Chapter 6

HYDRAULIC SYSTEM

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REMOVAL AND INSTALLATION

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DESCRIPTION AND OPERATION

INTRODUCTION

Note ...

(1) The accumulator numbers referred to in the text and illustrations of this chapter, apply to A.P.4647A, Vol.1 only, and is a convenient method of locating rapidly each individual accumulator; THESE NUMBERS WILL NOT BE FOUND ON THE AIRCRAFT.

(2) For pre mod. and post mod.249 cockpit hydraulic pressure gauges refer to Fig.16, and paras.73 and 74.

(3) To assist the reader in following the more complicated hydraulic pipe runs in the aircraft, continuation symbols (e.g. ⇐O) have been provided in those illustrations which are directly related to one another. The key to the symbols is given in Fig.6.

(4) Initial air charging pressures, and the location in the aircraft of header tanks and accumulators (and their dependant services), are given in TABLE 1 & 2.

(5) All one-way flow or restricted flow components and non-return valves are provided with tapes showing the direction of flow. The arrows show direction of full-flow in the component and not necessarily the normal flow when installed in the system e.g. flap throttle valves.

1. This chapter gives a general description of the hydraulic system and its functioning, together with servicing, removal and assembly instructions.

Further information is given in the following sections and chapters :-

For :-	Refer to Sect.	Chap.
Pre-flight servicing	2	2
Special tools and equipment	2	4
Wing fold mechanism	3	2
Flying controls	3	4
Undercarriage and arrester hook	3	5
Indicators and electrically operated valves	5	1
Instruments	5	2
Scanner unit	6	2

DISPOSITION OF COMPONENTS

2. To assist in locating any particular item, a list of the hydraulic components is given in Key to Fig.5. The list is divided into areas, which correspond with those shown in Fig.5.

GENERAL

3. The hydraulic system employs a mineral fluid to the specification given in the Leading Particulars, and is divided into four separate systems each of which is given a colour code, BLUE, YELLOW, RED and GREEN (Fig.1).

4. The BLUE system operates the ailerons, rudders and tailplane.

5. The YELLOW system also operates the ailerons, rudders, tailplane and in addition the autopilot.

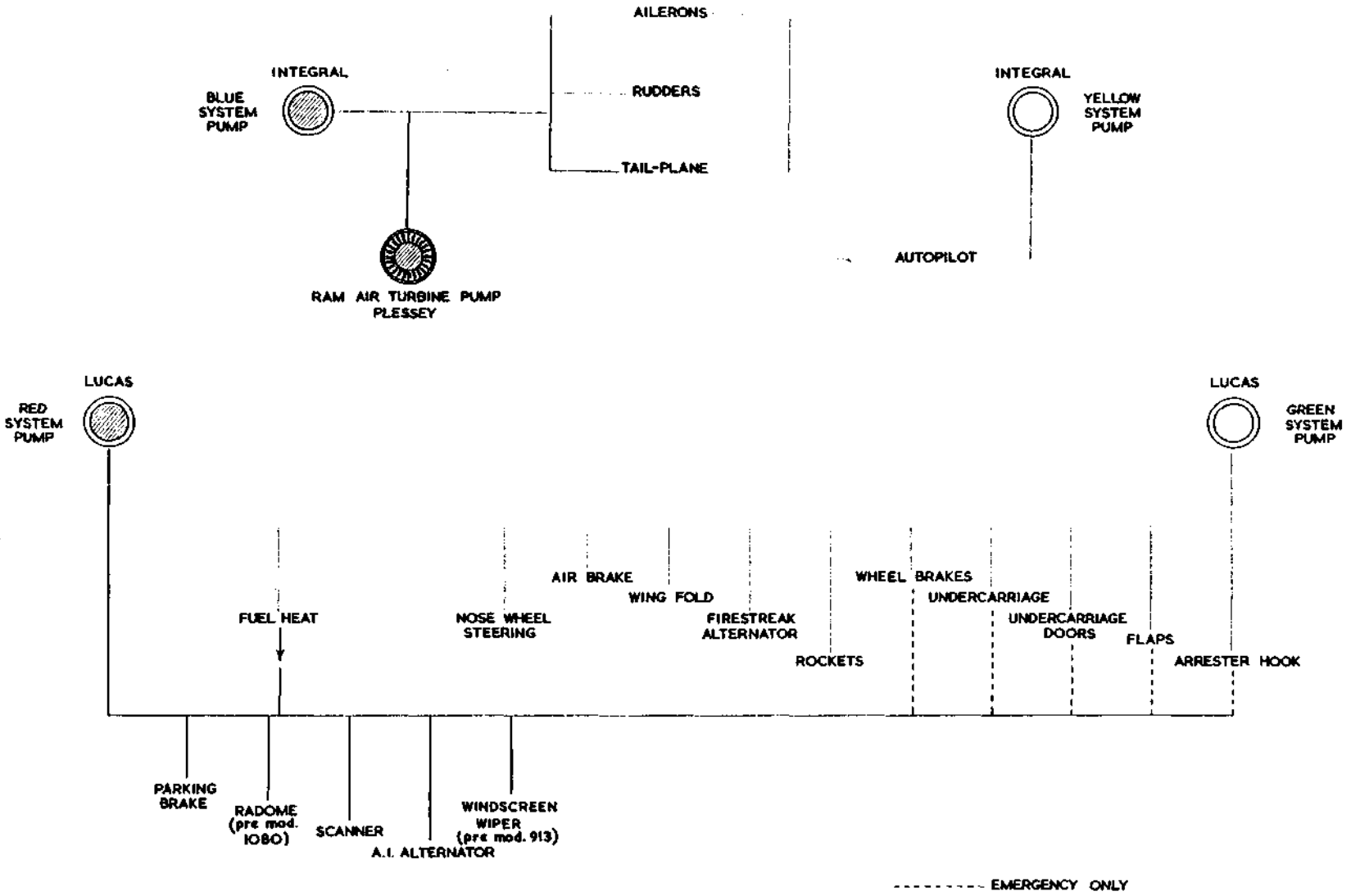
6. The GREEN system operates the undercarriage, flaps, air brake, arrester hook, wing fold, Firestreak alternator, nose wheel steering, rocket installation and normally the wheel brakes.

7. The RED system provides normal operation of the scanner, A.I. alternator, the radome operating jack (pre mod.1080), windscreen wiper (pre mod.913), and the emergency operation of the undercarriage, flaps, arrester hook and wheel brakes.

8. Fig.5 shows the hydraulic components on the aircraft, Fig.2 illustrates the system diagrammatically, and the theoretical diagrams for the BLUE and YELLOW, and RED and GREEN systems are given on Fig.3 and 4.

BLUE AND YELLOW POWER SYSTEMS

9. The BLUE and YELLOW systems are fed separately by Integral hydraulic pumps fitted to a gearbox. Both pumps are coupled in the gear-



VIX 0306 - R6

Fig. 1 Colour code and services operated diagram

◀ Pre mod. 913 and 1080 added. ▶

box to both engines and will be driven by the faster running engine. Therefore, if one engine fails, both pumps will be driven by the other engine. For emergency use, a ram air turbine driven hydraulic pump can be projected into the slipstream, and supplies pressure to the BLUE system.

10. As the systems are of the closed circuit type, air must be excluded from them as this would cause sluggish operation of the control surfaces, and, possibly, reversability under aerodynamic load. To keep the systems separate and independent, each system has its own individual header tank, within which a large piston is kept in constant contact with the fluid face by the system pressure acting on a small piston, attached to the large one by a shaft rod (Fig.7).

11. Each header tank is initially primed on the ground from the main reservoir, and normally no fluid is taken from the main reservoir or returned to it during the operation of these systems in flight. A hand pump in the starboard flap bay is used for priming and removing air from the BLUE and YELLOW systems (para. 158).

12. The BLUE and YELLOW systems each have an expansion cylinder which absorbs excess hydraulic fluid arising from thermal expansion; these expansion cylinders are charged with air in a similar manner to an accumulator, although at a much lower pressure.

13. Three accumulators, one in the power system and two in the tailplane circuit, provide a pressure reserve for each system.

14. A thermal relief valve protects each system against excessive pressures.

Pumps

15. Two Integral Type engine-driven pumps supply hydraulic pressure for the normal operation of the flying controls, one each for the BLUE and YELLOW systems. The pumps are attached by quick-release clamp fittings to the accessories gearbox which also drives the two hydraulic general services pumps (RED and GREEN system) and the electrical generators. The pumps are right-hand rotation when viewed from the splined ends of their drive shafts; the BLUE system is port and the YELLOW system starboard of the two inner pumps on the gearbox.

16. Each pump is a two-stage unit incorporating an off-loading mechanism which operates as line pressure increases. At maximum pressure with no demand, the high-pressure delivery ceases and the pump circulates fluid in the by-pass circuit only, which utilizes the system return lines to the header tanks. The first pump stage comprises a pair of meshing gears, and the second stage seven radially disposed pistons operated by an eccentric driving ring.

17. A magnetic filter in each pump casing extracts any ferrous particles which may be present in the by-pass fluid circulating in the low pressure section. The fluid which is by-passed to the header tank when the pump is running off-load, provides a constant circulation of fluid which assists in cooling the pump.

18. Each pump must be primed by removing the first stage pressure vent plug after installation until air-free fluid flows from the pump. The magnetic filter must be removed for cleaning and inspection as described in A.P.1803J, Vol.1, Sect.2, and when detailed in Vol.5. The removal of the pump from the gearbox is described in Cover 3, Sect.4, Chap.1.

Ram air turbine pump

19. A ram air turbine pump assembly, Type TRA 150/2, is designed to provide hydraulic power for the operation of the flying controls under emergency conditions when the main source of hydraulic power (the BLUE and YELLOW engine driven pumps)is out of action. The unit consists of an axial-flow, single stage, ram air turbine incorporating a mechanical speed governor and driving a Type AH 036 hydraulic pump, the whole being self-contained within a light

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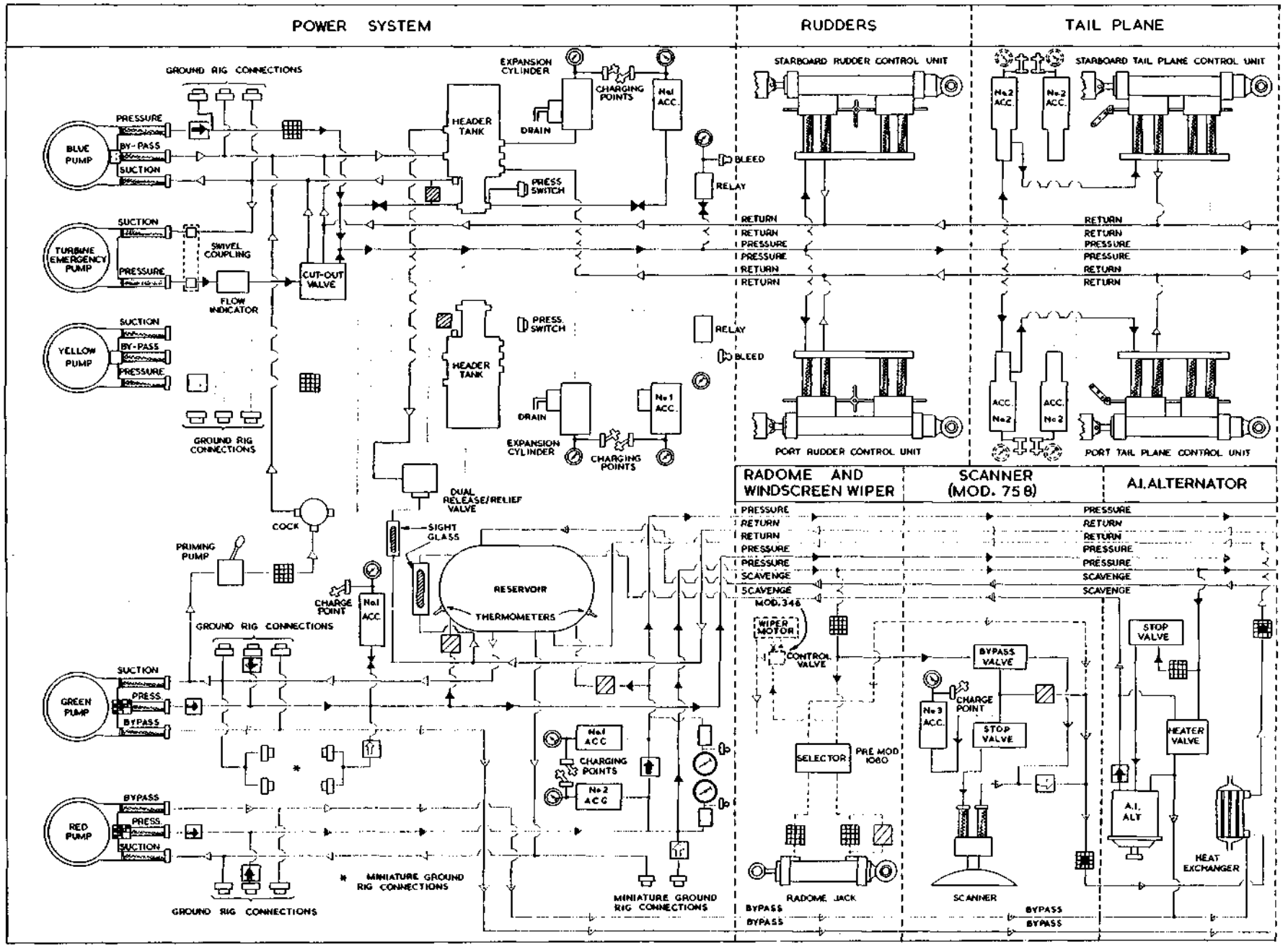

SEA VIXEN FAW Mk.1 AIRCRAFT
AIR DIAGRAM
7650 / MIN.

ISSUE 2 | PREPARED BY MINISTRY OF AVIATION FOR PROMULGATION BY ADMIRALTY

Fig.2 Hydraulic system diagram (1)

◀ Mod. 933, 1080 and 1184 ▶

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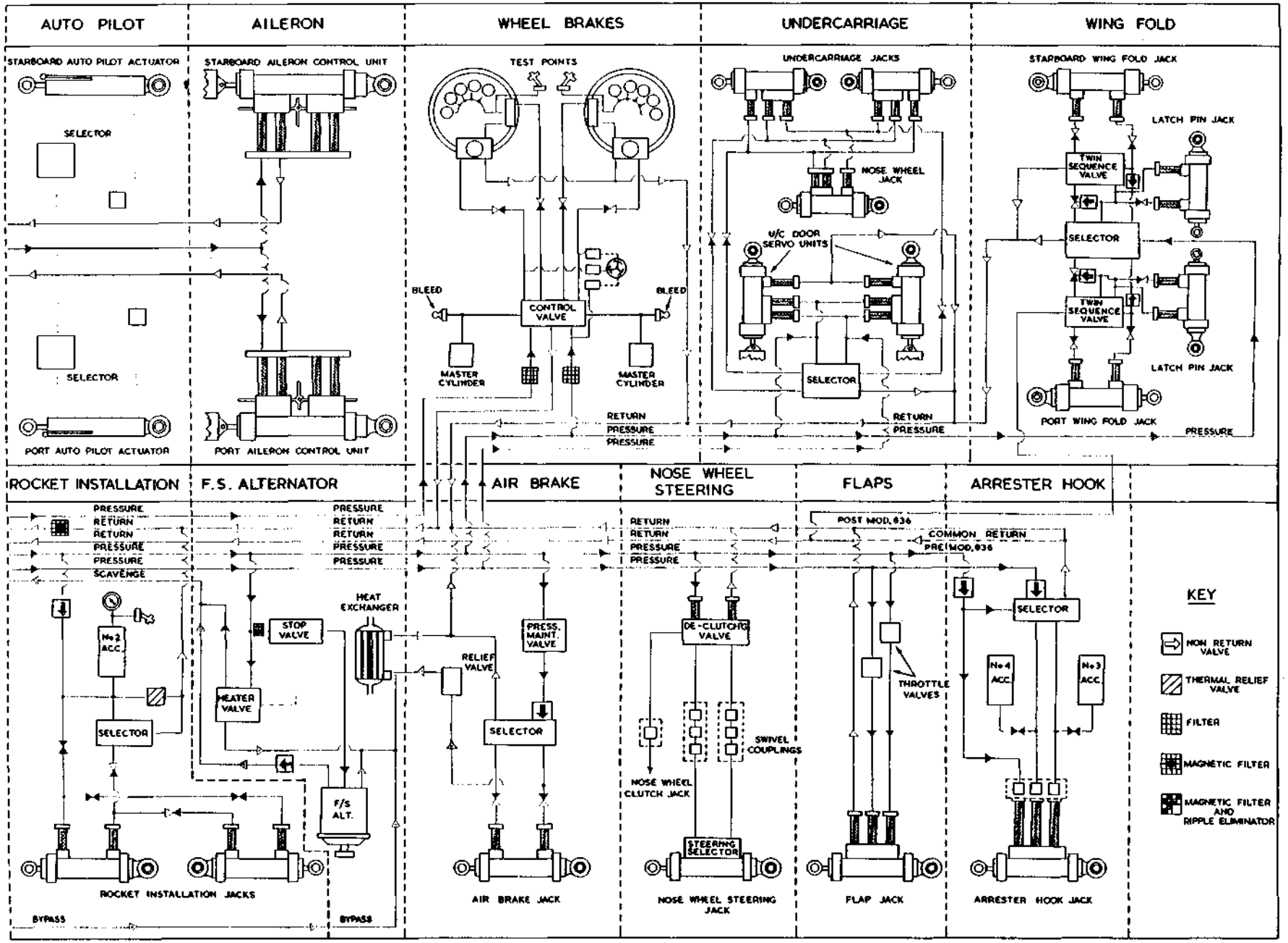
VIX 0306 - R8



SEA VIXEN FAW Mk.1 AIRCRAFT
AIR DIAGRAM
7651/MIN.
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Fig.2 Hydraulic system diagram (2)

◄ Flap return to GREEN line. ►

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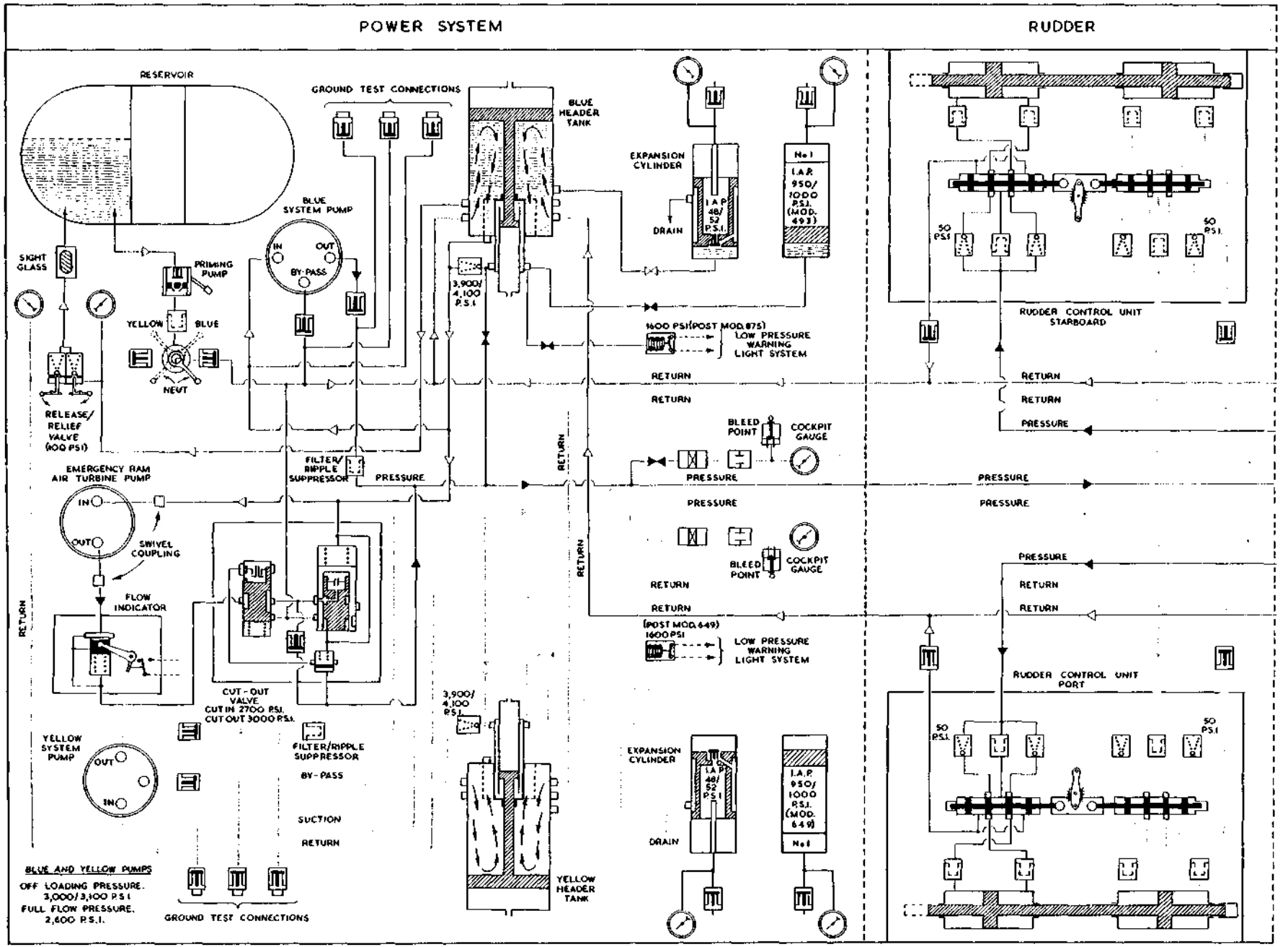

SEA VIXEN FAW Mk I AIRCRAFT
AIR DIAGRAM
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Fig.3 BLUE and YELLOW system theoretical diagram (1)

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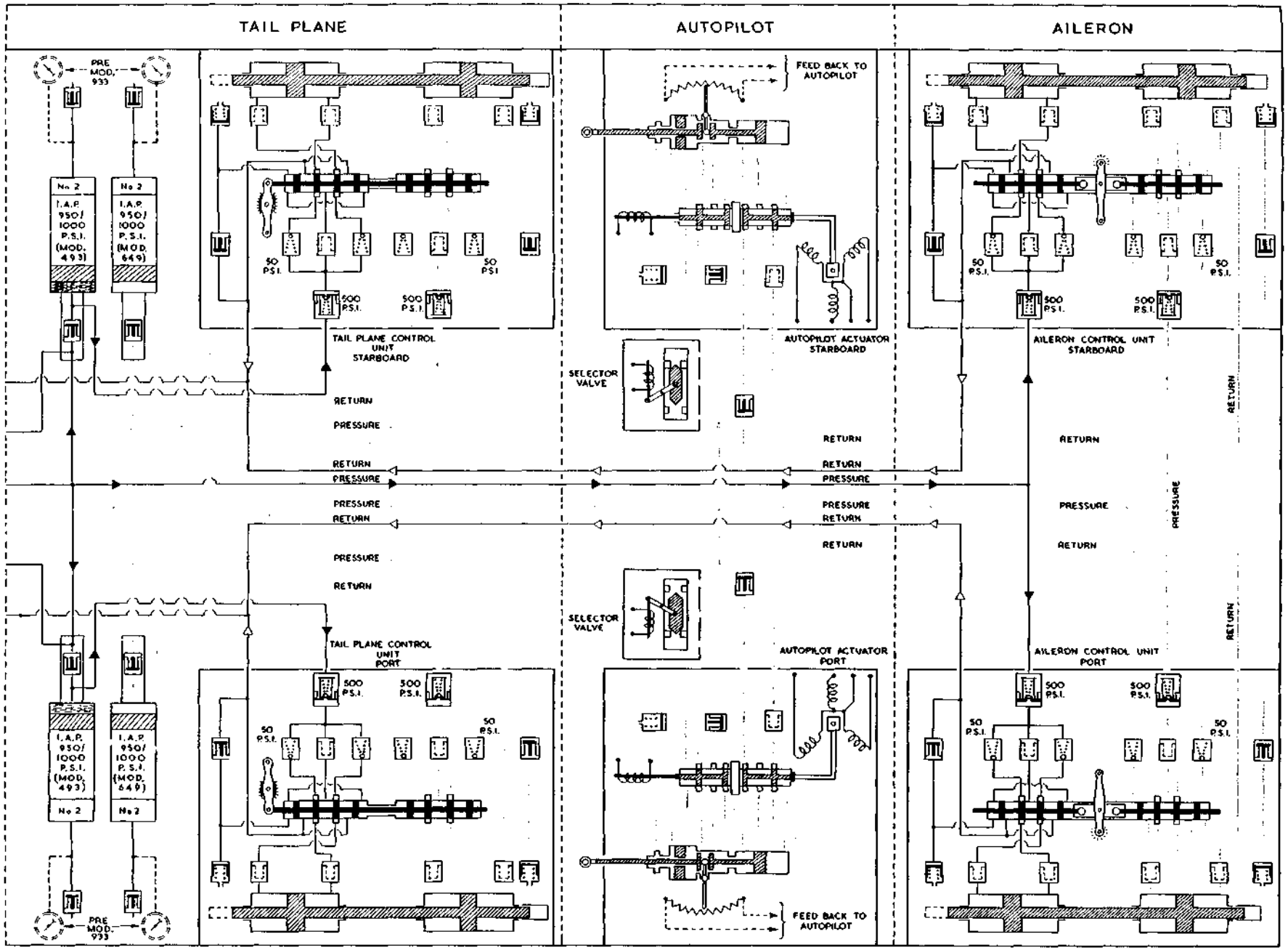

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SEA VIXEN FAW Mk.I AIRCRAFT
AIR DIAGRAM
7653/MIN.
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Fig. 3 BLUE and YELLOW system theoretical diagram (2)

◄ Tail-plane accumulators - mod 933 ►

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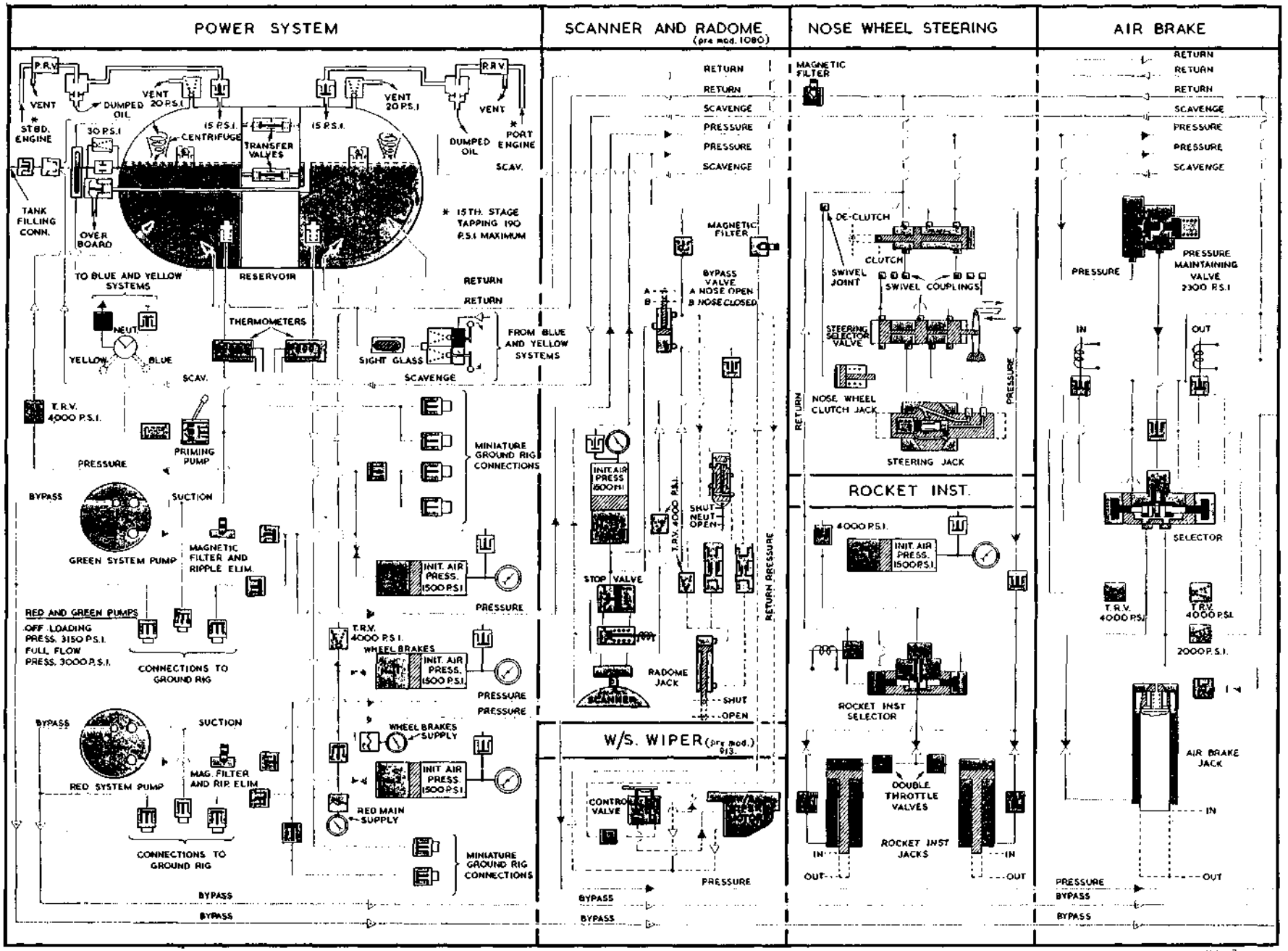

SEA VIXEN FAW Mk.1 AIRCRAFT
AIR DIAGRAM
7654/MIN.
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Fig.4 RED and GREEN system theoretical diagram (1)

◄ Mod 913, 1080 and 1284 ►

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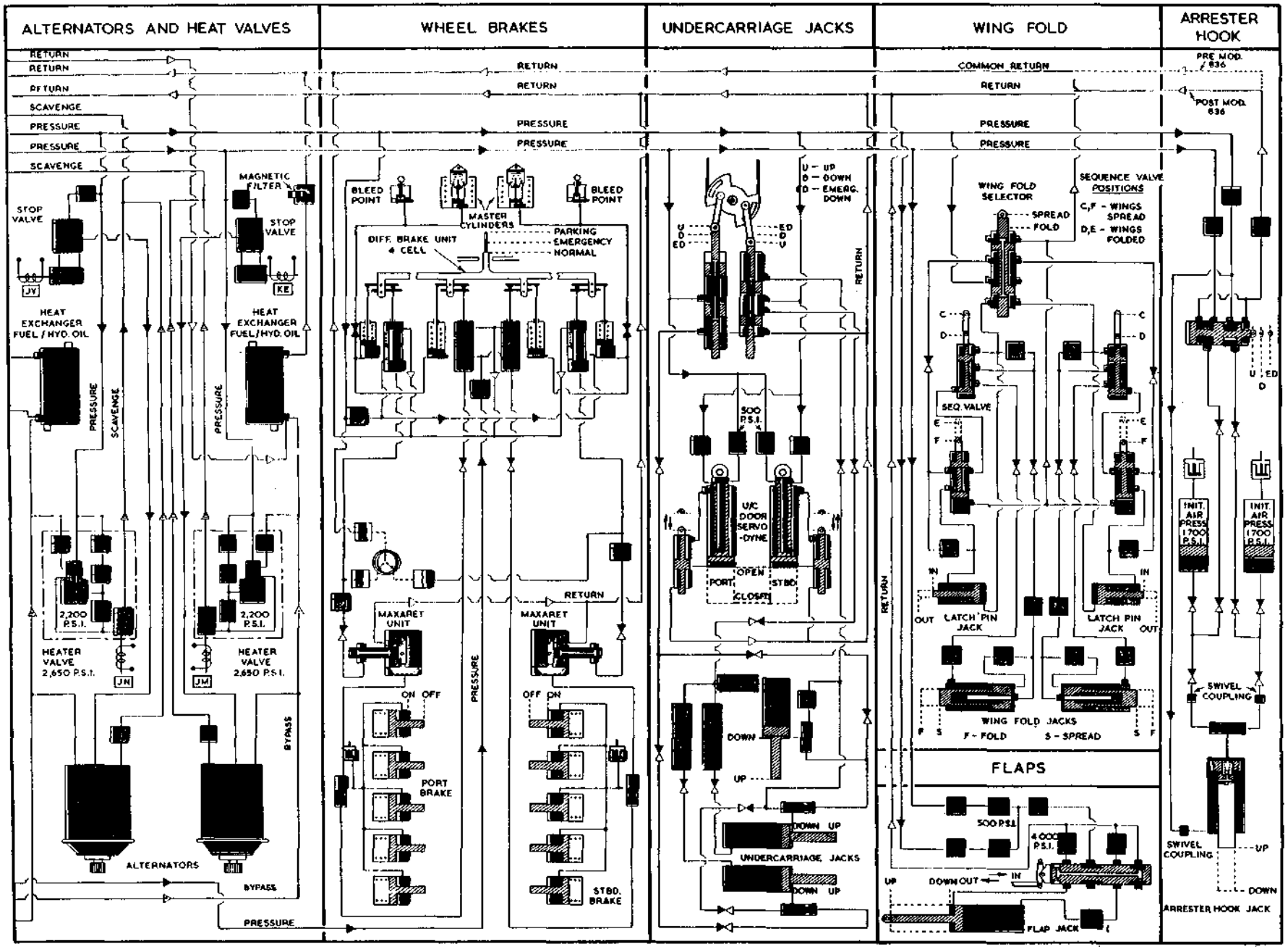

SEA VIXEN FAW Mk.1 AIRCRAFT
AIR DIAGRAM
7655 / MIN.

Fig. 4 RED and GREEN system theoretical diagram (2)

◀Heater valves return to heat exchangers▶

VIX 3-6
199.2.

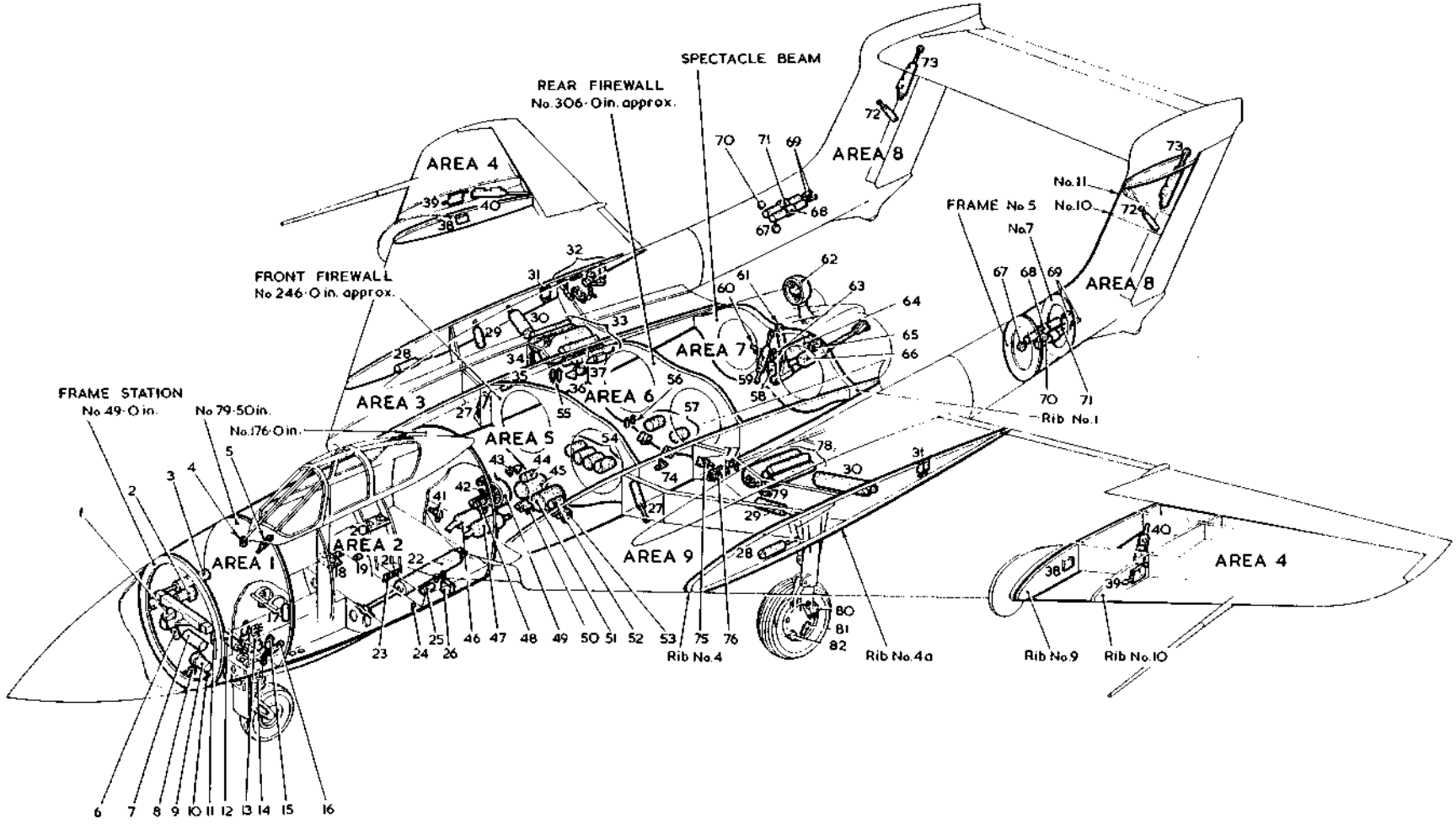

Fig. Disposition of hydraulic components

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KEY TO FIGURE 5

DISPOSITION OF HYDRAULIC COMPONENTS

(The part numbers given are the latest at the date of the amendment.)

Item No.	Component	Part No.	Servicing reference
		AREA 1	
1	Scanner mechanism	—	A.P.2892J, Vol. 1
2	By-pass valve	AIR 43522	A.P.1803B, Vol. 1, Book 2, Sect. 7
3	Radome operating jack or damper (mod. 1080)	AIR 43202	A.P.1803B, Vol. 1, Book 3, Sect. 11
4	Windscreen wiper control valve (pre mod. 913)	AC14960	A.P.1803S, Vol. 1, Book 2, Sect. 11
5	Windscreen wiper motor (pre mod. 913)	AC 14958	A.P.1803S, Vol. 1, Book 2, Sect. 11
6	Scanner selector valve	C.1012 Mk. 1	A.P.1803T, Vol. 1, Sect. 14
7	RED accumulator (No. 3)	AIR 43536	A.P.1803B, Vol. 1, Book 1, Sect. 5
8	Charging valve	A58	A.P.1803P, Vol. 1, Sect. 4
	Pressure gauge	AIR 103092	A.P.1275A, Vol. 1, Sect. 15
9	Purolator filter	MFHA 31703	A.P.1803B, Vol. 1, Book 1, Sect. 6
10	Restrictors (pre mod. 1080)	AIR 44054 and 56	A.P.1803B, Vol. 1, Book 2, Sect. 10
	Thermal relief valves	AS 4550	A.P.1803P, Vol. 1, Sect. 4.
11	Radome selector valve (pre. mod. 1080)	AIR 43332	A.P.1803B, Vol. 1, Book 2, Sect. 7
12	Nosewheel steering jack	AIR 44100	A.P.1803B, Vol. 1, Book 3, Sect. 11
13	Nosewheel steering head	10. 20UN.1103A	A.P.1803P, Vol. 1, Sect. 7
14	Nosewheel declutching valve	AIR 43414	A.P.1803B, Vol. 1, Book 2, Sect. 7
15	Rocket installation jack	AIR 44268 or AIR 44288	A.P.1803B, Vol. 1, Book 3, Sect. 11
		AREA 2	
16	Nose leg retraction jack	AIR 44050	A.P.1803B, Vol. 1, Book 3, Sect. 11
17	Wheel brake master cylinders	AC 18906	A.P.1803S, Vol. 1, Book 1, Sect. 3
18	BLUE and YELLOW pressure gauges	Mk. 14LL (6A/2693)	A.P.1275A, Vol. 1, Sect. 15
	GREEN triple pressure gauge (post mod. 249)	S214/1/19	A.P.1275A, Vol. 1, Sect. 16.
19	Scanner return magnetic filter	10.20S.9057A	—
20	GREEN brake pressure gauges (pre mod. 249)	Mk. 14 H (6A/2689)	A.P.1275A, Vol. 1, Sect. 15
	RED main and brake supply gauges (mod. 249)	Mk. 14LL (6A/2693)	A.P.1275A, Vol. 1, Sect. 15

Item No.	Component	Part No.	Servicing reference
21	RED main and brake supply pressure relays	ACM 18570	A.P.1803S, Vol. 1, Book 2, Sect. 8
22	Air brake jack	AIR 43188 or 47078	A.P.1803B, Vol. 1, Book 3, Sect. 11
23	Pressure transmitters (mod. 249)	S122/4/29	A.P.1275A, Vol. 1, Sect. 16
		S 122/4/31	A.P.1275A, Vol. 1, Sect 16
24	Rocket installation selector	C7416Y	A.P.1803D, Vol. 1, Book 3, Sect. 8
25	GREEN accumulator (No. 3)	AIR 43536	A.P.1803B, Vol. 1, Book 1, Sect. 5
26	Brake control valve	AC 14524 Iss.4	A.P.1803S, Vol. 1, Book 2, Sect. 7
	AREA 3		
27	Main undercarriage door Servodyne	AIR 44216	A.P.1803B, Vol. 1, Book 3, Sect. 11
28	Wing-fold latch pins jack	◀AIR 42964 or 47156▶	A.P.1803B, Vol. 1, Book 3, Sect. 11
29	Main undercarriage retraction jack	◀AIR 44053 or 47737 (mod. 1350)▶	A.P.1803B, Vol. 1, Book 3, Sect. 11
30	Wing-fold jack	AIR 43632	A.P.1803B, Vol. 1, Book 3, Sect. 11
31	Wing-fold sequence valve	AIR 42989	A.P.1803B, Vol. 1, Book 2, Sect. 8
32	BLUE and YELLOW systems priming equipment:—		
	Hand pump	AIR 67214	A.P.1803B, Vol. 1, Book 1, Sect. 3
	Selector cock	502/CA/90L	A.P.4737A, Vol. 1 and 6
	Non-return valves	AIR 43160	A.P.1803B, Vol. 1, Book 2, Sect. 10
	Sight glass	AIR 43184	A.P.1803B, Vol. 1, Book 3, Sect. 12
	Filter	MFHA 8101	A.P.1803B, Vol. 1, Book 1, Sect. 6
	Relief/release valves	AIR 42976	A.P.1803B, Vol. 1, Book 2, Sect. 7
	Miniature test rig connections	AVA 551B and 552B	A.P.1464D, Vol. 1, Part 2, Sect. 3
		AVA 551C and 552C	A.P. 1464D, Vol. 1, Part 2, Sect. 3
33	Reservoir	10.20S. 9911A	A.P.1803P, Vol. 1, Sect 8
	◀Reservoir (mod. 1410)▶	◀10.20S. 21483A▶	A.P.1803P, Vol. 1, Sect. 8
	Filling connection	AIR 43760	A.P.1803B, Vol. 1, Book 3, Sect 12
	Sight glass	AIR 43184	A.P.1803B, Vol. 1, Book 3, Sect. 12
	GREEN (No. 1), RED (No. 1 and 2) accumulators	AIR 43538	A.P.1803B, Vol. 1, Book 1, Sect. 5
	YELLOW accumulator (No. 1)	AIR 43538	A.P.1803B, Vol. 1, Book 1, Sect. 5
	YELLOW header tank	AIR 42987	A.P.1803B, Vol. 1, Book 1, Sect. 4
	YELLOW expansion cylinder	AIR 43206	A.P.1803B, Vol. 1, Book 1, Sect. 5
	YELLOW pressure switch	TP 5735	A.P.1275A, Vol. 1, Sect. 24
34	RED (No. 1 and 2) and GREEN accumulator charging valves	A58	A.P.1803P, Vol. 1, Sect. 4

KEY TO FIG 5 (*continued*)

Item No.	Component	Part No.	Servicing reference
35	GREEN return magnetic filter	10.20S. 9057A	—
36	Undercarriage selector valve	AIR 42950	A.P.1803B, Vol. 1, Book 2, Sect. 7
37	Wing-fold selector valve	AIR 43486	A.P.1803B, Vol. 1, Book 2, Sect. 7
		AREA 4	
38	Auto-pilot selector valve	C6601Y Mk. F	A.P.1803D, Vol. 1, Book 3, Sect. 8
39	Auto-pilot actuator (port)	297 Mk. 5	A.P.1469P, Vol. 1
	Auto-pilot actuator (stbd)	297 Mk. 6	A.P.1469P, Vol. 1
40	Aileron control unit	157 Mk. 1	A.P.4604F, Vol. 1
		AREA 5	
41	Air brake pressure relief valve	04651YA37	A.P.1803D, Vol. 1, Book 3A, Sect. 9
42	Air brake pressure maintaining valve	11656YB02	A.P.1803D, Vol. 1, Book 3A, Sect. 9
43	RED and GREEN low-pressure switches (pre-mod. 249)	TP 5660	A.P.1275A, Vol. 1, Sect. 24
44	Firestreak alternator filter	MFHA 2111 or 43400 (mod. 1292)	A.P.1803B, Vol. 1, Book 1, Sect. 6
45	Firestreak alternator	Ref. No. 5UB/6666	A.P.4343A, Vol. 1, Sect. 2
46	GREEN system heat exchanger	D613/4A	A.P.4340, Vol. 1, Book 2
47	RED system heat exchanger	D613/44A	A.P.4340, Vol. 1, Book 2
48	GREEN system heater choke valve	C.1016	A.P.1803T, Vol. 1, Sect. 14
	Firestreak alternator stop valve	C.1012 Mk. 3	A.P.1803T, Vol. 1, Sect. 14
49	Ram air turbine pump (pre-mod. 216)	150/2 (CK 16200)	A.P.1803P, Vol. 1, Sect. 2
50	RED system heater choke valve	C.1015 Mk. 3	A.P.1803T, Vol. 1, Sect. 14
	A.I. alternator stop valve	C.1012 Mk. 5	A.P.1803T, Vol. 1, Sect. 14
51	A.I. alternator	Ref. No. 5UB/6665	A.P.4343A, Vol. 1
52	A.I. alternator filter	MFHA 2111 or 43400 (mod. 1292)	A.P.1803B, Vol. 1, Book 1, Sect. 6
53	Airbrake selector valve	C7461Y	A.P.1803D, Vol. 1, Book 3, Sect. 8

KEY TO FIG. 5 (*continued*)

Item No.	Component	Part No.	Servicing reference
		AREA 6	
54	RED and GREEN hydraulic pumps	◀HOD 100 (Lucas mod. CP92243)▶	A.P.1803P, Vol. 1, Sect. 2
	BLUE and YELLOW hydraulic pumps	180 Mk. 37	A.P.1803J, Vol. 1, Sect. 2
55	Air pressure drain tanks	10.20S.11613/14	—
56	Air pressure reducing valves	PS.60/25	A.P.4303C, Vol. 1, Sect. 4
57	BLUE and YELLOW pump filters	MFHA 2111 or 43400 (mod. 1292)	A.P.1803B, Vol. 1, Book 1, Sect. 6
	Ground test connections	AVA 56F, 59D, 64D and F	A.P.1464D, Vol. 1, Sect. 3
		AREA 7	
58	Arrester hook swivel coupling	C9012Y	A.P.1803D, Vol. 1, Book 4, Sect. 11
59	Flap Servodyne	AIR 42932 or 47132	A.P.4602A, Vol. 1, Sect. 2
60	Non-return valve	10.20S.6787A	A.P.1803P, Vol. 1, Sect. 4
	Non-return valve	10.20S.8985A	A.P.1803P, Vol. 1, Sect. 4
61	Arrester hook damper/jack	AIR 43620	A.P.1803C, Vol. 1, Sect. 7
62	Ram air turbine	150/2 (CK 18942)	A.P.1803P, Vol. 1, Sect. 2
	Ram air turbine damper	AIR 44208	A.P.1803C, Vol. 1, Sect. 7
63	Flap throttling valves	D8636Y	A.P.1803D, Vol. 1, Book 3A, Sect. 9
64	GREEN accumulator (No. 3)	AIR 42962	A.P.1803B, Vol. 1, Book 1, Sect. 5
65	Arrester hook selector valve	AIR 43178	A.P.1803B, Vol. 1, Book 2, Sect. 7
66	RED accumulator (No. 4)	AIR 42962	A.P.1803B, Vol. 1, Book 1, Sect. 5
		AREA 8	
67	BLUE accumulator (No. 2) air charging valve	A 58	A.P.1803P, Vol. 1, Sect. 4
68	BLUE accumulator (No. 2)	AIR 44088	A.P.1803B, Vol. 1, Book 1, Sect. 5
69	Non-return valves (in lines from rudder control units)	10.20S.4731A ◀(UMC 738 N.R.V.)▶	A.P.1803P, Vol. 1, Sect. 4
70	YELLOW accumulator (No. 3) air charging valve	A 58	A.P.1803P, Vol. 1, Sect. 4
	Air pressure gauge (pre mod. 933)	AIR 103092	A.P.1275A, Vol. 1, Sect. 15
71	YELLOW accumulator (No. 2)	AIR 44088	A.P.1803B, Vol. 1, Book 1, Sect. 5
72	Rudder control unit	190 Mk. 2	A.P.4604F, Vol 1
73	Tail plane control unit	194 Mk. 6	A.P.4604F, Vol. 1

