Chapter 8C AIR SYSTEMS - CANOPY SEAL SYSTEM, DE-MISTING, RAIN DISPERSAL, ANTI-ICING AND ARMAMENT SERVICES

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DESCRIPTION

General information

1. Hot air for canopy seal inflation, de-misting, rain dispersal and air intake lip anti-icing is obtained, in that order, from the main air supply *(Chap.8A)* downstream of the constant-flow valve *(Chap.8E)* located in the No.1 engine bay. Condensation in the canopy side panel interspaces is prevented by the circulation of chemically-dried air. The missile pack is heated by 8th-stage compressor air drawn directly from No.1 engine.

CANOPY SEAL SYSTEM

General information *(fig.2)*

2. A hollow rubber seal of rectangular cross-section is bolted to the windscreen arch, canopy sills and the aft pressure bulkhead; it is automatically inflated when the canopy is locked, to seal the gap between cockpit and canopy. Air for inflation is supplied from the aircraft air system; for ground servicing an external charging point is provided *(fig.2)*

Air supplies

3. The aircraft supply is drawn from the main hot-air pipe, located between frames 16 and 17 on the port side. The ground servicing supply is applied to a charging connection, labelled CHARGING POINT CANOPY SEAL, mounted on the rear face of the aft pressure bulkhead. Both supplies are directed through their respective pipelines, each incorporating a non-return valve and a filter, to a four-way junction on the aft pressure bulkhead. Of the two remaining connections, one is connected to a pressure gauge, located just forward of the charging connection, and the other to a supply pipe which directs air through a pressure-reducing valve to a flanged

