

Chapter 7 PNEUMATIC SYSTEM

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DESCRIPTION AND OPERATION

Introduction

1. The pneumatic system provides controlled pressure for operating the Dunlop wheel brakes and the anti-G equipment. The two main wheel units have inflatable annular rubber bags which expand the segmented brake shoes radially on the brake drums (*Chap. 5*). The brakes are operated by a lever mounted on the control column in conjunction with the rudder pedals. The latter apply the pneumatic pressure differentially according to the position of the pedals. Fig. 4 illustrates the pipe runs to the brakes and fig. 6 the layout of the anti-G equipment.

Supply system (fig. 1)

2. The pressure, supplied from an engine-driven Hymatic compressor, is transmitted through a non-return valve (which also

incorporates a pressure-relief 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 supply for the pilot's anti-G suit runs from the T-joint between the pressure-reducing valve and the brake relay valve, through a pressure-maintaining valve and an ON/OFF valve, which controls the supply, to the anti-G suit through the respective reducing and anti-G valves.

Dunlop components

3. The following components are briefly described. For detailed information reference must be made to A.P.4303B, Vol. 1.

(1) *Air filter.* The air filter (Part No. ACP.1268) allows clean compressed air

to enter the system and collects any oil dust and water vapour in the base of the unit.

(2) *Pressure-reducing valve (brakes).* The pressure-reducing valve (Part No. AHO.5712) is fitted between the air filter and the brake control unit to reduce the air to the 220 lb. per sq. in. required to operate the brakes.

(3) *Brake control unit.* The brake control unit (Part No. AHO.8241), allows air pressure to pass from the reservoir to the brake units when the lever on the control column is pressed. With the rudder pedals in the central position the pressure will be equal on either brake, differential pressure being obtained by the movement of the rudder pedals which are connected to the brake unit by a connecting-rod.

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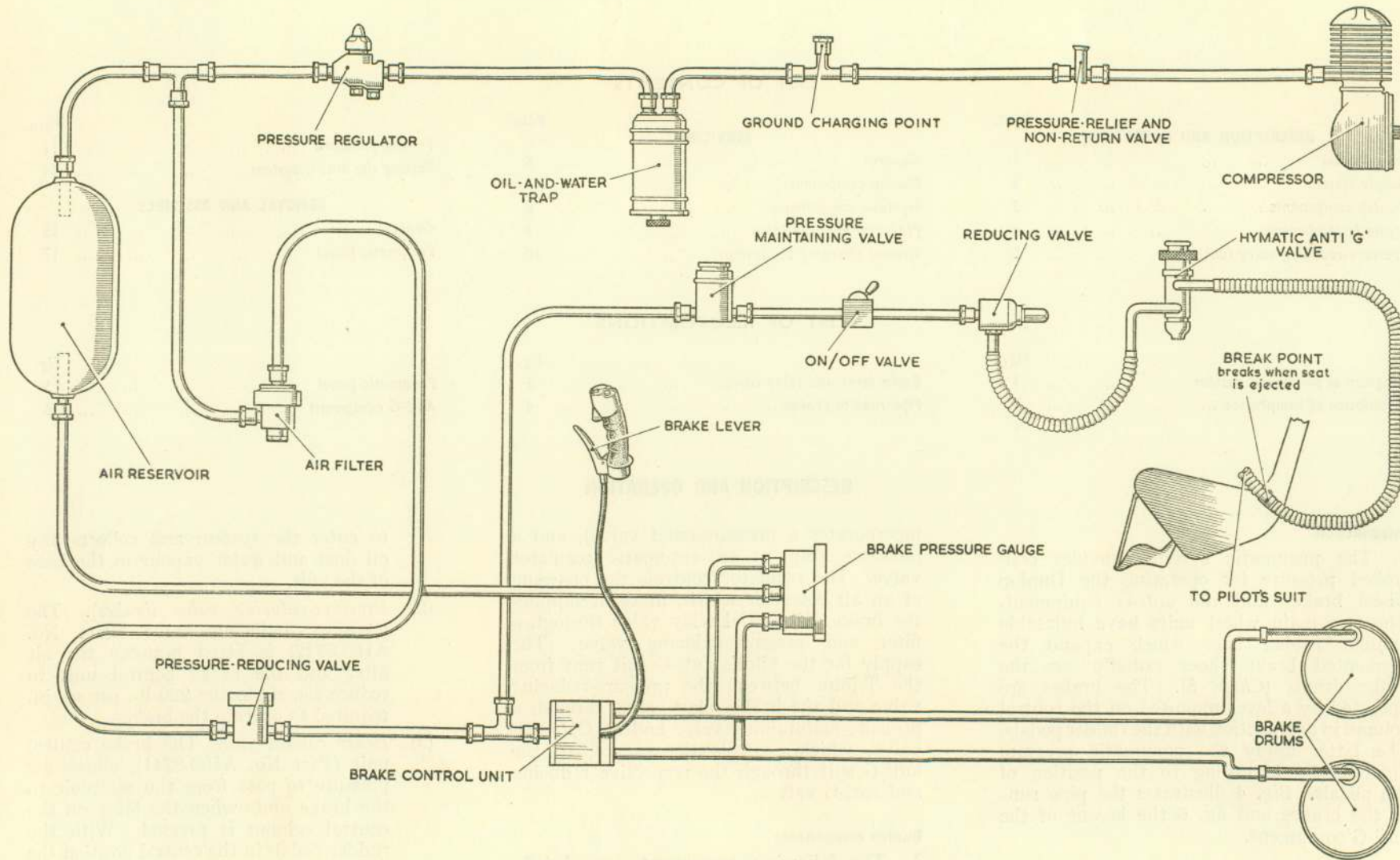


