Perkins
Engines

handbook
for diesel engines

D3.152

3.152

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 D3.152 and 3.152 diesel engines

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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.

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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 gases 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 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 our Overseas Companies and Distributors.

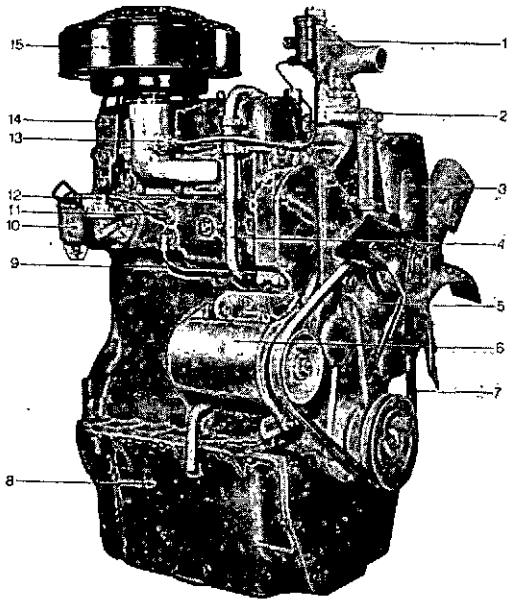
Workshop Manuals are also available from the same sources for a reasonable charge.

The ANCILLARY equipment fitted to the D3.152 and 3.152 engines will vary in accordance with the type of application to which it is fitted.

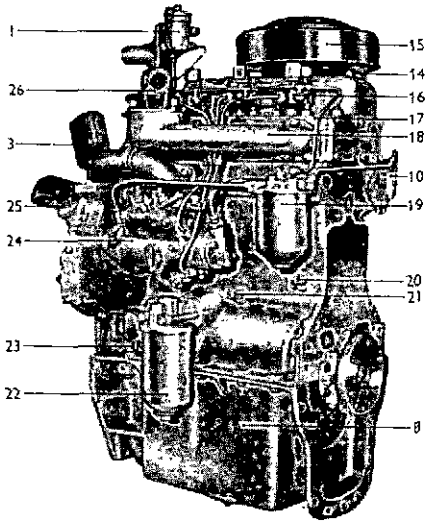
Repairs or replacements for worn parts, or any problems concerned with the ancillary equipment can be dealt with by the supplier of the vehicle or plant. If this is not possible, you should contact your nearest U.K. Distributor or Overseas Distributor for assistance.

Perkins engines are built to individual requirements to suit the applications for which they are intended and the following engine views do not necessarily typify any particular specification.

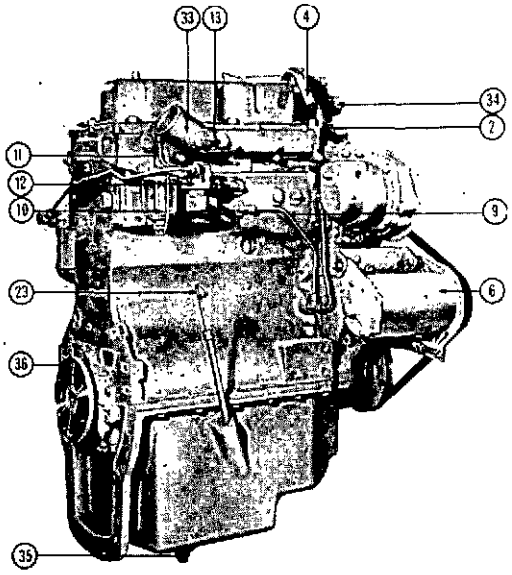
1. Cold Start Aid Fuel Reservoir.
2. Thermostat Housing.
3. Fan.
4. Engine Breather Pipe from Cylinder Head Cover.
5. Water Pump.
6. Dynamo.
7. Fan Belt.
8. Lubricating Oil Sump.
9. Inlet Pipe to Camshaft Reducer.
10. Fuel Oil Pre-Filter.
11. Outlet Pipe from Camshaft Reducer to Rocker Shaft.
12. Fuel Oil Lift Pump.
13. Cold Start Aid.
14. Engine Rear Lifting Bracket.
15. Air Cleaner.
16. Atomiser.
17. Atomiser Leak-off Pipe.
18. Exhaust Manifold.
19. Final Fuel Filter.
20. Cylinder Block Drain Tap.
21. Connection for Oil Pressure Gauge.
22. Lubricating Oil Filter.
23. Sump Dipstick.
24. Fuel Injection Pump.
25. Oil Filler Cap.
26. Engine Front Lifting Bracket.
27. Rocker Cover.
28. Intermediate Fuel Filter.
29. Crankshaft Pulley/P.T.O.
30. Timing Case Cover.
31. Generator Pulley.
32. Water Pump Pulley.
33. Induction Manifold.
34. Water Outlet.
35. Sump Drain Plug.
36. Crankshaft Flange.



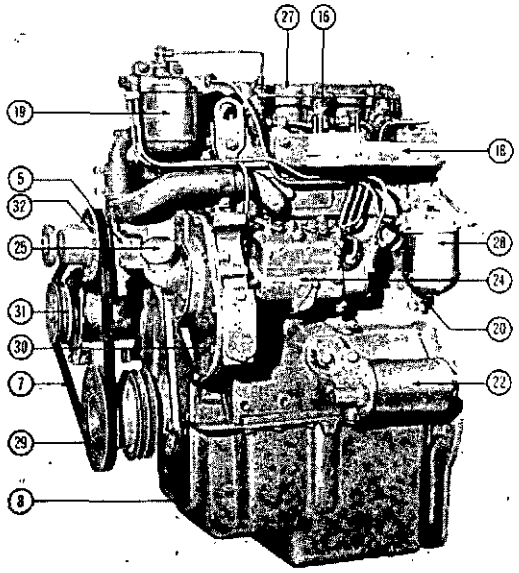
Right Hand Side View of 3.152 Industrial Engine.



Left Hand Side View of 3.152 Industrial Engine.



View of Right Hand Side of D3.152 Engine



View of Left Hand Side of D3.152 Engine.

engine identification

These engines are known as the D3.152 or 3.152 and if you 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 number is stamped on the top right hand side of the cylinder block as shown in Fig. 1 and consists of fifteen figures and letters, *i.e.* CE20800U510256D.

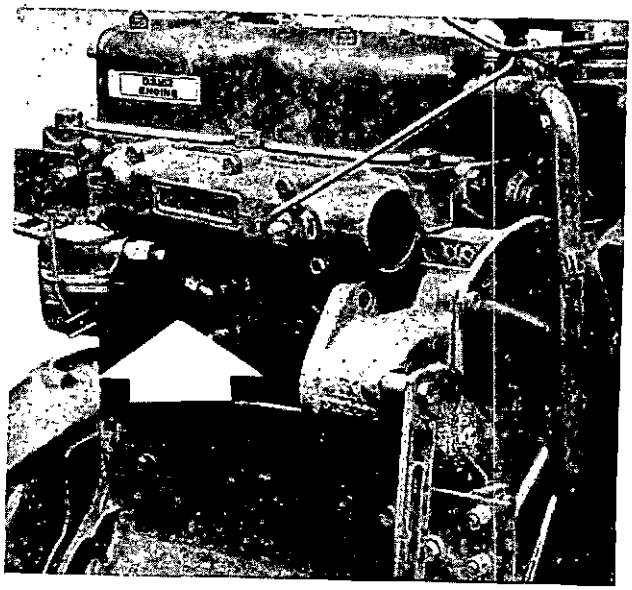


Fig. 1.
Engine Number Location.

ALTITUDE

If it is necessary to operate at altitudes above 2,000 ft (600 metres), 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.

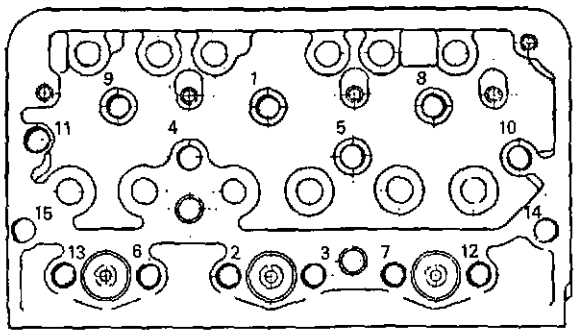


Fig. 2.

Torque Tightening Sequence for Cylinder Head Nuts/Setscrews.
(3.152 Engines)

See page 17 for torque settings.

