Chapter 8 AIR CONDITIONING SYSTEMS (Pre-Mod. 176)

(Including bomb bay heating and windscreen demisting systems)

(Completely revised)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

DESCRIPTION

Introduction

1. The air conditioning system installed in this aircraft enables operations to be carried out in comfort at extreme altitudes and under varying conditions of flight, the air in the crew's compartment being maintained at reasonable temperatures and pressures over the whole range of conditions likely to be encountered.

2. Air from the engine compressors is used to pressurise the cabin, the flow of air being automatically maintained by flow controllers. Pressure in the cabin is maintained by pressure controllers connected to a combined valve unit, the controllers regulating the amount of air allowed to pass to atmosphere through the duplicated discharge valves of the valve unit. Air release valves, which may operate either manually or by solenoids, are connected in the pressure line between the controllers and the discharge valves to provide for rapid depressurisation of the cabin in an emergency. The pressure controllers are normally set to maintain a cabin pressure equivalent to 8,000 ft. altitude up to a maximum differential pressure of approximately 9 p.s.i. (CRUISE conditions), but may be set when required to maintain 25,000 ft. conditions up to a maximum differential of 3.5 p.s.i. (COMBAT conditions) at 50,000 ft.

3. A reasonable temperature is maintained in the cabin by air conditioning equipment, installed in the nose-wheel bay, which controls the temperature of the air entering the cabin. A temperature control valve, operated electrically by temperature sensitive elements in the cabin, governs the path of the air through the conditioning equipment, and enables any cabin temperature between −5 deg. C. and +33 deg. C. to be maintained on selection.

4. Provision is made for ventilation during non-pressurised flight. A ram air intake, situated on the port side between the fuselage wall and the engine intake boundary layer fence, feeds the cabin through an actuator-operated flap-type valve; this valve is held closed during pressurised flight. The same ram air intake also feeds cooling air to the cooler in the conditioning apparatus, and an identical intake on the starboard side feeds cooling air to various electrical components in the nose-wheel bay.

5. Five-inch diameter ground conditioning connections are fitted in the pressure cabin and bomb door structures, to which a hose from a ground conditioning truck may be connected to enable air conditioning of the cabin and the bomb bay to be carried out while the aircraft is on the ground. Pressure test connections are also provided for ground pressure testing of the cabin and ducting.

6. A list of the main components in the pressurising and air conditioning system is given in the following table, together with their location in the aircraft and references to Air Publications which cover the components listed or similar equipment.

Key to Fig. 1—Air Conditioning System

1 TEMP. SELECTOR AUTO control—selects the required cabin temperature when the CABIN TEMP. CONTROL switch is in the AUTO position
COOL—NORMAL—WARM

2 TEMP. CONTROL VALVE indicator—gives position of temperature control valve

3 PRESSURE SELECTOR switch, has three positions:—
CRUISE—sets cabin pressure controller at CRUISE
COMBAT—sets cabin pressure controller at COMBAT
NO PRESSURE—depressurises the cabin

4 ENGINE AIR SWITCHES—control the engine air supply cocks (isolation cocks)—
OPEN—SHUT

5 CABIN AIR switches; each has two positions:—
OPEN—places the flow control valve under the control of the mass flow controller
SHUT—closes the flow control valve

6 *At present inoperative*

7 *At present inoperative*

8 RAM AIR VALVE switch has three positions:—
Central off position
SHUT—closes ram air valve
OPEN—opens ram air valve

9 RAM AIR VALVE position indicator

10 STARBOARD MANUAL switch—provides manual control of the air mass flow from starboard pair of engines—
INC.—DEC.

11 AIR FLOW indicator—gives the mass flow from port and starboard pairs of engines

12 PORT MANUAL switch—provides manual control of the air mass flow from port pair of engines
INC.—DEC.

13 CABIN TEMP. CONTROL switch—has four positions:—
Central off position
AUTO—places the temperature control valve under automatic control
MANUAL HOT—spring-loaded to off—moves the temperature control valve to the hot position
MANUAL COLD—spring-loaded to off—moves the temperature control valve to the cold position

EMERGENCY DECOMPRESS AND ABANDON AIRCRAFT switches—have two positions:—
Forward—switches supply PRESSURE SELECTOR switch
Rearward—switches energise decompression valves and the decompression and abandon aircraft warning lamps, respectively

CREW'S DECOMPRESSION HANDLE—provides for manual operation of decompression valves

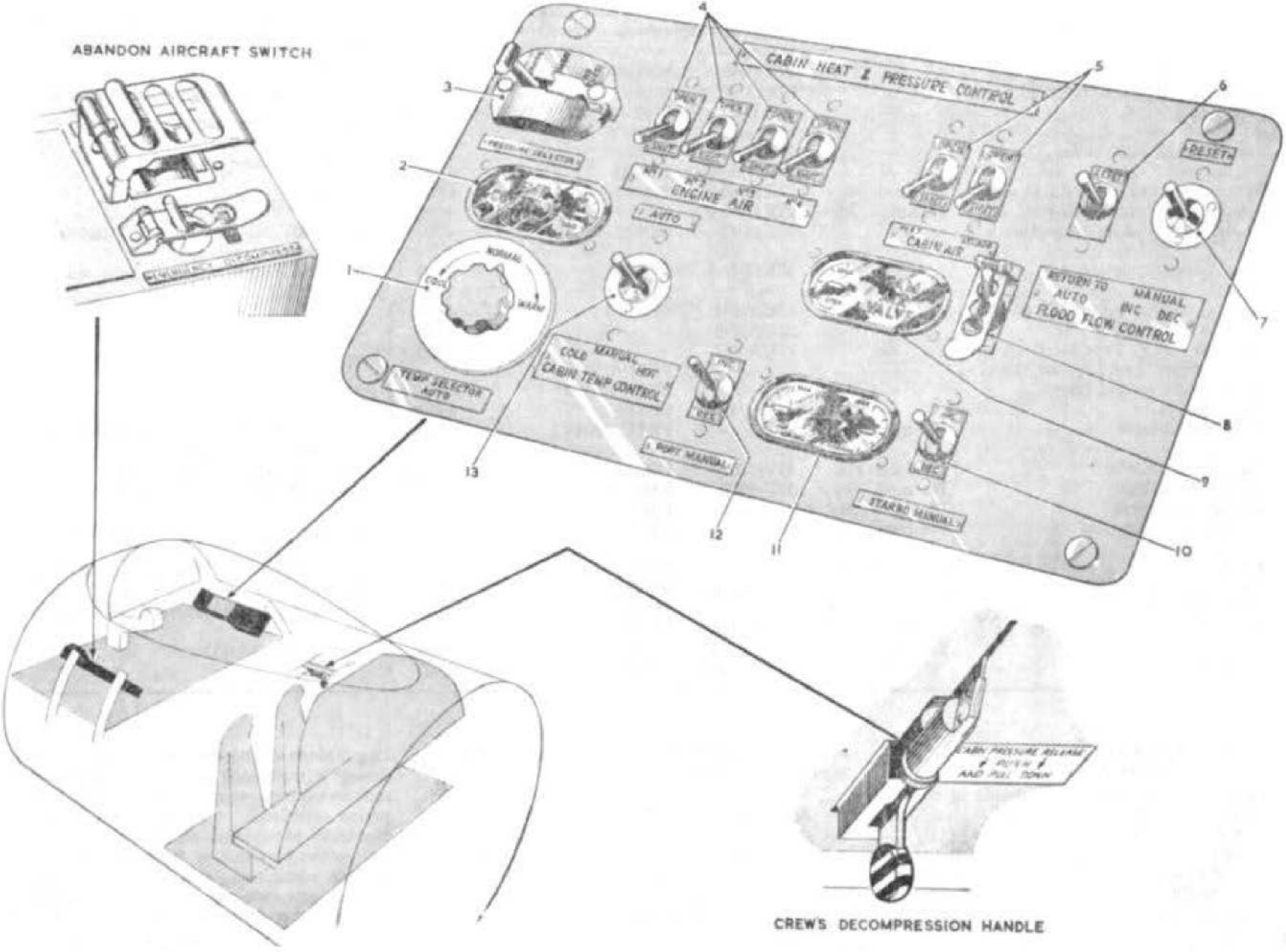

Fig. 1. Controls—air conditioning system

Table 1

Component	Modification	Ref. No.	Part No.	No. off	A.P. Ref.	Location
Pressure controller (motorised), Type B	—	27KD/620	510740	1	1275A	Pressure cabin, starboard side, under pilots' floor
Pressure controller, Type B	—	27KD/592	510350	1	1275A	
Combined valve unit, Type 20/65	—	27KD/37	503640	1	1275A	Forward side of front pressure bulkhead
Relay valve	—	27KD/625	510540	1	1275A	Pressure cabin, starboard side
Air release valve	—	—	C5748Y. Mk. A	2		
Inward relief valve 6·1 in.	—	27KD/626	509180	1	4340	Forward pressure bulkhead
Pressure relief valve	—	27KD/624	510660	1	4340	
Ground pressure test point 1¼ in.	Pre-mod. 79	27KD/10	504600	1	4340	Rear pressure bulkhead
Ground pressure test point 1 13/16 in.	Post-mod. 79	27KD/623	505570	1	4340	
Ground conditioning connection 5 in.	—	27KD/47	502910	1	4340	Forward end of cabin, in starboard side—external
Radar cooling coupling 2 in.	—	27KD/12	504300	1	4340	Forward end of cabin in port side—external
Water extractor, Type W.E. 60 Mk. 3	—	27UA/481	—	1	4340	Nose-wheel bay
Turbine refrigerating unit	—	27UA/493	—	1	4340	
Air to air cooler, Type D150-4A	—	27UA/487	—	1	4340	
Hot air valve 1½ in. (By-pass valve)	—	—	FKH/A/5040	1		
Temperature control valve	—	—	FKH/A/5050	1		
Duct relief valve	—	27KD/474	505170	1	4340	
Flow control valve	Pre-mod. 176	—	FKH/A/5049	2	4340	In ducting just forward of front spar (port and starboard)
Mass flow controller	Pre-mod. 176	27V/5269	FOA/A/7	2	1275A	Adjacent to flow control valve
Air flow modulator	Pre-mod. 299	27V/5270	FMY/A/1	2	1275A	Adjacent to flow control valve
Air flow modulator	Post-mod. 299	—	FMY/A/2	2		
Venturi (metering duct)	Pre-mod. 176	—	FKW/A/2	2	1275A	In ducting downstream of flow control valve (port and starboard)
Air driers	Pre-mod. 176	—	FOD/A/4 & 5	4		In lines from flow modulator to venturi
Non-return valve 3 in.	Pre-mod. 176	27KD/450	505350	2	4340	Rear bulkhead nose-wheel bay
Non-return valve 3 in.	Post-mod. 193	—	512330	1	4340	Forward side-rear pressure bulkhead
Non-return valve 4·1 in.	Pre-mod. 263	27KD/466	508190	1	4340	Rear pressure bulkhead
Non-return valve 4·25 in.	Post-mod. 263	27KD/483	513600	1	4340	
Emergency ram air valve	—	27KD/475	503400	1	4340	

COCKPIT CONTROLS AND INDICATORS

7. A panel on the starboard console in the pilots' compartment houses most of the controlling switches and indicators for the air conditioning system. An ABANDON AIRCRAFT switch and an emergency decompression switch are fitted on the side panel of the port console. The switches and indicators are illustrated in fig. 1, and the associated key gives a brief description of them. Reference should be made to Sect. 5, Chap. 1 of Book 2 of this publication for details of the electrical functions of the controlling switches.

