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(Superseding AP 2173D, Vol.1 & 6, Sect.2, Chap.2)

PETTER DIESEL ENGINE
Type PD3

GENERAL AND TECHNICAL INFORMATION
ILLUSTRATED PARTS CATALOGUE
REPAIR AND RECONDITIONING INSTRUCTIONS

BY COMMAND OF THE DEFENCE COUNC

Michael Cary

Ministry of Defence

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CONTENTS

PETTER DIESEL ENGINE, TYPE PD3

CONTENTS

TABLES

ILLUSTRATIONS

LEADING PARTICULARS

No.of cylinders	3
Bore	4·5 in. (114·3 mm)
Stroke	4·33 in. (110 mm)
Cubic capacity	207 in^3 (3387 ccs)
Power output (manufacturer's continuous ratings (B.S.649))	
	24 b.h.p. at 1200 rev/min
	30 b.h.p. at 1500 rev/min
	36 b.h.p. at 1800 rev/min
Compression ratio	16 to 1
Compression pressure	433 lb/in^2
Maximum firing pressure	1050 lb/in^2
Governor	Engine-mounted, centrifugal
Fuel system	
Injection pump	Bryce C3RA80A 01S1011
Nozzle	Bryce HL130S30C391
Nozzle holder	Bryce AL97SD233
Injection release pressure	2500 lb/in^2
Injection timing (spill)	
Up to 1499 rev/min	28 deg. before T.D.C.
1500-1800 rev/min	32 deg. before T.D.C.
Firing order	1,3,2 (from gear end)
Feed pump	AC-Delco E/FP.61532A
Fuel filter	Cooper Type 566
Air cleaner	Burgess OBBR 070/7
Lubrication	
Oil (fuel injection pump)	OEP-220 (Ref. No. 34D/9100542)
Oil (engine)	OMD-110 (Ref. No. 34D/9100581, Nato Code No. O-180)
System	Force feed, full flow filtration
Oil pressure (hot)	40 lb/in^2
Oil filter	Purolator MF4300
Sump capacity	
Deep sump	4¼ gallons
Shallow sump	3 gallons
Grease (fan bearings)	XG-271 (Ref. No. 34D/9100511 Nato Code No. G-382)
Electrical equipment	
Starter motor	C.A.V. BS512P-117
Generator	C.A.V. D45 DN 59
Valve timing	
Inlet valve opens	10 deg. before T.D.C.
Inlet valve closes	35 deg. after B.D.C.
Exhaust valve opens	45 deg. before B.D.C.
Exhaust valve closes	10 deg. after T.D.C.
Valve clearance (both valves - cold)	0·010 in.
Bumping clearance (piston crown to cylinder head)	0·031-0·039in.
Weight (standard engine - dry)	1124 lb

DESCRIPTION

General

1. The Petter PD3 engine (fig. 1, 12, 17, 18) is a three-cylinder four-stroke direct-injection diesel engine with pushrod-operated overhead valves, individual cylinders and detachable cylinder heads. It is air-cooled by a belt-driven axial-flow fan and partially enclosed in cowling which directs the air stream around the cylinders and heads. In general, Unified threads are used except for such parts as pipes and pipe unions and some items of auxiliary equipment.

2. The speed range is 1200 - 1800 rev/min with power output between 24 and 36 b.h.p. (manufacturer's continuous rating according to B.S.649:1958). The engine is controlled by an enclosed centrifugal governor which is suitable for variable-speed or fixed-speed applications.

3. All standard engines have a detachable starting handle and decompressor mechanism and can be fitted with 12-volt electric or hydraulic starting equipment. An axial starter motor, generator and voltage control are included in the electrical equipment. The voltage control and ammeter are mounted on the engine instrument panel which also carries an oil pressure gauge and (on some engines) a tachometer and the engine controls.

4. The direction of rotation is clockwise at the gear end of the engine and the power is usually taken from the flywheel end through a flexible coupling, an extension shaft or a clutch. If required, however, a direct drive of up to 24 b.h.p. may also be taken from the crankshaft at the gear end provided that the rating of the engine is not exceeded.

Note...

> The gear end of the engine is regarded as the front; right and left, where used in this text, are appropriate when looking at the engine from the front. No. 1 cylinder is at the gear end.

Crankcase, cylinders and cylinder heads

5. The crankcase is a monobloc iron casting with internal stiffening webs which support the camshaft and crankshaft, the latter being mounted in split main bearings. On the exterior of the crankcase are machined faces for such external fittings as the fuel feed pump and engine support brackets. A partial vacuum is produced in the crankcase by connecting it to the air intake ports via the pushrod tubes, rocker boxes and tubes inserted in the cylinder heads.

6. Each cylinder is a centrifugal casting, finned to provide a large cooling surface and of symmetrical form for uniform expansion. Separate cast-iron cylinder heads are fitted and, like the cylinders, the heads are finned for efficient cooling. The air inlet ports are directional, being designed, in conjunction with masked inlet valves, to promote swirl in the combustion chambers. Each cylinder and its head are secured to the crankcase by high-tensile steel studs and nuts.

Crankshaft and main bearings

7. The crankshaft is a mechanite casting embodying integral balance weights, four main journals and three cranks at 120 deg. It is mounted in precision-finished split steel shells lined with bearing metal. Crankshaft end thrust is taken by steel washers fitted in recesses on each side of the flywheel end

main bearing, each washer being faced with bearing metal and located by tonques which fit into slots in the bearing cap. A removable journal is fitted to the gear end of the crankshaft; this journal, which runs in a bearing supported in the timing gear cover, carries the generator belt driving pulley and the starting handle dog.

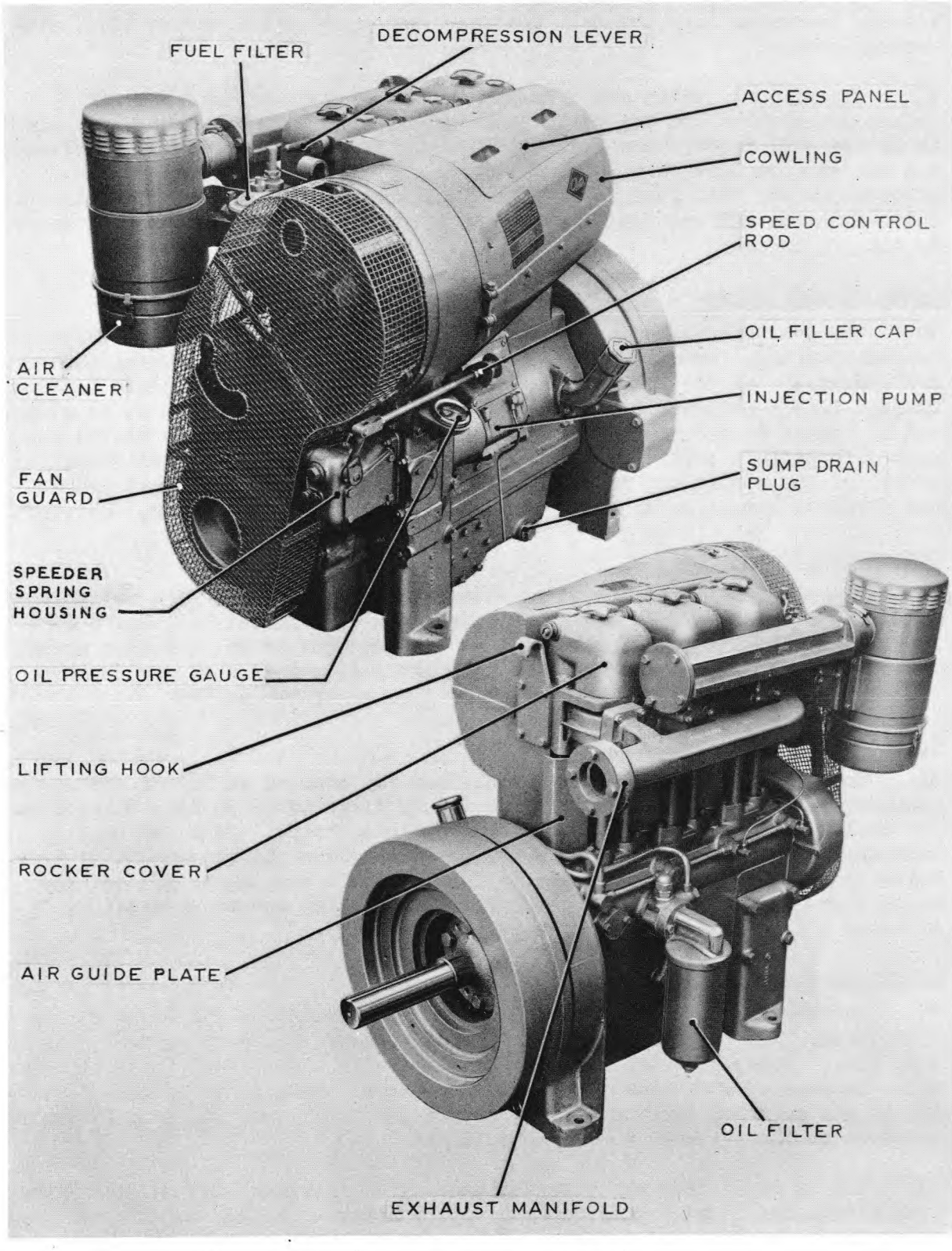


Fig. 1 Petter PD3 engine

Connecting-rods and pistons

8. The connecting-rods and caps are steel forgings, each rod assembly consisting of mated parts; to guide assembly, mating parts are stamped with the same serial number. Each end cap is scarfed and the joint face is inclined at 45 deg. to allow the rod to be withdrawn through its cylinder port. A phosphor-bronze bush is fitted in the connecting-rod small end while the big-end bearings, like the main bearings, are split steel shells lined with bearing metal.

9. The pistons, which are of aluminium alloy, have a hemispherical combustion chamber and two valve recesses machined in the crown. Each piston is fitted with three compression rings, the top ring being chromium plated, and two slotted scraper rings, one scraper ring being fitted above the gudgeon pin and the other at the bottom of the skirt. The gudgeon pins are fully-floating and retained in position by circlips which register in grooves in the pin bosses.

Camshaft and valves

10. The camshaft, which is mounted on the left of the engine and driven by helical gearing, operates the valves through conventional tappets, pushrods and rockers. At the gear end the camshaft is supported in a plain bearing pressed into a detachable housing (fig. 21) and at other points it is supported in bushes housed in the crankcase wall or webs. The inlet valves are masked to promote swirl in the combustion chamber and, to prevent these valves rotating, the spring cup on each inlet valve is located by a split pin and has a forked extension which locates on a peg screwed into the cylinder head.

Decompressor

11. A decompression mechanism is fitted to each cylinder. The mechanism consists of a screwed ped and shaft mounted in each rocker box, and a hand lever fitted to one end of the shaft at the gear end of No. 1 rocker cover. The shafts are coupled and when the hand lever is raised the pegs depress the exhaust valve rockers, so preventing closure of the valves.

Cooling

12. The engine is cooled by an axial-flow fan mounted on top of the timing gear cover. The air stream from the fan is directed by cowling through an oil cooler and around the cylinders and cylinder heads. Ball and roller bearings support the fan shaft, which is driven from the crankshaft by twin belts. A relief valve is fitted to the fan shaft housing to protect the seals when greasing the bearings. The belt tension can be adjusted by altering the position of an idler pulley (fig. 13).

Lubricating system (fig.2)

13. The engine is force-lubricated through a continuous full-flow system of filtration, the pressure being supplied by a gear-type pump submerged in the sump oil. Heavy-duty engines may be fitted with a deep sump (capacity 4¼ gal) instead of the three-gallon standard sump. An adjustable relief valve and an oil pressure gauge are incorporated in the system. At normal running temperature the pressure should be 40 lb/in^2.

14. Oil is drawn into the pump through a gauze strainer and on leaving the pump circulates through a filter and cooler before reaching an external pipe which forms the main oil gallery. From here it is distributed to the camshaft bearings and main bearings and main bearings through drillings in the crankcase. The removable journal and big-end bearings are supplied in the

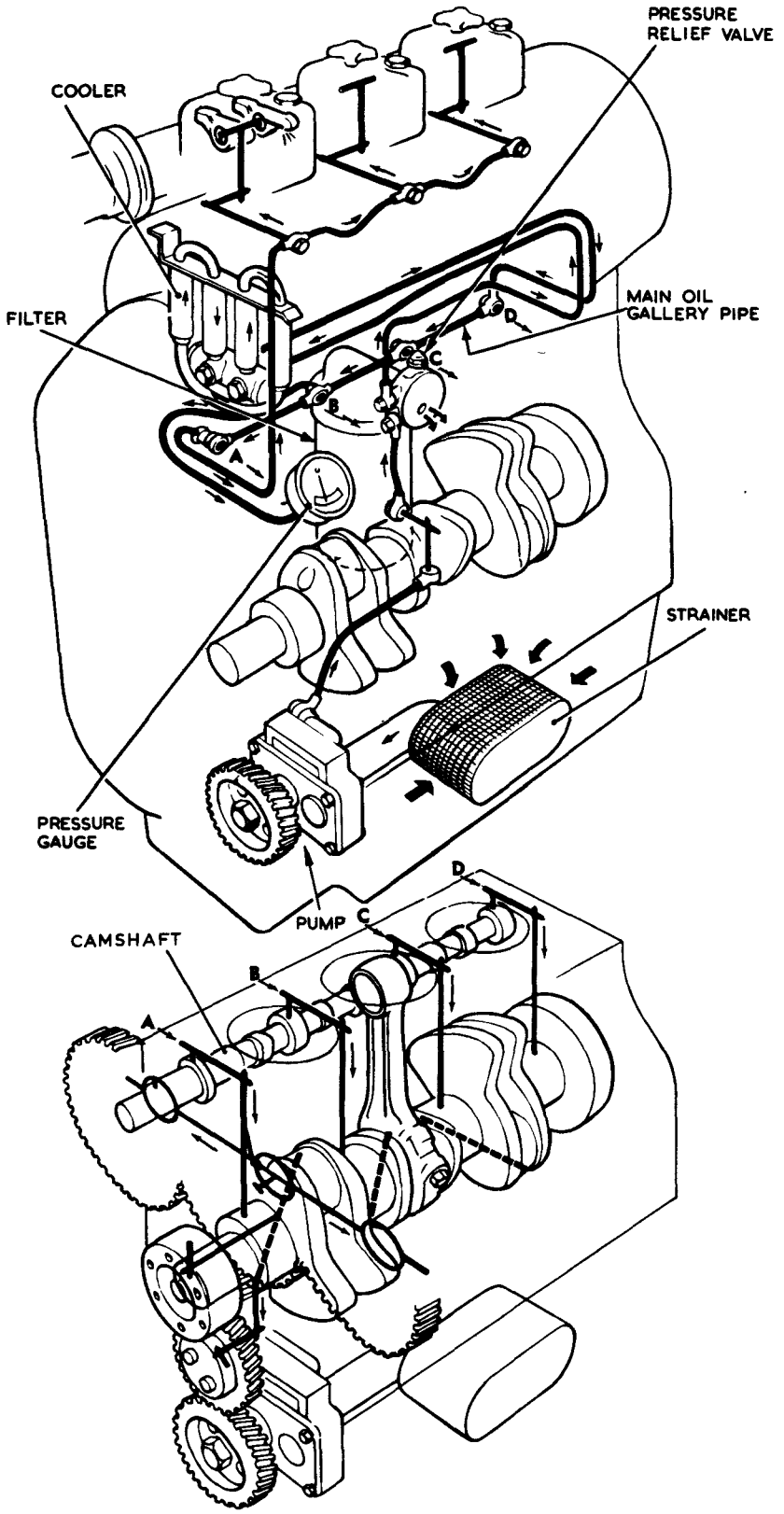


Fig. 2 Lubrication diagram

conventional manner by crankshaft drillings, while the gudgeon pins and cylinder walls are lubricated by splash. The rocker gear is lubricated by oil piped from the cooler to a gallery pipe along the cylinder heads and thence by drillings to each rocker. On the outside of each rocker arm bush there is a shallow vee-sectioned groove through which oil is metered to a drilling in the rocker arm and thence to the valve stems and springs. The fan and fuel pump drives are supplied from the main oil gallery by pipes and drillings.

Oil pump (fig. 25)

15. The lubricating oil pump, which is of the gear type, is submerged in the sump oil and driven from the timing gear train by a helical gearwheel. The pump intake is protected by a gauze strainer mounted on the inside of a plate secured to the side of the sump; this arrangement permits the strainer to be removed for cleaning without removing the sump.

Oil filter (fig. 3)

16. A Purolator MF4300 lubricating oil filter is connected into the delivery side of the pump and at running temperature all the oil circulated by the pump passes through the element. A relief valve permits oil to bypass the element when the pressure difference between inlet and outlet oils is 10 - 15 lb/in^2. This ensures that an adequate supply of oil will be circulated under cold conditions at starting when the viscosity of the oil may prevent it passing through the element. The valve also acts as a safeguard if the element becomes choked with dirt. The element is of the paper throw-away pattern which must be renewed when it becomes fouled.

Oil pressure relief valve (fig. 4)

17. An adjustable pressure relief valve is fitted to the oil filter adapter. The valve is set by the engine maker to operate at 40 lb/in^2 and should not require further adjustment unless the engine has been reconditioned. No attempt should be made to correct low oil pressure by adjustment of the relief valve; at normal running temperature small variations from the standard pressure are of no consequence but large fluctuations or low oil pressure (say a drop of about 8 lb/in^2) must be reported for workshop action.

Oil Cooler

18. The cooler, which is of gilled tube construction, is mounted behind the fan and thus lies in the air stream.

Fuel system

Fuel tank

19. The fuel tank is not a standard fitting and its design, location and capacity depend upon the equipment to which the engine is fitted.

A.C. fuel feed pump (fig. 14)

20. The fuel system may be gravity-fed or incorporate a feed pump. The feed pump, which is of the mechanically-operated diaphragm type incorporating a hand priming lever, supplies fuel to the injection pump at constant pressure. It is mounted on the side of the crankcase and operated by an eccentric on the engine camshaft. Full details of the construction and operation of A.C. fuel pumps are given in A.P.1464E, Vol. 1, Part 1, Sect. 2, Chap. 2.

1 Circlip
2 Spring seating washer
3 Relief valve spring
4 Relief valve
5 Filter head
6 Seal
7 Central tube
8 Filter element
9 Seal
10 Spring seating washer
11 Seal
12 Reinforcing plate
13 Spring
14 Element lower guide
15 Circlip
16 Sump
17 Central bolt
18 Element upper guide

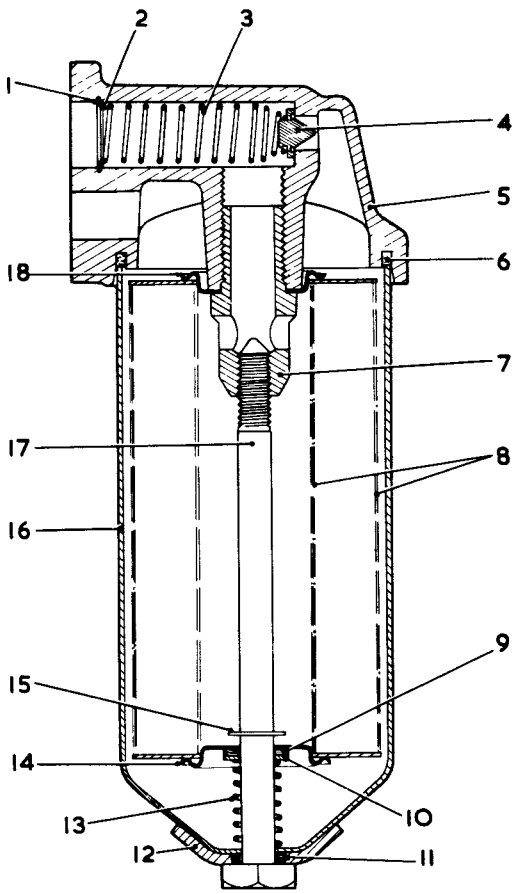


Fig. 3 Oil filter

21. At all engine speeds the pump is capable of delivering more fuel than the engine requires and when the fuel lines on the delivery side are full the fuel in the chamber prevents the return stroke of the diaphragm, which is then held at or about the bottom of its stroke. Under these conditions the butting faces of the rocker arm (18) and link (17), which must be in contact to transmit movement, are in contact only when the rocker arm is at or near the limit of its movement and the motion imparted to the diaphragm is then sufficient only to replace the fuel consumed by the engine.

Main fuel filter (fig. 5)

22. The main fuel filter is located between the feed pump and the injection pump or, in the case of gravity-fed systems, between the fuel tank and the injection pump. It consists of an element mounted upon a central bolt and enclosed in a container. The element is an assembly of felt pads surrounding a perforated tube and mounted between end plates which locate the element on the central bolt; both ends of the element assembly are sealed to prevent fuel bypassing the pads. Fuel enters the container at the top, passes through the felt pads and leaves through the drilling in the lower portion of the central bolt. A vent screw is provided for priming and a drain plug for removal of sediment. The leak-off from the injectors may be fed back into the system via a non-return valve on the filter or collected in a container.

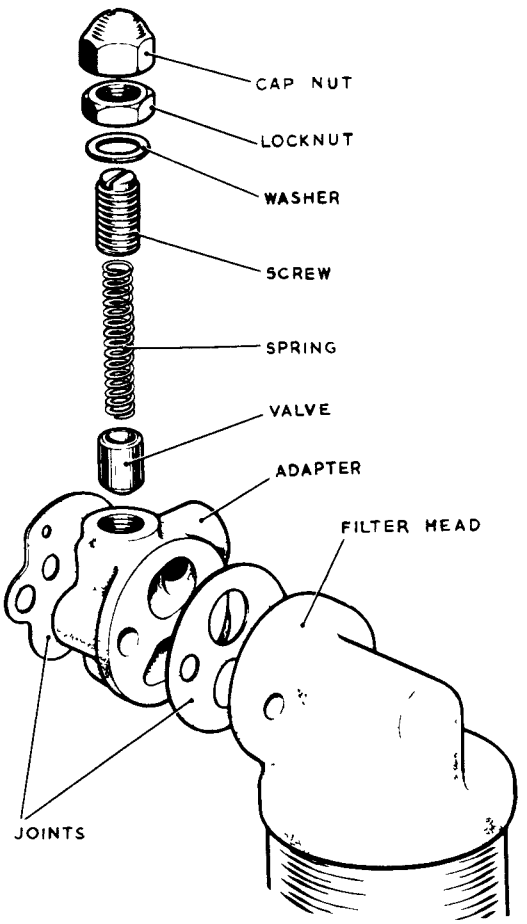


Fig. 4 Oil pressure relief valve

Fuel injection equipment

23. Standard engines are fitted with Bryce fuel injection equipment. The pumps and injectors are generally similar in design and operation to the equipment described in A.P.1464E, Vol. 1, Part 1, Sect. 2, Chap. 11 and 13.

24. Fuel injection pump (fig.6). The fuel injection pump is of the enclosed camshaft pattern operating on the constant-stroke variable-delivery principle, utilising a helical groove in the pump plunger in conjunction with two accurately machined ports at right angles to each other in the pump sleeve. A pump element is provided for each engine cylinder, each element consisting principally of a plunger and sleeve closed at the outlet by a spring-loaded valve; the plungers are operated by cams and roller tappets and are spring-loaded for recovery. The pump receives fuel from the main filter and each element outlet is connected by a steel pipe to the appropriate injector.

25. The engine speed depends on the amount of fuel injected into the cylinders and this, in turn, depends on the effective stroke of the plunger, i.e., that portion of the stroke during which both ports in the sleeve are masked by the plunger. Though the plunger stroke is constant, the working portion of the stroke can be varied by rotating the plunger, thus altering the position of the leading edge of the helical groove relative to the spill port in the sleeve.

