A.P.101B-0407-1A
A.L.158, Apr.77

SECTION 3

# AIRFRAME

LIST OF CHAPTERS OVERLEAF

## SECTION 3

# AIRFRAME

## LIST OF CHAPTERS

**Note:-** *A list of contents appears at the beginning of each chapter*

# Chapter 1 FUSELAGE

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## LIST OF ILLUSTRATIONS



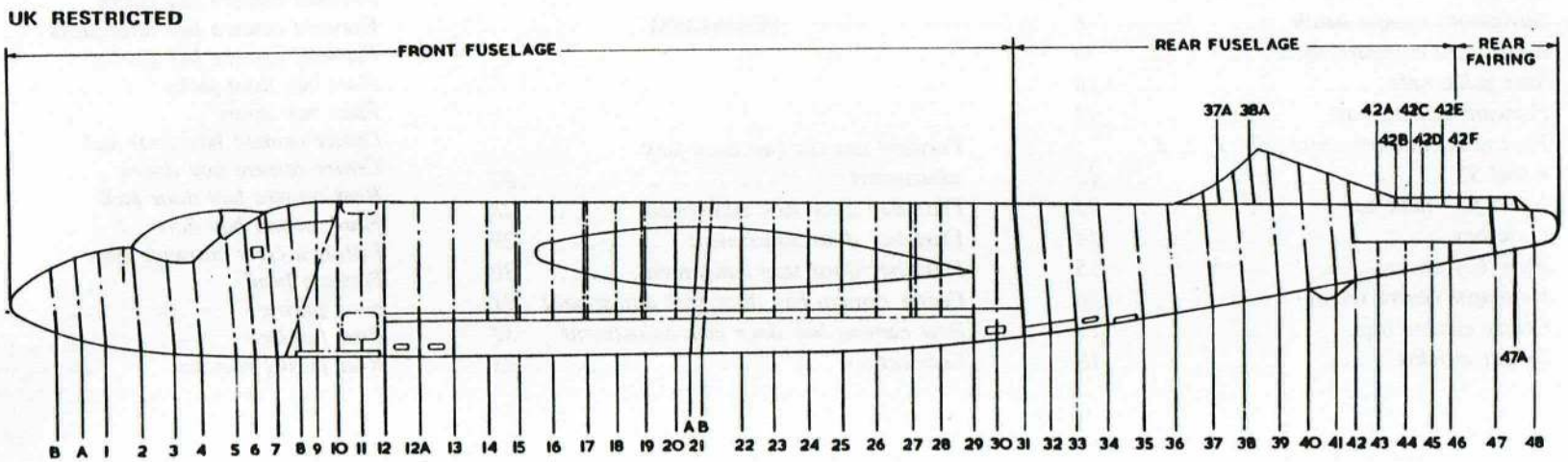



FIG. 1. KEY DIAGRAM

**Introduction**

1. This chapter gives a general description of the fuselage structure, together with the procedure for removing and assembling the main components.

## DESCRIPTION

**General information**

2. The all-metal fuselage is circular in section and of stressed skin construction throughout. A transport joint at frame 31 divides the fuselage into front and rear sections. Except at the transport joint and elsewhere where reinforcement is necessary, the structure is supported by flanged channel section frames, which are cut away on their outer edges to accommodate the fore-and-aft stringers. Fig. 1 illustrates the disposition of the fuselage sections and frames within the structure.

### FRONT FUSELAGE

**General information** *(fig.2)*

3. The front fuselage comprises a transparent plastic nose fairing, a pressure cabin sealed by a bulkhead, a nose undercarriage well, three equipment compartments, two camera bays, fuel compartments and a flare bay. The main floor of the pressure cabin extends from the cabin bulkhead forward to frame 1, where an extension ramp into the nose is fitted; a built up structure at the pilot's station forms the pilot's floor and raises his seat above the main floor level. The structure, forward of the cabin bulkhead, is cut away and suitably reinforced on the starboard side to accommodate the entrance door, and on the top to allow for the canopy and navigator's escape hatch; the canopy aperture being reinforced by a circular section coaming tube. A 0.125 in. dia. hole is drilled in the coaming tube at its lowest point on either side of the cabin. These holes, which facilitate the periodical draining of any water accumulation, are plugged with self tapping screws rolled in Bostik, to prevent loss of cabin pressure. Just aft of the entrance door, the structure is suitably reinforced to accommodate an occasional seat; when not in use the seat can be folded upwards and retained in this position by a strap. Windows, are provided in the port side at the navigator's station and in the underside of the nose aft of frame B. Aft of the cabin bulkhead, a horizontal diaphragm divides the area between the cabin bulkhead and the forward camera bay forward bulkhead into an upper equipment bay and a lower compartment, the latter being divided by two vertical diaphragms into the nose undercarriage well and flanking compartments. At this point the structure is cut away and suitably reinforced to accommodate the upper equipment bay hatch on the top side and the nose undercarriage doors on the bottom side. Access doors are fitted to the equipment compartment which flank the nose undercarriage well; these, like the undercarriage doors, are hinged to the structure. The forward camera bay, aft of the equipment compartments, is separated from the fuel tank compartments at the rear by a bulkhead. The structure on the underside of this bay is cut away and suitably reinforced to accommodate four hydraulically operated camera doors and a detachable fairing. Aft of the forward camera bay the fuselage is divided into upper and lower compartments; the upper compartment houses the main fuel tanks while the lower compartment, which is further divided by a bulkhead at the main spar frame, houses No. 6 fuel tank at the front and forms the flare bay at the rear. Static vent plates are fitted, one on either side of the nose fuselage. In the underside of the aircraft skin, just forward of the nose undercarriage well, a screwed pressure seal plug is provided for draining the pressure cabin.

4. The effective structure consists of the portion above the floor of the main fuel compartment which is of double skinned stressed skin construction with rolled Z-section stringers stiffening both the inner and outer skins. Transverse channel section girders, the ends of which follow the contour of the fuselage, provide the main support for the floor of the main fuel tank compartments; aft of the main spar frame, secondary support is provided by fore-and-aft channel section members. The centre camera bay is located aft of the flare bay and the underside of the structure at this point is cut away and suitably reinforced to accommodate two hydraulically operated camera doors.

**Nose fairing**

5. A transparent plastic nose fairing of sandwich construction is secured to the forward end of the structure by retaining ring segments and screws; the pitot head is mounted in its centre.

**Cabin bulkhead**

6. The cabin bulkhead is inclined aft across the fuselage from between frames 7 and 8 at the bottom to frame 10 at the top; it completely

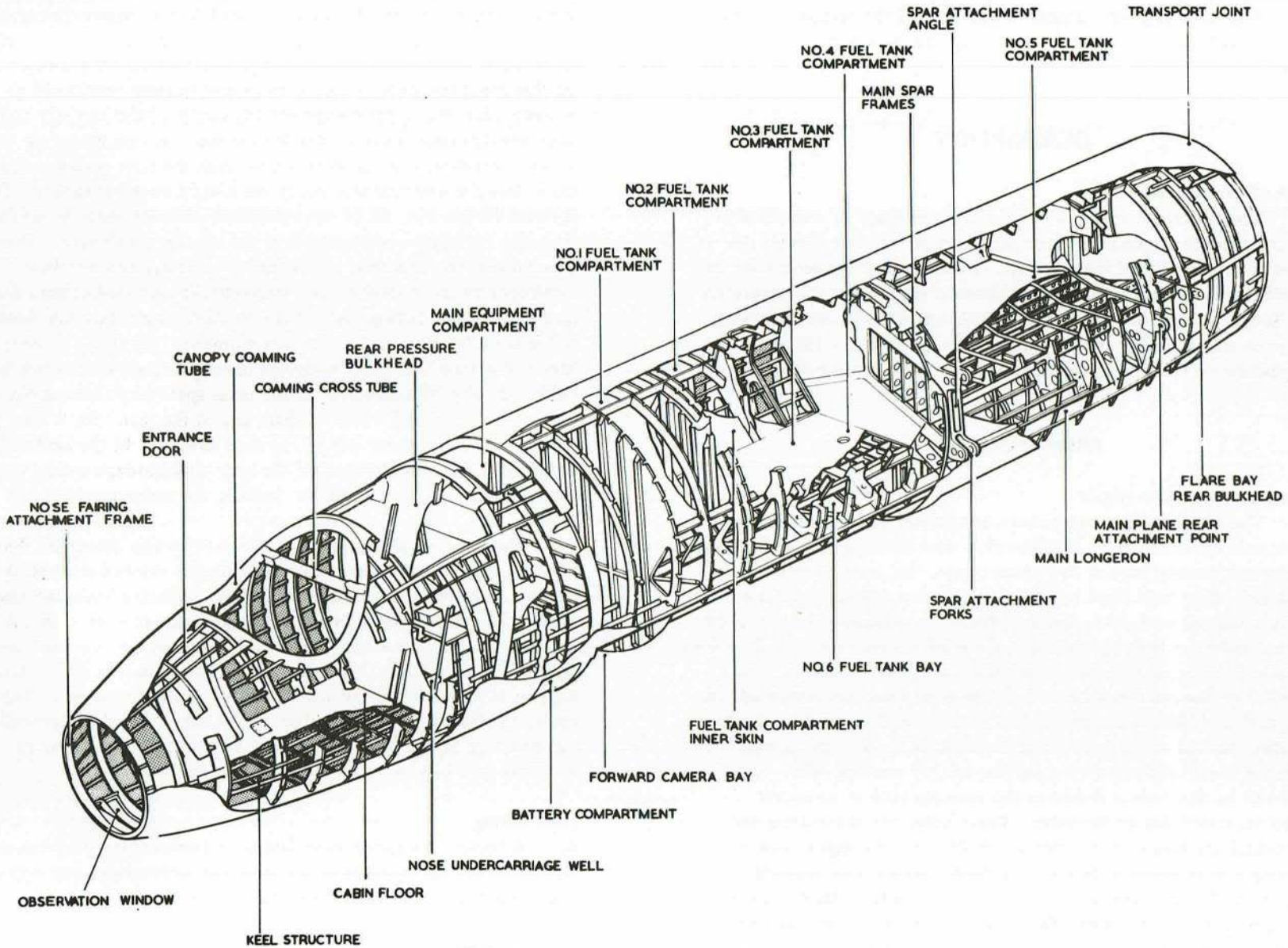



FIG.2. FRONT FUSELAGE

seals off the pressure cabin from the remainder of the fuselage. The bulkhead is reinforced on its rear face by vertical and horizontal channel section members.

**Canopy**

7. The canopy consists of two blown transparent plastic sheets forming a sandwich, and separated by an edge spacing piece. Two aerials are suppressed within the sandwich, and a hinged direct vision window of laminated glass is fitted to the forward face, offset slightly to port. The canopy is secured by 32 explosive attachment bolts to the coaming tube surrounding the fuselage aperture.

**Navigator's escape hatch**

8. The navigator's escape hatch is of metal construction reinforced on the inside by two channel section cross members and angle section stringers. Two flush fitted transparent plastic windows are installed and provision is made for mounting a periscopic sextant. Black-out curtains are fitted and are secured by Velcro tapes when extended and by Lift-the-Dot fasteners when rolled up. The hatch is secured to the boundary members of the fuselage cut-away section by 34 explosive bolts.

**Equipment compartments**

9. Three equipment compartments are located between the cabin bulkhead and frame 12. The upper compartment is above the nose undercarriage well, the well roof forming the compartment floor; access to this compartment is by a removable hatch on the top of the fuselage. The other compartments, one on each side of the nose undercarriage well, are formed by the sides of the well and the fuselage skin; each compartment is fitted with an access door, which is hinged at its lower edge to the fuselage side.

**Seat guide rails**

10. The pilot's ejection seat guide rail is attached to two longitudinal channel section members on the pilot's floor and to two brackets on the canopy coaming cross tube. The navigator's ejection seat guide rail is bolted to the front face of the cabin bulkhead and anchored to angle section brackets on the cabin floor.

**Forward camera bay** *(fig.12)*

11. The forward camera bay is located between the bulkheads at frame 12 and 13. Between these two bulkheads, the skinning beneath the main longerons is cut away to accommodate port and starboard flanking fairings to which four hydraulically operated camera doors are fitted. A removable panel on the underside between the two fairings provides access to the bay. The panel, is electrically bonded to the fuselage and is suspended on two straps, when in the open position.

**Fuel tank compartments (No.1, 2, 3, 4 and 5)**

12. The fuel tank compartment in the upper half of the fuselage extends from frame 13 to frame 29 and is divided at the spar frame by a bulkhead. The forward portion is further divided by false bulkheads into four compartments, each of which houses a crash proof collapsible fuel bag. The floor of each compartment consists of a removable panel reinforced on the underside by channel section intercostals. The rear portion, aft of the spar frame, houses a crash proof collapsible fuel bag. In the top of the double skin structure are ten small reinforced cut-away sections, five of which accommodate access panels while the other five, house the fuel tank filler caps.

**No. 6 fuel tank bay**

13. The No. 6 fuel tank bay in the lower half of the fuselage extends from frame 13 to frame 21. Between these frames, both of which carry bulkheads reinforced by channel section stiffeners, the skinning on the underside beneath the main longerons is cut away to accommodate an all-metal fuel tank which in shape, conforms to the contour of the fuselage. The tank is slung on metal straps attached to trunnions on the underside of each longeron at frames 15 and 19. An access panel in the skin at each trunnion provides access to the trunnions; at the rear of the tank on the undersurface, a removable fairing, reinforced on the inside by Z-section members and attached to the main longerons by four quick-release toggle fasteners, provides access to the tank collector box.

**Flare bay**

14. The flare bay, extending from frame 21 to frame 29, is formed by the lower half of the centre fuselage aft of the No. 6 tank, the lower portion of these two frames carrying bulkhead plates reinforced by channel section stiffeners. The transverse girders supporting the rear portion of the fuel tank compartment floor are extended downwards and reinforce the skirt along which the longerons run. The transverse girders at frames 21 and 29 provide support for the longitudinal flare beam; those at frames 23, 25 and 27 are channelled at the ends to accommodate the rollers of the flare bay doors. An access door on the bulkhead at frame 29 is provided for visual inspection of the flare bay without opening the flare bay doors.

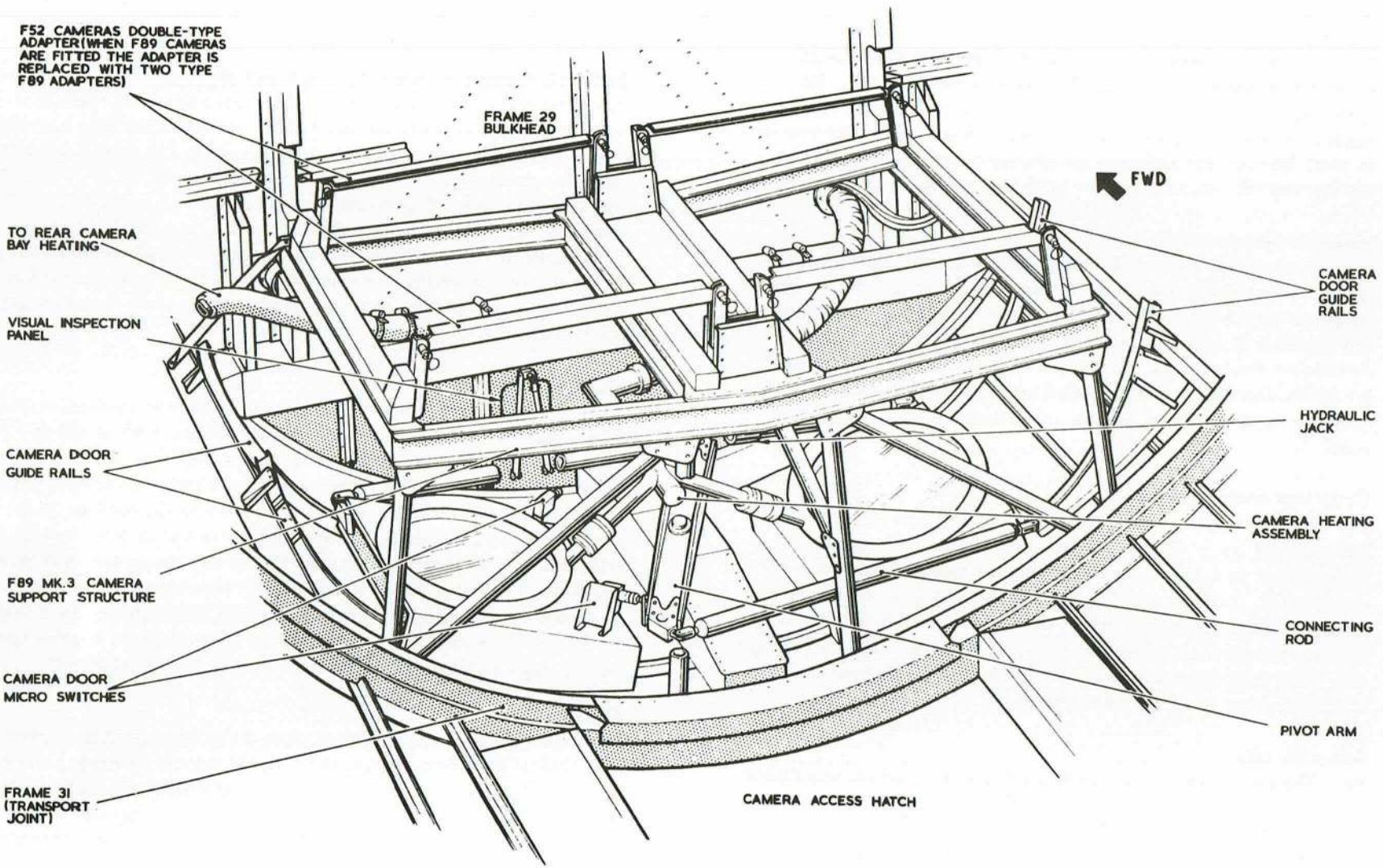



FIG.3. CENTRE CAMERA BAY

**Flare bay doors**

**15.** The flare bay doors are of light gauge duralumin construction, each door consisting of an inner and outer skin reinforced by longitudinal channel section stringers, internal stringers and ribs. Each door is supported at the ends by forged light alloy hinge brackets and by rollers operating in the channelled ends of the fuselage transverse floor girders at three stations along its length.

**Main spar centre section**

**16.** Two reinforced frames, interspaced by vertical channel section members and skinned to form a double plate bulkhead, continue the main spar through the fuselage. They are bounded by extruded angle section members and carry between them the main spar pick-ups which have forked ends for the boom attachments and an extruded centre for the attachment of the spar web.

**Centre camera bay** *(fig.3)*

**17.** The centre camera bay is located between frames 29 and 31 and at this point two circular apertures are cut in the underside of the fuselage skin, which is reinforced by angle section members. The apertures are each covered by diaphragms attached to the skin inside the fuselage and are fitted with circular glass camera windows. The sliding camera doors are of light gauge aluminium alloy construction, each door consisting of an inner and outer skin reinforced by channel section stiffeners. The doors, which are fitted with ball bearing rollers and roller guide pins, move in channel section tracks which pass beneath the diaphragms housing the camera windows and are attached along their length to the inside of the fuselage skin and at their outer ends to the longerons. Each door is linked by a connecting rod to a centrally mounted operating lever between the doors, and the doors are operated by a single hydraulic jack mounted forward of the starboard door tracks and connected to one end of the door pivot arm.

**Ballast weights** *(fig.4)*

**18.** To help maintain the C.G. position within the C.G. range *(Sect.2, Chap.3)* provision is made, on the starboard side of the aircraft between frames 1 and 2, beneath the observation ramp, to fit adjustable lead ballast comprising, a base weight bolted to the floor surmounted by a box in which four weights are carried and secured in position by a metal strap; for individual weight values refer to fig.4. Wooden blocks of similar form to the ballast weights are provided and must be fitted in position where a ballast weight is not used. Having determined the amount of ballast required for the aircraft role *(Sect.2, Chap.3)*, ballast weights to agree to that weight must be fitted.

**Note . . .**

*Any permutation of ballast weights may be fitted to attain the required amount of ballast. A tolerance of ± 10 lb. to the calculated adjustable weight required is permissible.*

## REAR FUSELAGE

**General information** *(fig.5)*

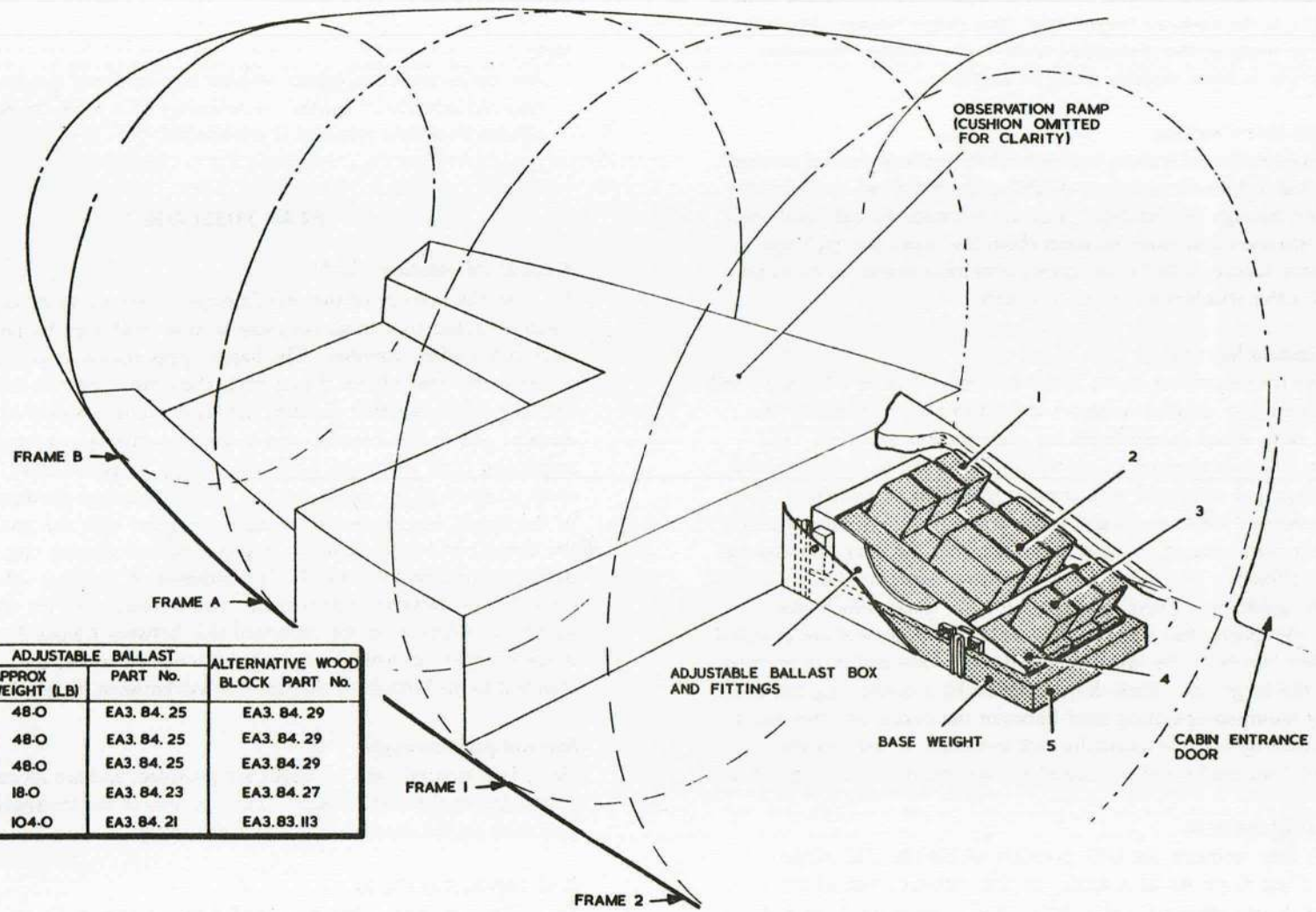
**19.** At the bottom of the rear fuselage between frames 31 and 33 a hatch is hinged to a small cut-away section reinforced by an angle section boundary member. The hatch opens outwards and provides access to the rear of No. 5 fuel tank, the centre and rear camera bays, the flare bay inspection panel in the flare bay rear bulkhead, and the elevator and rudder control runs in the rear fuselage; a hand rope suspended from the upper portion of frame 32 assists entry. A safety strap attached to the latch and the aircraft structure prevents the edge of the hatch, when open, from making contact with the ground should the aircraft be heavily loaded. A picketing and slinging ring bolts stowage, attached to frame 32, is positioned on the port side immediately above the hatch frame, and a stowage for six engine starter cartridges is on the starboard side between frames 31 and 32. A tail bumper, on which is mounted a moulded rubber pad, is attached to the bottom of the rear fuselage between frames 40 and 42.

**Survival pack stowages**

**20.** Two survival pack stowages are provided, and are located, one on either side of the rear fuselage. The position of the stowages is indicated on the outer skin of the rear fuselage.

**Rear camera bay** *(fig.6)*

**21.** The rear camera bay is located between frames 33 and 35 where, forward of frame 34, the underside of the skin is cut away and reinforced to accommodate two circular photocell windows and a downward identification lamp. Aft of frame 34 a circular aperture, cut in the underside of the skin, is covered by a diaphragm attached to




| ADJUSTABLE BALLAST | | ALTERNATIVE WOOD BLOCK PART No. |
|---|---|---|
| APPROX WEIGHT (LB) | PART No. | |
| 1 48-0 | EA3. 84. 25 | EA3. 84. 29 |
| 2 48-0 | EA3. 84. 25 | EA3. 84. 29 |
| 3 48-0 | EA3. 84. 25 | EA3. 84. 29 |
| 4 18-0 | EA3. 84. 23 | EA3. 84. 27 |
| 5 104-0 | EA3. 84. 21 | EA3. 83. 113 |

FIG. 4. BALLAST WEIGHTS

the inside of the fuselage and fitted with a circular, glass, camera window. The sliding camera door is of similar construction to those in the centre camera bay; it moves in channel section tracks attached along their length to the inside of the fuselage skin beneath the diaphragm housing the camera window. The door is operated by a hydraulic jack mounted forward of the door tracks and connected to an arm on the door.

**Minilift hoist installation**

22. To facilitate the assembly and removal of avionic equipment and cameras in the centre and rear fuselage, provision is made for the installation of a Minilift hoist. The hoist consists of a hand operated winch, attached to two small trolleys free to run in one of three rail assemblies secured to the roof structure of the fuselage. Each trolley is fitted with four rollers which run within the two channels forming each rail assembly. The Minilift hoist is attached on two suspension hooks on the front, and a single suspension hook on the rear trolley. The ends of the rails are cut away to enable the trolleys to be removed from the rails, and stop blocks are fitted at each end of the rails to prevent the trolleys running out of the channels.

**Tail plane attachments**

23. An extension to the lower half of the fuselage, aft of frame 42 and extending to frame 46, forms a platform for carrying the variable incidence tail plane and its electrical actuator; it is braced by a diagonal strut extending from the top of frame 42 to the rear of the extension. Attached to the rear of frame 42 are two brackets which carry the tail plane pivot pins; on each side of the fuselage, extending forward of frame 42 is a narrow, integral tail plane leading edge stub.

**Fin stub and fin attachments**

24. Attached to the top of the fuselage structure, between frames 37 and 42, are eight diaphragms forming the structure of the fin stub, the four diaphragms above frames 39 to 42 being reinforced by longitudinal angle section members. The diaphragm at frame 42 carries the fin post attachment lugs, secondary attachment points for the fin being provided on the diaphragms at frames 39 and 42A.

**Rudder stub**

25. The top of the fuselage structure is extended aft of frame 42 to form the rudder stub. The extension is formed by six angle sectioned, webbed frames and four longitudinal angle section members; the resulting box is plated with skinning on each side.

**Rear fairing** *(fig.16)*

26. The rear fairing is a detachable structure to which the metal skin covering for the rear fuselage extension is attached. It is built up to form one complete section and is attached to the rear fuselage at frames 42F and 46.

## SERVICING

**WARNING . . .**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**Forward camera bay door jack adjustment** *(fig.12)*

27. The pin centres of the port and starboard jacks are nominally set at 15.80 in. ± 0.1875 in. when the jacks are fully contracted; this is a manufacturer's setting which should not normally need alteration after assembly. If adjustment is necessary:-

(1) Remove the jack cover.

(2) Disconnect the jack piston rod from the bridge piece on the camera doors.

(3) Remove the locking wire from the locknut at the fork end of the jack piston rod and slacken off the locknut.

(4) Adjust as necessary by turning the fork end of the piston rod, one half turn at a time.

(5) Tighten, and wire-lock the locknut on the jack piston rod.

(6) Reconnect the jack piston rod to the bridge piece on the camera doors.

**Flare bay door jack adjustment** *(fig.7)*

28. The pin centres of the door jacks are nominally set at 18.625 in. ± 0.25 in. This dimension is measured between the jack attachment lug and the uppermost hole in the link end when the jacks are fully contracted *(dimension B)*. This is a manufacturer's setting which should not normally require alteration after assembly. If adjustment is necessary:-

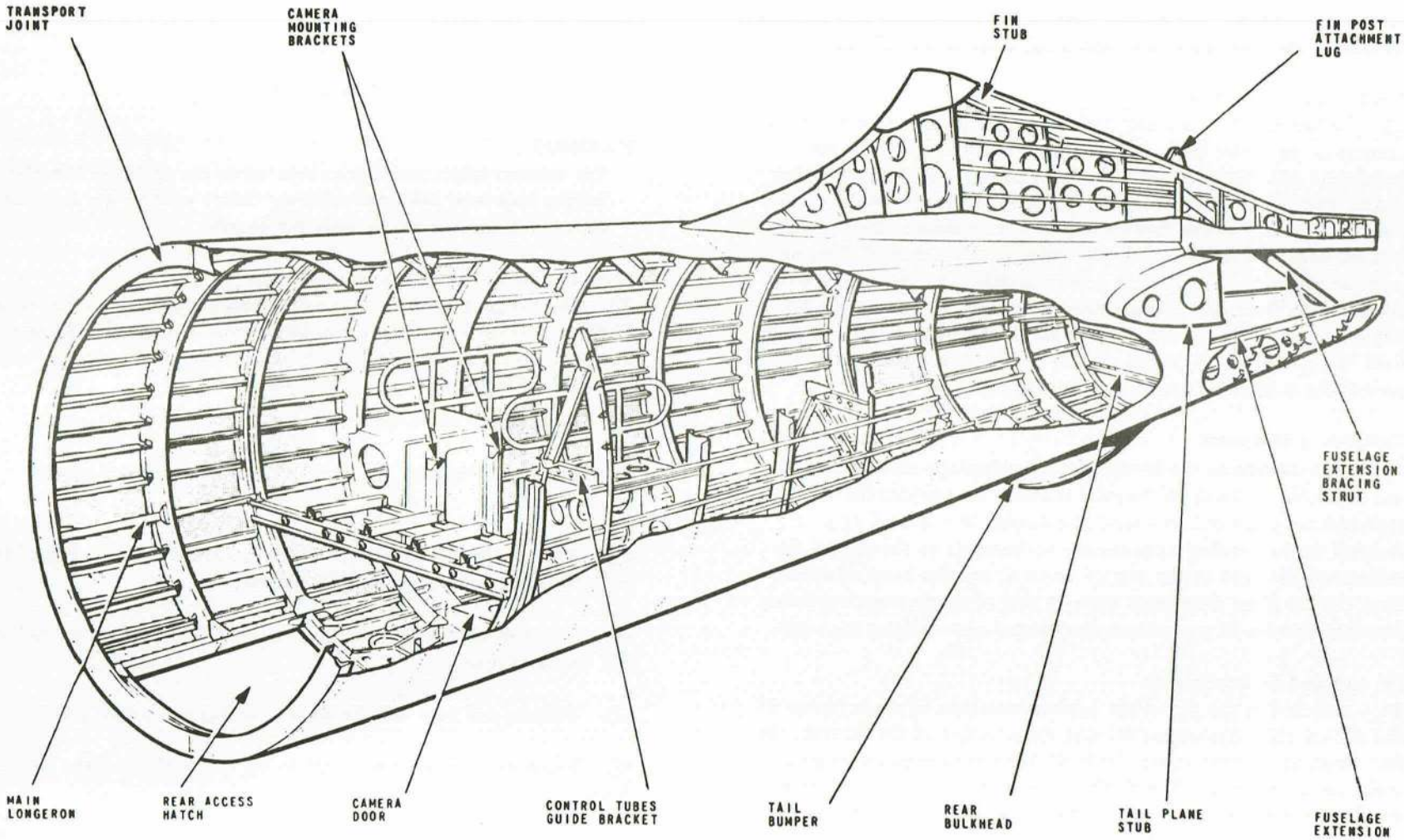



FIG.5. REAR FUSELAGE

(1) Remove the jack *(para.46)*

(2) Remove the locking wire from the locknut at the link end of the piston rod and slacken off the locknut.

(3) Adjust as necessary by turning the link end, one half turn at a time.

(4) Tighten, and wire-lock, the locknut on the jack piston rod.

(5) Refit the jack.

**Flare bay door adjustment** *(fig.7)*

**29.** The pin centres of the flare bay door actuating links are nominally set at 11.975 in. ± 0.25 in. At this setting the flare bay doors, when fully open, should be 49.70 in. ± 0.50 in. apart at the forward end and 42.50 in. ± 0.50 in. apart at the rear end measured inside the metal faces of the door edges. When the doors are fully closed the hydraulic jacks must be fully extended, and there should be a clearance of 0.20 in. between the metal faces of the door edges. To adjust the actuating links:-

(1) Fully open the flare bay doors.

(2) Remove the split pin and collar from the pin attaching the fork end of the actuating link to the hinge bracket, and withdraw the attachment pin.

(3) Slacken the locknut at the fork end of the actuating link, and turn the fork end of the actuating link as required.

(4) Tighten the locknut on the actuating link.

(5) Reconnect the actuating link to the hinge bracket.

(6) Check the operation of the doors.

**Flare bay door stay adjustment** *(fig.7)*

**30.** The pin centres of the flare bay door forward and aft stays are nominally set at 10.70 in. ± 0.15 in. and 16.70 in. ± 0.15 in. respectively. These are manufacturer's settings which should not normally need alteration. If adjustment is necessary:-

(1) Fully open the flare bay doors.

(2) Disconnect the fork end of the stay from the eye bolt on the door hinge bracket.

(3) Slacken the locknut on the stay and turn the fork end until the nominal pin centre distance is obtained.

(4) Tighten the locknut on the stay and connect the fork end to the eye bolt on the door hinge bracket.

(5) Check the operation of the doors.

**Centre camera bay door jack adjustment** *(fig.3)*

**31.** The pin centres of the centre camera bay door jack are nominally set at 15.80 in. ± 0.1875 in. when the jack is fully contracted; this is a manufacturer's setting which should not normally need alteration after assembly If adjustment is necessary:-

(1) Remove the jack cover.

(2) Disconnect the fork end of the jack piston rod from the pivot arm.

(3) Remove the locking wire from the locknut on the jack piston rod and slacken off the locknut.

(4) Adjust as necessary by turning the fork end, one half turn at a time.

(5) Tighten, and wire-lock, the locknut on the jack piston rod.

(6) Reconnect the fork end of the jack piston rod to the pivot arm.

(7) Replace the jack cover.

**Rear camera bay door jack adjustment** *(fig.6)*

**32.** The pin centres of the rear camera bay door jack are nominally set at 14.825 in. ± 0.1875 in. when the jacks are fully contracted; this is a manufacturer's setting which should not normally need alteration after assembly. If adjustment is necessary:-

(1) Fully extend the door jack.

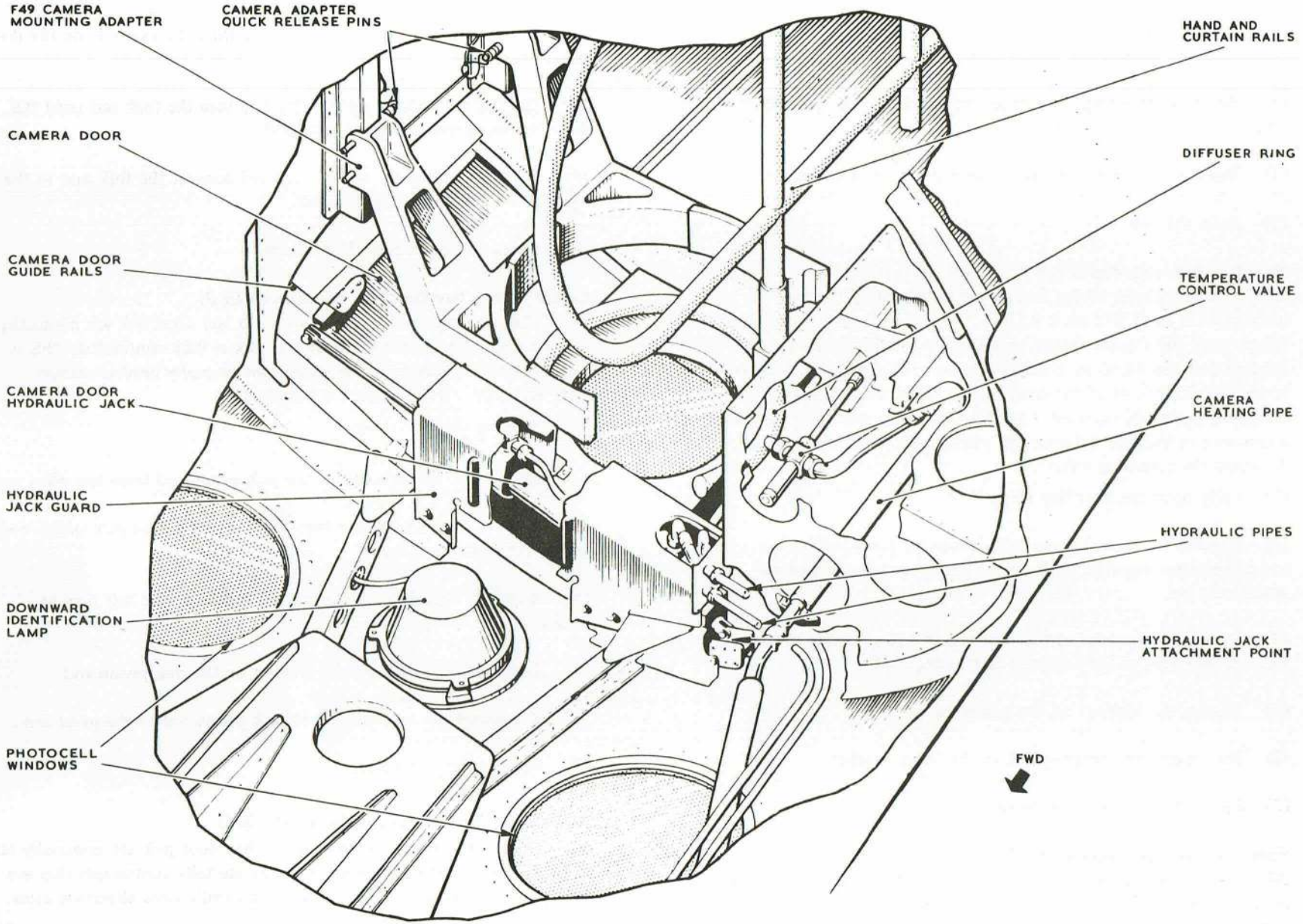



FIG.6. REAR CAMERA BAY

(2) Remove the nut and washer securing the jack piston rod to the door arm and disconnect the piston rod from the arm.

(3) Fully contract the jack.

(4) Remove the locking wire from the locknut on the jack piston rod and slacken off the locknut.

(5) Adjust as necessary by turning the fork end, one half turn at a time.

(6) Tighten, and wire-lock, the locknut on the jack piston rod.

(7) Reconnect the jack piston rod to the door arm.

**Lubrication** *(fig.19)*

**33.** The lubrication points and types of lubrication are shown in fig.19 which should be read in conjunction with the Lubrication Marker Card (Leading Particulars).

## REMOVAL AND ASSEMBLY

**General information**

**34.** The following paragraphs describe the removal and assembly operations of the fuselage and its principal components. Only the removal operations are described, since assembly is generally a reversal of these operations; where this is not the case, the fact is noted. The recommended sequence of operations is given, although in some cases it will be clear that it is not essential to adhere rigidly to this sequence. The necessary ground equipment is listed in Sect.2, Chap.4.

**Slinging**

**35.** The methods of slinging the fuselage sections are illustrated in fig. 17 and 18.

**Trestling**

**36.** The method of trestling the fuselage sections is illustrated in Sect.2, Chap.4. The Ref. No. and Part No. of these trestles are also given in that chapter.

▶ **Canopy**

*Removal*

**37.** To remove the canopy refer to A.P.101B-0400-6, Pt.1, Chap.2.

*Assembly*

**38.** To assemble the canopy refer to A.P.101B-0400-6, Pt.1, Chap.2.

*Fitting a new canopy*

**39.** The procedure for fitting a new canopy is described in A.P.101B-0400-6, Pt.1, Chap.2.

*Fitting a canopy D.V. window*

**40.** The procedure for fitting a canopy D.V. window is described in A.P.101B-0400-6, Pt.1, Chap.2.

**Navigator's escape hatch** *(fig.10)*

*Removal*

**41.** The procedure for the removal of the navigator's hatch is detailed in the following operations. Where the removal is undertaken in order to fit a new navigator's hatch, the removal operations are fully described in A.P.101B-0400-6, Pt.1, Chap.2. ▶

**WARNING . . .**

**Before any work on the crew hatch is undertaken the safety precautions detailed on the LETHAL WARNING marker card must be observed.**

(1) Disconnect, from the rear of the hatch the ejection seat secondary firing cable.

(2) Remove the canopy rear fairing by removing the two ¼ in. dia. countersunk head screws and the twelve 2 B.A. countersunk head bolts, stiffnuts and washers *(detail B)*.

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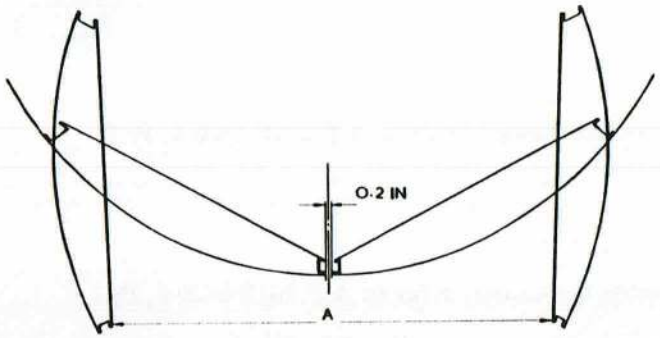


| | | | |
|---|---|---|---|
| A | FORWARD DIMENSION | 49·7 IN | 0·5 IN |
| | AFT DIMENSION | 42·5 IN | 0·5 IN |
| B | FORWARD AND AFT JACK | 18·625 IN | 0·25 IN |
| C | FORWARD AND AFT ACTUATING LINKS | 11·975 IN | 0·25 IN |
| D | FORWARD DOOR STAYS | 10·7 IN | 0·15 IN |
| | AFT DOOR STAYS | 16·7 IN | 0·15 IN |

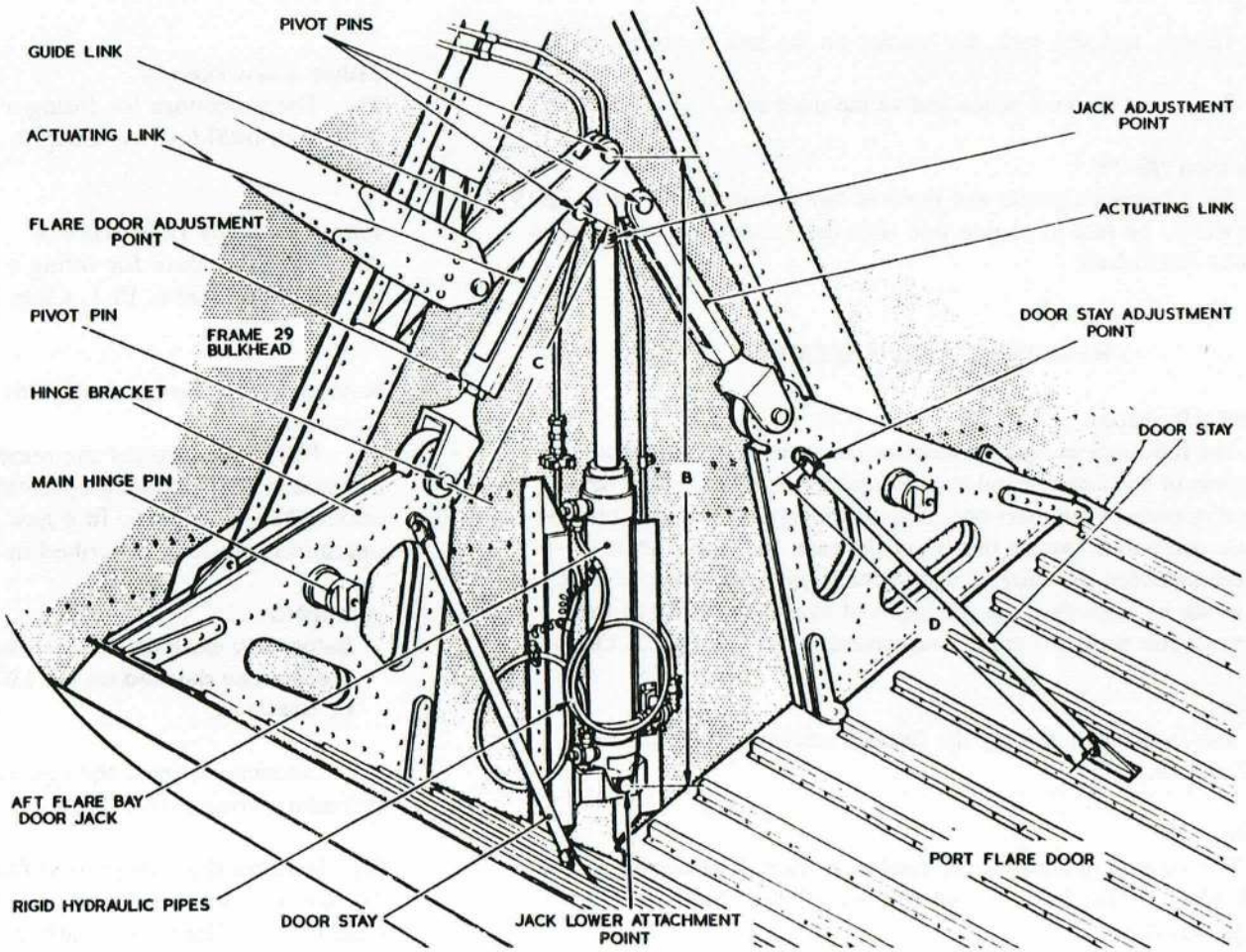


FIG.7 FLARE BAY DOORS ADJUSTMENT

(3) Remove the sixty six ¼ in. attachment bolts securing the hatch to the bolt frame.

(4) Remove the hatch by easing it upwards at the forward end to allow the screwed spigots to clear the sockets in the bulkhead and then, disconnect the butt connector.

*Assembly*

**42.** The procedure for the assembly of the navigator's hatch is detailed in the following operations. When a new navigator's hatch is being assembled the fitting operations are fully described in A.P.101B-0400-6, Pt.1, Chap.2.

(1) Ensure that the sealing strip and pressure seal are secure and in good condition *(detail A)*.

(2) Place the hatch in position on the bolt frame *(detail A)* and, taking care not to trap the seal irregularly, secure the hatch with the sixty six bolts and the two screws (which also attach the canopy rear fairing) in sequence, aft centre, front centre, outwards to the sides of the hatch and finally along the longitudinal edges.

(3) When all bolts and screws have been fitted, finally tighten, using equal pressure.

(4) Screw the spigots of the hatch down until the shoulders of the spigots butt firmly against the forward face of the pressure bulkhead; do not over tighten the spigots when tightening the locknuts *(detail E)*.

(5) Check and if necessary, adjust and align the periscope mounting butt connector *(fig.10, Detail D)* until there is a 12 lbf/in$^2$ pressure between the faces; this can be measured with a spring balance.

(6) Refit the 2 B.A. bolts and nuts to the canopy aft fairing *(detail B)*.

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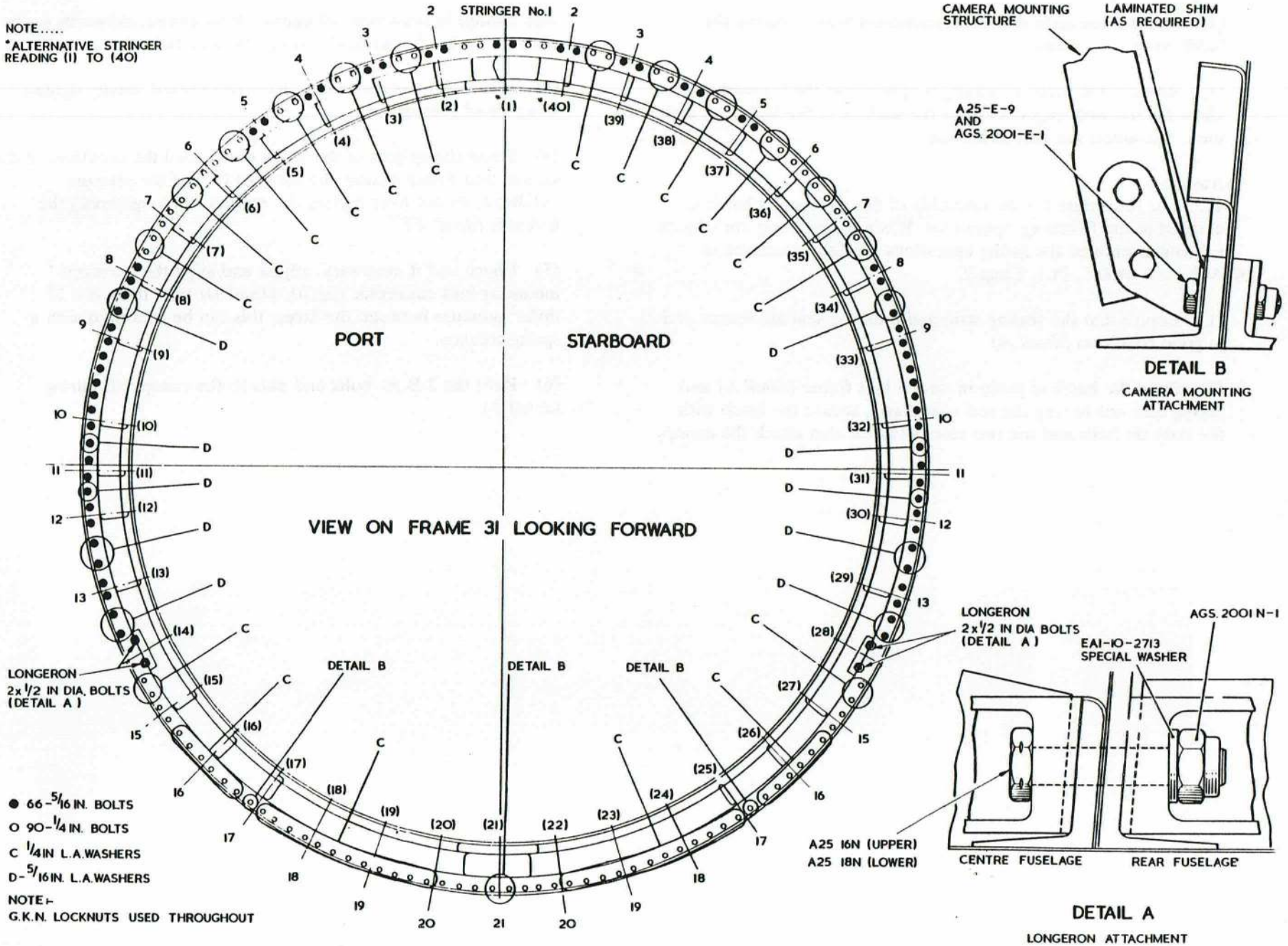


FIG. 8. ATTACHMENT BOLT DETAILS - REAR TO FRONT FUSELAGE

*(NOT USED)*

FIG.9.

(7) Reconnect the secondary firing cable to the hatch.

(8) Pressure test the cabin *(Sect.3, Chap.8)*.

**Note . . .**

*1. When fitting explosive bolts, lubricate the threads with a thin coating of grease XG-287. Ensure that the correct securing nut, Part No.AGS.2002/L/1, is fitted to the explosive bolt and that the appropriate distance tubes are used for any given position as instructed in A.P.101B-0400-6, Chap.2. The torque applied to tighten the bolts must not exceed 130 lb in.*

*2. Whenever fitting detonators into the explosive bolts (A.P.110N-0306-1), it is important that the detonator Ref.No.12G/1278, the distance tube Ref.No.26FZ/1807, and the spring Ref.No.26FZ/1579 be assembled as shown in fig.13. Prior to inserting the spring and screwing the cap home, using a gauge of local manufacture check the dimension between the distance tube and the end of the bolt; this should be 0.38 in. ± 0.04 in.*

*3. Ensure that the detonator leads are not trapped between the bolt retaining nuts and the surrounding structure.*

**Forward camera bay doors** *(fig.12)*

**43.** To remove the forward camera bay sliding doors:-

(1) Remove the nuts and washers from the three 2 B.A. bolts attaching each door to the bridge piece.

(2) Lift the bridge piece clear and slide the door upwards out of its guide rails.

**Forward camera bay door jacks** *(fig.12)*

**44.** To remove either of the forward camera bay door jacks:-

(1) Remove the jack cover.

(2) Disconnect the hydraulic pipes at the self sealing couplings.

(3) Disconnect the jack piston rod from the bridge piece.

(4) Disconnect the jack from the jack attachment bracket and remove the jack.

**Forward camera bay fairing** *(fig.12)*

**45.** To remove a forward camera bay fairing:-

(1) Remove the camera bay access panel *(Sect.2, Chap.4)*

(2) Remove the lagging and slacken off the clips securing the heating pipes slide-on connections and slide the connections clear of the joints.

(3) Disconnect the hydraulic pipes at the self sealing couplings.

(4) Remove the bolts attaching the camera door guide rails to the cleats adjacent to frames 12 and 13.

(5) Remove the bolts attaching the cleats of the camera door guide rails to the longeron.

(6) Remove the two bolts from the cleat attaching the jack upper housing to the longeron.

(7) Remove the two bolts attaching the fairing edge member to frame 12 *(detail B)*.

(8) Remove the two bolts attaching the fairing edge member to frame 13 *(detail C)*.

(9) With the fairing's weight suitably supported, remove the countersunk screws attaching the fore and aft ends of the fairing to frames 12 and 13 *(detail A)*.

(10) Remove the countersunk screws attaching the fairing upper edge to the longeron *(detail A)*, and remove the fairing.

(11) Blank off all exposed pipe ends and adequately protect the camera window glasses.

**Reassembly note . . .**

*Care must be taken when reassembling the box type lagging to the camera heating pipes. The jubilee clips attaching the lagging, should not be overtightened to the extent of collapsing it. It is considered satisfactory to tighten the clips to the stage where they can just be moved by hand.*

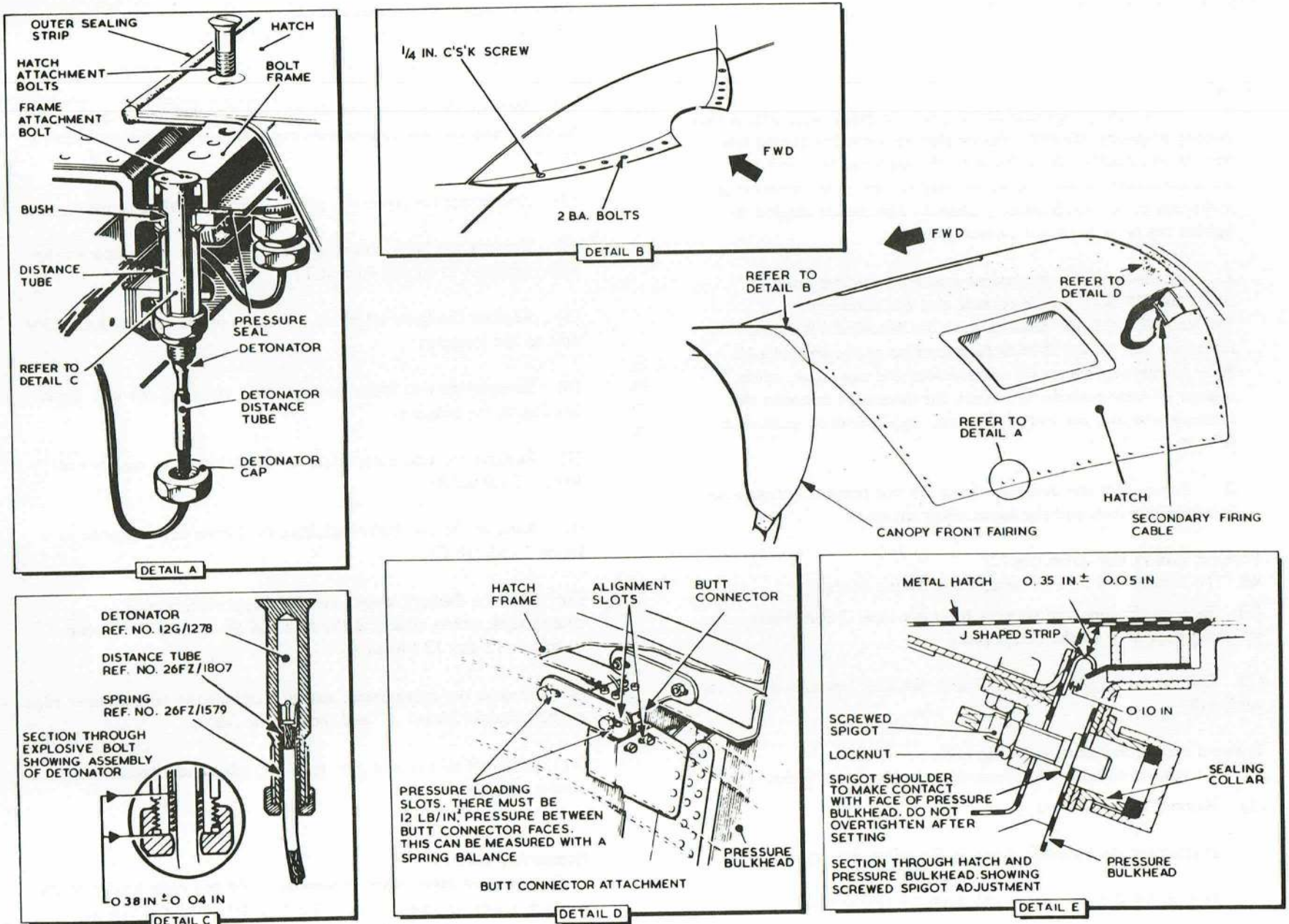


**FIG.10. NAVIGATOR'S HATCH REMOVAL**

**Flare bay door jacks** *(fig.7)*

**46.** To remove either of the flare bay door jacks:-

(1) Fully open the flare bay doors.

(2) Ensure that the hydraulic system is exhausted of all hydraulic pressure *(Sect.3, Chap.6)*, and disconnect the hydraulic pipes from the jack.

(3) Remove the split pins and collars from the actuating link pivot pins.

(4) Withdraw the pivot pins and, at the same time, move the actuating links away from the end fitting of the jack and remove the spherical washers from the bush.

(5) Remove the split pin and collar from the guide link pivot pin and withdraw the pivot pin.

(6) Remove the split pin and collar from the jack attachment pin, withdraw the attachment pin and remove the jack.

**Note . . .**

*When reassembling the jack it is important that the actuating link pivot pins are inserted from the bulkhead side of the links. After reassembly, bleed the circuit through the jack bleed screws (Sect.3, Chap.6).*

**Flare bay doors** *(fig.13)*

**47.** To remove the flare bay doors:-

(1) Fully open the flare bay doors.

(2) Ensure all electrical services are switched OFF.

(3) Remove the lower microswitch from its mounting bracket.

(4) Support the flare bay doors.

(5) Remove the No. 6 fuel tank rear fairing *(Sect.4, Chap.2)*.

(6) Remove the split pins and nuts from the hinge bracket pivot pins on the forward face of frame 21B and aft face of frame 29.

(7) Remove the pivot pins from the actuating links.

(8) Remove the pivot pins from the hinge brackets.

(9) Remove the doors.

**Note . . .**

*On assembly, guide the flare bay doors into their open position using a metal shim to protect the flare bay skirt and sealing strip.*

**Centre camera bay door jack** *(fig.3)*

**48.** To remove the centre camera bay door jack:-

(1) Remove the jack cover (if fitted).

(2) Ensure that the hydraulic system is exhausted of all hydraulic pressure *(Sect.3, Chap.6)*, and disconnect and blank off the hydraulic pipes from the jack.

(3) Disconnect the fork end of the jack piston rod from the pivot arm.

(4) Disconnect the jack from the jack attachment bracket and remove the jack.

**Centre camera bay doors** *(fig.3)*

**49.** To remove the centre camera bay sliding doors:-

(1) Fully retract the door jack.

(2) Disconnect the connecting rod from the door to be removed.

(3) Lift the connecting rod clear of the door and slide the door upwards out of its guide rails.

**Rear camera bay door jack** *(fig.6)*

**50.** To remove the rear camera bay door jack:-

(1) Remove the jack cover.

(2) Fully extend the door jack.

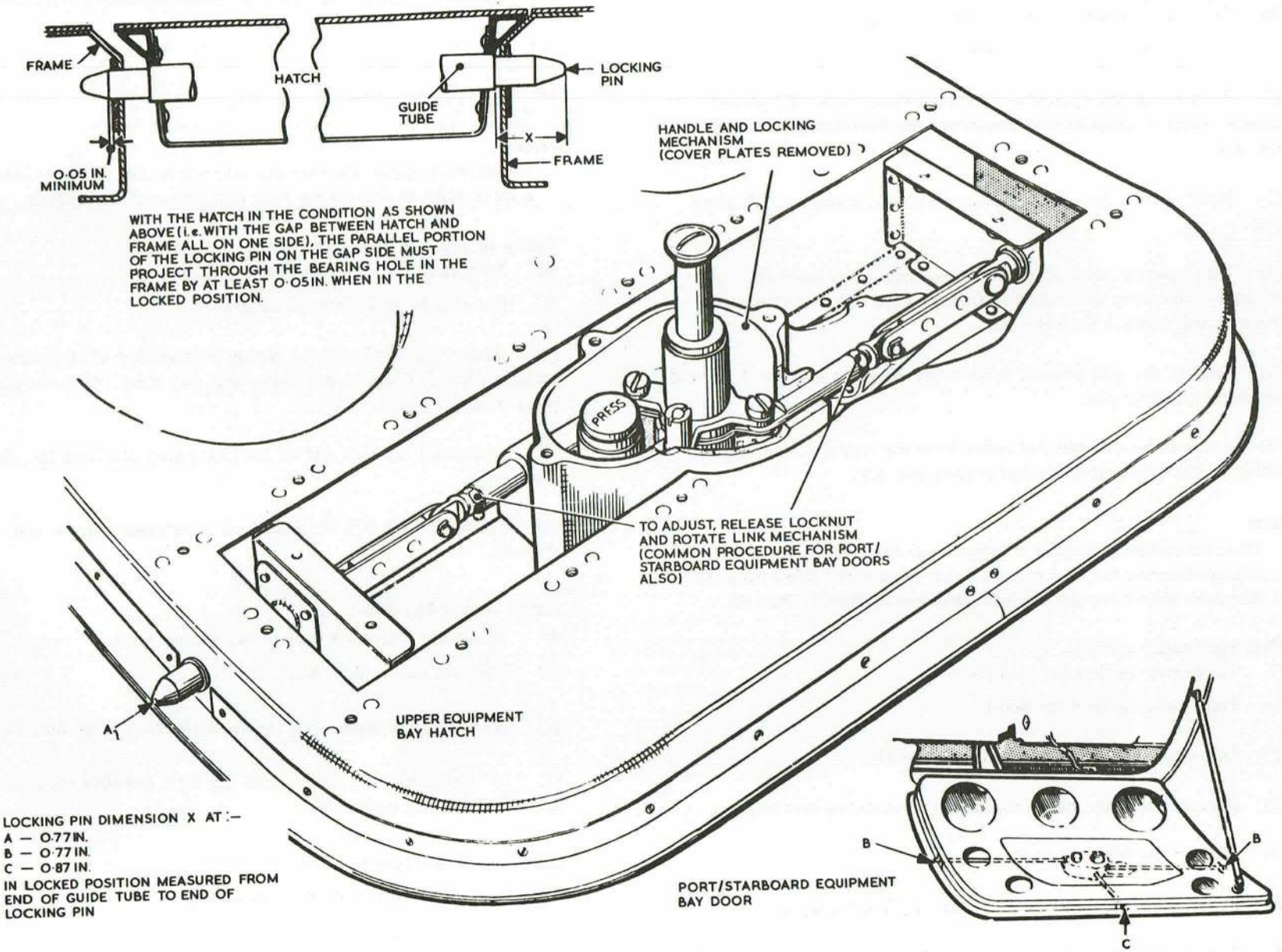


FIG.11. HATCH LOCKING PIN SETTINGS

(3) Ensure that the hydraulic system is exhausted of all hydraulic pressure *(Sect.3, Chap.6)* and disconnect and blank off the hydraulic pipes from the jack.

(4) Remove the nut and washer securing the jack piston rod to the door arm and disconnect the piston rod from the arm.

(5) Disconnect the jack from the jack attachment bracket and remove the jack.

**Rear camera bay door** *(fig.6)*

**51.** To remove the rear camera bay door:-

(1) Fully extend the door jack.

(2) Remove the nut and washer securing the jack piston rod to the door arm and disconnect the piston rod from the arm.

(3) Lift the jack piston rod clear and slide the door upwards out of its rails.

**Fitting a crew entrance door**

**52.** To remove the entrance door, operate the door jettison mechanism which is fully described in Sect.3, Chap.11. To replace the entrance door proceed as instructed in the following operations; where a new door is to be fitted follow the procedure detailed in A.P.101B-0400-6, Part 1, Chap.2.

(1) Rotate the door jettison handle to its full extent in a clockwise direction.

(2) Line up the free hinge pin cups so that their slots are in line with the slots in the hinge pin cups on the shaft.

(3) Offer up the door to the fuselage and insert the hinge pins into the hinge pin cups; an assistant stationed outside the aircraft should maintain pressure on the door to ensure that the hinge pins remain correctly located.

**WARNING . . .**

**Before securing the jettison handle ensure that the hinge pin cups are rotated fully to the 'safe' position. The door jettison handle must be rotated approximately four complete turns from the 'jettison' to the 'safe' position.**

(4) Rotate the jettison handle in a counter-clockwise direction to its full extent and secure the jettison handle with its securing strap.

**Pressure head**

**53.** To remove the pressure head from the nose fairing:-

(1) Disconnect the union nut securing the pitot piping to the pressure head assembly and blank off the apertures.

(2) Disconnect the electrical leads to the pressure head at the terminal block on frame A.

(3) Remove the locking wire securing the ring nut to the adapter tube, and remove the ring nut, washer, and rubber sealing ring.

(4) Remove the pressure head from the nose fairing.

**Reassembly notes . . .**

*1. Before fitting the ring nut, a thin coating of grease XG-287 must be applied to the threads of the ring nut and the pressure head adapter.*

*2. When finally tightening the ring nut, a torque of 120 lbf in. must not be exceeded.*

*3. To ensure an air tight joint, Boscoprene 2100 sealant Ref.No.33H/2244271 is to be applied round the periphery of the pressure head adapter at the junction with the front face of the nose fairing. Full instructions for the application of this sealant are given in A.P.1464B, Vol.II, Part 2.*

**Nose fairing**

**54.** To remove the nose fairing refer to A.P.101B-0400-6, Pt.1, Chap.2.

**Rear fuselage** *(fig.15)*

**55.** To remove the rear fuselage from the front fuselage:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

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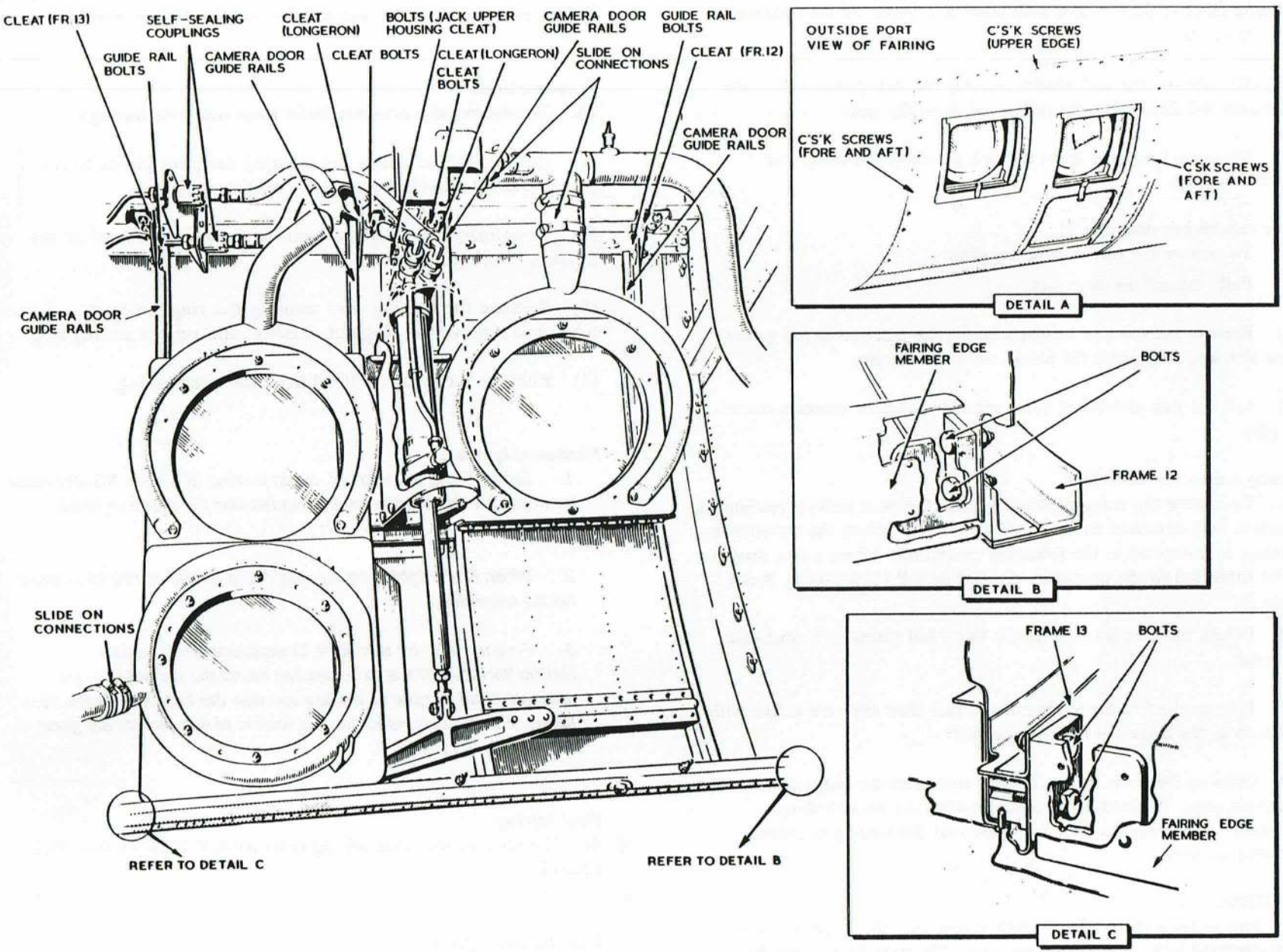


FIG.12. FORWARD CAMERA BAY FAIRING

(2) Attach the sling to the rear fuselage *(fig.18)*; take up the slackness on the sling.

(3) Disconnect all electrical supplies.

**Note . . .**

*Access to all connections and attachment bolts is gained through the camera access hatch in the lower surface of the rear fuselage. Should difficulty by experienced when closing and securing the camera hatch, it is recommended that the hatch be secured by first engaging the fasteners nearest to the hinge line and then working across the fuselage to the hatch outer edge.*

(4) Disconnect the electrical cables at the plug and socket connections on the bulkhead at frame 29 and stow them carefully in the rear fuselage.

(5) Disconnect the electrical cable 6H2 from the lighting box on the starboard side of the rear fuselage and carefully stow it in the front fuselage.

(6) Disconnect and blank off the rear camera heating pipe on the port side of the fuselage.

(7) Disconnect the elevator and rudder control tubes on the port side of the fuselage.

(8) Disconnect and blank off the fuel vent pipe on the starboard side of the fuselage.

(9) Dismantle the Minilift hoist rails from the roof of the fuselage. The eight 2 B.A. bolts attaching the guide rail brackets to the transport joint must also be removed.

(10) Ensure that there is no pressure in the hydraulic system *(Sect.3, Chap.6)*, and uncouple and blank off the rear camera door hydraulic pipes on the port side of the fuselage.

(11) Refer to fig.8 and remove the stiffnuts and washers from the eighty frame attachment bolts between the stringers, and remove the bolts.

**Note . . .**

*Where a notice, referring to Repair Leaflet B4/1 is painted inside the fuselage adjacent to stringer 13, longer bolts Part No.A25/14E will have been fitted at the rear transport joint adjacent to stringers 12 and 13. The position of these bolts must be noted on removal.*

(12) With the exception of those at stringer 1 and stringers 8 port and starboard, remove the stiffnuts and washers from the remaining seventy four frame attachment bolts on each side of the stringers, and remove the bolts.

(13) Remove the stiffnuts and washers from the frame attachment bolts on each side of stringer 1 and stringers 8 port and starboard, and remove the bolts.

(14) Disconnect the Chelton aerial and tension unit from the fin.

(15) Remove the stiffnuts and washers from the frame attachment bolts at each longeron, and withdraw the bolts. The rear fuselage is then free, and should be placed on trestles *(Sect.2, Chap.4)*.

**Reassembly notes . . .**

*1. Before reassembly, apply pigmented varnish jointing compound, Ref.No.33H/2202110, to the faces of the transport joint between the inner edge of the frame and the bolt holes, and Bostik glazing compound, Ref.No.33H/9704973, between the outer edge of the frame and the bolt holes. No jointing compound or Bostik must enter the bolt holes.*

*2. The fork end fittings of flying control rods are machined with a counterbored recess, on the outer face of the lugs, at the bolt hole. This recess is designed to take the nut when the control tubes are assembled.*

*3. Ensure bolts Part No.A25/14E are refitted at the positions noted in Para.55(11) Note.*

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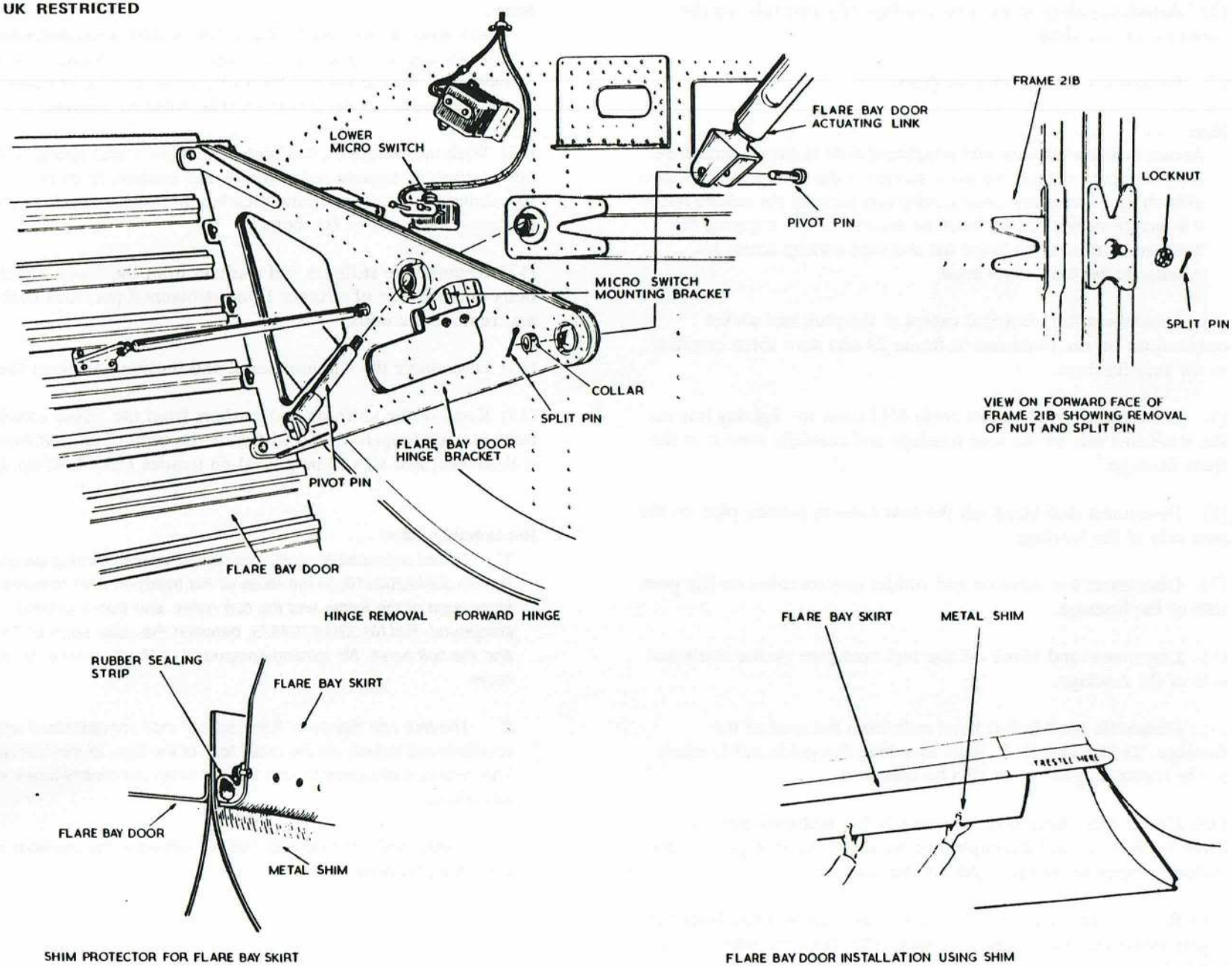


FIG.13. FLARE BAY DOOR REMOVAL

**Note . . .**

*A flight trim check must be made, as detailed in Sect.3, Chap.4, Appendix 1, whenever the rear fuselage is refitted or replaced to ensure, that the aircraft trim is within the limits laid down. Should the aircraft trim be outside the limits specified, a new elevator training edge strip should be fitted and the flight trim checks and subsequent trailing edge strip adjustments made.*

**Rear fairing removal** *(fig.16)*

**56.** To remove the rear fairing from the rear fuselage:-

(1) Remove the box fairings from both sides of the fuselage as follows:-

(a) Remove the access panels.

(b) Remove the two B.A. bolts from inside the box fairing.

(c) Remove the two 2 B.A. countersunk screws from the forward edge of each box fairing.

(d) Move the tail plane to its minimum incidence, and then remove the 2 B.A. bolt from each side of the rear end of each box fairing.

(e) Remove the box fairings.

(2) Support the rear fairing and remove the four ¼ in. stiffnuts *(detail A)*.

(3) Remove the ten 2 B.A. countersunk screws from each closing strip and remove the closing strips.

(4) Disconnect the electrical cables from the terminal block in the rear fuselage.

(5) Remove the 5/16 in. dia. bolts *(detail B)*.

(6) Unscrew the four countersunk 2 B.A. screws from the forward edge of the rear fairing.

(7) Remove the rear fairing.

*(NOT USED)*

FIG.14.

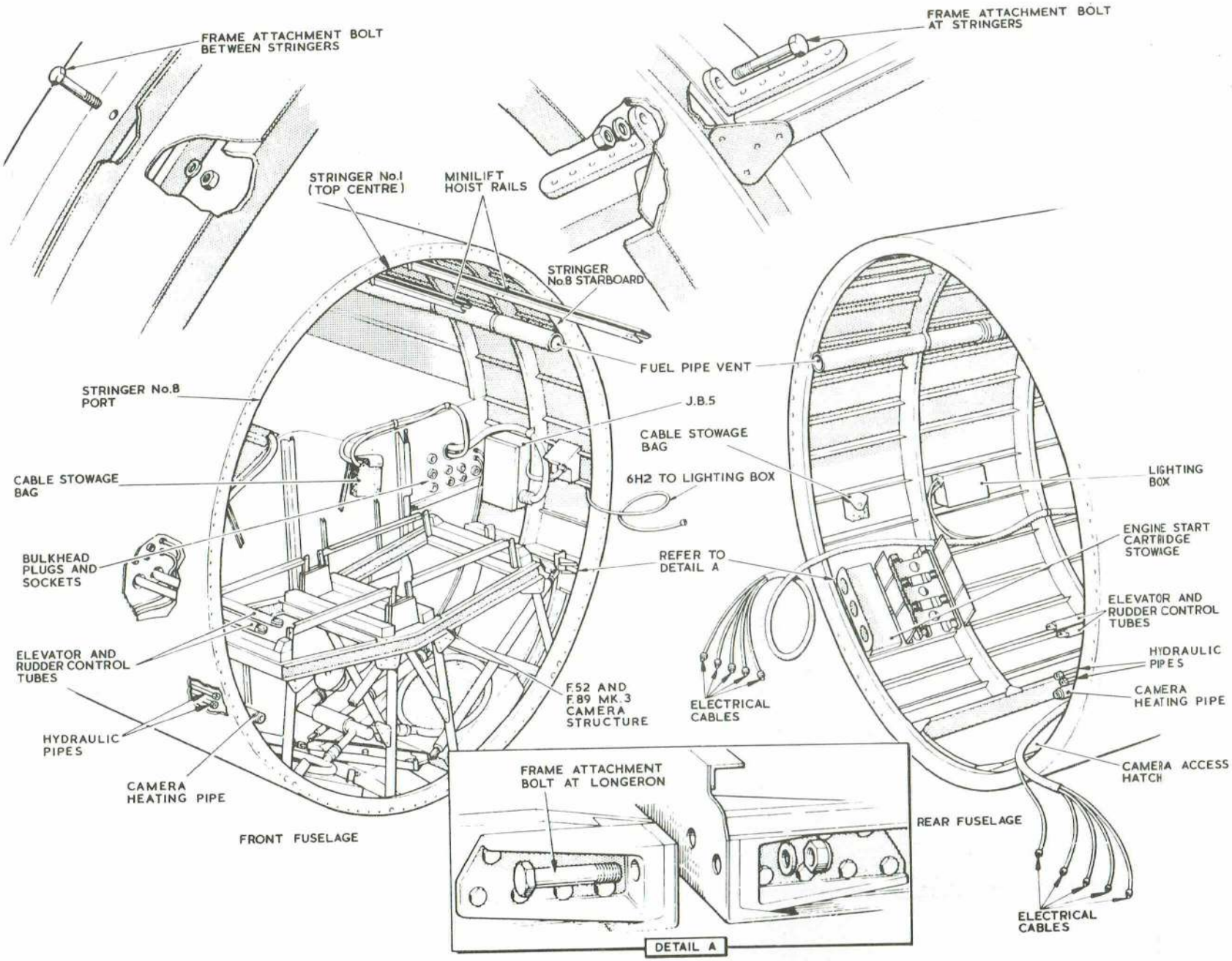


FIG.15. REAR FUSELAGE REMOVAL

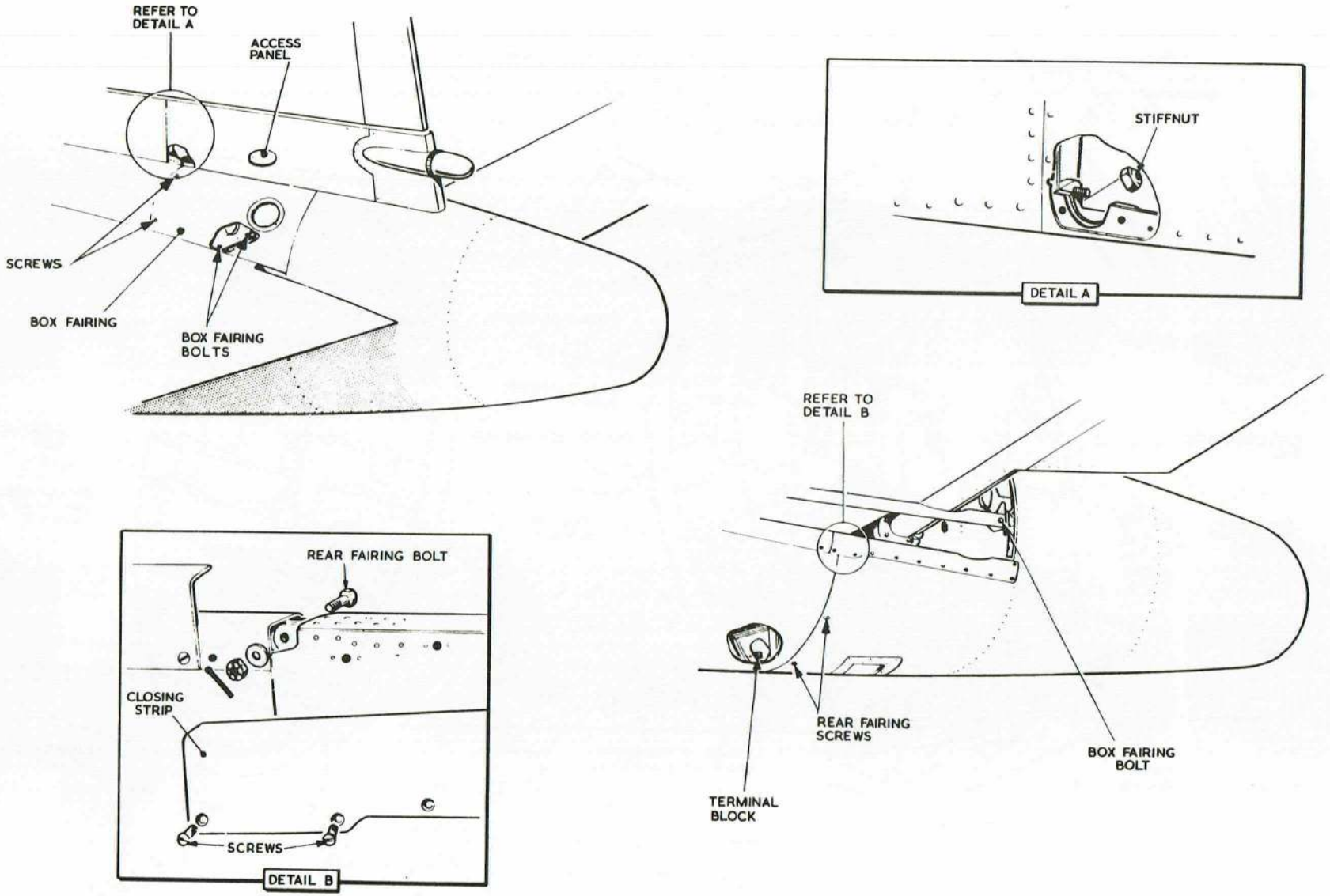


FIG.16. REAR FAIRING REMOVAL

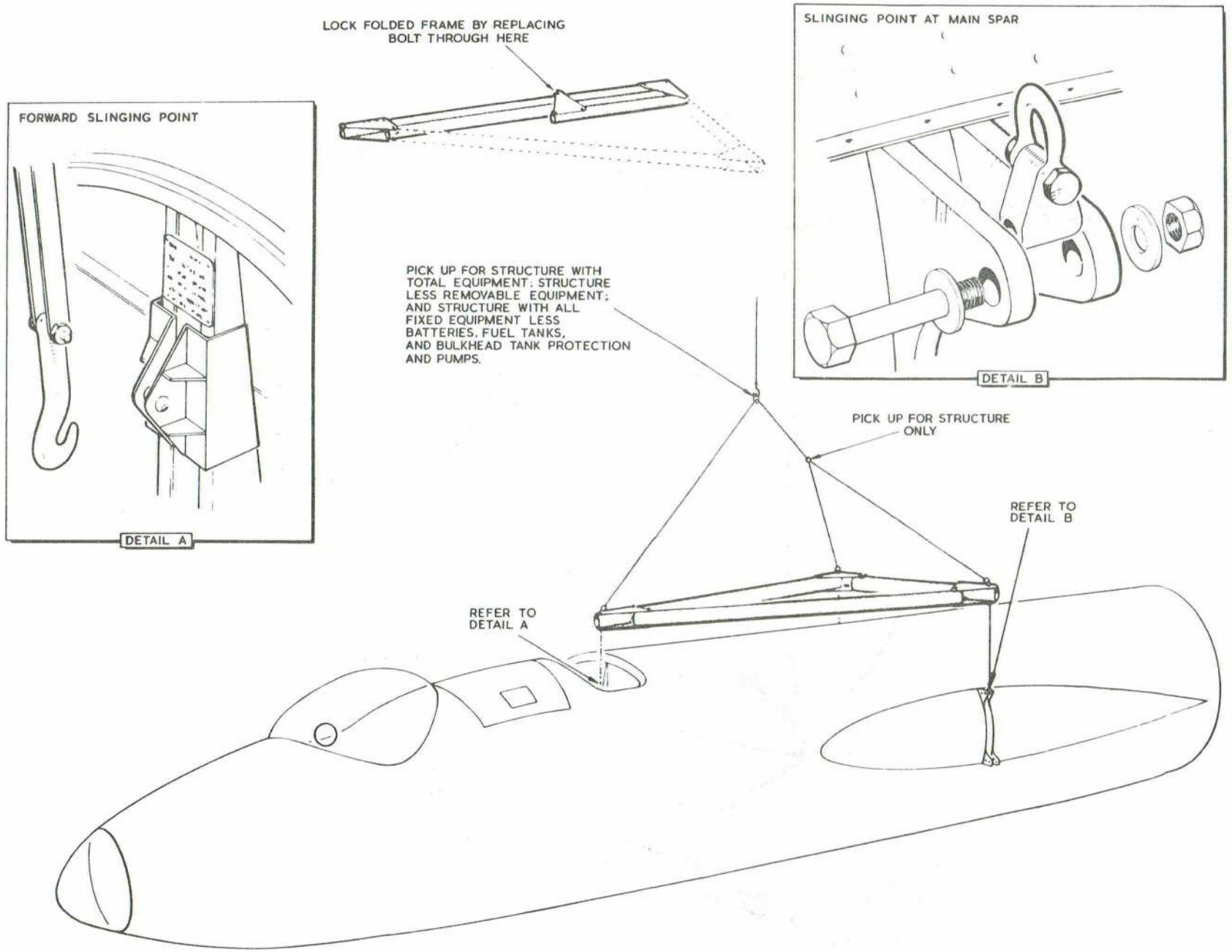


FIG. 17. FRONT FUSELAGE SLINGING

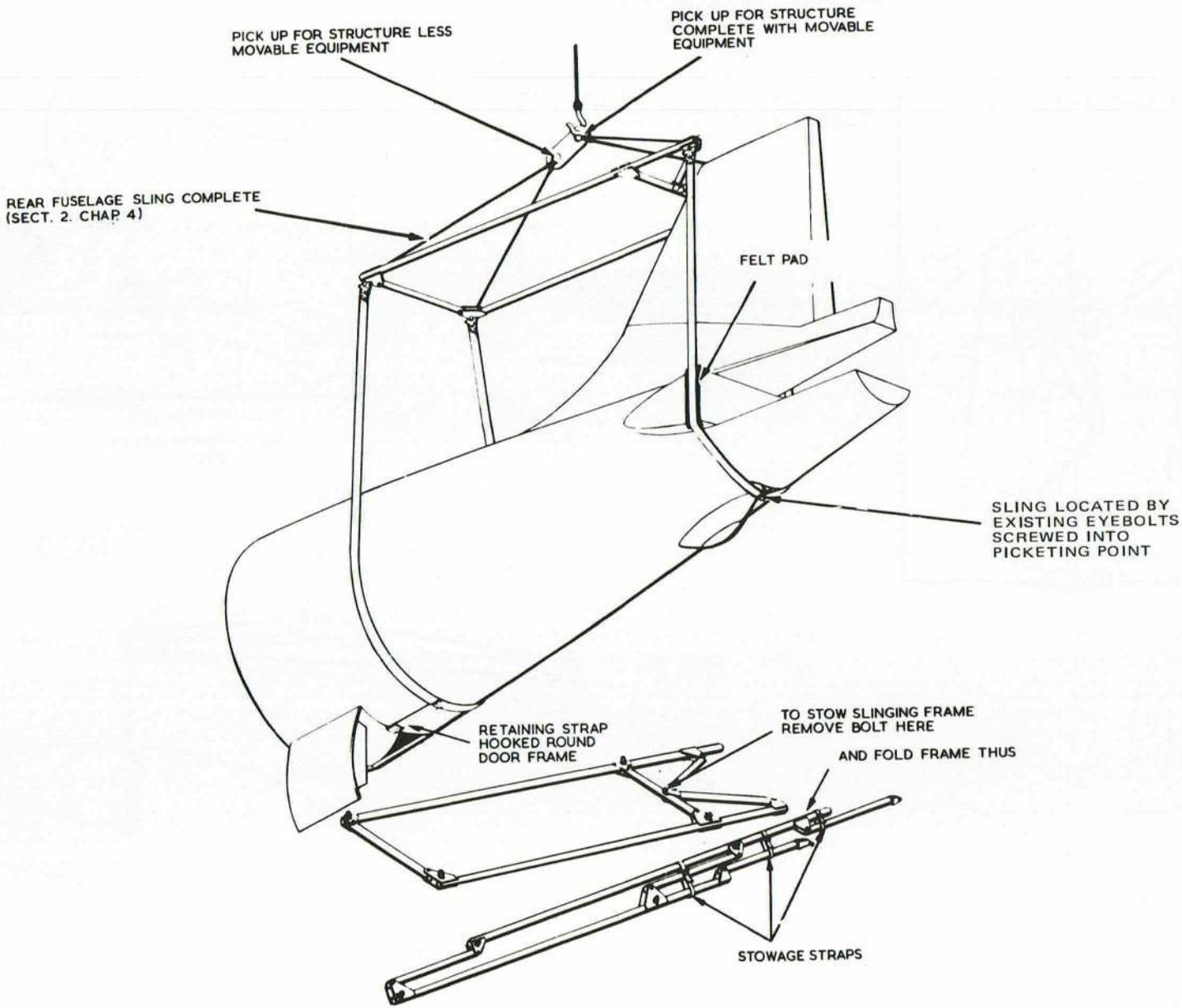


FIG. 18. REAR FUSELAGE SLINGING

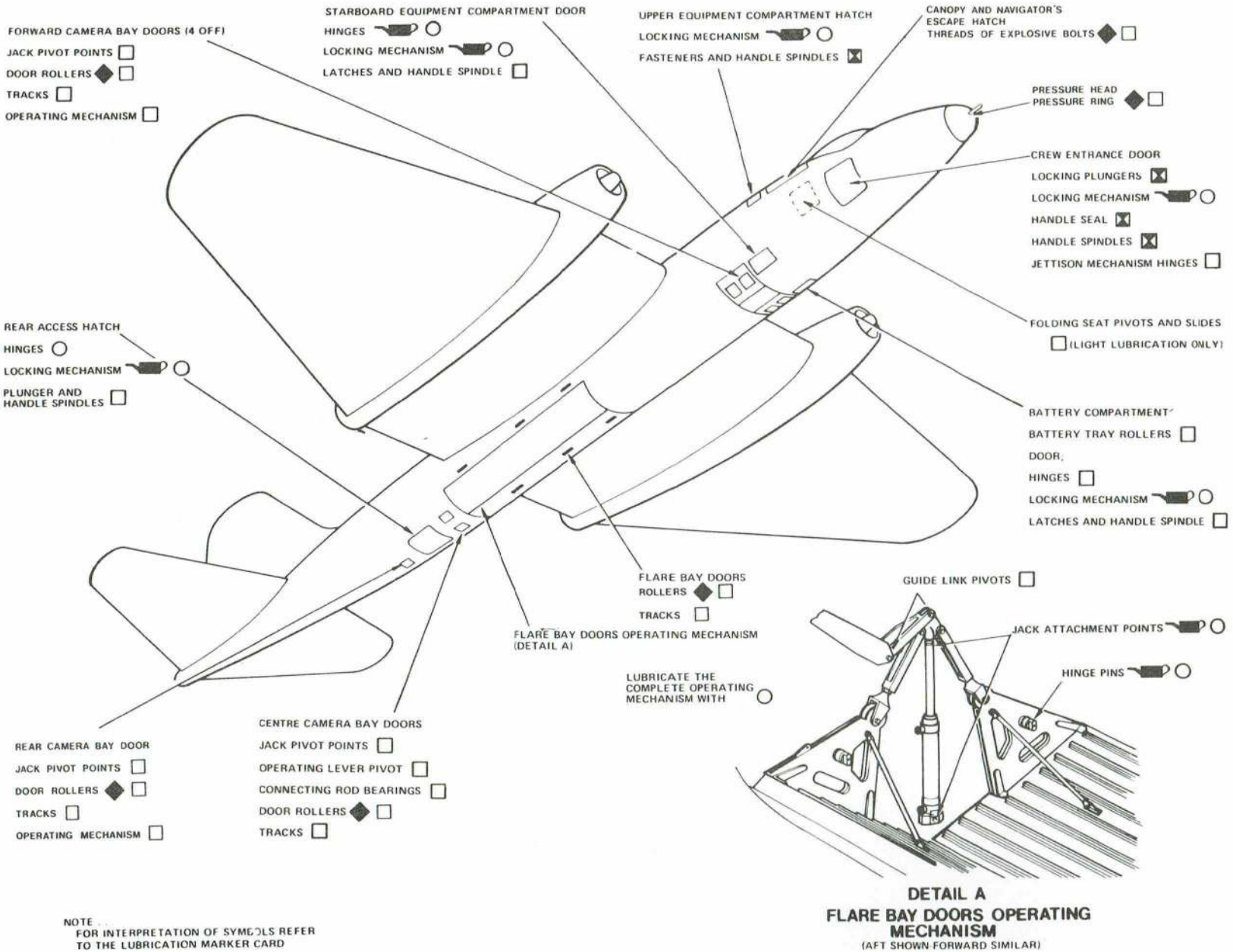


FIG. 19. LUBRICATION DIAGRAM

# Chapter 2 MAIN PLANE

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## LIST OF ILLUSTRATIONS

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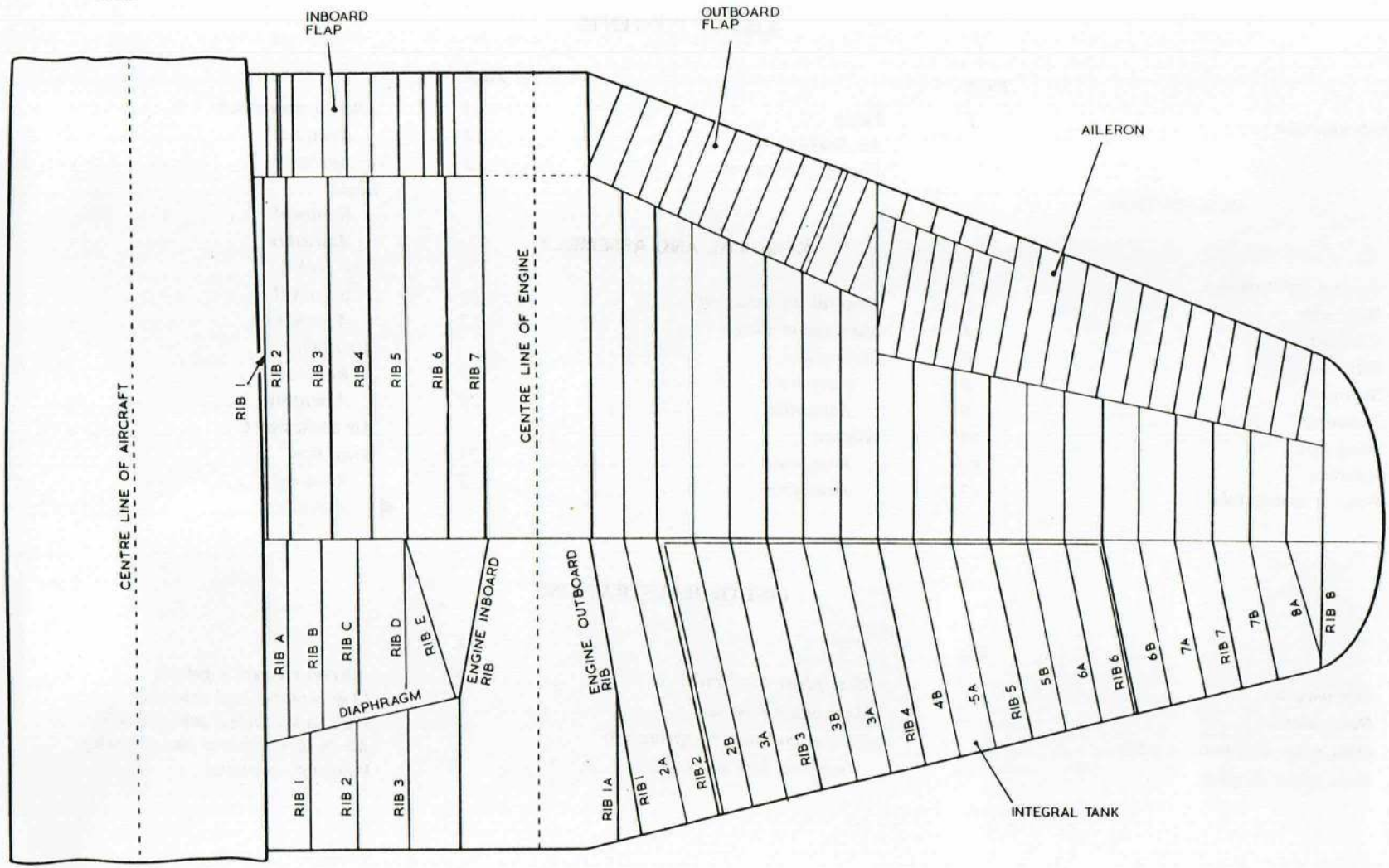


FIG.I. KEY DIAGRAM

**Introduction**

1. This chapter gives a general description of the main plane structure and describes the removal and assembly of certain components. The disposition of the spars and ribs within the structure is illustrated in fig. 1.

## DESCRIPTION

**General information** *(fig. 2)*

2. The main plane is a single spar, cantilever structure with a sectional rear wall, and is built in port and starboard units. There is no conventional centre section, the units being mounted direct on the sides of the fuselage with the spar continuation through the fuselage maintained by reinforced spar frames. In plan form the main plane units have a parallel chord inner portion extending to the outboard side of the engine bay, from which point they taper to the wing tip; the leading and trailing edges are straight. The basic structure consists of a torsion box, formed by the main spar and rear wall with the rib and stringer system and between-spar skinning. To this is added the inner and outer leading edge assemblies, the detachable wing tip, the flap shrouds, the air brake installation and the aileron and flaps, the latter being carried on hinges mounted on the aft face of the rear wall. The outer leading edge assemblies embody the integral fuel tanks, located between ribs 2 and 6.

**Main spar**

3. The main spar is a built-up beam extending from the root to the tip; it has a plate web and machined light-alloy booms, the cross section of which changes from a complex stepped T at the root to a plain T at the tip. Lightening holes in the web are reinforced with ring plates, except in the tip portion, where they have integral pressed flanges. To accommodate the engine jet pipe, which passes through the spar, the web is cut off square on each side of the aperture, leaving the booms as continuous members, and to the ends of the web so formed are bolted Y section fittings which form an anchorage for large, forged, light-alloy reinforcing ring-plates bolted to the arms of the Y-section fittings at the front and rear of the spar. A rolled, carbon-steel firewall is fitted to the forward face of the ring plate at the front of the spar.

**Rear wall**

4. The rear wall is divided into three sections, an inboard section extending from the root to the inboard side of the jet-pipe bay, a centre section extending from the outboard side of the jet-pipe bay to the rib at the inboard end of the aileron gap, and an outboard section extending the length of the aileron. The inboard and centre sections are joined by a forged light-alloy I-section ring, through which the jet pipe passes. Each section is built-up of plate webs stiffened by vertical angle-section members and T-section extruded flanges. The web of the outboard section is curved to form the front wall of the aileron pressure-balance box.

**Ribs**

5. Outboard of the jet-pipe bay the main spar and the rear wall are joined by a system of main full-depth ribs, flanked on either side by secondary ribs which, instead of being the full depth of the main plane, are made shallow to allow the spanwise stringers to pass outside their flanges. The main ribs have flat, plate webs with flanged lightening holes and extruded T-section booms. Those secondary ribs in the area bounded by the engine ribs and rib 4 have extruded bulb-angle-section booms, those between rib 4 and rib 8 have plain pressed flanges.

6. Forward of the main spar is a similar system of main and secondary ribs which match those aft of the spar but which are at right angles to the main plane leading edge. The secondary ribs do not extend as far forward as do the main ribs, but are cut off some inches short of the leading edge. The forward ends of each of secondary ribs are joined together and to their main ribs by a nose beam passed through the main-rib webs. From rib 2 to rib 6, forward of the main spar, the main and secondary ribs and the stringers are covered on the top, around the leading edge and on the underside by a one piece sheet-metal skin which, with the rear, the outboard and the inboard tank walls, form a fuel tank within the main plane structure. The tank section is located by spigots on the web of the main spar and is secured to the top and bottom flange sections of the spar boom, around the outboard flange of rib 2 and the inboard flange of rib 6 by countersunk bolts. The tank section may be removed without removing the main plane.

7. Inboard of the jet pipe bay, the main ribs aft of the spar are similar to those outboard of the bay, but the pressed flange secondary ribs are of full main-plane depth. Forward of the spar the leading edge houses the main undercarriage unit when retracted; it is divided spanwise by a diaphragm which forms the front wall of the wheel well and extends from the engine bay inboard rib to the fuselage. Forward of the diaphragm, the ribs are constructed with plate webs and angle flanges,

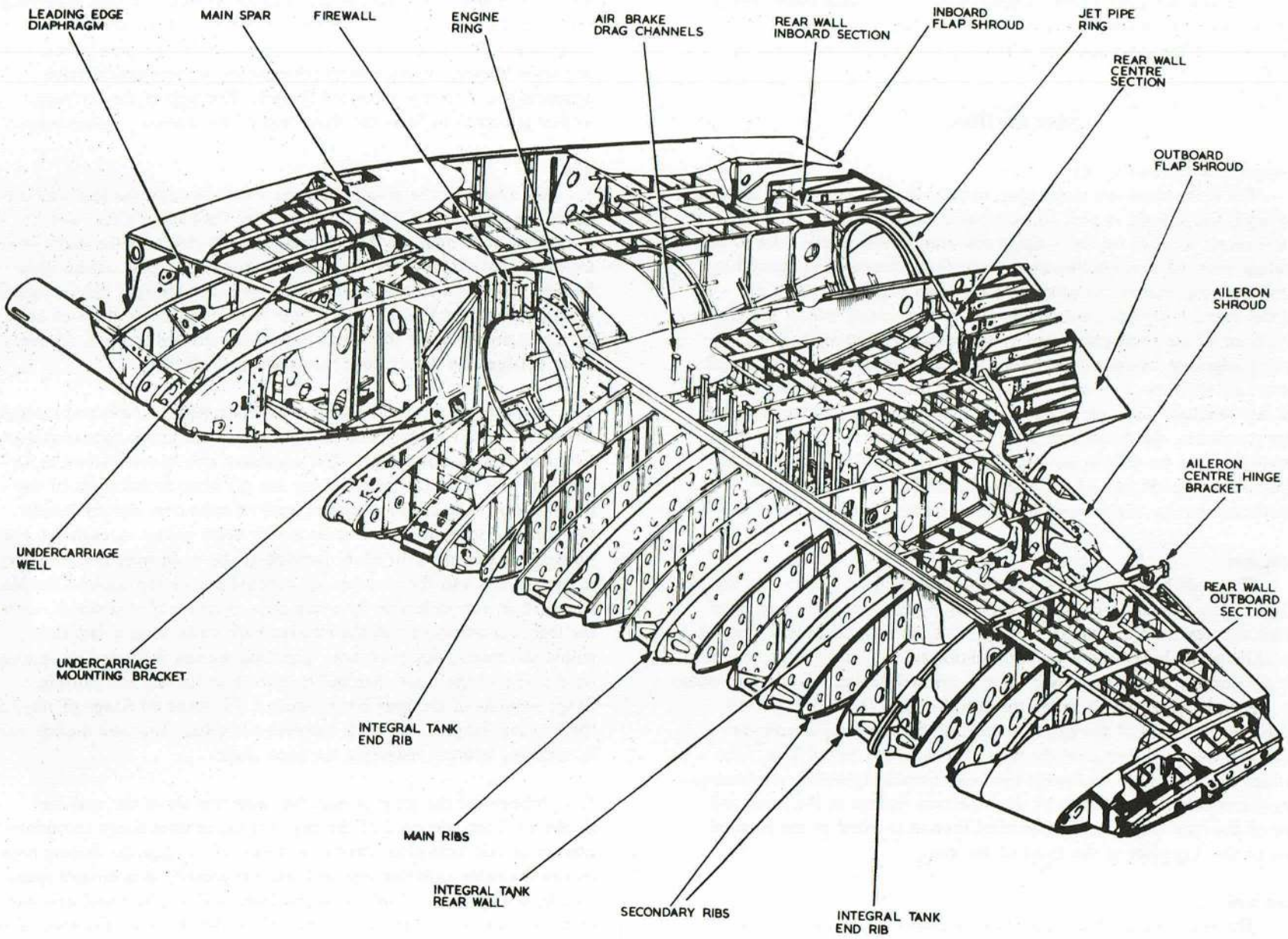


FIG. 2. MAIN PLANE

while aft of the diaphragm the ribs are closed top-hat-section members. On either side of the jet pipe and engine bays, special ribs are built up with plate webs and angle-section frames.

**Stringers**

8. Outboard of the engine and jet pipe bays, the spanwise stringers, of bulb-angle-section, lie intercostal with the main ribs but pass outside the secondary ribs. Inboard of these bays the stringers pass through the main and secondary ribs alike.

**Skinning**

9. The skin plating aft of the spar is in sheets with chordwise butt joints on the centre lines of the main ribs, reinforcing strips being interposed between the rib flanges and the skin. Spanwise joints are made on bulb T-section extrusions running from the outer side of the jet-pipe bay to the tip. The leading-edge panels are wrapped chordwise round the leading edge.

**Wing tips** *(fig.3)*

10. A detachable wing tip is carried on an extension to the main plane structure at outboard rib 8. The skin covering is attached to a pressed flanged rib and pressed flanged spanwise ribs, the complete assembly being attached to the leading and trailing edges of outboard rib 8, the spar extension rib and the two spanwise ribs of the main-plane extension. Navigation and taxying lamps are installed in the nose of the leading edge, the skin of which is moulded plastic, and static dischargers are fitted to the outboard trailing edge.

