

Chapter 9

SERVICING INFORMATION

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General

1. The aircraft Servicing Schedule details the routine servicing necessary to maintain the engine. As many of the requirements of the Schedule are self-explanatory they are not described in the following paragraphs.

2. Instructions for adjustment to tappet clearances and magneto contact breaker gaps are given in Chapter 10. Where blowing or leaking joints are observed, rectification by re-making the joint is covered in Chapter 12.

3. Ensure that both ignition switches are in the OFF position before commencing servicing, and that both are returned to the OFF position after any check for which they are switched on. Also ensure that the main fuel cock is turned off except during checks for which a supply of fuel is required. When an electric starter is fitted, set the ground/flight switch to GROUND but to ensure that the engine cannot be started accidentally, do not plug in a ground starter battery unless it is required to turn the engine by the electric starter.

4. Care must be taken during servicing that no dust or foreign matter is allowed to enter the engine, and approved blanks should be fitted to any aperture that is exposed. Rag or cloth must not be used for cleaning purposes as small particles of fluff may be carried into the oil ways.

5. Check the locking of all parts that have been disturbed and on completion of servicing, ensure that all tools and cleaning materials are removed from the engine and cowlings. A list of tools contained in the Flight Servicing Kit is given at the end of Chapter 12.

Airscoop

6. The airscoop is removed in two sections, the rear half first as it overlaps the front. Remove the two locking pins which secure the hinge pins at the front, and extract the hinge pins forward for about half their length whilst supporting the rear half of the airscoop. Remove this half and continue withdrawing the hinge pins to release the front half. When refitting the airscoop reverse these instructions, fitting the front half first. To remove the quickly detachable portion of the airscoop on Mk. 7 engines which have Mod. No. 1727 embodied, unscrew the three wing nuts which fasten the lower edge of the panel to the cylinder heads and release the three wing nuts at the centre of the airscoop; lift off the airscoop panel. When it is required to remove the remainder of the airscoop and the back-plate, reference should be made to Chapter 12.

Sparking plugs

7. To gain access to the sparking plugs on the port side of the engine the airscoop

must be removed. It is important that a thin film of graphite grease is applied to the threads before refitting the sparking plugs. Only the correct spanner T2200-16 with tommy bar T2300-193 may be used to tighten the sparking plugs. They should screw in freely by hand up to the washer, and then be tightened with the spanner but not to the extent that the circular sectioned washer is fully compressed. Take care not to over-tighten the sparking plugs, as instances have occurred where the sparking plug adapters fitted in the aluminium alloy cylinder heads on the Mk. 1C, 1F and 7 have been loosened in the cylinder head as a result.

Propeller nuts

8. The spinner must be removed to check the tightness of the propeller hub retaining nut or of the eight hub bolt nuts. Extract the split pin, unscrew the slotted nut, and remove the plain washer, the dished washer, and the spinner. Extract the four split pins, unscrew the four slotted 2 B.A. nuts which secure the locking plates, and remove the retaining nut locking plate. Using the spanner T1900-383, or T800-50A on engines without Mod. No. 903 embodied, with 30 inch tommy bar T1900-245, check the retaining nut and tighten if necessary; with the threads lubricated with engine oil, the retaining nut should be tightened to a torque of 350 to 400 lb. ft. Before the nuts on the propeller securing bolts can be checked; with spanner T2200-16 and tommy bar T2300-193, the second locking plate must be removed. After completion of the required checks, refit the two locking plates and the spinner; use four new $\frac{3}{8}$ in. by $\frac{3}{4}$ in. split pins to lock the nuts securing the locking plates, and a new $\frac{1}{8}$ in. by $\frac{3}{4}$ in. split pin for the spinner nut.

Rocker covers

9. Each rocker cover is identical and as the covers are free to fall once the central retaining screw is released, they should be supported by hand while the retaining screw is being unscrewed. Break the lock-wire and unscrew the retaining screw which is anchored to the rocker cover. Wash the cover in kerosine and examine the condition of the joint face and the joint face of the rocker casing attached to the cylinder head.

10. Check that the drain, or overflow, pipe is clear and ensure that the joint washer Part No. 1302-42 and the retaining screw washer Part No. 1302-66 are in good condition. To renew the retaining screw washer it will be necessary to release the retaining

screw from the rocker cover by extracting the split pin inside the cover; a new split pin must be used for re-assembly.

11. Fill the rocker cover to the level indicated by the collar on the drain pipe as shown in fig. 1, with oil to the specification given in the Leading Particulars. When refitting the rocker cover ensure that the joint washer is correctly positioned, and securely wire-lock the retaining screw.

Pressure filter

12. To clean the Auto-Klean pressure filter it is only necessary to give the handle at least one complete turn to remove particles from between the filter plates. At the hours stated in the Maintenance Schedule, the sediment must be cleaned out of the filter casing. Using spanner T2200-51 and tommy bar T2300-193 unscrew and remove the end cover with the filter assembly attached. *Do not attempt to dismantle the filter assembly from the end cover.* Thoroughly wash the filter and clean the inside of the filter casing with kerosine; dry off all traces of kerosine with a compressed air jet.

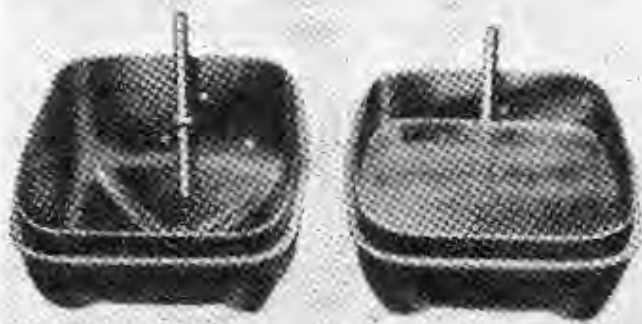


Fig. 1. Oil level in rocker covers

13. Ensure that the joint faces of both the end cover and the filter casing are clean and free from burrs which might prevent an oil-tight joint. Examine the copper-asbestos joint washer, Part No. 1405-40, and renew if necessary. Refit the end cover complete with the filter assembly and wire-lock.

Suction filter

14. Before removing the suction filter for examination or cleaning, break the lock-wire, remove the drain plug from the bottom of the casing and allow the oil to drain. Break the lock-wire, and unscrew the cap from the top of the filter casing. Withdraw the filter; ensure that the gauze is undamaged and wash in clean kerosine. When refitting the filter ensure that its inner end locates correctly in the recess in the bottom of the

filter casing. Examine both the drain plug washer Part No. 1406-90 and the cap-washer Part No. 1406-16A and renew if either is defective. Ensure that the joint faces of the plug, the cap, and the casing are clean and free from burrs which may cause air leaks and failure of the lubricating system. Fit and wire-lock the drain plug. Fit the filter cap but do not wire-lock until the lubricating system has been primed as described in Chapter 6.

Scavenge filters

15. In the Mk. 7 there are two scavenge filters, one in the bottom of the oil sump or settling tank at the rear of the engine and one in the starboard side of the crankcase just above No. 1 cylinder. As both are similar, the description for removal when examination or cleaning is required is applicable to either.

16. Unscrew the three plain nuts, remove the spring washers, and if Gipsy Mod. G.1483 has been embodied unhook the flame trap valve return spring anchorage (front scavenge filter only). Remove the cover and joint washer, and withdraw the filter. Examine the filter for signs of metal particles, then wash in clean kerosine and ensure that the gauze is intact. Check the filter casing and the cover joint faces, and the joint washer Part No. 1301-16 which must be renewed if defective. When refitting the filter, ensure that it locates correctly into the recess at both the inner end of its casing and in the cover. If Gipsy Mod. G.1483 has been embodied, hook the flame trap valve return spring anchorage over the top stud after refitting the front scavenge filter cover; refit the spring washers and plain nuts.

Fuel pump filters

17. When engine-driven fuel pumps are fitted, a filter is embodied in each fuel pump. Both are accessible by unscrewing the knurled nut under the filter bowl until the retaining stirrup can be swung sideways, when the filter bowl, cork washer and gauze filter can be removed. Examine and clean the filter, and the joint faces of the bowl and pump. To ensure against air leaks which may cause defects in the fuel system, it is advisable to fit a new cork washer, Part No. 854003, whenever the filter bowl is disturbed.

18. Fit the gauze filter with the metal-webbed side uppermost, followed by the

cork washer and the filter bowl. Ensure that the retaining boss is correctly positioned between the knurled nut and the filter bowl, and tighten the nut. It is very important that the filter bowl is securely clamped in position.

Fuel flow check (gravity feed)

19. If it is required to prove the correct functioning of the fuel supply to the carburettor on installations which rely on a gravity feed, make the following check. With the aircraft in the tail down position, ensure that the aircraft fuel filter is clean and correctly fitted. Disconnect the fuel supply pipe from the carburettor, turn on the fuel cock and note the time for one quart of fuel to flow. This time should not be more than 20 seconds.

Fuel pump check

20. Measuring the delivery of fuel from the pumps to the carburettor by connecting an auxiliary gravity fuel tank to the carburettor and checking the combined flow from both fuel pumps into a graduated container whilst the engine is running, does not check that both pumps are functioning correctly. Single pump delivery may, however, be checked by moving the priming lever on one pump to the full extent of its travel and holding the lever in this position whilst observing the delivery of the other pump.

21. If a replacement fuel pump unit has been fitted, or if it is required to prove the correct functioning of either pump the following checks will be necessary. Disconnect the fuel delivery pipe to the carburettor from the union between the two fuel pumps and attach a low reading pressure gauge in its place. Turn on the main fuel cock and operate in turn the priming lever on each pump. A pressure of approximately 2 lb. per sq. in. should be registered on the gauge almost immediately in each case.

22. To check the condition of the valves in the fuel pumps, proceed as described in the previous paragraph and, when a small pressure is registered on the gauge, lift the priming lever of the pump being tested to the full extent of its travel. The delivery valve should hold the pressure for about five seconds. When the pressure has fallen the priming lever should be released and a further pressure will be registered. The inlet valve should hold this pressure for at least a minute. Repeat the check for the

second pump. If the results of the test are unsatisfactory, remove the pressure gauge and operate the priming levers, since failure of the valves to hold pressure may be merely due to specks of dirt on the valve seatings which the flow of fuel induced by operation of the priming levers may wash away. Refit the pressure gauge and repeat the test.

23. It is not permissible to separate the fuel pump top cover from the main body for cleaning purposes. Instead, break the lock-wire and remove the valve chamber plugs, take out the springs and the valves, then flush the cover through with fuel. Ensure that all parts are clean and undamaged, and if necessary renew the copper washers, Part No. A.10-27/1, and refit each valve, spring and plug into its correct aperture. When screwing the valve plugs into the top cover ensure that the valve stems are truly inside the valve guides which are integral with the plugs, before tightening down. Check the valves for correct functioning as described in para. 21 and 22. When the test is satisfactory, wire-lock the valve plugs, remove the pressure gauge, re-connect the fuel delivery pipe and turn off the main fuel cock.

Flame trap

24. To examine the flame trap it will be necessary to remove the air-intake from the engine as described in Chapter 12.

Cylinder holding-down nuts and rocker bracket bolts

25. Three special spanners TS00-80, T1400-10, and T1400-11 are provided for checking and tightening the cylinder holding-down nuts. Each spanner has the jaw set at a different angle to the shank so all the cylinder holding-down nuts are accessible without any dismantling of the engine, except for removal of the aircscoop as described in para. 6. It is important that only the correct spanners are used as their length has been chosen to obviate any risk of over-tightening. After tightening any of the cylinder holding-down nuts the tappet clearance must be checked and adjusted if necessary.

26. At the periods specified for checking the tappet adjustment, a check to ensure that none of the rocker bracket bolts has slackened off should be made before the adjustment is carried out. To do this without disturbing the locking of the bolts, a $\frac{1}{2}$ in. Whitworth socket should be modified by grinding away two of the flats, as indicated in fig. 2, to clear the locking tabs; the valve rocker can be displaced outwards, against the spring, sufficiently to permit the

socket extension bar to pass. Alternatively, a thin open-ended jaw spanner, approximately 4 in. long can be used in conjunction

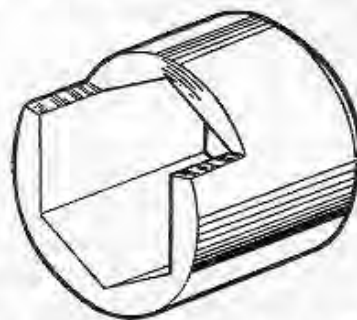


Fig. 2. Socket spanner modified to clear locking tabs

with a 3 in. tommy bar. To obtain a grip on the right-hand bolt head the thinnest spanner practical must be employed to obviate a foul with the tab washer. If one of the bolts is found to be loose, the valve rocker bracket must be removed, as described in Chapter 12, in order to check that the bolts are satisfactory and that no damage has been done by running the engine with the assembly slack; it will also be necessary to remove the rocker bracket to fit new locking devices.

Carburettor (See also page 196)

27. The main and power jets are accessible without removing the carburettor from the engine. Both the main jet, which is nearer the cylinders, and the power jet are located in the bottom of the carburettor, whereas the slow-running jet is in the upper part. If it is required to remove the slow-running jet, it is advisable to remove the carburettor assembly from the engine. Having removed the jets, turn on the main fuel cock and where fuel pumps are fitted, operate one of the fuel pump priming levers, to flush the carburettor and remove any water or sediment. Do not insert or use any tool to remove obstructions from the jets, but carefully blow the orifices through with a compressed air jet. Ensure that all parts are clean and undamaged before refitment. If necessary renew the fibre washers, Part No. CH.14726 for the slow-running jet, CH.10240 for the main jet, and CH.10261 for the power jet. The jets are similar in appearance, therefore it must be ensured that each is refitted in its correct location. Wire-lock after tightening.

