GENERAL

1. This chapter, which is applicable to the Gipsy Major Mk. 1, 1C, 1F and 7 engines, describes the method of testing after reconditioning. The instructions given are applicable to all these engines unless specifically indicated in the text.

2. The Running Conditions and Acceptance Figures, the Test Observation Code, and a Summary of Tests are presented as a series of tables at the beginning of this chapter. The Summary of Tests is intended for use only by experienced engine testers who have read and thoroughly understood the complete chapter, but to avoid needless repetition, reference will be made throughout the chapter to the figures contained in the appropriate table of the summary for any specific test. The specific instructions contained in the summary refer to military engines; when civil engines are being tested the current issue of the relevant Test Schedule must be obtained and used in conjunction with this chapter.

3. The observations for each particular test must be recorded as indicated in the appropriate table, and a record must be kept also of all adjustments, checks, starts (both successful and unsuccessful) and running times.

4. Observations which have to be compared with acceptance figures must be corrected in accordance with the approved atmospheric correction charts in order to obtain the equivalent for standard atmospheric conditions. Repair depots situated at an altitude exceeding 3,000 feet above sea level must obtain, from the engine manufacturers the necessary special correction charts and should refer to the manufacturers also for information regarding the type of test fan to be used in these conditions.

PRELIMINARY

5. The installation of the engine on the test bench follows closely the instructions contained in Chapter 5, but any specific instuctions issued by the test equipment manufacturer must, of course, be observed.

Oil priming

6. Before starting the engine for the first time after reconditioning, or at any time after the filters have been removed or any part of the oil system has been disconnected, the oil system must be primed, as detailed below, with oil to the correct specification heated to a temperature of 60 deg. C.

(1) Break the lock-wire and remove the oil suction filter cap.

(2) Pour in sufficient of the heated oil to fill the suction filter casing.

(3) Ensure that the ignition switches are in the OFF position and turn the crankshaft through several revolutions to circulate the oil through the engine.

(4) Replenish the filter casing with a further quantity of oil. Refit and wire-lock the filter cap.

7. Remove the four rocker covers and fill each, to the level indicated on the breather pipe, with oil to the correct specification. When replacing the covers ensure that the cover joints are correctly positioned.

Hot and cold air intake control

8. Throughout all test running the hot and cold air intake control must be locked in the cold air position.

Mixture control

9. The mixture control must be in the fully rich position during all tests other than the mixture control range check of the Final Test.

Accessories

10. Where an engine has an approved starter — either cartridge or electric — the starter must be assembled to the engine throughout the whole period of testing. An electric generator and vacuum pump of the approved type must be assembled to the Mk. 1G engine for any periods specified in the Test Schedule, and must be loaded as indicated. In no circumstances must these accessories be assembled to the engine before the initial running-in period has been completed, as it is during this time that any foreign matter is scavenged from the crankcase and top cover oilways.

STARTING AND RUNNING

Cartridge starter

11. The procedure for starting the engine by use of the cartridge starter is as follows:—

(1) Ensure that the starter breach is correctly loaded with cartridges of the correct type.

(2) Turn ON the necessary oil cocks.

(3) Ensure that the magneto switches are in the OFF position.

(4) Turn ON the fuel supply to the engine.

(5) Move the throttle lever to the FULLY CLOSED position.

(6) Operate one of the hand priming levers on the fuel pumps through the full range of travel while holding out the carburettor flooding device.

(7) Turn the crankshaft through several revolutions, by means of the propeller, in order to prime the cylinders.

(8) Move the throttle lever approximately ½ in. forward towards the open position.

(9) Switch ON both magnetos.

(10) Pull the cartridge starter operating handle to the full extent of its travel by a sustained even movement; this will index and fire a cartridge; a short or sharp pull on the cable does not permit correct operation of the indexing and firing mechanism.

WARNING

If a cartridge fails to fire, a fresh cartridge must not be indexed and fired for a period of at least 30 seconds, during which time all personnel must keep clear of the propeller and engine.

Electric starter

12. The procedure for starting the engine by use of the electric starter is as follows:—

(1) Turn ON the necessary oil cocks.

(2) Ensure that the magneto switches are in the OFF position.

(3) Turn ON the fuel supply to the engine.

(4) Move the throttle lever to the FULLY CLOSED position.

(5) Operate one of the hand priming levers on the fuel pumps through the full range of travel whilst holding out the carburettor flooding device.

(6) Turn the crankshaft through several revolutions, by means of the propeller, in order to prime the cylinders.

(7) Move the throttle lever approximately ½ in. forward towards the open position.

(8) Switch ON both magnetos.

(9) Press the starter push button.

Note . . .

The electric starter should not be operated continuously for periods exceeding 20 seconds, and at least 30 seconds should be allowed to elapse between successive attempts to start.

Swinging the propeller

13. The procedure to be followed when starting the engine by hand-swinging is as follows:—

(1) Turn ON the necessary oil cocks.

(2) Ensure that the magneto switches are in the OFF position.

(3) Turn ON the fuel supply to the engine.

(4) Move the throttle lever to the FULLY CLOSED position.

(5) On engines without fuel pumps, depress the carburettor flooder valve knob. On engines with fuel pumps, operate one of the hand priming levers on the fuel pumps through the full range of travel while holding out the carburettor flooding device.

(6) Turn the crankshaft through several revolutions, by means of the propeller, in order to prime the cylinders.

(7) Move the throttle lever approximately ½ in. forward towards the open position.

(8) Switch ON the starboard magneto.

(9) Swing the propeller cleanly through the compression stroke to start the engine. When the propeller is being swung it is advisable for a second operator to be ready to adjust the throttle lever setting if required.

(10) When the engine is running switch ON the port magneto.

Subsequent attempts to start

14. If the engine fails to start at the first attempt it is not necessary to repeat the complete starting sequence. In cold weather it may be advisable to give additional priming, but normally it will be necessary only to check the throttle setting and then to operate again the engine starter or to swing the propeller.

Starting a hot engine

15. When starting a hot engine that has been standing for a short period only since its previous run, the priming operations detailed above should be omitted.

Failure to start

16. In normal conditions the engine should start easily. The most likely cause of trouble is overpriming. If this is suspected, switch OFF both magnetos and, with the throttle fully open, turn the propeller backwards by hand through about six complete revolutions, then repeat the starting drill without priming. If the engine still fails to start after two or three successive attempts reference should be made to the list of running defects given later in this chapter.

Stopping the engine

17. Before shutting down, allow the engine to idle at between 800 and 900 r.p.m. for a few minutes to cool down gradually. Then proceed as follows:—

(1) Switch OFF both magnetos and open the throttle fully.

(2) Turn OFF the fuel supply to the engine.

(3) When the propeller has ceased to rotate, close the throttle.

Running precautions

18. If, after starting the engine, the oil pressure does not rise almost immediately to at least 30 to 40 lb. per sq. in. the engine must be shut down and the cause investigated. The oil pressure may rise considerably above this figure, particularly in cold weather. At all times during engine testing the maximum running conditions specified in Table A must be observed; in no circumstances may these conditions be exceeded.

SCHEDULE OF TESTS

19. Reference must be made to the local governing inspection authority for details of relaxations of the strip examination required after the power performance check, and also for the easements permissible for the schedule of tests given in the following paragraphs.

Running-in and tuning, Table C

20. The engine starter will be assembled to the Mk. 7 and Mk. 1G engines, but all other accessory mounting faces on the Mk. 1G engine must have the correct blanks fitted. The mixture control must be in the fully rich position throughout this part of the test running.

21. Having primed the engine with oil as detailed in para. 6 and 7, start the engine in accordance with the relevant instructions contained in para. 11 to 16.

22. Run light for the periods and at the r.p.m. specified in Table C. During the first 15 minute period check the whole installation for leaks. It is important that, during these initial periods of light running, a careful watch is kept on oil pressure, as the initial oil pressure setting will not be made until the period of running-in has been completed.

23. At the end of the specified time, open up in incremental stages to the r.p.m. indicated for initial oil pressure check and adjustment.

24. With the engine running steadily check the oil pressure. Adjust as necessary to the figure given in the Acceptance Limitations of Table A. Instructions for adjusting the oil pressure relief valve are contained in para. 71.

25. Run the engine steadily at the speeds necessary to enable the fuel consumption to be checked against the requirements of the relevant fuel consumption figures specified. Tune as necessary to bring the consumption to within the specified limits. Instructions for determining the consumption requirements are given in the schedule; further details regarding tuning are contained in para. 73.

26. Throttle down and check the slow-running. If necessary adjust as described in para. 72 to obtain steady idling at approximately 550 r.p.m. After adjustment, check that there are no 'flat spots' when the engine is opened up.

27. Shut down the engine and make a thorough general visual examination of the installation, especially for oil and fuel leaks and blowing or leaking joints.

Endurance test at maximum continuous r.p.m., Table D

28. Normally the generator and vacuum pump must be assembled to the Mk. 1G engine before this test is commenced, these accessories will remain fitted to the engine throughout the remainder of this part of the test running, being removed finally during strip examination. Instructions for fitting the accessories are given in para. 80 and 81. The loading of the accessories during the test must be as specified in the schedule: to enable the oil discharge from the vacuum pump to be recorded as necessary, the exhaust from the pump must be piped to a suitable measuring vessel. Ensure that the mixture control is in the fully rich position.

29. When all necessary preparatory work has been completed, start the engine and, as soon as oil temperature permits, accelerate smoothly to the r.p.m. specified in Table D. Set the throttle to maintain this figure, adjust the loading of the accessories of Mk. 1G engine to the correct figure and, when steady running conditions have been attained, carry out the first single ignition check as follows.

30. Observe carefully the indicated r.p.m., switch off one magneto and when the engine is again running steadily observe the new r.p.m. Repeat the check on the other

magneto. In no circumstances must the drop in r.p.m. on single ignition exceed the specified figure.

31. If satisfactory, proceed to take the first set of observations required. Take a record of all these observations at intervals of 15 minutes throughout the two hour test. The oil inlet temperature throughout this test should be maintained within the limits given in Table D.

32. After the requisite time has elapsed the loading of the generator on Mk. 1G engine must be increased to the value specified.

33. During the course of the endurance test the oil consumption, oil flow, barometer reading, and temperature of the air passing through the test fan are to be recorded. Five sets of observations should be taken at approximately equal intervals throughout the test, and the mean oil flow and consumption must be within the limitations contained in Table A.

34. At the end of the two hour period of running make another single ignition check as detailed in para. 30. Proceed to the endurance test at maximum weak-mixture manifold pressure.

Endurance test at maximum weak-mixture manifold pressure, Table E

35. The electric generator and vacuum pump on Mk. 1G engine must be loaded as specified in the schedule. The mixture control must be in the fully rich position.

36. Adjust the throttle to give the manifold pressure specified in Table E, and when steady running conditions have been attained take the first set of observations required. Take a record of all these observations at intervals of 10 minutes throughout the 30 minute test. The oil inlet temperature should be maintained within the limits given in the table. Proceed to the power performance check test.

Power performance check test, Table F

37. Relieve the generator and vacuum pump on Mk. 1G engines of all load. Ensure that the mixture control is in the fully rich position. Open the throttle steadily to the fully open position and run the engine for five minutes. In no circumstances should this time limit be exceeded. During this period, as soon as steady running conditions have been attained, record one set of observations as specified in Table F. The oil inlet temperature should be maintained within the limits given in the table.

38. The engine speed should be carefully noted and the observed r.p.m. must then be corrected for atmospheric temperature in accordance with the approved atmospheric correction charts. The corrected r.p.m. must not be less than 98 per cent of the standard r.p.m. established for the particular test fan in the actual environment in which it is being used. Proceed to slow-running and acceleration test.

Slow-running and acceleration test, Table G

39. Ensure that the mixture control is in the fully rich position and that there is no load on the generator and vacuum pump of Mk. 1G engines. Adjust the throttle to give 550 r.p.m., observe the oil pressure and temperature; the oil pressure at slow-running must not be less than 20 lb. per sq. in. with an oil inlet temperature of 65 deg. C.

40. Carry out the number of rapid accelerations from slow-running to full throttle specified in Table G, noting the time taken for the engine to complete each acceleration, and checking that the response of the engine over the whole throttle range is smooth and free from any flat spot. Shut down the engine.

41. While the engine is still hot make three starts by means of the approved starter, if applicable: see remarks contained in para. 10. Starting and stopping must be carried out in accordance with the instructions given in para. 11 to 17. Shut down the engine.

Strip examination

42. Upon satisfactory completion of the test detailed in the previous paragraphs, the engine is to be removed from the test bench and stripped to an extent that will allow the inspection of all working parts. The extent of any permissible deviation from the complete strip will be decided by the local governing inspection authority.

43. If any major component is rejected during the strip examination, the engine must, on reassembly, be re-submitted for all the above-mentioned tests or, at the discretion of the inspection authority, to a repeat test of a duration which must be agreed upon, after which a further strip

examination must be made. If it is necessary to renew any minor part, the duration of the next stage of test running, the Final Test, must be increased as is deemed necessary by the inspection authority.

