Chapter 8 AIR CONDITIONING SYSTEM

(Completely Revised)

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DESCRIPTION

General

1. The cabin is pressurized for high altitude flying by air supplied from the engine impeller. The pressurized cabin is enclosed between No. 1 bulkhead at the front and No. 2 bulkhead at the rear, by the canopy at the top and by the cabin decking at the bottom. To maintain the pressure within the cabin, and as a seal when the aircraft is parked, the entry hatch in the canopy is sealed when in the closed position. Details of this seal, which is automatically inflated by the pneumatic system air reservoir, are given in Chapter 1 of this Section. Fig. 1 illustrates the layout of the supply pipes and the components which regulate the temperature and the differential pressure.

Air supply for pressurizing

2. Compressed air from the engine impeller is discharged, through tappings in the rear face of the impeller casing, into a gallery pipe which leads to the air supply control valve indicated in Fig. 1. This valve serves not only as an ON-OFF cock, but also as an air temperature controller. By means of this cock, which is actuated by a Teleflex control from the cabin, the delivery of warm air from the impeller casing may be directed in varying proportions through the cooling system, thereby regulating the temperature of the air entering the cabin. The air enters the cabin through a non-return valve in No. 2 bulkhead, and is discharged through a number of small holes in a gallery pipe, which runs round the cabin coaming immediately beneath the side panels of the canopy and windscreen. These panels are demisted by the efflux of the warm air from the gallery pipe.

Differential pressure control

3. The pressure in the cabin is automatically regulated by a Normalair control valve mounted on the forward face of No. 1 bulkhead (Fig. 1). The functioning of the valve is such that the

