Chapter 1

TORCH IGNITER (Derwent Mk. 5 aero-engines)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

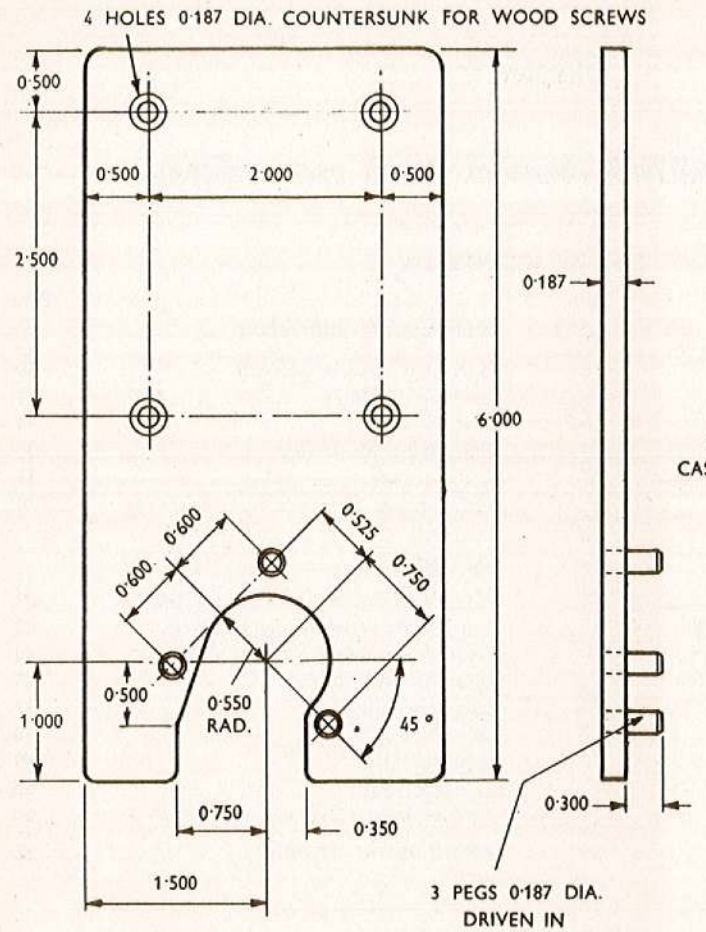
1. This chapter covers the reconditioning and rig testing of the Derwent Mk. 5 aero-engine torch igniter.

EQUIPMENT AND TOOLS

2. The equipment and tools are divided into two categories, those which are provisioned, and those which are considered to be within the manufacturing capabilities of a Maintenance Unit. The equipment in the latter category is distinct from, and in addition to that listed in the Base Tool Kit. Before attempting to manufacture this equipment, a check must be made to ensure that it has not been provisioned subsequent to the issue of this chapter.

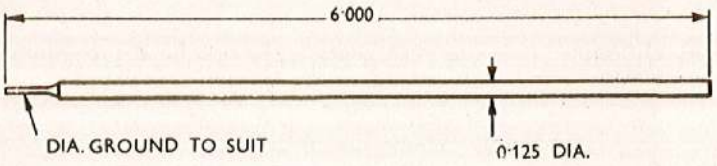
3. Dimensioned drawings are provided for the locally made equipment, giving sufficient information for their manufacture. The choice of materials and the design features are left to the discretion of the persons responsible for supervising the manufacture; this will allow some latitude for improvisation.