1 Vent plug
2 Plug
3 Circlip
4 Element nut
5 Element top plate
6 Perforated tube
7 Element (small felt)
8 Element (large felt)
9 Element support
10 Drain plug
11 Outlet banjo connection
12 Locknut
13 Spring
14 Felt sealing washer
15 Central bolt
16 Filter bowl
17 Inlet banjo connection
18 Joint
19 Filter cover
20 Cover retaining nut

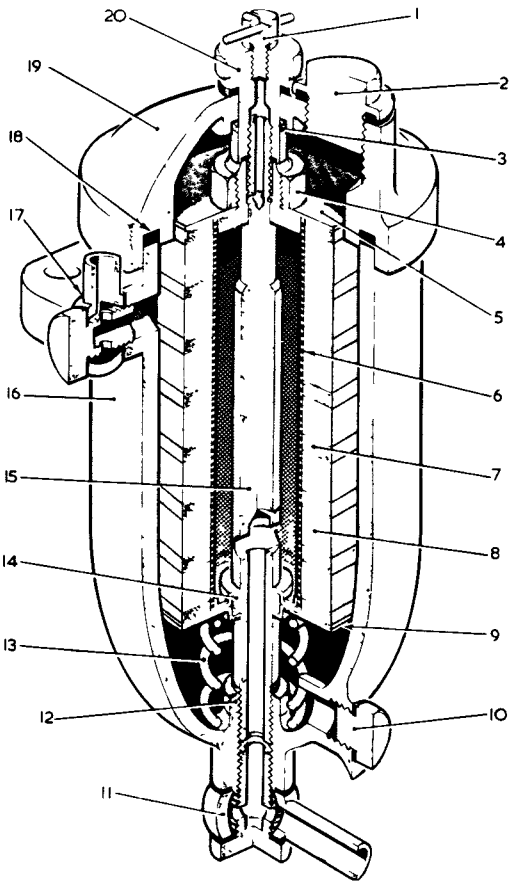


Fig. 5 Fuel filter

Rotation is effected by moving a rack which, at each pump element, meshes with a toothed quadrant which controls radially the position of the plunger. Moving the rack towards the pump coupling lengthens the effective stroke of the plunger. The pump elements are calibrated so that for any setting of the rack all elements deliver the same quality of fuel.

26. To prevent overloading, an overload stop (fig. 11) is fitted to the free end of the pump rack to limit its movement towards the pump coupling and so restrict the amount of fuel supplied to the engine. The stop can be tripped to allow additional movement of the rack and thus supply extra fuel for starting. When the engine starts, governor action moves the rack towards the idling position and the overload stop resets itself by gravity. The stop is adjusted by the engine manufacturer to suit the requirements of the engine and it should not be further adjusted.

27. Injectors (fig. 7). The injectors, which have integral fixing flanges, are mounted in the cylinder heads and inject directly into the cylinders. They are of the long-reach pattern in which the lapped portion of the needle is comparatively remote from the heat of combustion while that portion in the heated zone is surrounded and cooled by the fuel. Apart from this the injectors are of conventional design, embodying such features as a leak-off pipe and means of adjusting the spring release pressure. Final filtering is provided by a "button" filter fitted on the high-pressure side of each injector.

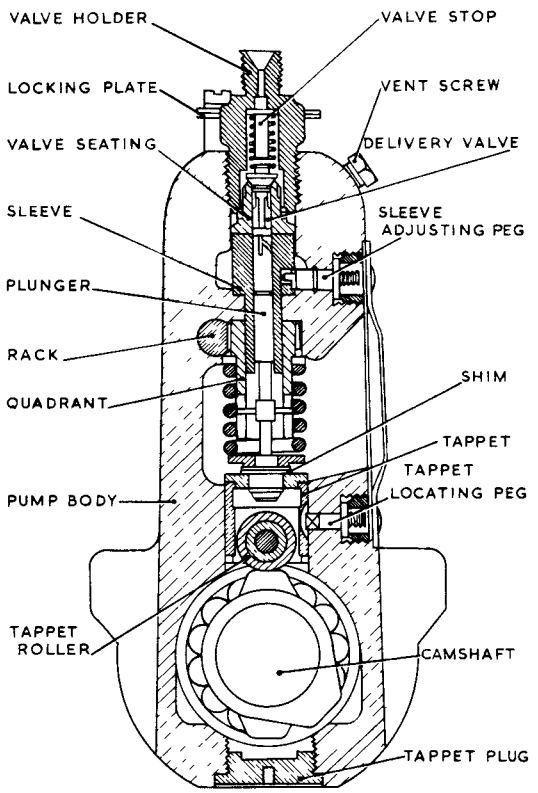


Fig. 6 Fuel injection pump

Governor gear

28. The governor gear (fig. 23) consists of four weights (19) and a spring-loaded link mechanism connected to the fuel injection pump rack. The weights, which are mounted on the injection pump driving gearwheel (18), are of bell-crank form and are pivoted so that any centrifugal force in them tends to actuate the linkage, moving the pump rack towards the idling position. The action of the speeder spring (23) is to move the rack towards the open position, hence the maximum speed of the engine depends upon the tension in the spring. When the speed rises above a predetermined maximum the centrifugal force in the weights is sufficient to overcome the tension in the speeder spring and the linkage operates to reduce the fuel supply.

29. On variable-speed engines the speed can be varied within a designed range by moving an external lever which controls the tension in the speeder spring. The maximum and idling speeds are determined by the spring characteristics and the positions of stop screws (2 and 25) which limit the movement of the speed control internal lever (24). The stop screws are adjusted by the engine manufacturer to permit a certain speed range and no attempt should be made to extend the range by further adjustment of the screws. The external control lever is usually linked by a flexible cable to a hand throttle control mounted in some convenient position, e.g. on the instrument panel. This arrangement, however, is not universal.

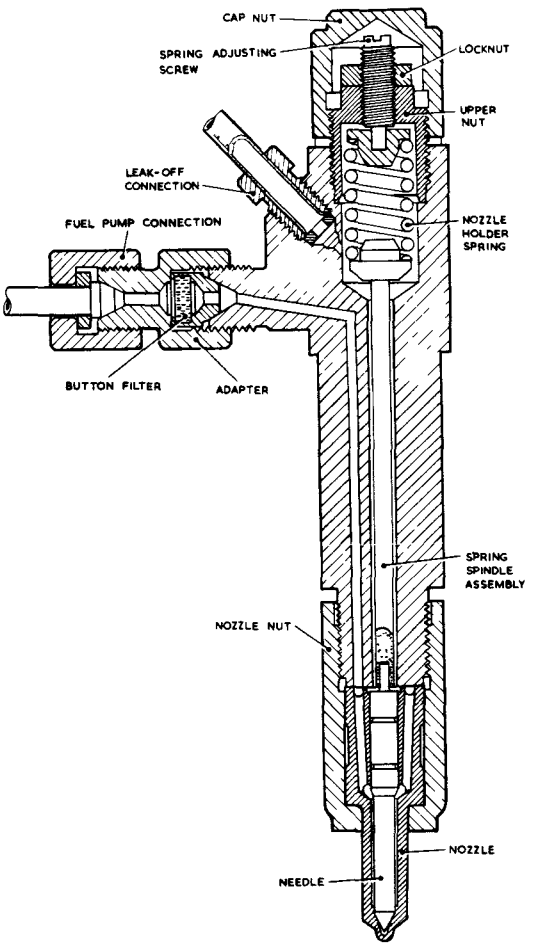


Fig. 7 Fuel injector

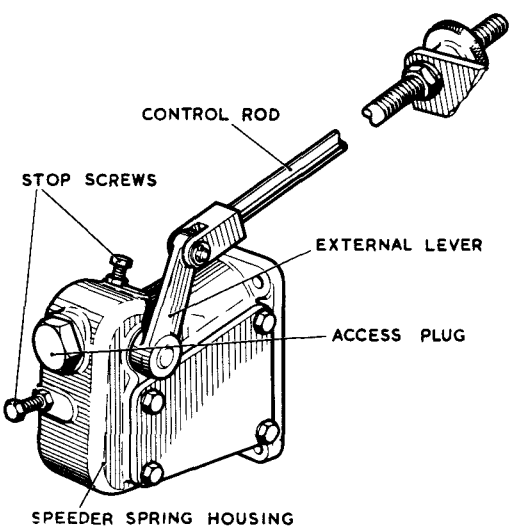


Fig. 8 Fixed-speed control

30. The governor on fixed-speed engines is similar to that on variable-speed engines, the difference being that the position of the speed control external lever is controlled by a screwed rod fitted between the lever and a bracket on the engine. The rod carries a knurled nut and locknut by which the rated speed is adjusted and the linkage locked. The controlled speed is set by the manufacturer but may be altered to any speed; adjustments outside the figures quoted should not be attempted.

Air cleaner (fig. 9)

31. The standard engine is fitted with a Burgess OBBR.070/7 air cleaner. In construction and operation this is generally similar to the detachable oil bath cleaner described in A.P.1464E, Vol. 1, Part 1, Sect. 2, Chap. 16 except that (a) the air is admitted through louvres instead of a centrifugal cleaner and (b) the element is in three parts, the bottom portion being removable to facilitate cleaning.

Electrical equipment

32. All standard engines can be fitted with 12 volt electric starting equipment, though not all engines are so fitted. The equipment normally consists of a lead-acid battery, starter motor, generator and a control panel which may be mounted on or remote from the engine. The wiring diagram shown in fig. 10 applies to standard engines; the equipment to which the engine is fitted may deviate from standard and the technician should refer to the appropriate publication for the applicable circuit.

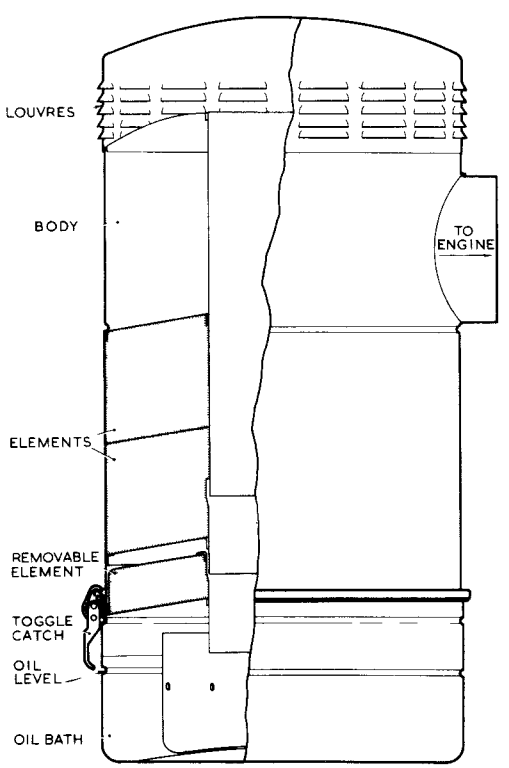


Fig. 9 Burgess OBBR 070/7 air cleaner

Starter motor

33. The starter motor is of the axial type in which the armature moves axially to bring the starter pinion into engagement with a gear ring on the flywheel. When not in use the pinion is held in the disengaged position by a helical compression spring housed in the armature shaft; in this position the armature only partially registers with the poles. The auxiliary field windings incorporate "holding-on" windings which hold the pinion in mesh with the flywheel gear ring until the push button is released. Should the engine backfire, an overload device in the form of a clutch is fitted to the armature shaft to prevent damage.

34. The starter incorporates a solenoid switch connected across the power supply in series with a starter push-button on the instrument panel. When the push button is pressed the solenoid coil is energized and closes the switch contacts; this permits a small current to flow through auxiliary windings, causing the armature to rotate slowly and at the same time move axially to mesh the starter pinion in the gear ring. The movement of the armature also operates a tripping device which releases the solenoid contacts and completes the main circuit; the full current then flows through the armature and field winding and the motor exerts its full torque.

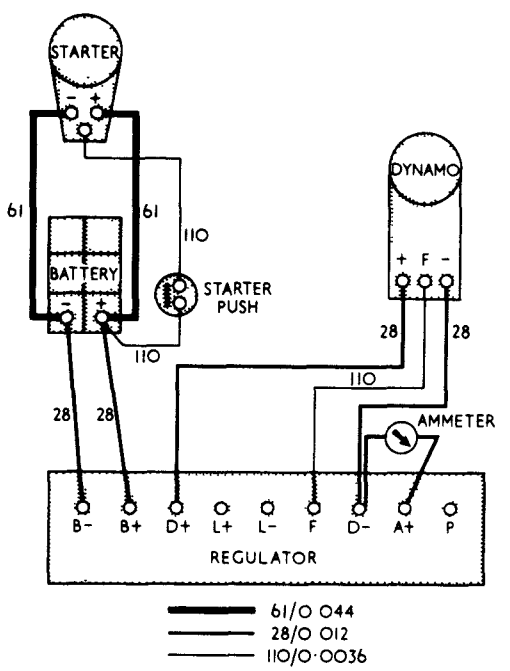


Fig. 10 Wiring diagram and wire chart.

Generator

35. The generator is swing-mounted on the right side of the engine and belt driven from a pulley on the crankshaft. A regulator and cut-out unit mounted on the control panel adjusts the generator output to suit the state of charge of the battery and prevents the battery discharging through the generator windings when the generator voltage is lower than that of the battery.

36. The C.A.V. D45DN59 generator fitted as standard is basically the same as the C.A.V. D45R generator described in A.P.120H-0804-16 (Formerly A.P. 4343M, Vol. 1 and 6, Sect. 1, Chap. 1), the principal difference being that the D45R model has a barrel type regulator fitted on the yoke.

OPERATING INSTRUCTIONS

Engine starting procedure

37. Before attempting to start the engine:-

(1) Ensure that (a) the lubricating oil level is correct and (b) there is fuel in the fuel tank and (c) the fuel cock is open.

(2) Check and (if necessary) adjust the fan belt tension.

(3) Ensure that the engine drive is disconnected from the driven unit (where means are provided).

(4) If the engine is new, has just been overhauled or has been idle for some time:

(a) Ensure that the air cleaner contains the correct amount of oil.

(b) Attend to all external lubricating points and generously lubricate the valve rocker gear.

(c) Decompress the engine and crank or motor it through a dozen or so revolutions to help prime the lubricating and fuel systems.

(d) Ensure that the fuel system is primed.

Starting the engine

38. Hand starting

(1) If a variable speed control is fitted, set it to the full-speed position.

(2) Set the overload stop to the excess fuel position (fig. 11).

(3) Raise the decompressor lever.

(4) Crank the engine as fast as possible and knock down the decompressor lever when a good speed is reached.

Note...

If the engine fails to start, lift the decompression lever and turn the engine slowly through a few revolutions before attempting again to start.

39. Electric starting

(1) If a variable speed control is fitted, set it to the full-speed position.

(2) Set the overload stop to the excess fuel position (fig. 11).

(3) Raise the decompressor lever, operate the starter motor and knock down the decompressor lever; release the starter button as soon as the engine fires.

Note...

Do not motor the engine for more than 20 consecutive seconds.

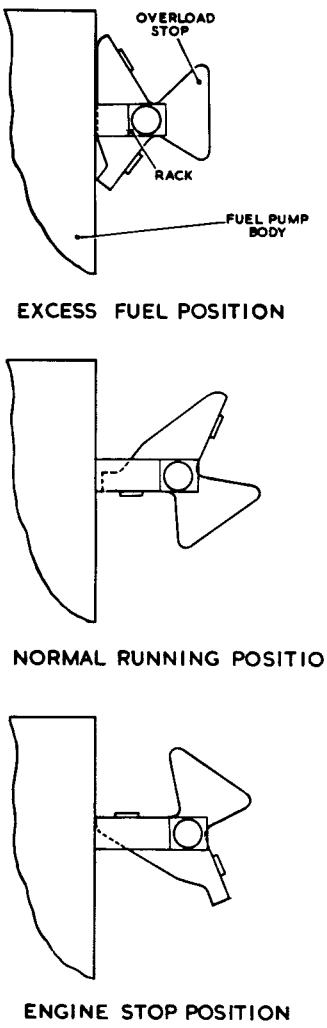


Fig. 11 Overload Stop

General running instructions

40. The following instructions should be observed when the engine is running:-

(1) Check the oil pressure; the engine must be stopped immediately if the oil pressure gauge fails to register.

(2) During prolonged running the fuel and lubricating oil levels should be regularly checked and the system replenished when necessary

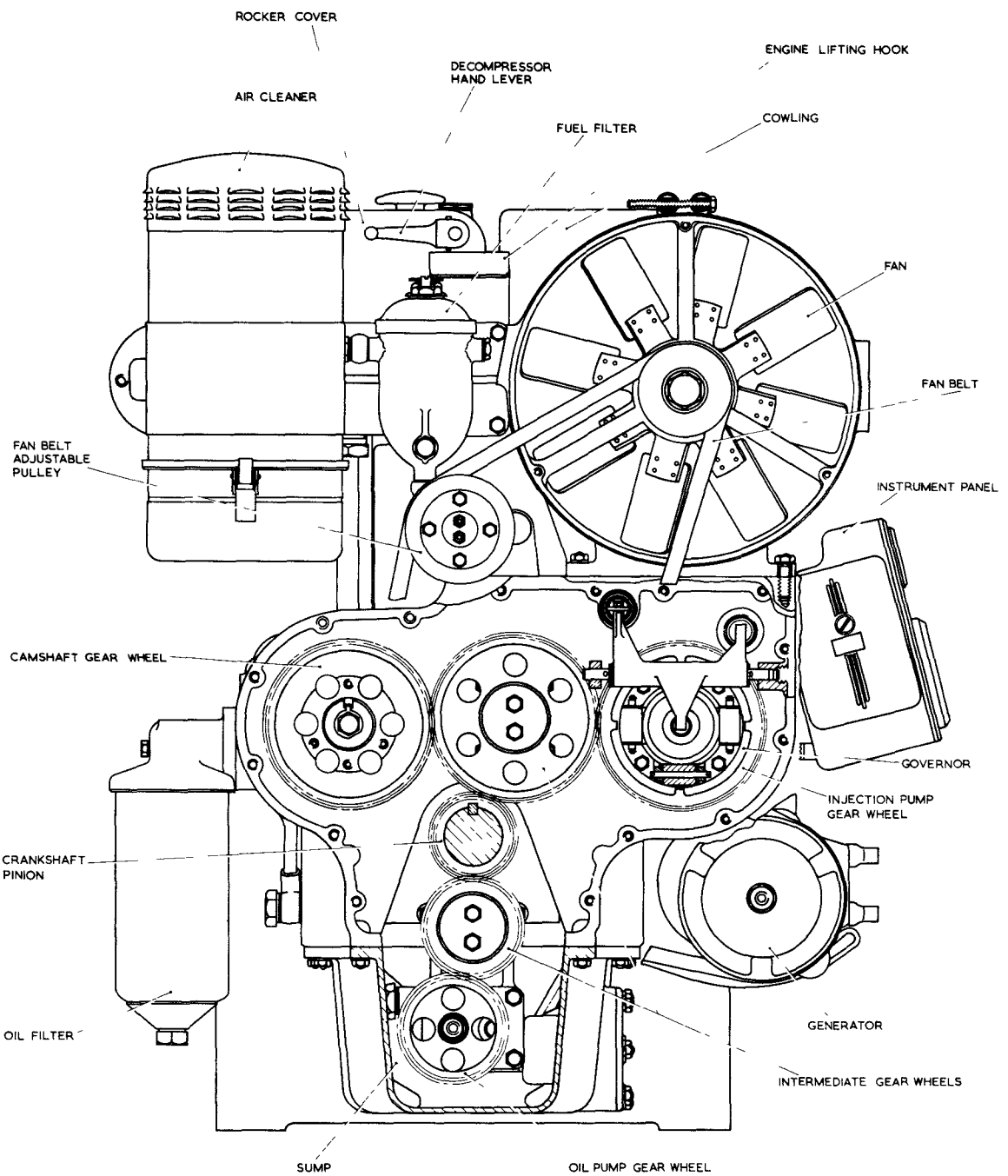


Fig.12 Gear end of engine

(3) Periodically check the ammeter reading, engine speed, oil pressure and condition of the exhaust.

(4) The engine must not be run with any part of the fan casing or engine cowling removed as this will cause overheating which may result in a piston seizure.

Stopping the engine

41. Before stopping the engine, allow it to run unloaded for a few minutes; variable speed engines should be shut down to fast idling for this period. The engine may be stopped by pulling the stop control (on engines so fitted) or by raising the overload stop to its fullest extent and holding it in this position.

Note...

The engine must not be stopped by closing the fuel tank cock; this will allow air to enter the fuel system, making it necessary to vent the system before restarting.

TECHNICAL INFORMATION AND MINOR REPAIRS

Servicing the air cleaner (fig. 9)

42. The air cleaner can be serviced as follows:-

(1) Take off the oil bath (secured by three toggle catches).

(2) Empty the old oil and sludge and wash the bath in kerosine.

(3) Wash the removable element in kerosine and allow it to drain.

(4) Put back the element.

(5) Fill the oil bath to the indicated level with engine oil and refit it to the cleaner body.

Changing the lubricating oil

43. Oil changes are best carried out at the end of a long run when the engine is hot as any sediment will be in suspension and will drain away with the oil. The sump drain plug is below the oil filler bend (fig.1). The oil pump strainer should be removed and cleaned each time the oil is changed.

Cleaning the oil pump strainer

44. Clean the oil pump strainer as follows:-

(1) Drain the sump.

(2) Take out the nuts securing the strainer cover; do not remove the two centre screws.

(3) Withdraw the cover and strainer.

(4) Wash the strainer in kerosine or fuel and allow it to drain.

(5) Ensure that the joint between strainer and pump intake is serviceable and correctly positioned and put back the strainer and cover.

(6) Refill the sump.

Servicing the lubricating oil filter (fig. 3)

45. Servicing the lubricating oil filter consists almost entirely of renewing the element, which is of the throw-away pattern; no attempt should be made to extend its life by cleaning. Renew an element as follows:-

(1) Clean the exterior of the filter.

(2) Unscrew the centre bolt (17) and remove the sump (16) and the filter element assembly (8); discard the filter.

(3) Clean the interior of the sump.

(4) Ensure that the sump upper seal (6) is serviceable and correctly positioned in the filter head (5).

(5) Place the new element centrally in the sump with the lower end on the element lower guide (14).

(6) Offer the sump to the filter head so that the sump fits squarely against its seal with the element located on the upper guide.

(7) Secure the sump with the centre bolt; the bolt must be screwed home firmly but without unnecessary force to ensure that there is no oil leakage past the upper and lower seals.

Fan belts

46. It is essential that the fan driving belts are kept clean and correctly tensioned. Any serious reduction in the efficiency of the belts will cause the engine to overheat, with consequent risk of seizure. The belt tension should be sufficient only to tramsmit the drive without slip; further tightening will overload bearings and belts. Ideally, the tensions in both belts should be identical. This, however, is difficult to obtain and usually some compromise is necessary. The idler pulley, therefore, should be adjusted to produce the correct tension in the tighter belt; if there is then undue discrepancy in the tension, both belts should be renewed. Belts should be renewed in pairs and before being fitted should be checked to ensure that they bear the same length symbol.

47. The tension in the belts can be altered by swinging the adjustable pulley (fig. 13) to the required position. On the lower right side of the belt guard is an opening through which the tension can be checked; at this point it should be possible to press each belt inward about $\frac{3}{8}$ in.

Generator belt

48. The generator belt must be kept clean and correctly tensioned. Adjustment is by swinging the generator towards or away from the engine. The tension should be such that there is about $\frac{1}{2}$ in. play at a point midway between the pulleys.

Adjusting the valve clearances

49. When the engine is cold there should be 0·010 in. clearance between the rocker arms and the valve stems. The cylinder head clearance (para. 51) must be correct and the cylinder head and rocker shaft nuts tightened to 75 lb ft (engine cold) before the valve clearances are adjusted.

