Chapter 7

PNEUMATIC SYSTEM

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DESCRIPTION AND OPERATION

Introduction

1. The complete installation of the aircraft pneumatic services is, in effect, two separate systems each supplied by a compressor. The compressed air is stored in air bottles which provide a reserve of air for the operation of the following services:-

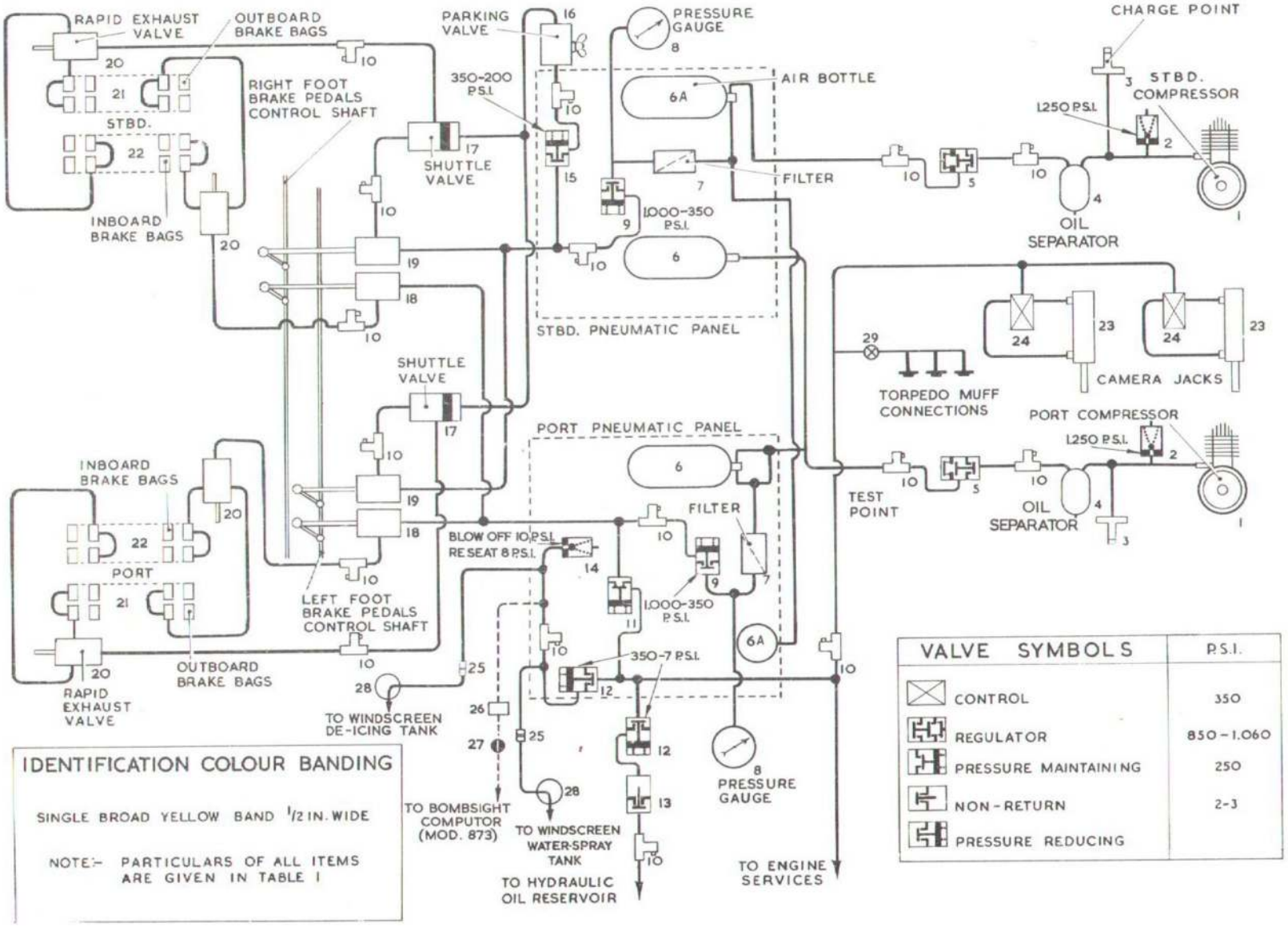

Fig. 1. Diagram of pneumatic system.
(◀ Mod No. 915 ▶)

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KEY TO FIG.1

(Refer also to Table 1)