4. In addition to the tools listed in the Base Tool Kit, and those detailed in this



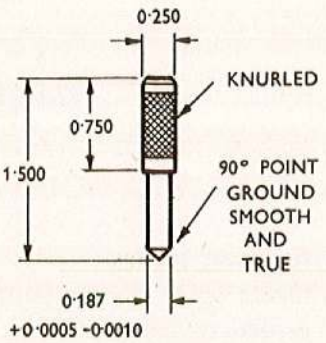
FIXTURE FOR TIGHTENING VALVE NUT

MATL: STEEL



LAPPING STICK FOR ATOMIZER

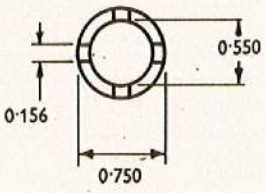
MATL CHERRY WOOD

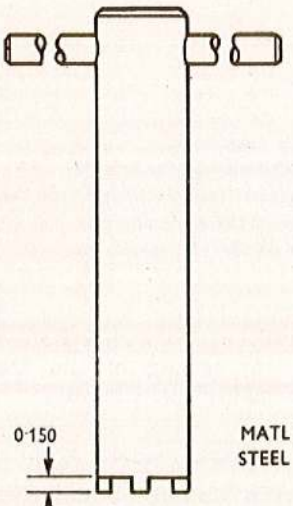


MATL: CAST STEEL

HDN. TEMPERED WELL BACK FROM POINT

BURNISHING TOOL FOR VALVE SEATING





SLOTTED SPANNER FOR VALVE HOUSING NUT

ALL DIMENSIONS IN INCHES

FIG. I. LOCALLY MADE TOOLS

chapter for local manufacture, a suitable rig will be provided to enable the necessary tests to be carried out.

5. Equipment and tools to be manufactured are detailed in fig. 1 and a list of these is as follows :—

Fixture, for tightening valve nut.

Burnishing tool, for valve seating.

Lapping stick, for atomizer.

Slotted spanner, for valve housing nut.

CHECKS BEFORE DISMANTLING

6. Mount the torch igniter on the test rig and carry out the checks detailed in the following paragraphs.

Insulation resistance check

7. Check the insulation resistance between the coil and casing using a 500-volt megger. The resistance must not be less than 20 megohms at 500 volts D.C.

Coil resistance check

8. Check the resistance of the solenoid coil at a room temperature of approximately 20 deg. C. The resistance must be not greater than 8·8 ohms and not less than 7·2 ohms.

9. If the solenoid fails in the foregoing tests, the assembly must be rejected. It is not practicable to recondition the coil assembly, but if the remaining valve parts are sound they may be used for the repair of other units, as required.

