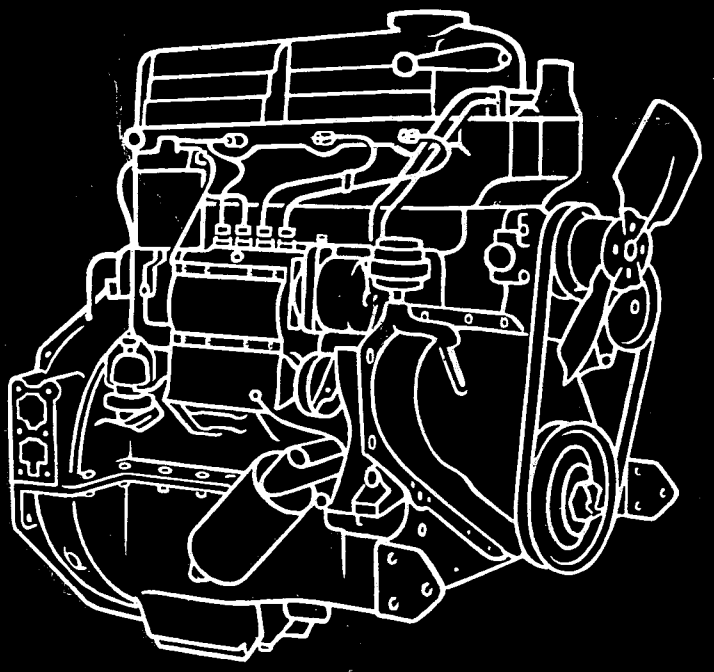
Ford



# Owner's Name

.....

## Address .....

.....

.....

.....

## Engine Number .....

## Date Purchased .....

## Authorised Dealer .....

.....

Should you require any further information or guidance write direct to:—

COPYRIGHT IN GREAT BRITAIN
JULY 1958

Reproduction in any manner, in whole or in part, prohibited without the express permission in writing of Ford Motor Company Ltd., 88, Regent Street, London, W.1, England.

# Contents


| | Page |
|---|---|
| Foreword | 4 |
| General Information | 6 |
| Operator's Instructions | 8 |
| Before Operation | 8 |
| Running In | 9 |
| Instruments and Control | 10 |
| Starting the Engine (Diesel) | 13 |
| Starting the Engine (Petrol) | 17 |
| Lubrication and Maintenance | 20 |
| Engine Fault Finding Chart (Diesel) | 30 |
| Engine Fault Finding Chart (Petrol) | 32 |
| Decarbonising | 34 |
| Ignition System | 42 |
| Diesel Fuel Injection System | 46 |
| Pneumatic Governor (Diesel Engine) | 54 |
| Mechanical Governor (Diesel Engine) | 56 |
| Fuel System (Petrol Engine) | 59 |
| Cooling System | 62 |
| Electrical System | 66 |
| Clutch (where fitted) | 70 |
| Mechanical Governor (Petrol Engines) | 71 |
| General Specification | 74 |
| Operator's Log | 80 |
| Index | 88 |

# Foreword

This book contains operating instructions and maintenanc recommendations which will enable you to become familiar with—anc obtain the most satisfactory performance from—your new Dagenhan built engine, with the minimum operating cost.

The life of your engine unit and the delivery of the high performance built into it will depend on the care it receives throughout its life. It is the operator's responsibility to ensure that the maintenance operations outlined in this book are carried out regularly after the specified hours of operation have been reached.

When repairs or replacements are necessary, it is important that only genuine parts are used and that the work is carried out by competent mechanics.

Where the term "right" or "left" occur in this book they refer to the respective sides of the engine unit when viewed from the flywheel end.

**FORD MOTOR COMPANY LTD**

**ENGLAND**

# General Information

# General Information

Your Industrial Engine was carefully inspected before leaving the factory. However, before putting it into operation, certain preliminary checks should be carried out to ensure that the engine gets off to a good start in its life. Read the operating instructions carefully.

The engine number is stamped on the left-hand side of the flywheel housing flange on early engines and on the front right-hand side of the cylinder block on current engines. When ordering parts or entering into correspondence concerning the engine, always quote the engine number.

Industrial engines manufactured by Ford Motor Company Ltd., England, are available through Ford Dealers and supervising Ford Companies throughout the world. When in need of parts or service, see your local Authorised Dealer or in the event of difficulties communicate directly with the supervising Ford Company in your area.

Available optional equipment includes the following:

Radiator installation
Air Cleaner
Instrument Panel
Magneto
Velocity Governor—E272/3/4 (according to speed)
Mechanical Governor
Clutch Disc
Clutch Pressure Plate Assembly
Tool Kit
Exhaust Pipe and Silencer Assembly
Fuel Tank
Battery
Cranking Handle
Coil
Fuel Tank Draincock
Oil Pressure Warning Light Switch
Solenoid Actuated Starter Motor
200 lb. Heavy Duty Flywheel
Reverse Flow Fans
Tachometer Drive (Generator)
Hourmeter

# Operating Instructions

# Operating Instructions

Your engine unit has been designed and built to furnish a reliable and economical source of power for many hours of service. However, no amount of engineering ingenuity or care in manufacture can obviate the need for reasonable attention and avoidance of mis-use by the operator. It is important to be as thoroughly familiar with the points requiring periodical attention as it is to know how to operate the unit. These points are completely covered in the subsequent lubrication and maintenance section of this book.

**You are strongly advised to ensure that adequate maintenance is provided, which will result in overall operating costs being kept to a minimum.**

# Before Operation

Before operating a new engine it should be thoroughly inspected to ensure that during transit and installation it has not suffered damage likely to affect its subsequent operation. Controls and instruments should be studied carefully in order that their functions may be thoroughly understood.

Open the cooling system drain cocks—located in the radiator bottom tank and in the cylinder block adjacent to the generator—and flush the cooling system with clean water. Close the drain cocks and fill the cooling system, preferably with soft water, to minimize corrosion. If hard water only is available, a suitable anti-corrosion agent may be added. Where freezing is anticipated anti-freeze should be added to the system. (See page 63).

Fill the engine sump to the full mark on the dipstick with the correct grade of lubricant. Use only high grade lubricants. "Cheap" lubricants may prove more costly in the long run.

Where an oil bath air cleaner is fitted, fill to the correct level with a light engine oil.

Ensure that the battery is topped up and fully charged. Maintain as per instructions on page 66.

# Running In

Your new engine should not be operated on full load or at high speed immediately; excessive wear or damage may result.

The following procedure should be adopted before running the engine under full load conditions:—

Run the engine on quarter load for the first 3 hours and then gradually increase the load until a half load condition is attained in a further 4 hours.

Gradually increase the load still further until the $\frac{3}{4}$ load condition is attained in a further 4 hours.

Gradual increase of load may then be applied until maximum load is attained after a total period of 15 hours.

When the engine is driving on air compressor, the equipment should be run at $\frac{1}{3}$ load for the first 6 hours, with a $\frac{2}{3}$ load being applied for a further period of 8 hours.

Full load may then be applied until the total running period completes 15 hours.

When the 15 hours have been completed, drain the oil whilst the engine is hot and re-fill to the "Full" mark on the dipstick. Also tighten cylinder head bolts to the required torque and then adjust valve clearances. (*See* General Specification, page 74).

The diesel engine must not be operated at **"No Load"** speeds in excess of 2,250 r.p.m., or damage may occur. In no circumstances should the diesel engine, when fitted with a pneumatic governor, be run without the air cleaner being fitted or with disconnected or loose governor suction pipes. If this is done the action of the governor will be affected and the engine might then reach an excessive speed.

# Instruments and Controls

The instrument panel (see Fig. 1) available for the engine unit incorporates the following compactly grouped instruments and controls; ammeter, coolant temperature gauge, oil pressure gauge, CVC regulator, choke and starter controls, ignition and/or lighting switch.

The function of each is described, as far as possible, in the order in which it is likely to be used.

**Choke Control (Petrol Engine).** This is located on the centre right-hand side of the instrument panel and is marked "C". It is pulled out (with the throttle in the closed position) when starting the engine from cold.

**Governor Control.** This is not part of the instrument panel, but can be fitted in any desired position, and controls the speed of the engine. To increase the engine speed, push the control downwards.

**Excess Fuel and Stop Device (Diesel Engine).** This is situated at the rear of pneumatically governed and "Minimec" injection pumps (see Figs. 2 and 31), but at the front on injection pumps with the GM and GV type mechanical governors. Push the button inwards and, on injection pumps with mechanical governors, move the control lever to the maximum speed position to supply excess fuel when starting from cold. On the earlier type injection pumps the stop lever is pulled outwards (at right angles to pump) to obtain excess fuel. The button, or lever, is returned to the running position automatically when the engine starts.

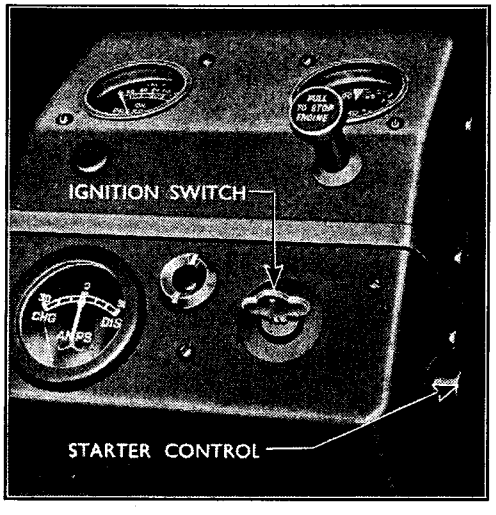



**Fig. 1**
**Instrument Panel (Diesel Engine)**

**Clutch Control.** This could be either a pedal or lever and is used when engaging or disengaging the clutch. When operated it releases the clutch, thus disconnecting the engine from the drive shaft.

Always allow the clutch control to return slowly and smoothly. Suddenly engaging the clutch imposes excessive strain on all parts and may stall the engine. Do not exert pressure on the control when it is engaged or slip may occur, leading to wear of the various parts.

**Ignition Switch.** The ignition switch is fitted at the centre of the lighting switch, at the lower right-hand corner of the instrument panel. When the key is vertical, the ignition is "off" and the key can be withdrawn.

To switch "on" the ignition, turn the key in an anti-clockwise direction, 45° from the vertical.

Where a diesel engine is fitted, this switch, when in the "off" position, isolates the starter motor only.

**Stop Control (Diesel Engine)** To stop the diesel engine, pull out the control on the right-hand side of the instrument panel.

**Starter Motor Control.** For the petrol engine the starter control is on the left-hand side of the instrument panel, and is pulled out to operate the starter switch which in turn operates the starter motor.

When the diesel engine is fitted, the starter control may be a hand operated lever on the left-hand side of the engine or a push-button on the instrument panel (Fig. 2). The control is not operative until the ignition switch, or isolating switch, is "on". On all diesel models the starter control on the instrument panel, marked "S", is removed and the hole blanked off.

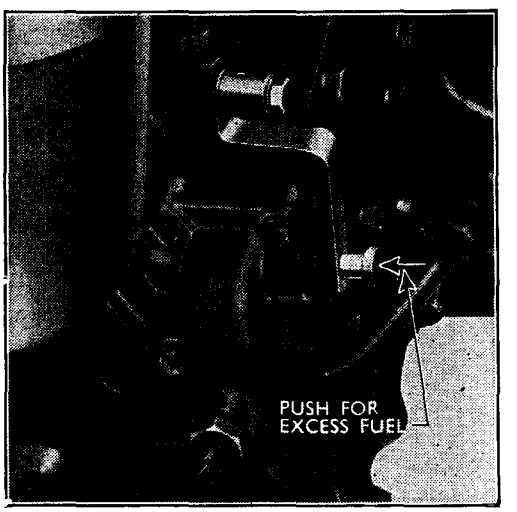



**Fig. 2**
**Excess Fuel Device**

# Instruments and Controls

**Ammeter.** This is located at the left-hand lower face of the instrument panel and registers the current charge or discharge.

**Oil Pressure Gauge.** This is located at the left-hand upper face of the instrument panel and indicates the oil pressure.

**Temperature Gauge.** This is located at the right-hand upper face of the instrument panel and records the temperature of the water in the cooling system.

**CVC Regulator.** The regulator controls the amount of current supplied by the generator to the battery and protects the battery from overcharging and the generator from burning out due to excessive output. The regulator adjusts the generator output to the needs of the battery. The ammeter will indicate a low charge rate when the battery is at or near full charge. Conversely a high charge rate will be indicated by the ammeter when the battery is low.

**Temperature Gauge.** The temperature gauge enables a close check to be kept on the coolant temperatures and will indicate overheating which may arise from low coolant level, clogged radiator, loose fanbelt, low oil levels, etc.

By bringing the engine to correct operating temperature 175°F-185°F. (79°C.- 85°C.) longer life and better fuel consumption will be ensured.

**Oil Pressure Gauge.** The oil pressure gauge registers the lubricating system pressure in lbs. per square inch and should be frequently checked to ensure that the system is functioning correctly. Normally the pressure registered by the gauge should remain constant for a given engine speed, but should the pressure recorded suddenly vary or fluctuate, the reason should be established. Loss of pressure must be investigated immediately otherwise severe damage may occur to the engine.

# Starting the Engine

## The Diesel Engine

Before attempting to start the engine, under any conditions always disconnect the driven equipment and turn on the fuel supply.

**To Start when Cold**

To start the diesel engine from cold with electric starting equipment, under normal conditions, the following method will be found most suitable. Additional notes are given to cover starting in conditions of extreme cold.

1. Check that the fuel injection pump stop control is pushed right in.
2. Close the radiator shutters (if fitted).
3. Set the governor control lever to the fully open position.
4. Turn the isolating switch to the "on" position, i.e., anti-clockwise.
5. Operate the starter motor control and, **as soon as the engine starts,** release the control and set the governor lever for the desired engine speed. If the engine fails to start, do not operate the starter again until all moving parts have come to rest.
6. Open the shutters when the normal operating temperature is reached.

**Decompressor Control.** (4-cylinder engine only). This control, located at the front of the rocker cover, enables the valves to be held off their seatings, so releasing the compression in each cylinder and allowing easier turning of the engine. To release compression, push the lever upwards against the stop, when it will be retained by the spring loaded ball. To restore compression when starting the engine, pull the control downwards until the ball registers in the hole in the arm.

**Starting in Extreme Cold Conditions with Electric Starter and Decompressor (4-cylinder engine only)**

1. Ensure that the fuel injection pump stop control on the dash is pushed right in.
2. Close the radiator shutters, set the governor control lever to the fully open position, disengage the clutch (when fitted).

**Fig. 3**
**Six cylinder Diesel Engine**

3. Push in the excess fuel device located on the fuel injection pump, see page 10.
4. Set the decompressor control in the "up" position, operate the starter motor for a few seconds to break the sealing effect of the cold oil, pull the decompressor lever down to restore compression and operate the starter control as for normal starting.
5. Open the radiator shutters when the normal operating temperature is reached.

**Hand Starting (4-cylinder engine only)**

If the engine is fitted with a heavy flywheel and decompressor it may be started by hand. Set all controls as outlined previously and the decompressor lever in the "up" position. Rotate the engine with the starting handle and when the cranking speed is sufficient (approx. 150 r.p.m.) pull the decompressor lever down; this will restore full compression and start the engine.

**To Restart when Warm**

1. Turn isolation switch (ignition key) to "on" position.
2. Set governor control approximately half open.
3. Operate the starter motor control and **release immediately engine starts.**

**Note.**—If the engine fails to start, adopt the procedure for normal cold starting as previously described.

**To Stop**

1. Pull the control marked "Pull to Stop"; do not use the decompressor control.

**Note.**—The ignition type isolation switch key controls only the starter motor circuit. The engine cannot be stopped by switching this off, as on petrol engines. This switch, when "off", prevents the starter motor control from being operated and therefore plays no part in stopping the engine. Removing the key when in the "off" position prevents unauthorised use of the engine.

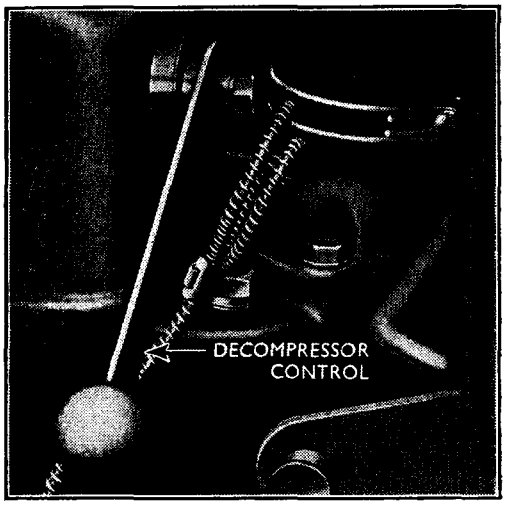



**Fig. 4**
**Decompressor Control (4-cylinder engine only)**

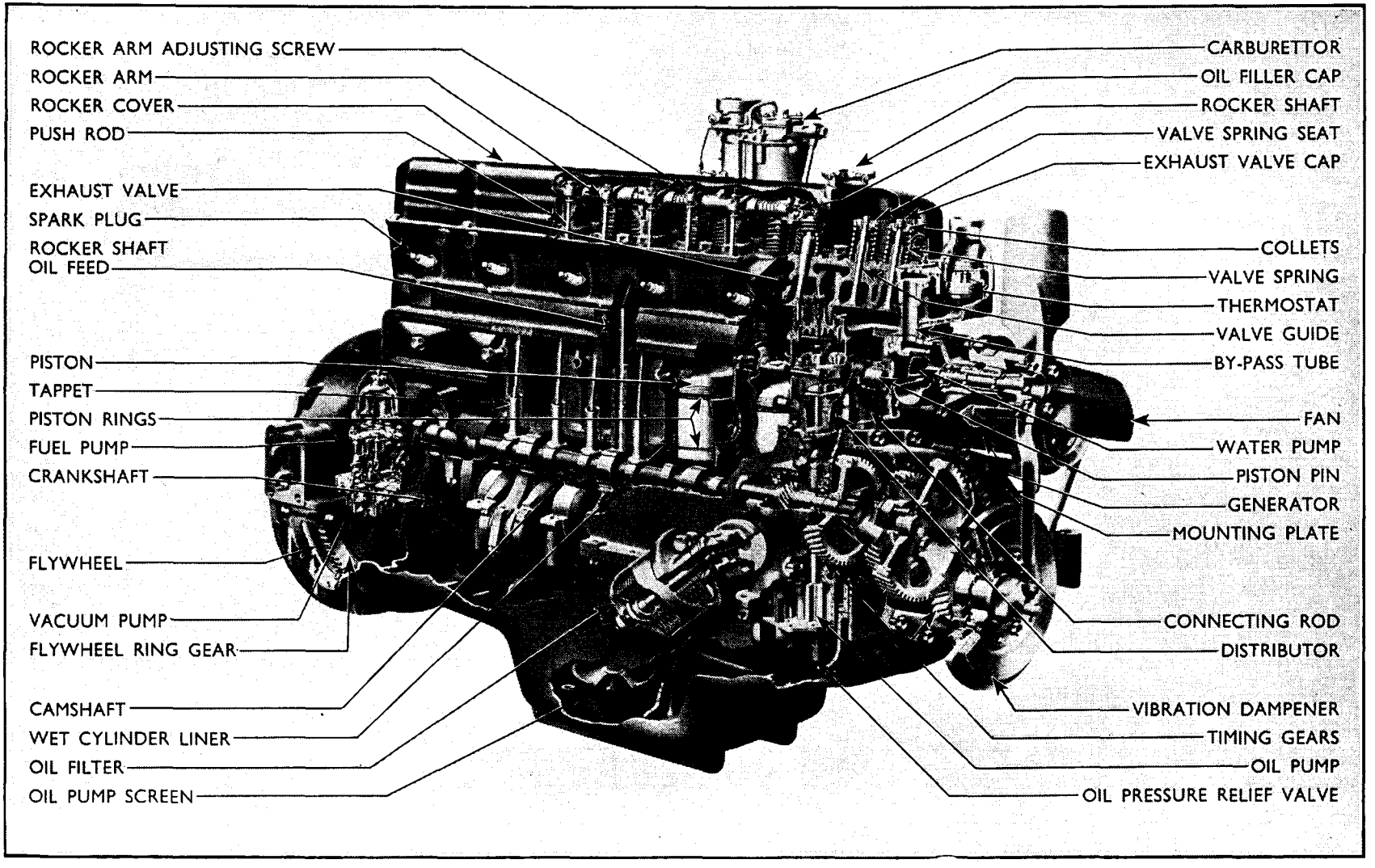



**Fig. 5**
**Six cylinder Petrol Engine**

# Starting the Engine

## The Petrol Engine

**To Start from Cold**

To start the petrol engine from cold under normal conditions, the following method should be adopted:—

1. Open the fuel tank tap.
2. Pull out the choke control marked "C" and ensure that the throttle control or governor control is in the closed position, i.e., upwards.
3. Close the radiator shutters (if fitted) by moving the operating control fully forward.
4. Switch the ignition "on", i.e., key turned anti-clockwise. Pull out the starter motor control and release as soon as the engine starts. Push in the choke control as far as possible, but avoid stalling the engine.
5. Allow the engine to idle until warm enough for the choke control to be pushed fully in. If the engine runs irregularly, ease out the choke control again until the operating temperature is sufficiently high for normal running when the choke control is released.
6. Open the radiator shutters when the normal operating temperature is reached.

