Chapter 7 PNEUMATIC SYSTEM

(Completely Revised)

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List of Illustrations

DESCRIPTION

Brakes

1. The pneumatic system supplies the Dunlop wheel brakes, canopy hatch seal and the hatch telescopic support strut. The two main wheel units have inflatable annular rubber bags, which expand the segmented brake shoes radially on to the brake drum (Sect. 3, Chap. 5). The brakes are operated by a lever mounted on each control column, in conjunction with the rudder pedals. The pedals apply pneumatic pressure differentially according to their position. The canopy hatch incorporates a rubber seal, which is inflated or deflated by an air valve when the hatch is respectively locked or unlocked. The pneumatic hatch is extended to open the hatch, when unlocked, by the operation of a control button on the port side of the main instrument panel. This completes an electrical circuit to energise the solenoid of an electromagnetic valve in the pneumatic system, thus passing air pressure into the strut via a reducing valve.

Supply system

2. The pressure, which is supplied from an engine-driven Hymatic compressor, is transmitted through a non-return valve and a moisture trap to an automatic regulator valve. The regulator controls the charging of an air reservoir which, in turn, supplies the brake differential relay valve through a filter and pressure-reducing valve. The air reservoir also supplies the hatch seal air valve and the pneumatic hatch strut through a common air filter and a pressure maintaining valve, then via a reducing valve in the case of the seal circuit and via an electro-magnetic air valve and a reducing valve in the strut circuit. Fig. 5 shows the relative positions of the pneumatic components in the system. Operating pressures are given in the Leading Particulars.

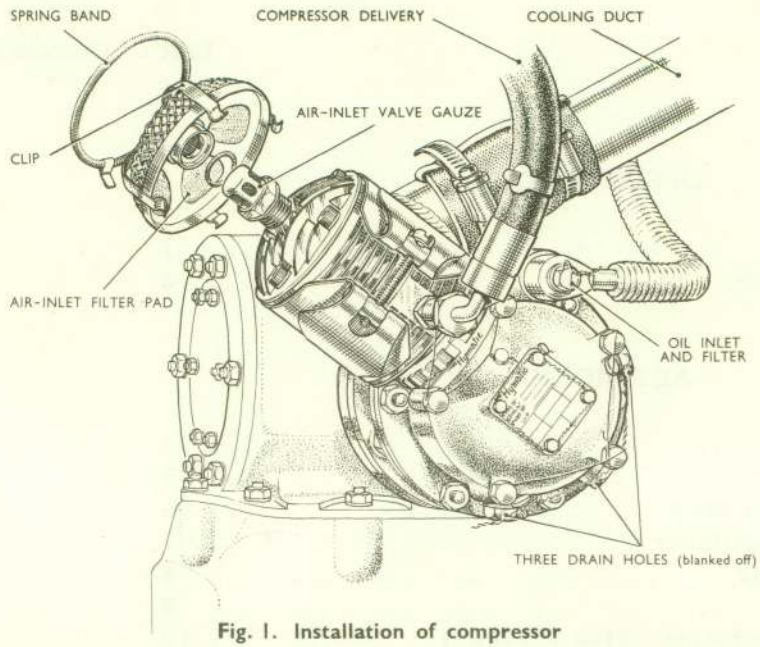

Fig. 1. Installation of compressor

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SERVICING

General

3. At the inspection periods quoted in Vol. 5, the pneumatic components must be systematically inspected and any adjustments or replacements made accordingly. Before dismantling any of the components from the pressure regulator onwards, or disconnecting a pipe joint in the circuit under pressure, all pressure from the reservoir must be released. This is accomplished by continuous movement of the rudder pedals with the brake lever ON, checking that the centre dial of the brake pressure gauge indicates zero. Extreme cleanliness must be observed during all servicing operations. Dust or dirt within the system may prevent a valve from seating and render the brakes inoperative.

4. The whole system must be maintained free from leaks and, where provision is made, locking devices for detachable components must be correctly applied. Information on the servicing of the various components in the system is given in the following paragraphs.

