Chapter 8 AIR CONDITIONING AND PRESSURIZATION SYSTEM

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DESCRIPTION

General

1. The crew are housed in a pressure cabin and can operate in either a pressurized or unpressurized condition, with hot or cold air entering the cabin for conditioning, used air being exhausted through a discharge valve on the rear pressure bulkhead. As the cabin is a sealed compartment it follows that all controls passing through the rear bulkhead must also pass through seals, otherwise loss of pressure would result. The sextant dome and ditching exit are provided with a rubber seal, and the cockpit canopy and main entrance door with inflatable seals, that for the door being operated by the opening and closing of the door.

2. The air conditioning and pressurizing system is essentially a pressure system, temperature being a secondary consideration. Conditions for the crew housed in the pressure cabin are maintained at a comfortable level during sustained flight at altitude. The system is linked with the following services in as much as the source of supply is the same (*fig.* 1).

(1) Airframe thermal de-icing.

(2) Fuel heating.

(3) Bomb bay heating.

(4) Water-methanol pumps.

(5) Refuelling-in-flight air turbine pumps system.

3. Air is taken from the 15th stage of the high pressure side of each engine compressor and is conveyed by ducting to the air conditioning bay where it is correctly conditioned, before delivery to the cabin, via a silencer and water extractor.

4. The operation of the system is controlled by the second pilot, the controls being mounted on the starboard console in the cockpit. A cabin altimeter is provided on each pilot's instrument panel so that comparison between the cabin and the aircraft altitude is readily available. An outside air temperature gauge is fitted to the second pilot's instrument panel and, although there is no cabin temperature gauge, position indicators are fitted for the temperature control valves.

5. The cabin pressure is controlled by a pressure controller operating in conjunction with a discharge valve to either of two conditions, CRUISE or COMBAT. In the CRUISE setting the aircraft remains unpressurized until 8000 ft.; above this altitude 8000 ft. is maintained in the cabin up to an aircraft altitude of 47,250 ft. Above this height the differential pressure is maintained to a maximum of $9 \pm 0{\cdot}25$ lb/in^2. In the COMBAT setting the aircraft remains unpressurized up to 25,000 ft., above this height the cabin being maintained at 25,000 ft. Provision is made to relieve any negative pressure in excess of 0·5 lb/in^2. An alarm bell in the cabin provides a warning to the crew that the cabin altitude has increased beyond the control limits in both the CRUISE and COMBAT settings. The aircraft can be flown unpressurized with conditioning air supplied from either the engines or the ram air-intake in the port wing.

6. If the cabin is punctured by enemy action, resulting is excessive air discharge, a flood flow system automatically operates when the cabin altitude rises above 29,000 ft.; this delivers ten times the normal amount of air via its own intercooler. Leak stoppers are provided in the cabin (*Sect.* 1, *Chap.* 3) to seal off damaged areas and prevent loss of cabin pressure.

7. Cabin temperature is controlled, the airflow passing from the engines through an intercooler, or through the intercooler and a cold air unit (*fig.* 2). The air bled from the engines can reach a temperature of 350 deg. C., dependent upon altitude, throttle opening and other variables. It is cooled by passing through the intercooler and, if further cooling is required, the cold air unit. Airflow to each of these units is controlled by electrically-operated valves operated by switches on the starboard console. The intercooler valve directs the airflow either direct to the cabin or through the intercooler to the cold air unit valve, where it is directed either to the cabin or through the cold air unit and then to the cabin depending on the degree of heating required. The valve positions are shown on a combined indicator adjacent to the control switches on the starboard console.

8. A ventilating fan, fitted in the ram air ducting, is used to provide the cabin with cooling air during taxying, provision also being made for connecting an air conditioning trolley (Ref. No. 4F/2013) to condition the cabin prior to flight.

9. A ground test connection is fitted to the ducting so that the cabin and ducting can be pressure tested without using the engines.

10. Provision is made for depressurizing the cabin at the positions occupied by the pilots and the rear crew.

AIR SUPPLY FROM ENGINES (*fig.* 1)

11. Hot air which can reach a temperature of 325 deg. C., is bled from the high pressure stage of each engine through electrically-operated gate valves on each engine starboard side and passes through non-return valves into a duct over each pair of engines. This duct continues outboard to serve the wing de-icing (*Sect.* 3, *Chap.* 9) and inboard through the inner plane to enter the fuselage at Stn. 557; here it branches fore and aft to feed ducts in the servicing bays between the bomb-bay walls and the fuselage skin. Tappings are taken to supply the fuel heaters, bomb-bay heating ducts, the water-methanol

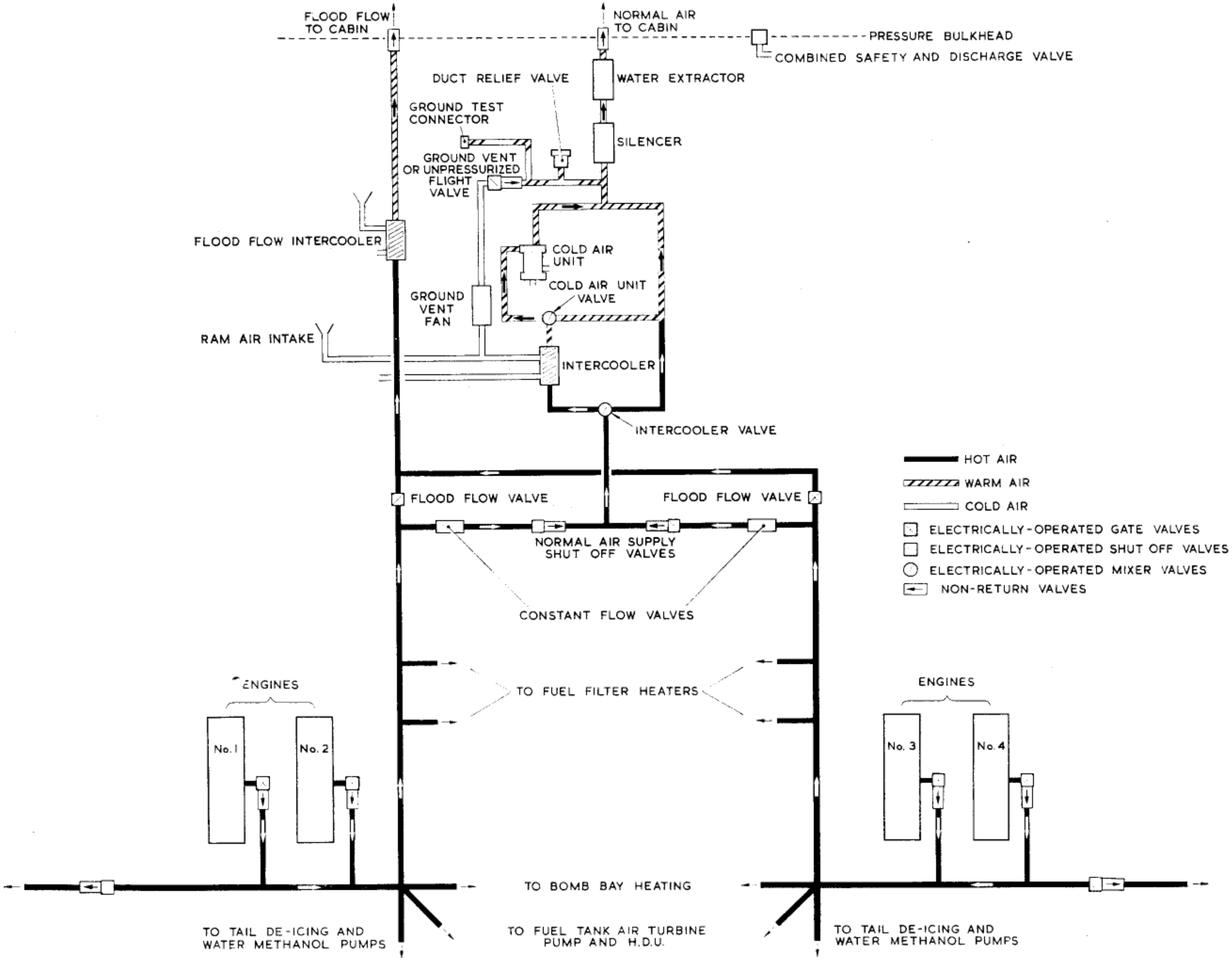

Fig. 1. Diagram of normal and flood flow air supply to cabin

system pumps and the refuelling-in-flight turbo pumps. The duct leading aft serves the tail unit de-icing system (*Sect.* 3, *Chap.* 9) and that leading forward continues to Stn. 370 where it again branches to serve the normal and flood flow systems.

12. At Stn. 370 the ducting at each side of the fuselage, for the normal and flood flow systems respectively, cross the fuselage and meet to form single ducts which continue forward on the port side.

13. Two electrically-operated flood flow control valves, mounted on the floor of the upper servicing bay (one on the fuselage centre line and the other on the port side) are fitted to the flood flow ducting.

14. The port and starboard branches of the normal supply ducting are connected to constant flow valves and non-return shut-off valves before they meet to form a single duct which continues forward and passes downwards through the upper servicing bay floor into the port servicing bay housing the air conditioning equipment. Here the ducting is connected to an intercooler valve having two outlets, one to cabin and the other to the intercooler and, depending upon the control setting in the cockpit, the airflow is ducted either to the cabin or through the intercooler to the cold air unit valve. This valve is similar to the intercooler valve and the two outlets connect to cabin and cold air unit.

15. Again depending upon the control setting, airflow is ducted to the cabin or through a cold air unit and then to the cabin. Both valves are electrically operated and sequenced by means of microswitches so that the cold air unit valve does not commence to open until the intercooler valve is fully open, and the intercooler valve will not commence to close until the cold air unit valve is fully closed. After passing through the air cooling equipment the airflow is ducted to the cabin through a silencer, a water extractor and a non-return valve.

16. Air entering the pressure cabin is ducted forward on the fuselage port side below the cabin floor, and a branch is led upwards through the floor to supply hot air to the diffusers at the rear crew position. On B/PR Mk. 1 and B/K/PR Mk. 1 aircraft only, a further branch is taken to the bomb-aimer's prone position to supply the diffusers. The main ducting continues forward to Stn. 145 where it again branches to serve the bomb-aimer's window demister through a by-pass valve, interconnected to shut-off valves at the rear crew and pilots' foot warmer branch ducts. It is then led up the fuselage wall to supply the pilots' foot warmers and the cockpit transparencies.

CABIN HEATING CONTROL

17. The second pilot can select HOT, COLD or any intermediate setting but there is no visual indication of the cabin temperature. The degree to which the temperature of air supplied to the cabin can be lowered is determined by the pressure existing in the system; thus it is essentially a pressure system, temperatures being subservient to pressures.

18. Temperature is controlled from the CABIN TEMPERATURE CONTROL on the starboard console. This is a three-position switch, spring-loaded to the OFF (centre) position, the other two positions being RAISE and LOWER. An indicator adjacent to the switch records the movement of both the intercooler and the cold air unit valves, the pointer for the intercooler moving between HIGH and LOW (temperature) and the cold air unit pointer between IN and OUT, indicating cold air unit in or out of circuit. To make a selection the switch is held in either the RAISE or LOWER position until the pointers indicate the required setting, and on being released it returns to OFF.

Engine gate valves (*fig.* 1)

19. Air from each pair of engines enters the ducting through electrically-operated gate valves on the starboard side of each engine, the valves being normally actuated by microswitches on the engine control rods so that, when the engines are running above ground idling r.p.m., the valves are open and when the engines are stopped the valves are closed. It is possible to override the microswitches by selecting one of the four switches (above the rear end of the starboard console) marked ENGINE GATE VALVE; NORMAL/EMERGENCY CLOSE, to close the valve on any one of the engines whilst it is running.