KEY TO FIG. 5 (*continued*)

Item No.	Component	Part No.	Servicing reference
		AREA 9	
27	Main undercarriage door Servodyne	AIR 44216	A.P.1803B, Vol. 1, Book 3, Sect. 11
28	Wing-fold latch pins jack	◀AIR 42964 or 41756▶	A.P.1803B, Vol. 1, Book 3, Sect. 11
29	Main undercarriage retraction jack	◀AIR 44052 or 47736 (mod. 1350)▶	A.P.1803B, Vol. 1, Book 3, Sect. 11
30	Wing-fold jack	AIR 43632	A.P.1803B, Vol. 1, Book 3, Sect. 11
31	Wing-fold sequence valve	AIR 42988	A.P.1803B, Vol. 1, Book 2, Sect. 8
74	RED return magnetic filter	10.20S.9057A	—
75	R.A.T. pump flow indicator	AIR 43644	A.P.1803B, Vol. 1, Book 2, Sect. 10
76	R.A.T. pump cut-out valve	AIR 43264	A.P.1803B, Vol. 1, Book 2, Sect. 10
77	BLUE and YELLOW pressure relays	ACM 18570	A.P.1803S, Vol. 1, Book 2, Sect. 8
78	BLUE header tank	AIR 42986	A.P.1803B, Vol. 1, Book 1, Sect. 4
	BLUE expansion cylinder	AIR 43206	A.P.1803B, Vol. 1, Book 1, Sect. 5
	BLUE accumulator (No. 1)	AIR 43538	A.P.1803B, Vol. 1, Book 1, Sect. 5
79	BLUE pressure switch	TP 5735	A.P.1275A, Vol. 1, Sect. 24
80	Maxaret anti-skid units	AC 61108	A.P.1803S, Vol. 1, Book 2, Sect. 8
		AC 61114	A.P.1803S, Vol. 1, Book 2, Sect. 8
81	Shuttle valve	◀AHM 6437 (mod. 1531)▶	A.P.2337, Vol. 1, Book 2, Sect. 3
82	Wheel brake unit (port)	AH 51449	A.P.2337, Vol. 1, Book 2, Sect. 3
	Wheel brake unit (stbd)	AH 51450	A.P.2337, Vol. 1, Book 2, Sect. 3

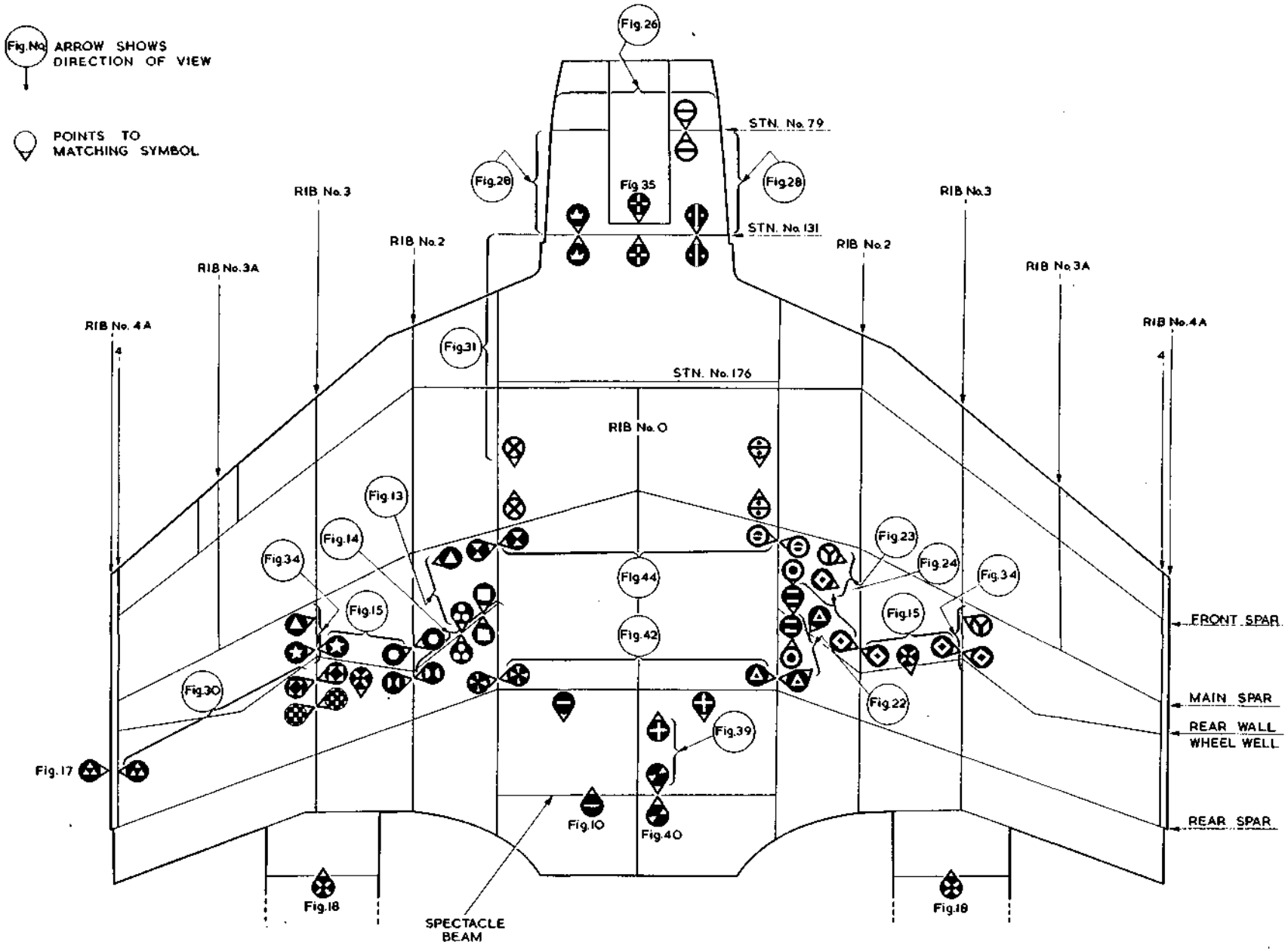
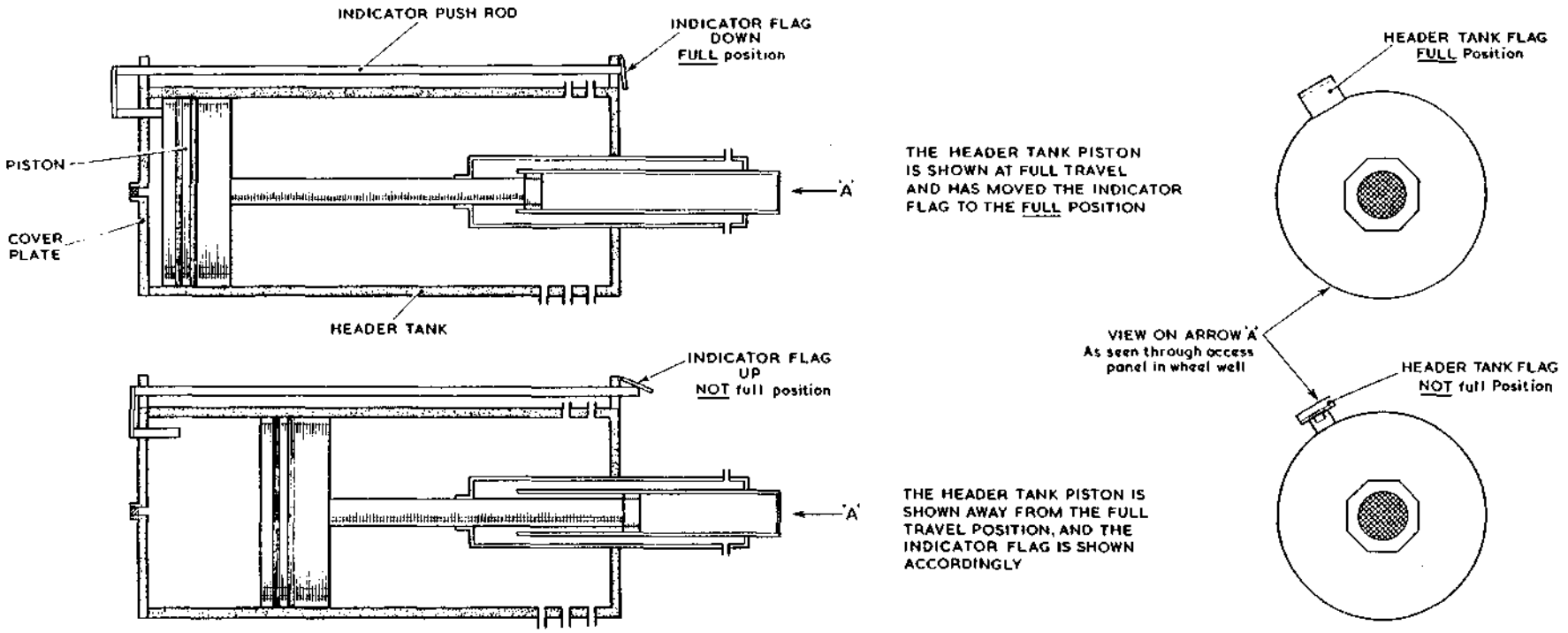
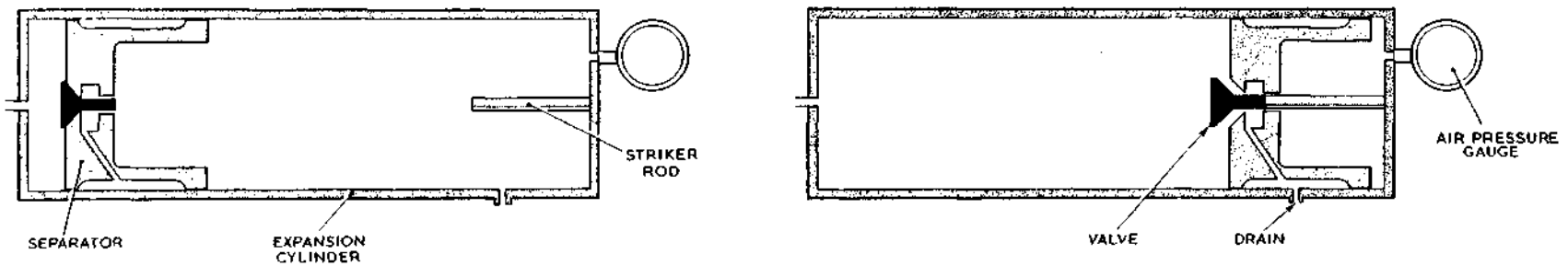


Fig. 6. Key to continuation symbols



LOCATION OF HEADER TANK PISTON IN RELATION TO INDICATOR FLAG



A striker rod is fixed to the head of the cylinder at the air charging end, and when the separator travels further than normal capacity the striker opens the valve on the separator and discharges excess fluid through the annulus between the separator body and the cylinder walls, from whence it is vented overboard.

For location of these components see Area 3 and 9, Fig 5

Fig. 7 Header tank and expansion cylinder

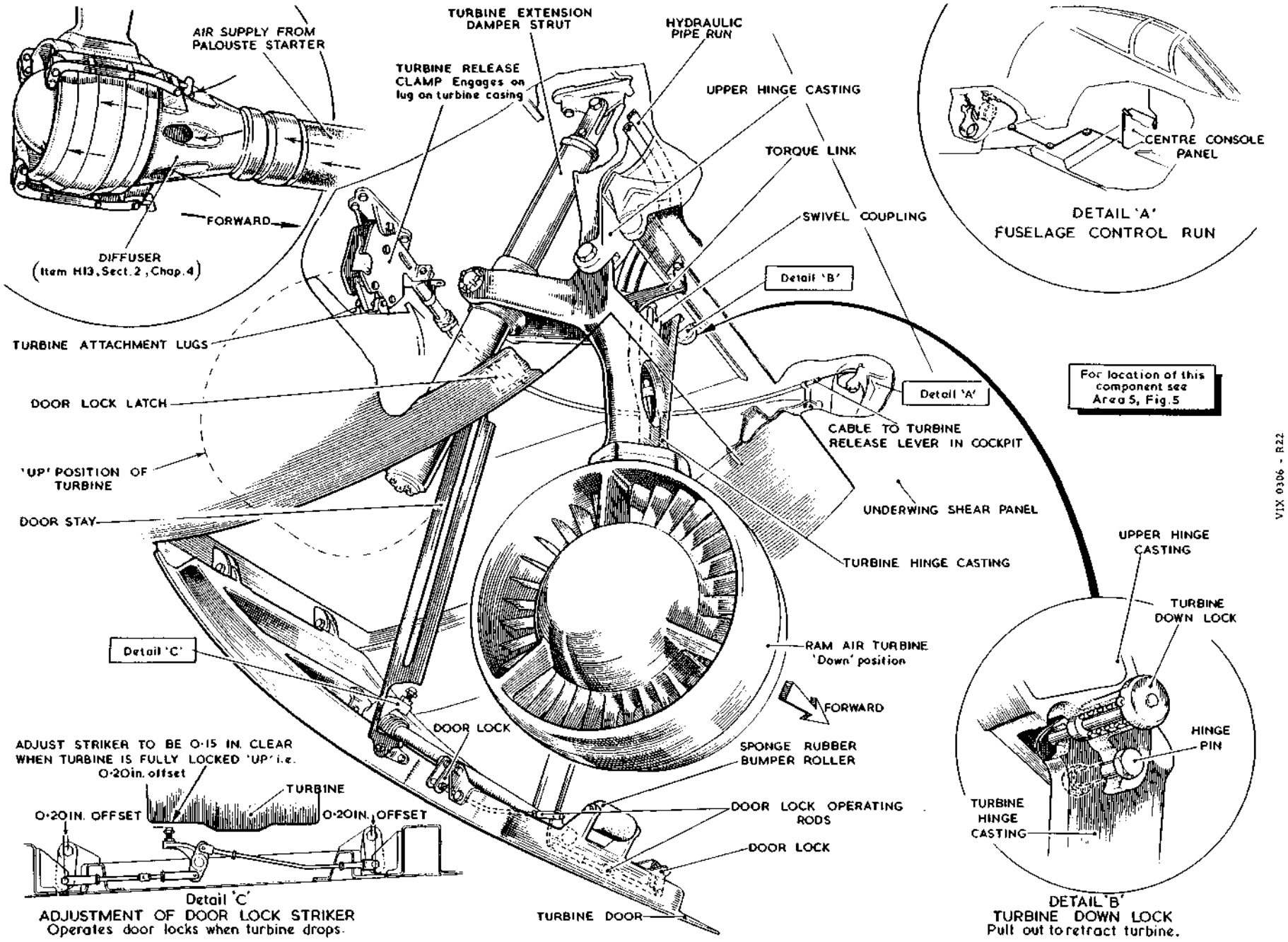


Fig. 8 Ram air turbine (pre mod. 216)

◀ Clearances at detail 'C'. ▶

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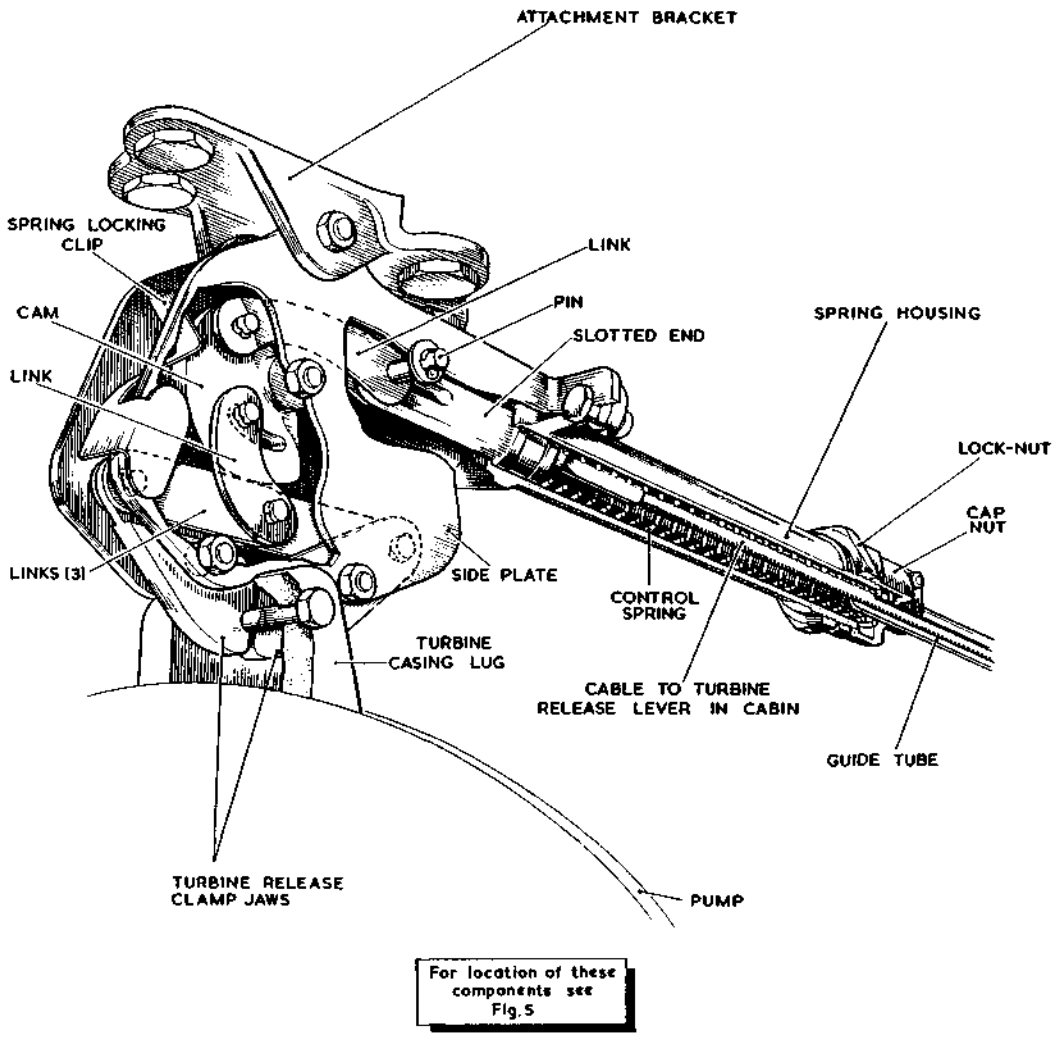

Fig.9 Turbine release clamp(pre mod.216)

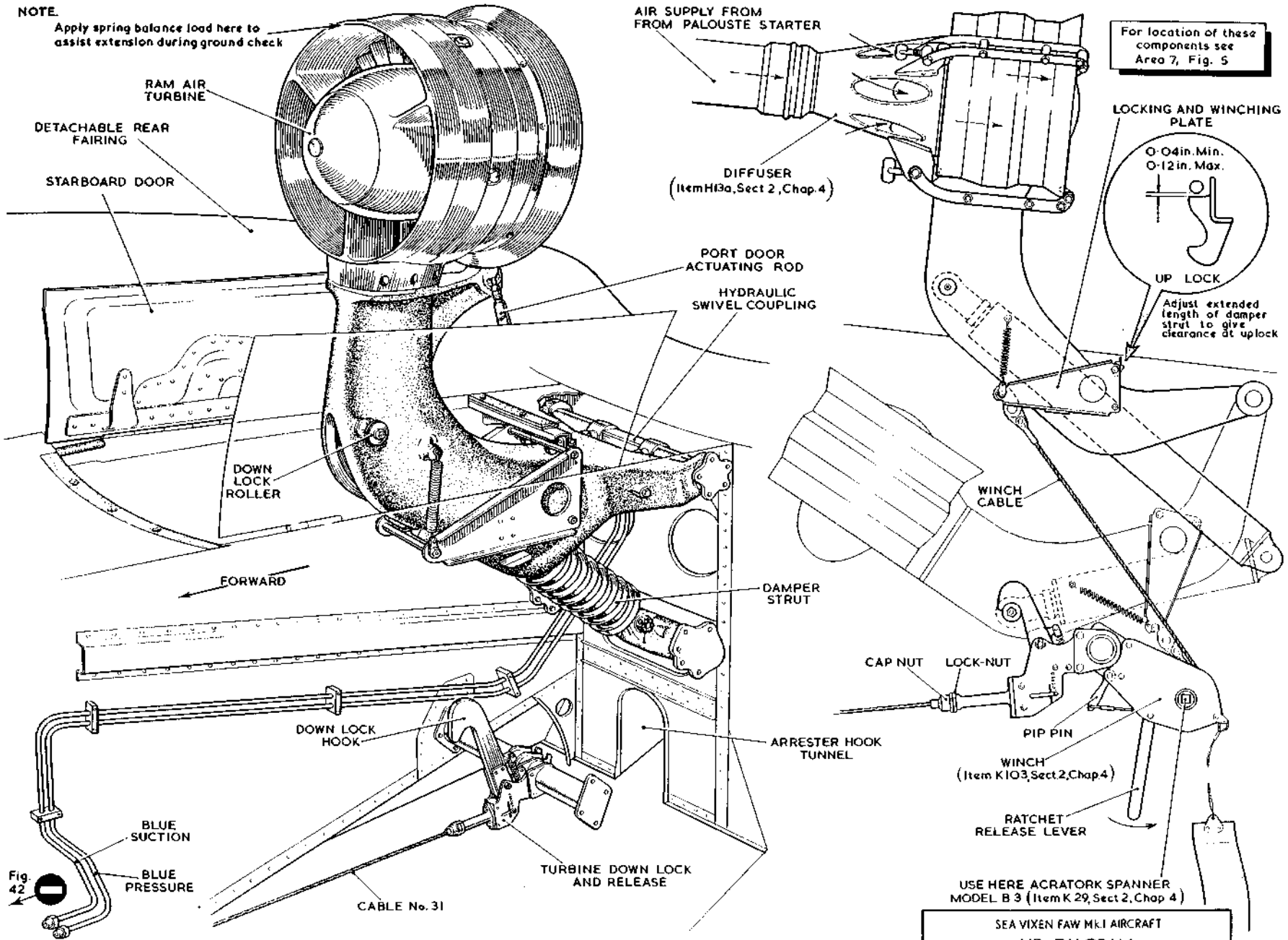

Fig. 10 Ram air turbine installation (post mod. 216)

◀ Up lock detail amended ▶

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alloy casing of aerodynamic form. The delivery from the pump passes through a flow indicator valve, and a micro-switch on the valve completes the circuit to an indicator (Item 15, fig. 16) which shows the pilot that pressure is being supplied to the BLUE system. The delivery circuit also incorporates a cut-out valve, which off loads the pump when the system reaches a predetermined pressure. A line from the cut-out valve drains any gland seepage of this component back into the suction line.

Ram air turbine installation (pre-mod. 216)

20. The ram air turbine is located in the centre section aft of the starboard main engine air-intake (fig. 8) and is normally stowed in the retracted position. The turbine assembly is secured in the stowed position by a turbine release mechanism attached to the airframe structure. A handle on the pilot's right-hand console (Item 26, fig. 16) is connected to the release by a cable run, and when the handle is operated, it actuates the release mechanism (fig. 9) and the initial downward movement of the turbine (assisted by a spring-strut) operates the door uplocks, the door and turbine then move to the extended position where a down-lock pin engages; this pin must be withdrawn manually on the ground before the pump can be retracted to its stowed position.

Ram air turbine installation (post-mod. 216)

21. The ram air turbine is located on the aircraft centre line in the top of the centre section between the spectacle beam and the jet pipe removable rear fairing (fig. 10) and is normally stowed in the retracted position. The turbine assembly is secured in the stowed position by a turbine release mechanism attached to the airframe structure. A handle on the pilot's right-hand console is connected to the release mechanism by a cable run, and when the handle is operated the hook is withdrawn from the down-lock roller, releasing the turbine, which will then be moved to the extended position by the turbine damper strut. The turbine doors are mechanically operated by adjustable rods attached to the ram air turbine casting. To retract the ram air turbine, a winch (Item K103, Sect. 2, Chap. 4) should be used as shown on fig. 10.

Header tanks

22. The BLUE and YELLOW flying control systems each incorporate a pressurized header tank, from which the pumps draw their fluid supply, and which also receive the return fluid. The BLUE tank is installed between ribs No. 2 and 3 in the port main plane, and the YELLOW tank between ribs No. 2 and 3 in the starboard main plane.

23. The header tanks differ substantially from a normal reservoir due to the need to prevent air from entering the flying control circuits. Each tank comprises a cylinder, within which a full bore piston is kept in constant contact with the fluid face by system pressure exerted on a small diameter piston; this piston is housed in an extension bore to the cylinder and is connected to the large diameter piston by a shaft.

24. The outgoing fluid feeds the pump through a large capacity mesh filter within the tank. The top of the tank above the large diameter piston is open to atmosphere through a filter gauze. The tank top is the far end when viewed from the wheel well.

25. During the priming procedure it is necessary to know when the tank is full and the piston is at the end of its travel, therefore an indicator plate is fixed to the near end, and is tripped (by a rod running down the outside) when the unit is full of fluid and the piston is at its full travel position (fig. 7).

Priming equipment (fig. 11)

26. The header tanks in the BLUE and YELLOW systems are primed from the main reservoir (GREEN compartment), and the systems freed from air by the priming equipment in the starboard flap shroud. The priming equipment comprises a micro-filter, hand pump, selector cock, and a combined release/relief valve and pressure gauge unit; the method of priming is given in para. 158.

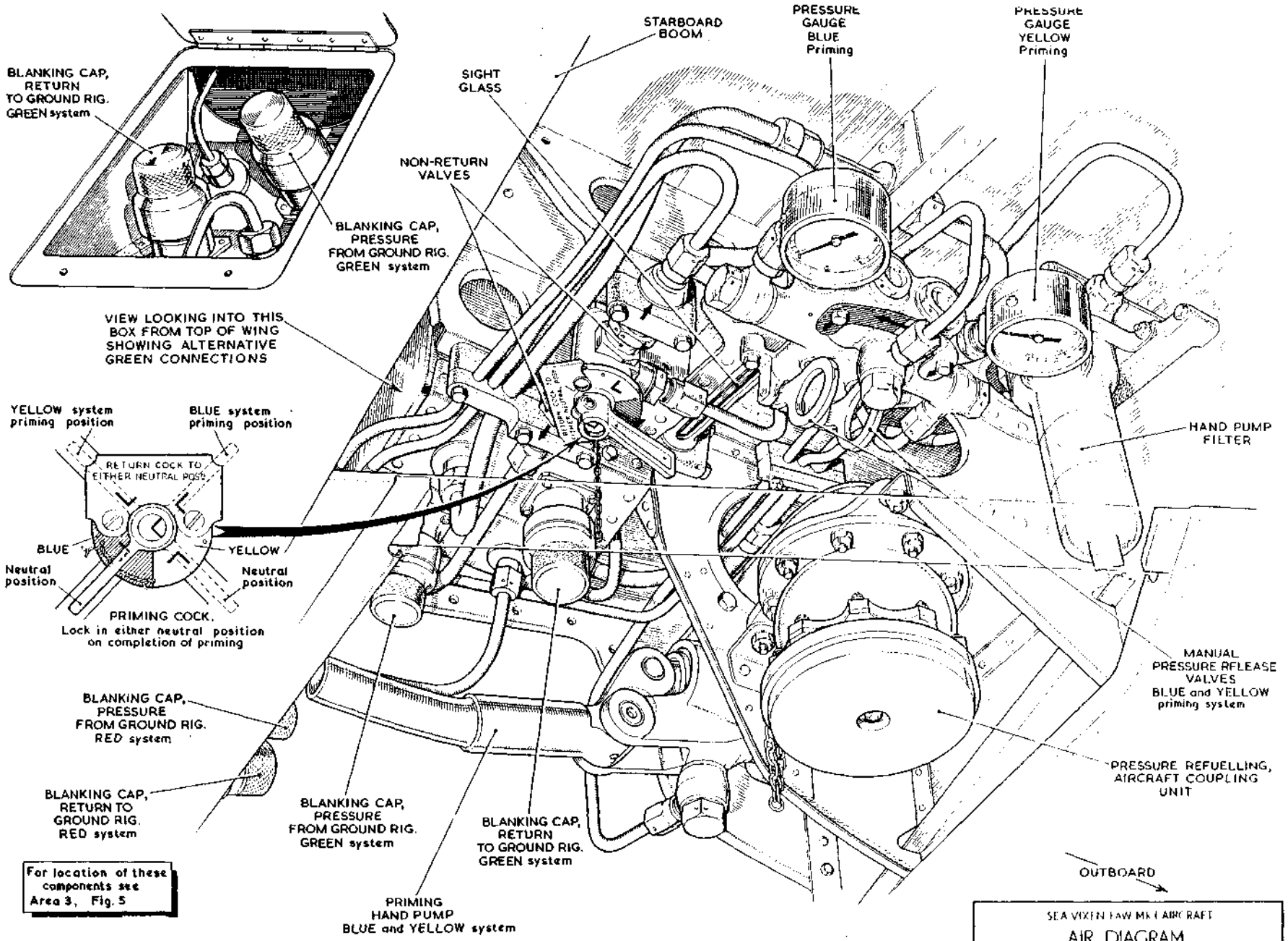


Fig. 11. BLUE and YELLOW system priming equipment

Combined release/relief valve and pressure gauge unit

27. The unit is installed in the starboard flap compartment and forms part of the priming equipment for the BLUE and YELLOW flying control systems; it comprises a block containing two pressure gauges, two release valves and two relief valves, i.e., one each for each control system. The gauges record the pressure in the header tanks during the priming procedure (and also allow the relief valves and settings to be checked).

28. The release valves allow the pressure built up during priming to be bled back to the reservoir through the sight glass to check that the fluid is clear of air; the relief valves also restrict any pressure rise in the header tanks to 100 p.s.i. during the operation of the flying controls, as pressure exceeding this figure will open the valve and vent the fluid back to the main reservoir.

Sight glass

29. The sight glass is part of the priming equipment for the BLUE and YELLOW flying control systems, and is situated in the starboard flap shroud. Return fluid from the header tank priming system passes to the combined release/relief valve and pressure gauge unit, and selection on this unit vents header tank fluid through the sight glass and back to the main reservoir; the glass permits visual inspection of the fluid to check that it is free from air.

Accumulators
(pre mod.493 and 649)

30. The six accumulators in the BLUE and YELLOW control systems are designed to prevent contamination of the hydraulic fluid by air, which would seriously affect the operation of the flying controls. The floating piston of an accumulator is recessed in the centre and has seals at each end, the space between the ends forming an annulus which is automatically charged with fluid from the accumulator main compartment via a valve in the piston head; this provides a fluid seal between the air and the system fluid in addition to the fabric and rubber seals on the piston lands, and also provides lubrication for the seals.

31. A thermal relief valve on the cylinder relieves excessive pressure in the annulus (and the accumulator) into the header tank, and a bleed valve on the wheel wall next to the accumulator charging valve allows any air trapped between the piston seals to be vented during the priming procedure. (No.1 accumulators). The bleed valves for the No.2 accumulators are fitted on the accumulators and the thermal relief valves are connected to the return lines.

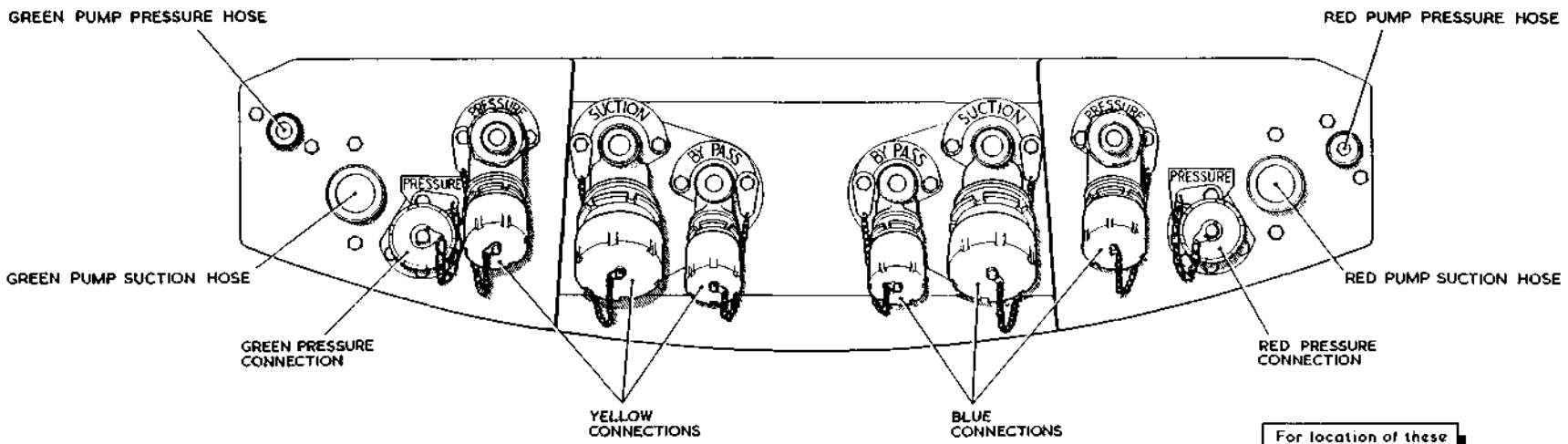
Accumulators
(post mod.493 and 649)

32. Mod.493 introduced modified accumulators in the BLUE system. The floating piston is shortened to give increased fluid capacity and the annulus, thermal relief valve and bleed point are deleted. The initial air pressure is reduced to 1000 p.s.i. To prevent the warning light from operating unnecessarily, the associated low pressure switch has been reset to 1600 p.s.i. by mod.875. When mod.649 is embodied, the YELLOW system is brought into line with the modified BLUE system.

Expansion cylinders

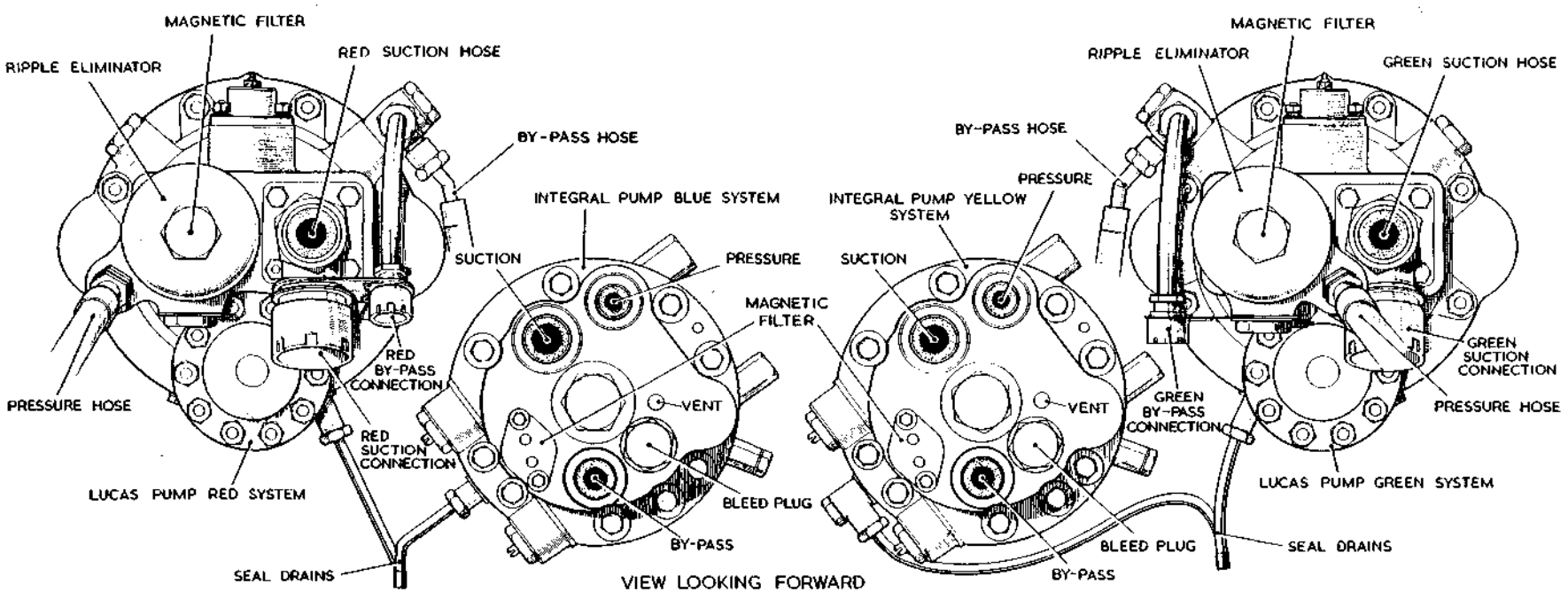
33. An expansion cylinder is fitted in each BLUE and YELLOW system, next to the associated header tank and accumulator between the main plane ribs No.2 and No.3 (BLUE system port and, YELLOW system starboard). The expansion cylinders absorb excess fluid from the header tanks caused by thermal expansion, and also damp out header tank pressure surges during rapid operation of the flying controls. The cylinders are necessary to avoid fluid loss on expansion, as the header tanks are completely filled and the systems are closed circuits except during ground priming.

34. The cylinders are similar in construction to an accumulator, and are pressurized to the figures given in Table 2 to ensure that the separator is always in contact with the fluid face, and so prevent cavitation and contamination of the system with air. In the event of excessive



VIEW LOOKING AFT ON REAR FIREWALL

For location of these components see Area 6, Fig 5



VIEW LOOKING FORWARD

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Fig. 12 Ground test connections in pump bay

◀ Magnetic filters annotated ▶

thermal expansion, a rise in pressure in the header tank will cause the combined pressure release/relief valve in the priming system (para.28) to vent fluid back into the main reservoir.

35. As a further safeguard in the event of excessive thermal expansion, each expansion cylinder has a relief valve on the separator, which operates when the cylinder is approaching full capacity. A striker rod is fixed to the head of the cylinder at the air charging end and, when the separator travels further than normal capacity, the striker opens the valve on the separator and discharges excess fluid through the annulus between the separator body and the cylinder walls, and is vented overboard. It is not expected however, that this valve will need to operate in normal service.

Pressure gauges

36. On pre mod.933 aircraft, each accumulator and expansion chamber has a pressure gauge to indicate the initial air pressure, and the hydraulic pressure when the systems are operating. On post mod.933 aircraft the tail plane accumulator gauges are deleted. Two gauges in the cockpit (Item 9, Fig.16) indicate the hydraulic pressure in the two systems. Restrictors are fitted in the gauge lines to damp out pressure fluctuations. Two gauges, BLUE and YELLOW, are fitted in the starboard flap bay (Fig.11) to indicate the header tank priming pressures, these are also used to show the hydraulic pressures in the header tank during functional tests.

Warning lights and indicator

37. A low pressure switch in each system operates warning lights in the centralized warning panel (Item 28, Fig.16). The pressure switches are set at 1900 p.s.i., but when mod.875 is embodied the BLUE switch is set at 1600 p.s.i., and when mod.649 is embodied the YELLOW switch is set at 1600 p.s.i.

38. An indicator in the cockpit (Item 15, Fig.16), operated by a flow switch, shows WHITE when the flow from the R.A.T. pump is satisfactory. When the pump is not in use or the flow is unsatisfactory the indicator shows BLACK.

Ground test connections

39. Hydraulic ground rig connections for the ground testing of the systems are provided on the forward face of the rear firewall (Fig.12), and are accessible by opening the gearbox rear cowling (Panel S, Fig.7, Sect.2, Chap.4).

Flying control units

40. The three types of control unit used in the flying control system are basically similar, and theoretical diagrams are shown on Fig.3. The selector valve within each unit is operated by the movement of the pilot's flying controls, transmitted by cable and pulley runs and connecting-rod linkages (Sect.3, Chap.4).

41. Each powered flying control unit is fed with pressure from the BLUE and YELLOW systems through independent pipe runs. The pressure acts simultaneously on two separate pistons (on one piston-rod) within the body of the unit. If one system fails, the other circuit will maintain control with only a very small decrease in operating speed. If the pressure acting on the two pistons varies by more than a pre-determined amount, a relief valve within the unit will exhaust excess pressure into the return lines.

42. The jacks at normal system pressure can support loads greater than the maximum end-loads, which ensures that they are hydraulically irreversible. Wire-wound filters are fitted and must be removed for cleaning at the periods laid down in Vol.5.

43. Cables from the pilot's control column and rudder pedals actuate the selector valve levers on their appropriate units. Each piston rod eye-end is anchored to the aircraft structure, and the casings are attached to the control surface linkages.

44. Hydraulic pressure on the selected piston faces causes the bodies to move relative to the stationary pistons, and operates the control surface levers in the same direction as the pilot's input movement on the unit

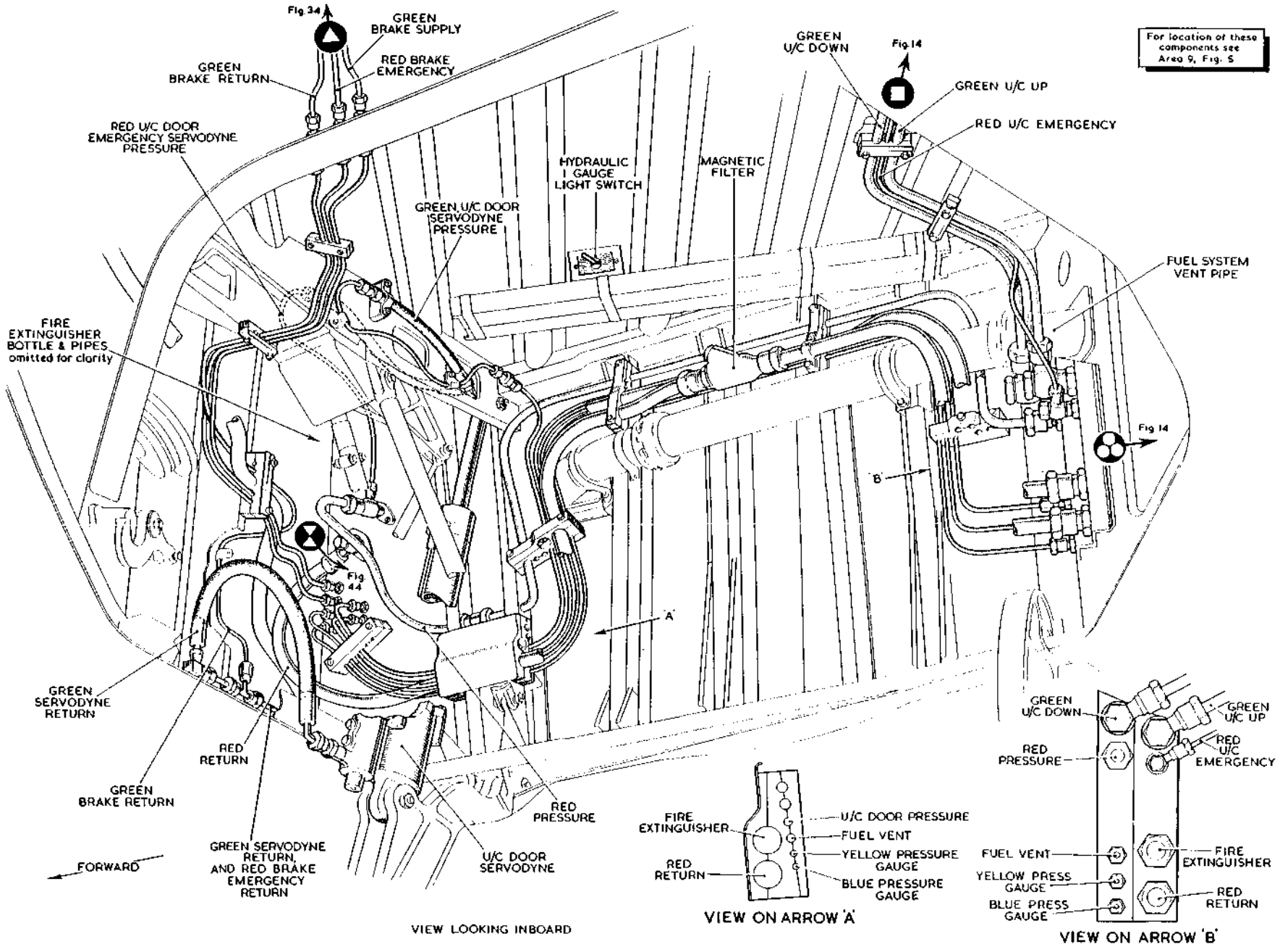


Fig.13 Hydraulics on rib No.1, port wheel well

◀ Pre mod. 216 and 331 pipelines deleted ▶

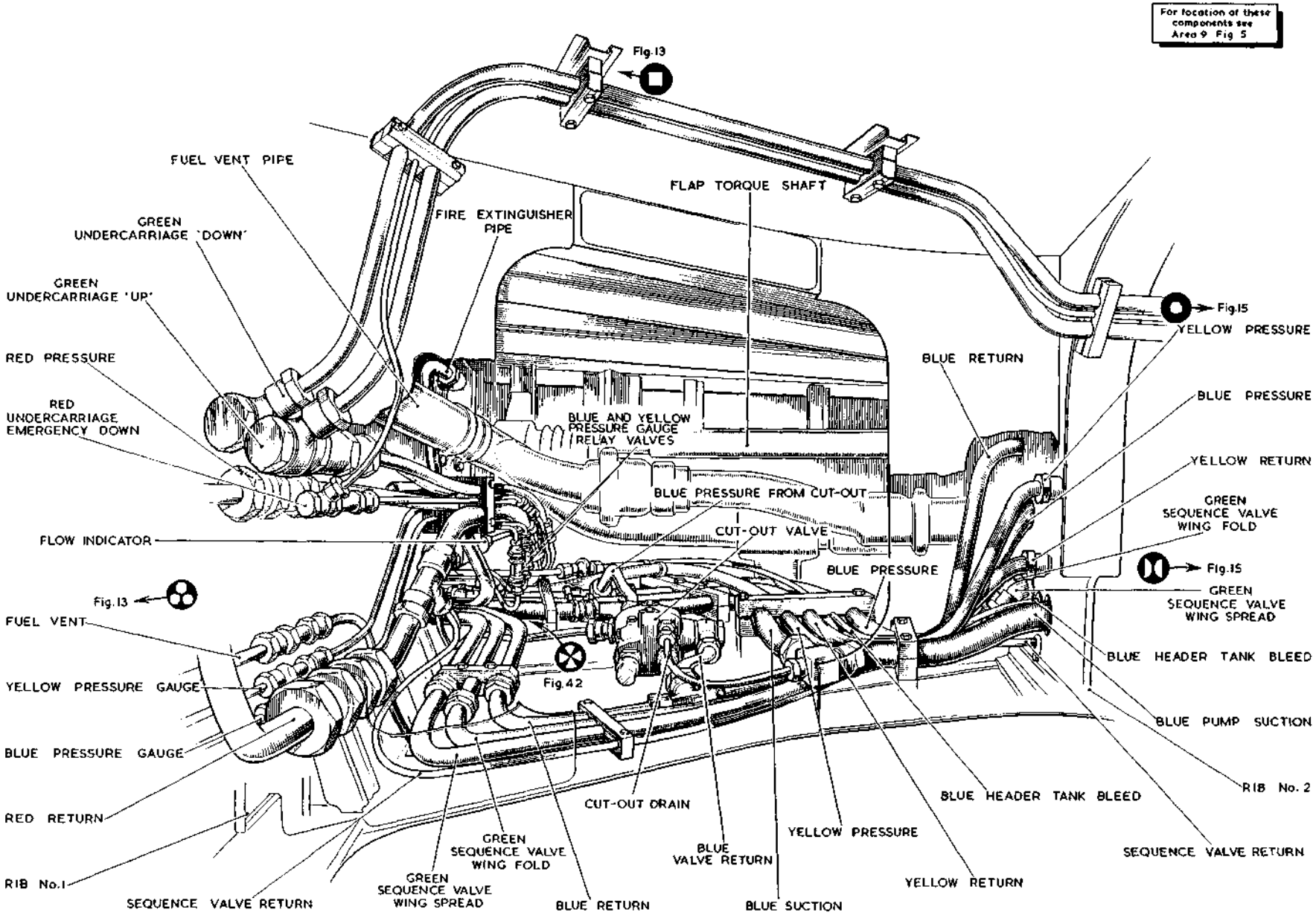
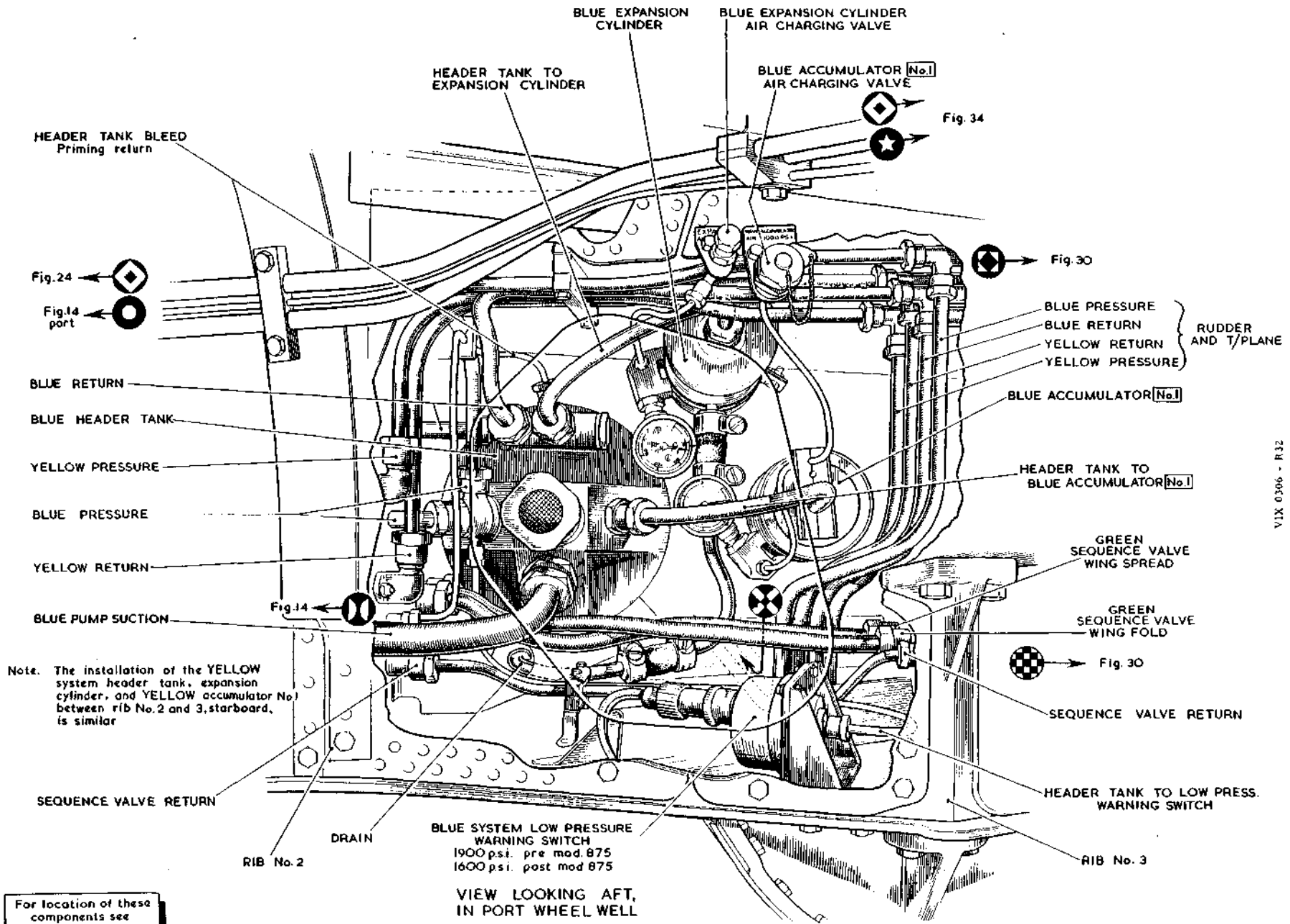


Fig.14 Hydraulic equipment between ribs No.1 and 2, port

◀ Post mod. 216 layout. ▶



Note. The installation of the YELLOW system header tank, expansion cylinder, and YELLOW accumulator No.1 between rib No.2 and 3, starboard, is similar

For location of these components see Area 9, Fig 5

Fig.15 Hydraulic equipment between rib No.2 and 3, port

selector valve levers. After the valve selector levers have been moved by the pilot, follow-up movement of the jack bodies restores the valve levers to neutral, and hydraulically lock the flying control surfaces in the selected positions. Further information is given in A.P.4604F, Vol.1.