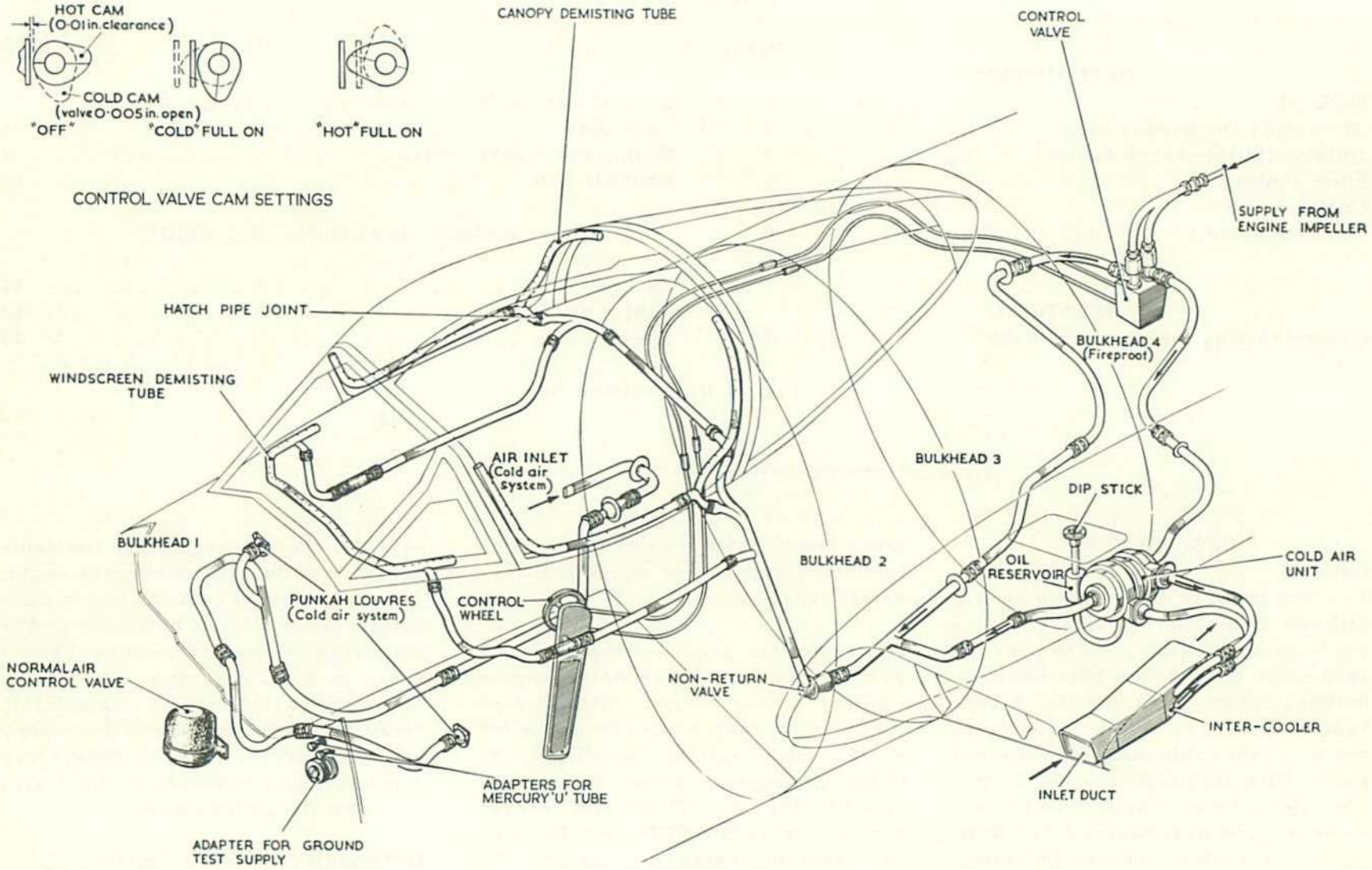

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Fig. 1 Air conditioning system

air pressure inside the cabin does not differ appreciably from the surrounding atomospheric pressure until the pressurizing height is attained. At this predetermined height, the action of the valve progressively increases the pressure in the cabin, in relation to the surrounding atmosphere, up to a maximum differential of 3 p.s.i. The unit incorporates a switch to operate a warning lamp should the cabin pressure drop more than $\frac{1}{2}$ p.s.i. below the normal for any altitude. Two more valves are included in the unit; an outward relief valve which acts as a safety valve if the regulating valve should fail to operate at the correct pressure, and an inward relief valve which operates when the ambient atmospheric pressure exceeds the pressure in the cabin, as would occur during a rapid descent. Details of the construction and mechanism of the control valve will be found in A.P. 1275A, Sect. 20.

Inter cooler

4. A Marston type inter cooler is positioned in the port wing (Fig. 1). The air to the cabin passes, via the compressor of the cold air unit, to the inter cooler where it is cooled by ram air admitted through an inlet duct in the port wing. By means of the air supply control valve, a varying proportion of the air flow to the cabin passes through the cooling system, ranging from zero to full flow. To avoid back pressure in the gallery when cold air is selected, a punkah louvre is connected to the system which allows unrestricted flow into the cabin.

Cold air unit

5. The cold air unit, which operates in conjunction with the inter cooler, is positioned in the stub of the port main plane, and consists of a centrifugal compressor and a turbine impeller which are directly connected to each other and rotate on a common shaft. Air, which had been through the inter cooler, passes via the turbine (thus driving the compressor) to the cabin. Details of the functioning and mechanism of the unit will be found in A.P. 4340, Vol. 1, Sect. 2.

Cold air system

6. For low altitude flying when the cabin is not pressurized, cold air may be admitted to the cabin through a pair of punkah louvres. These louvres, which incorporate an on-off valve, will also control the air draught in any desired direction. The ram air inlet for this system is in the leading edge of the starboard wing outboard of the engine duct. From the inlet, it is ducted through a non-return valve to the punkah louvres. The port and starboard units thus have a common supply (Fig. 1). When the cabin is pressurized, a reverse flow through the cold air system is prevented by the non-return valve.

SERVICING

Ground testing the pressure cabin

WARNING.

