

Chapter Forty-four

THE LUCAS BURNERS

Duplex Burners Type CSH. 42

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The information in this chapter has been supplied by Messrs. Joseph Lucas, Ltd., and all enquiries regarding their products should be made to them.

THE DUPLEX BURNER type CSH.42, has been introduced in order to enable a wide range of flows to be satisfactorily dealt with, as for example, when operating at very high altitudes. The burner has a fixed orifice and employs a common inlet for the primary and main fuel supply. A spring loaded relief valve is incorporated in the burner assembly and is set to allow fuel through the primary flow ports only, until the pressure in the system exceeds a predetermined figure when the valve opens to allow fuel to pass through the main port. The nomenclature CSH.42 is derived from Continuous Spray Holder of a type known as 42. Earlier types were known as the CSH.39, 37, and 28 types. The type CSH.39 is identical with the CSH.42 except for narrower spanner slots in the air shroud, and differs from the CSH.37 in that it is subjected to a de-embrittlement process. The earlier CSH.28 type was cadmium plated instead of nickel plated as with later types. Only the burner proper is of Lucas manufacture in Ghost engines; the burner holder, locating block, diaphragm, adjusting shim, nut and washers being engine parts and made by The de Havilland Engine Company.

THE BURNER (Fig. 1) comprises the body in to which is assembled the spring-loaded relief valve and the filter. The atomiser assembly, consisting of the distributor plate, main flow plate, distance

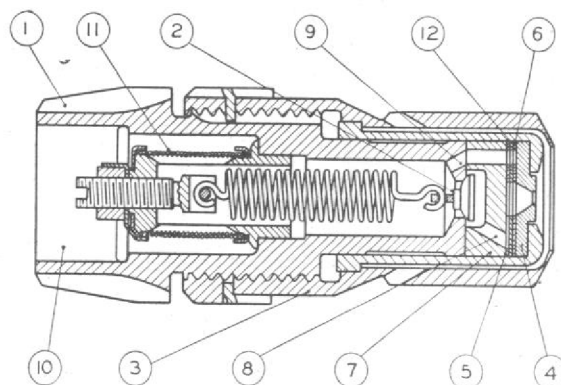


Fig. 1. General arrangement of burner.

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|--------------------------------|------------------------|
| 1. Body. | 7. Distributor plate. |
| 2. Spring-loaded relief valve. | 8. Main flow port. |
| 3. Shroud nut. | 9. Primary flow port. |
| 4. Orifice plate. | 10. Fuel inlet. |
| 5. Main flow plate. | 11. Filter (strainer). |
| 6. Primary flow plate. | 12. Distance plate. |

plate, primary flow plate, and orifice plate, is located at the forward end of the body and is retained in position by the sleeve and shroud nut. Correct

alignment of the individual atomiser components is ensured by two dowel pins which locate at their extremities with holes in both distributor plate and orifice plate.

The forward end of the body has an axial hole in which is accommodated the relief valve, this is retained in position by a spring attached at the rear end to an adjusting bolt. This bolt is carried in, and retains, the filter body in position in the main body. The filter is of the cylindrical wire wound type.

The distributor plate of the atomiser assembly is recessed on one side, to provide clearance for the operation of the relief valve, and also has drillings which form the primary and main flow ports. The primary port connects through a duct in the body with the primary fuel supply on one side and through to the primary flow plate on the other. The main ports are formed by inclined drillings in the distributor plate and connect the main fuel supply via the relief valve recess with the main flow plate. Both the primary and main flow plates have tangentially cut slots which set up a swirling motion to the fluid passing through to the orifice plate. The orifice plate is very carefully calibrated and machined to fine limits and must not be touched with a file or wire brush.

A cooling passage is provided between the shroud nut and sleeve, a series of holes in the shroud nut radially disposed at an angle to the centre line providing an entrance for air which is directed across the burner orifice by the formed end of the shroud nut.

The body is screwed at the rear end to provide the attachment to the burner holder.

The fuel, at low delivery pressure, enters the burner assembly through the filter and passes via the primary flow port in the distributor plate, to the primary flow plate where the swirling motion is set up by the tangentially cut entry slots so that a fine easily ignitable spray is emitted from the orifice plate. As the pump delivery increases, to meet rising engine requirements, a pressure is built up in the body of the burner until it is sufficient to overcome the spring loading of the relief valve. The increased flow of fuel is then admitted through the main flow port, to the main flow plate, which imparts the swirling motion, so that a combination of main and primary flows now feed the spray.