8. A control lever, mounted in the cabin roof, above the crew's table, provides for manual operation of the cabin pressure release valves to effect decompression of the cabin.

AIR SUPPLY

Ducting

9. Air is tapped from each engine compressor for cabin pressurisation and airframe anti-icing. None of the engines are handed, each having a three-inch diameter isolation cock and non-return valve fitted as part of the engine installation unit, positioned at about 45 degrees to the horizontal through the engine and on the port side in each case. The same tapping connection is used for both cabin air and anti-icing air, the ducting for both systems being common until just forward of the front spar. The ducting from adjacent engines is common downstream of the non-return valves, and runs forward above the

engines close to the bomb bay rib. As the ducting on each side approaches the front spar, it descends so that it passes through the spar just below the engine intakes. Immediately afterwards the duct divides into two branches, one going to the cabin and the other to the wing anti-icing system. The ducting to this point is of 4·5 in. dia. stainless steel.

10. The branches leading to the cabin are of 3 in. dia. stainless steel, in each of which is fitted an airflow controller. Downstream from the controllers, the ducts from port and starboard engine pairs enter the nose-wheel bay, joining at a mixer box and two non-return valves fitted on the rear bulkhead of the bay. A short piece of 4 in. dia. ducting connects the mixer box to the air conditioning apparatus, and a Y-shaped duct connects the two air conditioning unit outlets to a non-return valve on the rear pressure bulkhead of the cabin.

ENGINE ISOLATION COCKS

11. Each engine is provided with an electrically-operated ON-OFF cock, controlled by switches on the starboard console, to admit or isolate the air supplies as required. It should be noted that these cocks also control the supply of air to the anti-icing system (*Sect. 3, Chap. 9, of this Book*).

MASS FLOW CONTROL SYSTEM

General

12. This system consists of an actuator-operated flow control valve, electrically controlled by a pressure-operated capsule assembly known as the mass flow controller, the governing pressures for the latter being taken from tappings from a venturi fitted in the line, downstream of the valve. An additional device, in the form of an air flow modulator is provided to cater for the very wide range of airflows required. Fig. 2 illustrates the system diagrammatically, and it can be seen that pressure from tappings at the inlet and throat positions of the venturi is connected to the air flow modulator, and from there the duct static pressure is fed directly to one side of the mass flow controller, and the venturi throat pressure to the other side by way of a screw-adjusted needle valve. The throat pressure may also be connected with the static pressure by a cam-operated needle valve, which has the effect of partially short-circuiting the flow modulator. The mass flow controller consists basically of a diaphragm subjected to the venturi pressures, and an evacuated capsule which measures the density of the air at the entrance to the venturi. A switch mechanism controlled by the movements of the diaphragm and the capsule opens or closes the flow control valve to maintain a constant weight flow of air.

OPERATION

13. During normal operation, the cam-operated needle valve remains in the fully closed position, preventing any short-circuiting of the tapped pressures. In this condition with a flow of 5 lb. per minute through the venturi, the switch assembly in the mass flow controller is in equilibrium, and there is no electrical supply to either the 'increase flow' or 'decrease flow' sides of the flow control valve actuator.

14. Should the air flow increase, the venturi throat pressure will decrease, causing movement of the diaphragm in the mass flow controller. This movement operates the internal switch assembly to make the 'decrease flow' winding of the control valve circuit, thus reducing the air flow which falls until the diaphragm is restored to its equilibrium position with the centre contact in the 'OFF' position. Similarly, a decrease in flow will move the diaphragm in the opposite direction, operating the switch assembly to connect power with the 'increase flow' winding of the valve actuator

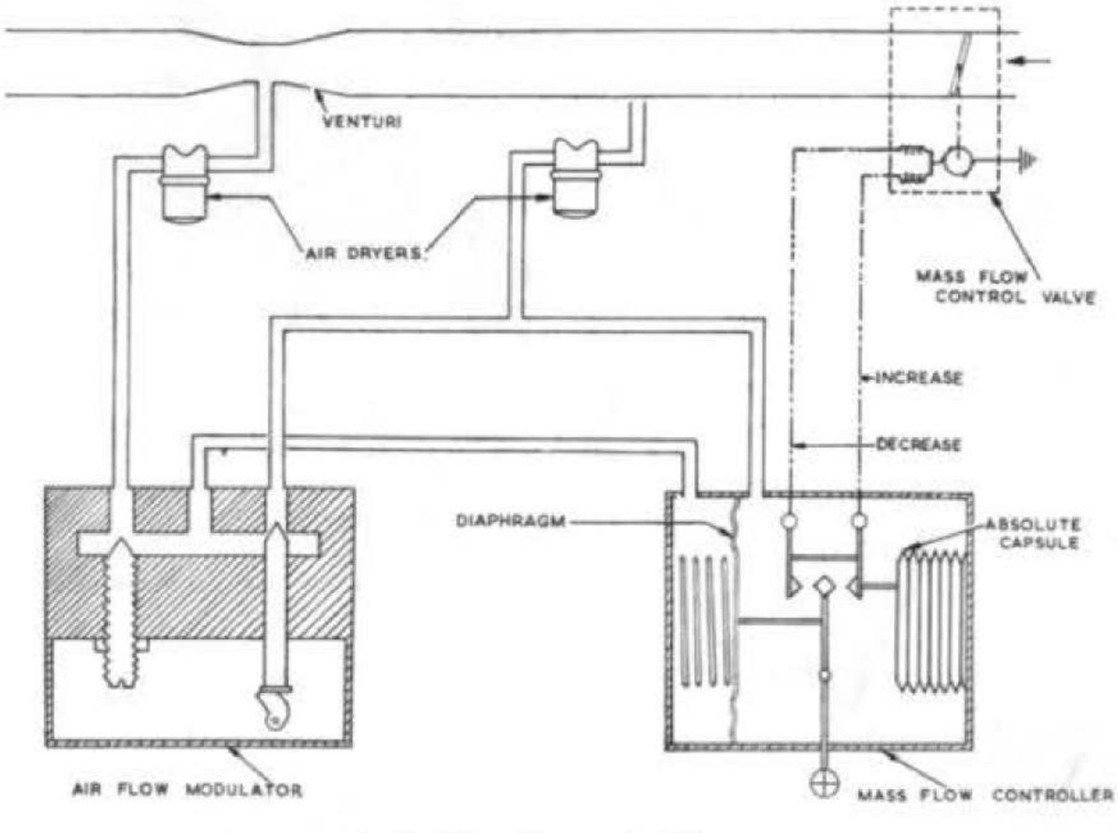

Fig. 2. Mass flow control diagram

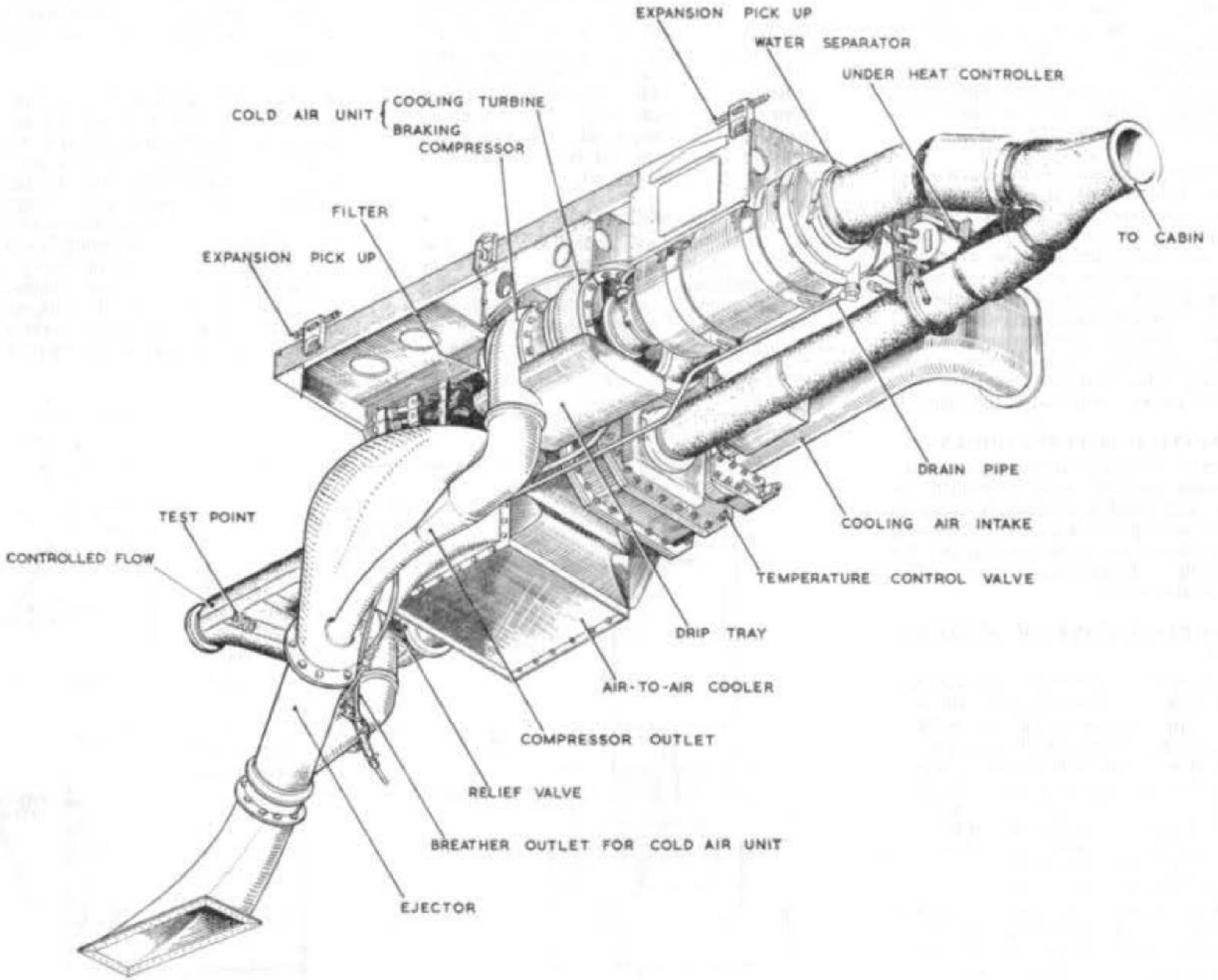

Fig. 3. Air conditioning unit

VULCAN B MK.1 (AND ASSOCIATED ROLE) AIRCRAFT

ADVANCE INFORMATION LEAFLET NO.8/59

Insert this leaflet in A.P.4505A, Vol.1, Book 1, Sect.3, Chap.8, to face para.21.

After Para.21 read as follows:-

The lubrication system for the bearings of the turbine refrigerating unit will not prime with oil until a rotational speed corresponding to an air flow of at least 10 lbs./minute through the turbine has been reached. Conditions under which non-lubrication may occur are, when the unit is started during ground idling, taxying, descent in flight, or at any time when the temperature control valve routes less than 1/5 of the total cabin air flow through the turbine. Once the lubrication system has been primed at high speed the speed of the unit can be reduced to below the critical value and the unit will only need repriming after being stationary for over one hour. To reprime the unit proceed as follows:

With at least one engine on each side of the aircraft at more than 80% of maximum r.p.m., with both ENGINE AIR and CABIN AIR switches OPEN, and with the temperature control in MANUAL move the temperature control valve to COLD. Keep this selection for at least one minute and then select the required position of the temperature control system in either AUTO or MANUAL.

