

Chapter 15

ASSEMBLING THE SUB-ASSEMBLIES

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General

1. This chapter contains instructions for reassembling the sub-assemblies using serviceable, reconditioned, or new parts.
2. Certain components, such as the airscoop and the cooling baffle, which have not been dismantled further than was necessary when removing them from the engine, do not require reassembling as sub-assemblies. Reassembly of components such as the ignition harness, magnetos, and fuel pumps is not described in this chapter. For fuel pump information refer to Chapter 17.
3. New locking devices, such as tab-washers, split pins, and new circlips, joint washers, oil seals and all similar parts, must always be used. All moving parts must be oiled with clean approved engine oil, during reassembly to ensure their adequate lubrication until normal pressure lubrication can reach them. Particular care must be taken that loose nuts, washers, and small tools are not left inside the sub-assemblies, and all openings and unions should be blanked off as early as possible, either with proper blanking plates, caps, or plugs, or with improvised plates of metal or plywood. Scrupulous cleanliness and care are essential at all times during the reassembly of the sub-assemblies.
4. Throughout this chapter where clearances or limits are not quoted, the operator must refer to the Schedule of Fits, Clearances, and Repair Tolerances; for essential dimensions and clearances see Chapter 20.
5. Before commencing to reassemble any sub-assembly, the instructions given in the inspection sheet must be carefully read and all work carried out as directed. In addition, ascertain that all renewals, repairs and modifications have been completed. After completing this work, all components must

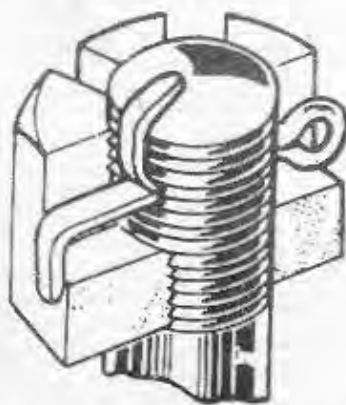


Fig. 1. Fitting split pins in stationary components

be washed in clean kerosene to remove any abrasive particles and the dismantled parts finally submitted to the Inspector-in-charge, who must certify that they are fit for reassembly.

Split pins

6. * Split pins must be fitted very carefully. The normal recommended practice for stationary components is for the head of the split pin to be fitted into the slot in the nut and for the legs of the pin to be bent up over the end of the bolt and down over the nut as shown in fig. 1. For moving components, the split pin must be twisted carefully through 90 deg., before fitting, so that with the head fitting correctly in the slot in the nut, the legs of the pin can be wrapped round the hexagon of the nut as shown in fig. 2. The head of the split pin must never protrude beyond the slot of the nut. Split pins should be inserted and the legs bent over with pliers and never by hitting with a hammer, otherwise the legs may be fractured at the point of bending, or at the base of the head, on the sharp edges of the nut.

Taper pins

7. Taper pins are used in a number of places in these engines. When refitting the original components care must be taken to ensure that the smaller end of the tapered hole in the female part is correctly aligned with the corresponding end of the tapered hole in the male part. When fitting new components, they must be secured temporarily in their correct relative positions whilst the necessary holes are drilled and taper-reamed. When locking a taper pin by riveting over its small end, the opposite end of the pin must be firmly supported so that the pin is not driven out or loosened instead of being locked securely in position.

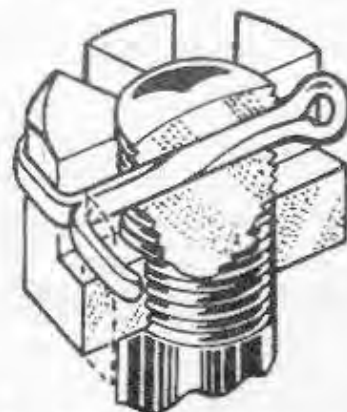


Fig. 2. Fitting split pins in moving components

Propeller boss

8. The tapered bore of the propeller boss is machined to a slightly smaller angle than the taper on the crankshaft to ensure the maximum grip between the two components. No attempt must be made to lap these components together, but a crankshaft lap T77132, and a propeller lap T77131, should be used to rectify fretting damage and looseness of the hub on the crankshaft. The nose cap, or spinner, the two locking plates, and the propeller boss plate, and the friction discs (Mk. 7), are not refitted until the propeller boss is refitted to the engine. If the timing pointer, or any of the four studs in the propeller boss plate, are renewed, they must be locked by lightly peening the end of the thread, which should then be filed flush with the surrounding surface of the metal.

- OP. 1. Insert the eight hub bolts from the rear of the propeller boss.
2. Position the hub lock plate over the heads of the hub bolts.
3. Place a new small tab-washer, Part No. 1900/21, on one of the eight set-bolts and secure the lock plate to the propeller boss by fitting this set-bolt in the position adjacent to the timing pointer.
4. Place a new tab-washer, Part No. 1900/19, on each of the remaining seven set-bolts and fit them into the remaining seven holes in the lock plate and propeller boss.
5. Tighten and lock the eight set-bolts.

Carburettor, air-intake, and induction pipe

9. It is advisable to assemble the carburettor, air-intake, and induction pipe bolted finger-tight before mounting the assembly on the engine. Before making this loose assembly the induction pipe joint faces must be checked for alignment and parallelism with one another; the maximum permissible distortion is 0.002 in. If the faces are outside this limit, correction by light regrinding is permissible. Prior to assembling on the bench, the individual sub-assemblies must be prepared for reassembly as follows:—

Flame trap control tube

10. The flame trap control tube assembly, which is fitted to Mk. 1 variants and to Mk. 7 when Mod. G.1483 has not been embodied, is reassembled as follows:—

- OP. 1. Position the clip and the brackets on the control tube and secure these parts by refitting the bolts, spring-washers, and nuts.
2. Position one of the trunnions on one end of the control cable, place a new lock washer, Part No. 1405/38, on the locking screw, refit the screw in the trunnion and tighten until the cable is securely clamped. Lock the screw.
3. Lubricate the cable with antifreeze grease (Stores Ref. 34B/174), thread it through the control tube and refit the second trunnion in a similar manner to the first.

Carburettor

II. To prepare the carburettor for mounting, the following engine parts should be refitted to it as follows:—

- OP. 1. Remove the cap nut and blanking sleeve from the fuel inlet union at the base of the carburettor float chamber.
2. With a new joint washer, Part No. CH16584, on either side, refit the inlet banjo and secure it with the cap nut removed in OP. 1.

Note . . .

New joint washers may be found with the carburettor when it is received after reconditioning.

- OP. 3. Refit the ball-joint balls in the throttle and altitude levers and lock by peening.
4. *Mk. 1 variants and Mk. 7 when Mod. G1483 has not been embodied.* Position the flame trap control lever and the dog on the throttle spindle as indicated in fig. 3. Drive in a new taper pin, Part No. AGS.859/12, check that the lever has the correct range of movement, and lock the taper pin by lightly riveting over its small end.
5. Position the altitude control bell-crank between the lug on the engine side of the carburettor float chamber so that the adjusting screw bears on the upper surface of the lug. Position the washer between the lug and

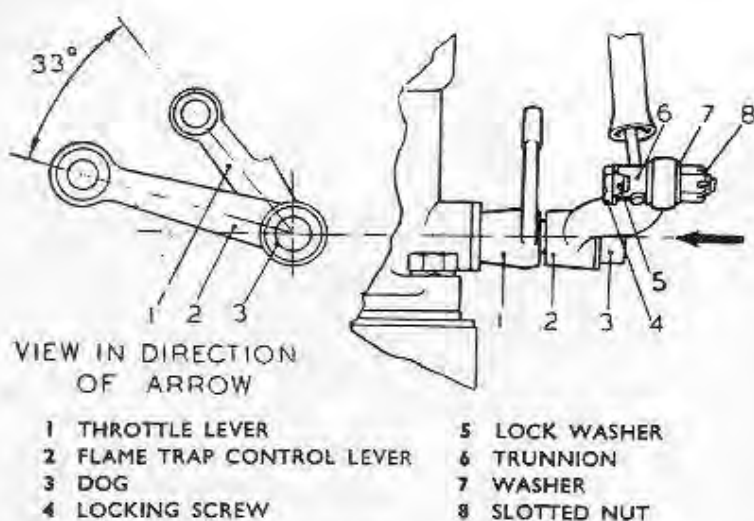


Fig. 3. Relationship of flame trap control lever to throttle lever

the bellcrank, and push the fulcrum through the lug and washer into the boss on the bellcrank. Align the tapered hole in the fulcrum with the hole in the bellcrank and drive in a new taper pin, Part No. AGS.859/13. Check the bellcrank for freedom and end float and, if satisfactory, lock the taper pin by lightly riveting over its small end.

- OP. 6. *Mk. 1 variants when fitted with engine-driven fuel pumps and Mk. 7.* Position the flooder operating lever on its fulcrum, fit a new taper pin, Part No. AGS.859/1, to secure the lever, and lightly rivet over the small end of the taper pin. Assemble the operating lever complete with fulcrum and spring to the carburettor, position the flooder lever on the fulcrum and secure by fitting a second new taper pin, Part No. AGS.859/1. Check the mechanism for freedom of operation and end float and, if satisfactory, lock the taper pin.
7. Couple the altitude control link to the bellcrank and to the lever on the carburettor. Lock the plug at each end of the control link by fitting new split pins, Part No. 800/SP1.
8. *Mk. 1 variants when fitted with engine-driven fuel pumps and Mk. 7.* Unscrew the two nuts from the studs in the carburettor body just above the altitude control bellcrank, re-

move the spring washers, mount the carburettor flooder bracket on the two studs, and secure it by refitting the spring washers and nuts.

9. *Mk. 1 variants and Mk. 7 when Mod. G. 1483 has not been embodied.* Unscrew the two nuts from the front two outboard studs in the carburettor body, remove the spring washers, mount the flame trap control assembly on the two studs, and secure it by refitting the spring washers and nuts.
10. *Mk. 1 variants and Mk. 7 when Mod. G.1483 has not been embodied.* Couple the cable to the lever on the throttle spindle by passing the threaded end of the trunnion through the hole in the lever. Refit the washer and the slotted nut which should be locked with a new split pin, Part No. 800/SP1.

Air-intake and flame trap housing

12. The individual parts of the flame trap are not supplied separately, and therefore this sub-assembly will not require reassembling. Proceed therefore as follows:—

- OP. 1. Position the lever, or pulley in the case of Mk. 7 embodying Mod. G.1483, on the end of the valve spindle and secure it by fitting a new taper pin, Part No. AGS.859/12 to secure the lever, or AGS.859/2 to secure the pulley. Lock the taper pin by lightly riveting the small end.
2. Position the flame trap valve in the air-intake, insert the spindle, align the holes in the valve and spindle, and drive in two new taper pins, Part No. AGS.859/3. In the case of Mk. 7 embodying Mod. G.1483, the correct taper pins are Part No. AGS.859/2.
3. Check the flame trap valve for freedom of operation and end float and, if satisfactory, lock both taper pins.
4. Push the throttle control bellcrank fulcrum into the lug in the air-intake, align the taper pin holes, drive in a new taper pin, Part No. AGS.859/3, and lightly rivet over its small end.

OP. 5. *Pre-mod.* 1498. Place the throttle control bellcrank and the collar on the fulcrum and secure the collar by fitting a new taper pin, Part No. AGS.859/3. Check the bellcrank for freedom and end float and, if satisfactory, lock the taper pin.

Mod. 1498. Place the throttle control bellcrank and washer on the fulcrum and secure by fitting a new circlip, Part No. N4233.

6. Position the flame trap in its housing and secure it with the eight spring washers and plain nuts.
7. Put the Silentbloc bush on the steady bracket stud and secure it with the spring washer and plain nut.
8. Couple the flame trap return spring to the lever or pulley.

Loose assembly of carburettor to air-intake and induction pipe

13. As stated in para. 9 it is advisable to assemble loosely the carburettor, air-intake, and induction pipe as follows, with the nuts and bolts finger-tight only:—

OP. 1. Hold the air-intake so that the carburettor mounting flange is uppermost, place a new joint washer Part No. 1905/18, over the four studs and fit the carburettor.

Mk. 1 variants and Mk. 7 when Mod. G.1483 has not been embodied. Position the top flame trap control bracket over the front outboard stud.

2. Refit the four spring washers and plain nuts.
3. *Mk. 1 variants and Mk. 7 when Mod. G.1483 has not been embodied.* Couple the upper end of the flame trap valve operating cable to the lever and secure the trunnion by refitting the slotted nut. Lock the nut with a new split pin, Part No. 800/SP1.
4. Couple the throttle control rod to the bellcrank on the air-intake and to the lever on the carburettor, and

lock the plug at each end of the control rod by fitting new split pins, Part No. 800/SP1.

5. Place a new joint washer, Part No. 2105/37, on the carburettor induction pipe flange, and position the induction pipe on the carburettor.
6. *Mk. 7 only.* Position the oil pipe clip link so that it will be secured under the spring washer on the bolt at the front inboard corner of the flange. Secure the carburettor to the induction pipe by refitting the four bolts and spring washers.

Cylinder heads

14. All four cylinder heads are identical, and therefore instructions for reassembling one only are given. It must be noted that the baffle assemblies are peculiar to their individual cylinder heads and care taken accordingly.

15. Before reassembling the cylinder head the spigot joint face should be checked for distortion. Slight distortion of the spigot joint face can be rectified by lapping the cylinder head to the barrel. All traces of abrasive must be removed after this operation has been completed. Greater distortion or damage to the spigot joint face may be rectified by a light skimming operation, to remove the minimum amount of metal.

16. Whenever it is necessary to remove metal from the spigot joint face, an equal thickness of metal must be removed also from the cylinder head outer face, and the capacity of the combustion chamber must afterwards be checked and rectified as necessary. The capacity of the combustion chamber with valves and sparking plugs in position should be $336 \pm \frac{1}{4}$ cc. when level with the spigot joint face.

17. To correct for low capacity, metal may, with discretion, be removed from inside the cylinder head. High capacity is corrected by machining metal from the spigot joint face. The combustion chamber must be blended to a smooth finish.

18. The correct tightening of the valve rock bracket bolts is of considerable importance and the instructions given should

be followed carefully. Although it is difficult to define the term "initial nip" precisely, probably the closest definition is—the point at which resistance is first experienced against UNSCREWING the bolt which is being tightened, when using the correct spanner. It is on this assumption that the term "initial nip" is used in the following instructions.

19. In early type engines, each valve guide, when driven into the cylinder head, imprisons the base of the valve gear casing and an aluminium joint washer between its flange and the cylinder head, there being no separate valve guide collars. Therefore, when reassembling the cylinder heads from one of these early engines, the valve gear casing must be refitted before any replacement valve guides are driven in.

20. Stand the cylinder head, combustion chamber downwards, on the bench and proceed as follows:—

OP. 1. Place the valve gear casing on the cylinder head so that the holes in the casing align with the corresponding holes in the head, and position the valve rocker bracket over the three large bolt holes.

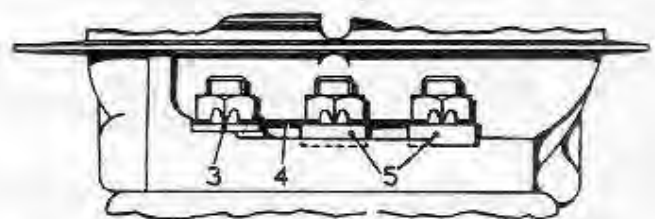
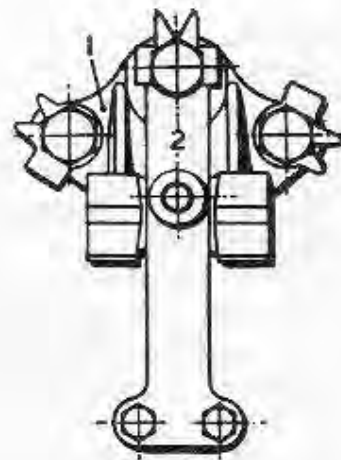
2. Position the stirrup bracket so that the single bolt hole is over the centre bolt hole in the rocker bracket, and the two smaller bolt holes align with the corresponding holes in the valve gear casing.

3. Place a new lock washer, Part No. N3773, on the bolt which goes through the stirrup bracket and the rocker bracket, and two new tab-washers, Part No. N3772, on the other two rocker bracket bolts.

4. Insert the three bolts, ensuring that the lock washer on the centre bolt is correctly positioned (fig. 4), and put the three distance pieces, followed by a new lock plate, Part No. 34682, on the threaded ends of the bolts.

Note . . .

Three identical distance pieces are fitted to the aluminium bronze heads of the Mk. 1, but two long distance pieces and one short distance piece are fitted to the aluminium alloy



1 VALVE ROCKER BRACKET 3 SHORT DISTANCE PIECE
2 STIRRUP BRACKET 4 LOCK PLATE
5 LONG DISTANCE PIECES

Fig. 4. Rocker bracket bolts

heads of the Mk. 1C, 1F, and 7. The short distance piece goes on the bolt nearest the exhaust valve guide as indicated in fig. 4.

OP. 5. Screw on the three nuts until they are finger-tight.

6. Place a washer on each of the two short stirrup bracket bolts and temporarily insert these bolts from the inside of the valve gear casing, fit the spring washers and screw on the plain nuts until they are finger-tight to ensure the correct positioning of the stirrup bracket.

7. Using jaw spanner T2500/37 to hold the nuts, and either special spanner T1900/490 or a 1/2 in. Whitworth socket, eight-inch extension bar and sliding "tee" bar to turn the bolt heads, evenly tighten the three rocker bracket bolts until the "initial nip" is obtained.

8. Continue to tighten the three bolts evenly, in progressive steps of half a flat (one twelfth of a turn) until



each bolt has been tightened one and a half flats (one quarter of a turn).

- OP. 9. Slacken off all three bolts completely.
10. Re-establish the "initial nip".
11. Change the spanner T1900/490 or the sliding "tee" bar for a Delapena torque spanner TQ50A (or Head Model 60), and tighten each bolt evenly in progressive steps of half a flat to a torque of 300 inch pounds.

Note . . .

In the absence of a torque spanner after initially tightening the bolts one quarter of a turn and slackening off all three bolts completely, proceed thus. Re-establish the "initial nip" and tighten each bolt evenly, in progressive steps of half a flat, to a total tightening of ONE flat. It has been found, using this technique that the approximate torque in the final tightening of these bolts is of the order of 300 inch pounds.

- OP. 12. Lock the three nuts, but do not lock the three bolt heads until they have been checked at the completion of the initial ground running.*
13. Remove the two nuts, washers, and short stirrup bracket bolts which were temporarily inserted to position the stirrup bracket correctly.
14. Position the correct baffle so that the holes in the baffle align with those in the valve gear casing. Place a washer on each of the two short stirrup bracket bolts and on each of the two baffle bolts, insert these four bolts from the inside of the valve gear casing, fit the spring washers, and screw on the plain nuts.
15. Evenly tighten the four bolts and nuts.