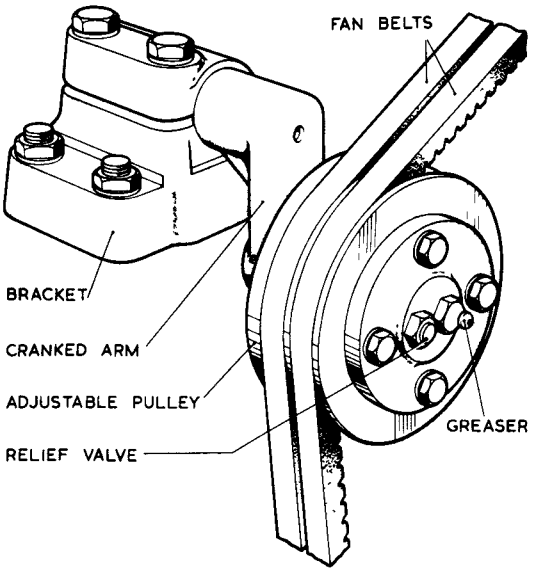


Fig. 13 Fan belt adjustment

The procedure for adjusting the clearances for any particular cylinder is as follows:-

(1) Remove the rocker cover and set the piston at T.D.C. on the compression stroke (both valves closed).

(2) Slacken the locknuts on the rocker adjusting screws.

(3) In turn push each rocker firmly down on its pushrod, turn the adjusting screw until the correct clearance is obtained then tighten the locknut.

Adjusting the decompressors

50. The valve lift due to decompressor action should not exceed 0·025 in. as this may involve a risk of the valve fouling the piston crown. The mechanism on each cylinder must be adjusted separately, following the procedure given below. The conditions of para. 49 concerning cylinder head clearance and tightness of nuts are also applicable here.

(1) Bring the piston on to the compression stroke.

(2) Take out the plug in the rocker cover.

(3) Raise the decompressor lever.

(4) Slacken the locknut. Adjust the decompressor screw until it just touches the valve rocker then give it a further half-turn clockwise and tighten the locknut (without permitting further movement of the screw).

(5) Put back the cover plug.

Adjusting the cylinder head clearance

51. The cylinder head clearance on each cylinder must be checked individually; the procedure is as follows:-

(1) Turn the engine until the piston being checked is just below T.D.C.

(2) Place two pieces of lead wire (about 0·048 in. dia. by $\frac{3}{4}$ in.long) on top of the piston, each roughly at right angles to the gudgeon pin.

Note...

The wires must be clear of the valve recesses.

(3) Fit the cylinder head gasket and the cylinder head and tighten the nuts to 75 lb ft.

(4) Pass the piston over T.D.C.

(5) Remove the cylinder head and measure the flattened wires; these should be between 0·031 and 0·039 in. thick.

(6) Bring the clearance within these limits by fitting or removing shims at the base of the cylinder.

Note...

The shims available are 0·005 and 0·015 in. thick.

52. The cylinder head clearances are adjusted when the engine is assembled and any change is invariably an increase due to wear on the moving parts. Between major repairs the necessity for this check should only arise when some new part such as a cylinder head or gasket is fitted.

Servicing the main fuel filter (fig. 5)

53. The position of the main fuel filter may vary, depending upon the installation of the fuel tanks and whether the system incorporates a fuel feed pump or uses gravity feed. In some cases it may be easier to remove the filter as an assembly before dismantling it. If a replacement element is not available the old element can be cleaned as follows:-

(1) Close the fuel tank cock.

(2) Remove the drain plug (10) and slacken or remove the vent screw (1).

(3) Disconnect the outlet banjo (11).

(4) Disconnect the injector leak-off pipe, unscrew the nut (20) and remove the cover (19).

(5) Take out the element assembly and wash it in clean fuel, gasoline, kerosine, or trichloroethane, allow it to drain if a cleaning agent other than fuel is used. Immerse the element in clean fuel pending refitment.

Note...

The element assembly must not be dismantled, nor compressed air used in the cleaning process.

(6) Clean the bowl (16).

(7) Ensure that all joints and sealing faces are serviceable and assemble the filter in the reverse order to dismantling.

(8) Vent the fuel system (para. 58).

The life of the element cannot be indefinitely prolonged by simple cleaning and the element must be renewed if the fouling is considered excessive or when it has already been cleaned three or four times.

Testing the fuel feed pump

54. The fuel feed pump can be tested by disconnecting the output pipe and operating the priming lever. There should be a well-defined spurt of fuel for every full working stroke of the lever. It may be necessary to turn the engine in order to bring the camshaft eccentric to a position which perimits a full stroke of the priming lever.

Removing and refitting the fuel feed pump

55. The procedure for removing the fuel feed pump is as follows:-

(1) Close the fuel tank cock.

(2) Disconnect the pipe unions at the pump.

(3) Remove the two bolts which secure the pump to the crankcase and withdraw the pump.

The procedure for putting back the pump is the reverse of that for its removal. A joint washer (0·015 in. thick) should be fitted between the pump flange and the crankcase. The system must be vented when the operation is complete.

Cleaning the feed pump filter (fig. 14)

56. The fuel feed pump filter can be cleaned as follows:-

(1) Remove the screw (1) securing the filter cover (3), take off the cover and lift out the filter (5).

(2) Clean the filter by washing in gasoline or blowing with an air jet.

(3) Remove deposits in the sediment chamber.

(4) Ensure that the cover joint is serviceable and put back the filter and cover.

The cover securing screw must not be tightened more than is necessary to prevent fuel leakage; overtightening may distort the cover and cause cracks in the upper casting. It is essential to fit a fibre washer (2) under the head of the screw. On some engines it may be necessary to close the fuel tank cock before disconnecting the pump feed pipe.

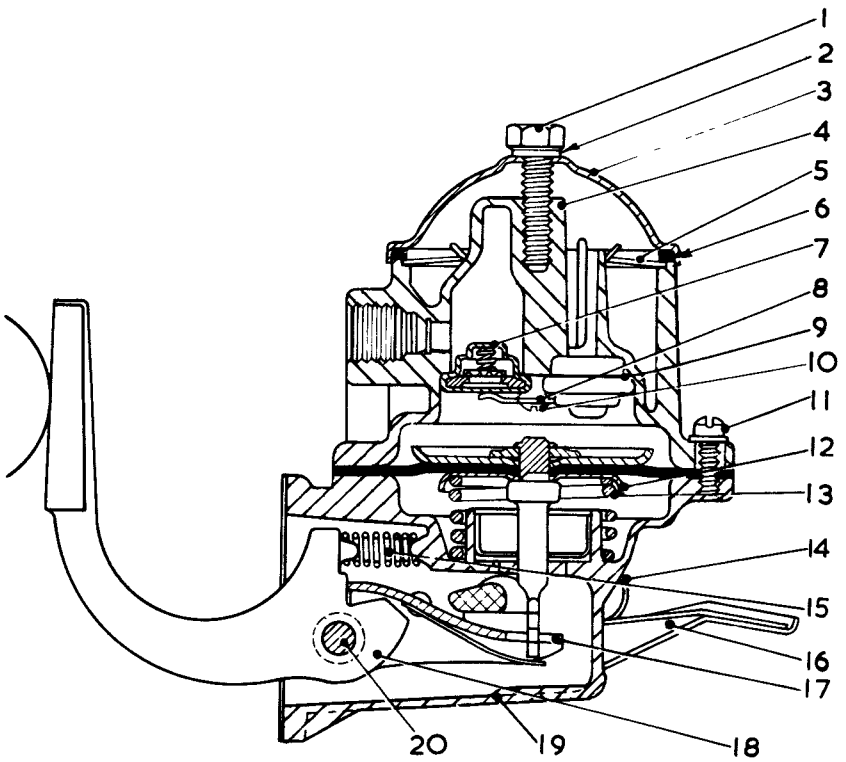
Fuel injection equipment - general

57. Strict cleanliness is essential when handling fuel injection equipment and parts which are removed from the engine should be immersed in clean fuel. Rag or waste must not be used for cleaning and the parts must be put back wet.

Venting the fuel system

58. The procedure for venting a gravity-fed fuel system is detailed below; venting a system which includes a fuel feed pump differs only in that the feed pump priming lever must be operated to prime the filter and the injection pump.

(1) Ensure that (a) there is fuel in the tank (b) the fuel cock is open and (c) the fuel pump rack is in the "start" position.



1 Cover screw
2 Fibre washer
3 Filter cover
4 Upper casting
5 Filter
6 Cover joint
7 Valve assembly
8 Valve retainer
9 Valve joint
10 Retainer screw
11 Screw
12 Diaphragm assembly
13 Diaphragm spring
14 Priming lever spring
15 Rocker spring
16 Priming lever
17 Rocker arm link
18 Rocker arm
19 Pump body
20 Rocker arm pivot pin

Fig. 14 Fuel feed pump

(2) Remove the vent screw on top of the filter (fig. 5), wait until bubble-free fuel appears then replace and tighten the screw.

(3) Remove the two vent screws (fig. 15) from the fuel injection pump, wait until bubble-free fuel appears then replace and tighten the screws.

(4) Take off the access panel on top of the cowling. Disconnect the high-pressure pipes at the injectors.

Note...

When disconnecting a high-pressure pipe the filter adapter (fig.7) should be held with a spanner to prevent distortion of the pipe.

(5) Turn the engine until bubble-free fuel issues from each pipe. Reconnect the pipes to the injectors.

Note...

Overtightening a pipe union can deform the nipple.

(6) Turn the engine until each injector "creaks", indicating thereby that it is primed.

Note...

Creak can be felt if the high-pressure pipe is held between the fingers while the engine is turned.

(7) Replace the access panel.

Locating and testing a faulty injector

59. Faulty injection may be indicated if the engine shows one or more of the following symptoms after reaching normal running temperature:-

(1) Smoky exhaust (black)

(2) Loss of power

(3) Knocking in the cylinders

(4) Overheating

(5) Increased fuel consumption.

These symptons, however, can have other causes and it should not be assumed that the injectors alone are faulty. A faulty injector can be located by "cutting out" each cylinder in turn and noting the effect upon the engine performance. Prevent each cylinder firing by interrupting the fuel supply to each injector in turn, observing the reduction in engine speed or output at each stage; the cylinder which has least effect is that which has the defective injector. The fuel supply can be interrupted by slackening the high-pressure pipe nut at the pump; the amount of slackening should be not more than is required to release the pressure.

60. An injector can be tested as described below. Before disconnecting the pipes of the suspect injector, ensure that the fault is not due to leaks in the high-pressure pipe and that the system is correctly vented.

(1) Take off the access panel in the cowling, disconnect the high-pressure and leak-off pipes at the injector and carefully lever the injector from the cylinder head.

(2) Reconnect the high-pressure pipe to the injector, with the nozzle pointing away from the engine so that the spray can be observed.

(3) Turn the engine so that the T.D.C. mark for the cylinder concerned is about 45 deg. before T.D.C. on the compression stroke (both valves closed).

(4) Set the rack to the mid-position.

(5) Slowly turn the engine in the direction of rotation and note the discharge from the nozzle. If both fuel pump and injector are serviceable the fuel should be ejected suddenly in three finely-atomized sprays which should just as suddenly stop.

Note...

(a) The high-pressure fuel can penetrate the skin and care should be taken that the spray does not contact any exposed part of the body.

(b) For convenience and to avoid injecting fuel into other cylinders the engine should be turned BACK for further tests on the same injector.

61. The pressure of carbon on the exterior of the nozzle or in the nozzle holes may cuase solid squirts of fuel, uneven sprays, or a tendency to dribble at the end of discharge. Exterior carbon can be removed with a piece of wood or brass wire brush. If the deposits are comparatively soft the holes may be cleared with a spray hole cleaner of the correct size. Before fitting a replacement injector it is advisable to test it as already described; if the spray is still unsatisfactory it is possible that the pump element is defective.

Fitting an injector

62. Each injector fits in a deep recess in its cylinder head and is secured by two studs and nuts. A sealing washer is fitted between the nozzle nut and bottom of the recess; only the washer supplied by the engine maker may be used. When fitting an injector ensure that the nozzle sealing washer is serviceable and that only one washer is fitted to each injector. Each injector should fit freely into its recess, sit squarely on its washer and the securing nuts should be tightened evenly. The system must be vented before connecting the high-pressure pipe to the injector.

Cleaning an injector filter (fig.7)

63. An injector filter can be cleaned by removing the adapter, complete with filter, and blowing through with clean dry compressed air in the reverse direction to fuel flow. The filter should not be removed from the adapter unless a replacement filter is available.

Removing the fuel injection pump

64. The procedure for removing a fuel injection pump is as follows:-

(1) Close the fuel tank cock.

(2) Disconnect the high-pressure, drain and feed pipes at the pump.

(3) Disconnect the governor control linkage.

(4) Take off the coupling guard and slacken the coupling screw.

(5) Remove the securing screws and lift off the pump.

Note...

(a) Reference marks are engraved on the side of the couplings; these should be noted as a guide to reassembly if it is found necessary to split the coupling and the same pump is to be refitted without being adjusted in any way.

(b) To prevent timing slip a kidney-shaped plate is fitted on the solid side of the coupling (fig. 15); such a part is drilled

on assembly to suit the engine and is unlikely to be correct if the pump is changed or adjusted. Replacement kidney plates are supplied undrilled.

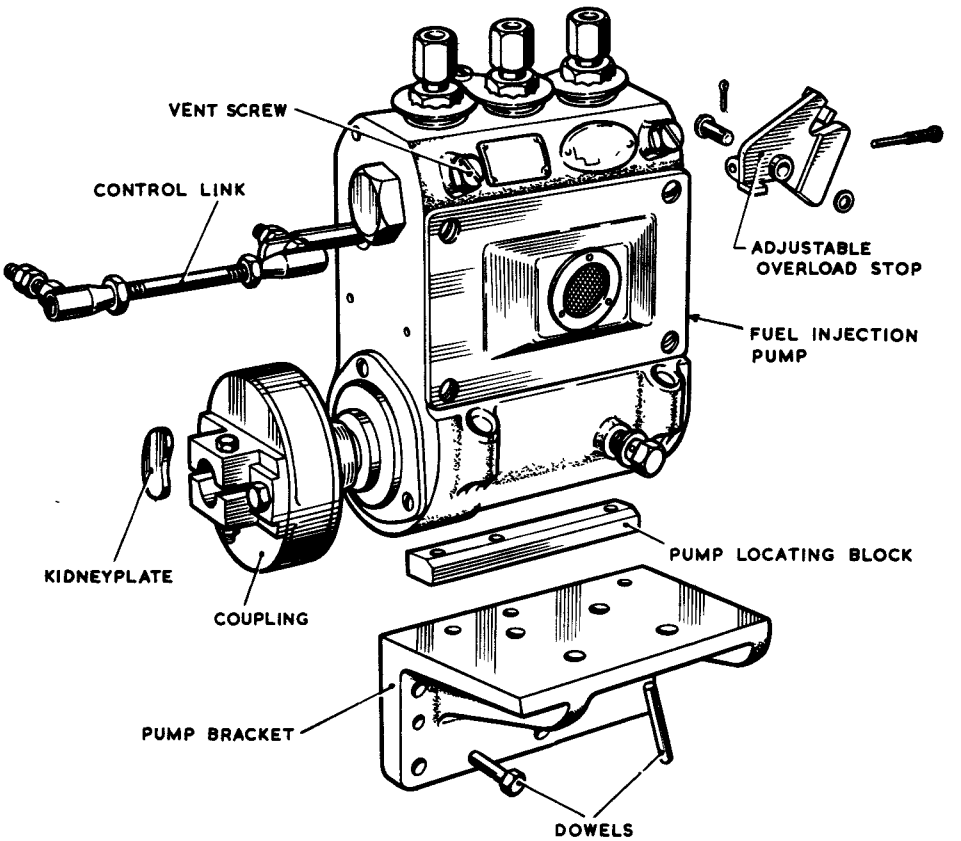


Fig.15. Fuel injection pump-external details

Fitting and timing the injection pump

65. The act of fitting the fuel injection pump to the engine usually involves retiming the injection. The timing operation need be carried out on one cylinder only (usually No. 1) and the timing for the other cylinders will be correct if the pump is correctly phased. The procedure for an engine having a gravity-fed fuel system is as follows:-

(1) With No. 1 piston on compression stroke, turn the engine forward until the appropriate firing mark on the flywheel (fig.16) coincides with the timing pointer or mark on the flywheel housing; check that both valves are closed.

Note...

Engines with maximum governed speeds of 1499 rev/min and below are timed 28 deg. before T.D.C., engines with higher speeds are timed 32 deg. before T.D.C.

(2) Turn the injection pump camshaft in the direction of rotation until No. 1 pump plunger starts to lift.

(3) Engage the coupling and secure the pump to its mounting bracket; do not tighten the coupling drive screws.

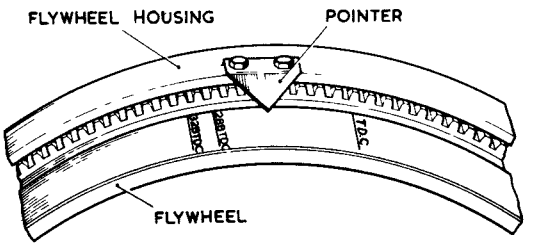


Fig.16 Flywheel timing marks.

Note...

The coupling bolt head must lead according to rotation.

(4) Connect the fuel feed pipe to the pump, vent the system up to the pump and close the fuel tank cock.

(5) Remove the locking plate and unscrew No. 1 valve holder. Take out the delivery valve, spring and stop; refit the valve holder and screw it firmly into place.

Note...

The valve seating should not be removed.

(6) Set the control rack at about the mid-position and open the fuel tank cock; fuel should flow from the valve holder.

(7) Slowly turn the pump camshaft in the direction of rotation until fuel just ceases to flow from the valve holder; this is the "end of spill". Tighten the coupling screws.

(8) Check the setting by reversing the engine to a point several degrees before the fuel cut-off point then coming up to it again. If necessary, slacken the coupling drive screws and readjust the setting so that the fuel cut-off occurs when the timing mark coincides with the pointer.

Note...

When checking the cut-off point the engine must be turned in the normal direction of rotation to take-up back-lash in the drive.

(9) If a kidney blank is not available, drill and shape a piece of steel plate to fit in the slot on the solid side of the coupling. The plate is to prevent timing slip; it should fit closely in the slot but must not interfer with the clamping action of the coupling bolt.

(10) Remove the valve holder, put back the delivery valve, spring and valve stop and refit the valve holder and locking washer.

Note...

The tightening torque for the valve holder is 35 lb ft when the pump is cold.

(11) Check the pump for "dead rack" by setting the rack in the stop position and turning the engine through a few revolutions; there should be no discharge of fuel from the valve holders.

(12) Connect the high-pressure pipes at the pump, vent the fuel lines up to the injectors and connect the pipes to the injectors.

Note...

Ensure that the high-pressure pipes are clipped together inside the cowling; failure to fit the clips will permit pipe vibration which may fracture the pipes.

(13) Connect the pump rack linkage and put back the access panels and coupling guard.

(14) Ensure that the pump contains the correct amount of lubricating oil.

66. Assembling the pump to an engine which is fitted with a fuel feed pump differs only in that the feed pump priming lever must be operated to produce the fuel flow.

Leak valve holders

67. The pump body may fracture if a valve holder is overtightened, possibly in an attempt to stop a fuel leak between the pump body and the valve holder. The correct tightening torque for the valve holder is 35 lb ft when the pump is cold. If leakage is apparent after tightening to this figure the sealing washer must be renewed and the valve holder pulled down once only to the correct torque. Only the washer supplied by the pump maker should be used; this is NOT made of copper.

Decarbonizing the engine

68. The following paragraphs give a general sequence for decarbonizing the engine. It has been assumed that equipment housings have been removed to permit access to the engine. As each component is removed it should be marked or grouped to ensure that it can be put back in its original position.

69. Partially dismantle the engine as follows:-

(1) Remove the air cleaner. Disconnect the exhaust at the manifold flange and take off the inlet and exhaust manifolds.

(2) Take off the fan housing strap and the upper cowling.

(3) Remove the rocker covers. Disconnect the lubricating oil pipe at the cylinder heads and the injector leak-off and high-pressure pipes at pumps and injectors. Remove the injectors.

(4) Take off the rocker assemblies and lift out the valve pushrods. Remove the cylinder nuts, working evenly across each head; take off the cylinder heads complete with pushrod tubes. Remove the cylinder head gaskets.

(5) Slacken or remove the pushrod tube gland nuts and withdraw the tubes.

(6) Take out the split pins locating the inlet valves, compress the valve springs, remove the collets and withdraw the valves, springs and cups.

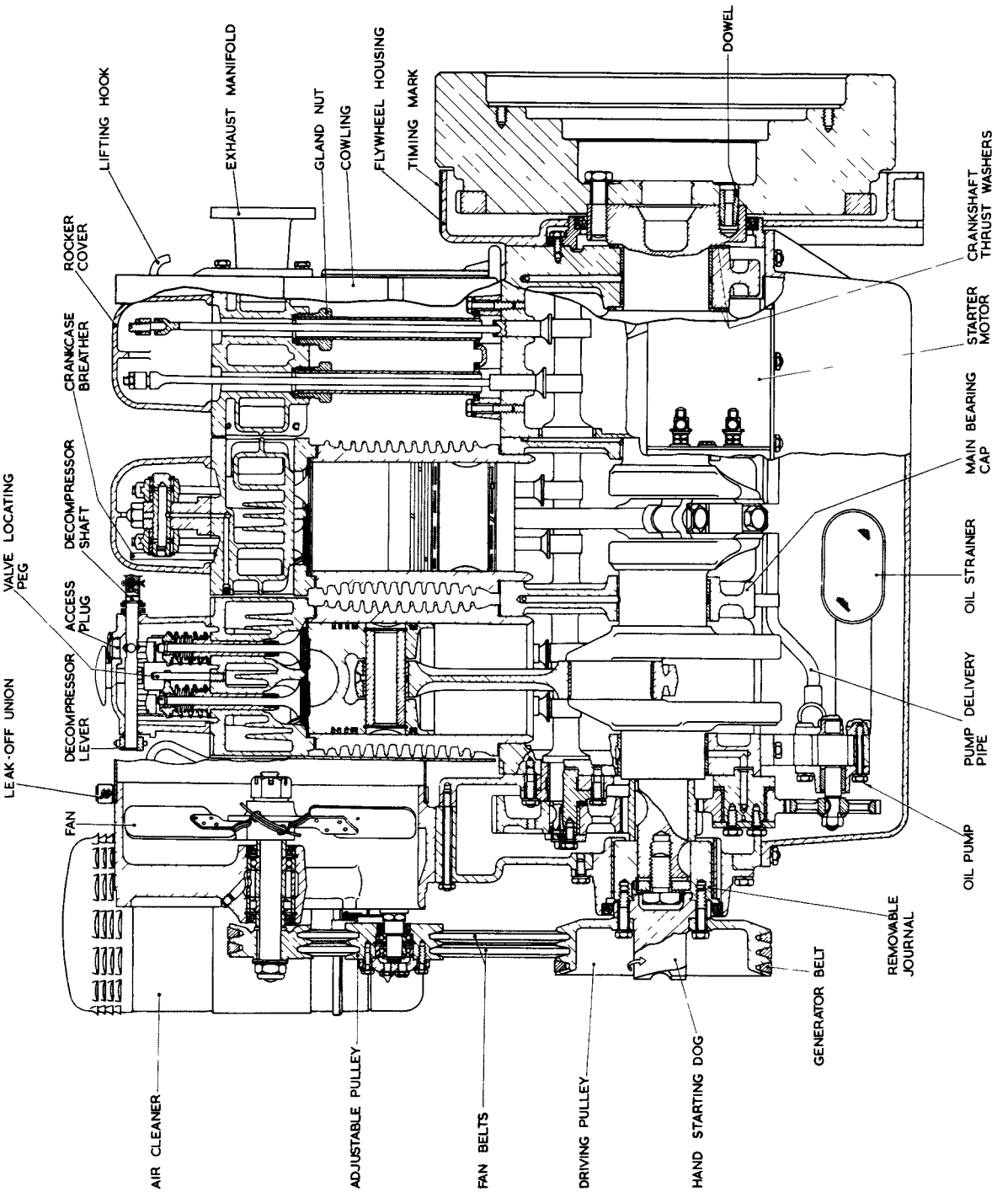


Fig. 17 Longitudinal section of engine

70. Remove the carbon deposit from the cylinder heads, piston crowns and valves. Wash the removed parts in kerosine and examine them for cracks, scores, distortion and other defects which affect serviceability; all unserviceable parts must be renewed or rendered serviceable by repair. Any component which appears to be cracked should be tested by an approved crack-detecting method A.P.119A-01 series. In addition to visual examination each valve spring should be tested by comparing its length under load with that of a new spring compressed under the same load; if either of a pair of springs is unserviceable both springs should be renewed.