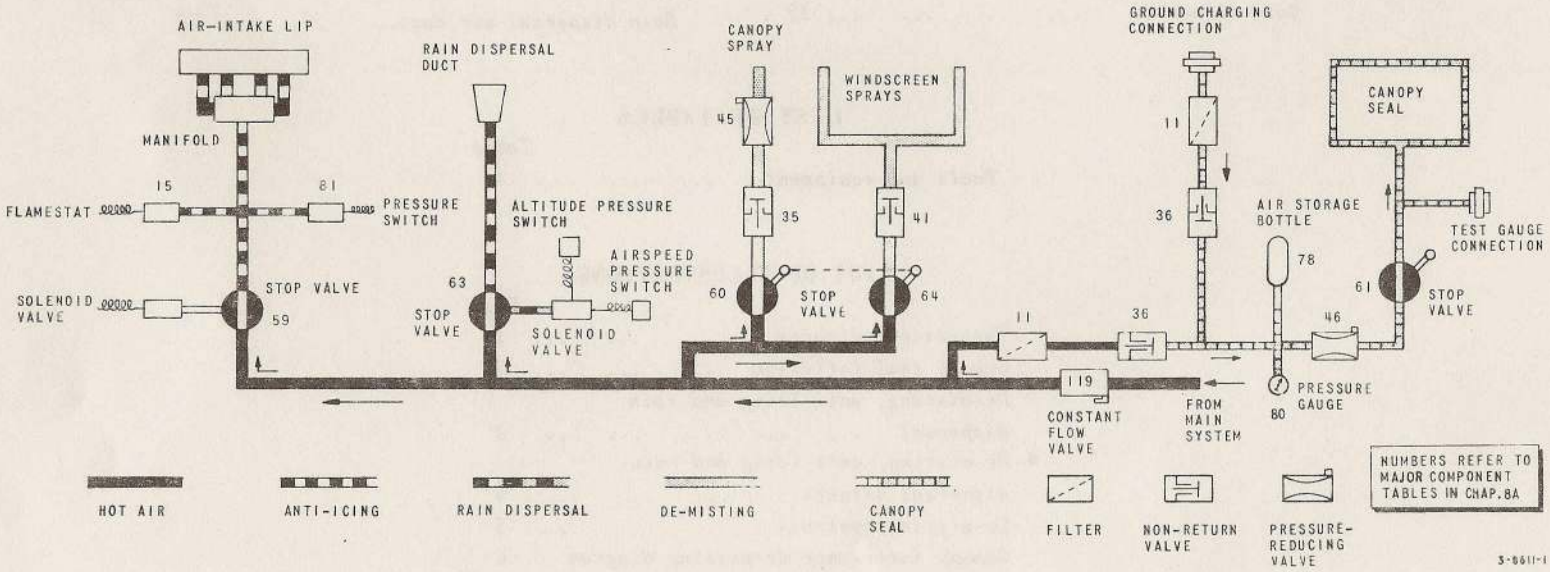

Fig.1. Theoretical diagram

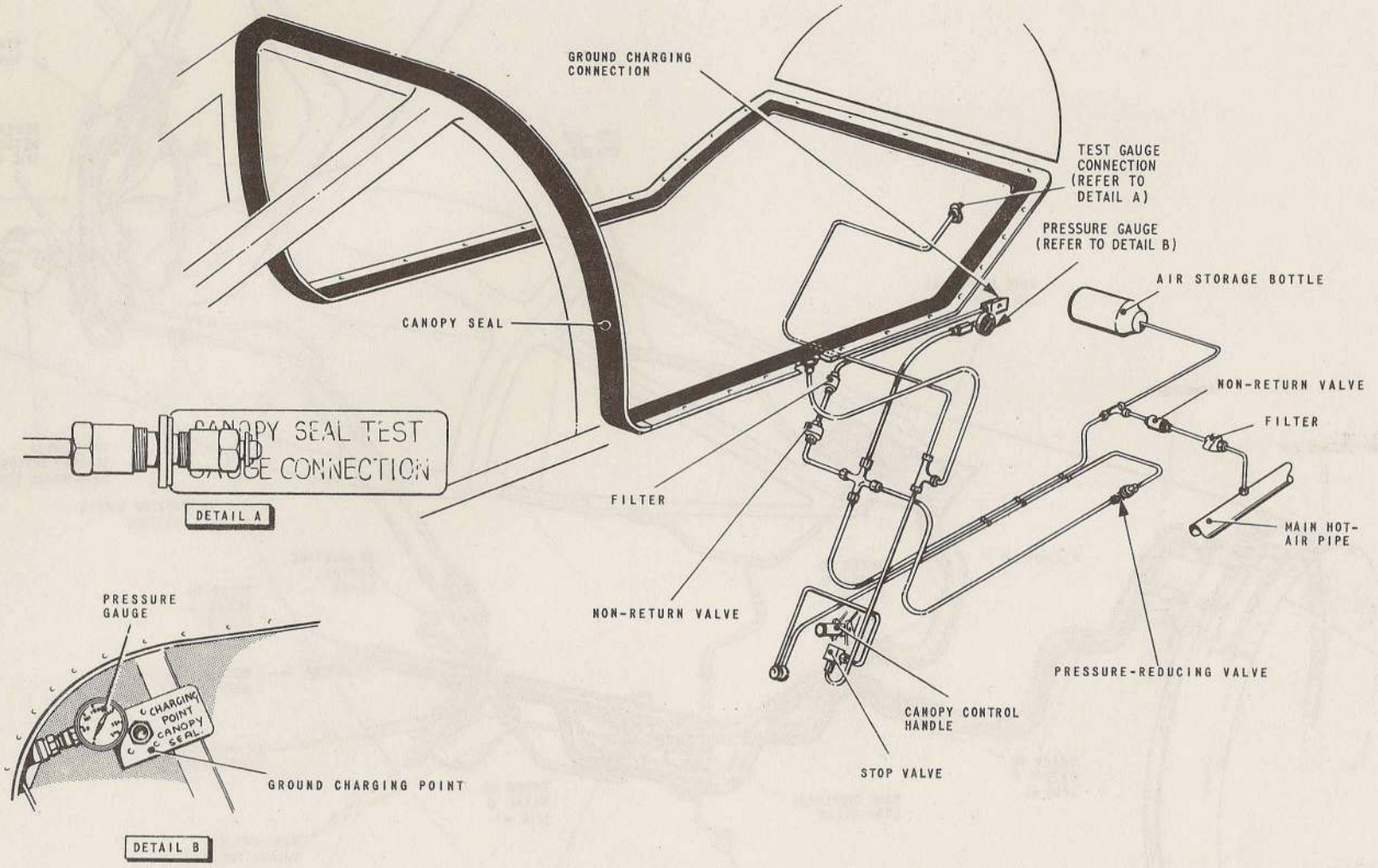

FIG. 2. CANOPY SEAL INFLATION

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