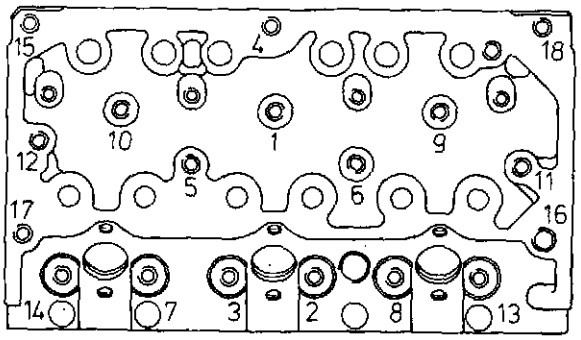


Fig. 3.

Torque Tightening Sequence for Cylinder Head Nuts/Setscrews.
(D3.152 Engines)

data

Type	Three Cylinder, Four Stroke 3.152 — Indirect Injection D3.152 — Direct Injection
Bore	3.6015/3.6025 in (91,48/91,50 mm)
Stroke	5 in (127 mm)
Compression Ratio	
3.152	17.4 : 1
D3.152	18.5 : 1
Cubic Capacity	152 in³ (2,5 litres)
Firing Order	1, 2, 3
Tappet Clearance	0.012 in (0,30 mm) cold

APPROVED FUEL OIL SPECIFICATIONS

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

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 a 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 :—

Slacken the air vent screw near the top of the governor control cover, see fig. 4.

Slacken the vent screw on the hydraulic head locking screw on the side of the fuel pump body, see fig. 5.

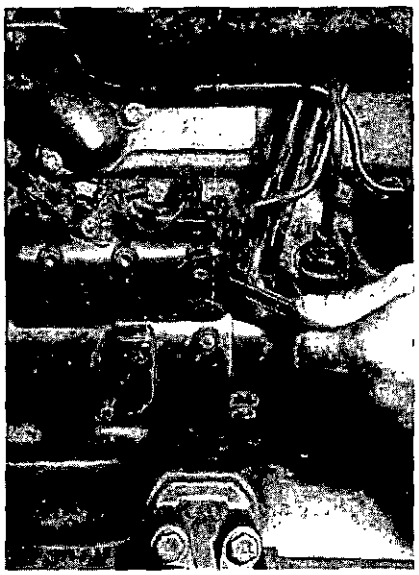


Fig. 4.
Slackening Vent Screw on Fuel Injection Pump Governor Control Cover.

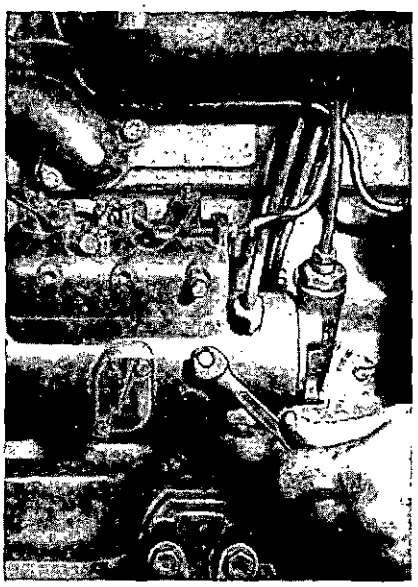


Fig. 5.
Slackening Hydraulic Head Locking Screw on Fuel Injection Pump.

Operate the priming lever of the fuel lift pump (see fig. 6) and when fuel, free from air bubbles, issues from each venting point, tighten the screws in the following order :

1. Head locking screw.
2. Governor vent screw.

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.

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

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

Turn the engine until fuel oil, free from air bubbles, issues from both fuel pipes.

Tighten the unions on the fuel pipes.

Slacken the union at the thermostart 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.

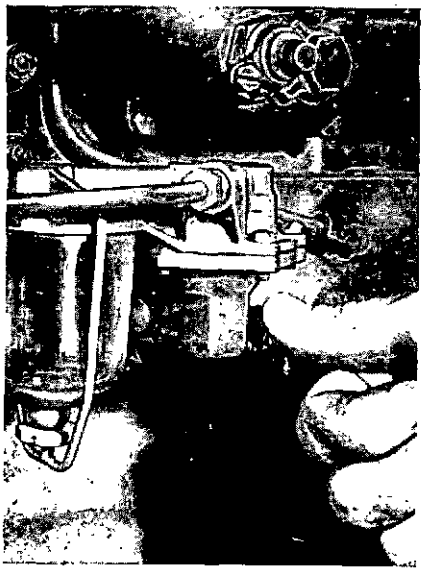


Fig. 6.
Operating the Hand Primer on the Fuel Lift Pump.

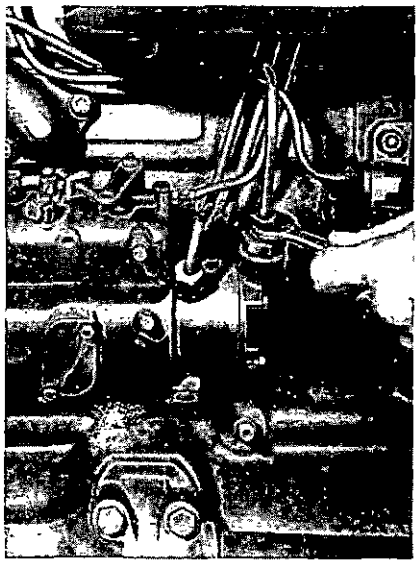


Fig. 7.
Slackening the Pipe Union Nut at the Fuel Injection Pump Inlet.

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.

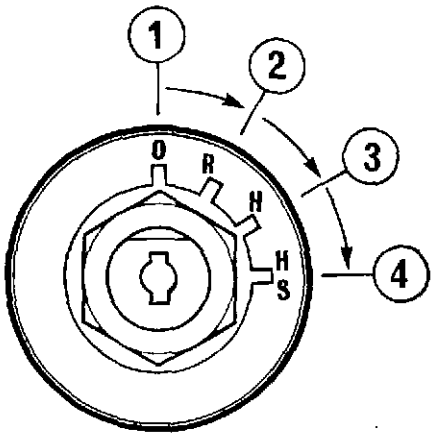


Fig. 8.
Heat/Start Switch.

1. Off Position.
2. Run Position.
3. Heat 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, and the Turner Quick-Start.

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 fifteen seconds, disengage the starter and return to the heat position for a further ten seconds before re-engaging the starter motor. Under certain 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, 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 desireable 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.

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 is first allowed to reach a coolant temperature of at least 140°F (60°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 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 Figs. 1 or 2) and to the correct torque of 60 lbf ft (8,3 kgf m) or 81 Nm for cylinder heads secured by all nuts or 70 lbf ft (9,68 kgf m) or 95 Nm for cylinder heads secured by nuts and setscrews.

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

   After tightening all the nuts/setscrews, the first 10 positions should be rechecked without further slackening off to ascertain they are still tightened to the correct torque.
3. Reset the tappet 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 26).
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 3.152 and D3.152 engines are reminded that the following periodical attentions are general in application: Therefore the operator should compare the routine maintenance for his engine with the schedules specified by the manufacturer of the application to which the engine is fitted and where necessary adopt the shorter periods.

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

It is good maintenance practice to check the engine for coolant, oil and fuel leaks, also tightness of nuts setscrews and hose clips at each servicing period.

The maintenance periods given are on the assumption that the fuel and lubricating oils are to 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 and empty dust bowl on dry type air cleaner.

EVERY 250 HOURS OR 4 MONTHS (WHICHEVER OCCURS FIRST)

Drain and renew lubricating oil.
Renew lubricating oil filter canister.
Check drive belt tension.
Clean oil bath air cleaner.
Empty dust bowl on dry type air cleaner.
Clean lift pump pre-filter (where fitted).
Clean water trap.

EVERY 500 HOURS OR 12 MONTHS (WHICHEVER OCCURS FIRST)

Renew intermediate and final fuel filter elements.
Clean element of dry type air cleaner or renew (if not indicated earlier).

EVERY 2,500 HOURS

Arrange for examination and service of proprietary equipment, i.e., starter motor, alternator, etc.
Service atomisers.
Check and adjust tappets.

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/in² (7 kgf/cm²) or 690 Nm 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.