20. Each valve has a carbon gate inlaid with a stainless steel frame to give added strength and resistance to high air temperatures. The air passes through non-return valves in the flexible couplings attached to the gate valves, each non-return valve consisting of two flap plates hinged about a centre pin across the valve body. They are blown open by the airflow and, if both engines of a pair are delivering equal pressures, both are open. If however, the pressure from one engine is lower than that from the other, the valve plates will be blown back onto their seatings and so prevent pressure from the engine delivering the higher pressure entering the compressor on the other engine. (For full details of these non-return valves see A.P.4340, Vol. 1, Sect. 6, Chap. 15.)

Constant flow valves (*fig.* 1)

21. The airflow next passes to two flow control valves, one in the ducting from each pair of engines at Stn. 370, designed to restrict the mass airflow to the cabin to 30 lb per minute, or 15 lb per minute from each pair of engines when the cold air unit is out of circulation. These valves each consist of a bobbin mounted on a spindle anchored to the down-stream end and spring-loaded against the airflow. A throat is formed in the valve body, the throat aperture being varied by the action of the bobbin. With no airflow through the valve the springs are extended and the bobbin is upstream and, as the engine temperatures and speeds vary when it is running, so the bobbin moves in and out of the throat to control the flow.

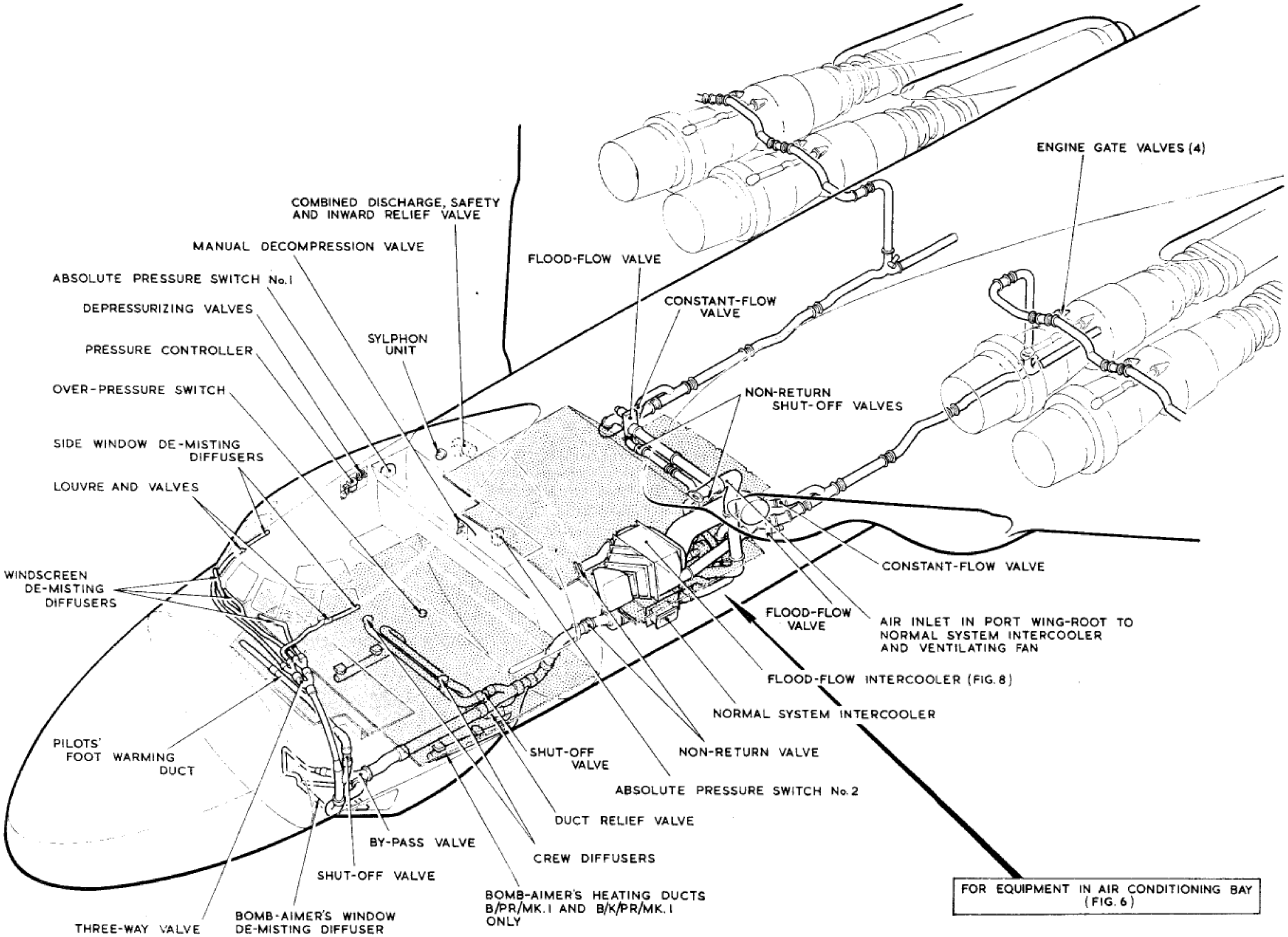

Fig. 2. Location of components and ducting

With the cold air unit in circuit the airflow through the valve increases due to back pressure increasing the air density. (For further details see A.P.4340, Vol. 1, Sect. 5, Chap. 20.)

Non-return shut-off valves (*fig.* 1)

22. From the constant flow valves the air is ducted to the air conditioning equipment in the port servicing bay through two non-return shut-off valves located on the floor of the upper servicing bay. These are electrically-actuated valves controlled by switches on the starboard console marked CABIN AIR SUPPLY; ON/OFF. The valve flap is mounted on a ball joint on a radius arm pivoted in the valve body, a spring-loaded arm attached to the actuator being in contact with a track on the arm. When the switch is OFF the spring-loaded arm loads the valve against its seat. With the switch ON, the actuator withdraws the spring-loaded arm and the valve flap is blown clear by the airflow through the valve. Should the airflow be reversed due to a pair of engines on one side delivering a higher pressure than those on the other, or a shattered duct upstream of one of the valves, air pressure will blow the valve onto its seat to prevent loss of cabin pressure.

Air conditioning equipment (*fig.* 6)

23. Air enters the air conditioning bay and is ducted to the intercooler valve, this being electrically actuated and interconnected through microswitches with the cold air unit valve. The intercooler valve, mounted on the roof in the rear inboard corner of the bay, has two outlets, one to cabin and the other to the intercooler. The valve flap will close the outlet to cabin but the flow through the intercooler is never entirely shut off. Selection of CABIN TEMPERATURE CONTROL will extend or retract the actuator arm which will in turn cause the valve flap to rotate. By releasing the control switch, the movement of the flap can be arrested anywhere in its travel.

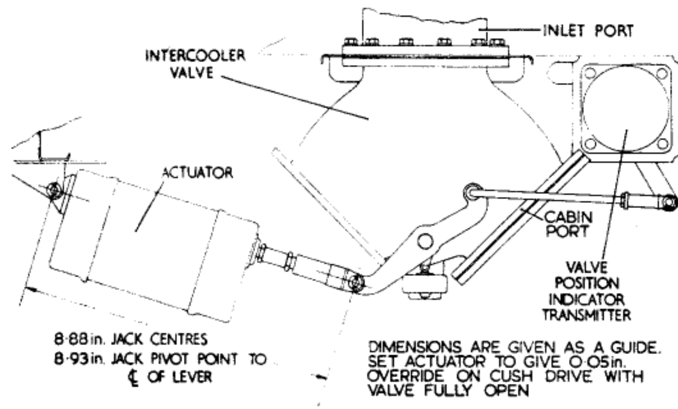

Fig. 3. Actuator setting for intercooler control valve

24. With the cold air unit out of circuit, the airflow passes through the intercooler and the cold air unit valve, and thence to the cabin via the silencer and water extractor. When the intercooler valve is fully open the 'cabin port' on the valve will be closed, and a microswitch on the valve is operated to transfer the power supply to the actuator on the cold air unit valve. Any further movement of the CABIN TEMPERATURE CONTROL to LOWER would cause the cold air valve to start to open and allow some of the airflow through the cold air unit. Airflow leaving the intercooler is always above ambient temperature.

25. The cold air unit valve is similar in construction and operation to the intercooler valve, its two outlets being to cabin and cold air unit respectively. The valve is mounted on the port servicing bay rear wall and is accessible through the rear access panel. The valve flap will close the cabin port, but airflow through the cold air unit is never completely shut off. With the intercooler valve fully open, all the airflow is through the intercooler to the cold air unit valve where the air is ducted either to cabin or through the cold air unit and then to cabin. As the CABIN TEMPERATURE CONTROL is moved to LOWER, so the valve is opened to admit more air to the cold air unit. Operation of the switch to raise the cabin temperature will progressively close the valve flap until it reaches the cold air unit OUT position and operates a microswitch on the valve body to transfer power back to the intercooler valve actuator. Any further movement of the control to RAISE would cause the intercooler valve to start to close. (For further details of this valve see A.P.4340, Vol. 1, Sect. 5, Chap. 22.)

COLD AIR UNIT CONTROL

26. When the cold air unit valve is fully open and the cold air unit is in circuit, two conditions unacceptable to the operation of the system are possible. One is a pressure differential in excess of 3·5 : 1 across the cold air unit which would give rise to over-speeding, and the other a pressure differential of 1 lb/in^2 or less across the constant flow valve which would give rise to a lowering of the cabin pressure. To prevent these conditions a pressure ratio switch and a pressure differential switch are fitted to close the cold air unit valve and divert airflow from the cold air unit until conditions return to normal.

Pressure ratio switch

27. To prevent overspeeding a pressure ratio switch is fitted to limit to 3·5 : 1 the pressure differential across the cold air unit. The switch is shock-absorber mounted on the port servicing bay inboard wall adjacent to the cold air unit valve. The switch body has a low and a high pressure chamber, these being connected by pipelines to the cold air unit outlet and inlet sides respectively. A rocking lever is pivoted on the wall (between the two chambers) and incorporates a flexible seal to prevent leakage between the chambers and allow the lever to move. Two evacuated bellows, one in each chamber, are attached to both the rocking lever and the switch body. The high pressure bellows is housed in a cradle and the low pressure is screwed to the lever to give fine adjustment. A roller rides on the rocking lever and carries a contact moving between two fixed electrical contacts.

28. The characteristics of the bellows and lever ratios are such that if the chamber pressures are equal the lever is horizontal, any increase in one pressure over the other resulting in an inclination of the lever. When the contacts are made the flow through the cold air unit is automatically reduced, ensuring that the differential pressure is not exceeded. In this condition operation of the CABIN TEMPERATURE CONTROL to LOWER has no effect, although a selection to RAISE would be effective.

Pressure differential switch

29. If the engine delivery pressure falls and the cold air unit is in circuit, the constant flow valves would ultimately be wide open and cease to control the airflow. In this condition the aerodynamic resistance offered by the cold air unit would restrict the flow sufficiently to affect the cabin pressurization. This condition exists when there is a pressure difference across the constant flow valves of 1 lb/in^2 or less. The pressure differential switch, adjacent to the cold air unit valve, detects this low pressure differential and energizes the cold air unit valve actuator to take the cold air unit out of circuit.