1. COMPRESSOR
2. RELIEF VALVE
3. CHARGING POINT
4. OIL-AND-WATER TRAP
5. PRESSURE REGULATING VALVE
6A. TWO BOTTLES ON EMBODIMENT OF MOD.392
6. AIR STORAGE BOTTLE
7. AIR FILTER
8. PRESSURE GAUGE
9. PRESSURE REDUCING VALVE
10. PRESSURE TEST POINTS
11. PRESSURE MAINTAINING VALVE
12. PRESSURE REDUCING VALVE
13. NON-RETURN VALVE
14. PRESSURE RELIEF VALVE
15. PRESSURE REDUCING VALVE
16. BRAKE PARKING VALVE
17. SHUTTLE VALVE
18. PORT SYSTEM BRAKE CONTROL VALVE
19. STBD. SYSTEM BRAKE CONTROL VALVE
20. RAPID EXHAUST VALVE
21. BRAKE UNIT - OUTBOARD BRAKE BAGS
22. BRAKE UNIT - INBOARD BRAKE BAGS
23. CAMERA JACK
24. ELECTRO-PNEUMATIC CONTROL VALVE
25. MODIFIED SELF-SEALING COUPLING
26. AIR DRIER MK.V (POST MOD.873)
27. COCK-NO.1 BOMBSIGHT (POST MOD.873)
28. UNIVALVE
29. ON-OFF COCK

(1) The main-wheel brakes (Sect.3, Chap.5).

(2) Engine services (Sect.4, Chap.1).

(3) Hydraulic oil reservoir pressurisation (Sect.3, Chap.6).

(4) Vision de-icing fluid tank pressurisation (Sect.3, Chap.9).

(5) Vision water-spray tank pressurisation (Sect.3, Chap.14).

(6) The pneumatically-operated camera jacks (Sect.5, Chap.2).

(7) The torpedo muff connections.

(8) No.1 bombsight installation.

2. Fig.1 is the system diagram; the system, as installed in the airframe, is illustrated in fig.3 and 4. Table 1 (at the end of the chapter) gives data on the components used in the system.

SUPPLY AND STORAGE SYSTEMS

General

3. The two systems are known as the port and starboard systems, each fed by its corresponding compressor and with its own storage system. The port system is supplied by a compressor mounted on the upper starboard drive face of No.2 engine accessory gearbox, and the starboard system by a compressor similarly mounted on No.3 engine accessory gearbox.

Port supply system

4. Compressed air, delivered from the compressor in No.2 engine nacelle, is piped to a pressure relief valve and thence to an oil-and-water trap mounted at the lower starboard corner of the aft face of the firewall. From this component a pipe, which incorporates a test connection, is led upwards to a pressure regulating valve on the upper starboard portion of the aft face of the firewall. A delivery pipe from the regulator incorporates another test connection and then extends along the front spar and forward, along the port side of the fuselage, to two air bottles under the floor of the nose.

Starboard supply system

5. In No.3 nacelle the system is a duplicate of that in No.2 nacelle, and the piping is run along the front spar to the starboard side of the fuselage and forward to an air bottle under the floor of the nose and an air bottle secured to the port side of the nose forward of former E.

Air charging points

6. From a T-union, connected in the pipe from the pressure relief valve in each nacelle, a pipe is run to a charging point on a small panel attached to the starboard undercarriage beam. Each panel is labelled PNEUMATIC CHARGING.

Air bottles (fig.4)

7. Three bottles are mounted on two pneumatic panels located one to port and one to starboard of the windscreen de-icing tank (Sect.3, Chap.9), immediately forward of former E under the floor in the nose. The fourth bottle, introduced by Mod.392, is located above the port gun beam. There are two bottles on the starboard panel and one on the port panel. The airline from the port nacelle feeds the T-piece on the forward bottle on the starboard panel and thence the bottle on the port panel. Air from the starboard nacelle is fed to the aft bottle on the starboard panel and the bottle above the port gun beam.

DELIVERY SYSTEMS (fig.1)

Port delivery system

General

8. The port system, with two air bottles, supplies all the services, including brakes, except when the latter are used for parking.

Pneumatic panel

9. Air at a nominal pressure of 1,000 p.s.i. from the air bottle on the port pneumatic panel and the forward bottle on the starboard panel is piped to a filter on the port panel. The outlet pipe from the filter is branched, one pipe leads to the port pressure gauge on the pilots' panel, the other is connected to a pressure-reducing valve which reduces the pressure to 350 p.s.i. A pipe from this valve incorporates a standard test connection and is led to a T-union.

Supply to brakes system

10. The through connection from the T-union is led to the brakes. This line feeds the two port brake valves of two pairs (one pair to port and the other to starboard) mounted under the transverse trough forward of the pilots' panel. The mechanical control of this valve by the pilot's toe-operated brake pedals is arranged so that operation of either the first or second pilot's left toe-pedal operates both of these port brake valves together (fig.1).