71. Lap each valve seat with its valve and when satisfactory seatings are obtained wash the parts in kerosine to remove all traces of abrasive. If a new valve is fitted its crown should not be less than 0·040 in. below the surface of the cylinder head; if necessary the valve should be refaced to obtain this clearance. The angle of valve seats and faces is 45 deg.

72. Put back the parts in the reverse order to dismantling. Inlet and exhaust valves are not interchangeable and each valve must be put back in its original position; note that the split-pin hole in the inlet valve stem is offset. The cylinder head gaskets should be renewed if there is any doubt about their serviceability. It is advisable to anneal the gaskets; this applies to both old and new gaskets. Ensure that the manifold faces on the cylinder heads are in line before tightening the cylinder nuts and pushrod tube adapters. The cylinders and cylinder heads are secured by long through studs and it is important to tighten the nuts evenly. The nuts should be screwed down to the head by hand and then tightened by increments of a quarter turn, working evenly across each head, until a final torque of 75 lb ft is reached. The shouldered nut is fitted on the injector side of each cylinder head. Adjust the valve clearances before putting back the injectors and rocker covers and vent the fuel system before fitting the cowling. Check the decompressor settings before attempting to start the engine.

Note...

> The torque of 75 lb ft applies to cold engines; the cylinder head nuts must not be further tightened when the engine is hot.

Servicing the electrical equipment

73. The maintenance and testing of lead acid batteries should be carried out in accordance with current practice.

74. Instructions for servicing the generator are contained in A.P.120H-0804-16 (formerly A.P.4343M, Vol. 1 and 6, Sect. 1, Chap. 1).

75. Instructions for servicing the starter motor are contained in A.P.120J-0104-16 (formerly A.P.4343M, Vol. 1 and 6, Sect.4, Chap. 4). When fitting a starter ensure that there is $\frac{1}{8} - \frac{3}{16}$ in. clearance between the face of the gear ring and the engaging face of the starter pinion when the armature is at rest.

MAJOR REPAIRS

General

76. The following paragraphs deal with the reconditioning of the engine; running adjustments and minor repairs which were detailed earlier are not repeated except in certain instances where the repair or adjustment is part of a series of operations. It has been assumed that the engine has been removed from its equipment and is being reconditioned in accordance with normal workshop procedure.

Dismantling the engine (fig. 12, 17, 18)

77. The engine can be dismantled as described below. Parts which can be interchanged within the engine should be marked or grouped to ensure that each can be put back in its original position.

(1) Drain the sump and remove the dipstick.

(2) Take off the air cleaner and inlet manifold, the exhaust manifold and (if still fitted) the silencer. Remove the fuel feed pump delivery pipe.

(3) Take off the belt guard(s) and belts.

(4) Remove the fuel filter, air cleaner bracket and front lifting hook and the fan belt adjusting pulley bracket assembly (fig. 19).

(5) Take out the speed control rod clevis pin and take off the rod and its bracket; the rod setting should not be altered.

(6) Remove the instrument panel and leads (if the panel is engine-mounted) or the oil pressure gauge and its bracket.

(7) Take off the upper portion of the air cowling.

(8) Disconnect the injection pump feed pipe at the pump. Remove the pump leak-off pipes, delivery pipes and injector leak-off pipes.

(9) Take off the engine rear lifting hook, the lower portion of the air cowling, and the fan assembly. Remove the injection pump feed pipe.

(10) Remove the fuel feed pump.

(11) Take off the oil cooler. Remove the rocker oil pipe, oil pressure gauge pipe, oil filter delivery pipe and the main oil gallery pipe.

(12) Disconnect the lubricating oil filter intake pipe, take off the filter and its adapter and remove the intake pipe.

(13) Withdraw the injectors.

(14) Take off the rocker covers and decompression mechanisms, slacked the cylinder head nuts, remove the rocker assemblies and lift out the rocker pushrods. Take off the cylinder heads complete with pushrod tubes and valves.

(15) Remove the pushrod tube adapters and the air guide plates on the left of the cylinders.

(16) Take off the injection pump control link (without altering its effective length), the pump coupling guard and the pump.

Note...

The pump bracket and pump locating block need not be removed. Both parts are doweled, the block to the bracket and the bracket to the crankcase (fig. 15).

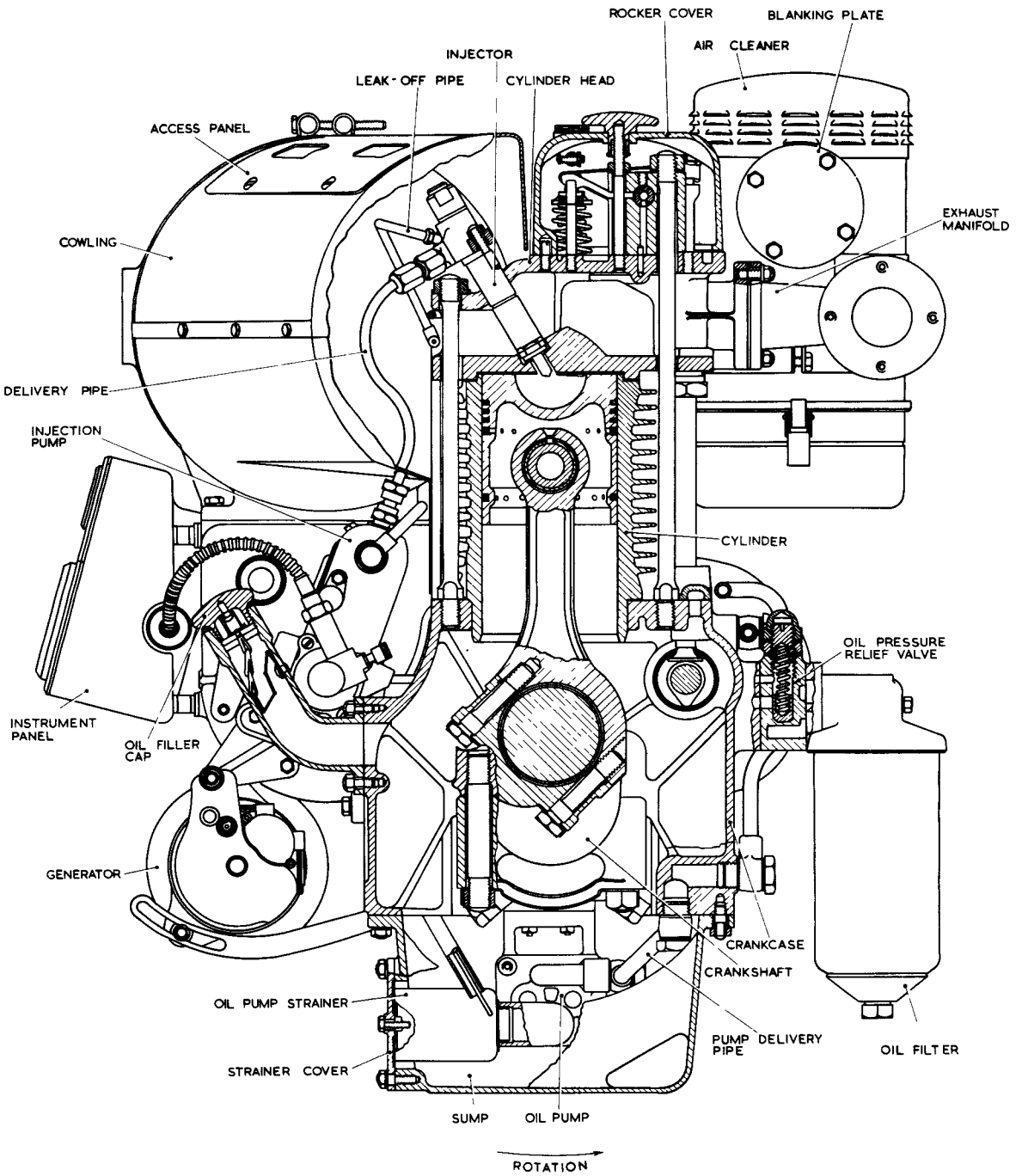


Fig.18 Transverse section of engine

(17) Take off the generator, the starter motor (if these are fitted) and the oil filler bend and cap. Unscrew the dipstick tube.

(18) Remove the power take-off shaft and flywheel.

Note...

(a) The power take-off shaft is doweled to the flywheel which in turn is doweled to the crankshaft flange; the dowels are tapped $\frac{3}{8}$ in. UNF to facilitate withdrawal.

(b) The flywheel and gear ring assembly weighs about 315 lb.

(19) Unhook the speeder spring (5 in fig. 23) from the lever (4) (through opening in top of gear cover).

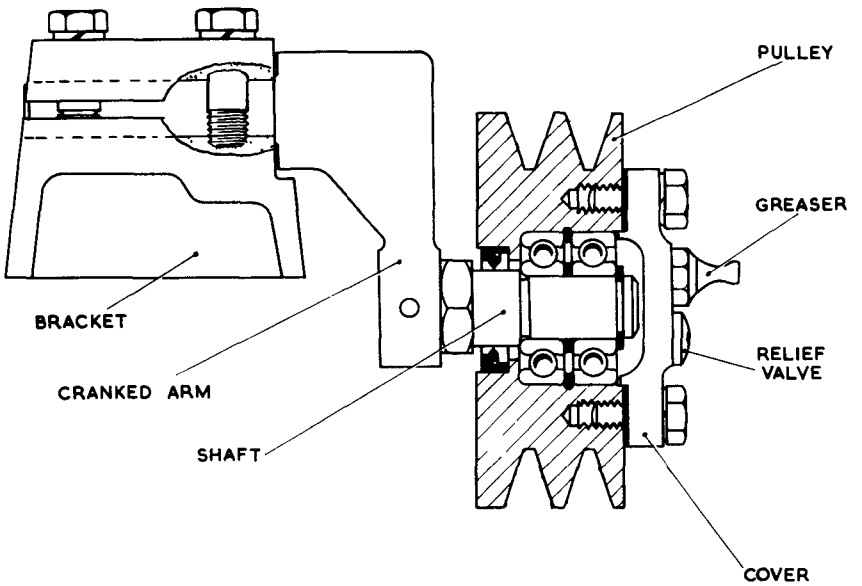


Fig. 19 Fan belt adjusting pulley

(20) Remove the hand-starting dog and the pulley at the gear end of the crankshaft. Take off the gear cover (3) complete with governor control linkage. Lift off the governor sleeve and thrust pad (20,21).

(21) Check the backlash between the timing gearwheels.

(22) Take out the lubricating oil pump strainer and remove the sump.

(23) Remove the oil pump delivery pipe, pump and gearwheel and the idler gearwheel and shaft.

(24) Take off the connecting-rod end caps and lift off each cylinder and its piston and connecting-rod. Note the thickness of the joints at the base of each cylinder.

(25) Invert the engine.

(26) Check the end float on camshaft and crankshaft (fig.20).

(27) Take off the engine support brackets, the flywheel housing and the oil seal and housing at the flywheel end.

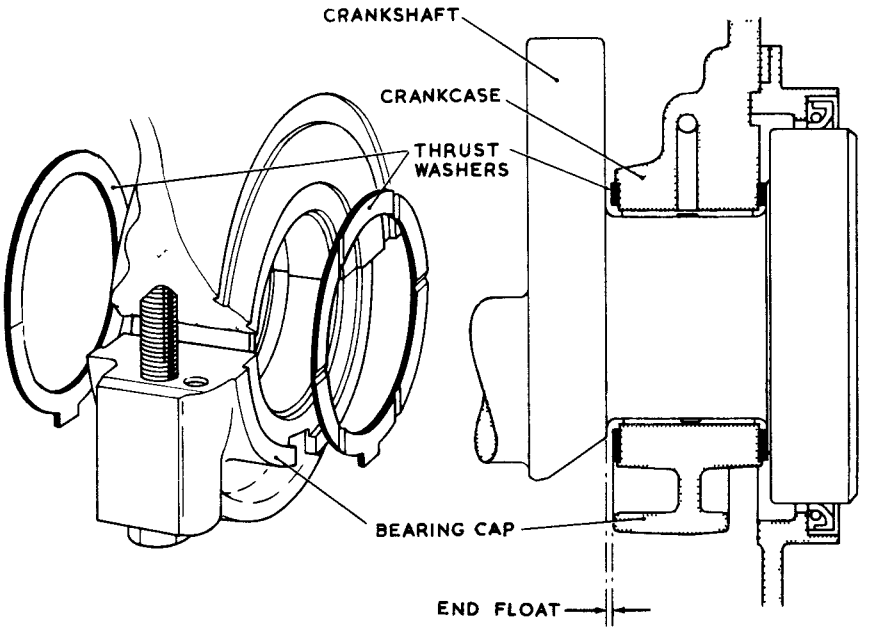


Fig.20. Crankshaft end float

(28) Check the main bearing cap stamping; each cap must bear the same serial number as the crankcase and should be fitted with the cap number on the same side as the crankcase number. Take out the main bearing caps and lift out the crankshaft. Collect the crankshaft thrust washers.

Note...

The halves of the crankshaft thrust washers must be regarded as mated; they must not be interchanged.

(29) Draw the camshaft gearwheel (fig. 21) and remove the nuts on the bearing housing studs. Ensure that the tappets are clear of the camshaft, draw the camshaft from its bearings and collect the tappets.

(30) Take off the gear cover plate and the intermediate and fuel pump gearwheels.

Cleaning

78. After removal from the engine the sub-assemblies should be stripped to the extent found necessary and all components degreased and cleaned; precautions should be taken to prevent rusting after cleaning. Details of suitable degreasants are given in A.P.119A-0509-1. Ball and roller bearings should be cleaned as described in A.P.1464B, Vol. 1, Part 2, Sect. 1, Chap.1.

Engine sub-assemblies-general

79. Detailed instructions are not given for dismantling, examining or reassembling sub-assemblies which are covered in earlier paragraphs, nor for those where such operations will present no difficulty. Piston rings should be identified or grouped so that if necessary each can be refitted in the groove from which it was removed. Split pins, oil seals, gaskets, joints, circlips, tab washers and similar parts should be discarded and new items fitted on assembly.

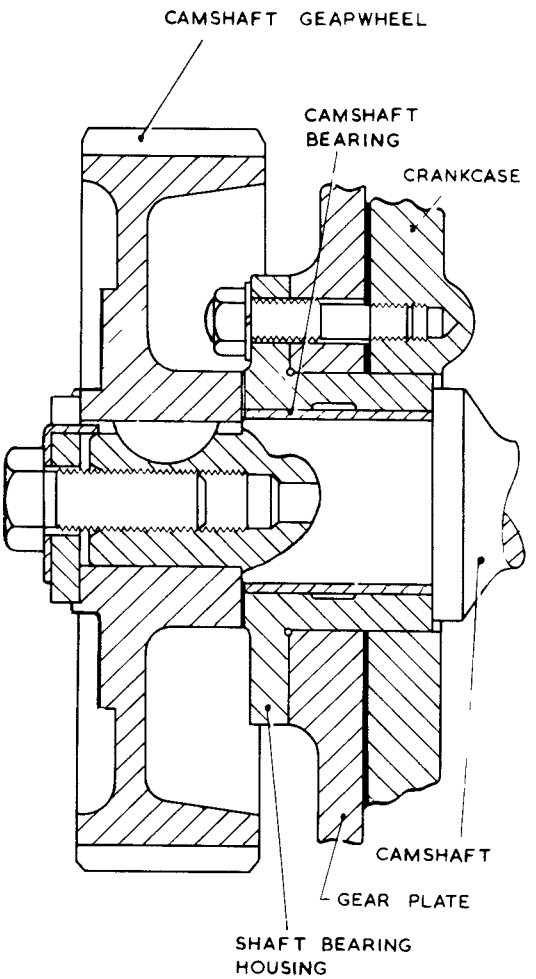


Fig. 21. Camshaft drive

80. When cleaned all parts must be examined for cracks, scores, distortion and any other defects likely to affect the serviceability of the component; surfaces subject to wear should be measured and the dimensions compared with those shown in Table 1. Plain bearings in housings should be secure and there should be no signs of creep. Ball and roller bearings must be examined and tested as described in A.P.1464B. Vol. 1, Part 2, Sect.1, Chap. 1.

81. After examination, the sub-assemblies should be rebuilt ready for refitment; unserviceable parts must be renewed or repaired. In general the procedure for assembly is the reverse of that for dismantling.

Fuel injection equipment

82. The reconditioning of fuel injection equipments should be undertaken only by units equipped for this work. After reconditioning, the pumps should be tested on a Hartridge Test Bench as described in A.P.1464E, Vol. 1, Part 1, Sect. 2, Chap. 12; Tables 4 and 5 of this chapter give test figures for reconditioned pumps and injectors.

Cylinder heads

83. The valve guides are pressed into the cylinder heads and if necessary can be removed with a simple extractor. If new guides are fitted the valve seats should be refaced before lapping the valves; the angle of valve seats and faces is 45 deg. The width of new valve seats is given in Table 1. Fig. 22 gives details of the fitting of valve seat inserts; when the inserts are fitted the seats must be recut to the dimensions shown. In addition to routine visual inspection the valve springs should be checked against the figures in Table 6. If a new valve is fitted its crown should be not less than 0·040 in. below the surface of the cylinder head; if necessary the valve should be refaced to obtain this clearance.

84. The cylinder head gaskets are copper and should be annealed.

85. When rebushing a rocker it is important to fit the bush so that when the rocker gear is assembled the hole in the bush coincides with the upper oil hole in the rocker shaft; the bush hole must not align with the drilling in the rocker. On completion of the bushing operation the oil passages should be checked to ensure that they are clear; choked passages may result in broken valve springs and a similar check should be made on all rockers whether rebushed or not. When assembling a rocker shaft in its bracket care must be exercised that the locating grubscrew registers in the dimple in the shaft, not in the oil feed hole.

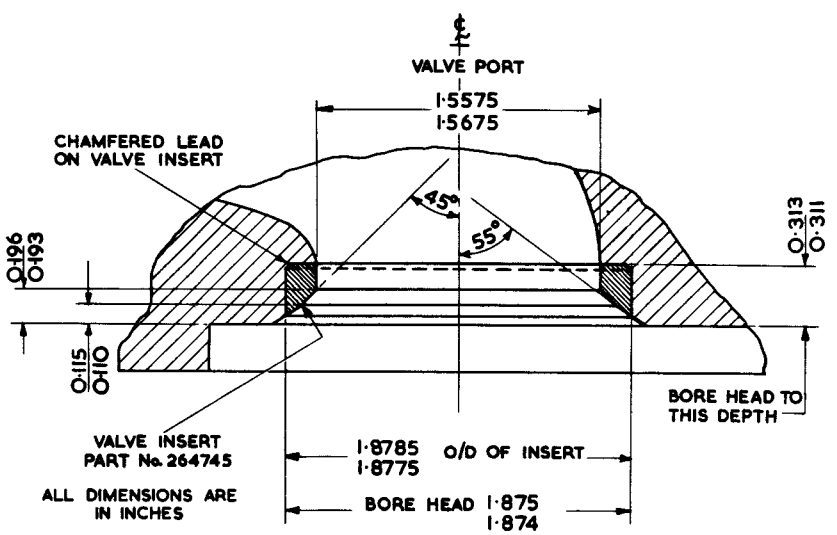


Fig.22 Valve seat inserts

Cylinders and pistons

86. Oversize pistons 0·020 and 0·040 in. above standard diameter are available (Table 1); the reboring operation should be completed by honing to the dimensions given in Table 2. The unworn ridge at the top of the cylinder should be removed if new rings or pistons are fitted without reboring. The diameter of the piston should be measured at right angles to the gudgeon pin, $\frac{1}{4}$ in. below the upper scraper ring. Gudgeon pins are a transition fit in the pistons and removal and fitting may be assisted by warming the pistons. The valve recesses in the crown are to the right when the connecting-rod butting faces slope up to the left (fig. 18).

87. Table 1 gives dimensional limits for piston rings. If rings are used again each must be fitted in its original groove with the original top side uppermost. Rings marked TOP must be fitted with that face uppermost.

Connecting-rods

88. Undersize big-end bearings are 0·010, 0·020, 0·030 and 0·040 in. below standard diameter; Table 3 gives crankshaft regrinding dimensions. The oil hole in the replacement small-end bush is predrilled and on assembly must be lined up with the hole in the connecting-rod.

89. The alignment limits for connecting-rods are:-

Parallelism	0·0005 in./in.
Twist	0·001 in./in.

The connecting-rod centres are 9·129 - 9·134 in. Small discrepancies may be corrected with the rod in the cold condition only. Rods and caps are identified by serial numbers which must be on the same side. The torque for the cap bolts is 100 lb ft.

Crankshaft and main bearings

90. The crankshaft should be crack-detected A.P.119A-01 series, after cleaning and again after regrinding if regrinding is necessary. If a crankshaft is found to be cracked it is essential to correct any contributory causes.

91. Undersize main bearings are 0·010, 0·020, 0·030 and 0·040 in. below standard diameter; Table 3 gives regrinding dimensions. The fillet radius on main journals is 3/16 in. and on crankpins is 5/32 in. Oil holes must be radiused and oilways flushed after regrinding. All main bearings must be renewed if any one bearing is found to be unserviceable. The bearings are precision finished and must not be scraped on assembly. The tightening torque for the cap nuts is 175 lb ft.

Governor gear (fig. 23)

92. The operation of the governor can be affected by wear and all moving parts in contact must be carefully examined. Particular attention must be given to the thrust face of the sleeve(20) and the contact faces of the weights (19). Slight indentations on the sleeve may be removed by careful stoning; the stoning should be the minimum required to reduce the indentations to negligible depth. No attempt should be made to restore the original profile of the operating faces of the governor weights and they must be renewed (as a set) if flats are found on the contact faces. If the weights are removed from the carrier they must be put back in their original positions.

93. There should be 0·004 - 0·009 in. float on the gearwheel shaft (17). At the output end of the shaft is a nut (14) which can be adjusted to correct the float; on completion of adjustment the nut must be locked by the pinch bolt. The gearwheel (18) is shrunk on to the shaft (17) and cannot be removed. The thrust washer (15) should be refitted with the original side in contact with the flanged bush (10) in the bearing housing.

Fan housing assembly

94. Fig. 24 shows the assembly of the fan in its housing. It is important that the roller bearing is fitted at the pulley end of the shaft.