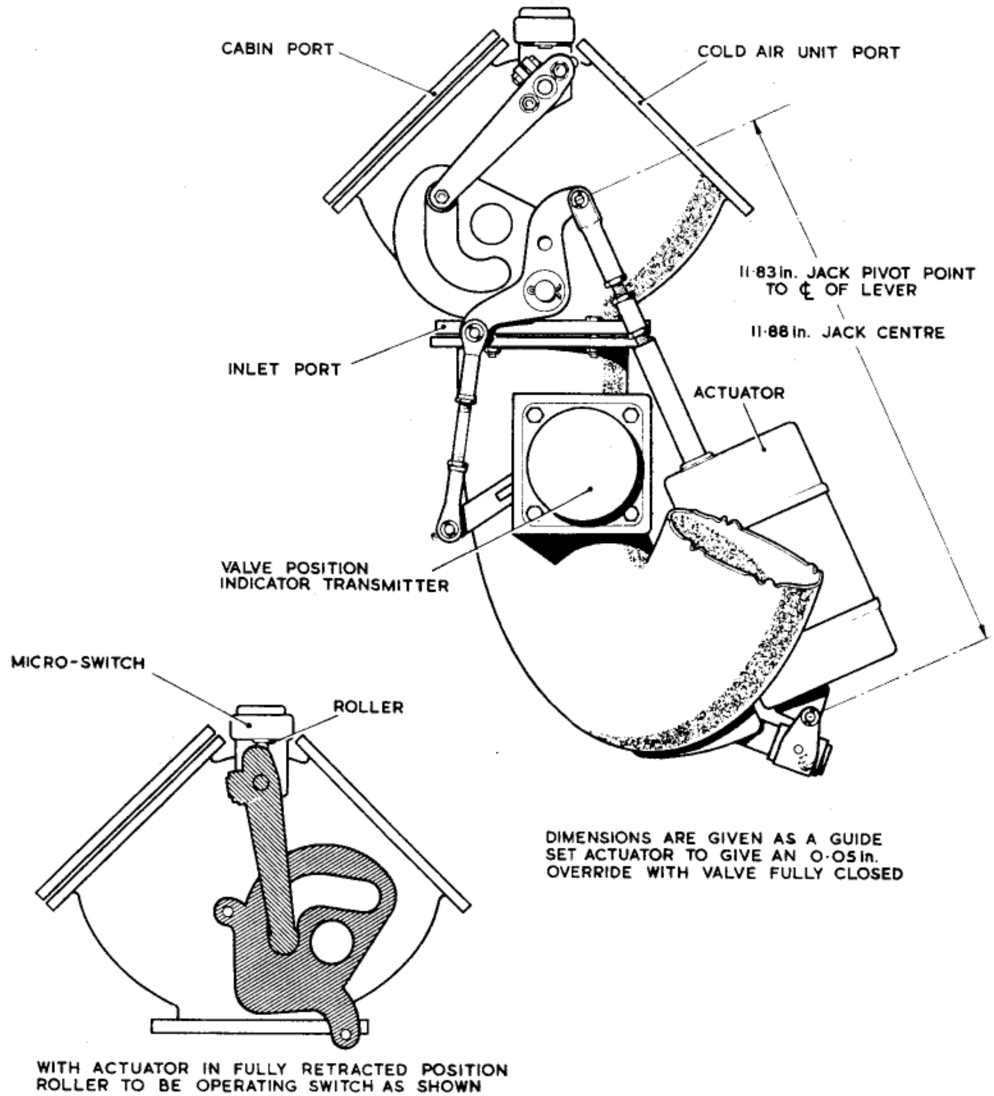

Fig. 4. Actuator setting for cold air unit valve

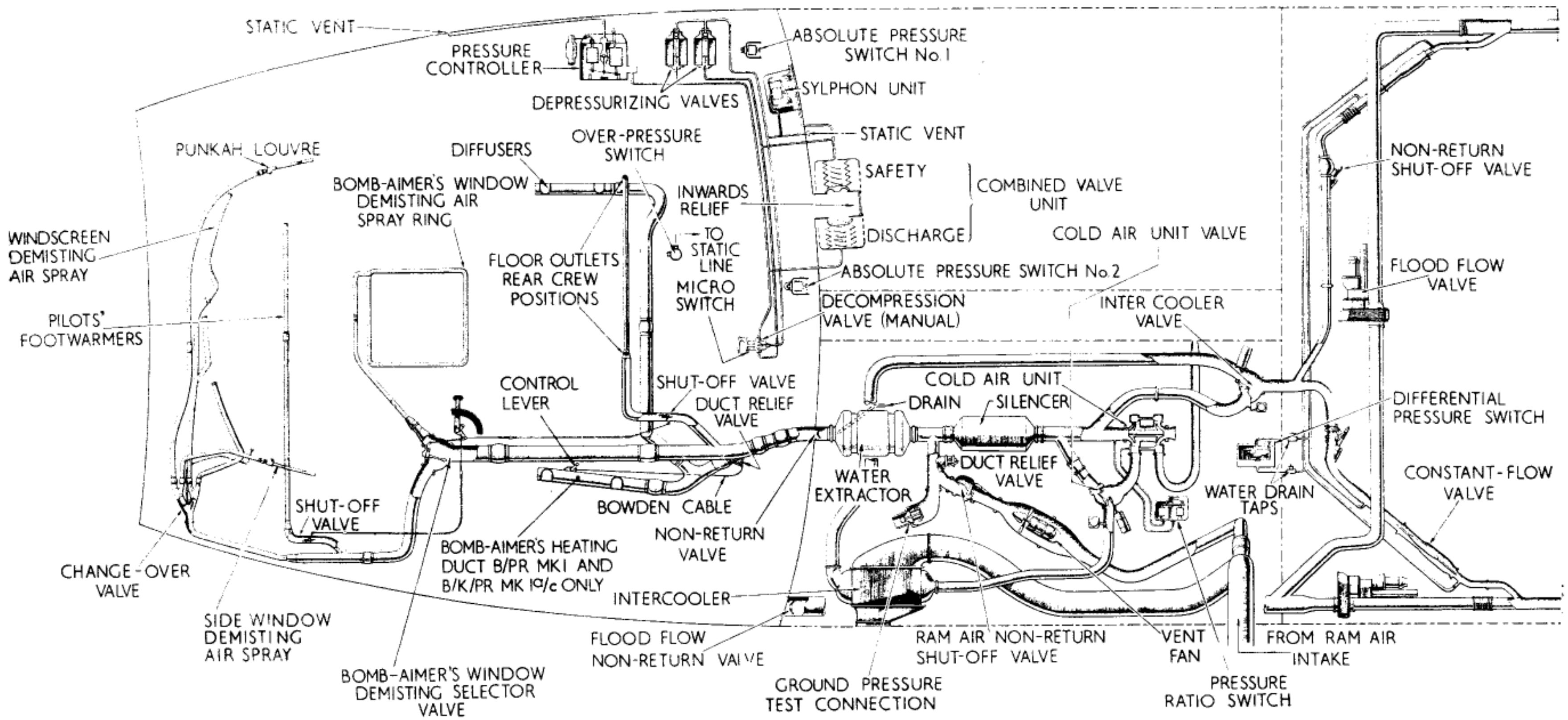

Fig. 5. Diagram of system

30. The switch has a high and a low pressure side, separated by a diaphragm, connected by pipelines to the flow control valves. The low pressure side is connected into the downstream sides of the valves and the high pressure side into the upstream sides. A stud, bearing on the diaphragm, projects into the switch low pressure side to operate an arm pivoted at one end. The arm is spring loaded and holds electrical contacts apart when the differential pressure is in excess of 1 lb/in^2. Up to this pressure the diaphragm flexes downwards, the contacts are made and the flow through the cold air unit reduced to restore the differential pressure to 1 lb/in^2 or more.

AIR DISTRIBUTION IN PRESSURE CABIN (*fig.* 2)

31. After passing through the air conditioning equipment, the silencer and the water extractor, air enters the cabin through a non-return valve on the rear pressure bulkhead, to serve the cabin pressure, heating and de-misting systems. It is ducted to all crew positions and essential transparencies. The system is arranged so that in normal flight, air is ducted to all positions except the bomb-aimer's window demister. A manually-operated selector valve diverts the air supply as necessary to the bomb-aimer's window.

32. In the cabin the ducting leading forward on the port side branches through a shut-off valve to the rear crew diffusers and then forward to the bomb-aimer's window demister valve. Hence one branch leads to the demister spray ring and the other up the fuselage wall where it branches, through a further shut-off valve, to the pilots' foot warmers. The main duct continues upwards to a manually-operated, three-way, change-over valve for the windscreen/punkah louvre/side-window demisters.

33. The bomb-aimer's window demister valve, attached to a floor beam on the port side of the bomb-aimer's compartment, is manually operated by a lever controlled by the bomb aimer. The lever is linked by Arens-type controls to the shut-off valves for the rear crew diffusers and the pilots' foot warmers. The valve is a Y-shaped manifold, the valve flap seating against the outlet to the bomb-aimer's demister. With the control lever at OFF the valve flap is against its seat, the supply to the bomb-aimer's position is closed and to all other positions is open. With the lever at ON the valve flap moves clear of its seat and air flows to the demister; at the same time the supply to the rear crew position and the pilots' foot warmers is closed. On B/PR Mk. 1 and B/K/PR Mk. 1 aircraft, provision is made for intermediate setting of the control lever, thus diverting the airflow partly to the demister spray and partly to the rear crew diffusers and the pilots' foot warmers. (For further details of the valve see A.P.4340, Vol. 1, Sect. 5, Chap. 19.)

34. The two shut-off valves, one for the rear crew diffusers under the floor on the port side at Stn. 216-241, and the other for the pilots' foot warmers on the fuselage port wall at Stn. 123, close the supply to these positions. The valves are similar in operation and construction and are fully described in A.P.4340, Vol. 1, Sect. 5, Chap. 23.

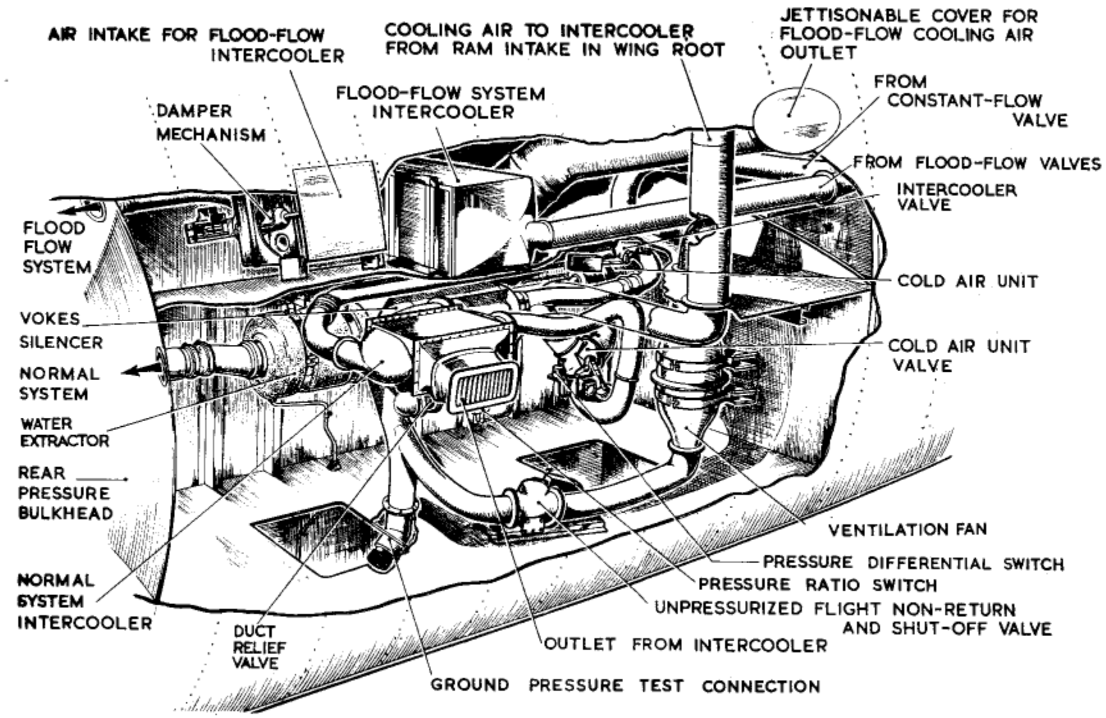

Fig. 6. Air conditioning bay

WINDSCREEN DEMISTING (*fig.* 2)

35. The airflow for demisting the cockpit transparencies is controlled by the first pilot. The three-way change-over valve is operated by an Arens-type control mounted on the cockpit port coaming. The valve is a Y-shaped manifold with two interconnected valve flaps, one in each arm of the Y. There are three settings and, depending on the position of the control knob, the airflow is directed respectively to the front windscreens only, the windscreens and side windows, or the side windows and punkah louvres. Post-Mod. 2400, the windscreen centre panel is also demisted by a supply tapped from the ducting leading to the second pilot's windscreen. (For information on the valve see A.P.4340, Vol. 1, Sect. 5, Chap. 18.)