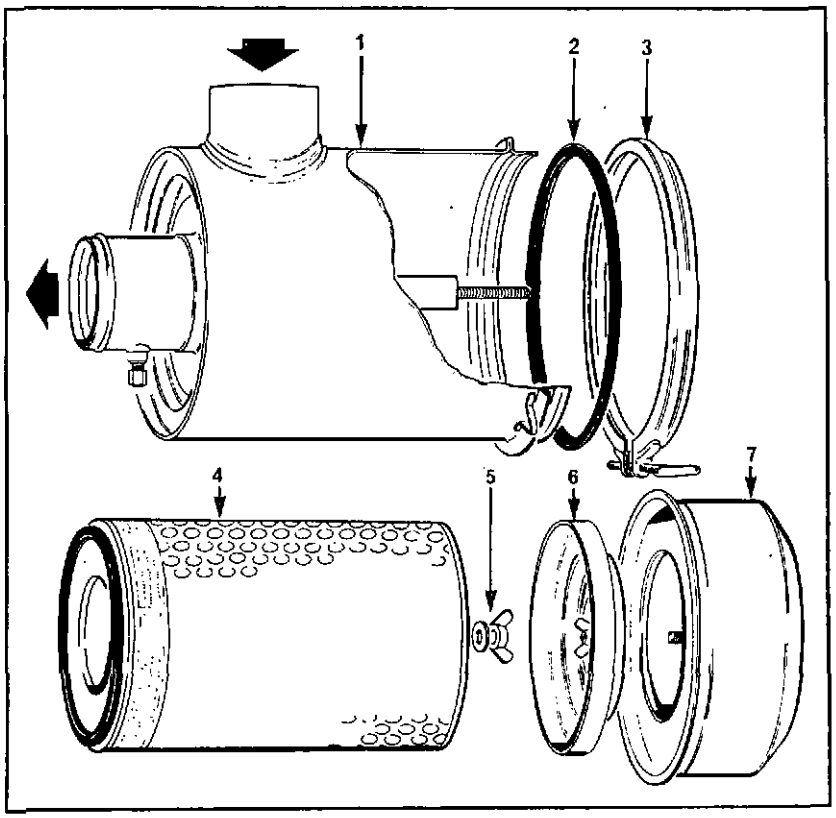


Fig. 9.
"Cyclopac" Type Air Cleaner.

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

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.

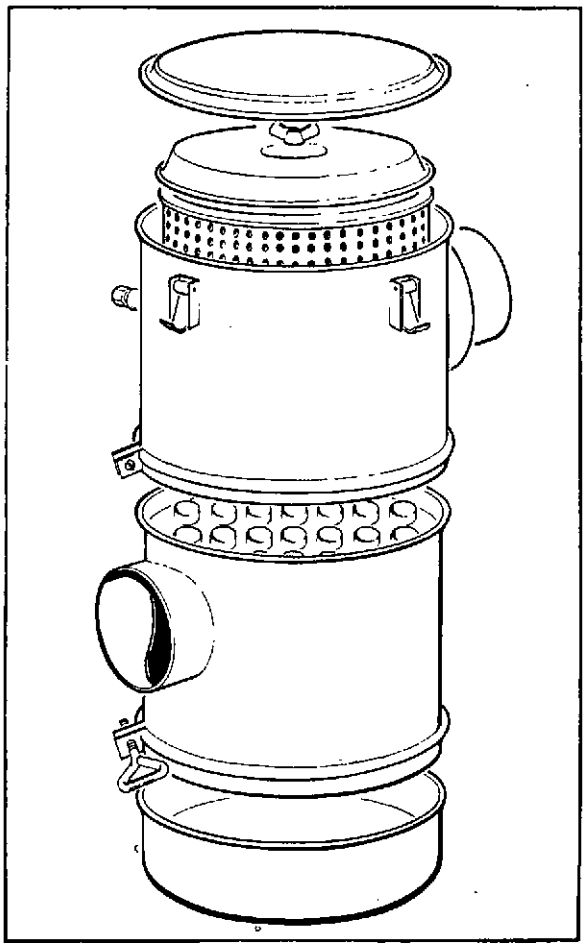


Fig. 10.
"Duo-Dry" Type Air Cleaner.

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

directing 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.

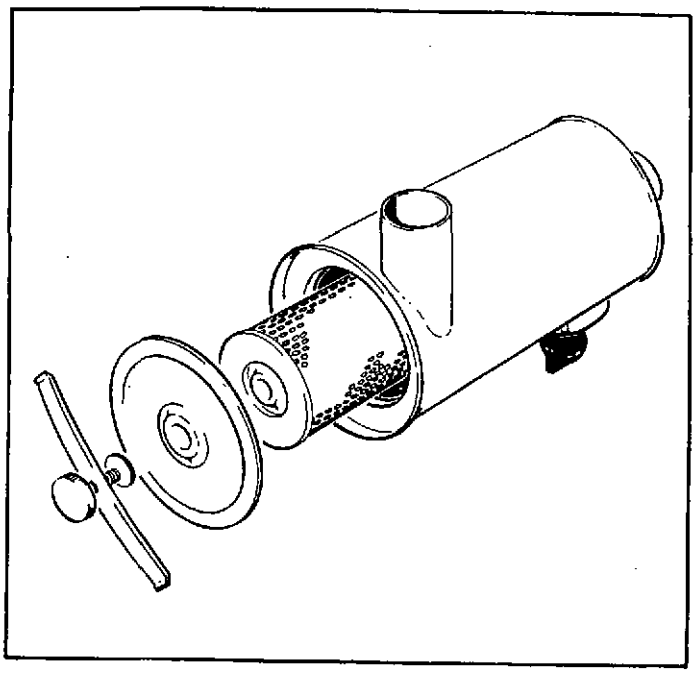


Fig. 11.

"Cyclone" Type Air Cleaner.

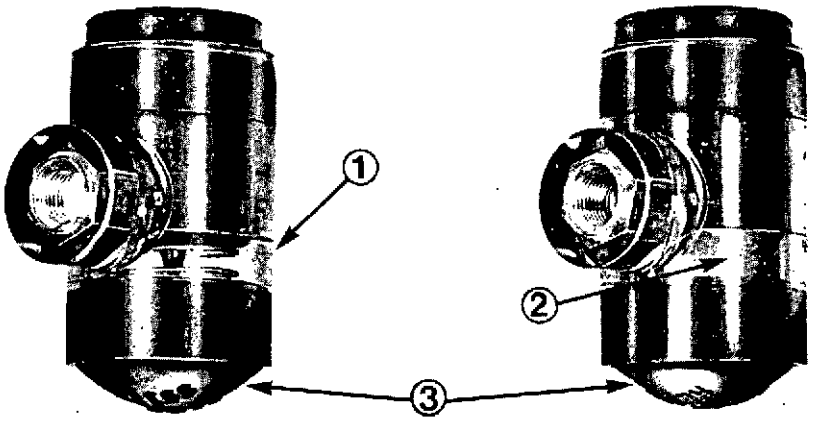


Fig. 12.
Restriction Indicator.

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 proprietory 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.

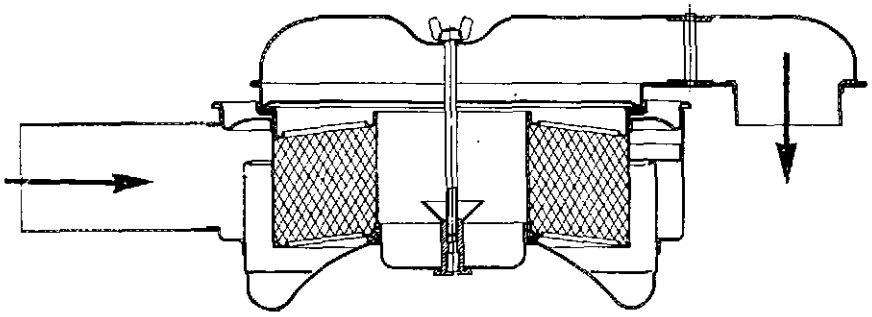


Fig. 13.
Oil Bath Air Cleaner.

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 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. 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 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 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 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.

