

ISSUED BY ECVSS

PNEUMATIC SYSTEM

References:- AP 4505B Volume 1
AP 4303B Volume 1 (Dunlop Pneumatic Components)

Introduction

1. The pneumatic services are divided into two groups, one being supplied with air from storage cylinders charged from a ground source, and the other with air tapped from the engines.
2. They are:
 - a. Cabin Pneumatics. Are divided again into groups as follows:
 - (1) Normal Cabin Pneumatics for entrance door closing, pressurizing the entrance door and canopy seals, and pressurizing the windscreen de-icing system.
 - (2) Emergency Cabin Pneumatics for opening the entrance door IN FLIGHT, and initiating the canopy jettison system.
 - b. Two storage cylinders, mounted in tandem, below the crews floor on the port side supply these systems, one for each system and the two are in no way pneumatically interconnected, and therefore one cannot be used to replenish the other in flight.
3. Two storage cylinders, mounted in the port side of the metal nose portion supply separate systems. One the H2S system, supplies regulated air to the scanner equipment in the nose section. The other, the NBS system, supplies regulated air to the associated NBS equipment in the nose wheel bay.
4. One storage cylinder, mounted under the second pilot's floor, supplies air to the T4 bombsight system. The air terminates into the bombsight computer to supply and operate the servo mechanisms.
5. Two interconnected storage cylinders mounted in the roof of the rear section at the rear, supplies air to the Rear Warning canister for pressurizing internal seals.
6. The engine air supplies are for pressurization of the fuel tanks, bomb door seals, hydraulic system reservoir and power pack, and the water glycol tank in the rear fuselage.

Entrance/Escape Door System

7. Four controls are available to open and close the door. One for external operation of door opening and one for internal door opening. One for external door closing and one for internal door closing. SWAP
8. Warning indicators at the rear of the internal opening handle consist of a RED lamp marked 'DOOR NOT SAFE' and a GREEN lamp marked 'DOOR SAFE'. Also, a magnetic indicator on the pilots centre instrument panel shows 'BLACK' when the door is secure and locked. A similar indicator in the nosewheel bay, starboard side, shows 'WHITE' when the door is secure and locked. These are operated by a micro switch connected to the door mechanism layshaft and a micro switch operated by the door. With Vulcan Mod 969 embodied (Gold Film Heated Windscreens.)

/at

ISSUED BY BCVSS

at Pilots Station) operation of these two micro switches when the entrance door is closed and locked puts a low heat condition onto the windscreen circuit when the 28V DC and 200V AC supplies are 'ON'.

9. The two storage cylinders are charged, through independent charging valves located in the nose wheel bay, port face of the rear pressure bulkhead. Adjacent to the charging valves are the pressure gauges and pressure relief valves, one for each cylinder.

Door Opening (Internal)

10. When the internal lever in the gated quadrant (under crews' floor port side) is pulled the following sequence of operation occurs:

a. The first 25° of lever movement moves a cam, on the door operating lay shaft, away from the sequence valve plunger, and the door seal exhausts to cabin atmosphere. Also the micro switch is operated with initial layshaft rotation which illuminates the red 'DOOR NOT SAFE' light on the quadrant. The magnetic indicator on the pilots centre instrument panel shows white, and the indicator in the nose wheel bay shows black.

b. The next $42\frac{1}{2}^{\circ}$ of lever movement withdraws the door pins and, with the aircraft on the ground, the door will open under its own weight.

c. But in flight, to open the door against the airstream upon it, the final $27\frac{1}{2}^{\circ}$ of lever movement through the spring loaded gate, to the EMERGENCY position, will depress the plunger of the door opening sequence valve. This admits air from the emergency storage cylinder, through a pressure reducing valve and through a by-pass valve or restrictor, to the down side of the jacks, the displaced air in the up side of the jacks being exhausted to cabin atmosphere via the door closing sequence valves.

11. The by-pass valve is coupled mechanically by a stiff link, passing through the rear pressure bulkhead, and connected to a bracket attached to the nose under carriage cross shaft. The linkage being so arranged that when the nose wheel is retracted the valve is opened. The restrictor is by passed and full operating pressure is applied to the jacks. Therefore the door should not be opened on EMERGENCY with the aircraft on jacks and the undercarriage raised.

12. With the nosewheel lowered, the by pass valve is closed by the linkage and air passes through the restrictor. This considerably reduces the speed of door opening and prevents damage to the door assembly and hinges, especially during ground testing.

13. The door can also be opened by a switch adjacent to the ABANDON AIRCRAFT warning sign on the navigator's instrument panel. When operated the switch causes a unimatic valve on the 'door open' system to open and pass air to the layshaft operating jack. The jack then extends to rotate the layshaft to cause the actions previously described in paragraphs 10a and 10b to occur. On the internal door opening lever reaching the spring loaded gate, the action of the push pull rod causes the lever to bend at its spring loaded hinge. The top part remains against the gate, the bottom part, being connected to the push pull rod, continues its movement to operate the door opening sequence valve to cause the action previously described in paragraphs 10a, 10b, 10c, 11, 12.

Door Opening (External)

14. The operation of this handle, just to the rear of the door aperture flush to the aircraft skinning, rotates the layshaft (the initial movement of which deflates the door seal), to withdraw the door pins to allow the door to open under

its own weight. The range of movement of this handle then ceases, so that an emergency door open selection is not available.

Door Closing (Internal)

15. Internal door closing is achieved by means of a handle and cable attachment, normally covered by a hinged access panel in the crews floor between the centre and starboard crew seats, which operates the door closing sequence valve to admit air from the normal storage cylinder, through a pressure reducing valve and the ground isolation cock, to the up side of the door jacks, the displaced air in the down side of the jacks being exhausted to cabin atmosphere via the door opening sequence valve.
16. As the door nears the closed position the door pin catch plates strike the door pins to push them back into the door pin housings against the action of the layshaft return springs. This action has now released the door seal deflation valve to isolate the seal air supply from the normal storage cylinder. The seal inflation valve is already in the exhausted condition as the door is away from the striker.
17. Further jack movement completely closes the door to strike the seal inflation valve and associated micro switch, but as the layshaft is still in the unlocked condition air cannot be admitted to the seal, and, the layshaft operated micro switch is still broken to keep the door quadrant RED light illuminated. The pilots and nose wheel bay indicators also show the unlocked condition.
18. As soon as the catch plates door pin recesses are in line the door pins can enter the door to lock it. This action causes the layshaft to rotate to strike the seal deflation valve to admit air to the seal via the already open door seal inflation valve. The layshaft micro switch is also operated and in series with the already operated door micro switch illuminates the GREEN door safe indicator, energises the pilot indicator to BLACK, and the nosewheel bay indicator to WHITE.

Door Closing (External)

19. This is achieved by means of a push button flush to the fuselage skin adjacent to the external door opening handle.
20. Pressing of this button operates the door closing sequence valve to admit air to the door jacks and perform the door closing function as previously described in paragraphs ~~14~~ to ~~17~~ 15 to 18.