IT IS ESSENTIAL THAT THE PERSONNEL DETAILED FOR GROUND TESTING THE PRESSURE CABIN ARE OF THE APPROVED MEDICAL CATEGORY (A.P. 1464D, VOL. 2, PART 1, LEAFLET 36 REFERS).

7. The routine testing of the pressure cabin should be carried out as follows:-

(1) Close the canopy (thus inflating the seal, Chap. 1) and connect the test rig air supply to the adapter on No. 1 bulkhead (Fig. 1). A non-return valve must be interposed between the rig and the adapter.

(2) If a mercury U-tube is not embodied in the test rig, attach a U-tube to the adapter of No. 1 bulkhead.

(3) Blank off the atmospheric vent on the Normalair valve (A.P. 1275A, Sect. 20, Chap. 3).

(4) Start the air supply rig and pressurize the cabin to 2 p.s.i.

(5) Check the Normalair control valve for leaks by placing the hand over the gauze exit around the periphery of the valve body.

(6) Raise the cabin pressure to 3.1 p.s.i. and ensure that the Normalair valve relieves at this pressure. This will be indicated by a passage of air through the gauze exit at the bottom of the valve body. Increase

the rate of air flow slightly and ensure that the pressure does not rise above 3.1 p.s.i.

(7) With the cabin pressurized to 3 p.s.i., switch off the air supply and check that the time taken for the differential pressure to drop from 3 to 1.5 p.s.i. is not less than 12 seconds.. If this time is less than 12 seconds, inflate to 2 p.s.i. and maintain this pressure while major leaks are traced.

(8) Rectify all major leaks and repeat test sequence as before.

(9) If the measured time is greater than the stated figure, allow the cabin pressure to dissipate and when the differential is zero, only then may the canopy be opened.

(10) At the completion of the test, the air supply rig and mercury U-tube should be removed from their adapters on No. 1 bulkhead and the blanking caps securely replaced. The blanking plug must be removed from the Normalair valve.

(11) Test the electrical circuit of the pressure warning lamp by removing the terminal block cover on the Normalair valve and bridge the terminals. The warning lamp should now indicate by illuminating.

Ground testing of pressure cabin on repaired aircraft.

8. After structural repairs or modifications affecting the bulkheads or walls of the pressurized cabin have been completed, the following test should be made:-

(1) The fuselage must be complete with canopy, hatch, windows, control seals, etc.

(2) Tests may be made in an open hanger, provided the necessary safety precautions are taken.

(3) Compressed air is to be supplied to the pressure test connection, and the air line is to have a stop valve and exhaust valve provided at a safe distance from the aircraft.

(4) A mercury manometer is to be provided adjacent to the air valves; one leg of the manometer connected to the pressure test connection on No. 1 bulkhead and the other leg vented to atomosphere.

(5) Remove the existing Normalair pressure control valve and install a special proof test safety valve set at 4 p.s.i. in its place.

(6) Inflate the fuselage to a pressure of 4.0 p.s.i. and maintain for one minute.

(7) Shut off the air supply and measure the time for the cabin differential pressure to fall from 3 to 1.5 p.s.i.

(8) If this time is less than 12 seconds, inflate the fuselage to 2 p.s.i. and maintain this pressure while the major leaks are traced.

(9) Rectify all major leaks and repeat the test sequence as above. The procedure for rectifying leaks is given in A.P. 1464B, Vol. 1 Part 2, Sect. 4, Chap. 6. The Peratol sealing process is outlined in Chap. 1 of this section.

(10) If the measured time is greater than the stated figure, allow the cabin pressure to dissipate and when the differential is zero, only then may the canopy be opened.

Setting the control valve

9. The following procedure for setting the two cams on the splined Teleflex control shaft should be read in conjunction with the diagram in Fig. 1. Set the control wheel in the cabin to the fully OFF position, then proceed as follows: -

(1) Assemble the hot air cam, which may be identified by its shape, on its respective splined shaft. The cam must be assembled so that the heavily scribed line appears on the outside and is in line with the centre - line of the valve stem as indicated in Fig. 1. Refit and tighten the cam retaining nut.