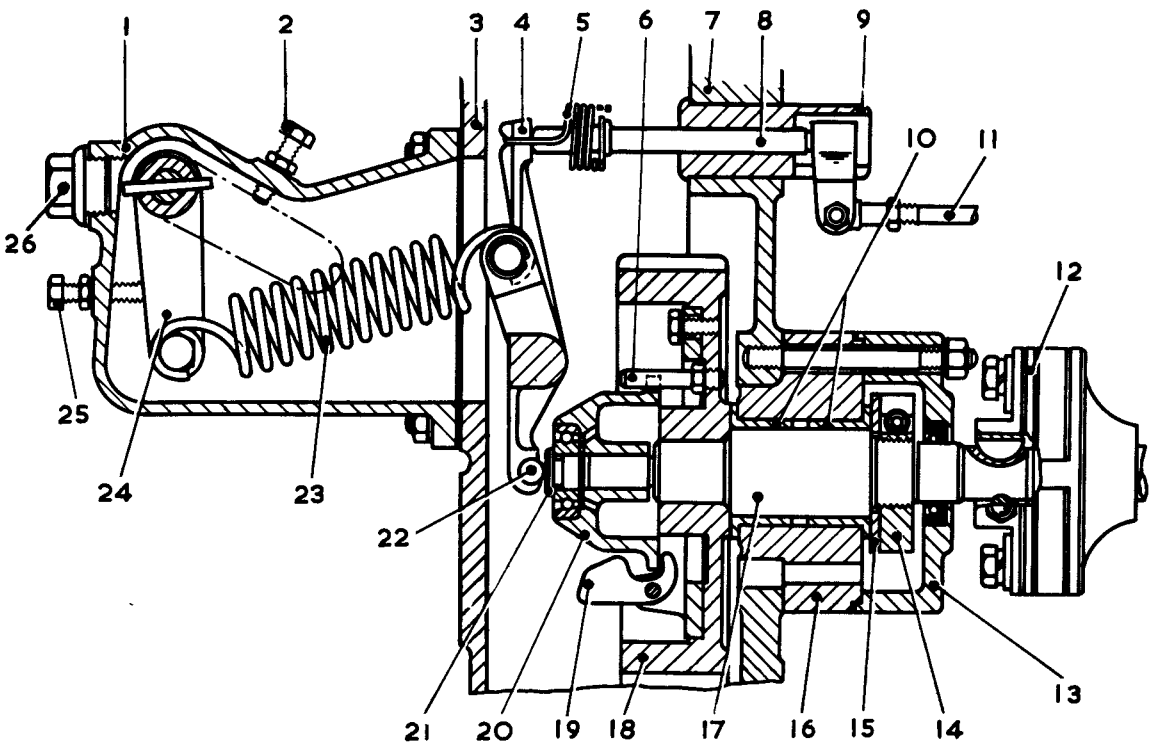


Fig.23 Governor mechanism

1	Governor spring housing	14	Nut
2	Idling stop screw	15	Thrust washer
3	Gear cover	16	Bearing housing
4	Governor lever	17	Shaft
5	Pushrod spring	18	Gearwheel
6	Sleeve locating peg	19	Governor weight
7	Gear cover plate	20	Governor sleeve
8	Governor pushrod	21	Thrust pad
9	Pushrod sleeve	22	Roller
10	Flanged bushes	23	Speeder spring
11	Adjustable link	24	Speed control internal lever
12	Injection pump coupling	25	Maximum speed stop screw
13	Oil seal housing	26	Access plug.

Fuel tank

95. The test pressure for the fuel tank is 5 lb in^2.

Oil cooler

96. The test pressure for the oil cooler is 120 lb in^2.

Oil pump (fig. 25)

97. On early oil pumps only the cover side of the driving gearwheel was bushed. On later pumps both gearwheels are bushed (7) in cover (3) and body (8). If wear on early pumps warrants it the cover and body can be machined to receive new bushes Part no. 264795. Fig.26 gives machining details for the cover; the body dimensions are identical.

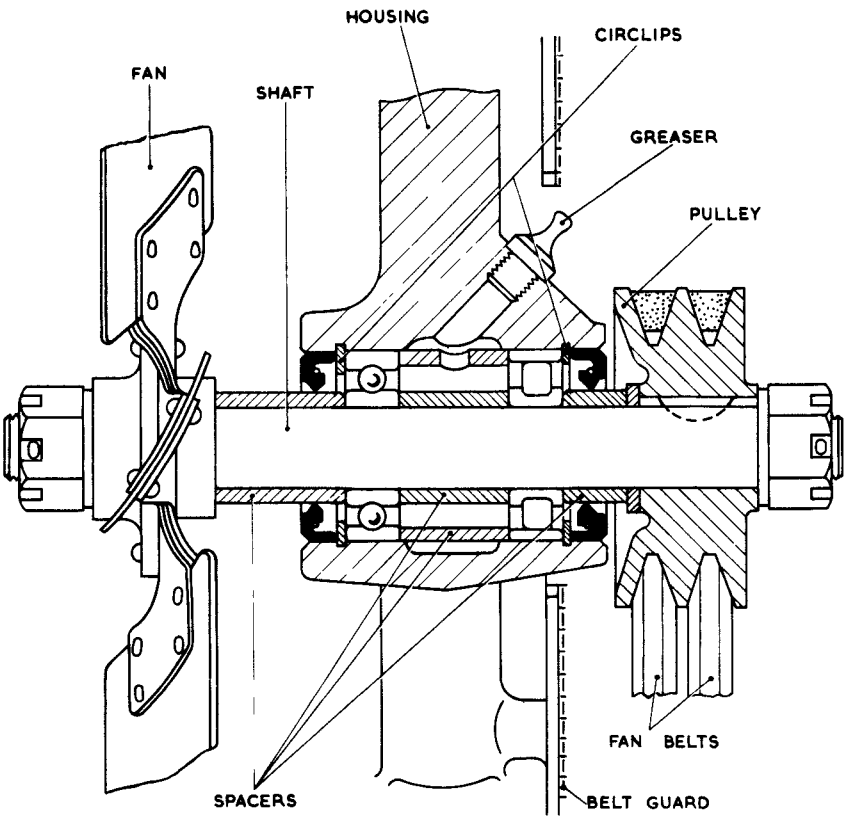
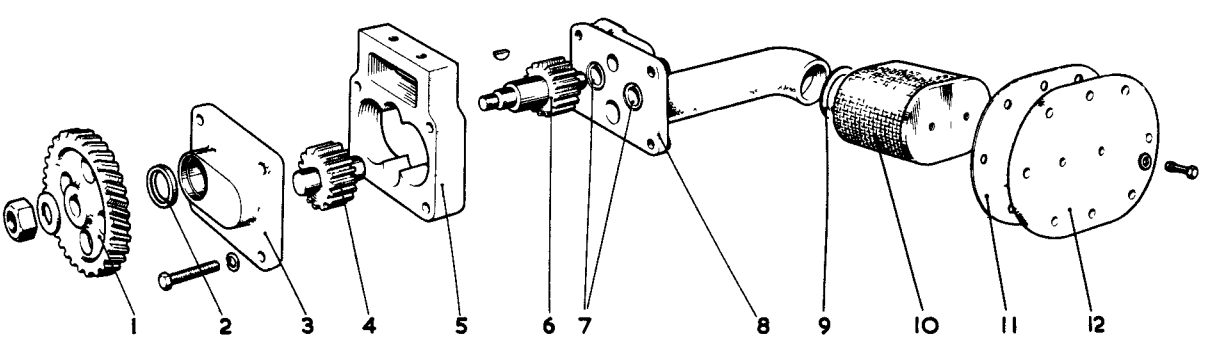


Fig.24. Fan mounting



1 Oil pump gearwheel
2 Seal
3 Cover
4 Driven gearwheel
5 Plate
6 Driving gearwheel
7 Bushes
8 Body
9 Seal
10 Strainer
11 Joint
12 Strainer cover

Fig. 25 Oil pump - exploded

Assembling the engine (fig. 12, 17, 18)

98. The engine should be assembled in accordance with normal workshop practice, generally following the sequence shown below.

(1) With the crankcase inverted, fit the gear cover plate and the fuel pump gearwheel.

(2) Put back the tappets and fit the camshaft and its front bearing housing (fig. 21). Fit the camshaft gearwheel and check the end float (Table 1).

(3) Fit the main bearings, crankshaft thrust washers and crankshaft. Check end float (fig. 20 and Table 1).

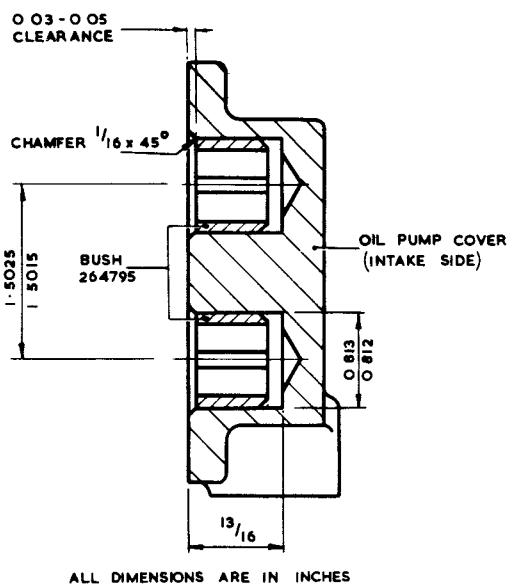


Fig. 26 Oil pump - machining for bushes

Note...

(a) Ensure that the bearing faces of the thrust washers are toward the crank webs.

(b) The serial number on the main bearing caps must be the same as the crankcase number and on the same side as that number.

(c) The tightening torque for the cap nuts is 175 lb ft.

(4) Fit the connecting-rod and piston assemblies.

Note...

(a) The connecting-rods and caps are identified by serial numbers. The numbers must agree and must face the camshaft (left) side of the engine.

(b) The valve recesses in the piston crown must be on the camshaft (left) side of the engine.

(c) The tightening torque for the cap bolts is 100 lb ft.

(5) Fit the oil pump intermediate gearwheel, oil pump and delivery pipe.

(6) Put back the crankshaft oil seal housing and seal at the flywheel end of the crankcase.

(7) Fit the sump and put back the oil pump strainer; the sump nuts should not be finally tightened at this stage.

(8) Put back the flywheel housing and the engine support brackets.

(9) Turn the crankcase over.

(10) Equi-space the piston rings and fit the cylinders and their base joints.

Note...

Fit one base joint (0·005 in. thick) per cylinder if any parts affecting piston travel have been renewed; if no such parts have been renewed the original thickness of base joints should be fitted (para. 77 (24)) pending a check on the bumping clearance.

(11) Bring No. 1 piston to T.D.C. Fit the fuel pump intermediate gearwheel, meshing the timing marks as shown in fig. 27. Check the backlash between the timing gearwheels if new wheels have been fitted.

Note...

When No. 1 piston is at T.D.C. the keyway in the crankshaft pinion is also at T.D.C. and the marked teeth are the first pair to the right of the tooth at 12 o'clock on the pinion. The keyway in the removable journal is opposite that in the pinion.

(12) Put back the governor sleeve and thrust pad (20, 21 in fig. 23) and fit the gear cover (3) complete with the governor control linkage. Hook the governor pushrod spring (5) over the lever (4) (through opening in top of gear cover).

(13) Tighten the sump nuts.

(14) Fit the removable journal bearing and its housing and oil seal, the crankshaft belt pulley and the hand-starting dog.

(15) Fit the flywheel and the power take-off shaft; ensure that each is located by three dowels.

(16) Put back the oil filler bend, dipstick tube and dipstick.

(17) Fit the main oil gallery and the oil filter adapter, filter and intake pipe. Fit the fuel feed pump.

(18) On top of each piston place two pieces of lead wire ($\frac{1}{2}$ in. long by about 0·048 in. dia.) opposite each other, at right angles to the gudgeon pin and clear of the valve recesses. Fit the cylinder heads and pass the pistons over T.D.C. Remove the heads, measure the thickness of the flattened wires and compare the results with the designed

bumping clearance (0·031 - 0·039 in.). If required, correct the clearances by altering the thickness of the base joints.

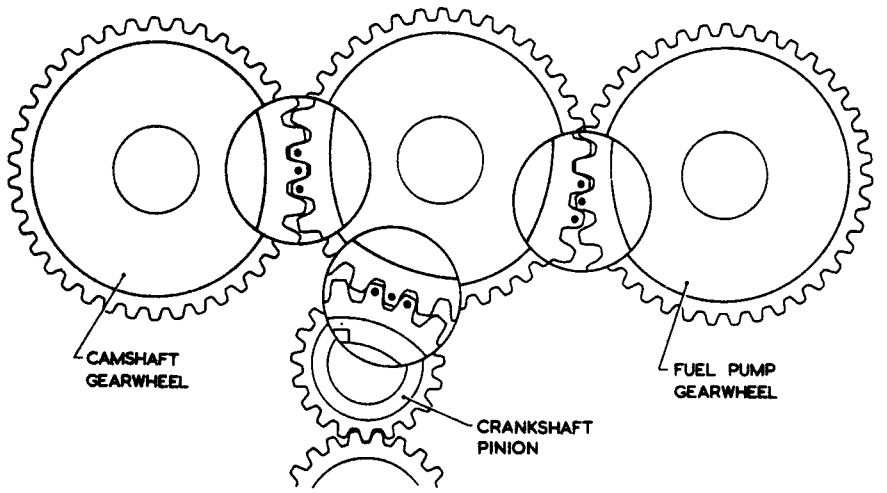


Fig.27. Gear train timing marks

Note...

The torque for the cylinder head nuts is 75 lb.ft.

(19) Fit the air guide plates and the valve pushrod tube adapters.

(20) Put back the cylinder heads and pushrod tubes, pushrods and rockers; check the alignment of the manifold faces before final tightening of the cylinder head nuts and pushrod tube adapters. Adjust the valve clearances.

(21) Fit the oil cooler and connect the delivery pipe. Fit the cooler intake pipe and the oil pressure gauge, bracket and pipe (if control panel is not fitted).

(22) Fit the rocker oil pipes. Fill the sump to the prescribed level.

(23) Put back the fan housing, fan belt adjustable pulley and belts.

(24) Put back the generator and its belt, and the starter motor and control panel (if fitted). Make the connections.

Note...

There must be 1/8 - 3/16 in. clearance between the face of the gear ring and the engaging face of the starter pinion when this is at rest.

(25) Fit the air cleaner bracket, engine front lifting hook, fuel filter and fuel feed pump delivery pipe.

(26) Fit the fuel injection pump and its feed and leak-off pipes. Connect the speed control linkage and fit the speed control rod and bracket.

(27) Rig up a fuel feed (including a filter) and check and correct the injection timing (para. 65). Put back the pump coupling guard.

(28) Fit the lower portion of the air cowling and the engine rear lifting hook.

(29) Fit the injection pump delivery pipes, injectors and leak-off pipes. Loosely connect the pump delivery pipes to the injectors. Fit the upper portion of the cowling.

(30) Put back the valve rocker covers and adjust the decompressor lift.

(31) Complete the venting of the fuel system.

(32) Put back the belt guard(s) and fit the exhaust and inlet manifolds and air cleaner.

(33) Slacken the rocker oil feed connection at No. 3 cylinder head and turn the engine until oil appears. Tighten the connection. Check the sump oil level and replenish if necessary

(34) Put back the access panel in the cowling.

Engine testing

99. The engine manufacturer's running-in and test procedure is given in Table 7. As soon as the engine is started the oil pressure relief valve (fig. 4) should be set to relieve at 40 - 60 lb/in^2. During the run the pressure should not be allowed to fall below 40 lb/in^2; this may require frequent adjustment during the warming-up period. When the engine reaches normal running temperature the relief valve must be adjusted to operate at 40 lb/in^2 and left at this setting.

Fits, clearances and repair tolerances

100. The figures shown in column (2) of Table 1 represent the maximum and minimum dimensions of new parts; the difference between these dimensions is the manufacturing tolerance. The maximum and minimum clearances which result from mating two parts is shown in column (3). The dimensions in this table are intended to guide the technician in his assessment of wear and assist him to determine which of two mating parts has worn most.

STORAGE

Preservation

▶ 101. For detailed information on engine storage and preservation procedures, refer to AP 119A-1301-1.

Packing

102. A.P.830, Vol. 2, details the packing of engines for storage and transport.

TABLE 1

Fits, clearances and repair tolerances

(All dimensions are in inches)

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
PISTON AND CYLINDER BORE			
Cylinder bore, standard dia.	4·5045 / 4·5040	0·0105 / 0·0095	Piston measured across thrust face ¼ in. below top scraper ring. Oversize pistons are 0·020 and 0·040 in above standard diameter (Table 2). Rebore cylinder when diameter has worn 0·012 in.
Piston, standard dia.	4·4945 / 4.4940		
PISTON RINGS, GROOVES AND GAPS			
Top groove, width	0·130 / 0·129	0·006 / 0·004	The top ring is chromium plated.
Top ring, width	0·125 / 0·124		
Second and third grooves, width	0·129 / 0·128	0·005 / 0·003	No. 1 groove is at the top.
Second and third rings, width	0·125 / 0·124		
Fourth and fifth grooves, width	0·253 / 0·252	0·004 / 0·002	
Fourth and fifth rings, width	0·250 / 0·249		
Piston ring gap (all rings)		0·022 / 0·018	Piston ring gap not to exceed 0·060 in.

Table 1 (Contd)

Fits, clearances and repair tolerances

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
PISTON AND GUDGEON PIN			
Piston boss, bore dia.	1·56250 / 1·56200		
		+0·00025 / −0·0005	Transition fit-maximum interference 0·0005 in.
Gudgeon pin dia.	1·56250 / 1·56225		
SMALL-END BUSH AND GUDGEON PIN			
Small-end bush, dia.	1·5650 / 1.5645		
		0·00275 / 0·0020	
Gudgeon pin, dia.	1·56250 / 1·56225		
BIG-END BEARINGS AND CRANKPINS			
Crankpin, standard dia.	3·2495 / 3·2490		Undersize big-end bearings are 0·010, 0·020, 0.030 and 0·040 in. below standard diameter (Table 3). Ovality or taper on crankpin not to exceed 0·003 in. The connecting-rod centres are 9·129 - 9·134 in.
		0·0040 / 0·0025	
Thickness of standard shell	0·08225 / 0·08200		
Big-end bearing bore in connecting-rod	3·4170 / 3·4165		

Table 1 (Contd)

Fits, clearances and repair tolerances

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
MAIN BEARINGS AND CRANKSHAFT JOURNALS			
Crankshaft journals, standard dia	3·4985 / 3·4980	0·005 / 0·003	Undersize main bearings are 0·010, 0·020, 0·030 and 0·040 in. below standard diameter (Table 3). Ovality or taper of crankshaft journal not to exceed 0·003 in.
Thickness of standard shell	0·08225 / 0·08200		
Main bearing bore in crankcase	3·667 / 3·666		
Crankshaft end float		0·005 / 0·013	Crankshaft end float not to exceed 0·015 in.
Thickness of crankshaft thrust washer	0·093 / 0·091		
CAMSHAFT AND BEARINGS			
Gear end bearing, dia	1·376 / 1·375	0·0045 / 0·0017	
Gear end journal, dia	1·3733 / 1·3715		
Camshaft bushes, dia	1·9386 / 1·9360	0·0066 / 0·0030	
Camshaft journals, dia	1·933 / 1·932		

Table 1 (Contd)

Fits, clearances and repair tolerances

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
Gear end bearing housing, length	1·5775 / 1·5745		
Gear end journal, length	1·5645 / 1·5625	0·015 / 0·010	These clearances constitute camshaft end float.
Cam lift	0·310		
VALVE GEAR			
Valve tappet bore in crankcase, dia	0·626 / 0·625		
Valve tappet, dia.	0·6235 / 0·6225	0·0035 / 0·0015	Exhaust valve lift by decompressor not to exceed 0·025 in.
Valve guide, dia.	0·3758 / 0·3755		
Valve stem, dia	0·3730 / 0·3718	0·004 / 0·0025	
Valve rocker shaft, dia.	0·7505 / 0·7500		

Table 1 (Contd)

Fits, clearances and repair tolerances

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
Width of valve seat	0·122 / 0·110		
Valve stand-in		0·061 / 0·040	
FUEL INJECTION PUMP DRIVE			
Pump driving shaft bushes, dia.	1·2525 / 1·2520		
		0.0042 / 0·0030	
Pump driving shaft, dia.	1·2490 / 1·2483		
Pump driving shaft, end float		0·009 / 0·004	
Intermediate gearwheel bearing dia.	1·6264 / 1·6250		
		0·0034 / 0·0010	
Intermediate gearwheel shaft, dia.	1·6240 / 1·6230		
Intermediate gearwheel end float		0·015 / 0·005	
Thickness of intermediate gearwheel thrust washer	0·127 / 0·125		

Table 1 (Contd)

Fits, clearances and repair tolerance

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
FAN DRIVE			
Fan driving pulley shaft bush,dia.	$\frac{1{\cdot}2525}{1{\cdot}2520}$	$\frac{0{\cdot}0055}{0{\cdot}0038}$	
Fan driving pulley shaft, dia.	$\frac{1{\cdot}2482}{1{\cdot}2470}$		
LUBRICATING OIL PUMP			
Driving gearwheel large bush,dia.	$\frac{0{\cdot}751}{0{\cdot}750}$	$\frac{0{\cdot}0035}{0{\cdot}0015}$	
Driving gearwheel spigot,dia	$\frac{0.7485}{0{\cdot}7475}$		
Driving gearwheel small bush,bore	$\frac{0{\cdot}6265}{0{\cdot}6255}$	$\frac{0{\cdot}004}{0{\cdot}002}$	
Driven gearwheel spigots, dia.	$\frac{0{\cdot}6235}{0{\cdot}6225}$		
Driven gearwheel spigot bushes,bore	$\frac{0{\cdot}6265}{0{\cdot}6255}$	$\frac{0{\cdot}004}{0{\cdot}002}$	
Driven gearwheel spigot, dia.	$\frac{0{\cdot}6235}{0{\cdot}6225}$		
Pump gearwheels, end float		$\frac{0{\cdot}004}{0{\cdot}002}$	

Table 1 (Contd)

Fits, clearances and repair tolerances

Parts and description	Dimensions new	Clearance new	Remarks
(1)	(2)	(3)	(4)
Oil pump intermediate gearwheel bush, dia.	1·62650 / 1·62575	0·00350 / 0·00175	
Oil pump intermediate gearwheel shaft, dia.	1·6240 / 1·6230		
Oil pump intermediate gearwheel end float.		0·015 / 0·005	
Thickness of intermediate gearwheel thrust washer.	0·127 / 0·125		

TABLE 2

Cylinder reboring data

(All dimensions are in inches)

Nominal amount oversize	Diameter of bore	Diameter of piston	Remarks
0·020	4·5240 - 4·5245	4·5140 - 4·5145	Rebore when diameter has worn 0·012 in.
0·040	4·5440 - 4·5445	4·5340 - 4·5355	

Note...

(a) The clearances shown in column (3) of Table 1 apply also to oversize bores and pistons.

(b) Oversize pistons are marked with the amount of oversize.

TABLE 3

Crankshaft regrinding and undersize bearings-data

(All dimensions are in inches)

Nominal amount undersize	Diameter of main journal	Diameter of crankpin	Thickness of new main and big-end bearing shell
0·010	3·4880 - 3·4885	3·2390 - 3·2395	0·0870 - 0·08725
0·020	3·4780 - 3·4785	3·2290 - 3·2295	0·0920 - 0·09225
0·030	3·4680 - 3·4685	3·2190 - 3·2195	0·0970 - 0·09725
0·040	3·4580 - 3·4585	3·2090 - 3·2095	0·1020 - 0·10225

Note...

(a) The blending radius on main journals is 3/16 in. and on crank pins is 5/32 in.

(b) The bearing clearances shown in column (3) of Table 1 apply also to undersize bearings.

(c) The thickness of bearing shells can be measured with a flat-anvil micrometer and a precision roller; undersize bearings are marked with the amount of undersize.

TABLE 4

Test details for fuel injection pump

Test No.	Camshaft Speed (±1%) (r.p.m)	Rack Setting (±0·1mm) (mm)	No.of injections	Delivery (cm^3)	Permissible scatter between all deliveries (cm^3)	Dead rack (±0·5mm) (mm)
1	200	7·5	500	5·6- 8·0	1·5	
2	750	10·5	200	10·5-11·5	0·4	3
3	1000	13·0	200	14·0-16·0	1·0	

Table 4 (Contd)

Note...