28. For further examination of the carburettor, such as inspection of the float or to check the fuel level in the float chamber, it will be necessary to remove the carburettor from the engine as described in Chapter 12.

29. To check the functioning of the impulse starter fitted to the starboard magneto, proceed as follows. Ensure that both ignition switches are OFF and turn the propeller slowly by hand when the actuation of the impulse starter should be heard distinctly. There should be two audible clicks for each complete revolution of the crankshaft. If, due to other noises, this check is not conclusive, arrange for a second operator to place a hand on the static portion of the impulse starter and proceed in the same way, when a positive impulse should be felt. If this does not occur, check that the flexible coupling has not become swollen and that it has between 0.010 and 0.020 in. end float. If the end float is insufficient, loosen the two magneto holding-down screws and endeavour to obtain the required end float by adjusting the position of the magneto. If this is not possible, a replacement coupling should be fitted in accordance with the instructions given in Chapter 12. Assuming the end float is correct, flushing the mechanism with thin lubricating oil preferably containing colloidal graphite may be effective. If the foregoing does not effect a remedy the magneto must be removed as described in Chapter 12 and the impulse starter dismantled as described in the following paragraph.

30. Bend back the locking tab and unscrew the retaining nut from the magneto armature spindle. An extractor will be required to withdraw the rotating portion of the impulse starter and give access to the spring, which is the most probable cause of failure. If this is in good condition and not broken, check that the pawls are free; if necessary remove the circlips and push out the pivot pins. Clean and inspect all parts for damage or wear and re-assemble using new circlips* and a new locking washer under the retaining nut, and refit the magneto to the engine.

31. To lubricate the impulse starter, ensure that the ignition switches are OFF and turn the engine backwards by hand until the holes in the fixed and rotating portions of the impulse starter align. Inject the lubricant specified in the Servicing Schedule and clean off all traces of oil which may drain out. (See page 283)

Magnetos

32. To examine the contact-breaker points and check the gap, move the retaining spring

to one side and detach the contact breaker cover. If it is required to true the contact points unscrew the central retaining screw and remove the contact breaker. When either of the contact breaker covers is removed on engines without Mod. No. 2010 embodied, it is important to note that the ignition switch is inoperative and it is stressed that *the propeller must not be turned* under these conditions unless the H.T. leads have been detached or a sparking plug removed from each cylinder.

33. Examine the contact points, and remove any deposit with a cloth moistened with trichlorethylene; if the contacts are pitted, the surfaces may be carefully faced with a piece of fine emery cloth or if necessary by stoning, provided that the thickness of the platinum contact after facing will be not less than $\frac{1}{2}$ mm. and the two contact faces absolutely parallel when the parts are assembled. After facing by either method the contact faces should be thoroughly cleaned with a cloth moistened in trichlorethylene. The internal oil wick of the pivot pin and the cam ring should be given *one drop only* of engine oil at the specified intervals.

34. When refitting the contact breaker assembly ensure that the key on the contact breaker base is correctly located in the keyway in the armature spindle.

35. It is important that the contact points are kept free from oil which will prevent good electrical contact. Feeler gauges used to check the contact breaker gap should be cleaned before inserting between the contacts.

36. Turn the engine until the contact points are fully separated and using feeler gauges check, and if necessary adjust, the gap to 0.012 ± 0.001 in. as described in Chapter 10.

37. Carbon or metal particles inside the distributor are liable to cause tracking which may result in misfiring or poor starting. In the case of the Mk. 7 engine with screened ignition, it will first be necessary to unscrew the four nuts securing the distributor screen cover and to remove the cover. To obtain access to the distributor and brush holder for examination, unscrew the two nuts which secure the distributor to the magneto and remove the distributor. The brush holder will then be exposed and

*Mod. 2189 introduces a thin washer, Part No. CX 138687, fitted between the locking washer and the hollow fixing nut, which prevents damage to the locking tab when the nut is tightened.

can be wiped clean. Similarly, clean the inside of the distributor before refitting components. Check that the ventilation holes in the distributor moulding are clear, and clean as necessary. Blocked ventilation holes promote conditions for condensation with subsequent cracking and burning of the rotor and moulding.

38. To examine and clean the H.T. pick-up slip ring, unscrew the two screws securing the driving end cover and remove the cover. This exposes the collector moulding which can be removed after unscrewing the two fixing screws. Wipe off any dust with a cloth moistened in gasoline. Do not unnecessarily remove the carbon brush from the collector moulding. Clean the slip ring and flanges by lightly pressing one corner of the cloth between the slip ring flanges and slowly turning the crankshaft; ensure that the ignition switches are OFF and observe the warning given in para. 31.

39. Refit the parts when they are clean and serviceable, care being taken that the carbon brush and spring in the collector moulding are correctly positioned. For fuller information relating to the magnetos, reference should be made to the relevant magneto publication.

Crankshaft

40 If the crankshaft has a tapered end, it should be examined for cracks at intervals not exceeding the following: (a) Crankshaft pre-Modification G.424 standard: 50 flying hours. (b) Crankshaft of Modification G.424 standard: 100 flying hours. The examination should be conducted as follows:

- (1) Raise the tail of the aircraft until the engine is in a slightly nose-down attitude. Secure the aircraft in this position.
- (2) Turn the propeller until the key in the crankshaft is at top centre relative to the operator.
- (3) Remove the propeller hub and propeller as a complete unit, as described on page 117, paragraph 15, operations 1, 2, 5, 6 and 7.
- (4) Screw extractor T 2200-B6 (or a 5 mm set-screw) into the tapped hole in the key until the key has been forced out of the keyway.
- (5) Extract the split pins, and remove the five slotted nuts which secure the front cover to the top cover and the crankcase. Remove the washers, front cover, the steel shim, and the packing shims.
- (6) If Modification G.2094 or G.2495 have not been embodied, release the locking tab, hold the crankshaft stationary and, using spanner T 1300-51, unscrew the thrust bearing lock nut. Slide the lock nut and the tab washer off the front end of the crankshaft.

- (7) Clean the front end of the crankshaft, and pre-Modification G.2094 or G.2495, the thread.
- (8) Examine the fit of the key in the keyway to ensure that there is no excessive movement and that the key is not stepped in any way.
- (9) (a) On engines not embodying Modification G.2094 or G.2495.

Using a powerful magnifying glass, make an extremely thorough inspection for cracks in the tapered portion of the crankshaft and the root of the first three threads; be careful to check the complete circumference of the shaft. Particular attention should be paid to the bottom and sides of the keyway, and the area between the rear of the keyway and the first thread.

(b) On engines in which Modification G.2094 or G.2495 is embodied.

Using a powerful magnifying glass, make an extremely thorough inspection for cracks in the tapered portion of the crankshaft; be careful to check the complete circumference of the shaft. Particular attention should be paid to the bottom and sides of the keyway, the front edge of the sleeve where it mates with crankshaft, and the area immediately to the rear of the keyway.

- (10) (a) Apply a dyed penetrating fluid to the areas defined in (9)(a) or (9)(b), as appropriate; the application should be carried out in accordance with the fluid manufacturer's instructions.

The following proprietary fluids are recommended for this purpose: Ardrox 996, manufactured by the Brent Chemical Company, Commerce Road, Brentford, England. Met-L-Chek, manufactured by the Magnaflux Corporation, Chicago, Ill., U.S.A.

(b) Using a powerful magnifying glass, carefully inspect the treated areas for cracks; if cracks are present they will appear as dark lines.

- (11) If no cracks are revealed the shaft is serviceable and it should therefore be cleaned and dried in preparation for refitting of the propeller.

Note: If portable Magnaflux crack detection equipment is available this may be used as an alternative to the procedures described in paragraphs (9)(a), (9)(b), (10)(a), and (10)(b).

Chapter 10

ADJUSTMENTS

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General

1. There are few adjustments that require to be made between reconditioning periods. The tappet clearance and contact breaker gap tend to alter as the result of settling down and wear, and the slow-running setting may require adjustment to compensate for seasonal changes of atmospheric temperature. The oil pressure setting should not normally require adjustment. Similarly the control linkwork should not normally require adjustment unless replacement of certain components is necessary. If it is desired to check the valve timing when investigating a defect for which no obvious cause can be found, the procedure is described in page 81 of Chapter 8. The procedure for timing the magnetos is given in Chapter 12.

Tappet clearance

2. The tappet clearance should be checked and adjusted only when the engine is cold. If the cylinder holding-down nuts require tightening, this must be completed before any attempt is made to check or adjust the tappet clearances. To obtain access to the tappet adjustment, remove the rocker covers, as described in Chapter 9. Use feeler gauges inserted between the end of the rocker and

the thimble on the tip of the valve stem to check the clearance. A screwdriver will be required for the ball-end adjusting screw at the other end of the rocker and a spanner to loosen and tighten the lock-nut. Before checking the clearance, ensure that both tappets for the cylinder being dealt with are on the base circles of their cams, i.e., with the cylinder on compression and both valves closed. This position can be determined readily by observing the "rocking" of the valve rockers in the overlap period, on the other cylinder in the same crank position as given in the following table.

<i>When adjusting tappets on cylinder number</i>	<i>Observe valve rockers on cylinder number</i>
1	4
2	3
3	2
4	1

3. Slacken the lock-nut, set the clearance to the value stated in the Leading Particulars, and retighten the lock-nut ensuring that the adjustment does not alter; re-check the tappet clearance. After the tappets on each cylinder have been adjusted replace the rocker covers.

Contact breaker gap

4. Do not adjust the contact breaker gap unnecessarily. To ensure good electrical contact it is important that the contact points are kept free from oil. Feeler gauges used to check the contact breaker gap should be wiped with a cloth moistened in trichlorethylene before inserting between the contacts. When either of the contact breaker covers is removed on engines without Mod. No. 2010 embodied, it is important to note that the ignition switch is inoperative, and it is stressed that *the propeller must not be turned* under these conditions unless the H.T. leads have been detached or a sparking plug removed from each cylinder.

5. To obtain access to the contact breaker, move the retaining spring to one side and detach the contact breaker cover.

6. Turn the engine until the contacts are fully separated with the heel of the moving contact arm on the highest part of the cam. To avoid operating the impulse starter when dealing with the starboard magneto, turn the engine backwards until the contacts have separated and just closed, and then turn the engine in its normal direction of rotation until the contacts are fully separated. Using feeler gauges, measure the gap between the contacts which should be 0.012 ± 0.001 in.

7. When it is necessary to adjust the contact breaker points, slacken the lock-nut on the adjustable contact and turn this contact until the gap is correct, using the combined spanner and feeler gauge T800-20. Tighten the lock-nut and re-check the gap. After completion of this adjustment, check that the two contact faces are parallel when closed, as it is important that contact is made over a high percentage of their area. Replace the contact breaker cover and refit and/or reconnect the sparking plugs.

Slow-running

8. Only two adjustments both affecting the slow-running, may be made to the carburettor. All other adjustments are made on the test bed during manufacture or reconditioning.

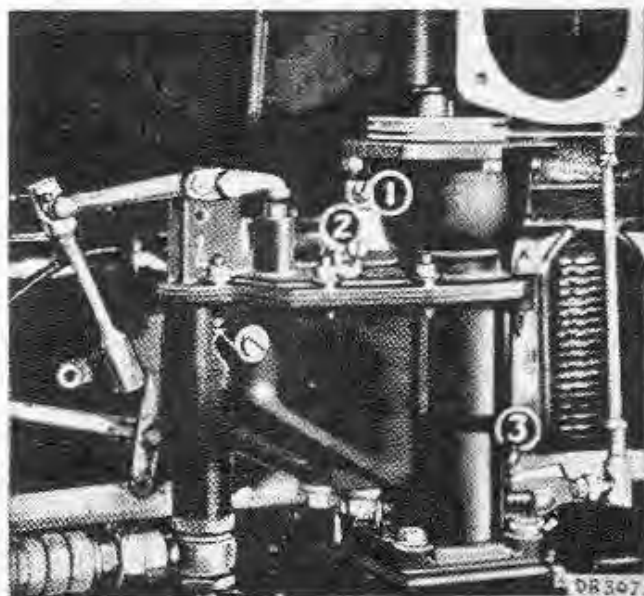
9. These two adjustments are:—

(1) The adjustable slow-running throttle stop (*item 3 in fig. 1*) which controls the extent to which the throttle valve can close and thus the quantity of mixture admitted to the cylinders.

(2) The slow-running mixture adjustment screw (*item 1 in fig. 1*) which regulates the

quality of the slow-running mixture by bleeding either more or less air into the system.

10. The slow-running mixture screw (*item 1 in fig. 1*) is the upper of the two adjustable screws on top of the carburettor and must not be confused with the lower screw (*item 2 in fig. 1*) which is the mixture control screw. Unscrewing the slow-running mixture screw weakens the mixture and vice versa. If it is necessary for this adjustment to be screwed right in, it is an indication that excessive air leaks are occurring, and the joints between the induction manifold, and the carburettor and cylinder heads should be examined. The induction manifold drain should also be checked.



- 1 SLOW-RUNNING ADJUSTMENT SCREW
- 2 MIXTURE CONTROL SCREW
(sealed and not to be altered)
- 3 ADJUSTABLE SLOW-RUNNING THROTTLE STOP

Fig. 1. Carburettor adjustments

Note . . .

The mixture control screw or diffuser air adjusting screw is adjusted and sealed on the test bed, and must not be altered in any circumstances.