Compressor (Fig. 1)

5. The Hymatic two-stage air compressor is mounted on the port side of the top engine wheelcase and is inclined forward at an angle of 60 deg. from the vertical. It is lubricated by the engine high-pressure oil system through an external pipe from the top of the accessory wheelcase. The three drain connections on the pump crankcase are blanked off since the returning oil is fed back to the wheelcase through the pump facing. The oil inlet filter screw should be removed periodically and the gauze filter cleaned. If the gauze is damaged a new assembly must be fitted. Anneal the joint washer before reassembling the screw. The air inlet valve gauze and the air inlet filter pad should be examined periodically the latter being renewed when necessary Full details of the operation and servicing of the compressor are contained in A.P.4303C, Vol.1. The efficiency of the compressor can be tested by checking the rate of pressure increase with the engine running and the system not fully charged.

Oil and water trap

6. As its name implies, the function of this unit is to remove any oil or water from the compressed air passing from the compressor to the regulator. The trap should periodically be drained and this is best accomplished when the system is being charged. Unscrew the hexagon blanking cap at the base of the trap about one quarter turn and allow the oil and water to be blown out. If the system is not being charged the blanking cap must be removed. The trap should periodically be removed from the aircraft and serviced in accordance with instructions detailed in A.P.4303C, Vol.1.

Pressure regulator

7. The regulator controls the charging of the air reservoir up to the operating pressure of the system. At this pressure which is given in the Leading Particulars, the output of the compressor is diverted from the regulator to atmosphere. A safety relief valve is also incorporated in the body of the regulator. This valve is set to relieve at a pressure slightly above that of the main regulating valve and acts as a safeguard in the event of failure of the latter. The air-inlet filter should be removed periodically for cleaning by unscrewing the inlet union. If the adjusting screws for either the regulating or safety valve have been disturbed, the regulator must be removed from the aircraft and tested on a rig as described in A.P.4303C, Vol.1, Sect.4, Chap.1. These adjusting screws are protected by the two hexagon blanking caps projecting from the top of the valve body and each is identified on the side of the casting. The regulator also incorporates a non-return valve which should be checked for leakage in accordance with the instructions contained in para.21.

Air reservoir

8. A cylindrical shell with hemispherical ends forms the reservoir (Fig. 4) in which the pneumatic energy is stored. The inlet and outlet pipes to and from the reservoir, project horizontally for a few inches inside the container and form stack-pipes, which prevent any condensation forming within the reservoir from passing on to the remainder of the system. The only servicing necessary on the reservoir is occasional removal from the aircraft to drain off the condensation. To do this it is necessary to unscrew an adapter and withdraw one of the stack-pipes. The procedure for the removal of the pneumatic panel is described in para.24.

Air filter (Fig. 4)

9. Air passing from the reservoir to the brake relay control valve, the hatch seal and the hatch strut must first pass through a filter. The filter is a felt element, sandwiched between two perforated metal discs, housed within a cylindrical body. The inlet and outlet connections are marked on the body and a drain plug at the base should be removed periodically.

Pressure-reducing valve (brakes)

10. This valve (Fig. 4) is situated in the line between the air filter and brake relay control valve. Its purpose is to reduce the reservoir air pressure to an amount specified in the Leading Particulars, which is suitable for the operation of the brakes. The inlet and outlet connections are marked on the valve body and it is important that the valve is assembled to the pneumatic panel with these connections in the correct position. The adjusting bolt on the head of the valve is turned clockwise to increase the output pressure, but as the valve is set on assembly it should not need further attention. If it is necessary to readjust the setting, the valve should be removed from the aircraft and adjusted on a test rig. An independent relief valve is also incorporated within this unit.

Brake relay control valve (Fig. 2)

11. The brake relay valve (A.P. 4303B, Vol. 1) is mounted in the cockpit forward and above the rudder pedals, and is mechanically controlled by a combination of the brake levers on the control columns and the rudder pedals. The former are connected to the relay valve by Bowden cables and the latter by a short adjustable link. An illustration of the wheel brake unit is given in Chapter 5.

