Chapter 1

BURNERS SIMPLEX, TYPE C.S.H.9/F.A.19

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LIST OF ILLUSTRATIONS

General

1. The C.S.H.9/F.A.19 simplex type burner is of the fixed orifice type. This consists of a holder type C.S.H.9 and an atomiser number F.A.19.C.S.H.9/F.A.19 burners are fitted to Rolls Royce Derwent Mk. 5 aero-engines, and a dismantled view of a burner of this type is given in fig. 1.

2. The importance of cleanliness during re-conditioning cannot be over emphasised. Care must also be taken to avoid damaging components during handling or storage, consequently only the methods and tools described in the following paragraphs may be used.

3. Parts that are interchangeable are detailed in para. 30.

SPECIAL TOOLS

4. The repair of burners necessitates the use of special tools and jigs and these are of two categories, those which may be provisioned and those which are to be manufactured from local resources.

5. All special tools required are detailed in the accompanying tool list and for details of the tool to be manufactured see fig. 2.

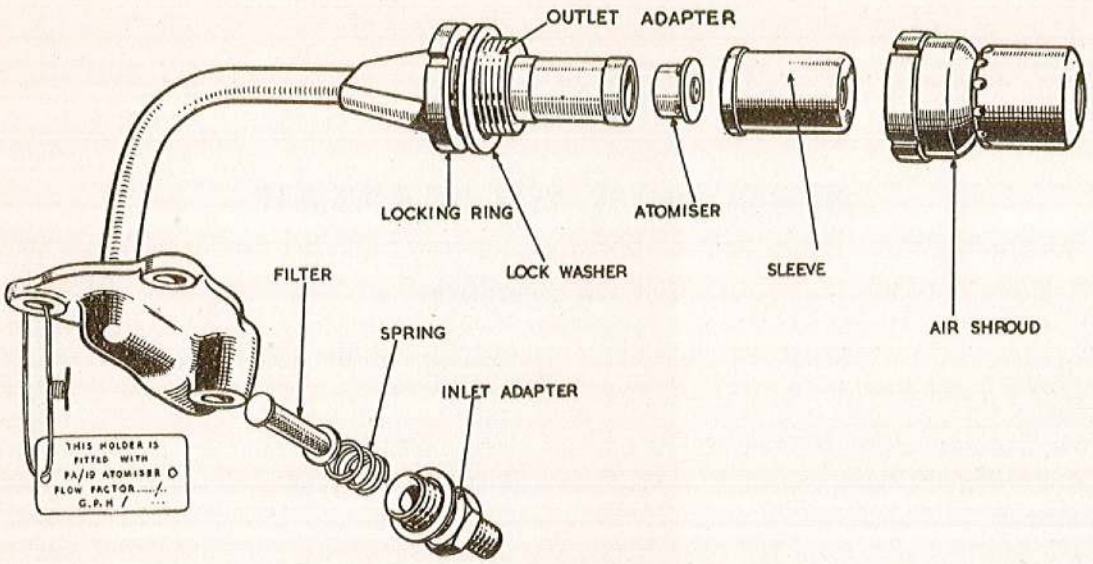

Fig. 1. Dismantled view of simplex type burner

List of special tools required during overhaul

Part No.	Nomenclature
T.151199	Spanner, 'C' for shroud and lock-nut
R.42	Rig, test, calibration
	Rig, test, patternation
	Jig, distortion

Tool to be manufactured locally

Nomenclature
Stick, lapping (wood).

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

6. Make a visual examination of the burner and ascertain that there is no damage which would entail rejection. Check that the rubber sealing cap is fitted over the burner outlet, and a dust cap over the inlet connection.

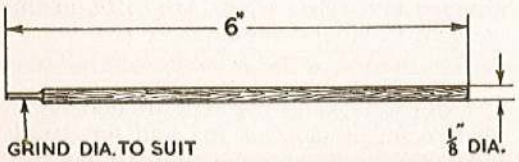

Fig. 2. Cherry wood lapping stick

7. After the burner has been visually examined it should be stripped and cleaned. All carbon must be removed and great care must be taken during these operations to avoid damaging the burner. A careful examination of the burner must be made before subjecting it to any check tests.

8. To ensure that damage is not caused to the flats and corners of the inlet adapter, a box or ring spanner must be used during removal.