11. Before attempting to adjust the slow-running, the engine should be warmed up to normal operating temperature. Unlock the two adjustable screws and proceed as follows. With the engine running steadily, adjust the throttle stop until the desired idling speed of 600 to 650 r.p.m. is obtained. In conjunction with this adjustment it will be necessary to correct the mixture strength by means of the slow-running adjustment screw. The adjustments should be made

with care, moving each screw a small amount at a time in the appropriate direction.

Note

When the throttle stop has been unscrewed for the purpose of adjusting control linkwork as instructed in para. 17 it will be necessary to screw in the throttle stop initially.

12. If, as the desired idling speed is approached, the engine tends to stall and run erratically, the mixture is probably too weak and the slow-running adjustment screw must be screwed in; conversely if the engine labours with a smoky exhaust, the mixture is too rich and the adjustment will require unscrewing. As the correct mixture strength is approached, the engine speed should tend to increase and further adjustment of the throttle stop will be needed to bring the r.p.m. to the desired value. Should it prove impossible to weaken the mixture sufficiently by means of the slow-running adjustment screw, the induction manifold drain elbow, Part No. 1905-36, which includes a 2 mm. diameter orifice to give a known air leak, may be obstructed or damaged. The Part No. should also be checked as a similar part intended for another type of engine would not have the correct size orifice. A loose or restricted slow-running jet in the carburettor will also affect the slow-running mixture.

13. Having obtained satisfactory slow-running, check that the engine opens up cleanly without any hesitation or tendency to a "flat" spot. If the acceleration is not entirely satisfactory, it will be necessary to enrich the slow-running mixture slightly. When the desired conditions are obtained, lock both adjustments.

Oil pressure

14. The oil pressure relief valve setting is altered by increasing or decreasing the number of 20 s.w.g. discs (0.036 in. thick), Part No. 806-15, which are fitted between the end of the relief valve spring and the inner end of the hollow valve plunger. Add discs to increase the oil pressure and remove the discs to decrease the oil pressure. To do this, bend down the lock washer tab and unscrew the cap-nut which is situated below the oil pump delivery connection; as the end of the thread is approached, ensure that the valve parts do not spring out. Add or remove discs as required and after ensuring that all

the parts are clean and serviceable, fit a new lock-washer (Part No. 1306-16) and re-assemble the parts in the pump rear cover but do not lock the cap-nut until the engine has been run to check the oil pressure.

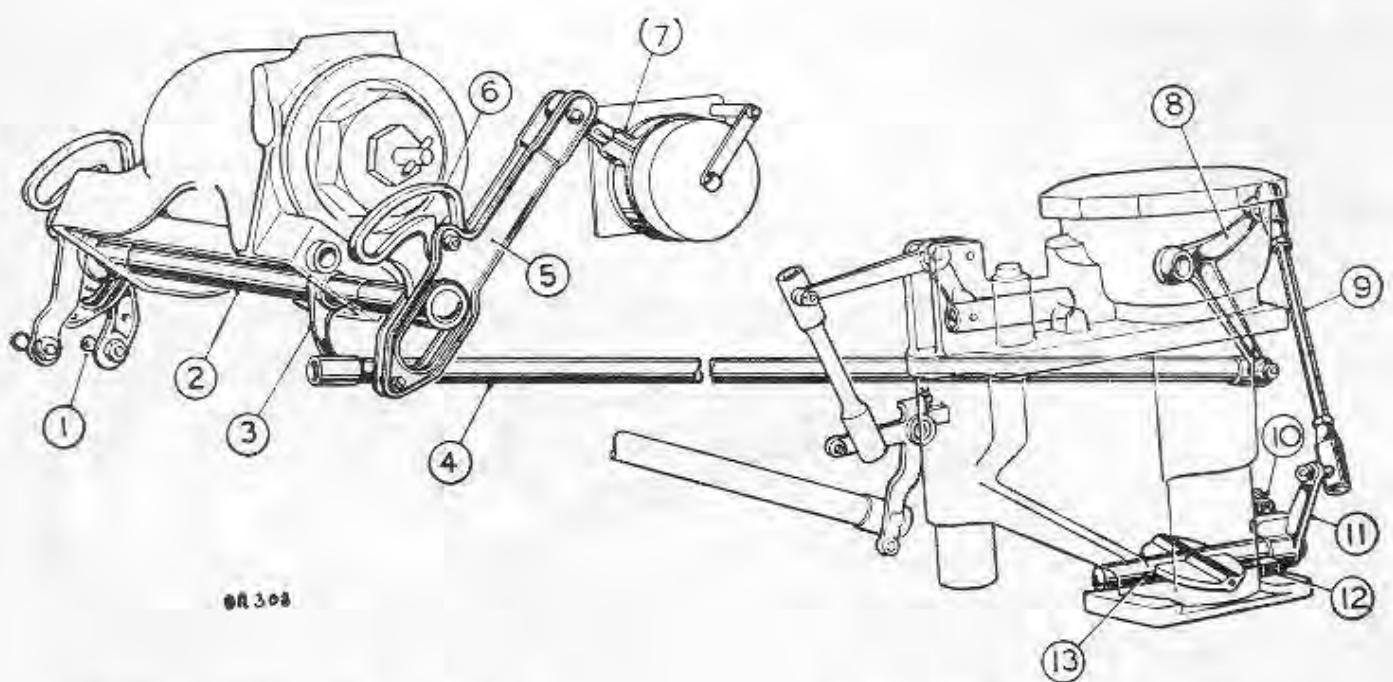
15. With the engine running at 2,100 r.p.m. in the case of a Mk. 1, 1C, or 1F, and at 2,300 r.p.m. in the case of a Mk. 7, and an oil inlet temperature of 70 ± 2 deg. C., the oil pressure should be between 40 and 45 lb. per sq. in. If it is difficult to obtain this temperature without excessive running, and the design of the aircraft permits, a blank should be temporarily fitted to the oil tank cooling duct. If the required temperature proves impossible to obtain, an oil inlet temperature of 50 deg. C. may be used as a datum. In this case the oil pressure at the recommended r.p.m. should be between 45 and 50 lb. per sq. in. When the oil pressure is satisfactory, lock the cap-nut by bending up the tabs of the lock-washer.

Control linkwork

16. Adjustment of the control linkwork is made by slackening the lock-nuts and altering the position of the socket end fitting. 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.

17. The arrangement of the throttle and ignition control linkwork is shown in fig. 2. Before fitting the throttle control tube and the throttle control rod, 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. On Mk. 1 variants and on the Mk. 7 when Mod. G.1483 has not been embodied it is necessary to ensure first that the movement of the throttle lever is not limited by the inter-connected flame trap valve control as described in para. 22.

18. Connect the socket ends 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 enough to align one of the split pin holes with a slot in the plug.



- 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

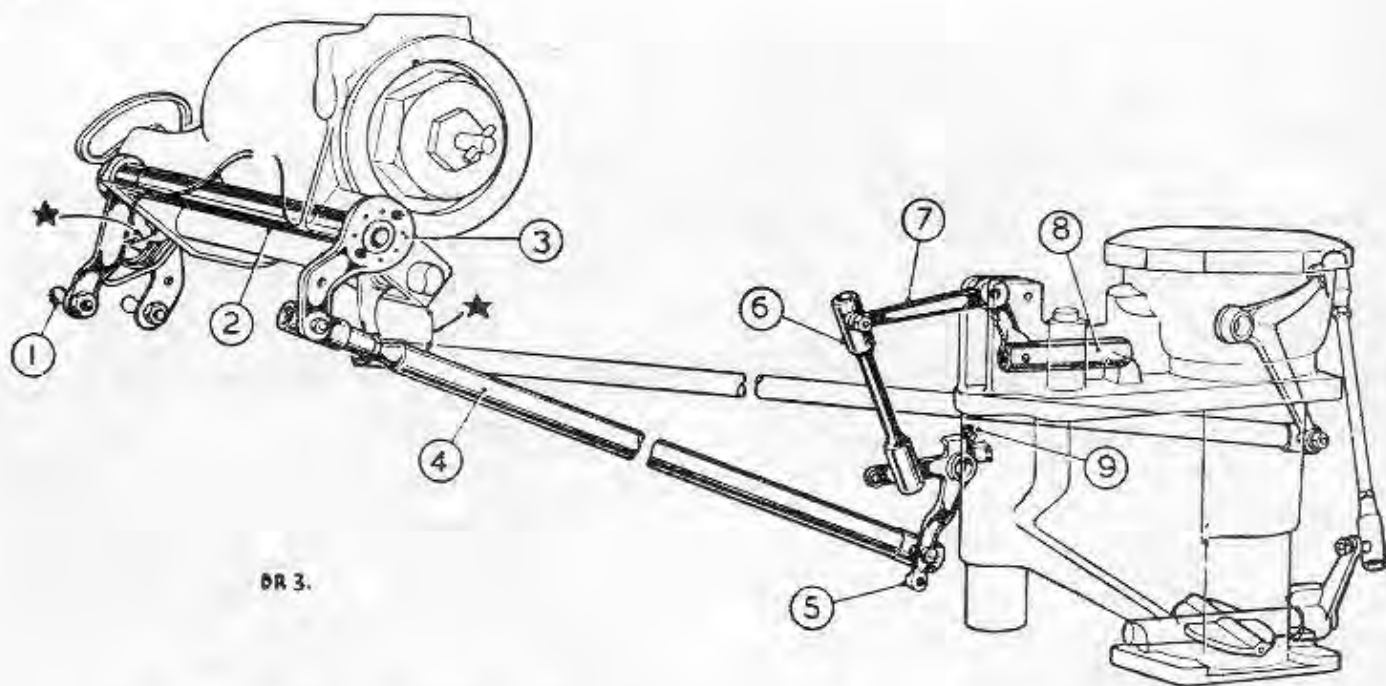
Fig. 2. Throttle and ignition control linkwork in the throttle closed and ignition retarded position

19. The lengths of the throttle control tube and the throttle control should be adjusted so that when the throttle valve is fully closed the magnetos are fully retarded; also so that the throttle valve is fully open before the magneto control link roller reaches the end of the slot in the cam. Check that these conditions are obtained by operating the pilot's throttle control through its full travel. Observe 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 the stops in the magneto will allow, when the throttle valve is fully open. A 0.001½ in. feeler gauge placed against the slow-running and full throttle stops on the carburettor should be gripped when the throttle control lever in the cockpit is moved to the full extent of its travel. Finally lock the plug in each ball-end socket with a split pin.

20. When these adjustments are satisfactory, the slow-running throttle stop must be adjusted; reference should be made to para. 8 to 13 before carrying this out.

21. On certain Mk. 1 variant installations

the altitude control tube, cross-shaft and associated parts are not fitted and the altitude control link (item 6 on fig. 3) is replaced by a locking bracket fitted between the end of the altitude valve operating lever and the bell-crank fulcrum on the carburettor so that the altitude control is positively locked in the fully rich position. Where, however, manual control of the altitude valve is provided, the following instructions should be followed. The control tube of the altitude valve control is provided with an adjustable end, the length of the control link rod being fixed. There is however a vernier connection between the altitude operating lever and the altitude control cross-shaft, by which further adjustment is possible. When fitting the altitude (mixture) control tube and the altitude control link-rod, ensure that the 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



DR 3.

- | | |
|--------------------------------------|--|
| 1 ALTITUDE CONTROL PICK-UP LEVER | 6 ALTITUDE CONTROL LINK |
| 2 ALTITUDE CONTROL CROSS SHAFT | 7 ALTITUDE VALVE OPERATING LEVER |
| 3 ALTITUDE CONTROL OPERATING LEVER | 8 ALTITUDE VALVE |
| 4 ALTITUDE CONTROL TUBE | 9 STOP SCREW
(sealed and not to be altered) |
| 5 ALTITUDE BELL-CRANK ON CARBURETTOR | |

★ Points at which fouling may occur through faulty adjustment

Fig. 3. Altitude (mixture) control linkwork

are indicated by stars in fig. 3, which also shows the arrangement of the control linkwork. 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 on 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 in fig. 3. 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 (it is 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 this mark of Gipsy Major engine. When the control operation is satisfactory, lock the plug in each ball-end socket with a new split pin.

22. On Mk. 1 variants and on the Mk. 7 when Mod. G.1483 has not been embodied, movement of the throttle lever must not be limited by the interconnected flame trap valve control, i.e., the hot-air inlet should not be completely closed when the throttle is fully open against its stop. To check this, 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. Retighten the brackets and repeat the check. On Mk. 7 engines where Mod. G.1483 has been embodied, the hot-and-cold air-

intake control should have the operating cable adjusted so that the valve in the air-take has full travel and that friction in the control system does not prevent the return spring returning the valve to the cold air position.

23. Where engine-driven fuel pumps are fitted, the flooder control should have the cable adjusted so that the flooder (tickler) 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.

VALVE CLEARANCES

The Major I engine started life with dural push-rods and aluminium bronze cylinder heads. The valve clearances in this instance were 0.005 in. inlet and 0.005 in. exhaust. Upon the embodiment of Modification G.470, however, the material of the push-rods was changed from dural to steel, but the valve clearances remained the same, e.g. 0.005 in. inlet and exhaust.

A short while afterwards, Modification G.475 was introduced to obviate carbon deposits on the inlet valves, and the clearances were altered as follows:—

Steel Rods—Inlet from 0.005 in. to 0.010 in.

Dural Rods—Inlet from 0.005 in. to 0.015 in.

In both instances the exhaust clearance remained unchanged at 0.005 in.

Modification G.1064 changed the material of the rods from steel to aluminium, the clearances remaining unchanged at 0.010 in. inlet and 0.005 in. exhaust. The 0.015 in. inlet clearance used for dural rods of course no longer applied.

