

# handbook for diesel engines

4.108

Every endeavour has been made to ensure that the information contained in this book is correct at the date of publication, but due to continuous developments, Perkins Engines Ltd., reserve the right to alter the contents without notice.

# **handbook for 4.108 diesel engines**

## **Perkins Engines, Inc.**

32500 Van Born Road  
P.O. Box 697 • Wayne, Michigan 48184 • U.S.A.  
Tel.: (313) 595-9600 • Telex: 23-4002

©

1981

Publication No. 201 SER 0281 1057

NA-4542

## PERKINS COMPANIES

### AUSTRALIA

Perkins Engines Australia Pty. Ltd.  
P.O. Box 156, Dandenong, Victoria 3175, Australia.  
Telephone: 792-0431. Telex: 30816. Cables: 'Perkoil' Melbourne.

### BRAZIL

Motores Perkins S.A.  
Caixa Postal 30.028, 01000 Sao Paulo, SP-Brazil.  
Telephone: 448-1499. Telex: 0114013 and 0114294. Cables 'Perkoil' Sao Paulo

### FRANCE

Moteurs Perkins S.A.  
9-11 Ave. Michelet, Boite Postale 69, 93402 Saint Ouen, Cedex, France  
Telephone: 257-14-90. Telex: Perkoil 642924.

### GERMANY

Perkins Motoren G.m.b.H.  
8752 Kleinostheim, Postfach 1180, Germany  
Telephone: 06027/8081. Telex: 4188869.

### GREAT BRITAIN

Perkins Engines Limited  
Peterborough, England, PE1 5NA.  
Telephone: 67474. Telex: 32501. Cables: 'Perkoil' Peterborough.

### ITALY

Motori Perkins S.p.A.  
Via Gorizia 11, P.O. Box 12, 22070 Particello Luisago (Como), Italy.  
Telephone: (031) 927364. Telex: 38063. Cables: 'Perkoil' Camerlata.

### JAPAN

Perkins Engines (North Pacific) Ltd.  
6th Floor, Reinanzaka Building, 14-2 Akasaka 1 chome, Minato-Ku, Tokyo 107, Japan.  
Telephone: (03) 586-7377. Telex: 24292 Tokyo.

### SOUTH AFRICA

Perkins Engines (Pty.) Ltd.  
P.O. Box 31285, 6th Floor, Noswal Hall, Braamfontein 2017, Johannesburg, South Africa.  
Telephone: Johannesburg 39 28 21. Telex: 8-00375A. Cables: 'Perkoil'

### UNITED STATES OF AMERICA

Perkins Engines Inc.  
P.O. Box 697, 32500 Van Born Road, Wayne, Michigan 48184, U.S.A.  
Telephone: 313-595-9600 Telex: 23-4002.

Perkins Engines Latin America Inc.  
32500 Van Born Road  
P.O. Box 697 • Wayne, Michigan 48184 • U.S.A.  
Tel: (313) 595-9600 • Telex: 23-4002

## ASSOCIATE COMPANIES AND MANUFACTURING LICENSEES

### ARGENTINA

Perkins Argentina S.A.I.C.  
Bolívar 388, Buenos Aires, Argentina.  
Telephone: 338231, Telex: 121162. Cables: 'Perkinsa'.

### KOREA

Hyundai Motor Co.  
Hyundai Building, 178 Sejong-Ro, Jongro-Ku, Seoul, Korea.  
Telephone: 74-8311 and 75-6511. Telex: Hdmoco K2391.

### MEXICO

Motores Perkins S.A.  
Antiguo Camino San Lorenzo S/N, Apartado Postal 194, Toluca, Estado de Mexico, Mexico.  
Telephone: Toluca 4-4455. Telex: 00178493. Cables: 'Mopesa' Toluca.

### PERU

Motores Diesel Andinos S.A.  
Antero Aspillaga No. 585, Apartado 11179, Lima 14, Peru.  
Telephone: 406882. Telex: 21076.

### SINGAPORE

Perkins Engines Eastern Ltd.  
549 Upper Thomson Road, Singapore 20.  
Telephone: 4524471/4521841. Telex: Perkoil R23360

### SPAIN

Motor Iberica S.A. (Division Zona 2).  
Carretera del Aero-Club, Carabanchel Alto, Madrid, Spain.  
Telephone: 208 52-40, 208 96-40, 208 98-40. Telex: 27324. Cables: 'Perki-e' Madrid.

### URUGUAY

Perkins Rio de la Plata S.A.  
Av. Juan Carlos Gormez 1492, Paraguay 2182, Montevideo, Uruguay.  
Telephone: 290-726. Telex: 6278 Perk UY. Cables: 'Perkins' Montevideo.

### YUGOSLAVIA

Industrija Motora Rakovica.  
Patrijarha Dimitrija 7-13, Rakovica, Belgrade, Yugoslavia.  
Telephone: 562-043/562-322/562-992. Telex: 11341 YU IMR. Cables: 'Indmotor' Beograd.

In addition to the above, there are Perkins Distributors in the majority of countries throughout the world. For further details apply to Perkins Engines Limited, Peterborough, or to one of the above companies.

## index

Air Cleaner	...	...	...	...	...	...	...	18
Air Restriction Indicator	...	...	...	...	...	...	...	23
Altitude	...	...	...	...	...	...	...	6
Approved Fuel Oil Specifications	...	...	...	...	...	...	...	7
Approved Lubricating Oils	...	...	...	...	...	...	...	34
Atomiser Faulty/Replacement	...	...	...	...	...	...	...	31
Cold Weather Starting Aids	...	...	...	...	...	...	...	14
Cylinder Head Tightening Torque and Sequence	...	...	...	...	...	...	...	6
Data	...	...	...	...	...	...	...	8
De-aerating (bleeding) the Fuel System	...	...	...	...	...	...	...	9
Dynamo Rear Bush...	...	...	...	...	...	...	...	26
Engine Identification	...	...	...	...	...	...	...	6
Engine Number	...	...	...	...	...	...	...	6
Fan Belt	...	...	...	...	...	...	...	25
Fault Finding	...	...	...	...	...	...	...	32
Frost Precautions	...	...	...	...	...	...	...	36
First 25/50 Hours Service	...	...	...	...	...	...	...	16
Fuel Filter Element Change	...	...	...	...	...	...	...	27
Introduction	...	...	...	...	...	...	...	5
Oil Filter Element Change	...	...	...	...	...	...	...	28
Overseas Companies	...	...	...	...	...	...	...	2
Preservation of Engine	...	...	...	...	...	...	...	30
Preventive Maintenance	...	...	...	...	...	...	...	17
Running Adjustment	...	...	...	...	...	...	...	16
Safety Precautions	...	...	...	...	...	...	...	4
Running-in	...	...	...	...	...	...	...	16
Starting	...	...	...	...	...	...	...	13
Stopping	...	...	...	...	...	...	...	13
Valve Tip Clearance	...	...	...	...	...	...	...	29

## **safety precautions**

These safety precautions are for guidance only and should be interpreted in conjunction with the local and government regulations valid for your country.

Do not smoke when refuelling.

Always remove spilt fuel and soaked clothing to a safe place.

Do not refuel whilst the engine is running (unless absolutely necessary).

Never clean, lubricate or adjust the engine whilst it is running (unless qualified to do so, in which case, extreme care should be taken to avoid injury).

Do not attempt any adjustments you do not understand.

Ensure the engine is positioned so as to prevent a build-up of toxic emissions.

Warn persons in the area to keep well clear during engine and equipment or vehicle operation.

Do not wear loose clothing or allow long hair near moving machinery.

Keep well clear of rotating parts or machinery in operation. Note that fans are not visible whilst the engine is running.

Do not run the engine with any safety guards removed.

Do not remove the radiator cap whilst the engine is hot and the coolant is under pressure as scalding can result.

Keep sparks or flames away from batteries as the gasses from the electrolyte (especially whilst the battery is under charge) are highly inflammable. This acid is also dangerous to the skin and especially the eyes.

Always disconnect battery terminals before repairing or interfering with the electrical system.

Only one person should be in control of the engine.

Always operate the engine from the control panel or operators seat.

If your skin comes into contact with high pressure fuel, seek medical attention immediately.

Diesel fuel can cause skin infection to some people. Use protective gloves or hand cream.

Do not move mobile equipment without first ensuring that the brakes are in good working order.

Ensure that the transmission drive control is in "Out of Drive" position before starting the engine.

**SAFETY IS SENSE. USE IT.**

## introduction

This handbook has been written to assist the owner/operator in the correct starting, stopping and maintenance procedure he should use so that his Perkins engine can give him continued reliability until repairs or replacement parts become necessary, due to normal wearing of the engine component parts.