Grinding in the valves

21. Ensure that there are no burrs or rough places on the valve stems which might damage the valve guides; any marks of this nature should be removed by stoning, or

with a fine file. Before the valves are finally reassembled to the cylinder head they must be ground-in to their seats. A suction type grinding-in tool should be used for this purpose. Each valve should be carefully ground-in in accordance with standard workshop practice, and after grinding-in all traces of abrasive must be carefully removed. The mating faces of both valves and valve seats should have an even matt surface free from high or low spots. If necessary, repeat the grinding-in process until satisfactory conditions are obtained, but avoid excessive grinding-in as this produces an abnormally wide seat.

Testing the valves and seatings

22. When the condition of the valves and seats is considered to be satisfactory, test the valves and seatings as follows:—

- OP. 1. Lubricate the valve stems with clean approved oil and insert each valve into its respective valve guide.
2. Push the rocker spindle into the rocker bracket.
3. Using a suitable bench block and bench-type valve spring compressor, assemble the valve guide collar, inner and outer valve springs, valve collar, and collets to each valve.
4. Stand the cylinder head so that the ports are uppermost, and pour sufficient kerosene into both ports to cover the valves. Allow the cylinder head to stand thus for about ten minutes and check that no leakage has occurred into the combustion chamber. When the results of this test are satisfactory, proceed with the following operation, otherwise repeat the grinding-in and testing until no leakage occurs.
5. Drain off the kerosene and dry off the cylinder head with a jet of compressed air. Oil the steel parts to prevent rusting.

Completing assembly of cylinder head

23. Having satisfactorily ground-in and tested the valves, complete the assembly of the cylinder head as follows:—

*Although the manufacture supply spare cylinder heads with the locking devices correctly positioned, it is still necessary to check the tightness of the rocker bracket bolts after the initial ground run.

- OP. 1. Place the following parts on each end of the rocker spindle—thrust washer, rocker (so that the fixed pad will bear on the valve stem), thrust collar, spring and cap.
2. Compress the springs by pressing the caps towards the rockers and insert the retaining pins so that their cut-away surfaces are towards the rockers.
3. Position the retaining pins in the grooves in the caps and pull the caps away from the rockers to ensure that they are seated correctly against the pins.
4. Insert the two rocker bracket clamping bolts and fit the spring washers. Screw on the two plain nuts until they are finger-tight.
5. *If the valve gear cover has been dismantled to fit a new washer or retaining screw.* Place a new washer, Part No. 1302/66, against the head of the screw, pass the screw through the hole in the cover and secure it by fitting a new split pin, Part No. 800/SP2, through the hole in the screw.

Pistons and Cylinders

24. If new piston rings are being fitted, and this is the normal practice at overhaul, it is necessary to check that the side clearance in the piston grooves and the gaps of the rings when in the cylinder are within the limits given in the Schedule of Fits and Clearances. Never open the gap in a piston ring more than is essential to get it into position. Probably the best method of fitting piston rings is to use three thin strips of metal, polished so that there are no sharp edges which might scratch the piston, and spaced equally around the piston so that each ring can be manoeuvred into position with the least risk of breakage.

- OP. 1. Using piston ring gap checking tool, T2200/470A, check the rings for gap.

Note . . .

If the cylinders have been bored oversize, oversize rings must be fitted and checked with the appropriate oversize piston ring gap checking tool, T2200/811 (0.005 in. oversize), or T2200/814 (0.010 in. oversize).

- OP. 2. Ensuring that each ring is correctly assembled into its own particular groove, assemble the rings to the pistons and measure the side clearance by feeler gauges.

Note . . .

The scraper ring must be fitted with the stepped side towards the gudgeon pin bores, and the two gas rings, which occupy the grooves nearest the piston crown, must be fitted so that the letter "C" which is etched on each is towards the crown of the piston.

- OP. 3. Remove the three piston rings from each piston and retain them in sets.

Note . . .

Owing to the risk of damage when the pistons are fitted, the rings should not be assembled finally until immediately before fitting the cylinder during the rebuild of the engine.

Main control bracket

25. The main control bracket assembly must be reassembled using new taper pins to replace those removed. The control bracket assembly will not have been dismantled further than was necessary to renew any damaged parts, or to check for wear in the bushes or on the shafts, or to rectify excessive end float, therefore all the following operations may not be necessary.

26. Fig. 5 shows the correct position and angular relationship of each part and reference must be made to this illustration when carrying out the operations given in para. 27. When the original parts are being refitted, it is only necessary to ensure that the taper pin holes are correctly aligned, and that the correct end-float is obtained. If new parts are being fitted it will be necessary to secure them in position (as indicated in fig. 5) temporarily whilst the taper pin holes are drilled and reamed. When the sub-assembly has been reassembled satisfactorily, the small end of each new taper pin must be securely peened over. Before the taper pin holes are drilled and reamed in the two vernier flanges, the flanges must be silver-soldered (B.S. 1843, type "C") to the cross-shafts. When the holes have been drilled and reamed, the taper pins are fitted and the small end of each pin securely peened over.

27. Making reference to fig. 5 as necessary, reassemble the main control bracket assembly as follows:—

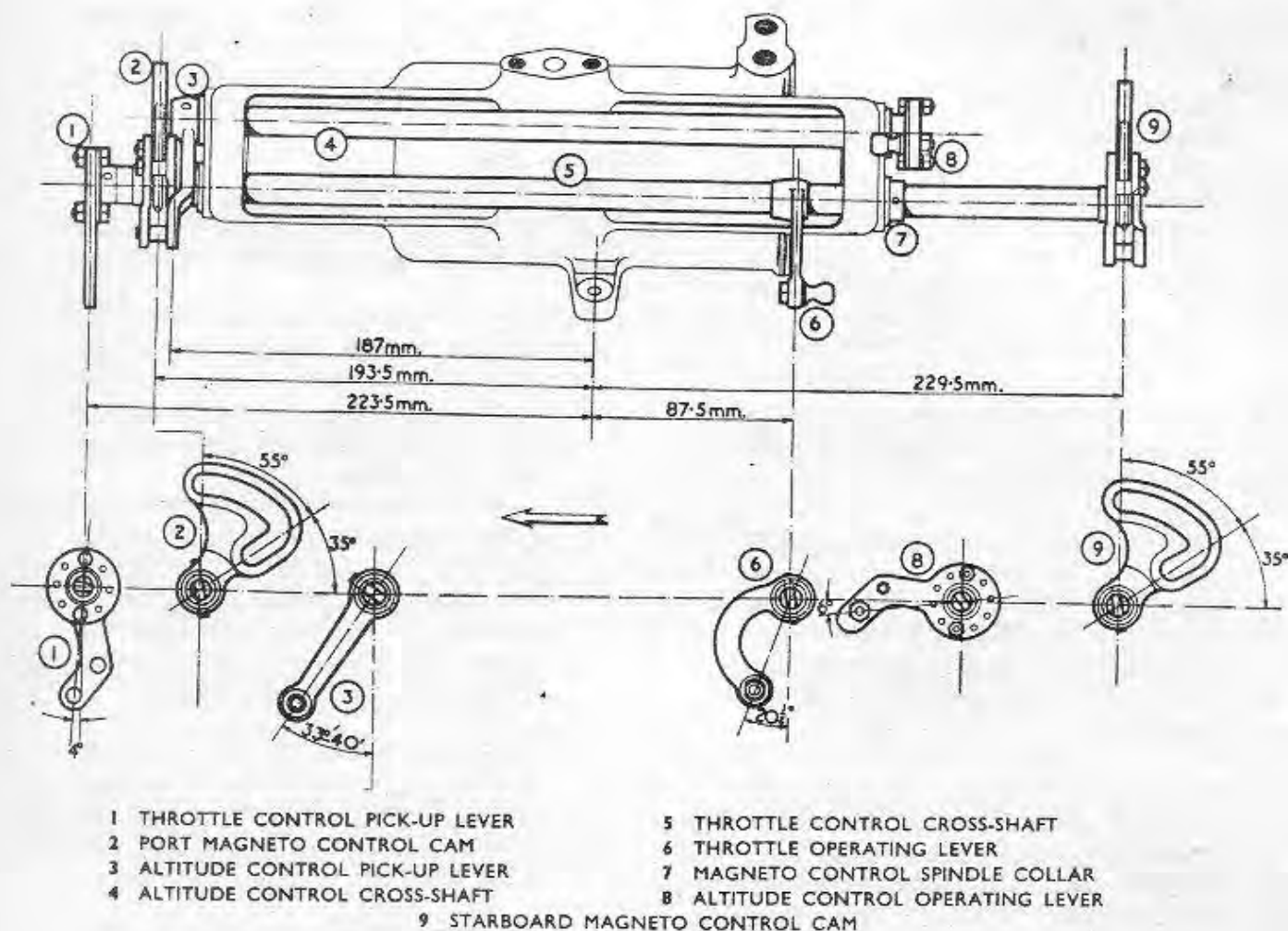


Fig. 5. Control bracket assembly

- OP. 1. To embody Mod. No. 2058, position, and silver-solder the vernier flange to the starboard end of the altitude control cross-shaft ensuring that the lever, when bolted to the flange, is in the fully closed position. Drill and ream the hole for the taper pin, Part No. A.G.S.859/23, fit the pin and securely peen over the small end.
2. Insert the altitude control cross-shaft, complete with flange, into the upper pair of bearings in the control bracket so that the flange is on the starboard side.
3. Refit the altitude control pick-up lever on the altitude control cross-shaft, secure it by fitting a new taper pin, Part No. A.G.S.859/23 and check the shaft for freedom and end-float.
4. Refit the port magneto control cam, and one of the L.H. magneto control link plates on the throttle cross-shaft; the vernier flange having been silver-soldered and pinned to the throttle cross-shaft using the same method described in Op. 1.
5. Refit one of the R.H. magneto control link plates, position one of the rollers in the control cam, place one of the distance pieces in the roller, insert one of the bolts through the link plates, distance piece and roller, place a spring washer over the threaded end of the bolt and screw on the plain 2B.A. nut.
6. Fit a second distance piece, bolt, spring washer, and plain nut at the lower end of the link plates, tighten

both bolts and nuts and check the assembly for freedom.

Insert the throttle control cross-shaft, complete with vernier flange and port magneto control, into the lower of the pair of bearings in the control bracket from the port side, and mount the throttle operating lever on the cross-shaft before entering the shaft into the second bearing.

8. Secure the throttle operating lever to the cross-shaft with a new taper pin, Part No. AGS859/33.
9. Position the magneto control spindle collar on the throttle control cross-shaft and drive in a new taper pin, Part No. AGS859/13. Check the assembly for freedom and end-float and, if satisfactory, lock the taper pin.
10. Refit the second L.H. magneto control link plate, the starboard magneto control cam, the second R.H. magneto control link plate, roller, distance piece, bolts, spring washers and nuts in a similar manner to that described in OP.4, 5, and 6.
11. Refit the ball joint balls in the throttle operating lever and in the altitude control operating lever, securing each with a plain nut. Shorten and rivet-over the threaded end of each ball.
12. Refit the ball joint ball in the altitude control pick-up lever, and secure it with a slotted nut which must be locked with a new split pin, Part No. 800/SPI.
13. Secure the throttle control pick-up lever to the vernier flange on the throttle control cross-shaft, by fitting the two 2B.A. bolts, spring washers, and plain nuts.
14. Secure the altitude control operating lever to the vernier flange on the altitude control cross-shaft by fitting the two 2B.A. bolts, spring washers, and plain nuts.
15. Check the entire sub-assembly for completeness, correct positioning and

angular relationship of levers, freedom of operation and end-float. Shorten and rivet-over the ends of all new bolts and ball ends.

Oil pressure filter

28. The oil pressure filter casing is an integral part of the main control bracket, and the detail parts should be reassembled as follows:

- OP. 1. Place a new tab-washer, Part No. 1306/65, on the timing gear oil jet union, screw the union into the upper of the pair of outlets on the rear of the pressure filter casing. Lock the union.
2. Place a new joint washer, Part No. 1306/32A, on the outlet face at the top of the pressure filter casing, position the delivery elbow on the studs, and secure it with the two spring washers and plain nuts.
 3. Rinse the Auto-Klean filter in clean kerosene to ensure that it is absolutely clean. Ensure that the interior of the casing is also perfectly clean.
 4. Fit a new filter cover joint washer, Part No. 1406/40, and screw the filter assembly into the casing.

Note . . .

The filter cover should be tightened finally after the control bracket has been mounted on the engine.

Suction filter

29. The suction filter should be reassembled as follows:—

- OP. 1. Place a new joint washer, Part No. 1306/32A, on the inlet elbow face, fit the inlet elbow, and secure it with two spring washers and plain nuts.
2. Place a new joint washer, Part No. 1306/19, on the outlet union and screw the union into the bottom of the filter body.
 3. Place a new joint washer, Part No. 1406/90, on the drain plug and screw the drain plug into the filter body.
 4. Place the gauze filter in the body, put a new joint washer, Part No.

1406/16A, on the large plug, and screw the plug into the top of the filter body.

Note . . .

It may be easier to tighten these items finally after the filter is secured to the rear of the engine during the rebuild.

Front scavenge filter

30. If the union adapter has been removed from the front scavenge filter casing, place a new joint washer, Part No. 1306/19, on the union and screw the union into the casing.

Dual quarter engine-speed tachometer drive

31. The quarter engine-speed tachometer drive fitted to certain Mk. 1 variants and to Mk. 7, is reassembled as follows:—

- OP. 1. Place a new tab-washer, Part No. 1306/65, on the casing plug, screw the plug into the casing, and lock it.
2. Place the adjusting washer on the driving shaft and insert the shaft into the casing through the opening in the top of the latter.
3. Fit the key in the driving shaft, push the driving gear on to the shaft, followed by a new lock washer, Part No. 1303/40, and secure the gear with the plain nut.
4. With the nut fully tightened, check the driving shaft for freedom and end-float.

Note . . .

Adjusting washers, Part No. 1303/68, are available in the following thicknesses :—2 mm. 2.125 mm. 2.25 mm. 2.375 mm. 2.5 mm. 2.675 mm. 2.75 mm. Select an adjusting washer or combination of adjusting washers to give the required end-float.

- OP. 5. When satisfactory end-float has been obtained, lock the nut on the driving shaft.
6. Place the adjusting washer on one of the driven gears and insert the gear into the casing. Screw in the appropriate bearing.

7. With the bearing fully tightened, check the driven gear for freedom and end-float. Refer to the Note immediately following OP.4.
8. Repeat OP.6 and 7 to fit the second driven gear.
9. When satisfactory end-float has been obtained, wire-lock the two bearings together with 20 s.w.g. locking wire.
10. Place a new washer, Part No. 1303/72, on the housing cap and screw the cap into the top of the casing.
11. *Mk. 7 only.* Place a new spacing washer, Part No. 2102/43, in the blanking cap and screw the cap on to the left-hand tachometer drive connection which is not used on this mark of Gipsy Major.

Dual engine-speed tachometer drive

32. The engine-speed tachometer drive fitted to certain Mk. 1 variants is reassembled as follows:—

- OP. 1. Insert the driving shaft into the housing from the top of the latter.
2. Fit the key in the driving shaft, push the driving gear on to the shaft, followed by a new lock washer Part No. 1303/40, and secure the gear with the plain nut.
3. With the nut fully tightened, check the driving shaft for freedom and end-float.

Note . . .

Insufficient end-float may be increased by facing off the bushes in the housing.

- OP. 4. When the end-float is satisfactory, lock the nut on the driving shaft.
5. Place the auxiliary gear in the housing.
6. Fit the cover and secure it by fitting the countersunk screw, and the two spring washers and plain nuts.

OP. 7. Check the sub-assembly for freedom, backlash between the gears, and end-float.

8. When everything is satisfactory, remove the cover and reassemble it with approved jointing compound.

Timing gear cover

33. With the exception of the idler gear assembly, which is reassembled to the rear wall of the crankcase during the rebuilding of the complete engine, the magneto drive, the oil pump and the crankcase breather connection are reassembled to the timing gear cover as a sub-assembly. For this purpose the timing gear cover should be mounted on a suitable stand, or carefully held in a vice, using soft clamps to protect the cover from injury. It is assumed that the mating of the timing gear cover to the rear of the crankcase and top cover has been checked as detailed in para. 52. The mating of the oil pump housings, tachometer drive casing, and the settling tank or rear oil drain to the relevant faces on the timing gear cover should be checked and, if necessary, rectified in a similar manner. Any studs which are loose or damaged should be replaced.

Magneto drive

34: The magneto drive, with the exception of the idler gear assembly which is reassembled to the rear wall of the crankcase during the rebuilding of the complete engine, is reassembled to the timing gear cover as follows :—

- OP. 1. Press the two ball bearings into the two housings.
2. Fit the key into the keyway in the magneto driving shaft.
 3. Position the magneto driven gear in the timing gear cover, align the key in the shaft with the keyway in the gear, and insert the shaft into the gear.
 4. Place the original oil baffles at either end of the driving shaft.
 5. Smear a thin film of jointing compound on the mating faces and press the bearing housing, Part No. 1303/24, with the small lip to locate the ball bearing, complete with the ball bearing, into the starboard side of the timing gear cover ; ensure

that the end of the driving shaft correctly enters the bore through the ball bearing as the latter is pressed in.

6. Repeat the foregoing operation to fit the other bearing housing, Part No. 1303/23, and ball bearing into the port (tappet) side of the timing gear cover.
7. Smear a thin film of jointing compound on the mating faces and fit the tappet side oil retainer, Part No. 1302/22, on to the studs of the timing gear cover.
8. Similarly fit the other oil retainer, Part No. 1302/25, on the opposite side ; this is the oil retainer with the longer spigot.
9. Fit the eight spring washers and tighten the plain nuts evenly.
10. Check that the gear spins freely.
11. Align the slot in each magneto coupling flange with the key in the driving shaft, and push each coupling into the shaft until they are both right home.
12. Insert the bolt from the tappet side, put the distance piece on the threaded end of the bolt, and screw on the slotted nut. Hold the bolt head with a box spanner and tighten the nut.
13. Spin the coupling flanges to check that the sub-assembly is free. If the sub-assembly does not rotate freely inspect the coupling flange bosses for signs of rubbing and, if necessary, carefully ease any high spots.
14. Check the end-float. If the equipment illustrated in Fig. 6 is being used, fit the disc (1) into the hollow boss of the coupling and mount the bracket (4), complete with dial test indicator, on the adjacent magneto mounting ; adjust the indicator pointer so that it bears on the disc (1), move the coupling through its axial travel and note the reading obtained on the indicator.