44. The removal of the engine from the test bench is almost a complete reversal of the installation procedure described in Chapter 5. Ensure that oil cocks are turned OFF before breaking the connections to the engine. Blanks should be fitted to the engine immediately a connection is broken or a component is removed and all pipes, controls, cables, etc. should be carefully stowed as soon as disconnected so that they will not foul as the engine is withdrawn.

WARNING—engines with cartridge starters

All live cartridges must be removed from the starter breech of these engines before work of any kind is commenced on the engine or accessories.

45. The engine must be dismantled, inspected and reassembled in accordance with the instructions contained in Sections 2, 3 and 4 of this publication. During inspection particular attention should be given to the condition of any new components assembled to the engine during overhaul. During reassembly the cartridge starter and breech, or the electric starter, as applicable (Mk. 7 and 1G) must be assembled to the engine. All other accessory mounting faces on Mk. 1G engines must be blanked off.

46. On completion of the strip examination the reassembled engine must be installed again on the test bench in the manner previously adopted (refer to para. 5 of this chapter) and be prepared for final test.

Final test, Table H

47. To enable supplementary fuel to be supplied to the engine during the mixture control range check of the final test, one of the auxiliary fuel feed pipes of the test bench system must be connected to the adapter on the engine induction system. The control cocks must be set in such a way that, while one of the flowmeters is registering the fuel flow through the carburettor during the check, thus enabling the percentage weakening caused by the operation of the mixture control to be readily calculated, the supplementary fuel supply can be regulated to maintain engine power by preventing excessive weakness of the actual mixture passing to the cylinders.

48. Turn ON the necessary oil cocks. Prime the engine and fill the valve rocker covers with oil as detailed in para. 6 and 7. Load the cartridge starter breech (where applicable) with cartridges of the approved type. Ensure that the mixture control is in the fully rich position, where it must remain except for the mixture control range check.

49. Perform three starts, one from cold; the object of this is to test the starting qualities of the engine, therefore during the first and second starts, switch off the magnetos to stop the engine as soon as it is apparent that the start has been successful.

50. Following the third start, run light for five minutes and during this time carefully check the installation for signs of leaks. During the next ten minutes open up progressively to the engine speed specified in Table H.

51. Run the engine steadily at the speeds necessary to check the tuning; the fuel consumption should be within the limits specified on the relevant Test Schedule (see remarks in para. 25). Readjust the throttle to give the r.p.m. specified in the table.

52. Carry out a single ignition check as described in para. 30. When steady running conditions are again attained, record the first set of readings as indicated in the table. Repeat the observations at intervals of 10 minutes during the next 30 minutes running, and during this time record the oil consumption, oil flow, barometer reading, and temperature of the air passing through the test fan. The oil flow consumption must be within the limitations contained in Table A. During this part of the test the oil inlet temperature must be maintained within the limits specified in Table H. At the end of 30 minutes make a further single ignition check as above.

53. Throttle back to slow-running r.p.m. and allow the engine to idle for at least the period specified in the relevant schedule; check that the oil pressure at slow-running is not less than 20 lb. per sq. in. with an oil inlet temperature of 65 deg. C. At the end of this time carry out the acceleration check detailed in Table H; record the time taken for the engine to complete each acceleration and check that the response over the whole range is smooth and free from flat spots.

54. At the conclusion of the acceleration check, open up the engine steadily to full throttle and run for five minutes at this

condition. Record one set of observations as specified in Table H. The observed r.p.m. must be corrected for atmospheric temperature in accordance with the approved atmospheric correction chart. The corrected r.p.m. must not be less than 98 per cent of the standard r.p.m. established for the particular test fan in the actual environment in which it is being used.

55. Run the engine at the speed specified in Table H for the mixture control range check and observe carefully the fuel flow. Check the range of mixture control available and record the fuel flow over the range. The percentage weakening obtained should be within the limits given in the Table. Adjust the altitude control adjustment screw as necessary to obtain the required range. During this check the auxiliary fuel supply should be adjusted so that sufficient supplementary fuel is supplied to the induction system to enable normal engine power to be maintained, see para. 47.

56. At the end of this check, shut down the engine, remove, examine, clean and replace all oil filters.

Check run, Table J

57. If no anti-corrosion run is required a check run must now be made to check that the filters have been replaced satisfactory.

58. Prime the engine with oil as detailed in para. 6, ensure that the mixture control is in the fully rich position, and start the engine.

59. Run the engine at 2,000 r.p.m. and make a careful examination of the reassembled filters for signs of oil leakage. If any leaks are apparent the engine must be shut down and remedial action taken, after which a further check run must be made. If the check is satisfactory shut down the engine.

Anti-corrosion run, Table K

60. If the engine is not required for immediate use an anti-corrosion run must be made. In these circumstances the check run described in the previous paragraphs is not required, as the final check for oil leaks at the reassembled filters is made during the run on storage oil.

61. Any specific instructions that may exist regarding the use of the test bench oil and fuel systems must be adhered to in order that the inhibiting run may be completed satisfactorily. Only the authorised grades of unleaded fuel and storage oil must be used.

62. Prime the engine with oil as detailed in para. 6, ensure that the mixture control is in the fully rich position, change over the fuel supply to unleaded fuel (R.A.F.Ref. 34A/135) and start up.

63. Run the engine for 15 minutes at 2,000 r.p.m. Check for leaks at the reassembled oil filters.

Note . . .

If the entire test has been run on unleaded fuel the above run may be omitted.

64. Shut down engine. Remove all oil filters and allow surplus oil to drain from the engine. Clean the oil filters and reassemble them to the engine. Set the oil system cocks so that storage oil to specification D.T.D.698 (R.A.F.Ref. 34A/180) is being supplied to the engine from the inhibiting tank and the return from the engine is being run to waste.

65. Prime the engine as detailed in para. 6 with storage oil, ensure that the fuel supply is still connected to unleaded fuel and start up. Increase the engine speed to 1,500 r.p.m. and run at this condition for 10 minutes.

Note . . .

The delay between changing from normal oil to the storage oil and running the engine must be as short as possible. On no account must the engine be allowed to stand overnight between these stages.

66. The initial oil return from the engine will be highly contaminated with engine oil and must be allowed to run to waste, but as soon as a clean return flow of storage oil is observed, set the oil return control cock to return the oil to the inhibiting tank.

67. Maintain the oil temperatures throughout this period of running at the lowest value possible; the oil outlet temperature must not exceed 60 deg. C. The cooling draught from the test fan must be the maximum obtainable when running at this duty. Check that there are no oil leaks from the reassembled oil filters.

68. At the end of ten minutes running shut down the engine in the normal manner.

REMOVAL FROM TEST BENCH

69. After satisfactory completion of the final test and the check run or anti-corrosion run as applicable, the engine must be removed from the test bench and passed to the

dispatch bay with the minimum of delay where, if the engine is not required for immediate use, the necessary protective treatment must be completed.

70. The removal of the engine from the test bench is almost a complete reversal of the installation procedure described in Chapter 5. Ensure that oil cocks are turned OFF before breaking the connections to the engine. Blanks should be fitted to the engine as soon as a connection is broken or a component is removed. Similarly, precautions should be taken to protect the open ends of test bench equipment. All pipes, controls, cables, etc. should be carefully stowed when disconnected so that they will not foul as the engine is withdrawn.

WARNING—engines with cartridge starters

All live cartridges must be removed from the starter breech of these engines before work of any kind is commenced on the engine or accessories.

ADJUSTMENTS AND TUNING

Oil pressure adjustment

71. If it is necessary to reset the oil pressure relief valve (*fig.* 1) proceed as follows:—

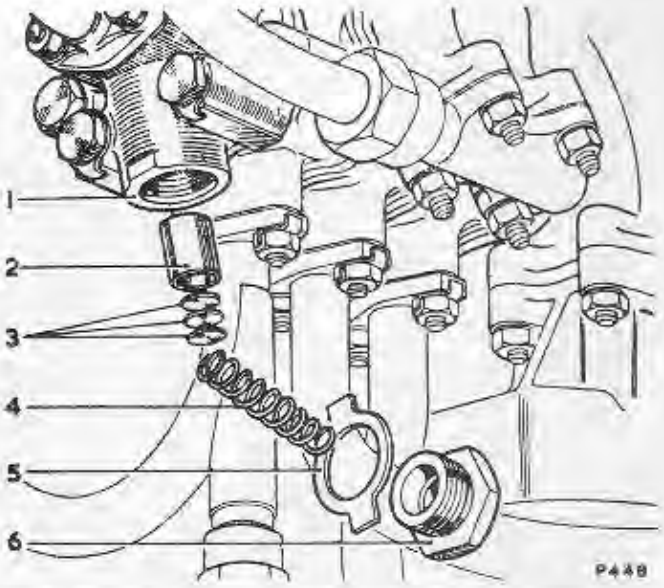
(1) Bend down the locking tab and unscrew the cap-nut below the oil pump delivery connection on the rear cover of the oil pump unit. Normally it will be found that the locking tab has not been bent up during reassembly to allow for initial setting during the preliminary test bench running. When removing the cap-nut ensure that the spring and valve, which are retained by this nut, do not spring out.

(2) Alter the relief valve setting as necessary by increasing or decreasing the number of 20 S.W.G. discs (Part No. 806-15) between the end of the relief valve spring and the inner end of the hollow valve plunger. To increase the oil pressure add to the number of discs, and to decrease the pressure, subtract discs.

(3) Reassemble the component parts, using a new lock-washer (Part No. 1306-16) if the tab on the original washer was previously locked, but do not bend up the locking tab until the oil pressure has been proved to be satisfactory by further test-running.

Slow-running adjustment

72. When adjustment to the slow-running is found to be necessary during the preliminary test running, proceed as follows:—



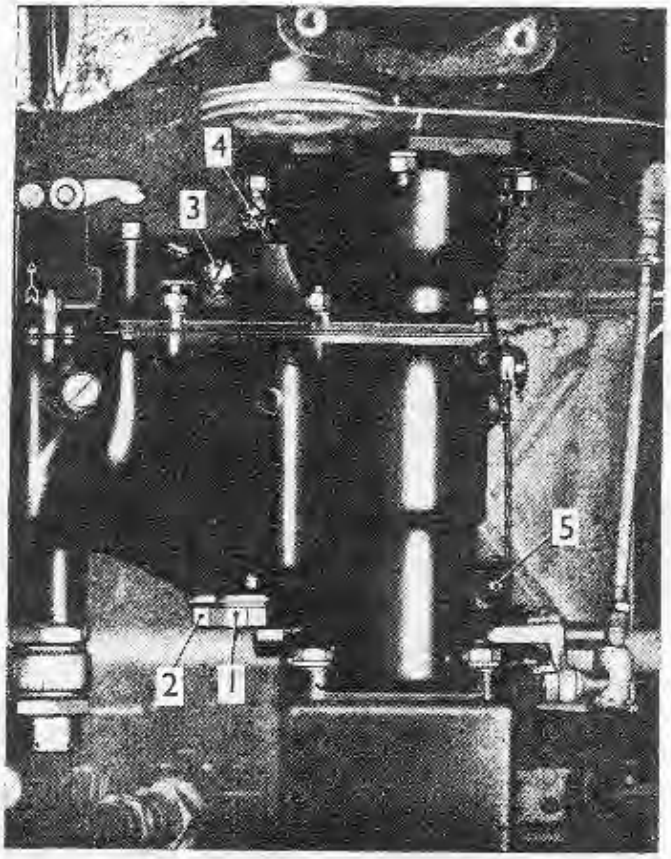
1 RELIEF VALVE HOUSING IN PUMP REAR COVER
2 RELIEF VALVE
3 ADJUSTMENT DISCS
4 SPRING
5 LOCK-WASHER
6 CAP-NUT

Fig. 1. Oil pressure relief valve

(1) Unlock the throttle slow-running stop and the slow-running mixture adjustment screw and, with the engine running steadily, adjust the throttle stop until the desired idling speed is obtained. At the same time correct the mixture strength by means of the slow-running mixture adjustment screw so that the engine runs smoothly at this speed. Screwing out the adjustment screw weakens the mixture and vice-versa; in no circumstances should it be necessary for the screw to be screwed right in as this would indicate probable air leaks in the induction system. The adjustments should be made with care, moving each screw a small amount at a time in the appropriate direction. It will be found that, as the correct mixture strength is approached, the engine speed tends to increase, necessitating further adjustment of the throttle stop to bring the r.p.m. to the desired value.

(2) Having obtained satisfactory slow-running, check that the engine opens up cleanly without any indication of a flat-spot. It may be found necessary to increase slightly the slow-running mixture strength to achieve this condition.

(3) When the desired conditions are obtained securely lock both adjustments.