INSTALLATION

The burner assembly which comprises the atomiser details screwed to holder with its mounting diaphragm and feed pipe, which are engine manufacturer's supply, is inserted into the combustion chamber, and is secured by set-bolts to a boss cast at the junction of the two entry ducts of the twin entry expansion chamber.

SERVICING

Once the burner is installed, no servicing is normally necessary except for regular inspection of the pipes and connections for any signs of leakage. No leakage is permissible.

Whenever pipes are disconnected for attention to leaks, it is always necessary to bleed the fuel system, as the presence of air in the system will adversely affect the efficiency of the fuel system components. The procedure for bleeding the fuel system is described in chapter 8.

OVERHAUL

While these instructions apply primarily to the type CSH.42 burner, they are applicable also to the superseded types CSH.28, CSH.37, and CSH.39.

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 used in the following pages may be used. Parts that are interchangeable are listed in the Replacements section (see page 4).

SPECIAL TOOLS

The repair of these burners necessitates the use of special tools and a test rig, full particulars of which are listed below.

Tool No.	Description.
T.166503	Spanner 'C' for shroud and locknut.
G.57252	Gauge, length.
R.42	Rig, test calibration and patternation.

CHECKS AND PRECAUTIONS BEFORE DISMANTLING

Visually inspect the burner and ensure that there is no damage necessitating rejection. Check that the rubber sealing cap is fitted over the burner outlet, and that the inlet connection is suitably blanked off (if the holder is fitted) or the inlet plug is in position in the burner inlet.

The unit must now be dismantled and cleaned. All carbon must be removed and great care taken to avoid damaging the burner.

DISMANTLING THE BURNER

To dismantle the burner proceed as follows:—

Remove the rubber protective cap from the outlet connection and the dust cap from the holder (if fitted), or the screwed plug and washer from the inlet connection.

Mount the burner in a plain jawed vice with suitable soft packing, gripping either the holder or the flats of the screwed plug. Carefully bend back the caulking points of the lockwasher and slacken the locking ring using the special 'C' spanner T.166503. Using the same spanner unscrew and remove the air shroud from the atomiser body. Lift off the sleeve and carefully withdraw the orifice plate, primary flow plate, distance plate, main flow plate and distributor plate, taking care to retain the two dowels locating these atomiser details.

NOTE.—Dismantling of the relief valve assembly will affect the calibration of the unit and

normally is not recommended. However, if this is essential continue to dismantle the burner as follows.

Remove the unit from the vice and knock back the lip of the tab washer securing the locknut to the adjustment screw and screw in the latter sufficiently to enable the valve to be detached from the spring. Then drive out the strainer complete with spring, adjustment screw, tab washer and locknut by inserting a hollow drift of suitable size through the hole in the atomiser body which forms the valve seat. Unscrew the adjustment screw out of the strainer after first removing the locknut and tab washer off the other side.

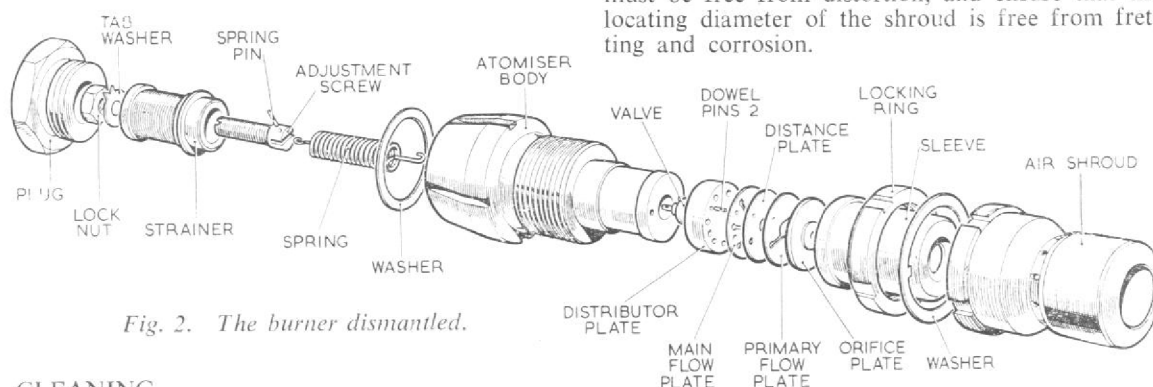


Fig. 2. The burner dismantled.

CLEANING

It is important that the bench upon which work is carried out is scrupulously clean and kept 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.

The use of a wire brush may be necessary to remove the carbon deposit from the outer face of the air shroud and sleeve, though some may be removed by means of the parawash machine.