Over many years, it has been our experience that owners who conform to the maintenance periods listed in our Service Publications and to the recommended procedures, are those who obtain the best service from their engine.

We have also found that a majority of complaints raised against our engines have been associated with bad maintenance, in particular, with lack of attention to the LUBRICATING OIL CHANGE, the FUEL AND OIL FILTERS and the AIR CLEANER. Should you consider you are working in unusually dusty or heavy, arduous conditions then you should carry out the preventive maintenance more often than is indicated in this handbook. We cannot stress enough the importance of KEEPING YOUR ENGINE CLEAN INSIDE as well as outside.

For engines fitted with DRY TYPE AIR CLEANERS, there are devices known as RESTRICTION INDICATORS which can be fitted to the induction system to indicate that the air cleaner needs attention, and it is suggested that you have one fitted to your engine to warn you of the necessity to CLEAN your AIR CLEANER.

Repairs or adjustments to your engine should be carried out by a trained engineer whose services are usually available at the supplier of the vehicle or machine.

Spare parts, service, advice, as well as the benefit of a Perkins trained engineer may be had at your local Industrial Distributor in the United Kingdom, or for overseas operators, our various Overseas Companies and Distributors will offer the same service.

Workshop Manuals are also available from the same sources for a reasonable charge.

The ANCILLIARY EQUIPMENT fitted to the 4.108 engines will vary in accordance with the type of application to which it is fitted.

Repairs or replacements for parts, or any problems concerned with the ancillary equipment can be dealt with by the supplier of the vehicle or plant. If this is not possible, you should contact your nearest U.K. Distributor or Overseas Distributor for assistance.

## ENGINE IDENTIFICATION

These engines are known as the 4.108 and if you have cause to communicate with anyone concerning Service or Parts requirements then you should always quote the type of engine, its **full engine number** and the vehicle or machine it is fitted in.

The engine numbering will, where possible, be standardised on a pad on the left hand side of the engine viewed from the rear, near the fuel injection pump. A typical number is ED21038U500123C.

Please quote all letters and numbers in the same sequence as they are stamped on the engine.

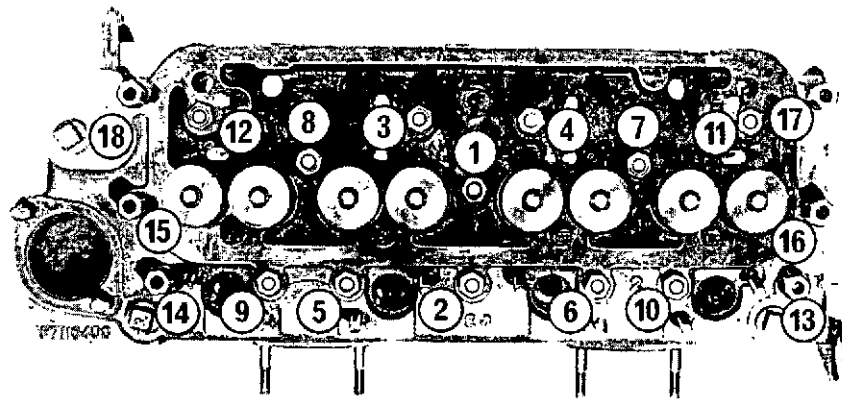


Fig. 1  
Torque Tightening Sequence for Cylinder Head Nuts.  
60 lbf ft (8,3 kgf m) — 81 Nm.

## ALTITUDE

If it is necessary to operate continuously at altitudes above 2,000 ft (600 metre) then it may be necessary to derate the engine by reducing the amount of fuel being fed into the engine. The C.A.V. dealer in your territory or Perkins Engines Ltd., will advise.

## approved fuel oil specifications

<b>United Kingdom</b>	BS.2869 : 1967	Class A.1 or A.2
<b>United States</b>	VV-F-800a A.S.T.M./D975-66T	Grades DF-A, DF-1 or DF-2 Nos. 1.D or 2-D
<b>France</b>	(J.O. 14/9/57)	Gas Oil or Fuel Domestique
<b>India</b>	IS : 1460/1968	Grade Special or Grade A
<b>Germany</b>	DIN-51601 (1967)	—
<b>Italy</b>	CUNA-Gas Oil NC-630-01 (1957)	—
<b>Sweden</b>	SIS. 15 54 32 (1969)	—
<b>Switzerland</b>	Federal Military Spec. 9140-335-1404 (1965)	—

Fuel Oils available in territories other than those listed above which are to an equivalent specification may be used.

## **data**

Type	Four Cylinder, Four Stroke, Indirect Injection
Bore	3.125 in (79,735 mm) — nominal
Stroke	3.5 in (88,9 mm)
Compression Ratio	22 : 1
Cubic Capacity	107 in <sup>3</sup> (1,76 litre)
Firing Order	1, 3, 4, 2.
Valve Tip Clearance	0.012 in (0,30 mm) Cold

---

# **USE GENUINE PERKINS PARTS**

To ensure you obtain the best results from your engine and to safeguard your own guarantee, fit only genuine Perkins Parts. These are readily obtainable throughout the world.

## de-aerating the fuel system

This procedure is otherwise called "bleeding" the system (of air).

Air in the fuel system can cause difficult starting, erratic running and loss of power.

Air can enter the fuel system, as the result of running out of fuel, leaks in the system, changing filters or pipes, or any disturbance of any fuel connection.

Bleed the system as follows: —

Unscrew by two or three turns, the vent plug on top of the fuel filter cover (not the return pipe to the tank) (see Fig. 2).

Slacken the vent screw on the hydraulic head locking screw on the side of the fuel injection pump (see Fig. 3).

Slacken the air vent screw near the top of the governor housing on the fuel injection pump (see Figs 4 or 5).

Operate the priming lever of the fuel lift pump (see Fig. 6) until fuel, free from air bubbles, issues from each vent point.

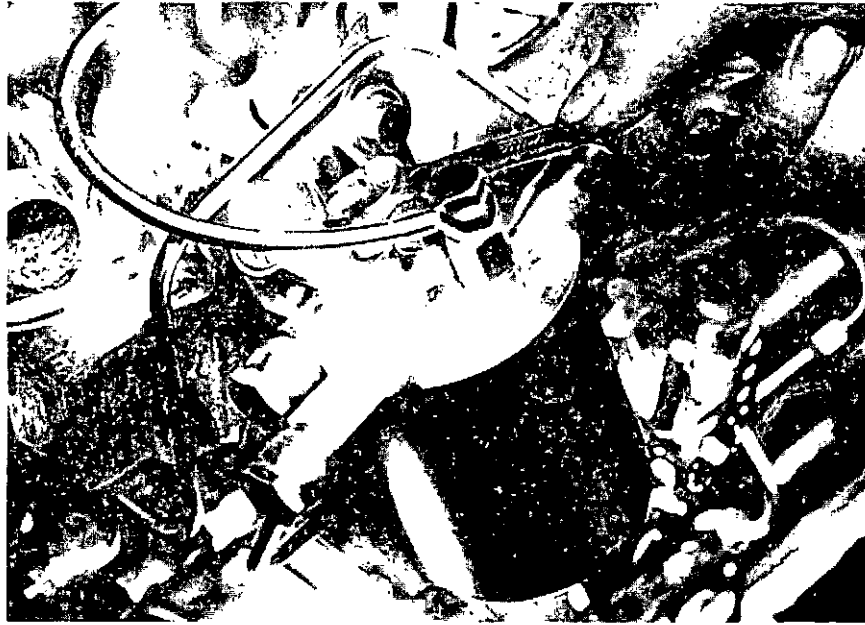


Fig. 2  
Slackening Vent Screw on Top of Final Fuel Filter.

It may not be possible to operate the priming lever if the driving cam is in the maximum lift position. To rectify this condition, turn the engine one complete revolution.

Tighten the connections in the following order:—

1. Filter head venting screw.
2. Head locking screw on fuel injection pump.
3. Governor vent screw on fuel injection pump.

Slacken the pipe union nut at the fuel injection pump inlet (see Fig. 7), operate the priming lever on the lift pump and re-tighten when fuel, free from air bubbles, issues from around the threads.

It must be realised that this whole operation must be carried out completely and no action to tighten connections must be made until all signs of air bubbles have disappeared. Unless care is taken with this operation, and this could take some four or five minutes of hand priming, failure to start will result.

Slacken the unions at the injector ends of two high pressure fuel pipes.

Set the accelerator in the fully open position and ensure that the stop control is in the "run" position.