Fig. 1. Diagram of pneumatic system

Hymatic components

4. The following components are briefly described. For detailed information reference must be made to A.P.4303C, Vol. 1.

- (1) *Compressor (fig. 2).* The two stage air compressor (Type SH.6/2A), mounted on the starboard side of the top engine wheel case, is designed to deliver air at a pressure of 450 lb. per sq. in., and is lubricated by engine high-pressure oil fed through the mounting flange.
- (2) *Pressure-relief valve.* This valve (Part No. R.V.10) acts as a safety valve by relieving excessive pressure in the system to atmosphere, and prevents back pressure on the second stage of the compressor.
- (3) *Oil-and-water trap.* This unit (Type No. OWT46/8) is mounted on the pneumatic panel between the ground charging point and the pressure regulator, and its purpose is to prevent oil and water entering the system.
- (4) *Pressure regulator.* The regulator (Type AR.5/450-2), controls the charging of the air reservoir so that any pressure in excess of that required for operating the system is automatically relieved to atmosphere. The safety relief valve incorporated in the regulator is set to relieve at a slightly higher pressure than the main regulating valve and acts as a safeguard should the latter fail.
- (5) *Air reservoir.* The air pressure is stored in the reservoir (Type E), which comprises a cylindrical shell with hemispherical ends; the inlet and outlet pipes project a few inches inside the reservoir to prevent any moisture from passing into the system.
- (6) *Pressure-maintaining valve.* This valve (Part No. PM.2) is fitted between the brake line circuit and anti-G circuit, so

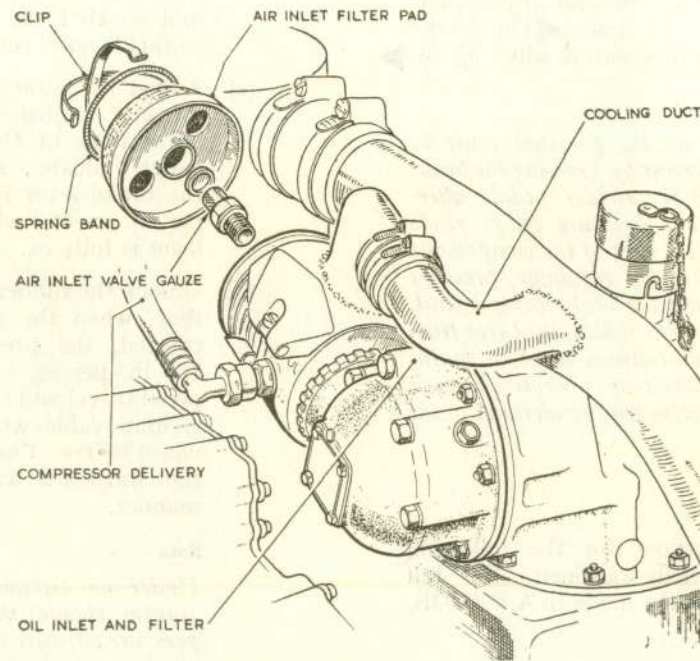


Fig. 2. Installation of compressor

that, in the event of leakage in the subsidiary services, pressure will be maintained for the braking system. The valve is set for a maximum pressure of 600 lb. per sq. in. and automatically closes when the pressure drops to 150 ± 10 lb. per sq. in.