Notes

(1) The information contained in this leaflet will be incorporated by normal amendment list action in due course.

(2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in the leaflet is to take precedence.

ENGINEER

until equilibrium is restored in the mass flow controller.

15. The evacuated capsule measures the pressure, and therefore the density, at the entrance to the venturi. Changes in duct pressure, such as occur when the cabin altitude is varied in flight, either extend or compress the capsule, causing switch contact to be made to increase or decrease the flow, so that the variation in air density caused by the change in duct pressure is compensated.

16. In normal conditions, the airflow to the cabin is 5 lb. per minute from each side of the aircraft, but in cooling or refrigerating conditions this may rise to 27·5 lb. per minute each side. Pressure fed to the mass flow controller in the latter case could cause excessive diaphragm distortion, with a consequent loss of sensitivity; therefore during refrigeration the pressure tappings are 'short-circuited' within the flow modulator to make the pressure difference fed to the controller correspond to that under normal conditions. This is accomplished by movement of a needle valve in the modulator, spring-loaded against an eccentric cam driven by an electric motor; this valve remains fully closed until an electrical signal is received from the temperature controller circuit indicating that the temperature control valve has reached its FULLY COLD position, and that more cabin cooling is required.

17. On later aircraft provision will be made for flood airflows at high aircraft altitudes for cases where the cabin is punctured by a large hole, such as could be caused by enemy action, and the cabin altitude rises to a pre-determined danger level. The flood flow will be designed to deliver sufficient air to keep the cabin at as low an altitude as possible in such conditions.

AIR CONDITIONING

18. The conditioning unit, in the nose-wheel bay, controls the temperature of the air entering the cabin to maintain a reasonable cabin temperature throughout the widely varied conditions encountered in flight. The unit is mounted on the port side of the nose-wheel bay, and is easily removed for servicing or renewal. The principal components of the unit are as follow:—

(1) An air-to-air cooler

(2) A 4 in. dia. cooler by-pass duct

(3) Temperature control valve

(4) Refrigerator unit, consisting of an expanding turbine driving a brake in the form of a compressor

(5) Water separator, fitted just downstream of the turbine.

(6) A 4 in. dia. cold air unit by-pass duct.

A small ram air intake, on the port side between the fuselage wall and the engine intake boundary layer fence, feeds cooling air to the air-to-air cooler and ram air valve. The cooler exhaust duct terminates in a rearward-facing slot under the conditioning unit. For information concerning electrical control of the conditioning system, reference should be made to Sect. 5, Chap. 1 of Book 2 of this publication.

TEMPERATURE CONTROL VALVE

19. This component of the air conditioning system is a four-way actuator-operated hot air valve, which responds to temperature-sensitive elements in the cabin, and governs the path of air through the conditioning equipment. Operation may be automatic in conjunction with a selector on the starboard console, or the valve may be controlled manually by a temperature control switch. When full heat is required, the hot air from the engine passes directly through the air conditioning unit to the cabin, by-passing the cooler and refrigerator units. If cooling is then required and the valve moved towards the 'NORMAL' position, an increasing proportion of the air is routed by the valve through the air-to-air cooler until the whole flow is passing through the cooler and by-passing the refrigerator. If valve movement is continued towards the 'COOL' position, an increasing proportion of the air is directed through the turbine refrigerating unit until the whole flow is passing through the cooler and also through the refrigerating unit. Any further cooling required is attained by an increase in mass flow, the temperature control valve being retained in the 'COOL' position.

TURBINE REFRIGERATING UNIT

20. This unit consists of a small inward flow turbine directly coupled to a small centrifugal braking compressor. The turbine inlet is connected by way of the temperature control valve to the cooler outlet; the turbine outlet discharges into the ducting to a water separator. Air is taken into the centrifugal compressor, which functions as a brake in absorbing the turbine energy, through a No. 8, 24 s.w.g. brass wire filter and is discharged from it into the ejector. The ejection of compressed air from the outlet side of the compressor into the air-to-air cooler exhaust tends to increase the cooling air flow through the cooler, thereby increasing the reduction of temperature in the cooler.

21. Under refrigerating conditions, when the mass flow is high, the turbine may overspeed. The speed of the turbine is related to the pressure ratio across it, this ratio being applied to a pressure ratio switch. Should the rotor speed and therefore the pressure ratio become too great, the switch operates an electrical circuit to move the mass flow control valves towards the low flow position. When the pressure ratio has decreased, the mass flow controllers are returned to normal. At ground level, protection against overspeeding of the turbine is afforded by a duct relief valve, which blows off at 55 p.s.i., keeping the pressure ratio within reasonable limits.

UNDERHEAT BY-PASS VALVE

22. Under refrigerating conditions the temperature of the air efflux from the cold air unit could fall below freezing point. This would mean that moisture in the air would be present in the form of frozen particles, which would be difficult to isolate and could cause difficulty with blockages. A small hot air valve, controlled by a temperature sensitive element set at 2 deg. C. operates when the air leaving the turbine is below this temperature, and allows sufficient hot air to by-pass the turbine and mix with the fully cold air before passing through the water separator to keep the air above freezing point.

OVERHEAT SWITCH

23. An overheat switch is coupled into the temperature control system to prevent overheating. Should the air temperature rise to 175 deg. C. the switch operates automatically

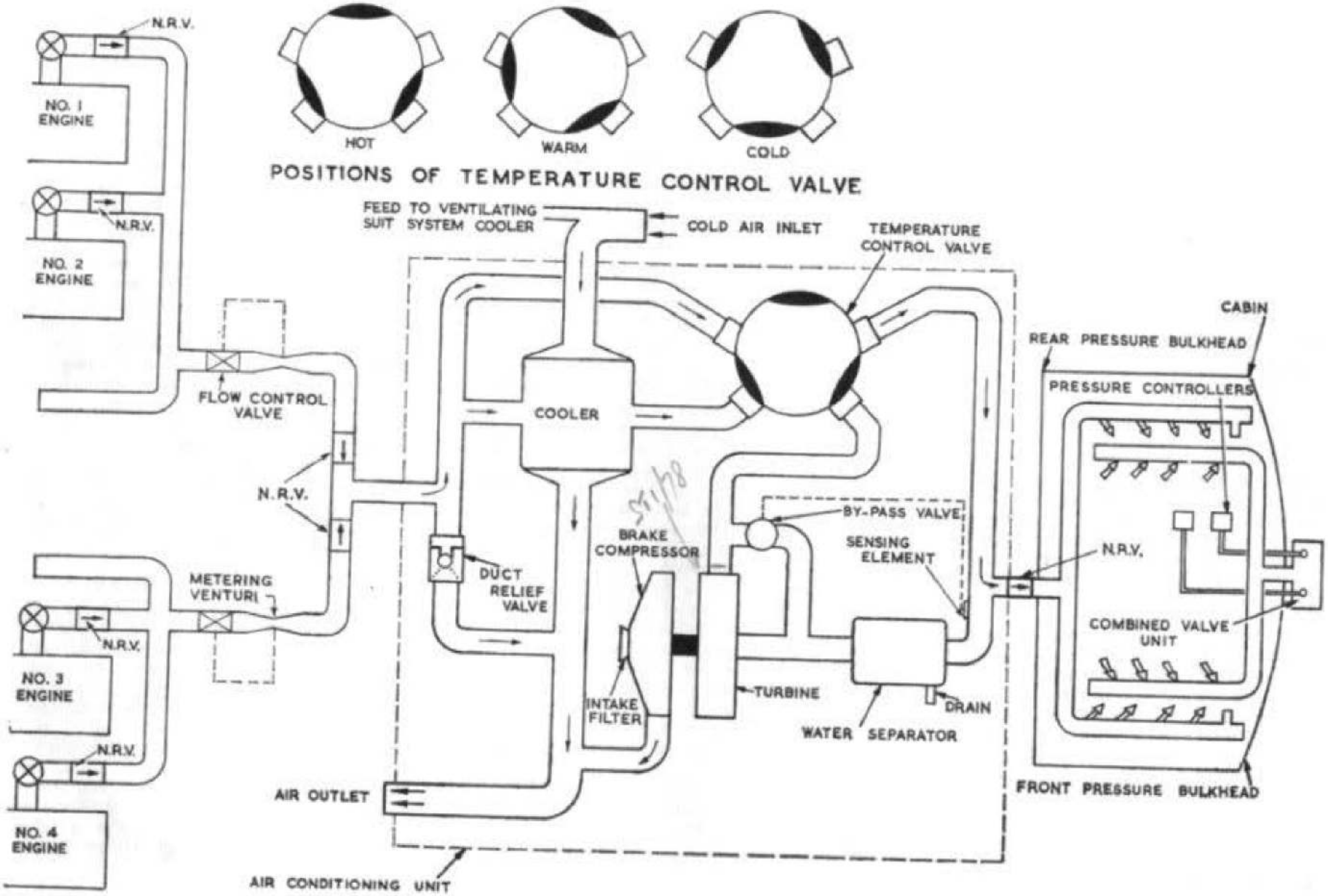

Fig. 4. Air conditioning system diagram

to move the temperature control valve towards the cool position. When the temperature has fallen to 165 deg. C. the switch returns to normal. The action of the switch overrides any control action that may be taking place at the time.

WATER SEPARATOR

24. When the aircraft is operating in a warm, humid atmosphere, the temperature control valve will be at the cold position in response to the call for cooling from the cabin temperature sensing system. The air from the cold air unit will be cooled below the dew point, and water vapour in the air will condense into droplets which, if permitted to enter the cabin, would cause misting and fogging troubles and add to crew discomfort. A small drain pipe drains the water overboard through a cooler exhaust duct.

OPERATION

25. Provision is made for both automatic and manual control of the air conditioning. When the cabin temperature control switch is moved to the AUTO position, the temperature control valve functions automatically to maintain the cabin temperature according to the selection made on the temperature selector. When manual control is used, the temperature control valve may be set to any position by use of the temperature control switch, reference being made to the temperature control valve position indicator. Reference should be made to Sect. 5, Chap. 1 of Book 2 of this publication for details of the electrical operations involved.

CABIN PRESSURE SYSTEM

DUCTING

26. After entering the cabin through a 4·1 in. (pre-mod. 263) or 4·25 in. (post-mod. 263) non-return valve, the air supply ducting divides and runs forward under the crew's floor each side of the main entrance door. Small stub pipes feed air into wall ducts formed by the spaces between the trimming panels and the fibreglass sheet between adjacent formers. Louvres at floor level allow air in to the cabin, and small branch pipes feed air to the bomb aimer's pannier and window. The feed ducts are joined together at the forward end by a nozzle gallery pipe which directs air on to the air bomber's window to prevent misting.

27. Two extractor ducts run forward, adjacent to the feed ducts, short stub pipes connecting them to wall ducts similar to, and interposed between, the wall feed ducts. The used air in the cabin is collected through louvres and the fuselage former ducts, and led to a common discharge point on the front pressure bulkhead. It is there passed through a combined valve unit, and then blown over radar equipment for conditioning purposes; finally the air passes overboard through outlet grilles on the under surface of the aircraft nose.