1 POWER JET
2 MAIN JET
3 MIXTURE ADJUSTMENT SCREW
4 SLOW-RUNNING MIXTURE ADJUSTMENT SCREW
5 SLOW-RUNNING THROTTLE STOP

Fig. 2. Carburettor adjustment points

Tuning

73. To bring the fuel consumption to within the limits specified on the relevant Engine Test Schedule, the carburettor must be tuned during the preliminary test running. Any instructions regarding the use of the test bench fuel system during fuel consumption checks, must be closely followed.

74. On the Hobson A.I.48 carburettor *(fig. 2)* as fitted to these engines, alterations to the fuel consumption at cruising and full throttle conditions can be effected on the test bench by changing the main and power jets for others of a higher or lower calibrated flow, and by altering the setting of the mixture adjustment screw. Reference must be made to Spare Parts List for the available range of jet sizes.

75. The main jet is designed to operate economically at cruising conditions, and the power jet is provided to supplement the fuel flow from the main jet at the higher throttle openings and so produce the supply necessary for full power operation. The mixture adjustment screw is a means of introducing more or less air to the main jet fuel supply thus controlling the mixture strength.

76. When tuning the carburettor therefore, alterations to the fuel flow at full throttle without affecting the cruising consumption can be made only by changing the power jet for another of different calibrated flow, while main jet changes will affect consumption over the cruising and full throttle range. Similarly, the mixture adjustment screw, which must be used in conjunction with main jet tuning, will affect consumption over the whole range. Screwing out the adjustment screw weakens the mixture and vice-versa.

77. In no circumstances should it be necessary to adjust the mixture adjustment screw to either of its extremes, and when adjustment has been completed satisfactorily, the screw must be locked by means of its lock-nut. At the end of the final test the adjustment screw must be wire-locked and sealed.

78. When it is necessary to change jets during tuning the correct spanner (CHA. 38216) should be used and it should be ensured that a fibre washer is assembled to the carburettor with each jet.

FITTING AND REMOVING ACCESSORIES

Starter

79. Instructions for assembling the electric starter to the engine and for removing the starter are contained in paras. 55 and 56 of Chapter 5.

Electric generator (Mk. 8 engines only)

80. To assemble the electric generator to a Mk. 1G engine *(fig. 3)* proceed as follows:—

(1) Remove the blanking cover from the generator mounting face on the engine rear cover; retain the four plain nuts and spring washers.

(2) On engines with Mod. G.1723 embodied, ensure that the circlip at the forward end of the generator drive coupling is securely located in its groove, lightly lubricate the splined end with approved graphite grease and push the coupling into position in the generator drive, ensuring that the male splines of the coupling engage correctly with the female splines in the drive.

(3) Ensure that the generator and rear cover mounting faces are clean, lightly lubricate the splined end of the armature spindle with approved graphite grease, engage the splined end of the generator armature spindle with the splines in the engine drive; and push the generator into position over the mounting studs, ensuring that the spigot enters correctly into the rear cover.

(4) Assemble the four spring washers and nuts to the mounting studs and evenly tighten the nuts.

Vacuum pump

81. To assemble the vacuum pump to a Mk. 1G engine *(fig. 3)* proceed as follows:—

(1) Remove the blanking cover from the vacuum pump mounting face on the port side of the engine rear cover; retain the four plain nuts and spring washers and the Hallite joint washer.

(2) Ensure that the mounting faces both of the pump and the engine rear cover are clean. Inspect the oil hole on either face to check that it is free from obstruction.

(3) Assemble the Hallite joint washer to the mounting face on the rear cover, ensuring that the washer lies flat and that the oil hole aligns with that on the mounting face.

(4) Engage the driving coupling of the vacuum pump with the engine drive and push the vacuum pump into position over the four studs, ensuring that the spigot enters correctly into the rear cover.

(5) Assemble the four spring washers and nuts to the mounting studs and evenly tighten the nuts.

Removing accessories

82. The operations required for removing the accessories are largely a matter of reversing the sequence given in the foregoing paragraphs. After removal of accessories from the engine the correct blanking covers must be assembled immediately to the rear cover and similar precautions must be taken to protect the accessories also; the vacuum pump Hallite joint washer must remain with the engine.

RUNNING DEFECTS

83. No attempt has been made in this chapter to cover all running defects that might possibly occur, nor have factors such as visible leakages, insufficient or incorrect grades of oil and fuel, faulty instruments or closed cocks been considered. It is assumed too that during test-running after overhaul no troubles will normally occur that can be attributed to dirty filters or sparking plugs or to defective or worn components. If it is found necessary to consult a detailed table of running defects, reference should be made to the list contained on pages 75 to 77 of this publication.

Failure to start

84. If a slave starter is used on the test bench the starter should be serviced at frequent intervals to ensure trouble-free starting. On cartridge starters take care that only the correct type of safety disc is used in the starter and also that cartridges are kept in covered dry storage until required for use.

85. Starting difficulty may be caused by a sticking impulse starter. The starter is fitted to the starboard magneto and if sticking is suspected both magneto switches should be turned OFF and the propeller turned by hand slowly in the normal direction of rotation, when the actuation of the starter should be clearly audible; there should be two distinct "clicks" during each complete revolution of the crankshaft. Impulse starter failure on a reconditioned engine should rarely be encountered and initial slight sticking may be remedied by tapping lightly on the starter housing with a hide mallet. Should sticking reoccur it may be necessary to flush the mechanism with thin lubricating oil preferably containing colloidal graphite.

Low oil pressure

86. If, before the initial oil pressure check and adjustment is made, the oil pressure is excessively low, the suction side of the oil system should be checked for air leaks that may have been caused by inefficient connections having been made during installation on the test bench, or by the suction filter cap having been left loose during the priming operation. If any doubt exists regarding the priming operation the engine must be reprimed.

87. Low observed oil pressure at any time during test after the oil pressure relief valve has been set may be caused by foreign matter holding the relief valve off its seating and the valve should be dismantled, inspected, cleaned and replaced without altering the setting.

88. Any excessively low oil pressure during test, especially if accompanied by high oil temperature, must be treated as suspect and the engine must be shut down and the filters inspected.

Faulty acceleration

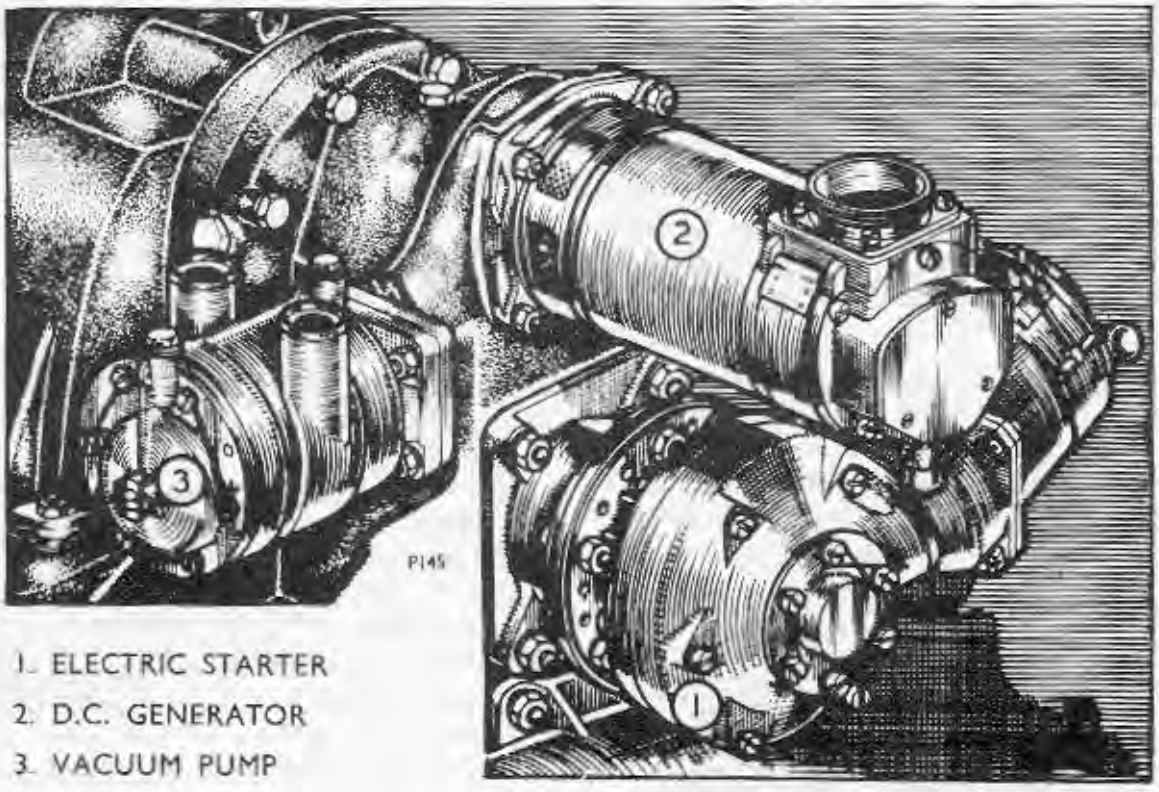
89. Provided the engine tuning and slow-running mixture adjustment are carried out satisfactorily during the preliminary running, the acceleration over the whole throttle range should be smooth and free from flat spots. If poor acceleration is experienced on initial running, or after the strip examination, the induction system should be inspected for signs of faulty or leaking joints. During normal test running it must be ensured that, excepting where specific instructions are given in the Test Schedule, the mixture control is kept always in the fully rich position.

Excessive drop in r.p.m. on single ignition

90. Excessive r.p.m. drop when running on single ignition may be caused by oiling-up during long periods of idling, such as may be occasioned by slow-running checks and adjustment. In such instances the faulty plugs must be removed from the engine, cleaned and replaced. If rough running during initial test is traced to faulty ignition, all H.T. connections to the sparking plugs, and L.T. connections to the magnetos should be checked.

Vibration and rough running

91. Should excessive vibration or roughness occur during test running, the test fan should be checked for tightness on the propeller shaft and the engine mounting bolts should be checked for security and tightened as necessary.



1. ELECTRIC STARTER
2. D.C. GENERATOR
3. VACUUM PUMP

Fig. 3. Location of accessories Gipsy Major Mk. 1G

Chapter 25

SPECIAL TOOLS AND EQUIPMENT

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

General

1. The Overhaul Kit, which contains the tools necessary for dismantling, reassembling, and reconditioning the Gipsy Major Mk. 1 variants and Mk. 7 engines, is comprehensive and, with the Servicing Kit, provides all tools that will normally be required.

2. Where tools for any specific operation are included in the approved tool kits, the tools are referred to by part number in the chapter of this volume containing the description of the operation, and all tools that are specified for use in any one chapter are listed at the end of that chapter. In addition, the use of specific tools has been illustrated where necessary.

3. Many articles of general workshop equipment and normal plant may be necessary or advantages during overhaul, and full use should be made of these.

4. Details of special tools that are required for use when servicing and overhauling accessories are contained in the relevant manufacturer's publication, to which reference must be made before work is commenced.

5. The use of unapproved tools and equipment must be avoided, as serious damage can be caused to components by this practice, but in addition to the tools and equipment to which reference has already been made certain other items, which can be easily

manufactured locally or adapted from existing equipment, will be found to be of use during the overhaul of the engine, and it is with these items mainly that this section deals.

6. Where necessary these special tools and items of equipment are illustrated with sufficient dimensions and instructions to enable them to be manufactured readily. The overall conception of any particular item, however, is a general one, and, provided the critical dimensions are adhered to, the recommended design may be modified to suit individual circumstances. The final choice of material too will rest with the unit responsible, who must use the most suitable material available.