**Ailerons** *(fig.3)*

11. The ailerons are carried on a centre main hinge and on pin-and-socket hinges at their extremities. The skin covering is attached to pressed ribs which have flanged lightening holes. The ribs are flanged on their lower edge and have a separate angle-section extruded flange on the upper edge. The aileron spar, to which the ribs are attached, has a plate web with flanged lightening holes and carries the D-shaped nose ribs and aileron beaks. Upper and lower aileron shroud plates, which may be opened to facilitate servicing of the aileron operating mechanism, are mounted on piano-type hinges on the main plane rear wall. Mass balance of the surface is effected by heavy-alloy strips riveted between the beak ribs. Between the inboard end and rib 7 the trailing edge of the aileron is cut away to accommodate the spring tab; the ribs between these points are shortened and carry a curved rear web which forms the front wall of the spring tab pressure-balance box. Static dischargers are fitted to the trailing edge.

**Aileron spring tabs** *(fig.3)*

12. The aileron spring tabs are hinged to the aileron by a main centre hinge and pin-and-socket hinges at their extremities. The skin covering is attached to pressed flanged ribs and the tubular spar. The spar is reinforced at the centre hinge point by an inner tube and each end of the spar houses a socket in which the hinge pin is secured. Extensions to the upper and lower skins forward of, and riveted to, the spar, form a beak in which triangular wood alignment blocks are inserted at intervals. At the apex of the beak the upper and lower skins are continued forward to form a flat plate extension, terminating in a 60 degree extrusion.

**Flaps** *(fig.3)*

13. The split trailing-edge flaps are single-spar structures of triangular cross-section, each carried on two hinges. Pressed, flanged nose and trailing-edge ribs are attached to the spar, the whole structure being covered with a light-alloy skin riveted to the spar and ribs. Flanged lightening holes are cut in the upper skin surface.

**Air brakes** *(fig.11)*

14. The hydraulically-operated air brakes consist of twenty one drag channels housed inside each main plane, aft of the main spar. In the OUT position, nine of the channels protrude through the upper skin surface and twelve through the lower surface; when in their IN position, the ends of all the drag channels lie flush with the main plane skin surfaces. The drag channels are attached to the ends of centrally pivoted rocker arm assemblies, which are attached to a spanwise torque tube, constructed in three portions and connected together at outboard ribs 3A and 3B; the tube is carried in bearings at its centre and ends. Annular plates attached to the webs of outboard ribs 2 and 4 accommodate the end bearings; the centre bearing at rib 3 consists of three rollers, one of which is adjustable to facilitate removal and assembly of the torque tube. A lever, in the centre and integral with a rocker arm assembly is connected to the hydraulically-operated jack mounted on the rear of the main spar.

**Vortex generators**

15. Vortex generators are fitted to both the wing tips and the wing-tip tanks or pods. The generators, eight in number, are fitted two to the underside of each wing tip forward of the main spar, inboard of rib 8 and inclined 10 deg to the main plane chord line, and two to the inboard face of each wing-tip tank or pod.

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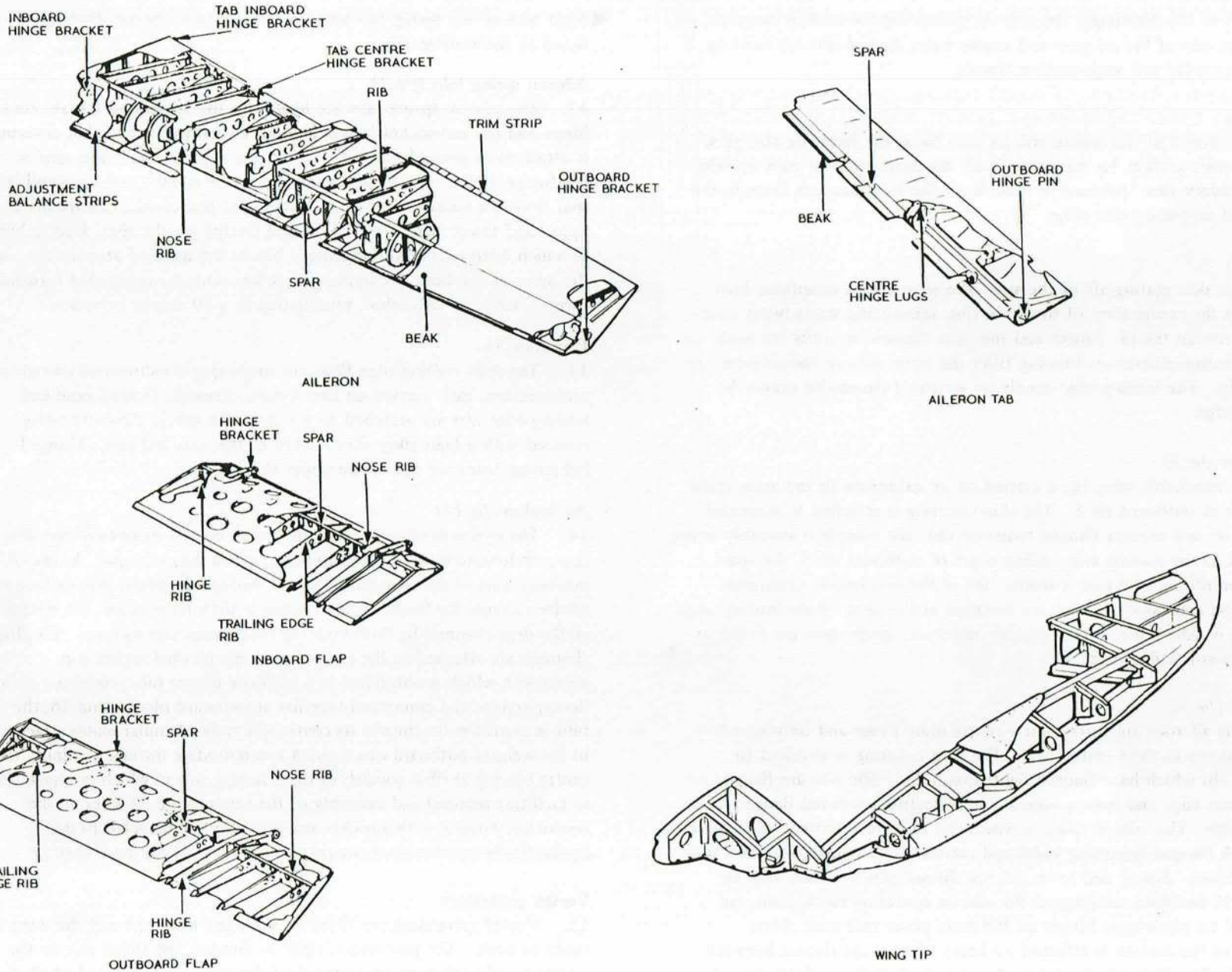



FIG.3. MAIN PLANE COMPONENT PARTS

**Note . . .**

*To obtain the benefit of the vortex generators, both the wing tips and the wing-tip tanks must be modified. Although it is possible to fit an unmodified tank to a modified wing tip and vice versa, no benefit from the modified member will be obtained thereby.*

## REMOVAL AND ASSEMBLY

**Note . . .**

*After the reassembly of any component which may affect the longitudinal trim of the aircraft, carry out flight trim checks as specified in Sect.3, Chap.4, App.1.*

**General information**

**16.** The following paragraphs describe the removal and assembly operations of the main plane and its principal components. Only the removal operations are described, since the assembly is generally a reversal of these operations; where this is not the case, the fact is noted. The recommended sequence of operations is given, although in some cases it will be clear that it is not essential to adhere rigidly to this sequence. The necessary ground equipment is listed in Sect.2, Chap.4.

**Main-plane sling** *(fig.4)*

**17.** The main-plane sling, which can only be used when the engine and jet pipe are removed, is a triangular tubular frame, which is attached to the main plane by a beam at the engine rear-mounting bracket *(detail B)*, ◀ by a hook at the rear wall connecting ring and by a picketing/slinging ring bolt fitted at the slinging point in the upper surface of the main plane (Sect.2, Chap.4). It is designed to sling both the port and the starboard main planes and its preparation procedure is detailed in fig.4. Three rings, for attachment to the crane-hook shackle, are provided in the slinging cables and are used in either one of two conditions, depending on which components are fitted to the main plane during the lifting operation. Both conditions are given in fig.4.

**Note. . .**

*1. Integral tank fuel must be drained (Sect.4, Chap.2) before a main plane is slung.*

*2. During main-plane removal, and more particularly during assembly, great care must be taken to prevent any damage to the upper and lower main spar skin attachment flanges. These flanges, if subjected to excessive loads, are liable to crack and this condition may occur if fouling of the flanges with the main plane attachment lugs takes place. It is therefore essential that the main plane is balanced in the correct attitude, relative to the fuselage, before it is offered up. Although the main-plane sling will balance it in approximately the correct position it is imperative that final adjustments are made by ballasting.*

*3. It is recommended that, whenever possible, the flaps and ailerons* ▶ *are removed both for main plane removal and replacement.*

**18.** To attach the sling to a main plane:-

(1) Remove the caps from both the engine rear-mounting brackets.

(2) Place the slinging beam across the engine bay with the spherical ends of the beam resting in the lower halves of the engine mounting brackets. Refit the caps on the engine-mounting brackets.

(3) Insert the picketing and slinging ring bolt in the slinging point in the upper surface of the main plane *(Sect.2, Chap.4)*.

(4) Assemble the slinging frame to suit the main plane being lifted and attach the sling to the hoist by the slinging eye, or eyes *(para.17)*.

(5) Adjust the hoist until the cable at the forward apex of the frame can be attached to the centre of the slinging beam, pass the hook on the cable at the rear apex of the frame under the rear wall connecting ring, and the hook on the cable at the outboard apex of the frame through the picketing and slinging ring in the main plane.

**Main plane** *(fig.6)*

*Removal*

**19.** To remove a main plane proceed as follows:-

**Note . . .**

*All pipe lines must be blanked off, as soon as possible after disconnection.*

(1) Ensure all power supplies are disconnected *(Sect.5, Chap.1)*.

(2) Exhaust all hydraulic pressure *(Sect.3, Chap.6)*.

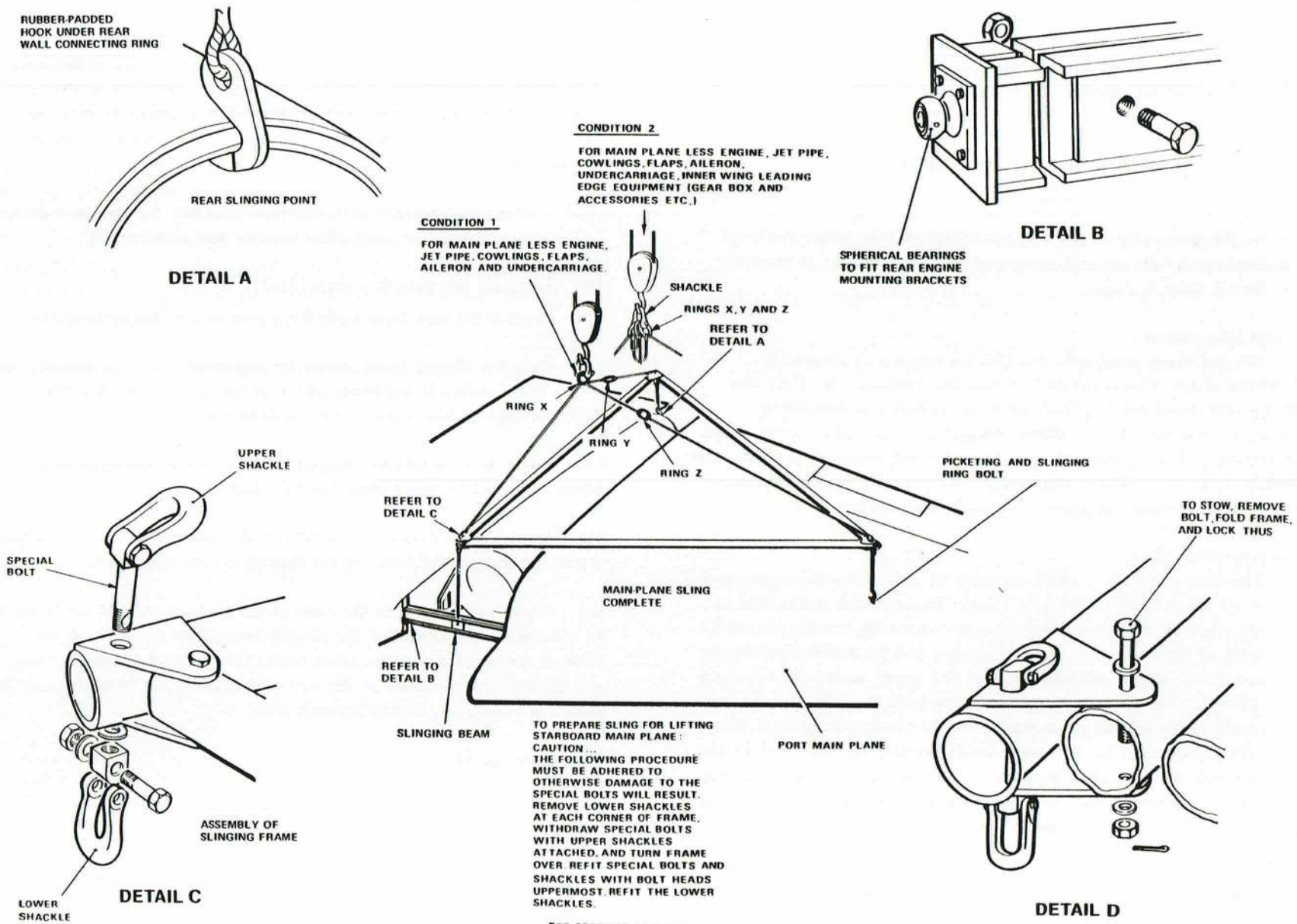



**FIG. 4. MAIN PLANE SLINGING**

◀ MOD. GE5224 EMBODIED ▶

(3) Drain the fuel from the integral and wing-tip tanks *(Sect.4, Chap.2).*

(4) Remove the wing-tip tanks *(Sect.4, Chap.2).*

(5) Remove the engine and jet pipe *(Sect.4, Chap.1).*

(6) Jack and trestle the aircraft *(Sect.2, Chap.4)*

(7) Remove the main-undercarriage door and undercarriage unit *(Sect.3, Chap.5).*

**Note . . .**
*If the aileron and flaps are to be removed it is advisable to do so before removing the main plane.*

(8) Attach the sling to the main plane as instructed in para.18 and fig.4. Take the weight of the main plane on the sling.

(9) Remove the access panels.

(10) Remove the closing strips.

(11) Remove the screws securing the leading edge of the main-plane skin to the angle-section fuselage attachment.

(12) Disconnect the fuselage/main-plane connections of the following controls and services :-

(a) Engine controls.

(b) Hydraulic pipes, suction and delivery.

(c) Hot air delivery pipe to camera bays.

(d) Cabin air delivery pipe (port side only).

(e) Pitot and static pipes to the A.M.U. (port side only).

(f) Fuel delivery pipe.

(g) Fire protection pipe.

(h) Hydraulic pipes.

(j) Air brakes hydraulic pipes.

(k) Wing-tip fuel tank fuel transfer pipe and wing-tip fuel tank air pipes.

(l) Aileron control rod.

(m) Flaps hydraulic pipes.

(n) Cabin air delivery pipe, primary cooler to mixing valve.

(o) Doppler 72 (port side only).

(p) I.L.S. localizer aerial connection (port side only).

(q) Disconnect and withdraw the I.L.S. marker aerial (stbd. side only).

(r) I.L.S. glide path aerial connection (stbd. side only).

(13) Ensure that all electrical, radio and radar connections have been disconnected *(Sect.5 and 6).*

(14) Remove the split pin, nut and washer from the bolt at the forward attachment point and withdraw the bolt.

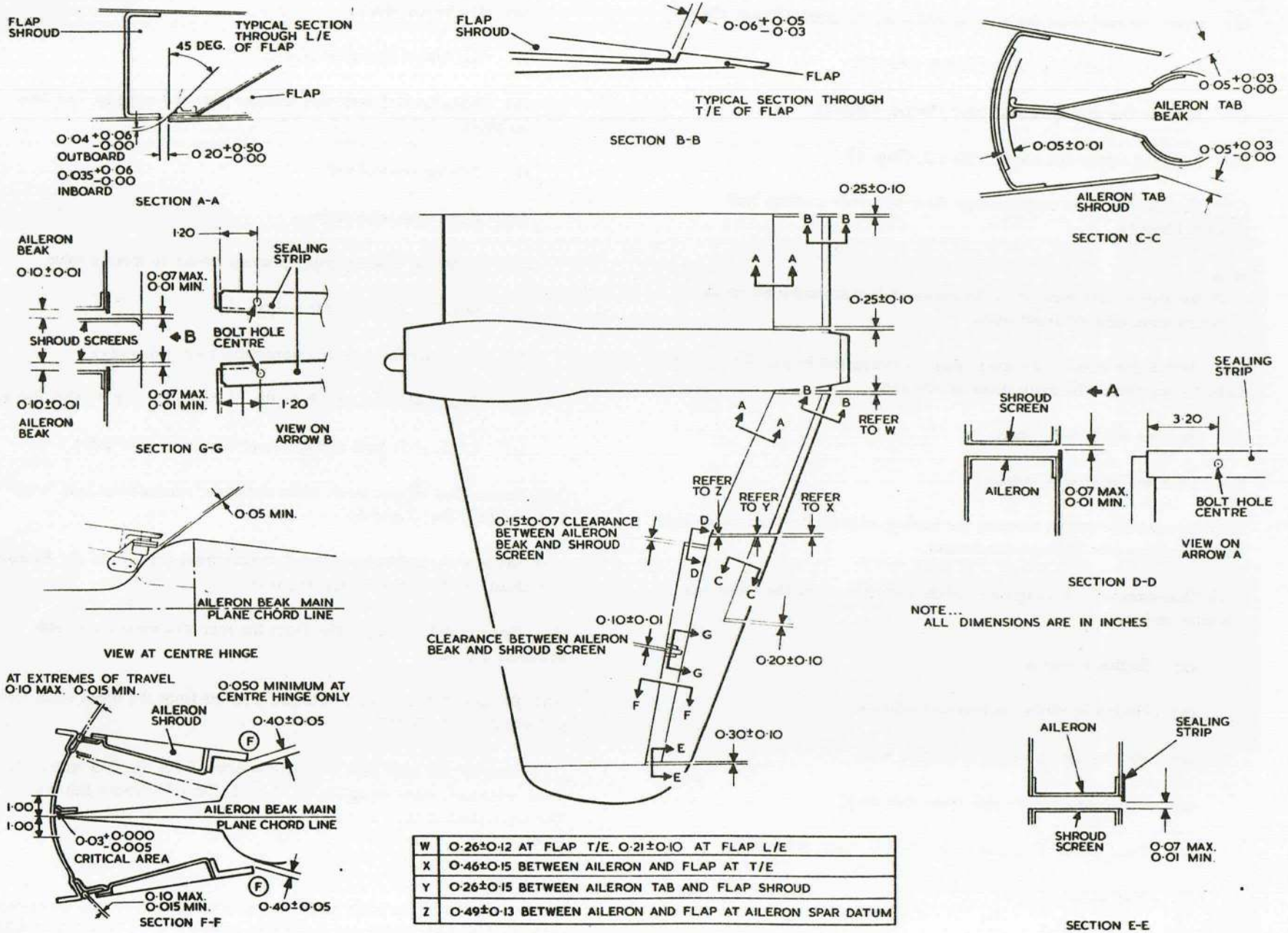
(15) Remove the locking collar from the rear attachment bolt and withdraw the bolt.

(16) Remove the split pins, nuts and washers from the seven shear bolts and withdraw the bolts.

(17) Remove the split pins, nuts and washers from the four main attachment bolts and, using an extractor *(Sect.2, Chap.4)* remove the bolts. The main plane is then free and should be lifted clear and placed on trestles *(Sect.2, Chap.4).*

*Assembly*

**20.** Assembly of the main plane is a reversal of the removal procedure with the following additional operations included:-




| | |
|---|---|
| W | 0·26±0·12 AT FLAP T/E. 0·21±0·10 AT FLAP L/E |
| X | 0·46±0·15 BETWEEN AILERON AND FLAP AT T/E |
| Y | 0·26±0·15 BETWEEN AILERON TAB AND FLAP SHROUD |
| Z | 0·49±0·13 BETWEEN AILERON AND FLAP AT AILERON SPAR DATUM |

FIG. 5. MAIN PLANE CLEARANCES

◀REDRAWN AND CLARIFIED▶

(1) Before assembling the main plane in the fuselage ensure that the sealing blocks Part No.EA1-20-2897 (upper) and EA3-20-135 (lower) are securely attached with rubber resin cement Ref.No.33H/2245977 within the forks of the centre section spar fitting, as shown in the detail. Ensure that S.T.I./Can/498A has been satisfied.

(2) Before fitting the spar lower attachment bolts use grease XG 287 to lubricate the bolt threads and the nut faces and, when tightening the nuts, apply a torque of 1500 lbf in., using a suitable torque wrench. Tighten the nuts alternatively.

(3) After assembling the main plane to the fuselage, and before fitting the seven shear bolts, attach with rubber resin cement Ref.No.33H/2245977 a sealing block Part No.EA1-20-2899. The block must be hard up to the forward face of the spar lower boom and the fuselage side, as shown in the detail.

(4) At the forward attachment point, the attachment bolt is a ½in. dia. B.S.F. (A59/11N). It is to be torque tightened to 100 lbf in.

**Note . . .**

*This bolt must be removed, discarded and replaced by a new bolt at each subsequent Minor Star Servicing (STI/CAN/605B).*

(5) When securing the main plane skin to the angle-section fuselage attachment, the sixty-eight 2 B.A. screws securing the leading-edge skin, from the main spar on the upper surface, to the forward edge of the main undercarriage bay, must be fully tightened and then slackened off one quarter of a turn; this ensures freedom of movement between the wing and the fuselage.

**Note . . .**

*After refitment or replacement of a main plane, a flight trim check must be made in accordance with Sect.3, Chap.4, App.1, to ensure that the aircraft trim is within the specified limits. Should the aircraft trim be outside the specified limits, a new elevator trailing edge strip must be fitted and the flight trim checks and subsequent trailing-edge strip adjustments made.*

Aileron *(fig.7)*

*Removal*

**CAUTION . . .**

**Ailerons must neither be removed nor refitted while wing-tip tanks are fitted to the main plane.**

21. To remove an aileron, with or without the spring tab fitted, proceed as follows:-

(1) Open all aileron shrouds by removing the countersunk screws at the extremities of each shroud.

(2) Disconnect the aileron control rod from the aileron lever arm *(detail E)*.

(3) Remove the access panel from the underside of the wing tip *(detail B)*.

(4) Remove the four 0.25 in. dia. bolts attaching the centre hinge bracket to the aileron *(detail D)* and note the quantity of shims. To facilitate the removal of these bolts, the centre shroud attachment brackets may be removed.*(detail D)*.

**Note . . .**

*In the event of the centre hinge shroud attachment brackets being removed, note the quantity and position of shims Ref. No. 26FZ/6143. During reassembly, check the shroud and attachment bracket bolt holes for alignment and fit shims as necessary to ensure that no gap exists between the aileron centre hinge and shroud attachment brackets.*

(5) Lower the flaps, support the aileron at its extremities, remove the nut and bolt from the inboard hinge pin and, using the extractor *(Sect.2, Chap.4)* withdraw the hinge pin *(detail A)*.

(6) Remove the nut and bolt from the outboard hinge pin,and, using the extractor *(Sect.2, Chap.4)* withdraw the hinge pin *(detail B)*.

(7) Remove the aileron.

*Assembly*

**Notes . . .**

1. *If new ailerons are to be fitted, ensure the static dischargers are refitted (Mod.5119).*
2. *It is essential that both ailerons, conform to the same standard of mass balance (Mod.895).*
3. *Before assembling an aileron to the aircraft, lubricate the hinge points with grease XG-287.*
4. *If the aileron centre hinge bracket to mainplane rear wall attachments are disturbed then check alignment of bracket using tool ST8/25533 and adjust shimming as required.*

22. Assembly of the existing aileron to the main plane is a reversal of the removal procedure plus checking the clearances *(fig.5)*, but if a new aileron is being fitted, before fitting it, check the alignment of the centre hinge bearing and if necessary adjust as follows:-

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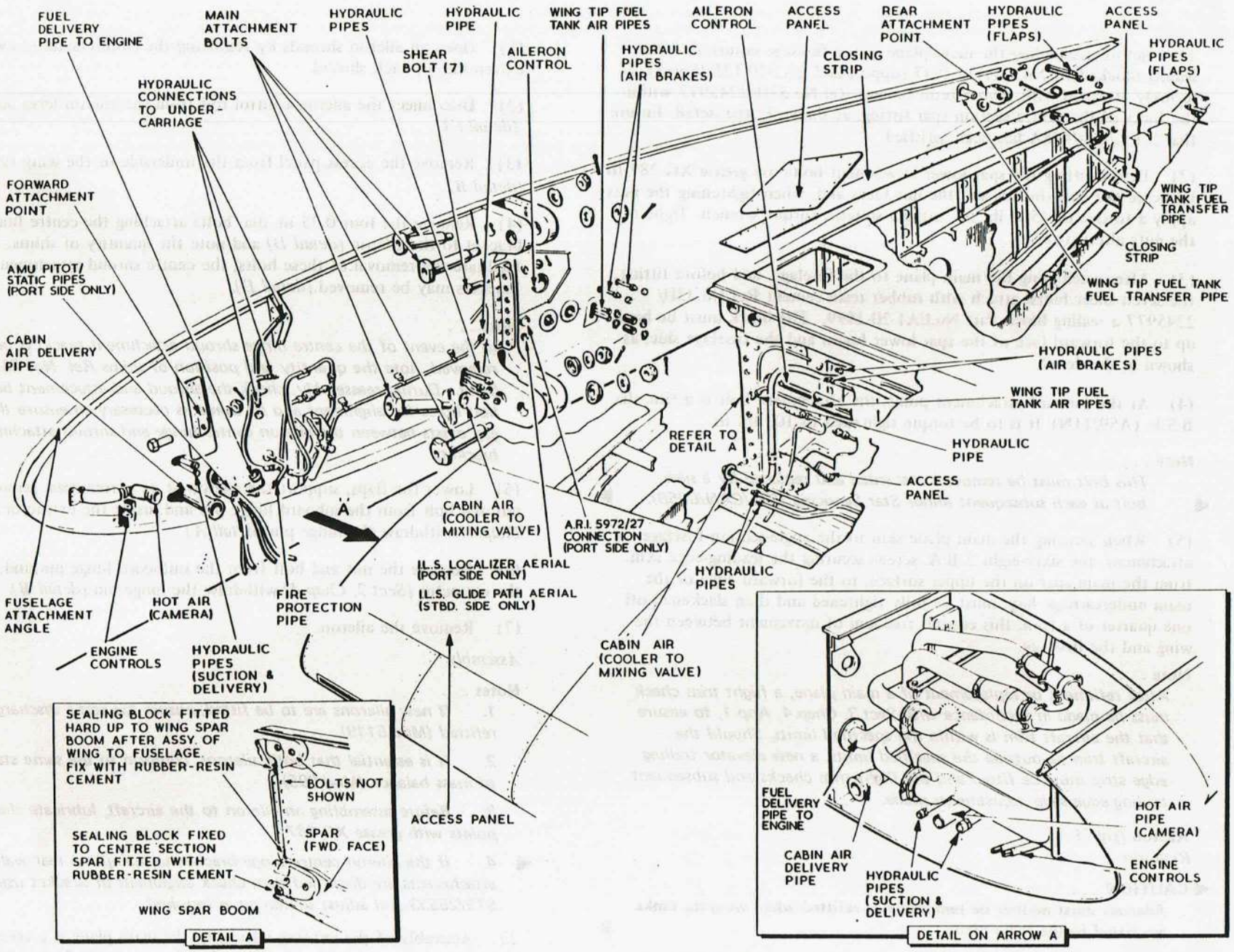



FIG. 6. MAIN PLANE REMOVAL

(1) Offer the aileron to the main plane and engage the inboard and outboard hinge pins.

(2) Check the clearance between the aileron hinge bracket and the forward face of the aileron spar.

(3) Remove the aileron and attach a shim Ref. No. 26FZ/5001 (supplied with a new aileron), of the thickness required at operation (2), to the forward face of the aileron spar using the hinge bracket attachment screws; a maximum of two shims (0.10 in.) may be fitted.

(4) With the end holes of the shim as guides, mark out and drill two holes 0.0785 in. dia. in the aileron spar and secure the assembly with P.K. screws Part No. 2R3/16 in. S971.

(5) Remove the attachment screws used at operation (3).

23. After fitting a new aileron, check the clearances *(fig.5)* and, if necessary, make the following adjustments:-

(1) To obtain the correct clearance between the aileron beak and the main plane rear wall in the critical area one inch either side of the main plane chord line *(Section F-F)*, it is permissible to have a clearance of 0.015 in. min. to 0.10 in. max. between the beak and wall over the remainder of the travel. Should the aileron beak foul the fabric over the shroud hinges, trim the fabric locally to clear.

(2) To obtain the correct clearance between the two aileron shroud screens and the aileron beak at the centre hinge *(Section G-G)*:-

(a) Open the aileron upper shrouds and remove the sealing strips from the aileron beak. The lower shrouds support the screens and are to be opened only as necessary to obtain the required clearance between the aileron shroud screens and aileron beak.

(b) Sandwich the clearance gauge *(Fig. 8)* between either of the screens and the beak; hold it in position by applying hand pressure to the screen and gently close the corresponding upper and lower shrouds. Check that the pegs on the screen enter the holes in the shrouds; if they do not, remove the clearance gauge and carry out a repair in accordance with A.P.101B-0400-6, Part 2.

(c) Remove the clearance gauge and repeat operations (a) and (b) on the other screen.

(d) Reopen the upper shroud at either of the screens. Using the clearance gauge, check that the correct clearance between the beak and screen is maintained and secure the screen in position, using the appropriate centre screen locating jig *(fig. 8)*, by locating the two upper pegs of the screen in the corresponding holes in the jig and bolting the aft end of the jig to the shroud angle attachment bracket. Remove the clearance gauge.

(e) Assemble the sealing strip to the aileron beak, unlock the ailerons and obtain the correct clearance over the full range of aileron movement.

(f) Remove the locating jig and close the aileron shroud.

(g) Repeat operations (a), (b), (c), (d), (e) and (f) at the other screen.

(3) To obtain the correct clearance between the aileron inboard shroud screen and the aileron beak *(Section D-D)*:-

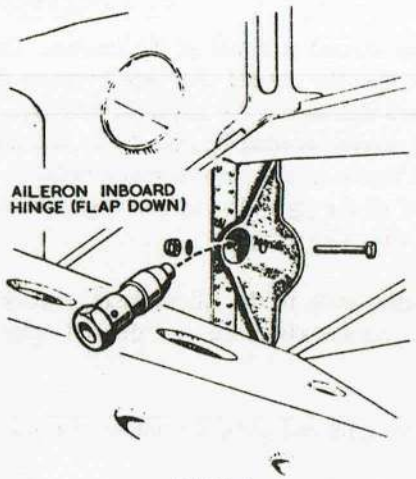
(a) Open the aileron upper inboard shroud, and remove the sealing strip from the aileron beak inboard edge.

(b) Position the inboard shroud locating jig *(fig. 8)*, on top of the screen by mating the screen peg with the jig and the point of the jig pointing aft. Mark off and drill a hole in the screen flange using the end hole in the locating jig as a template and bolt the two items together at this position.

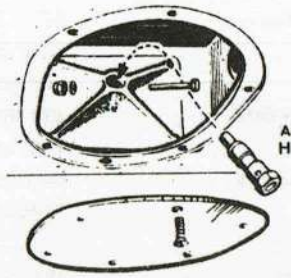
(c) Close the shroud so that the shroud takes on its normal position and, using a pencil, mark the position of the aft point of the locating jig on to the aileron. Reopen the shroud.

(d) Align the aft point of the locating jig with the pencilled mark on the aileron and, while held in this position, bolt the second (moveable) leg of the jig to the shroud angle attachment bracket.

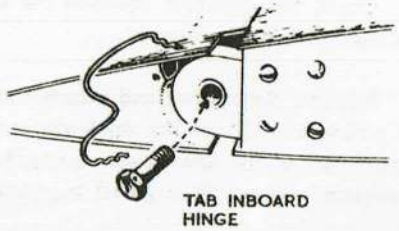
(e) Using a feeler gauge, measure the clearance between the screen and aileron, this should be 0.15 in. ± 0.07 in.; if the clearance is incorrect, carry out a repair in accordance with A.P.101B-0400-6, Part 2.



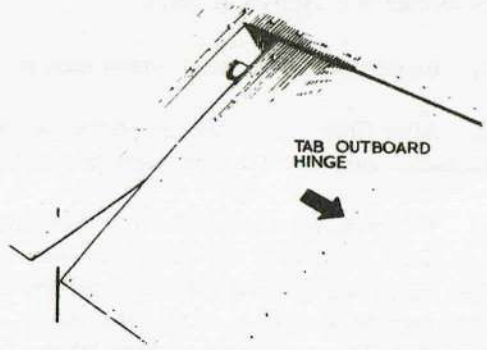

DETAIL A



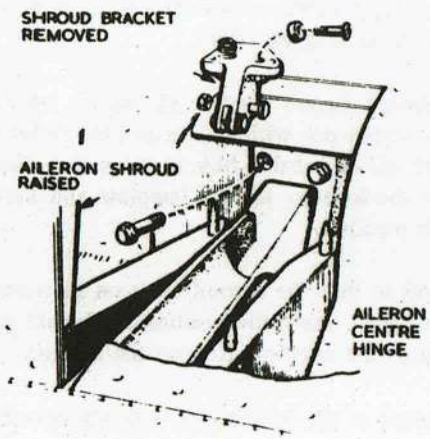

DETAIL B



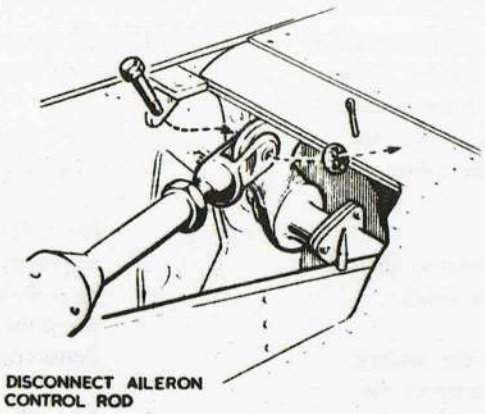

DETAIL C



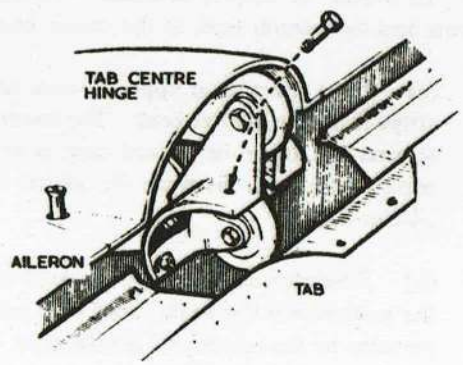

DETAIL F




DETAIL D




DETAIL E




DETAIL G

FIG.7 AILERON AND AILERON SPRING TAB REMOVAL AND ASSEMBLY

◀REDRAWN AND CLARIFIED▶

(f) Assemble the sealing strip to the aileron beak, unlock the ailerons, and obtain the correct clearance over the full range of aileron movement.

(g) Remove the locating jig.

(4) To obtain the correct clearance between the aileron outboard shroud screen and the aileron beak *(Section E-E)*.

(a) Slacken the sealing strip attachment screws and adjust the strip.

(b) Tighten the attachment screws after adjustment.

(5) Check the alignment of the aileron shrouds *(Section F-F)*: they must be in true alignment with the main plane and aileron contours ± 0.0312 in. measured along the upper and lower surfaces at the trailing edges of the shrouds at F. Adjust their alignment by the shims on the aileron shroud angle brackets at ribs 4, 6 and 8.

(6) If there is not sufficient clearance between the aileron shrouds and the aileron *(Section F-F)*, file the edges of the shroud, leaving a minimum of 0.025 in. between the rivet heads and the edge of the shroud; do not adjust this clearance by reshimming the aileron shrouds. Apply protective treatment *(A.P.119A-0509-1)* to filed surfaces.

**Note . . .**

*After assembly of the aileron to the main plane, flight trim checks as specified in Sect.3, Chap.4, App.1 must be carried out.*

**Aileron spring tab** *(fig.7)*

*Removal*

**24.** To remove an aileron spring tab proceed as follows:-

(1) Remove the two countersunk screws attaching the control rod fairing to the aileron and remove the fairing *(detail G)*.

(2) Remove the four 2 B.A. bolts and the two countersunk screws attaching the centre hinge bracket to the tab *(detail G)*.

**Note . . .**

*Tabs bearing serial numbers prefixed with letters GEO/EEP or GEO/R3/DA3:- when refitting bolt and screws, removed at sub para (2), check for adequate locking. If unsatisfactory, remove the bolts and screws and fit shakeproof washers AGS.2035/C to the bolts or AGS.2036/C to the screws. When AGS.2036/C washers are fitted, check clearance between head of screws and fairing edge.*

(3) Remove the locking wire from the inboard hinge pin and, with the tab adequately supported, remove the hinge pin *(detail C)*.

(4) Remove the tab from its outboard hinge pin by drawing the tab inboard *(detail F)*.

*Assembly*

**Note . . .**

*Before assembling a tab to an aileron, lubricate the hinge points with grease XG-287.*

**25.** Assembly of the existing aileron spring tab to the aileron is a reversal of the removal procedure plus checking the clearances *(fig.5)*, but if a new tab is being fitted, after its fitment, check for correct clearance and if necessary make the following adjustments:-

(1) If the clearance between the tab beak and the rear web of the aileron *(Section C-C)* is incorrect, it may be adjusted by filing the tab beak.

(2) If the clearance between the tab shrouds and the tab *(Section G-G)* is incorrect it may be adjusted by filing the edges of the shrouds. The correct protective treatment *(A.P.119A-0509-1)* must be applied to the filed surfaces.

**Note . . .**

*Whenever an aileron or aileron tab is replaced or adjusted, a flight trim check must be made in accordance with Sect.3, Chap.4, App.1, to ensure that the aircraft trim is within the specified limits. Should the aircraft trim be outside the specified limits, a new elevator trailing-edge strip must be fitted and the flight trim checks and subsequent trailing-edge strip adjustments made.*

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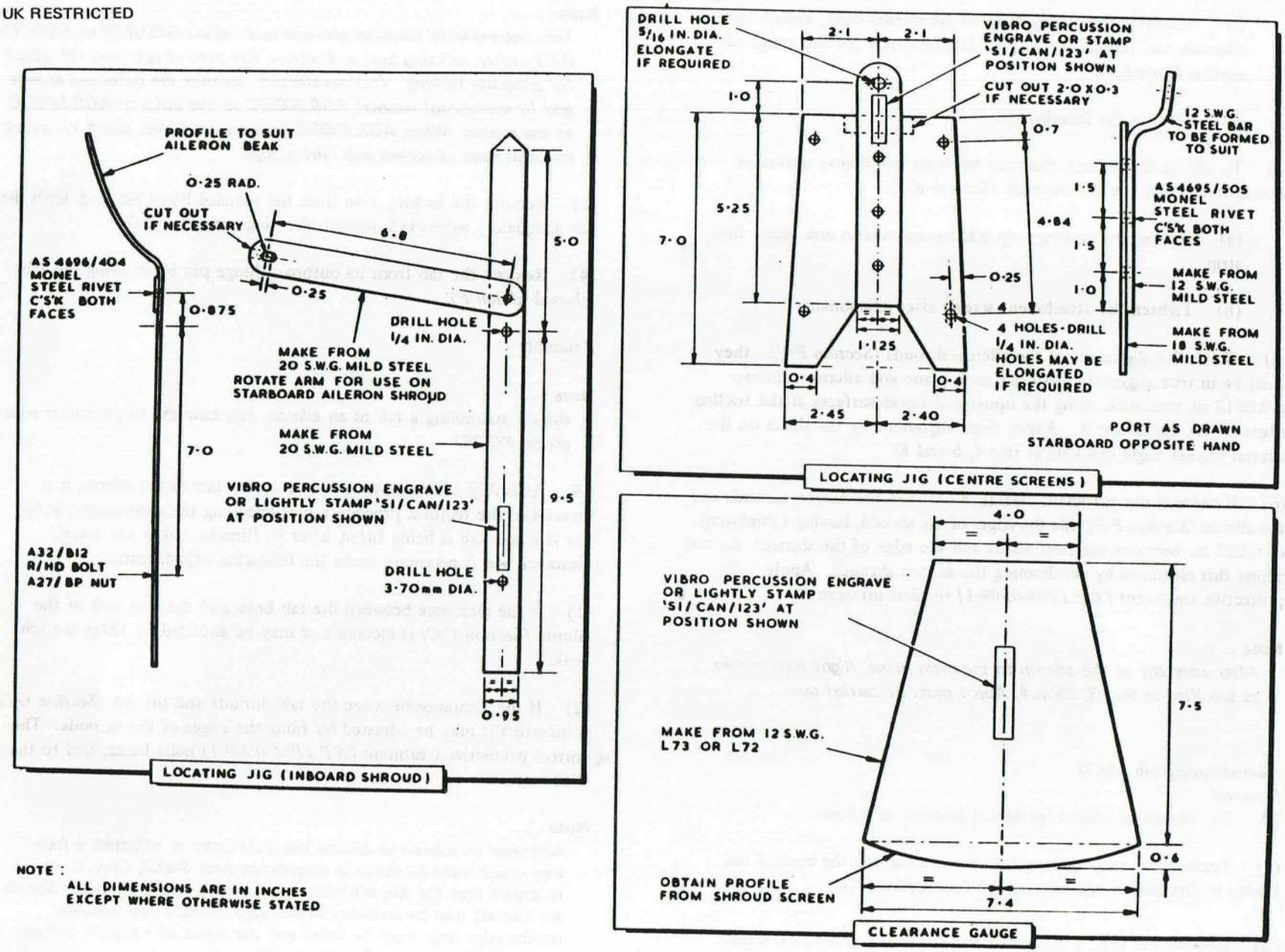


NOTE :
ALL DIMENSIONS ARE IN INCHES EXCEPT WHERE OTHERWISE STATED

FIG. 8. AILERON CLEARANCE GAUGES

**Flaps** *(fig.9)*

*Removal*

**26.** To remove a flap proceed as follows:-

**Note . . .**

*Removal and assembly procedure is common for all flaps, and the lubricating details are given in Chap.4.*

(1) Select flaps DOWN and lower the flaps fully.

(2) Support the flap and remove the attachment pin B from both operating mechanisms. Record the position of the bevel washers to assist in reassembly. Retain the attachment pins, bevel washers, plain washer and slotted nut.

(3) With the flap adequately supported at its centre and extremities, remove the hinge pin A from both hinge brackets. Retain the hinge pins, slotted nuts, washers and, at the datum hinges only, note the position of and retain the semi-spherical washers.

(4) Move the flap aft and downwards and remove it from the main plane.

*Assembly*

**27.** Assembly of the existing flap to the main plane is a reversal of the removal procedure with care being taken to ensure that the bevel washers removed in para.26 operation (2), are refitted correctly in their original positions. The semi-spherical washers, removed in para.26 operation (3) must also be refitted in their original positions.

◀ **Note . . .**

*The hinge pin nuts are to be tightened finger tight only, and slackened back to the first alignment of the split pin hole and slot.* ▶

**28.** If a new flap is fitted to the main plane, check, for correct clearances *(fig.5)*. If the clearance between the leading edge of the flap and the main plane is incorrect *(Section A-A)*, it may be adjusted by filing the leading edge of the flap. Ensure that the 45 deg. chamfer is maintained on the leading edge of the flap. Protective treatment *(A.P.119A-0509-1)* must be applied to all filed surfaces.

**Flap jack** *(fig.10)*

*Removal*

**29.** To remove a flap jack proceed as follows:-

(1) Lower the flaps to their fully down position.

(2) Exhaust the system of hydraulic pressure *(Chap.6)*.

(3) Disconnect the two hydraulic pipes from the jack, and blank off the pipelines and the jack connections.

(4) Remove the split pin and washer from the connecting pin securing the jack connecting rod to the flap mechanism and remove the connecting pins.

(5) Remove the six 2 B.A. bolts and nuts securing each of the two cover plates to the ribs adjacent to the jack body, and remove the cover plates.

(6) Remove the two 3/8 in. BSF nuts and bolts securing the flanged end of the jack to the mounting bracket and the two 5/16 in. bolts securing the ring mounting to the bracket at the opposite end.

(7) Remove the jack from the main plane.

*Assembly*

**30.** Assembly of the flap jack to the main plane is a reversal of the removal procedure plus the following operations:-

(1) Ensure that the washers fitted to the mounting bolts at the flanged end of the jack are correctly positioned *(fig.10)*.

(2) Adjust the jack connecting rod fork ends as necessary to enable the connecting pins to connect with the flap mechanism push rods (the fork end at the flanged end of the jack first). After making this adjustment, check the dimension between the pin centre and the nearest face of the cylinder flange; this must be 3.13 in.± 0.25 in. When the final adjustment of the opposite fork end is completed check the dimension between the jack pin centres; this must be 18.30 in. ± 0.25 in. For checking purposes, jack travel is 3.90 in. ± 0.015 in. After adjustment, wire lock both fork ends, spanner grips and locknuts.

(3) Bleed the jack and pipelines, and test the functioning of the flaps *(Sect.3, Chap.6)*.

**Air brakes** *(fig.11)*

*Removal*

**31.** To remove the air brakes proceed as follows:-

(1) Remove the access panel in the lower surface of the main plane *(Sect.2, Chap.4)*.

(2) Disconnect the hydraulic jack at the lever on the rocker arm assembly.

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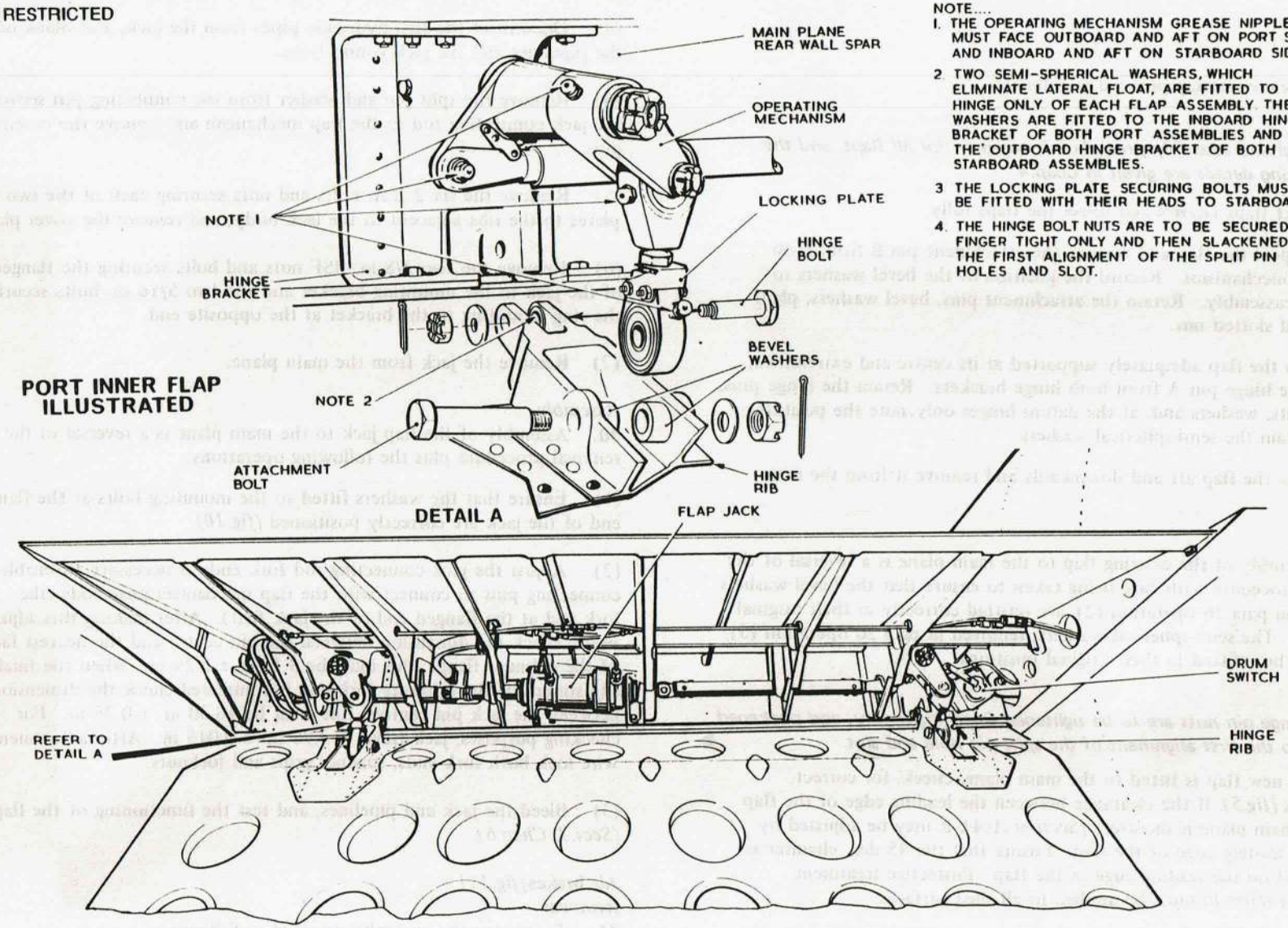


NOTE....

1. THE OPERATING MECHANISM GREASE NIPPLES MUST FACE OUTBOARD AND AFT ON PORT SIDE AND INBOARD AND AFT ON STARBOARD SIDE.
2. TWO SEMI-SPHERICAL WASHERS, WHICH ELIMINATE LATERAL FLOAT, ARE FITTED TO ONE HINGE ONLY OF EACH FLAP ASSEMBLY. THE WASHERS ARE FITTED TO THE INBOARD HINGE BRACKET OF BOTH PORT ASSEMBLIES AND TO THE OUTBOARD HINGE BRACKET OF BOTH STARBOARD ASSEMBLIES.
3. THE LOCKING PLATE SECURING BOLTS MUST BE FITTED WITH THEIR HEADS TO STARBOARD.
4. THE HINGE BOLT NUTS ARE TO BE SECURED FINGER TIGHT ONLY AND THEN SLACKENED TO THE FIRST ALIGNMENT OF THE SPLIT PIN HOLES AND SLOT.

FIG. 9. FLAP-REMOVAL AND ASSEMBLY

(3) Remove all drag channels from their rocker arms by unlocking and removing their attachment nuts *(detail D)*.

(4) Remove the nipples and spokes from all rocker arm assemblies and joint tubes *(detail C)*.

(5) Slacken the locknut on the adjustable roller on the bearing on rib 3 and lower the roller to its full extent *(detail A)*.

(6) Remove the nut from the end of the torque tube at rib 2, and the bearing on that rib, after removing the screws securing its annular plate *(detail B)*.

(7) Slide the inboard and centre torque tubes toward rib 1, removing the rocker arm assemblies and the joint tube from the main plane as they are released.

(8) Separate the centre and inner portions of the torque tube, removing the rocker arm assemblies and joint tube as they are released.

(9) Move the centre tube to rib 3 and pivoting it on the adjustable roller, remove it from the main plane.

(10) Move the inboard torque tube to rib 3 and remove it in a similar manner as at (9).

(11) Remove the outer torque tube from the main plane in a similar manner as at (9), removing the remaining rocker arm assemblies as they are freed.

*Assembly*

**Note . . .**

*Lubricating details are given in Chap.4.*

32. After assembling the air brakes into the main plane (removal procedure in reverse) set the mechanism in the manner described in Sect.3, Chap.4.

**Air brakes jack**

33. When an air brakes hydraulic jack is removed and a replacement jack fitted, it is essential that the standard locknut and tab washer are removed from the jack piston rod, and a special locknut, Part No. EA3-73-303 and tab washer, Part No. EA3-73-305 are fitted.

34. After fitting a replacement jack, check that there is a clearance of 0.5 in., minimum, between the coils of the hydraulic pipes.

**Wing tips** *(fig.12)*

*Removal*

35. To remove a wing tip proceed as follows:-

(1) Remove the access panel in the wing tip top skin.

(2) Disconnect the electrical cables from the terminal block in the leading edge.

(3) Remove the bolts securing the wing tip to rib 8 trailing edge.

(4) Remove the countersunk screws securing the wing tip to the main plane extension.

(5) Remove the wing tip.

◀ *Assembly*

36. Assembly of the existing wing tip to the main plane is the reversal of the removal procedure, but if a new wing tip is required, ensure the static dischargers are refitted *(Mod.5119)*. ▶

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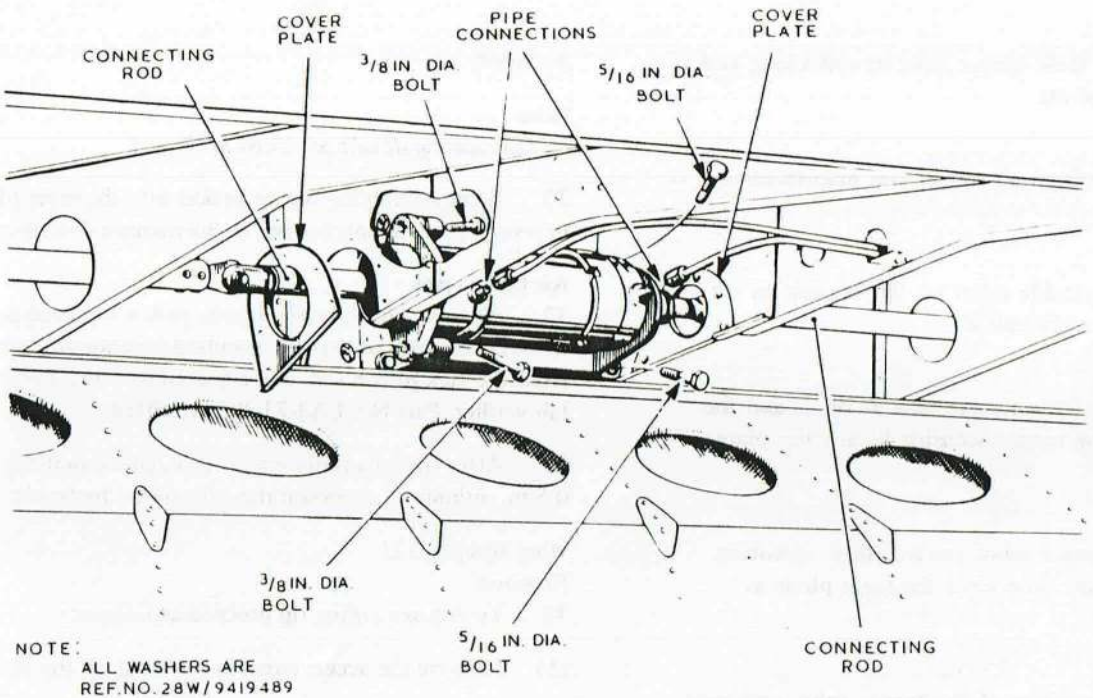


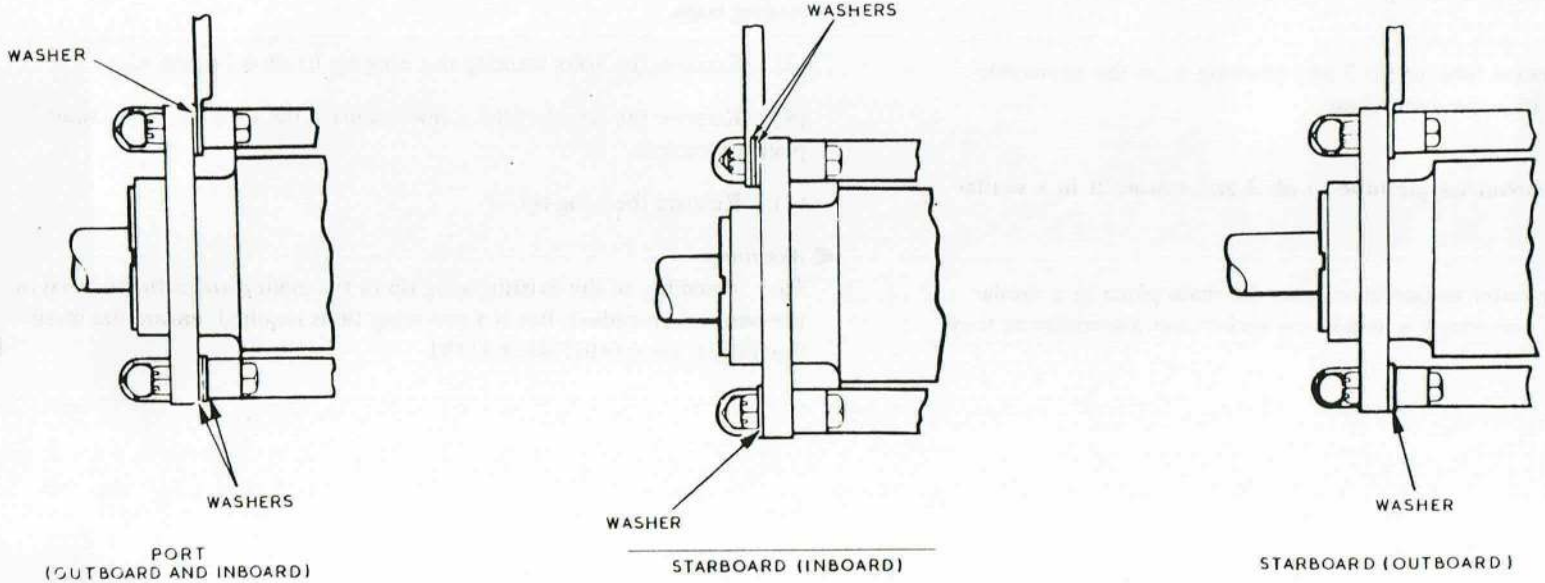


FIG. 10. FLAP JACK REMOVAL AND ASSEMBLY

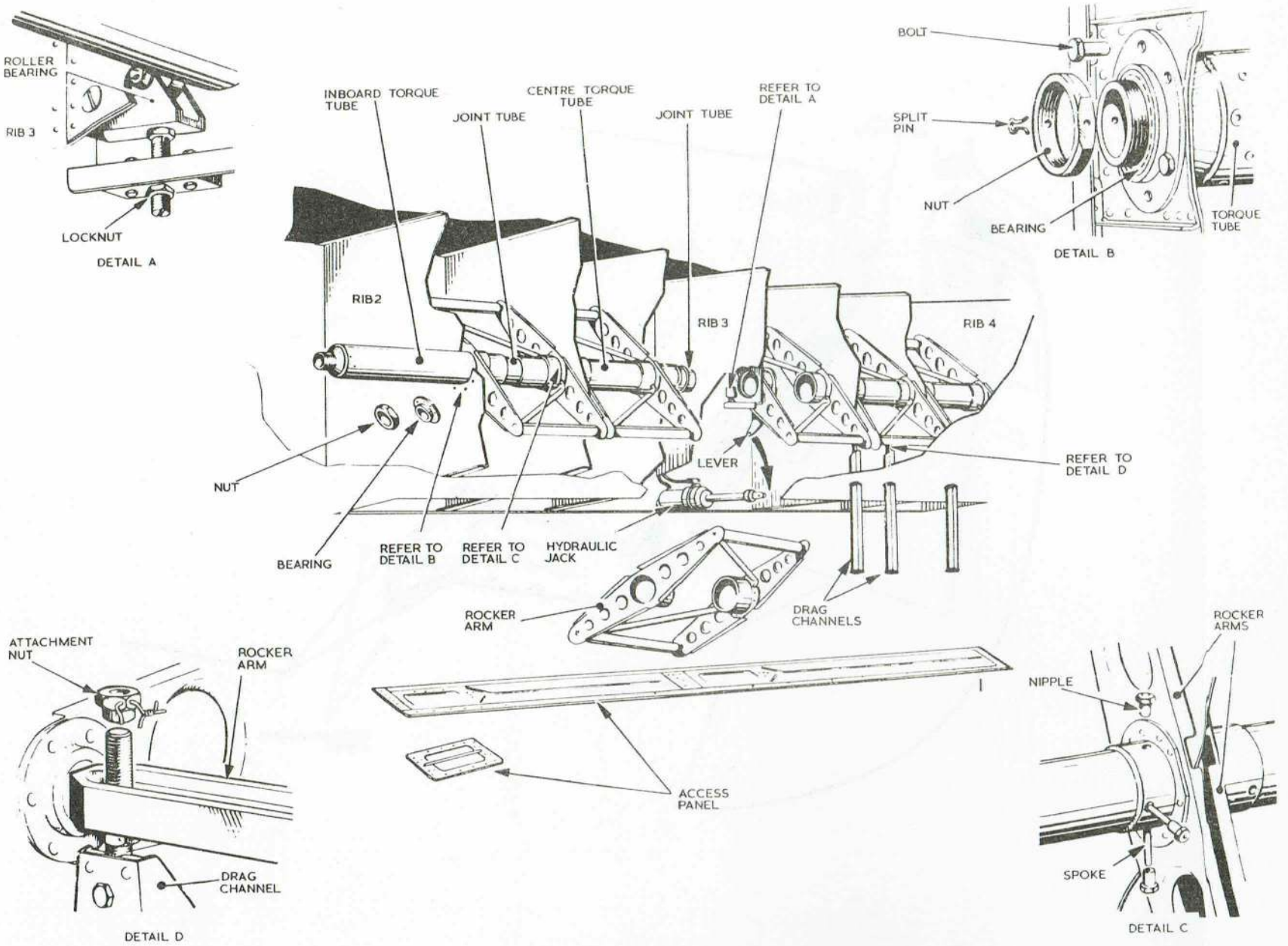


FIG.11. AIR BRAKES REMOVAL AND ASSEMBLY

◀REDRAWN AND CLARIFIED▶

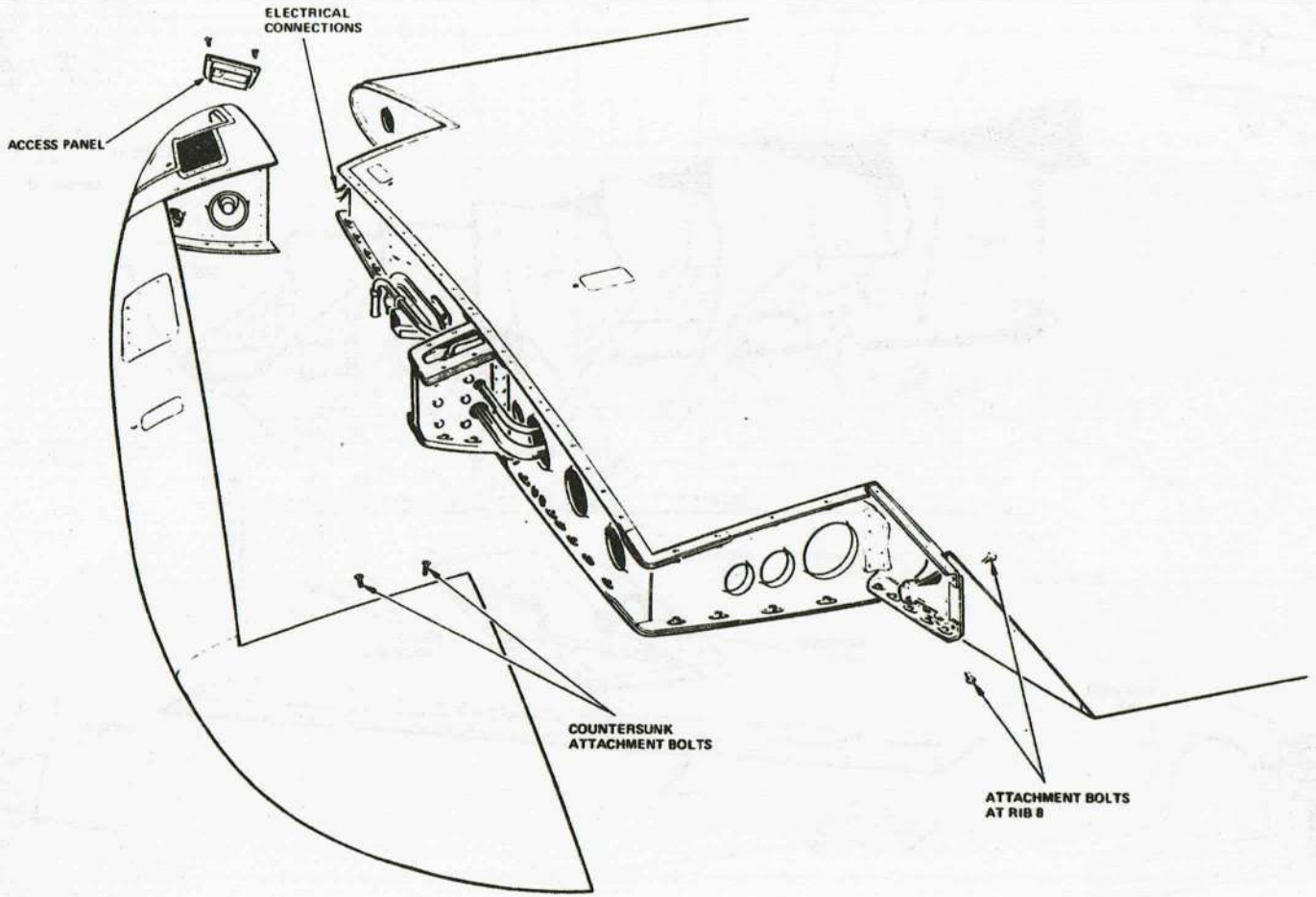


FIG.12. WING TIP – REMOVAL

# Chapter 3 TAIL UNIT

*(completely revised)*

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS

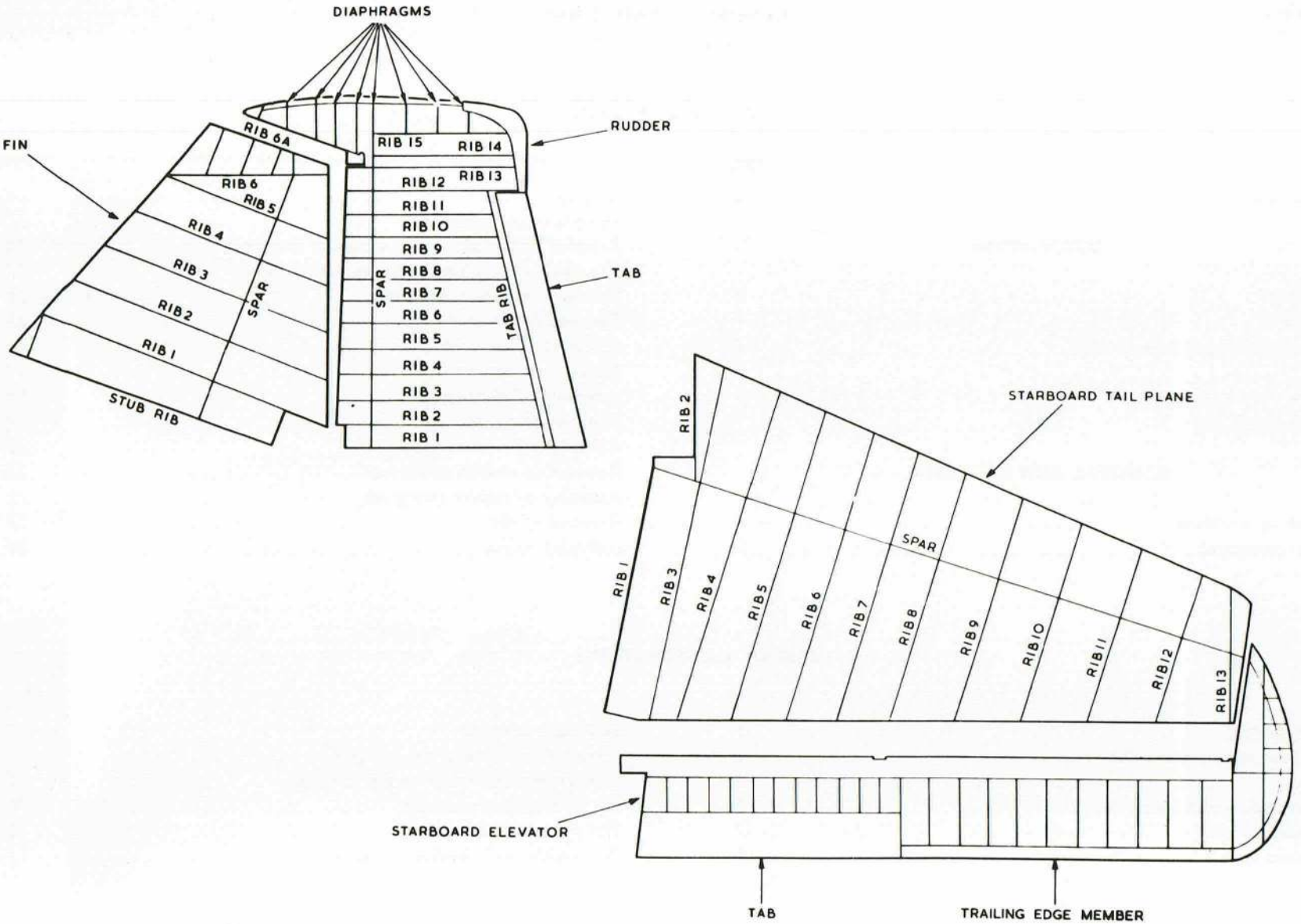


FIG.1. KEY DIAGRAM

**Introduction**

**1.** This chapter gives a general description of the tail unit structure and pictorially describes the removal and assembly operations. The disposition of the spars and ribs within the structure is illustrated in fig.1.

**Note . . .**

*The upper, lower and spring tab hinges of the rudder; the spring tab hinges of the elevator and the hinge pins of the tail plane are to be greased (using gun) with XG-287. The elevator hinges and the tail plane attachment points are to be oiled using OX-14. Details of lubrication of the flying control connections can be found in Sect.3, Chap.4.*

## DESCRIPTION

**Tail plane** *(fig.2)*

**2.** The electrically-actuated variable-incidence tail plane is a single-spar structure with a false rear spar, built in port and starboard units which are connected together at their roots to form a single assembly. The spar has extruded T-section booms, and a plate web stiffened with angle sections; the false rear spar, which carries the elevator hinge attachment brackets, is a flanged plate stiffened with angle sections. Flanged plate ribs, stiffened with angle-section members, join the main and false spars, the ribs being cut away to accommodate bulb angle-section spanwise stringers. The leading-edge ribs are continuations of those aft of the spar and are of similar section, the inboard faces of those at the root being faced with spruce strips. Each unit is coverd with a light-alloy skin riveted to the ribs, stingers and spars and post Mod.5536, stengthened along the main spar upper and lower surfaces, by reinforcing plates. A forged light-alloy centre section connects the port and starboard units at the spars whilst the false spars are joined directly to each other, the triangular aperture thus formed being plated with top and bottom skins which are supported on three diaphragms and spanwise stringers. The complete tail plane is carried on two brackets on the fuselage at the rear of frame 42 by fork end brackets on the forward face of the centre section forging, and is supported near the false spar by an electrical actuator. Sealing stips are fitted between the tail plane and rear fuselage.

**Elevators** *(fig.2)*

**3.** Each elevator, which is hinged to the tail plane at its centre and extremities, has a D-section spar, forming the leading edge, with flanged plate ribs and a light-alloy skin covering behind the spar and over the horn. The inboard ribs are cut away at their trailing edges and are bounded by a plate web to which the tab hinge brackets are attached, the skin being extended beyond the web to form a shroud over the leading edge of the tab. Interconnection of the elevators is effected by vertical torque levers connected to flanges at the root of each spar, the levers being joined at their ends by a coupling link. Static dischargers are fitted to the trailing edge of each elevator. The elevators are mass-balanced by bob weights mounted on tubular arms projecting from the leading edge into the interior of the tail plane. On the underside of the elevators, at the centre hinge positions, an access panel, secured by rivets, is provided for examination and replacement of the centre hinge brackets.

**Elevator spring and balance tabs** *(fig.2)*

**4.** The elevator spring and balance tabs are hinged to the elevators by end hinges and two intermediate hinge pins, the spring tab being mounted on the port elevator and the balance tab on the starboard elevator. The skin covering is attached to a tubular spar and pressed flanged ribs, the tabs being balanced by spanwise mild steel tubes attached to the spar and protruding into the elevator interior.

**Fin** *(fig.3)*

**5.** The fin is a composite structure of wood and metal, built arounda single light-alloy spar consisting of T-section booms and a plate web reinforced by angle sections. The leading-edge structure is formed by wooden ribs, with stiffeners, and a laminated spruce leading-edge member covered by a metal leading-edge strip and plywood side skins which are Reduxed at their aft edges to the outside of the T-section booms forward of the spar web. Aft of the spar the structure is entirely of metal construction, consisting of flanged plate ribs, with angle section stiffeners, and a curved rear wall forming the rudder shroud. The rudder upper hinge plate is attached to rib 6 at the top of the shroud.

**Rudder** *(fig.4)*

**6.** The rudder is of all-metal construction consisting of a built-up spar, flanged plate ribs aft of the spar and D-shaped leading-edge ribs. At the upper end, a horn extends forward of the spar and this together with the upper edge of the rudder, is built up with vertical diaphragms. Ribs 1 to 11 are shortened at their trailing edges and are bounded by a plate web, to which is attached the tab centre hinge bracket; the tab upper hinge socket is mounted on rib 12 and the lower hinge bracket is attached to the underside of rib 1. The whole structure is covered with a light-alloy skin which extends beyond the trailing-edge plate web to form the tab shroud. Static dischargers are fitted to the upper and trailing edges. The rudder is hinged to the fin rear wall at its upper end, and in a bearing in the rudder stub of the rear fuselage at its lower end, and is mass balanced by two weights, one mounted in the rudder horn and the other attached to an arm at the bottom of the spar.

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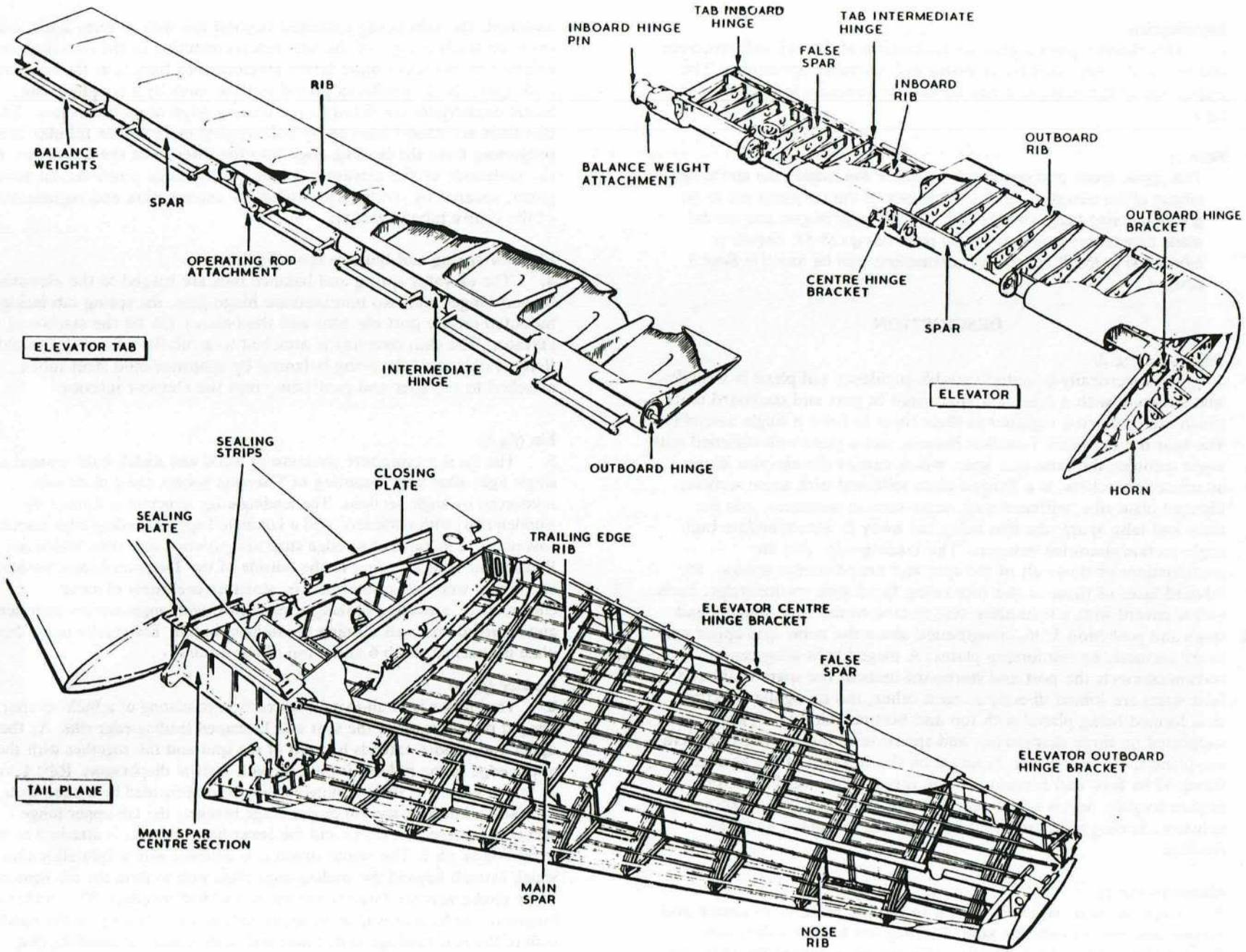


FIG.2 . TAIL PLANE, ELEVATORS AND TAB

**Rudder spring tab** *(fig.4)*

7. The rudder spring tab is similar in construction to the elevator spring and balance tabs *(para.4)*, and is hinged to the rudder by upper and centre hinge pins and a lower hinge bracket. The tab is balanced by weights carried on arms attached to the spar and protruding into the rudder interior.

## REMOVAL AND ASSEMBLY

**Note . . .**

*After the replacement or adjustment of any component which may affect the longitudinal trim of the aircraft, carry out flight trim checks as detailed in Sect.3, Chap.4, Appendix 1.*

**General information**

8. The methods of removing and assembling the components of the tail unit are given in the associated paragraphs. Only the removal operations are given in detail since the assembly is generally a reversal of this detail; where this is not the case the fact is noted.

**Shroud clearances** *(fig.12)*

9. After fitting a new rudder to the fin, or a tab to either the rudder or elevator, the gap between the shroud and the leading edge of the component must be checked *(details C and B)*. After fitting a new elevator to the tail plane, check the gap between the shroud and the leading edge of the elevator *(detail A)*. If the fig.12 dimensions are not obtained the edges of the shroud may be trimmed by filing. The correct ◀ protective treatment as detailed in A.P.119A-0509-1, must be applied to ▶ all filed surfaces.

**Slinging** *(fig.5)*

10. The method of slinging the tail plane is illustrated in fig.5, using the tail-plane sling *(Sect.2, Chap.4, Table 1)*. The cables of the sling are identified for the fore or aft positions by tags attached to the cables. It should be noted that only 6 in. lift is permissible above the installed position and care should be taken not to foul the underside of the rudder stub when lifting. The rudder and fin are slung by passing a suitable strap through the holes at the positions indicated in Sect.2, Chap.4; these holes on the fin are normally covered with fabric patches but on the rudder they are closed by spring-loaded plugs which may be removed by screwing a 4 B.A. bolt into the hole in the plug and pulling outwards.

**Tail plane seal adjustment** *(fig.6)*

11. The clearance between the tail-plane fairing and the sealing strip is adjusted by means of the 10 adjusting screws, five on each side of the tail-plane stub. These adjusting screws must not be fully tightened.

**Removal of tail plane with elevators removed** *(fig.7)*

12. Procedure:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)* fit the picketing and slinging ring bolt into the slinging point, upper surface of the tail plane. Attach the sling to the tail plane, taking up any slackness in the sling.

(2) Remove the tail-plane actuator *(Sect.3, Chap.4)*.

(3) Remove the ten adjusting bolts from the tail-plane stubs (five each side) which secure the sealing plates.

(4) Remove the circular access panel on the port side of the fin stub *(Sect.2, Chap.4)*. This panel gives access to the bracing strut upper attachment.

(5) Refer to detail B; remove the split pin, nut, and washer from the bolt attaching the bracing strut to the lug on the rear of frame 42, and remove the bolt.

(6) Move the tail plane to its minimum incidence by lifting with the sling.

(7) Refer to detail A; remove the split pin, nut, and washer from the bolt attaching the bracing strut to the lug on the rear fuselage.

(8) Refer to detail A; remove the bolt and withdraw the strut.

(9) Remove the split pin, nut, and washer from each hinge pin.

(10) Withdraw the hinge pins from the lugs on the spar centre section and hinge brackets on the rear fuselage. The tail plane is then free to be removed.

**Removal of tail plane with elevators attached** *(fig.7)*

13. Procedure:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)* fit the picketing and slinging ring bolt into the slinging point, upper surface of the tail plane. Attach the sling to the tail plane, taking up any slackness in the sling.

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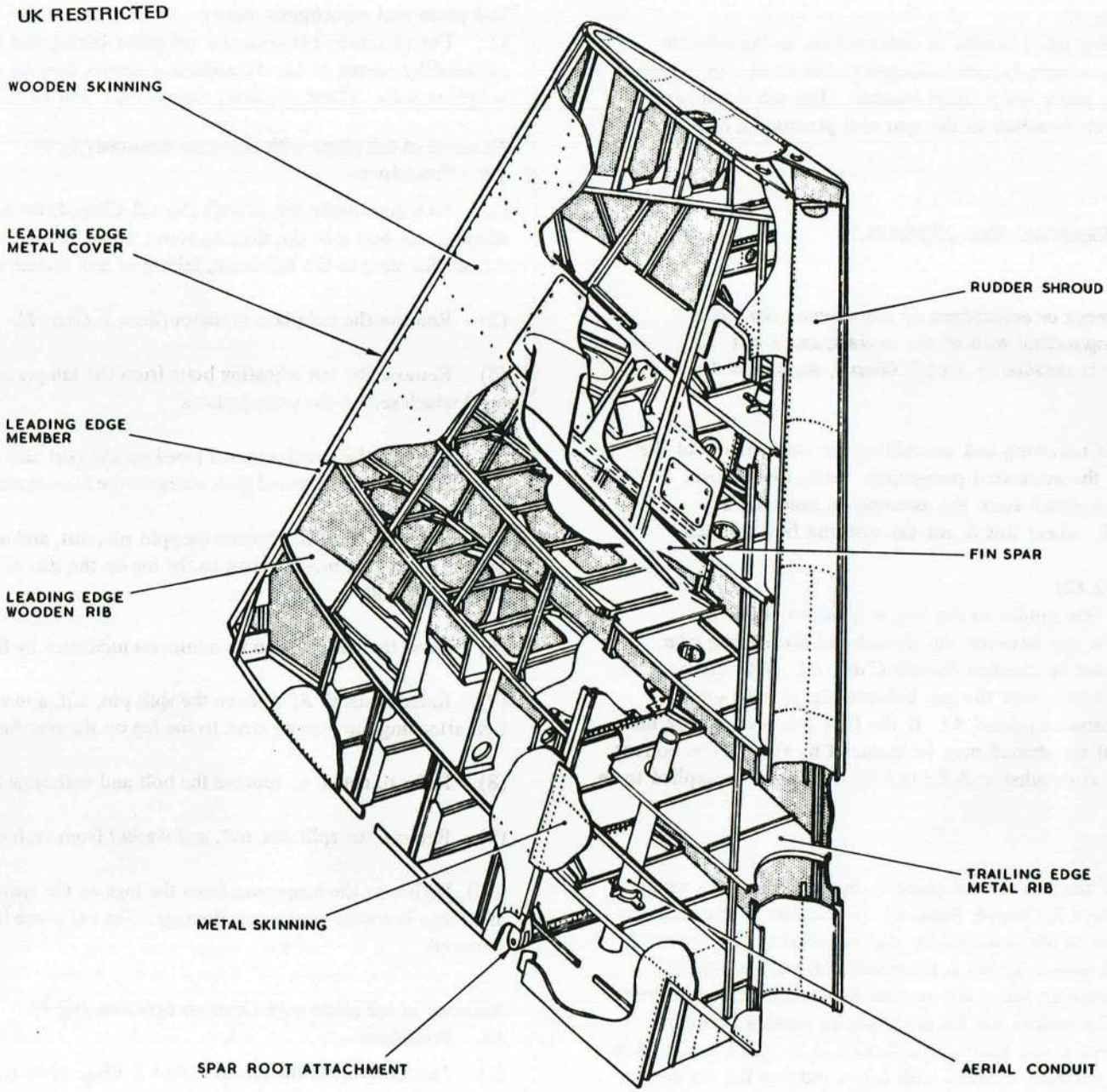



FIG.3. FIN

(2) Remove the box fairing and the rear fairing *(Sect.3, Chap.1).*

(3) Disconnect the control rod from the port elevator lever and at the lever on the bulkhead at fuselage frame 42.

(4) Remove and retain the disconnected section of the control rod.

(5) Proceed as instructed in operations (2) to (10) for the removal of the tail plane with the elevators removed.

**Assembly of new tail plane**

**14.** The following instructions are applicable when fitting a new tail plane:-

(1) Before commencing to fit a tail plane to the rear fuselage, ensure that the lower cover plate, on the port side of the rudder stub, is securely positioned (access to this plate is not possible with the tail plane in position).

(2) Ensure that all contact faces of moving parts of the tail-plane joints *(fig.7)* are liberally coated with grease XG-276; the tail plane actuator attachment points are to be lubricated with oil OX-14.

(3) Check the clearance between the sealing plate on the underside of the tail plane and the closing strip on the fuselage *(fig.11)*, before the installation of the tail-plane actuator, as follows:-

(a) Ensure that the lower microswitch tappet is screwed back fully.

(b) Set the tail plane to 5 deg. 42 min. incidence measured at the starboard inboard rigging position; at this incidence the sealing plate and the closing strip are adjacent over practically their whole length, and the clearance can be ascertained.

(c) Check the clearance *(detail B, lower dimension).*

(4) With the tail plane actuator installed, set the tail plane to 3 deg. 15 min ± 2 min. incidence, measured at the starboard inboard rigging position or at the take-off position on the cockpit gauge, and check the following clearances *(fig.11)*:-

(a) Between the tail plane and tail-plane stub *(detail A).* If this dimension is not obtained the clearance may be adjusted by adding extra packing, or facing off existing packing on the tail plane, as required.

(b) Between the tail plane and the forward face of the rear cone *(position E).*

(c) Between the tail plane box fairing and the fuselage *(detail B, upper dimension).*

**Note . . .**

*The minimum clearance at this point between the tail plane seal rivets and the fin, is 0.080 in. (detail B).*

(5) Set the tail plane in line with the tail-plane stub and adjust the sealing strips (the adjusting screws must not be fully tightened) to obtain the following clearances *(fig.11)*:-

(a) Between the sealing strips (two bolt position) and the tail-plane stub *(detail C).*

(b) Between the sealing strips (three bolt position) and the tail-plane stub *(detail D).*

(6) Ensure that there is complete freedom of movement throughout full range of tail-plane travel.

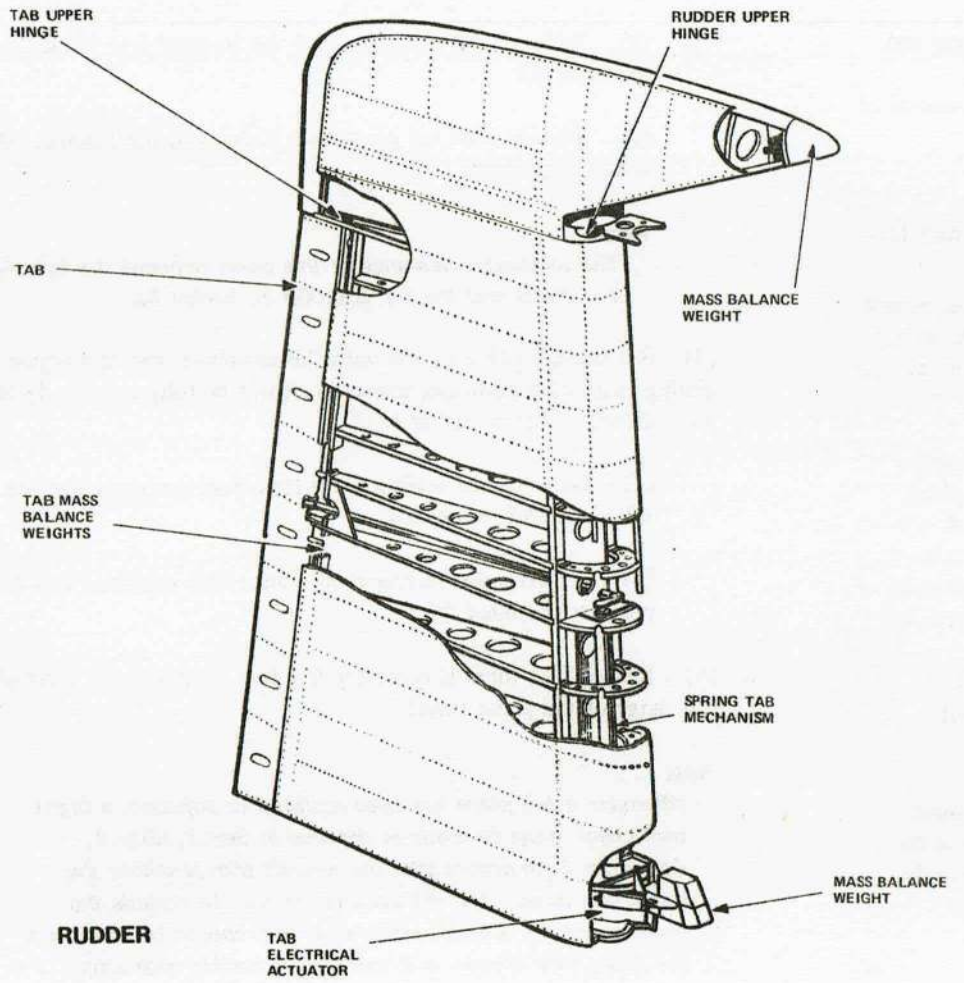
**Note . . .**

*Whenever a tail plane has been replaced or adjusted, a flight trim check must be made as detailed in Sect.3, Chap.4, Appendix 1, to ensure that the aircraft trim is within the limits laid down. Should the aircraft trim be outside the limits specified, a new trailing-edge strip should be fitted and the flight trim checks, and subsequent trailing edge strip adjustments carried out.*

**Removal of elevator** *(fig.8)*

**15.** Procedure:-

(1) Set the tail plane to its mid-travel position.



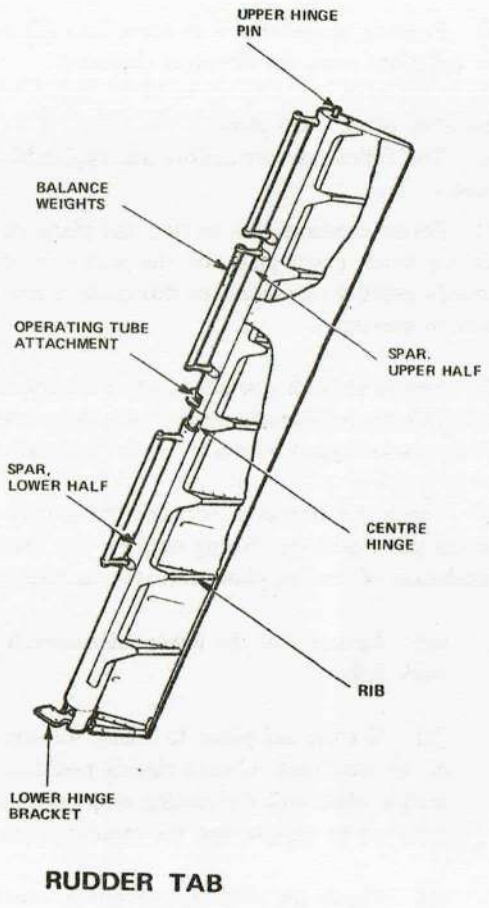




**FIG.4. RUDDER AND RUDDER SPRING TAB**

◀ REDRAWN AND CLARIFIED ▶

(2) Remove the box fairing and the rear fairing as instructed in Sect.3, Chap.1.

(3) Disconnect the elevator control rod from the lever.

(4) Remove the access panel from the upper surface of the starboard elevator. This panel gives access to the connecting screw on the operating lever of the starboard tab.

(5) Disconnect the starboard tab-operating lever at the connecting screw.

(6) Remove the split pin, nut and washer from each balance weight arm and withdraw the balance weights and arms from the elevator spars.

(7) Disconnect the coupling link from the starboard elevator.

(8) Remove the split pin, nut and washer from the inboard hinge pin of the port elevator.

(9) Remove the port elevator from its hinges by moving it outboard, until it is clear of the centre and inboard hinges and then aft.

(10) Proceed as instructed in operations (8) and (9) with the starboard elevator.

**Assembly of elevator**

**16.** The assembly of the elevator is the reverse of the removal sequence but additionally, lubricate the hinge points with oil OX-14, or if the elevator is new, ensure that static dischargers are fitted *(Mod.5119).*

**Note . . .**

*To enable the alignment of the centre and outboard hinges to be checked during reassembly, apertures, closed by spring loaded sealing plugs (detail J) are provided on the underside of the elevators at these hinge points. To remove, screw a 4 B.A. bolt into the hole in the plug and pull outwards; to replace, remove the bolt, insert the plug in the aperture and press it home. Ensure that the plug is flush with the elevator skin. The bolt securing the coupling link must, when inserted, have its head to port.*

**Removal of elevator tab** *(fig.8)*

**17.** Procedure:-

(1) Remove the access panels, port and starboard, and, at this point, disconnect the tab-operating rod from the lever by removing the connecting screw in the case of the starboard tab, and by removing the connecting bolt in the case of the port tab *(detail B and C).*

(2) Disconnect the tab-operating rod from the tab, and move the operating rod clear of the attachment lugs *(detail D and E).*

(3) Remove the inboard hinge bracket *(detail H).*

(4) Raise the tab and remove it by moving it inboard until it is clear of the outboard and intermediate hinges, and then aft.

**Note . . .**

*If new tabs are to be fitted it will be necessary to remove the inboard hinge pin. The pin (detail H) is to be wire-locked on reassembly.*

**Assembly of elevator tab**

**18.** The assembly of the elevator tab is the reverse of the removal sequence but additionally, lubricate the hinge points with grease XG-287.

**Assembly notes . . .**

*1. Before assembly, inspect the extreme end of the tab operating rod and the surface between the two lugs of the tab-hinge fitting. Where a foul has occurred, clear it by lightly filing a small flat between the two lugs at the point of contact, so that a minimum clearance of 0.005 in. is obtained. The width of the slot is not to exceed the width of the rod end, and the amount of metal removed should not exceed 0.010 in, in depth.*

*2. When a new or replacement tab is to be fitted it must be checked for loose balance weights which are riveted to the inner face of each end rib. Check by tapping the skin and ribs at each end; loose weights will be indicated by a rattling sound. Repair as detailed in S.P.'s for elevator balance tabs.*

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MAX. HEIGHT OF LIFT IS 6·0 IN.
ABOVE THE INSTALLED POSTITION.

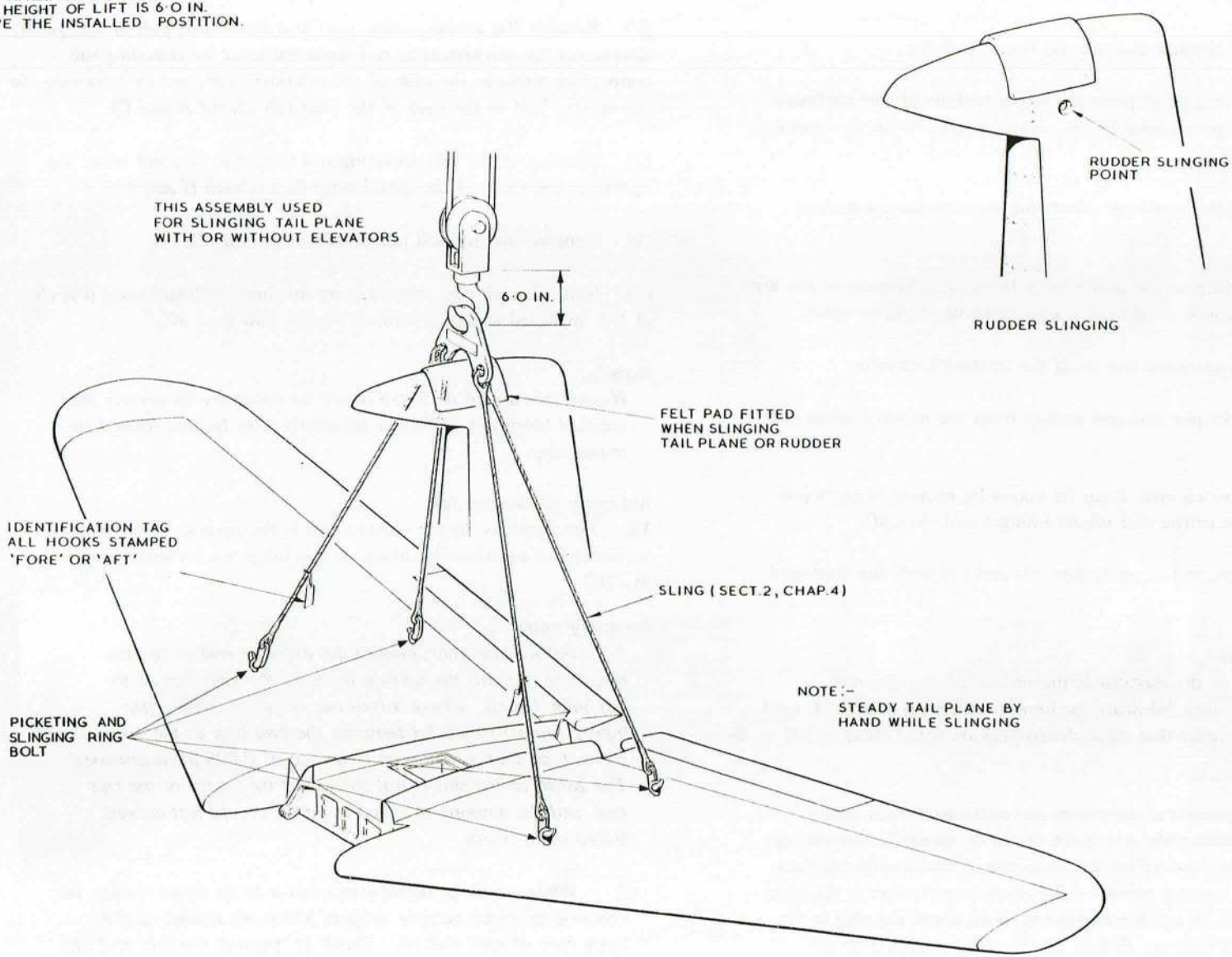


FIG.5. TAIL PLANE SLINGING

*3. When assembling an elevator tab, ensure that the tab operating rod is connected to its attachment lugs with bolt Pt.No.EA1.31.65, and that no load is placed on the operating rod attachment lugs when the nut is tightened, by fitting the plain and shim washers as detailed in Note 4.*

*4. For the port tab (detail E) the thin plain washer Pt.No.S.P.15/C and shim Pt.No.EA1.31.277 must be positioned between the ballrace and the outboard bracket, and the plain washer Pt.No.S.P.16/C between the nut and the inboard bracket. For the starboard tab (detail D) the thin plain washer must be positioned between the ballrace and the outboard bracket, the shim between the ballrace and the inboard bracket and the other plain washer between the nut and the inboard bracket. Lock the nut with a new split pin. It may be necessary to tap the bolt through the ballrace in the tab operating rod; the tapping must be as light as possible to avoid any possibility of fracturing the attachment lugs.*

*5. To ensure correct adjustment of the starboard tab, the connecting screw (detail B and C) must be screwed into the operating lever and the operating rod simultaneously.*

*6. After fitting a new elevator, the clearance between the elevator horn and the tail plane must be checked; the clearance is given in fig.12.*

*7. After fitting a new tab to the elevator, the clearance between the outboard end of the tab and the elevator must be checked; the clearance is given in fig.12.*

**Note . . .**

*A flight trim check must be made whenever an elevator, or elevator tab, is replaced or adjusted (Sect.3, Chap.4, Appendix 1).*

**Removal of rudder** *(fig.9)*

**19.** Procedure:-

(1) Remove the two spring-loaded plugs, port and starboard, by screwing into each a 4 B.A. bolt and pulling outwards. Attach a rudder sling *(Sect.2, Chap.4, Table 1)* through the rudder at this point.

(2) Remove the cover plates at the base of the rudder, and the access panels at the base of the fin.

(3) Disconnect the control rod from the main operating lever *(detail B).*

(4) Disconnect the electrical cables from the rudder tab electrical actuator.

(5) Turn the rudder to port and remove the port closing plate.

(6) Turn the rudder to starboard and remove the starboard closing plate.

(7) Remove the circular access panel on the port side of the rudder stub.

(8) Remove the split pin, nut and washer from the lower hinge.

(9) Turn the rudder to port and remove the three bolts from the port side of the upper hinge plate.

(10) Turn the rudder to starboard and remove the three bolts from the starboard side of the upper hinge plate. The rudder is then free to be removed by lifting.

**Note . . .**

*Care must be taken when lifting the rudder to ensure that the lower mass balance weight does not foul the underside of the fin trailing edge.*

**Assembly of rudder**

**20.** The assembly of the rudder is the reverse of the removal sequence.

◀ **Notes . . .**

*1. If the rudder is new, ensure the static dischargers are fitted (Mod.5119).*

*2. Pack the lower hinge bracket in the fuselage with grease XG-287.* ▶

After assembling a rudder, refer to fig.12 and check the clearances:-

(1) Between the top of the fin and the rudder horn.

(2) Between the base of the rudder and the rudder stub.

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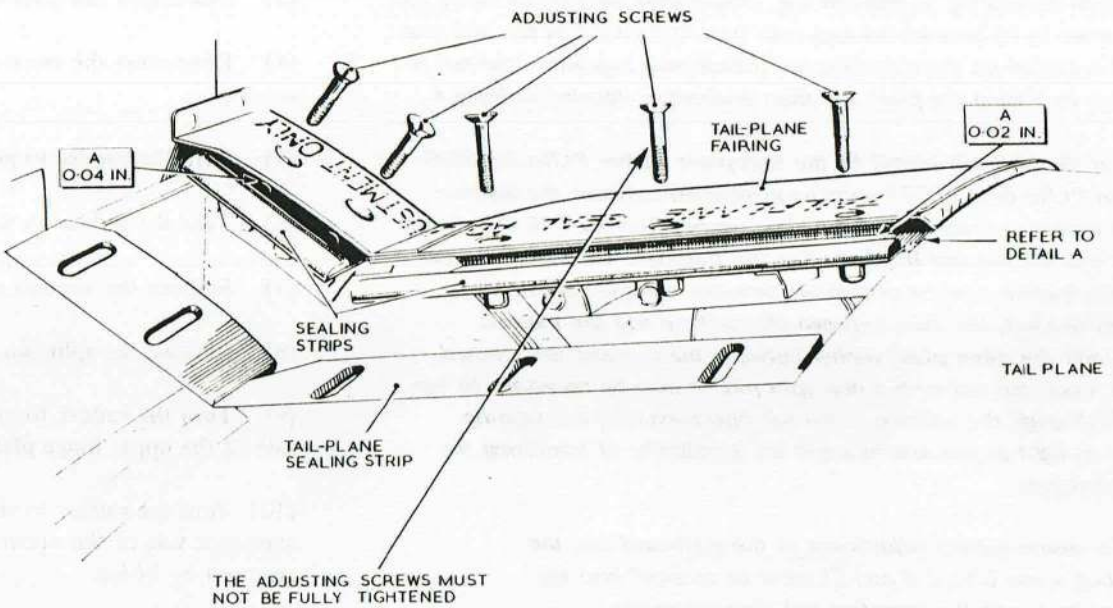


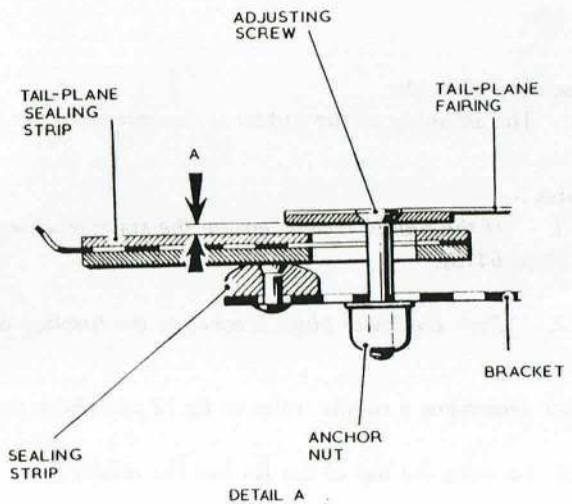


FIG.6. TAIL-PLANE SEALS

If these clearances are not obtained, remove the shim Part No. EA1.12.201 situated between the rudder lower bearing housing and the stub, and substitute a solid packing of the same overall dimensions and material (L.73) but of a thickness between 17 s.w.g. and 12 s.w.g. as required.

(3) When fitting a new rudder, it is permissible to reduce the 0.50 in. depth of either trailing-edge spoiler to suit the characteristics of the aircraft.

**Note . . .**

*The amount of spoiler strip remaining must not be less than 0.25 in.*

**Removal of rudder spring tab** *(fig.9)*

**21.** Procedure:-

(1) Remove the tab control rod cowl.

(2) Remove the split pin, nut and washer from the bolt attaching the control rod to the lugs on the tab spar, and remove the bolt *(detail A)*.

(3) Remove the three 2 B.A. bolts attaching the lower hinge bracket to the rudder.

(4) Remove the tab from its hinges by lowering it slightly and moving it outwards.

◀ **Notes . . .**

*1. If a new tab is to be fitted, remove and retain the hinge pin from the hinge bracket. Upon reassembly, the hinge pin is to be wire-locked.*

*2. Ensure the static discharger is fitted (Mod.5119).* ▶

**Assembly of rudder spring tab**

**22.** The assembly of the tab is the reverse of the removal sequence but additionally, lubricate the hinge points with grease XG-287. After fitting a new tab, refer to fig.12 and check the following clearances:-

(1) Between the top of the tab and the rudder.

(2) Between the bottom of the tab and the rudder stub.

**Note . . .**

*An additional axial tab movement of 0.02 in. in respect of these dimensions is permissible.*

**Removal of fin** *(fig.10)*

**23.** Procedure:-

(1) Remove the rudder *(para.19)*.

(2) Remove the access panel and disconnect the coaxial cable to the A.R.I. aerial. Withdraw the cable from the aerial conduit.

(3) Disconnect the Chelton aerial and tension unit from the fin.

(4) Remove the leading edge cover plate and remove the six 2 B.A. bolts securing the forward attachment former to the stub angle pieces.

(5) Remove the ten 2 B.A. bolts attaching the rear diaphragm to the stub angle piece.

(6) Remove the one hundred and two 2 B.A. countersunk bolts attaching the fin skin to the skin of the fin stub.

(7) Remove the cover plates from each side of the fin.

(8) Remove the port and starboard bolts securing the fin post lugs to the fin attachment lugs.

(9) Remove the fin.

**Note . . .**

*The fin may be slung by removing the fabric patch from each side of the fin and passing a sling through the fin at this point.*

**Assembly of fin**

**24.** Procedure:-

(1) Offer up the fin and insert the A.R.I. aerial coaxial cable through the conduit. Connect the cable.

(2) Insert the port and starboard bolts (removed at operation 23(8)); do not tighten them at this stage.

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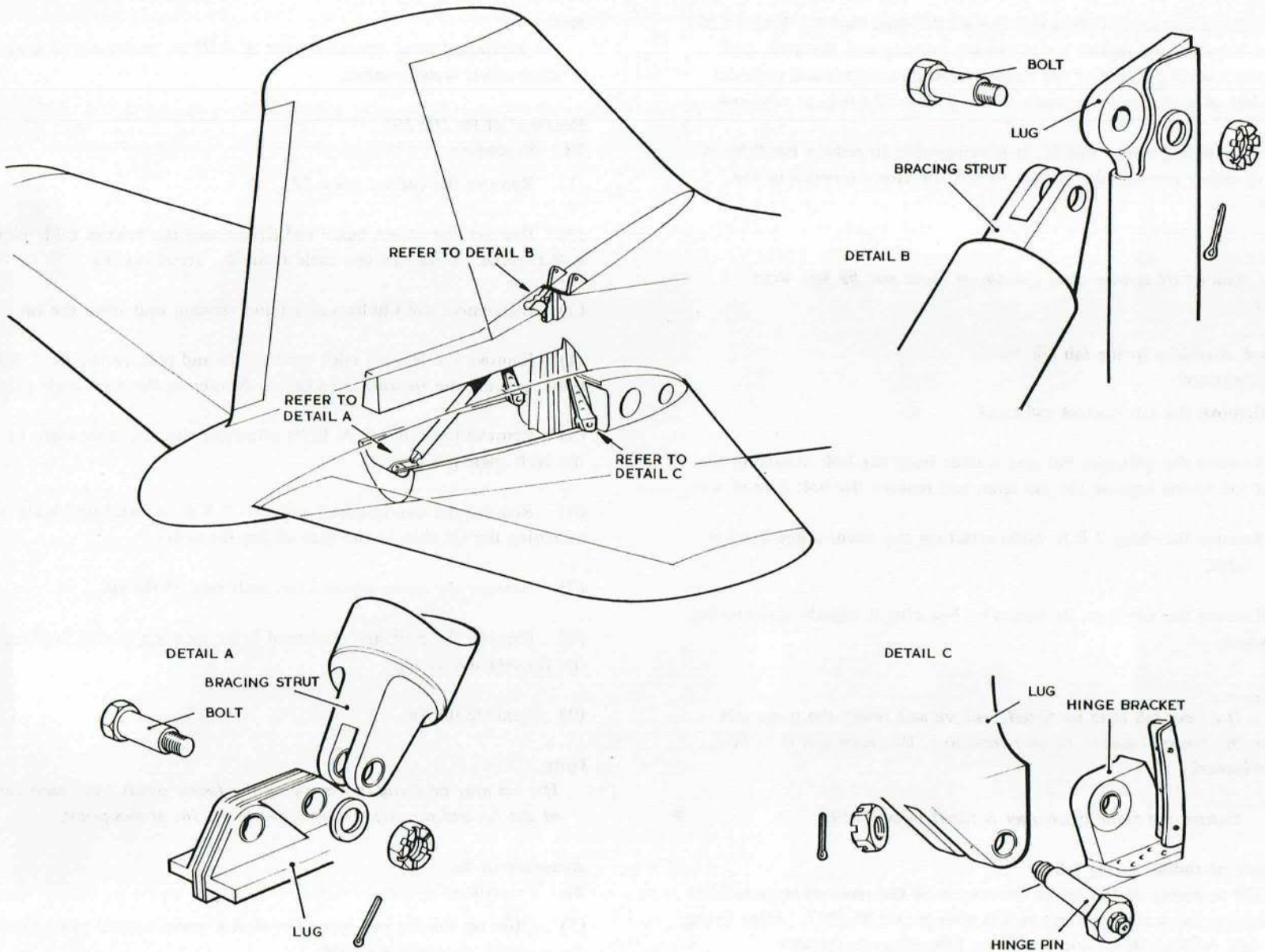


FIG.7. TAIL PLANE REMOVAL

(3) Secure the forward attachment former to the stub angle piece using the six 2 B.A. bolts.

