Chapter 17

THE D.H.A.C. FUEL PUMP

Contents

	Page		Page
Dismantling and reassembling ...	... 186	Routine inspection	185
General description	... 184	Test procedure	189
Installation	... 184	Fits and clearances	190

Illustrations

	Fig.		Fig.
Section drawing	1	Diaphragm pressure-test rig	4
Rocker arm and link	2	Fuel pumps test rig	5
Diaphragm assembly	3	Clearances diagram	6

This pump (Fig. 1) is of the reciprocating diaphragm type Two identical pumps, each including an integral fuel filter, form a dual pump unit and are mounted on the port side of the crankcase. Drive is from individual eccentrics integral with the camshaft, the eccentrics being 180 degrees out of phase to ensure an even flow of fuel to the carburettor. The delivery of either pump is sufficient for adequate emergency functioning of the engine. Flow adjustment to suit carburettor requirements is automatic. Spring-loaded, non-return, suction and delivery valves are fitted in the inlet and outlet passages.

Each pump consists of a main body containing the operating mechanism, a top cover with the suction and delivery valves, and a bottom cover housing the priming lever.

The eccentrics drive the pump through the medium of a rocker arm, one end of which bears on the eccentrics and the other on the cap of a coil spring, within the bottom cover. A link is attached to the diaphragm pull-rod at the inner end and pivoted on the rocker-arm fulcrum pin at the outer end. The rocker arm bears on a pin across the link transmitting motion to the pull-rod and diaphragm.

It will be seen that, whilst the rocker arm moves through the full range of its travel at all times, when the carburettor needle valve checks the fuel flow a pressure is built up above the diaphragm and the pull-rod link assembly does not return to the top of its stroke. The rocker arm, therefore, travels idly downwards until it re-engages the pin in the link. In this way the diaphragm movement varies in relation to the demands of the carburettor.

The filter bowl is attached to the underside of the top cover with a cork joint ring and stainless-steel gauze filter between, held by a stirrup, boss and knurled nut.

Fuel is sucked through the inlet valve above the filter bowl on the downward stroke of the diaphragm. On the upward movement of the diaphragm the inlet valve closes, whilst the delivery valve opens under pressure from the pump chamber, passing the fuel to the carburettor.

The two pumps are inter-connected by means of a two-way union on one pump and a banjo union on the other. Thus both are fed by a single fuel pipe from the aircraft tank/s. The outlets are joined by a " T " pipe leading to the carburettor.

Installation

Before installation remove the dust covers from the fuel ports and fit the correct joint washers to the crankcase facings. It is important that no other type of washer is used than that authorised because variation in thickness would alter the preselected setting of the rocker arm pad and camshaft eccentric. This setting allows for a small further movement of the arm when the eccentric is in the "full lift" position.

After installation of a new pump a test should be made for delivery pressure. Connect the fuel pipe from the aircraft tank s to the union on the left side of the rearmost pump and attach a pressure gauge to the "T" pipe delivery union between the two pumps. Operate the hand priming levers. Rapid priming should result and a pressure of some 2 lb. per sq. in., *0,140 kg. per sq. cm.*, be registered on the gauge.

Remove the pressure gauge and connect the fuel pipe leading to the carburettor.

In no circumstances should compressed air be applied to the fuel lines whilst the pump

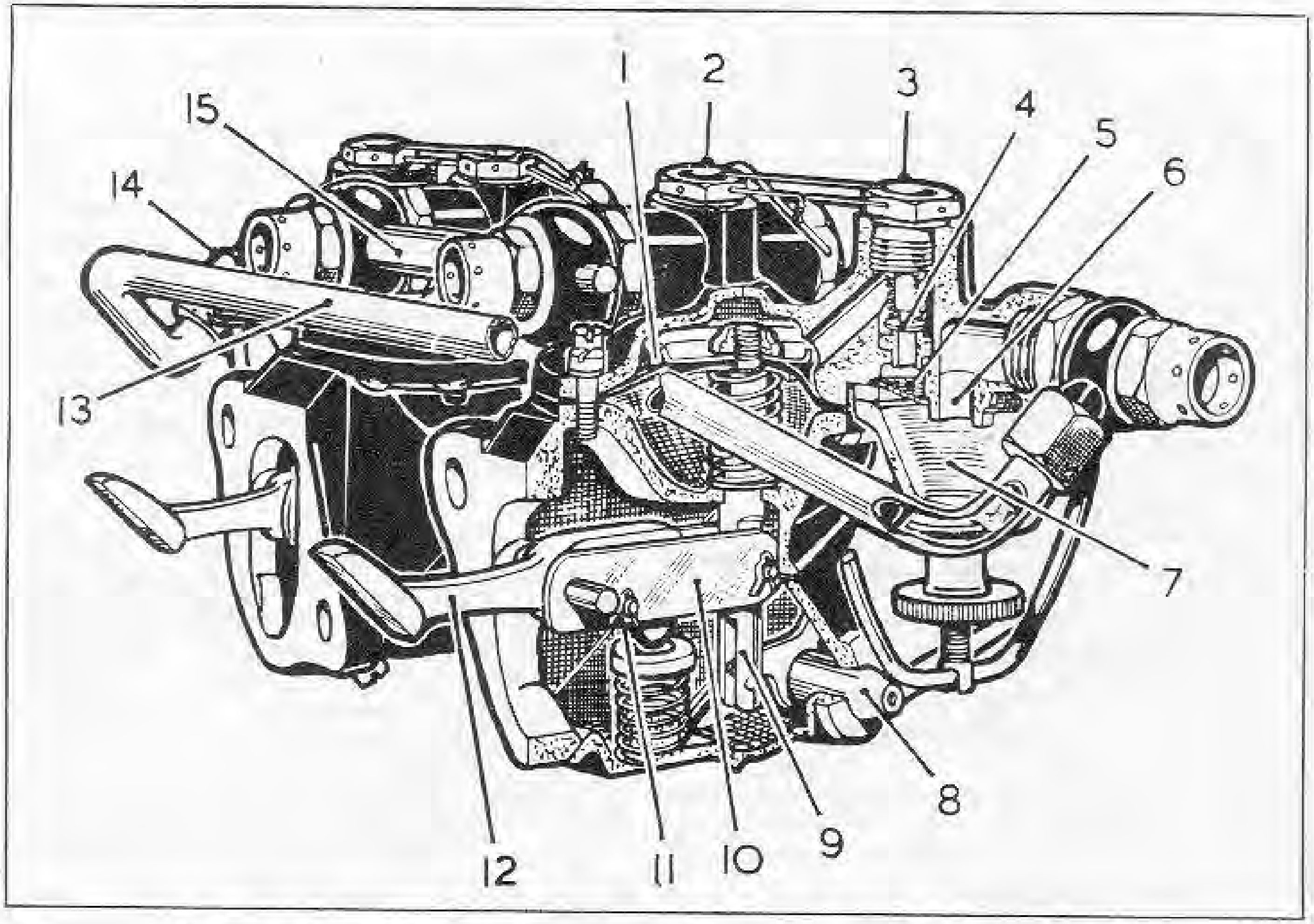


Fig. 1. Pair of D.H.A.C. Fuel Pumps, showing one pump in section.

1. DIAPHRAGM.
2. DELIVERY VALVE PLUG AND GUIDE.
3. INLET VALVE PLUG AND GUIDE.
4. INLET VALVE.
5. STEEL GAUZE FILTER.
6. INLET PASSAGE.
7. FILTER BOWL.
8. HAND PRIMING LEVER.
9. DIAPHRAGM PULL-ROD.
10. LINK.
11. LINK PIN IN LINK.
12. ROCKER ARM.
13. PIPE FROM INLET BANJO TO RIGHT-HAND PUMP.
14. FUEL INLET BANJO SERVING BOTH PUMPS.
15. COMMON DELIVERY "T" PIPE TO CARBURETTOR.

unit is connected. Damage to the diaphragm would almost certainly result.

Connect the drains to the appropriate drain pipes.

Inspection should be carried out at intervals in accordance with the maintenance schedule in current use. The filter bowl and filter should be removed, cleaned and replaced tightly and correctly. The pressure and priming tests mentioned above should be made. A new cork filter washer should be fitted whenever the filter bowl has been removed.

It is inadvisable to separate the top cover from the main body for cleaning purposes Instead, remove the valve plugs and valves and flush out with petrol. Replace, tighten and lock with wire. See that the copper washers on the valve plugs are in place.

If leaking valves are suspected a test may be carried out with the pump unit attached to the crankcase. A pressure gauge is fitted to the delivery union and the hand priming lever operated until a small pressure is registered. The priming lever is lifted to the fullest extent of its travel, and the delivery valve should hold the pressure shown for about five seconds.

When the pressure has fallen right off, the priming lever is dropped and a further pressure should be registered. The inlet valve should now hold this pressure for at least a minute. In the event of unsatisfactory results the test should be repeated since failure of the valves to maintain pressure may be due to specks of dirt on the valve seatings.

Dismantling and Reassembling

Dismantling is quite straightforward and, therefore, reassembling only is detailed here.

