Chapter 2

BURNERS, SIMPLEX

Type C.S.H. 23/F.A. 20, 21, 22, 23 and C.S.H. 24/F.A. 52, 53, 54, 55, 57, 58, 59

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GENERAL

1. The C.S.H. 23/F.A.20, 21, 22 and 23 type simplex burner, a dismantled view of which is given in fig. 1, is of the fixed orifice type and derives its designation from the type of holder, C.S.H.23, and the size of the orifice in the flanged atomiser, i.e., F.A.20, 21, 22 or 23. Burners of this type are fitted to Goblin Mk. 2 aero-engines. The type C.S.H.24 burner is very similar in construction to the C.S.H.23 type. The main difference between the two types being the three hole triangular plate mounting on the C.S.H.23 and the two hole oval plate on the C.S.H.24. There are also minor detail differences in the construction of the holder. The C.S.H.24 has a range of atomiser sizes of F.A.52, 53, 54, 55, 57, 58 and 59. This type of burner is fitted to the Goblin Mk. 3 aero engine.

2. In order to obtain correct fuel distribution to the combustion chambers, each chamber has a burner with a flow suitable for the air flow of that particular chamber within the specified orifice range. The size of the burner orifice required for each chamber is specified, but owing to various factors it may be found necessary during engine test to vary the size of the orifice from that specified, although the size will still be within the aforementioned range. It is therefore important that when removing the burners from the combustion chambers, the burners are clearly marked with the number of the chamber from which they are removed and the records marked accordingly.

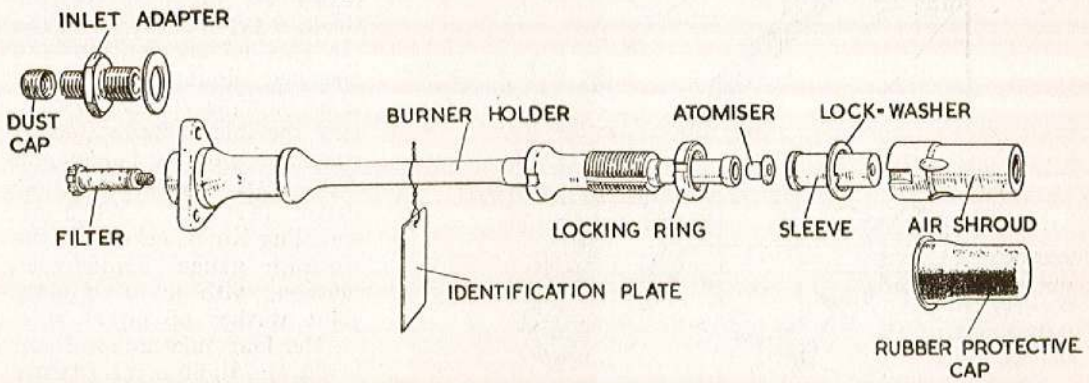

Fig. 1. Dismantled view of C.S.H.23 burner

3. The construction and operation of these burners closely resemble the C.S.H.9 type, consequently the sequence and methods of dismantling, cleaning, inspection, repair and testing are similar to those described in Chapter 1 of this section. The main differences are as follows :—

(1) the tools required, due to the difference in shape of the burner.
(2) the specified pressures at which the burner operates.
(3) the spray angles to be observed during test.

SPECIAL TOOLS

4. In addition to the special test rig (R.42), described in Chapter 6 of Section 1 of this Volume, the following tools will be required. Their use is illustrated in fig. 2 and 3.

Part No.	Nomenclature
T151196	C spanner for shroud
T157871	Alignment gauge
T158223	Vice for holding C.S.H.23 type burner
T159826	Vice for holding C.S.H.24 type burner
G41714	Distortion jig
T70173	Screwdriver for filter (Goblin tool kit)

5. The lapping stick (*fig.* 2), Chapter 1 will be required for cleaning the atomiser ; this stick is to be made locally.

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

6. The checks and precautions to be taken are the same as those described in the previous chapter.

DISMANTLING THE BURNER

7. The sequence of operations for dismantling the burner are the same as those for the C.S.H. 9 burner. The special vice (T158223) will be required for holding the burner during dismantling and reassembly. As the filter assembly of both C.S.H.23 and C.S.H.24 burners is screwed into the burner holder and is not retained by a spring as with the C.S.H. 9 burner, the special screwdriver (T70173) supplied with the Goblin tool kit will be required for removing and refitting this unit. To accommodate the pressure gauge connection, a special inlet adapter is fitted to No. 3 burner, and the pressure gauge banjo, together with aluminium joint washers, is fitted between the hexagon head of the adapter and the burner holder.