**Note . . .**

*When fitting a new fin it will be necessary at this stage to mark off and remove the fin for drilling, dimpling and trimming.*

(4) Secure the rear diaphragm to the stub angle piece using the ten 2 B.A. bolts.

(5) Secure the fin skin to the skin of the fin stub using the one hundred and two 2 B.A. countersunk bolts.

(6) Screw home the port fin post lug attachment bolt. Do not over tighten.

(7) Screw home the starboard fin post lug attachment bolt to a point where the nut is drawn against the inboard lug of the fin post, and obtain a clearance of 0.0015 in. between the head of the bolt and the lug.

(8) Fit the access panel and cover plate.

(9) Fit the Chelton aerial and tension unit *(Section 6, Chap.1, Part 4).*

(10) Fit the rudder *(para.20).*

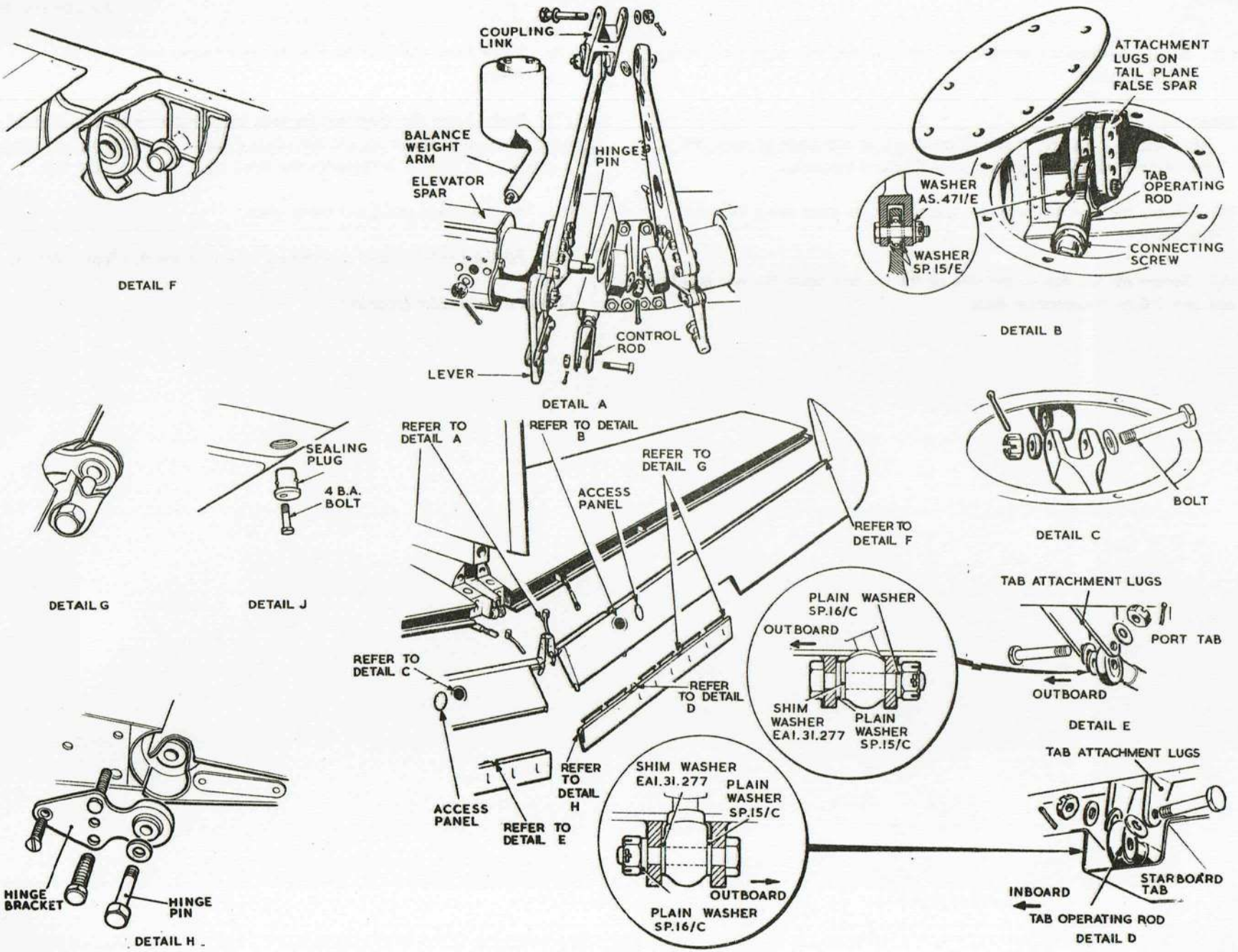


FIG. 8. ELEVATOR AND ELEVATOR TAB REMOVAL

◀DETAIL REFERENCES ADDED▶

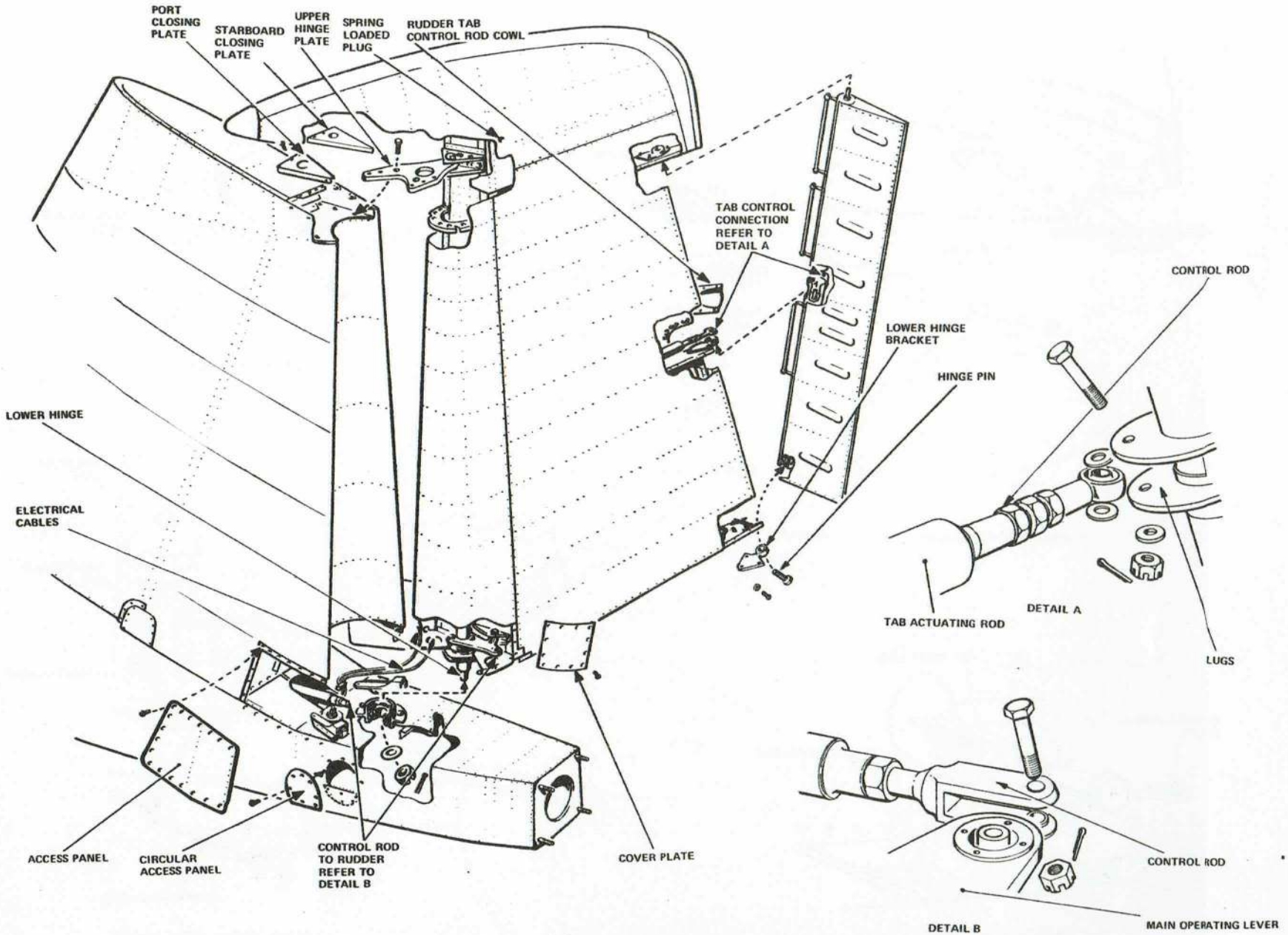


**FIG. 9. RUDDER AND RUDDER SPRING TAB REMOVAL**

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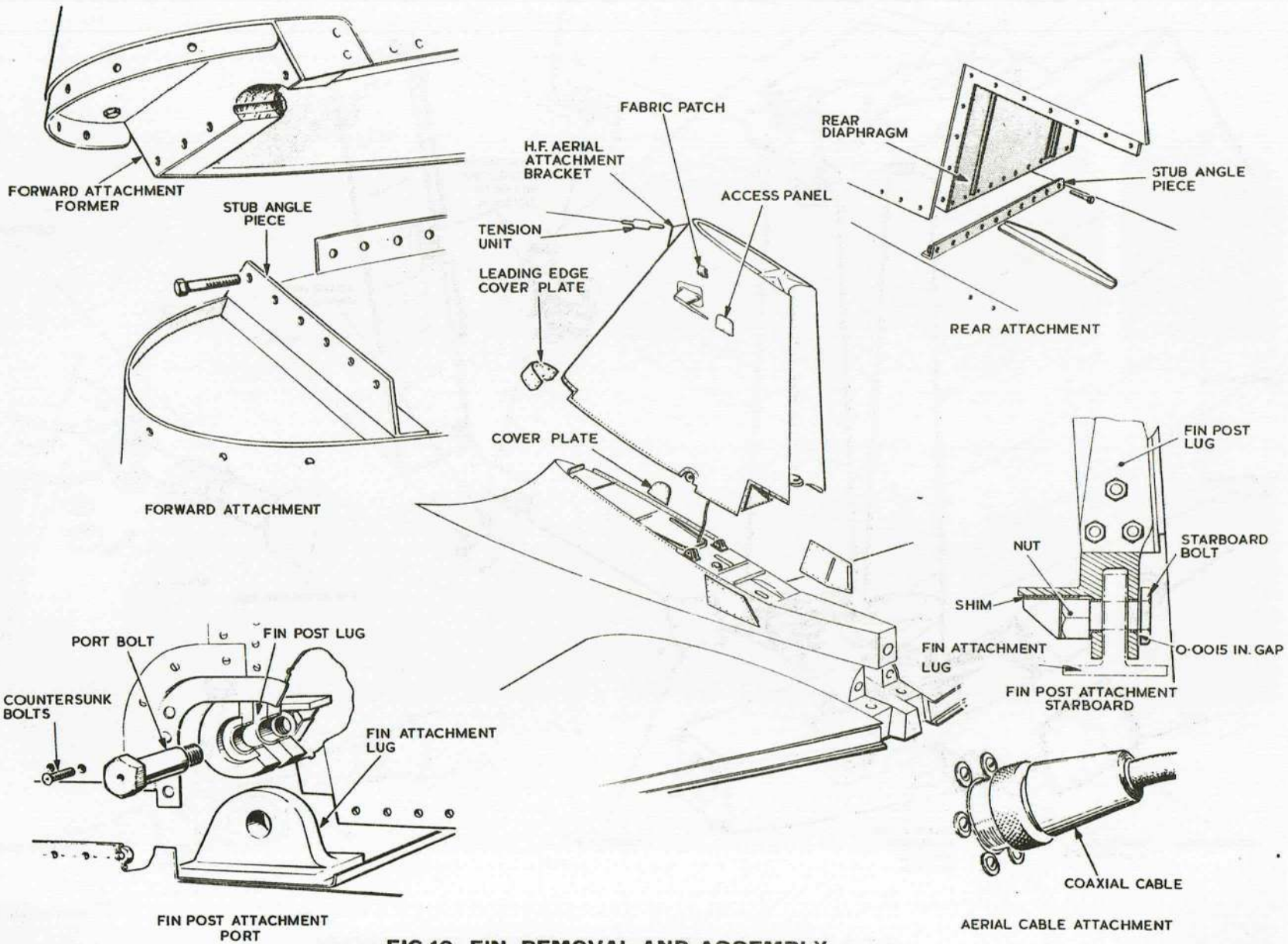


**FIG.10. FIN-REMOVAL AND ASSEMBLY**

◀ REDRAWN AND CLARIFIED ▶

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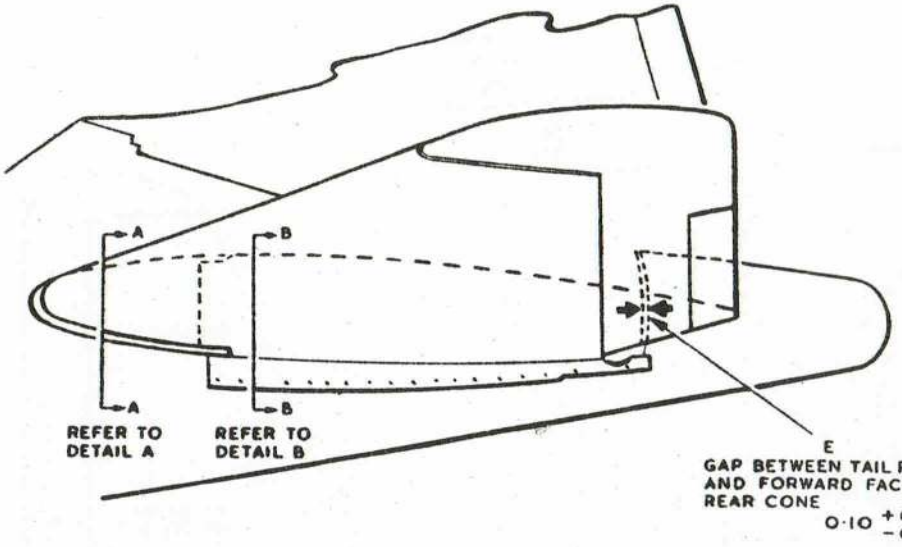
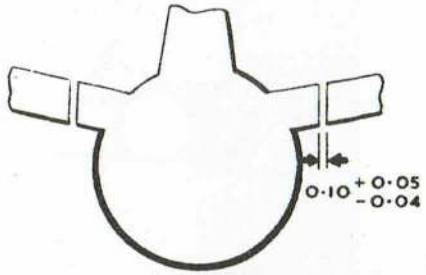
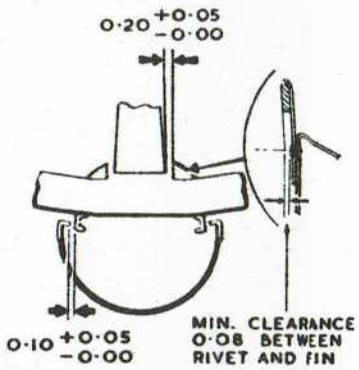
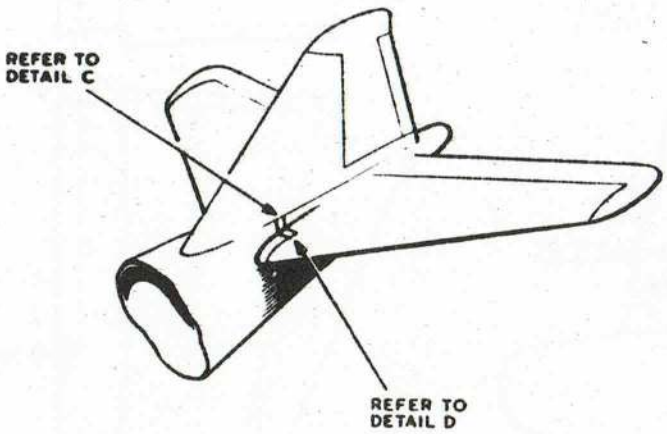



DETAIL A

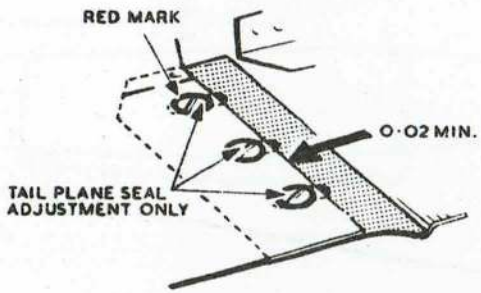



DETAIL B



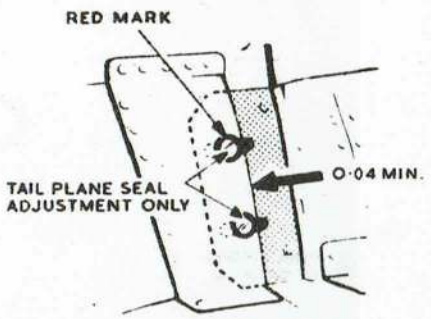

NOTE...
ALL DIMENSIONS ARE IN INCHES

3-BOLT POSITION




DETAIL D

2-BOLT POSITION




DETAIL C

FIG. 11. TAIL PLANE CLEARANCES

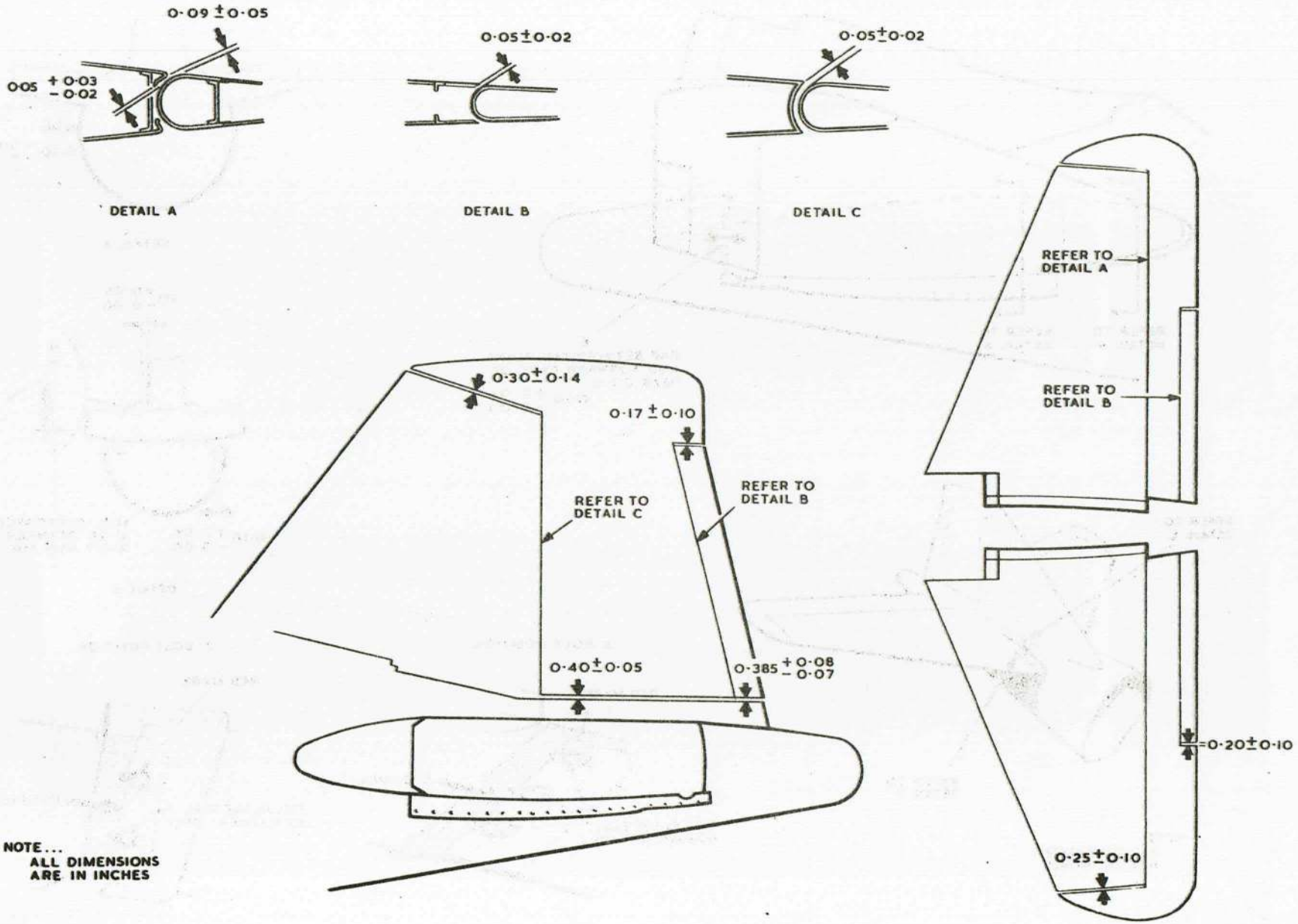



FIG.12. FIN, RUDDER AND ELEVATOR CLEARANCES

# Chapter 4 FLYING CONTROLS

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



## LIST OF APPENDICES

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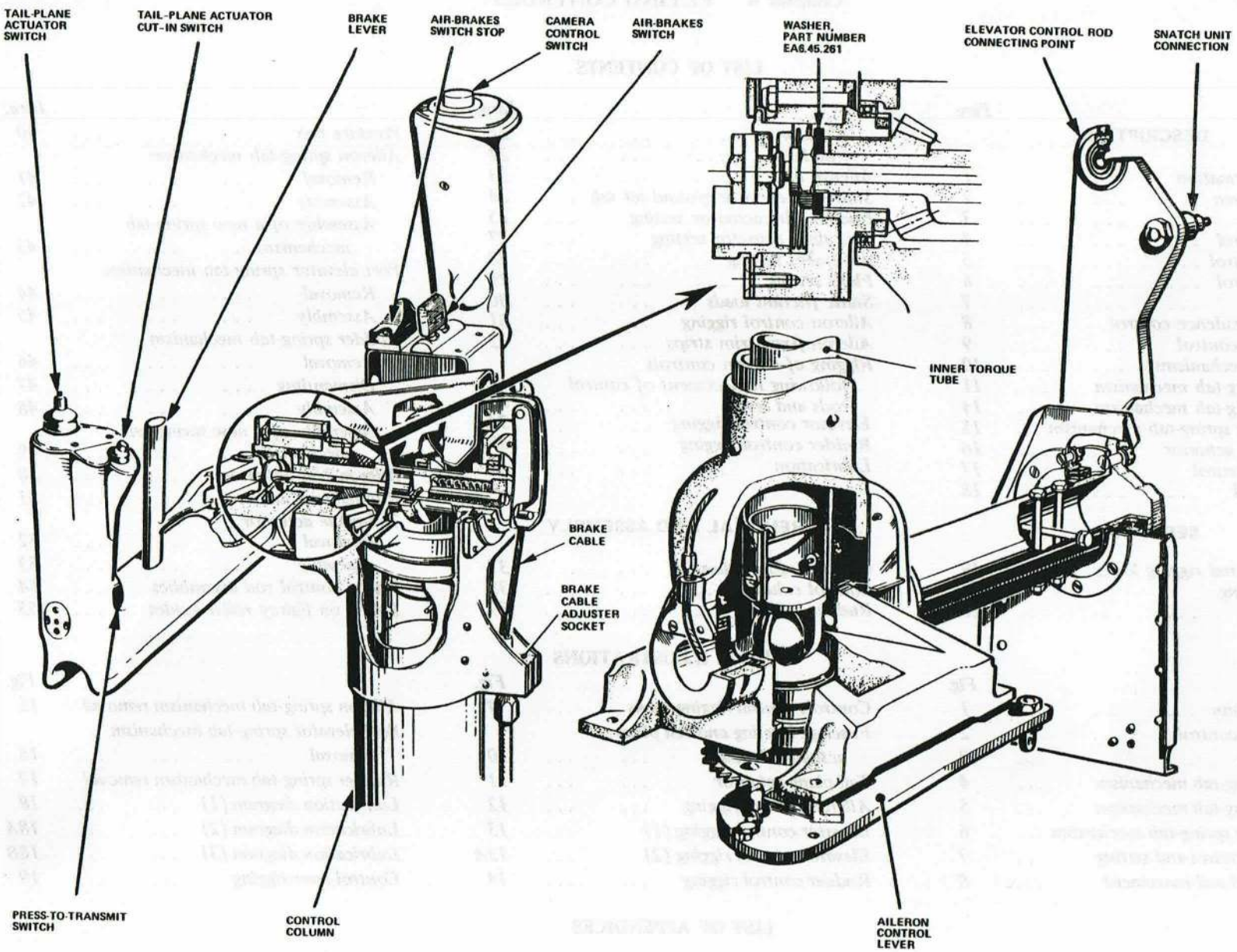



**FIG. 1. CONTROL COLUMN**

◀ TWO ANNOTATIONS ADDED ▶

## DESCRIPTION

**General information**

1. The flying controls are conventional in operation, the control runs consisting of push-pull rods and levers, with adjustable ends fitted to the rods on each control run. Tabs in the trailing edges of the ailerons, port elevator and rudder, are operated automatically through torque tubes and blow-back rods incorporated in the structure of the control surfaces. The starboard elevator tab operates as a balance tab, and can only be set on the ground. Trim strips are fitted to the trailing edges of the elevators and these are adjusted to the specifications in Appendix 1 of this chapter. The upper trailing edge of the rudder is fitted with spoilers which may be adjusted if necessary to suit the characteristics of individual aircraft; they are preset by the manufacturer and should not normally require alteration. Each aileron is fitted with a fixed trim strip which can be adjusted on the ground as detailed in para. 32. An electrical control permits the rudder tab to be used additionally as a trim tab in flight. Trim tabs are not fitted to the ailerons, but aileron bias is provided which is effected electrically by a bias actuator mounted beneath the pilot's floor. The variable incidence tail plane is electrically actuated and controlled; the flaps and air brakes are also electrically controlled, but are hydraulically operated.

**Control column** *(fig. 1)*

2. The control column, situated on the port side of the cabin centre line, is a tubular member which moves fore-and-aft on its support housing under the cabin floor. At this housing it is coupled with a tubular shaft running laterally outboard to a bracket on the port side; a lever attached to the end of this shaft is connected to the elevator control run. Forward of this lever, and on the same shaft, is a shorter lever connected to the snatch rod of the snatch unit *(Sect.3, Chap.11)*. At its upper end the control column carries a horn type control wheel, the shaft of which passes into the interior of the column where a bevel gear, integral with the shaft, meshes with a toothed segment at the top of the torque tube contained within the control column. The torque tube is supported in a bearing at the upper end of the column, and terminates at its lower end in a universal joint, which links it with a short shaft carried in the support casting; a lever at the end of this shaft is connected with the aileron control run. Mounted on the control handwheel are the wheel brakes operating lever, the air brakes selector switch, and various other switches.

**Rudder bar**

3. The rudder pedals are fitted at each end of a centrally pivoted horizontal cross tube, and are fitted with alignment linkage giving them parallel fore-and-aft movement. The cross tube is attached to a short vertical torque tube which protrudes through the pilot's floor, and is linked to an adjusting-screw mechanism by which the pedals can be set to suit the pilot's leg reach. Movement of the rudder pedals is transmitted via the torque shaft and a horizontal lever at the bottom of the tube, to a push-pull rudder control rod. Attached to this horizontal lever is a connecting rod to the brake relay control valve, which controls differential braking *(Sect.3, Chap.6)*. The movement of the rudder pedals is limited by two adjustable stops in the pressure box on the pressure bulkhead acting on the main operating lever *(fig.3)*.

**Aileron control**

4. The movement of the ailerons is controlled by the control column handwheel, movement of which rotates the inner torque tube of the control column, and the aileron control lever at its lower end converts the rotary movement into a fore-and-aft movement which is transmitted to the ailerons push-pull rods and levers. Attached by a tension spring to the aileron lever at the control column base is the bias actuator *(para.9)*. From the aileron control lever at the base of the control column the control passes aft along the port side of the cabin to the inboard one of three levers mounted in the pressure box just aft of the pressure bulkhead. The control run continues from this lever through the battery bay, forward camera bay, fuel tank bay and along the roof of the flare bay to just aft of the main spar where, via a bell-crank lever, the controls enter the main planes. Here further bell-crank levers connect the control rods to the aileron levers. The control rods are carried along the fuselage by roller guides and are supported in the main planes by the bell-crank and aileron levers. Adjustable stops are provided at the pressure box on the pressure bulkhead in line with the aileron lever, these limit handwheel movement, while the control surface movement is limited by stops at the aileron inboard hinges.

**Elevator control**

5. The elevators are controlled by a fore-and-aft movement of the control column, this movement being transmitted, by a lever attached to the outboard end of the lateral tube at the bottom of the control column, to the port elevator by push-pull rods and levers. From this control lever, the control rod passes aft, along the port side of the

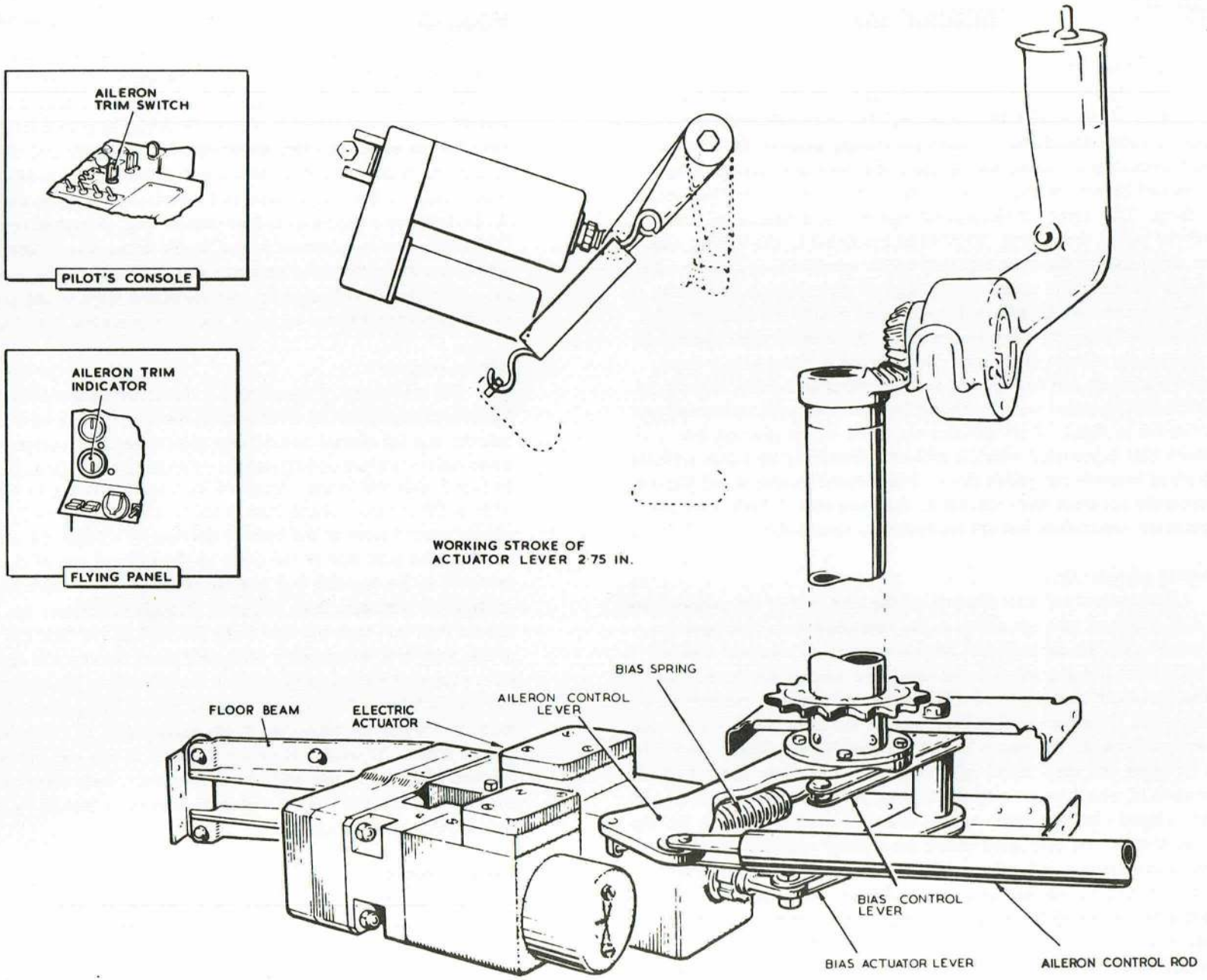



FIG. 2. AILERON BIAS CONTROL

cabin to a lever mounted at frame 6, which reverses its movement, then on to the outboard one of the three levers mounted in the pressure box just aft of the pressure bulkhead. The control continues from this lever, through the battery bay, forward camera bay, fuel tank bay, along the roof of the flare bay and through the rear fuselage, to a lever on the bulkhead at frame 42. The port elevator lever is connected to this lever by a further control rod, and the port and starboard elevators are interconnected by a coupling link joining the levers on the inboard ends of both elevator spars. The control rods are carried in roller guides suitably positioned in the fuselage structure and are provided with a coupling at the fuselage transport joint positions. Adjustable stops, located at the pressure box on the pressure bulkhead in line with the elevator lever, limit control column movement, and adjustable control surface limit stops are provided at the starboard elevator link lever.

**Rudder control**

6. The rudder is controlled by movement of the rudder pedals, this movement being transmitted to the rudder by a horizontal lever at the bottom of the rudder torque shaft, and push-pull rods and levers. From the rudder torque tube lever, the control rod passes aft along the port side of the cabin, to the centre one of the three levers mounted in the pressure box just aft of the pressure bulkhead. The control run continues from the pressure box lever through the battery bay, forward camera bay, fuel tank bay, along the roof of the flare bay and through the fuselage to the lower end of a lever on the bulkhead at frame 42. From the opposite end of this lever, a further control rod is connected to a lever at the bottom of the rudder. The control rods are carried in Fairey roller guides, suitably positioned in the aircraft structure, and are provided with couplings at the fuselage transport joint positions. Adjustable stops located at the pressure box on the pressure bulkhead in line with the rudder lever, limit rudder bar movement. The rudder movement is limited by rubber stops at its lower hinge.

**Pressure box** *(fig.3)*

7. The point at which the flying controls pass through the pressure bulkhead is called the pressure box. The box is of reinforced-alloy construction and is bolted, over a rubber pressure seal, to the pressure bulkhead. On entering the pressure box from the cabin the flying control rods connect to the lower attachment points of individual, centrally pivoted levers, which are pressure sealed about their pivot points. The upper portions of the three levers are connected to the control rods which continue through the battery compartment. Stop bolts mounted on two channel-section members, act on the levers in the pressure box and limit the movement of the pilot's controls; these stops are adjustable, and the correct dimensions and method of setting are given in the relevant control rigging diagram and paragraphs.

**Tail plane incidence control**

8. The variable incidence tail plane is hinged by two brackets at the rear of frame 42 with fork end brackets on the forward face of the main spar centre section. Trailing-edge support is provided adjacent to the false spar by an electrical actuator, forming a strut between the tail plane and the fuselage. The tail-plane incidence is controlled by the length of the actuator strut which may be varied in flight by the pilot; extension of the actuator decreases the tail-plane incidence. The actuator is controlled by a three-position switch on the right hand-grip of the control column handwheel. A cut-in switch, on the same handgrip, has first to be depressed before electrical power is supplied to the actuator.

**Aileron bias control** *(fig.2)*

9. Aileron trim is effected by a bias gear connected to the aileron control lever at the lower end of the control column, there being no independent aileron trim tab. The gear is operated by an electrical actuator which at one end is attached to a floor member, and at the other to a bias actuator lever pivoted on a floor member adjacent to the control column. A bias spring lever, integral with the bias actuator lever, is connected to the aileron control lever at the lower end of the control column by a tension spring. The relationship of the two levers is such that when the actuator is at its mid position, i.e. half extended, the spring is at its minimum tension when the control handwheel is at neutral, and an equal load will be applied to the control when the handwheel is moved to port or starboard. Operation of the actuator either in or out, will increase the effect of the spring in one direction and decrease it in the other, and bias the control accordingly. The actuator is controlled by a spring-loaded centre-off position AILERON TRIM L-R switch on the cockpit port console and an AILERON TRIM indicator, operated by the actuator, is mounted on the flight instrument panel.

**Spring-tab mechanisms**

10. The rudder, port elevator, and both ailerons are fitted with spring tabs complete with blow-back rod and torque tube mechanisms, which,

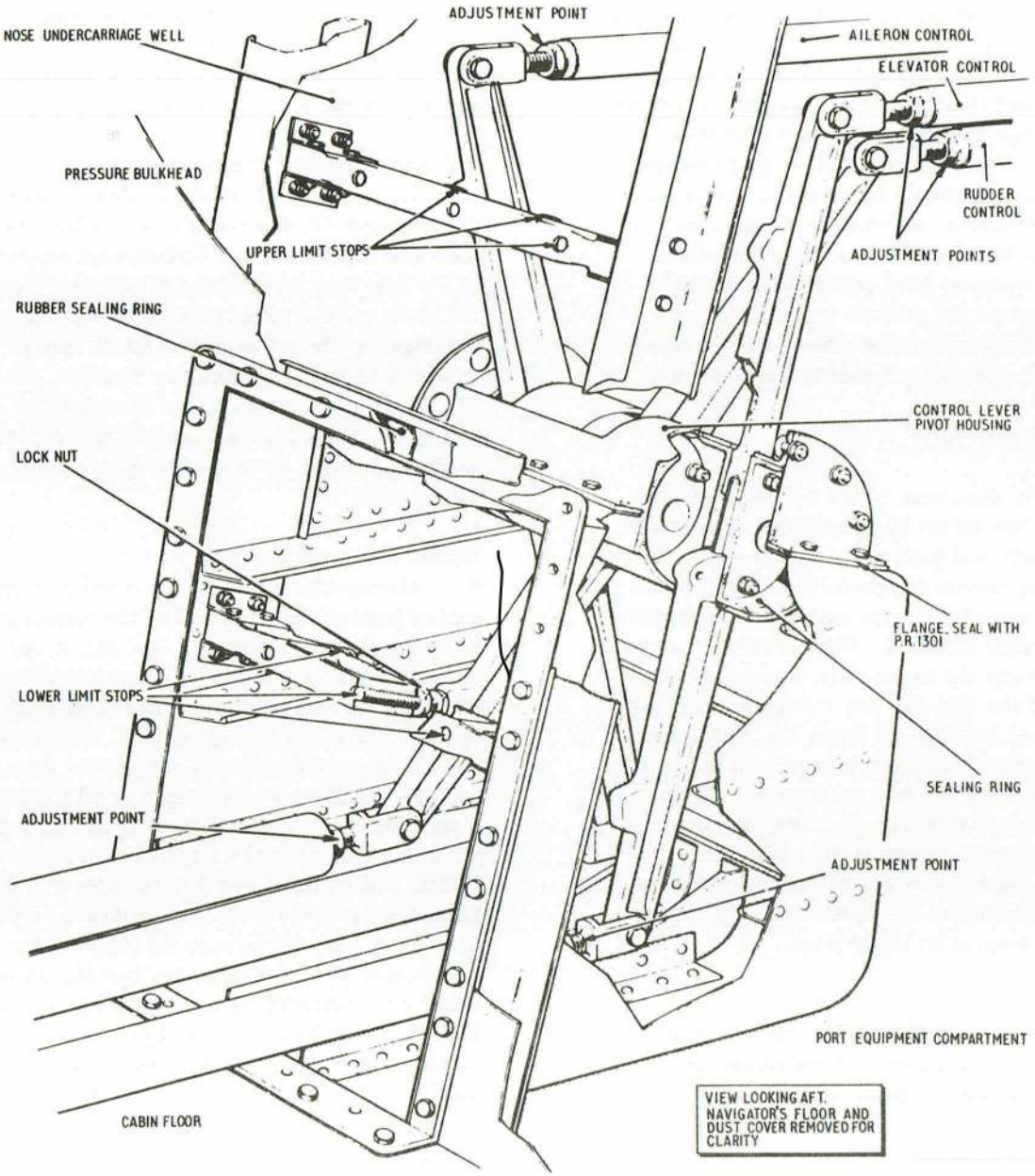



FIG. 3. PRESSURE BOX

in addition to their normal function when operated by the flying controls, have an entirely separate automatic operation. Their normal function is to relieve the pilot of heavy physical loads on the controls normally occasioned by major changes of direction at high speed, their automatic operation prevents the application of excessive control surface movement. With the exception of the rudder mechanism, which is fitted with two concentric torque tubes acting as one tube, the mechanisms differ only in size. The rudder mechanism is described in full but is equally applicable to the mechanisms fitted to the aileron and elevator tabs.

**Rudder spring-tab mechanism** *(fig.4)*

**11.** During normal flight the electrical actuator acts as a strut with fixed centres anchoring the actuator lever to the rudder structure through the mass balance arm. The actuator's function when used as a strut with variable pin centres is described in para.16.

**12.** Consider a normal turn to starboard. The pilot pushes on the starboard rudder pedal and the control rod moves aft, rotating the rudder main operating lever in a counter-clockwise direction. The torque applied by the main operating lever is transmitted through the inner and outer torque tubes to the actuator lever which, through the actuator moves the rudder over to starboard. Assuming that there is no air load on the rudder and that the rudder hinges are frictionless, the actuator lever and consequently the rudder will rotate through the same angle as the main operating lever. During flight, the air load on the rudder resists the rudder rotation, and since the torque tubes are torsion springs, they twist under the pilot's effort, so consequently, the main operating lever moves through a greater angle than the actuator lever and the rudder. The main operating lever has now rotated in a counter-clockwise direction relative to the rudder, as has the tab-actuating lever, due to the rotation of the blow-back rod which, at its lower end, is attached to the main operating lever. This rotation of the tab-actuating lever is transmitted to the tab-actuating rod and moves the tab to port, the air load on the tab then moves the rudder to starboard.

**13.** In addition to its function as a driving shaft between the main operating lever and the tab-actuating lever, the blow-back rod has a safety role. The maximum movements of the rudder and tab, as regulated by their stops, are required for control at low speeds. If it were possible for the pilot to move the rudder through these maximum angles at high speed prohibitive loads would be imposed on the aircraft structure. In flight, the angle of the rudder is determined by the angle of the tab, so that by restricting the tab movement during high speeds excessive loads on the structure are avoided. The restriction of tab movement is imposed by the blow-back rod, which under the influence of the high air load imposed by the application of large tab angles at high speeds, twists in the direction opposite to that applied by the pilot to the main operating lever, with consequent reduction of tab and rudder angles. A stop bolt, attached to the rudder spar, operates in a slot in the main operating lever in order to prevent the pilot applying excessive twist to the torque tubes. In flight, when the main operating lever is moved relative to the rudder and so moves the tab, one end of the slot will momentarily approach the stop bolt but the applied tab, causes the rudder to turn in the same direction as the main operating lever, and the bolt will move away from the end of the slot.

**Aileron spring-tab mechanism** *(fig.5)*

**14.** The spring tab blow-back rod and torque tube mechanism is mounted laterally, forward of the aileron spar. The operation of the mechanism is similar to that for the rudder spring tab *(para.11)*.

**Port elevator spring-tab mechanism** *(fig.6)*

**15.** The spring tab blow-back rod and torque tube mechanism is mounted laterally, aft of the port elevator spar. The operation of the mechanism is similar to that for the rudder spring tab *(para.11)*.

**Rudder trim actuator**

**16.** The rudder trim tab actuator forms a strut between the outer torque tube of the spring-tab mechanism and the mass balance arm at the base of the rudder. Operation of the actuator alters the position of the spring-tab mechanism relative to the rudder, and moves the rudder tab to an angle corresponding to the rudder angle required, thus enabling the aircraft to be flown without applying any load at the rudder bar. The actuator is controlled by two spring-loaded, centre-off switches, marked RUDDER TRIM L-R on the cockpit port console, both of which must be operated to move the actuator. A RUDDER TRIM indicator, operated by the actuator is mounted on the flight instrument panel.

**Air-brakes control** *(fig.7)*

**17.** The air brakes have three positions, and consist of twenty one finger-type drag channels installed in each main plane, situated outboard

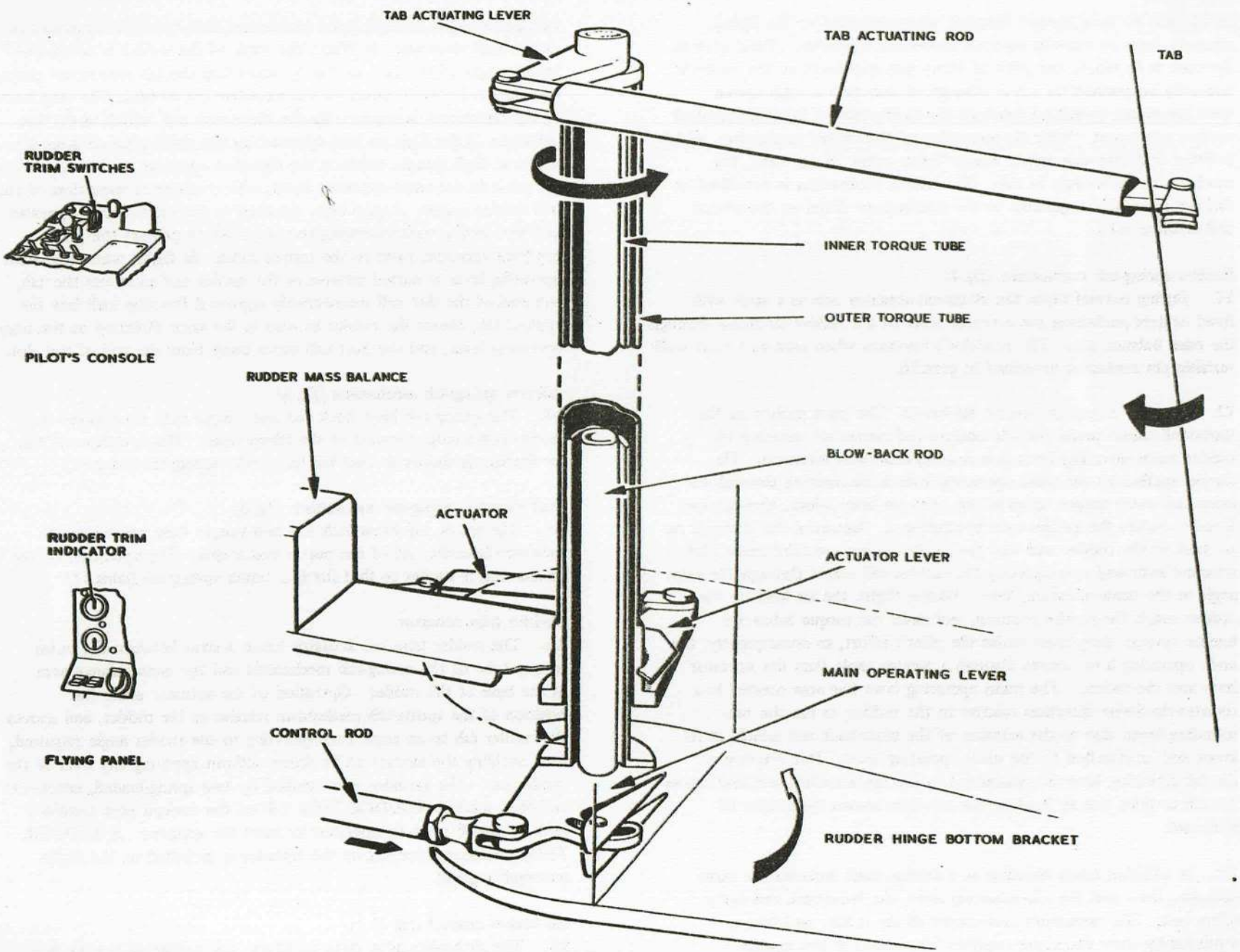



FIG. 4. RUDDER SPRING-TAB MECHANISM

◀ ANNOTATIONS AMMENDED TO CLARIFY ▶

of the engines and just aft of the main spar. In the out position nine of the drag channels protrude through the upper skin surface, and twelve through the lower skin surface of each main plane. A single hydraulic jack operates the drag channels in each main plane. Control is electrical by a switch mounted on the top of the control column marked IN-MID-OUT. An OUT position safety slide is fitted to prevent accidental operation of the air brakes to the fully OUT position above the limitations stated on the warning plate adjacent to the switch. The air-brake mechanism is described in Sect.3, Chap.2 and the hydraulic circuit in Sect.3, Chap.6.

**Flaps control** *(fig.8)*

**18.** The flaps are operated by four double-ended hydraulic jacks, one jack to each flap. They are controlled electrically by a selector switch marked UP-DOWN mounted on the port sloping panel. A FLAPS UP-DOWN indicator, operated by a transmitter is mounted to the left of the selector switch.

## SERVICING

**WARNING . . .**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft**

**Controls neutral rigging locks** *(fig.9)*

**19.** Three neutral rigging locks are provided for use when rigging the flying controls. They are:-

(1) Aileron lock – The lock is clamped to the control column so that the lock horns contact the underside of the handwheel.

(2) Elevator lock – The lock is clamped to the control column and an adjustable tie-rod terminating in a spade end, passes through the engine starting panel and is locked in position by a quick release pin.

(3) Rudder lock – The lock fits over the rudder bar starwheel spindle and is secured to the pilot's floor by four bolts. The front plate of the lock fits hard against the starwheel, which is prevented from rotating by two bolts protruding through the plate.

**Control rigging**

*Aileron*

**20.** The method of rigging the aileron controls is given in para.31 and illustrated in fig.12.

*Elevator*

**21.** The method of rigging the elevator controls is given in para.34 and illustrated in fig.13.

*Rudder*

**22.** The method of rigging the rudder controls is given in para.35 and illustrated in fig.14.

**Aileron bias**

**23.** No adjustment is provided in the aileron bias mechanism. The actuator pin centre distance is set by the manufacturers and will not need further adjustment.

**Starboard elevator ground-set tab**

**24.** To adjust the starboard elevator ground-set tab:-

(1) Lock the elevator in its neutral position by clamping the elevator horn to the tail plane.

(2) Remove the elevator tab control access panel on the upper surface of the elevator *(Sect.2, Chap.4)*.

(3) Slacken the locknuts on the adjuster between the tab-connecting rod and the end piece.

(4) Operate the adjuster until the tab chord line is 2 deg 21 min up relative to the elevator chord (linear dimension 0.25 in. ± 0.05 in. between the trailing edges of the elevator and tab, measured at the outboard end of the tab). Relock the adjuster locknuts.

(5) Remove the lock fitted in operation (1) move the elevator through its full travel in both directions and check the tab movement; it should be 17 deg 30 min with the elevator up or down (linear dimension 1.85 in. ± 0.10 in. measured as in operation (4)).

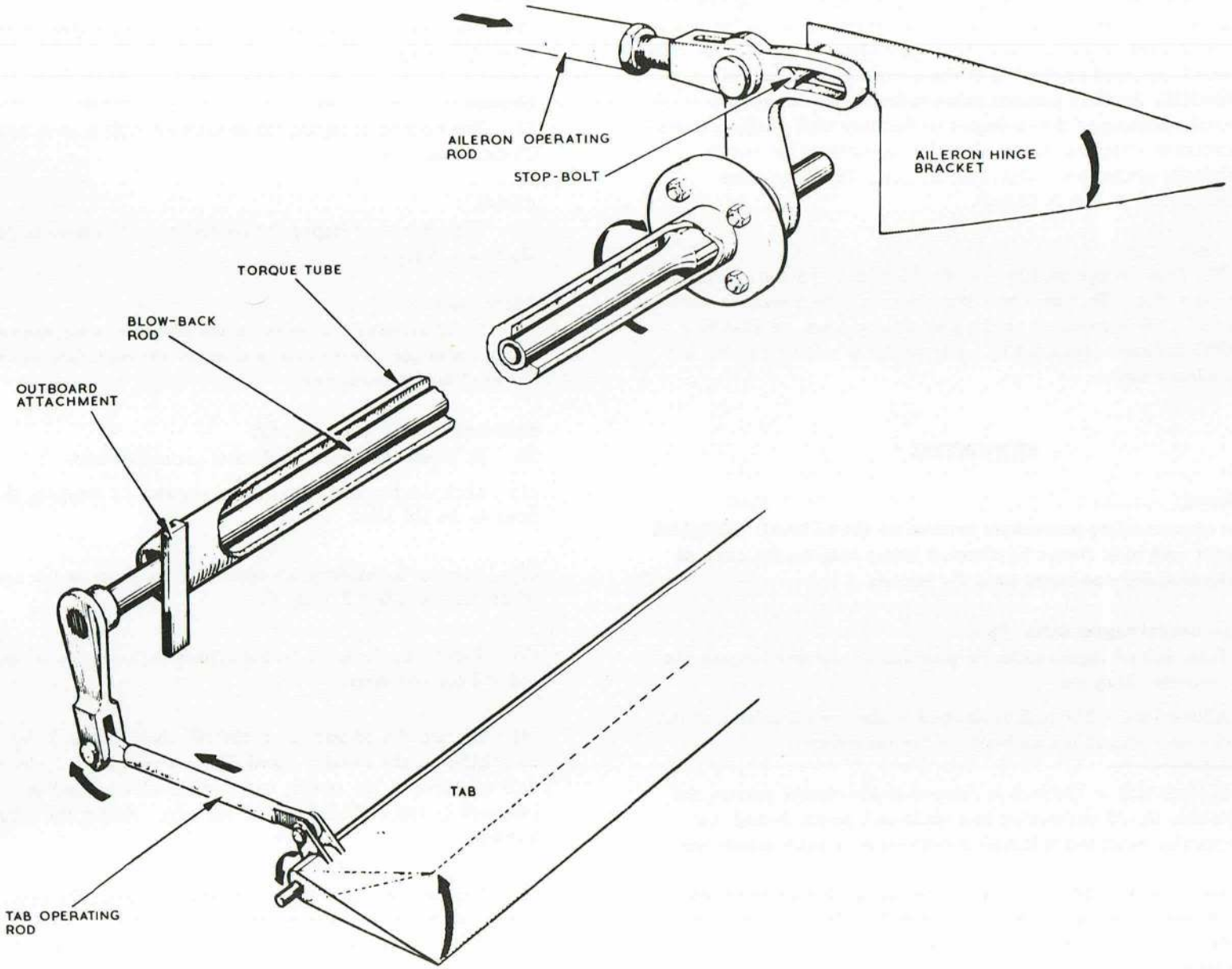



FIG. 5. AILERON SPRING-TAB MECHANISM

**Rudder trim actuator setting**

25. The rudder trim actuator electrical stops are set to give a working stroke of 2.72 in. and the pin centres are nominally set at 7.50 in. (fully contracted) against an electrical stop. The mechanical stops are set to give a working stroke of 3 in. and the pin centres are nominally set at 7.425 in. (fully contracted) against a mechanical stop. These are manufacturer's settings and should not require any adjustment, however, should it be necessary, the pin centres may be adjusted ± 0.125 in. as follows:-

(1) Remove the actuator *(para.51)*.

(2) Using an 18-volt electrical supply, extend the actuator until the $\frac{1}{16}$ in. dia. hole in the actuator arm is visible.

(3) Slacken the locknut securing the fork end and screw the fork end either inwards or outwards to adjust.

(4) After adjustment, insert a piece of $\frac{1}{16}$ in. dia. wire into the hole in the actuator arm. If the penetration is greater than $\frac{1}{16}$ in. too much outward adjustment has been made and the fork end must be screwed inward.

(5) Tighten the locknut securing the fork end.

(6) Using an 18-volt electrical supply, inch the actuator on to the electrical stops and check that the electrical stops operate when the pin centres are 7.50 in. and 10.22 in.

(7) Reassembly of the actuator to the aircraft is the reverse order of removal.

26. To check the movement of the rubber tab and actuator:-

(1) Connect a ground electrical supply at the ground supply socket.

(2) With the rudder in line with the fin, and the tab in line with the rudder, operate the actuator until the pin centres are 9.42 in., and ensure that the tab is moved 18 deg to starboard (linear dimension $1.73 \pm \frac{0.00}{0.10}$ in. measured from the inboard trailing edge of the tab to the normal centre line of the rudder).

(3) Retract the actuator to obtain pin centres of 8.37 in. and ensure that the tab is moved 18 deg to port (linear dimension $1.73 \pm \frac{0.00}{0.10}$ in. measured as in operation (2)).

**Note . . .**

*1. The excess of working stroke over the amount required to give full tab movement, is provided to cater for deflection of the torque tube and blow-back rod when an air load is applied to the tab.*

*2. If the rudder tab movement is in excess of 18 deg a new rudder tab actuating lever stop plate Ref.No.26FZ/5495 (fig.20) should be fitted, and the stop faces filed, if necessary, to obtain the desired 18 deg movement. Similarly, if the 18 deg movement is unobtainable, the existing stop plate may be filed. The correct protective treatment (A.P.119A-0509-1) must be applied to all filed surfaces.*

**Tail plane actuator setting**

27. The following instructions for the setting of the Type 4022 tail plane actuator are listed in the sequence in which the operation must be carried out; no adjustment is possible on the actuator itself. For detailed information on the actuator refer to A.P.113E-0142-16.

**Note . . .**

*All tail-plane angles are to be measured on the STARBOARD tail plane at the inboard rigging board position, using incidence gauge (Sect.2, Chap.4, Table 1) relative to the fuselage horizontal datum. The clinometer should not be disturbed during the rigging operations and readings should be related to its initial setting.*

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Open the rear hatch and place the lateral leveling gauge *(Sect.2, Chap.4, Table 1)* on the leveling brackets, port and starboard, at frame 31. The port and starboard ends are indicated on the gauge *(fig.10)*.

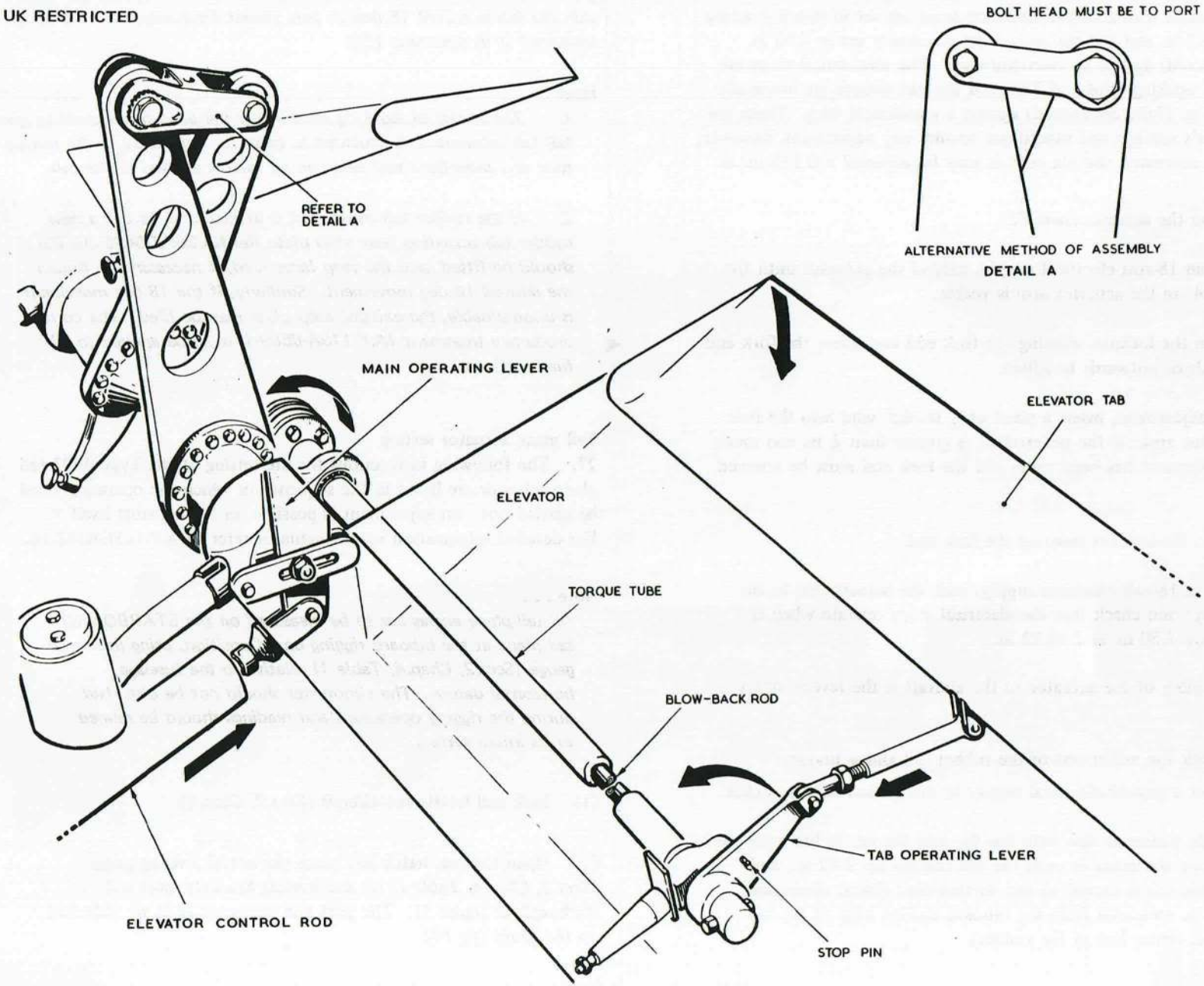



FIG. 6. PORT ELEVATOR SPRING-TAB MECHANISM

(3) Level the aircraft laterally (0 deg ± 0 min).

**Note . . .**

*It is very important that the aircraft is rigged to this degree of accuracy, both laterally and longitudinally, otherwise any deviation will have to be allowed for in the subsequent tail-plane settings.*

(4) With the lateral gauge in position place the longitudinal gauge *(Sect.2, Chap.4, Table 1)* on the leveling bracket on the starboard side of frame 29 bulkhead, and on the datum pad on the lateral gauge *(fig.10).*

(5) Level the aircraft longitudinally (0 deg ± 0 min).

(6) Ensure that the microswitch tappets are screwed fully home, and that the upper and lower microswitches are set to give the minimum distance between the switches and tappets *(fig.11).*

(7) Retract the actuator on to its mechanical down stop and ensure that the up travel limit (tail plane leading edge up) is 4 deg 7 min ± 13 min relative to the fuselage datum *(fig.10).*

**Note . . .**

*As a precaution against damaging the actuator when running it on to its down stop, it is advisable to operate the motor in that direction at a reduced voltage. This is achieved by disconnecting the cable core T33L-1 (circuit C21) from the terminal A1 on the low-speed motor reversing relay in the rear fuselage, and then connecting a resistor of approximately 2.2 ohms resistance and 200 watt rating between the cable terminal B, and the relay terminal A1. A suitable resistor would be a Painton Type 5007, of approximately 2.2 ohms resistance.*

(8) Check and record the angle found in operation (7).

(9) Reduce the angle recorded in (8) by 8 min $\pm\frac{1}{0}$ min. This will give the angle at which the lower microswitch must be tripped *(fig.11).*

(10) Adjust the lower tappet to operate the lower microswitch at the angle found in (9).

(11) Extend the actuator on to its mechanical stop and ensure that the down travel limit (tail plane leading edge down) is 2 deg 4 min ± 13 min relative to the fuselage horizontal datum *(fig.10).*

(12) Check and record the correct angle found in operation (11).

(13) Increase the angle recorded in (12) by 8 min $\pm\frac{1}{0}$ min. This will give the angle at which the upper microswitch must be tripped *(fig.10).*

(14) Adjust the upper tappet to operate the upper microswitch at the angle found in (13).

(15) Recheck the operational angles of incidence at both upper and lower actuator positions moving the actuator slowly when approaching the microswitches, and check that the tail-plane indicator in the cockpit registers the take-off position when the incidence is 3 deg 15 min ± 2 min.

(16) Finally, carry out flight trim checks as specified in Appendix 1.

**Air-brakes setting** *(fig.7)*

28. To set the air-brake mechanism:-

(1) Remove the panels giving access to the air-brake mechanism *(Sect.2, Chap.4)* from the underside of each main plane.

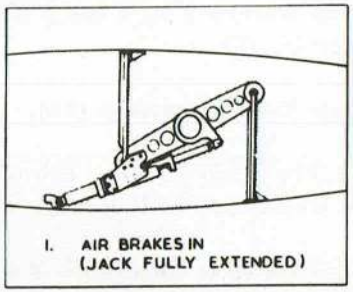
(2) Set the air brakes and flaps ground selector to GROUND and using the aircraft hand pump, fully extend the jacks.

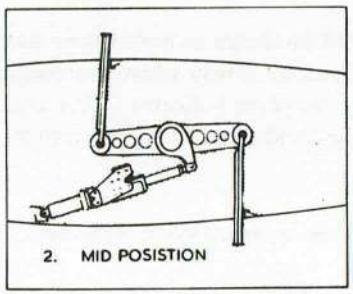
(3) Check the dimension between the pin centres of the piston rod and jack body; this should be 24.92 in. Adjustment is effected by unlocking and rotating the eye end of the jack piston rod.

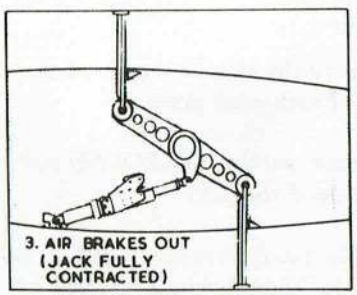
(4) Check that all drag channel end plates are flush with the main-plane skin.

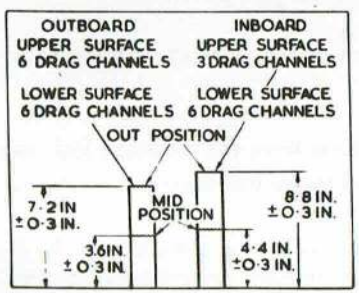
(5) Disconnect the hydraulic pipelines from the starboard jack and blank off. Connect an external hand pump test rig.

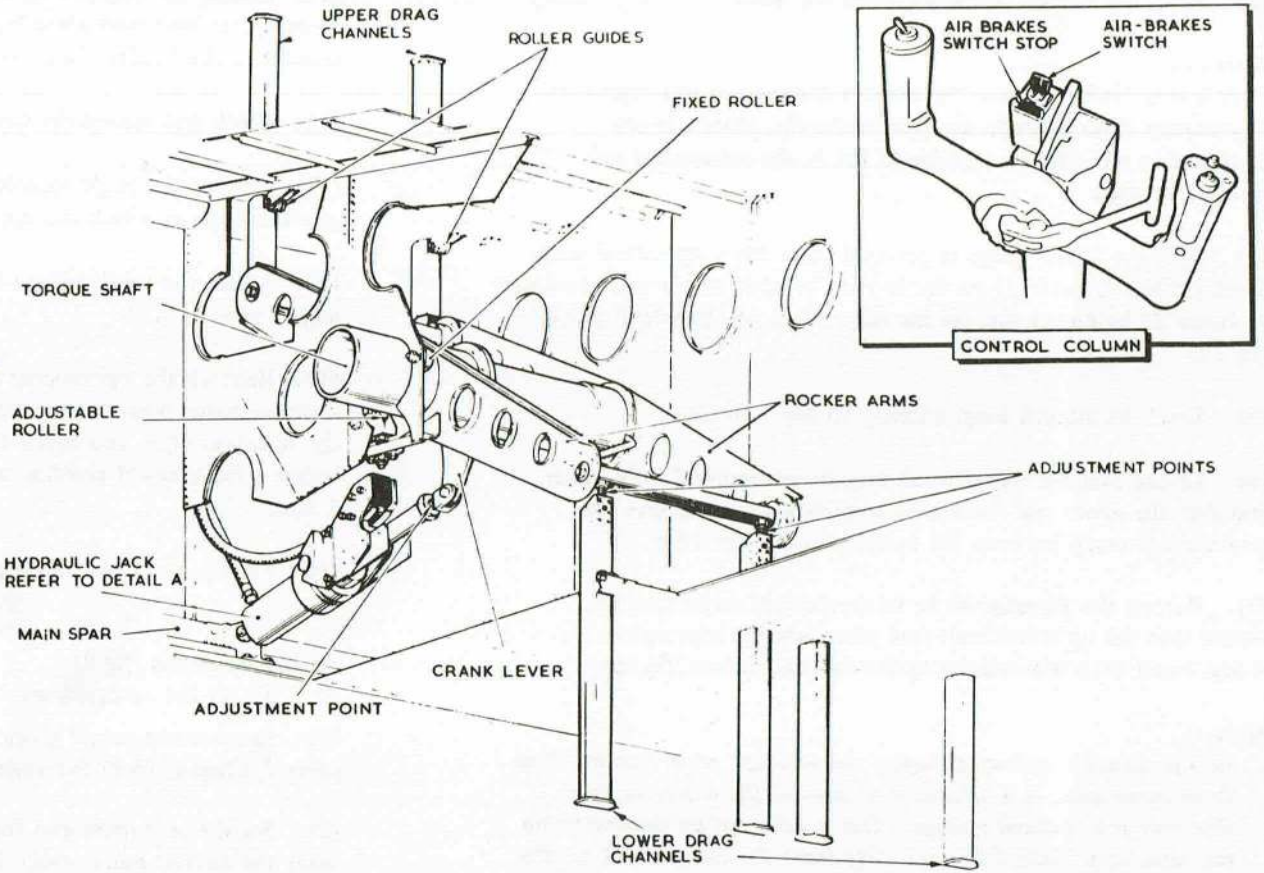
(6) Slacken the securing bolts of the cam slide assembly on the jack piston rod and move the slide a short distance along the piston rod towards the eye end of the rod.







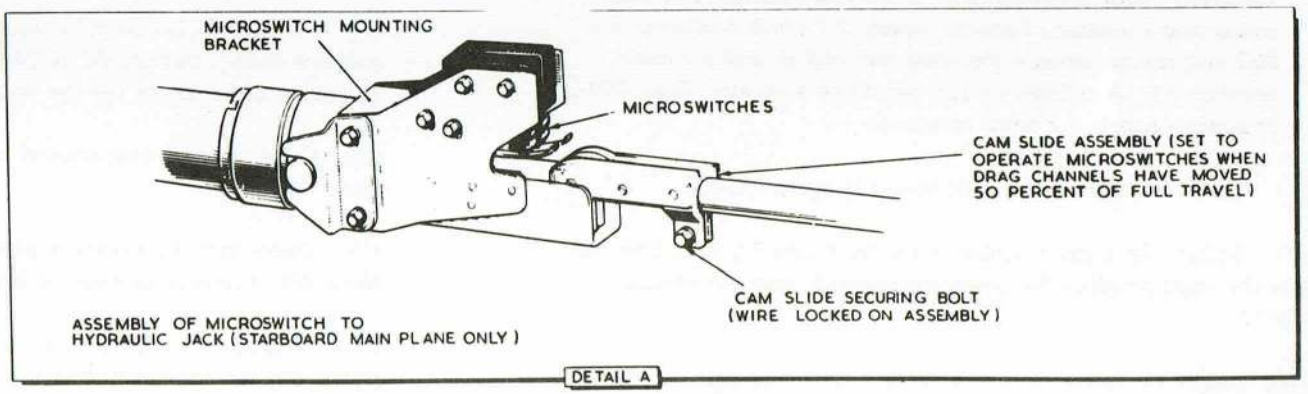



FIG.7. AIR-BRAKES CONTROL AND SETTING

(7) Retract the jack to extend the drag channels to the MID position in accordance with the dimension given in fig.7.

(8) Adjust the position of the cam slide on the piston rod to operate the microswitches at this point; tighten and wire-lock the securing bolts.

(9) Disconnect the external test rig from the starboard jack, reconnect the pipeline and bleed off the air-brake system.

(10) Fully extend the jacks, select MID and OUT, and check that the drag channel protrusion in each position agrees with the dimensions given in fig. 7.

**Note . . .**

*In the MID positions, the inboard and outboard drag channel extensions on one main plane must not differ by more than 0.5 in. to the extensions of the corresponding sets of channels on the opposite main plane.*

(11) Select IN, extend the jacks, lock all adjustment points and replace the access panels.

**Note . . .**

*Ensure the access panel bolts are all the same length and diameter. If fourteen x 5/16 in. B.S.F. bolts are fitted the overall length must be 0.7 in., and if twenty six x 2 B.A. bolts are fitted the overall length must be 0.6 in.*

(12) Set the air brakes and flaps ground selector to FLIGHT and wire-lock.

**Flaps setting** *(fig.8)*

**29.** To set the flap mechanism, proceed as follows for all flaps, using the hydraulic hand pump to operate them:-

(1) Check the distance between the pin centres of the flap jack piston rods *(Chap.2).*

(2) With the flaps down, remove the locking plates from the links connecting the flaps to their operating levers, and slightly slacken all link adjustment screws *(fig.8).*

(3) Raise the flaps, moving them slowly when approaching the fully-up position, and check that they do not bear on the underside of the main plane when the jacks are bottoming.

(4) Lower the flaps sufficiently to give access to the link adjustment screws and adjust at these points until, when the jacks are bottoming, they bear without undue pressure on the underside of the main plane.

(5) The movement of the flaps from the fully-up to the fully-down position is 29.28 in. ± 0.50 in. (inboard flap) and 26.65 in. ± 0.50 in. (outboard flap). This movement is to be measured from the trailing edge of the wing, at the outboard end of the inboard flap and at the inboard end of the output flap. Maximum permissible backlash in the new condition is 0.30 in. to allow for adverse tolerances of bolts and bores in the total linkage from jack to flap *(fig.8)*. Where backlash exceeds 0.60 in. refer to A.P.101B-0400-6.

(6) When the correct flap settings have been obtained, check that there is a minimum clearance of 0.050 in. between the push rod fork ends and the flap hinge brackets throughout the full flap travel *(fig.8)*. Ensure that all of the free lift in the flap at the hinges has been taken up when this check is made. If this clearance cannot be obtained, it is permissible to file and remove locally up to 0.10 in. maximum from the flap hinge bracket to clear the foul; blend out the rebate and restore the local finish *(A.P.119A-0509-1).*

(7) Refit the locking plates, ensuring that the securing bolts, are fitted with their heads to starboard as illustrated on Fig.8.

**Static friction loads**

**30.** The maximum acceptable values for the static friction loads of the control runs are as follows:-

| | |
|---|---|
| Aileron | 4 lb |
| Elevator | 6½ lb |
| Rudder | 6½ lb |

The loads are to be measured with a spring balance *(Sect.2, Chap.4, Table 2)* connected to the control at the point of application of the

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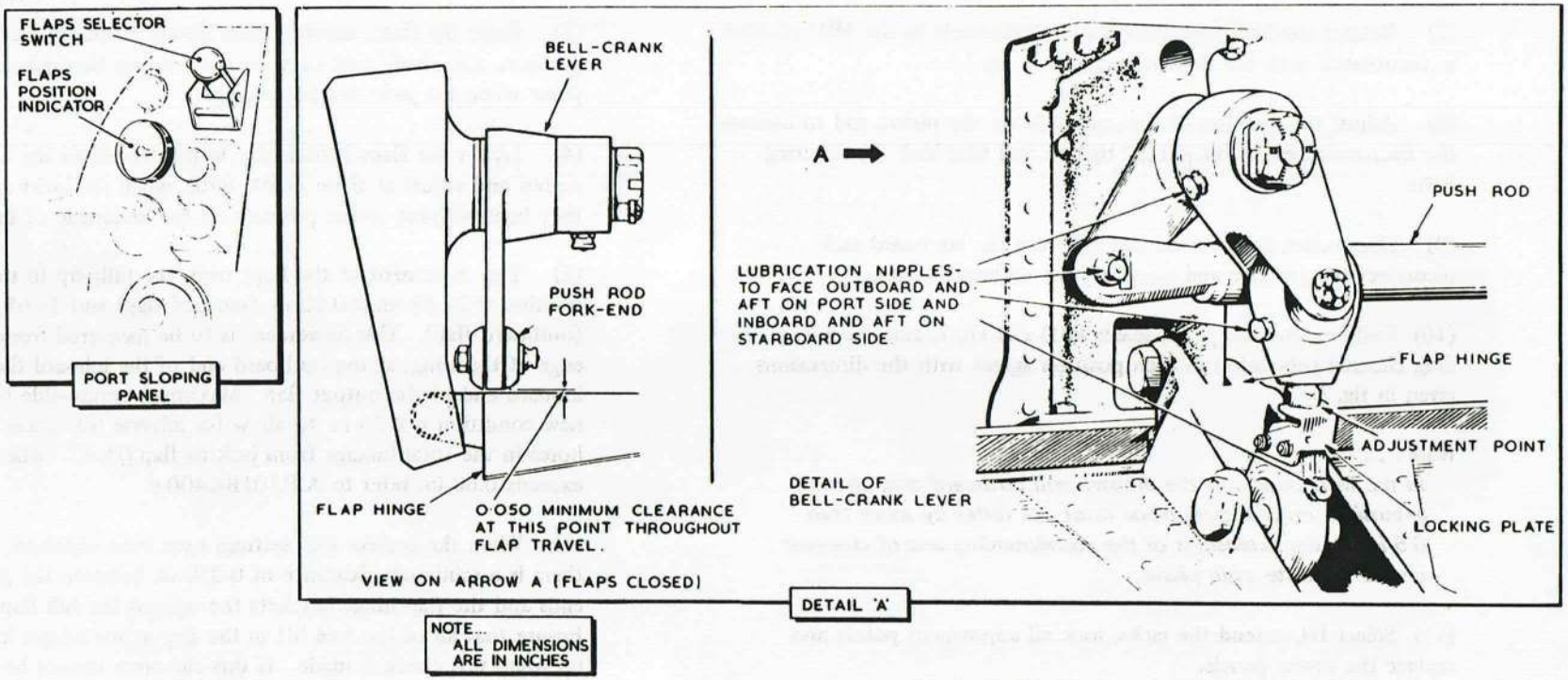


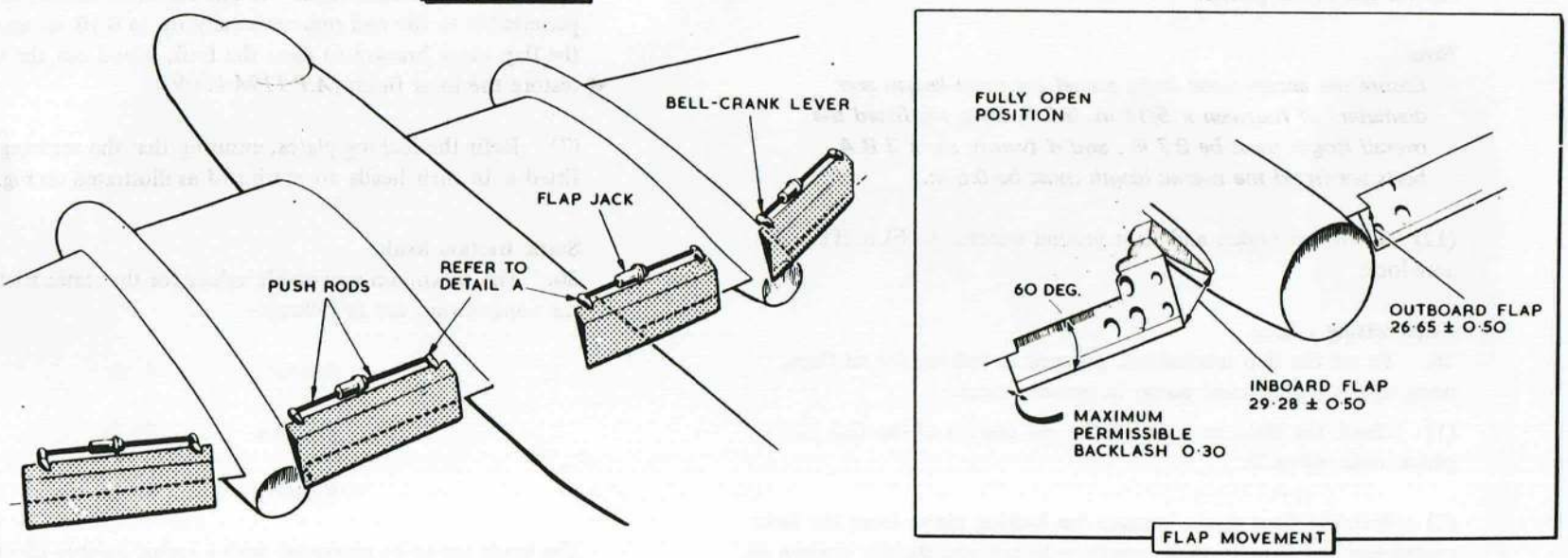




FIG.8. FLAPS CONTROL AND MOVEMENT

pilot's effort. The readings of the rudder and aileron runs are to be taken when the control commences to move. Due to the out-of-balance moment of the elevator control run, it is necessary to pull the control column forward by means of the spring balance, and take the maximum reading. Hold the control column in this position and zero the spring balance, then allow the control column to move back, with the spring balance held, and again take the reading. Half the difference of the two readings will be the static friction load.

**Aileron control rigging** *(fig.12)*

**31.** To rig the aileron control:-

(1) Jack and trestle the aircraft laterally and longitudinally level *(Sect.2, Chap.4)*.

(2) Disconnect the aileron control rod *(detail 3, point F)* from the upper end of the lever, and screw back the upper and lower stop screws on the pressure bulkhead. These operations, except for the lower limit stop screw, can be made through the port equipment compartment on the port side of the fuselage. The lower limit stop screw is on the forward face of the pressure bulkhead.

(3) Set the control column handwheel to its neutral position, i.e. horizontal laterally, using a straight edge and clinometer applied over the top of the handwheel. Lock the handwheel in this position *(para.19)*.

**Note . . .**

*Use the same location for the straight edge for all subsequent angular measurements of the handwheel.*

(4) With the handwheel locked in the neutral position, set the control lever aft of the pressure bulkhead *(fig.19)*, to its neutral position (7.15 in. measured square from the pressure bulkhead to the upper control attachment bolt centre) by adjusting the control rod at point D *(fig.12, detail 3)*.

(5) Unlock and rotate the handwheel to 96 deg ± 0 deg 15 min to port and adjust the upper limit stop-screw on the pressure bulkhead *(detail 3)* until it contacts the upper arm of the control lever. Tighten locking nut.

**Note . . .**

*To prevent a foul occurring between the wheel brake lever and air brake switch, the wheel brake lever must be locked in the parked position during hand wheel rigging operations.*

(6) Rotate the handwheel to 80 deg ± 0 deg 15 min to starboard and adjust the lower limit stop screw on the pressure bulkhead *(detail 3)* until it contacts the lower arm of the control lever. Tighten locking nut.

(7) Lock the handwheel in its neutral position and reconnect the aileron control rod *(detail 3, point F)* to the upper end of the lever at the pressure bulkhead.

(8) Check that the lower arm of the bell-crank lever, aft of the main spar frame in the roof of the flare bay, is parallel to the main spar. Adjust, if necessary, at the control rod connections at either end of the control rod *(points F or G)*.

(9) With the stop pins in the ailerons at the aft end of the slots in the control levers, adjust both aileron control rods at point H *(detail 1)* to give the ailerons a droop of 4 deg 54 min (linear dimension 1.45 in ± 0.10 in. measured at point C).

(10) Disconnect the aileron control rods at the aileron levers and, with the aileron stop pins at the aft end of the slots in the control levers *(detail 1)*, set the tabs with 15 deg droop relative to the aileron datum (linear dimensions 1.38 ± 0.10 in. measured at point A). Adjust the tab control rod by removing the control rod fairing *(Chap.2)*, slackening the locknut at the tab end of the control rod, and the locknut at the control-rod connection to the tab lever *(detail 2, point B)* and turning the control rod as necessary.

(11) Remove the stop pin *(detail 1)* and ensure that the tab setting *(operation (10))* does not alter; this is to check that there is no preloading of the aileron spring tab torque tube. If preloading is found, adjustment to relieve it may be made on the torque tube bracket attachment bolts by transferring shims from one bolt to the other.

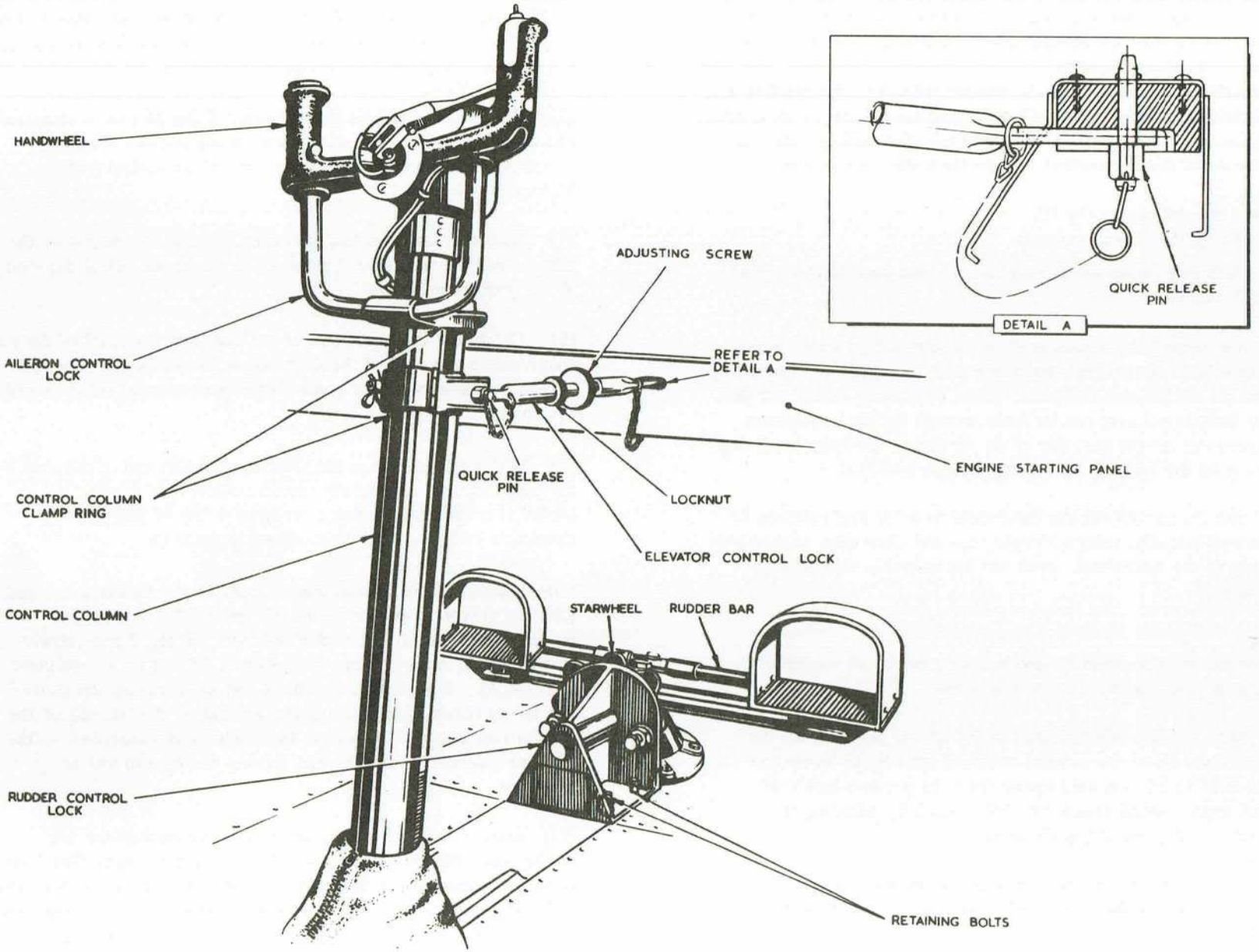



FIG .9. CONTROLS NEUTRAL RIGGING LOCKS

**Note . . .**

*The shims are initially fitted to a thickness of 0.040 in. between the outboard attachment bracket and the aileron spar at each of the two bolts. Shims removed from one bolt must be added to the other bolt so that there remains an aggregate of 0.080 in. shimming at the two bolt positions.*

(12) Move the ailerons up (manually) 15 deg (linear dimension 4.58 in. ± 0.20 in. measured at point C), and set the upper limit stop *(detail 1)*.

(13) Move the ailerons down (manually) 15 deg (linear dimension 4.58 in. ± 0.20 in. measured at point C), and set the lower limit stop *(detail 1)*.

**Note . . .**

*Excessive force must not be applied to the ailerons, as such action may initiate cracking of the inboard hinge brackets.*

(14) Reconnect the aileron control rod to the aileron lever *(detail 1)* and unlock the handwheel.

**Note . . .**

*The bolt 'J' must be inserted from inboard and the bolt head must locate in the recess in the forked end; to achieve this condition when adjusting the controls it may be necessary to rotate the complete rod assembly through 180 deg so that the recess faces inboard.*

(15) Move the handwheel in both directions until the movement is arrested by the down aileron limit stop. It will be noted that the down aileron reaches its limit stop in advance of the up aileron. Further movement of the handwheel in both directions will give the ailerons and tabs their respective full movements *(detail 4)*.

(16) Ensure that all adjustment points are securely locked and that the control-rod couplings do not foul the roller guides during any position of the aileron control movement.

(17) Carry out a flight trim check as detailed in Appendix 1.

**Aileron fixed trim strips**

**32.** The neutral position of the aileron fixed trim strip on each aileron is in line with the aileron chord line. These strips are set by the manufacturer and the setting should not normally need alteration. If, however, adjustment is necessary, progressive adjustment to a maximum of 10 deg either up or down from the neutral position may be made on the ground using a setting tool and gauge *(Sect.2, Chap.4, Table 1)*.

**Note . . .**

*An adjustment of 3 deg up on one fixed trim strip and 3 deg down on the other is equivalent to five divisions on the aileron trim indicator when the aircraft is flying at 450 knots I.A.S.*

**Rigging of aileron controls following replacement of control rods and levers**

**33.** The following method of rigging the aileron controls, frame 21 to aileron attachment *(fig.12)* port and starboard is recommended:-

(1) Set the inboard adjustable control rods bell-crank lever to lever arm at rib 4, centre wing, to nominal length (1½ turns in from the safety check hole).

(2) Ensure that the lower arm of the bell-crank lever aft of main spar frame is parallel to the main spar.

(3) Fit control rods as follows:-

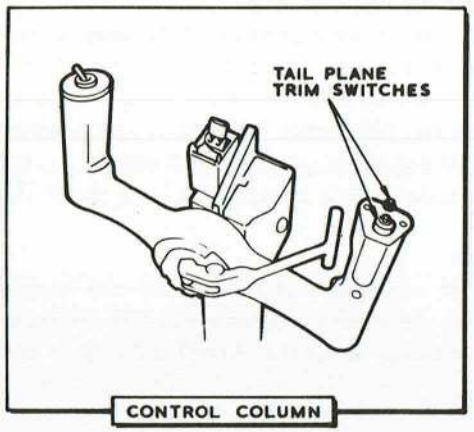
(a) Bell-crank lever to lever arm, rib 4, centre wing.

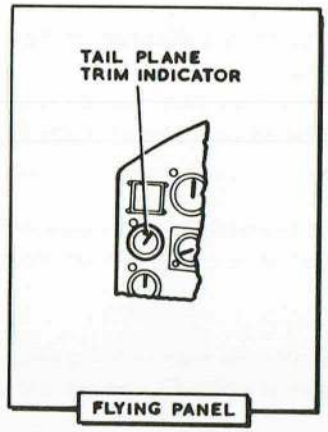
(b) Lever arm to centre lever, engine bay.

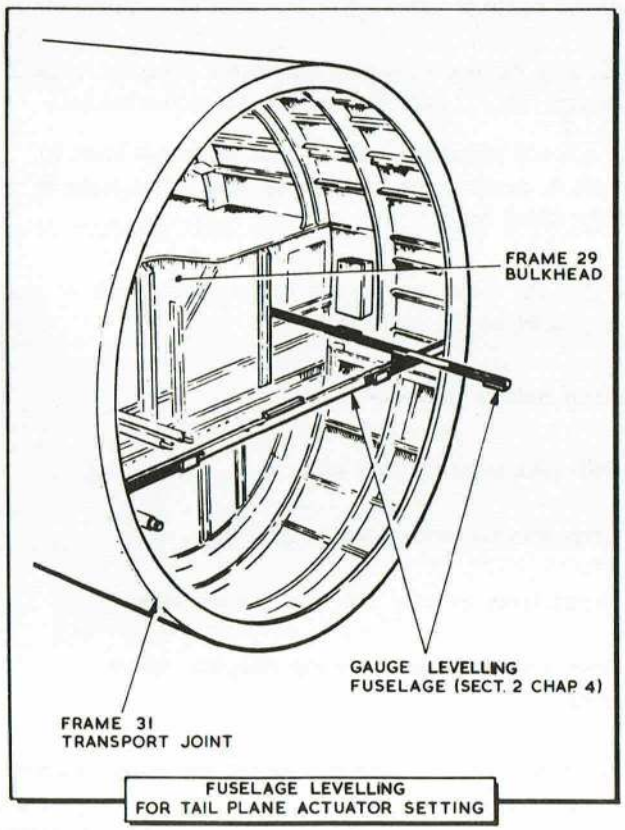
(c) Centre lever to lever arm, rib 2, outer wing.

(d) Lever arm to hinge mounting assembly, rib 4, outer wing.

(e) Hinge mounting to aileron. Adjust for correct aileron droop. Check for safety.



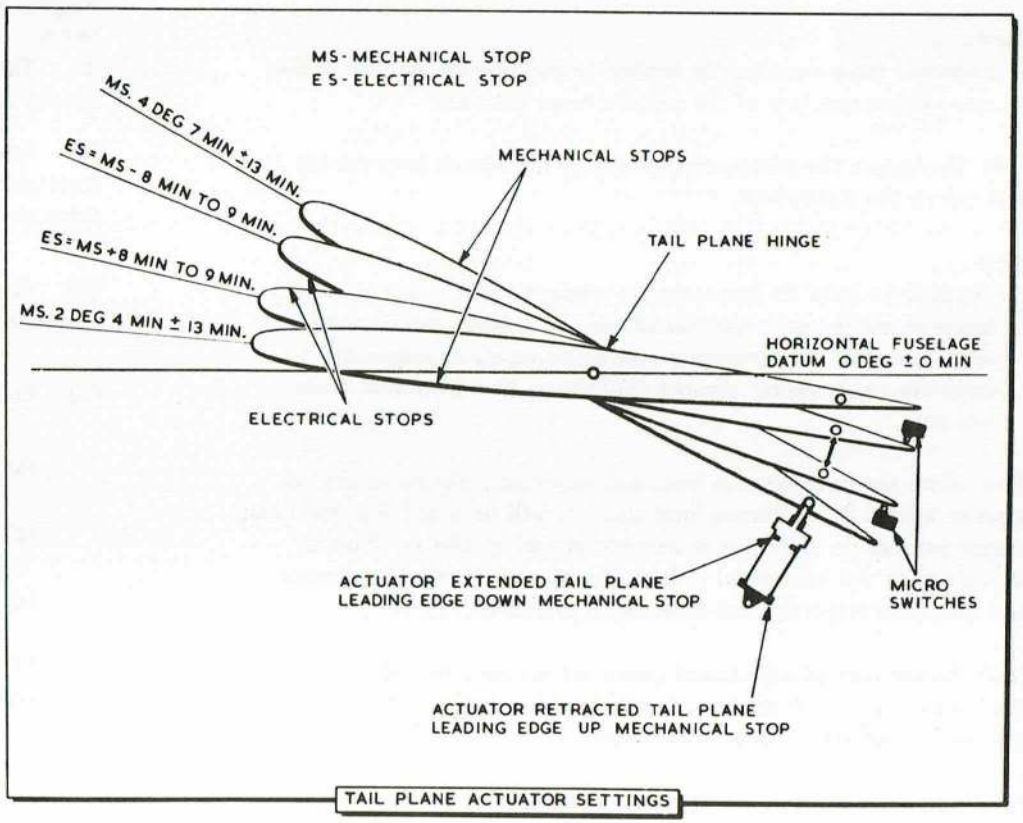




FIG.10 FUSELAGE LEVELING AND TAIL PLANE ACTUATOR SETTING

**Note . . .**

*Due to the fact that the control rod attachment bolt to aileron, is required to be fitted with the head in the recess in the fork end, and facing inboard, adjustment at this point can only be made in full turns in or out as required. In the event of a half-turn adjustment being required, the full turn should be applied, and a half-turn adjustment made in the opposite direction at the adjustable end of the bell-crank lever to lever arm control rod at rib 4, centre wing.*

◀ **Elevator control rigging** *(fig.13 and 13A)* ▶

**34.** To rig the elevator control:-

**WARNING . . .**

**Before making any adjustments to the elevator stops, ensure that all relevant safety precautions as detailed on the LETHAL WARNING marker card have been observed.**

(1) Jack and trestle the aircraft laterally and longitudinally level *(Sect.2, Chap.4)*.

(2) Disconnect the elevator control rod *(detail 1, point B)* from the upper end of the lever, and screw back the upper and lower stop screws on the pressure bulkhead. These operations, except for the lower limit stop screw, can be made through the equipment compartment on the port side of the fuselage. The lower limit stop screw is on the forward face of the pressure bulkhead.

(3) Set the control column to its neutral position (6 deg. 30 min. forward of the vertical), using a clinometer applied to the rear of the control column. Lock the control column in this position *(para.19)*.

(4) Set the control lever aft of the pressure bulkhead *(detail 1)*, to its neutral position (7.25 in. measured from the pressure bulkhead to the upper control attachment bolt centre) by adjusting the control rod at point A or C.

**Note . . .**

*Any adjustments made at the pressure bulkhead may affect the clearances at the snatch unit bell-crank lever/toggle switch. Ensure that the dimensions are in accordance with Chap.11.*

**WARNING . . .**

**Unlock the control column, move it through its full travel in both directions, and ensure that the explosive collar does not foul the adjacent structure. If it is necessary to move the collar, obliterate the original red lines and paint new red lines, one on either side of the collar, on the control rod (Chap.11).**

(5) Move the control column 16 deg forward of the vertical. Adjust the upper limit stop screw on the pressure bulkhead *(detail 1)* until it contacts the upper arm of the control lever. Tighten the locking nut.

(6) Move the control column 6 deg 30 min aft of the vertical and adjust the lower limit stop screw on the pressure bulkhead *(detail 1)* until it contacts the lower arm of the control lever. Tighten the locking nut.

(7) Reconnect the elevator control rod *(detail 1, point B)* to the upper end of the lever aft of the pressure bulkhead.

(8) Disconnect the elevator control rod at point D *(detail 2)* from the lever on the bulkhead at frame 42; access is through the rear camera hatch.

(9) Set the tail plane to its take-off position with the incidence gauge at the starboard tail plane inboard position reading 3 deg 15 min ± 2 min, and the tail plane incidence gauge in the cockpit at the take-off position.

(10) Move the elevator down (manually) and adjust the elevator lower limit stop at the starboard elevator link lever to give the elevator horn an upward movement of 15 deg (linear dimension 8.4 in. ± 0.3 in., measured from the leading edge of the tail plane to the leading edge of the elevator horn *(point F)*).

(11) Move the elevator upwards (manually) and adjust the elevator up limit at the starboard elevator link lever to give the elevator horn a downward movement of 20 deg (linear dimension 11.16 in. $\pm^{0.30}_{0.50}$ in. measured as for operation (10)).

**Note . . .**

*The measurements given in operations (10) and (11) are obtained with the rubber stop pads removed. With the stop pads in position the measurements will be slightly less.*

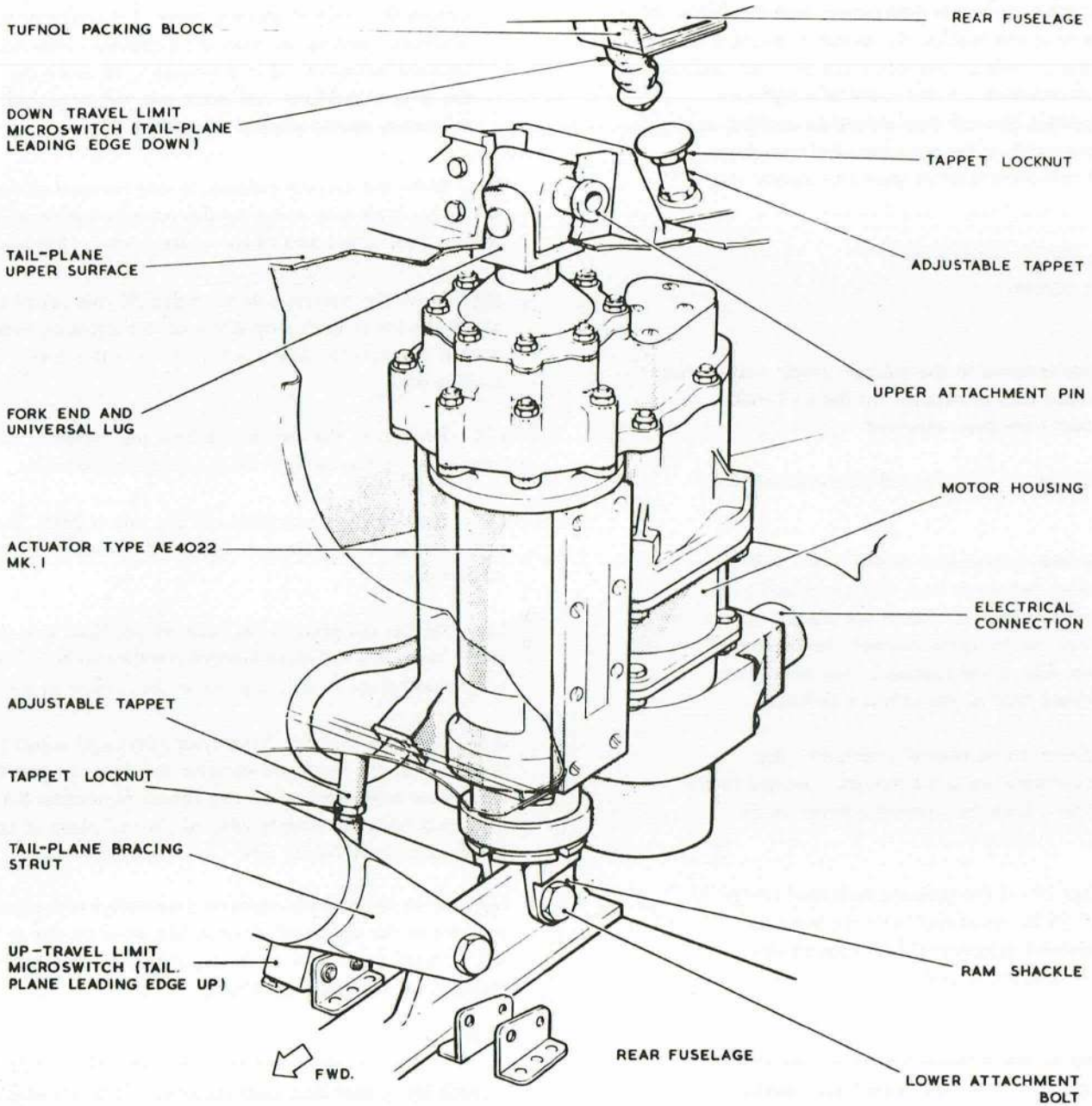



FIG.11. TAIL-PLANE ACTUATOR

(12) With the tail plane in its take-off position *(operation 9)*, lock the elevator in its neutral position, i.e. in line with the chord line of the tail plane, by fitting the external control lock to the starboard elevator, and a toggle between the port elevator horn and tail plane.

(13) Adjust the port tab control rod until the tab is 12 deg 30 min up relative to the elevator (linear dimension 1.30 in. ± 0.10 in.). These dimensions are measured between the trailing edges of the elevator and tab *(point G)*, with the stop pin in the centre of the slot in the tab operating lever.

(14) With the tail plane, elevator, and port tab in their neutral positions set the control lever on the bulkhead at frame 42 to its neutral position (6.35 in. ± 0.1 in. measured square from the bulkhead to the control attachment bolt) by adjusting the control rod at point E.

(15) Lock the control column in the neutral position, reconnect the control rod at point D *(detail 2)* to the lever on the bulkhead at frame 42, adjusting the rear end of the main control rods *(point D)* as necessary.

(16) Unlock the control column and elevators, and check the elevator and tab movement. The elevator movements should be those given in operations (10) and (11). The linear dimension of the starboard tab should be that given in para.24. Relock the port elevator and check the movement of the port spring tab; these should be, tab up 1.7 in. min, tab down 0.60 in. min. With the relative tab to elevator angle greater than 20 deg with the tab fully up, a foul occurs between the tab mass balance and the elevator skin; this is acceptable as this tab angle never occurs in flight. However, during ground checks, all control movements must be done gently, thereby avoiding heavy contact between balance weights and skin.

(17) Unlock the port elevator.

(18) Ensure that all adjustment points are securely locked and that the control rod couplings do not foul the roller guides at any point of the control column movement.

(19) On completion of rigging, check the operation of the control column snatch unit *(Chap.11)*.

(20) Carry out flight trim checks as specified in Appendix 1.

**Rudder control rigging** *(fig.14)*

**35.** To rig the rudder control:-

(1) Disconnect the rudder control rod *(detail 1, point A)* from the upper end of the control lever, and screw back the upper and lower stop screws on the pressure bulkhead. These operations, except for the lower limit stop screw, can be made through the battery bay on the port side of the fuselage. The lower limit stop screw is on the forward face of the pressure bulkhead.

(2) Turn the adjustment screw on the rudder bar until the pedals are in their neutral position and the two portions of the rudder bar are in line.

(3) Set the rudder bar in its neutral position (at right angles to the centre line of the fuselage) and lock it in this position.

(4) Set the control lever, aft of the pressure bulkhead *(fig.19)* to its neutral position (7.4 in., measured square from the pressure bulkhead to the upper control attachment bolt centre), by adjusting the control rod at point B *(detail 1)*.

(5) Unlock the rudder bar and apply port rudder until the port pedal is 27 deg ± 0 deg 15 min. forward of the neutral position. Adjust the lower control limit stop screw on the pressure bulkhead *(detail 1)* until it contacts the lower arm of the lever. Tighten the locking nut.

(6) Apply starboard rudder until the starboard pedal is 25 deg ± 0 deg 15 min forward of the neutral position and adjust the upper control limit stop screw on the pressure bulkhead *(detail 1)* until it contacts the upper arm of the lever. Tighten the locking nut.

(7) Reconnect the rudder control rod *(detail 1, point A)* to the upper end of the lever at the pressure bulkhead.

(8) Lock the rudder bar at neutral *(para.19)*.

(9) Disconnect the control rod from the rudder lever at point E, and lock the rudder in its neutral position by applying a clamp between the lower edge of the rudder and rudder stub, forward of the spring tab.

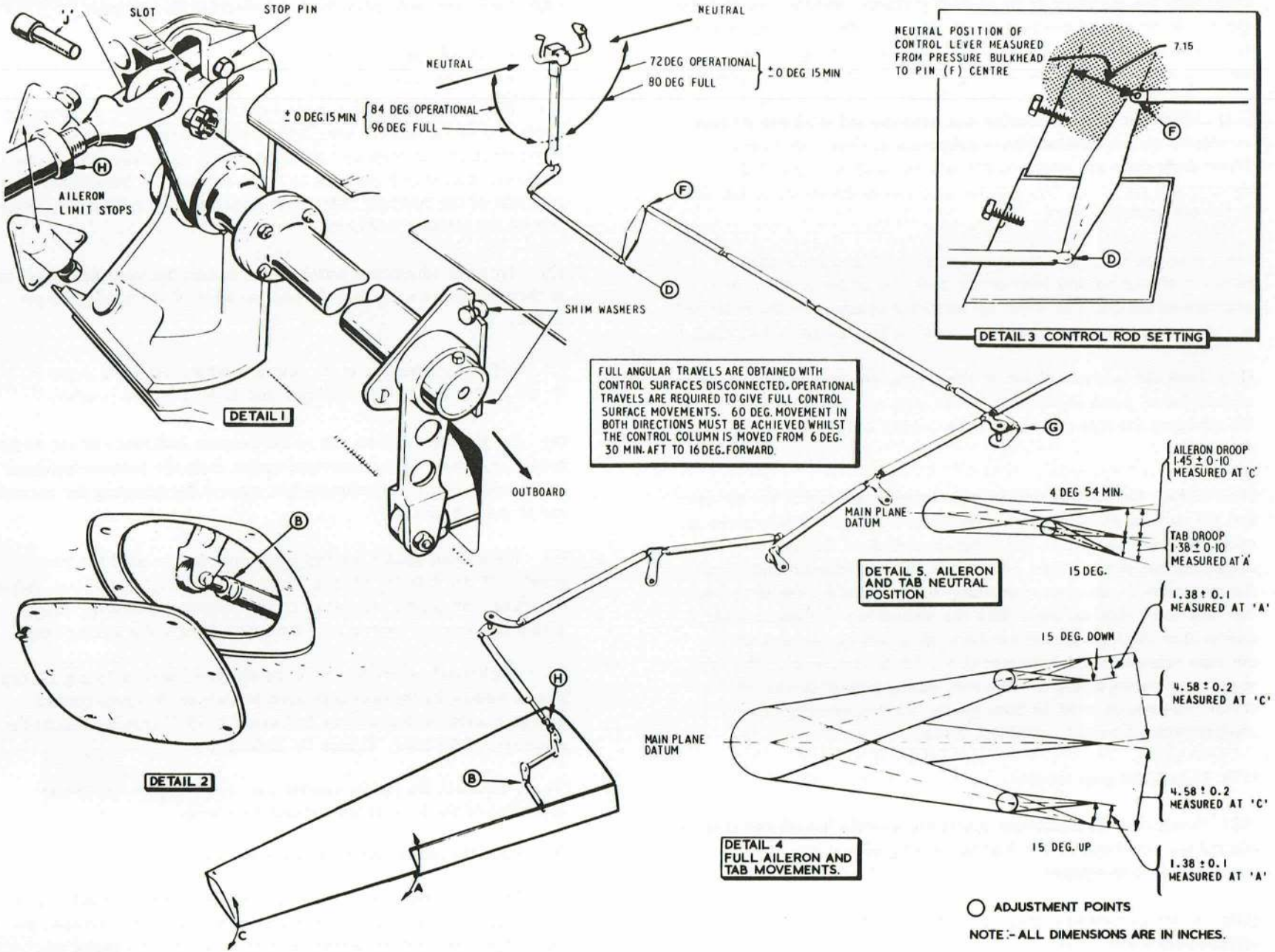



**FIG. 12. AILERON CONTROL RIGGING**

(10) Operate the trim tab actuator until its pin centres are set at 8.90 in. ± 0.125 in. and adjust the tab actuating rod on the starboard side of the rudder until the tab is in line with the rudder.