- (7) *Selector valve (anti-G).* The selector valve (Part No. SV.9), positioned below the pilot's oxygen regulator, controls air pressure to the anti-G valves by movement of the ON/OFF control handle.
- (8) *Anti-G valve.* The pilot's anti-G valve is fitted on the starboard side of the

cabin adjacent to Junction box No. 1. The valve controls the flow of low pressure air to the pilot's anti-G suit, and automatically increases or decreases the pressure as "G" increases or decreases. The valve also acts as a reducing valve, since the maximum pressure admitted to the suit is 7.25 lb. per sq. in.

Pressure reducing valve (anti-G)

5. A Palmer valve (Part No. C.58) is situated in the pipe line between the ON/OFF valve and the Hymatic anti-G valve, and reduces the air pressure to the anti-G valve to between 10 and 20 lb. per sq. in. For full details refer to A.P.4303Z, Vol. 1.

SERVICING

General

6. The pneumatic components must be inspected at the periods laid down in the relevant servicing schedule and any adjustments or replacements made. The brake cable must be lubricated periodically (fig. 3).

Note . . .

It is essential that all the pressure must be released from the reservoir by pressing the brake lever, and operating the rudder pedals alternately, until the brake pressure gauge reads zero, before dismantling any of the components between, and including the regulator, pressure maintaining valve and the brake control unit. The entire system must be maintained free from leaks, and extreme cleanliness must be maintained during all servicing operations since dirt or dust in the system may render any of the valves inoperative.

Dunlop components

7. Servicing operations for the following components are briefly outlined. For full details reference must be made to A.P.4303B, Vol. 1.

- (1) *Air filter.* The lock-nut and drain plug must be slackened off periodically to allow the foreign matter to drain from the base of the filter.
- (2) *Pressure-reducing valve (brakes).* If it is necessary to re-adjust the setting, the valve must be removed from the aircraft and adjusted on a test rig. The inlet and outlet connections are marked on the valve body and it is essential that these should be correctly fitted when the valve is assembled to the pneumatic panel.
- (3) *Brake control unit (fig. 3).* Differential control of the brakes is obtained by adjusting the unit as follows:—
 - (a) Jack the aircraft until the wheels are clear of the ground and charge the air reservoir to a pressure of at least 220 lb. per sq. in.

- (b) Lock the rudder pedals in the neutral position, and adjust the link rod between the rudder pedal layshaft and the lever on the control unit so that the pointer attached to this lever is central.
- (c) Adjust the cable tensioner and the pressure adjuster until the two lower dials of the brake pressure gauge indicate a zero reading when the brake lever is off, and 150 lb. per sq. in. at each brake when the lever is fully on.
- (d) Unlock the rudder pedals and check that, when the port pedal is depressed, the pressure remains at 150 lb. per sq. in. throughout the pedal travel and that the port wheel is immovable while the starboard wheel is free. Check the braking of the starboard wheel in a similar manner.

Note . . .

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

Humatic components

8. Servicing operations for the following components are briefly outlined. For full details reference must be made to A.P.4303C, Vol. 1.

- (1) *Compressor.* The oil inlet filter screw should be removed periodically and the gauze filter cleaned or renewed if necessary. The air inlet valve gauze and the air inlet filter pad should be examined periodically, the latter being renewed when necessary.

- (2) *Pressure-relief valve.* If the valve is suspect, it must be removed and tested on a test rig.
- (3) *Oil-and-water trap.* Draining, which should be carried out periodically, is effected by unscrewing the blanking cap at the base of the trap and allowing the fluid to run out. Draining under pressure can be carried out with the engine running, or by applying pressure at the ground charging point.
- (4) *Pressure regulator.* The adjusting screws for the regulator, or the relief valve incorporated with it, should not be altered unless the unit is removed and tested on a test rig.
- (5) *Air reservoir.* The only servicing necessary is occasional removal from the aircraft to drain off condensation, by unscrewing an adapter and withdrawing one of the stack pipes.