DISMANTLING THE BURNER

9. To dismantle the burner proceed as follows :—

OP. 1. Remove the dust cap and the rubber protective cap from the inlet and outlet connections respectively.

2. Mount the burner in a plain-jawed vice (without knurling) or, alternatively, suitable soft packing should be used in the jaws of the vice to prevent damage to the burner holder. The latter must be held firmly in the vice by tightening on to the special flats provided on the holder (*fig.* 3).

3. Before unscrewing the locking ring of the outlet adapter carefully bend back the caulking points of the lock-washer.

4. Slacken the locking ring using the special 'C' spanner T.151199 (*fig.* 3).

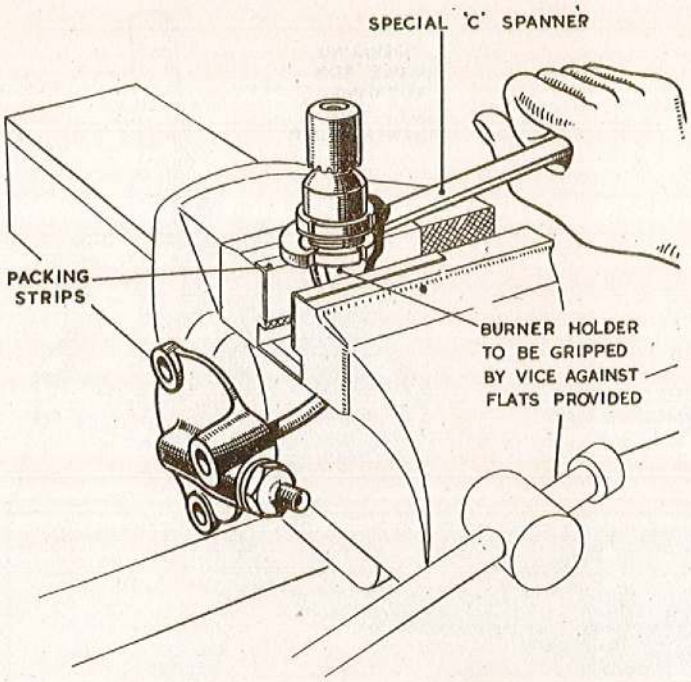

Fig. 3. View showing method of mounting burner in vice and use of special "C" spanner

OP. 5. Using the same spanner, unscrew, and remove the air shroud from the outlet adapter.

6. Lift off the sleeve and carefully withdraw the atomiser.

7. Slide the lock-washer along the locating slot of the burner adapter and remove it from the adapter.

8. Unscrew and remove the locking ring from the outlet adapter.

9. Unscrew and remove the inlet adapter, together with the plain washer. Withdraw the helical spring and filter.

CLEANING

10. It is important that the bench upon which work is carried out is scrupulously clean and free from all dirt, swarf, etc. The bench should be covered with zinc sheeting or linoleum and a clean container should be available for storing the dismantled parts.

11. The use of a wire brush will be necessary to remove the carbon deposit from the outer face of the air shroud and sleeve. Normally, carbon can be washed off the simplex type atomiser by means of a parawash machine, but occasionally it may have to be removed by other means, in which case the careful use of a wire brush will be necessary. The wire brush must not be used for cleaning the face, orifice, or the tangential holes. If it is not possible to remove the carbon from these positions by the parawash machine the atomiser must be cleaned in the following manner :—

OP. 1. To remove the carbon from the orifice face, mount the atomiser in a motor-driven collet and, with the atomiser revolving, place some very fine rouge

