

**SECTION 3**

**AIRFRAME**

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SECT

3

## Chapter 1 FUSELAGE

(Completely revised)

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### Introduction

1. This chapter gives descriptive and servicing information on the fuselage construction, the crew's seat installation and the operation of the hinged nose, the navigator's frangible escape hatch, cockpit hood, flare bay and camera doors. Instructions are given for removing and installing the main components of the fuselage, including where necessary, the methods of jacking, trestling and slinging.

2. Due to its extensive nature the chapter has been divided so that the more involved installations and mechanisms are dealt with separately and completely,

each under its own main heading as indicated in the List of Contents.

### Camera installation

3. Provision is made for the installation of cameras at the hinged nose, the front fuselage, fore-and-aft of the centre fuselage and in the rear fuselage. Hydraulically operated doors are fitted over the camera apertures at the centre and rear fuselage positions, these and the relevant fixed mounting structures are dealt with in this chapter. For information on the various roles, the installation of cameras and their controls, refer to Sect. 5, Chap. 2.

## FUSELAGE STRUCTURE - GENERAL

### DESCRIPTION AND OPERATION

4. The fuselage is circular in section and of stressed skin, all-metal construction. Two transport joints divide the structure into three main units, front fuselage, centre fuselage and rear fuselage; details of these joints are shown in fig. 12 and 13.

In general the structure consists of channel-section

transverse frames which, except those at the joints and positions requiring reinforcement, are cut away on the outer edges to accommodate longitudinal stiffeners. The light alloy skin is riveted to the structure and reinforced where necessary by doublers. Fig. 1 illustrates the disposition of the fuselage sections and frames within the structure.

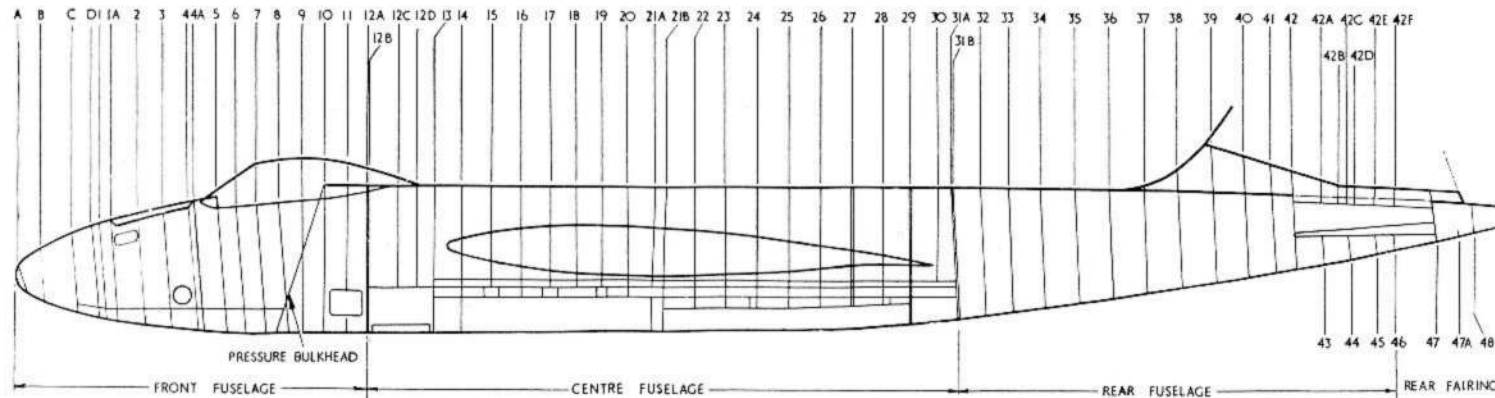


Fig. 1 Frame stations

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## FRONT FUSELAGE

5. The front fuselage (fig. 2) incorporates the pressurized cabin for pilot and navigator, extending from the front of the hinged nose at frame A for approximately two-thirds of the front fuselage unit, terminating at a reinforced sloping pressure bulkhead between frames 8 and 10. The nose undercarriage bay occupies the lower central portion of the fuselage between the pressure bulkhead and the bulkhead of the transport joint at frame 12A. The spaces on either side of the

undercarriage bay, formed by its vertical walls and the port and starboard skin sheeting, and above by a floor section and top skin sheeting provide three equipment compartments, each with its own access door.

Pressurized cabin

6. The pressurized cabin is entered at the pilot's station through the canopy aperture via an external ladder against the port side, and at the navigator's

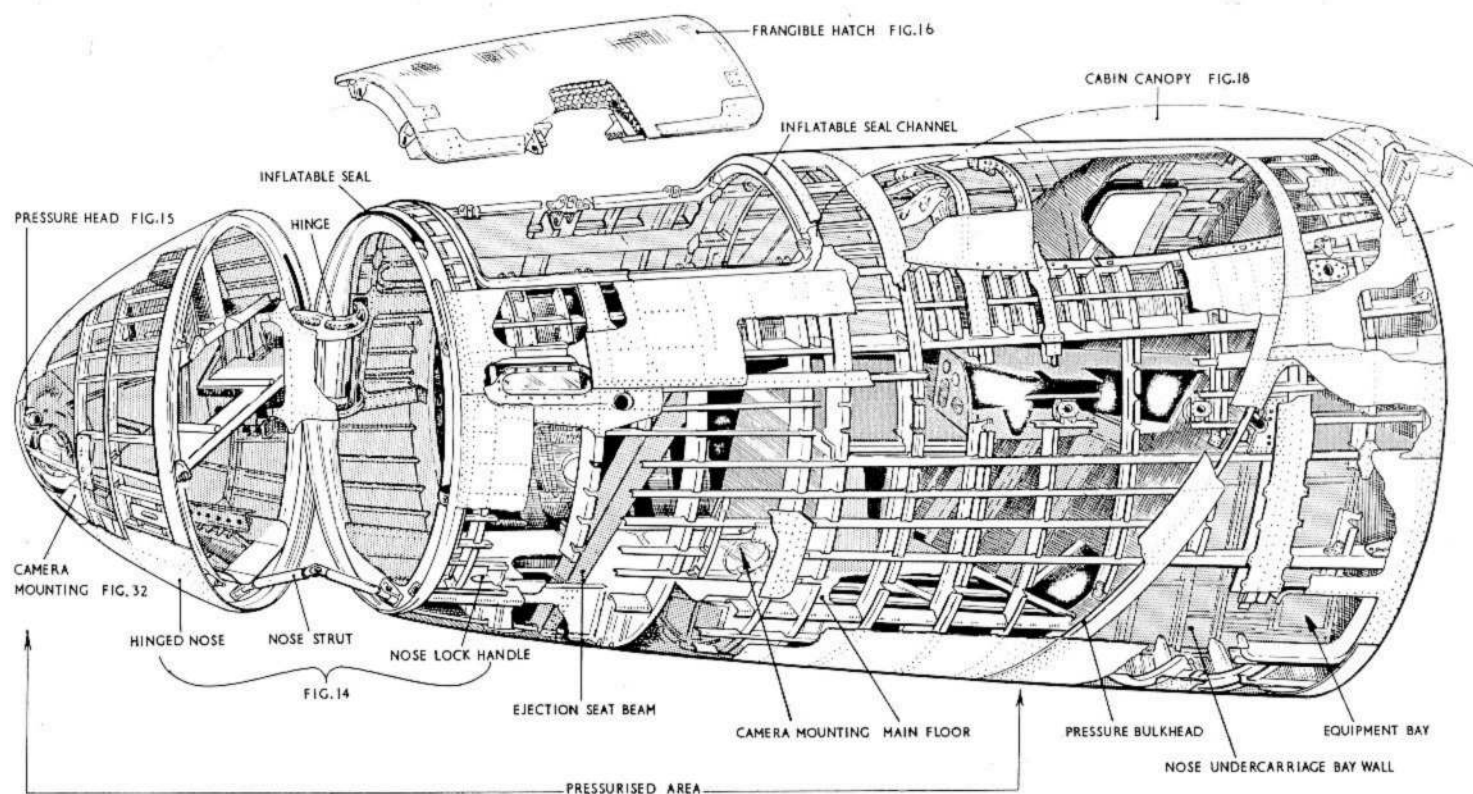


Fig. 2 Front fuselage construction

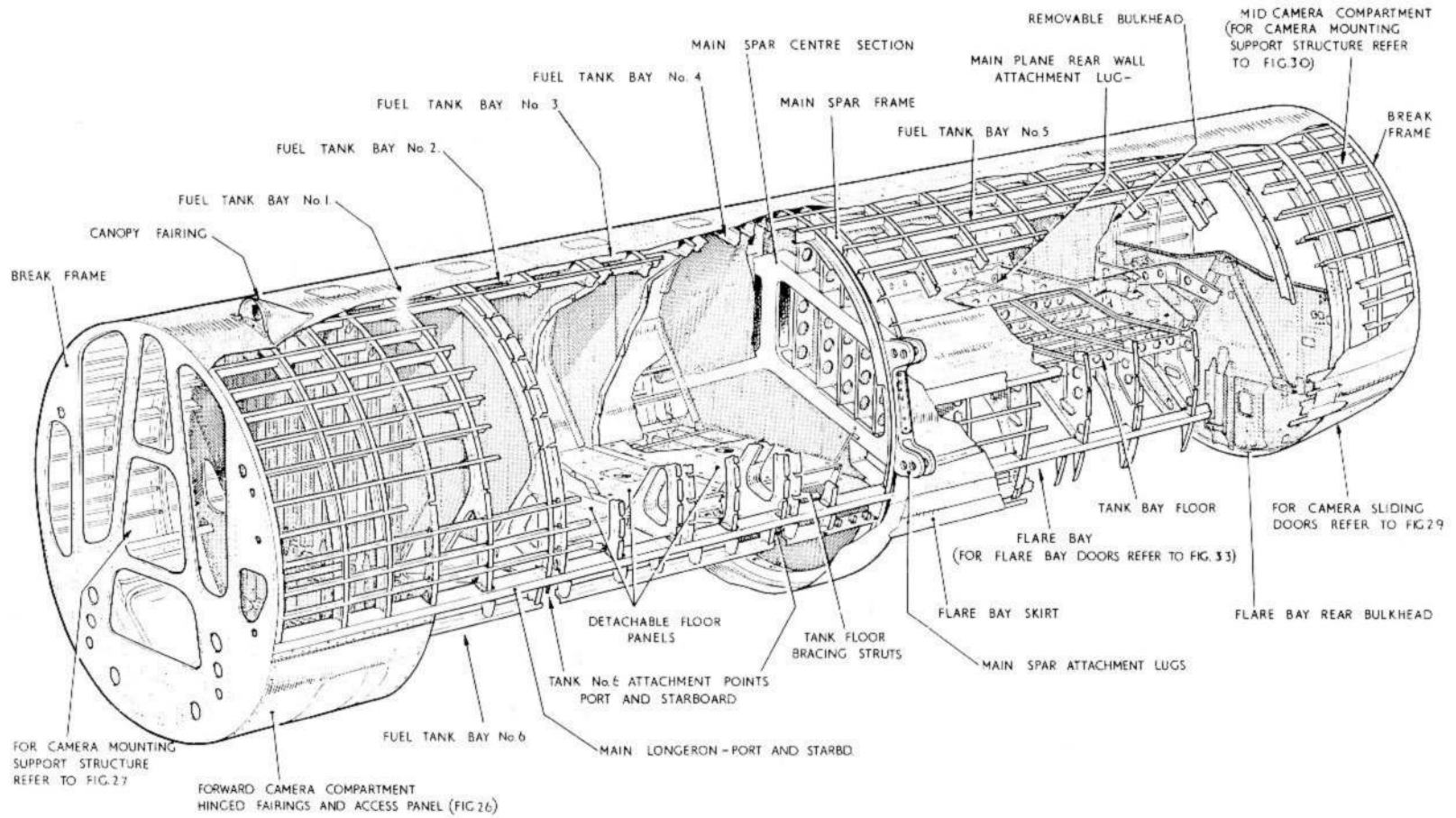


Fig. 3. Centre fuselage construction

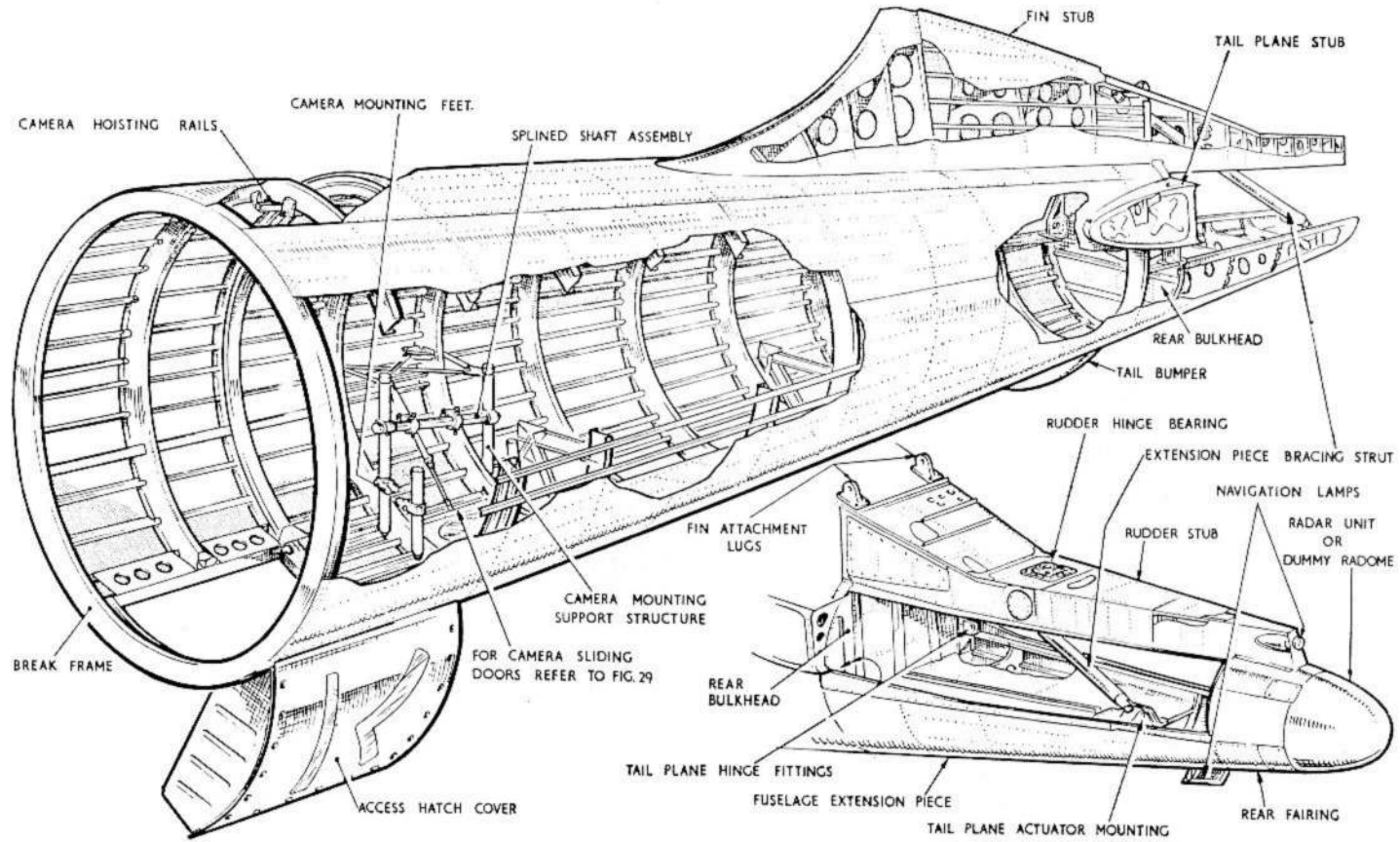


Fig. 4. Rear fuselage construction

station through the hinged nose which is automatically pressure sealed on closure. Mod. 3720 introduces an electrically operated cabin pressure dump valve on the aft face of the pressure bulkhead to increase the navigator's escape facility.

#### Navigator's roof hatch

7. The navigator's station in the front fuselage between frames 1 and 5 is provided with a hatch of frangible fibre glass secured to the aperture coamings at eight strong points by mechanically-operated shoot-bolts. An inflatable pressure seal is accommodated in a channel attached to the surrounding structure.

#### Navigator's windows

8. Two windows are provided at the navigator's station, set into the fuselage aft of frame 1A immediately below the escape hatch coamings at port and starboard. The windows are fitted as inner and outer transparent plastic panels with a sealed interspace served by the dry air de-misting system (Sect. 3, Chap. 8).

### CENTRE FUSELAGE

9. The centre fuselage (fig. 3) carries the main fuel tanks and houses the front and mid camera compartments and the flare bay. Between the camera compartments, which are situated at each end of the unit, the fuselage is divided by floors into upper and lower compartments. Forward of the spar frame, fitted approximately midway between the break frame, the upper compartment is divided by bulkheads into four fuel tank bays (tanks Nos. 1, 2, 3 and 4). Below the floor at this position is carried the belly tank (tank No. 6), which is of metal construction, shaped to the fuselage profile, and suspended by metal straps attached to trunnions on the fuselage longerons (Sect. 4,

Chap. 2). Aft of the spar frame and extending above floor level to a removable bulkhead just forward of the mid camera compartment, is the bay for fuel tank No. 5. The floor, extending from the spar frame to a bulkhead at the mid camera compartment forms the roof of the flare bay. The flare bay is closed by two hydraulically operated doors.

#### Spar frame and main plane attachments

10. The spar frame consists of two reinforced frames which carry between them the centre section of the main plane spar, the frames being interspaced with vertical channel-section members and skinned to form a double plate bulkhead. Machined from a single light alloy forging, the spar centre section incorporates the main plane attachment lugs which protrude beyond the fuselage profile. The main plane rear wall attachment lugs are fitted to a double reinforced frame situated at the rear end of the No. 5 fuel tank bay.

#### Fuel tank bays

11. The bays for fuel tanks No. 1, 2, 3, 4 and 5 are lined with an internal metal skin riveted to the inner flanges of the fuselage frames and longitudinal Z-section stiffeners. Double plate bulkheads, interspaced with vertical channel-section members, separate the four fuel tank bays forward of the spar frame. Removable floor panels, secured to port and starboard longitudinal floor bearers and transverse bearers at the bulkhead positions, are fitted in each of the forward bays. The longitudinal floor bearers are braced by tubular members fitted between the bearers and the fuselage longerons. The floor of the rear tank bay is formed by the roof of the flare bay and is not removable, access to the bay being provided by a removable bulkhead.

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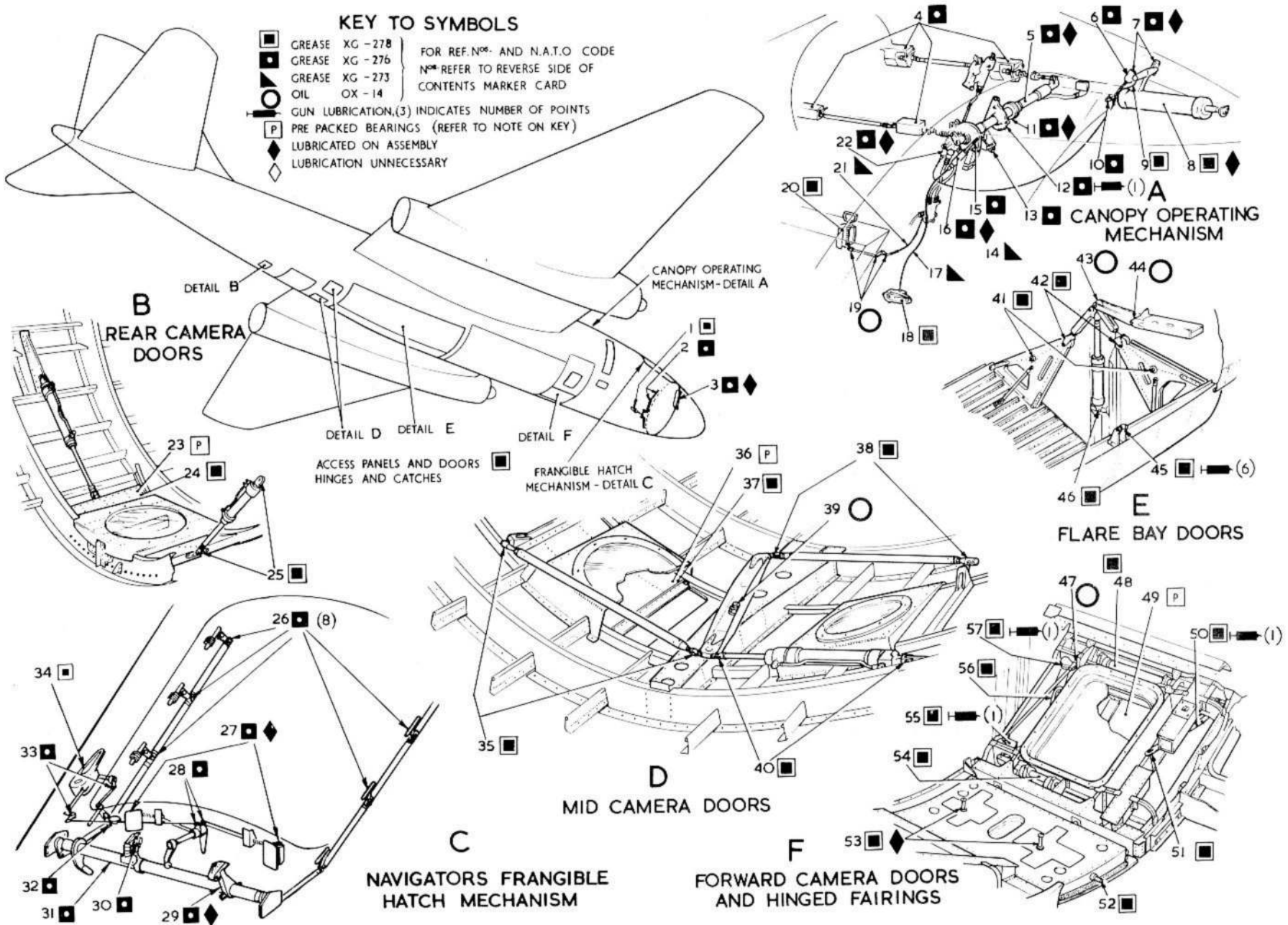


Fig. 5 Lubrication - fuselage

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## Key to Fig. 5.

## (LUBRICATION—FUSELAGE)

- |    |  |    |  |    |  |
|----|--|----|--|----|--|
| 1  | MANUAL RELEASE CONTROL HANDLE  | 19 | HOOD JETTISON LEVER CONTROLS                                   | 38 | CONTROL ROD CONNECTIONS  |
| 2  | HINGED NOSE LOCKING MECHANISM  | 20 | HOOD JETTISON LEVER PLUNGER                                    | 39 | ARM PIVOT  |
| 3  | NOSE HINGE   | 21 | HOOD JETTISON LEVER CONTROLS<br>BOWDEN CABLE                   | 40 | JACK ATTACHMENT  |
| 4  | HOOD LOCKING PINS AND LOCKING PIN<br>PUSH RODS (SMEAR WITH GREASE)       | 22 | HINGE RELEASE MECHANISM SPRING BOX                             | 41 | HINGE SPHERICAL BEARINGS (PORT AND<br>STARBOARD) FRONT AND REAR            |
| 5  | HOOD LOCKING MECHANISM TORQUE<br>SHAFT BEARINGS                          | 23 | SLIDING DOORS (PORT AND STARBOARD)<br>HORIZONTAL ROLLERS       | 42 | ACTUATOR LINK SPHERICAL BEARINGS<br>(PORT AND STARBOARD) FRONT AND<br>REAR |
| 6  | HOOD HINGE ASSEMBLIES, ALL MOVING<br>PARTS                               | 24 | SLIDING DOORS (PORT AND STARBOARD)<br>VERTICAL ROLLERS         | 43 | LINK ATTACHMENTS TO JACK, FRONT<br>AND REAR                                |
| 7  | HINGE INTERFERENCE PINS  | 25 | HYDRAULIC JACK ATTACHMENTS (PORT<br>AND STARBOARD) RODS        | 44 | LINK PIVOT, FRONT AND REAR   |
| 8  | HOOD OPERATING SPRING BOX, ALL<br>MOVING PARTS                           | 26 | HATCH LOCKING PINS AND LOCKING PIN<br>PUSH (SMEAR WITH GREASE) | 45 | DOOR ROLLERS, PORT AND STARBOARD   |
| 9  | HOOD OPERATING LEVER, PIVOT AND<br>CONNECTIONS TO HOOD AND SPRING<br>BOX | 27 | SPRING LOADED PLUNGERS   | 46 | JACK ATTACHMENT  |
| 10 | INTERFERENCE PIN OPERATING MECHANISM                                     | 28 | CATCH PIN RELEASE CABLE AND ROD                                | 47 | CONTROL ROD CONNECTIONS  |
| 11 | TORQUE SHAFT OVER-CENTRE SPRING<br>BOXES (TWO)                           | 29 | SPRING LOADED LOCKING PLUNGER                                  | 48 | JACK ATTACHMENTS   |
| 12 | RACK AND PINION  | 30 | PAWL AND MICRO SWITCH LEVER                                    | 49 | SLIDING DOOR ROLLERS   |
| 13 | AIR CONTROL VALVE OPERATING<br>MECHANISM                                 | 31 | TORQUE SHAFT BEARINGS  | 50 | LEVER ARM PIVOT  |
| 14 | HINGE RELEASE MECHANISM BOWDEN<br>CABLE                                  | 32 | CATCH PIN CABLE PULLEY   | 51 | LEVER ARM ATTACHMENT TO SLIDING<br>DOOR                                    |
| 15 | MANUAL RELEASE SPRING BOX CONNec-<br>TION TO LEVER                       | 33 | EXTERNAL RELEASE MECHANISM ALL<br>MOVING PARTS                 | 52 | ACCESS PANEL LATCH BOLTS (SIX)   |
| 16 | MANUAL RELEASE SPRING BOX  | 34 | MANUAL RELEASE CONTROL HANDLE                                  | 53 | ACCESS PANEL LOCKS (TWO) AND LINKAGE<br>TO LATCH BOLTS                     |
| 17 | MANUAL RELEASE BOWDEN CABLE  | 35 | CONTROL ROD CONNECTIONS  | 54 | JACK ATTACHMENTS   |
| 18 | MANUAL RELEASE CONTROL HANDLE  | 36 | SLIDING DOOR (PORT AND STARBOARD)<br>HORIZONTAL ROLLERS        | 55 | LEVER BEARING  |
|    |  | 37 | SLIDING DOOR (PORT AND STARBOARD)<br>VERTICAL ROLLERS          | 56 | LEVER ARM ATTACHMENT TO SLIDING<br>DOOR                                    |
|    |  |    |  | 57 | LEVER BEARING  |

Note . . . When renewing pre-packed bearings, existing grease must be washed out and replaced with grease XG-278

## REAR FUSELAGE

12. The rear fuselage (fig. 4) incorporates the fin and tail plane attachment points and houses the rear camera compartment.