Aileron circuit

45. The aileron flying control units are mounted between ribs No.9 and 10 in the main planes, outboard of the wing-fold break. The cables from the aileron mechanism in the cockpit pass down the fuselage and along the leading edge of each main plane to the wing break. From this position, movement is transmitted outboard by connecting-rods to a spring feel unit on each front spar. The control unit selector valves are actuated by linkage from the spring feel unit, and the autopilot electro-hydraulic actuator (para.50) is connected to this linkage (on the starboard side only, the linkage between the spring feel unit and the control unit also incorporates an electrical trim actuator).

46. Each control unit is anchored at its piston-rod eye-end to a bracket on each main spar, and the eye-end on the body of the unit is attached to the aileron link. The selector valve is in the centre of the body, and movement of the control unit takes place in the same direction as that in which the valve is moved. The fluid supply is taken in rigid piping to rib No.9 in each main plane, from whence flexible hoses complete the circuit to the units. The rigging instructions, and a full description of the power-operated aileron installation, are given in Sect.3, Chap.4.

Tail plane and rudder circuits

47. A tail plane and a rudder flying control unit are mounted in the port and the starboard fin and are fed jointly from the BLUE and YELLOW systems. The selector valves on the units are controlled by cable and pulley runs from the control column and rudder pedals in the cockpit.

48. Two accumulators are mounted in each tail boom; these feed the tail plane units only, and ensure an adequate pressure supply and sensitive response, especially under extreme low temperature conditions or when coarse movements are made at low speed.

49. Non-return valves are fitted in the rudder control unit return lines, where they join the tail plane return circuit, to avoid a high back-pressure building up in the rudder return lines when the large-capacity tail plane units are operated. A description of the power-operated rudder and tail plane together with rigging instructions, is given in Sect.3, Chap.4.

Autopilot circuit

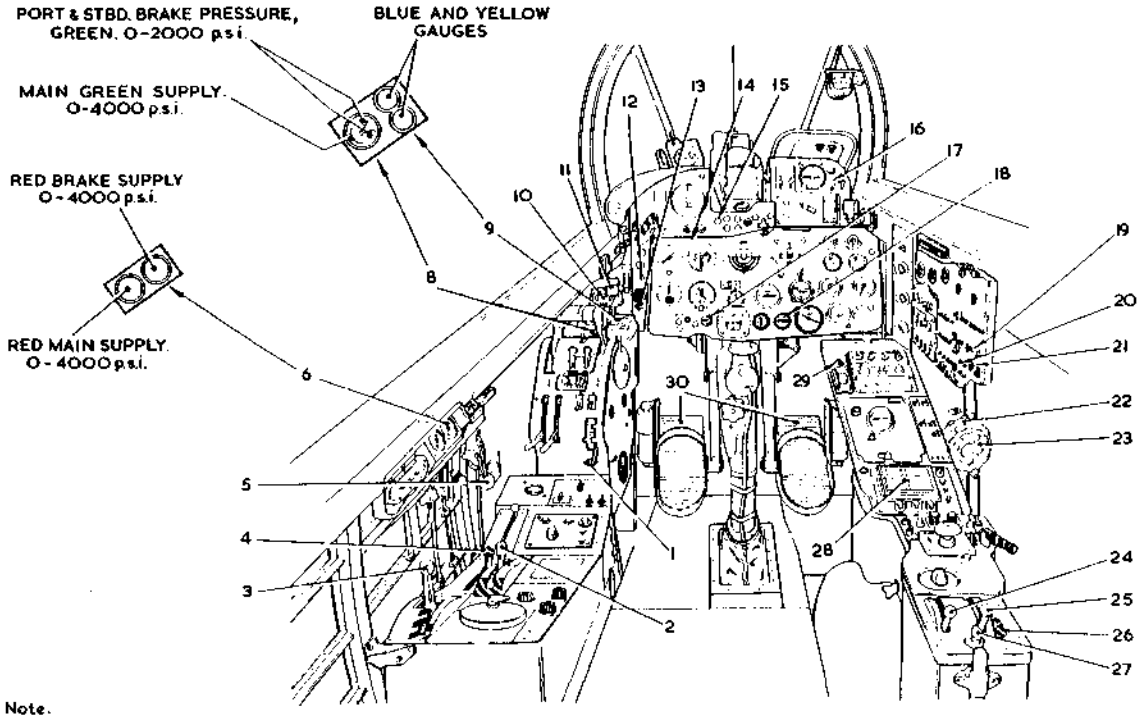
50. The autopilot sensing mechanism is electrical, and is described in Sect.5, Chap.2. The impulses are fed to an autopilot electro-hydraulic actuator in each main plane (which is connected in turn to the aileron operating mechanism), and to an electrical trim actuator in the port rudder circuit; the system is operated by YELLOW pressure only.

51. An electrically operated selector valve in each main plane controls hydraulic pressure to the actuator, and is operated automatically when the autopilot is selected. The mechanical arrangement is described and illustrated in Sect.3, Chap.4, where the rigging instructions are also given.

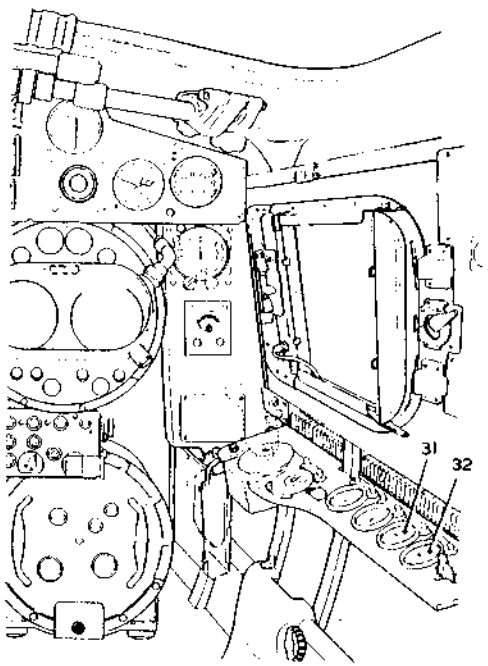
RED AND GREEN POWER SYSTEMS

52. The RED and GREEN systems are each fed by a Lucas pump (para.59) fitted to a gearbox coupled to the engines. The port engine drives the RED pump, and the starboard engine the GREEN pump. The pumps draw fluid from the respective compartment of an air pressurized reservoir (para.62).

53. Both systems have accumulators (para.71) to provide a pressure reserve. The RED system has four; brake (No.1), main (No.2), scanner (No.3), and arrester hook (No.4). The GREEN system has three accumulators; main (No.1), rocket installation (No.2) and arrester hook (No.3). The arrester hook accumulators absorb pressure surges during landing, and also provide pressure for rapid re-extension of the hook if partially retracted during landing.



Note.
The descriptive nomenclature below is in accordance with the cockpit labelling



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KEY

1. FLAP SELECTOR LEVER.
2. ARRESTER HOOK SELECTOR LEVER.
3. CABIN AIR SUPPLY LEVER.
4. AIR BRAKE EMERGENCY SHUT LEVER.
5. WHEEL BRAKES LEVER.
6. RED MAIN AND BRAKE SUPPLY GAUGES (MOD. 249)
7. AIR BRAKE SWITCH.
8. GREEN MAIN, AND PORT AND STARBOARD BRAKE PRESSURE GAUGES (MOD. 249).
9. BLUE AND YELLOW MAIN PRESSURE GAUGES.
10. UNDERCARRIAGE INDICATOR (ALSO SHOWS FLAP/TAIL-PLANE TAB UNLOCKED, AND AIR BRAKE NOT UP).
11. UNDERCARRIAGE SELECTOR LEVER.
12. HOOK DOWN WARNING LIGHT.
13. AIR BRAKE POSITION SELECTOR SWITCH (PRE MOD. 1030).
14. WINDSCREEN WIPER CONTROL LEVER (PRE MOD. 913)
15. EMERGENCY HYDRAULIC PUMP FLOW INDICATOR.
16. FUEL FILTER DE-ICING SWITCH, HYDRAULIC.
17. AIR BRAKE INDICATOR.
18. FLAP POSITION INDICATOR.
19. ROCKET BATTERIES EXTENDED WARNING LIGHT.
20. MASTER ARMAMENT SELECTOR SWITCH.
21. ROCKET BATTERY SELECTOR SWITCH.
22. NOSE WHEEL STEERING WHEEL, COARSE CONTROL.
23. NOSE WHEEL STEERING WHEEL, FINE CONTROL
24. WING FOLD LOCK LEVER.
25. WING FOLD SELECTOR LEVER.
26. EMERGENCY FLYING CONTROL HYDRAULIC PUMP.
27. FLAP INTERLOCK OVERRIDE.
28. CENTRALIZED WARNING PANEL.
29. OBSERVER'S HATCH/RADOME/WING UNLOCKED INDICATOR.
30. WHEEL BRAKE TOE PEDALS.
31. RED SYSTEM HYDRAULIC TEMPERATURE GAUGE.
32. GREEN SYSTEM HYDRAULIC TEMPERATURE GAUGE.

Fig.16 Hydraulic controls and indicators in cockpit

◀ New illustration ▶

54. A ripple eliminator (para.130) is fitted in each output line close to each pump; each ripple eliminator has a magnetic filter element (para. 128) screwed into its casing.

55. Thermal relief valves protect the systems against excessive pressure, by relieving back to the reservoir.

56. Ground test connections are provided for normal and emergency operation on the ground (para.75).

General services supply (Fig.4)

57. The general services are operated by the RED or GREEN system as shown below.

Emergency operation

58. The undercarriage, wheel brakes and arrester hook must be selected manually for emergency operation by the RED system if the GREEN system fails. But the undercarriage door Servodynes and flap Servodyne unit use RED system pressure automatically when the GREEN system pressure drops 500 p.s.i. below RED system pressure. The air brake can be selected UP manually if the electro-hydraulic selector fails.

Pumps

59. The RED and GREEN systems are supplied with fluid pressure from two Lucas pumps, mounted on the engine-driven accessories gearbox. The RED pump, is driven from the port engine and the GREEN from the starboard engine, and both have left-hand rotation when viewed from the

Undercarriage retraction jacks	GREEN system - Normal; RED system - Emergency (down only).
Wheel well doors	GREEN system - Normal; RED system - Emergency (full operation).
Wheel brakes	GREEN system - Normal; RED system - Emergency (full operation by-passing the Maxarets) RED system - Parking (full system pressure, i.e., by-passing the reducing valve mechanism)
Flaps	GREEN system - Normal; RED system - Emergency (full operation).
A.1. alternator	RED system.
Firestreak alternator	GREEN system.
Rocket installation	GREEN system.
Arrester hook	GREEN system - Normal; RED system - Emergency (down only).
Wing fold	GREEN system.
Air brake	GREEN system.
Nose wheel steering	GREEN system.
Scanner	RED system.
Radome (pre mod.1080)	RED system.
Fuel heating	RED and GREEN systems.
Windscreen wiper (pre mod.913).	RED system.

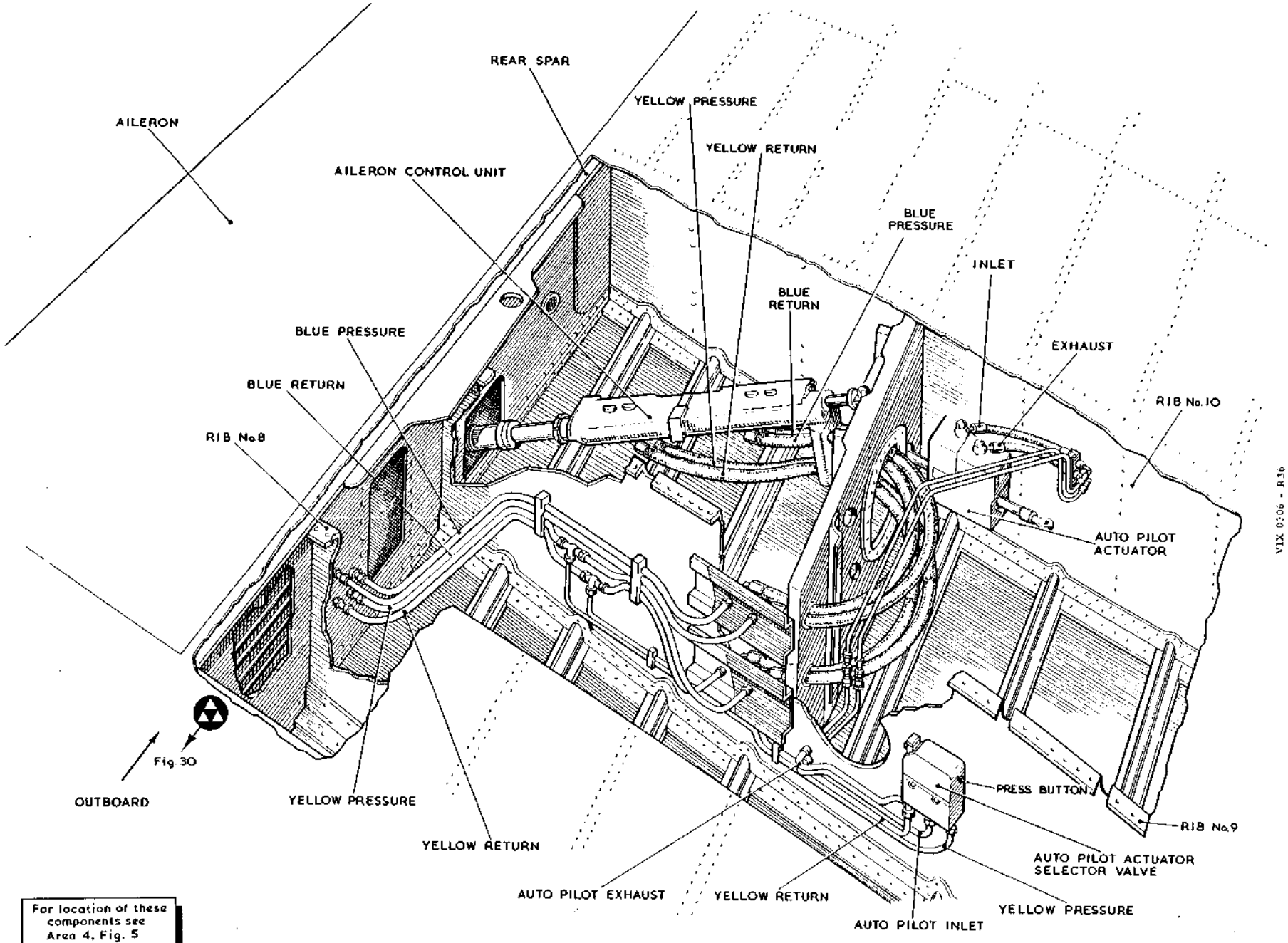

Fig.17 Hydraulics in port wing

◀ Position of symbol amended. ▶

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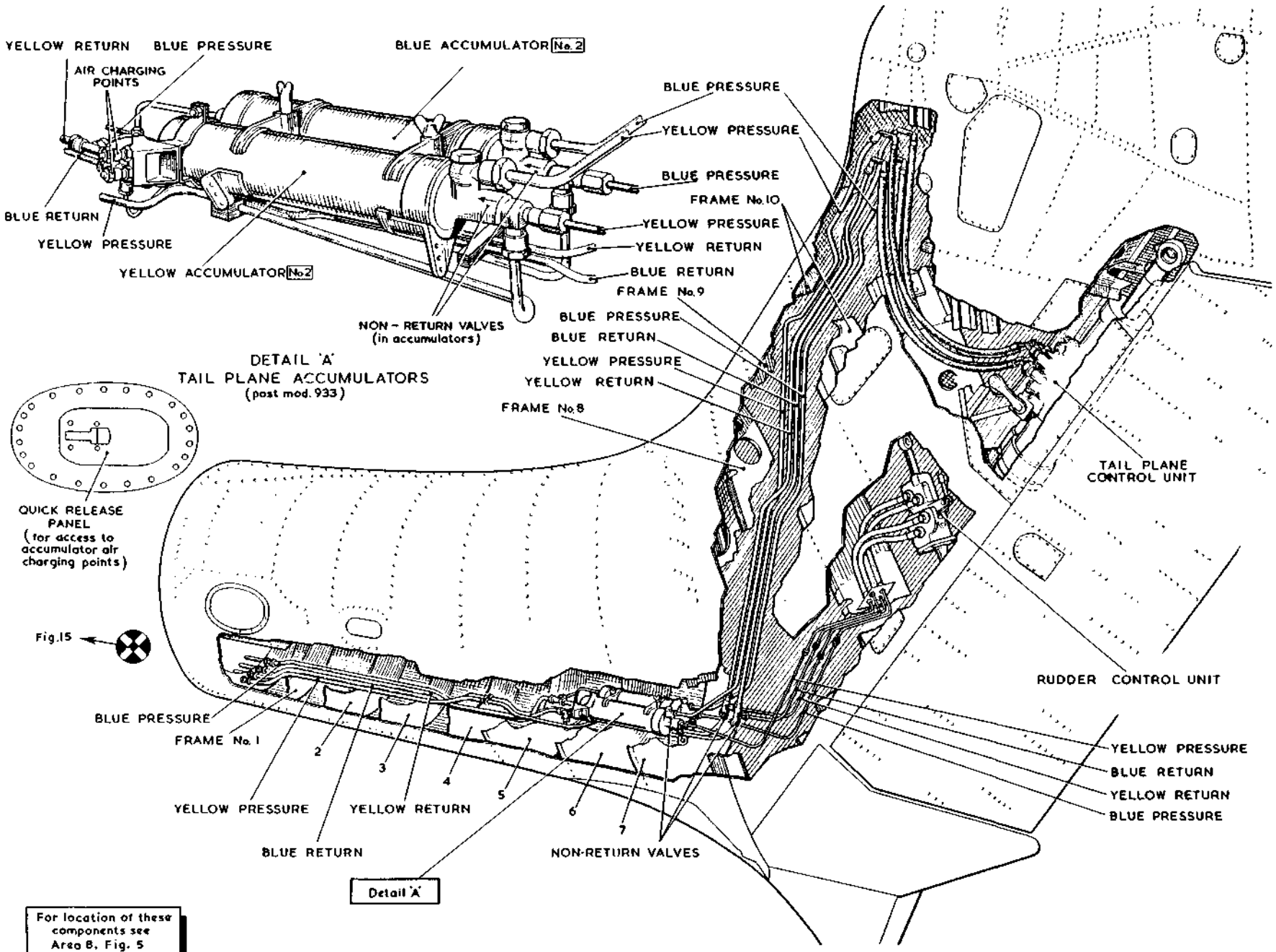

Fig.18 Hydraulics in port boom and fin

◀ Mod 493, 649 and 933. ▶

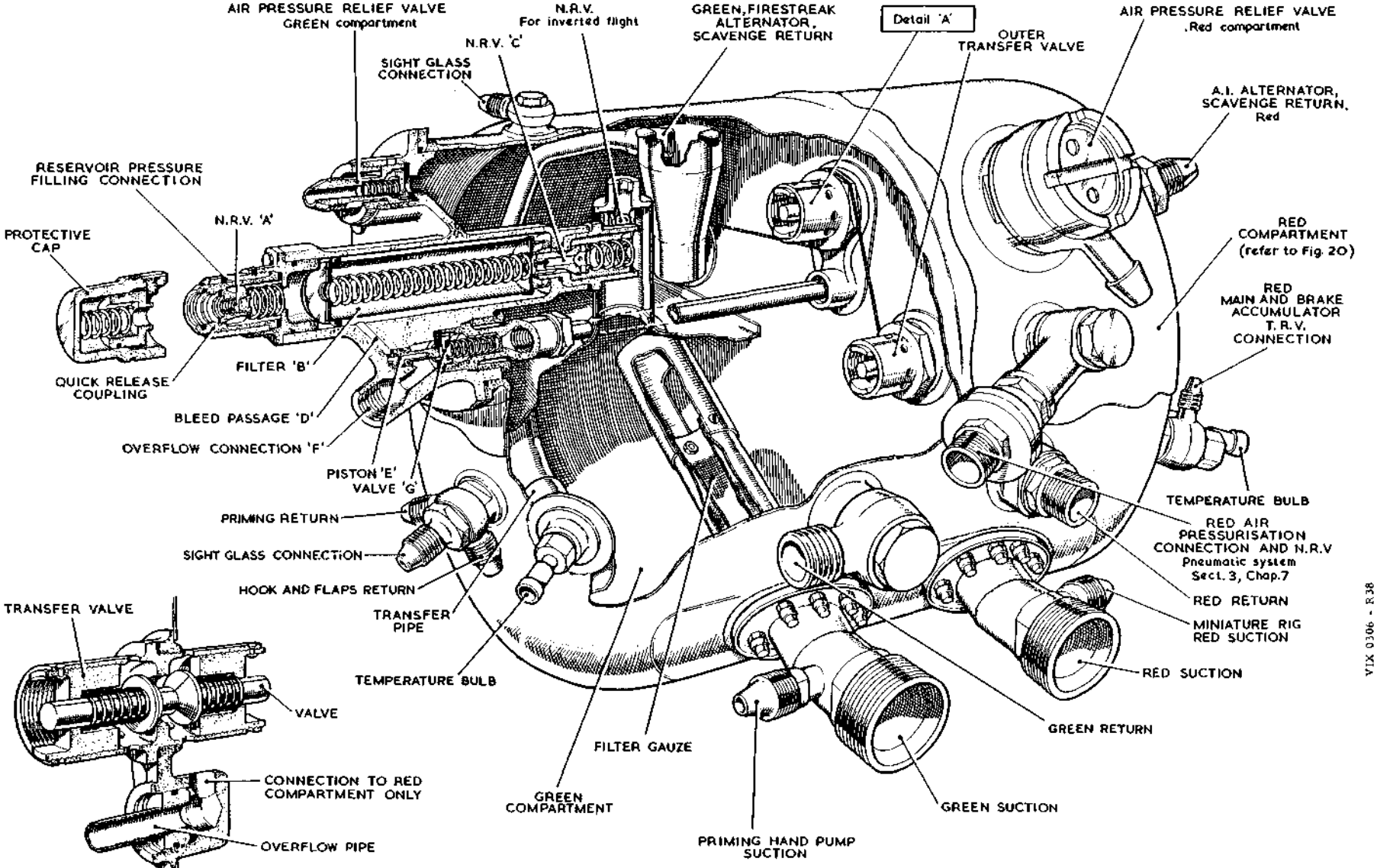

Fig.19 Hydraulic reservoir

◀ Mod 836, 1073 and 1184 ▶

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splined end of the pump drive quill shaft.

60. Each pump, a variable-stroke, positive displacement, multi-plunger unit incorporates a servo-operated stroke control system for the automatic regulation of pump output, together with a constant pressure valve which automatically controls the delivery line pressure. A relief valve limits the line pressure by controlling the pump stroke, thereby reducing the work demanded of the pump during low-demand periods. Each pump must be primed before it is fitted to the gearbox.

61. A by-pass line from each pump (RED and GREEN) is taken to the RED or GREEN heat exchanger and then returns to the respective compartment in the reservoir. A seal drain on each pump discharges overboard any small seepage past the seals.

Hydraulic reservoir

62. The hydraulic reservoir (Fig.19) is the primary source of fluid supply for all the hydraulic services. The suction and return lines for the RED and GREEN systems are connected to the reservoir, which also provides the fluid for priming the otherwise self-contained BLUE and YELLOW systems.

63. The reservoir, fitted in the starboard centre-section between ribs No.1 and 2, is constructed of two sections of aluminium alloy welded at the joints. A horizontal and a vertical diaphragm divide the reservoir into two top and two bottom compartments.

Bottom compartments

64. Each bottom compartment is exclusive to its own system; the GREEN compartment is below the pressure filling connection. All return lines except the alternator scavenge lines return to the bottom compartments. At each suction connection a stackpipe containing a gauze filter is fitted at a 30 deg. angle across each compartment. The ends of the stackpipes are fitted with baffles to prevent the entry of aerated fluid (mod.1073).

65. A temperature bulb is fitted in each compartment to show the RED and GREEN fluid temperature on gauges in the observer's cockpit.

66. Each diaphragm between the top and bottom compartments contains a simple ball-type non-return valve in a stackpipe extending into the top compartment. This ensures that fluid is retained in the bottom compartments during inverted flight and negative-g conditions.

Top compartments

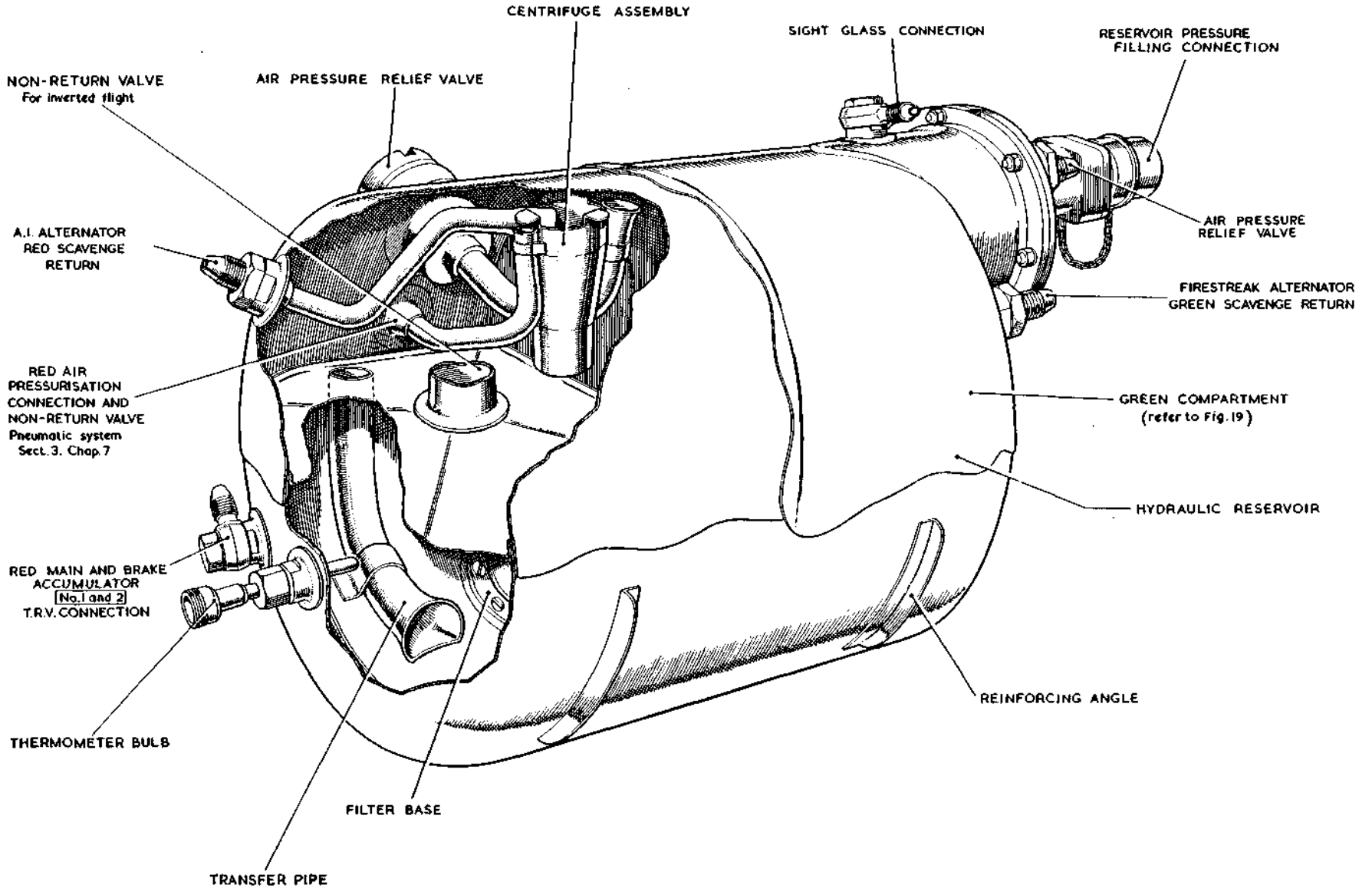
67. The top compartments are connected by three transfer valves in the centre diaphragm (Fig.19). The valves are spring loaded to the central position and normally allow air and fluid to pass both ways; but if one system fails, the air pressure and fluid will be retained in the serviceable system.

68. The RED and GREEN compartments are pressurized by tappings at the 15th stage of the compressors of the port and starboard engines respectively. The air pressure is regulated to 15 p.s.i. (see Sect.3, Chap.7), and a pressure relief valve in each compartment is set at 20 p.s.i. For ground tests the reservoir can be pressurized through an air charging valve on the rear wall of the starboard wheel-well (Fig.24).

69. A centrifuge assembly in each compartment de-aerates the scavenge return fluid from its associated alternator.

Pressure filling

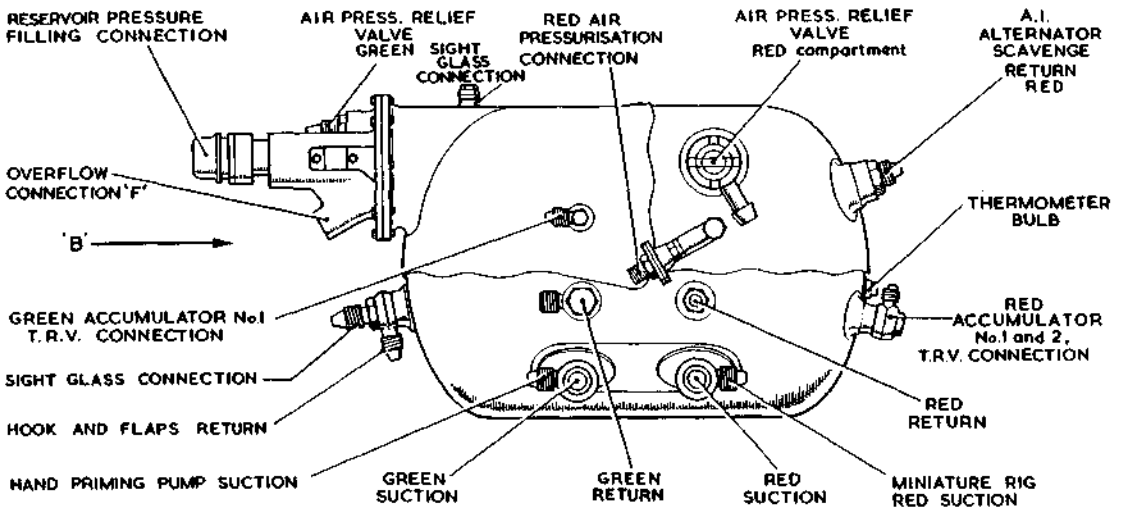
70. The reservoir is filled at 30 p.s.i. with micro-filtered fluid from a replenishing can (Item H9, Sect.2, Chap.4) through a pressure filling unit mounted in the GREEN compartment. The filling connection has a protective cap on the quick-release self-sealing coupling. When the hose is connected, the non-return valve A (Fig.19) is opened by the coupling, and fluid will flow through the filter B and non-return valve C into the reservoir. Pressure in the bleed passage D is exerted on piston E which opens valve G. When the fluid reaches the overflow pipe in the RED compartment it will flow past valve G to the overflow connection F, and is

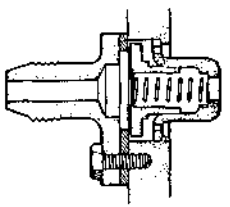


For location of this component see Area 3 Fig. 5

Fig.20 Reservoir, RED compartment

◀ Mod. 1184. ▶





DETAIL 'A'
PRESSURISATION CONNECTION

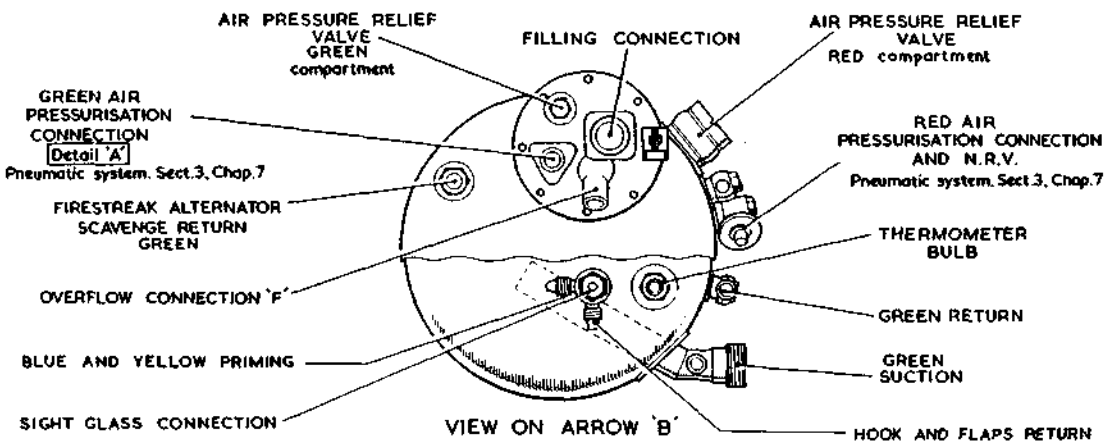


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Fig. 21 Reservoir pipe connections

◀ Mod. 836, 1073 and 1184. ▶

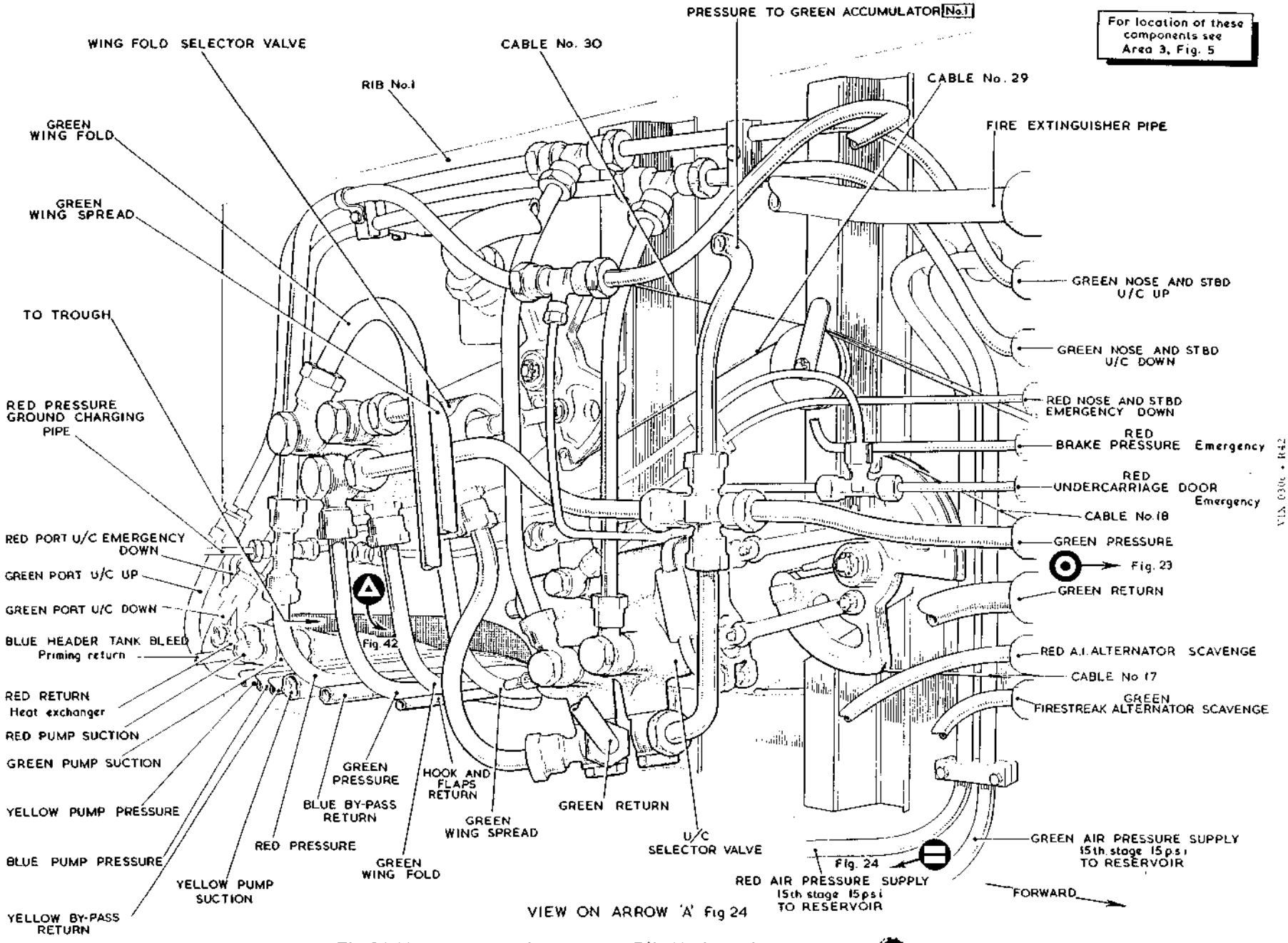

Fig.22 Hydraulic equipment on Rib No.1 outboard, starboard

◀ Hook and flaps return added ▶

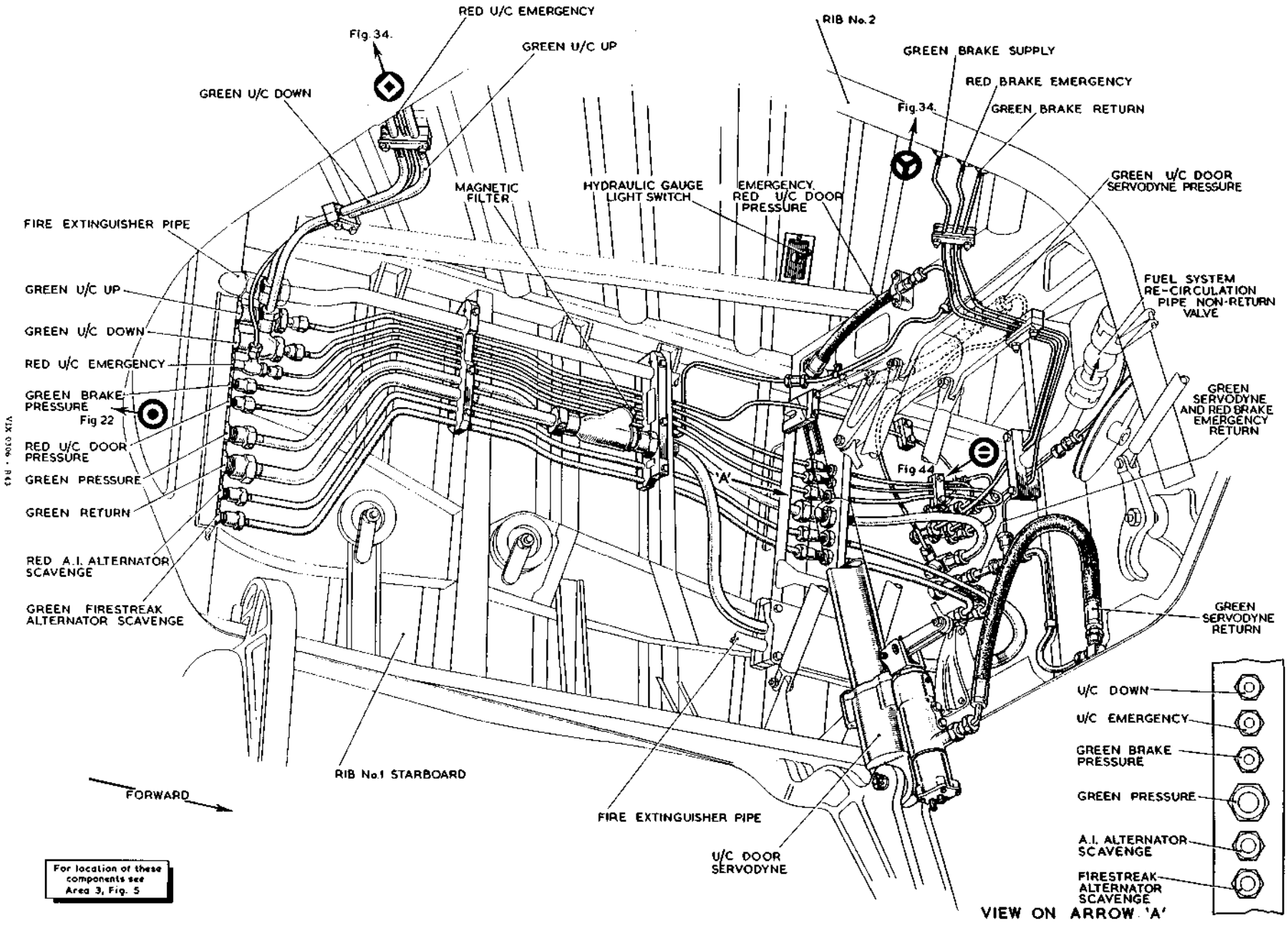

Fig.23 Hydraulics on rib No.1, starboard wheel well

◀ Door Servodyne and annotation ▶

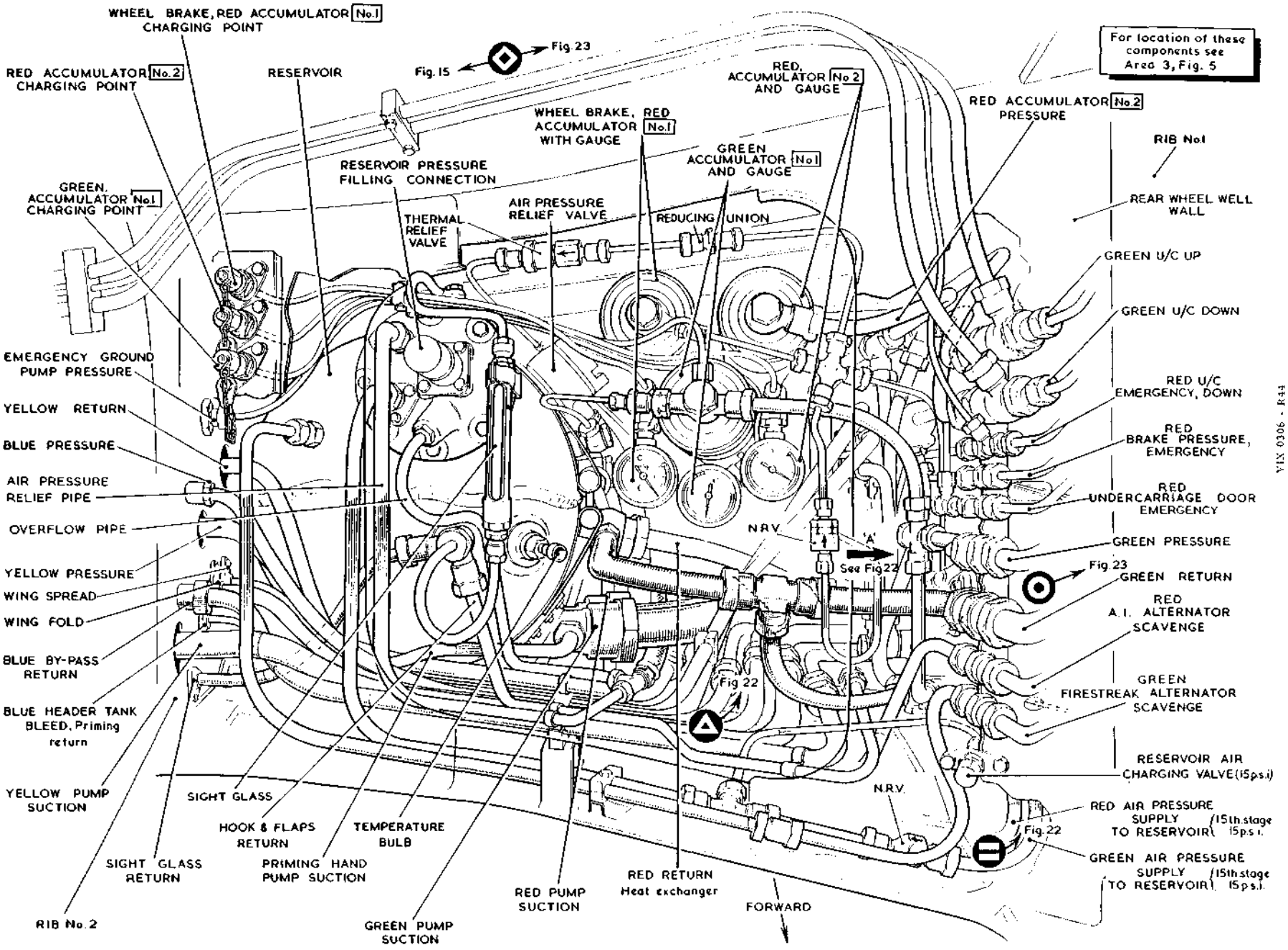

Fig.24 Hydraulic equipment between Ribs No.1 and 2, starboard

◀ Mod 673, 836, 1073 and 1184 ▶

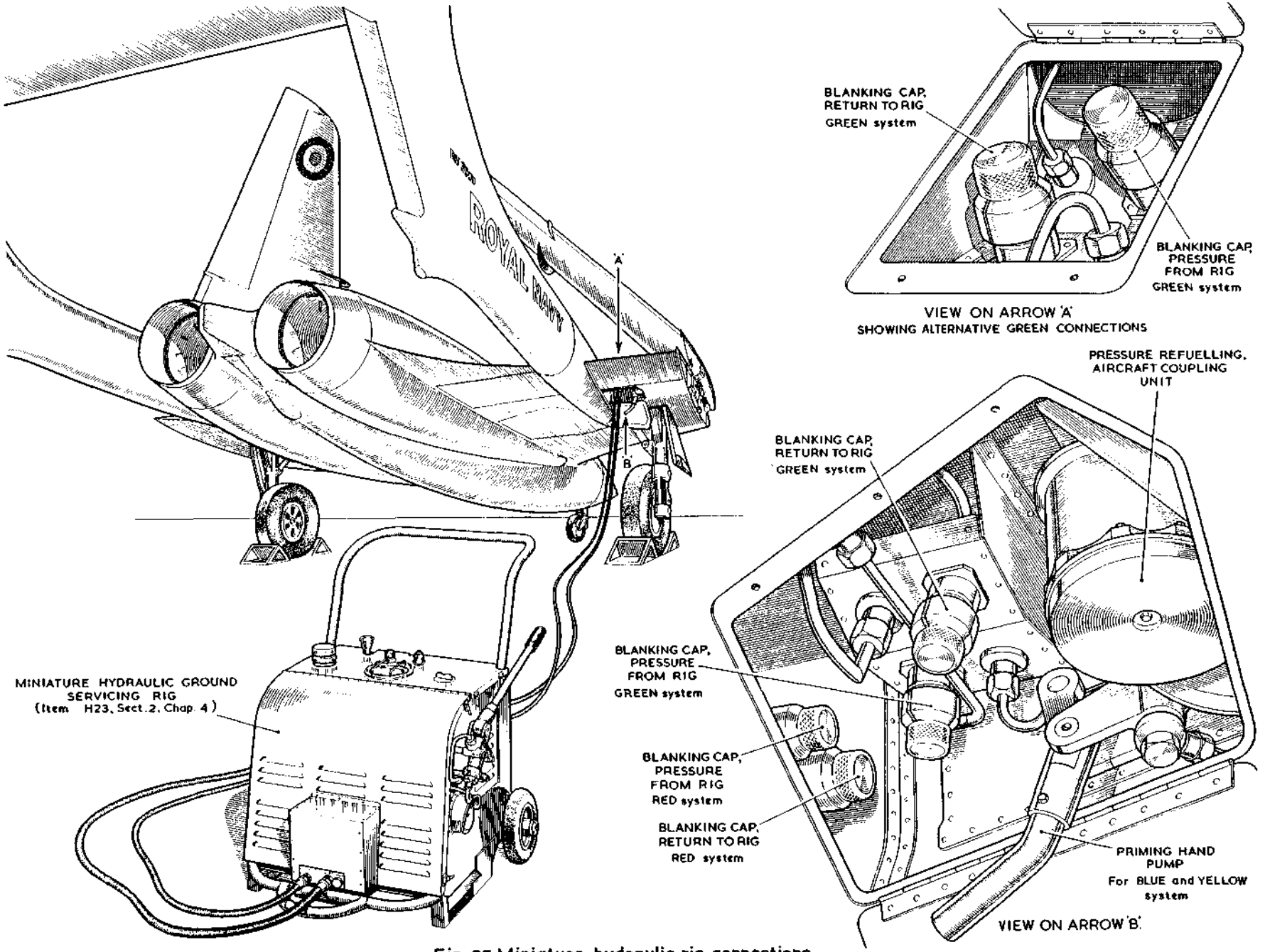

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Fig. 25 Miniature hydraulic rig connections

◀ Annotation ▶

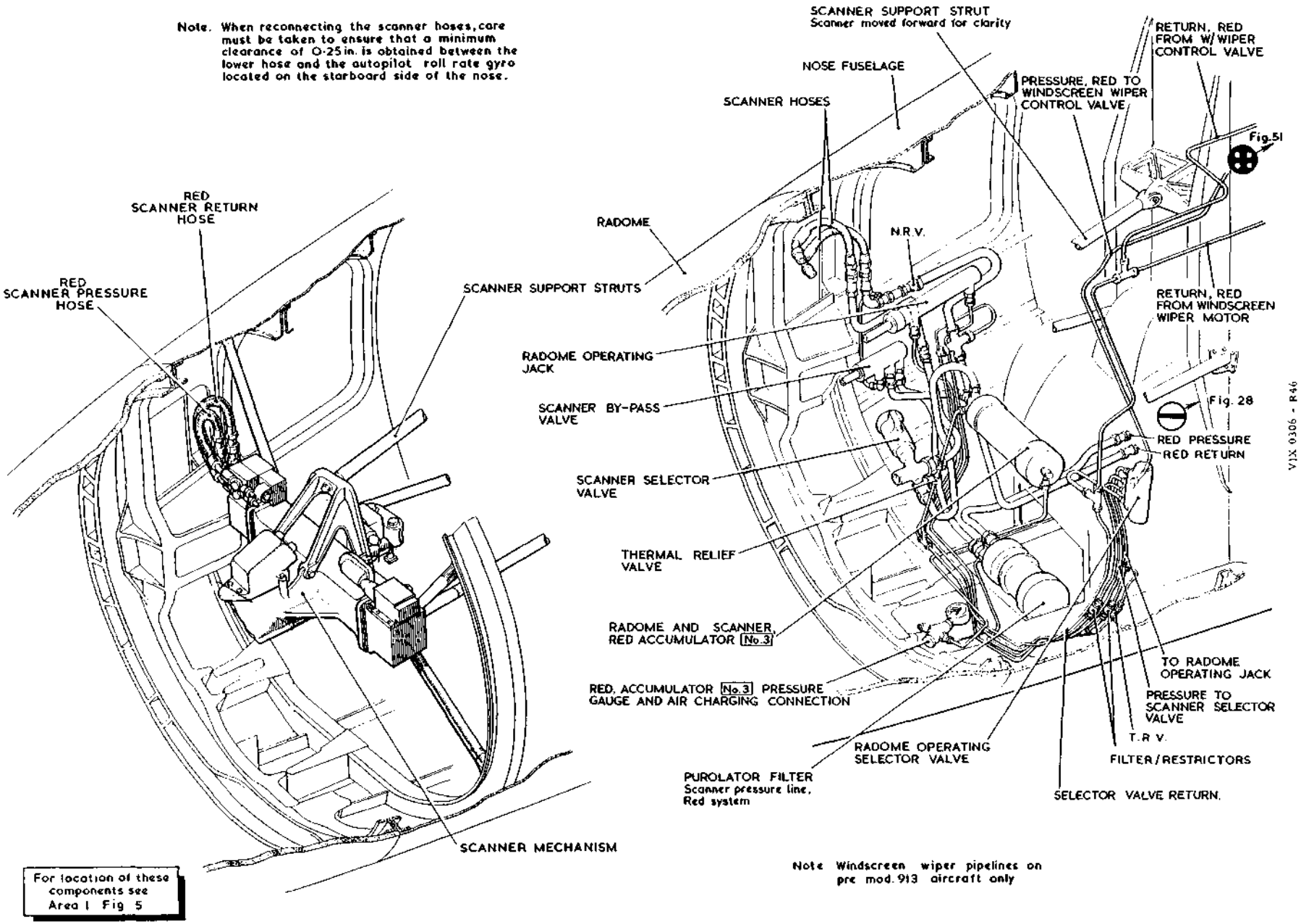


Fig.26 Hydraulics in nose fuselage (pre mod. 1080)

◄ Amendment and mod. 826 ►

then dumped overboard. The level is thus automatically controlled. As an additional safeguard to avoid low levels due to false overflow indications, a sight glass has been added to enable the operator to check the level visually (mod.1184). Checking is facilitated by an additional lamp and a transparent panel inset in the access panel in the rear wall of the wheel-well.