Canopy Seal System

21. This seal, in conjunction with the door seal, prevent loss of internal pressure when the air conditioning system is in use. Unlike the door seal which is attached to the door aperture, the canopy seal is attached to the canopy, the connection to the seal air supply being made by a "tulip valve" assembly.
22. The canopy seal is inflated from the normal storage cylinder through the canopy seal inflation valve which is normally held in the open condition, by a spring loaded plunger attached to the canopy bulkhead. The spring loading on plunger maintains a constant pressure onto the seal inflation valve during flight to offset any upward canopy movement.
23. When the canopy is jettisoned, the plunger is no longer in contact with the seal inflation valve and the seal is deflated. The normal storage cylinder air is not wasted to atmosphere as the inflation valve is closed to inlet supply therefore air is maintained in the system to supply the windshield de-icing system.

ISSUED BY BCVSS

24. A schrader type air valve in the supply line to the seal, provides the means for seal inflation by use of a hand pump should the normal storage cylinder be empty or removed.
25. A non return valve in the supply line to the seal, maintains seal pressure should the normal storage cylinder be empty or removed.

Canopy Jettison Circuit

26. Emergency storage cylinder air is used to initiate canopy ejection and three methods are provided:
- Pulling of the firing blind handle on either pilot's ejection seat.
 - Operation of a gated lever, painted with yellow and black stripes, on either side of the cockpit coaming adjacent to each pilot's seat.
 - Operation of an external red painted handle on the port side of the front fuselage which is cable attached to the port gated lever in the cockpit.

Firing Blind Handle Operation

27. Operation of either blind handles will operate the canopy control valve by means of cable attachments to the blind handles. Emergency storage cylinder air pressure is then admitted to the canopy release ram, via a pressure reducing valve and canopy control valve, to extend the ram to mechanically operate the gated lever mechanism to open the four release unit attachments to release the canopy and withdraw the sear from the canopy gun firing pin. The canopy gun is attached by its ram to the canopy bulkhead by a pip pin, the ball end on the gun body seated in a socket plate mounted on the cockpit coaming. The gun cartridge gas pressures extend the ram to lift the canopy, and, after approximately 20° of upward movement has been completed, the rear canopy attachments are automatically released.
28. The canopy is then released complete with seal and ejection gun, and is lifted over the fin and rudder by the slipstream.

Time Delay Unit Operation Seat Ejection

29. This action by means of a cable and clip assembly, withdraws the safety pins from the time delay units on the ejection seats, one of which has been cocked by the initial firing blind handle operation, to enable the seat to be ejected. The remaining seat is then ejected normally, when the firing blind handle is pulled.

Gated Lever Operation

30. Operation of either gated lever will only open the four canopy release units and withdraw the sear from the canopy gun. The canopy is then ejected as previously mentioned. The ejection seat time delay pins are removed, but as they have not been cocked by firing blind operation the seats are not ejected.

External Release Lever

31. Operation of this lever, because of its cable connection to the port gated lever assembly, will cause a similar sequence of events to take place as in paragraph 230

De-Icing System

32. The de-icing system is installed to provide for de-icing of the three sandwich ply windows and the air bomber's window, from a de-icing tank of 12 gallons capacity. The de-icing tank is pressurised from the cabin pneumatic normal storage cylinder, via the 2000/400 psi pressure reducing valve, the ground isolation cock, a pressure maintaining valve set to 150 psi then through a pressure reducing valve where the 400 psi is reduced to 15 psi and then into the de-icing tank to pressurise the de-icing fluid.

Ground Isolation Cock

33. This cock is fitted on the underside of the crews floor, port side, and is normally locked in the 'ON' position by a red cover. When the cover is removed the cock is turned off to isolate the normal storage cylinder from the door and canopy seals and the de-icing tank. This operation is necessary when replenishing the de-icing tank or refitting the canopy.

Pressure Maintaining Valve

34. The pressure maintaining valve reserves air pressure at 150 psi for the door and canopy seals, in case of leakage or excessive consumption in the de-icing system lines or tank.

Controls

35. When a particular de-icing operation is required, operation of the system switch will energise an electro-hydraulic valve to allow fluid at 15 psi to pass to the windows as selected. Pilots station de-icing is achieved by a switch situated on the 2nd pilots instrument panel and has three positions, ie NORMAL-OFF-EMERGENCY. Operation of either 'Normal' or 'Emergency' energises a solenoid operated valve adjacent to the de-icing tank in the roof of the nose section beak. A 'normal' selection provides a rate of flow from the spray pipes at 44 pints per hour and an 'Emergency' selection increases the flow to 73 pints an hour. Air-bombers station de-icing is by a similar three position control switch situated on the air bombers oxygen intercomm. and switching panel which is located at the starboard side of the visual bombing window. This switch, by means, of a separate solenoid operated valve provides a 'Normal' rate of flow of 4 pints per hour, and an 'Emergency' rate of 16 pints per hour.

T.4 Bombsight System

36. This system is installed to provide pressure air to the T.4 bombsight computer at 60 psi. A single cylinder is mounted under the second pilots floor and is charged from a ground charging point in the nosewheel bay on the main cabin pneumatics charging panel to 2000 psi. A non return valve prevents the marriage of air between the normal storage cylinder air and T.4 bombsight air. From the cylinder, the air is supplied through a shut-off valve to a 2000/60 psi reducing valve, also to a 65/70 psi pressure relief valve, an air drier, and then the air inlet of the bombsight computer.

Controls

37. The shut-off cock, mounted at the rear of the pilots floor port side, when operated allows air at 2000psi to pass to the pressure reducing valve. Adjacent to it is a pressure gauge which provides a reading of pressure delivery at the bombsight computer.

H2S and NBS Systems

38. These systems are provided to pressurise certain components in the H2S and NBS equipment. Two separate storage cylinders, under the all metal nose section are charged from the same point to the same pressure (1800psi), the pressure in each cylinder being registered on separate gauges adjacent to the charging valve on the port side of the nose section under a panel marked H2S SCANNER AND NBS AIR CHARGING POINT.

39. A pressure relief valve in the storage cylinder charging line is set to relieve at 2000psi.

Controls

40. The operation of the electromechanical taps in each system allow pressure to pass to the systems required, by ON/OFF switches located on the starboard side of the crews instrument panel adjacent to gauges showing absolute pressure supplied to the H2S and NBS equipment.

Ancillary Pneumatic Supplies.

41. The ancillary pneumatics are supplied with air from the engines up to 200psi for pressurising the bomb bay door seals, the hydraulic reservoir and power pack, and the water glycol tank in the rear fuselage. Each engine also maintains an air supply to its own associated group for tank pressurisation.

Bomb Bay Door Seals System

42. Inflatable seals are fitted at the forward and rear end of the bomb bay to assist in preventing heat losses, since they cater for variations in the gaps between the door and surrounding structure, caused by the deflection of the structure in flight

43. From the engine supply the air passes through a reducing valve where the pressure is reduced to 10psi and then through a fore and aft junction to the front and rear spars, through solenoid operated unimatic valves, to rapid exhaust valves, then to the seals.

44. Initial control of the inflation of the seals is the action of the 'bomb doors closed' micro switches located on the port and stbd door forward. Deflation of the seals is controlled by the action of selecting "OPEN" on the bomb door control switches in the cabin.

