You want the best out of this Machine. Give this handbook to the man who has to look after it.

BOOK 352/954

PRICE 5/-

INSTRUCTION BOOK

AND

PARTS LIST

Lister

AIR COOLED

DIESEL ENGINE

(PATENT APPLIED FOR)

TYPE LD

R. A. LISTER & CO. LTD.
DURSLEY, GLOUCESTERSHIRE
ENGLAND

INDEX

IMPORTANT

Unified threads conforming to International Standard are used where applicable.

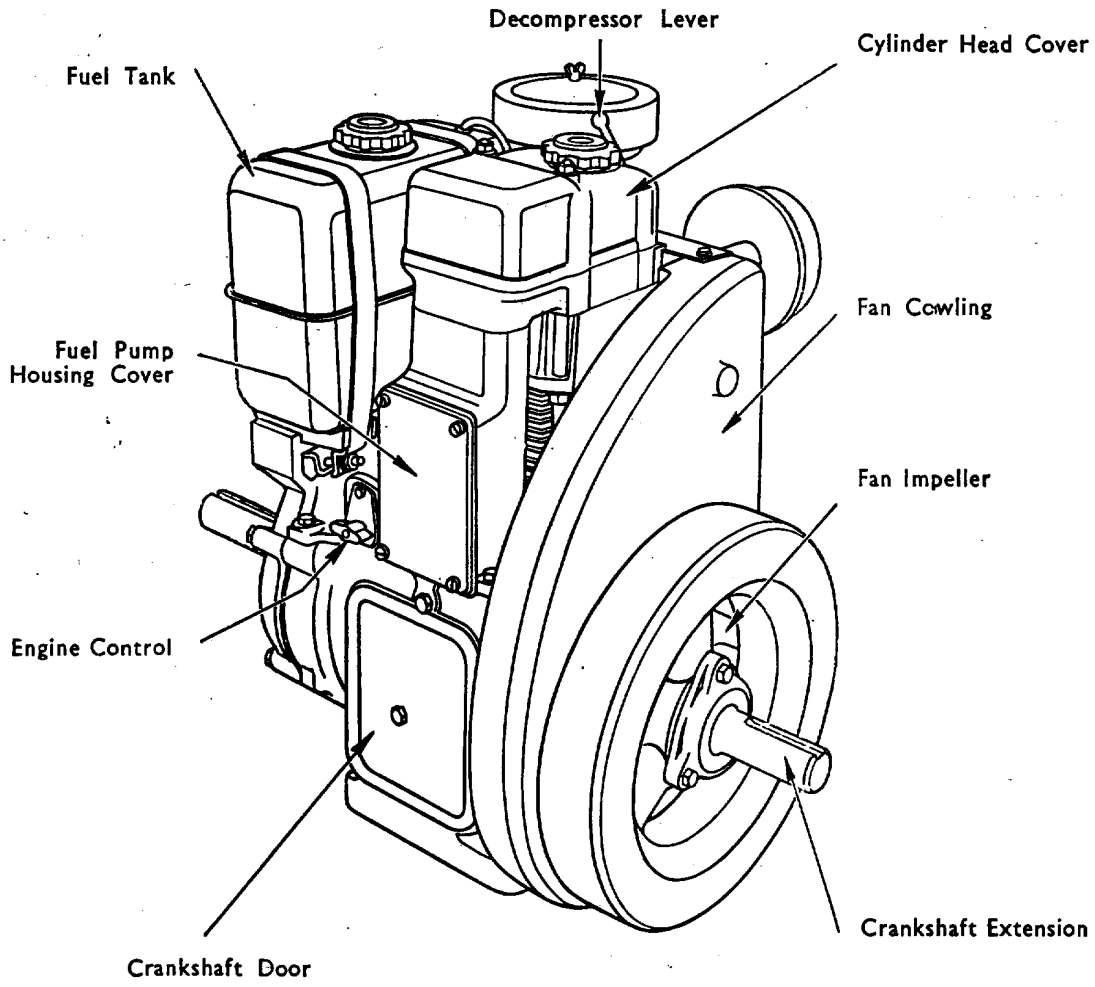


Fig. 1. Type LD Engine—Front View.

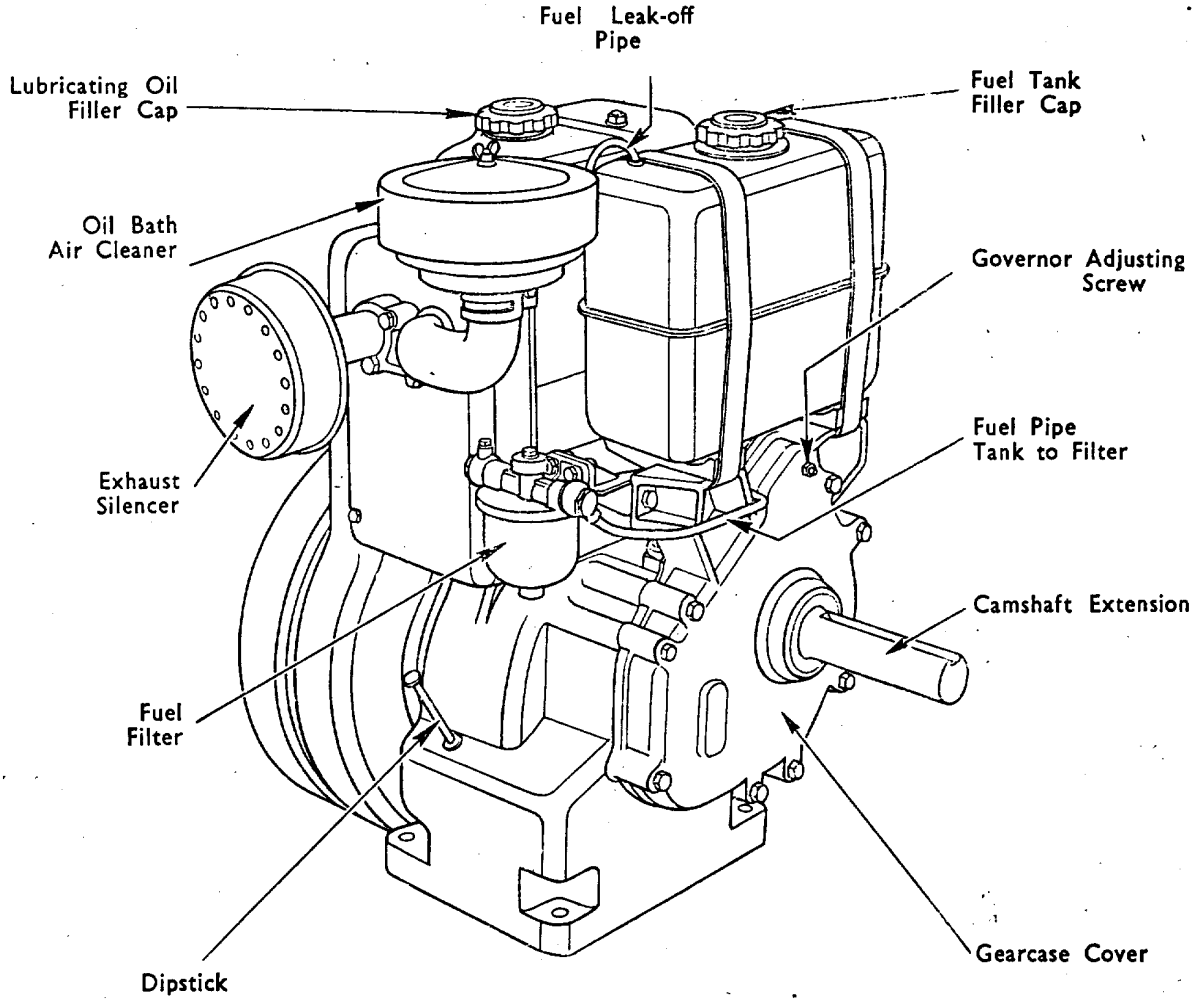


Fig. 2. Type LD Engine—Back View.

INSTALLATION

The engine must be installed where a generous supply of fresh air is assured.

A portable electric light is recommended in addition to the fixed lighting.

Keep the exhaust pipe as short and straight as possible. Up to 20ft. use 1″ Diameter Pipe, over 20ft. use 1¼″ Diameter Pipe.

The engine must be secured in a level position.

Belt Drive.

Driving belts must be run as close up to the engine as possible to avoid undue strain on the bearings. Where "fast" and "loose" pulleys are used the fast pulley must be driven from the side nearest the engine.

Cooling.

The engine is cooled by air. A fan impeller is secured to the flywheel. Air is drawn into the impeller through the spokes of the flywheel and discharged through trunking and shrouding to the fins of the cylinder and cylinder head.

The cooling air intake must not be obstructed. The following illustration shows the clearance required for the air to freely enter the flywheel.

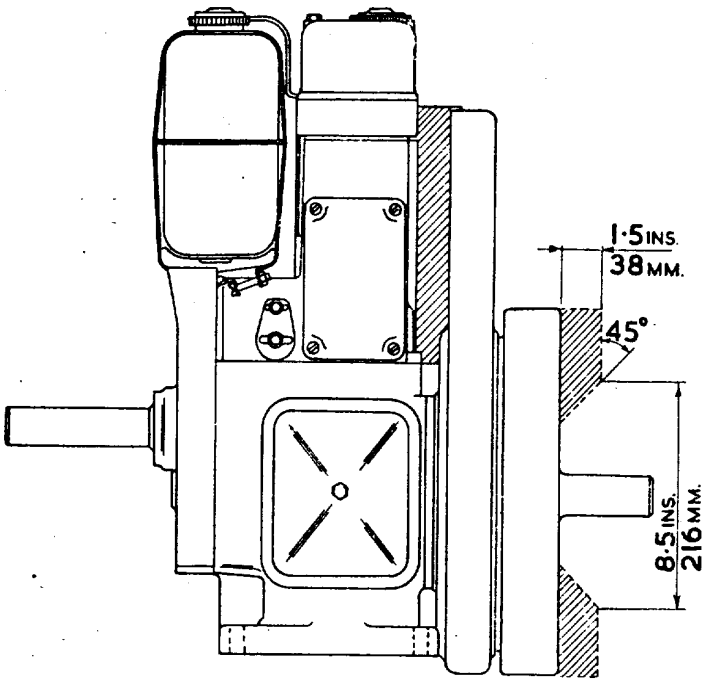


Fig. 3.—Minimum clearance for Air Intake.

If the engine is enclosed in a housing, openings must be provided opposite the cooling air intake and outlet. It is important that the hot air is ejected from the housing and not recirculated to the air intake as this will cause the engine to overheat. The openings must have a clear area of at least 30 square inches (194 cm²) each. If they are covered with mesh the area taken by it must be deducted. The use of simple ductings and deflectors inside the housing may be advisable in some cases.

Wherever possible the makers' approval should be obtained in the case of engines installed in small housings.

The ingress of dirt, sawdust, chaff etc., into the cooling air intake must be prevented by the provision of suitable shields or by placing the engine in a sheltered place.

FUEL SUPPLY

It has not been found practicable to recommend any particular fuel for universal use, but the fuel must be a distillate and not a residual oil or a blend thereof. It should have a Specification conforming to British Standard No. 209—1947, Class A.

Calorific Value	19,000 B.Th. U/lb.
Viscosity (Redwood No. 1) at 100°F.	31—45 secs.
Flash Point (closed)	Min. 150°F.
Cetane Number	Min. 45.
Distillation by Volume at 350°C.	Min. 85%
Conradson Carbon by Weight	Max. 0.1%
Water by Volume	Max. 0.1%
Ash by Weight	Max. 0.01%
Sediment by Weight	Max. 0.01%
Sulphur by Weight	Max. 1.5%
Acidity (Inorganic)	Nil.
Corrosion Copper Strip at 212°F.	Negative

The purchaser must satisfy himself that his Engine is capable of dealing with the fuel at the lowest temperature to which it may be exposed.

The following fuel oils have been used with satisfaction in these Engines:—

Shell Diesolene.
Shell Gas Oil.
Pratts Diesel Fuel A.
Essogasol.
Light Diesoleum Diesovap.
Esso Diesel.
Texaco 811 Diesel Gasoil.
Vacuum Co.'s Atlantic Diesel.

It must be understood, however, that different Fuel Oils become available in different areas and that variations in a particular brand of fuel oil may occur.

When in doubt as to the suitability of a fuel oil, the local dealer should be consulted.

Burning or Illuminating Paraffin (Kerosene) may be used as a fuel if ¼ pint of lubricating oil is added to each gallon of paraffin.

Vaporising Oils are unsuitable as fuel for Lister Diesel Engines.

In general, the fuel must be free from foreign matter or excessive wear will take place in the Fuel Injection system; some fuels are unsuitable owing to the excessive pressures resulting from their use or excessive carbon formation and chemical action on moving parts. The user is cautioned that although the engine may run satisfactorily for a short time on cheap fuel, excessive wear and damage will ultimately be suffered by the engine and its life materially shortened. For these reasons we can accept no responsibility for such damage or wear caused by the use of unsuitable or dirty fuels.

Clean fuel is of the utmost importance in maintaining standard performance.