Note ...

The wings must be folded when the reservoir is filled, but the other services can be in any position. An initial overflow when the replenishing can is connected is not to be taken as an indication that the reservoir is full. Always check the level on the sight glass when fitted. The mark on the sight glass shows the correct level, when the wings are folded, all accumulator and reservoir pressures released and the wheels are on the ground.

Accumulators

71. Seven accumulators serve the RED and GREEN systems :-

No.1 RED	Wheel brakes
No.2 RED	Main supply
No.3 RED	Scanner and radome
No.4 RED	Arrester hook
No.1 GREEN	Main supply
No.2 GREEN	Rocket installation
No.3 GREEN	Arrester hook

The accumulators are of conventional pattern, with a floating piston separating the air from the fluid. The positions of the accumulators are shown on Fig.5. Air charging pressures are given in the Leading Particulars and in Table 1.

Pressure gauges

72. All the RED and GREEN accumulators, except those in the arrester hook circuit which are subject to high pressure surges, are fitted with air pressure gauges to indicate their initial air pressure. The gauges also show the hydraulic pressure in the associated circuit when it is operated.

73. Post mod.249 aircraft have gauges in the cockpit to register the hydraulic pressure in the RED main (No.2) and RED brake supply (No.1) accumulators (Fig.16). In pre mod. 249 aircraft the gauges in the same position indicate the pressures in the port and starboard brake lines being applied by the GREEN system. Post mod.249, these pressures are shown on a triple pressure gauge which also shows the pressure in the GREEN main supply accumulator (No.1).

Pressure indicators

74. On pre mod.249 aircraft, indicators are fitted to show a loss in system pressure (Fig.16). The indicators, operated by pressure switches, show WHITE if the pressure drops below 2550 ± 100 p.s.i., and BLACK when the pressure reaches 2700 ± 100 p.s.i.

Ground test connections

75. Hydraulic ground rig connections are provided for the ground testing of the RED and GREEN systems. The couplings for the suction and by-pass lines are on the pumps and the pressure line is on the rear firewall (Fig.12). Access is gained by opening the gearbox rear cowling (Panel S, Fig.7, Sect.2, Chap.4).

76. Emergency connections can be made, using the miniature ground rig (H23, Sect.2, Chap.4), at the starboard flap shroud (Fig.25). The primary purpose is to provide power to fold the wings on a crashed aircraft or to replenish the wheel brake accumulator, although the rig may be used to operate any of the RED and GREEN services.

77. Quick-release couplings to RED and GREEN systems are provided adjacent to the priming equipment at the starboard underwing refuelling point; a panel on the top surface of the centre section at the same position gives access to an alternative pair of couplings for the GREEN system (Fig.25). The hydraulic system is designed to use micro-filtered fluid and every care must be taken that the aircraft and rig couplings are scrupulously clean before use.

Scanner circuit (Fig.26)

78. The scanner is operated by the RED system pressure; the pressure supply passes first through a micro-filter and then to the scanner via a by-pass valve and an electro-hydraulic stop valve. An accumulator (No.3) provides reserve pressure, and the

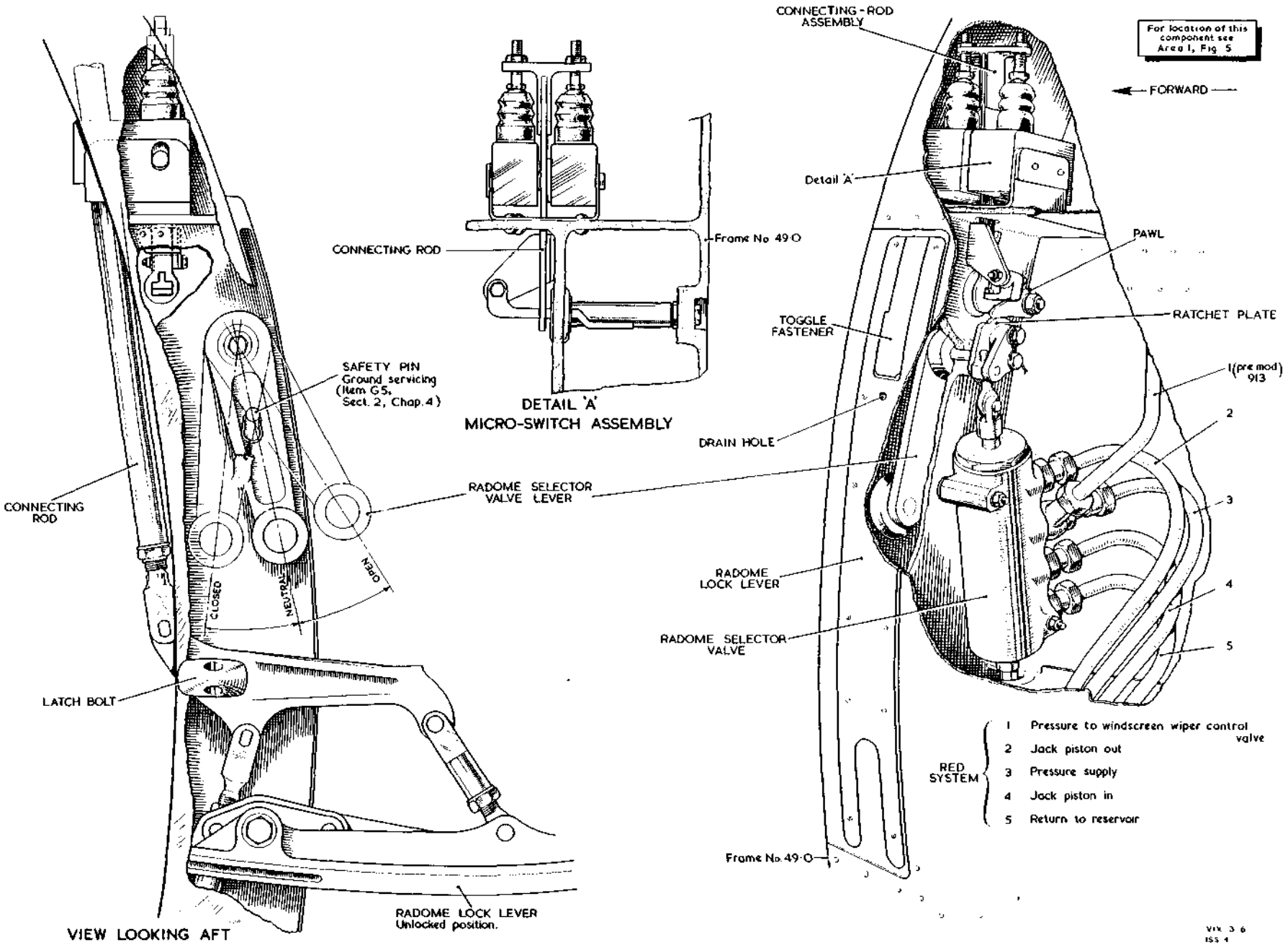


Fig.27 Radome selector valve assembly (pre mod. 930)

◀ Microswitch assembly ▶

circuit is protected by a thermal relief valve. Return fluid passes through a non-return valve, magnetic filter and the RED heat exchanger before joining the common RED return to the reservoir.

79. The by-pass valve is a safety device to prevent the scanner being accidentally operated while the radome is open and personnel are working there.

80. The radome mechanical locking mechanism is connected to the by-pass valve and automatically makes the scanner "safe" when the radome is open by opening the by-pass valve and exhausting the RED accumulator (No. 3). For test purposes, however, the radome lock lever on the fuselage port side can be closed while the radome is open, which will close the by-pass valve and permit normal scanner operation (fig. 27). An air charging point and pressure gauge for the accumulator are situated in the front of the nose compartment, and are readily accessible with the radome open. Micro-switches energize warning indicators when the radome is not locked (Sect. 5, Chap. 1).

WARNING . . .

The scanner can inflict serious injury, and adequate safety precautions must be taken if it is operated with the radome open.

Radome circuit

81. On pre-mod. 1080 aircraft, the radome is opened and closed hydraulically by a jack fitted on the starboard side of the nose bay. The circuit uses RED system pressure and is controlled by a selector valve on the port side of the nose bay (fig. 26). The selector operating lever is only accessible when the radome lock lever is pulled down and the latches are unlocked. The selector lever has three positions; CLOSED, NEUTRAL, and OPEN. The lever can be locked in the NEUTRAL position by a safety pin (Item G5, Sect. 2, Chap. 4) to prevent inadvertent closing of the radome.

82. On post-mod. 1080 aircraft, the radome is opened and closed manually, but has an independent hydraulic damper system comprising two relief valves, two non-return valves, an accumulator, a charging block, and a damper in place of the jack.

83. Further details of the radome operating mechanism and radome damper system are given in Sect. 3, Chap. 1.

Windscreen wiper installation (fig. 50)

84. On aircraft not using the air blast system of rain shedding, a windscreen wiper is fitted to the port front windscreen panel. The wiper is operated, through mechanical linkage, by a Dunlop hydraulic wiper motor. The speed of the wiper is controlled, from "Park" to "Max. speed", by a Dunlop control valve, which is connected by cables to a lever in the cockpit (fig. 51). The system is operated by RED pressure, which is taken from and returned to, pipelines adjacent to the radome selector valve.

Rocket installation (fig. 28)

85. The under-fuselage rocket installation consists of two retractable rocket carriers, located one to port and one to starboard of the nose wheel bay; each rocket carrier is raised and lowered by its own hydraulic jack, the jacks receiving their power supply from the GREEN system. When the electro-hydraulic selector valve is energized to put the rocket carriers down, GREEN system pressure is applied to the large area side of the jacks, and they extend; flow restrictors are fitted in the pipe lines to the large and small area sides of each jack piston. When mod. 1265 is embodied, the electrical operation of the carriers is deleted, and they can only be lowered by operating the selector manually.

86. With the rocket carriers retracted, full GREEN system pressure (backed by the rocket system accumulator No. 2) is permanently applied to the small area side of the jacks; should the GREEN pump or main system pressure fail, a non-return valve, in the pressure feed line to the jacks and the accumulator, ensures that hydraulic pressure is available for operation of the rocket installation.

87. To prevent inadvertent retraction of the rocket carriers, a locking pin (Item K100, Sect. 2, Chap. 4), can be fitted to the electro-hydraulic selector valve, ensuring

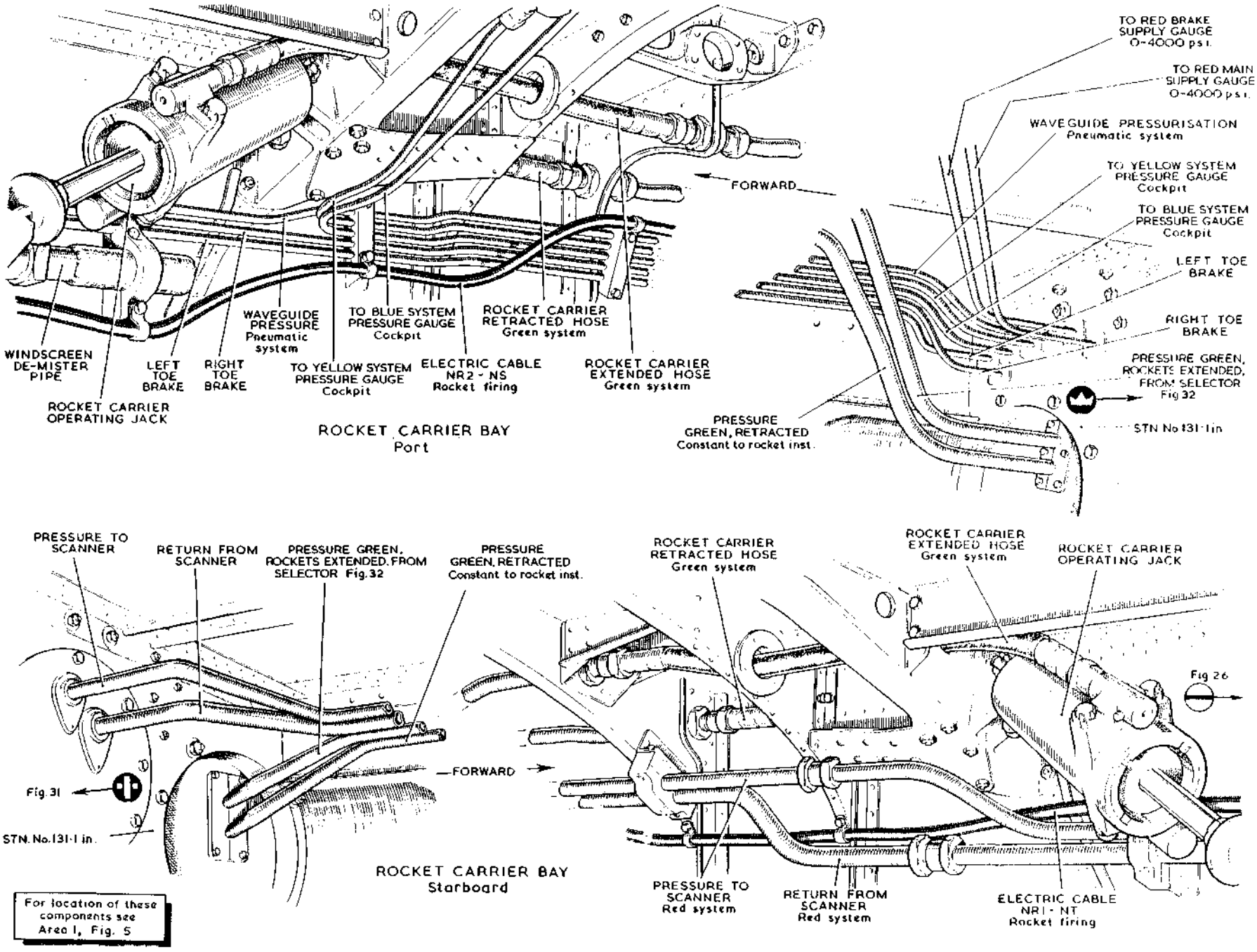


Fig. 28. Hydraulics in rocket carrier bays

that the installation remains extended. As an additional safeguard, safety locks (Item K33, Sect.2, Chap.4) can be fitted to the jacks (Fig.57).

Air brake circuit

88. The under-fuselage air brake is operated by a single large jack which uses GREEN pressure only. The electro-hydraulic selector valve is mounted on the port under-wing shear panel (Area 5, Fig.5) and is operated by a switch on the throttle control hand-grip, which allows it to be trimmed in any desired position shown by an indicator on the main instrument panel. The jack is extended for air brake OUT.

89. If the air load on the air brake becomes excessive to the point of structural overload, a relief valve in the air brake OUT line opens at 2000 p.s.i. and relieves the pressure through the GREEN heat exchanger to the reservoir. Because the valve will relieve continuously when the air brake is OUT, the fluid will overheat, and during ground tests the air brake must not be left OUT for more than 5 mins. with pressure being applied.

90. There is an emergency manual override on the electro-hydraulic selector valve, which is operated by a lever on the port console connected to the valve by a cable run, and, when operated, mechanically moves the selector valve to the air brake closed position. There is no manual override selection for air brake open.

91. A pressure maintaining valve, set at 2300 p.s.i., is fitted in the air brake circuit to prevent the operation of the air brake from lowering the GREEN system pressure sufficiently to cause the Firestreak alternator frequency to drop more than the permitted 3%.

92. The fully extended air brake projects below the landing wheels when the alighting gear is down, therefore it is arranged that the air brake is automatically selected closed when the nose undercarriage is locked down. If the air brake does not close, the RED nose undercarriage indicator light will be lit. A switch in the air brake bay permits the air brake to be partially extended for test or access. On pre mod.1030 aircraft, a 50/60 deg. selector switch (locked at 50 deg.) is fitted in the cockpit (Item 13, Fig.16).

93. To prevent inadvertent retraction of the air brake a ground lock (Item A2, Sect.2, Chap.4) is supplied, to be fitted to the ground/flight switch. As an additional safeguard a safety sleeve (Item A1, Sect.2, Chap.4) can be fitted to the air brake jack.

Heat exchangers (Fig.29)

94. A fluid/fuel heat exchanger is fitted in the GREEN and RED return lines to the main reservoir, both heat exchangers being of equal capacity. The normal function of the heat exchangers is to cool the high temperature hydraulic fluid returning to the main reservoir from the alternators, the scanner, the by-pass fluid from the RED and GREEN engine-driven hydraulic pumps and the 2000 p.s.i. relief valve in the air brake circuit. Fuel passes through the matrix of each heat exchanger and heated hydraulic fluid is circulated through the body, the heat of the hydraulic fluid being absorbed by the fuel.

95. The second function of the heat exchangers is to raise the temperature of the fuel, thus preventing or dispersing minute ice particles caused by water precipitated under very low temperature conditions. This is achieved by raising the normal temperature of the hydraulic fluid before it passes through the heat exchanger. The temperature is raised by a heater valve which is under the control of the pilot.

Heater valves

96. A heater valve is installed close to each heat exchanger in the RED and GREEN systems. Hydraulic fluid is passed through the heater valve where the system pressure is reduced to return line pressure. The energy lost, due to pressure drop, is dissipated in the form of heat. The rate of increase in the temperature of the fluid is in proportion to the rate of flow through the heater. The heater valves can be controlled manually or automatically by the hydraulic de-icing switch (Item 16, Fig.16). An indicator adjacent to the switch shows WHITE when icing is occuring.

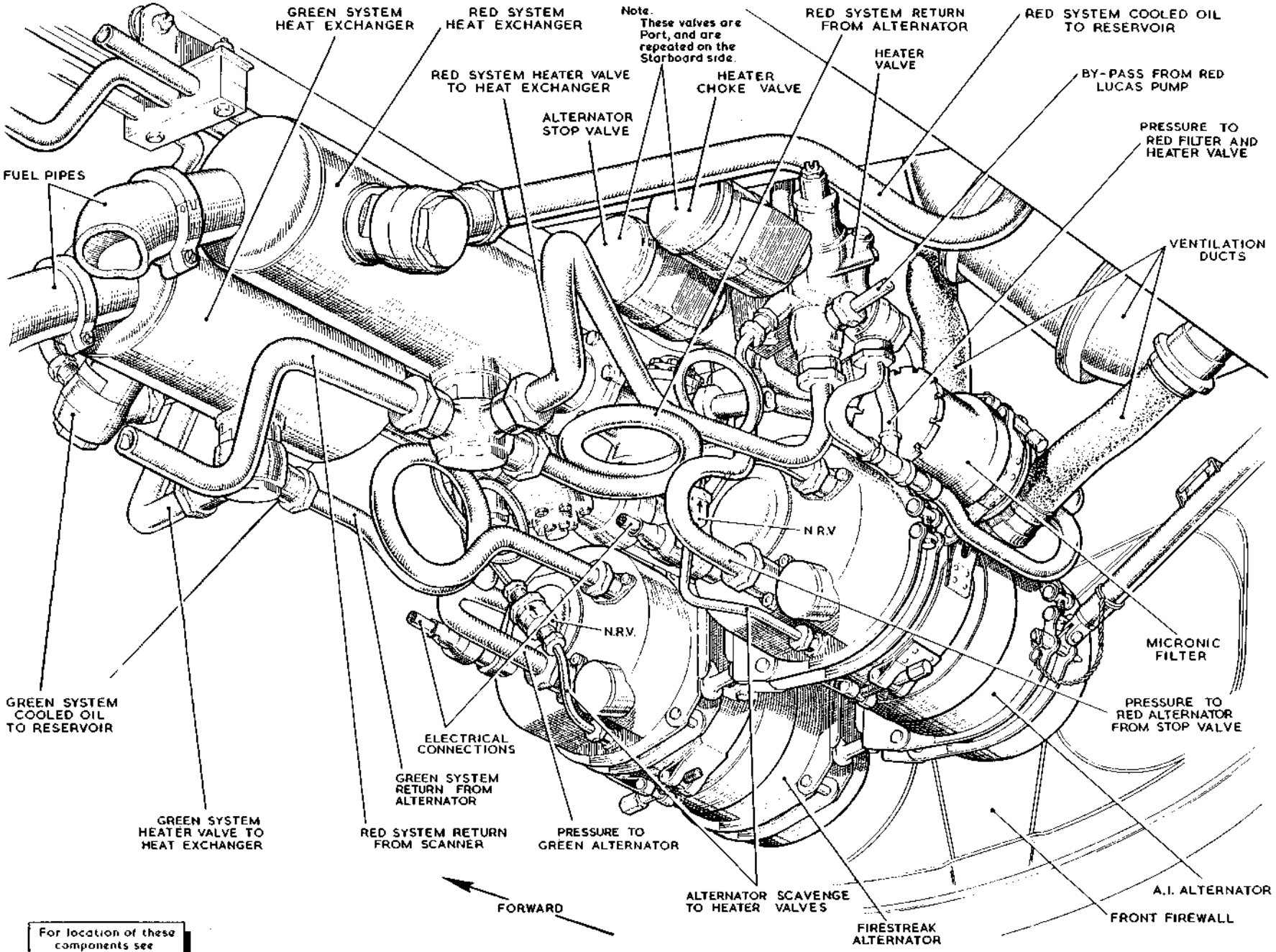


Fig.29 Installation of alternators and heat exchangers

97. If the fuel temperature rises above 40 deg.C, a temperature controlled by-pass valve, in the engine fuel line, diverts part of the fuel flow to the wing tanks. This increases the fuel flow and reduces the fuel temperature (Sect.4, Chap.2). A secondary function of the heater valve is to heat the hydraulic fluid before the alternator circuits are switched on. The fluid temperature must be above 10 deg.C, and below 80 deg.C for the correct functioning of the alternators. Thermometer bulbs, (Fig.20) fitted in the RED and the GREEN compartment of the reservoir, sense the temperature shown on gauges on the starboard side of the observer's cockpit.

Wing-fold circuit (Fig.30)

98. The wing-fold circuit consists of the two wing-fold jacks and their associated sequence valves and latch pin jacks. The selector valve is mounted on the outboard face of the starboard rib No.1 and is accessible through the wheel well.

99. The wing-fold selector lever is on the starboard console, and is connected to the selector valve by a pulley and a cable run. The wing-fold and pin jacks are retracted for wings spread, and operate on GREEN system pressure only. Micro-switches energize warning indicators if the locks are not properly engaged (Sect.5, Chap.1). A mechanical lock (Fig.16, Sect.2, Chap.1) allows one wing at a time to be hydraulically folded.

Alighting gear circuit

100. The alighting gear circuit is controlled by a lever on the port side of the pilot's instrument panel. The selector valve is mounted on rib No.1 in the starboard main plane, and is accessible through the wheel well, the selector lever is connected to the valve by a cable and pulley run (Fig. 49). The main undercarriage door Servodyne has an integral valve which is controlled by linkage from the main undercarriage to operate the door in the correct sequence, i.e., DOWN selection - door down, leg down, door up. UP selection - door down, leg up, door up (Fig.23).

101. The selector lever on the instrument panel has positions for UP, DOWN and EMERGENCY DOWN (Fig. 52). The lever knob has to be pulled out and rotated clockwise and pushed in again to select to the EMERGENCY DOWN position. The lever must be returned to normal DOWN before the knob is turned anti-clockwise to its normal position after emergency selection.

102. A solenoid lock prevents UP selection when the weight of the aircraft is on the wheels, but if the selector lever knob is rotated as above when selected DOWN, this will override the solenoid and permit UP selection in an emergency, e.g., brake failure.

103. The main and nose undercarriage jacks are retracted for undercarriage DOWN and the door Servodynes extended for door OPEN. Normal operation is from the GREEN system. RED pressure is used for emergency DOWN, but cannot be used to retract the undercarriage. A description of the undercarriage, together with rigging instructions is given in Sect.3, Chap.5.

Wheel brake installation

104. Dunlop plate-type wheel brakes with Maxaret anti-skid units are fitted to the main undercarriage wheels. The brakes are controlled by a brake control valve which is connected to a lever in the cockpit by a cable run. There are three alternative positions for the lever, NORMAL, EMERGENCY and PARK.

105. NORMAL braking is via rudder pedal master cylinders and the brake control valve. The master cylinders are filled with hydraulic fluid and act as miniature jacks to transmit both the required braking force and the differential braking force to the brake control valve (mounted in area 2, Fig. 5). The pressure from the pedal cylinders operates selectors within the control valve, and GREEN brakes system pressure is transmitted from the control valve to the Maxaret unit and then to the port and starboard wheel brake jacks in the proportions determined by the operation of the master cylinders. Gauges in the cockpit record the pressure at each wheel only when using GREEN system pressure, i.e., normal braking.

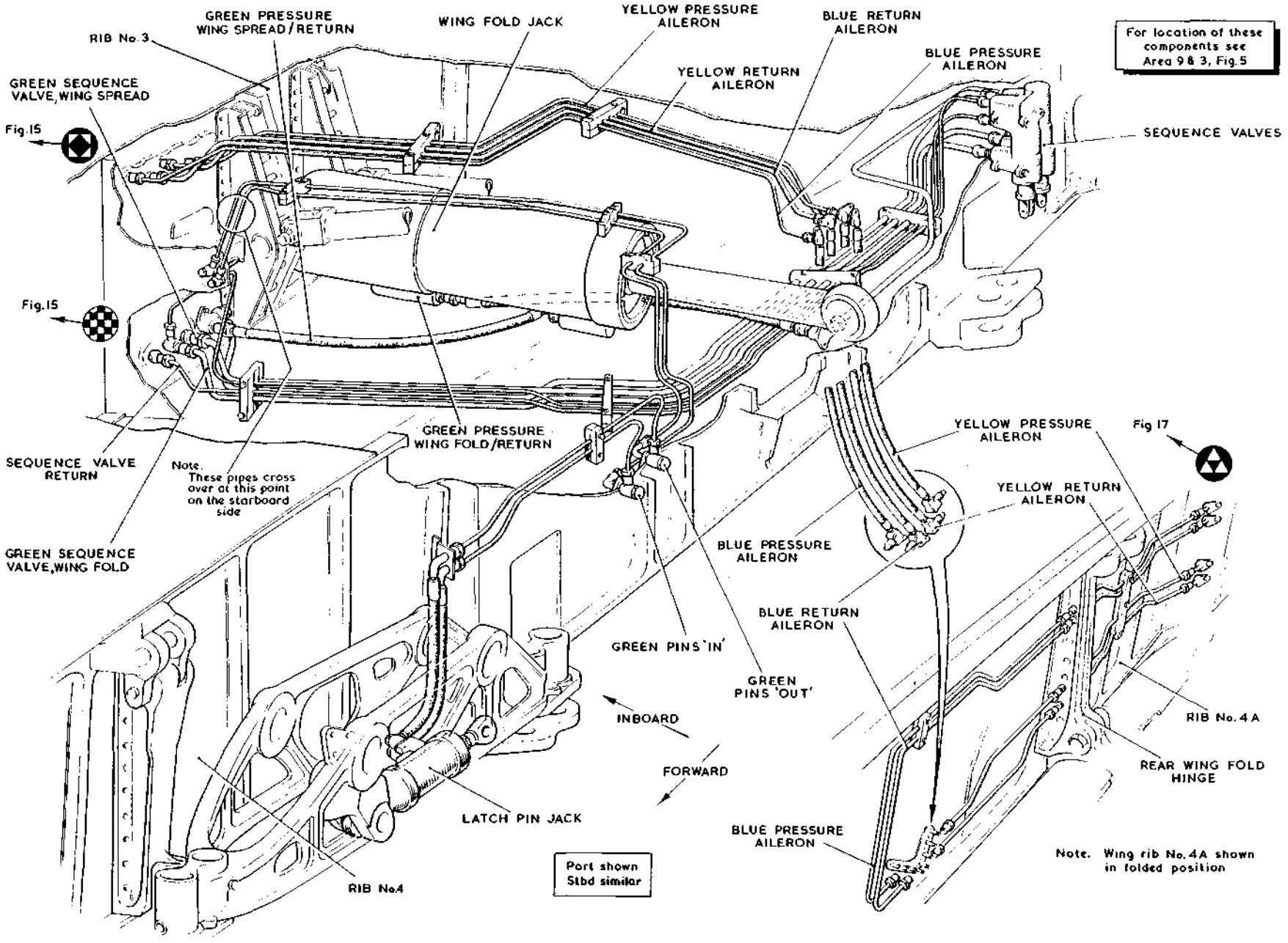
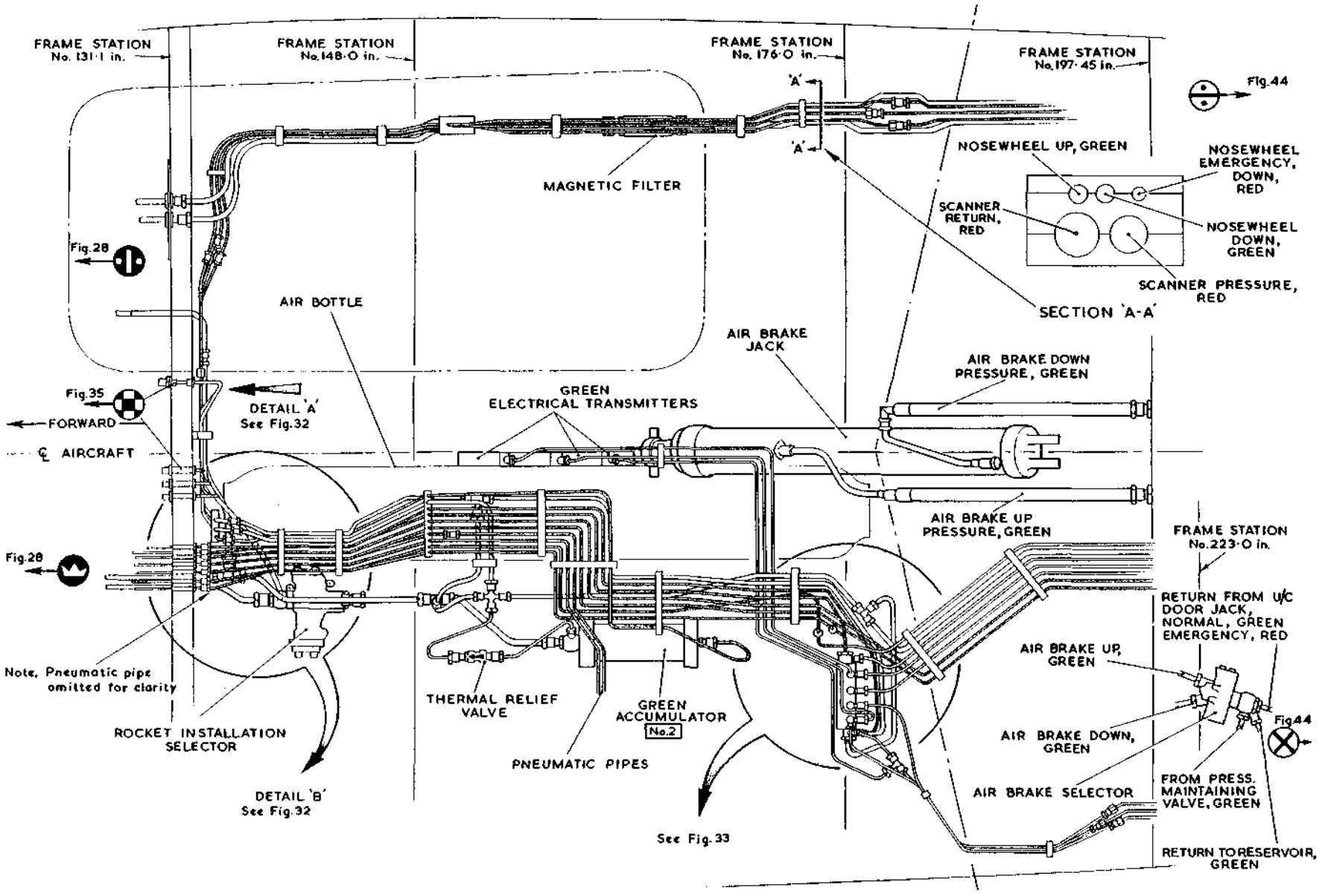


Fig.30 Wing to centre section hydraulics

◄ Annotation ►



For location of these components see Area 2 Fig. 5

Fig. 31 Hydraulic pipe runs under cockpit floor (1)

◀ Continuation symbols. ▶

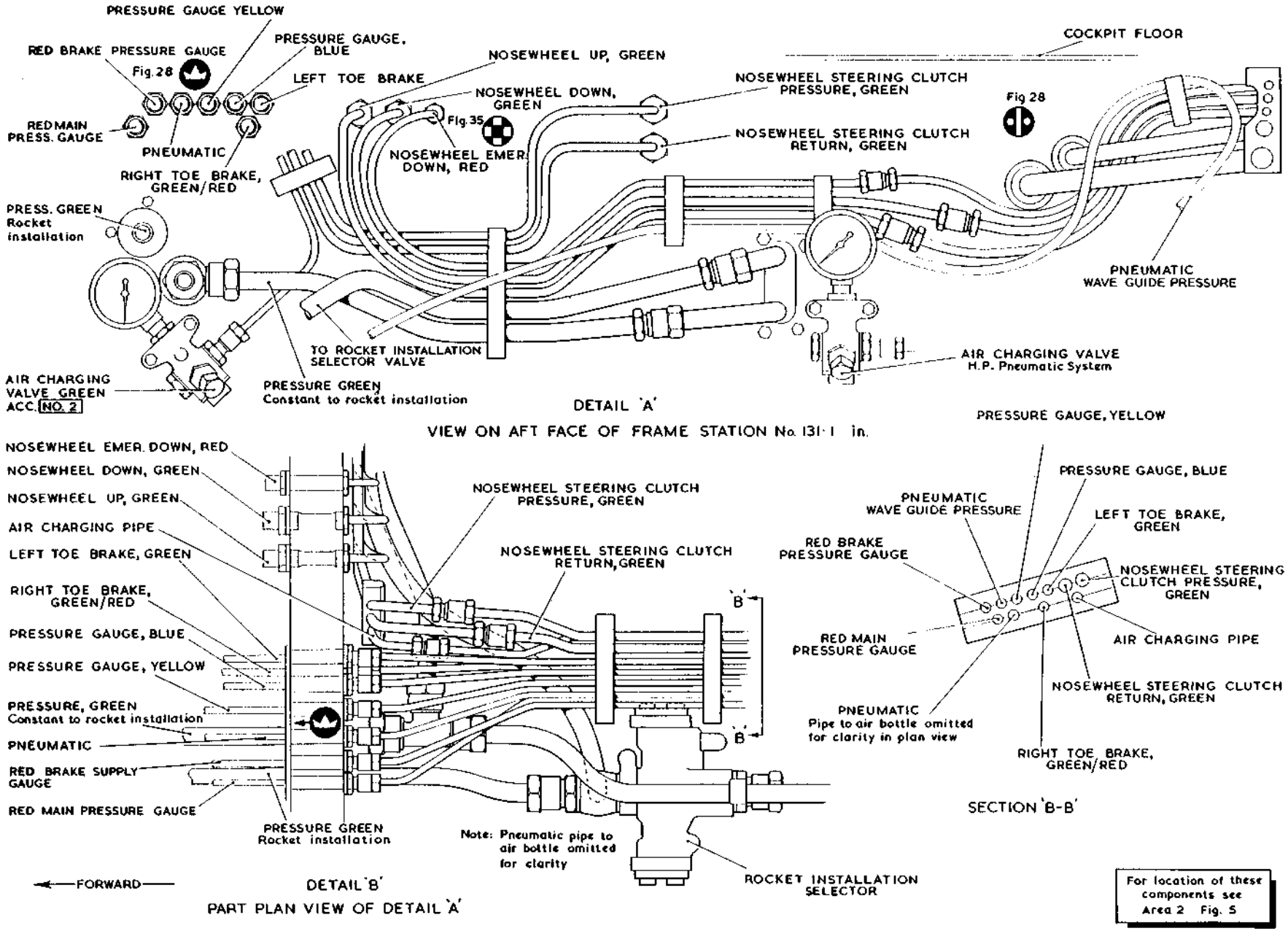


Fig.32 Hydraulic pipes under cockpit floor (2)

◀ Continuation symbols ▶

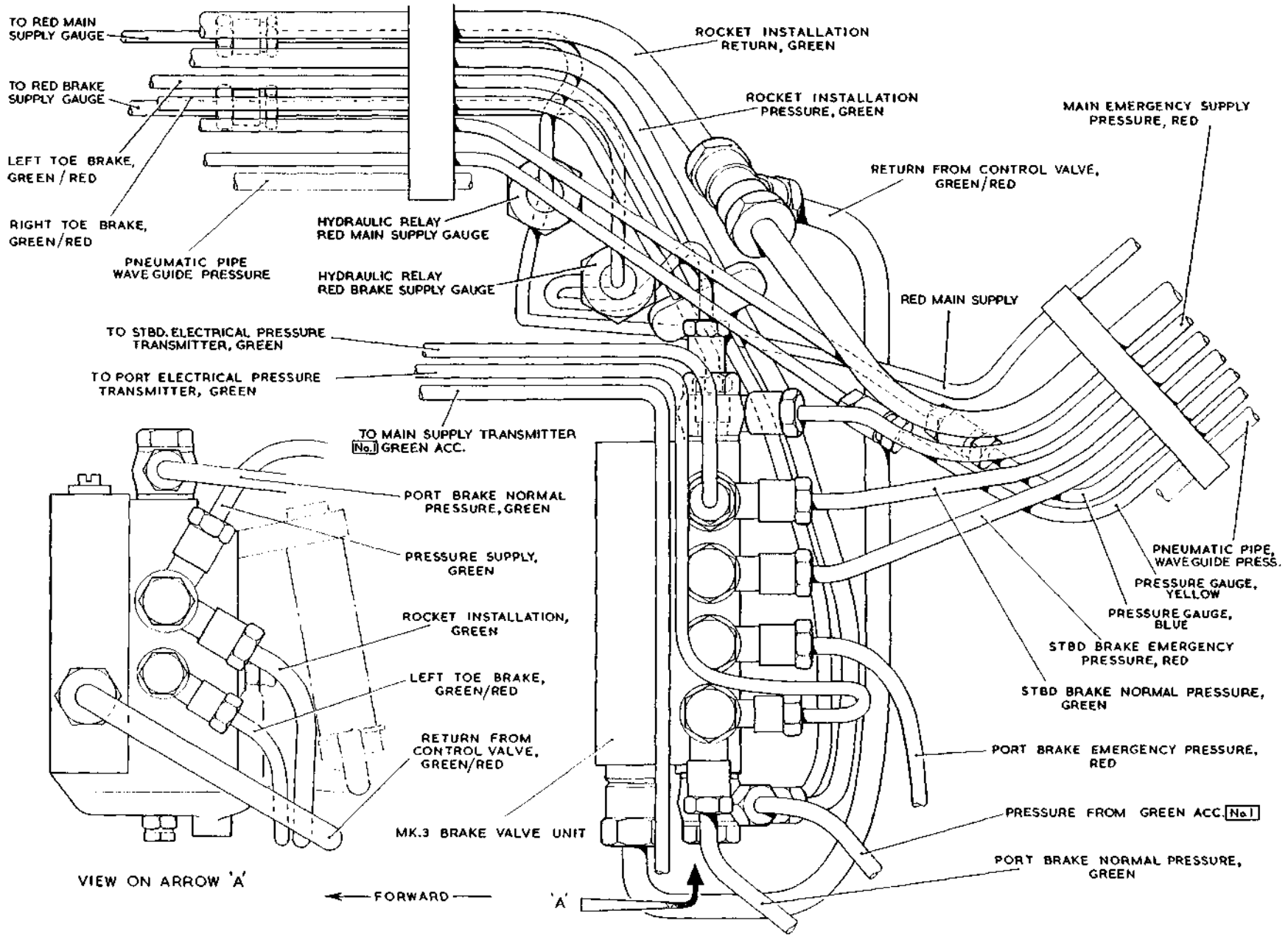


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Fig. 33 Hydraulic pipe runs under cockpit floor (3)