INSPECTION

All viewing and inspection checks are described in this section, and are listed to correspond as nearly as possible to the dismantling sequence.

LENGTH CHECK. This check is made by the use of a special gauge G.57252 which enables the length of the burner to be ascertained—it should be between 3.124 and 3.148 in.

PERMISSIBLE WEAR. Ensure that the locating diameter of the air shroud is within the permissible worn tolerances.

REDUNDANT AND CONSUMABLE PARTS. All parts rendered redundant by the embodiment of essential modifications must be rejected during inspection. All inspectors must have available, therefore, all information concerning relative modifications. The air shroud lock washer must be rejected during dismantling irrespective of condition.

SURFACE DAMAGE. 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.

AIR SHROUD. 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. 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 DETAILS. The atomiser details comprise the orifice plate, primary flow plate, distance plate, main flow plate and distributor plate; these are all located together by means of two dowel pins which terminate in blind holes in the inner faces of distributor plate and orifice plate. Ensure that all atomiser details are clean and undamaged, that all holes are unobstructed and ascertain that the dowel pins are sound.

LOCK WASHER. Discard the air shroud lock washer irrespective of condition.

LOCKING RING. 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.

VALVE, SPRING, ANCHOR PIN, ADJUSTING SCREW, LOCK-NUT, TAB-WASHER AND STRAINER ASSEMBLY. Normally these details may be regarded as an assembly though the individual parts may be replaced separately. Inspect the valve generally for condition, particularly its seating and the hole through which the spring is normally secured. Visually inspect the spring for condition and ensure that it is free from sharp edges or fractures. Ascertain that the anchor pin is sound, as this is normally peened over after inserting through both adjusting screw and spring. Inspect the adjusting screw for condition, ensure that its threads and screwdriver slots are clean and sound. Ascertain

that the lock-nut is sound and discard the tab-washer if the lip is opened out for dismantling. Ensure that the strainer is clean and sound.

ATOMISER BODY. Examine the atomiser body for cleanliness and condition, ensure that all holes are unobstructed and the threads undamaged.

REPLACEMENTS

New lock washers must be fitted when re-assembling the burner. The atomiser details are always supplied as a set and individual items must not be replaced separately. The strainer is supplied as an assembly, while all remaining parts may be replaced separately. If the test results do not come within the specified limits, no attempt must be made to enlarge the holes or slots of the atomiser details, but a complete replacement atomiser unit must be fitted. In the event of flaking of the plating of any part, the defective part is to be rejected, and a replacement fitted, the defective part or parts being returned to the Stores for replating.

and pull the spring eyelet sufficiently through to enable the valve to be attached. Remove the tool. Lower the annular block into the sleeve (with central recess to give clearance for valve operation, and to serve as a blanking block for the main outlet holes in the atomiser body) and screw both sleeve and shroud on to atomiser body.

Mount the burner on the test rig and effect a test to check the seating of the valve. Remove the air shroud, sleeve and block and assemble the atomiser details comprising distributor plate, two dowel pins, main flow plate, distance plate, primary flow plate and orifice plate to holder and secure with locking ring, washer, sleeve and air shroud. Tighten air shroud to 75 lb./ft. torque pressure with special wrench T.167265 and 'C' spanner T.166503. Ascertain that the air metering gap between the orifice end of the shroud and sleeve is as specified using a standard 0.024 in. 'GO'—0.028 in. 'NOT GO' gauge.

NOTE.—Do not caulk over the lock washer at this stage.

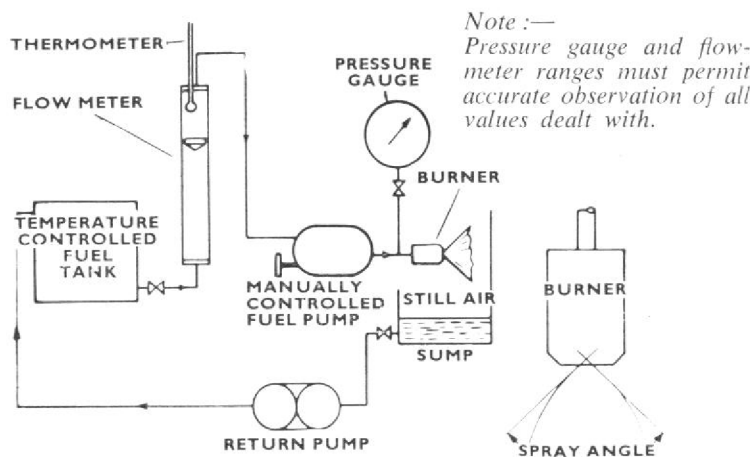


Fig. 3. Diagrammatic layout of calibration rig.