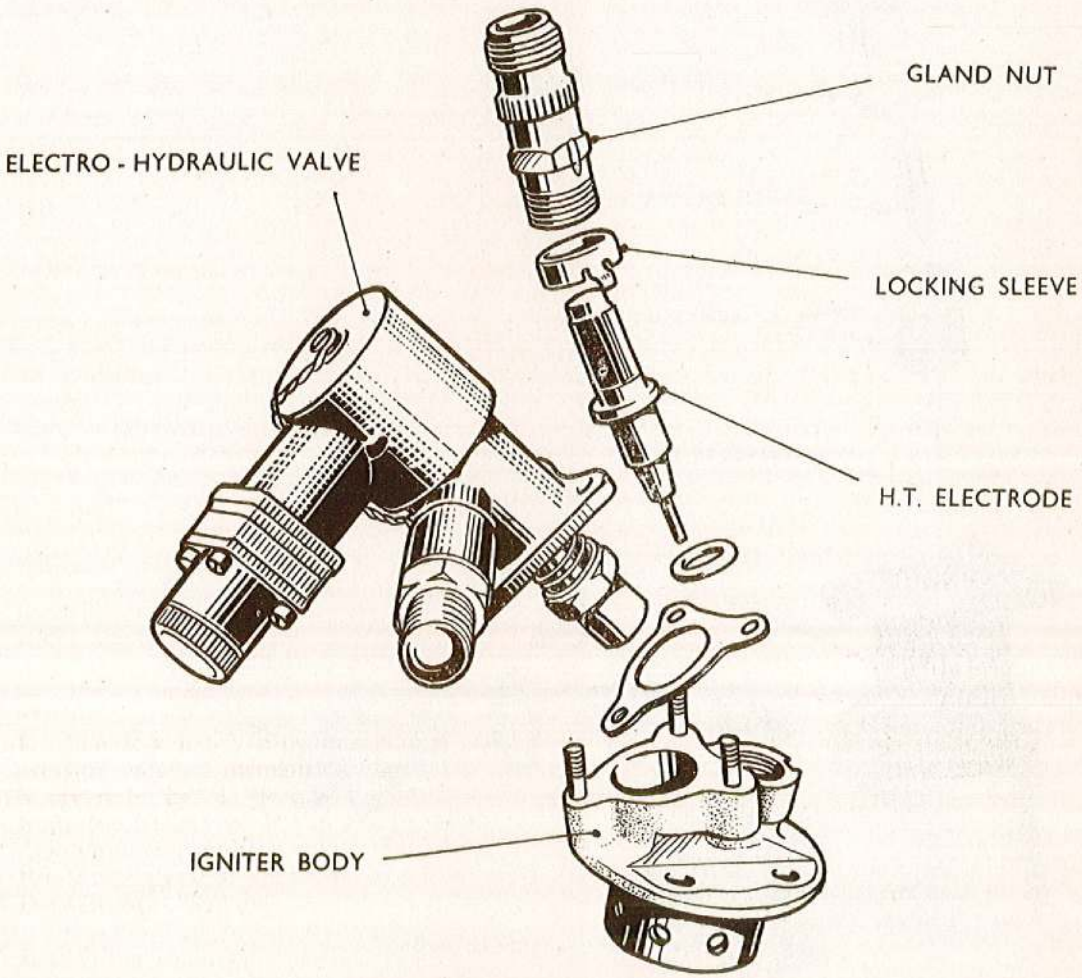


Fig. 2. Exploded view of torch igniter

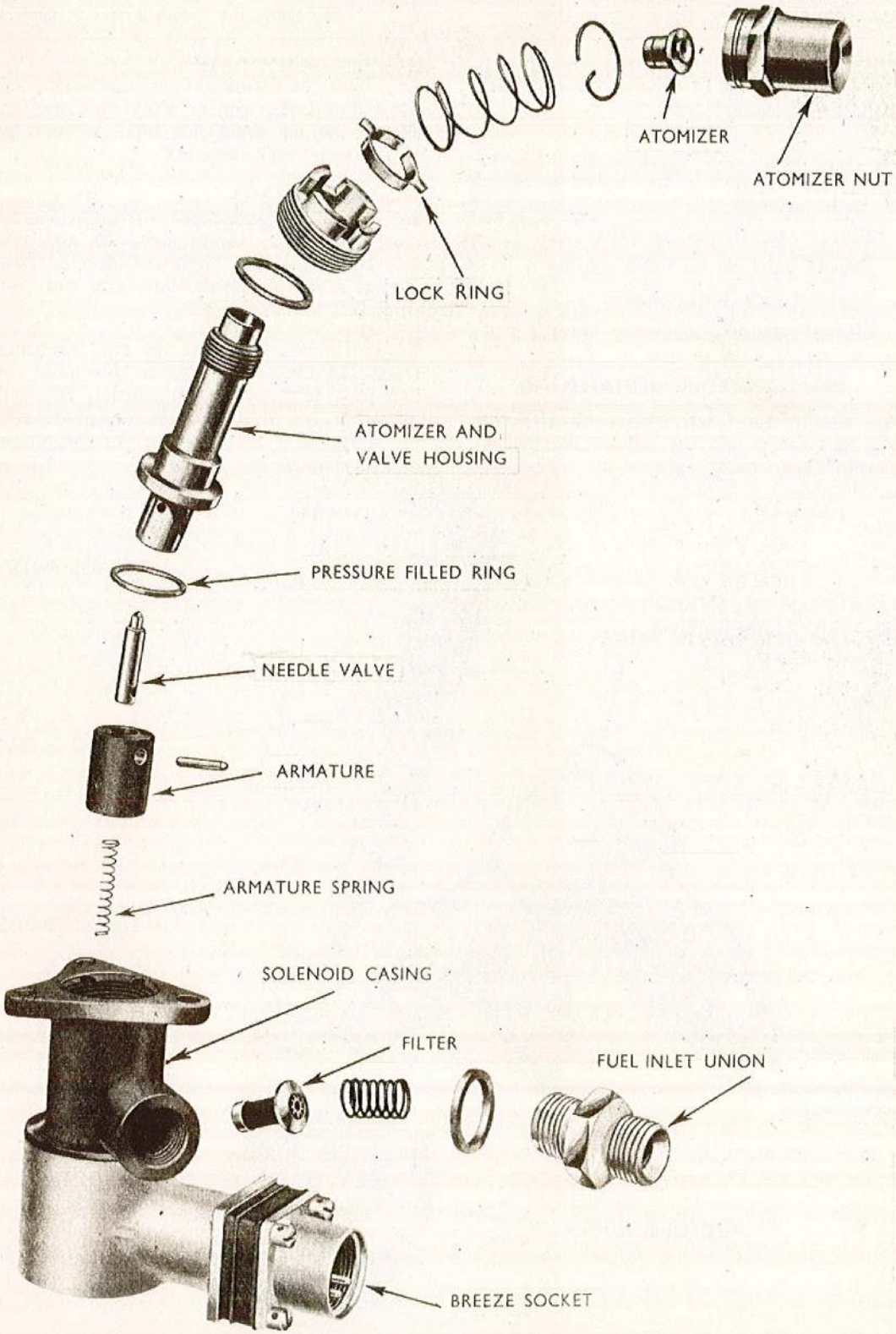


FIG. 3. EXPLODED VIEW OF ELECTRO-HYDRAULIC VALVE

DISMANTLING

10. Unscrew the three 2 B.A. nuts securing the electro-hydraulic valve to the torch igniter body and remove the valve assembly (*fig.* 4). Discard the joint packing.

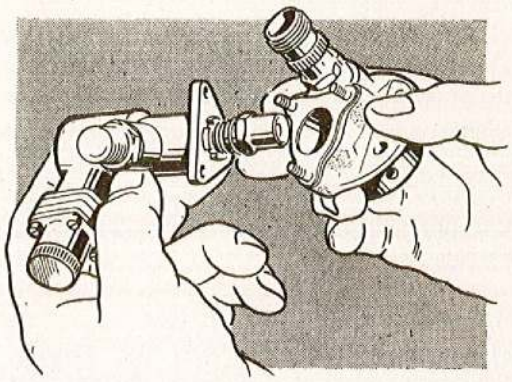


Fig. 4. Removing the valve assembly

11. Unscrew the insulated gland nut retaining the H.T. electrode (*fig.* 5). Remove the locking sleeve, H.T. electrode and gland washer (*fig.* 6). Discard the locking sleeve and washer. Unscrew the fuel inlet union and shake out the filter. Discard the aluminium washer.

12. Fit the valve assembly to the fixture shown in fig. 1, and, with the atomizer end uppermost, remove the spring locking ring and sleeve nut, lift off