Rotate the engine with the starter motor until fuel oil, free from air bubbles, issues from all fuel pipes. Some 30 to 60 seconds of rotation may be necessary before this condition is reached, and the time will be dependent upon the speed of rotation and

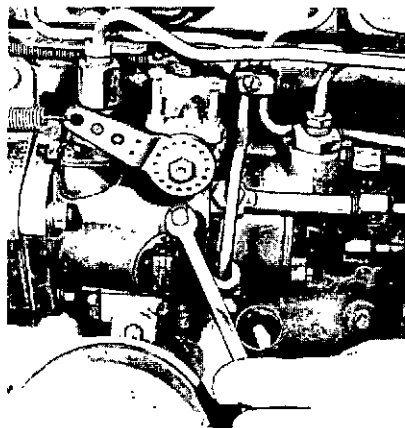


Fig. 3  
Slackening Vent Screw on Hydraulic  
Head Locking Screw on Fuel Injection  
Pump

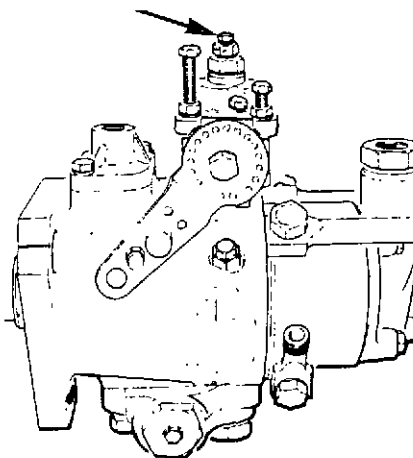


Fig. 4  
Vent Screw on Governor Housing  
(Hydraulic Governor)

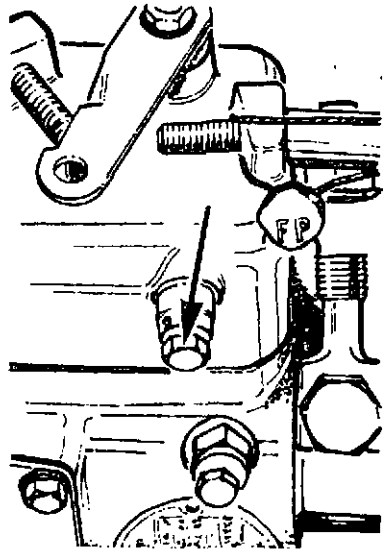


Fig. 5  
Vent Screw on Governor Housing  
(Mechanical Governor)

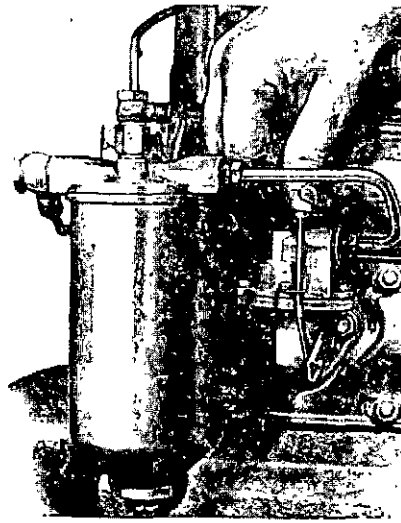


Fig. 6  
Operating the Hand Primer  
on the Fuel Lift Pump

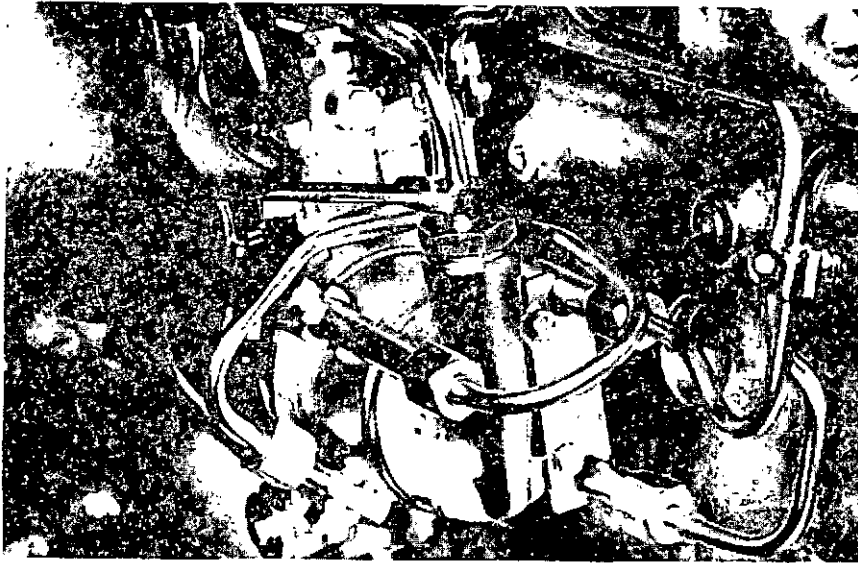


Fig. 7  
Slackening Pipe Union Nut at Fuel Injection Pump Inlet.

the effectiveness of the bleeding operation described above. A fully charged battery in a temperate or warm climate will rotate the engine at upwards of 280 rev/min, and *under these conditions, the remaining air should be expelled in under 30 seconds.* Cold conditions or partially discharged batteries may take longer.

Tighten the unions on both of the fuel pipes.

Slacken the union at the thermostat cold start aid and again turn the engine until fuel free from air issues from this connection. Tighten the union.

The engine is then ready for starting.

If, after bleeding the fuel system, the engine starts and runs satisfactorily, but after a few minutes stops, then it can be assumed that air is trapped in the fuel injection pump and the bleeding procedure should be repeated, at the same time checking for air leaks on the suction side, such as loose connections or faulty joints.

## starting the engine

Under warm conditions it is only necessary to engage starter motor by turning the "ignition" type key to the position "HS" at the same time adjusting the engine speed control. On some applications a button type switch is fitted. Always ensure the stop control is in the "run" position.

As soon as the engine starts, release the starter switch or button. Always ensure that the flywheel and starter pinion have stopped rotating before attempting to re-engage the starter motor, otherwise the starter ring or pinion gear, or both, may be damaged.

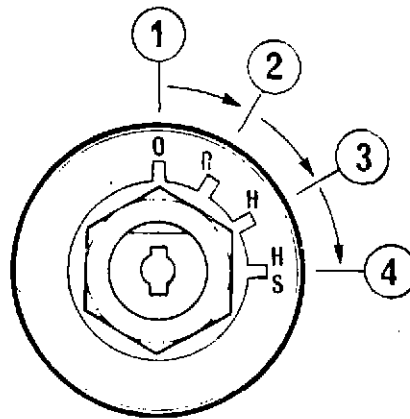


Fig. 8  
Combined Heat/Start Switch.

- |                  |                             |
|------------------|-----------------------------|
| 1. Off Position. | 3. Heat Position.           |
| 2. Run Position. | 4. Heat and Start Position. |

## TO STOP THE ENGINE

A spring loaded stop control is usually situated near the normal engine controls and it is only necessary to pull out the stop control until the engine ceases to rotate. Ensure the engine movement has completely stopped before returning the control to the normal "running" condition. Turn start switch to the "O" position.

Some engines may have an electric solenoid stop control on the fuel injection pump operated by a switch on the control panel.

## cold weather starting aids

Different types of cold starting devices may be found fitted to Perkins Diesel Engines depending upon the manufacturer of the vehicle or machine.

Cold starting aids consist of the C.A.V. Thermostart, the Start Pilot Viso-F, the Turner Quick-Start and Glow Plugs.

### THERMOSTART

To operate the **Thermostart**, ensure that if a tap is fitted in the fuel pipe to the unit in the induction manifold, it is turned to the "ON" position. Operation may be an electrical ignition type of rotary switch, or by push button. Turn the rotary switch to the "H" position or push the button marked "HEATER" and hold for fifteen seconds. Adjust the engine speed control to maximum speed position and turn the rotary switch key to the "HS" position or depress the "starter" button.

If the engine fails to start after about fifteen seconds, disengage the starter and return to the heat position for a further ten seconds before re-engaging the starter motor. Under cold conditions, i.e. temperature below 0°F (-18°C) it may be found helpful to retain the "HEAT" position for a further ten seconds after the engine has started, but with the starter disengaged. Having started the engine turn off the tap that may be fitted in the fuel supply pipe to the Thermostart.

If any difficulty is experienced, check that fuel is reaching the starting aid. Operation of the Thermostart can be seen in most cases, by removing the air cleaner or induction trunking. The unit should glow when the "Heat" position is engaged and the fuel becomes ignited on engagement of the starter motor.

