Chapter 6 HYDRAULIC SYSTEM

(*Completely revised*)

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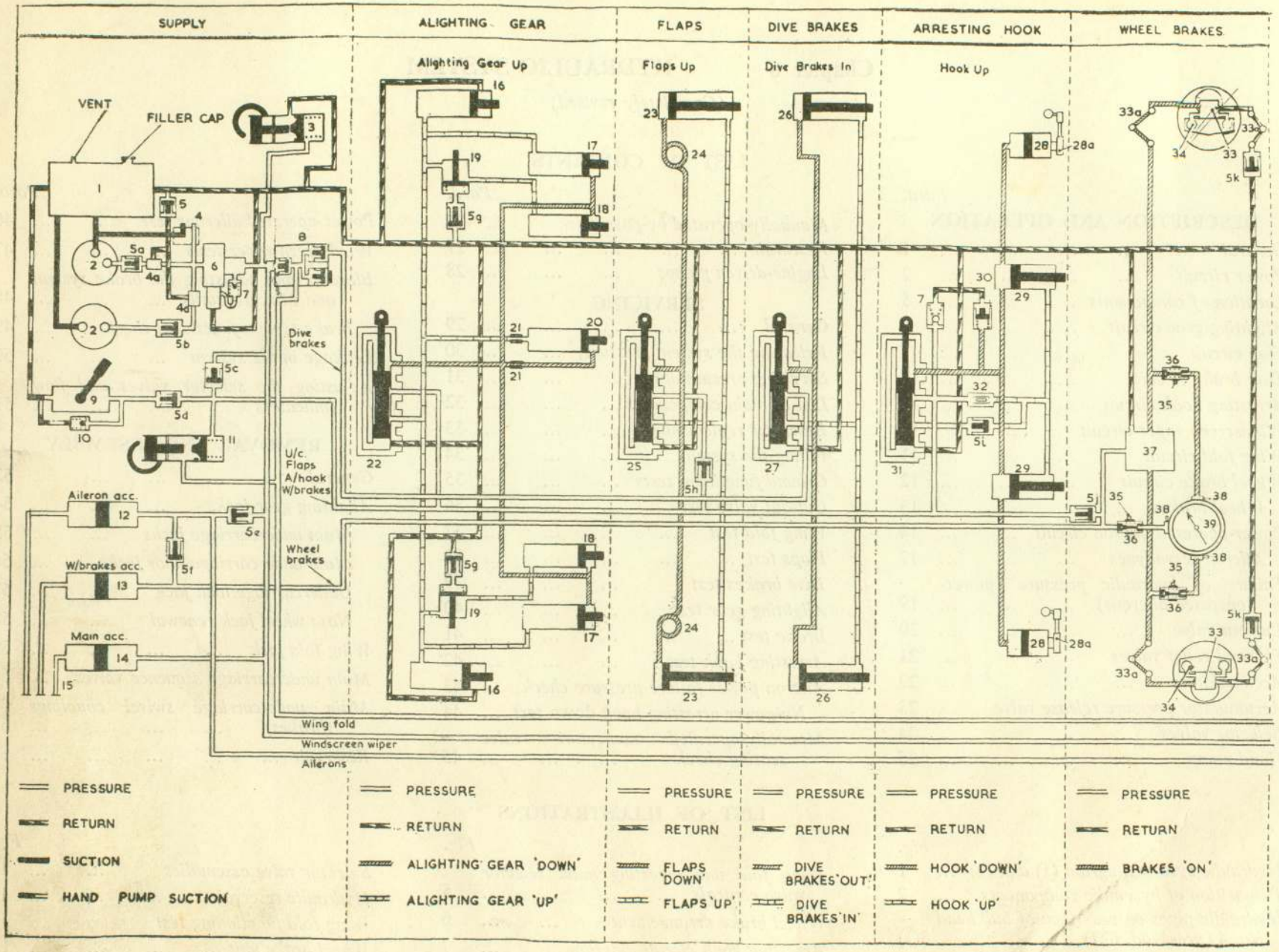
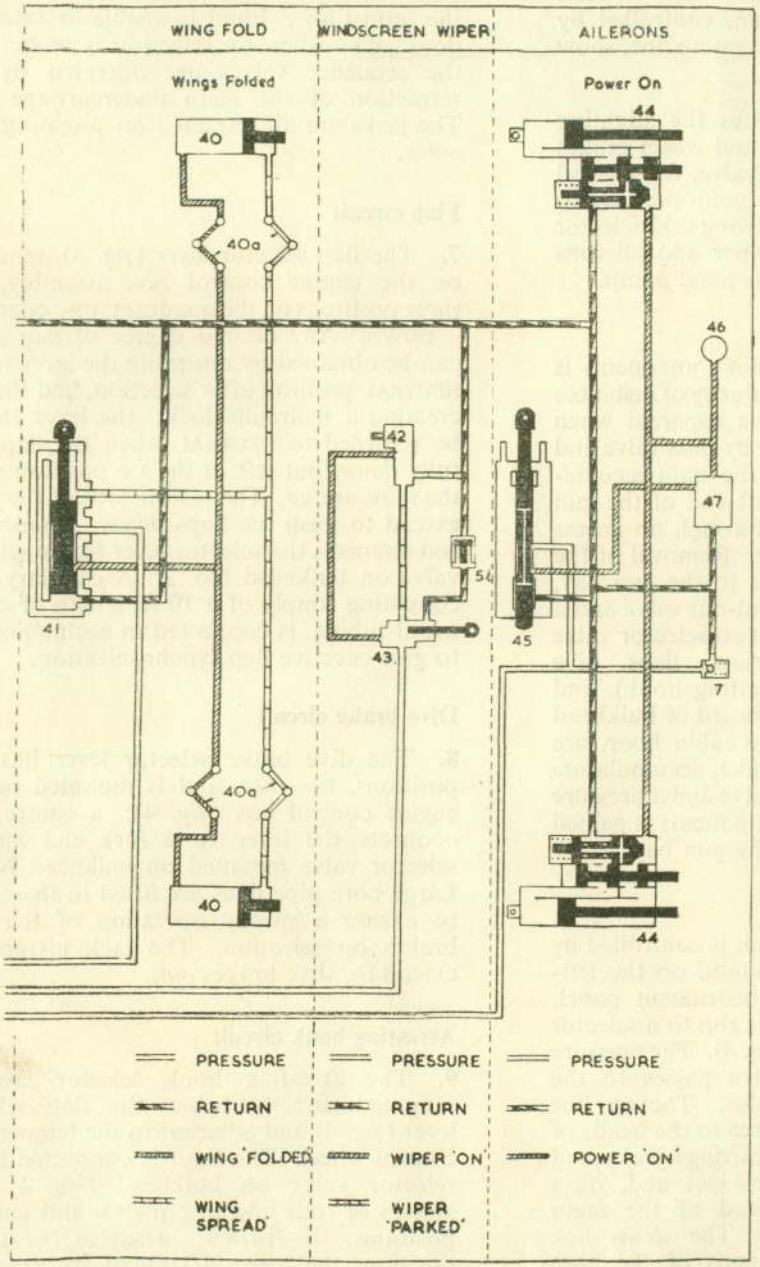


Fig. 1. Hydraulic system diagram (1)



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Caution.-The pressure release valve exhausts the main accumulator only. The other accumulators must be exhausted as instructed in para. 30.

Fig. 1. Hydraulic system diagram (2)

General

1. The hydraulic installation is a Lockheed high-pressure system operating the alighting gear, flaps, dive brakes, arresting hook, wing fold and ailerons; in addition, there are Dunlop Maxaret anti-skid units on the main undercarriage wheels and a Dunlop windscreen wiper installation. The installation is illustrated diagrammatically in fig. 1, the location of the hydraulic components is shown in fig. 2, and a list of the main components and their part numbers is given in para. 32; the pressure and fluid specifications for the system are given in the Leading Particulars.

Power circuit

2. Two engine-driven pumps supply the pressure circuit; the pumps draw fluid from a reservoir mounted on the decking beneath the aft end of the canopy and deliver it at high pressure to an automatic cut-out valve. A hand pump for emergency use is mounted on the starboard side of the pilot's seat. From the cut-out valve the engine pump pressure goes to:—

(1) The main, brake and aileron accumulators.

(2) The alighting gear, flap, arresting hook, wheel brake, aileron and windscreen wiper circuits.

(3) Via a multiple non-return valve to the wing fold and dive brake circuits.

3. The cut-out valve enables the pumps to charge the three accumulators to the operating pressure of the system and then diverts the pump delivery through an idling circuit back to the reservoir. Two thermal relief valves (*para.* 21), in the cut-out and aileron circuits respectively, relieve excessive thermal pressures back into the return line. The main accumulator supplies the windscreen wiper, alighting gear, flap, dive brake, arresting hook, wheel brake and wing fold circuits. The wheel brake accumulator supplies the brake circuit only. The aileron accumulator supplies the aileron circuit and, under certain conditions, all accumulators augment the supply to the wheel brakes. Warning lamps in the cabin, controlled by flow indicators fitted in each pump line, show when either pump fails.

4. The hand pump operates the alighting gear, flaps, arresting hook and wheel brakes while in flight. A by-pass valve, for ground use only, permits the hand pump pressure to flow to the dive brakes and wing fold selector valves. The windscreen wiper and ailerons cannot be operated from the hand pump.

Location of components

5. The location of the main components is shown in fig. 2 and in the majority of instances the means of access will be apparent when viewed on the aircraft. The by-pass valve and a pressure release valve for the main accumulator are mounted in the aft end of the gun bay, and can be reached through an access panel in the gun bay doors. Removal of the gun bay doors gives access to the gun bay, in which are mounted the cut-out valve and a multiple non-return valve, two selector valve banks (for the undercarriage, flaps, dive brakes, wing fold and arresting hook), and the main accumulator. Forward of bulkhead No. 2, and underneath the cabin floor, are the aileron and wheel brake accumulators and an aileron anti-surge valve and a pressure switch; access to these components is gained from the forward end of the gun bay.

Alighting gear circuit

6. The alighting gear circuit is controlled by a two-position lever, UP-DOWN, on the left-hand side of the pilot's instrument panel, from which connecting-rods run to a selector valve on bulkhead No. 2 (*fig.* 4). The pressure line from the cut-out valve passes to the alighting gear selector valve. The *up* line from the selector valve passes to the heads of the nose and main undercarriage jacks and the main undercarriage lock jack and, via a sequence valve, to the head of the main undercarriage door jack. The *down* line passes to the piston-rod ends of the nose jack and main undercarriage lock and door jacks. The piston-rod end of each main undercarriage jack is connected directly to the return line. Fluid is unable to enter the door jacks when UP selection is made until the sequence valves are operated by the retraction of the main undercarriage legs. The jacks are all retracted for alighting gear *down*.

Flap circuit

7. The flap selector lever (*fig.* 4), mounted on the engine control box assembly, has three positions on the quadrant, UP—NEUTRAL—DOWN. Any desired degree of flap angle can be obtained by returning the lever to the NEUTRAL position after selection, and thereby creating a hydraulic lock; the lever should be returned to NEUTRAL when the flaps are fully *down*, but left in the UP position when the flaps are *up*. The piston-rods of the jacks extend to push the flaps *down*. A push-pull rod connects the selector lever to the selector valve on bulkhead No. 2. A capillary coil, consisting simply of a 10 ft. length of coiled metal tubing, is connected in each *down* line to give effective flap synchronization.

Dive brake circuit

8. The dive brake selector lever has two positions, IN—OUT, and is mounted on the engine control box (*fig.* 4); a control rod connects the lever to a fork end on the selector valve mounted on bulkhead No. 2. Large bore pipe lines are fitted in the circuit to ensure a speedy operation of the dive brakes on selection. The jack piston-rods extend for dive brakes *out*.

Arresting hook circuit

9. The arresting hook selector lever is mounted directly below the flap selector lever (*fig.* 4) and adjacent to the temperature control wheel. The lever is connected to the selector valve on bulkhead No. 2 by a system of rods and link plates, and has two positions, UP—DOWN; when in the DOWN position, the lever is secured by a spring-loaded locking pin, which can be released by pressure on a trigger plate bolted to the lever.

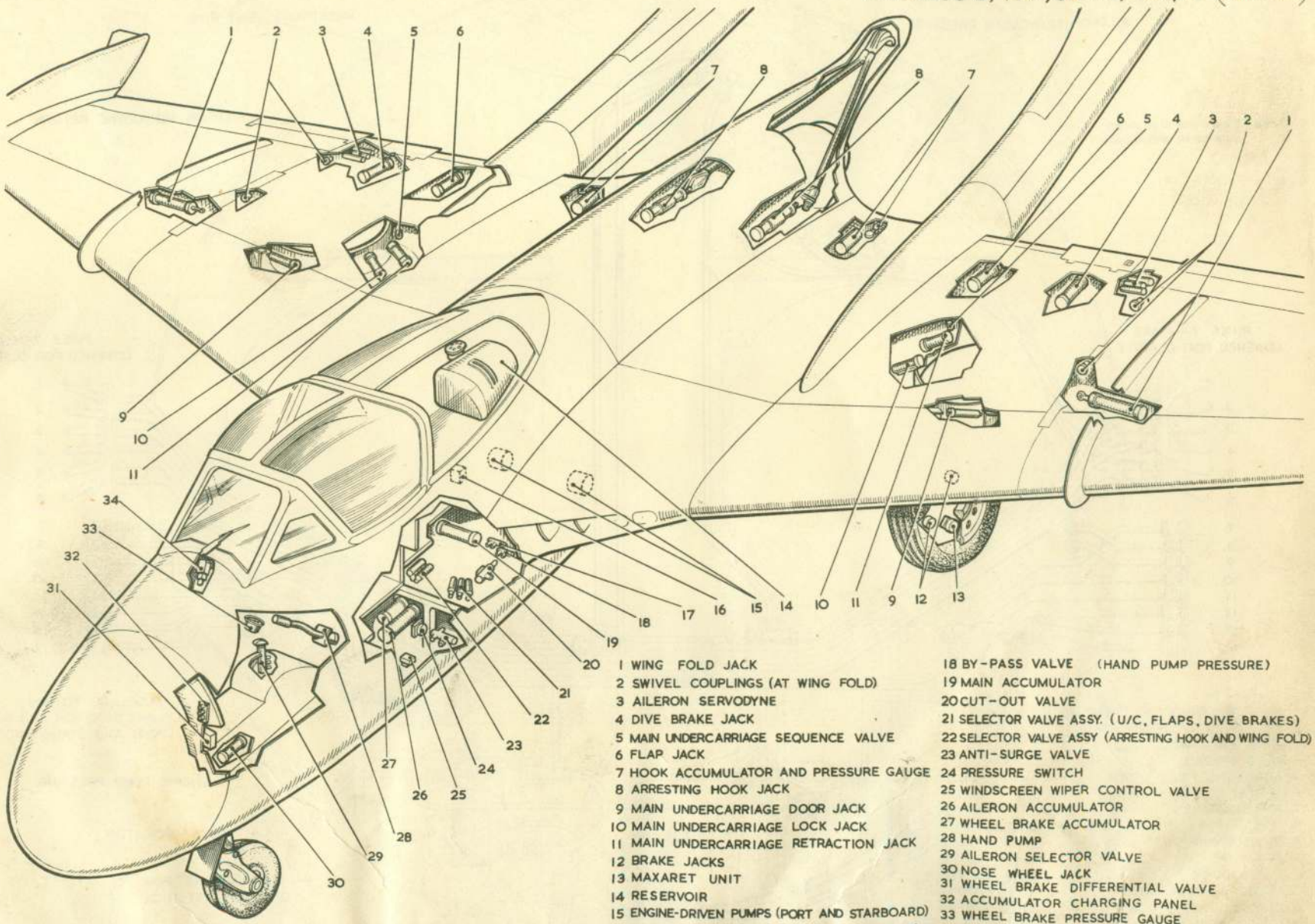

Fig. 2. Disposition of hydraulic components.