**To Restart when Warm**

1. Open the throttle or governor slightly, i.e., control downwards.
2. Switch ignition "on" and pull the starter motor control, releasing as soon as engine starts. If, however, the engine fails to start use the choke control as for normal cold starting, but avoid excessive use of this control.

**To Stop**

1. Switch off the engine by means of the ignition key.

If the halt is likely to be of some duration the fuel may be turned off at the fuel tank.

Do not allow the engine to remain stationary with the ignition still on as this can cause damage to the ignition coil as well as causing the battery to discharge.

# The Petrol Engine (with Magneto Ignition)

**To Start**

Switch on the ignition by turning the key anti-clockwise and start as previously outlined.

**To Stop**

Turn the ignition key to the "off" (vertical) position to "earth" the primary circuit of the magneto and cut out the ignition.

# Lubrication and Maintenance

# Lubrication and Maintenance

The importance of correct lubrication, periodic inspection anc adjustment cannot be over-emphasised. On it will depend, to a very large extent, the service which the engine will give.

Regular attention to the points mentioned below will be amply repaid in long life, reliability, and freedom from repair.

Should the prevailing circumstances be such that you cannot find sufficient time for the lubrication and maintenance of your new engine, then we would suggest that you discuss the matter with your Authorised Dealer, who will be pleased to advise you of the maintenance schemes available.

To assist in operating a satisfactory arrangement for lubrication and maintenance, this work has been divided into the following periods:—

(a) Twice daily.
(b) After every 50 hours running.
(c) After every 200 hours running.
(d) After every 400 hours running.

Pages 22 to 27 give full information as to the points requiring attention.

## General

**Engine Lubrication**

The engine has a forced feed lubrication system and requires no attention from the operator except to ensure that the oil level is kept up to the **"Full"** mark on the dipstick, and that the oil is changed at the specified periods. The oil pressure gauge registers the pressure in the main oil gallery.

The oil pump, driven from the engine auxiliary drive shaft, draws oil through a gauze type screen, submerged in the sump oil. Oil under pressure is then delivered from the pump to a full-flow filter, fitted externally and having a renewable element.

After passing through the filter the oil lubricates the main and camshaft bearings through passages within the cylinder block. Further passageways in the crankshaft supply oil to the connecting rod big end bearings.

# Lubrication and Maintenance

Oil from the main gallery lubricates the timing gears at the front of the engine.

The centre camshaft bearing incorporates a means for controlling the oil feed to the overhead rocker shaft, rocker levers, push rods and valves.

The cylinder bores, pistons and connecting rod small end bearings are lubricated with oil mist thrown up by the crankshaft.

Under no circumstances must the oil in the engine be allowed to fall below the lower mark on the dipstick, (see Fig. 7) which is located on the left-hand side of the engine. The correct way to ascertain the oil level is as follows:—

With the unit standing level and the engine stopped, pull out the dipstick, wipe it with a clean rag, re-insert fully and again remove it, when the mark made by the oil indicates its level.

Top up if necessary. The oil filler is located on top of the rocker shaft cover. (see Fig. 6)

A new unit must have the engine oil changed at the end of 15 working hours, and thereafter every 200 working hours. To do this, remove the drain plug underneath the crankcase. The oil filter element, illustrated in Fig. 11, should also be renewed after every 200 working hours by removing the central bolt and detaching the filter body and element. Clean the body and fit a new element. Refill the engine with the correct grade of oil, see pages 74 and 76.

Do not flush out the engine with paraffin.

On later pages (see Specifications) details are given as to the suitable viscosity figures of engine oil for use under various climatic conditions.

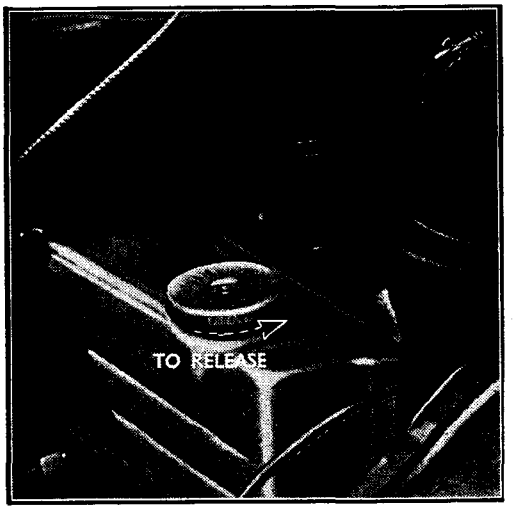



**Fig. 6**
**Oil Filler Cap**

# Twice Daily

**Engine**

Check the oil level and replenish, if necessary, to the **"Full"** mark on the dipstick, see Fig. 7, with a good quality oil of the correct grade.

**Radiator**

Top up water level if necessary.

# After Every 50 Hours Running

**Oil Bath Air Cleaner**

Disconnect the air hose connecting the air cleaner to the inlet manifold, unscrew the centre bolt securing the air cleaner to its mounting bracket and remove the assembly. Remove the gauze element, wash it in petrol or fuel oil and preferably dry it with compressed air. Thoroughly clean out the body and refill it to the level indicated on the side with new engine oil and refit the element.

Refit the air cleaner to its bracket, ensure that the gasket is in good condition and secure it in place with the centre bolt and reconnect the air hose to the inlet manifold.

On early type engines release the clips and remove the base. Clean the bottom screen of the element, also the base thoroughly, and refill to oil level with engine oil.

**Fig. 7**
**Engine Oil Dipstick**

**Distributor**

Screw up the lubricator or grease cup (if fitted) one turn every 50 working hours and refill it every 250 working hours.

# After Every 50 Hours Running

**Fig. 8**
**Oil Bath Air Cleaner**

Remove the rotor and add two drops of engine oil to the cam spindle, also add a film of oil to the contact breaker pivot post ensuring that none contaminates the points and lightly lubricate the governor weight mechanism through the gap in the breaker plate. Lightly smear the cam with petroleum jelly.

**Magneto** (when fitted)

Smear the cam with petroleum jelly.

Fill up the lubricator, situated on the side of the body, with engine oil every three months.

**Battery**

Top up with distilled water and clean the terminals as instructed in the Electrical Section, page 66.

**Mechanical Governor (GM and GV types only)**

Remove both the oil level and filler plugs from the rear face of the governor case (see Figs. 29 and 30) and add oil through the filler plug hole until oil flows from the level plug hole. Refit the filler plug and allow surplus oil to drain before refitting the level plug. Do not overfill the governor as this may cause sluggish action and unsatisfactory governing (see page 56).

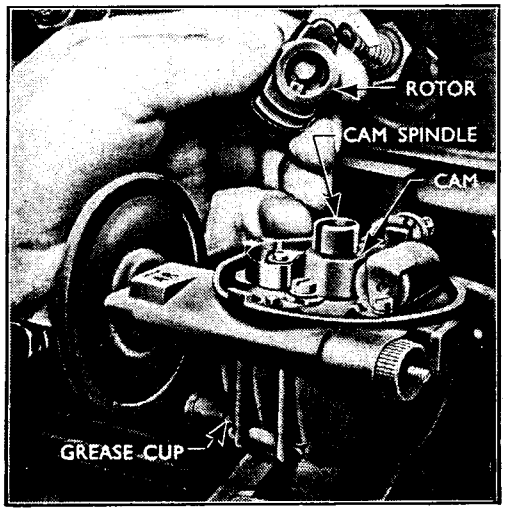



**Fig. 9**
**Distributor Lubrication Points**

# Every 200 Hours Running

**Generator**

On the current type add two drops of engine oil. (Fig. 10). On early types remove the generator lubricator cap and fill with petroleum jelly.

**Engine Oil Filler Cap**

The small oil bath air cleaner incorporated in the oil filler cap on early engines should be cleaned and filled to the correct level, as indicated by the arrow on the side of the body, with clean engine oil.

**Pneumatic Governor (Diesel)**

Remove the pneumatic governor air breather capsule—clean and oil lightly.

**Fuel Lift Pump (Horizontial Diaphragm Type)—High Speed Diesel Engines**

The mechanical fuel lift pump is located on the body of the injection pump, on these engines, and is operated by an eccentric on the pump camshaft. It incorporates a filter screen and a hand priming lever.

To clean the lift pump filter screen, unscrew the centre bolt and lift off the cover and screen (see Fig. 21). Wash the screen with clean fuel and replace. Fit a new cork gasket to the top cover and replace. Do not over-tighten the centre bolt. Bleed the system as outlined on page 49.

**Fuel Lift Pump (Horizontal Diaphragm Type)—Petrol and Low speed Diesel Engines**

This fuel lift pump is attached to the right-hand side of the cylinder block and is driven by an eccentric on the engine camshaft. It incorporates a filter screen, a sediment bulb and a hand priming lever.

Any accumulation of water or foreign matter should be removed, its presence is visible in the glass sediment bulb of the fuel lift pump. Unscrew the clamp at the top, move the retainer aside

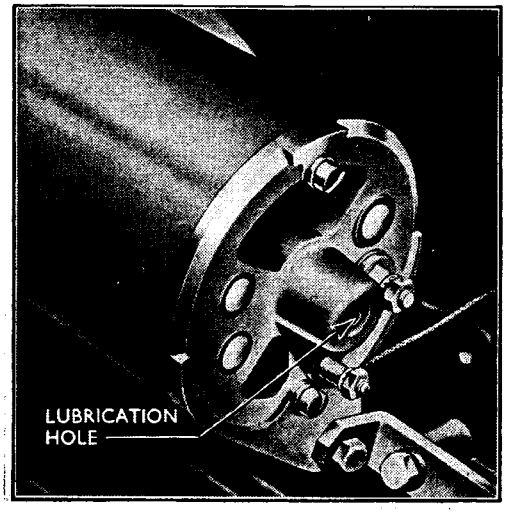



**Fig. 10**
**Generator Lubrication Point**

and lift off the sediment bulb and screen for cleaning, When replacing the bulb, ensure that the cork gasket is in good condition.

The fuel system must be bled to remove all traces of air after servicing the fuel lift pump or whenever the sediment bulb is removed.

**Fuel Lift Pump (Vertical Diaphragm Type)**

The vertical diaphragm type fuel lift pumps are located on the right hand side of the cylinder block on petrol and low speed diesel engines (with exhausters) and on the injection pump body on high speed diesel engines (also low speed diesel engines with exhausters). These pumps are driven by eccentrics on the engine and injection pump camshafts respectively. This type of lift pump incorporates a pulsator diaphragm, to reduce fuel delivery surge, and a hand priming lever.

To clean the lift pump, unscrew the centre bolt and remove the cover and pulsator diaphragm (see Fig. 22). When refitting the cover, ensure that the pulsator diaphragm is in good condition. Bleed the fuel system, as outlined on page 49, after reassembly.

**Minimec Injection Pump (Diesel)**

Drain the injection pump lubricating oil by removing the drain plug from the base of the governor housing (see Fig. 31), after first cleaning the pump exterior. Remove the filler and level plugs, which are on the top and side of the governor housing respectively, replace the drain plug and add engine oil until it reaches the level plug orifice. When the level is correct, replace both filler and level plugs.

The capacities are:—

4 cylinder pump—
$\frac{5}{8}$ Imp. pt. ($\frac{3}{4}$ U.S. pt.; 0.35 litre)

6 cylinder pump—
$\frac{3}{4}$ Imp. pt. (0.9 U.S. pt.; 0.42 litre)

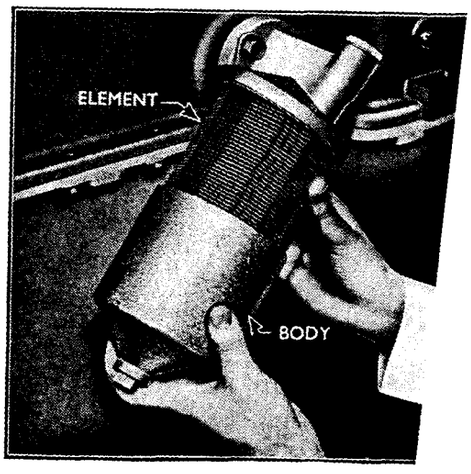



**Fig. 11**
**Oil Filter Element**

# Every 200 Hours Running

**Engine**

Drain the engine oil on all models, flush out and refill with correct grade of approved lubricant, see pages 74 and 76. Do not use paraffin for flushing purposes.

**Oil Filter**

The oil filter is fitted direct to the cylinder block, no connecting pipes to the engine being required. To change the filter body, undo the hexagon-headed bolt retaining the filter unit to the filter head and withdraw the filter assembly, see Fig. 11.

Withdraw the filter element from the body, wash the body and fit the new element.

A new rubber gasket is suppled with each element. Remove the existing gasket, then locate the new gasket in the groove at four diametrically opposite points and seat it all round the groove.

Do not fit the gasket at one point and then work it round the groove as the rubber may stretch, thus leaving a surplus which may cause an oil leak.

Refit the body assembly to the filter head ensuring that the washer is in place under the bolt head. Do not overtighten the centre bolt.

**Crankcase Breather**

Remove the breather (where fitted) from the engine front cover and detach the cap. Drain all oil from the main body and rinse in paraffin: also rinse the cap to clean the gauze. Refill to the level mark with clean engine oil (see Fig. 12) and then reassemble the breather.

**Carry out this operation more frequently under very dusty conditions.**

**Fig. 12**
**Crankcase Breather**

# Every 400 Hours Running

**Diesel Fuel Filter**

A replaceable element filter is bolted to the rear of the cylinder head on the right-hand side. The element should be changed every 400 hours. Do not unpack the new filter element before necessary to prevent it becoming contaminated.

To change the element, unscrew the centre nut and remove the body and old element. Discard the old element, thoroughly wash out the body. **Do not wipe the body with a cloth.**

Fit a new rubber seal to the filter head. Unpack the new filter, fit to body and replace the body (see Fig. 13).

Whenever the fuel system has been disconnected between the injection pump and fuel tank it is necessary to bleed the system, as outlined on page 49.

**Fuel Injectors**

The fuel injectors should be removed from the engine for testing and servicing at periods not exceeding 400 working hours.

Unless special equipment is available for testing and adjusting the injectors, this work should only be done by an Authorised Dealer.