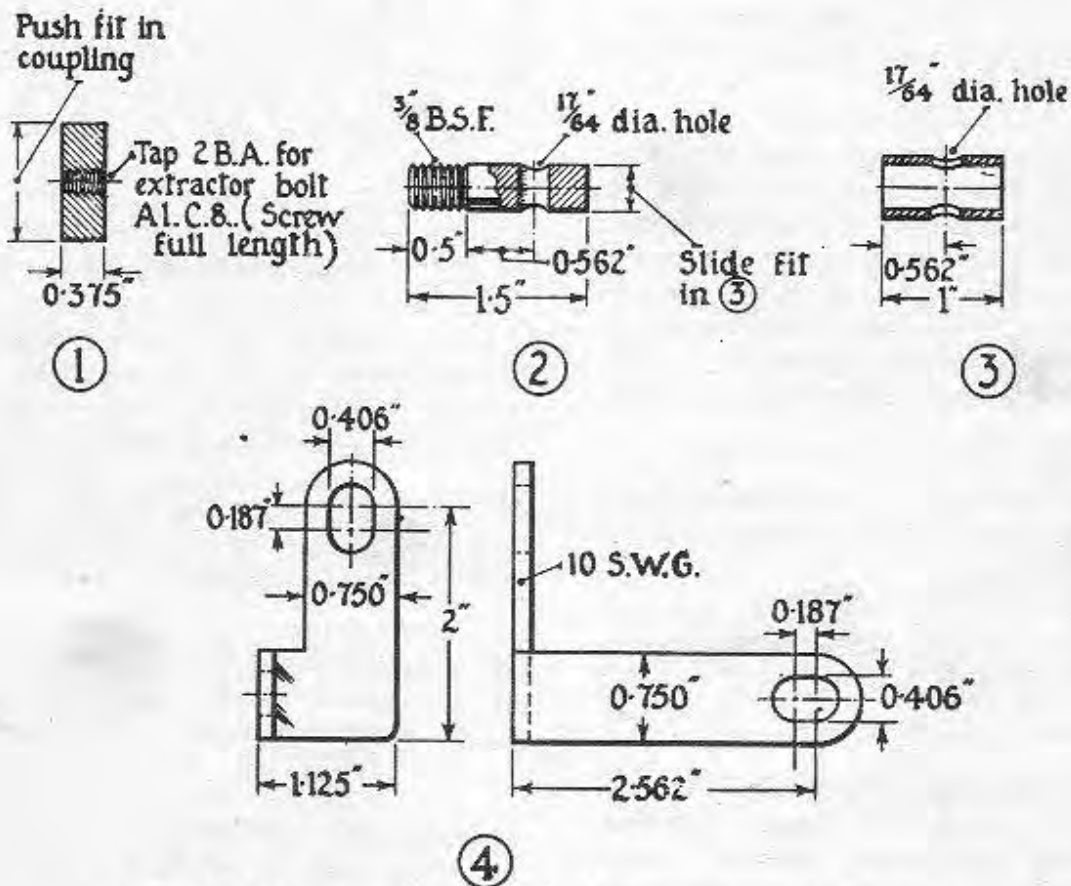
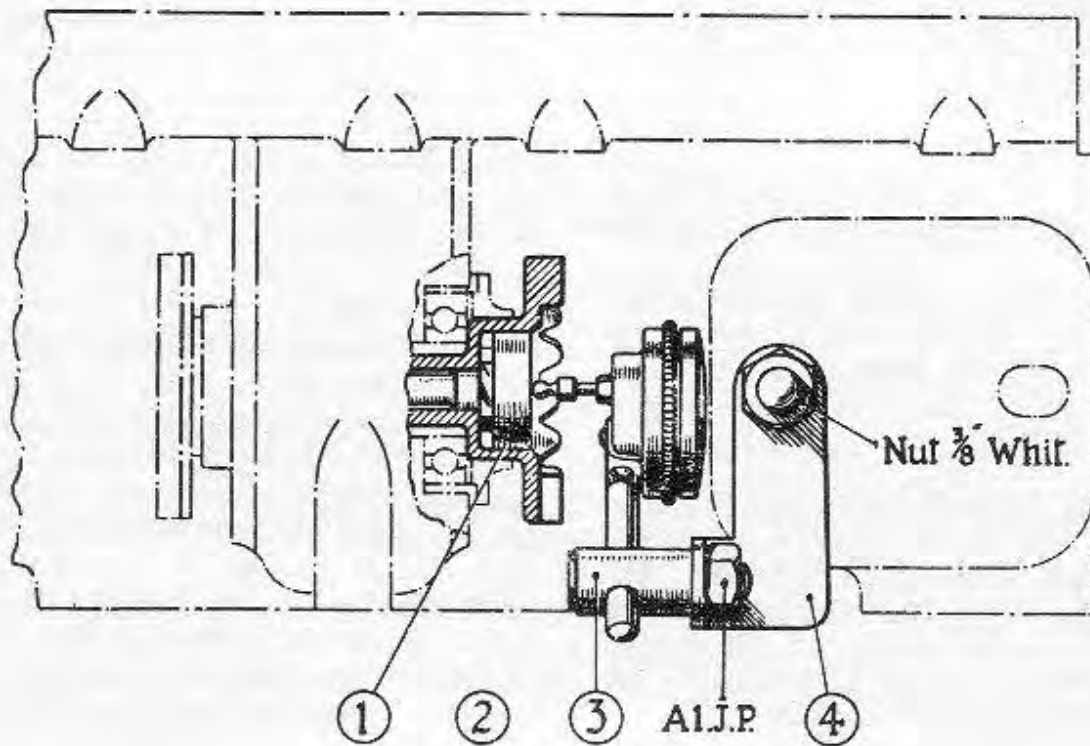


Fig. 6. Checking the end float of the magneto driving gear

Note . . .

Baffles are supplied 0.024, 0.025, 0.028, 0.030, 0.032, and 0.034 in. thick and can be varied, if necessary, to alter the relative position and meshing of the magneto driven gear with the magneto driving gear on the idler

spindle. If the original parts are being reassembled, the correct meshing should be obtained, but when fitting new parts it may be necessary to select baffles of a suitable thickness to obtain the correct meshing.

15. When everything is satisfactory, fit a split pin, Part No. 800/SP2, to the slotted nut.

Oil pump (Mk. 1 variants)

35. The single pressure-pump fitted to Mk. 1 variants should be reassembled as follows:—

- OP. 1. Temporarily attach the front cover to the pressure pump housing by means of two slave bolts and nuts, and place the oil pump gears into the housing.
2. Using a straight-edge placed across the face of the housing and feeler gauges, measure the end-float. Insufficient end-float may be remedied by carefully facing off the gears; too much end-float may be corrected by facing off the housing.
 3. Press the driving gear on to the threaded end of the driver gear spindle and secure the gear with its plain nut.
 4. Use feeler gauges between the driving gear and the front face of the bush in the cover to measure the end-float of the gear in the front cover. The end-float of the driver gear in the pressure pump housing must always be greater than the end-float of the driver gear in the front cover.
 5. Check the backlash between the two pump gears with the aid of narrow feeler gauges.
 6. Dismantle the parts which have been assembled temporarily.

Note . . .

When finally assembling the oil pumps, use a thin film of approved jointing compound only on each mating face; too much jointing compound would tend to increase the end-float of the gears.

- OP. 7. Apply a thin film of approved jointing compound and slide the front cover on to the five studs in the timing gear cover.
8. Pass the threaded end of the driver gear spindle through the bushes in

the front cover and position the driven gear in the second bushed hole.

9. Apply a thin film of jointing compound and slide the pressure pump housing on to the studs.

Note . . .

Do not put jointing compound on the rear cover at this stage, as this cover must be removed during reassembly of the complete engine to check the backlash between the oil pump driving gear and the camshaft gear.

- OP. 10. Push the rear cover on to the studs, fit the lockwire tab and the five spring washers, and secure the oil pump by the five plain nuts.
11. Fit the key into the keyway in the threaded end of the driver gear spindle, press on the driving gear, fit a new lock washer, Part No. 1306/12, and secure the gear with the nut.

Note . . .

If preferred, the backlash between the oil pump gears may be checked at this stage using a dial test indicator on the driving gear and making a suitable allowance for the difference in pitch circle radius, or on an improvised backlash indicator fitted on the driving gear nut. The gear on the driven spindle can be locked through the inlet connection.

- OP. 12. Place the original number of packing discs in the relief valve, put the valve into the rear cover followed by its spring, fit a new lock washer, Part No. 1306/16, on the relief valve plug and using spanner T2300/198, screw in, but do not lock, the plug.
13. Rotate the driving gear to ensure that the pump still rotates freely, and if everything is satisfactory, lock the driving gear nut.

Oil pump (Mk. 7 only)

36. The pressure and dual scavenge pump fitted to Mk. 7 engine should be reassembled as described in the following paragraphs.

37. With the exception of the driver and driven gears, which with their integral spindles cannot be incorrectly reassembled, each part of the oil pump is marked to indicate its location in the sub-assembly, and the numbers forming these marks are quoted in the following paragraphs. The housings and the dividing plates are marked so that the numbers will be on the port side of the oil pump when it is on the engine. The numbers on the gears must face towards the

38. Before finally assembling the oil pump, the end-float checks detailed in this paragraph should be made. Insufficient end-float may be remedied by carefully facing off the gears. Too much end-float may be corrected by facing off the housings. Never reduce the end-float of the driver gear in the front suction pump housing below its end-float in the front cover.

- OP. 1. Temporarily attach the rear cover to the pressure pump housing by two slave bolts and nuts, and place the pressure pump gears (the auxiliary gears marked "3" and "4" respectively) into the housing.
2. Using a straight-edge placed across the face of the housing and feeler gauges, measure the end-float.
 3. Similarly, attach the front cover to the front suction pump housing, place the driver and driven gears in the housing and check the end-float.
 4. Fit the driving gear on to the threaded end of the driver gear spindle and secure it with the nut.
 5. Use feeler gauges between the driving gear and the front face of the bush in the cover to measure the end-float of the gear in the front cover.
 6. Place the rear suction pump housing on a surface plate and check the end-float of the remaining pair of auxiliary gears with the aid of a straight-edge and feeler gauges, alternatively, measure the length of the gears and their housing with a micrometer and compute the end-float by comparing the two measurements.

39. When finally assembling the oil pump, as described in this paragraph, use a thin film of approved jointing compound only on each mating face; too much jointing compound would tend to increase the end-float of the gears. Do not apply jointing compound on the rear cover at this stage, as this cover must be removed during reassembly of the complete engine to check the backlash between the oil pump driving gear and the camshaft gear. As assembly proceeds, the backlash between each pair of gears may be checked with the aid of narrow flexible feeler gauges; temporary assembly of the rear cover will assist in ensuring that the spindles are held parallel whilst dealing with the two pairs of suction pump gears. Alternatively, the backlash may be checked with the aid of a dial test indicator after the oil pump is completely reassembled. Proceed with the assembling as follows:—

- OP. 1. Insert the two dowels into the front cover from the forward side and slide the cover on to the five studs in the timing gear cover.
2. Pass the threaded end of the driver gear spindle through the bushes in the front cover, and position the driven gear in the second bushed hole.
 3. Slide the front suction pump housing (marked "2") and the dividing plate (marked "3") on to the studs.
 4. Fit the first key into the first keyway in the driver gear spindle, align the keyway in the auxiliary gear (marked "1") with the key and push it on to the spindle.
 5. Push the auxiliary gear (marked "2") on the driven gear spindle and mesh the marked teeth.
 6. Push the rear suction pump housing (marked "4") and the dividing plate (marked "5") on to the studs.
 7. Fit the second key into the second keyway, align the keyway in the auxiliary gear (marked "3") with the key and push it on to the spindle.
 8. Push the auxiliary gear (marked "4") on the driven gear spindle and mesh the marked teeth.

- OP. 9. Push the pressure pump housing and the rear cover on to the studs; do not use any jointing compound between the rear cover and the housing.
10. Fit five new lock washers, Part No. 2103/20, and secure the oil pump by the five cap nuts, but do not lock these nuts.
11. Fit the key into the keyway in the threaded end of the driver gear spindle, press on the driving gear, fit a new lock washer, Part No. 1306/12, and secure the gear with the nut.

Note . . .

The backlash between each pair of oil pump gears may be checked at this stage using a dial test indicator on the driving gear and making a suitable allowance for the difference in pitch circle radius, or on an improvised backlash indicator fitted on the driving gear nut. The gears on the driven spindle can be locked in turn through the pump connection flanges whilst the backlash on each pair of gears is checked.

12. Put new joint washers, Part No. 1306/32A, on the outlet connection flanges, push the outlet connection on to the four studs and secure the connection with the four spring washers and plain nuts.
13. Place the original number of packing discs in the relief valve, put the valve into the rear cover followed by its spring. Fit a new lock washer, Part No. 1306/16, on the relief valve plug and, using spanner T2300/198, screw in, but do not lock, the plug.
14. Rotate the driving gear to ensure that the pump still rotates freely and if everything is satisfactory, lock the driving gear nut.

Crankcase breather connection

40. The crankcase breather connection is reassembled as follows:—

- OP. 1. Place a new joint washer, Part No. 1403/4, on the four studs which secure the breather connection.

2. Fit the breather shield so that the holes within the timing gear cover will face downwards when the engine is in its normal attitude, then fit a second new joint washer, Part No. 1403/4, the breather connection, four spring washers, and the four plain nuts.

Timing gear oil jet and union

41. The timing gear oil jet union, and the timing gear oil jet should be refitted as follows:—

- OP. 1. Place a new washer, Part No. 1306/67, on the oil jet union, and screw the union into the rearward facing hole immediately below the tachometer drive facing.
2. Screw the cap nut on to the short end of the oil jet, place a new tab-washer, Part No. 1306/69B, on the oil jet, and screw the oil jet into the side-ways facing hole just below the tachometer drive facing.
3. Lock the oil jet.

Blanking cover (Mk. 1 variants)

42. The blanking cover, which will remain fitted to the timing gear cover of Mk. 1 variants, should be fitted as follows:—

- OP. 1. Smear a thin film of approved jointing compound on the mating faces and position the blanking cover on the four studs in the timing gear cover.
2. Secure the blanking cover by refitting the four spring washers and plain nuts.

Starter adapter (Mk. 7 only)

43. The starter adapter which is fitted to the timing gear cover of the Mk. 7, is refitted in a similar manner to the blanking cover described in para. 42.

Crankshaft

44. For reassembly, the crankshaft should be mounted on a suitable stand. Oil-tight joints will be obtained with greater certainty if the copper oil seal washers are annealed immediately before assembly. To do this, heat them to about 600 deg. C. (or a bright red) for about five minutes and quench them in water.

45. No attempt must be made to lap the propeller boss on to the tapered end of the crankshaft. When lapping is necessary to rectify damage due to fretting of the propeller boss and the crankshaft, a propeller hub lap T77131, and a crankshaft lap T77132 should be used.

46. Reassemble the crankshaft as follows:—

OP. 1. Oil the splines and carefully drive the gear into the rear end of the crankshaft. Use a 0.001½ in. feeler gauge to check that the gear is fully home in the crankshaft.

2. Insert the bolt from the rear end, put the clamp washer on the threaded end of the bolt, tighten and using split pin, Part No. AGS784/11, lock the nut.

3. *Mk. 7 only.* Mount the extension shaft (or starter dog) on the gear and secure it by fitting the six bolts and slotted nuts. Do not fully tighten or split pin these nuts until after the concentricity of the extension shaft has been checked during the rebuilding of the complete engine.

4. Taking each oil seal in turn, place a small copper oil seal washer, oil seal, and a large copper oil seal washer, on the bolt in that order.

5. Pass the bolt through the relevant crankpin or journal so that the nut can be fitted in accordance with the following table:—

Positioning of oil seal nuts

No.	Crankpins	Journals
1	at rear	—
2	at front	at rear
3	at rear	—
4	at front	at rear

OP. 6. Place a second large oil seal washer, oil seal, small copper washer, and a steel washer on the threaded end of the bolt in that order.

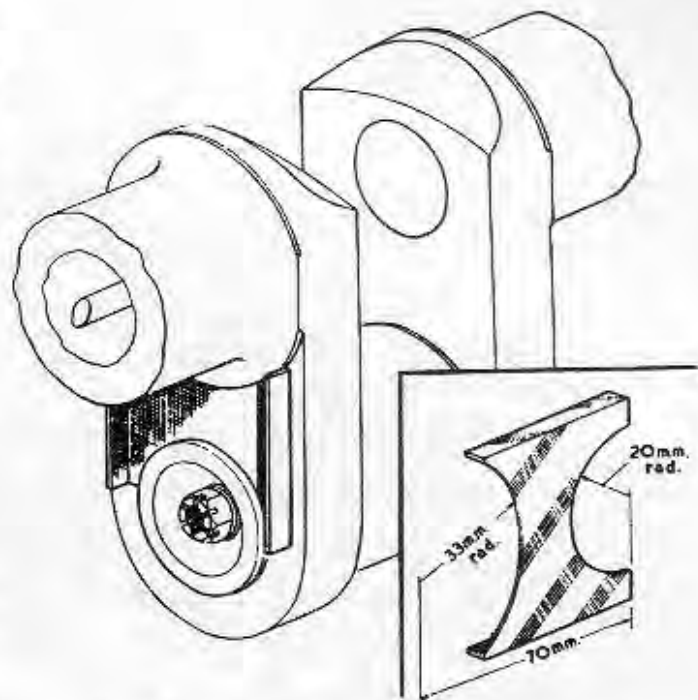


Fig. 7. Oil seal concentricity gauge

7. Screw on the slotted nut until finger-tight.

8. Ensure that the large oil seal washers are seating correctly and that the oil seal assembly is central in the crankpin or journal. A simple concentricity gauge can be made on the lines suggested in fig. 7, and an adjacent crankpin or journal used as a point of register to check the correct positioning of these parts.

9. When all the oil seals are correctly positioned, tighten the nuts evenly, and lock them with new split pins, Part No. AGS784/2.

10. Press the thrust bearing on to the crankshaft, or carefully drive it on, with a suitable tubular drift.

Note . . .

The thrust bearing, should be fitted on the crankshaft so that the part number faces forwards.

11. Fit a new tab washer, Part No. 1300/13A or N.2882 (Mod. 2094), and holding the crankshaft stationary, tighten the lock nut with spanner T1300/51 or T86381.

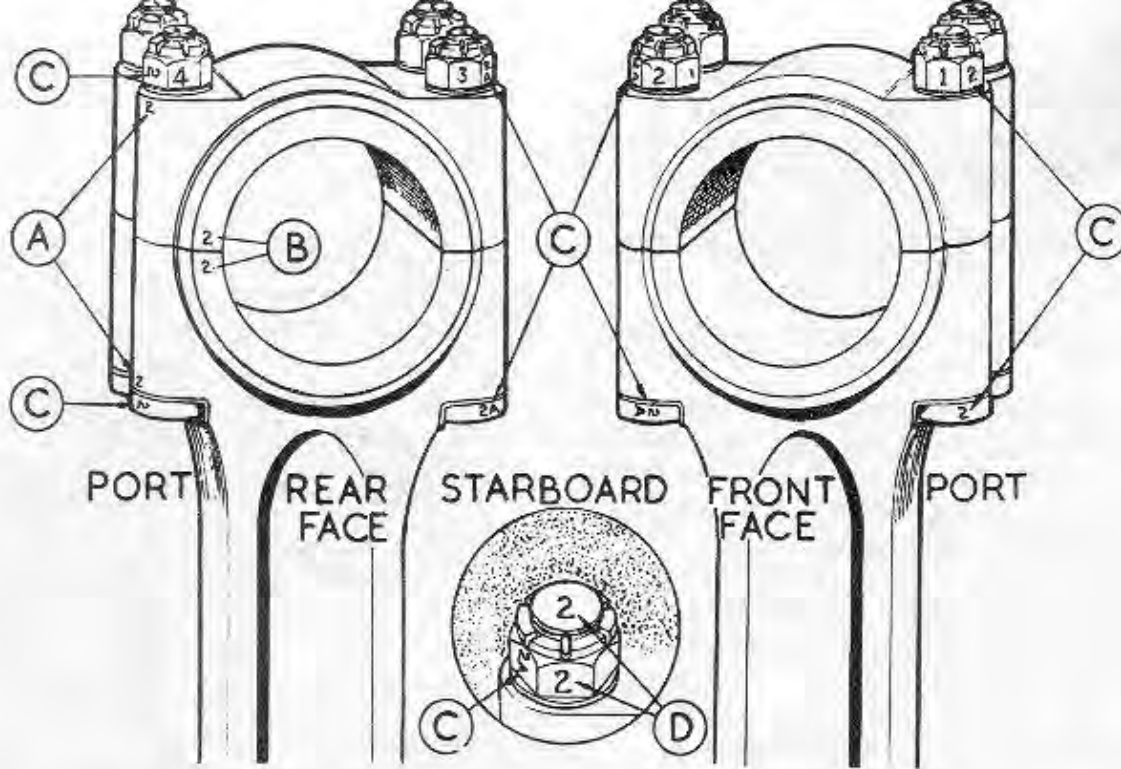


Fig. 8. Identification marks on connecting rod parts

OP. 12. Lock the nut.