the atomizer, the spring, and lock ring, and using the spanner shown in fig. 1, unscrew the slotted nut. The valve assembly can then be removed in the following order :—joint washer, valve housing, pressure filled joint ring, valve needle, and armature with loose transverse pin, and finally the armature spring.

13. This completes the dismantling, and the parts should be placed in a tray ready for washing and cleaning.

CLEANING

Precautions

14. Cleanliness is of paramount importance. It is essential that the cleaning equipment is in perfect order and that the tray for the washed parts is scrupulously

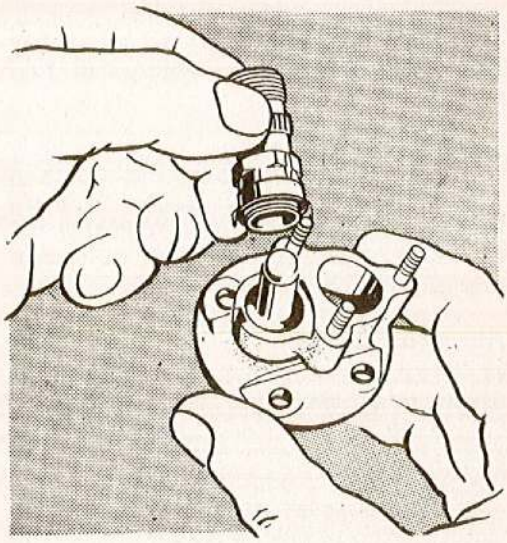


Fig. 5. Removing the H.T. gland nut

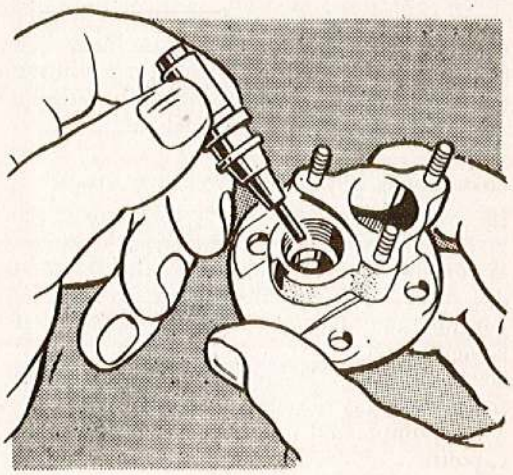


Fig. 6. Removing the H.T. electrode

clean. Under no circumstances must cloth or cotton waste be used for cleaning internal parts.