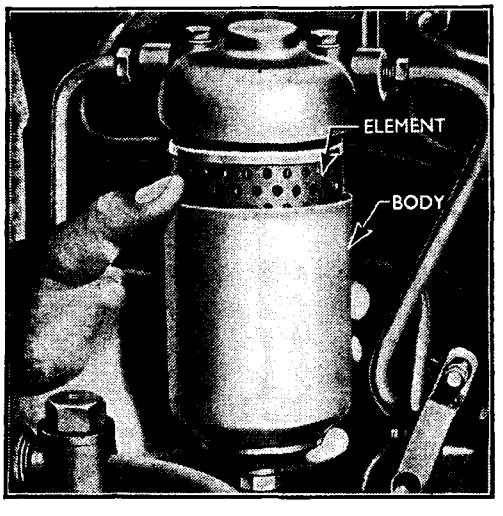
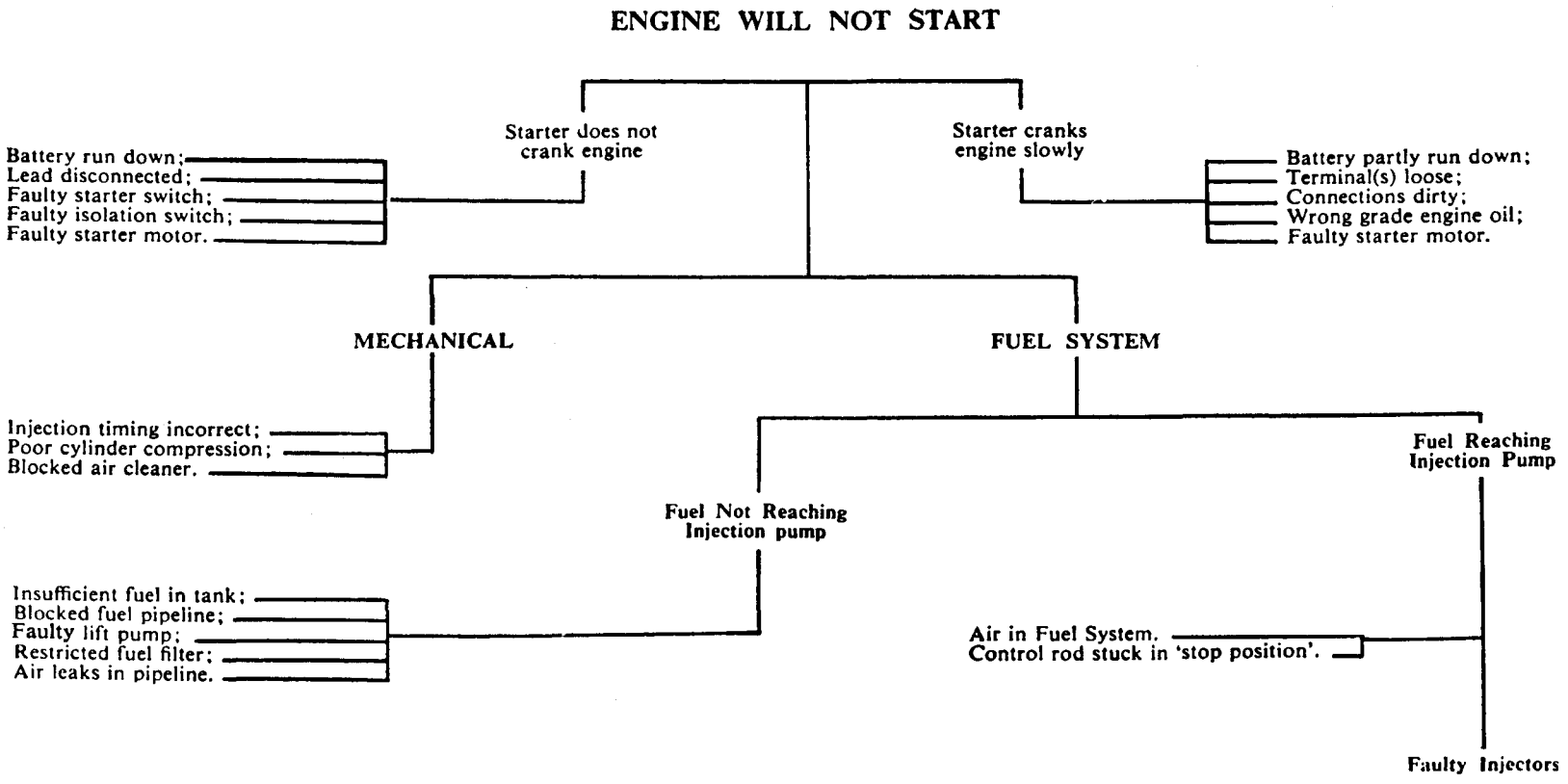
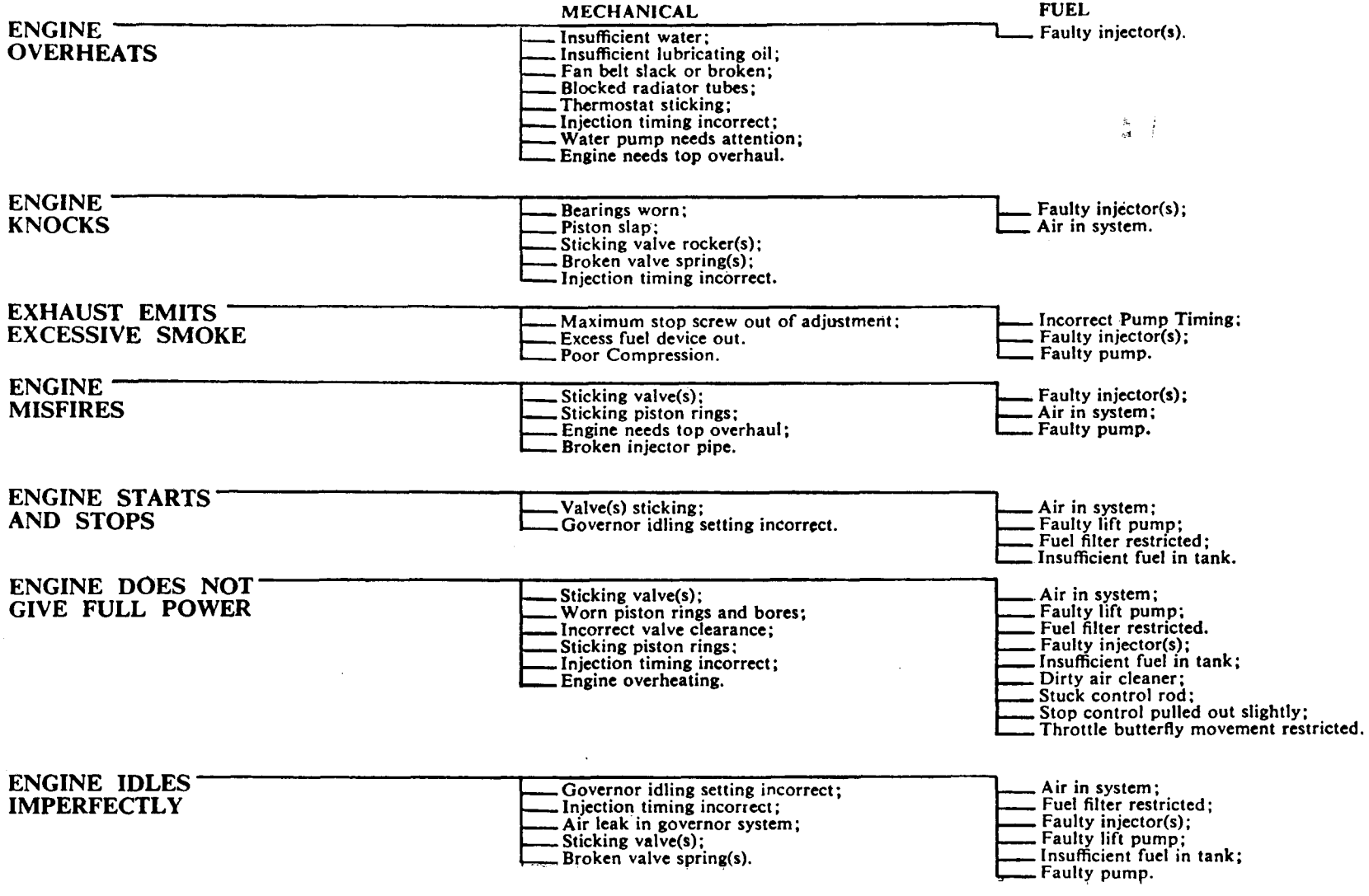



**Fig. 13**
**Replacing Fuel Filter Element**

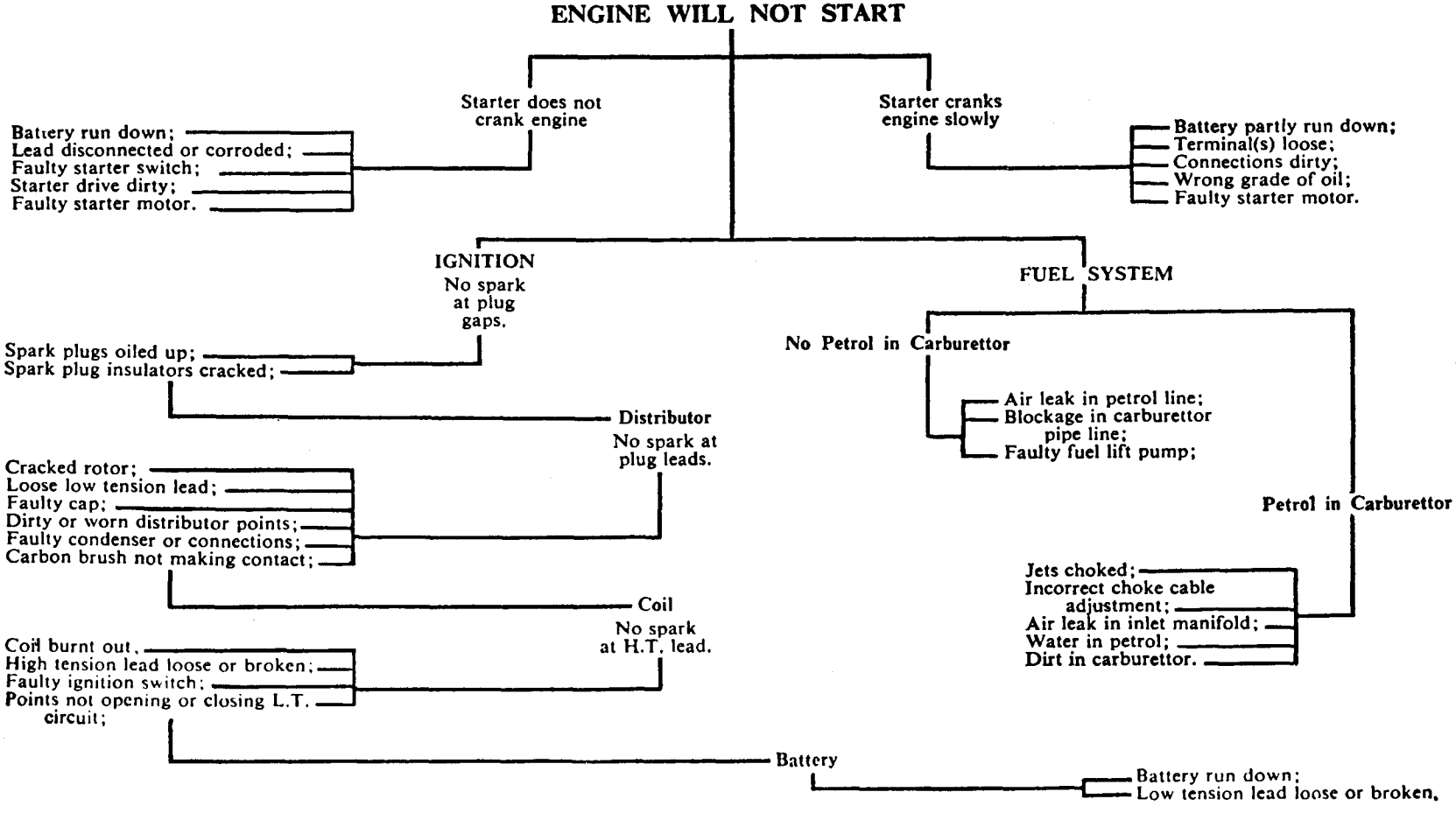
# Fault Finding and Minor Repair Procedure

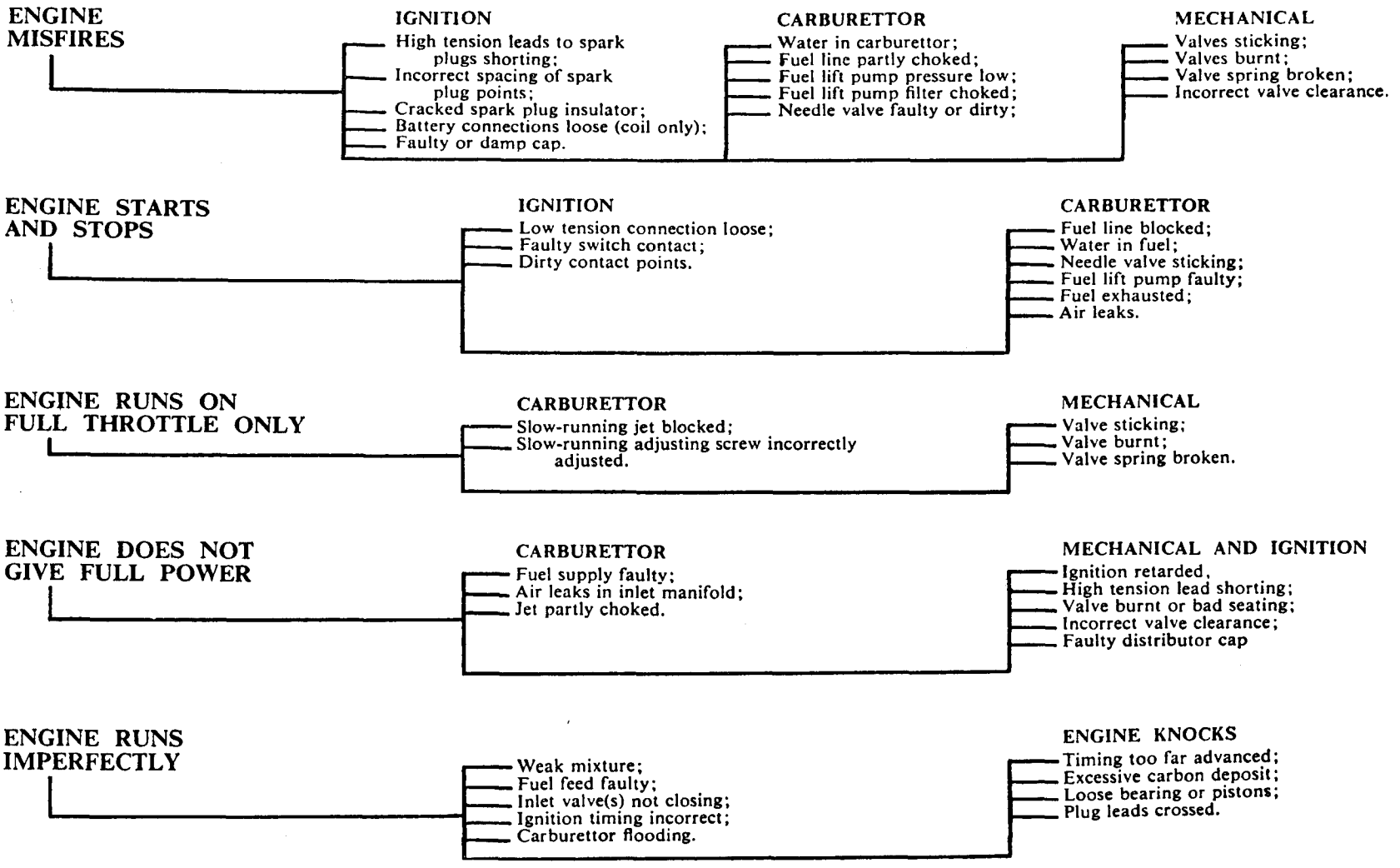
# Engine Fault Finding Chart (Diesel)




MECHANICAL
FUEL
ENGINE OVERHEATS
Insufficient water;
Insufficient lubricating oil;
Fan belt slack or broken;
Blocked radiator tubes;
Thermostat sticking;
Injection timing incorrect;
Water pump needs attention;
Engine needs top overhaul.
Faulty injector(s).
ENGINE KNOCKS
Bearings worn;
Piston slap;
Sticking valve rocker(s);
Broken valve spring(s);
Injection timing incorrect.
Faulty injector(s);
Air in system.
EXHAUST EMITS EXCESSIVE SMOKE
Maximum stop screw out of adjustment;
Excess fuel device out.
Poor Compression.
Incorrect Pump Timing;
Faulty injector(s);
Faulty pump.
ENGINE MISFIRES
Sticking valve(s);
Sticking piston rings;
Engine needs top overhaul;
Broken injector pipe.
Faulty injector(s);
Air in system;
Faulty pump.
ENGINE STARTS AND STOPS
Valve(s) sticking;
Governor idling setting incorrect.
Air in system;
Faulty lift pump;
Fuel filter restricted;
Insufficient fuel in tank.
ENGINE DOES NOT GIVE FULL POWER
Sticking valve(s);
Worn piston rings and bores;
Incorrect valve clearance;
Sticking piston rings;
Injection timing incorrect;
Engine overheating.
Air in system;
Faulty lift pump;
Fuel filter restricted.
Faulty injector(s);
Insufficient fuel in tank;
Dirty air cleaner;
Stuck control rod;
Stop control pulled out slightly;
Throttle butterfly movement restricted.
ENGINE IDLES IMPERFECTLY
Governor idling setting incorrect;
Injection timing incorrect;
Air leak in governor system;
Sticking valve(s);
Broken valve spring(s).
Air in system;
Fuel filter restricted;
Faulty injector(s);
Faulty lift pump;
Insufficient fuel in tank;
Faulty pump.

# Engine Fault Finding Chart (Petrol)




ENGINE MISFIRES
IGNITION
High tension leads to spark plugs shorting;
Incorrect spacing of spark plug points;
Cracked spark plug insulator;
Battery connections loose (coil only);
Faulty or damp cap.
CARBURETTOR
Water in carburettor;
Fuel line partly choked;
Fuel lift pump pressure low;
Fuel lift pump filter choked;
Needle valve faulty or dirty;
MECHANICAL
Valves sticking;
Valves burnt;
Valve spring broken;
Incorrect valve clearance.
ENGINE STARTS AND STOPS
IGNITION
Low tension connection loose;
Faulty switch contact;
Dirty contact points.
CARBURETTOR
Fuel line blocked;
Water in fuel;
Needle valve sticking;
Fuel lift pump faulty;
Fuel exhausted;
Air leaks.
ENGINE RUNS ON FULL THROTTLE ONLY
CARBURETTOR
Slow-running jet blocked;
Slow-running adjusting screw incorrectly adjusted.
MECHANICAL
Valve sticking;
Valve burnt;
Valve spring broken.
ENGINE DOES NOT GIVE FULL POWER
CARBURETTOR
Fuel supply faulty;
Air leaks in inlet manifold;
Jet partly choked.
MECHANICAL AND IGNITION
Ignition retarded,
High tension lead shorting;
Valve burnt or bad seating;
Incorrect valve clearance;
Faulty distributor cap
ENGINE RUNS IMPERFECTLY
Weak mixture;
Fuel feed faulty;
Inlet valve(s) not closing;
Ignition timing incorrect;
Carburettor flooding.
ENGINE KNOCKS
Timing too far advanced;
Excessive carbon deposit;
Loose bearing or pistons;
Plug leads crossed.

# Minor Repair Procedure

The need for decarbonising arises when an excessive amount of carbon deposit has formed on the inside of the cylinder head, on the tops of the pistons and on the heads of the valves.

One cannot stipulate any particular period after which decarbonisation should be carried out since the use of different fuels, lubricating oils and varying operating conditions have a considerable influence on the rate of carbon formation.

The usual indications that decarbonising is advisable are a falling off in performance, possibly accompanied by a tendency for the engine to overheat or, in the case of the petrol engine, for a light tapping or knocking sound to be produced by the engine when pulling hard.

A very similar sound may be caused by having the ignition setting too far advanced in the case of the petrol engine.

Because we consider that experience is the best guide in making a decision about when to decarbonise, we recommend that you permit an authorised dealer to help you in making that decision and also to carry out the work when the occasion arises.

# Decarbonising

The operation is quite simple and should be carried out in the orthodox manner, but if you are not familiar with the normal methods and the customary precautions which must be observed it is quite possible that you will do more harm than good. For those who decide to do the work themselves, we have set out the following points for their guidance.

**Preparation**

Before starting on the actual work, provide yourself with suitable equipment, cleaning material and the necessary replacement gaskets. The materials and tools required, other than standard tools, are a valve spring compressor, a suitable tool for removing the carbon deposit, a suction cup valve grinding tool, valve grinding compound, plenty of cleaning rags, a wire brush, a flat tin receptacle and paraffin for washing the various components.

Two types of valve assembly will be encountered in service. Early production petrol engines are fitted with inlet and exhaust valves of the non-rotator type, although later models incorporate rotator type exhaust valves. All diesel engines are fitted with non-rotator inlet valves

and rotator type exhaust valves. In each case, reference should be made to the appropriate instructions.

**To Remove the Cylinder Head**

Drain the cooling system by opening the drain tap under the radiator.

Disconnect the battery earth strap.

Undo the two clips and remove the radiator top water hose.

Disconnect the ventilating system suction pipe on the air cleaner (current type engines only).

Unscrew the rocker cover bolts, and remove the cover. If a decompressor is fitted, detach the lever before removing the rocker cover.

On the petrol engine disconnect the plug leads and remove the plugs.

Disconnect the exhaust pipe flange from the exhaust manifold, if horizontal silencer is fitted. Where a vertical type is fitted this can be lifted out of the manifold.

Disconnect the throttle control from the manifold butterfly.

On petrol engines, disconnect the feed pipe to the carburettor from the lift pump, and the distributor vacuum pipe at the carburettor.

Disconnect the two air cleaner pipe clips and remove the pipe and cleaner.

On petrol engines disconnect the carburettor choke control cable.