Slings

7. Only the approved slings should be used for hoisting operations concerned with the complete engine.

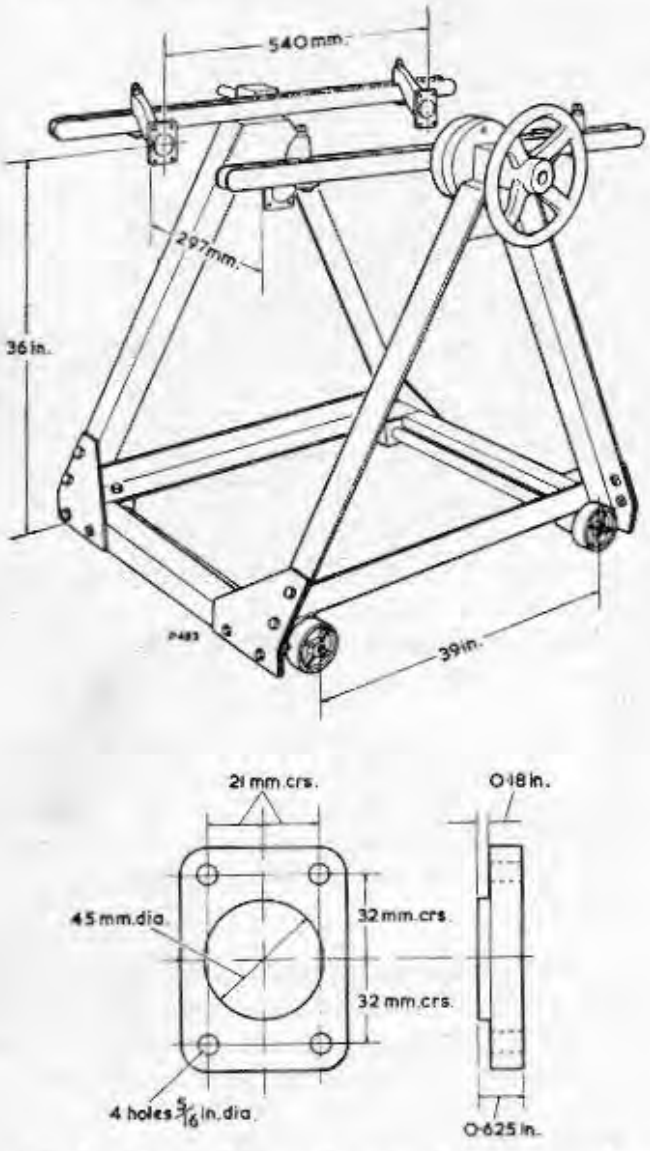


Fig. 1. Reversible engine stand and mounting arm attachments

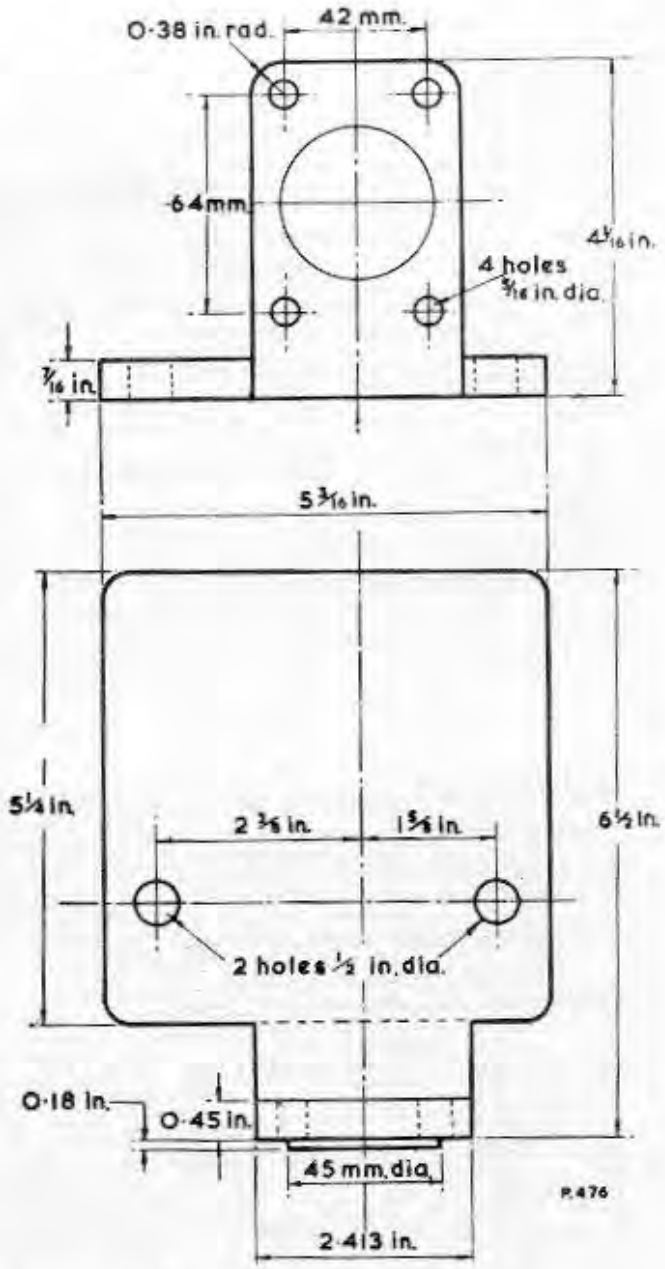


Fig. 2. Transport bearer arm

8. When it is necessary to employ a sling to lift individual engine components such as the crankshaft or crankcase, a flexible wire rope sling can be adapted for this purpose, but the loops of the sling that will come into contact with the engine component must be sheathed with soft leather to prevent damage being sustained by the component.

Engine stand

9. A normal reversible stand is recommended for use during the dismantling and rebuild of the engine. If this stand is not available a stand such as that illustrated in fig. 1 can be used.

10. The main framework of the stand should be constructed of approximately 2 in. × 2 in. × 3/8 in. angle iron. The mounting members

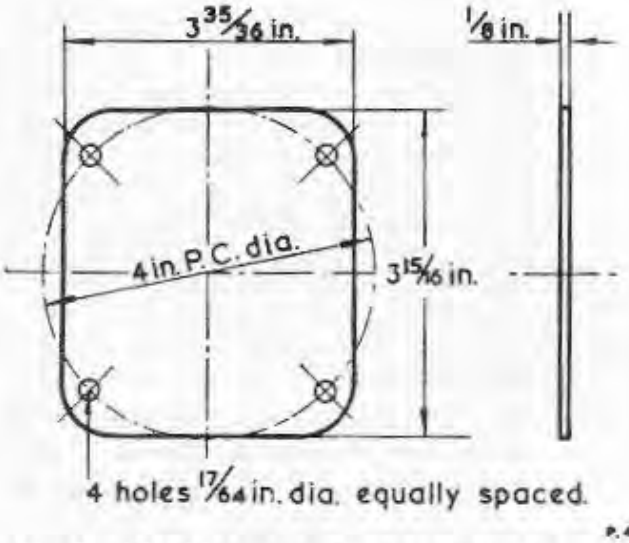


Fig. 3. Blanking cover for generator mounting face, Mk. 1G engine

should be capable of receiving either the transport bearer arms of the engine, or the type of bearer arm illustrated.

11. It is essential that the stand is capable of complete reversal, as this will enable the components at the underside of the crankcase to be removed and refitted more conveniently. Also it must be possible to lock the stand during use positively in any desired position. The base of the stand must be capable of receiving a standard drip tray, and some method of locking the wheels is recommended so that the stand does not move about during operations.

12. When the progress of an engine through workshops during overhaul is stopped at a stage that makes necessary the use of an engine stand, it may be found more economical to employ a waiting stand than to use the reversible stand to accommodate the engine during what may be a considerable period.

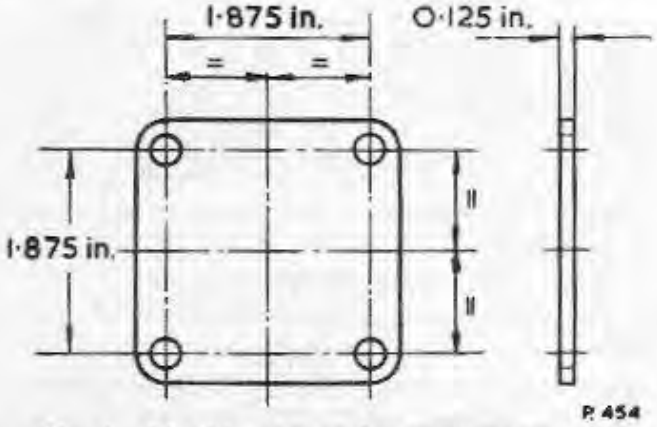


Fig. 4. Blanking cover for vacuum pump mounting face, Mk. 1G engine

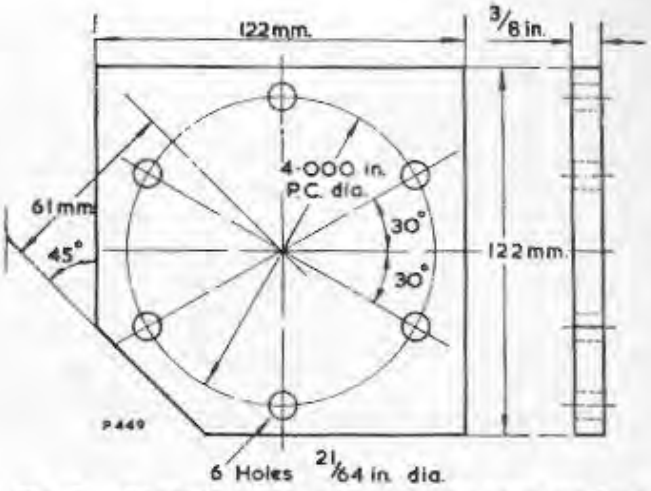


Fig. 5. Blanking cover for starter adapter face

13. For this purpose an engine transport stand, which is the lower component of the packing and transit case illustrated in Chapter 5, fig. 1 page 55, can be easily adapted and the engine mounted thereon by means of four transport bearer arms of the type shown in fig. 2, page 272.

Containers

14. Although the use of containers for segregating and transporting component parts during overhaul is not essential, this practice is strongly recommended for it will be found that in this way the risk of damage to components during transit, or the possibility of the loss of smaller parts, is greatly reduced and the general progress of work made easier in consequence.

15. The usual range of workshop containers can easily be adapted for use during the overhaul of Gipsy Major engines. No special containers, therefore, are described in this chapter.

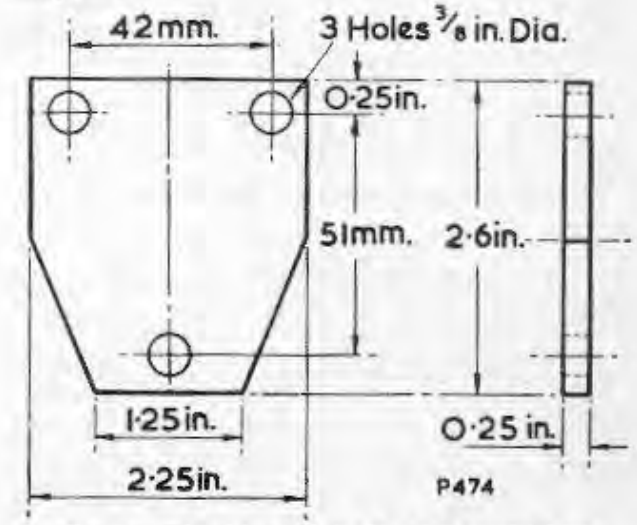


Fig. 6. Blanking plate for exhaust flange

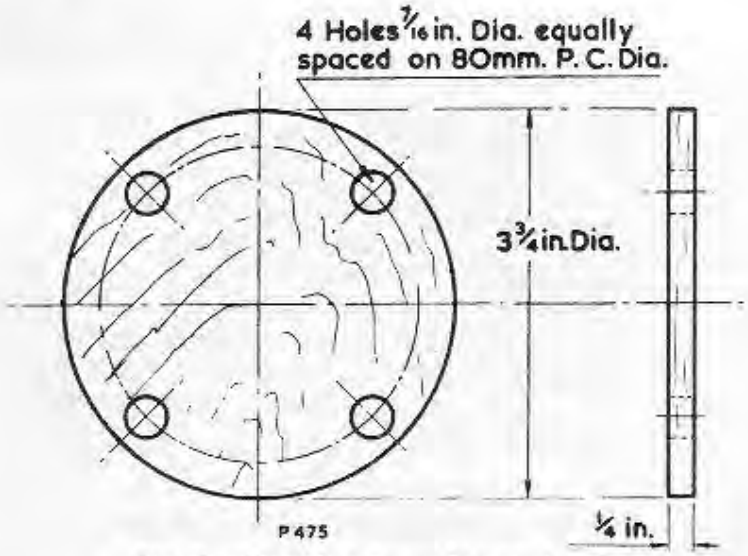


Fig. 7. Blanking cover for air-intake

Blanks and transport spares

16. A list of blanks and transport spares is contained in the Gipsy Major 1 and 10 Spare Parts List, to which reference should be made.

17. If these blanking plates and covers are not available, satisfactory blanks for the larger orifices may be manufactured locally to the dimensions given in figs. 3, 4, 5, 6, and 7.

Dummy propeller

18. To enable the crankshaft to be held stationary while the propeller boss is withdrawn, as described in Chapter 13, page 117, a dummy propeller may be made up locally from any suitable length of wood to the dimensions shown in fig. 8. For use on these engines the diameter of the centre hole, A, must be 2½ in.

Crankshaft stand

19. Details of a suitable crankshaft stand are shown in fig. 9. Any suitable wood of approximately the dimensions indicated may be used. It must be ensured however that the finished stand is completely rigid and capable of withstanding the considerable leverage that is applied when tightening the connecting-rod bolts.