Fuel Tank.

The Fuel Tank, capacity 1¼ Gallons, is carried on two cradles and secured by 2 steel straps to the Engine Gear Casing. The outlet connection projects inside the Tank to prevent any residue from entering the Fuel system.

Always fill the Fuel Tank through a fine Strainer, preferably at the end of a run. If any sediment is stirred up during the process this has time to settle before the Engine is used again. If cans are used avoid tipping out the last few drops.

Funnels are very difficult to keep clean in dusty conditions. Wash them before and after use and wrap them up when not required, or fill Service Tank direct from a small mouthed screw capped can such as a 2 gallon petrol can.

LUBRICATION

Specification

The type of lubricating oil suitable for use in a diesel engine is dependent on a number of factors of which the sulphur content of the fuel oil used is perhaps the most important. In recent years the sulphur content of Class 'A' fuels has been increasing and fuels having a sulphur content of up to 1% and more are encountered. To minimise the ill-effects of this high sulphur content, only the best Heavy Duty Diesel Engine (Detergent) lubricants complying with British Standard Specification 1905/52 or U.S. Army Specification MIL–0–2104 are recommended.

Viscosity.

The viscosity is to be SAE10W for starting temperatures below 85°F (30°C) Temperate Climate and SAE20 for starting temperatures above 85°F, Tropical Climates.

Branded Oils.

In order to assist engine users a list of brands of oil normally obtainable in world markets which have proved satisfactory in our engines is given on page 7.

Mixing of Oils.

If an engine has been run on straight mineral oil for more than 250 hours since completely overhauled (or since new) before it is changed to Heavy Duty (Detergents) Lubricants, the deposits formed by the straight oils may be dislodged by the latter and choke the oilways and strainer. For this reason it is necessary to flush the engine thoroughly with Heavy Duty (Detergent) oil and change the oil after 50 hours and then resume normal changes every 250 hours. The strainer must receive frequent attention during this initial period.

DO NOT MIX TWO DIFFERENT BRANDS OF OIL. THOROUGHLY DRAIN OFF THE ONE BEFORE ADDING THE OTHER.

Lubricating Oil System.

Oil is supplied under pressure from a plunger pump to all crankshaft bearings and the two valve rockers.

The oil is drawn through the wire gauze strainer and ball suction valve. The suction valve and seating is screwed into the base of the crankcase. The delivery valve is carried in the bottom of the hollow plunger, the oil passing into the hollow tappet and out into a manifold. From the manifold the oil is distributed by two pipes pressed into the main bearing housings and a single pipe which lubricates the valve rocker gear.

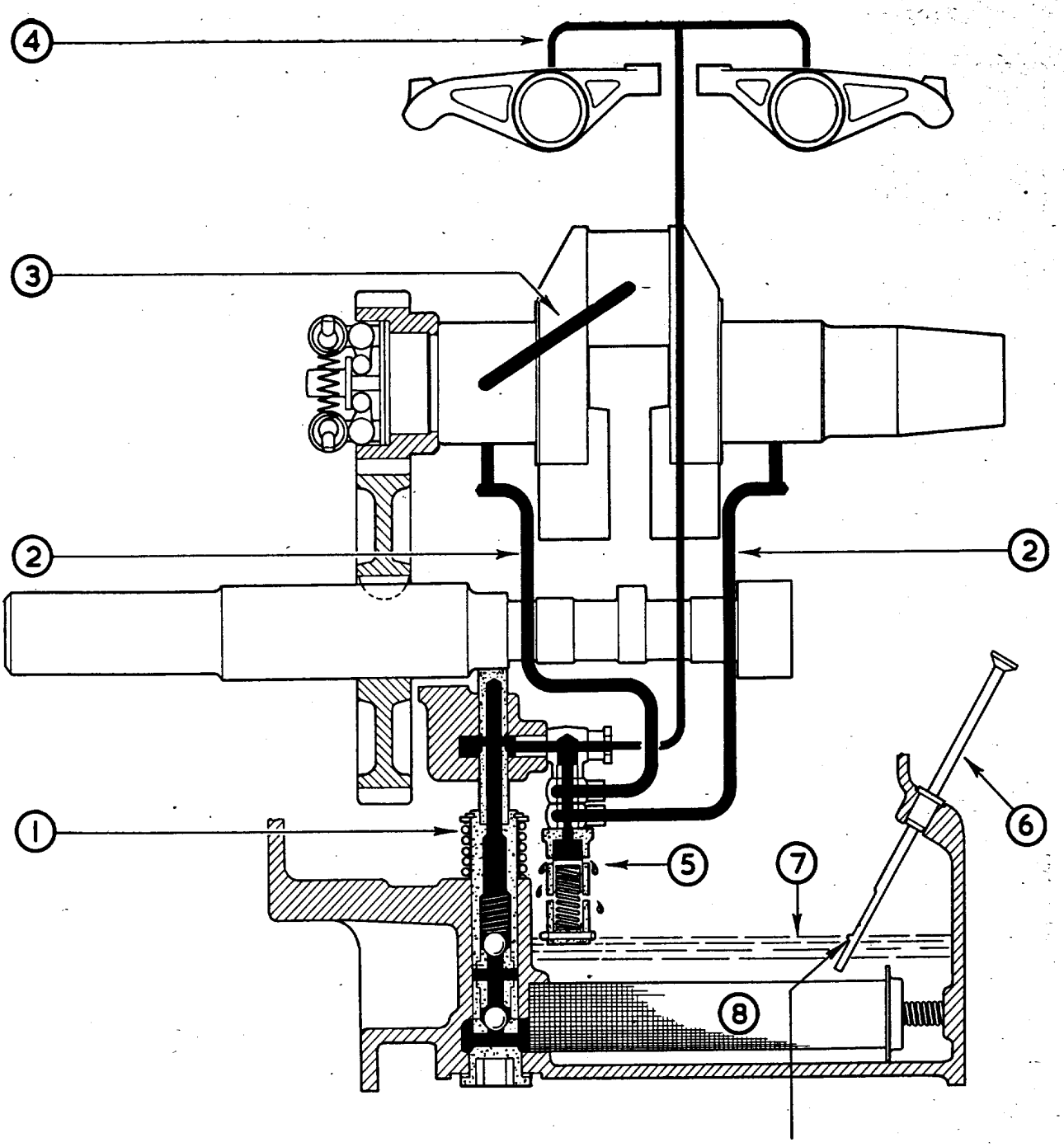
The relief valve is carried in the securing plug for the oil pipes to the main bearings and incorporates a pressure reservoir which maintains oil pressure on the bearings during the suction stroke of the pump. The relief valve is set to open at 50lbs./sq. in. and is not adjustable.

The crankcase may be drained through a drain plug at the back of the engine.

Before Starting or After Overhaul.

Fill engine crankcase through the oil filler in the cylinder head cover to the mark "max" on dipstick. (4 pints approx.).

Remove crankcase door and turn engine fast until oil is seen to be discharged under pressure, from the relief valve at each stroke of the pump.



1. Lubricating Oil Pump.
2. Oil Pipe to Main Bearings.
3. Oil passage to Big End Bearing.
4. Oil Pipe to Valve Rockers.
5. Lubricating Oil Relief Valve.
6. Lubricating Oil Dipstick.
7. Lubricating Oil Level.
8. Lubricating Oil Suction Strainer.

Fig. 4. Schematic diagram of Lubricating Oil System.

LIST OF OILS COMPLYING WITH B.S.S. 1905/52 or U.S.A. SPCN. MIL-O-2104

OIL COMPANY	Temperate Climates SAE 10 or 10W BRAND	Tropical Climates. SAE 20 or 20W BRAND
Alexander Duckham & Co., Ltd.	Duckhams HD 10/MIL	Duckhams HD 20/MIL Tractor Diesel 20
Esso Petroleum Co., Ltd.	Essolube HD 10 Esstic HD 10	Essolube HD 20 Esstic HD 20
Freedom-Valvoline Oil Co.	Valvoline VPR 206 Mil-O-2104	Valvoline VPR 306 Mil-O-2104
Germ Lubricants Ltd.	Germil 101	Germil 201
Power Petroleum Co.	Energol Diesel D-SAE 10W	Energol Diesel D-SAE 20W
Regent Oil Co., Ltd.	Caltex RPM Delo Special SAE 10W Caltex Ursa Oil X10**	Caltex RPM Delo Special SAE 20W Caltex Ursa Oil X20**
Shell Group of Companies.	Shell Talona Oil 10W Shell Rotella Oil 10W	Shell Talona Oil 20 Shell Rotella Oil 20/20W
Snowdon, Sons & Co.	Royal Snowdrift Apennine SAE 10	Royal Snowdrift Apennine SAE 20
Vacuum Oil Co., Ltd.	Delvac Oil 910	Delvac Oil 920 Mobiland Diesel 20
Vigzol Oil Co., Ltd.	New Ace 10	New Ace 20
C. C. Wakefield & Co., Ltd.	Castrol CR 10 Agricastrol HD10	Castrol CR 20 Agricastrol HD 20
Gulf Oil (Great Britain) Ltd.	Gulflube Motor Oil HD10W Gulflube Motor Oil XHD10W Gulf Dieselube HD10W	Gulflube Motor Oil HD20/20W Gulflube Motor Oil XHD20/20W Gulf Dieselube HD20/20W
Fina Petroleum Products Ltd.	Solco HD10 or 10W Solna HD10 or 10W	Solco HD20 or 20W Solna HD20 or 20W
Edward Joy & Sons.	Diesel Filtrate 10	Diesel Filtrate 20

STARTING AND STOPPING

To Start Engine.

(a) Check fuel and lubricating oil level.

(b) Ensure fuel and lubricating oil systems are primed. (See Pages 5 and 20).

(c) Move decompressor lever over towards the Flywheel.

(d) Pull control lever outwards and allow it to rotate anticlockwise so that it abuts against the top stop and it is in a vertical position, see illustrations below.

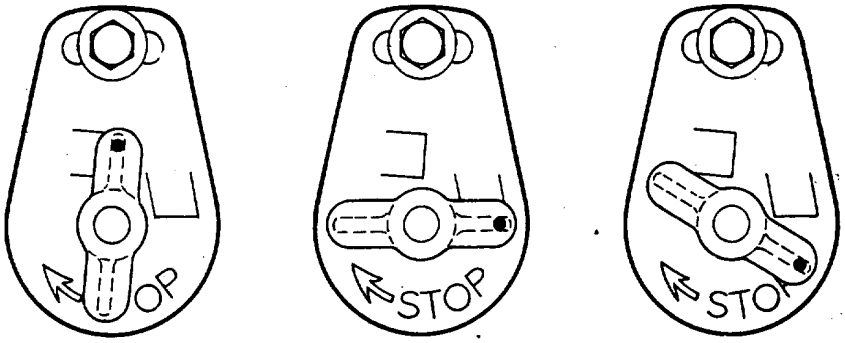
(e) Lightly oil the end of the camshaft extension and fit the Starting Handle. It is recommended that this shaft should always be used for starting the engine.

With certain applications it may be necessary to start the engine at the Flywheel end (i.e. Crankshaft). In these cases a 16″ diameter Flywheel must be fitted and the Crankshaft Extension bolted to the flywheel to take the Starting Handle.

(f) Turn engine slowly from 3 to 20 turns on the camshaft according to the temperature and period of standing unused, in order to prime the combustion chamber and the lubricating oil system.

(g) Turn handle smartly in a clockwise direction, move decompression lever towards Fuel Tank and continue turning, slip off starting handle when engine fires.

(h) As soon as the engine reaches normal speed, turn the control lever clockwise to a horizontal position so that it abuts against the horizontal stop—THIS IS MOST IMPORTANT.



START RUN STOP

Fig. 5. Engine Control.

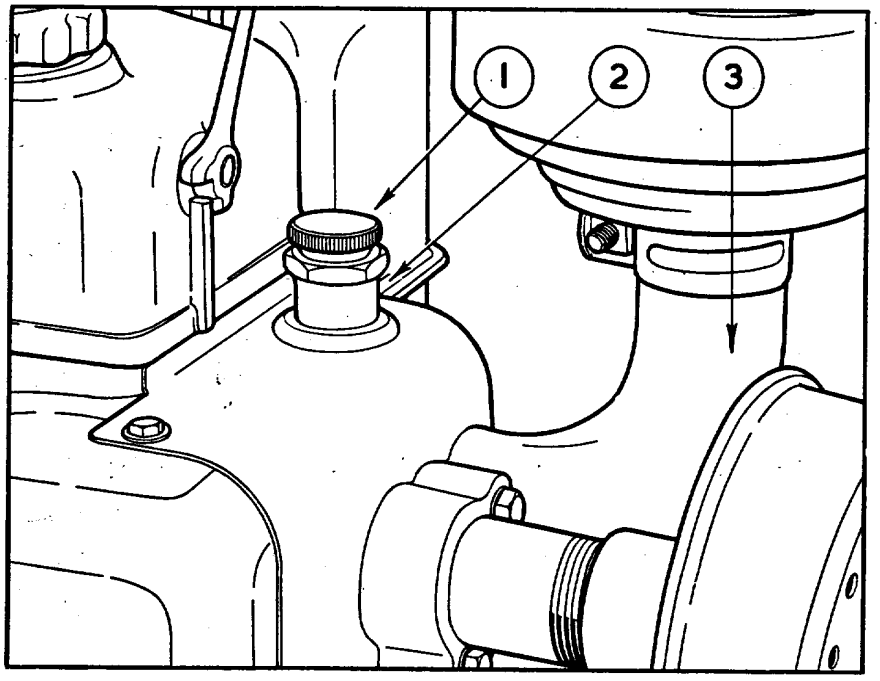
Starting under Cold Conditions.