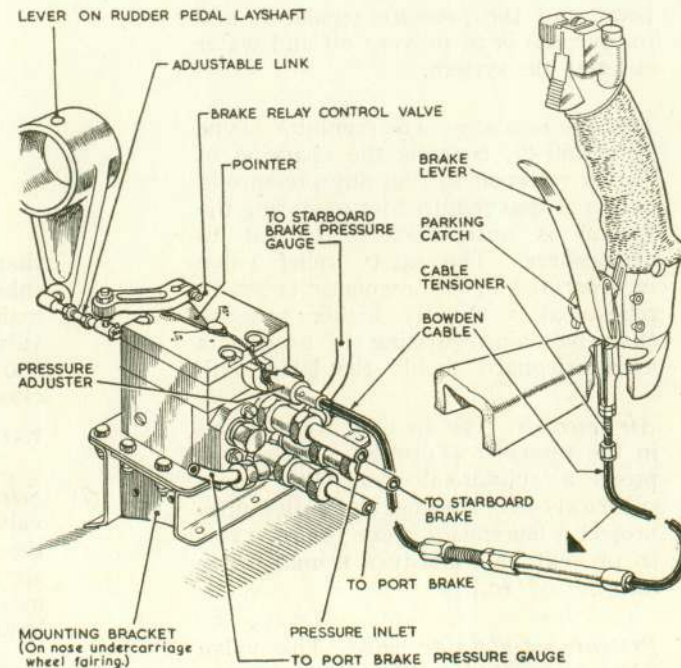


Fig. 3. Brake lever and relay valve

- (6) *Pressure-maintaining valve.* Testing and adjusting of the valve must be carried out on a test rig.
- (7) *Selector valve (anti-G).* If suspect, the valve must be removed and tested on a test rig.
- (8) *Anti-G valve.* No servicing is permitted unless the valve is removed and tested on a test rig. A test push button is mounted in the top of the valve to enable the pilot to check inflation of his anti-G suit.

Pressure-reducing valve (anti-G)

9. No servicing is necessary except when the valve is removed and can be tested on a test rig. For full details refer to A.P.4303Z, Vol. 1.

Ground charging the system

10. The air reservoir can be replenished from a ground supply by removing the dust cap from the ground charging point and connecting the charging hose from a portable charging trolley. Commence charging at a moderate rate, checking the readings on the centre dial of the cabin pressure gauge and on the gauge of the charging trolley. When the readings indicate a maximum pressure of 450 lb. per sq. in. in the system reservoir, switch off the supply from the trolley, disconnect the hose and replace the dust cap on the connection. When the reservoir has been charged to the correct pressure, a check should be made that the system regulator relieves any excess pressure to atmosphere.

Testing for leaks

11. Leakage in any part of the system may be checked by charging the system, locking the rudder pedals (*Sect. 2, Chap. 1*), applying the brakes and checking the readings on the pressure gauge. The brakes should be left *on* for approximately 12 hours.

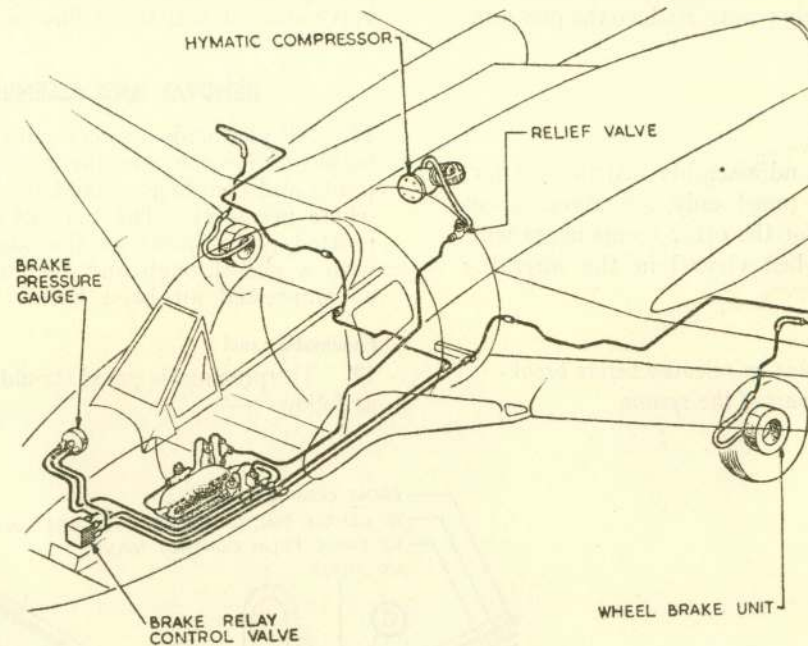


Fig. 4. Pipe runs to brakes

WARNING

This test must only be carried out when the wheels are fitted on the aircraft, since the air bags will be damaged if pressure is applied when the wheels have been removed.