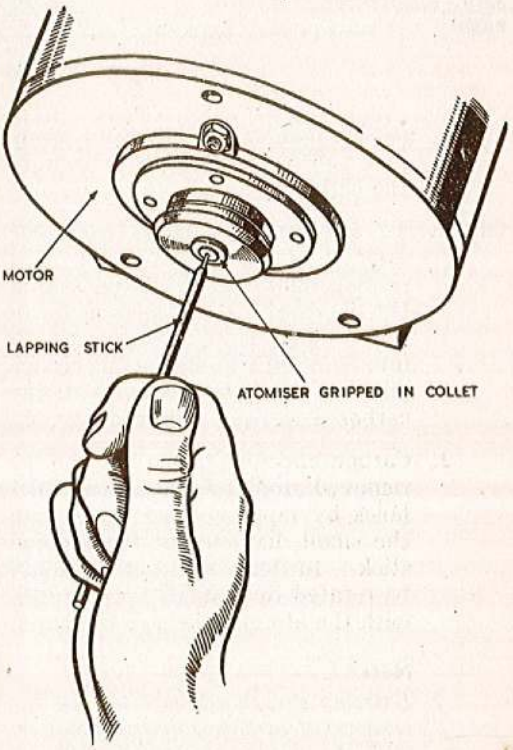

Fig. 4. View of lapping stick in use

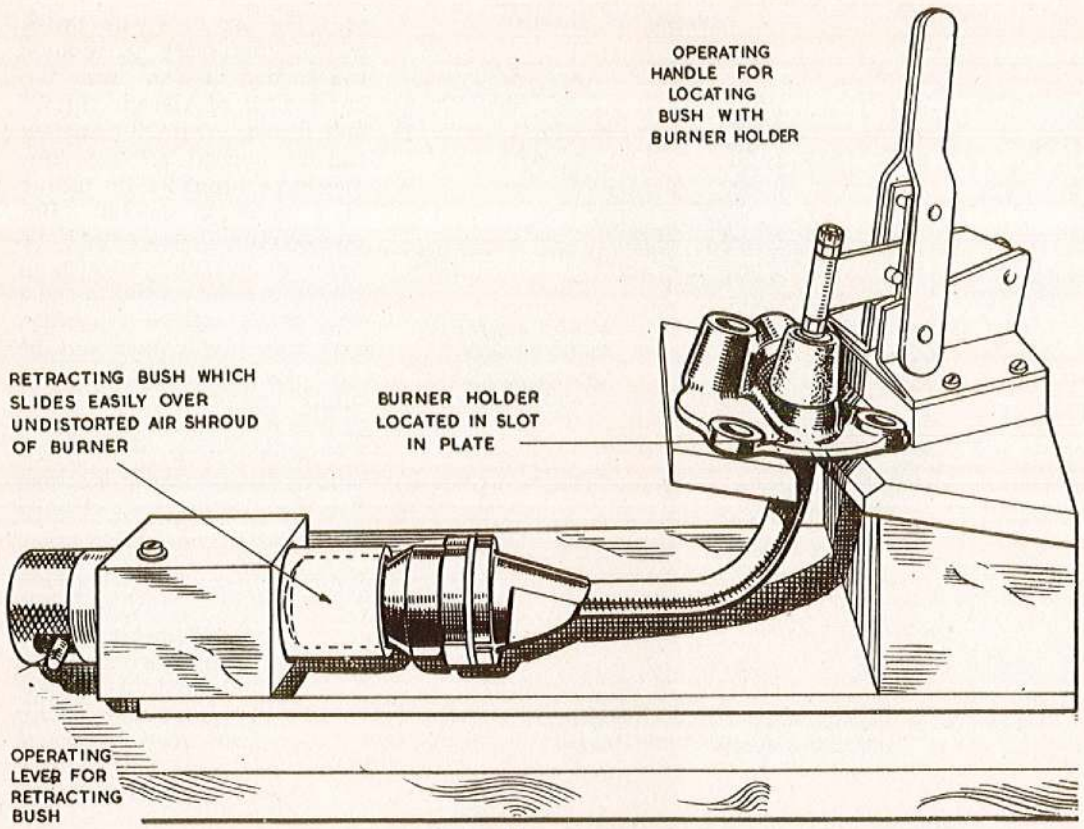

Fig. 5. Typical distortion check jig

paper against the face and apply just sufficient pressure to remove the carbon.

OP. 2. To remove the carbon from the orifice, mount the atomiser in a similar manner to that described in Op. 1, insert the small diameter of the wooden lapping stick (*fig.* 2) into the orifice and using rouge powder, carefully lap until all the carbon has been removed (*fig.* 4).

3. Carbon and foreign matter may be removed from the tangential inlet holes by lapping these holes with the small diameter of the lapping stick. In this case the stick should be rotated by a small electric drill, with the atomiser held in the hand.

Note . . .