36. Adjacent to the side window demisters, the punkah louvres direct warm air on to the two pilots. Under the control of an individual pilot, they can be adjusted to any desired position, and are opened and closed by a lever on the top of the louvre body.

BOMB-AIMER'S COMPARTMENT HEATING SUPPLY

(B/PR Mk. 1, and B/K/PR Mk. 1 (Mod. 2023))

37. On these aircraft an additional supply is taken to the bomb-aimer's compartment. A branch from the main ducting at Stn. 241 ducts airflow through a combined by-pass and relief valve to diffusers on each side of the compartment. The valve, mounted under the floor at Stn. 241, is Bowden-cable controlled by a lever on the compartment port side at Stn. 191. The valve consists of a simple plate-type valve operated by movement of the control lever and a spring-loaded diaphragm interconnected by a link plate, movement of the lever to open the valve causing the spring to compress. A back pressure (built up in the ducting) acts on the diaphragm, compresses the spring and opens the valve to relieve excessive pressures. The valve cannot be operated by the control lever when it is fully relieving, but it can fully open the valve if it is only partially relieving. The control lever must always be returned to OFF when the selection is not required.

CABIN PRESSURE CONTROL (*fig.* 7)

38. The cabin pressure is controlled by the opening of a discharge valve regulated by a pressure controller on the pressure cabin starboard wall. Pressure can be controlled in either of two settings, CRUISE or COMBAT, and once selected control is automatic. The setting is selected by the second pilot, on a CRUISE, COMBAT, NO PRESSURE switch on the starboard console. It is necessary to lift the

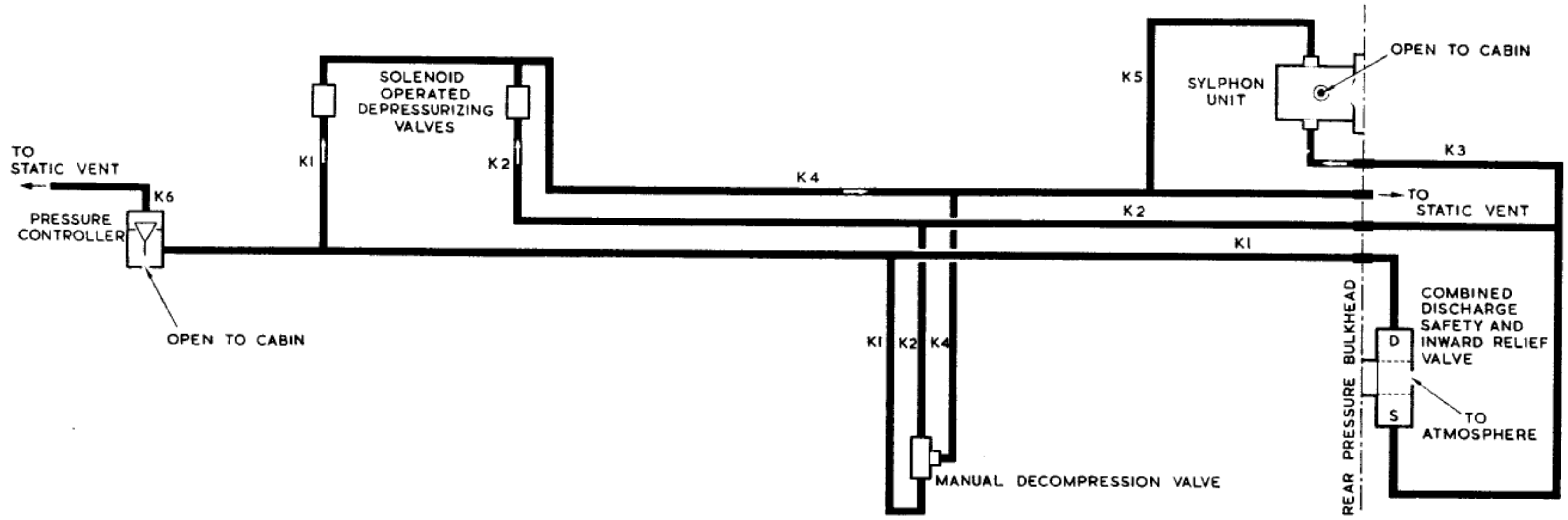

Fig. 7. Cabin pressure control system diagram

switch through a gate to move it from the COMBAT position. The discharge valve is mounted on the rear pressure bulkhead and forms part of the combined discharge, safety and inward-relief valve unit.

39. If any malfunctioning of the normal pressure control equipment results in the cabin differential pressure rising above the safety limit, the safety valve (regulated by the sylphon unit on the rear pressure bulkhead) will open to limit it to 9·5 lb/in².

40. An inward-relief valve, forming the third part of the combined valve unit, is fitted to prevent negative differential pressures in excess of 0·5 lb/in² existing across the cabin walls when ambient pressure exceeds that in the cabin.

41. There is a common airflow for pressurization, heating and demisting. It is ducted from the engines to the cabin (*para.* 7 *to* 14) where it enters through a non-return valve on the rear pressure bulkhead rear face. The non-return valve consists of two flap plates hinged to a spindle mounted centrally across the bore of the valve body. Air entering the cabin blows the valve flaps clear of their seating, and if the flow is reversed due to a loss of pressure outside the cabin they will blow back onto their seating to prevent loss of cabin pressure. (For further details of the valve see A.P.4340, Vol. 1, Sect. 6, Chap. 27.)

42. With the cabin pressure switch selected to CRUISE or COMBAT, and the aircraft below pressurizing control height of 8000 ft. or 25000 ft. respectively, air entering the cabin for ventilating and conditioning is exhausted to atmosphere by the discharge valve. Above the control height the cabin pressure controller takes over to regulate the discharge valve outlet and maintain the cabin altitude at 8000 ft. or 25000 ft., depending upon selection. The pressure controller comprises three essential components, viz., the controller proper, and an electric motor and gearbox to change the CRUISE/COMBAT setting.

Pressure controller

43. The controller consists of a differential and an absolute capsule stack, the capsules contacting the ends of a beam. A control valve positioned between the capsules is actuated by the beam, a short link extending from the beam and making internal contacts to ring an alarm bell in the event of serious loss of cabin pressure. There are three connections on the controller body; they are to static vent, connecting the inside of the differential capsule and the inside of the controller to atmosphere, to cabin (incorporating a fixed bleed connecting the inside of the controller to cabin pressure) and an outlet to the bellows operating the discharge valve flap.

44. With the aircraft below control height, air entering the cabin blows the discharge valve spring-loaded flap off its seat and is exhausted to atmosphere; it also enters the pressure controller through the fixed bleed and out to atmosphere via the control valve and static vent connection. As altitude increases the absolute capsule expands and lowers the control valve to restrict the flow to atmosphere through the static vent. As the aircraft descends the control valve will be raised due to the absolute capsule contracting as the higher pressure air enters the controller through the fixed bleed. Thus the control valve, by limiting the bleed to static, controls the opening of the discharge valve by maintaining a control pressure in the pressure controller and the discharge valve bellows. This control pressure so positions the discharge valve plate that the restriction it offers to the outgoing air is such that it maintains cabin altitude at the required level.

45. With the aircraft continuing to climb the differential pressure increases, causing the differential capsule to contract due to its internal pressure becoming progressively lower until, at 47250 ft., the absolute capsule will be controlling at the maximum differential of 9 lb/in^2. At this height in the CRUISE setting the cabin altitude will again commence to rise as the aircraft climbs. At 47250 ft. the absolute capsule has expanded and lowered its end of the beam onto a stop. The differential capsule then contacts the other end of the beam, and any further rise in aircraft altitude will cause the capsule to contract still further to lift the control valve from its seat. Thus the differential capsule then takes over and maintains the differential pressure at 9 lb/in^2 maximum by regulating the bleed to static to control the opening of the discharge valve plate.

46. In the COMBAT setting the absolute capsule is raised by the motor and gearbox, but acts exactly the same as in the CRUISE setting. Due to its new position however, it requires an altitude of 25000 ft. before it will lower the beam and bring the control valve into the control position to act upon the discharge valve to maintain a cabin altitude of 25000 ft. It should be noted that in this setting the differential capsule never controls the control valve.

Safety valve

47. In the event of failure of the normal pressure control equipment the sylphon unit, acting in conjunction with the safety valve on the combined valve unit, will limit the cabin pressure to a maximum differential of 9·5 lb/in^2.

48. The sylphon unit, on the rear pressure bulkhead just below the combined valve unit outlet, consists of a control valve operated by a differential capsule with a spring-loaded beam interposed between them. There are four connections on the unit body, viz., to cabin (incorporating a fixed bleed), to static vent, to the safety valve bellows, and to cabin pressure. The cabin connection is to the underside of the control valve and then to the bellows; the static vent is to the top side of the control valve and the capsule chamber, and the cabin pressure to the inside of the capsule.

49. With the cabin differential pressure approaching 9·5 lb/in^2 the differential capsule load will equal the spring load, and the capsule length will not alter. Cabin pressure entering the unit through the fixed bleed is felt on the underside of the control valve and on the bellows side of the safety valve plate. In the unoperated condition, cabin pressure is felt on both sides of the safety valve plate, but because of its differential areas it remains closed.

50. As the cabin differential pressure rises above 9·5 lb/in^2, the bellows expand and overcome the spring pressure to operate the beam, which in turn opens the control valve. This allows cabin pressure to bleed away to static from the underside of the control valve and the safety valve bellows, cabin pressure then opening the valve to prevent any increase in the cabin differential pressure.

Combined valve unit

51. The combined discharge, safety and inwards relief valve (automatic in operation) is mounted on the rear pressure bulkhead rear face. The discharge and safety valves, diametrically opposite each other, are bolted to that part of the unit containing the inward relief valve which is flanged for connection to the bulkhead. The discharge and safety valves are similar in construction and operation, each consisting of a valve flap lightly spring loaded onto its seat and connected to a flexible bellows. The bellows are attached to the valve body and connected by pipelines to the pressure controller and the sylphon unit respectively. When the aircraft is below control height the discharge valve flap can be blown open to allow air entering the cabin for ventilating and conditioning to exhaust to atmosphere. Above control height, cabin pressure is introduced to the bellows by the controller or the sylphon unit to regulate the opening of the valve plates, and control cabin pressure.

52. The inward relief valve consists of two flap plates spring loaded onto their seat. They will be blown off this seat to allow air to enter the cabin, should a negative pressure (ambient greater than cabin pressure) exist across the cabin walls.

Cabin overpressurization

53. The maximum cabin differential pressure should not normally exceed 9·5 lb/in^2. On aircraft post-Mod. 2490 a differential pressure switch, under the cabin floor at Stn. 241, operates to illuminate a warning lamp above the pressure head heater switch on the second pilot's instrument panel. The switch, open to cabin pressure and connected to static, 'makes' when the cabin pressure rises above 9·5 lb/in^2 and 'breaks' at 9·1 lb/in^2.