13. Gently tap the key, which locates the propeller boss on the tapered end of the crankshaft, into the keyway.

Connecting Rods

47. The connecting rods, caps, bolts, nuts and bearings should have been kept in sets. The identification of the components in each set should be checked to ensure that they correspond with the correct markings described below and illustrated in fig. 8.

- (A) Connecting rod number is marked on both cap and rod. Connecting rods are numbered 1, 2, 3, and 4, commencing with that nearest the propeller. These numbers must be on the port (camshaft) side when the connecting rod is in the engine.
- (B) Big-end linings are marked with the number of the connecting rod to which they belong. These numbers must face towards the rear of the engine.
- (C) The head of each bolt and one flat of each nut is marked with the number of the connecting rod to which they belong. To identify

these parts further, those on the starboard side are also marked with a letter, and the markings on the rear port and front starboard bolt and nut are at right-angles to the axis of the bolt.

- (D) The plain end of each bolt and a second flat on each nut is marked 1, 2, 3, or 4. The bolts and nuts are fitted so that these numbers are in sequence clockwise, starting with No. 1 at the front on the port (camshaft) side.

48. Each connecting rod is reassembled as follows :—

- OP. 1. Position the shim adjacent to the heads of each pair of bolts, and gently drive the bolts into the connecting rods so that the flat on each bolt head lies against the connecting rod.
2. Bearing in mind that each connecting rod must be fitted on its correct crankpin and must be the correct way round, ensure that the rod half of the bearing is correctly positioned in the connecting rod and press the connecting rod firmly against its appropriate crankpin.

Note (1) . . .

When the crankshaft and the connecting rods are in the engine, the position numbers on the connecting rods must be towards the camshaft side of the engine, and each connecting rod must be on its correct crankpin.

Note (2) . . .

As the oil seals are already in position it will not be possible to put the connecting rod in place unless it is held at a wide angle to the crankwebs.

- OP. 3. Ensure that the cap half of the bearing is correctly positioned in the cap and gently tap the cap into position on the four bolts.
4. Fit the four washers and, using spanner T1900/1A, tighten the nuts evenly, about a sixth of a turn at a time.

Note . . .

It is essential that the nuts are neither over-tightened, nor slackened off, in order to align the split pin holes. If a new nut or bolt is fitted, it must be stamped with its appropriate identification marks.

- OP. 5. Check the nip on the big-end bearing by slackening off the two nuts on one side of the connecting rod and inserting feeler gauges in the gap which will open between the rod and the cap. This gap should be between 0.008 in. and 0.010 in.
6. To avoid distortion, slacken off all the nuts and re-tighten as described in Op. 4.
7. When the nuts have been tightened correctly, make a final check that all the parts are correctly positioned, and check each connecting rod for freedom and end-float.
8. Lock the nuts with new split pins, Part No. AGS784/3A.

Idler gear

49. If the magneto driving gear has been separated from the idler gear, bolt the former to the flange on the latter, fitting the four

bolts so that their heads are towards the idler gear, and the distance pieces are under the slotted nuts. Fit split pins, Part No. 800/SP1, to the four nuts.

Camshaft

50. Before installing the camshaft in the crankcase it is essential to check its end-float in the camshaft rear bearing as follows:—

- OP. 1. Position the camshaft rear bearing on the rear end of the camshaft so that its flanged end is remote from the cams.
2. Fit the camshaft gear and lock washer.
3. Using box spanner T800/53, fully tighten the camshaft gear nut.
4. Use feeler gauges to measure the end-float by measuring the clearance between the forward face of the bearing and the small flange on the camshaft.

51. Insufficient end-float may be remedied by carefully facing off the forward face of the bearing. If the camshaft will not rotate freely in the bearing, locate the high spots, with the aid of blue marking, and carefully ease them by hand scraping.

Crankcase and top cover

52. As the component parts of the crankcase and top cover will not normally have been disturbed, reassembly will only consist of fitting new studs, dowels, plugs and similar parts in place of any that are loose or damaged. To ensure that the associated parts will be in correct alignment and that oil-tight joints will be obtained when rebuilding the engine, it is necessary to check that all the joint faces of the crankcase and the top cover are flat and true. As the securing studs preclude checking the crankcase to a surface plate it is usual to check the mating flange to a surface plate, using blue marking, and if necessary hand scraping, until at least 75 per cent marking is obtained, and then similarly to mate the trued flange to the appropriate crankcase face.

53. Ensure that the top cover has been passed by the Inspector-in-charge, and that the joint face has been checked to a surface plate. If necessary, apply a thin film of blue

marking to a surface plate and, placing the top cover joint face downwards, rub the cover with a light hand pressure on the surface plate to obtain a marking. An even marking should be obtained over the whole of the joint face, and any high spots should be rectified by careful hand scraping until the maximum marking possible is obtained.

54. Each of the other joint faces of the crankcase and the top cover, such as those for

the timing gear cover, front cover, front scavenge filter and fuel pumps, should be checked in a similar manner, using the appropriate mating component to mark the joint face.

55. If any of the main oil feed plugs or the intermediate camshaft bearings have been removed, they must be refitted using new lock washers on the oil feed plugs and on the camshaft intermediate bearing lock screws.

LIST OF TOOLS

56. The following tools are available in the Dismantling and Assembling Tool Kit :—

Part No.	Description
T2500/37	Spanner, jaw
T1900/490	Spanner, box, for valve rocker bracket bolts
TQ50	Delapena torque spanner (standard equipment)
T2200/470A	Tool, piston ring gap checking
T2200/811	Tool, piston ring gap checking 0.005 in. oversize
T2200/814	Tool, piston ring gap checking 0.010 in. oversize
T2300/198	Spanner, oil pressure relief valve plug
T1300/51	Spanner, slotted, for crankshaft lock nut (Pre-mod. 2094)
T1900/1A	Spanner, connecting rod bolt nuts
T800/53	Spanner, box, for camshaft gear-wheel nut.
T85011	Valve spring compressor
T85010	Wooden block
T77131	Lap, propeller hub taper
T77132	Lap, crankshaft taper
T86381	Spanner, crankshaft, front nut (Mod. 2094)

LIST OF CONSUMABLE STORES

57. The following new parts will be required at each reassembly :—

Part No.	Description	No. off
1900/21	Tab-washer for propeller boss set-bolt	1 ✓
1900/19	Tab-washers for propeller boss set-bolts	7 ✓
405/38	Lock-washers for flame trap control cable locking screws	2 ✓
CH16584	Joint washers for carburettor inlet banjo	2 ✓
AGS859/12	Taper pin for throttle spindle dog	1
AGS859/13	Taper pin for altitude control bellcrank	1
AGS859/1	Taper pin for flooder operating lever	1
AGS859/1	Taper pin for flooder lever	1
800/SP1	Split pins for altitude control link	2
800/SP1	Split pin for flame trap control trunnion	1
AGS859/12	Taper pin for flame trap valve lever	1
AGS859/2	Taper pin for flame trap valve pulley	1
AGS859/3	Taper pins for Pre-mod. G.1483 flame trap valve	2
AGS859/2	Taper pins for Mod. G. 1483 flame trap valve	2
AGS859/3	Taper pin for throttle control bellcrank fulcrum	1

List of consumable stores--contd.

Part No.	Description	No. off
AGS859/3	Taper pin for Pre-mod. G.1498 throttle control bellcrank collar	1
N4233	Circclip for Mod. 1498 throttle control bellcrank	1
1905/18	Joint washer for air-intake/carburettor joint	1 ✓
* 800/SP1	Split pin for flame trap valve control trunnion	1
* 800/SP1	Split pins for throttle control rod	2
2105/37	Joint washer for induction pipe/carburettor joint	1 ✓
N3773	Lock washers for rocker bracket bolt	4
N3772	Tab washers for rocker bracket bolts	8
34682	Lock plates for rocker bracket bolt nuts	4
1302/66	Washers for valve gear cover retaining screw	4 ✓
* 800/SP2	Split pins for valve gear cover retaining screw	4
AGS859/23	Taper pin for altitude control pick-up lever.. .. .	1
AGS859/23	Taper pin for altitude control vernier flange	1
AGS859/23	Taper pin for port magneto control cam	1
AGS859/23	Taper pin for throttle control vernier flange	1
AGS859/33	Taper pin for throttle operating lever	1
AGS859/13	Taper pin for magneto control spindle collar	1
AGS859/23	Taper pin for starboard magneto control cam	1
* 800/SP1	Split pin for altitude control pick-up ball joint ball	1
1306/65	Tab-washer for timing gear oil jet union	1
1306/32A	Joint washer for pressure filter outlet	1 ✓
1406/40	Joint washer for pressure filter cover	1
1306/32A	Joint washer for suction filter inlet	1
1306/19	Joint washer for suction filter outlet	1
1406/90	Joint washer for suction filter drain	1
1406/16A	Joint washer for suction filter plug	1
1306/19	Joint washer for front scavenge filter union.. .. .	1
1306/65	Tab-washer for tachometer drive casing plug	1
1303/10	Lock washer for tachometer driving gear nut	1
1303/72	Washer for tachometer drive housing cap	1
2102/43	Spacing washer for tachometer drive blanking cap.. .. .	1
* 800/SP2	Split pin for magneto drive nut	1
1306/12	Lock washer for oil pump driving gear nut	1
1306/16	Lock washer for relief valve plug	1
2103/20	Lock washers for oil pump cap nuts	5
1306/32A	Joint washers for oil pump outlet flanges	2
1403/4	Joint washers for crankcase breather connection	2
1306/67	Washer for timing gear oil jet union	1
1306/69	Tab-washer for timing gear oil jet	1
* AGS784/11	Split pin for crankshaft gear clamp nut	1
* AGS784/2	Split pins for crankshaft oil seal nuts	6
1300/13A	Tab-washer for crankshaft lock nut (Pre-mod. 2094)	1
AGS784/3A	Split pins for connecting rod nuts	16
* 800/SP1	Split pins for idler gear nuts	4
N2882	Tab-washer for crankshaft lock nut (Mod. 2094)	1

*These split pins are obsolete and are to be replaced as required by the following equivalents: 800 SP1 and AGS784/2 ... S.P.9-C6
800 SP2 and AGS784/11 ... S.P.9-EX.

Chapter 16

ASSEMBLING THE ENGINE

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1. This chapter describes the assembly of the engine from the basic components and sub-assemblies. All parts and assemblies should have been scrupulously cleaned during the reconditioning processes and, when applicable, freely lubricated during assembly. Particular care should be taken to ensure that all abrasive has been thoroughly removed. Do not use jointing compound unless specified, and then only sparingly, as any excess is liable to obstruct oil-ways. Jointing compound is not applied where joint washers are used. Components must be inspected for aligning marks and numerals which are used to assist correct assembly. Oil-ways must be inspected for cleanliness, and all bearing surfaces and running parts lubricated, with approved engine oil only, before assembly.

2. New joint washers, tab-washers, circlips and split pins must be used throughout. In certain instances during the rebuild, the legs of split pins are required to be twisted at 90 deg. in relation to the head before insertion, and the legs then turned in opposite directions around the nut into the nearest slots. This is also the recommended practice where maximum clearance over the head of the bolt is advisable.

3. *Throughout this chapter where tolerances are not quoted, or the phrase "within the limits" occurs, it implies that the operator must refer to the Schedule of Fits and Clearances: for essential dimensions and clearances see Chapter 20.* Where it is required to secure a dial test indicator to a convenient stud for the purpose of backlash or end float checks, the instrument should be clamped to a suitable stud box, screwed on to the selected stud. Certain tests may require an extension pillar screwed into the stud box to facilitate locating the stylus. Stylus pointers of several lengths will also be necessary.

Preliminary operations

4. Attach suitable workshop feet, or bearer arms, to the four faces on the crankcase and mount the crankcase on the erecting stand so that it is in its normal attitude, that is, with the cylinder apertures downwards. Use a jet of dry compressed air to blow out all traces of swarf or dust, and to ensure that the crankcase and oil ways are perfectly clean. Check that all dowels, studs and plugs are in position and are secure and undamaged before proceeding.

Camshaft

5. The end-float of the camshaft in the rear camshaft bearing will have been checked as instructed in Chapter 15. Proceed to fit the camshaft in the crankcase as follows:—

- (1) Apply a film of jointing compound to the flange of the front camshaft bearing, and to its mating face at the front of the crankcase.
- (2) Align the "O" on the bearing flange with the "O" on the crankcase and push the bearing into position.
- (3) Fit the three spring washers and nuts and tighten them evenly.
- (4) Insert the camshaft from the rear end of the crankcase, through the three intermediate bearings until the front end of the camshaft is in position in the front bearing.
- (5) Check that the camshaft is free to rotate, but if it binds at any point locate the high spots with the aid of blue marking and ease them by careful use of a half-round scraper.
- (6) Fit the rear camshaft bearing into position, place the two plain washers on the studs and screw on the slotted nuts.
- (7) Again check that the camshaft is free to rotate and, if necessary, rectify any slight binding.
- (8) Fit the key into the keyway in the rear end of the camshaft.
- (9) Align one of the keyways in the gear with the key, the keyway originally used should have been marked when the engine was being dismantled, and gently drive the gear into position.
- (10) Fit a new lock washer, Part No. 1304-7, and using spanner T800-53 and tommy bar T2300-193, fully tighten the ring nut.
- (11) Make a final check that the camshaft rotates freely and that the end-float is within the limits.
- (12) Remove the nut, lock washer, and the gear.
- (13) Split pin, Part No. 800-SP1, the two rear bearing nuts.

Idler gear

6. The idler gear assembly should be assembled to the rear wall of the crankcase as follows :—

- (1) Check that the dowel is in position in the crankcase, it is situated at the three-o'clock position relative to the idler spindle hole in the crankcase rear wall.
- (2) Screw a suitable inserter (*use T86081 from Gipsy Major tool kit*) on to the threaded end of the idler spindle and enter the front end of the spindle into the hole in the crankcase rear wall so that the dowel hole in the flange on the spindle is slightly above the dowel; it should be noted that it is impossible to turn the spindle in an anti-clockwise direction by means of the inserter, to align the dowel hole with the dowel.
- (3) Drive in the spindle until the flange almost reaches the dowel, then turn the inserter and spindle clockwise until the dowel hole is in line with the dowel, and drive the spindle right home.
- (4) Remove the inserter.
- (5) Place a new lock washer, Part No. 1303-10, on the idler spindle plug and screw the plug into the front end of the spindle.
- (6) Position the thrust bearing, followed by the original shim or shims, on the idler spindle.

Note . . .

These shims control the end-float of the idler gear. If the original parts are being reassembled, the correct end-float should be obtained, but if new parts are being fitted it may be necessary to make a trial assembly and to vary the number of shims, to obtain the correct end-float.

- (7) Slide the idler gear on to the spindle so that the straight spur gear is nearest the crankcase rear wall.
- (8) Fit the washer and screw on the lock nut.
- (9) Check the gear for freedom to rotate and measure the end-float. If the end-float is incorrect, remove or add shims between the gear and the thrust bearing to obtain the correct value.

- (10) Lock the plug at the forward end of the idler spindle.
- (11) Fit a split pin, Part No. 1300-SP2 to the locknut, wrapping the legs of the split pin round the hexagon of the nut as for a moving component (*fig. 2 Chap. 15*).

Tappets and tappet guides

7. To refit the tappets and tappet guides, turn the crankcase through 180 deg. so that the cylinder apertures are uppermost, and ensure that the stand is properly locked in this position. The tappets and tappet guides are numbered 1 to 8 from the front of the engine. Proceed as follows :—

- (1) Place a new joint ring, Part No. 1304-9, on each tappet guide.
- (2) Insert each tappet into its correct tappet guide and check each tappet for freedom.
- (3) Position each tappet and guide in its correct aperture in the crankcase so that the bore in the tappet guide is offset away from the centre of the crankcase.
- (4) Fit a spring washer and plain nut on each of the sixteen studs and tighten the nuts a little more than finger-tight.
- (5) Turn the crankcase through 180 deg. so that the cylinder apertures face downwards and ensure that the stand is properly locked in this position.
- (6) Taking each tappet in turn, shine a light on the side of the crankcase behind the camshaft, press lightly on the push rod end of the tappet to keep it in contact with its cam and rotate the camshaft slowly. As the cam just starts to lift its tappet, check that no light is visible between the cam and the tappet; i.e., that the tappet is making full contact with its cam.

Note . . .

A piece of white paper held behind each cam as it is checked will often make it easier to see whether the tappet is in full contact with its cam.

- (7) Correct slight malalignment by lightly tapping the guide so that it turns in the desired direction, within the limits of

clearance between the studs and holes in the tappet guide flange.

- (8) As each tappet is positioned correctly, tighten the two securing nuts and re-check the contact between the tappet and its cam.

Crankshaft

8. The main bearings are usually marked with the serial number of the crankcase to which they belong and care must be taken to ensure that the correct set of main bearings is being fitted. The bearings are also marked to indicate their position in the crankcase; ensure that each bearing half and each bearing cap is correctly located. The white metallised bearing linings are marked on one of the flanges and should be fitted so that the identification marks are towards the camshaft side of the crankcase. Proceed to fit the main bearings and the crankshaft as follows:—

- (1) Fit the five crankcase halves of the main bearings and make an oil flow check by supplying oil under pressure to each of the oil ducts in the crankcase top flange in turn. Oil should flow freely into each bearing.
- (2) Fit the cap half of each main bearing into its correct main bearing cap. Ensure that the dowel hole in each white metallised bearing fits correctly over the dowel.
- (3) Fit the crankshaft, complete with connecting rods, gear, extension shaft (starter dog, Mk. 7 only), thrust bearing distance piece (Mod. 2094), and thrust bearing, into the bearings in the crankcase.
- (4) Ensure that none of the bearings has been displaced.
- (5) Fit the five main bearing caps in their correct locations so that the identification marks are towards the camshaft side of the crankcase.
- (6) Place a new lock washer, Part No. 801-95 for No. 1 bearing, and 801-94 for the others, on each main bearing stud, and screw on the castellated nuts, mating the numbered nuts with the correspondingly numbered studs.
- (7) Make a final check that every part is correctly fitted, and using spanner T2200-91 and tommy bar T2200-92, evenly tighten all twelve nuts to the correct torque.