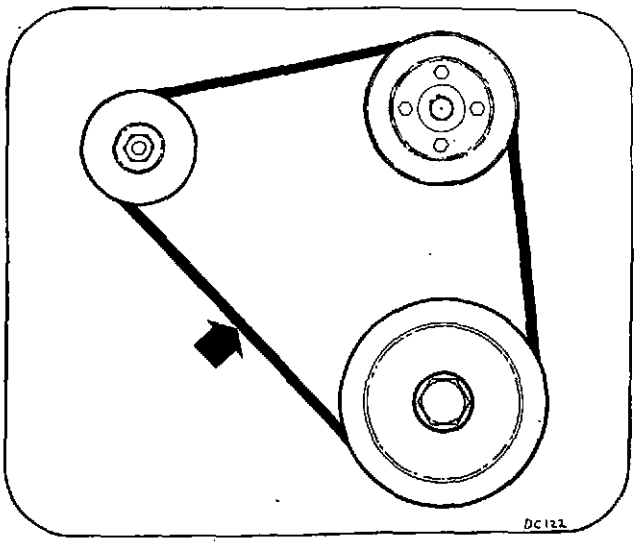


Fig. 14.
Checking Fan Belt Tension.

TO CLEAN FILTER IN WATER TRAP

Slacken securing attachment and remove bowl (see Fig. 15).

Remove gauze strainer (see Fig. 16) and clean in a suitable cleaning fluid. Clean bowl and replace strainer and bowl ensuring a good joint is obtained. Bleed the system as detailed at the end of the following section.

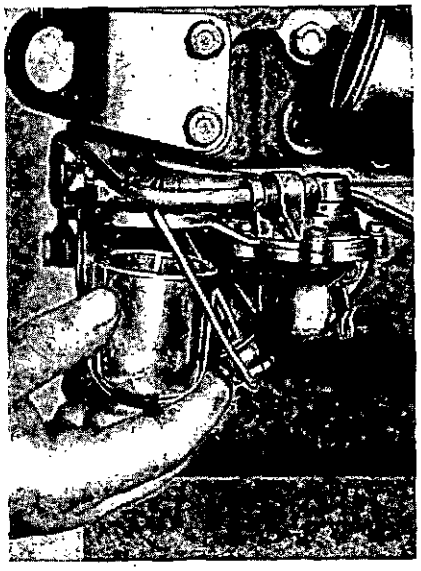


Fig. 15
Removing Water Trap Bowl.

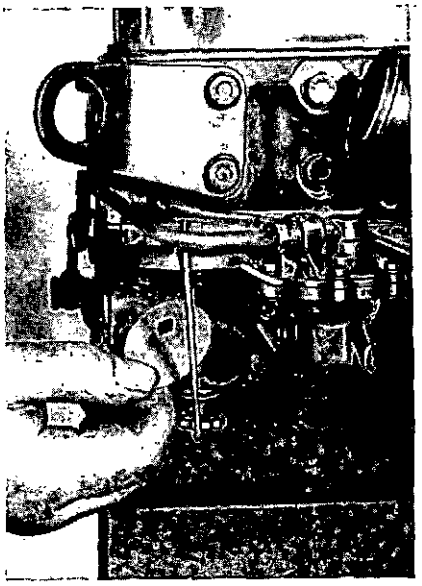


Fig. 16.
Removing Water Trap Strainer.

TO RENEW PAPER ELEMENTS IN INTERMEDIATE AND FINAL FUEL FILTERS

(a) Unscrew the bolt in the centre of the top filter cover (see Fig. 17).
(b) Lower filter bottom cover clear (see Fig. 18)
(c) Remove the element and discard.
(d) Clean the filter top and bottom covers in a suitable cleaning fluid.
(e) Inspect the sealing rings and renew if damaged in any way.
(f) Reassemble ensuring the filter element is fitted squarely in the top and bottom covers.

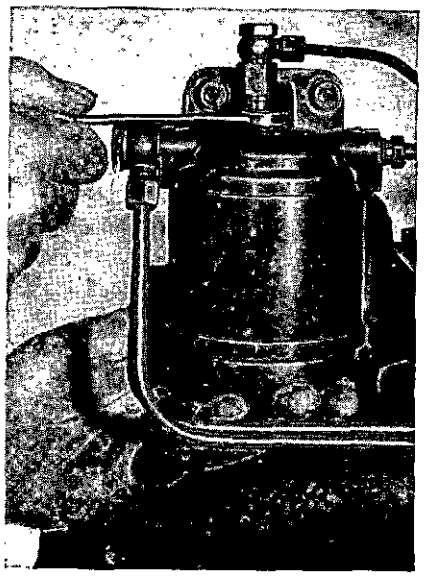


Fig. 17.
Unscrewing the Filter Bowl Securing Bolt.

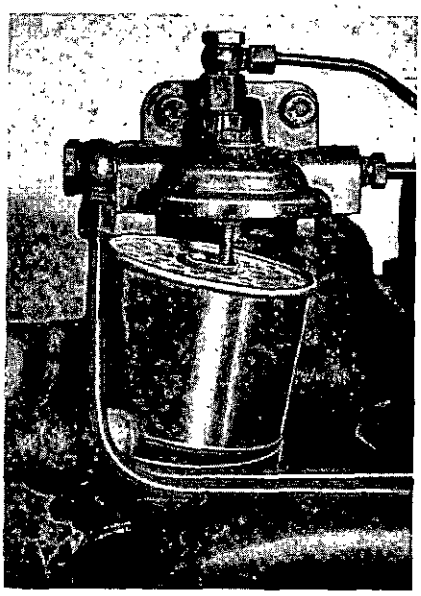


Fig. 18.
Removing the Filter Bowl.

After the fuel filters have been reassembled, it is necessary to remove air from the fuel system. Slacken the pipe union nut at the fuel pump inlet and operate the priming lever of the fuel lift pump. Retighten the nut when fuel, free from air bubbles, issues from around the threads. The engine is then ready for starting.

TO RENEW ELEMENT IN DISPOSABLE LUBRICATING OIL FILTER

(a) Unscrew filter canister from filter head (see Fig. 19).

(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. 19
Renewing Lubricating
Oil Filter Canister.

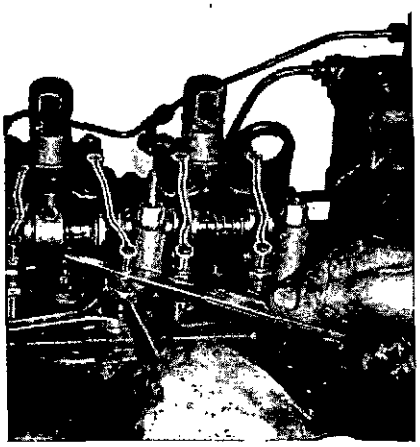


Fig. 20
Adjusting Tappet Clearances.

TO CHECK TAPPET CLEARANCES

Rotate the crankshaft until the valves of No. 1 cylinder are rocking (inlet valve opening and exhaust valve closing).

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

Check and adjust clearances as necessary on Nos. 4 and 6 valves (see Fig. 20).

Turn crankshaft one revolution (360°) and repeat for Nos. 1, 2, 3 and 5 valves.

Tappet clearances for both inlet and exhaust should be set to 0.012 in (0,30 mm) cold.

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

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, ¼ pint (0,14 litre) of lubricating oil divided between the 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".

    battery terminals should be treated to prevent corrosion.
13. Disconnect the battery and store in a fully charged condition. Before storing, the
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, 45, 59.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 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 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 US Ordnance Specification MIL-L-46152 or MIL-L-2104C.

Some of these oils are listed below and on next page but any other oils that meet these specifications and have a minimum viscosity index of 80 are also suitable.

MIL-L-46152 OILS

Company	Brand	SAE Designation 0°F (−18°C) to 30°F (−1°C)	SAE Designation 30°F (−1°C) to 80°F (27°C)	SAE Designation Over 80°F (27°C)
B.P. Ltd.	Vanellus M	10W	20W	30
	Vanellus M		20W/50	20W/50
Castrol Ltd.	Castrol/Deusol CRX	10W	20	30
	Castrol/Deusol CRX	10W/30	10W/30	10W/30
	Castrol/Deusol CRX		20W/50	20W/50
	Deusol RX Super		20W/40	20W/40
A. Duckham & Co. Ltd.	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
	Farmadcol HDX		20	30
Esso Petroleum Co. Ltd.	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

The above specifications are subject to alteration without notice.

LUBRICATING OILS

MIL-L-2104C OILS

Company	Brand	SAE 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 C3	10W	20W/20	30
Castrol Ltd.	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
Mobil Oil Co. Ltd.	Delvac 1300 Series	1310	1320	1330
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 Oil Co. Ltd.	Total HD3-C (Rubia S)	10W	20W/20	30
	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 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 anti-freeze manufactured to BS 3151 in water in a properly maintained engine should maintain its anti-freeze 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.

parts section

This section can be used as a general guide for the description of components to assist in obtaining parts.

Due to application differences, individual components may vary pictorially from those shown.