(a) The setting point is 52·5 - 57·5 mm^3 per stroke at 750 rev/min at 10·5 mm rack.

(b) The injector is HL130S28C209P3 set to release at 2500 lb/in^2.

(c) The tolerance on phasing is $\pm \frac{1}{2}$ degree.

(d) The fuel flow through the test rig should not be less than 850 cm^3 in 60 sec.

TABLE 5

Nozzle servicing and testing data

Nozzle details			
Angle of needle seating	max	59°	05′
	min	58°	55′
Angle of needle	max	60°	25′
	min	60°	00′
Lift of needle (mm)	max	0·25	
	min	0·20	
Nozzle needle seat test			
Needle spring setting (atm)		136	
Test pressure (atm)		129	
Duration of test (sec)		15	
Back-leak test			
Pressure drop (atm)	From	250	
	To	200	
Back-leak time (sec)	max	24	
	min	4	
Temperature of test oil (°F)		68	

Note...

(a) For back-leak test use type S holder with 80 mm reach; connecting pipe to be 6 mm by 2 mm bore by 16 in. long.

(b) Higher temperatures will reduce the back-leak time, lower temperatures will increase it.

(c) The nozzle must pass a seat-leak test before being tested for back-leak.

TABLE 6

Spring data

Component	Part No.	Free length (in)	Rate (lb/in)	Aid to identification
Valve spring, inner	3/271758	1·953	30(approx)	Orange and white longitudinal bands. See also note (c)
Valve spring, outer	260649	1·857	129(approx)	See note (b)
Speeder spring, 900-1200 rev/min	260853	-	9	Green/red
Speeder spring, 1201-1800 rev/min	260837	-	19	Green/white
Speeder spring, variable speed	260900	3·375	30 ± 0·75	Mean coil dia. 1·00in., wire dia. 0·116 in.
Oil pressure relief valve spring	263285	2·75	23·5	Brown/yellow ends

Note...

(a) The outer valve spring is to Category III, Class A of B.S.1726: 1951. Load/lengths are 1·72 in./20 ± 1 lb. and 1·23 in./83·2 ± 4·2 lb.

(b) Outer valve springs are painted (1) brown and red (2) brown and green (3) brown and yellow or (4) brown and blue longitudinal bands. The varying colour combinations identify the spring manufacturer and all outer valve springs have the same characteristics.

(c) Early pattern inner valve springs were identified by the same colour combinations as outer valve springs (Note (b)).

(d) Speeder rings measured between inside of loops.

TABLE 7

Engine manufacturer's running-in and test procedure

Test speed (rev/min)	Load (b.h.p.) 1200 rev/min engines	1500 rev/min engines	1800 rev/min engines	Duration
Low	Nil	Nil	Nil	10 min
1000	5	5	5	10 min
1000	10	10	10	10 min
1200	12	12	12	10 min
1200	18	-	-	30 min
1200	24	-	-	3 hr
1500	-	22·5	22·5	30 min
1500	-	30	-	3 hr
1800	-	-	18	1 hr
1800	-	-	27	1 hr

Table 7 (Contd)

Test speed (rev/min)	Load (b.h.p.) 1200 rev/min engines	1500 rev/min engines	1800 rev/min engines	Duration
1800	-	-	36	5 hr
Rated	26·4	33	39·6	15 min
Rated	24	30	36	15 min
Rated	12	15	18	15 min
Rated	Light	Light	light	10 min

Note...

(a) Carry out tests in order of ascending speed.

(b) During full load test periods check governing and record fuel consumption, exhaust conditions and oil temperature and pressure.

(c) Record oil temperature and pressure and exhaust conditions during overload period.

(d) When cold check rocker clearances (0·010 in) and tightness of cylinder head nuts (75 lb ft).

Illustrated Parts Catalogue

CONTENTS

Introduction

1. This illustrated parts catalogue (IPC) is designed as an aid to the identification of component parts or assemblies of parts of the equipment, and to provide the information necessary for the demanding of spares.

2. This IPC may list some or all of the parts comprising the equipment concerned, but only those parts given a NATO stock number or service catalogue or reference number will normally be available as spares. Should there be a requirement for an item not assigned a number, demands may be submitted quoting the code number of the publication, item number, figure reference and item name. Where a manufacturer's number is known this should also be quoted.

Quantities

3. The figure in the 'Number Off' column specifies the quantity required for the unit (or assembly, sub-assembly etc) concerned; it does not indicate the quantity to be demanded.

Demands

4. Items are available at both 2nd and 3rd line unless the class of store in column 7 is prefixed by 3; when this occurs items are available only at 3rd line. Items annotated NP RN are listed for identification purposes only and have not been provisioned in support of this equipment.

Modification state

5. When appropriate, a modification record will be included listing equipment modifications which have been incorporated in this IPC.

Annotations

6. The following annotations are used in this IPC.

NP RN - Not provisioned for Royal Navy use.
P - Permanent store.
C - Consumable store.

Abbreviations

7. Abbreviations and symbols used in this IPC have been approved and are listed separately.

Indentations

8. The dot system of indentation is used in which each dot depicts the relationship of the item to the main assembly as follows:-

MAIN ASSEMBLY
Attaching parts for main assembly
. SUB-ASSEMBLY (or detail part of main assembly)
. Attaching parts for sub-assembly
. . SUB-SUB-ASSEMBLY (or detail part of sub-assembly).
. . Attaching parts for sub-sub-assembly.

Publication Information

9. Any communication regarding this IPC should be made to the controlling authority at the following address: OIC NATEC, HMS DAEDALUS, LEE-ON-SOLENT, HANTS (for the attention of PGO(GE)).

ILLUSTRATED PARTS CATALOGUE (-3)

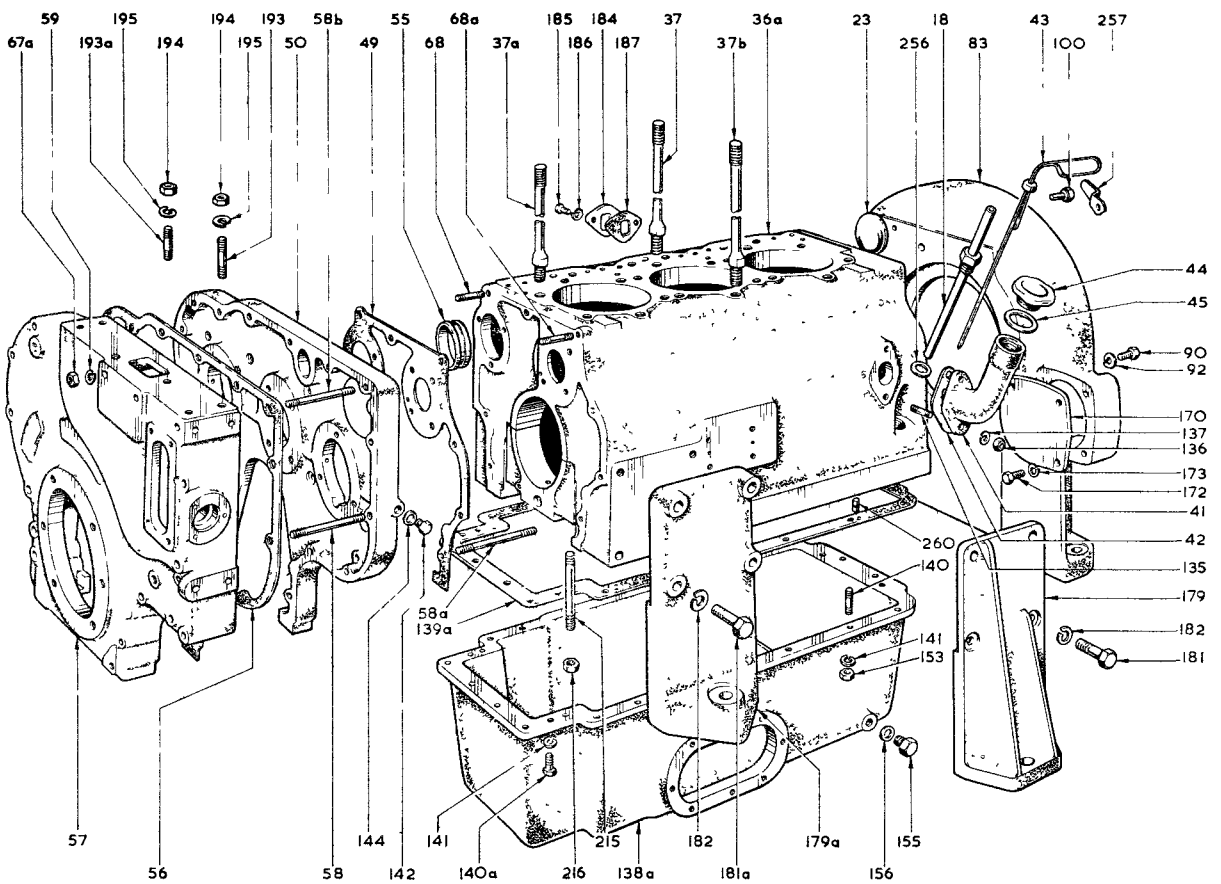


Fig 1 Crankcase assembly

MAIN EQUIPMENT PETTERS DIESEL ENGINE, TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
1	42CQ/2815-99-112-3747	PETTERS 144385	ENGINE-DIESEL PD 3			A	
			CRANKCASE ASSEMBLY				
2	42CQ/5330-99-470-3202	261354	. JOINT AND GASKET SET	A/R		C	
3	42CQ/5306-99-222-6124	FA37	. STUD, CYLINDER HEAD	3		C	1/37
4	42CQ/5306-99-222-6125	FA37A	. STUD, CYLINDER HEAD	12		C	1/37a
5	42CQ/5307-99-222-4775	260004	. STUD, CYLINDER HEAD	3		C	1/37b
6	42CQ/2815-99-223-1564	195081 Issue 2	. OIL FILLER	1		C	1/41
7	42CQ/5330-99-142-8614	260633	. JOINT, OIL FILLER	1		C	1/42
8	42CQ/6680-99-223-1566	26396B Issue 1	. DIPSTICK	1		C	1/43b
9	42CQ/2815-99-200-2683	257568	. CAP, OIL FILLER	1		C	1/44
10	42CQ/2815-99-200-2265	256542	. JOINT OIL FILLER CAP	1		C	1/45
11	42CQ/2815-99-223-1568	142849 Issue 2	. JOINT, GEAR COVER PLATE	1		C	1/49
12	42CQ/2815-99-207-0480	261169	. BEARING CAMSHAFT	3		C	1/55
13	42CQ/2815-99-223-1569	2/142850 Issue 1	. JOINT GEAR COVER	1		C	1/56
14	42CQ/2815-99-223-1573	195793 Issue 3	. JOINT, SUMP	1		C	1/139a
15	42CQ/5340-99-142-8678	823076 799x3/4in.	. PLUG, SUMP DRAIN	1		C	1/155a
16	42CQ/5330-99-112-5146	843153	. JOINT WASHER 3/8in.	1		C	1/156
17	42CQ/2805-99-112-4263	843156	. JOINT, WASHER	1	FOR SUMP PLUG DRAIN	C	1/156a
18	42CQ/2815-99-413-9317	261139	. JOINT	1		C	1/187
19	42CQ/5310-99-112-4257	843107	. JOINT	1		C	1/256

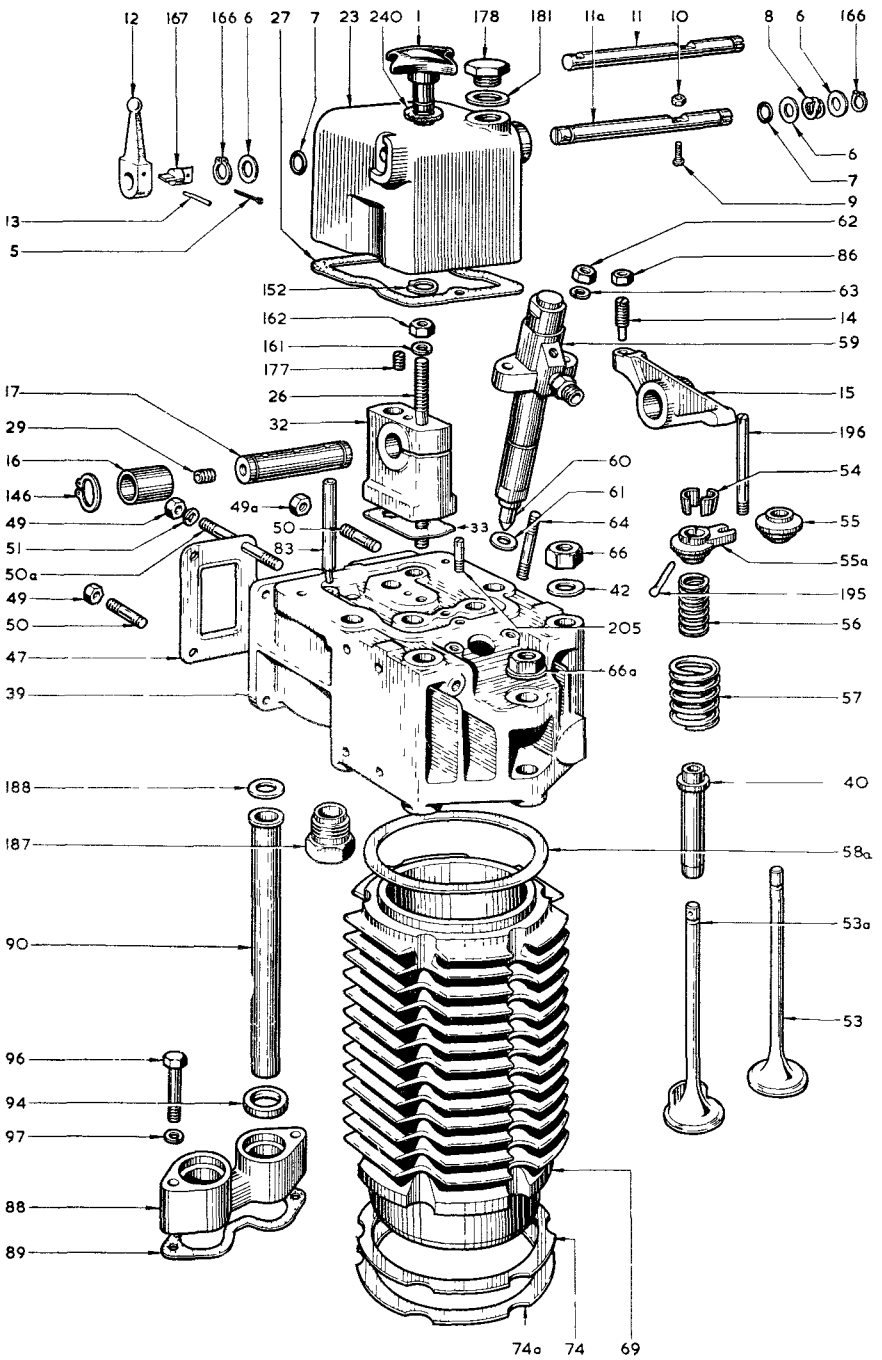


Fig 2 Cylinder assembly

MAIN EQUIPMENT PETTER DIESEL ENGINE TYPE P.D 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
20	42CQ/5310-99-134-3398	746023	. NUT, SELF LOCKING	8		C	1/216
			CYLINDER ASSEMBLY				
21	42CQ/5310-99-112-4253	785015	. WASHER DECOMPRESSION SHAFT	8		C	2/6
22	42CQ/5330-99-223-1561	261314	. OIL SEAL DECOMPRESSION SHAFT	6		C	2/7
23	42CQ/5310-99-112-4254	786208	. THACKERY WASHER DECOMPRESSION SHAFT	3		C	2/8
24	42CQ/2815-99-203-9564	FB14	. SCREW, VALVE ROCKER ADJUSTMENT	6		C	2/14
25	42CQ/2990-99-112-4485	261127	. ROCKER, VALVE	6		C	2/15
26	10AR/3120-99-954-3315	FB16	. BUSH, ROCKER VALVE	6		C	2/16
27	42CQ/2815-99-413-9319	FB27	. JOINT, ROCKER BOX	3		C	2/27
28	42CQ/2805-99-413-9320	FB33	. JOINT, ROCKER SHAFT	3		C	2/33
29	42CQ/2815-99-223-1570	142957 Issue 8	. CYLINDER	3		B	2/69
30	42CQ/2805-99-413-9322	FB40	. VALVE GUIDE	6		C	2/40
31	42CQ/2990-99-413-9323	FB47	. GASKET, INLET AND EXHAUST MANIFOLD	6		C	2/47
32	42CQ/2805-99-413-9325	UB53A	. VALVE, INLET	3		C	2/53a
33	42CQ/2805-99-413-9324	FB53	. VALVE, EXHAUST	3		C	2/53
34	42CQ/2805-99-413-9326	UB54	. COLLET, VALVE	6prs		C	2/54
35	42CQ/2805-99-413-9327	FB55	. CUP, EXHAUST VALVE	3		C	2/55
36	42CQ/2805-99-413-9328	FB55A	. CUP, INLET VALVE	3		C	2/55a
37	42CQ/5340-99-413-9329	UB56	. SPRING, VALVE (INNER)	6		C	2/56

MAIN EQUIPMENT PETTER DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
38	42CQ/5340-99-413-9330	FB57	. SPRING VALVE (OUTER)	6		C	2/57
39	42CQ/2815-99-413-9331	FB58A	. GASKET, CYLINDER HEAD	3		C	2/58a
40	LV6MT12/2910-99-430-5297	UB59	. INJECTOR, FUEL	3	WITHOUT NOZZLE	B	2/59
41	LV6MT12/2910-99-430-5296	FB60	. NOZZLE, FUEL	3		B	2/60
42	42CQ/2910-99-202-3109	BRYCE BERGER E114/3	. WASHER	3	FUEL INJECTOR NOZZLE	C	2/61
43	42CQ/2815-99-413-9334	260654	. JOINT, CYLINDER	A/R	0.015in.thk.	C	2/74
44	42CQ/2815-99-413-9335	260655	. JOINT, CYLINDER	A/R	0.005in.thk.	C	2/74a
45	42CQ/5310-99-413-9336	FB86	. LOCKNUT ROCKER ADJUSTMENT	6		C	2/86
46	42CQ/2805-99-413-9337	FB89	. JOINT PUSH ROD TUBES	3		C	2/89
47	LV6MT1/5330-99-801-4860	FB94	. OIL SEAL, PUSH ROD TUBES	6		C	2/94
48	42CQ/5340-99-910-8194	SSM(L) 7-3	. CIRCLIP, ROCKER SHAFT	6		C	2/146
49	42CQ/2815-99-223-1577	260014 Issue 1	. COUPLING DECOMPRESSOR SHAFT	2		C	2/167
50	42CQ/5330-99-112-4259	843007	. JOINT	3		C	2/181
51	42CQ/2805-99-413-9339	FB 188	. JOINT WASHER	6		C	2/188
52	29E/5315-99-942-5548	BS1574	. SPLIT PIN INLET VALVE	3		C	2/195
			CRANKSHAFT ASSEMBLY				
53	42CQ/2815-99-413-9342	2/261132	.OIL SEAL, FLY WHEEL END	1		C	3/5
54	42CQ/1730-99-223-0145	195794/2	. JOINT, OIL SEAL HOUSING	1		C	3/7
55	42CQ/3120-99-207-0474	2/260661	. BEARING, MAIN, FLY-WHEEL END	1pr.		C	3/8

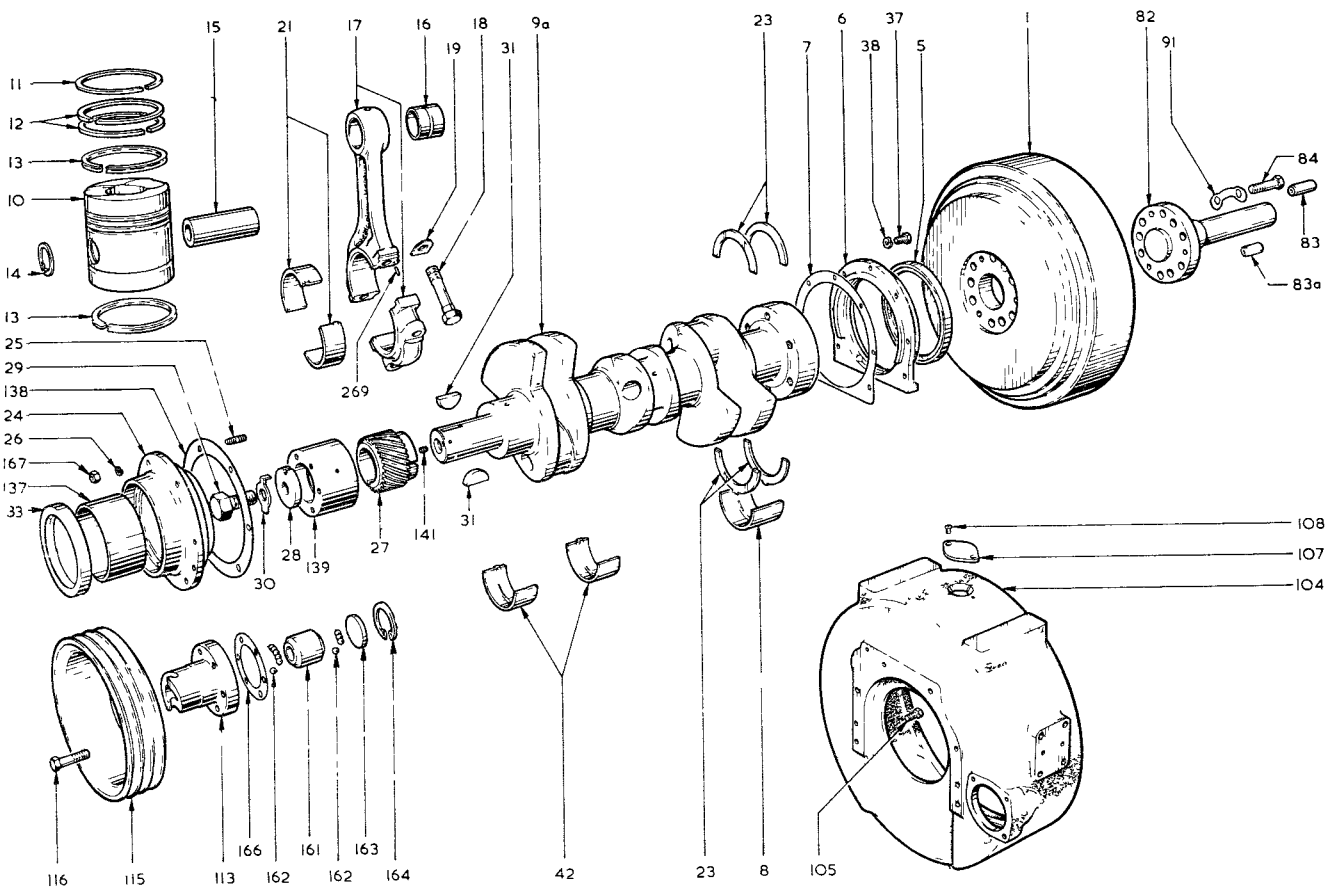


Fig 3 Crankshaft assembly

MAIN EQUIPMENT PETTER DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
56	42CQ/2815-99-413-9343	2/260925	. PISTON ASSEMBLY	3		C	3/10
57	42CQ/2805-99-413-9344	FC11	. RING, COMPRESSION	3	CHROMIUM PLATED.	C	3/11
58	42CQ/2805-99-413-9345	FC12	. RING, COMPRESSION	6		C	3/12
59	42CQ/2805-99-413-9346	FC13	. RING, SCRAPER	6		C	3/13
60	42CQ/2805-99-413-9347	UC14	. CIRCLIP GUDGEON PIN	6		C	3/14
61	42CQ/3120-99-222-9075	2/260021 Issue 3	. BUSH, SMALL END	3		C	3/16
62	42CQ/2815-99-223-0147	4/196247	. CONNECTING ROD ASSEMBLY	3	C/N ITEMS 61,63,65.	C	3/17
63	42CQ/136-1660	FC18	. BOLT, BIG END	6		C	3/18
64	42CQ/5310-99-413-9352	FC19	. TABWASHER, BIG END	6		C	3/19
65	42CQ/2815-99-413-9351	FC.21	. BEARING,BIG END	3prs		C	3/21
66	42CQ/5315-99-112-4262	792025	. KEY CRANKSHAFT JOURNAL	2		C	3/31
67	42CQ/3120-99-207-0475	2/260670	. BEARING, MAIN	3prs		C	3/42
68	42CQ/2990-99-223-1571	195245 Issue 8	. STARTING DOG	1		C	3/113
69	42CQ/5330-99-222-6866	FC 133	. OIL SEAL GEAR END	1		C	3/133
70	42CQ/2815-99-207-0471	260672	. BEARING, JOURNAL	1		C	3/137
71	42CQ/2815-99-223-1572	195101 Issue 2	. JOINT MAIN BEARING HOUSING	1		C	3/138
72	42CQ/2815-99-207-0481	260155	. BEARING STARTER DOG	1		C	3/161
73	42CQ/2815-99-223-1576	260156 Issue 2	. PLATE BEARING RETAINING	1		C	3/163
74	42CQ/5330-99-142-8612	260821	. JOINT, STARTER DOG	1		C	3/166