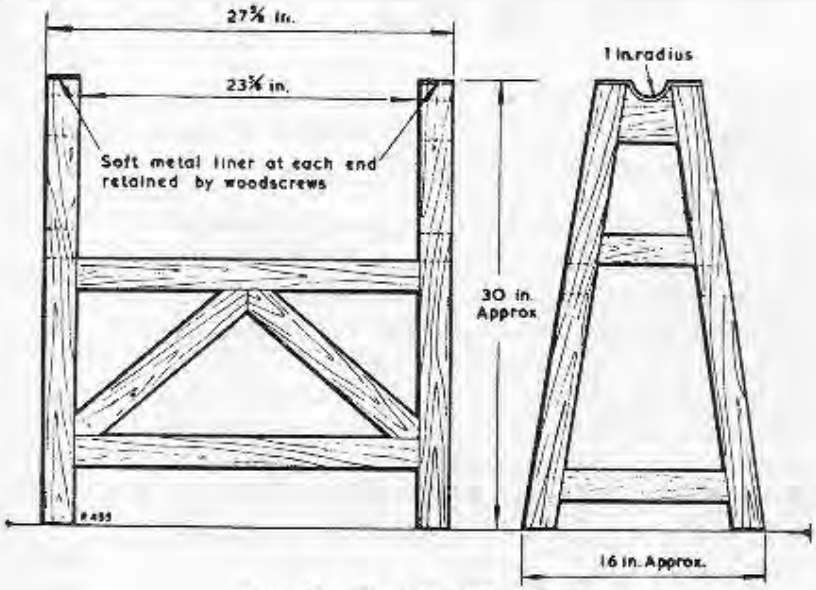


Fig. 9. Crankshaft stand

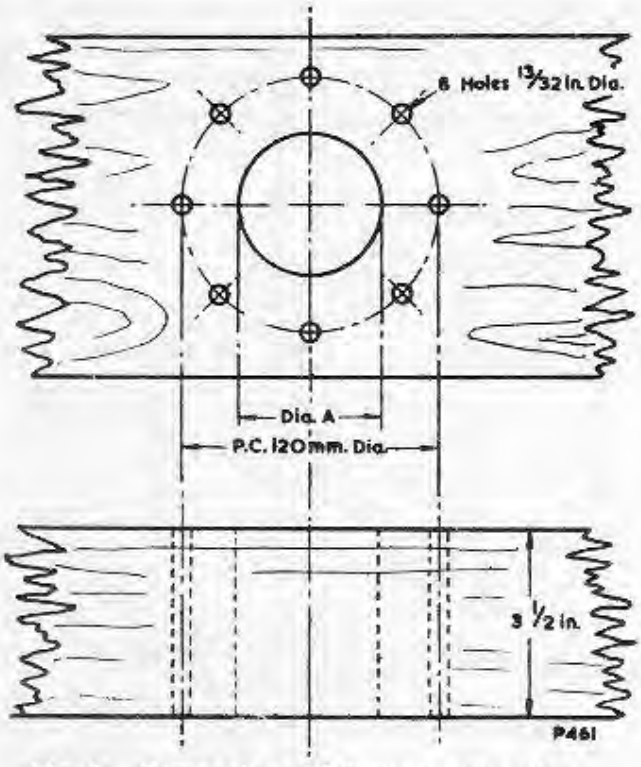


Fig. 8. Dimensions of dummy propeller

20. Wheels may be fitted to the stand if mobility is necessary, but, as with all component stands that are used during dismantling or assembling operations, it must be possible to lock the wheels easily and efficiently and so prevent movement of the stand while work is in progress.

Drifts

21. Various drifts for use during overhaul may be manufactured locally from the most suitable material available and details of these tools are contained in the following paragraphs.

22. To enable the camshaft front bearing to be driven out of its location, as described in Chapter 13, page 125, a drift manufactured to the dimension given in fig. 10 is recommended.

23. For removing the tappet guides, drift T85941 is included in the Overhaul Tool Kit, but if this tool is not available a suitable drift may be made up locally to the dimensions shown in fig. 11.

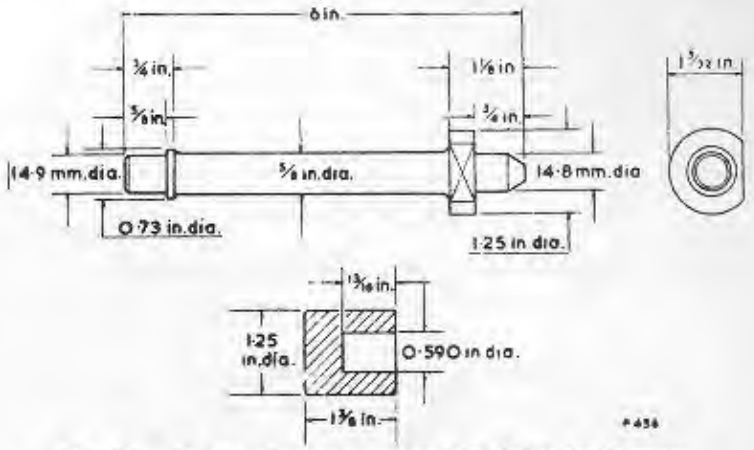


Fig. 12. Extractor for magneto drive ball race

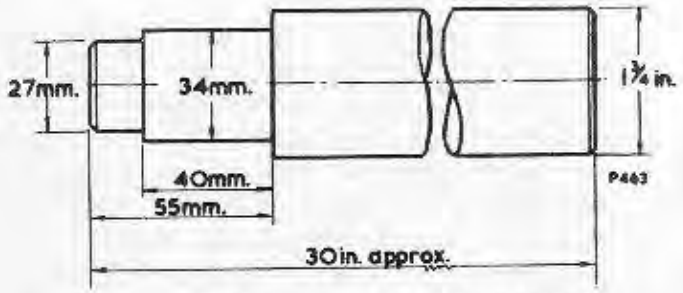


Fig. 10. Drift for camshaft front bearing

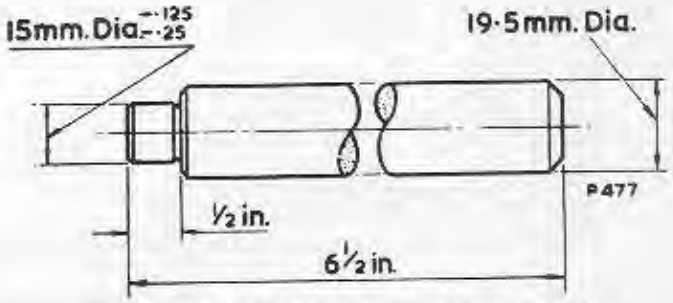


Fig. 13. Drift for magneto drive shaft

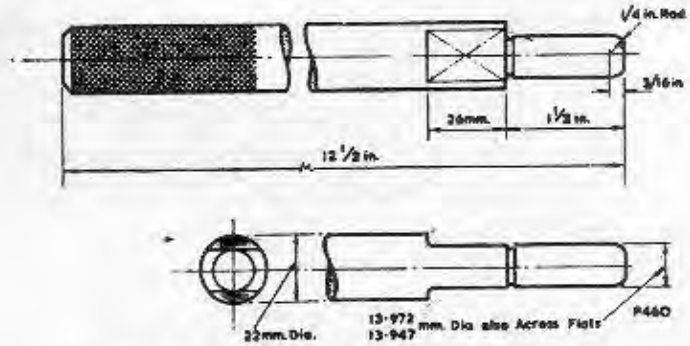


Fig. 11. Drift for tappet guide

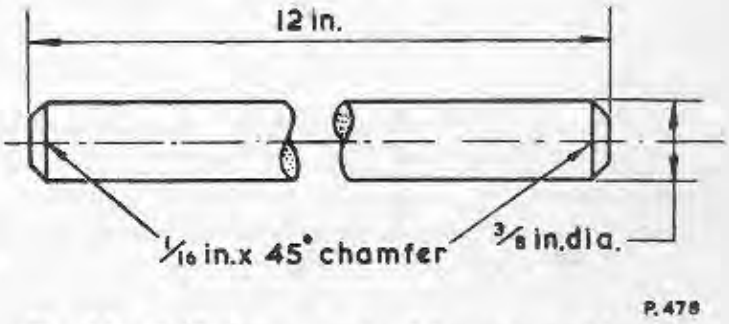


Fig. 14. Drift for magneto drive race and housing

24. During the dismantling of the magneto drive, as described in Chapter 14, page 136, two drifts and an extractor are necessary. Tools for these operations are included in the Overhaul Kit for the Major engine, but if it is necessary to improvise from local resources, the soft-metal drifts shown in fig. 12 and 13, and the combined bearing inserter-extractor illustrated in fig. 14, may be manufactured from available suitable materials.

25. When dismantling the vacuum pump drive from the timing gear cover of Mk. 1G engines a soft metal drift manufactured to the dimensions indicated in fig. 15 will be necessary. The tool is inserted through the air compressor mounting aperture.

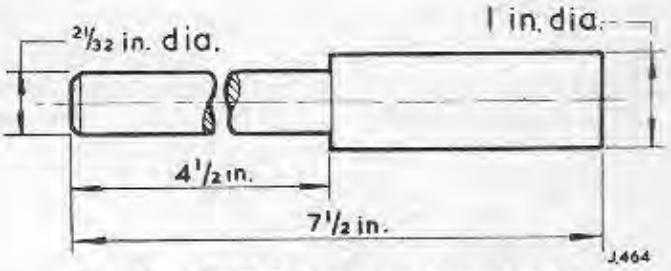


Fig. 15. Drift for vacuum pump pinion

26. A brass drift T85019 for removing the connecting-rod bolts is available in the Overhaul Kit and the use of the tool is described in Chapter 14, page 137. Should it become necessary to manufacture a suitable drift locally the dimensions given in fig. 16 should be followed.

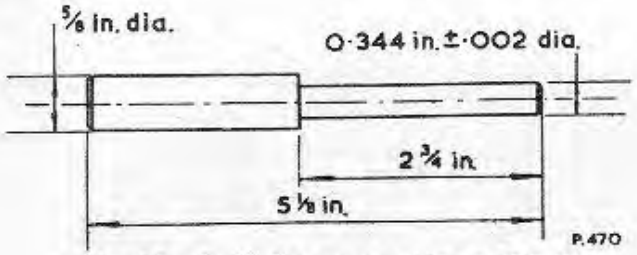


Fig. 16. Drift for connecting-rod bolts

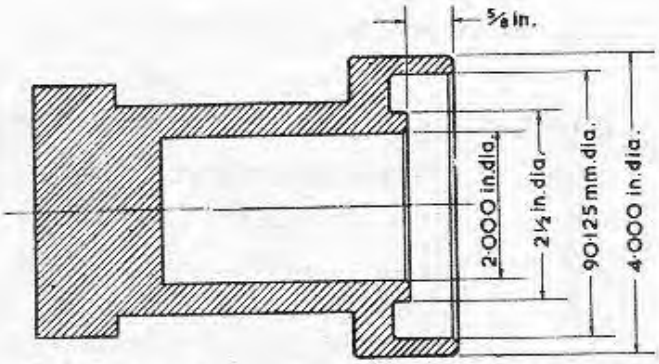


Fig. 17. Drift for thrust race, Mk. 1 and 7 engines

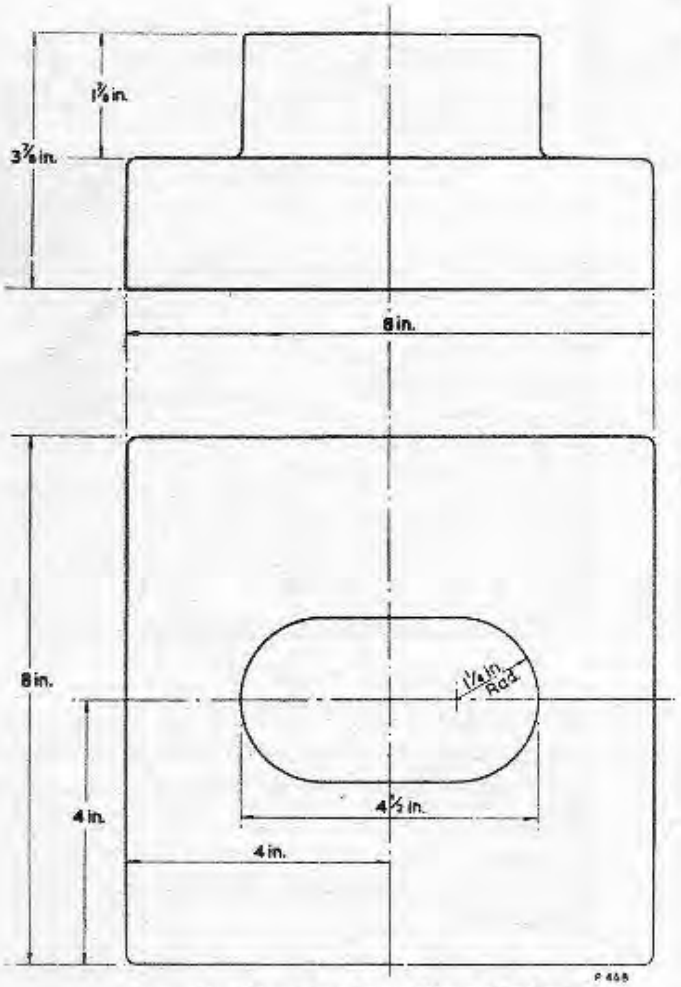


Fig. 18. Bench block for cylinder

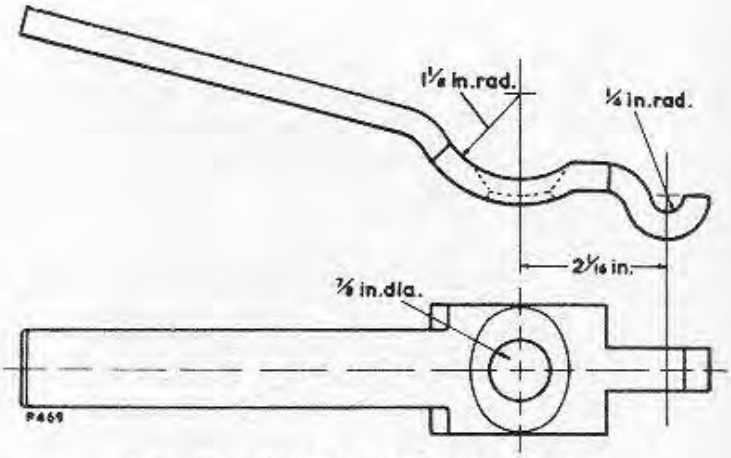


Fig. 19. Valve spring compressor

27. To assemble the thrust bearing to the crankshaft of Mk. 1 and Mk. 7 engines an inserter T85996, the use of which is described in Chapter 15, on page 155, is provided in the Overhaul Kit. If this tool is not available, however, a suitable tubular drift may be used to drive the bearing into position. The dimensions necessary for the manufacture of a hollow drift for this purpose are indicated in fig. 17. The use of phosphor-bronze is recommended if available.