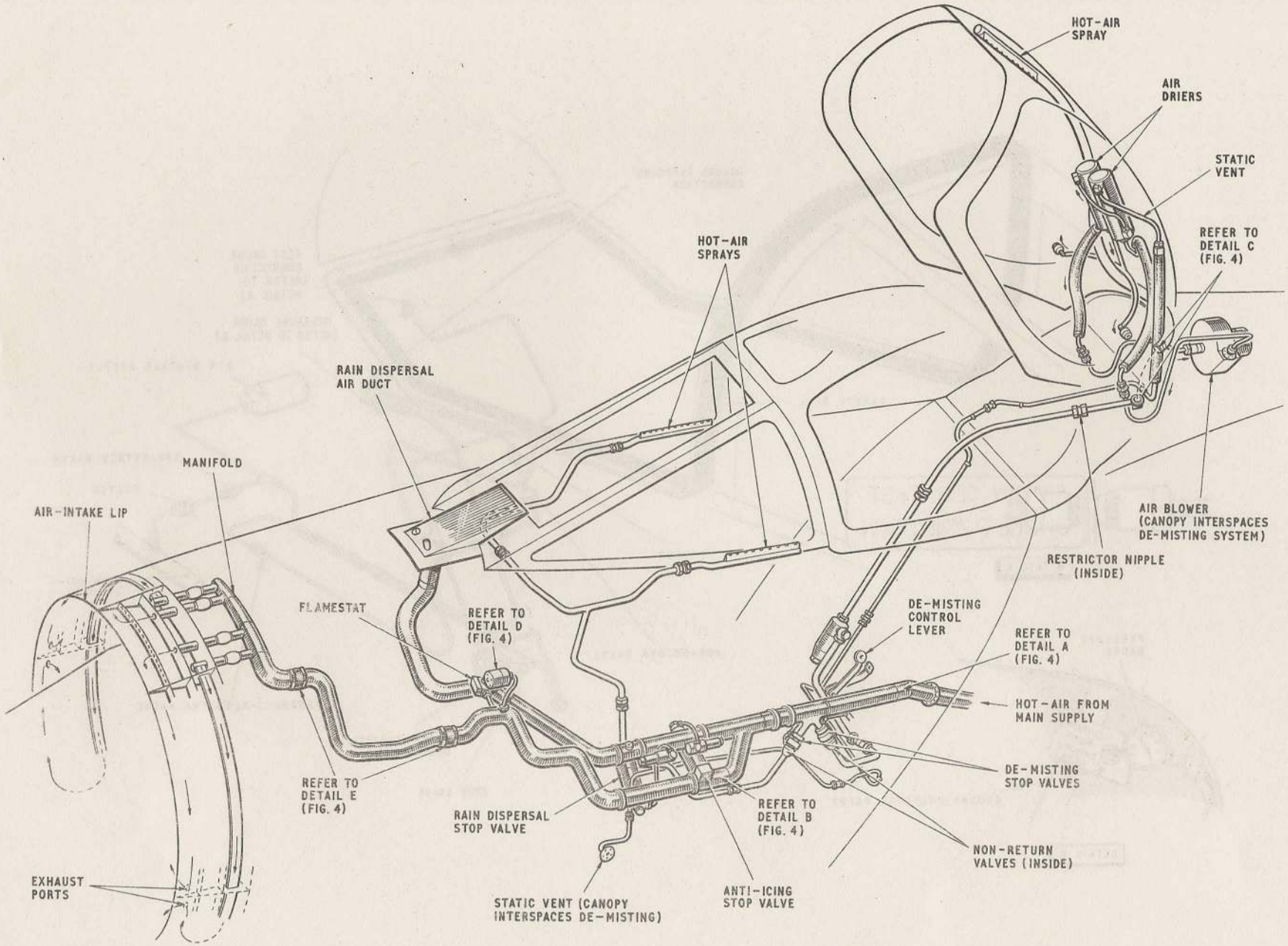

FIG. 3. DE-MISTING, ANTI-ICING AND RAIN DISPERSAL

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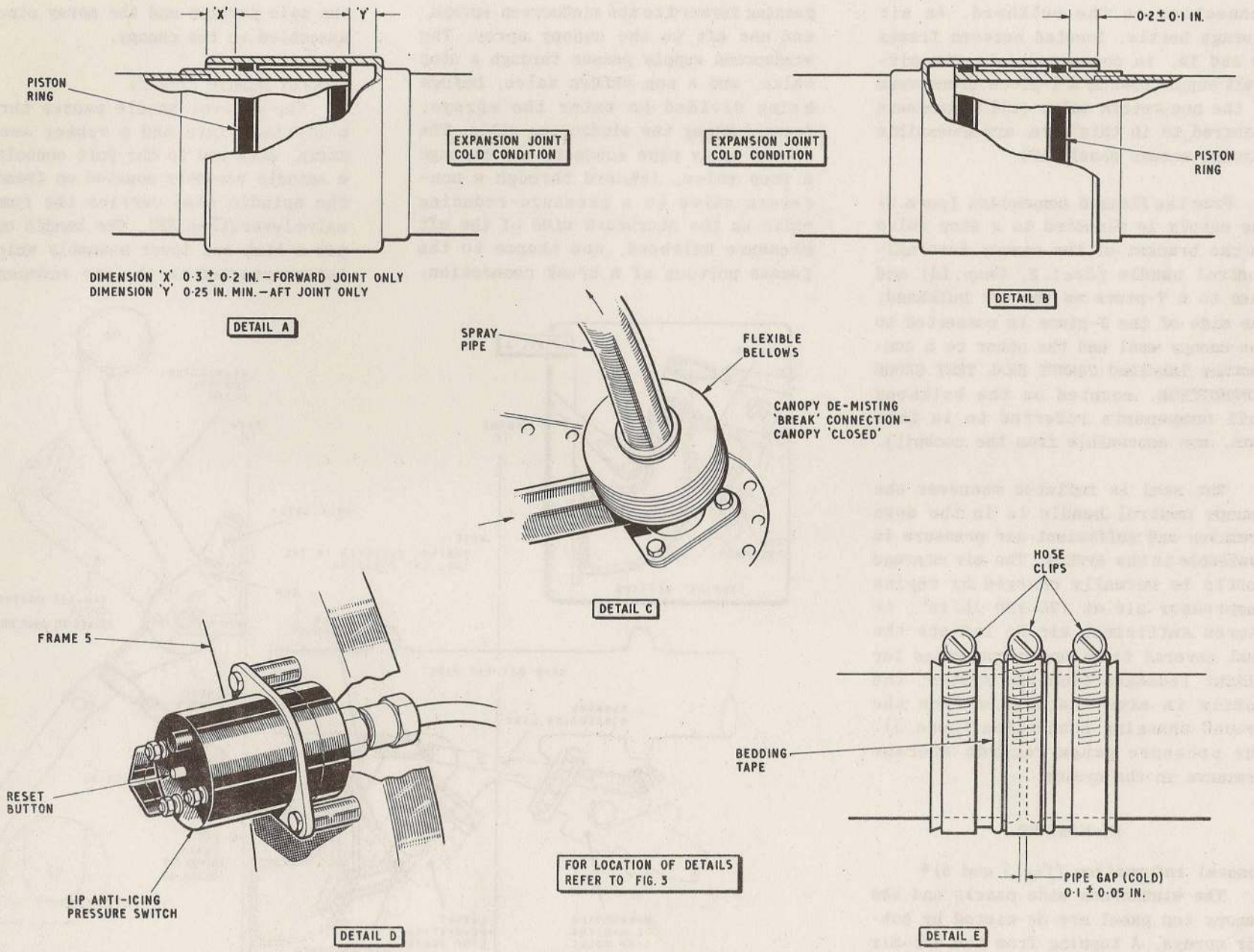