DISCHARGE VALVES

28. A combined valve unit, Type 20/65, containing two bellows-operated discharge valves, is mounted on the forward face of the front pressure bulkhead, its function being to regulate cabin pressure by offering restriction to the discharge of air from the cabin. Each valve is controlled by a pressure controller, and controlling pressures supplied by the capsule chambers of the latter regulate the pressure in the discharge valve bellows. In the case of the motorised controller (*para.* 31), this is done by way of a relay valve, which operates the discharge valve bellows rapidly enough to prevent lag when there is any surge or sudden fluctuation in cabin pressure. The consequent restriction imposed by the bellows on the discharged air determines the cabin pressure. The discharge valve unit is enclosed by a shroud, and a duct feeds the discharge air into the nose section to provide cooling for the radar equipment.

PRESSURE CONTROLLERS

29. Two Type-B pressure controllers, each controlling one discharge valve, are mounted in the pressurised compartment, their function being to maintain a cabin pressure greater than atmospheric at aircraft altitudes over 8,000 ft. The motorised controller is set to control up to a maximum differential pressure of 8·9 p.s.i., and the unmotorised controller to 9·36 p.s.i. The reason for this difference is to ensure that there will be no interference between the two controllers. If both had the same setting they would attempt to control to the same pressure at the same time, and since only the motorised controllers is in series with a relay valve the insensitivity of the system to flow variation would be lost. The motorised controller should be in full control at all times, except in emergency and in case of failure of the controller. If such a failure occurs, the unmotorised unit will take over control at the slightly higher pressure given by its setting.

30. Each controller consists basically of two pressure-sensitive capsules operating a needle control valve by way of a simple beam mechanism, the interior of the capsule chamber being open to cabin air through a small fixed orifice. One capsule is evacuated and sealed and so is sensitive to changes in absolute pressure, while the other, its interior being connected with static ambient pressure, responds to changes in differential pressure. The pressure in the capsule chamber is regulated by the setting of the control valve, which is piped to atmosphere, in relation to the fixed orifice. Since the capsule chamber is connected to the discharge valve bellows, the action of the capsules and the setting of the control valve govern the restriction offered by the discharge bellows to the passage of air from the cabin.

31. At take-off, the differential capsule is at its nominal length and the absolute capsule is compressed to a minimum, consequently the beam mechanism opens the valve to such an extent that pressure cannot build up in the discharge valve and little resistance is offered to the flow of air from the cabin. The cabin pressure, therefore, is for all practical purposes the same as atmospheric pressure. As the aircraft climbs, the absolute capsule expands, causing the control valve to close progressively. At 8,000 ft. the valve has closed to such an extent that enough pressure can build up in the capsule chamber and the discharge valves for the latter to begin to restrict the flow from the cabin. This restriction causes the cabin pressure, and therefore the differential pressure, to increase. As the aircraft continues to climb, the cabin altitude is maintained at 8,000 ft. and the differential pressure increases progressively, causing continued expansion of the absolute capsule and contraction of the differential capsule, until at approximately 46,000 ft.

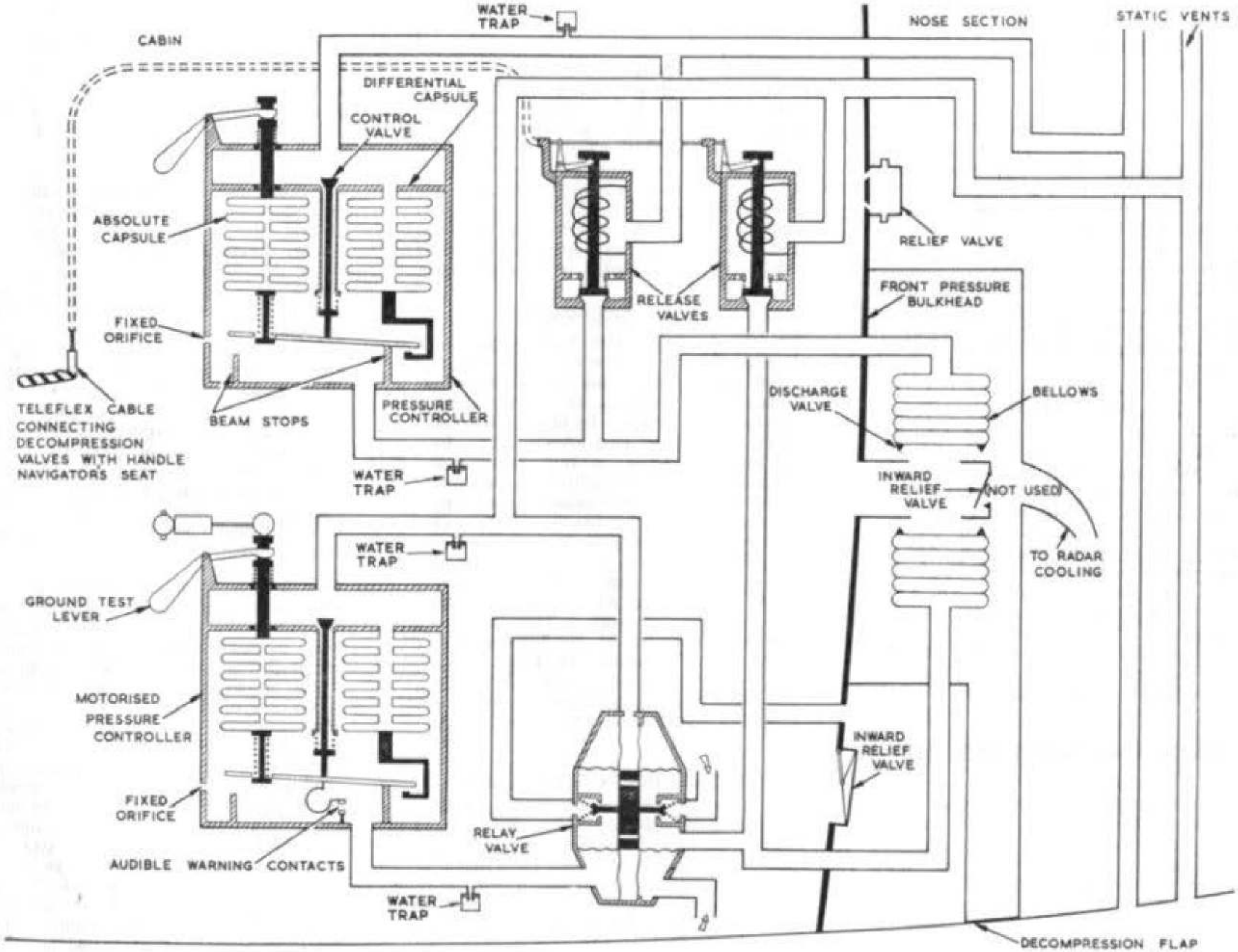

Fig. 5. Cabin pressure control diagram

the differential pressure becomes 9 p.s.i. At this altitude the absolute capsule becomes non-effective as that end of the beam comes against its stop. The differential capsule, the compressive movement of which so far has not affected the control valve but merely taken up the gap between its end fitting and the beam, now takes over, and any tendency for the 9 p.s.i. differential to be increased is offset by further contraction of the differential capsule to cause the opening of the control valve to increase. The 9 p.s.i. differential is maintained throughout any further aircraft climb.

CABIN ALTITUDE SELECTION

32. In one of the pressure controllers the absolute capsule can be reset by a cam and rocker gear operated by a small electric motor through a two-speed gearbox. If the pressure selector switch is placed to the COMBAT position, the cam is rotated and resets the absolute capsule so that pressurisation does not commence until the aircraft reaches an altitude of 25,000 ft., and a maximum differential of 3½ p.s.i. is attained at 50,000 ft. In this condition the cabin pressure is governed by the discharge valve under the control of the motorised controller, whilst the other discharge valve remains closed. If COMBAT is selected from the CRUISE position, the cam resets the absolute capsule at a rate of 12 p.s.i. per minute; if CRUISE is selected from COMBAT, the capsule is reset at 1 p.s.i. per minute. The differential rate of resetting is accomplished by the two-speed gearbox, which transfers the drive from the motor to the camshaft at differing ratios according to the direction of rotation.

SAFETY PRECAUTIONS

33. The motorised pressure controller incorporates a contact mechanism which operates an audible warning device in the cabin in the event of a serious loss of cabin pressure. A manually-operated override switch, located under the crew's floor, is provided so that the warning horn automatic switch can be cut out during ground servicing operations.

34. An inwards relief valve is mounted on the front pressure bulkhead, to limit to a safe value any negative differential pressure which may arise. Normally the air supplied to the cabin is sufficient to prevent any reversal of pressure, but in certain circumstances such as very rapid descent following engine failure or cabin supply failure, the external pressure could exceed cabin pressure. In such a case the inwards relief valve opens to allow air to enter the cabin, and as soon as cabin and atmospheric pressures are approximately the same the valve closes.

35. A relief valve Type-D, is fitted to the front pressure bulkhead to prevent excessive pressures in the cabin. In the event of failure of pressure controllers or associated equipment, it is possible that the differential pressure may exceed the maximum value permitted. As soon as the differential pressure reaches 9·75 p.s.i., the relief valve opens to allow air to escape to atmosphere.

Note . . .

It is not permitted to raise cabin pressure to 9·75 p.s.i. for the purpose of testing this valve; it should be removed from the aircraft for servicing and the setting of correct blow-off pressure.

DECOMPRESSION

36. Air release valves, which may be operated either electrically or manually, are connected in the pressure lines between controllers and discharge valves. Operation of these release valves allows the pipe pressure to be connected directly to static atmosphere, thus effectively breaking the connection between controller and combined valve unit. This means that the discharge valve bellows will collapse, allowing the maximum area for outlet flow of air from the cabin; i.e., rapidly depressurising the cabin. The airflow from the cabin during this decompression does not flow through the normal collection ducting, but passes directly into the combined valve unit through a lightly loaded spring flap at the junction of the port and starboard collection ducts; this ensures that the required rate of decompression is achieved, and avoids very high pressure drops in the ducting. Electrical operation of the release valves is obtained by moving either pilot's pressure control switches to NO PRESSURE or by initial movement of the door opening lever. A mechanical means of operating the valves is provided by a teleflex linkage, attached to a lever above the crew's table within easy reach of the three rear crew members.

SERVICING

General

37. Servicing of the air conditioning system consists of making the routine checks at the periods stipulated in the relevant Servicing Schedule. Where details of these checks are required, they are given in the following paragraphs.

COMPONENT CHECKS

38. Static checks with engines stopped can be performed to test the functioning of certain components which have both switches and indicators on the control panel. These are:—

(1) Emergency ram air valve—check by reference to the indicator that the valve opens and closes correctly

(2) Flow modulators—airflow indicators should follow increase/decrease switches

(3) Temperature control valve—indicator should follow hot/cold switch selection

(4) Temperature selector—temperature contol valve indicator should follow hot/cold selection of temperature selector when selection switch is at AUTO

(5) Inward relief valve—on front bulkhead; check manually for freedom of operation.