Genuine Perkins Parts are of the highest quality and standard developed through many years experience by Perkins. We would recommend that when parts are required, you use only genuine Perkins parts available from your local Distributor/ Dealer.

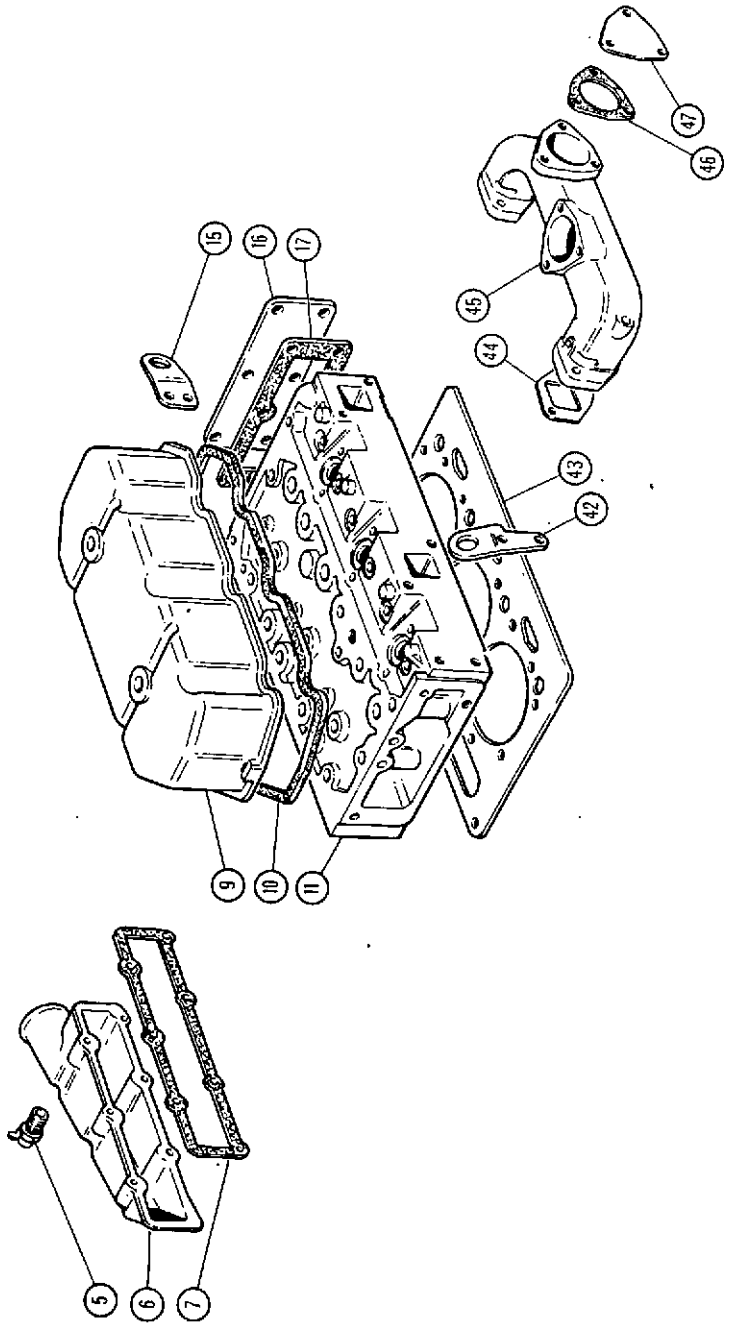
When Ordering: To ensure you receive the correct parts, always quote the engine number, machine description and serial number.

Note: Perkins are unable to deal direct with the operator, therefore parts are available by placing a firm order with your Perkins Distributor/Dealer.

PART DESCRIPTIONS

To be used in conjunction with the illustrations given on the following pages.