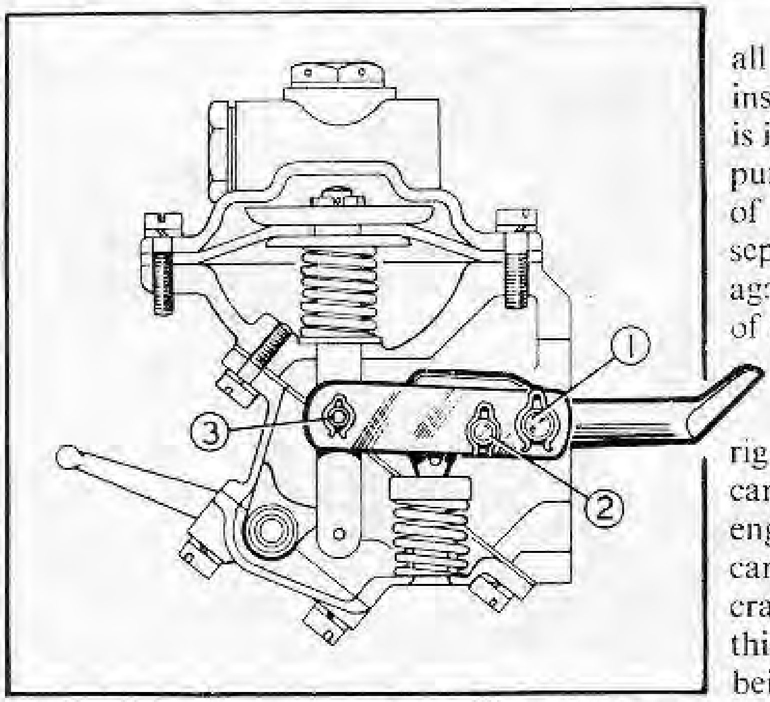


Fig. 2. Rocker arm and link. When fitting the link ensure that pin (2) is offset below the centre line of pins (1) and (3).

During dismantling it is important that all groups of parts are separated to facilitate inspection and reassembly. A sectional tray is ideal for this purpose. Where two or more pumps are being dealt with the components of each individual pump should be kept separate. Worn parts should be checked against the figures in the petrol pump section of the Table of Fits and Clearances, page 191.

For assembly purposes a dummy rig consisting of mounting facings and camshaft with eccentrics arranged as on the engine is a great convenience. Such a rig can be made up from part of a scrapped crankcase and camshaft. In the absence of this the engine itself is employed, the pumps being reassembled **before** the top cover of the engine is fitted in order that access may be obtained to the camshaft and rocker arms for checking purposes.

The valve seatings are not normally removed, but if these are damaged they may be ground out and replaced. The new seatings are spun out slightly at the underside to lock them into the casting.

The integral plugs and valve guides are assembled with the valve springs, valves and thick copper washers. When screwing the plugs into the top cover care must be taken to ensure that the valve stems are truly inside the guides before tightening down, otherwise damage will result.

Insert the link pin in the link and fasten with circlips.

Assemble the rocker arm, fulcrum pin and link as shown in Fig. 2 with the link pin offset **away from** the direction of the rocker arm. Fasten the fulcrum pin with two split pins. A side clearance between the link and the main pump body of 0.002 in.–0.004½ in., *0,051 mm.–0,114 mm.*, is necessary for free movement of the rocker arm assembly.

The diaphragm pull-rod is passed through the central hole in the diaphragm chamber with the threaded end uppermost. The other end of the pull-rod is machined with two flats and drilled to receive the pin through the link end. This pin is inserted to connect the link and the pull-rod but the two circlips need not be fitted until after the diaphragm pull-rod assembly has been tested for leaks.

Over the pull-rod collar projecting into the diaphragm chamber are placed the adjustment washers by means of which the correct travel of the rocker-arm is obtained. It will probably be necessary to make one or two trial assemblies in order to ascertain the exact combination of washers required.

These washers are supplied in the following thicknesses, 16, 18 and 20 S.W.G., and one of these, or a combination of two or more, will enable the necessary adjustment to be accomplished. With the camshaft eccentric in the maximum lift position a further 0.035 in. to 0.055 in., *0,89 mm.* to *1,40 mm.*, movement of the rocker arm pad should be obtained.

This may be measured either during engine assembly before the top cover is fitted, or with the pump assembled on the checking fixture, T86240.

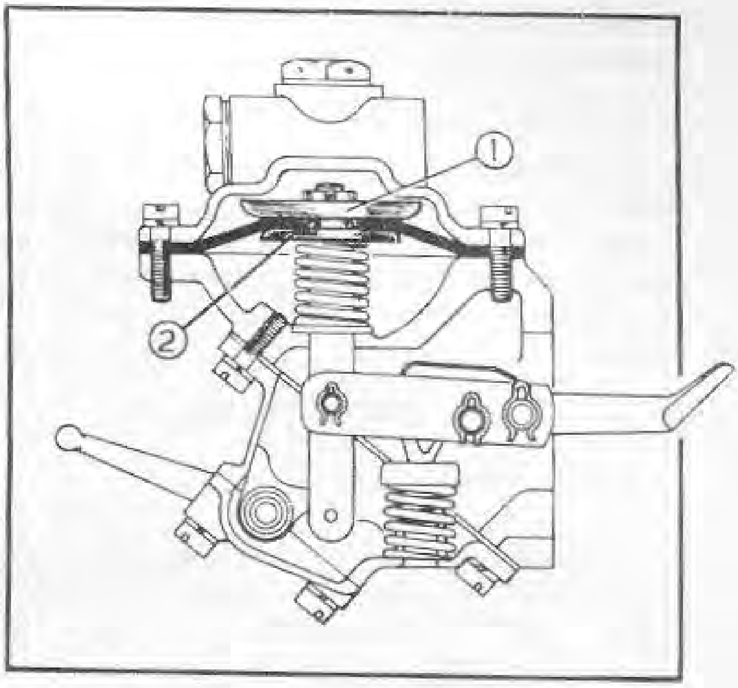


Fig. 3. Diaphragm assembly, showing arrangement of the large diaphragm washer (1) and small diaphragm washer (2). Adjustment washers are located immediately beneath the small diaphragm washer.

Within the diaphragm chamber the gland and return spring (blue) are placed over the pull-rod end followed by the small diaphragm washer, the four layer diaphragm and the large diaphragm washer as shown in Fig. 3. The assembly is held by the retaining nut and split pin.

It is advisable to place the six cheese-headed screws in the holes through the diaphragm and the main body in order to ensure alignment when the retaining nut is tightened. The nut should not be tightened more than is necessary to ensure a leak-proof joint.

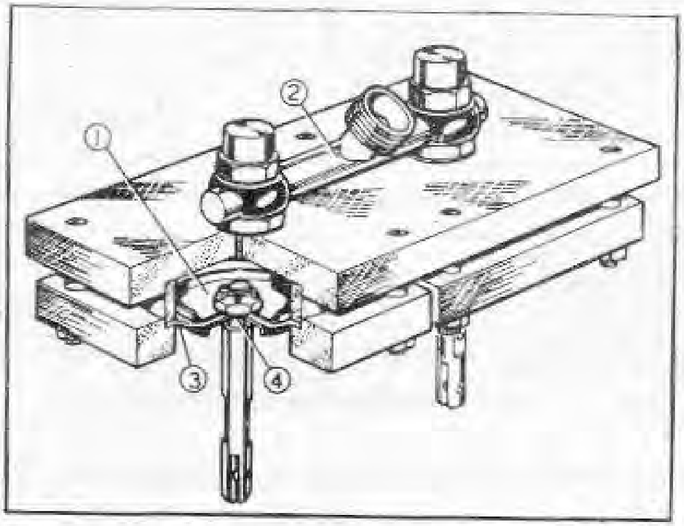


Fig. 4. Diaphragm pressure test rig. A pressure of 10 lb. per sq. in., 0,70 kg. per cm², is built up in chamber (1), using a standard pump connected to "T" union (2). A visual check is made for seepage and/or leaks at (3) and (4). If either are discernible the diaphragm is unserviceable.

Diaphragm assembly pressure test. Using a pressure-test rig such as that illustrated in Fig. 4, pressure test the pull-rod and diaphragm assembly by applying paraffin (kerosene) at a pressure of 10 lb. per sq. in., *0,7 kg. per cm²*. Whilst the pressure is applied, carefully examine for leakage, particularly in the region of the pull-rod centre disc and nut. No leakage is permissible.

The drain connection (if it has been removed) is screwed into the threaded hole provided on the outside of the diaphragm chamber.

The filter bowl stirrup is sprung into the holes provided on either side of the inlet valve in the top cover.

The stainless-steel gauze filter is inserted with the metal-webbed side towards the top cover ; followed by the cork washer and the filter bowl. The retaining boss and knurled nut are then fitted to the threaded stirrup.

It is important that the filter bowl be clamped securely otherwise air leaks will result.

The priming lever is carried in a split bearing between the bottom cover and the cap. The lever is fitted with a fibre washer and a coil spring and placed in the body of the bottom cover. The cap is then secured with three cheese-headed screws and spring washers. Care must be taken to centralise the spindle of the priming lever accurately before tightening the cheese-headed screws. Failure to do this will result in oil leakage after installation on the engine.