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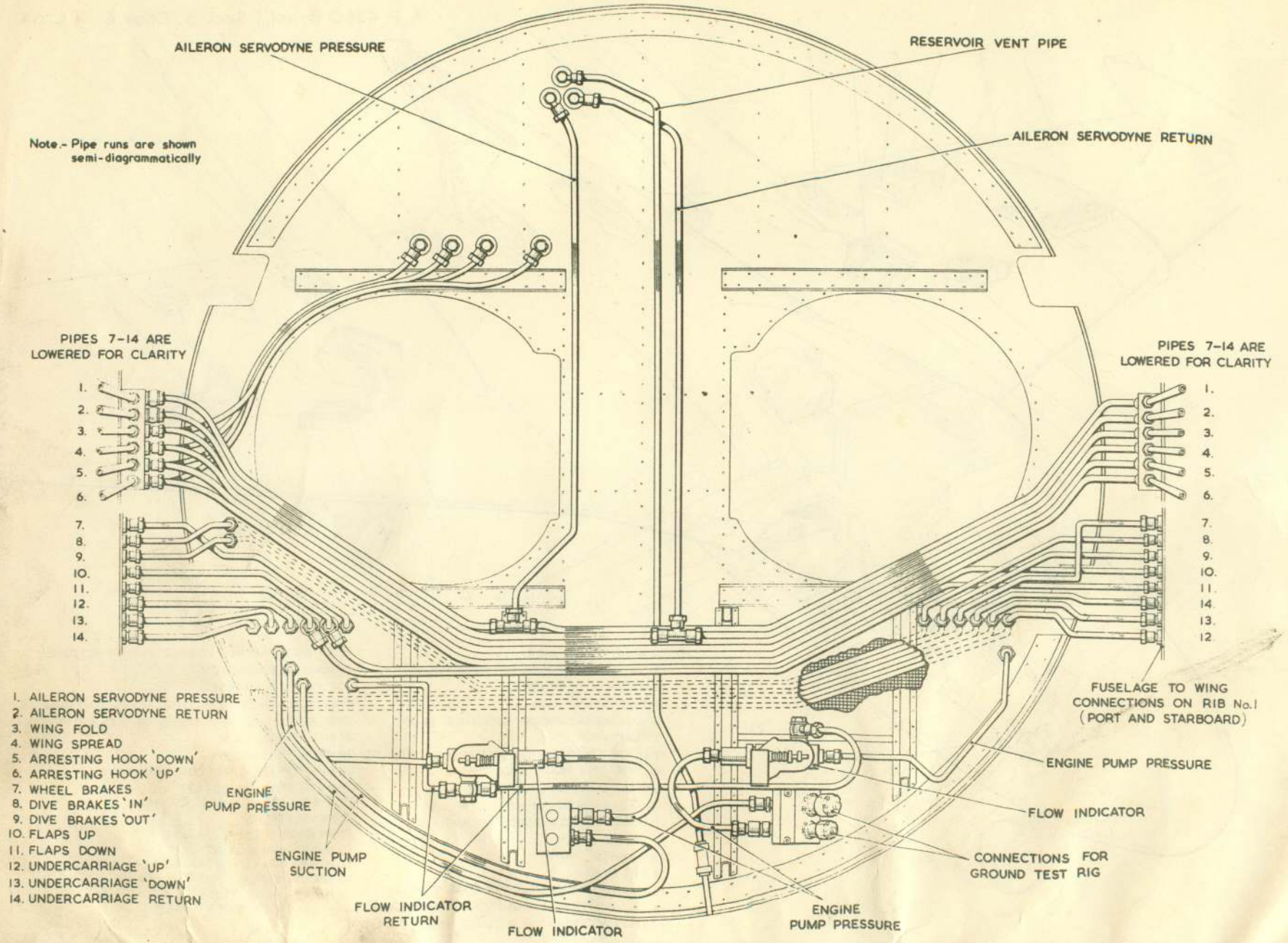

Fig. 3(1) Hydraulic pipes on rear face of bulkhead No. 4 (pre-Mod. 627)

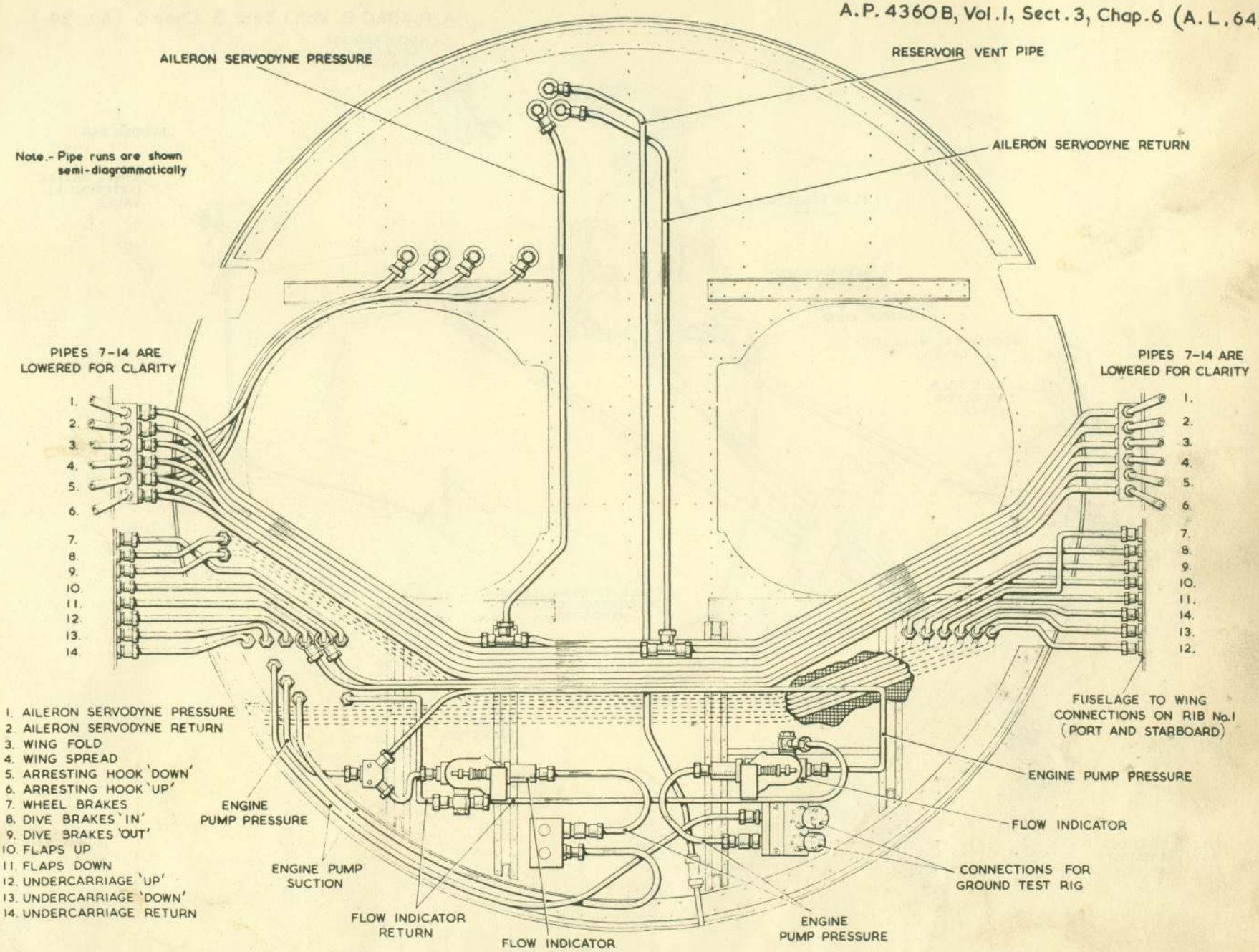

Fig. 3(2) Hydraulic pipes on rear face of bulkhead No. 4 (post-Mod. 627)

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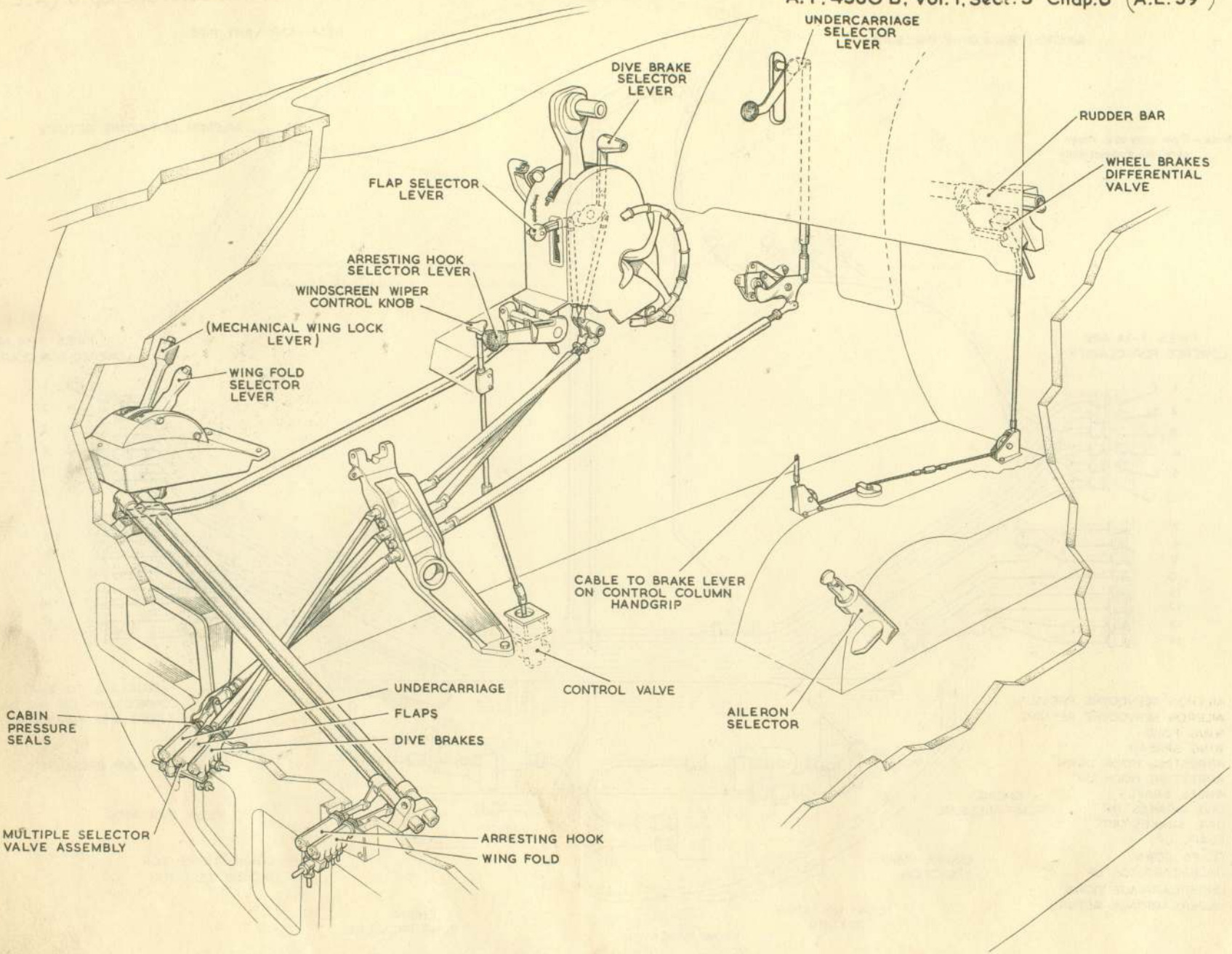