Adjusting the brake relay valve (Fig. 2)

12. The procedure for adjusting the relay valve to obtain the differential control of the brakes is as follows :-

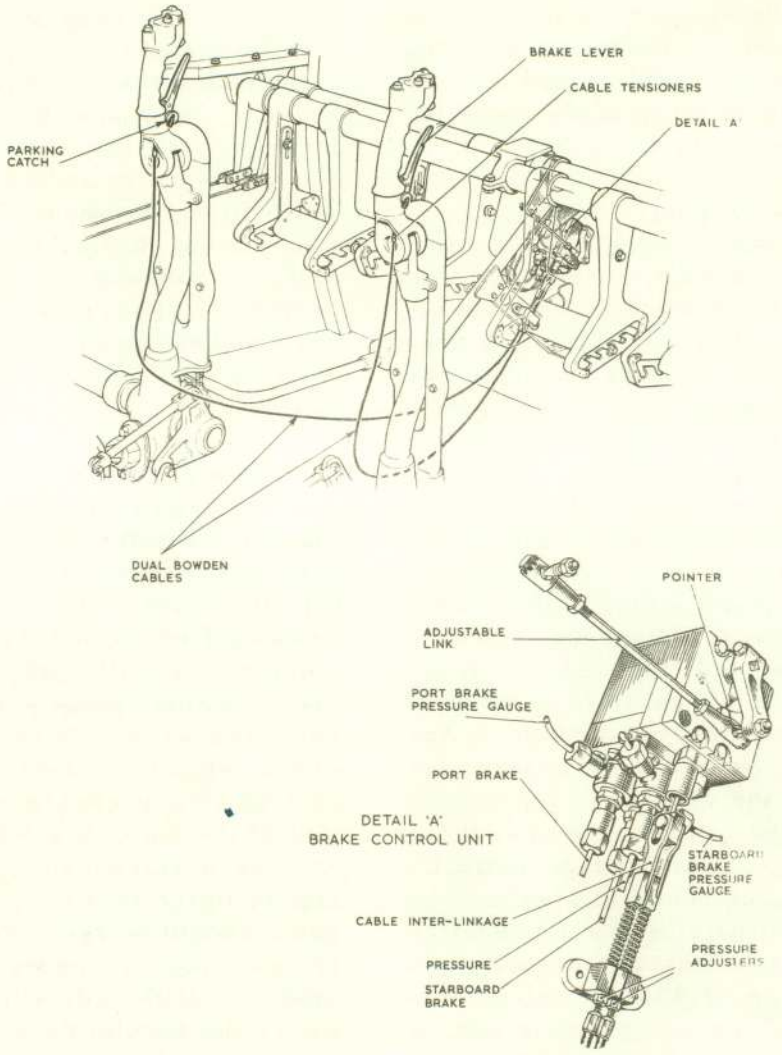

Fig 2 Brake controls and relay valve

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(1) Jack the aircraft so that the wheels are clear of the ground and charge the air reservoir to a pressure above 200 p.s.i.

(2) Lock the rudder pedals in the central position (Sect. 3, Chap. 4) and adjust the short link between the rudder pedal layshaft and the lever on the relay valve, so that the pointer attached to this lever is central.

(3) Adjust the cable tensioners below the brake lever in conjunction with the pressure adjusters, through which the cable passes into the relay valve, so that there is no pressure recorded on either of the two lower dials of the brake pressure gauge when the brake levers are OFF, then check that the pressure at each brake is as specified in the Leading Particulars when the lever is fully ON.

(4) Unlock the rudder pedals and check the differential action of the control. When the port rudder pedal is depressed, the pressure on the port brake should remain as specified throughout the travel, whilst the pressure on the starboard brake should progressively decrease to zero. With full port rudder the port wheel should be locked and the starboard wheel free. Check the braking of the starboard wheel by applying full starboard rudder.

NOTE...
Under no circumstances should the pressure adjusters be used for cable adjustment.