Pneumatic services

11. The branch of the T-union is led to a pressure maintaining valve, set at 250 p.s.i. from which air is piped to the pneumatic services. The outlet pipe from the pressure-maintaining valve is branched, one leading to a pressure-reducing valve, set at 350/7 p.s.i., from which a pipe, incorporating a test connection and a self sealing coupling (Chap.9), is led to the de-icing fluid tank. A branch from the latter pipe is connected to a pressure relief valve set to blow off at 10 p.s.i. and re-seat at 8 p.s.i. When Mod.987 is embodied a T-union is fitted in the line after the 350/7 p.s.i. pressure-reducing valve and supplies pressure to the wind-screen water spray tank. When Mod.873 is embodied a T-union is fitted downstream of the test connection and supplies pressure to the No.1 bombsight instal-

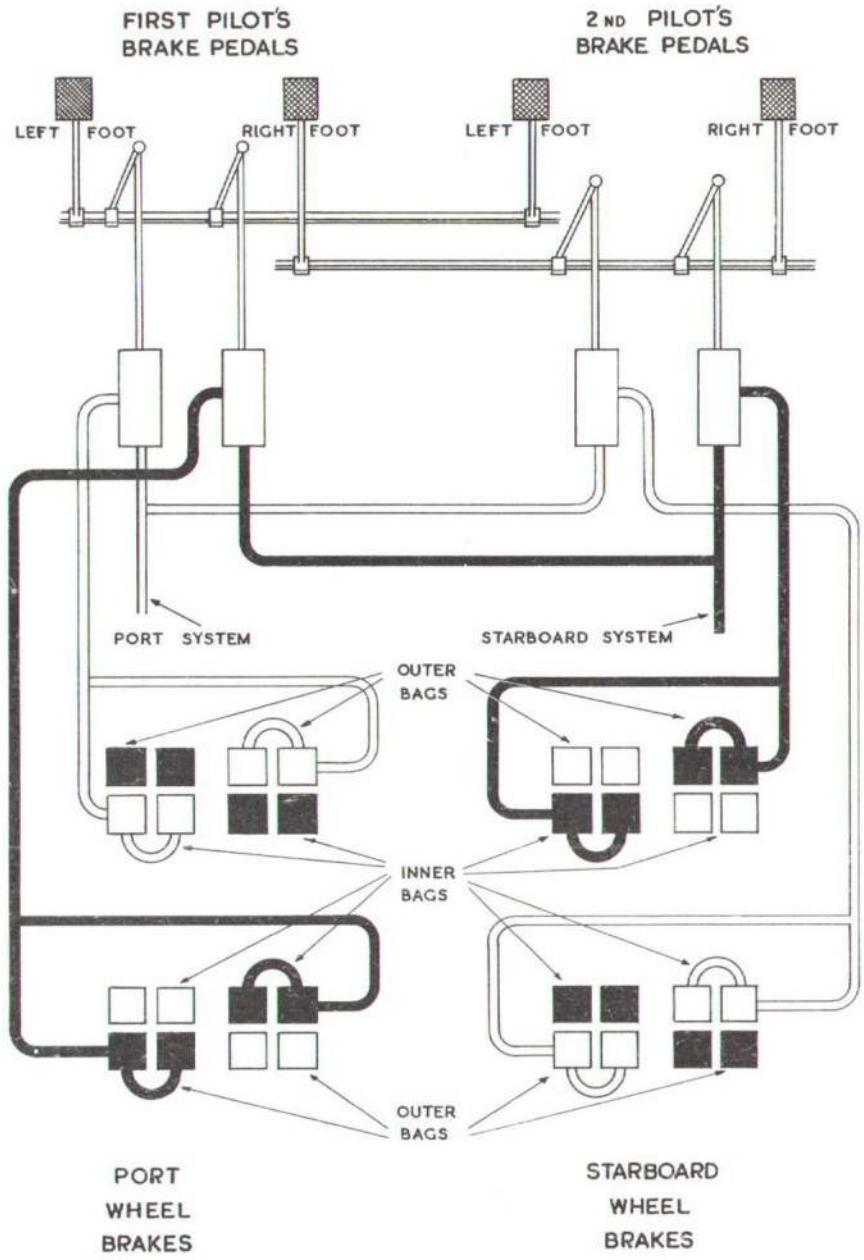

Fig.2. Brake system - simplified diagram

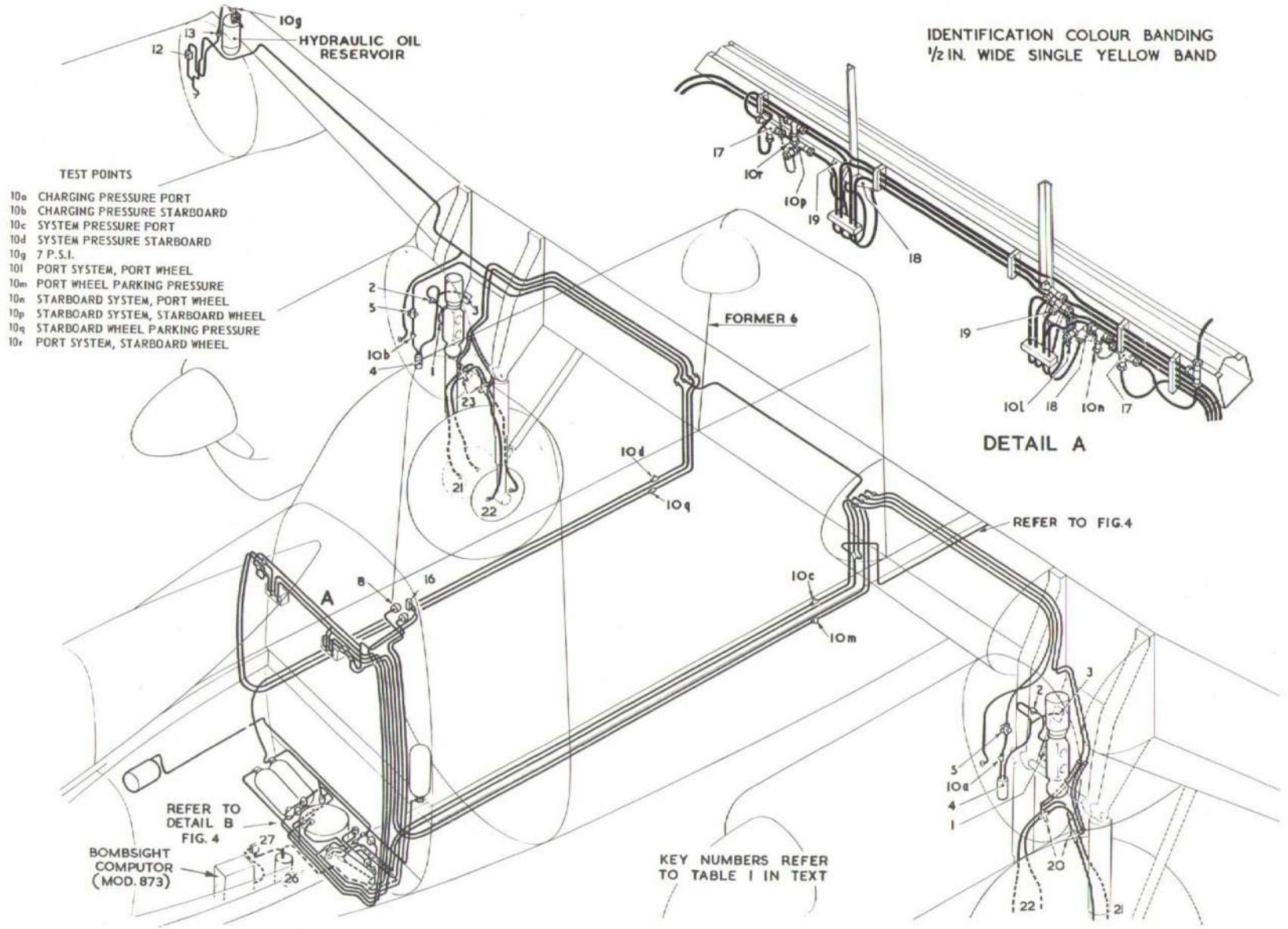

Fig. 3. Pneumatic system. (I)