1. Pulley
2. *Alternator*
3. Bracket
4. Bracket
5. Thermostart
6. Induction Manifold
7. Joint
8. Joint
9. Cylinder Head Cover
10. Joint
11. Cylinder Head
12. Outlet Connection
13. Joint
14. Thermostat
15. Lifting Plate
16. Cover Plate
17. Joint
18. Rocker Lever
19. Rocker Lever
20. Bracket
21. *Circlip*
22. Plug
23. *Rocker Shaft*
24. Washer
25. Spring
26. Lubricating Oil Pipe
27. Spring
28. Lever
29. Spacer
30. Fuel Lift Pump
31. Joint
32. By-pass Connection
33. Hose
34. Clip
35. Plug
36. Joint
37. Backplate
38. *Joint*
39. Thermostat Housing
40. *Block Water Connection*
41. Cylinder Liner
42. Lifting Plate
43. Gasket
44. Joint
45. Exhaust Manifold
46. Joint
47. Blanking Plate
48. Tappet Screw
49. Locknut
50. Tappet
51. Oil Pipe Connection
52. Valve Cotters
53. Valve Cap
54. Valve Spring
55. Seating Washer
56. Valve Seat
57. Exhaust Valve
58. Valve Guide
59. Inlet Valve
60. Fan
61. Washer
62. Setscrew
63. Camshaft Gear
64. Camshaft
65. Cover (P.T.O.)
66. Joint
67. Pulley
68. *Water Pump*
69. Joint
70. Hose
71. Clip
72. Joint
73. Lub. Oil Filler