Electro-hydraulic valve parts

15. The internal parts of this assembly must be washed in clean paraffin and dried off with compressed air or trichlorethylene vapour. Normally carbon can be washed off the atomizer with paraffin, but it may be necessary in some instances to use a stiff wire brush. For still more obstinate cases the carbon must be removed mechanically by mounting the atomizer in a motor

driven collet and cleaning its orifice face by light application of very fine rouge paper. After washing in clean paraffin, compressed air must be passed alternately both ways through the orifice and tangential holes.

16. The coil and breeze socket assembly must be wiped externally with a clean paraffin cloth and clean paraffin squirted into the inside of the casing, cleaning out the internal sleeve. Dry off with compressed air.

H.T. electrode

17. Two types of H.T. electrode are fitted; those with mica insulation and the later type with ceramic insulation. The cleaning methods are different. To clean the mica type, mount the electrode in a motor driven collet and apply very smooth emery cloth previously wetted with paraffin. Finally wash in clean paraffin and dry off with compressed air. The ceramic type of electrode can be cleaned by sand blasting. In carrying out this operation, screw the electrode into the torch igniter body and sand blast the earth electrodes and housing simultaneously. Finally wash in paraffin and dry off with compressed air.

Igniter body, filter, and remaining details

18. Sand blast the earth electrodes, the H.T. electrode pocket, and adjacent faces. Wash the body assembly in paraffin, and dry off. Wash the filter in perfectly clean paraffin and dry with compressed air. It is again emphasised that cloth or cotton waste must not be used for drying. Wash the remaining details in paraffin and dry with compressed air or trichlorethylene vapour.

INSPECTION OF DETAILS

Electro-hydraulic valve and atomizer

19. All parts must first be inspected for cleanliness, paying special attention to internal fittings.

20. Inspect the coil casing and inner sleeve for superficial damage and ensure that the wire locking is undamaged and intact. Ascertain that the contacts in the breeze socket are clean and in good condition.

21. Examine the valve needle, and dimensionally check the stem for wear. If there are any appreciable signs of wear or corrosion on the valve face, the valve needle must be rejected.

22. Examine the atomizer for superficial damage and reject any with scratches on the orifice face. Ascertain that the tangential holes and the orifice are quite clean and free from carbon.

23. Check the valve housing for wear in the needle bore. This can be checked against a new needle. It is essential that the needle is a free fit in the bore. Examine the needle spring for cracks and "seaming". Inspect the slotted nut for spanner damage. Visually inspect the remaining details for damage.

H.T. electrode and gland nut

24. Examine the electrode for damage caused in handling. Visually inspect the insulator and ensure that it is sound, and in the case of the ceramic type, free from cracks. Ensure that the electrode itself is clean and free from signs of excessive burning. All electrodes burnt to the extent of fifty per cent. of their diameter must be rejected as scrap. Inspect the gland nut for spanner damage and ensure that the thread is in good condition.

Earth electrodes and igniter body

25. Examine the earth electrodes for burning; any which are burnt to the extent of fifty per cent. of their diameter must be rejected as scrap. Ascertain that the earth electrodes are tight in the body and that the H.T. electrode pocket, the earth electrodes and adjacent faces are free from carbon. Ensure that the assembly is free from damage caused in use or handling.