FIG. 4. DE-MISTING, ANTI-ICING AND RAIN DISPERSAL DETAILS

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connection on the bulkhead. An air storage bottle, located between frames 18 and 19, is connected into the aircraft supply pipe by a T-piece downstream of the non-return valve (all components referred to in this para. are accessible through access panel 21P).

4. From the flanged connection *(para. 3)* the supply is directed to a stop valve on the bracket of the canopy internal-control handle *(Sect. 1, Chap. 1A)* and then to a T-piece on the aft bulkhead; one side of the T-piece is connected to the canopy seal and the other to a connection labelled CANOPY SEAL TEST GAUGE CONNECTION, mounted on the bulkhead (all components referred to in this para. are accessible from the cockpit).

5. The seal is inflated whenever the canopy control handle is in the down position and sufficient air pressure is available in the system. The air storage bottle is normally charged by engine compressor air at 170-190 lb/in^2; it stores sufficient air to inflate the seal several times and compensates for slight leakages from the system; the bottle is also chargeable from the ground charging connection *(para. 3)*. The pressure gauge records storage pressure in the system.

DE-MISTING

General information *(fig. 3 and 4)*

6. The windscreen side panels and the canopy top panel are de-misted by hot-air sprays. A tapping from the hot-air pipe, at frame 12 on the port side, is divided into two separate pipes, one passing forward to the windscreen sprays, and one aft to the canopy spray. The windscreen supply passes through a stop valve, and a non-return valve, before being divided to enter the sprays, located along the windscreen sills. The canopy spray pipe conducts air through a stop valve, inboard through a non-return valve to a pressure-reducing valve on the starboard side of the aft pressure bulkhead, and thence to the female portion of a break connection; the male portion and the spray pipe are assembled to the canopy.

Control handle *(fig. 5)*

7. The control handle passes through a slotted plate and a rubber sealing strip, attached to the port console, to a spindle assembly mounted on frame 13; the spindle also carries the ram-air valve lever *(Chap. 8B)*. The handle operates a link and lever assembly which is interconnected to the two independent