Modification G.1099 was introduced to permit the fitting of aluminium cylinder heads for use with leaded fuels. When this modification is embodied, the valve clearances should be set to 0.005 in., inlet and exhaust.

The following table indicates the changes that have been made during the life of the engine:—

<i>Type of Head</i>	<i>Type of Push Rods</i>	<i>Valve Clearance</i>		<i>Remarks</i>
		<i>Inlet</i>	<i>Exhaust</i>	
Bronze	Dural	0.005 in.	0.005 in.	
Bronze	Steel	0.005 in.	0.005 in.	Mod. 470
Bronze	Steel	0.010 in.	0.005 in.	Mod. 475
Bronze	Dural	0.015 in.	0.005 in.	Mod. 475
Bronze	Aluminium	0.010 in.	0.005 in.	Mod. 1064
Aluminium	Aluminium	0.005 in.	0.005 in.	Mods. 1064 and 1099
Aluminium	Steel	0.005 in.	0.005 in.	Mods. 470 and 1099
Aluminium	Dural	0.005 in.	0.005 in.	Mods. 475 and 1099

Chapter 11

INSPECTION FOR DAMAGE AFTER SHOCK-LOADING

The action which should be taken on an engine after the aircraft in which it is installed has crash-landed, or had its propeller damaged, is detailed in Technical News Sheet G. No. 8. A copy of this Technical News Sheet can be obtained free on request from The Service Department, Bristol Siddeley Engines Limited, Leavesden, Hertfordshire, England.

Chapter 12

MINOR REPAIRS

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General

1. The extent of the minor repairs described in this chapter is determined by the tools provided in the Flight Servicing Kit which are listed at the end of this chapter. Apart from reconditioning the cylinder heads, the tools do not cater for the dismantling and rectification of individual sub-assemblies, but are intended for servicing and engine unit replacement purposes. Where the method of refitting a component or unit is not described it may be assumed that the procedure is a reversal of that given for its removal.

2. Before commencing to remove any unit or component, except where its correct replacement is such that a mistake cannot occur, check that it is marked to indicate its position on the engine. If necessary, components which can be turned through 90 deg. or 180 deg. should be marked to ensure that they are refitted the correct way round.

3. Immediately a connection is broken or a component is removed, it is important to close any apertures with approved blanks. A complete list of blanks and transport

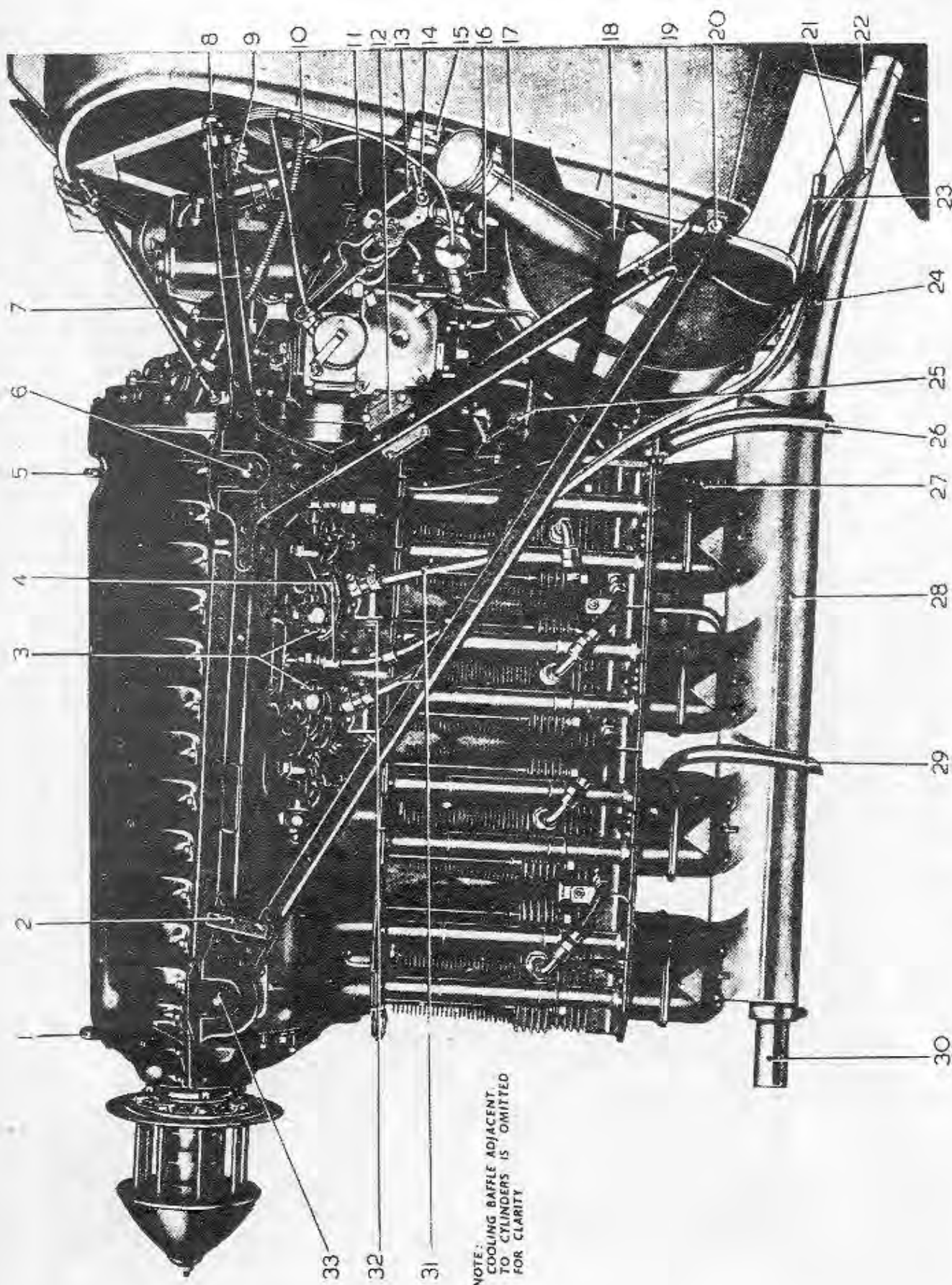


Fig. 1. Mk. 7 engine installation, Port side. For key see over.

KEY TO FIG. 1 (ENGINE INSTALLATION—PORT SIDE)

- | | | | | | |
|----|---------------------------------------|----|--|----|--|
| 1 | FRONT LIFTING EYEBOLT | 13 | MIXTURE CONTROL ROD CONNECTION | 23 | OIL TANK VENT PIPE |
| 2 | NOSE COWLING ATTACHMENT BRACKET | 14 | THROTTLE ROD CONNECTION | 24 | COWLING ATTACHMENT BRACKET |
| 3 | ENGINE-DRIVEN FUEL PUMPS | 15 | FLAME SWITCH | 25 | CARBURETTOR FLOAT TICKLER WIRE |
| 4 | FUEL SUPPLY PIPE—PUMPS TO CARBURETTOR | 16 | OIL TEMPERATURE THERMOMETER | 26 | CRANKCASE BREATHER PIPE |
| 5 | REAR LIFTING EYEBOLT | 17 | OIL TANK FILLER NECK | 27 | CABIN HEATER TUBE |
| 6 | ENGINE REAR FOOT AND MOUNTING BRACKET | 18 | FUEL SUPPLY PIPE—COCK TO PUMPS | 28 | HEATER MUFF |
| 7 | ENGINE ALIGNMENT STAY | 19 | ENGINE MOUNTING FRAME | 29 | CARBURETTOR HEATER EXHAUST OUTLET PIPE |
| 8 | FIREWALL | 20 | ENGINE MOUNTING FRAME BOTTOM ATTACHMENT BOLT | 30 | INTENSIFIER TUBE |
| 9 | FLAME SWITCH | 21 | INLET MANIFOLD DRAIN PIPE
(visible behind fuel drain pipe 22) | 31 | FUEL PUMPS DRAIN PIPE[see item 22] |
| 10 | TACHOMETER FLEXIBLE DRIVE | 22 | FUEL PUMPS DRAIN PIPE OUTLET
(the two drain pipes 31 are joined and have a single outlet) | 32 | FUEL PUMPS PRIMING LEVERS |
| 11 | OIL SUPPLY PIPE TO SUCTION FILTER | | | 33 | ENGINE FRONT FOOT AND MOUNTING BRACKET |
| 12 | FLAME SWITCH | | | | |

KEY TO FIG. 2 (ENGINE INSTALLATION—STARBOARD SIDE)

- | | | | | | |
|----|--|----|--|----|---|
| 1 | ENGINE ALIGNMENT STAY | 11 | INTENSIFIER TUBE | 22 | IGNITION LEAD FROM MAGNETO DISTRIBUTOR TO PLUGS |
| 2 | CRANKCASE BREATHER PIPE | 12 | CARBURETTOR HEATER EXHAUST OUTLET PIPE | 23 | OIL RETURN PIPE—SCAVENGE PUMP TO COOLER |
| 3 | ENGINE REAR FOOT AND MOUNTING BRACKET | 13 | HEATER MUFF | 24 | FLAME SWITCH |
| 4 | OIL PRESSURE GAUGE BANJO CONNECTION | 14 | FLAME SWITCH | 25 | CABIN HEATER TUBE |
| 5 | CARBURETTOR FLAME TRAP AND WARM-AIR INTAKE | 15 | OIL COOLER | 26 | CABIN HEATER |
| 6 | CARBURETTOR AIR-INTAKE | 16 | CARBURETTOR MIXTURE CONTROL ROD | 27 | IGNITION SWITCH LEAD TO STARBOARD MAGNETO |
| 7 | NOSE COWLING ATTACHMENT BRACKET | 17 | OIL RETURN PIPE—COOLER TO TANK | 28 | FLAME SWITCH |
| 8 | ENGINE FRONT FOOT AND MOUNTING BRACKET | 18 | ENGINE MOUNTING FRAME | 29 | OIL PRESSURE GAUGE CAPILLARY |
| 9 | FRONT LIFTING EYEBOLT | 19 | ENGINE MOUNTING FRAME BOTTOM ATTACHMENT BOLT | 30 | ENGINE MOUNTING FRAME TOP ATTACHMENT BOLT |
| 10 | OIL RETURN PIPE—CRANKCASE TO SCAVENGE PUMP | 20 | COWLING RAIL | 31 | ENGINE STARTER |
| | | 21 | OIL TANK | | |

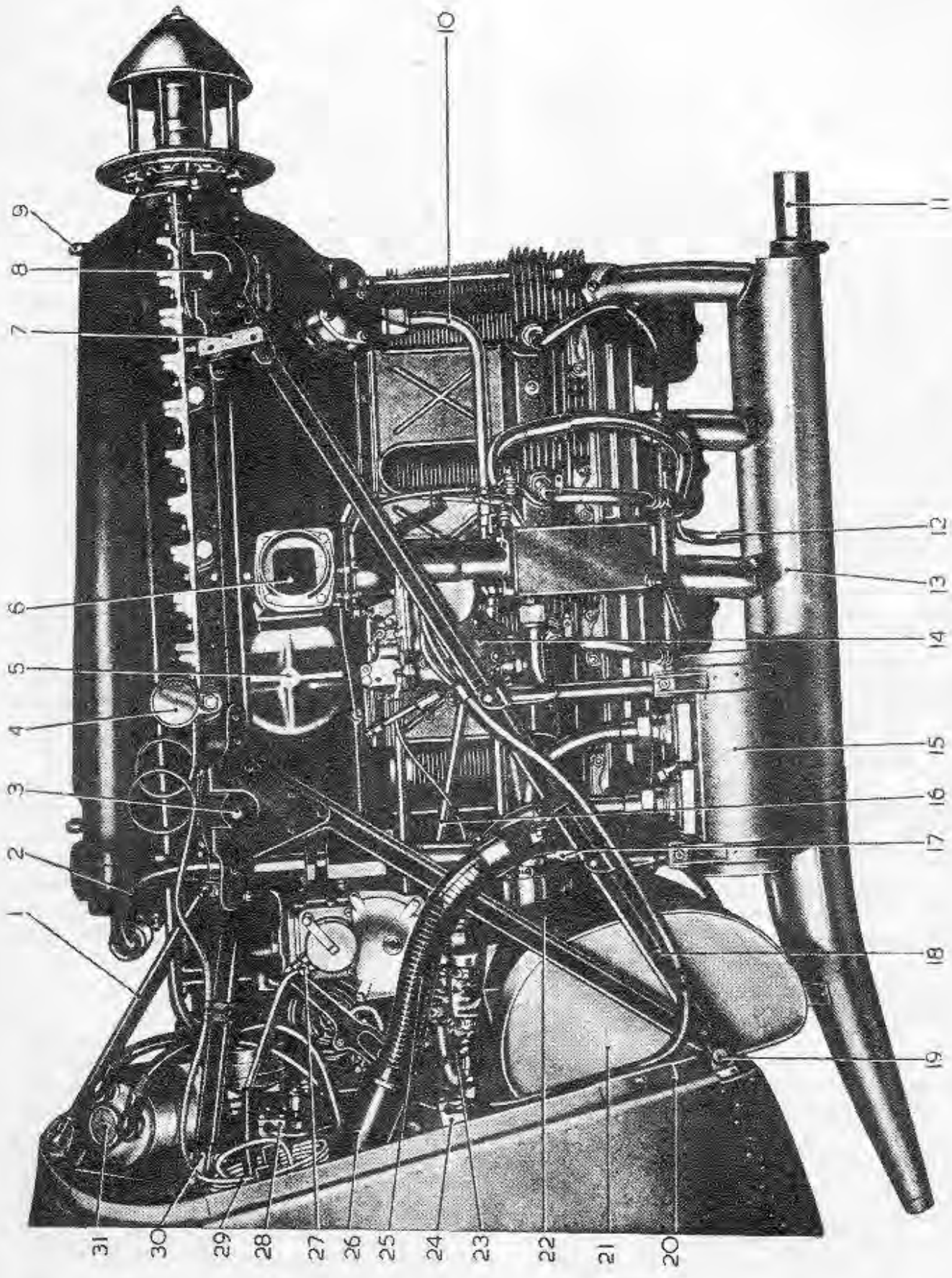


Fig. 2. Mk. 7 engine installation. Starboard side

spares applicable to these engines is given in Chapter 5.