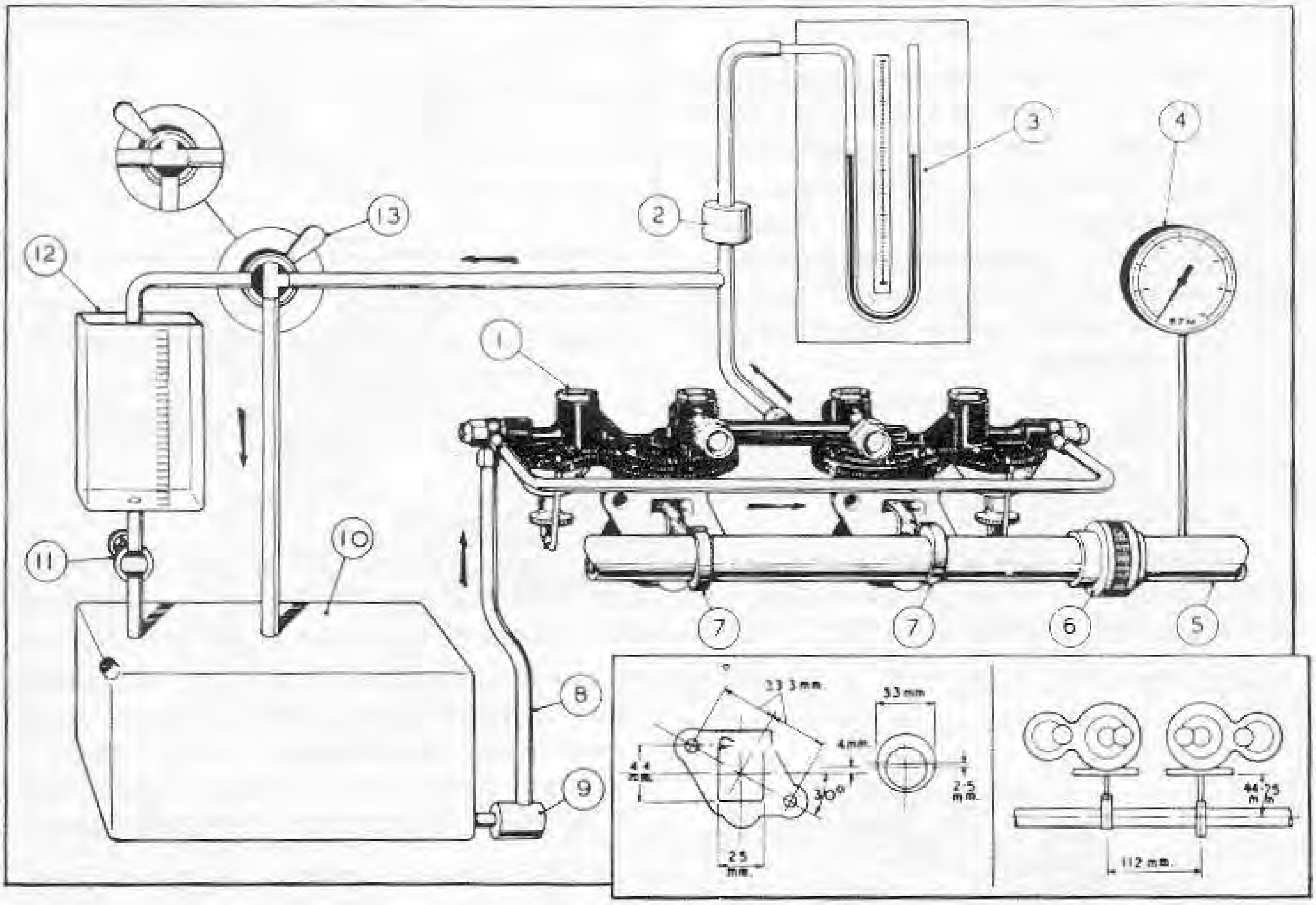


Fig. 5. Fuel pump test rig.

1. PUMPS UNIT ON TEST.
2. FUEL TRAP.
3. MANOMETER.
4. REVOLUTIONS INDICATOR.
5. DRIVING SHAFT.
6. FLEXIBLE COUPLING.
7. ECCENTRICS ON SHAFT.
8. SUCTION PIPE.
9. FILTER.
10. VENTILATED FUEL TANK.
11. DRAIN COCK.
12. MEASURING TANK.
13. TWO-WAY COCK.

The rocker arm return spring is located on a boss within the body of the bottom cover and fitted with a metal cap.

With a gasket between, the bottom cover assembly is applied to the main pump body so that the longer tongue of the priming lever rests within the slot in the bottom end of the pull-rod. Attachment is by three cheese-headed screws and spring washers.

Before fitting the top cover to the main pump body a thin layer of grease should be spread between the flanges on either side of the diaphragm.

THE TEST EQUIPMENT required is illustrated diagrammatically in Fig. 5. The test rig must embody a suitable mounting face on which to mount the fuel pump and include a suitable cam, or eccentric, shaft to operate it. A variable speed drive is required having a speed range from 250 to 1275 r.p.m. The power required is approximately ¼ h.p. and the motor should be flame-proof. There should be a flexible coupling between the drive and the eccentric shaft used to operate the pumps. A revolution indicator is necessary to measure the speed at which the shaft is being driven. Provision for lubricating the fuel pump mechanism must be made.

Fuel should be supplied from a ventilated tank holding some five gallons, *22 litres*, of test fluid through an inlet (suction) pipe of ⅜ in., *9,5 mm.*, bore drawing from the bottom of the tank through a fine gauze filter. The position of the tank, relative to the pump being tested, must be adjustable so that the fuel level in the tank can be varied between zero and 24 inches, *61 cm.*, below the level of the pump inlet port.

The delivery pipe should be ⅜ in., *9,5 mm.*, bore and should return fuel to the tank through a flow meter registering up to 250 pints, *145 litres*, per hour. Alternatively, a calibrated vessel into which the pump delivery is diverted by means of a three-way cock may be used as indicated on the diagram in this chapter, the time taken for delivery of a precise quantity being measured with a stop watch and the delivery calculated from this observation. A mercury manometer should be connected as closely as possible to the delivery port in order to measure the delivery pressure, and a fuel trap should be provided to prevent fuel from being driven into the manometer tube in the event of a sudden rise in pressure for any reason.

In order to facilitate mounting and to absorb vibration, flexible pipes should be used in the vicinity of the pump, and all pipes, joints and traps must be properly sealed, otherwise misleading test results will be obtained.

THE TEST FLUID is to be to specification D.E.R.D. 2471 and must pass through a fine mesh filter. The lubricating oil is to be to specification D.E.D. 2472; a list of oils conforming to this specification is given at the beginning of this handbook.

THE FUEL PUMP must be securely mounted on the test rig and connected up as indicated on the diagram. When mounting the pump on the test rig, the clearance between each actuating lever and the operating cam, or eccentric, must be checked. This clearance must be between 0.035 and 0.055 in., *0,89 and 1,40 mm.*

TESTING. The test instructions contained in this chapter are based on de Havilland Reciprocating Test Specification R.T.S.2, issue 4. As these Test Specifications are subject to continual revision it is always desirable to check with The de Havilland Engine Company whether this is the latest specification before commencing to test components.

All calibrations and endurance test results should be carefully recorded. Checks should be made at regular intervals to ensure that the test fluid conforms to the specified standard and the filter which is in the supply pipe should be cleaned at frequent intervals.

A DIAPHRAGM ASSEMBLY PRESSURE TEST must have been carried out as described on page 187 before the pump is accepted for testing on the test rig.

DURING ALL TEST RUNNING there must be no fuel leakage from the drain connections.

INITIAL CALIBRATION. With a suction lift of two feet, *61 cm.* (1.3 in., *3,3 cm.*, Hg.), and an unrestricted fuel delivery, run the pump as indicated below.

Pump drive r.p.m.	250	1150	1275
Single pump delivery—			
pints per hour	90	105	105
litres per hour	*51*	*59,5*	*59,5*

To obtain single pump delivery, move the priming lever on one pump to the full extent of its travel and hold the lever in this position whilst observing the delivery of the other pump. By this means, record the delivery of each pump in turn.

RESTRICTED FLOW TEST. Close the outlet valve so that the fuel flow ceases and record the outlet pressure of each pump in turn ; render the second pump inoperative by manipulation of the priming lever as described above. A constant pressure of 2 ±0.2 lb. per sq. in., *0,14 kg. per cm.*², should be observed. The pump speed for this test should be 1275 r.p.m.

ENDURANCE TEST. With the fuel suction pressure and delivery as specified for the initial calibration, run the pump for five minutes at 1150 r.p.m. Fuel pumps which are intended for use as spare units are to be run under these conditions for a period of one hour, unless otherwise authorised by the inspector of the local governing body ; in the United Kingdom this will be the Air Registration Board's surveyor for civil engines and the Inspector-in-charge A.I.D. for military engines. During the endurance test there must be no fluctuation of fuel delivery. Fluctuation indicates faulty valve operation and the defect must be rectified.

FINAL CALIBRATION. The fuel pumps must be calibrated to the requirements and conditions tabled below.

Pump drive r.p.m.	Fuel delivery	Suction lift feet	*cm.*	Single pump delivery pints per hour	*litres per hour*
250	Unrestricted	2	*61*	90	*51*
250	Unrestricted	0	*0*	90	*51*
1150	Unrestricted	2	*61*	105	*59,5*
1150	Unrestricted	0	*0*	105	*59,5*
1275	Unrestricted	2	*61*	105	*59,5*
1275	Unrestricted	0	*0*	105	*59,5*

Steady test conditions must be obtained before recording the fuel delivery of each pump.

Repeat the restricted flow test as described already.

On satisfactory completion of these tests, remove the pump from the test rig and blank off all connections and openings.

Fits and Clearances

THE DIMENSIONS given on page 191 should be worked to during inspection and reassembly.

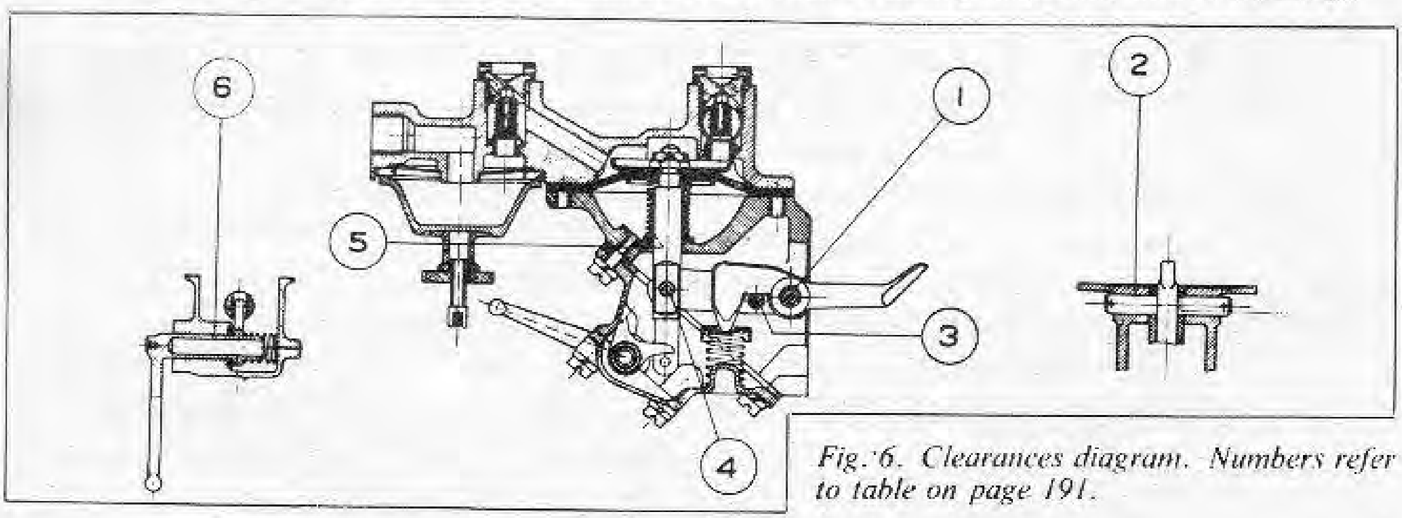


Fig. 6. Clearances diagram. Numbers refer to table on page 191.