To attempt to use the Thermostart without a supply of fuel will result in the unit becoming burned out.

### START PILOT

When **Start Pilot** equipment is fitted, use of any heater device is strictly prohibited.

The pump should not be used until the starter motor has been engaged. In very cold conditions it may be necessary to assist engine running with a further one or two strokes of the pump to attain steady running.

To charge the container with fluid using only Start Pilot Multi-fill Can Type F, lift the hinged cover of the VISO-F reservoir. Press the can, head down, onto the filler valve and retain in a square position until fluid flows into the transparent bowl. **Do not allow the fluid level to rise above the maximum indicated by arrow markings on the bowl.**

Experience will show how much fluid is required for a single start under various temperatures and it is desirable to charge the reservoir with just sufficient fluid for a single start, especially when the unit is mounted near the engine.

The air filter fitted at the outward end of the V20S pump cylinder should occasionally be examined and if necessary, removed and washed in Kerosene. A thin smear of light lubricating oil may be applied to the cylinder.

The spray nozzle may become partially blocked and this can be cleaned by dismantling from the engine induction manifold and washed in Kerosene.

### **TURNER QUICK-START**

Procedure for using this cold starting aid is as follows:—

Pull out the "Quick Start" knob prior to starting.

Engage the starter motor and after one complete revolution of the engine push in the "quick Start" knob.

It may be necessary to assist continuous running by injecting more fluid by further strokes of the "Quick Start" knob.

### **WARNING**

The **START PILOT VISO-F** unit and the **TURNER QUICK START** device both use high energy fuels with low combustion temperatures or flash points, therefore you are warned that these aids should only be used to start very cold engines. If used carelessly or excessively for the purpose of obtaining a boost of power, serious damage can occur to the engine for which we, as diesel engine manufacturers, cannot be held liable. If any damage does occur for the reasons stated, they are usually readily identified.

Do not use any starting device that uses high energy fuels in conjunction with a heater unit.

### **GLOW PLUGS**

**Glow Plugs** are sometimes fitted to engines in applications such as refrigeration units, or fork lift trucks and other certain 4.108 mechanically governed engines rated at 3,000 rev/min and below. As the buss bar connecting these glow plugs may not be insulated, extreme care should be exercised to keep pipes, clips or other metal objects well clear as the consequences of a direct short of this buss bar to earth when energised are obvious.

It should be noted that in no circumstances should either or any other unauthorised starting aids be used at the same time as **Glow Plugs**.

To operate, the following procedure should be adopted.

Before operating the starter motor, press the "Heat" button for 20 to 30 seconds.

With the "Heat" button still depressed, engage the starter motor until the engine starts.

Continue to press the "Heat" button for a few seconds after the engine has started until even running has been obtained.

If the engine does not start, disengage the starter motor, but keep the "Heat" button depressed for a further 10 to 15 seconds, when a further attempt should be made to start the engine, keeping the **Glow Plugs** energised whilst starting and for a few seconds after the engine has fired until even running is obtained.

## running in

It is not necessary to gradually run-in a new or factory rebuilt engine and any prolonged light load running during the early life of the engine can in fact prove harmful to the bedding in of piston rings and liners.

Full load can be applied on a new or factory rebuilt engine as soon as the engine is used, provided that the engine coolant is first allowed to reach a temperature of at least 140 degrees F (60 degrees C).

### FIRST 25/50 HOURS SERVICE

After a customer has taken delivery of his engine, a general service must be carried out by an experienced fitter after the first 500/1,000 miles (800/1,600 km) or 25/50 hours in service and must include the re-tightening of the cylinder head nuts in the correct sequence. With the engine thoroughly warmed through, the service should include the following:—

1. Drain the lubricating oil sump and refill to the correct level with clean new oil (See Pages 34 and 35). Do not overfill. Use correct temperature grade and specification. Renew lubricating oil filter element.
2. Remove the rocker assembly; tighten the cylinder head nuts in the correct sequence (see Fig. 1) and to the correct torque of 60 lbf ft (8,3 kgf m) or 81 Nm.

Note: If the nuts move when re-tightening, then tighten up to the torque quoted. If a nut does not move before the correct torque is achieved, then slacken off 1/12 to 1/6 (30 degrees to 60 degrees) of a turn and re-tighten to the correct torque.

After tightening all the nuts, the first 10 positions should be rechecked without further slackening off to ascertain they are still tightened to the correct torque.

3. Reset the valve tip clearance to 0.012 in (0,3 mm) with the engine cold, (see Page 29).
4. Check the tension of the fan belt (See Page 25).
5. Check the tightness of all external nuts, setscrews, mountings, hose clips, etc.
6. Start the engine and check for any fuel, coolant or lubricating oil leaks. Check oil feed to rockers.
7. Adjust idling speed where necessary.

### RUNNING ADJUSTMENT

The driver or user of this engine should not interfere with the idling or maximum speed settings. Whilst the engine is under the manufacturer's guarantee, the breaking or interference of the fuel pump seals by an unauthorised person may possibly render the guarantee null and void, because interference with the speeds set by the manufacturer can cause considerable damage to the engine and/or transmission.

## preventive maintenance

Operators of engines are reminded that the following preventive maintenance periods are general in application. They should be compared with the schedules specified by the manufacturer of the application to which the engine is fitted and where necessary, the shorter periods should be adopted also bearing in mind that on stop start low mileage work, the hours run are more applicable than the mileage covered.

Whilst we have given specific periods for preventive maintenance, you should have due regard for the local regulations concerning your vehicle or machine and ensure that the engine is operating within those regulations.

It is good engineering practice to check for water, fuel and lubricating oil leaks and the tightness of nuts, setscrews and hose clips at each servicing period.

When adopting the fuel maintenance periods, it is assumed that the fuel oil and lubricating oil meet the specifications given in this handbook.

### **DAILY OR EVERY 8 HOURS (WHICHEVER OCCURS FIRST)**

Check coolant level.

Check sump oil level.

Check oil pressures (where gauge fitted).

In extreme dust conditions, clean oil bath air cleaner or empty dust bowl on dry-type air cleaner.

### **EVERY 150 HOURS 4,000 MILES (6,000 km) or 3 MONTHS (WHICHEVER OCCURS FIRST)**

\* Drain and renew engine lubricating oil (see Pages 34 and 35).

\* Renew lubricating oil filter element.

Clean oil bath air cleaner or empty dust bowl on dry-type cleaner.

Check drive belt tension.

Clean fuel water trap (where fitted).

Lubricate dynamo rear bush (where fitted).

\* Refrigeration unit engines have a much larger capacity sump and larger lubricating oil filter element and the oil and filter change can be extended to 1,000 hours.

### **EVERY 450 HOURS, 12,000 MILES (18,000 km) or 12 MONTHS (WHICHEVER OCCURS FIRST)**

Renew final fuel filter element (Agricultural and Industrial).

Clean element of dry type air cleaner or renew (if not indicated earlier).

### **EVERY 900 HOURS, 24,000 MILES (36,000 km) (WHICHEVER OCCURS FIRST)**

Renew final fuel element (Vehicle Applications).

Clean ventilated oil filler cap (where fitted).

Clean breather vent valve (where fitted).

### **EVERY 2,700 HOURS, 72,000 MILES (108,000 km) (WHICHEVER OCCURS FIRST)**

Arrange for examination and service of proprietary equipment, i.e. Compressor/exhauster, starter motor, dynamo etc.

Service atomisers.

Check and adjust valve clearance.

# instructions for maintenance

## AIR CLEANERS

Operating conditions play an important part in deciding how frequently it is necessary to service the air cleaner. Where the cleaner has a dust bowl fitted, the amount of dust present in the bowl, when removed, will show whether it is being emptied at the correct time for the prevailing conditions. If the dust bowl is allowed to become full it will reduce the life of the element.

If an automatic dust ejector is fitted, it should be kept clean and the lips of the rubber ejector checked to see that they close but do not adhere together.

Where a restriction indicator is fitted, this will give a positive indication that the air cleaner element needs attention and eliminate haphazard servicing. If you do not have a restriction indicator fitted, you should consider having one fitted on the trunking between the cleaner and the induction manifold — an 18 in. water gauge indicator, fitted on the cleaner outlet, is suitable in the majority of cases. It should be remembered that the indicator does not show the amount of dust present in the dust bowl.

The type of air cleaner fitted to your vehicle or machine depends upon the manufacturer of your equipment. Usually, guidance for the method of servicing is shown on the body of the air cleaner, but the following advice may also help.