Note . . .

No specific torque loading figures are available but the following range may be used temporarily: 300-400 in./lb. for bearing No. 1, 500-600 in./lb. for bearing No. 2, 3, 4, and 5.

- (8) Next check the nip on the main bearings by slackening off the nuts on one side of each main bearing and inserting feeler gauges in the gap which will open between the crankcase and the bearing cap. This gap should be between 0.004 in. and 0.008 in.
- (9) To avoid distortion, slacken off all the nuts and re-tighten as detailed in OP. 7.
- (10) Fit the crankshaft turning tool T1900-355.
- (11) Repeat the oil flow check, and while oil pressure is applied to Nos. 2 and 4 main bearings rotate the crankshaft and check that oil is ejected from the two holes in each connecting rod cap once in each complete revolution. While oil pressure is applied to No. 5 main bearing, check that oil is reaching the idler gear assembly. There should be no leakage at the crankshaft oil seals.

Note . . .

On early type engines, the oil pressure should be applied through the external oil gallery along the starboard side of the crankcase. The oil should be supplied at a pressure of about 60 lb. per sq. in. and it is important that this pressure is reasonably maintained.

- (12) Lock all twelve nuts by bending one tab on each lock washer up against one of the flats on its nut. Do not attempt to hammer the tab "round the corner" flush with two flats as this may fracture the lock washer and result in its breaking up when the engine is running. Also lock all twelve nuts to the studs by fitting split pins, Part No. 800-SP3.

Note . . .

Should any difficulty be experienced in bringing the split pin hole into line, the nuts should not be over-tightened or slackened but should be faced off on the underside. If any parts mentioned in these operations have to be removed, the new parts must be stamped with the correct position number.

Pistons and cylinders

9. In order to fit the pistons and cylinders, turn the crankcase on the stand through 180 deg. so that the cylinder apertures are uppermost. While doing this, steady the four connecting-rods so that they do not knock against the sides of the cylinder apertures. Ensure that the stand is properly locked.

10. It is probably most convenient to commence with No. 4 piston and cylinder as, although the order of re-assembly is immaterial, No. 4 piston must be fitted before No. 3. Although the piston rings can be previously fitted on the bench, it is advisable to defer fitting each set of rings to its piston until immediately before the cylinder is fitted, as otherwise there is a possibility of the rings being damaged or broken by contact with the cylinder holding-down studs, or by being trapped in the crankcase aperture when the crankshaft is turned. During all rotation of the crankshaft, connecting-rods to which pistons and cylinders have not been fitted must be supported to prevent them knocking against the crankcase and so being damaged or injuring the cylinder apertures in the crankcase.

11. When fitting the first washer on to each gudgeon-pin, do not slide it along the full length of the pin as this may scratch and injure the bearing surface of the latter. New circlips must be fitted in place of those removed, but any circlip which has not been disturbed and which is secure in its groove need not be renewed. Normally, circlips can be fitted with the fingers, but the gudgeon-pin circlip inserter T200-162 is available for use when required (*fig. 1*).

12. Each piston must be fitted to its correct connecting-rod, according to the sequence number stamped on the piston crown. Assembly is correct when the sequence number can be read from the propeller end of the engine. Fit each piston in the following manner:—

- (1) Set the crankshaft so that the appropriate crank and connecting-rod are at T.D.C.
- (2) Fit one washer and a new circlip, Part No. 800-19, to one end of the gudgeon-pin so that the chamfered face of the washer will be away from the piston.

- (3) Align the gudgeon-pin holes in the piston with the small end of the connecting rod and support the piston so that no bending load will be imposed on the connecting-rod.
- (4) Lubricate the small end bore with clean engine oil and insert the gudgeon-pin. If necessary, use a rubber mallet to tap the gudgeon-pin into position.
- (5) Fit the second washer so that its chamfered face is away from the piston and secure it with a new circlip.
- (6) Ensure that both circlips are correctly located in their grooves.
- (7) Fit the three piston rings, ensuring that they are fitted into their correct grooves in the piston and that each is the correct way round.

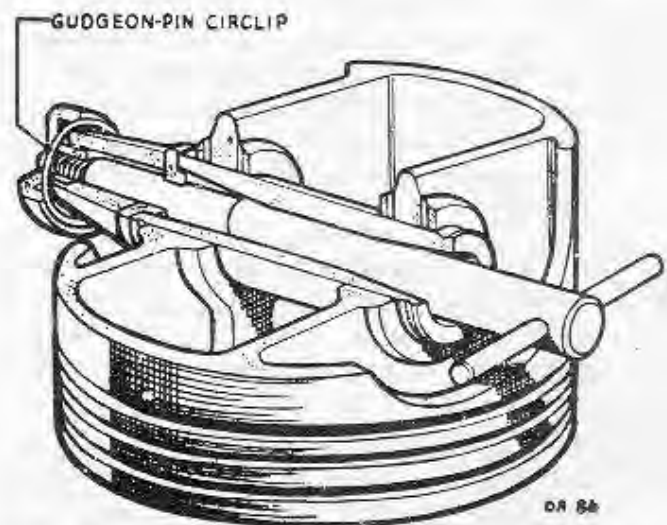


Fig. 1. Method of using gudgeon-pin circlip expander

Notes . . .

The scraper ring must be fitted with the stepped side towards the gudgeon-pin, and the two gas rings, which occupy the grooves nearest the piston crown, must be fitted so that the letter "C" which is etched on each is towards the crown of the piston. Never open the gap in a piston ring more than is essential to get it into position. The best method of fitting piston rings is to use three thin strips of metal, polished so that there are no sharp edges which might scratch the piston, spaced equally around the piston so that each ring can be slid into position with

the least risk of breakage. Space the three ring gaps equidistantly round the piston.

13. Each cylinder barrel should be assembled so that the part number faces the camshaft side of the engine. If the crankcase apertures have been re-faced under an approved repair scheme, it is important to ensure that packing shim equal to the thickness of metal removed is in position in each crankcase aperture.

- (1) Fit a new joint ring, Part No. 1302-38, on the locating spigot of each cylinder.
- (2) Liberally oil the bore of the cylinder and the piston with clean engine oil.
- (3) Compress the piston rings with piston ring compressor T2200-167 and slide the cylinder over the piston until the piston ring compressor is displaced.
- (4) Remove the piston ring compressor over the connecting-rod and push the cylinder into position in the crankcase, taking care that the locating spigot flange seats squarely on the crankcase face.

Cylinder heads

14. The cylinder heads are fitted so that the ports are away from the camshaft side of the engine, and they are sequence numbered to indicate their position on the engine.

- (1) Wipe the joint faces of the cylinder barrels and heads clean and dry.
- (2) Fit a new copper-asbestos cylinder head washer, Part No. 37257, in each cylinder head; a smear of grease may be used to keep them in position.
- (3) Fit the correct cylinder head on to its cylinder holding-down studs and push it into position on its cylinder barrel.
- (4) When all four cylinder heads are in position, fit the three cooling baffle brackets on Nos. 3, 5, and 7 cylinder holding-down studs on the carburettor side, and the two ignition harness clip supports on Nos. 2 and 3, and 6 and 7 on the camshaft side.
- (5) Fit the seven thin washers on the studs mentioned in OP. 4, and the nine thick washers on the other nine studs.
- (6) Screw on the sixteen nuts until they are little more than finger-tight.

- (7) Using feeler gauges and a straight-edge aligned against the inlet port faces just below the two upper studs, check that the alignment of the four cylinder heads is within the limits (0.006 in.). The essential feature of this check is to ensure that the cylinder head flanges are parallel with the straight-edge and are as far as possible in the same plane. Slight malalignment may be remedied by carefully tapping the cylinders with a mallet.
- (8) Working diagonally, evenly tighten each set of nuts, using the jaw spanners, T800-80, T1400-10 and T1400-11, as necessary. Tighten each nut about a sixth of a turn at a time.
- (9) When all the nuts are fully tightened, recheck the cylinder head alignment with the straight-edge and feeler gauges.

Note . . .

The gaps between any part of the finning of adjacent cylinder heads should be approximately equal, and differences may indicate that the cylinder holding-down nuts have been tightened unevenly, or that the cylinder is not seating squarely in the crankcase. The second point may be checked by attempting to insert a 0.0015 in. feeler gauge between the cylinder and the crankcase. If this is possible at any point, the joint must be re-made and the cylinder head alignment rechecked. When correcting errors of alignment, it is important to slacken off all four nuts on a particular cylinder head; avoid slackening off on one side and tightening up on the other.

- (10) Place new joint washers, Part No. 1302-12A, on the exhaust port flanges, fit the four exhaust flange blanking plates and secure each with three spring washers and plain nuts.

Starter dog (extension shaft) concentricity check

15. Before commencing to check the concentricity of the starter dog (or extension shaft) which is fitted to the after end of the crankshaft of the Mk. 7, turn the engine on its stand through 180 deg. so that the cylinders are downwards and ensure that the stand is properly locked. Then proceed as follows:—

- (1) Mount a dial test indicator at the after end of the crankcase so that its stylus bears on the periphery of the starter dog.

(2) Rotate the crankshaft slowly and observe the dial test indicator which will show whether the starter dog is concentric with the crankshaft centre line. A dial reading up to 0.004 in. is permissible which will be double the actual eccentricity, i.e., 0.002 in. maximum. Excessive eccentricity probably indicates that the extension shaft is not seating squarely on the crankshaft gear flange, possibly due to a piece of grit between the two.

(3) When the six slotted nuts have been tightened fully and everything is satisfactory, fit split pins, Part No. 800-SP1, to the nuts.

Fuel pumps (engines with engine-driven fuel pumps)

16. Mk. 7 engines will have been turned over in the erecting stand already, but Mk. 1 variants must now be turned over as instructed in para. 15. It is advisable to fit the fuel pumps before the top cover is refitted so that the clearance between the rocker arm and each camshaft eccentric may be checked. This check is not essential if the fuel pumps are known to have been reassembled on a suitable rig and provided the correct joint washers only are used.

- (1) Place two new joint washers, Part No. 801-86, on to the two fuel pump facings on the port side of the crankcase.
- (2) Fit the pair of fuel pumps into position and secure them with four spring washers and plain nuts.
- (3) Rotate the camshaft slowly and check that each rocker arm pad can be moved a further 0.035 to 0.055 in. when the relevant camshaft eccentric is in the maximum lift position.

Top cover

17. Mk. 1 Variants which are fitted with fuel pumps, and Mk. 7 engines will have been turned over in the erecting stand already, but Mk. 1 variants which are not fitted with fuel pumps must now be turned over as instructed in para. 15. Before fitting the top cover on the crankcase, make a thorough check that every part within the crankcase has been correctly reassembled and locked. Ensure that no foreign matter, small tools, or loose parts have been left inside the engine.

- (1) Remove the crankshaft turning tool.

(2) Apply a thin film of jointing compound to the mating surfaces and carefully lower the top cover on to the studs in the crankcase.

- (3) Check that the front cover face aligns with the corresponding face on the crankcase.
- (4) Fit the four fitting bolts.

Note . . .

Four of the twenty-seven bolts, which secure the top cover, are fitting bolts and are slightly larger in diameter than the others. Ensure that the two special fitting bolts which also secure the air-intake and flame trap steady bracket are correctly located on the starboard side. On engines pre-Mod. G.1635 the other two fitting bolts go on the port side opposite those which secure the steady bracket, but when mod. G.1635 has been embodied, these two fitting bolts are fitted at the front and rear of the port and starboard sides respectively.

- (5) Fit the air-intake steady bracket and the thirty-five spring washers and plain nuts.
- (6) Working progressively from the centre of each side towards each end of the engine, evenly tighten all the nuts and bolts.

Thrust bearing nip

18. The nip between the outer race of the thrust bearing and the front cover must be checked as shown in fig. 2 to ensure that it is within the limits. Fig. 2 illustrates the method of using the thrust bearing fixture and special nut to determine the thickness of shims required.

- (1) Assemble the thrust bearing fixture T85998 on the front end of the crankshaft and secure it with nut T85999 as indicated in fig. 2.
- (2) Use feeler gauges to measure the gap between the fixture and the front of the crankcase.
- (3) Remove the nut and fixture.
- (4) SUBTRACT the specified nip from the dimension measured in OP.2 and select packing shims to give a thickness equal to the resultant dimension.

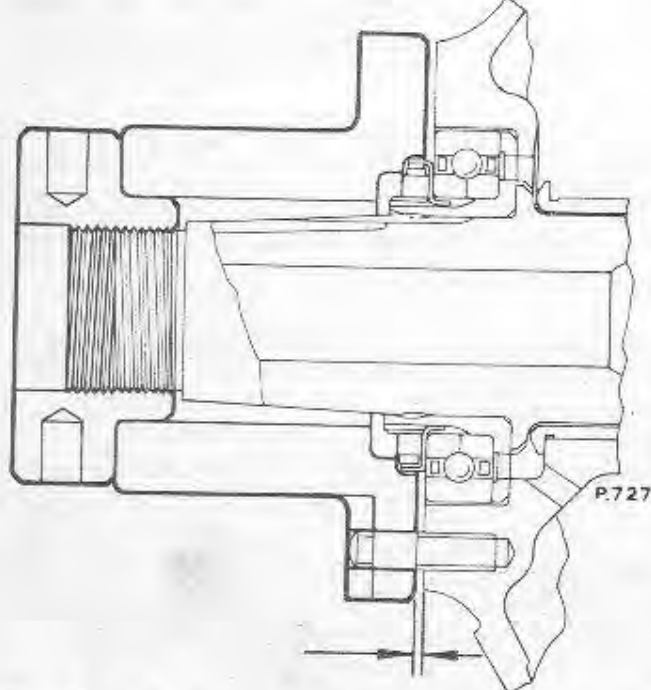


Fig. 2. Checking the front cover and thrust bearing nip

Front cover

19. After checking the shim thickness required to give the specified thrust bearing nip, fit the front cover as follows:—

- (1) Smear a thin film of jointing on the shim(s), and on the mating surfaces of the crankcase and the front cover.
- (2) Position the brass packing shim(s), the steel shim Part No. 1306-26, and the front cover, in that order, on the five studs, fit the five washers, and screw on the slotted nuts until a little more than finger-tight.
- (3) Position the centralising gauge T85843 on the crankshaft and use feeler gauges to measure the radial clearance between the gauge and the front cover as shown in fig. 3.
- (4) If necessary, move the cover within the limits of clearance in the stud holes, until the clearance is equal all the way round; that is, until the front cover is concentric with the crankshaft.
- (5) Tighten the nuts and fit split pins, Part No. 800-SP2.
- (6) Remove the centralising gauge.

Propeller boss

20. The tapered bore in the propeller boss is machined to a slightly smaller angle than the

taper on the crankshaft to ensure the maximum grip between the two components at the driving end. No attempt must be made to lap these components together, but a crankshaft lap T77132, and a propeller hub lap T77131, should be used to rectify fretting damage and looseness of the hub on the crankshaft. After a "blueing" check to ensure that an 80 per cent surface contact is obtained between the crankshaft and the propeller boss, particularly at the rear position of the the taper, fit the propeller boss as follows:—

- (1) Ensure that both the tapered end of the crankshaft and the tapered hole in the boss are perfectly clean and dry.
- (2) Check that the key is correctly positioned in the crankshaft.
- (3) Align the keyway in the propeller boss with the key in the crankshaft and push the boss on to the crankshaft.
- (4) When the propeller boss is in position, lightly lubricate the threaded end of the crankshaft with clean engine oil.
- (5) Using box spanner T1900-383 or T800-5A, if Mod. 903 is not embodied, with tommy bar T1900-245, and a slave or dummy propeller to hold the crankshaft stationary (as described in Chapter 13), tighten the front nut to a torque of 350-400 foot pounds.
- (6) Fit the propeller nut locking plate and the front nut locking plate, and secure by fitting the four slotted nuts.

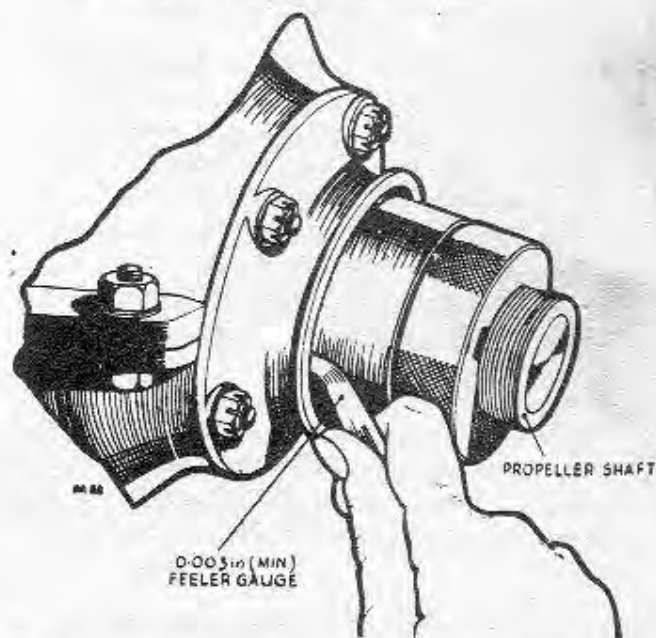


Fig. 3. Method of using front cover centralising gauge

Note . . .

The slave or dummy propeller will be required to enable the crankshaft to be turned for valve and magneto timing, therefore it should be left in position. Do not fit split pins to the slotted nuts, and do not fit the spinner at this stage.

Valve timing

21. Before commencing to time the valves, turn the engine on the stand through 180 deg. so that the cylinders are uppermost and ensure that the stand is properly locked. Using the timing pointer which is attached to the propeller boss and the timing marks which are on the front cover, time the valves as follows:—

- (1) Set the camshaft so that neither of the tappets for No. 1 cylinder are lifted.
- (2) Pull the exhaust rocker on No. 1 cylinder head, away from the rocker bracket, compressing both rocker springs, and position one of the push rods so that its ball end locates in the tappet. Allow the rocker to return to its normal position and at the same time engage the cap end of the push rod with the ball end in the rocker.
- (4) Fit the thimble on the end of the exhaust valve stem in No. 1 cylinder.
- (5) Using feeler gauges between the rocker pad and the thimble on the valve stem, adjust exhaust tappet clearance to the correct value PLUS 0.005 in.

Note . . .

This will enable a 0.005 in. feeler gauge, which will be nipped and freed respectively, to be used to determine the exact opening and closing points of the valve. Alternatively, set the tappet clearances to the normal value and rotate the push rod with the fingers; the push rod will be free up to the instant the valve commences to open and will remain nipped until the instant the valve closes.