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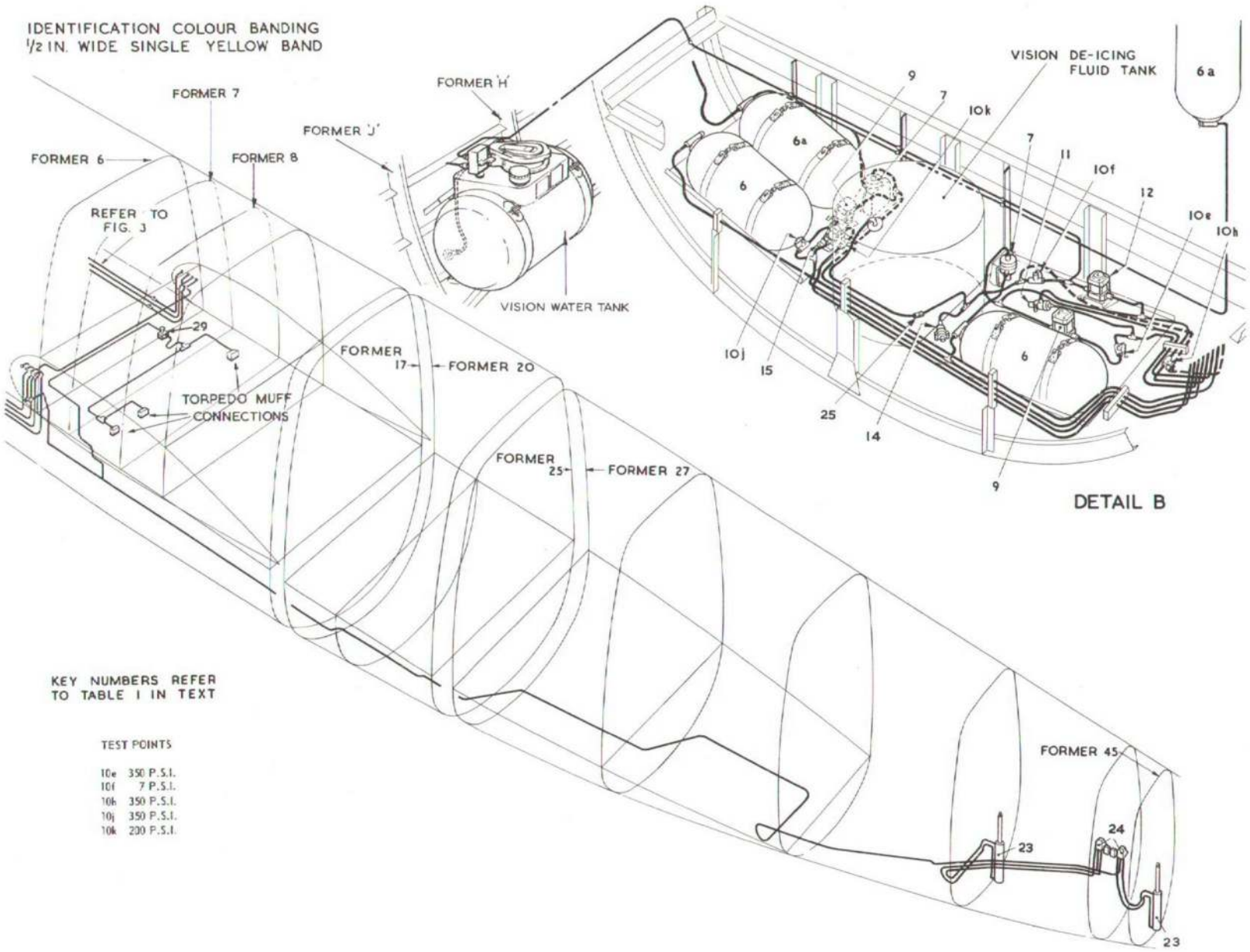

Fig. 4. Pneumatic system (2)
(◀ Mod No: 915 ▶)

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lation. The line from this union passes to an air drier and then to a manually operated on/off cock, the outlet from which is connected, by a flexible hose, to the bombsight computor.

12. The other branch in the outlet pipe from the pressure - maintaining valve divides, one line supplying the hydraulic reservoir through a 350/7 p.s.i. reducing valve and a non-return valve (after which is a test point) and the other, all four engine services through a pipe which is run along the front spar.

13. A branch from the engine services supply is run aft, through a test point, along the port side of the fuselage to the retractable cameras. The supply line to the retractable cameras divides to feed two electro-pneumatic two-way selector valves, one controlling the forward camera jack and one the rear camera jack. From the pipe to the camera bay a branch is taken, aft of former 7, through an on/off cock (Mod.915) situated alongside the sonobuoy operator's seat, to the three torpedo muff control points in the bomb bay.

Starboard delivery system

General

14. The starboard system supplies air to the starboard brake system and to the brake parking system.

Pneumatic panel

15. Air, stored in the aft bottle (and the bottle introduced by Mod.392 when fitted) at a nominal pressure of 1,000 p.s.i. is delivered through a filter to a reducing valve which reduces the air pressure to 350 p.s.i. A branch pipe is led to the starboard pressure gauge in the pilots' panel. This valve is connected to a T-union by a pipe incorporating a standard mounted on the transverse trough(para.10). These two valves are operated by either the first or second pilot's right toe-operated brake pedal.

BRAKES SYSTEM (fig.2)

16. Twin double brake bags are fitted, providing, under each of the two brake linings in each wheel hub, two concentric pairs of brake bags in tandem. This arrangement provides greater brake efficiency and thermal capacity than is provided by a single concentric pair.

17. Reference to fig.2 will show that the port pair of brake valves is operated by both pilots' left-foot brake pedals and that the starboard pair is operated by both right-foot pedals. Since, of each pair of brake valves, the left-hand valve is fed by the port pneumatic system and the right-hand valve by the starboard system, and, since each brake valve feeds either the inner or outer tandem pair of brake bags under each brake lining, either pneumatic system operates all four brake linings and test connection. From the branch of the T-union a pipe is led to a reducing valve which reduces the pressure to 200 p.s.i. This valve is followed by a standard test connection from which a pipe is led to a parking valve. The through line from the 350 p.s.i. reducing valve is led to the two starboard brake valves of the two pairs both systems together operate all the brake bags. Quick deflation of the brake bags is ensured by the action of rapid exhaust valves incorporated in the feed pipe from each brake valve to its associated brake bags. Of these four feed pipes, those from the port system brake valves are led direct to their associated brake bags, whilst the two from the starboard system are each led first to a shuttle valve which is also connected to the parking system. The outlets from the two shuttle valves are led to the starboard-system-operated brake bags. A total of six test points is provided in the brake system and their dispositions are shown in fig.3 and 4.