Access hatch cover

13. A hatch in the undersurface immediately aft of the break frame is closed by a hinged cover and gives access to the rear fuselage and the mid camera compartment and rear fuel tank bay in the centre fuselage. This cover is pivoted on a piano hinge about its port edge and opens outwards. It is secured in the closed position by seventeen Fairey type fasteners fitted to the cover edges. A safety strap attached to the cover and the fuselage structure prevents the edge of the cover from making contact with the ground when the aircraft is heavily loaded.

Tail unit stubs and attachments

14. Built on to the fuselage at the rear of the unit are stubs for the fin and rudder, and the tail plane leading edge. A bulkhead, fitted across the fuselage at frame 42, extends into the fin stub and carries at its top the fin spar attachment lugs. A secondary attachment plate for the fin is fitted to the top of a diaphragm at the forward end of the stub. The fin stub is extended aft of frame 42 to form the rudder stub which carries the lower hinge bearing for the rudder.

15. Aft of the bulkhead at frame 42, the fuselage consists of a lower half extension, thus forming a slot for the variable incidence tail plane between the extension piece and the rudder stub. A tubular bracing strut is connected to the rear end of the extension and to the bulkhead in the fin stub. On each side of the fuselage forward of the slot, is a narrow

integral stub for the tail plane leading edge. Two hinge brackets for the tail plane are mounted on the bulkhead at frame 42.

Rear fairing

16. A detachable rear fairing forms the extreme tail of the rear fuselage. It consists of a metal structure, incorporating the trailing edge of the rudder stub and the rear section of the fuselage extension piece, and carries the radar unit for the tail warning installation. Attachment at the rudder stub is made to four studs projecting from the rear of the forward section, and to the extension piece by bolts through two main attachments and four screws at the skin lap. A dummy radome is provided to fit in place of the radar unit when this has been removed.

Tail bumper

17. The tail bumper consists of a moulded rubber pad secured to a metal fairing which is attached to the underside of the fuselage, between frame 40 and 42, by screws into anchor nuts on the fairing.

## SERVICING

Lubrication

18. The lubrication points, type of lubricant to be used and method of application are shown in fig. 5. The key to the lubrication symbols, Ref. No. and N. A. T. O. Ref. No. will be found on the reverse side of the Contents marker card. Sealed bearings do not need further lubrication until major inspection.

## REMOVAL AND INSTALLATION

Note...

Whenever an aircraft component which affects, or can affect, longitudinal trim is removed and

refitted, renewed, or adjusted, a flight trim check must be carried out in accordance with the instructions given in Sect. 3, Chap. 4, to ensure that the aircraft trim is within the stated limits.

19. The following paragraphs present a guide to the recommended methods of removing and installing the principal components of the fuselage structure. Generally, only the removal is dealt with, since the installation is usually a reversal of the removal operations; notes are given on the illustrations or in the following paragraphs to cover special installation points.

20. Blanking devices and/or covers must be fitted to all pipe ends, adapters, etc., as they are detached or removed. Care must be taken on installation to

restore locking, bonding, or sealing to its original condition.

#### Hinged nose

21. Instructions for the removal and installation of the hinged nose are given in para. 65 and 66.

#### Pressure heads

22. Instructions for the removal and installation of the pressure heads are given in para. 67 to 70.

#### Hinged nose cradle

23. When the hinged nose portion of the front fuselage is removed from the aircraft a transport cradle (fig. 6) is required to facilitate handling and avoid damage to the structure. The cradle, Ref. No. 26FZ/95521 consists of bolted and reinforced timber supports,

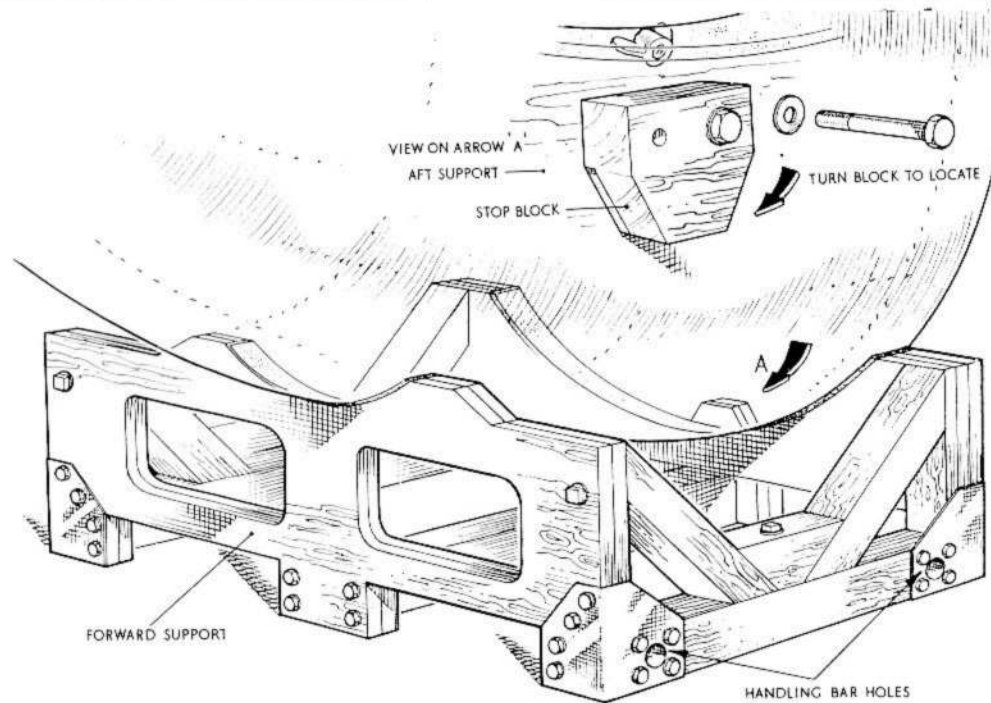


Fig. 6 Hinged nose cradle

padded and contoured to the nose profile. A rotatable block secured by a bolt and wing nut to the aft member is arranged to project against the rear frame of the cradled nose to prevent slip.

### Front fuselage

#### Slings (fig. 7)

24. The front fuselage sling, Ref.No. 26FZ/95457

consists of a front lifting band and a pair of rear lifting wires attached to a tubular steel frame which in turn, is connected by four wire ropes to a two-position lifting bracket. The forward lifting band, which is of  $3\frac{1}{2}$  in. webbing, is located on the fuselage at frame 2, and spigots, assembled to the lower ends of the rear lifting wires, are screwed into the jacking points in the fuselage side just aft of the pressure bulkhead. To facilitate attachment, each spigot is

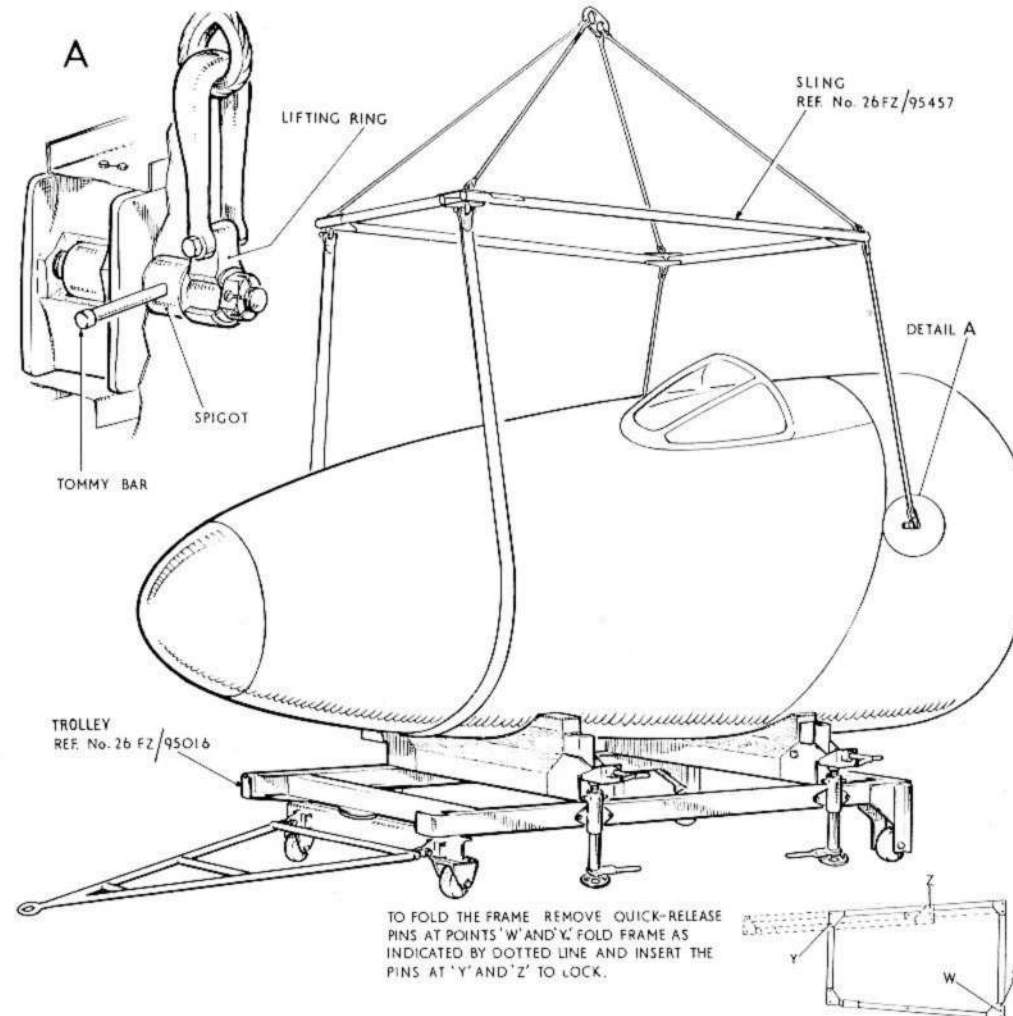


Fig. 7 Front fuselage-slinging and trestling

fitted with a tommy bar, the spigot, which is assembled to a lifting ring attached to the lifting wire, being free to rotate in the lifting ring. Before the sling can be attached to the fuselage, the blanking plugs in the jacking points must be removed, using the special spanner Ref. No. 26FZ/95065. Two pick-up holes in the lifting bracket provide for lifting fuselage with or without removable equipment in the fuselage, the forward hole being used for the fuselage with removable equipment. To stow the sling, the frame may be folded as shown in the detail.

#### Trestling (fig. 7)

25. When trestling, the front fuselage is supported on two formers mounted on a four-wheel trolley, Ref. No. 26FZ/95016. Each of the formers is supported on brackets fitted to the heads of two standard jack bodies (Ref. No. 4G/2451) which are bolted to the side members of the rectangular main frame of the trolley. Adjusting screws are incorporated in the support brackets to provide for lateral adjustment of the formers. The rear wheels of the trolley are mounted between vertical members secured to the main frame, and the front wheels are fitted to a steering member which is pivoted at its centre on the front lateral member of the frame. A towing yoke of tubular construction is attached to lugs at each end of the steering member. The former positions, marked on the fuselage side, TRESTLE HERE, are at frame 3 and the pressure bulkhead. ▶

#### Removal

26. Instructions for removing the front fuselage are given in fig. 12.

#### Installation

27. Instructions for installing the front fuselage are given in fig. 12.

#### Centre fuselage

##### Slinging

28. The centre fuselage may be lifted separately using the sling, Ref. No. 26FZ/95006, Fig. 8, or together with the front fuselage using sling, Ref. No. 26FZ/95516 (Fig. 9).

29. The sling, Ref. No. 26FZ/95006 (fig. 8) consists of front and rear pairs of lifting wires attached to a rectangular, tubular steel frame which in turn is connected by wire ropes to lifting brackets. The lifting wires are attached to the fuselage by shackles, the front wires are attached to the main plane forward attachment brackets at frame 17 and the rear wires to the main plane rear attachment lugs at frame 27. The two lifting brackets, one incorporating two pick-up holes, provide lifting positions to suit three different loading conditions of the centre fuselage as indicated in fig. 8.

##### Trestling (fig. 8)

30. When trestling, the centre fuselage is supported by two special adjustable trestles; one Ref. No. 26FZ/95037, is positioned under frame 13 and the other, Ref. No. 26FZ/95038, under frame 29. Each trestle consists of a support block, padded and shaped to the fuselage profile at the trestle position and secured to two adjustment screw jacks incorporated in a base unit constructed of steel channel identical for both trestles.

#### Fuel tanks

31. Instructions for removing and installing the fuel tanks in the centre fuselage are given in Sect. 4, Chap. 2.

Rear fairing (fig. 10)

Removal

32. To remove the rear fairing, proceed as follows:-

(1) Remove the port and starboard box fairings, proceeding as follows for each fairing.

(a) Remove the access panel 9.

(b) Remove the two bolts 11 securing the fairing to the tail plane.

(c) Remove the two countersunk screws 12.

(d) Move the tail plane up and remove the two screws 10.

(e) Remove the fairings.

(2) Remove access panel 4.

(3) Disconnect the electrical cables at the navigational lamps 2 and 6, unclip the cables and withdraw them into the rear fuselage.

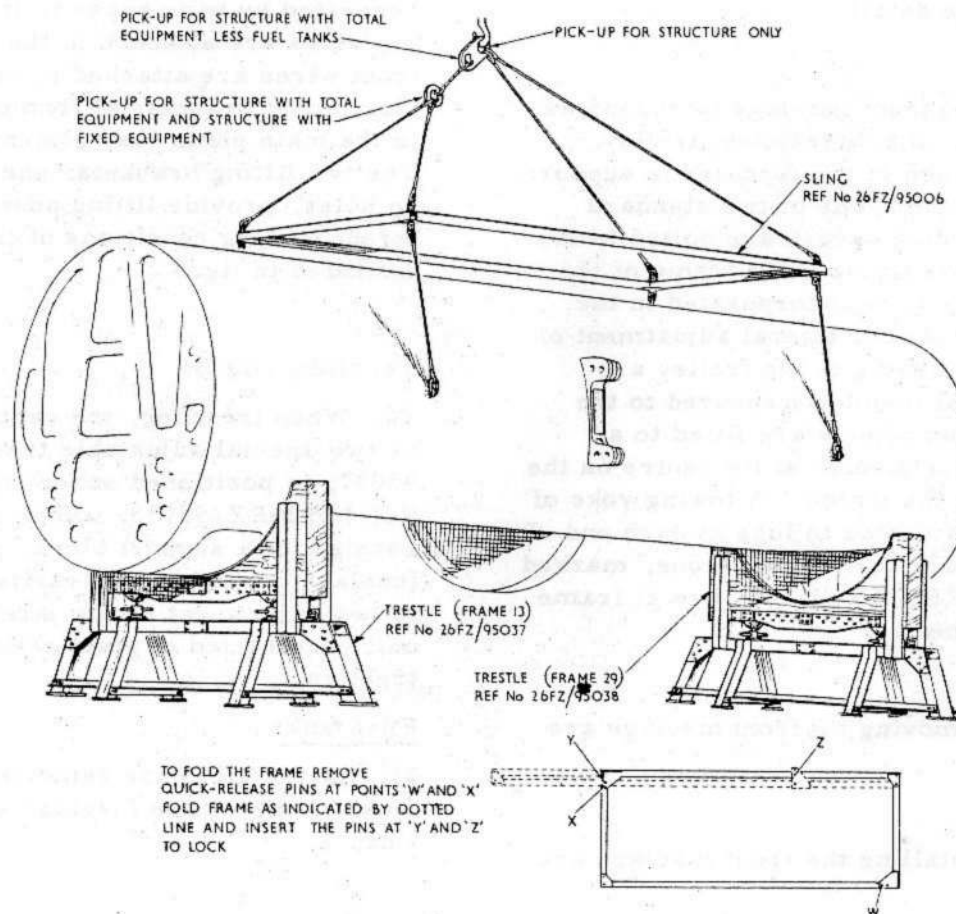


Fig.8 Centre fuselage-slinging and trestling

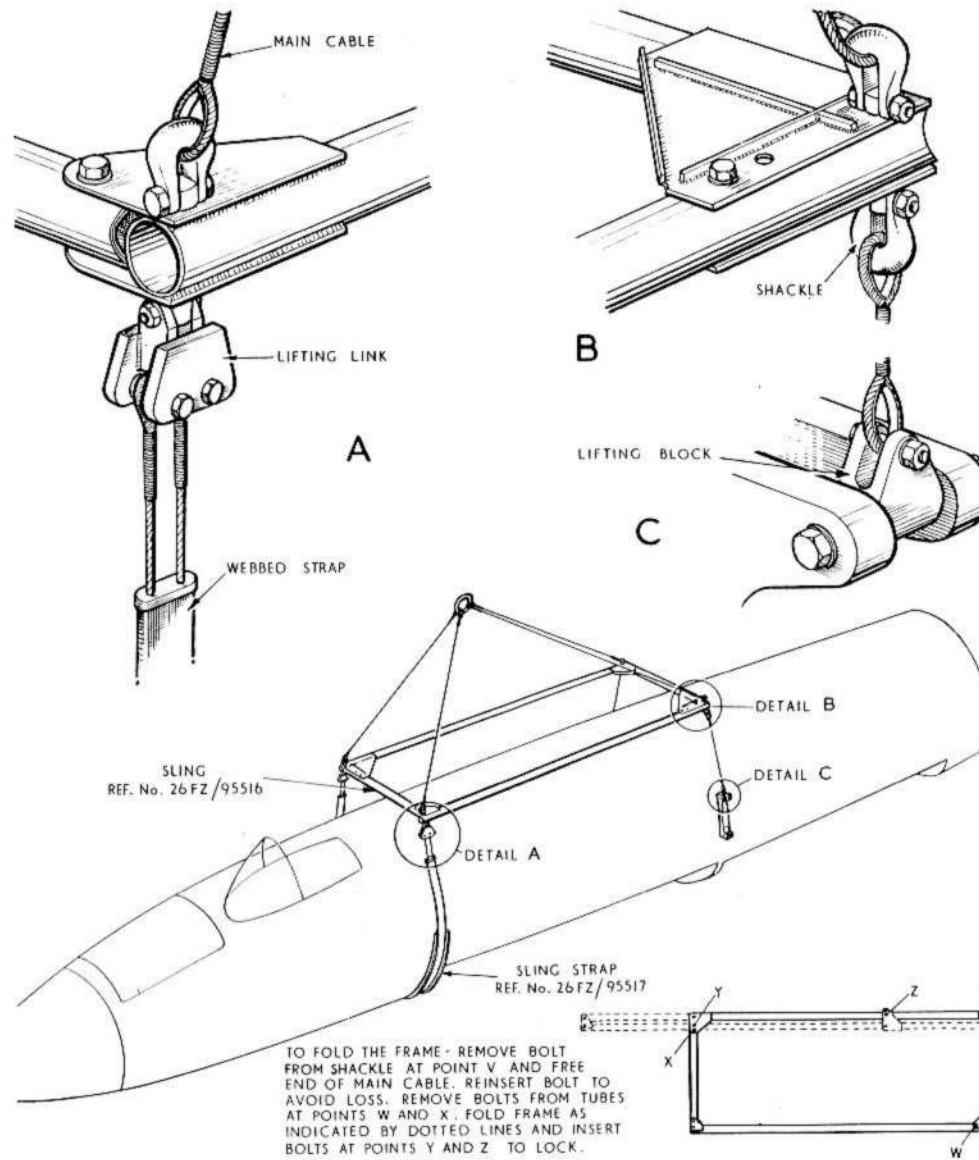


Fig. 9 Slinging the combined nose fuselage and centre fuselage

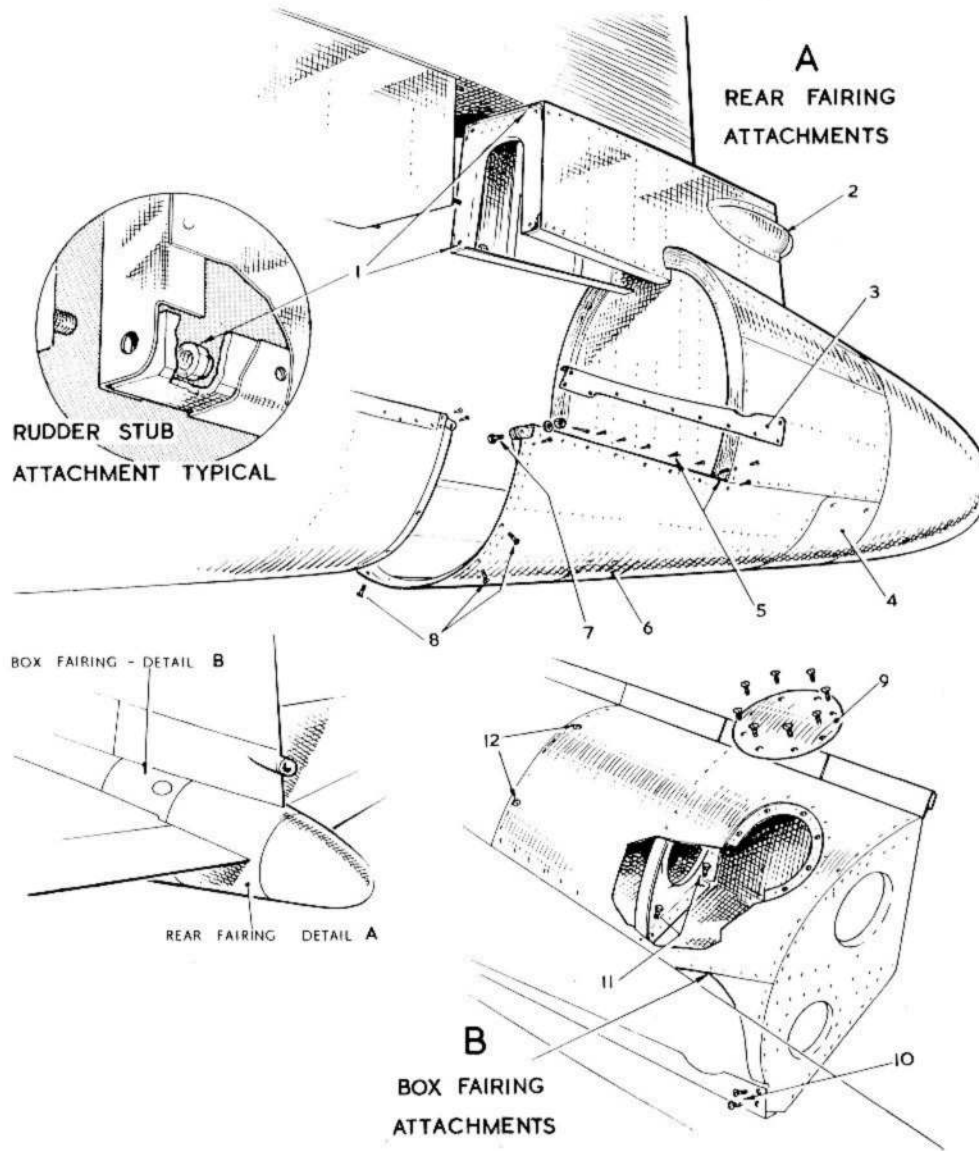


Fig.10 Rear fairing removal

- (4) If the tail warning radar unit is fitted, disconnect the electrical cables at the plugs and sockets on the unit, unclip the cables and withdraw them into the rear fuselage.
- (5) Remove the four nuts 1 at the rudder stub attachments.
- (6) On each side, remove the eleven screws 5 and remove the sealing strip 3.
- (7) Remove the four screws 8.
- (8) Support the rear fairing, and on each side, remove the split pin, nut, washer and bolt 7.
- (9) Remove the fairing.