Bomb Doors Closed

45. Closing of the doors operates the microswitch to energise the unimatic valve, the solenoids of which are energised to allow air pressure at 10psi to the rapid exhaust valves. Air pressure moves the pistons of the latter to close off the exhaust to atmosphere, and the air is thus allowed to pass into and inflate the seals.

Bomb Doors Open

46. Selecting "OPEN" breaks the electrical circuit to the pneumatic valves and de-energises the solenoids to cause the inlet sides of the valves to close and the exhausts to open. Loss of air pressure to the inlet side of the rapid exhaust valves causes their pistons to open the exhaust ports, to allow air from the seals to exhaust to atmosphere through these valves.

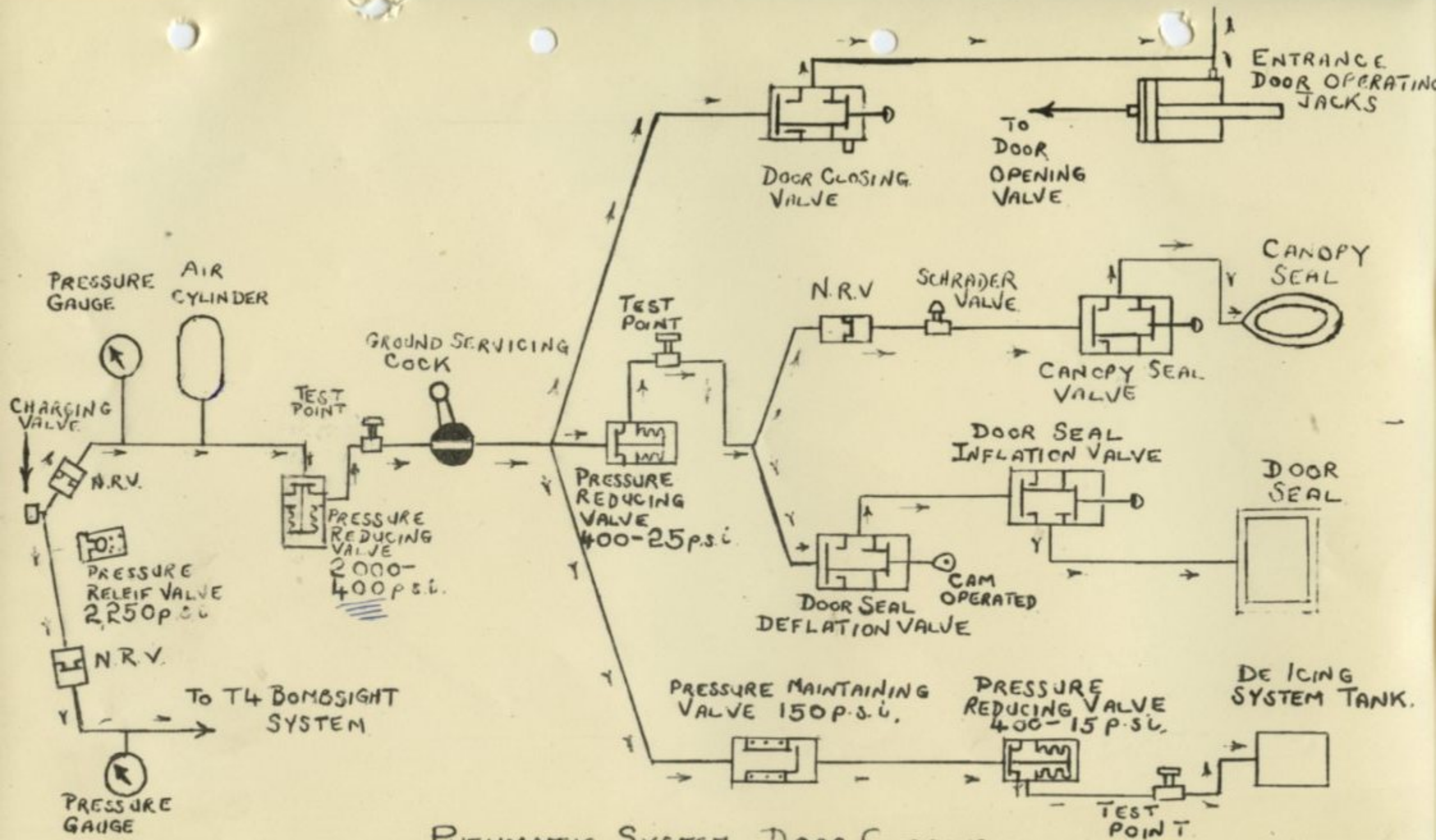
/Reservoir and Power..

RESERVOIR AND POWER PACK PRESSURISATION

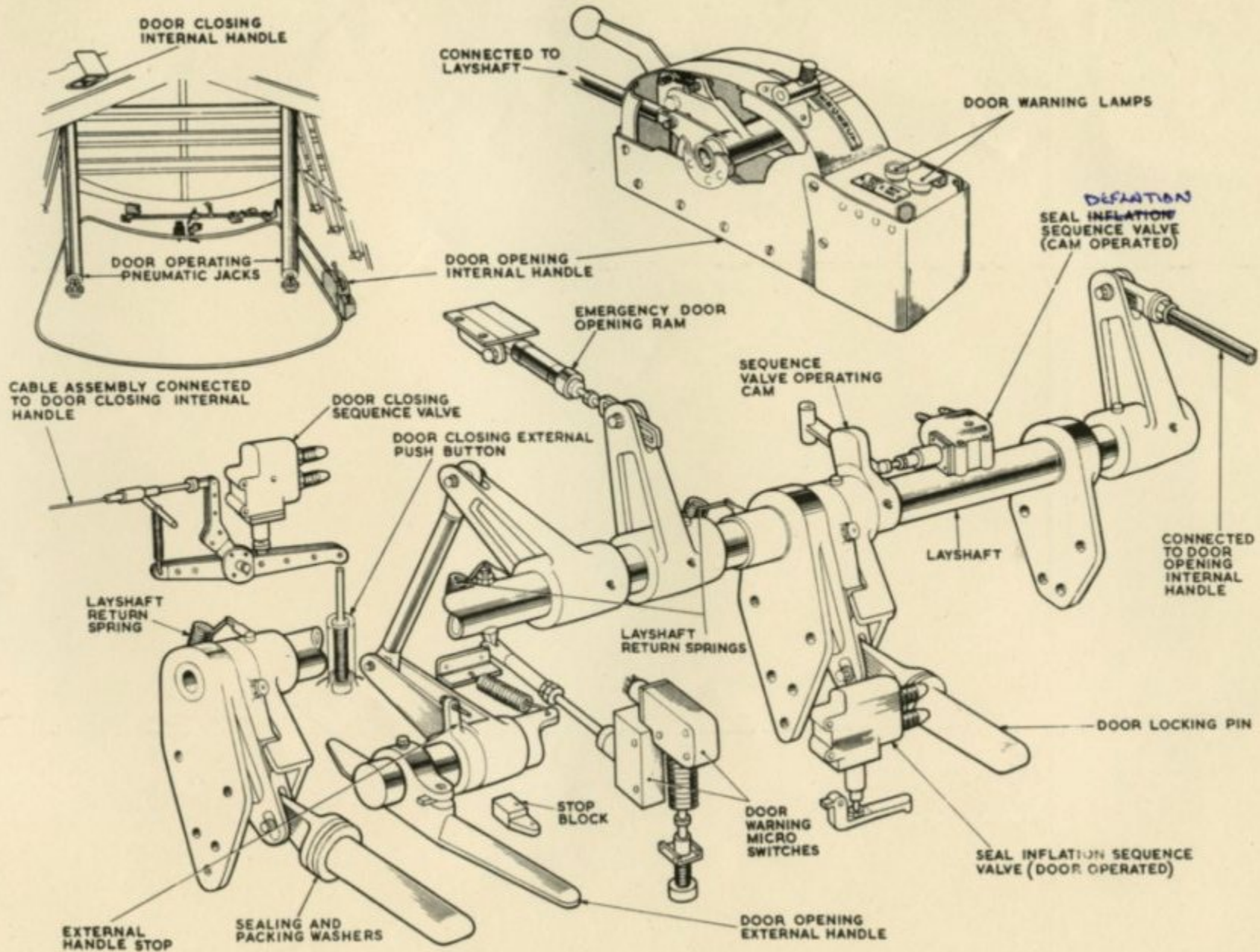
47. The reservoir and power pack are pressurized with air from the engines to ensure that a positive head of pressure is maintained, at the suction outlet connection, to the hydraulic pumps to prevent cavitation.
48. From the same engine supply as for the bomb bay seals, the air passes through a separate reducing valve, where the pressure is reduced from 200 psi to 15 to 18 psi, and a non-return valve before branching to the reservoir and power pack.
49. The branch pipe to the reservoir passes through a restrictor and a non-return valve, the purpose of the restrictor being to cause a back pressure to be felt to the power pack in event of a loss of fluid from the main hydraulic reservoir. Incorporated in the reservoir system is a pressure relief valve set to relieve excess pressures at 22 - 27 psi.
50. The branch pipe to the power pack passes through a non-return valve into the power pack, and an inward's vent valve in the circuit prevents cavitation of the reservoir and power pack during ground operations when there is no air supply from the engines.