On diesel engines disconnect the two governor control pipes from the air intake manifold. (pneumatic type governor only).

Undo the bolts retaining the manifolds to the cylinder head and remove the manifolds and gaskets (when fitted).

Release the tab washers on the rocker bracket bolts, undo the bolts and remove the rocker assembly. Take care not to dislodge the rotator type exhaust valve caps. Lift the rotator caps off each exhaust valve and (where fitted) the caps on inlet valves.

It will be noted from Fig. 14 that there is a clearance between the end of the valve stem and the inside of the rotator cap.

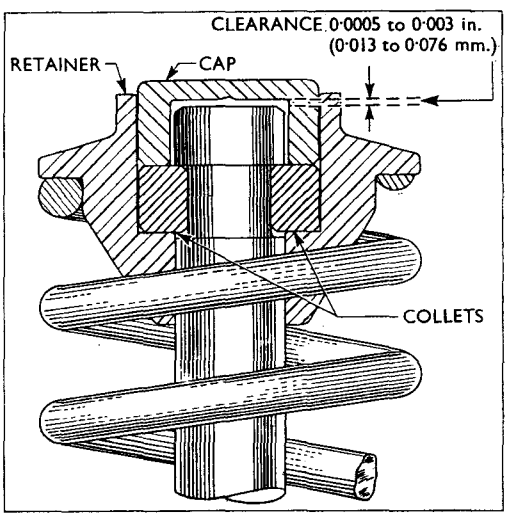



**Fig. 14**
**Rotator Exhaust Valve Assembly**

# Decarbonising

Remove the push rods and retain in their correct sequence for reassembly.

On diesel engines disconnect the fuel leak-off pipe.

Disconnect the injector pipes from the delivery valve holders and injectors and remove the pipes.

Fit suitable blanking plugs to the delivery valve holders, injector inlet adaptors and pipe nuts to prevent foreign matter entering these components.

Remove the two bolts securing each injector to the cylinder head and withdraw the injectors. **Store the injectors carefully to prevent damage to the nozzle tips.**

Remove the copper sealing washers from the injector housings, unless these have been withdrawn on the injectors.

Slacken off the cylinder head bolts in the order shown in Fig. 15, or the reverse order to that shown in Fig. 16, remove the cylinder head gasket, and oil sealing washer. The cylinder head gasket may be made of steel, copper/asbestos, or composition type material and it is important that the correct replacement is fitted. If in doubt consult your Authorised Dealer.

**Decarbonising the Engine**

It is essential that absolute cleanliness be also observed throughout this operation, carbon should not be allowed to find its way on to the working surfaces of the pistons or cylinder walls since scoring may result, leading to excessive oil consumption.

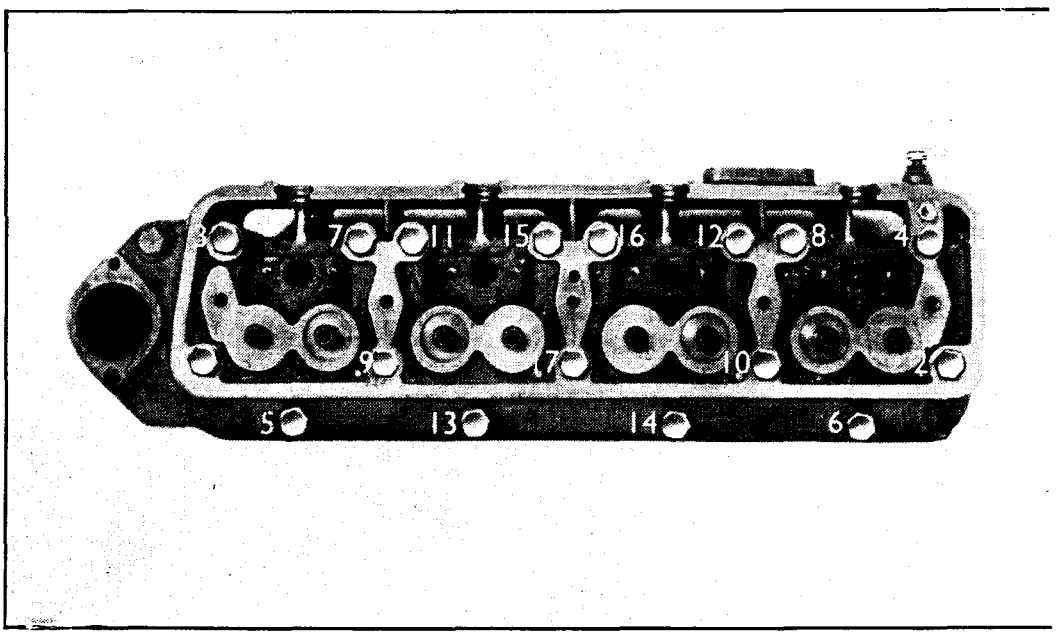



**Fig. 15**
**Cylinder Head Bolt Slackening Sequence (4-cylinder)**

Place some grease around the tops of cylinders 1 and 4 or 1 and 6 then rotate the engine until these pistons are at the top of their stroke. It will be noticed that the grease fills the small gap between the pistons and cylinder walls thus preventing carbon working its way into the piston rings.

Cover the other cylinder bores with a piece of clean rag as a precaution against carbon chips.

Working from the outer edge of each piston, carefully remove all carbon without scratching the piston top. Repeat this procedure for the other pistons, cleaning off all the grease after removing any carbon existing on the cylinder block top face.

Thoroughly clean the cylinder walls and oil them to provide initial lubrication during the first few strokes of the engine, until the engine oil has had time to circulate.

**Removing the Valves from the Cylinder Head (Non-rotator type)**

Using the valve spring compressor, compress the valve spring so that it is possible to remove the split taper collets from the end of the valve stem, see Fig. 17.

Release the spring compressor, remove the spring retainer and spring. Detach the rubber oil seal from the lower groove in the valve stem. From 1958 onwards an umbrella type seal is fitted to both inlet and exhaust valves in diesel engines.

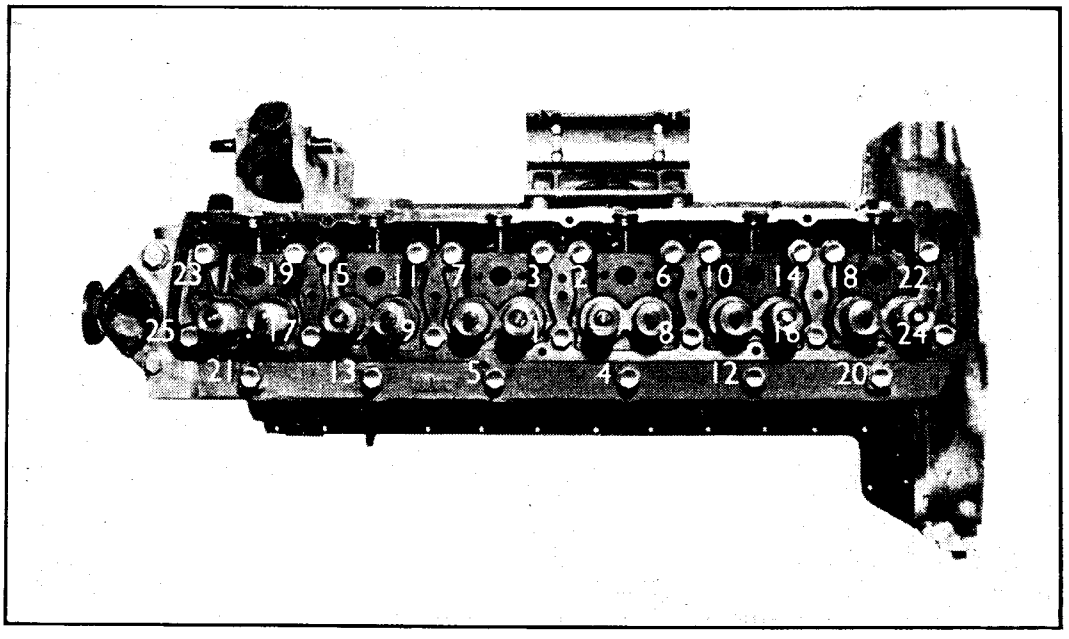



**Fig. 16**
**Cylinder Head Bolt Tightening Sequence (6-cylinder)**

# Decarbonising

It is then possible to withdraw the valve from the cylinder head. Retain the valves, springs, retainers and caps in their correct sequence to facilitate reassembly.

**Removing the Valves from the Cylinder Head (Rotator type)**

Compress the valve spring so that it is possible to remove the parallel collets from the end of the valve stem.

Release the spring compressor, remove the spring retainer, spring and spacer, which is fitted to diesel engines only.

Do not mark the valve heads with a centre punch or number stamp.

Carefully remove all carbon from the valves, using a wire brush or suitable tool, taking care not to damage the seat.

**To Decarbonise the Cylinder Head**

Using a blunt screwdriver or suitable tool, remove all carbon from the cylinder head, including the valve ports, again taking care not to scratch the valve seats or damage the valve guides.

**Valve Grinding**

It should be appreciated that valve grinding is a finishing process and cannot take the place of valve refacing or seat recutting tools. Excessive hand grinding to seat a valve should not be attempted.

Special seat cutters and valve refacing tools are available and should be used where necessary.The angle of the valve seat is 30° and the angle of the valve 29½°.

Before commencing to grind the valves, the condition of the valve guides should be ascertained.

If the valve is a loose fit in its guide, wear may have taken place on the valve stem or in the valve guide bore, necessitating renewal of these parts. Special tools possessed by your Authorised Dealer are necessary to remove and replace the valve guides.

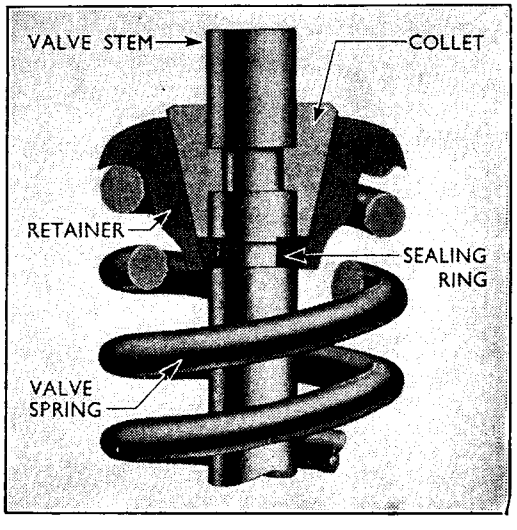



**Fig. 17**
**Diesel Inlet Valve Assembly (Before 1958)**

If the valve, valve seat and guide are in good condition, proceed as follows:

Apply a small amount of valve grinding compound to the seat on the head of the valve, distributing it evenly but not too liberally.

Replace the valve in its position in the head and rotate backwards and forwards, using the rubber suction lapper held between the palms of the hands, at the same time keeping the valve in contact with the seat.

No pressure is required other than the weight of the valve and the lapping tool; periodically the valve should be lifted and repositioned a quarter or a third of a turn round.

Although coarse grinding compound may be necessary on a valve at the start of grinding, the operation should be completed by using fine compound.

When correctly ground, the mating faces at the valve seating should present an even, clean, grey matt appearance without any signs of bright rings round the head or of pitting. The seating width should be between $\frac{1}{32}$ in. and $\frac{1}{16}$ in.

When the valves have been ground in, carefully remove all traces of the grinding compound with a petrol soaked rag.

**Do not allow excess liquid to wash the compound into the valve guides or ports.**

### Reassembly

The good results which are to be expected from careful and accurate work can only be achieved by careful reassembly under scrupulously clean conditions. Dirt lodging under a gasket or getting on the cylinder bores can bring about trouble out of all proportion to the cause. Sufficient emphasis cannot be laid upon the necessity for observing the utmost care to prevent dirt, carbon or grit falling on to machined surfaces or gaskets during final reassembly.

Proceed with reassembling the engine in the reverse order to that for dismantling, keeping each valve to its own guide and refitting a new oil seal to the valve stem lower groove after compressing the spring and before fitting the collets. Where umbrella type oil seals are fitted (Diesel 1958 onwards) these should be fitted to the valve stems before fitting the springs.

No oil seal is fitted to rotator type exhaust valves on petrol engines.

The inlet valve collets are tapered, with the larger diameter at the valve stem end.

Each valve spring has closer wound coils at one end and this end must be fitted to the cylinder head.

# Decarbonising

**Note.**—The rotator type valve collets, caps and spring seats are larger in diameter on current engines and can only be interchanged in sets.

Fit the umbrella type oil seals and the spring (close coils towards the cylinder head) and spring retainer. Compress the spring and fit the parallel collets and ensure that they are correctly located.

Remove the spring compressor.

Fit the rotator caps to the valve stems. Ensure that there is a clearance between the end of the valve stem and the inside top face of the valve cap as shown in Fig. 14.

Before fitting the cylinder head and gasket, refit a new oil sealing washer in the rocker feed hole in the cylinder head face, midway along the block.

The cylinder head gasket must be fitted so that the water port at the front and the oil passage for the rocker shaft register correctly: take care to align the bolt holes in the gasket, block and cylinder head accurately, so that the bolts can be inserted.

Replace the gasket and cylinder head, tightening the bolts in the order shown in Fig. 16, or the reverse order to that shown on Fig. 15, evenly and securely.

On the diesel engine make sure the injectors are serviceable and clean externally before refitting. As injector servicing requires the use of special equipment it is advisable to have the injectors serviced by an authorised dealer. Locate a copper washer in each injector housing and fit the injectors. Tighten the injector bolts down evenly and reconnect the pipes.

**Note.**—When refitting the control pipes (pneumatic governor only) to the diesel engine, it is most important to ensure that the upper connection on the manifold is connected to the outer connection on the fuel injection pump governor.

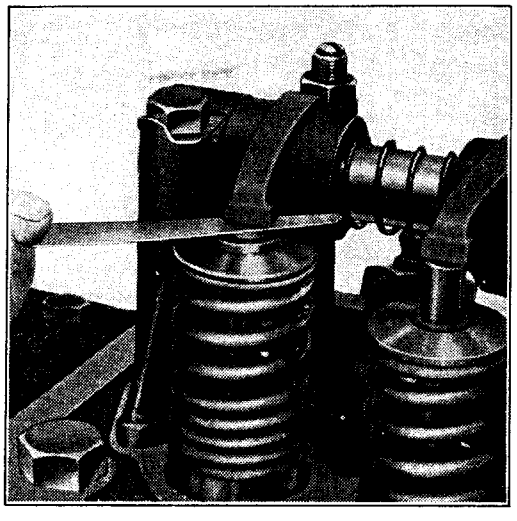


**Fig. 18**
**Checking Valve Clearance**

# Decarbonising

New gaskets should be fitted to the manifolds and the rocker cover.

On the diesel engine it will be necessary to bleed all traces of air from the fuel system (see page 49) before running the engine.

**Caution**

**On no account should the pneumatically governed diesel engine be run with the air cleaner or governor pipes disconnected; serious damage may result through the governor action being affected and allowing the engine to race.**

Set the valve clearances initially at 0.015 in. (0.381 m.m.) for inlet and non-rotator type exhaust valves and 0.012 in. (0.305 m.m.) for rotator type exhaust valves, tightening up the locknuts securely after this adjustment, see Fig. 18. Run the engine and when hot finally tighten down the cylinder head bolts. (Ensure that if a decompressor is fitted it is in the fully released position.)

Recheck the valve clearances while the engine is hot, to the above clearances.

On petrol engines it is advisable that the distributor, spark plugs and carburettor receive attention after decarbonising. (see pages 42, 45 and 60).

# Ignition System (Petrol Engine)

The ignition system consists of a battery, ignition switch, distributor, ignition coil, sparking plugs and the necessary leads.

Magneto ignition may be fitted as optional equipment.

The 12 volt battery supplies low tension current to the ignition coil which, in conjunction with the distributor, transforms it into high tension current of sufficient strength to bridge the sparking plug point gaps and ignite the mixture of fuel and air.

The distributor contact breaker points interrupt the flow of the low tension current while the distributor rotor distributes the high tension current from the ignition coil to the appropriate sparking plugs in the firing order of 1, 2, 4, 3, or 1, 5, 3, 6, 2, 4.

The vertical type distributor is located at the right-hand side of the engine near the front. It is driven by an offset tongue engaging in a slot on the top of the oil pump drive. The distributor is fitted with mechanical and vacuum advance mechanisms ensuring correct ignition timing at all times to suit engine speed and load.

**Automatic Mechanical Advance Mechanism**

The ignition timing is automatically varied by the centrifugal governor weights and springs, and centrifugal action advances the timing in proportion to the engine speed. When the engine is stationary, the timing is retarded.

**Vacuum Advance Mechanism**

The vacuum advance mechanism is operated independently of the centrifugal weight mechanism.

A metal pipe leads from the base of the carburettor body and the vacuum which normally exists at this point causes the vacuum diaphragm to compress the spring and advances the ignition timing by rotating the contact breaker plate.

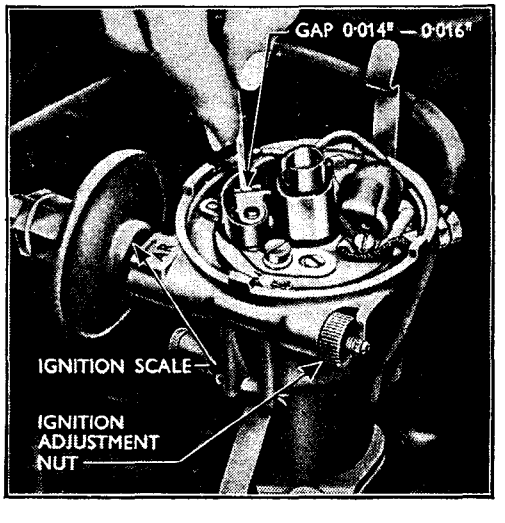



**Fig. 19**
**Checking Contact Breaker Points Gap**

When the throttle is opened the manifold vacuum is temporarily reduced and the spring tension overcomes the vacuum diaphragm thus retarding the ignition.

When the engine picks up speed the suction again increases in the connecting pipe and causes the vacuum diaphragm to compress the spring, so advancing the ignition in the normal manner.

**Contact Breaker Points**

If the contact breaker points are dirty, pitted or incorrectly set, engine misfiring and loss of power may result.

Badly pitted or burnt points are often an indication of a faulty condenser or oil having reached the points.

The contact breaker points should be set so that when the moving contact is fully opened there is a gap of 0.014 in. to 0.016 in. (.36 to .41 mm.). Magneto ignition 0.010 in. to 0.012 in. (.25 to 30 mm.).

This gap can be adjusted by slackening the one or two locking screws on the fixed contact point and moving it by means of the eccentric screw until the gap setting is within the above limits (see Fig. 19).

**Distributor Lubrication**

Remove the distributor cap and rotor every 50 working hours and add two drops of engine oil to the cam spindle. Smear the cam with petroleum jelly. Lubricate the governor weight mechanism with a few drops of engine oil through the contact breaker plate and also add a film of engine oil to the contact breaker pivot, ensuring that none contaminates the points.

Keep the grease cup (if fitted) on the distributor body filled with high melting point grease and give one complete turn every 50 working hours.

**Ignition Timing**

If for any reason the distributor has been removed from the engine it is essential that it be correctly timed when refitted.

To time the engine, fit the distributor to the top of the oil pump shaft, ensuring that the offset tongue enters the offset slot in the shaft correctly. The vacuum control should face towards the rear of the engine.