Fig. 4 Cabin selector valve controls

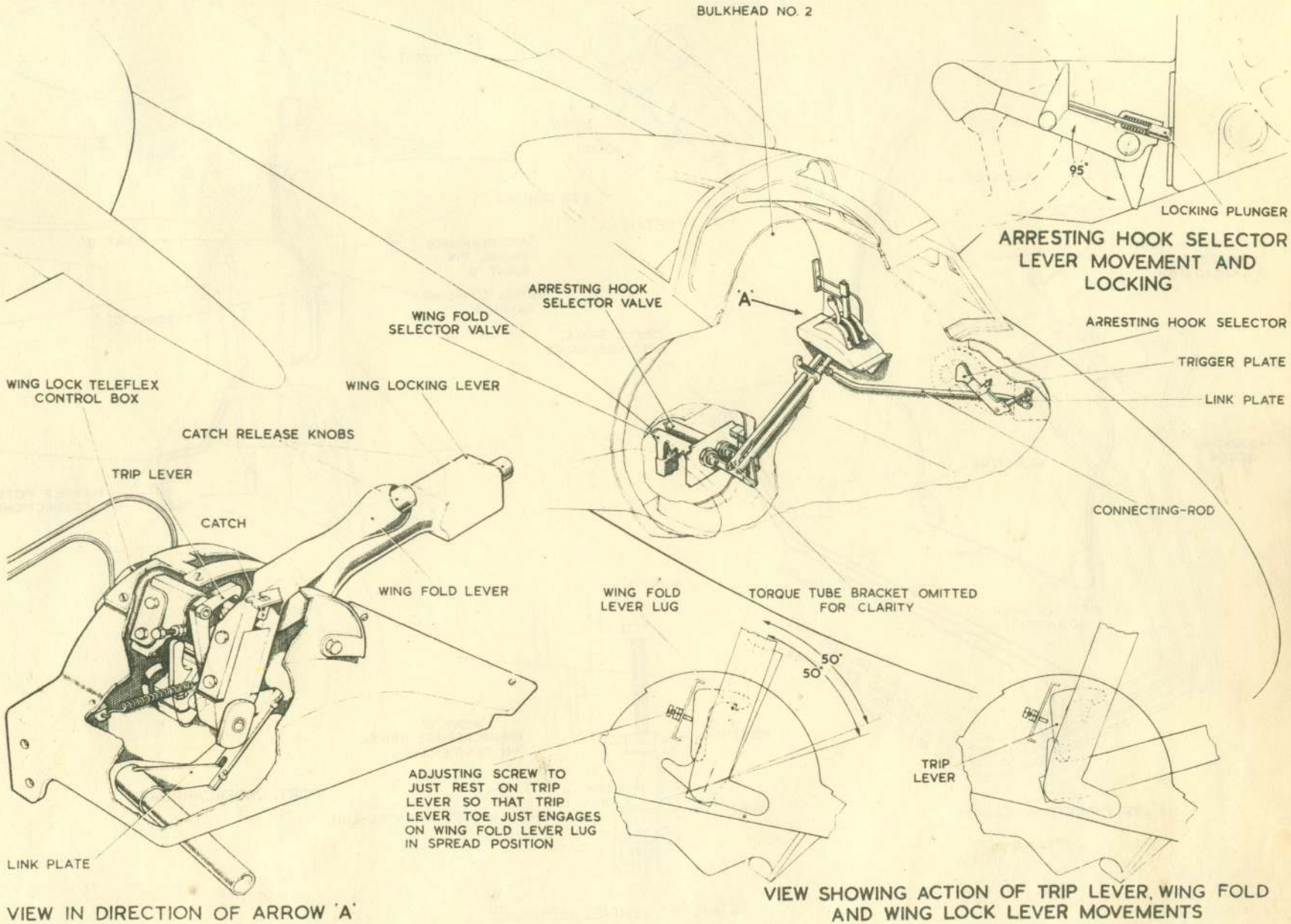

Fig. 5. Wing fold and arresting hook selector valve controls

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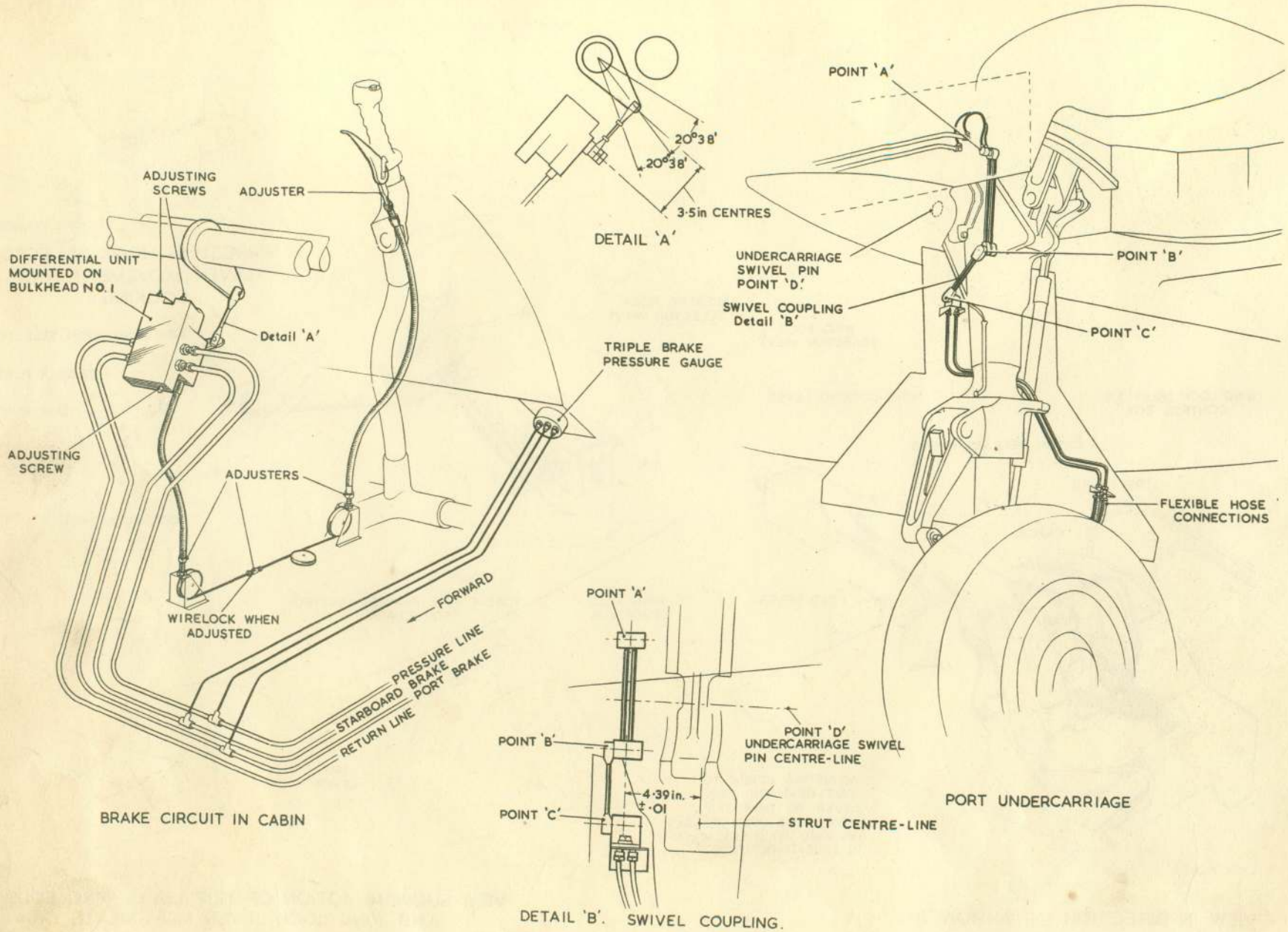

Fig. 6. Wheel brake arrangement.

A description of the operation of the circuit (*fig.* 7) is given below.

(1) *Hook selected* UP. With the hook selected UP, fluid from the cut-out branches through the selector valve and through the 0·018 in. dia. restrictor, and (controlled also by the 0·030 in. dia. restrictor screwed into the selector valve) passes to the piston-rod ends of the jacks. Fluid from the heads of the jacks and from the hook accumulators passes to the reservoir through the selector valve, via the built-in restrictor. Three restrictors control the hook operating speed and prevent damage at the end of the movement. The hook accumulators are discharged when the hook is *up*. The hook is lifted by direct pressure, and maintained in the *up* position by pressure from the main accumulator and, if the pumps fail and the main accumulator is discharged, by non-return valves in the supply system.

(2) *Hook selected* DOWN. With the hook selected DOWN, fluid is transferred to the heads of the jacks and to the hook accumulators from the piston-rod ends of the jacks, via the selector valve and the 0·043 in. dia. restrictor which controls the rate of descent of the hook. The fluid from the supply passes through the selector valve to the jack heads and the accumulators to make up the volume required to charge the accumulators, and to replace the difference between the cylinder head and the piston-rod end displacements. The hook accumulators are charged when the hook is *down*. The hook is lowered by its own weight and by the difference in the effective areas of the two sides of the jack pistons, both sides having the same system pressure applied (i.e., the motivating area is the cross-section of the piston-rod).

(3) *Hook bounce*. When the hook is selected DOWN and upward bounce occurs, there is an increase in hook accumulator pressure above system pressure, and an increase in hook accumulator fluid volume; a similar but damped surge occurs in the brake accumulator. Some of the displaced fluid is transferred to the piston-rod ends

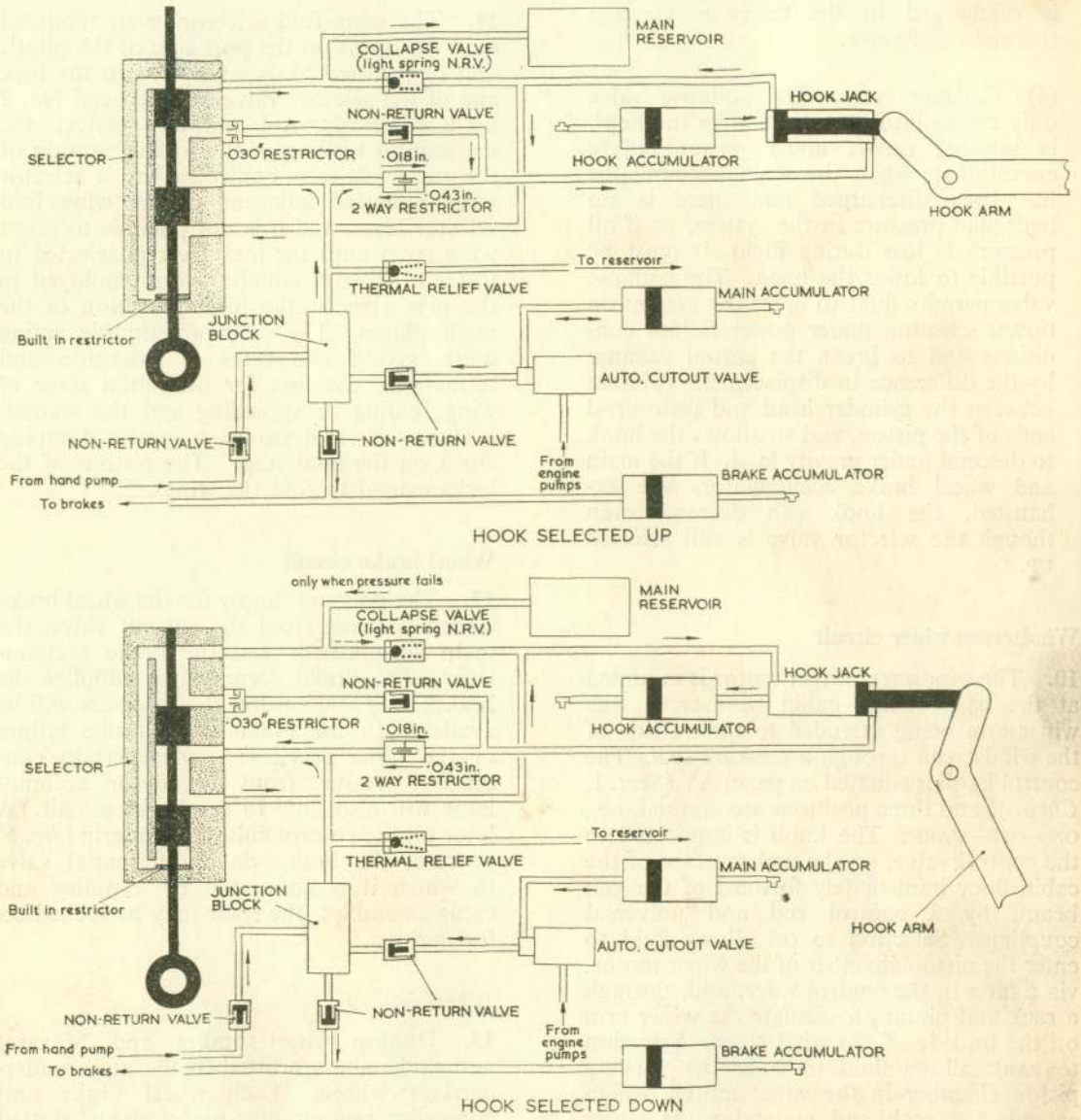

Fig. 7. Arresting hook circuit diagram

of the jacks, via the 0·018 in. dia. restrictor, and this and the excess fluid in the accumulators then returns to the heads of the jacks and restores the hook to the *down* position. If surge pressure reaches 3,000 p.s.i., fluid is discharged to the reservoir via the thermal relief valve.

(4) *Collapse valve.* The collapse valve only comes into operation when the hook is selected DOWN under power failure conditions; when the main accumulator has been discharged and there is no hydraulic pressure in the system, or if all pressure is lost during flight, it must be possible to lower the hook. The collapse valve permits fluid to enter the system on DOWN selection under power failure conditions and to break the partial vacuum by the difference in displacement volumes between the cylinder head and piston-rod ends of the piston, and so allows the hook to descend under gravity load. If the main and wheel brake accumulators are exhausted, the hook can descend even though the selector valve is still selected UP.

Windscreen wiper circuit

10. The windscreen wiper motor is mounted at the base of the cabin windscreen, the wiper arm being extended to the outside of the windscreen through a pressure seal. The control knob is situated on panel AV (*Sect.* 1, *Chap.* 1) and three positions are marked, i.e., ON—OFF—PARK. The knob is connected to the control valve, on the undersurface of the cabin floor immediately forward of the gun beam, by a control rod and universal couplings. Selection to ON allows fluid to enter the piston chamber of the wiper motor, via a filter in the control valve, and, through a rack and pinion, to actuate the wiper arm on the outside of the windscreen. Selection to PARK allows fluid to enter the parking piston chamber in the wiper motor, which extends the rack and maintains the wiper arm at its lowest point of travel on the windscreen. A non-return valve in the control valve exhaust line relieves the hydraulic lock caused when selection is made from PARK. A typical system is described in A.P.1803S, Vol. 1.