54. Should it be necessary to reduce the cabin pressure due to overpressurization, without depressurizing the cabin, it is possible to reduce the differential pressure to $3\frac{1}{2}$ lb/in^2 by lifting the knob on the top of the pressure controller.

DEPRESSURIZING

55. The cabin is depressurized by the operation of two solenoid-operated decompression valves mounted adjacent to the pressure controller on the cabin starboard wall. These valves are normally controlled by selecting the CABIN PRESSURE switch to NO PRESSURE; in emergency the valves can also be controlled by the first pilot selecting the guarded NORMAL/DEPRESSURIZE switch to DEPRESSURIZE. When operated these valves open to connect the control pipelines from the pressure controller and the sylphon unit to a static connection on the rear bulkhead.

The control pressure to the discharge and safety valve bellows is bled to atmosphere, the valve flaps are blown off their seats and cabin pressure is reduced. Post-Mod. 2057, electrical interconnections prevent automatic operation of the flood flow system when the cabin is deliberately depressurized.

Manual emergency depressurization valve

56. This valve, mounted centrally on top of the radio crate at the rear crew position, is provided for use in the event of electrical failure. Post-Mod. 2877, the valve is fitted in the 1st navigator's table and is concealed under a hinged cover marked with yellow stripes on a black background. It is a taper plug type valve connected to the control pipelines to the discharge and safety valves, and has two positions, NORMAL and EMERGENCY DEPRESSURIZE. At NORMAL the valve ports are closed, but when the valve handle is moved to EMERGENCY DEPRESSURIZE, the ports are opened and the control lines to the discharge and safety valve bellows are connected to the static vent connection on the rear pressure bulkhead, control pressure is bled to atmosphere, the valves open and cabin pressure is reduced. Post-Mod. 2057, a microswitch, fitted to the valve and operated by the valve handle, prevents operation of the flood flow system when the cabin is deliberately depressurized.

57. In emergency, when it is required to reduce the cabin pressure quickly, it will be necessary to turn and lift the knob on top of the cabin pressure controller. The knob is spring loaded downwards and is attached to an extension of the stem of the differential capsule stack. If the cabin pressure exceeds $3\frac{1}{2}$lb/in² when the knob is lifted the differential capsule will lift, raise the control valve from its seat and bleed control pressure to atmosphere through the static vent connection on the controller. Control pressure bleeds from the discharge valve bellows, the valve opens and cabin pressure is reduced. The absolute capsule then expands due to the lower cabin pressure entering the controller through the fixed bleed from the cabin, and the differential capsule will control at $3\frac{1}{2}$ lb/in². With the aircraft at an altitude where the differential capsule is controlling (i.e., above 47250 ft. in the CRUISE setting) the differential capsule stack is lifted and, in its new position, will control the maximum differential pressure at $3\frac{1}{2}$ lb/in².

FLOOD FLOW SYSTEM (*fig.* 1)

58. The flood flow system (separate from the normal system) with its own intercooler, is brought in to compensate for loss of cabin pressure as a result of enemy action at high altitude. With the aircraft at 50000 ft. it is capable of maintaining 25000 ft. in a cabin, the skin of which has been penetrated up to 10 sq. in. Full flood flow will admit an extra 90 lb of air per minute to the cabin, 45 lb from each pair of engines. The system is introduced automatically by an absolute pressure switch when the cabin altitude rises to 29000 ft. It can also be controlled by the operation of the EMERGENCY INCREASED AIR SUPPLY switches on the starboard console ; they are spring loaded to the centre OFF position and are marked INCREASE/DECREASE.

59. These switches can open the flood flow valves at any time, but cannot close them if the cabin altitude is above 29000 ft., due to a clutch which is held in the 'off' position by the action of the absolute pressure switch. A second absolute pressure switch prevents inadvertent operation of the system. Post-Mod. 2057, electrical interconnection with the depressurizing controls prevents operation of the system when the cabin is deliberately depressurized.

Air supply

60. Airflow for the system is led from the engines through the same ducting as the normal system as far as fuselage Stn. 370, whence the normal ducting branches off through the constant flow valves. The starboard flood flow ducting extends across the fuselage at this point to join that on the port side, forming a single duct passing forward to the intercooler and then to a non-return valve on the rear pressure bulkhead. (For details of the non-return valve see A.P.4340, Vol. 1, Sect. 6, Chap. 26).

Flood flow valves

61. Two gate type valves, one in the ducting from each pair of engines, normally remain in the closed position. They are located on the floor of the upper servicing bay, one on the aircraft centre line and the other on the port side. The valve body is in two halves bolted together, the inlet and outlet ports being opposite each other on the top and bottom halves respectively. The valve assembly comprises an upper plate with two carrier side plates supporting a lower plate. A connecting link attaches the upper plate to an operating lever splined to a spindle. A quadrant, splined to the upper end of this spindle, is moved by a driving gear splined to a shaft driven through a clutch by an electrical actuator to open and close the valve. A cable, wrapped around a pulley on the same shaft as the driving gear, is attached to a tension spring which is loaded to open the valve. (For further details of the valve see A.P.4340, Vol. 1, Sect. 5, Chap. 28).

Absolute pressure switches

62. The absolute pressure switches, No. 1 mounted on top of the radio crate to starboard and No. 2 (Mod. 2386) on the forward face of the rear bulkhead, each consist of an absolute pressure capsule which operates a microswitch when the cabin altitude rises above 29000 ft. With the absolute pressure switches inoperative, the clutch between the actuator and the driving shaft to the flood flow gate valve quadrant will be engaged and the valve will be controllable by the EMERGENCY INCREASED AIR SUPPLY switches on the starboard console; moving the switches to INCREASE opens the valves and to DECREASE closes them.

63. With the cabin altitude above 29000 ft., the pressure switch absolute capsule will operate the microswitch, the clutch solenoid is energized and the clutch disengaged, and a tension spring opens the valve. The clutch

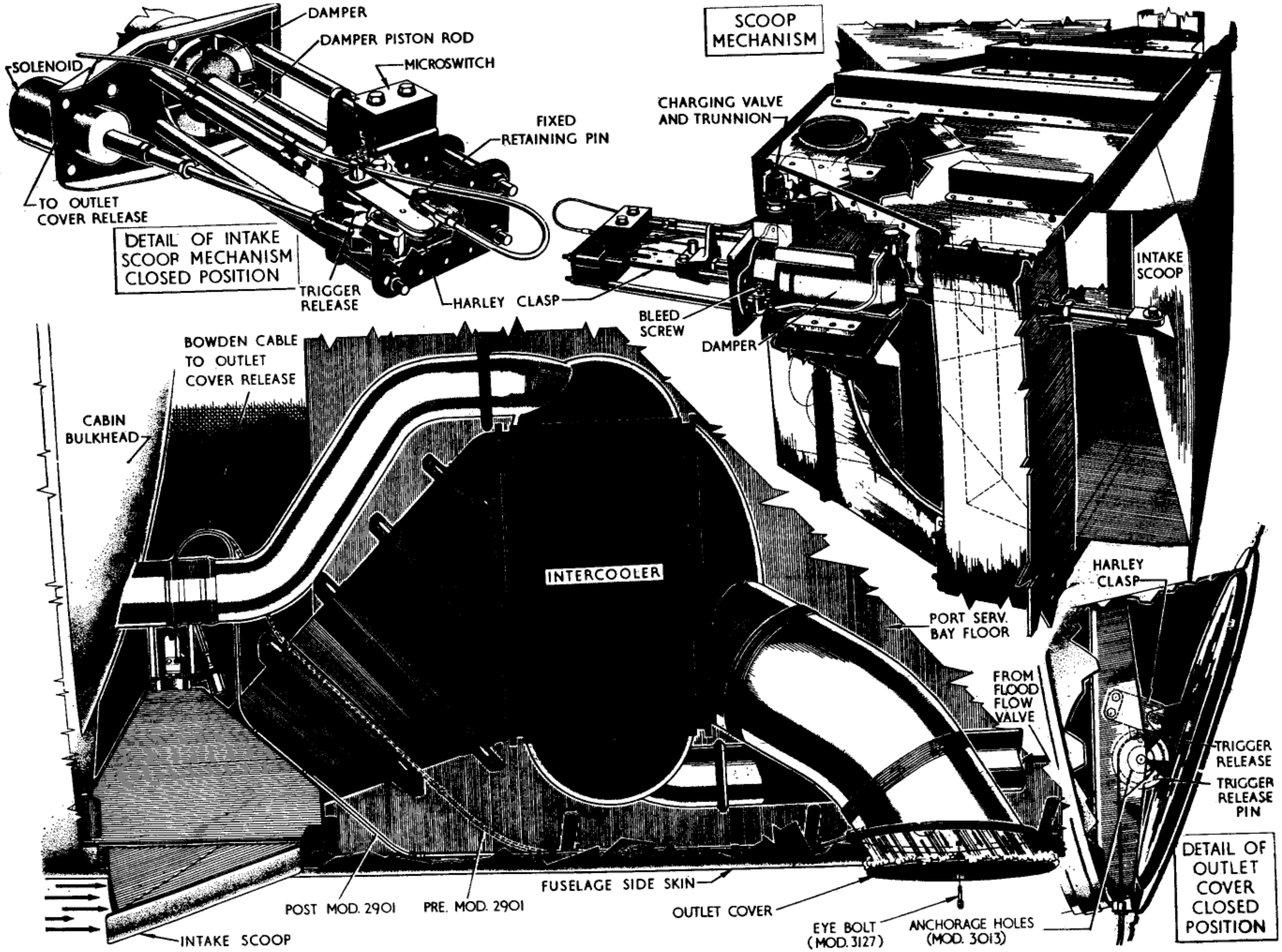

Fig. 8. Flood flow scoop mechanism

solenoid remains energized so long as the cabin altitude is above 29000 ft. and in this condition the valves cannot be operated by the switches on the starboard console, and will remain open. If the cabin pressure is now raised as a result of the increased airflow and the altitude drops below 29000 ft., the microswitch is 'broken', the solenoid de-energized and the clutch engaged. The valves will still remain open but they can then be controlled by the switches on the starboard console.

Flood flow intercooler (*fig.* 8)

64. The intercooler, on the floor of the upper servicing bay, is the only means of cooling the airflow to the flood flow system. It is provided with an air-intake scoop and an outlet duct in the fuselage port skin. In normal conditions the scoop fits flush with the skin (blanking off the intake duct) and the outlet is blanked off with a flush-fitting cover. When the absolute pressure switch is operated to open the flood valves, the intake scoop and outlet cover are simultaneously released and a flow of cooling air is introduced through the intercooler. (For details of the intercooler see A.P.4340, Vol. 1, Sect. 8, Chap. 1, App. 9).

Intake scoop mechanism (*fig.* 8)

65. The cooling air intake duct is fitted with a hinged scoop, held in the closed position by a Harley clasp. Operation of the absolute pressure switch trips the clasp, and the scoop is forced into the airflow by a spring-loaded hydraulic damper, the airstream taking over to complete the opening. At the same time the cooling air outlet cover is jettisoned by a release mechanism; there is no control over this and, once operated, it can be reset only on the ground.

66. The intake scoop release mechanism comprises a damper mounted in bearings on the intake duct, a microswitch, a solenoid-operated trigger release (operating the Harley clasp), and an attachment for a Bowden cable (operating the outlet cover release). The attachment is bracket-mounted on four pillars secured to the damper cylinder inboard end. One end of the damper piston rod is connected to the intake scoop and the other to the release mechanism.