Table of Fits and Clearances (Fig. 6).

Ref. No.	Component and Description	New Dimensions	Permissible Worn Dimensions	New Clearances		Permissible Worn Clearances		Remarks
		in.	in.	mm.	in.	mm.	in.	
1	Rocker Arm Pin in Lever and Link							Permissible worn clearance of 0.005 in. applicable only to that portion of the pin on which rocker lever and links have their bearings
	Lever and Link, Bore	0·245½ / 0·247½	0·250	+0,013 / +0,076	+0·000½ / +0·003	+0,13	+0·005 (see remarks)	
	Pin, Diameter	0·244½ / 0·245	0·240½					
2	Rocker Arm Pin in Body							Rocker Arm Pin diameter measured on ends in body only
	Body, Bore	0·244 / 0·245	—	−0,025 / +0,013	−0·001 / +0·000½	—	—	
	Pin, Diameter	0·244½ / 0·245	—					
3	Link Pins in Links							
	Link, Bore	0·184 / 0·186	0·188½	+0,051 / +0,115	+0·002 / +0·004½	+0,17	+0·006½	
	Link Pin, Diameter	0·181½ / 0·182	0·177½					
4	Link Pin in Pull Rod							
	Pull Rod, Bore	0·182½ / 0·184½	0·187	+0,013 / +0,076	+0·000½ / +0·003	+0,13	+0·005	
	Link Pin, Diameter	0·181½ / 0·182	0·177½					
5	Pull Rod in Gland							
	Gland, Bore	0·380 / 0·382	0·386	+0,127 / +0,229	+0·005 / +0·009	+0,28	+0·011	
	Pull Rod, outside Diameter	0·373 / 0·375	0·369					
6	Priming Lever in Bottom Cover and Cap							
	Bottom Cover and Cap Bore	7,993 mm. / 8,007 mm.	8,068 mm.	+0,005 / +0,026	+0·000¼ / +0·001	+0,08	+0·003	
	Priming Lever, Diameter	7,981 mm. / 7,988 mm.	7,913 mm.					

Chapter 18

CARE OF ENGINE WHEN NOT IN USE

General

The instructions given in the following paragraphs are based on de Havilland Specification R.T.S. 1, Issue 7. As these specifications are subject to continual revision it is always desirable, before commencing work, to check with the Service Department of The de Havilland Engine Company that this is the latest specification.

It is emphasised that the protection afforded against corrosion by the procedure detailed in the following pages is dependent almost entirely upon the conditions in which the engine is stored, and that the recommended periods before re-inhibiting becomes necessary apply only where ideal storage conditions (those of cool, dry, covered storage) prevail. Where engines are stored in other than ideal conditions, it is recommended that they be inspected at intervals not exceeding three months and that the periods between re-inhibiting are then determined from the results of these examinations.

To prevent corrosion, serviceable engines which are not expected to be out of use for more than a month should be run at least once a week at about 1000 to 1200 r.p.m. until normal oil and cylinder head temperatures are attained. If a serviceable engine is to remain static for a period exceeding seven days, it is recommended that the treatment described in the following paragraphs be applied and maintained, being repeated every six months on installed engines stored in the open or every twelve months on engines stored under cover.

Unserviceable engines should be inhibited to the greatest possible extent allowed by the degree of unserviceability. If an engine cannot be turned the interior of each cylinder should be treated statically with the normal recommended amount (5 c.c.) of inhibitor D.T.D. 791A. Unserviceable engines should be stripped for repair as soon as possible. All inhibiting should be carried out within 48 hours of the last run.

After any inhibiting of the engine an entry must be made in the engine log book stating clearly the date and extent of the inhibiting.

Materials

The materials required for the inhibiting process are: storage oil D.E.F. 2181, cylinder protective (wax thickened) D.T.D. 791A, Hall's anti-corrosion engine varnish No. 72972 D.T.D. 4189, or Anaco "B" external air-drying varnish D.T.D. 4053, and anti-freeze oil D.E.F. 2001 or D.Eng. R.D.2490. Additional requirements are: sufficient lead-free petrol D. Eng.R.D. 2485 to run the engine as necessary, small quantities of anti-freeze grease D.T.D. 577, and pure white lanolin D.T.D. 122B.

Storage of the inhibiting fluids may result in partial separation from the base fluid of the active corrosion preventive materials, with consequent lessened concentration of these constituents in the upper layers of the fluid in the container. It is essential, therefore, that every container of inhibitor be agitated thoroughly before opening for use to ensure that the fluid is uniformly mixed. Where practicable, containers should be kept in covered, heated storage.

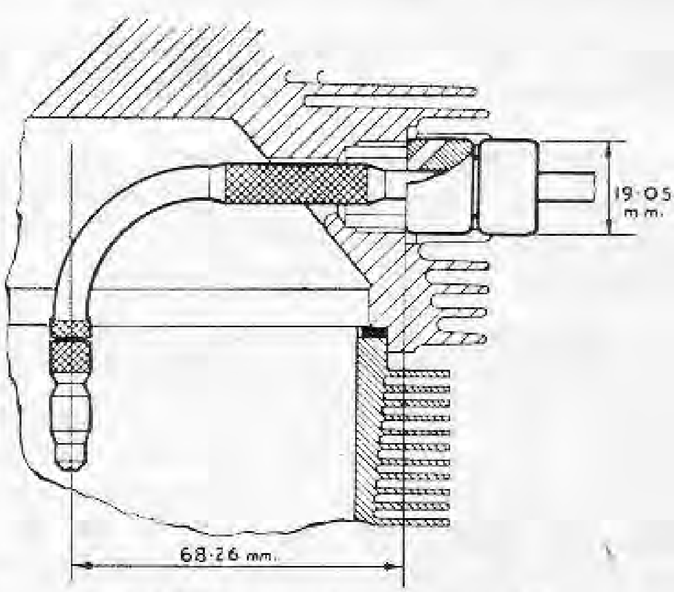
It is essential that cylinder protective D.T.D. 791A be stored in airtight containers until required for immediate use.

NOTE: Because of the petroleum spirit content of D.T.D. 791A, adequate precautions against fire risk must be taken when spraying this protective. Because of the slightly toxic nature of D.T.D. 4189 and D.T.D. 4053, operators are advised to wear respirators when spraying these protectives unless such spraying is carried out in a suitably ventilated location.

To ensure that the engine is inhibited satisfactorily it is essential that clean and efficient equipment be used when applying the protective mediums.

Internal protection

For internal protection the equipment should be capable of delivering an atomised mixture of moisture-free compressed air and inhibitor D.T.D. 791A at a constant pressure and in the requisite proportions. A standard Miller "Skyhi" spray gun model CSC 103 with modified spray tube and rotary nozzle type G.134, or an A.I.D. spray gun Mk.III Type TF.3.C1 with modified spray tube and rotary nozzle is recommended. It is essential that the specified quantity of inhibitor is deposited in an even film to cover the cylinder walls, the cylinder head and the piston crown; to give this, the spray tube contour must be such that the nozzle is capable of reaching to the centre of the cylinder space between the cylinder head and the piston crown with the piston at Inner (Bottom) Dead Centre; Fig. 1 shows the spray tube contour. When in use, the equipment should be checked frequently for freedom from clogging, efficient atomisation, constant delivery of correctly proportioned mixture, and moisture-free delivery from the air-line. Periodic tests of the equipment should also be made, using a mock-up spare cylinder assembly of the type being treated and the specified quantity of inhibitor, to ascertain that the equipment efficiently deposits this quantity of inhibitor in an even coat, covering completely



Inhibiting nozzle and spray tube.

During the spraying operation it is important that the dimension from the nozzle centre line to the sparking plug adapter counterbore-face is maintained at the value indicated. The spray tube stop must be held squarely and firmly against the sparking plug adapter counterbore-face.

the cylinder walls, cylinder head and piston crown. The results of such tests must be to the satisfaction of the relevant Inspection Authority.

External protection

For external protection D.T.D. 4189 or D.T.D. 4053 may be applied using any recognised type of spray gun, or in the absence of such equipment, by hand brushing using a clean paint brush. For the treatment to give adequate protection, a thin, even film of the inhibitor is all that is required, and this can be obtained easily, provided that the spraying equipment is maintained in a clean and serviceable condition and that normal care is taken during the spraying operation.

Inhibiting procedure

The inhibiting procedure recommended for application to serviceable installed engines is as follows. For application to uninstalled engines the instructions must be modified as necessary, but the general principles will still apply. It should be noted that, because of the absence of switch-lead connections on un-installed engines, the magnetos should be earthed, by means of a suitable lead from the L.T. connection to a convenient point on the engine, to prevent possible sparking at the H.T. lead-ends during crankshaft turning.

Within 48 hours of the last engine run:-

(1) Drain one or more fuel tanks as applicable and refill with sufficient lead-free fuel D.Eng.R.D.2485 to enable the engine to be run as necessary.

(2) Run the engine for five minutes at 1000-1200 r.p.m., adjusting the engine speed should detonation occur.