(11) Set the control lever *(detail 2)* on the bulkhead at frame 42 to its neutral position (8.65 in. ± 0.10 in. measured square from the bulkhead to the control attachment bolt centre) by adjusting the control rod at point D.

(12) Reconnect the control rod to the rudder lever at point E, adjusting the fork end of the control tube at points C or E, as necessary.

(13) Remove the lock from the rudder and unlock the rudder bar.

(14) Apply port rudder until the rudder stop is contacted and ensure that the rudder movement is 25 deg to port (linear dimension 23.10 ± 1.00 in. at point G).

(15) Apply further port rudder until the tab has moved 18 deg to starboard (linear dimension measured from the inboard edge of the tab to the centre of the trailing edge of the rudder must be 1.73 in. $\pm \frac{0.00}{0.10}$ in. as shown in detail 3, point F).

(16) Repeat operations (14) and (15) but with starboard rudder and check the movement of the rudder and tab; these must be the same as for port rudder.

**Note . . .**

*1. The measurements given in operations (14) and (15) are obtained with the rubber stop pads removed. With the stop pads in position and normal force applied to the rudder bar, the linear measurement given in operation (14) must be 21.75 in. ± 1.00 in.*

*2. If the rudder tab movement, operation (15), is in excess of 18 deg a new rudder tab operating lever stop plate Ref.No.26FZ/5495 (fig.20) must be fitted, and the stop faces filed, if necessary, to obtain the desired 18 deg movement. Similarly if the 18 deg movement is unobtainable, the existing stop plate must be filed. The correct protective treatment (A.P.119A-0509-1) must be applied to all filed surfaces.*

(17) Ensure that all adjustment points are securely locked and that the control rod couplings do not foul the roller guides at any position of the rudder bar.

**Lubrication**

**36.** The lubrication points in the flying control system are illustrated in fig. 18, 18A and 18B and these should be read in conjunction with the Lubrication Marker Card (Leading Particulars). With the exception of the air brakes drag channel rollers which are lubricated with oil OX-14, and the prepacked roller bearings, all points are to be lubricated with low temperature grease XG-287.

**Note . . .**

*No grease or oil is to be applied to the flying control push-pull rods or their roller guides.*

## REMOVAL AND ASSEMBLY

**General information**

**37.** The following paragraphs contain information on the removal and assembly of certain components of the flying controls. Only the removal operations are described, since the assembly is generally the reverse of these operations; where this is not the case, the fact is noted. The recommended sequence of operations is given, although in some cases it will be clear that it is not essential to adhere rigidly to the sequence. The necessary ground equipment is listed in Sect.2, Chap.4.

**Control column**

**38.** To remove the control column:-

**WARNING . . .**

**Ensure that all relevant safety precautions as detailed on the LETHAL WARNING marker card have been observed.**

**Note . . .**

*To prevent ingress of swarf, and/or scoring of the inner torque tube, control columns fitted with a vertical conduit channel must not have the channel removed in situ, or the channel attachment rivets substituted by PK self-tapping screws.*

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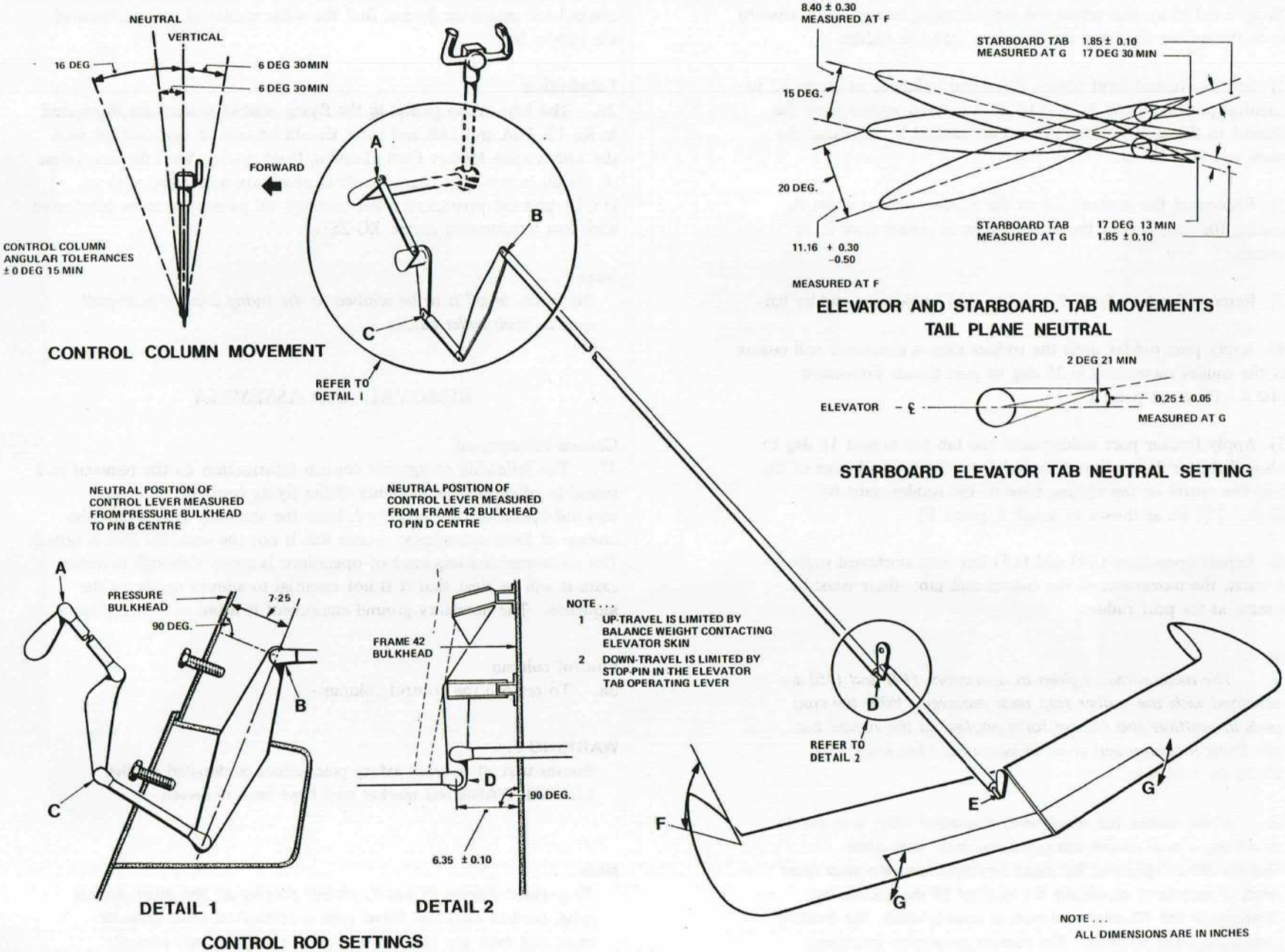
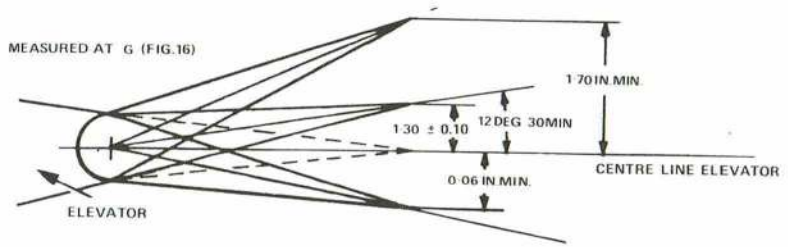



FIG.13 ELEVATOR CONTROL RIGGING (1)

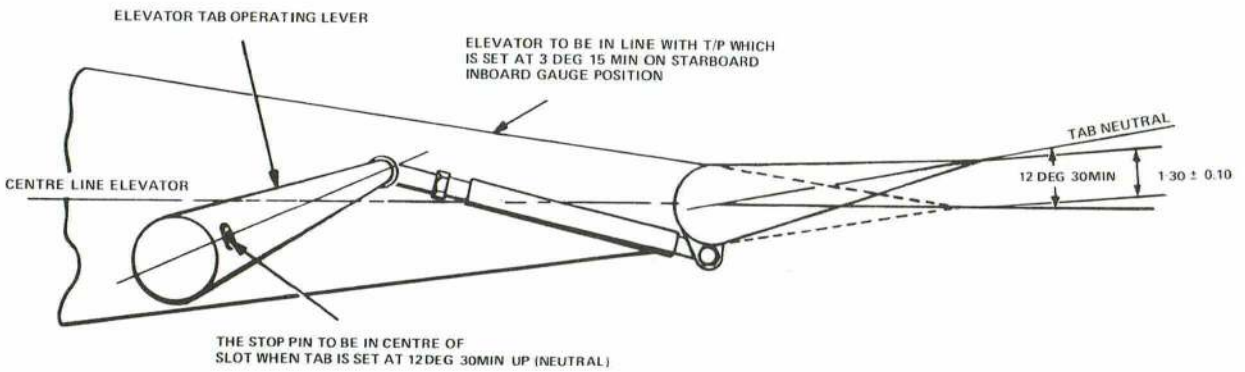
**DETAIL A**

NOTE . . .

UP-TRAVEL AND DOWN-TRAVEL IS LIMITED
BY STOP-PIN IN ELEVATOR TAB-OPERATING LEVER




**PORT TAB MOVEMENT – ELEVATOR LOCKED NEUTRAL**




**PORT ELEVATOR TAB RIGGING**

NOTE. . .
ALL DIMENSIONS ARE IN
INCHES, UNLESS OTHERWISE
STATED

**FIG. 13A ELEVATOR CONTROL RIGGING (2)**

(1) Disconnect all electrical supplies.

(2) Remove the pilot's seat bucket.

(3) Remove the screws securing the port foot ramp to the floor of the cockpit and remove the foot ramp.

(4) Remove the two leather dust covers from the base of the control column.

(5) Remove the two sealing cover plates, one at each side of the base of the control column.

(6) Remove the cover plate in the floor of the cockpit, forward of the control column, and the cover plate in the floor to port of the control column.

(7) Remove the access panels on the inboard face of the pilot's console (forward end).

(8) Disconnect the aileron control rod from the lever at the bottom of the control column, and the elevator control rod and snatch unit from within the pilot's console *(Chap.11)*.

(9) Disconnect the wheel brakes Bowden cable at the top of the control column, and remove the cable adjusters and the clips retaining the Bowden cable to the control column. Remove the cable.

◀ **CAUTION . . .**

**1. Prior to reassembly of the Bowden cable to the control valve, check the cable for damage to the strands, and for kinking. If either are evident the cable must be replaced.**

**2. When a new cable is to be fitted the nipple end may require dressing to suit the control valve. Extreme care must be used during this process to ensure the cable is not kinked or its strands damaged.** ▶

**Note . . .**

*Check the conduit socket EA1-45-123, which retains the brake cable at the top of the control column, for security of the rivets before replacing the cable (Fig.1).*

(10) Disconnect the electrical cables from the terminal block beneath the cockpit floor, forward of the control column.

(11) Remove the eight 2 B.A. bolts securing the elevator torque tube bearing retaining plate to the inner face of the console.

(12) Remove the four ¼ in. dia. bolts from the control column support casting.

(13) Partly lift the control column, release the bias spring from its attachment on the aileron control lever, move the control column slightly to starboard and remove it from the cockpit floor.

**Rudder bar**

**39.** To remove the rudder bar:–

(1) Disconnect the control rod from the rudder main operating lever at the bottom of the rudder bar torque tube.

(2) Disconnect the brake control valve lever from the rudder main operating lever.

(3) Remove the four ¼ in. dia. nipples from the two spokes retaining the rudder main operating lever to the rudder bar torque tube, and withdraw the spokes.

**Note . . .**

*Close tolerance 5/16 in. bolts may be fitted in lieu of the spokes (A.P.101B-0400-6, Repair leaflet B.2/27).*

(4) Remove the rudder main operating lever.

(5) Remove the eight ¼ in. dia. bolts securing the rudder bar pedestal to the cockpit floor, and remove the rudder bar.

**Pressure box** *(fig.3)*

**40.** Whenever a pressure box assembly has been refitted or replaced, a cabin pressure test must be made *(Chap.8A)*. Each control must be moved over its full range at least three times when the pressure test is in progress. Refer to the relevant rigging diagram and reset the lever limit stops.

**Note . . .**

*It may be found on reassembly that a new rubber seal Ref. No. 26FZ/12173 is required between the bulkhead and pressure box.*

**Aileron spring-tab mechanism** *(fig.15)*

*Removal*

**41.** To remove an aileron spring-tab mechanism:–

(1) Remove the aileron *(Sect.3, Chap.2)*.

(2) Remove the access panels from the leading edge of the aileron and disconnect the tab operating rod from the torque tube lever.

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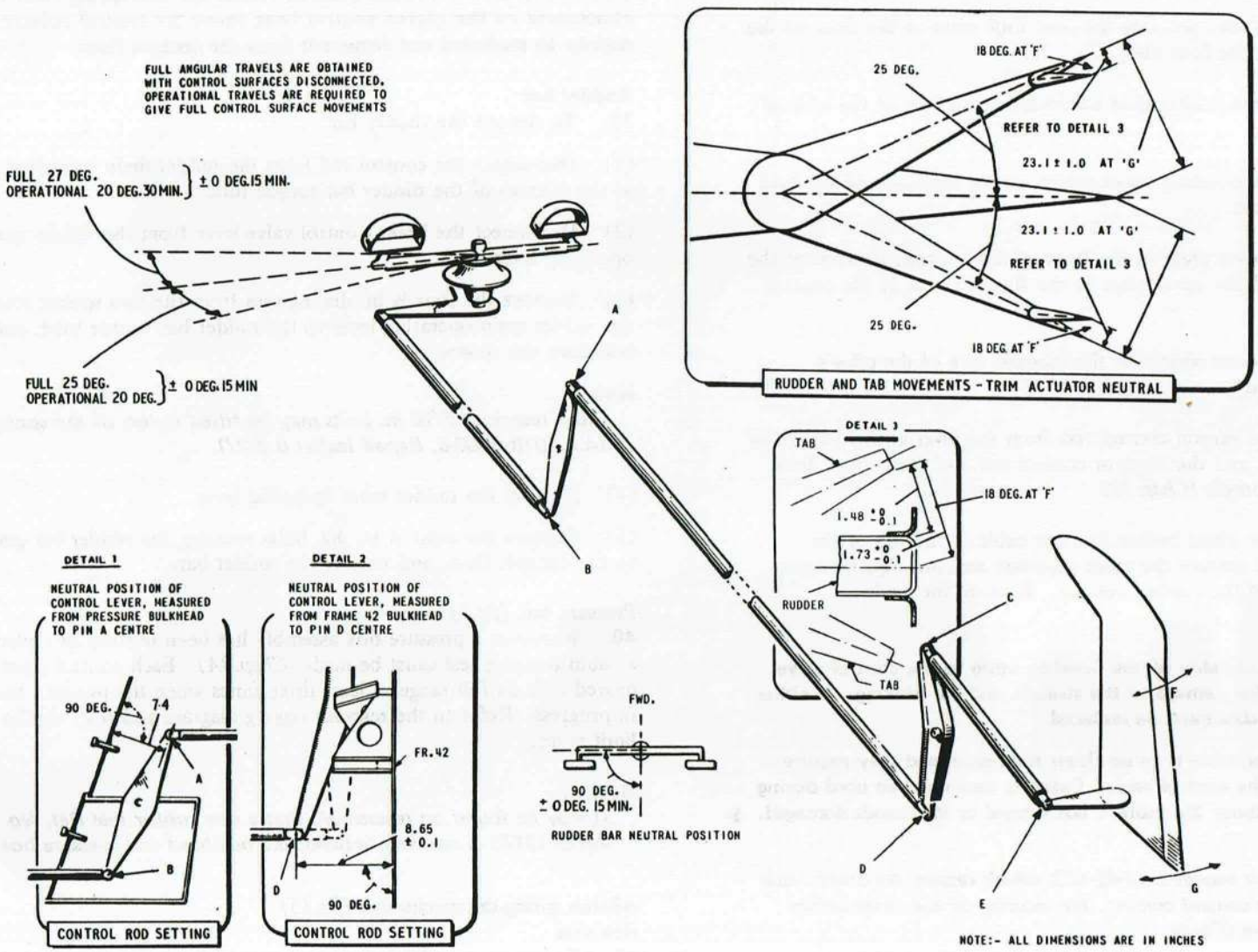



**FIG.14. RUDDER CONTROL RIGGING**

(3) Remove the stop bolt and bush from the slot in the aileron operating lever arm at the inboard end of the tab operating gear assembly *(detail B)*.

(4) Remove the bolt securing the torque tube lever to the blow-back rod at the outboard end of the assembly *(detail A)*.

(5) Using an extractor *(Sect.2, Chap.4, Table 1)*, withdraw the tab-operating lever from the splines of the blow-back rod *(detail A)*.

(6) Remove the two bolts attaching the mounting bracket at the outboard end of the tab operating mechanism, to the aileron spar.

(7) Ease the spigot, at the inboard end of the tab operating gear, from its ballrace and withdraw the mechanism from the aileron.

*Assembly*

**42.** The assembly sequence for refitting the existing spring-tab mechanism is the reverse of that given for the removal.

**Note . . .**

*Between the outboard mounting bracket and the aileron spar, shim washers are fitted which are used to adjust the spring-tab mechanism (detail A). It is important that these shim washers are refitted in their original positions, as neglecting to do this may subject the torque tube assembly to undue strain.*

*Assembly of a new spring-tab mechanism*

**43.** Assemble a new spring-tab mechanism as follows:-

(1) Assemble the original outboard mounting bracket to the new spring-tab mechanism, with the flange of the bracket positioned approximately parallel to the bolt hole in the splined end of the blow-back rod.

(2) Assemble the mechanism into the aileron and temporarily bolt the mounting brackets to the aileron spar, fitting between the mounting bracket and the spar, a shim washer at both bolt positions.

(3) Assemble the stop bolt and bush through the slot in the aileron operating lever at the inboard end of the tab operating gear *(detail B)*.

(4) Assemble the torque tube lever to the splined end of the blow-back rod, and fit the bolt, nut, saddle washers and split pin *(detail A)*.

(5) Fit the tab operating rod.

(6) Check, that with the stop bolt at the aft end of the slot in the aileron operating lever, there is no pre-loading in the torque tube. If pre-loading is found, adjustment to relieve it may be made on the outboard mounting bracket attachment bolts by transferring shims from one bolt position to the other.

**Note . . .**

*Between the outboard mounting bracket and the aileron spar, a 0.040 in. shim washer is fitted at both attachment bolt positions (detail B). In order to maintain existing torque tube centres any shimming removed from one bolt position must be fitted at the other. Both shim packs may be fitted at one bolt position (i.e. 0.080 in. at one bolt and none at the other) or it is permissible for the shims to be fitted in any combination (e.g. 0.060 in. and 0.020 in., or 0.070 in. and 0.010 in.) providing total amount of shimming does not exceed 0.080 in.*

(7) Adjust the tab operating rod to give the tab a 15 deg droop.

(8) Refit the aileron to the aircraft *(Chap.2)*.

(9) Rig the aileron control *(fig.12)*.

(10) Carry out flight trim checks as detailed in Appendix 1.

**Port elevator spring-tab mechanism** *(fig.16)*

*Removal*

**44.** Remove the port elevator spring-tab mechanism as follows:-

(1) Refer to Chap.3, and remove the port elevator from the aircraft.

(2) Obtain access to the outboard end of the tab-operating gear assembly by removing the panel in the top surface of the elevator *(Sect.2, Chap.4)*.

(3) Unfasten the nut and withdraw the bolt that secures the tab operating lever to the extreme outboard end of the tab operating gear assembly.

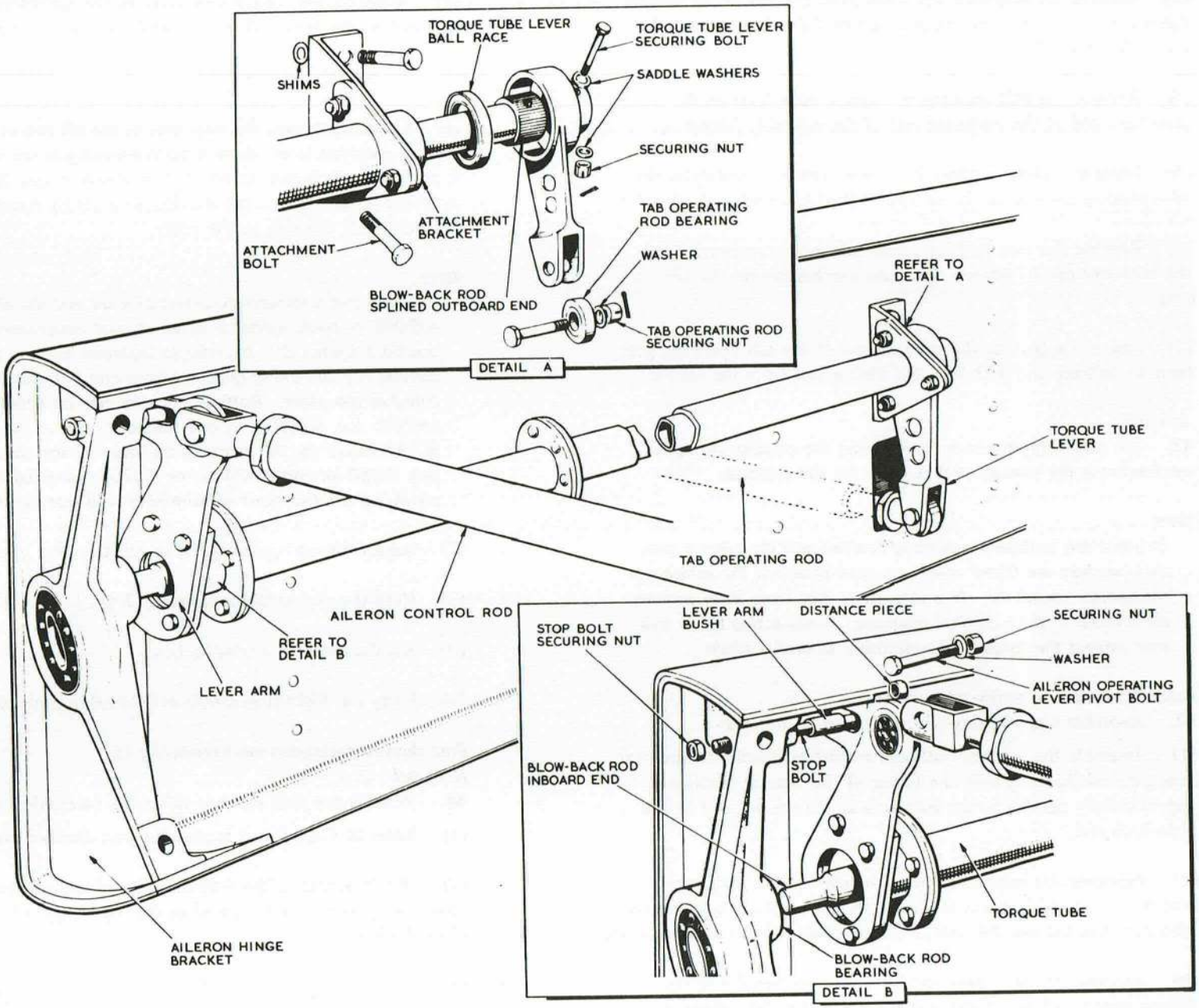



FIG.15. AILERON SPRING-TAB MECHANISM REMOVAL

(4) Remove the split pin from the shackle pin, and withdraw the shackle pin from the slots in the links at the inboard end of the tab operating gear, and allow the links to swing downwards clear of the main operating lever.

(5) Remove the two nuts and withdraw the bolts securing the bearing bracket to the elevator main spar at the extreme inboard end of the torque tube assembly.

(6) Break the locking wire and slacken the torque tube clamp nut which secures the outboard end of the assembly to the outboard bearing bracket; the complete torque tube assembly can then be withdrawn through the inboard end of the elevator.

*Assembly*

**45.** Assemble the port elevator spring-tab mechanism as follows:-

(1) Offer up the torque tube, the inboard bearing bracket, the blow-back rod, and the main operating lever, to the elevator.

(2) Pass the splined end of the torque tube through the clamp nut into the tab operating lever; fit and tighten the tab operating lever securing bolt.

(3) Fit the two bolts which attach the inboard bearing bracket to the elevator main spar.

(4) Tighten the torque tube clamp nut, and ensure that the gap between the outboard bearing bracket and the tab operating lever does not exceed 0.25 in. *(detail A).*

**Note . . .**

*If this dimension cannot be obtained, or when fitting a new rod, refer to A.P.101B-0400-6.*

(5) Secure the links to the main operating lever by fitting the shackle pin, together with its associated washers and split pin.

(6) With the top surface of the elevator uppermost, the centres of the shackle pins must be 3.12 in. apart. With the stop pin in the centre of the slot of the tab operating lever *(detail A)*, and the tab in its neutral position (12 deg 30 min up), clamp together the main operating lever and the flanges of the torque tube and blow-back rod.

(7) Check the tab movements.

(8) From the 5/32 in. dia. pilot holes in the flange of the blow-back rod, drill and ream (0.185 in. dia.) the main operating lever and the flange of the torque tube. Secure the assembly with four countersunk bolts, and remove the clamps fitted in operation (6).

(9) Wire-lock the torque tube clamp nut.

(10) Fit the access panel to the top surface of the elevator.

(11) Refit the elevator to the aircraft *(Chap.3).*

(12) Rig the elevator controls *(fig.13).*

(13) Carry out flight trim checks as detailed in Appendix 1.

**Note . . .**

*The above instructions are for fitting a new blow-back rod, torque tube, and main operating lever. If the torque tube and blow-back rod assembly is being refitted in the same elevator from which it was removed, the fitting of the clamps, drilling and reaming, will not be necessary*

**Rudder spring-tab mechanism**

*Removal (fig.17)*

**46.** Remove the rudder spring-tab mechanism as follows:-

(1) Remove the rudder from the aircraft *(Chap.3).*

(2) Remove the two access panels from the base of the rudder nose.

(3) Disconnect the tab actuator and remove it from the rudder.

(4) Remove the two 2 B.A. bolts securing the stop bracket to the rudder hinge bottom bracket.

(5) Remove the two ¼ in. dia. B.S.F. bolts securing the rudder hinge bottom bracket to nose rib 2 behind the rudder spar.

(6) Remove the thirty one 2 B.A. bolts which secure the rudder hinge bottom bracket to the rudder.

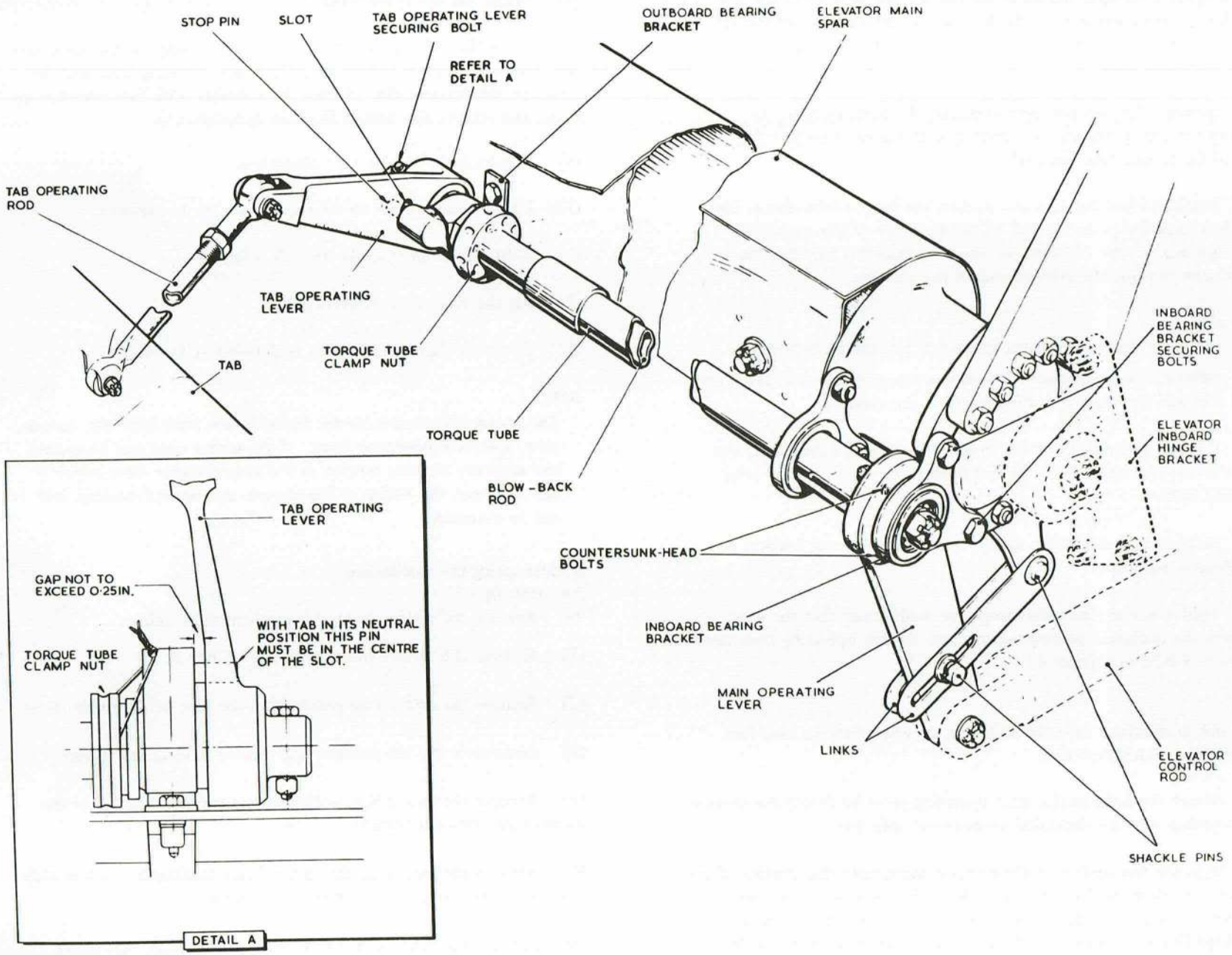



FIG.16. PORT ELEVATOR SPRING-TAB MECHANISM REMOVAL

**Note . . .**

*Ensure that the rudder hinge bottom bracket is completely free from the rudder.*

(7) Remove the access panel at rib 6 from the rudder nose.

(8) Unfasten the nut and withdraw the bolt that secures the tab actuating lever to the splined end of the blow-back rod.

(9) Remove the two diametrically opposite bolts which secure the upper bearing housing to rib 6, and fit the special extractor *(Sect.2, Chap.4, Table 1)*.

(10) By operating the extractor, force out the torque tube assembly complete with the rudder bottom hinge bracket and stop bracket, taking care to keep the main operating lever kidney slot clear from the rudder spar.

**Note . . .**

*In some cases the spring-tab mechanism may be extremely difficult to remove; this is generally caused by the upper and outer torque tube bearings binding in their bearing housings. If all the above operations have been correctly followed and the rudder hinge bottom bracket is free, it may be advantageous to remove the main operating lever and, although this will not actually assist in the mechanism removal, a greater twisting movement can be applied to the tab actuator lever, and this action, together with the downward force of the extractor (operation (10)) will free the mechanism from the rudder.*

*Dismantling*

47. Remove the two self-tapping screws which fasten the sealing plate over the bearings at the base of the tab mechanism. Remove the sealing plate. Separate the rudder bottom hinge bracket from the tab mechanism at the bottom bearing using separating tool Pt.No.EB6.88.101.

*Assembly*

48. The sequence of assembly for a removed rudder spring-tab mechanism is the reverse of the removal procedure.

**Note . . .**

*In preparation, ensure that the bearing between the inner and outer torque tube, and the outer torque tube bearing, are packed with grease XG-287.*

*Assembly of a new spring-tab mechanism*

49. Assemble a new rudder spring-tab mechanism as follows:-

**Note . . .**

*In preparation, ensure that the bearing between the inner and outer torque tube, and the outer torque tube bearing, are packed with grease XG-287.*

(1) Assemble the rudder bottom hinge bracket to the new spring-tab mechanism, and fit the spigot and bearings into the bottom hinge bearing housings.

(2) Secure the sealing plate over the bearing housing using two self-tapping screws and jointing compound Ref.No.33H/2202110.

(3) At the access panel at rib 6 on the rudder nose, remove the two remaining bolts which secure the upper bearing bracket to the rib, and disconnect the tab control lever from the tab actuating rod. Remove the tab actuating lever and bearing housing complete. Pack the upper bearing with grease XG-287.

(4) Offer up the assembly to the rudder and fit the bolts which secure the rudder bottom hinge bracket and stop bracket.

◀ (5) Manufacture a block to fit to each side of the stop bolt, thus centralizing it in the kidney slot. With the actuator in mid position, refit it to the rudder and connect the tab actuator lever to the ram, adjusting ram as required. Remove blocks from slot on completion of rigging. ▶

(6) Locate the tab actuating lever and upper bearing housing on to the splined end of the blow-back rod, and position it with the lever mid way between its stops.

(7) With the tab set in its neutral position, reconnect the tab actuating rod to the tab actuating lever. Refit the four bolts which secure the upper bearing housing.

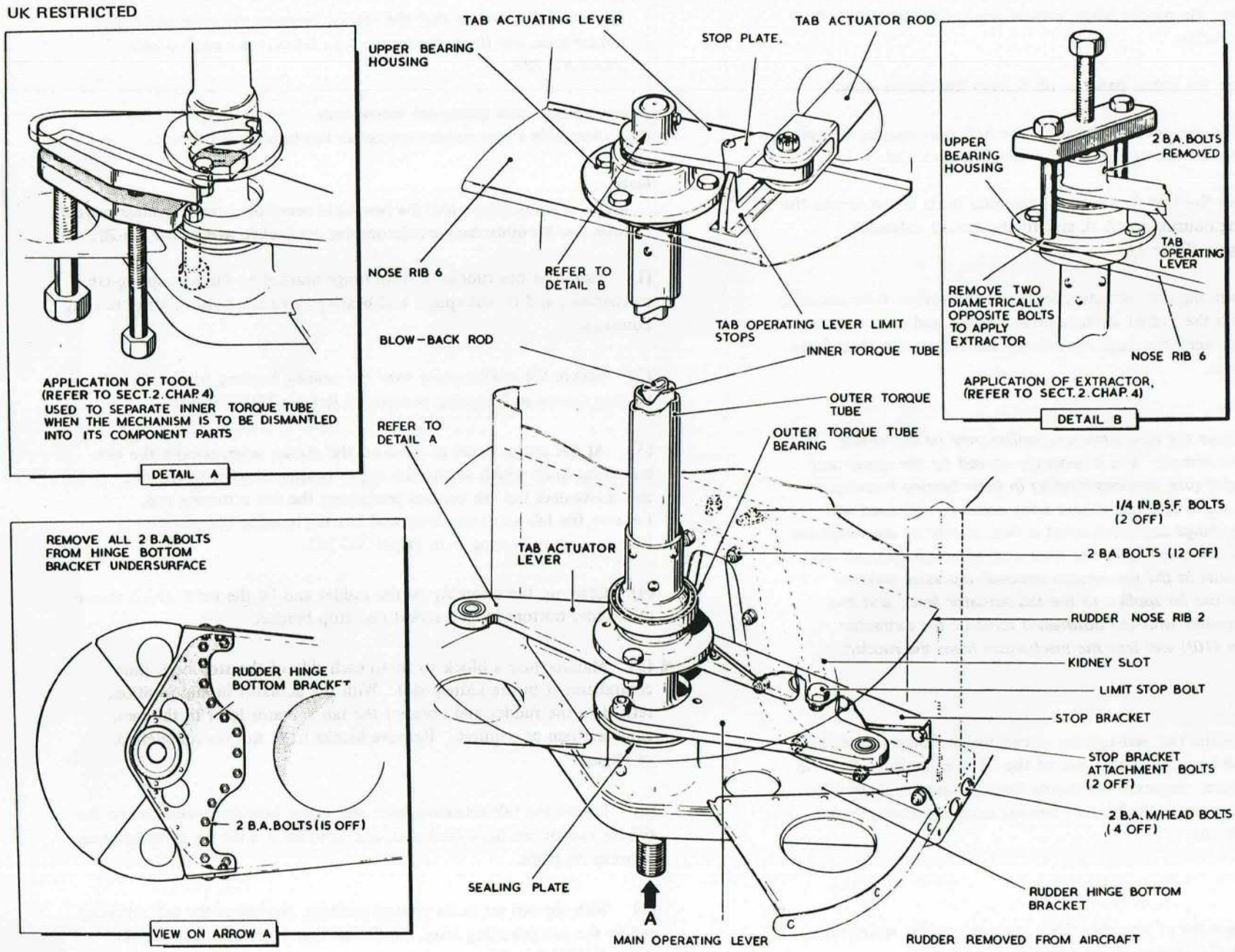



FIG.17. RUDDER SPRING-TAB MECHANISM REMOVAL

(8) Operate the tab, and check that the maximum travels quoted in fig.14 are obtained, and that the stops of the tab actuating lever are reached before the limit stop reaches the ends of the kidney slot.

(9) Ensure that no foul occurs between the sealing plate and the bolts which secure the main operating lever when the lever is moved through its complete travel.

(10) Through existing holes in the tab actuating lever drill a $\frac{3}{16}$ in. dia. hole in the splined end of the blow-back rod.

(11) Secure the tab actuating lever by using a new 2 B.A. nut and bolt, and the two existing saddle washers. Centre punch to lock.

(12) Refit the access panels.

**Note . . .**

*The screws securing the access panel at rib 6, in the rudder nose, must be of the correct length (0.4 in. thread length) to obtain satisfactory locking.*

(13) Refit the rudder to the aircraft *(Sect.3, Chap.3).*

(14) Rig the rudder controls *(fig.14).*

**Note . . .**

*1. If the rudder tab movement is in excess of 18 deg, a new rudder tab operating lever stop plate Ref.No.26FZ/5495 must be fitted, and the stop faces filed, if necessary, to obtain the desired 18 deg movement. Similarly, if the 18 deg movement is unobtainable, the existing stop plate must be filed. The correct protective treatment (A.P.119A-0509-1) must be applied to all filed surfaces.*

*2. The sequence for fitting a reconditioned rudder spring-tab mechanism Ref.No.26FZ/2102 is similar to the above, except that the drilling detailed in operation (10) will already have been done when the blow-back rod was fitted to its original rudder. Should it be necessary to misalign this hole relative to the hole in the tab actuating lever to obtain a condition of 'no foul', the misalignment must be corrected by drilling through with a ¼ in. dia. drill, and fitting a larger bolt at operation (11).*

(15) Carry out a flight trim check as detailed in Appendix 1.

**Aileron bias actuator** *(fig.2)*

**50.** To remove the aileron bias actuator:-

(1) Remove the floor cover plate forward of the control column.

(2) Disconnect the electrical cables from the actuator.

(3) Turn the control column handwheel fully to starboard; this will give greater ease of access to the aileron bias lever.

(4) Remove the split pin, nut and bolt securing the actuator ram to the actuator lever.

(5) Remove the split pin, nut and shouldered bolt securing the actuator to the floor beam, and remove the actuator.

**Rudder trim actuator**

**51.** To remove the rudder trim actuator:-

(1) Remove the actuator access panel on the starboard side of the fin.

(2) Disconnect the electrical cables from the actuator.

(3) Remove the split pin and nut from the bolt connecting the actuator ram to the actuator lever and remove the bolt.

(4) Remove the split pin from the shouldered bolt attaching the actuator to the mass balance lever and remove the bolt.

(5) Remove the actuator.

**Tail-plane actuator**

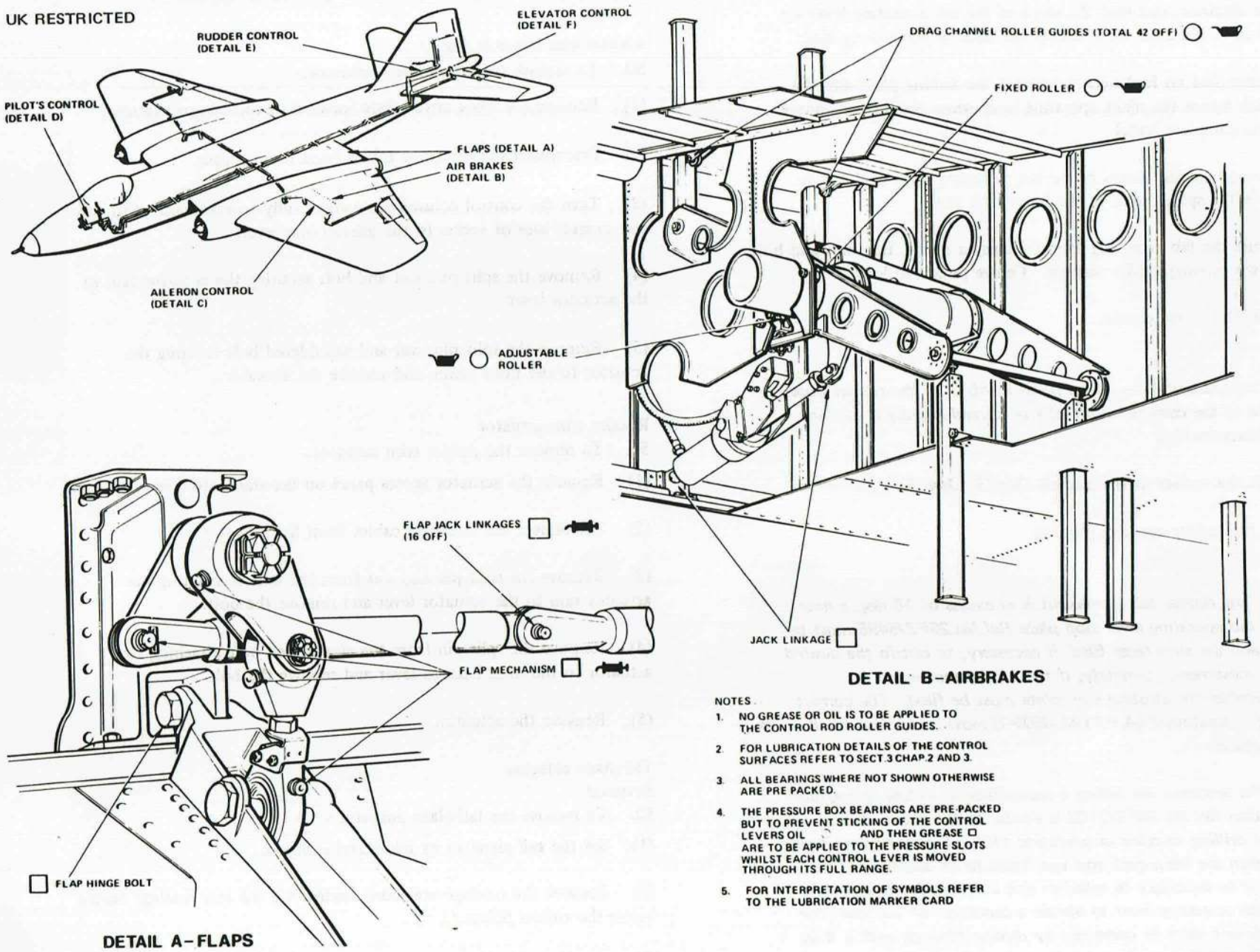
*Removal*

**52.** To remove the tail-plane actuator:-

(1) Set the tail plane to its mid-travel position.

(2) Remove the fuselage rear cone fairing and the rear fuselage fairing below the rudder *(Chap.1).*

(3) Disconnect the electrical cables from the actuator.




NOTES

1. NO GREASE OR OIL IS TO BE APPLIED TO THE CONTROL ROD ROLLER GUIDES.
2. FOR LUBRICATION DETAILS OF THE CONTROL SURFACES REFER TO SECT.3 CHAP.2 AND 3.
3. ALL BEARINGS WHERE NOT SHOWN OTHERWISE ARE PRE PACKED.
4. THE PRESSURE BOX BEARINGS ARE PRE-PACKED BUT TO PREVENT STICKING OF THE CONTROL LEVERS OIL AND THEN GREASE ARE TO BE APPLIED TO THE PRESSURE SLOTS WHILST EACH CONTROL LEVER IS MOVED THROUGH ITS FULL RANGE.
5. FOR INTERPRETATION OF SYMBOLS REFER TO THE LUBRICATION MARKER CARD

FIG.18. LUBRICATION DIAGRAM (1)

(4) Remove the five seal adjustment bolts from each side of the tail plane.

(5) Attach a tail-plane sling *(Sect.2, Chap.4, Table 1)*, to the tail plane *(Chap.3)*.

(6) Remove the split pin and nut from the bolt attaching the actuator to the reinforcement piece on frame 46 of the fuselage.

(7) Raise the sling until it takes the weight of the tail plane off the actuator, and withdraw the actuator attachment bolt.

(8) Remove the locking pin from the bolt connecting the actuator ram to the tail plane, and withdraw the bolt.

(9) Withdraw the actuator from the underside of the tail plane.

**Note . . .**

*When the actuator has been removed a tail-plane jury strut (Sect.2, Chap.4, Table 1) must be fitted before detaching the tail-plane sling.*

*Assembly*

**53.** Assemble the tail-plane actuator as follows:-

**Note . . .**

*Ensure that the actuator cables T33H (not used) and T33L have a free length of 17 to 19 in. between the cable clamp at frame 46 and the tail-plane actuator socket.*

Assemble the tail-plane actuator to the aircraft in the reverse order to that given in para.52 and carry out the following checks:-

(1) The tail plane must be set to the neutral position, i.e. 3 deg 56 min incidence measured at the starboard rigging position, and the sealing strips adjusted to give the following clearances:-

(a) Between the sealing strips (2-bolt position) and the tail-plane stub fairing, 0.04 in. minimum.

(b) Between the sealing strips (3-bolt position) and the tail-plane stub fairing, 0.02 in. minimum.

(2) Ensure complete freedom of movement throughout the full range of tail-plane travel.

(3) Whenever a tail-plane actuator has been replaced or adjusted, a flight trim check as detailed in Appendix 1 must be made to ensure that the aircraft trim is within the permitted limits. Should the aircraft trim be outside these limits, a new trailing-edge strip must be fitted and the flight trim checks repeated until a satisfactory result is obtained.

**Flying control rod assemblies**

**54.** The fork end fittings of flying control rods are machined with a counter-bored recess on the outer face of one of the lugs concentric with the bolt hole. This recess is provided to accommodate the nut, when the rods are connected. Should the bolt be reversed on assembly, i.e. with the bolt head in the recess, fouling with the airframe may occur at frame 12. An exception is at the connection of the control rods to the aileron levers at which point the bolt must be inserted from inboard and the head must locate in the recess in the forked end *(fig.15, 'J')*.

**Limits on Fairey roller guides**

**55.** During assembly of the control rods, the following procedure should be adopted to obtain the correct clearance between the control rods and the roller guides:-

(1) Assemble the control rods through the fairleads.

(2) Release the locking screw in each adjustable roller guide assembly and, at the point of maximum diameter, adjust until the three rollers in each assembly are in contact with the control rods.

(3) Tighten the locking screws and recheck the adjustment.

(4) Move the control rods to the slackest position of travel, at which point the following clearances between the rod and any one roller must not exceed 0.006 in. at the fairlead nearest to any lever motion and 0.012 in. at any other fairlead.

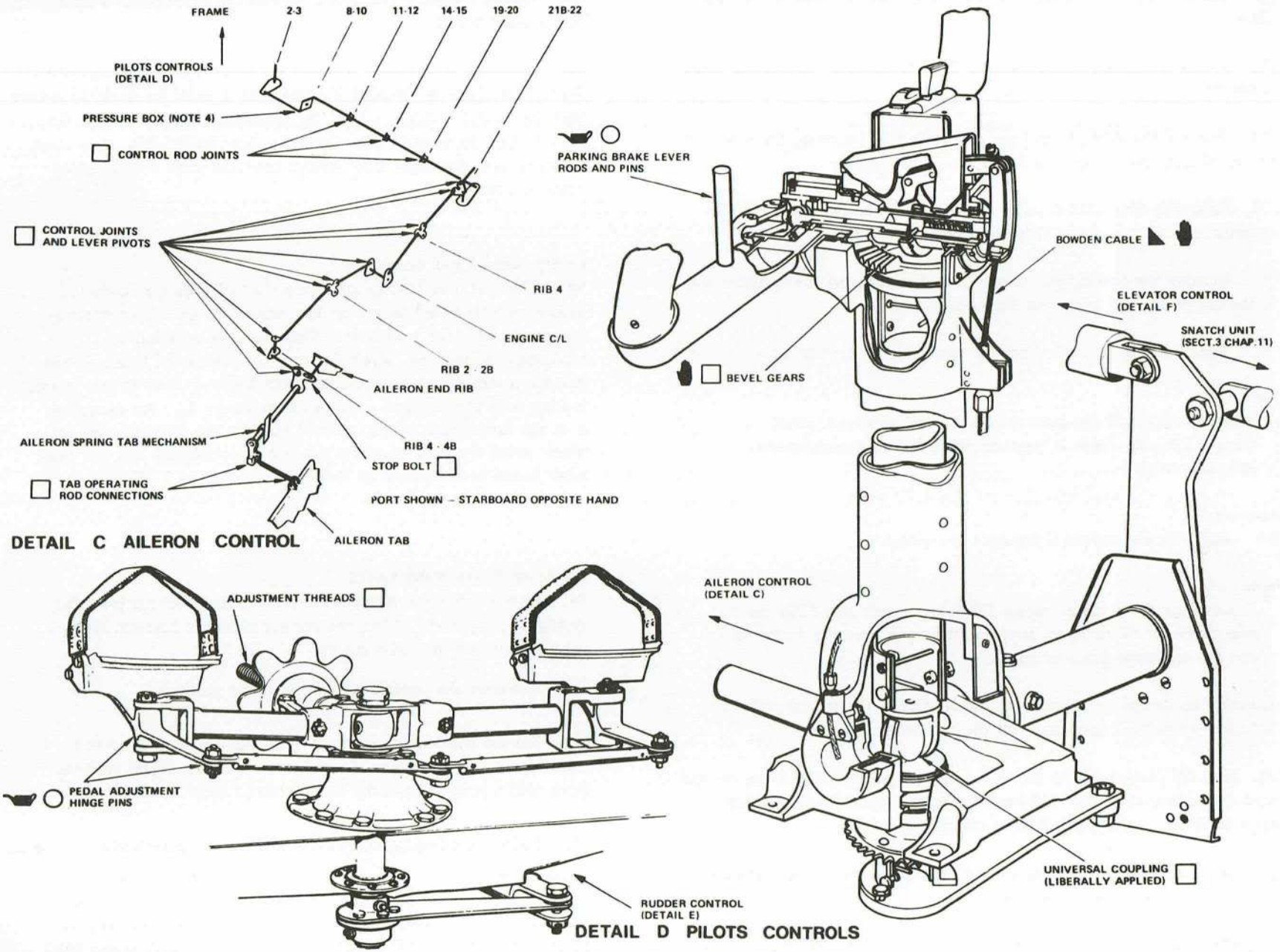
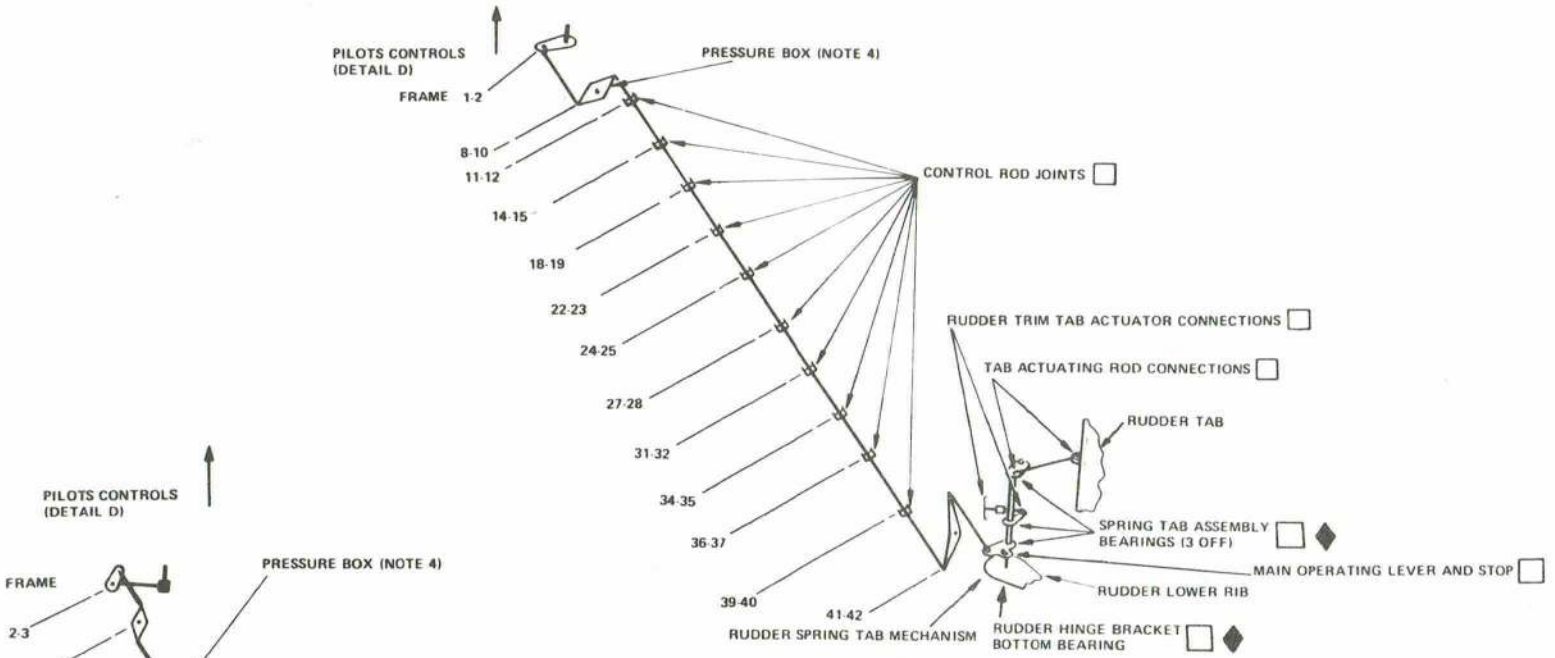
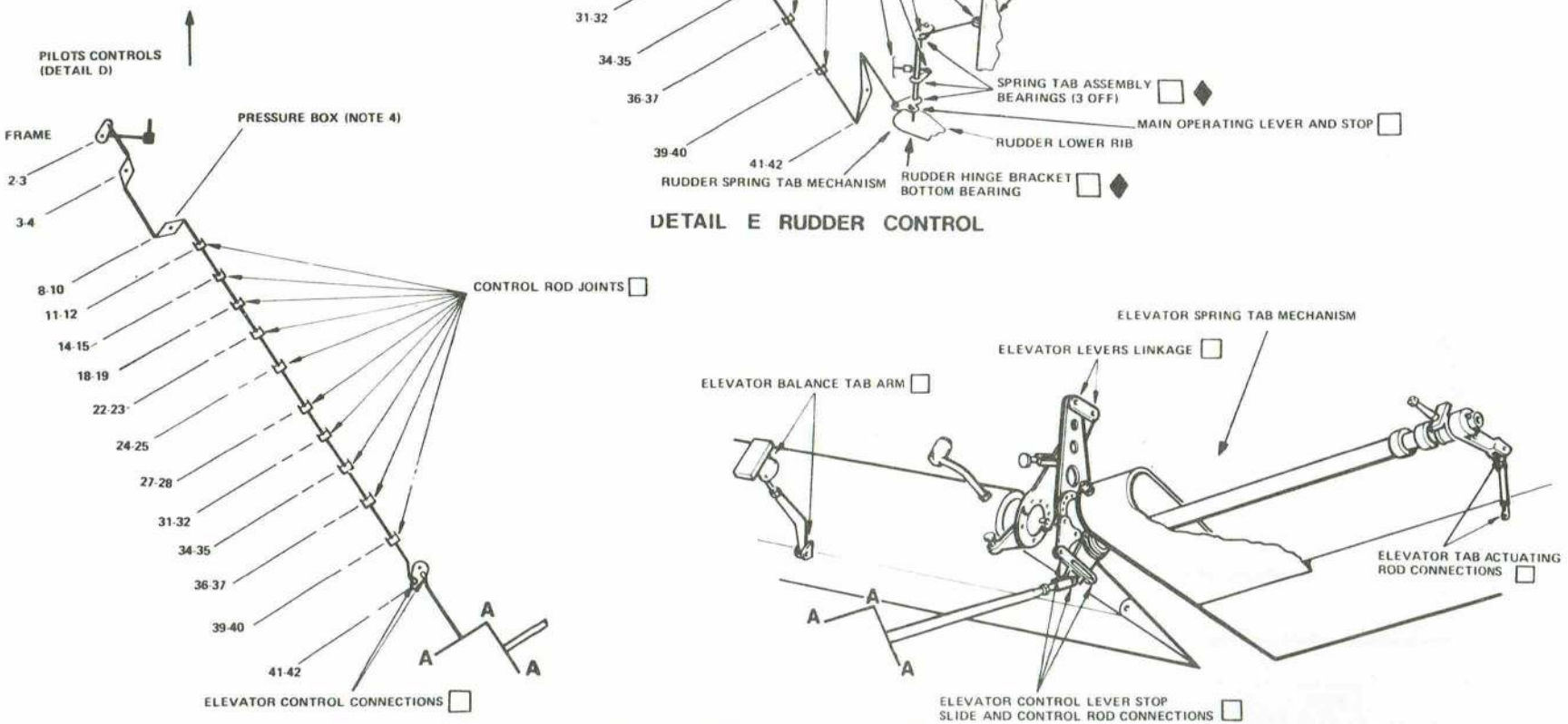



FIG.18A. LUBRICATION DIAGRAM (2)




DETAIL E RUDDER CONTROL




DETAIL F ELEVATOR CONTROL

FIG.18B. LUBRICATION DIAGRAM (3)

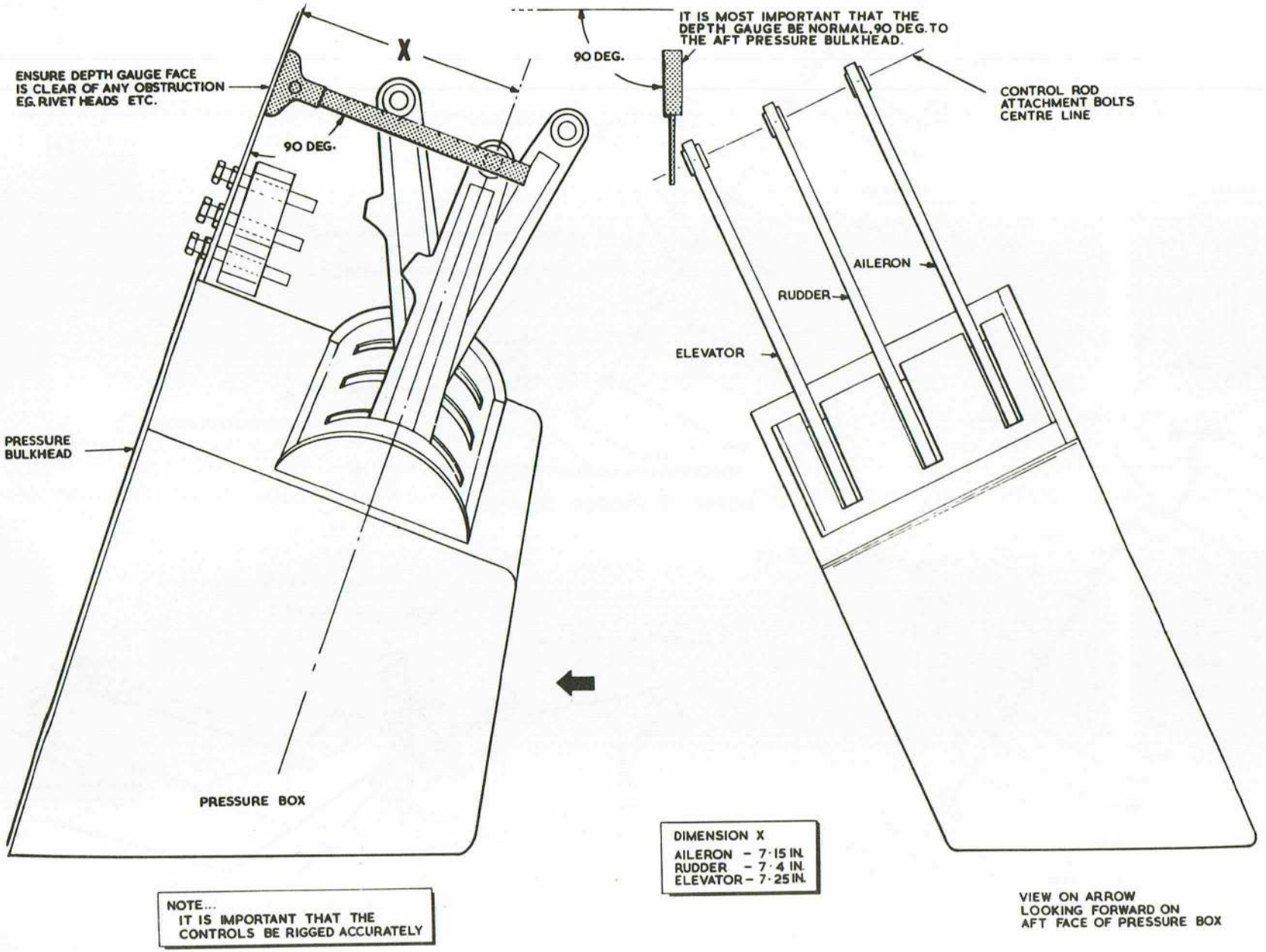



FIG.19. CONTROL LEVER RIGGING

# Appendix 1 FLIGHT TRIM CHECKS

*(completely revised)*

## LIST OF CONTENTS

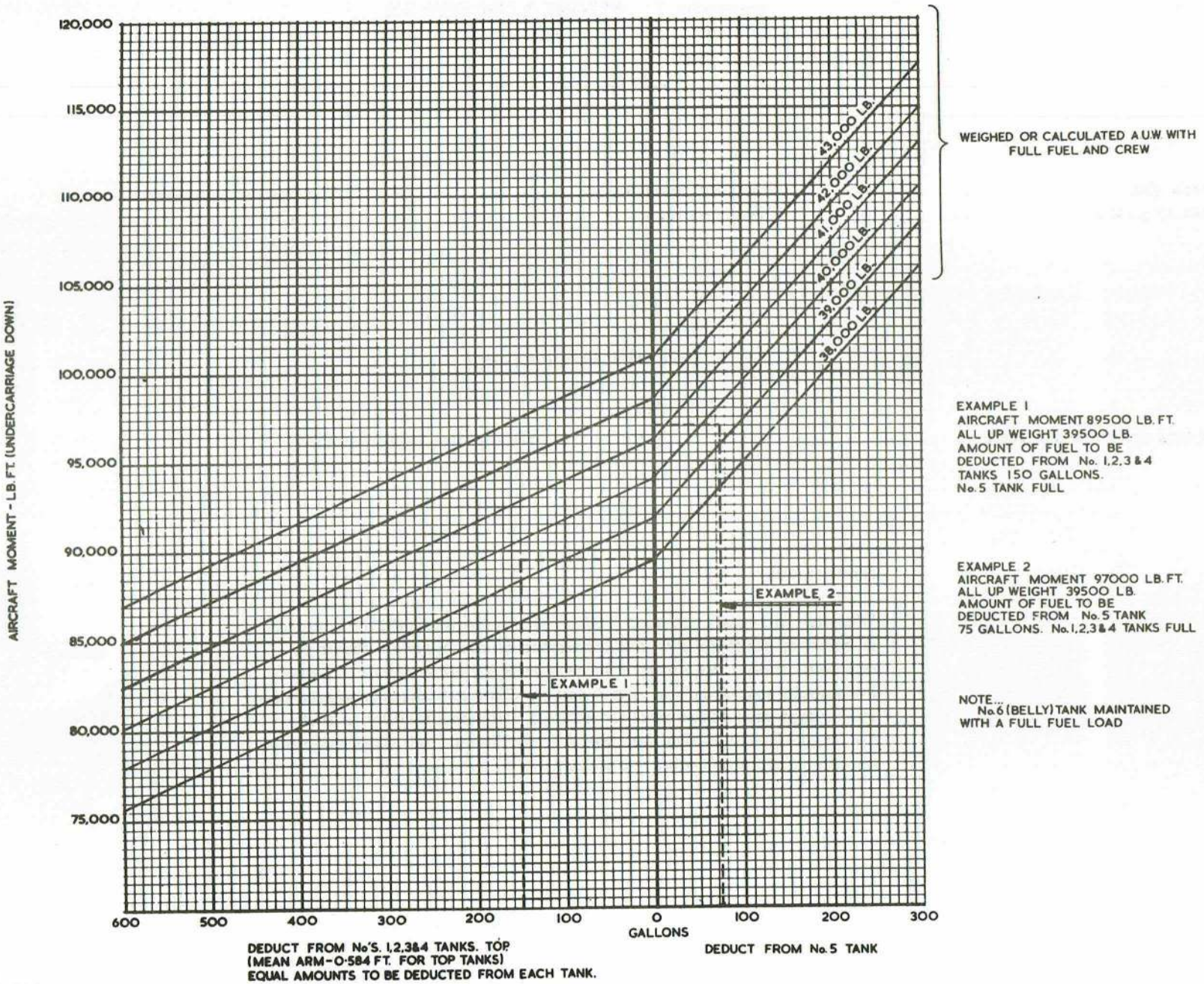


## LIST OF ILLUSTRATIONS



**IMPORTANT**

*Whenever an aircraft component which affects longitudinal trim is replaced or adjusted, the flight trim checks specified in this Appendix should be repeated. Should the aircraft trim be outside the limits specified, a new trailing-edge strip should be fitted, and the flight trim checks and subsequent trailing-edge strip adjustments carried out. Components likely to affect the longitudinal trimming, are:- wing(s), rear fuselage, tail plane, tail-plane actuator, ailerons, elevators and aileron and elevator tabs.*




WEIGHED OR CALCULATED A.U.W. WITH FULL FUEL AND CREW

EXAMPLE 1
AIRCRAFT MOMENT 89500 LB. FT.
ALL UP WEIGHT 39500 LB.
AMOUNT OF FUEL TO BE DEDUCTED FROM No. 1,2,3 & 4 TANKS 150 GALLONS.
No. 5 TANK FULL

EXAMPLE 2
AIRCRAFT MOMENT 97000 LB. FT.
ALL UP WEIGHT 39500 LB.
AMOUNT OF FUEL TO BE DEDUCTED FROM No. 5 TANK 75 GALLONS. No. 1,2,3 & 4 TANKS FULL

NOTE...
No. 6 (BELLY) TANK MAINTAINED WITH A FULL FUEL LOAD

FIG. 1. FUEL LOAD DETERMINATION GRAPH

**Introduction**

1. This Appendix details the flight trim checks, and the subsequent trimming of the elevator trailing-edge strips necessary to ensure that the aircraft trim is within the limits laid down, thus enabling the pilot to maintain control of the aircraft under any flight condition within service limits, should the tail-plane actuator have run away to the maximum aircraft 'nose-down' position, i.e. the actuator on its mechanical stop.

**Centre of gravity**

2. During flight tests, the centre of gravity is to be maintained at 2.285 ft. ± 0.15 ft. aft of the c.g. datum. This is achieved by a pre-determined distribution of the fuel load at engine start-up which will allow for fuel consumed in taxying, take-off, and climb to test altitude (up to 6000 ft). Two crew members only (pilot and navigator) are to be carried; the wing-tip tanks, and all military load must be removed, and the integral wing tanks drained.

3. The weight and moment of the aircraft with undercarriage down, are to be determined with full fuselage fuel load and two crew but no stores, by weighing, calculation, or reference to the current Form 4908. These values will be used in conjunction with the graph (*fig.1*) to determine the reduction of the full fuel load at start-up in tanks 1, 2, 3 and 4, or tank 5 to ensure a correct c.g. position at the commencement of the test run.

**Note . . .**

*The weight and moment of the navigator at his normal station should be used.*

**Fuel load determination** *(fig.1)*

4. The appropriate value of the aircraft moment is read off from the vertical axis of the graph and a horizontal line is extended from this value to intersect the aircraft weight value on, or between the weight lines. A vertical line is then dropped from this intersection to the horizontal axis of the graph to indicate the amount of fuel to be removed from the relevant tank to give the correct trim at start-up.

Example 1 *(fig.1)*

| | |
|---|---|
| Aircraft moment | 89500 lb/ft |
| All-up weight | 39500 lb |
| Amount of fuel to be deducted from No. 1, 2, 3 and 4 tanks | 150 gal (total) |
| No.5 tank | Full |

Example 2 *(fig.1)*

| | |
|---|---|
| Aircraft moment | 97000 lb/ft |
| All-up weight | 39500 lb |
| Amount of fuel to be deducted from No.5 tank | 75 gal |
| No. 1, 2, 3 and 4 tanks | Full |

**Note . . .**

*No.6 (belly) tank is maintained with a full fuel load.*

5. The test run should commence immediately on reaching test altitude using fuel from No. 1, 2, 3, 4 and 5 tanks, thereafter fuel from No. 1, 2, 3, 4 and 5 tanks should be used until completion of the test run.

**Flight procedure**

**Note . . .**

*(1) All speeds quoted are I.A.S.*

*(2) Before the first flight test, the elevator trailing-edge strips (Part No. EA1.31.677) should be examined and, if they are bent, kinked, or damaged, should be removed and new strips fitted; correct alignment of the trailing-edge strips is essential, therefore, exercise extreme care during replacement of these strips. Bowing where the strip follows the line of the elevator edge is acceptable.*

*(3) It is better to remove too little trailing-edge strip since, if the aircraft trim is over-adjusted, a new strip will have to be fitted and the tests recommenced.*

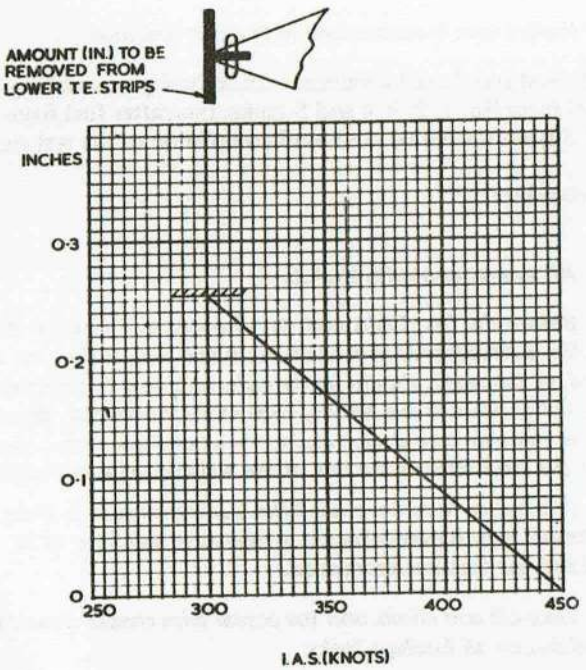
*(4) Take-off and climb, and the actual trim checks should be carried out on all fuselage tanks.*

*(5) Tests are to be carried out in calm air and good visibility.*

◀ *(6) When fitting a new trailing-edge strip, care must be taken to ensure that the new strip is correctly aligned in the position vacated by the old strip.* ▶

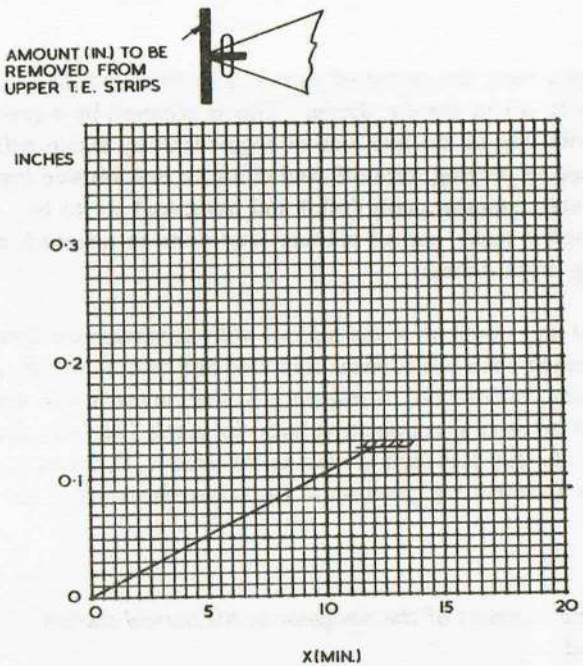
6. Operate the fuel system as instructed in Note (4), and climb to test altitude (1013 millibars setting), and increase speed slowly until:-

(1) Case 1 - The aircraft can just be trimmed 'hands-off' in level flight with speed steady using full NOSE-DOWN trim. Record the speed. Increase the speed slowly beyond this point to ensure that a push force develops on the control column.
OR




MAXIMUM I.A.S. AT WHICH AIRCRAFT CAN BE TRIMMED HANDS OFF USING FULL AIRCRAFT NOSE DOWN TRIM

LOWER TRAILING EDGE STRIP ADJUSTMENT




X= T/P ANGLE ON ELECTRICAL STOP MINUS T/P ANGLE REQUIRED TO TRIM AIRCRAFT "HANDS OFF" AT 450 KNOTS. (ANGLES TO BE MEASURED BY INCLINOMETER)

UPPER TRAILING EDGE STRIP ADJUSTMENT

FIG.2. TRAILING EDGE STRIP ADJUSTMENT

(2) Case 2 - If 450 knots is reached before the condition described in Case 1, trim the aircraft 'hands-off' at 450 knots and, without further adjustment of the tail trimmer reduce speed slowly using elevator and throttle, and land the aircraft.

**Note . . .**

*Care should be exercised when reducing speed since an aircraft 'nose-down' change of trim will generally occur as speed is reduced. The stick force to hold this change of trim may increase initially as speed is reduced, but will diminish below 350 knots. Lower the undercarriage at 190 knots, and the flaps at 160 knots. The pull force on the control column should be greatly reduced and may become a small push force when the flaps are lowered.*

**Adjustment procedure**

*Case 1*

7. Refer to fig.2 (lower trailing edge strip.)

(1) Read off the amount of metal to be removed from the elevator strips, according to the speed reached, and remove this amount from the depth of the lower strips on both elevators, along the whole length of the strips.

(2) Refuel the aircraft *(para.4)*, repeat the flight trim check *(para.6 (1))* and trailing-edge strip adjustment (1) as necessary until the following trim conditions are achieved:-

(a) The aircraft can be flown 'hands-off' at a speed between 425 and 450 knots with full NOSE-DOWN trim applied.

Typical example

Consider an aircraft which, on its first flight check, can be flown 'hands-off' at 355 knots with full aircraft NOSE-DOWN trim. Reference to the curve *(fig.2)* will show that 0.16 inch must be removed from the depth of the lower strips. After the second flight, and assuming that the aircraft is now in trim at 390 knots, a further 0.1 inch should be removed from the lower strips. If on the third flight, the 'hands-off' trim speed with full aircraft NOSE-DOWN trim applied, lies between 425 and 450 knots, the trailing-edge strip adjustment is satisfactory.

**Note . . .**

*(1) There is no restriction on the amount of lower strip which may be removed; the whole of the lower strip may be removed if necessary.*

*(2) If, due to over-adjustment, the aircraft becomes 'Case 2', this condition is satisfactory providing the tail-plane setting at 450 knots is not more than 3 minutes from the tail plane leading-edge UP electrical stop (refer to para.6(2)), and para.8(1) and (2), for the procedure in this case. If excessive over-adjustment has occurred, and the tail plane setting at 450 knots is greater than 3 minutes from the tail plane leading-edge UP electrical stop, the trailing-edge strip must be renewed and the tests recommenced. It is not permissible to remove metal from both the upper and lower elevator strips.*

*(3) Correct alignment of the trailing-edge strips is essential, therefore, exercise extreme care during replacement of these strips.*

*Case 2*

8. Refer to fig.2 (upper trailing edge strip)

(1) Place the aircraft on a level standing and support the fuselage with a trestle. Without disturbing the tail trim setting, and, using a clinometer and gauge, measure the tail-plane incidence (this was the angle found necessary to trim 'hands-off' at 450 knots).

(2) Without removing the clinometer run the actuator on to its leading-edge UP electrical stop. Record the difference in angle between the 'hands-off' at 450 knots trim position, and the electrical stop.

(3) Read off the amount of metal to be removed from the upper strips corresponding to the difference found in operation (2). Remove the required amount of metal from both elevators along the whole length of the strips.

(4) Refuel the aircraft *(para.4)* and repeat the flight check *(para.6(2))* and trailing edge strip adjustment (3) as necessary until the following trim conditions are achieved:-

(a) The aircraft can be flown 'hands-off' at a speed of 450 knots with the tail plane setting not more than 3 minutes from the leading-edge UP electrical stop.

Typical example

Consider an aircraft on which the tail plane angle required to fly 'hands-off' at 450 knots was 3 deg 52 min, and the electrical stop is found to be set at 4 deg giving a difference of 0 deg 8 min.

Reference to the curve *(fig.2)* will show that 0.08 inch. must be removed from the depth of the upper strips. Assuming that 450 knots tail-plane setting is 4 minutes from the electrical stop on the second flight, a further 0.040 inch. must be removed from the upper strips. If, on the third flight, the aircraft will fly 'hands-off' at 450 knots with the tail plane set at not more than 3 minutes from the leading-edge UP electrical stop, the trailing edge strip adjustment is satisfactory.

**Note . . .**

*(1) The amount of metal that can be removed from the upper strips is restricted to half the depth of the strip.*

*(2) If, due to over-adjustment, the aircraft becomes 'Case 1' this condition is satisfactory providing that the aircraft can be flown 'hands-off' using full aircraft NOSE-DOWN trim at a speed not less than 425 knots. If excessive over-adjustment has occurred resulting in a 'hands-off' trim speed of less than 425 knots using full aircraft NOSE-DOWN trim, the trailing-edge strips must be renewed, and the tests recommenced.*

*(3) Correct alignment of the trailing-edge strips is essential therefore, exercise extreme care during replacement of these strips.*

# Chapter 5 ALIGHTING GEAR

## LIST OF CONTENTS



**Note . . .**

*A detailed list of contents will be found at the beginning of each chapter.*

## INTRODUCTION

1. Because of its bulk, this chapter is divided into sub Chapter A (main undercarriage) and B (nose undercarriage). Each sub chapter describes, and illustrates in detail, the mechanics and disposition of the major components, the servicing operations and the major removal and assembly procedures.

2. The tricycle alighting gear consists of two main units which retract inward into bays in the main planes and a single nose unit which retracts rearward into a bay in the nose fuselage aft of the pressure bulkhead. Each main undercarriage has a single wheel mounted on an inward-facing stub axle incorporating Dunlop hydraulic copper plate type brake units fitted to each wheel. To reduce shimmy, the nose undercarriage is fitted with twin wheels; these are smaller in diameter than the main wheels and are mounted on a common axle. Mud guards, fitted over both wheels, protect the interior of the nose-wheel bay.

3. Movement of the alighting gear is effected by hydraulic jacks *(Chap.6)* which are electrically controlled by selector push-buttons mounted on the alighting gear sloping panel on the port side of the instrument flying panel. Indicator lights, which show GREEN locked down and RED unlocked are mounted on the same panel adjacent to the selector push-buttons. Provision is made for an override UP selection; this is accomplished by turning the knobbed ring clockwise through 60 deg (or 90 deg according to type) followed by depression of the button. Alighting gear DOWN emergency selection is made by pulling the black-and-yellow painted handle protruding above the alighting gear sloping panel *(Chap.11)*.

4. The apertures into which the alighting gear retracts are sealed upon completion of retraction by flush-fitting doors operated by hydraulic jacks. Correct retraction and lowering sequence is ensured by the incorporation of sequence valves in the hydraulic circuit, details of which are given in Chapter 6.

5. A canvas bag stowage, located in the centre camera bay, is provided for the alighting gear ground locks.

◀ *Intentionally blank* ▶

# Chapter 5A MAIN UNDERCARRIAGE

## LIST OF CONTENTS

## LIST OF TABLES



## LIST OF ILLUSTRATIONS

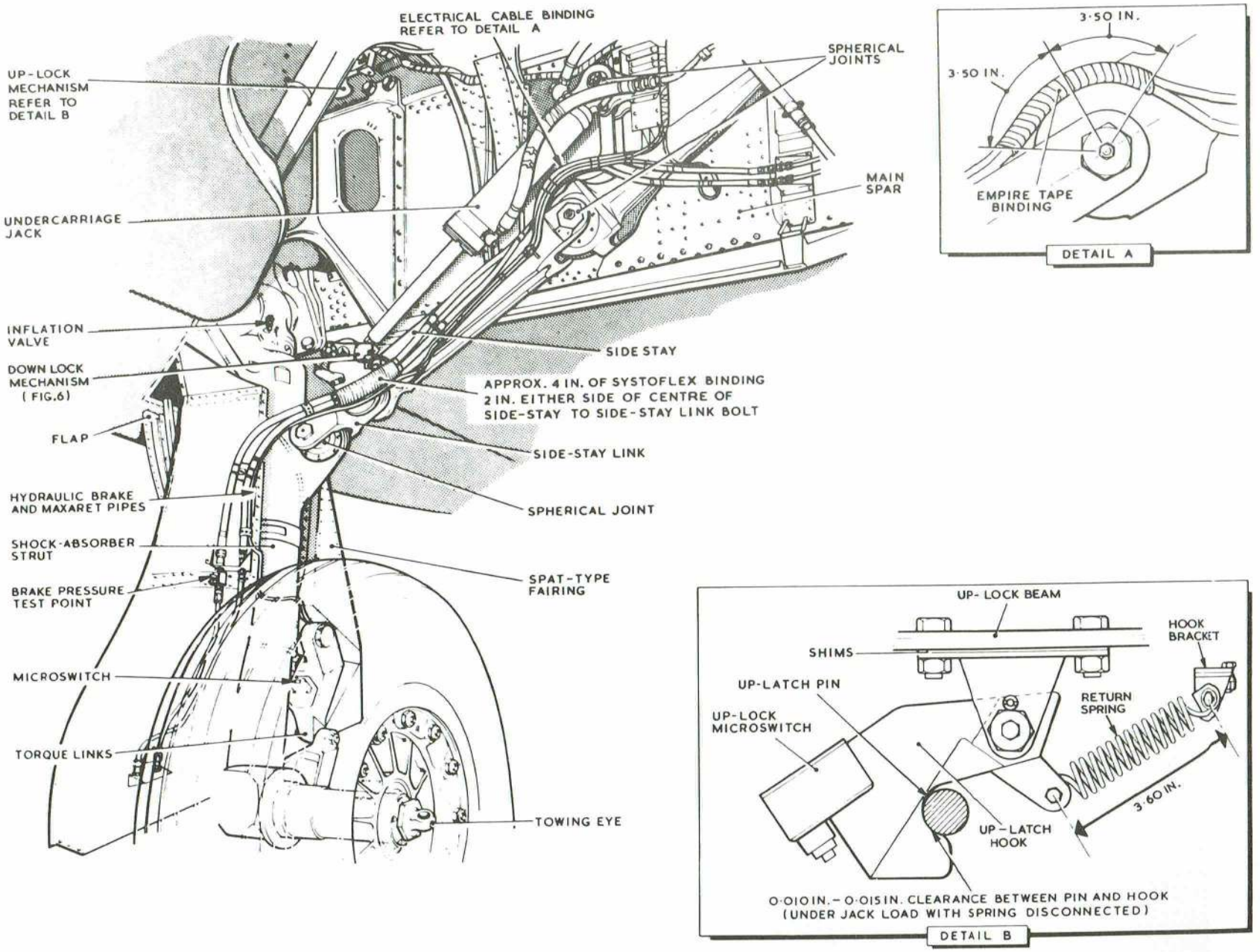



FIG.1. STARBOARD UNDERCARRIAGE

## DESCRIPTION

**General information** *(fig.1)*

1. Each main undercarriage consists of a cantilever shock-absorber strut of the oleo pneumatic type, carrying a single wheel and retracting inwards into the main plane. In the down position the shock absorber is braced against side loads by a knuckle-jointed side stay *(para.3)* which incorporates the down-lock mechanism. The undercarriage jack is attached by a spherical joint to the main plane structure and to the lock lever assembly on the side-stay assembly down-lock mechanism *(fig.6)*. Spat-type fairings are attached to the shock absorber struts to fair off the housing when the undercarriage is retracted. The unit is fully described in A.P.104B-1401-1.

**Shock-absorber struts**

2. Each shock-absorber strut is suspended by its main pivot from large bearing bracket lugs on the front face of the main plane main spar, one on each side of the engine inboard rib. The struts consist of two cylinders sliding one within the other, two pistons operating one within each cylinder, and an axle which is formed at the base of the inner cylinder or sliding tube. Torque links hinged to lugs on both inner and outer cylinders form a scissors connection between the two cylinders and transmit the torque loads from the wheel to the outer cylinder, thus preventing rotation of the sliding tube. An adapter, fitted with an oil level tube and an inflation valve, is fitted into the head of the outer cylinder.

**Side stay** *(fig.6)*

3. The side stay assembly consists of a side stay, a side-stay link, and the down-lock mechanism. The stay and stay link are hinged together and the hinge bolt is offset below the centre-line of the assembly; this ensures that the loading on the side stay will tend to fold it downwards, though this is resisted by a stop bolt fitted on the stay which butts against a buttress formed on the upper face of the stay link. The upper end of the side stay is attached by a spherical joint on a bracket to the front face of the main spar, and the lower end, which is the side stay link fork, is attached to the spherical bearing lug on the shock-absorber strut. The side stay carries the pick-up point for the hydraulic jack piston rod, the down lock lever and rollers, the down-lock microswitch, up latch pin, and an adjustable tappet for operating the door jack sequence valve.

**Up-lock mechanism** *(fig.3)*

4. The up-lock hook is mounted on the main-plane structure in the roof of the wheel well and is held in the engaged position by a coil spring. The undersurface of the hook is so shaped that when the up-latch pin in the side stay contacts it during retraction, the hook pivots to permit the pin to pass and then, under the influence of its spring, snaps back to its original position, engages the pin and retains the undercarriage in the retracted position. The UP indicator lights are actuated by the upper surface of the side stay fork which contacts a microswitch mounted on the up-lock hook.

5. When DOWN is selected the initial movement of the jack releases the lock. The pivot pin connecting the eye end of the jack piston rod to the side stay is fitted in slotted holes and moves across the holes as the jack extends. The eye end of the jack contacts the end of the hook and, by a protrusion above the centre-line of the eye, pushes the hook out of engagement. The undercarriage falls under gravity for the first part of its travel during which time the jack pivot is returned to its former position. As the undercarriage approaches the down position, hydraulic pressure in the jack straightens the side-stay assembly and pushes the down-lock lever into engagement with the stay link lip *(fig.6)*.

**Down-lock mechanism** *(fig.3)*

6. The down-lock mechanism consists of a lever, pivoted on the up-latch pin in the side stay, which is moved into position against the lip on the end of the stay link by the action of the undercarriage jack; it is retained in position by a spring-loaded stop in the side stay. A flanged plate lever is attached to the pivot bolt and the jack attachment bolt so that it moves with the lock levers and depresses the plunger of a micro-switch which operates the DOWN indicator lights. When UP is selected, the initial movement of the jack moves the down-lock lever out of engagement with the lip of the stay link and unlocks the unit.

**Door-operating mechanism** *(fig.2 and 4)*

7. The main doors open downwards and inboard on two hinge attached to the fuselage side. Jointed check links, which abut when the doors are fully open, are attached to the lugs of the forward hinge; the upper check link carries a trip lever with an adjustable tappet which operates the down sequence valve. This valve is positioned so that the

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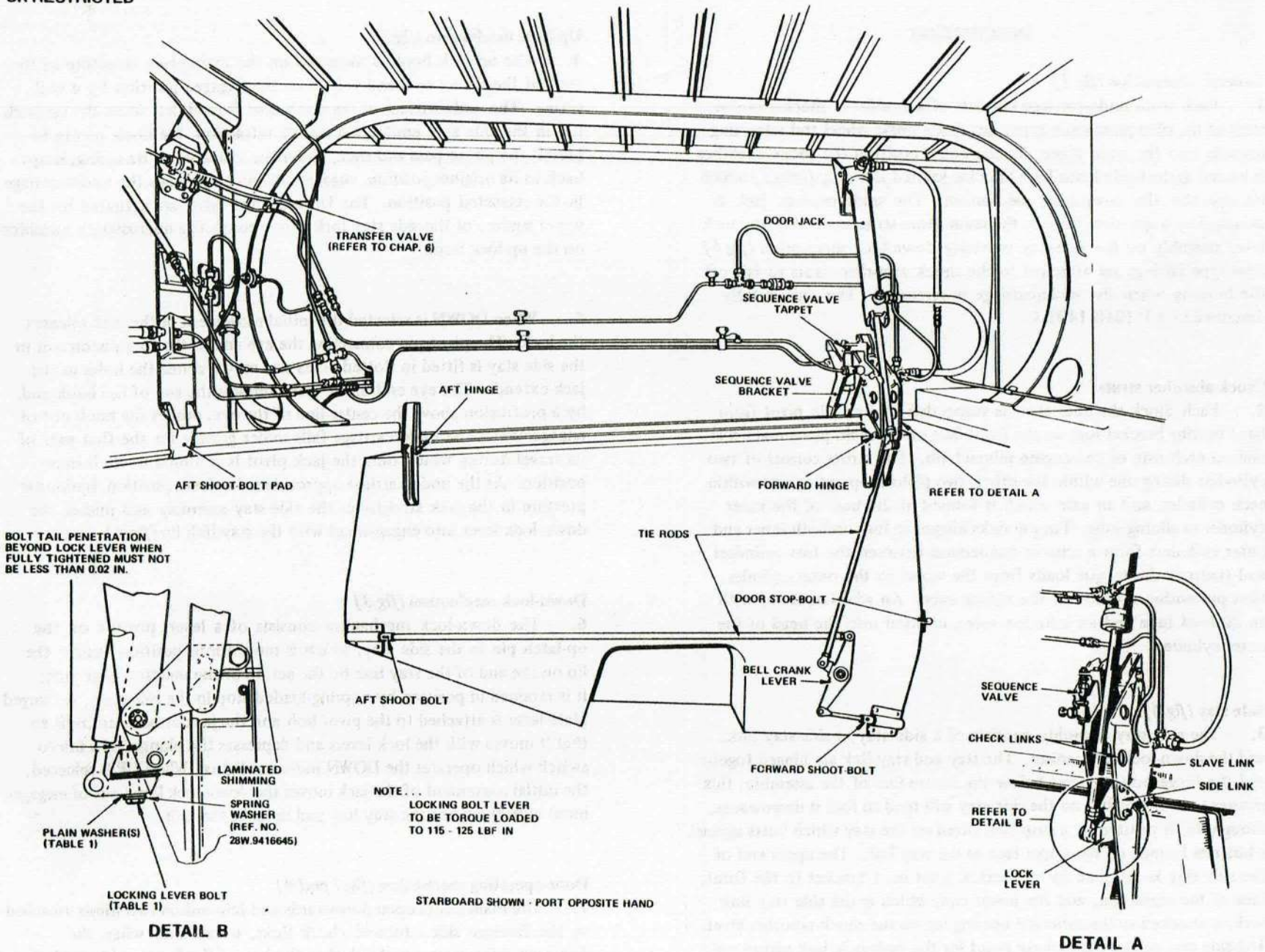


**FIG. 2. MAIN UNDERCARRIAGE DOOR-OPERATING MECHANISM**

◂ TORQUE LOADING NOTE ADDED TO LOCKING LEVER BOLT ▸

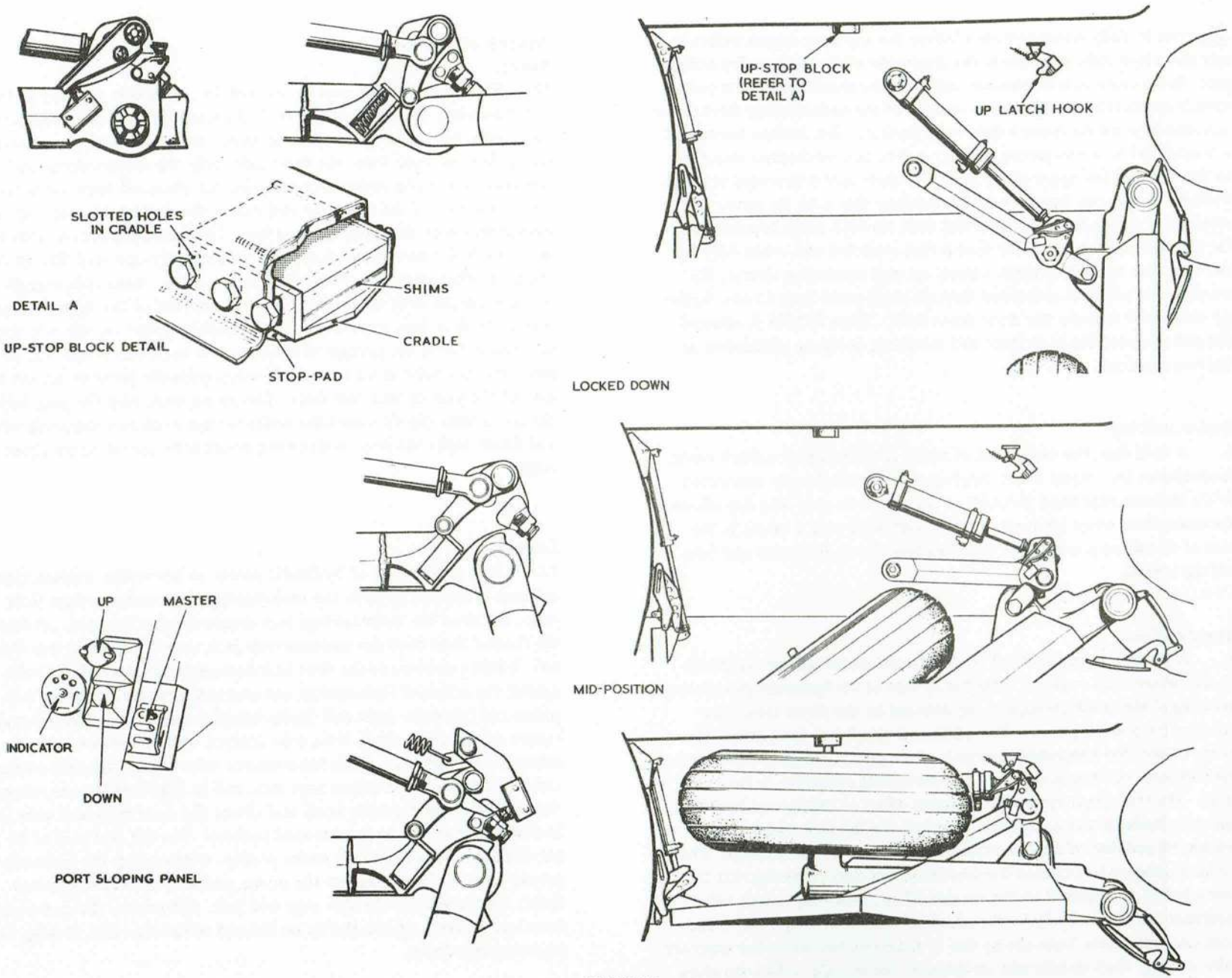


**FIG.3. MAIN UNDERCARRIAGE DOOR-OPERATION**

◀ REDRAWN AND CLARIFIED ▶

door must be fully down and open before the trip lever tappet strikes it and allows hydraulic pressure to the down side to the main undercarriage jack. In the event of a mechanical failure of the check links the sequence valve is operated by an inboard movement of the undercarriage door in the airstream beyond its normal fully-open position; this further movement is transmitted to the sequence valve by a slave link mechanism attached to the door and the upper check link. The door jack is mounted vertically downwards between brackets on the fuselage skin with its piston rod attached to a lock lever between the door forward hinge bracket lugs. On contraction of the jack the door is first retracted and, when fully up, the lock lever rotates through a small arc and operates a tie-rod, the movement of which is redirected through a bell-crank lever to two further tie rods which operate the door shoot bolts. When DOWN is selected the jack operates the lock lever and the shoot bolts are withdrawn as the first operation.

**Engine cowl flap**

8. A small flap, the movement of which is restricted by a check cable, is situated in the engine lower cowling and is mechanically connected to the undercarriage main pivot by an adjustable tie rod. The flap allows the main strut, when lowered, to move outboard into a recess in the skin of the engine cowling and, on retraction, fits in the recess and fairs off the cowling.

**Transfer valves**

9. A transfer valve installed in each main undercarriage hydraulic circuit, allows fluid expelled from the up side of the hydraulic jack during lowering of the undercarriage to be diverted to the down side, thus reducing the lowering time. The additional supply of fluid assists the pump to meet the immediate demands of the undercarriage circuit, ensuring a smooth continuous lowering and preventing cavitation in the main jacks. This transfer is especially effective when an emergency lowering has to be made as the extra fluid provided for the jack down stroke reduces the number of strokes required on the aircraft hand pump. When the undercarriage is retracted the transfer valves close, ensuring that the pump supply is confined to the up side of the jack only. Each valve incorporates a thermal relief valve which, in abnormal temperatures and pressures, will relieve from the up line to the down line when the sequence valve is open. Full details and servicing of the transfer valves are given in A.P.105B-0003-1.

**Principle of operation** *(fig.3)*

*Raising*

10. When the alighting gear is selected UP, hydraulic pressure is felt simultaneously on the up side of both the undercarriage and undercarriage door jacks, but, as the door jack sequence valve is closed, preventing a return flow of fluid from the door jack, only the undercarriage jack operates. The initial movement pulls the jack pivot pin back along the slot in the end of the side stay and moves the down-lock lever out of engagement with the lip of the stay link. Continued retraction raises the unit and at the same time closes the mechanically-operated flap in the engine cowling *(para.8)*. Final contraction of the main jack engages the up-latch pin with the up-latch hook in the roof of the wheel well and brings the door jack sequence valve adjustable tappet on the side stay into contact with the plunger of the door jack sequence valve. The door jack sequence valve is now open allowing hydraulic pressure on the up side of the jack to raise the door. During its retraction the jack folds the check links *(fig.4)*, closes the undercarriage main jack sequence valve, and finally locks the door in its closed position by operating the shoot-bolts.

*Lowering*

11. Upon application of hydraulic power to lower the undercarriage, pressure is applied to both the undercarriage and undercarriage door jacks, but since the undercarriage jack sequence valve is closed, preventing the flow of fluid from the undercarriage jack, only the door jack is operated. Initial extension of the door jack disengages the door shoot bolts against the action of their springs and continued movement of the jack piston rod opens the door and finally brings the sequence valve adjustable tappet on the door check links into contact with the undercarriage sequence valve plunger. With the sequence valve open, hydraulic power can now operate the undercarriage jack, and its initial movement releases the unit from the up-latch hook and closes the door sequence valve, locking the door jack in its extended position. For the first part of its travel the undercarriage falls under gravity, overrunning the hydraulic pressure but, as it approaches the down position, hydraulic pressure builds up, straightens the side stay and link, and pushes the down-lock lever into position against the lip on the end of the stay link, locking the undercarriage down.

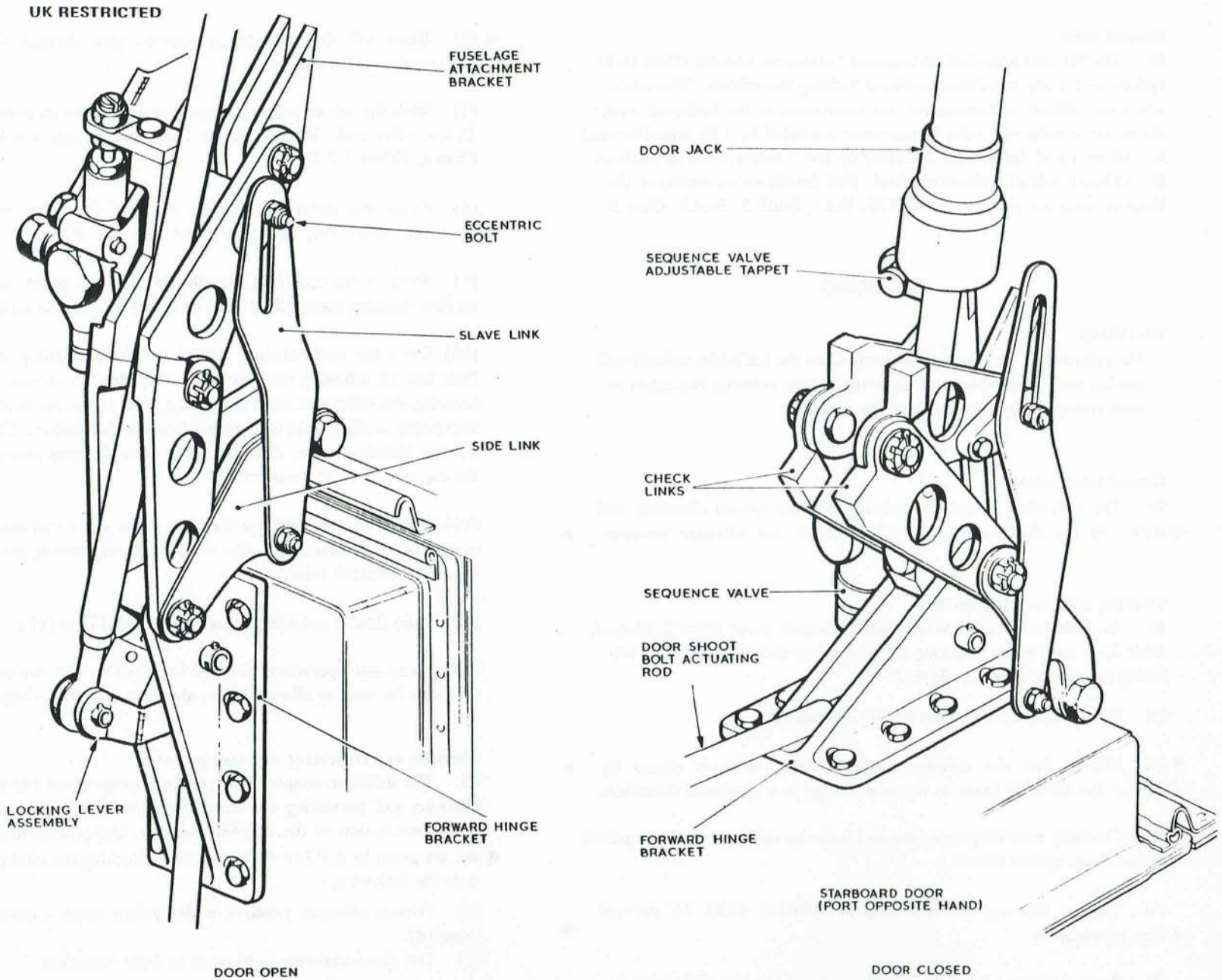


FIG.4. UNDERCARRIAGE DOOR - OPERATING MECHANISM

**Maxaret units**

12. The Maxaret anti-skid units permit maximum braking effort to be applied under any conditions without locking the wheels. The units, which are entirely self-contained, are interposed in the hydraulic brake circuit and consist of a valve arrangement regulated by a fly-wheel housed in a rubber-tyred shell which is rotated by direct contact with a track on the outboard side of each main wheel. Full details and servicing of the Maxaret units are given in A.P.1803S, Vol.1, Book 2, Sect.8, Chap.5.

## SERVICING

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**General information**

13. The following paragraphs provide information on checking and correcting the shock-absorber struts oil level and nitrogen pressure.

**Checking and correcting oil level**

14. An inflation adapter fitted with a pressure gauge *(Sect.2, Chap.4, Table 2)* is used when checking and correcting the oil level. The following procedure must be adopted:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Ensure that the adapter nitrogen-release valve is closed by turning the knurled knob as far as it will go in a clockwise direction.

(3) Carefully turn the gauge counter-clockwise until the stop is reached; do not strain against the stop.

(4) Tighten the cap at the adapter inflation point to prevent nitrogen escaping.

(5) Remove the cap from the inflation valve at the top of the shock-absorber strut and screw on the adapter assembly, taking care not to disturb the position of the gauge.

(6) Bleed off the nitrogen pressue to zero through the nitrogen-release valve in the adapter.

(7) With the release valve still open, compress the strut fully, using a 15-ton pillar jack, Mk.27 adapter head and jacking bracket *(Sect.2, Chap.4, Tables 1 & 2).*

(8) Close the inflation valve by rotating the gauge in a counter-clockwise direction, and close the adapter nitrogen-release valve.

(9) Remove the cap from the adapter inflation point, and connect an oleo charging pump *(Sect.2, Chap.4, Table 2)* to the inflation point.

(10) Open the undercarriage inflation valve and pump in hydraulic fluid OM-15, allowing the shock-absorber strut to extend by gradually lowering the pillar jack until the sliding tube of the shock-absorber strut is exposed to the extent of between one and two inches. Close the undercarriage inflation valve, disconnect the oleo charging pump and refit the cap on the inflation point.

(11) Open the undercarriage inflation valve and expel the excess fluid, compressing the shock-absorber strut by slowly raising the pillar jack. Close the inflation valve.

(12) If no fluid is expelled, repeat operations (7) to (11).

(13) Carry out operations detailed in para.15. The correct inflation pressures for varying all-up weights are given in Sect.2, Chap.2.

**Checking and correcting nitrogen pressure**

15. The inflation adapter and pressure gauge *(para.14)* is used when checking and correcting the shock-absorber strut inflation pressure. A full description of the inflation adapter, and general instructions for use are given in A.P.119 Series. Before checking the nitrogen pressure, note the following:-

(1) Correct nitrogen pressure is dependent upon a correct oil level *(para.14).*

(2) The shock-absorber strut must be fully extended.

(3) The strut inflation valve is the non-return type, therefore a reading will be obtained on the adapter gauge without slackening the valve.

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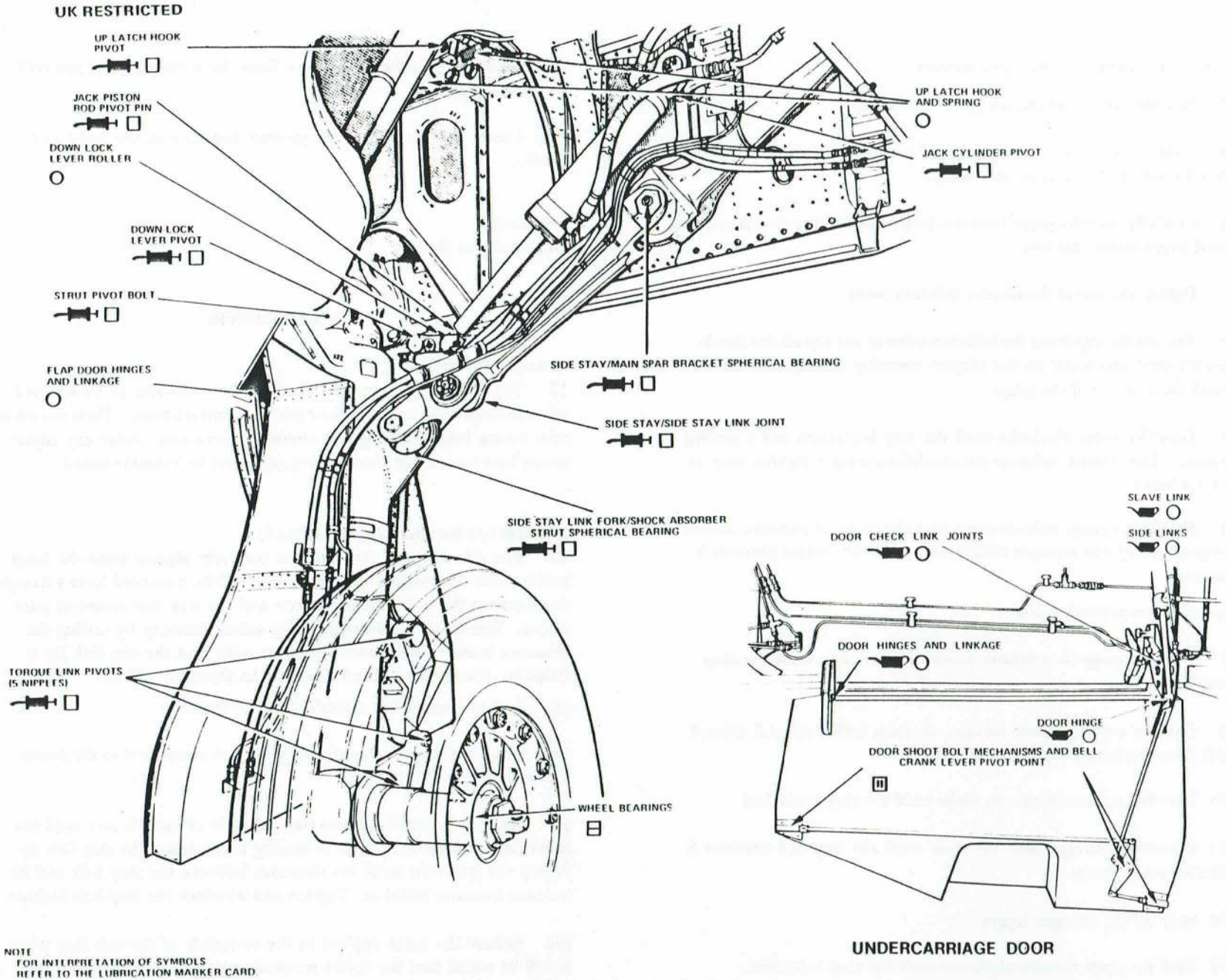



NOTE
FOR INTERPRETATION OF SYMBOLS REFER TO THE LUBRICATION MARKER CARD

**FIG. 5. LUBRICATION DIAGRAM**

◀ To check and correct the nitrogen pressure:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Ensure that the adapter nitrogen release valve is closed by turning knurled knob clockwise as far as it will go. ▶

(3) Carefully turn the gauge counter-clockwise until the stop is reached; do not strain against the stop.