39. With at least one engine at each side running, functioning of most components can be checked by their effect on the air delivery to the cabin. Checks are as follow:—

(1) Flow modulators—by noting indication of change of flow with manual selection

(2) Cold air unit—by noting slight vibration of the unit, or by low cabin inlet temperature

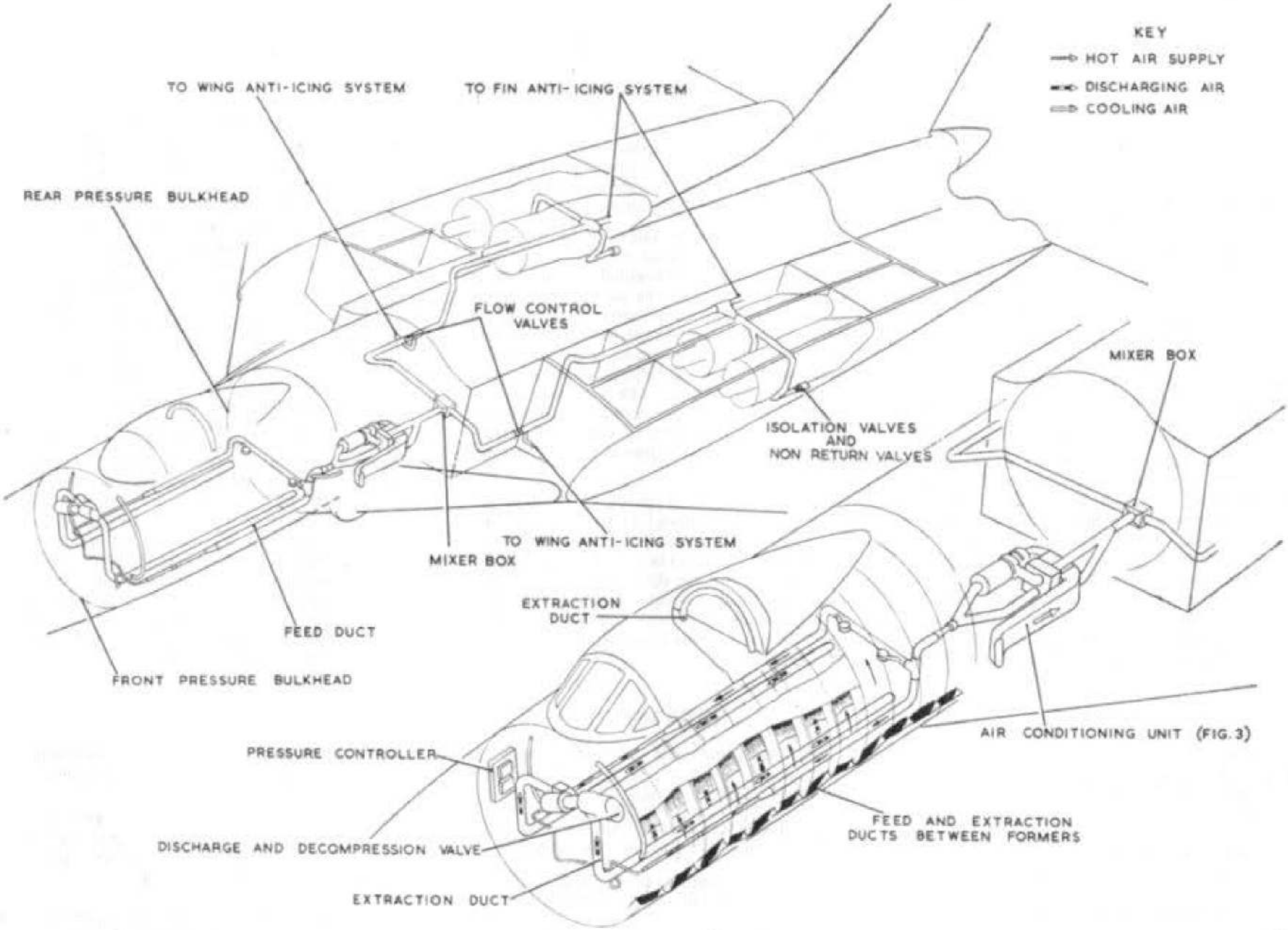

Fig. 6. Air conditioning system installation

(3) Pressure controllers (4) Combined valve unit	by use of ground test levers to inflate to maximum differential

(5) Air release valves—with NO PRESSURE selected no pressure can build up.

40. Regular changing of the silica gel crystals (Ref. No. 33C/1454) of the air driers in the instrument lines of each mass flow control system is also required, access to these being through a door in the underside of each engine air intake, just forward of the front spar. When air driers have been broken down for any reason, great care must be taken on reassembly, and the driers should be pressure tested independently (approximately 10-12 p.s.i.) before installation to ensure they do not leak. Leaking air driers will cause lack of control by the mass flow control system in which they are installed.

PRESSURE AND LEAKAGE TESTS

41. The following paragraphs describe the various tests which may be required when it is suspected that the system is not functioning properly or that air leaks are occurring. The tests should also be effected at the servicing periods stipulated in the Servicing Schedule applicable to this aircraft.

PRECAUTIONS

42. The following general precautions must be observed when routine pressure tests are being made:—

(1) All personnel engaged inside the aircraft during pressure tests must be approved by the Medical Officer as being physically fit for the work (A.P. 1464D, Vol. 2, Part 1, Leaflet No. 36 refers).

(2) The correct ground test rig (Ref. No. 4F/2013) must be used and must be operated only by authorised personnel. A compressed air line must not be used and the relief valve on the test rig must never be set above 10 p.s.i.

(3) When personnel occupy the fuselage during pressure and leakage tests, a system of communication must be arranged with personnel outside the fuselage.

(4) When personnel occupy the fuselage during tests, rates of change of pressure should be kept at a level not exceeding the equivalent of 1,000 ft. per minute.

(5) All pressures inside the fuselage should be measured with an accurate boost gauge or manometer. The boost gauge should be calibrated to read pressures in excess of that used for the test, so that it can be accurately checked that the cabin pressure stabilises at the correct level.

(6) It is recommended that during pressure tests the aircraft should be moved away from other aircraft and personnel not actively engaged in the tests.

CABIN PRESSURE TESTS WITH ENGINES RUNNING

43. (1) Blank off at the forward pressure bulkhead:—

(*a*) the vent to the N.B.S. pressure controller

(*b*) the relief pipe line from the cabin to the H2S scanner regulator

(*c*) ensure that the static line is connected to the calculator type 3 in the N.B.S. Mk. 1.

(2) An accurate boost gauge and a rate-of-climb indicator should be taken into the cabin and the initial pressure on the boost gauge noted.

(3) Check that the engines are at ground idling r.p.m.

Note . . .

It is advisable to have the 112-v. ground supply plugged in to maintain electrical supplies.

(4) Move the ground test levers of both pressure controllers to the ground test position.

(5) Shut the ram air valve and lock the switch with the locking guard.

(6) Check that the canopy is locked, the main entrance door is closed and locked, pressure seals are inflated and the clear vision windows are closed and secured. Check also that the signal pistol is in position and locked, and that the front pressure bulkhead door is secure.

(7) Check that all anti-icing and bomb bay heating switches are OFF.

(8) Disconnect the unmotorised pressure controller from the combined valve unit. The pipe should be disconnected at a convenient position *within* the pressure cabin and *not* blanked off.

(9) Switch all ENGINE AIR switches to OPEN. During the test these should be tested individually to see if there is still a flow into the cabin.

(10) Switch the CABIN AIR switches to OPEN. Check that an increase in cabin pressure is still maintained when either switch is placed to OFF.

(11) Adjust engine r.p.m. to increase cabin pressure at a comfortable rate not exceeding 1,000 ft. per minute.

(12) Check that the cabin pressure stabilises at 8·46 to 8·9 p.s.i. after making allowances for the initial reading on the boost gauge.

(13) Switch the CABIN AIR and ENGINE AIR to SHUT and reduce engine r.p.m. to GROUND IDLING.

(14) Make a leakage test if required (*para.* 47).

(15) When the cabin pressure has fallen to atmospheric pressure, reconnect the controller disconnected at (8).

(16) Disconnect the piping to the second controller as in (8).

(17) Repeat items (11), (12) and (13). The

cabin pressure this time should stabilise at 8·82 to 9·36 p.s.i. due to the higher setting of the unmotorised controller.

(18) When the cabin pressure has fallen to atmospherical pressure, inch the ram air fully OPEN.

(19) Reconnect the disconnected controller and reset the ground test levers on both controllers to the flight position.

(20) Reconnect at the forward pressure bulkhead the vent to the N.B.S. controller and the relief pipe line from the cabin to the H2S scanner regulator.

During one of the pressure tests already described, while the pressure is at 9 p.s.i. and the engines are running, functioning of the flow modulators and the cold air unit may be checked by selection of various temperatures on the temperature selector and also by means of manual selection of airflow.

Note . . .

When Mod. 193 is embodied, a 3-inch dia. non-return valve (Part No. 512330) is fitted on the cabin side of the ram air valve, on the rear pressure bulkhead. Fitment of this modification permits the use of the ram air valve to depressurise the cabin after ground pressure tests, so that a rate of cabin pressure reduction higher than that obtainable by natural leakage may be employed. The non-return valve is so designed that the resulting leakage rate, when the cabin is pressurised and the ram air valve is opened fully, gives a safe rate of pressure reduction.

CABIN PRESSURE TEST USING THE GROUND TEST RIG

44. For this test one of the ground testing trolleys listed in Table 1, Sect. 2, Chap. 4, should be used.

(1) Blank off at the forward pressure bulkhead:—

(*a*) the vent to the N.B.S. controller

(*b*) the relief pipe line from the cabin to the H2S scanner regulator.

(*c*) ensure that the static line is connected to the calculator type 3 in the N.B.S. Mk. 1.

(2) Connect the testing trolley to the 1¼ in. (pre-mod. 79) or 1 13/16 in. (post-mod. 79) test connection on the rear pressure bulkhead.

(3) Connect a manometer to the adapter adjacent to the test connection.

(4) Check that the ram air valve is shut.

(5) Operate the ground test levers of both pressure controllers to the ground test position.

(6) Disconnect the unmotorised controller from the combined valve unit. The pipe should be disconnected at a convenient point *within* the pressure cabin and *not* blanked off.

(7) Check that the canopy is locked, the clear vision windows are closed and secured, the signal pistol is in position and locked and the front pressure bulkhead door is secured. Ensure that all personnel leave the cabin and close and secure the main entrance door.

Check the indicator on the starboard side of the nose-wheel bay, aft of the front pressure bulkhead, to ensure that the door is closed and locked.

Note . . .

The decompression switch on this panel is NOT *to be used to decompress the cabin during cabin pressure tests.*

(8) *Check that the relief valve on the testing trolley is set to* 10 *p.s.i.*

(9) Start the testing trolley and set the controls to pressurise the cabin.

(10) Check that the cabin pressure stabilises at 8·46 to 8·9 p.s.i.

(11) Shut off the testing trolley.

(12) Make a leakage test if required (*para.* 47).

(13) When the cabin pressure has fallen to atmospheric pressure, enter the aircraft and reconnect the unmotorised pressure controller disconnected at (6).

(14) Disconnect the piping to the second controller as in (6).

(15) Repeat items (7) to (11). This time the cabin pressure should stabilise at 8·82 to 9·36 p.s.i. due to the higher setting of the unmotorised controller.

(16) When the cabin pressure has fallen to atmospheric pressure, open the entrance door, and remove the ground testing trolley and the boost gauge or manometer.

(17) Reset the ground test levers on the pressure controllers to the flight position and switch the ram air valve to OPEN.

(18) Reconnect at the forward pressure bulkhead the vent to the N.B.S. controller and the relief pipe line from the cabin to the H2S scanner regulator.

LEAK TEST OF COMPLETE CONTROLLER INSTALLATION

45. Following a cabin pressure test, or whenever a component of the controller installation has been disconnected or replaced, the following leak test should be carried out:—

(1) Remove the filters from the cabin air inlet connections on the front face of each pressure controller.

(2) Interconnect the two relay valve cabin air inlet connections with a piece of rubber tubing.