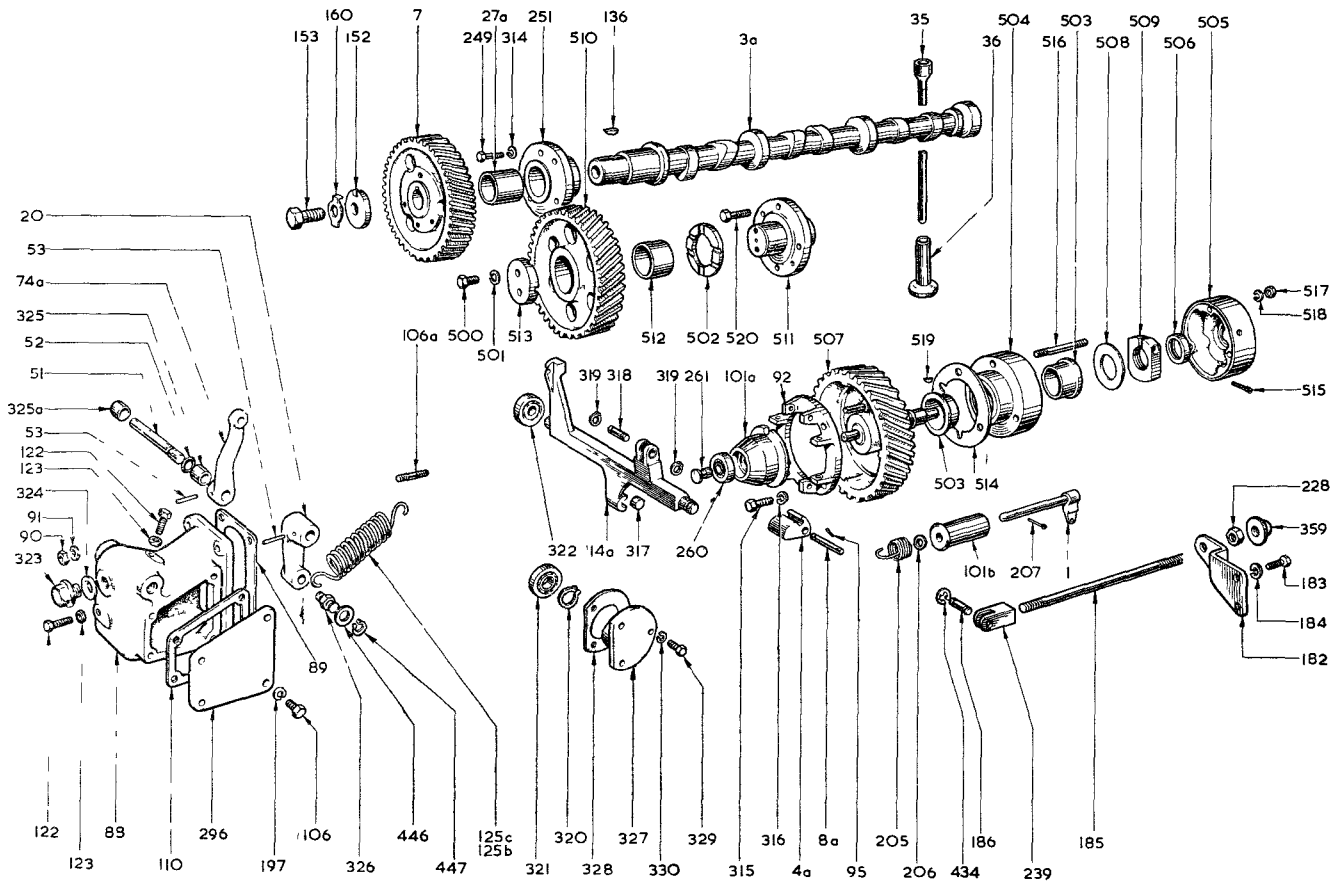


Fig 4 Camshaft and governor assembly

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
75	42CQ/2805-99-413-9348	FC15	. GUDGEON PIN	3		C	3/15
			CAMSHAFT AND GOVERNOR ASSEMBLY				
76	42CQ/2990-99-142-8613	261126	. WEIGHT, GOVERNOR	2prs.		C	4/4a
77	42CQ/5315-99-203-9576	260083	. PIN, GOVERNOR WEIGHT	4		C	4/8a
78	LV6MT1/3120-99-800-9046	PD27A	. BEARING CAMSHAFT	1		C	4/27a
79	42CQ/2815-99-413-9356	FD35	. PUSH ROD, VALVE ROCKER	6		C	4/35
80	42CQ/2815-99-222-6742	2/260030	. TAPPET	6		C	4/36
81	42CQ/5315-99-142-8615	260258	. SPINDLE, SPEED CONTROL LEVER	1		C	4/51
82	42CQ/5330-99-801-6806	G.A. CO. R110	. OIL SEAL, CONTROL LEVER SPINDLE	1		C	4/52
83	42CQ/5315-99-142-6885	772032	. TAPER PIN	2		C	4/53
84	42CQ/2990-99-413-9357	FD 89	. JOINT, SPEEDER SPRING HOUSING	1		C	4/89
85	42CQ/5830-99-222-6744	260847	. JOINT, HOUSING COVER	1		C	4/110
86	42CQ/5360-99-207-0378	260837	. SPRING, SPEEDER	1		C	4/125b
87	42CQ/5340-99-413-9361	FD 205	. SPRING, GOVERNOR PUSH ROD	1		C	4/205
88	2A/3110-99-950-0381	SKEFCO ALS4	. BEARING, GOVERNOR THRUST	1		C	4/206
89	42CQ/2910-99-203-9566	FD261	. PAD, GOVERNOR THRUST	1		C	4/261
90	42CQ/3110-99-432-1600	RVESY	. ROLLER BEARING FUEL PUMP OPERATING LEVER	1		C	4/317
91	LV6MT7/3110-99-950-1178	FD321	. BEARING, FUEL PUMP OPERATING LEVER (SPRING END)	1		C	4/321
92	LV6MT7/3110-99-950-1177	FD322	. BEARING, FUEL PUMP OPERATING LEVER (PUSH ROD END).	1		C	4/322
93	42CQ/2815-99-203-1739	843154	. JOINT, WASHER	1		C	4/324

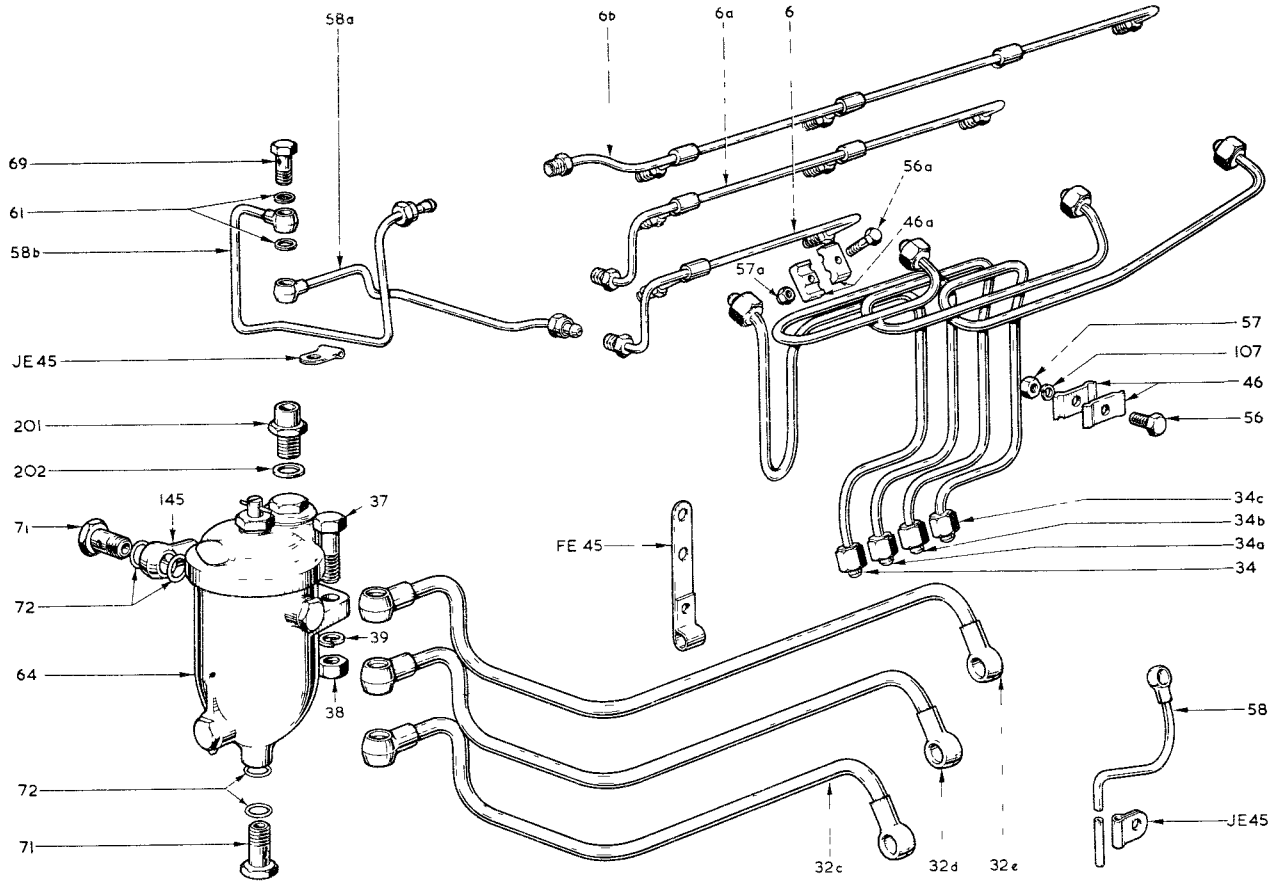


Fig 5a Fuel and oil pipelines

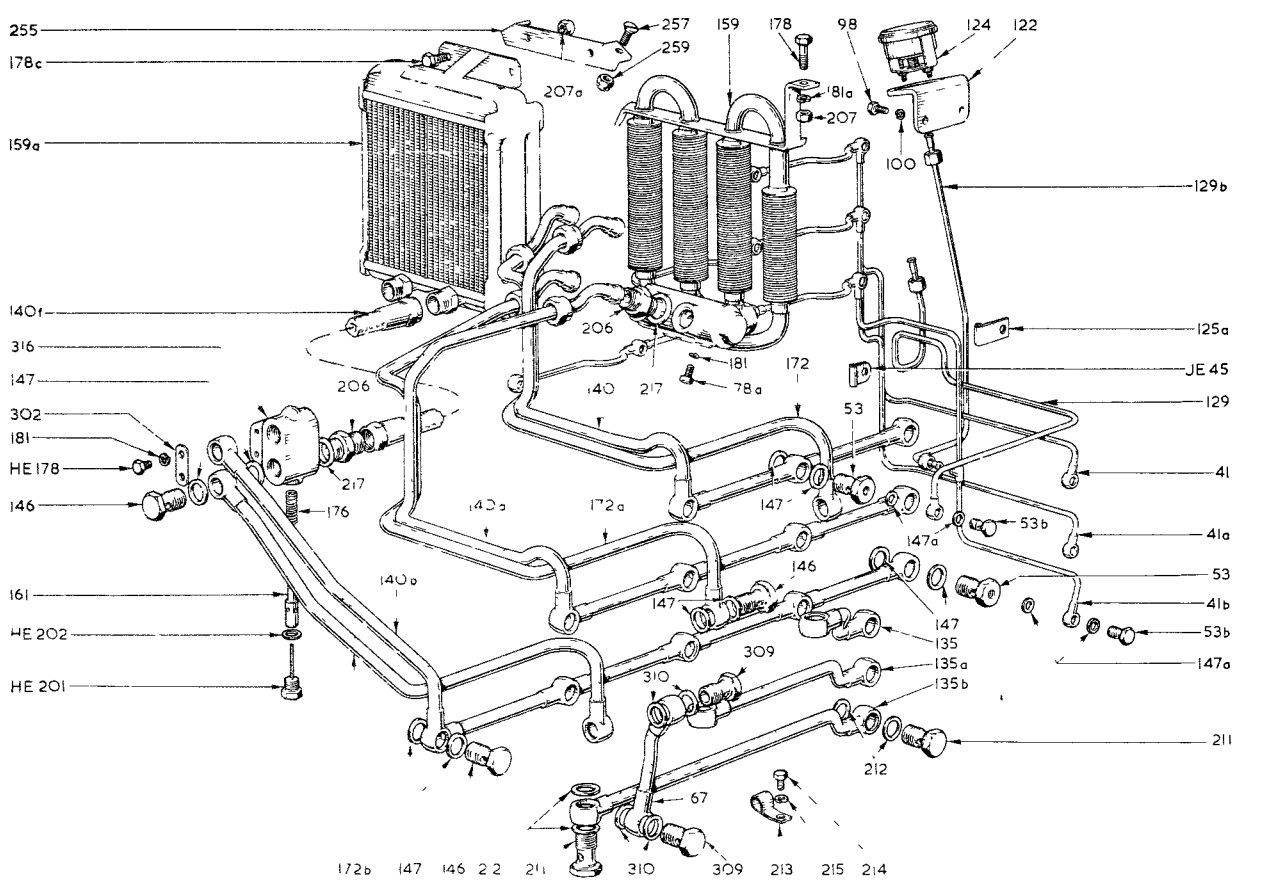


Fig 5b Fuel and oil pipelines

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
94	42CQ/3120-99-142-8619	261304	. BUSH, SPEED LEVER SPINDLE	1		C	4/325
95	42CQ/3120-99-142-8620	261305	. BUSH, SPEED LEVER SPINDLE	1		C	4/325a
96	42CQ/2815-99-203-9572	FD502	. WASHER, FUEL PUMP IDLER GEAR	1		C	4/502
97	42CQ/5330-99-222-6867	FD506	. SEAL, FUEL PUMP DRIVE	1		C	4/506
98	42CQ/2815-99-413-9835	260678	. BEARING, FUEL PUMP IDLER	1		C	4/512
99	42CQ/2815-99-222-4776	261135	. JOINT, FUEL PUMP DRIVE	1		C	4/514
100	42CQ/5315-99-112-4261	792011	. KEY, FUEL PUMP COUPLING	1		C	4/519
101	42CQ/2990-99-119-0642	260441 Mod 3	. LEVER, SPEED CONTROL	1		C	4/74a
			FUEL AND OIL PIPELINES				
102	42CQ/2815-99-202-2712	NSD 189-1/2	. BOLT, BANJO	2		C	5b/53
103	42CQ/4730-99-112-4255	831025	. BOLT, BANJO	2	1/8in. B.S.P.	C	5b/53b
104	42CQ/5310-99-142-6892	843104	. JOINT, WASHER	2	3/8in.	C	5a/61
105	42CQ/4730-99-128-3251	NSD 1891	. BOLT, BANJO FILTER CHECK VALVE	1		C	5a/69
106	42CQ/4730-99-123-3947	252440	. BOLT, BANJO, FUEL FILTER	2		C	5a/71
107	42CQ/2815-99-202-2184	252439	. JOINT, WASHER	4		C	5a/72
108	42CQ/2805-99-413-9363	256742	. GAUGE, PRESSURE	1		C	5b/124
109	42CQ/4933-99-112-3084	195570	. PIPE, PRESSURE GAUGE	1		C	5b/129
110	42CQ/4730-99-223-1575	207008 Issue 4	. BANJO, FUEL FILTER INLET	1		C	5a/145
111	42CQ/4730-99-112-4256	831028	. BOLT, BANJO	3		C	5b/146

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
112	42CQ/5310-99-112-4257	843107	. JOINT WASHER	10	3/4inch.	C	5b/147
113	42CQ/5310-99-142-6892	843104	. JOINT WASHER	2	3/8inch.	C	5b/147d
114	42CQ/5360-99-470-3204	260721	. VALVE, FILTER, CHECK	1		C	5a/201
115	42CQ/5310-99-222-4767	FE202	. JOINT, WASHER CHECK VALVE	1		C	5a/202
116	42CQ/1740-99-112-4260	833031	. UNION, OIL COOLER RELIEF VALVE	2		C	5b/206
117	42CQ/4730-99-112-4256	831028	. BOLT, BANJO	2		C	5a/211
118	42CQ/5310-99-112-4257	843107	. JOINT, WASHER	4	3/4inch.	C	5b/212
119	42CQ/4730-99-112-4255	831025	. JOINT, WASHER	2		C	5b/217
120	42CQ/4730-99-223-1575	207008/4	. BOLT, BANJO CRANKCASE FILTER PIPE	2		C	5b/309
121	42CQ/5310-99-112-4257	843107	. JOINT, WASHER	4	3/4in.	C	5b/410
			COWLINGS, MANIFOLDS AND AIR CLEANER				
122	42CQ/2940-99-223-1563	BURGESS D8/8601	. AIR CLEANER	1		C	6/35
123	42CQ/2990-99-413-9367	FF38	. JOINT, SILENCER FLANGE	1		C	6/38
124	42CQ/2815-99-223-1565	142511 Issue 4	. MANIFOLD, INLET	1		C	6/43a
125	42CQ/5330-99-222-6115	260801	. JOINT	2		C	6/63
126	42CQ/4720-99-142-8622	261192	. HOSE, AIR CLEANER	1		C	6/90
127	42CQ/2815-99-867-4281	260696	. VALVE, RELIEF FAN SHAFT AND IDLER	1		C	6/159
128	42CQ/2815-99-223-1578	4/260063 Issue 2	. SHAFT, MAN	1		C	6/227
129	42CQ/5340-99-142-8616	3/260065	. COLLAR, FAN SHAFT	1	FAN END	C	6/275
130	42CQ/2815-99-222-4781	FF275A	. COLLAR, FAN SHAFT	1	PULLEY END	C	6/275a

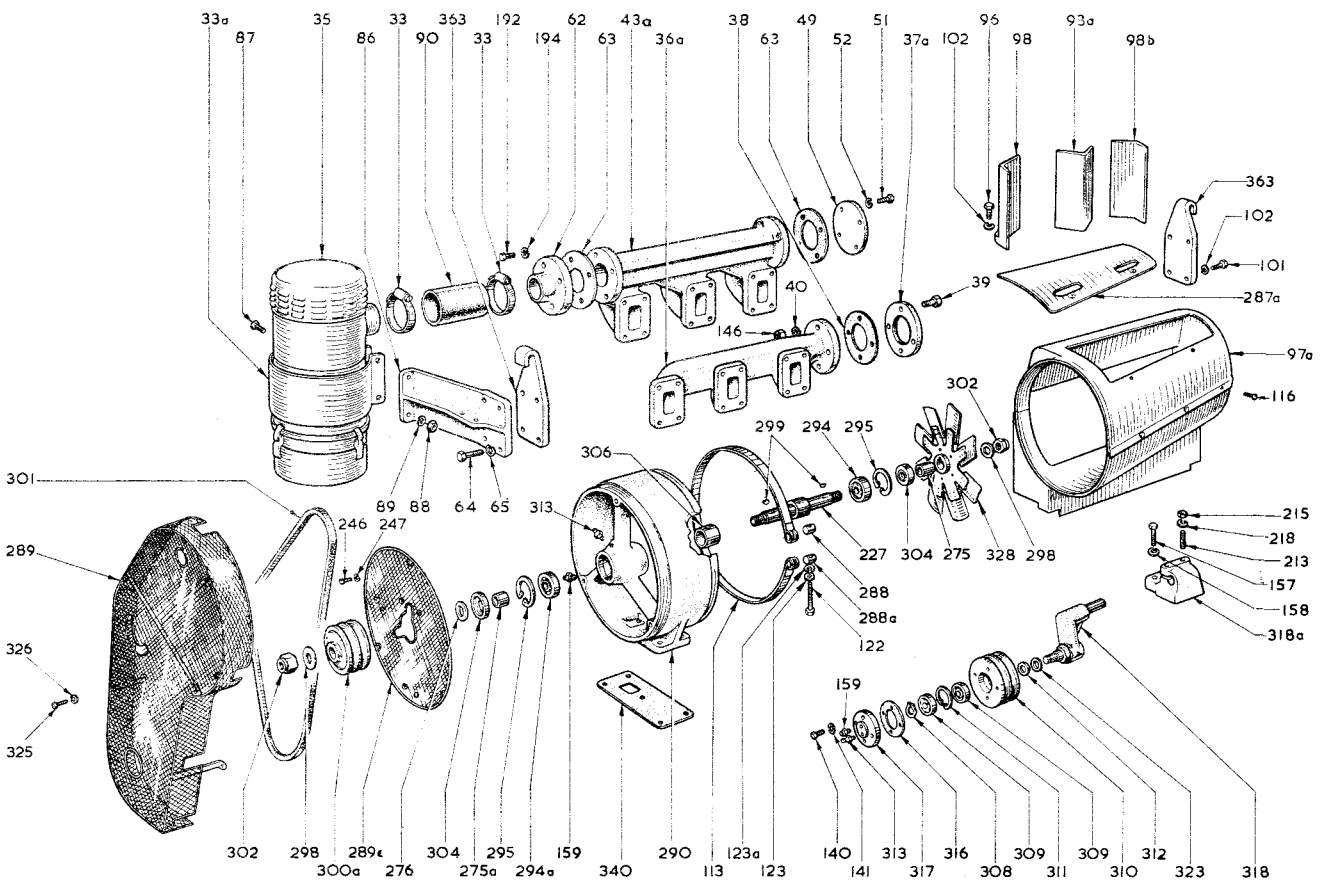


Fig 6 Cowlings, manifolds and air cleaner

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
131	2A/3110-99-950-1284	HOFFMAN L.S.9	. BEARING, FAN DRIVE	1		C	6/294
132	42CQ/3110-99-950-0736	260694	. BEARING, FAN DRIVE	1		C	6/294a
133	42CQ/5340-99-112-4251	784015	. CIRCLIP, FAN SHAFT	2		C	6/295
134	42CQ/5310-99-112-4252	785016	. WASHER	2		C	6/298
135	29E/5315-99-943-5953	B.S. 46 PART 1 No.405	. KEY WOODRUFF	2	FAN/PULLEY	C	6/299
136	42CQ/2990-99-112-4484	GOODYEAR V1086XH	. BELT, FAN	2		C	6/301b
137	LV6MT1/5330-99-408-5994	FF304	. OIL, SEAL, FAN SHAFT	2		C	6/304
138	42CQ/5340-99-142-8621	260060	. SPACER, SLEEVE	1		C	6/306
139	2A/3110-99-950-1242	FF309	. BEARING, IDLER PULLEY SHAFT	2		C	6/309
140	42CQ/4730-99-142-8617	TECALEMIT NA 5704	. NIPPLE, LUBRICATING	2		C	6/313
141	42CQ/2805-99-413-9369	FF316	. JOINT, IDLER PULLEY COVER	1		C	6/316
142	LV6MT1/5330-99-923-9737	FF 323	. OIL SEAL, IDLER PULLEY	1		C	6/323
143	42CQ/2930-99-223-1579	196286 ISSUE 6	. FAN	1		C	6/328
			OIL FILTER AND PUMP ASSEMBLY				
144			. PUMP, OIL	1	NP.RN.		
145	42CQ/4320-99-223-1567	260055 Issue 2	. . VALVE, RELIEF	1		C	7/44
146	42CQ/5360-99-470-3203	263285	. . . SPRING	1		C	7/46
147	42CQ/5310-99-112-4258	843109	. . . JOINT WASHER	2		C	7/50
148	42CQ/5340-99-142-8623	260337	. . . COLLAR	A/R		C	7/74