Secure the distributor base to the block by means of the two screws and then loosen the clamp bolt.

On earlier type engines, turn the crankshaft so that when No. 1 piston is approaching the top of the compression stroke, the mark on the crankshaft pulley coincides with the timing pointer fitted to the front of the engine.

Set the points to the correct gap and, with the long line on the ignition scale just visible, rotate the distributor body clockwise, until the points are just opening. The rotor arm should now line up with No. 1 plug contact in the distributor cap. Then tighten the clamp bolt.

On current engines the timing pointer is no longer fitted to the front cover. The periphery of the flywheel is marked in degrees, the degree markings and index mark are visible after moving the inspection cover, on the right-hand side of the sump-flywheel housing, to expose the flywheel (see Fig. 20).

To check the ignition timing set the engine with No. 1 cylinder on compression stroke (both valves closed), move the inspection cover to one side and rotate the crankshaft until the six degree (6 cylinder and early 4 cylinder engines) or ten degree (current 4 cylinder engines) mark before zero is in line with the index notch on the side of the inspection aperture. Set the distributor timing in the normal manner as described above.

**Ignition Timing—Magneto Ignition**

Turn the engine so that when No. 1 piston is approaching the top of the compression stroke the mark on the crankshaft pulley or flywheel coincides with the timing pointer or index notch.

Fit the magneto to the top of the oil pump shaft, ensuring that the offset tongue enters the offset slot in the shaft correctly.

Secure the magneto base to the block by means of the two screws and then loosen the clamp bolt.

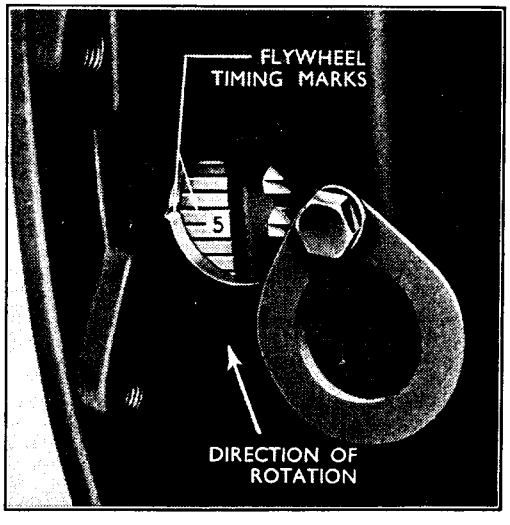



**Fig. 20**
**Flywheel Timing Marks (Petrol Engine)**

With the points set to the correct gap, rotate the magneto body clockwise, until the points are just opening. The rotor arm should now line up with No. 1 plug contact in the distributor cap. Tighten the clamping bolt.

**Varying Ignition Settings for Different Fuels**

When using certain fuels, an improvement in engine performance may be obtained by varying the ignition setting slightly by means of the micro adjustment.

By rotating the ignition advance adjustment nut shown in Fig. 19, it is possible to turn the contact breaker base plate slightly, so either advancing or retarding the ignition. It must be remembered, however, that only small deviations from the normal setting outlined above are necessary to effect this compensation.

**Sparking Plugs**

Difficult starting or engine misfiring can be caused by dirty sparking plugs or incorrect plug gaps. Keep the plugs clean and the gaps set correctly. Adjust the gap by moving the side or earth electrode. Do not bend the centre electrode or its insulation may be damaged.

Ensure that the sparking plug insulators are kept free from dirt to prevent the possibility of high tension "tracking".

There is nothing to be gained by experimenting with different makes or types of sparking plugs, as those fitted on engines leaving the factory are best suited to the requirements of the engine.

| | Ignition Timing | Plug Gaps |
|---|---|---|
| Early 4 cylinder | 6° B.T.D.C. | .038–.043 in. (0.065–1.092 mm.) |
| Current 4 cylinder | 10° B.T.D.C. | .025 (0.64 mm.) |
| 6 cylinder | 6° B.T.D.C. | .025 (0.64 mm.) |

# Diesel Fuel Injection System

The fuel injection equipment is made to very accurate limits and therefore even the smallest particle of dirt entering the system will destroy its efficiency by causing scoring or premature wear on the highly finished parts.

Cleanliness is therefore absolutely essential, and this can only be accomplished by always ensuring that care is taken in storing and handling the fuel.

**Diesel Fuel**

Use only well-known brands of diesel fuel, which nowadays are refined to a very high degree.

**Storage**

The most satisfactory arrangement is a bulk storage installation with a tank and pump, but a gravity feed installation set to slope downwards at the rear (to allow sediment to settle) is a wise investment.

**Never use a galvanised tank** as the zinc from the coating reacts with the diesel fuel and forms undesirable compounds, which can adversely affect the operation of the fuel injection equipment.

If circumstances dictate that the fuel must be kept in drums or barrels, it is preferable to keep them on a concrete floor in a clean dry shed.

If possible use a 40 gallon barrel, fitted with a tap and mounted lengthwise on a trestle, so that the barrel slopes downwards approximately half-inch per foot away from the tap. This will allow the sediment in the fuel to settle at the rear of the tank and remain as the fuel is drawn from the barrel. Never tip the barrel in order to use fuel which is below the level of the tap.

After use, ensure that the tap is not leaking and clean up any fuel which may have been spilt, as fuel oil does not evaporate and will collect dust and dirt if allowed to remain.

When a new barrel of fuel is to be used, it should be mounted on trestles and allowed to stand for at least 24 hours to allow any sediment that may be present to settle.

**Refuelling**

A suitable can and a funnel with a fine gauze filter should be obtained and used only when filling with fuel. Do not be tempted when in a hurry to use any can that may come to hand as if there is water, dirt or rust in the can, it will then enter the tank with the fuel.

Try to make a practice of refuelling in a sheltered position and

always wipe the fuel tank around the filler cap before and after the filling and immediately replace the cap.

The reliable and efficient operation of the diesel engine fuel system depends on the service and maintenance given to the fuel system.

In handling and storing diesel fuel, only clean containers must be used and all possible precautions taken to prevent the ingress of dirt or foreign matter when filling the fuel tank.

**Filters Must be Serviced Regularly**

Whenever the fuel system is disconnected at any point, fit suitable blanking plugs to the pipes and unions to prevent foreign matter entering, and observe scrupulous cleanliness when handling any of the components. The fuel system must be bled after reconnecting the pipes and similarly should the installation run out of fuel.

The fuel system consists of a tank, a sediment bowl, a mechanical lift pump, a replaceable paper element type filter bolted to the right-hand side of the cylinder head, the injection pump and injectors.

**Fuel Sediment Bowl**

Fuel passes through a sediment bowl incorporating a filter screen before entering the lift pump. Any dirt or foreign matter will be trapped by the bowl which may be cleaned as required.

To clean the sediment bowl, unscrew the clamp nut, move the retainer to one side and remove the bowl and filter screen. Wash the screen in clean fuel and replace. **Do not wipe the screen with cloth.** Ensure that the gasket is in good condition and replace the bowl.

Do not overtighten the retaining clamp.

**Fuel Lift Pump (Horizontal Diaphragm Type)—High Speed Engines**

The mechanical fuel lift pump is located on the body of the injection pump, on these engines, and is operated by an eccentric on the pump camshaft. It incorporates a filter screen and a hand priming lever.

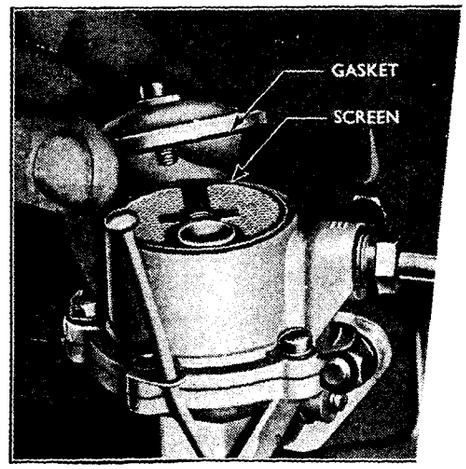



**Fig. 21**
**Fuel Lift Pump (Horizontal Diaphragm Type)—High Speed Engines**

# Diesel Fuel Injection System

Being entirely automatic in action the pump requires little attentio apart from normal servicing to keep it free from dirt and sediment

To clean the lift pump filter screen on high speed engines unscrev the centre bolt and lift off the cover and screen (see Fig. 21). Wash the screen with clean fuel and replace. Fit a new gasket to the top cover (if not fit for further use) and replace. Do not overtighten the centre bolt.

**Fuel Lift Pump (Horizontal Diaphragm Type)—Low Speed Engines**

On these engines, the fuel lift pump is attached to the right-hand side of the cylinder block and is driven by an eccentric on the engine camshaft. It incorporates a filter screen, a sediment bulb and a hand priming lever.

Any accumulation of water or foreign matter should be removed, its presence is visible in the glass sediment bulb of the fuel lift pump. Unscrew the clamp at the top, move the retainer aside and lift off the sediment bulb and screen for cleaning, When replacing the bulb, ensure that the gasket is in good condition.

The fuel system must be bled to remove all traces of air after servicing the fuel lift pump or whenever the sediment bulb is removed.

**Fuel Lift Pump (Vertical Diaphragm Type)**

The vertical diaphragm type fuel lift pumps are located on the right-hand side of the cylinder block on low speed engines (without exhausters) and on the injection pump body on high speed engines (also low speed engines with exhausters). These pumps are driven by eccentrics on the engine and injection pump camshafts respectively. This type of lift pump incorporates a pulsator diaphragm, to reduce fuel delivery surge, and a hand priming lever.

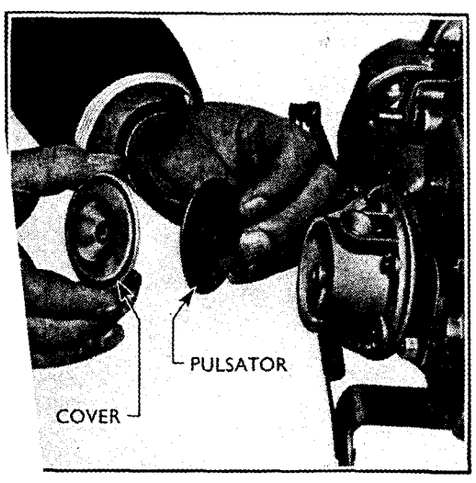



**Fig. 22**
**Vertical Diaphragm Type Fuel Lift Pump**

To clean the lift pump, unscrew the centre bolt and remove the cover and pulsator diaphragm (see Fig. 22). When refitting the cover, ensure that the pulsator diaphragm is in good condition. Bleed the fuel system, as outlined on this page, after reassembly.

**Fuel Filter**

A replaceable element filter is bolted to the rear of the cylinder head on the right-hand side. Do not unpack the new filter element before necessary to prevent it becoming contaminated.

To change the element, unscrew the centre nut and remove the body and old element. Discard the old element, thoroughly wash out the body. **Do not wipe the body with a cloth.**

Fit a new rubber seal to the filter head. Unpack the new filter, fit to the body and replace the body (see Fig. 13). Do not overtighten the centre bolt.

Bleed the fuel system.

**Bleeding the System**

Whenever the fuel system has been disconnected between the injection pump and fuel tank it is necessary to bleed the system. This is carried out in the following manner:

Ensure that there is sufficient fuel in the tank and turn the tap to the **"on"** position.

Open the bleed valve on the inlet side of the filter (see Fig. 23). Operate the lift pump priming lever until a flow of fuel free from all air is expelled from the valve.

Close the inlet bleed valve. Open the outlet bleed valve and repeat the process. Close the outlet bleed valve.

Open the bleed valve on the injection pump gallery and expel all air from this point. Close the bleed valve.

Wipe all surplus fuel from the injection pump and filter body.

**Take care to expel all air from the system, or misfiring and erratic running may result.**

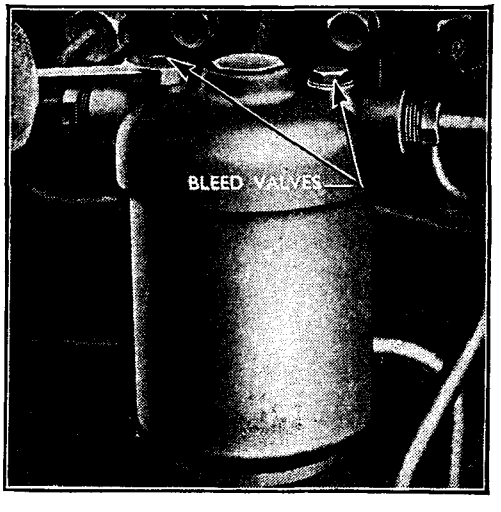



**Fig. 23**
**Fuel Filter Bleed Valves**

# Diesel Fuel Injection System

**Fuel Injection Pump**

The fuel injection pump is an accurately made unit and should not require attention between engine overhauls provided the fuel is kept clean and the fuel filters are serviced regularly.

The correct supply of lubricant is put in the cam box on assembly and, on injection pumps with pneumatic or GV and GM mechanical governors, does not require attention as it is automatically maintained at the correct level in service. On "Minimec" injection pumps the oil should be changed every 200 hours as it also lubricates the mechanical governor (see page 25). A bleed pipe is fitted to the cam box to allow surplus lubricant to drain off. Never operate the engine with this pipe disconnected.

The pump side cover must never be removed otherwise dust and dirt may enter the pump and cause premature wear of the working parts.

If, in the unlikely event of pump failure, repairs are needed, these should only be entrusted to an Authorised Dealer.

**To Remove the Injectors**

Remove the rocker cover. Disconnect and remove the back leak pipe. Hold the delivery valve holders with a suitable spanner and disconnect the pipes. Unscrew the pipe nuts from the injector inlet adaptors and remove the pipes. Fit suitable blanking plugs to the pipe nuts, injector inlet adaptors and delivery valve holders to prevent the ingress of dirt.

Remove the two bolts securing each injector to the cylinder head, carefully remove the injector using the lifting bar (see Fig. 24), ensuring that no foreign matter drops into the housing.

Remove the copper sealing washer from the housing, if it has not been withdrawn with the injector.

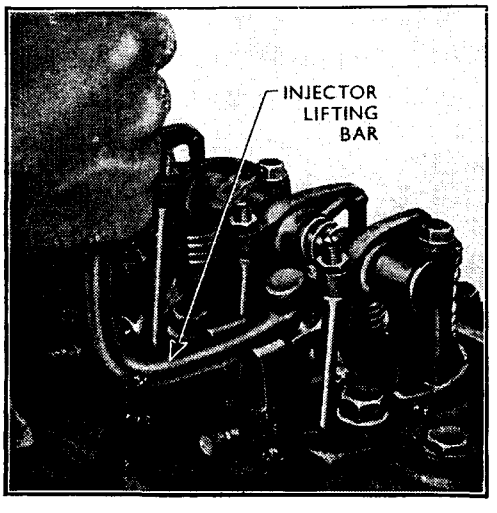



**Fig. 24**
**Removing Injector**

**To Replace the Injectors**

Locate the new copper sealing washers in the injector housings. Fit the reconditioned injectors to the cylinder head, carefully and evenly tighten the retaining bolts. **Do not use excessive leverage.**

**Injector Pipes**

Refit the injector pipe and back leak pipe.

The injector pipes are heat treated steel, fitted with detachable steel olives. When removing the injectors completely remove the pipes. **Never bend the pipes.** Do not use excessive leverage when tightening the pipe nuts.

To renew the olives in case of leakage, remove the pipe, grip the olive and by twisting and pulling remove the olive.

Fit a new olive with the taper seat to the end of the pipe, ensure that the olive is flush with the end of the pipe. Fit the pipe with the new olive correctly seated and tighten the nut to grip the olive on the pipe. It is advisable to have the other end of the pipe free when carrying out this operation.

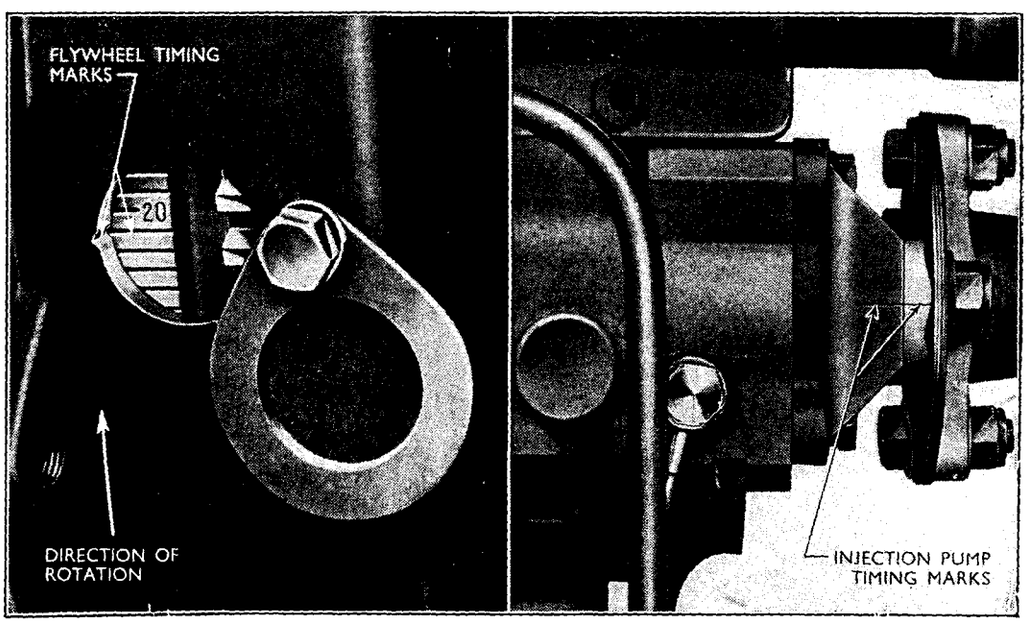



**Fig. 25**
**Diesel Engine Timing Marks**

# Diesel Fuel Injection System

**Timing the Fuel Injection Pump**

Fuel injection pumps, with pneumatic or GV and GM mechanica governors, used on these engines have a type identification numbei stamped on a pad on the pump side cover plate. On the "Minimec" injection pump the type identification number is shown on a plate rivetted to the pump body.

Engines fitted with injection pumps identified by the prefix SPE 4A 75 (4 cylinder) and SPE 6A 75 (6 cylinder) before the model number are timed at 19° B.T.D.C. Earlier types of 4 cylinder engines with SPE 4A 70 injection pumps are time at 26° B.T.D.C. for low speed engines and 29° B.T.D.C. for high speed engines.

The pumps on these engines are not interchangeable and no attempt should be made to time an engine fitted with an SPE 4A 75 pump to 26° or 29° B.T.D.C. or one fitted with an SPE 4A 70 pump to 19° B.T.D.C.

Engines fitted with the "Minimec" injection pump are timed at 21° B.T.D.C.

The periphery of the flywheel is marked in degrees, the degree markings and index mark are visible after moving the inspection cover, on the right-hand side of the sump-flywheel housing, to expose the flywheel. (See Fig. 25).

To check the injection pump timing, set the engine with No. 1 cylinder on compression stroke, move the inspection cover to one side and rotate the crankshaft until the appropriate B.T.D.C. mark is in line with the index notch on the side of the inspection aperture.