PARKING SYSTEM

18. Air from the parking valve, which is supplied from the starboard pneumatic system, is piped through a T-union to the two shuttle valves which are normally set to permit air from the pedal-operated valves to pass to the brakes. When the parking valve is opened, the air released moves the shuttle valve pistons to allow air to pass into the brake lines normally fed by the starboard system brake control valves which operate the inboard inner and the outboard outer twin brake bags in each main wheel. When the parking valve is closed and the brake pedals operated the pistons of the shuttle valves automatically move to their normal position.

SERVICING

TEST POINTS

19. These are indicated in fig.1, 3 and 4 and consist of standard test connections, A58, each fitted to a T-union in the system. The pressure to be expected at each point may be found by referring to fig.1, in which test points are item 10. To test the pressure at each point use an inflation adapter, Ref.No.4G/4131 and a pressure gauge, Ref.No.4G/3026 for 350 p.s.i. and below, or 4G/3028 for 1,000 p.s.i.

CHARGING POINTS

20. These are located behind the starboard undercarriage beam in each inboard nacelle (fig.3, item 3) The maximum pressure to which the storage bottles may be charged is 1,000 p.s.i.

WARNING...

Care must be taken to charge the systems slowly to prevent the possibility of damage to the regulator valve (fig.1, item 5).

ADJUSTMENTS AND TESTING

21. Components of the system are adjusted and tested in accordance with the instructions contained in A.P.4303. With the port system air bottles fully charged, operation times of the camera jacks are satisfactory if the cameras retract in four seconds maximum, and are fully lowered in seven seconds maximum.

Leakage tests

22. In order to test the complete system for leakage, the parking brake valve should be set to ON and all brakes applied by wedging the brake valve shafts to apply the brakes fully, the system must then be left for 12 hours. If, after this period, the fall in pressure of either system exceeds 50 p.s.i., the leak or leaks must be traced and rectified. If soapy water is used on any portion of the system, it should be removed by thorough cleaning to avoid subsequent corrosion.

Brake pressures and control setting

23. The maximum pressure available at the test points in the pipes from the brake valves (fig.1, item 18 and 19) should be 190-200 p.s.i. These four test points are located, two at the port side of the electric cable trough, forward of the pilots' panel. The maximum pressure due to the operation of the parking valve should be 220 p.s.i. and measured at the two test points located between formers 4 and 5, one either side of the bomb compartment. These pressures are tested as described in para.19 using the gauge Ref.No.4G/3026. The correct relief setting of the spring-loaded control rods between the toe-operated pedals and the transverse brake-valve control rods is 32 lb.

REMOVAL AND ASSEMBLY

RELEASING AIR PRESSURE

24. Before removal of any component or releasing any union, the air pressure in the system must be released by using an inflation adapter at test connections in the following order:-

(1) At the two test points adjacent to item 9 (the 1,000-350 p.s.i. reducing valve) on each pneumatic panel.

(2) At the test connection and at the charging point in each inboard nacelle.

Finally, operate the brakes sufficiently to use up any remaining air in the system, and vent the hydraulic reservoir several times (Chap.6) until the remaining pressure in the engine services and camera operating system is negligible.

LEAKAGE TESTING AFTER ASSEMBLY OF COMPONENTS

25. After refitting or replacing any components of the system, a local check should be made at all unions which have been released during the operation (para.19).

TABLE 1

Pneumatic system components
(as shown in Fig.1)

Item No. Fig.1	Part No.	Ref. No.	Component	Working pressure	No. off
1	SH6/10C	37G/508	Compressor	1,000 (1,060 max.) p.s.i.	2
2	RV/11	37G/8001	Relief valve	1,250 p.s.i.	2
3	A58	28Y/15486	Charging point	Max. pressure 1,000 p.s.i.	2
4	OWT/46/6 or 46/8	27VB/3173 or 27VB/2960	Oil-and-water trap	Max. pressure 1,060 p.s.i.	2
5	ARI6/1000	27VB/3002	Pressure-regulating valve	1,060 (max.) 850 (min.) p.s.i.	2

TABLE 1 (continued)