(3) Blank off the static or low pressure connection from the relay valve at the vent located on the forward pressure bulkhead.

(4) Disconnect and blank off the static pipelines to the ambient altitude switch.

(5) Open the release valves manually or electrically.

(6) Ensure the ground test levers are in the down or normal position.

(7) Connect a source of clean, low pressure air to the cabin air inlet connection on the front face of the motorised controller, i.e., the ⅜ B.S.P. union revealed when the filter nut is removed.

Note . . .

Ensure that the air supply can be carefully controlled, and has provision for a pressure gauge between a stop cock and the connecting union. The stop cock should be as close to the controller inlet as possible.

(8) Blank off the cabin air inlet connection on the non-motorised controller.

(9) Apply air pressure slowly to 8 p.s.i., allow time for the pressure to stabilize and then close the supply stop cock.

(10) Check the pressure drop over a period of two minutes. The pressure should not fall below 7 p.s.i.

(11) Remove the blanks from the static vent of the motorised controller and ensure that the pressure falls rapidly to zero. Replace the blanks.

(12) Apply air pressure slowly once again to 8 p.s.i., allow time for the pressure to stabilize, and then close the supply stop cock.

(13) Remove the blanks from the static vents of the non-motorised controller and ensure the pressure falls rapidly to zero.

(14) Remove all test equipment and blanks and reset the air release valves.

PROVING PRESSURE TEST OF CABIN

46. A proving pressure test, involving the pressurising of the cabin to 1·33 times normal operating pressure, i.e., 12 p.s.i., will only be required when major repairs to the primary structure of the cabin have been effected. It is emphasised that this is not a routine test but, owing to the comparatively high pressure used, is only to be done when considered necessary to prove the strength of repairs. In addition to the general precautions detailed in para. 42, the following special precautions must be observed:—

As the pressure involved considerably exceeds normal operating pressure, a proving test should be made out in the open.

Shelters should be provided for the observers at a safe distance from the aircraft and the approach to the test area should be policed to prevent anyone approaching the vicinity of the cabin under test. Whenever it is necessary for observers to approach the cabin, the pressure should be first reduced to 9 p.s.i.

The procedure for the test is as follows:—

(1) Blank off at the forward pressure bulkhead:—

(*a*) the vent to the N.B.S. pressure controller

(*b*) the relief pipe line from the cabin to the H2S scanner regulator.

(*c*) ensure that the static line is connected to the calculator type 3 in the N.B.S. Mk. 1.

(2) Disconnect the pipes between the discharge valves and the pressure controllers. These pipes should be disconnected at a convenient point *within* the pressure cabin and left loose. They should not be blanked in any way.

(3) Remove the pressure relief valve (Part No. 510660) from the front pressure bulkhead and fit the blanking plate (Part No. D10232) from the flight tool kit.

(4) Ensure that all personnel leave the aircraft. Close ram air valve and lock the switch, the door and the canopy, and connect the inflatable seals to any convenient charging point so that they can be inflated from outside the aircraft by a foot pump. Ensure that the wheel brakes have been left ON.

(5) Connect a manometer and rate-of-climb indicator to the connection on the rear pressure bulkhead.

(6) Connect the testing trolley (*Table* 1, *Sect.* 2, *Chap.* 4) to the ground test point on the rear cabin bulkhead.

(7) Check that the relief valve on the testing trolley is set to 12 p.s.i.

(8) Inflate the cabin to 12 p.s.i. as read on the manometer and hold for 60 seconds.

(9) It is convenient, at this point, to hold a leakage test; this can be done while pressure in the cabin is falling naturally (*para.* 47).

(10) After checking the leakage rate, discontinue the test, remove the test equipment and reconnect the discharge valve pipes.

(11) Remove the blanking plate (Part No. D10232) and refit the pressure relief valve on the front pressure bulkhead.

LEAKAGE TEST

47. The leakage allowance is based on a total leakage flow of 1·5 lb./min. at altitude when the cabin differential pressure is 9 p.s.i. The time intervals for pressure to fall from each pressure to the next must not be less than the figures quoted at the end of this paragraph. Each interval must be cleared separately and total times must not be considered. The first time interval from 9 to 8 p.s.i. will not be achieved when testing from the motorised pressure controller setting, which is less than 9 p.s.i. and the next interval should then be considered as the first.

When leakage testing the cabin, inflation should be by means of the 1½-in. or 1 11/16 in. test connection on the rear bulkhead, and the manometer should be connected to the adjacent ground test connection on this bulkhead.

Note . . .

The 4·1 in. or 4·25 in. non-return valve should not be locked 'closed' for a cabin leak rate check; it is to function as a non-return valve. A check should be made to ensure that the static vents for the pressure controllers are not blanked off.

CABIN PRESSURE p.s.i. gauge	TIME min. sec.
9 — 8	1 26
8 — 7	1 35
7 — 6	1 48
6 — 5	2 5
5 — 4	2 29
4 — 3	3 2
3 — 2	3 51
2 — 1	5 7

DUCT PRESSURE AND LEAKAGE TESTS

48. The ducting is divided into two sections, one working at higher pressures than the other. The high pressure section extends from the engine isolation valves to the mass flow control valves, and is in two separate portions, one each side of the aircraft. The low pressure section extends from the mass flow control valve on either side of the aircraft to the rear cabin bulkhead.

49. During leakage testing it should be noted where possible, whether duct joints or the various valves and other items of equipment are leaking. Duct joints should not leak noticeably. Leakages from the cold air unit, cooler or temperature control valve are more serious than leakage from the water separator since this item is tested to a pressure far in excess of its normal working pressure. If a high pressure air supply is employed for the tests, it is necessary to use suitable reducing valves to ensure that the correct test pressures are not exceeded. It is also advisable to check the output pressure from the supply unit before connecting to the test connections in the ducting.

50. In cases where high pressure ducting is tested whilst disconnected from the power unit and blanked off, that portion of the ducting which is normally connected to the engine must be firmly supported to prevent movement when pressure is applied. When repairs or renewals are made in the ducting, the complete section of duct in which the repair or renewal has been made must be tested.

HIGH PRESSURE DUCTING TESTS

51. (1) The mass flow control valves, anti-icing hot air valves for wing and fin, and the bomb bay heating hot air valve should be CLOSED.

(2) Close all engine isolation cocks.

(3) Connect the supply unit with pressure gauge to the ⅜ in. bore pressure test point adjacent to the duct run in the wing anti-icing branch.

(4) Raise the duct pressure to 190 p.s.i. and hold for 60 seconds.

(5) The leakage test can be done at this stage as pressure is falling in the ducts. The time for the pressure to fall from 90 to 60 p.s.i. gauge should not be less than two minutes.

LOW PRESSURE DUCTING TESTS

52. This is best done in two stages; the first, for the nose-wheel bay installation from the 3 in. non-return valves to the cabin, being as follows:—

(1) Lock the 4·1 in. non-return valve adjacent to the rear cabin bulkhead in the closed position, with the lever provided.

(2) Ensure that both 3 in. non-return valves at the junction of the port and starboard supply systems are closed.

(3) Disconnect the water drain pipe on the water separator and blank off the tapping.

(4) Disconnect the oil vent pipe from the cold air unit and blank off the tapping.

(5) Connect the ground supply unit and gauge to the ¼ in. B.S.P. pressure test point between the 3 in. non-return valves and the cooler.

(6) Raise the duct pressure to 50 p.s.i. gauge, and hold for 60 seconds.

(7) Raise the pressure further and check that the duct relief valve cracks at 55-56 p.s.i.

(8) The leakage test can be done at this stage as pressure is falling in the ducts. The times for the pressure to fall from 40 to 25 p.s.i. gauge should not be less than 32 seconds.

53. The following is the procedure for the complete low pressure ducting tested in conjunction with all the high pressure ducting:—

(1) Ensure that the mass flow control valves are OPEN.

(2) Ensure that the wing and fin anti-icing and bomb bay heating hot air valves and also the engine isolation cocks, are CLOSED.

(3) Crack open the 3 in. non-return valves with the test levers provided, and check that the 4·1 in. non-return valve is CLOSED.

(4) Raise the duct pressure to 50 p.s.i. gauge and hold for 60 seconds.

(5) The leakage test may now be done as pressure is falling in the ducts. The time taken for the pressure to fall from 40 to 25 p.s.i. gauge should not be less than 1 min. 30 seconds.

(6) Unlock the 4·1 in. non-return valve to ensure that it is not left in the locked position for flight.

REMOVAL AND ASSEMBLY

AIR CONDITIONING UNIT (*fig.* 7)

54. The air conditioning equipment in the nose-wheel bay can be removed, when required, as a complete unit together with the crate to which it is fitted. Two special hoists are required for the removal operation, each comprising the following items:—

Winch, aircraft heavy components	Ref. No. 4GC/5425
Handle winch, 9 in. ...	Ref. No. 4GC/5426
Extension tube, 84 in.	Ref. No. 4GC/5452
Top sheath (type No. 1) hook	Ref. No. 4GC/5700
Ball-end cable winch ...	Ref. No. 4GC/5433.

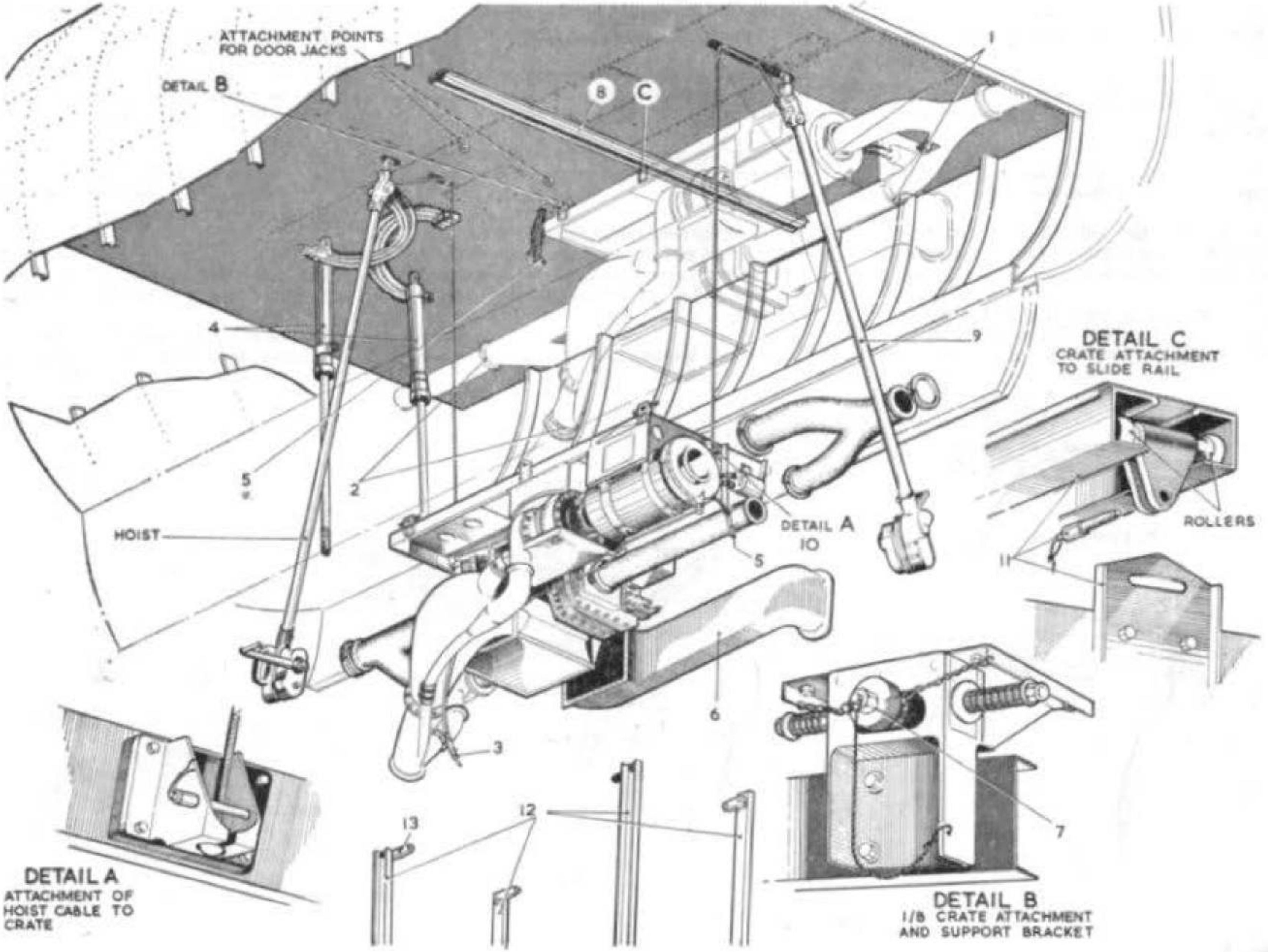

Fig. 7. Removal of air conditioning unit

The procedure for removal is as follows:—

(1) Disconnect two forward clamps on the Y-piece to the cabin; also disconnect the bonding.