(3) While the engine is still warm, drain the oil tank and remove the pressure and scavenge filters from the engine, to allow as much surplus oil as possible to drain off. Refit the oil filters, then prime the system and fill the oil tank with storage oil D.E.F. 2181.

(4) When the engine is cool, but within four hours of the run specified in (2) above, run the engine for a period of fifteen minutes. Where possible, the aircraft should be headed into wind, and every effort should be made to keep the oil and cylinder head temperatures as low as possible during this run; in no circumstances must the temperatures specified for normal operation be exceeded. At the end of fifteen minutes switch off the fuel supply and allow the engine to run dry.

(5) Remove the sparking plugs from the engine. Remove the oil filters and turn the engine by hand through at least six crankshaft revolutions to remove surplus oil. Use a syringe, entered through the spark plug adapters when the piston is at T.D.C., to remove surplus oil and condensation from each cylinder in turn.

(6) Spray the valve gear with inhibitor D.T.D. 791A; excess inhibitor

should not be sprayed, an even coating is all that is necessary to ensure adequate protection. The valve stems and inner springs should be sprayed through the springs with the valves in the closed position; the exhaust valves and ports should be sprayed with the exhaust valves open. Turn the engine by hand through at least six revolutions in order to work as much inhibitor as possible down between the valves and guides.

(7) With the piston at B.D.C. on the power stroke, use the recommended equipment to spray the bore of each cylinder in turn with inhibitor D.T.D. 791A. Enter the spray nozzle through the port spark plug adapter aperture, hold the nozzle stop squarely against the spark plug adapter counterbore face (see Fig.1), and apply 5 c.c. of inhibitor to each cylinder. To avoid unnecessary turning of the engine the cylinders should be dealt with in the firing order - 1, 3, 4, 2. When this initial spraying is completed, turn the engine so that No. 1 piston is at B.D.C., and, without further turning of the crankshaft, spray an additional 5 c.c. of inhibitor through the port spark plug aperature into each cylinder.

NOTE: On no account must the engine be turned after this stage.

(8) Replenish the oil tank to normal level with storage oil D.E.F. 2181. Replace and lock the engine oil filters and fit approved-type dummy spark plugs to all cylinders. Remove the exhaust manifold and suitably blank off the air-intake and exhaust ports, using waterproof paper and adhesive tape if manufactured blanks are not available; similarly blank off all other ports, openings, breather pipes, etc. The joint faces of blanking plates should be smeared, before assembly, with a thin film of pure white lanolin D.T.D. 122B so that they will be as airtight as possible; the use of red lanolin, as used for external protection, is dangerous, as it hardens when exposed to air and does not soften readily in oil or with temperature.

(9) Using adhesive masking tape, or suitable wax-impregnated brown paper, mask all ignition harness terminal ends and rubber-covered H.T. leads. Treat similarly the magneto vents and breathers and contact-breaker covers, making sure that the masking is adequate to prevent the penetration of inhibitor between the contact-breaker housing and the magneto body. Pack all control mechanism ball joints liberally with anti-freeze grease D.T.D. 577. If the propeller is removed thoroughly coat propeller shaft with D.T.D. 791A and fit transport cover.

(10) Remove the airscoop and baffles and thoroughly clean all external surfaces of the engine by spraying with Kearsleys engine cleaning solvent and drying with compressed air. Spray all external parts and surfaces of the engine with a thin, even coating of D.T.D. 4189, D.T.D. 4053, irrespective of any existing enamelling or other protective process; care should be taken to avoid too heavy an application particularly on H.T. leads, and all masking must be left in position after spraying. Spray and reassemble the airscoop and baffles, "touching-up" as necessary after assembly so that the protective coating over the whole of the engine is continuous and undamaged. If at any time during the subsequent storage period the external protective coating is damaged in any way, it must be made good immediately if maximum protection is to be ensured.

(11) Display prominently on the propeller, or other suitable position on the engine, a notice stating that the engine has been preserved against corrosion, and that the fuel and oil tanks, as applicable, have been filled respectively with lead-free fuel and storage oil. The notice should indicate also the date of inhibiting and should state clearly that the engine must not be turned. Make an entry in the log book of the engine showing that the engine has been inhibited, giving the date at which the process was completed.

When an inhibited engine is received from storage and is to be installed in an airframe but not brought into immediate use, all nuts, bolts, split-pins, etc., used during installation must be lightly coated with D.T.D. 4189, or D.T.D. 4053; any deterioration of the external protective coating resulting from the installation operation must be treated similarly.

An engine that has been "cocoon" packed has no external protective coating once the "cocoon" has been removed; such an engine, therefore, if not required for immediate use after installation, must be given the full external treatment detailed above, care being taken that those parts of the engine not readily accessible after installation are adequately treated before the engine is installed. It is advisable, of course, to leave the "cocoon" intact until immediately before the engine is required for installation.

In the event of hand turning becoming necessary during installation, the cylinders must be re-inhibited, to the standard detailed previously, as soon after as is practicable.

Corrosion of carburettors and fuel pumps

When an engine is idle for considerable periods, or is flown less than 10 hours per month, there is a possibility that condensation will occur in the carburettor (and fuel pumps, when fitted), and the following supplementary servicing should be carried out at monthly intervals.

1. (a) Gravity feed. Remove the filter bowl and filter element and examine for water content and sediment.

   (b) Pump feed. Remove the filter bowl, filter element, fuel pump filter bowls and elements and examine for corrosion, water content and sediment.

2. Drain a small quantity of fuel from the fuel tanks, through the filter with the filter bowl removed (gravity feed) or drain from the tanks (pump feed), to check for water accumulation and sediment.

3. Remove the jets in the base of the carburettor and flush out the jet wells and the float chamber. If signs of corrosion or gelatinous substance are found the carburettor must be dismantled and cleaned.

Chapter 19

MAINTENANCE SCHEDULE

As any maintenance schedule is designed to ensure that the engine is maintained in a satisfactory and efficient mechanical condition, its composition must be determined largely by the local conditions in which the aircraft is housed and operated, by the duration of flight, and by the power at which the aircraft is generally flown. The schedule should comprise routine attentions and periodic examinations to check adjustments, and to ascertain the progress of wear and tear, and the extent of deterioration, this latter being particularly important if the engine is flown only at intervals.

No schedule compiled without reference to the specific conditions in which the engine is to operate can be more than an estimate of the actual requirements, and to obtain maximum reliability and serviceability at minimum cost, the schedule must be modified as experience dictates. Items should be added as necessary to cover special installations or equipment and to include the provisions of any local or national regulations, and the engine log book must be referred to for details of any modifications that may affect the basic schedule.

The following detail of routine checks and inspections is intended to serve as a basis from which, for each particular case, the most efficient schedule can be compiled. It has been divided into four routine checks commencing with the Pre-flight inspection, to which the necessary items have been added for each of the more comprehensive checks, and includes recommendations for a "bedding-down" check to be carried out 10 hours after installation. The recommended time at which the routine checks should be made are approximately those given below, but as longer periods between checks may be authorised from time to time by the Air Registration Board or the equivalent local governing body on the recommendation of the engine manufacturer or in the light of experience, the figures given are intended as a guide only.

Check	Recommended frequency
Pre-flight check	As necessary
Check 1	After the first 10 flying hours following installation
Check 2	After every 50 flying hours
Check 3	After every 150 flying hours
Check 4	After every 300 flying hours

Pre-flight check

Examine the pilot's report or running log for the previous day and rectify any faults noted.

Inspect the propeller and spinner for damage and security.

Check the installation for blowing or leaking joints and rectify or renew as necessary.

Ensure that the induction manifold drain is unobstructed.

Turn ON the fuel cock and check the fuel system for leaks.

With the fuel cock ON operate the fuel pump priming levers, but without operating the carburettor tickler,and ensure that the carburettor does not flood.

Turn the handle of the "Auto-Klean" filter once in a clockwise direction.

Note .... This operation is to be completed once per day only.

Replenish the fuel and oil tanks as necessary.

Check 1.

Examine the pilot's report or running log and rectify any faults noted.

Inspect the propeller and spinner for damage and security. Check that the propeller and hub are not loose on shaft, and that all locking devices are secure.

Note ....

After fitting the propeller, the hub retaining nut should be checked for tightness after the check run and also following each of the first three flights. The hub bolt nuts too should be checked for tightness after the check run; care must be taken not to over-tighten these nuts.

Ensure that all H.T. connections to the sparking plugs and all H.T. and L.T. connections to the magnetos are secure.

Check all cylinder holding-down nuts for tightness; all nuts must be tightened evenly.

Check the rocker bracket bolts for tightness.

Check the tappet clearances, after making the two previous checks, and adjust as necessary.

Check 2.

Remove the spinner and check the tightness of the propeller hub retaining nut; inspect all propeller locking devices for security and damage.

> Note .... Necessary only at first Check 2 after propeller has been installed.

Check all cylinder holding-down nuts for tightness and check the cylinders for cracks and for signs of overheating.

Remove the valve gear covers and examine the valve springs for serviceability.

Check the rocker bracket bolts for tightness.

Check the tappet clearances,after making the three previous checks, and adjust as necessary.

Clean the rocker covers and refill each to the level of the collar on the vent pipe with oil to the correct specification.

Examine and clean the suction and scavenge filters. Drain the oil tank and refill with oil to the correct specification.

> Note .... After refitting the oil filters, prime the lubrication system as described in Chapter 6.

On engines with fuel pumps fitted, remove the pump filters, examine for corrosion, water content and sediment, clean and replace. (see page 196).

Remove the carburettor jets and examine these for obstruction. Flush the carburettor; replace jets.

Check that all vent and breather pipes are unobstructed.

Lubricate all joints, cables and bearings in the engine control linkwork, including the spindle on the flame trap valve, and examine for serviceability and operation (see page 282). Check security of taper pin (Pre-mod. 2058) in vernier flange on throttle cross-shaft.