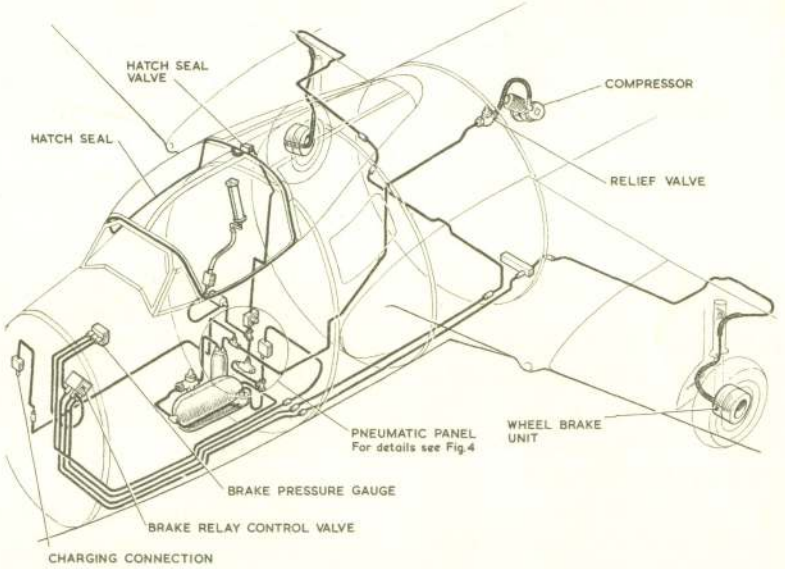

Fig. 3 Pipe lines to brakes and hatch seal

Ground charging the system

13. The charging point (Fig. 3) is located on the inflator panel on No. 1 bulkhead and incorporates a non-return valve which is illustrated in A.P.4303Z, Vol. 1, Sect. 4, Chap. 1. The air reservoir can be replenished from a ground supply by removing the sealing cap from the ground charging point and connecting a standard Turner gauge. Connect the hose of a portable charging trolley to the Turner gauge. Commence charging at a moderate rate, and screw the head of the Turner gauge in so that the system pressure will be registered on the dial face; do NOT screw the head down tightly. When the pressure in the system reaches 450 p.s.i., check that the pressure regulator can be heard to blow-off. Wait until the pressure regulator valve has reseated, and check that the maximum pressure in the system is 450 p.s.i.

Pressure-maintaining valve (Fig. 4)

14. This valve is fitted in the pneumatic system as a safety device, to eliminate the possibility of complete loss of pressure to the brakes in the event of leakage from the hatch seal, the hatch strut or from their respective pipe-lines or system components. Air pressure from the pneumatic system enters the valve seat housing and on attaining the set opening pressure, forces the valve to open against the valve main spring. Thus the valve will remain open until the inlet pressure drops below the set minimum. For the opening and closing pressures

of the valve refer to Leading Particulars. As the valve is sealed on assembly, no adjustment is possible. A suspect valve should be tested on a test rig and if faulty, replaced by a new unit.

Pressure-reducing valve (hatch seal) (Fig. 4)

15. This valve is fitted in the line between the pressure-maintaining valve and the hatch seal inflation valve. Its purpose is to reduce the reservoir air pressure (Leading Particulars) to an amount which is suitable for the operation of the hatch seal. For full details of the valve and servicing instructions, refer to A. P. 4303C, Vol. 1, Sect. 4.

Hatch seal valve

16. This valve is mounted on the canopy frame aft of the hatch. One end of the valve is connected to the pneumatic system, the opposite end incorporates a tappet. An adapter is screwed into the body for the hatch seal flexible connection. When the hatch locking mechanism is moved to the closed position, the end of a connecting rod depresses the tappet, allowing air pressure to inflate the hatch seal. When the hatch locking mechanism is moved to the open position, the tappet returns to its original position and closes the supply from the system, allowing the seal to exhaust to atmosphere. Adjustment is as follows :-

(1) Slacken the locking screw on the tappet split-nut with a screwdriver, accessible through the hole in the mounting bracket.

(2) Screw in the tappet by hand to its limit

(3) Move the hatch locking mechanism to the closed position and operating the locking handle, adjust the tappet until the hatch seal just inflates without any leakage from the valve.

(4) Tighten the split-nut locking screw and finally check the operation of the valve. A suspect valve should be tested on a test rig at a pressure of 10 p. s. i. for five minutes in each position. No leakage should be apparent.

Hatch lifting strut

17. The hatch lifting strut contains a hollow piston-rod to which is attached a piston assembly. The inside of the upper end of the strut incorporates a spring-loaded buffer plate and a locking pin; the piston has a bevelled skirt and radial groove which engages the locking pin automatically at the upper end of the stroke. A Gaco packing cup is attached to the bottom of the piston and secured by an adjustable retainer. Air enters the chamber below the piston through a high-pressure Schrader valve. If a load of 450 - 500 lb. is not maintained at the limit of compression, or if, due to piston seal leakage, the hatch fails to close steadily, packing washers and a distance piece may be placed over the adjustable retainer to expand the Gaco packing cup.

Electro-magnetic valve (hatch strut)

18. This valve is fitted on aircraft equipped with a pneumatic hatch support-strut, between the pressure-maintaining valve and the pressure-reducing valve in the line to the strut and is secured to the underside of the gun bay decking just above the pneumatic panel. Its purpose is to pass air pressure, via a reducing valve, to extend the support strut and thus open the canopy hatch, when the control button on the port side of the main instrument panel is depressed.