4. When components are removed, a close examination should be made for indications of scoring or overheating through undue friction. Such defects are more readily detected before cleaning when the burnt oil or the loosened surface of the metal is present.

5. Should difficulty arise in deciding what replacement parts or assemblies are applicable to a particular engine, reference should be made to the Gipsy Major Spare Parts List. The engine log should also be consulted for details of any modifications embodied.

Exhaust manifold

6. Ascertain whether any extension pipe supporting clips, or stay tubes, must be detached before the exhaust manifold can be removed. In certain installations, where the exhaust system is utilized to supply warm air for cabin heating e.g., the Mk. 7 in the Auster T Mk. 7, the cabin heater tube must be disconnected as instructed in the relevant aircraft publication.

7. To remove the exhaust manifold, unscrew the $\frac{1}{2}$ in. B.S.P. union nut which couples the induction manifold heater muff inlet pipe to the induction manifold heater muff. Using the universal box spanner T2500-39 in conjunction with tommy bar T2500-46, remove the twelve nuts and spring washers from the exhaust port flanges and draw the exhaust manifold clear of the engine.

8. When refitting the exhaust manifold, four new joint washers, Part No. 1302-12A, should be used and the manifold and cylinder head joint faces examined for any damage that might prevent a gastight joint being made.

Air-intake, carburettor, and induction manifold

9. The air-intake, carburettor, and induction manifold, are removed as a complete sub-assembly; the individual components can then be separated as required.

- (1) The unscreened H.T. leads on Mk. 1 variants need not be disturbed but the screened harness on the Mk. 7 must be removed as follows. Detach the H.T. leads from the four starboard sparking plugs, remove the nuts and washers securing the ignition harness to the induction manifold, and swing the

harness to the rear, away from the manifold. The harness can be disconnected from the distributor and removed complete, or tied to an adjacent portion of the engine mounting structure.

- (2) Remove the four nuts, spring washers and bolts from the cold air-intake flange and remove the carburettor air-intake duct and the fibre gasket.
- (3) Ensure that the main fuel cock is OFF, unscrew the union nut and disconnect the fuel pipe from the carburettor.
- (4) Unhook the return spring from the hot-and-cold air-intake, and where an independent manual control is provided, disconnect the control cable from the pulley.
- (5) Remove the split pin, unscrew the plug at each end of the throttle control tube and release the tube from the bellcrank on the air-intake and from the lever on the cross-shaft.
- (6) Disconnect the altitude control tube (if fitted) from the bellcrank on the carburettor in a similar manner.
- (7) Uncouple the flooder cable (if fitted) from the lever on the carburettor by removing the split pin and the shackle pin, and release the cable guide from the bracket on the carburettor by removing the two bolts and nuts and the cap which secures it.
- (8) Unscrew the union nut securing the induction manifold drain pipe to the union at the rear of the manifold and disconnect the pipe. On Magister aircraft disconnect the hose connection in the vacuum system suction pipe at the rear of the manifold.
- (9) Remove the exhaust manifold as described in para. 6 and 7.
- (10) In the case of Mk. 1 variants, it will probably be necessary to remove the front oil drain pipe by releasing the worm-drive clips which secure the rubber connections at each end of the pipe; it may only be necessary to release one end to move it away from the engine sufficiently to permit the air-intake, carburettor, and induction manifold assembly to be withdrawn. In the case of a Mk. 7, remove the nut and washer securing the front scavenge pipe clip to the link on the lower flange of the carburettor and move the clip clear of the carburettor.

- (11) Remove the two bolts, nuts, and spring washers securing the clip, which clamps the Silentbloc bush at the top of the air-intake, to the steady bracket.
- (12) Remove the sixteen nuts and spring washers from the cylinder head inlet port studs.
- (13) Check that all the connections have been disconnected and that there is nothing to prevent removal of the sub-assembly. Carefully draw it off the cylinder head studs as far from the engine as the mounting structure will permit, then lower the complete sub-assembly clear of the engine and structure.

10. Before refitting the air-intake, carburettor and induction manifold, ensure that the joint faces of the manifold and the cylinder heads are clean and examine for any damage that might prevent a gastight joint. New joint washers Part No. 1302-13/1 should be fitted, as air leaks into the induction system will seriously affect the engine's performance.

Air-intake

11. Remove the air-intake, carburettor, and induction manifold from the engine as described in para. 9, and separate the air-intake from the carburettor as detailed in the following paragraph.

12. Uncouple the throttle control rod which connects the bell-crank on the air-intake to the lever on the carburettor. Where an interconnected throttle and flame trap valve is fitted, detach the upper end of the valve operating cable by removing the nut on the link pin. Do not disturb the bolt in the lower end of the link pin as this is a cable clamping screw. Remove the four plain nuts and spring washers securing the air-intake bottom flange to the carburettor, and separate the components. There is a fibre joint washer between the air-intake flange and the carburettor.

13. Before refitting the air-intake to the carburettor, ensure that both joint faces are clean and free from burrs. The fibre joint washer, Part No. 1905-18, should be renewed. Where an interconnected throttle and flame trap valve is fitted, reconnect the link pin to the flap valve lever and check the adjustment as described in Chapter 2.

Carburettor and induction manifold

14. Proceed as described in para. 9 and remove the air-intake, carburettor, and induction manifold assembly from the engine. The induction manifold can then be separated from the carburettor and air-intake as detailed in the next paragraph. By combining the instructions contained in para. 12 and 15, the carburettor will be completely separated from its associated components.

15. Remove the four bolts and spring washers which secure the top flange on the induction manifold to the bottom flange on the carburettor, and separate the components.

16. Before refitting the induction manifold to the carburettor, ensure that both joint faces are clean and examine for any damage that might prevent a gastight joint. A new joint washer, Part No. 2105-37, should be fitted, as air leaks into the induction system will seriously affect the engine's performance. When re-assembling the components to Mk. 7 engines, refit the oil pipe clip link under the head of the front inboard bolt.

Cooling baffle

17. The cooling baffle on the starboard side of the engine cannot be removed until the air-intake, carburettor, and induction manifold assembly have been removed as described in para. 9. The unscreened H.T. leads on Mk. 1 variants must be removed.

18. Detach the H.T. leads from the four starboard sparking plugs, remove the nuts and washers securing the H.T. cable tube to the cooling baffle and move the tube rearwards away from the cooling baffle. The H.T. cables can be disconnected from the distributor and removed complete, or tied to an adjacent portion of the engine mounting structure. Remove the three nuts, spring and plain washers from the studs securing the upper edge of the baffle to the crankcase, and the nuts and washers which secure the baffle to the three brackets at the lower edge of the baffle. Detach the baffle from the engine.

Airscoop backplate and top plate

19. Instructions for removing the airscoop, or the quickly detachable bottom portion of the airscoop of engines with Mod. No. 1727 embodied, are given in Chapter 9. The fixed portions of the airscoop and the backplates are removed as described in the following paragraph.

20. When engine-driven fuel pumps are fitted, remove the bolt and nut fastening the fuel pipe clip to the bracket on the backplate and gently move the pipe clear of the backplate. When unscreened H.T. cables are fitted, remove the two screws securing the fibre cable guide to the backplate. Remove the nut and bolt which secures the bracket at the top of the backplate to the rear end of the top plate, and the two nuts and bolts which secure the bracket at the bottom of the backplate to the baffle on No. 4 cylinder head. Remove the backplate. Remove the four nuts which secure the top plate to the studs in the crankcase and remove the top plate. On Mk. 7 engines which have Mod. No. 1727 embodied, remove the four nuts which secure the upper edge of the fixed portion of the airscop to the studs in the crankcase, and the nut and bolt at the rear which secure the top of the back-plate. Unscrew the nuts which secure the rear edge of the airscop to the back-plate flange and remove the fixed portion of the airscop. Remove the two bolts which hold in position the ignition harness grommet retaining plate, unscrew the bolts and nuts which secure the bracket at the lower edge of the backplate to No. 4 cylinder baffle, and remove the back-plate.

Fuel pumps

21. Where applicable, before commencing to remove the engine-driven fuel pumps, ensure that the main fuel cock is turned OFF.

22. Unscrew the two union nuts and disconnect the fuel supply and delivery pipes from the inlet union at the rear of the pump unit, and the outlet union between the two pumps. Disconnect the two drain pipes from below the pumps. Remove the four nuts and spring washers that secure them to the port side of the crankcase, and draw the pair of pumps off the studs. Separate the pumps, repair the defective pump or fit a reconditioned pump in accordance with the instructions in Chapter 17.

23. Before refitting the pumps, ensure that the joint faces of both pumps and the crankcase are clean and undamaged. New joint washers, Part No. 801-86, should be fitted, and it is important that only the correct joint washers are used, as any variation in thickness would alter the relationship between the pump rocker arm pad and the eccentric on the camshaft. This relationship is adjusted during assembly of each fuel pump

to allow a small further movement of the rocker arm when the eccentric is in the "full lift" position.

24. After refitting the fuel pumps, but before connecting up the fuel delivery pipe, a delivery pressure check should be made. Attach a low-reading pressure gauge to the delivery union between the two pumps, turn on the main fuel cock, and operate each of the priming levers in turn. A pressure of approximately 2 lb. per sq. in. should be registered almost immediately in each case. On satisfactory completion of this check, remove the pressure gauge and connect up the fuel delivery pipe.

Top cover

25. If it is necessary to rectify a serious oil leak at the crankcase joint face, or to make an internal examination of the engine, the top cover may be removed as described in the following paragraphs.

26. Remove the propeller and propeller hub as described in para. 33; extract the split pins, and unscrew the five slotted nuts which secure the front cover to the top cover and crankcase. Remove the washers, front cover and packing shim.

27. Unscrew the eight set-bolts securing the timing gear cover to the top cover. Remove the twenty-seven nuts and bolts and the eight nuts from the studs securing the top cover to the crankcase. Note the positions of the four fitting bolts, which are slightly larger in diameter than the others, as these fitting bolts must be refitted in their original locations. Two of the fitting bolts, on the starboard side, also secure the air-intake steady bracket. On engines Pre-mod. G1635, the other two fitting bolts are on the port side opposite those which secure the steady bracket, but when Mod. G1635 has been embodied these two bolts are fitted at the front and rear of the port and starboard sides respectively. The top cover should now be free to be lifted off.

28. Particular care is required to remove the top cover squarely from the crankcase. The engine lifting sling attached to the lifting eyes in the top cover should be used in conjunction with a crane. If this is not available it is inadvisable to attempt the operation single-handed. If difficulty is experienced in separating the two faces due to adhesion of jointing compound, careful use of a rubber mallet should be sufficient to break the joint. On no account should a wedge be inserted between the joint faces.

29. While the top cover is removed, every care must be taken to ensure that no small tools, nuts, or other foreign bodies enter the engine. Before refitting the cover, check the locking of the main bearing and big-end cap-nuts; ensure that the top cover and crank-case joint faces are clean and free from burrs which might prevent an oil-tight joint being made. If necessary the upper timing gear cover joint washer Part No. 1903-2 should be renewed.

Sump

30. To remove the sump or settling tank (Mk. 7 only), proceed as follows. Unlock and remove the two nuts and bolts securing the lower end of the oil pipe from the sump to the oil pump. Remove the nut and spring washer securing the fuel pipe clip and move the clip away from the stud in the sump.

31. Remove the four nuts securing the sump to the bottom of the rear cover, slide the clips supporting the flooder control cable and the oil scavenge pipe clear of the flange on the sump, and pull the sump off the four studs in the rear cover.

Oil pump

32. The diameter of the oil pump driving gear on the oil pump spindle is larger than the aperture in the rear cover through which the pump spindle passes. It is therefore not possible to remove the oil pump unless the engine is dismantled.

Propeller hub

33. To remove the propeller and the propeller hub, proceed as follows. Extract the split pin, unscrew the slotted nut and remove the washers and the spinner. Extract the split pins, unscrew the four slotted nuts and remove the two locking plates. Using spanner T1900-383, or T800-50A on engines without Mod. No. 903 embodied, with tommy bar T1900-245 unscrew the propeller hub retaining nut. Unscrew the bolt of the extractor T1900-252 until the threaded end is flush with the body of the extractor (if dealing with a Pre-mod. G903 type of hub use extractor T1900-4) and screw the extractor into the propeller boss. Using tommy bar T2200-180 screw in the extractor bolt until the propeller boss is forced off the taper on the crankshaft; remove the extractor. It is important to note that the tapered bore of the propeller boss is machined to a slightly smaller angle than the taper on the crank-

shaft to ensure the maximum grip between the two components. This difference of angle is easily destroyed and no attempt must be made to lap these components together. A crankshaft lap T77132, and a propeller hub lap T77131, introduced by Mod. 2125, should be used to rectify fretting damage and loosening of the propeller hub on the crankshaft. When refitting the propeller boss, ensure that both the tapered end of the crankshaft and the tapered hole in the boss are perfectly clean and dry. Check that the key is correctly positioned in the crankshaft and that the keyway in the propeller boss aligns with the key correctly. Lubricate the threaded end of the crankshaft with clean engine oil and tighten the front nut. Refit the remaining parts and split pin the nuts as described in Chapter 9.