## DRY TYPE TWO STAGE "CYCLOPAC" See Fig. 9

### Dust Bowl

Unclamp the dust bowl, remove the baffle plate, empty out the dust and clean the bowl. The dust in the bowl should never be allowed to build up to within  $\frac{1}{2}$  in (13 mm) of the dust entry slot in the baffle. Do not use petrol (gasoline) for cleaning.

Refit the plate to the bowl, check that the bowl joint is serviceable and fit the bowl to the cleaner ensuring that, where the cleaner is mounted horizontally, the dust entry slot in the bowl is fitted at the top.

### Element

When the dust bowl has been detached, the element can be removed after releasing the wing nut securing it to the body. The element can be cleaned as follows: —

If the element is contaminated by dry dust, it can be cleaned by directing clean dry air up and down the pleats on the clean air side of the element. The air pressure should not exceed 100 lbf/in<sup>2</sup> (7 kgf/cm<sup>2</sup>) or 690 kN/m<sup>2</sup> and the nozzle should not be held too near the pleats.

If the element is contaminated by oil or soot, it can be washed in warm water at approximately 120°F (50°C) using a suitable non-foaming detergent as recommended by the air cleaner manufacturers. Allow the element to soak for at least 10 minutes and gently agitate at the end of the soaking period to remove loosened dirt. Rinse out thoroughly by directing clean water to the clean air side of the element and allow to dry — do not oven dry. **Never fit a wet element to the cleaner as dust may be carried through the element by the water.**

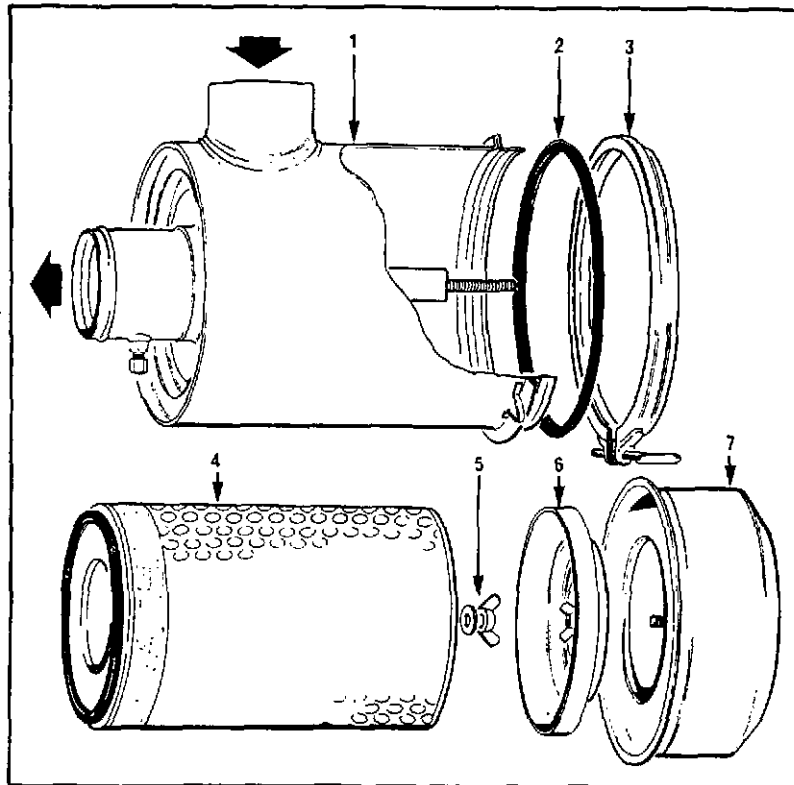


Fig. 9  
"Cyclopac" Type Air Cleaner

- |                 |                   |
|-----------------|-------------------|
| 1. Cleaner Body | 5. Nut and Gasket |
| 2. Sealing Ring | 6. Baffle Plate   |
| 3. Clamp        | 7. Dust Bowl      |
| 4. Element      |                   |

Inspect the cleaned element for damage by placing a bright light inside and looking through the element. Any thin spots, pin holes or other damage will render the element unfit for further use.

The element should be renewed after six cleanings or annually, whichever occurs first. You should bear in mind that an element that has been cleaned may require attention after a shorter period than when it was fitted new.

Clean the inside of the cleaner body and the fins and dry thoroughly ensuring that no dust or foreign matter is allowed to enter the air cleaner outlet.

Do not use petrol (gasoline) for cleaning.

Inspect the joints and hoses and renew, where necessary.

Reassemble the cleaner ensuring that all the joints are leakproof.

## **DRY TYPE TWO STAGE "DUO-DRY" See Fig. 10**

### **Dust Bowl**

Unclamp the dust bowl, empty out the dust and clean the bowl — do not use petrol (gasoline) for cleaning. The dust in the bowl must never be allowed to build up to 1 in (25 mm) of the bottom of the tubes.

Ensure that the bowl joint is serviceable and refit the bowl.

### **Element**

Clean the top of the cleaner and then unclip and remove the top cover. Unscrew the wing nut and remove the inner cover and element.

Clean and inspect the element as detailed for the "Cyclopac" cleaner, bearing in mind that the clean side of the element of the "Duo-Dry" cleaner illustrated is the outside of the element.

Clean the inside of the body — do not use petrol. If the tubes are not too dirty, they can be cleaned with a stiff fibre brush but, if heavily contaminated, the tube body should be removed and cleaned with compressed air or warm water not exceeding 150°F (65°C).

Inspect all joints and hoses and renew where necessary.

Reassemble the cleaner ensuring that all parts are dry and all joints are leakproof.

If the tube body has been removed, tighten the clamp between it and the upper body before tightening the mounting clamp.

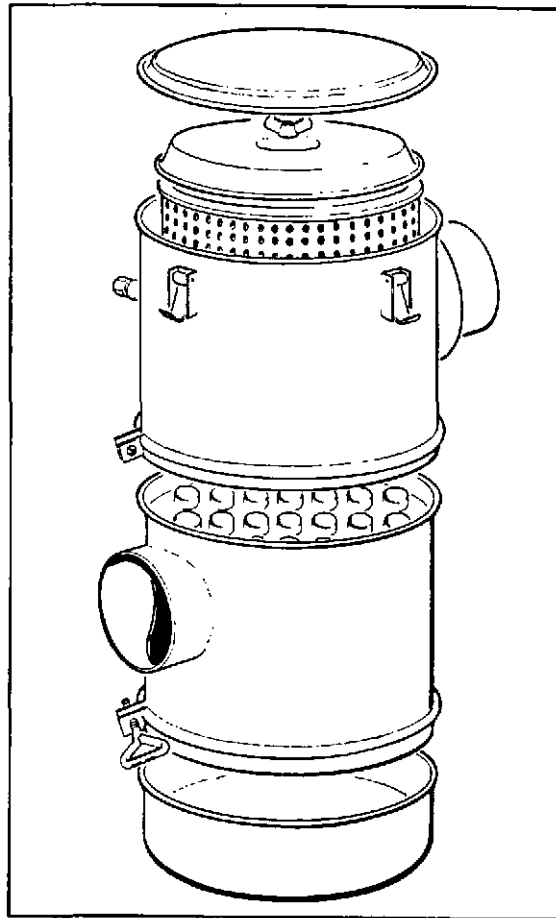


Fig. 10  
"Duo-Dry" Type Air Cleaner

**DRY TYPE TWO STAGE "CYCLONE" See Fig. 11**

Unscrew the clamping screw and remove the element retaining strip. Remove the seal plate and the element.

If the element is contaminated by dry dust, clean by carefully hand tapping the element or by directing low pressure compressed air on to the clean air side of the element.

If the element is contaminated by oil or soot, it can be cleaned by washing in a suitable non-foaming detergent solution. After washing, rinse out thoroughly by direct-

ing clean water on to the clean air side of the element and allow to dry — do not oven dry.

Inspect the cleaned element by placing a bright light inside and looking through the element. Any thin spots, pin holes or other damage will render the element unfit for further use. The element should be renewed after six detergent washes or annually, whichever occurs first.

Clean the inside of the cleaner body and dry thoroughly — do not use petrol (gasoline).

Inspect the joints and hoses and renew where necessary.

Reassemble the cleaner ensuring that all the joints are leakproof. Never fit a wet element to the cleaner as dust may be carried through the element by the water.