74. Filler Cap
75. Strainer
76. Cylinder Block
77. Joint
78. Seal Housing
79. Seal
80. Tab Washer
81. Balance Weight
82. Dust Seal
83. Nut
84. Washer
85. *Fuel Leak Off Pipe*
86. Banjo Bolt
87. *Connection*
88. Joint
89. Fuel Injection Pump
90. Heat Shield (3.1522)
91. Nozzle
92. Needle
93. Atomiser Body
94. Fuel Pipe
95. Fuel Filter
96. Jolnt
97. Lub. Oil Filter
98. Plug
99. Joint
100. Cover Plate
101. Seal
102. Timing Case Cover
103. Joint
104. Setscrew
105. Tab Washer
106. Washer
107. Hub
108. Timing Case
109. Bottom Cover
110. Idler Gear
111. Fuel Pump Gear
112. Setscrew
113. Washer
114. Pulley.
115. Crankshaft Gear
116. Spacer
117. *Circlip*
118. Oil Pump Idler Gear
119. *Joint*
120. Cover Plate
121. Key
122. Crankshaft
123. Bush
124. Oil Pump Gear
125. Lub. Oil Pump
126. Olive
127. Nut
128. Suction Pipe Assembly
129. Joint
130. Joint
131. Sump
132. Dipstick Tube
133. Dipstick
134. Main Bearings
135. Thrust Washer Upper
136. Thrust Washer Lower
137. Circlip
138. *Small End Bush*
139. Gudgeon Pin
140. *Piston Rings*
141. Circlip
142. Piston