**On very early engines, flywheel timing was not used, and no inspection cover will therefore be fitted, in which case the engine should be turned until the mark on the crankshaft pulley is in line with the timing pointer at the front of the engine with No. 1 piston approaching the top of the compression stroke.**

If correctly timed the injection pump coupling timing mark should be in line with the timing plate fitted to the front of the pump, as illustrated in Fig. 25. If this is not so, slacken off the two claw bolts on the driving coupling and adjust the setting until the timing marks coincide. Tighten the claw bolts securely.

**The Air Cleaner**

The cleaner is of the oil bath type, the oil bath forming the lower section of the casing as shown in Fig. 8.

Maintain the cleaner as described on page 22.

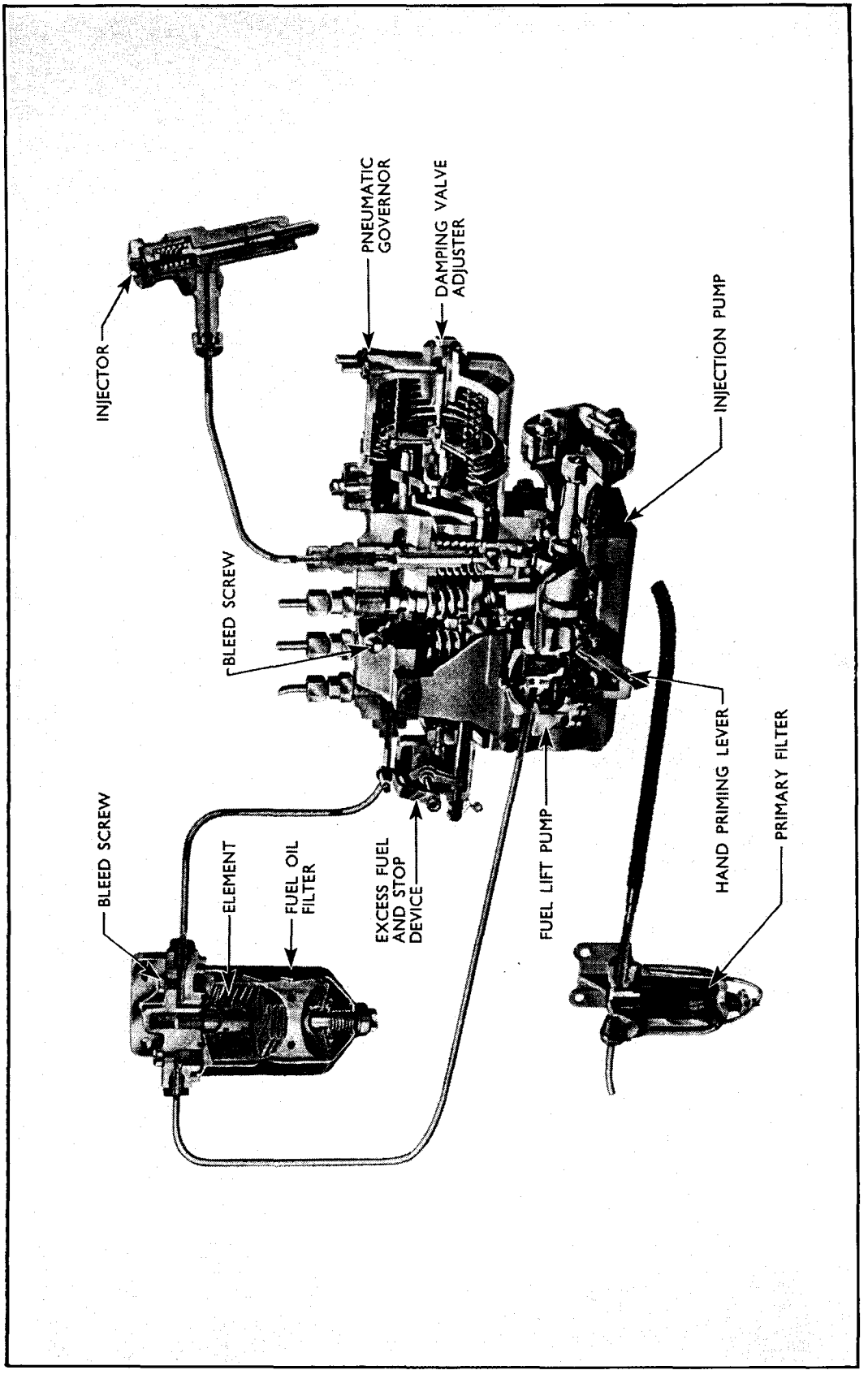



**Fig. 26**
**Fuel Injection System with Pneumatic Governor**

# Diesel Fuel Injection System
# The Engine
# Pneumatic Governor

A pneumatic all-speed governor is fitted (where a mechanical governor is not in use, see page 56) to control the amount of fuel supplied to the engine in accordance with the engine load and speed.

The governor unit consists of two assemblies:

(1) The throttle unit in the inlet manifold.

(2) The governor unit mounted on the injection pump directly connected to the internal control rod. (see Fig. 27)

The throttle unit is connected to the governor unit diaphragm chamber by a suction pipe and to the damping valve by a bleed pipe. The governor control is connected to the throttle plate and regulates the speed of air through the inlet manifold tract and consequently controls the operation of the governor.

When the engine is idling, the throttle plate is nearly closed and air is being drawn past the plate at high speed, creating a high vacuum in the diaphragm chamber, and drawing the control rod to the minimum fuel delivery position.

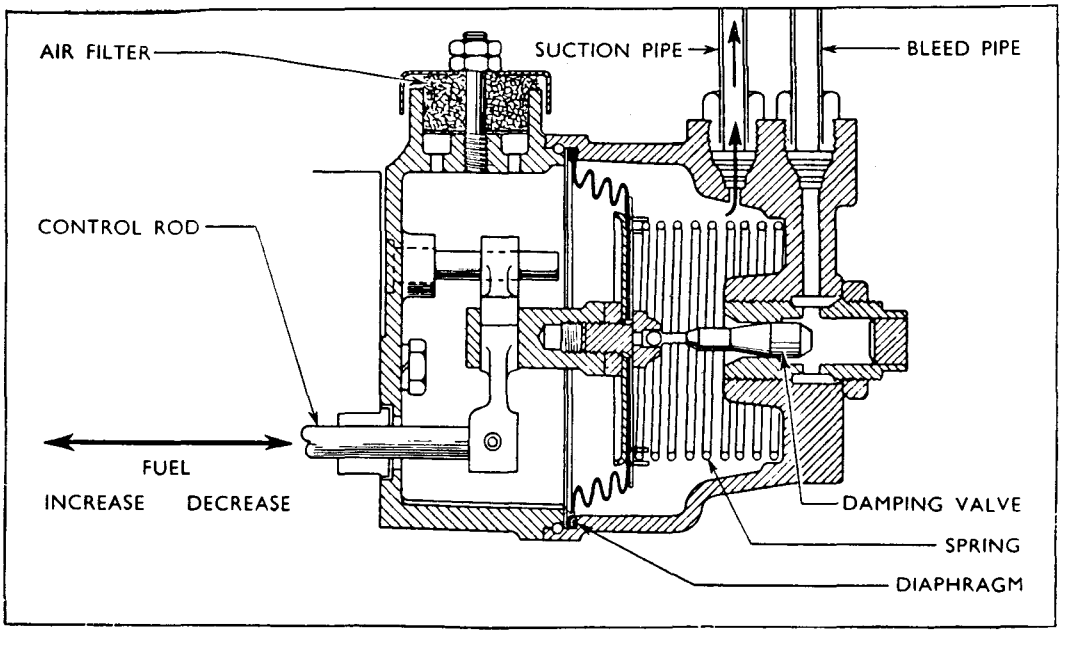



**Fig. 27**
**Pneumatic Governor**

When the engine is under load, the air speed past the open throttle plate will be low and consequently the fuel pump control rod will be held in the maximum delivery position by the governor spring. An adjustable damping valve is fitted to prevent surging or irregular idling.

**Idling Adjustment**

If it should be necessary to adjust the idling speed, the following method should be adopted with the engine at its normal working temperature.

(1) Adjust the manifold idling screw to give an idling speed of 450 to 500 r.p.m. (see Fig. 28, right-hand side).

(2) Slacken the damping valve guide lock nut and adjust the damping valve guide (see Fig. 28, left-hand side) until the engine idles evenly. Tighten the lock nut.

(3) Re-adjust the manifold idling screw if there has been any change in idling speed.

**Governor Air Filter**

A wire gauze filter is fitted in the governor housing. Every 200 hours, or more often under dusty conditions, the filter must be removed, cleaned and lightly oiled before refitting.

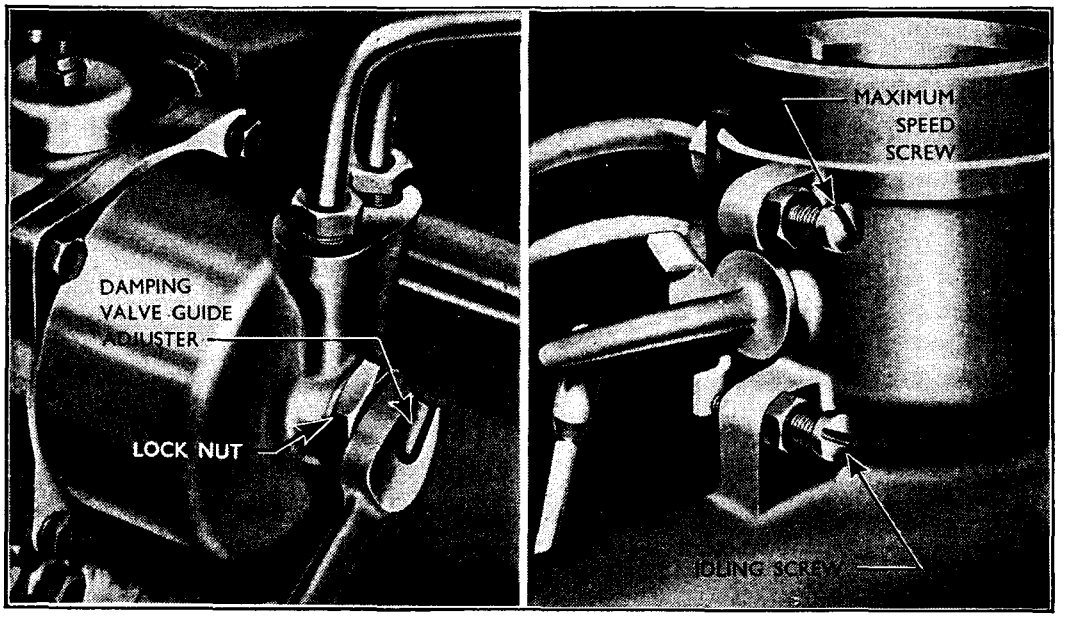



**Fig. 28**
**Idling Adjustments (Diesel Engine)**

# Diesel Fuel Injection System

# The Engine Mechanical Governor

Engines used in industrial applications where a high accuracy of governing is required at a set speed, are fitted with a fuel injection pump having a mechanical governor.

Three types of mechanical governor may be met in service, these are the early type GV and new GM variable speed governors and "Minimec".

The two GV models are to B.S. Standards at rated speeds of 1,500 and 1,800 r.p.m. and three GM models which are to B.S. Standards at rated speeds of 1,500, 1,800 and 2,250 r.p.m.

The speed range and type of governor is indicated in the number incorporated in the name plate on the rear half of the governor housing. This number may be GVA 350/900 S - - - and the figures 350/900 indicate the governed speed range in pump r.p.m., that is half engine speed, so that this marking would indicate that the governed speed range is 700 to 1,800 engine r.p.m.

The mechanical governor consists of a fly-weight assembly keyed to the fuel injection pump camshaft and connected by a suitable linkage to the fuel injection pump control rod.

Stop screws are provided to limit the movement of the governor control lever and set the maximum and idling speeds (see Figs. 29 and 30).

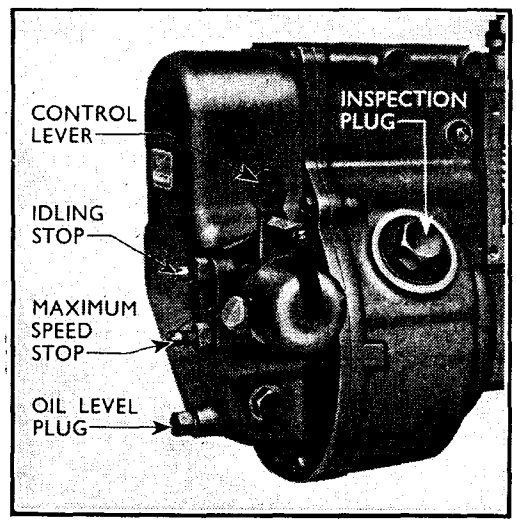



**Fig. 29**
**Mechanical Governor (GV Type)**

The normal maximum fuel stop is fitted on the opposite end of the fuel injection pump. The excess fuel device and stop control operate as explained on page 10.

With the engine stationary the control rod is held in the maximum fuel position by a light spring.

With the engine running and the control lever against the idling stop, the engine will operate at idling speed since the control rod in the fuel injection pump is held in the minimum fuel position.

If the governor control lever is moved to the maximum speed position with no load on the engine, the control rod will move over to the maximum fuel position causing the engine speed to increase. As the engine speed increases the fly-weights will move outwards and, through the linkage, move the fuel injection pump control rod rearwards until the speed set by the governor control lever is balanced.

If a load is now applied to the engine with the governor control lever in the maximum speed position, the tendency will be to reduce the engine speed. This will cause the governor weights to close in and so move the control rod in the fuel injection pump towards maximum fuel position. This increased fuel delivery to the engine will maintain the speed set by the governor control rod prior to the application of the load.

The Minimec model is rated at 1,600, 1,800 and 2,250 r.p.m.

The mechanical governor consists of two pair of roller shaped weight assemblies, located between the flanges of a channel sectioned back plate which is dowelled and bolted to the injection pump camshaft. A rocking lever connects the governor to the injection pump control rod by a spring loaded link.

At idling speed the governor spring load is small and therefore, the weights are thrown outwards by a small centrifugal force. Under these conditions the rocking lever and link hold the injection pump control rod in a position to give a smooth engine idling speed.

To obtain the engine full load, the throttle lever is moved forwards. The governor weights are then drawn in towards the camshaft, as the weights carrier and hub moves forward. The injection pump control rod is thus moved to the maximum fuel position and will remain in this position until the governed speed is reached.

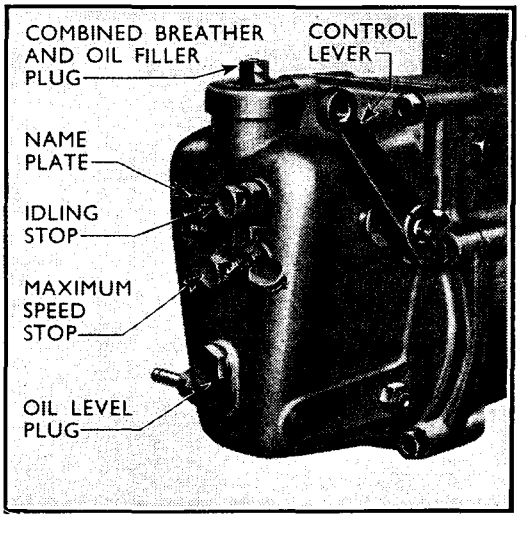



**Fig. 30**
**Mechanical Governor (GM Type)**

### Governor Adjustments

On no account should the maximum speed stop (see Figs. 29 and 30) be interfered with as they must be accurately set with the aid of a tachometer and are set on leaving the factory.

The idling speed stop (see Figs. 29, 30 and 31) can be adjusted if required to give a steady idle with no "hunting" or vibration.

### Lubrication

The GV and GM type governors should be lubricated weekly by adding engine oil through the filler plug on the governor case. Remove the level plug at the bottom of the case (see Figs. 29 and 30) and add oil until it flows from this hole. Replace the level plug and filler plug. Do not overfill the governor as this may cause sluggish action and unsatisfactory governing.

The governor of the "Minimec" injection pump runs in the same lubricant as the pump camshaft. Drain the injection pump lubricating oil every 200 hours, by removing the drain plug from the base of the governor housing, after first cleaning the pump exterior. Remove the filler and level plugs, which are on the top and side of the governor housing respectively (see Fig. 31), replace the drain plug and add engine oil until it reaches the level plug orifice. When the level is correct, replace both filler and level plugs.

The capacities are:—

4 cylinder pump—$\frac{5}{8}$ Imp. pt. ($\frac{3}{4}$ U.S. pt.; 0.35 litre)

6 cylinder pump—$\frac{3}{4}$ Imp. pt. (0.9 U.S. pt.; 0.42 litre)

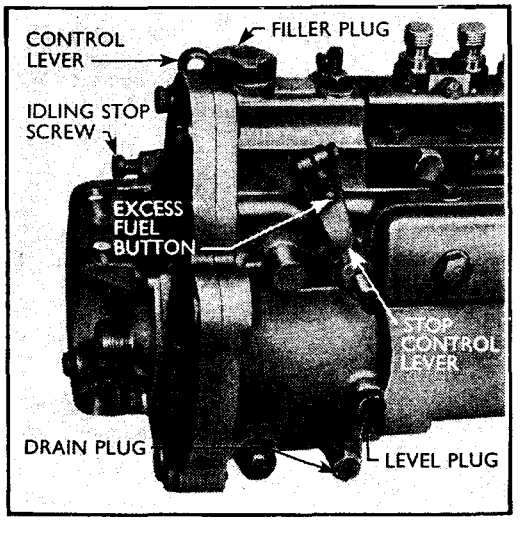



**Fig. 31**
**Mechanical Governor (Minimec Type)**

# Fuel System (Petrol Engine)

The fuel system consists of a petrol tank, a mechanical fuel lift pump, operated from the engine camshaft, and a carburettor of the single down-draught type with the necessary fuel connecting lines.

Make sure that the vent in the filler cap is clear of obstruction at all times, otherwise failure of the fuel supply to the carburettor may result.

**Fuel Lift Pump**

The mechanical type fuel pump, which may be of the horizontal or vertical diaphragm types, is mounted on the right-hand side of the cylinder block and is driven by an eccentric on the camshaft.

Being entirely automatic in action, the pump requires little attention other than the normal servicing to keep it free from dirt and sediment, but an occasional check should be made to ensure that the fuel line connections are kept tight.

A comparatively simple test can be carried out by disconnecting the fuel feed pipe to the carburettor, when a distinct spurt of petrol should be evident for each revolution of the camshaft.

When it is necessary to clean the filter screen, on the horizontal diaphragm type pump, unscrew the clamp nut at the top, move the retainer to one side and lift off the sediment bulb and filter screen. When replacing the bulb, ensure that the gasket is in good condition.

To clean the vertical diaphragm type lift pump, unscrew the centre bolt and remove the cover and pulsator diaphragm. When refitting the cover ensure that the pulsator diaphragm is in good condition.

**The Carburettor**

The carburettor is of the single down-draught type with an acceleration pump, and is entirely automatic in action.

All adjustments are made at the time the engine leaves the works, with the exception of the idling adjustment, which may require re-setting, especially after the engine has been "run-in".