Extreme care must be taken in the removal of carbon from the atomiser, otherwise serious damage to this part may result, with consequent adverse effect on performance

INSPECTION

12. With the exception of dimensional detail checks, which are covered separately in the Part 2 of this Volume, all viewing and inspection checks are described in this section. These viewing and inspection checks are listed to correspond with the normal dismantling sequence.

Distortion check

13. This check is made by use of a special jig (*fig.* 5), which enables any distortion between the alignment of the burner pipe and the mounting flange to be corrected. The unit is secured to the jig by locating both the pipe and the holder as shown in fig. 5. If the alignment is correct, the alignment bush should pass easily over the air shroud ; any malalignment can be corrected by gently setting the outlet adapter and the burner pipe in the desired direction.

Permissible wear

14. Ensure that the wear on the locating diameter of the air shroud is within the permissible worn tolerances.

Redundant and consumable parts

15. All parts rendered redundant by the embodiment of essential modifications must be rejected during inspection. All inspectors must therefore have available all information concerning relative modifications.

16. The air shroud lock-washer must be rejected during dismantling irrespective of condition.

Surface damage

17. The standard of acceptance for surface damage may vary, depending on the number of hours the burner is to be in use, availability of spares, and experience gained during the operation of these burners. Where it is found necessary to alter any accepted standards, instructions will be issued accordingly.

Note . . .

If there is any sign of flaking of the plating on any part, the defective part is to be rejected (*para.* 32).

Air shroud

18. Carefully examine the air shroud for general condition. Ensure that the internal threads are satisfactory and that the edges of the locking slots are not cracked or broken. Ensure that all air holes are clean and free from sharp edges. The end flange of the shroud (at the outlet) must be free from distortion, and ensure that the locating diameter of the shroud is free from fretting and corrosion.

Sleeve

19. Examine the sleeve for corrosion and cleanliness. The sealing face must be free from damage and distortion in order that a good joint can be made at this seal.

Atomiser

20. Ensure that the orifice face has a smooth flat surface entirely free from scratches. If this face is scratched the atomiser is to be rejected (*para.* 36). Ascertain that the tangential inlet holes and the orifice are free from carbon or other foreign particles.

Lock-washer

21. The air shroud lock-washer must be rejected during dismantling irrespective of condition.

Locking ring

22. Carefully examine the inner threads of the locking ring for cleanliness and freedom from damage. Ensure that the ring is generally sound and that no cracks or damage exist along the edges of the locking slots.

Inlet adapter and joint washer

23. Ensure that the hexagon flats, the $\frac{1}{4}$ in. B.S.P. and $\frac{1}{8}$ in. B.S.P. threads of the inlet adapter are free from damage and distortion. Ascertain that the $\frac{1}{8}$ in. B.S.P. connection is not bell-mouthed due to excessive tightening of the feed pipe during initial installation. The joint washer must be in such condition that it will ensure a fuel-tight joint.

Spring

24. Inspect the helical spring for sharp edges or fractures.

Filter

25. Carefully examine the filter for signs of fracture, the presence of foreign matter, or distortion of the filter ends.

Burner holder assembly

26. Examine the holder for corrosion or damage.

27. Ensure that the $\frac{1}{4}$ in. B.S.P. internal tappings in the holder are sound and clean. Inspect the $\frac{3}{4}$ in. B.S.P. thread on the outlet adapter for damage and ensure that the slots are clean and that no cracks are present on the sides.

RE-BUILDING THE BURNER

28. During the re-assembly of the burner, only one set of component parts should be on the bench at a time. This will prevent the accidental inclusion of other burner components during rebuild and will also indicate shortages.

29. Ensure all parts are thoroughly clean and proceed as follows :—

OP. 1. Place the cylindrical filter and the helical spring into the inlet connection of the burner holder. Fit the plain washer over the $\frac{1}{4}$ in. B.S.P. thread of the inlet adapter, then screw and tighten the adapter into the burner holder.