Bench-block, valve spring compressor, and cylinder barrel retaining block

28. The removal of valve springs and valves after the cylinder heads have been removed from the engine is effected by the use of a wooden bench-block and valve spring compressor.

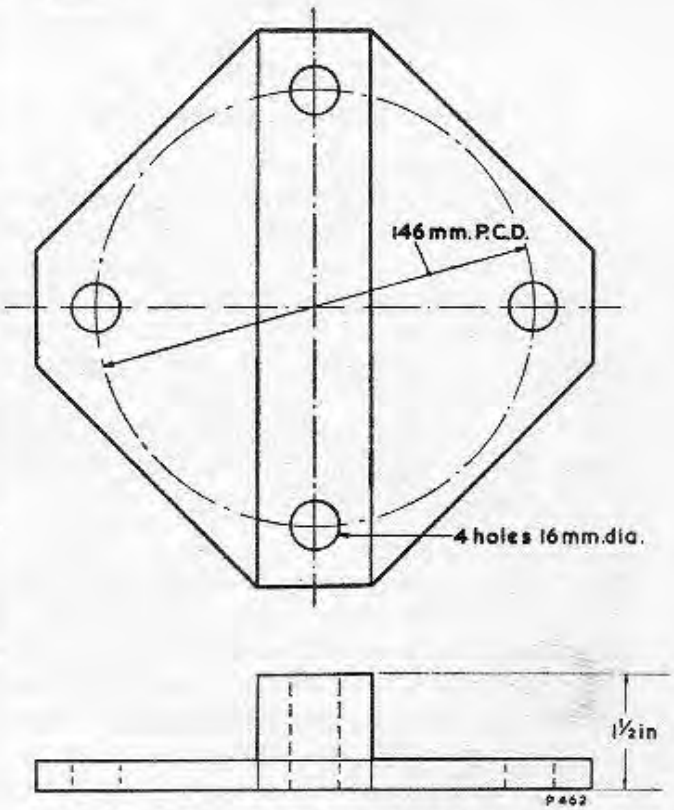


Fig. 20. Retaining block for cylinder barrel

29. Bench-block T85010 and valve spring compressor T85011 are included in the Overhaul Kit for this operation, but if these tools are not available suitable tools may be manufactured to the dimensions given in figs. 18 and 19.

30. When it is necessary to retain the cylinder barrels in position on the engine after the cylinder heads have been removed, combination blanking and packing blocks manufactured from suitable wood to the dimensions indicated in fig. 20, may be assembled to the cylinder holding down studs and secured in position by the holding down nuts.

Fixture for checking end float of magneto driving gear

31. Equipment suitable for checking the end float of the magneto driving gear during the assembly of the timing gear cover is illustrated with dimensions on page 151. The dial test indicator is standard equipment, but the fixture can be readily manufactured locally from suitable materials. The use of the fixture is described on page 150.

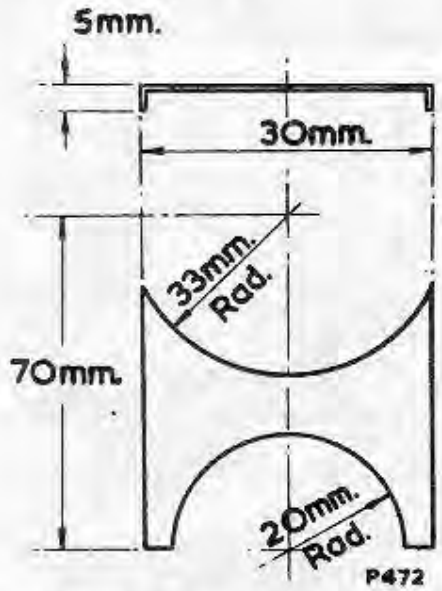


Fig. 21. Concentricity gauge for crankshaft oil seals

Concentricity gauge for crankshaft oil seals

32. For checking the position of oil seal washers on the crankshaft journals and crankpins during reassembly a simple concentricity gauge may be manufactured from any suitable available material to the dimensions indicated in fig. 21. The assembly operation and use of the gauge are described in Chapter 15 on page 155.

Inserter for idler gear spindle

33. During the assembly of the idler gear to the rear wall of the crankcase, as described in Chapter 16 on page 162, an inserter will be needed. The Overhaul Kit for the Major engine contains inserter T86081 for use during this operation, but if this is not available a suitable tool may be manufactured to the dimensions given in fig. 22.

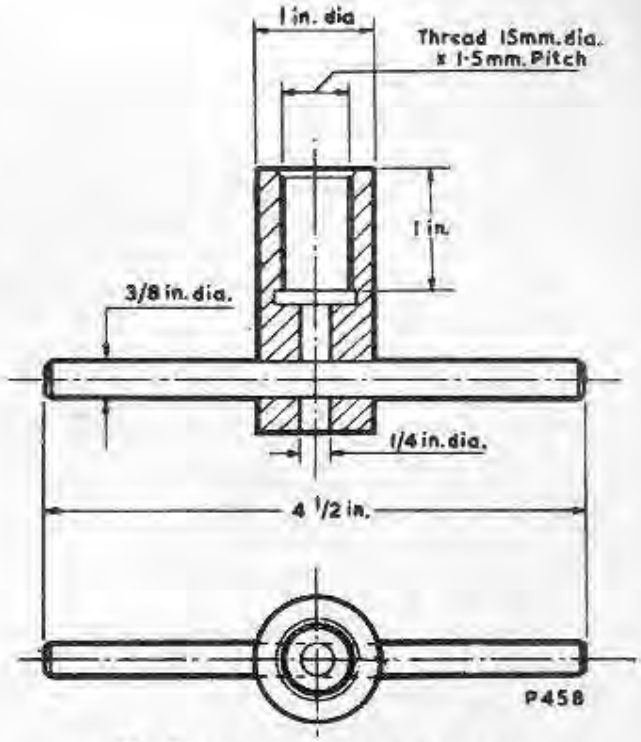


Fig. 22. Inserter for idler gear

Backlash indicator for oil pump drive

34. When checking the backlash between the oil pump driving gear and the camshaft gear after the timing gear cover has been assembled to the engine, a standard dial test indicator together with backlash indicator T85950, which forms part of the Overhaul Kit for the Major engine, should be used if available.

35. If it is necessary to manufacture a suitable tool from local resources however, a fixture should be manufactured and set up as on page 171. If the oil pump housing is in position the distance pieces, item 3, will not be required and only the pump rear cover need be removed to enable the operation to be carried out as described in Chapter 16 on page 170. The distance piece, item 11, as illustrated is suitable for use on early engines, but for use on scavenge system engines the length of this item must be increased to allow for the length of the scavenge pumps housings.

Adapter sets and equipment required for engine testing

36. Information regarding the necessary adapter sets, the test bench and its associated equipment, and the test fan, should be obtained from the test bench manufacturers and the Service Dept. of the Engine Company.

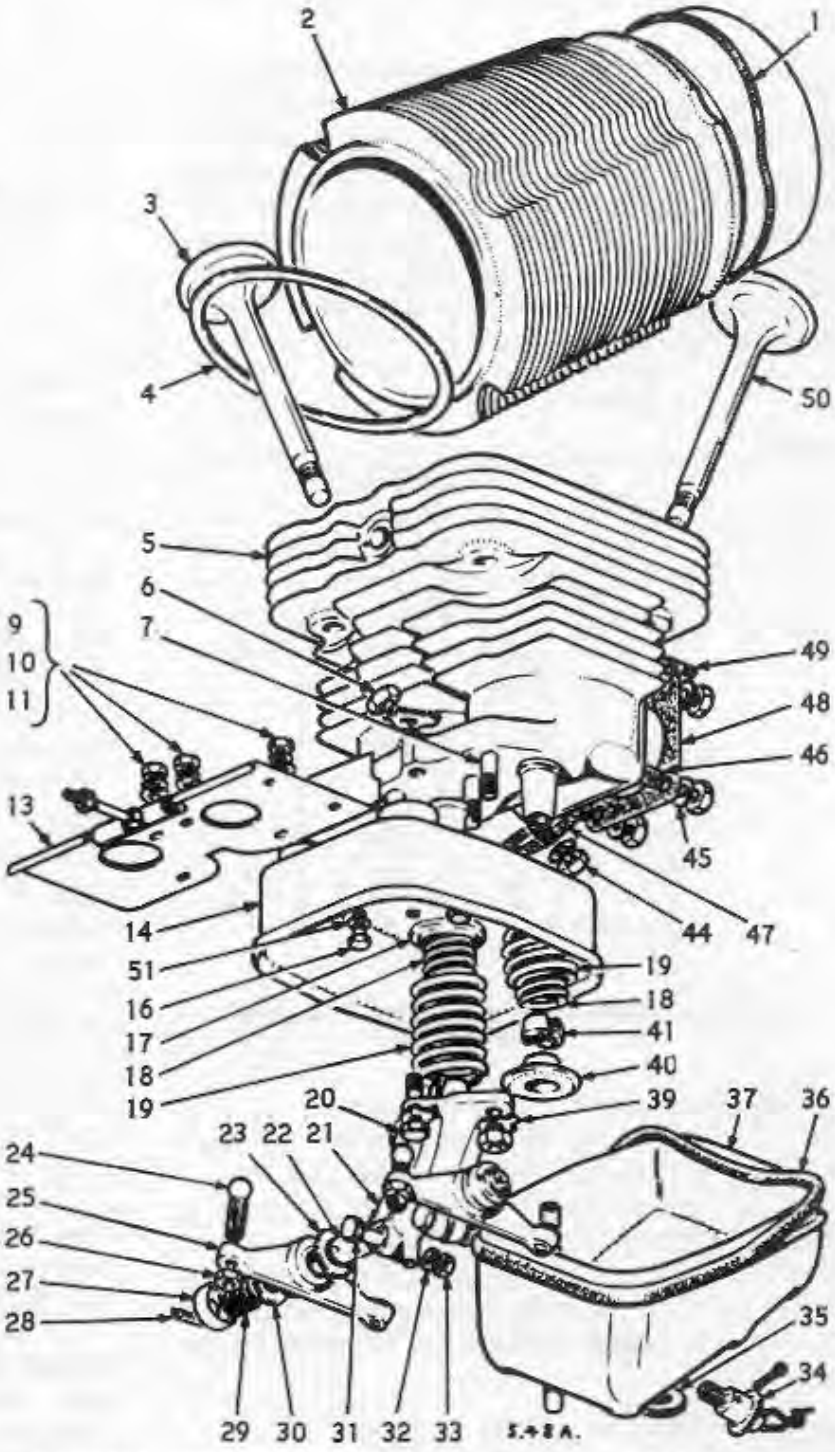
CYLINDER HEADS TO MODIFICATION 2197 STANDARD

Modification 2197 introduces a re-designed cylinder head which incorporates webs to strengthen the valve rocker platform. A new valve rocker bracket is attached to the cylinder head by three studs and one bolt; the valve rocker cover is attached to this bracket by a single stud. A sodium-filled exhaust valve, and improved finning in the vicinity of the exhaust port, result in better cooling. 14 mm sparking plug adapters replace the 12 mm type, and the end fittings of both screened and unscreened ignition cables are replaced by fittings appropriate to 14 mm screened-type plugs.

Modification 2197 must not be applied to one cylinder head only; all heads on an engine must be modified concurrently.