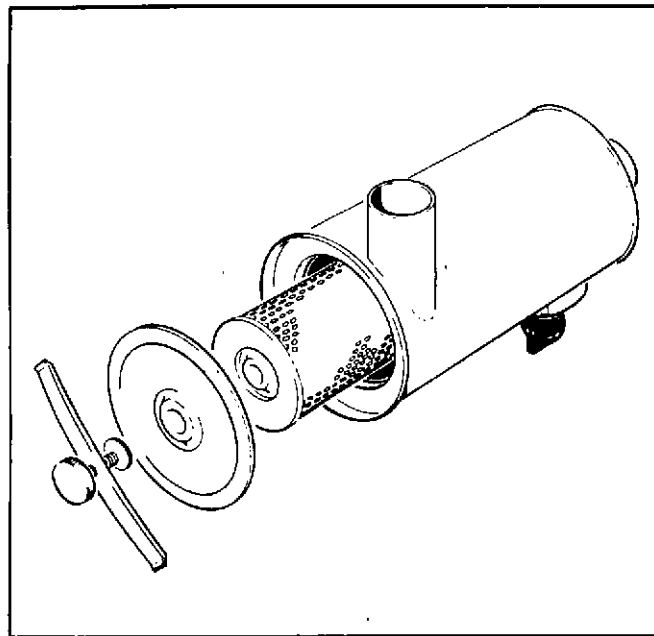


Fig. 11  
"Cyclone" Type Air Cleaner

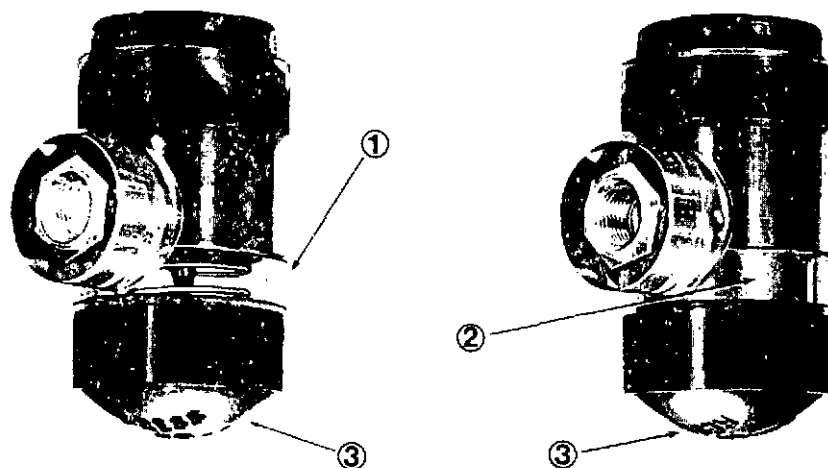


Fig. 12  
Restriction Indicator

1. Transparent Panel (No restriction).
2. Red Panel (Service the Filter).
3. Resetting Button.

### **RESTRICTION INDICATOR See Fig. 12**

The restriction indicator is operated by the depression between the air cleaner and the engine and at a preset figure, the red warning indicator will remain locked up in a visible position after the engine has stopped running.

When the warning indicator is locked up, the air cleaner element should be removed and cleaned or renewed.

After the element has been serviced, the indicator should be released by pressing the reset button.

## OIL BATH AIR CLEANERS

To service the oil bath type cleaner, the lid should be removed and the element lifted out. The oil in the container should be drained out and the dirt and sludge thoroughly cleaned out with a proprietary cleaning fluid or Kerosene. Refill the container with clean new engine lubricating oil to the indicated level. The woven filter element should be cleaned in a bath of Kerosene. Do not use petrol (gasoline) as this highly volatile fuel could cause explosive damage within the engine. The indicated filling mark level should never be exceeded, otherwise oil can be drawn up into the engine which could lead to uncontrolled engine speeds, and excessive engine wear.

Some heavy duty, oil bath air cleaners are fitted with a centrifugal pre-cleaner mounted on top of the main cleaner, this should be removed and the air inlet vanes in the bottom plate of the assembly, the ejection slots on the side of the cone and the vanes in the outlet tube, cleaned of dust and dirt. The detachable element is accessible by lowering the oil container, which may be attached by clips or a pinch screwed clamp.

Thoroughly clean the container and refill to the indicated level with new engine lubricating oil. The separate element should be cleaned in a Kerosene bath.

The upper element, which is permanently attached inside the body, should be periodically cleaned by washing in a Kerosene bath. Drain the element thoroughly before reassembly and do not use petrol (gasoline) for cleaning purposes.

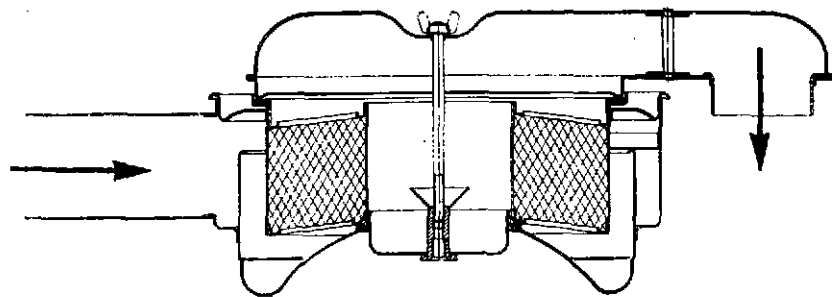


Fig. 13  
Oil Bath Air Cleaner.

## TO ADJUST FAN BELT TENSION

The tension of the belt should be such that it is not loose to a degree that it can slip at the crankshaft pulley, thus preventing the full operation of the water pump and also not turning the dynamo or alternator at sufficient speeds to charge the battery.

If the belt is overtightened this can cause overloading of the bearings fitted in the water pump and alternator or dynamo. The belt itself can be damaged internally creating an early failure condition.

When fitting a belt never prise it onto a pulley by using a lever, always close in the adjustment on the dynamo or alternator and "place" the belt in position. At least "wind" the belt over the pulley by turning belt and pulley together by hand.

There is an engineering method of tensioning belts by using spring balances and correct dimensioning but the practical way as installed, is to decide which is the

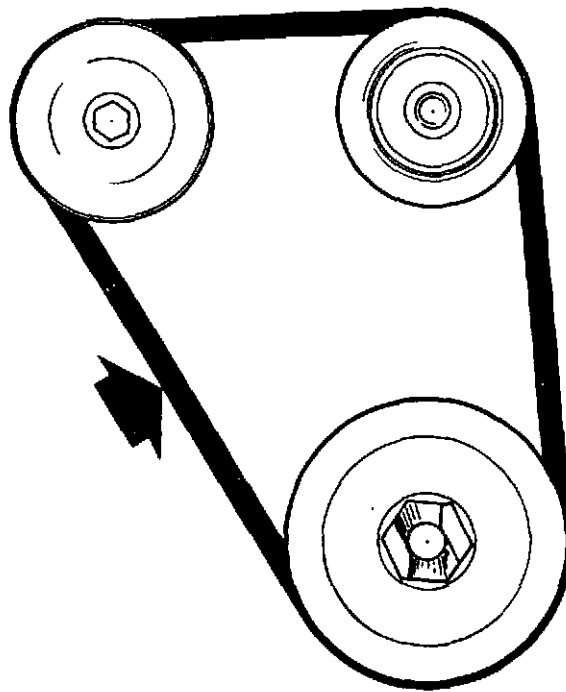


Fig. 14  
Checking Fan Belt Tension.

longest run of belt between any two pulleys and apply pressure in the centre of the run and adjust the tension until the belt deflects about  $\frac{3}{8}$  in (10 mm) as shown in Fig. 14.

When making adjustments loosen all the setscrews and/or nuts securing the dynamo or alternator to its brackets as well as both ends of the adjustable linkage. On obtaining the correct tension, retighten all the securing points.

When a new belt is fitted, it is necessary to recheck the adjustment after a short running period when the belt will have settled into the grooves of the pulleys and the initial stretch, if any, will have been completed.

### TO LUBRICATE DYNAMO REAR BUSH

Where a dynamo is fitted, remove the rubber plug at the rear end of commutator end bearing housing and inject a few drops of engine oil to lubricate the bush. See Fig. 15.

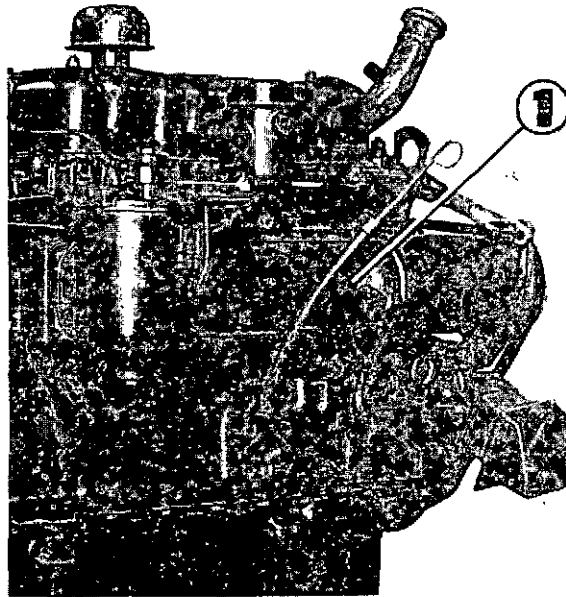


Fig. 15  
Lubricating Dynamo Rear Bush  
1. Location of Oil Hole.