Item No.	Part No.	Ref. No.	Component	Working pressure	No. off
6	ACO/3147	27VA/2948	Air storage bottle	1,000 (max.) p.s.i.	4*
7	ACO/1268	27G/2091	Air filter	1,000 (max.) p.s.i.	2
8	-	6A/2689	Pressure gauge	1,000 (max.) p.s.i.	2
9	ACO/1292	27G/2015	Pressure-reducing valve	1,000 to 350 p.s.i.	2
10	A58	28Y/15486	Pressure test point	-	16
11	ACM/16268	27VA/3259	Pressure-maintaining valve	250 p.s.i.	1
12	AHO/19130	27G/2132	Pressure-reducing valve	350 to 7 p.s.i.	2
13	2137Y	27Q/636	Non-return valve	2-3 p.s.i.	1
14	E2258Y or D6709Y	27Q/821 -	Pressure relief valve	Blow off at 10, re-seat at 8 p.s.i.	1
15	AHO/5712	27G/2022	Pressure-reducing valve	Range 500 to 220 p.s.i.	1
16	AC/11216	-	Brake parking valve	220 (max.) p.s.i.	1
17	ACO/1812	27VA/2873	Shuttle valve	220 (max.) p.s.i.	2
18	AC/10168	27VA/3266	Port system brake control valve	Supply 350 (max.) delivery 190-200 (max.) p.s.i.	2
19	AC/10168	27VA/3266	Stbd. system brake control valve	Supply 350 (max.) delivery 190-200 (max.) p.s.i.	2
20	ACM/16126	-	Rapid exhaust valve	220 (max.) p.s.i.	4
21	AH/9506	27G/4072	Brake unit-outboard brake bags	220 (max.) p.s.i.	4
22	AH/9506	27G/4072	Brake unit-inboard brake bags	220 (max.) p.s.i.	4
◀ 23	AC/11108	27VA/3907	Camera jack	350 p.s.i.	2
24	AC/1010	27VA/3901	Electro-pneumatic control valve	350 p.s.i.	2 ▶
25	/SK.18040	26FP/1701	Modified self-sealing coupling	-	1
26	-	9.4592	Air drier Mk.V	7 p.s.i.	1†
27	-	6H/1950	Cock-No.1 bombsight	-	1†
28.	AC/11270	-	Univalve	7 p.s.i.	2
◀ 29	1S/2490	26FP/-	On-off cock	-	1 ▶

Reference to A.P.4303A, Vol.1, Index, will provide information as to where servicing and descriptive matter on individual components can be found in the A.P.4303 series.

*Three prior to incorporation of Mod.392. †Post Mod.873.

◄ Appendix 1 MOD. 600 — INTRODUCTION OF A.S.V.21 EQUIPMENT

Pneumatic System

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ILLUSTRATION

DESCRIPTION AND OPERATIO N

Introduction

1. Mod. 600 introduces an independent pressurisation system for the A.S.V. Mk. 21 equipment.

A.S.V. PRESSURISATION SYSTEM

General

2. The components of the A.S.V. pressurisation system (*fig. 1A*) are located in the scanner cupola and with the exception of the storage cylinder are mounted on one panel. The system diagram and the installation in the aircraft are shown in fig. 1A. Key numbers in the text refer to the item numbers in fig. 1A and the List of Components in Table 1.

3. The air storage cylinder (5) is charged to a pressure of 1,800 p.s.i. through a starboard ground charging valve (2), a filter (3), and a blow-off valve (4), set to relieve at 2,000 p.s.i. The pressure in the cylinder is indicated on a gauge (1), adjacent to the charging valve. Cylinder pressure is reduced to a working level of 30 p.s.i. by a pressure reducing valve (6). The system is controlled by an ON/OFF switch on the radar operator's panel which operates an electromatic tap (7). With the switch in the ON position, pressure is supplied to the A.S.V. equipment via a regulator valve (8), and manifold. The pressure regulator valve maintains a pressure of 1½-2 p.s.i. in the A.S.V. equipment and this pressure is indicated on the low pressure gauge (9).