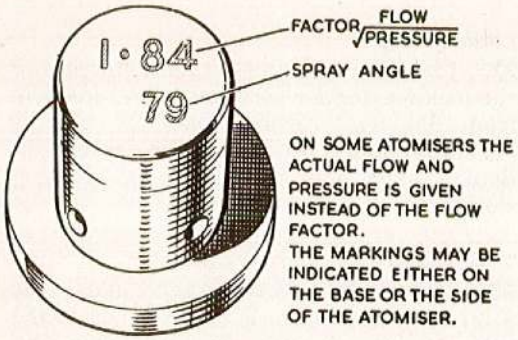

Fig. 6. Flow factor and spray angle markings

OP. 2. Screw the locking ring on to the burner outlet adapter, with its chamfered face away from the burner outlet. To ensure that the sleeve will seat correctly when fitted, screw the ring as far down the adapter as possible.

3. Slide the lock washer along the locating slot of the outlet adapter up to the mating face of the locking ring.

4. Mount the partially assembled holder in the vice as detailed in (*para.* 9 *Op.* 2).

5. Fit the atomiser into position in the burner outlet adapter, then fit the sleeve and screw the air shroud down as far as possible.

6. Place the lock-washer against the inner face of the air shroud and tighten the locking ring against both lock-washer and air shroud.

7. To ensure that the adapter does not unscrew when the locking ring is tightened, use ' C ' spanners, one for holding the air shroud and the other for tightening the locking ring.

8. Ascertain that the air metering gap between the orifice end of the shroud and the sleeve is correct. This standard setting is 0·025 in. to 0·028 in. and can be measured with a feeler gauge.

Note . . .

Do not caulk over the lock-washer at this stage.

REPLACEMENTS

30. New lock-washers are always to be fitted when re-assembling the burner. All other parts are separately interchangeable, but if an atomiser is replaced, the flow number and spray angle of the replacement atomiser must be the same as the number and angle of the atomiser that is removed. The location of these markings is shown on fig. 6.

31. If the test results are not within the specified limits, the atomiser must be rejected and a replacement fitted. *Do not attempt to enlarge either the tangential inlet holes or the orifice of the atomiser.*

32. If there is any sign of flaking of the plating on any part, the defective part is to be rejected and a replacement fitted. The rejected part or parts must be returned to the stores for replating.

RIG TESTS

33. On completion of the re-assembly, the burner must be subjected to the following tests :—(1) Flow performance, (2) Spray angle, (3) Patternation and (4) Leakage. The composite test rig R.42 is designed to carry out tests 1, 2 and 3, but a high pressure rig is necessary for the leakage test. All calibration and tests results must be accurately recorded on the approved record sheet.

34. Unless stated otherwise, the fuel used throughout these tests is to be paraffin to specification D.R.D. 2482 latest issue. The limits of temperature of the fuel must be between 20 deg. C. minimum and 21 deg. C. maximum, and its specific gravity between 0·801 and 0·806.

Flow performance

35. Mount the burner in the transparent box as shown in fig. 7. Apply an inlet pressure of 200 lb. per sq. in. and make a