◀ Annotation ▶

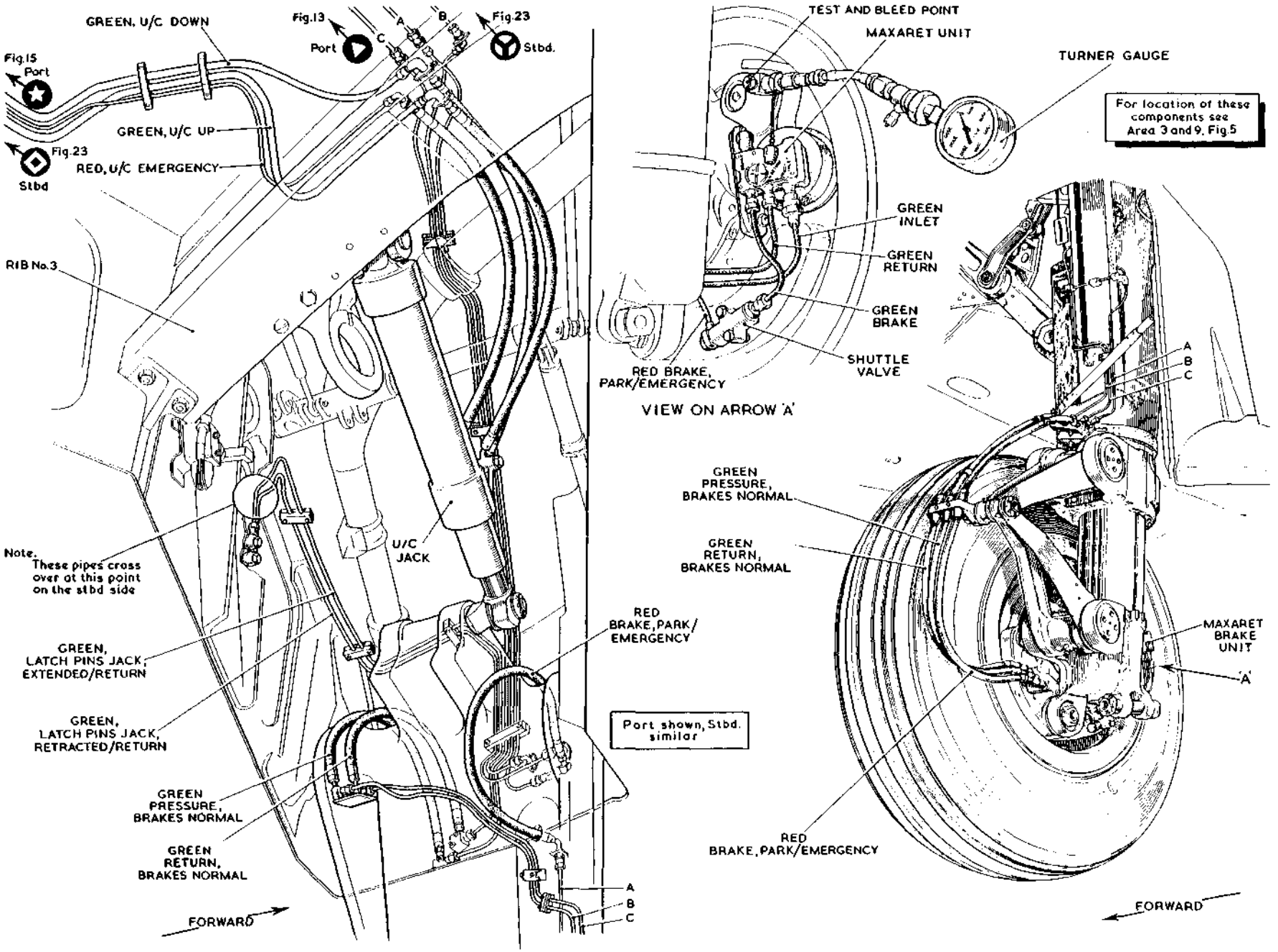


Fig.34 Hydraulic pipe runs, wheel well and undercarriage leg

◄ Maxaret pipelines - mod 671. ►

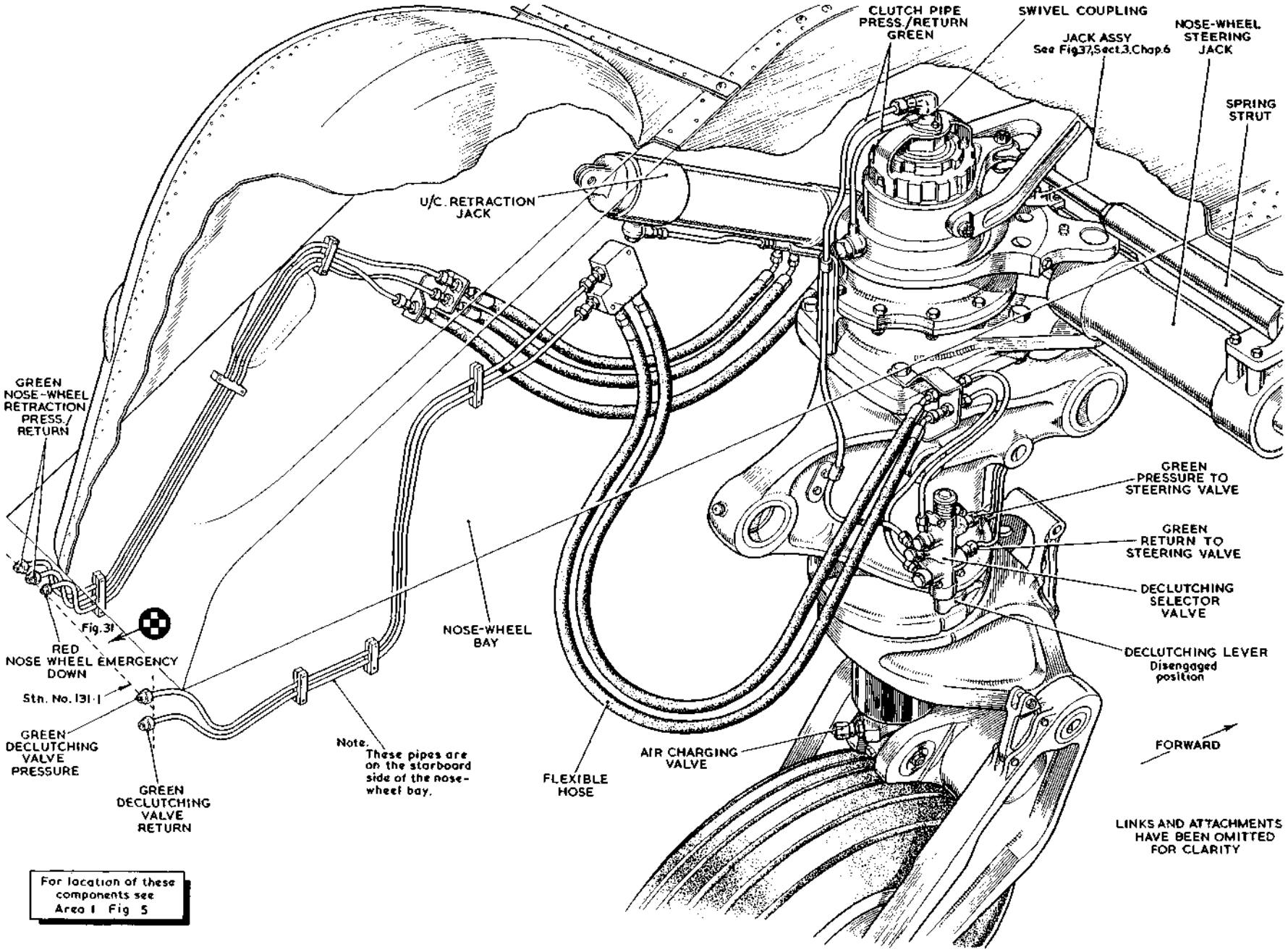
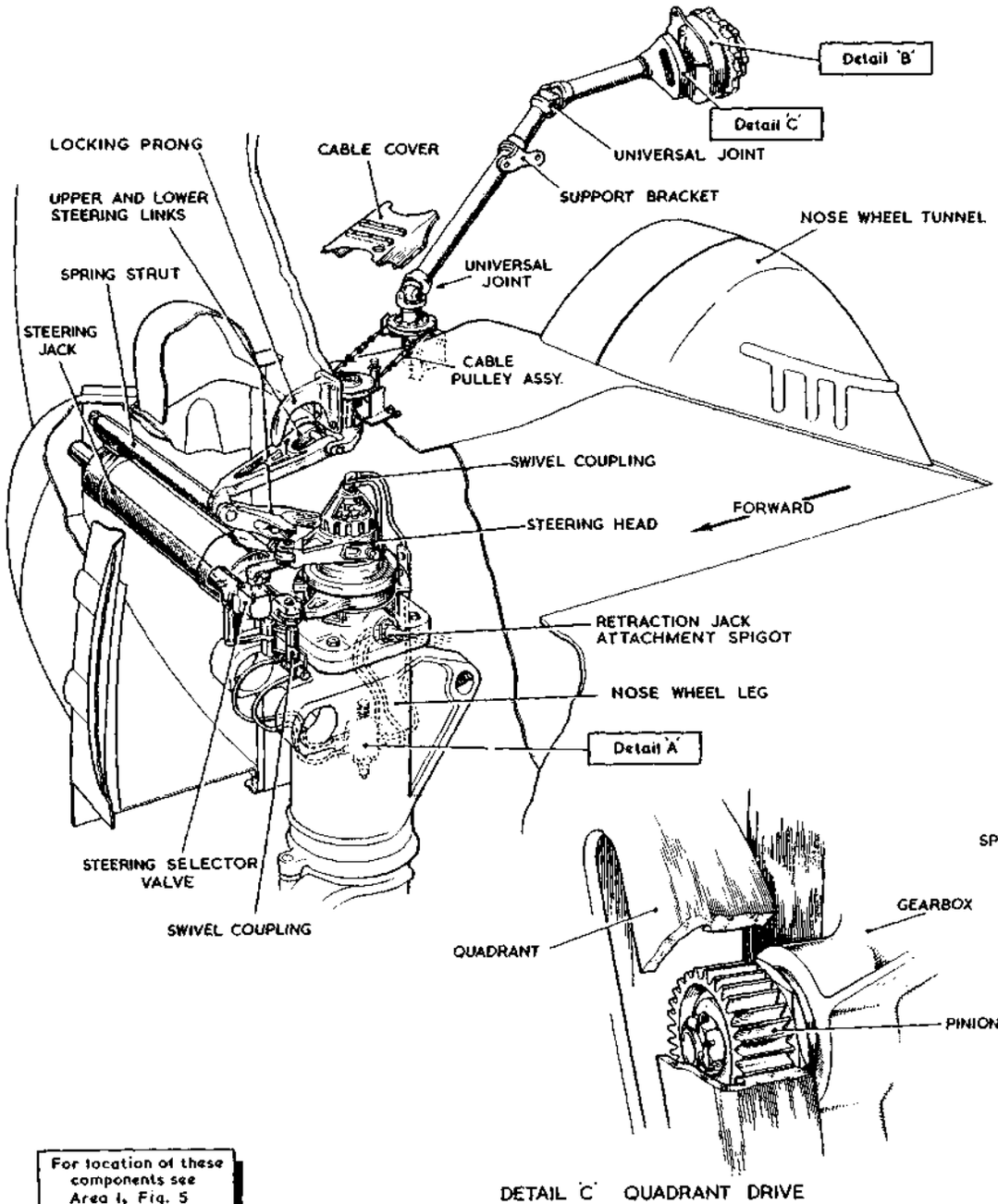
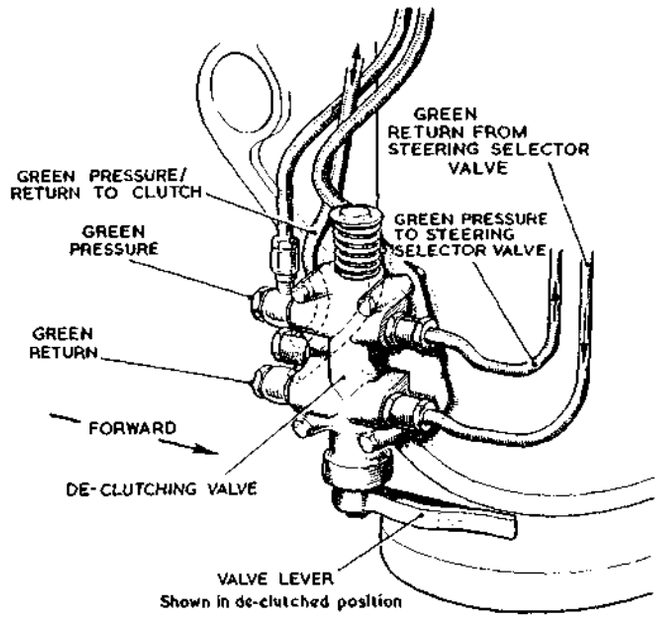


Fig.35 Hydraulic pipe runs, nose wheel and bay

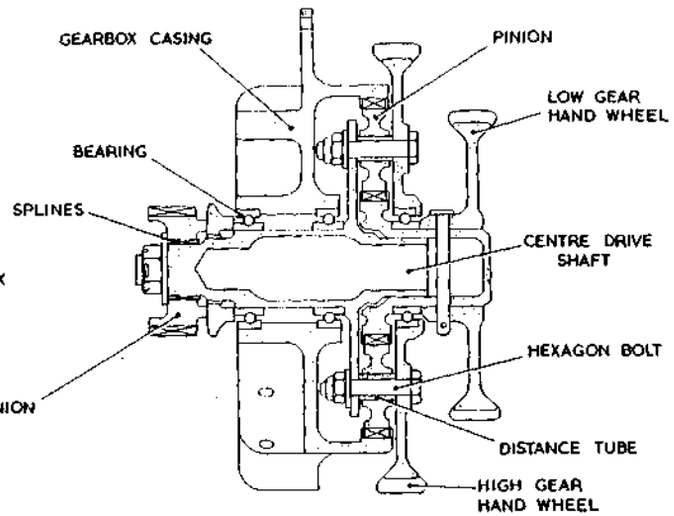
◀ Declutching valve pipelines - mod. 1070. ▶





DETAIL 'A'
DE-CLUTCHING VALVE

DETAIL 'C' QUADRANT DRIVE



DETAIL 'B'
GEARBOX SECTION

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For location of these components see Area 1, Fig. 5

Fig. 36 Nose wheel steering mechanism

◄ Declutching valve pipelines - mod 1070 ►

106. Operation of the lever to EMERGENCY selects the control valve to the RED system, and braking and differential control is from the pedal master cylinders as with normal braking. Separate pipe runs from the control valve to the wheels are used for the GREEN (normal) and the RED (emergency) pressure (Fig. 34).

107. When RED emergency pressure is used, it operates a shuttle valve which seals off the GREEN pressure line and the Maxaret units, and the RED pressure passes straight to the brake jacks. In addition to the RED system accumulator (No. 2) there is an additional accumulator (No. 1) in this system which supplies the wheel brakes only; this accumulator is separated from the RED system accumulator by a N.R.V.

108. When the lever is selected to PARK, the rudder pedal master cylinders and the normal differential braking mechanism are by-passed, and slightly less than the full aircraft RED system pressure is applied to the brake jacks, using the RED emergency brake pipe circuit and by-passing the Maxaret units. PARK is used for parking and for engine run-up when maximum braking effort is required.

Note . . .

During engine run-up the wheels can be held locked when selected to PARK, and tyre adhesion becomes the limiting factor.

109. The rudder pedal master cylinders are filled with hydraulic fluid of the same specification as that used in the aircraft main systems (Leading Particulars) and must be filled and ◀ bled as directed in para. 141a.▶ The Maxaret unit and brake lines must be carefully bled if the system has been broken down.

Nose wheel steering (fig. 35)

110. The nose wheel may be steered up to 45 deg. either side of central by steering mechanism mounted on the top of the non-rotating portion of the nose wheel leg.

111. A steering selector valve is attached to the front of the nose wheel head, and is operated by a two-speed gearbox mounted on a panel on the pilot's starboard side. The gearbox has two hand wheels, the smaller giving fine, and the larger coarse control; the gearbox is linked to the selector valve on the steering head by torque tubes, and a cable and pulley run (Fig. 36).

112. Operation of either of the hand wheels in the cockpit moves the steering selector valve port or starboard, and the nose wheel is rotated in the same direction in which the valve is moved. The selector valve ports are sealed off in a normal follow-up action and the nose wheel is hydraulically locked in the selected position.

113. The oleo leg passes through the leg casing into a clutch mechanism in the head, and is connected via splines and the clutch to an operating jack on the outside of the leg casing. The jack extends or retracts in response to the supply from the selector valve. Extension and retraction of the jack, being fixed to the outer casing, causes the oleo leg and its attached wheel to rotate, full travel being 45 deg. port or starboard of the centre-line.

114. A spring centring strut is fixed to the outboard end of the steering jack and to the fixed portion of the nose wheel casing making the leg self-centring when the hand wheel is released (Fig. 37).

De-clutching valve

115. A de-clutching valve (Fig. 36) is mounted on the lower portion of the nose wheel leg; the valve releases hydraulic pressure from a clutch pressure chamber (Fig. 38) in the steering head, permitting free 360 deg. castering of the nose wheel leg for ground handling and towing. The valve can only be operated on the ground, and is set to the clutch engaged position for take-off; in this position the valve operating lever is lying flush with the leg. A microswitch prevents alighting gear retraction unless the nose wheel is central.

Steering head

116. The steering head is a general term used to describe all the steering mechanism at the top of the nose

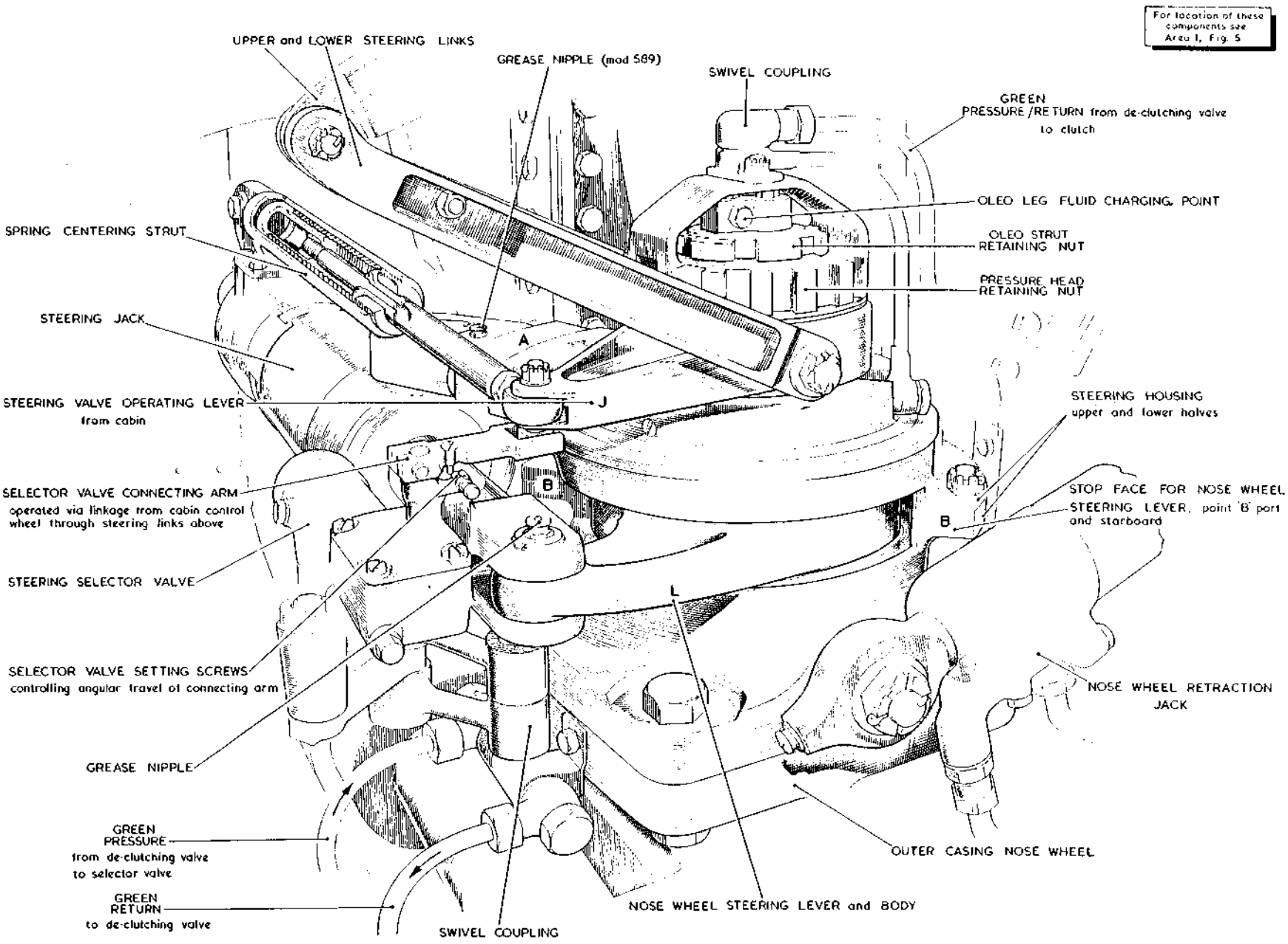
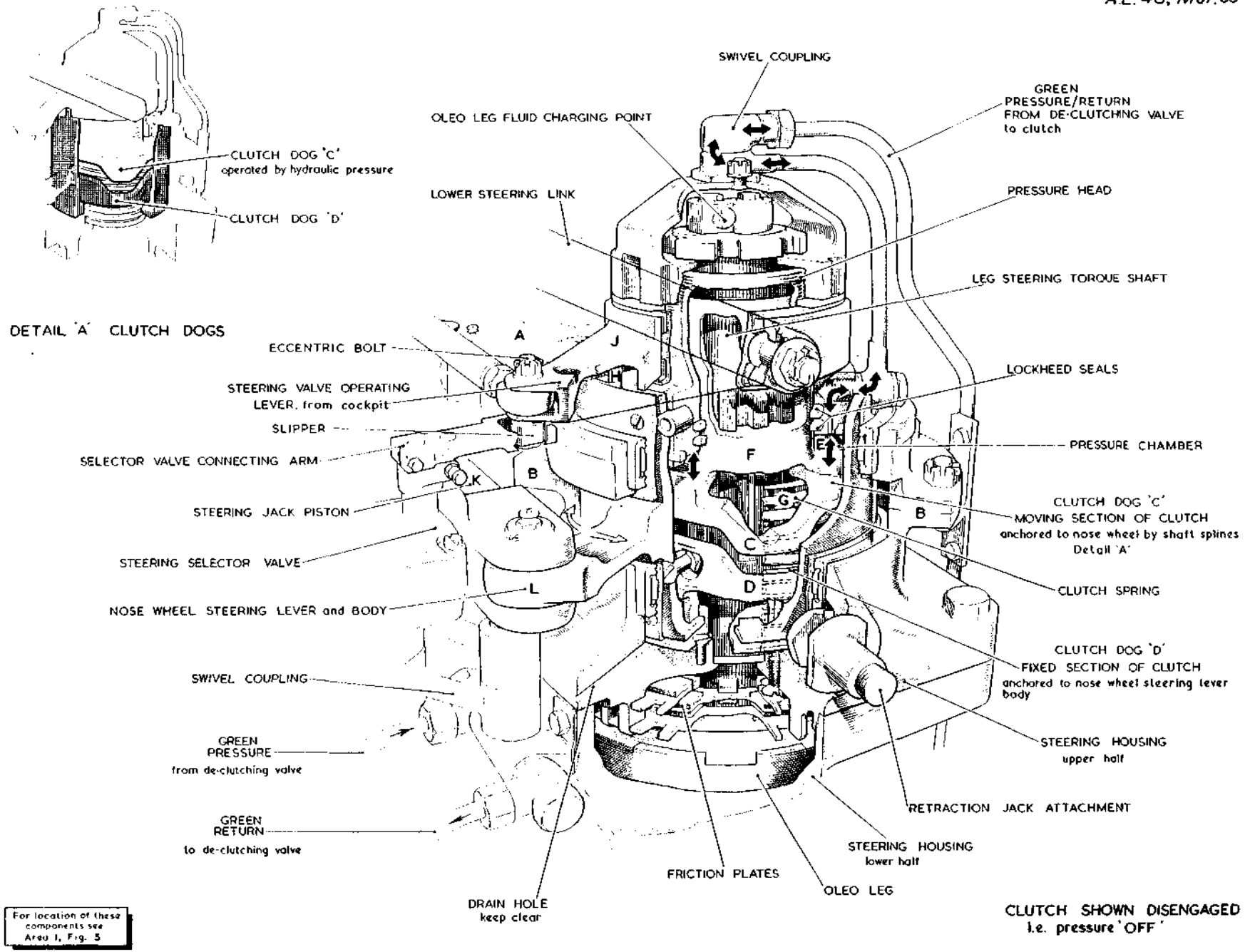


Fig. 37. Nose wheel steering head



For location of these components see Area 1, Fig. 5

Fig.38 Nose wheel steering head (sectioned)

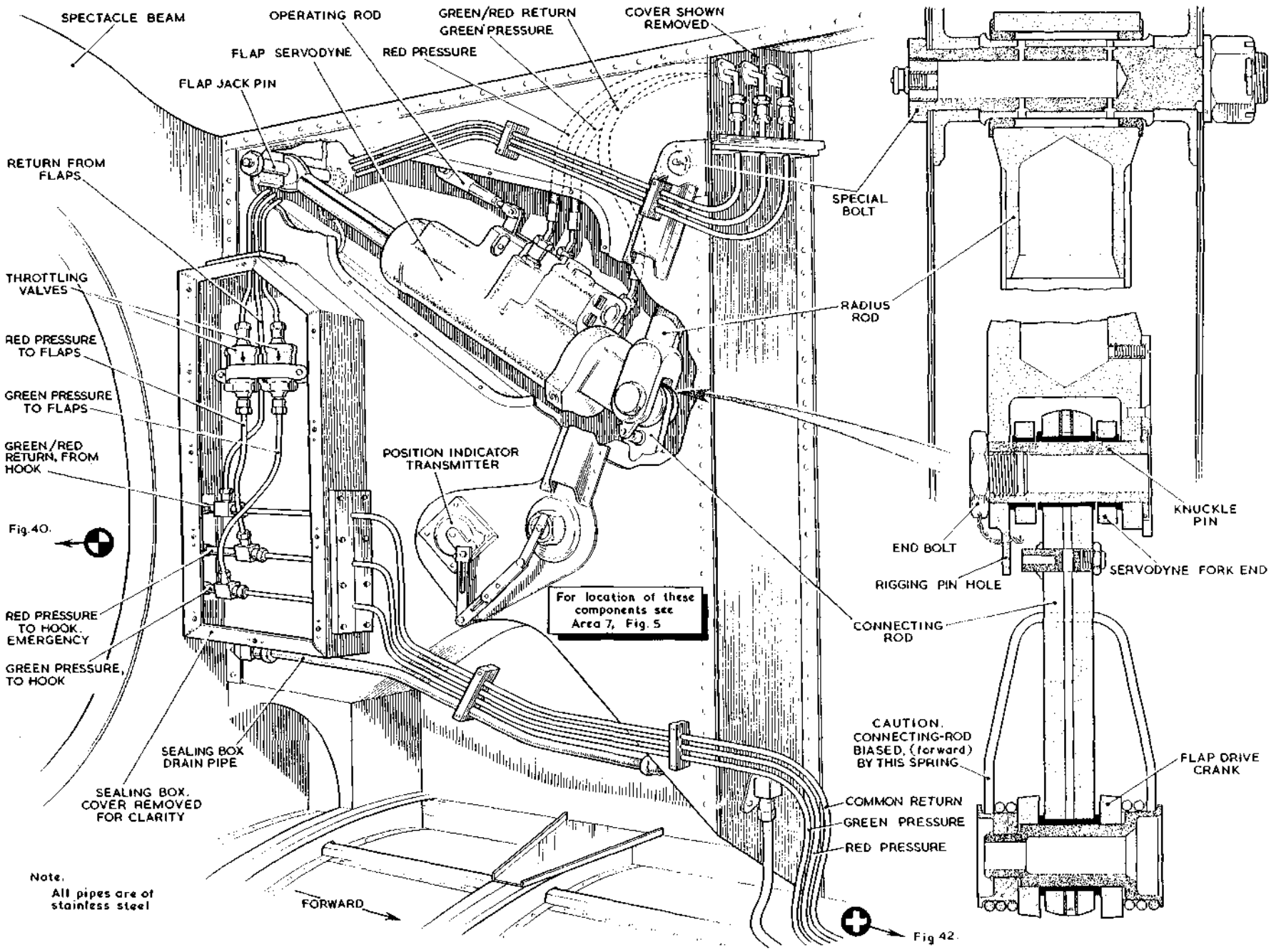


Fig.39 Flap servodyne assembly

◀ Connecting rod and annotation ▶

wheel leg. The steering head is illustrated in a cut-away view on Fig. 38. The head is bolted to the non-rotating part of the nose wheel leg, and externally provides the mounting for the selector valve operating lever and internally houses the hydraulically-operated clutch and the anti-shimmy damping arrangement. The pipes and swivel coupling at the top of the head connect the de-clutching valve on the leg to the clutch pressure chamber within the head.

117. With the system charged, hydraulic pressure in the head holds the clutch dogs C and D (Fig.38) in engagement; when the de-clutching valve is operated it seals off the pressure line to the head, and relieves the pressure within the chamber to the return line, and the clutch spring G then disengages the dogs.

118. The steering valve operating lever J is a free rotating fit on the steering head, and can move within the limits of the slot at point H; this free movement is sufficient to allow the lever J to open the ports on the steering valve when either of the cockpit hand wheels are operated, and the steering jack piston-rod K then extends or retracts according to the direction of selection. Within the steering jack is a pressure relief valve to limit the maximum side loads on the oleo leg and aircraft structure.

119. The drive from the steering jack is transmitted to the nose wheel steering lever body L to which clutch dog D is splined, then to the clutch dog C which is splined to the top of the rotating oleo leg.

120. At the bottom of the steering head is an anti-shimmy friction damping assembly, consisting of Ferodo friction rings and steel plates splined alternately to the steering head and the oleo leg; the friction rings must be free of oil or grease on assembly.

121. A small drain hole at the base of the steering head is provided to drain away any internal seepage of hydraulic fluid; this drain hole must always be kept clear.

Flap circuit (Fig.39)

122. A flap selection lever is located on the aft face of the engine control box on the cockpit port side, and the single Servodyne unit is mounted parallel to the centre-line of the aircraft on rib No.0 between the aft firewall and the spectacle beam, the piston is retracted for flaps down. The selector lever is connected to the servo unit selector valve by a cable and pulley run, and movement of the valve in either direction provides hydraulic assistance in the same direction.

123. Normal operation of the flaps is by pressure from the GREEN system, but a valve within the servo unit body automatically selects RED pressure if the GREEN system falls 500 p.s.i. below RED system pressure.

124. Throttling valves are fitted in the GREEN and RED pressure lines to control the speed of flap operation. A full description of the flap installation together with rigging instructions is given in Sect.3, Chap.2 and Chap.4.

Arrester hook circuit (Fig.40)

125. The arrester hook is controlled by a lever on the port console with selections for UP, DOWN and EMERGENCY DOWN. The jack, selector valve and RED and GREEN accumulators are installed together aft of the spectacle beam; a cable and pulley run connects the cabin selector lever to the valve (Fig.52).

126. Normal operation is from the GREEN system; the RED system provides EMERGENCY DOWN only, which, when selected, operates a shuttle valve within the jack and seals off the GREEN system pressure line. The separate accumulators for the RED and GREEN circuits (fitted between the selector valve and the retraction jack) absorb the surge caused when the hook partially retracts on landing, and provide a pressure reserve to put the hook down quickly after bounce.

127. A relief valve within the piston head of the jack allows fluid to pass from the piston rod side to the head

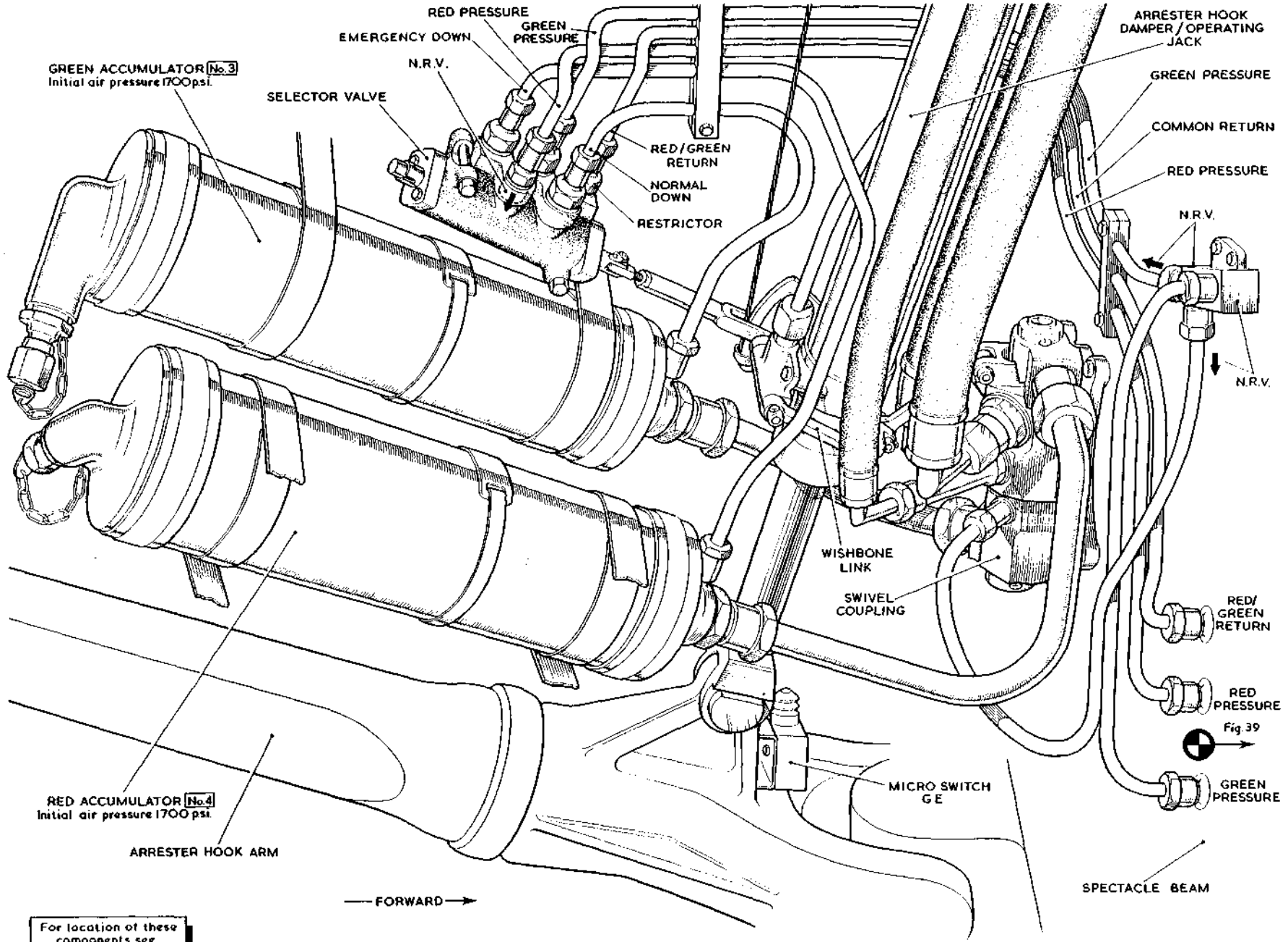


Fig.40 Arrester hook hydraulics

◀ Annotation ▶

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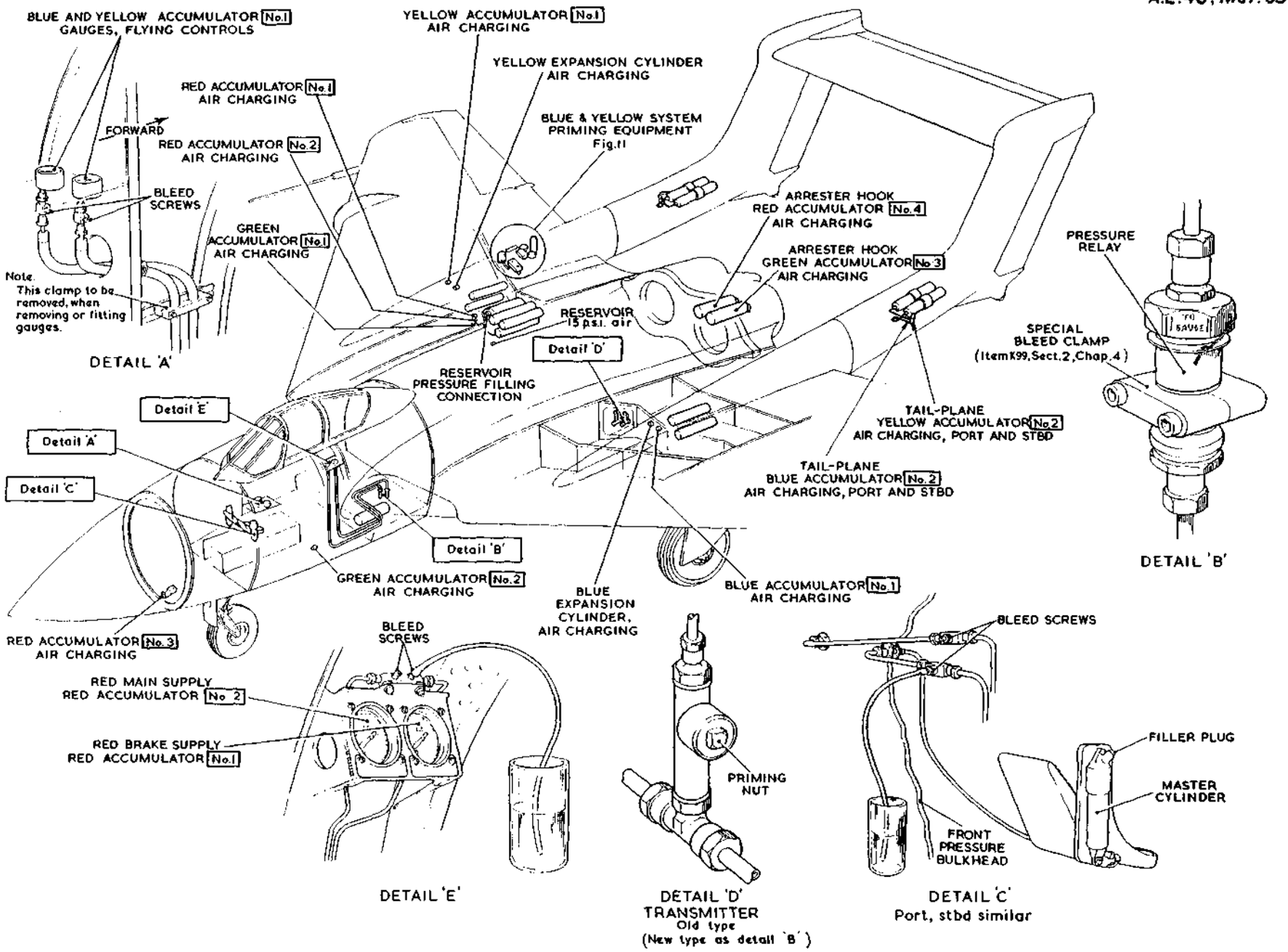

Fig.41 Charging and bleeding points

◀ Annotation ▶

of the jack if an excessive pressure is created within the jack. Non-return valves are fitted in the RED and GREEN pressure lines to the selector valve. The jack is extended for hook down. A full description of the hook installation is given in Sect. 3, Chap. 5.

Magnetic filters

128. Magnetic filters are fitted in each ripple eliminator attached to the RED and GREEN pumps, in each wheel bay in the return lines from the heat exchangers, in the casing of the BLUE and YELLOW pumps and on the starboard side of the air brake bay in the scanner return line. These filters provide a check on the mechanical condition of the pumps, alternators and scanner, and prevent ferrous particles spreading through the systems.

129. Each filter comprises a short stem of magnetic material with a threaded mild steel hexagon head and the stem is covered with a brass tube over which are fitted steel circlips at intervals; the circlips provide a concentration of magnetic force which form efficient gathering points for ferrous contaminent in the hydraulic fluid. A magnetic filter will intercept metallic particles without causing system back-pressure which can arise from mesh filters.

Ripple eliminators

130. A ripple eliminator is fitted in each RED and GREEN hydraulic pump output line to damp out system pulsation. Each eliminator consists of a small steel cylinder, the sides of which expand and contract minutely and absorb slight uneveness in pump delivery. The casing of the filters in the hydraulic trough performs a similar function in the BLUE and YELLOW systems.

Wire-wound filters

131. A restrictor interposed between two wire-wound filters is fitted to the UP connection on the main and nose undercarriage jacks, and also in both pipelines to the radome jack (pre mod. 1080).

Scanner and alternators

132. Details of the scanner mechanism are given in Book 2, Cover 2, Sect. 6, Chap. 2, and in A.P.2892J, Vol. 1, and of the alternators in A.P.4343A, Vol. 1.

SERVICING

WARNING ...

(1) The undercarriage locks (Item G2 and G3, Sect. 2, Chap. 4) must always be in position whilst working under the aircraft.

(2) Before work is commenced, the arrester hook must always be lowered whether there is pressure in the system or not.

(3) Before personnel work on the flying control surfaces, all hydraulic pressure must be discharged from the BLUE and YELLOW systems (para. 136 (1)).

(4) The hydraulic pumps must not be run dry with the pipes disconnected and blanking plates fitted on the pump connections, or serious damage will result. When draining the system, drain from the suction, pressure and by-pass connections adjacent to the pumps (Fig. 12).

(5) The flap interlock override (Item 27, Fig. 16) must never be used when spreading the wings without first ensuring that all flaps (inner, centre and outer) are mechanically locked in the fully UP position, and that the locking slider (Fig. 34, Sect. 3, Chap. 2) on rib No. 4A has sprung fully out. Failure to observe this precaution when using the override plunger in spreading the wings may result in structural damage to the flap high-speed shaft assembly.

(6) The wings must always be folded or spread using a Mk. 4B hydraulic rig (Item H22, Sect. 2, Chap. 4) or using the starboard engine, which must be run at a minimum of 30% of the maximum r.p.m. If the hydraulic system has been broken down or has not been operated for 10 days or more, prime the wing-fold circuit as follows :-

(a) Ensure that the wing-fold selector corresponds with the position of the wings.

(b) Using a Mk. 4B hydraulic rig or the starboard engine, pressurise the GREEN system to off-load pressure.

(c) Select wings FOLD, if not already folded.

(d) With wings folded, top up the reservoir using Item H9, Sect. 2, Chap. 4.

(e) Select wings SPREAD.

(f) Repeat (c), (d), and (e) twice.

(g) Select wings FOLD, and top up reservoir.

(7) When the fuselage rocket batteries have been extended for ground servicing purposes by means of the NORMAL/EXTEND switch (pre-mod. 1265), inadvertent movement of the switch back to the NORMAL position or accidental removal of the aircraft electrical supply will de-energize the selector valve solenoid and retract the batteries, with consequent injury to personnel working in the space above them. To prevent this a special safety lock assembly (Item K33, Sect. 2, Chap. 4) is inserted over the ram of each fuselage rocket battery hydraulic jack and locked in that position. The selector valve solenoid is also provided with a manually-operated lever by means of which the fuselage rocket batteries can be extended or retracted. This lever can be locked in the extended position by inserting a special key (Item K100, Sect. 2, Chap. 4). The key, which has a red flag attached to it, is stowed in a small compartment in the air brake centre access door. See fig. 57.

(8) The hydraulic servicing trolley Mk. 4B (Item H22, Sect. 2, Chap. 4) must be completely disconnected whilst priming the BLUE and YELLOW hydraulic systems. Failure to observe this will result in damage to the Mk. 4B servicing trolley.

(9) Before any work is started in, or adjacent to, the air brake bay, a safety sleeve (Item A1, Sect. 2, Chap. 4) must be fitted to the air brake jack, and a ground lock (Item A2, Sect. 2, Chap. 4) must be fitted to the air brake ground test switch. As an additional safeguard the circuit fuse can be removed (in conjunction with an electrical tradesman).

General

133. An illustration showing the aircraft access panels is given in Sect. 2, Chap. 4, and should be used with fig. 5 which gives the positions, and description of the aircraft hydraulic components. The accumulator numbers referred to in the text and illustrations of this chapter, apply to A.P.4647A, Vol. 1, Book 1 only and are given as a convenient method of locating rapidly each individual accumulator; these numbers will not be found on the aeroplane.

134. The systems are designed to operate on micro-filtered fluid, and hydraulic breakdown is inevitable unless the highest standards of cleanliness are observed at all times. All hydraulic system piping is identified by N.A.T.O. coding; individual pipe lines are identified by a code number at each end, and this code number, its identification and Part Number is given in A.P.4647A, Vol. 3.

135. External leakages will be readily apparent. Internal leakages (within components and between systems) will usually cause sluggish or erratic movement in a particular circuit, or creeping from a selected position; the latter fault may be due to a faulty non-return or thermal relief valve which is seating incorrectly. The presence of air in the system will be indicated by the operational speed being below normal, back-lash at fairing doors, etc., or hammering noises when the system is operated.

Releasing system pressure

136. Before any work is commenced on a hydraulic system the pressure for that particular system must be released as follows:—

(1) BLUE and YELLOW systems: Operate the tailplane controls, at first through a coarse movement and then, as pressure decreases, through a finer movement about the neutral position until the pilot's control column locks. This procedure ensures that the controls are in approximately the neutral position when pressure is exhausted.

WARNING . . .

The flying controls must be exhausted by operating the tail plane, because operation of the ailerons or rudders will not release the pressure in the tail plane accumulators which are isolated by non-return valves in the accumulator inlets.

(2) Flying control header tanks: The pressure from the BLUE and YELLOW system header tanks can be released by operation of the release valves on the priming gauge unit (para. 27 and fig. 11) after the main system pressure has been released from the accumulators.

Note . . .

The main system pressure operates on the header tank internal pressurizing jack which is the reason why these accumulators must be discharged before releasing the header tank pressure.

TABLE 1

RED and GREEN system charging

(All air pressures are with hydraulic pressure released)

Description		Dependent Services	Location of Charging Points	Initial Air Press (p.s.i.)
Reservoir	*	RED and GREEN systems.	Starboard wheel well, between rib No. 1 and 2. Access after releasing undercarriage door.	15
RED accumulator	(No. 1)*	Wheel brakes (emergency and Park).		1500±25
RED accumulator	(No. 2)*	A.I. alternator and heater valve, undercarriage door Servodynes (emergency), flaps (emergency), arrester hook (emergency).	Starboard wheel well, between rib No. 1 and 2. Access after releasing undercarriage door.	1500±25
RED accumulator	(No. 3)	Radar scanner.	Nose compartment. Access with radome open.	1500±25
RED accumulator	(No. 4)	Arrester hook.	Fairing aft of spectacle frame, between engine tailpipes. Access with hook down, or at Panel No. 175. Use Turner gauge.	1700±25
GREEN accumulator	(No. 1)*	Nose-wheel steering, rocket installation, air brake, Firestreak alternator and heater valve, wheel brakes, undercarriage door Servodynes, undercarriage jacks, flaps, wing-fold and arrester hook.	Starboard wheel well, between rib No. 1 and 2. Access after releasing undercarriage door.	1500±25

***Note.**—The pressure gauges and sight glass for these components can be illuminated by built-in lighting and viewed through windows in the rear wall of each main wheel well. The light switch is fitted in the wheel well.

TABLE 1—*continued*

RED and GREEN system charging
(All air pressures are with hydraulic pressure released)

Description	Dependent services	Location of charging points	Initial air press (p.s.i.)
GREEN accumulator (No. 2)	Rocket installation	Air brake bay	1500±25
GREEN accumulator (No. 3)	Arrester hook	Fairing aft of spectacle frame, between engine tailpipes. Access with ◀hook down or at Panel No. 175.▶ Use Turner gauge	1700±25

TABLE 2

BLUE and YELLOW system charging
(All air pressures are with hydraulic pressure released)

Description	Dependent services	Location of charging points	Initial air press (p.s.i.)
BLUE accumulator (No. 1)*	Rudders, tail plane, ailerons	Port wheel well, between rib No. 2 and 3. Access after releasing undercarriage door	1800±25 (pre mod. 493) 975±25 (post mod. 493)
BLUE accumulator (No. 2) (2 off)	Tail plane	Port and starboard booms, access ◀panel No. 85▶ (Fig. 6, Sect. 2, Chap. 4). When mod. 933 is embodied, use Turner gauge at quick release panel	1800±25 (pre mod. 493) 975±25 (post mod. 493)
BLUE expansion cylinder*	Rudders, tail plane and aileron system surges	Port wheel well, between rib No. 2 and 3. Access after releasing undercarriage door	50±2
BLUE header tank	Rudders, tail plane, ailerons, system surge. BLUE pump fluid supply	Starboard flap shroud at panel No. ◀321▶ (Fig. 7, Sect. 2, Chap. 4)	—

TABLE 2—*continued*

BLUE and YELLOW system charging
(All air pressures are with hydraulic pressure released)

Description	Dependent services	Location of charging points	Initial air press (p.s.i.)
YELLOW accumulator (No. 1)*	Rudders, tail plane, ailerons, and autopilot.	Starboard wheel well, between rib No. 2 and 3. Access after releasing undercarriage door	1800±25 (pre mod. 649) 975±25 (post mod. 649)
YELLOW accumulator (No. 2) (2 off)	Tail plane	Port and starboard booms, access ◀panels No. 66 and 85▶ (Fig. 6, Sect. 2, Chap. 4). When mod. 933 is embodied use Turner gauge at quick release panel	1800±25 (pre mod. 649) 975±25 (post mod. 649)
YELLOW expansion cylinder*	Rudders, tail plane, ailerons, system surge	Starboard wheel well, between rib No. 2 and 3, after releasing undercarriage door	50±2
YELLOW header tank	Rudders, tail plane, ailerons, system surge; YELLOW pump fluid supply	Starboard flap shroud, at panel ◀No. 321▶ (Fig. 7, Sect. 2, Chap. 4).	—

***Note . . .** *The pressure gauges and sight glass for these components can be illuminated by built-in lighting and viewed through windows in the rear wall of each main wheel well. The light switch is fitted in the wheel well.*

(3) GREEN system: Operate the flaps, air brake, rocket installation and arrester hook (emergency down position), the controls and indicators for these will be found on fig. 16.

Caution . . . (Pre-mod. 836)

If the GREEN *hydraulic pump is running,* EMERGENCY DOWN *(arrester hook) must not be selected, because full* GREEN *pressure by-passes through the selector valve back into the* RED *side of the reservoir and thence via the vent to atmosphere, causing complete loss of* GREEN *fluid, and a seized pump.*

(4) RED system: Operate the wheel brakes (park), arrester hook (EMERGENCY DOWN position, see WARNING sub-para. (3)), and scanner by-pass valve.

(5) Brake accumulator (RED system accumulator (No. 1)): Repeatedly operate the wheel brake lever on the left-hand side of the cockpit from the OFF to the PARK position.