Water/Glycol Tank Pressurisation

51. The water/glycol tank is pressurised with air tapped from the engines by means of a branch line from the reducing valve to the bomb door seal system at 10 psi then through an NRV and into the tank. A relief valve on the tank prevents pressures in excess of 15 to 18 psi. The pressure air ensures that evaporation of the contents and pump cavitation is prevented at high altitudes.
52. The complete ancilliary pneumatic system can be pressurised for test purposes, without the use of the engines, by means of a charging point in No 2 engine bay on the inboard rib, forward.



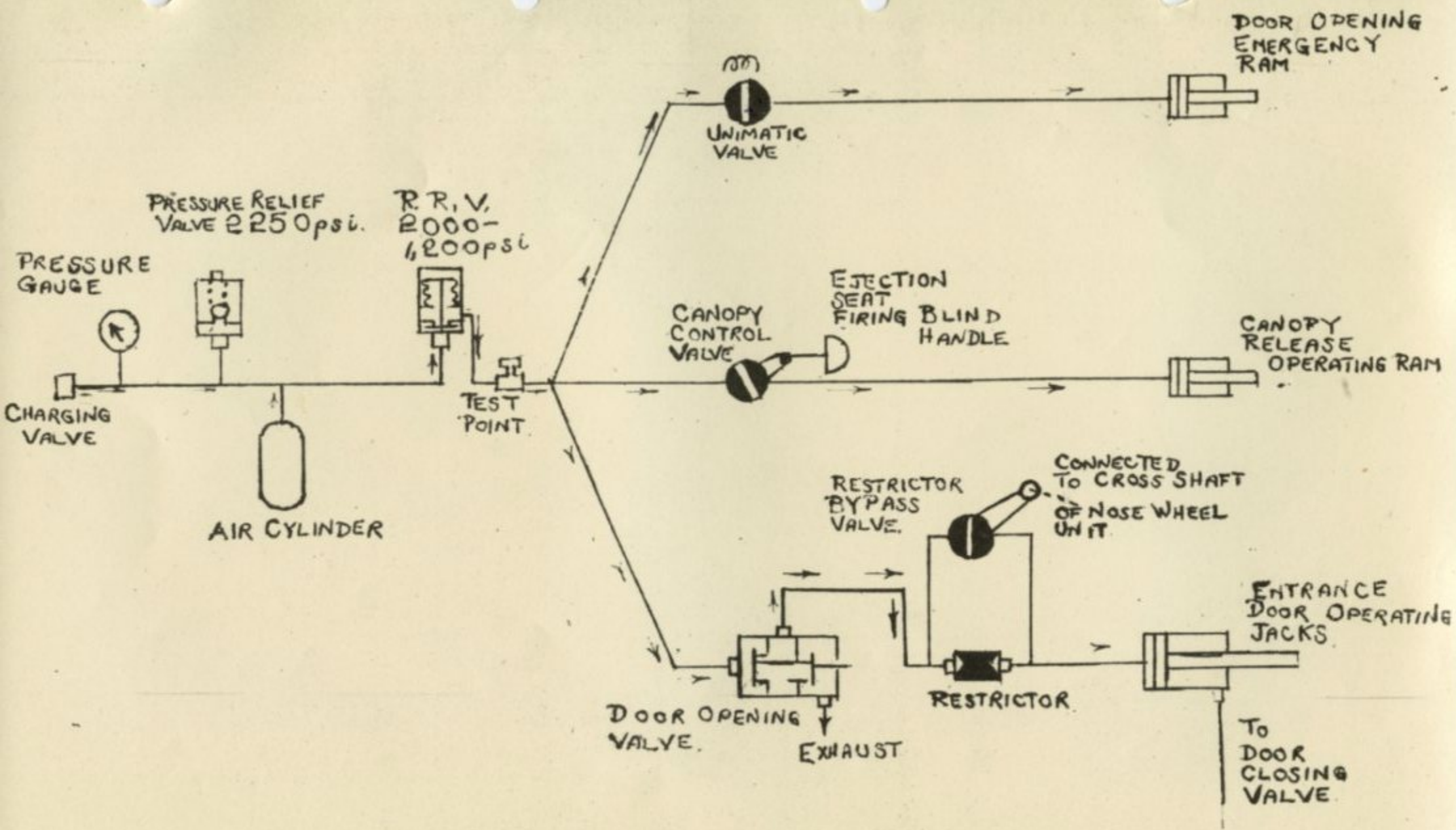
PNEUMATIC SYSTEM. DOOR CLOSING.