An Oil Cup is provided, mounted on the Inlet Valve Port, to assist starting under frosty conditions and should be used as follows:—

For starting under normal frosty conditions the cup should be half filled with SAE10W lubricating oil, the plunger pressed to the bottom of its stroke and the engine turned at least 5 complete revolutions with the exhaust valve decompressed. The engine should then be started in the usual way.

For starting under extremely frosty conditions the cup should be completely filled with a mixture of 50% fuel oil and 50% SAE10W lubricating oil and then follow the procedure for normal frosty conditions.

The fuel and lubricating oil must be suitable for the temperature at which the engine has to be started—they must have a pour point lower than this temperature. For temperatures below 0°F it is permissible to dilute the SAE10W lubricating oil with up to 25% fuel oil, and to run and top up the sump with this mixture, or use SAE5 lubricating oil.



1.—Plunger.

2.—Oil Cup.

3.—Air Inlet.

Fig. 6. Cold Starting Oil Injector Device.

To Stop Engine.

Turn control clockwise and hold in this position until engine stops.

Speed Adjustment.

A slight adjustment of speed may be made by turning the screwed rod which projects through the gear case. Turn anti-clockwise to increase speed, clockwise to decrease. Secure locknut.

Do not increase speed above 2½% without consulting makers.

STARTING AND RUNNING FAULTS

Essentials for Easy Starting.

(a) Engine to turn easily when decompressed; if not it may be due to:—
Unsuitable Lubricating Oil (too heavy).
Incorrect Decompressor clearance.

(b) Injector creak must be heard (or felt). If not, it may be due to:—
No fuel in tank.
Air lock in system.
Injector Nozzle Valve stuck open.
Fuel Pump Delivery Valve scored.

(c) Good Compression, if not, it may be due to:—
Worn Cylinder.
Piston Rings carboned in grooves.
Leaking Inlet or Exhaust Valve.

(d) Fuel Pump Rack to be free.

(e) Control must be vertical to give extra fuel for starting.

Knocking, this may be caused by:—

(a) Valve, probably exhaust sticking in guide and touching piston—Clean Stems and Guides.
(b) Slack Bearing—Fit new Bearing, if Crankshaft is not worn.
(c) Insufficient clearance between the Piston and Cylinder Head—Check and adjust.
(d) Injection too early—Check and adjust.
(e) Flywheel loose on shaft.
(f) Too much crankshaft end play.
(g) Excessive carbon deposit on piston.

Carbon Deposit, excessive deposit may be due to:—

(a) Choked Exhaust System—dismantle and clean.
(b) Long period of idling.
(c) Unsuitable Fuel Oil.
(d) Unsuitable Lubricating Oil.
(e) Injector not spraying correctly—clean nozzle.
(f) Late Injection of Fuel—check timing.

Smoky Exhaust.—Black smoke is due to incomplete combustion of fuel caused by:—

(a) Overload, causing an excessive quantity of fuel being injected.
(b) Choked Air Intake.
(c) Poor atomisation due to a choked Injector Nozzle.
(d) Unsuitable Fuel.

Blue smoke, when faint, is generally the result of light load.
Heavy blue smoke is caused by lubrication oil passing the Piston Rings, because of either stuck Piston Rings or a worn Cylinder.

Engine Stops.—This may be due to:—

(a) Lack of Fuel, Air or Water in fuel system. Fuel system choked.
(b) Overload.
(c) Overheating, due to shortage of lubricating oil.
(d) Loss of Compression.
(e) Dirt in injector or fuel system.

Loss of Power.—This may be due to

(a) Loss of compression.
(b) Incorrect tappet clearance.
(c) Choked exhaust pipe.
(d) Fuel injection system. Fuel Injector or Fuel Pump out of order.

Failure to Obtain Normal Speed.

(a) Engine started under overload.
(b) Fuel system not primed properly.
(c) Insufficient Fuel.
(d) Injection retarded.

Loss of Oil Pressure.

(a) Oil level below mark on Dipstick.
(b) Strainer choked.
(c) Fractured Pipe or leaking joint.
(d) Badly worn or run out bearing.
(e) Relief Valve not seating due to dirt, or worn out.
(f) Oil Pump Piston and Valves, worn or dirty.

MAINTENANCE ROUTINE

When Engine is in continuous use:—

Daily:

Check supply of Fuel Oil.
Check level and condition of Lubricating Oil.
Clean Air Cleaner under very dusty conditions.
Drain moisture trap in Exhaust pipe, if fitted.

100 Hours:

Clean Air Cleaner under moderately dusty conditions.
Check leaks of Oil, Fuel—tighten Nuts and Fittings if necessary.
Wipe Engine and Baseplate clean.

250 Hours :

Drain Oil and refill with correct grade and type.

500 Hours:

Decarbonise if Engine shows loss of compression, or blow by the Piston, do not disturb otherwise.
Adjust Valve clearances.
Clean Cooling Fins if necessary.
Wash Engine down with Paraffin or Fuel Oil.
Check Injector spray and clean if necessary.

1500 Hours:

Decarbonise.
Clean Inlet Manifold and Exhaust System.
Clean Fins on Cylinder Head, Injector Sleeve and Cylinder.
Examine Fan Blades and Clean.
Check Free Working of Governor Linkage.
Drain and clean Fuel Tank.
Clean Fuel Filter Element. Replace if necessary.
Adjust Injector Pressure setting.
Check Fuel Pump timing.

5000 Hours:

Check Big End and Main Bearings.

A reasonable amount of time spent in checking over the details as described in the foregoing is the user's best insurance against loss of valuable time and costly repairs.

MAINTENANCE

Breather.

The crankcase breather, in the form of a copper pipe with a thimble cap, is screwed into the top of the Cylinder Head and connects with the Inlet Port.

The oil laden vapour is drawn into the Inlet Port and a partial vacuum maintained in the crankcase. This prevents the Lubricating Oil from working out through the joints and bearings.

Fuel Filter.

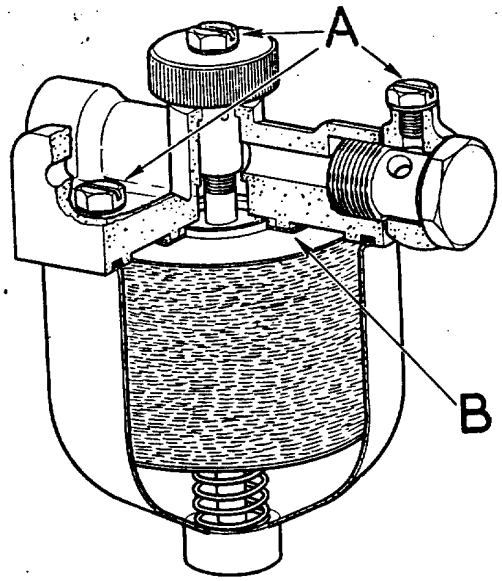
The fuel filter is an essential component of a Diesel Engine and must not be removed or used without an element.

Clean or renew the element every 1,500 hours if clean fuel is used, if fuel is dirty attend to filter more often.

The element may be washed in clean paraffin or fuel oil taking care to prevent dirt reaching the inside of the element or delivery pipes. Clean inside the Bowl.

Assemble carefully and prime Fuel System by slackening the three priming screws shown in the illustration below, until all air is removed and then tightening again.

If the engine runs erratically it should be further primed at the Fuel Pump Inlet Union which is accessible after removing the door above the crankcase door.



A—Vent Screws.

B—Felt Washer. This **must** be in place.

Fig. 7. Fuel Filter

Air Cleaner.

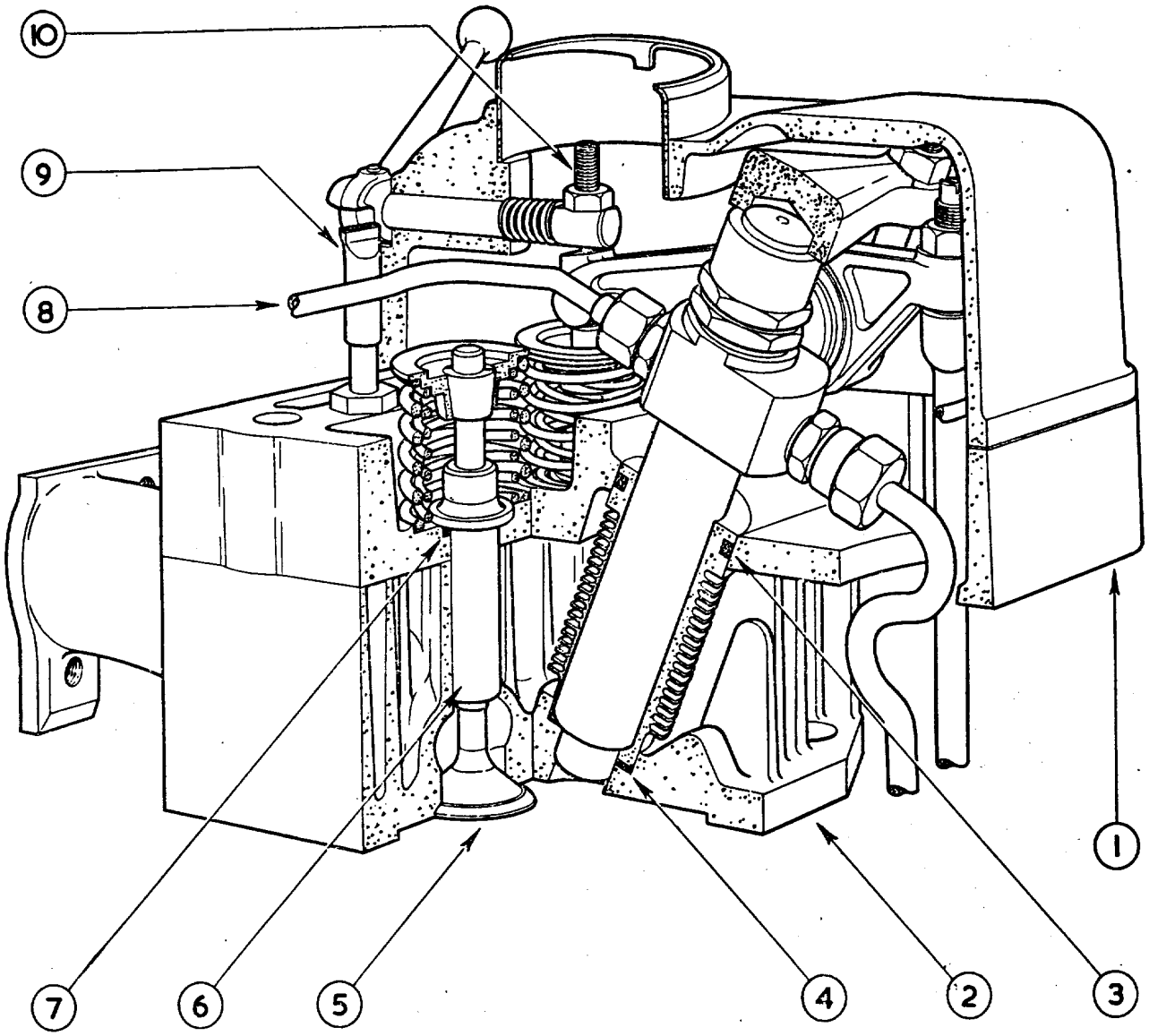
An oil bath type of cleaner must be cleaned according to the amount of foreign matter in the air. Dismantle and wash in paraffin. Dry thoroughly before reassembling.

The oil level must be maintained up to the mark.

To Remove Cylinder Head.

Remove:—

(a) Cylinder head cover.
(b) Fuel pump housing door.
(c) Lubrication oil pipe to valve rockers.
(d) Fuel leak-off pipe.
(e) Fuel pipe—fuel pump to injector.
(f) Fuel Injector.
(g) Inlet and exhaust manifold.
(h) Remove Oil Starting Reservoir.
(j) Air shroud at back of cylinder.
(k) 4 holding down nuts and washers and lift off head.



1. Cylinder Head—Top Plate.
2. Cylinder Head.
3. Injector Sleeve Oil Seal Ring.
4. Washer for Injector Sleeve.
5. Inlet Valve.
6. Inlet Valve Guide.
7. Valve Guide Oil Seal Ring.
8. Fuel Leak-off Pipe.
9. Breather.
10. Decompressor Screw.

Fig. 8. Cylinder Head.

Valve Guides.

The cylinder head is in two parts (an upper and lower). The valve guides are a press fit in the lower half only and hold the two parts together. They are jointed on rubber rings under the collars at the top. The two parts should not be separated unless it is necessary to replace components.

The exhaust valve guide is recessed at the lower end and two oil holes near the top of the guide provide lubrication for the valve stem.