There must be no drop in pressure. Any loss must be investigated. The extent of the leakage may be localised by switching off the brakes and the anti-G selector valves. If the leak persists, the system between the air compressor and the cabin pressure must be checked. The subsidiary systems, i.e., brakes and anti-G, may be checked in a similar manner.

12. The pipe lines and joints should be brushed with soapy water to trace leakage. Any parts subjected to this test must be thoroughly cleaned afterwards to avoid the possibility of corrosion.

13. The regulator non-return valve should be checked for leakage by charging the reservoir fully, and unscrewing the drain nut on the oil-and-water trap to release any pressure from the trap. Tighten the drain nut, brush soapy water round it and leave it for at least 15 minutes. Unscrew the nut after this period and, if there is an escape of air, take remedial action in accordance with A.P.4303C, Vol. 1, Sect. 4, Chap. 1.

Testing the anti-G system

14. Place the anti-G selector valve to the OFF position, connect up a ground air supply to the ground charging point on the aircraft, and charge the air reservoir to a pressure of 450 lb. per sq. in. Place the anti-G selector valve ON and check that there is no air flow from the anti-G suit supply point on the ejector seat. Depress

the button on the anti-G valve and check that there is a positive flow of air from the anti-G suit supply point. Reduce the pressure

General

15. Removal and assembly instructions for the pneumatic panel only are given since the procedure for the other components will be apparent when viewed in the aircraft.

WARNING

All pressure must be released before breaking down any part of the system.

in the air reservoir to just above $\llcorner 160 \gg$ lb. per sq. in., depress the button on the anti-G valve and check that the flow of air from the

anti-G suit supply point ceases when the pressure in the air reservoir drops to 150 lb. per sq. in.

REMOVAL AND ASSEMBLY

16. All pipe ends and components must be blanked off as they are disconnected and pipe joints and couplings should only be broken where necessary. The bore of any new or refitted piping must be thoroughly cleaned with a pull-through and then subjected to a compressed air blast before attachment.

Pneumatic panel

17. The pneumatic panel should be removed as follows :—

- (1) Open the gun bay doors and remove the ammunition feed chutes from the inboard guns (*Sect. 7, Chap. 3*).
- (2) Disconnect pipes A, B and C as indicated in fig. 5.
- (3) Withdraw the eight bolts securing the panel to No. 2 bulkhead.
- (4) Remove the panel through the gun bay. Assembly is the reverse of removal.