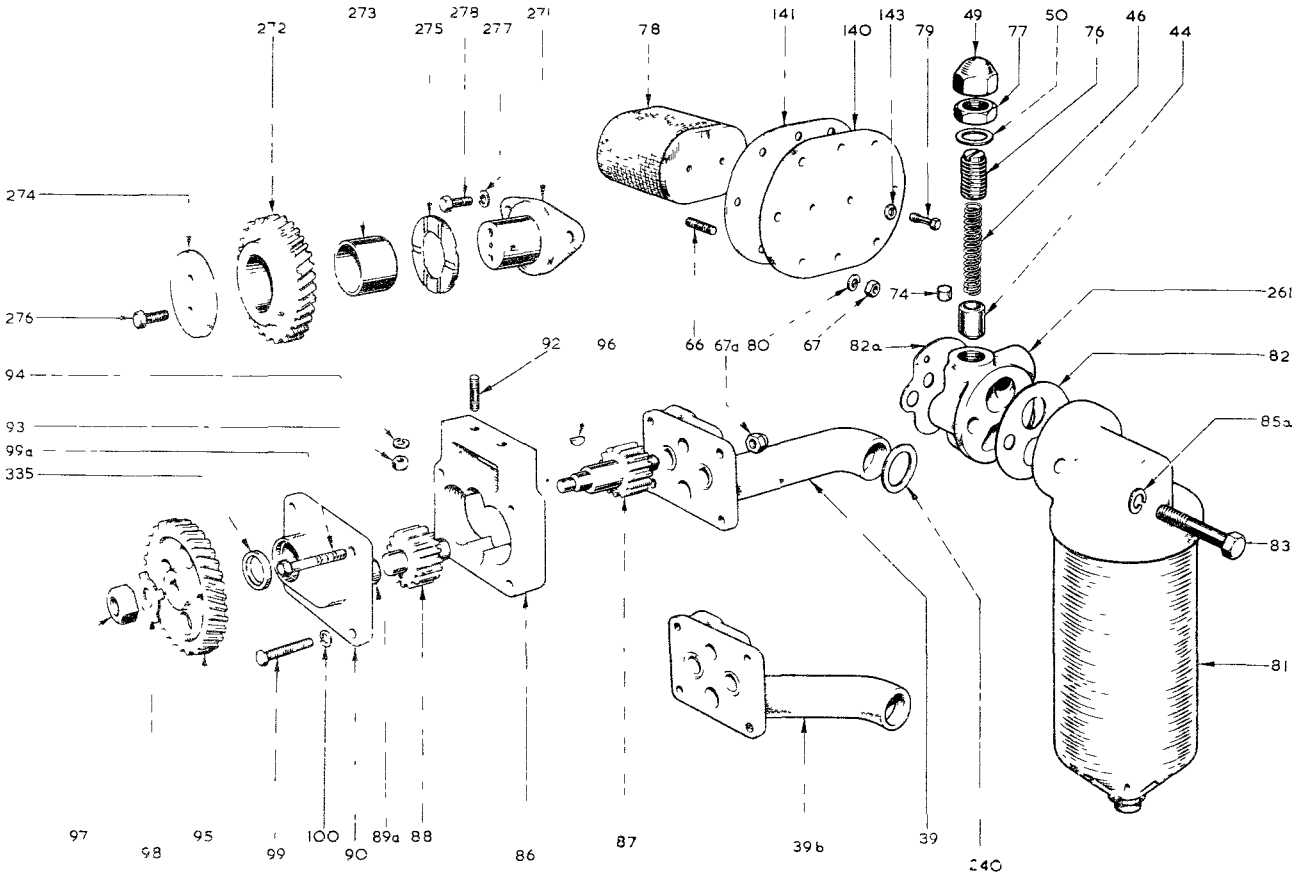


Fig 7 Oil filter and pump assembly

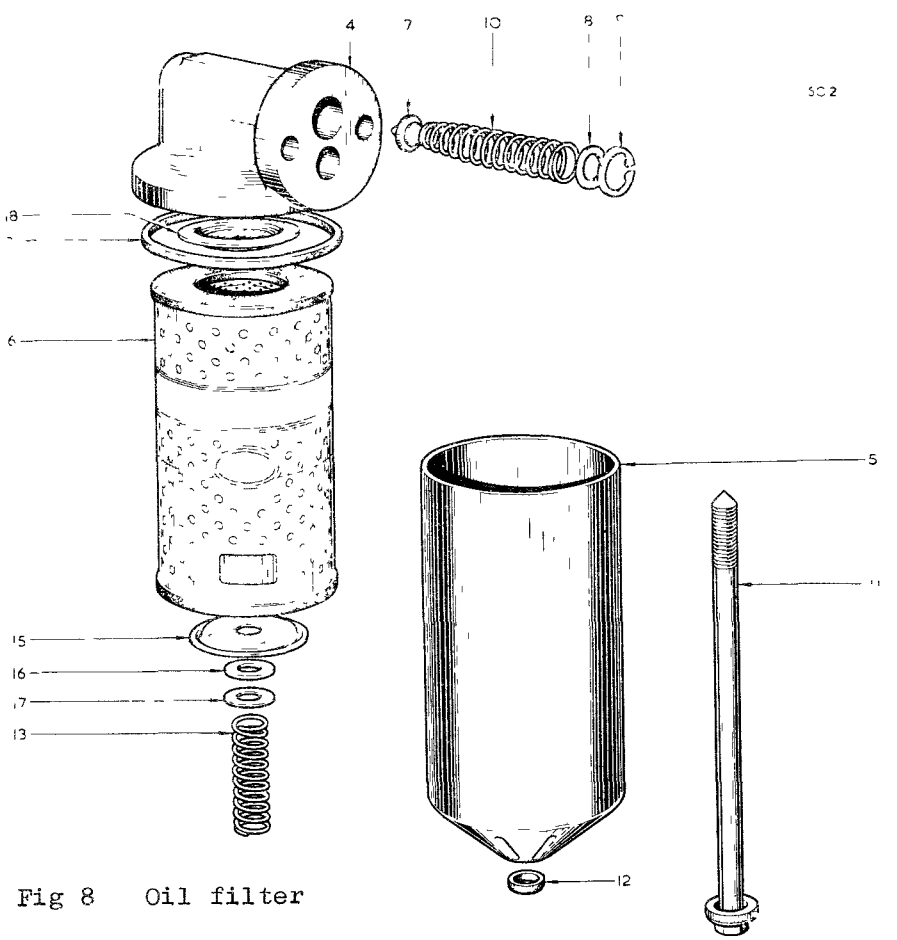


Fig 8 Oil filter

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D.3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
149	42CQ/2940-99-223-5306	COOPERS DRAWINGS 3 PD.19	. STRAINER	1		C	7/78
150	42CQ/2805-99-413-9378	FK82	. JOINT OIL FILTER	1		C	7/82
151	42CQ/2940-99-413-9379	FK82A	. JOINT, OIL FILTER/RELIEF VALVE	1		C	7/82a
152	42CQ/2815-99-223-1574	260713 ISSUE 2	. JOINT STRAINER COVER	1		C	7/141
153	42CQ/5330-99-413-9384	260690	. JOINT, STRAINER	1		C	7/240
154	42CQ/2815-99-413-9385	FK273	. BEARING, OIL PUMP IDLER	1		C	7/273
155	42CQ/5340-99-201-5710	250230	. OIL SEAL, PUMP COVER	1		C	7/335
156	LV6MT12/2940-99-802-5739	MF4306	. FILTER, OIL	1		C	7/81
157	LV6MT9 /5330-99-915-2670	MIC 10981	. . SEAL, SUMP	1	TOP END	C	8/2
158	42CQ/4310-99-112-3097	MIC 7100 Issue 2	. . HEAD	1		C	8/4
159	42CQ/2940-99-112-5794	MIC 7111	. . SUMP	1		C	8/5
160	LV6MT9/2940-99-800-8413	MF 43A	. . ELEMENT	1		C	8/6
161	42CQ/1740-99-112-5150	MIC 4741	. . . SPRING	1		C	8/13
162	42CQ/4310-99-112-3415	MIC 5604-4 ISSUE 4	. . . GUIDE	1		C	8/15
163	42CQ/4310-99-112-3096	MIC 4727-4 Issue 2	. . VALVE, RELIEF	1		C	8/7
164	42CQ/5310-99-112-3094	MIC 4728-4	. . . WASHER	1		C	8/8
165	42CQ/5340-99-112-3095	MIC 11056 Issue 2	. . . SPRING	1		C	8/10
166	42CQ/5306-99-135-1488	MIC 7164	. . CENTRE BOLT	1		C	8/11
167	LV6MT9/5330-99-200-1861	MIC 4734	. . . SEAL	1		C	8/16

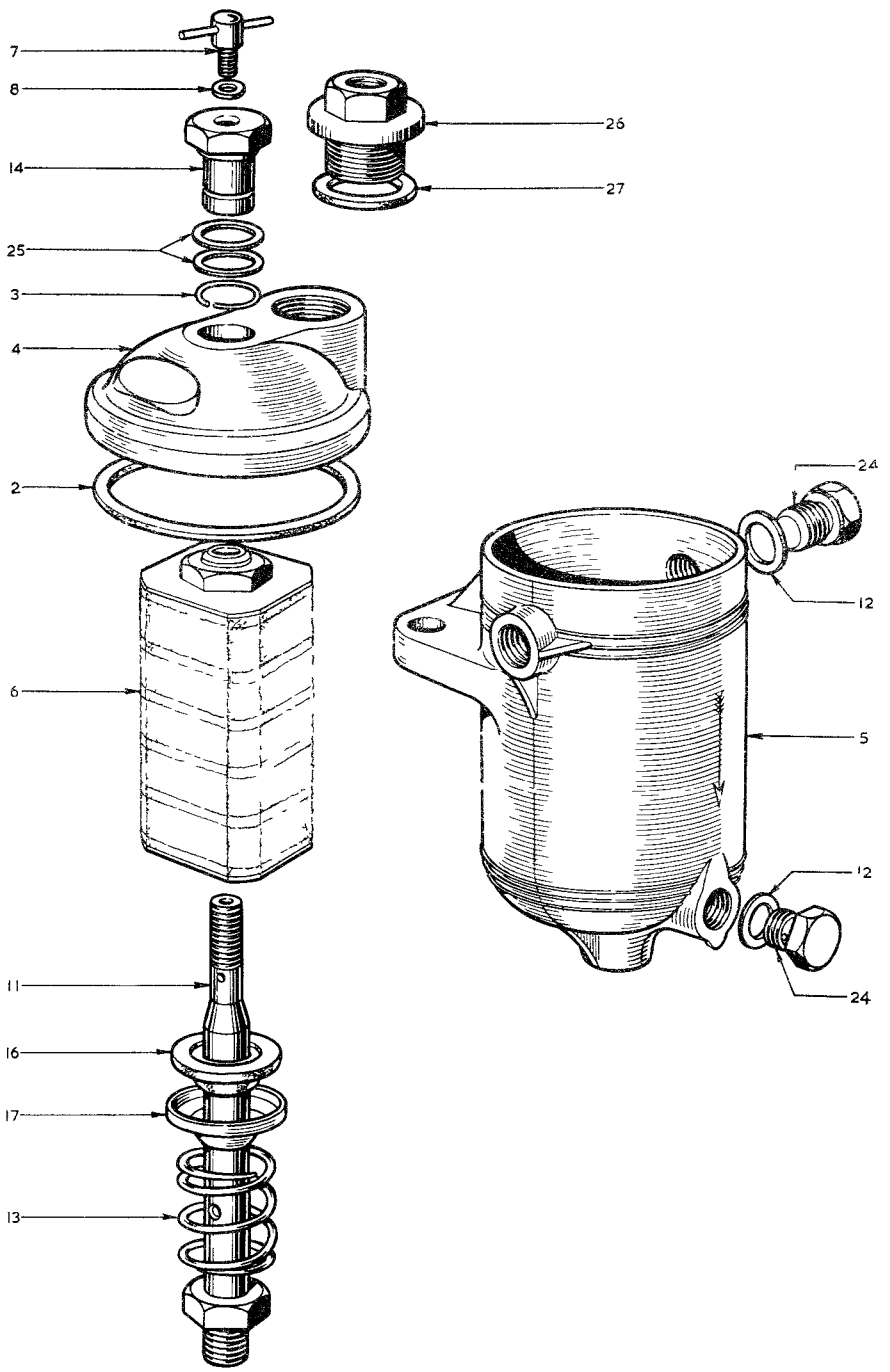


Fig 9 Fuel filter

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
168	LV6MT9/5330-99-200-1862	MIC 4733	. . WASHER NON-METALLIC	1	SUMP BOTTOM	C	8/12
			FUEL FILTER A'D PUMP ASSEMBLY				
169	42CQ/2940-99-222-4315	CAV LTD. BFA-5P2	. FILTER, FUEL	1		C	9
170	42CQ/2805-99-413-9389	FE64/2	. . JOINT, BODY	1		C	9/2
171	42CQ/2805-99-413-9390	FE64/6	. . ELEMENT	1		C	9/6
172	42CQ/2910-99-222-5173	BRYCE-BERGER C-RA-AO-1S-1011	. PUMP, FUEL	1	C/W LINK & COUPLING.	B	
173	42CQ/5330-99-222-2380	E106/87	. . WASHER, PIPE, DELIVERY	3		C	
174	42CQ/2910-99-222-2384	D13/152	. . DISCHARGE UNION	3		C	
175	42CQ/2910-99-203-6856	D13/153D	. . DELIVERY VALVE ASSEMBLY	3		C	
176	42ZZ/5340-99-407-2141	D13/157	. . SPRING, DELIVERY VALVE	3		C	
177	42ZZ/5330-99-222-2377	D13/82	. . WASHER DISCHARGE UNION	3		C	
178	42CQ/4920-99-223-9220	D13/154D	. . DELIVERY VALVE SEAT ASSEMBLY	3		C	
179	42CQ/5330-99-222-4301	ANGUS E234/103	. . 'O' RING	3		C	
180	42CQ/2910-99-222-5170	13/53	. . CAMSHAFT	1		C	
181	42CQ/2815-99-222-2751	C13/62	. . TAPPET ASSEMBLY	3		C	
182	42CQ/2910-99-222-2383	D13/142	. . . BUTTON, TAPPET	3		C	
183	42CQ/2815-99-222-2752	C13/63	. . . BODY, TAPPET	3		C	
184	42CQ/3120-99-222-2754	D13/67	. . . BUSH, TAPPET ROLLER	3		C	
185	42CQ/2815-99-222-2753	D13/66	. . . ROLLER, TAPPET	3		C	

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
186	5UD/5330-99-801-7396	ANGUS MIM 2030	. . SEAL, OIL	1	END BEARING	C	
187	42CQ/5330-99-222-2750	D13/157	. . JOINT, END PLATE	1		C	
188	2A/3110-99-222-4308	132/23	. . BEARING, END PLATE	1		C	
189	42CQ/2910-99-203-1461	1/4621	. . BOLT, BANJO	1		C	
190	42CQ/2815-99-203-1460	114/4755	. . WASHER INLET BANJO BOLT	2		C	
191	42CQ/4730-99-407-2069	1/91	. . ADAPTOR INLET BANJO BOLT	2		C	
192	42CQ/4730-99-222-4783	1/4620A	. . CONNECTOR, MULTIPLE FLUID PRESSURE LINE.	1		C	
193	42CQ/5330-99-222-2381	E106/64	. . WASHER, NON METALLIC	2		C	
194	42CQ/2815-99-222-4782	13/37	. . JOINT SIDE COVER	1		C	
195	42CQ/4820-99-222-7818	CAV.LTD. Z7019/239	. . RELIEF VALVE ASSEMBLY	1		C	
196	42CQ/2910-99-203-1462	1/4620	. . BANJO, RELIEF VALVE	1		C	
			ELECTRICAL EQUIPMENT				
197	42CQ/2920-99-222-4316	CAV G512-7	. DYNAMO	1		C	
198	2A/3110-99-950-0109	HOFFMAN 1158	. . BEARING	1		C	
199	42CQ/3110-99-222-2390	Z5827-27	. . RETAINER, BEARING	1		C	
200	42CQ/2920-99-222-8563	A399	. . ARMATURE	1		C	
201	42CQ/6150-99-222-2620	Z5827/58	. . SHIELD, D.E.	1		C	
202	2A/3110-99-950-0297	RANSOME & MARLES L1155	. . BEARING D.E.	1		C	
203	42CQ/6150-99-222-8572	827/96A	. . SHIELD ASSEMBLY, C/END	1		C	
204	42CQ/5340-99-222-2391	Y5827-24	. . SPRING, BRUSH	2		C	

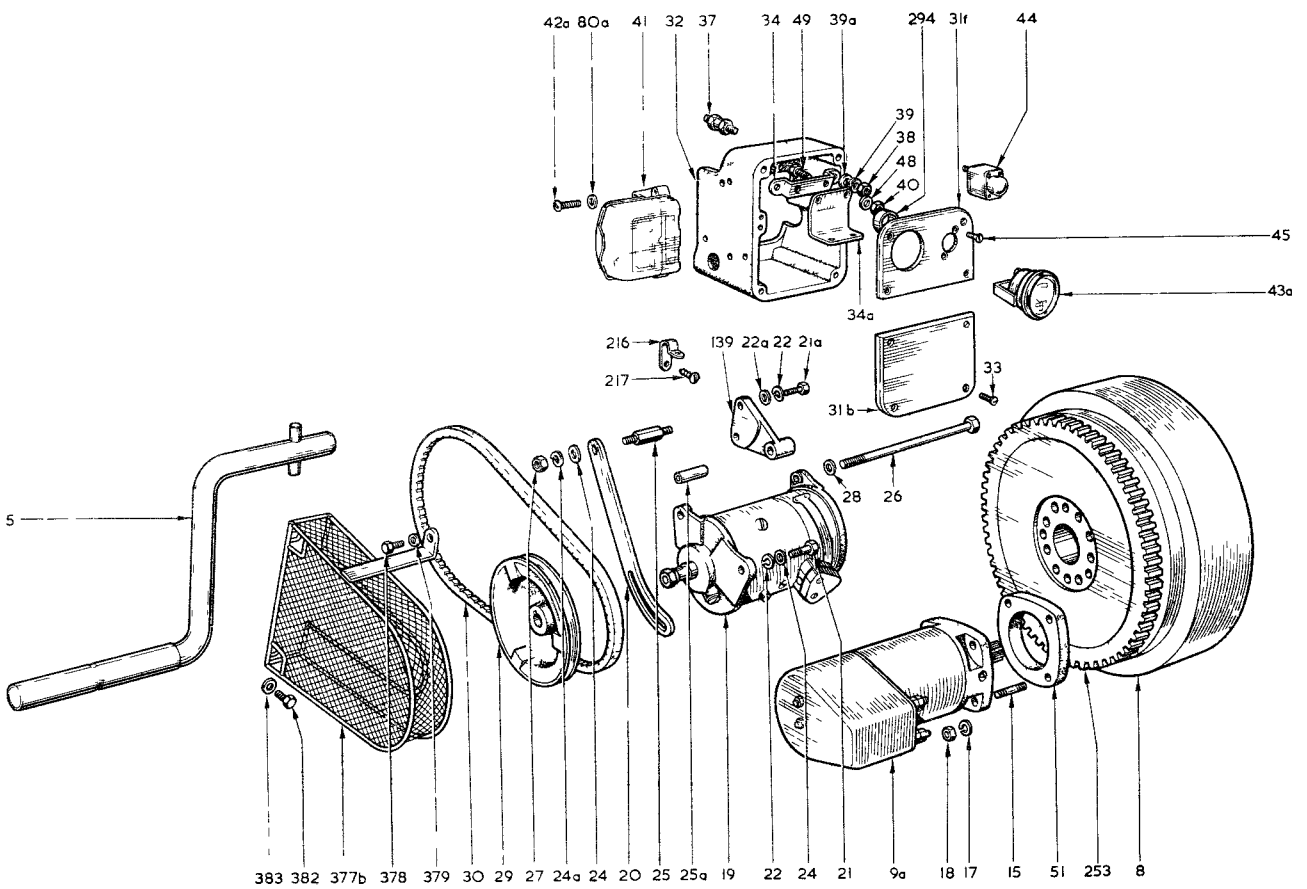


Fig 10 Electrical equipment

MAIN EQUIPMENT PETTERS DIESEL ENGINE TYPE P.D. 3

(1) Item No.	(2) Ref. No.	(3) Part No.	(4) 1 2 3 4 5 6 7 Description	(5) No. Off	(6) Remarks	(7) C of E	(8) Plate/ Cct Ref
205	42CQ/5977-99-222-2618	Y5827-33	. . BRUSH	2		C	
206	42CQ/2920-99-222-8568	CAV G524-7	. DYNAMO	1		B	
207	2A/3110-99-950-0108	HOFFMAN 115P	. . BEARING, C/END	1		C	
208	42CQ/3110-99-222-2390	Z5827-27	. . RETAINER, BEARING	1		C	
209	42CQ/2920-99-222-8564	A395	. . ARMATURE	1		C	
210	42CQ/6150-99-222-2620	W5827-58	. . SHIELD, D.E.	1		C	
211	2A/3110-99-950-0297	RANSOME & MARLES LJ15DD	. . BEARING, D.E.	1		C	
212	42CQ/6150-99-222-8571	W5827/71	. . SHIELD ASSEMBLY C/END	1		C	
213	42CQ/5340-99-222-2391	X5827/24	. . SPRING, BRUSH	2		C	
214	42CQ/5977-99-222-2619	X5827/33b	. . BRUSH	2		C	
215	42CQ/2920-99-222-8569	203-14	. CONTROL BOARD	1		B	
216	42CQ/2920-99-222-2392	X5844-5	. . COVER	1		C	
217	42CQ/2920-99-222-8566	CLRT9-19	. . REGULATOR	1		C	
218	42CQ/5905-99-222-8574	Y5844/21B	. . RESISTANCE, CARBON	1		C	
219	42CQ/5905-99-222-8573	5844-4B	. . RESISTOR, WIREWOUND	1		C	
220	42CQ/2920-99-222-8570	203-24	. CONTROL BOARD	1		B	
221	42CQ/2920-99-222-2392	X5844-5	. . COVER	1		C	
222	42CQ/2920-99-222-8567	CLRT9-10	. . REGULATOR	1		C	
223	42CQ/2990-99-222-1864	BS512-P117M-12volt.	. STARTER	1		B	
224	42CQ/2990-99-222-1865	BS 524 P117M-24volt.	. STARTER	1		B	