#### Installation

33. The procedure for installing the rear fairing is a reversal of the removal operations.

#### Rear fuselage

##### Slings (fig. 11)

34. The rear fuselage sling, Ref. No. 26FZ/95007, consists of front and rear lifting bands of 3 in. webbing, attached to a tubular steel, rectangular frame, which is connected by four wire rope cables to a two-position lifting bracket. The lifting bands are located on the fuselage at frames 34 and 42, each band being attached to the underside of the fuselage by a bolt

which is secured to the band by a retaining wire. The forward band is secured to a special anchor nut on frame 34 (detail A) and the rear band to the picketing point just aft of the tail bumper (detail B). Two pick-up holes in the lifting bracket provide for lifting the fuselage with or without removable equipment in the rear fuselage, the forward hole being used for the fuselage less the removable equipment. To stow the sling the frame may be folded and secured by straps as shown in detail C.

##### Trestling (fig. 11)

35. When trestling, the rear fuselage is supported on two universal jacking trestles which have been adapted by the fitment of special formers. The trestling positions, marked TRESTLE HERE, are at frames 31 and 39. At the forward position, a universal jacking trestle No. 1 is used in conjunction with a special former, Ref. No. 36FZ/95017, and at the rear position a universal jacking trestle No. 7 with a special former, Ref. No. 26FZ/95018, is used.

##### Removal

36. Instructions for removing the rear fuselage are given in fig. 13.

##### Installation

37. Instructions for installing the rear fuselage are given in fig. 13.

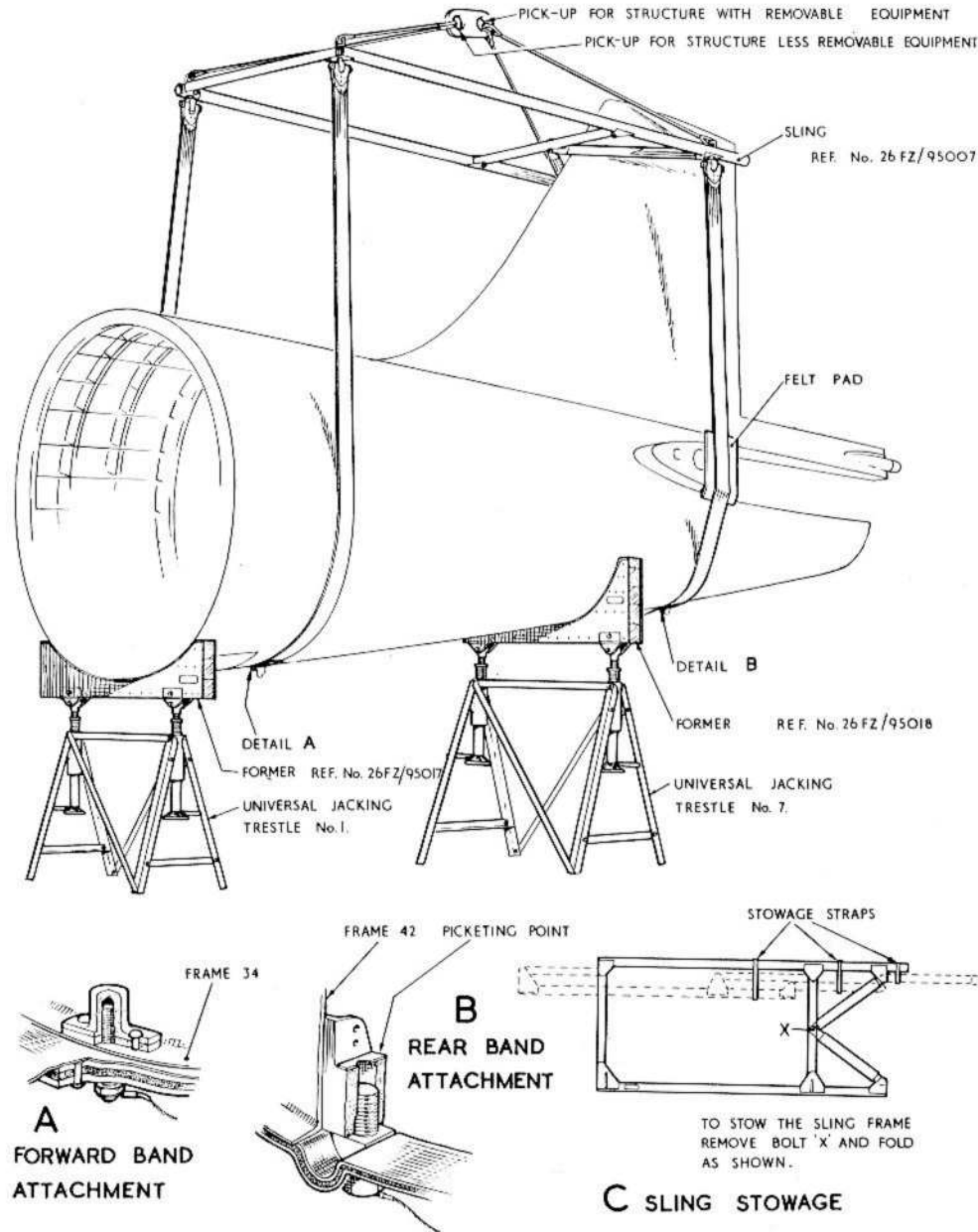


Fig. II Rear fuselage - slinging and trestling

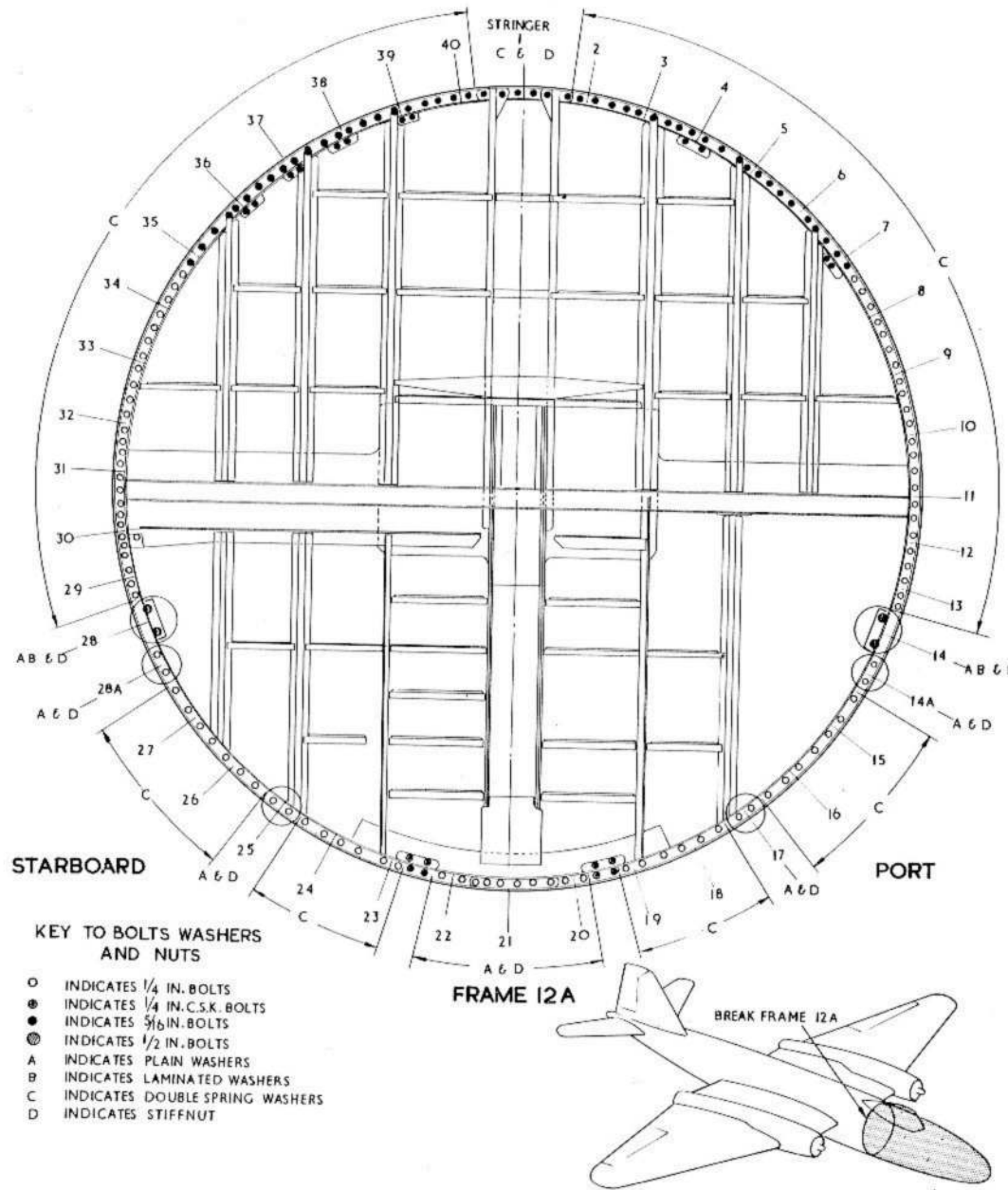


Fig.12 Front fuselage removal

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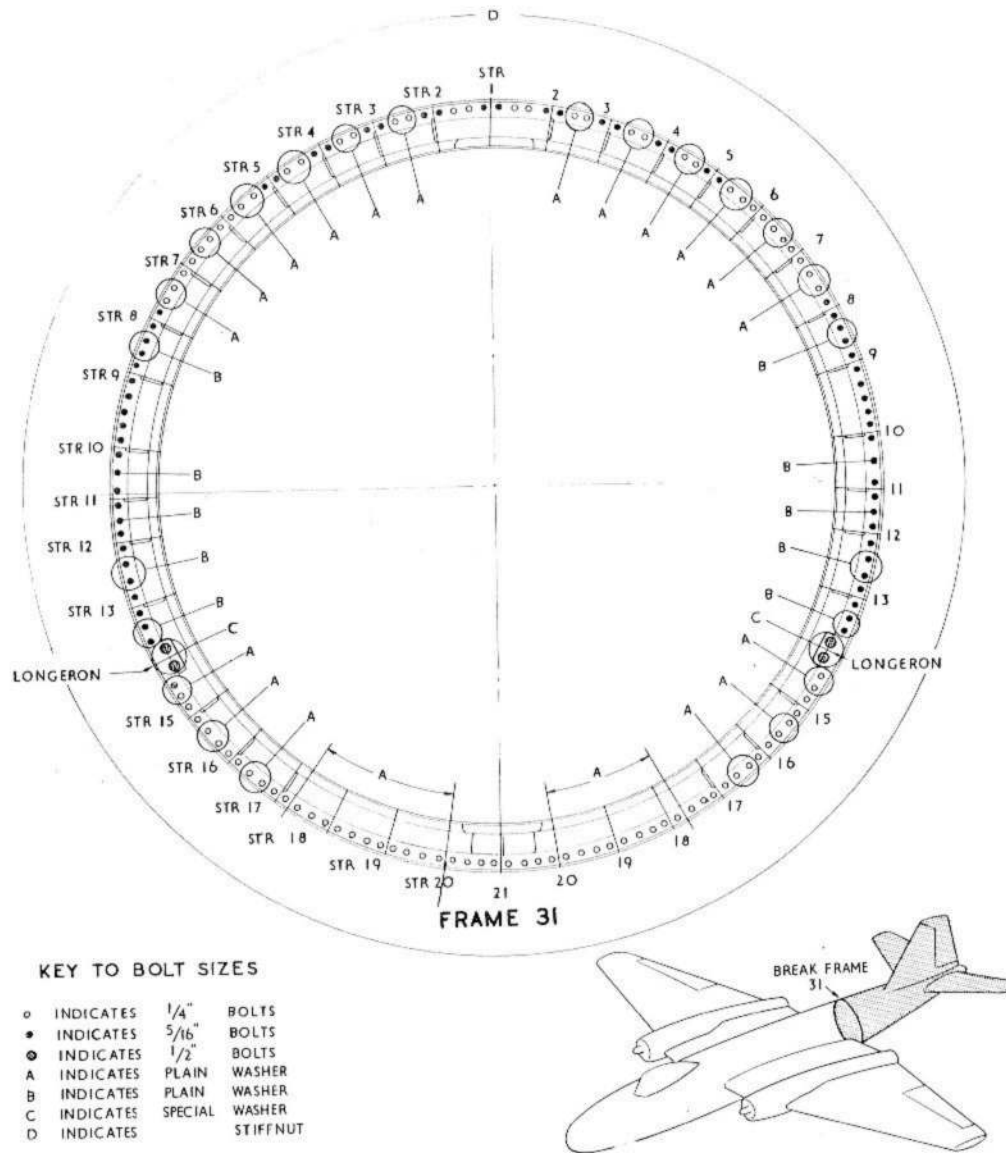


Fig.13 Rear fuselage removal

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## HINGED NOSE AND NAVIGATOR'S ROOF HATCH

## DESCRIPTION AND OPERATION

Hinged nose

60. The nose portion of the front fuselage from frames A to D, hinges on the starboard side and opens forward to provide entrance for the navigator. It is retained in the open position by a folding strut hinged at its centre point and bracketed to the lower frames D and 1. The hinge of the strut is locked in the open position with a quick release pin normally stowed in an adjacent hole (fig. 14, detail C).

Operation

61. The nose can be opened internally or externally by a flush fitting handle of the 'Press button - pull out' type. To open the nose from outside the aircraft, depress the button, withdraw the handle from its recess and turn clockwise. To open the nose from inside the aircraft, depress the button, push handle in and turn anti-clockwise.

Locking mechanism (fig. 14, detail A)

62. When closed the nose is secured by two shoot bolts located behind frame 1 of the nose fuselage which enter the holes of the two related spigots mounted on the aft face of frame D of the nose. Travel of the bolts is effected by a linkage of rods and levers controlled by the operating handle and no movement can occur until the handle button is depressed and the handle withdrawn for normal operation.

Pressure sealing

63. The nose is sealed in the closed position by the inflation of the tubular seal mounted on the forward face of frame 1 of the front fuselage. Air to the seal

is supplied by the general pressurisation system (Sect. 3, Chap. 8) and controlled by a univalve mechanically linked to the nose locking handle unit, so that the final closing movement recessing the handle, opens the valve and automatically inflates the seal (fig. 14, detail A). Reversal of this operation on opening the nose, shuts off the air supply and vents the seal to atmosphere at the univalve.

Nose hinge

64. The hinge attaching the nose to the front fuselage consists of an upper and lower hinge arm casting contained within a fairing, attached at reinforced points to the frame and stringers of the nose, and pivoting about two close tolerance hinge bolts carried in mounting brackets located in reinforced sections between frames 1 and 1A of the front fuselage (fig. 14, detail D).

Removal

65. To remove the hinged nose, proceed as follows:-

- (1) Disconnect the six pitot and static rubber hose connections at the front fuselage joints (frame 1A) and tie back into the nose.
- (2) Disconnect the following electric cables from the equipment in the nose, unclip as necessary and tie back into the front fuselage.

Cable Loom N63	Oxygen Magnetic Indicator
Cable Loom 15A	G IV B Compass Screened J. B.
Cable Loom N53	Fuel flowmeter
Cable Loom N52	Fuel S. G switch
Cable Loom 16	Reconnaissance Viewfinder
Cable Loom 16JB	Radio Compass Indicator
Cable Loom 16JC	Control Unit Type 8283

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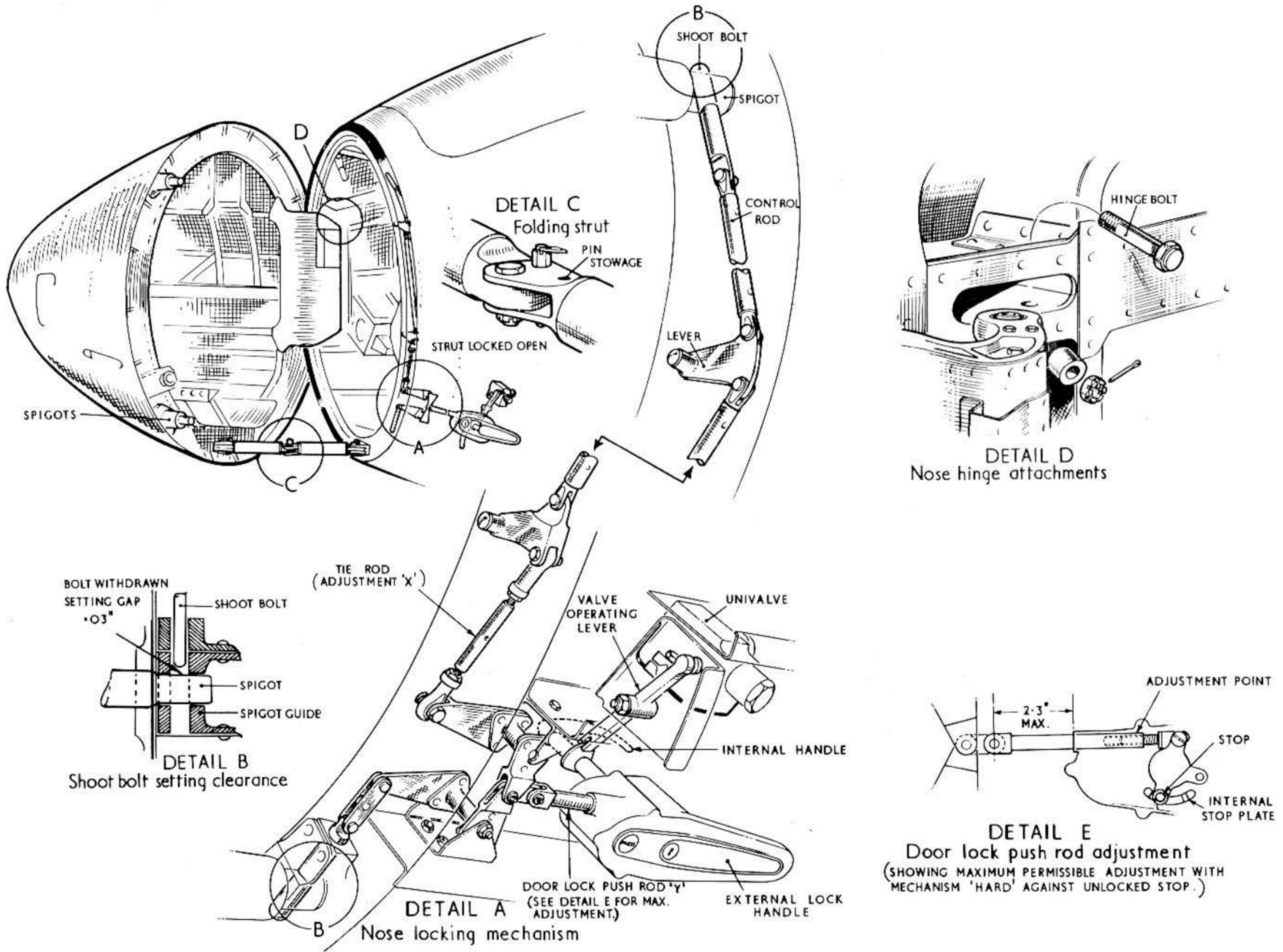


Fig.14 Hinged nose locking mechanism and attachment

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Cable Loom	16HA	Pitot Head T. B.
Cable Loom	16QC	Air Temperature Indicator
Cable Loom	N6B	Day Camera Functioning Lights
Cable Loom	N67	Night Camera Functioning Lights
Cable Loom	N66	F95 Camera Centre
Cable Loom	E24	Earth Connector Block
Cable Loom	N70	Hatch Indicator
Connector	LD	Indicator G. P. 1 Mk. 4 Green Satin
Connector	LC	Indicator Type 101 Green Satin
Connector	QJ	Amplifier (R. F.) Radio Compass
Connector	QC	Amplifier (R. F.) Radio Compass
Connector	QE	Amplifier (R. F.) Radio Compass
Connector	QH	Amplifier (R. F.) Radio Compass
Connector	-	Indicator Type 9547 Tacan

(3) Remove the centre joint bolt of the folding strut, separate the strut and tie back each limb.

(4) Ensure that adequate assistance is available and that the storage cradle, Ref. No. 26FZ/95521 (fig 6) is easily accessible, remove the upper and lower hinge bolts (fig. 14, detail D) free the hinge arms from the mountings and lower the nose to the cradle.

66. Installation of the nose is a reversal of the foregoing procedure.

#### Pressure heads

Removal - nose pressure head (fig. 15)

67. To remove the forward pressure head from the nose:

(1) Disconnect the pressure head piping at the union 2.

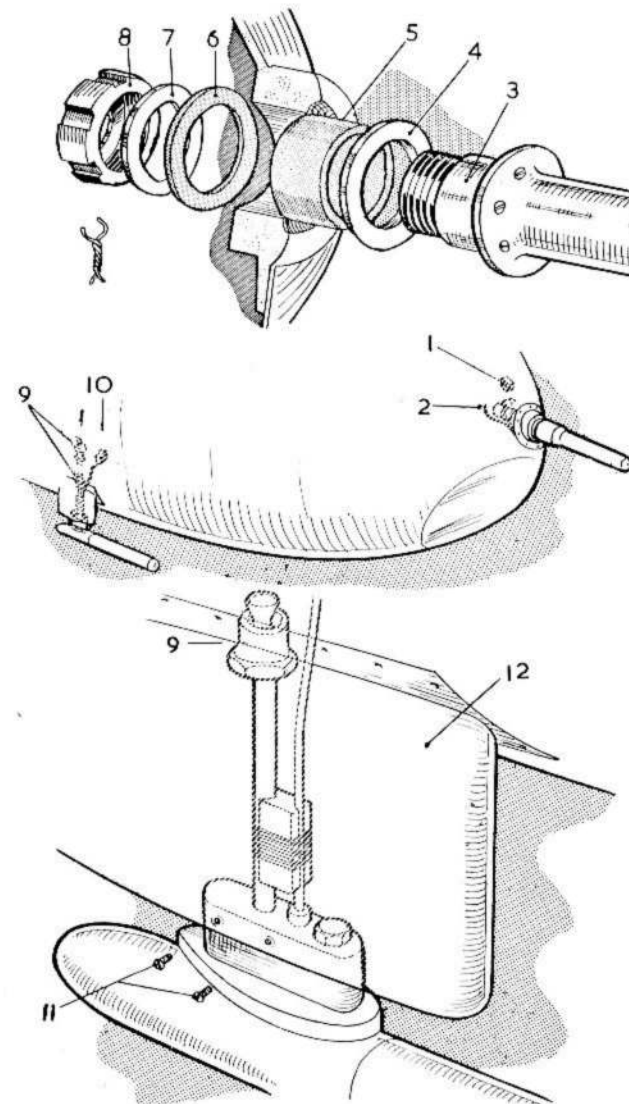


Fig. 15 Pressure-head removal

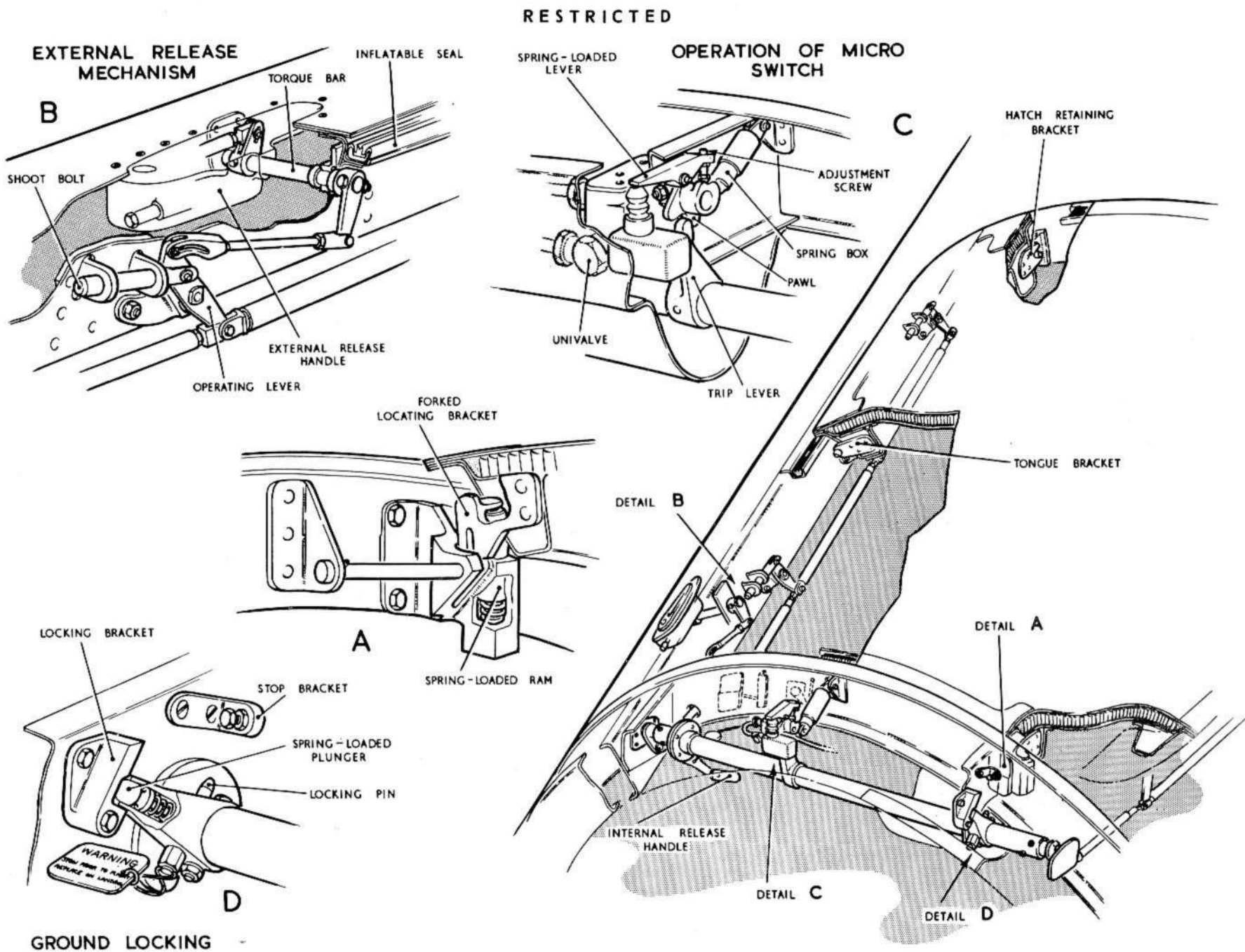


Fig. 16 Navigator's roof hatch  
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- (2) Disconnect the electrical leads at the terminal block 1.
- (3) Break locking wire and remove the ring nut 8, washer 7, and rubber sealing ring 6.
- (4) Remove the pressure head complete with its mounting adapter 3, washer 4, and rubber sleeve 5.