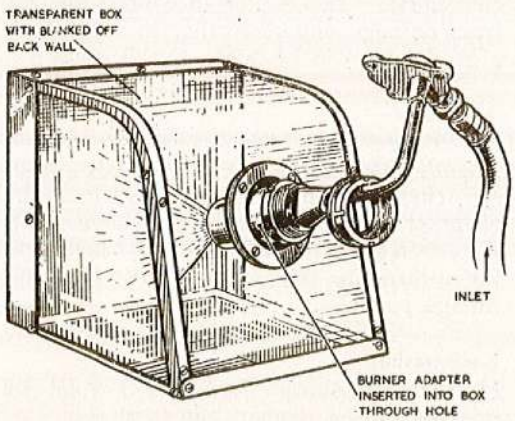

Fig. 7. View of burner showing inspection of spray for streaks

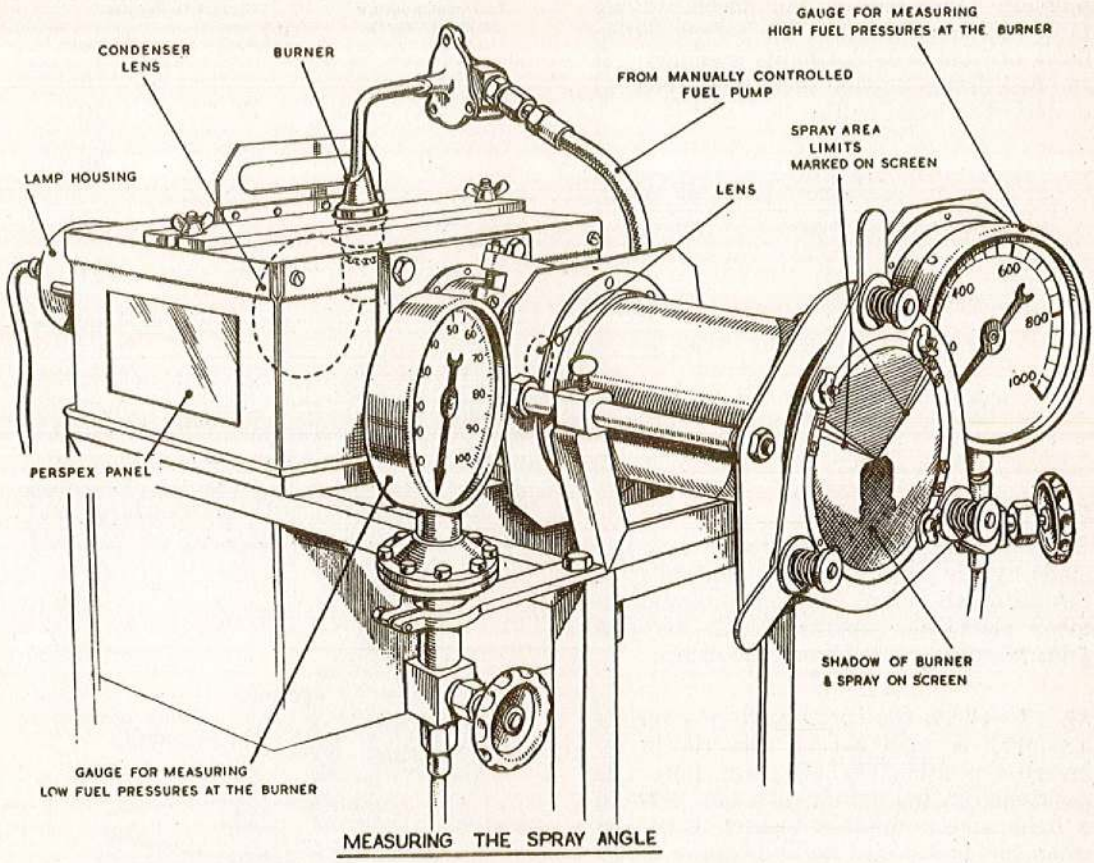

Fig. 8a. Calibration rig for burners

visual examination of the spray from the burner. The spray must be symmetrical about the nozzle axis, and free from streaks.

36. Streaks indicate the presence of foreign matter such as a particle of carbon obstructing the flow of fuel from the orifice. Scratches on the atomiser face which extend to the orifice will also cause streaks. In such instances the atomiser must be replaced (*para.* 29 *and* 30); or the obstruction removed by gently lapping either or both the orifice and the tangential holes with the wooden lapping stick (*para.* 11, Op. 1, 2 *and* 3).

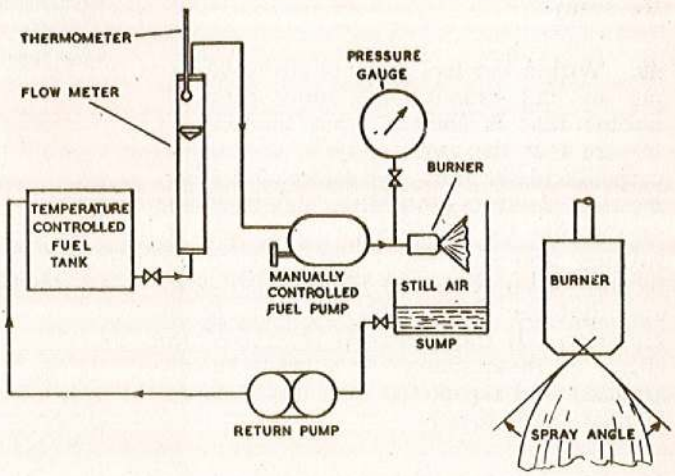

Fig. 8b. Diagrammatic layout of calibration rig

37. Inject fuel into the burner at the pressure tabulated in the accompanying table and ascertain that the corresponding flows are between the limits specified. If the fuel flow is outside these limits proceed as described in para. 31.