67. The damper, filled with oil OM-15, initiates movement of the scoop into the airstream, and then controls its rate of opening; it is fitted with a charging valve and a bleed valve. The piston is spring loaded to one end of the cylinder and is relieved by two metering holes, the cylinder bore having machined flutes at the spring end to assist initial movement of the piston. With the intake scoop closed, the spring is compressed and the piston is in the fluted portion of the cylinder. Operation of the absolute pressure switch energizes the trigger release solenoid which opens the Harley clasp and the spring forces the piston down the fluted portion of the cylinder to force the scoop out into the airflow, the flutes allowing oil to pass freely from one side of the piston to the other. The piston moves out of the fluted area and the airstream continues to open the scoop, the damper controlling the rate of opening as the oil must then pass through the piston metering holes.

Outlet cover release mechanism (*fig.* 8)

68. The outlet cover is held in position by a Harley clasp operated by a trigger release pin on a pulley mounted in the outlet duct; a Bowden cable encircles the pulley and is connected to the intake release mechanism. When the intake scoop is released and forced into the airstream, the piston rod pulling on the Bowden cable rotates the pulley. The trigger release pin trips the clasp and releases the outlet cover; at the same time the microswitch is tripped to de-energize the trigger release solenoid. Ram air is then directed through the intercooler to atmosphere.

Note . . .

When servicing in the vicinity of the outlet cover release Bowden cable, care must be taken to avoid damaging or disturbing the cable. (Mod. 2901 re-routes the Bowden cable.) Always check the outlet cover for security;◀Mod. 2901 re-routes the Bowden cable, and Mod. 3127 introduces a special tool. Pt. No. 70655-649, which can be hooked into the cover to facilitate the security check.▶

GROUND CONDITIONING AND VENTILATING

69. An air conditioning trolley provides for conditioning the cabin when the aircraft is on the ground. A fan is also fitted to ventilate the cabin during taxying and unpressurized flight.

Note . . .

The aircraft cold air unit must not be used to reduce the cabin temperature in these conditions.

Ground conditioning connection

70. The ground conditioning connection, mounted on the cabin starboard wall at Stn. 180, is covered by a hinged outward-opening flap secured by a captive screw (in the flap) which screws into a threaded boss on the inward-opening valve plate. (For further details of the connection see A.P. 4340, Vol. 1, Sect. 13, Chap. 3).◀Post-Mod. 3107, to provide automatic separation from the ground supply as soon as forward movement of the aircraft begins, this item is removed and replaced by a quick-release connector and non-return valve.▶

Ventilating fan

71. The ventilating fan, driven by an electric motor, is mounted in the port servicing bay, the whole unit being fitted inside the ducting from the ram air intake (in the port inner wing) to the ram air non-return shut-off valve. Operation of the fan is controlled by the VENT AIR ON/OFF switch on the starboard console.

Unpressurized flight (ram air) valve

72. The electrically-operated, non-return shut-off valve, mounted on the floor of the port servicing bay, is controlled by a RAM AIR ON/OFF switch on the starboard console. WITH the switch at ON the valve is open and ventilating air is admitted to the cabin from the ram air intake. If left open during pressurized flight, the valve will be blown on to its seat by cabin pressure to act as a non-return valve and prevent loss of pressure. The construction and operation of the valve is similar to that described in para. 22.

Ground test connection

73. Provision is made in the port servicing bay for connecting a compressor for pressure testing the cabin and the hot air ducting. A ground test connection on the ducting is fitted on the floor of the port servicing bay just aft of the forward access panel. (For further details see A.P.4340, Vol. 1, Sect. 13, Chap. 1, App. 6).

Hot air ducting

74. The ducts subject to high temperature are of steel. Where they cross the fuselage at Stn. 370 they are wrapped in glass fibre and covered with glass-cloth to safeguard the electrical equipment on panel 'J'. Sealing rings of corrugated steel with asbestos packing are fitted in grooves in the duct end flanges where they connect to the expansion joints, and the joints are secured by clamp-type couplings.

Duct expansion joints

75. Bellows-type expansion joints, to cater for linear expansion of the engine and the ducting, are located on each side of the T-branch pipe leading from the gate valve on each engine, in the wing de-icing system outboard of each outer engine and in the ducts immediately after they enter the fuselage. Further expansion joints are fitted at intervals in the branches of the hot air ducts.

76. The expansion joints in the wings and just inside the fuselage are of corrugated three-ply bronze tubing, silver soldered to short end ducts, the duct flanges being connected by two straps passing over the corrugations and bolted to the flanges. The complete assembly is nickel plated inside and out and secured to the ducting by clamp-type couplings. The expansion joints on each side of the T-branch pipes from the engine gate valves, are of stainless steel with two spiders (screwed into the bellows end fittings) projecting into the bellows and attached to each other by a universal coupling; bolted flanges secure the joint to the duct, a Metaflex sealing ring being interposed between the flanges. Bellows-type expansion joints are fitted in the hot air branches, the joints being of three-ply bronze tubing silver soldered to short end ducts, the whole assembly being nickel plated. They are secured to the ducting by clamp type couplings.

Ducting in air conditioning bay

77. In the air conditioning bay the ducting subject to high temperatures and pressures is of steel with Metaflex sealing rings and clamp type joints. Other ducting is of light alloy with joints of silicone rubber hose secured with jubilee clips.

Ducting in pressure cabin

78. All ducting in the cabin is of light alloy, the duct ends being beaded and the silicone rubber hose joints each secured by four turns of 20 s.w.g. copper wire.

Ducting in flood flow system

79. Upstream of the intercooler the ducting is of steel with clamp-type joints; down stream it is of light alloy with joints of silicone rubber hose secured by jubilee clips.

Silencers

80. To reduce noise to an acceptable level, a Vokes and a Burgess silencer are fitted in tandem in the port servicing bay. In aircraft post-Mod. 2192 the Burgess silencer is replaced by a water extractor. (For details of silencers see A.P.1464D, Vol. 1, Part 2, Sect. 1, Chap. 4).

Water extractor

81. The water extractor (*para.* 80) extracts moisture from the airflow before it enters the cabin. Water is collected in the base of the unit and drains to atmosphere through a restricter and drain pipe. The restricter minimizes pressure losses when the extractor is inoperative. (For further details see A.P. 4340, Vol. 1, Sect. 9, Chap. 5).

Pipeline markings

82. The pressure control equipment pipelines are each identified by three rings of small black dots and the words AIR CONDITIONING on a white pipe label. Pipes throughout the installation are identified at bulkhead connections and clamps by the code letter K, and individual pipe runs between components by a number thus:—K1, K2, etc. Where necessary, direction-of-flow labels (Mod. 2736) are attached to the non-return valve connecting pipes in the system.

PRESSURE TESTING

83. The cabin and equipment can be tested, using air supplied from the engines or from a ground test rig. The aircraft instruments do not include a cabin differential pressure gauge and, when making the following tests, it will be necessary to mount a gauge temporarily in the cabin. The gauge which must be capable of reading at least + 12 lb/in² in quarters of a pound, must have its static line connected to the spare ¼ in. B.S.P. connection on the rear pressure bulkhead; this connection is the lowest in the starboard bank and is adjacent to that marked B38. The external blanking cap must be removed.

Note . . .

To make certain tests there must be at least one person in the pressure cabin. Personnel should be medically fit to withstand pressure change rates of $\pm$ 2 lb/in² per minute (A.P.1464, Vol. 2, Part 1, Leaflet 36, refers).

TESTING WITH SUPPLY FROM ENGINES

84. There are no mandatory safety precautions other than those in force for engine ground running. (A.P.970, Vol. 2, refers). Throughout these tests the ground running limitations for the engines must be observed (A.P.4481A, D and E, Vol. 1). During the safety valve test all personnel other than operators should be at least 75 yards from the cabin. There must be adequate intercommunication between personnel inside and outside the aircraft.

Preparation for testing

85. Before entering the cabin ensure that the static vents to the pressure controller and the sylphon unit are clear. Fit a blank to the water extractor drain pipe (post-Mod.

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2192). Enter the cabin and check the following:—

(1) DEPRESSURIZATION SWITCH on port console at NORMAL.

(2) Manual decompression valve at NORMAL.

(3) D.V. windows open.

(4) Sextant dome, crash landing exit and canopy correctly fitted.

(5) With the entrance door closed and bolted, the door seal must inflate and the ENTRANCE DOOR indicator show black.

(6) Cabin air supply switch at OFF.

(7) Ram air switch at OFF.

(8) Emergency increased air supply switches at OFF.

(9) Ventilating fan switch at OFF.

(10) The engine gate valve switches are at NORMAL.

(11) Cabin temperature control; select RAISE to open intercooler valve, and release switch.

When the above checks are completed start up any one engine and set to idling r.p.m. Close the D.V. windows before proceeding with the following tests.

Pressure controller and discharge valve test

86. (1) Select COMBAT on the cabin pressurization switch.

(2) Select the appropriate cabin air supply switch ON.

(3) Check that there is no pressure rise in the cabin.

(4) Select CRUISE on the cabin pressurization switch.

(5) Again check that there is no rise in cabin pressure.

(6) RAISE the ground test lever on the pressure controller; the warning bell should ring.

(7) Carefully increase engine r.p.m and ensure that the pressure rise does not exceed 2 lb/in² per minute.

(8) Check that the cabin differential pressure rises to 9 ± 0·25 lb/in² and stabilizes. Do not allow the maximum differential pressure to be exceeded if the pressure does not stabilize at the above figure.

(9) Ensure that the overpressurization warning lamp remains 'off'.

Cabin leak test and controls check

87. When the pressure has stabilized at 9 ± 0·25 lb/in² check all flying and engine controls for full range and freedom of movement. Select OFF on the cabin air supply switch and take time readings◀in accordance with the Major Servicing Schedule (A.P.4377A, Vol. 4, Part 4). The time taken for the pressure to fall to 1·0 lb/in² must be not less than 7 min. 7 sec.▶

Alternate supply check

88. Start an engine on the side opposite to that previously used, set to idling r.p.m. and:—

(1) Select appropriate cabin air supply switch to ON.

(2) With the cabin pressurization switch selected to CRUISE, proceed as in para. 86, operations (6), (7), (8) and (9).

(3) Switch OFF cabin air supply and allow pressure to leak away to 0·5 ± 0·25 lb/in² on the gauge.

(4) Open the D.V. windows.

Sylphon unit and safety valve test

89. It is first necessary to isolate the pressure controller; proceed as follows:—

(1) At the controller or any convenient point, disconnect pipe K1 from the pressure controller to the discharge valve, and blank off the connection to the controller only.

(2) Start one engine and set to idling r.p.m. select CRUISE or COMBAT on the cabin pressurization switch.

(3) Select the appropriate cabin air supply switch to ON.

(4) Carefully increase engine r.p.m. and ensure that the pressure rise does not exceed 2 lb/in² per minute.

(5) Check that the cabin differential pressure rises to 9·5 ± 0·25 lb/in² and stabilizes.

(6) The cabin overpressurization warning lamp, set to operate at 9·5 lb/in² with a rising pressure, should come 'on'.

WARNING . . .

If the safety valve fails to operate at this figure it is essential to shut off the air supply immediately.

Depressurization test

90. With the pressure control system connected up normally, and the cabin pressurization switch selected to CRUISE or COMBAT, proceed as follows:—

(1) Start one engine and set to idling r.p.m.

(2) RAISE the ground test lever on the pressure controller.

(3) Select the appropriate cabin air supply switch to ON.

(4) Pressurize the cabin to not more than 2 lb/in².

(5) Select cabin pressurization switch to NO PRESSURE; the pressure should immediately fall. Reset the switch to CRUISE or COMBAT.

(6) Repeat operation (4) and then select the switch on the port console to

DEPRESSURIZE; the pressure should fall immediately. Reset the switch to NORMAL.

(7) Repeat operation (4) and select the manual decompression valve to EMERGENCY DEPRESSURIZE; the pressure should fall immediately. Reset the valve to NORMAL.

Duct leak test

91. Complete the following operations:—

(1) Ensure that the AIRFRAME AND ENGINE DE-ICING MASTER SWITCH on the starboard console is OFF.