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

34. The starboard H.T. cables cannot be completely removed until the air-intake, carburettor and induction manifold have been removed as described in para. 9. Detach the four H.T. leads from the sparking plugs and their terminals on the distributor; remove the nuts and washers securing the H.T. cable tube to the cooling baffle and lift the tube together with the leads from the engine. The port H.T. cables cannot be removed until the airscoop has been removed. Detach the four H.T. leads from the sparking plugs and their terminals on the distributor. Remove the two screws securing the fibre cable guide to the airscoop back plate, unscrew the two nuts and bolts securing the H.T. cable tube to the brackets on the cylinder heads and lift the tube together with the leads away from the engine. When refitting either the starboard or the port ignition harness, ensure that each H.T. lead is connected to its correct terminal on the distributor. Each lead is marked with its relative cylinder number; the terminal positions on the distributors are indicated in fig. 3.

Screened ignition harness (Mk. 7)

35. The starboard ignition harness is removed as follows. Detach the four H.T. leads from the sparking plugs. Unscrew the four nuts securing the distributor screen cover and remove the cover. Detach the four H.T. leads from their terminals, unscrew the two nuts securing the ignition harness to the studs at the bottom of the distributor and carefully draw the harness clear of the

distributor. Temporarily assemble the H.T. lead retaining nuts to their terminals, and the cover, with its securing bolts, spring washers and nuts, and the two nuts, to the distributor. Remove the two nuts securing the ignition harness to the studs on the induction manifold and lift the harness away from the engine. The port ignition harness cannot be completely removed until the push rods and push rod covers for all four cylinders have been removed as described in para. 54. When these parts have been removed proceed as follows. Detach the ignition harness from the sparking plugs and the port distributor in a similar manner to that described for the starboard harness. Unscrew the two nuts and bolts securing the ignition harness to the brackets on the cylinder heads, and lift the harness away from the engine. When refitting either the starboard or the port ignition harness ensure that each H.T. lead is connected to its correct terminal in the distributor. Each lead is marked with its relative cylinder number; the terminal positions in the distributors are illustrated in fig. 3.

MAGNETOS

Removal

36. Disconnect the unscreened H.T. cables or the screened ignition harness from the distributor, and the low tension (magneto earthing) lead from the terminal on the contact breaker cover. Remove the split pin and shackle pin connecting the magneto control link to the magneto timing lever, and place the control link clear of the magneto. Support the magneto with one hand and unscrew the two set-bolts securing the base of the magneto to its platform. Draw the magneto clear of the engine, care being taken to retain the flexible coupling and the magneto base packing piece.

Note . . .

If a replacement magneto is fitted to an engine with Mod. No. 2010 embodied it must be ensured that the magneto is to this modification standard.

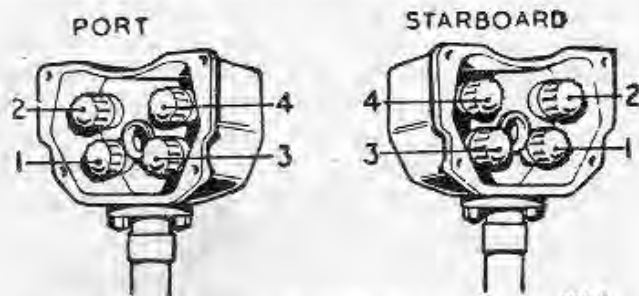


Fig. 3. Diagram of distributor terminals

Timing

37. The following instructions detail the procedure for fitting either the port or starboard magneto. The information is also the basis for checking, should incorrect timing be suspected.

38. Before commencing to time the magnetos, remove one sparking plug from each cylinder to facilitate turning the crankshaft and to avoid the risk of accident, since the ignition switches are inoperative when the contact breaker covers are removed.

39. Except that the magnetos rotate in opposite directions when viewed from their driving ends, each magneto is timed in a similar manner, therefore the procedure for only one is described. Reference should be made to the Leading Particulars for the actual ignition timing. Since a safety gap is incorporated in the magnetos, special precautions against operating the impulse starter when the starboard magneto is rotated without the H.T. leads connected are unnecessary.

40. Detach the contact breaker cover, check the contact breaker gap and if necessary adjust the contact points as described in Chapter 10. If difficulty is experienced in setting the contact breaker at the required position due to 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 forward until the contacts just separate.

41. Remove No. 1 rocker cover so that the valves can be observed to identify the compression stroke. 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.

42. Move the throttle control lever in the cockpit to the full throttle position and ensure that the magneto is fully advanced with the magneto timing lever as far forward as the stops will permit.

43. In the case of the screened magnetos fitted to the Mk. 7, remove the distributor screen cover. In all cases remove the distributor; rotate the magneto spindle in the direction indicated by the arrow on the magneto until the rotating electrode is in the bottom forward quadrant of its travel approaching No. 1 distributor segment, and the contact breaker contacts are just about to separate. This position is best determined with a lamp and battery tester having leads

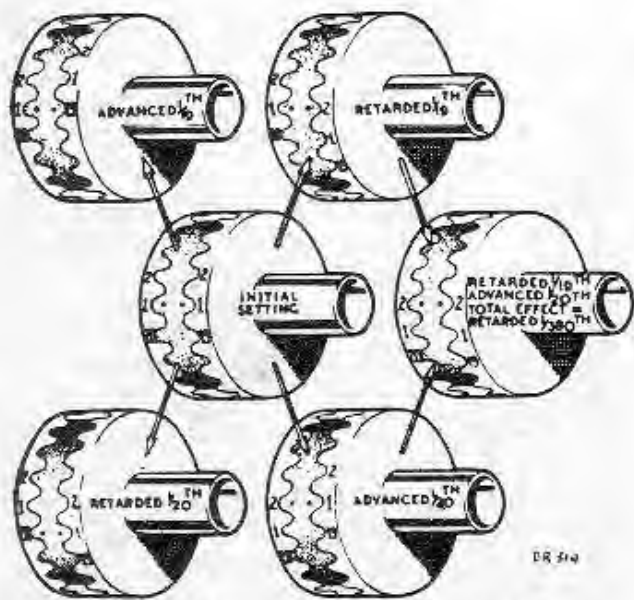


Fig. 4. Adjustment of vernier coupling

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 sufficient 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; retighten the screw. *Do not omit* to remove the oiled silk when the timing operation is completed. In an emergency a 0.001½ in. feeler gauge, inserted between the contacts, may be used to determine their point of separation.

44. Having set the crankshaft and the magneto correctly, turn the engine half of the magneto coupling in the reverse direction of rotation to take up any backlash. Place the packing piece on the magneto base, and position the flexible coupling so that its teeth engage fully with the serrations in the magneto and engine portions of the coupling *without* rotating the magneto spindle. Slide the magneto inwards until the flexible coupling is secure and temporarily tighten the two magneto holding-down screws.*

45. Check the timing by turning the magneto coupling within the limits of the backlash in the drive. The contacts should "make" and "break" within this narrow range; if not, adjustment of the vernier coupling will be necessary.

46. The magneto half of the coupling has twenty serrations and the engine half has nineteen. Fig. 4 illustrates the cumulative effect on timing of turning only the flexible coupling relative to the magneto and engine portions of the coupling. The markings are for explanatory purposes only and do not appear on the actual engine parts. This diagram refers to the port magneto which rotates in a counter-clockwise direction as viewed from the driving end. Read "retarded" for "advanced" and vice versa when considering the starboard magneto.

47. When the magneto has been satisfactorily timed, adjust its position so that the flexible coupling has between 0.010 and 0.020 in. end float, and securely tighten and wire-lock the magneto holding-down screws.

48. Remove any insulating material used under the contact breaker retaining screw and tighten the screw. Refit No. 1 rocker cover, the distributor, and in the case of a Mk. 7 the distributor screen cover. Refit the contact breaker covers and the sparking plugs. Ensure that the ignition switches are OFF and reconnect the H.T. leads to the sparking plugs.

DISMANTLING THE CYLINDER ASSEMBLY

Valve Springs (Important, see page 280)

49. Using the valve spring compressor T1300-78A in conjunction with the valve supporting tool T800-6 as shown in fig. 5, a suspected, faulty, or broken valve spring can be replaced without disturbing the cylinder head. These tools are intended for servicing purposes only, and are unsuitable for workshop use.

50. Remove the rocker cover and turn the crankshaft until the valve in question is closed; remove the airscoop and proceed as follows:—

- (1) Press back the cap at the end of the rocker spindle against the spring and push out the retaining pin.
- (2) Remove the cap, spring, collar, rocker, valve stem thimble, thrust washer, and push rod.

*To avoid damaging the magneto armature, the length of the shank of each 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.

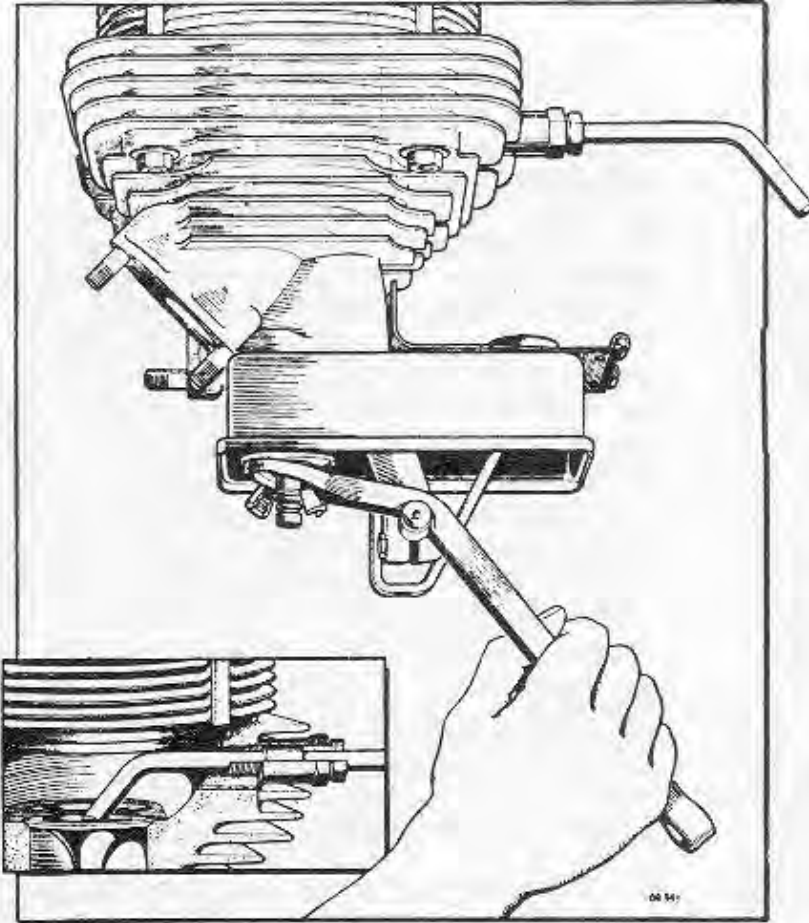


Fig. 5. Valve spring compressor and valve supporting tool

- (3) Remove the port sparking plug and screw the valve supporting tool into the sparking plug hole. Position the inner end of the rod so that it engages the head of the valve to be dealt with and lock in position.
- (4) Position the valve spring compressor under the rocker spindle and locate the end of the compressor on the valve collar.
- (5) Press on the other end of the valve spring compressor and depress the valve springs until the split collets can be removed.
- (6) Carefully release the pressure and remove the collar and the inner and outer valve springs.
- (7) Fit the replacement inner and/or outer springs in a similar manner; assemble the valve stem thimble, and the valve rocker parts and remove the valve supporting tool. Check and if necessary adjust the tappet clearance.

Cylinder heads

51. Before a cylinder head can be removed it is necessary to remove the following components:—

- (1) Exhaust manifold (*para. 6*).

- (2) Air-intake, carburettor, and induction manifold (*para. 9*).
- (3) Cooling baffle (*para. 17*).
- (4) Airscoop and back plate (*para. 19*).
- (5) Unscreened H.T. cables or screened port ignition harness (*para. 34 and 35*).
- (6) Sparking plugs (*Chap. 9*).
- (7) Rocker covers (*Chap. 9*).

52. The method of removing each of the four cylinder heads is identical and therefore instructions for removing only one are detailed in this chapter. When one cylinder head only is to be removed, set the relevant piston at T.D.C. with both valves closed so that there is no spring load on the valve operating mechanism. Should it not be possible to break the cylinder head to barrel joint it will be necessary to remove the cylinder head and barrel together, in which case reference must first be made to *para. 57 and 58*.