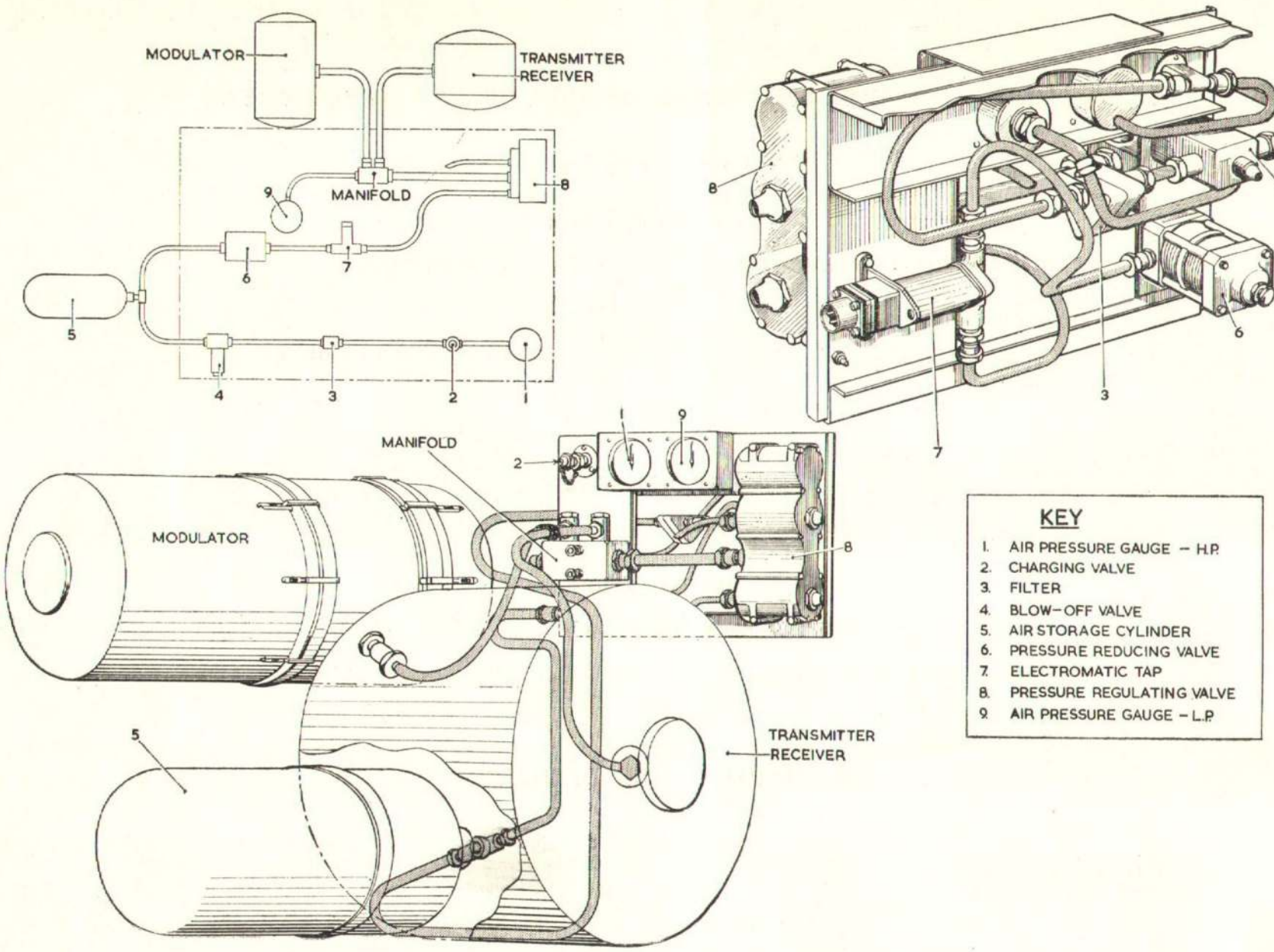

Fig. 1A. A.S.V. pressurisation system

SERVICING

General

4. The filter should be removed for examination at routine servicing periods, otherwise servicing *in situ* is restricted to leakage tests and examination of individual components for freedom from damage and corrosion and security of attachment. Details of the bench servicing and testing of components are given in their respective Air Publications (Table 1).

REMOVAL AND ASSEMBLY

General

5. Before removing the storage cylinder or other high pressure components in the system, pressure must be released by using an inflation adaptor (4G/4131) at the charging valve.

6. To remove the air cylinder:—

(1) Remove wire locking and disconnect pipe unions.

(2) Remove wire locking at securing strap turnbuckles.

(3) Support cylinder and unscrew turnbuckles until the cylinder can be lifted clear of securing straps.

7. To remove panel components disconnect relevant pipe unions and remove panel attachment bolts. When pipes are disconnected they must be blanked off to prevent ingress of dirt and moisture.

8. Assembly is the reverse of the removal sequence.

Table 1.— List of components

Item No.	Component	Working Pressure (p.s.i.)	Part No.	Ref. No.	A.P. Ref.
1	Air pressure gauge	0-2,000	—	6A/2688	1275A
2	Charging valve	—	A58	—	—
3	Filter	—	ACM.18302	27VA/5212	4303B
4	Blow-off valve	2,000	ACM.15318	27VA/5214	4303B
5	Air storage cylinder	1,800	—	6D/1405H	—
6	Pressure reducing valve	1,800-30	ACM.17500	27VA/5216	4303B
7	Electromatic tap	—	AC.11312	27VA/5215	4303B
8	Pressure regulator valve	—	Type X4447	6W/20	2890G
9	Air pressure gauge	—	126BG	—	—