Injector Sleeve

This need not be removed from the Cylinder Head unless it is necessary to separate the two parts; it may, however, lift out with the injector. In this case the carbon must be brushed from the projecting part of the injector with a wire brush, care being taken not to damage the pintle valve which projects through the end of the injector, and then push the injector out of the sleeve.

To Replace Cylinder Head.

Examine Cylinder Head Gasket—renew if damaged.

Replace Cylinder Head and pull down the 4 nuts evenly. Tighten to a torque of 40 lb. ft. This is very tightly with a spanner about 7″ long.

To Check Cylinder Head Clearance.

Place a piece of lead wire .048″ x 1″ on top of piston clear of valve recesses and combustion chamber in the top of the piston.

Tighten down Cylinder Head and turn piston past T.D.C.

Remove Cylinder Head and measure thickness of lead. This should be between .030″ (.76 mm.) and .033″ (.84 mm.) and may be adjusted by copper shims .003″ (.075 mm.) thick placed between the cylinder head and the gasket. Only one paper joint must be used between the crankcase and the cylinder barrel.

To Remove Piston.

(a) Remove Cylinder Head.
(b) Remove Air Guide Plates at sides of Cylinder.
(c) Remove Crankcase Door.
(d) Disconnect Connecting Rod Big End Bearing.
(e) Lift off Cylinder complete with Piston and Connecting Rod.

Withdraw Piston from Cylinder.

To remove Gudgeon Pin, immerse Piston in hot water, remove Spring Circlip and Gudgeon Pin may be tapped out.

Piston rings may be removed by inserting thin metal strips between the ring and the piston and easing off the ring, but it is recommended that a ring expanding tool as made for car engines is used.

To Replace Piston Rings.

Clean piston ring grooves, oil holes and rings carefully.

Roll each ring (except the top one which is taper sided) round in its own groove.

Measure the gap between the ends of the new ring when placed in the bottom of the cylinder. This should be between .008″ and .020″. (.20/.50 mm.)

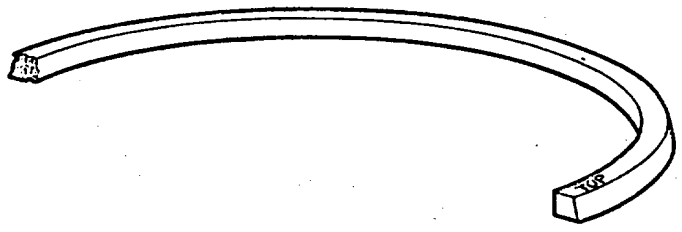


Fig. 9. Piston Ring.

The top ring is taper sided and chromium plated.

The second and third rings have tapered faces against the cylinder, these should be fitted with the large end of the taper at the bottom. New rings are marked ' TOP ' on the top side- -

To Replace Piston and Connecting Rod.

Always check the clearance between the piston and the cylinder which must be not less than .005" (.127 mm.) measured with a feeler pushed between the two.

Oil and place piston and connecting rod in cylinder block. Place one paper joint at base of cylinder block.

Turn cylinder block with flats on the fins towards the flywheel and fuel tank ends respectively.

Turn piston with wording 'CAMSHAFTSIDE' on top towards camshaft (fuel pump housing).

Turn crankshaft to T.D.C, lower into position Cylinder complete with Piston and Connecting Rod, and when the Connecting Rod Bolts have passed over the crankpin, turn crank towards door as Piston is pressed down.

Place top half of connecting rod bearing on crank pin and press piston and rod down on to bearing.

Assemble Big End Bearing according to the marks and secure with the self locking nuts. Correct tightening torque is 12 lb. ft.

Connecting Rod Big End Bearings.

Big End Bearings are copper-lead lined precision finished, and require no fitting; under no circumstances should they be scraped or touched up in any way.

If the Big End has been dismantled because of failure of the metal, the Oil Passage in the Crankshaft must also be examined for obstruction and fragments of metal. After cleaning out, it is advisable to crank the Engine over by hand to see that oil reaches the bearing, and to flush out the oil passage.

Main Bearings.

Engines are built with steel backed, bearing metal lined, split bush main bearings with separate thrust washers. When re-assembling an engine, care must be taken that the thrust washers are correctly positioned. If new bearings are fitted ensure that the oil holes are in line with the holes in the bearing housing, and that the bearing is correctly fitted, i.e. the end of bearing is 1/16" below Housing on inside edge.

Valve Adjustment.

Both valves are interchangeable, but should be retained in their respective guides when decarbonising.

Valve clearance must be set to .002" (.05 mm.) Cold for both Inlet and Exhaust Valves.

To adjust, turn the Piston to TDC firing stroke. Remove cylinder head cover. Slacken locknut on adjusting screw and turn screw until correct clearance is obtained. Tighten locknut.

The Valve rocker operates directly on to the valve stem.

Inlet valve	Opens	10° B.T.D.C.
	Closes	30° A.B.D.C.
Exhaust valve	Opens	30° B.B.D.C.
	Closes	10° A.T.D.C.

Valve heads must be between .015" and .040" under the face of the cylinder head.

Decarbonising.

Decarbonise after about 1500 hours.

(a) Remove cylinder head.

(b) Remove piston and rings.

All parts must be thoroughly cleaned and washed in paraffin.
Special care must be taken with regard to:—

(a) Recess in exhaust valve guide.

(b) Valve ports.

(c) Piston rings and grooves.
(d) Combustion chamber in the top of the piston. (Do not remove).
(e) Fins must be cleaned on Cylinder, Cylinder head and Injector sleeve. This is very important.
(f) The inside of the Piston.
(g) Regrind valve seats if not in perfect condition.
(h) Clean out Exhaust piping and silencer.

To Adjust Decompressor.

The decompressor is carried in the cylinder head cover and access to it is through the oil filler.
Turn Piston to TDC firing stroke.
Move decompressor lever over towards Flywheel.
Slacken locknut and turn decompressor screw down until exhaust valve touches the piston.
Turn screw back ½ turn and tighten locknut.

Flywheel.

The flywheel is mounted on a taper. A withdrawing tool is required to remove it. Do not slacken the nut more than 2 Turns before loosening the Flywheel on the cone.

Air Cooling Fan.

To ensure that the fan has side clearance inside the fan cowling the latter is positioned axially by means of joints or shims between the bearing housing and the fan cowl so that there is between .040″ and .090″ clearance between the side of the flywheel and the fan cowling.

To Remove Fuel Pump.

(a) Drain fuel at fuel filter.
(b) Remove fuel pipe to injector.
(c) Disconnect fuel supply pipe.
(d) Release governor adjusting spring.
(e) Disconnect governor link.
(f) Remove fuel pump clamp setscrew and clamp lift out pump, taking care of adjusting shims below pump body.

Camshaft.

The camshaft is carried in three porous bronze bushes. Two pressed into the crankcase and the third in the gear end cover.

The camshaft is extended beyond the cover and is the same diameter as the crankshaft providing a second position for power take off at half the engine speed.

To Remove Camshaft

(a) Remove fuel pump cover.
(b) Disconnect governor adjusting spring.
(c) Disconnect fuel pipe—filter to pump, and drain fuel.
(d) Remove fuel pump and tappet.
(e) Remove set screws in gear end cover.
(f) Turn camshaft keyway to bottom.
(g) Remove crankcase door.
(h) Compress lubricating oil pump return spring until pump tappet is below level of camshaft bearing.
(i) Remove gear end cover.
(j) Hold up tappets and slide out camshaft—collect tappets.

To Time Camshaft.

The camshaft is timed by matching the letters 'O' on the camshaft gearwheel and the crankshaft pinion.

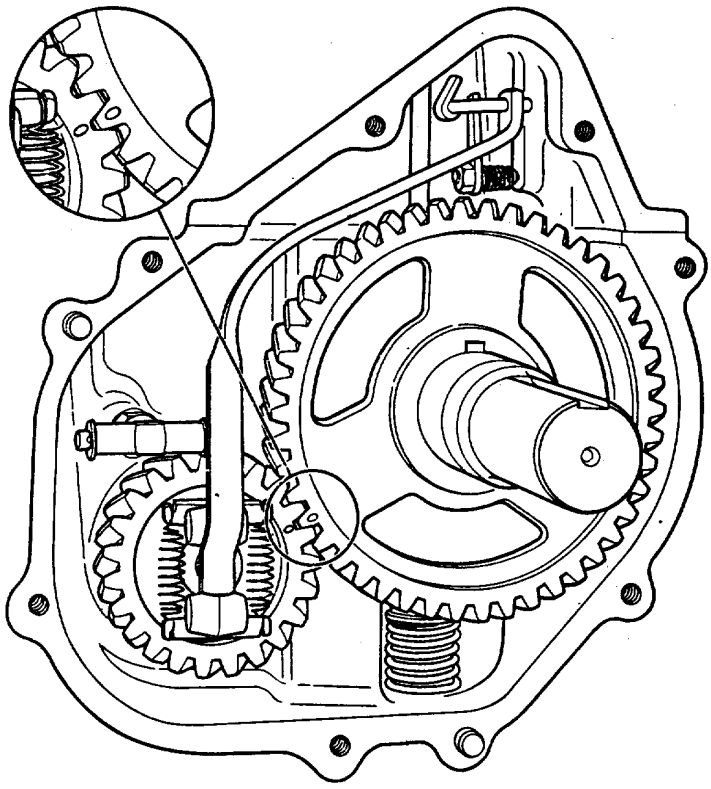


Fig. 10. Camshaft Timing.

Governor.

The engine speed governor is attached to the pinion end of the crankshaft and secures the pinion to the shaft.

The governor weight carrier plate is fitted into a recess in the pinion and secured with two set-screws.

The governor lever operating the fuel pump is carried in a fulcrum bearing secured to the crankcase above the pinion. This bearing **must** be fitted so that the centre line of the bearing is $\frac{3}{4}$" from the facing on the crankcase and is secured by a locknut.

The lever is curved to pass over the camshaft gearwheel and is joined to the fuel pump by a link arm.

Lubricating Oil Pump.

The plunger type pump is cam operated from the camshaft and the suction valve being below the level of the oil should require little attention. Always see the hollow end of the pump tappet is down towards the pump.

To Remove Lubricating Oil Pump.

(a) Compress pump return spring to relieve pressure on the circlip.
(b) Remove circlip.
(c) Release pump spring.
(d) Remove suction valve from bottom of crankcase.

Pump plunger and tappet may now be pushed out.

Remove spring and carrier ring from the crankcase.

The suction strainer is held in place by a spring end cap in the front of the crankcase.

Main Bearing Housing.

To remove:—

(a) Remove flywheel.
(b) Remove air and exhaust manifold.
(c) Remove air shroud at back of cylinder.
(d) Remove fan impeller trunking (4 setscrews and washers).
(e) Remove crankcase door.
(f) Remove lubricating oil relief valve and oil pipe to main bearing in the housing.

The Housing may now be removed from the crankcase.

Before replacing see the main bearing bush is in correct position—lubricating oil holes in line.

Crankshaft end play must be between .005″ and .009″ (.12/.21 mm) this can be adjusted by the joints and metal shims (always use a paper joint between shims and between shim and casting) between the housing and crankcase.

When replacing the fan cowling the vertical edge must be in line with the face of the inlet and exhaust port flange on the cylinder head.

To Remove Crankshaft.

(a) Remove piston and connecting rod.
(b) Remove gear end cover.
(c) Remove governor and control rod.
(d) Remove crankshaft pinion (keyed to crankshaft).
(e) Remove main bearing housing, withdraw crankshaft through the housing bore.

Replace in the reverse order for removing.

Oil Seals.

The crankcase is sealed at the crankshaft and camshaft by screw type oil seals and felt rings.

There is a ring type oil thrower on the flywheel end of the crankshaft and care must be taken to guide this ring over the end of the crankshaft when fitting the main bearing housing.

FUEL EQUIPMENT

Important.

When priming or checking the fuel pump timing, care must be taken to prevent the overflow of fuel passing into the crankcase.

Always fit a NEW joint washer when a joint has been broken.

Special care must be taken to see there is no leakage from the joints of the fuel pipe connection to the pump.

To Prime Fuel System.

(i) Fill fuel tank.

(ii) Vent fuel filter. (See Page 13).

(iii) Vent fuel pipe at fuel pump. Turn engine as for Starting i.e 3 to 20 turns until injector 'creaks,' and then attempt to start the engine. If the engine fails to start, a more detailed method of priming must be used as follows:—

(a) Remove cylinder head cover.

(b) Remove fuel injector pipe.

(c) Remove delivery valve holder and spring on pump and slightly raise delivery valve until fuel free from air flows. (At least $\frac{1}{4}$ pint fuel must be allowed to flow).

(d) Replace delivery valve spring and holder and tighten down.

(e) Connect fuel injector pipe to pump.

(f) Set control to start position.

(g) Turn engine until fuel free from air flows from injector pipe. Secure pipe to injector and continue turning engine until injector 'creaks.'

With the Engine Control in the Run position, and a .010" feeler inserted as shown on Fig. 11, the calibration mark on the Fuel Pump rack must rest against the Fuel Body. This can be secured by an adjustment of the quadrant on the Engine Control, but the setting at the works must not be altered unless a new fuel pump is fitted.