53. Unless it is required to remove the screened port ignition harness as described

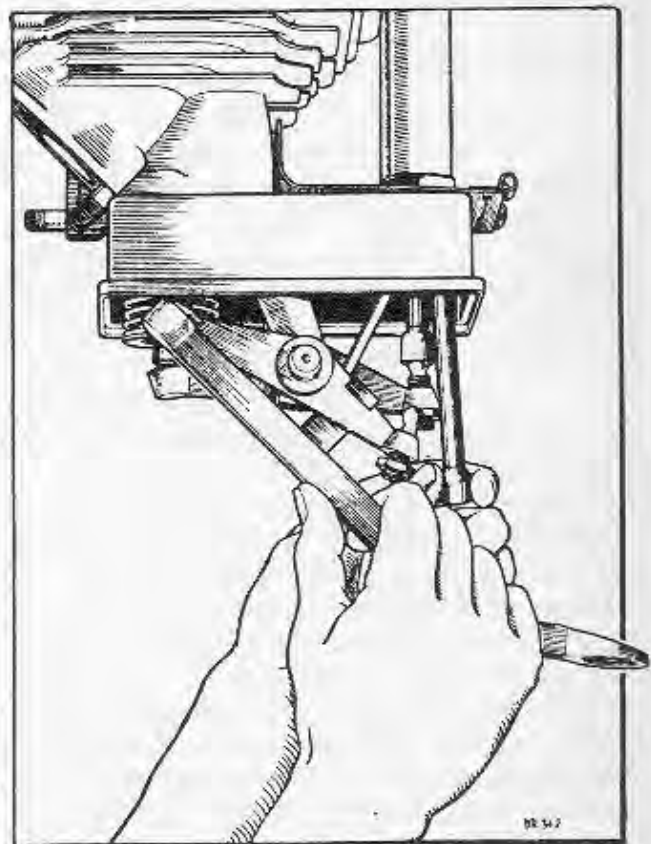


Fig. 6. Removal of push rods

in para. 35, the cylinder heads may be removed without prior removal of the push rods and the push-rod covers, in which case care must be taken that they do not fall and become damaged when the head is removed. Normally, the push rods and push-rod covers are removed first.

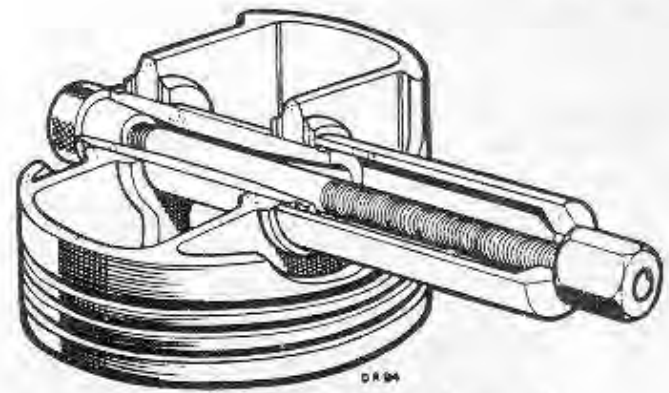


Fig. 7. Extracting a gudgeon-pin

54. Having removed all the relevant parts and checked that there is nothing to hinder the removal of the cylinder head or heads, proceed as follows. Using the valve spring compressor T1300-78A with its hook engaged under the rocker arm as illustrated in fig. 6, force down the valve until the tappet adjusting ball-end can be disengaged from the push rod and the latter withdrawn from push-rod cover. Remove the thimble from the tip of the valve stem. Repeat the process with the second rocker and push rod. Alternatively it may be possible to displace the rocker sideways against its bearing spring and disengage the push rod without use of the valve spring compressor. Having removed the push rods, telescope the push-rod covers and remove them from between the crankcase and cylinder head.

55. Using the correct jaw spanners, T800-80, T1400-10, and T1400-11, remove the four cylinder holding-down nuts and the four washers from the cylinder holding-down studs. Also remove the nut and washer from the adjacent cylinder holding-down stud which secures the other end of the H.I. cable, or ignition harness support, on the port side of the engine and remove the support. When removing cylinder head No. 2, 3, or 4, the baffle bracket must be taken off the cylinder holding-down stud on the starboard side. Ease the cylinder head off the cylinder barrel and remove the cylinder-head joint washer. A piece of wood about $1\frac{1}{2}$ in. thick having two $\frac{5}{8}$ in. holes drilled at $5\frac{3}{4}$ in. centres must be secured to two of the cylinder holding-down studs to prevent the barrel falling off, with consequent damage.

56. If it has been necessary to remove the cylinder head and barrel as a unit, they should be separated as follows. Fix a wooden post, which should be long enough to reach the inside of the cylinder head and an easy fit in the barrel, vertically on a bench. Bring the inside of the head down smartly on to the post and the cylinder head will break free from the barrel.

Cylinder barrels

57. Before a cylinder barrel can be withdrawn the cylinder head concerned must be removed as described in para. 51 to 55. If one barrel only is being removed the piston should be set at T.D.C. To obviate the risk of the scraper rings being trapped in their crankcase apertures if more than one cylinder barrel is to be removed, the crankshaft must be positioned so that all the pistons concerned are clear of the underside of the crankcase.

58. Carefully withdraw the cylinder barrel down out of the crankcase and off the piston. If difficulty is experienced in freeing a cylinder barrel from the crankcase it may be eased by lightly striking alternative sides with a rubber mallet. Support the piston as it emerges from the cylinder barrel to avoid the risk of damage to the piston and rings through fouling the holding-down studs.

Pistons

59. Having removed both cylinder head and barrel, the piston can be removed as follows. Insert the end of the circlip extractor T2200-156 in one of the slots provided in the gudgeon-pin and prise off the circlip. Each circlip that is removed must be discarded and under no circumstances used again. Take off the thrust washer and supporting the piston with one hand, push out the gudgeon-pin.

60. If the gudgeon-pin is too tight to be withdrawn by hand, remove the remaining circlip and thrust washer and use the gudgeon-pin extractor T2200-157. Thread the extractor draw bolt through the gudgeon-pin as shown in fig. 7, until the knurled nut abuts one end of the gudgeon-pin. Place the extractor body over the

opposite end of the gudgeon-pin. Screw the hexagon extractor nut on to the draw bolt, take the weight of the piston and tighten until the gudgeon-pin is fully withdrawn.

REPLACING THE CYLINDER ASSEMBLY

Pistons

61. New circlips, Part No. 800-19, 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 replaced. Normally circlips can be refitted with the fingers but the gudgeon-pin circlip inserter T2200-162 may be used as shown in fig. 8. Fit a thrust washer and circlip to one end of the gudgeon-pin so that the chamfered face of the washer is towards the circlip. Each piston must be fitted to its correct connecting-rod, according to the sequence number stamped on the piston crown, and assembly is correct when the number can be read from the propeller end of the engine. Support the piston so that no bending load will be imposed on the connecting-rod, lubricate the small end bore with clean approved engine oil and insert the gudgeon-pin, if necessary using a rubber mallet to tap it into position. Fit the remaining thrust washer with the chamfered face away from the piston followed by the circlip, ensuring that it is correctly located in its groove.

Cylinder barrels

62. If more than one cylinder barrel has been removed, it is advisable to fit the rings to the piston immediately before the cylinder barrel is fitted, otherwise there is likelihood of the rings being broken or damaged by contact with the cylinder holding-down

studs or being trapped in the crankcase aperture. Ensure that the rings are correctly fitted in their grooves as detailed in para. 74.

63. Each cylinder barrel is assembled with the part number facing the port, or camshaft, side of the engine. Ensure that the piston, cylinder bore and locating spigot, and the aperture in the crankcase are clean. If the crankcase apertures have previously been refaced by a repair scheme it is important that the packing shim representing the thickness of metal removed is placed in position in each crankcase aperture.

64. Place a new joint ring, Part No. 1302-38, on the locating spigot of the cylinder barrel and liberally oil the bore and piston with clean approved engine oil. Using the piston ring compressor T2200-167, slide the cylinder barrel over the piston until the compressor is displaced. Remove the ring compressor over the connecting-rod and push the cylinder barrel into position, care being taken that the locating spigot flange seats squarely on the crankcase face. Precautions similar to those described in para. 55 should be taken until the cylinder head is fitted to avoid any risk to the barrel dropping down with consequent damage.

Cylinder heads

65. Remove the wood retaining the cylinder barrel in position and lubricate the bore with clean approved engine oil. Wipe the joint faces of the cylinder barrel and head clean and dry, and proceed as follows:—

- (1) Position a new copper-and-asbestos joint washer, Part No. 37257, in the cylinder head. A smear of grease may be used to keep it in position.
- (2) Place the correct sequence numbered cylinder head on to its cylinder holding-down studs and push it into position. Support the cylinder head with one hand. Refit the H.T. cable, or ignition harness, support and the thin washer and nut on the adjacent cylinder holding-down stud on the port side. When refitting cylinder head No. 2, 3, or 4, refit the baffle bracket on the forward cylinder holding-down stud on the starboard side. Fit the four plain washers (the thin washers go on the studs which also accommodate the H.T. cable or ignition harness support, or the baffle bracket) and screw the nuts on to the studs until they are finger-tight.

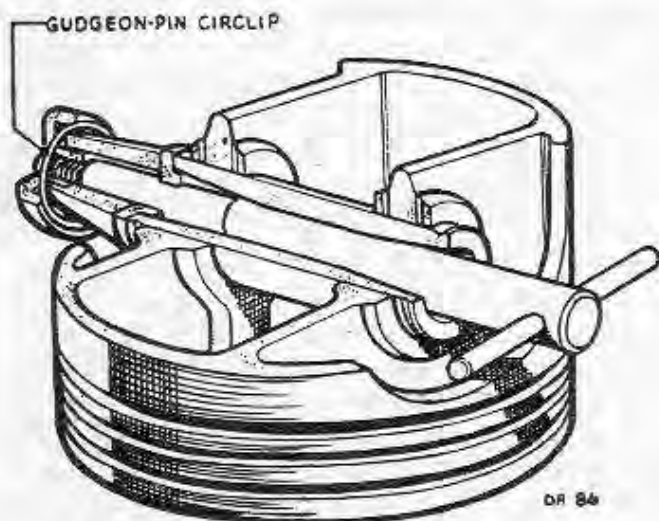


Fig. 8. Inserting a gudgeon-pin circlip

- (3) If more than one cylinder head has been removed, assemble the remaining heads in a similar manner.
- (4) Using feeler gauges and a straight-edge aligned against the inlet port faces just above the two lower studs, check that the alignment of the four cylinder heads is within the limits (0.006 in.).
- (5) Working diagonally, tighten each set of nuts evenly, using the spanners specified in para. 55, and tightening each nut about a sixth of a turn at a time.
- (6) Re-check the alignment with straight-edge and feeler gauges.

66. 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 barrel is not seating squarely in the crankcase. Correct seating of the cylinder barrel may be verified by attempting to insert a 0.001½ in. feeler gauge between the cylinder barrel and the crankcase. If this is possible at any point the joint must be remade and the cylinder head alignment rechecked. When correcting errors of alignment it is important to slacken off all the nuts on a particular cylinder head. Never slacken on one side and tighten on another.

67. Before the push-rod covers are fitted to a Mk. 7 engine, the port ignition harness situated between them and the cylinders must be secured to the two support brackets on the cylinder heads. Refitting the push-rod covers, push rods, and valve stem thimbles is a reversal of the dismantling procedure detailed in para. 54, and the crankshaft must be turned until both tappets for the cylinder in question are in the valves closed position. New joint rings, Part No. 1304-5A, should be fitted to the push-rod covers.

68. Adjust the tappet clearance in accordance with the instructions given in Chapter 2 and fill each rocker cover with clean engine oil to the correct level.

69. Finally replace all the components and unit assemblies listed in para. 51, removed to obtain access to the cylinder head.

Pistons

70. Since in most cases the piston will have been removed for a defect resulting from faulty piston rings these will normally be renewed. If however, the rings have been exposed for some other reason they should be carefully examined and if obviously worn or if the grooves are badly carboned, they should be discarded. It is not desirable to remove the piston rings unless it is intended to renew them. If new rings are fitted, or if the old ones are left in position, check with feeler gauges that the side clearance in the grooves is within the permissible limits. The gap of new rings should also be checked in the unworn portion of the cylinder barrel nearest the combustion chamber.

71. The piston rings are best removed by using three thin strips of metal, polished so that there are no sharp edges which might scratch the piston. Insert the strips one at a time under the rings and slide them round until they are equally spaced around the piston. The rings can then be manoeuvred off the piston with little risk of breakage or damage.

72. Remove all carbon from the piston crown, which must be polished with metal polish and then washed in clean kerosine. Examine the skirt for obvious wear and if contact with the cylinder bore has resulted in picking-up, blend out the marks by careful stoning, using kerosine freely. Examine the gudgeon-pin bore and blend any score marks by polishing. Examine the piston for cracks, especially in the region of the gudgeon-pin bosses. Ensure that all oil-drain holes are clear.

73. Examine the gudgeon-pin for wear or scores and if necessary polish with worn fine-grade emery cloth. Clean the thrust washers and examine them for cracks or damage. Also ensure that the small end of the connecting-rod is not worn and check the fit of the gudgeon-pin in its bore. Do not slide the thrust washers along the full length of the gudgeon-pin as this may scratch and injure the bearing surface.

74. It is important to ensure that the piston rings are assembled into their grooves in the piston the correct way round. The two compression rings which occupy the grooves

* See, "Field" repairs to cylinder head fins, page 112.

nearest the piston crown must be fitted so that the letter "c" which is etched on each is towards the crown of the piston. The scraper ring must be fitted with the stepped portion towards the gudgeon-pin.

75. The piston rings should be fitted with the same metal strips used for their removal. It is advisable to fit the rings to the piston immediately before the cylinder barrel is fitted, otherwise there is likelihood of the rings being broken or damaged by contact with the cylinder holding-down studs or being trapped in the crankcase aperture if the crankshaft is turned.

Valves

76. A suitable wooden block and a bench-type valve spring compressor are required to remove and refit the valve springs. Remove the rockers as described in para. 50, then with the cylinder head positioned on the wooden block so that the valves are held firmly against their seats, depress each valve collar in turn and remove the split collets, valve collar, and springs.

77. Clean off any carbon deposit from the valve stems and examine for burrs or nicks which might damage the valve guides; any marks should be removed by stoning or with a fine file before attempting to remove the valves.