Wing fold circuit

11. The wing fold selector lever, mounted on a quadrant on the port side of the pilot's seat (*fig.* 4 *and* 5), is connected to the fork end of the selector valve on bulkhead No. 2 by a connecting-rod and link plates; the mechanical locking of the folding section of the main plane is controlled by a selector lever mounted adjacent to the wing fold selector lever, and it is not possible to select wing FOLD until the lock lever is selected to UNLOCK. Swivel couplings are employed in the pipe runs at the folding section of the main planes. The jacks are double acting units, giving two rates of extension and retraction; the first for the initial stage of wing folding or spreading and the second, a more restricted stroke, to give a damping effect on the final stage. The pistons of the jacks extend to fold the wings.

Wheel brake circuit

12. The pressure supply for the wheel brake circuit is taken from the cut-out valve, the main accumulator and the brake accumulator. The brake accumulator supplies the brakes only and ensures that pressure will be available in the event of hydraulic failure of the other services; under certain conditions, pressure from the aileron accumulator will also flow to the brake circuit. A lever on the control column handgrip (*fig.* 6) operates the brake via a differential valve to which it is connected by a pulley and cable assembly; the lever may be locked ON for parking.

Wheel brakes

13. Dunlop wheel brakes and Maxaret anti-skid units are fitted to the main undercarriage wheels. Each wheel brake unit comprises two circular brake plates, slotted into the main wheel, and inner and outer friction pads which bear on the rings; the friction pads are operated by two hydraulic jacks mounted on a torque plate. The fluid supply to the brake jacks is controlled by the lever on the control column handgrip and by the position of the rudder pedals which, through a valve unit mounted forward of the rudder bar, allows differential braking. Interposed in the main supply to the brake jacks is the Maxaret anti-skid unit, which is mounted on the brake torque plate and permits the pilot to apply maximum braking effort without the risk of locking the wheel; the units consists primarily of a valve arrangement housed in a rubber tyre, which is rotated by contact with the inner rim of the aircraft main wheel. When conditions arise consistent with an approaching skid, the valve releases the braking pressure on the affected wheel, restoring the pressure automatically when the wheel regains speed.

Power-operated aileron circuit

14. The power-operated aileron installation ensures the efficient operation of the ailerons under high Mach number conditions. The control cable runs between the control column and the aileron hydraulic servodynes on the main planes are basically similar to those of a conventional manual flying control system. The ailerons are normally operated by a servodyne unit mounted on each main plane just inboard of the wing fold, and the control cables are connected to the selector plunger on each servodyne through a sprocket and lever assembly; the piston of the servodyne is anchored to the main plane structure (*fig.* 8) and the moving body operates the aileron hinge mechanism. The principle of operation of the servodynes is described in para. 17 and the power-operated aileron installation is described in Section 3, Chapter 4.

15. The aileron power circuit is controlled by a selector valve (*fig.* 9) mounted on the nose wheel fairing on the cabin floor. The valve is pulled OUT for POWER *on* and pushed IN for MANUAL (power *off*), and must be turned right to lock in either position. The pressure from the selector valve flows to the servodynes on the main plane via a flow surge restrictor valve, and a thermal relief valve in the same circuit relieves any excessive

pressure build-up into the return line. In the event of hydraulic pressure falling below a preset figure, a pressure switch in the aileron circuit, mounted under the cabin floor in the forward part of the gun bay, operates a warning lamp in the cabin; it also switches in an electric actuator by which the pilot can control the setting of the port aileron tab to give assistance during high speed manoeuvres. The pressure switch will also operate when the aileron selector valve is selected to MANUAL (IN).

16. The ailerons may be operated manually, if desired, by selecting the control valve to MANUAL (IN). Under hydraulic failure conditions, or with the selector valve IN, an automatic by-pass valve within each servodyne allows the body to move freely over its anchored piston; the force from the control column handle is then transmitted mechanically by the control cables via the servodyne to the aileron.

Aileron servodynes

17. The mounting of both servodynes and the arrangement of their respective control runs and aileron operating mechanism are identical (with the exception of the electrically-operated trim tab on the port aileron). The servodynes are correctly set on manufacture and wire-locked, and no adjustment may be made on the aircraft. The body of a servodyne contains three basic operating parts: a selector valve operated by control column movement, the operating piston, and an automatic by-pass valve. The by-pass valve permits the piston to move freely within the servodyne body, when pressure drops below a selected figure, by allowing fluid to bleed freely from one side of the piston face to the other. With hydraulic fluid available at operating pressure, the by-pass valve closes automatically, permitting fluid to pass only to the piston face which has been selected by the servodyne selector valve. The piston-rod is anchored to the main plane rear spar and the moving body of the servodyne connects to the aileron operating linkage. The selector valve piston, to which the control column cables are connected through a sprocket and lever and connecting-rod assembly, enter the same end of the unit as the piston-rod. The servodyne is illustrated in fig. 8, and its relation to the

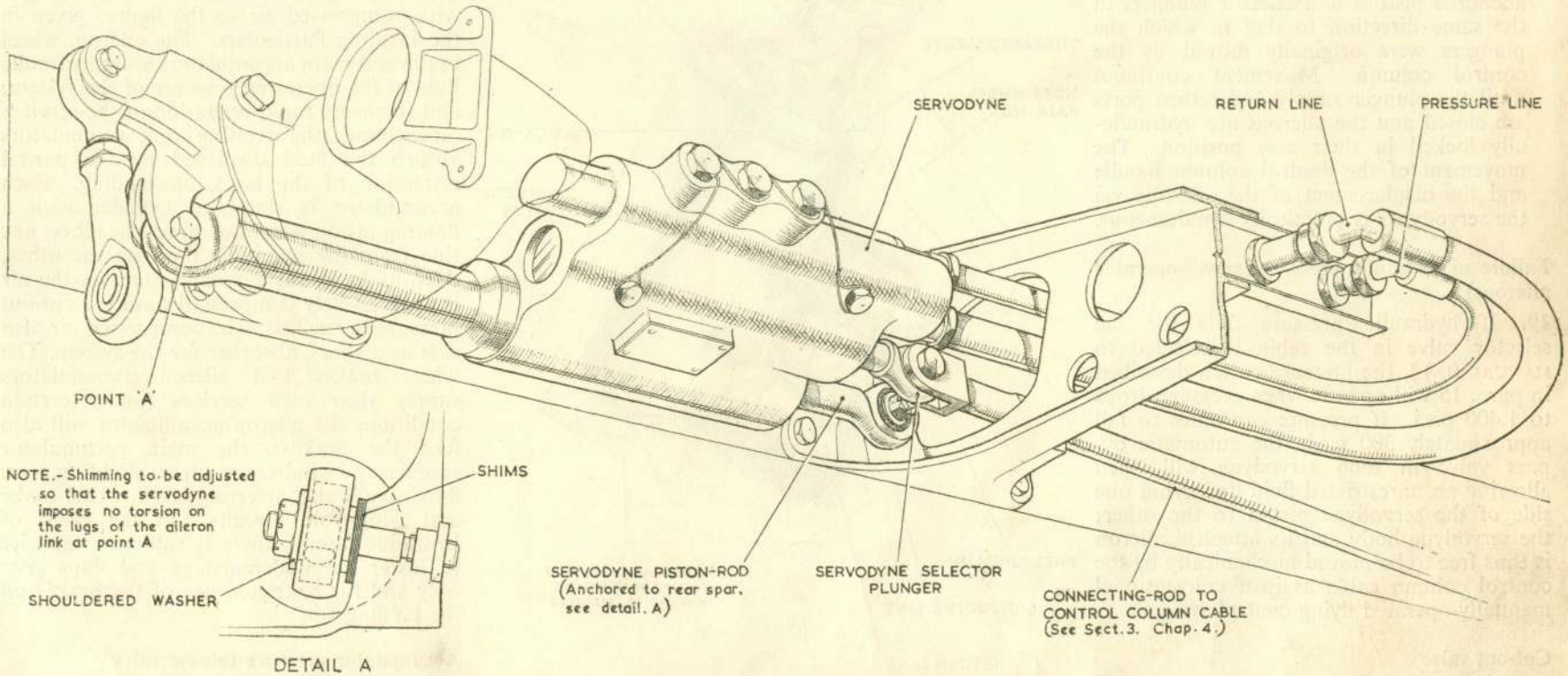

Fig. 8. Aileron servodyne (port)

aileron assembly is shown in Section 3, Chapter 4.

18. The principle of operation of the servodynes is as follows:—

(1) When POWER (OUT) is selected on the cabin selector valve, pressure passes to the servodynes via a flow surge restrictor valve which prevents control column snatch. The fluid pressure at the servodynes closes the automatic spring-loaded by-pass valves so that fluid goes only to the selected piston faces.

(2) Movement of the control column handle operates the servodyne selector valve pistons, thus opening the ports to the appropriate sides of the piston faces and connecting the opposite faces to the return line.

(3) The pressure differential causes the servodyne bodies to move over their anchored pistons and selector plungers in the same direction to that in which the plungers were originally moved by the control column. Movement continues until the plunger supply and return ports are closed and the ailerons are hydraulically locked in their new position. The movement of the control column handle and the displacement of the ailerons via the servodynes is practically simultaneous.

Failure of hydraulic pressure (power-operated ailerons)

19. If hydraulic pressure fails (or the selector valve in the cabin is selected to MANUAL (IN)), the pressure switch described in para. 15 will operate when pressure drops to 1,400 p.s.i. If pressure continues to fall approximately 300 p.s.i., the automatic by-pass valve in each servodyne will open allowing an unrestricted fluid flow from one side of the servodyne piston to the other; the servodyne body and its attached aileron is thus free to be moved mechanically by the control column cable as in a conventional manually-operated flying control system.

Cut-out valve

20. The cut-out valve is mounted on the roof of the gun bay and regulates the operating pressure of the system. The delivery lines from the engine-driven pumps connect to the valve and, when the accumulators are charged to the operating pressure of the system, the valve diverts the pump delivery into a low-pressure return line to the reservoir.

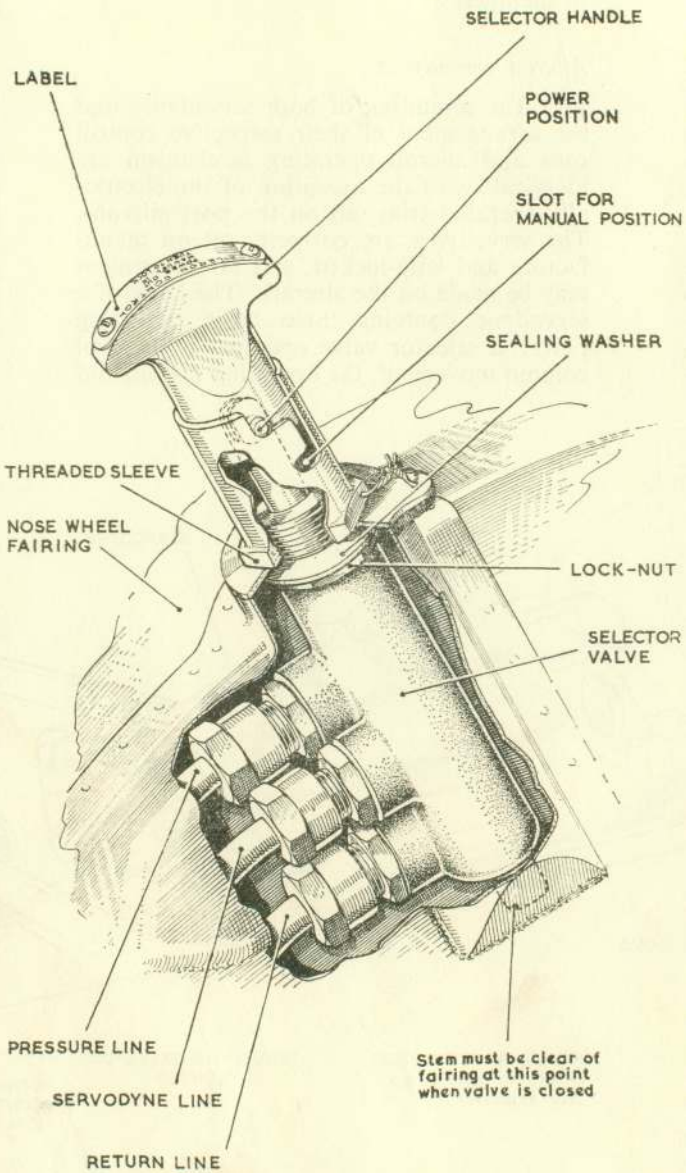

Fig. 9. Aileron selector valve

Thermal relief valves

21. One thermal relief valve is located between the delivery and return junction blocks on the cut-out valve, and its function is to relieve excessive pressure built up in the main accumulator due to rising temperature and to act as a safety valve in the event of cut-out failure; a second thermal relief valve is connected between the aileron pressure supply line and the return line. The valves are set to relieve at 3,000 p.s.i. and are not adjustable.

Accumulators

22. The aileron and wheel brake accumulators are mounted in the gun bay underneath the cockpit floor and forward of bulkhead No. 2, the main accumulator being mounted transversely in the gun bay beneath the ammunition bay floor and the two arrester hook accumulators situated, one each, in the inner flap bays; the accumulators are charged with compressed air to the figures given in the Leading Particulars. The aileron, wheel brake and main accumulators store hydraulic fluid at the operating pressure of the system, and so ensure rapid operation of the services on selection; the arresting hook accumulators absorb the fluid displaced by the partial retraction of the hook on landing. Each accumulator is simply a cylinder with a floating piston which separates the air on one side from the hydraulic fluid on the other, thus, as hydraulic pressure increases the air is progressively compressed until the cut-out pressure is reached; the compressed air also acts as a shock absorber for the system. The wheel brakes and aileron accumulators supply their own services (under certain conditions the aileron accumulator will also feed the brakes), the main accumulator supplies the windscreen wiper, alighting gear, flap, dive brake, arresting hook, wheel brake and wing fold circuits. In the event of hydraulic failure, there is sufficient capacity to lower the undercarriage and flaps *once* only and for restricted use of the brakes on the landing run.