1. Cylinder joint ring
2. Cylinder
3. Exhaust valve
4. Cylinder barrel washer
5. Cylinder head
6. Nut, rocker bracket bolt
7. Stud for valve rocker bracket
9. Nut for baffle bolts
10. Spring washer for baffle bolts
11. Plain washer for baffles
13. Cylinder baffle
14. Valve gear casing
16. Bolt for baffle
17. Valve guide collar
18. Inner spring for valve
19. Outer spring for valve
20. Bolt for rocker bracket
21. Rocker bracket
22. Rocker spindle
23. Thrust washer for rocker bracket bolt
24. Ball end
25. Rocker
26. Locking nut for ball end
27. Rocker spindle cap
28. Retaining pin
29. Spring
30. Thrust collar
31. Clamping bolt
32. Spring washer
33. Plain nut
34. Retaining screw
35. Washer for retaining screw
36. Joint for valve gear cover
37. Valve gear cover
39. Tab washer
40. Valve collar
41. Collet for valve spring
44. Nut
45. Spring washer for flange studs
46. Stud
47. Exhaust flange joint
48. Inlet flange joint
49. Thermocouple stud
50. Inlet valve
51. Plain washer

Numbers 8, 12, 15, 38, 42, and 43 were allocated to parts deleted by Modification 2197



Cylinder, and cylinder head, Modification 2197 standard

Continuation of Table of Fits and Clearances

OIL PUMP

Component and Description	*New Dimensions*	*Permissible Worn Dimensions*	*Permissible Worn Clearances*
Oil Pump Auxiliary Gears In Casings, Diametral Clearance			
Pump casings, bore	35.513 / 35.532	35.595	
			0.25
Pump gears, diameter over teeth	35.320 / 35.345	35.263	
	Mk.7 type only. Mod. G.1990		
Oil Relief Valve in Bush			
Bush, bore	13.993 / 14.013	14.065	
			0.10
Valve, outside diameter	13.955 / 13.965	13.893	
	Mk. 7 only		
Oil Relief Valve Bush in Oil Pump Rear Cover			
Standard size			
Rear Cover, bore	16.993 / 17.013	-	-
Bush, outside diameter	17.019 / 17.026	-	-
0.010 in. Oversize			
Rear Cover, bore	17.247 / 17.267	-	-
Bush, outside diameter	17.273 / 17.280	-	-
	Mk.7. See Repair Drawing No. R.258		

VALVE SPRING LOADING

It is important that the load imposed by the valve springs is closely controlled because a reduction in the loading can affect engine performance, whilst excessive loading will result in higher working stresses, and may lead to valve spring failure. Reduced or excessive loadings can be caused by incorrect assembly. Reduced loadings can also be caused by spring fatigue, wear in associated components, and valve and valve seat regrinding. To avoid incorrect reassembly, and thus upseting the valve spring loading, the location of the collets, valve collars, springs, valves and valve guide collars, must be identified as they are dismantled. Particular care must be taken to ensure that the collets are kept in pairs. The spring loading is determined by the length of the assembled springs. It can be adjusted, if necessary, by the use of an oversize valve guide collar which, by reducing the spring length, increases the loading. The spring length is measured, with the valve assembled and in its closed position. The measurement can be taken more easily if the valve is assembled using the inner spring only. The valve should be bounced vigorously on its seating to settle the assembly before measuring the distance between the inner faces of the valve spring collar and the valve guide collar. The length should be 1·858 in. and must not be less than 1·750 in. The correct length is obtained by using a collar selected from the following range.

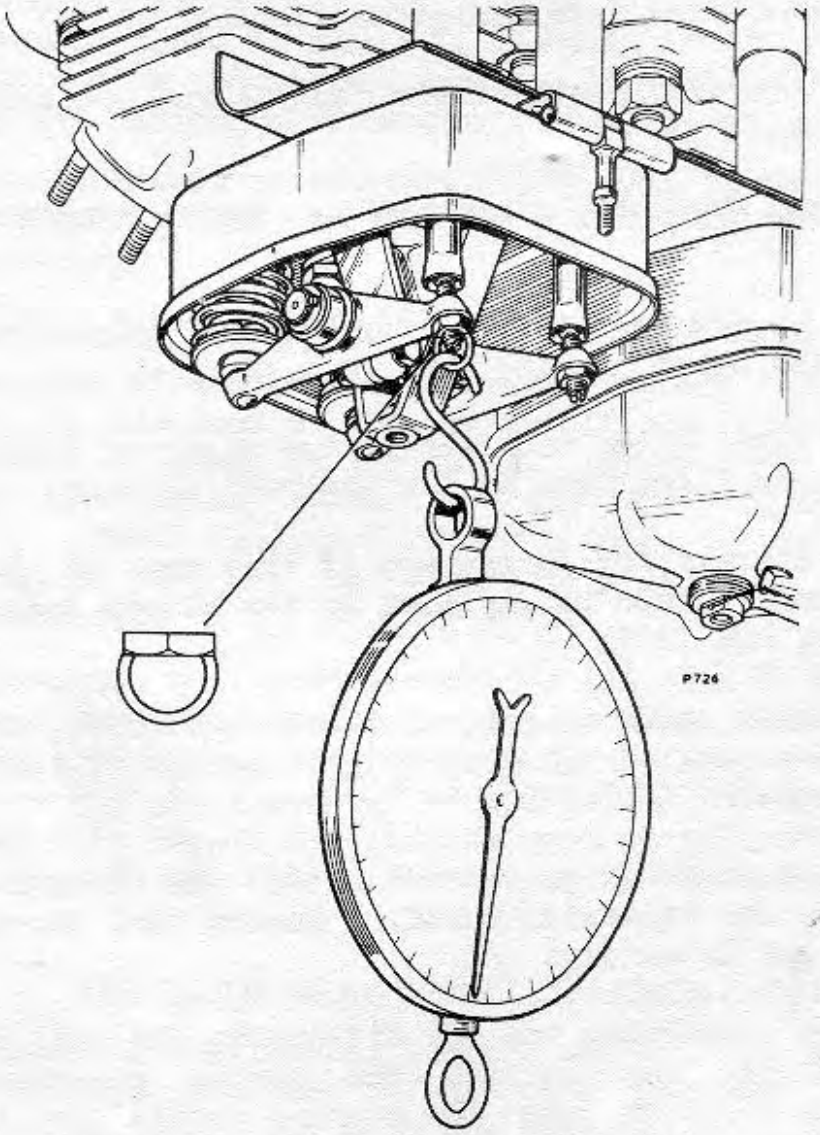
Valve guide collars

Flange thickness	Part No.
Standard	1302-85
Plus 0,75 mm	39331
Plus 1,50 mm	39332
Plus 2,25 mm	39333
Plus 3,00 mm	39334

When the correct length has been achieved, the springs must be assembled and checked for correct loading. The force necessary just to move the valve from its closed position must be at least 25·5 lb. and as little above this as possible. To test the spring loading, both the springs must be assembled on the valve and, if possible, the test should be done by applying a load squarely at the end of the valve stem. A satisfactory alternative method, which can be used on an installed engine, is to apply the load by means of a spring balance attached to a suitable eye welded to a slave tappet adjusting lock nut (see figure). Where a load is applied by this method, it is necessary to divide the balance reading by 1·14, which is the rocker arm ratio. To minimise frictional error, and to obtain an average value, the test should be repeated several times.

When the load is less than 25·5 lb., the springs must be removed, their pressures checked, individually, on the lines suggested on page 241, and renewed if the values obtained are less than the permissible worn limits given on page 215. If the load is appreciably above 25·5 lb., recheck the dimension between the two collars and if necessary, select a thinner valve guide collar. If it is still impossible to obtain the required spring length/loading another spring should be used.

When the loading is correct, set the tappet clearance to ·010 in. and insert a slip ·070 in. thick between the valve stem and rocker pad. Turn the crankshaft slowly and ensure that there is clearance between the coils of the springs when the valve is fully open. Upon completion of this check the tappets must be re-adjusted to the clearances quoted in the Leading Particulars.



Testing Valve Spring Loading

SERVICING ENGINE CONTROLS

To avoid the cumulative effect of wear on control-rod ball-end fittings, which will cause lost movement and may result in disconnection of the linkage, the control linkwork should be serviced, in accordance with the following instructions, at intervals of 50 hours or some longer period as experience, and safe operation dictate.

1. Measure the overall length of the control rod and make a note of the dimension.

2. Remove the end fittings, dismantle to their component parts and clean.

3. Examine the bronze bearing cups for signs of wear especially on the threads of the outer bearing cup.

4. Examine the light alloy end fitting for signs of damage around the ball end aperture and wear of the internal threads.

5. Examine the springs for damage and if they are of the open ends coil type, they should be replaced by the closed end coil springs introduced by mod.2092.

6. If wear on these parts is not considered excessive, the end fitting should be re-assembled using a light smear of low temperature waterproof grease, (DTD.825).

7. Adjust the end fittings on the rod until the length of the rod conforms with the dimension noted. Ensure that the threads of the control rod are in safety.

8. Finally, when assembling the end fitting to the ball end, screw the the outer bearing cup against the spring pressure until all adjustment is taken up, when the control should be tight on the ball end. Unscrew the bearing cup screw until the nearest split pin holes in the light alloy fitting align with the screwdriver slot in the bearing cup.

9. Fit the split pin and check that the control rod is free to turn.

BALL AND ROLLER BEARINGS

Ball and roller bearings are manufactured to two standards, "Commercial" and "Aircraft". Although similar bearings to those two standards may look identical and have the same type number, the aircraft bearings are made from selected materials of higher quality and are submitted to more rigid inspection.

As serious consequences may result from fitting commercial standard bearings in place of those to aircraft standard it is recommended that replacement bearings be ordered through The de Havilland Engine Co. Ltd. and not through the bearing manufacturers local agent.

It is emphasized that no responsibility will be accepted for damage to engines which result from the failure of bearings obtained other than through this Company.

PREVENTION OF FRETTING ON STEEL MATING SURFACES

The examination of engines at complete overhaul has revealed that severe fretting has occurred to the crankshaft and propeller hub splines and to the surfaces adjacent to the thrust bearings. This type of fretting can be considerably reduced by the application of an anti-fretting grease. Shell Rhodina No.2 has proved to be a successful material, and may be used as an alternative to the Ragosine L.M. previously recommended.

It is recommended that when assembling all steel mating surfaces except those used for centralising purposes, such as the sloping surfaces of cones or propeller hub tapers, the mating surfaces should be wiped clean and then very lightly smeared with a grease to this specification. In certain cases this grease may also be used where bronze material is mating with steel such as, the bore and rear abutment face of bronze propeller cones.

IMPULSE STARTER — LUBRICATION

Malfunctioning of the impulse starter may be due to insufficient lubrication. Furthermore, the effects of a lubricant upon the impulse starter mechanism may also vary with the prevailing climatic conditions, but tests have shown that satisfactory operation under varying conditions is achieved if the following procedure is adopted.

Thoroughly flush the assembly with clean kerosene to remove all trace of lubricants and foreign matter. Dilute some colloidal graphite with thin oil, e.g. "Oildag", manufactured by Acheson Colloids Ltd., and pump the mixture through the holes provided in the front face of the unit or the locking hole at the side. Thus a film of graphite will be left on the parts after the oil has been dispersed during service. This treatment should be applied to the unit as often as operating experience dictates.

Where there are facilities for dismantling the starter it is also advisable to place a thin layer of graphite grease or anti-seize compound in the front cover, where the helical spring seats. This will ensure that a graphited lubricant is always present, for dilution with thin oil, during the life of the unit.

FUELS FOR GIPSY ENGINES

During recent years, certain essential changes have been made to the standard grades of aviation gasoline. As a result, with the exception of small supplies of 80 octane, lead-free fuel available for the anti-corrosion run aero-engines are given prior to inhibiting and storage, the aviation gasolines marketed by the distributors in The United Kingdom are; 73 octane, which is the only unleaded fuel; and 91/96, and 100/130 grades which contain 5.5 ml. T.E.L. per Imperial gallon.

The lead content of these two latter fuels is higher than the limitation of 4 ml. T.E.L. per Imperial gallon specified for certain types of Gipsy engines. However, as 73 octane and 100/130 grade are generally available at airfields, it is possible for a 50/50 mixture of 73 and 100/130 grades to be made with a total lead content within the specified limits when a fuel of 80 octane rating is required. This mixture does, in fact, exceed the minimum requirement of 80 octane but, in the interests of aircraft safety, these are the only proportions which anybody responsible for filling aircraft fuel tanks should be expected to handle.

Where dealers and operators with one-pump sites do not require to provide a completely lead-free fuel, the fuel distributor may supply bulk deliveries consisting of one-third 100/130 grade and two-thirds 73 octane, which will give a minimum rating of 80 octane with a T.E.L. content not exceeding 2 ml. per Imperial gallon.