143. Connecting Rod
144. Connecting Rod Cap
145. Big End Bearing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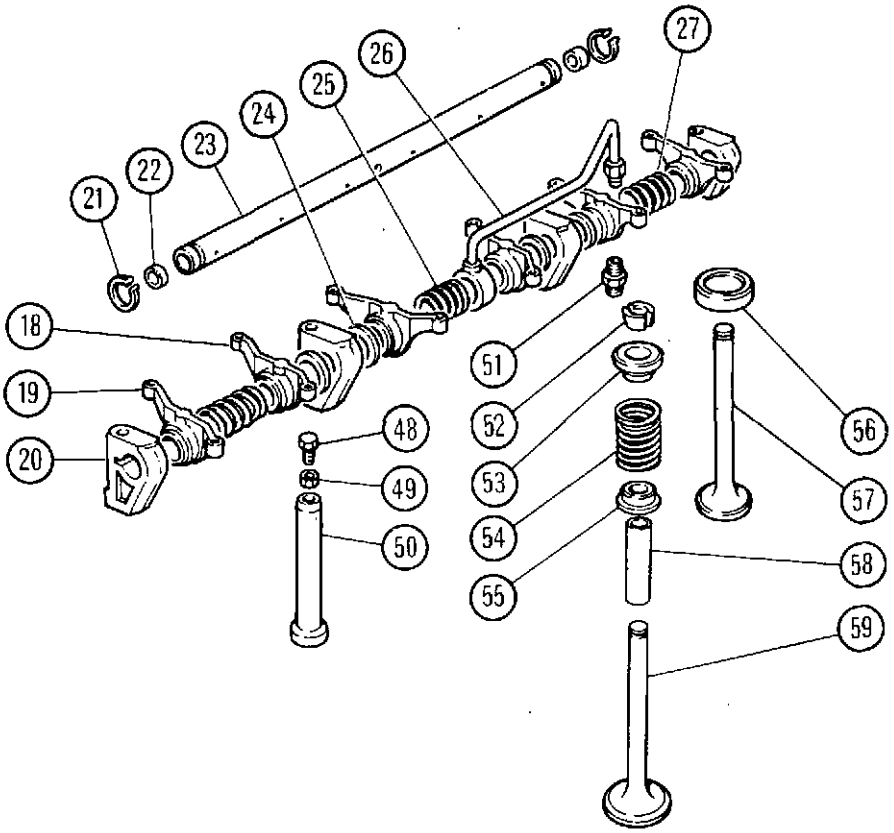
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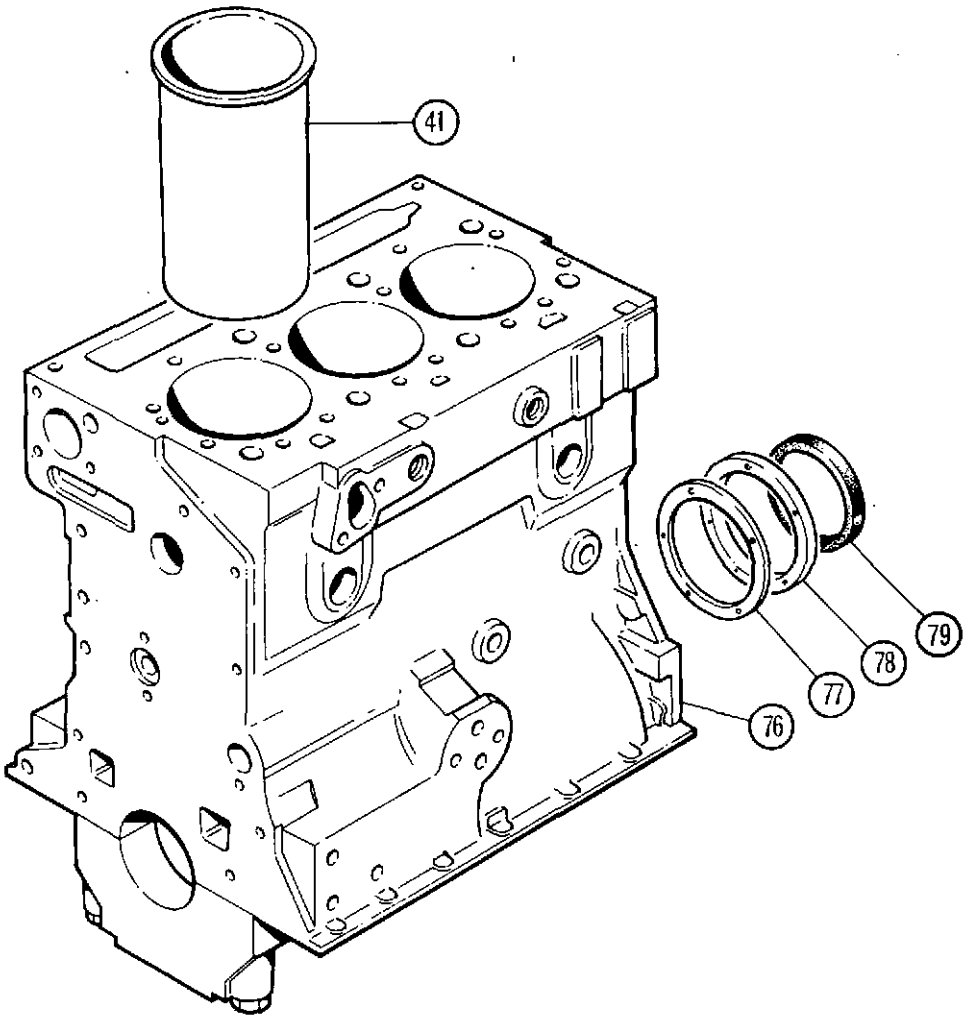
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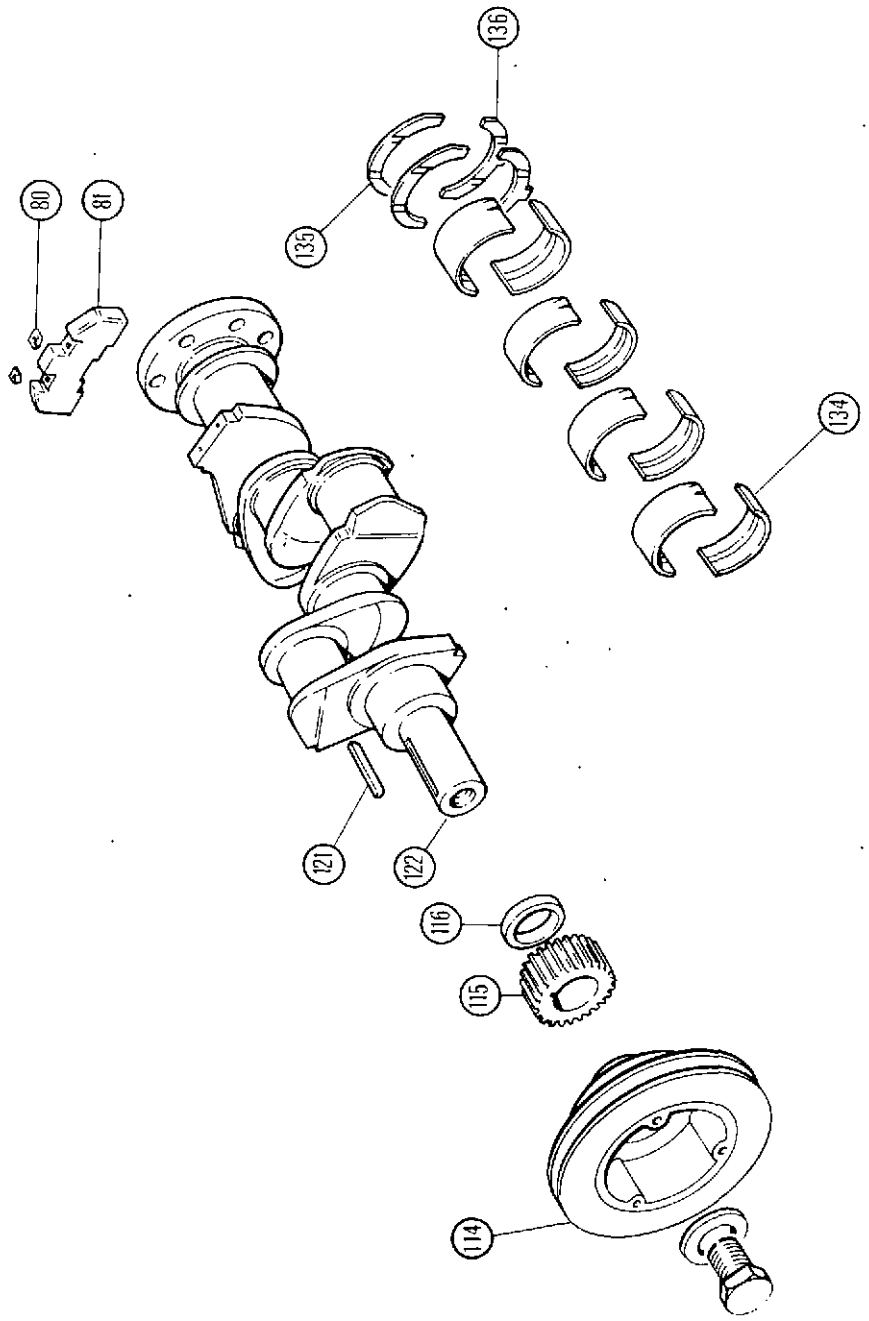
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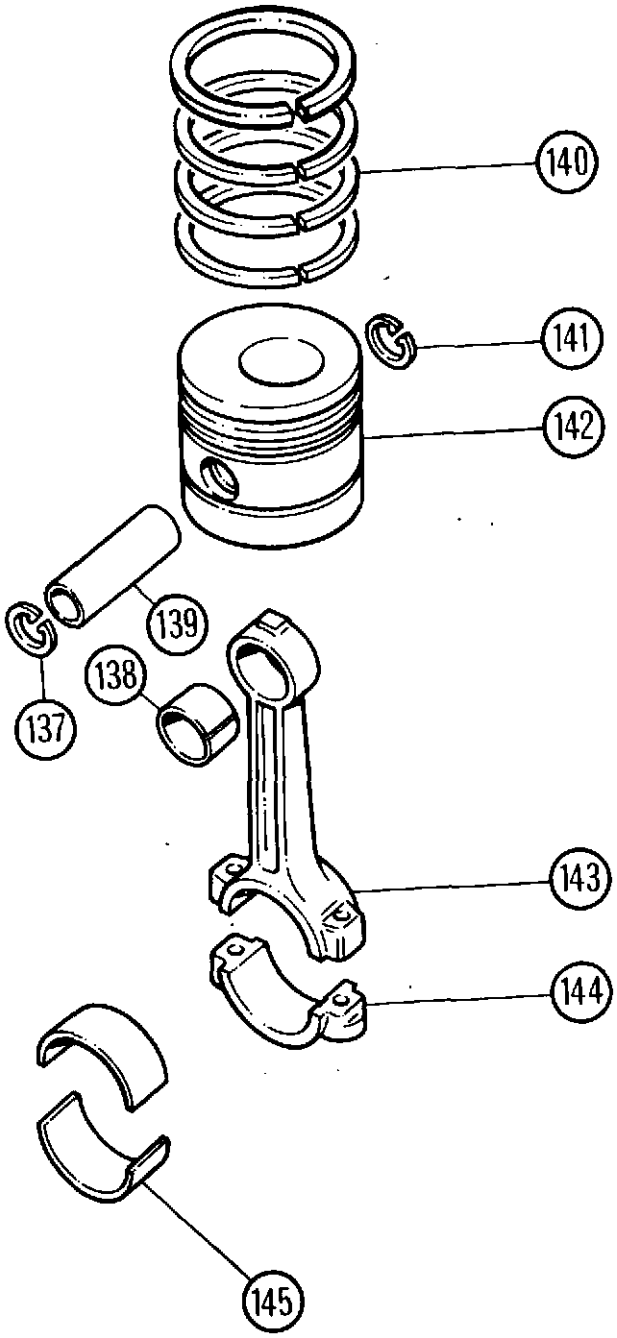
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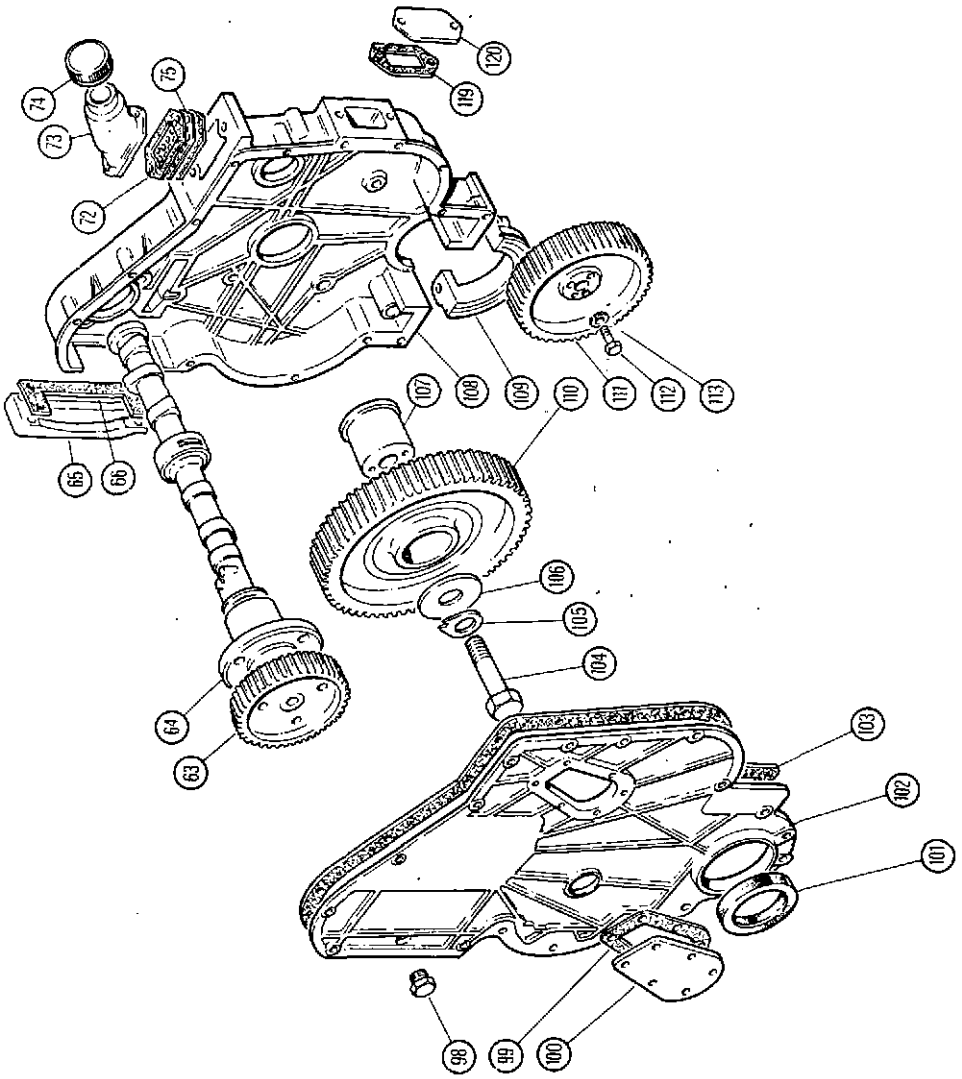
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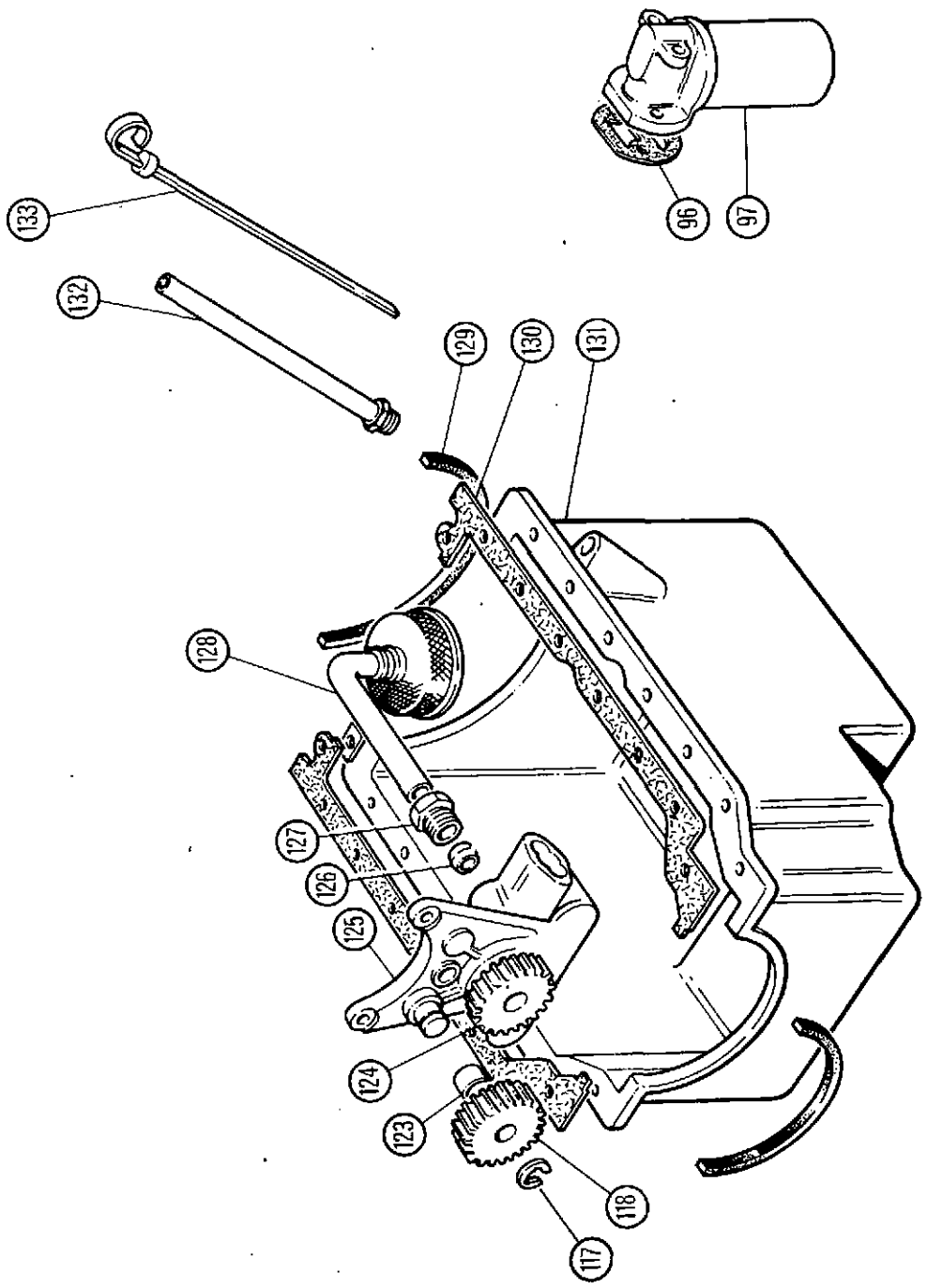
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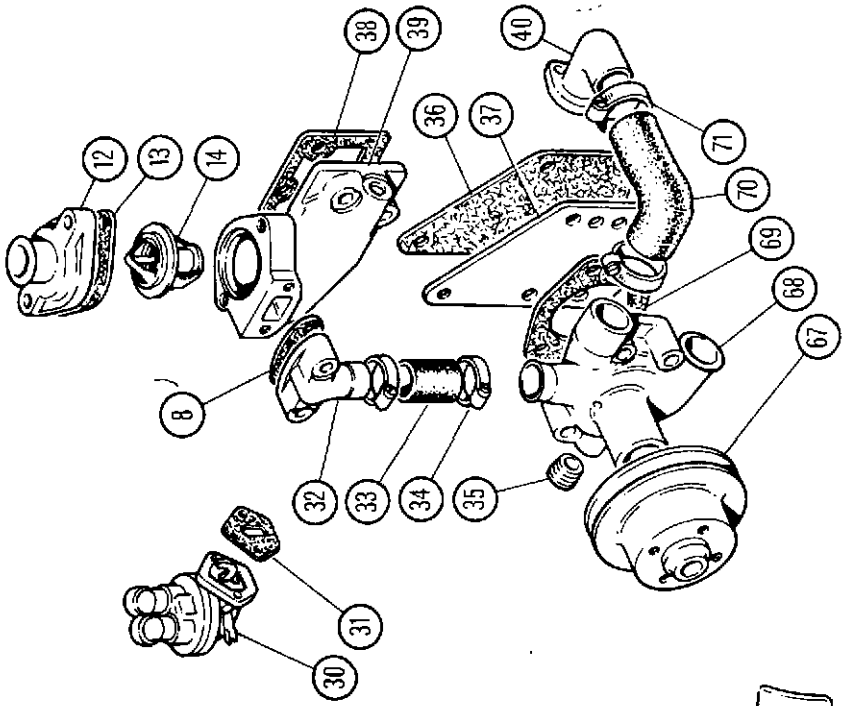
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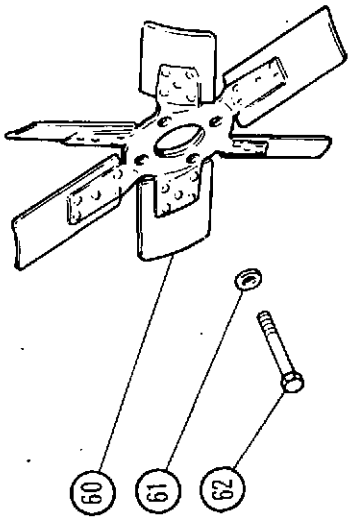
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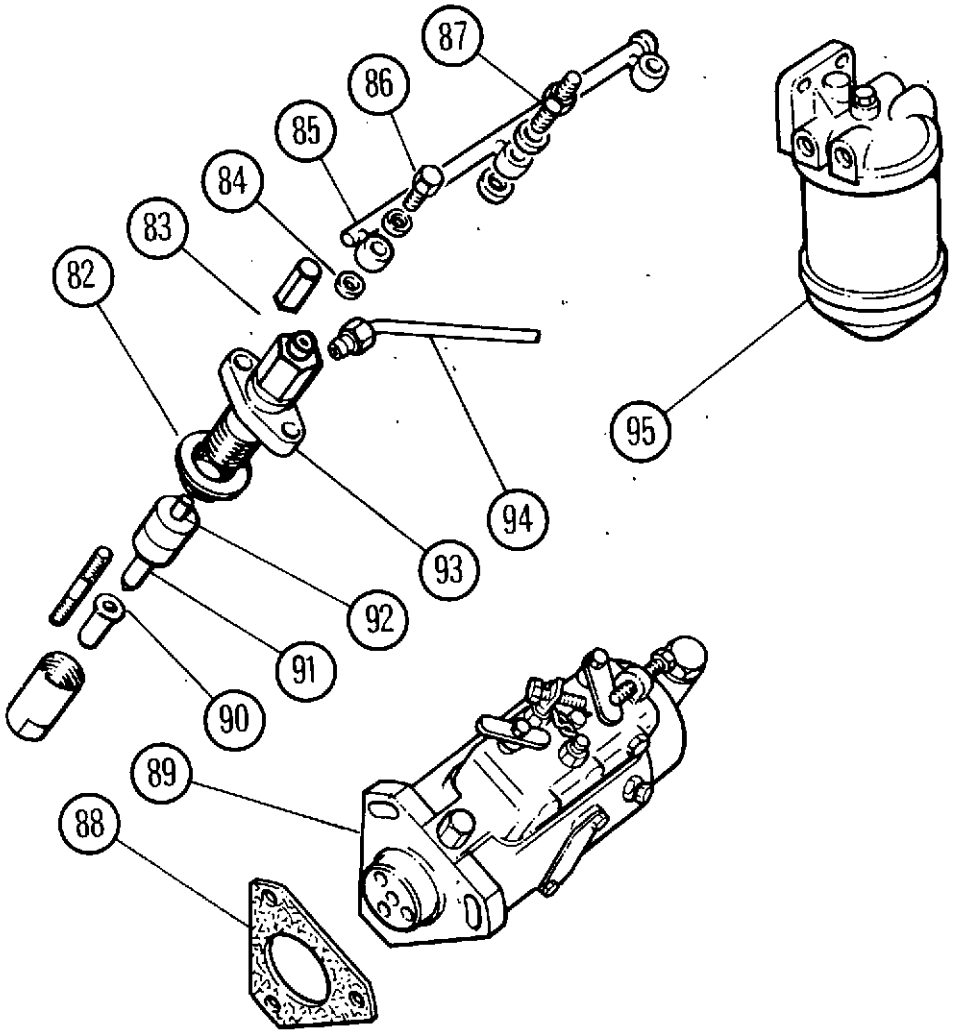
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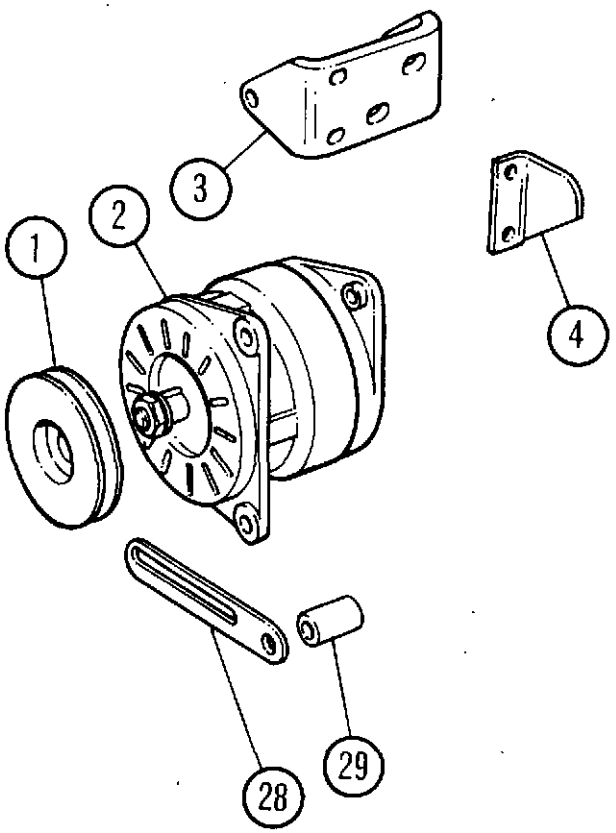
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