To Time Fuel Pump.

(a) Set control to start position.

(b) Turn flywheel to firing position. When firing mark ⌐¬ on flywheel is opposite centre mark on fan trunking and both valves are closed. 25° before T.D.C. 3-1/16" (77.8 mm.) on the rim of the 14" diameter flywheel, or 3-1/2" on the rim of the 16" diameter flywheel.

(c) Disconnect fuel injector pipe at pump and injector.

(d) Remove delivery valve holder, delivery valve and spring. If fuel flows from pump turn crankshaft forward until flow ceases.

(e) Replace delivery valve holder without valve and spring and lightly tighten.

(f) Turn crankshaft backwards until fuel commences to flow then turn in direction of rotation until flow ceases. Blow fuel from top of holder to make sure flow has ceased. At this position the firing mark on the rim of the flywheel should be opposite the centre mark on the fan trunking. If it is not, the shims below the pump body must be adjusted.

Remove shims to advance.
Add shims to retard.

Shims of .005" and .010" to a total of about .035" are below the fuel pump.

.005" (.125 mm.) Shim=$\frac{3}{16}$" (4.76 mm.) on rim of 14" (35.5 cm.) Flywheel.

Fuel Injector (Pintle Nozzle Type).

The fuel injector, located in the cylinder head, fits into a finned aluminium alloy sleeve. The sleeve is jointed at the bottom on an asbestos joint ring and at the top by a rubber ring which fits into a groove. See page 14.

Main Bearing Housing.

To remove:—

(a) Remove flywheel.
(b) Remove air and exhaust manifold.
(c) Remove air shroud at back of cylinder.
(d) Remove fan impeller trunking (4 setscrews and washers).
(e) Remove crankcase door.
(f) Remove lubricating oil relief valve and oil pipe to main bearing in the housing.

The Housing may now be removed from the crankcase.

Before replacing see the main bearing bush is in correct position—lubricating oil holes in line.

Crankshaft end play must be between .005″ and .009″ (.12/.21 mm) this can be adjusted by the joints and metal shims (always use a paper joint between shims and between shim and casting) between the housing and crankcase.

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FUEL EQUIPMENT

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When priming or checking the fuel pump timing, care must be taken to prevent the overflow of fuel passing into the crankcase.

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Special care must be taken to see there is no leakage from the joints of the fuel pipe connection to the pump.

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(ii) Vent fuel filter. (See Page 13).

(iii) Vent fuel pipe at fuel pump. Turn engine as for Starting i.e 3 to 20 turns until injector 'creaks,' and then attempt to start the engine. If the engine fails to start, a more detailed method of priming must be used as follows:—

(a) Remove cylinder head cover.

(b) Remove fuel injector pipe.

(c) Remove delivery valve holder and spring on pump and slightly raise delivery valve until fuel free from air flows. (At least ¼ pint fuel must be allowed to flow).

(d) Replace delivery valve spring and holder and tighten down.

(e) Connect fuel injector pipe to pump.

(f) Set control to start position.

(g) Turn engine until fuel free from air flows from injector pipe. Secure pipe to injector and continue turning engine until injector 'creaks.'

With the Engine Control in the Run position, and a .010" feeler inserted as shown on Fig. 11, the calibration mark on the Fuel Pump rack must rest against the Fuel Body. This can be secured by an adjustment of the quadrant on the Engine Control, but the setting at the works must not be altered unless a new fuel pump is fitted.

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(c) Disconnect fuel injector pipe at pump and injector.

(d) Remove delivery valve holder, delivery valve and spring. If fuel flows from pump turn crankshaft forward until flow ceases.

(e) Replace delivery valve holder without valve and spring and lightly tighten.

(f) Turn crankshaft backwards until fuel commences to flow then turn in direction of rotation until flow ceases. Blow fuel from top of holder to make sure flow has ceased. At this position the firing mark on the rim of the flywheel should be opposite the centre mark on the fan trunking. If it is not, the shims below the pump body must be adjusted.

Remove shims to advance.
Add shims to retard.

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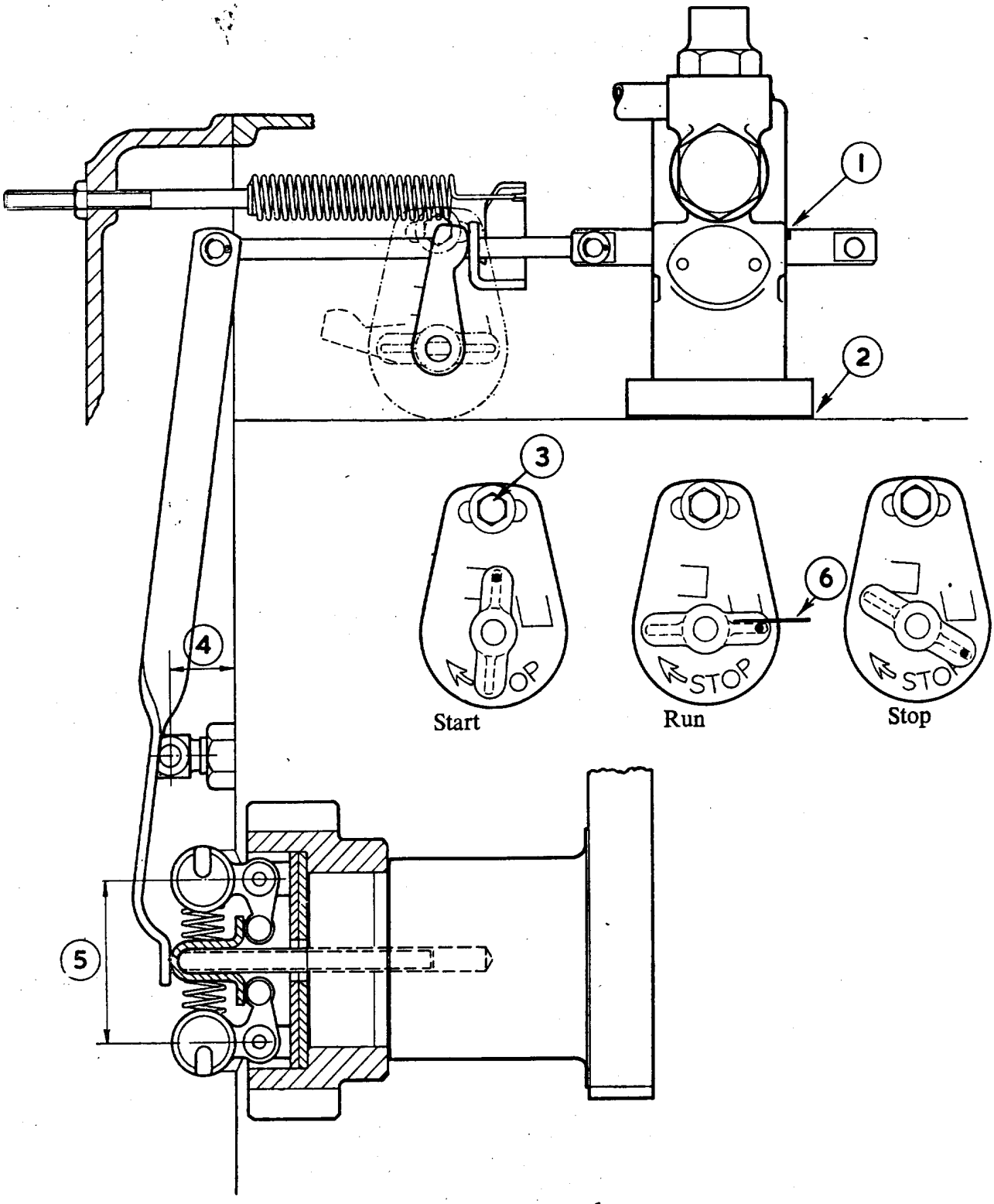

1. Calibration mark, Fuel Pump rack.
2. Fuel Pump Shims.
3. Engine Control Quadrant adjusting screw.
4. Governor Lever Fulcrum Bearing Adjustment—$\frac{3}{4}$ inch.
5. Governor Weight setting—$1\frac{3}{4}$" between centres.
6. .010" Feeler.

Fig. 11. Setting Fuel Pump.

Examine the nozzle if suspected and clean carefully. The use of absolutely clean fuel is essential.

The injector should be set to 160 atmospheres. The nominal pressure is 150 atmospheres, but the higher setting allows for settling.

The injector is secured by a clamp which fits over two studs screwed into the valve rocker bracket. The clamp nuts must be tightened evenly to 12lb. ft. torque ensuring that the clamp is level and bears evenly on the injector. The steel fuel pipe from the pump to the injector **must not** be tightened until the clamp is correctly secured.

To test a nozzle, remove from the cylinder head and turn so that it sprays into the air away from the operator (the spray can easily penetrate the skin).

A perfect spray is in the form of a fine mist and shows no signs of being "streaky" or "dribbling."

On no account must the standard fuel injection pipe from the engine be bent for this test—use a special pipe.

A nozzle must only be cleaned with the necessary special tools and by a qualified service engineer.

There is no joint between the injector and the sleeve.

IMPORTANT

Spare Parts—Directions for Ordering

1. Always quote the Engine No., Part No. and Description of Part when ordering Spare Parts. The Engine No. will be found on the brass plate on the Fuel Pump Housing Door and stamped on the Flywheel Rim.

2. The Engine components have been divided into convenient groups and illustrated. DO NOT quote illustration numbers when ordering.

3. Rotation is Clockwise when looking on either shaft end.

4. Unified Threads are used where applicable throughout the Engine.

PARTS LIST

SEE DIRECTIONS FOR ORDERING—PAGE 22

PLATE I. CRANKCASE.

Illus. No.	Description	Part No.	No. per Engine
	CRANKCASE		
1	Crankcase	201-1001/3	1
2	Camshaft Bush—Gear End	201-1018/1	1
3	,, ,, —Flywheel End	201-1019	1
4	Cylinder Head Stud—Long 7/16" UNF x 11-11/16"	201-1104/2	2
5	,, ,, ,, —Short 7/16" UNF x 9-13/16"	201-1105/2	2
6	,, ,, Cover Stud 1/4" UNF x 1-1/4"	270-120	2
	Drain Plug	27-1815	1
7	Camshaft End Cover	201-1239	1
8	,, ,, ,, Joint	201-1240	1
9	,, ,, ,, Screw 1/4" UNF x 5/8"	270-208	3
10	,, ,, ,, Washer	27-3988	3
11	Crankcase Door	201-1118	1
12	,, ,, Joint	291-2234/1	1
	,, ,, Clamp Bar	291-2320	1
13	,, ,, Setscrew 5/16" UNF	201-1119	1
	,, ,, ,, Joint Washer	616-1608	1
	,, ,, ,, Split Pin	27-2255	1
	,, ,, Washer	291-3063	1
	END COVER		
14	End Cover	201-1120/2	1
15	,, ,, Bush	201-1017/1	1
16	,, ,, Oil Retaining Ring	201-1024	1
17	,, ,, Felt Ring	201-1025	1
18	,, ,, Joint	201-1121/1	1
19	,, ,, Dowel	27-1430	2
20	,, ,, Setscrew 5/16" UNF x 2-1/4"	270-66	7
21	,, ,, Washer	616-1608	7
	CYLINDER BLOCK		
22	Cylinder Block	201-1027/3	1
23	,, ,, Joint	201-1039	1
	FLYWHEEL, FAN & SHROUD		
24	Fan Shroud	201-1042/2	1
25	,, ,, Shim—.010"	201-1246	As Reqd.
	,, ,, ,, —.048"	201-1246/1	,, ,,
26	Flywheel 14" dia. x 2-3/8" face	201-1020/3	1
	,, 16" dia. x 2-3/8" face	201-1020/4	
27	,, Key	S1228	1
28	Fan	201-1054/3	1
29	,, Dowel	201-1076	1
30	,, Setscrew 1/4" UNF x 2-1/2"	270-186	3
31	,, Spring Washer	S451	3
32	Flywheel Retaining Screw	201-1222	1
33	,, ,, ,, Lockwasher	201-1223	1
34	Crankshaft Extension	201-1221	1
35	,, ,, Socket Capscrew 3/8" UNF x 3/4"	270-174	3
	COWLING		
36	Cowling	201-1046/1	1
37	,, Setscrew .190" UNF x 3/8"	270-172	3
38	,, ,, Washer	27-1698	3
39	Side Shield, Governor End	201-1241	1
40	,, ,, Flywheel ,,	201-1242	1