Pressure-reducing valve (hatch strut)

19. This valve is fitted on the strut side of the electro-magnetic valve in the line from the pressure-maintaining valve and is mounted on the forward face of bulkhead 2. Its purpose is to reduce the reservoir air pressure (Leading Particulars) to an amount which is suitable for the operation of the hatch strut. For full details of the valve and servicing instructions refer to A. P. 4303B, Vol. 1, Sect. 4.

Testing for leaks

20. With the system fully charged, the rudder pedals locked and the brake lever held on by the parking catch, the pressure must be maintained in the system for a period of 12 hours. If, after making due allowance for change in temperature, the pressure has decreased by more than 20 p. s. i. the

source of the leak must be traced. If the leak persists when the brake lever is off, the wheel units and the pipe runs thereto can be considered free of leaks. If the non-return valve in the regulator is serviceable (para. 21), the leak must be between this unit and the brake relay valve. Apply soapy water to all pipe connections, components and relief vents to detect leak. For the rectification of leaking components reference is directed to A. P. 2337, Vol. 1, and A. P. 4303C, Vol. 1. Remove all traces of the soapy water when the leak has been identified.

WARNING...

AIR MUST NOT BE ADMITTED TO THE BRAKES TO TEST FOR LEAKAGE, OR FOR ANY OTHER PURPOSE, WHILST THE WHEELS ARE REMOVED.

21. To check the regulator non-return valve for leakage, fully charge the reservoir then unscrew the drain nut on the oil and water trap to release any pressure which has built up during charging. Close the drain nut and allow to stand for about 15 mins. Brush soapy water around the nut and then release as before. An escape of air indicates a faulty non-return valve in the regulator and remedial action should be taken in accordance with the instructions contained in A. P. 4303C, Vol. 1, Sect. 4, Chap. 1.

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REMOVAL AND INSTALLATION

General

22. The procedure for the removal and assembly of the individual pneumatic components from the aircraft will be clearly apparent when the items are viewed on the aircraft and, apart from the pneumatic panel, no tabulated instructions will be given. All pipe ends and components should be sealed when they are dismantled.

23. Pipe couplings should not be interfered with unless it is necessary to break the joint for a specific purpose. When fitting new lengths of pipe or refitting an existing pipe, the bore should be thoroughly cleaned with a pull-through and then subjected to a compressed air blast.

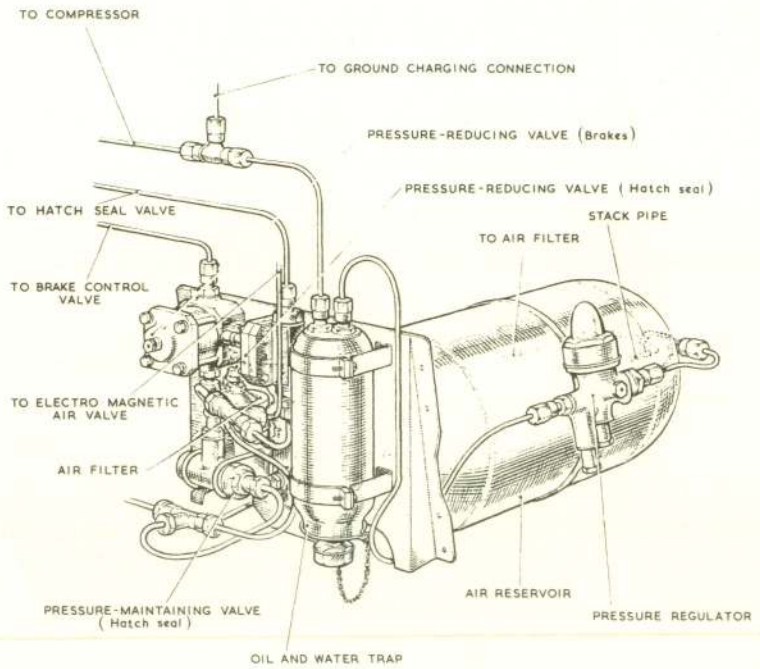

Fig. 4. Pneumatic panel

Pneumatic panel

24. To gain access to the pressure regulator, the air filter and the reservoir, it is necessary to remove the pneumatic panel assembly from No. 2 bulkhead (Fig. 4). The sequence of operations is as follows :-

(1) Remove the ammunition feed chute from the inboard guns.