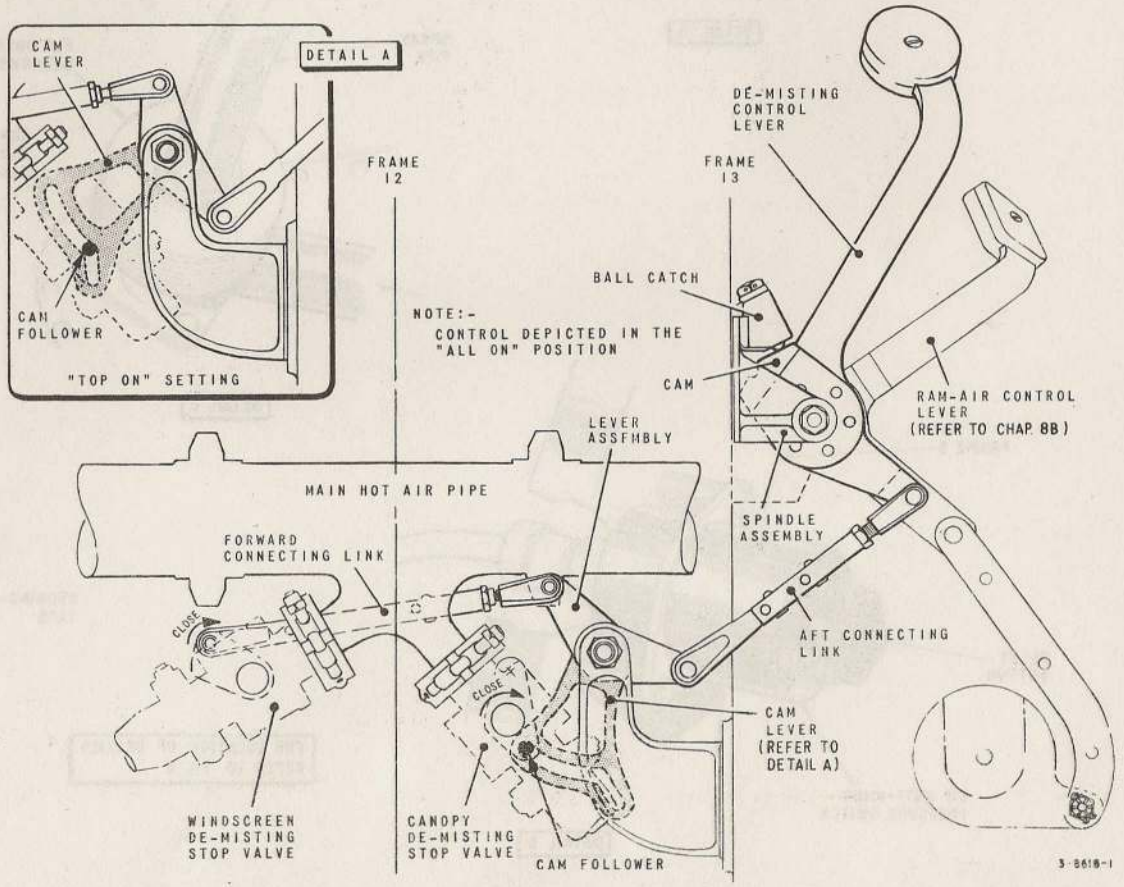

Fig. 5. De-misting controls

stop-valves in the windscreen and canopy de-misting supply lines by the forward connecting link and slotted cam-lever respectively. Three selected positions are available:-

OFF - both valves closed

TOP ON - canopy valve fully open and windscreen partly open

ALL ON - both valves open

Positive location of the handle in the TOP ON selection is effected by a detent on the face of the handle cam engaging a spring-loaded ball catch on frame 13.

Canopy interspace de-misting *(fig.3 and 6)*

8. Air to the canopy side panel interspaces is dried by passing it through two chemical air driers *(fig.7)* mounted on the canopy top member. The air is circulated by an electrically-driven blower mounted between the canopy hinge brackets, aft of the cockpit; air-pressure build-up is relieved by a static bleed pipe, connected between the port air-drier and a vent in the fuselage skin. The blower is controlled by the W/SCR SIDE switch on the starboard leg panel.

Chemical air driers

9. Each air-drier assembly *(fig.7)* comprises a cylindrical container containing a removable cartridge packed with desiccant (silica-gel) crystals, the assembly being completed by a spring and a screwed end plug. The container embodies three air supply connections, two on the body and the other at the closed end; the connection embodied in the inboard end of the upper container is blanked off by a sealing disc. The connection at the closed end incorporates a spring-loaded valve, which is held open by the cartridge when the assembly is complete; the valve closes when the cartridge is removed to prevent the ingress of dirt and moisture. The cartridge incorporates a stainless steel gauze separator and a filter, and is closed by an end cap, the cap being held in position by adhesive tape. Ports in the closed end of the body and in the end cap permit air to flow through the assembly. Windows in the container end plug and the end of the cartridge permit in-situ inspection of the crystals.

RAIN DISPERSAL AND ANTI-ICING

General information *(fig.3 and 4)*

10. The three-position RAIN/DISPL/OFF/DE-ICING ON switch on the port console provides control of the rain dispersal and anti-icing systems, the DE-ICING selection being common to air intake lip anti-icing, engine anti-icing, and air intake Spraymat electrical surface heaters. A three-position indicator forward of the switch presents a caption marked I or R, only when DE-ICING or RAIN DISPL respectively is selected and the associated stop valve is fully open; the indicator shows black when the valves are fully closed.

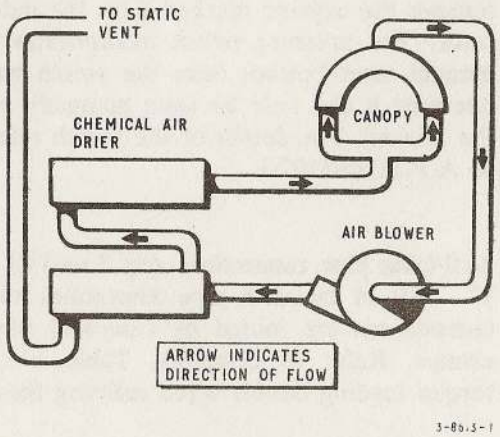

Fig.6. Canopy interspace de-misting diagram

11. Spraymat electrical surface heaters are incorporated on the leading edges of the radar-head pylon and strut and the air-intake duct bifurcation. For details of the engine anti-icing system and electrical circuits refer to A.P. 102C-1520-1 and Sect.6, Chap.6 of this publication, respectively.

Note...

1. Upon no account must the RAIN DISPL/OFF/DE-ICING ON switch be selected to DE-ICING ON with an external a.c. power supply connected and the engines not running. Failure to observe this warning could result in the Spraymat heaters being quickly burnt out.