(4) Tighten the cap at the adapter inflation point.

(5) Remove the cap from the inflation valve at the top of the shock-absorber strut and screw on the adapter assembly, taking care not to disturb the position of the gauge.

(6) Turn the gauge clockwise until the stop is reached and a reading obtained. For related inflation pressure/all-up-weight figures refer to Sect.2, Chap.2.

(7) Should the gauge indicate more than the required pressure, release ◀ nitrogen through the nitrogen release valve until the correct pressure is indicated.

When nitrogen pressure is low:-

(8) Turn the gauge in a counter-clockwise direction until the stop is reached.

(9) Connect a high-pressure nitrogen charging trolley *(Sect.2, Chap.4, Table 2)* to the inflation point of the adapter.

(10) Turn the pressure gauge clockwise until the stop is reached.

(11) Introduce nitrogen into the strut until the required pressure is indicated on the gauge.

(12) Shut off the nitrogen supply.

(13) Turn the gauge counter-clockwise until the stop is reached.

(14) Disconnect the nitrogen supply connection from the adapter ▶ inflation point.

(15) Remove the inflation adapter from the inflation valve and refit the blanking cap.

(16) Lower the aircraft to the ground and remove the jacks and trestles.

**Lubrication**

**16.** Refer to fig.5.

## ADJUSTMENTS

**General information**

**17.** The following paragraphs describe the procedure to be adopted when settings have to be checked and adjustments made. These occasions arise during both servicing and assembly operations. After any adjustments have been made the alighting gear must be function tested.

**Side-stay and stay-link alignment** *(fig.6)*

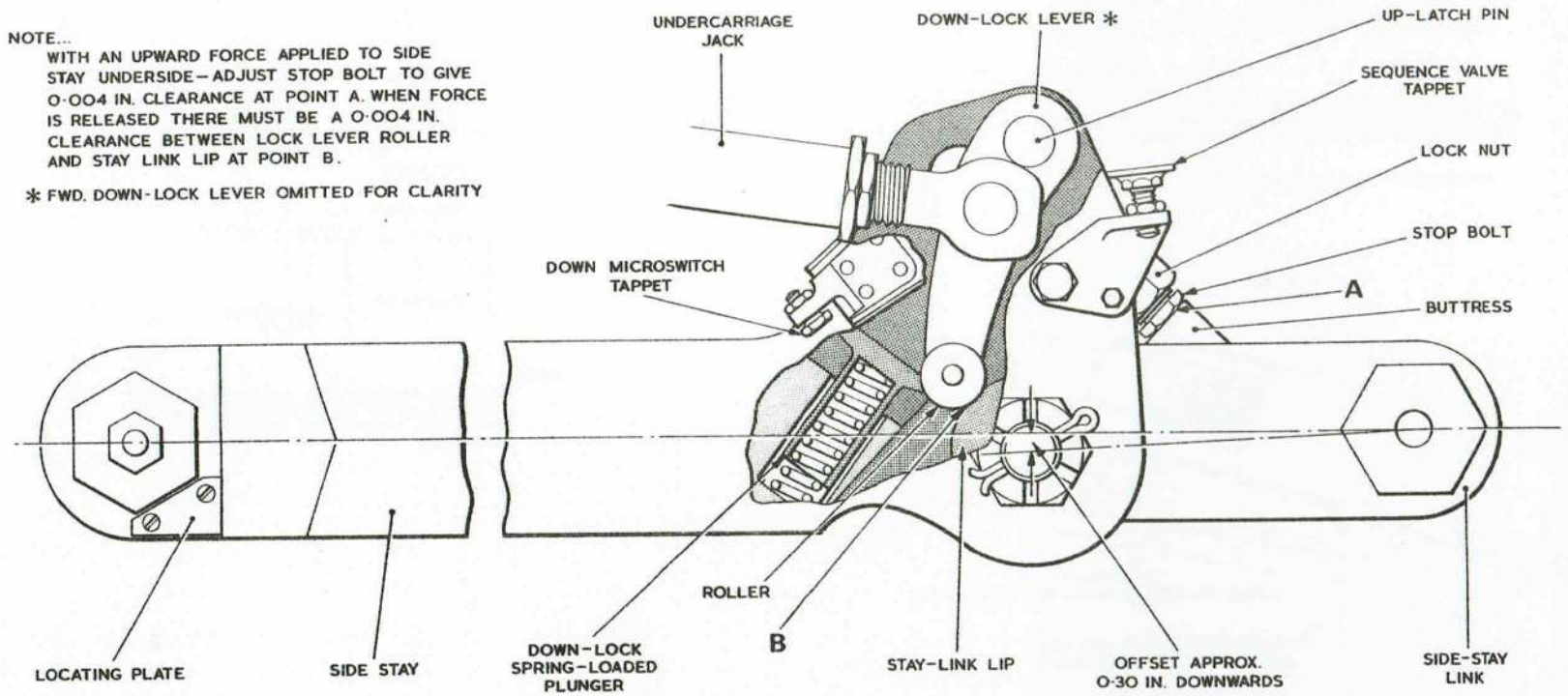
**18.** The side stay and stay link are correctly aligned when the hinge bolt is offset downwards approximately 0.30 in. measured from a straight line between the side stay pin centre and the stay link spherical joint centre. This offset is adjusted during initial assembly by setting the clearance between the down-lock lever roller and the stay-link lip at 0.004 in. Should it be found necessary to adjust the offset:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Remove the pivot pin attaching the jack piston rod to the down-lock lever and retract the jack.

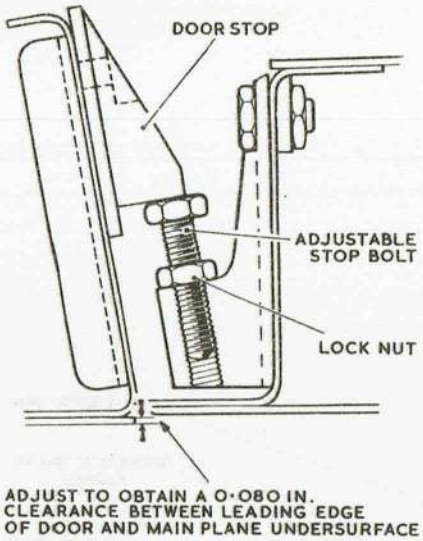
(3) Apply an upward force to the underside of the side stay until the roller on the down lock lever is bearing hard against the stay link lip. Adjust the stop bolt until the clearance between the stop bolt and its buttress measures 0.004 in. Tighten and wire-lock the stop-bolt locknut.

(4) Release the force applied to the underside of the side stay when it will be noted that the 0.004 in. clearance now exists between the roller on the lock lever and the stay-link lip. This can be checked by depressing the spring-loaded stop in the side stay and inserting a 0.004 in. feeler gauge between the lock-lever roller and the stay-link lip.




VIEW ON FORWARD FACE, PORT SIDE

FIG. 6. SIDE-STAY AND SIDE-STAY LINK ALIGNMENT



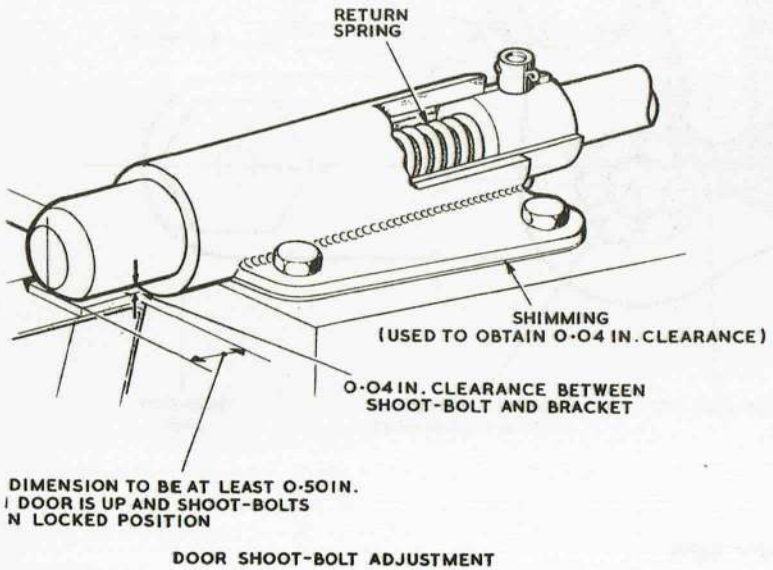
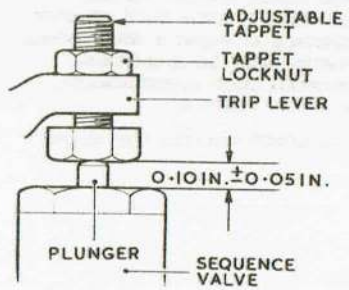




FIG.7. DOOR ADJUSTMENT POINTS

◀ REDRAWN AND CLARIFIED ▶




NOTE...
TAPPET LOCKNUT MAY BE POSITIONED EITHER SIDE OF TRIP LEVER DEPENDING UPON THE AMOUNT OF ADJUSTMENT REQUIRED

FIG.8. SEQUENCE-VALVE SETTING

◀ REDRAWN AND CLARIFIED ▶

(5) Extend the jack until the pick up centres coincide, then secure the piston rod end to the down lock lever pin. Lock the slotted nut with a split pin.

**Jack settings**

*Main jack*

**19.** The distance between the pin centres of the main jack when fully closed must not exceed 20.63 in. ± 0.25 in., the jack piston rod travel is 11.22 in. ± 0.045 in. The exact pin-centre dimension is governed by the pick-up points on the aircraft structure and side stay down lock lever. The centres must be checked following renewal, replacement, or after any servicing which may have affected its setting. The length of the jack is adjusted in the following manner:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Remove the pivot pin attaching the jack piston rod to the down-lock lever.

(3) Check the alignment of the side-stay and stay-link *(para.18),* and adjust as necessary.

(4) Ensure that all hydraulic pressure is exhausted *(Chap.6).* Disconnect the hydraulic pipes and connect the jack to a hydraulic test rig.

(5) Pump the jack into the fully extended position.

(6) Loosen the locknut on the piston rod and adjust the length of the fully extended jack until the distance between the jack pin centres exceeds the pick-up centres on the aircraft structure and side stay down-lock lever by 0.15 in. $^{+0.00}_{-0.05}$ in.

(7) Check that the piston rod eye end is in safety and tighten the locknut against the spanner grip. Wire-lock the locknut and the spanner grip together.

(8) Close the jack until the jack pin centre is in alignment with the pick-up centre of the down-lock lever and fit the jack pivot pin.

(9) Remove the rig and reconnect the hydraulic pipes to the jack. Prime and bleed the jack, and function test the undercarriage *(Chap.6).*

*Door jack*

**20.** The distance between the pin centres of the door jack when fully closed must not exceed 16.21 in. ± 0.25 in., the ram travel is 9.19 in. ± 0.06 in. The exact pin-centre dimension is governed by the pick-up points on the aircraft structure and undercarriage door lock lever. The jack pin centres must be checked, and if necessary, adjusted in the following manner, following renewal, replacement, or after any servicing which may have affected its setting:-

(1) Ensure that all hydraulic pressure is exhausted from the system *(Chap.6).*

(2) Remove the pin attaching the lower end of the door jack piston rod to the door lock lever.

(3) Check the movement of the slave link *(fig.12)* to ensure that 0.02 in. minimum to 0.03 in. maximum clearance exists between the top of the slot and the eccentric bolt shank when the door is fully down. Check the sequence valve to ensure that the plunger is depressed only to within the limits given in para.23. If the necessary clearance does not exist at the top of the slave-link slot, it can be obtained by adjustment of the eccentric bolt; adjust the sequence-valve tappet as detailed in para.23.

**Note . . .**

*There must be adequate clearance between the bottom of the slave-link slot and the eccentric bolt when the door is fully up, and the link must not foul anywhere throughout its travel.*

(4) Disconnect the hydraulic pipes at the door jack and connect a hydraulic test rig to the jack.

(5) Remove the locking-wire from the locknut and the splined nut at the end of the jack piston rod and slacken the locknut.

(6) Disconnect the lower rear check link from the upper link.

(7) Close the door by hand and pull up the lock lever to move the shoot-bolts into the fully locked position.

(8) Pump the jack into the fully-retracted position, and check whether a minimum override of 0.125 in. exists by positioning the eye end of the piston rod between the forks of the lock lever and noting the alignment of the attachment-pin hole in both components. If the override

is less than the minimum required, increase it by turning the eye end of the piston rod one half-turn at a time until the necessary dimension is obtained.

(9) Open the door, tighten the locknut on the jack piston rod, and wire-lock in position.

(10) Connect the lower rear check link to the upper link.

(11) Pump the jack into the fully extended position and, with the door held open but not sprung, check the alignment of the attachment-pin hole through the lock lever and piston rod eye end; there should be a maximum override of 0.02 in. If the override is greater or appreciably less, adjust it by varying the amount of shimming between the two parts of the lock lever; the packing is made up of 0.003 in. laminations *(fig. 12 and para.35)*.

(12) After adjustment of the shimming between the two parts of the lock lever, check that the thread of the bolt which secures the two parts of the lock lever together, protrudes by 0.02 in. minimum - when fully tightened. If necessary, up to three washers in addition to the spring washer, may be fitted beneath the head of the bolt to prevent thread binding *(fig.12)*.

(13) Ensure that the lock lever countersunk screw has been locked by centre popping.

(14) Retract the jack slightly and align the attachment pin holes in the lock lever and the end of the piston rod by moving the door. Insert the attachment pin and fully extend the jack.

(15) With the door fully open, check again that the maximum override (operation (11)) is present by applying hand pressure to the lower inside edge of the door; it should be possible to rotate the pin securing the lock lever.

(16) Disconnect the test rig, and reconnect the pipes to the jack. Prime and bleed the jack, and test the functioning of the undercarriage and door *(Chap.6)*.

**Door shoot-bolt setting** *(fig. 7)*

21. The operation and setting of the door shoot bolts must be checked after servicing. Should adjustment be necessary proceed as follows:-

(1) Before any adjustments are made, check the door hinges for excessive wear *(A.P.101B-0400-6, Part 1, Chap.3)*.

(2) Disconnect the door jack by removing the pin attaching the lower end of the door jack piston rod to the lock lever.

(3) Disconnect the rear shoot-bolt tie-rod and adjust to its minimum length, reconnect the tie rod, leaving the locknut slack.

(4) Manually close the door, disconnect the tie rod between the lock lever and the bell-crank lever at the bell-crank lever end, slacken the tie-rod locknut and adjust by turning the fork end one half-turn at a time, and connecting the tie rod to the bell-crank lever between adjustments, until the front shoot bolt has a minimum engagement of 0.50 in. when locked. Repeat this adjustment for the rear shoot bolt by adjusting the tie rod between the rear shoot bolt and bell-crank lever, with the door unlocked there should be a clearance of 0.11 in. between the end of the shoot bolts and the pads with which they engage.

**Note . . .**

*The dimension 0.11 in. is for the linkage in an as new condition. A relaxation of this dimension to 0.060 in. is permitted due to subsequent cumulative wear in the linkage. (Refer to A.P.101B-0400-6, Part 1, Chap.3 for maximum wear limits.)*

(5) When the correct adjustments have been made, tighten the locknut(s) on the tie rod(s) and reconnect the tie rod(s) to the bell-crank lever.

(6) Manually close the door and fully lock the shoot bolts, checking that the two shoot bolts contact their engagements pads either simultaneously or with the forward shoot bolt slightly in advance of the rear shoot bolt. Check also that the pins attaching the shoot bolts to the tie rods do not foul the shoot-bolt housings when the shoot bolts are fully locked.

(7) Check that there is a 0.04 in. clearance between the flats of the shoot bolts and their brackets *(para.22)*.

(8) Reconnect the door jack piston rod to the lock lever.

(9) Manually operate the door jack sequence valve and operate the hydraulic hand pump to test the operation of the door; recheck the adjustments.

**Door setting** *(fig.7 and 12)*

22. An adjustable stop bolt is provided on the leading edge of the door to ensure that the door, when closed, is in its correct position relative to the wing contour. The stop bolt is adjusted to permit the leading edge of the door to move 0.08 in. max. inside the wing contour; the door hinge shimming may also require adjustment to obtain this figure *(para.35)*. With the door in its correct position the clearance between the door shoot-bolt flats and their bracket must be 0.04 in. This clearance can be obtained by adjustment of the shimming between the shoot-bolt housings and the door *(fig.12)*.

**Note . . .**

*It is not essential that the shoot bolts and brackets are parallel across their flats; an additional 0.02 in. is permissible along one edge providing that it does not affect the clearance of 0.04 in. at the other.*

**Sequence valve setting** *(fig.8)*

23. To adjust the sequence-valve tappet slacken the locknut and screw the tappet until a 0.10 in. ± 0.05 in. clearance is obtained between the striking face of the tappet and the body of the sequence valve when the valve plunger is depressed *(fig.8)*. After adjustment, check the operation of the sequence valve *(Chap.6)* and tighten the locknut.

**Up-latch hook setting** *(fig.1)*

24. The up-latch hook is set by the manufacturers and should not normally require alteration, the clearance between the hook and up-latch pin being obtainable by adjustment of the up-stop pad *(para.25)*. If, after renewal of the hook or undercarriage unit, it is found necessary to adjust the hook bracket, the shimming between the bracket and up-lock beam may be varied accordingly, care being taken to ensure that the attitude of the hook is not altered when doing so. To adjust the hook bracket:-

(1) Disconnect the return spring from the up-latch hook and remove the hook from the bracket, ensuring no damage is done to the microswitch or its connections.

(2) Remove and discard the attachment bolts and remove the bracket from the up-lock beam.

(3) Adjust the shimming as necessary and ensure that it will not affect the original attitude of the hook.

(4) Refit the bracket to the up lock beam using new bolts. When the hook is correctly set *(para.25)*, peen over the bolts to lock.

(5) Refit the up-latch hook and connect the return spring.

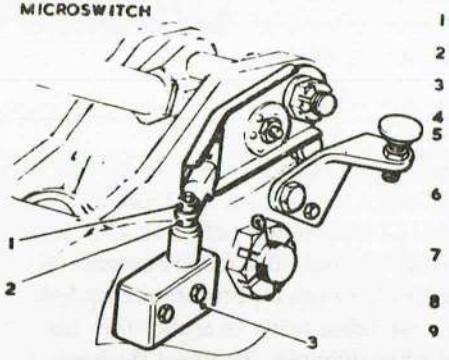
**Note . . .**

*When a new hook is fitted the up microswitch must be adjusted (fig.9).*

**Up-stop pad setting** *(fig.3)*

25. A rubber or Tufnol pad in the roof of the wheel well receives the impact made by the wheel axle towing eye when the undercarriage is retracted. The pad is adjusted to obtain the correct clearance (0.010 in. to 0.015 in.) between the up-latch hook and up-latch pin *(para.24)*. Tufnol pads are to be filed and trimmed to suit, rubber pads are to be reduced if too large or packed with light-alloy strips if too small to obtain the required clearance. Access to the up-latch hook when the under-carriage is raised is gained through a panel in the main-plane upper surface *(Sect.2, Chap.4)*.

DOWN LOCK MICROSWITCH



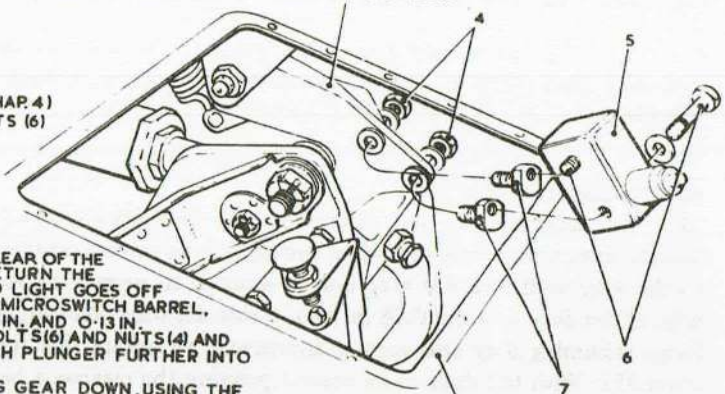

DOWN LOCK MICROSWITCH ADJUSTMENT

1 CONNECT A 24-VOLT POWER SUPPLY TO THE EXTERNAL SUPPLY SOCKET
2 SLACKEN LOCKNUT (1)
3 SCREW STRIKER BOLT (2) AWAY FROM MICROSWITCH (3) (GREEN LIGHT OFF)
4 SCREW STRIKER BOLT (2) TOWARDS MICROSWITCH (3) UNTIL A DEFINITE CLICK IS HEARD (GREEN LIGHT ON) AND THEN GIVE A FURTHER TWO COMPLETE TURNS
5 TIGHTEN LOCKNUT (1) AND ENSURE THAT SOME PLUNGER MOVEMENT REMAINS

UP LOCK MICROSWITCH ADJUSTMENT: U/C IN THE UP POSITION ON FULL HYDRAULIC PRESSURE

1 JACK AND TRESTLE THE AIRCRAFT WITH THE WHEELS CLEAR OF THE GROUND (SECT. 2, CHAP. 4)
2 CONNECT A 24-VOLT POWER SUPPLY TO THE EXTERNAL SUPPLY SOCKET, GREEN LIGHT ON
3 REMOVE THE APPROPRIATE ACCESS PANEL FROM THE UPPER SURFACE OF THE MAIN PLANE INNER WING (SECT. 2, CHAP. 4)
4 SLACKEN THE NUTS (4) AND MICROSWITCH ATTACHMENT BOLTS (6)
5 TURN THE HEADS OF THE ECCENTRIC BOLTS (7) SO THAT THE MICROSWITCH ATTACHMENT TAPPED HOLES ARE AT THE FURTHEST POINT OF ADJUSTMENT AWAY FROM THE HOOK: TIGHTEN THE ATTACHMENT BOLTS (6) AND NUTS (4)
6 RETRACT THE ALIGHTING GEAR, USING THE HAND PUMP, APPLYING FULL JACK PRESSURE. CHECK THAT THE RED LIGHT COMES ON DURING OPERATION, AND GOES OFF WHEN THE UP-LATCH HOOK IS FULLY ENGAGED
7 THROUGH THE ACCESS PANEL, LIFT THE UP-LATCH HOOK CLEAR OF THE LATCH PIN, AND ENSURE THAT THE RED LIGHT COMES ON. RETURN THE UP-LATCH HOOK TO THE ENGAGED POSITION AND ENSURE RED LIGHT GOES OFF
8 USING FEELER GAUGES, CHECK THAT THE GAP BETWEEN THE MICROSWITCH BARREL, AND OPERATING FACE OF THE SIDE STAY IS BETWEEN 0·08 IN. AND 0·13 IN.
9 IF THE GAP IS IN EXCESS OF 0·13 IN., SLACKEN ATTACHING BOLTS (6) AND NUTS (4) AND ROTATE ECCENTRIC BOLT (7) TO DEPRESS THE MICROSWITCH PLUNGER FURTHER INTO OVERTRAVEL
10 EXHAUST THE JACK PRESSURE AND SELECT THE ALIGHTING GEAR DOWN, USING THE HAND PUMP. SLOWLY LOWER THE ALIGHTING GEAR UNTIL THE D-DOOR UNLOCKS. PULL THE DOOR OPEN AND OPERATE THE DOWN SEQUENCE VALVE. THE RED LIGHT MUST NOT COME ON. IF THE RED LIGHT DOES COME ON REPEAT OPERATION 9
11 SELECT THE ALIGHTING GEAR UP, FULLY RETRACT THE ALIGHTING GEAR USING THE HAND PUMP, AND RECHECK THE PLUNGER GAP AS IN OPERATION 8

UP LOCK MICROSWITCH




NOTE....
AFTER ADJUSTMENT OF THE UP OR DOWN LOCK MICROSWITCHES AN ALIGHTING GEAR RETRACTION TEST MUST BE MADE AND THE WARNING LIGHTS CHECKED

STARBOARD OLEO STRUT MICROSWITCH ADJUSTMENT

1 JACK AND TRESTLE THE AIRCRAFT WITH THE WHEELS CLEAR OF THE GROUND (SECT. 2, CHAP. 4)
2 INSERT A 0·120 IN. FEELER GAUGE BETWEEN THE MICROSWITCH PLUNGER AND THE OLEO STRIKER PIN. THE PLUNGER SHOULD JUST BE BOTTOMING
3 IF THE ADJUSTMENT (OPERATION 2) IS INCORRECT PROCEED AS FOLLOWS:-
(A) REMOVE THE MICROSWITCH ATTACHMENT NUTS (8) AND WASHERS, AND WITHDRAW THE MICROSWITCH TOGETHER WITH LAMINATED PACKING PLATE (9)
(B) BY PEELING A NEW LAMINATED PACKING PLATE REF. No. 26FZ/706 ADJUST THE MICROSWITCH TO OBTAIN THE CONDITION DESCRIBED IN OPERATION 2
4 RE-CHECK THE ADJUSTMENT AFTER HAVING FINALLY REFITTED THE MICROSWITCH AND TIGHTENED THE SECURING NUTS

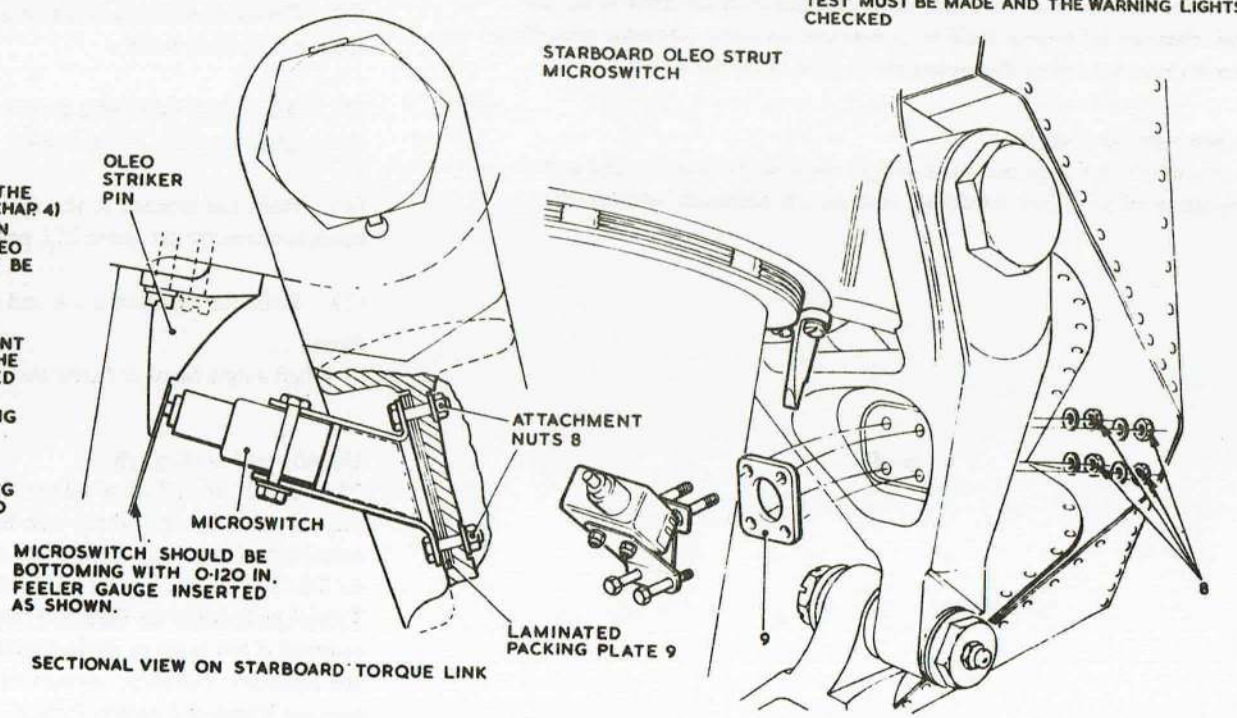



FIG. 9. MICROSWITCH ADJUSTMENT

**Torque-link tolerance and adjustment**

26. The centre pivot pin of the torque links should be examined for wear during servicing operations on the undercarriage. The correct clearance at this point is 0.001 in. to 0.004 in. but a maximum clearance of 0.010 in. is permissible. If the clearance exceeds 0.010 in. a new washer, Ref.No.26FZ/715 is to be fitted to regain the original clearance.

**Microswitch settings**

27. After any servicing or component replacement which may have affected the microswitch settings, a thorough check, and if necessary resetting, must be made as detailed in fig.9.

**Strut fairing alignment**

28. The undercarriage strut spat type fairing is adjusted to the main-plane contours by varying the shims fitted between the fairing and the four attachment bosses on the strut. When all the undercarriage adjustments are correct, the undercarriage raised and resting in the up-latch hook, adjust the shims until the leading edge of the fairing is 0.05 in. inside the main-plane contour and the trailing edge is flush. When a new fairing is fitted file off the trim allowance to give 0.05 in. to 0.08 in. clearance around the spat perimeter.

**Note . . .**

◀ *Protective treatment (A.P.119A-0509-1) must be applied to all filed surfaces.*

**New engine cowl flap fitting and adjustment**

29. The flap is adjusted by means of the tie rod which connects it to the top of the shock-absorber strut. Adjustment is made until the flap is flush with the engine cowl skin when the undercarriage is fully retracted. When fitting a new flap the following procedure must be adopted:-

(1) Attach the flap to the engine cowl and connect the tie rod and check cable.

(2) Remove the rubber or Tufnol stop pads *(fig.3)*.

(3) With the engine lower rear cowl fitted and the undercarriage retracted, file the trim allowance of the flap to ensure a butt fit on the cowl skin with the flap 'out-of-airflow' and apply protective treatment in accordance with A.P.119A-0509-1. ▶

(4) Remove the engine top cowl, connect the tie rod to the shock-absorber strut bracket, and adjust the tie rod until the flap is closed.

(5) Fully slacken the check cable tension rod.

(6) Lower the undercarriage.

(7) Partially retract the undercarriage and fit the rubber or Tufnol stop pads.

**Note . . .**

*Tufnol pads are to be filed and trimmed to suit. Rubber pads are to be reduced if too large and packed by light-alloy strip if too small.*

(8) With the flap in the open position, adjust the check cable tension rod until it is finger-tight and then slacken it one turn. Lock the tension rod.

(9) Tighten the nut and peen over the bolt attaching the check cable to the flap arm.

## REMOVAL AND ASSEMBLY

**General information**

30. The following paragraphs detail the removal and assembly operations for the undercarriage and its main components. Items which do not require special instructions for removal or assembly are not included. The sequence of operations for assembling the undercarriage and door must be adhered to. Checks and subsequent adjustments referred to are to be made at the stated operations.

**Undercarriage** *(fig.11)*

*Removal*

31. To remove the undercarriage and its main components:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Exhaust all hydraulic pressure from both the main and brake hydraulic systems *(Chap.6)*.

**Note . . .**

*Unless the brake unit is life expired or damaged, it need be removed only if a replacement strut is to be fitted. Care must be taken when handling a shock-absorber strut when the brake unit has not been removed.*

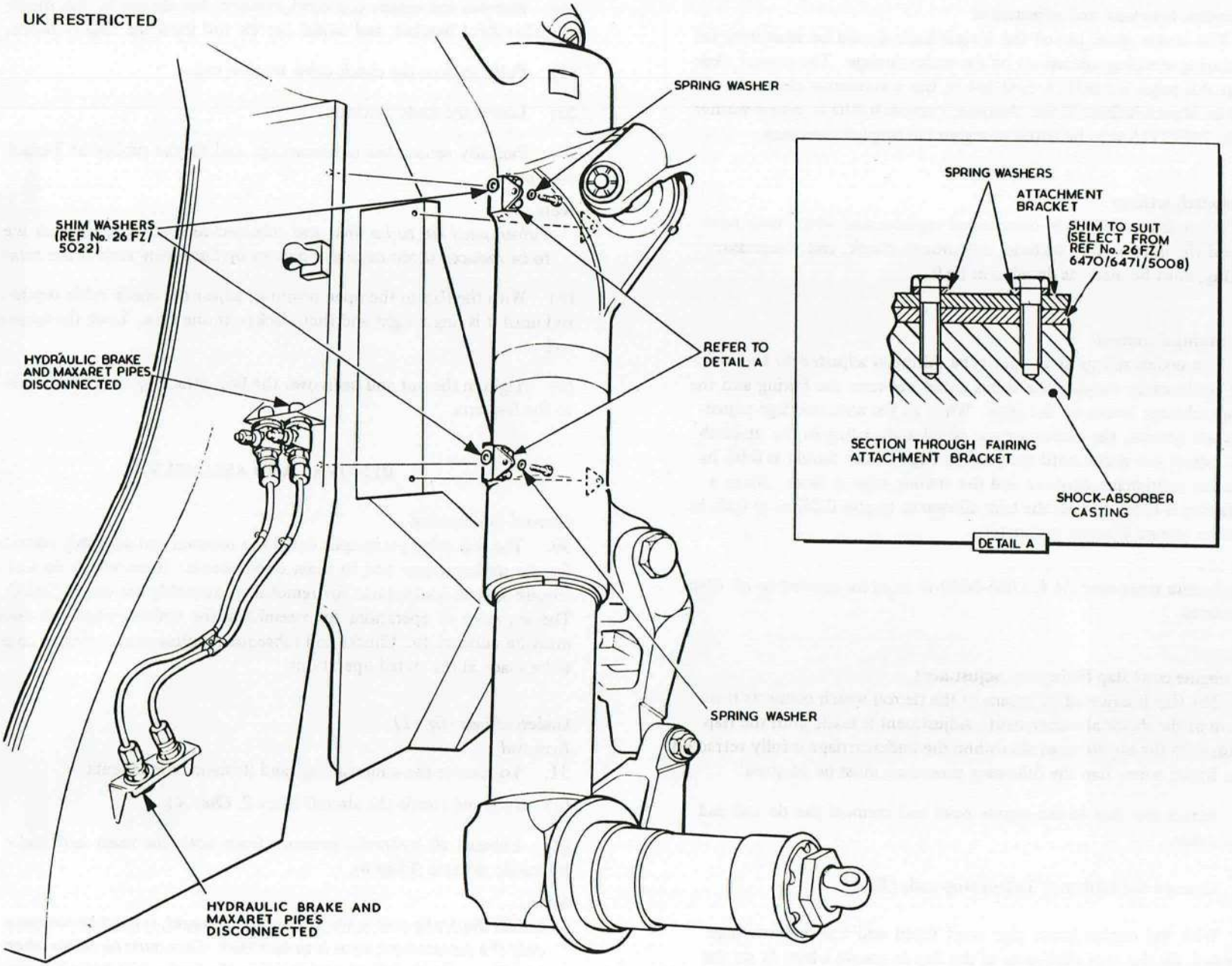



FIG. 10. STRUT FAIRING-REMOVAL AND ASSEMBLY

(3) Remove the wheel and if necessary the brake unit *(fig.13)* from the wheel axle. Blank off exposed hydraulic pipes and apertures.

(4) Remove the bolt from the shock-absorber strut end of the flap door actuating link *(detail B)*.

(5) Remove the engine bottom rear cowl *(Sect.4, Chap.1)*.

(6) Disconnect the wheel brake flexible hydraulic pipes from the connection at the bleed valve bracket on the spat fairing *(fig.10)*. Blank off exposed pipe ends.

(7) Unclip the flexible hydraulic pipe from the top of the fairing.

(8) Disconnect the flexible hydraulic pipes from the bracket at the bottom of the fairing. Blank off exposed pipe ends.

(9) Disconnect the electrical cables from the microswitch on the upper torque link, and unclip and release the cable from the fairing (starboard undercarriage only).

(10) Remove the four fairing attachment bolts from the brackets of the shock-absorber strut, remove the fairing and retain the shimming *(fig.10)*.

**Note . . .**

*If the fairing or strut is to be replaced the four brackets must be removed from the bosses on the strut. Retain the shimming.*

(11) Disconnect both flexible hydraulic pipes from the main jack *(detail C)*. Blank off exposed pipes and apertures.

(12) Remove the split pin and nut from the jack piston rod pivot pin *(detail A)*, and remove the pin.

(13) Remove the split pin and nut from the jack pivot pin *(detail C)*, and remove the jack from the aircraft.

(14) Disconnect the electrical cables from the down lock microswitch *(detail A)*.

(15) Unclip the hydraulic pipe and electrical cables from the side stay. Coil and stow the electrical cables.

(16) Disconnect the flexible hydraulic brake pipe from the bracket at rib B on the main spar bulkhead, and remove the pipe from the aircraft. Blank off exposed pipe ends.

(17) Remove the split nut from the side stay link bolt at the spherical joint on the shock-absorber strut casting, and withdraw the bolt *(detail A)*.

(18) Support the side stay and link and remove the locating plate from the side stay spherical pivot bolt *(detail D)*.

(19) Withdraw the side stay pivot bolt and remove the side stay and link from the aircraft.

(20) Remove the split pin from the slotted nut on the shock-absorber strut main pivot bolt and, using a spanner *(Sect.2, Chap.4, Table 1)*, remove the nut. With the nut removed, withdraw the locking plate *(detail B)*.

**Note . . .**

*1. Access to the head of the main pivot bolt can be gained through a panel in the main-plane undersurface (Sect.2, Chap.4).*

*2. Should difficulty be encountered when removing the main pivot bolt, it may be found advantageous to screw the inserter (Sect.2, Chap.4, Table 1 and fig.11, detail B) on to the thread of the pivot bolt and give the end of the inserter a sharp knock with a hide-faced mallet.*

◀ *3. Care must be taken to avoid damage, when handling a shock absorber with the brake unit still fitted. Ensure that the strut is adequately supported before withdrawing the main pivot pin.* ▶

(21) Support the strut and, using the spanner *(Sect.2, Chap.4, Table 1)*, withdraw the main pivot bolt *(detail B)*. Remove the shock-absorber strut from the aircraft.

*Assembly (fig.11)*

32. To assemble the undercarriage and its components:-

(1) With the inserter *(Sect.2, Chap.4, Table 1)* screwed on to the threads of the main pivot pin, assemble the shock-absorber strut, less wheel and spat type fairing to the main plane pick-up point.

(2) Remove the inserter and fit the pivot pin locking plate, slotted nut and split pin to secure the pivot pin.

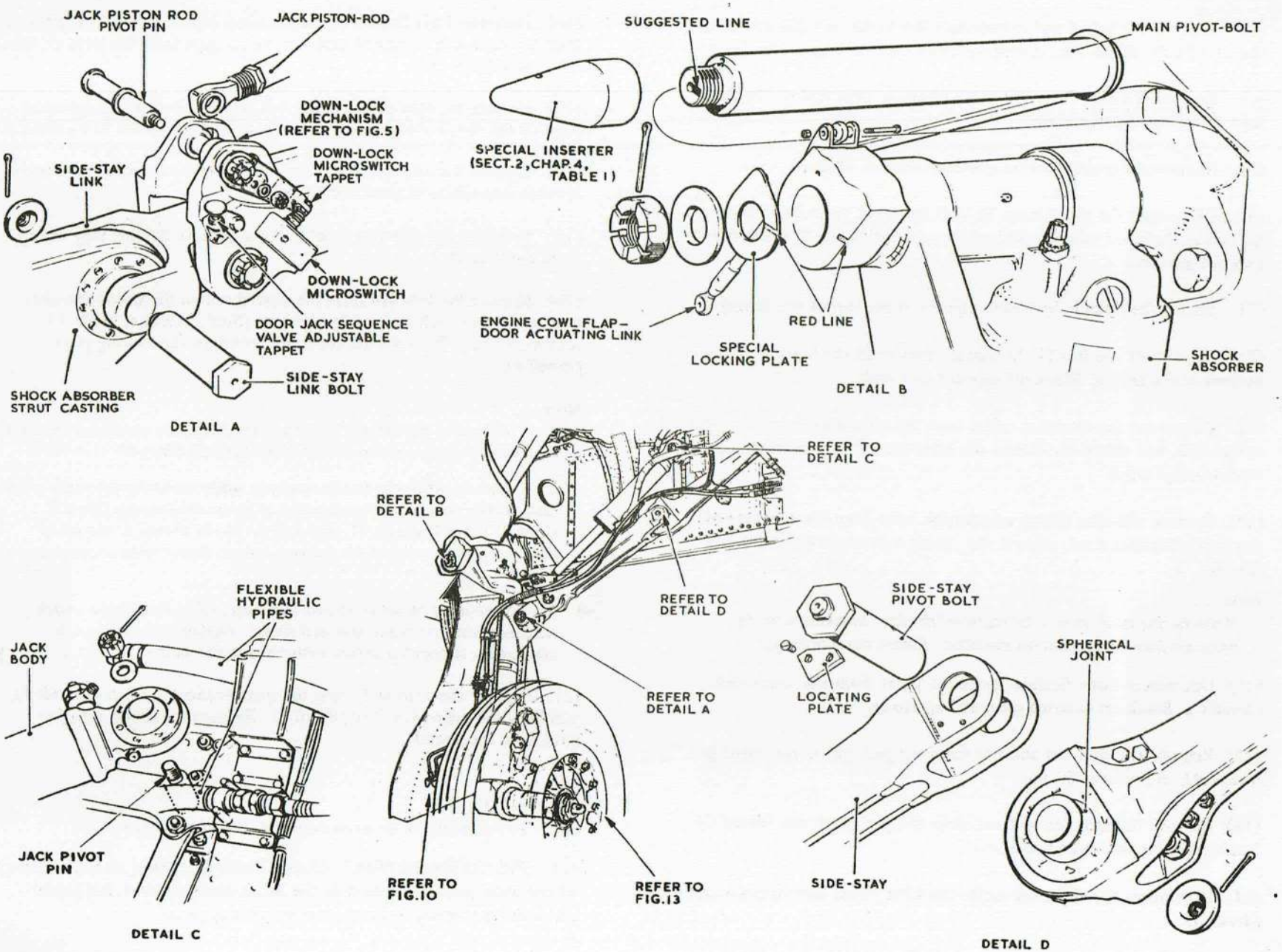



FIG. 11. UNDERCARRIAGE-REMOVAL AND ASSEMBLY

◀ REDRAWN AND CLARIFIED ▶

(3) Check that the red line (detail B) is still visible, and that the locking plate dowel holes are aligned. If necessary, rotate the pivot bolt to enable the plate to be pushed home by hand; the dowels must not be forced home by tightening the nut. A red line painted on the end of the main pivot bolt in the same relative position as the line on the pivot bracket will enable a check to be made, before tightening the nut, to ensure that the pivot bolt and locking plate are in line.

(4) Fit a dummy sleeve and weight, Part No.EA1.88.371, to the wheel axle to make up the width of the wheel hub against which the towing eye abuts. The towing eye forms the undercarriage up-stops.

(5) Assemble the side stay and link in the reverse order of removal (para.31), fitting split-pins to lock the slotted nuts of both pivot bolts. Secure the locating plate at the side stay pivot bolt head and wire-lock the pivot bolt grease nipple stud to the locating plate (detail D).

(6) Fit the undercarriage jack at its main spar pivot attachment and lock the slotted nut with a split pin.

(7) Connect a hydraulic test rig (Sect.2, Chap.4, Table 2) to the jack and ensure that the jack is fully extended. Adjust its length by screwing the piston rod eye end either in or out to obtain the correct override past the jack pivot pin centres on the stay link lock lever bolt (para.19). Wire-lock the piston-rod locknut.

(8) Close the jack until the pick-up centres coincide, and secure the piston rod end to the down lock lever bolt. Lock the slotted nut with a split pin.

(9) Uncouple the up-latch hook return spring.

(10) With the hydraulic test rig connected to the main jack, raise the undercarriage (2750lb/in$^2$) and, whilst under jack load, check the clearance between the up-latch hook and up-latch pin (fig.1). If adjustment is required, vary the shim thickness beneath the up-stop pad in the wheel-well roof (para.24).

Note...

1. It may be necessary to adjust the up-latch hook (para.24); ensure that the hook attitude is not altered.

2. Access to the up-latch hook, when the undercarriage is retracted, is gained through a panel in the upper surface of the inner main plane (Sect.2, Chap.4).

(11) Lower the undercarriage and reconnect the up-latch hook return spring.

(12) Release the locknut of the door jack sequence-valve tappet on the side stay knuckle joint, and screw the tappet as far as possible into the casting.

(13) Raise the undercarriage and adjust the tappet so that the sequence-valve plunger is depressed to the dimensions given in fig.8. Tighten the locknut.

Note...

Access to the sequence-valve tappet when the undercarriage is raised is gained through the same panel as for the up-latch hook (operation (10), Note 2).

(14) Check the up microswitch setting and adjust if necessary (fig.9).

(15) Partly raise the undercarriage and attach the spat-type fairing to the shock-absorber strut in the reverse order of its removal (para.31).

(16) With the undercarriage resting in the up-latch hook, check the skin contour dimensions around the fairing perimeter; they must be as given in para.28. If adjustment is required, vary the shims beneath the fairing attachment brackets on the four bosses of the shock-absorber strut (fig.11).

(17) Lower the undercarriage, remove the dummy sleeve from the wheel axle and fit the wheel (fig.13).

(18) Reconnect and clip the brake hydraulic pipes to the side stay and strut fairing, leaving the clips partly tightened. Wire-lock the unions.

(19) Reconnect and clip the microswitch cables to the side stay and hydraulic pipes as shown in figs. 11A and 11B. Leave the clips partly tightened.

(20) Check the settings of the down-lock micro-switch and, on the starboard undercarriage, the shock-absorber strut switch; if necessary, adjust (fig.9).

(21) Fit the rear half of the engine lower cowling, connect the flap-operating link and, if necessary, adjust to give the flap a flush fit with the cowl (para.29) when the undercarriage is raised.

(22) Using the hydraulic test rig, raise and lower the undercarriage to check no setting has been disturbed.

◀(23) Disconnect the test rig and connect the hydraulic pipes to the undercarriage jack as shown in Fig.11C. Wirelock the unions. ▶

(24) Upon completion of the wiring and piping installation and before final tightening of the securing clips, using the hand pump, fully retract and lower the undercarriage (Sect.3, Chap.6).

(25) Check that, at all points of travel (and with the undercarriage locked up and down), all pipes and cables are safely routed (figs. 1, 11A and 11B), do not chafe and are not trapped or stretched.

(26) Tighten all securing clips and tape the hydraulic pipes (fig.1).

(27) Prime and bleed the jack and brakes.

(28) Test the functioning of the alighting gear and brakes (Chap.6).

(29) Ensure that all bolts, nuts, pins and unions are correctly locked.

Note...

If after fitting a replacement shock-absorber strut, slight oil leakage occurs from the gland area, further flights may be made to allow the seals to bed-in before rejecting the strut as unserviceable.

Fitting a replacement undercarriage unit

33. The following operations, additional to para. 32, are applicable whenever a main undercarriage unit is changed.

(1) Fit the up-stop cradle and pad (fig.3) together with the special shim packing, Ref. No. 26FZ/9184.

(2) Fit undercarriage up-latch bracket, with hook attached and spring connected, and the special shim, Ref. No. 26FZ/18513, interposed between structure and bracket.

(3) Wrap a 0.010 in. to 0.015 in. lamination around the up-latch pin and raise the undercarriage by hand pump or hydraulic rig applying full hydraulic pressure.

(4) Check that the up-latch hook is moved only by the up-latch pin. To ensure correct alignment between the up-latch hook and the up-latch pin, adjustment may be made by tapering the shim.

Note...

1. If the towing eye on the undercarriage main wheel hits the stop pad and the door-jack sequence valve is operated before the up-latch hook engages correctly, further shimming, Ref. No. 26FZ/5055, may be added to the up-latch hook bracket with a corresponding reduction of shimming under the stop pad.

2. Any additional laminations required at either position must be halved and the equivalent amount removed from the other, e.g. if 0.050 in. is required under the up-latch hook bracket fit 0.025 in. and remove 0.025 in. from under the stop pad. Additional shims to the basic 10 s.w.g. L.72 packing under the stop pad may be made by adding laminations from laminated aluminium shim, Ref.No. 26FZ/6166.

(5) Check, after adjusting shims, that the initial movement of the up-latch hook is made by contact with the up-latch pin and not the lever on the side stay and that a gap of 0.010 in. to 0.015 in. between the up-latch pin and the up-latch hook (fig.1) is present on full retraction.

(6) Fit and adjust the microswitch (fig.9)

(7) Repeat the undercarriage retraction and check alignment and relevant settings.

(8) Finally, check that on retraction the undercarriage fixed fairing is correctly aligned (para.28) by adjustment of the shim packings fitted between the shock-absorber strut and the fixed fairing.

Undercarriage door (fig.12)

Removal

34. To remove an undercarriage door:-

(1) Fully open the door

(2) Remove the pin connecting the door jack piston rod to the lock lever between the lugs of the forward hinge bracket.

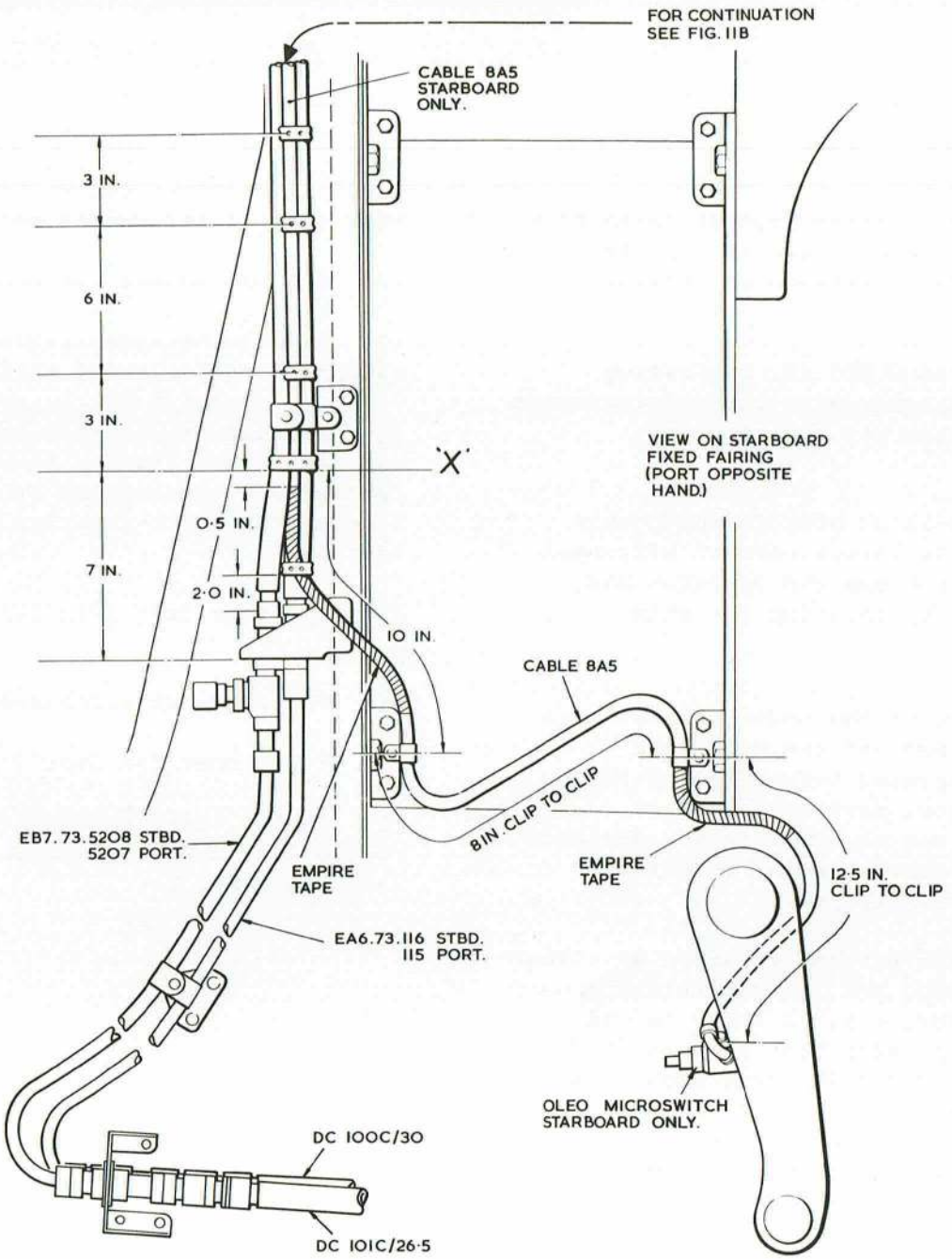



FIG. 11A. UNDERCARRIAGE – PIPING AND WIRING INSTALLATION

◄ NEW ILLUSTRATION ►

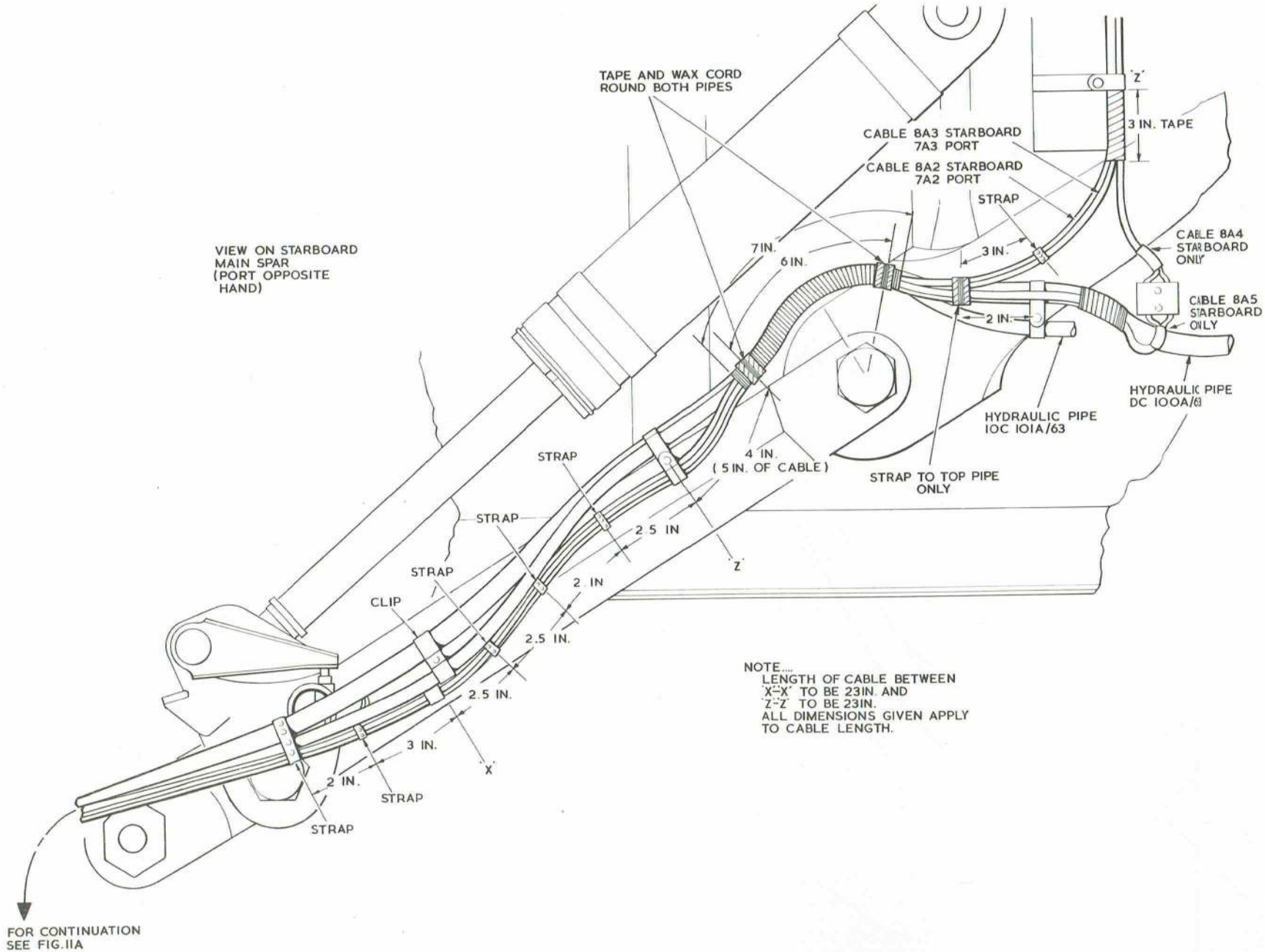



FIG.11B. UNDERCARRIAGE – PIPING AND WIRING INSTALLATION

◄ NEW ILLUSTRATION ►

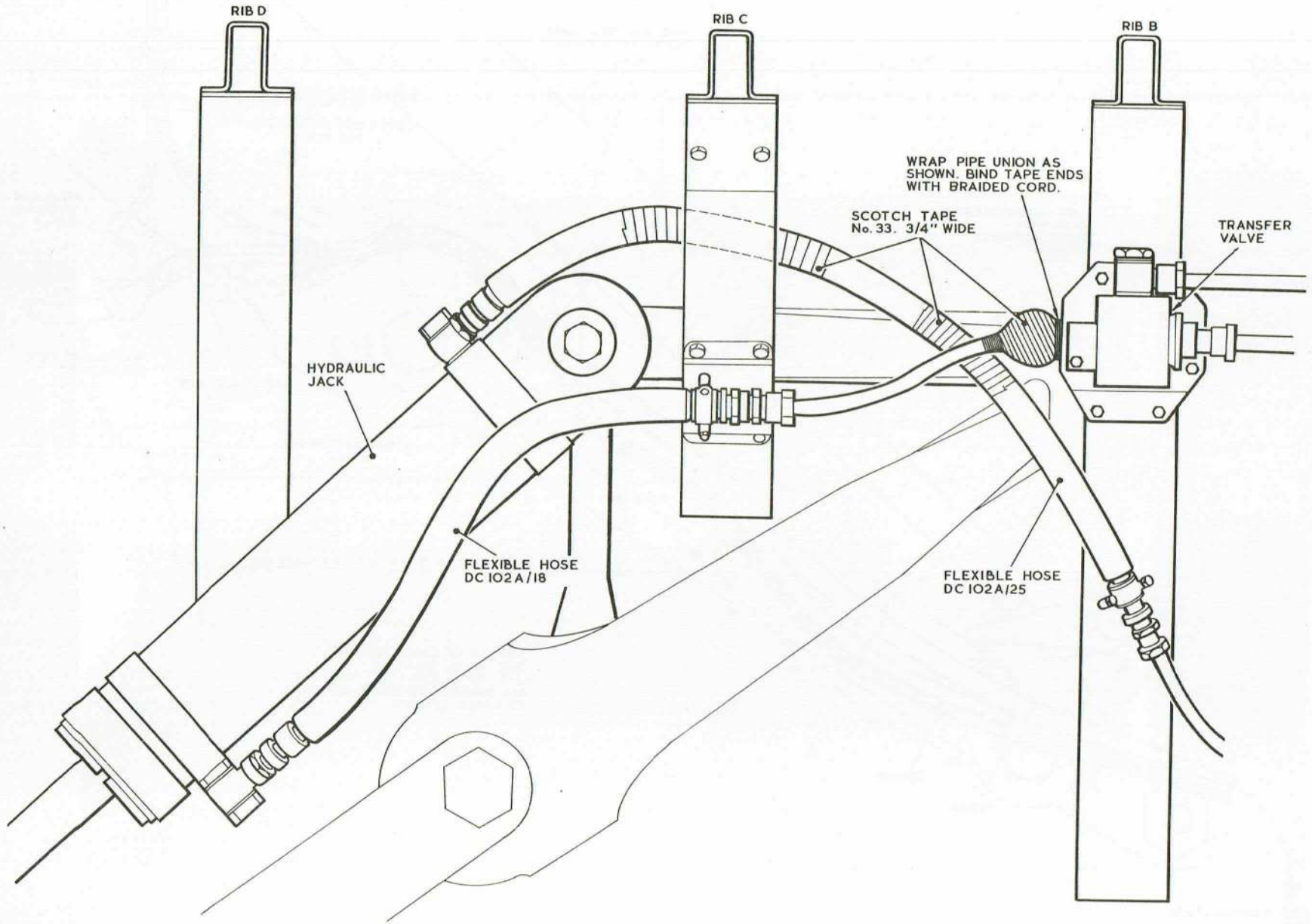



FIG. 11C. UNDERCARRIAGE - HOSE INSTALLATION

◀ NEW ILLUSTRATION ▶



101B-0407-1A/176/8233453/207/8-81/BAe/1307

(3) Remove the bolt about which the lock lever, side links and lower check links pivot.

(4) Remove the hinge bolt from the front and rear door hinges, and remove the door.

*Assembly*

35. To assemble the undercarriage door:-

**Note . . .**

*Refer to A.P.101B-0400-6, Part 1, Chap.3, for fitment of a new undercarriage door.*

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Attach the door to its hinges and fit the slave link mechanism *(para.36).*

**Note . . .**

*The front hinge bolt acts as a pivot for the side links at their inboard end.*

(3) Close the door manually and ensure that a 0.08 in. maximum skin gap exists at the door leading edge. File the leading edge if necessary, then apply protective treatment in accordance with A.P.119A-0509-1.

(4) Adjust the door stop bolt *(para.22)* until the door leading edge is 0.08 in. inside the wing contour out-of-airflow. If necessary, adjust the shimming between the door forward hinge bracket and door *(para.37).*

(5) The trailing edge of the door must be flush with the skin contour. If necessary, adjust the shimming between the door rear hinge bracket and door *(para.37).*

(6) Fit the bolt about which the lock lever, side links and lower check links pivot.

(7) Ensure that all pressure is exhausted from the hydraulic system *(Chap.6).* Disconnect the flexible pipes from the door jack and connect a hydraulic test rig to the jack.

(8) Check, and if necessary, adjust the door jack overrides *(para.20).*

(9) Connect the door jack piston rod to the operating mechanism.

(10) After adjustment of the shimming between the two parts of the lock lever, check the shim thickness and, in accordance with Table 1, fit the correct bolt and number of plain washers. Torque load to 115-125 lbf in. Ensure that the bolt tail, when fully tightened, protrudes 0.02 in. minimum.

(11) Check that the lock lever countersunk locating screw has been locked by centre-popping.

(12) Check the operating of the door shoot bolts and adjust if necessary *(para.21).*

(13) Check the sequence valve tappet setting and if necessary adjust *(para.23).*

(14) Disconnect the hydraulic test rig and recouple the flexible pipes to the door jack. Bleed the jack *(Chap.6).*

(15) Functionally test the undercarriage and door *(Chap.6).*

(16) Ensure that there is a good even fit between the door and undercarriage spat-type fairing.

(17) Check that the door shoot bolts engage properly and in correct sequence *(para.21).*

(18) Ensure that all bolts, nuts, pins, and unions are correctly locked.

**TABLE 1**

**Door locking lever bolt and shim details**

| Shim thickness (in.) | Bolt Pt. No. | No. of plain washers |
|---|---|---|
| 0.000 - 0.050 | A59 - 10G | 3 |
| 0.051 - 0.098 | A59 - 10G | 2 |
| 0.099 - 0.146 | A59 - 10G | 1 |
| 0.147 - 0.202 | A59 - 10G | 0 |
| 0.203 - 0.250 | A59 - 12G | 3 |
| 0.251 - 0.298 | A59 - 12G | 2 |
| 0.299 - 0.350 | A59 - 12G | 1 |

**Note . . .**

1. *Also fit, in each case, one spring washer Ref.No.28W/9416645.*

2. *Bolt A59 - 10G is Ref.No.28D/1213610, bolt, A59 - 12G is Ref.No.28D/1213611 and the plain washers are Ref.No.28W/9419403.*

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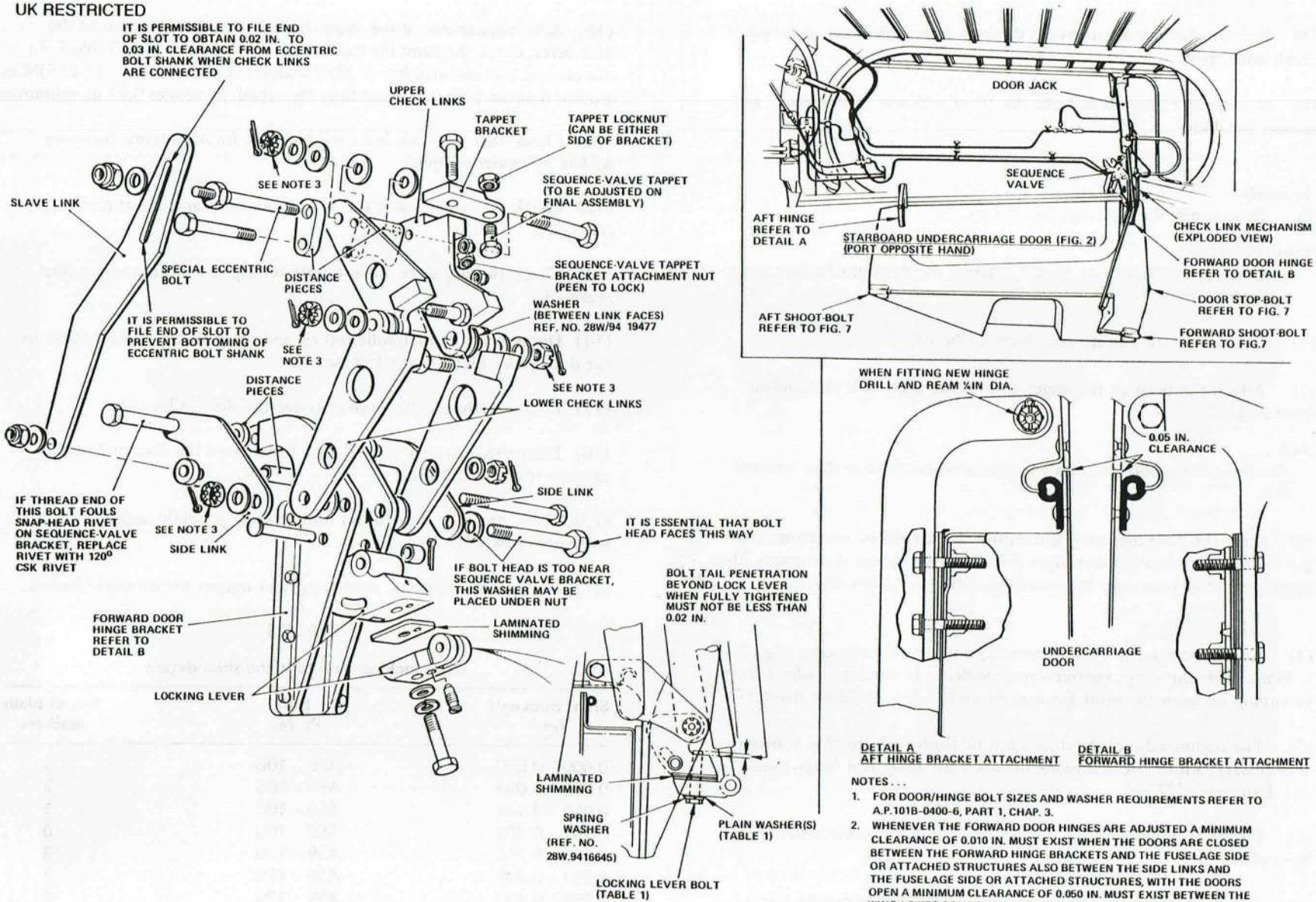



**CHECK-LINK MECHANISM ASSEMBLY**

NOTES . . .

1. FOR DOOR/HINGE BOLT SIZES AND WASHER REQUIREMENTS REFER TO A.P.101B-0400-6, PART 1, CHAP. 3.
2. WHENEVER THE FORWARD DOOR HINGES ARE ADJUSTED A MINIMUM CLEARANCE OF 0.010 IN. MUST EXIST WHEN THE DOORS ARE CLOSED BETWEEN THE FORWARD HINGE BRACKETS AND THE FUSELAGE SIDE OR ATTACHED STRUCTURES ALSO BETWEEN THE SIDE LINKS AND THE FUSELAGE SIDE OR ATTACHED STRUCTURES, WITH THE DOORS OPEN A MINIMUM CLEARANCE OF 0.050 IN. MUST EXIST BETWEEN THE WING LOWER BOUNDARY ANGLES AND RIVETS, AND THE HINGE BRACKETS, AND ALSO THE SIDE LINKS.
3. TO ENSURE UNRESTRICTED MOVEMENT OF CHECK LINKS ABOUT FULCRUM AND PIVOT POINTS THE FOUR SLOTTED NUTS MUST BE FULLY TIGHTENED AND TURNED BACK ONE QUARTER OF A TURN BEFORE DRILLING HOLE IN BOLT FOR SPLIT PIN.
4. THE LOCKING LEVER BOLT IS TO BE TORQUE LOADED TO 115-125 LBF IN.

**FIG.12. CHECK-LINK MECHANISM AND DOOR — REMOVAL AND ASSEMBLY.**

**Door checks links** *(fig.12)*

36. The door check link mechanism should not normally require any attention apart from normal periodic lubrication *(fig.5)*. If, however, it is found necessary to remove and replace parts of, or the whole of, the mechanism, the following assembly points must be noted and functioning checks made. The removal of the mechanism is straightforward and requires no explanation.

Assembly notes and functioning checks

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)* and remove the main undercarriage jack piston rod pivot pin *(para.31)*.

(2) Assemble the side links, but not the slave link. Set the check links and sequence valve and ensure that the sequence valve plunger is not bottoming *(para.23)*.

**Note . . .**

*1. A foul may occur between the bolt Ref.No.26FZ/21079, about which the lock lever, side links and lower check links pivot, and the flange of the adjacent sequence valve bracket. This bolt must be fitted with its head facing aft and, if the foul still exists the washer under the head of the bolt must be fitted under the nut.*

*2. When assembling the check links ensure that the two 3/8 in. dia. fulcrum bolts Ref.No.26FZ/21081 are positioned with their heads on the inner faces of the links with the spacing washer between the hinge and the check links (refer to Note 3) and a plain washer fitted under each nut. After fully tightening these nuts and the nuts on the check links upper and lower attachment bolts, screw them back one quarter of a turn before drilling the split-pin hole; this allows for free movement of the links.*

*3. It is permissible to fit both spacing washers on either the forward or the aft side in order to provide a safer working clearance between the jack ram and the heads of the fulcrum bolts.*

(3) Fit the slave link and adjust to the dimension given in fig.12.

(4) With the door jack disconnected at the lock lever, manually close the door and check that the slave link is free throughout its movement and does not foul the door-sealing strip or check-link pins. Observe the clearance at the top of the slot and ensure the slot does not bottom during the whole movement, there must also be adequate clearance at the bottom of the slot when the door is fully up.

(5) Remove the two 3/8 in. dia. bolts from the fulcrum of the check links and ensure that the slave mechanism operates the sequence-valve plunger with the door pushed to the fully open position.

(6) Reconnect the door jack to the lock lever and pump the jack fully down. Check that the slave mechanism still operates the sequence-valve plunger.

(7) Ensure that with the check link fulcrum bolts removed, there is no clearance between the top of the slave link slot and the eccentric bolt shank when the door is in the down position.

(8) Pull the door in an outboard direction and ensure that the mechanism is firm and that the sequence-valve plunger is still depressed.

(9) Refit the bolts in the check links fulcrum points (operation (2) Note 2) and, observing the quarter turn back of the nuts, fit the split pins.

(10) Finally check that with the door fully down there is still a clearance between the top of the slave-link slot and the eccentric-bolt shank.

(11) Refit the main undercarriage jack piston rod pivot pin *(para.32)*.

(12) Function test the alighting gear *(Chap.6)*.

**Door hinges** *(fig.12)*

37. The amount of thread of a hinge bracket attachment bolt which passes into its anchor nut is critical. It is, therefore, important that, during assembly of the hinge brackets one of the following procedures is carefully observed, dependent on the type of bolt fitted.

(1) *Bolt A25*

Measure the amount of the existing packing and fit the appropriate length of bolt and/or washers selected from the following table:–

| PACKING FWD. HINGE | FASTENING |
|---|---|
| Nil | bolt A.25/3C |
| less than 0.05 in. | bolt A.25/4C and washer SP./15C |

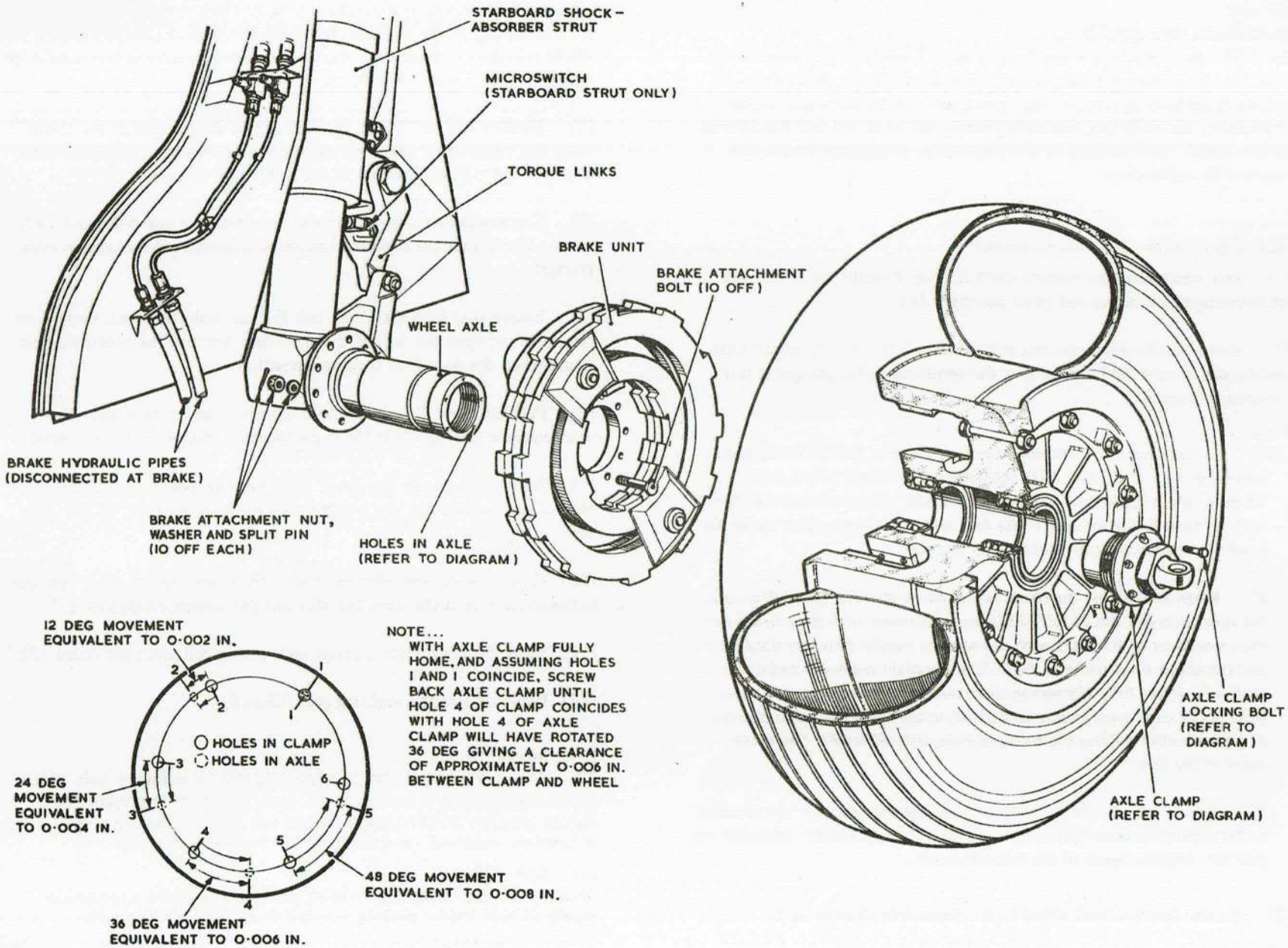



DIAGRAM SHOWING RELATIONSHIP BETWEEN HOLES IN AXLE CLAMP AND AXLE

FIG. 13. WHEEL AND BRAKE-REMOVAL AND ASSEMBLY

◀REDRAWN AND CLARIFIED▶

| PACKING | FASTENING |
|---|---|
| FWD. HINGE – continued | |
| 0.05 in. to 0.10 in. | bolt A.25/4C |
| 0.10 in. to 0.13 in. | bolt A.25/5C and washer SP./15C |
| AFT HINGE (top bolt) | |
| Nil | bolt A.25/2C |
| less than 0.03 in. | bolt A.25/3C and washer SP./15C |
| 0.03 in. to 0.08 in. | bolt A.25/3C |
| 0.08 in. to 0.13 in. | bolt A.25/4C and washer SP./15C |
| AFT HINGE (remaining bolts) | |
| less than 0.07 in. | bolt A.25/3C and washer |
| 0.07 in. to 0.13 in. | bolt A.25/3C |

or

(2) *Bolt EA3-20-2045*

Assemble the main undercarriage door to the forward and aft hinges using 1.05 in. long bolts Part No.EA3-20-2045 adjusting the amount of each bolt plain shank engagement with an appropriate amount of washers (S.P.15/C) beneath each bolt head to obtain a combined thickness of packings, shims and washers as follows:–

| | |
|---|---|
| Forward hinge | 0.15 to 0.20 in. |
| Aft hinge | 0.20 to 0.25 in. |

**Note . . .**

*Procedure (1) was introduced by STI/CAN/148. Procedure (2) is required on the current issue of the relevant drawings and has the advantage of constant bolt length.*

**Wheel** *(fig.13)*

*Removal*

38.

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Ensure that the aircraft parking brake is off *(Chap.6).*

(3) Unlock the brake piston rods by removing the retaining springs and locking plates. Screw the piston rods in tight.

(4) Remove the locking wire and unscrew and remove the locking bolt from the axle clamp.

(5) Unscrew and remove the axle clamp.

(6) Using wheel extractor *(Sect.2, Chap.4, Table 1)* remove the wheel from the axle.

*Assembly*

39. When reassembling the wheel it is important that the wheel bearing and brake clearances are correctly adjusted, and that shock loads are not transmitted to the Maxaret unit. To obtain these clearances the following sequence of operations must be observed:-

(1) Ensure that the wheel bearings are lubricated with grease *(fig.5).*

(2) Slide the wheel on to the axle until it is fully engaged with the brake tenons. Release the brake by unscrewing each piston rod one complete revolution. The wheel should now be free to rotate.

(3) Whilst rotating the wheel, screw on the axle clamp until the taper bearings are fully home and the clearance is taken up. Do not overtighten the axle clamp during this operation.

(4) When the axle clamp is fully home and the clearance taken up, unscrew the axle clamp to obtain a clearance of 0.005 in. $^{+0.005}_{-0.000}$ in. between the clamp and the wheel.

**Note . . .**

*Six locating holes for the locking bolts are provided in the axle clamp and five in the axle, therefore only one of the axle clamp holes will coincide with a hole in the axle at any one time (fig.13). This coincidence will occur at different holes at 12 deg intervals as the axle clamp is rotated. The axle clamp is threaded 16 t.p.i., thus one complete turn of the clamp will give a clearance of 0.0625 in. A movement of 12 deg from one hole coincidence to the next would, therefore, give a clearance of 12/360 of 1/16 = 0.002 in. approximately. To obtain the minimum defined clearance the axle clamp must be unscrewed through the coincidence of three holes which will give the correct clearance of 0.006 in.*

(5) Insert the locking bolt into the coinciding holes; tighten and wire-lock.

(6) Adjust the brake clearance by screwing in the piston rods until resistance to rotation is felt, indicating that the brake clearance is taken up. Slacken each piston rod one complete turn, plus the amount required to re-engage the end of the piston rod with the spring loaded self locking plate. *(AP104J-1047-1)*

(7) Function test the operation of the brakes *(Chap.6)*.

**Brake unit** *(fig.13)*

*Removal*

**40.**

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Ensure that all hydraulic pressure is exhausted *(Chap.6)*.

(3) Remove the wheel *(para.38)*.

(4) Disconnect the flexible hydraulic pipes from the brake and Maxaret units.

(5) Remove the split pins from the ten slotted nuts which secure the brake unit to the axle.

(6) Remove the brake unit.

*Assembly*

**41.**

(1) Assemble the brake unit to the stub axle and secure with the slotted nuts and new split pins.

(2) Bleed and reconnect the hydraulic pipes to the brake and Maxaret units.

(3) Refit the wheel and adjust the brake piston rods *(para.39)*.

(4) Function test the operation of the brakes *(Chap.6)*.

# Chapter 5B NOSE UNDERCARRIAGE

*(completely revised)*

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS

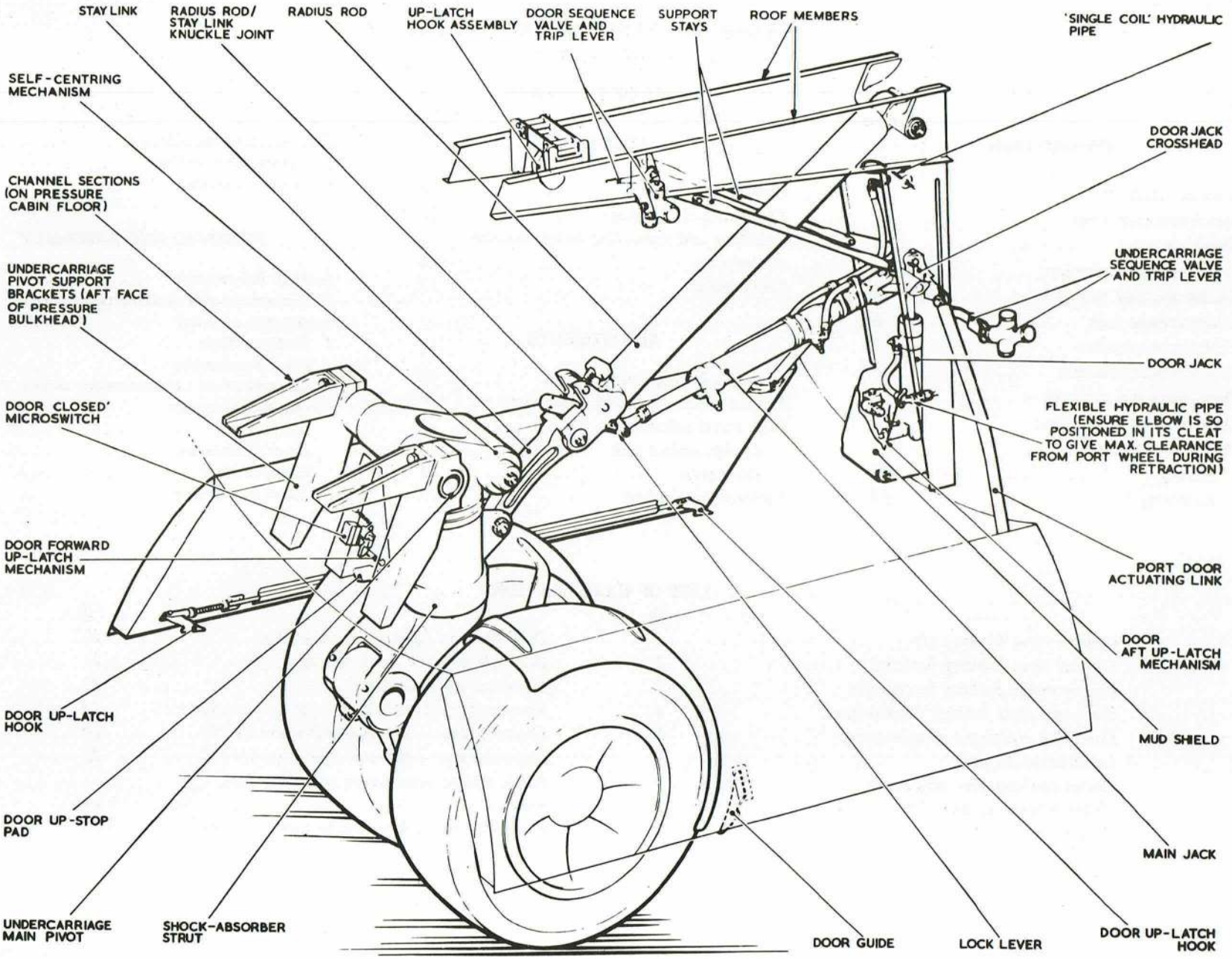



FIG.I. GENERAL VIEW, LOOKING AFT

## DESCRIPTION

**General information** *(fig.1 and 2)*

1. The nose undercarriage is a twin wheel, lever suspension type, fitted with a liquid spring shock-absorber and a spring-loaded self-centring device *(A.P.1803E, Vol.1, Sect.6)*. The unit pivots about support brackets mounted on the aft face of the pressure bulkhead and, on retraction, a hydraulic jack moves it rearwards and upwards into the nose-wheel well *(Chap.1)*. After retraction, the nose wheel well is faired-off flush with the aircraft skin by two doors actuated by another hydraulic jack mounted on the aft bulkhead of the well. A mudguard, attached to the bearing bracket on the axle is provided for each wheel. A radius rod and stay link, spanned between the aircraft structure and the shock-absorber, incorporates a down-lock mechanism in its knuckle joint; the undercarriage is held locked in the retracted position by an up-latch hook situated in the roof of the wheel well. Sequence valves, interposed in the hydraulic jacks circuits, ensure correctly sequenced opening and closing of the doors in relation to the undercarriage operation *(Chap.6)*.

**Shock-absorber strut**

2. The strut consists of a main fitting, which houses the main pivot shaft and self-centring mechanism, a pivot fork and link fitting, a twin-stub axle beam, and a liquid-spring shock absorber. Two bearing brackets of the aft face of the pressure bulkhead provide a suspension and pivoting point for the strut main pivot shaft, while lugs on the rear of the strut outer sleeve form attachment points for the stay link which connects the strut to the retracting mechanism *(para.5)*. The wheels are carried on the stub axle beam pivoted to the lower end of the inner sleeve, with the lower end of the shock-absorber strut pin-jointed to the beam between the axle and pivot pin.

**Shock absorber**

3. The shock absorber is a liquid-spring unit housed within the strut outer sleeve and retained in the strut by a pip-pin. It consists of a cylinder, housing a piston assembly, and is described in A.P.1803E, Vol.1, Sect.6.

**Self-centring mechanism**

4. The spring-loaded self-centring mechanism is an integral part of the strut outer sleeve. It is housed in a dashpot at the top of the sleeve and acts as a damper to any shimmying effect which might occur during taxying. The unit is fully castering, controlled within a range of 25 deg on each side of the trailing position.

**Radius rod and stay link**

5. The radius rod pivots at its upper end in a block mounted between two heavy support beams on the underside of the undercarriage well roof, and is pin-jointed at its lower end to the stay link which connects it to the strut outer sleeve. Where the radius rod joins the stay link a knuckle joint is formed which folds during undercarriage retraction. Incorporated in this knuckle joint is the down-lock mechanism and a pin which engages the up-latch hook when the undercarriage is fully retracted. Two microswitches, which when operated, illuminate the undercarriage indicator lights at the pilot's station, are mounted on the knuckle joint.

**Undercarriage jack**

6. The jack is situated below the radius rod, and at its body end is pivoted between the two channel stiffeners on the aft bulkhead of the undercarriage well. At its forward end the jack piston rod is attached through the down-lock lever to the knuckle joint of the radius rod. The jack is extended when the undercarriage is retracted.

**Up-latch mechanism** *(fig.8)*

7. The up-latch hook assembly is mounted between the two support beams on the underside of the wheel-well roof. The hook is retained in its normal locking position by a spring, one end of which is attached to an extension of the hook, while the other is attached to the support beam. When the undercarriage is fully retracted, the hook, under the action of its spring, engages the up-latch pin on the end of the radius rod; when the jack retracts to lower the undercarriage, the initial movement rotates the down-lock lever and a roller on the end of the lever dis-engages the up-latch hook from the up-latch pin to release the under-carriage. An adjustable pedestal is mounted on each side of the up-latch hook to limit the upward movement of the radius rod. The door sequence valve and trip lever is mounted just aft of the up-latch hook assembly on the port longitudinal well roof beam; the lever is operated, during under-carriage retraction, by the upper face of the radius rod.

**Down-lock mechanism** *(fig.3 and 7)*

8. The down-lock mechanism is carried in the forked end of the radius rod in which the stay link is hinged. It consists of a lever, mounted on a pivot bolt, carrying two rollers on its upper end; the lower end of the lever is connected to the end of the jack piston rod. When in the down position, the lower of the two rollers on the lever rests on the profiled end of the stay link, in which position it is locked by a spring-loaded latch pin.

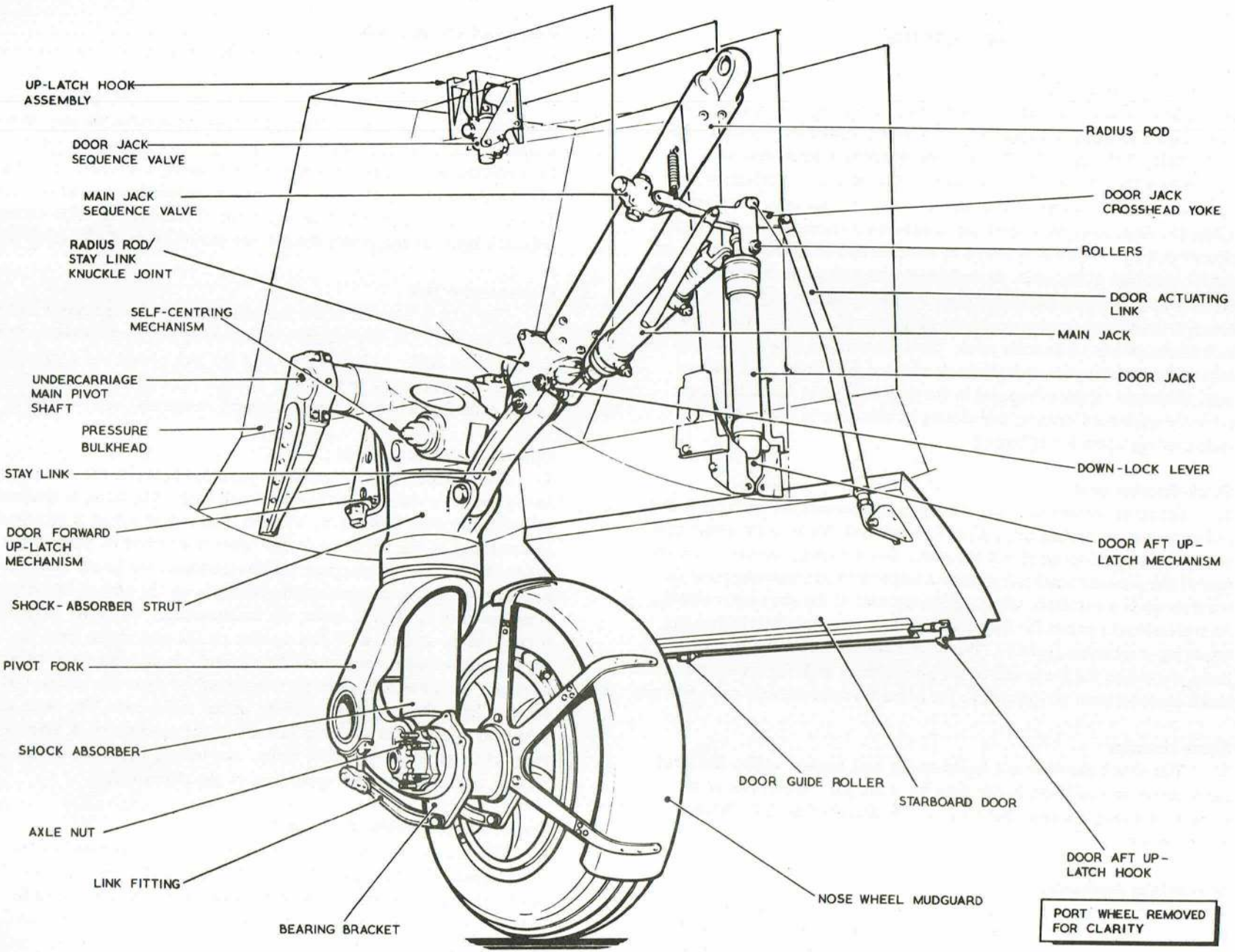



FIG.2. GENERAL VIEW, LOOKING FORWARD

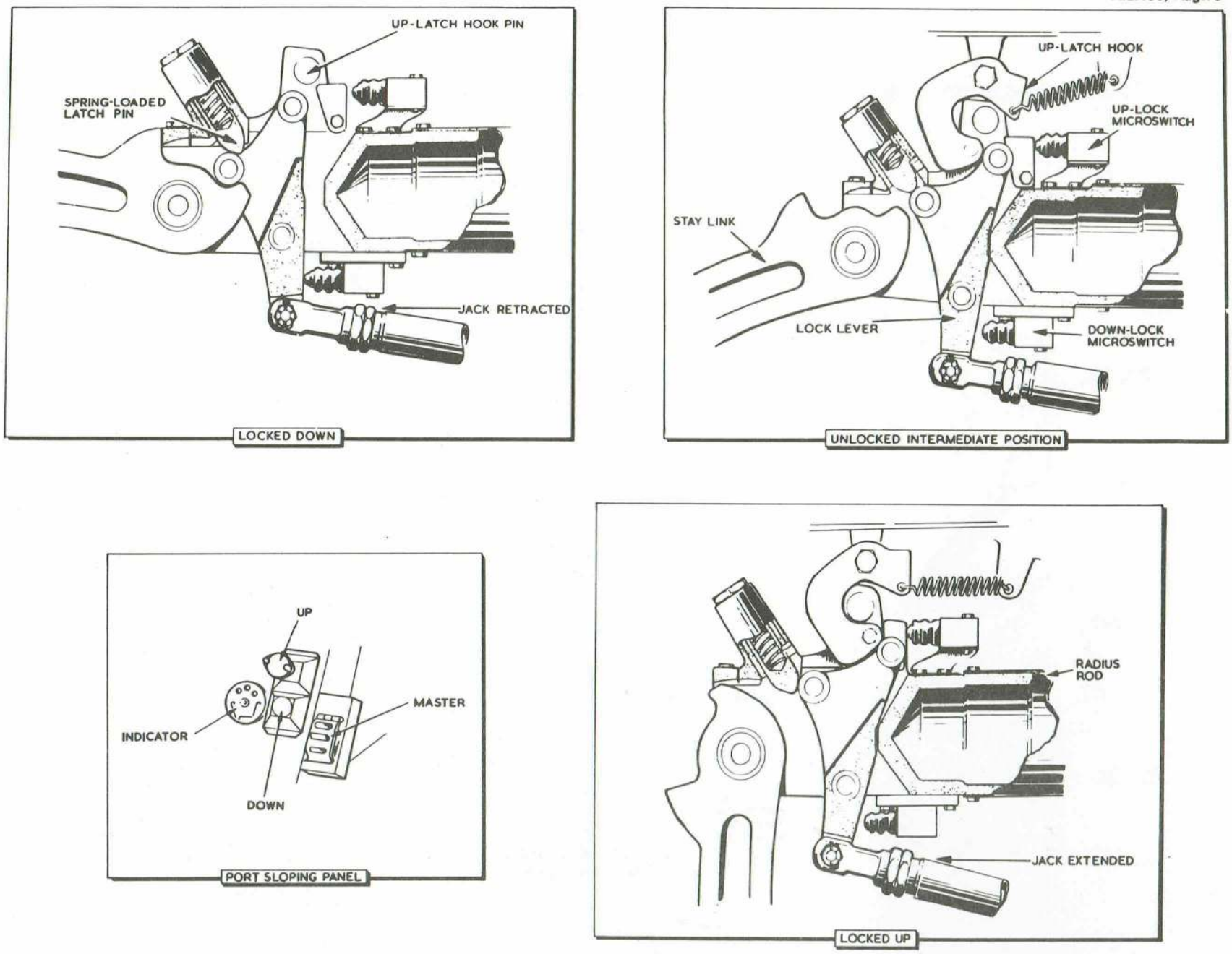



FIG.3. UNDERCARRIAGE LOCKING MECHANISM

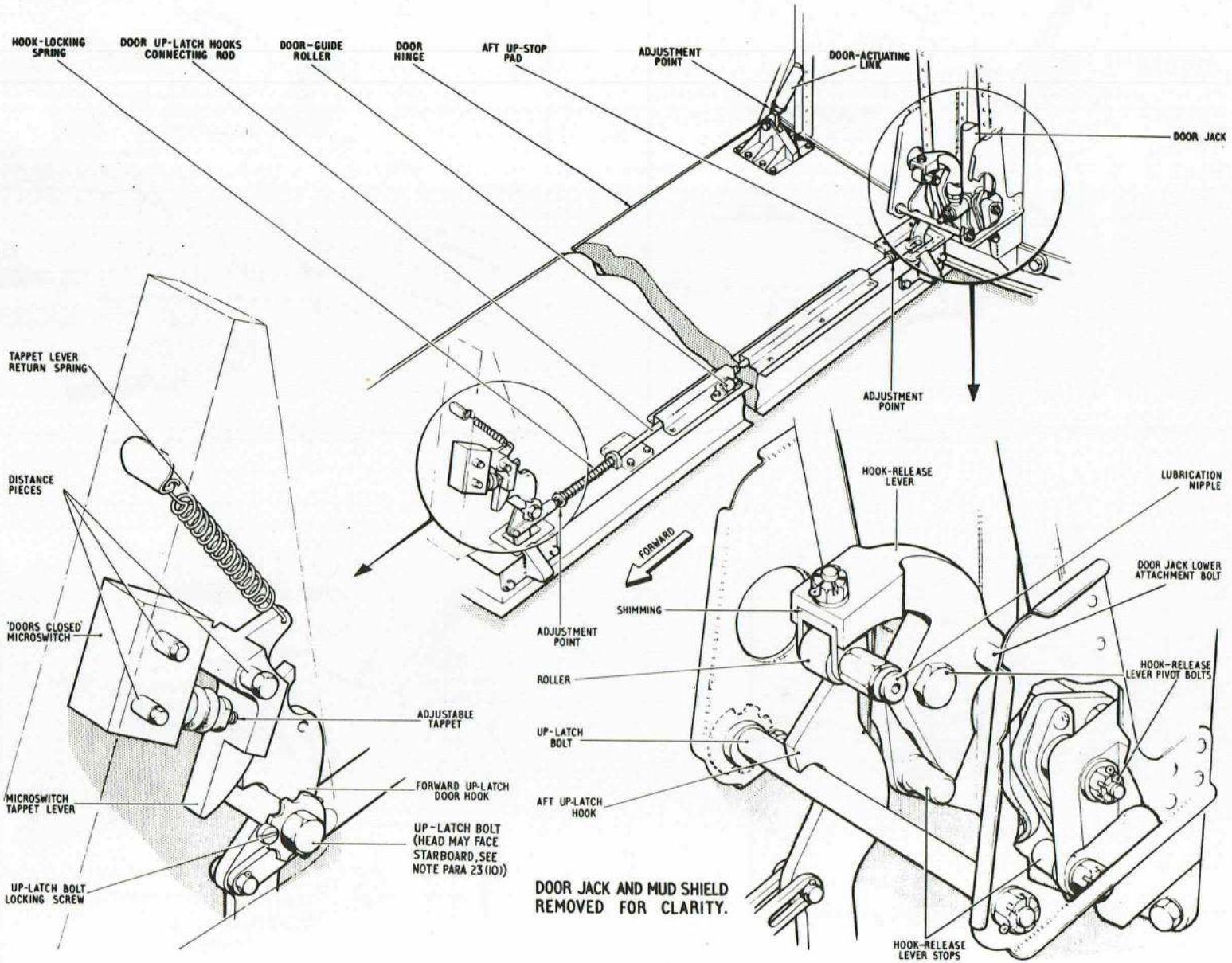



FIG. 4. STARBOARD DOOR LOCKING MECHANISM

◂ STI/CAN/199 INCORPORATED ▸

**Door-operating mechanism** *(fig.5)*

**9.** The two doors are hinged to the under-surface of the fuselage, one on either side of the undercarriage well, and open downward and outward. The doors are operated by a jack mounted vertically on the rear bulkhead of the undercarriage well, the upper end of the jack piston rod being connected to a crosshead yoke which is connected to the rear of both doors by actuating links; the lower end of the jack is connected to the door up-latch hook release lever *(fig.4 and 11)*. A trip screw on the port arm of the crosshead operates, through a lever, the undercarriage jack sequence valve when the doors are opened.

**Door-latching mechanism** *(fig.4)*

**10.** The doors are secured in their closed position by two latches, one at each end of the starboard door, which hook over the two up-latch bolts suitably positioned on the forward and aft walls of the undercarriage well. The port door is held in the closed position by two bevelled abutment faces *(fig.8 and 9)*, fitted to the edge of the starboard door, which mate with corresponding inverted abutment faces on the edge of the port door. The two door up-latch hooks are connected by an adjustable rod, and are loaded in the locked position by a latch return spring. Up stops are provided for both doors, one at the front and two at the rear of the undercarriage well; the rear stop packings are on the doors, and all three are adjustable by shimming to ensure a correct fit of the doors to the fuselage. The doors are shaped in such a manner that the forward ends close first.

**11.** The doors are opened when the latches are operated by a hook release lever mounted at the rear end of the undercarriage well; the lever is pivoted about its centre, and its upper end carries a striker roller so positioned that downward movement will cause it to contact the upper face of the aft latch. The lever carries the door jack lower pick-up point, and forward swing limit stops are fitted to the lever bracket to contact the lever and ensure a positive operating point for the jack when closing the doors. Initial retraction of the jack gives an upward movement to its lower pick-up point and a forward and downward movement to the hook release lever, which causes the striker roller to contact and move the aft latch out of engagement with its latch bolt. Movement of the aft latch is transmitted by the connecting rod to the front latch which is simultaneously released; further movement of the jack opens the doors. When the doors are being closed, the final movement of the jack brings the upper edges of the latch hooks into contact with the latch bolts and, due to their bevelled shape, the latches are moved rearwards until the doors are fully closed then, under the action of the latch return spring, they move forward and lock the doors.

**Principle of operation**

*Raising*

**12.** Upon selecting alighting gear UP, hydraulic pressure is first felt at both the undercarriage and door jacks but, since the door jack sequence valve is closed, preventing a flow of fluid from the door jack, only the undercarriage jack is operated. Initial extension of the jack piston rod overrides the spring-loaded lock lever plunger and withdraws the lower roller of the lock lever from the profiled end of the stay link *(fig.3)*; further movement breaks the stay link/radius rod knuckle joint, raises the radius rod and retracts the undercarriage. As the undercarriage approaches the end of its movement, the up-latch bolt is engaged by the up-latch hook, and the radius rod trips the door sequence valve operating lever, permitting a flow of fluid from the door jack. Initial extension of the door jack piston rod closes the undercarriage jack sequence valve, and continued movement of the door jack closes the doors *(para.11)*.

*Lowering*

**13.** When the alighting gear is selected DOWN, hydraulic pressure is first felt at both the undercarriage and door jacks but, since the undercarriage sequence valve is closed, preventing a flow of fluid from the undercarriage jack, only the door jack is operated. Initial retraction of the door jack piston rod operates the door latches *(para.11)* and continued retraction opens the doors which finally operate the undercarriage jack sequence valve, allowing fluid to flow from the undercarriage jack. Initial movement of the undercarriage jack causes the lock lever to pivot and disengage the up-latch hook, the radius rod falls and closes the door jack sequence valve and further movement of the jack lowers the undercarriage. The undercarriage is finally locked down by the engagement of the lower roller of the lock lever in the lip on the end of the stay link and the operation of the spring-loaded lock lever plunger *(fig.3)*.

## SERVICING

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**General information**

**14.** The following paragraphs provide information on the routine servicing of component parts.

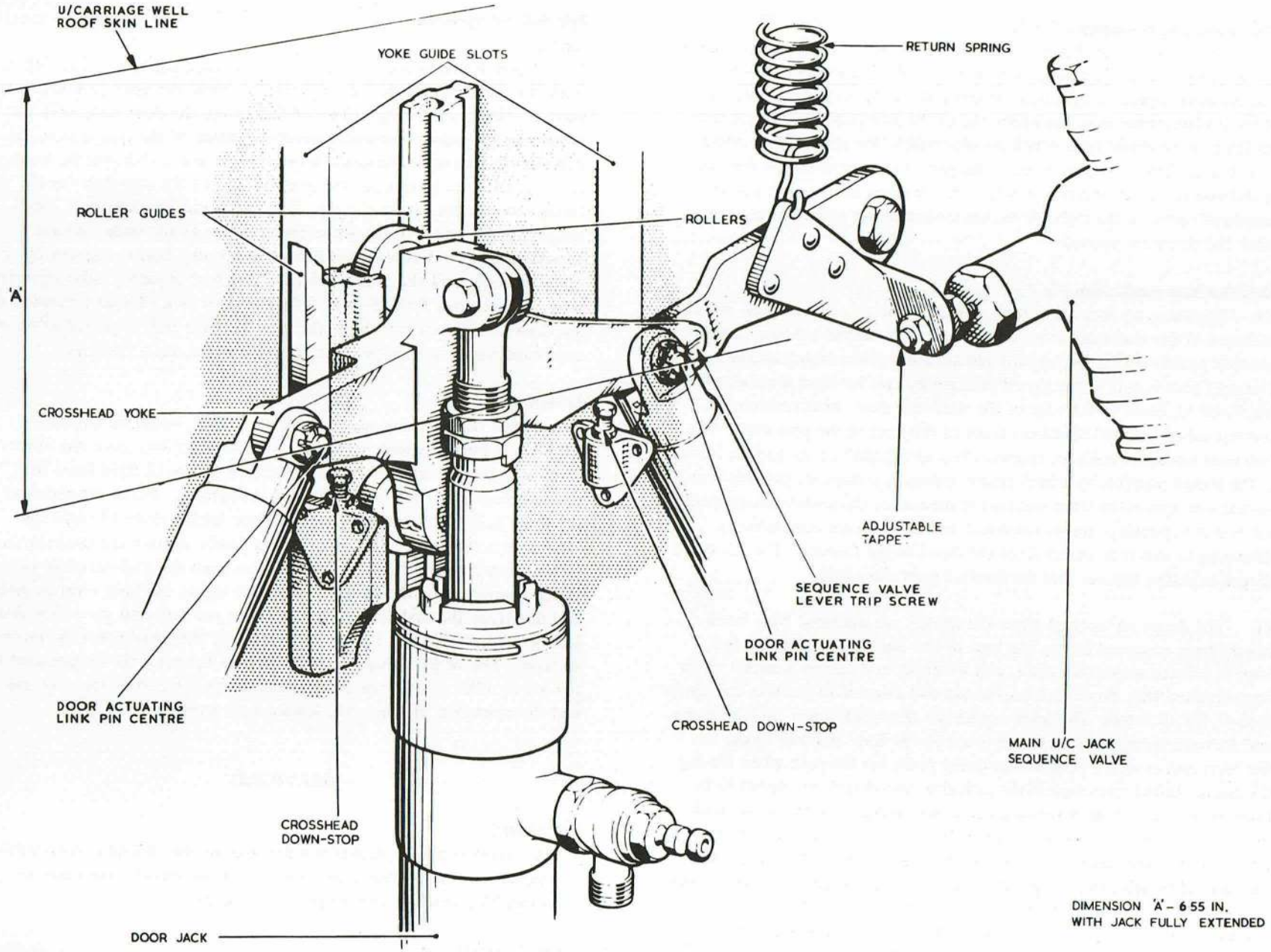



FIG.5. DOOR JACK CROSSHEAD ARRANGEMENT

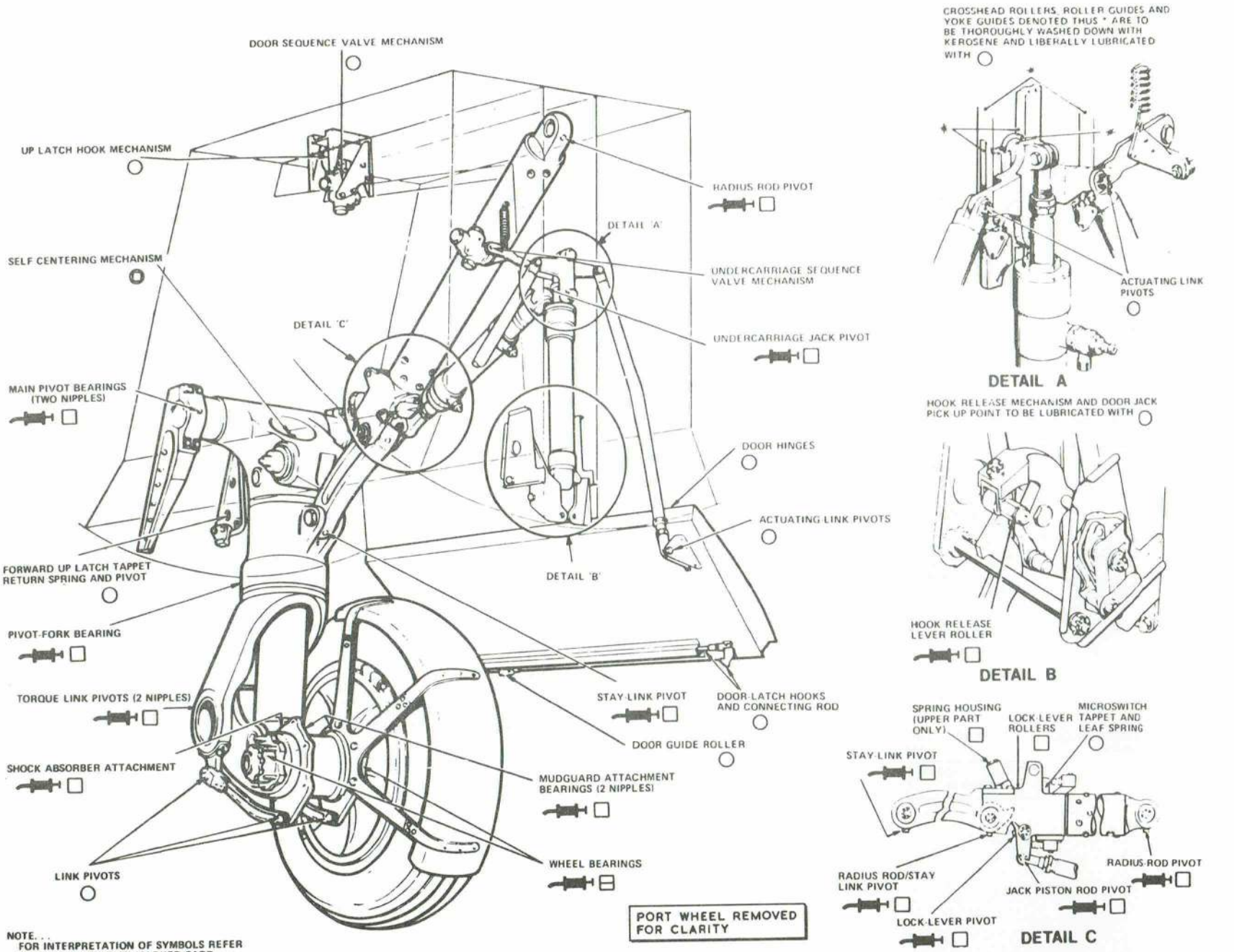



FIG. 6. LUBRICATION DIAGRAM

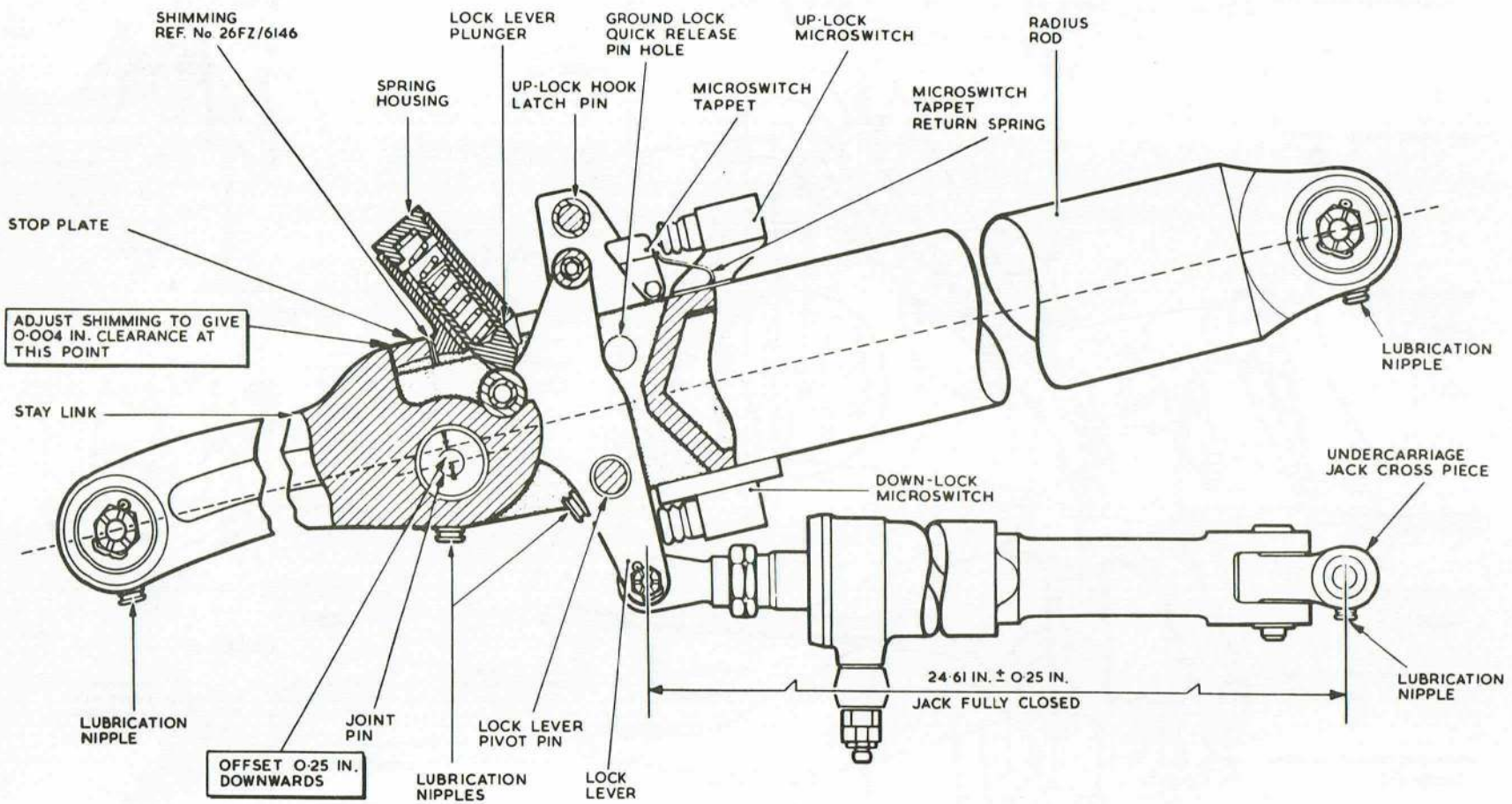



FIG. 7. RADIUS ROD/STAY LINK ALIGNMENT

**Shock-absorber leakage**

15. External leakage from the shock absorber is an indication of a defective sealing ring or gland washer. In these cases the unit must be considered unserviceable and a replacement fitted. If leakage occurs past the bleed plug it may be caused by slackness of the plug or grit under the ball; if cleaning and tightening proves ineffective the unit must be replaced.