(6) Arrester hook accumulators (RED accumulator (No. 4) and GREEN accumulator (No. 3) systems): Exhaust the RED and GREEN systems by operating the flaps, then select the arrester hook UP. If the hook is required to be left in the DOWN position, re-select DOWN (see WARNING, sub-para. (3)).

(7) Scanner accumulator (RED system accumulator (No. 3)): Operate the by-pass valve in the nose compartment, by moving the radome lock lever (fig. 27) to the OPEN position.

(8) Fuselage rocket installation (GREEN system accumulator (No. 2)): Operate the rocket installation.

Accumulator and expansion cylinder charging

137. Charging and bleeding points are shown in fig. 41. Before charging or checking accumulator for expansion cylinder air pressures, the relevant system hydraulic pressure must first be released.

Caution . . .

Should the presence of hydraulic oil be apparent at the air charging valve during an air pressure check, then the accumulator or expansion cylinder must be regarded as unserviceable. It is essential that the flying control hydraulic system should not be contaminated with air.

138. A description of the number of hydraulic system accumulators, expansion cylinders, and header tanks, together with the location of the charging points, initial air charging pressures (where applicable) is given in Table 1 and 2; before any functioning test in the form of servicing is carried out, the accumulators or expansion cylinders must be charged with air to the figures quoted in Table 1 and Table 2.

FLUSHING AND BLEEDING

General

139. The following general notes ◀apply to para. 139a to 146, and 150 to▶ 155:—

(1) The instructions describe the flushing and bleeding of the complete hydraulic system; in service, the extent of the flushing will depend on the nature of the contamination, and the bleeding upon the extent of the dismantling which has occurred.

(2) It is assumed that the system is complete.

(3) If a component has broken down and ferrous particles are liable to be present in the system, examine the magnetic filters to ascertain the spread of the contamination. Note that it is normal to find very fine particles on the magnetic filters.

(4) A hydraulic flushing kit (Item K119, Sect. 2, Chap. 4) comprising a set of pipes, connectors and blocks; a solenoid valve operating rig; and a slave filter assembly, is required to flush the system.

RED AND GREEN SYSTEMS

FLUSHING AND BLEEDING

◀Reservoir suction and by-pass lines

139a. Following a component breakdown, clean the reservoir, and flush the reservoir suction and by-pass lines as follows: —

(1) Remove the reservoir for cleaning.

(2) Using locally made adapters, connect a Puralator filter between the reservoir main return and suction lines of the contaminated system.

(3) Connect the hydraulic servicing trolley (Item H22, Sect. 2, Chap. 4) to the couplings in the pump bay, with the pressure line connected to the by-pass coupling, and the suction line to the suction coupling of the contaminated system.

(4) Operate the trolley in open circuit at low r.p.m. to flush the pipelines.

(5) When the contaminant is cleared, remove the filter fitted in sub-para. (2), and fit a clean reservoir.

(6) Continue flushing remainder of system as described in para. 141 – 146.▶

Preparation

140. Prepare to flush and bleed the RED and GREEN systems as follows:—

(1) Disconnect the pipelines and fit the flushing equipment at the following points:—

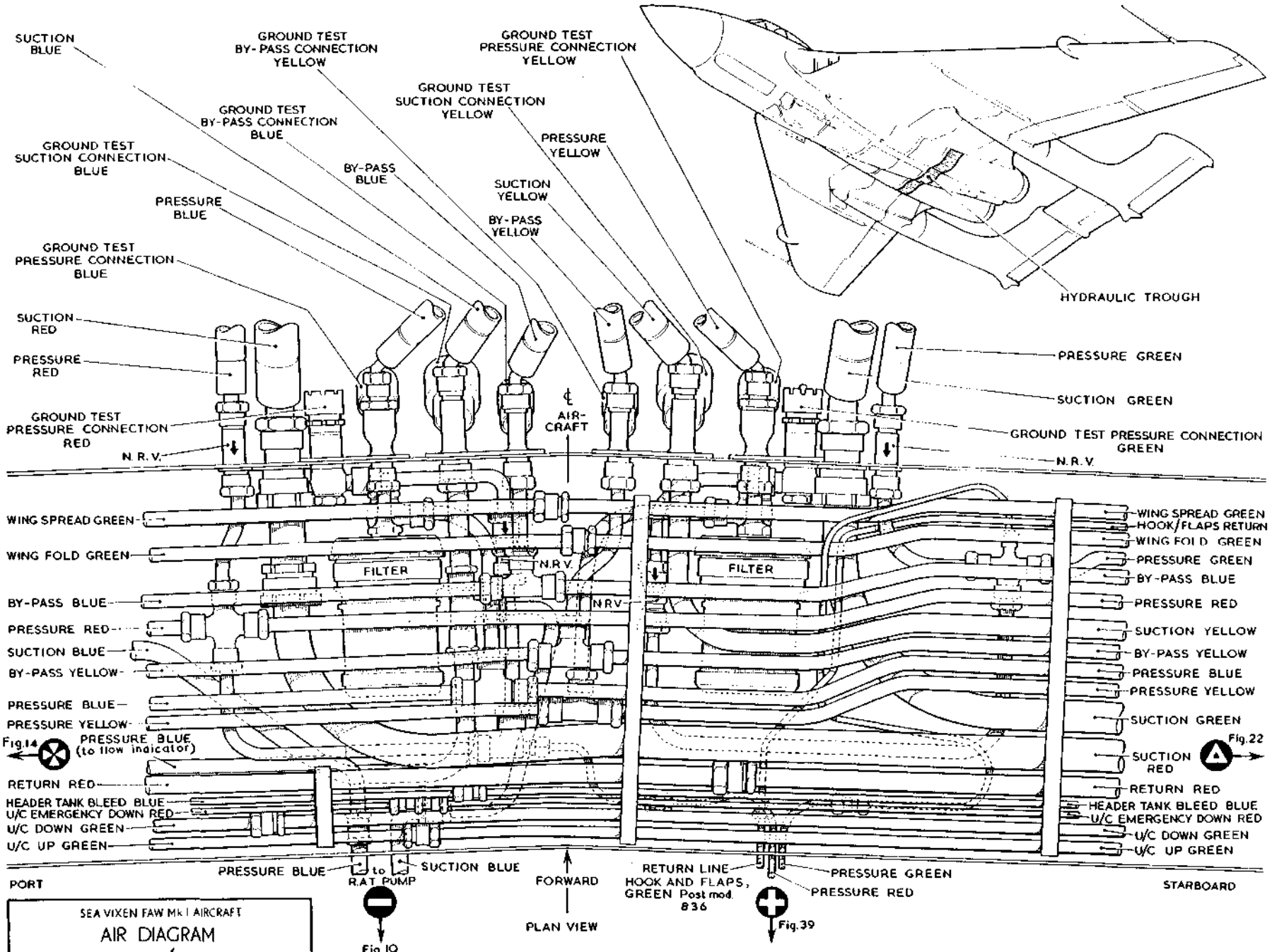

Fig. 42. Pipe runs in hydraulic trough

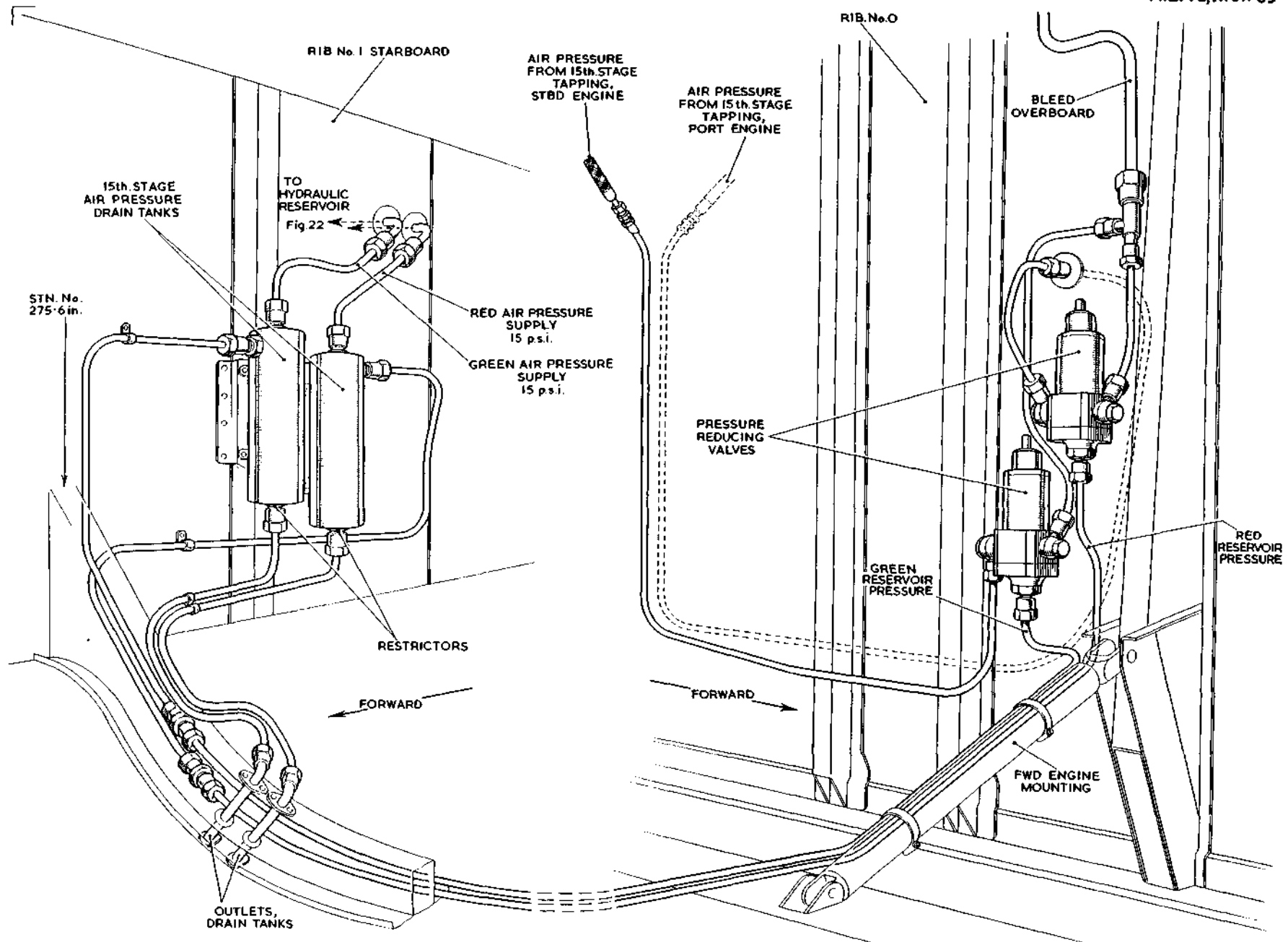

Fig. 43 Hydraulics in starboard engine bay

◀ Annotation ▶

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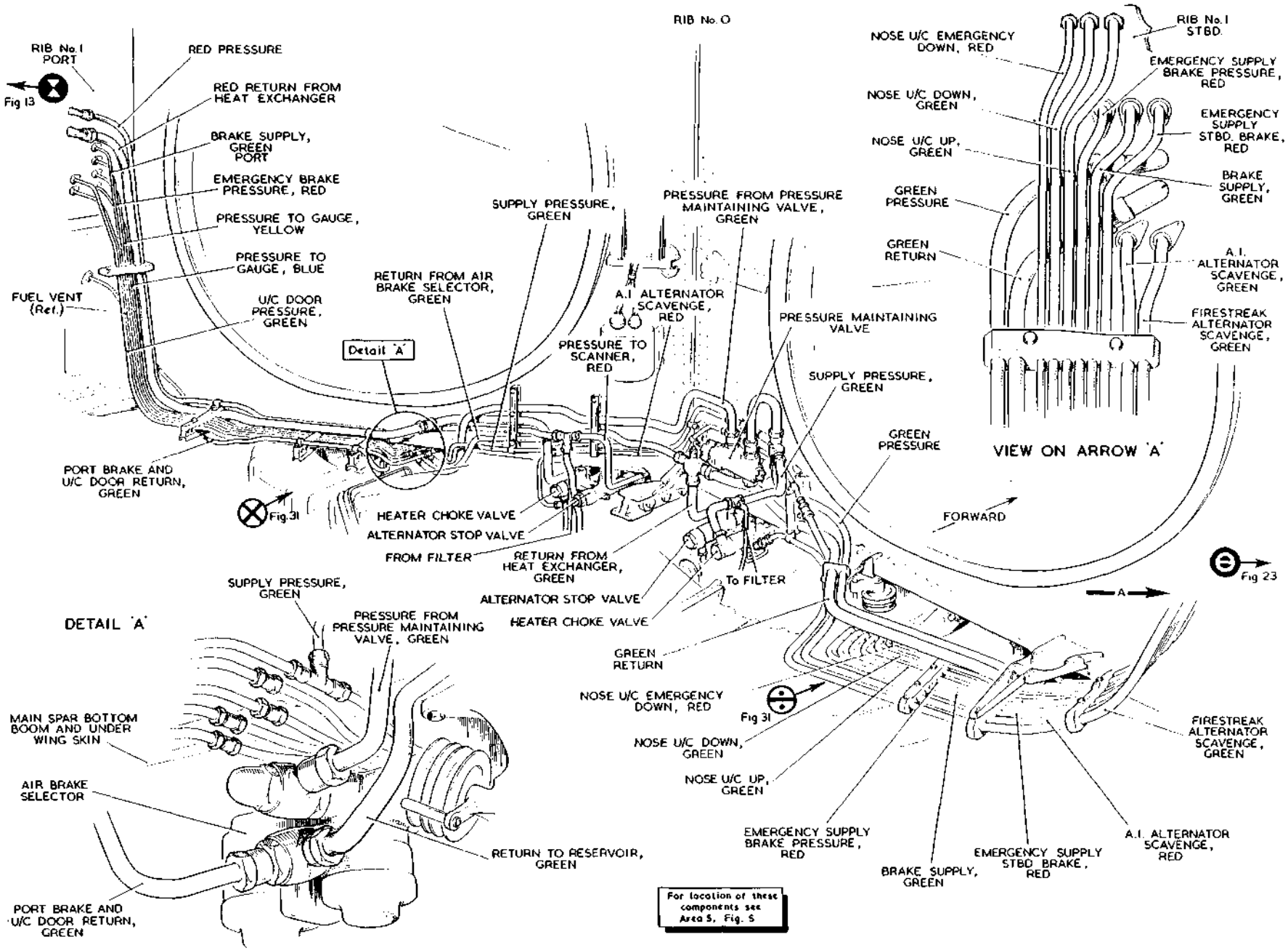


Fig.44 Pipe runs, centre section, main spar, rear face.

(a) Flexible hoses to scanner, and, pre-mod. 1080, pipes to radome jack and the restrictor valves (fig. 46, detail "A").

(b) Nose wheel steering jack (fig. 46, detail "B").

(c) Nose undercarriage jack (fig. 46, detail "C").

(d) Rocket installation jacks (fig. 47, detail "D").

(e) RED and GREEN alternators on pre-mod. 725 aircraft (fig. 47, detail "G"). On post-mod. 725 aircraft, fit slave filters and flushing pipes (fig. 47, detail "E").

(f) Wing-fold jacks and latch pin jacks (fig. 47, detail "F").

(g) Main undercarriage jacks, door Servodynes, port magnetic filter and RED accumulator (fig. 48, detail "K" and "L").

(2) Connect the solenoid valve operating rig to the alternator and scanner solenoid valves, and connect a 24V d.c. supply to the rig, and a 28V d.c. supply to the aircraft.

(3) Check that the accumulators are correctly charged to the air pressures given in Table 1 and 2.

(4) Connect a replenishing can (Item H9, Sect. 2, Chap. 4) to the reservoir, and check that the reservoir is full (para. 158). On post-mod. 1184 aircraft check the fluid level on the sight glass. The mark shows the correct level when the wheels are on the ground.

Note . . .

(1) *The wings must normally be folded when the reservoir is filled, but if the wing-fold circuit has been dismantled it must be bled before attempting wing-fold. See WARNING* (6) *following para.* 132.

(2) *If there is an initial flow of hydraulic fluid from the overflow pipe when the replenishing can is connected, this is NOT to be taken as an indication that the reservoir is full.*

(5) Apply 15 p.s.i. air pressure to the reservoir pressurizing connection on the rear wall of the starboard main wheel well.

(6) Connect a hydraulic servicing trolley (Item H22, Sect. 2, Chap. 4) to the GREEN ground test connections in the pump bay.

Flushing

141. Flush the RED and GREEN systems as follows:—

(1) Run the servicing trolley and flush the following circuits, making periodic changes of selection:—

(a) Undercarriage and door.

(b) Wing-fold.

(c) Rocket.

(d) Nose-wheel steering.

(2) Connect the servicing trolley to the RED ground test connections, and flush the following circuits making periodic changes of selection:—

(a) Radome (pre-mod. 1080).

(b) Undercarriage emergency.

(3) Stop the servicing trolley, remove the flushing equipment from the circuits flushed in sub-para. (1) and (2), and connect the pipelines to their respective components.

Brake servo system bleeding

141a. Bleed the brake servo system as follows:—

(1) Open the port nose access door No. 113, disconnect and remove the main power unit.

(2) Check that the hydraulic reservoir is replenished.

(3) Open panel No. 303, and disconnect the air brake jack as described in Sect. 3, Chap. 1.

(4) Check the fluid level in the starboard brake master cylinder, and replenish if necessary, using oil OM–15, until the level reaches the lower threads of the filler orifice. Fit the adapter to the filler neck.

(5) Connect the miniature hydraulic rig (Item H23, Sect. 2, Chap. 4) pressure connection to the adapter, and the suction connection to the GREEN system miniature connection at panel No. 321.

Caution . . .

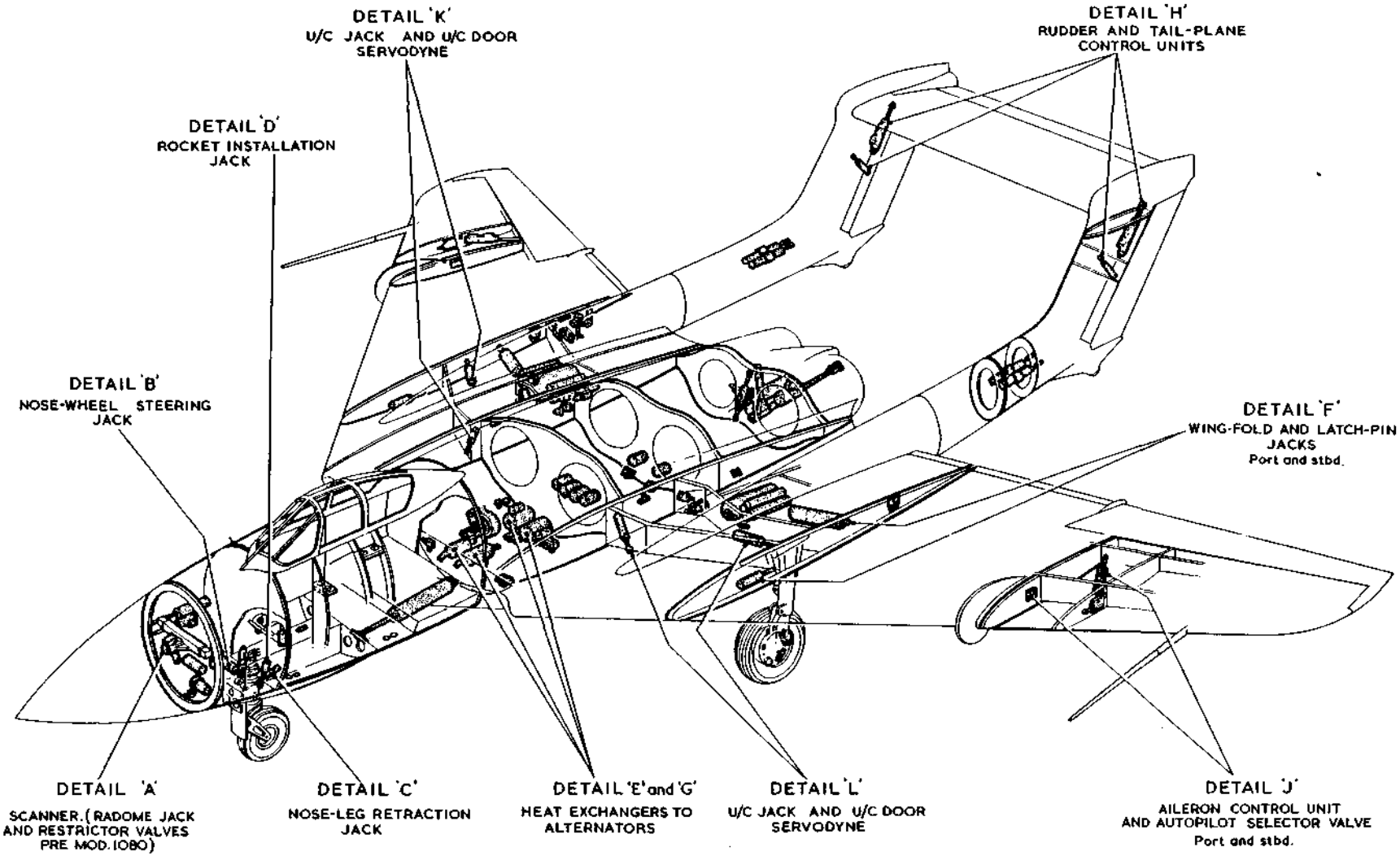
During operations (5) *and* (8) *do NOT exceed a pressure of* 50 *p.s.i.*

(6) Operate the rig hand pump, and bleed, first from the upper bleed screw on the front pressure bulkhead (Fig. 41), and then from the inboard bleed screw on the brake control valve (Fig. 52), until an air-free flow of fluid is obtained. Tighten the bleed screws.

Note . . .

Use a rubber tube and container when bleeding to avoid contamination of the structure.

(7) Disconnect the pressure connection from the adapter, remove the adapter, and fit the filler cap.



DISPOSITION OF HYDRAULIC COMPONENTS

Fig. 45. Connection points for system flushing (1)

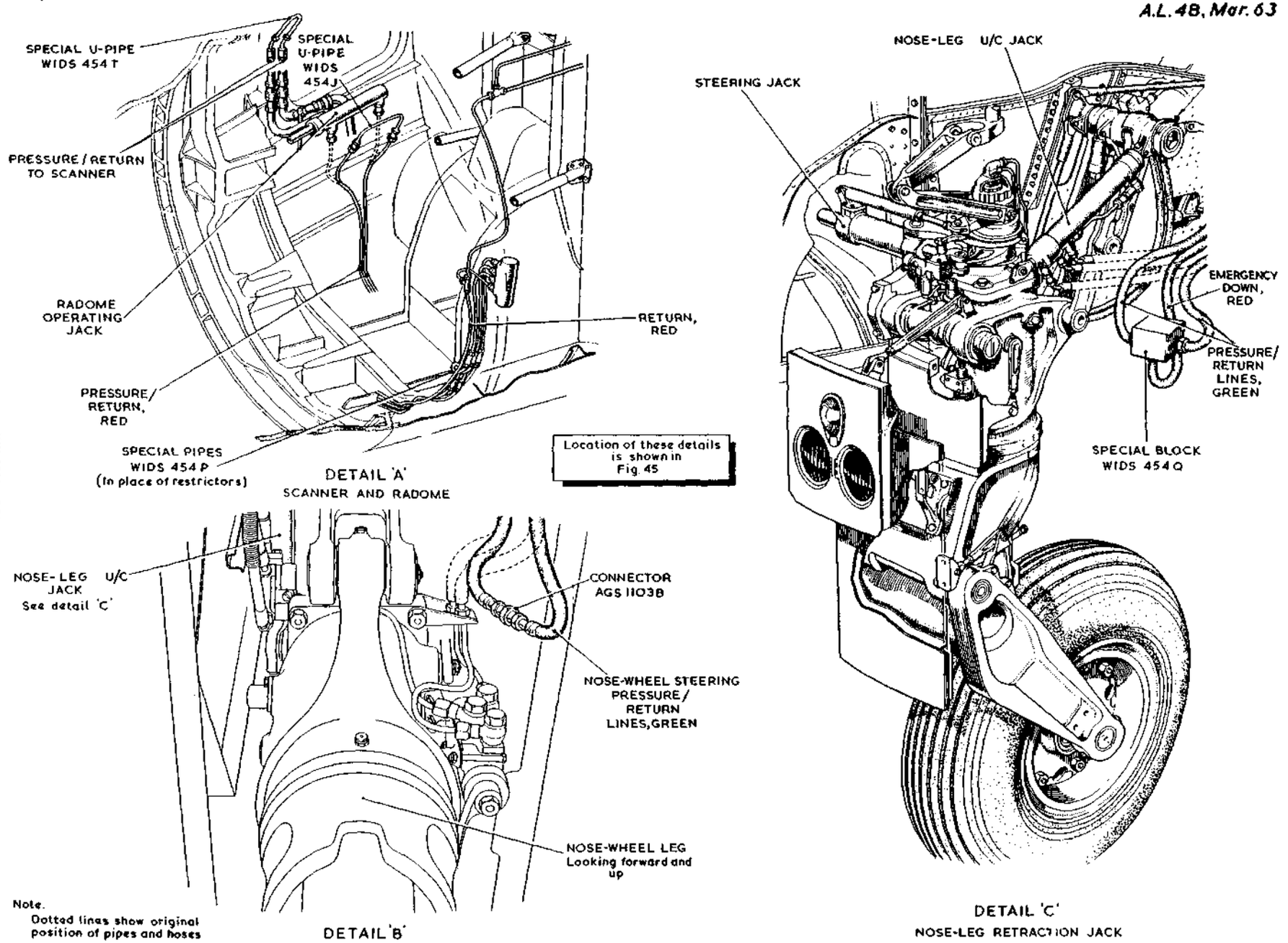


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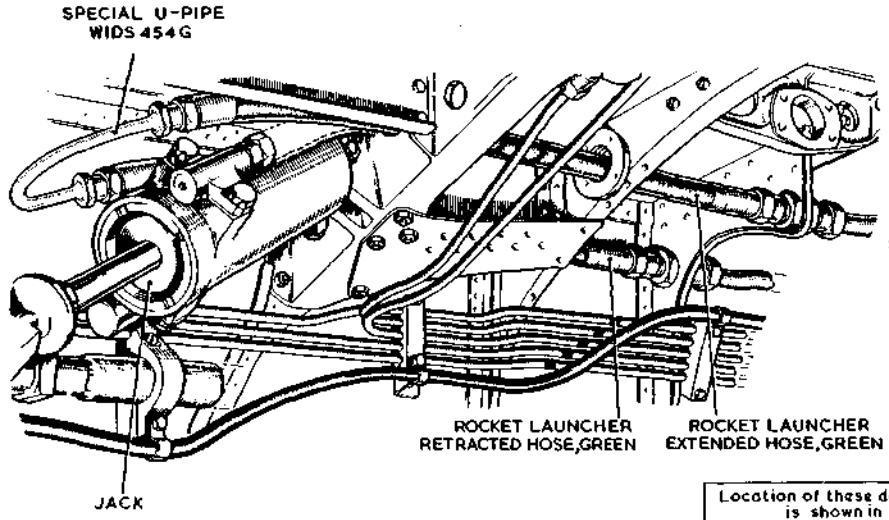
Fig.46 Connection points for system flushing (2)

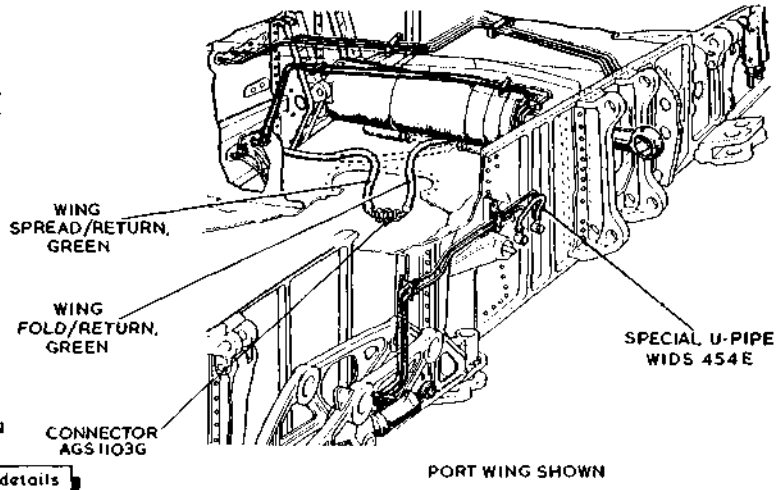
◀ Detail 'A' and 'C' ▶



DETAIL 'D'

FUSELAGE ROCKET INSTALLATION JACK, PORT (starboard similar)

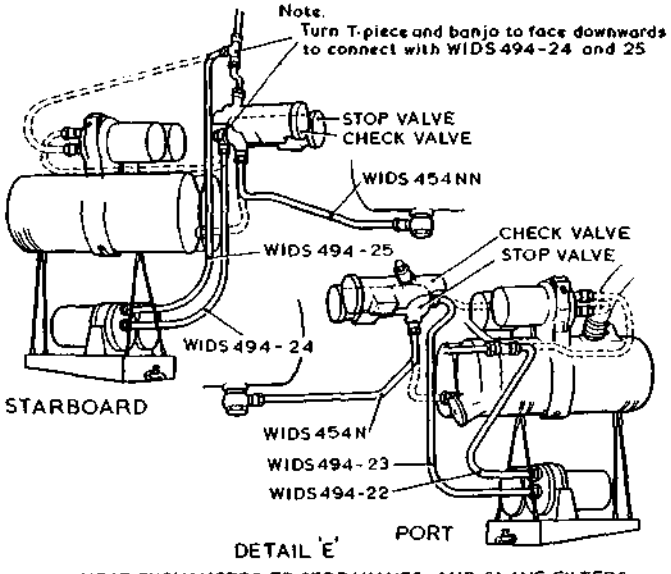
Location of these details is shown in Fig.45



PORT WING SHOWN

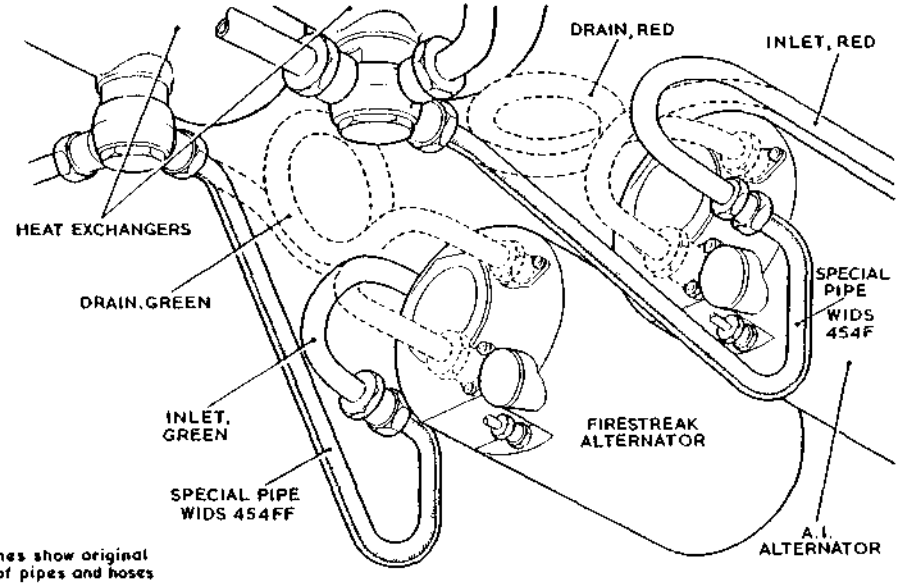
DETAIL 'F'

WING-FOLD AND LATCH PIN JACKS, PORT AND STARBOARD



DETAIL 'E'

HEAT EXCHANGERS TO STOP VALVES, AND SLAVE FILTERS
(post mod. 725)



Note.
Dotted lines show original position of pipes and hoses

DETAIL 'G'

HEAT EXCHANGERS TO ALTERNATORS (pre mod. 725)

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Fig.47 Connection points for system flushing (3)

◀ Detail 'E' and 'F' ▶

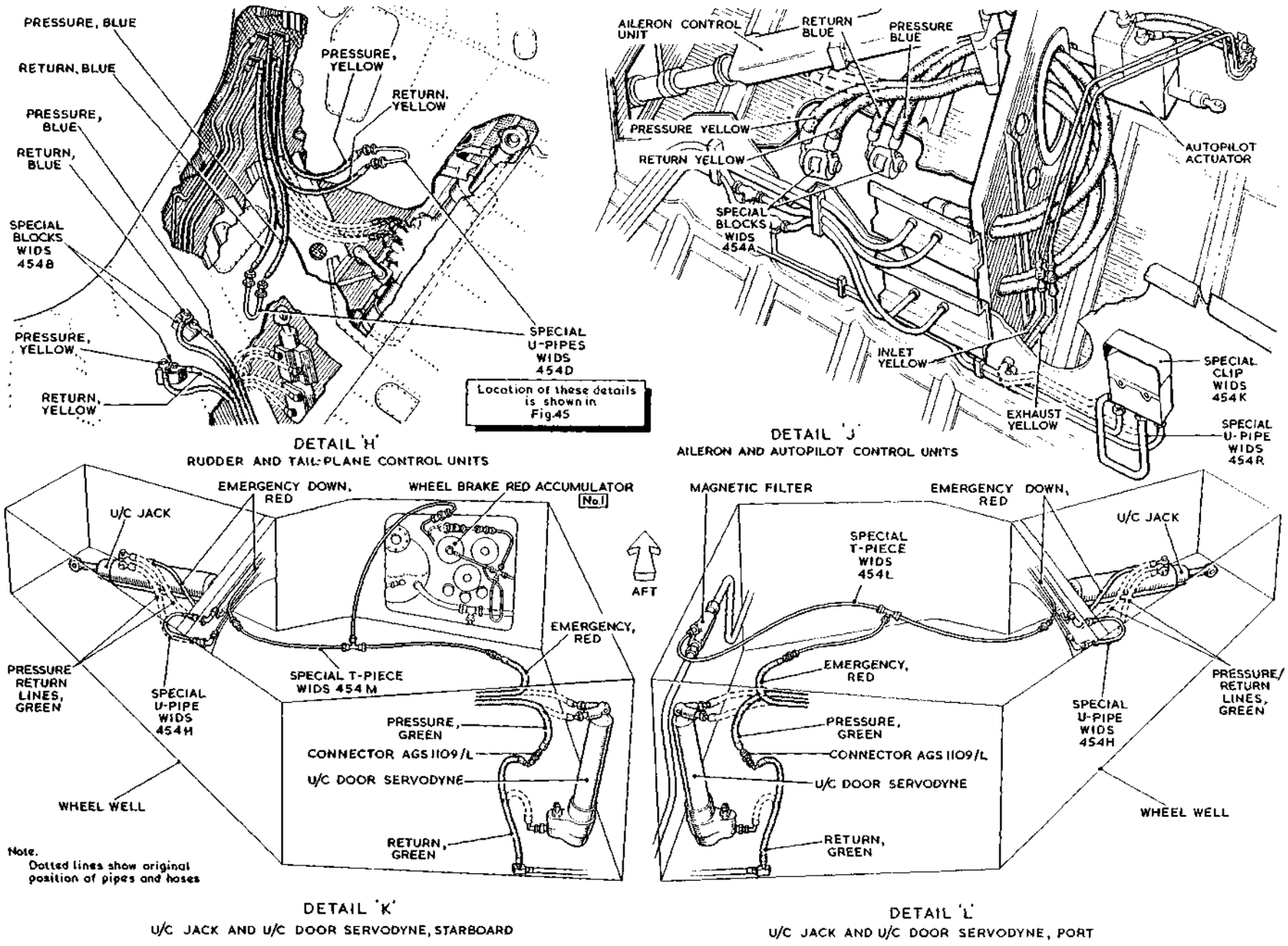

Fig. 48. Connection points for system flushing (4)

(8) Repeat operations (4), (5), (6) and (7) for the port brake system, using the lower bleed screw on the front pressure bulkhead, and the outboard bleed screw on the brake control valve.

(9) Disconnect the suction connection, fit the blanking cap, and fasten panel No. 321.

(10) Wire-lock the four bleed screws.

(11) Operate the brake pedals to pressurize the system, examine for leakage and check the correct operation of the brakes.

(12) Release the brake pedals and check that the fluid level in the master cylinders is correct and replenish as necessary. Tighten and wire-lock filler caps.

(13) Fit and connect the main power unit, and secure panel No. 113.

Note . . .

Carry out the pressure, cooling air, standby timing cycle and functional checks on the main power unit in accordance with current instructions.

(14) Connect the air brake jack as described in Sect. 3, Chap. 1.

(15) Replenish the hydraulic reservoir.▶

GREEN system bleeding

142. Bleed the GREEN system as follows:—

◀(1) Connect a hand pump rig (Item H17, Sect. 2, Chap. 4) and pump fluid to all the GREEN system jacks, slacken the pipe connections at the jacks to release air, making the necessary selections to bleed both end of the jacks. Ensure that the reservoir is topped-up.

Caution . . .

Special care must be taken when bleeding the wing-fold circuit. If the wings are folded, bleed the latch pin jacks and wing-fold jacks, as far as possible, without spreading the wings. If the wings are spread, when bleeding with wing FOLD selected, only apply sufficient pressure with the hand pump to operate the sequence valves; do not fold the wing. See WARNING (6) following para. 132.

(2) Bleed the wheel brake unit cylinders at the test point on each brake unit, apply the brakes using the foot pedals, and spin the Maxaret units several times during bleeding.

(3) Slowly operate each GREEN service, except the wing-fold, to check that there is no mechanical fouling, and to purge all air from the system.

(4) Bleed the GREEN system wheel brake gauge circuits as described in paras. 147 and 148.▶

RED system bleeding

143. Bleed the RED system as follows:—

(1) Connect the hand pump rig to the RED system, release the GREEN system pressure and pump fluid to the jacks using RED pressure. Slacken the pipe connections as necessary to release air. RED pressure is only applied to the down side of the undercarriage and arrester hook jacks.

(2) Bleed the RED pipelines to the brake units at the test point on each brake unit; apply the brakes using the brake lever in the PARK position.

(3) Slowly operate each RED service that has two-way movement to check for fouling and to purge air from the system.

Alternator circuit flushing

144. Flush the alternator circuits as follows:—

(1) Check that the reservoir air pressure is 15 p.s.i., and that the fluid level is correct.

(2) Connect the servicing trolley to the GREEN system, switch the starboard alternator solenoid valve OPEN on the solenoid operating rig, and run the rig to flush the alternator lines thoroughly.

(3) Close the solenoid valve, operate all GREEN services several times, then open the solenoid valve and flush the alternator lines again.

(4) Stop the servicing trolley, remove the GREEN alternator flushing pipes, and the slave filter on post mod. 725 aircraft. Connect the original pipes to the alternator.

(5) Connect the servicing trolley to the RED system, and flush the port alternator as described for starboard alternator.

Scanner circuit flushing

145. Flush the scanner circuit as follows:—

(1) Switch the scanner solenoid valve to OPEN on the solenoid valve operating and thoroughly flush the scanner lines.

(2) Remove the scanner micronic filter, extract the element and examine it for cleanliness after sawing it through just inside the end discs. If the element is dirty fit a new filter, flush again, and repeat until the circuit is clean. Finally fit a new filter.

(3) Remove the scanner circuit flushing pipe, and connect the scanner hoses, ensuring that a minimum clearance of 0·25 in. is obtained between the lower hose and the autopilot roll rate gyro located on the starboard side of the nose compartment.

Final checks

146. On completion of flushing, complete the checks as follows:—

(1) Fit new elements in the alternator filters.

(2) If ferrous contamination was found during the initial check,

examine the magnetic filters to check that the contamination has been cleared.

(3) Operate all services using a servicing trolley to check that there is no leakage where the systems have been disturbed. Refer to WARNING (6) following para.132 before operating the wing-fold circuit.

WHEEL BRAKE GAUGE BLEEDING (pre mod.249)

147. The wheel brake gauge systems (see para.73) are bled as follows :-

(1) Fit a flexible tube to each bleed screw above the gauges (Fig. 41, detail 'E') and place the free ends in a container. Slacken the bleed screws.

(2) Fit a bleed clamp (Item K99, Sect.2, Chap.4) between the lines on each relay body (Fig.41, detail 'B'). Do not overtighten the clamp screws.

(3) Check that the brake lever is in the OFF position, build up pressure in the GREEN system using a hand pump rig and apply the port toe brake. Operate the brake until air-free fluid is discharged at the bleed screw. Tighten the bleed screw, and continue pumping until the gauge reads 1500 p.s.i., then remove the bleed clamp. Check that the pressure drops to zero when the toe brake is released.

(4) Repeat operation (3) for the starboard relay and gauge.

(5) Operate both toe brakes to check the response of the gauges. Wirelock the bleed screws.

WHEEL BRAKE GAUGE BLEEDING (post mod.249)

148. The wheel brake gauge systems (see para.73) are bled as follows :-

(1) Check that the brake lever is in the OFF position, and build up pressure in the GREEN system using a hand pump rig.

(2) Slacken the pipe union on the aft transmitter in the air brake bay, and tighten the union when air-free fluid flows.

(3) Apply the port toe brake, slacken the union to the centre transmitter, and tighten the union when air-free fluid flows.

(4) Apply the starboard toe brake, slacken the union to the forward transmitter, and tighten the union when air-free fluid flows.

(5) Check the response of the indicator needles on the triple pressure gauge. The main GREEN pressure reading can be checked against the main GREEN accumulator (No.1) pressure gauge, and the port and starboard brake pressures by fitting a Turner gauge to the test points on the brake unit castings (Fig.34).

RED MAIN AND BRAKE SUPPLY GAUGES-BLEEDING

149. The RED main and brake supply gauge systems are bled as follows :-

(1) Fit a flexible tube to each bleed screw above the gauges (Fig.41, detail 'E'), and place the free ends in a container. Slacken the bleed screws.

(2) Fit a bleed clamp (Item K99, Sect.2, Chap.4) between the lines on each relay body (Fig.41, detail 'B'). Do not overtighten the clamp screws.

(3) Build up pressure in the RED system using a hand pump rig, and tighten the bleed screws when air-free fluid flows.

(4) Continue pumping until both gauges read 3000 p.s.i. then remove the clamps from the relays.

(5) Release the RED system pressure and check that each gauge registers zero.

(6) Build up RED system pressure and check the response of the gauges when pressure is released.

BLUE SYSTEM FLUSHING AND BLEEDING

CAUTION ...
Refer to WARNING (8) following para.132 before working on the BLUE system.

Tail plane and rudder circuits flushing

150. Refer to para.139, then flush the tail plane and rudder circuits as follows :-

(1) Disconnect the BLUE system hoses from the tail plane and rudder control units, and fit the U-pipes and blocks to connect the pressure and return lines (Fig.48, detail 'H'). Leave the aileron hoses attached to the control units, or blanked off.

(2) Check that the BLUE header tank is full and free of air as follows :-

(a) Select the BLUE system on the priming cock in the starboard flap shroud outboard of the boom (Fig.11).

(b) Operate the priming pump steadily until the priming pressure gauge indicates 60 p.s.i.

(c) Check that the header tank indicator shows WHITE (Fig.7).

(d) Release the pressure by operating the manual release valve, and examine the fluid passing through the sight glass. Repeat the priming procedure until air-free fluid passes through the sight glass.

Note ...
Maintain the fluid level in the reservoir by frequent topping-up during this operation.

(3) Extend the ram air turbine, and spin the turbine to purge air from the emergency lines, using a Palouste starter and diffuser (Item H13, or H13a, Sect.2, Chap.4).

(4) Retract the ram air turbine (para.20 or 21).

(5) Connect a hand pump rig to the BLUE system ground test connections, and pump fluid through all the BLUE system pressure lines. Frequently bleed air off through the release valve, and ensure that the header tank is kept full, and that the reservoir is topped-up.

(6) Connect a servicing trolley, and run to thoroughly flush the tail plane and rudder circuits; stop the servicing trolley and connect the hoses to their respective control units.

Aileron circuit flushing

151. Refer to para.139, then flush the BLUE aileron circuit as follows :-

(1) Disconnect the BLUE system hoses from the aileron control units, and join the pressure and return hoses with the special blocks (Fig.48, detail 'J').

(2) Check that the BLUE header tank is full and free of air (para. 150, (2)).

(3) Run the servicing trolley to thoroughly flush the aileron circuit, then stop the trolley and connect the hoses to the control units.

BLUE system bleeding

152. Bleed the BLUE system as follows :-

(1) Check that the BLUE header tank is full and free of air (para. 150 (2)).

(2) Using a hand pump rig, pump fluid through the BLUE system pressure lines, and bleed air off at the control units and at the highest points of the system in the fins.

Note ...
Suitable precautions must be taken to prevent the bled fluid from contaminating the aircraft structure.

(3) Operate all controls over full stroke to check for fouling and to purge air from the system. Frequently check that the header tank is full and free of air.

(4) Bleed the BLUE system pressure gauge and relay - Barnet Type 2340 (pre mod.611), or Dunlop relay Type ACM 18570 (post mod. 611) as described in para.156 and 157.

(5) Bleed the BLUE system engine

driven pump by unscrewing the bleed plug until fluid flows out, and then tighten and wirelock the plug.

(6) Fit a new element in the BLUE system micronic filter, and run a servicing trolley to make the functional and leak rate checks.

YELLOW SYSTEM FLUSHING AND BLEEDING

Tail plane and rudder circuits flushing

153. Flush the YELLOW tail plane and rudder circuit as described for the BLUE system, but with the YELLOW system selected on the priming cock.

Aileron and autopilot circuits flushing

154. Flush the aileron and autopilot circuits as follows :-

(1) Disconnect the YELLOW system hoses from the aileron control units, and the pressure and return lines at the autopilot selector valve on rib No.9, port and starboard.

(2) Connect the pipelines using the special blocks and U-pipes, and fit the special clip to the autopilot selector valves (Fig.48, detail 'J').

(3) Check that the YELLOW header tank is full and free of air.

(4) Run the servicing trolley to thoroughly flush the aileron and autopilot pipelines, then stop the trolley and connect the pipelines to the control units and selector valves.

YELLOW system bleeding

155. Bleed the YELLOW system as follows :-

(1) Check that the YELLOW header tank is full and free of air.

(2) Using a hand pump rig, pump fluid through the YELLOW system pressure lines, and bleed air off at the control units and at the highest points of the system in the fins.

Note ...
Suitable precautions must be taken to prevent the bled fluid from contaminating the aircraft structure.

(3) Operate all controls over full stroke to check for fouling and to purge air from the system. Frequently check that the header tank is full and free of air.

(4) Bleed the YELLOW system pressure gauge and relay - Barnet Type 2340 (pre mod.611) or Dunlop Type ACM 18570 (post mod.611) as described in para.156 and 157.

(5) Bleed the YELLOW system engine driven pump by unscrewing the pump bleed plug (Fig.12) until fluid flows out, and then tighten and wirelock the plug.

(6) Fit a new element in the YELLOW system micronic filter, and run a servicing trolley to make the functional and leak rate checks.

BLUE AND YELLOW PRESSURE GAUGE BLEEDING (pre mod.611)

156. Bleed the BLUE and YELLOW systems pressure gauges and Barnet Type 2340 transmitters as follows :-

(1) Attach a suitable length of $\frac{1}{4}$ in. I/D soft rubber tube to the bleed screw at the back of the instrument, and lead the free end into a suitable container; slacken off the bleed screw at the back of the instrument.

Note ...
The gauge will have to be lifted from the console to allow access to the bleed screw (Detail 'A' in Fig.41) located beneath the gauge.

(2) Set the transmitter (Detail 'D' in Fig.41) for priming by rotating the priming screw anti-clockwise by hand until resistance is felt; the priming screw has a right-hand thread and must not be forced at the out position because of the risk of damage to the internal stops. The transmitter is located to the rear of the port undercarriage wheel well between ribs No.1 and 2, and is accessible after the removal of a panel.

(3) Build up the pressure in the system by operating the hand pump rig (Item H17, Sect.2, Chap.4), until fluid leaks out of the BLUE

system gauge bleed connections; when fluid flow is free from aeration, screw up the bleed connection and lock; wipe away any waste fluid. Continue pumping until the gauge reads 3000 p.s.i., then screw in the transmitter priming screw tightly and wire-lock. Stop pumping and operate the tail-plane control unit to exhaust the accumulators. Check that the BLUE system gauge indicates zero pressure.

(4) Build up the BLUE system pressure and operate the flying controls several times to check the response of the gauge.

(5) Repeat the above operations for the YELLOW system pressure gauge and Barnet Type 2340 transmitter (pre mod.611).

BLUE AND YELLOW PRESSURE GAUGE BLEEDING (post mod.611)

157. Bleed the BLUE and YELLOW systems pressure gauges and Dunlop relay ACM 18570 as follows :-

(1) Attach a suitable length of $\frac{1}{4}$ in. I/D soft rubber tube to the bleed screw at the back of the instrument, and lead the free end into a suitable container; slacken off the bleed screw at the back of the instrument.

Note ...
The gauge will have to be lifted from the console to allow access to the bleed screw (Detail 'A' on Fig.41) located beneath the gauge.