78. Before the valves are assembled to the cylinder head they must be ground-in to their seats. A standard suction-type grinding-in tool is used for this purpose.

- (1) Lightly coat the seating face of the valve with approved abrasive paste, care being taken that none of the abrasive is deposited on the valve stem, oil the valve stem and insert the valve into its guide.
- (2) Press the grinding-in tool on to the valve head and proceed to lap the valve lightly to its seat, lifting it at intervals to redistribute the abrasive and avoid grooving the seatings.
- (3) Remove the valve and wash both valve and cylinder head seats with kerosine to eliminate all traces of abrasive.
- (4) Examine both seatings, which should have an even matt surface free from high or low spots. If necessary repeat the grinding-in process until satisfactory

conditions are obtained. Avoid excessive grinding-in, as this produces an excessively wide seat; the finished surfaces of the seatings should be tested for even contact by the use of marking blue.

- (5) When the condition of the valves and seats is satisfactory lubricate the valve stems with clean engine oil, insert the valves into their respective guides and using the valve spring compressor assemble the inner and outer springs and collar to each valve and secure with the split collets.
- (6) Stand the cylinder head so that the ports are uppermost, and pour sufficient kerosine into both ports to cover the valves. Allow to stand for about ten minutes and check that no leakage has occurred into the combustion space, then drain off the kerosine, and dry off with compressed air.

Valve rockers and valve rocker brackets

79. If, during the periodic check recommended in Chapter 9, a valve rocker bolt is found to be loose, or if it is required to remove the valve rocker bracket, the cylinder head baffle, or the valve gear casing, proceed as described in the following paragraphs.

80. This repair can be dealt with by removing the cylinder head from the engine or with the cylinder head in situ as described in para. 87. In the latter case it will be necessary to remove the push rods, the push-rod covers, and the port H.T. leads, or on the Mk. 7 the ignition harness as described in para. 34, 35 and 54. If No. 4 cylinder head is concerned it will also be necessary to remove the bolts and nuts securing the cylinder head baffle to the airscoop backplate to release the baffle. The following assumes that the cylinder head has been removed from the engine.

81. To remove the valve rocker bracket, remove the two plain nuts, spring washers, plain washers, and bolts which secure the cylinder head baffle to the valve gear casing. Remove the two plain nuts, spring washers, and short bolts which secure the two-hole end of the stirrup bracket. Unscrew the three rocker bracket bolts and remove the nuts, lock plate, distance pieces, bolts and tab-washers. The stirrup bracket, rocker bracket complete with rockers, valve gear casing, and baffle can then be detached from the cylinder head.

82. The baffle assemblies are peculiar to their individual cylinder heads and each must be refitted to its original head. The correct tightening of the valve rocker bracket bolts is of considerable importance, and the following instructions should be followed carefully. The application of the term "initial nip" which is used in the subsequent paragraphs, is considered to be the point at which resistance is first experienced if, when using the correct spanner, a motion is made to *unscrew* the nut which is being tightened.

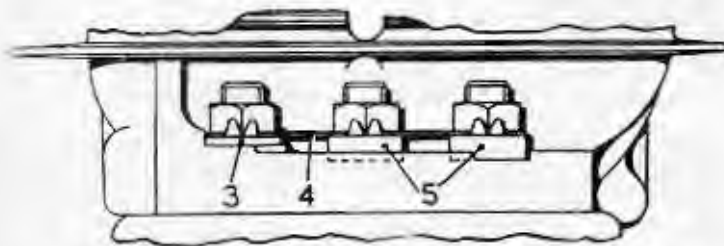
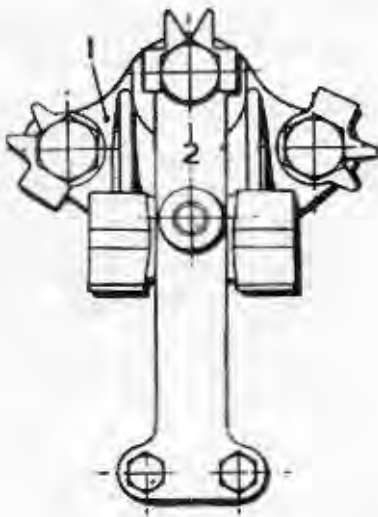
83. Stand the cylinder head, combustion chamber downwards, on the bench. Place the valve gear casing on the cylinder head so that the holes in the casing align with the corresponding holes in the head, and position the valve rocker bracket over the three large bolt holes. Position the stirrup bracket 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. Place a new lock-washer on the bolt that goes through the stirrup bracket and the rocker bracket, and two new tab-washers on the other two rocker bracket bolts. Insert the three bolts, ensuring that the lock-washer on the centre bolt is correctly positioned (*fig. 9*), and put the three distance pieces followed by the lock-plate on the threaded ends of the bolts; the short distance piece goes on the bolt nearest the exhaust valve guide. In the case of Mk. 1 engines having bronze cylinder heads, all three distance pieces are the same length. Screw on the three nuts finger-tight.

84. 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 finger-tight to ensure correct positioning of the stirrup bracket.

85. Using socket MSW.204, eight-inch extension bar SES.206L, and sliding "tee" bar SSD. 206, evenly tighten the three rocker bracket bolts until the "initial nip" is obtained. 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). Slacken off all three bolts completely. Re-establish the "initial nip". Change the sliding "tee" bar for Delapena torque spanner TQ.50A (or Head Model 60) and tighten each bolt evenly in progressive steps of half a flat to a torque of 300 lb. in. Lock the three nuts but do not lock the three bolt heads until they have been checked at the completion of the initial ground run. In the absence of a torque spanner; after the "initial nip" has been established in the first instance and the bolts then slackened off; re-establish the "initial nip" and tighten each bolt evenly in progressive steps of half a flat, to a total tightening of *one* flat. Using this technique, the torque established in the final tightening of these bolts is of the order of 300 lb. in.

86. Remove the two nuts, washers, and short stirrup bracket bolts which were temporarily inserted to position the stirrup bracket correctly. Position the correct baffle so that the holes in the baffle align



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

Fig. 9. Assembly of rocker bracket bolts

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. Evenly tighten the four bolts and nuts.

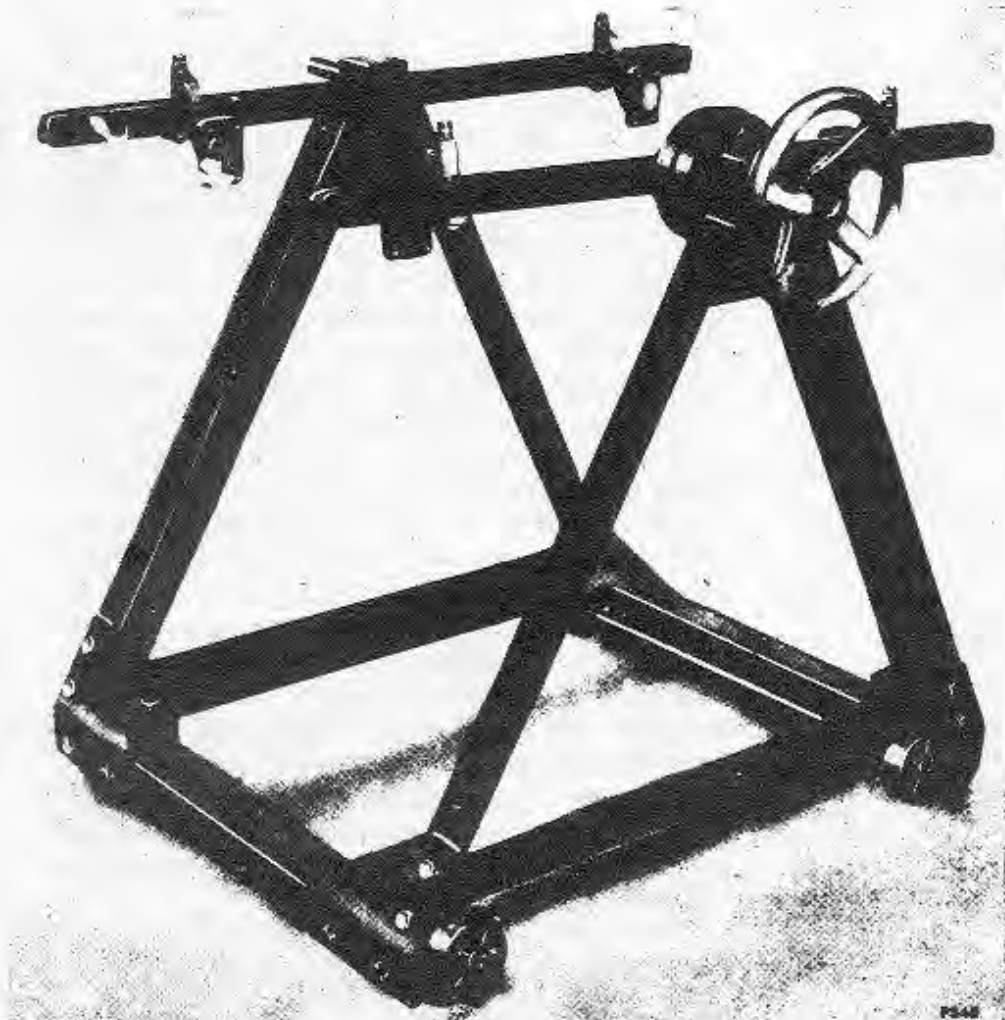
87. If it is desired to rectify a loose rocker bracket bolt without removing the cylinder head, remove the components given in para. 80 and proceed as follows. Remove the four plain nuts and spring washers from the two baffle bolts and the two short stirrup bolts. Remove the four bolts, plain washers, and the baffle. Unlock the three rocker bracket bolt heads, unscrew the bolts and remove the nuts, lock-plate, distance pieces, rocker bracket bolts, lock-washer, two tab-washers, stirrup bracket, rocker bracket, and valve gear casing. Using a new lock-plate, lock-washer, and tab-washers reassemble all these parts, tightening the rocker bracket

bolts to the correct torque as described already. Lock the three nuts but do not lock the bolt heads until after checking at the completion of the initial ground run.

88. At the conclusion of the initial ground run, using socket MSW204, extension bar SES.206L, and Delapena torque spanner TQ.50A (or Head Model 60) check that the torque of 300 lb. in. is still maintained on the three rocker bracket bolts; the valve rocker can be displaced outwards, against the spring, sufficiently to permit the extension bar to pass. If any of the bolts have slackened off, re-tighten them to the correct torque; 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. When everything is satisfactory lock the three bolt heads.

"FIELD" REPAIRS TO CYLINDER HEAD FINS

Where damage to fins is found, the rough edges must be smoothed off and the damage blended out. Cracks are to be drilled, if possible, to prevent them extending.



Typical Reversible engine stand with workshop feet or bearer arms.

89. In addition to the tools provided for general use, the following special tools are available.

Tool No.	Description
T800-6	Valve supporting tool
T800-50A	Box spanner for crankshaft front nut (Pre-Mod. G903)
T800-80	0-700/0-697 in. across flats, jaw spanner, for cylinder head nuts
T1300-77A	Gudgeon-pin circlip expander
T1300-78A	Valve spring compressor
T1300-104	Sleeve for gudgeon-pin circlip expander
T1400-10	0-700/0-697 in. across flats, jaw spanner, for cylinder head nuts
T1400-11	0-700/0-697 in. across flats, jaw spanner, for cylinder head nuts
T1400-127	0-600/0-595 in. across flats, box spanner
T1400-128	Feeler gauges
T1900-245	Tommy bar $\frac{3}{4}$ in. by 30 in. for use with T800-50 and T1900-383
T1900-252	Propeller hub extractor (Mod. G903)
T1900-383	Box spanner for crankshaft front nut (Mod. G903)
T1900-490	Spanner for rocker bracket nuts
T2200-16	Spanner for sparking plugs and propeller hub bolts and nuts
T1400-129	Spanner for sparking plugs, and propeller hub bolt nuts
T2200-51	Auto-Klean oil pressure filter cover spanner
T2200-59	6 mm. box spanner
T2200-61	4 B.A. box spanner
T2200-62	2 B.A. box spanner
T2200-66	Tommy bar, $\frac{1}{4}$ in. by 5 in.
T2200-86	Tommy bar, $\frac{1}{8}$ in. by 2 in.
T2200-91	0-920/0-915 in. and 0-820/0-815 in. across flats box spanner
T2200-92	Tommy bar, $\frac{1}{2}$ in. by 7 $\frac{1}{2}$ in.
T2200-156	Gudgeon-pin circlip extractor
T2200-157	Gudgeon-pin extractor
T2200-162	Gudgeon-pin circlip expander
T2200-167	Piston ring compressor
T2200-180	Tommy bar $\frac{5}{8}$ in. by 23 $\frac{3}{4}$ in. for use with T1900-4 or T1900-252
T2200-470	Piston ring gap checking tool
T2300-193	Tommy bar, $\frac{3}{8}$ in. by 9 in. for use with T2200-51 and T2200-16
T2300-198	Spanner for oil pressure relief valve plug
T2300-232	Tommy bar, $\frac{5}{16}$ in. by 5 $\frac{1}{2}$ in. for use with T1400-129
T2500-33	Valve grinding-in tool
T2500-37	0-605/0-600 in. and 0-530/0-525 in. across flats jaw spanner
T2500-38	0-445/0-440 in. and 0-324/0-321 in. across flats jaw spanner
T2500-39	6 mm. universal box spanner
T2500-46	Tommy bar, $\frac{3}{16}$ in. by 102 mm.
T77131	Lap, propeller hub taper (Mod. 2125)
T77132	Lap, crankshaft taper (Mod. 2125)