Examine the contact breaker points and check the contact breaker point gaps.

Remove the sparking plugs, clean, reset gap, and test; refit plugs.

Check the compression of each cylinder; this test should be made in conjunction with the sparking plug change.

Check 3.

Repeat Check 2, and in addition:-

Remove and clean the distributor and check that the vent holes are clear. Check the condition of the H.T. pick-up brush and moulding.

Remove the contact breakers, recondition and lubricate as necessary.

Note ... Do not over-lubricate. One drop of oil only should be applied to the oil wick of the pivot pin and cam ring. Remove any surplus oil.

Check 4.

Repeat Checks 2 and 3, and in addition:-

Remove the propeller and hub and inspect,with the aid of a magnifying glass, the area of the crankshaft around the keyway and towards the thrust race retaining nut thread for signs of cracks.

Examine the propeller hub key for signs of 'stepping' and check that the key has no excess movement in the keyway.

Remove and clean the "Auto-Klean pressure filter and remove all sediment from the filter casing.

Inspect, and, if necessary, clean the flame trap.

Examine the magneto flexible couplings for deterioration and oil soakage.

Clean the magneto H.T. pick-up slip rings and the flanged collector mouldings.

Examine the ignition harness for signs of deterioration and check for continuity and insulation resistance.

AMENDMENT TO GIPSY MAJOR 1,1C,1D,1F,1G,HC AND 7 HANDBOOK

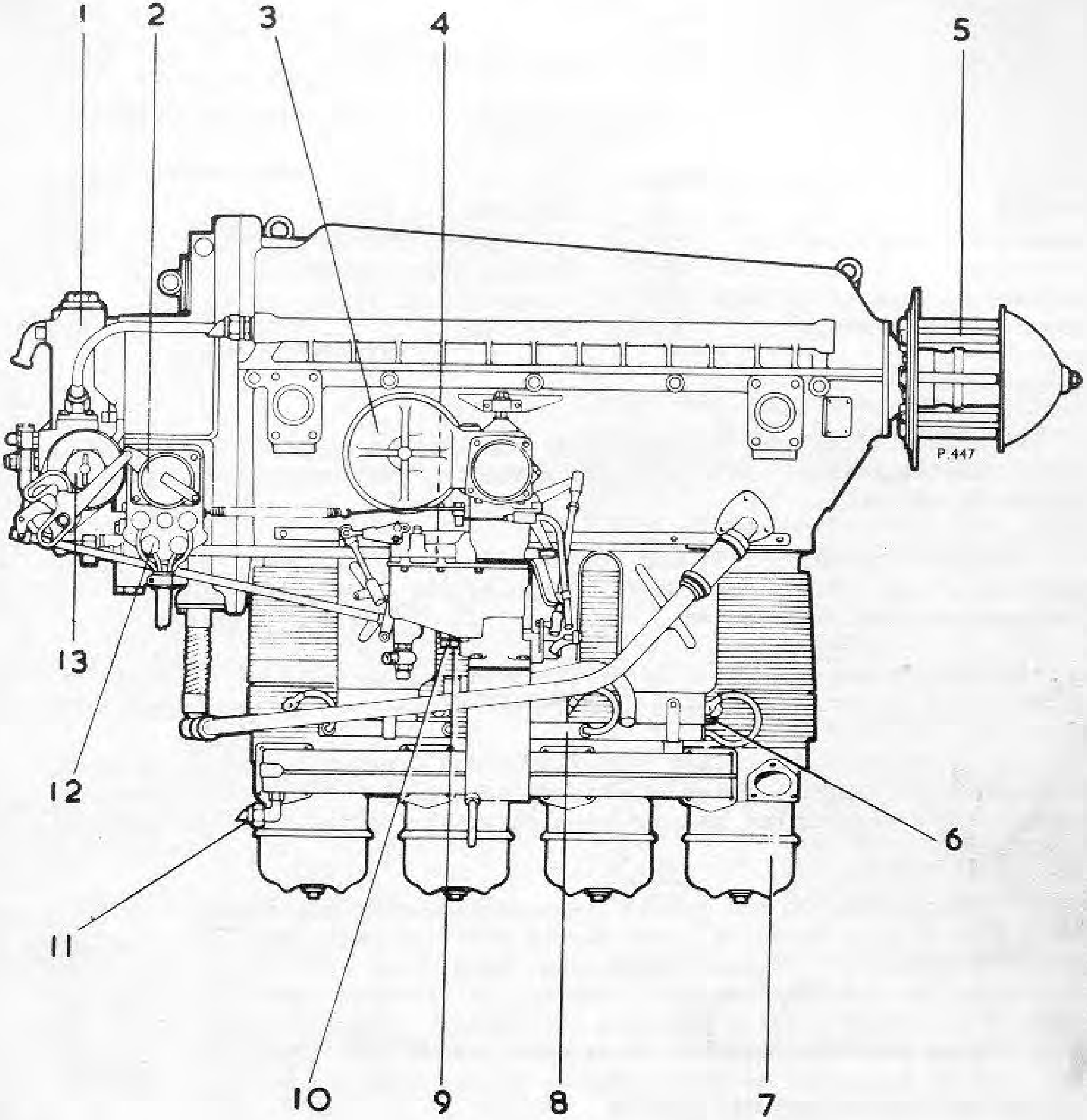
Page 200, Overhaul life. Moisten the back of this slip and stick it to the page to cover the paragraph headed Overhaul life.

Overhaul life

The above inspection cycle should be repeated until the specified overhaul period is reached.

The authorised overhaul lives for Gipsy Major Series 1 engines are given in Technical News Sheet G. No.15.

October 20 1970



1 SUCTION FILTER
2 CONTACT BREAKER COVER
3 FLAME TRAP
4 SLOW-RUNNING JET
5 PROPELLER HUB
6 SPARKING PLUGS
7 ROCKER COVER
8 IGNITION HARNESS
9 POWER JET
10 MAIN JET
11 INDUCTION MANIFOLD DRAIN
12 DISTRIBUTOR COVER
13 PRESSURE ('AUTO-KLEAN') FILTER

Location of the principal servicing points

Chapter 20

TABLE OF FITS AND CLEARANCES

LIST OF CONTENTS

	Page
General	202
Crankshaft, crankcase and bearings	203
Pistons and connecting rods	206
Camshaft and bearings ...	212
Tappets and guides	213
Cylinders, valves and rockers	213
Timing gear, magneto drive and E.S.I. drive	217
Oil pump	219

General.

When inspecting and reassembling the engine during overhaul or repair, the dimensions and clearances given in this chapter should be adhered to strictly.

The data regarding fits and clearances is specified under three headings, i.e. "New Dimensions", "Permissible Worn Dimensions" and "Permissible Worn Clearances".

All dimensions are given in millimetres and decimals of a millimetre except where otherwise stated.

The figures in the column "New Dimensions", are the drawing sizes to which parts are made. These dimensions are given in limit form and represent the minimum and maximum size to which parts may be accepted when new.

The dimensions in the column "Permissible Worn Dimensions" represent the limits of size to which parts may be worn and refitted for a further period of service. These dimensions have been so fixed that the components are fit for the full period of further service which is normally permitted between complete overhauls. When, however, parts are found during complete overhaul to be worn beyond the specified limits, they must be discarded as unserviceable unless they can be made serviceable by an approved salvage scheme.

The "Permissible Worn Clearance" is the limit of working clearance permissible between any two parts assembled together. If a male member, worn to the minimum size is assembled with a corresponding new female part machined to the minimum drawing limit, the resulting working clearance between the two parts will in most instances correspond with the maximum permissible worn clearance. Similarly, if a female part, worn to the maximum permissible size, is assembled with a corresponding male part, machined to the maximum drawing limit, the resulting working clearance will be the same.

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Journals and Bearings.			
Standard size.	1.968"		
Journals, diameter	49.968 / 49.987	49.920	
Bearing, bore (Finished size)	50.050 / 50.057	50.117 1.974	0.13
	Unless new bearings are required, bearings which are found to be within the limit of wear before being refitted are to be carefully inspected to ensure that the white metal is in a serviceable condition.		
Journals, stages of re-grinding:-			
1st	49.843 / 49.862		
2nd	49.718 / 49.737	When re-grinding, care is to be taken to ensure that no material is removed from the face of crankwebs.	
3rd	49.593 / 49.612		
4th	49.468 / 49.487	49.420 1.948	Minimum worn size.
Journals, ovality	-	0.050	
	Minimum diameter to be such that the "Permissible Worn Clearance" for journal bearing is not exceeded.		
Journal bearings, stages of undersize:-			
1st	49.925 / 49.932	-	-

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Journals and Bearings. (Cont'd.)			
Journal bearings, stages of undersize. (Cont'd.):-			
2nd	49.800 / 49.807	-	-
3rd	49.675 / 49.682	-	-
4th	49.550 / 49.557	-	-
Crankpins, Diameter			
Crankpins, standard size	49.968 / 49.987	49.895	0.13
Crankpins, stages of re-grinding:-			
1st	49.843 / 49.862		
2nd	49.718 / 49.737	When re-grinding, care is to be taken to ensure that no material is removed from the face of crankwebs.	
3rd	49.593 / 49.612		
4th	49.468 / 49.487	49.395	Minimum worn size.
Crankpins, ovality	-	0.050	-
	Minimum diameter to be such that the "Permissible Worn Clearance" for crankpin bearing is not exceeded.		
Crankpins, Length.	50.988 / 51.012	51.138	

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Crankpin, Parallelism.			
Lack of parallelism of crankpin with journals per inch of length.	-	0.040	-
	Measured in two planes at 90 deg.		
Crankshaft, End Float.			
Crankshaft ball bearing end float between inner and outer races.	-	-	0.30
Crankcase Ball Bearing In Crankcase.	Outer race of bearing is to be nipped in crankcase to the extent of $\frac{0.004}{0.005}$ in. by the front cover to prevent rotation. Shims 0.002 in. thick are provided for this purpose.		
Crankshaft Centre Journal, Lack Of Truth.			
Lack of truth of centre journal when crankshaft is supported by journals one and five in V-blocks. (Errors due to ovality to be subtracted)	-	0.050 Dial indicator reading 0.100	-
Wear On Face Of Crankcase Caused By Fretting Of Cylinder Barrels.	-	0.250	-

When this figure is exceeded the crankcase face is to be machined down in accordance with Gipsy Salvage and Repair Drawing No. R.7 and a packing shim representing the thickness of metal removed is to be fitted under the cylinder barrel flanges.