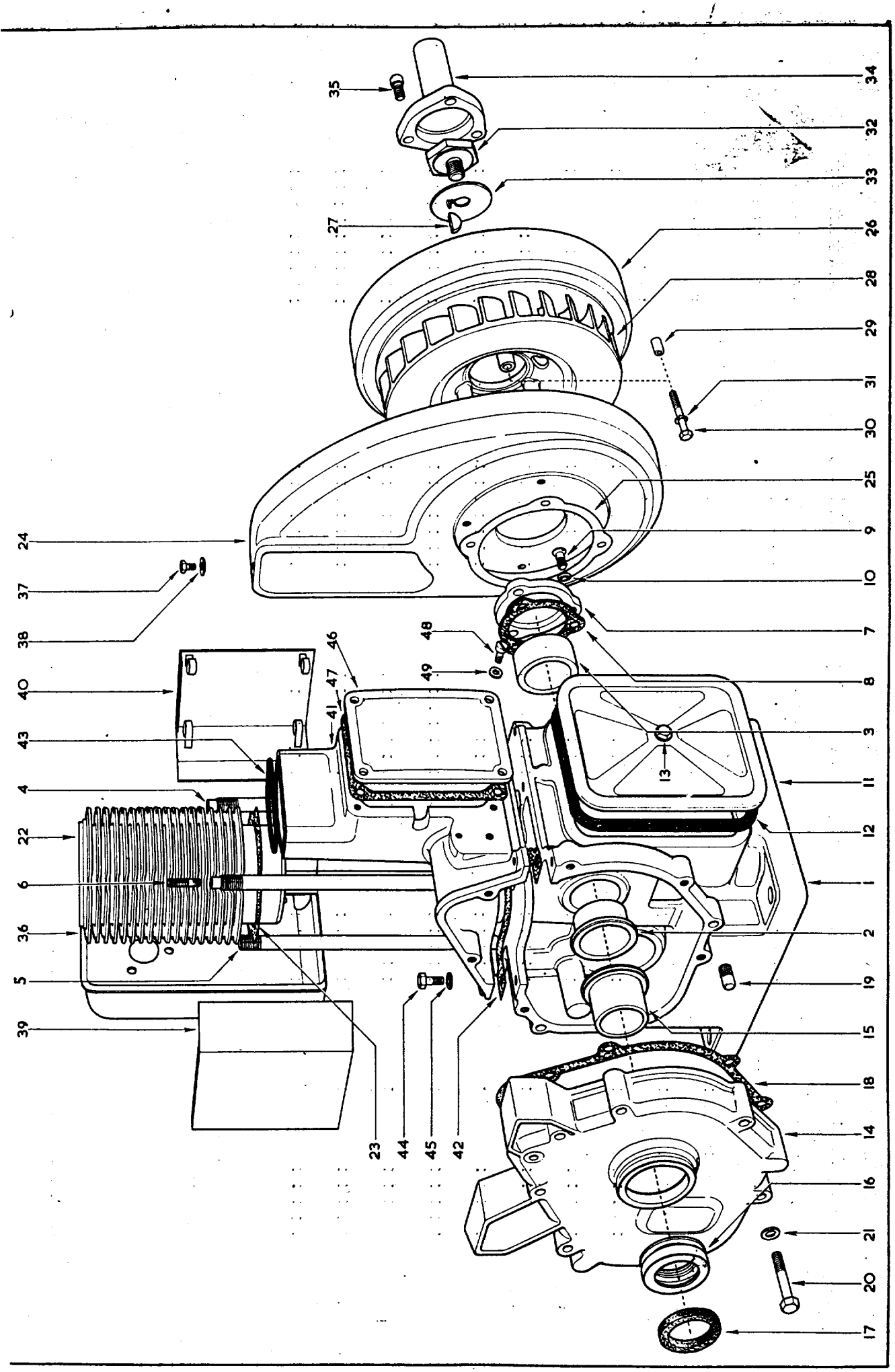

PLATE 1.

CRANKCASE.

PLATE I CRANKCASE (Contd.)

Illus. No.	Description	Part No.	No. per Engine
	FUEL PUMP HOUSING		
41	Fuel Pump Housing	201-1117/4	1
42	,, ,, ,, Joint—To Crankcase	201-1140/2	1
43	,, ,, ,, ,, —To Top Plate	201-1141/3	1
44	,, ,, ,, Setscrew 1/4" UNF x 7/8"	270-114	5
45	,, ,, ,, Washer	291-2609	5
46	,, ,, ,, Door	201-1157/1	1
47	,, ,, ,, ,, Joint	201-1158/1	1
48	,, ,, ,, ,, Screw 1/4" UNF x 5/8"	270-53	4
49	,, ,, ,, ,, Washer	291-2609	4

PLATE II. CRANKSHAFT, CONNECTING ROD & PISTON.

	CRANKSHAFT		
50	Crankshaft	201-1000/8	1
51	,, Balance Weight	201-1014/2	2
52	,, ,, ,, Screw 3/8" UNF x 1-1/2"	270-185	2
53	,, Pinion	201-1114/1	1
54	,, ,, Key	S352	1
55	,, Oil Thrower	201-1224	1
56	,, Thrust Washer	201-1238	2
	MAIN BEARING HOUSING		
57	Main Bearing Housing	201-1007/4	1
58	,, ,, ,, Joint	201-1026/3	1 to 3
59	,, ,, ,, Setscrew 5/16" UNF x 1"	270-61	4
60	,, ,, ,, Shakeproof Washer	27-3929	4
61	Main Bearing	201-1006/3	2
62	Oil Retaining Ring	201-1289	1
63	,, ,, ,, Felt	201-1290	1
	,, ,, ,, Shim .010"	201-1246	As Reqd.
	,, ,, ,, ,, .005"	201-1246/2	,,
	CONNECTING ROD		
64	Connecting Rod	201-1003/1	1
65	,, ,, Bearing	201-1004	1 Pr.
66	,, ,, Bolt 5/16" UNF	201-1005/1	2
67	,, ,, Nut 5/16" UNF	270-154	2
68	,, ,, Bush	201-1015	1
	PISTON		
69	Piston	201-1008/41	1
70	,, Cup	201-1191/11	1
71	,, ,, Insulating Disc	201-1249	1
	,, ,, Insulating Strip	201-1309	1
72	,, Top	201-1187/11	1
73	,, Ring 5/32" Taper	201-1231	1
74	,, ,, 3/32"	201-1012/1	2
75	,, Scraper Ring	201-1013	2
76	Gudgeon Pin Not supplied without the Piston	201-1009	1
77	,, ,, Circlip	201-1010	2

Not supplied separately

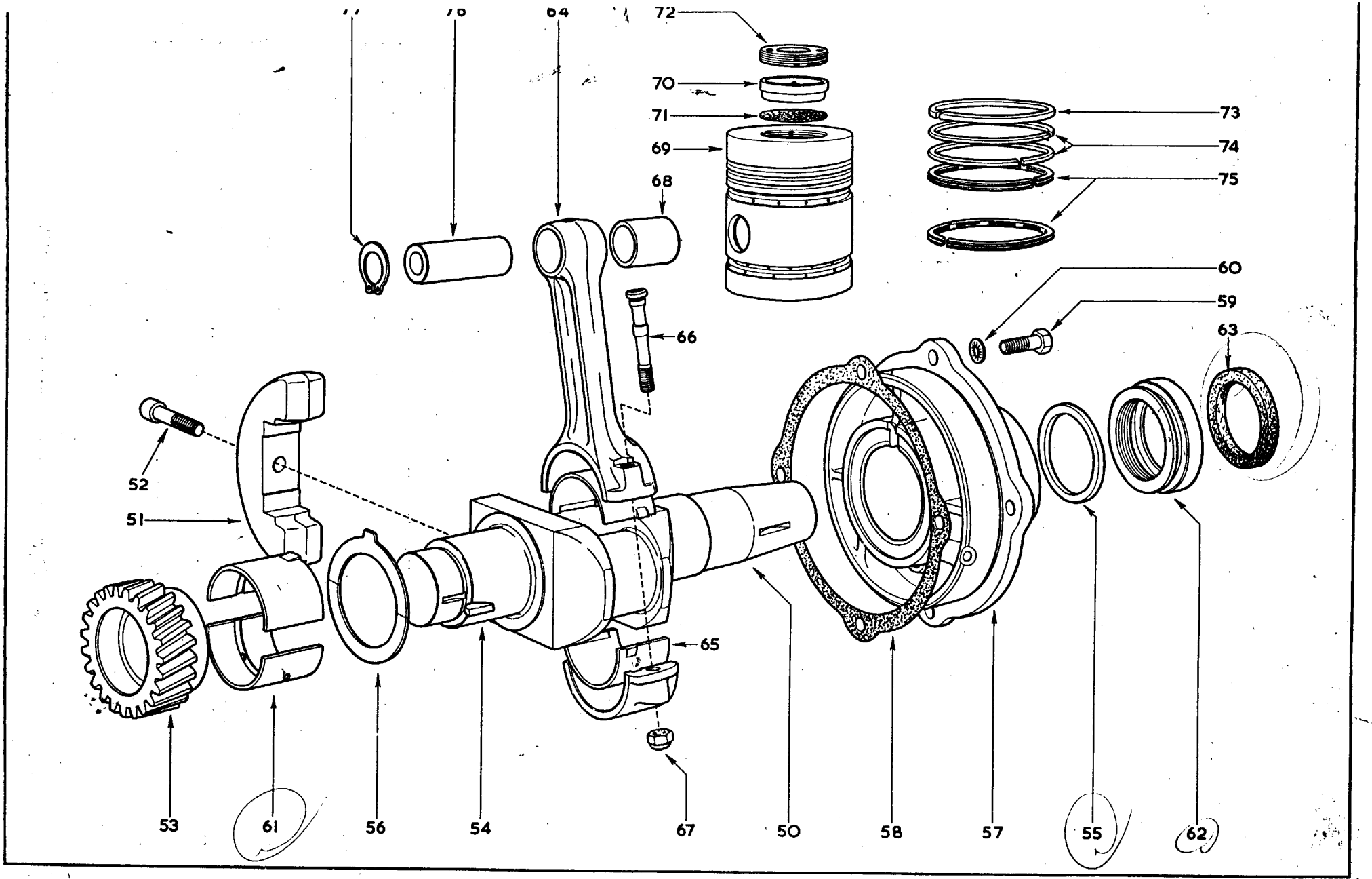

PLATE II. CRANKSHAFT, CONNECTING ROD & PISTON.

PLATE. III. CAMSHAFT, FUEL PUMP & GOVERNOR.

Illus. No.	Description	Part No.	No. per Engi
	CAMSHAFT & GEARWHEEL		
78	Camshaft and Gearwheel Assembly	201-1133/1	1
79	Valve Tappet	291-2131	2
80	Push Rod	201-1031/1	2
	FUEL PUMP		
81	Fuel Pump CAV BPF1A60AS6258 (6 mm.)	201-1151	1
	Fuel Pump Delivery Valve	CAV7033/101A	
	" " " " Holder	CAV7003A/97	
82	" " Shim .005"	201-1152	As Reqd.
	" " " .010"	201-1153	" "
83	" " Clamp	201-1154	1
84	" " " Bolt 5/16" UNF x 1-3/4"	270-64	1
85	" " " " Washer	201-1156	1
86	Guide for Fuel Pump Tappet	201-1147/1	1
87	" Locating Pin	201-1148/1	1
88	" " " Washer	616-1608	1
	Fuel Pump Tappet complete comprising:—	201-1143/1C	1
89	Fuel Pump Tappet	201-1143/1	1
90	" " " Cap	201-1144	1
91	" " " Roller Pin	201-1145/1	1
92	" " " " Bush	291-2255	1
93	" " " "	291-2256	1
94	Retaining Pin for Roller Pin	201-1146	1
95	Locating Plate for Control Lever	201-1237	1
96	" " Screw .190" UNF x 1/2"	270-103	1
97	" " Spring Washer	27-717	1
98	Control Lever Spindle Assembly	201-1236	1
	" " " Joint Ring	201-1312	1
99	" " Spring	201-1233	1
100	" Lever	201-1232	1
101	" " Nut 1/4" UNF	270-2	1
102	" " Spring Washer	27-451	1
103	Washer	27-1698	1
	GOVERNOR		
104	Governor Weight Carrier Assembly	201-1071	1
105	" Weight up to 1700 RPM	201-1073	2
	" " over 1700 RPM	201-1296	2
106	" " Pin	201-1072	2
107	" " Boot	201-1074	2
108	" " Carrier Setscrew 1/4" UNF x 5/8"	270-23	2
109	" " Spring 900-1300 R.P.M.	S451	2
	" " Spring 1400-1800 R.P.M.	201-1082/1	2
110	" " Spring	201-1082	2
111	" Sleeve Assembly	201-1080	1
112	Governor Lever Assembly	201-1084/1	1
113	" " Fulcrum	201-1083	1
114	" " " Nut 3/8" UNF	270-4	1
115	" " " Washer	S618	2
116	" " " Split Pin	27-2255	1
117	" Link Assembly	201-1089/1	1
118	" " Washer	64-2580/4	2
119	" " Split Pin	27-1986	2
	" Speeder Spring 900-1000 R.P.M.	201-1090/3	1
120	" Speeder Spring 1100-1800 R.P.M.	201-1090	1
121	" Adjusting Screw .190" UNF x 2-1/2"	270-112	1
122	" " " Nut .190" UNF	270-1	1