(2) Disconnect the two rear clamps—ejector and inlet from the mixer box; also disconnect the bonding.

(3) Disconnect the cold air unit breather pipe at the lower rubber connection.

(4) Remove the split pin, nut and bolt from the top and bottom of each nose-wheel door jack, and tie jacks back out of the way.

(5) Having first ensured that the power supplies are switched off, remove the three Breeze-type plugs at the rear of the unit and the small plug on the upper side of the Y-piece duct at the forward end.

(6) Remove the cooling air intake.

(7) Remove the two knurled nuts which secure the unit and bring the unit off its locating pins.

(8) Slide the unit on its fixed rail until it is positioned in the centre of the nose-wheel bay.

(9) Hook the two Minilift hoists in position; pull the ball end on the hoist cable 18 in. out from both hoists and thread the ends over the fixed pulleys in the roof of the nose-wheel bay.

(10) Attach the ball ends of the cables in the sockets provided at each end of the crate. Quick-release pins are provided at these points to ensure that the ball ends do not inadvertently escape from the sockets.

(11) Take the weight of the crate on the hoists and remove the quick-release pins attaching the crate to the slide.

Note . . .

These pins must on no account be removed until the weight of the unit is fully and safely borne by the hoist cables.

(12) Position a trolley, Ref. No. 26DC/95150 under the unit; swing the support arms at the corners of the trolley outwards.

(13) Lower the unit into the trolley; swing the support arms of the trolley inwards and

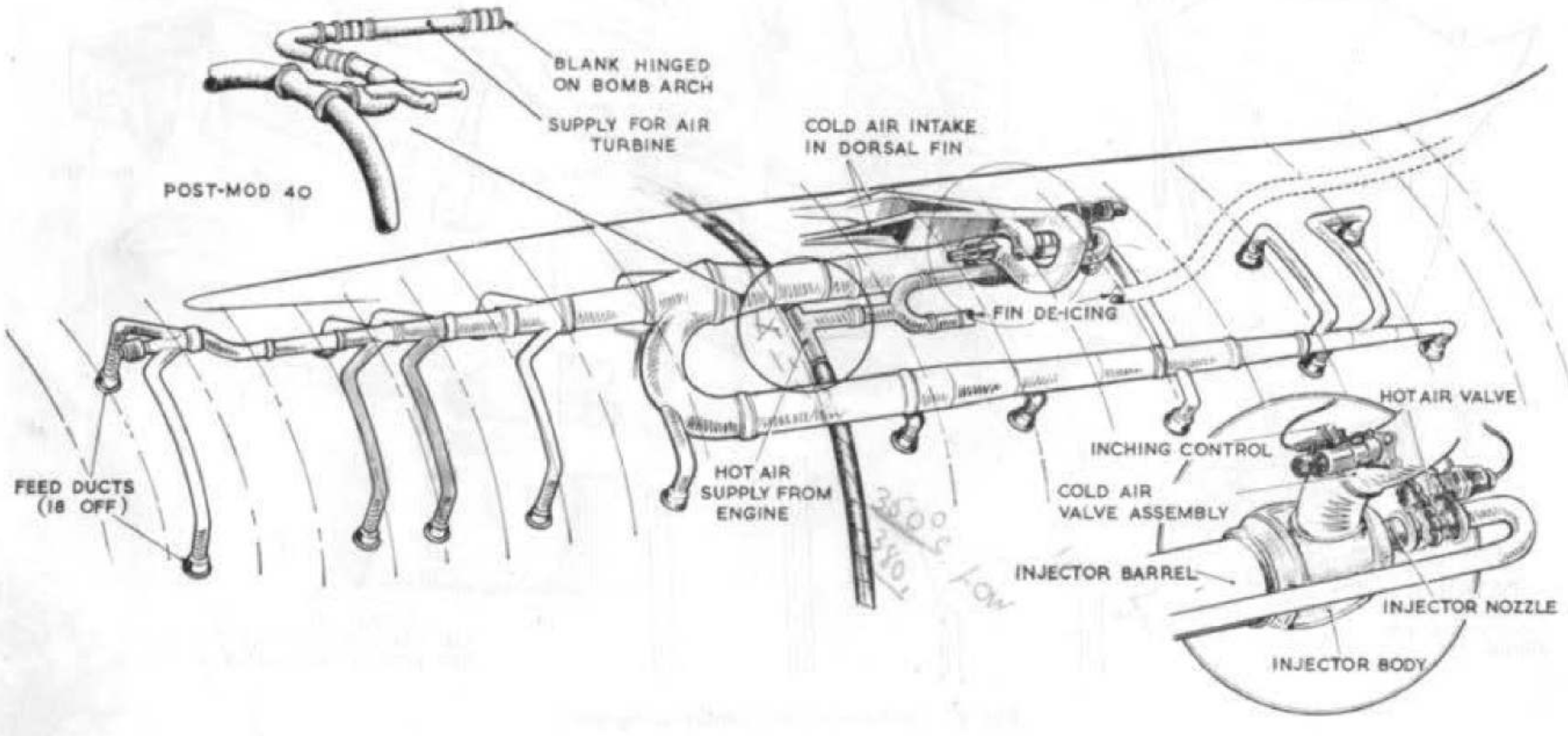

Fig. 8. Bomb bay heating

secure the crate with the quick-release pins supplied.

(14) Remove the Minilift hoists.

55. The procedure for installation is the reverse of the foregoing. When installing, all pins, rollers, rails, etc. should be lubricated with grease XG-295 (34B/9423152). It is also important to note that if a duct joint is broken for any reason, the seals making the joint must be replaced by new seals; i.e., *seals must only be used once*.

BOMB BAY HEATING SYSTEM

Introduction

56. Provision is made for heating the bomb bay as the temperature of the bay must not fall below freezing point when certain stores are carried. The heating system, which may be operated under either automatic or manual control, utilises air tapped off the main engine compressors which is mixed with cold air and circulated through the bomb bay. All controllers are electrically operated, and reference should be made to Book 2, Sect. 5, Chap. 1 of this publication for electrical description and servicing information.

DESCRIPTION

CONTROLS AND INDICATORS

57. These are mounted on the starboard upper portion of the crew's panel, and consist of:—

(1) Main control switch—three positions, AUTO-OFF-MANUAL.

(2) MANUAL HEAT CONTROL switch—three positions, INC.-OFF-DEC., spring-loaded to the centre OFF position.

(3) Setting potentiometer—enables the operator to set the datum temperature under automatic control.

(4) Bomb bay temperature indicator.

HOT AIR SYSTEM (*fig.* 8)

58. Hot air, from the delivery side of the main engine compressors, is fed from the port and starboard pairs of engines to the hot air valves of the fin anti-icing and bomb bay systems. The flow of air into the bomb bay heating system is controlled by an electrically-operated hot air valve. A temperature controller opens or closes the valve as necessary to maintain a bomb bay temperature of 2-10 deg. C.

COLD AIR SYSTEM

59. Two flush-type air-intakes back to back in the dorsal fin are connected to an injector through the cold air valve. The cold air valve is controlled by an inching control which opens or closes the valve to maintain a heating air temperature at the injector outlet of 100 deg. C.

INJECTOR

60. Hot air from the engine compressors passes through the hot air control valve to the nozzle of the injector. The air leaves the nozzle at considerable velocity and passes down the mixing tube, mixing with and imparting some of its velocity to the cold air which enters the tube around the nozzle. At the far end of the tube complete mixing has taken place, and the final temperature depends on the proportion and initial temperatures of the hot air and the cold air.

HEATING AIR DUCTING

61. The heating air from the injector passes forward and aft along the bomb bay in two main distribution ducts which pass through the bomb arches, leaving the bay unobstructed. Feed ducts from the main distribution ducts supply heating air to eighteen outlet points situated in pairs along the length of the bay. The air finally passes to atmosphere through an exit louvre fitted in the port inner bomb bay door.

OPERATION

Automatic

62. To operate the system under automatic control proceed as follows:—

(1) Ensure that the ENGINE AIR switches are open (pressurisation panel).

(2) Place the main control switch to AUTO.

(3) When the bomb bay temperature has stabilised, operate the setting potentiometer as required.

63. When the main control switch is placed to AUTO, the following operations take place:—

(1) The cold air valve opens fully.

(2) After a delay of 10 seconds the hot air valve is placed under the control of the temperature controller.

(3) At the same time as (2) the cold air valve is placed under the control of the inching control.

(4) The hot air valve opens and closes to maintain a bomb bay temperature of 2-10 deg. C., and the cold air valve opens and closes to maintain a heating air temperature of 100 deg. C.

Manual

64. To operate the system under manual control proceed as follows:—

(1) Check that the ENGINE AIR switches are OPEN (pressurisation panel).

(2) Place the main control switch to MANUAL. The cold air valve opens fully and a positive supply is applied to the MANUAL HEAT CONTROL switch.

(3) Operate the MANUAL HEAT CONTROL switch to INC. or DEC. to obtain the required bomb bay temperature. This operation controls the hot air valve direct.