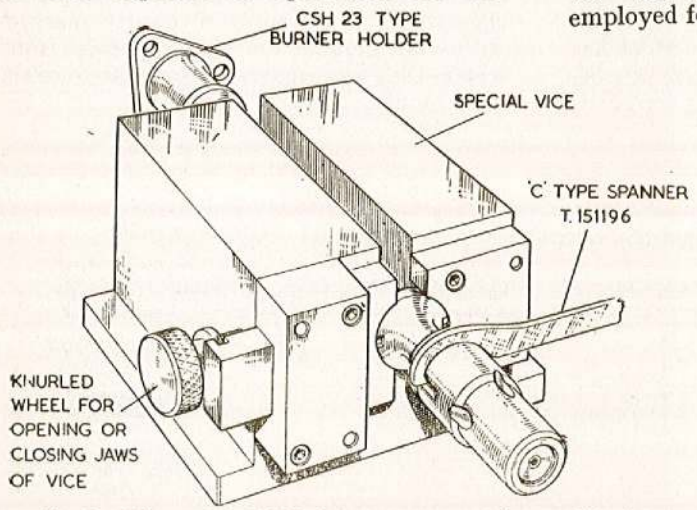

Fig. 2. View of C.S.H.23 burner mounted in special vice

CLEANING

8. Cleaning is carried out in the same way as described in Chapter 1.

INSPECTION

9. The sequence of inspection is the same as in Chap. 1 except that distortion jig (G41714) will be used in place of jig (G42110). In addition to the distortion check, the burner requires to be checked for length ; this is carried out on the same jig, the length being gauged by the stepped plunger fitted to the shroud end of the jig, the step indicating the minimum and maximum permissible length (*fig.* 3). The burner air shroud and holder should also be checked for alignment (*fig.* 3) using the special gauge T.157871. The filter (*para.* 7) should be inspected for cleanliness and fractures, and the screwdriver slots and threads for damage.

REBUILDING THE BURNER

10. The same sequence of operations is employed for reassembling the burners. The air gap for the C.S.H.23 burner must be within 0·010 to 0·015 in. instead of 0·025 to 0·028 in. specified for the C.S.H.9 type burner. If the air gap is not within the specified limits, the sleeve must be replaced. Before fitting the inlet adapter, screw the filter into the holder and tighten with the special screwdriver (T70173). When assembling No. 3 burner, fit the pressure gauge banjo connection, with an aluminium joint washer on either side, to the long inlet adapter and screw and tighten the adapter into the holder.