►◄

Rain dispersal

12. The rain dispersal hot-air system ensures clear vision through the windscreen when the aircraft is operating in conditions of rain. It is controlled automatically to operate within certain air speed and height limitations when the RAIN DISPL switch is selected ON. The control system incorporates two pressure switches, an airspeed switch

and an altitude switch, which are set to operate at 350 knots and 10,000 feet respectively. If either limit is exceeded the stop valve *(para.18)* will close until acceptable conditions are regained.

13. Hot air, tapped from the hot-air pipe, is delivered through an electrically-controlled, pressure-operated butterfly valve *(para.18)*, mounted between frames 8 and 9 beneath the port console (panel 8P). When the valve is open air is directed to the spray nozzles mounted forward of the windscreen; efflux from the forward nozzles creates a degree of turbulence sufficient to break up the larger raindrops whilst the aft nozzle directs a flat jet of hot air to disperse the rain on the windscreen panel.

Note. . .

To obviate the possibility of the windscreen being damaged by overheating, the RAIN DISPL switch must not be left on when the aircraft is on the ground.

Air-intake lip anti-icing *(fig.3 and 4)*

14. The air-intake lip is a circular, wedge section, stainless steel structure which constitutes the leading edge of the intake and is divided, by horizontal blanking plates, into two (top and bottom) semi-circles. The complete structure is also divided, by an annular partition, into forward and aft compartments.

15. Heated air is delivered through an electrically-controlled, pressure-operated, butterfly-type stop valve*(para.18)*, to a manifold situated behind the top edge of the air-intake lip. Four outlet stubs extend forward from the manifold, the inner pair being connected, by rubber pipes, directly to the upper half of the aft compartment and the outer pair, through pipes led around the upper half of the intake and attached to the lower half of the aft compartment. Communication between forward and aft compartments is through holes drilled at equidistant intervals in the annular partition. Bleed holes drilled through the inner skin of the forward one ensure a continuous flow of heated air through the compartments.

16. Possible damage to the intake structure due to overheating or excessive pressure in the lip is prevented by an automatic system comprising a pressure switch and a flamestat. These are tapped into the anti-icing pipe downstream of the butterfly valve and operate at 75 – 80 lb/in^2 gauge pressure and 350 deg C respectively; if either figure is exceeded the associated switch will override the manual selection to close the valve and remove the caption marked I on the indicator. The pressure switch incorporates a manual reset button; once the switch has operated it can only be reset manually on the ground. For details of the switch refer to A.P.112G-1107-1.

Anti-icing pipe connections *(fig.3 and 4)*

17. Aft of frame 5 pipe assemblies and components are joined by Conoseal type clamps. Refer to Chap.8A. Table 1 for torque loading details when refitting these clamps. Forward of frame 5 pipe connections are made by asbestos hoses, each hose being secured by three Jubilee clips, the third Jubilee clip is secured around bedding tape and positioned at the centre of each hose, thus eliminating the possibility of the hoses ballooning under surge pressure. The outer clips are torque loaded to 25 ± 1 lb in. and the centre clip to a nominal 5 lb in. Gaps between pipe lengths are set, when cold, to 0.1 ± 0.05 in.

Stop valves

18. The valves in the rain dispersal and anti-icing systems incorporate independent switches which signal the associated R-off-I indicator when the rain dispersal, or anti-icing valve respectively, is fully open. The valves are operated by the air pressure in the main pipe upstream of the respective valve, under the control of remote solenoid valves which are in circuit with the associated selections of the RAIN DISPL/DE-ICING ON switch. While no air flows in the main pipe both valves are inoperative.

ARMAMENT SERVICES

Guided weapon pack heating

19. Hot air from No.1 engine compressor, 8th stage, flows through a pipe passing along the starboard side of the fuselage and across the bottom of frame 21, to terminate in a union connection; the connection is blanked off whenever the Firestreak pack *(Sect.5, Chap.7)* is not fitted.