**Checking and correcting shock-absorber oil pressure**

16. If the shock-absorber strut extension does not conform to the dimensions given in Sect.2, Chap.2 when the undercarriage is in the normal static-loaded condition and the shock absorber shows no signs of leakage, the unit must be topped up as follows:-

(1) Jack the aircraft nose *(Sect.2, Chap.4)* to remove the load from the shock absorber.

(2) Connect a flexible charging adapter to a universal lubricating gun *(Sect.2, Chap.4, Table 2)* and prime the charging adapter using hydraulic fluid OM-15.

(3) Remove the cap from the shock absorber charging valve and connect the primed charging adapter and gun to the valve.

(4) Charge the shock absorber to a pressure of 1500 ± 0.00 lb/in$^2$. Release the pressure in the charging adapter bleed screw. Remove the adapter and gun; refit the valve cap and lower the aircraft to the ground.

(5) Recheck the strut extension dimension *(Sect.2, Chap.2)*.

**Lubrication**

17. Refer to fig.6.

## ADJUSTMENTS

**General information**

18. The paragraphs in this section describe the procedure to be adopted when settings have to be checked and adjustments made. The occasions arise during both servicing and assembly operations and have for that reason been incorporated in this separate section, with relevant cross references made as necessary from other sections. After any adjustments have been made the nose undercarriage must be function tested *(Chap.6)*.

**Note . . .**

*1. Operation of the nose undercarriage UP/FLIGHT selector valve to UP isolates and prevents main undercarriage retraction (Chap.6).*

*2. When raising the nose undercarriage with the door-actuating links disconnected from the doors, an assistant must hold and guide the links to prevent damage to the adjacent hydraulic piping.*

**Radius-rod and stay-link adjustment** *(fig.7)*

19. The radius rod and stay link are in correct alignment when their joint pivot pin is offset 0.25 in. downwards from a straight line between the radius rod pin centre and the stay link pin centre. The dimension can be measured with either the jack connected and under hydraulic pressure or by applying strong upward manual pressure to the radius rod. With hydraulic pressure released, there must be a 0.004 in. clearance between the upper lip of the side stay and the radius rod stop plate *(fig.7)*. Should adjustment be necessary, either add to, or subtract from, the shimming Ref.No.26FZ/6146 (total pack 0.0625 in. in laminations of 0.002 in.) provided behind the stop plate, in the following manner:-

(1) With the aircraft jacked and trestled *(Sect.2, Chap.4)*, select UP on the UP/FLIGHT selector valve and partly raise the undercarriage by operating the aircraft hand pump.

(2) Remove the stop plate by unscrewing the securing bolts and adjust the shimming *(para.19)* as necessary. Refit the stop plate.

(3) Select FLIGHT on the UP/FLIGHT selector and fully lower the undercarriage by operating the aircraft hand pump.

(4) Release the hydraulic pressure and check that the 0.004 in. clearance has been obtained.

**Jack travel adjustments**

*Undercarriage jack*

20. The distance between the pin centres of the undercarriage jack when fully closed is 24.61 in. ± 0.25 in.; the jack piston rod travel is 9.09 in. ± 0.06 in. The exact pin-centre dimension is governed by the

pick-up points on the aircraft structure and the radius rod lock lever. The jack length must be checked upon renewal and after any servicing which may have affected its setting. To adjust the length:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Disconnect the jack piston rod from the lock lever by removing the attachment bolt *(para.27).*

(3) Disconnect the stay link and radius rod assembly from the shock absorber strut by removing the stay link lower pivot bolt *(para.27).*

(4) Ensure that the radius rod assembly does not fall below its normal operating position whilst disconnected at its lower end, or its underside will foul and damage the rigid single-coil hydraulic pipe situated on the aft bulkhead immediately below the radius rod upper pivot attachment *(fig.1).*

(5) Unlock the nose undercarriage UP/FLIGHT hydraulic selector valve *(Chap.6),* select UP, and fully extend the jack by operating the aircraft hand pump.

(6) Loosen the locknut on the jack piston rod eye end.

(7) Manually lift the radius rod assembly hard against the up-lock pedestal stops and adjust the length of the jack by screwing the piston rod eye end either in or out, until the distance between the jack pin centres exceeds the distance between the centre of the piston rod attachment hole in the lock lever and the centre of the jack attachment bolt in the aircraft structure by 0.18 in. ± 0.02 in. Do not reconnect the jack piston rod to the lock lever at this stage.

(8) Reconnect the radius rod and stay-link assembly to the shock absorber strut in the down position. Check the radius rod and stay link for correct alignment *(para.19).*

(9) Ensure that the undercarriage jack hydraulic pipes are so positioned and secured that, during all operations of the jack, they will not foul either the undercarriage door jack crosshead or any part of the structure. The method of positioning and securing the pipes is described and illustrated in fig.17.

(10) Select FLIGHT on the nose undercarriage UP/FLIGHT selector valve, and operate the hand pump to fully close the jack.

(11) With the radius-rod assembly locked down and the jack fully closed, check that the distance between the centre of the jack piston rod attachment hole in the lock lever and the centre of the jack attachment bolt in the aircraft structure exceeds the jack pin centres by 0.22 in. $^{+\ 0.04}_{-\ 0.05}$ in.

**Note . . .**

*Ensure that the lock lever is correctly positioned by inserting the ground lock quick-release pin (Sect.2, Chap.4, Table 1); remove the pin before continuing with the adjustment.*

(12) Select UP on the nose undercarriage UP/FLIGHT selector valve and, using the aircraft hand pump, extend the jack until its piston rod eye end and the holes in the lock lever coincide. Fit and lock the attachment bolt *(para.31).*

(13) Tighten and wire-lock the jack piston rod locknut.

(14) Reselect the UP/FLIGHT selector valve to FLIGHT and wire-lock. Fully close the jack. Check that the clearance between the radius rod stop plate and the lip of the side stay is 0.004 in. *(fig.7).* Should adjustment be necessary refer to para.19.

*Door jack*

**21.** The distance between the pin centres of the door jack when fully closed must not exceed 16.21 in. ± 0.25 in. the jack piston rod travel is 9.19 in. ± 0.06 in. The exact pin centres dimension is obtained by measuring from the undercarriage well roof to the door actuating link pin centres on the jack crosshead; this dimension is 6.55 in. when the jack is fully extended *(fig.5, dimension A).* The jack closed position is governed by the setting of the crosshead stops. On replacement of the jack or after any servicing which may have affected its setting, the jack length must be checked, and, if necessary, adjusted in the following manner:-

(1) Disconnect the undercarriage jack from the radius rod lock lever and the aircraft structure and remove the jack *(para.27).* Disconnect the door actuating links from the doors *(para.28).*

(2) Unlock and select UP on the nose undercarriage UP/FLIGHT selector valve, and fully extend the door jack.

(3) Release the jack piston rod locknut and remove the piston rod eye end connecting bolt from the crosshead.

(4) Adjust the jack length by turning the eye end one half turn at a time, reinserting the connecting bolt, but not locking it and, with a straight edge placed across the pin centres of the two door actuating link attachment bolts on the crosshead, measure a vertical dimension to the skin of the well roof. Adjust until a vertical dimension of 6.55 in. is obtained *(fig.5, dimension A)*.

(5) Tighten and wire-lock the piston rod locknut.

(6) Lock the slotted nut to the jack piston rod connecting bolt with a split pin.

(7) Reconnect the door actuating links.

(8) Adjust the crosshead stops until the doors are at their fully open position; 54.50 in. ± 0.50 in. measured between the outer edges of their outer skins.

(9) Refit the undercarriage jack to the aircraft *(para.31)*.

(10) Check that the flexible hydraulic pipe which runs to the top of the door jack, is positioned in its cleat on the mud shield so as to give the maximum possible clearance between its elbow union and the port wheel tyre during nose undercarriage retraction.

**Up-latch mechanism** *(fig.8)*

**22. The following information covers the installation of a replacement up-latch hook and/or bracket assembly. It will be evident that the whole procedure is not necessary for a normal check of the hook setting, but the additional information relating to the initial hook setting has been incorporated to cover cases of extreme maladjustment, when the complete procedure must be adopted. To assemble the up-latch mechanism:-**

**(1) Jack and trestle the aircraft** *(Sect.2, Chap.4)*.

**(2) Remove the mudguards and wheels** *(para.27)*.

**(3) Disconnect the door-actuating links from the doors.**

**(4) Disconnect the jack piston rod from the radius rod lock lever** *(para.27)*.

(5) Do not allow the radius rod assembly to fall below its normal operating position whilst disconnected at its lower end or its underside will foul and damage the rigid single-coil hydraulic pipe situated on the aft bulkhead immediately below the radius rod upper pivot attachment *(fig.1)*.

(6) Remove the pivot bolt attaching the radius rod stay link to the undercarriage strut *(para.27)*.

(7) Remove the cover box of the up-latch mechanism from the floor of the upper equipment compartment. Remove the hook and bracket assembly and the up-stop pedestals and discard the unserviceable item. Retain the shims and fastenings, less split pins.

(8) Assemble the hook bracket, less shims, to the well roof structure and secure with a stiffnut. Do not exceed a torque loading of 125 lb in.

(9) Assemble the up-stop pedestals, complete with shims, and secure with stiffnuts. Do not exceed a torque loading of 125 lb in.

(10) Refer to fig.8 and with a 0.375 in. $^{+\ 0.000}_{-\ 0.001}$ in. dia. pin inserted in the hook pivot bracket, set the hook and pedestals to the dimensions given in the illustration. Attach the hook and connect the hook spring.

(11) Manually raise the radius rod until the latch pin rests in the hook.

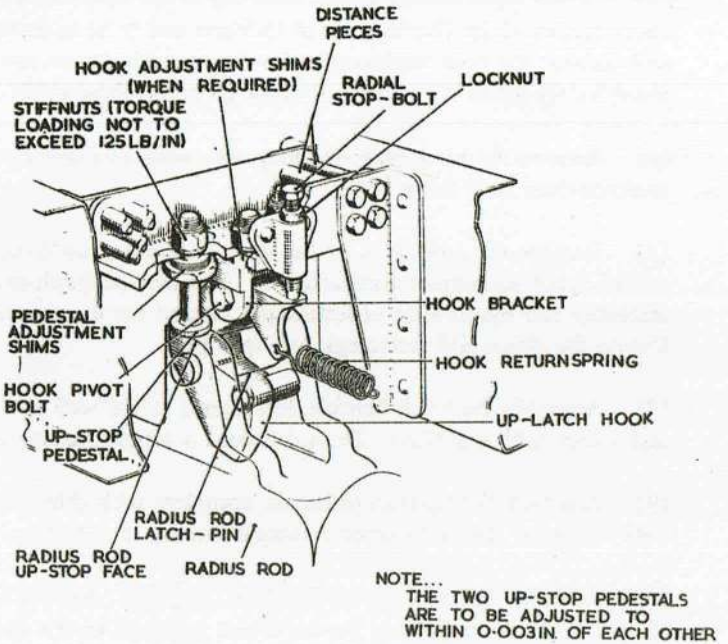
(12) Adjust the radial stop-bolt to give a clearance of 0.004 in. between the end face of the radial stop bolt and the hook flat. Tighten the radial stop-bolt locknut.

(13) With the latch-pin still resting in the hook, adjust the up-stop pedestals to give a clearance of 0.050 in. ± 0.015 in. between the pedestals and the radius rod stop faces.

**Note . . .**

*1. If the 0.050 in. clearance cannot be attained after the removal of all the shims from beneath the up-stop pedestals, shims must be inserted beneath the hook bracket and, if necessary, further adjustment obtained by reshimming the up-stop pedestals.*

*2. The two up-stop pedestals are to be adjusted to within 0.003 in. of each other.*



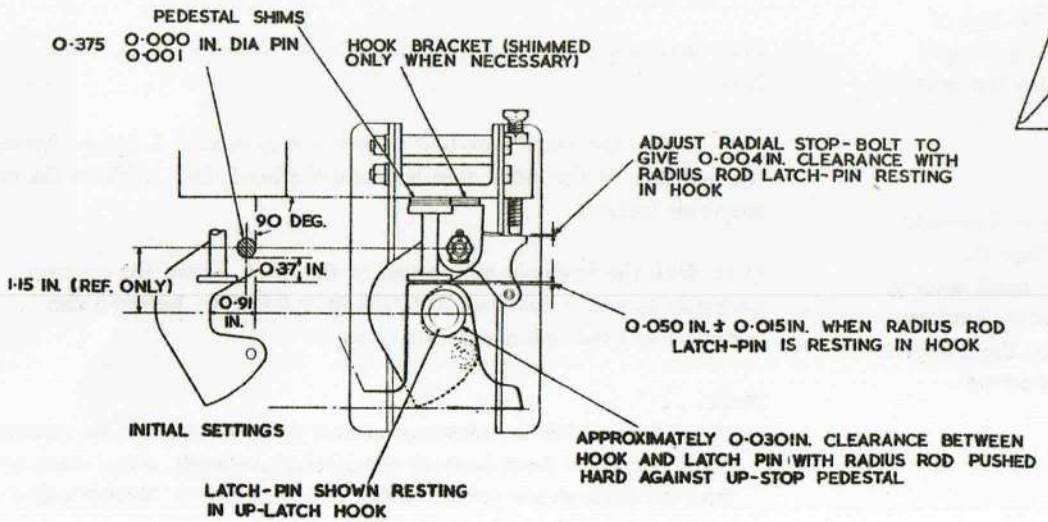
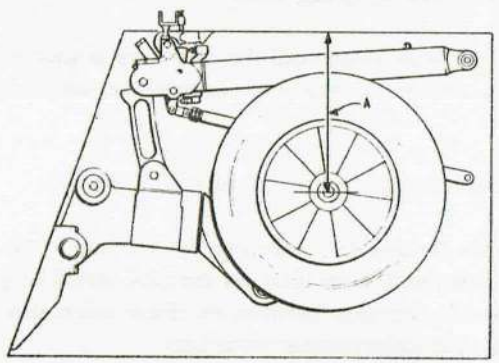




FIG. 8. UP-LATCH HOOK SETTING (1)

◀REDRAWN AND CLARIFIED▶




DIMENSION 'A'-VERTICAL MEASUREMENT FROM WHEEL WELL ROOF TO WHEEL AXLE

FIG. 9. UP-LATCH HOOK SETTING (2)

◀REDRAWN AND CLARIFIED▶

(14) Manually push the radius rod hard up against the up-stop pedestals and support it in that position.

(15) Check, and if necessary adjust, the jack override (para.20). Connect the jack to the radius rod lock lever (para.31).

◀ (16) Select the UP/FLIGHT selector valve to UP ▶ and, by using the aircraft hand pump, force the radius rod against the up-stop pedestals and adjust the sequence valve (para.24).

(17) Disconnect the jack from the lock lever, lift the radius rod clear of the hook and lower by hand to reconnect the stay link to the undercarriage strut (para.31). Check that the radius rod lock lever is engaged.

(18) Select the UP/FLIGHT selector valve to ◀ FLIGHT ▶ and fully close the jack under pressure. Check its closed override (para.20) and connect the jack to the lock lever (para.31).

(19) With the wheels or an equivalent weight fitted to the undercarriage stub axles, raise the undercarriage under hydraulic pressure.

(20) Take and record a vertical measurement from a point in the roof of the wheel well to the undercarriage stub axle (fig.9, dimension A).

(21) Place a jack or trestle beneath the strut allowing a clearance of approximately 1 in. between the strut and the jack or trestle.

(22) Using the aircraft hand pump, lower the door jack until its cross-head trips the undercarriage sequence valve. An audible click will be heard when the radius rod latch-pin drops into the well of the up-latch hook. When this occurs, stop pumping immediately, leaving the undercarriage suspended by the up-latch hook.

(23) Take a second measurement from the same point in the roof, to the nosewheel axle (fig.9, dimension A): this dimension should exceed that obtained in operation (19) by 0.20 in, $\pm$ 0.050 in. If this dimensional difference in incorrect, it can be corrected by adjusting the shimming beneath the up-stop pedestals.

Note...

The 0.20 in. $\pm$ 0.050 in. dimension ensures that, with the radius rod hard up against the up-stop pedestals, a gap of approximately 0.030 in. exists between the latch pin and the hook.

(24) Function test the nose undercarriage and ensure that the hook engages correctly with the latch pin. Recheck the sequence-valve setting and the jack overrides.

(25) Refit the box cover over the up-latch mechanism in the upper equipment compartment.

(26) Reconnect the door-actuating links and ensure all nuts, pins and unions are correctly locked.

Door-latching mechanism (fig.10 and 11)

23. The correct setting of the doors in the up position depends upon the critical setting of several adjustable items, namely; the forward and aft door up-latch hooks and connecting rod, the door up-stop pads, abutment faces, and the door actuating links. Any item which is maladjusted can affect the setting of each of the other items; for this reason the following

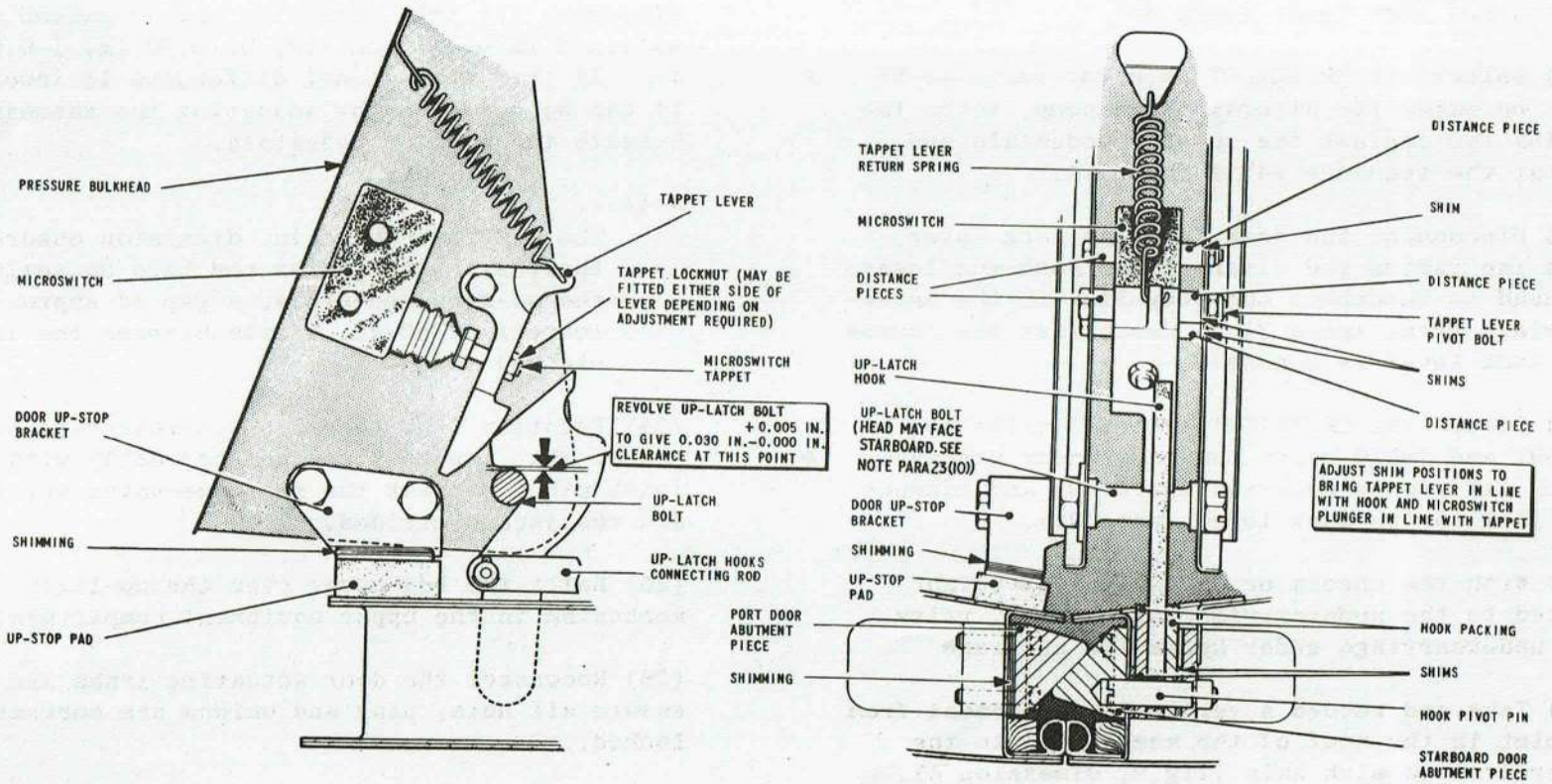



FIG. 10. DOOR FORWARD UP-LATCH HOOK SETTING

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procedure must be adopted, as the sequence in which the settings are made is as important as the setting themselves. To set the nose under-carriage doors:-

(1) Jack and trestle the aircraft (Sect.2, Chap.4).

(2) Remove, and mark for reidentification, both door actuating links.

(3) For ease of access remove the landing wheels and mudguards.

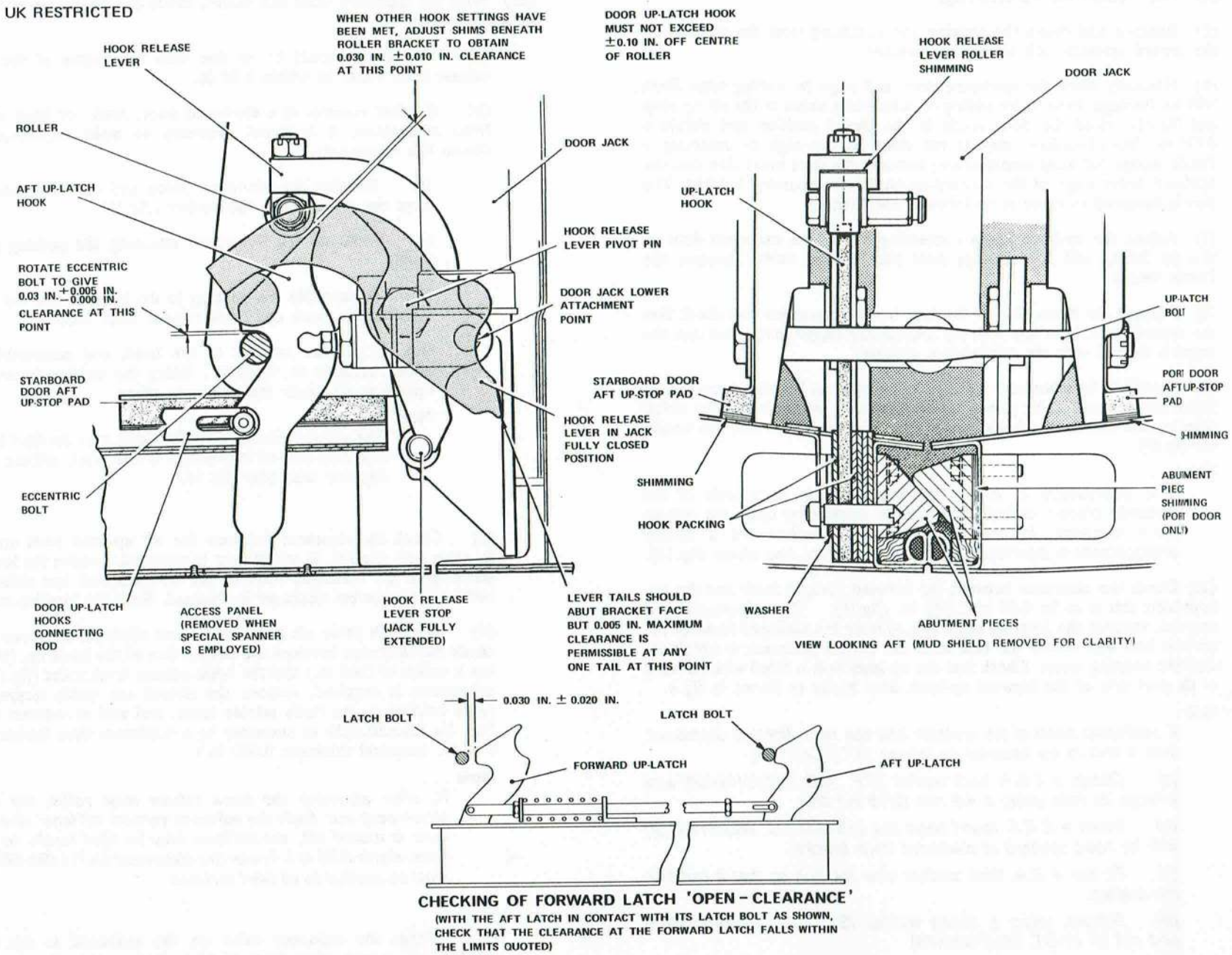



**FIG. 11. DOOR AFT UP-LATCH HOOK SETTING**

(4) Fully retract the undercarriage.

(5) Remove and retain the packing and shimming from the up-stop on the forward up-latch bolt attachment bracket.

(6) Manually close the starboard door and align its trailing edge flush with the fuselage contour by adding or subtracting shims at the aft up-stop pad *(fig.11)*. Hold the door firmly in the closed position and obtain a 0.030 in. 'out-of-airflow' step at the door leading-edge by inserting a Paxalin wedge (of local manufacture) between the door inner skin and the starboard lower edge of the forward-up-latch bolt mounting bracket. The door is designed to close at its forward end first.

(7) Adjust the up-latch hooks connecting rod on the starboard door so that the hooks will fully engage over the up-latch bolts. Remove the Paxalin wedge.

(8) Support the front edge of the door in the up position and check that the forward hook is in line with the microswitch tappet lever, and that the tappet is in line with the microswitch plunger.

(9) Should it be necessary to align the tappet and/or the microswitch, lateral adjustment can be gained on both items by repositioning the shims fitted on the attachment bolts between the distance pieces and the brackets *(fig.10)*.

Note . . .

*It is permissible to fit the shims equally on each side of the distance pieces, or both at one side, depending upon the adjustment required. In cases of extreme maladjustment a similar arrangement is permissible with the hook pivot pins shims (fig.10).*

(10) Check the clearance between the forward up-latch hook and the up-latch bolt; this is to be 0.03 in. $^{+0.005}_{-0.000}$ in. *(fig.10)*. If adjustment is required, remove the locating screw *(fig.4)* from the scalloped head of the up-latch bolt and rotate the bolt until the correct clearance is obtained. Refit the locating screw. Check that the up-latch bolt is fitted with its head at the port side of the forward up-latch door hooks as shown in fig.4.

Note . . .

*If scalloped head of the up-latch bolt has been fitted to starboard, then it should be secured as follows (S.T.I./Can/199):-*

*(a) Obtain a 4 B.A. thick washer (S.P. 16/B, 28W/9419486) and enlarge its hole using a 4.8 mm (3/16 in.) drill.*

*(b) Insert a 2 B.A. round head bolt (AS1246/1/C, 28D/3140202) with its head inboard of starboard latch bracket.*

*(c) Fit the 4 B.A. thick washer over the bolt so that it seats in the scallop.*

*(d) Secure, using a spring washer (S.P. 47/C, 28W/9416643) and nut (A 27-CT, 28M/1006473).*

(11) Check, and if necessary, adjust the forward up-latch microswitch tappet *(fig.13)*.

(12) With the starboard door still closed, check the clearances of the aft up-latch mechanism:-

(a) The hook should be in line with the centre of the hook release lever roller to within 0.10 in.

(b) If, after renewal of a starboard door, hook, or hook release lever mechanism, it is found necessary to make adjustments to obtain this alignment:-

(i) Remove the abutment piece and the hook assembly from the door, retain the washer *(fig.11)*.

(ii) Drill out the five rivets attaching the packing to the hook.

(iii) Reassemble the packing to the hook to suit the alignment of the hook and hook release lever roller.

(iv) Rivet the packing to the hook and reassemble the hook assembly to the door, fitting the washer removed in operation (i). Refit the abutment piece.

Note . . .

*The washer Ref.No.28W/9419476 may be filed to give free fore-and-aft movement of the hook, without allowing any side play (fig.11).*

(c) Check the clearance between the aft up-latch hook and the up-latch bolt *(fig.11)*. If adjustment is required, remove the locating screw from the scalloped head of the up-latch bolt and rotate the bolt until the correct clearance is obtained. Refit the locating screw.

(d) When all other aft latch mechanism settings have been met, check the clearance between the flat portion of the hook lip, (the tip has a radius of 0.05 in.) and the hook release lever roller *(fig.11)*. If adjustment is required, remove the slotted nut which secures the roller housing to the hook release lever, and add or subtract shims Part No.EA3.10.3339 as necessary to a maximum shim thickness of 0.20 in. (nominal thickness 0.080 in.).

Note . . .

*If, after adjusting the hook release lever roller, the roller attachment nut fouls the adjacent vertical stiffener when the lever is moved aft, the stiffener may be filed locally to clear (max. depth 0.20 in.). Protective treatment (A.P. 119A-0509-1) must be applied to all filed surfaces.*

(e) Wedge the sequence valve on the bulkhead in the open position i.e. tappet away from plunger, and remove the sequence valve lever trip screw from the port arm of the jack crosshead. THIS IS IMPORTANT.

(f) Ensure that the crosshead down-stops are correctly set *(para.21)* and fully close the jack. The two tails of the hook release lever should abut the lever bracket, but a maximum gap of 0.005 in. is allowed at any one tail *(fig.11)*.

(13) Slightly open the starboard door and check the 'open-clearance' of the forward up-latch hook (fig.11). Manually raise the port door and adjust the up-stop pad at the aft end until the door leading edge is 0.030 in. inside the fuselage contour, 'out-of-wind'. With the aft up--stop' correctly set, refit the forward up-stop packing removed in operation (5) and shim to suit the 0.030 in. condition.

(14) Close both doors and, with pressure applied to the starboard door, check that the doors fit flush with each other and that their leading edges are 0.030 in. inside the fuselage contour 'out-of-airflow'. If the doors do not fit flush with each other, adjust the shims beneath the port door abutment pieces *(fig.10 and 11)*.

**Note . . .**

*The door up-latch hooks can be released when the doors are locked up by removing the small access panel from below the aft hook in the door skin, and operating the hook tail with the appropriate spanner (Sect.2, Chap.4, Table 1).*

(15) Ensure the door jack is fully extended and fit the starboard door-actuating link; adjust the link if necessary by turning the link eye end until, with the port door closed manually, the doors fit as in operation (14). Tighten the link locknut and remove the link.

(16) Fit the port door-actuating link and adjust the link if necessary as in operation (15), until the condition described in operation (14) is obtained. Tighten the actuating link locknut and split pin the attachment bolts.

(17) Close the door jack and refit and lock the starboard door actuating link.

(18) Support the undercarriage and remove the wedge from the sequence valve on the bulkhead. Refit the sequence valve lever trip screw to the port arm of the door jack crosshead.

(19) Hydraulically lower the undercarriage *(Chap.6)*.

(20) Refit the landing wheels and mudguards.

(21) Hydraulically raise the undercarriage and check that the doors fit correctly and that the 0.030 in. 'out-of-airflow' condition is maintained.

(22) Check that the door microswitch functions correctly *(fig.13)*.

(23) Check all skin gaps around both doors *(A.P.101B-0400-6, Part 1)*.

(24) Function test the undercarriage *(Chap.6)*.

**Sequence valve settings** *(fig.12)*

24. The sequence-valve lever tappets are adjusted to a 0.15 in. dimension measured from the striking face of the tappet and the body of the valve when the lever is in its fully operated position. After any adjustments to the sequence-valve setting a functional check of the undercarriage must be made *(Chap.6)*.

**Microswitch settings** *(fig.13)*

25. Following any servicing or component replacement which may have affected the microswitch settings, a thorough check and, if necessary, resetting must be made as detailed in fig.13.

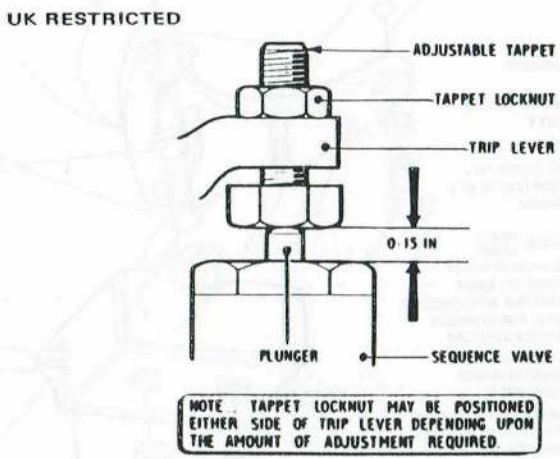
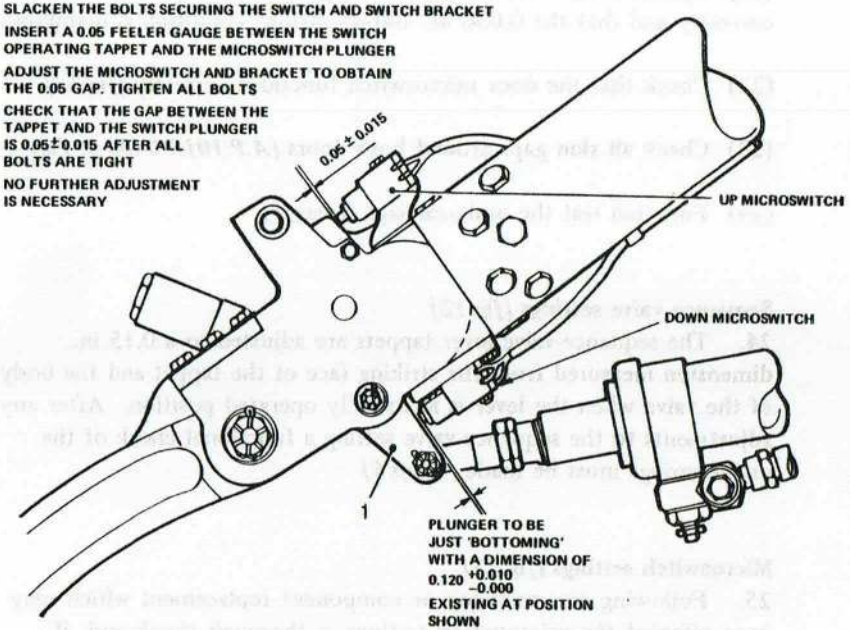


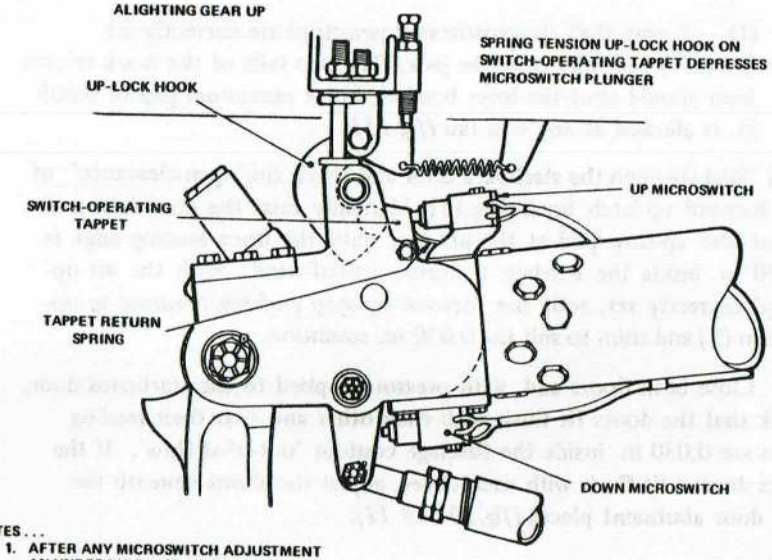

**Fig.12. Sequence valve setting**

UK RESTRICTED

UP MICROSWITCH ADJUSTMENT WITH U/C IN THE DOWN POSITION

1. SLACKEN THE BOLTS SECURING THE SWITCH AND SWITCH BRACKET
2. INSERT A 0.05 FEELER GAUGE BETWEEN THE SWITCH OPERATING TAPPET AND THE MICROSWITCH PLUNGER
3. ADJUST THE MICROSWITCH AND BRACKET TO OBTAIN THE 0.05 GAP. TIGHTEN ALL BOLTS
4. CHECK THAT THE GAP BETWEEN THE TAPPET AND THE SWITCH PLUNGER IS 0.05±0.015 AFTER ALL BOLTS ARE TIGHT
5. NO FURTHER ADJUSTMENT IS NECESSARY



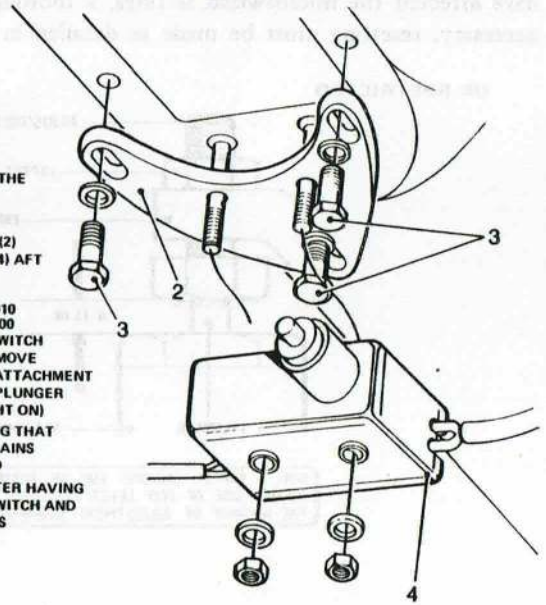




NOTES . . .

1. AFTER ANY MICROSWITCH ADJUSTMENT AN UNDERCARRIAGE RETRACTION TEST MUST BE MADE AND THE WARNING LIGHTS CHECKED
2. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE STATED

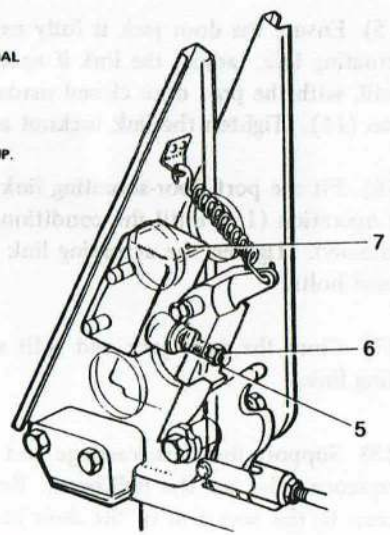
DOWN MICROSWITCH ADJUSTMENT
U/C IN DOWN POSITION

1. CONNECT A 24 VOLT SUPPLY TO THE EXTERNAL SUPPLY SOCKET
2. SLACKEN THE BOLTS (3)
3. MOVE THE ATTACHMENT PLATE (2) COMPLETE WITH MICROSWITCH (4) AFT TO THE LIMIT OF ITS TRAVEL (GREEN LIGHT OFF)
4. WITH A DIMENSION OF 0.120 +0.010 −0.000 EXISTING BETWEEN THE MICROSWITCH PLUNGER AND LOCK LEVER (1), MOVE THE MICROSWITCH (4) AND THE ATTACHMENT PLATE (2) FORWARD UNTIL THE PLUNGER IS JUST BOTTOMING (GREEN LIGHT ON)
5. TIGHTEN THE BOLTS (3) ENSURING THAT SOME PLUNGER MOVE MENT REMAINS WHEN ADJUSTMENT IS FINALISED
6. RE-CHECK THE ADJUSTMENT AFTER HAVING FINALLY REFITTED THE MICROSWITCH AND TIGHTENED THE SECURING BOLTS




DOOR MICROSWITCH ADJUSTMENT

1. JACK THE NOSE (SECT.2,CHAP.4)
2. CONNECT A 24 VOLT SUPPLY TO THE EXTERNAL SUPPLY SOCKET
3. DISCONNECT THE PORT DOOR ACTUATING LINK (FIG.1) AT IT'S LOWER END
4. UNLOCK AND SELECT THE NOSE UNDERCARRIAGE UP/FLIGHT SELECTOR TO UP. USING THE HAND PUMP, FULLY RAISE THE NOSE WHEEL, ENSURING THAT THE DISCONNECTED LINK IS HELD CLEAR
5. SLACKEN THE TAPPET LOCKNUT (6)
6. SCREW TAPPET (6) AWAY FROM THE MICROSWITCH (7) (RED LIGHT ON)
7. SCREW TAPPET (5) TOWARDS THE MICROSWITCH (7) UNTIL A DEFINITE CLICK IS HEARD (RED LIGHT OFF) AND GIVE A FURTHER TWO COMPLETE TURNS
8. TIGHTEN THE LOCKNUT (6) AND ENSURE THAT SOME PLUNGER MOVEMENT STILL REMAINS
9. SELECT THE NOSE UNDERCARRIAGE UP/FLIGHT SELECTOR TO FLIGHT. USING THE HAND PUMP, FULLY LOWER THE NOSE WHEEL, ENSURING THAT THE DISCONNECTED DOOR LINK IS HELD CLEAR. WIRE LOCK THE UP/FLIGHT SELECTOR IN THE FLIGHT POSITION
10. RECONNECT THE PORT DOOR ACTUATING LINK




## FIG. 13 MICROSWITCH ADJUSTMENT - NOSE UNDERCARRIAGE

◀ 'DOWN' MICROSWITCH SETTING DIMENSIONS AMENDED ▶

## REMOVAL AND ASSEMBLY

**General information**

**26.** The following paragraphs detail the removal and assembly operations for the nose undercarriage and its main components. Items which do not require special instructions for removal or assembly are not included. The sequence of operations for assembling the undercarriage must be adhered to, and checks and subsequent adjustments are to be made at the stated operation.

**Undercarriage and undercarriage doors mechanism removal** *(fig.14, 15 and 16).*

**Note . . .**

*The undercarriage and doors mechanism can be removed independently of each other.*

*Undercarriage*

**27.**

(1) Jack and trestle the aircraft *(Sect.2, Chap.4).*

(2) Exhaust all hydraulic pressure *(Chap.6).*

(3) Remove the three bolts and washers securing each mudguard to its bearing bracket and remove the mudguards.

(4) Remove the six stiffnuts and washers securing each landing wheel to its axle and remove the wheels.

(5) Disconnect the hydraulic fluid pipes from the undercarriage jack and blank off the pipe ends and jack apertures *(Chap.6).*

(6) Remove the clamps and blocks from the jack body *(fig.17)* and release the hydraulic fluid pipes.

(7) Remove the split pin and slotted nut from the jack piston rod pivot bolt and withdraw the pivot bolt *(fig.15, detail C).*

(8) Remove the split pin, slotted nut and washer, from the jack crosspiece pivot between the two channel members on the aft bulkhead, and withdraw the pivot bolt *(fig.15, detail E).* Remove also and retain the two plain washers Ref.No.28W/9419467 fitted one at each side of the jack pivot between the jack crosspiece and the vertical channel members.

**Note . . .**

*Some aircraft have flanged bushes riveted to the vertical channel members. These are fitted by the manufacturers to rectify oversize rivet holes and each is equivalent in thickness to washer Ref.No.28W/9419467.*

(9) Remove the jack.

(10) Disconnect the electrical cables from the two microswitches on the radius rod knuckle joint *(A.P.101B-0407-1B, Sect.5, Chap.1, Group G)* remove the three cable clips from the radius rod tube, and coil and stow the cables in the roof of the wheel well.

(11) Remove the split pin, slotted nut and special washer from the stay link pivot bolt on the shock-absorber strut *(fig.15, detail D).*

(12) Remove the locating grub screw from the head of the stay-link pivot bolt and, using an extractor, withdraw the pivot bolt. Support the radius rod assembly.

(13) Do not allow the radius rod assembly to fall below its normal operating position or its underside will foul and damage the single coil-shaped rigid hydraulic pipe situated on the aft bulkhead immediately below the radius rod upper pivot attachment *(fig.1).*

(14) Remove the split pin, slotted nut and special washer from the radius rod upper pivot bolt. The head of the pivot bolt is a plain nut which is, and must remain, peened, *(fig.14, detail A).*

(15) Slacken the bearing pin retaining grub screw on the starboard shoulder of the radius rod pivot bracket casting *(fig.14, detail A)* and, taking the weight of the assembly from the pivot, withdraw the pivot bolt, special washer, and bearing pin. Carefully lower and remove the radius rod/stay-link assembly.

(16) Support the undercarriage and remove the split pins, slotted nuts and washers from the four bolts attaching each saddle clamp at the undercarriage main pivot *(fig.15, detail B).* The heads of the four upper attachment bolts are accessible from inside the pressure cabin.

(17) Withdraw the lower bolts and remove the saddle clamps. Remove the undercarriage.

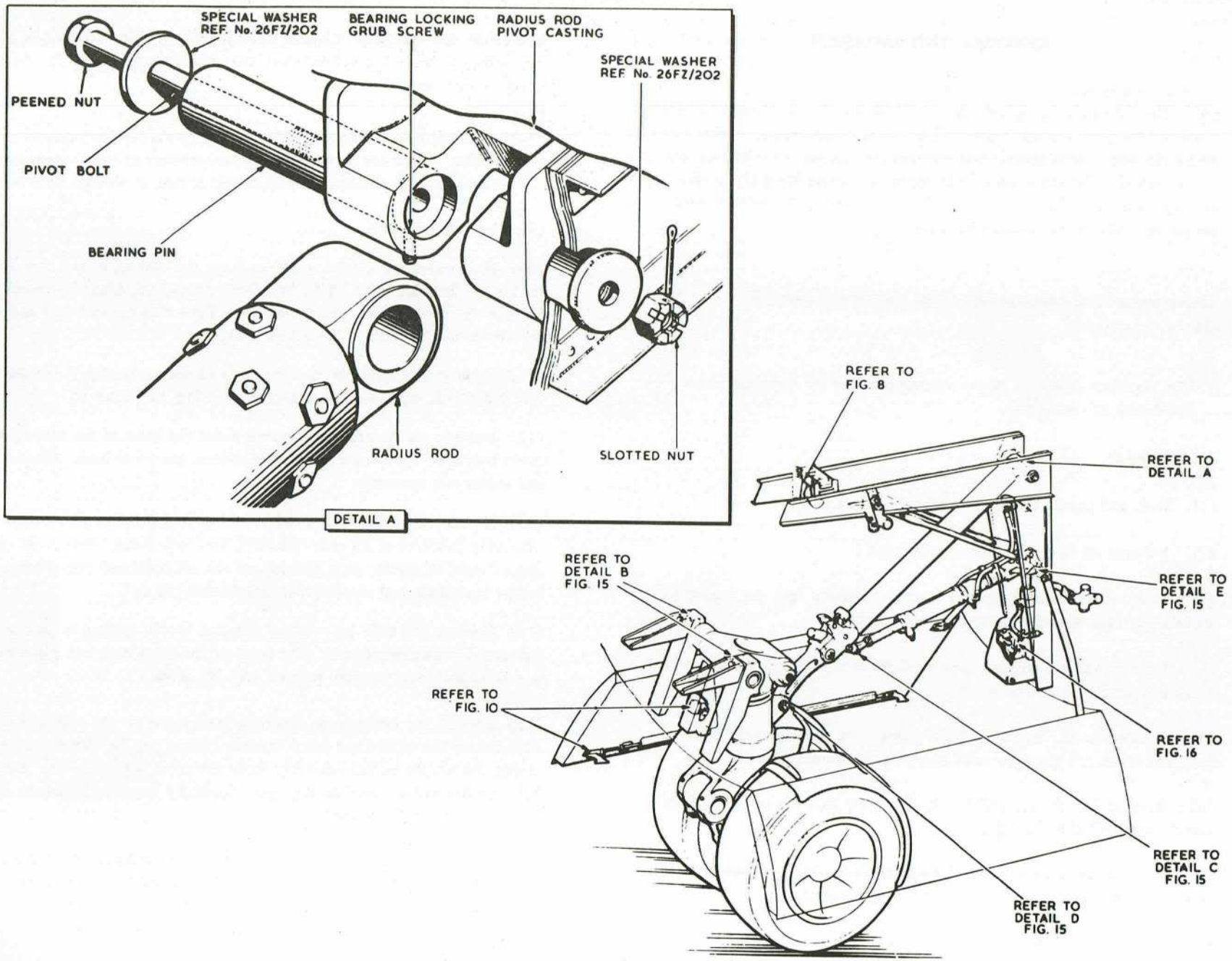



FIG. 14. UNDERCARRIAGE–REMOVAL AND ASSEMBLY (1)

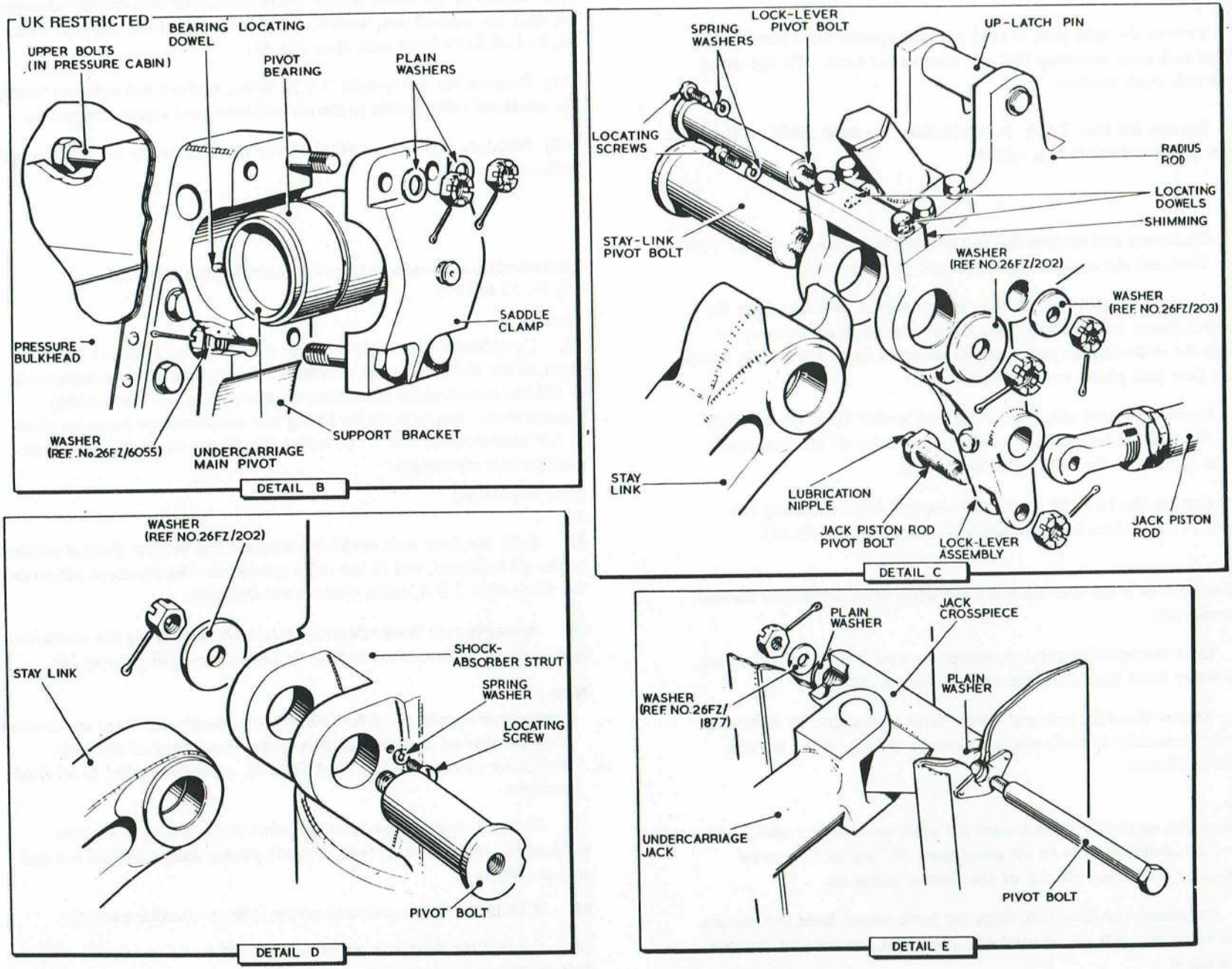



FIG. 15. UNDERCARRIAGE – REMOVAL AND ASSEMBLY (2)

*Door mechanism*

**28.**

(1) Remove the split pins, slotted nuts and special bolts from both ends of each door actuating link and remove the links. Tie the doors in the fully open position.

(2) Remove the four 2 B.A. bolts attaching the mud shield to the hook release lever mechanism box section.

(3) Disconnect and remove the flexible hydraulic pipes from the door jack. Blank off the exposed pipe ends and jack apertures.

(4) Remove the split pin, slotted nut and special bolt attaching the door jack piston rod to the crosshead. To do this it is necessary to remove the undercarriage jack from its aft pivot *(para.27)* to gain access to the door jack piston rod attachment bolt.

(5) Remove the split pin, slotted nut and washer from the up-latch bolt. Remove the bolt, taking note of the position of the scalloped head in relation to the locating screw *(fig.16)*.

(6) Remove the two 1/4 in. dia. countersunk bolts attaching the bottom of each release lever bracket to the aft bulkhead *(fig.16)*.

**Note . . .**

*The heads of these four bolts are accessible from within the forward camera bay.*

(7) Break the wire-locking and remove the two 2 B.A. bolts securing each release lever bracket to the vertical channel stiffeners.

(8) Remove the door jack and release lever mechanism by sliding the complete assembly upwards and out through the top of the vertical channel stiffeners.

**Note . . .**

*When this operation is made with the undercarriage jack still in situ and disconnected from its aft pivot (para.27), the jack must be strapped clear from the top of the channel stiffeners.*

(9) Disconnect the door jack from the hook release lever mechanism by removing the split pin, slotted nut, pivot bolt, washer and distance pieces *(fig.16)*.

(10) Dismantle the hook release levers from their brackets by removing the split pin, slotted nut, washer, Part No.EA1.10.1407 and bolt Part No.EA1.10.3219 from each lever *(fig.16)*.

(11) Remove the thirty-eight 2 B.A. bolts, washers and stiffnuts securing the crosshead roller guides to the aft bulkhead, and remove the guides.

(12) Withdraw the jack crosshead from the slots in the vertical channel stiffeners.

**Undercarriage and undercarriage doors mechanism assembly**
*(fig.14, 15 and 16).*

*General*

**29.** Consideration has been given in the following sequence of operations, to the additional work entailed in fitting replacement components. It will be obvious which operations are necessary when reassembling original items. Instructions for fitting new undercarriage doors are given in A.P.101B-0400-6, Part 1. To reassemble the undercarriage and undercarriage door mechanism:-

*Door mechanism*

**30.**

(1) Refit the door jack crosshead between the vertical channel stiffeners on the aft bulkhead, and fit the roller guides over the crosshead rollers using the thirty-eight 2 B.A. bolts, washers and stiffnuts.

(2) Assemble each hook release lever to its bracket using the special-to-type bolt and washer, plain washer, slotted nut and split pin *(fig.16)*.

**Note . . .**

*The washer Part No.EA1.10.1407 fitted between each lever and bracket may be filed on assembly to obtain free movement of the lever. Protective treatment (A.P.119A-0509-1), must be applied to all filed surfaces.*

(3) Fit the door jack lower pick-up point to the hook release lever mechanism, using the pivot bolt, distance pieces, washer, slotted nut and split pin *(fig.16)*.

(4) Refit the complete jack and release lever mechanism assembly.

(5) Connect the door jack piston rod eye end to the crosshead, using the bolt, slotted nut and split pin.

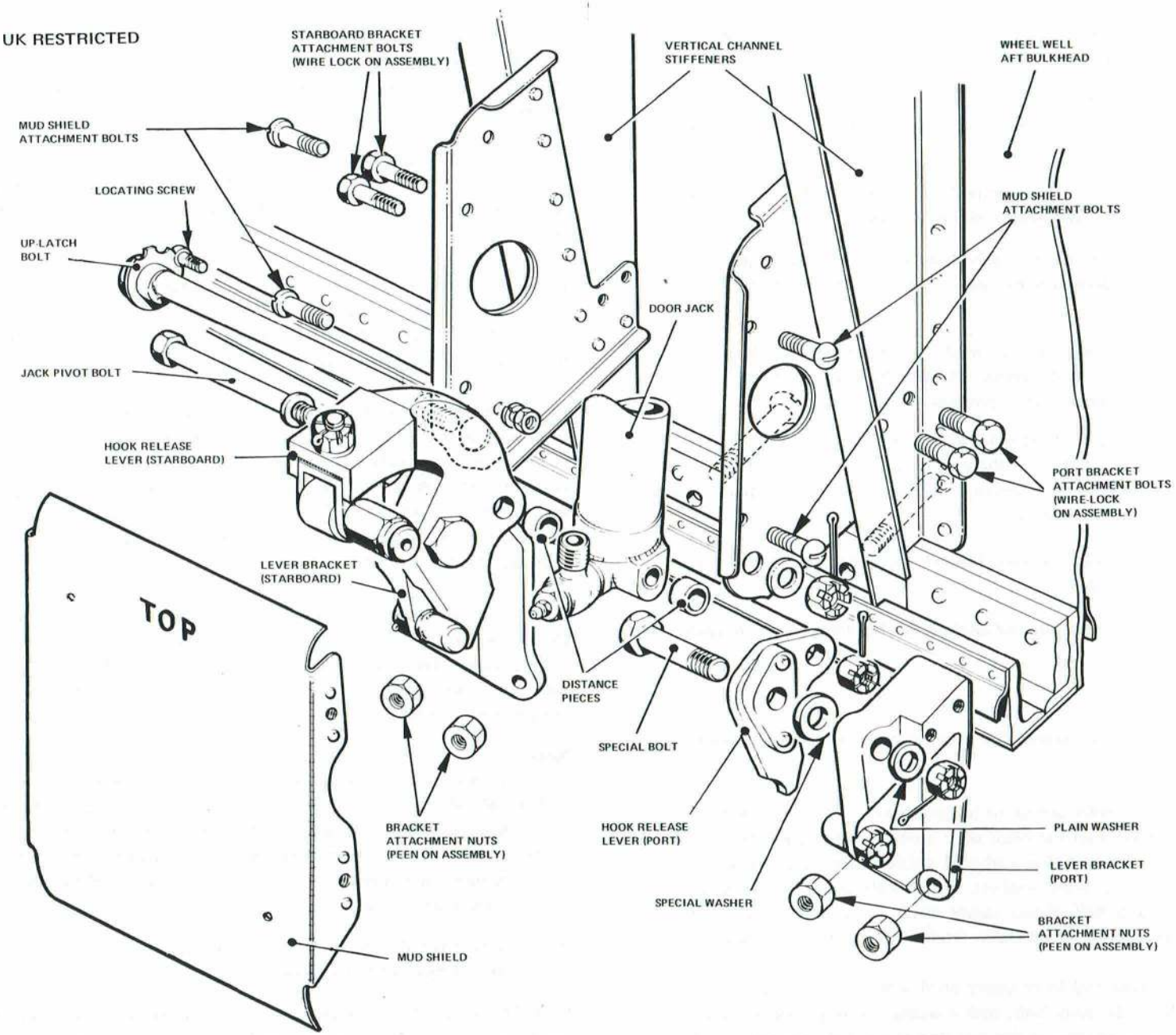



**FIG.16. HOOK RELEASE MECHANISM & DOOR JACK REMOVAL**

◀ WASHERS FOR MUD SHIELD ATTACHMENT BOLTS DELETED ▶

(6) Bolt the hook release lever brackets to the aft bulkhead using the four 1/4 in. countersunk bolts. Peen the nuts *(fig.16)*.

(7) Fit the two 2 B.A. bolts to secure each release lever support bracket to the vertical channel stiffeners *(fig.16)*. Tighten and wire-lock the bolt heads together.

(8) Refit the up-latch bolt, ensuring the scalloped head is returned to its original position. Fit the washer, slotted nut and split pin *(fig.16)*.

(9) Reconnect the flexible hydraulic fluid pipes to the door jack. Prime and bleed the door jack hydraulic circuit *(Chap.6)*. Wire-lock the pipe unions.

(10) Refit the mud shield over the hook release lever mechanism box section using the four 2 B.A. screws. Replace the packing washers, if any, *(para.28(2))* in their original positions.

(11) Check the hydraulic fluid pipe, which runs to the top of the door jack, is positioned in its cleat on the mud shield so as to give the maximum possible clearance between its elbow union and the port wheel tyre during undercarriage reaction.

(12) Reconnect the door-actuating links to the doors using the bolts, slotted nuts and split pins.

(13) Check the door-operating and latching mechanism adjustment *(para.23)*.

*Undercarriage*

**31.**

(1) For ease of access, remove the door actuating links and tie back the doors.

(2) Assemble the undercarriage to its main pivot support brackets, taking care to ensure that the pivot shaft bush is properly located by its spigot on both the port and starboard saddle clamp faces *(fig.15, detail B)*. Fit the four bolts, washers, slotted nuts and split pins which secure the removable half of each saddle clamp. The heads of the four upper saddle clamp bolts are accessible from inside the pressure cabin.

(3) Refit the radius rod to its upper pivot point by inserting the bearing pin. Slide the pivot bolt, with a washer, through the bearing pin and secure with another washer and slotted nut and split pin *(fig.14, detail A)*. Tighten the bearing pin locking grub screw.

(4) Do not allow the radius rod assembly to fall below its normal operating position or its underside will foul and damage the single-coil-shaped rigid hydraulic pipe situated on the aft bulkhead immediately below the radius rod upper pivot attachment *(fig.1)*.

(5) Reconnect the stay link to the lugs on the undercarriage strut, using the pivot bolt and washer, slotted nut and split pin. Refit and tighten the locating grub screw at the head of the pivot bolt *(fig.15, detail D)*.

(6) Reconnect the electrical cables to the two microswitches on the radius rod/stay link knuckle joint. Reclip the cables to the radius rod tube *(A.P.101B-0407-1B, Sect.5, Chap.1, Group G)* and ensure they will not foul when the undercarriage is retracted.

(7) Position the undercarriage jack crosspiece between the aft bulkhead vertical flanged stiffeners. If flanged bushes are not fitted to the channel stiffeners *(para.27)* ensure that a washer, Ref.No.28W/9419467 is inserted at each side of the jack pivot, between the jack crosspiece and the channel stiffeners. Insert the pivot bolt from the port side, ensuring that its head seats into the locking plate on the port channel stiffener *(fig.15, detail E)*.

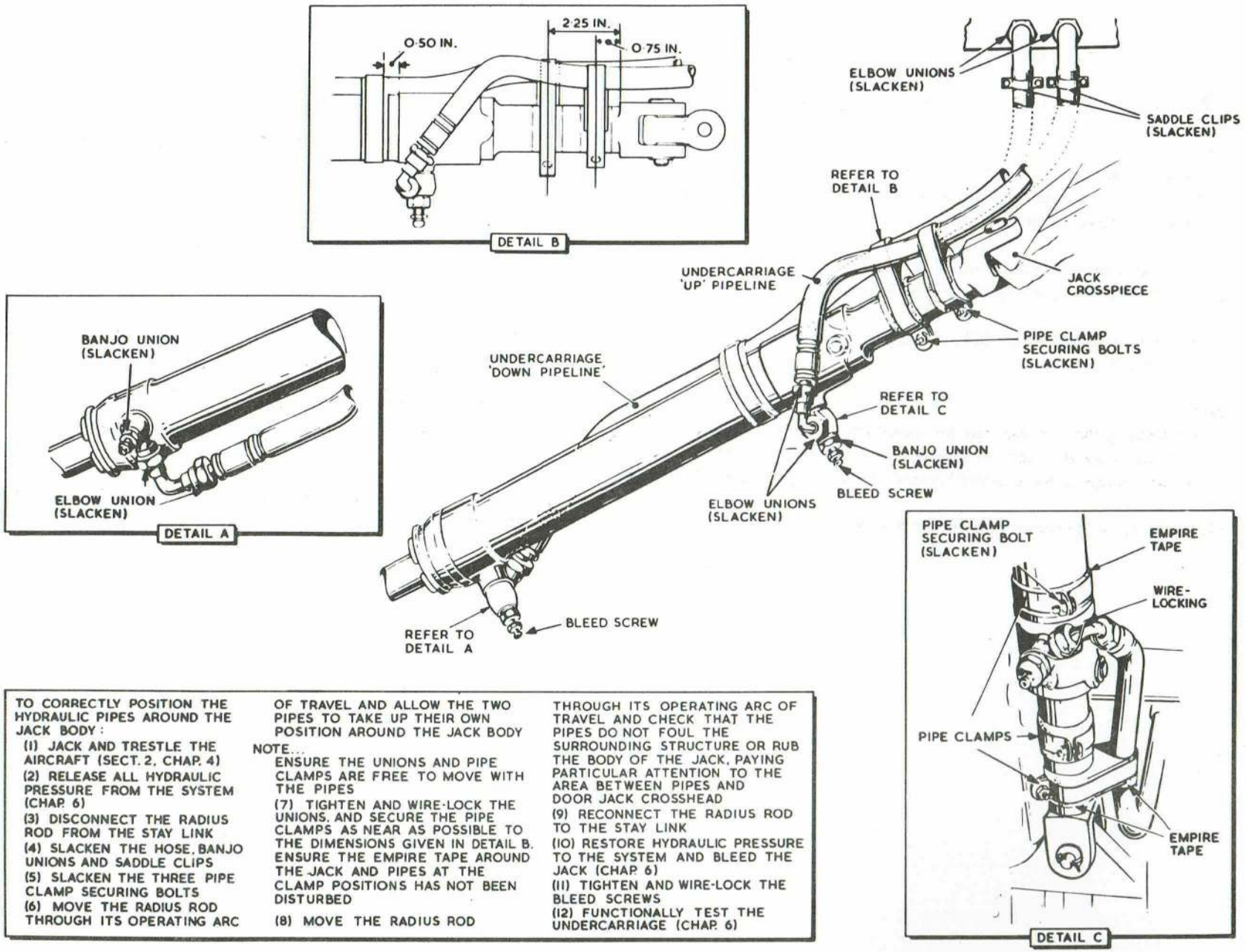
(8) Secure the pivot bolt using the washer and slotted nut. Measure the gap at each end of the crosspiece; the washers (if fitted) must be pressed against the channel stiffeners. Where the total of the two gaps does not exceed 0.015 in. lubricate the assembly and fit the split pin to the pivot bolt slotted nut.

**Note . . .**

*Should the total gap exceed 0.015 in. standard washers, Ref.No. 28W/9419467 and/or locally manufactured washers are to be fitted to equalize the gaps and give a total gap of between 0.005 in. and 0.010 in. Locally manufactured washers are to be made from the appropriate s.w.g. steel sheet Spec.S.520 or S.521. No washer is to be less than 30 s.w.g. (0.012 in.).*

(9) Connect the flexible hydraulic fluid pipes to the jack and fit the blocks and clamps to the jack body *(fig.17)*.

(10) Check that the hydraulic pipes are so positioned and secured in their blocks that, during the operation of the jack, they will not foul either the door jack crosshead or any other part of the structure *(fig.17)*.




TO CORRECTLY POSITION THE HYDRAULIC PIPES AROUND THE JACK BODY :

(1) JACK AND TRESTLE THE AIRCRAFT (SECT. 2, CHAP. 4)

(2) RELEASE ALL HYDRAULIC PRESSURE FROM THE SYSTEM (CHAP. 6)

(3) DISCONNECT THE RADIUS ROD FROM THE STAY LINK

(4) SLACKEN THE HOSE, BANJO UNIONS AND SADDLE CLIPS

(5) SLACKEN THE THREE PIPE CLAMP SECURING BOLTS

(6) MOVE THE RADIUS ROD THROUGH ITS OPERATING ARC OF TRAVEL AND ALLOW THE TWO PIPES TO TAKE UP THEIR OWN POSITION AROUND THE JACK BODY

NOTE...
ENSURE THE UNIONS AND PIPE CLAMPS ARE FREE TO MOVE WITH THE PIPES

(7) TIGHTEN AND WIRE-LOCK THE UNIONS, AND SECURE THE PIPE CLAMPS AS NEAR AS POSSIBLE TO THE DIMENSIONS GIVEN IN DETAIL B. ENSURE THE EMPIRE TAPE AROUND THE JACK AND PIPES AT THE CLAMP POSITIONS HAS NOT BEEN DISTURBED

(8) MOVE THE RADIUS ROD THROUGH ITS OPERATING ARC OF TRAVEL AND CHECK THAT THE PIPES DO NOT FOUL THE SURROUNDING STRUCTURE OR RUB THE BODY OF THE JACK, PAYING PARTICULAR ATTENTION TO THE AREA BETWEEN PIPES AND DOOR JACK CROSSHEAD

(9) RECONNECT THE RADIUS ROD TO THE STAY LINK

(10) RESTORE HYDRAULIC PRESSURE TO THE SYSTEM AND BLEED THE JACK (CHAP. 6)

(11) TIGHTEN AND WIRE-LOCK THE BLEED SCREWS

(12) FUNCTIONALLY TEST THE UNDERCARRIAGE (CHAP. 6)

FIG. 17 UNDERCARRIAGE JACK HYDRAULIC PIPES CLIPPING

(11) Prime and bleed the jack and pipelines *(Chap.6)* and fully close the jack, using the aircraft hand pump.

(12) Check, and if necessary adjust, the jack overrides *(para.20)*.

**Note . . .**

*When hydraulic pressure is first applied, the door jack will move and trip the undercarriage sequence valve, allowing pressure to be transmitted to the undercarriage jack.*

(13) Connect the jack piston rod to the radius rod lock lever using the pivot bolt, slotted nut and split pin *(fig.15, detail C)*.

(14) Raise the undercarriage fully and adjust the door jack sequence valve *(para.24)*.

**Note . . .**

*When raising the undercarriage door jack with the actuating links disconnected from the doors, an assistant must hold and guide the links to prevent damage to the adjacent hydraulic fluid piping and aircraft structure.*

(15) Check, and if necessary adjust, the up-stop pedestals *(para.22)*.

(16) Ensure that the up-latch hook is engaging the radius rod latch pin. Adjust if necessary *(para.22)*.

(17) Lower the undercarriage and fit the landing wheels and mudguards.

(18) Fit the starboard door-actuating link *(para.30)* and raise the undercarriage. Ensure that the undercarriage and undercarriage door mechanism is operating correctly.

(19) Check, and if necessary adjust, the undercarriage and undercarriage door microswitches *(fig.13)*.

(20) Fit the port door-actuating link *(para.30)* and raise the undercarriage. Check that the doors fit flush with each other and that their leading edges are 0.030 in. 'out-of-airflow' *(para.23)*.

(21) Function check the operation of the undercarriage *(Chap.6)*.

**Up-latch mechanism**

**32.** The removal and assembly procedure for the up-latch mechanism is given in para.22.

# Chapter 6 HYDRAULIC SYSTEM

## LIST OF CONTENTS



## LIST OF TABLES



## LIST OF ILLUSTRATIONS

**Introduction**

1. This chapter describes and illustrates the hydraulic system, gives details of the servicing operations and recommends methods for the removal and assembly of certain components. The system provides power for the operation of the alighting gear, flaps, flare-bay doors, camera doors, air brakes and wheel brakes.

2. The location of the hydraulic units in the fuselage and main planes is illustrated in fig.3 and 4 respectively and the system is illustrated diagrammatically in fig.1 and 2. A list of system components, together with the relevant Air Publication is given in Table 2.

## DESCRIPTION

**Hydraulic fluid reservoir**

3. The reservoir is mounted immediately aft of the pressure bulkhead, against the upper starboard fuselage skin. It is oval in shape and is inclined at an angle of approximately 45 deg. The filler neck is on the side and is accessible through a Dzus fastened panel in the fuselage skin. The engine-driven pump suction pipeline is taken from a stack pipe in the bottom of the reservoir, thus providing a reserve of fluid for the hand pump. The suction pipe for the hand pump is taken from a point slightly higher up, although, due to the reservoir being inclined, this is its lowest point. A pipeline from the pressure bulkhead ducts cabin pressure to the reservoir, and a non-return valve in this pipeline maintains a maximum pressure difference of ½ lb/in$^2$ between the cabin and reservoir pressures when the cabin pressure system is in operation. A pressure relief valve, situated in a pipeline connecting with the tank above fluid level, blows off at 12 to 17 lb/in$^2$, reseating itself when the pressure falls to 8 lb/in$^2$, this blow-off line is led to atmosphere through the bottom of the fuselage.

**Power circuit**

4. Power is supplied by two continuously-running hydraulic pumps, one mounted on each engine accessories gearbox. The pumps draw fluid from the reservoir, through a filter located on the starboard wall of the forward camera bay, and deliver it under pressure to the five rotary control valves and the brake relay control valve. A non-return valve is fitted in the pipeline on the pressure side of each pump and the flexible pipes from each pump are fitted with self-sealing couplings. An automatic cut-out valve, located in the starboard main plane leading edge, is fitted in the pressure line and connects to the return line, providing an idling circuit and diverting the pump delivery back to the reservoir between operation demands; it is set to cut-out when the accumulator pressure reaches $2700 \pm {}^{50}_{0}$ lb/in$^2$ and cuts in at a minimum pressure of 2200 lb/in$^2$. A gauge mounted on the miscellaneous instrument panel gives indication of the pressure in the power circuit.

**Note . . .**

*This pressure gauge must not be used for circuit testing.*

*Accumulators*

5. The main hydraulic accumulator is mounted inboard of rib 1 in the starboard main plane leading edge, and is connected to the power circuit by a branch pipe; it maintains a reserve of power, prevents hammering of the cut-out, and provides initial power for the movement of the jacks when a service is selected. The charging valve and pressure gauge for the main accumulator is situated on the forward diaphragm of the starboard wheel well. A second hydraulic accumulator, located on the port side of the forward face of the forward camera bay rear bulkhead, is connected to the pressure line of the wheel brakes circuit to facilitate smooth braking and maintain an independent reserve of power for application of the brakes. The brakes accumulator pressure gauge and charging valve are positioned just below the accumulator.

*Relief valve*

6. Thermal relief valves, suitably positioned in the circuits, open when, due to temperature variation, pressure in the line of service increases to 3350 to 3550 lb/in$^2$, these valves reseat when the pressure falls to 3100 lb/in$^2$ (min). An additional thermal relief valve is interposed between the sequence valve and the transfer valve of each main undercarriage circuit. To avoid premature pressure relief of this system, and to ensure satisfactory functioning of this valve, the brake relay control valve installed in the wheel brakes system, has a pressure relief valve installed which relieves at 3500 ± 100 lb/in$^2$.

**Hand-pump circuit**

7. The hand pump situated on the starboard side of the pilot's seat, will operate the alighting gear, flare-bay doors and wheel brakes after the appropriate selection has been made. A non-return valve in the pressure line normally isolates the air brakes, flaps and camera doors from the hand pump circuit, but provision is made for operating these services by

the hand pump during ground servicing operations. The hand pump draws fluid from the reservoir, through a filter mounted on the aft face of frame 12 bulkhead in the forward camera bay, and delivers it under pressure to the service selected. In the event of hydraulic failure due to loss of fluid in the system, sufficient fluid is retained in the reservoir to operate the flare bay doors and alighting gear using the hand pump. A non-return valve, fitted between the transfer valve and door jack operated sequence valve of each main undercarriage, prevents the flow of fluid from the down line to the up line. This, eliminates any loss of the reserve fluid via a failed up-line pipe during lowering of the alighting gear.

**Alighting-gear circuit**

8. Operation of the alighting gear is controlled by two push-buttons marked UP and DOWN, which are mounted on the sloping panel to port of the pilot's instrument flying panel. When a push-button is depressed, the selector valve, located in the roof of the flare bay, is operated by an electrical actuator, and fluid is delivered to the jacks operating the alighting gear and doors. Fluid already in the nose undercarriage and door jacks is returned via the selector valve and return line to the reservoir. Fluid in the main undercarriage jack down circuits, is similarly returned to the reservoir, but return flow fluid in the jack up circuits is passed through transfer valves and sequence valves to the down side of the jacks. This increases the rate of lowering of the main undercarriage and is especially effective when the hand pump is used to make an emergency lowering. The main undercarriage units are raised, and their doors closed, by retraction of the jack operating rams; the nose undercarriage is raised and its doors closed by the extension of the operating jack rams. Sequence valves incorporated in the circuits ensure that the door and undercarriage unit circuits operate in their proper sequence. An UP/FLIGHT selector is fitted in the nose undercarriage circuit to enable it to be retracted independent of the main undercarriage whilst the aircraft is on the ground.

**Flaps circuit**

9. The flaps are operated by a two-position selector switch marked UP and DOWN, mounted on the sloping panel. The switch controls an electrical actuator which operates the flap selector valve mounted in the roof of the flare-bay; the selector valve directs fluid to either end of the double-ended flap jacks. Fluid displaced by the movement of the jacks is returned, via the selector valve and return line, to the reservoir. There is no mechanical linkage between the jacks in the opposite main planes, and to ensure a gradual movement of the flaps, a two-way restrictor valve is incorporated in the down line of the circuit.

**Air-brakes circuit**

10. This circuit is controlled by a three-position selector switch mounted on the top of the control column; the selector valve is operated by an electrical actuator both of which are mounted in the roof of the flare bay. Fluid under pressure is delivered through the selector valve to the jacks operating the air brakes, and fluid displaced by the movement of the jacks is returned, via the selector valve, to the reservoir. Flow dividers are incorporated in both lines of the circuit to ensure synchronization of the two operating jacks.

11. Three positions, IN, OUT and MID, may be selected for the drag channels, these positions being indicated on the selector switch. The first two positions are obtained by the selector valve directing the fluid to the appropriate end of the jacks, the displaced fluid returning to the reservoir. To obtain the MID position, two microswitches, mounted on a bracket attached to the body of the starboard jack, an electrical relay, and a solenoid-operated valve, located in the OUT pressure line, are employed; the microswitches are operated by cams mounted on the piston rod of the starboard jack. When MID position is selected from IN, the selector valve is operated as for OUT, and fluid is directed to the piston-rod end of the jack, causing it to retract and extend the drag channels out of the main plane. When half-travel position has been reached, the cams on the piston rod engage the microswitches, which complete an electrical circuit and cause the solenoid-operated valve to close and the selector valve to be reversed, directing pressure fluid to the piston end of the jack. The solenoid-operated valve, being closed, prevents displacement of the fluid from the piston rod end of the jack and so forms a hydraulic lock. Movement of the selector switch to OUT from MID reverses the selector valve and opens the solenoid-operated valve, permitting the jack to retract fully and further extend the drag channels out of the main plane. Selection of MID from OUT operates the selector valve to extend the jacks, and withdraws the drag channels to the half-travel position when, as for outward travel, completion of the electrical circuit causes the solenoid-operated valve to close, and prevent, by the hydraulic lock so formed, further movement. When IN is selected from MID, the solenoid-operated valve opens and permits the flow of displaced fluid from the jack, which extends to the outward limit, withdrawing the drag channels into the main plane. Selection of IN from OUT or vice versa, isolates the microswitch circuit and permits a normal flow of fluid through the system.

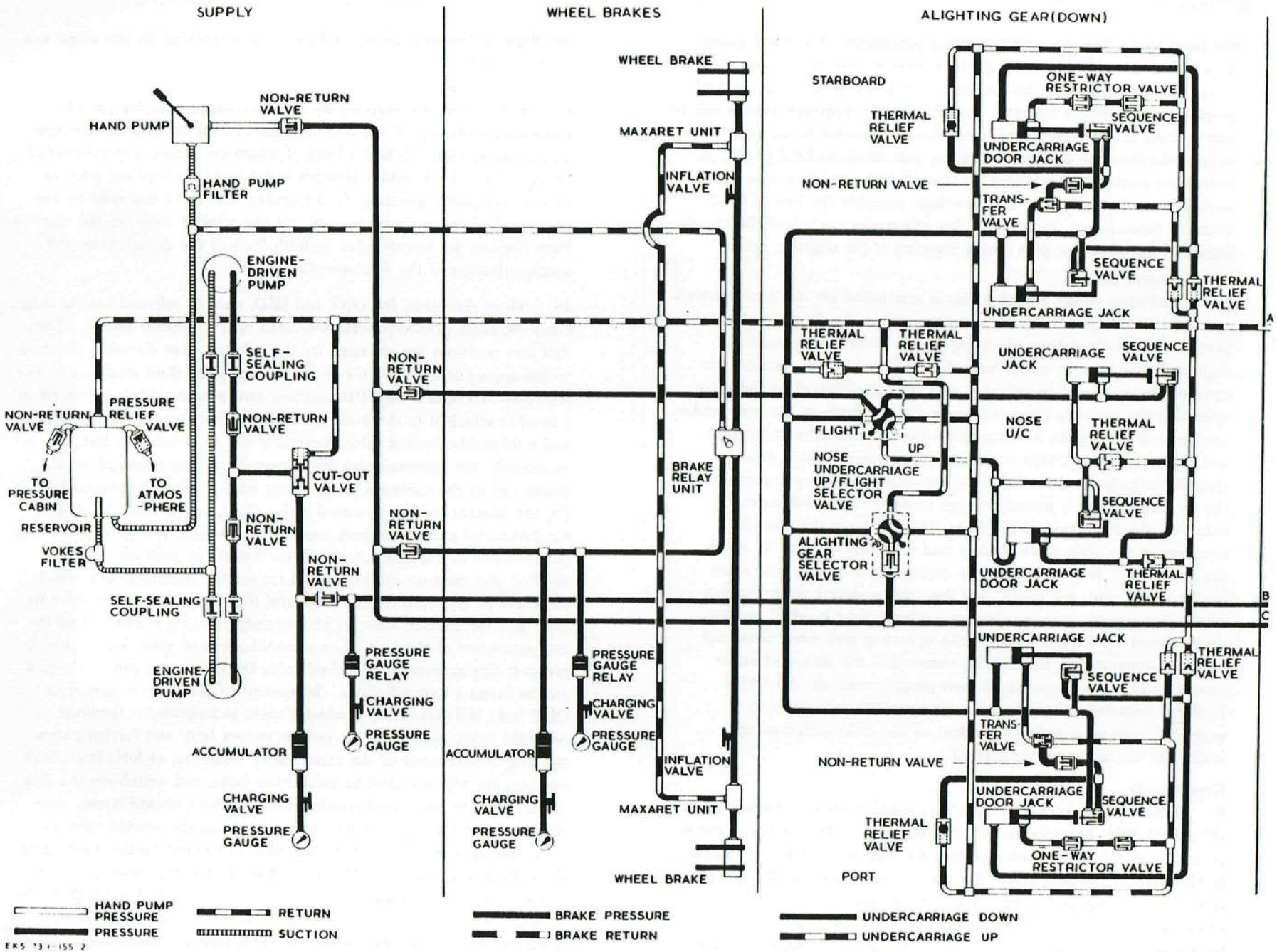



FIG.1. HYDRAULIC SYSTEM DIAGRAM, SUPPLY, WHEEL BRAKES, ALIGHTING GEAR

◂ MOD 5118 EMBODIED ▸

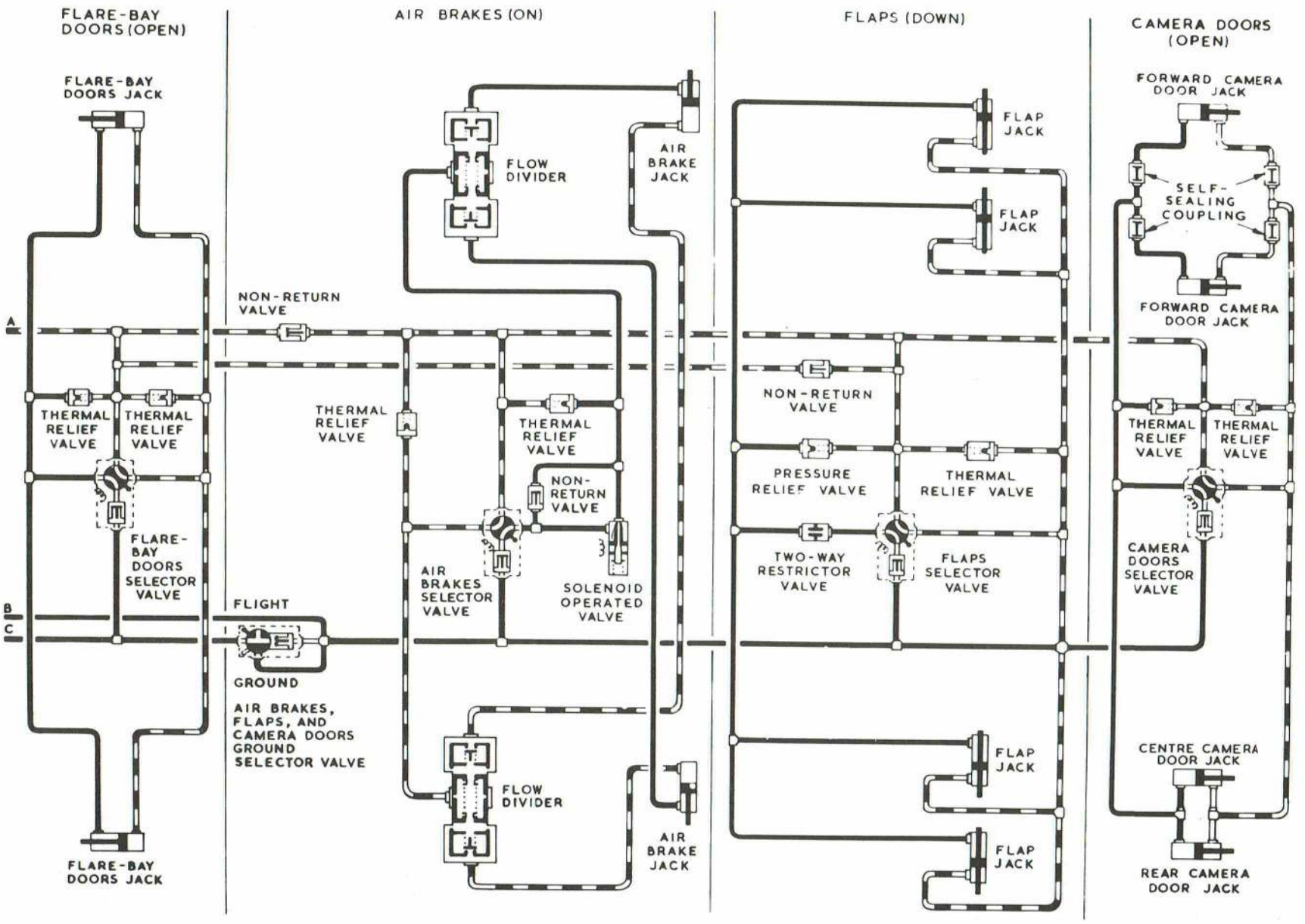



FIG. 2, HYDRAULIC SYSTEM DIAGRAM, FLARE-BAY DOORS, AIR BRAKES, FLAPS, AND CAMERA DOORS

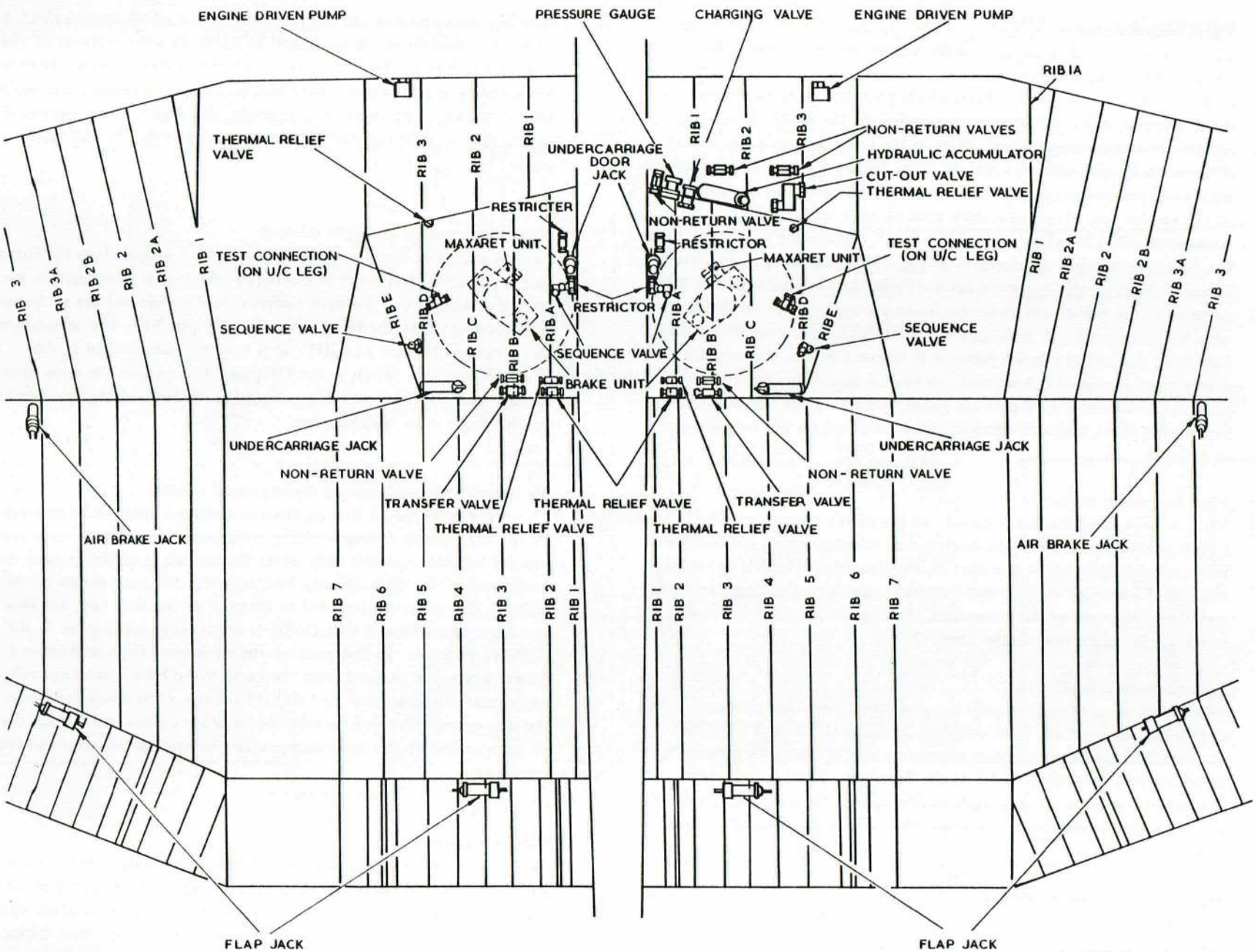



FIG. 4. LOCATION OF HYDRAULIC UNITS IN MAIN PLANES

◂MOD 5118 EMBODIED▸

the main pressure gauge pipeline and is mounted on the forward face of frame 1 in the pressure cabin; this valve is used for priming the pressure gauge and its pipeline *(para.27)*. The wheel brakes pressure gauge also has a valve installed in its pipeline to serve a similar purpose; this valve is situated adjacent to the main gauge valve on frame 1.

## SERVICING

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**Note . . .**

*1. After the removal of any component, or if the system has been drained or partly drained, the engine-driven pumps must be primed (para.49) and the complete system bled (para.24).*

*2. During the reassembly of system components, new bonded seals, AGS.1186 are to be fitted to all banjo connections. Care must be taken not to overtighten banjo bolts (A.P.1803A, Vol.1, Sect.2, Chap.1, Table 1).*

**General information**

**19.** Scrupulous cleanliness is essential during all servicing operations on hydraulic mechanisms. When dismantling a component, which should be done, when possible, in a dust free atmosphere, the parts removed should be laid out in a suitable drip tray.

**Note . . .**

*Hydraulic fluid has a deleterious effect on paint, rubber, electric cables, etc., and care must be taken to avoid spilling it on such parts.*

**20.** Because the presence of a foreign body, no matter how minute, in a component might not only shorten the life of the equipment, but might also result in a serious failure, benches, tools and test rigs must be kept spotlessly clean. All pipe ends and unions exposed during servicing operations must be blanked off to prevent the entry of dirt. Containers used for holding fluid or for the reception of drained fluid must be kept perfectly clean; after a container has been cleaned it must be rinsed with a small quantity of fluid which must then be discarded. Always work with clean hands, clean tools and a clean bench.

**Topping up the reservoir**

**21.** The reservoir must only be topped up when the alighting gear is down, the flare-bay doors open, and the accumulator hydraulic pressures exhausted. The fluid in the main accumulator may be exhausted by operating either the flaps selector switch or the flare-bay doors selector switch until no further movement can be obtained on the flaps or flare-bay doors. Operate the wheel brakes to exhaust the brakes accumulator pressure. The reservoir must be topped up to the maximum possible level with fluid, OM-15; a drainpipe is provided for fluid spilt through overfilling.

◀ **22.** Before topping up the reservoir, check the nitrogen pressure in the accumulators; the gauges are situated, one in the starboard undercarriage well (main) and the other on the forward face of the forward camera bay rear bulkhead (brakes); the pressure should be as given in the Leading Particulars when the accumulators are exhausted of fluid pressure. If the pressure is high it is an indication that fluid is still contained in the accumulator, and if low the accumulator should be examined and, if it is undamaged and showing no signs of leakage, charged up to the correct pressure. ▶

**Draining the reservoir**

**23.** The reservoir must only be drained when the alighting gear and flaps are DOWN, the air brakes IN, and the flare-bay doors OPEN.

(1) Connect an external electrical supply.

(2) Exhaust the hydraulic pressure as detailed in para.21.

(3) Select flare-bay doors CLOSED, to exhaust any residual pressure.

(4) Select flare-bay doors OPEN. THIS IS IMPORTANT.

(5) Remove the hand pump suction line banjo connection at the reservoir, and drain the reservoir at this point.

**Note . . .**

*Overtightening of the banjo bolt may result in stripping the threads. A leak at this point is to be rectified by fitting washers AGS.1186C, not by increasing the torque loading on the bolt.*

**Filling the system**

24. To fill the system:-

(1) Jack the aircraft with the wheels clear of the ground *(Sect.2, Chap.4).*

(2) Examine the gauze filter in the neck of the reservoir, and clean it if necessary. Fill the reservoir to the maximum possible level with fluid OM-15; a drainpipe is provided for fluid spilt through overfilling.

(3) Break the locking wire and move the air brakes, flaps and camera doors ground selector *(para.17)* to GROUND.

(4) Using the hand pump, operate each hydraulic service several times in the folowing order:- air brakes, flaps, alighting gear, camera doors, flare-bay doors, bleeding air through the respective jack bleed screws and topping up the reservoir until the system is full.

**Draining the system**

25. The bulk of the fluid can be drained from the system by uncoupling unions or connections at the lowest point of individual pipe runs, depending upon the attitude of the aircraft. Providing the aircraft is suitably trestled or jacked with the wheels clear of the ground, draining may be facilitated by operation of the jacks by the hand pump.

**Charging the accumulators**

26. The main accumulator charging valve is located in the starboard undercarriage well, and the wheel-brakes accumulator is on the face of the forward camera bay rear bulkhead; the pressure gauges, recording the accumulator pressures, are adjacent to the charging valves. The accumulators are to be inflated, when all hydraulic pressure is exhausted *(para.21)*, to the pressures given in the Leading Particulars.

**Filling the pressure gauge lines**

27. The pipelines to the main and wheel-brakes pressure gauges are to be filled with fluid OM-15. A Gyp Type A.58 inflation valve, located on the forward face of frame 1 starboard side, is provided to fill the main pressure gauge line, and a similar inflation valve, located adjacent to the main gauge inflation valve, provides the wheel brakes pressure gauge line with the same facility. The following items of equipment are required.

(1) Portable hydraulic hand pump rig with a 0-3500 lb/in$^2$ pressure gauge *(Sect.2, Chap.4, Table 2).*

(2) Charging valve adapter *(Sect.2, Chap.4, Table 2).*

28. The following operations apply to both the main and the wheel brakes pressure gauge pipelines. To fill the gauge pipelines with fluid:-

(1) Exhaust the hydraulic pressure from the main and the wheel-brake accumulators as instructed in para.21.

(2) Remove the locking wire, and slacken the priming plug of the gauge relay; located between frames 15 and 16 on the port wall of the flare bay for the main pressure gauge, and between frames 1 and 2 beneath the nose ramp, for the wheel brakes pressure gauge.

(3) Remove the screwed cap of the charging valve at frame 1 and attach the flexible pipe, with adapter, from the hand pump rig, to which the pressure gauge is fitted.

(4) Commence to pump slowly to fill the pipeline and continue until the fluid flows from the gauge relay priming point clearly and free from air. Tighten and wire-lock the priming plug.

(5) Slacken the pipe union at the aircraft pressure gauge. Operate the pump until clear fluid flows from the pipe union, and tighten the union.

(6) Build up a pressure of 2500 lb/in$^2$ and note that the aircraft and rig pressure gauges each register this pressure.

(7) Gradually slacken the pipe union at the aircraft pressure gauge and allow the pressure to fall to zero. Tighten the pipe union.

(8) Remove the adapter from the charging valve, and replace the screwed cap.

**Pressure settings and component adjustments**

29. Pressure settings of all pressure relief and thermal relief valves are given in Leading Particulars; the adjustment of all the hydraulic components is described in the appropriate Air Publication listed in Table 2.

**Automatic cut-out valve setting**

**30.** The cut-out valve is to be set to cut-out at $2700 \pm {}^{50}_{0}$ lb/in$^2$. Final adjustment may be carried out with the valve fitted in the aircraft but prior to installation preliminary setting and testing is necessary, using a static test rig *(Sect.2, Chap.4, Table 2)*, with hydraulic fluid, OM-15. To adjust the cut-out and cut-in pressures; the cut-in pressure is to be 2200 lb/in$^2$ minimum.

**Preliminary adjustment**

**31.**

(1) Blank off the system connection of the valve and couple the pump connection to the test rig.

(2) Build up pressure gradually with a smooth action of the hand pump and note the pressure at which fluid commences to escape from the reservoir connection; this is the cut-out pressure.

(3) Remove the blank from the system connection to allow the fluid trapped behind the non-return valve to escape, then replace the blank.

(4) Adjust the pressure setting by turning the adjusting screw clockwise to increase, or counter-clockwise to reduce the pressure. Test and adjust alternately until $2700 \pm {}^{50}_{0}$ lb/in$^2$ is obtained.

**Leakage test**

**32.**

(1) Disconnect the test rig from the pump connection and couple to the system connection of the valve.

(2) Apply a pressure of 2700 lb/in$^2$; seepage from either pump or reservoir connections must not exceed 10 cc per minute.

(3) Disconnect the coupling from the system connection and couple to the pump connection.

(4) Apply a pressure of 2200 lb/in$^2$; seepage from the reservoir connection must not exceed 10 cc per minute.

(5) Disconnect the coupling from the pump connection and couple to the reservoir connection.

(6) Blank off the pump and system connections and apply a pressure of 250 lb/in$^2$, there must be no leakage.

**Final adjustment in the aircraft**

**33.**

(1) Install the valve and couple to the aircraft system.

(2) Trestle the aircraft *(Sect.2, Chap.4)* and couple a hydraulic servicing trolley *(Sect.2, Chap.4, Table 2)* fitted with a Lockheed Mk.9 hydraulic pump, to the system.

(3) Fill the system *(para.24)* and inflate the accumulators to the correct pressure *(para.26)*.

(4) Start and run the servicing trolley at 2500 r.p.m. and note that when the valve cuts out, the main accumulator pressure gauge registers $2700 \pm {}^{50}_{0}$ lb/in$^2$. If the cut-out pressure is incorrect, turn the adjusting screw in the appropriate direction until the correct setting is obtained.

(5) Operate the flaps to discharge the accumulator and cause the valve to cut in. Note that the cut-in pressure is at or above the minimum of 2200 lb/in$^2$. If not, the valve must be considered unserviceable.

(6) When the correct settings are obtained wire-lock the connections and repeat the test several times to ensure that the settings remain constant.

**Important**

*It is essential that replacement valves are adjusted and marked in accordance with the foregoing instructions before final installation.*

**Pressure test of the system**

**34.** To pressure test the system:-

**Note . . .**

*The reservoir must be kept topped-up to the correct level during all bleeding operations. The aircraft hand pump must be used for the operation and bleeding of the jacks. The hand pump of the auxiliary rig must be used only for building up pressure.*

(1) Jack the aircraft with the wheels clear of the ground *(Sect.2, Chap.4)*.

(2) Connect an electrical supply to the external supply socket *(Sect.2, Chap.2)*.

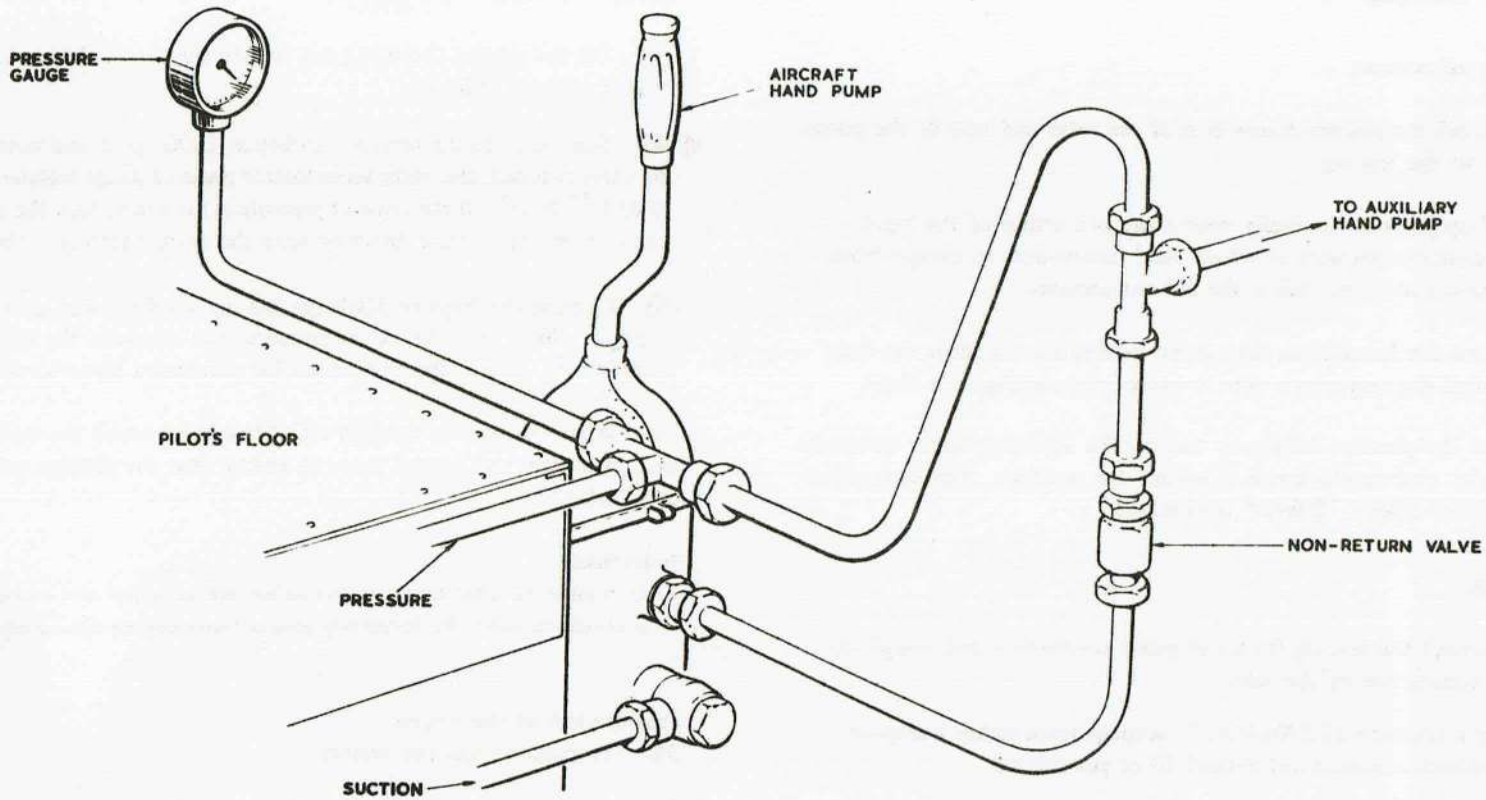



FIG.5. AUXILIARY HAND PUMP CIRCUIT

(3) Uncouple the hand pump pressure pipe at the hand pump and connect an auxiliary hand pump circuit *(fig.5)*.

(4) Uncouple the delivery pipe at the flap relief valve, adjacent to the flap selector valve in the roof of the flare bay, and blank off the pipe.

(5) Charge the main accumulator *(para.26)*.

(6) Charge the wheel brakes accumulator *(para.26)*.

(7) Move the air brakes, flaps and camera doors ground selector *(para.17)* to GROUND.

(8) Fill the reservoir with hydraulic fluid, OM-15.

(9) Prime and bleed the aircraft hand pump.

(10) With the alighting gear selected DOWN, the UP/FLIGHT nose wheel selector at FLIGHT, the flare-bay doors selected at OPEN, the flaps selector at DOWN, the air-brakes selector at IN, the camera doors selector at OPEN, and the wheel brakes parked, use the aircraft hand pump to fill the system and jacks with fluid until pressure commences to build up. Check jack and sequence valve settings.

(11) Top up the reservoir and replace its cap.

**Note . . .**

*The reservoir cap must be fitted during all the following tests and must not be removed when the alighting gear is UP.*

(12) Bleed all jack pipelines and wheel units at the respective bleed valves or suitable connections on individual jacks.

◀ (13) Build up a preliminary test pressure of 2200 to 2750 lb/in$^2$ with ▶ the auxiliary hand pump and check the pressure lines for leaks and security. Hold this pressure for a few minutes and then release.

(14) Remove the nose undercarriage doors actuating links at the doors and tie back the doors in the open position.

(15) Select alighting gear UP, and using the aircraft hand pump retract the alighting gear as far as possible, but leaving the jack bleed valves accessible. Bleed the main and nose undercarriage jacks.

(16) Using the aircraft hand pump, fully retract the alighting gear, disconnecting the main undercarriage door jacks from the doors as soon as they commence to retract.

(17) Retract the main undercarriage door jacks and extend the nose undercarriage door jack; bleed all three jacks when they have completed the doors closed stroke.

(18) Select flare-bay doors CLOSED and partially close the flare-bay doors. Bleed the jacks.

(19) Fully close the flare-bay doors. Ensure that the jacks are at the end of their strokes and are not straining the doors by checking that there is a 0.20 ± 0.06 in. clearance between the metal faces of the edges of the doors. The method of adjusting the flare-bay doors is given in Sect.3, Chap.1.

(20) Select flaps UP, partially raise the flaps and bleed the jacks. If the flaps are not assembled to the mechanism, operate the jacks to the end of their stroke before bleeding.

(21) Fully raise the flaps. Ensure that they are not strained when in the fully up position *(Sect.3, Chap.4)*.

(22) Select air brakes OUT, operate the air brakes fully and bleed the jacks.