#### Installation - nose pressure head

68. Installation is a reversal of the foregoing procedure with three special notes:

- (1) Before replacing the ring nut 8, a thin coating of grease XG-278 is to be applied to the threads of the ring nut and the mounting adapter.
- (2) When tightening the ring nut a maximum wrench torque of 15 lb/ft is to be applied.
- (3) To ensure an airtight joint, rubber resin cement is to be applied around the periphery of the pressure head mounting adapter at the junction with the front of the nose.

#### Removal - starboard pressure head (fig.15)

69. To remove the starboard pressure head (introduced by Mod 3101).

- (1) Disconnect the pressure head piping at the union (9).
- (2) Disconnect the electrical cable at the terminal (10).
- (3) Remove the four screws (11), securing the pressure head to the fairing (12), and carefully withdraw the head from the fairing.

#### Installation - starboard pressure head

70. Installation is a straightforward reversal of the procedure described in the preceding paragraph; ensure that each of the four screws securing the pressure head to the fairing are locked by 'popping'.

#### Navigator's roof hatch

71. This hatch (fig.16) is normally only opened for ground servicing, but it can also be released from inside in an emergency. It is frangible to permit ejection through the closed hatch, if necessary. It comprises a formed panel of glasscloth honeycomb sandwiched between inner and outer glass cloth skins and riveted to a surrounding alloy frame. The hatch is retained by eight shoot bolts, four each side of the hatch, and two open-ended fork brackets at the aft end.

#### ◀ WARNING:

ON AIRCRAFT EMBODYING MOD 4397 THE NAVIGATORS HATCH IS FITTED WITH A MINIATURE DETONATING CORD SYSTEM WHICH EXPLODES TO CUT OUT THE FRANGIBLE PORTION OF THE HATCH IMMEDIATELY THE EJECTION SEAT BEGINS TO RISE.

#### Manual Operation ▶

72. The external release handle is connected by a torque bar and connecting rod to the tube and lever mechanism which operates the four shoot bolts on the starboard side. Movement is transmitted to the shoot bolts on the port side by means of a transverse torque tube, to which the internal release handle is fitted. On the torque tube is mounted a univalve which controls the hatch aperture inflatable seal.

73. Operation of either handle releases the hatch as follows:

(1) Stage 1. The initial movement of the release handle imparts a rotary movement to a trip lever and pawl mechanism which opens the univalve, thus venting the seal to atmosphere and simultaneously operating a microswitch transmitting a warning signal to the pilot.

(2) Stage 2. Continued forward movement of the release handle actuates the rod and lever mechanism withdrawing the four shoot bolts on each side of the coaming. At this point two spring-loaded rams raise the forward end of the hatch. The hatch may then be lifted clear or, in flight, is carried clear by the slip-stream.

#### ◀ MDC operation (Post Mod 4397)

73A The MDC system consists of two loops of miniature detonating cord and a detonator, fired by the rising ejector seat to remove the frangible portion of the hatch. The detonator assembly is mounted on the frame of the hatch at the rear. The miniature detonating cord is in two series-connected loops, one on the inner and the other on the outer skin of the hatch near the edges; the two ends being ducted through two steel tubes to the detonator. Operation of the system is by the ejection of a sear which holds the detonator plunger, in the extended position against its internal spring. The sear is ejected to release the plunger, thus firing the detonator, by a lever connected to another lever operated by a striker plate attached to the seat, fig.17A. To prevent inadvertent operation on the ground a safety pin is inserted through the plunger and sear. **THIS PIN MUST BE REMOVED AND STOWED IMMEDIATELY PRIOR TO FLIGHT AND RE-FITTED ON LANDING.** ▶

#### Mechanical stops

74. To prevent inadvertent operation of the internal release handle when the mechanism is fully closed, a spring-loaded

locking plunger mounted on the port end of the torque tube engages a recessed bracket; the same plunger butting against an adjustable screw stop in the fully open position, limits the travel of the mechanism to prevent a damaging override (fig.16, detail D). To prevent illicit entry via the escape hatch of parked aircraft a quick-release pin is inserted with the plunger in the fully closed position to render the entire mechanism inoperable. **THIS PIN MUST BE REMOVED IMMEDIATELY PRIOR TO FLIGHT AND REFITTED ON LANDING.**

#### SERVICING

##### Hinged nose - lubrication

75. The lubrication points, type of lubricant to be used and methods of application are shown in fig.5. Sealed bearings do not need further lubrication until major servicing.

##### Locking mechanism - setting (fig.14)

76. When re-setting the locking mechanism after installation of the hinged nose, the following procedure should be adopted:-

- (1) With the handles in the unlocked position (contact being made with the lock internal stop), adjust the door lock push rod 'Y' (detail A) until a bottom shoot bolt clearance of 0.03 in. is obtained at the guide hole of the spigot fitting (detail B).

Note... Refer to detail E for maximum permissible adjustment of push rod.

- (2) Maintain the handles in the unlocked position and adjust the tie rod 'X' (detail A) to obtain an identical clearance of 0.03 in. for the top shoot bolt.

- (3) Operate shoot bolts with door open and ensure that in

each case the full diameter of the shoot bolt protrudes through the spigot guide.

#### Navigator's roof hatch - lubrication

77. The lubrication points, type of lubricant to be used and method of application are shown in fig.5. Sealed bearings do not need further lubrication until major servicing. All moving parts are to be smeared with grease XG-287.

#### Attachment mechanism setting (fig.17)

78. When resetting the attachment mechanism of the roof hatch after installation, the following conditions are to be obtained:-

(1) Operating valve-seal. With pawl and compression spring assembled and valve in the full closed position set the valve operating lever to engage to pawl, allowing a gap of 0.02-0.03 in. to ensure the valve is fully closed (detail A).

(2) Shoot bolts - The end faces of all bolts must coincide with the datum line A (detail B) in the open position to ensure identical disengagement. The dimension on each side of datum line B must be maintained to ensure complete shoot-bolt movement at each attachment point.

(3) Microswitch (detail A) . With seal valve and mechanism fully closed, loosely assemble the pawl and adjust to obtain a gap of 0.010-0.020 in. between switch and lever and a gap of 0.020-0.30 in. between the pawl and adjustment screw. Secure pawl to spindle.

(4) Stops (fig.16, detail D). With valve and mechanism fully closed, position the plunger against the locking bracket and secure to the torque tube. With the valve fully open and the shoot bolts fully disengaged, adjust the screw travel limit stop to bear on the side of the plunger.

#### Note...

It is important to check that after this final travel limiting adjustment is made, none of the eight main attachment pins protrudes beyond the datum line A (detail B).

#### MDC operating mechanism setting (Post Mod 4397)

78A Referring to fig.17A the procedure for setting the mechanism is as follows:-

**WARNING: BEFORE MAKING ANY ADJUSTMENTS TO THIS MECHANISM THE SYSTEM MUST BE DISARMED BY REMOVING THE LIVE DETONATOR AND REPLACING IT WITH A DUMMY ONE.**

#### (1) Disarming the system

(a) Ensure that safety pin (A) is in position (through the detonator plunger and sear) and remove the sear guard.

(b) Unscrew nut (C).

◀ (c) Remove live detonator and install dummy Ref.26VA/ 6047546. ▶

**WARNING: TOOL REF. 26VA/6045291 IS TO BE USED FOR REMOVING THE LIVE DETONATOR. FOR SAFETY REASONS IT IS IMPORTANT THAT NO OTHER TOOL IS USED.**

#### (2) Rigging the system

(a) With the dummy detonator in position and the sear guard removed disconnect push rod (D) at its top end.

(b) Remove the safety pin (A) from the firing unit.

(c) Pull downwards on the detonator plunger (N) until the internal spring compressed sufficiently to allow the sear (E) to be withdrawn. Remove the sear carefully to avoid damage and allow the plunger to retract gently.

(d) Detach cap (F) from striker plate (G).

(e) Fit setting block assembly (M) to striker mechanism (G), as shown in detail 'B' on fig.17A, taking care not to overtighten its fixing bolts.

(f) Adjust the position of spigot plate (H) on the serrated plate to achieve the required setting of the adjusting lever pivot point relative to face X on the striker plate, detail 'A' on fig.17A.

(g) Adjust the adjuster lever (J) so that it takes up the position shown in detail 'B' on fig.17A and secure with locking wire.

(h) Position lever (K) so that sear striker face (L) is in contact with the detonator plunger, detail 'A' fig.17A.

(i) Retain settings (g), and (h), and adjust the length of push rod (D) to engage lever (K). Secure with shear pin, washer and split pin. Check the fork end is in safety and lock with locking nut.

(j) Remove setting block assembly (M), hold lever (J) against striker plate (G), replace cap (F) and secure with shear pin, washer and split pin. Ensure that when lever (J) is contacting striker plate (G) that the striker pad (L) is just clear of the detonator housing.

### (3) Arming the system

(a) Refit sear (E) to the firing unit assembly.

(b) Replace safety pin (A) through plunger housing and sear.

(c) Unscrew nut (C) on detonator assembly and remove dummy detonator.

(d) Fit live detonator and replace nut(C) ensuring that the slot in the plunger flange is engaged with the projecting tongue on the base fitting.

**WARNING:** TOOL REF. 26VA/6045291 IS TO BE USED FOR FITTING THE LIVE DETONATOR. FOR SAFETY REASONS IT IS IMPORTANT THAT NO OTHER TOOL IS USED.

(e) Torque tighten nut (C) to 300 lb. and wire lock.

(f) Replace sear guard (B), secure and lock.

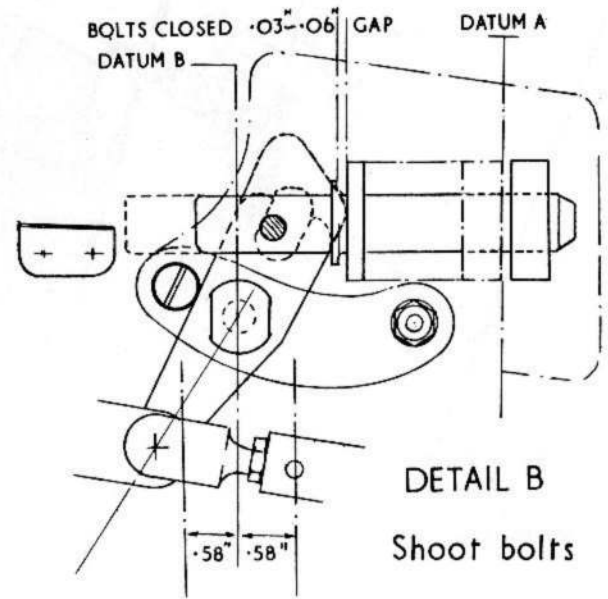
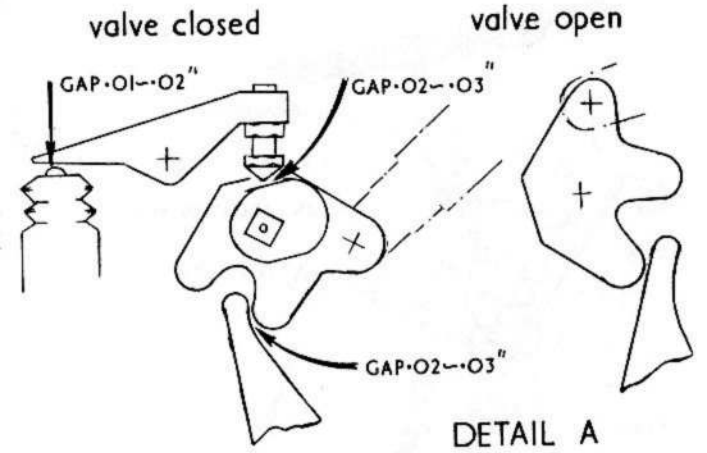


Fig.17 Hatch mechanism settings

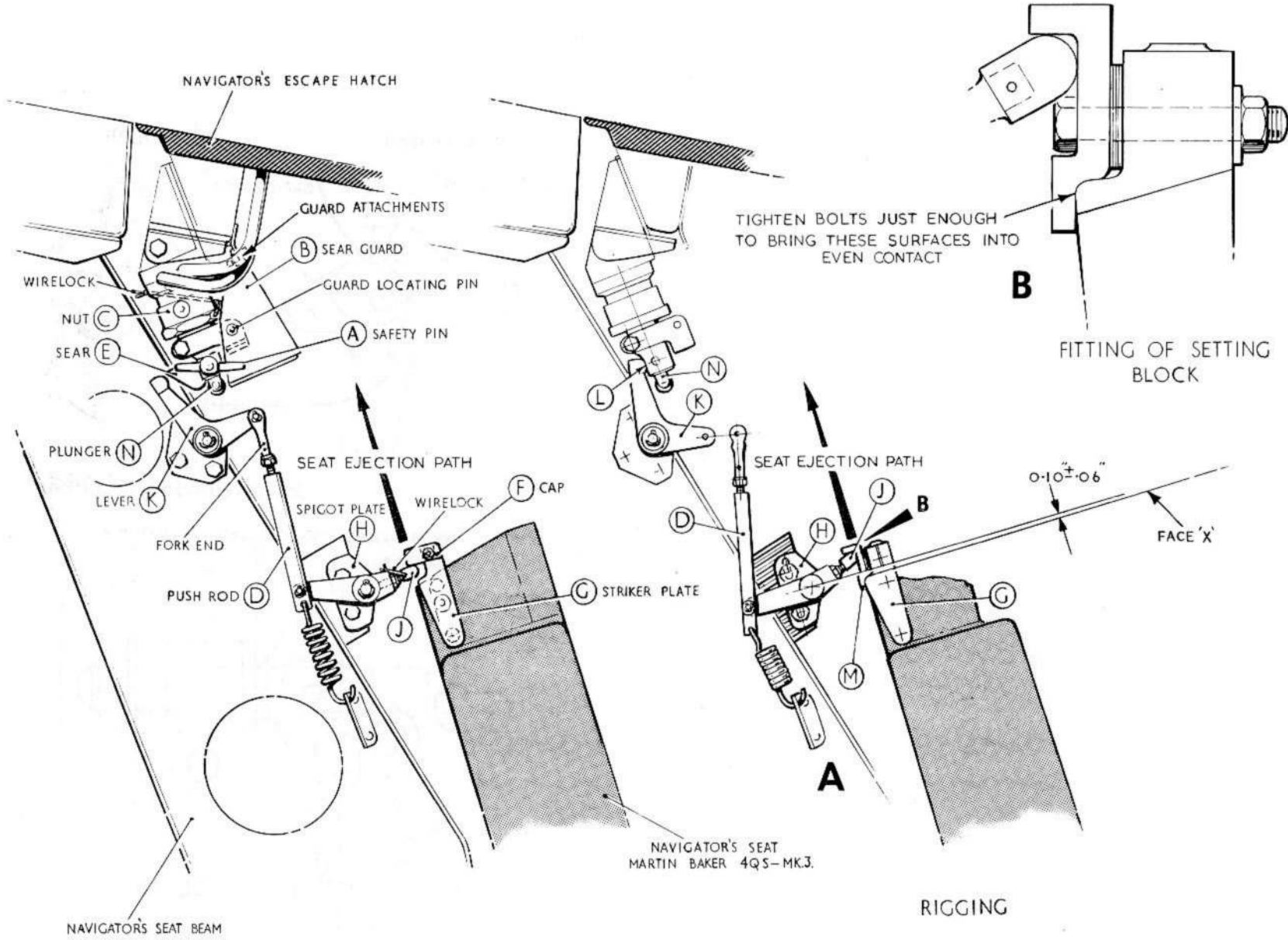


Fig.17A. Navigator's hatch. M.D.C. initiating mechanism. (Post mod.4397.)

◀ (NEW ILLUSTRATION) ▶

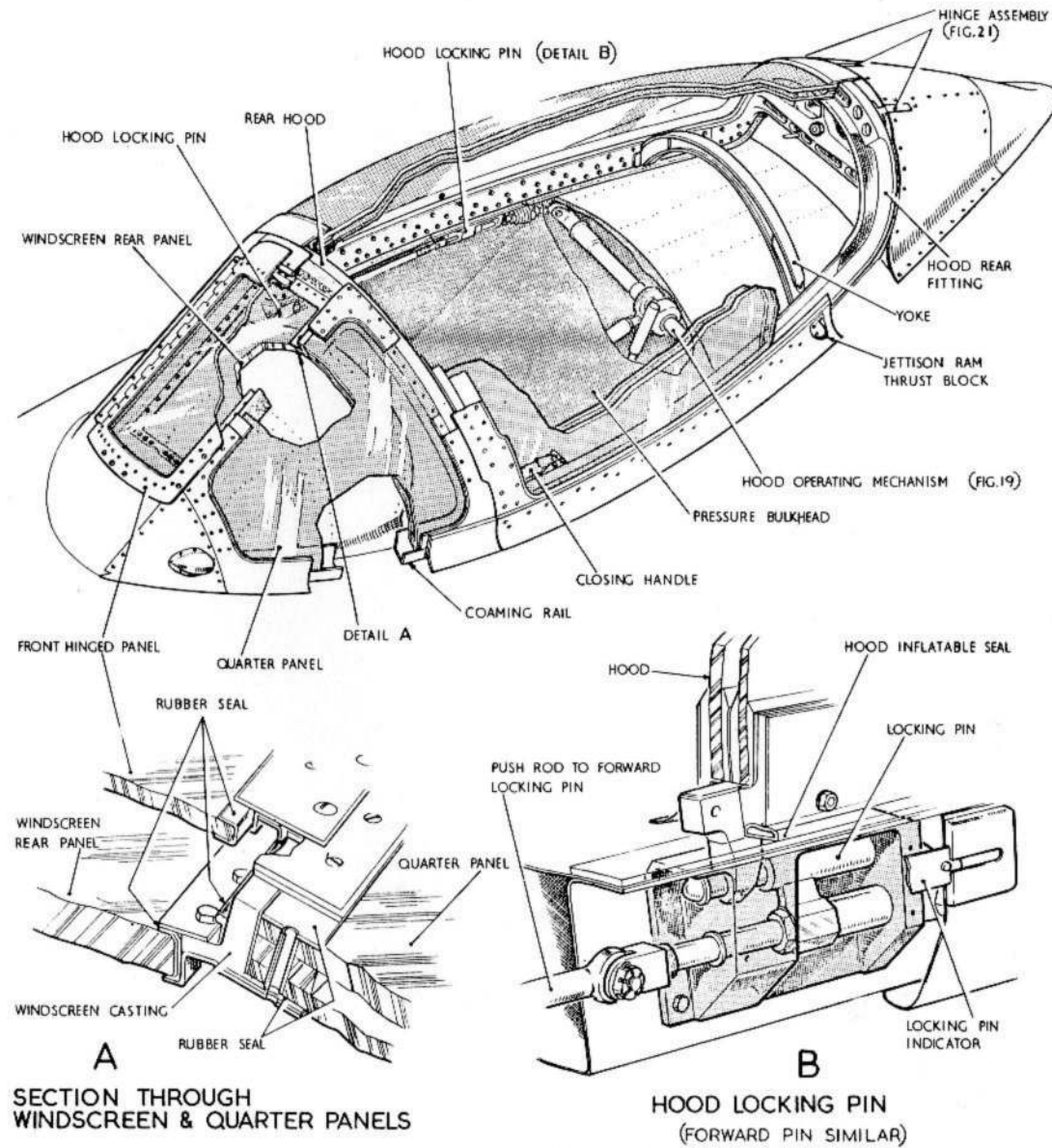


Fig. 18 Canopy construction

## DESCRIPTION AND OPERATION

90. The cabin canopy, consisting of a windscreen, hood and rear fairing, is offset to port of the aircraft centre line to improve the visual range. Fig. 18 shows the general method of construction and the inner and outer transparent panels which provide an interspace for dry air de-misting (Sect. 3, Chap. 8).

Windscreen

91. The windscreen structure, which supports an aft sloping windscreen and port and starboard quarter panels, consists of the windscreen casting and rear hoop. The rear hoop is secured to the coaming rail on each side of the cockpit aperture and the casting is secured at its base to the fuselage structure and at the top to the rear hoop. Fitted to the windscreen casting are the two glass panels which form the windscreen. The forward panel, which is of toughened plate glass,  $\frac{1}{4}$  in. thick and curved to the canopy profile, is mounted on a hinged metal frame to provide access to the rear panel. This panel, secured by clamping strips to the casting, is of flat laminated safety glass, 0.95 in. thick. Each of the two quarter panels consists of inner and outer transparent plastic panels separated by edge members to form an inter-space. They are secured by retaining plates and bolts to the windscreen structure, and side members fitted to the coaming rails.

Hood

92. The hood, which may be jettisoned in an emergency, is hinged to the rear fairing structure and is opened to provide normal entry and exit for the pilot. In the closed position the hood is secured by four locking pins, two on each side of the aperture, which engage with holes in shoot bolt receivers fitted to the side members. When the pins have been withdrawn, the hood is

lifted and retained in the open position by a spring-box mounted in the rear fairing (fig. 21). Two handles, fitted one on each side at the forward end of the hood, are used to pull down the hood to the closed position before engaging the locking pins; these handles may be folded against the hood when not required.

93. The hood structure consists of forward and side members of extruded angle-section secured to a moulded glass cloth rear end fitting, which carries the hinge assemblies. Inner and outer transparent plastic panels, separated by edge members to form an interspace, are secured by retaining plates and bolts to the structure. Rubber strips are fitted between the structure and the plastic panels to form a seal. Just forward of the end fitting, the hood is braced across its width by a moulded glass cloth yoke which is attached to the side members by metal brackets and bolts. Fitted externally to the side members at the yoke attachment positions are two thrust blocks on which rams act during the jettison operation.

Hood locking pin mechanism

94. Each of the hood locking pins (fig. 18, detail B) is operated by a key fitted to a push-rod which together with the locking pin, is mounted in a cast bracket secured to the coaming rail. On each side of the canopy aperture, the front and rear push rods are connected by a push-pull tube, and the rear push rods are linked to levers which are fitted at each end of a torque shaft mounted on the rear face of the pressure bulkhead. The torque shaft (fig. 19) is operated by an electrical actuator through a rack and pinion fitted centrally in the shaft. The actuator is energized to extend and withdraw the locking pins by operation of either of two push-switches, one of which is mounted above the pilot's instrument panel and the other in

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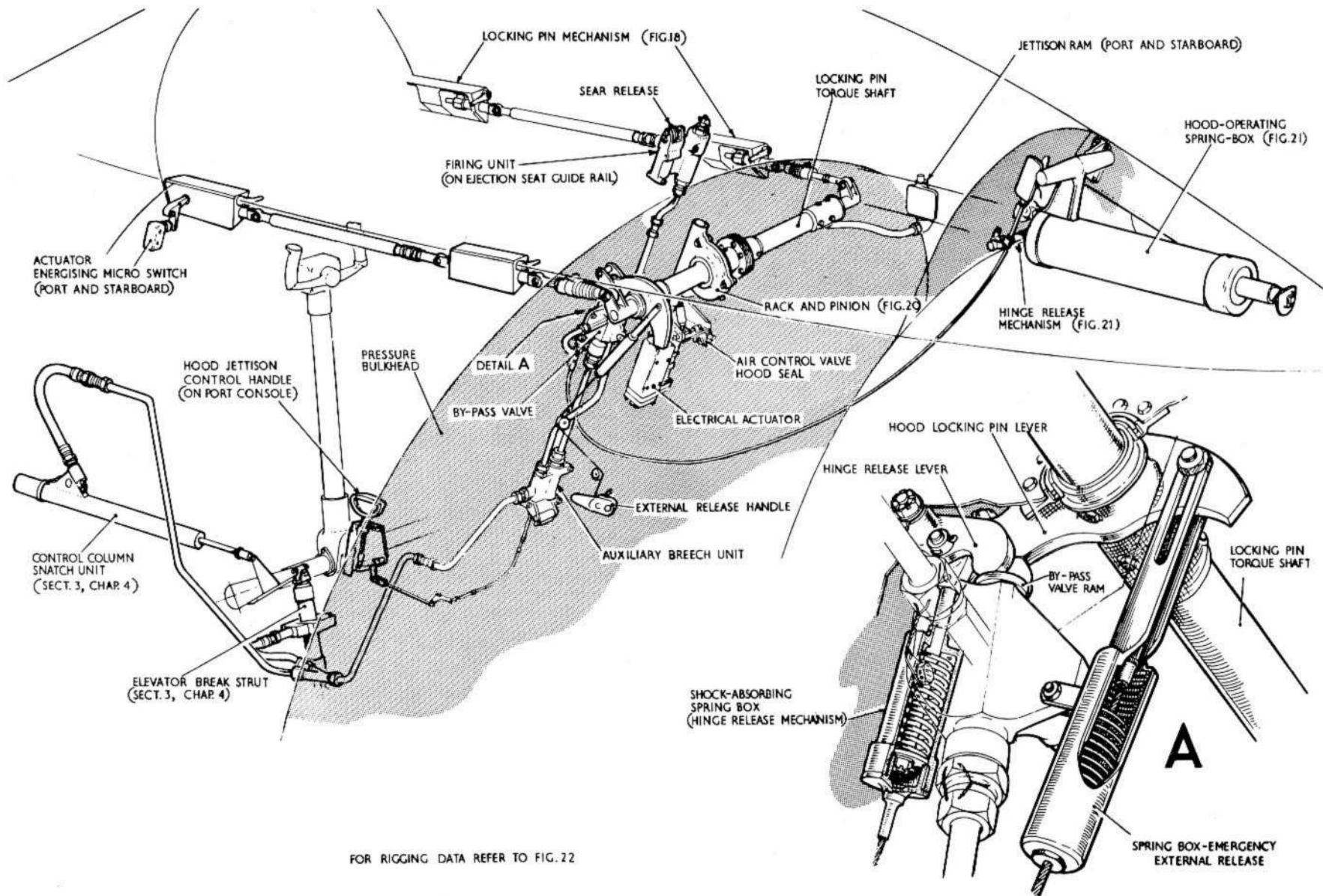


Fig.19 Hood- Operating Mechanism (I)

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the starboard equipment compartment. When the hood is closed, the actuator is energized to retract and engage the locking pins by operation of two microswitches fitted below the coaming rails. These are operated by the hood forward locking lugs which, when the hood is pulled down to the fully closed position, depress the microswitch operating triggers. The final movement of the actuator in each direction disengages the rack from the pinion, thus leaving the torque shaft free to rotate independently of the actuator. This enables the locking pins to be withdrawn by an external manual release handle (para. 95) or by the jettison mechanism (para. 105). A microswitch, mounted between two brackets bolted to the pinion casing, acts as a cut-out to prevent damage to the actuator should it override the electrical stop. An over-centre spring box, which is anchored to the pressure bulkhead and connected to a lever on the torque shaft adjacent to the rack and pinion, loads the shaft in both the locked and unlocked positions.