RE-BUILDING THE BURNER

During the re-assembling 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 re-build and will indicate shortages also. Ensure that all parts are thoroughly clean and proceed as follows:—

NOTE.—It is assumed that the burner is being assembled with details separate as for first build.

Locate spring with slot and holes in adjustment screw, insert spring anchor pin and peen over both ends of pin. Hold spring and lower adjustment screw into strainer and turn to tighten the adjustment screw in the strainer until the screw projects through the strainer about $\frac{1}{4}$ in. Locate the tab-washer and nut over the adjustment screw and tighten. Carefully lap the seat of the valve to ensure sound sealing on atomiser body face. Offer the spring (with strainer assembly) into the atomiser body and insert a suitable hooked tool through the central hole (or valve seat) in the atomiser body

RIG TESTS

The unit must undergo the following tests:

1. Flow performance.
2. Combined flow performance.
3. Spray angle.
4. Patternation.
5. Leakage.

The first four tests may be effected on the Burner Test Rig, type R42, but a high pressure rig (e.g., the type R36 General Purpose Rig) is necessary for the leakage test.

Unless stated otherwise the fuel used throughout these tests is to be Pool Burning Oil to specification D.Eng.RD.2482 latest issue. The limits of temperature of the fuel must be between 20 degrees C. minimum and 21 degrees C. maximum and its Specific Gravity between 0.801 and 0.806.

FLOW PERFORMANCE. Mount the burner in a suitable slave holder on the rig schematically illustrated in Fig. 3. Raise the inlet pressure to 200 lb. per sq. in. and visually inspect the spray for streaks. The spray must be symmetrical about the nozzle axis and free from streaks. 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 details must be replaced.

When satisfactory with regard to streaks, etc., apply the fuel inlet pressure as tabulated below, and ascertain that the flow is between the limits specified.

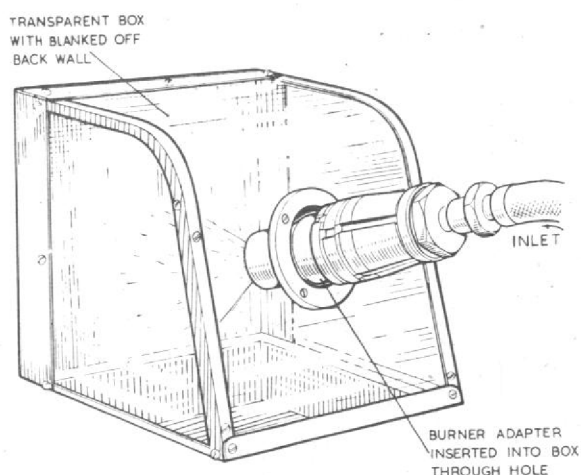


Fig. 4. Equipment for examination of spray.

CALIBRATION LIMITS

Inlet Pressure lb. per sq. in.	Flow (G.P.H.)		
	Minimum	Nominal	Maximum
49	4.77 ±0.13	4.9 F.N. 0.7 on noml. flow	5.03
600	62.7 ±1	63.7 F.N. 2.6 on noml. flow	64.7

COMBINED FLOW PERFORMANCE. With the burner mounted on the rig as on page 4 adjust the fuel inlet pressure to the burner to 125 lb. per

sq. in. and ascertain that the flow is between 14 and 15 g.p.h. Similarly check that the flow at 150 lb. per sq. in. is between 20 and 22 g.p.h.

NOTE.—It may be necessary to alter the setting of the adjustment 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 in the preceding paragraph. If satisfactory, securely tighten the lock-nut.

Adjust the fuel inlet pressure to the burner to 49, 125, 150 and 600 lb. per sq. in. respectively and record the corresponding flows.

SPRAY ANGLE. 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. cone emitted from the orifice. To check the spray angle the burner assembly is mounted on the rig as shown in Fig. 5. 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 details for correctness of seating, also that the burner adapter is secured squarely to the rig. If the trouble is not traced to either of these sources fit replacement atomiser details and repeat the test until satisfactory.