- (6) Turn the crankshaft forwards in the normal direction of rotation until the timing pointer attached to the propeller boss coincides with the mark EO on the front cover.
- (7) Turn the camshaft in its normal direction of rotation until No. 1 exhaust valve

is just about to open; that is, until all clearance is taken up on No. 1 exhaust tappet.

- (8) Ensure that the key is in position in the camshaft, align the marked keyway in the camshaft gear with the key and push the gear on to the camshaft, meshing it with the idler gear.
- (9) Fit the new lock washer on the camshaft and screw on the nut just sufficiently to retain the gear.
- (10) Rotate the crankshaft in the normal direction of rotation and observe whether the timing pointer attached to the propeller boss coincides with the mark EO on the front cover when the exhaust valve on No. 1 cylinder opens.

Note . . .

If the timing is incorrect, remove and reposition the camshaft gear. There are four alternative keyways in the camshaft gear, spaced so that the angle between each keyway and the nearest full tooth is different in each case. If new parts are being fitted, or satisfactory timing cannot be obtained using the marked keyway, select the keyway which gives the timing closest to that specified and mark that keyway for future reference; at the same time remove any previous markings. The valve timing figures for each engine type covered by this set of instructions can be found in the Leading Particulars.

- (11) When the timing is satisfactory, turn the crankshaft until No. 1 piston is at T.D.C. with the exhaust valve closed, and remove the push rod.

Port screened ignition harness (Mk. 7 only)

22. The port screened ignition harness cannot be fitted after the eight push rods and their covers are in place, and this harness must therefore be fitted at this stage in the following manner:—

- (1) Position the port screened ignition harness alongside the cylinder heads.
- (2) Secure the harness to the supports on the cylinder heads by fitting the two bolts, spring washers, and plain nuts.

Push-rod covers and push rods

23. Fit the push-rod covers and the push rods as follows :—

- (1) Place a thimble on to each valve stem.
- (2) Assemble the two portions of each push rod cover with its spring, and fit a new rubber joint ring, Part No. 1304-5, at each end.
- (3) Locate the inner telescopic portion of each push rod cover into its tappet guide and telescope the cover until the other end can be seated into position in the cylinder head.
- (4) Fit the eight push rods as described for valve timing, turning the crankshaft as required to bring the relevant cams and tappets to their lowest point ; that is, so that there is no lift on the valve operating mechanism.
- (5) Centralise the rocker spindles, turn them until the retaining pins are vertical and tighten the clamping bolts.

Tappet adjustment and valve gear covers

24. While the cylinders are uppermost adjust the tappet clearances and fit the valve gear covers as follows :—

- (1) Carefully adjust all eight tappet clearances to the correct value and ensure that they remain correct after the locknuts have been tightened fully.
- (2) Place a new valve gear cover joint washer, Part No. 1302-42, on each valve casing.
- (3) Fit the four valve gear covers, securing each by tightening its retaining screw.
- (4) Label all four covers " NO OIL ".

Idler gear backlash

25. Before proceeding, turn the engine on its stand through 180 deg. so that the cylinders are downwards and ensure that the stand is properly locked. Proceed to check the idler gear backlash as follows :—

- (1) Clamp a suitable backlash indicator on to the idler gear and mount a dial test indicator on a convenient crankcase stud so that its stylus bears on the backlash indicator at a point equivalent to the pitch circle radius of the idler gear.

- (2) Regarding the camshaft as being "locked" by the action of the valve springs, measure the backlash between the idler gear and the camshaft gear by gently rocking the crankshaft by the slave or dummy propeller so that the idler gear is moved through the amount of the backlash.
- (3) Regarding the crankshaft as "locked" by inertia and friction, measure the backlash between the idler gear and the crankshaft gear by using the camshaft gear to move the idler gear.
- (4) Upon the satisfactory completion of these checks, remove the dial test indicator and the backlash indicator.
- (5) Ensure that the nut at the rear end of the camshaft is fully tightened and locked.

Timing gear cover

26. The timing gear cover, magneto drive, and oil pump have been built up into a sub-assembly. When fitting the timing gear cover it will assist if the two portions of the timing gear cover joint washer are retained against the rear of the crankcase and top cover with a smear of jointing compound. Fit the timing gear cover as follows :—

- (1) Position the lower half of a new timing gear cover joint washer, Part No. 1903-3, on the studs at the rear of the crankcase, and the upper half of a new joint washer, Part No. 1903-2, on the rear face of the top cover.
- (2) Carefully ease the timing gear cover into position on the rear of the crankcase, ensuring that the gears in the timing gear cover slip into mesh with the gears in the crankcase ; it may be necessary to rock the crankshaft gently by the slave or dummy propeller to assist the gear to slip into mesh.

Note . . .

Immediately there is enough of the threaded end of the stud adjacent to the oil pump outlet protruding through the timing gear cover, fit the spring washer and plain nut, as this cannot be done after the cover is right home.

- (3) Temporarily secure the timing gear cover at four equidistantly spaced points in order to carry out the following backlash checks.

Magneto drive backlash

27. The magneto drive backlash should be checked as follows :—

- (1) Clamp a backlash indicator, such as that illustrated in fig. 4, on to either of the magneto coupling flanges, and mount a dial test indicator so that its stylus bears on the backlash indicator.

Note . . .

As the effective radius of the backlash indicator illustrated in fig. 4 is four times the pitch circle radius of the magneto driven gear, the observed measurement must be divided by four. Whatever backlash indicator is used, bear in mind this relationship of the pitch circle radius to the effective radius of mark on the backlash indicator, and make any allowance necessary.

- (2) Carefully turn the crankshaft by the slave or dummy propeller until the idler gear is, in effect, "locked" between the crankshaft gear and the camshaft gear.
- (3) Measure the backlash between the magneto driving and driven gears.
- (4) Remove the backlash indicator and the dial test indicators.

Oil pump drive backlash

28. A suitable backlash indicator with which to measure the oil pump drive backlash is illustrated in fig. 5, but the distance piece (item 3) will not be required. The backlash in the oil pump drive of both Mk. 1

variants and Mk. 7 can be measured as follows :—

- (1) Remove the oil pump rear cover; the joint was assembled without jointing compound to enable this to be done.
- (2) Attach the pointer (7) to its sleeve (4) and secure it with the knurled nut (6). Fit the distance piece (1) and rubber washer (2) on the bolt (5) and pass the bolt through the pointer sleeve. Screw the wing nut, AGS 113/C, lightly on to the bolt.
- (3) Insert the assembly in the bore of the oil pump driven gear spindle and secure it by tightening the wing nut, which will cause the rubber washer to swell and grip the bore.
- (4) Mount the dial test indicator bracket assembly on a convenient timing gear cover stud as illustrated in fig. 5.
- (5) Regarding the camshaft gear as being "locked" by the action of the valve springs, measure the backlash between the oil pump driving gear and the camshaft gear.
- (6) Remove the backlash indicator and the dial test indicator.
- (7) Smear a thin film of jointing compound on the pressure pump housing and on the oil pump rear cover.
- (8) Push the rear cover into position, fit the

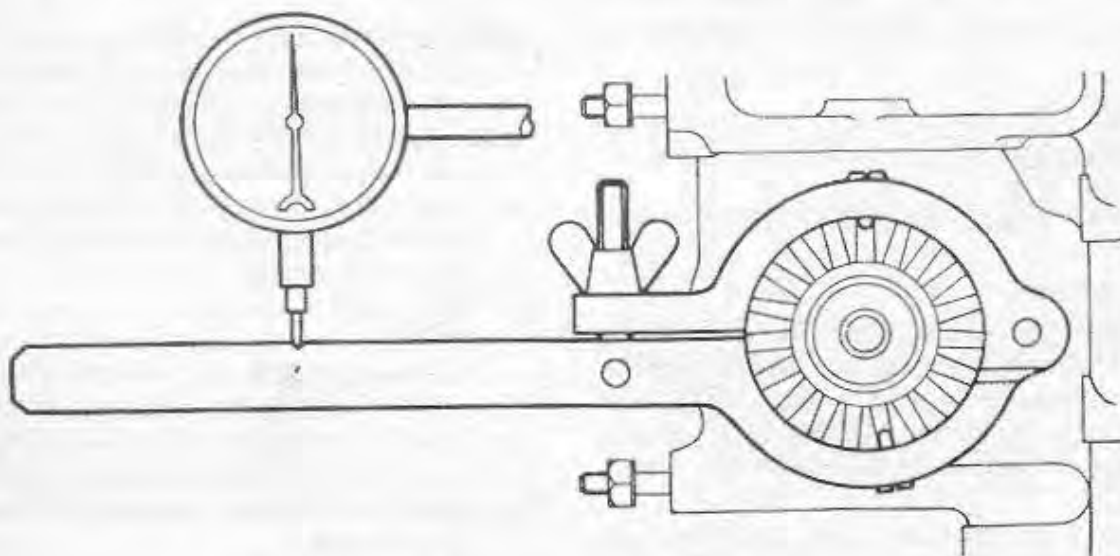
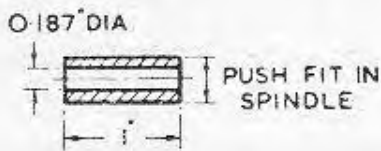
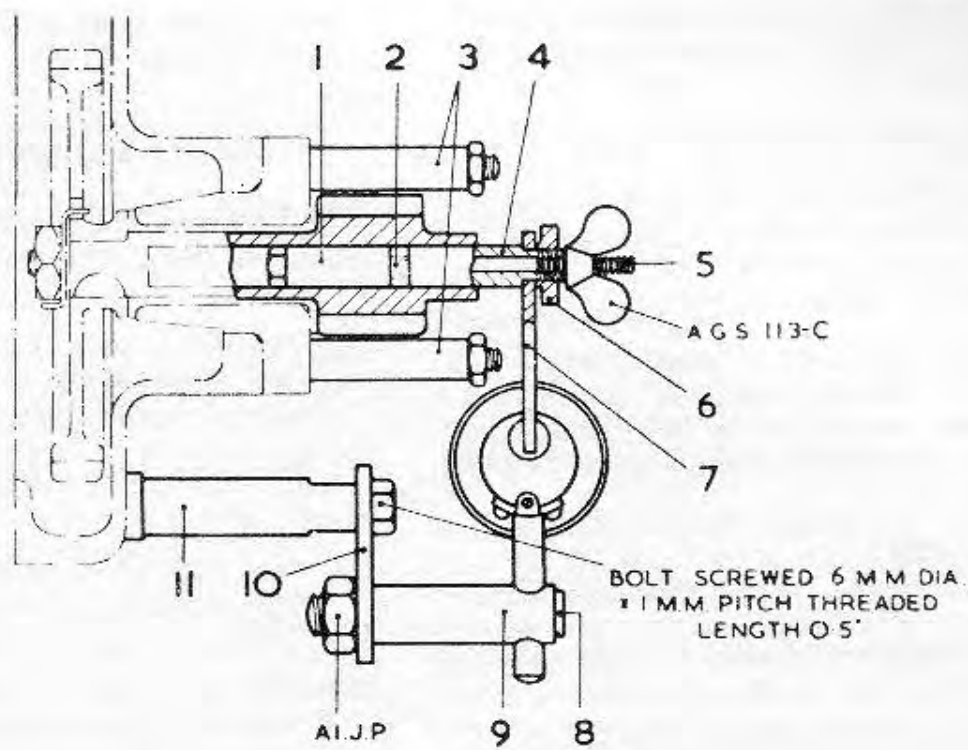
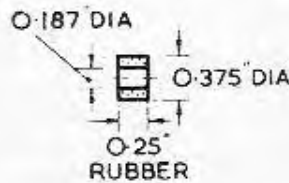


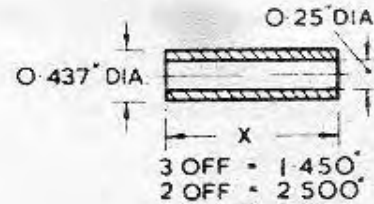
Fig. 4. Method of measuring magneto drive backlash



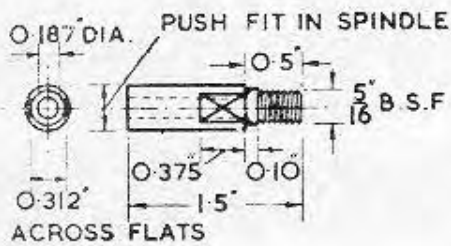
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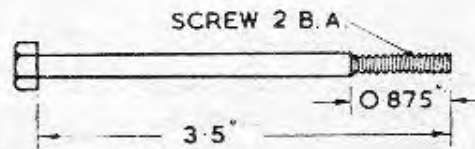
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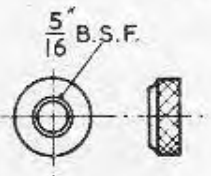
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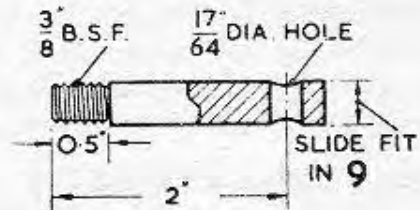
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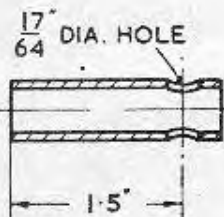
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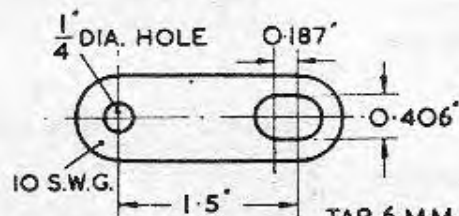
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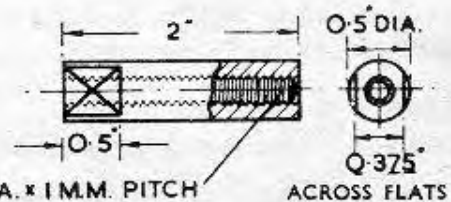
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10



11

Fig. 5. Method of measuring oil pump drive backlash

spring washers (*Mk. 1 variants*), or lock washers (*Mk. 7*), and evenly tighten the five nuts.

- (9) *Mk. 7 only*. Lock the cap nuts.
- (10) Finally secure the timing gear cover by fitting the remainder of the eight bolts and spring washers, and the thirteen plain nuts and spring washers.

When engine-driven fuel pumps are fitted. Fit the left-hand clip on the flooder control guide tube under the spring washer on the left-hand bottom stud.

Tachometer drive

29. Although the tachometer drive differs according to whether a dual quarter engine-speed tachometer drive or a dual engine-speed drive is fitted, the procedure for its refitment is the same in each instance and is as follows:—

- (1) Place a new joint washer, Part No. 1303-63, on the tachometer drive assembly.
- (2) Position the tachometer drive assembly in the timing gear cover.
- (3) Secure the tachometer drive assembly by refitting the three spring washers and plain nuts.

Cooling baffle

30. The cooling baffle should be positioned so that its upper edge will be held by the three studs in the starboard side of the crankcase, and its lower edge by the three brackets attached to the cylinder heads. Secure the baffle with six plain washers, spring washers, and plain nuts.

Starboard unscreened H.T. cables (*Mk. 1 variants*)

31. The starboard unscreened H.T. cables should be fitted before the carburettor, air-intake, and induction pipe are refitted.

- (1) Position the sub-assembly of H.T. cables on the starboard side of the engine.
- (2) Fit the two washers and nuts to secure the H.T. cable tube to the cooling baffle.

Front oil drain (*Mk. 1 variants*)

32. The front oil drain is fitted as follows:—

- (1) Place a new joint Part No. 1301-16 on

the studded face on the starboard side of the crankcase.

- (2) Fit the front oil drain and secure it with the three spring washers and plain nuts.

Front scavenge filter (*Mk. 7 only*)

33. The front scavenge filter is fitted as follows:—

- (1) Position a new joint washer Part No. 1301-16 on the three studs near the front of the starboard side of the crankcase.
- (2) Fit the front scavenge filter casing on to the studs.
- (3) Fit a second new joint washer, place the gauze filter in its casing, and push on the cover.
- (4) *If Mod. G.1483 has been embodied.* Fit the lower two spring washers and plain nuts finger-tight, but do not fit the third spring washer and nut as the flame-trap valve return-spring anchorage must be fitted to this stud after the carburettor, air-intake, and induction pipe have been fitted.

If Mod. G.1483 has not been embodied. Fit the three spring washers and plain nuts and evenly tighten all three nuts.

Crankcase to suction pump oil pipe (*Mk. 7 only*)

34. The crankcase to suction pump oil pipe must be fitted before the carburettor, air-intake, and induction pipe as follows:—

- (1) Place a new joint washer, Part No. 1306-32A, on the rear suction pump inlet port.
- (2) Ensure that the two oil pipe clips are in position on the oil pipe.
- (3) Position the nipple on the oil pipe in the union in the front scavenge filter casing, and its flanged end on the rear suction pump inlet port.
- (4) Secure the rear end of the oil pipe with two spring washers and plain nuts, and the front end by tightening the union nut.

Carburettor, air-intake, and induction pipe

35. The carburettor, air-intake, and induction pipe have been assembled loosely as a sub-assembly, and the steady bracket has

been attached to the starboard side of the crankcase/top cover flange when the bolts were fitted in positions 7 and 9 when bolting the top cover to the crankcase. This sub-assembly should be fitted as follows :—

- (1) Place a new joint washer, Part No. 1302-13, on each cylinder head induction pipe flange.
- (2) Position the carburettor, air-intake, and induction pipe sub-assembly on the starboard side of the engine so that the sixteen holes in the induction pipe flanges slide over the studs in the cylinder head flange and the Silentbloc bush aligns with the steady bracket.
- (3) Position the clip around the Silentbloc bush and secure it to the steady bracket by fitting the two bolts, spring washers, and nuts; tighten the nuts until the Silentbloc bush is just held.
- (4) Place spring washers on the sixteen cylinder head flange studs and screw on the nuts until finger-tight.
- (5) *Mk. 7 only.* Align the hole in the oil pipe clip link with the corresponding hole in the oil pipe clip, and fit the bolt, spring washer, and nut; tighten the nut until finger-tight.
- (6) Working diagonally, evenly tighten the sixteen nuts which secure the induction pipe to the cylinder heads.
- (7) Similarly tighten the four bolts which secure the carburettor to the induction pipe, and the four nuts which secure it to the air-intake.
- (8) Tighten the bolts and nuts which secure the clip to the steady bracket.
- (9) *Mk. 7 only.* Tighten the bolt and nut which secure the oil pipe clip to the link.
- (10) *Mk. 1 variants, and Mk. 7 when Mod. G.1483 has not been embodied.* Fit the return spring to the hot and cold air-intake.

Mk. 7 in which Gipsy Mod. G.1483 has been embodied. Hook the return spring anchorage over the top stud in the front scavenge filter and secure it by fitting the spring washer and plain nut. Evenly tighten all three front scavenge filter nuts.

(11) *Mk. 1 variants when fitted with engine-driven fuel pumps and Mk. 7.* Couple the flooder cable to the lever on the carburettor using a new split pin, Part No. AGS784/1B, and clamp the cable guide to the bracket on the carburettor by fitting the cap and two bolts, spring washers, and nuts.