Four stages of refacing are allowed, details of which are given on this drawing together with details of the appropriate shims.

The maximum amount of metal which may be removed is 1.250 which represents a dimension of $\frac{192.700}{192.850}$ between the top and bottom faces of the crankcase. When this stage is reached the face may be allowed to wear down 0.250 after which the crankcase is to be discarded.

April 1955

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Crankshaft, Propeller Location			
Eccentricity of the front end of crankshaft i.e. propeller location	-	0.05	-
	Total indicator clock reading 0.100		
Starter Extension Shaft			
Eccentricity of the periphery of the starter dog on assembly	-	0.05	-
	Total indicator clock reading 0.100		

PISTONS AND CONNECTING RODS

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Connecting Rods, Errors of Alignment			
Errors of alignment between big and small ends, per inch of mandrel			
Parallelism	-	0.051	-
Twist	-	0.076	-
Big End Bearing			
Bore, standard size	50.025 / 50.031	50.117	-
Bore, stages of undersize			
1st	49.900 / 49.906	-	-
2nd	49.775 / 49.781	-	-
3rd	49.650 / 49.656	-	-
4th	49.525 / 49.531	-	-

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Working clearance for big end bearing on crankpin	-	-	0.13
Unless new bearings are required, bearings which are found to be within the limits of wear are to be carefully inspected to ensure that the white metal is in a serviceable condition before being refitted.			
Big End Bearing, End Float			
Big end bearing, width	50.862 / 50.888	50.738	-
End float of big end bearing on crankpin.	-	-	0.25
Gudgeon Pin In Connecting Rod.			
(1 and 1F types and Pre-Mod.2360, types 1C and 7)			
Small end, bore	25.000 / 25.020	25.074	0.08
Gudgeon pin, diameter in centre	24.981 / 24.994	24.920	
(1C and 7, Mod.2360)			
Small end, bore	25.012 / 25.020	25.074	0.08
Gudgeon pin, diameter in centre	24.981 / 24.994	24.932	
Gudgeon pin, ovality	-	0.025	-
	Minimum diameter to be such that "Permissible Worn Clearance" for gudgeon pin is not exceeded.		
Gudgeon Pin In Piston			
Gudgeon pin boss, bore	24.993 / 25.013	25.064	0.07
Gudgeon pin, diameter at ends	24.981 / 24.994	24.923	
End float	-	-	1.50

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Compression Rings In Ring Grooves			
Compression ring groove, top and 2nd, width	2.675 / 2.700	2.830	
			0.33
Compression ring, top and 2nd, width	2.475 / 2.500	2.345	
	Standard piston and standard or 0.125 oversize rings.		
Compression ring groove, top and 2nd, width	2.425 / 2.465	2.580	
			0.33
Compression ring, top and 2nd, width	2.238 / 2.250	2.095	
	1C and 7 types only. Standard piston and standard or 0.125 oversize rings.		
Compression ring groove, top and 2nd, width	2.425 / 2.450	2.580	
			0.33
Compression ring, top and 2nd, width	2.225 / 2.250	2.095	
	1 and 1F types only. 0.250 oversize piston and rings.		
Compression ring groove, top and 2nd, width	2.175 / 2.215	2.330	
			0.33
Compression ring, top and 2nd, width	1.988 / 2.000	1.845	
	1C and 7 types only. 0.250 oversize piston and rings.		
Scraper Rings In Ring Grooves			
Scraper ring groove, width	3.125 / 3.150	3.330	
			0.33
Scraper ring, width	2.975 / 3.000	2.795	
	1 and 1F types only. Standard piston and standard or 0.125 oversize rings.		

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Scraper Rings in Ring Grooves (Cont'd.).			
Scraper ring groove, width	2.625 2.650	2.730	0.23
Scraper ring, width	2.488 2.500	2.395	
	1C and 7 types only. Standard piston and standard or 0.125 oversize rings.		
Scraper ring groove, width	2.875 2.900	3.080	0.33
Scraper ring, width	2.725 2.750	2.545	
	1 and 1F types only 0.250 oversize piston and ring.		
Scraper ring groove, width	2.375 2.400	2.480	0.23
Scraper ring, width	2.238 2.250	2.145	
	1C and 7 types only. 0.250 oversize piston and ring.		
Compression Ring Gap.			
Top compression ring (nearest crown of piston); gap when measured in 118, 118.125 or 118.250 exact size ring gauge for standard, 0.125 oversize or 0.250 oversize rings respectively.	1 and 1F types only 0.711 .028 0.813 .032 1 and 1	-	1.20 .047
- do -	1C and 7 types only 0.813 .032 0.914 .036	-	1.30

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Compression Ring Gap (Cont'd).			
2nd Compression ring; gap when measured in 118, 118.125 or 118.250 exact size ring gauge for standard, 0.125 oversize or 0.250 oversize rings re-respectively	1 and 1F types only 0.711 .028 0.813 .032	-	1.20 .047
- do -	1C and 7 types only 0.813 .032 0.914 .036	-	1.30 .051
Scraper Ring Gap			
Scraper ring gap when measured in 118, 118.125 or 118.250 exact size ring gauge for standard, 0.125 oversize or 0.250 oversize rings respectively	1 and 1F types only 0.457 .018 0.559 .022	-	0.94 .037
- do -	1C and 7 types only 0.559 .022 0.660 .024	-	1.04 .040
Pistons, Land and Skirt Diameters and Clearance in Cylinder.			
Standard piston diameters:- Diameter at top of piston	117.175 117.225	116.945	-
Diameter of piston, 2nd & 3rd lands from crown	117.275 117.325	117.045	-
Diameter of skirt:-			
Top	117.475 117.525	117.245	-
Bottom	117.555 117.605	117.325	-
0.250 oversize piston diameters:-			
Diameter at top of piston	117.425 117.475	117.195	-

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Pistons, Land And Skirt Diameters and Clearance in Cylinder. (Cont'd.).			
0.250 oversize piston diameters:-			
Diameter of piston, 2nd & 3rd lands from crown	117.525 / 117.575	117.295	-
Diameter of skirt:-			
Top	117.725 / 117.775	117.495	-
Bottom	117.805 / 117.855	117.575	-
Clearance between piston and cylinder when measured in centre of cylinder			
Standard cylinder and piston, also 0.250 oversize cylinder bore and piston:-			
Top land	-	-	1.03
2nd & 3rd lands	-	-	0.93
Skirt top	-	-	0.73
Skirt bottom	-	-	0.65
0.125 oversize cylinder bore and standard piston:-			
Top land	-	-	1.15
2nd & 3rd lands	-	-	1.05
Skirt top	-	-	0.86
Skirt bottom	-	-	0.78

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Pistons and Connecting Rods Assembly, Weight Variation.			
Permissible variation in weight between any two connecting rods, complete with gudgeon pins and pistons and all details in any individual engine.	1 oz. 10 drm.	-	-

CAMSHAFT AND BEARINGS

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Camshaft in Bearings.			
Bearings, front and rear, bore	27.993 / 28.019	28.158	0.19
Journals, front and rear, diameter	27.936 / 27.968	27.803	
Bearings, intermediate, bore	50.972 / 50.985	51.117	0.17 (Pre Mod. Gipsy 936)
Journals, intermediate, diameter	50.922 / 50.947	50.802	
Bearings, intermediate, bore	50.972 / 50.985	51.122	0.20 (Mod. Gipsy 936)
Journals, intermediate, diameter	50.896 / 50.922	50.772	
Camshaft End Float			
Camshaft, width between flange on camshaft and face of timing gear	38.050 / 38.100	38.205	0.18
Rear end bush, width	37.975 / 38.025	37.870	

CAMSHAFT AND BEARINGS

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Camshaft Centre Journal, Lack of Truth.			
Lack of truth of centre journal when front and rear journals are supported on V-blocks	-	0.050 Dial indicator reading 0.100	

TAPPETS AND GUIDES

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Tappets, Cylindrical Portion, In Guides.			
Guide, bore	13.993 14.007	14.101	0.12
Tappet, diameter	13.968 13.981	13.873	
Tappets, Rectangular Portion, In Guides			
Guide slot, width	13.993 14.050	14.131	0.15
Tappet flat, width	13.968 13.981	13.843	

CYLINDERS, VALVES AND ROCKER GEAR

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Cylinder Bore.			
Standard	117.975 118.025	118.120	
1st stage of re-grind (0.125 oversize)	118.100 118.150	118.245	-

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Cylinder Bore (Cont'd)			
2nd stage of re-grind (0.250 oversize)	118.225 / 118.275	118.370	-
Ovality measured in centre of cylinder	-	0.076	-
The largest diameter of cylinder bore, when measured in centre of cylinder, to be within the "Permissible Worn Dimension".			
Lack of parallelism of cylinder bore	-	0.130	-
Local wear at the top of cylinder bore may be permitted up to 0.200 above the maximum new dimension (i.e. 118.025) for cylinder bore.			
Valves in Guides			
Valve guide, inlet bore up to 12 m.m. from each end	11.050 / 11.070	.440 11.170	0.20 .0079.
Valve, inlet, stem diameter	10.950 / 10.970	10.850 .427	
Valve guide, exhaust bore up to 12 m.m. from each end (Pre-Mod.2197)	11.050 / 11.070	11.170	0.20
Valve guide, exhaust bore up to 12 m.m. from each end (Mod. 2197)	12.550 / 12.570	12.670	
Valve, exhaust, stem diameter (Pre-Mod.2197)	10.950 / 10.970	10.850 ,427	0.20
Valve, exhaust, stem diameter (Mod. 2197)	12.450 / 12.470	12.350 ,486.	
Valves, Inlet and Exhaust, Ovality of Stems	-	0.076	-
Minimum diameter to be not less than "Permissible Worn Dimension" for valve stems.			
Valve Guide Bores, Ovality			
Valve guides, inlet and exhaust, ovality of bore up to 12 m.m. from outer end	-	0.076	-
	Maximum diameter to be not greater than "Permissible Worn Dimension" for valve guide bores.		