With the fuel inlet pressure set at 90 lb. per sq. in. check that the spray angle does not exceed 115 degrees. Similarly with the inlet pressure set

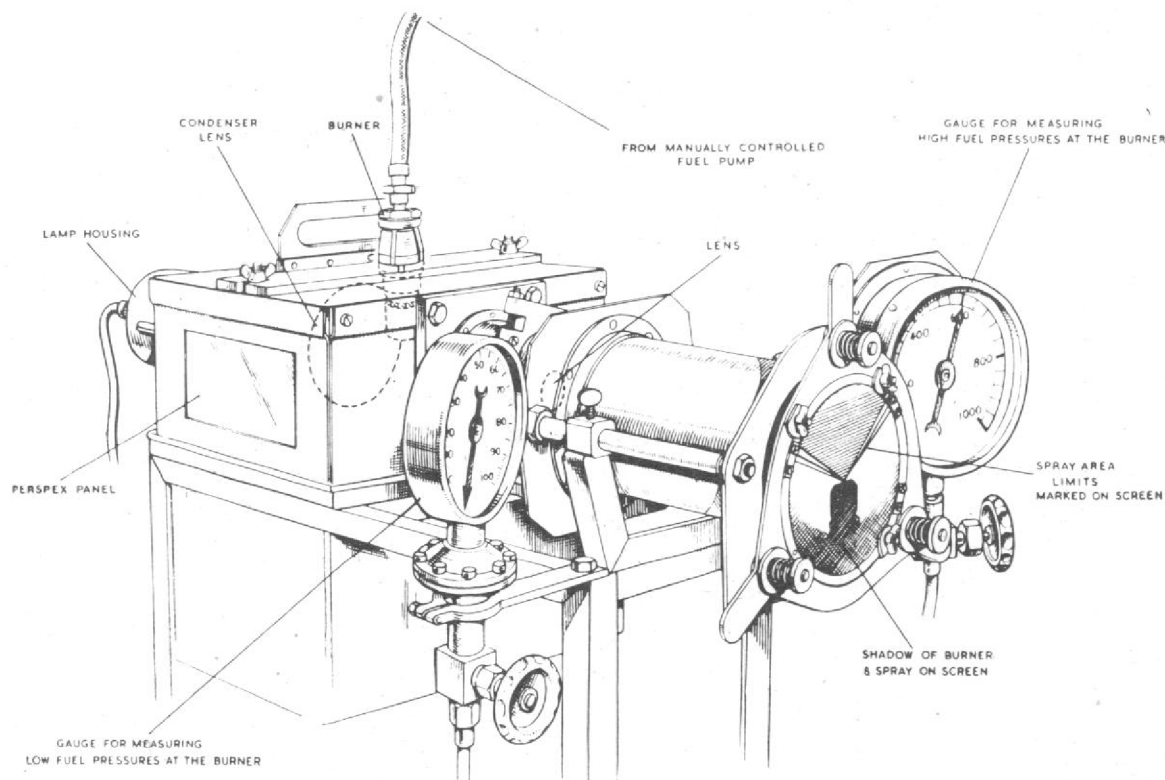


Fig. 5. Illuminated rig for measuring spray angle.

at 600 lb. per sq. in. check that the angle of the combined spray does not exceed $90^\circ \pm 2^\circ$ degrees.

NOTE.—If the readings are not within the specified limits, the atomiser details must be replaced and the tests repeated. **Do not attempt to enlarge the holes or slots in the atomiser details.**

PATTERNATION. The purpose of the patternation test is to check the equal distribution of fuel over the whole cone angle of the burner spray. With the fuel inlet pressure adjusted to 45 lb. per sq. in. check the fuel flow until the highest reading in any one cylinder reaches 75 cc. At this point shut off the fuel and ascertain that there is not less than 56 cc. in any one cylinder.

NOTE.—In the event of any readings falling outside these limits, replace the atomiser details and again repeat **all** the tests previously effected.

LENGTH CHECK. On completion of the patternation test again effect a length check with the gauge G.57252 and ensure that the length of the unit is within the specified limits.

LEAKAGE TEST. Mount the burner on a high pressure rig and ensure that it is thoroughly dry by wiping it clean and then applying compressed air. Raise the fuel inlet pressure to 1500 lb. per sq. in. for a minimum period of 4 minutes, and during this period examine for leaks. Particular attention must be paid to all brazed joints and inlet joints. Leaks observed during this test must be traced and rectified. Set copper washers into two or more slots. Again check the air gap between both shroud and sleeve with wire gauge (see page 4).

INHIBITING

Thoroughly flush the burner by injecting oil (Specification D.T.D.587) into the inlet connection and secure transportation plug and washer (or dust cap if holder is fitted) and position rubber protective cap over burner outlet.

PREPARATION FOR DISPATCH

A test record sheet containing all test record figures must be included with each burner. Pack burners in sets of ten in special cardboard containers.

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