Settling tank (Mk. 7 only)

36. To fit the settling tank (or sump), turn the engine on its stand through 180 deg. so that the cylinders are uppermost and ensure that the stand is properly locked.

- (1) Place a new joint washer, Part No. 1303-57, on the face at the bottom of the timing gear cover.
- (2) Position the settling tank on the four studs.
- (3) Place a spring washer and a plain nut on each of the two rear studs to hold the settling tank while the next operation is performed.
- (4) Fit the flooder control clip and the suction oil pipe clip over the front inboard and outboard studs respectively.
- (5) Fit a spring washer and a plain nut on each of the two front studs.
- (6) Evenly tighten all four nuts.

Rear oil drain (Mk. 1 variants)

37. To fit the rear oil drain, turn the engine on its stand through 180 deg. so that the cylinders are uppermost and ensure that the stand is properly locked.

- (1) Place a new joint washer, Part No. 1303-57, on the face of the timing gear cover.
- (2) Position the rear oil drain on the four studs.
- (3) *When engine-driven fuel pumps are fitted.* Fit the flooder control clip over the front inboard stud.
- (4) Fit a spring washer and plain nut on each of the four studs and tighten all four nuts evenly.

Settling tank to pump oil pipe (Mk. 7 only)

38. Fit the settling tank to pump oil pipe as follows :—

- (1) Position a new joint washer, Part No.

1306-32A, on the front suction pump inlet port and on the settling tank outlet flange.

- (2) Position the oil pipe so that its flanged end fits on to the studs in the front suction pump inlet port and its elbow mates with the flange on the settling tank.
- (3) Secure the oil pipe to the settling tank by fitting the two bolts, lock washers, Part No. 1406-77, and nuts.
- (4) Secure the oil pipe to the oil pump by fitting two lock washers, Part No. 1406-77, and the two nuts.
- (5) Tighten all four nuts evenly and lock them.

Rear scavenge filter (Mk. 7 only)

39. Fit the rear scavenge filter as follows :—

- (1) Place a new joint washer, Part No. 1301-16, on the three studs at the bottom of the settling tank.
- (2) Fit the gauze filter into its casing.
- (3) Fit the cover and secure it with three spring washers and plain nuts.

Airscoop top plate and back plate

40. The airscoop top plate and back plate are fitted as follows :—

- (1) Position the top plate on the four studs in the crankcase adjacent to the tappets and secure it by fitting the four spring washers and plain nuts.
- (2) Position the back plate at the rear of the cylinders and secure it to the extreme rear end of the top plate by fitting the bolt and nut, and to the baffle on No. 4 cylinder head by fitting the two bolts and nuts.

Magneto timing

41. Except that the magnetos rotate in opposite directions, each is timed in a similar manner, and the procedure for fitting and timing one only is described. Reference should be made to the Leading Particulars on page 2 of this handbook if ignition timing data is required. As a safety gap is incorporated in these magnetos, no special precautions need be taken to avoid operating the impulse starter when the starboard mag-

neto spindle is rotated whilst the H.T. leads are not connected.

42. The point at which the contact breaker separates is best determined by a lamp and battery tester having leads terminating in crocodile clips, one lead being clipped to the insulated contact, and the other to any convenient earthed portion of the magneto, usually the moving contact springs; the light will go out immediately the contacts separate. When using this method, it is necessary to insulate the fixed contact from the primary winding on the armature to obviate a false indication due to the current earthing through the winding and causing the light to remain on even though the contacts have separated. Slacken the central retaining screw sufficiently to insert a piece of oiled silk between the screw head and the contact breaker, care being taken not to disturb the contact breaker assembly; re-tighten the screw. Do not omit to remove the oiled silk when the timing operation is completed. In an emergency a 0.001 $\frac{1}{2}$ in. feeler gauge, inserted between the contacts, may be used to determine their point of separation. If difficulty is experienced in setting the contact breaker of the starboard magneto at the required position because of the "flick over" action of the impulse starter, turn the magneto spindle in the reverse direction of rotation until the contacts have separated and just closed, and then turn the spindle forwards until the contacts just separate.

43. The magneto timing operation is carried out as follows :—

- (1) Remove No. 1 valve gear cover so that the valves can be observed to identify the compression stroke.
- (2) Using the slave or dummy propeller, turn the crankshaft forwards in the normal direction of rotation until the timing pointer attached to the propeller boss coincides with the mark "MAG.ADV" on the front cover with both valves in No. 1 cylinder closed.
- (3) Take off the contact breaker cover, check the contact gap, and if necessary adjust the contact points.
- (4) *Mk. 7 only.* Remove the distributor screen cover.
- (5) Remove the distributor.

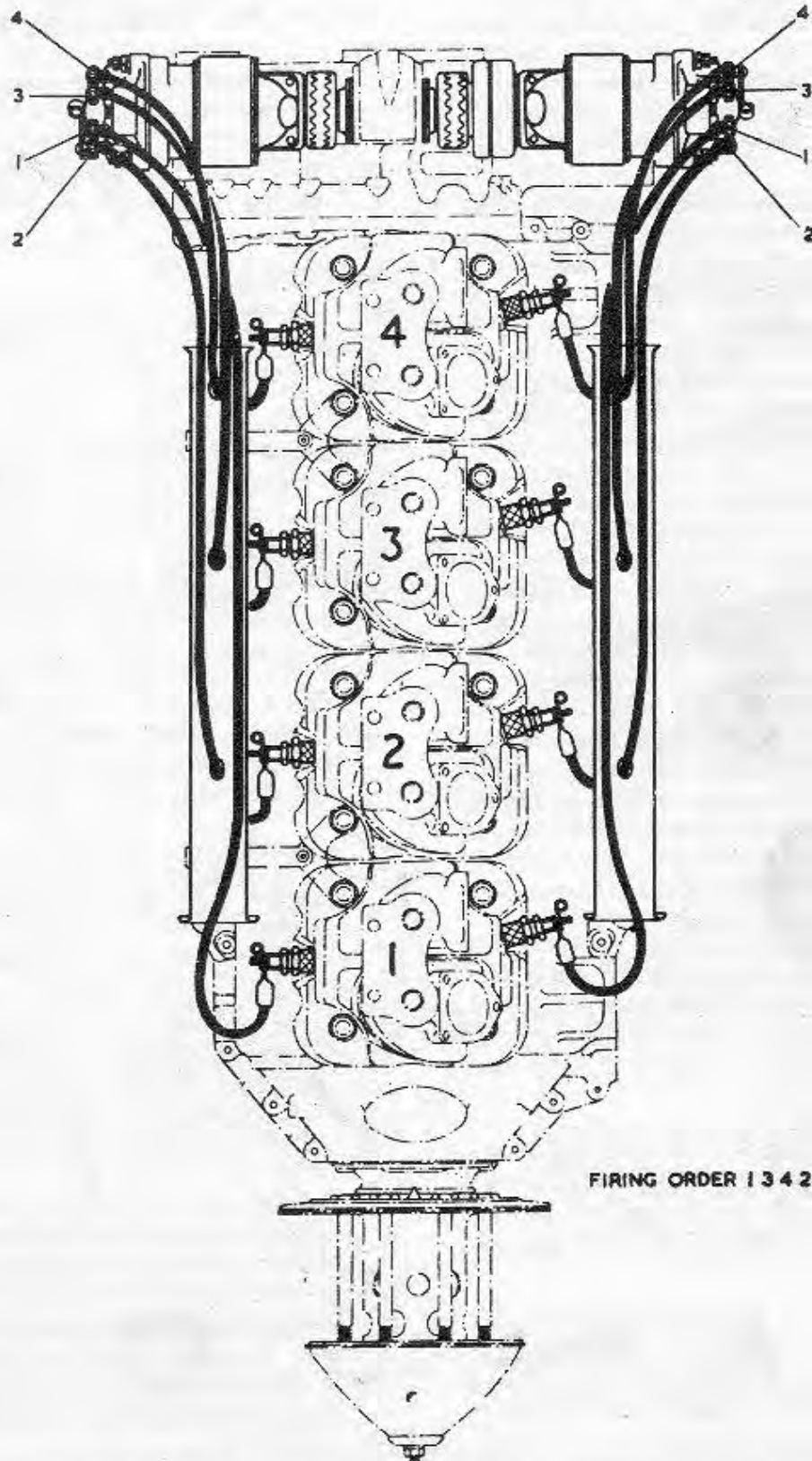
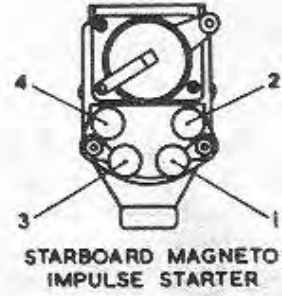
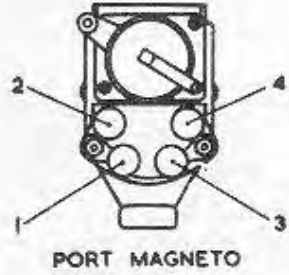


Fig. 6. Diagram of H.T. cables and distributor terminals

- (6) Ensure that the magneto is fully advanced by moving the magneto timing lever as far forward as the stops will permit.
- (7) Rotate the magneto spindle in the direction indicated by the arrow on the magneto until the rotating electrode is in the bottom forward (regarding the magneto as though installed on the engine with the latter in its normal attitude) quadrant of its travel approaching No. 1 distributor segment and the contact breaker contacts are just about to separate. The method of determining this has been fully described in para. 42.
- (8) Having set the crankshaft and the magneto correctly, turn the magneto coupling flange on the engine in the reverse direction of rotation to take up the backlash in the drive.
- (9) Place the packing piece on the magneto mounting and the two washers on the magneto securing screws.
- (10) Stand the magneto in position, and position the flexible coupling so that its teeth will engage the serrations in the magneto coupling flanges WITHOUT rotation of either the magneto spindle or the engine drive.

Note . . .

The coupling flange on the magneto has twenty serrations, and that on the engine nineteen. This provides a vernier adjustment and enables the timing to be altered in small steps by changing the relationship of the flexible coupling to the coupling flanges.

- (11) Slide the magneto inwards until the flexible coupling is in close contact and secure the magneto by fitting the two securing screws. Temporarily tighten the screws.*
- (12) Check the timing by turning the magneto spindle within the limits of the backlash in the drive. The contacts should "make" and "break" within this narrow range.
- (13) When the timing is satisfactory, finally tighten the magneto securing screws, ensuring that the starboard magneto is positioned so that the flexible coupling

has the end-float specified in the Schedule of Fits and Clearances.

- (14) Remove any insulating material used under the contact breaker retaining screw and re-tighten the screw.
- (15) Fit the contact breaker cover and the distributor, but (*Mk. 7 only*) leave the distributor screen cover off in preparation for connecting up the H.T. leads.
- (16) Wire-lock the two magneto securing screws with 18 S.W.G. locking wire.
- (17) Refit No. 1 valve gear cover, ensuring that it is labelled "NO OIL".

Sparking plugs

44. Screw eight dummy, or serviceable sparking plugs into the cylinder heads according to the requirements.

Unscreened H.T. cables (*Mk. 1 variants*)

45. The starboard H.T. cables have been attached to the starboard side of the engine already. Proceed to connect the starboard H.T. cables to the starboard distributor and to fit the port H.T. cables as follows:—

- (1) Connect the four starboard H.T. leads to the terminals on the starboard distributor. Ensure that each H.T. lead is connected to its correct terminal and fit the retaining nuts.

Note . . .

Each H.T. lead is marked with its relative cylinder number and the terminals in the distributor can be identified with the aid of fig. 6.

- (2) Position the port H.T. cable assembly on the port side of the engine and secure the H.T. cable tube to the brackets on the cylinder heads by the two bolts and nuts.
- (3) Secure the red fibre cable guide to the airscoop back plate by the two screws.
- (4) Bearing in mind the note which follows OP. 1, connect the four port H.T. leads to the terminals on the port distributor. Ensure that each H.T. lead is connected

* To avoid damaging the magneto armature, the length of the shank of each holding-down screw should not exceed 27 mm., and if necessary must be reduced to this length and the threaded end finished with a 1 mm., 45 deg. chamfer.

to its correct terminal and fit the retaining nuts.

Screened ignition harness (Mk. 7 only)

46. The port ignition harness has been attached to the cylinder heads already. Proceed to fit the starboard ignition harness and to connect up the port harness as follows :—

- (1) Position the starboard ignition harness assembly on the two studs in the induction pipe, and secure it by fitting the two spring washers and nuts.
- (2) Remove the H.T. lead retaining nuts from the terminals in the starboard distributor.
- (3) Carefully thread the leads into the distributor until the flange on the ignition harness fits on to the two studs in the distributor.
- (4) Connect the four starboard H.T. leads to the terminals in the starboard distributor. Ensure that each H.T. lead is connected to its correct terminal and fit the retaining nuts.

Note . . .

Each H.T. lead is marked with its relative cylinder number and the terminals in the distributor may be identified with the aid of fig. 6.

- (5) Fit the two nuts which secure the harness to the distributor and refit the distributor screen cover.
- (6) Bearing in mind the note which follows OP.4, connect the port ignition harness to its distributor in a similar manner.

Main control bracket

47. Before proceeding, turn the engine in its stand through 180 deg. so that it is in its normal attitude, and ensure that the stand is properly locked. The main control bracket assembly, including the oil pressure filter, should be refitted as follows :—

- (1) Position the main control bracket assembly on the studs in the timing gear cover.
- (2) Secure it to the timing gear cover by the three spring washers and plain nuts.
- (3) Using spanner T2200-51, finally tighten the oil pressure filter cover.

Throttle and ignition control linkwork

48. Adjustment of the control linkwork is

made by slackening the lock-nut and altering the position of the socket end fittings. After altering the length of a control rod or tube, ensure that the lock-nut is properly tightened and check that the adjustment has not altered whilst tightening the lock-nut; check that the socket end fitting is in "safety" by ensuring that a full-diameter pin will not enter the safety holes. The arrangement of the throttle and ignition control linkwork is shown in fig. 7. Connect the socket end of the control tube or rod to the ball-ends on the levers by unscrewing the plug sufficiently for the socket to be slipped over the ball-end on the lever, when the spring-loaded cup inside the socket is depressed. Screw in the plug until it just nips the ball and then unscrew it just enough to align one of the split pin holes with a slot in the plug. On certain Mk. 1 variant installations the altitude control tube, cross-shaft, and associated parts are not fitted, and the altitude control link (6 on fig. 8) is replaced by a locking bracket fitted between the end of the altitude valve operating lever and the bellcrank fulcrum on the carburettor so that the altitude control is locked positively in the full rich position.

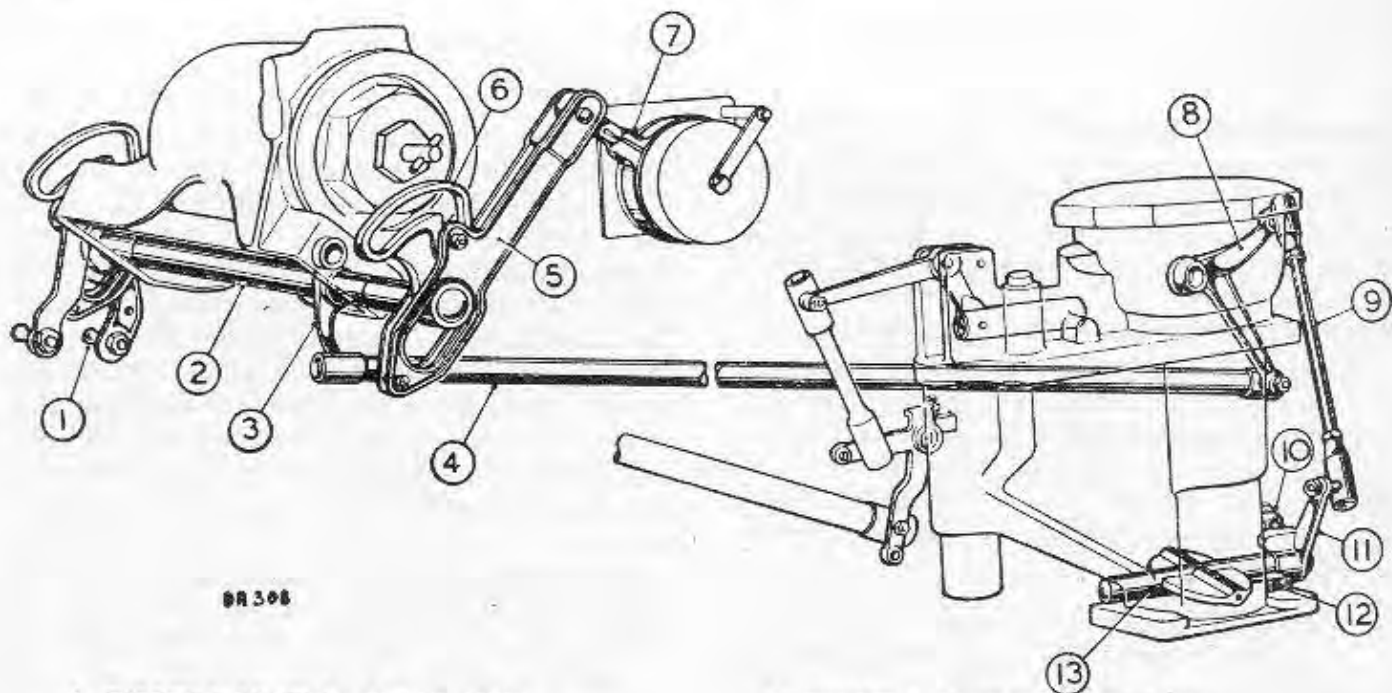
49. Refit and adjust the control linkwork as follows :—

- (1) Slacken the lock-nut and unscrew the slow-running adjustable throttle stop until the butterfly throttle valve is fully closed. Lock the stop in this position.
- (2) *Mk. 1 variants and Mk. 7 when Mod. G.1483 has not been embodied.* Open the throttle and then push the flame trap valve lever forward. A slight movement of the lever should be felt. If not, loosen the brackets holding the flap valve cable guide and adjust their position within the limits of the securing studs. Repeat the check after retightening the brackets.

Note . . .

Movement of the throttle lever must not be limited by the interconnected flame trap valve control. In other words the hot-air inlet should not be closed completely when the throttle is open fully against its stop.