95. The locking pins may also be withdrawn manually from outside the aircraft. A standard flush-fitting handle, mounted on the port side of the fuselage just aft of the pressure bulkhead, is connected by cable and pulley to the plunger of a spring box. The plunger arm is connected to a lever integral with the bearing fitting at the port end of the locking pin torque shaft, the arm being slotted so that the spring box is undisturbed during the normal electrical operation of the shaft. Operation of the external handle will compress the spring box and rotate the torque shaft to withdraw the pins. After withdrawal by this method it is necessary to reset the locking pin mechanism (para. 116) before the electrical actuator can again be used.

#### Locking pin indicators

96. Mounted on covers which enclose the locking pin mechanism below the coaming rails, are indicators for the locking pins, one for each pin. Each indicator is painted and labelled so that when the locking pin is fully engaged the word LOCKED on a green background shows at a slot in its guide. When the pin is in any position other than fully engaged, the red painted area of the strip will show at the slot.

#### Hood inflatable seals

97. The air control valve for the hood seal is operated by the locking pin mechanism. A spigot extension to the connecting bolt at the actuator and rack and pinion connection, operates a cam lever fitted on a short torque shaft on the control valve mounting bracket. A lever at the other end of the shaft is connected by a link to the control valve operating lever. The shaft is loaded in both the 'on' and 'off' positions by a spring box which is anchored to the pressure bulkhead and connected to a lever fitted centrally on the shaft. The control valve is operated by movement of the actuator when the rack is disengaged from the pinion, thus the seal is deflated before the locking pins are withdrawn and inflated after engagement, the cam lever acting as a lost motion device during the movement of the pins. The hood is jettisoned with the seal inflated. For details of the air system for seal inflation reference should be made to Sect. 3, Chap. 8.

#### Hood-operating spring box

98. The hood-operating spring box (fig. 21), mounted on the rear fairing contains two springs, an inner and outer, which are fitted between two retaining pieces over an inner tube assembly, the whole being housed

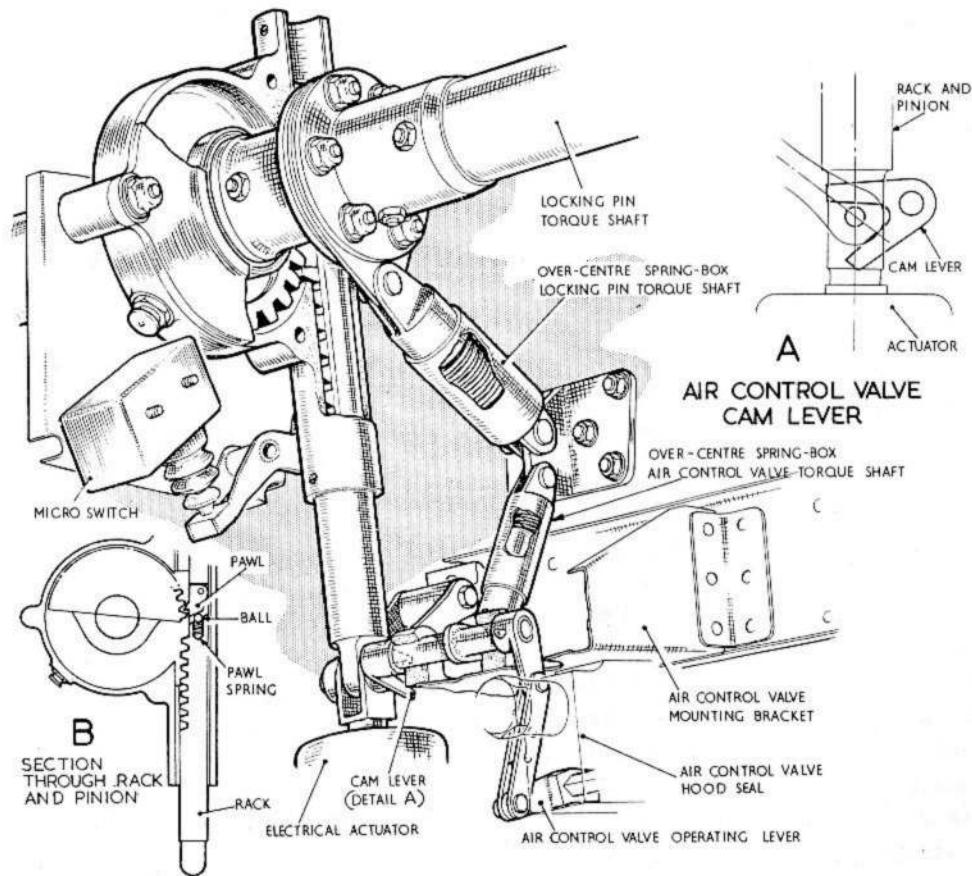


Fig.20 Hood operating mechanism (2)

in a light alloy barrel. At the forward end, the spring retaining piece bears against the flange of a fork-end secured to the inner tube, and at the rear end, against a steel end-cap screwed on to the barrel. The extension of the springs is limited by the flange of an adjustment screw bearing against the rear retaining piece. The adjustment screw is fitted into the rear end of the inner tube and secured in the required position by a locking screw incorporating a square head on an extension barrel which passes through and beyond the bore of the adjusting screw.

99. The spring box is pivoted in the rear fairing on two hinge bolts inserted into bosses welded to the rear end cap. At the forward end, the inner tube is connected by its fork-end to an operating arm which is also pivoted in the rear fairing. A pin through the forward extension of the operating arm locates under the lugs of a hook bolt on the hood rear end fitting. Thus, when the hood is closed the spring box is compressed, the barrel being suitably cut away to clear the operating arm. On release of the hood locking pin the box will extend and, through the operating arm, will lift and retain the hood in the open position.

#### Hood jettison

100. The hood jettison mechanism is operated by pressure from a cartridge gas system which is associated with the pilot's seat ejection and enables hood jettison to be initiated automatically with the operation of the seat ejection control. The system is also arranged to permit the hood to be jettisoned independently if required for, say, ditching.

#### Cartridge gas system

101. This system, which also operates the elevator break strut and control column snatch unit (Chap. 4),

incorporates two cartridges, one in a firing unit mounted at the top of the seat rails and the other in an auxiliary breech unit mounted on the rear face of the pressure bulkhead. The latter cartridge supplies the entire pressure required for hood jettison. Pressure for the operation of the elevator break strut and control column snatch unit is obtained from the cartridge in the firing unit, but before being released to these components, the pressure acts on a piston in the auxiliary breech unit to operate the firing mechanism and so detonate the cartridge. The firing unit is operated directly by the seat ejection control; a timing gear, incorporated in the unit, delays the release of the seat ejection cartridge for one second after the operation of the control. During this delay, the hood is jettisoned and the control column is moved forward against the instrument panel.

102. The sequence of operation initiated by the operation of the seat ejection control is as follows:-

- (1) On pulling the seat ejection firing mechanism, the cartridge in the firing unit is fired instantly and the timing gear is set in motion.
- (2) Gas pressure from the firing unit cartridge acts on a piston in the auxiliary breech unit; the piston extends and acts directly on the operating lever of the unit and fires the cartridge, pressure from which operates the hood jettison mechanism (para. 106).
- (3) Meanwhile, gas pressure from the firing unit, released from the auxiliary breech unit, operates the elevator break strut and control column snatch unit, moving the control column forward against the instrument panel.
- (4) One second after pulling the seat ejection control, the timing gear operates the seat release and fires the seat ejection cartridge.

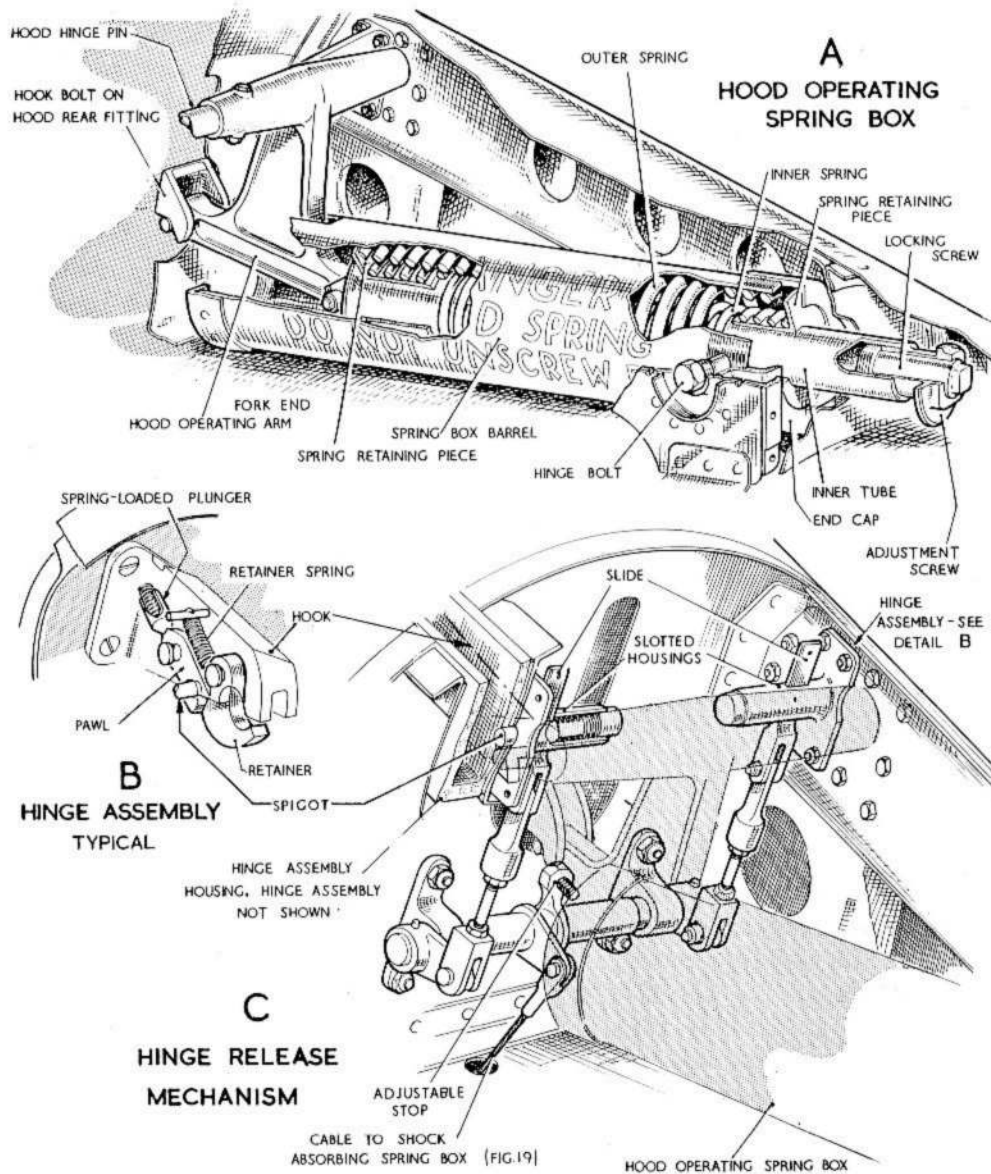


Fig. 21 Hood operating mechanism (3)

103. To jettison the hood independently, the cartridge in the auxiliary breech unit only, is fired; this is done by a full upward movement of the spring-loaded stirrup handle located at the aft end of the pilot's port console. The control handle, which is screened to prevent inadvertent operation in flight, is connected by levers and rod to a bell crank lever on the aft face of the pressure bulkhead, and thence by Bowden cable to a sear pin in the auxiliary breech unit. When the handle is pulled fully upward, the sear is withdrawn allowing the firing pin to strike and fire the cartridge. A safety pin must be inserted in the sear to prevent the latter being withdrawn whilst the aircraft is on the ground; the safety pin must be withdrawn prior to flight, and stowed in the spring clip provided on the inside of the port equipment bay door.

104. A description of the firing unit, Part No. MBCJ/100, and the auxiliary breech unit, Part No. MBCJ/470, is given in A. P. 109A-0001-1.

#### Hood jettison mechanism

105. Operation of the hood jettison mechanism withdraws the hood locking pins and releases the hinges, and two jettison rams impart an initial upward thrust to the hood. The rams, which are mounted on the coaming rail aft of the pressure bulkhead, act against thrust blocks on the members at each side of the hood. Both the jettison mechanism and rams are operated by gas pressure from the cartridge in the auxiliary breech unit.

106. When the cartridge in the auxiliary breech unit is fired, gas pressure from the cartridge enters a by-pass valve mounted on the pressure bulkhead. The pressure operates a ram with the valve and is then released to operate the jettison rams. The by-pass valve ram extends from the top of the valve and acts

on two levers, one operating the hood locking pin torque shaft to withdraw the locking pins, and the other the hinge release mechanism (para. 108).

107. A description of the by-pass valve, Part No. MBCJ/471, and the jettison rams, Part No. MBCJ/474 and 475, is given in A. P. 109A-0001-1.

#### Hinge release mechanism

108. Two hinge assemblies, bolted to the hood rear fairing, are constructed in the form of hooks (fig. 21, detail B). Each assembly is engaged with the hinge pin in the rear fairing, and secured by a retainer which is spring loaded to release, but held in position by a pawl. The pawl is retained by a spring loaded plunger which engages with a notch in the forward cam face of the pawl. When the hood is jettisoned, a slotted spigot is inserted into the hinge assembly so that it locates over a lug projecting from the side of the pawl. The pawl is thus prevented from rotating with the hinge assembly as the hood swings back, releasing the retainer and allowing the hinge assembly to disengage from the hinge pin. The slotted spigots (fig. 21, detail C) are spring-biased to their withdrawn positions and are induced to provide pawl interference, against the action of their springs, by the outboard cam faces of torque shaft operated tongued slides. Rotation of the shaft extracts the slides thus forcing the spigots outboard. A third lever on the torque shaft is connected by Bowden cable to a shock absorbing spring box, and thence to the lever operated by the by-pass valve ram (para. 106). Rotation of the torque shaft is limited by an adjustable stop on the torque shaft.

#### SERVICING

##### Lubrication

109. The lubrication points, type of lubricants to be used and the method of application are shown in fig. 5.

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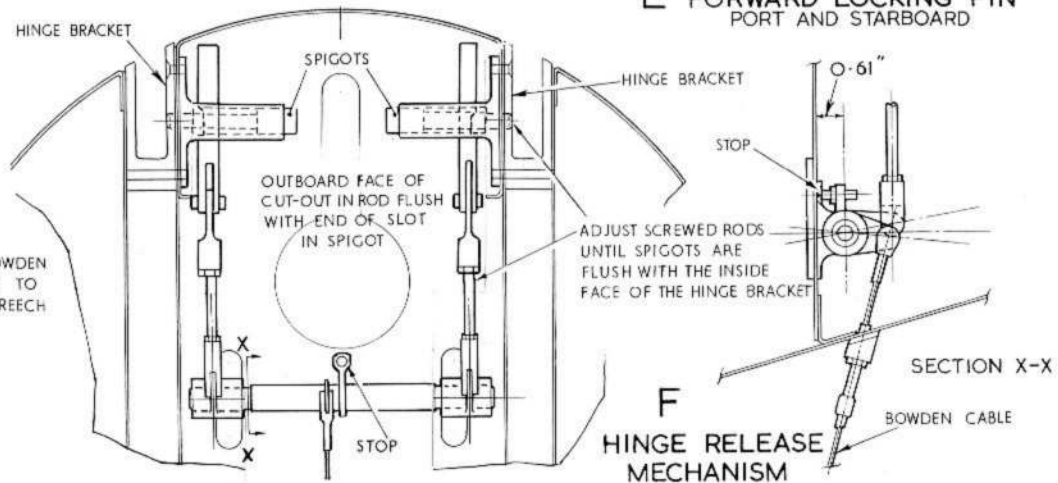
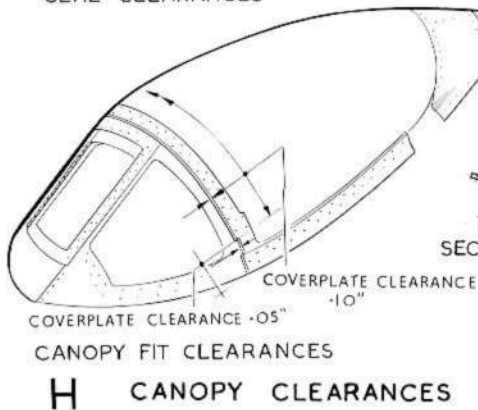
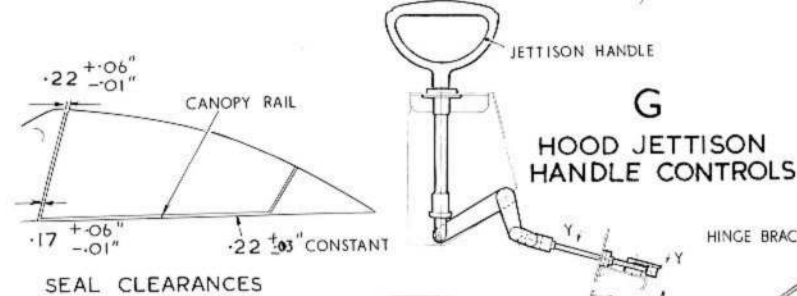
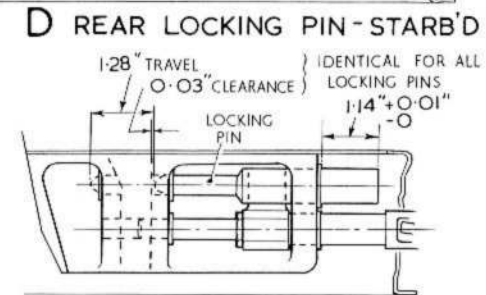
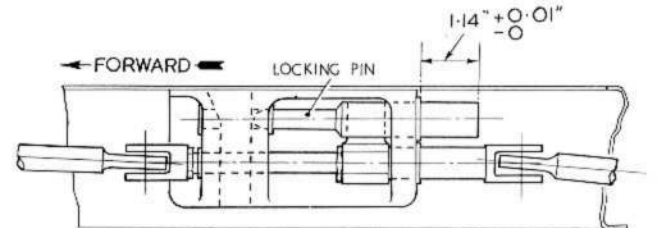
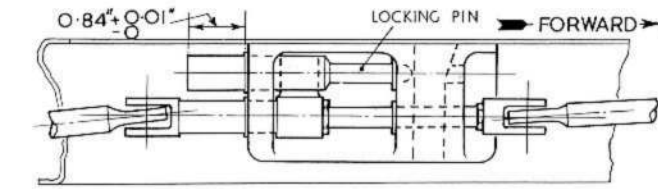
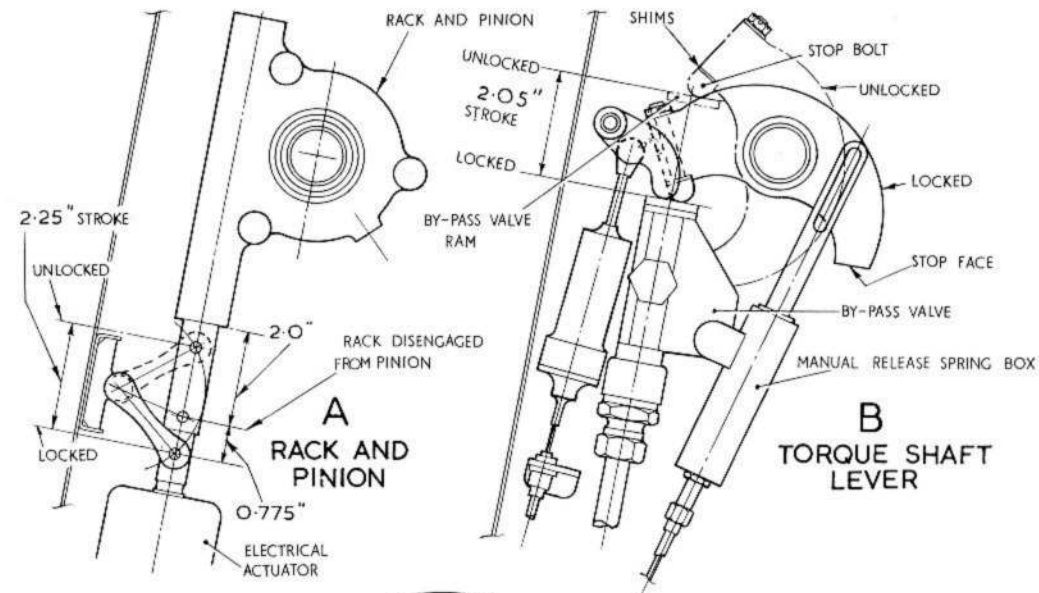


Fig.22 Hood operating mechanism - rigging data

◀ (DETAIL 'X' ALTERED) ▶

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Hood-operating mechanism - rigging (fig. 22)

110. The following components are set prior to their installation in the aircraft and will require no further adjustment when rigging the hood operating mechanism:-

- Hood-operating spring box (para. 98)
- Hood jettison rams, Pt. No. MBCJ/474 and 475.
- Control column snatch unit ( Chap. 4).
- Electrical actuator.

## Setting the hood locking pins

111. (1) With the electrical actuator disconnected from the rack and pinion, and the manual release spring box disconnected from the lever at the port end of the locking pin torque shaft, check that at the 2.0 in. dimension stated in detail A, the rack has disengaged from the pinion, i. e., the rack will withdraw from this point without rotating the torque shaft. Adjust as necessary the shim thickness under the head of the stop bolt on the torque shaft lever (detail B) to obtain this condition.
- (2) Check that the full stroke of the by-pass valve piston is obtainable; the stop face on the torque shaft lever may be filed if necessary (detail B).
- (3) With the external release handle in the locked position, connect the manual release spring box to the torque shaft lever.
- (4) Adjust the cable at the spring box so that the connecting pin is at the top of the slot with the torque shaft lever in the locked position, i. e. stop bolt against the by pass valve ram (detail B).
- (5) Connect the actuator to the rack and ex-

tend the actuator to the 'hood unlocked' position (detail A).

- (6) Set the rear locking pins to within the limits stated in detail C and D by adjusting the links connecting the locking pin push-rods to the levers on the torque shaft.
- (7) Set the front locking pins to within the limits stated in detail E by adjusting the push-pull rods between the front and rear locking pin push-rods.
- (8) Close the actuator to the 'hood locked' position and check the travel of the locking pins.
- (9) Check the operation of the pins using the manual release handle.

## Note...

After operation by the manual-release handle the locking pin mechanism must be reset as instructed in para. 116 before the mechanism can be operated by the electrical actuator.

- (10) When the final adjustments have been made, ensure that all adjustment points and connections are securely locked.

## Setting the hinge release mechanism

112. (1) In the canopy rear fairing, set the stop at the centre of the torque shaft to the dimension stated in detail F.
- (2) Adjust both vertical screwed rods until the interference pins are flush with the inside faces of the hinge brackets (detail F).
- (3) Adjust the cable to take up any slack whilst ensuring full movement of the control.
- (4) When final adjustments have been made, ensure that all adjustments points are securely locked.