## TO RENEW FINAL FUEL FILTER ELEMENT

- (a) Clean exterior of filter assembly.
- (b) Unscrew setscrew at top of filter bowl (see fig. 16).
- (c) Either lower filter bowl clear and discard element or lower base and discard element (see fig. 17).
- (d) Clean filter head and bowl or base in suitable cleaning fluid.
- (e) Check sealing rings and if damaged, renew.
- (f) Fit new element to filter bowl or new element to base.
- (g) Place square against filter head and tighten setscrew.
- (h) Bleed fuel system as described previously.

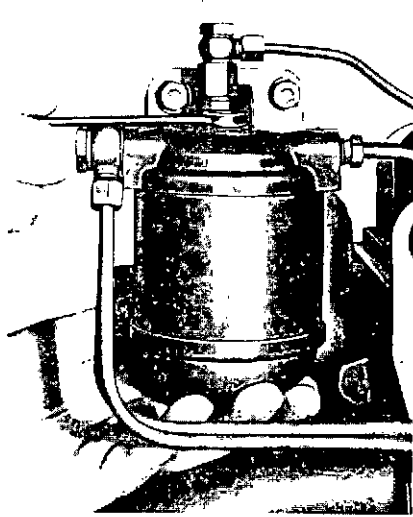


Fig. 16  
Unscrewing the Filter Securing Bolt.

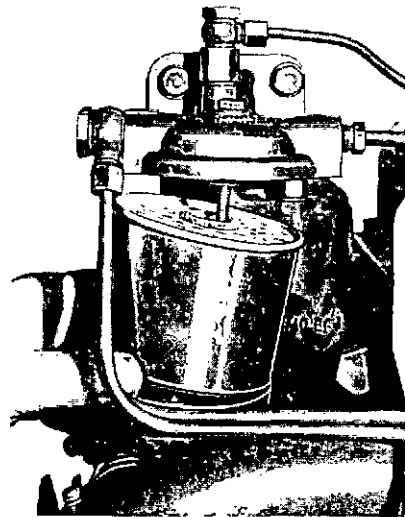


Fig. 17  
Removing the Filter element.

Slacken the pipe union at the fuel pump inlet, operate the priming lever. Retighten the nut when fuel, free from air bubbles, issues from around the threads. The engine is then ready for starting.

### **TO RENEW DISPOSABLE LUBRICATING OIL FILTER, Fig. 18**

- (a) Unscrew filter canister from filter head.
- (b) Discard old canister.
- (c) Clean filter head.
- (d) Using clean engine oil, liberally oil top seal of replacement canister.
- (e) Prime the canister with lubricating oil, allowing time for the oil to filter through the element. Screw replacement canister onto filter head until seal just touches head and then tighten by hand as per instructions on canister. Where a tool is available, tighten to 15 lbf ft (2,07 kgf m) or 20 Nm.
- (f) Run engine and check for leaks.

**NOTE:** The lubricating oil filter canister has an internal non drain valve and stack pipe and it is important that the correct canister is used.



Fig. 18  
Renewing Lubricating  
Oil Filter Canister.

## TO CHECK VALVE TIP CLEARANCES

This is set between the top of the valve stem and rocker arm (see Fig. 19) and should be 0.012 in (0,3 mm) with the engine cold.

When setting valve clearances the following procedure should be adopted:

- (a) With the valves rocking on No. 4 cylinder (i.e., the period between the opening of the inlet valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.
- (b) With the valves rocking on No. 2 cylinder, set the valve clearances on No. 3 cylinder.
- (c) With the valves rocking on No. 1 cylinder, set the valve clearances on No. 4 cylinder.
- (d) With the valves rocking on No. 3 cylinder, set the valve clearances on No. 2 cylinder.

No. 1 cylinder is at the front of the engine.

With the engine running at fast idling, check that the oil flow to the rocker assembly is satisfactory.

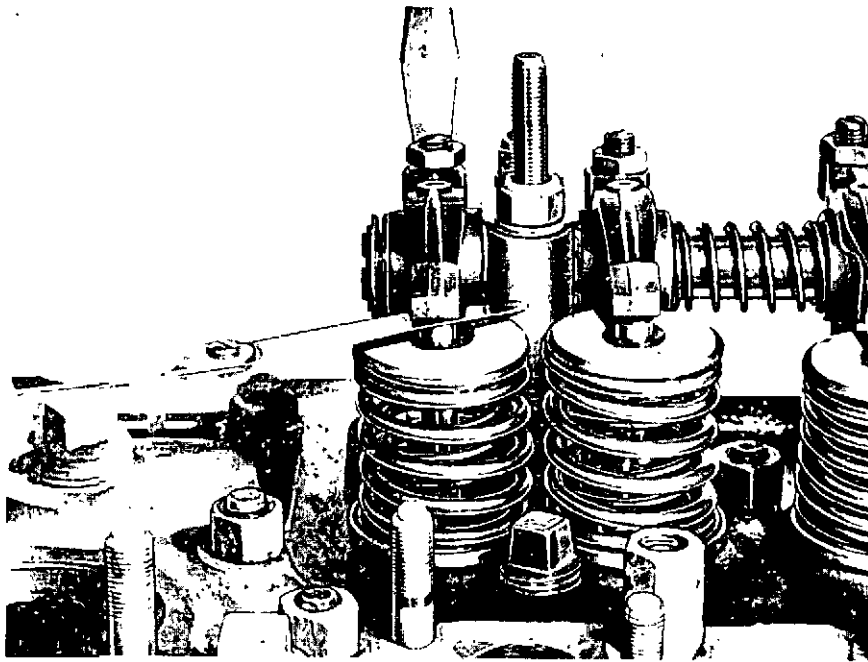


Fig. 19  
Setting Valve Clearance.

## preservation of laid up engine

---

It is recommended that the following procedure be adopted and applied immediately the unit is withdrawn from service: —

1. Thoroughly clean all external parts of the engine.
2. Where a preservative fuel is to be used, drain fuel system and refill with preservative fluid.
3. Run the engine until well warmed through. Stop the engine and drain the lubricating oil sump.
4. Renew element in full flow lubricating oil filter.
5. Fill sump to correct level with clean new lubricating oil or with a suitable preservation fluid.
6. Run engine for a short period to circulate the lubricant or fluid.
7. Drain water from radiator and cylinder block.
8. Clean out engine breather pipe.
9. Remove atomisers and spray into the cylinder bores,  $\frac{1}{4}$  pint (0,14 litre) of lubricating oil divided between the four cylinders.
10. Slowly turn engine one revolution and replace atomisers.
11. Remove the air cleaner and any intake pipe which may be fitted between the air intake orifice with water-proofed adhesive tape or some other suitable medium.
12. Remove exhaust pipe and seal opening in manifold as in "11".
13. Disconnect the battery and store in a fully charged condition. Before storing, the battery terminals should be treated to prevent corrosion.
14. Where a preservative is not used in the fuel system, it may be left charged with normal fuel oil. In this case before recommencing operations, the fuel tank should be drained and the interior of the tank thoroughly cleaned. The fuel oil drained off should be discarded as unfit for further use. The element in the final fuel filter and the intermediate filter, where fitted must also be renewed before commencing service.

**Note.** Where a preservative is used in the lubricating oil sump, this should be drained off and replaced by normal lubricant prior to re-starting the engine at the end of the storage period.

Before starting an engine after laying up, it should first be motored over with the stop control in the "non run" position until oil pressure is registered.

### **FAULTY ATOMISER (INJECTOR)**

A faulty atomiser may show itself as an intermittent or consistent misfire and can be detected by running the engine at a fast idling speed and slackening off each atomiser pipe union in turn taking particular notice of the note of the engine. The faulty atomiser will have little or no effect upon the engine note as the union is slackened off. Replace with a known good atomiser, not forgetting to replace the washer upon which the atomiser seats in the cylinder head.

### **REPLACING AN ATOMISER (INJECTOR)**

Never bend the high pressure pipe between the atomiser and the fuel injection pump. Remove the pipe completely.

Fit the replacement atomiser as square as possible into the head by pulling down with the securing nuts a little at a time, each side in turn until a torque of 12 lbf ft (1,7 kgf m) or 16 Nm is achieved.