Accumulator pressure release valve

23. The pressure release valve is positioned in the aft end of the gun bay on the port side

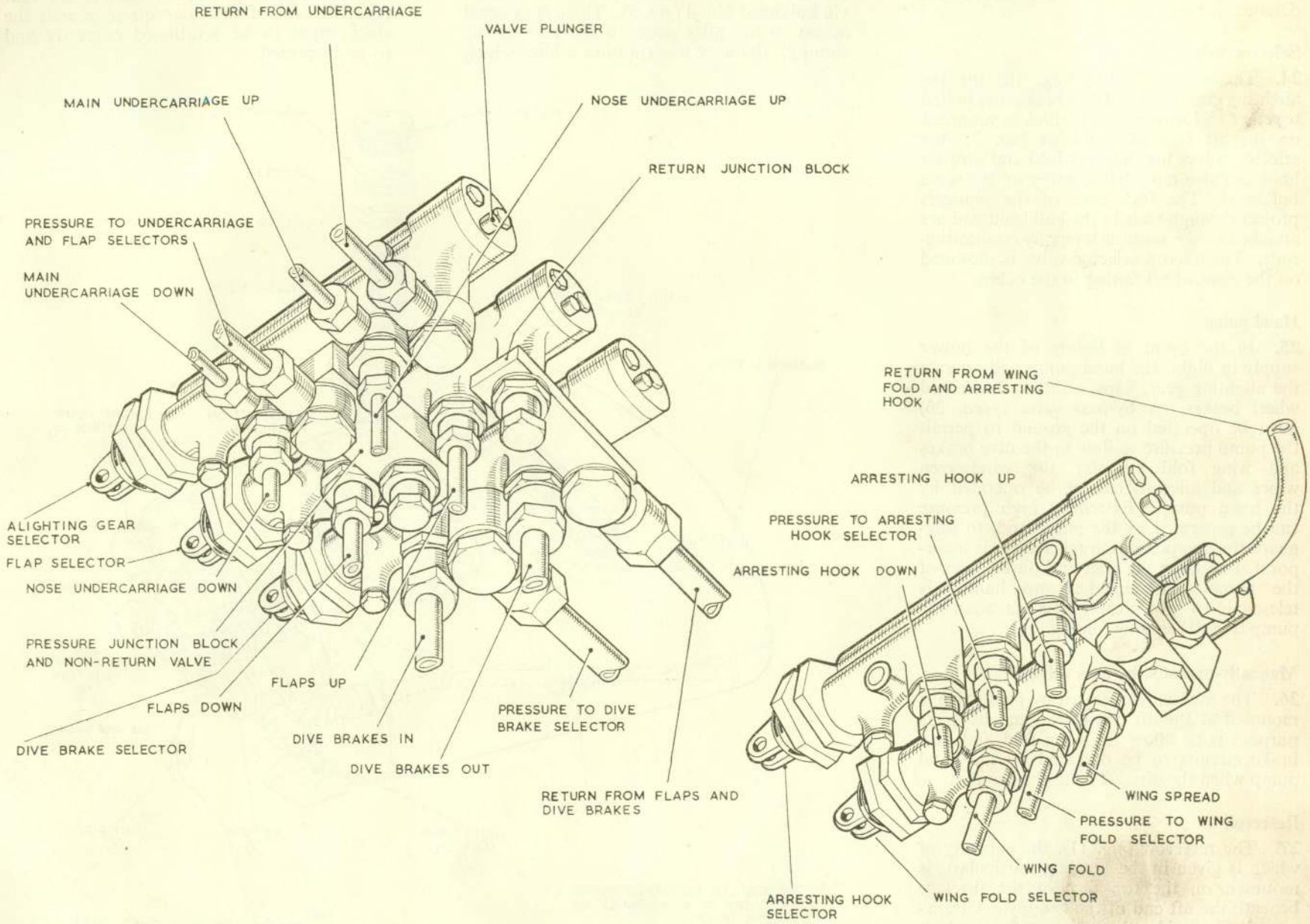

Fig. 10. Selector valve assemblies

and releases hydraulic pressure from the *main accumulator only*; the pressure from the other accumulators must be released as detailed in para. 30.

Selector valves

24. The selector valves (*fig.* 10) for the alighting gear, flaps and dive brakes are bolted together to form one unit which is mounted on the aft face of bulkhead No. 2; the selector valves for the wing fold and arrester hook are also mounted together on the same bulkhead. The fork ends of the plungers project through seals in the bulkhead and are attached to the selector levers by connecting-rods. The aileron selector valve is mounted on the nose wheel fairing in the cabin.

Hand pump

25. In the event of failure of the power supply in flight, the hand pump will operate the alighting gear, flaps, arresting hook and wheel brakes. A by-pass valve (*para.* 26) must be operated on the ground to permit the pump pressure to flow to the dive brakes and wing fold circuits; the windscreen wiper and ailerons cannot be operated by the hand pump. Extremely high pressure can be generated by the pump and, to safeguard the components, a relief valve is incorporated between the inlet and outlet sides of the pump. The hand pump handle is telescopic to give greater leverage when the pump is used for wing folding.

Manually-operated by-pass valve

26. The manually-operated by-pass valve is mounted at the aft end of the gun bay; its purpose is to allow the wing fold and dive brake circuits to be operated by the hand pump when the aircraft is on the ground.

Reservoir

27. The reservoir (*fig.* 11), the capacity of which is given in the Leading Particulars, is mounted on the top face of the fuselage beneath the aft end of the canopy. A transverse baffle divides the tank into fore and aft compartments, a fluid level sight glass being fitted to the top side of the forward compartment. Return fluid feeds into the forward compartment from which the hand pump suction line draws its supply; the vent line is directed to the bottom of the aircraft via bulkhead No. 4 (*fig.* 3). There is external access to the filler neck on the rear of the canopy; the neck incorporates a filter which can be removed for cleaning, and which must always be in position when filling. An inspection plate provides access to the rear compartment of the reservoir to permit the stack pipes to be positioned correctly and to be inspected.

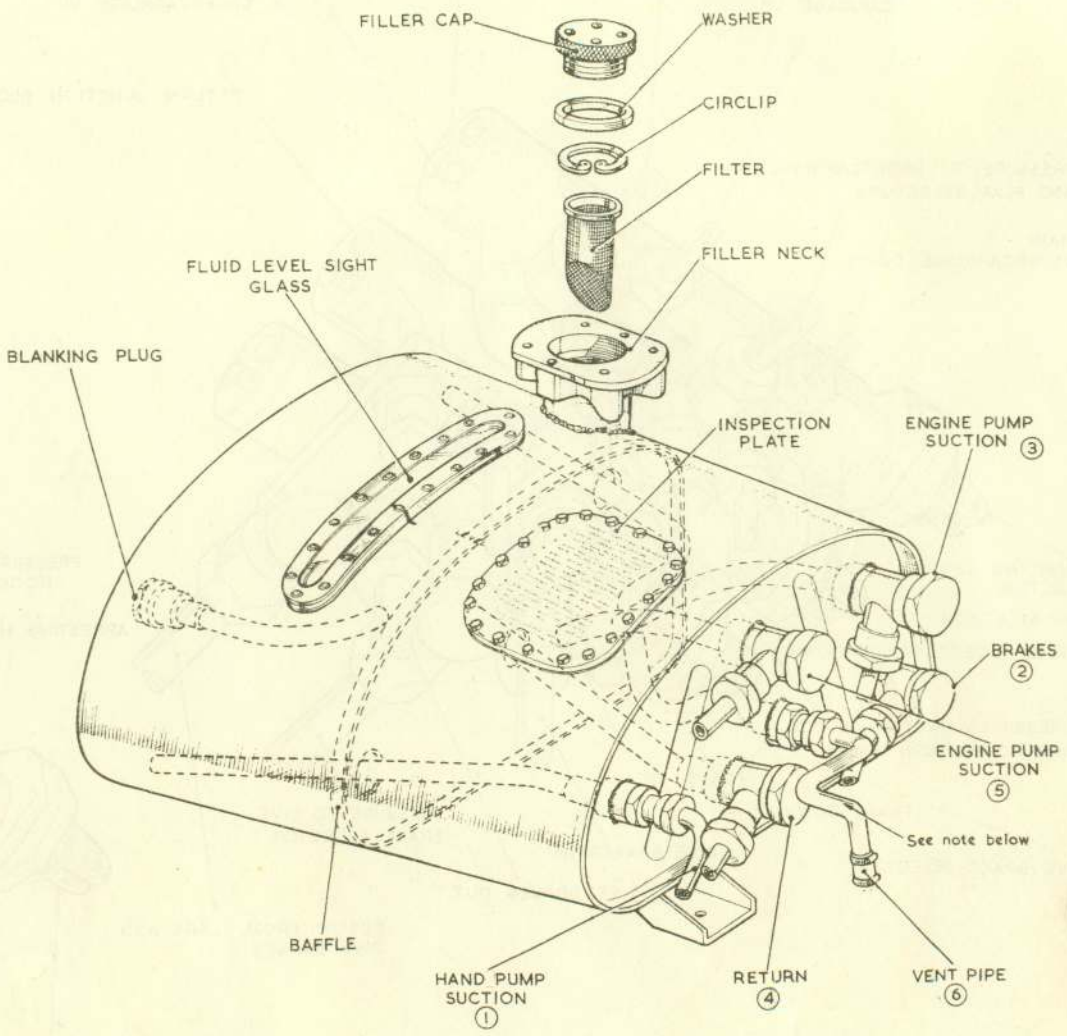

Fig. 11. Hydraulic reservoir

Engine-driven pumps

28. The two Lockheed high-pressure engine-driven pumps are mounted on the lower engine wheelcase, one port and one starboard; the inlet and outlet ports of the pumps are connected to the system through self-sealing couplings. The pumps *must not be run* unless all the couplings are connected; if the pumps are rotated for even one revolution with a self-sealing coupling disconnected and the pipes full of fluid, a very high pressure will be generated and failure will inevitably result. The position of the pumps relative to the reservoir makes them self-priming.

SERVICING

Warning

(1) *Personnel must take special care to keep their hands clear of the ailerons when they are being power-operated.*

(2) *The instructions detailed in para.* 30 *and* 31 *must be followed closely before any dismantling of the system is attempted.*

General

29. A full description and instructions for the dismantling and servicing of the Lockheed (AIR) and UMC components are given in A.P.1803B, Vol. 1 and A.P.1803P, Vol. 1, respectively; the servodynes are described in A.P.4602A, Vol. 1, and the Dunlop brake and windscreen wiper components are described in A.P.1803S, Vol. 1; no dismantling or adjustment may be made to these components without reference to the relevant Air Publication. The reservoir is of de Havilland manufacture and its dismantling is limited to the removal of the pipe connections from the shell, and the filter from the filler necks. The only servicing normally required is the cleaning of the filter and periodic flushing to remove sediment from the interior of the reservoir; for this latter purpose, the reservoir must be removed from the aircraft and only fluid of the same specification as that normally used in the aircraft hydraulic system may be used as the flushing medium. For convenience of reference, a list of manufacturers' part numbers of the components used in the system is given in para. 32, and a list of special tools in Sect. 2, Chap. 4.

Releasing the system pressure

30. The fluid pressure must be released separately from each accumulator and, owing to the interconnection between the accumulators, the pressure must be released from *all* the accumulators if *any* part of the system is being dismantled; the pressure release valve in the aft part of the gun bay releases pressure from the *main accumulator only*. To exhaust the brake accumulator, the wheel brake controls must be operated until the brake pressure gauge shows *zero*, and then operated slowly for a further six times (the main and aileron accumulators also supply the brake circuit). The control column handgrip must be operated full travel from side to side at least six times, with the aileron selector valve in the POWER (OUT) position, to exhaust the aileron accumulator. To discharge the arresting hook accumulators, the hook must be selected UP and DOWN until power is exhausted.

Servicing precautions

31. Failure to observe the following precautions before any part of the system is dismantled may result in severe injury to personnel:—

(1) All pipe ends and component ports exposed by disconnection must be sealed off immediately, by the fitting of approved A.G.S. blanking plugs, to prevent the ingress of foreign matter into the system. Rag, masking tape and similar material should not be used.

(2) On no account should the engine be turned with the pump self-sealing couplings disconnected (*para.* 28).

(3) It must be ensured that the system being disconnected is safe and is not being fed from another accumulator.

(4) If any form of wedge is used to hold open the by-pass valve in the gun bay for ground testing, a warning flag must be attached to the wedge to safeguard it against being forgotten.

List of main components (*fig.* 2)

32.