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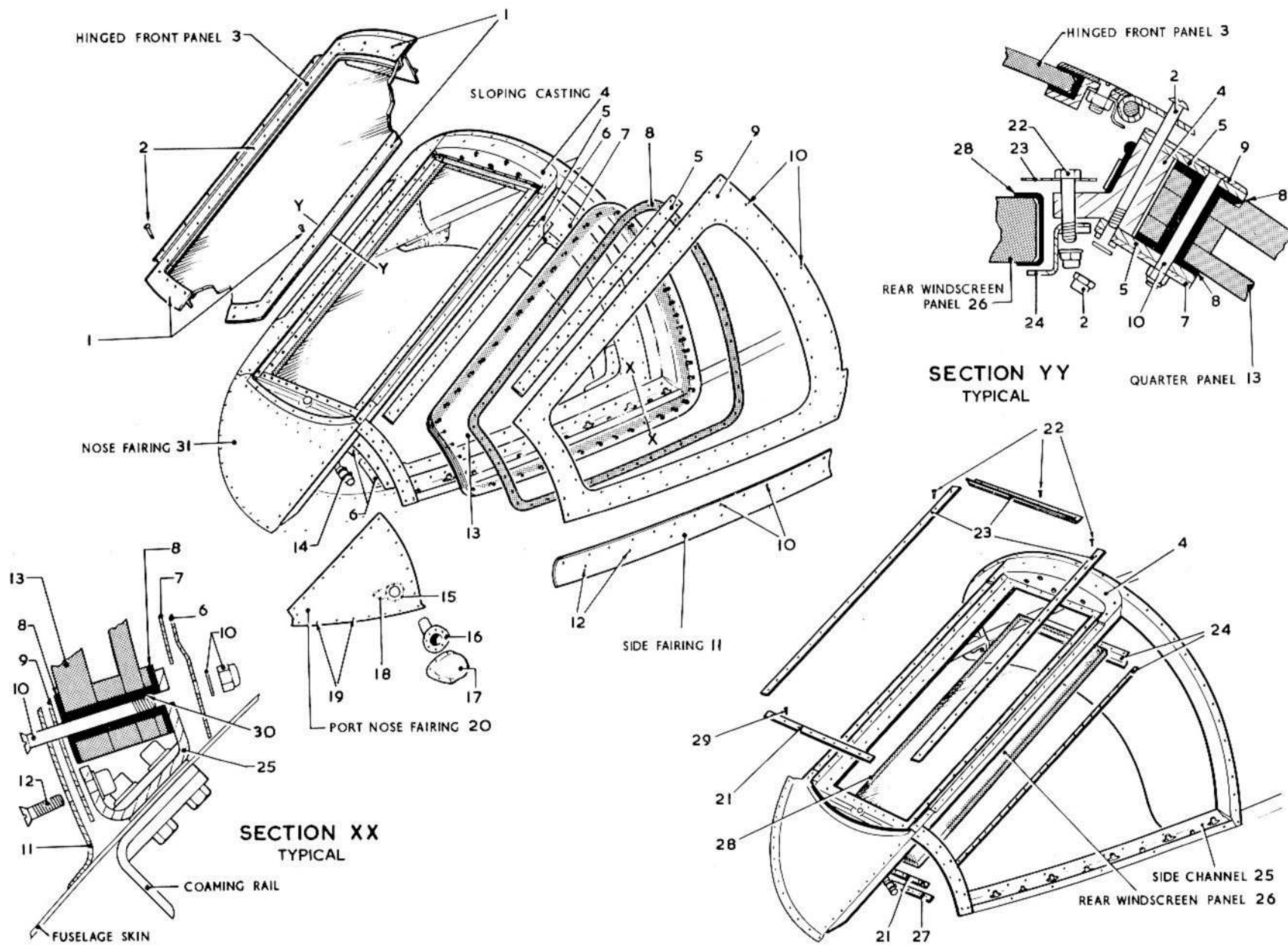


Fig.23 Windscreen removal

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## Setting the hood jettison handle controls

113. (1) With the handle fully home, set the bellcrank lever aft of the pressure bulkhead to the dimension given in detail F by adjusting the control rod.
- (2) Adjust the Bowden cable connecting the bellcrank lever to the auxiliary breech unit to take up any slack whilst ensuring full movement of the control.
- (3) When final adjustments have been made, ensure that all adjustment points are securely locked.

## Hood jettison-functional test

## Note...

First ensure that no cartridges are fitted in any part of the hood or seat system.

114. (1) Raise the forked hinge release lever by hand through the arc normally imposed by the by-pass ram valve.
- (2) Check that the interference pins engage in the hinge panels.
- (3) Check that engagement of the pins effects the breaking of the hinge within 12.75 in. and 15.125 in. of canopy movement, measured between the top edge of the canopy and the top edge of the windscreen.

## Actuators - energizing microswitches

115. When the hood has been installed, adjust the microswitches in accordance with the instructions given in Sect. 5, Chap. 1.

## Resetting the hood locking pin mechanism

116. When the manual release handle has been used

to withdraw the locking pins, the mechanism must be reset before it can be operated by the electrical actuator and the hood closed. To reset the mechanism, rotate the locking pin torque shaft by hand to the 'locked' position. Operate the electrical actuator to withdraw the pins before closing the hood in the normal manner.

## REMOVAL AND INSTALLATION

Windscreen removal (fig. 23)

## Hinged front panel

117. To remove the hinged front panel:-

- (1) Remove the closing bolts 1 and hinge open the front panel 3.
- (2) Remove the nuts, bolts and washers 2 attaching the hinged side of the panel to the sloping casting, and remove the panel 3.

## Nose fairing, port

118. To remove the port nose fairing proceed as follows:-

- (1) Remove the bolts 18 attaching the shroud 17 to the fairing 20, and remove the shroud.
- (2) Remove the bolts 15 attaching the flanged outlet pipe to the fairing 20.
- (3) Remove the fairing attachment bolts 19.
- (4) Slacken the pipe clip 14 and remove the flanged pipe 16 and the port nose fairing 20.

## Quarter panels, port and starboard

119. To remove a quarter panel, proceed as follows for each panel:-

- (1) Hinge open or remove the hinged front panel (para. 117).



- (2) Disconnect the dry-air de-misting pipe.
- (3) Remove the nuts, bolts and washers 10 attaching the side fairing to the quarter panels 13.
- (4) Remove the bolts 12 securing side fairing 11 to the side channel 25, and remove the fairing.
- (5) Remove the nuts, bolts and washers 10 attaching the quarter panel to the windscreen assembly.
- (6) Remove the gusset plates 6, casting reinforcing strips 5, inner and outer retaining plates 7 and 9 respectively, rubber seals 8, and remove the transparent panel 13.

#### Rear windscreen panel

120. To remove the rear windscreen panel, open the hinged front panel, para. 117, and proceed as follows:-

- (1) Remove the attachment bolts 29 and upper and lower retaining strips 21 and the nut strip 27.
- (2) Remove the remaining nuts, bolts and washers 22, upper and lower retaining strips 23 and 24 respectively and remove the transparent panel 26 and rubber seal 28.

#### Windscreen installation

121. The installation of the various components is given in the following paragraphs. Special care should be taken to see that all mating surfaces are sealed with Bostik 2100, Bostik 2102 or Prestik, and that no solvent or thinners is used to clean the transparent panels.

#### Rear windscreen panel

122. To install the rear windscreen panel proceed

in the reverse order of para. 120 and fit a new rubber sealing strip 28.

Quarter panel, port and starboard

123. Proceed as follows:-

- (1) Insert new rubber bushes 30 in the transparent panel 13 using rubber tube 3/8 in. o.d. 3/16 in. i.d. and install in the reverse order of para. 118 fitting new rubber seals 8. Bolt size at the various positions are given in fig.24.

Nose fairing, port (fig. 23)

124. To install the fairing proceed as follows:-

- (1) Introduce the flanged pipe 16 into the hole in the fairing 20 and bolt in position.
- (2) Assemble the flanged pipe 16 to the flexible pipe and tighten the pipe clip 14.
- (3) Insert the top edge of the fairing between the nose fairing 31 and the sloping casting 4, align the bolt holes and bolt the fairing 20 in position.
- (4) Bolt the shroud 17 in position over the flanged pipe.

Hood seals

125. The procedure for the renewal of worn or damaged seals is as follows:-

- (1) Remove and retain the nuts, washers and bolts securing the sealing strips to the canopy rail.
- (2) Remove the sealing strip and old seal, and the Aero Jablex pads in way of the shoot bolt receivers.

(3) Ensure that the metal has been thoroughly cleaned, then attach new pads using Bostik CS. 2558.

(4) Attach the new seal by means of the sealing strips. Fig. 22, detail H, shows the necessary clearances.

Note...

Bostik CS. 2558 may be used sparingly to tack the new seal in position on the canopy rail prior to fitting the sealing strips.

Hood

WARNING...

BEFORE ENTERING THE COCKPIT PERSONNEL SHOULD REFER TO THE 'LETHAL WARNING' CARD AT THE BEGINNING OF THIS VOLUME, AND ENSURE THAT ALL RELEVANT PRECAUTIONS HAVE BEEN TAKEN.

Removal

126. To enable the hood to be removed simply and with complete safety the following tool is recommended. Form a hook from a piece of 1/8 in. dia. wire approximately 6 in. long. Bend up one end of the wire at 90 deg. to form a hook about 3/8 in. long, flatten and file to a point. Bend down about 1/2 in. at the other end of the wire to provide a finger grip. With the hook to hand proceed as follows:-

- (1) Open the hood.
- (2) Disconnect the dry air de-misting pipes - one on each side of the hood.
- (3) Disconnect the air pipe to the inflatable seal on the hood rear fairing.

(4) Raise and support the hood at an angle of at least 45 deg. insert the wire hook below the hinge in each hinge channel in turn, and release the pawls (detail B, fig. 21), allowing the retainers to swing down clear of the hooks.

(5) Lift off the hood.

Installation

Note...

Post Mod. 3239, new canopies are supplied with a minimum trim allowance of 0.1 in. on the forward and aft cover plates (fig. 22, detail H, which also shows the necessary clearances when fitting a new seal). The cover plate clearances shown must be obtained after they have been trimmed and fitted, otherwise the canopy may jam or crack.

127. To install the hood proceed as follows:-

- (1) Hold the hood in the upright position above the hinge pin assembly and disengage the pawls to allow the retainers to swing clear of the hooks.
- (2) Lower the hood until the hooks engage the hood hinge pins and re-engage the pawls.
- (3) Close the hood and connect the air pipe to the inflatable seal connection.
- (4) Connect the dry air de-misting pipes.
- (5) Replace the hood rear fairing panels.

Hood operating spring box

128. To remove the hood operating spring box proceed as follows:-

- (1) Remove the hood para. 126.
- (2) With the hood operating arm in the forward position withdraw the split pin, collar and pin

attaching the fork of the operating arm to the inner tube of the spring box, fig. 21, detail A.

- (3) Remove the hinge bolts at the aft end of the spring box barrel and withdraw the spring box.

129. To install the spring box, proceed in the reverse order of the removal instructions; replace the hood and rear fairing panels.

#### Spring box compressor

130. The bed of the compressor is made of channel-section steel with bench attachment angles welded to the base. An attachment lug, to which the fork end

of the spring box is secured is bolted to one end of the top surface of the channel, and a central hinged clamp is provided to secure the body of the spring box. A fixed head, bolted to the other end of the channel, houses a screwed sleeve keyed to a rotating head, and a sliding screw keyed to the fixed head. A locating rod, having a screwed plug end, runs through a central hole in the sliding screw.

131. To remove the end cap from the spring box:-

- (1) Secure the fork end of the spring box to the attachment lug on the compressor by means of the pip pin.

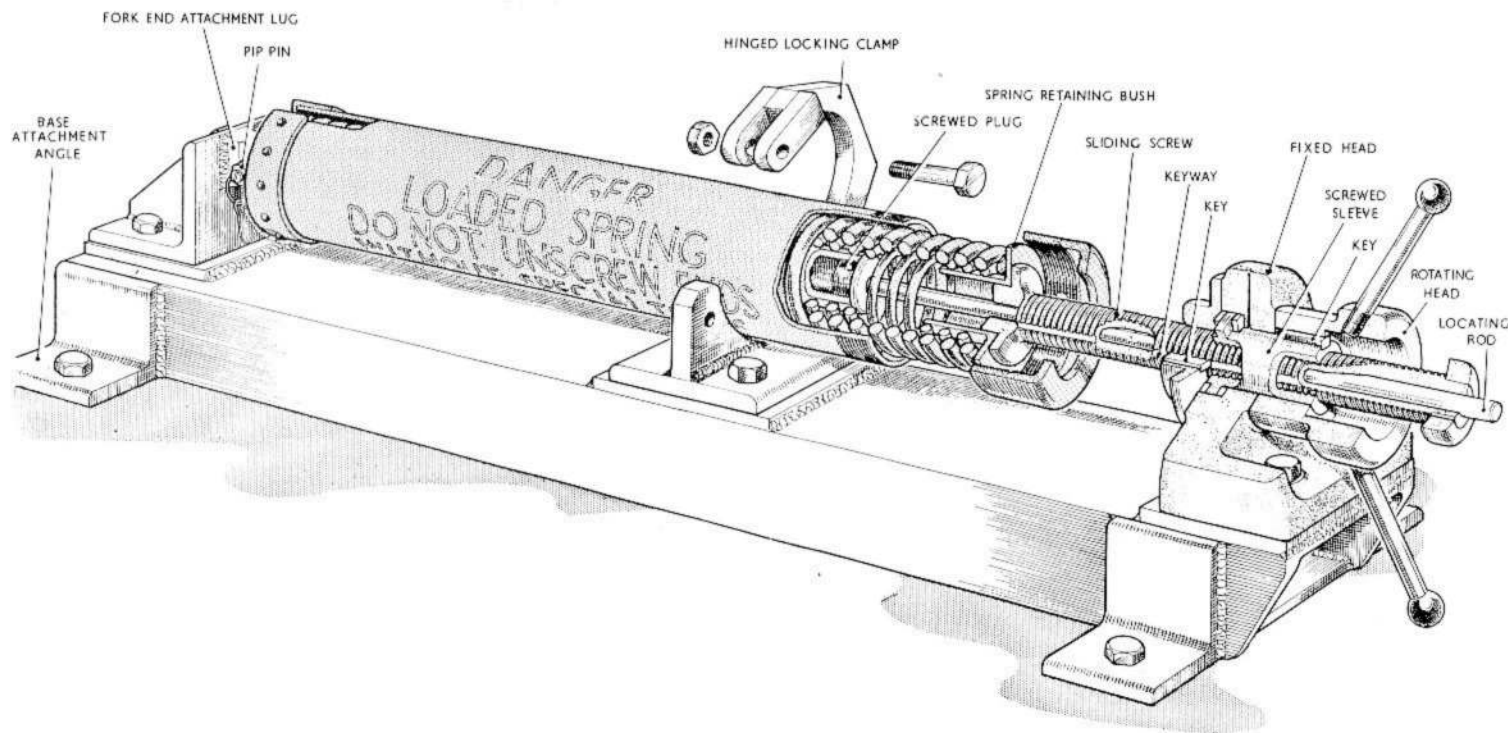


Fig. 25 Spring compressor for hood spring box

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- (2) Secure the body of the spring box by means of the hinged clamp, and lock the clamp with the bolt and nut provided.
- (3) Slacken the locking screw in the sleeve of the adjusting screw, unscrew and remove the adjusting screw and the locking screw.
- (4) Slide the locating rod forward and screw the plug end home into the inner tube of the spring box until the flange on the plug end bears on the end of the inner tube.
- (5) Turn the spokes of the rotating head clockwise until the shouldered end of the sliding screw bearing on the spring retaining flange takes the strain of the spring.
- (6) Remove the end cap locking screw and remove

the end cap.

- (7) Turn the spokes of the rotating head anti-clockwise until the spring is de-compressed.
- (8) The spring box may now be removed from the compressor for servicing.

132. To replace the end cap on the spring box, the cap should first be placed over the sliding screw. The spring box is then secured to the compressor as described in the previous paragraph and the plug end of the locating rod inserted into the tube. Repeat operation (5) until the spring is compressed sufficiently to allow the end cap to be screwed on. Pressure on the spring should not be released until the locking screw is replaced in the end cap.

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## SEATS

## DESCRIPTION AND OPERATION

Pilot's seat installation

## General

140. A description of the Martin Baker Type 3 CS Mk. 2 ejection seat fitted at the pilot's station is given in A. P. 109B-0102-1. The seat guide rail is bolted to the front face of the pressure bulkhead, and is anchored, at the level of the pilot's floor, to a vertical member assembly which is also attached to the pressure bulkhead and extends to the main floor of the cabin. The time release and drogue gun static lines are secured by quick-release pins to brackets fitted on the pressure bulkhead, and the leg restraining cords are attached similarly to brackets on the pilot's floor.

## Seat ejection

141. Prior to the ejection of the pilot's seat, the canopy hood must be jettisoned and the control column moved forward against the instrument panel to ensure an unobstructed exit for the pilot.

142. These operations are initiated by the single action of operating the seat ejection control and carried out by means of a cartridge gas system. Firing the seat ejection cartridge is delayed by a timing

gear to enable the canopy to be jettisoned and control column displaced before the seat is ejected. The sequence of operations and the cartridge gas system are described in para. 102.

Navigator's seat installation

## General

143. A description of the Martin Baker Mk. 4QS ejection seat fitted at the navigator's station is given in A. P. 109B-0103-1. The seat guide rails are bolted to the front face of the seat beam which extends as an integral part of the aircraft structure from the bottom of the keel frames to a reinforced area between the tops of frames 4A and 5.

## Seat injection

144. The navigator's roof hatch is of a frangible nature, but is normally jettisoned prior to ejection. A cabin pressure 'dumping' facility is provided at both crew stations with appropriate warning lamps and a pressure gauge is provided at the navigator's station. ◀ On aircraft embodying Mod 4397 the hatch is provided with a miniature detonating cord system to cut out the frangible port when the seat is ejected with the hatch closed (para 73A). ▶

Removal and installation

145. Instructions for the removal and installation of the seats are given in A. P. 109B-0103-5. Access for this purpose when authorised is obtained by the external releasing of the frangible hatch (para. 72).

## CAMERA COMPARTMENTS

## DESCRIPTION AND OPERATION

General

170. The three main camera compartments are situated between frames 12 and 13, 29 and 31, and 34 and 35, provision being made for the installation of two cameras in both the front and mid compartments and one in the rear. A hatch is provided in the underside

of the front compartment, but access to the mid and rear compartments is obtained by entering the aircraft through the hatch in the underside of the rear fuselage. The camera windows, which are of twin ground plate glass, are protected by hydraulically operated sliding doors fitted between the windows and the aperture in the fuselage skin. Tubular structures to which the camera mountings are attached and

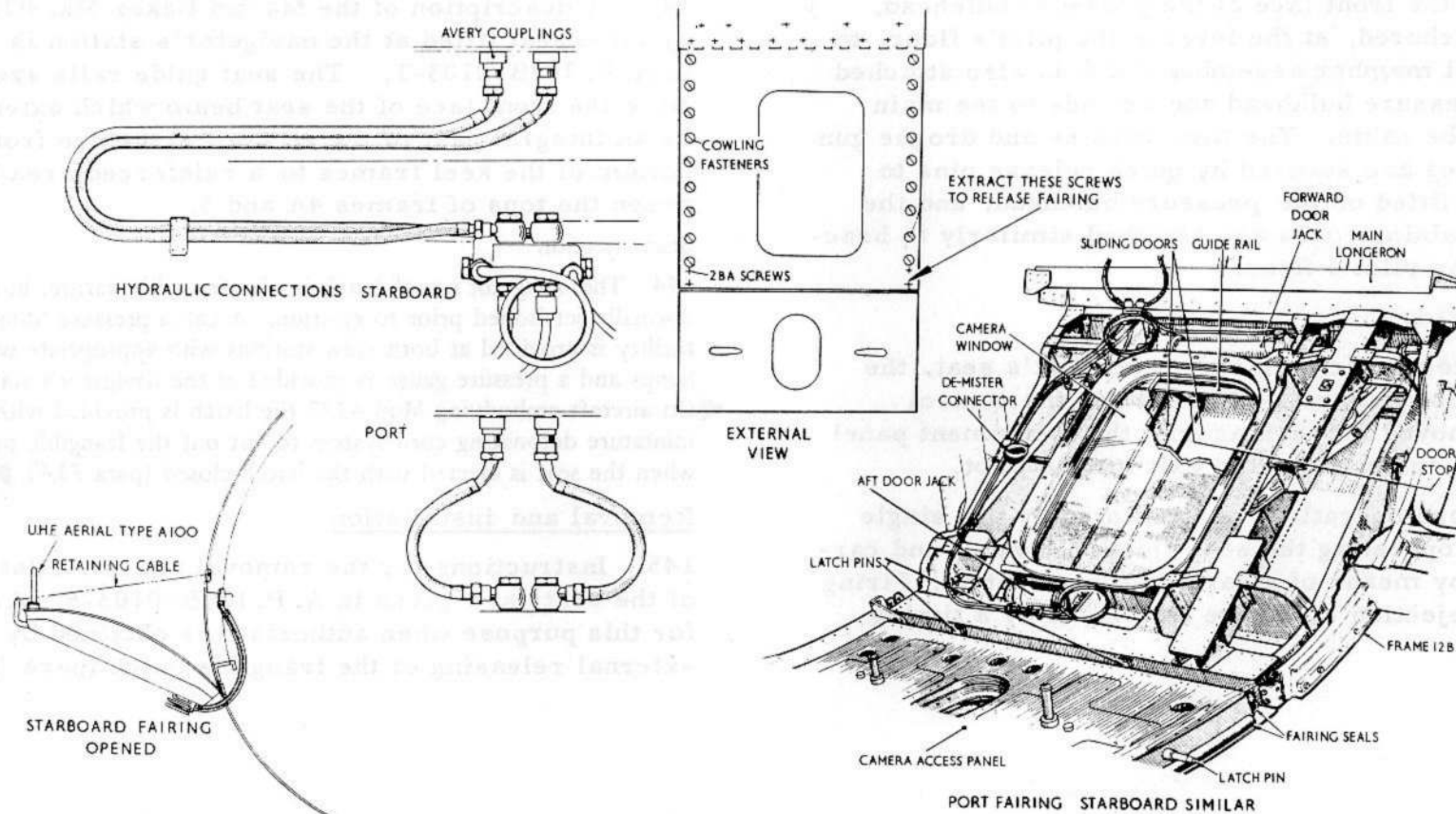


Fig. 26 Front camera doors

certain parts of the camera hoisting gear are fitted permanently in each compartment. Details of the various operational roles, the installation of the cameras and camera controls are given in Sect. 5, Chap. 2. In addition three camera mounting positions are provided in the forward fuselage and hinged nose to accommodate the camera installations required for low level oblique survey operations (fig. 32).

#### Front camera compartment

##### Hinged fairings and camera access panel

171. The hatch below main longeron level in the front camera compartment is closed by port and starboard fairings, hinged to the longerons, and an access panel fitted centrally between the fairings (fig. 26). The access panel is completely detachable and provides an entry to the compartment for camera loading and inspection. It is secured to the fairing edges and adjacent frames by six latch pins, two in each side and one at each end, operated by two S. B. A. C. standard flush fitting locks. The hinged fairings are opened for the removal and installation of the cameras; in the closed position they are secured to the adjacent fuselage frames by 'Custodian' fasteners. A camera window is mounted in each fairing above an aperture in the outer skin, hydraulically operated sliding doors (para. 172) being fitted between the window and the aperture to protect the glass.

##### Sliding doors

172. The aperture beneath the camera window in each fairing is closed by two sliding doors which are mounted on vertical and horizontal rollers in a pair of channel-section guide rails, running fore and aft in the fairing. The doors are of double skin construction with the outer skin shaped to the fuselage profile, the forward door being longer than the rear. Rubber

strips are fitted to the abutting edges to form a seal when the doors are closed.

173. Each door is operated by a hydraulic jack. For the forward door, the jack is mounted near to the top edge of the fairing; its piston rod end is connected to one end of a centrally pivoted arm, the other end of the arm being connected to a pivot pin fitted centrally to the upper surface of the door near to its front edge. The rear door jack, mounted near to the lower edge of the fairing, is connected to a lever on a triple lever assembly which in turn is linked by a push-pull tube to a double lever assembly near to the top edge of the fairing. Both lever assemblies are connected to pivot pins on the upper surface of the rear door near to its rear edge. When the jacks are fully extended the doors are closed; stops are fitted in the guide rails at the closed position. A description of the door controls and hydraulic system is given in Chap. 6 of this Section.