ASSEMBLING

Electro-hydraulic valve and atomizer

26. Connect the valve needle to the armature by means of the transverse pin. Fit the spring in the end of the armature, and holding the solenoid casing with the open end downwards, insert the assembly into the casing (*fig.* 7). Turn the casing over to bring the open end uppermost and fit to the assembling fixture (*fig.* 1). Add a pressure filled joint ring followed by the valve housing, taking care to locate it on the needle without damage to either part

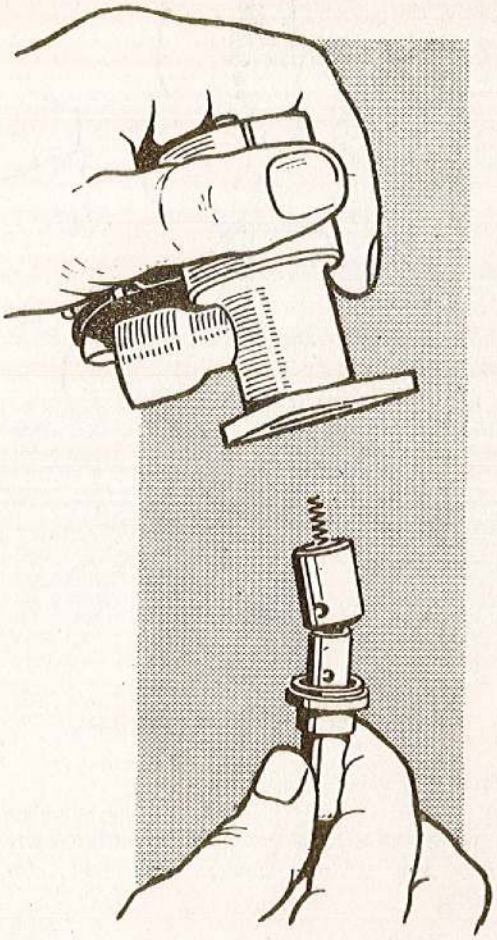


Fig. 7. Assembling the valve and armature

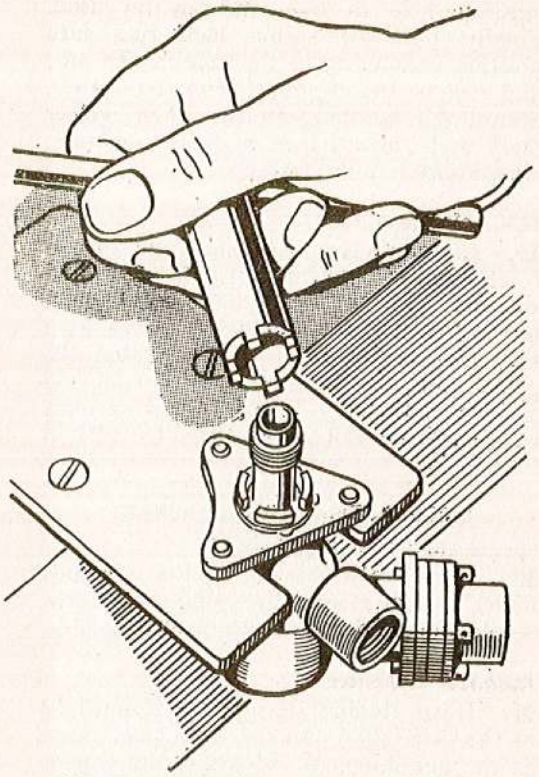


Fig. 8. The valve housing nut fitted

27. Add a new copper joint washer and the slotted nut. Tighten the nut using the slotted spanner (*fig.* 8). The nut must be tightened to accommodate the lock washer which is afterwards dropped over the valve housing with the tabs registering in the slots in the nut and the solenoid casing.

28. Next, add the lock washer retaining spring and the spring locking ring. Fit the atomizer into the end of the valve housing, and make secure with the sleeve nut (*fig.* 9). When the nut is tight drill through the lock ring groove in the sleeve nut and into the valve housing, using a No. 60 (0·040 in. dia.) drill. The depth of drilling in the valve body must be 0·050 in. It is recommended that a stop drill is used as it is most important that this