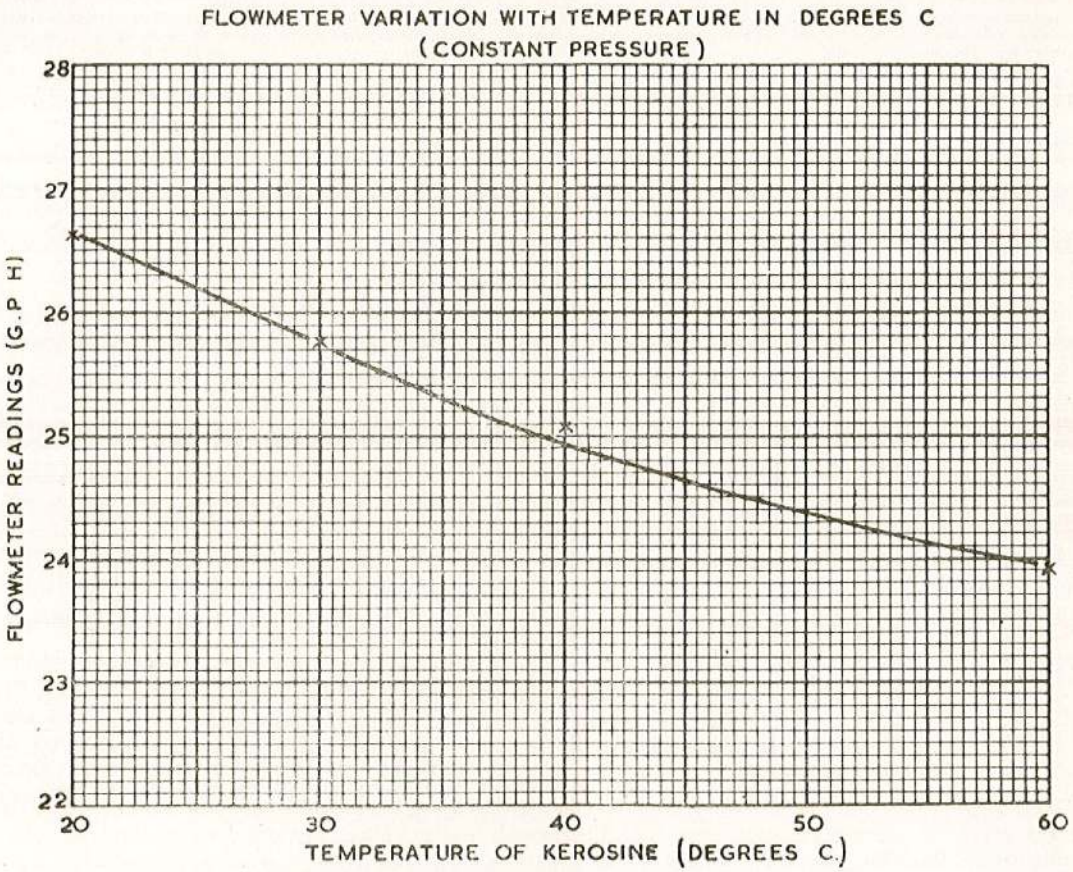

Fig. 2. Typical master burner temperature correction curve

(7) Connect the master burner to the rig T-piece and apply the specified burner pressure. Note the flowmeter reading and compare with the limits stated in the appendix.

(8) Remove the master from the rig, connect the burner to be calibrated to the rig and apply the specified pressure as in previous sub para. The flow must be within the stated limits and is to be recorded on the test sheet.

(9) Repeat the tests as above on the remaining master burners throughout the range of specified pressures.

Flow performance

39. Mount the burner in a suitable slave holder on the rig. Raise the inlet pressure to that given in the Appendix, and visually inspect the spray. The spray must be symmetrical about the nozzle axis and free from streaks.

40. Streaks indicate the presence of foreign matter such as a particle of carbon obstructing the flow of fuel from the orifice. Scratches across the face of the orifice plate extending from the orifice will also cause streaks. In such instances the complete set of atomiser parts must be replaced.

41. When satisfactory with regard to streaks, apply an inlet fuel pressure, as given in the Appendix, and ascertain that the flow is between the limits specified.

Combined flow performance

42. With the burner mounted on the rig as in para. 39, fully open the main cock, check the combined flow and again inspect the spray. Note that any adjustment to the calibration of the primary flow will affect the combined flow and will necessitate a re-check of the combined flow performance. Record the final flow on the test sheet.

Note . . .

It may be necessary to alter the setting of the adjustment screw to which the valve is anchored. This may be done by disconnecting the burner from the rig fuel pipe to gain access to the adjustment screw. Slacken the lock-nut and tighten or loosen the screw; temporarily secure the lock-nut. Recheck as above. If satisfactory, tighten the lock-nut.

43. When matching the burners in sets of ten, the maximum variation in flow is as stated in the appendix.

Spray angle

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

45. To check the spray angle the burner assembly must be mounted on the rig as shown in Chapter 1, fig. 8a.

46. Apply the specified fuel pressures and examine the spray cone by using the protractor G.61125. Should the spray angles be outside the limits, inspect the atomiser plates for correct alignment and repeat the tests so far described.

47. Repeat the calibration tests and record the final readings on the test sheet.

Note . . .

If the readings are not within the specified limits the atomiser parts may be replaced and the tests repeated. Do not attempt to enlarge the holes or slots in the atomiser parts.

Flow distribution

48. The purpose of the flow distribution test is to check the evenness of fuel distribution over the whole cone angle of the burner spray. The cone of fuel ejected is subdivided into twelve segments which are arranged to separate into graduated measuring cylinders situated on the universal test rig.

49. The burner is connected to the rig, the fuel pressure adjusted to that stated in the appendix and the flow directed into the graduated cylinders and then cut off when the highest reading reaches the upper limit specified. The lowest reading must be at or above the lower limit stated in the appendix.