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Valve Springs, Inlet and Exhaust			
Outer spring (Part No. 1302-9/4			
Test length	34.500	-	-
Equivalent load	32.6 lb. 34.6 lb.	30.25 lb. (Pre Mod.G.801)	-
Inner Spring (Part No. 1302-10 A/4)			
Test length	34.500	-	-
Equivalent load	21 lb. 23 lb.	19.75 lb. (Pre Mod.G.801)	-
Outer Spring (Part No. 1902-19 A/3)			
Test length	34.50	-	-
Equivalent load	38 lb.13 oz. 42 lb.13 oz.	36 lb. 12 oz. (Mod. G.801)	-
Inner Spring (Part No. 1902-20 A/3)			
Test length	34.50	-	-
Equivalent load	30 lb.9½ oz. 33 lb.13 oz.	29 lb. 0 oz. (Mod. G.801)	-

Important note on spring load irrespective of Mod. standard

The spring load in position on each valve must not be less than 25.5 lb. and the length in position on each valve must never be less than 44 MM 1.750 in. This condition may be maintained by the fitting of an oversize valve guide bottom collar if the standard collar does not give these requirements. See page 280 for instructions and collar sizes.

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Valve Seats			
Dia. of 30° seating:-			
Inlet	49.450 49.550	51.000	-

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Valve Seats (Cont'd.)			
Dia. of 30° seating (cont'd.):-			
Exhaust	46.950 / 47.050	48.500	-

The permissible worn dimensions quoted are the dimensions to which the seat diameter may extend before re-cutting is necessary.
Depth of seat after maximum permissible re-cutting:-
For aluminium bronze type heads only; Inlet 3.08 mm. Exhaust 3.46 mm. (see Salvage and Repair Drawing No. R.15). For cylinder heads with replaceable seats; Standard plain type seats 2.00 mm. Standard screwed type exhaust seats 2.15 mm. (See Salvage and Repair Drawing No. R.337).

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Valves, Re-Grinding			
Valves, minimum thickness of valve head after re-grinding of valve face (i.e. dimension from lower edge of valve face to bottom of valve head)			
Inlet valve	-	0.750 .0295"	-
Exhaust valve (Part No. 1903-23/1)	-	1.120 (Mod. G.801) .0441	-

Exhaust valve (Part No. 1902-23/1) is obsolescent but should not be discarded unless unserviceable.

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Exhaust valve (Part No. 1902-23/A)	-	1.500 (Mod. G.959)	-
Inlet valve	1.500	0.750	1C, 1F and 7 types only
Exhaust valve	4.000	3.260 *	

* At the permissible worn dimension given, 0.51 of Stellite facing still remains.

CYLINDERS, VALVES AND ROCKER GEAR

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Bushes On Rocker Spindle.			
Bushes, bore	11.993 12.007	12.101	0.12
Spindle, diameter	11.968 11.981	11.873	
Rocker and Bush End Float.	-	-	0.20
Valve Rocker Pad.			
Re-conditioning.	Valve rocker pad may be re-conditioned by hand-stoning to a smooth contour provided a V.P.N. figure of 700 is obtained. Care must be taken to keep the face true with the longitudinal axis of the pad.		

TIMING GEAR, MAGNETO DRIVES AND ENGINE SPEED INDICATOR DRIVE

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Engine Speed Indicator Driving And Driven Spindles In Bearings.			
Bearing, bore	11.993 12.007	12.068	0.10
Spindle, diameter	11.945 11.968	11.893	
Driving Spindle			
End float	-	-	0.30 .011
	1, 1F (Tiger Moth) & 7 types.		
Spindle, length from flange face to gear abutment face	67.500 67.537	67.640	0.25
Housing, length over bushes	67.350 67.390	67.250	
	1C, & 1F (Magister) types.		

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Driven Spindle End float	-	-	0.30
	1, 1F (Tiger Moth) and 7 types.		
Housing, depth to bush face	8.050 / 8.125	8.275	0.30
Shaft, width of gear wheel and shoulder	7.925 / 7.975	7.750	
	1C and 1F (Magister) types.		
Engine Speed Indicator Driving Gear, and Idler Spiral Gear. Backlash	-	-	0.51
Engine Speed Indicator Driving Gear, and Driven Gear (s). Backlash	-	-	0.25
Idler Gear, Assembled With Bushes, on Spindle.			
Bushes, bore	17.993 / 18.013	18.068	0.14
Spindle, diameter	17.915 / 17.928	17.853	
Idler Gear End float	-	-	0.051 / 0.152 (new)

Adjustable by shims between race and shoulder of bearing bush. Shims are supplied in the following thicknesses:- 0.005 in.,0.010 in.

Mod.2318 deletes these shims and substitutes a spacing washer, Part No.42288, which is positioned between the thrust race and the shoulder of the bearing bush. The washer is ground during assembly to give the correct end float.

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Crankshaft Gear And Idler Gear.			
Backlash	-	-	0.38
Idler Gear, Camshaft Gear And Oil Pump Driving Gear.			
Backlash between either pair	-	-	0.30
Magneto Driven Gear Assembled On Cross Shaft.			
End float between inner and outer races of bearings	-	-	0.30
Side clearance of outer race in bearing housing	-	-	0.070 0.210 (new)
	Impulse starter side of magneto drive.		
Magneto Driving Gear And Magneto Driven Gear.			
Backlash	-	-	0.51
Simms Coupling			
End float of Simms Coupling measured on Impulse Starter side only	-	-	0.254 0.508 (new)
	To be obtained by adjusting the position of the magneto.		

OIL PUMP

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Pump Bearings.			
Bushes, bore	15.993 16.013	16.095	0.12

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Pump Bearings (Cont'd.)			
Journal, diameter	15.949 / 15.975 (.628 / .629)	15.873 (.625)	0.12 (.004)
Gear Spindle Bushes In Housings			
Standard size			
Housings, bore	19.993 / 20.013	-	-
Bushes, outside diameter	20.038 / 20.050	-	-
1st Oversize			
Housings, bore	20.247 / 20.267	-	-
Bushes, outside diameter	20.292 / 20.304	-	-
2nd Oversize			
Housings, bore	20.501 / 20.521	-	-
Bushes, outside diameter	20.546 / 20.558	-	-
Locating Dowels in Oil Pump Assembly			
Standard size			
Oil pump assembly, dowel holes	5.993 / 6.007	-	-
Locating dowels, diameter	5.981 / 5.994	-	-
1st Oversize			
Oil pump assembly dowel holes	6.243 / 6.257	-	-
Locating dowels diameter	6.231 / 6.244	-	-
2nd Oversize			
Oil pump assembly, dowel holes	6.493 / 6.507	-	-

See Repair Drawing No. R.257 Mk.7 only

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Locating Dowels in Oil Pump Assembly (Cont'd.)			
2nd Oversize (cont'd.) Locating dowels, diameter	6.481 / 6.494	- See Repair Drawing No. R.257 Mk.7 only.	-
Pump Gears Backlash	-	-	0.38
Oil Pump Driving Gear End float	-	-	0.18

End thrust of driving gear must be taken on the face of the bush adjacent to bore of gear wheel and not on the pump gear in the casing. Therefore, the end float of the driving spindle, with driving gear assembled, must not under any condition of wear exceed the end float of the pump gear in its casing when measured with the driving gear removed.

Pump Gears, End Float			
Pump casing with bushes fitted, width between flanges	25.050 / 25.124	25.155	0.18
Pump Gears, length	24.950 / 24.975	24.870	

1, 1F and 1C types

Pressure and Front Section Pump Gears, End Float			
Pump casing with bush fitted, width for gear wheels	25.050 / 25.124	25.155	0.18
Pump gears, length	24.950 / 24.975	24.870	

Mk. 7 type. * Pre Mods. G.1371 and G.1372

* If the dividing plates are worn, the clearance may be wholly or partially restored by lapping the joint faces of either the dividing plates or the casings (excepting the end covers), but the depth of casing for the gears must not be reduced below the minimum new dimension and the width of the dividing plate must not be less than 3.25 after lapping. The gear end float must not exceed 0.152 or be less than 0.101 after lapping.

Component and Description	New Dimensions	Permissible Worn Dimensions	Permissible Worn Clearances
Pressure and Front Suction Pump Gears, End Float (Cont'd.)			
Pump casing with bush fitted, width for gear wheels	25.050 / 25.125	25.155	0.18
Pump gears, length	24.950 / 24.975	24.870	
	Mk. 7 type. x Mods. G.1371 and G.1372		
	x (see previous page)		
Rear Suction Pump Gears, End Float			
Pump casing, width	25.050 / 25.125	25.155	0.18
Pump gears, length	24.950 / 24.975	24.870	
	Mk. 7 type x (see previous page)		
Pump Gears, Clearance on Diameters			
Pump casing, bore	35.493 / 35.545	35.595	0.20
Pump gears, diameter over teeth	35.370 / 35.395	35.293	
	1, 1F and 1C types, and Mk.7 type Pre Mod. G.1371		
Pump, casing, bore	35.513 / 35.532	35.595	0.20
Pump gears, diameter over teeth	35.370 / 35.395	35.313	
	Mk.7 type only. Mod. G.1371 (all gears) and Pre Mod. G.1990 (auxiliary gears only)		

CONTINUED ON PAGE 279.