52

Fig. 3. Door-operating mechanism.
(4 Sealing washers added)
RESTRICTED

PNEUMATIC SYSTEM-DOOR OPENING (EMERGENCY)



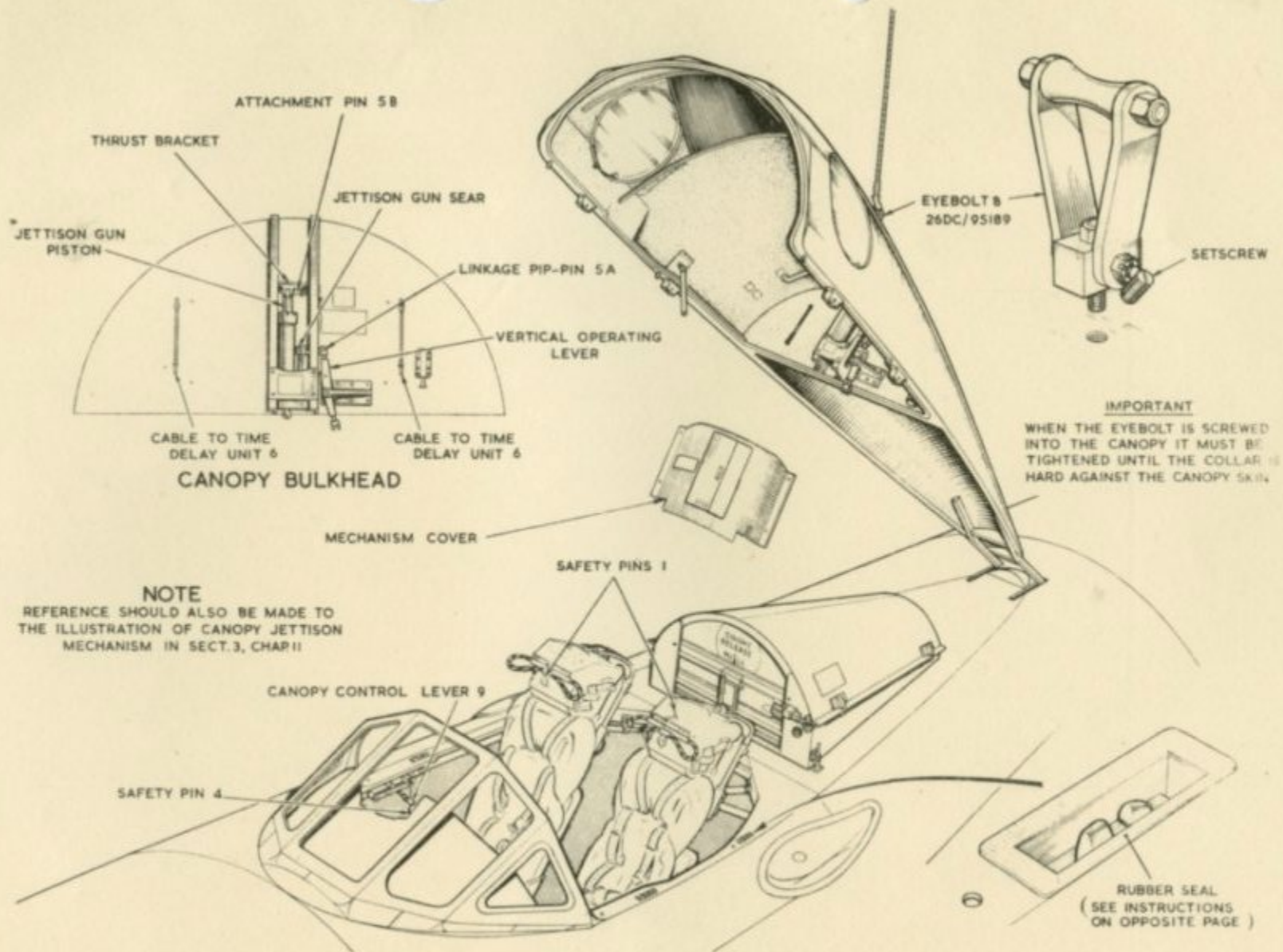


Fig. 18. Canopy removal.

(4 Seats added)