50. On completion of the flow distribution test, again effect a length check as described in para. 11 and ensure that the length of the unit is within the specified limits.

Leakage test

51. Re-check the torque load tightening of the shroud (*para.* 31 (8)); then mount the burner on a high pressure rig and ensure that it is thoroughly dry by wiping it clean, then applying compressed air.

Note . . .

In the event of any readings falling outside these limits, replace the atomiser parts and again repeat all tests as described above.

52. Raise the fuel inlet pressure to the conditions stated and examine for leaks. Particular attention must be paid to all brazed joints and inlet joints. Any leaks observed during this test must be traced and rectified.

53. Lock the copper washer, located between the shroud and the locking ring, by peening the washer into the slots, using the punch; T.157870.

54. Again check the air gap between the air shroud and the sleeve with the wire gauge (*para.* 31, *sub-para.* 9).

INHIBITING

55. Thoroughly flush the burner by injecting oil, OM-11 into the inlet connection. Secure the transportation plug and washer (or dust cap if holder is fitted), position the rubber protective cap over the burner outlet and mask off the air inlet holes with adhesive tape.

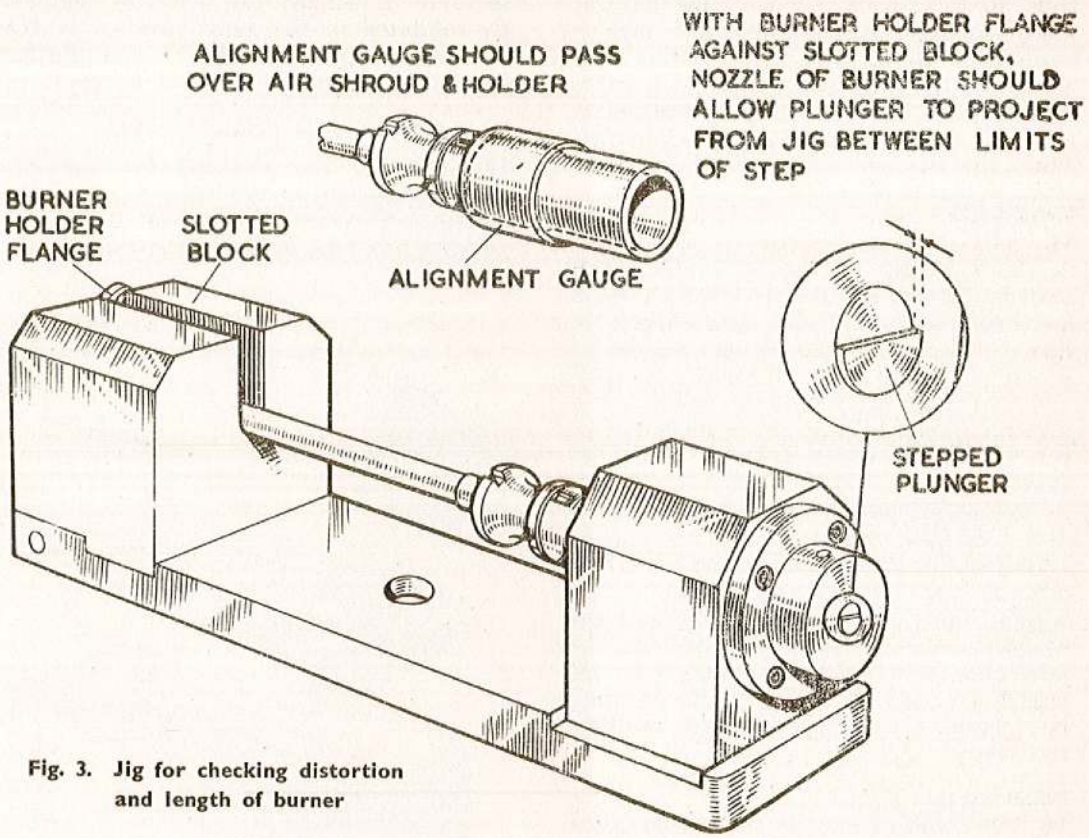

Fig. 3. Jig for checking distortion and length of burner

RIG TESTS

11. The tests for flow performance, spray angle, patternation and leakage tests are the same as those described in the previous chapter, except that the specified pressures and spray angles are different. The fuel used for these tests must be to specification D.R.D. Eng. 2482 (latest issue), the limits of temperature must be maintained between 20 and 21 deg. C. and the specific gravity between 0·801 and 0·806.