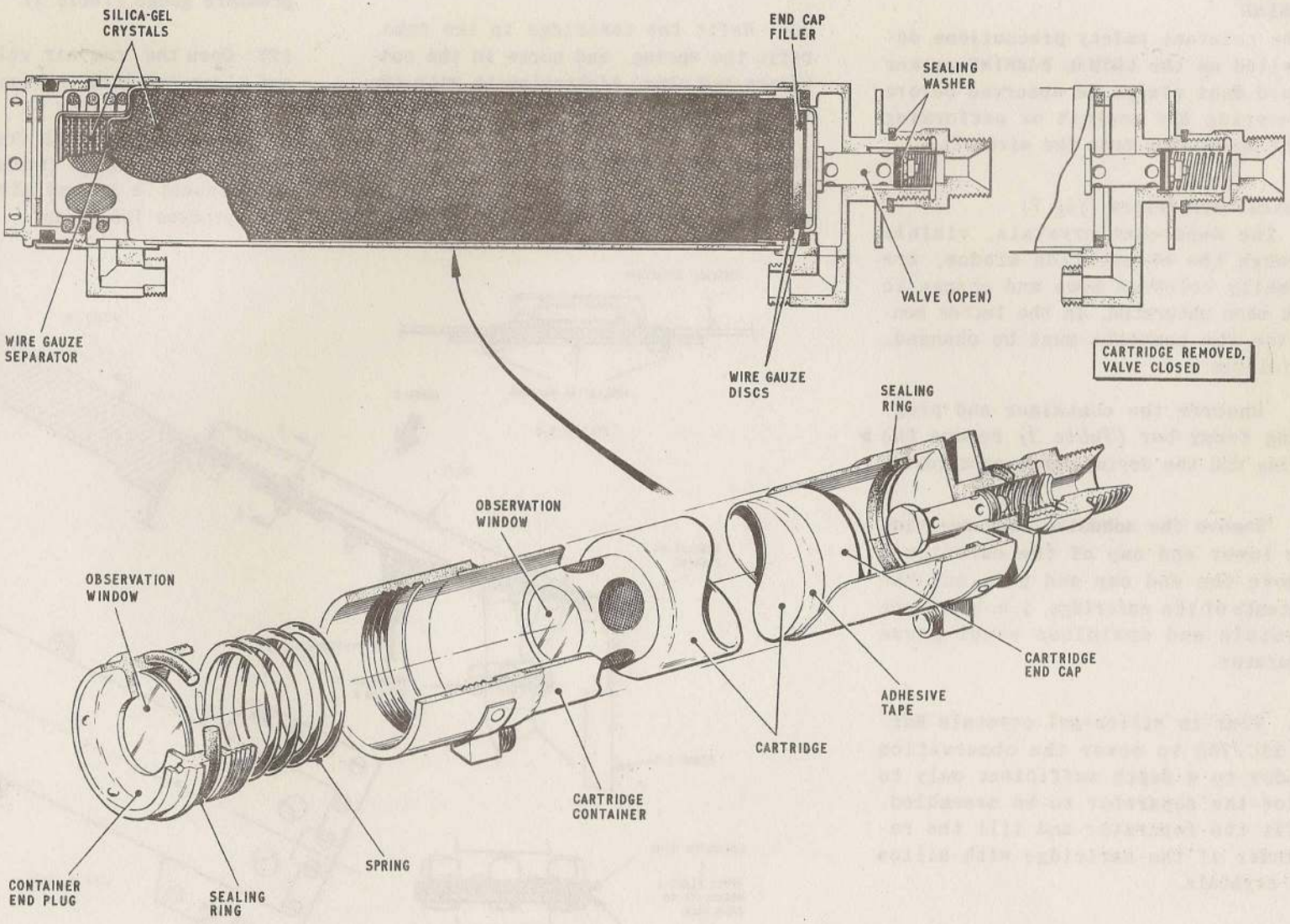

FIG. 7. CHEMICAL AIR DRIER

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SERVICING

WARNING

The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cockpit or performing any operations upon the aircraft.

Chemical air-driers *(fig. 7)*

20. The desiccant crystals, visible through the observation window, are normally coloured blue and change to pink when saturated. In the latter condition the contents must be changed, as follows:-

(1) Unscrew the container end plug, using tommy bar *(Table 1)* remove the spring and the drying agent cartridge.

(2) Remove the adhesive tape securing the lower end cap of the cartridge. Remove the end cap and pour out the contents of the cartridge, i.e. desiccant crystals and stainless steel gauze separator.

(3) Pour in silica-gel crystals Ref. No.33C/790 to cover the observation window to a depth sufficient only to allow the separator to be assembled. Refit the separator and fill the remainder of the cartridge with silica gel crystals.

Note...

Be careful not to shatter the crystals.

(4) Clean the cartridge end cap filter; refit the filter and end cap. Secure them with adhesive tape, not exceeding 5.80 in. in length to avoid overlapping.

(5) Refit the cartridge in the tube, refit the spring, and screw in the container end plug, tightening it with the tommy bar.

Canopy seal leakage test *(fig. 2)*

21.

(1) Remove the blank from the test gauge connection and fit test a connector *(Table 1)* and a 0-15 lb/in^2 pressure gauge *(Table 1)*.

(2) Open the ram-air valve *(Chap. 8B)* and close and lock the canopy.

(3) Remove the blank from the ground charging connection (access panel 21P) and connect a ground air supply that will produce 100 lb/in^2.