When fitting high pressure pipes, tighten the unions to 15 lbf ft (2,1 kgf m) or 20 Nm.

Having fitted atomiser and pipe, run the engine and listen for any "blowing" from the atomiser seat which will indicate that it is not square with the cylinder head. Carefully ease off the atomiser securing nuts in turn and retighten until the "blowing" stops. Check for fuel leaks at the pipe unions.

**WARNING** — Do not start engine with loose atomiser nuts, the atomiser may fly out!

## fault finding chart

Fault	Possible Cause
Low cranking speed	1, 2, 3, 4.
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33.
Difficult starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33.
Lack of power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33.
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32.
Excessive fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33.
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33.
Blue/White exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56.
Low oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58.
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59.
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49.
High oil pressure	4, 38, 41.
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 47, 50, 51, 52, 53, 54, 57.
Excessive crankcase pressure	25, 31, 33, 34, 45, 55.
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59.
Starts and stops	10, 11, 12.

## KEY TO FAULT FINDING CHART

1. Battery capacity low.
2. Bad electrical connections.
3. Faulty starter motor.
4. Incorrect grade of lubricating oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Blocked fuel feed pipe.
9. Faulty fuel lift pump.
10. Choked fuel filter.
11. Restriction in air cleaner or induction system.
12. Air in fuel system.
13. Faulty fuel injection pump.
14. Faulty atomisers or incorrect type.
15. Incorrect use of cold start equipment.
16. Faulty cold starting equipment.
17. Broken fuel injection pump drive.
18. Incorrect fuel pump timing.
19. Incorrect valve timing.
20. Poor compression.
21. Blocked fuel tank vent.
22. Incorrect type or grade of fuel.
23. Sticking throttle or restricted movement.
24. Exhaust pipe restriction.
25. Cylinder head gasket leaking.
26. Overheating.
27. Cold running.
28. Incorrect tappet adjustment.
29. Sticking valves.
30. Incorrect high pressure pipes.
31. Worn cylinder bores.
32. Pitted valves and seats.
33. Broken, worn or sticking piston ring(s).
34. Worn valve stems and guides.
35. Overfull air cleaner or use of incorrect grade of oil.
36. Worn or damaged bearings.
37. Insufficient oil in sump.
38. Inaccurate gauge.
39. Oil pump worn.
40. Pressure relief valve sticking open.
41. Pressure relief valve sticking closed.
42. Broken relief valve spring.
43. Faulty suction pipe.
44. Choked oil filter.
45. Piston seizure/pick up.
46. Incorrect piston height.
47. Damaged Fan.
48. Faulty engine mounting (housing).
49. Incorrectly aligned flywheel housing or flywheel.
50. Faulty thermostat.
51. Restriction in water jacket.
52. Loose fan belt.
53. Choked radiator.
54. Faulty water pump.
55. Choked breather pipe.
56. Damaged valve stem oil deflectors (if fitted).
57. Coolant level too low.
58. Blocked sump strainer.
59. Broken valve spring.

### LUBRICATING OILS

Lubricating oils should meet the requirements of the U.S. Ordnance Specifications MIL-L-46152 or MIL-L-2104C. Lubricating oils for engines installed in Heavy Duty Earthmoving Equipment should meet the U.S. Ordnance Specification MIL-L-2104C. Some of these oils are listed below. Any other oils which meet these specifications are also suitable.

Lubricating oils for use in Perkins engines should have a minimum viscosity index of 80.

#### MIL-L-46152 Oils

Company	Brand	S.A.E. Designation		
		0°F (-18°C) to 30°F (-1°C)	30°F (-1°C) to 80°F (27°C)	Over 80°F (27°C)
B.P. Ltd.	Vanellus M	10W	20W	30
Castrol Ltd.	Vanellus M		20W/50	20W/50
	Castrol/Deusol CRX	10W	20	30
	Castrol/Deusol CRX	10W/30	10W/30	10W/30
	Castrol/Deusol CRX		20W/50	20W/50
A. Duckham & Co. Ltd.	Deusol RX Super		20W/40	20W/40
	Fleetol HDX	10	20	30
	Fleetol Multi V		20W/50	20W/50
	Fleetol Multilite	10W/30	10W/30	10W/30
	Q Motor Oil		20W/50	20W/50
Esso Petroleum Co. Ltd.	Farmadcol HDX		20	30
	Essolube XD-3	10W	20W	30
	Essolube XD-3		15W/40	15W/40
Mobil Oil Co. Ltd.	Delvac 1200 Series	1210	1220	1230
	Delvac Special	10W/30	10W/30	10W/30
Shell	Rimula X	10W	20W/20	30
	Rimula X	10W/30	10W/30	10W/30
	Rimula X		15W/40	15W/40
	Rimula X		20W/40	20W/40
	Rotella TX	10W	20W/20	30
	Rotella TX		20W/40	20W/40
Total Oil Co. Ltd.	Total Super HD		20W/20	30
	Total HD2-M	10W/30	20W/40	20W/50
	Total HD3-C (Rubia S)	10W	20W/20	30
	Total HD3-C (Rubia TM)		15W/40	15W/40
	Total Universal Tractor Oil (Multagri)		20W/30	20W/30
	Total Super Universal Tractor Oil (Multagri TM)		20W/30	20W/30

MIL-L-2104C Oils

Company	Brand	S.A.E. Designation		
		0°F (-18°C) to 30°F (-1°C)	30°F (-1°C) to 80°F (27°C)	Over 80°F (27°C)
B. P. Ltd. Castrol Ltd.	Vanellus C3	10W	20W/20	30
	Castrol/Deusol CRD	10W	20	30
	Deusol RX Super		20W/40	20W/40
	Agricastrol HDD	10W	20	30
	Agricastrol MP		20W/30	20W/30
	Agricastrol MP		20W/40	20W/40
A. Duckham & Co. Ltd.	Fleetol 3	3/10	3/20	3/30
	Farmadcol 3	3/10	3/20	3/30
Esso Petroleum Co. Ltd.	Essolube D-3HP	10W	20W	30
	Essolube XD-3	10W	20W	30
	Essolube XD-3		15W/40	15W/40
	Delvac 1300 Series	1310	1320	1330
Mobil Oil Co. Ltd. Shell	Rimula CT	10W	20W/20	30
	Rimula X	10W	20W/20	30
	Rimula X	10W/30	10W/30	10W/30
	Rimula X		15W/40	15W/40
	Rimula X		20W/40	20W/40
	Rotella TX	10W	20W/20	30
	Rotella TX		20W/40	20W/40
	Total HD3-C (Rubia S)	10W	20W/20	30
Total Oil Co. Ltd.	Total HD3-C (Rubia TM)		15W/40	15W/40
	Total Super Universal Tractor Oil (Multagri TM)		20W/30	20W/30

Where oils to the MIL-L-46152 or MIL-L-2104C specification are not available, then oils to the previous specification MIL-L-2104B may continue to be used providing they give satisfactory service.

**The above specifications are subject to alteration without notice.**

## frost precautions

---

Precautions against damage by frost should be taken if the engine is to be left exposed to frost either by adequately draining the water system or using an anti-freeze of reputable make and incorporating a suitable corrosion inhibitor.

If you decide to add anti-freeze to the cooling system, it is advisable that the manufacturers of the mixture be asked if their products are suitable for use in Perkins engines and also that their products will have no harmful effects on the cooling system generally. It is our experience that the best results are obtained from anti-freeze which conforms to British Standard 3151 or has been approved by testing in accordance with BS 5117 Clause 5, to give at least as good a result as BS 3151.

The coolant solution containing 25 per cent antifreeze manufactured to BS 3151 in water in a properly maintained engine should maintain its antifreeze and anti-corrosive properties throughout the winter season in the U.K. and in general, a safe life of 12 months may be reasonably expected.

*After an anti-freeze has been used, the cooling system should be thoroughly flushed in accordance with the manufacturers instructions before refilling with normal coolant.*

When draining the cooling system, it is not enough merely to open the radiator drain tap. The one on the cylinder block must also be opened. This tap is on the side of the cylinder block near the flywheel housing. Later engines may have a drain plug. Where a pressurised radiator filler cap is used, this should be removed before draining the cooling system. Ensure engine is standing level when draining the coolant.

Sometimes it is possible for a small quantity of water to remain lodged in the bottom of the water pump after draining. If this freezes it could prevent the impeller from turning when the engine is next used with consequent overheating. If the water pump pulley cannot be turned by hand, the cooling system should be filled with warm water before starting.

If the foregoing action is taken, no harmful effects should be experienced, but Perkins Engines Ltd., cannot be held responsible for any frost damage or corrosion which may be incurred.