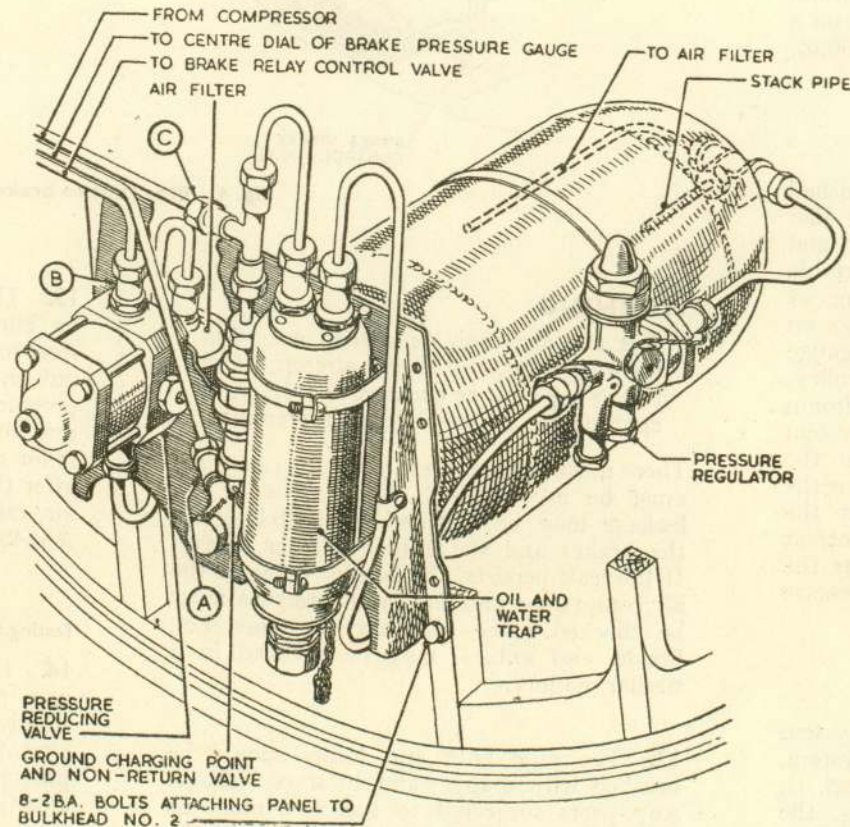


Fig. 5. Pneumatic panel

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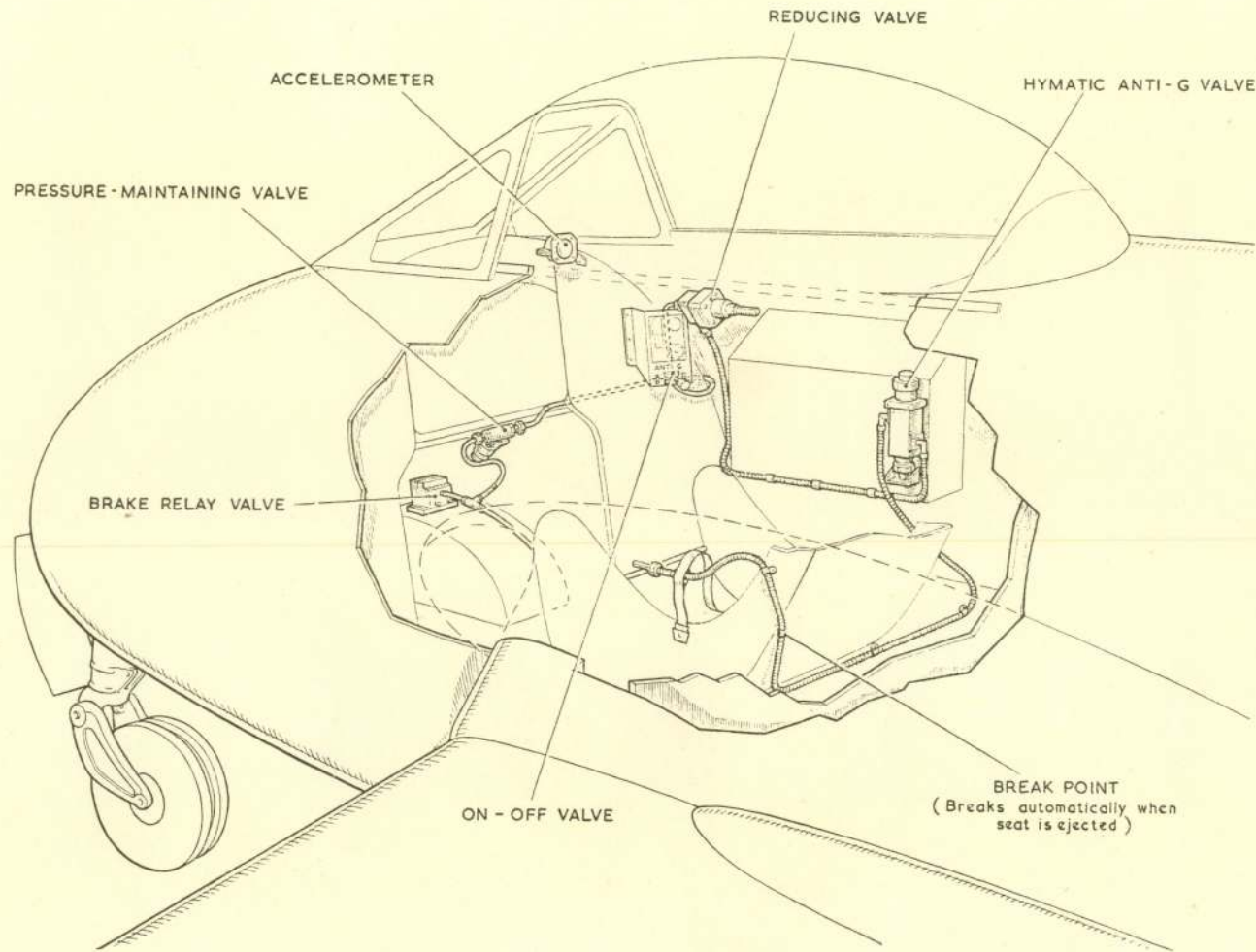


Fig. 6. Anti-G equipment



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