(2) Set the relay for bleeding by mounting a bleed clamp (Item K99, Sect.2, Chap.4) about the base of the relay between the indicated lines on the relay body (similar to detail 'B' on Fig.41); do not over-tighten the two clamp screws.

(3) Build up pressure in the BLUE system by operating the BLUE rig pump until discharging fluid from the BLUE system gauge is observed to be free of air. Screw up the bleed connection and lock.

(4) Continue pumping until the gauge reads 3000 p.s.i., then remove the bleed clamp from the relay body. Stop pumping and operate the tailplane control to exhaust the BLUE accumulators. Check that the BLUE hydraulic gauge indicates zero pressure.

(5) Build up system pressure and operate the controls several times to check the response of the BLUE hydraulic gauge.

(6) Repeat the above operations for the YELLOW system pressure gauge and Dunlop relay Type ACM. 18570 (post mod.611).

RED, GREEN, BLUE AND YELLOW SYSTEMS FILLING

WARNING ...
Attention is called to WARNING (8) following para.132.

158. Filling of general services reservoir (RED and GREEN), and header tanks (BLUE and YELLOW) must be carried out as follows :-

(1) Remove the blanking cap from the reservoir pressure filling connection (Fig.24), and couple up the replenishing can (Item H9, Sect.2, Chap.4).

(2) Ensure that the wings are folded.

(3) With the undercarriage down and the air brake up, exhaust the RED (No.2) and GREEN (No.1) hydraulic accumulators by operating the flaps, and the brake RED (No.1) accumulator by operating the parking brake; exhaust the BLUE (No.1 and 2) accumulators and the YELLOW (No.1 and 2) accumulators by gently operating the tail plane.

(4) Check that the accumulator and expansion cylinder pressures conform to those given in Table 1 and 2; rectify where necessary.

(5) Select BLUE system on the priming cock and operate the priming hand pump (Fig.11) until the BLUE priming gauge registers 60 p.s.i.

(6) Operate the tailplane control slightly to release any fluid in the header tank pressurizing jack, and then check that the mechanical in-

dicator flap (Fig.7) on the header tank shows full (i.e. full area of white flag showing); this indicator can be viewed through the window in the rear wall of the wheel well.

(7) Operate the release valve adjacent to the priming pump and observe the fluid passing through the sight glass. Repeatedly pressurize and depressurize the system until the released fluid (through the sight glass) is clear of air bubbles. Finally, pressurize the BLUE system to 60 p.s.i.

(8) Select YELLOW system, on the priming cock, and repeat for the YELLOW system, the operations given in sub-para.(5), (6) and (7).

(9) Top up the reservoir using the replenishing can until fluid flows from the overflow pipe. On post mod.1184 aircraft, the fluid level must be in line with the mark on the sight glass when the wheels are on the ground. The level must not drop more than 0.2 in. in 15 mins with 15 p.s.i. pressure in the reservoir; a greater drop in the level indicates that the fluid is aerated.

BLUE AND YELLOW SYSTEMS OPERATIONAL CHECKS

159. Proceed as follows :-

(1) Charge both header tanks as detailed in para.158.

(2) Select BLUE system on the priming cock and pressurize the system (using the priming hand pump) until the relief valve opens in the release/relief valve. This can be checked by pumping very slowly, and noting the start of flow through the sight glass. Check that the valve relieves at 100-110 p.s.i. (Fig.11).

(3) Maintain tank pressure at 100 p.s.i. and check for leakage at the BLUE pump shaft, seal drain, pump suction line and all return lines. There must be no leakage.

(4) Select YELLOW system on the priming cock and repeat the tests for the YELLOW system as in sub-para.(2) and (3).

(5) Connect the hydraulic servicing trolley to the BLUE and YELLOW ground test connections (Fig.12).

(6) In conjunction with an electrical tradesman, plug in a 24V d.c. supply to the aircraft; check that there are no lights illuminated on the centralized warning panel (Item 28, Fig.16), the exception could be (depending upon their position) wing fold, radome, or observer's hatch unlocked.

(7) With the M (Mute) push button in the flight position (IN), press the G.T. button (ground test button), to the right of Item 28, Fig.16, to illuminate all low-pressure warning indicator lights (generators, hydraulics (BLUE and YELLOW), fuel, oil pressure, fire, cabin pressure, oxygen, A.S.I. and wing fold); the port and starboard centralized warning attention lights will also flash when the low pressure warning indicator lights are on.

(8) The audio warning circuit and centralized system warning lights will also operate at this stage, and must be cancelled by depressing the spring-loaded cancel button (marked C) to the right of Item 28, Fig.16.

(9) Check that the emergency flying control hydraulic pump flow indicator (Item 15, Fig.16) is indicating BLACK, and remains at this indication throughout the test.

(10) Run the hydraulic servicing trolley until the pumps off-load and then check :-

(a) That the low-pressure warning indicator lights (Item 28, Fig. 16) for the BLUE and YELLOW hydraulic pressures have been extinguished.

Note ...
Do not leave the M (Mute) push button for the centralized warning panel in the flight position (IN) for longer than is absolutely necessary.

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(b) That the cockpit gauges (Item 9, Fig.16) read 3100 - 3150 p.s.i. and compare them with the gauges on the hydraulic servicing trolley.

(c) That both (No.1 and 2) BLUE and YELLOW accumulator air pressure gauges read 3050 - 3125 p.s.i. (Fit Turner gauges to the No.2 accumulators on post mod. 933 aircraft).

(d) That both BLUE and YELLOW expansion cylinder air pressure gauges read 48 - 52 p.s.i.

(e) That the BLUE and YELLOW priming pressure gauges (Fig.11) read 45 - 60 p.s.i.

(f) All pipes and components for external leakage.

Flying control units
leak check

160. The flying control units (aileron, tailplane and rudder) should be checked as follows :-

Note ...
When mod.933 is embodied, fit Turner gauges to the tail plane accumulator (No. 2) air charging points.

(1) With the conditions in para. 159 fulfilled, switch off the hydraulic servicing trolley and check the internal leak rate. The minimum times for the pressure to drop from 3000 p.s.i. to 2000 p.s.i., at a fluid temperature of 15 deg.C to 25 deg.C are :-

BLUE system
Main accumulators (No.1) :-
Pre mod.493...1 min.
Post mod.493...40 secs.
Tailplane accumulators (No.2) :-
Pre mod.493...$3\frac{1}{2}$ mins.
Post mod.493...$2\frac{1}{4}$ mins.

YELLOW system
Main accumulators (No.1) :-
Auto-pilot off
Pre mod.649...1 min.
Post mod.649...40 secs.
Auto-pilot on
Pre mod.649...30 secs.
Post mod.649...20 secs.
Tailplane accumulators (No.2)
Pre mod.649...$3\frac{1}{2}$ mins.
Post mod.649...$2\frac{1}{4}$ mins.

(2) With pumps still off and pressure falling, check that the BLUE low-pressure warning light comes ON at :-

1900 ± 100 p.s.i. pre mod.493 and 875
1600 ± 50 p.s.i. post mod.493 and 875

Check that the YELLOW low-pressure warning light comes ON at :-

1900 ± 100 p.s.i. pre mod.649
or 1600 ± 50 p.s.i. post mod.649

(3) Operate the hand pump rig and check that the low pressure warning lights go OFF at a pressure not greater than 300 p.s.i. above the ON pressure, measured on the cockpit gauges.

(4) Start the pump on the hydraulic servicing trolley, and operate all controls slowly through full travel and check all moving parts for fouling.

(5) Check that the rigging movements of all control surfaces conform with those detailed in Sect.3, Chap.4.

(6) Operate all controls through full travel at maximum rate, checking for leaks past the release/relief valve during the operation of the tailplane. Check that the maximum pressure recorded on the BLUE and YELLOW priming gauges (Fig.11) does not exceed 75 p.s.i.

(7) Check all controls for judder. A slight rudder or aileron tremble during operation is permissible, provided that it can be stopped by lightly holding a trailing edge with one hand. The tailplane must be judder-free, and all surfaces must operate smoothly over their full range.

(8) Check the break-out forces of all controls, detailed in Sect.3, Chap.4; these tests are to be made with both BLUE and YELLOW sys-

tems running, and with each system separately. When testing each system separately, the accumulators of the dead system must have been exhausted by several movements of the tailplane.

Autopilot operational check

Note ...
This operational check is carried out to test only the hydraulic system of the autopilot, and when satisfactorily completed it must not be assumed that the autopilot is serviceable unless reference has been made to the autopilot servicing given in A.P.4647A, Vol.1, Book 2, Cover 1, Sect.5, Chap.2, Group D3.

161. With the hydraulic servicing trolley YELLOW pump running, carry out an autopilot operational check as follows :-

(1) Operate the autopilot test circuit to give the actuators unrestricted stroke (A.P.4647A, Vol. 1, Book 2, Cover 1, Sect.5, Chap. 2, Group D3).

(2) Check that aileron movement is 5 deg. UP, and 5 deg. 30 min. DOWN. Repeat several times.

(3) Switch off the autopilot and check that the actuators return to the neutral position.

(4) With the autopilot still switched off and the YELLOW pump running, jar the control column by a sharp tap on the top of the handgrip in a fore and aft direction. Repeat several times and check that the autopilot actuators remain in the neutral position.

(5) Operate the autopilot test circuit to give the actuators restricted stroke. Check that aileron movement is $\pm 2\frac{1}{2}$ deg. from neutral. Repeat several times.

(6) Switch off the autopilot and check that the actuators return to the neutral position.

Ram air turbine operational check (pre mod.216)

162. Check the ram air turbine driven hydraulic pump as follows :-

(1) Ensure that the area in the vicinity of the ram air turbine (Fig. 8; and Item 49, Fig.5) is clear of obstructions and, supporting the ram air turbine door, move the ram air turbine selector lever (Item 26, Fig.16) forward to unlock, extend the ram air turbine and lower it gently to its fully extended position; check that the hinged door opens without fouling, that the down-lock pin engages and that the pump is correctly locked in the out position.

WARNING ...
In addition to being automatically locked at the extended position, the ram air turbine is backed up by a spring strut; with the aircraft on the ground, care must therefore be taken when extending the ram air turbine assembly into the extended position by hand.

(2) Fit an air diffuser (Item H13, Sect.2, Chap.4) to the turbine casing and run the ram air turbine at maximum speed by means of the Palouste engine starter.

Note ...
The Palouste engine, installed in the L.P. air starting trolley, is cleared for 2 lb./sec. air delivery at 35000 max. r.p.m. and 560 deg.C. max. j.p.t. for one minute. The flexible hose used to deliver air to the ram air turbine is also cleared to these conditions for operations at three minute intervals.

(3) With the servicing trolley hydraulic pumps inoperative, and the ram air turbine pump running, check that the YELLOW low-pressure warning light is ON, that the BLUE low-pressure warning is OFF (Item 28, Fig.16) and that the emergency ram air turbine hydraulic pump flow indicator (Item 15, Fig.16) indicates WHITE.

(4) With all controls stationary, check that the emergency pump offloads and that the cut-out pressure on the BLUE system cockpit gauge is 3000 - 3050 p.s.i.

Note ...
Post mod.493 aircraft will take approximately twice as long as unmodified aircraft to reach cut-out pressure.

(5) Operate all controls slowly, and check that the emergency pump cuts-in and cuts-out regularly and that the cut-in pressure is not less than 2700 p.s.i. Check that the

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BLUE hydraulic warning light is OFF and that the emergency ram air turbine hydraulic pump flow indicator indicates WHITE.

(6) Stop the Palouste engine starter, remove the diffuser from the ram air turbine casing and retract the ram air turbine into the fuselage.

Note ...
The ram air turbine down-lock pin must be withdrawn manually (Fig.8) before the turbine can be retracted.

(7) On completion of the above tests, recheck the internal leak rate detailed in para.160.(1).

Ram air turbine check
(post mod.216)

163. Check the ram air turbine driven hydraulic pump as follows :-

(1) Ensure that the area above the ram air turbine (Item 62, Fig.5) is clear of obstructions. Move the R.A.T. selector lever (Item 26, Fig.16) to the unlocked position. The R.A.T. assembly must lock in the extended position with the assistance of 15 lb. load applied gradually to the rim of the turbine, and held for 5 secs. (Fig.10). Check that the doors open without fouling and that the turbine is correctly locked in the extended position.

(2) Fit an air diffuser (Item H13a, Sect.2, Chap.4), to the turbine casing. See Note in para.162.

(3) Carry out the tests detailed in para.162, sub-paras.(3), (4) and (5).

(4) Stop the Palouste starter, remove the diffuser and retract the ram air turbine assembly using a winch (Item K103, Sect.2, Chap.4) shown on Fig.10.

(5) Recheck the internal leak rate detailed in para.160 (1).

RED AND GREEN SYSTEMS OPERATIONAL CHECKS

Note ...
All references to low-pressure warning indicators can be ignored when mod.249 is embodied.

164. Carry out the RED and GREEN systems check as follows :-

(1) Fill the general services reservoir (para.158) with the wings folded.

(2) Connect the hydraulic servicing trolley to the RED and GREEN ground test connections (Fig.12).

(3) In conjunction with an electrical tradesman, plug in a 28V d.c. supply to the aircraft.

(4) Apply 15 p.s.i. air pressure to the reservoir, via the pressurizing test connection (Fig.24) on the rear wheel well wall of the starboard main wheel well. Check the RED and GREEN suction and return lines for leaks.

WARNING ...
Release the general services reservoir air pressure before dismantling any part of the hydraulic system.

(5) Switch on aircraft instruments and check that the RED and GREEN low-pressure warning indicators (Item 9, Fig.16) are showing WHITE, and that the RED and GREEN hydraulic fluid temperature gauges (Item 31 and 32, Fig.16) read approximately the ambient temperature prevailing at the time. (This assumes that the RED and GREEN systems have not been run immediately prior to the above tests).

(6) Check that the RED and GREEN system accumulators (No.1, 2, 3 and 4) are exhausted of hydraulic pressure, then operate the GREEN pump on the hydraulic servicing trolley and check that the GREEN low-pressure warning indicator shows BLACK at 2700 ± 100 p.s.i. measured on the GREEN accumulator (No.1) gauge in the starboard wheel well.

(7) Select the following services to these positions :-

(a) Wings - FOLD.

(b) Undercarriage - Normal DOWN.

(c) Hook - UP.

(d) Flaps - UP.

(e) Air brake - UP.

(8) Check for external leaks in the main GREEN high-pressure lines and in the lines from valves to jacks.

(9) Stop the pump on the hydraulic servicing trolley and check the internal leakage of the GREEN system by noting the time for accumulator (No.1) to fall from 3000 p.s.i. to 2500 p.s.i. This time must not be less than $1\frac{1}{4}$ minutes. Check that the low-pressure warning indicator shows WHITE at 2550 ± 100 p.s.i.

(10) Check that the aircraft is jacked high enough to allow the air brake to be fully extended, then run the GREEN pump on the hydraulic servicing trolley and select the following services to these positions :-

(a) Wings - SPREAD (WARNING (5) and (6) following para. 132).

(b) Undercarriage - UP.

(c) Hook - Normal DOWN.

(d) Flaps - DOWN.

(e) Air brake - DOWN.

(11) Check for external leaks in the lines from all valves to jacks.

(12) Stop the GREEN pump and check the internal leakage rate of the GREEN system.

The minimum times for the pressure to drop from 3000 to 2500 p.s.i. are :-

GREEN accumulator (No.1) - $1\frac{1}{4}$ mins.
GREEN accumulator (No.3) - 20 mins.

Note ...
A Turner gauge must be used on the arrester hook accumulators (GREEN (No.3) and RED (No.4)).

(13) Retract the hook and then exhaust the GREEN accumulators (No.1) by operating the flaps.

(14) Operate the RED hand pump on the hydraulic servicing trolley and check that the RED low-pressure warning indicator shows BLACK at 2700 ± 100 p.s.i. measured at the RED accumulator (No.2) gauge in the starboard wheel well (Fig.24).

(15) Run the RED pump of the hydraulic servicing trolley, and check that the cut-out pressure given by the hydraulic servicing trolley gauges, RED accumulator (No.1) gauge, and RED accumulator (No.2) gauge, is 3125 - 3175 p.s.i.

(16) When a windscreen wiper is fitted, (mod.346) :-

(a) Arrange an adequate supply of water to wet the windscreen for the duration of the test.

(b) Check that with the windscreen control lever in the PARK position the wiper remains stationary.

(c) Slowly move the lever to the RUN position, and check that all linkage is free and operating smoothly.

(d) Run slowly for 5 mins, keeping the windscreen wet, and return lever to the PARK position.

CAUTION ...
Do not run wiper fast under any circumstances.

(17) Retract the flaps (Item 1 and 18, Fig.16), open the radome (Fig. 27) and check that the RED accumulator (No.3) pressure is 1475 - 1525 p.s.i.

(18) Check for external leakage in all main RED system lines and in the lines from all valves to jacks.

(19) Stop the pump and check the internal leakage rate of the RED system. The minimum time for

the pressure of RED accumulator (No.2) to drop from 3000 to 2500 p.s.i. is 2 minutes.

(20) Check that the low-pressure warning indicator shows WHITE at 2550 ± 100 p.s.i.

(21) Run the RED pump of the hydraulic servicing trolley, and select the services as below :-

(a) Undercarriage - emergency DOWN.

(b) Hook - emergency DOWN.

(c) Flaps - DOWN.

(d) Radome (pre mod.1080) - CLOSED.

(22) Check for external leaks in the lines from all valves to jacks.

(23) Stop the RED pump, and check the internal leakage rate of the RED system. The minimum times for the pressure to drop from 3000 to 2500 p.s.i. are :-

(a) RED brake accumulator (No.1) - 40 mins.

(b) RED main accumulator (No.2)

Pre mod.758 - $1\frac{3}{4}$ mins.

Post mod.758 with 28V d.c. supply OFF - $2\frac{1}{2}$ mins.

With 28V d.c. supply ON and scanner parked - 10 secs.

(24) Select hook normal DOWN.

(25) Start the GREEN pump of the hydraulic servicing trolley and select the services as follows :-

(a) Wings - SPREAD (WARNING (5) and (6) preceding para. 133).

(b) Undercarriage - UP, then normal DOWN.

(c) Air brake - UP.

(d) Hook - UP.

(26) With both pumps stopped, exhaust GREEN accumulator (No.1) by operating the flaps, and RED accumulator (No.2) by operating the parking brake. Check for discharge of air and fluid from the reservoir relief valve (Fig.21).

Flaps check

165. Check the operation of the flaps finally as follows :-

(1) Using the RED pump of the hydraulic servicing trolley, select the flaps fully DOWN (Item 1, Fig. 16), then move the tailplane to the full negative position and check its angle against the figures given in Sect.3, Chap.4. Repeat raising and lowering the flaps between each operation (WARNING (5) preceding para.133), to check that the tailplane movement is consistent.

(2) Stop the RED pump, and operate the flaps to exhaust the RED accumulator (No.2).

(3) Start the GREEN pump of the hydraulic servicing trolley, retract the undercarriage and then repeat the flap and tailplane operations as given in sub-para.(1).

(4) Check that the flap/elevator unlocked warning light (Item 10, Fig.16) is illuminated when the flaps are in any position except fully locked up.

(5) Physically check that the flaps are accurately positioned when at the take-off and the down positions; these dimensional checks are to be taken at the inboard end of the inboard flap, and full information is given in Sect.3, Chap.4.

(6) Check that the flap position indicator (Item 18, Fig.16) gives an accurate indication at each setting of the flaps.

(7) Note the operating times of the flaps; the average times are to be as follows :-

UP to TAKE-OFF $4\frac{1}{2}$ to 6 sec.

TAKE-OFF to DOWN	3 to 4 sec.
DOWN to TAKE-OFF	$3\frac{1}{2}$ to $4\frac{1}{2}$ sec.
TAKE-OFF to UP	$5\frac{1}{2}$ to 7 sec.
UP to DOWN	$7\frac{1}{2}$ to 9 sec.
DOWN to UP	9 to 11 sec.

(8) Stop the GREEN pump and operate the flaps to exhaust the GREEN accumulator (No.1), and then start the RED pump of the hydraulic servicing trolley.

(9) Note the operating times of the flaps; the average times are to be the same as those given in sub-para.(7).

(10) Check that the spring strut (Sect.3, Chap.4) pre-load is adequate to overcome the servo-valve operating force after static periods of 5, 10 and 30 minutes.

Undercarriage retraction tests

166. Undercarriage retractions must be carried out as follows :-

(1) In conjunction with an electrical tradesman, and with an electrical supply on the aircraft, check that all three green lights of the undercarriage indicator (Item 10, Fig.16) are illuminated with the undercarriage down and locked.

(2) With the RED and GREEN pumps running (hydraulic servicing trolley), time the operation of the undercarriage from selection of UP (Item 11, Fig.16) to the extinction of the red undercarriage indicator lights, and then from the selection of normal DOWN to the appearance of the green indicator lights.

(3) Check that the nose and main undercarriage doors function smoothly, and securely lock in both the up and down positions. Retract and lower the undercarriage, checking the times and ensuring that they conform with those given below :-

RETRACTION	
Nose undercarriage	2 to 4 sec.
Port main undercarriage	5 to 6 sec.
Starboard main undercarriage	5 to 6 sec.

EXTENSION	
Nose undercarriage	4 to 6 sec.
Port main undercarriage	6 to 8 sec.
Starboard main undercarriage	6 to 8 sec.

(4) Retract the main undercarriage. Stop both pumps and exhaust the RED accumulator (No.2) and GREEN accumulator (No.1) by operating the flaps.

(5) Start the RED pump on the hydraulic servicing trolley, wait until the pump off-loads and then time the extension of the undercarriage from selection of EMERGENCY DOWN to the appearance of the green indicator lights.

(6) Check that both the nose and main undercarriage doors function correctly. Restart the GREEN pump, retract the undercarriage and repeat the EMERGENCY DOWN extension. Retract and lower the undercarriage, ensuring that the average times conform to those given below :-

EMERGENCY EXTENSION TIMES	
Nose undercarriage	4 to 6 sec.
Port main undercarriage	6 to 8 sec.
Starboard main undercarriage	6 to 8 sec.

Nose wheel steering check

167. The nose wheel steering must be operationally checked as follows :-

(1) With the nose wheel clear of the ground, and the GREEN pump of the hydraulic servicing trolley operating, move the clutch lever on the side of the nose wheel leg to the engaged position.

(2) Operate the nose wheel steering wheel (Item 22 and 23, Fig.16) in the cockpit to give full lock port and then full lock starboard. Check that the clutch engages and that the steering angle is 45 deg. to port and to starboard from the central position.

(3) With the nose wheel at full lock to port, release the hand wheel and check that the nose wheel returns immediately to the neutral position. Repeat with full lock to starboard, and then repeat with port and starboard intermediate positions.

Air brake check

WARNING ...
Attention is called to the WARNING (9) preceding para.133.

Note ...
To prevent high fluid temperatures developing, the airbrake must not be left extended for more than 5 mins, with GREEN pressure being applied.

168. The air brake must be operationally checked as follows :-

(1) Ensure that the aircraft is jacked high enough to enable the air brake to clear the ground; start the GREEN pump of the hydraulic servicing trolley.

(2) Select the undercarriage DOWN, and then select air brake OPEN by operation of the throttle switch (Item 7, Fig.16); check that the air brake remains closed, and that the position indicator (Item 17, Fig.16) shows CLOSED and that the air brake open warning light i.e. the nose leg red light (Item 10, Fig.16) is OFF, select air brake CLOSED.

(3) Retract the undercarriage (Item 11, Fig.16) and select 50 deg. on the air brake position selector switch (pre mod.1030) (Item 13, Fig.16); select air brake OPEN by means of the throttle switch and check that the air brake opens to 50 deg. Check that the position indicator reading corresponds to the air brake position.

(4) Select air brake closed, then time the operation of the air brake from the instant of selection to 50 deg. OPEN and CLOSED positions, check that the air brake can be stopped in any intermediate position, and note the average operating times for the air brake, which must not exceed the following :-

CLOSED - to 50 deg. OPEN $3\frac{1}{2}$ sec.
50 deg. OPEN - to CLOSED $4\frac{1}{2}$ sec.

Note ...
On pre mod.249 aircraft, it is permissible for the GREEN low-pressure warning indicator to show WHITE during the movement of the airbrake. On post mod.249 aircraft the indicator is not fitted.

(6) Select the air brake OPEN, extend the undercarriage and check that the air brake closes when the nose wheel locks down. Check also that the air brake open warning light becomes illuminated as the undercarriage extends, and then goes out when the air brake closes.

(7) With the undercarriage up, select air brake OPEN, then switch off the electrical supply and operate the air brake emergency shut lever (Item 4, Fig.16) and check that the air brake closes.

(8) With the undercarriage down, air brake closed, and electrical power restored, select air brake OPEN on the throttle switch. The air brake should remain closed and the warning light OFF.

(9) Open the port access door (Panel 153, Fig.7, Sect.2, Chap.4) just forward of the air brake. Stand clear of the air brake, then select the ground servicing switch (through the access door aperture) from the FLIGHT to the GROUND position. Check that the air brake opens to 29 deg. and that the air brake open warning light becomes illuminated.

(10) Return the ground servicing switch to the FLIGHT position and check that the air brake returns to the closed position, and that the warning light is extinguished. Repeat the operations given in sub-para.(6), (7) and (8).

(11) Retract the undercarriage and open the air brake with the throttle switch. Stop the GREEN pump of the hydraulic servicing trolley and exhaust the GREEN accumulator (No.1) by operating the flaps (WARNING (5) preceding para.133).

(12) Start the RED pump and select

the undercarriage lever to EMERGENCY DOWN. Switch off the electrical supply and check that it is possible to move the air brake by the application of 120 lb. drag load, applied at the trailing edge of the air brake on the centre-line of the aircraft. After this test, restart the GREEN pump and restore electrical power, then close the air brake by the throttle switch.

Arrester hook check

169. Check the operation of the arrester hook as follows:—

(1) With the GREEN and RED pumps of the hydraulic servicing trolley running, and Turner gauges fitted to the RED accumulator (No. 3) and GREEN accumulator (No. 4) air charging valves. Select arrester hook NORMAL DOWN (Item 2, fig. 16) and check that the hook extends and that the green light (Item 12, fig. 16) is illuminated. Check that the pressure on the gauge of the RED accumulator (No. 4) is 1700 p.s.i. and on the gauge of the GREEN accumulator (No. 3) is 3125 p.s.i.

(2) Select the hook UP and check that the hook retracts and that the indicator light is extinguished.

(3) Extend the hook and measure the time for extension, then retract the hook and note the retraction time. Leave the hook in the retracted position. Carry out several operations, and obtain the average times which must not exceed those given below:—

Hook normal time DOWN	1 sec.
Hook normal time UP ..	3 sec.

(4) Stop both pumps and exhaust the GREEN accumulator (No. 1) and the RED accumulator (No. 2) by operating the flaps. Start the RED pump and let the pump off-load, then select the arrester hook to the EMERGENCY DOWN position. Check that the hook extends and that the green indicator light becomes illuminated. Check that the pressures read as follows:—

GREEN accumulator (No. 3)	1700 p.s.i.
RED accumulator (No. 4)	3125 p.s.i.

(5) Select hook UP, and check that it is possible for one man to lift the hook at least 2 ft above full down position. After this test, select hook DOWN.

(6) Without retraction of the hook, check manually that the hook returns to the central position from the maximum off-centre position each side of the centre-line of the aircraft.

Wheel brakes check

Note . . .

Checks involving Maxaret indicator rods only apply to pre-mod. 1094 *and* 1095 *aircraft.*

170. With the wheels clear of the ground, check the wheel brakes finally as follows:—

(1) With both pumps (RED and GREEN) stopped, exhaust the RED accumulators (No. 1) and (No. 2), and the GREEN accumulator (No. 1) by operating the flaps (WARNING (5) preceding para. 133) and parking brake (Item 5, fig. 16). Fit Turner gauges to each brake test point on the port and starboard brake back plates (fig. 34).

(2) Run the GREEN pump of the hydraulic servicing trolley; select the wheel brake lever to OFF and check that the Maxaret indicator rods are approximately flush with the faces of the units, and both wheels are free to rotate.

(3) On pre-mod. 249 aircraft check that both Turner gauges (view on arrow A, fig. 24) and cockpit gauges (Item 6, fig. 16) read zero. On post-mod. 249 aircraft, check that both RED main supply, and RED brake supply hydraulic gauges (RED accumulator (No. 2) system pressure, and RED accumulator (No. 1) system pressure respectively), the electrical brake gauges, and the Turner gauges read zero; check that the main GREEN supply gauge (Item 8, fig. 16) reads 3000 p.s.i.

(4) Select the wheel brakes lever to the EMERGENCY position and then to PARK. Check that pre- and post-mod. 249 aircraft conform to sub-para. (3).

(5) Return the wheel brakes lever to OFF. Apply the port wheel brake toe pedal and check that the brake pressure recorded on the port brake system increase smoothly with increase of foot pressure on the brake pedal, and that a maximum pressure of 1500–1900 p.s.i. is obtained. Repeat with the starboard brake, then with the port and starboard brakes together.

(6) Check that the Maxaret indicator rods are still flush with the faces of units when the brakes are ON and check the pressure drops quickly to zero, and that the wheels are free to rotate.

(7) Remove the port main wheel, and with the port brake on, rotate the Maxaret wheel smartly by hand in the direction of the arrow marked on the case; stop the wheel suddenly, and check that the indicator rod protrudes approximately 0·06 in. from the face of the unit and that the Turner gauge reading falls to approximately zero. Repeat several times, checking the operation of the indicator rod each time.

(8) Remove the starboard main wheel and with the starboard brake ON, check the operation of the starboard Maxaret unit as in sub-para. (7) above. Refit the main wheels.

(9) Stop the GREEN pump and exhaust the GREEN accumulator (No. 1) by repeated operations of both port and starboard brakes; note the number of full operations to exhaust the accumulator. Run the GREEN pump and repeat the test. Both runs must give at least 24 operations of the brakes.

(10) On pre-mod. 249 aircraft start the RED pump, and with the wheel brakes lever in the OFF position, check that both the cockpit gauges and the port and starboard Turner gauges show zero pressure. On post-mod. 249 aircraft, start the RED pump, and with the wheel brakes lever in the OFF position, check that the port and starboard Turner gauges and the electrical triple gauge show zero, and that both RED hydraulic gauges read 3000 p.s.i.

(11) On pre-mod. 249 aircraft, set the wheel brakes lever to the EMERGENCY position and check that both the cockpit gauges and the port and starboard Turner gauges show zero pressure. On post-mod. 249 aircraft, set the wheel brakes lever to the EMERGENCY position, and check that the port and starboard Turner gauges and the electrical triple gauge show zero, and that both RED hydraulic gauges read 3000 p.s.i.

(12) Apply the port brake, and check that the port gauge still shows zero pressure, but the port Turner gauge pressure increases smoothly with the increase of foot pressure on the brake pedal and that a maximum pressure of 1500 p.s.i. to 1900 p.s.i. is obtained. Repeat with the starboard brake, then with the port and starboard brakes together. Variation between port and starboard brake pressures must not be more than 100 p.s.i. Check that the pressure drops to zero and that the wheels are free to rotate, when pressure is released.

(13) On pre-mod. 249 aircraft, set the hand brake to PARK, and check ◀that both Turner gauges read 2400 p.s.i. minimum and that both the cockpit▶ gauges read zero. Release the brakes and check that the wheels are free to rotate. On post-mod. 249 aircraft, set the wheel brakes lever to PARK and check that both ◀Turner gauges read 2400 p.s.i. minimum, and that the cockpit▶ electrical triple gauge reads zero, and that both RED main supply and RED brake supply (RED accumulator (No. 2) system pressure, and RED accumulator (No. 1) system pressure respectively) hydraulic gauges read 3000 p.s.i. Variation between port and starboard brake pressures must not exceed 300 p.s.i. Release the brakes and check that the wheels are free to rotate.

(14) Stop the RED pump of the hydraulic servicing trolley, and exhaust

the RED accumulator (No. 2) by operating the flaps, and then exhaust RED accumulator (No. 1) by repeated operation of the wheel brakes lever from OFF to PARK. Note the number of full operations to exhaust RED accumulator (No. 1). Run the RED pump again and repeat the test. Both runs must give at least 24 operations.

(15) If the brake pressure does not drop to zero when the brakes are released after using the brake pedals, but is satisfactory when the brake lever is used, a possible cause is the failure of the master cylinder to return to the fully extended position. This can be caused by dirt on the rudder pedals or incorrect adjustment of the master cylinder eccentric spigot (para. 195).

Wing-fold check

WARNING . . .

Attention is called to WARNING (5) and (6) preceding para. 133.

171. Check the operations of the wing fold mechansim in the following manner:—

(1) With the GREEN pump of the hydraulic servicing trolley running, and with electrical power on the aircraft, select flaps (Item 1, fig. 16) to the TAKE-OFF (20 deg.) position, stop the pump and exhaust GREEN accumulator (No. 1) by repeated operation of the wheel brakes in the same manner as is given in para. 170, sub-para. (9).

(2) Check that the wing-fold lock lever (Item 24, fig. 16) is at LOCK, and that the wing-fold lever (Item 25, fig. 16) cannot be moved away from the SPREAD position. Disconnect the electrical supply and operate the flap interlock override (Item 27, fig. 16) and then check that the wing-fold lock lever can be moved to the UNLOCK position, and that the wing-fold lever can be moved to the FOLD position. Return the controls to the SPREAD and LOCK positions and restore the electrical power.

(3) Start the GREEN pump, retract the flaps and close the radome (fig. 27). Check that the radome and wing unlocked warning light is OFF (Item 28, fig. 16). Refer also to para. 159, sub-para. (6), (7) and (8).

(4) Select the wing-fold lock lever to UNLOCKED, and check that the radome and wing unlocked warning light illuminates.

(5) Select the wing-fold lever to FOLD. Check that the wings travel smoothly from the spread to the folded position. When the wings are folded, check the aileron control hoses at the wing-fold joint for chafiing and pulling on the attachment fittings.

(6) Operate the flaps up and down and check that the outer flaps remain retracted and secure while the inner flaps function in the normal way. Leave the flaps UP.

(7) With the wings still in the folded position, run the BLUE system pump, and check that both ailerons can be operated over their full range by rotating the outboard half of the Teleflex bell-crank compensator at each port and starboard rib No. 4A.

(8) Select the flaps to the take-off position, and then stop the GREEN pump. Exhaust the GREEN accumulator (No. 1) by operating the wheel brakes in the manner given in para. 170, sub-para. (9).

(9) Check that the wing-fold lever cannot be moved from the FOLD position. Disconnect the electrical supply, and operate the flap interlock override (WARNING (5) preceding para. 133), then check that the wing-fold lever can be moved to the SPREAD position. Return the wing-fold lever to the FOLD position and restore electrical power.

(10) Run the GREEN pump on the hydraulic servicing trolley and retract the flaps. Select SPREAD, and check that the wings spread smoothly and lock down, that the ailerons return to their neutral position and that the radome and wing unlocked warning light is extinguished.

(11) Fold and spread the wings, timing the operation. The average time must not exceed the following:—

From selection of FOLD
to wings folded .. 18 sec. max.

From selection of SPREAD
to wings spread .. 16 sec. max.

(12) With the aircraft standing on its wheels, and the wings loaded with internal fuel and full drop tanks, run the GREEN pump and check that the wing-fold mechanism operates correctly, and that during the folding and spreading operation warning lights operate in the correct sequence. Stop the pump and exhaust the GREEN system.

Latch pins check

171a. Check the operation of the wing-fold latch pins, with wings folded, as follows:

(1) Release GREEN system hydraulic pressure.

(2) Fit maintenance safety gags ◀(Item K143, Sect. 2, Chap. 4)▶ to sequence valve "A" roller-actuated levers, port and starboard, ensuring that the levers (painted red) are fully depressed.

(3) Connect the miniature hydraulic rig (Item H23, Sect. 2, Chap. 4) to the GREEN system.

(4) Select wings SPREAD, and using hand pump pressure ONLY, operate latch pins.

(5) Remove maintenance safety gags.

(6) Select wing FOLD, pump to withdraw latch pins, and continue pumping until GREEN system cut-out pressure is reached.

Radome check (pre-mod. 1080)

172. Check the radome operating mechanism as follows:—

(1) Run the RED pump of the hydraulic servicing trolley, and with the radome closed and locked, check that the radome and wing unlocked warning light is extinguished (Item 28, fig. 16 and refer also to para. 159, sub-para. (6), (7) and (8) for the electrical operation of the warning lights).

(2) Unlock the radome bolts and check that the radome and wing unlocked warning light is illuminated. Select the radome OPEN and check that it opens smoothly, note the time of operation from the selection to fully open position.

(3) Select the radome CLOSED and check that the radome closes smoothly and that the bolts engage correctly. Note the time of operation from selection to the fully closed position.

(4) Lock the radome bolts and check that the warning light is extinguished. Repeat the opening and closing of the radome several times and obtain the average times for these operations. Leave the radome in the closed position.

Time to open:
Pre-mod. 304 .. .. 10 sec.
Post-mod. 304 .. .. 10–15 sec.

Time to close:—
Pre-mod. 304 .. .. 8 sec.
Post-mod. 304 .. .. 8–12 sec.

(5) Stop the RED pump of the hydraulic servicing trolley, then open and close the radome until the RED accumulator (No. 2) is exhausted. Note the number of operations required to exhaust the accumulator. Run the RED pump again and repeat the test. Both runs must give $2\frac{1}{2}$ complete operations.

Miniature ground test connections check

173. Check the functioning of the miniature ground rig connections for the RED and GREEN systems as follows:—

(1) Open the top access panel in the starboard flap shroud just outboard of the starboard stub boom, and connect the miniature hydraulic ground servicing rig (Item H23, Sect. 2, Chap. 4) to the upper miniature GREEN connections (fig. 25). Operate the flaps twice.

(2) Disconnect the rig hoses and check that no leakage occurs at the connections.

(3) Open the bottom access panel in the starboard flap shroud just outboard of the starboard stub boom and repeat the operations given in sub-para. (1) and (2) above, using the lower miniature GREEN connections.

(4) Connect the rig hoses to the RED system miniature connections (fig. 25) and operate the flaps twice (WARNING (5) following para. 132).

Disconnect the rig hoses and check that no leakage occurs at the connections.

Pressure maintaining valve check

Note . . .

On pre-mod. 249 *aircraft, it is permissible for the GREEN low-pressure warning indicator to show WHITE during the movement of the airbrake. On post-mod.* 249 *aircraft the indicator is not fitted.*

174. The operation of the pressure maintaining valve must be checked as follows:—

(1) Jack up the aircraft high enough to allow the air brake to be fully extended.

(2) With the hydraulic servicing trolley (Item H22, Sect. 2, Chap. 4) GREEN pump running, and with an electrical power supply connected to the aircraft, open the GREEN alternator solenoid valve.

(3) With an alternator running on full load, and the air brake angle switch (Item 13, fig. 16) selected to 50 deg. (pre-mod. 1030), select the air brake to the 50 deg. position by means of the air brake switch (Item 7, fig. 16).

(4) As the air brake is moving toward the open position, and in conjunction with an electrical tradesman, check that the GREEN alternator (Firestreak) frequency does not vary within ±3 per cent of 2400 c.p.s., and that the alternator voltage does not vary within ±3 per cent of 115 volts during the actual movement of the air brake.

(5) Under steady conditions the variation of frequency and voltage is to be within ±1 per cent of the figures quoted above.

(6) Repeat the check given in sub-para. (4) and (5) with the air brake selected from 50 deg. to the fully closed position.

(7) The air brake operational times with the GREEN alternator ON must not exceed the following:—

From closed to 50 deg. . .	5 sec.
From 50 deg. to closed . .	5½ sec.

(8) With the filter de-icing (hydraulic) switched on, and alternator on full load, repeat the air brake selection from closed to 50 deg. and from 50 deg. to the closed position. Frequency and voltage regulation to be within the limits quoted in sub-para. (4) and (5).

(9) The air brake operational times with the GREEN alternator and heater valves ON must not exceed:—

Closed to 50 deg.	6 sec.
50 deg. to closed	6 sec.

Heater valves check

175. Check the heater valves as follows:—

(1) Check that the RED and GREEN hydraulic temperature gauges (Items 31 and 32, fig. 16) read approximately the ambient temperature prevailing at the time. (This assumes that the systems have not been run immediately prior to this test).

(2) Run the GREEN and RED pumps of the hydraulic servicing trolley and with the hydraulic cooling radiator on the trolley OFF, switch on the fuel filter de-icing switch hydraulic (Item 16, fig. 16) and run for 10 minutes; the temperature rise at the end of this time should not be less than 40 deg. C.

(3) Check that on the RED system with the de-icing switch ON, and the RED alternator (A.I.) running on full load, the alternator frequency and voltage variation is less than ±1 per cent of 2400 c.p.s. and 115V respectively.

Fuselage rocket installation check (pre-mod. 1265)

WARNING . . .

Attention is called to the WARNING (7) following para. 132 and to fig. 57.

Note . . .

When mod. 1265 *is embodied, the rocket batteries cannot be operated electrically, therefore only a manual functional check is required.*

176. The hydraulic check of the fuselage rocket installation must be carried out in conjunction with the electrical test on the installation which is given in A.P.4647A, Vol. 5. Proceed as follows:—

(1) Select the cabin air supply lever (Item 3, fig. 16) to the ON position.

(2) Disconnect the L.T. supply to the engine high energy igniter boxes (fig. 9, Sect. 4, Chap. 1).

(3) In conjunction with an arma-

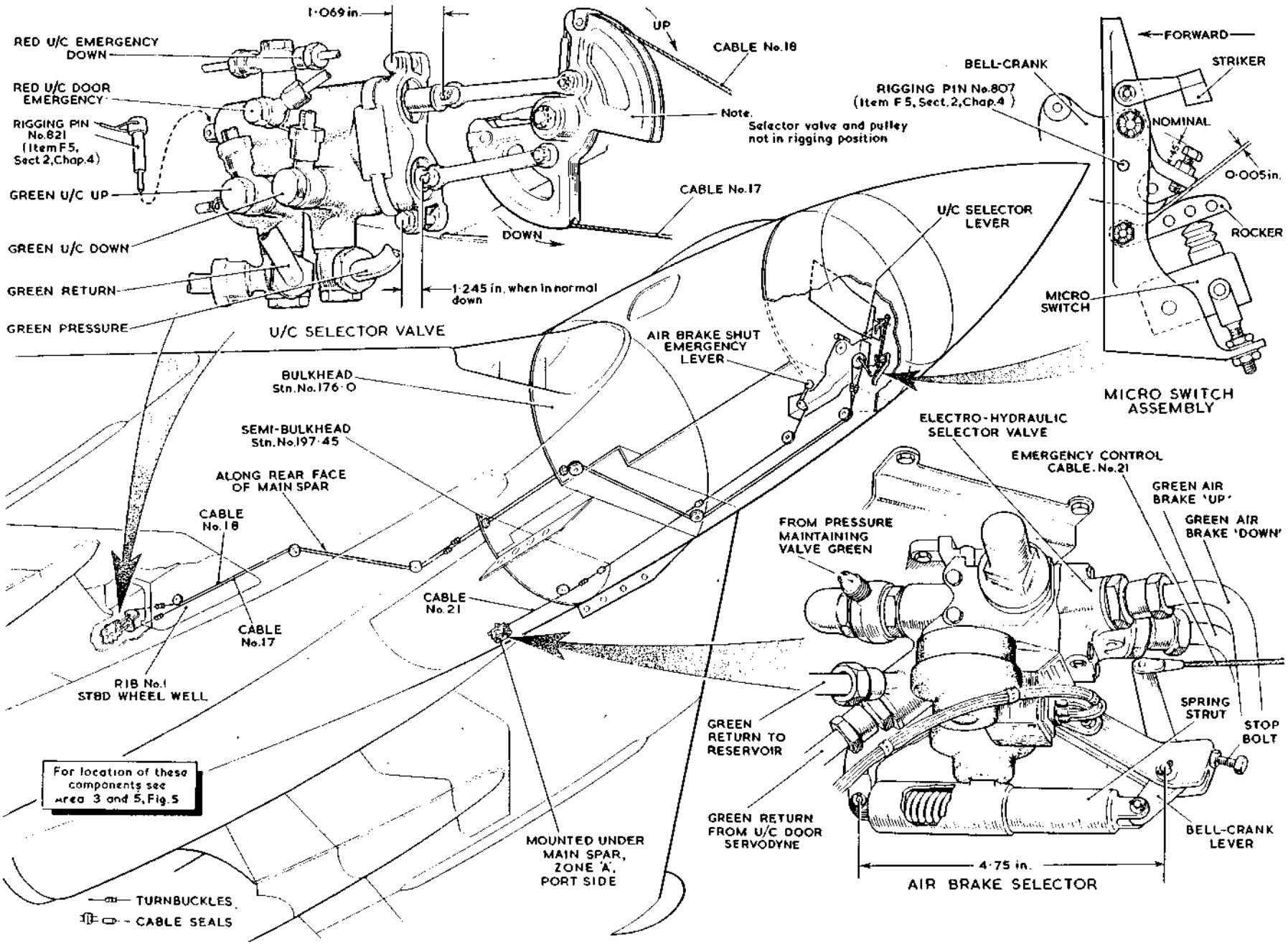


Fig. 49. Air brake and undercarriage selector controls

ment tradesman, insert and close the armament ground test key. (Item K37, Sect.2, Chap.4).

(4) Run the hydraulic servicing trolley GREEN pump. Select EXTEND and check that the AMBER warning light (Item 19, Fig.16) is ON when either rocket battery is not fully retracted.

(5) Select NORMAL, and check that the warning light goes out when the rocket batteries are fully retracted.

(6) Select the Master armament selector switch (Item 20, Fig.16) to R.B., the Rocket batteries selector (Item 21, Fig.16) to FUSELAGE, and depress the weapons button.

(7) Check that the AMBER warning light comes on, the rocket batteries extend and, after 3 secs. delay, retract together. The AMBER warning light should then go out.

(8) Repeat sub-paras.(4) to (7) six times, allowing 12 secs. to elapse between each operation. Check that the rocket batteries extend and retract together.

(9) Stop the hydraulic servicing trolley, and release the GREEN system main accumulator (No.1) pressure, by operating the flaps. Pressure should remain in the rocket installation accumulator (No.2).

(10) Disconnect the electrical supply, and insert the locking pin (Item K100, Sect.2, Chap.4), in the selector valve. Check that the rocket batteries extend and remain extended.

(11) Remove pin, and check that the rocket batteries fully retract; refit pin and batteries should partially extend. Check that the GREEN accumulator (No.2) is exhausted.

RIGGING OF HYDRAULIC CONTROLS

Undercarriage control rigging

177. The undercarriage control circuit is rigged as follows :-

(1) Select the undercarriage selector lever (Item 11, Fig.16) to the DOWN position.

(2) Insert a rigging pin No.807 (Item F5, Sect.2, Chap.4) into the bellcrank lever and mounting bracket (Fig.49) located inside the throttle box in the cockpit.

(3) Adjust the length of the connecting rod so as to give a 0.005 in. clearance between the bell-crank cam and the rocker arm as shown.

(4) Insert a rigging pin, No.821 (Item F5, Sect.2, Chap.4) into the undercarriage selector valve located on the outboard face of the starboard rib No.1. The pin is inserted through the plunger and extension tube with the plungers in the mid-position (normal DOWN).

Note ...

The forkends are adjusted during assembly of the valve to the measurements shown in Fig.49.

(5) Connect the cable runs No.17 and 18 and tension to 20 lb.

(6) Remove both rigging pins.

(7) In conjunction with an electrical tradesman, select undercarriage UP and check that contact on the micro switch under the bellcrank lever is not made, and that the contacts on the microswitches operated by the striker bolt and anvil are made.