RESTRICTED

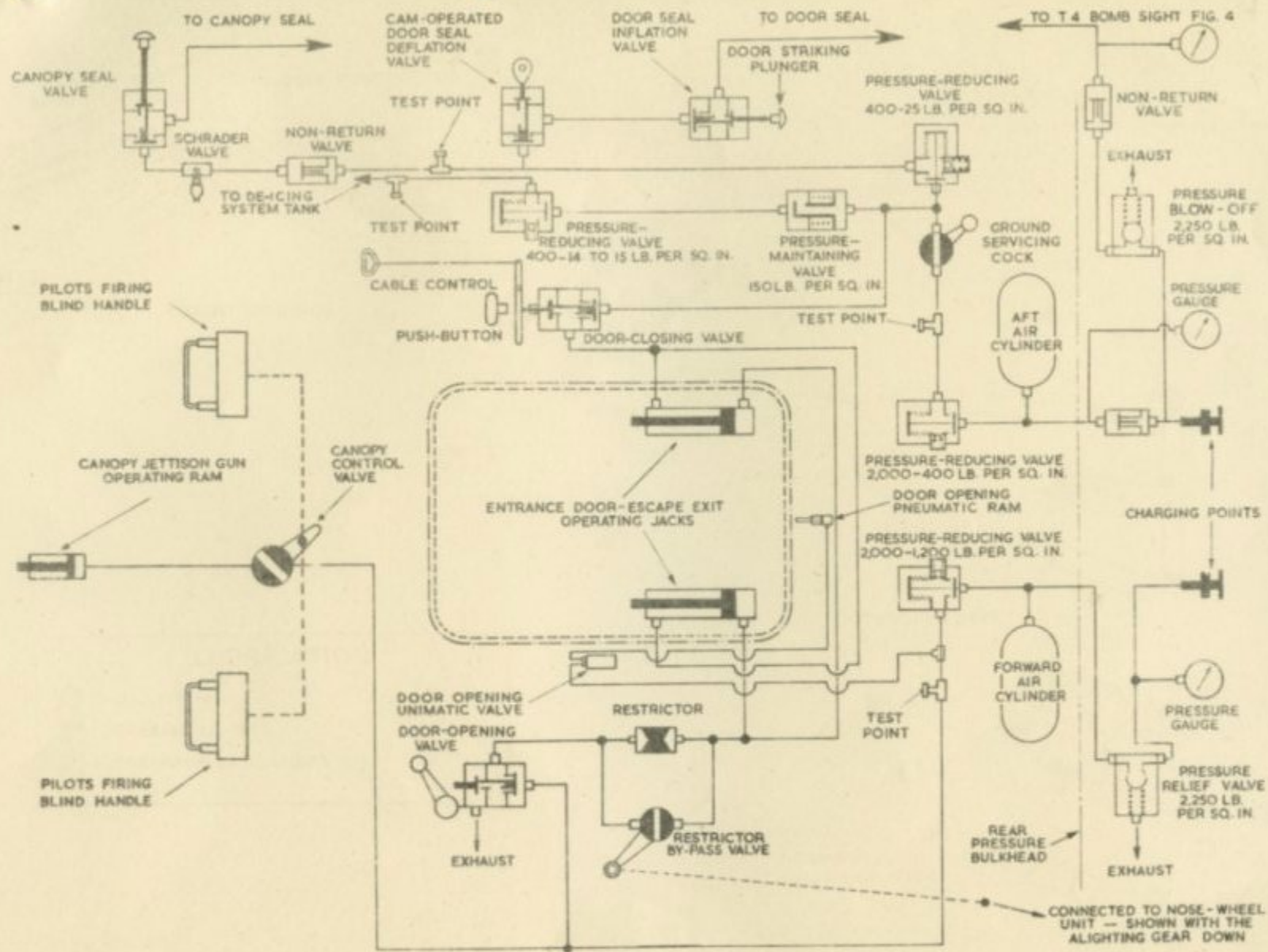
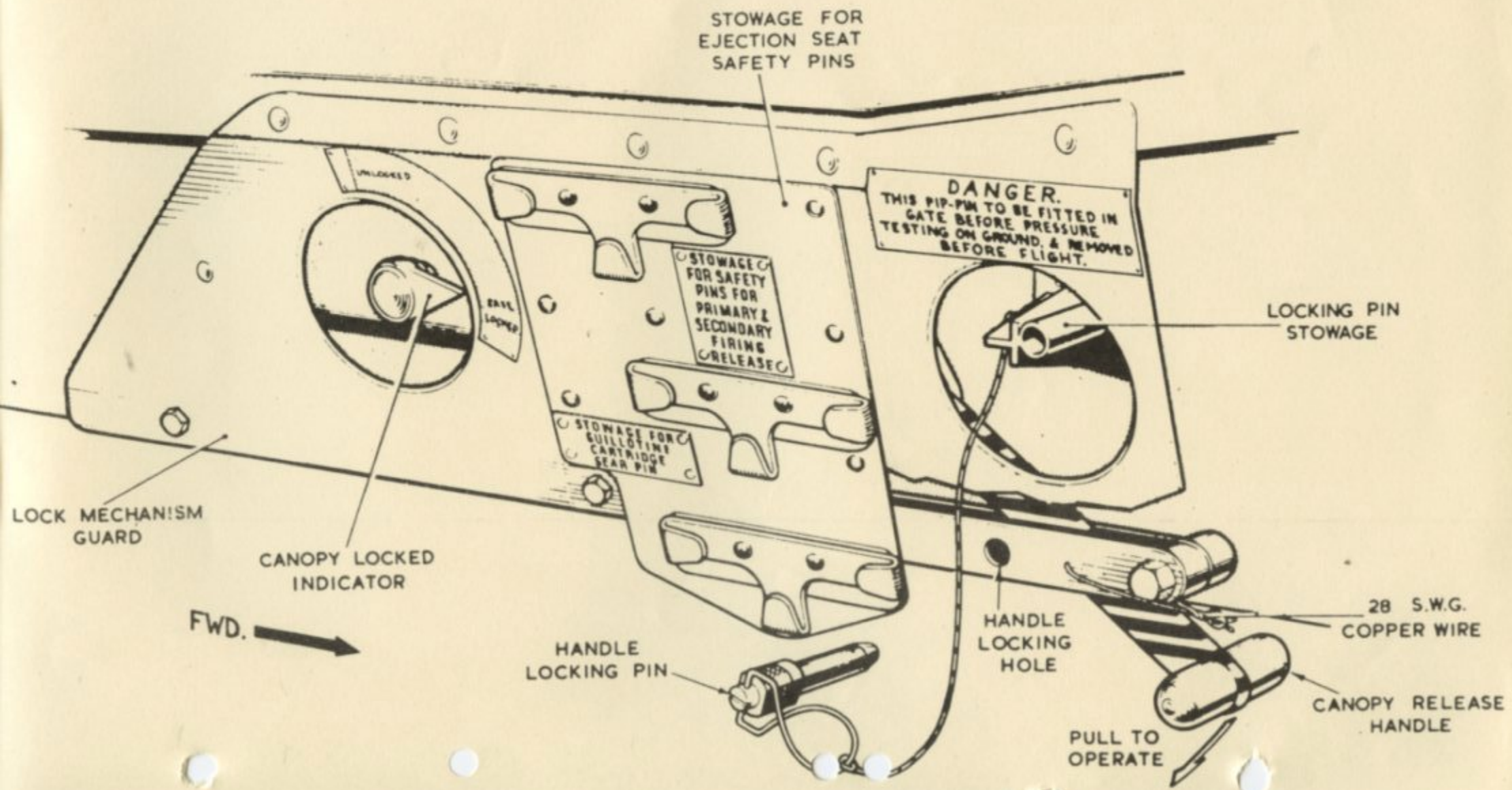


Fig. 1. Pneumatic system diagram - entrance door.