Fuel inlet pressure in lb. per sq. in.	Fuel flow in gallons per hour	
	Minimum	Maximum
9	5·7	6·0
200	25·5	26·3
600	44·3	45·7

Spray angle

38. The spray angle is defined as the angle made by the cone of paraffin emitted from the atomiser before complete atomisation takes place, i.e., approximately the first $\frac{1}{4}$ in. of cone emitted from the orifice.

39. To check the spray angle the burner assembly is mounted on the rig in an inverted position (*fig.* 8). The burner is positioned in the illumination box between a light and a suitably focused lens, and when fuel is supplied under pressure to the burner, an image of the fuel spray is projected on to a screen. The screen must be so positioned that it is possible to measure, with a protractor, the projected angle of the spray.

40. With a low fuel pressure (10 to 20 lb. per sq. in.) examine the spray cone or bubble that is emitted from the orifice. Ensure that the angle of spray is emitted perpendicularly from the orifice and symmetrical about its centre-line. If this is not so, examine the atomiser for correctness of seating, also that the burner adapter is secured squarely to the illumination box, and that the orifice and tangential holes are clean. If the trouble is not traced to either of these sources fit a replacement atomiser and repeat the test until a satisfactory one is found.

41. With the fuel inlet pressure set at the figures given in the following table, the angle of the projected image of spray must be within the limits laid down against each specific pressure.

Fuel inlet pressure in lb. per sq. in.	Angle of spray emitted from burner in degrees	
	Minimum	Maximum
20	72	76
60	75	79
200	77	81
400	80	84

42. If the readings are not within the specified limits the atomiser must be rejected and a replacement fitted. *Do not attempt to enlarge either the tangential inlet holes or the orifice of the atomiser.* Re-check the flow performance in each instance and record all readings obtained on the test record sheet.

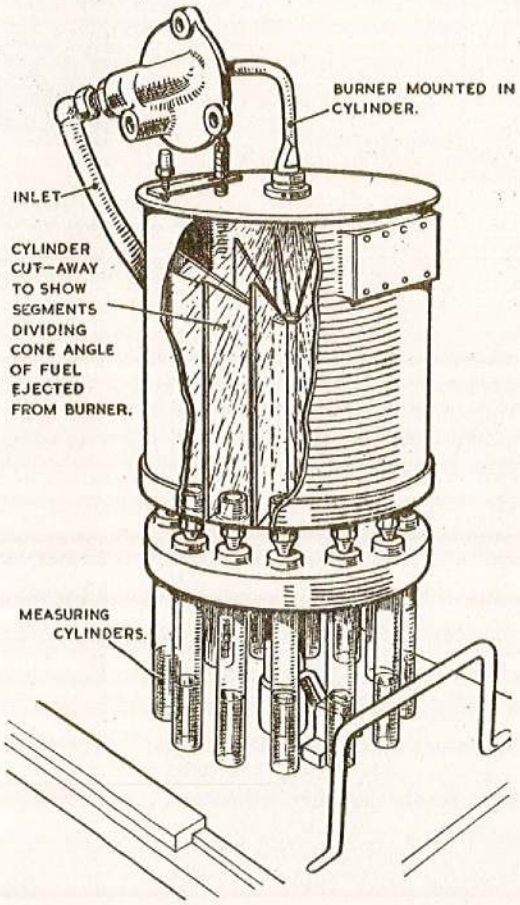

Fig. 9. View of patternation rig

Patternation

43. The purpose of the patternation test is to check the equal distribution of fuel over the whole cone angle of the burner spray. This test is carried out on the composite test rig R42.

44. The rig shown in fig. 9 is a typical example of a patternation rig and consists of a cylinder, which is sub-divided for approximately two-thirds of its height into twelve segments. At the base of each segment is a drain which connects with a graduated measuring cylinder. The burner is mounted in the inverted position and fuel is supplied to it at a given pressure. The resultant spray is directed over the twelve segments and the spray cone angle is thus separated into twelve parts and the fuel collected by each segment drains into its measuring cylinder.