(23) Using the auxiliary hand pump, apply a test pressure of 2900 lb/in$^2$, or as near as possible to the thermal relief valve operating pressure. Retain this pressure and check the pressure drop; it must not exceed 150 lb/in$^2$, during the first 15 minutes. Hold the pressure for a total of 30 minutes and then release.

(24) Lower the flaps, close the air brakes, open the flare-bay doors and lower the alighting gear, recoupling the alighting gear door jacks to the doors before the jacks are fully extended. Reconnect the nose undercarriage door actuating links.

(25) Repeat operation (23).

(26) Disconnect the auxiliary hand pump circuit and connect the hand pump pressure pipe, and also the delivery pipe to the flap pressure-relief valve.

(27) Move the air brakes, flaps, and camera doors ground selector to FLIGHT, and wire-lock.

**Functioning tests of services**

35. Jack and trestle the aircraft with the wheels clear of the ground *(Sect.2, Chap.4).* Connect two Mk.2A, or 2B or 2C hydraulic servicing trolleys, fitted with Lockheed Mk.9 engine-driven pumps, to the self-sealing couplings in the suction and delivery lines at the engine-driven pumps and test the functioning of the services, with the pumps running at 2500 rpm, as follows:-

**Note . . .**

*The air brakes, flaps and camera doors GROUND/FLIGHT selector in the roof of the flare-bay must be in the FLIGHT position for all power tests.*

(1) Connect an electrical supply to the external supply socket *(Sect.2, Chap.2).*

(2) Test the power circuit using both servicing trolleys and check the operation of the automatic cut-out valve by operating the flare-bay doors, camera doors, air brakes and flaps. The cut-out valve should cut-in at 2200 lb/in$^2$ (min.) and cut-out when the system pressure has built up to 2700 $^{+50}_{-0}$ lb/in$^2$.

(3) Using both servicing trolleys, retract and lower the alighting gear five times, and check that the mechanical down locks, up locks, door locks and indicating lights function correctly. The time taken to retract and lower the alighting gear must not exceed fourteen and eight seconds respectively.

(4) Stop the servicing trolleys, release all hydraulic pressure and raise the alighting gear using the aircraft hand pump.

(5) Operate the alighting gear emergency control and lower the alighting gear using the aircraft hand pump. Ensure that the nose undercarriage door hooks engage centrally and check the operation of the main undercarriage doors and shoot bolts. *(Sect.3, Chap.5A).*

**Note . . .**

*To prevent oscillation when lowering the alighting gear by hand pump, station a man at each alighting gear door with instructions to hold the doors fully open to ensure that the sequence valves controlling the lowering of the alighting gear remain open for the returning fluid.*

(6) Reset the selector actuator and the emergency control *(Sect.3, Chap.11),* set the nose undercarriage UP/FLIGHT selector to UP and retract the nose undercarriage by the hand pump. Set the selector to FLIGHT and lower the nose undercarriage.

(7) Using the port servicing trolley only, retract and lower the alighting gear once.

(8) Repeat operation (7) using the starboard servicing trolley only.

(9) Using both servicing trolleys, retract and lower the alighting gear three times. Check the alighting gear indicating lights function correctly *(A.P.101B-0407-1B, Sect.5, Chap.1, Group G).*

(10) Remove both main door jacks attachment bolts at the piston rod ends *(Sect.3, Chap.5A).*

(11) Remove the bolts which connect the door check links to the doors.

(12) Using both servicing trolleys retract the main undercarriages ensuring that the door jack rams are clear of surrounding mechanisms and structure.

(13) Fold the check links back to remove pressure from the sequence valve plungers.

(14) With the servicing trolleys still running, select alighting gear DOWN and operate the aircraft hand pump until the undercarriages are locked down.

(15) Partially retract the undercarriages and reconnect the door check links and door jacks *(Sect.3, Chap.5A).*

(16) Using both servicing trolleys, retract and lower the alighting gear.

(17) Using both servicing trolleys, close and open the flare-bay doors and check that the warning lamp is illuminated when the doors are open. The time taken to close and open the flare-bay doors must not exceed six and five seconds respectively.

(18) Using the port servicing trolley only, close and open the flare-bay doors.

(19) Repeat operation (18) using the starboard servicing trolley only.

(20) Stop the servicing trolleys, release the pressure and, using the aircraft hand pump, close the flare-bay doors. Operate the flare-bay doors emergency control and open the flare-bay doors using the aircraft hand pump.

(21) Reset the flare bay doors emergency control *(Sect.3, Chap.11)*, and using both servicing trolleys close and open the flare-bay doors.

(22) Using both servicing trolleys, raise and lower the flaps, four times, checking the operation of the position indicator and the synchronization of the port and starboard flaps. The time taken to either raise or lower the flaps must be between fifteen and nineteen seconds.

(23) Using the port servicing trolley only, raise and lower the flaps.

(24) Repeat operation (23) using the starboard trolley only.

(25) Stop both servicing trolleys and release the pressure. Place the air brakes, flaps and camera doors ground selector in the flare bay to the GROUND position and, using the aircraft hand pump, raise and lower the flaps once.

(26) Return the ground selector to FLIGHT and wire-lock. Check that the flaps cannot be operated by the hand pump.

(27) Using both servicing trolleys, operate the air brakes OUT, MID and IN, three times, checking the synchronization of the port and starboard brakes. In the MID position the inboard or outboard drag channel extensions must not differ by more than 0.5 in. between each main plane. The time taken to either extend or retract the air brake drag channels must be between 0.5 and 2.5 seconds.

(28) Using each servicing trolley independently operate the air brakes as in operation (27).

(29) Using both servicing trolleys, select camera doors OPEN and CLOSED. The time taken to either open or close the forward doors is to be 5 seconds; the time taken to open or close the central or rear doors is to be 3 seconds.

(30) Using each servicing trolley, independently, open and close the camera doors.

(31) Stop the servicing trolleys and remove both main wheels. Start the servicing trolleys and pressurize the system. Apply the brake lever and test each Maxaret unit in turn by spinning the Maxaret wheel in the direction of the arrow; ensure that the brake pistons operate and the brake discs come 'on'. Stop each wheel abruptly and ensure that the brakes come 'off' immediately and the indicator rods pop out. Release the brake lever, stop the servicing trolleys, release the pressure and refit the main wheels.

(32) Attach a Turner inflation adapter with associated pressure gauge *(Sect.2, Chap.4, Table 2)* to the wheelbrake test connections in the hydraulic pipes to the brakes.

(33) Start the servicing trolleys and with the wheel brakes off and the rudder bar central, check that the wheels are free to rotate.

(34) Using the brake lever, apply the brakes progressively and, with the rudder bar central, check that at intermediate positions the pressures at each brake do not vary considerably from each other and that when the brakes are full on there is a steady pressure of $1500 \pm^{150}_{0}$ lb/in$^2$ at each brake.

**Note . . .**

*For all pressures from zero to 1000 lb/in$^2$ the pressure gauge readings must be within 100 lb/in$^2$ of each other; for all pressures from 1000 to 1500 lb/in$^2$ the readings must be within 150 lb/in$^2$ of each other.*

(35) Apply full port rudder and check that the pressure at the port brake remains at $1500 \pm^{150}_{0}$ lb/in$^2$ and the pressure at the starboard brake falls to zero.

(36) Apply full starboard rudder and check that the pressure at the port brake falls to zero and the pressure at the starboard brake returns to $1500 \pm^{150}_{0}$ lb/in$^2$.

(37) Repeat operation (33).

(38) Remove the Turner inflation adapter and pressure gauge from both wheel brake test connections.

(39) Fully apply the brake lever and operate the parking lever; this must operate easily with one hand.

(40) Place the air brakes, flaps, and camera doors ground selector in the flare-bay to the GROUND position, and check that all services can be operated by the hand pump.

(41) Move the air brakes, flaps, and camera doors ground selector to the FLIGHT position and check that the air brakes, flaps and camera doors cannot be operated by the hand pump.

36. After the functioning tests are satisfactorily completed the following operations must be carried out:-

(1) Disconnect the external electrical supply.

(2) Disconnect the servicing trolleys and connect the aircraft engine-driven pumps at the self-sealing couplings.

(3) Bleed the pumps and top up the reservoir *(para.21)*.

(4) Reseal the emergency release cables at the pressure bulkhead *(Sect.3, Chap.8)*.

(5) Wire-lock the air brakes, flaps, and camera doors ground selector, and the nose undercarriage UP/FLIGHT selector, in the FLIGHT position.

(6) Relock and seal the alighting gear and flare bay door emergency release handles *(Sect.3, Chap.11)*.

## REMOVAL AND ASSEMBLY

**General information**

37. Methods of removing certain items from the system are given in the following paragraphs. Generally, the assembly sequence is the reverse of removal but where there are special reassembly features they are specifically mentioned. The removal, assembly and adjustment of the flare bay door jacks is given in Chap.1, the air brakes and flap jacks in Chap.2 and the alighting gear jacks in Chap.5A and Chap.5B.

**Note . . .**

*1. After the removal of any component, or if the system has been drained or partly drained, the engine-driven pumps must be primed (para.49) and the complete system bled (para.24).*

*2. When reassembling hydraulic pipes Pt.No.EA3.73.799 and EA3.73.803 to the transfer valve in the port wheel bay, ensure that they are not crossed. The two pipes should run parallel throughout their length.*

*3. During the reassembly of system components, new bonded seals, AGS.1186, are to be fitted to all banjo connections. Care must be taken not to overtighten banjo bolts (A.P.1803A, Vol.1, Sect.2, Chap.1, Table 1).*

**Reservoir**

38. To remove the reservoir:-

(1) Drain the reservoir *(para.23)*.

(2) Disconnect all the remaining pipes from the reservoir, and blank off all exposed pipe ends and apertures.

(3) Remove the locking wire from the trunnion tension rods and unscrew the tension rods. This operation will release the straps retaining the reservoir in position. Remove the reservoir.

**Note . . .**

*1. When assembling the reservoir, it is important that pieces of hard felt, 3/4 in. x 1/8 in. x 16 in. long, are attached to the reservoir with rubber resin cement at the retaining strap position,*

*2. Care must be taken not to overtighten the hand pump suction pipe banjo bolt when reassembling. Leakage at this point should be rectified by fitting washers AGS.1186C, not by increasing the torque loading on the banjo bolt.*

**Main accumulator**

39. To remove the main accumulator:-

(1) Exhaust all hydraulic pressure from the system *(para.21)*.

(2) Remove the inboard access panel from the upper surface of the starboard main plane leading edge *(Sect.2, Chap.4)*.

◀ (3) Release the nitrogen pressure by depressing the Schrader unit in the charging valve.

(4) Disconnect and blank off the nitrogen charging pipeline and the hydraulic pipeline at the accumulator. ▶

(5) Remove the bolts on the two retaining straps and remove the accumulator.

**Note . . .**

*When assembling the accumulator it is important that pieces of hard felt, 3/4 in. x 3/8 in. x 10 in. long are attached to the accumulator with rubber-resin cement at the retaining strap positions.*

**Wheel brakes accumulator**

**40.** Removal and assembly operations for this accumulator are the same as for the main accumulator *(para.39)*, except that it is removed through the battery compartment door on the port side of the fuselage.

**Automatic cut-out valve**

**41.** To remove the automatic cut-out valve:-

(1) Exhaust the system of hydraulic pressure *(para.21)*.

(2) Remove the inboard access panel from the upper surface of the starboard main plane leading edge *(Sect.2, Chap.4)*.

(3) Disconnect and blank off the pressure pipelines and the return to reservoir pipeline.

(4) Remove the three retaining bolts and remove the cut-out valve.

**Filter**

**42.** To remove the filter:-

(1) Exhaust the system of hydraulic pressure *(para.21)*.

(2) Drain the reservoir *(para.23)*.

(3) Disconnect and blank off the inlet and outlet pipes.

(4) Remove the two retaining bolts attaching the filter to the channel-section on the starboard side of the forward camera bay.

(5) Lift the filter out of the retaining ring and remove the filter.

**Hand pump**

**43.** To remove the hand pump:-

(1) Exhaust the system of hydraulic pressure *(para.21)*.

(2) Disconnect and blank off the pressure and suction pipes.

(3) Remove the three attachment bolts in the side of the pump and remove the pump.

**Brake relay control valve**

*Removal*

**44.** To remove the brake relay control valve:-

(1) Exhaust the system of hydraulic pressure *(para.21)*.

(2) Drain the system *(para.25)*.

(3) Remove the access panels from the cabin floor.

(4) Disconnect the four pipelines at the control unit.

(5) Disconnect the Bowden cable.

(6) Disconnect the operating lever from the rudder lever.

(7) Remove the bolts securing the control unit to the cabin floor, and remove the unit.

**CAUTION . . .**

**Prior to reassembly of the Bowden cable to the control valve, check the cable for damage to the strands, and for kinking. If either are evident the cable must be replaced.**

*Assembly*

**45.** ▶◀

(1) Bolt the control valve to the cabin floor, and connect the four pipelines and the Bowden cable to their respective points on the control valve.

◀(2) With the rudder bar centralized, connect the operating rod to the control valve and adjust the rod until the pointer on the control valve is central.▶

(3) Fit Turner inflation adapters and gauges to the connections in the hydraulic pipes to the brakes.

(4) Ensure that the main hydraulic pressure is 2700 lbf in$^2$.

(5) With the aircraft wheels jacked clear of the ground *(Sect.2, Chap.4)*. and with the rudder bar central, apply the hand brake lever and adjust the Bowden cable to give a brake pressure of $1500\ ^{+150}_{-0}$ lbf in$^2$ on the Turner gauges. Release the brakes and ensure that the pressure falls to zero and that the wheels are free to rotate.

(6) Apply full port rudder, and check the pressures registered on the Turner gauges; they should be:-

Port – $1500\ ^{+150}_{-0}$ lbf in$^2$

Starboard – Zero, with the wheel free to rotate.

(7) Apply full starboard rudder and repeat the check in operation (6), the pressures should be:-

Starboard — $1500 \pm^{150}_{0}$ lbf in$^2$.

Port — Zero, with the wheel free to rotate.

(8) Check the pressures at various brake lever settings with the rudder bar central. For partly applied brakes at pressures up to 1000 lbf in$^2$ there should not be more than 100 lbf in$^2$ between port and starboard gauge readings. For partly applied brakes at pressures exceeding 1000 lbf in$^2$ there should not more than 150 lbf in$^2$ between gauge readings.

**Note . . .**

*The brake lever must not be snatched on, as high and incorrect readings may result.*

(9) Remove the Turner inflation adapters and gauges.

46. Should any fluctuation in the pressures occur at the Turner gauges it is an indication that there is a leak past the relay control valve and the valve is unserviceable.

**Engine-driven pump**

*Removal*

47.

(1) Exhaust the system of hydraulic pressure *(para.21)*.

(2) Remove the appropriate access panel *(Sect.2, Chap.4)*.

(3) Drain the hydraulic fluid from the pump.

(4) Disconnect and blank off the hydraulic pipes to the pump, and blank off the pump apertures.

(5) Disconnect the pump drainpipe.

(6) Remove the six nuts and spring washers securing the pump to the accessories gearbox, and remove the pump.

(7) Remove the driving quill from the gearbox driveshaft, attach to the blanking cover, and blank off the gearbox aperture.

*Assembly*

48. To assemble the pump to the accessories gearbox:-

(1) Remove the blanking cover from the gearbox aperture, and retain the gasket.

(2) Lightly smear the pump driving quill with grease XG-271 and insert into the gearbox driveshaft.

**Note . . .**

*Driving quills are supplied with each gearbox.*

(3) Fit the gasket to the pump seating flange on the gearbox.

(4) Prime the pump with hydraulic fluid OM-15.

(5) Offer up the pump to the gearbox, line up the splines and fit the pump over the securing studs on the gearbox flange, ensuring that the bleed screw is at the top of the pump.

(6) Fit and tighten the six nuts and spring washers.

(7) Remove the blanks from the hydraulic pipes and pump apertures, and fit the pipes to the pump. Wire-lock the unions.

(8) Connect the drainpipe to the pump, and wire-lock the union.

(9) Bleed the pump *(para.49)*.

*Priming and bleeding*

49.

(1) Top up the reservoir with hydraulic fluid OM-15.

(2) Slacken the bleed screw on the pump.

(3) Build up a pressure of 1 to 2 lbf in$^2$ in the reservoir.

**Note . . .**

*To pressurize the reservoir, a cap of local manufacture incorporating a Schrader valve and 0-5 lbf in$^2$ pressure gauge, may be used. Pressure should be built up slowly to 1 or 2 lbf in$^2$.*

(4) Allow fluid to flow from the bleed vent until it flows freely and free from air.

(5) Tighten and wire-lock the bleed screw.

## TABLE 1

### Faults and remedies

The more common hydraulic faults and their remedies are listed in the following table: faults in individual components are covered in the appropriate AP listed in Table 2

| | Fault | Possible cause | Remedy |
|---|---|---|---|
| (1) | Engine-driven pump and hand pump fail to operate the system | No fluid in the system<br>Leakage in the system | Refill the system<br>Correct the leak and refill the system<br>**Note . . .**<br>*There is no need to change the engine-driven pump unless it has been running in a dry condition for more than thirty minutes.* |
| (2) | Engine-driven pump drive shears | Pump seized<br>Excessive pressure due to foreign matter in system<br>Hammering of the automatic cut-out | Change the pump<br>Drain the system and replenish with clean fluid<br>Renew the automatic cut-out |
| (3) | All services inoperative by engine-driven pumps but services can be operated by the hand pump | Engine-driven pump drives sheared<br>Foreign matter in the filter<br>By-pass valve in the automatic cut-out leaking | Refer to (2)<br>Remove the filter and clean it<br>Renew the automatic cut-out |
| (4) | Spongy action on hand pump | Air in particular service<br>Faulty non-return valves | Bleed the affected service and test<br>Renew the affected non-return valves |
| (5) | All services inoperative by hand pump | Hand pump worn or damaged | Renew the hand pump |
| (6) | Flaps droop, or spring back from the lowered position | Jack piston rod glands leaking<br>Non-return valve in selector valve leaking<br>Air in system | Renew the jack<br>Renew the selector valve<br>Bleed the system and test |
| (7) | Flaps return to original position after moving | Jack piston rod glands leaking<br>Leaking selector valve<br>Leaking thermal relief valve | Renew the jack<br>Renew the selector valve<br>Renew the thermal relief valve |
| (8) | No movement of flaps upon selection with accumulator pressure correct | Actuator fuse blown | Renew fuse No.25 |
| (9) | Flaps on one side move in advance of those on the other side | Foreign matter in restrictor valve and pressure relief valve<br>Air in system | Remove the restrictor valve and pressure relief valve, and clean them<br>Bleed the system and test |

*continued . . .*

**TABLE 1 Faults and remedies** – *continued*

| Fault | Possible cause | Remedy |
|---|---|---|
| (10) Flare-bay doors droop | Jack piston rod glands leaking | Renew the jack |
| | Non-return valve in selector valve leaking | Renew the selector valve |
| | Air in system | Bleed the system and test |
| (11) No movement of flare bay doors upon selection, with accumulator pressure correct | Actuator fuse blown | Renew fuse No.24 |
| (12) Alighting gear doors droop | Door jack piston rod glands leaking | Renew the affected jack |
| | Non-return valve in selector valve leaking | Renew the selector valve |
| | Air in system | Bleed the system and test |
| | Incorrect setting of door jack sequence valves | Reset affected sequence valve |
| (13) No movement of alighting gear upon selection with accumulator pressure correct | Actuator fuse blown | Renew fuse No.52 |
| (14) Wheel brakes inoperative with accumulator pressure correct | Broken Bowden cable | Renew the Bowden cable |
| | Slack Bowden cable | Release the cable and adjust |
| (15) Wheel brakes remain on after brake lever is released | Tight Bowden cable | Release the Bowden cable and adjust |
| | Frayed Bowden cable | Renew the Bowden cable |
| (16) Air brakes inoperative upon selection with accumulator pressure correct | Actuator fuse blown | Renew fuse No.65 |
| (17) Air brake drag channels protrude from main plane surfaces | Jack piston rod glands leaking | Renew the jack |
| | Non-return valve in selector valve leaking | Renew the selector valve |
| | Air in system | Bleed the system and test |
| (18) No movement of camera doors upon selection, with accumulator pressure correct | Actuator fuse blown | Renew fuse No.57 |
| (19) Incomplete movement of camera doors upon selection | Door jack piston rod glands leaking | Renew the affected jack |
| | Non-return valve in selector valve leaking | Renew the selector valve |
| | Air in system | Bleed the system and test |

*continued . . .*

**TABLE 1 Faults and remedies** — *continued*

| Fault | Possible cause | Remedy |
|---|---|---|
| (20) Hammering of the automatic cut-out | Air in the system | Bleed the system |
| | Leaking non-return valve<br>Broken secondary spring | Renew the automatic cut-out |
| | Leaking selector valve | Renew the affected selector valve |
| | Restriction in pressure line | Flush the pressure line — renew if damaged |
| (21) Slow movement of services | Insufficient air in the appropriate accumulator due to leakage at inflation point | Stop the leak, reinflate and test |
| (22) Sluggish movement of a particular service with correct accumulator pressure | Air in system | Bleed the system and test |

**Note . . .**

*Fault (22) may be apparent only in flight, or with one engine at idling rev/min, and not when using the servicing trolleys.*

## TABLE 2

### List of principal components

| Component | Description | No. off per A/C | AP | Sect. | Chap. |
|---|---|---|---|---|---|
| Accumulators | Lockheed, AIR 40016 | 2 | 1803B | 5 | 1 |
| Maxaret anti-skid unit, | | | | | |
| port | Dunlop, AC11516 | 1 | 1803S | 8 | 5 |
| starboard | Dunlop, AC11514 | 1 | 1803S | 8 | 5 |
| Brake relay control valve | Dunlop, AC61762 | 1 | 1803S | 7 | 2 |
| Brake units, | | | | | |
| port | Dunlop, AH9780 | 1 | 104J-1047-1 | | |
| starboard | Dunlop, AH9781 | 1 | 104J-1047-1 | | |
| Gyp inflation valves | High Pressure Components Ltd. A.58 | 6 | 105B-07225-1 | | |
| Cut-out valve | Lockheed, AIR 43634 | 1 | 1803B | 10 | 2 |
| Engine-driven pumps | 37J/266 Lockheed, Mk.9 | 2 | 105B-0110-1 | | |
| Filter | 27B/1877 Vokes, E30L/1 in./7915 or | | | | |
| | 27B/2620 Vokes, E30L/1 in./22537 | 1 | 1464C, Pt.1 | 3 | 2 |
| Flow dividers | British Messier, 8076/052 | 2 | 1803T | 13 | 1 |
| Gauge relays | Electro hydraulics, 7391 | 2 | 1803F | 14 | 1 |
| Hand pump | Turner, 77C/1275 | 1 | 105B-0217-1 | 3 | 1 |
| Jacks: | | | | | |
| Air brakes | Dowty, 103035001 and 103036001 | 2 | 105B-0986-16C | – | – |
| Flare-bay doors | Dowty, 100522001 | 2 | 1803D | 10 | 35 |
| Flaps | Dowty, 07016Y.C.O.1 | 4 | 1803D | 10 | 38 |
| Main undercarriage | Dowty, 07017Y.C.O.1 | 2 | 1803D | 10 | 36 |
| Main and nose undercarriage doors | Dowty, 08246Y.C.O.1 | 3 | 1803D | 10 | 34 |
| Nose undercarriage | Dowty, 08214Y.C.O.1 | 1 | 1803D | 10 | 37 |
| Camera doors, port, starboard and | | | | | |
| centre | Dowty, C8244Y | 3 | 1803D | 10 | 33 |
| Camera doors, aft | Dowty, 100524001 | 1 | 1803D | 10 | 58 |
| ◀ Non-return valves | UMC.703 and 706 | 9 | 105B-07398-1 | | ▶ |
| Non-return valves (pressurization) | British Messier, 8557 | 1 | 1803T | 13 | 10 |
| Non-return valve (return line) | Dowty, D5240Y | 2 | 1803D | 9 | 58 |
| Oil filter unit | Dowty, C2254Y | 1 | 105B-0483-1 | | |
| Pressure relief valves:- | | | | | |
| Flaps | Dowty, C1034Y, Mk.Q | 1 | 1803D | 9 | 11 |
| Reservoir | Dowty, D2568Y | 1 | 1803D | 9 | 42 |

*continued . . .*

**TABLE 2 List of principal components** – *continued*

| Component | Description | No. off per A/C | AP | Sect. | Chap. |
|---|---|---|---|---|---|
| Restrictor valves: | | | | | |
| Flaps | Dowty, D657Y | 1 | 1803D | 9 | 21 |
| Main undercarriage doors | Dowty, 06209Y.B.O.1 | 2 | 1803D | 9 | 81 |
| Selector valves: | | | | | |
| Air brakes, flaps and camera doors | Dowty, C408Y, B.L. | 3 | 105B-05117-1 | | |
| Alighting gear | Dowty, C408Y, B.Q | 1 | 105B-05117-1 | | |
| Flare doors | Dowty, C408Y, B.R | 1 | 105B-05117-1 | | |
| Up/flight selector valve: | | | | | |
| Nose undercarriage | Dowty, C1183Y, Mk.B | 1 | 105B-05119-1 | | |
| Ground/flight selector valve: | | | | | |
| Air brakes, flaps and camera doors | Dowty, C408Y, Mk.AN | 1 | 105B-05118-1 | | |
| Sequence valves: | | | | | |
| Main undercarriage, port | Dowty, D401Y, Mk.L | 1 | 1803D | 9 | 23 |
| Main undercarriage, starboard | Dowty, D401Y, Mk.M | 1 | 1803D | 9 | 23 |
| Main undercarriage door, port | Dowty, D401Y, Mk.K | 1 | 1803D | 9 | 23 |
| Main undercarriage door, starboard | Dowty, D401Y, Mk.J | 1 | 1803D | 9 | 23 |
| Nose undercarriage | Dowty, D401Y, Mk.G | 1 | 1803D | 9 | 23 |
| Nose undercarriage doors | Dowty, D401Y, Mk.H | 1 | 1803D | 9 | 23 |
| Solenoid-operated valve | British Messier, 6330 | 1 | 1803T | 14 | 1 |
| Thermal relief valves | Dowty, C4603Y, Mk.E | 15 | 105B-0738-16 | – | – |
| Transfer valves | Dowty, C67907, Mk.A | 2 | 1803D | 9 | 67 |
| Thermal relief valve | Dowty, C8697Y, Mk.A | 2 | 105B-0738-16 | – | – |

# Chapter 8 AIR SYSTEMS

*(completely revised)*

## LIST OF CONTENTS



**Note . . .**

*A detailed list of contents will be found at the beginning of each chapter.*

# Chapter 8A CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM

*(completely revised)*

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## LIST OF TABLES



## LIST OF ILLUSTRATIONS

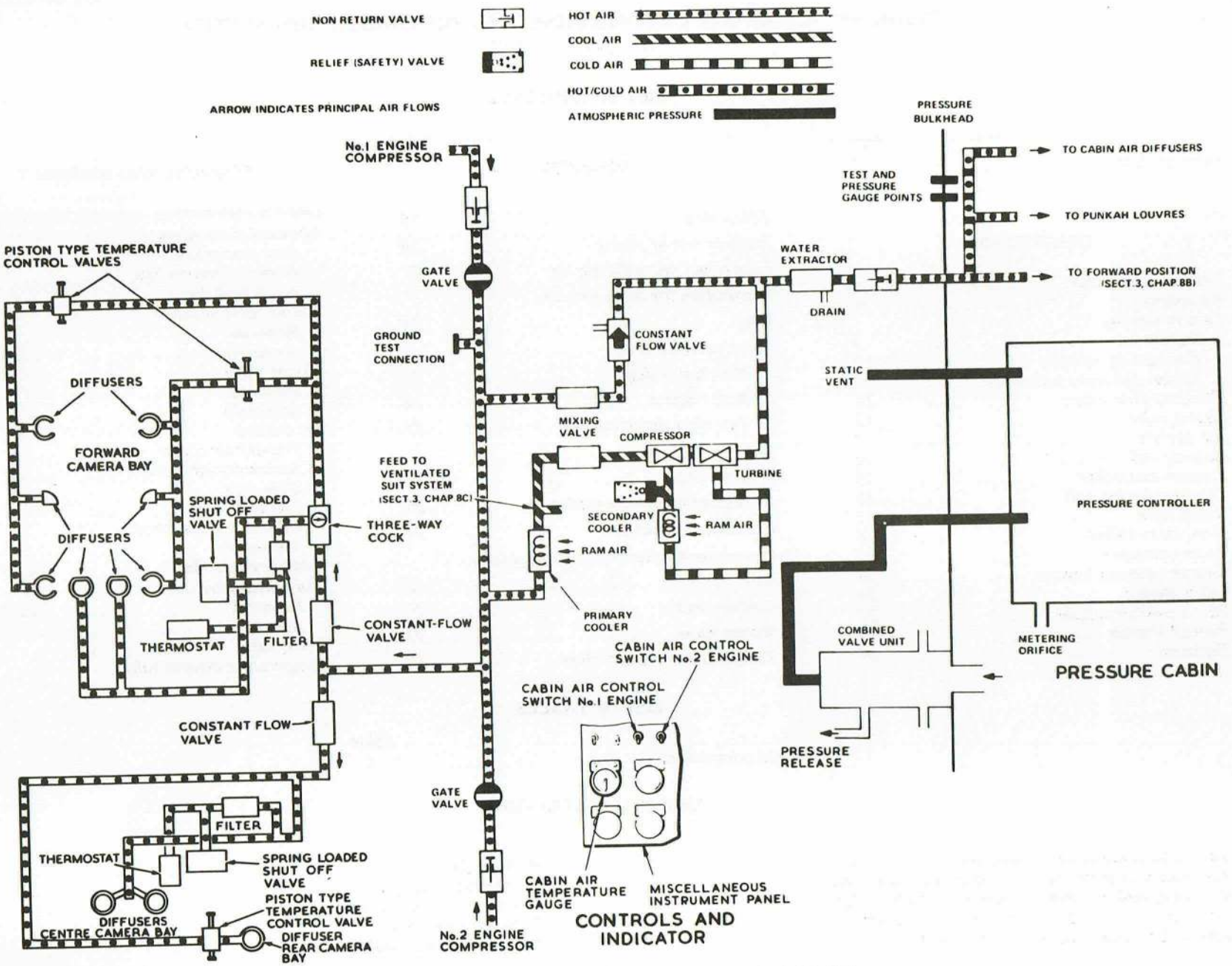



FIG.1. AIR CONDITIONING SYSTEM-DIAGRAM

**Introduction**

1. This chapter describes and illustrates the air conditioning and pressurizing system, gives details of certain servicing operations and recommends methods of removal and assembly of certain components from the aircraft. The systems provide air for pressurizing and heating the cabin, and for heating the camera windows. The air conditioning system is shown diagrammatically in fig. 1 and the location of the units is illustrated in fig. 2.

2. Details of major components of the systems, together with their Air Publication references, where applicable are listed in Table 1.

## DESCRIPTION

**General information**

3. Air supply for pressurizing, conditioning, camera heating and the ventilated suit system is supplied by both engine compressors. Cabin pressure is controlled by a pressure controller and combined-valve unit, and the temperature by a two-way mixing valve. The pressure and temperature of the air for heating the cameras are not controllable by the pilot, the temperature being governed by temperature control valves situated in the vicinity of the cameras. The pressure controller, in combination with the combined-valve unit, controls the cabin pressure above 10,000 ft; cabin pressure and atmospheric pressure below this height are approximately the same. The cabin temperature is controlled by a cabin heat control switch mounted on the miscellaneous instrument panel. The cabin is insulated by a fibreglass blanket affixed to the interior of the fuselage skin.

**Air supply** *(fig. 1, 2 & 3)*

4. Hot air from each engine compressor passes through a non-return valve and a gate valve into a common duct routed across the fuselage at frame 21. Three tappings are taken from the duct; the first directs air through constant-flow valves, a three-way cock and temperature control valves to the camera diffusers, the second directs air to the mixing valve hot inlet and the third directs air through the primary cooler and thence to the mixing valve cold inlet. A supply is taken from a T-union in the duct between the primary cooler and the mixing valve to feed the ventilated suit system *(Chap. 8C)*. The mixing valve *(para. 12)* provides variable restriction to the hot inlet/outlet air and cold inlet/outlet air. From the mixing valve cold outlet the air, partially cooled by the primary cooler, passes to the cold air unit compressor and secondary cooler. A relief valve in the secondary cooler input prevents excessive pressure build-up. From the mixing valve hot outlet the air passes through a constant-flow valve and joins the now very cold air output from the secondary cooler. Mixing occurs according to the rate of flow in each branch set by the mixing valve and air at the required temperature passes through a water extractor and a non-return valve into the pressure cabin.

5. The CABIN AIR heat control switch can be operated to vary the temperature of the air supply. The switch has a centre, spring loaded, OFF position and when in use must be held to the HOT or COLD position, until the desired temperature is obtained, and then returned to OFF. The setting of the mixing valve is registered on the CABIN AIR indicator, mounted below the heat control switches on the miscellaneous instrument panel.

**Note . . .**

*1. No air will be supplied to the cabin unless one or both gate valve switches, marked ENGINE AIR TO CABIN are set to ON.*

*2. In the event of a fault developing in the supply from an engine, or if an engine fails or is shut off, the gate valve switch for that engine must be set to OFF.*

6. Within the cabin the common delivery duct passes along the port side to the position forward of frame 3 where branch pipes supply four punkah louvres and four diffusers, two of which are fish tail. Details of the locations of the louvres and diffusers are given in para.23 and 24. Branch pipes also supply two diffusers; one on the forward face of the canopy, and a fish tail in the nose fairing, both forming part of the de-misting system *(Chap.8B)*.

**Camera heating**

*Supply*

7. From the common duct *(para.4)* hot air for the camera bays is ducted forward, through a constant-flow valve to the forward camera bay and aft also through a constant-flow valve, to the centre and rear camera bays.

*Forward camera bay (fig.4)*

8. After passing through the constant-flow valve the hot air is fed to a three-way cock in the forward camera bay. The cock, which is pre-set during camera installation, directs the hot air flow to either the F.52 or F.97 Mk.2 camera diffusers. The cock mounting is idented, and care should be taken to ensure that the cock is always selected to the type of camera installed.

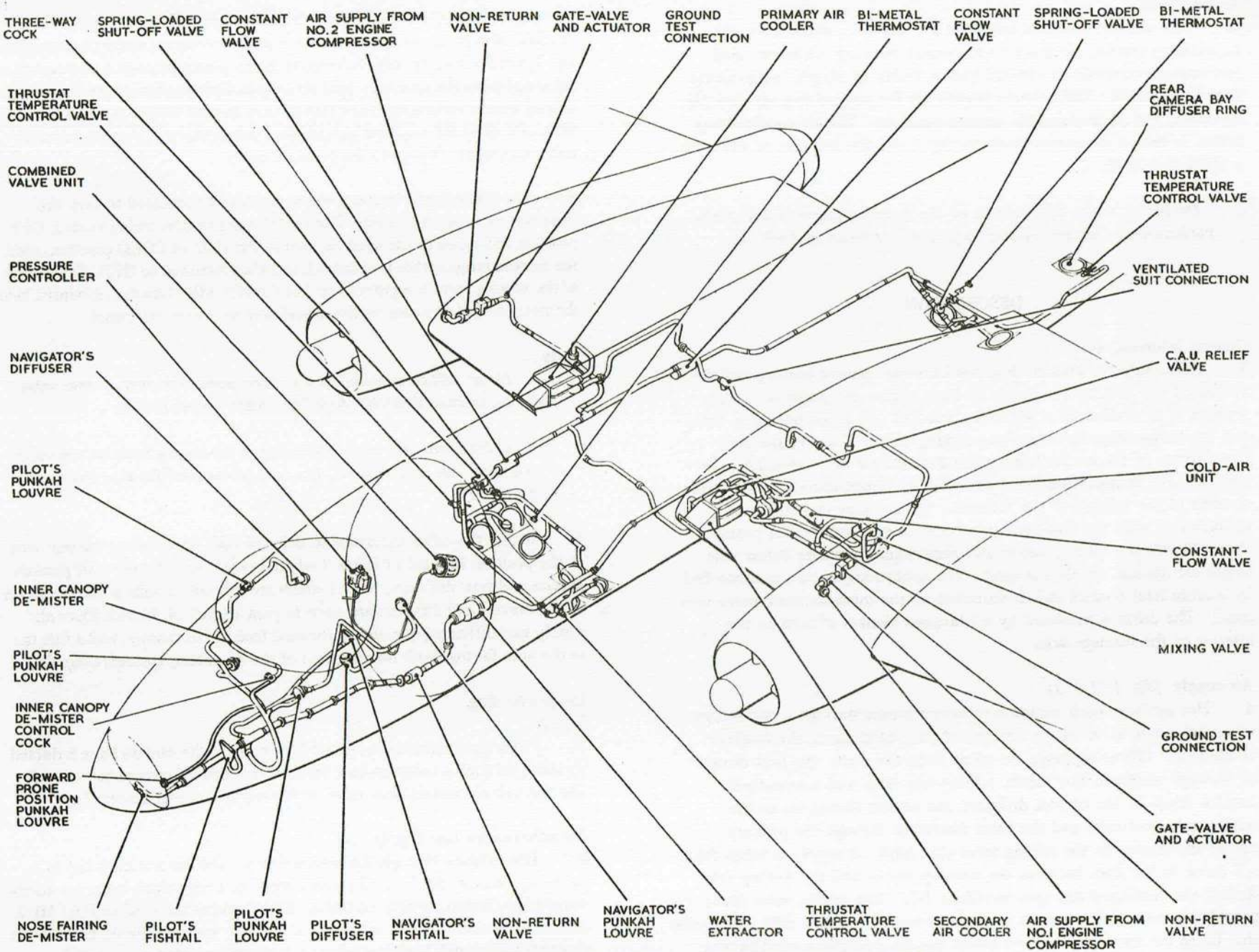



FIG.2. AIR CONDITIONING SYSTEM - LOCATION OF COMPONENTS

◀ MOD 5182 EMBODIED ▶

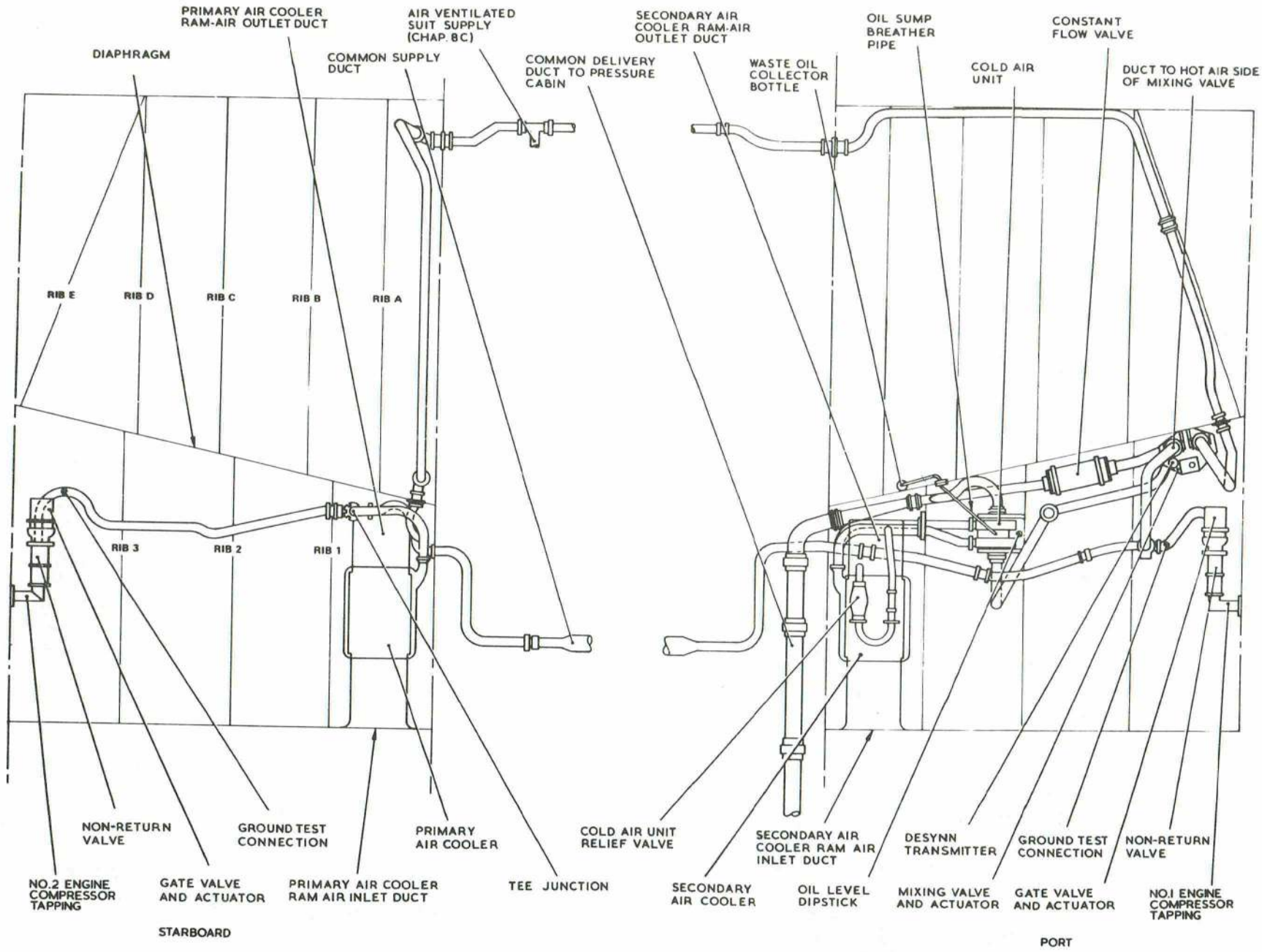



FIG. 3. AIR CONDITIONING SYSTEM-INNER WING LEADING EDGES

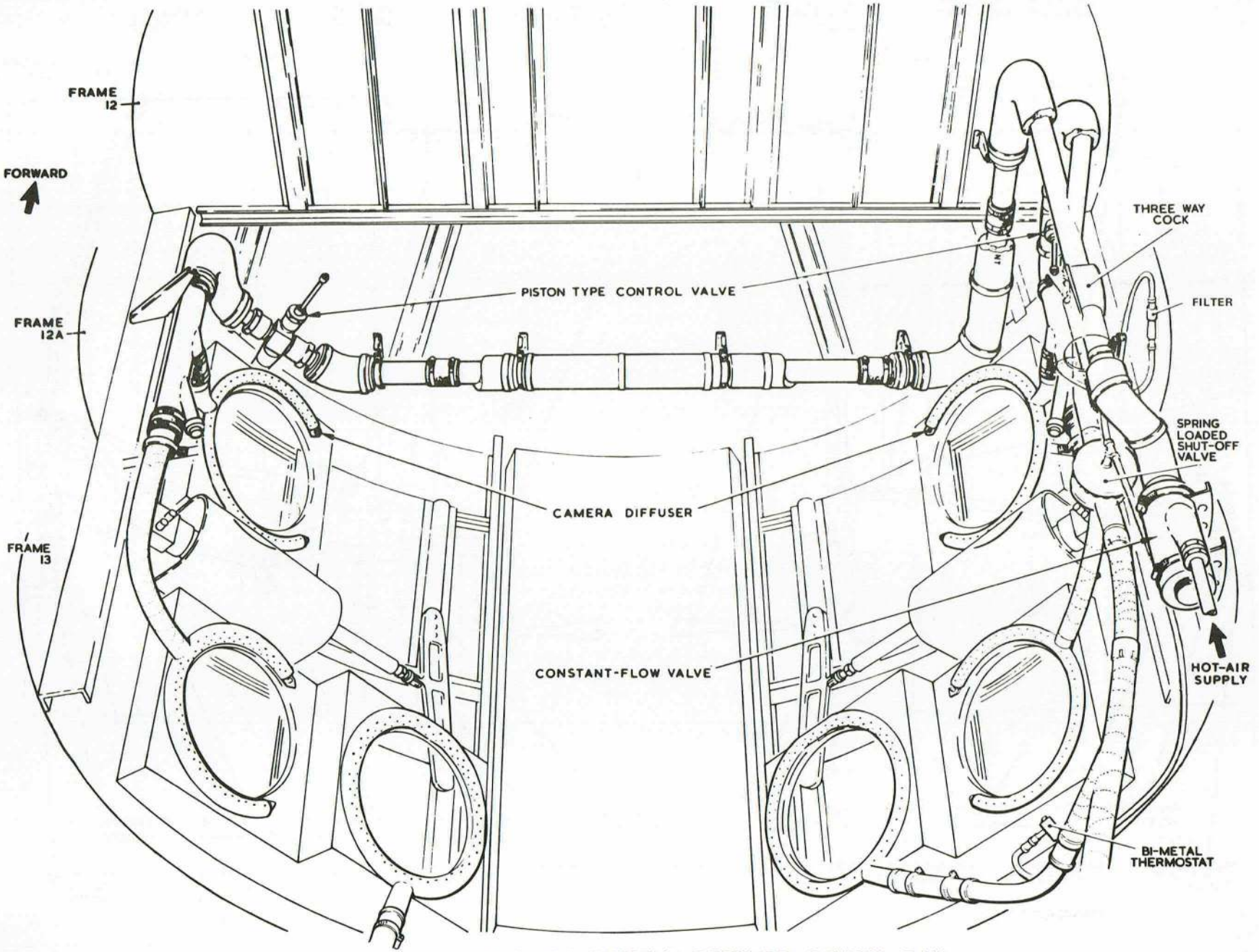



FIG. 4. AIR CONDITIONING SYSTEM - FORWARD CAMERA BAY

**9.** Two methods of temperature control are employed in the forward camera bay. When F.52 cameras are installed the temperature is governed by piston type temperature control valves *(fig.8)*, installed one on each side of the bay, to serve the port and starboard camera installations individually. Should the temperature on either side of the bay rise above a predetermined limit, the thrustat part of the valve expands causing a piston in the valve body to shut off the supply of hot air to the camera diffusers. The contraction of the thrustat, due to a drop in temperature, allows a spring to move the piston in the other direction so that hot air can again flow through the valve to the diffusers. The other method of temperature control, which serves the F.97 Mk.2 cameras, comprises a bi-metal thermostat and a spring loaded shut-off valve *(fig.8)*. When the temperature in the camera bay is above 8 deg C ± 2 deg C, the bi-metal thermostat seals off the shut-off valve's by-pass pipeline. This results in a build-up of pressure on the diaphragm of the shut-off valve which eventually closes the valve shutting off air to the camera diffusers. Should the temperature in the camera bay fall below 8 deg C ± 2 deg C, the bi-metal thermostat will operate and open the by-pass pipeline, resulting in a loss of pressure on the shut-off valve diaphragm. The valve now opens under spring action, and permits hot air to pass to the camera diffusers.

*Centre and rear camera bays (fig.5)*

**10.** Hot air to the centre and rear camera bays is conveyed through a duct along the starboard side of the flare bay and crosses the fuselage on the aft face of the bulkhead at frame 29, where a branch pipe serves the centre camera bay, while the main duct continues along the port side of the rear fuselage to a single diffuser ring at the rear camera bay. The branch pipe to the centre bay terminates at two diffuser rings, and the bay temperature is governed by a bi-metal thermostat, mounted on the underside of the camera mounting, and a spring-loaded shut-off valve which work on the same principle and through the same range as the temperature control system described in para.9. The temperature in the rear bay is controlled by a single piston type temperature control valve situated adjacent to the F.49 camera mounting.

**Constant-flow valves**

**11.** Three constant-flow valves, each incorporating a removable filter, provide the required constant flow of air from the engine compressors to the cabin and camera bays, for a pre-determined altitude and temperature irrespective of engine speed. Air is ducted through the valve filter into the support tube where it passes between the flow controller and the orifice body, leaving the valve at the outlet port to flow along the ducting.

**Mixing valve** *(fig. 6)*

**12.** The mixing valve, installed in the leading edge of the port main plane, consists of a light-alloy body housing two carbon slide valves, each with an inlet port and an outlet port. The valves are operated simultaneously by two crankshafts geared together, and are so arranged that when one valve is open, the other is fully closed, both valves being half open at the mid position of the unit. The movement of each slide valve from open to closed is effected by 180 deg rotation of its crankshaft. Hot air is led to one inlet port and cooled air to the other, the two air streams being entirely separate within the valve. Temperature control is effected by varying the amount each valve is open and thus the amount of cool air supplied to the secondary cooler and/or hot air supplied to the cabin. The valve is operated by an electrical actuator controlled by the CABIN AIR switch on the miscellaneous instrument panel. The switch is centre loaded OFF and must be held to HOT or COLD until the mixing valve is in the desired position. The position of the valve is displayed to the pilot by a CABIN AIR indicator mounted adjacent to the valve control switch. The indicator is operated by a Desynn transmitter connected to the valve.

**Air coolers**

**13.** The primary and secondary air coolers are in the starboard and port main planes respectively between the fuselage and rib 1. Ram air enters through the intakes in the leading edge skinning, cools the air passing through the units, and exhausts to atmosphere beneath the main planes.

**Cold-air unit**

**14.** The cold-air unit, installed in the leading edge of the port main plane, consists of a turbine driving a centrifugal compressor, being mounted on a common shaft and operating in separate chambers. The motive power for the unit is supplied by air from the engine compressors. The unit is operational over all temperature selections, except fully HOT when no air flows to the cold air unit.

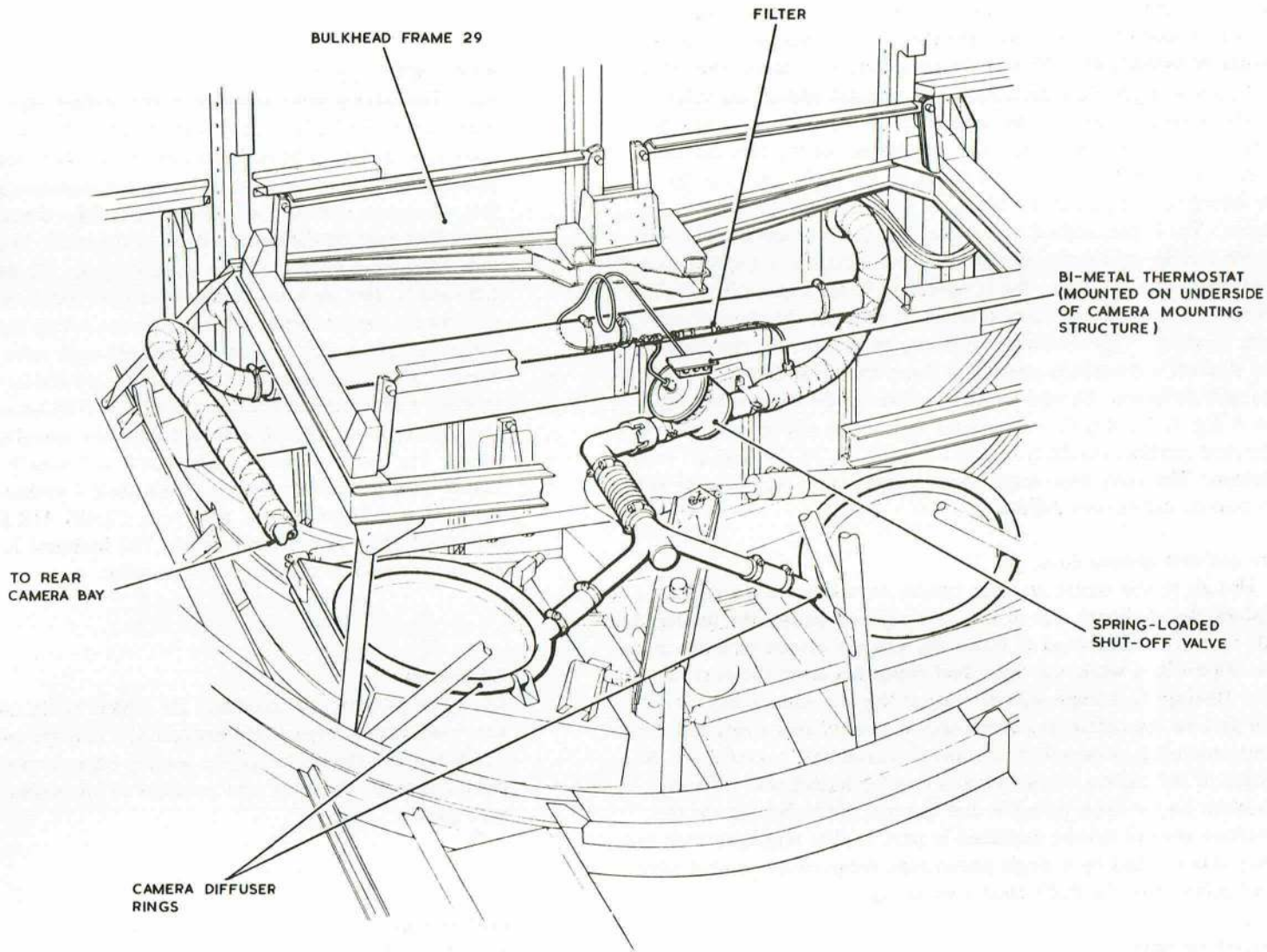



FIG.5. AIR CONDITIONING SYSTEM – CENTRE CAMERA BAY

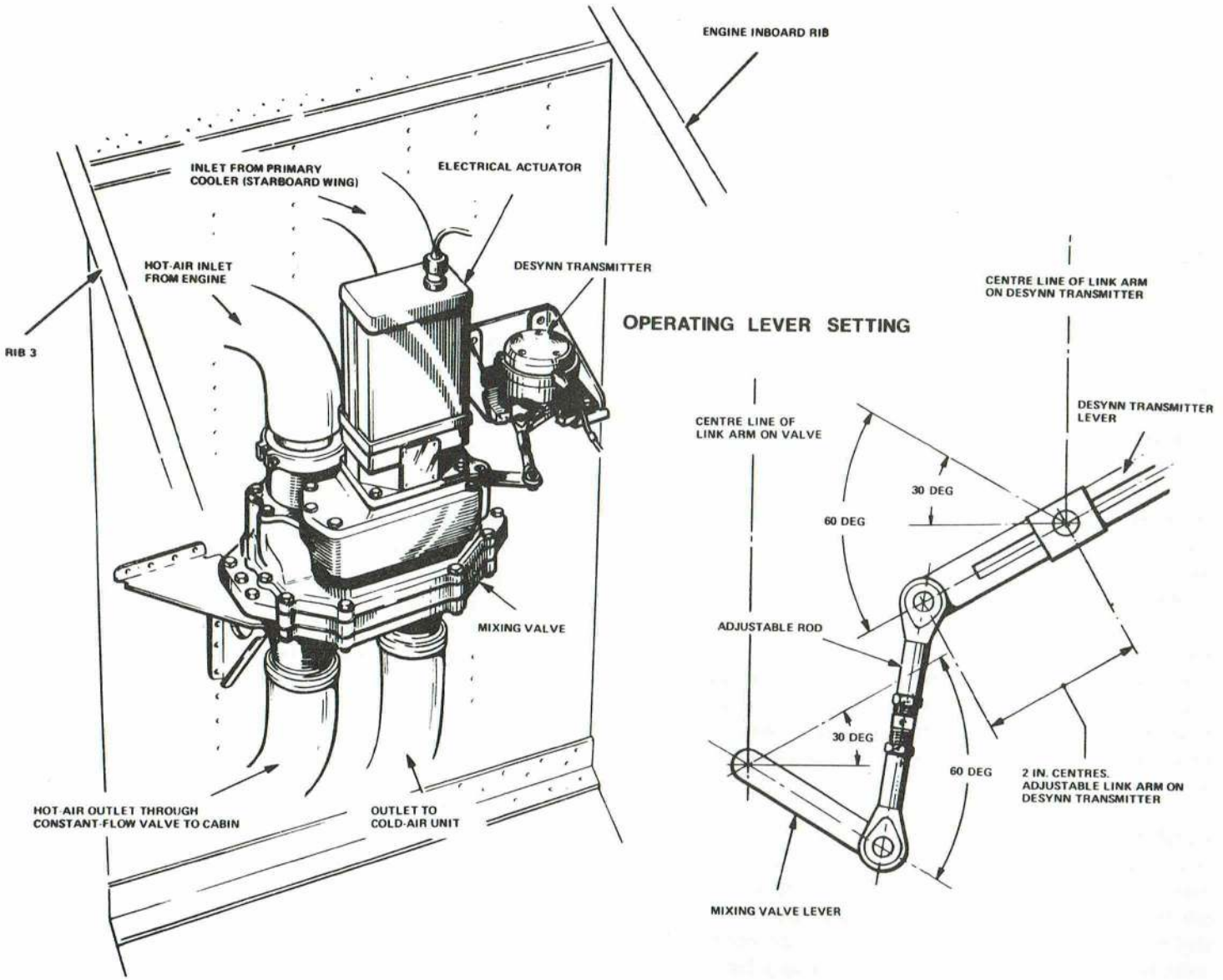



FIG.6. MIXING VALVE

**Pressure controller**

15. The pressure controller is mounted on the forward face of the pressure bulkhead and maintains, in conjunction with the combined valve unit, a cabin pressure greater than atmospheric pressure at altitudes above 10,000 ft, the difference between these two pressures being termed the differential pressure. The unit is designed to initiate cabin pressurization at approximately 10,000 ft, and to build up and maintain a maximum differential pressure of 3.5 lb/in$^2$ at 25,000 ft, and above. Below 10,000 ft, cabin pressure and atmospheric pressure are approximately the same. The unit regulates the pressure in the cabin by adjusting the opening of the discharge valve in the combined valve unit, thus regulating the discharge of air from the cabin.
A warning horn is operated by the controller in the event of a serious drop in pressure.

**Combined-valve unit**

16. The combined-valve unit, mounted on the rear face of the pressure bulkhead, regulates the cabin pressure by controlling the rate at which air is allowed to escape from the cabin. Two safety valves are incorporated in the unit to release excess pressure should the cabin pressure rise to more than 4.2 lb/in$^2$ above atmospheric pressure.
An inwards relief valve limits to a safe value the amount of negative differential pressure which may occur in certain circumstances, such as a rapid aircraft descent following engine failure.

**Relief valve**

17. A relief valve is incorporated between the compressor stage of the cold-air unit and the secondary cooler input. The valve is mounted on top of the secondary cooler and operates to prevent pressure build up in the cold-air unit, discharging excess pressure to atmosphere via the secondary cooler outlet duct.

**Non-return valves**

18. A spring loaded non-return valve is incorporated in the system aft of the pressure bulkhead to prevent any back flow of air through the supply duct in the event of the compressors failing. A non-return valve is also fitted in each inner wing leading edge between the engine and the gate valve to prevent back flow in the event of engine failure.

**Water extractor**

19. A water extractor is installed in the supply duct, aft of the pressure bulkhead, to prevent condensation in the cabin. A drain from the extractor has an outlet in the port side of the fuselage.

**Pressure warning system**

20. A warning horn, operated by the pressure controller and mounted on the starboard side of the cabin aft of the entrance door, gives audible warning if the cabin pressure should fall to a dangerous level. A CABIN PRESS WRNG HORN, ON/OFF/TEST switch, spring-loaded from TEST to OFF is mounted on the miscellaneous instrument panel and permits testing or isolation of the horn.

**Cabin sealing** *(fig. 9 and 10).*

21. The entrance door, pilot's canopy, navigator's escape hatch, and the joint between the nose fairing and the fuselage are sealed by rubber sealing strips and bushes. All electrical connections, controls, etc. passing through the pressure bulkhead are also sealed. The sealing of joints in the cabin structure is made with Peratol and Bostik sealing compounds.

**Pilot's cold air supply** *(fig. 7)*

22. A supply of cold air to the pilot is provided by an air scoop on the front fuselage, immediately forward of the canopy, connected to a punkah louvre at the side of the instrument flying panel, which may be closed or adjusted. A non-return valve is fitted in the pipe to prevent loss of cabin pressurization. A drain trap is located in the fuselage, port side forward of frame 2.

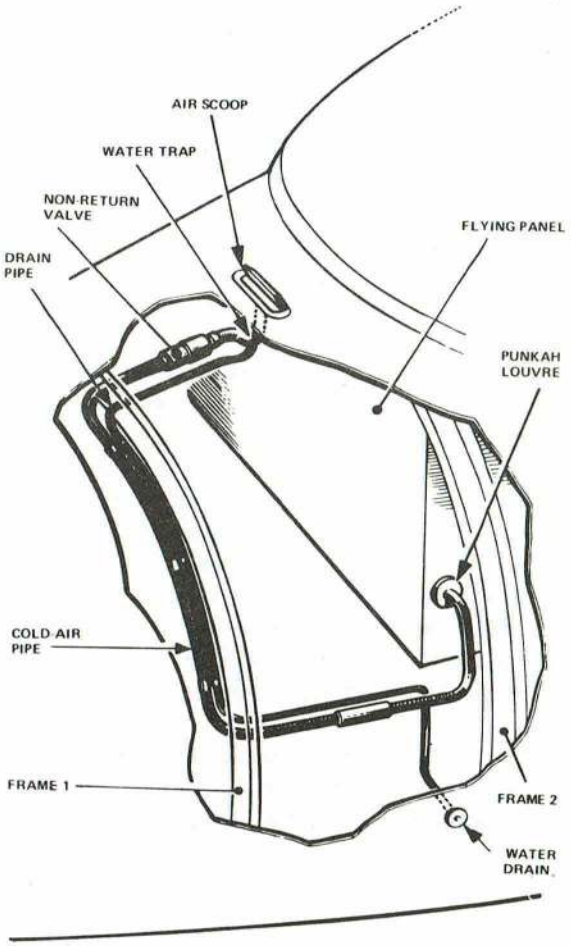



**FIG.7. PILOT'S COLD AIR SUPPLY**

**Punkah louvres**

**23.** Six punkah louvres are provided, four at the pilot's station, one at the navigator's station and one, located in the forward prone position. Location of the four at the pilot's station are – one on the rudder pedal guard, one on the coaming tube above the entrance door, one on the port front panel, all of these fed from the air conditioning supply *(para.4)*, the other louvre, at the port side of the instrument panel is fed from the cold air supply *(para.22)*. At the navigator's station the louvre is fitted on the port wall, the forward prone position louvre located at the port side of Fr. B above the anglepoise dimmer switch, both of these louvres being fed from the air conditioning system. All louvres are manually controllable.

**Note . . .**

*The louvre on the coaming tube above the entrance door must have its attachment bolts fitted with their heads outboard to prevent fouling the canopy detonator cable at frame 4.*

**Diffusers**

**24.** The pilot's and the navigator's stations are each provided with a fish-tail shaped diffuser, located forward of the respective crew member's feet, and a diffuser is fitted to the coaming tube to port of the pilot and also to the inboard edge of the navigator's instrument panel. These latter diffusers may be controlled to deliver either a jet or a diffused flow of air into the cabin by rotation of the diffuser top, they cannot be shut off.

## SERVICING

WARNING

The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.

Note...

1. With the exception of SILASTIC hose joints, the standard procedure for remaking hose joints must be adopted (A.P.101A-0300-1A). To remake the SILASTIC hose joints, proceed as follows:-

   (a) Renew the SILASTIC hose.

   (b) Ensure that the gap between the ends of the pipes to be connected is between 0.10 in. and 0.50 in.

   (c) Fit the hose clips using clamping rings (Pt.No.EEAS.66/14) beneath each clip.

   (d) Fully tighten the hose clips and ensure that the gap between the ends of the clamping ring beneath each clip is between 0.50 in. and 0.07 in.

2. Whenever box type lagging is removed from the air conditioning pipes, care must be taken on reassembly, to ensure that the clips securing the lagging are not overtightened to the extent of crushing the lagging. It is considered satisfactory that the clips are tightened to the stage where they can just be moved by hand.

◄ 3. To avoid distress or discomfort to the crew from objectionable odours generated in the system and transmitted to the cabin, the following precautions are to be taken:-

   (a) When pipes or ducts are disconnected they are to be blanked off to exclude foreign matter.

   (b) Replacement non-metallic pipes must bear a red rectangle. Whenever a new pipe is to be fitted, it is first to be blown through with hot air from a non-toxic heater for a minimum period of 30 minutes at a temperature of 85 deg C. During this time the pipe is to be checked for odours and rigidity; any pipe which softens or continues to generate odours after this period is to be rejected and reported defective.

   (c) New components and metallic pipes fitted to the system must be thoroughly degreased if they carry cabin air through ducts or apertures or can contaminate the system in any way.

   (d) When any part of the system has been disturbed, a check, with engines running is to be made to ensure that the system is functioning satisfactorily, does not leak, and with full cabin heat selected does not give off odours. ►

Test points

25. A test point, positioned in the main supply pipe from the engine, is located in each inner mainplane leading edge (fig.3); either test point may be used for pressure testing the pipelines of the system. A third test point, and a pressure

gauge connection, fitted on the rear face of the pressure bulkhead and accessible from the nose undercarriage well, are used when pressure testing the cabin.

Pressure test of piping

26. Pressure test the system piping as follows:-

(1) Disconnect the pipes from the mixing valve to the cold-air unit, and the mixing valve to the constant-flow valves in the forward camera bay and No.6 tank bay. Disconnect and blank off the ventilated suit supply pipe at the three-way connection situated at frame 21 (Chap.8A).

(2) Disconnect the delivery pipes from each engine, and blank off the engine apertures.

(3) Securely blank off the disconnected pipelines.

(4) Connect a test rig incorporating a 0-100 lb/in$^2$ pressure gauge to either port or starboard delivery pipe, and open the engine gate valves. Blank off delivery pipe not in use.

(5) Set the mixing valve to cold.

(6) Switch on the test rig, and raise the pressure to 80 lb/in$^3$.

(7) Switch off the test rig, and check that the time taken for the pressure drop to 30 lb/in$^2$ is not less than 10 min.

(8) Using an approved soap and water solution, check all joints and pipelines for leaks.

(9) Release the pressure, and remove all traces of soap solution.

(10) Disconnect the test rig, and reconnect both delivery pipes to the engine.

(11) Remove the blanks, and reconnect the pipes disconnected in operation (1).

(12) Close the engine gate valves.

(13) Return the mixing valve to HOT.

**Functional test with test rig**

27. Carry out the functional test as follows:-

(1) Ensure that the cold-air unit is filled with oil, OEP.71 up to the MAX mark on the dipstick.

(2) Disconnect the supply pipe at the engine inboard rib in the starboard inner wing leading edge and connect a test rig incorporating a 0-100 lb/in$^2$ pressure gauge.

(3) Connect an electrical supply to the external supply socket *(Sect.2, Chap.2)*.

(4) Select fully HOT at the CABIN AIR control switch, and move the No. 2 engine gate valve switch to ON. Both these switches are situated on the miscellaneous instrument panel.

(5) Operate the test rig to give a pressure of 80 lb/in$^2$ to the system. Ensure that all louvres supplied from the air conditioning system are open and that air is flowing from these louvres, the air-conditioning diffusers and the nose de-misting diffuser.

(6) Disconnect the mixing valve to cold-air unit pipe, and check that there is no air escaping.

(7) Reconnect the pipe, disconnected in (6).

(8) Switch off and remove the test rig, reconnect the pipe to the engine delivery pipe, and connect the test rig to the delivery pipe at the No. 1 engine inboard rib.

(9) Select fully COLD at the CABIN AIR control switch, and switch the No. 1 engine gate valve switch ON.

(10) Switch on the test rig and carry out the flow test op. (5).

(11) Visually check that the cold-air unit is running by disconnecting the pipe from the cold-air unit to the water extractor. Reconnect the pipe.

(12) Remove the test rig, and reconnect the delivery pipe at the No. 1 engine inboard rib.

(13) Select fully HOT at the CABIN AIR control switch, and move both engine gate valve switches to OFF.

(14) Disconnect the external electrical supply.

**Preparation for cabin pressure tests**

28. Prepare the aircraft for ground cabin pressure tests as follows:-

(1) Test the operating of the warning horn by selecting TEST on the pressure controller ON/OFF/TEST switch *(para.20)*.

(2) Ensure that the canopy, observation panel, and navigator's window air driers are fitted and that vent plugs are removed. Close each ventilated suit control valve.

(3) Remove the blanking cap from the pressure gauge connection on the rear face of the pressure bulkhead, accessible from the nose undercarriage well, and fit a 0 to 10 lb/in$^2$ pressure gauge to the connection.

**Cabin pressure tests**

**WARNING**

**1. Only personnel certified by the station or unit medical officer as fit for servicing duties inside pressure cabins, are permitted inside the pressurized portion of an aircraft during tests at ground level. Personnel with colds must have further medical approval.**

**2. Pressure must not exceed 3.5 lb/in$^2$ with personnel inside the cabin.**

**3. At no time is the cabin pressure to exceed 4.7 lb/in$^2$.**

**4. On completion of a pressure test, the cabin entrance door must not be opened until the pressure gauge reads zero and two minutes have elapsed to allow any residual pressure to escape.**

**Note . . .**

*During pressure tests, each control passing through the pressure bulkhead must be operated very slowly, at least three times, over its entire range.*

*With test trolley*

29. The pressure cabin must be tested in the following manner, using a Mk.1C pressure cabin testing trolley *(Sect.2, Chap.4, Table 2)*, instructions for the operation of which are given in A.P.119F-1508-126A.

This test must always be carried out whenever hatches, windows, or other items affecting the sealing of the pressure cabin have been removed and refitted or replaced.

(1) Ensure that the aircraft has been prepared in accordance with para.28.

◄ (2) Remove all static vent plugs, fit static vent blanks (6C/1059239) to cabin pressure system. ►

(3) Ensure that the air supply adapter is fitted to the delivery hose of the ground testing trolley. Connect the hose to the ground test connection situated on the rear face of the pressure bulkhead; access is through the nose undercarriage well.

(4) With the entrance door and the direct vision window closed, pressurize the cabin and record the pressure at which the safety valve 'cracks' open. This pressure is to be $4.4 \pm^{0}_{0.25}$ lb/in$^2$, with an airflow of 5 lb/mm.

(5) Check the cabin structure for any signs of permanent distortion, use a soap and water solution to check for leaks.

(6) Stop the trolley, check with a stop watch the time taken for the pressure to fall to 1.75 lb/in$^2$. This must not be less than 35 sec.

**Note . . .**

*If the time taken is less than the above figure, then check for leaks (5), rectify and repeat the pressure test.*

◄ (7) Remove the pressure gauge and replace blanking cap.

(8) Remove static vent blanks (6C/1059239), refit all static vent plugs.

(9) Test the operation of the warning horn *(para.28 (1))*. ►

*With engines*

**WARNING**

**When the aircraft is stationary there is no cooling air flow through the primary and secondary coolers. Prolonged ground running with cold selected is therefore to be avoided, and, with the engines running (maximum speed 5000 rev/min), the cold-air unit must not be operated for longer than ten minutes during any one period. It is permissible, however, to use the cold-air unit whilst taxying.**

**30.** Test the pressure cabin as follows:-

(1) Ensure that the aircraft has been prepared in accordance with para.28.

(2) Top up oil level in cold-air unit to the MAX mark on the dipstick; oil level is critical, do not overfill.

(3) Disconnect the pipe, which connects the combined-valve unit to the pressure controller, at the combined-valve unit, and blank off the pipe only using special plug *(Sect.2, Chap.4, Table 1)*.

(4) Before starting the engines, operate the cabin heat control switch to secure full travel of the mixing valve and note the time taken for this operation; the time of operation in each direction should be approximately 3 sec. Switch the mixing valve to the cold position.

(5) Start the engines, and with the No. 1 engine running at 5500 rev/min and the No. 2 engine idling, check that air enters the cabin. Operate the CABIN AIR control switch and check the time taken for the mixing valve to move from one extreme of travel to the other. The maximum time for this operation in each direction is 5 sec.

(6) With the No. 2 engine running at 5500 rev/min and the No. 1 engine idling, repeat operation (5).

(7) Close all doors and hatches, and with both engines running at 5500/6000 rev/min carry out the following test:-

(a) With temperature at fully HOT check the time of pressure rise to 3.5 lb/in$^2$; this is to be within 60 sec.

(b) With temperature at fully COLD check the time of pressure rise to 3.5 lb/in$^2$; this is to be within 60 sec.

(c) At the change of the selector from HOT to COLD, check that there is a change of air temperature entering the cabin. Check that air is entering at all louvres, diffusers and fish tails.

(d) With the No. 1 engine idling and No. 2 engine running at 5500 rev/min, check that the cabin pressure can be maintained for at least 3 min. Repeat test with No. 2 engine idling and No. 1 engine running at 5500 rev/min.

(e) Switch off the engine gate valves, and with both engines idling check the time of pressure drop from 3.5 lb/in$^2$ to 1.75 lb/in$^2$; this must not be less than 35 sec.

(f) Check that air ceases to enter the cabin when the engine gate valves are switched off.

(8) Ensure all pressure inside the cabin has been released, and remove the blanking plug from the pressure-controller pipe and reconnect the pipe to the combined-valve unit and wire lock.

(9) Close all doors and hatches, select fully HOT, and with both engines running at 5500 rev/min, check that the cabin pressure does not exceed 1.0 lb/in$^2$.

**Note . . .**

*The hot and cold pressurizing are to be regarded as two independent systems. Times and pressures are to be recorded under both headings.*

(10) Remove the pressure gauge from the rear face of the pressure bulkhead, and refit blanking cap to the bulkhead connection.

*Test after major repair*

**31.** The following tests must be completed whenever replacements of, or repairs to, components affecting the pressure sealing of the cabin have been made. A Mk.1C pressure cabin testing trolley fitted with an air supply adapter *(Sect.2, Chap.4, Table 2)* is required.

(1) Ensure that the aircraft has been prepared in accordance with para.28.

(2) Disconnect the pipe which connects the pressure controller to the combined-valve unit, at the combined-valve unit, and blank off the pipe only, using special plug *(Sect.2, Chap.4, Table 1)*.

(3) Connect the delivery hose, fitted with air supply adapter, to the cabin pressure test connection on the rear face of the pressure bulkhead in the nose undercarriage well.

(4) Close the cabin door and D.V. window, and start the testing trolley.

(5) Pressurize the cabin with an airflow of 5 lb/min to a maximum pressure of 4.4 $^{+0}_{-0.25}$ lb/in$^2$ at which pressure the combined-valve unit safety valves should open. Turn off the air supply to the cabin, check for air leaks and allow the pressure to drop to 3 lb/in$^2$.

(6) Examine the cabin structure for signs of permanent distortion.

(7) Using the test rig pressurize the cabin to 3.5 lb/in$^2$ and using a stop watch, note the time taken for the pressure to fall to 1.75 lb/in$^2$. This must not be less than 35 sec.

(8) Remove the delivery hose from the ground test connection and refit the blanking cap.

(9) Remove the blanking plug from the pressure-controller pipe, and reconnect the pipe to the combined valve unit and wire lock.

(10) Remove the pressure gauge and replace the blanking cap.

(11) Refit static vent plugs.

**Sealing** *(fig. 9 and 10).*

*Structural*

**32.** Two alternative types of sealant, Bostik and Peratol, were used for sealing the pressure cabin during manufacture, but on repair, Bostik only should be used. Full particulars of Bostik sealing compound for repairing damaged sealing are given in A.P.1464B, Vol. 1, Part 2, Sect.4, Chap.7, and details of the method of application are given in A.P.101B-0400-6, Part 1, Chap.2.

*Emergency release cables*

**33.** The barrel on the pressure bulkhead through which the alighting gear and flare doors emergency release cables pass, houses seven felt washers, which are impregnated on assembly with anti-freezing oil. If either emergency control has been operated, remove the circlip on the front of the barrel and fully impregnate the sealing washers with oil, OX-14. Replace the circlip after repacking with oil.

**Constant-flow valves**

**34.** These valves are set by the manufacturers and the only servicing permitted is the removal of the filter for cleaning. This is accessible when the knurled end cap has been unscrewed and the end plate, together with the asbestos washer, removed.

**Pressure controller and combined-valve unit**

**35.** Servicing instructions for the pressure controller and the combined valve unit are given in the relevant A.P. listed in Table 1.

WARNING

Particular care must be taken to ensure that the gauze inlet filter of the combined valve unit is kept clean. Failure to do so may result in serious damage to the pressure cabin and the mechanism of the combined-valve unit.

Cold-air unit

36. Servicing instructions for the cold-air unit are given in the relevant A.P. listed in Table 1.

Mixing valve

37. Servicing instructions for the mixing valve are given in the relevant A.P. listed in Table 1.

Temperature control valves

38. Instructions for adjusting and testing the piston type control valves are given in fig.8. The spring-loaded shut-off valves and associated bi-metal thermostats can be checked as follows:-

(1) The bi-metal thermostats are adjusted to seal off the shut-off valves by-pass pipeline when the ambient air temperature is above 8 deg C ± 2 deg C. This is a manufacturer's setting and should not need subsequent adjustment. If a check is necessary, the thermostat should be removed and cold tested in an instrument bay.

(2) The operation of the spring-loaded shut-off valves can be checked in situ. To do this:-

(a) Disconnect the shut-off valve by-pass pipeline from the bi-metal thermostat.

(b) Apply an air pressure of 5 lb/in$^2$ to the inlet side of the shut-off valve and check that air is expelled from the camera diffuser rings on the outlet side of the valve.

(c) Place a finger over the open end of the valve by-pass pipeline; the valve should close and, consequently, seal off the air supply to the camera diffuser rings.

REMOVAL AND ASSEMBLY

Notes...

1. With the exception of SILASTIC hose joints, the standard procedure for remaking hose joints must be adopted (A.P.101A-0300-1A). To remake the SILASTIC hose joints, proceed as follows:-

(a) Renew the SILASTIC hose.

(b) Ensure that the gap between the ends of the pipes to be connected is between 0.10 in. and 0.50 in.

(c) Fit the hose clips using clamping rings (Pt.No. EEAS.66/14) beneath each clip.

(d) Fully tighten the hose clips and ensure that the gap between the ends of the clamping ring beneath each clip is between 0.50 in. and 0.70 in.

2. Whenever box-type lagging is removed from the air conditioning pipes, care must be taken, on reassembly, to ensure that the clips securing the lagging are not overtightened to the extent of crushing the lagging. It is considered satisfactory that the clips are tightened to the stage where they can just be moved by hand.

◄ 3. To avoid distress or discomfort to the crew from objectionable odours generated in ►

◄ the system and transmitted to the cabin, the following precautions are to be taken:-

(a) When pipes or ducts are disconnected they are to be blanked off to exclude foreign matter.

(b) Replacement non-metallic pipes must bear a red rectangle. Whenever a new pipe is to be fitted, it is first to be blown through with hot air from a non-toxic heater for a minimum period of 30 minutes at a temperature of 85 deg C. During this time the pipe is to be checked for odours and rigidity, any pipe which softens or continues to generate odours after this period is to be rejected and reported defective.

(c) New components and metallic pipes fitted to the system must be thoroughly degreased if they carry cabin air through ducts or apertures or can contaminate the system in any way.

(d) When any part of the system has been disturbed, a check, with engines running is to be made to ensure that the system is functioning satisfactorily, does not leak, and with full cabin heat selected does not give off odours. ►

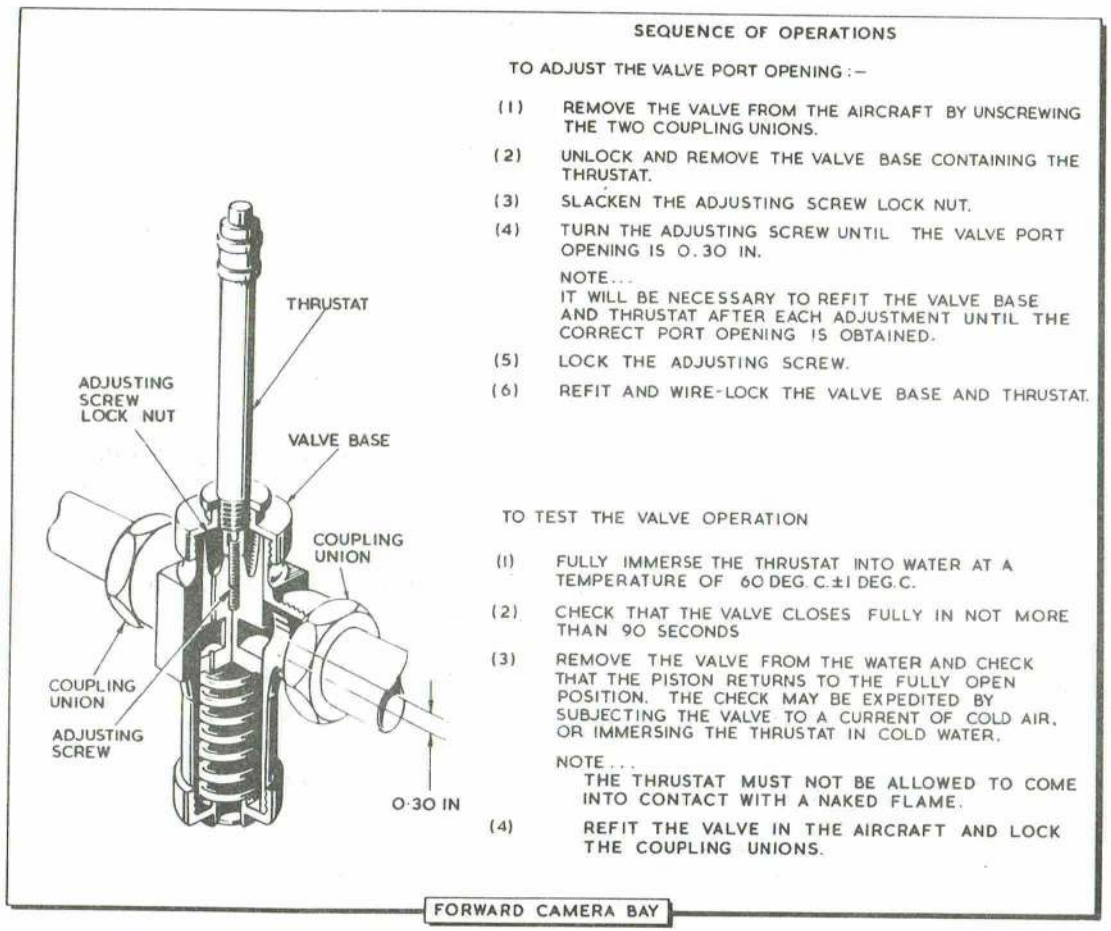
General information

39. The following paragraphs detail the recommended methods of removing certain components from the system. Generally the assembly sequence is the reverse of the removal, but where there are special assembly features they are specifically mentioned.

Note...

1. A pipeline pressure test must be carried out in accordance with para.26 whenever a system component is removed or replaced.

2. To obviate seizure, treat the threads of all metal couplings, upon assembly, with anti-seizure compound ZX-38.



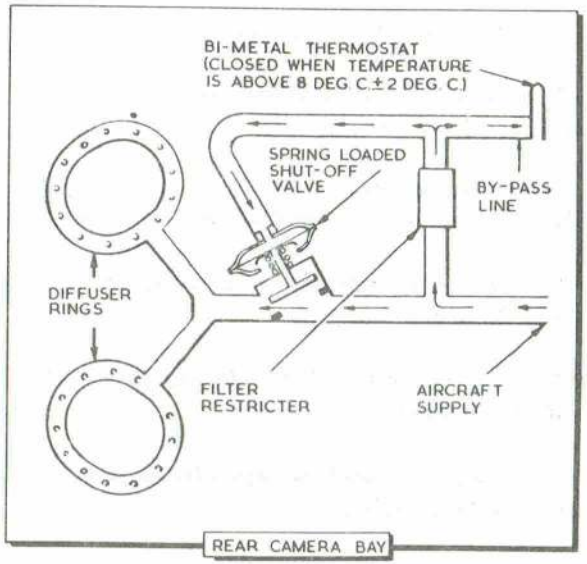




FIG. 8. TEMPERATURE CONTROL VALVES

**Constant-flow valves**

*Port main plane*

**40.** Remove the constant-flow valve as follows:-

(1) Remove the access panels from the upper surface of the port main plane leading edge *(Sect.2, Chap.4)*.

(2) Disconnect the clamping ring on the outlet pipe inboard of rib 2.

(3) Disconnect the supply pipe at the inlet port of the valve.

(4) Release the two hose clips securing the valve to its mounting, and remove the valve.

*Forward camera bay*

**41.** Remove the constant-flow valve as follows:-

(1) Unscrew the inlet-pipe adapter and disconnect the inlet pipe from the valve.

(2) Remove the six 2 B.A. bolts and washers attaching the outlet pipe to the valve.

(3) Release the two hose clips attaching the valve to its mounting, and remove the valve.

*No. 6 tank bay*

**42.** Remove the constant-flow valve as follows:-

(1) Remove No. 6 tank *(Sect.4, Chap.2)*.

(2) Proceed as instructed in para.41 for the valve in the forward camera bay.

**Mixing-valve actuator**

*Removal*

**43.** Remove the mixing-valve actuator as follows:-

(1) Disconnect the electrical supply.

(2) Remove the outboard access panel from the upper surface of the port main plane leading edge *(Sect.2, Chap.4)*.

(3) Remove the Plessey plug from the actuator socket.

(4) Remove the four 2 B.A. nuts from the studs on the mixing valve and remove the actuator.

*Assembly*

**44.** Assemble the actuator to the mixing valve as follows:-

(1) Turn the actuator shaft to the full extent of its travel in an anti-clockwise direction, when viewed looking into the gearbox from the drive end.

(2) Turn the mixing valve drive shaft clockwise, so that the master spline on the drive shaft attains a position relative to the master slot in the actuator drive.

(3) Offer up the actuator to the mixing valve ensuring that the master spline engages with the master slot in the actuator drive shaft.

**Note . . .**

*It may be necessary to operate the follower lever slightly to achieve actuator engagement.*

(4) Fit and tighten the four 2 B.A. nuts, and plain and spring washers securing the actuator to the mixing valve.

(5) Test the operation of the assembly *(para.30)*.

**Mixing valve** *(fig. 6)*

*Removal*

**45.** Remove the mixing valve as follows:-

(1) Remove the outboard access panel from the upper surface of the port main plane leading edge *(Sect.2, Chap.4)*.

(2) Remove the actuator *(para.43)*.

(3) Remove the split pin, steel pin and washer connecting the link arm to the Desynn transmitter.

(4) Remove the clamping rings at each of the following connections.

(a) Mixing valve to primary cooler.

(b) Mixing valve to engine compressors.

(c) Mixing valve to cold-air unit.

(d) Mixing valve to constant-flow valve.

(5) Remove the six 2 B.A. nuts and bolts attaching the mixing valve to the mounting bracket on the forward face of the undercarriage well diaphragm, and remove the valve.

(6) Securely blank off all pipe ends and valve apertures.

*Assembly*

**46.** Assemble the mixing valve as follows:-

(1) Remove all blanking caps.

(2) Fit the valve to the mounting bracket on the forward face of the undercarriage well diaphragm, and fit and tighten the six 2 B.A. bolts, nuts, plain and spring washers.

(3) Fit and tighten the clamping rings connecting the pipes to the valve at the following ports:-

(a) Mixing valve to primary cooler.

(b) Mixing valve to engine compressors.

(c) Mixing valve to cold-air unit.

(d) Mixing valve to constant-flow valve.

(4) Assemble the actuator *(para.44).*

(5) Set the mixing valve follower lever at its mid position i.e. 30 deg from either end of full travel.

(6) Set the adjustable Desynn transmitter lever at its mid position i.e. 30 deg from either end of full travel.

**Note . . .**

*The lever should initially be set at 2.0 in. from the centre of the shaft to the connecting pin centre.*

(7) Connect the two levers without disturbing the setting, by fitting the adjusting tie-rod. If adjustment is necessary to fit the tie-rod, ensure that both the mixing valve follower lever and the Desynn transmitter operating lever have full 60 deg travel, i.e. 30 deg either side of the mid position after adjustment has been made.

(8) Fit the steel pins, washers and split pins, and lock all adjustment points.

(9) Test the operation of the assembly *(para.30).*

**Air coolers**

*Primary air cooler*

**47.** Remove the primary air cooler as follows:-

(1) Remove the inboard access panel from the upper surface of the starboard main plane leading edge *(Sect.2, Chap.4).*

(2) Disconnect the supply pipes at the inlet and outlet ports of the cooler.

(3) Disconnect and remove the clamping rings at the inlet and outlet ducts of the cooler.

(4) Remove the bolt attaching the cooler to the top support bracket and remove the air cooler, by lifting clear of the two bottom locating brackets.

(5) Blank off pipe ends.

*Secondary air cooler*

**48.** Remove the secondary air cooler as follows:-

(1) Remove the inboard access panel from the upper surface of the port main plane leading edge *(Sect.2, Chap.4).*

(2) Disconnect the relief valve pipe at the junction on the compressor to cooler pipe.

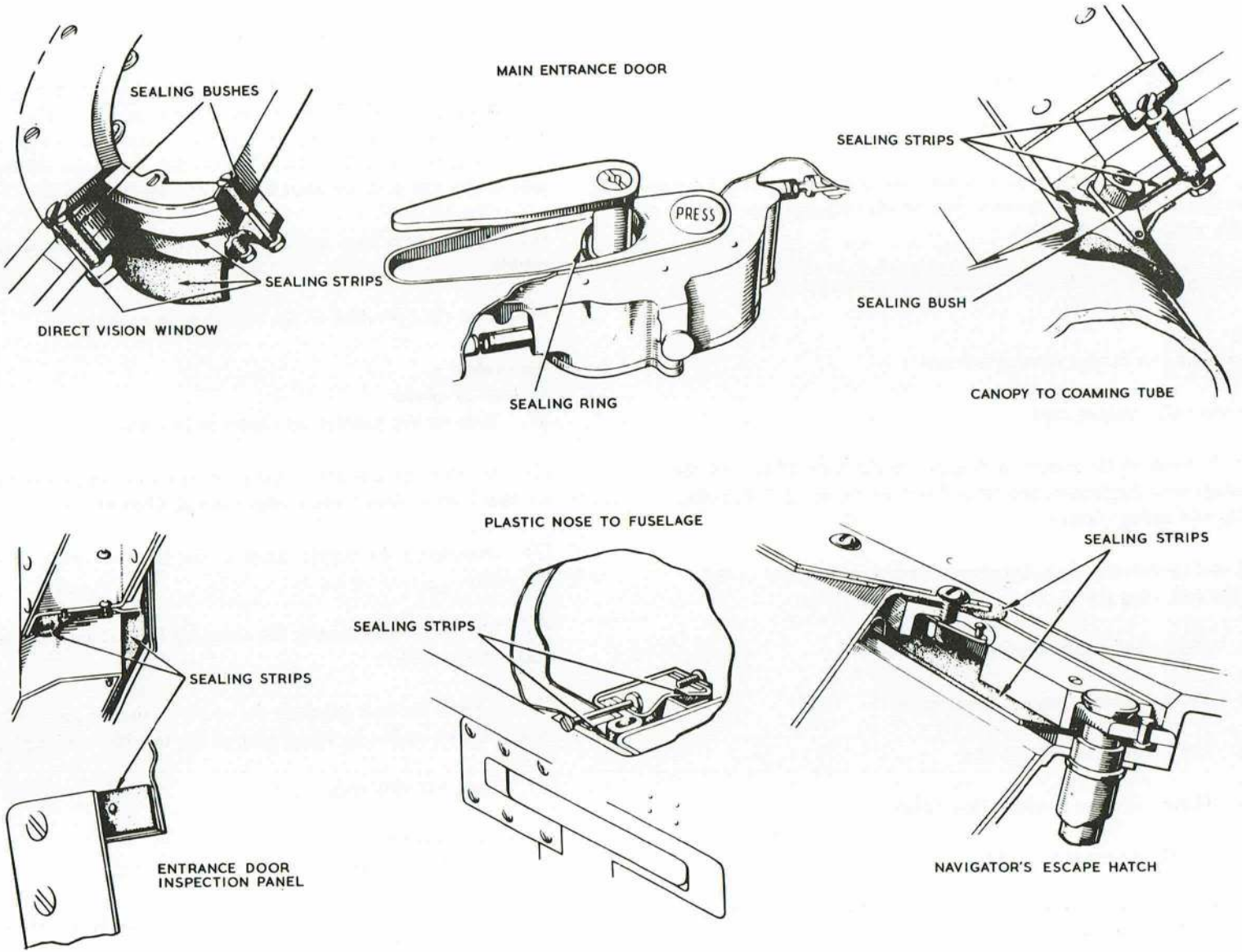



FIG. 9. PRESSURE CABIN SEALING

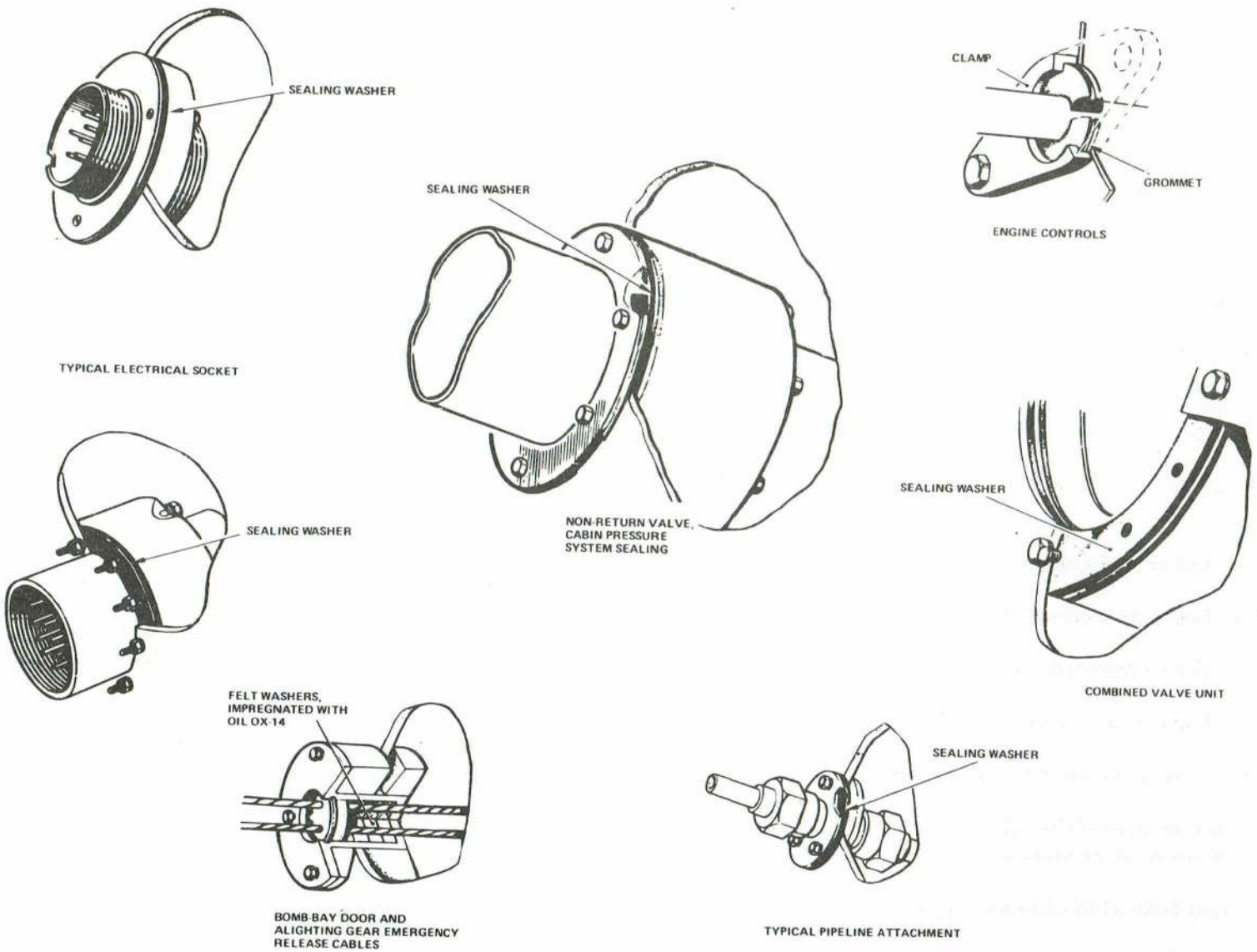



FIG. 10. PRESSURE BULKHEAD SEALING

(3) Disconnect the relief valve to outlet duct clamp.

(4) Disconnect the supply pipes at the inlet and outlet ports of the cooler.

(5) Disconnect and remove the clamping rings at the inlet and outlet ducts of the cooler.

(6) Remove the bolt attaching the cooler to the top support bracket, and remove the cooler by lifting clear of the bottom support bracket.

(7) Blank off pipe ends.

**Cold-air unit**

*Removal*

**49.** Remove the cold-air unit as follows:-

(1) Remove the inboard access panel from upper surface of the port main plane leading edge *(Sect. 2, Chap. 4)*.

(2) Remove the clamping rings at each of the following connections to the unit:

(a) Unit to mixing valve.

(b) Unit to cabin delivery duct.

(c) Unit compressor to secondary cooler.

(d) Unit turbine to secondary cooler.

(3) Disconnect the breather pipe from the unit.

(4) Remove the sixteen bolts, light alloy and double spring washers securing the unit to the mounting brackets and remove the unit.

(5) Securely blank off all pipe ends and unit apertures.

*Oil priming and testing*

**50.** To oil prime the cold-air unit, and test for oil leaks before installation:-

(1) Stand the unit on a bench with the rotor shaft horizontal, and the vent plug uppermost.

(2) Ensure that the dipstick is secure, then remove the breather and its washer from the top of the centre casing. Discard the washer.

(3) Slowly pour approximately 85 cc (3 fl oz) of oil, OEP-71, through the tapped hole in the centre casing from which the breather has been removed. Spin the turbine wheel in the normal direction of rotation.

**Note . . .**

***Ensure that both the oil and oil container used are scrupulously clean.***

(4) Allow the unit to stand for one hour with the rotor shaft horizontal, then examine the oil-level dipstick and filler assembly banjo connection. If oil leakage has occurred, remake the banjo connection and repeat this test.

(5) When no oil leakage occurs, drain the oil from the centre casing.

(6) Refit the breather, using a new joint washer, to the top of the centre casing. Wire-lock the banjo bolt and the breather.

*Assembly*

**51.** Assemble the cold-air unit as follows:-

(1) Remove all blanking caps.

(2) Position the unit in the aircraft and fit and tighten the sixteen bolts, light alloy washers *(Pt.No.SP.16/C)*, and double spring washers *(Pt.No.AGS.586/C)*.

(3) Make the connections between the unit and the following ducts:-

(a) Unit to mixing valve.

(b) Unit to pressure cabin delivery duct.

(c) Unit compressor to secondary cooler.

(d) Unit turbine to secondary cooler.

(4) Ensure that each split clamp is tightened to give an equal gap between each clamp half.

(5) Reconnect the breather pipe to the unit.

(6) Following assembly, remove the filler cap, and fill the unit with oil OEP-71, to the MAX, mark on the dipstick.

(7) Refit the filler cap and access panel.

**Note . . .**

*1. Owing to the speed at which the cold-air unit operates, gyroscopic forces are high, and the alignment of the unit in the aircraft is critical. It is essential that if the unit be removed or replaced, the packings, if any, are replaced exactly as found on the original installation, and the unit is securely fitted.*

*2. When fitting a replacement unit it is essential that new banjo bolts and washers are fitted, or internal leakage of oil may ensue.*

**Pressure controller**

52. Remove the pressure controller as follows:-

(1) Disconnect the pipe to the combined-valve unit at the base of the unit.

(2) Disconnect the static pipe at the base of the unit.

(3) Remove the nuts and washers from the two bolts securing the controller to the pressure bulkhead and remove the controller.

(4) Blank off pipe ends and controller apertures.

**Combined-valve unit**

*Removal*

53. Remove the combined-valve unit as follows:-

(1) Remove the inlet grid of the unit on the forward face of the pressure bulkhead by turning the grid counter-clockwise and lifting it clear of the three special-to-type bolts.

(2) Remove the wirelocking and disconnect the pipe to the pressure controller at the banjo union, and remove the union by unscrewing the bolt.

(3) Remove the three special-to-type bolts, and the eight ¼ in. B.S.F. bolts and washers securing the unit to the rear face of the pressure bulkhead and remove the unit from the upper equipment compartment.

*Assembly*

54. Assemble the combined-valve unit as follows:-

(1) Remove the inlet grid from the valve unit by rotating it counter-clockwise, and lifting it clear of the three special bolts.

(2) Remove the three special-to-type bolts and the banjo connection bolt containing the metering orifice, noting their respective positions.

(3) Offer up the combined-valve unit to the rear face of the pressure bulkhead, ensuring that the rubber sealing ring is fitted between the bulkhead and the valve unit, and that the metering orifice housing is in the 7 o'clock position when viewed from the cabin.

(4) Secure the unit to the bulkhead by fitting the three special-to-type bolts, eight ¼ in. B.S.F. bolts and the metering orifice banjo bolt, fitting both plain and spring washers. Ensure that the three bolts are in their correct positions as noted in operation (2), and that the two washers are in their correct positions on the banjo bolt.

(5) Connect the pipe from the pressure controller to the banjo union and wire-lock the union. Check that all bolts are tight. Refit the inlet grid to the three special-to-type bolts, by rotating the grid frame clockwise to the fullest extent of the keyhole slots.

(6) Test the pressure controller, refer to Table 1 for relevant A.P.

(7) Pressure test the cabin *(para.29)*.

**Relief valve**

**55.** Remove the relief valve as follows:-

(1) Remove the inboard access panel from the upper surface of the port main plane leading edge *(Sect.2, Chap.4)*.

(2) Remove the clamp from the forward end of the valve and the hose clip from the rear end.

(3) Remove the two bolts securing the valve to the secondary cooler and remove the valve.

**Temperature control valves**

**56.** The piston type temperature control valves are removed by disconnecting the two coupling unions, one on either side of the valve body. The spring-loaded shut-off valve is removed in a similar manner, though the small union on the valve dome also requires disconnecting. The bi-metal strip valve is removed by disconnecting the union nut, and withdrawing the bolts which attach it to the structure.

## TABLE 1

### Principal components

| Component | Manufacturer | Type or Part No. | Qty. | A.P. Reference A.P. | Sect. | Chap. |
|---|---|---|---|---|---|---|
| ◀ Cabin air conditioning | | | | | | |
| Actuator (gate valve) | BAe | Type 234 | 2 | 113E-0249-1 | | |
| Actuator (mixing valve) | BAe | Type 233 | 1 | | | |
| Cold-air unit | Godfrey | ACRE 9 Mk.10E | 1 | 107B-0142-1 | | |
| Combined-valve unit | Normalair | 527060 | 1 | 107B-1415-1 | | |
| Constant-flow valve | Normalair | 502090 | 1 | 107B-0911-16 | | |
| Desynn transmitter | — | Type C 132 FL | 1 | 112G-0501-16 | | |
| Hot air (gate) valve | Teddington | FKH/A/16 | 2 | 107B-10112-1 | | |
| Mixing valve | Teddington | FKH/A/15 | 1 | 107B-10109-1 | | |
| Non-return valve | Normalair | 500457 | 1 | 107B-0905-16AD | | |
| Non-return valve | Normalair | 501670 | 1 | 107B-0905-16AD | | |
| Pressure controller | Normalair | 500326 | 1 | 107B-1407-1 | | |
| Pressure relief valve | BAe | FB6.75.729 | 1 | 101B-0407-1A | 3 | 8A |
| Primary cooler | Marston | D 106/8A | 1 | 107B-0614-1 | | |
| Secondary cooler | Marston | D 106/6A | 1 | 107B-0614-1 | | |
| Thermostat, bi-metal | BPA | MS 51/67 | 2 | — | | |
| Valve, spring loaded shut-off | BPA | MS51/30 (pre mod. 5245) | 2 | — | | |
| | BAe | EB7.75.1041 (post mod. 5245) | 2 | | | |
| Valve, temperature control | BAe | EA2.75.669 | 3 | — | | |
| Water extractor | Godfrey | WE 30. Mk.2B | 1 | 107B-0522-1 | | |
| Miscellaneous | | | | | | |
| Non-return valve | BAe | EA3.74.23 | 1 | 101B-0407-1A | 3 | 8A |
| Punkah louvre (pilot) | Thermotank | DAR.2 | 1 | | | |
| Punkah louvre (navigator) | BAe | EB7.75.55 | 1 | | | |
| Diffuser | BAe | EB7.75.23 | 2 | | | |
| Valve, canopy | BAe | EA3.76.223 | 2 | | | ▶ |

# Chapter 8B DE-MISTING SYSTEMS

*(completely revised)*

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## LIST OF TABLES



## LIST OF ILLUSTRATIONS

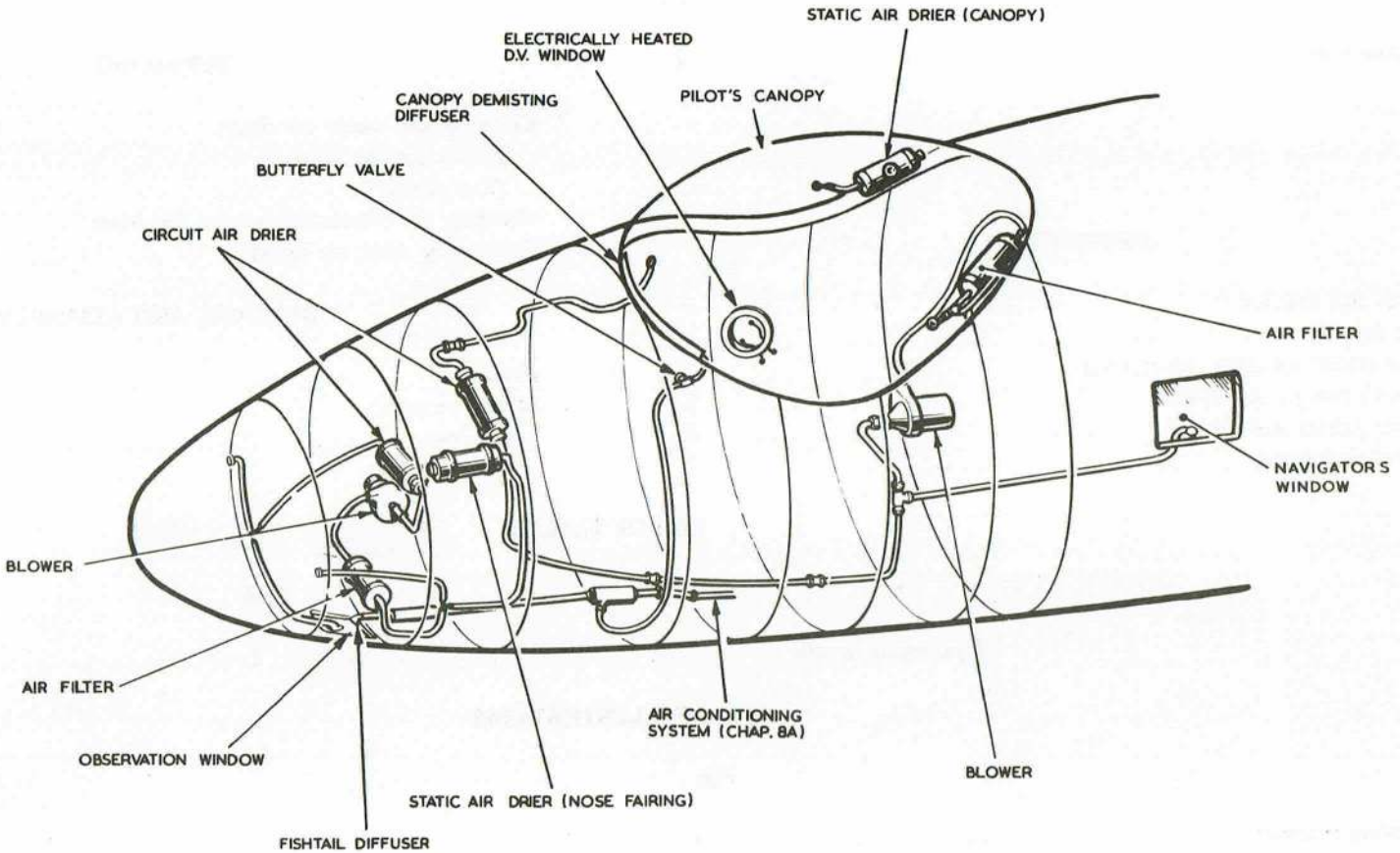



FIG. 1. DE-MISTING SYSTEMS

**Introduction**

1. The purpose of the de-misting system is to prevent, or clear, the formation of condensation within the interspaces of the transparent fairings and on the surfaces of principal transparencies, direct vision and sighting windows. This chapter describes and illustrates the system, gives details of servicing operations and recommends methods for the removal and assembly of certain components.

2. Details of the de-misting system principal components are given in Table 1 and their location in fig.1.

## DESCRIPTION

**General information** *(fig.1 & 2)*

3. The pilot's canopy, transparent nose fairing, observation window and navigator's window are all provided with dry air de-misting. Two separate systems are employed, one system serves the pilot's canopy and navigator's window; the other serves the nose fairing and observation window. Each system comprises two air driers, an electrically-driven blower and a filter. In each system one air drier is of the static type and is equipped with inward and outward vent valves; the other air drier is incorporated in a sub-system which provides for an initial circulation of air through the pilot's canopy or nose fairing respectively. The navigator's window and the observation window each have one connection only into their respective sub-systems so that the role of the air drier in relation to these windows is purely static. All pipe connections to the pilot's canopy are by rubber pipe slip-on joints, permitting the joint to be broken when the canopy is jettisoned; at other points where the rubber pipe slip-on joints are employed the ◀connections are clipped. The drying medium in static air ▶ driers is silica-gel, whilst in the circulatory systems air driers the indicator cell is filled with activated alumina Type 1 and the main cell with activated alumina Type A.

**Static air driers** *(fig.3)*

4. The static air driers are fitted with inward and outward valves to allow the air pressure inside the cavity of the pilot's canopy and nose fairing to equate (within the limits of the valves settings) to ambient air pressure during flight. The pilot's canopy static air drier is mounted on the starboard side of the canopy coaming tube and is connected to the inner sheet of the canopy. The nose fairing static air drier is mounted on the port side of the fuselage nose forward of frame 1 and between stringers 5 and 7; it is connected to a branch pipe of the circulatory system.

**Closed circuit air drier sub-systems**

*Pilot's canopy sub-system (fig.2)*

5. The air drier for this sub-system is mounted in the roof of the fuselage on the forward face of frame 1 and is connected to the forward part of the canopy inner sheet. The drier is part of a sub-system forming a closed circuit which ensures that the air initially contained in the canopy cavity is extracted, dried and returned to the canopy. This is accomplished by the air blower which draws air from the canopy through the air drier and returns the air via a filter mounted on the port side of the canopy coaming tube and connected to the canopy inner sheet. The blower *(Sect.5, Chap.1, Group H)* is mounted on a bracket forward of the navigator's table and is controlled by the canopy de-misting switch on the pilot's take-off panel. The navigator's window is connected to the suction side of the sub-system, but there is no feed-back when the blower is running.