RESTRICTED



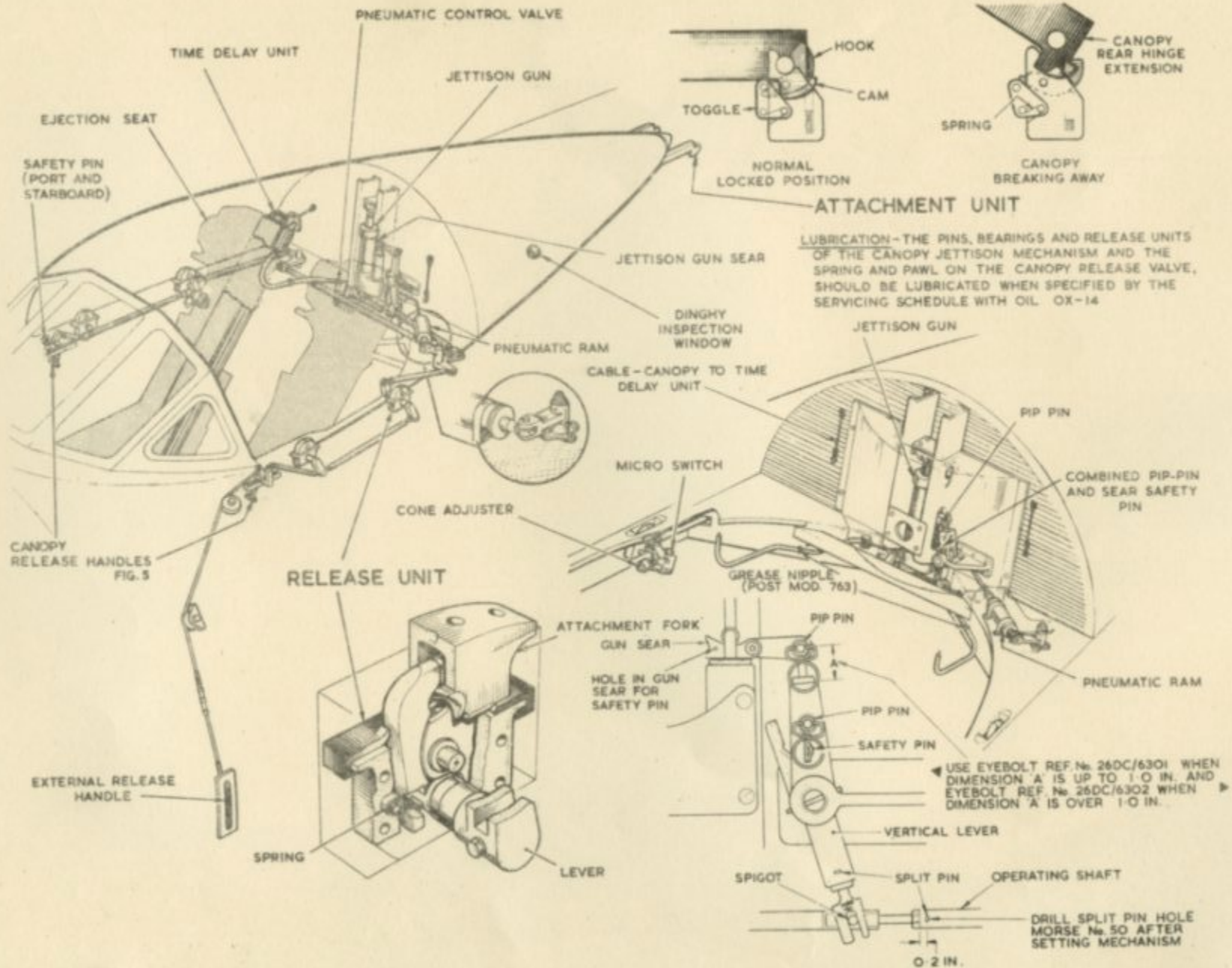


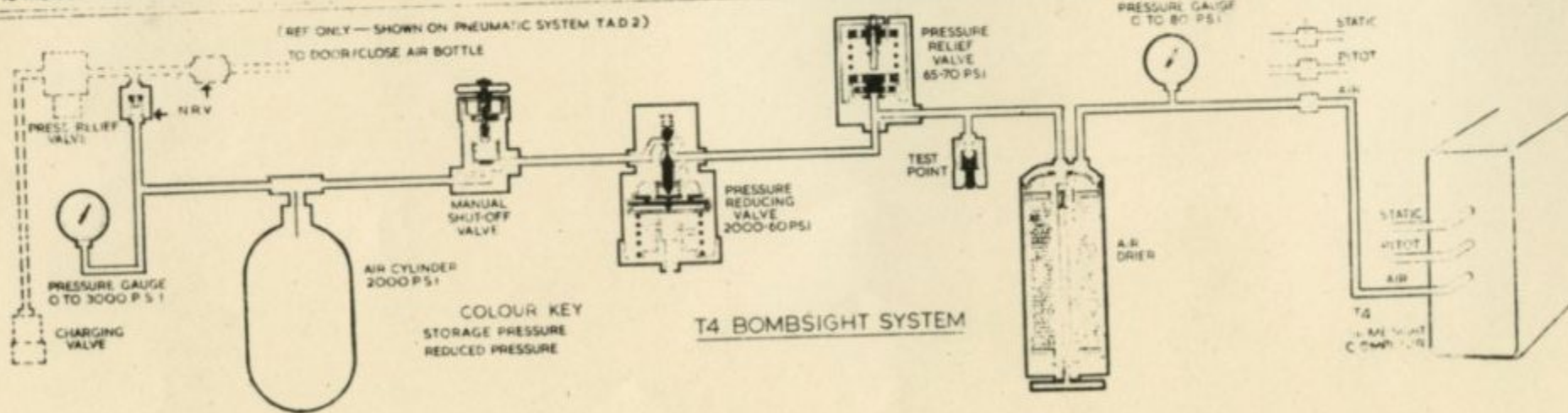
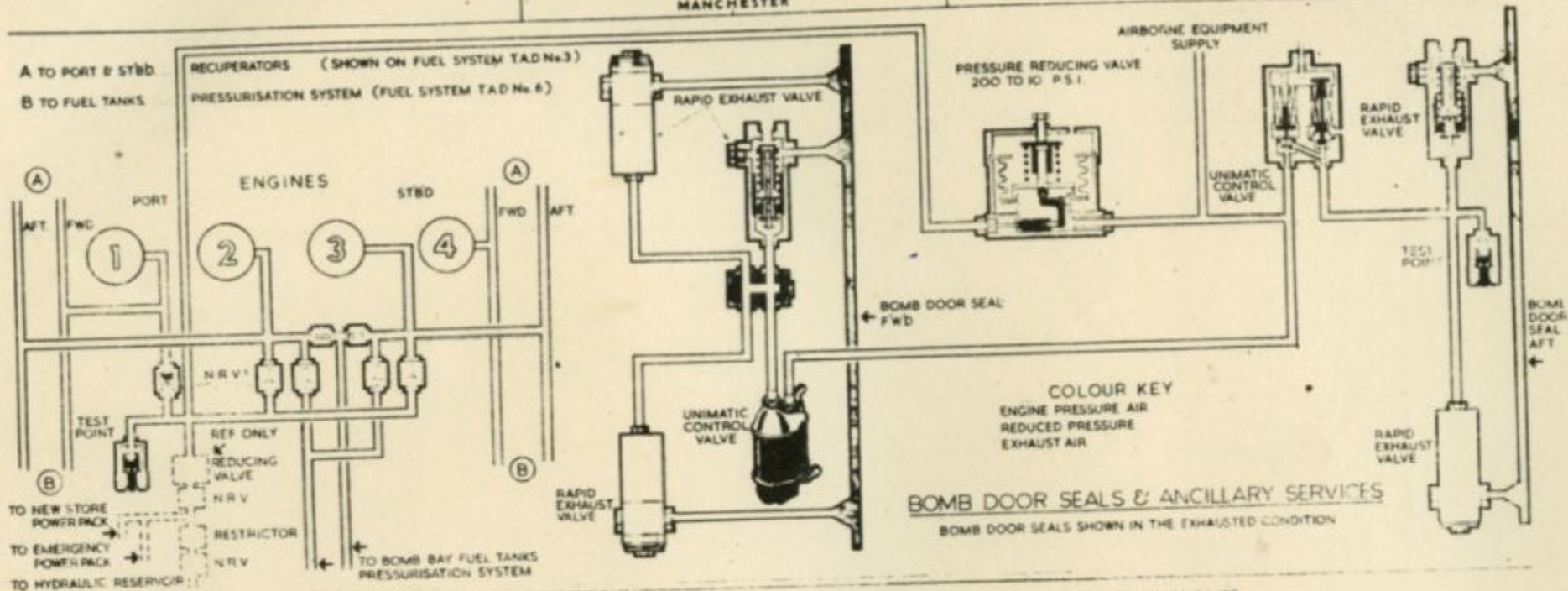
Fig.6. Canopy jettison mechanism.