(2) Select both cabin air supply switches ON and, with special spanners 26SR/95148, lock open both cabin air supply non-return shut-off valves.

(3) Start one engine and ensure that the throttle levers of the engines not being used are fully back in the H.P. cock shut-off position.

(4) With the pressure controller at CRUISE, proceed as in para. 86, operation (6), (7) and (8).

(5) Check all duct joints between the cabin and the engine gate valves, and ensure that there are no excessive leaks.

(6) Close down the engine and check that the rate of pressure drop conforms with the specified requirements (*para.* 87).

(7) Remove the spanners fitted in operation (2).

92. On completion of the tests described above return the complete pressure system to its normal condition, remove the differential pressure gauge and refit the blanking cap on the rear pressure bulkhead. Remove the blanking cap from the water extractor drain pipe (Mod. 2192).

Flood flow test

93. Complete the following operations:—

(1) "Short" out the absolute pressure switches for a minimum of 2 seconds. (Pre-Mod. 2386 there is only one; post-Mod, 2386 there are two.)

(2) Ensure that this:—

(a) Trips open both flood flow valves.

(b) Opens the flood flow scoop a minimum of $\frac{3}{4}$ in.

(c) Releases the flood flow intercooler cooling air outlet cover; check that the cover is jettisoned cleanly.

(3) Pull out the scoop to its full extent (6 in.) and lift off the outlet cover to check the Bowden cable and Harley clasp.

(4) Leave the cabin door open and cabin air supply switches OFF.

(5) Start one port engine and set to idling r.p.m.

(6) Check that air enters the cabin through the flood flow non-return valve on the rear pressure bulkhead.

(7) Ensure that the rate of airflow is controllable by the port EMERGENCY AIR SUPPLY CUT-OUT SWITCH. Finally select DECREASE and hold until valves are closed.

(8) Repeat operations (5), (6) and (7), using one starboard engine and the starboard cut-out switch.

(9) On completion of the test, close the flood flow intake scoop by hand and, with the tool 26SR/95103, replace the outlet cover (*para.* 111 *and* 112).

TESTING, USING GROUND TEST RIG

Preparation for testing

94. Although the test rig is equipped with a pressure gauge it is desirable that a gauge is also fitted in the pressure cabin as described in para. 83. It is essential that there is adequate intercommunication between personnel inside and outside the aircraft. Proceed as in para. 85 and complete the checks detailed in operations (1), (2) and (4) to (11) inclusive. Connect the ground test rig to the ground test connection in the port servicing bay.

Pressure controller and discharge valve test

95. This test can be made by either of the two methods described in para. 96 and 97.

96. *With an operator inside the cabin:—*

(1) Select COMBAT on the cabin pressurization switch.

(2) Start up the pressure rig and ensure that there is no pressure rise.

(3) Select CRUISE on cabin pressurization switch and ensure that there is no pressure rise.

(4) Raise the ground test lever on the pressure controller; the alarm bell should ring.

(5) Note that the cabin differential pressure rises to 9 $\pm$ 0·25 lb/in^2 and stabilizes.

(6) On post-Mod. 2490 aircraft, ensure that cabin overpressurization warning lamp remains 'off'.

(7) Do not exceed a pressure rise of 2 lb/in^2 per minute and do not permit the maximum differential pressure to be exceeded if the pressure does not stabilize at the figure specified in operation (5).

97. *With the cabin unoccupied:—*

(1) Place the cabin differential pressure gauge so that it is visible through the bomb-aimer's window.

(2) Proceed as in para. 95, operations

(1), (2) and (3).

(3) Shut off the ground test rig and then RAISE the ground test lever.

(4) Leave the cabin and secure the door from the outside.

(5) Start the ground test rig and pressurize to a maximum differential pressure of 9 ± 0·25 lb/in².

(6) Do not exceed a pressure rise of 2 lb/in² per minute and do not allow the maximum differential pressure to be exceeded if the pressure does not stabilize at the above pressure.

Release of cabin pressure

98. It must be appreciated that with no one in the cabin the cabin pressure cannot be relieved. It is recommended that the air in the cabin be allowed to leak away until the gauge reads zero. Care must be taken when opening the door, bearing in mind that a small amount of residual pressure may remain in the cabin due to the pressure exerted by the springs in the combined valve unit.

Cabin leak test

99. *With an operator in the cabin:—*

(1) Proceed as in para. 96.

(2) When the pressure has stabilized at 9 ± 0·25 lb/in² check all flying and engine controls for freedom of movement and full range.

(3) Shut off the ground test rig and take time readings at 1 lb/in² intervals as the pressure drops. The time must be not less than that shown in the pressure-fall chart (*fig.* 9).

Note . . .

An alternative test, with the cabin unoccupied, is given in para. 100.

100. *Cabin unoccupied:—*

(1) Proceed as in para. 97.

(2) When the pressure stabilizes, shut off the ground test rig and take readings as in para. 93, operation (3).

Sylphon unit and safety valve test

101. This test can be made without an operator in the cabin:—

(1) Isolate the pressure controller as detailed in para. 89, operation (1).

(2) Place the gauge so that it is visible through the bomb-aimer's window.

(3) Close and bolt the entrance door.

(4) Start the test rig and check that the cabin differential pressure rises to 9·5 ± 0·25 lb/in² and stabilizes.

On aircraft post-Mod. 2490 it will be necessary to have an operator in the cabin to check the cabin overpressurization warning lamp.

WARNING . . .

Should the safety valve fail to blow off at the figure specified in operation (4), it is essential to shut off the test rig immediately.

(5) Stop the test rig and allow cabin pressure to leak away.

(6) On completion of test reconnect the pressure controller.

Depressurization test

102. This test requires an operator in the cabin:—

(1) With the pressure control system connected normally, select CRUISE or COMBAT on the cabin pressurization switch.

(2) RAISE the ground test lever and start up the ground test rig.

(3) Pressurize to *not more* than 2 lb/in².

(4) Select NO PRESSURE on the cabin pressurization switch ; the pressure should fall immediately. Reset the switch to CRUISE or COMBAT.

(5) Repeat operation (3) and select switch on port console to DEPRESSURISE; the pressure should fall immediately. Reset the switch to NORMAL.

(6) Repeat operation (3) and operate the manual decompression valve to EMERGENCY DEPRESSURIZE; the pressure should fall immediately.

(7) Open the D.V. windows.

(8) Reselect NORMAL on the manual decompression valve.

Duct leak test

103. This test can be made with the cabin unoccupied:—

(1) Ensure that the AIRFRAME AND ENGINE DE-ICING MASTER SWITCH IS OFF.

(2) Ensure that the four throttle levers are fully back in the H.P. cock shut-off position.

(3) Ensure that both cabin air supply switches are ON and, using the spanners 26SR/95148, lock open both cabin air non-return shut-off valves.

(4) Select CRUISE or COMBAT and RAISE the ground test lever.

(5) Place the gauge so that it is visible through the bomb-aimer's window.

(6) Leave the cabin, and close and bolt the door.

(7) Start the test rig and pressurize to a differential pressure of 9 ± 0·25 lb/in².

(8) Check all duct joints between the cabin and the engine gate valves and ensure that there are no excessive leaks.

(9) Stop the test rig and note that the rate of pressure drop conforms with the cabin pressure-fall chart (*fig.* 9).

(10) Remove the spanners fitted in operation (3).

104. On completion of all the above tests, return the complete pressure system to its normal condition, remove the differential pressure gauge and refit the blanking cap on the bulkhead connection. Remove the blanking cap from the water extractor drain pipe (Mod. 2192) and disconnect the ground test rig.

WINDOW DEMISTING AND VENTING SYSTEM (*fig.* 10)

105. The canopy and the bomb-aimer's side windows are demisted and vented by a common piping system (incorporating a desiccator) which introduces dry air to the space between the windows, the system venting to atmosphere at a point forward of the canopy starboard window.

Testing the system (*fig.* 10)

106. The pipelines and windows are tested separately as follows:—

Pipelines

(1) Fit blanks at connections A, B and D.
(2) At connection E, apply dry air at 10 lb/in^2, a suitable gauge being fitted in the pressure line to ensure that there is no appreciable leakage over a period of 15 minutes.
(3) When remaking joints A, B, D and E, ensure that they are secure as they will not be subjected to a pressure test.

Windows

(1) Disconnect the couplings at T-piece A.
(2) Apply a pressure of $\frac{1}{4}$ lb/in^2 to the pipeline to the starboard window, a suitable gauge being fitted in the pressure line to ensure that there is no appreciable leakage over a period of 15 minutes.
(3) Repeat the test on the port window.
(4) Disconnect the couplings at D and test the bomb-aimer's side windows, using the method described in operation (2).

Pressure testing the inner windows (*fig.* 10)

107. When an inner window has been renewed it should be pressure tested. Pressurize the cabin (normal ground pressure test) and ensure that there is no continuous leak at the vent on the starboard side of the canopy.

SERVICING

108. For the servicing of actuators and valves, etc., consult the relevant specialist publication; for details of the aircraft electrical system and wiring diagrams see Book 2, Sect. 5, Chap. 5 of this publication.

Replenishing the cold air unit oil system

109. At the stipulated servicing period, check the oil level in the sump of the cold air unit. On certain units a dipstick/oil filler assembly is screwed into the side of the sump; on later units a visual oil level gauge is fitted. Top up with oil OX-38 to the indicated level on either dipstick or gauge.

Flood flow system

110. After operating the flood flow system, or function testing the flood flow valves, the EMERGENCY INCREASED AIR SUPPLY switches on the starboard console must be held to DECREASE for at least 15 seconds to ensure that the valves are fully closed. In aircraft post-Mod. 1733, six $\frac{1}{8}$ in. dia. holes are provided around the base of the spring support tube to assist in positioning the valve. The spring end piece should be seen or felt through the holes, indicating that the valve is closed.

Resetting the flood flow intake and outlet cover

111. The intake scoop can be almost closed by hand, but it will be necessary for an operator in the servicing bay to complete the closure with tool 26SR/95103, engaging the toggles between the damper and the Harley clasp bracket and drawing the two together until the clasp engages a fixed retaining pin.

112. When resetting the scoop the cable to the outlet cover release is slackened, thus permitting the pulley to wind it up to the normal position. Should the pulley fail to take up the cable slack, the operating spigot must be checked to ensure that it has not gone beyond the tip position of the clasp lever. When the cable is correctly reset the outlet cover can be fitted by engagement with the clasp; ensure that the setting is such that the cover will be released simultaneously with the opening of the scoop. Mod. 3127 provides for a check to prevent inadvertent loss of the cover during flight.◀The special tool, Pt. No. 70655-649, after being hooked into the eyebolt in the cover,▶should be pulled to ensure that the cover is firmly retained in position. When not in use the tool is stowed in the blackout screen satchel in the cabin.

REMOVING AND REFITTING COMPONENTS

113. When refitting items of pressurization equipment in an unpressurized portion of the aircraft, satisfactory joints must be made to prevent air losses from the system. Where there are flanged couplings with interposed seals, Bostik sealing compound S.1751 and S.1790 must be used. Rubber hose couplings, renewed as necessary, must be connected as originally.

Note . . .

Where a Metaflex sealing ring is used in a duct joint. it is to be discarded when the joint is broken and replaced by a new ring when the joint is remade.

114. Electrical bonding must be restored to its original form whenever it has been removed during dismantling of the system.

Bomb-aimer's demister selector valve

115. The valve is bolted through its flanged ends to the ducting at Stn. 145; removal of the valve after disconnecting the control is a simple matter of unbolting and careful withdrawal. When refitting the valve remove all traces of old sealing compound, apply new Bostik sealing compound S.1751 and S.1790, and fit new seal washers (66055-519 (2 off) and 66055-741 (1 off)).