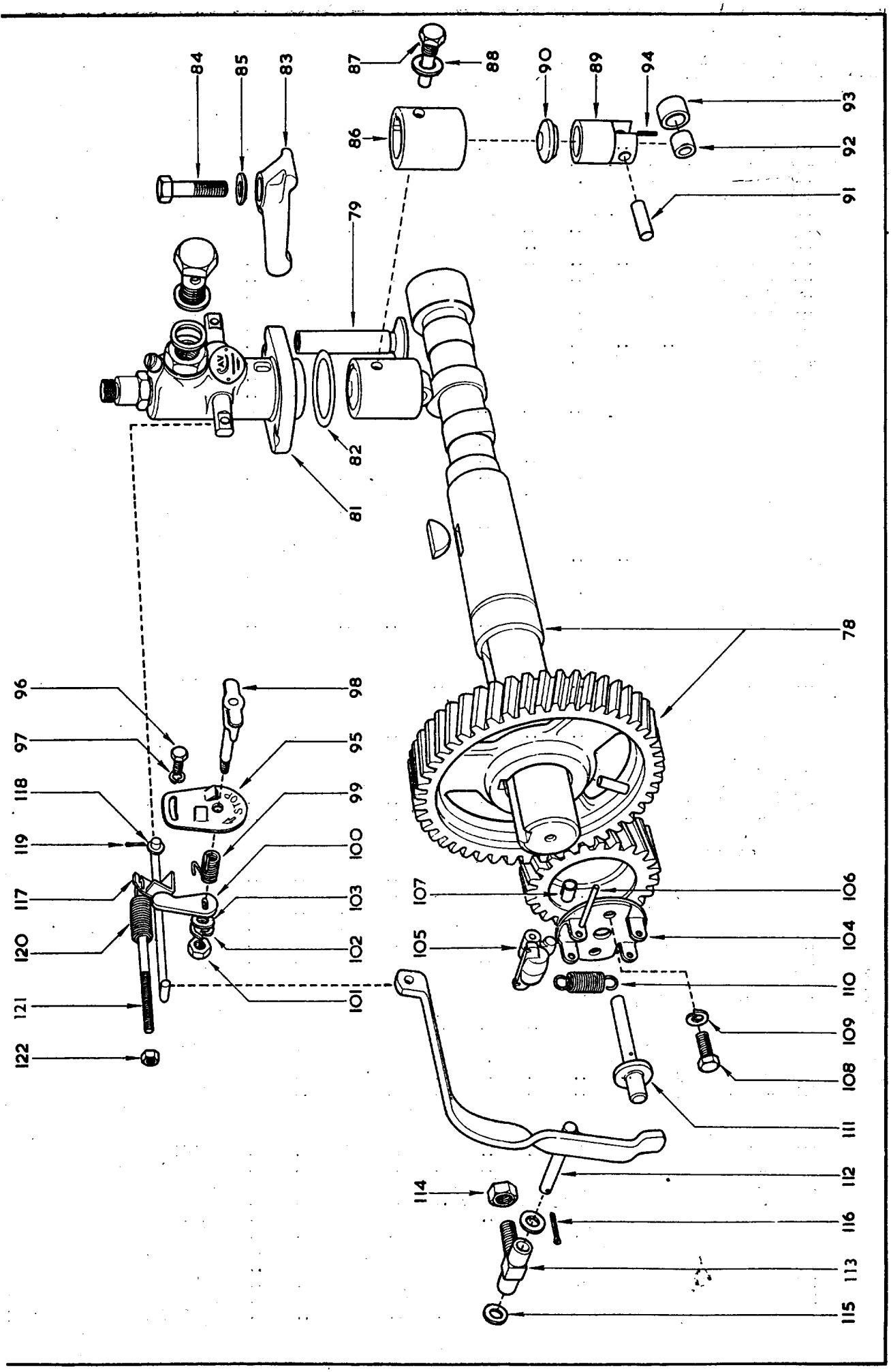

PLATE III. CAMSHAFT, FUEL PUMP & GOVERNOR.

PLATE IV. CYLINDER HEAD & FITTINGS.

Illus. No.	Description	Part No.	No. per
	CYLINDER HEAD		
123	Cylinder Head	201-1002/8	
124	,, ,, Gasket	201-1038/2	
125	,, ,, Shim	201-1230	As
126	,, ,, Top Plate	201-1050/4	
127	,, ,, Nut 7/16" UNF	270-5	
128	,, ,, Washer	201-1189	
129	Oil Seal Ring for Valve Guide	616-1742	
130	Inlet Valve Guide	201-1040	
131	Exhaust Valve Guide	201-1032	
132	Inlet and Exhaust Valve	201-1036/3	
133	Valve Spring—Outer	291-2064	
134	,, ,, —Inner	291-2065	
135	Valve Collet	204-189	2 F
136	,, Spring Carrier	201-1035	
137	Rocker Bracket R.H. Exhaust	201-1052/3	
	,, ,, L.H. Inlet	201-1053/3	
139	,, ,, Joint	201-1190/1	
140	,, ,, Setscrew 1/4" UNF x 7/8"	270-114	
141	,, ,, Spring Washer	S451	
142	Injector Clamp Stud 5/16" UNF	201-1106/1	
143	Valve Rocker Lever	201-1029/1	
144	,, ,, ,, Bush	291-2070	
145	,, ,, ,, Adjusting Screw 5/16" UNF	292-167	
146	,, ,, ,, Nut 5/16" UNF	270-3	
147	,, ,, ,, Circlip	201-1163	
148	Injector Sleeve	201-1093/8	1
149	,, ,, Oil Seal Ring	201-1108	1
150	,, ,, Washer	201-1172	1
151	Breather Assembly	201-1098/2	1
152	,, Cap	201-1226/1	1
	FUEL INJECTOR		
153	Fuel Injector	201-1177	1
	Comprising { Nozzle Holder BKB80SD629	201-1205	1
	{ Nozzle BDN12SD12	201-1206	1
154	Fuel Injector Clamp	201-1092/3	1
155	,, ,, ,, Nut 5/16" UNF	270-3	2
156	,, Pipe—Pump to Injector	201-1111/1	1
157	Union for Leak-Off Pipe	201-1169	1
158	Fuel Leak-Off Pipe	201-1110/1	1
159	,, ,, ,, ,, Bush	201-1109	1
	CYLINDER HEAD COVER		
	Cylinder Head Cover, comprising	201-1091	1
160	Cover	201-1049	1
161	Oil Filler	27-3821	1
162	Decompressor Shaft	201-1095	1
163	,, Lever	201-1097	1
164	,, Spring	201-1227	1
165	,, Screw 1/4" UNF x 1-3/16"	201-1096	1
166	,, ,, Nut 1/4" UNF	270-2	1
	"Mills" Pin for Decompressor Lever	201-1173	1
167	Cylinder Head Cover Joint	201-1051	2
168	,, ,, ,, Nut 1/4" UNF	270-2	2
169	,, ,, ,, Washer	27-618	2
170	Oil Filler Cap	27-3824	1
171	,, ,, ,, Joint	303-253	1
	INLET & EXHAUST MANIFOLD		
172	Inlet and Exhaust Manifold	201-1112/1	1
173	,, ,, ,, ,, Joint	201-1113	1
174	,, ,, ,, ,, Bolt 1/4" UNF	270-113	3
175	,, ,, ,, ,, Spring Washer	S451	3
176	Exhaust Silencer	D301	1
177	,, ,, Pipe	S431	1
178	Air Cleaner	201-1142/1	1
179	,, ,, Clip	27-4028	1
180	Oil Reservoir	201-1293/1	1
181	,, ,, Plunger	201-1294/1	1
182	,, ,, Grommet	201-1295/1	1

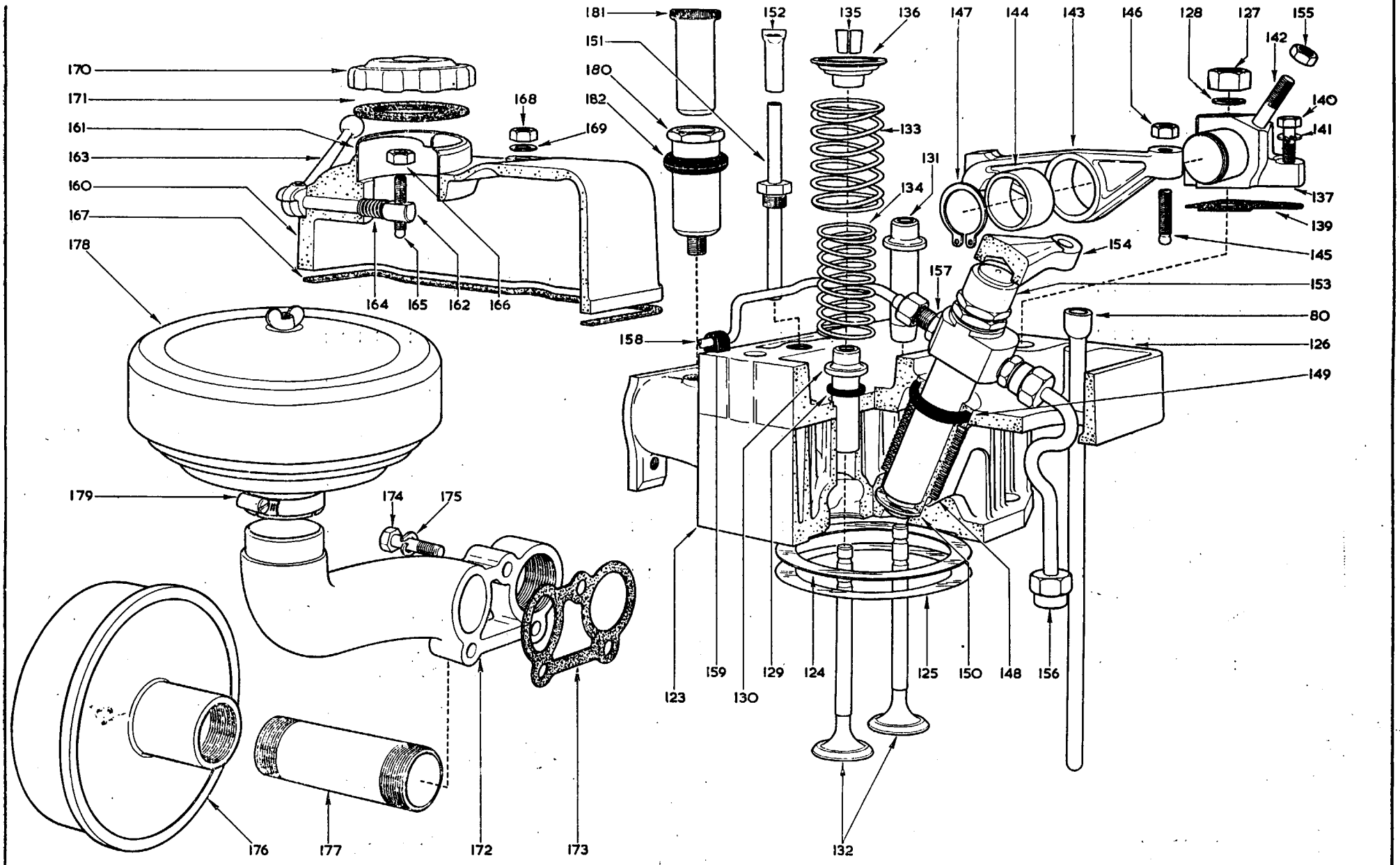

PLATE IV.

CYLINDER HEAD & FITTINGS.

PLATE V. LUBRICATING OIL SYSTEM.