(2) With the hot air cam in this position, adjust the end cap on the valve stem so that there is a clear-

ance of 0.01 in. between the cam and the end cap. Tighten the locknut on the end cap after this adjustment.

(3) Assemble the cold air cam on its respective shaft so that the heavily scribed line appears on the outside and is in line with the centre-line of the valve stem. Refit and tighten the cam retaining nut.

(4) With the cold aid cam in this position, adjust the end cap on the valve stem to touch the cam, then adjust it a further quarter turn so that the valve is kept open approximately 0.005 in. and tighten the locknut.

(5) Check that the loading on the control wheel in the cabin is 12 ± 2 lb. The spring balance should be attached at a point 2 in. from the centre-line of the wheel on the most convenient spoke.

Cold air unit

10 Instructions for servicing the cold air unit are given in A.P.4340, Vol. 1 and 6, Sect. 2, to which reference should be made before dismantling the unit. The oil level in the auxilliary tank should be checked periodically. The unit should be kept filled with engine oil to the mark indicated on the dipstick. Ensure that the breather hole on the top side of the filler neck is clear. The matrices of the inter cooler must also be periodically inspected for damage.

WARNING...

THE COLD AIR UNIT WILL OVERHEAT IF USED WHEN THE AIRCRAFT IS ON THE GROUND, THEREFORE THE AIR CONDITIONING CONTROL WHEEL IN THE CABIN MUST BE SET TO OFF WHEN THE ENGINE IS RUNNING ON THE GROUND.

REMOVAL AND INSTALLATION

General

11. The procedure for the removal and installation of most of the air conditioning equipment will be readily apparent when the items are viewed on the aircraft. Extreme cleanliness is essential during these operations.

Cold air unit

12. To remove the cold air unit, proceed as follows:-

(1) Remove the access panel from the upper surface of the main plane immediately above the cold air unit by removing the 2 B.A. countersunk screws. Remove six 2 B.A. countersunk screws and withdraw the reinforcing stringer which is fitted across the aperture.

(2) Remove the 2 B.A. bolts securing the compressor inlet flange and the turbine outlet flange.

(3) Release the Jubilee clip securing the oil hose to the base of the oil reservoir. Withdraw the reservoir and collect the oil which will flow from the reservoir and the hose.

(4) Remove the top and bottom long bolts which secure the cold air unit to No. 1B rib, then remove the unit.

(5) Installation of the unit is the reverse of the removal procedure. Ensure that the annular rubber seals in the inlet and outlet connections of the unit are correctly positioned and are in good condition before installing the unit. Sealing compounds must NOT be used in the vicinity of the connecting pipe flange joints.

Inter cooler

13. With the cold air unit removed (para 12), the procedure for removing the inter cooler is as follows:-

(1) Remove the four 2 B.A. countersunk bolts securing the compressor outlet and turbine inlet pipe connections to No. 1B rib.

(2) Remove the 2 B.A. bolts securing the channel and the access panel to No. 1B rib. The removal of the channel and panel, allows access to the inter cooler.

NOTE...

With No. 1 fuel tank removed, the inter cooler is more accessible through the access hole (4.5 in. dia.) in the main spar, inboard of No. 2 rib.

(3) Remove the clips securing the two inter cooler pipes to the inter cooler, then withdraw the pipes.

(4) Remove the four 2 B.A. mushroom head inter cooler mounting bolts from the under surface of the main plane.

(5) Withdraw the inter cooler aft from the inter cooler duct and remove it through the access aperture in No. 1B rib, then through the access aperture in the main plane top skin.

(6) Installation of the unit is the reverse of the removal sequence. When installing the inter cooler, it is important that its forward end enters correctly into the leading edge duct.

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