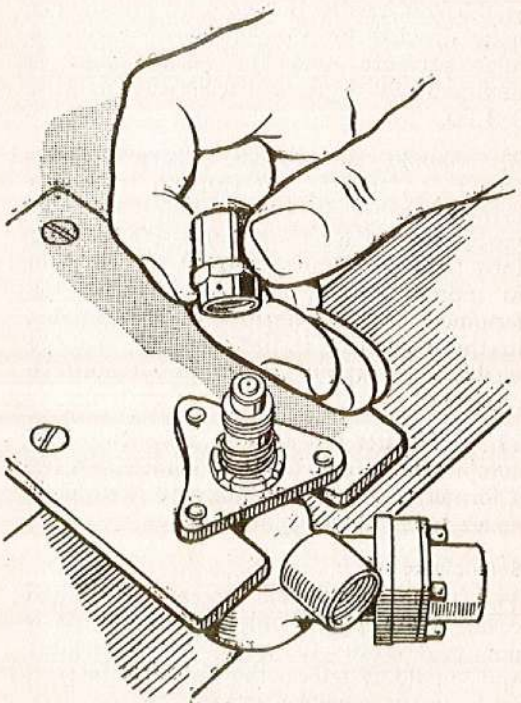


Fig. 9. Fitting the atomizer

depth is not exceeded. In the event of sleeve nuts being used more than once the existing hole in the nut can be used. Finally pull the spring lock ring into position registering in the hole in the nut, and remove the assembly from the fixture. Secure the assembly to the torch igniter body with three 2 B.A. washers and nuts, interposing a joint washer.

H.T. electrode

29. Assemble the H.T. electrode to the torch igniter body, interposing a new gland washer. Fit the locking sleeve and gland nut, engaging the tab on the sleeve with the slot in the body. Fully tighten the gland nut, but do not indent the locking sleeve at this stage. Set the gap between the earth and H.T. electrodes at 0·050 to 0·053 in.

REPLACEMENTS AND REPAIR

Spares and interchangeability

30. Parts of the torch igniter supplied under separate reference numbers in the Schedule of Spare Parts are interchangeable.

Atomizer and filter

31. If an atomizer is replaced it must be of the same flow number, and spray angle as the one rejected. Identification can be verified by the markings on the atomizer. The flow number, which in this instance is 0.3, represents the flow in gallons per hour divided by the square root of the inlet pressure, and the spray angle is nominally 90 degrees. Hence the marking 0·3/90.

32. Should an atomizer prove unsatisfactory on the rig test through the spray being streaky, it is an indication that particles of carbon or scratches running into the orifice are prevalent. These can in most instances be removed with the lapping stick as described under Cleaning in this chapter. If the scratches are still visible after lapping, the atomizer must be rejected.

33. The filter assembly is a built-up unit comprising an end cap, a wound wire filter, a former, and an end plate, and is supplied as an assembly ready for fitting.

Solenoid coil

34. The solenoid coil, breeze socket and casing are supplied only as a unit. It is not practicable to repair this assembly and should it fail on the electrical tests, a replacement must be fitted.

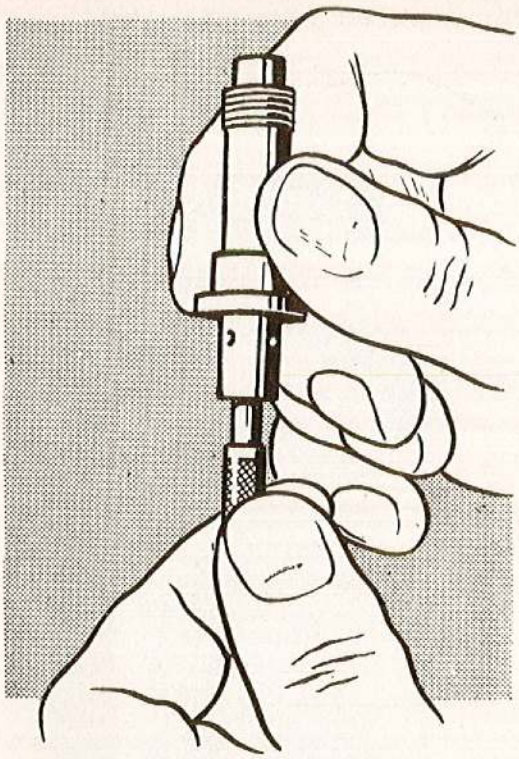


Fig. 10. Burnishing the valve seat

Valve and valve housing

35. Both the valve needle and valve housing are supplied as spares, and normally these are interchangeable and ready for fitting.