Illus. No.	Description	Part No.	No. per Engine
	LUBRICATING OIL PUMP		
183	Oil Pump Tappet	201-1065/1	1
184	,, ,, Plunger	201-1060/2	1
185	,, ,, ,, Ball Valve	210-393	1
186	,, ,, ,, ,, ,, Spring	D100	1
187	,, ,, Delivery Valve Seat	201-1063	1
188	,, ,, Return Spring	201-1245	1
189	,, ,, ,, ,, Washer	201-1066	1
190	,, ,, ,, ,, Circlip	201-1067	1
191	,, ,, Plug	201-1061	1
192	,, ,, Ball Valve	210-393	1
193	,, ,, Suction Valve Retainer	201-1062	1
194	,, ,, Plug Joint Washer	291-3064	1
	LUBRICATING OIL RELIEF VALVE		
195	Support for Valve Body	201-1134	1
196	Valve Body	201-1254	1
197	Valve	201-1255/1	1
198	,, Spring	201-1256/1	1
199	,, ,, Cap	201-1257	1
200	,, ,, Split Pin	27-2252	1
201	Lubricating Oil Pipe to Main Bearing	201-1137/1	1
202	,, ,, ,, ,, ,, ,,	201-1186/1	1
203	Gland Nut for Rocker Feed Pipe	201-1138	1
204	,, ,, Packing Washer	201-1139	1
205	Lubricating Oil Pipe—Pump to Tee	201-1208/1	1
206	,, ,, ,, Bush	201-1228	1
207	,, ,, ,, Tee	201-1166/2	1
208	,, ,, ,, ,, to Rocker Bracket	201-1165/2	2
	LUBRICATING OIL STRAINER		
209	Lubricating Oil Strainer	201-1077/1	1
210	,, ,, ,, End Cap	201-1078	1
211	,, ,, ,, Retaining Pin	201-1079	1
212	,, ,, ,, ,, ,, Spring	291-2195	1
213	,, ,, ,, Split Pin	27-2255	1
	Dipstick	201-1321	1

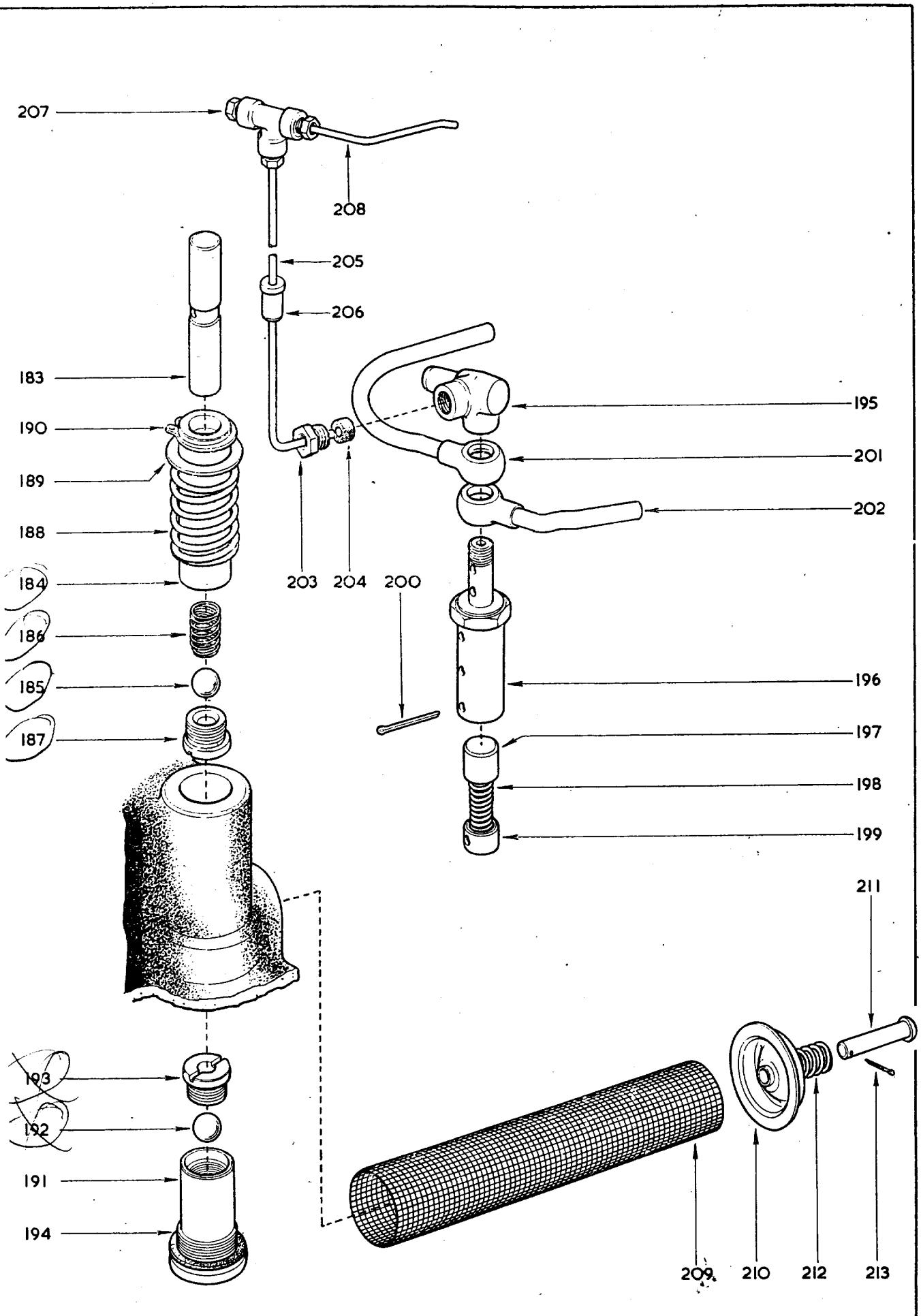

PLATE V. LUBRICATING OIL SYSTEM.

PLATE VI. FUEL FILTER & TANK.

Illus. No.	Description	Part No.	No. per Engine
	FUEL FILTER		
214	**Fuel Filter**	201-1161/1	1
215	,, ,, **Element** C/W Four Joints	201-1311	1
216	,, ,, **Bracket**	201-1126/6	1
217	,, ,, ,, **Bolt** 1/4" UNF x 3/4"	270-55	3
218	,, ,, ,, **Nut** 1/4" UNF	270-2	3
219	,, ,, ,, **Washer**	291-2609	3
220	**Fuel Pipe**—Tank to Filter	201-1167/3	1
221	**Swivel Union Plug**	2-508	2
222	,, ,, ,, **Joint Washer**	291-3062	4
223	**Fuel Pipe**—Filter to Pump	201-1164/3	1
224	,, ,, **Bush**	201-1127/1	1
225	,, ,, **Venting Setscrew** .190" UNF x 3/8"	270-172	1
226	,, ,, ,, ,, **Washer**	616-1601	1
227	,, ,, **Joint Washer**	201-1297	2
	FUEL TANK		
228	**Fuel Tank**	201-1128/2	1
229	,, **Filler Cap**	27-3824	1
230	,, ,, ,, **Joint**	303-253	1
231	**Grommet** for Leak-Off Pipe	201-1171	1
232	**Fuel Tank Block**	201-1149/1	2
233	,, ,, **Strap**	201-1150/2	2
234	,, ,, ,, **Screw** 1/4" UNF x 1-3/4"	270-119	2
235	,, ,, ,, **Nut** 1/4" UNF	270-2	2
236	,, ,, ,, **Washer**	S618	4
237	,, ,, **Pad**	201-1229	2

ACCESSORIES

	STARTING HANDLE		
	Starting Handle, complete, comprising	201-1251	1
	,, ,, **Crank**	201-1250	1
	,, ,, **Clutch Pin**	A125	1
	,, ,, ,, ,, **Spring**	A126	1
	,, ,, **Split Pin**	S120	1
	,, ,, **Wood Grip**	3364	1
	,, ,, **Quill Iron**	201-1252	1
	,, ,, **Washer**	S85	1
	PULLEY		
	Bolt on Flywheel without the Extension Shaft		
	Pulley 3-1/4" diameter x 4-1/2" face	201-1333	
	,, 4" ,, x 4-1/2" ,, ...	*201-1334	
	,, 5" ,, x 4-1/2" ,, ...	*201-1335	
	,, 6" ,, x 4-1/2" ,, ...	*201-1336	
	,, 7" ,, x 4-1/2" ,, ...	201-1337	
	,, 8" ,, x 4-1/2" ,, ...	201-1338	
	Stud 3/8" UNF x 1-1/4"	270-111	1
	Nut 3/8" UNF	270-4	3
	Spring Washer	27-393	3
	Key-on Half Speed Shaft		
	Pulley 5" diameter x 4-1/2" face	*201-1339	
	,, 6" ,, x 4-1/2" ,, ...	*201-1340	
	,, 7" ,, x 4-1/2" ,, ...	201-1341	
	,, 8" ,, x 4-1/2" ,, ...	201-1342	
	Key for Pulley	S353	1
	Setscrew	270-60	1
	* Standard Sizes		
	COUPLING		
	Coupling **Studs** 3/8" U.N.F.	201-1280	3
	Tab Washers	201-1317	3
	Self Locking **Nuts** 3/8" U.N.F.	270-159	3
	Coupling rough bored 3/4" dia	1/1172	1
	,, **disc**	Y307	1
	,, **Bolts**	S201	3
	,, **Washers**	S184	3
	,, **Nuts**	S6	3

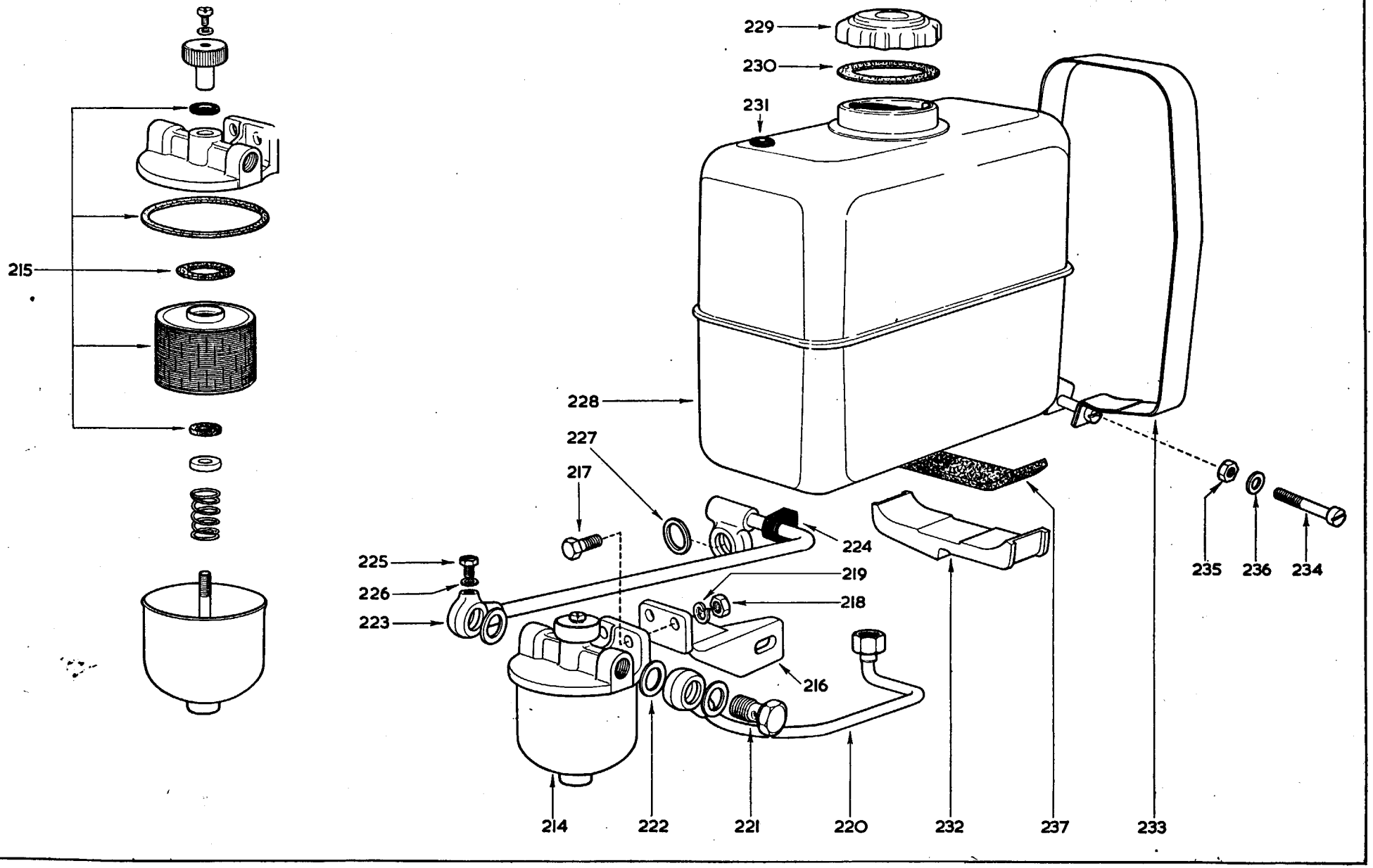

PLATE VI.

FUEL FILTER & TANK.

LIST OF JOINTS FOR TYPE LD ENGINE

Ordering Reference No. List SP 880

Description	Part No.	Material	No. per set
Camshaft End Cover	201-1240	Fibre	1
Control Spindle Ring	201-1312	Rubber	1
Crankcase Door	291-2234/1	Rubber	1
Cylinder Head Cover	*201-1051	Cork & Paper	2
Cylinder Head Nuts	*201-1189	Copper	4
Cylinder Block	*201-1039	Paper	1
Cylinder Head Gasket	*201-1038/2	Copper	1
Cylinder Head Shim	*201-1230	Copper	3
End Cover	201-1121/1	Paper	1
Fuel Pump Housing	201-1140/2	Fibre	1
Fuel Pump Housing Door	201-1158/1	Cork	1
Fuel Pump Inlet Union	201-1297	Steel & Rubber	2
Fuel Pump Housing	201-1141/3	Rubber	1
Fuel Swivel Union Plug	291-3062	Copper	4
Fuel Vent Screw	616-1601	Copper	1
Injector Sleeve	*201-1172	Fibre	1
Injector Sleeve Oil Seal	*201-1108	Rubber	1
Inlet & Exhaust Manifold	*201-1113	Fibre	1
Lub. Oil Pump Plug	291-3064	Copper	1
Main Bearing Housing	201-1026/3	Paper	3
Oil Drain Plug	*291-3063	Copper	1
Oil Filler & Fuel Tank Cap	303-253	Cork	2
Oil Reservoir Grommet	*201-1295/1	Rubber	1
Rocker Bracket	*201-1190/1	Paper	2
Valve Guide Seal Ring	616-1742	Rubber	2
Valve Rocker Oil Pipe Gland Nut	201-1139	Rubber	1

* Joints for Decarbonising.