When the aircraft tanks are being filled with a 50/50 mixture, each tank must be treated individually,and the 100/130 grade delivered first. Thus, if the tanks or pipe-lines were dry before refuelling, and the fuel does not adequately mix in the refuelling process, the engine will consume high octane fuel at take-off when maximum power is required. If 73 octane is delivered first, it is possible that due to inadequate mixing, severe detonation may occur during take-off and the initial stages of climb.

It is emphasized that lead-free fuel only should be used in engines fitted with bronze cylinder heads since the effect of the lead content on the bronze material renders the head completely unserviceable in a very short time (see Summary of Civil Variants, page 8). The fuel grades specified for Gipsy Major engines are given in the Leading Particulars, page 6.

LOG BOOK ENTRY OF ENGINE RUNNING TIMES

To standardise procedure, the Air Registration Board, recommend the following method of entering engine running times in engine log books.

Running times of acceptance and final tests after initial build or overhaul.

These times, which usually fall within certain closely defined limits should be entered on the appropriate Engine Inspection and Test Certificate. The times will be ignored in computing the engine life between overhauls and this applies even when an engine may have been rejected in its initial test or have run additional hours for reduction of oil consumption prior to acceptance.

Ground running times.

The duration of ground running of engines installed in aircraft need not be entered in log books, but the fact that engines have been run, together with any appropriate comments, should be entered either in log books, or in engine run records where these are used in conjunction with approved maintenance schedules.

Running times in flight.

The duration of engine running times in flight should be entered in log books on a "chock-to-chock" basis. As the approved periods between overhauls will be based only on these times, the time run between overhauls should be determined by the sum of these times and no others need be taken into account (see page 200).

RECTIFICATION AND SALVAGE SCHEMES

Although in many instances, repair and reconditioning of Gipsy Major engines is most easily and most economically effected by replacing worn or damaged parts by new standard-size parts, certain worn or damaged components can, of course, be salvaged by the application of approved schemes.

The following salvage schemes have been approved for use on Major 1 engines and operators who wish to obtain copies of the relevant working drawings should submit their orders to the Service Department of the Engine Company at the address given at the beginning of this handbook.

Drawing number	Description
R.1	Crankshaft: regrinding journals and crankpins.
R.2	Crankshaft: oversize keyway.
R.3 and R.4	Connecting rod: oversize dowel.
R.5	Connecting rod: increased nip on bearing.
R.6	Crankcase: camshaft intermediate bearings.
R.7	Crankcase: repair operation to cylinder face.
R.8	Crankcase: oversize cylinder holding-down stud.
R.9	Crankcase: repair to cylinder holding-down stud thread.
R.10 and R.11	Crankshaft bearing caps: oversize dowels.
R.12 and R.13	Cylinder: oversize regrinding.
R.14	Cylinder head: oversize valve guides (bronze heads).
R.15	Cylinder head: recutting valve seats (bronze-heads).
R.17 and R.18	Cylinder head: oversize studs for exhaust port flange (bronze heads).
R.19	Timing gear cover: oversize bush for idler gear spindle.
R.20	Camshaft: oversize keyway.
R.21	Induction manifold: replacement of heater boxes.
R.22	Airscoop backplate: replacement of damaged portion.
R.23	Magneto control lever: rebushing.

R.24 and R.25	Flame trap housing and air-intake bend: oversize bushes.
R.26	Spinner retaining plate: bolt replacement.
R.27	Cylinder head: oversize valve seats (aluminium heads).
R.28 and R.29	Cylinder head: oversize studs for exhaust port flange (aluminium heads).
R.30	Cylinder head: oversize valve guides (aluminium heads).
R.34 and R.35	Connecting rod: oversize dowel.
R.70	Magneto drive idler gear: oversize bushes.
R.90	Crankcase: oversize studs.
R.96	Crankcase: repair operation to cylinder chamfer.
R.101-1 and -2	Airscoop: replacement of hinges.
R.107	Cylinder head: repair to exhaust port stud threads (aluminium heads).
R.108	Cylinder head: repair to exhaust port stud threads (bronze heads).
R.110	Crankcase: repair to bearer foot recess.
R.285	Pressure oil filter: repair to casing.
R.287	Crankcase: worn camshaft bushes.
R.288	Cylinder head: oversize sparking plug adapter (aluminium heads).
R.313 and R.328	Crankcase: repair to damaged bearer arm stud holes.
R.342	Stud holes: general repair (metric threads).
R.352	Cylinder head: oversize studs for inlet port flanges.
R.367	Timing gear cover: repair to fretted starter adapter mounting face.
R.377	Cylinder head: recutting of inlet and exhaust valve seats (aluminium head).
R.378	Crankcase: idler spindle bore.
R.380	Housing flame trap: carburettor air-intake oversize fulcrum.
R.383	Impulse starters: rectification of wear.
R.388	Induction system: replacement of fulcrum pin.
R.393	Impulse starter: rectification of wear.
R.399	Flame trap: repair of loose element.
R.404	Main control unit: worn and damaged taper pin holes.
R.413	Cylinder barrels: salvage when the spigot joint face has become fretted.
R.425	Metric thread holes: salvage when stripped or damaged.
R.429	Splined crankshaft: salvage of front nuts.

METRIC SCREW THREAD DATA — B.S.1095

The British Standard Specification B.S.1095 (1942) was introduced to provide manufacturers and other users with detailed information regarding the standard metric thread form and series. The metric thread form and principle series of both B.S.1095 and the Système International are identical.

The form of threads in the more general range of sizes used on de Havilland Gipsy aero-engines is based upon the B.S. and S.I. specifications. The following tables and diagrams provide the important dimensions of studs, bolts and nuts in this general range, but do not include the larger diameter special threads used for certain applications on the engine.

The thread standards marked thus "*" in Table 1 conform completely to the S.I. specification, but the remainder in this table, although conforming to the S.I. standard thread form, have a pitch/diameter ratio to a de Havilland Drawing Office Standard.

The "fast-end" stud threads listed in Table 2, although based upon the S.I. thread form, are oversize, and incorporate a slight truncation on the outside diameter to prevent binding at the crests. Such threads are normally screwed into tapped holes conforming to the standard for nuts, Table 1. It should also be noted that the tolerances for the effective diameter of fast end stud threads are very close.

TABLE 1

FORM AND TOLERANCES IN ACCORDANCE WITH B.S.1095 (MED. FIT)
ALL DIMENSIONS IN MILLIMETRES.

BASIC SIZES			BOLTS AND STUDS (NUT END) — A					NUTS — B				
Nominal Dia.	Pitch	Depth of Thread	Major Dia.		Effective Dia.		Minor Dia.	Major Dia.	Effective Dia.		Minor Dia.	
			Max.	Tol. Minus	Max.	Tol. Minus	Max.	Min.	Min.	Tol. (+)	Min.	Tol. (+)
5	.75	.487	5.000	.131	4.513	.092	4.148	5.000	4.513	.092	4.148	.121
* 6	1.00	.650	6.000	.158	5.350	.096	4.863	6.000	5.350	.096	4.863	.163
* 7	1.00	.650	7.000	.158	6.350	.100	5.863	7.000	6.350	.100	5.863	.163
8	1.00	.650	8.000	.158	7.350	.108	6.863	8.000	7.350	.108	6.863	.163
9	1.00	.650	9.000	.158	8.350	.108	7.863	9.000	8.350	.108	7.863	.163
10	1.00	.650	10.000	.158	9.350	.108	8.863	10.000	9.350	.108	8.863	.163
11	1.00	.650	11.000	.158	10.350	.114	9.863	11.000	10.350	.114	9.863	.163
12	1.00	.650	12.000	.158	11.350	.114	10.863	12.000	11.350	.114	10.863	.163

TABLE 2

BASIC SIZES			STUDS (FAST END ONLY) C				
Nominal Dia.	Pitch	Depth of Thread	Major Dia. Truncated		Effective Dia.		Minor Dia.
			Max.	Tol. Minus	Max.	Tol. Minus	Max.
5	.75	.487	5.000	.20	4.563	.050	4.198
6	1.00	.650	6.000	.25	5.430	.055	4.943
7	1.00	.650	7.000	.25	6.430	.055	5.943
8	1.00	.650	8.000	.25	7.430	.055	6.943
9	1.00	.650	9.000	.25	8.430	.055	7.943
10	1.00	.650	10.000	.25	9.430	.055	8.943
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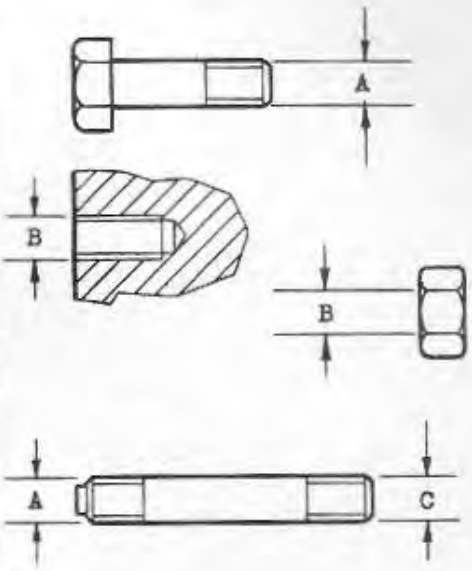
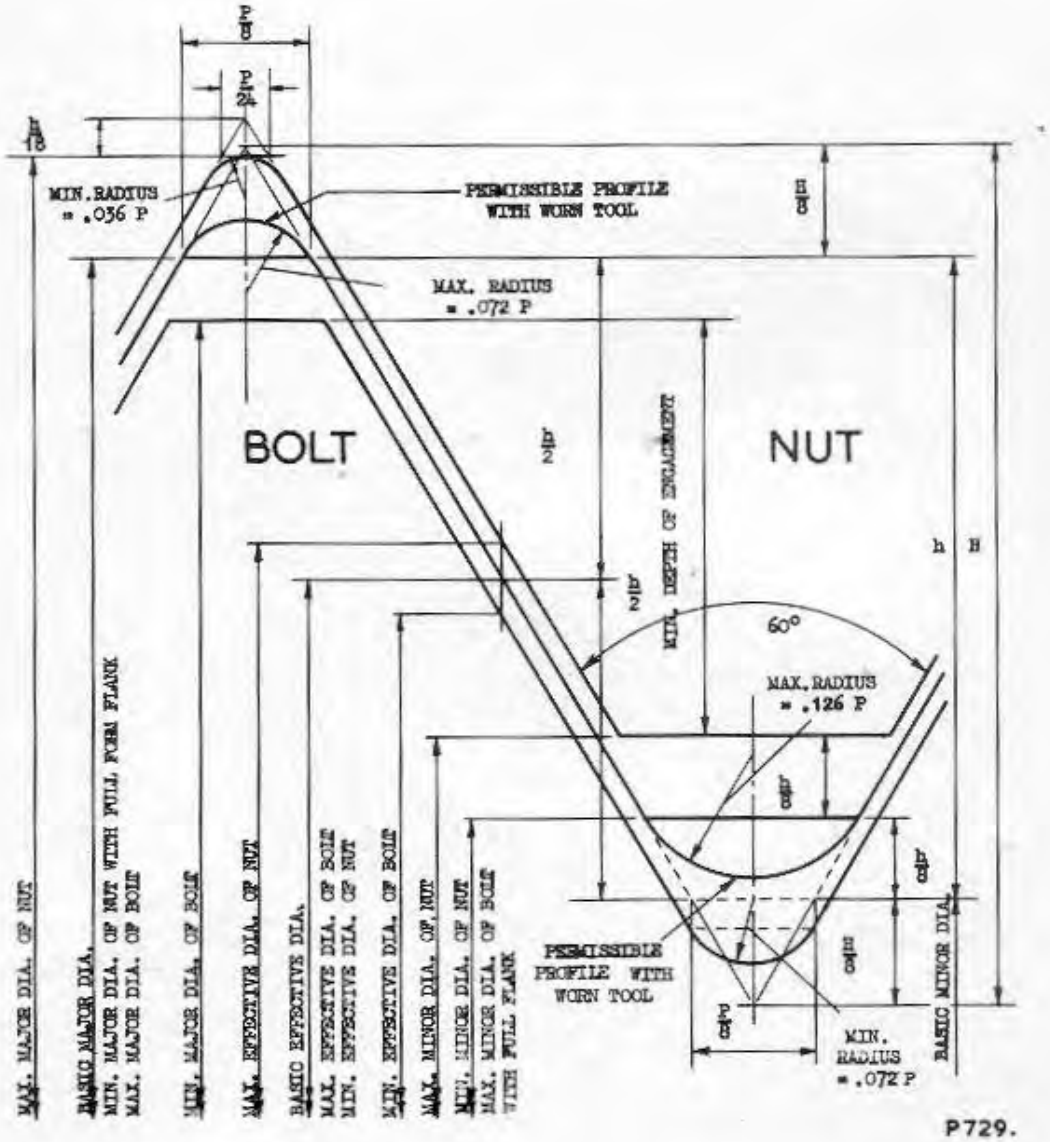
12	1.00	.650	12.000	.25	11.430	.055	10.943





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Systeme International Thread Form

APRIL 1955