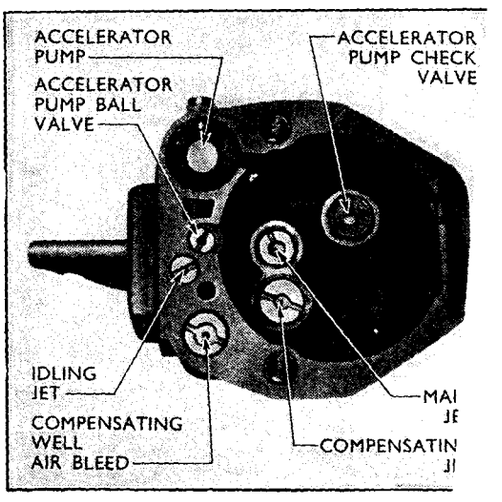



**Fig. 32**
**Carburettor Jets**

# Fuel System (Petrol Engine)

Jets may be removed for cleaning after detaching the carburetto bowl (see Fig. 32).

Obstructions should be cleared by blowing through the jets anc passages with a tyre pump.

On no account should wire or anything which would enlarge the orifices be used, as carburettor jets are calibrated to very fine limits, and not only economy, but also general engine performance can be upset by enlargement of the jets in this manner.

A filter screen is located in the banjo union above the float chamber. When replacing the union bolt and filter, ensure that a fibre washer is located on either side of the banjo union.

It is advisable to consult your Authorised Dealer should the engine's performance indicate that an adjustment is necessary.

**Carburettor Adjustment**

The only adjustments required are to the throttle stop screw and the mixture control screw for idling speeds.

The throttle stop screw controls the amount by which the throttle approaches the closed position and hence regulates the engine speed when idling.

The mixture control screw enables the mixture strength to be varied, a greater proportion of air being admitted when the screw is turned anti-clockwise.

When the choke control is operated an interconnecting linkage opens the throttle slightly from the normal slow-running position to facilitate starting. Should this adjustment have been disturbed at any time, loosening the pinch bolt permits the link to be reset as required. With the choke fully released, the adjustment must be

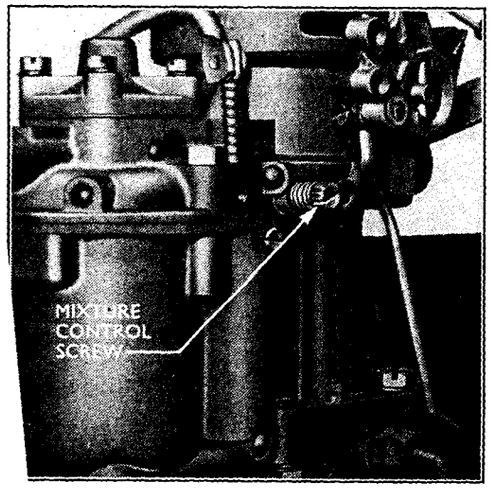



**Fig. 33**
**Mixture Control Screw**

such that the throttle lever is resting against the stop screw.

The approximate settings are as follows:

The mixture control screw should be set approximately two turns open from the fully closed position (see Fig. 33.)

The throttle stop adjusting screw should be screwed in about ½ to 1½ turns after the set screw touches the throttle lever. Three-quarters of a turn open will usually be found most satisfactory (see Fig. 34).

To obtain the exact settings for the individual engine, proceed as follows:

When the engine is warm, turn the throttle adjusting screw so that the engine will run sufficiently fast to prevent stalling.

The mixture adjusting screw should next be screwed in or out until the engine runs evenly. Now readjust the throttle stop screw if the engine is running too fast, followed by a further readjustment of the mixture screw.

These operations should be repeated until the idling speed is satisfactory.

It may also be necessary to adjust the ignition setting (see page 43), in order to obtain satisfactory idling.

Do not expect a new engine to idle perfectly at low speed, until the various machined surfaces have had a chance to "run themselves in".

**The Carburettor Air Cleaner**

The carburettor air cleaner, mounted on the manifold or engine canopy is connected to the carburettor by a flexible hose.

The cleaner is of the oil bath type, the oil bath forming the lower section of the casing as shown in Fig. 8.

Full maintenance instructions for the air cleaner appear on page 22.

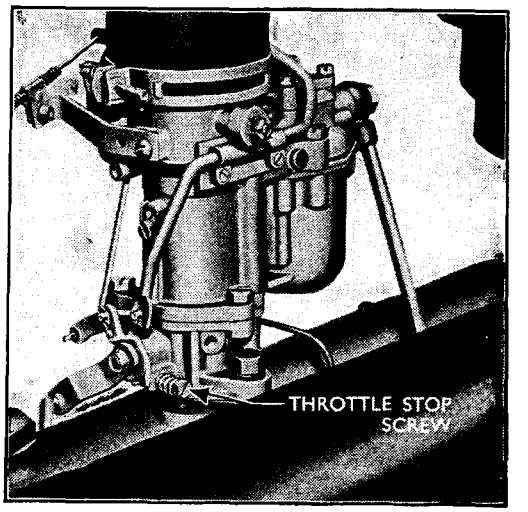



**Fig. 34**
**Throttle Stop Screw**

# Cooling System

The engine is cooled by the circulation of water through the water jackets surrounding the cylinders, cylinder head and valve seats. The heated water flows by thermo-syphonic action, assisted by a pump at the front of the cylinder block, to the radiator and, as it flows downwards through the radiator tubes, it is cooled by the stream of air induced by the fan placed behind the radiator. A temperature gauge if fitted to the cooling system enables the operator to see at a glance if the cooling water is at the correct temperature, i.e. 175°F.—185°F. (79°C.—85°C.).

**Under no circumstances may the engine be started without water in the cooling system as this will cause overheating of the cylinder liner seals and consequent water leaks.**

Two types of radiator may be used with these units. The truck type which can be identified by the filler cap which is integral with the header tank, or the tractor type on which the filler cap is fitted on a flexible filler neck, and may be pressurised. The capacity of the cooling system will vary according to the type of radiator fitted.

### Refilling the Radiator

The radiator should be kept filled at all times, and should be checked several times daily if the engine is in continuous use in hot weather or whenever the cooling water boils.

**It is dangerous to remove the radiator cap until the water has been allowed to cool down.**

Different capacity radiators may be fitted depending on the application of the unit. The cooling system capacities are given in the General Specifications pages 74 and 76.

### If the Engine Overheats

Always allow the engine to cool down until the back of the hand can be held against the cylinder head without discomfort before refilling with water.

If there is water in the radiator top tank, the radiator may be refilled with safety, if not, allow the engine to cool down completely before topping up.

**To Adjust the Fan Belt**

Any slackness that may develop in the fan belt after extended use may be readily adjusted by moving the generator.

Slacken the generator adjusting arm bolt and the two generator bracket bolts. Move the generator outwards to give the correct belt tension. Tighten the bolts and check the adjustment: there should be a total free movement of $\frac{1}{2}$ in. measured mid-way between the generator and fan pulleys, see Fig. 35.

**Anti-Freezing Mixture in Winter**

The engine should be properly housed when not in use and so protected from severe weather conditions.

In winter it is advisable to use an anti-freezing mixture in the cooling system, as the cylinder block, cylinder head, etc., may suffer damage if the water freezes.

Before putting the mixture into the radiator, the cylinder head bolts should be tightened down to prevent the possibility of any mixture getting into the cylinders or crankcase, where it will cause serious damage.

Where anti-freeze solution is required, this may be obtained from your authorised dealer under part No. ME—1163—B.

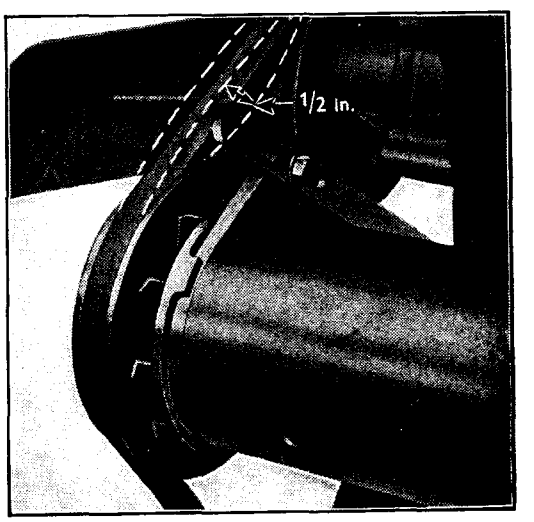



**Fig. 35**
**Fan Belt Adjustment**

# Cooling System

If an anti-freezing mixture is not being used in frosty weather, it is essential that the radiator be drained if the engine is left out overnight, and refilled the following morning.

The following table has been compiled to give the percentage of anti-freeze required to protect the cooling system.

| Volume of ME–1163–B in Water | Protection | Tractor Type Radiator | | Truck Type Radiator | | | |
|---|---|---|---|---|---|---|---|
| | | | | 4 Cyl. | | 6 Cyl. | |
| | | Pints | Litres | Pints | Litres | Pints | Litres |
| 10% | 17°F. (−8°C) | 2½ | 1.5 | 2½ | 1.5 | 3 | 1.7 |
| 15% | 7°F. (−14°C) | 3½ | 2.1 | 4 | 2.3 | 4½ | 2.6 |
| 20% | −3°F. (−19°C) | 5 | 2.9 | 5 | 2.9 | 6 | 3.4 |
| 25% | −20°F. (−29°C) | 6 | 3.4 | 6½ | 3.7 | 7½ | 4.3 |

Top up with an anti-freezing solution when the engine is hot: this will prevent loss of the solution via the overflow pipe as would occur when the radiator is filled with the engine cold.

Salt solutions, etc., can be extremely harmful and should not be used.

**Draining the Radiator**

When draining the radiator, remove the pressure cap and open the two drain cocks, one under the radiator, the other on the cylinder block beneath the generator. When the flow ceases probe the cocks carefully to dislodge any sediment that may be causing a temporary blockage.

**Draining and Cleaning the Radiator**

Occasionally the entire cooling system should be flushed out thoroughly. All that is necessary is to remove the pressure cap (if fitted) and open the two drain cocks, one under the radiator, the other on the

cylinder block beneath the generator, and pour water into the top tank until such time as the water coming out of the drain cocks is quite clear.

If the radiator grilles become clogged they should be cleaned as otherwise the air circulation is restricted and the engine may then overheat.

**The Water Pump**

The water pump requires no attention in service as the design incorporates a pre-lubricated shaft bearing, whilst the gland is rubber sealed, with a self-adjusting spring loading which obviates leakage or need for adjustment.

**Thermostat**

A thermostat is incorporated in the water outlet from the cylinder head: this is set to open at a pre-determined temperature and should not require any attention.

If it is suspected at any time that this is not operating correctly it may be immersed in a suitable container and gradually heated. The butterfly valve should commence to open at approximately 170°F. to 179°F. (76°C. to 81°C.) and be fully open at 199°F. (93°C.). Do not attempt any adjustment if it does not function properly at this setting. Replace with a new unit.

**The Pressure Cap (If fitted)**

This filler cap seals the system so that a slight pressure is developed in normal operating conditions. A relief valve, however, is fitted so that there will not be any undesirable rise in pressure and this adjustment is pre-set when the cap is built. This cap can be identified by the marking "Remove Slowly".

It may be an advantage to fit a pressure cap under severe operating conditions and high ambient atmospheric temperature since the boiling point of the water is raised, thus minimising loss of coolant under these conditions.

# Electrical System

## The Battery

This is a twelve-volt unit 57 ampere-hour capacity at 20-hour rate for the petrol engine, and 129 ampere-hour capacity at 20-hour rate for the diesel engine. In some installations, two six-volt batteries, connected in series and having a comparable capacity, are used with the diesel engine.

## Care of the Battery

Every week, check the electrolyte in the battery to see that it is at the proper level, i.e., $\frac{3}{8}$ in. (9.5 mm.) above the tops of the separators. If below this point, add distilled water until the electrolyte reaches the proper level.

Water for battery use should be kept in clean, covered vessels of glass, china, rubber or lead. In cold weather, add water only immediately before running the engine, so that the charging will mix the water and electrolyte: this will prevent freezing.

If the battery is allowed to stand in frosty weather in an unduly discharged condition there is the possibility that it may freeze, so causing damage to the container. Take care, therefore, always to keep the battery as fully charged as possible (i.e., 1.270 to 1.285 at 70°F. (21°C.)) since then it is unlikely to be affected by frost. A battery which is $\frac{3}{4}$ charged (sp. gr. approx. 1.245) will not freeze until a temperature of nearly minus 50°F. has been reached, whilst when fully discharged it will freeze at 16°F. (16°F. below freezing point).

The battery should not be allowed to become unduly discharged, or to stand in a run-down condition as this will materially affect its life.

Keep the battery filler plugs and connections tight, and the top of the battery clean. Wiping the battery with a rag moistened with ammonia will counteract the effect of any of the solution which may be on the outside of the battery.

A coating of a good grade of petroleum jelly will protect the terminals from corrosion. It is of vital importance that the battery is firmly secured.

To remove the battery: remove terminal leads, undo the securing

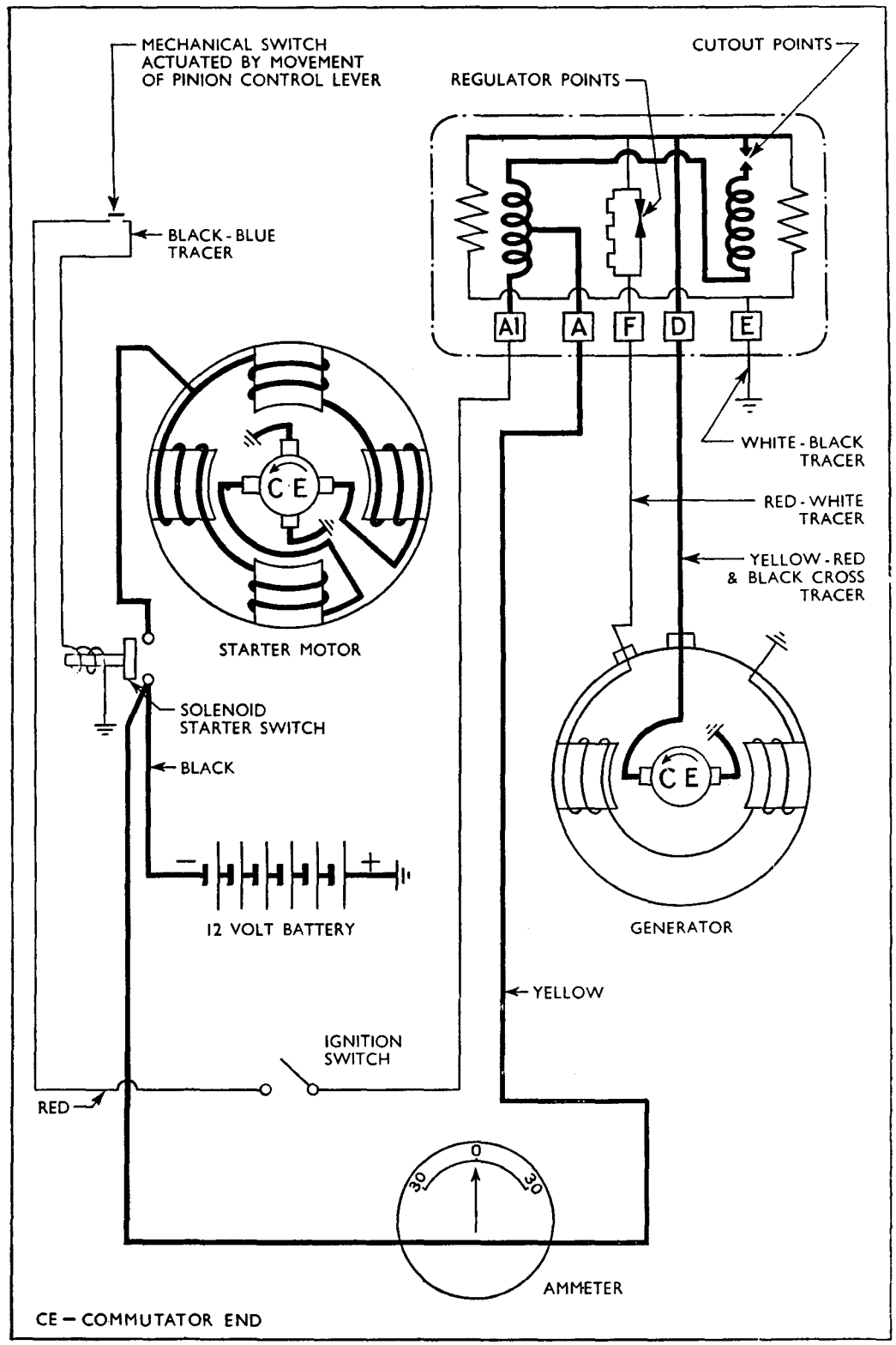



**Fig. 36**
**Wiring Diagram (Diesel Engine)**

nuts, and lift off the battery. When replacing the battery, be sure to install it with the **positive terminal earthed.**

### Generator

This is mounted on a bracket on the left of the cylinder block at the front and is driven from the crankshaft by the fan belt.

The generator charging rate is adjusted automatically by the regulator to provide sufficient electric current to keep the battery fully charged under normal operating conditions.

### Attention Needed by the Generator

No lubricator is provided at the pulley bearing as it is packed at assembly and only the lubricator at the commutator end will require attention.

At intervals of approximately 200 working hours inject two drops of engine oil into the generator rear bearing. See Fig. 10.

**Every six months,** remove the brush cover (if fitted) and clean the commutator by holding a strip of very fine glass paper against it (not emery cloth) with a small piece of wood whilst the engine is idling. Then blow out any carbon or copper dust that may have accumulated and examine the brushes for excessive wear. Replace any that have worn to such an extent that there is a possibility of the brush lead fastenings fouling the commutator, or at which excessive sparking occurs. See that all connections are clean and tight.

### The Cut-out and Voltage Regulator

The cut-out and regulator is a self-contained unit which automatically connects the generator to the battery when the output has risen sufficiently and also prevents the battery discharging itself when for any reason the charging rate falls below a minimum value as, for instance, when the engine is idling or stopped.

There is also provision for automatic regulation of the current supplied by the generator so that if the battery is considerably discharged the charging rate increases. When the battery is fully charged the charging rate will decrease and so there is no provision for any external adjustment on the generator or regulator unit.

### Starter Motor

The starter motor is mounted on the left-hand side of the engine, it requires no attention beyond seeing that the cable connections are clean and tight, the commutator is kept clean and the brushes are renewed when necessary.