##### Camera mounting support structure, pre Mod. 3756 (fig. 27)

174. This structure is identical at both port and starboard camera positions and consists of front and rear pairs of vertical support tubes, each carrying a horizontal splined shaft assembly. The support tubes are attached to the adjacent bulkhead by brackets at their ends and clamps at approximately mid height. The splined shaft assemblies are inserted at each end into support blocks on the vertical tubes, the support blocks being secured to the tubes by quick-release pins and made rigid by clamping. Alternative holes are provided in the vertical tubes to enable the splined shaft assemblies to be positioned to suit the focal length of the camera lens, each position being identified by a label fitted to the bulkhead. The arms of the central attachment clamps on the vertical tubes

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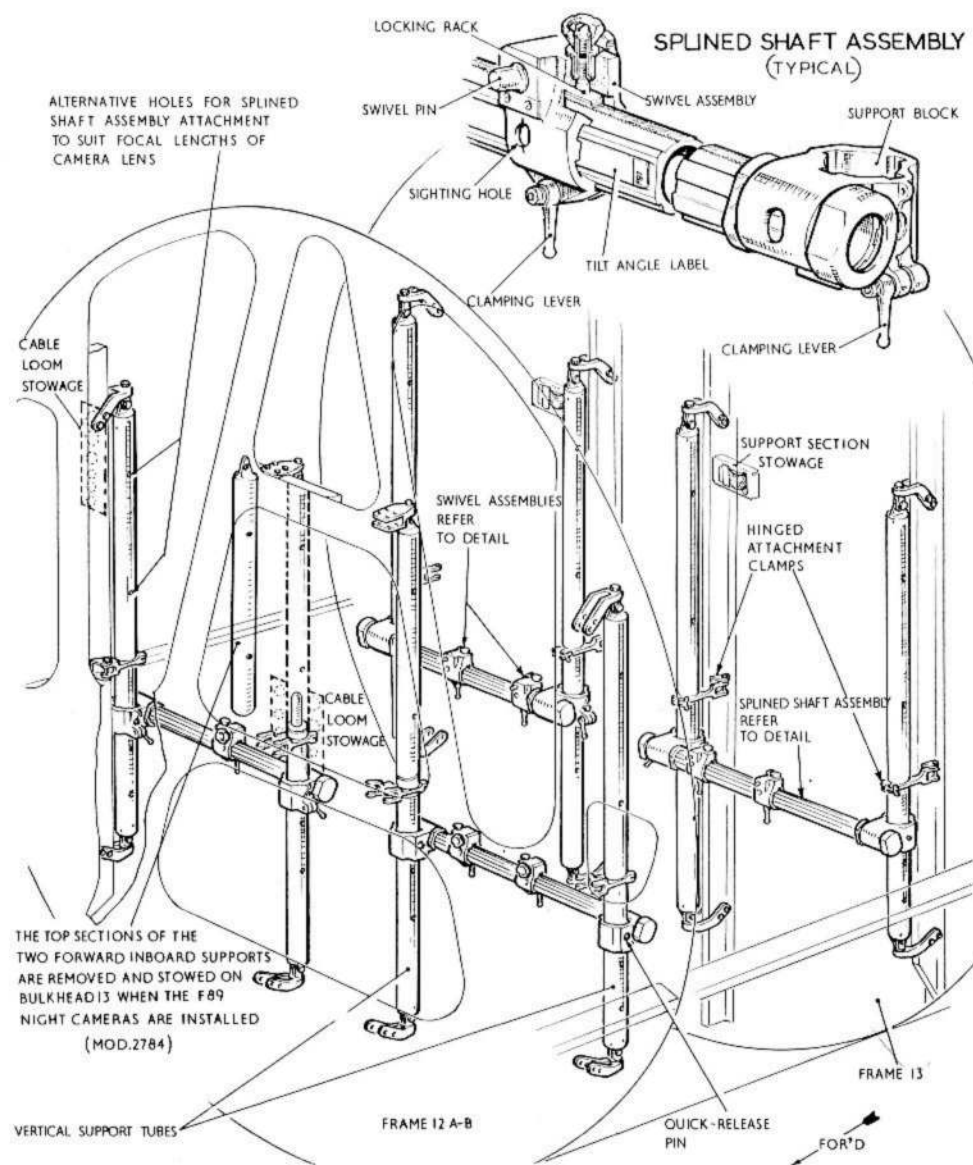


Fig. 27 Camera - mounting support structure, front compartment, pre - Mod. 3756

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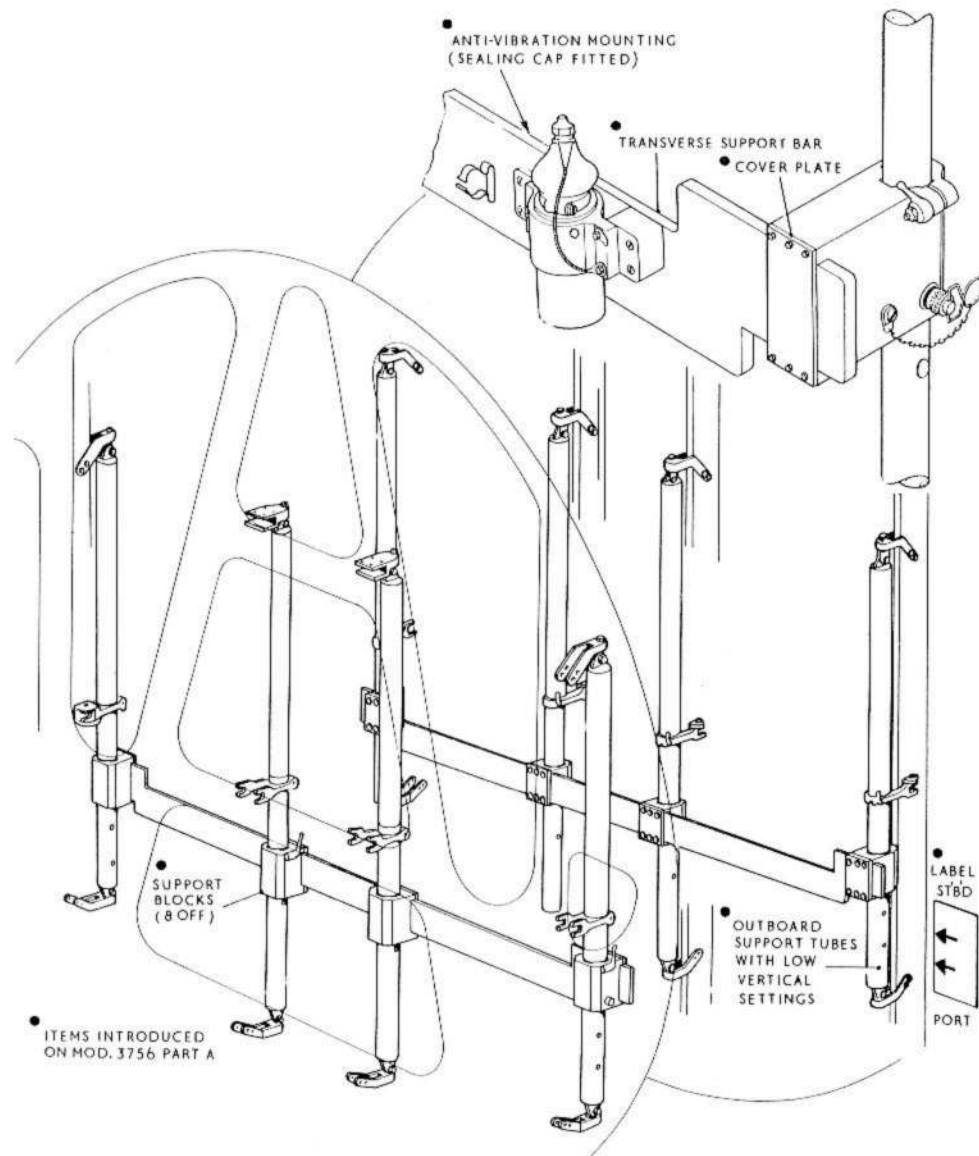


Fig.28 Camera mounting support structure, front compartment, post Mod. 3756

are hinged so that they may be swung aside when repositioning the splined shaft assemblies.

175. Two swivel assemblies, which incorporate swivel pins for supporting the camera mounting, are fitted on each splined shaft. To suit the required tilt angle of a camera, the assemblies may be moved along the shaft; the positions of the various angles are indicated on a label fitted to the side of the shaft and sighting holes with indicator lines are provided in the swivel assemblies. A locking rack, operated by a fingerwheel, is engaged with a serrated spline at the top of the shaft to lock a swivel assembly in the required position, the assembly being made rigid on the shaft by clamping. The swivel pins are retracted and extended when installing the camera by rotating a small handwheel.

Camera mounting support structure, post Mod. 3756 (fig. 28).

176. To provide facilities for oblique photography through the port or starboard camera window, using one F9648 in. camera at 15 or 20 deg. angles, a modified mounting arrangement (Part A of Mod. 3756) is used. Transverse bars, incorporating anti-vibration mountings, and two pairs of camera mounting angles are substituted for the splined cross shaft assemblies; the four outboard vertical support tubes are replaced by new members, each of which has an additional pair of setting holes, identified by labels which are attached to the adjacent bulkheads.

To prepare the structural requirements proceed as follows:

- (1) Detach the eight vertical support tubes from the bottom brackets and remove the splined cross-shaft assemblies and support blocks.
- (2) Detach the four outboard vertical supports from the top brackets and substitute a new tube Pt. No. EB8-83-2343 at each position, using split-pinned slotted nuts in lieu of the existing nuts.
- (3) Slide the eight new support blocks on to the tubes and re-attach the tubes to the bottom brackets.
- (4) Detach the cover plates from each of the support blocks, set in position the two transverse bars complete with antivibration mountings, and replace the cover plates.

Note...

It is important to ensure that the red sealing caps are screwed on to the antivibration mountings to guard against seepage of the silicone fluid when the assemblies are not in use.

- (5) Adjust the transverse bar assemblies to a convenient height, insert the support block quick-release pins and leave the arrangement in readiness for the requirements of Part B of this modification (Sect. 5, Chap. 2).
- (6) At the bulkheads of frames 12B and 13 attach with suitable adhesive the four camera-height indicator labels, ensuring that the arrows marked on the labels coincide as nearly as possible with the pairs of holes at the lower ends of the four new outboard vertical support tubes.

Mid camera compartment

## Sliding doors (fig. 29)

177. In the mid camera compartment, two camera windows are mounted above apertures cut into the fuselage underside skin, each aperture being closed by a sliding door to protect the window. The doors are of double skin construction and shaped to the fuselage profile; they are mounted on rollers and move in lateral guide-rails, which are secured to the fuselage skin and main longerons. A single hydraulic jack, mounted just forward of the port window, operates both doors simultaneously. The jack, which is fully extended when the doors are open, is connected at its piston rod end to a centrally pivoted arm mounted between the windows, the arm being linked by push-pull tubes to the outer edge of each door.

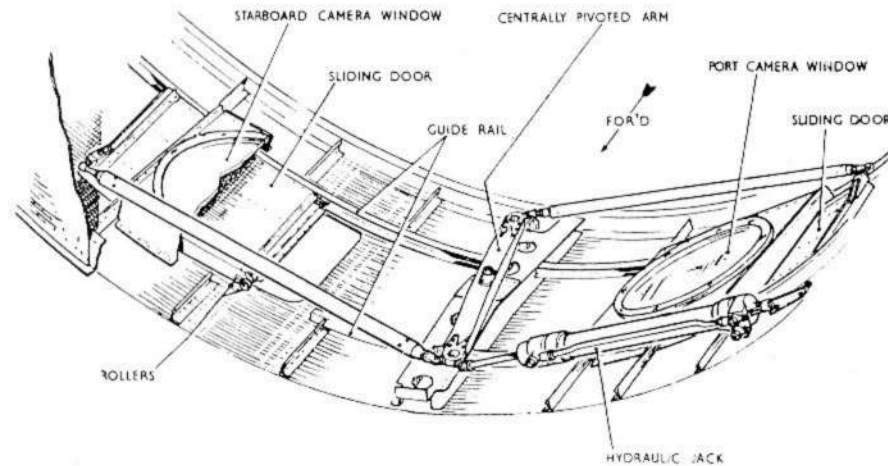


Fig. 29 Mid camera doors

## Camera mounting support structure (fig. 30)

178. Three horizontal members consisting of a centre member and port and starboard outer members, are secured at their forward ends to the half bulkhead at frame 29. The centre member, which is of back-to-back channel-section construction, is supported at its rear end by a diagonal bracing strut attached at its lower end to the bulkhead. The outer members, of single channel-section, are each supported at the rear end by two adjustable, tubular ties, one vertical and the other horizontal, both attached to fuselage skin stiffeners. Front and rear end castings, which incorporate the pivot pins for the camera mounting, are carried between the centre member and the outer member on each side, the casting being attached by horizontal and vertical quick-release pins at each end.

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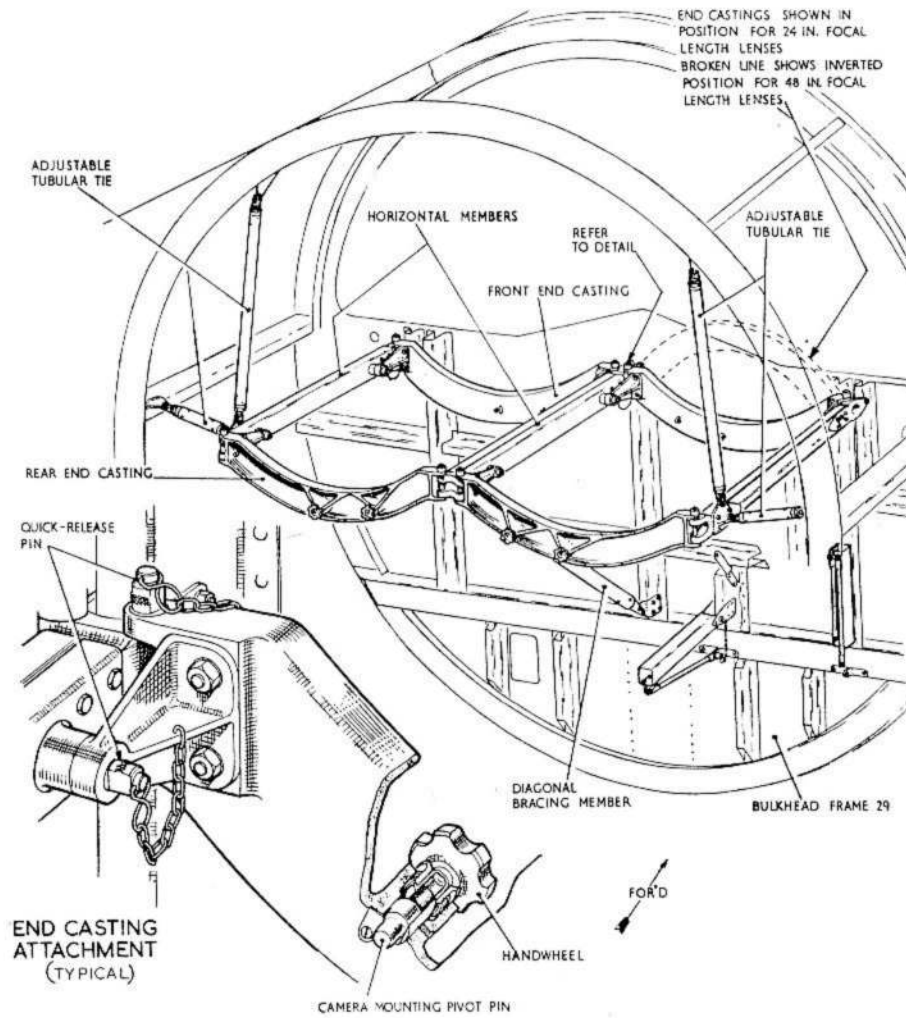


Fig. 30 Camera mounting support structure, mid compartment

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179. To provide for the installation of cameras with either 48 in. or 24 in. focal length lenses, the end castings are curved in shape, so that by interchanging the castings, port with starboard and inverting, two mounting levels may be obtained. The castings are marked to indicate the mounting position to suit each lens. The two pivot pins are retracted and extended by the rotation of handwheels.

#### Rear camera compartment

Sliding doors (fig. 31)

180. A single camera window is mounted between frames 34 and 35 above an aperture cut in the fuselage underside skin, the aperture being closed by a pair of sliding doors to protect the window. The doors, which are of double skin construction and shaped to the fuselage profile, are mounted on vertical and horizontal rollers and move in lateral guide rails attached to the adjacent frames. Each door is operated by a hydraulic jack anchored to the fuselage side above the door, and connected directly at its piston rod end to the edge of the door.

Camera mounting support structure (fig. 4)

181. This structure consists of port and starboard pairs of vertical support tubes, each of which carries a splined shaft assembly and a pair of mounting feet. The vertical tubes are secured by forkends at their bases to top-hat section members riveted to the fuselage skin, and at their tops by bracing members to the fuselage side. The splined shaft assemblies are similar to those described for the front compartment (para. 174) and are used when mounting an F. 89 camera. The mounting feet, used when mounting an F. 49 camera, are secured to each vertical tube by a quick-release pin and made rigid by clamping. Alternative holes are provided in the vertical tubes to enable both the

splined shaft assemblies and mounting feet to be positioned to suit the focal length of the camera lens, each hole being labelled to indicate the camera and lens for which it is intended.

### SERVICING

#### Lubrication

182. The lubrication points, type of lubricant to be used and method of application are shown in fig. 5. Sealed bearings do not need further lubrication until major servicing.

#### Door jack adjustment

183. The pin centres of the sliding door jacks are normally set at the following dimensions:-

Front camera compartment

Forward door jacks 15.90 in.  $\pm$  0.1

Rear door jacks 9.50 in.  $\pm$  0.1 in.

Mid camera compartment jack 15.80 in.  $\pm$  3/16 in.

Rear camera compartment jack 13.52 in.  $\pm$  3/16 in.

These are manufacturer's settings which should not normally need alteration after assembly. If adjustment to a jack is necessary, proceed as follows:-

- (1) Disconnect the jack from the door mechanism at the piston-rod fork-end.
- (2) Ensure that the jack is fully retracted.
- (3) Remove the locking wire and slacken the lock-nut on the jack piston-rod.
- (4) Adjust as necessary by turning the fork-end one-half turn at a time.
- (5) Tighten the lock-nut on the jack piston rod and lock with a new locking wire.

- (6) Re-connect the fork-end of the jack piston-rod to the door mechanism.

### REMOVAL AND INSTALLATION

#### General

184. Reference should be made to Sect. 5, Chap. 2 for instructions on installing the cameras in the mounting support structures, and to Chap. 6 of this Section for removal and installation instructions on the sliding door operating jacks.

#### Sliding doors - front camera compartment

##### Removal

185. To remove the sliding doors proceed as follows for each door.

- (1) Disconnect the operating lever by removing the split pin and pivot pin (rear door, two operating levers).
- (2) At each guide rail, take out the bolt and washer and remove the door stop.
- (3) Slide the door to be removed over the aperture in the fairing skin so that the screws attaching the door outer skin are accessible.
- (4) Remove the rubber sealing strip from the abutting edge of the door.
- (5) Take out the 4BA screws (forward door - forty-eight, rear door - thirty-six) and remove the door outer skin.

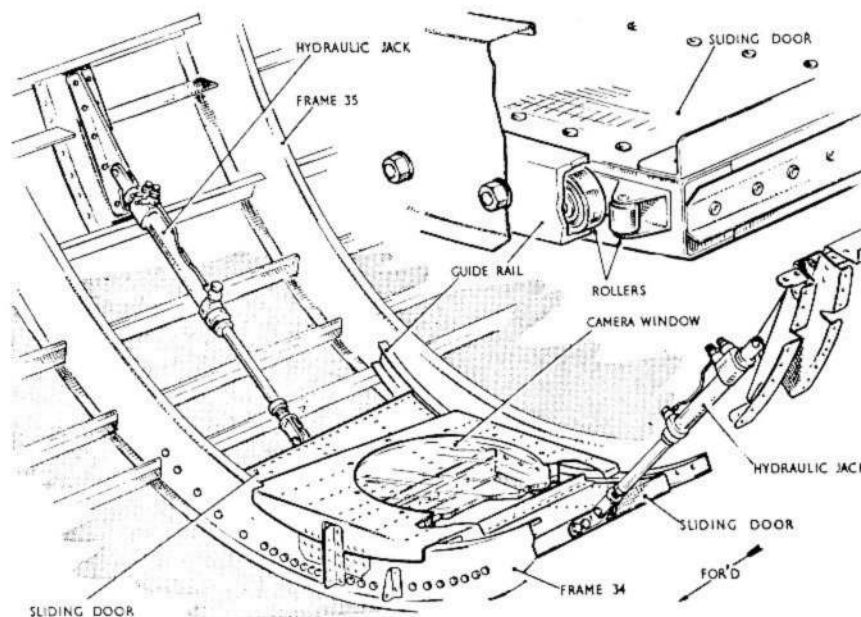


Fig. 31 Rear camera doors

(6) Remove the 2BA bolts (forward door - ten, rear door - six) joining the two halves of the door at the centre diaphragm.

Note...

At the forward door the removal of these bolts will detach the operating lever attachment fitting.

(7) Remove each half of the door from the aircraft.

Installation

186. The procedure for installing the sliding doors is a reversal of the removal operations. The door sealing strip should be attached with rubber-resin cement, Ref.No. 33C/1173. After fitting the door stops to the guide rails, the bolt should be locked by centre punching.

Sliding doors - mid camera compartment

Removal

187. To remove the sliding doors proceed as follows for each door:-

- (1) Fully retract the door jack.
- (2) Disconnect the push-pull tube at the door.

(3) Lift the push-pull tube clear of the door and slide the door upwards out of the guide rails.

Installation

188. The procedure for installing the sliding doors is a reversal of the removal operations.

Sliding doors - rear camera compartment

Removal

189. To remove the sliding doors, proceed as follows for each door:-

- (1) Fully extend the door jack.
- (2) Disconnect the jack piston-rod from the lug on the door.
- (3) Lift the jack clear of the door and slide the door out of the guide rails.

Installation

190. The procedure for installing the sliding doors is a reversal of the removal operations.

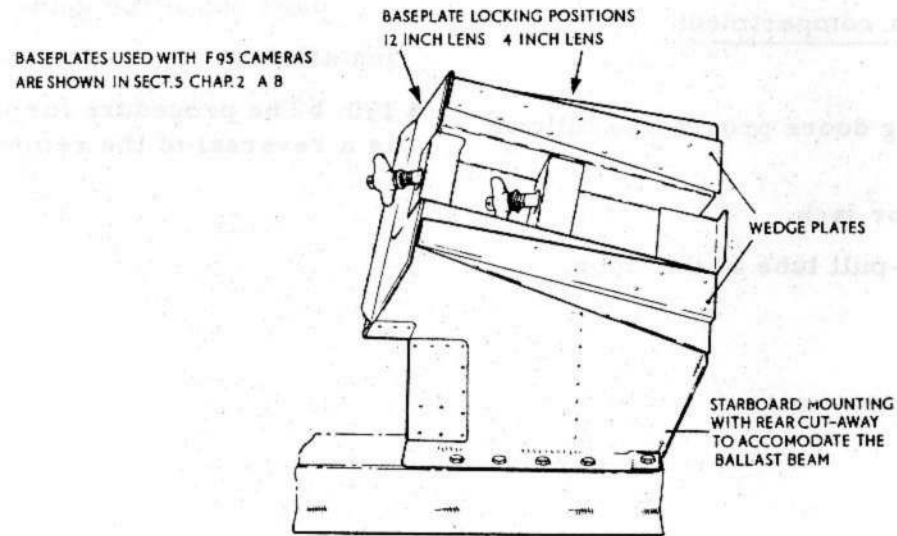
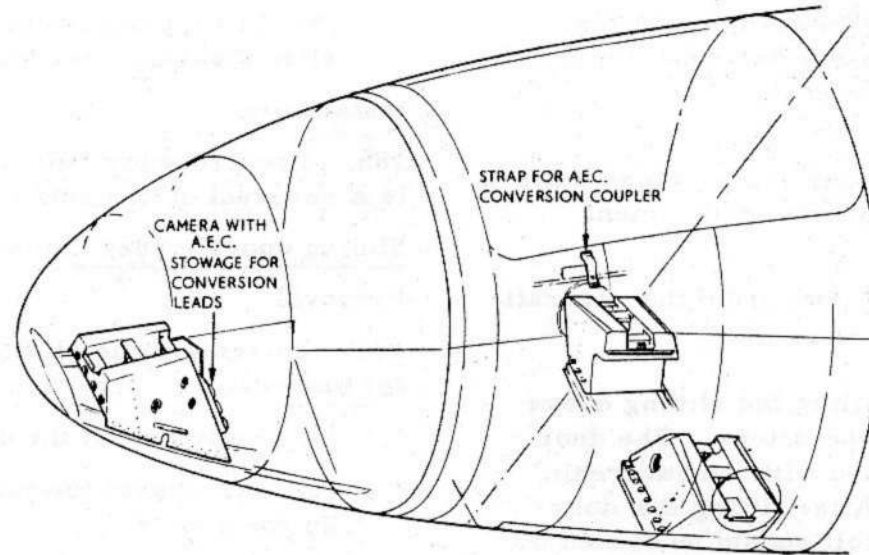


Fig.32 Front fuselage camera mountings

## FLARE BAY DOORS

## DESCRIPTION AND OPERATION

Construction (fig. 33)

210. The flare bay door structure consists of transverse ribs, fitted between inboard and outboard longitudinal, channel-section members, covered externally and internally with light-alloy skin. The external skin, shaped to the fuselage profile, is reinforced internally by continuous longitudinal, angle-section stiffeners, whilst external longitudinal, top-hat section stiffeners are riveted to the internal skin. Each door is hinged at each end to the flare bay bulkheads, the hinge pins (fig. 36) passing through spherical bearings, incorporated in built-up hinge brackets which are bolted to the doors and braced by a tubular stay. Three rollers mounted in brackets, secured to the outboard longitudinal member of each door (fig. 33) operate in the channelled edges of the fuselage transverse floor girders. To provide adjustment, each roller rotates on a sleeve mounted eccentrically on a support bolt (detail A) the sleeve being locked in the required position by engagement of an integral serrated flange with a triangular locking plate bolted to the roller bracket.

211. Mod. 4254 Part B in conjunction with Part C introduces new flare bay doors with aperture for use with the F49 Mk. 4 Day Role survey camera pack - Role B3 (see Sect. 5, Chap. 2, Group A & B.)