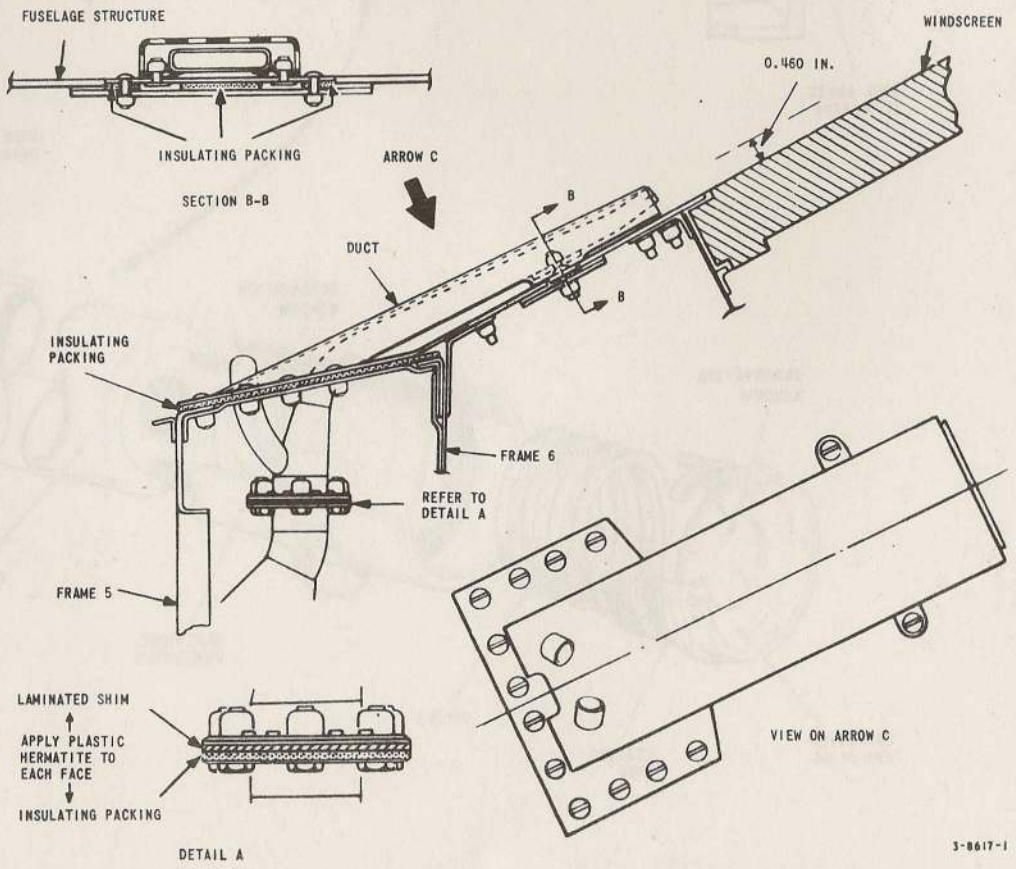

Fig. 8. Rain dispersal air duct

(4) Turn on the air supply and slowly increase the pressure until the aircraft pressure gauge reads 20 lb/in².

(5) Check that the test gauge reads between 7.75 and 9.5 lb/in² and that the seal is inflated.

(6) Check that there is no leakage from pipe joints and components.

(7) Slowly increase the supply pressure until the aircraft pressure gauge reads 50 lb/in², then 80 lb/in². At both figures the test gauge should continue to read between 7.75 and 9.5 lb/in².

(8) With the aircraft pressure gauge reading 80 lb/in² unlock the canopy and check that the test gauge pressure falls to zero and that the seal deflates.

(9) Reduce the supply pressure by successive inflations and deflations of the seal and then, with the canopy locked, adjust the supply pressure to 20 lb/in². Check the leakage rate from the system by one of the following methods:-

(a) With the seal inflated for a period of not less than 24 hours, check that the test pressure gauge reading does not fall below 7.75 lb/in².

(b) With the seal inflated for a period of not less than 3 hours, check that the aircraft pressure gauge does not fall by more than 1.5 lb/in² from the initial 20 lb/in².

Setting the de-misting controls *(fig.5)*

22. (1) Disconnect the forward and aft connecting links from the lever assembly and control lever respectively.

(2) Set the control lever to TOP ON, ensuring that the detent in the cam-face is positively engaged by the ball catch on frame 13.

(3) With the canopy stop-valve fully open, set the slotted cam-lever so that the cam-follower is at the apex of the slots *(detail A)*. Adjust the aft link until the pin hole lines up with the hole in the control lever. Fit and lock the link pin.

(4) Set the control lever to OFF.

(5) With the windscreen stop-valve in the fully off position adjust the forward link until the pin hole lines up with the hole in the lever assembly. Fit and lock the link pin.

(6) Lubricate the linkage, using ◀grease XG-287 ▶

(7) Operate the control, checking for fouls and correct functioning.

REMOVAL AND ASSEMBLY

Rain dispersal air duct *(fig.8)*

23. Prior to assembly, lightly coat each face of the insulating packing and laminated shim *(detail A)* with plastic Hermatite 1250, ensuring that no surplus enters the duct. The dimension given in the illustration must be obtained when fitting the duct. It is permissible, if necessary to achieve correct positioning of the duct, to file the insulating packing located at the top of frames 5 and 6.

TABLE 1

Tools and equipment

Ref.No.	Description	System	Application
26DK/95181	Bar, tommy	Canopy interspaces	Air drier end plug
26DK/95228	Connector, test	Canopy seal inflation	Leakage test
4F/2191	Gauge, 0-15 lb/in^2 pressure	Canopy seal inflation	Leakage test