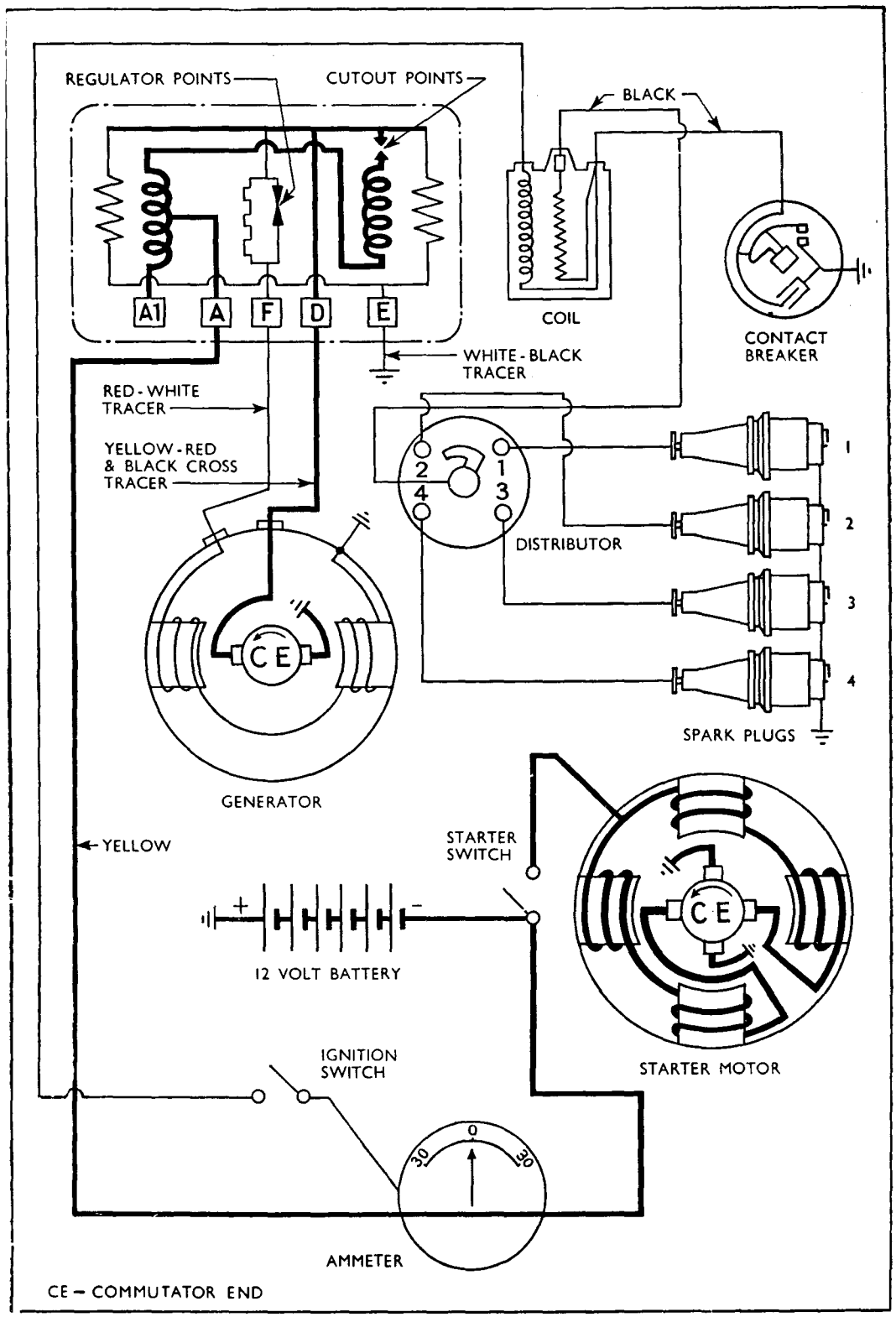



**Fig. 37**
**Wiring Diagram (Petrol Engine)**

# Clutch

The clutch is of the "dry" single plate type. The pressure plate springs are set to the required pressure before the unit leaves the factory, and no attempt should be made to adjust the pressure by interfering with the setting of the clutch release fingers.

Always ensure that the clutch is fully engaged when the engine is running; partial engagement will result in excessive wear of the release bearing and clutch lining, necessitating frequent adjustment of the clutch, in addition to causing loss of power through clutch slip. Clutch slip in such circumstances may cause distortion due to the heat developed and subsequent clutch control adjustment may not then correct the condition.

**Clutch Release Bearing**

The clutch release bearing, when utilised, is of the "greaseless" type and requires no lubrication.

Where a clutch release shaft is fitted, a suitable clearance between the release bearing and fingers should be maintained at all times by adjusting the operating rod.

# The Mechanical Governor
## (Petrol Engines)

Two types of governor may be fitted to petrol engines, these are:

(a) the velocity governor fitted between the carburettor and manifold which is sealed and requires no maintenance;

(b) a centrifugal governor driven off the auxiliary drive shaft.

**Maintenance**

The governor oil level should be checked weekly by removing the square headed plug marked **"Oil Level"** from the rear cover. If necessary add engine oil until it flows from the hole, allow the surplus oil to drain off and refit the level plug. Lubricate all ball joints on the linkage to ensure smooth operation.

**Adjustments**

The governor can be adjusted to control the engine at three speeds, 1,500 r.p.m., 1,800 r.p.m. or 2,250 r.p.m. The governor setting can be adjusted by altering the location of the spring. With the spring located in the inner hole of the arm the speed will be 1,500 r.p.m., with the spring in the centre hole the speed will be 1,800 r.p.m., whilst with the spring in the outer hole the speed will be 2,250 r.p.m.

If it is necessary at any time to change the governor setting, slacken the locknut and adjusting bolt located below the operating arm (see Fig. 38) and position the spring in the correct hole. With the engine running under load adjust the bolt to give the correct steady speed and tighten the locknut.

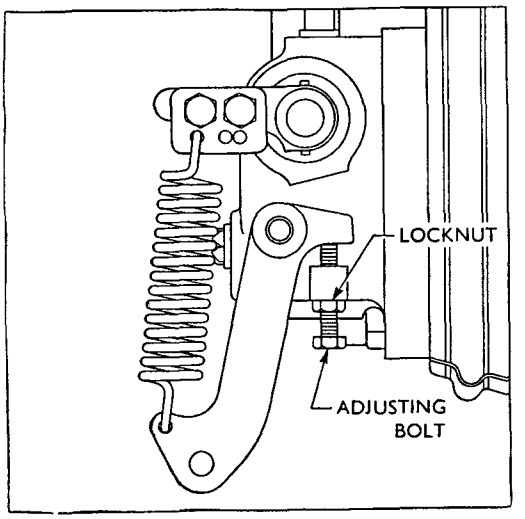



**Fig. 38**
**Mechanical Governor Adjustment (Petrol Engine)**

# The Mechanical Governor

The idling adjustment should be carried out in the normal manner (see page 60). After adjusting the idling speed, slacken the locknut and screw out the buffer spring adjuster, this is located next to the oil level plug. Run the engine under load, then quickly remove the load, if the engine runs steadily tighten the locknut on the adjuster, if surging develops gradually screw in the adjuster to eliminate surging then tighten the locknut.

# General Specification

# General Specification

# (Early Type Engine)

| Model | Production Date |
|---|---|
| Tractor Type Petrol | 1/52 to 4/57 |
| Tractor Type Diesel (Low Speed) | 1/52 to 4/57 |
| Truck Type Petrol | 4/53 to 4/57 |
| Truck Type Diesel (High Speed) | 2/54 to 4/57 |

**Engine**

| | | |
|---|---|---|
| Type | 4 Cylinder, in line, Overhead Valve type. | |
| | *Diesel* | *Petrol* |
| Bore | 3·937 in. (100 mm.) | 3·937 in. (100 mm.) |
| Stroke | 4.524 in. (115 mm.) | 4.524 in. (115 mm.) |
| Cubic Capacity | 220 cu. in. (3,610 c.c.) | 220 cu. in. (3,610 c.c.) |
| Compression Ratio | 16 : 1 | 6·0 : 1 |
| Pistons—Aluminium | Solid skirt for diesel. | Split skirt type for petrol. |
| Connecting Rods—Steel | Not interchangeable. Marked for identification purposes. Removable shell type bearing liners. | |
| Crankshaft | Forged steel for diesel engine.<br>Cast steel for petrol engine.<br>Located in 5 shell type bearing liners. | |
| Cylinder Block | Cast iron, wet liner type. Block interchangeable for both engines. | |
| Cylinder Liners—Cast Iron | Replaceable on both engines. | |
| Cylinder Head | Detachable cast iron type, not interchangeable. | |
| Valves | Inclined overhead type for petrol engine; vertical overhead type for diesel engine. Operated by push rods from the gear-driven camshaft. Diameter of inlet valve head larger than exhaust.<br>Clearances: see page 41. | |

**Lubrication**

| | | |
|---|---|---|
| Lubricating System | Pressure feed by spur gear type pump. Full flow oil filter fitted direct to cylinder block. | |
| Sump Capacity | 12 Imp. pints (14·4 U.S. pints, 6·816 litres) in addition 2 Imp. pints (2·4 U.S. pints, 1·136 litres) for dry oil filter. Oil drain plug at base of sump filter plate. | |
| Lubricant | Use an approved brand of engine oil in accordance with the viscosity figures and temperature ranges tabulated below: | |
| | *Diesel* | *Petrol* |
| Below 10°F. (—12°C.) | H.D. SAE 5W or H.D. SAE 10W+10% Kerosene | SAE 5W or SAE 10W+10% Kerosene |
| 10°F. to 40°F. (—12°C. to 4°C.) | H.D. SAE 10—10W | SAE 10—10W |
| 20°F. to 90°F. (—7°C. to 32°C.) | H.D. SAE 20—20W | SAE 20—20W |
| Above 90°F. (32°C.) | H.D. SAE 30 | SAE 30 |

# General Specification

**Cooling System**

| | |
|---|---|
| Type | Thermo-syphon, impeller assisted system, with thermostatic circulation control fitted in the cylinder head water outlet. |
| Capacity | |
| Truck type | 27 pints (15.34 litres). |
| Tractor type | 24 pints (13.64 litres). |
| Fan | Driven by a single "V" belt. |
| Petrol | Over 90°F. 4-blade 18 in. dia.<br>Below 90°F. 2-blade 18 in. dia. |
| Diesel | Over 90°F. 2-blade 18 in. dia.<br>Below 90°F. 2-blade 15 in. dia. |

**Fuel System**

| | | |
|---|---|---|
| Carburettor (*Petrol Engine*): | | |
| Tractor Type | Double downdraught. | |
| Jet Sizes | Choke Tube | 23·01 mm. |
| | Main | 2·4 mm. |
| | Metering | 1·19 mm. |
| | Idling | ·787 mm. |
| Truck Type | Single downdraught. | |
| Jet Sizes | Main | 90 |
| | Compensating | 105 |
| | Idling | 55 |
| Starting Device | Manual choke. | |
| Injection Pump (*Diesel Engine*) | Plunger type pump incorporating vacuum or mechanically controlled governor.<br>Starting device, excess fuel control. | |
| Injectors (*Diesel Engine*) | Type | Four-hole, long stem. |
| | Hole Diameter | .010 in. (0.25 mm.) |
| | Pressure | 185 ats. |
| | Firing Order | 1, 2, 4, 3. |
| | Injection Pump Timing | |
| | (Low Speed) | 26° B.T.D.C. |
| | (High Speed) | 29° B.T.D.C. |

**Ignition System**

| | |
|---|---|
| (*Petrol Engine*) | Coil and distributor. Magneto optional. Automatic control by distributor governor weight mechanism combined with vacuum control from the induction manifold. |
| Firing Order | 1, 2, 4, 3. |
| Sparking Plugs (*Petrol Engine*) | Size—14 mm.<br>Point gap 0·038–0·043 in. (0·965–1·092 mm.). |

**Clutch** (where fitted)

| | |
|---|---|
| Type | Dry single plate, 11 in. (27·94 cm.) dia. disc. |
| Friction Area | 123·75 sq. in. (791·9 sq. cms.). |

**Electrical System**

12 volt, two-brush generator, belt-driven from crankshaft and water pump pulleys, with automatic voltage control by regulator unit. Starter motor fitted on left-hand side of engine.
Battery—positive earth.
Battery size—Petrol 57 a.h. at 20 hr. rate.
Diesel 129 a.h. at 20 hr. rate.

**Engine Number Location**

Stamped on flywheel housing flange, left-hand side.

# General Specification
# (Current Type Engine)

Production Date—From 4/57

**Engine**

590E—6 cyl. Diesel — 589E—6 cyl. Petrol
592E—4 cyl. Diesel — 591E—4 cyl. Petrol

| | | | | |
|---|---|---|---|---|
| Type | 4 or 6 Cylinder Overhead Valve. | | | |
| Stroke | 4·524 in. (115·00 mm.). | | | |
| | *Diesel* | | *Petrol* | |
| Bore | 3·9375 in. (100 mm.). | | 3·74 in. (95 mm.). | |
| Compression Ratio | 16 : 1 | | 6·4 : 1 | |
| | 4 *Cyl.* | 6 *Cyl.* | 4 *Cyl.* | 6 *Cyl.* |
| Cubic Capacity | 220 cu. in. 3,611 ccs. | 330 cu. in. 5,416 ccs. | 199 cu. in. 3,260 ccs. | 298·3 cu. in. 4,888 ccs. |
| Max. B.H.P. (B.S. Overload) | 62 at 2,250 r.p.m. | 96 at 2,250 r.p.m. | 62 at 2,250 r.p.m. | 98 at 2,250 r.p.m. |
| B.S. Rating | 57 at 2,250 r.p.m. | 86·5 at 2,250 r.p.m. | 56·5 at 2,250 r.p.m. | 88 at 2,250 r.p.m. |
| Max. Torque | 158 lb. ft. at 1,600 r.p.m. | 242 lb. ft. at 1,500 r.p.m. | 158 lb. ft. at 1,600 r.p.m. | 242 lb. ft. at 1,300 r.p.m. |
| Valve Clearance | Inlet: ·015 in. (0·381 mm.)<br>Exhaust: ·012 in. (0·305 mm.) | | | |

**Lubrication**

| | |
|---|---|
| Type | Pressure feed by gear type pump. Full flow oil filter. |
| Sump Capacity | 4 Cylinder: 13½ Imp. pints (16·2 U.S. pints, 7·7 litres), including 1½ Imp. pints (1·8 U.S. pints, 0·9 litres) for filter.<br>6 Cylinder: 20 Imp. pints (24 U.S. pints, 11·4 litres), including 2 Imp. pints (2·4 U.S. pints, 1·136 litres) for filter. |
| Oil Drain | Plug at base of sump. |
| Lubricant | Use an approved brand of engine oil in accordance with the following temperature ranges. |

| | *Diesel* | *Petrol* |
|---|---|---|
| Below 10°F. (—12°C.) | H.D. SAE 5W or H.D. SAE 10W+10% Kerosene | SAE 5W or SAE 10W+10% Kerosene |
| 10°F. to 40°F. (—12°C. to 4°C.) | H.D. SAE 10—10W | SAE 10—10W |
| 20°F. to 90°F. (—7°C. to 32°C.) | H.D. SAE 20—20W | SAE 20—20W |
| Above 90°F. (32°C.) | H.D. SAE 30 | SAE 30 |

**Cooling System**

Type — Thermo-syphon system, thermostatically controlled, impeller-assisted.

| | *Diesel* | | *Petrol* | |
|---|---|---|---|---|
| | 4 *Cyl.* | 6 *Cyl.* | 4 *Cyl.* | 6 *Cyl.* |
| Capacity | 26 pints (14·7 litres) | 30 pints (17·0 litres) | 26 pints (14·7 litres) | 32 pints (18·0 litres) |

**Cooling System**—*continued*

| | | | | |
|---|---|---|---|---|
| Engine Coolant Capacity | 12 Imp. pints (6·8 litres) | 14 Imp. pints (7·9 litres) | 12 Imp. pints (6·8 litres) | 14 Imp. pints (7·9 litres) |
| Fan | 2 Blade | 2 Blade | 2 Blade | 4 Blade |
| Pressurized to | — | 4 lb. per sq. in. (·028 Kg. per sq. cm.) | — | 4 lb. per sq. in. (·028 Kg. per sq. cm.) |

**Carburettor** (*Petrol Engine*)

| | | |
|---|---|---|
| Type | Single venturi down draught. | |
| | 4 *Cyl.* | 6 *Cyl.* |
| Jet Sizes | | |
| Main | 97 | 125 |
| Compensating | 70 | 130 |
| Idling | 60 | 55 |
| Pump Jet | 70 | 80 |
| Choke Tube | 29 mm. | 35 mm. |
| Needle Valve | 2·0 mm. | 2·5 mm. |

**Injectors** (*Diesel Engine*)

| | |
|---|---|
| Type | Four-hole long stem. |
| Hole diameter | ·011 in. (·27 mm.). |
| Pressure | 185 atmospheres. |
| Firing Order | 1, 5, 3, 6, 2, 4, or 1, 2, 4, 3. |
| Injection Pump Timing | 19° B.T.D.C. (SPE 4A 75 or SPE 6A 75)<br>**Note.**—When steel gasket is replaced by copper asbestos gasket on engines prior to S.199204 (4 cyl.) and S.203971 (6 cyl.), injection pump timing is 23° B.T.D.C.<br>21° B.T.D.C. ("Minimec") |

**Ignition System** (*Petrol Engine*)

| | |
|---|---|
| Type | Distributor and separate coil. Automatic control by weight mechanism combined with vacuum control from induction manifold.<br>Optional magneto. |
| Contact Breaker | |
| Points Gap | ·014 in. to ·016 in. (0·35 to 0·41 mm.). |
| Sparking Plugs | Champion N8c. |
| Plug Gap | ·025 in. (0·64 mm.). |
| Firing order | 1, 5, 3, 6, 2, 4, or 1, 2, 4, 3. |
| Ignition Timing | 10° B.T.D.C. (4 cyl.). 6° B.T.D.C. (6 cyl.). |

**Clutch** (where fitted)

| | |
|---|---|
| | Single dry plate |
| Diameter | 4 cyl. 11 in. (27·94 cm.)<br>6 cyl. 12 in. (30·48 cm.)<br>4/6 cyl. 13 in. (33·02 cm.) |
| Friction Area | 4 cyl. 123.7 sq. ins. (791·9 sq. cms.)<br>6 cyl. 141.4 sq. ins. (912·26 sq. cms.)<br>4/6 cyl. 157.8 sq. ins. (1011·52 sq. cms.) |

*Ford Policy is one of continuous improvement and the right to change prices, specifications and equipment at any time without notice is reserved.*

# Operator's Log

# Operator's Log

| )ate | Hours | Fuel | Oil | Service or Repairs carried out |
|---|---|---|---|---|
| | | | | |

# Operator's Log

| : | Hours | Fuel | Oil | Service or Repairs carried out |
|---|---|---|---|---|
| | | | | |

# Operator's Log

| ate | Hours | Fuel | Oil | Service or Repairs carried out |
|---|---|---|---|---|
| | | | | |

# Index


Fan belt adjustment .. .. 63
Pressure cap .. .. .. 65
Radiator .. .. .. .. 64
Thermostat .. .. .. 65

**Electrical System** .. .. .. 66
Battery .. .. .. .. 66
Cut-out and voltage regulator .. 68
Generator .. .. .. 68
Starter motor .. .. .. 68

**Engine**
Decarbonising .. .. .. 34
Lubrication and maintenance .. 20
Starting the diesel engine .. 13
Starting the petrol engine .. 17

**Fan Belt Adjustment** .. .. 63

Contact breaker points—adjustment .. .. .. .. 43
Distributor .. .. .. 43
Ignition timing—Magneto Ignition .. .. .. .. 44
Ignition timing .. .. .. 43
Sparking plugs .. .. .. 45

**Instruction for Operators** .. .. 8

**Instruments** .. .. .. .. 10
Ammeter .. .. .. .. 12
Oil pressure gauge .. .. 12
Water temperature gauge .. 12

**Introduction to Engine** .. .. 8

**Lubrication** .. .. .. .. 20
Distributor .. .. .. 22
Engine .. .. .. .. 22