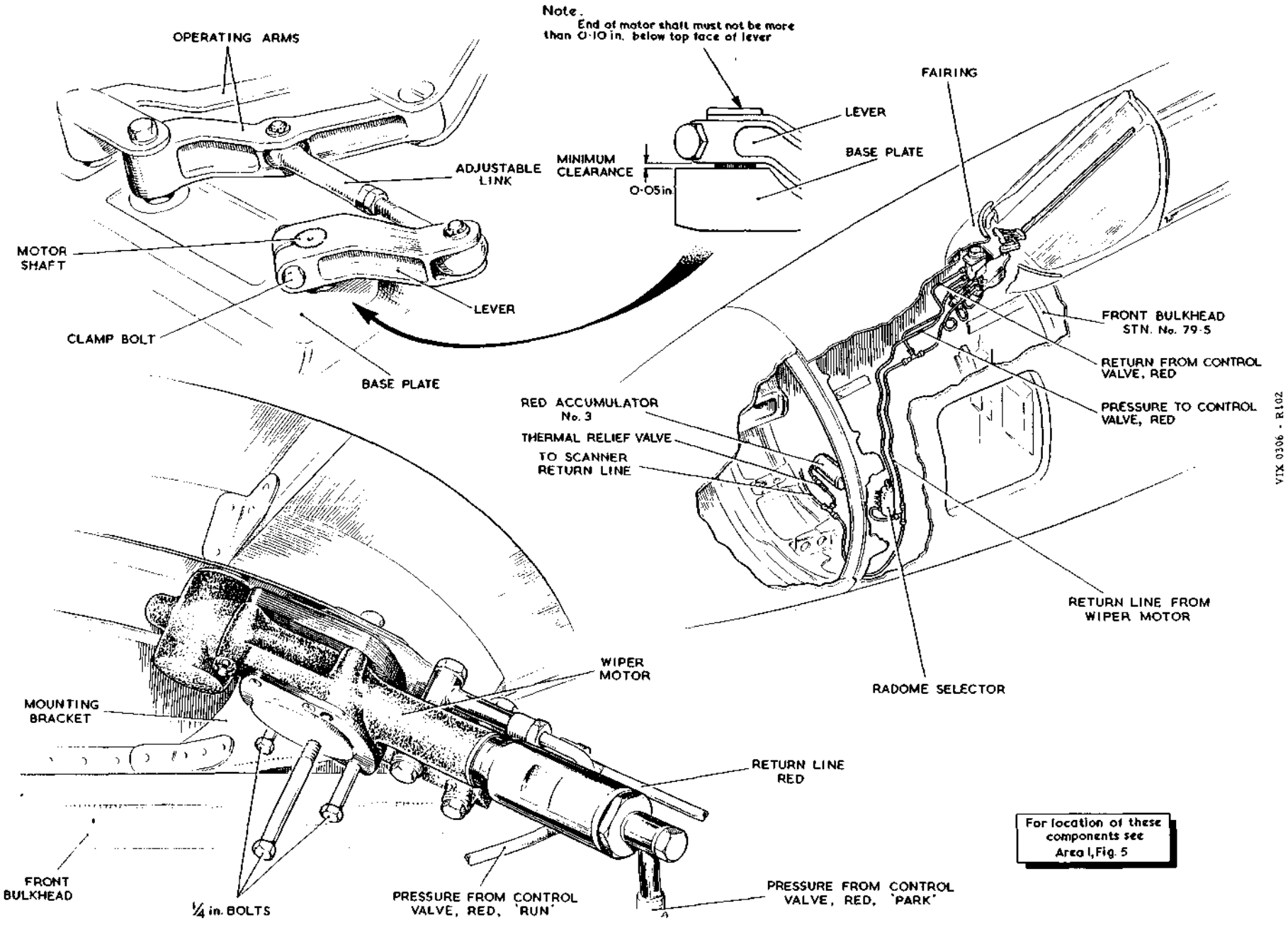
(8) Check the system for freedom of movement and for normal and emergency selections.

Ram air turbine release control rigging (pre mod.216)

178. The ram air turbine release control must be rigged as follows:-

(1) Place the emergency flying control hydraulic pump selector (Item 26, Fig.16) in the aft position.

(2) Check that the release unit is closed and locked (Fig.9) with the spring locking clip engaged with the notch in the cam.



For location of these components see Area 1, Fig. 5

Fig. 50 Windscreen wiper installation (1)

◄ Annotation ►

RESTRICTED

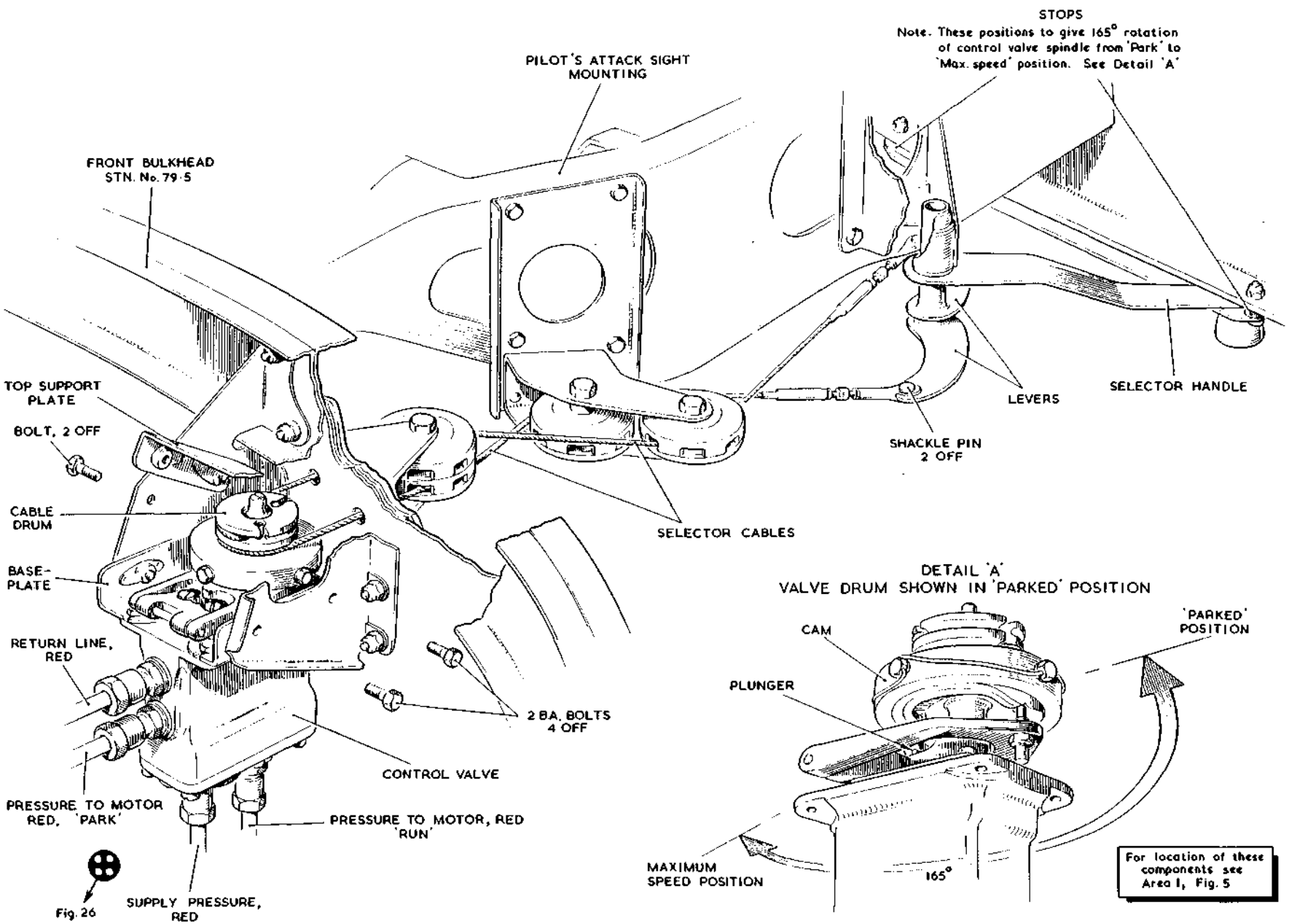


Fig. 51. Windscreen wiper installation (2)

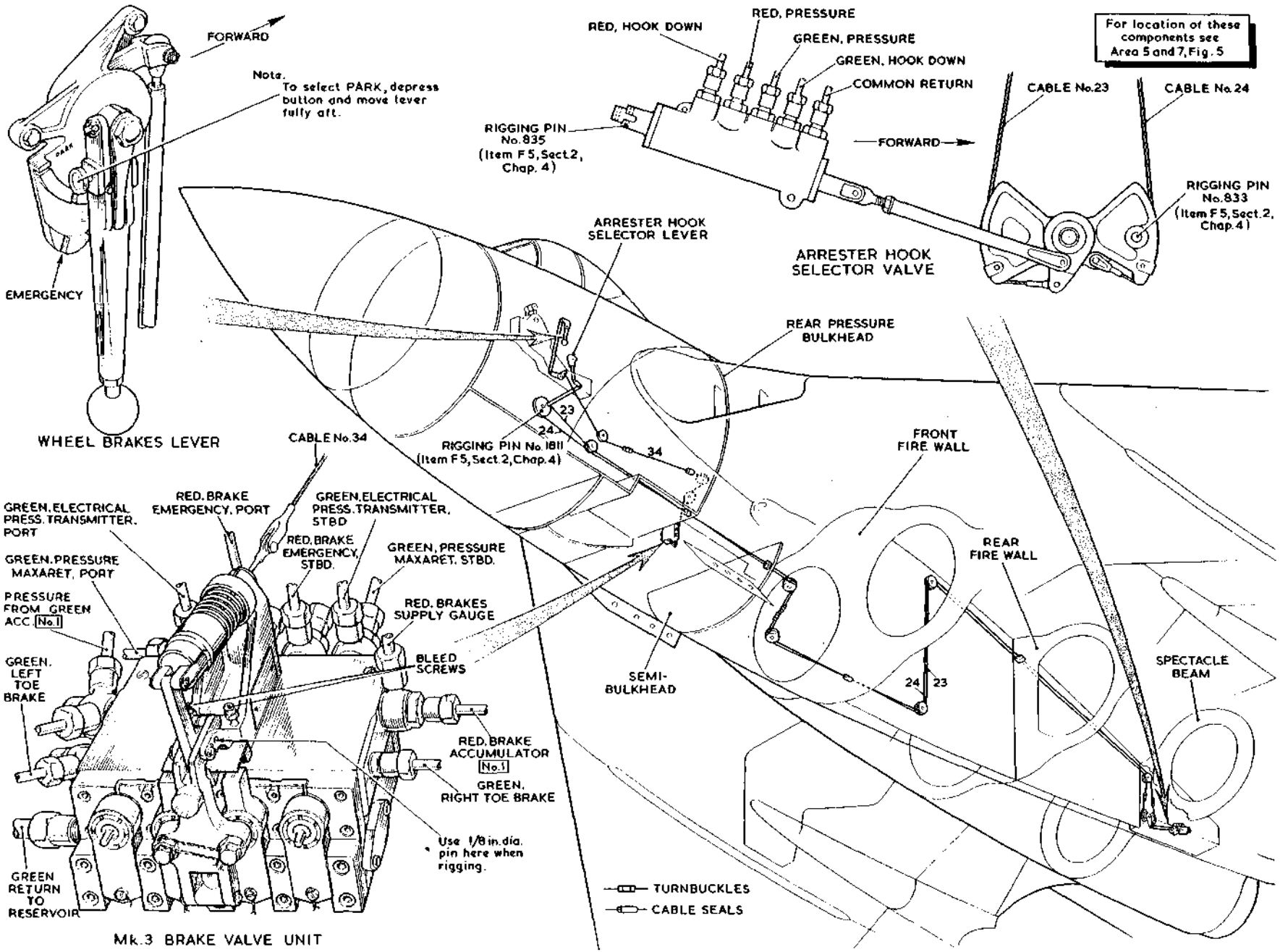


Fig. 52. Parking brake and arrester hook selector controls

(BRAKE LEVER LOCKING DELETED, DISTANCE PIECE ADDED)

(3) Connect the cable run (No.31) and tension until the control spring in the trip mechanism is just beginning to compress (at a load of approx. 5 lb.).

(4) Check the operation of the release and note that the control spring returns the trip mechanism to the same position.

Note ...
The loading of the control spring can be increased by slackening the 4 B.A. clamping bolt (through the tube), and the cap nut lock-nut, and screwing the cap nut further on to the housing.

Ram air turbine release control rigging (post mod.216)

179. The ram air turbine release control is rigged as follows :-

(1) Place the emergency flying control hydraulic pump selector (Item 26, Fig.16) in the aft position.

(2) Check that the release unit (Fig.10) is in the locked position.

(3) Connect the cable run (No.31) and tension until the control spring in the trip mechanism is just beginning to compress (at a load of approx. 5 lb.).

(4) Check the operation of the release and note that the control spring returns the catch assembly to the locked position.

Note ...
The loading of the control spring can be increased by slackening off the lock-nut, and screwing the cap nut further on to the housing, then tighten lock-nut.

Air brake emergency shut control rigging

180. The air brake emergency shut control is rigged as follows :-

(1) Place the air brake emergency shut lever (Item 4, Fig.16) to the SHUT position.

(2) Retract fully the lever stop on the electro-hydraulic selector valve lever, check that the spring strut is the length given in Fig.49 and adjust the lever stop to allow operation of the solenoid with no overtravel when the operating lever is hard on the stop.

(3) With the operating lever against the stop, connect the cable run (No.21) and tension to 25 lb.

(4) Carry out a functional check as detailed in para.168.

Windscreen wiper arm setting

181. The windscreen wiper arm is fitted as follows :-

(1) Set the adjustable link (Fig.50) to the approximate mid-position (2.53 in. between centres).

(2) Set motor to the PARK position, and fit the lever to the motor shaft in the nearest position that will leave a minimum gap of 0.10 in. between the inner edge of the blade and the port outer edge of the glass panel.

(3) Set the blade position, if necessary, by adjusting the link between the limits of 2.35 in. and 2.71 in. between centres.

(4) Leave a minimum of 0.05 in. between the lever and the baseplate, and ensure that the end of the motor shaft is not more than 0.1 in. below the top face of the lever (Fig. 50).

(5) Attach a spring balance at the point of attachment of the blade to the wiper arm.

(6) Apply a load, normal to the windscreen, just sufficient to remove the blade from the glass.

(7) Adjust the special nut securing the spring which bears on the wiper arm, to give a spring balance load of 8 lb. $\pm \frac{1}{2}$ lb. when the conditions in (6) are satisfied.

Parking brake rigging

182. The parking brake control is rigged as follows :-

(1) Place the wheel brakes lever (Item 5, Fig.16) to the EMERGENCY position (Fig.52).

(2) Tension cable run (No.34) until an 1/8 in. dia. pin can pass freely

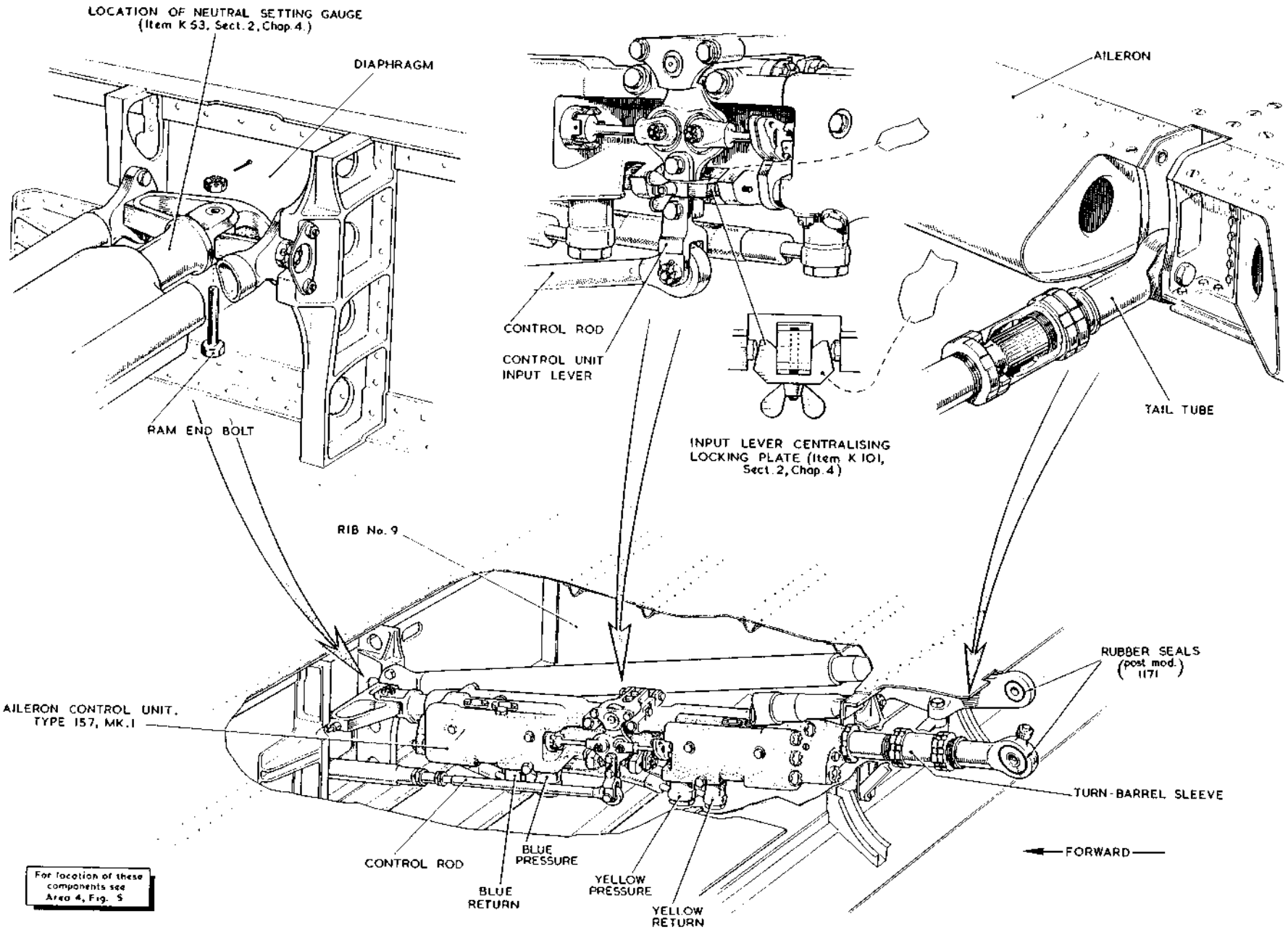


Fig.53 Aileron control unit

Steering seal and tail tube attachment ▶

through the rigging hole in the operating arm of the Mk. 3 brake valve unit; this is located on the aft face of the rear bulkhead at Stn. 176·0 in.

(3) Select PARK on the wheel brakes lever and check that the lever on the Mk. 3 brake valve unit is fully OPEN.

(4) Select OFF on the wheel brakes lever and ensure that the control spring returns the brake unit lever and cable (No. 34) to the closed position.

(5) Check the functioning of the brakes as detailed in para. 170.

Arrester hook control rigging

183. The arrester hook control circuit is rigged as follows:—

(1) Place the arrester hook selector lever (Item 2, fig. 16) to the DOWN position.

(2) Insert a rigging pin No. 1811 (Item F5, Sect. 2, Chap. 4) through the pulley bracket casting and pulley (fig. 52) below the left-hand console.

(3) Set the connecting rod to a nominal length of 10·17 in., and adjust it to fit between the arrester hook selector lever and the pulley; tighten the connector lock-nuts, and remove the rigging pin.

(4) Insert a rigging pin No. 833 (Item F5, Sect. 2, Chap. 4) into the terminal pulley quadrant (fig. 52) just aft of the spectacle beam.

(5) Connect cable runs (No. 23 and 24) and tension the cables to 20 lb.

(6) Insert a rigging pin No. 835 (Item F5, Sect. 2, Chap. 4) into the hook selector valve, and adjust the length of the connecting rod which connects the selector valve to the quadrant pulley so that it can be assembled.

(7) Remove all rigging pins, and carry out a functional check as detailed in para. 169.

REMOVAL AND INSTALLATION

WARNING . . .

The WARNING following para. 132 must be read before any of the removal and installation procedures are commenced.

Note . . .

(1) *When hydraulic components are removed or pipelines are disconnected, the deposits of anti-seize compound, ZX–28, must be removed, using methylated spirits, and all pipelines, etc. blanked off. Before reassembly a thin smear of anti-seize compound ZX–28 must be applied to threads and collars.*

(2) *When new ¼ in. O.D. pipes are fitted outer sleeves AGS 2111 must be fitted in place of AGS 904/B (mod. 1244).*

(3) *When phosphor bronze bonding strips are removed, replace with zinc strips, and coat with PX–3 protective compound (mod. 1326).*

AILERON CONTROL UNIT, TYPE 157

Removal

184. An aileron control unit (fig. 53) is removed as follows:—

(1) Remove access panels No. 91, 95, 203, 204 and 210 (port) or 122, 125, 231, 232, 233 (starboard) (fig. 6 and 7, Sect. 2, Chap. 4) to the appropriate control unit.

(2) With the ailerons in neutral, ensure that all hydraulic pressure is released from the BLUE and YELLOW hydraulic systems (para. 136).

(3) Remove the insulating sock and using two C-spanners (Item K94, Sect. 2, Chap. 4), disconnect the aileron from the control unit (fig. 53) by unscrewing the turn-barrel locknuts and screwing the barrel on to the control unit until the tail tube becomes disconnected.

(4) Remove the tail tube from the aileron.

(5) Disconnect the control unit input lever from the control rod.

(6) Remove the pressure and return lines of the BLUE and YELLOW systems and blank off with suitable blanks both the control unit and the hydraulic system pipe lines.

(7) Remove the bolt anchoring the control unit to the diaphragm between ribs No. 9 and 10.

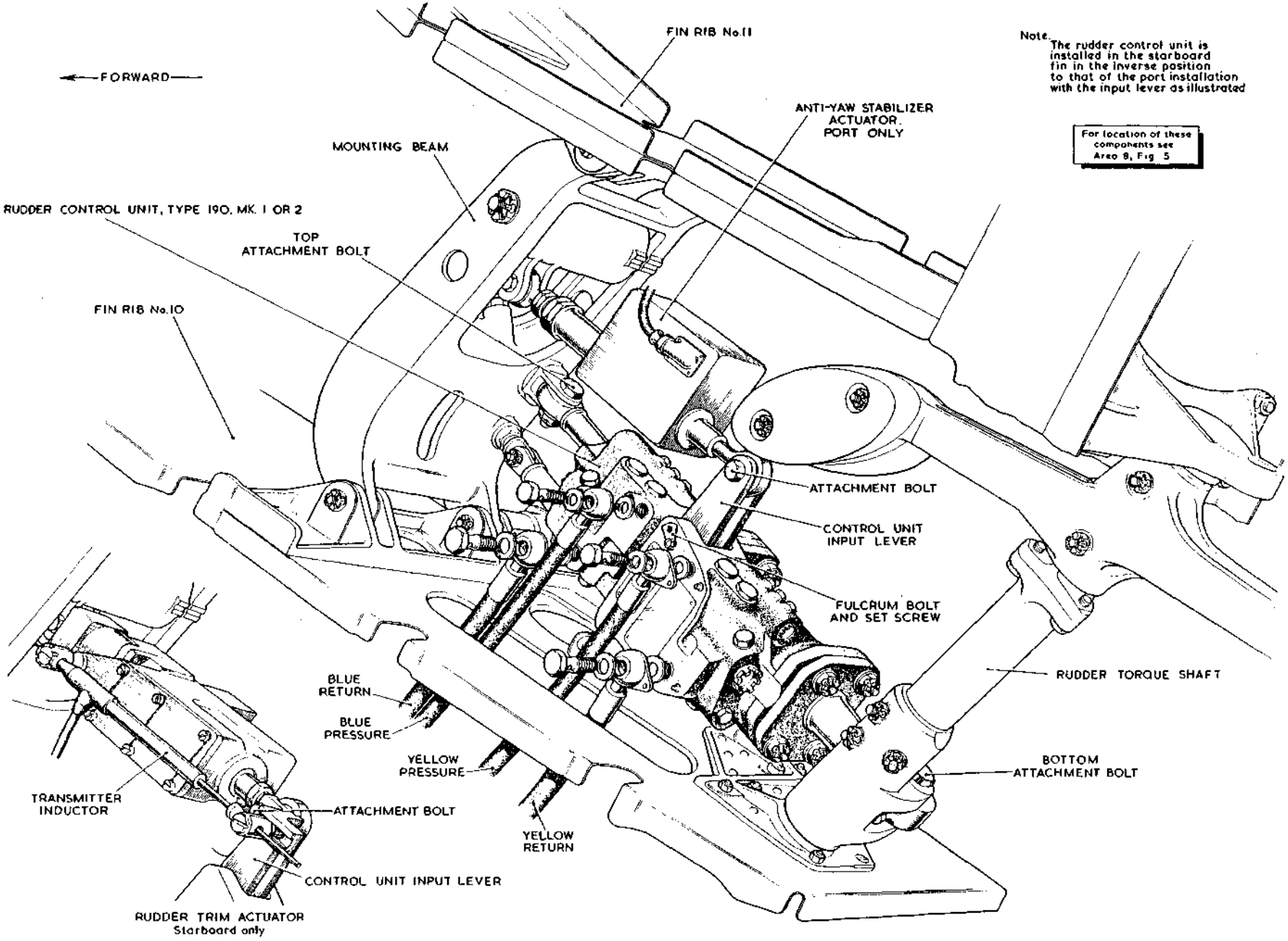


Fig. 54. Rudder control unit, port

(8) Withdraw the control unit through the access hole in the aileron shroud.

Installation

185. Prior to its installation, the replacement control unit should be stroked over its full range by a hand pump rig to check its operation. The control unit is then installed in the aircraft as follows:—

(1) Remove the tail tube and eye-end from the control unit, and attach it to the aileron.

(2) With the hand pump rig, extend the control unit 2·60 in. from the closed position (fig. 53) and check this setting with a neutral setting gauge (Item. K53, Sect. 2, Chap. 4).

(3) Fit an input lever centralizing locking plate (Item K101, Sect. 2, Chap. 4) to the control unit and mount the control unit in the wing by assembling the ram end of the unit to the wing attachment by means of the ram end bolt.

(4) Fit the insulating sock and lower the aileron, engage the splines of the tail tube with the control unit, and then start the threads of the turnbarrel simultaneously at both ends.

(5) Adjust the turnbarrel to bring the trailing edge of the aileron to the neutral position, using the rigging gauge (Item F1, Sect. 2, Chap. 4), and then tighten the turnbarrel locknuts using a C-spanner (Item K94, Sect. 2, Chap. 4) and a C-type spanner with a Northbar torque spanner (Items K95 and K120, Sect. 2, Chap. 4) to a torque loading of 90 lb. ft. and fit the insulating sock hose clip.

(6) Couple up the input lever control rod, and remove the input lever centralizing locking plate.

(7) Connect the BLUE and YELLOW systems pressure and return hoses.

(8) With the BLUE and YELLOW systems pressurized, move the ailerons full travel each way and ensure that they operate smoothly over their full range, and that any tremble can be stopped by lightly holding the trailing edge.

(9) Check that the aileron rigging figures are in accordance with those given in Sect. 3, Chap. 4.

(10) Check all locking and fit access panels.

RUDDER CONTROL UNIT, TYPE 190

General

186. The Type 190 (Mk. 1 or 2) port and starboard control units differ only in the position of the input lever; the unit installed in the starboard fin is in an inverse position to that in the port fin, but the input lever is positioned as illustrated in fig. 54. Change the handling of a control unit as follows:

(1) Remove the set screw retaining the fulcrum pin.

(2) Withdraw the fulcrum pin and the input lever.

(3) Transfer the lever to the new position, fit the fulcrum pin and set screw. If the sliders require aligning to engage with the forks of the input lever use two spanners (Item K89, Sect. 2, Chap. 4).

(4) Restore locking to normal.

Removal

187. A rudder control unit (fig. 54) is removed as follows :—

(1) Remove access panels No. 41, 78, and 79 (port boom), or No. 62, 134 and 141 (starboard boom), as applicable.

(2) Connect up a hydraulic hand pump (Item H17, Sect. 2, Chap. 4) to either the BLUE or the YELLOW hydraulic system.

Note . . .

The port and starboard control unit installations may be considered to be identical with the exception that the input lever of the port control unit has connected to it an anti-yaw actuator, while connected to the input lever of the starboard control unit is a rudder trim actuator.

(3) Disconnect the actuator from the control unit input lever and swing the actuator clear.

(4) Disconnect the control unit top and bottom attachment bolts from the rudder torque shaft and mounting beam.

(5) Retract the control unit ram, release the BLUE and YELLOW system pressure and then remove the four hydraulic pipe lines. Blank off the ends of the pipes and the apertures in the control unit.

(6) Remove the control unit from the fin. This is best accomplished by lowering the control unit and rotating it so that the input lever faces inboard. Lift the control unit up towards the inboard access panel, then ease the bottom of the control unit out of the outboard access panel, and remove it from the fin.

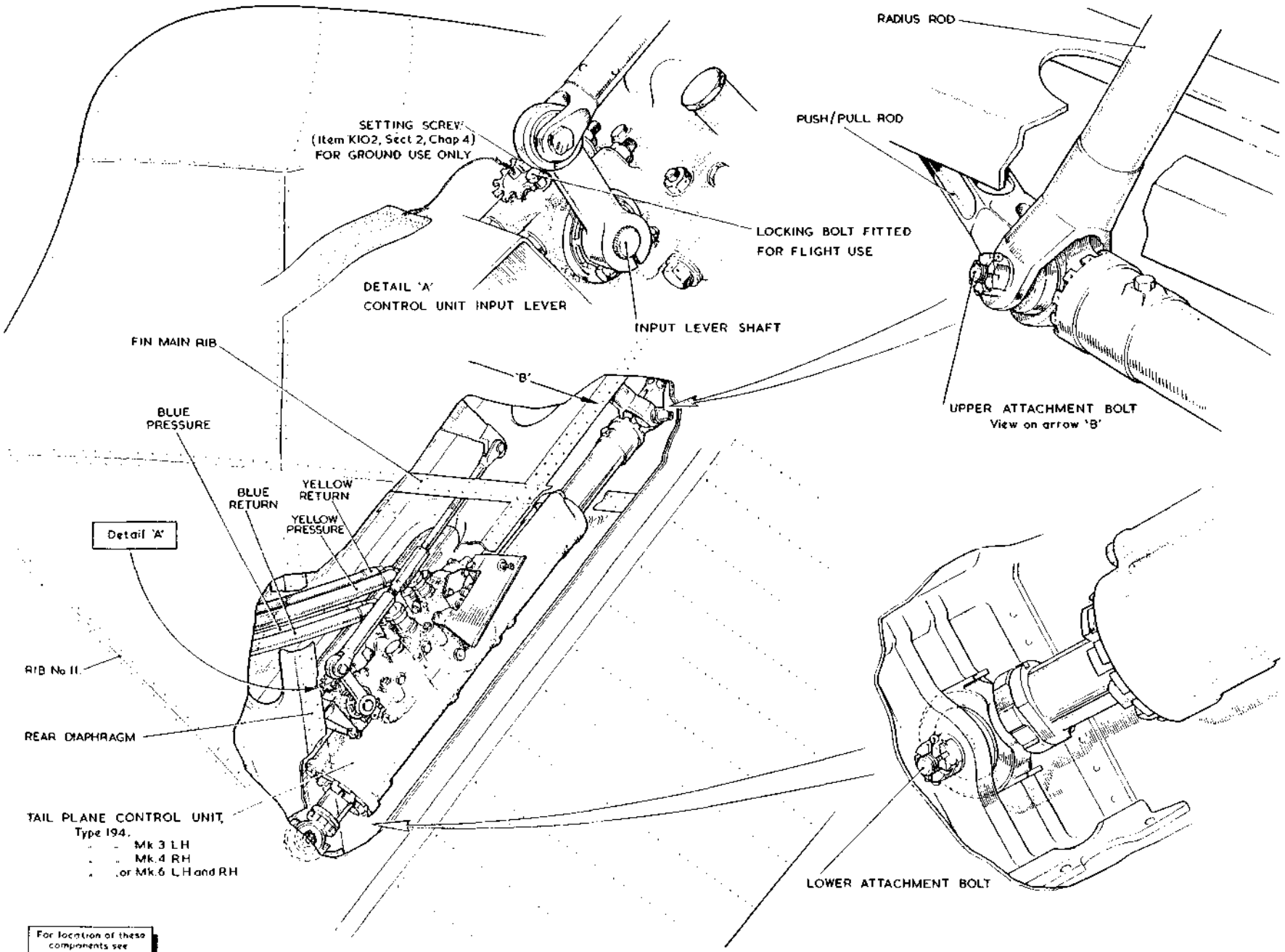


Fig. 55. Tail plane control unit

Installation

188. Prior to its installation, the replacement control unit should be stroked over its full range by a hand pump rig to check its operation and to align the eye-ends; the control unit (Fig. 54) is then installed in the aircraft as follows:—

(1) Lubricate the control unit bearings with grease, XG-295.

(2) Using the hand pump rig, pump the control unit ram fully in.

(3) Offer up the control unit to the fin, reversing the method given in para. 187 (6). ◀ and fit the top attachment bolt.▶

(4) Fit the BLUE and YELLOW pressure and return hoses to the control unit.

(5) Using the hand pump, inch the ram of the control unit out until the bottom attachment bolt can be fitted.

(6) Connect the actuator to the control unit input lever.

(7) Apply hydraulic pressure and operate the rudder over the full range, ensuring that the control does not bottom and that the input lever strikes the adjustable stops.

(8) Check that each rudder movement is smooth and judder-free. A slight rudder tremble during operation is permissible, provided that it can be stopped by lightly holding a trailing edge with one hand.

(9) Operate each actuator and check their respective operations.

(10) Relock at all points where the locking has been broken down during the control unit change, and refit all access panels.

TAIL PLANE CONTROL UNIT, TYPE 194

General

189. The Type 194 (Mk. 6) port and starboard control units differ only in the disposition of the input lever (Fig. 55). If necessary, change the handing of the control unit as follows:—

(1) Remove the input lever.

(2) Remove the split pin, nut, and washer from the end of the lever shaft.

(3) Unlock and unscrew the bearing retaining rings using a socket adapter (Item K93, Sect. 2, Chap. 4).

(4) Carefully tap out the shaft; the distance piece and bearing will remain on the shaft.

(5) Tap out, in the opposite direction, the bearing sleeve and bearing.

(6) Insert the shaft, in the side of the body to give the handing required, complete with distance piece and bearing; engaging the shaft in the control lever master spline.

(7) Insert the bearing sleeve and bearing.

(8) Fit the bearing retaining rings and wirelock.

(9) Fit the washer, nut, and split pin to the shaft.

(10) Fit the input lever, and the lever retaining bolt; lock the retaining bolt nut with a tab washer.

(11) Apply hydraulic pressure to the control unit, and maintain the valve in the sensitive position for 30 seconds.

(12) Apply a spring balance to the input lever bearing and measure the load to move the lever. The maximum permissible load is 1 lb.

Removal

190. Tail plane control units should only be changed singly, a double control unit change should be treated as two single units; this will eliminate the necessity of attaching a hoist and sling to the tail plane to give control of the push-pull rod when removing and refitting a control unit top attachment bolt. A control unit is removed as follows:—

◀(1) Remove the access panels No. 42A, 44, 76 and 77 from the port fin, or No. 52, 55, 139A and 220 from the starboard fin (Fig. 6 and 7, Sect. 2, Chap. 4).▶

(2) Fit the hydraulic hand pump rig (Item H17, Sect. 2, Chap. 4) to either the BLUE or YELLOW system.

(3) Pump the tail plane to a position whereby the control unit top attachment bolt (Fig. 55) can be withdrawn through the access panel in the fin skin. Remove the split pin and nut and withdraw the attachment bolt.

(4) Ease the radius rod away from the control unit body and the push-pull connecting-rod and remove the bush coupling the control unit to the push-pull rod.

(5) Disconnect the control unit input lever from the input control connecting-rod.

(6) Remove the split pin and nut from the control unit lever attachment bolt and remove the bolt.

(7) Using the control unit that is remaining in situ, raise the tail plane to its fully up position.

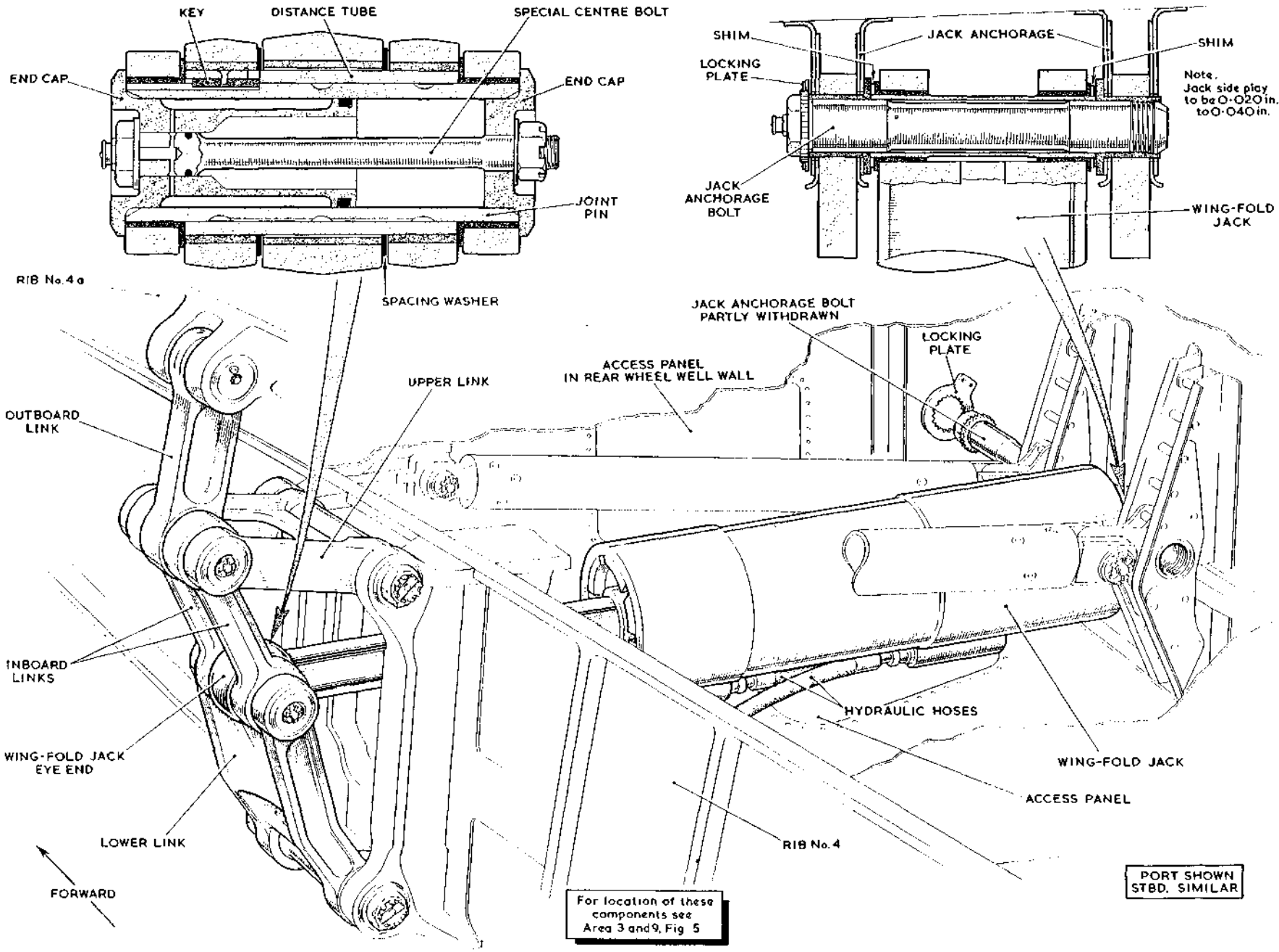


Fig. 56. Wing-fold jack

Note . . .

Wire-lock the input lever in the tail plane full up position so that the control unit is bottoming.

(8) Pump the ram fully in on the control unit to be changed.

(9) Disconnect the BLUE and YELLOW pressure and return hydraulic hoses, and fit blanks to both the control unit and the hydraulic hoses.

(10) Remove the control unit by easing it bodily up into the finhead, ease the ram end out of the fin, rotate the control unit inwards and withdraw.

Installation (fig. 55)

191. Prior to its installation, the replacement control unit should be stroked over its full range by a hand pump rig (Item H17, Sect. 2, Chap. 4) and the control unit eye ends should be lubricated with grease, XG–295. Proceed with the installation of the control unit as follows:—

(1) Offer up the control unit to the fin head (Fig. 55), reversing the method given in para. 190 (10), and fit the lower attachment bolt.

(2) Fit the BLUE and YELLOW pressure and return hydraulic hoses to the control unit.

Note . . .

It is advisable to wire-lock the two inboard connections prior to fitting the two outboard connections.

(3) Lower the tail plane until the push-pull rod is in line with the centre of the top attachment access hole, and inch out the control unit until the top attachment lines up with the push-pull connecting-rod.

(4) Ensure that the top bush is correctly assembled, and line up the radius rod with the push-pull rod and control unit and fit the top attachment bolt, ensuring that the head of the bolt is outboard (use a locally-made bullet for the lining up procedure).

(5) Assemble the input connecting-rod to the input lever. If the locking wire hole in the connecting-rod fork end is at the top, put the locking wire in position before the connecting-rod and lever.

(6) Lock the input lever and fit the nuts and split pins to the control unit top and bottom attachment bolts.

(7) Prime and bleed the BLUE and YELLOW hydraulic systems.

(8) Inch the tail plane to its neutral position and check the incidence at both ends; this will indicate the presence of any twist in the tail plane if either of the control units have been incorrectly set. Repeat in the fully up and down positions. The tolerances should conform with those given in Sect. 3, Chap. 4.

(9) With hydraulic power on, slowly operate the tail plane up and down to eliminate any air in the system.

(10) Select coarse gear (t/p gear change, Sect. 3, Chap. 4) and neutral trim. Check the tail plane incidence on both datum ribs (Sect. 3, Chap. 4) with the tail plane fully up and fully down.

(11) Ensure that the gear change unit engages the stops in the fin head when the tail plane is in its maximum up and maximum down positions and that the control units are not bottoming in these conditions.

WING-FOLD HYDRAULIC JACK

Removal

192. A port or starboard wing-fold hydraulic jack should be changed as follows:—

◀(1) Remove access panels No. 270 or 325 (fig. 7, Sect. 2, Chap. 4) and panel No. 451 or 459 (fig. 7b, Sect. 2, Chap. 4).▶

(2) Fold the wings and fit a jury strut (Item G1, Sect. 2, Chap. 4) to the side from which the jack is to be removed. See Sect. 2, Chap. 1 for details of fitting the jury strut. The wings must be folded using a Mk. 4B hydraulic rig (Item H22, Sect. 2, Chap. 4) or using the starboard engine, which must be run at a minimum of 30 per cent of the maximum r.p.m. (See WARNING (6) preceding para. 133). When the wings have been folded, release GREEN system pressure.

(3) At the wing-fold linkage, remove the special centre bolt retaining the two end caps in position (fig. 56) and withdraw the end caps.

(4) Support the lower link and knock out the joint pin (in a rearwards direction) with a soft metal drift. The lower link will now be free to fall away from the inboard links.

Note . . .

This joint pin can only move in an aft direction. Forward movement will be prevented by a key located between the distance tube and the joint pin (fig. 56).

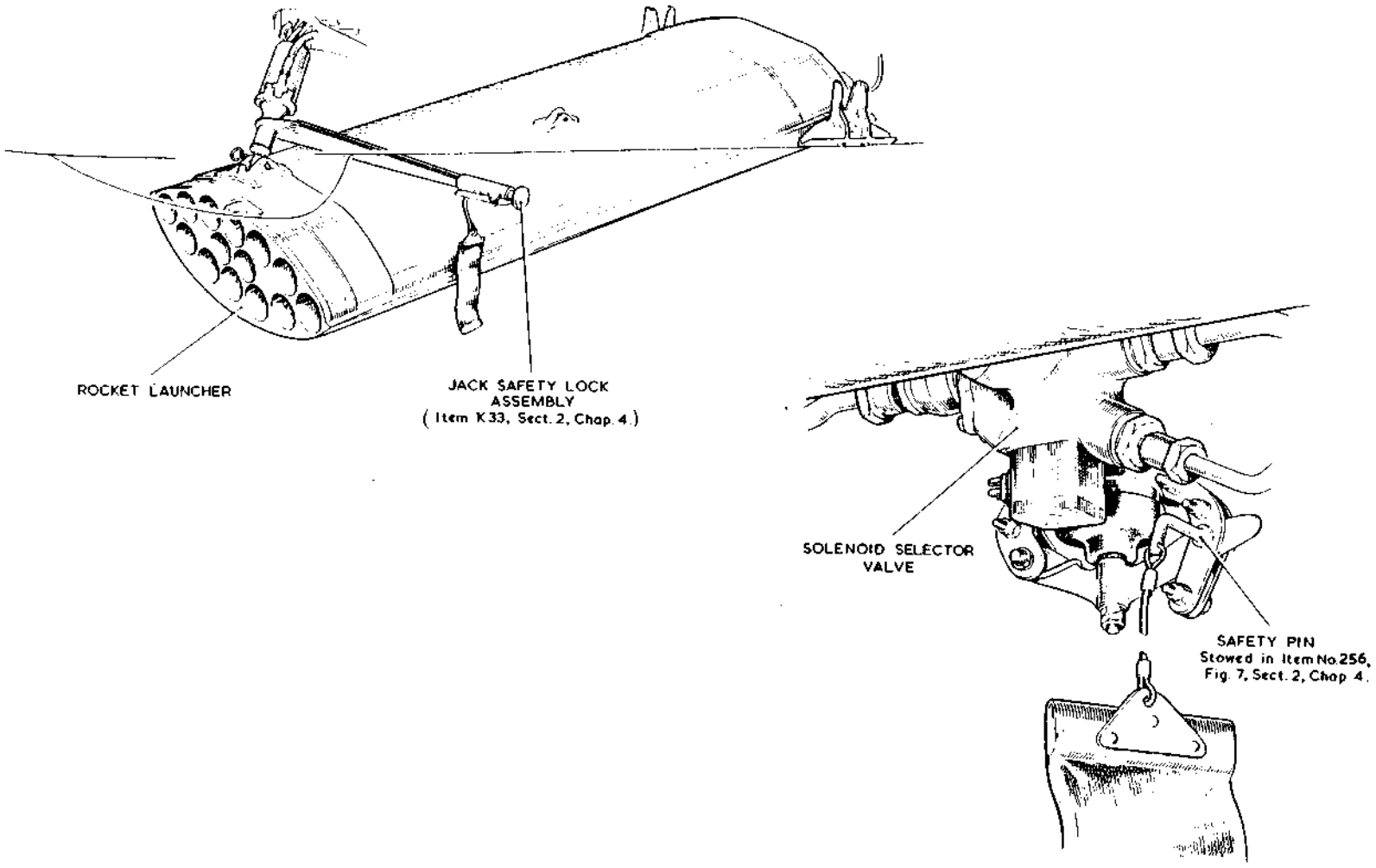


Fig. 57. Safety devices—fuselage rocket batteries

(PANEL NUMBER CORRECTED)

(5) Support the wing-fold jack ram and knock out the distance tube; lower the ram on to the edge of the aperture in rib No. 4. The ram must be suspended in such a manner as to prevent damage to the surrounding structure should the ram be inadvertently moved under hydraulic power.

(6) Disconnect and blank-off the two flexible hoses to the jack.

(7) Remove the locking plate on the jack anchorage bolt, support the wing-fold jack, and with a suitable socket and extension, slacken off and remove the jack anchorage bolt.

(8) Withdraw the jack through rib No. 4.

Installation

193. The refitting of a port or starboard wing-fold jack is the reverse of the order of removal (para. 192); particular note should be taken of the sequence of assembly when marrying the wing-fold jack to the wing-fold linkage. A replacement jack will be of a fixed pin-centre length.

194. After re-assembling the wing-fold jack and the wing-fold linkage, a spread and fold operational check (para. 171) must be carried out to ensure the serviceability of the assembly(WARNING (6) preceding para. 133).

BRAKE MASTER CYLINDER

Removal

195. Remove a brake master cylinder as follows:—

(1) Arrange a container to collect the hydraulic oil when the hose is disconnected.

(2) Disconnect and blank off the hose.

(3) Remove the top and bottom attachment nuts and slide the master cylinder off the spigots.

Installation

196. Install a brake master cylinder as follows:—

(1) Ensure that the rudder toe pedals have free and full movement.

(2) Set the rudder pedals in the fully aft position.

(3) Offer up the master cylinder to check that the between centres length (6·58 in. to 6·66 in.) is the same as the distance between the spigots.

(4) Adjust the bottom eccentric spigot by removing it approximately 0·25 in. to disengage the serrations, turn to the correct between centres length and re-insert in the serrations.

(5) Fit the master cylinder and reconnect the hose, ensuring that the elbow of the end fitting is kept in the fore and aft position.

◀(6) Bleed the brake servo system as described in para. 141a.▶

RED AND GREEN PUMP HOSES

Installation

197. When installing the RED and GREEN pressure hoses from the pumps to the bulkhead adapters, ensure that the hoses clear the structure by a minimum of 0·3 in.

DE-CLUTCHING VALVE HOSES

198. When installing the pressure and return hoses to the de-clutching valve, bias the hoses to avoid fouling and de-clutching valve connections when the nose leg is retracted, and protect the hoses with PTFE or plastic tape.

PARKING BRAKE LEVER

General

199. With the deletion of the locking wire from the parking brake lever, it is possible for the knob and spindle to unscrew from the tongue, and the coupling to unscrew from the end of the lever; to avoid this they must be assembled with Loctite "C" (Ref. No. 33H/2202572).

Removal

200. Remove the parking brake lever knob as follows:—

(1) Unscrew knob and spindle from tongue; remove tongue and spring.

(2) Unscrew the coupling from the lever.

(3) Remove sheared-off portion of locking wire from spindle and tongue.

Installation

201. Install the parking brake lever knob as follows:—

(1) Screw coupling into end of lever, using Loctite "C".

(2) Insert spring and tongue into lever.

(3) Screw spindle into tongue, using Loctite "C", until thread-bound.

(4) Push knob in, and check that, when knob is touching coupling, the tongue is at the end of the slot. To alter the position of the knob, the $\frac{3}{32}$ in. rivet securing knob to spindle must be removed.