Flow performance

12. With the burner pressure set at 20 lb. per sq. in., examine the spray from the burner for streaks, and check that the spray is symmetrical about the nozzle axis and the flow within the limits specified in the following table. Streaks indicate either the presence of foreign matter, such as a particle of carbon obstructing the orifice and inlet holes, or scratches on the face of the atomiser which run into the orifice.

Atomiser type No.	TEST No. 1 Inlet pressure lb. per sq. in.	Flow gall. per hour Min.	Flow gall. per hour Max.	TEST No. 2 Inlet pressure lb. per sq. in.	Flow gall. per hour Min.	Flow gall. per hour Max.
F.A.20	645	27·6	28·4	9	3·57	3·75
F.A.21	645	31·5	32·5	9	4·1	4·3
F.A.22	645	29·95	30·85	9	3·89	4·09
F.A.23	645	26·4	27·2	9	3·57	3·59
F.A.52	645	34·47	35·53	9	4·44	4·7
F.A.53	645	32·9	33·9	9	4·07	4·27
F.A.54	645	30·34	31·26	9	3·76	3·96
F.A.55	645	29·06	29·94	9	3·64	3·82
F.A.57	645	36·15	37·25	9	4·58	4·82
F.A.58	645	28·56	29·44	9	3·6	3·8
F.A.59	645	30·1	31·1	9	3·7	3·9

Where foreign matter is obstructing the flow, it should be removed by lapping either the orifice or the tangential holes or both, with the lapping stick; if this does not rectify the trouble a new atomiser must be fitted. If the face of the atomiser is scratched or the flow is outside the specified limits, the atomiser must be replaced.

Spray angle

13. The spray angle check is carried out in the same manner as for the C.S.H.9 burners, except that the specified pressures and angles are different. The spray must first be checked at 20 lb. per sq. in. to ensure that the cone of spray is equal around the centre line of the orifice. The pressure should then be increased to 200 lb. per sq. in., at which pressure the spray angle should be between 81 and 85 deg. for all atomisers fitted on both C.S.H.23 and C.S.H.24 burners except the F.A.59 type and this should be between 84 and 88 degrees. If the observed angle is not within these limits, fit a replacement atomiser. Under no circumstances are the tangential inlet holes or orifice to be enlarged. In every instance when the atomiser is replaced, the flow performance must be rechecked.

Patternation

14. The procedure for the patternation check is identical to that described in Chapter 1, para. 43 of this section.

Distortion check and leakage test

15. The distortion check and leakage test are the same as described in the previous chapter.

INHIBITION

16. The C.S.H.23 and C.S.H.24 burners are inhibited in the same manner as the C.S.H.9 except that oil to specification D.T.D.561 (latest issue) must be used.

PREPARATION FOR DESPATCH

17. Burners are prepared for despatch and despatched in the same way as described in Chapter 1 except that the special packing box (*fig.* 4) should be used.

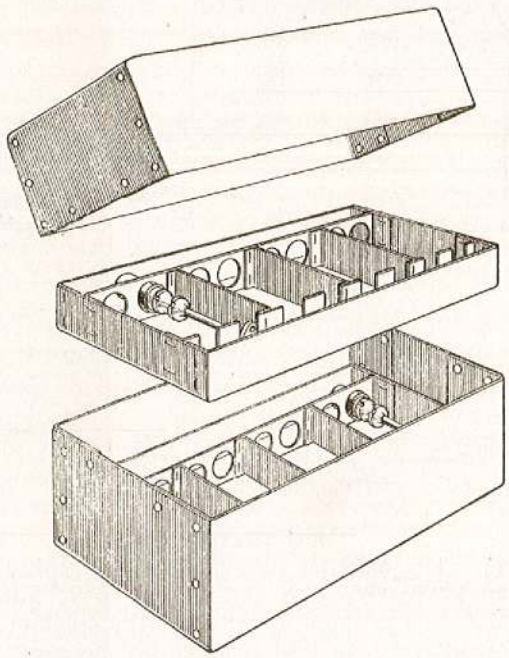

Fig. 4 Special packing box