(2) Disconnect the pipelines leading

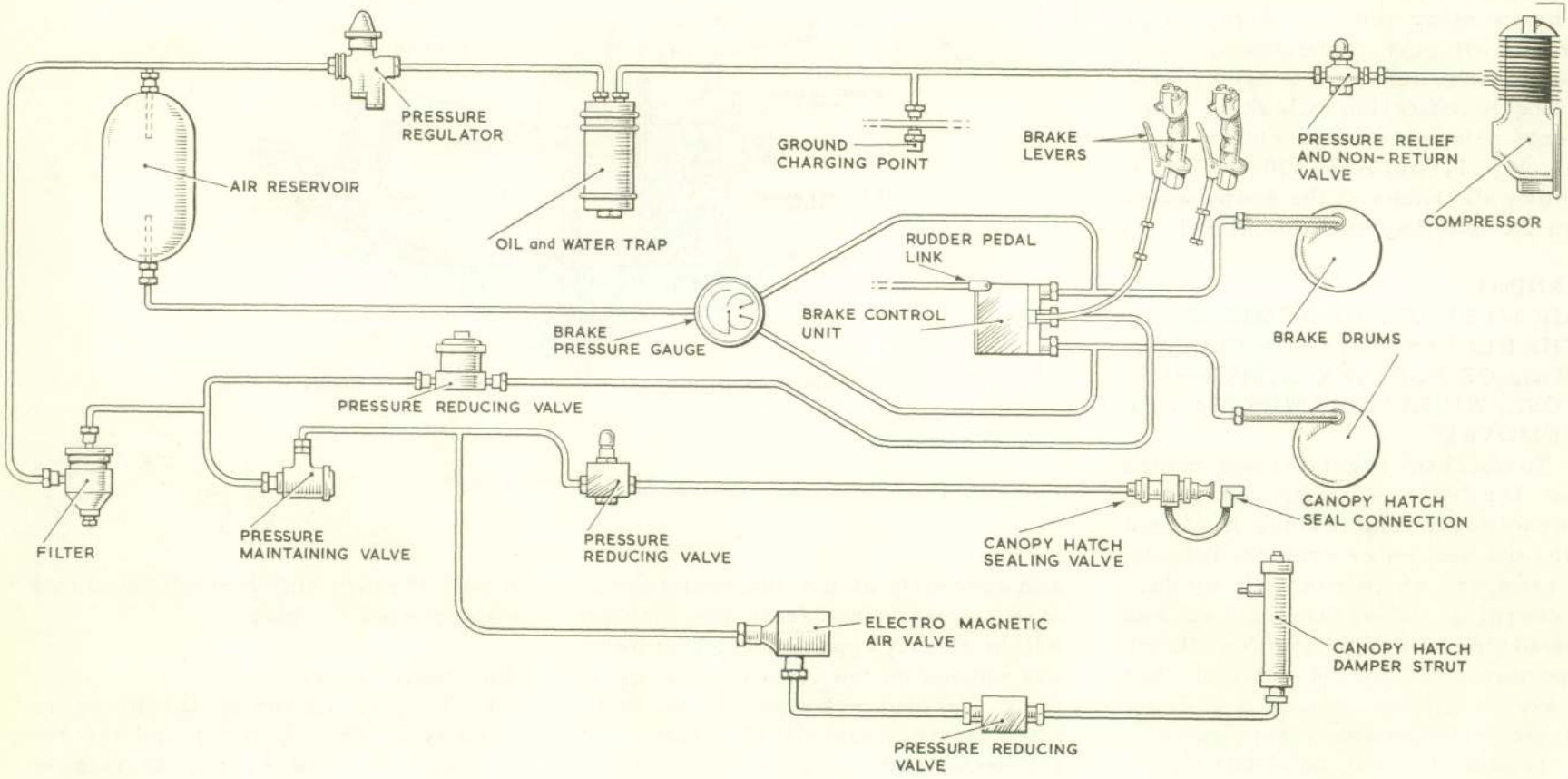

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Fig. 5. Pneumatic system diagram

to the panel.

(3) Remove the eight 2 B. A. bolts securing the panel to No. 2 bulkhead.

(4) Withdraw the assembly into the gun bay and lower.

(5) Installation is the reverse of removal.

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