Item No.	Component	Part No.
1	Reservoir	12. 21S. 3941
2	Engine-driven pumps (2)	AIR.41000
3	Accumulator pressure release valve	AIR.40018
4	Ground test connections	12. 21S. 3523A
4a	Flow indicators (2)	AIR.42840
5	Non-return valve	UMC.704
5a	Non-return valve	AIR.62600
5b	Non-return valve	AIR.62600
5c	Non-return valve	UMC.706
5d	Non-return valve	UMC.703
5e	Non-return valve	UMC.706
5f	Non-return valve	UMC.704
5g	Non-return valve	AIR.66576
5h	Non-return valve connector	AIR.34126
5i	Non-return valve	UMC.706
5j	Non-return valve	UMC.704
5k	Non-return valve	AIR.66576
5l	Non-return valve	UMC.703
6	Cut-out valve	AIR.42268
7	Thermal relief valve	UMC.632
8	Multiple non-return valve	AIR.42800 *or* AIR.43470
9	Hand pump	AIR.43254
10	Pressure relief valve	AIR.42704
11	Manually-operated by-pass valve	AIR.40504
12	Aileron accumulator	AIR.40016
13	Wheel brake accumulator	AIR.42540
14	Main accumulator	AIR.40016
15	Ground charging points	AVA.59D AVA.56F

Item No.	Component	Part No.
16	Main undercarriage jacks (2)	AIR.42436
17	Main undercarriage lock jacks (2)	AIR.42439
18	Main undercarriage door jacks (2)	AIR.42024
19	Sequence valves (2)	AIR.42014
20	Nose undercarriage jack	AIR.42360
21	Restrictors (2)	12. 21S. 1573
22	Alighting gear selector valve	AIR.40758
23	Flap jacks (2)	AIR.42208
24	Capillary coils (2)	12. 21S. 2432
25	Flap selector valve	AIR.40272
26	Dive brake jacks (2)	AIR.41474
27	Dive brake selector valve	AIR.40272
28	Arresting hook accumulators (2)	AIR.42426
29	Arresting hook jacks (2)	AIR.42394
30	Collapse valve	AIR.60314
31	Arresting hook selector valve	AIR.40272
32	Two-speed restrictor	AIR.62370
33	Maxaret anti-skid unit	AC.11514 (Type R.C.M. Port) AC.11516 (Type L.A.M. Stbd.)
33a	Swivel coupling	7792y/A (Port) 7792y/B (Stbd.)
34	Brake unit	AH.50396 (Port) Iss. 1 AH.50397 (Stbd.)Iss.1
35	Brake relay clamp	ACO.5928
36	Relay valve	ACM.15698 *or* ACM.18570
37	Brake differential valve	AC.12724
38	Bleeder valves	6S.7799B
39	Triple brake pressure gauge	ACO.7173
40	Wing fold jacks (2)	AIR.42202
41	Wing fold selector valve	AIR.40272
42	Windscreen wiper motor	AC.12446
43	Windscreen wiper control valve	ACM.13478
44	Aileron servodyne	AIR.42604 (Port) AIR.42605 (Stbd)
45	Aileron selector valve	AIR.42164
46	Pressure switch	T.P.5216
47	Anti-surge valve	AIR.42500

Reservoir replenishing

33. Before the reservoir is replenished, it should be ensured that there is no hydraulic pressure in the system (*para.* 30), and that the main, aileron, wheel brake and arresting hook accumulators have been inflated to the figures given in the Leading Particulars; the procedure is then as follows:—

(1) With the aircraft parked on its wheels:—

(*a*) Check the tyre and oleo leg pressures.

(*b*) Select wheel brakes and windscreen wiper OFF, dive brakes IN, and flaps and arresting hook UP.

(*c*) Lash the arresting hook *up*.

(*d*) If the wings are folded, fill the reservoir to the *lower* level line.

(*e*) If wings are spread, fill the reservoir to the *upper* level line.

(2) With the aircraft in the rigging position:—

(*a*) Select undercarriage DOWN, and, with the exception of sub-para. (1)(*a*), follow sequence given above.

Filling the system

34. With the aircraft in the rigging position (*Sect.* 2, *Chap.* 4), proceed as follows:—

(1) Fit brake relay clamps to each brake relay valve and tighten the clamps.

(2) Replenish the reservoir (*para.* 33).

(3) Fold the wings manually and support with the jury struts (*Sect.* 2, *Chap.* 1). Disconnect the wing fold jacks at their piston-rod eye ends, and fit sheet metal guards (*para.* 37).

(4) Set the controls levers in the cabin as follows:—

Undercarriage and flaps	UP
Dive brakes	IN
Arresting hook	UP
Wings	SPREAD
Ailerons	MANUAL (IN)
Wheel brakes	OFF

Hold open the manually-operated non-return valve in the gun bay, work the hand pump until all the jacks have operated fully, and top-up the reservoir as required (*para.* 33).

(5) Re-set the cabin controls as follows:—

Undercarriage and flaps	DOWN
Dive brakes	OUT
Arresting hook	DOWN
Wings	FOLD
Aileron	POWER (OUT)
Wheel brakes	OFF

Hold open the manually-operated non-return valve in the gun bay, work the hand pump until all the jacks are operated fully, and top-up the reservoir as required.

(6) Using the hand pump, proceed with the bleeding and adjustment of the Maxaret anti-skid units and the brake system (*para.* 48).

(7) Replenish the reservoir.

Warning

(1) *It is essential that only clean hydraulic fluid to the correct specification be used (Leading Particulars). Scrupulously clean containers must be used because minute particles of foreign matter from dirty containers can be a serious source of hydraulic breakdown.*

(2) *Ground personnel must ensure at all times that the alighting gear selector lever is correctly engaged and* gated *in the* DOWN *position.*

(3) *After the system has been filled and before the aircraft engine-driven hydraulic pumps are operated, the vent plug on each pump must be unscrewed to check*

that the pump is primed properly; the pumps must never be run dry or severe damage will occur.

Ground functional tests

35. To make the functional tests, ensure that the test rig is serviceable, then proceed as follows:—

(1) Remove the blanking caps from the ground test connections on the lower port side of the aft face of bulkhead No. 4. Couple up the power-operated test rig supply and return lines, and bleed air from the test rig and the aircraft engine-driven pump vents; apply power for five to ten seconds and bleed again. Repeat the process until the fluid is free from air bubbles.

(2) Make final adjustments, but on no account disturb the setting of the servo-dynes. Ensure that all ground locks and rigging locks are removed.

(3) Run the test rig for two minutes, holding the accumulator release valve open, and observe that the flow indicator warning lamps in the cabin do not light or blink while the test rig is running. Stop the test rig and check that the lamps light when the flow has ceased.

Cut-out valve test

36. With pressure gauges mounted on the accumulators, the test rig should be used to check that the cut-out valve operates at 2,400-2,500 p.s.i.; it is not satisfactory to check the *cut-in* pressure on the aircraft, this must be done periodically on a suitable flow test rig. If the *cut-out* figure does not agree with that given above, the cut-out valve must be removed from the aircraft and adjusted and tested on a rig as described in A.P.1803B, Vol. 1, Sect. 10; *no adjustment of this valve is permissible on the aircraft.*

Note . . .

Where operating times of a service less than the requirement are encountered, the issue No. of the cut-out valve AIR.42268 should be checked, and if found to be issue 4, *should be replaced by an issue* 5, *or* 3, *valve.*

Wing fold test

37. With wings supported by the jury struts and the wing fold jack piston-rods disconnected at their eye ends (*para.* 34 (3)), and with power available from the test rig, the wings should be selected alternately to FOLD and SPREAD; a piece of sheet metal (about 18 in. × 4 in.) must be positioned to protect each main plane from damage by the jack piston-rod eye end as it travels in and out. Sixty continuous movements will be required to clear all trace of air, allowing pressure to build-up fully between each reversal; the sheet metal strips should then be removed, the jack piston-rod eye ends reconnected, the jury struts removed and the wings spread. Functional tests should then be made as follows:—

(1) Using the test rig set to a pressure of 350 p.s.i. and with a tip tank on each wing-tip loaded to the figure given in fig. 12, select wing FOLD from the wing SPREAD position and reverse several times. Check carefully that the latch pins enter and withdraw correctly.

◄ **Warning**

During the above tests and those given in sub-para. (2), *should the full operation of the wing* spread *movement be arrested for any reason before the extension wing reaches approximately* 45 *deg. past top dead centre, the fully* spread *condition must be completed before wing* FOLD *is selected.* ►

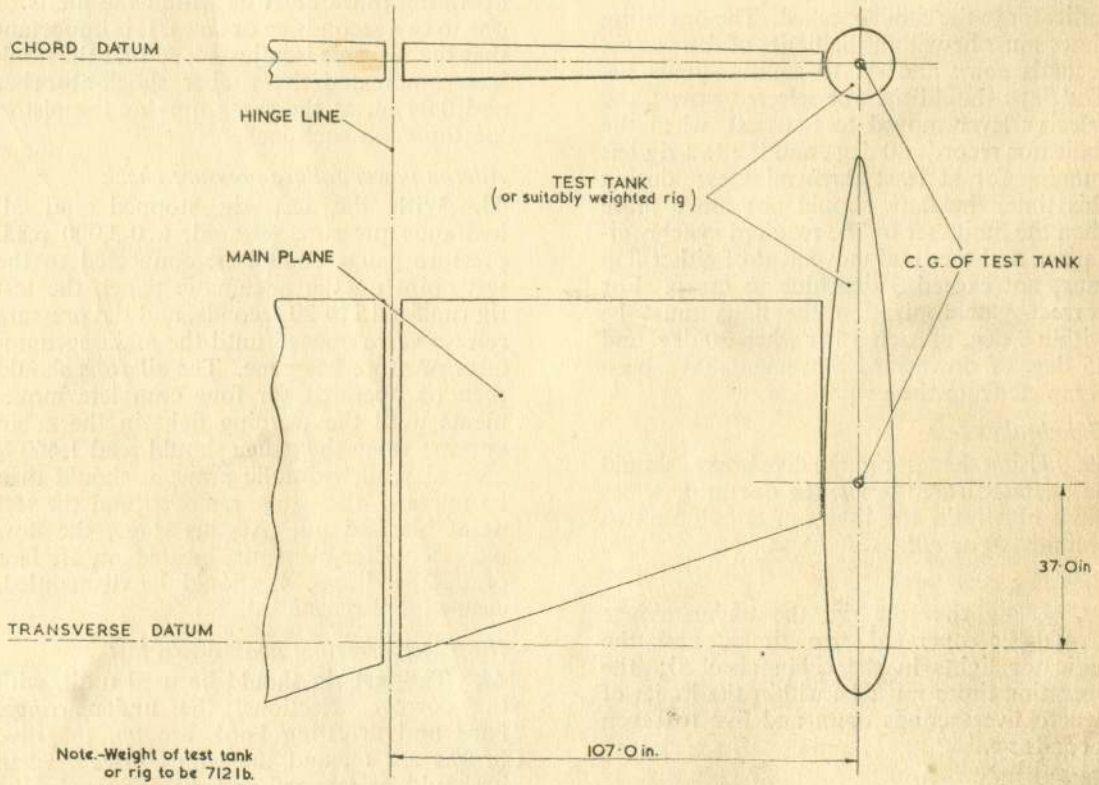

Fig. 12. Wing fold functioning test

(2) Increase the test rig pressure to 2,500 p.s.i. and repeat the test, selecting wing FOLD from SPREAD and back to SPREAD, checking the correct operation of the latch pins at each reversal.

(3) Repeat the operations described in sub-para. (1) and (2) above *without* tip tanks, checking carefully the correct functioning of the latch pins at each reversal.

(4) Using the test rig, operate the wing fold system five times, and check the operation of the indicator lights in the cabin; the operating times must be within the limits of 16 to 21 seconds *folded* or *spread* and synchronization within one to four seconds.

Flaps test

38. Using the test rig, the flaps should be operated three times and the operation of the indicator in the cabin checked. The operating times must be within the limits of four to six seconds *down* and six to eight seconds *up*. The flaps should then be selected DOWN, the selector lever moved to NEUTRAL when the indicator records 30 deg., and the test rig left running for at least three minutes; during this time, the flaps should not move more than the limits set by the required synchronization, and the total movement of either flap must not exceed 3 deg. due to creep. For correct synchronization the flaps must be within 3 deg. of each other when 30 deg. and 45 deg. of downward movement have been complete from the *up* position.

Dive brakes test

39. Using the test rig, the dive brakes should be operated three times, the operating times must be within the limits of a half to two seconds, *in* or *out*.

Alighting gear test

40. Using the test rig, the undercarriage should be operated five times, and the indicator lights in the cabin checked; the operating times must be within the limits of two to five seconds *down* and five to seven seconds *up*.

Note . . .

The leg fairing carries the striker for the undercarriage door sequence valve; if functional tests are carried out without the fairing in place, the sequence valve must be depressed manually until the door lock breaks at the start of the undercarriage down *movement, otherwise the lock will be distorted and probably broken. The operator must be careful to position himself clear of the radius of movement of the door and leg. Alternatively, a dummy striker to operate the sequence valve may be made up from* 0·125 *in. mild steel strip and bolted to the fairing attachment lug on the aft face of the undercarriage leg.*

Brake test

41. Using the test rig, the brake system should be operated as detailed in para. 49.

Arresting hook test

42. Using the test rig, the arresting hook should be operated three times, and the indicator lights in the cabin checked; the operating times must be within the limits of one to two seconds *up* or *down*. It is important that the A frame is adjusted, so that the hook has compressed the rubber shock-absorber pad 0·04 in. at the same time as the piston 'bottoms' on each jack.

Aileron power failure pressure check

43. With the test rig stopped and all hydraulic pressure released, a 0-3,000 p.s.i. pressure gauge should be connected to the test point on the pneumatic panel, the test rig run for 15 to 20 seconds, and the pressure release valve opened until the main accumulator pressure has gone. The ailerons should then be operated for four complete movements until the warning light in the cabin appears when the gauge should read 1,400 ± 25 p.s.i.; all hydraulic pressure should then be released, the gauge removed and the test point blanked off. At this stage, the flow indicator filter elements, located on aft face of bulkhead No. 4, should be dismantled, cleaned and reinstalled.

No-power arresting hook down *test*

44. The test rig should be used until, with the correct selections, the undercarriage, flaps and arresting hook are *up*, the dive brakes are *in*, and the wings *spread*, when it should be stopped and disconnected; the pressure release valve in the gun bay should now be opened to release all hydraulic pressure from the main accumulator only, and the arresting hook selected DOWN. The hook should fall freely within two seconds.

Manually-operated non-return valve seating check

45. The test rig return line should be connected at the test coupling on the firewall, the rig started, and the fluid collected in a clean container for re-use; the rig should be stopped as the flow ceases (without allowing the pump to run dry) and the pressure line connected. The hand pump should be used until, with the correct selection, the arresting hook is *up*, and the undercarriage and flaps *down*, and pressure maintained until resistance reaches a maximum (the fluid for the hand pump will come from the reservoir hand pump reserve left after fluid has ceased flowing from the pump pressure line). The dive brakes should now be selected OUT, and pressure maintained on the hand pump for two minutes during which time the dive brakes should not move; although a slight flutter at the trailing edges immediately after selection may be disregarded; if there is any definite movement, it will be due to a faulty manually-operated non-return valve.