36. When a new valve needle or valve housing is fitted, it may be necessary to use the burnishing tool shown in fig. 1. This should be rotated backwards and forwards on the valve seating using a suitable lubricant such as Hydraulic Fluid to specification DTD.585. This should be sufficient to ensure that the valve needle fits correctly when closed.

H.T. electrode

37. H.T. electrodes are supplied ready for fitting, subject to the electrical test when fitted. No repair work is practicable when dealing with this component, and if it is worn, damaged, or fails on test, a new part must be fitted.

Torch igniter body and earth electrodes

38. The earth electrodes are brazed into the body and are not normally changeable. Damaged studs in the body can be changed, following the usual workshop methods.

RIG TEST

H.T. electrode back pressure test

39. Mount the assembly on to the H.T. side of the test rig J.44470, interposing a joint washer and make secure with four washers and nuts.

40. With the electrode gaps in view apply air at a pressure of 20 lb. per sq. in. followed by a voltage of 12,000 volts D.C. peak loading to the H.T. electrode. Maintain these conditions for a period of three seconds, and during this time there must be no misfiring at the gaps.

41. On completion of the above test, increase the air pressure to 100 lb. per sq. in., connect a rubber tubing to the screen tube, and one to the fuel feed union, and immerse the free ends in kerosene or white spirit to a depth of two inches. Observe that no air bubbles emerge from the immersed ends of the two tubes for a period of one minute, then release the pressure. Special care must be taken to ensure that the atomizer is not obstructed by water or dirt, both before and after the test.

42. Immediately these tests are satisfactorily concluded, using a punch indent the locking sleeve into the slot in the H.T. electrode gland nut, thus locking the nut.

Coil and insulation resistance checks

43. Carry out the two checks given in para. 7 and para. 8.

Residual Magnetism test

44. Operate the valve three times on 32 volts D.C. within 15 seconds, and check that the valve does not stick in the open position. If this does occur, the solenoid assembly must be rejected as scrap.

Operation test

45. The fuel to be used for these tests must be to specification D.Eng.RD. 2482 plus 1 per cent. lubricating oil to specification D.E.D. 2472 B/O.

46. Transfer the assembly to the fuel side of the test rig, and feed fuel at 50 lb. per sq. in. through the valve inlet connection. The valve must open when 6 volts D.C. are applied to the coil. When the current is switched off, the spray from the atomizer must cease without any dribble. Repeat this test three times operating at 6 volts D.C. and then three times operating at 29 volts D.C.

Calibration test

47. Reduce the fuel pressure to 25 lb. per sq. in. and operate the valve at 8 volts D.C. The flow from the atomizer must be between 132 c.c. and 145 c.c. in one minute.

Leakage test

48. Increase the fuel pressure to 50 lb. per sq. in. and operating at 29 volts D.C., carry out the following tests to check for fuel leaks from the atomizer. Leakage from this point must not exceed one drop in one minute, and there must be no leakage from any other point.

Heat cycle test

49. Maintain the pressure at 50 lb. per sq. in. and operating at 29 volts D.C., switch on the current and keep the valve open for thirty seconds followed by two minutes with the current off, and the valve closed. Repeat these operations four times, at the end of which the current taken by the coil shall be not less than 65 per cent. nor greater than 85 per cent. of that taken at 20 deg. C.

Seat proof test

50. Operate the valve 24 times within one minute and repeat the leakage test given in para. 48.

Final calibration and insulation check

51. Repeat the calibration test given in para. 47 after which the coil insulation must again be measured. This must not be less than twenty megohms at 500 volts D.C.

PREPARATION FOR DESPATCH

52. Connect an oil supply to the fuel inlet of the torch igniter and feed oil (DTD.44D) at a low pressure. Operate the solenoid to ensure that the oil has passed right through the valve and atomizer. Disconnect from the oil supply and paint or spray all external surfaces, threads and orifices with rust preventative to specification DTD.121. Fit dust caps to the fuel inlet, the breeze socket and the H.T. connection.

53. If the assembly is to be despatched as a separate unit the lower end of the torch igniter must be covered with waterproof material to enclose the atomizer and H.T. electrode. The whole assembly must then be wrapped in greaseproof paper and packed in an approved box.