RESTRICTED

VULCAN B. MK.2



AUX. PNEUMATIC SYSTEM BOMB DOOR SEALS & ANCILLARY SERVICES T4 BOMBSIGHT SYSTEM (BELOW)



F.S/

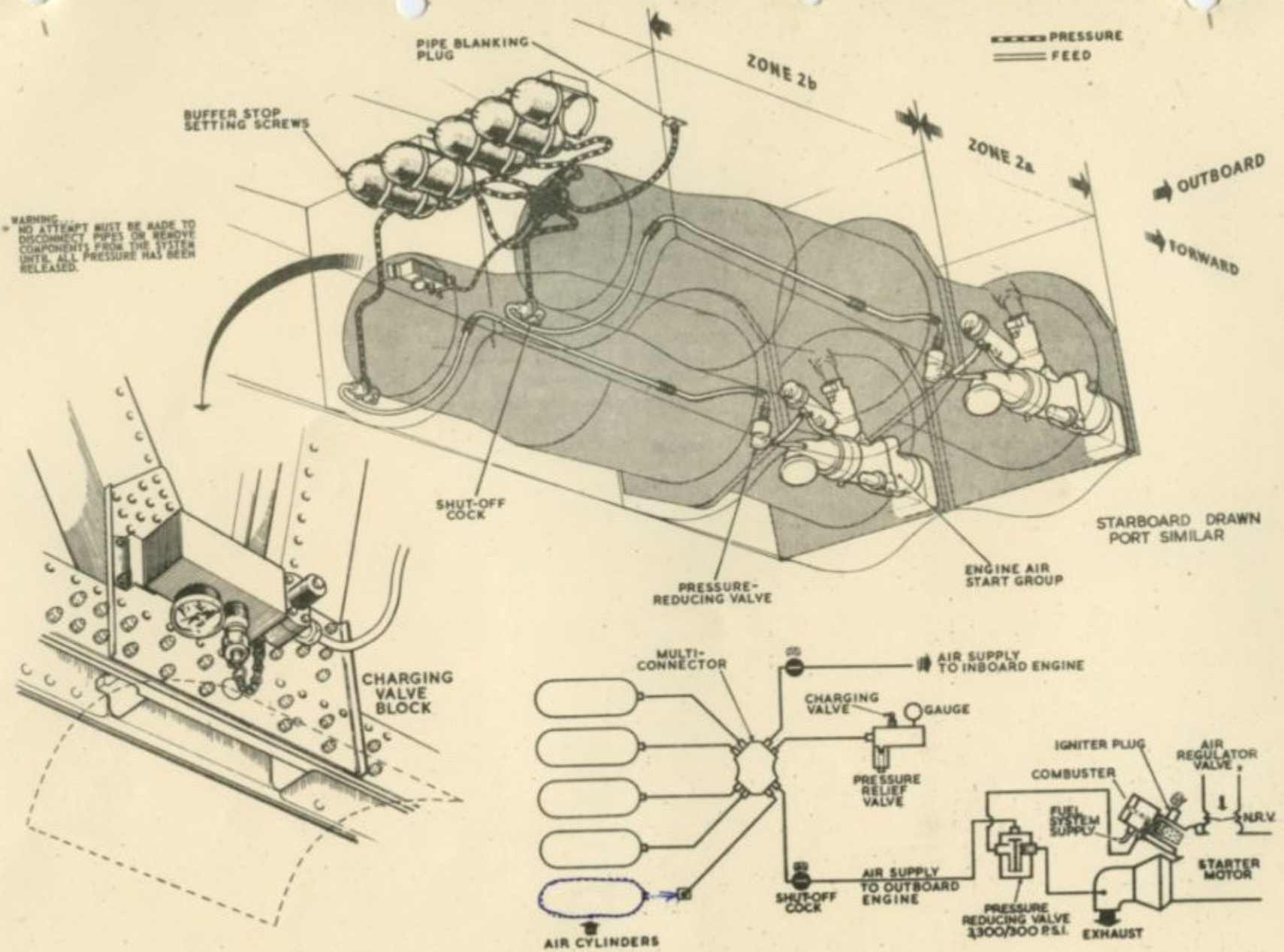


Fig. 4. Engine rapid start system
 (Mod. 1790 and 1791)
RESTRICTED

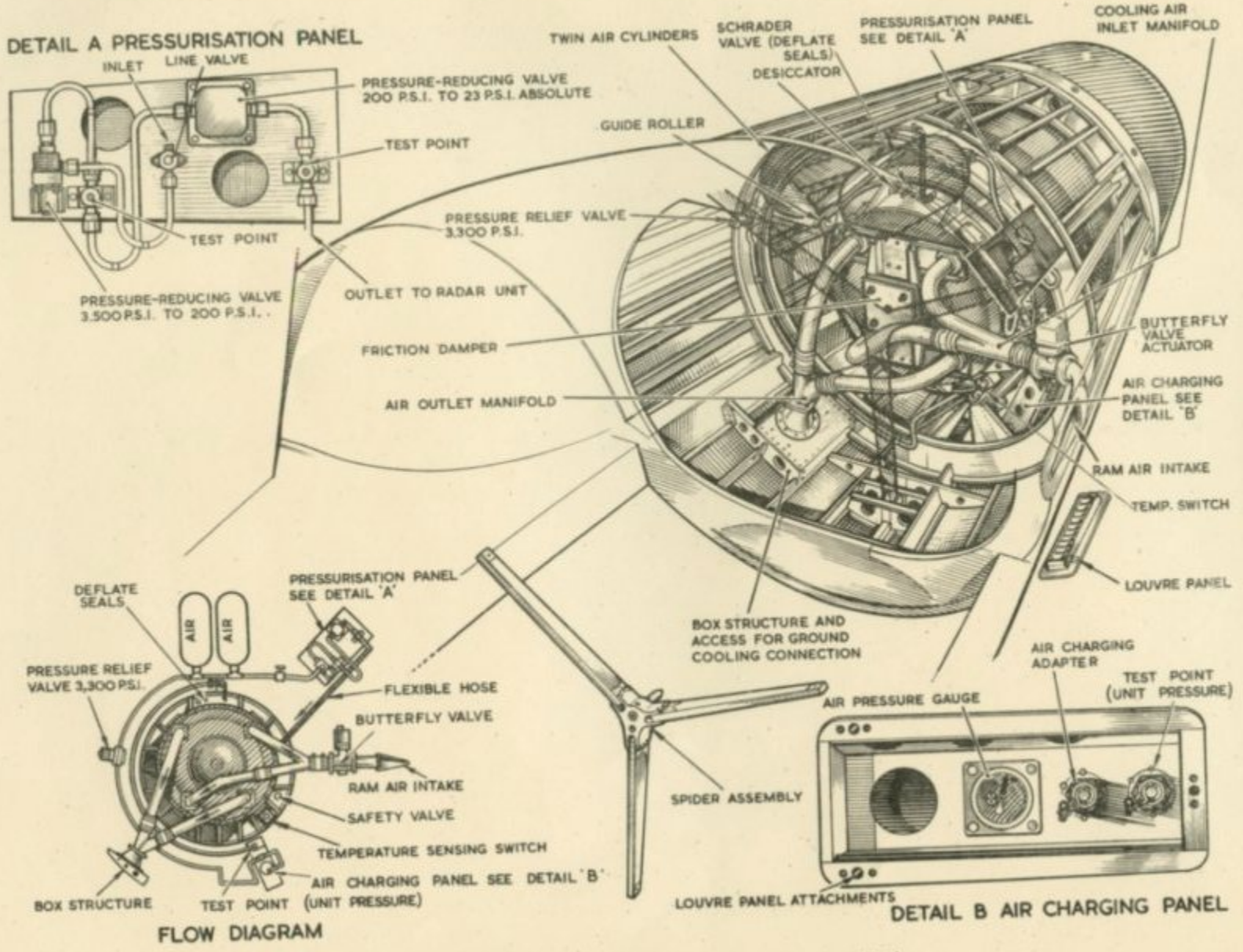


Fig. 7 Rear warning cooling and pressurisation installation

RESTRICTED

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.