Power-operated ailerons test

46. Before the power-operated ailerons are tested, the reservoir should be replenished (*para.* 33), and the accumulator air pressures checked while there is no hydraulic pressure in the system; the procedure is then as follows:—

(1) Check the general operation of the aileron actuating system. Ensure that backlash has been eliminated, that the cables have been tensioned correctly, and that all pivots and joints are lubricated correctly (*Sect.* 2, *Chap.* 4).

(2) Connect the test rig to the aircraft, run at 2,800-2,900 r.p.m. for five to ten minutes, and operate the dive brakes, ailerons and flaps to eliminate air from the system.

(3) Check the controls for judder. A slight aileron tremble is permissible during operation provided that it can be damped out with one hand holding the trailing edge (care being taken to avoid the

fingers being entrapped); the complete installation should operate smoothly. The servodynes may be checked for smoothness by disconnecting the controls at the servodynes and operating by hand; no adjustment may be made to the servodynes while they are fitted to the aircraft.

(4) Check that the break out force at the top of the control column conforms to the figure given in Sect. 3, Chap. 4.

(5) Check that there is no excessive snatch on the control column when selecting to POWER (OUT).

(6) With the test rig running at 1,300 to 1,400 r.p.m., operate the ailerons continuously by moving the head of the control column from centre to port, full travel, then full travel to starboard, returning to centre; each full cycle should take approximately four seconds while operating. ◄The cycle of operations is to be repeated 60 to 75 times, except when a new servodyne has been fitted, when 100 reversals must be made. During the cycle of reversals, select windscreen wiper ON, then select undercarriage UP and DOWN twice, dive brakes OUT and IN six times, flaps DOWN and UP twice, each of these latter three services should be operated singly, without overlapping one another, and at intervals of not less than five to eight seconds between each selection; at no time should control tighten up (i.e. revert to MANUAL) through lack of hydraulic pressure. ►

(7) Stop and disconnect the test rig, check the reservoir fluid level and the accumulator pressures, and repeat the replenishing procedure if necessary.

Windscreen wiper test

47. The windscreen wiper test should be conducted as follows:—

(1) With the wiper control in the OFF position both feed pipes to the wiper motor should be isolated.

(2) With hydraulic supply available at operating pressure, select PARK and check that the blade parks solidly just off the windscreen.

Note . . .

Under no circumstances must the wiper be operated on a dry windscreen for even one sweep.

(3) With the screen lubricated with clear water, select wiper ON and slowly increase speed. Care must be taken when increasing speed that the screen is covered with water all the time; dust or dirt on the windscreen must be washed off with clear water before the wiper is operated.

(4) Operate the complete sequence, i.e., PARK—OFF—ON, five times taking care to change slowly from PARK to ON, and check that the wiper operates smoothly and correctly according to selection.

(5) Attach a spring balance to the fulcrum of the wiper blade and check that the load is 7 lb. when the blade is lifted just clear of the windscreen by the spring balance.

Bleeding and adjusting the brake system and Maxaret units

48. The system must be filled as detailed in para. 34 before the Maxaret anti-skid units (*fig.* 13) are bled and adjusted. The Maxaret units and the brake circuit must be bled whenever components are changed or the brake system is dismantled; the procedure is as follows:—

(1) Check that the differential control valve AC.12724 has been fitted.

(2) Lock the rudders in a central position. Remove the slack from the brake control cable in the cabin by adjusting the turnbuckle, and adjust the connecting link between the rudder pedals and the differential valve to set the valve indicator arm in a central position.

(3) Lock the brake plates in each main wheel by depressing the locking collar and tightening the square-headed piston-rod head. Remove the locking plate from the wheel hub nut and unscrew the hub nut approximately 0·50 in., until the Maxaret tyre is just clear of the inner rim of the wheel. Release the brake plates by unscrewing the piston-rod head two flats or slightly more to engage the locking collar.

(4) Disconnect each Maxaret unit return pipe and attach a short length of tubing to the exhaust connection to lead into a suitable receptacle.

(5) Operate the hand pump continuously, and select wheel brakes ON. Rotate each aircraft wheel sharply by hand so that the Maxaret tyre rotates in the direction of the arrow on the type-reference label, and then bring the wheel to rest; each time that the wheel stops, a small volume of fluid is discharged from the exhaust connection. Repeat this sequence until the fluid is free from air.

(6) Check the free and correct movement of the indicator rods; each rod should protrude for brakes *off* and be flush with the casing for brakes *on*.

(7) Reconnect the Maxaret unit return pipes. Continue to use the hand pump and check the brake units and pipe connections for external leakage.

(8) Using the hand pump, bleed each brake cylinder at the bleed screws, then bleed the brake gauge at the three bleeder screws on the connections to the triple brake pressure gauge in the cabin, until the system is clear of air. The presence of air in the pipe lines or components is usually indicated by a spongy feeling when the brakes are applied and a sluggish response of the needles on the pressure gauge, the relay valves moving up and sealing the gauge off.

(9) Cease to use the hand pump, lock all bleed screws and replaced pipe union nuts, and remove the clamps from the brake relay valves. Ease the wheels inboard carefully and run the tyres of the Maxaret units into their normal position, screw up the hub nuts and lock. Press in the locking collars and

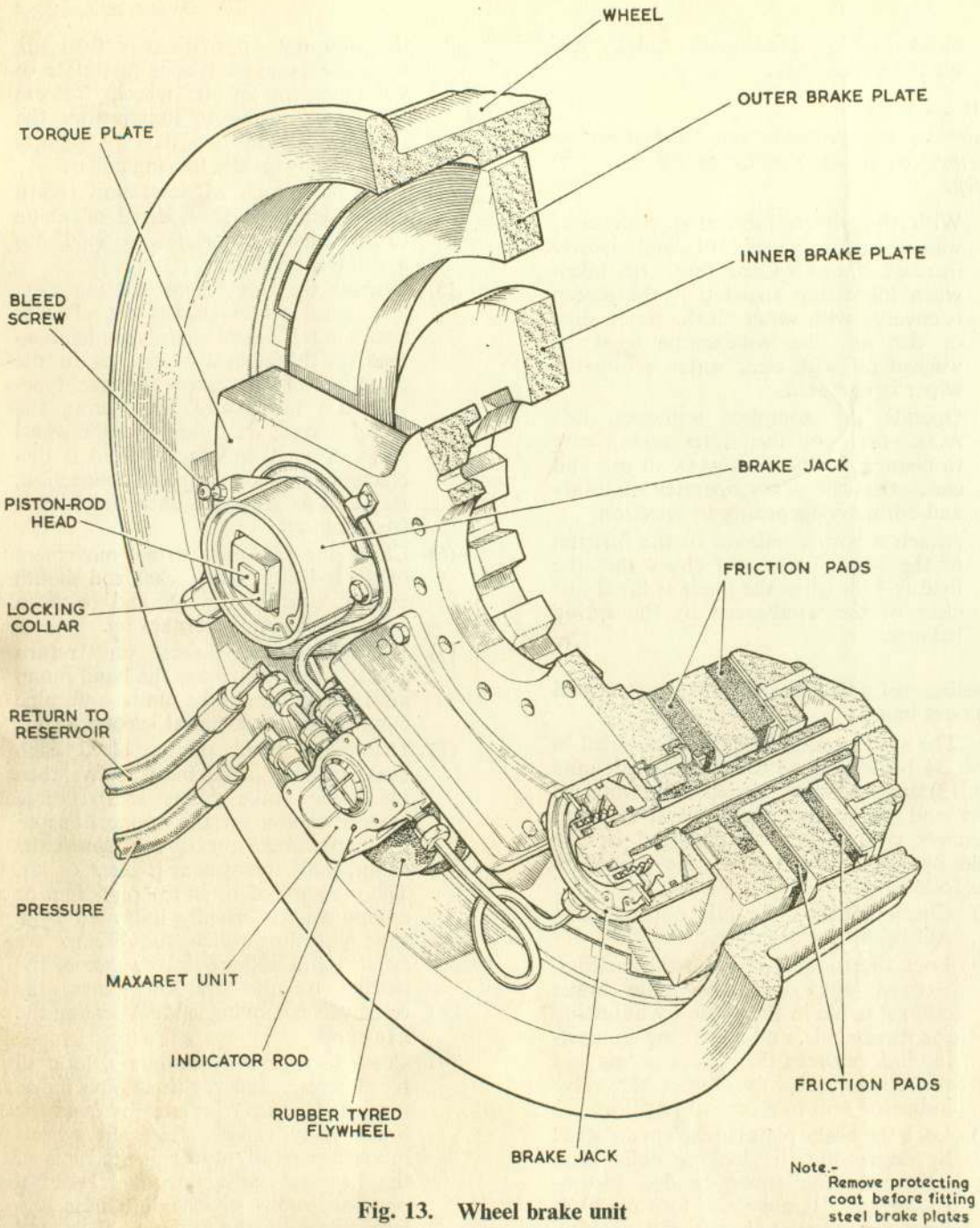

Fig. 13. Wheel brake unit

tighten the square-headed piston-rod heads until all play in the assemblies is removed, then unscrew the piston-rod heads two flats or slightly more to re-engage the locking collars.

(10) Check that the landing wheels drive the Maxaret units in the direction indicated by the arrows on the type reference labels.

Note . . .

(1) *During bleeding operations, the greatest care must be taken to prevent contamination by hydraulic fluid of the friction surfaces, wheel rims and tyres.*

(2) *The adjustment of the Maxaret units must be checked whenever the wheels or brake assemblies are disturbed.*

(3) *If severe overheating of the hydraulic brakes is experienced on landing, the Maxaret units must be examined for possible damage.*

(4) *Whenever the aircraft is left standing for any length of time, each Maxaret tyre must be rotated periodically to avoid a flat forming where it is in contact with the rim of the aircraft wheel.*

(11) Check the Maxaret unit clearances (*fig.* 14); fitting and servicing instructions for the unit are given in A.P.1803S, Vol. 1, Sect. 8.

Brake system functional check

49. The brake system functional check should be made in the following manner:—

(1) With the test rig running, apply the brakes fully, and check that the maximum pressure registered on the brake gauge for each brake is 1,750 p.s.i. while the other is within the range of 1,600-1,900 p.s.i.; if the correct maximum pressure is not registered on the brake gauge, screw in the stop at the base of the brake lever on the control column if the pressure is too low, or unscrew the stop if the pressure is too high. When the brake lever is released the gauge pressure must return to *zero*; if the pressure is not fully exhausting on the gauge, check that the operating cable is not over-tensioned, or if one gauge only registers *zero*, adjust the connecting link

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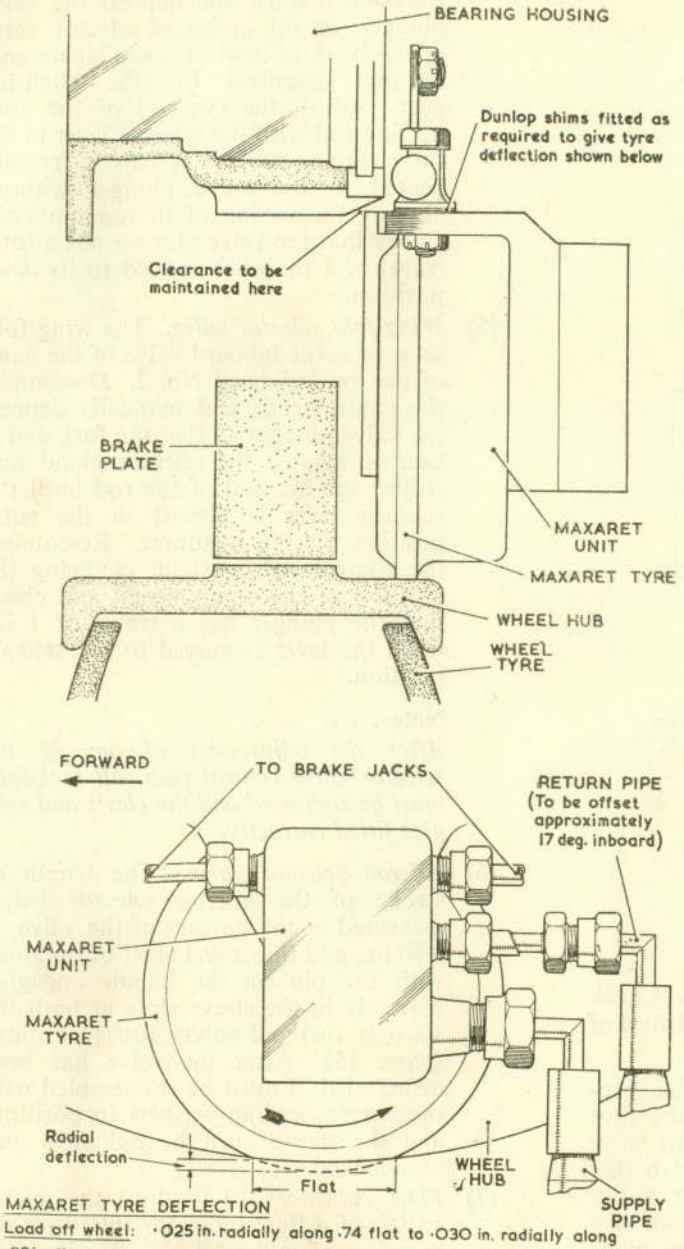

Fig. 14. Maxaret unit clearances

between the rudder pedals and the differential valve to zero the other. If adjustments are made to zero the gauges, the maximum pressures must again be checked and, if necessary, corrected.

(2) Apply the brakes progressively and observe the brake gauge readings; when one indicator arm reaches 1,000 p.s.i., the other must be between 900 and 1,150 p.s.i. At all pressures between 1,000 and 1,900 p.s.i. the gauges must not show more than 150 p.s.i. difference.