OVERHEAT

65. If the temperature of the heating air rises above 130 deg. C., an overheat switch in the ducting operates and the hot air valve is disconnected from the manual or automatic controls and closed. When the duct temperature falls below 120 deg. C., the switch returns

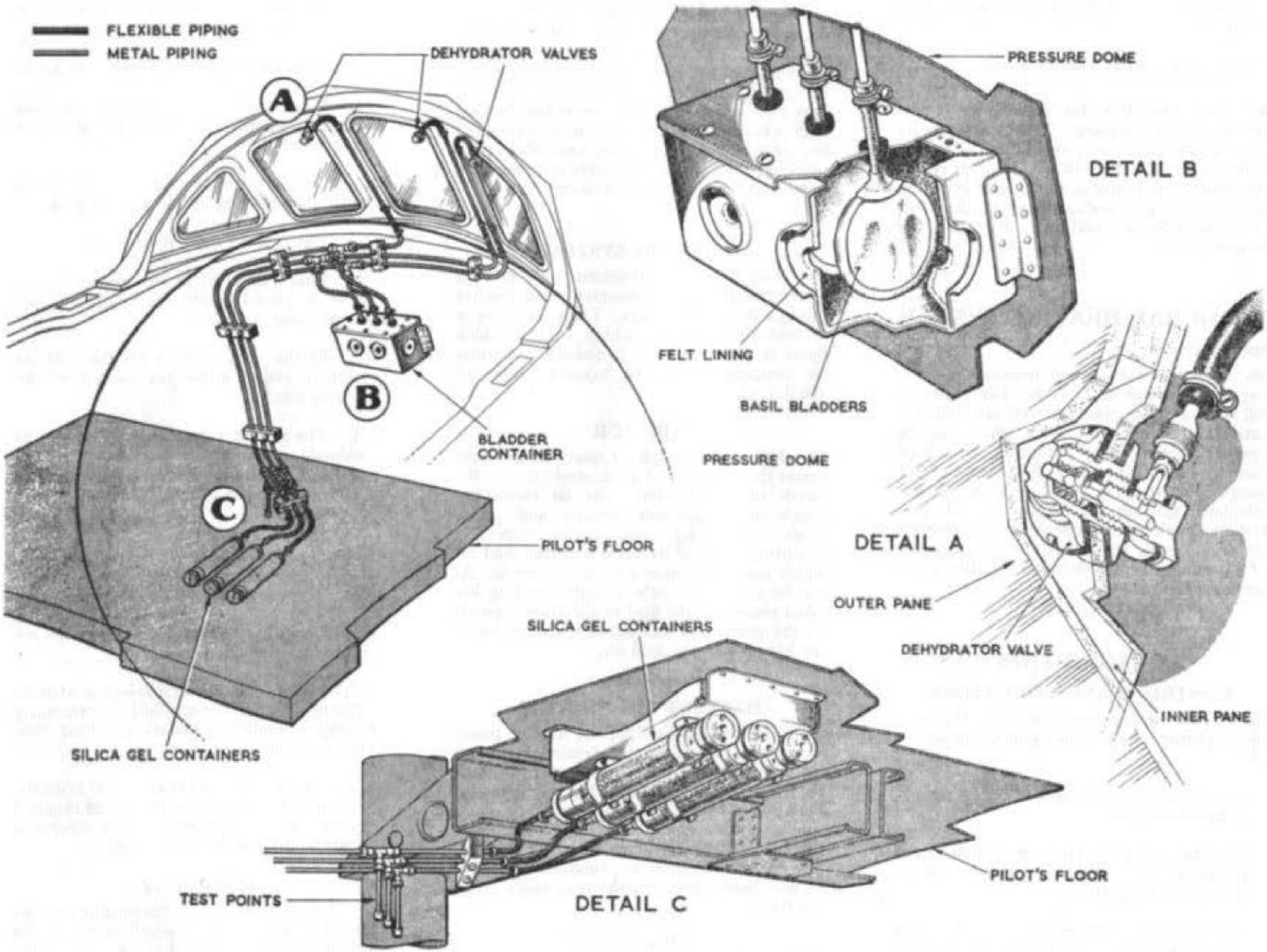

Fig. 9. Windscreen demisting—silica gel system

to normal and the hot air valve is returned to manual or automatic control.

SWITCHING OFF

66. When the main control switch is returned to OFF, the hot air valve is closed. When the hot air valve has closed the cold air valve closes.

WINDSCREEN DEMISTING

SILICA GEL SYSTEM

Introduction

67. The three centre panels of the pilots' windscreen are of sandwich type construction, and to prevent internal misting of the inner and outer windows an air-drying system is installed, connected to the space between the windows.

DESCRIPTION (*fig.* 9)

68. Fitted in the upper portion and on the inner side of the three centre windscreen panels is a self-sealing dehydrator valve, Vickers Part No. A1971. These valves effectively seal the space between the windows until they are connected to the pipe lines of the system by dehydrator valve connectors, Vickers Part No. A.1985, which maintain the valves in the open position thus ensuring that only dried air is admitted to the interspace.

69. Pipe lines from each valve pass downwards on the cabin side of the forward pressure dome to air-drying cartridges mounted at the forward end of the underside of the pilots' floor, on the port side. The connections at each end of the pipe lines are made with short lengths of flexible tubing.

70. The air drying cartridges, Part No. 11/D10435, are filled with silica gel as an air-drying medium. The silica gel is blue when fresh, and slowly changes to pink as it absorbs moisture.

71. As the system is completely contained within the pressure cabin, it follows that the air in the windscreen interspace is at the same pressure as the cabin air, at all times. Should the cabin be depressurised in an emergency, it is necessary that the pressure in the windscreen interspace be reduced at approximately the same rate as the cabin pressure, in order to avoid possible damage to the screen through differential pressure. To obtain this condition three small basil bladders are connected to the system, one to each pipe line by short branch pipes. These bladders permit rapid expansion of the air and therefore rapid reduction of the pressure in the windscreen and pipe lines. A light alloy box on the rear side of the forward pressure dome houses the three bladders.

SERVICING

AIR DRIERS

72. Air-drying cartridges should be replaced when the silica gel contents have changed from blue to pink.

To do this proceed as follows:—

(1) Before removing an affected cartridge, clip the flexible tube connecting the cartridge to the windscreen pipe line, in order to

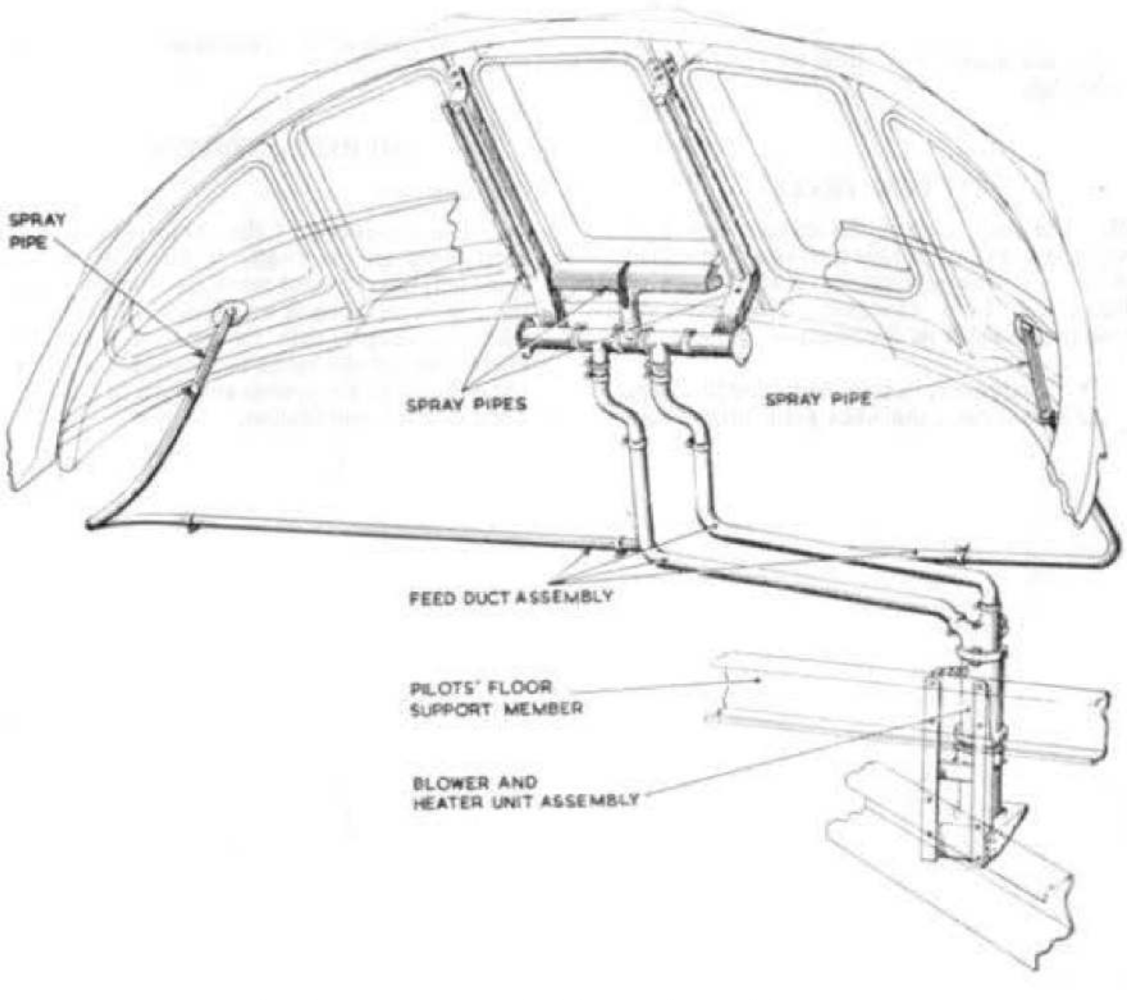

Fig. 10. Windscreen demisting—thermal system

prevent ingress of moist air to the windscreen interspace.

(2) Disconnect the cartridge from the flexible tube.

(3) Remove the cartridge from the mounting.

(4) Fit a new cartridge containing silica gel (Ref. No. 33C/1454).

(5) Reconnect the flexible tube and remove the clip.

SYSTEM TESTS

73. The pipe lines of the system should be pressure tested at suitable intervals as specified in Vol. 4 of this publication, or when any pipe lines have been changed. The following procedure should be followed:—

(1) Disconnect, in turn, each pipe line from the windscreen, the silica gel container and the related bladder; clip or blank off the three ends.

(2) With a suitable pump connected to the point provided just forward of the silica gel container, check for air tightness of joints at a pressure of 2 p.s.i.

(3) Reconnect the pipe at the windscreen only, and check for leakage through the outer windscreen at a pressure of 1 lb. per sq. in., using a soapy solution to check for leaks.

(4) Remake all connections and check them for security.

THERMAL SYSTEM

Introduction

74. For demisting of the cabin side of the windscreen an electrically-operated system is provided, using heated cabin air directed on to the windscreen panels as required. It is electrically arranged that the system does not operate whilst the cabin is pressurised. Electrical details of the system are given in Book 2, Sect. 5 of this publication.

DESCRIPTION (*fig.* 10)

75. Control of the heating supply for the windscreen is by a two-position switch, marked ON-OFF, which is located on the anti-icing panel (pre-mod. 38) or the flight refuelling panel (post-mod. 38) on the starboard console. When the switch is moved to the ON position, current is supplied to start a motor-driven blower, which is mounted below the pilots' floor on the starboard side. Air is drawn in by the blower and passed through ducting on its outlet side to a 1 k.w. heater unit. From the heater, the air continues along the ducting which passes into the cabin above the pilots' floor. Just above the floor the duct divides, and the air passes along these twin ducts to outlets fitted on the cockpit side of the windscreen so that an adequate supply of warm air is directed on to the panels.

OVERHEATING

76. Should the temperature of the air in the ducting rise above 80 deg. C., two thermal switches located in the duct just above the pilots' floor, interrupt the electrical supply to the heater unit. When the temperature in the duct falls to 60 deg. C., the thermal switches "remake" and the heater comes into action again.

D/d 8467 353183 500 1/50 378/3 J.L.Ltd.


847
DANGER
CANOPY
DANGER
EJECTION SEAT
ENTRANCE OTHER SIDE