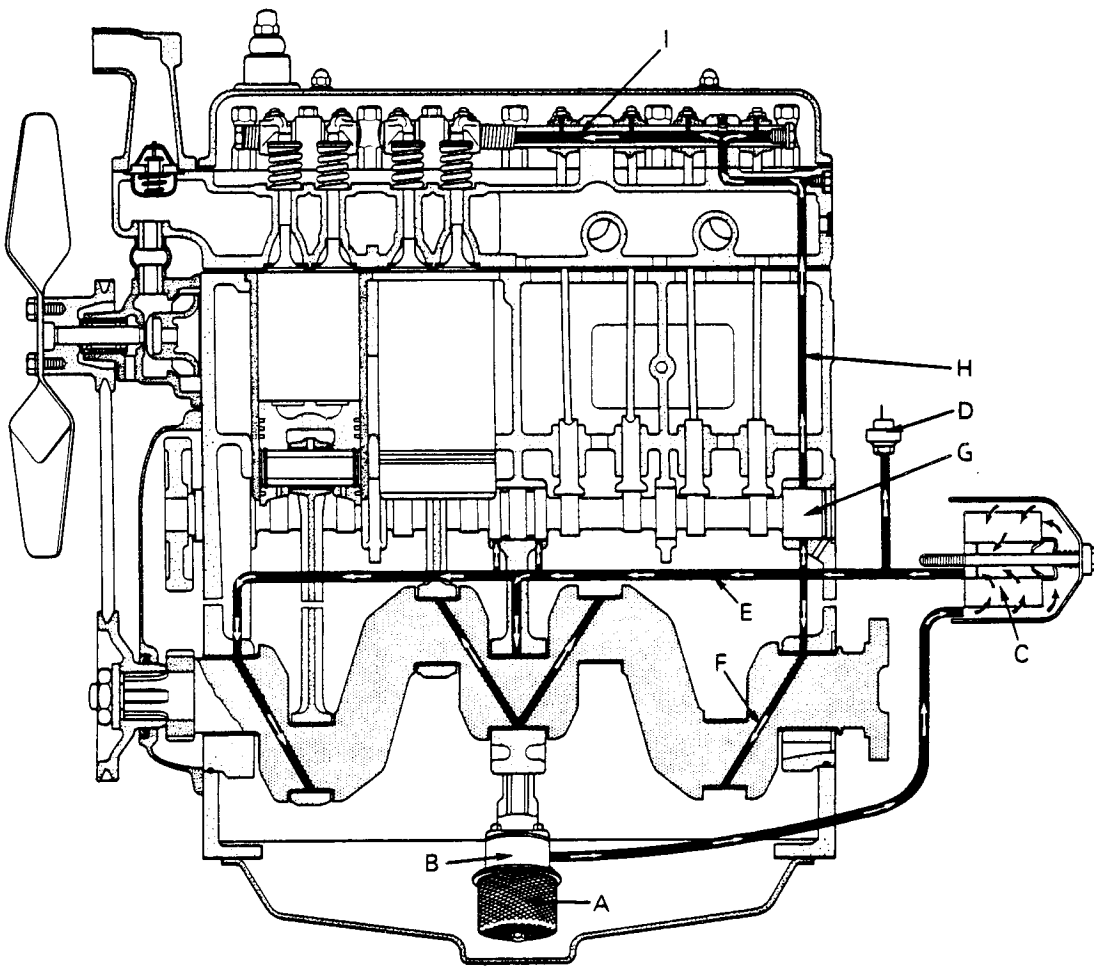


Figure 19. LUBRICATION SYSTEM

- | | | | |
|--------------------|---------------------------|--------------------------|-------------------------|
| A. Inlet gauze | B. Oil pump | C. Filter | D. Warning light switch |
| E. Oil gallery | F. Crankshaft oil passage | G. Camshaft rear bearing | |
| H. Valve gear feed | I. 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.

The rocker shaft and valve rockers are intermittently fed with oil from the camshaft rear bearing through oilways in block and head and an external connecting pipe. The camshaft is drilled off-centre so that the oilways are connected only once in each revolution. (See Fig. 20.) The oil lubricates the tappets and push rods as it returns to the sump.

The intermediate gear is pressure fed via its hollow shaft and an oil-way in the cylinder block. A connection at the front end of the main oil gallery supplies a reduced flow of oil to the injection pump drive gear. Surplus oil in the timing cover forms an oil bath which splash lubricates the timing gears.

A full-flow oil filter is mounted on the left-hand side of the cylinder block. The filter incorporates a by-pass valve so that if the pressure difference between the filter inlet and outlet exceeds 10 lb/sq in. the valve opens and allows oil to by-pass the element and flow straight into the oil gallery. The engine is not, therefore, starved of oil if the element is allowed to become choked, but it is supplied with unfiltered oil. The replaceable paper element should be renewed at the intervals specified on Page 1. A new element should also be fitted when an engine is overhauled and also if a cylinder head gasket fails.