(3) Release the rudder lock. With the brakes applied and with full port rudder, the starboard wheel should be free, and with *zero* reading on the starboard gauge, the port brake pressure gauge reading must be 1,750 p.s.i.; With full starboard rudder, the port wheel should be free, and with *zero* reading on the port gauge, the starboard brake pressure gauge reading must be 1,750 p.s.i. It is permissible to have a surge pressure of +100 p.s.i. and, when full port or full starboard rudder is applied, the differential indicator arm should be at a minimum of 45 deg. in each instance.

(4) Check that the operating load of the brake control lever on the control column does not exceed an average of 22 lb. over the whole range of the aileron control movement.

(5) Ensure that the maximum brake pressure of the system shown on the gauge is between 2,400 and 2,500 p.s.i. at the time check readings are made.

(6) Stop the test rig, and open the pressure release valve until the main accumulator pressure is exhausted. Operate the ailerons until pressure is exhausted, and then check that ten full-pressure brake applications can be made before the power is exhausted; if this requirement is not satisfied, re-bleed the system and repeat the check.

Leakage in the system

50. Internal or external leakage of the hydraulic fluid will cause erratic functioning and hammering of the cut-out valve, and sluggish operation of the services, and the cowlings and gun bay doors should therefore be removed and an inspection made for signs of external leakage. If no leakage is visible, the various components must be checked for internal leakage in the following manner:—

(1) With the system under pressure, operate the levers of the by-pass and pressure release valves to clear possible foreign matter from the valve seatings.

(2) With the above-mentioned components free from fault, move the plungers of the selectors to their mid-travel positions; if the pressure now remains constant, the leakage should be either in one of the jacks or in a pipe line to a jack. Trace the fault by checking each circuit in turn until the faulty component is located, and rectify in accordance with the relevant Air Publications.

Adjusting the selector valves and flow indicators

51. The selector valves and the flow indicators (*fig.* 4, 9 *and* 10) should be adjusted as follows:—

(1) *Alighting gear.* Disconnect the connecting-rod from the selector valve (the outboard valve of the bank of three) and, with the selector lever engaged in the DOWN position, ensure that there is a gap of 0·03 in. between the dome head bolt in the bell-crank of the lever and the contact point of the micro-switch. Then adjust the selector lever connecting-rod until there is a clearance of 0·03 in. between the latch plate and the lower side of the solenoid latch. When the latch is fully retracted there should be also a clearance of 0·03 in. between the end of the latch and the side of the latch plate (*fig.* 15). Manually press the fork end of the valve plunger so that the fork end is bearing against the gland nuts, then, with the selector lever almost against the *upper* end of its slot, adjust the control rods as necessary to allow them to be re-connected between the valve and lever without altering the setting of the components. Move the selector lever fully DOWN, and check that the total travel of the valve plunger, which protrudes from the aft face of the selector (in the gun bay) is 1 inch.

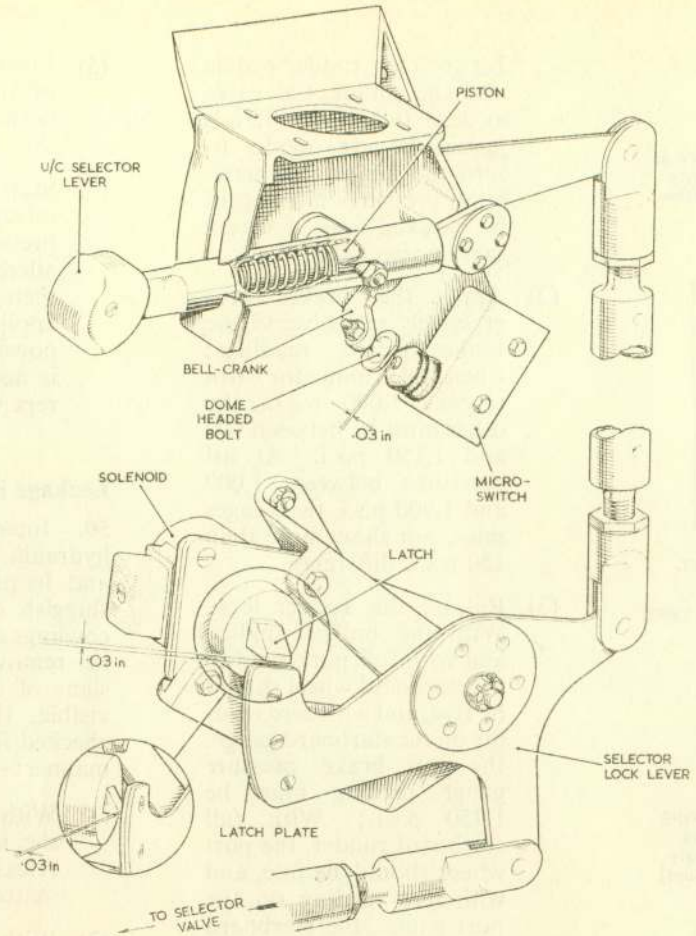

Fig. 15. Adjustment of undercarriage selector lever

(2) *Flap selector valve.* The flap selector valve is the centre valve in the bank of three. Disconnect the control rod from the valve fork end, and as it has a NEUTRAL setting, move the valve plunger to the mid-travel position, i.e., 0·50 in. from either full travel position. Set the selector lever on the control box in the NEUTRAL position, and adjust the control rods, so that they may be re-connected to the valve and lever without altering the setting of these components. Check that the valve plunger has a full travel of 1 inch.

(3) *Dive brake selector valve.* The procedure for the adjustment of the dive brake selector valve (the inboard valve of the bank of three) is similar to that for the alighting gear selector valve, except that, with the control rods disconnected, adjustment must be made with the dive brakes selector lever almost against the rear *lower* end of its quadrant slot. Check that the total travel of the valve plunger is 1 inch.

(4) *Arresting hook selector valve.* Disconnect the control rods, and depress the valve plunger (on the outboard selector valve of the bank of two) in a similar manner to that described for the alighting gear. Adjust the eye end of the connecting-rod with the selector lever in the UP position, so that it can be re-connected to the valve plunger without altering the setting of the components. Check that the valve plunger has a total travel of 1 in. when moved to its *down* position.

(5) *Wing fold selector valve.* The wing fold selector is the inboard valve of the bank of two on bulkhead No. 2. Disconnect the control rods and manually depress the valve plunger so that the fork end is bearing against the selector gland nut. Adjust the eye end of the rod until the selector lever is almost in the FOLD position on the quadrant. Re-connect the control rods without changing the position of the components, and check that the plunger has a travel of 1 in. when the lever is moved to the SPREAD position.

Note . . .
After the adjustment of any of the selector valve control rods, all lock-nuts must be tightened and the clevis and split pins fitted correctly.

(6) *Aileron selector valve.* The length of stroke of the aileron selector valve, measured at the bottom of the valve, is 0·60 in., and this travel must be obtained with the pin on the handle engaging correctly in the sleeve slots at both the MANUAL (IN) and POWER (OUT) positions (*para.* 15). After the valve has been dismantled, it must be reassembled with the correct sealing washers in position, and the sleeve must be tightened and wire-locked.

(7) *Flow indicators.* To adjust the micro-switch of a flow indicator (fitted on the rear face of bulkhead No. 4), adjust the set-screw until the switch just 'makes', then turn back the set-screw three turns plus or minus half-a-turn, and lock with the tab washer and lock-nut.

REMOVAL AND ASSEMBLY

General

52. The sequence of operations for the removal and replacement of most of the hydraulic components will be obvious when viewed on the aircraft. The procedure for certain items which is not clearly apparent is given below.

Warning

Before any dismantling is attempted, all the system pressure must be released as instructed in para. 30. *Failure to observe this instruction could result in serious injury.*

53. All disconnected pipe ends must be protected in the approved manner (*para.* 31) to prevent the ingress of foreign matter. When pipe connections are being re-assembled, care must be taken to avoid damaging the fired joints by over-tightening. Where a leak persists it cannot be cured by continued tightening of the union nut; the joint must be dismantled and the component parts examined for cracks or other damage. The brake cable must be reassembled with sufficient cable loop at the top and bottom of the connecting-rod of the variable-ratio control column to allow aileron control movement both in POWER and MANUAL, and with the two cable clips attached at their original positions.

Alighting gear jacks

54. Before the removal of the alighting gear jacks is commenced, the aircraft must be trestled with the alighting gear *down* and the wheels clear of the ground. If the hydraulic system has not been drained, the circuit must be isolated by positioning the selector valve in its mid-travel position. Unless otherwise stated, assembly is the reverse of that given for removal. The installation of the various jacks is shown in Sect. 3, Chap. 5.

Main undercarriage jacks

55. A main undercarriage jack should be removed in the following manner:—

(1) Remove the nose fairing of the tail boom from the underside of the main plane.

(2) Disconnect the flexible hoses and pipe unions from the junction block adjacent to the jack, and remove the junction block.

(3) Remove the lever attachment bolt at the eye end of the piston-rod. It may be necessary to remove the undercarriage operating arm (channel casting) to gain access to the split pin and nut on the attachment bolt.

(4) Remove the locking ring at the head of the jack, using the special spanner listed in Sect. 2, Chap. 4, and slide the jack inboard and remove.

Main undercarriage door jacks

56. With the inspection panels on the forward face of the wheel well removed, the instructions for the removal and assembly of a main undercarriage door jack are as follows:—

(1) *Removal.*
- (*a*) Remove the fairlead holding the hydraulic pipes inboard of the jack and disconnect the flexible hoses at the pipe unions.
- (*b*) Remove the connecting bolt at the piston-rod eye end.
- (*c*) Remove the anchorage bolt at the jack cylinder head.
- (*d*) Ensure that the jack is fully retracted and withdraw the jack through the outboard handhole with the flexible hoses attached.

(2) *Assembly.*
- (*a*) Fit the flexible hoses to the jack, and wire-lock in the approved manner.
- (*b*) Pass two pieces of wire (in-board to outboard) through the holes in the diaphragm at the jack anchorage point. Attach the outboard ends of the wire to the flexible hoses, insert the jack in the outboard handhole, and draw the jack and hoses into position with the wires.
- (*c*) Insert the anchorage bolt at the head and the connecting bolt at the piston-rod eye end of the jack.
- (*d*) Connect up the hoses and lock in the approved manner, and replace the fairlead.

Undercarriage lock jack

57. The procedure for the removal of an undercarriage lock jack is as follows:—

(1) Remove the hydraulic 'Y' piece attached to the inboard end of the jack.

(2) Remove the lever attachment bolt at the piston-rod eye end.

(3) Remove the attachment bolt securing the jack cylinder head to the radius rod assembly, and withdraw the jack.

Nose wheel jack renewal

58. When the nose wheel jack has to be replaced, the following procedure must be carried out:—

(1) Support the aircraft on jacks and insert the nose undercarriage ground lock pins.

(2) Exhaust all pressure from the hydraulic system as outlined in para. 30.

(3) Withdraw the pivot pin from the aft end of the jack.

(4) Disconnect the flexible pipes from the bracket on the roof of the nose wheel tunnel.

(5) Withdraw the nuts and bolts from the forward end, then the aft end, of the jack.

(6) Remove the jack.

(7) Transpose the hydraulic pipes from the old to the new jack.

(8) Attach the forward end of the jack to the arm at the top of the leg.

(9) Re-connect the flexible pipes to the bracket.

(10) Attach the aft end of the jack to the arm at the top of the radius rod.

Wing fold jack

59. With the access panels to the jack from the underside of the wing removed, the procedure for the removal and assembly of a wing fold jack is as follows:—

(1) *Removal.*

(*a*) Fold the wings manually as described in Sect. 3, Chap. 1.

(*b*) Fit the wing jury struts.

(*c*) Isolate the jack by placing the wing fold selector valve in its mid-position.

(*d*) Remove the two pins locking the securing bolt to the jack lever (at the wing fold), and withdraw the bolt.

(*e*) Disconnect the two hoses to the jack at the elbow joints, and seal off (it is unnecessary to disconnect the hydraulic union at the head of the jack).

(*f*) Remove the nut and tab washer from the bolt securing the cylinder head of the jack to the wing structure, and withdraw the bolt.

(*g*) Pull the jack towards the folding mechanism until the cylinder head is free to be lifted through the large access door.

(2) *Assembly.* Ensure that the pins securing the jack lever pin (*Sect.* 3, *Chap.* 2) at the piston-rod end of the jack are replaced with their heads facing *outboard* when the wings are *folded* (*downwards* with the wings in the *spread* position).

Main undercarriage sequence valves

60. The removal and assembly of the main undercarriage sequence valves is straightforward, except that it will be necessary to remove the radius rod assemblies as the bolts holding the valves are peened over. Instructions for the removal of the radius rods are given in Sect. 3, Chap. 5.

Main undercarriage swivel couplings (brakes)

61. The swivel couplings on an undercarriage leg must be parallel to the centre-line of the undercarriage strut at points 'A', 'B' and 'C' to the dimensions given in fig. 6, and parallel to the centre-line of the strut swivel pins at point 'D' throughout retraction. The top connections may be shimmed under the mounting feet as required.

Reservoir

62. When all hydraulic pressure in the system has been released (*para.* 30) and the fluid drained from the reservoir, the reservoir (*fig.* 11) should be removed and assembled as follows:—

(1) *Removal.*

(*a*) Remove the port rear Perspex panel from the canopy to give free access to the hydraulic pipe lines and the reservoir.

(*b*) Disconnect the pipe lines from the tank and canopy decking, leaving the banjo body on the pipe where possible, and blank off the open ends and adapters (*para.* 31).

(*c*) Remove the six 4 B.A. bolts from the filler neck attachments and the three fixing bolts from the reservoir support brackets. Remove the reservoir.

(2) *Assembly.*

(*a*) Place the reservoir in position, and secure the filler neck to the canopy, ensuring good sealing; then bolt the reservoir support brackets to the canopy decking, and check there is a clearance between the reservoir and the Perspex panel.

(*b*) Replace the hydraulic pipes in the numerical sequence shown in fig. 11.

Note . . .

Banjo bodies may be reversed to obtain clearance or correct alignment of the pipes.

(*c*) Fill the reservoir (*para.* 33), and operate such services as the hand pump and brakes to circulate the fluid through the pipe lines; check the system for leakage.

(*d*) Replace the Perspex panel.

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