45. With the fuel inlet pressure adjusted to 45 lb. per sq. in. check the fuel flow until the highest reading in any one measuring cylinder reaches 75 cc. At this point the fuel must be shut off. The quantity of fuel in the remaining cylinders should then be measured and if there is less than 56 cc. in any one cylinder the atomiser must be replaced. When a replacement atomiser is fitted it will be necessary to repeat all the aforementioned tests. The 75 cc. reading together with the lowest reading must be recorded on the test record sheet.

Distortion check

46. On completion of the patternation test, subject the burner to a distortion check as described in para. 13.

Leakage test

47. Mount the burner on a high pressure rig and ensure that it is thoroughly dry by wiping it clean and then blowing it with compressed air.

48. Raise the fuel inlet pressure to 1,500 lb. per sq. in. and maintain this for at least two minutes. During the period that the burner assembly is subjected to this pressure, examine for leaks. Particular attention must be paid to all brazed joints, the adapter slots, and the inlet joints. It will be noted that there will be a flow of fuel from the orifice during this period. Leaks observed during this test must be traced and rectified.

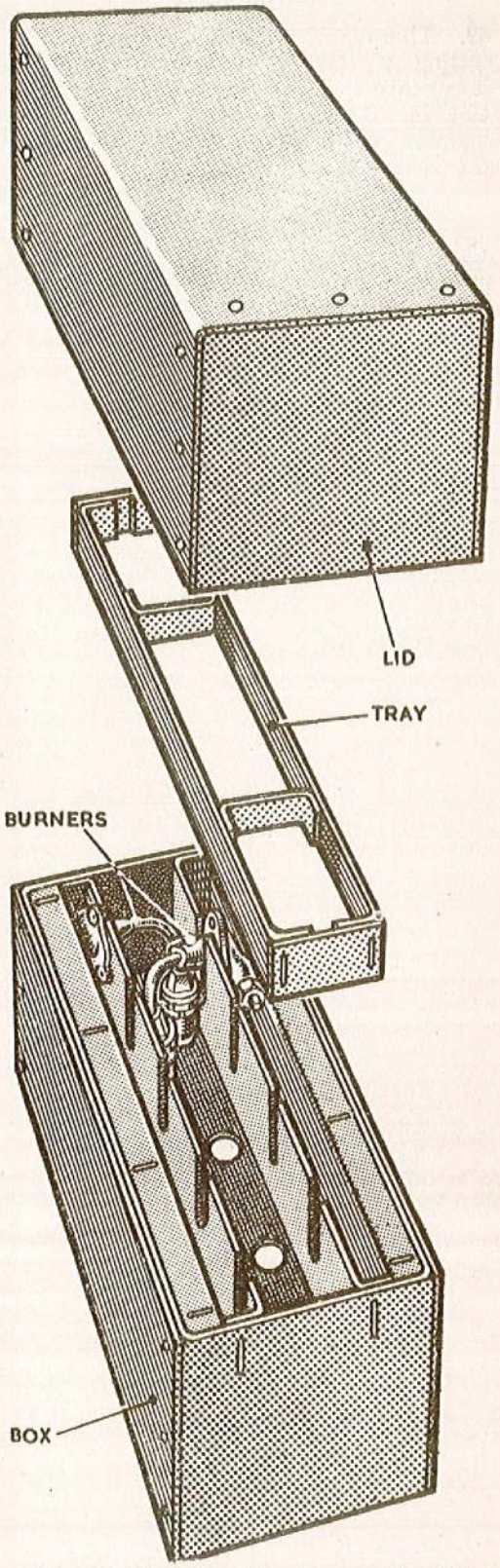

Fig. 10. Special packing box for despatch

INHIBITION

49. Thoroughly flush the burner by injecting oil (specification D.T.D.44 latest issue) into the inlet connection, and secure a $\frac{1}{8}$ in. B.S.P. dust cap over the inlet adapter, and a rubber protection cap over the air shroud.

PREPARATION FOR DESPATCH

50. Lock the outlet adapter by caulking over the lock-washer into the slots in both locking ring and adapter.

51. A test record sheet containing all test figures must be included with each burner and the number and flow factor of the atomiser fitted to the burner must be stamped on a label, and secured to the burner by wire (*fig.* 1).

Packing for despatch

52. A special cardboard container (*fig.* 10) is to be used for transporting burners, one complete set of nine burners being enclosed in each container.