- (3) Couple each magneto control link to the timing lever on the relevant magneto by fitting the shackle pin and a new split pin, Part No. 800-SP5.
- (4) Adjust the lengths of the throttle control tube and the throttle control rod so that

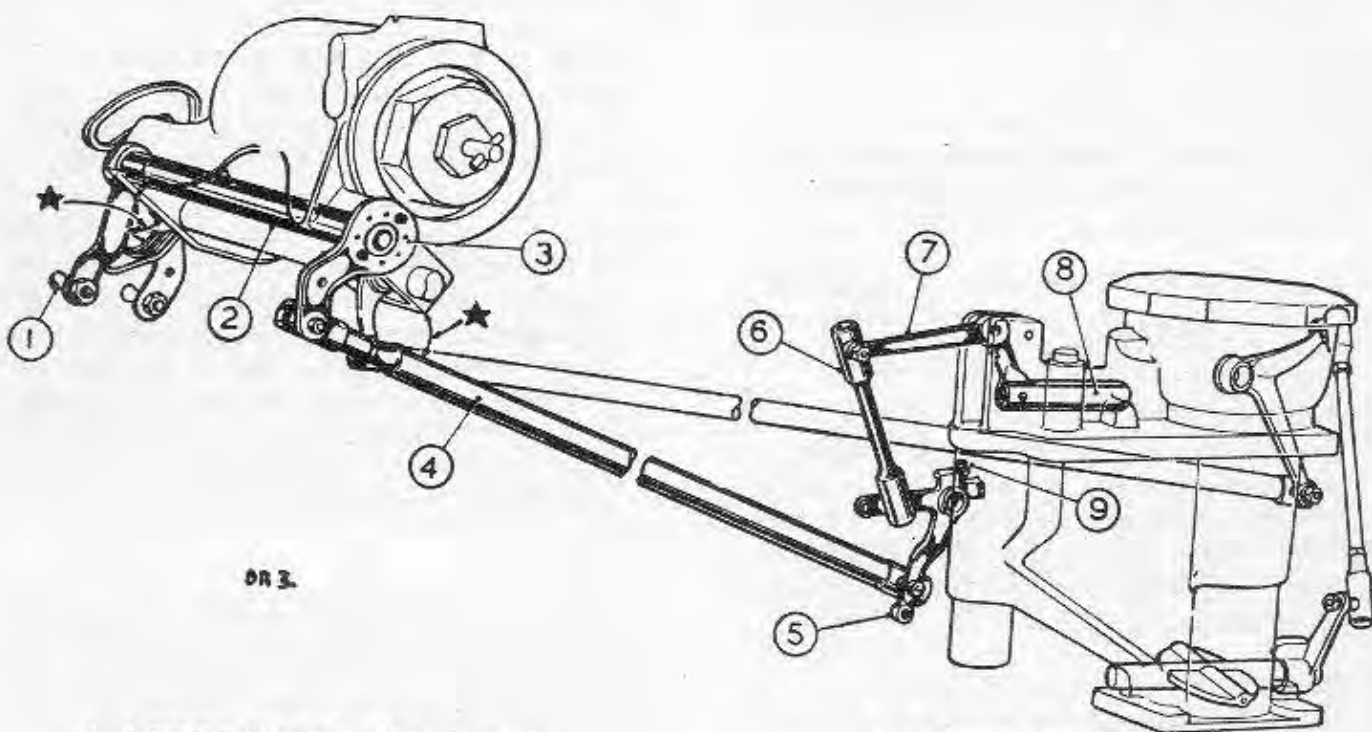


DR 308

- 1 THROTTLE CONTROL PICK-UP LEVER
- 2 THROTTLE CONTROL CROSS SHAFT
- 3 THROTTLE OPERATING LEVER
- 4 THROTTLE CONTROL TUBE
- 5 MAGNETO CONTROL LINK
- 6 MAGNETO CONTROL CAM
- 7 MAGNETO TIMING LEVER

- 8 THROTTLE CONTROL BELL CRANK
- 9 THROTTLE CONTROL ROD
- 10 ADJUSTABLE SLOW-RUNNING THROTTLE STOP
- 11 BUTTERFLY SPINDLE LEVER
- 12 FULL-THROTTLE STOP
- 13 BUTTERFLY THROTTLE VALVE

Fig. 7. Throttle and ignition control linkwork in the throttle-closed and ignition-retarded position



DR 3.

- 1 ALTITUDE CONTROL PICK-UP LEVER
- 2 ALTITUDE CONTROL CROSS SHAFT
- 3 ALTITUDE CONTROL OPERATING LEVER
- 4 ALTITUDE CONTROL TUBE
- 5 ALTITUDE BELL-CRANK ON CARBURETTOR

- 6 ALTITUDE CONTROL LINK
- 7 ALTITUDE VALVE OPERATING LEVER
- 8 ALTITUDE VALVE
- 9 STOP SCREW
(sealed and not to be altered)

★ Points at which fouling may occur through faulty adjustment

Fig. 8. Altitude (mixture) control linkwork

when the throttle valve is fully closed the magnetos are fully retarded, also so that the throttle valve opens fully before the magneto-control-link roller reaches the end of the slot in the cam.

- (5) Check that these conditions are obtained by operating the throttle pick-up lever through its full travel. Ensure that the magnetos are fully retarded when the throttle valve is fully closed, and fully advanced, i.e., with the magneto timing lever as far forward as stops in the magneto will allow, when the throttle valve is fully open. A 0.0015 in. feeler gauge placed against the slow-running and full throttle stops on the carburettor should be gripped when the throttle pick-up lever is moved to the full extent of its travel.

- (6) Lock the plug in each ball-end socket with a new split pin, Part No. 800-SP1.

Note . . .

The slow-running throttle stop cannot be adjusted finally until the engine is running on a test bench or in an airframe.

- (7) Adjust the length of the altitude (mixture) control tube so that movement of the altitude control valve in the carburettor is not limited by the pilot's altitude control pick-up lever on the port side of the engine (this may occur by the pick-up lever contacting the throttle control cross-shaft at one end of its travel), and the side of the altitude control tube fouling the main bracket casting at the other. These points are indicated by stars in fig. 8, which also shows the arrangement of the altitude control linkwork.

Note . . .

The control tube of the altitude valve control is provided with an adjustable end, but the length of the control link (rod) is fixed. There is a vernier connection between the altitude operating lever and the altitude control cross-shaft by which further adjustment is possible.

- (8) Check that the control operation is satisfactory and lock the plug in each ball-end socket with a new split pin, Part No. 800-SP1.

50. Both arms of the altitude bell-crank on the carburettor, and the altitude control operating lever, are provided with two holes

for the ball-end attachments. In the case of the bell-crank the holes nearest the pivot are used whilst the one nearer the end of the lever is used in the case of the operating lever. By fitting the ball in the upper arm of the bell-crank in the hole furthest from the pivot an increase in the range of travel of the mixture control valve can be obtained. In the inner setting the range of travel is sufficient to provide control of mixture strength up to about 15,000 feet. For altitudes above this, where the maximum range is required, the outer setting is necessary. Normally the mixture control is set for altitudes up to 15,000 feet, the link being connected to the inner position on the bell-crank as illustrated. If it is required to increase the range of travel of the mixture control valve for high altitude cruising, the ball must be moved to the outer position on the upper bell-crank lever, and locked by lightly riveting over the threaded end, and the link connected to the ball in this new position. This alteration must not be made without specific authority, and the setting of the adjustable stop in the bell-crank must not be altered. The remaining holes are not used on these marks of Gipsy Major engines.

51. Where engine-driven fuel pumps are fitted, the flooder control should have the cable adjusted so that the carburettor flooder valve knob is depressed when the control is operated and is able to return to its highest position when the pull on the cable is released.

Suction filter

52. Refit the suction filter as follows :—

- (1) Position the suction filter on the three studs in the timing gear cover.
- (2) Secure the suction filter by refitting the three spring washers and plain nuts.
- (3) When the suction filter is firmly attached to the engine, check that the drain plug, union, inlet elbow nuts, and large plug are securely tightened.

Oil pipes

53. The crankcase to suction pump oil pipe (Mk. 7), and the settling tank to pump oil pipe (Mk. 7) have been refitted already. The remaining oil pipes should now be refitted to the rear of the engine thus :—

- (1) *Mk. I variants.* Position the suction pump oil pipe assembly so that it connects the union at the bottom of the

suction filter to the inlet on the oil pump; tighten the union nuts at each end of the oil pipe, and wire-lock both union nuts with 18 S.W.G. locking wire.

Mk. 7. Place a new joint washer, Part No. 1306-32A, on the pressure pump inlet port and position the suction filter to pressure pump oil pipe so that its flanged end fits on to the two studs in the pressure pump inlet, and the nipple at its opposite end fits into the union at the bottom of the suction filter. Secure the oil pipe to the pressure pump by fitting two new locking washers, Part No. 1406-77, and the two nuts, and to the filter by screwing up the union nut. Lock the two nuts and wire-lock the union nut.

- (2) *Mk. 1 variants.* Fit a new joint washer, Part No. 1306-32A, on the pressure filter inlet and position the nipple at the end of the main oil pump to filter pipe assembly in the pump outlet and the elbow at its other end of the studs in the filter. Secure the pipe by tightening the union nut and by fitting the two spring washers and plain nuts. Wire-lock the union nut with 22 S.W.G. locking wire.

**Mk. 7.* Fit a new joint washer, Part No. 1306-32A, on the pressure pump outlet port and on the pressure filter inlet and position the flanged end of the pipe on the studs in the pump and its elbow on the studs in the filter. Place two spring washers on the studs in the filter and two new lock-washers, Part No. 1406-77, on the studs in the pump. Secure the pipe by fitting the four nuts and lock the nuts on the pump.

- (3) Ensure that the small gauze filter is fitted on the union on the pressure filter, and fit the small oil pipe which connects this union to the timing gear oil jet union adjacent to the tachometer drive. Tighten the union nut, place a new tab-washer, Part No. 1306/69B, on the pressure filter union and refit the nut. Lock the nut and wirelock the union nut with 22 S.W.G. locking wire.
- (4) Position the pressure filter to gallery in top cover oil pipe so that the nipples enter the unions on the pressure filter, and at the rear of the top cover, and secure the oil pipe by screwing up the

two union nuts. Wire-lock both union nuts with 22 S.W.G. locking wire.

- (5) *Mk. 1 variants.* Fit a hose connection to each end of the oil drain pipe. Wrap a 6½ in. × 4 in. piece of 120 mesh copper gauze round each hose connection and fit the four Jubilee or Supergrip clips. Position the oil drain pipe so that it connects the front oil drain to the rear oil drain and tighten the four clips.

Fuel pipe (engines with engine-driven fuel pumps)

54. No fuel pipe is fitted on Mk. 1 variants intended for installation in Tiger Moth Mk. 2 aircraft, which have a gravity feed. In all other instances, engine-driven fuel pumps are fitted and must be connected to the carburettor by refitting the fuel pipe as follows:—

- (1) Ensure that the clips are in position on the fuel pipe.
- (2) Connect the pipe to the fuel pump outlet by screwing up the union nut.

Note . . .

The fuel pump outlet is the connection between the pair of pumps.

- (3) Secure the front fuel pipe clip to the bracket on the airscoop back plate by fitting the bolt, spring washer, and plain nut.
- (4) *Mk. 7.* Fit the rear fuel pipe clip on to the stud in the settling tank and secure it with a spring washer and plain nut.
- (5) Connect the pipe to the banjo union on the carburettor and screw up the union nut.
- (6) Wire-lock the union nuts.

Electric starter (Mk. 7 only)

55. The starter adapter, which is secured to the mounting face on the timing gear cover of the Mk. 7, is regarded as part of the engine and should always be transferred with the engine. The electric starter will not normally be fitted, but if an electric starter is required for test purposes, it should be fitted as follows:—

- (1) Check that the clearance between the engine starter-dog jaws and the starter jaw, when the latter is fully retracted, is not less than $\frac{3}{32}$ in.

*Where Mod. 1982 has been embodied, the joint faces are mated satisfactorily, without straining the pipe, by using a laminum shim Part No. 37781 at either end of the pipes. The laminum shim must be assembled between two joint washers, Part No. 1306-32A.

(2) Apply a thin oil-jointing compound to the mating faces.

(3) Secure the starter to the adapter by fitting the six bolts, nuts and spring washers.

(4) Tighten the six nuts evenly.

Removing slave or dummy propeller

56. As described in para. 20, a slave or dummy propeller was fitted to enable the crankshaft to be held stationary and turned as required when tightening the front nut, and when timing the valves and magnetos. This must now be removed and the remaining propeller boss parts assembled as follows :—

- (1) Unscrew the four slotted 2 B.A. nuts which secure the locking plates and remove both the locking plates.
- (2) Unscrew the eight propeller bolt nuts, and remove the propeller boss plate and the slave or dummy propeller.
- (3) Refit the friction discs (Mk. 7), and the propeller boss plate.
- (4) Place three new shrinkage washers, Part No. 1900-16, on each of the eight propeller bolts and, using spanner T1400-129 and tommy bar T2300-232, refit the eight nuts.
- (5) Refit the two locking plates and secure them by refitting the four slotted 2 B.A. nuts.
- (6) Insert four new split pins, Part No. AGS 784/2B, but do not open the legs more than is essential to prevent the split pins falling out.
- (7) Refit the spinner or nose cap, dished washer, plain washer, and slotted nut.
- (8) Insert a new split pin, Part No. 800-SPI, but do not open the legs more than is essential to prevent the split pin falling out.

Final operations

57. Finally, hoist the engine off the erecting stand and carry out the following operations.

- (1) Check that all openings are blanked off.
- (2) Check all locking and complete any wire-locking that has not been done.
- (3) Remove the work-shop feet, or bearer arms, and refit the sixteen plain nuts, and sixteen new tab-washers, Part No. 801-52, on to the bearer arm studs.
- (4) Refit the two sections of the airscoop.

58. The engine must now be submitted to the specified tests, or prepared for despatch, storage, or installation as required.

At conclusion of test

59. At the conclusion of the engine test running, or the initial ground running, the three rocker bracket bolts must be checked as follows :—

- (1) Using a $\frac{1}{4}$ in. Whitworth socket, eight-inch extension bar, and a Delapena torque spanner TQ.50A (or Head Model 60) check that the three rocker bracket bolts are tight at a torque of 300 in. lb. ; the valve rocker can be displaced outwards against the spring sufficiently to permit the extension bar to pass.
- (2) If any of the bolts have slackened-off, re-tighten them to the correct torque.

Note . . .

It is recommended that the baffle is removed from the relevant cylinder head in order to ensure that the nuts are correctly locked, and that there is no tendency for them to turn when the bolts are re-tightened.

- (3) When everything is satisfactory, lock the three bolt heads.

LIST OF TOOLS

60. The following tools are available in the Dismantling and Assembling Tool Kit :—

Tool No.	Description
T800-53	Spanner, box, for camshaft gear-wheel nut
T2300-193	Bar, tommy, $\frac{3}{8}$ in. by 9 in. for camshaft gear-wheel nut spanner
T86081	Insertor for idler gear spindle
T2200-91	Spanner, box, for main bearing nuts

Tool No.	Description
T2200-92	Bar, tommy, $\frac{1}{2}$ in. by $7\frac{1}{2}$ in. for main bearing nut spanner
T1900-355	Tool, crankshaft turning
T2200-162	Insertor, gudgeon-pin circlip
T2200-167	Compressor, piston rings
T800-80	Spanner, jaw, for cylinder head retaining nuts
T1400-10	Spanner, jaw, for cylinder head retaining nuts
T1400-11	Spanner, jaw, for cylinder head retaining nuts
T85998	Fixture, thrust bearing nip
T85999	Nut for thrust bearing nip fixture
T85843	Centralising gauge for front cover
T2200-51	Spanner, pressure oil filter cover
TQ50A	Delapena torque spanner 0 to 600 lb. ; $\frac{1}{4}$ in. Whitworth socket ; and 8 in. $\frac{3}{8}$ in. square drive extension bar
T1400-129	Spanner, propeller hub bolt nut
T2300-232	Bar, tommy
T1900-383	Spanner, box, for crankshaft front nut
T1900-245	Bar, tommy, $\frac{3}{4}$ in. by 30 in. long for use with crankshaft front nut spanner
T77131	Lap, propeller hub taper
T77132	Lap, crankshaft taper

LIST OF CONSUMABLE STORES

61. The following new parts will be required at each assembly :—

Note . . .

Part numbers bracketed together are alternatives

Part No.	Description	No. off
1304-7	Lock washer for camshaft gear	1 ✓
AGS784-27 *800-SP1	} Split pins for rear camshaft bearing	2
1303-10			Lock washer for idler spindle plug	1
AGS784-12 *1300-SP2	} Split pin for idler spindle lock nut	1
35989			Joint ring for tappet guides	8 ✓
801-95	Lock washer for No. 1 main bearing	4
801-94	Lock washer for main bearings	8
*AGS784-20 800-SP3	} Split pins for main bearings	12
800-19			Circlips for gudgeon pins	8
35631	Joint ring for cylinder to crankcase joint	4
37257	Cylinder head joint washer	4
1302-12A	Joint washer for exhaust port flanges	4
*AGS784-2 800-SP1	} Split pins for starter dog nuts	6

LIST OF CONSUMABLE STORES—contd.

Part No.	Description	No. off
801-86	Joint washers for fuel pumps to crankcase joint	2
* AGS784-11 800-SP2	} Split pins for front cover nuts	5
35988		Joint rings for push-rod covers	16
1302-42	Joint washers for valve gear covers	4
1903-3	Joint washer for timing gear cover to crankcase joint	1 ✓
1903-2	Joint washer for timing gear cover to top cover joint	1 ✓
35987	Joint washer for tachometer drive to timing gear cover	1 ✓
1301-16	Joint washer for front oil drain to crankcase joint	1 ✓
1301-16	Joint washers for front scavenge filter	2 ✓
1306-32A	Joint washer for suction pump inlet port	1 ✓
1302-13	Joint washers for induction port flanges	4 ✓
* AGS784-1B	Split pin for flooder control	1
1303-57	Joint washer for settling tank to timing gear cover joint	1
1303-57	Joint washer for rear oil drain to timing gear cover joint	1
1306-32A	Joint washer for front suction pump inlet port and settling tank outlet port	2
1406-77	Lock washers for settling tank oil pipe bolts nuts	2
1406-77	Lock washers for oil pipe oil pump nuts	2
1301-16	Joint washer for rear scavenge filter cover	1
* 800-SP5	Split pins for magneto timing levers	2
AGS784-2 * 800-SP1	} Split pins for throttle control tube and rod	4
1306-32A		Joint washer for pressure pump inlet
1406-77	Lock washers for pressure pump inlet nuts	2
1306-32A	Joint washer for pressure filter inlet	1
1306-32A	Joint washer for pressure pump outlet	1
1406-77	Lock washers for pressure pump outlet nuts	2
1306-69B	Tab-washer for pressure filter union nuts	2
1900-16	Shrinkage washers for propeller bolts	24
* AGS784-2B	Split pins for propeller boss locking plate nuts	4
* AGS784-27 800-SP1	} Split pin for spinner nut	1
801-52		Tab-washers for bearer arm studs	16
37781	Laminum shim, for oil filter to pressure pump pipe	1

*These split pins are obsolete and are to be replaced as required by the following equivalents:—

800-SP1 and AGS784-2	...	...	...	...	...	...	...	...	SP9-C6
800-SP2 and AGS784-11	...	...	...	...	...	...	...	...	SP9-E8
800-SP3 and AGS784-20	...	...	...	...	...	...	...	...	SP9-G10
800-SP5	...	...	...	...	...	...	...	...	SP9-C4
1300-SP2 and AGS784-12	...	...	...	...	...	...	...	...	SP9-E10
AGS784-1B	...	...	...	...	...	...	...	...	SP9-B4
AGS784-2B	...	...	...	...	...	...	...	...	SP9-B6
AGS784-27	...	...	...	...	...	...	...	...	SP9-H8