*Nose fairing sub-system (fig.2)*

6. The air drier and blower *(Sect.5, Chap.1, Group H)* for this sub-system are mounted on the forward face of frame 1 and the filter is mounted on the fuselage skin aft of frame B, starboard side; all under the floor. The blower draws air through the starboard connection on the nose fairing via the air drier, passes the air through the filter and returns it through the port connection of the nose fairing. The pipe-line from the observation window is connected to the pipeline between the nose fairing starboard connection and the air drier. The static air drier is connected into the pipeline which connects the filter to the port connection of the nose fairing. The system is controlled by a switch on the pilot's take-off panel.

**Internal de-misting**

7. To prevent misting of the nose fairing and canopy inner surfaces, conditioned air is ducted from the cabin air system and delivered to these surfaces through diffusers. The canopy diffuser has a control valve located on the frame to port of the alighting gear control panel; the diffuser for the nose fairing is not controllable but delivers conditioned air to the inner surface simultaneously with the cabin air supply.

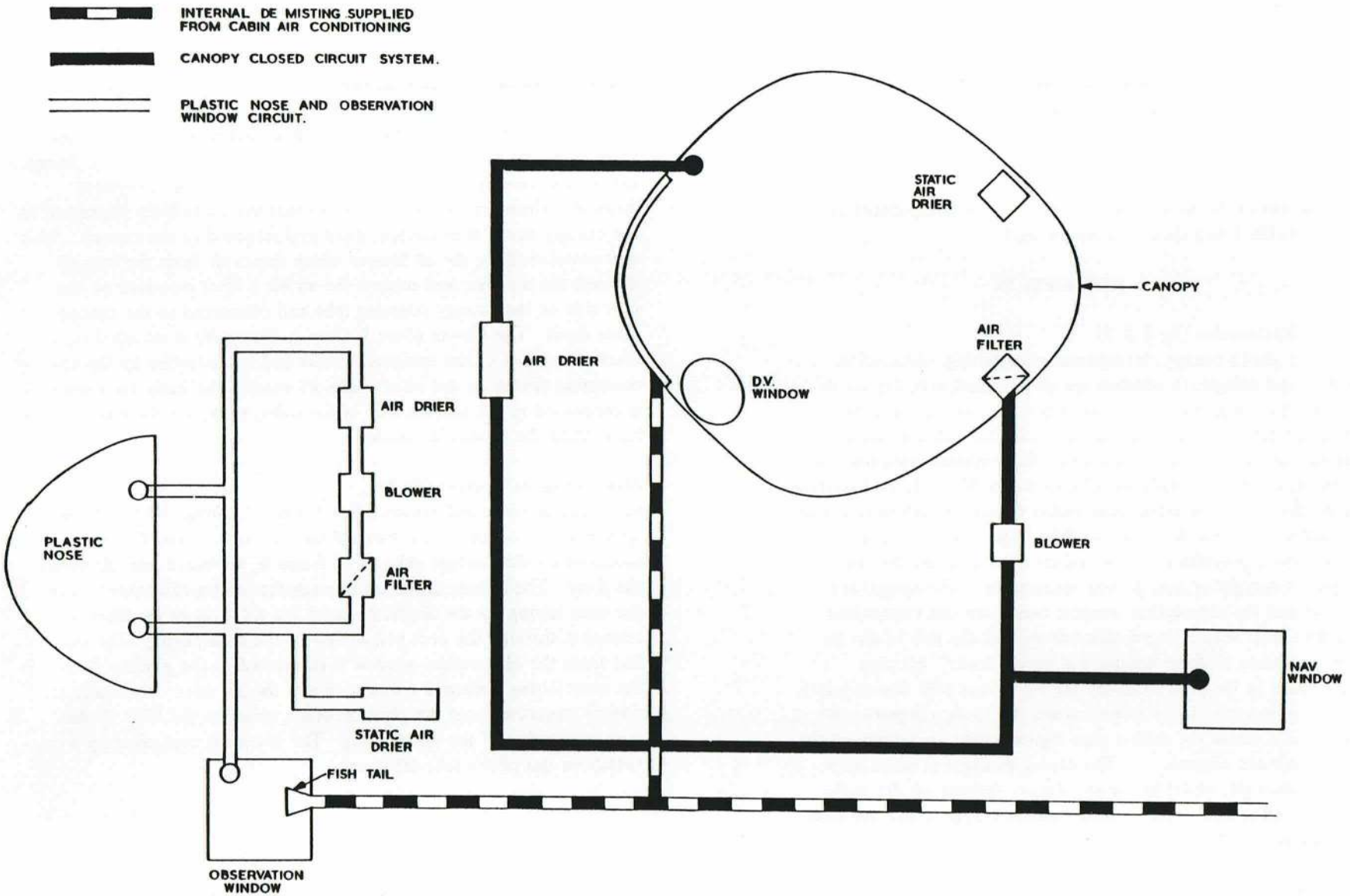
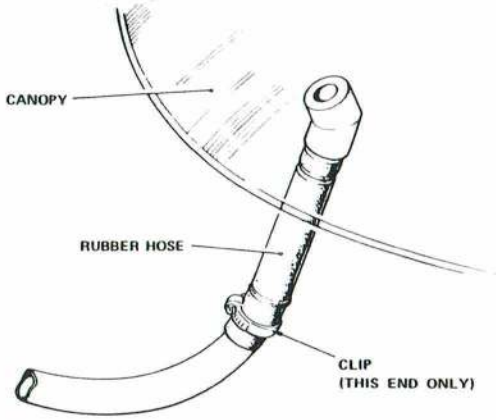
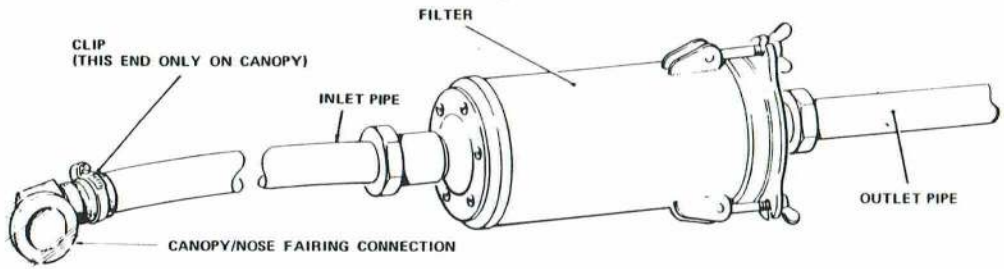


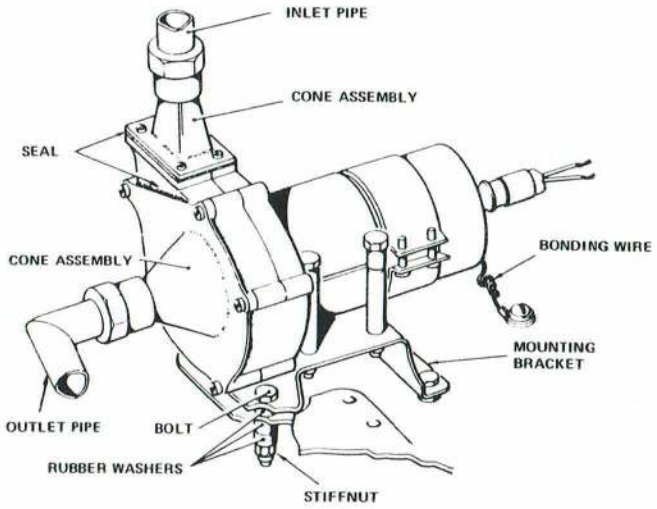

FIG. 2. DE-MISTING SYSTEMS-DIAGRAM



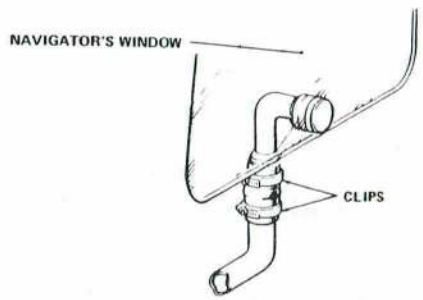

CANOPY CONNECTION




CLOSED CIRCUIT FILTER




BLOWER UNIT




NAVIGATOR'S WINDOW CONNECTION

FIG.4. DE-MISTING SYSTEM COMPONENTS

◀ MOD. 5238 EMBODIED ▶

(8) Replace the air drier in the aircraft and tighten the hose clips securing it in the brackets.

(9) Unseal each pipe in turn, ensure that the nipple adapter is fitted and secure each pipe to the air drier with the union nut.

(10) Wire-lock each union nut.

**Testing the static air driers** *(fig.5)*

**11.** The following equipment is required for testing either static air drier:—

(1) A test rig capable of applying an air pressure of 2 lb/in$^2$ and a suction of 0.6 lb/in$^2$.

(2) A 12 in. mercury U-tube.

**12.** Before testing the air drier, it must be removed from the aircraft *(para.8 or 9)*, then proceed as follows:—

(1) Connect the air-pressure pipe from the test rig to the canopy end (A) of the air drier with the mercury tube interposed *(fig.5)*. Blank off the aperture (B) at the opposite end of the air drier.

(2) Apply a pressure of 2 lb/in$^2$ and check that the complete assembly is airtight.

(3) Release the pressure and remove the blank from the end of the air drier.

(4) Apply pressure and check that the outlet valve opens at 0.6 lb/in$^2$ but that it is airtight below 0.3 lb/in$^2$.

(5) Remove the pressure pipe and connect the suction pipe in its place.

(6) Apply suction and check that the inlet valve opens at 0.6 lb/in$^2$ but that it is airtight at 0.3 lb/in$^2$.

(7) Disconnect the test rig and refit the air drier into the aircraft.

## REMOVAL AND ASSEMBLY

**Filters**

**13.** Similar mountings are utilized for the filter in both circulatory systems. To remove the element from a filter:-

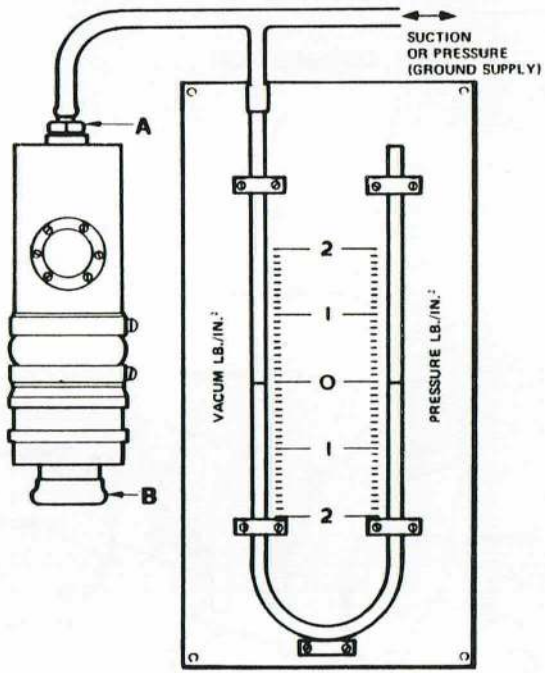



**FIG.5. STATIC AIR DRIER TEST RIG**

(1) At each end of the filter cut the locking wire and undo the union nut.

(2) Remove the pipe from each end of the filter and seal the pipe.

(3) Release the hose clips securing the filter and remove it from the aircraft.

(4) Unscrew the wingnuts and remove the end cap, sealing washer, filter element, sealing washer, sealing plug and spring from the container.

**14.** The assembly of the filter unit is the reverse sequence to the procedure detailed in para.13. Before assembly the ends of the filter element must be lightly greased with lanolin.

**Blower motors**

*Canopy (fig.4)*

**15.** To remove the blower motor:–

(1) Disconnect the electrical cable at the suppressor (adjacent to the motor).

(2) Cut the locking wire and undo the union nuts at the inlet and outlet elbow connections, disconnect the elbow connectors and seal the elbows and the blower ports.

(3) Remove the four 2 B.A. stiffnuts and bolts from the mounting bracket.

(4) Remove the top half of the mounting bracket and then remove the blower motor.

**16.** The assembly of the blower motor is a reversal of the procedure detailed in para.15.

**Note . . .**

*Ensure that the bonding wire is reconnected when assembling the motor.*

*Nose fairing*

**17.** To remove the blower motor:–

(1) Disconnect the electrical cable at the suppressor (adjacent to the filter).

(2) Slacken the hose clips securing the connections at the inlet and outlet ports; disconnect the inlet and outlet pipes, seal the pipe ends and the blower ports.

(3) Remove the two 2 B.A. bolts and washers securing the motor to its mounting and remove the blower and motor.

**18.** The assembly of the blower is a reversal of the procedure detailed in para.17.

TABLE 1

Equipment details

| Component | Part/Ref. No. | System | A.P. Reference |
|---|---|---|---|
| Blower Type 1 | 5UD/3310 | Canopy | 4343D, Vol.1, Sect.20, Chap.13 |
| Blower unit | 5UD/6193 | Nose fairing | 4343D, Vol.1, Sect.20, Chap.13 |
| Closed circuit air driers | 26FZ/12522 | Canopy and nose fairing | 101B-0407-1A, Sect.3, Chap.8B |
| Filter | 26FZ/12524 | Canopy and nose fairing | 101B-0407-1A, Sect.3, Chap.8B |
| Static air drier | 26FZ/12521 | Canopy and nose fairing | 101B-0407-1A, Sect.3, Chap.8B |
| ◀ Silicone rubber hose | DTD818L3 | Canopy ▶ | |

# Chapter 8C AIR VENTILATED SUIT SYSTEM (POST MOD.3425)

*(completely revised)*

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## LIST OF TABLES



## LIST OF ILLUSTRATIONS

**Introduction**

1. Provision is made for air-ventilated suits at the pilot's, navigator's aft and navigator's forward stations. This chapter describes and illustrates the system, gives details of servicing operations and recommends methods for the removal and assembly of certain components. Details of the system principal components together with their Air Publication references are listed in Table 2.

## DESCRIPTION

**General information** *(fig.1 & 2)*

2. The air supply for the ventilated-suit system is taken from the air-conditioning system pipeline between the primary air cooler and the mixing valve *(Chap.8A)*: the T-piece union is on the port side of the flare bay. From this T-piece the pipeline is routed forward to a non-return valve in the forward camera bay; then into the port equipment compartment to a water extractor, pressure reducing valve and pressure relief valve. The pipe then passes through the nose-wheel well wall to a second non-return valve and then through the pressure bulkhead into the cabin. To enable the system to be used while the aircraft is at rest, an external breakaway charging connection for a ground supply is provided between frames 12 and 12A entering the system between the first non-return valve and the water extractor.

**Cabin distribution**

3. On passing through the pressure bulkhead the supply is divided into two separate pipelines, one to supply the navigator and one to supply the pilot and the navigator's prone position. The navigator's supply is routed directly to a manual control valve and quick-release socket situated to starboard of the navigator's ejection seat on the pressure bulkhead. A flexible hose from the quick-release socket is clipped to the seat structure.

4. The pilot's supply is routed forward under the navigator's floor to a branch pipe situated forward of the E.C.P. and alongside the pilot's ejection seat. A kink-proof hose is taken from the branch pipe to the pilot's manual control valve and quick-release socket mounted on top of the E.C.P. and then to the pilot's air ventilated suit connection. From the branch pipe assembly, a supply is also routed forward under the pilot's floor, to a third manual control valve situated on the starboard side of the aircraft, between frames A and B. A kink-proof hose clipped on frame A and stringer 35 between frames A and 1 to a stowage point just aft of frame A, connects the system to the navigator's air-ventilated suit, at his forward station.

**Water extractor**

5. This unit, mounted at frame 11 in the port equipment compartment, ensures that the air is free from moisture when delivered to the ventilated-suits. The moisture is drained to atmosphere through a drainpipe.

**Pressure-reducing valve**

6. This valve receives the system air at approximately 90 lb/in$^2$ and maintains a delivery pressure of 12 lb/in$^2$ at all cabin pressures and altitudes. The valve is controlled by the ambient pressure in the port equipment compartment.

**Relief valve**

7. The relief valve is positioned between the pressure-reducing valve and the second non-return valve. It relieves excess pressure in the system when all crew control valves are closed, or in the event of failure of the pressure-reducing valve. The valve relieves pressures in excess of 8 lb/in$^2$.

**Non-return valves**

8. A non-return valve is fitted between the T-piece union for the breakaway charging connection and the supply from the air-conditioning system. The valve ensures that air is fed directly to the crew stations when cooling air is being supplied through the external charging valve. A second non-return valve is fitted in the pipeline just aft of the pressure bulkhead. This ensures that the cabin pressure is not lost when the suits are not in use and the manual control valves are ON.

**Air supply**

*External*

9. A breakaway charging connector is installed on the fuselage port side between frames 12 and 12A and provides for ground supply air to be fed direct to the crew control valves when the engines are not running. The connection is automatically sealed when the ground supply is disconnected. Cooling air to the air system may be supplied by:-

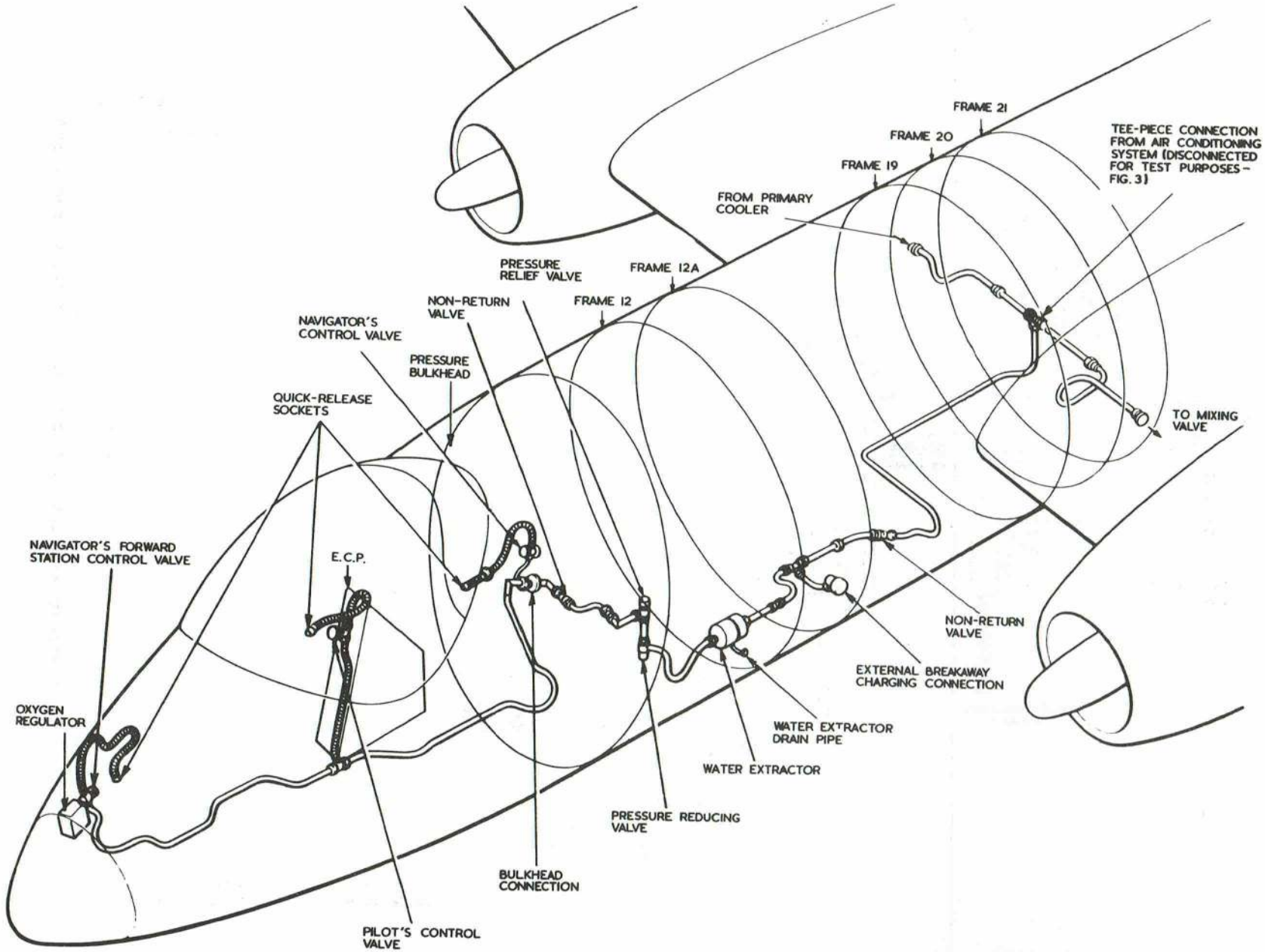


FIG. 1 AIR VENTILATED SUIT SYSTEM

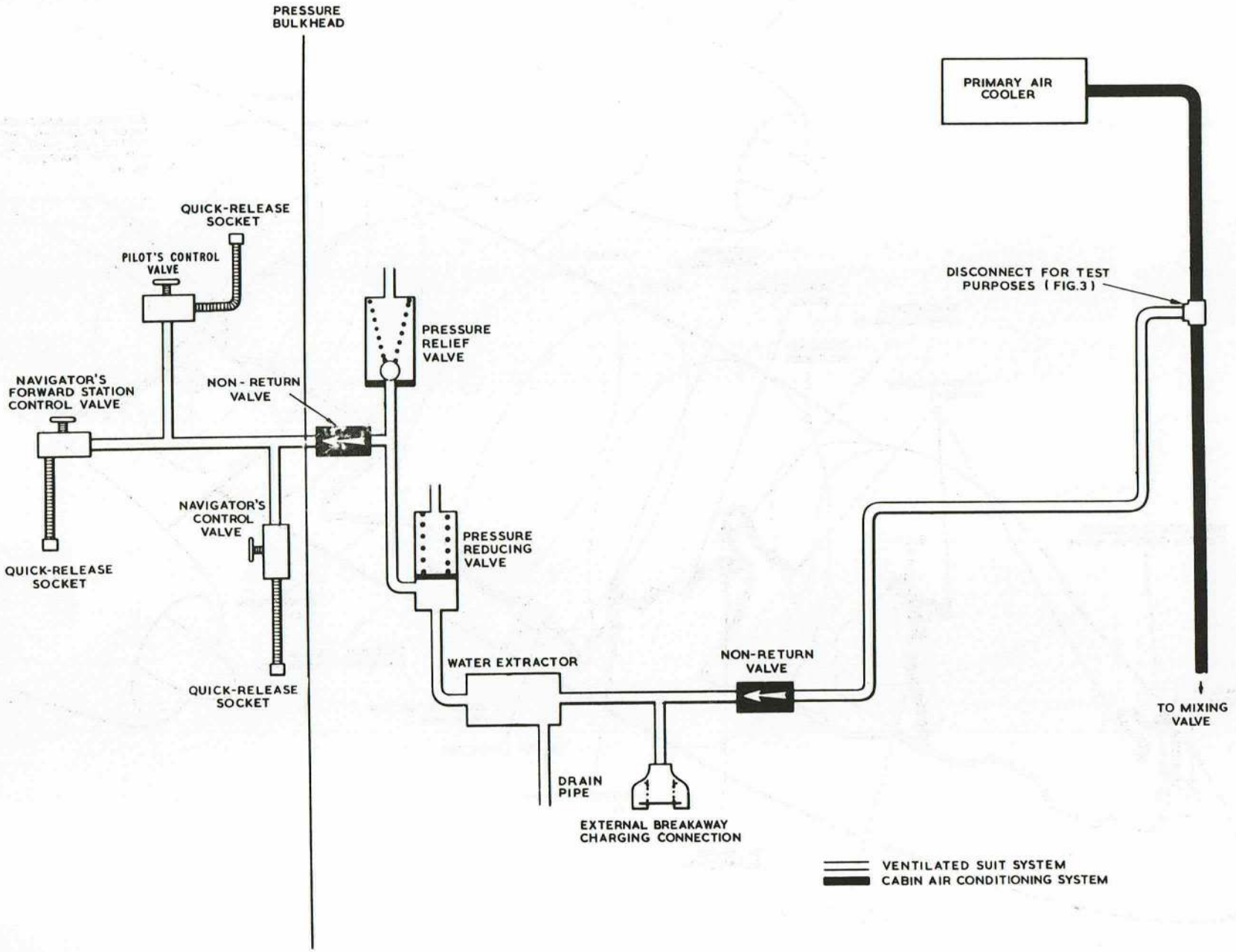


FIG. 2 AIR VENTILATED SUIT SYSTEM DIAGRAM

(1) Trolley, air supply Mk.4 *(Ref.4F/2376)*

(2) One or more 15000 litres air bottles charged to 3500 lb/in$^2$ with dry air. The air to be fed through a suitable arrangement of reducing valves to reduce the pressure to 12 lb/in$^2$.

**Note . . .**

*The flexible hose connecting the external air supply to the aircraft must be fitted with a Normalair Connector Pt.No. 512080.*

*Internal*

**10.** With the ground supply disconnected and one or both engines running, cooling air is controlled by fully selecting COLD on the CABIN AIR CONTROL switch *(Chap.8A)*. This selection must not exceed five minutes whilst the aircraft is stationary and the engine rev/min must not exceed 5000 continuously. When taxying, the cooling effect attains its maximum efficiency with one, or both engines running at 5000 rev/min.

**Control valves**

**11.** Three control valves are fitted in the pressure cabin, one adjacent to each crew member's seat and one at the navigator's forward station. Each valve gives independent control of cool air to the respective suit.

## SERVICING

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**Test set** *(fig.4)*

**12.** A test set *(Sect.2, Chap.4, Table 1)* contains in its case the items listed in Table 1 which are required to perform the leakage and flow tests.

**Leakage test**

**13.** Prepare and test the system for leaks as follows:-

**Note . . .**

*The test equipment required is contained in the test set (Table 1) and the arrangement is functionally shown in fig.3.*

(1) Disconnect and remove part of the air-conditioning system pipe at the T-junction in the flare bay at frame 21 *(fig.1)*.

(2) Connect the test gauge adapter Pt.No.EA3.88.5069 and the 0 - 30 lb/in$^2$ test gauge to the ventilated-suit system pipe line.

(3) Connect a source of clean, dry air, capable of supplying 10 lb/in$^2$ to the test adapter.

(4) Using blanking plug assembly Pt.No.EA3.88.5061, blank off the water extractor drain.

(5) Remove the reducing valve vent filter and blank off the vent using blanking plug assembly, Pt.No.EA3.88.5059.

(6) Blank off the relief valve inlet using blanking plug assembly, Pt.No.EA3.88.5063.

(7) Close all crew station manual control valves.

(8) Carefully pressurize the system to 8 lb/in$^2$ and turn off the air supply.

**Note . . .**

*Restrict the supply pressure to 8 lb/in$^2$; a high pressure will damage the 0 - 30 lb/in test gauge.*

(9) Check all pipelines and components for leaks using a soap solution (A.P.107D-0001-1).

**Note . . .**

*If a leak is found it is generally caused by dirt on the nipple or branch mating face; this is remedied by cleaning and degreasing the affected parts. If the leak persists renew the parts.*

(10) Upon satisfactory completion of (9) all traces of the soap solution must be removed.

(11) Repeat (8); over a period of 15 minutes the maximum permissible pressure drop is 5 lb/in$^2$.

(12) Release all pressure from system then remove blanks from the water extractor drain, the relief valve inlet and the reducing valve vent; replace the reducing valve vent filter.

(13) Remove the test gauge and adapter. Refit the removed part of the air conditioning system pipe. Return test equipment to its carrying case.

**Flow tests**

*External air*

**14.** Flow test the system using an external air supply as follows:-

**Note . . .**

*The test equipment required is contained in the test set (Table 1) and the arrangement is shown in fig.3.*

(1) Disconnect and remove part of the air-conditioning system pipe at the T-junction in the flare bay at frame 21 *(fig.1)*.

(2) Connect the test gauge adapter Pt.No.EA3.88.5069 and the 0 - 200 lb/in$^2$ test gauge to the ventilated-suit pipeline.

(3) Using blanking plug assembly Pt.No.EA3.88.5061 blank off the water extractor drain.

(4) Connect a source of clean, dry air capable of supplying 12 to 120 lb/in$^2$ to the test adapter.

(5) Remove the flexible pipe from the navigator's forward station control valve.

(6) Connect the test gauge adapter Pt.No.EA3.88.5077 and the 0 - 30 lb /in$^2$ test gauge to the navigator's forward station control valve.

(7) Ensure that all three crew station manual control valves are closed.

(8) Pressurize the system to 90 lb/in$^2$ on the 0 - 200 lb/in$^2$ test gauge.

(9) Ensure that all joints and pipelines up to the pressure-reducing valve are leak tight.

(10) Open the navigator's forward station manual control valve and test equipment control valve.

(11) Ensure that, with the pressure-reducing valve datum pressure outlet suddenly blanked off, the pressure indicated on the 0 - 30 lb/in$^2$ test gauge does not exceed 8 lb/in$^2$. If a greater pressure than 8 lb/in$^2$ is indicated, the relief valve is suspect.

(12) Shut off the ground air supply and disconnect from the test gauge adapter. Remove the test gauge and adapter from the system pipeline. Refit the removed part of the air conditioning system pipe.

(13) Remove the blanking plug assembly from the water extractor drain.

(14) Remove the test gauge adapter and test gauge from the navigator's forward station manual control valve. Refit the flexible pipe to the control valve.

(15) Close the navigator's forward station manual control valve. Return the test equipment to its carrying case.

*Internal air*

**15.** Flow test the system with one or both engines running as follows:-

**Note . . .**

1. *The test equipment required is contained in the test set (Table 1) and the arrangement is shown in fig.3.*

2. *Do not blank off the water extractor drain.*

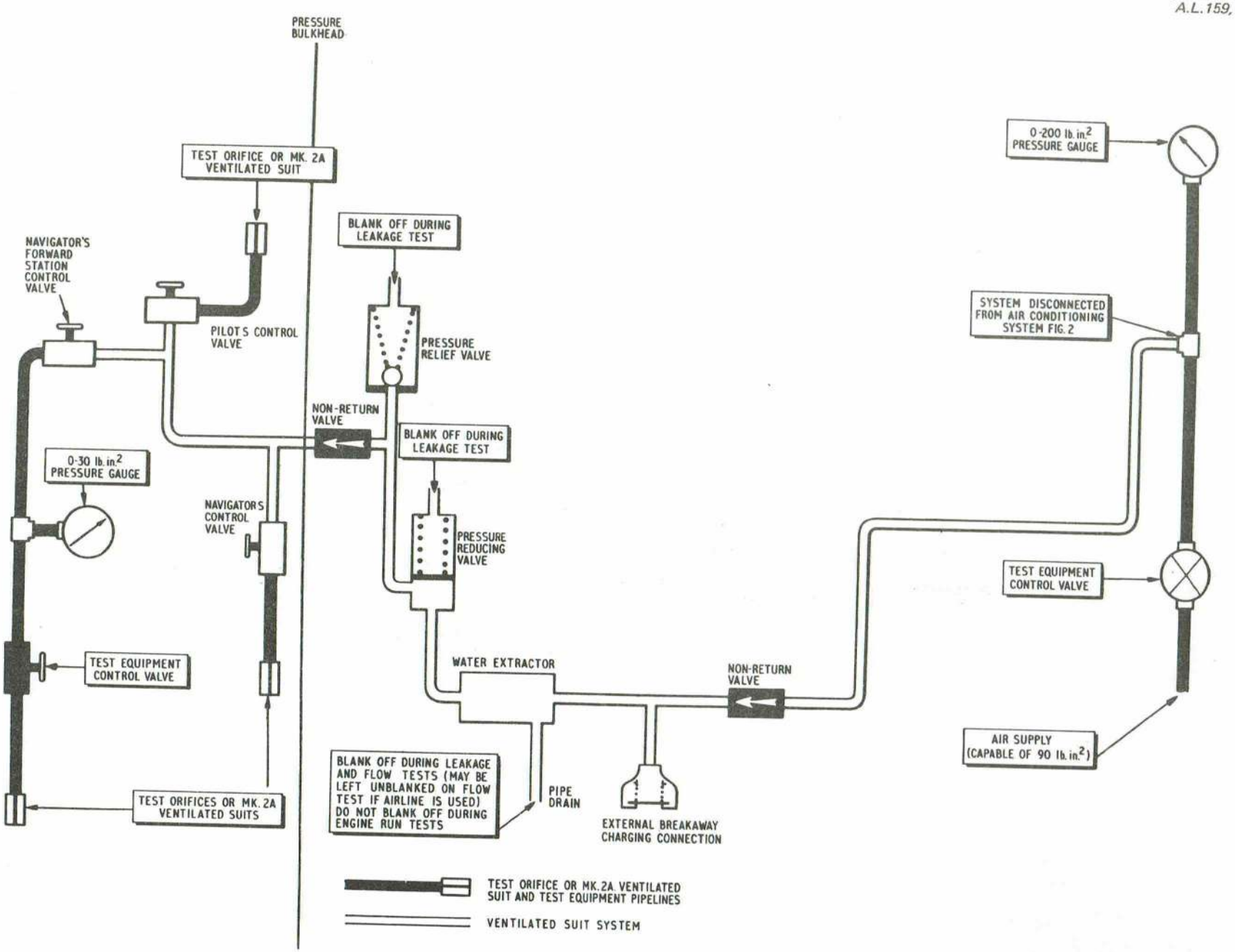


FIG. 3. AIR VENTILATED SUIT SYSTEM WITH TEST EQUIPMENT

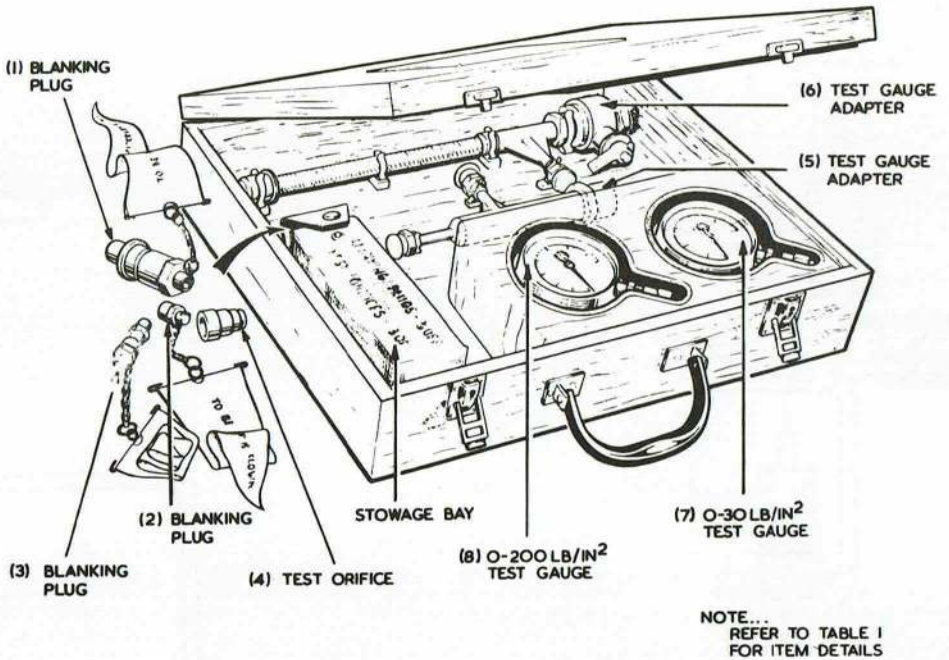


**FIG.4. TEST SET**

**WARNING**

**The air-conditioning system must not be selected to cold during these tests.**

(1) Ensure all three crew station manual control valves are closed.

(2) Remove the flexible pipes from all three crew station manual control valves. Connect the test gauge adapter Pt.No.EA3.88.5077 and the 0 - 30 lb/in$^2$ test gauge to the navigator's forward station manual control valve. Fit test orifices to the pilot's and navigator's operational station manual control valves.

(3) Open the pilot's and navigator's forward station manual control valves and also the test equipment control valve. The navigator's operational station manual control valve must be closed. Ensure that the pressure indicated on the 0 - 30 lb/in$^2$ test gauge does not fall below the following:-

(a) 2.0 lb/in$^2$ with the engine(s) running at 5500 rev/min.

(b) 2.5 lb/in$^2$ with the engine(s) running at 7400 rev/min.

(4) In conjunction with operation (3), close the pilot's manual control valve at each rev/min setting and check that indicated pressure does not rise above 5.5 lb/in$^2$.

(5) Close all control valves. Transfer the test equipment to the pilot's manual control valve and the test orifice to the navigator's forward station manual control valve.

(6) Repeat operation (3) and (4).

(7) Close all control valves, transfer the test equipment to the navigator's operational manual control valve and the test orifice to the pilot's manual control valve.

(8) Open the pilot's navigator's operational position and test equipment control valves. The navigator's forward station manual control valve must be closed. Ensure that the pressure indicated on the 0 - 30 lb/in$^2$ test gauge does not fall below the following:-

(a) 2.0 lb/in$^2$ with engine(s) running at 5500 rev/min.

(b) 2.5 lb/in$^2$ with engine(s) running at 7400 rev/min.

(9) In conjunction with operation (8) close the pilot's manual control valve at each rev/min setting and check that indicated pressure does not rise above 5.5 lb/in$^2$.

(10) Ensure all manual control valves are closed, remove the test equipment and the test orifices and return them to the carrying case. Refit the flexible pipes at all three crew stations.

**CAUTION**

**Ensure that no test orifices remain in the manual control valves. The three orifices provided must be in the stowage in the carrying case.**

## REMOVAL AND ASSEMBLY

**General information**

**16.** In the following paragraphs only the removal sequence is detailed since assembly is a reversal of the removal sequence. Any special assembly instructions are noted.

**Water extractor and vent pipe**

**17.** Remove the water extractor and vent pipe as follows:-

(1) Disconnect the inlet and outlet pipes by slackening off their respective outer sleeves. Retain the inner nipples.

(2) Disconnect the vent pipe by slackening off the outer sleeve attaching the pipe to the vent connection in the fuselage skin.

(3) Release the body of the extractor by loosening the screws securing the retaining straps.

(4) Blank off the exposed pipe ends.

**Breakaway charging connection**

**18.** Remove the breakaway charging connection as follows:-

(1) Disconnect the pipe from the body of the connection and from the T-union in the supply pipe. Retain the inner nipple.

(2) Remove the four 2 B.A. screws adjacent to the connection aperture in the fuselage skin.

(3) Remove the charging connection from the aircraft. Retain the packing from between the fuselage skin and the connection.

(4) Blank off the exposed pipe ends.

**Pressure-reducing valve**

**19.** Remove the pressure-reducing valve as follows:-

(1) Disconnect the two pressure pipes from the valve body by releasing their respective outer sleeves. Retain the inner nipples.

(2) Remove the two 2 B.A. bolts securing the saddle clamp to the nose-wheel well wall. Remove the pressure-reducing valve. Retain the saddle clamp.

(3) Blank off the exposed pipe ends.

**Relief valve**

**20.** To remove the relief valve:-

(1) Disconnect the two pipes by releasing their respective outer sleeves. Retain the inner nipples.

(2) Remove the two B.A. bolts and washers securing the saddle clamp to the nose-wheel well wall. Remove the relief valve. Retain the saddle clamp.

(3) Blank off the exposed pipe ends.

## TABLE 1

**Test set components (fig.4)**

| Item No. | Pt. No. | Description | Qty. | Application |
|---|---|---|---|---|
| 1 | EA3.88.5063 | Blanking plug assembly | 1 | Pressure-relief valve |
| 2 | EA3.88.5059 | Blanking plug assembly | 1 | Pressure-reducing valve |
| 3 | EA3.88.5061 | Blanking plug assembly | 1 | Water extractor |
| 4 | EA3.88.5057 | Test orifice | 3 | — |
| 5 | EA3.88.5069 | Test gauge adapter | 1 | — |
| 6 | EA3.88.5077 | Test gauge adapter | 1 | — |
| 7 | — | Test gauge 0-30 lb/in$^2$ | 1 | — |
| 8 | — | Test gauge 0-200 lb/in$^2$ | 1 | — |

## TABLE 2

**Equipment details**

| Ref. No. | Component | Description/Pt. No. | Qty. | A.P. Reference |
|---|---|---|---|---|
| 27KD/969 | Charging connector | Normalair 512070 | 1 | 107B-1111-16 |
| 27KD/989 | Control valve | Normalair 513390 | 3 | 107B-1027-16 |
| 27FR/30867 | Non-return valve | Flight Refuelling 9811125H | 2 | — |
| 27VB/5761 | Pressure-relief valve | Hymatic RAV.158/002 | 1 | 105C-05148-1 |
| 27VB/5732 | Reducing valve | Hymatic N.PAS. 148/074 | 1 | 105C-05109-1 |
| 27UA/-217 | Water extractor | Godfrey Type WE 5. Mk.9 | 1 | 107B-0523-1 |

# Chapter 10 OXYGEN SYSTEM

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## LIST OF TABLES



## LIST OF ILLUSTRATIONS

**WARNING**

**Oxygen and grease unite explosively. When handling any equipment used in high-pressure oxygen systems, keep all oil and grease from contact with the equipment. Failure to do this may result in loss of life and equipment.**

**Introduction**

1. This chapter contains a description of the oxygen system and the procedure for the removal and assembly of certain components. The procedures for servicing the components of the system, and the method of charging the cylinders, is given in A.P.107D series and A.P.108F series *(Table 1)*.

## DESCRIPTION

**General information** *(fig.1 & 2)*

2. Oxygen is carried in one 2250 litre cylinder and six 750 litre cylinders mounted in the equipment compartment, aft of the pressure bulkhead; each cylinder is fitted with a five-way connector incorporating two non-return valves. In order to reduce vulnerability and to prevent total loss of oxygen through a supply pipe fracture, the cylinders and supply pipes are divided into two banks, isolated from each other, and the high-pressure system is duplicated. A charging valve, acting as a manually operated stop valve is located in the starboard equipment compartment, and is connected through a filter to all cylinders, enabling them to be replenished in situ.

3. The high-pressure supply pipes, one from each bank of cylinders, pass through the port and starboard sides of the pressure bulkhead, to manually operated stop valves, located one on the port wall of the navigator's station and one on the forward face of the bulkhead respectively. From the stop valves the high pressure supply pipes pass along the walls of the pressure cabin to a point forward of the pilot's instrument panels, where the port supply pipe passes across the cabin to join the starboard pipe. The supply pipes are joined by a three-way connector housing a non-return valve in each of the connections to the supply pipes, the third being connected to a pipe leading to a Mk.1 pressure-reducing valve, and housing a filter in the pipe connection. From the pressure-reducing valve, which reduces the pressure to 400 lb/in$^2$, an intermediate-pressure supply pipe is connected to the pilot's Mk.17F pressure regulator mounted on the port wall of the cabin above the console and, through a three-way connector in the pipe, to a Mk.17F pressure regulator on the starboard side of the navigator's forward station in the aircraft nose. The navigator's normal station is supplied by a pipe leading inboard from each high-pressure supply pipe, along the canopy coaming cross-tube to a three-way connector, and a high-pressure pipe from the connector carries the supply to an adjacent pressure-reducing valve, non-return valves in the connector preventing interflow between the two supplies. An intermediate-pressure pipe from the reducing valve conveys the supply to the navigator's pressure regulator on the canopy coaming cross-tube. Two oxygen contents pressure gauges, fitted on the miscellaneous instrument panel, are connected into the high pressure supply pipes to give an indication of the amount of oxygen available from each bank of cylinders. Remote magnetic indicators electrically connected to each pressure regulator, are provided to indicate oxygen flow; refer to Sect.5, Chap.1, Group W and Sect.5, Chap.2, Group D for locations of the indicators and the wiring details.

◀ **Note. . .**

*A label is fitted adjacent to the navigator's stop valve, stating that the valve must be left open.* ▶

**Pilot's supply**

4. From the Mk.17F pressure regulator on the port wall of the cabin at the pilot's station, a low-pressure pipe, terminating in a flanged connector, takes the supply to an attachment point on the starboard side of the ejection seat. A flexible tube from the pilot's face mask connects to a break point on the connector so that it will disengage when the seat is ejected.

**Navigator's supply**

5. From the Mk.17F pressure regulator on the canopy coaming cross-tube the supply is conveyed by a low-pressure pipe, terminating in a quick-release socket on the ejection seat. A face-mask tube connects to the quick-release socket so that it will disengage when the seat is ejected.

**Note . . .**

*When a Mk.7 quick-release socket is fitted, a rubber stopper, which is attached to it by a retaining cable, must be inserted into the socket to cut off the supply when the flexible tube to the face mask is disconnected.*

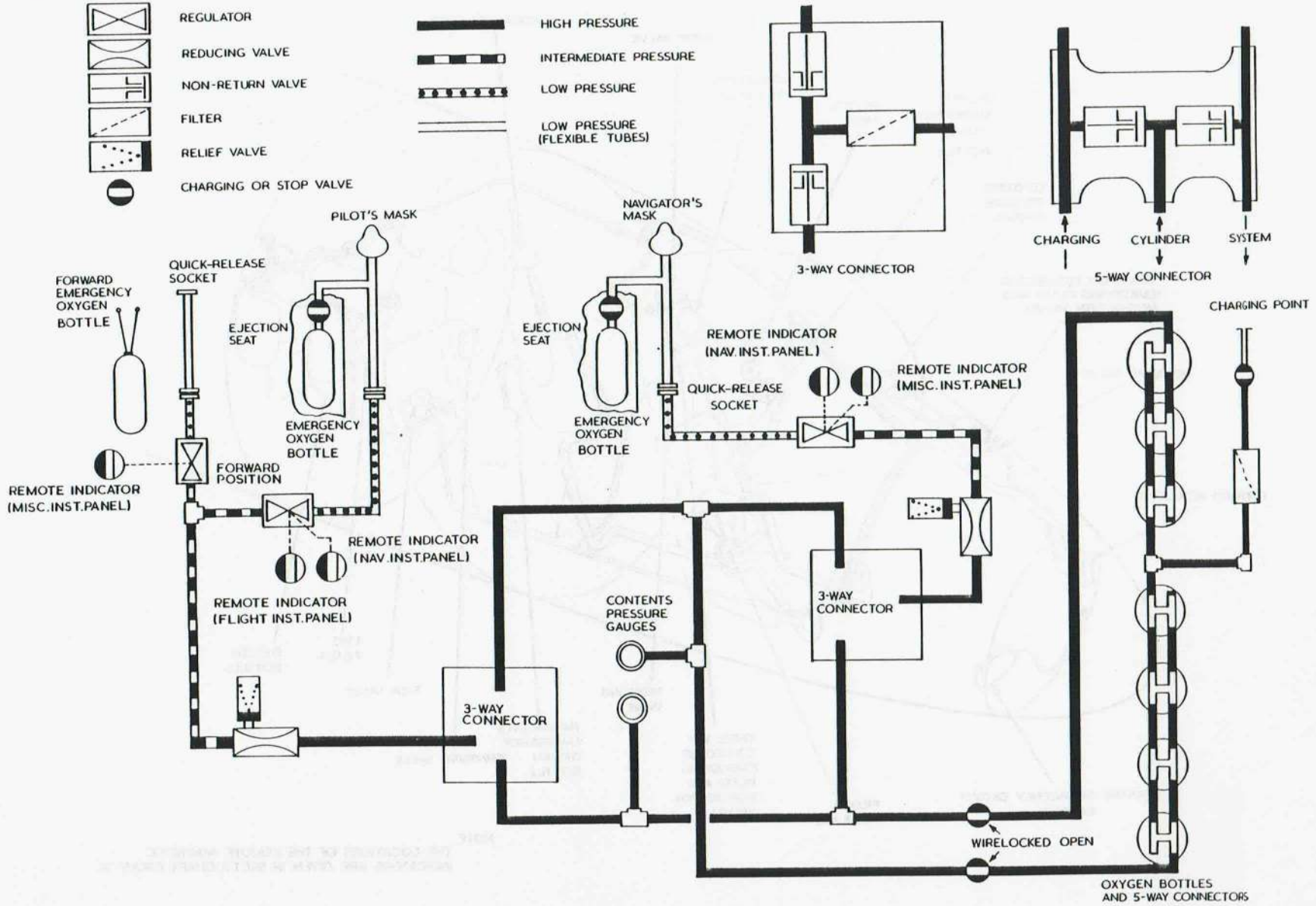


FIG.1. OXYGEN SYSTEM

◀ SYSTEM AMENDED ▶

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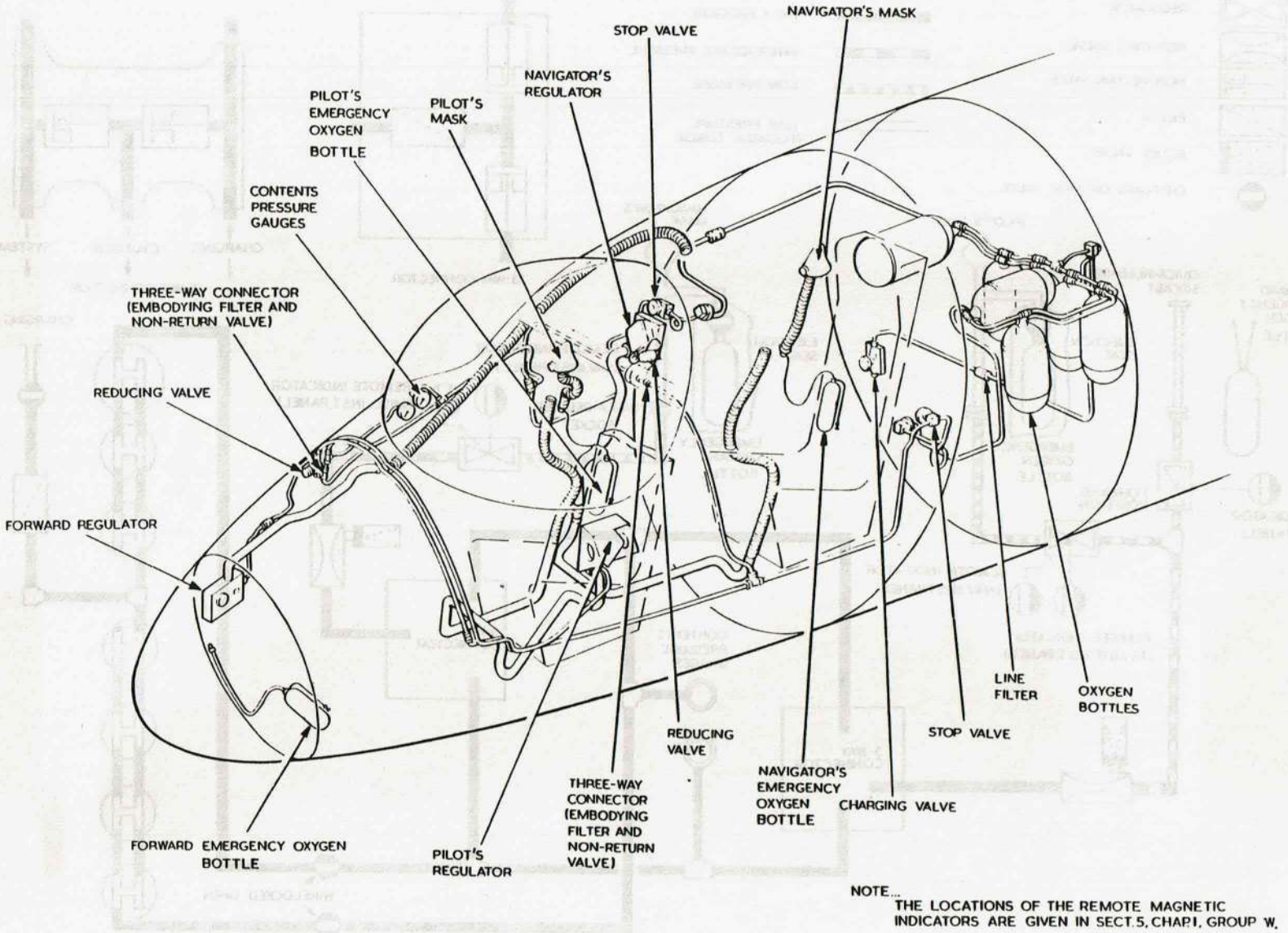


FIG. 2. OXYGEN SYSTEM-LOCATION OF COMPONENTS

**Navigator's forward station supply**

6. A low-pressure pipe from the Mk.17F pressure regulator on the starboard side of the navigator's forward station conveys the supply aft, to a point inside the pilot's cabin from whence it is continued by a flexible tube, terminating in a quick-release socket, to a clip stowage on the starboard side of the navigator's station; the rubber stopper must be fitted in the socket when this supply is not in use. The arrangement of this supply and the navigator's normal supply *(para.5)* enables the navigator to change over when preparing to move to his forward station, by disconnecting his face mask tube at the quick-release connection on the ejection seat and connecting it to the alternative supply tube, which is of sufficient length to enable him to move freely to his forward station.

**Emergency oxygen**

7. An emergency oxygen cylinder is mounted on the starboard side of the Mk.2CA.1 and 2CA.2 ejection seats; these may be used in the event of failure of the main supply as instructed in Sect.1, Chap.3. An emergency oxygen cylinder is also fitted at the forward station to supply the navigator when at that station.

## SERVICING

**WARNING**

**Oxygen and oil or grease unite explosively. When handling any equipment used in high pressure oxygen systems, keep all oil and grease from contact with the equipment. Failure to do this may result in loss of life and equipment.**

**General information**

8. The servicing necessary to maintain the system in an efficient working condition consists of keeping the installation free from oil, grease and moisture, ensuring that all cylinders are fully charged, and testing for leaks at all joints. An examination of the system must also be made for signs of damage and security of components. Ensure that the flexible tubes are fitted securely and, at the pilot's station, that the flexible tube is fully down to the flange at the ejector seat break point. The standard serviceability and operational test of the components are fully described in A.P.107D series and A.P.108F series. *(Table 1).*

**Charging the main cylinders**

9. Scrupulous cleanliness of all connections must be observed during charging operations. To charge the cylinders:-

(1) Remove the blanking cap from the oxygen charging valve in the ▶ starboard equipment compartment. ◀

(2) Connect a high pressure oxygen supply from an oxygen charging trolley and, observing the precautions detailed in A.P.107D-0001-1 charge the cylinders to approximately 2000 lb/in$^2$, which on cooling will fall to approximately 1800 lb/in$^2$.

(3) When charging is completed, disconnect the charging trolley and replace the blanking cap on the charging valve.

**Note . . .**

*Oxygen is prevented from escaping from the system through the charging valve by non-return valves integral with each five-way connector.*

**System leakage test**

10. Test the system for leaks as follows:-

(1) Remove the locking wire and switch all three oxygen regulators ON/OFF valves to OFF.

(2) Ensure there is between 1700 lb/in$^2$ and 1800 lb/in$^2$ pressure in the oxygen cylinders.

(3) Check that the stop valves on the pressure bulkhead are OPEN.

(4) Check all pipes (3/16 in. copper and 5/16 in. L.A. piping) and components from the charging valve to the regulators for leaks, using a solution as detailed in A.P.107D-0001-1

**Note . . .**

*If a leak is found it is generally caused by dirt on the nipple or branch mating face; this is remedied by cleaning and degreasing the faulty fitting. If the leak persists, the fitting should be renewed.*

(5) On completion of the test all traces of the solution must be removed.

(6) Return the regulator ON/OFF valves to ON and wire-lock using 28 s.w.g. enamelled copper wire.

**System functional test**

**11.** Test the functioning of the system and system components as follows:-

(1) Ensure there is between 1700 lb/in$^2$ and 1800 lb/in$^2$ pressure in the oxygen cylinders.

(2) Close both high pressure stop valves on the pressure bulkhead.

(3) Exhaust the system forward of the stop valves by depressing the valve in the free end of the pilot's flexible hose connection and operating the pilot's oxygen regulator EMERGENCY – PRESS TO TEST MASK switch.

(4) Open the stop valve on the port side of the pressure bulkhead. Pressure indication will rise rapidly on the forward contents gauge, and slowly on the rear contents gauge, registering an acceptable leak through the non-return valve in the starboard supply pipe.

(5) Close the stop valve on the port side of the pressure bulkhead.

(6) Exhaust pressure as in operation (3).

(7) Open the stop valve on the starboard side of the pressure bulkhead. Pressure indication will rise rapidly on the rear contents gauge, and slowly on the forward contents gauge, registering an acceptable leak through the non-return valve in the port supply pipe.

(8) Open the stop valve on the port side of the pressure bulkhead.

(9) Ensure that the flexible hose is down to the flange at the pilot's ejection seat break point and that the oxygen hose will pull-off with a force of between 1 lbf and 3 lbf.

(10) Make the following checks at all three oxygen regulators.

(a) Ensure that each regulator pressure gauge indicates between 200 lb/in$^2$ and 400 lb/in$^2$. If the indicated pressure at the regulator gauge is greater or less, the pressure reducing valve is suspect and should be tested as detailed in the relevant A.P. *(Table 1).*

(b) Test each regulator for internal leakage by removing the locking wire and switching the ON/OFF valve to OFF, then check the pressure drop on the regulator gauge. This must not exceed 25 lb/in$^2$ in 60 seconds. Switch the regulator ON.

(c) Test the integrity of the low-pressure pipe by setting the air inlet shutter on each regulator to NORMAL, insert a rubber stopper in the mask socket connection, switch the emergency toggle to left or right and switch the regulator ON/OFF valve to OFF. Ensure that the time taken for the regulator pressure to drop to zero is not less than 60 seconds.

(d) Ensure that each air inlet shutter is functioning correctly by selecting 100% OXYGEN with the regulator ON/OFF valve set to OFF, and suck gently through face mask. There must be a considerable resistance to suction. Whilst still sucking move air inlet shutter to NORMAL; there must be no resistance to suction.

(11) Make the following tests using a face mask.

(a) Switch each regulator ON/OFF valve to ON and the air inlet shutter to NORMAL, ensure that the magnetic indicator, on the regulator panel, also the associated remote indicator, operates with each inhalation.

(b) Deflect the EMERGENCY toggle to the left and ensure that there is continuous oxygen flow. Repeat, after deflecting the toggle to the right. With the toggle switch returned to centre, push the toggle switch downwards; ensure that there is a continuous oxygen flow at a much increased rate. Release the toggle switch and insert a rubber stopper in the mask socket connection; ensure that at each toggle switch position (left, right and centre) oxygen ceases to flow and the magnetic indicator returns to normal.

(12) On satisfactory completion of these tests wire-lock, using 22 s.w.g.

nickel chrome wire, the stop valves on the pressure bulkhead in the fully OPEN position. Wire-lock, using 28 s.w.g. enamelled copper wire, the regulators' ON/OFF valves ON.

**Emergency oxygen control lever**

12. The pull-off load for the emergency oxygen control lever must not exceed 30 lb.

**Lubrication**

13. Refer to the WARNING proceeding para.8. The authorized lubricant for use on the screw threads of the oxygen equipment is graphited lubricating fluid (ZX-32). No other lubricant may be used. Instructions for lubrication are contained in A.P.107D-0001-1.

## REMOVAL AND ASSEMBLY

**Oxygen cylinders**

*Removal*

14. Procedure:-

(1) Remove the appropriate access panel *(Sect.2, Chap.4)*.

(2) Remove the locking wire from the high pressure stop valve in the supply line from the appropriate bank of cylinders, and fully close the valve.

(3) Unscrew the stop valve forward union, slowly open the stop valve, and allow the oxygen to escape.

(4) Disconnect the cylinder pipelines and blank off the exposed pipe ends.

(5) Release the two cylinder retaining straps by unscrewing the two turnbuckles.

(6) Remove the cylinder from the compartment.

*Assembly*

15. Assembly is a reversal of the removal procedure.

**Oxygen regulator**

*Removal*

16. Procedure:-

(1) Disconnect all electrical supplies.

(2) Disconnect the electrical plug from its socket at the rear of the regulator.

(3) Uncouple, remove and blank off the oxygen supply and delivery pipes. Blank off the exposed regulator ports.

(4) Remove the four 2 B.A. securing screws and remove the regulator.

◀ **Note . . .**

*After removal of the Post Mod 3225 oxygen regulator, the protective guard must be removed and attached to the replacement regulator prior to its installation.* ▶

*Assembly*

17. Procedure:-

(1) Position the regulator in its bracket and secure with the four 2 B.A. screws.

(2) Remove the blanks and reconnect the oxygen supply and delivery pipes.

(3) Reconnect the electrical plug to the socket.

(4) Reconnect the electrical supplies.

(5) Functionally test the regulator and system *(para.11)*.

## TABLE 1

**Principal components**

| Ref. No. | Description | Qty. per A/C | A.P. Reference |
|---|---|---|---|
| 6D/9429900 | Cylinder, Mk.10A, 2250 litres | 1 | 107D-0111-1 |
| 6D/9429896 | Cylinder, Mk.5D, 750 litres | 6 | 107D-0111-1 |
| 6D/1650 | Connector, flanged, L.P. pipe | 2 | 107D-0400C-1 |
| 6D/1644 | Emergency oxygen set, Mk.2A | 1 | 107D-1002-1 |
| 6D/2678 | Emergency oxygen set, Mk.7J | 2 | 107D-1002-1 |
| 6D/574 | Filter, Mk.1, pipeline, H.P. | 1 | 107D-0111-1 |
| 6D/2237 | Gauge, Mk.4 contents | 2 | 107D-0305-1 |
| 6D/2671 | Regulator, Mk.17F | 3 | 107D-0201-1 |
| 6D/1817 | Socket, Mk.10A, quick release | 1 | 107D-0400B-1 |
| 6D/1652 | Socket, Mk.9, quick release | 2 | 107D-0400B-1 |
| 6D/427 | Valve, Mk.1 non-return | 4 | 107D-0111-1 |
| 6D/1616 | Valve, Mk.1, pressure reducing | 2 | 107D-0512-1 |
| 6D/2244774 | Charging valve, Type 1 | 1 | |
| 6D/2244775 | Stop valve, Type 1 | 2 | |

# Chapter 11 EMERGENCY EQUIPMENT

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS

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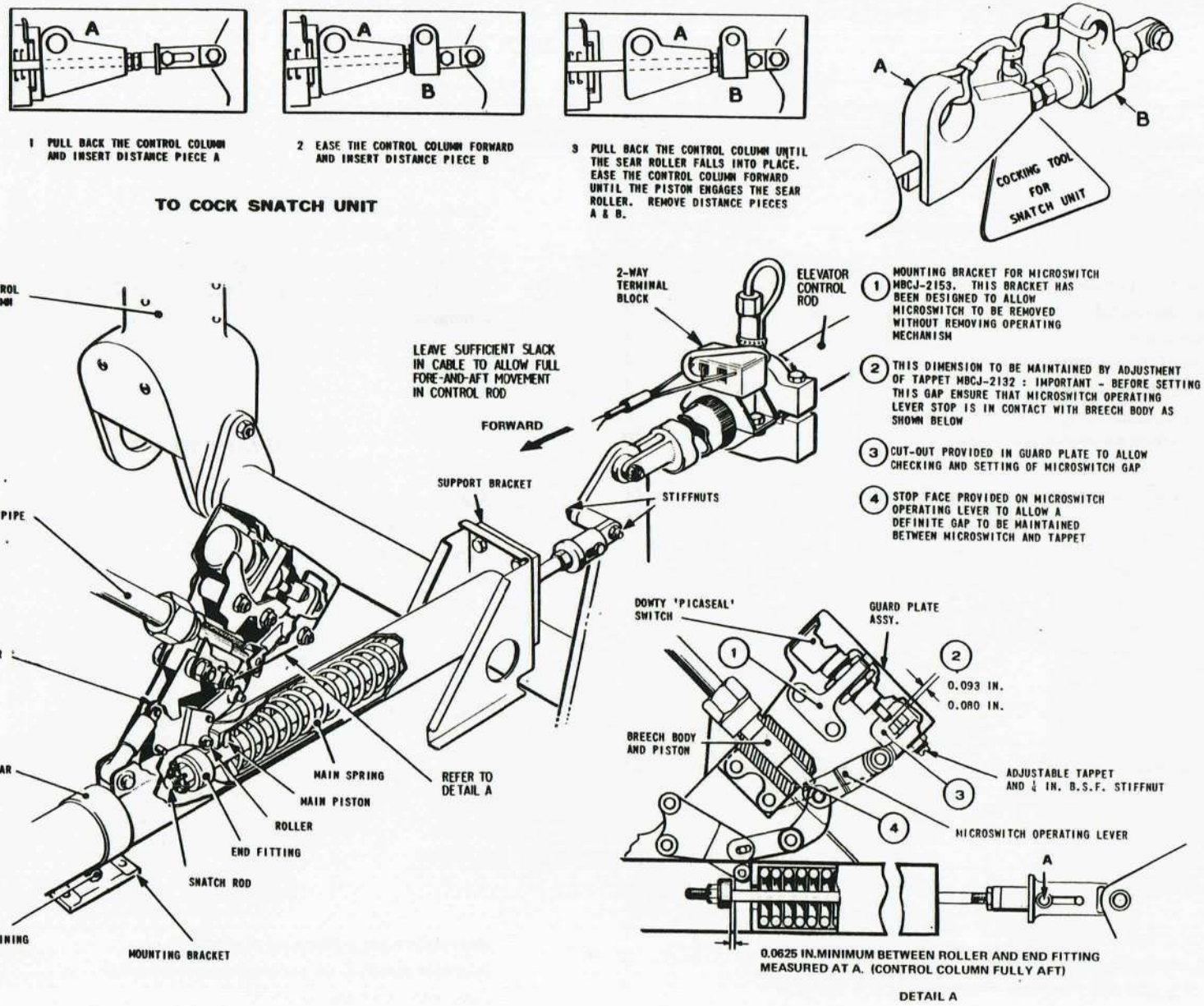



**FIG. 1. CONTROL COLUMN SNATCH UNIT**

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

## DESCRIPTION

**General information**

1. The emergency equipment comprises: Martin Baker ejection seats, with 'single-lever' facilities, for the pilot and navigator; provision for emergency lowering and raising of the alighting gear; fire detection and extinguishing systems; an aircraft destructor and provisions for jettisoning the entrance door, canopy, and navigator's hatch. Operating instructions are given in Sect.1, Chap.3.

**Canopy and hatch**

2. The pilot's canopy and the navigator's escape hatch are attached to the fuselage by bolts containing detonators; both are jettisonable by operation of the associated jettison switches.

**Ejection seats**

3. Type 2CA1 pilot, and Type 2CA2 navigator, ejection seats are fitted. The seats are described in A.P.109B-0107-1.

**Combined time-release and breech unit**

4. This unit provides the power to operate the snatch unit and incorporates a time-delay mechanism which withdraws the sear from the seat ejection-gun approximately one second after the snatch unit gun has been fired. The snatch unit gun and the time-delay mechanism are contained in separate compartments within a casing bolted to the rear of the guide rail. At the base of the snatch unit gun is a threaded union which, together with a soft metal washer, forms a gas-tight connection with a pipe which communicates with the chamber of the piston valve assembly on the top of the snatch unit. For a description of the combined time-release and breech unit Pt.No. MBSJ/159 refer to A.P.109C-0201-1.

**Control column snatch unit** *(fig.1)*

5. This unit is located within the pilot's console on the port side of the cockpit and is connected to the elevator control lever. Its purpose is to move the control column forward and hold it against the instrument panel to provide an unobstructed exit for the pilot in his ejection seat when abandoning the aircraft. An explosive severance-unit, fitted around the elevator control rod aft of the control lever and fired prior to the operation of the snatch unit, severs the elevator control rod which nullifies the effect that movement of the control column, due to the action of the snatch unit, would otherwise have upon the flying attitude of the aircraft.

6. The unit consists of a tubular casing supported at the rear end by a bracket and attached at the forward end to the aircraft structure by a collar secured to a mounting bracket by a retaining pin and split pin. The tubular casing houses a hollow piston which, when the unit is cocked, holds the mainspring under compression against the closed rear end of the casing. The piston is retained in the cocked position by a sear, the roller of which projects through the wall of the tubular casing; the sear is spring-loaded in its cocked position by the sear return spring. A snatch rod passes through the rear-end casing inside the mainspring and through the drilled head of the hollow piston, to terminate in a shouldered end-fitting carrying a rubber cushion. The other end of the rod is screwed into a slotted attachment fitting and locked by a locknut; the length of the snatch rod can be adjusted at this point. The end of the slotted attachment fitting is drilled and bushed to fit on to a shouldered stud fitted to the elevator control lever; the bush is radiused at one end and it is essential that this end faces the shouldered stud. The slot allows free movement of the snatch rod, and the rod, which is of sufficient length to allow full fore-and-aft movement of the control column, moves freely within the piston.

7. The snatch unit and the elevator control rod severance-unit detonator switch (which is mounted on a bracket secured to the snatch unit) are controlled by the ejection seat face-screen, or seat-pan, firing handle. When either handle is operated a cartridge is fired in the combined time-release and breech unit *(para.4)* from which the resultant gas pressure is directed through a pipe to a valve piston assembly mounted on the top of the snatch unit. The valve piston engages a boss at the interconnection of the sear operating lever and the microswitch operating lever. The sear operating lever is pivoted at its centre on the snatch unit and is inter-linked at its lower end to the sear; the microswitch operating lever, which is pivoted on the mounting plate, has an adjustable tappet at its switch end and a stop face at the other end, which bears against the breech casing of the valve piston assembly. The gas pressure forces the piston against the

COCKING OF HATCH JETTISONING MECHANISM

1 INSERT COCKING LEVER INTO COCKING LINK APERTURE

2 MOVE COCKING LEVER TO STARBOARD AND ENGAGE ON LOCKING PEG.

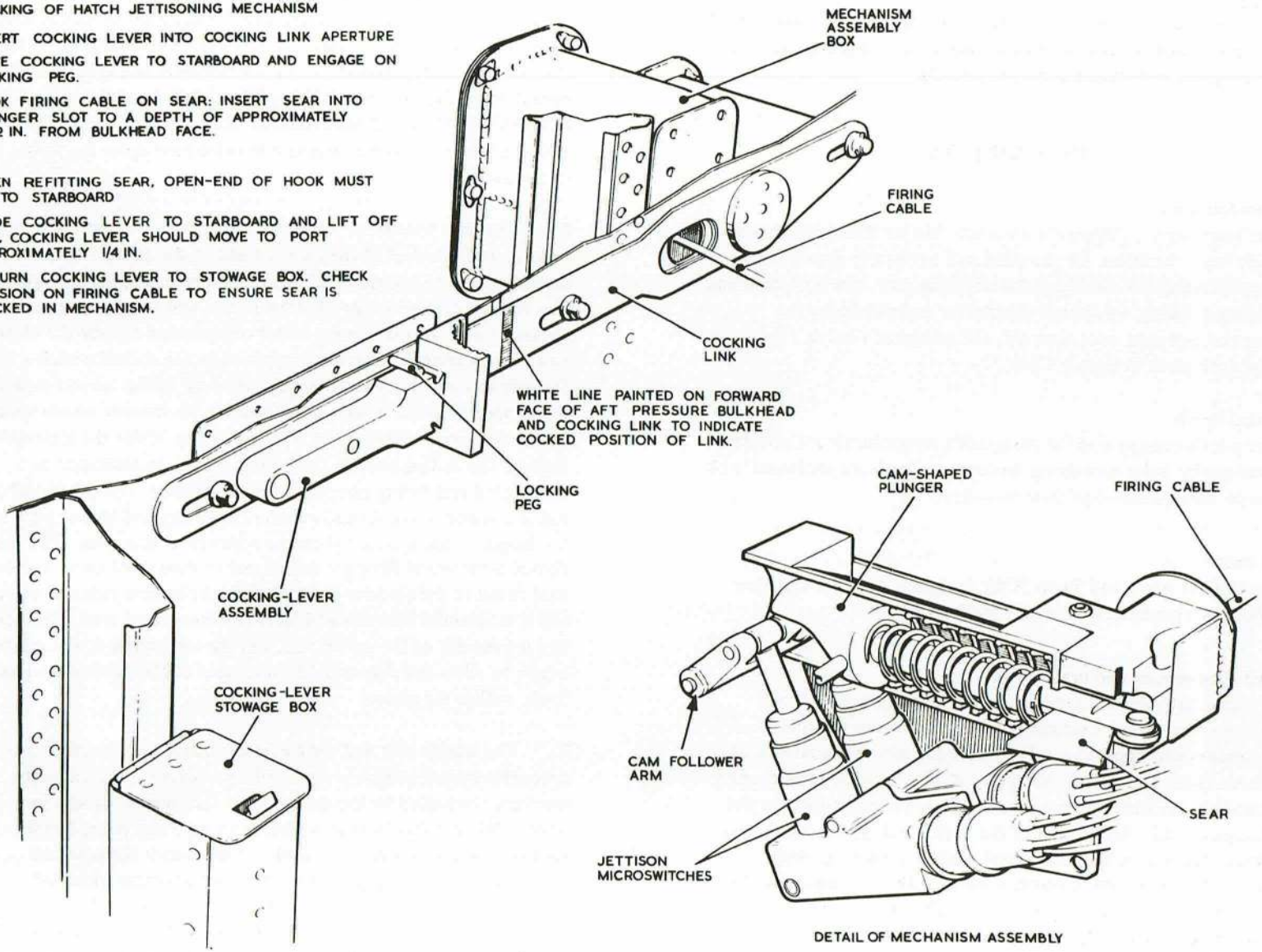
3 HOOK FIRING CABLE ON SEAR: INSERT SEAR INTO PLUNGER SLOT TO A DEPTH OF APPROXIMATELY 2 1/2 IN. FROM BULKHEAD FACE.

NOTE....

WHEN REFITTING SEAR, OPEN-END OF HOOK MUST BE TO STARBOARD

4 SLIDE COCKING LEVER TO STARBOARD AND LIFT OFF PEG, COCKING LEVER SHOULD MOVE TO PORT APPROXIMATELY 1/4 IN.

5 RETURN COCKING LEVER TO STOWAGE BOX. CHECK TENSION ON FIRING CABLE TO ENSURE SEAR IS LOCKED IN MECHANISM.




DETAIL OF MECHANISM ASSEMBLY

FIG. 2. HATCH JETTISONING MECHANISM

boss and rotates both levers, the sear operating lever withdraws the sear and the microswitch operating lever operates the microswitch, the severance unit charge being exploded before the snatch unit operates. Operation of the firing handle also trips the release of the combined time release and breech unit which, after a delay of one second, withdraws the ejection-gun sear, to initiate seat ejection.

8. The action of releasing the sear frees the hollow piston which, under the force of the mainspring, is propelled along the interior of the casing and contacts the end fitting of the snatch rod; further extension of the spring moves the snatch rod forward and, through the elevator control lever, rotates the elevator torque shaft and moves the control column forward against the instrument panel.

**Hatch jettisoning single lever ejection**

9. The single lever ejection system for the navigator comprises a Type 2 CA2 Mk.2 ejection seat and a hatch-jettisoning mechanism which is secured to the rear face of the pressure bulkhead. The ejection gun of this seat has a breech-type time-delayed firing unit fitted with a restrictor and safety catch *(A.P.109C-0206-1)*, the latter being connected to the hatch by a secondary firing cable. The seat-firing cable is bifurcated, one leg being connected to the ejection-gun sear and the other to the sear of the hatch-jettisoning mechanism.

**Hatch jettisoning mechanism box** *(fig.2)*

10. This unit is mounted on the aft face of the pressure bulkhead and is positioned behind the navigator's ejection seat; its purpose is to initiate automatic jettisoning of the hatch prior to ejection of the navigator's seat. The box is sealed to the bulkhead to prevent pressurized air from the cabin escaping to atmosphere via the sear and cocking-lever apertures.

11. The box houses two microswitches, which when operated complete the circuit to the hatch detonators, and a tubular casing containing a spring-loaded plunger which is cam-shaped at one end. The plunger, when cocked, holds the mainspring in compression against the closed end of the casing and is retained in that position by a sear which is attached to the seat-firing cable. A cam-follower assembly, comprising three rollers mounted on a pivoted arm, transmits the contours of the cam to the microswitches.

12. When either firing handle of the associated ejection seat is operated, one leg of the bifurcated firing cable withdraws the sear from the breech-type time-delayed firing unit. Withdrawal of the sear causes the firing pin to rise slightly and its roller is immediately trapped by the restrictor pawl; a safety catch positioned in the restrictor jaws prevents the release of the firing pin. Simultaneously, the other leg of the bifurcated firing cable withdraws the sear from the hatch-jettisoning mechanism and, under the influence of its spring, the cam-face of the plunger forces the cam-follower to operate the microswitches. This completes the circuit to the hatch detonators and the hatch is blown off. As the hatch leaves the aircraft the secondary firing cable withdraws the safety catch from the restrictor of the firing unit and the firing pin is thereby released to fire the ejection gun, which it does after a delay of approximately one second.

**Secondary firing cable**

13. The upper end of the cable is connected to the hatch by a steel shackle pin and secured by a washer and split pin; the lower end is similarly connected to the safety catch in the breech-type time-delayed firing unit. The purpose of the cable is to withdraw the safety catch from the ejection-gun firing unit as the hatch leaves the aircraft, thereby ensuring correct sequencing of hatch jettisoning and seat ejection.

**Alighting gear emergency lowering control** *(fig.3)*

14. The emergency control for lowering the alighting gear is a black-and-yellow striped T-shaped handle situated to port of the instrument-flying panel; it is connected by cable to a spring-loaded lever on the alighting-gear selector in the flare bay. The control is locked in the operated position by a wire spring, contained in the shaft of the handle, which hooks over the end of the control housing when the handle is fully extended. For resetting instructions refer to para.28.

15. The control cable passes over pulleys behind the instrument panel, aft down the port side of the fuselage, through the pressure bulkhead and equipment compartment, and into the flare bay where it is connected to the lever on the alighting-gear selector. The lever is spring-loaded to the off position.

**Alighting gear emergency raising control**

◀ 16. The UP mechanical lock can be overriden in an emergency, or if required during servicing, by turning the knobbed ring which encircles the UP button, clockwise through 60 deg. (or 90 deg. according to type) and then depressing the button in the normal manner. If an UP selection ▶

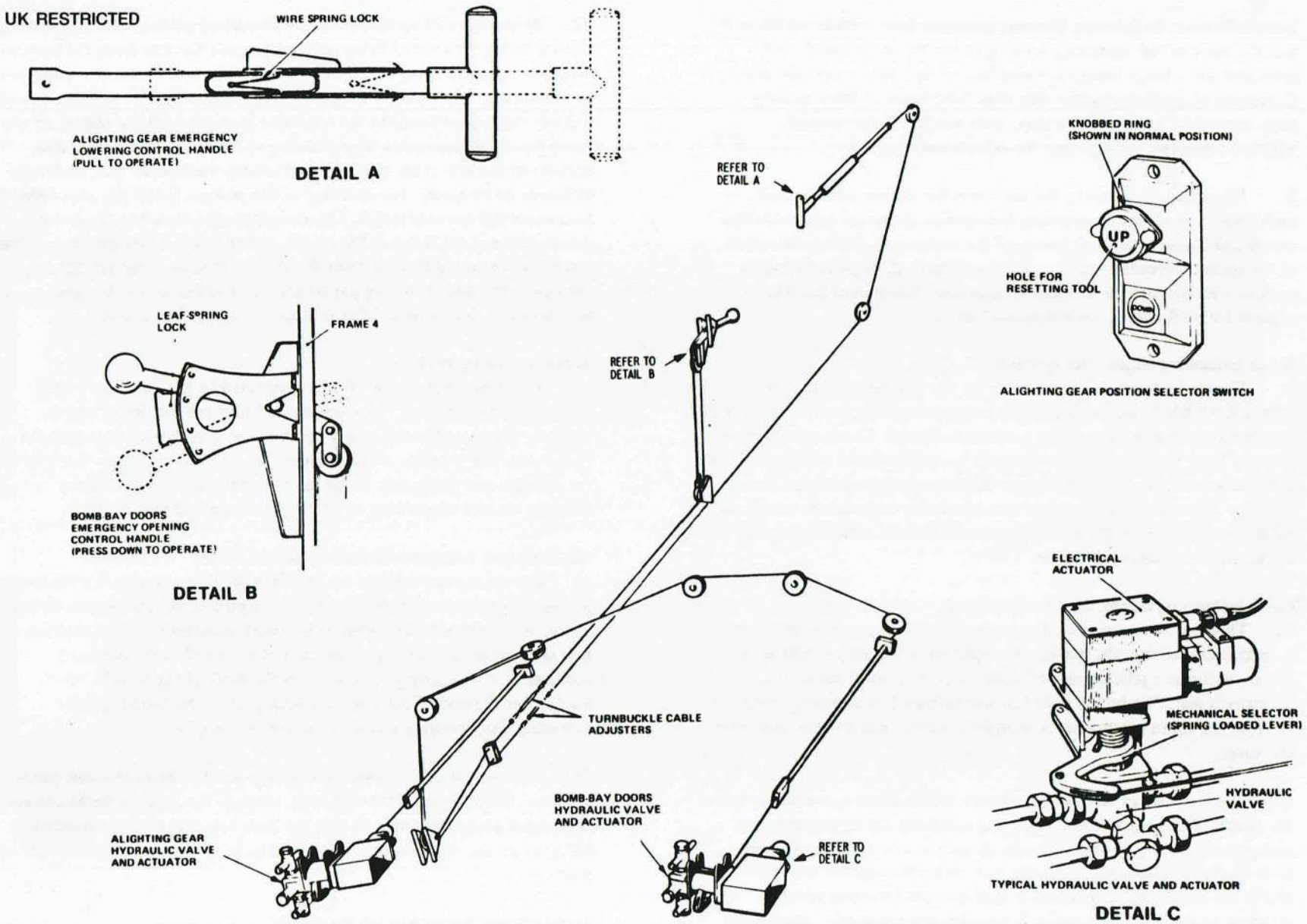



FIG. 3. ALIGHTING GEAR AND FLARE-BAY DOORS EMERGENCY CONTROLS

is made this way, the mechanical lock will remain inoperative until reset. To reset, lightly depress the DOWN selector button and hold depressed. Insert into the small hole in the face of the selector button a resetting tool (see Section 2, Chapter 4, Table 2). Exert a steady pressure on the reset tool to overcome internal spring tension until the UP button rises and the knobbed rig rotates counter-clockwise to its normal position (the knob horizontal to the switch body) under its own internal spring pressure. Ensure that the UP button cannot be depressed using normal finger pressure.

**WARNING**

**Under no circumstances must the knobbed ring be turned past the 60 deg. (or 90 deg.) stop as such action will damage the switch, and may result in inadvertent retraction of the alighting gear. Similarly it is important that returning the UP selector button to normal mode be carried out as detailed. Any attempt to reset it by any other method, or by using a different tool will cause damage to the switch mechanism.**

**Flare-bay doors emergency opening control** *(fig.3)*

**17.** The emergency control for opening the flare-bay doors is a black-and-yellow striped lever situated on the port side of the cabin; it is connected by a cable to a spring-loaded lever on the flare-bay doors selector in the flare-bay. The control is locked in its operated position by a leaf-spring lock incorporated in the lever bracket. For resetting instructions refer to para.28.

**18.** The control cable is anchored to a bracket on the port side of the fuselage and passes upward over a pulley on the end of the control lever, then down and along the port side of the fuselage, parallel with the cable for the alighting gear emergency lowering control, into the flare bay. Within the flare bay the cable passes over to the starboard side where it again passes aft to the lever on the flare-bay doors selector. The lever is spring-loaded to its off position.

**Entrance door jettisoning mechanism** *(fig.4)*

**19.** This is contained within the frame of the door aperture at its upper side. A horizontal shaft carries a hinge-pin bearer cup at each end; a wormwheel, pinned to the centre of the shaft, is meshed with a worm on the shaft of the door-jettisoning handle. The horizontal shaft is carried in three bearings, one at either end and one, a double bearing, in the centre; the centre bearing, in addition to locating the wormwheel, also forms the bearing for the shaft of the jettison handle. The aft collar of the shaft is designed to stop the shaft at the extremes of rotation (i.e. door safe or unsafe) by abutting integral lugs on the aft bearing housing.

**20.** The door carries two hinge brackets on its upper frame, each bracket having a freely rotating hinge-pin which extends outward on either side. The hinge-pins are accommodated in the hinge-pin cups, which, in the safe condition, are rotated so that their slots are facing inboard, thereby forming sockets in which the hinge-pins are retained. The position of the hinge-pins relative to the cups is adjusted during initial assembly by guide bolts which project through the inboard face of the bearings and bear on the inner face of the door hinge brackets.

**21.** When the door is assembled to the fuselage and the mechanism is in the safe condition, the slots in the hinge-pin cups are facing inboard and the door is retained in the door aperture; in this condition the jettison handle has been rotated in a counter-clockwise direction. To jettison the door, the handle is rotated in a clockwise direction, thereby revolving the horizontal shaft and hinge-pin cups until their slots face outboard and permit the door to fall away from the aircraft. To facilitate ground servicing the door may be removed by this means.

**Fire protection system**

**22.** Refer to Sect.4, Chap.5.

**Aircraft-destructor stowage**

**23.** This is attached to the inner surface of the starboard equipment bay door.

**Sonar locator beacon**

◀ **23A.** The beacon is located in the port wheel well, attached to the diaphragm, outboard of the wheel well rib. ▶

## SERVICING

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**Ejection seats**

**24.** Refer to para.3 and A.P.109B-0107-5F.

**Combined time-release and breech unit**

**25.** Refer to para.4 and A.P.109C-0201-5F

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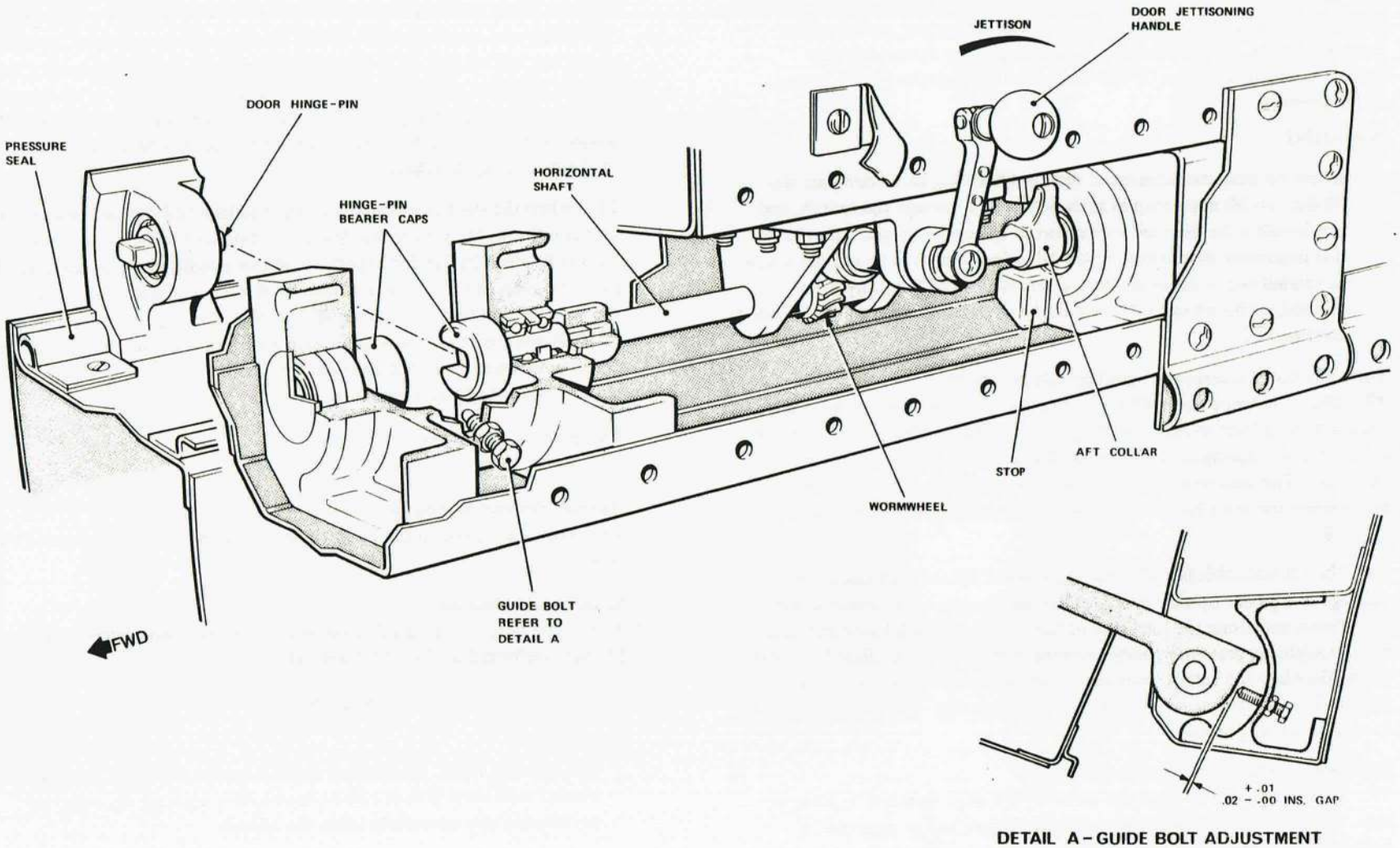



FIG. 4. ENTRANCE DOOR JETTISONING MECHANISM

**Cocking the snatch unit**

26. Refer to para.5 and fig.1.

**Cocking the hatch jettisoning mechanism box**

27. Refer to para.10 and fig.2.

**Resetting the alighting gear lowering and flare-bay doors emergency controls**

**Note . . .**

*Ensure that the aircraft is raised on jacks (Sect.2, Chap.4) before resetting the alighting gear emergency lowering control.*

28. Exhaust hydraulic pressure and electrically select the alighting gear actuator to UP or the flare-bay doors actuator to CLOSED before resetting the emergency control. Both procedures are similar. In the case of the alighting-gear control, press in the ends of the spring lock in the shaft and push the handle into its housing, in that of the flare-bay doors control, move the leaf-spring outboard and return the handle to the UP position. After resetting the controls, lock the handles in position with 0.355 mm enamelled copper tell-tale/restraint wire; check that the levers on the respective selectors have been returned to the off position and that they are bearing on their stops, repack the sealing washers where the cables pass through the pressure bulkhead *(Sect.3, Chap.8)*. Carry out a functional test of the normal system for correct operation.

29. Deleted.

**Lubrication**

30. Controls of emergency equipment are lubricated on assembly and, except where detailed in appropriate chapters of this volume and in A.P.101B-0400-5 series require no further lubrication.

## REMOVAL AND ASSEMBLY

**WARNING**

**The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cabin or performing any operations upon the aircraft.**

**Ejection seats** *(fig.6)*

*Navigator's seat*

31. Remove the navigator's seat as follows:-

(1) Remove the navigator's hatch *(Sect.3, Chap.1)*.

(2) Remove the cartridges from the ejection and drogue guns *(A.P.109A-0001-1)*.

(3) Disconnect the leg-restraining straps by withdrawing the quick-release pins.

(4) Disconnect the emergency oxygen cable at the anchor hook.

(5) Remove the bolts securing the mic/tel socket.

(6) Disconnect the air ventilated suit hose (if fitted) at the shut-off valve.

(7) Disconnect the demand oxygen hose at the flanged connector.

(8) Disengage the top stops with tool Pt.No. MBEU 13935/A to release the seat from the rail, then slide the seat out through the escape hatch aperture.

32. Assembly of the navigator's seat is a reversal of the removal operations.

*Pilot's seat*

33. Remove the pilot's seat complete with guide rail, refer to A.P.109B-0107-1 and proceed as follows:-

(1) Remove the cartridges from the ejection gun, drogue gun and the time-release and breech unit *(A.P.109A-0001-1)*.

(2) Disconnect the leg-restraining straps by withdrawing the quick-release pins.

(3) Disconnect the seat pan firing handle from the bracket, then remove the seat pan in accordance with A.P.109B-0107-1.

(4) Disconnect the gas pipe from the time-release and breech unit.

(5) Remove the top two bolts securing the guide rail to the adjacent structure.

(6) Disconnect the emergency oxygen cable at the anchor hook.

(7) Disconnect the demand oxygen hose from the flanged connection.

(8) Remove the two bolts securing the mic/tel socket to the bracket on the guide rail.

(9) Disconnect the air ventilated suit hose (if fitted) at the shut-off valve.

(10) Secure all loose items.

(11) Remove the bottom two bolts securing the guide rail to the adjacent structure.

(12) Withdraw the seat and guide rail through the cabin entrance door aperture.

34. Assembly of the pilot's seat is a reversal of the removal procedure.

**Snatch unit**

**WARNING**

**Some Control Column Snatch Units have been fitted with a shortened snatch rod to overcome rigging problems. Whenever a CCSU is removed or refitted the ADD Log of the aircraft concerned is to be consulted to ensure that an EA approved concession has been granted and recorded. Under no circumstances is a standard rod to be fitted in lieu of a shortened rod or vice versa.**

*Removal*

35. Procedure:-

(1) Disconnect all normal, emergency and ground electrical supplies.

(2) Remove the time-release and breech unit cartridge *(A.P.109C-0201-1)*.

(3) Remove the forward inboard side panel from the pilot's console.

(4) Remove the elevator severance unit detonator *(para.38)*.

(5) Disconnect the microswitch electrical leads at the six-way terminal block.

(6) Remove the locking wire and disconnect the gas pipe from the valve piston chamber.

(7) Remove the stiffnut and washer and disconnect the snatch rod from the elevator control lever.

(8) Remove the split pin from the tubular casing forward retaining pin and withdraw the retaining pin from the mounting bracket.

*Assembly*

36. This is the reverse of the removal procedure but the following points should be noted:-

**(1) The microswitch clearance is to be as shown in fig.1 and cables routed as in fig.7.**

(2) After assembly make electrical checks *(Sect.5, Chap.1, Group W)*.

(3) The snatch unit is to be tested as detailed in the relevant Servicing Procedure detailed in A.P.101B-0407-5A3.

37. Upon completion of the instructions detailed in the previous paragraph, and whenever the elevator control circuit is readjusted or

◀ the snatch unit is test fired and reset:-

(1) Move the control column aft until the elevator bulkhead stop is contacted. At the same time closely observe the sear return spring and the sear operating lever on the snatch unit for movement.

(2) Movement indicates that the snatch rod is fouling the sear which may result in premature operation of the snatch unit. Where movement ▶ is found, check, and if necessary adjust, the setting of the elevator bulkhead stops *(Chap.4)*.

(3) Check, by applying hand pressure to the snatch-unit rod, that, with the control on the bulkhead stop, it is capable of a minimum of 0.0625 in. free travel between contacting the end of the slot in its attachment fitting at the elevators control lever and contacting the sear. If necessary adjust the length of the snatch rod *(para.6)*.

**Elevator control rod severance unit** *(fig.5)*

*Removal*

38. Procedure:-

(1) Disconnect the normal, emergency and ground electrical supplies.

(2) Remove the centre access panel from the inboard side of the pilot's console.

(3) Disconnect the detonator and input cables at the terminal block mounted on the control rod.

**WARNING**

**Before handling detonators refer to the LETHAL WARNING marker card at the beginning of this book.**

(4) Unscrew the detonator securing nut and remove the detonator from the detonator chamber.

(5) Ensure that red bands have been painted in the correct position on the control rod on either side of the severance unit assembly. Renew paint if necessary.

(6) Supporting the lower section of the explosive collar, remove the securing nuts and bolts and remove the two sections of the explosive collar from the control rod.

*Assembly*

39. This is a reversal of the removal procedure *(para.38)* but great care must be taken to ensure that fig.5 dimensions and instructions are strictly adhered to and the following points noted:-

(1) When tightening the explosive collar securing nuts, care must be taken to pull the nuts up evenly to prevent damage to the foil covering the explosive filling.

(2) Ensure that the detonator rests on the explosive filling before tightening the detonator securing nut. For information on the assembly of the detonator refer to A.P.110N-0306-1.

(3) After refitting the access panel removed in para.38 (2), move the control column through its full fore-and-aft travel to ensure that the severance unit assembly does not foul the access panel or surrounding structure.

UK RESTRICTED

ASSEMBLY NOTES

NOTE ....

1. LOCATE THE TERMINAL BLOCK AND CLAMP ASSEMBLY HARD UP AGAINST THE NIPPLE, AS INDICATED BY ARROW A, AND SECURE IN THE VERTICAL POSITION AS ILLUSTRATED. ( THE VERTICAL POSITION IS DETERMINED BY ROCKING THE ELEVATOR CONTROL ROD ABOUT ITS LONGITUDINAL AXIS AND SETTING IT IN THE MID POSITION).

2. PAINT THE RED BAND ADJACENT TO THE CLAMP ASSEMBLY

3. LOCATE THE EXPLOSIVE COLLAR IN THE VERTICAL POSITION HARD UP AGAINST THE TERMINAL BLOCK. TIGHTEN THE SECURING NUTS UNTIL THE RUBBER SPACERS BULGE AND THE EXPLOSIVE COLLAR IS SECURE AGAINST MANUAL ROTATION.

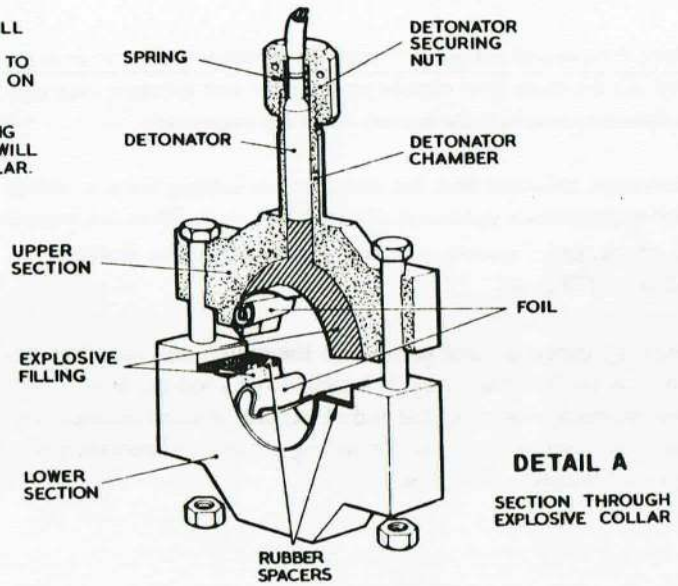
4. AFTER CONNECTING THE DETONATOR CABLE SECURE EXCESS CABLE AS ILLUSTRATED. (USE TYTON STRAPPING 5E/1147500 AND STUDS 5E/1147501).

5. WHEN CONNECTING THE INPUT CABLE ALLOW SUFFICIENT SLACK FOR FULL FORE-AND-AFT TRAVEL OF THE CONTROL ROD. THIS LENGTH IS NOT TO EXCEED 9 IN. BETWEEN THE LAST 'P' CLIP AND THE CENTRE OF THE TERMINAL BLOCK.

WARNING:

1. GREAT CARE IS TO BE EXERCISED DURING ALL EXPLOSIVE COLLAR FITTING, REMOVAL AND LOCATING OPERATIONS TO PREVENT DAMAGE TO THE FOIL COVERING THE EXPLOSIVE FILLING ON THE INNER PERIPHERY OF THE COLLAR.

2. TIGHTEN DOWN THE DETONATOR SECURING NUT FINGER TIGHT ONLY. EXCESSIVE FORCE WILL CAUSE BULGING OF THE FOIL ON THE COLLAR.



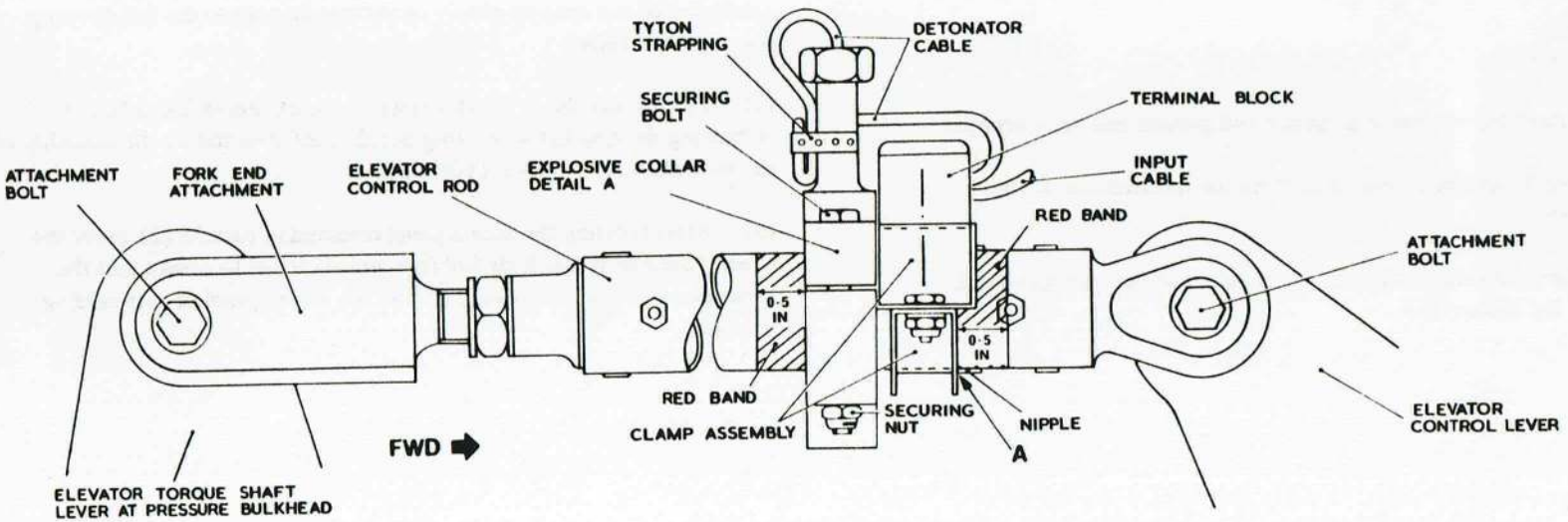




FIG.5. ELEVATOR CONTROL ROD SEVERANCE UNIT ASSEMBLY

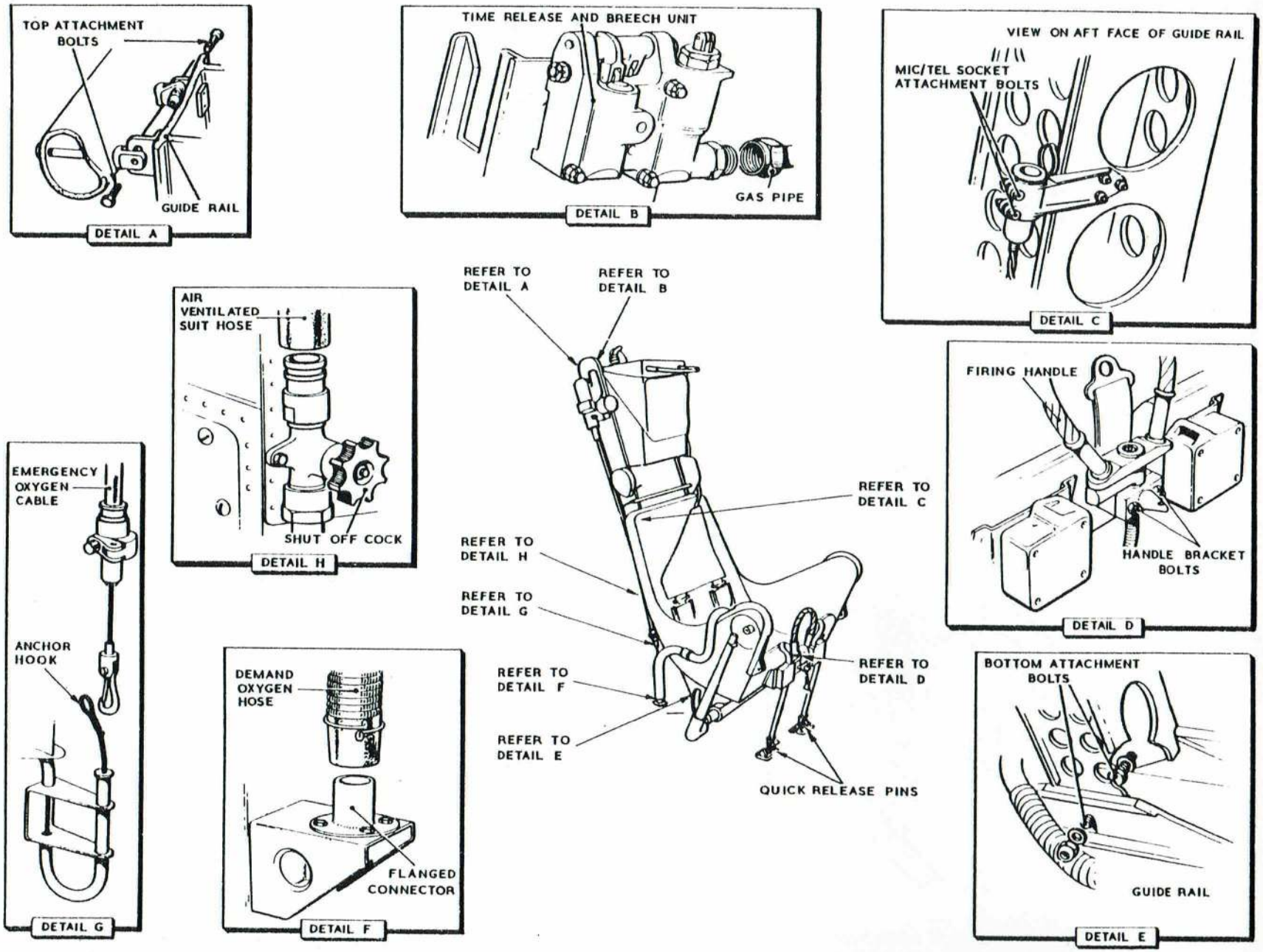



FIG.6.PILOTS EJECTION SEAT REMOVAL

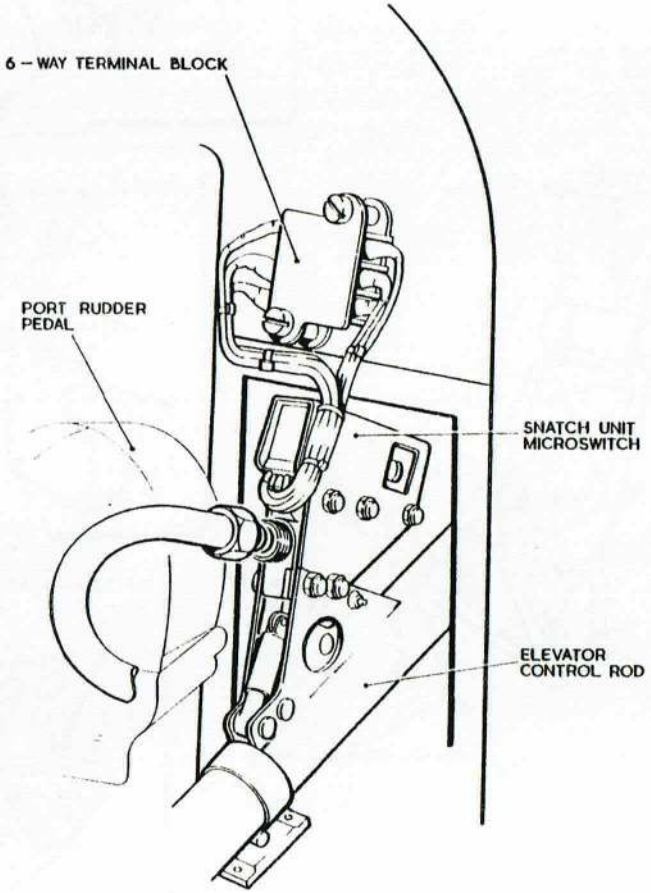
ASSEMBLY NOTES

WHEN CONNECTING A SNATCH UNIT MICROSWITCH AND/OR ELEVATOR DETONATOR TO THE 6-WAY TERMINAL BLOCK PROCEED AS FOLLOWS:-

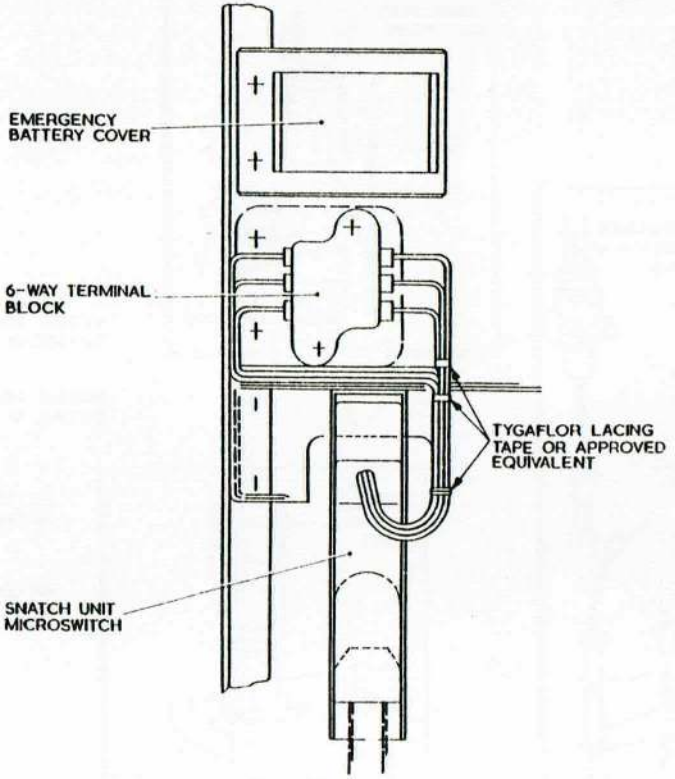
1. ROUTE CABLES OUTBOARD FROM THE MICROSWITCH TO THE TERMINAL BLOCK AS SHOWN.
2. CABLES ARE TO BE CUT TO THE MINIMUM LENGTH REQUIRED TO REACH THE TERMINAL BLOCK.
3. BIND CABLES TOGETHER AND WHERE POSSIBLE BIND TO ANY ADJACENT CABLES TO KEEP IN POSITION.
4. WHERE NECESSARY CRIMP NEW 4BA TAGS, HELLERMANN REF. HE.294 TO RELEVANT CABLES.

WARNING

ENSURE THAT THE CABLES ARE ROUTED AND SECURED SO THAT THEY CANNOT PROTRUDE INTO THE PILOT'S FOOTWELL BEYOND THE EMERGENCY BATTERY ACCESS PANEL.




ELEVATOR SNATCH UNIT MICROSWITCH WIRING
VIEW LOOKING AFT PORT SIDE




ROUTEING OF CABLES

FIG. 7 CONTROL COLUMN SNATCH UNIT - CABLE ROUTEING

◄ NEW ILLUSTRATION ►

*101B-0407-1A/188/8233508/204/2-83/BAe/1307*