Three-way change-over valve (windscreen)

116. This valve is connected by silicone rubber hose to the system ducting at Stn. 123·6. Disconnect the valve controls, withdraw the hose connections from the valve ports and remove the securing bolts from the valve bracket.

Shut-off valves (rear crew and pilots' foot warmers)

117. These two valves are each connected to the ducting by rubber hose. Disconnect the valve controls and remove the hose connections, remove the bolts securing the valve to the aircraft structure and withdraw the valve.

Combined valve unit

118. This valve, on the rear face of the rear pressure bulkhead, is secured by half clamps bolted together. Disconnect the pipelines to the discharge and safety valves, and remove by unbolting the clamp ring. Blank off the pipelines and valve connections to prevent ingress of dirt and foreign matter.

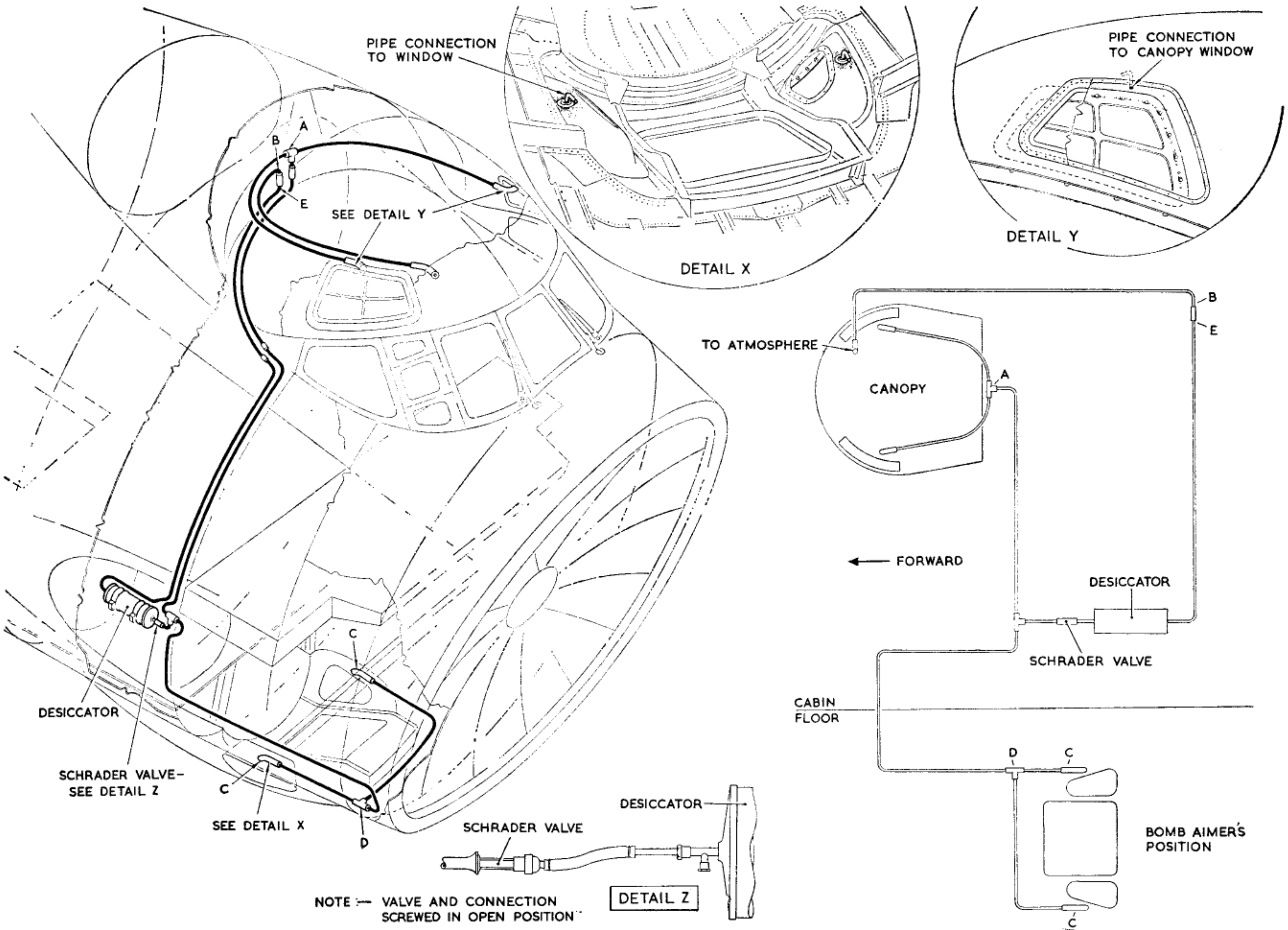

Fig. 10. Window demisting and venting system

Sylphon unit

119. This unit is bolted to a bracket on the forward face of the rear pressure bulkhead. Disconnect the pipelines to the safety valve and the solenoid-operated decompression valves, and remove the unit from its bracket. Blank off the pipelines and nuit body (*para.* 118).

Cabin pressure controller and decompression valves

120. These items are mounted on a panel on the pressure cabin starboard wall. The panel can be easily removed and any item quickly detached, after disconnecting the pipelines and electrical connections. Blank off all pipelines and unions (*para.* 118).

Cold air unit

121. This unit, mounted in the port servicing bay, is secured by bolts to a wall bracket and to the ducting by rubber hose and clamp rings. Remove the hose, withdraw the clamp ring bolts, unbolt and remove the unit.

Ventilating fan

122. Removal entails the removal of the duct between the bottom of the fan and the ram air non-return shut-off valve in the port servicing bay. Unscrew the ducting from the fan, disconnect the electrical wiring, release the two securing straps and withdraw the fan.

Differential presure switch

123. Disconnect the electrical wiring, disconnect the pipelines from the top and bottom of the switch, remove the four bolts securing the unit to the mounting bracket and withdraw. Blank off the pipelines and the switch body unions (*para.* 118).

Pressure ratio switch

124. Disconnect the electrical wiring and pipelines, remove the four bolts securing the switch to the mounting bracket and withdraw. Blank off the pipelines and unions on the switch body (*para.* 118).

Intercooler valve

125. The valve is bolted through its flanges to the upper servicing bay floor at the inlet, and to the system ducting at the two outlet ports. Before removing the valve, first disconnect the electrical connections to the actuator and the position transmitter. When replacing the valve the actuator must not be connected to it until the dimensions specified in fig. 3 have been checked.

Non-return shut-off valves (normal system and vent fan)

126. Disconnect the actuator from the valve lever and the ducts from the valve ports, unbolt the valve from the bracket on each side and withdraw it from the system. When replacing the valve, before connecting to the valve lever the actuator should be adjusted to give an 0·05 in. override on the cush drive, with the valve fully closed.

Constant flow valves

127. Access to these valves is from the nose wheel bay. Unbolt the half-clamp couplings securing each valve to the ducting, and withdraw from the system.

Normal system intercooler

128. The intercooler should be removed with the short lengths of ducting immediately attached to it, by first removing the duct attachments to the system, and then removing the attachment bolts between the intercooler suspension brackets and the aircraft structure.

Cold air unit valve

129. The valve, complete with the actuator, position transmitter and the portion of ducting connected to the inlet port, must be removed as follows: —

(1) Disconnect the ducts from the two outlet ports and free the inlet port duct from its neighbour.

(2) Disconnect the electrical connections from the actuator and the position transmitter.

(3) Withdraw the csk/hd. screw from each outlet port flange.

(4) Withdraw the two bolts, passing through the inlet port flanges and the ducting to the valve bracket, and remove the valve from the system.

When refitting the valve, the actuator must be adjusted to give 0·05 in. override with the valve closed (*fig.* 4).

Non-return valves (normal and flood flow system)

130. These valves are bolted to the rear pressure bulkhead and connected to the system ducting by rubber hose. Removal of the bolts and hose couplings will enable the valves to be withdrawn. On replacement, remove existing sealing compound from the valve flanges and apply new Bostik sealing compound S.1751 and S.1790. ◀The non-return valve Part No. 66755 Sht.67 must be replaced with the valve spindle in the vertical position and the connector aligned with the connection to the water separator.▶

Flood flow valves

131. Disconnect the electrical connections, remove the bolts securing the valves to the ducting and withdraw the units from the system.

Flood flow intercooler

132. This unit should not normally require removal, but should this be necessary, access for removal would entail dismantling adjacent items of equipment. Having obtained access, withdraw the bolts in the clamp rings securing the inlet and outlet connections. Remove the bolts securing the duct connecting straps on the cooling air outlet duct, and those securing the intake ducting to the intercooler. Then remove the bolts between the brackets on the intercooler and the aircraft structure, and carefully detach the unit from the system.

Silencers

133. Remove the rubber hose connections from the ducts, release the retaining straps and lift the silencers clear.

Water extractor

134. Disconnect the drain pipe from the unit front end, remove the rubber hose connections at each end, release the retaining straps and lift the extractor clear.

Absolute pressure switches

135. Disconnect the electrical connections, withdraw the four bolts securing each switch to its mounting bracket and carefully remove from the system.

Table 1 Components

Component	Type No.	A.P.	Vol.	Sect.	Chap.
Engine gate valve (Teddington)	FMA/A/12	4303E	1	2	4
Constant flow valve	67455-Sht. 81	4340	1	5	20
Non-return shut-off valve	66755-Sht. 26				
Non-return shut-off valve	67455-Sht. 45				
Non-return shut-off valve (vent fan)	66755-Sht. 89				
Intercooler valve	66755-Sht. 5				
Intercooler (Marston)	D29-40A	4340	1	8	1
Cold air unit valve	67455-Sht. 71	4340	1	5	22
Cold air unit (Godfrey)	BT9, Mk. 2B	4340	1	2	6
Pressure ratio switch	Fly/A/6	1275A	1	24 (A)	16
Pressure differential switch	T.P.5197	1275A	1	24 (A)	11
Vokes silencer	D.33333	1464D	1 Pt. 2	1	4
Burgess silencer (pre-Mod. 2192)	D2/2455/1 or A.C.A. 080/1	1464D	1 Pt. 2	1	4
Water extractor (Mod. 2192)	WE-60-Mk. 3	4340	1	9	5
Gaiter	103485	—	—	—	—
Non-return valve (at engine gate valve)	67438-Sht. 223	4340	1	6	25
Demister selector valve (bomb aimer)	66055-Sht. 19	4340	1	5	19
Shut-off valves (rear crew and pilots' foot warmer)	66055-Sht. 83	4340	1	5	23
Non-return valve (normal)	67455-Sht. 67	4340	1	6	27
Non-return valve (flood flow)	66755-Sht. 45	4340	1	6	26
Three-way change-over valve (windscreen)	67355-Sht. 91	4340	1	5	18
Ground conditioning connection (Normalair)	508420	4340	1	13	3
Ground test connection (Normalair)	505160	4340	1	13	1 App. 6
Duct relief valve	70655-Sht. 113				
Combined valve unit (Normalair)	503640	1275A	1	20	15 App. 2
Pressure controller (Normalair)	510730	1275A	1	20	14 App. 2
Duct relief and by-pass valve	70655-Sht. 33				
Flood flow intercooler (Marston)	D191-2A	4340	1	8	1 App. 9
Flood flow valve	67455-Sht. 113	4340	1	5	28
Ventilation fan	66755-Sht. 81	—	—	—	—
Sylphon unit	66055-Sht. 179	1275A	1	20	—
Decompression valve (electrical)	FAW/A/228	4343E	1	1	10
Decompression valve (manual)	A5377A-Sht. 1				
Punkah louvre	67355-Sht. 93/94	4340	1	5	27
Absolute pressure switch	5439-Sht. 3A	1275A	1	24 (A)	24
Over-pressure warning switch	353 P.G.	1275A	1	24 (A)	17

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