The new flare bay doors (fig. 34) are structurally similar to, and interchangeable with, the existing components; operation and functioning are unaffected, the major alteration being the provision of a permanent aperture below the Mk. 4 camera pack, and a closing fairing for role variants. The doors once fitted are

not removed except for subsequent servicing requirements, and when the aircraft is used in a different role the aperture is closed by fitting the fairing and reverting the structure to its original profile.

The fairing is designed in port and starboard half-sections, each part being virtually a cut-out section of the door profile with weather sealing at the centre line joint and locating spigots on the outboard edge. Both sections of the fairing are fitted by mating the locating spigots with sockets in the door cut-out, and secured by double locking quick-release pins, forward and aft in each section, which interlock the structure at rib stations 4 and 11 of the flare bay doors. Screwed panels at the locking positions on the inner skin of the fairing provide access to the pins.

212. Sealing for the doors is provided by tubular rubber strips attached to the front and rear and inboard edges of the door, and to the lower edge of the flare bay skirt on the fuselage.

Operation

213. The flare bay doors are operated by two hydraulic jacks mounted one at each end of the flare bay. Each jack is mounted vertically, the body being anchored to a bracket fitted to the adjacent bulkhead. A three-holed link-end on the piston rod is connected at the centre hole to a guide link pivoted on the bulkhead structure. Adjustable actuating links, attached to the piston rod link-ends, connect the jacks to spherical bearings incorporated in the door hinge brackets. The jacks are fully extended when the doors are closed. When the doors are opened, the jack closes and the doors pivot about the hinge pins, the outboard edge of the doors moving upwards into the flare bay.

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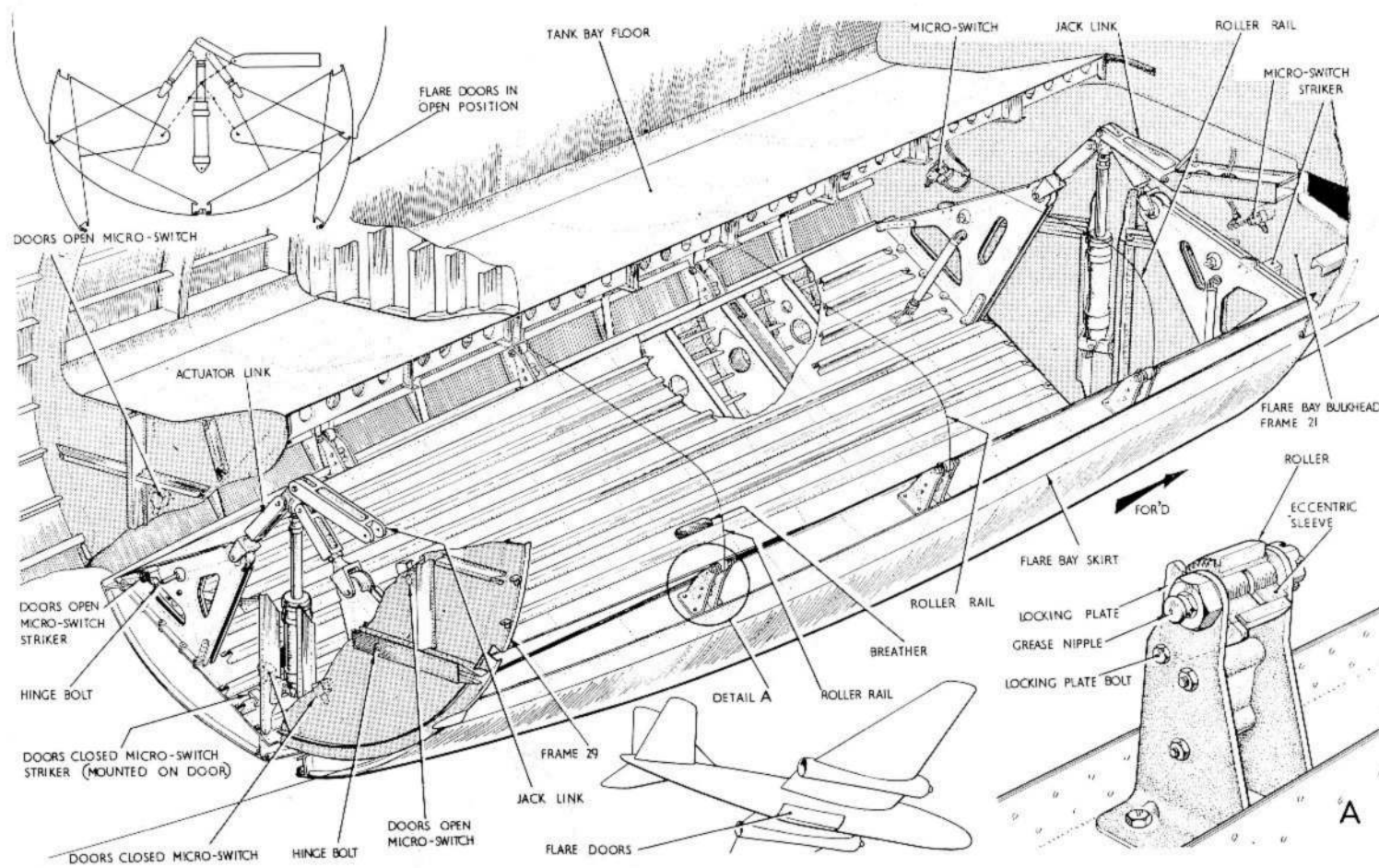


Fig.33 Flare bay doors

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NOTE: THESE DOORS ARE INTERCHANGEABLE WITH THE PRE-MOD. 4254 VERSION AND THE NOMINAL INSTALLATION DIMENSIONS OF FIG. 35 APPLY ALTHOUGH ADJUSTMENT TO HINGE BOLT SHIMS AND ACTUATOR LINKS MAY BE REQUIRED.

FURTHER ADJUSTMENT WILL BE NECESSARY WHEN INSTALLING THE F49MK4 CAMERA PACK DESCRIBED IN SECT. 5, CHAP. 2, GROUP A/B.

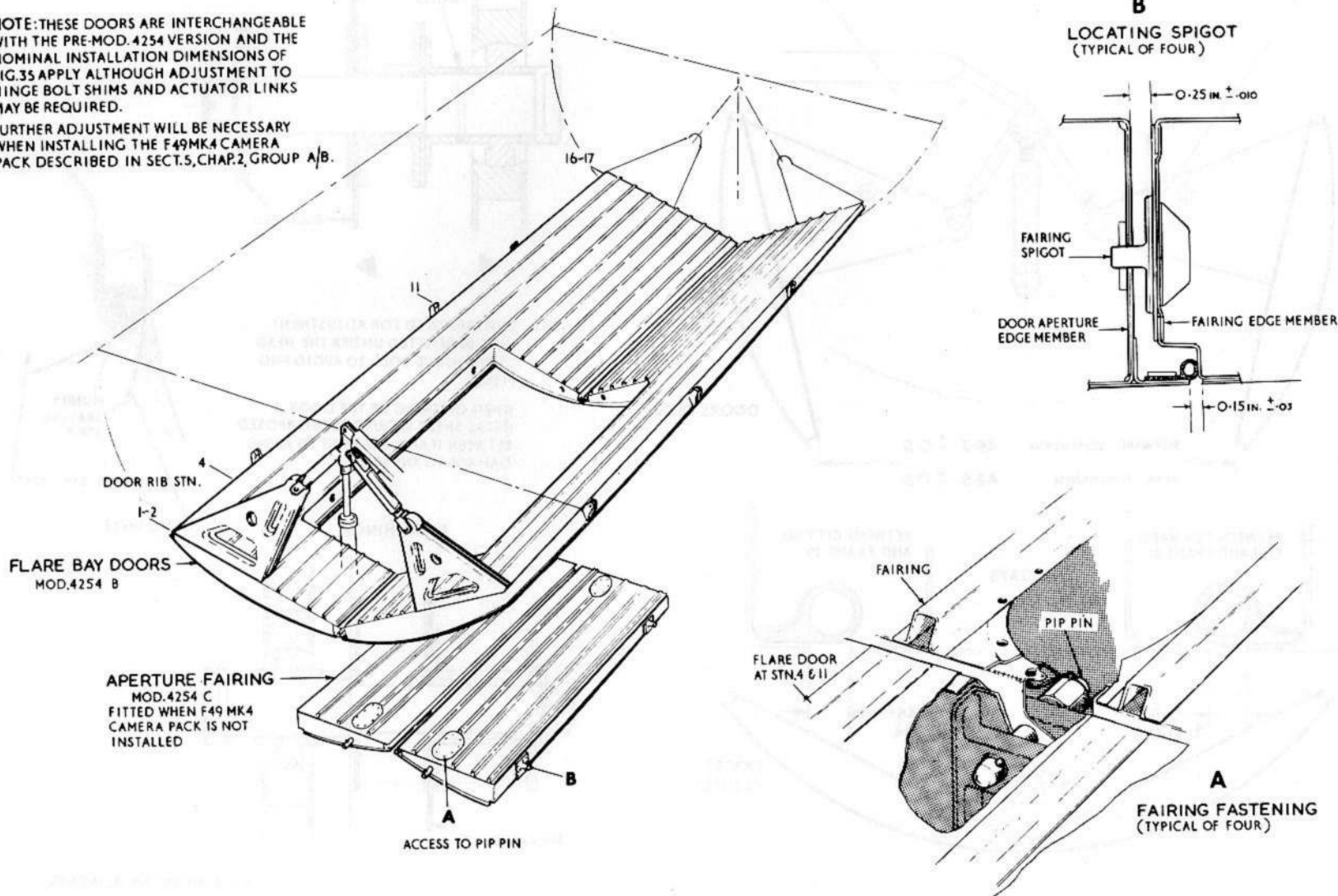
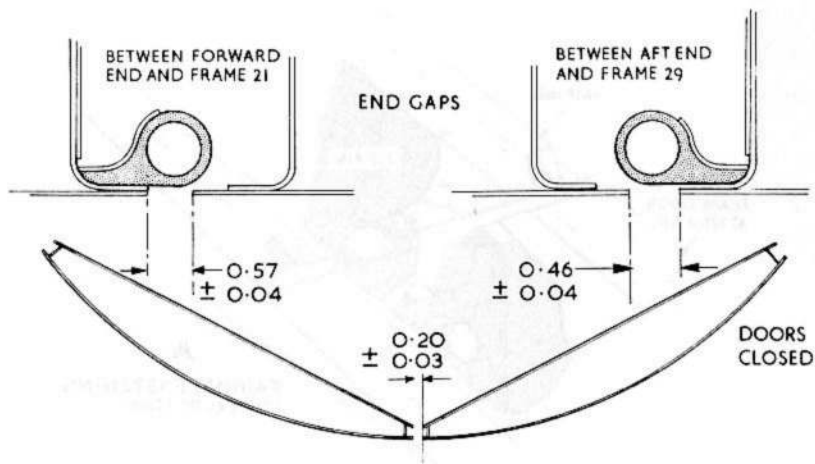
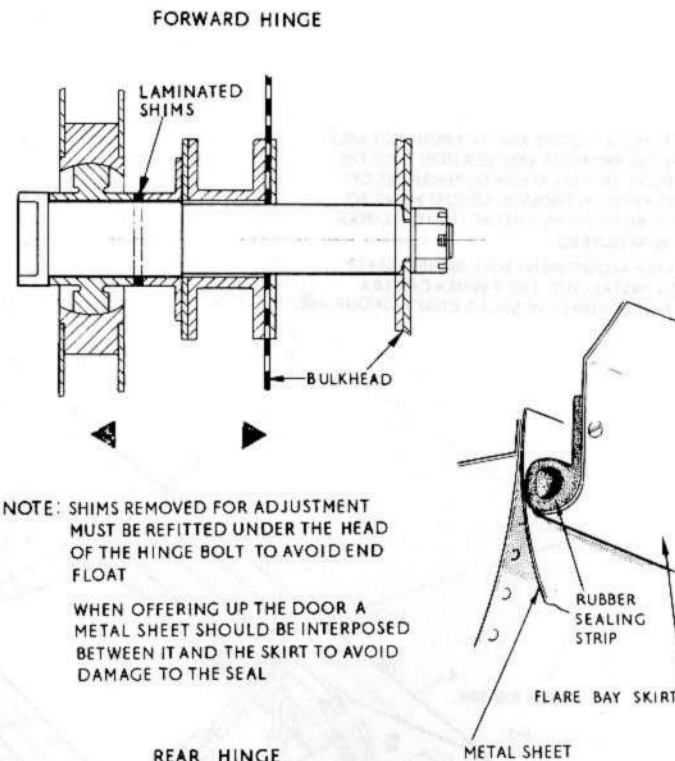
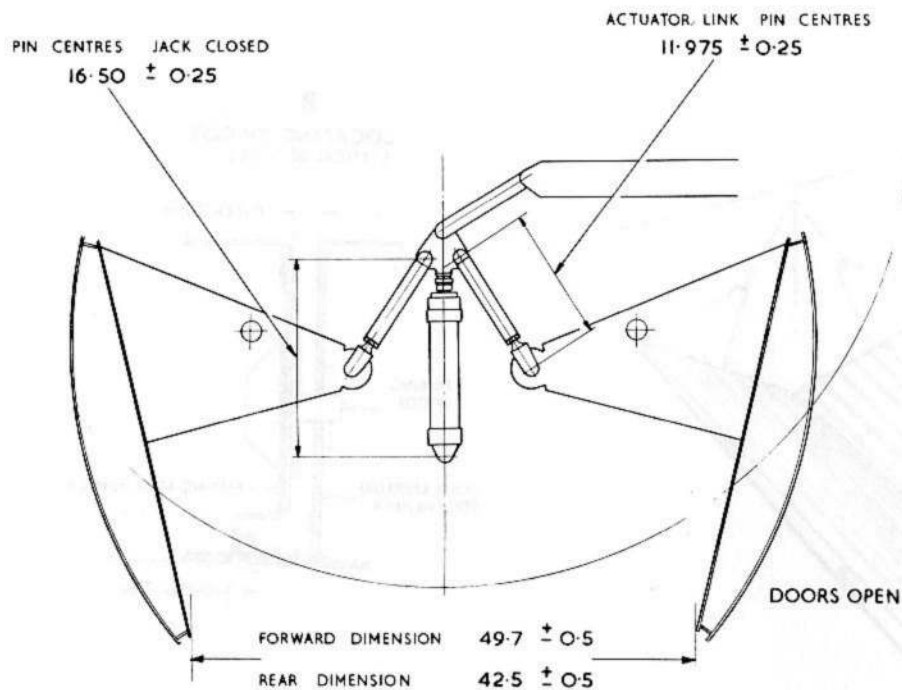


Fig. 34 Flare bay doors with aperture fairing  
(POST MOD. 4254)



ALL DIMENSIONS IN INCHES

Fig.35 Flare bay doors- adjustments

A description of the hydraulic system is given in Chap. 6 of this Section, and details of the electrical control circuits and position indicators are given in Sect. 5, Chap. 2.

### SERVICING

#### Lubrication

214. The lubrication points, type of lubricant to be used and method of application are shown in fig. 5.

#### Flare bay door jack adjustment (fig. 35)

215 The pin centres (actuating link attachments) of the door jacks are nominally set at 16.50 in.  $\pm$  0.25 in. when the jacks are in the closed position; this is a manufacturers setting which should not normally need alteration after assembly. If, however, adjustment should be necessary, proceed as follows:-

- (1) Remove the jack as instructed in Chap. 6.
- (2) Remove the locking wire from the lock-nut at the link-end of the piston rod and slacken the lock-nut.
- (3) Adjust as necessary by turning the link-end one half turn at a time.
- (4) Tighten the lock-nut on the jack piston rod and re-lock with new locking wire.
- (5) Install the jack.

#### Flare bay door adjustment (fig. 35)

216. The pin centres of the flare bay door actuating links are nominally set at 11.975 in.  $\pm$  0.25 in. At this setting the flare bay doors, when fully open, should be 49.70 in.  $\pm$  0.50 in. apart at the forward end and 42.50 in.  $\pm$  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 jack 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, proceed as follows:-

- (1) Fully open the flare bay doors and 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.
- (2) Slacken the lock-nut at the fork-end of the actuating link, and turn the fork-end as required.
- (3) Tighten the lock-nut on the actuating link.
- (4) Re-connect the actuating link to the hinge bracket.

#### Flare bay door stay adjustment

217. 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 respectively. These are manufacturers settings which should not normally need alteration. If, however, adjustment should be necessary, proceed as follows:

- (1) Fully open the flare bay doors and disconnect the fork-end of the stay from the eye-bolt on the door hinge bracket.
- (2) Slacken the lock-nut on the stay and turn the fork-end until the nominal pin-centre distance is obtained.
- (3) Tighten the lock-nut on the stay and connect the fork-end to the eyebolt on the door hinge bracket.
- (4) Check the operation of the doors.

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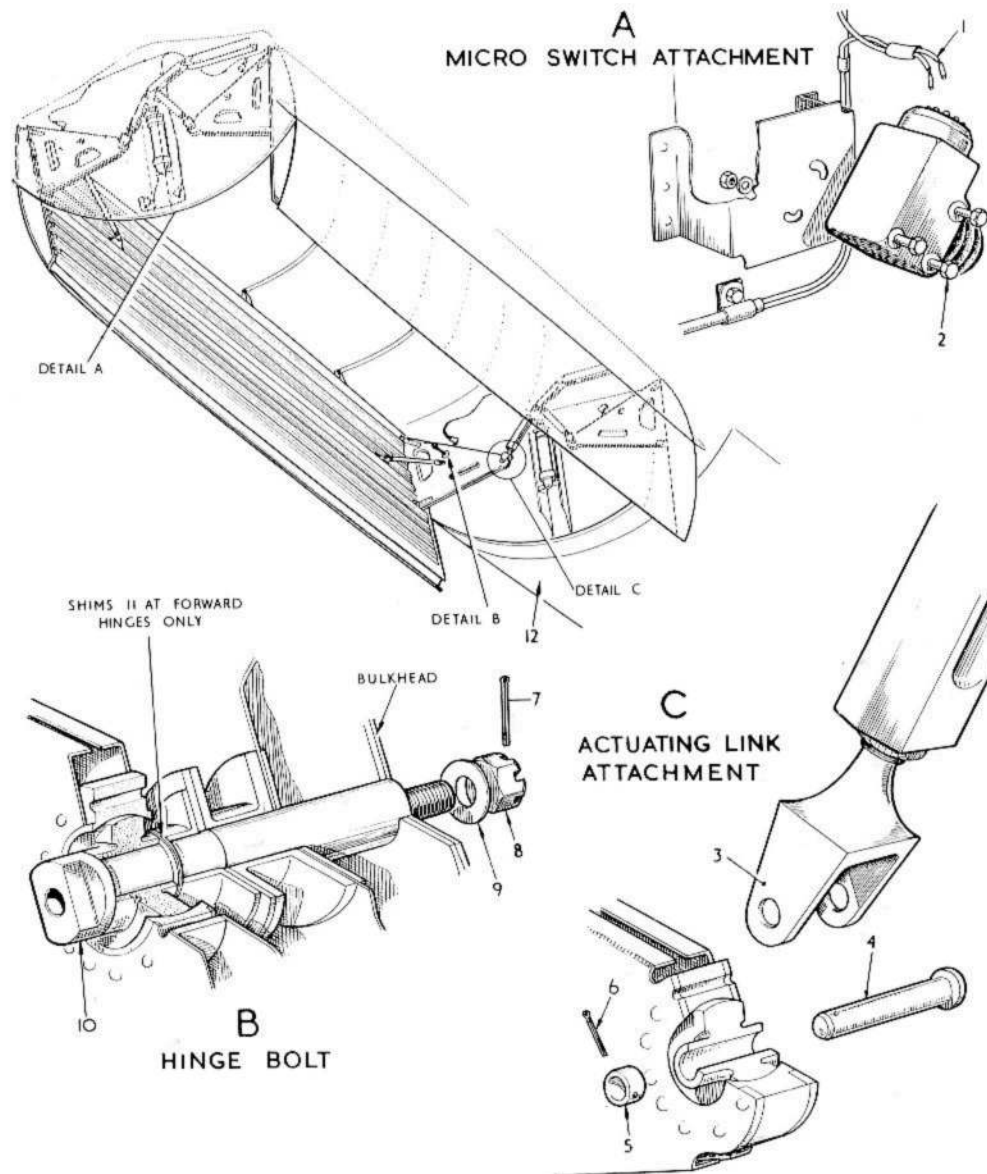


Fig. 36 Flare bay doors-removal

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Flare bay door microswitches

218. Instructions for setting the microswitches operated by the flare bay doors are given in Sect. 5, Chap. 2.

## REMOVAL AND INSTALLATION

General

219. Instructions for removing the flare bay door operating jacks are given in Chap. 6 of this Section.

Flare bay doors

## Removal (fig. 36)

220. To remove the flare bay doors, proceed as follows for each door:-

- (1) Fully open the flare bay doors and disconnect the electrical leads, 1, to the flare bay doors 'closed' microswitch.
- (2) Remove the three bolts, 2, and remove the microswitch.
- (3) At both the front and rear hinge brackets, remove the split pin, 6, collar, 5, and pin, 4, and disconnect the actuating link, 3.
- (4) Remove the access panel, 12, in the underside of the fuselage immediately forward of the spar frame and remove the split pin, 7, nut, 8, and washer, 9, at the forward hinge.
- (5) Support the door and at the forward hinge, withdraw the hinge bolt, 10, and remove shims, 11.
- (6) Enter the fuselage through the rear access hatch and remove the split pin, 7, nut, 8, and washer, 9, at the rear hinge.

- (7) At the rear hinge, withdraw the hinge bolt, 10.
- (8) Remove the door from the aircraft.

## Installation

221. The procedure for installing the flare bay doors, is, in general, a reversal of the removal operations, but consideration should be given to the following special points:-

- (1) When installing, guide the flare bay door into the open position, using a metal shim to protect the flare bay skirt and sealing strip (fig. 35)
- (2) Grease the spherical bearings at the hinge and actuator link attachments with grease XG-278.
- (3) The doors should be positioned longitudinally by adjusting the shims forward of the hinge bracket ◀ at the forward hinge position until the end gap dimensions indicated in fig.35 are obtained. ▶

## Note...

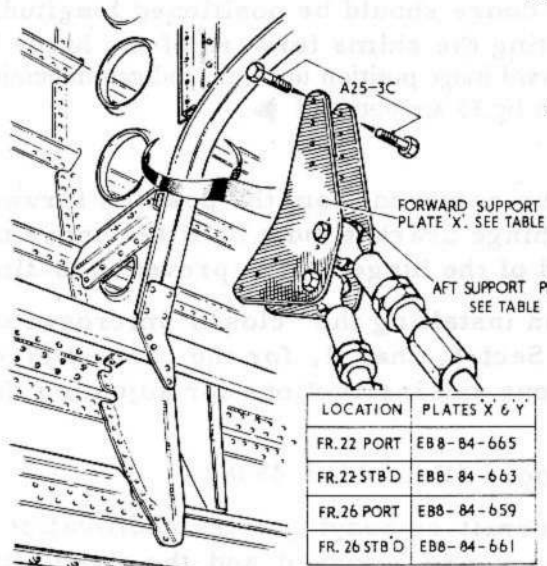
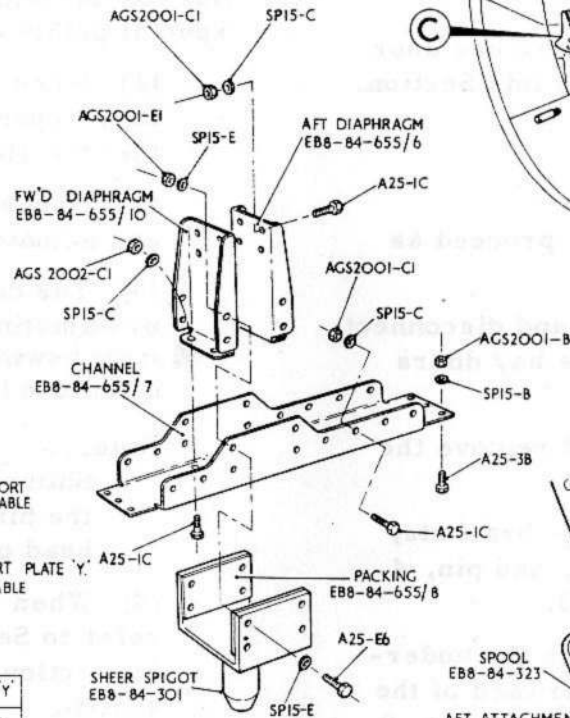
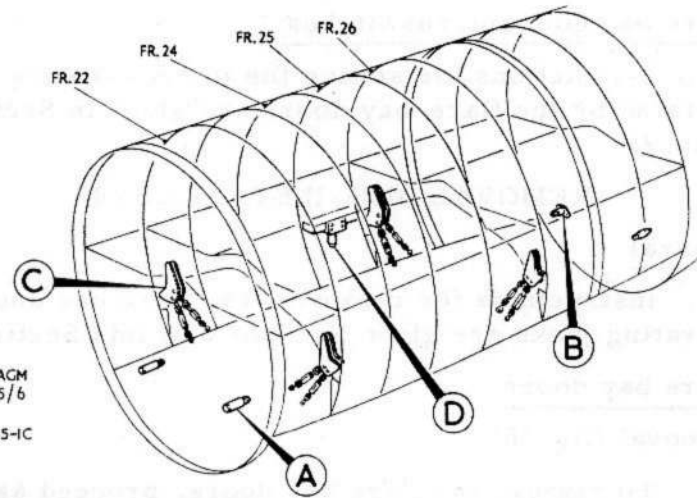
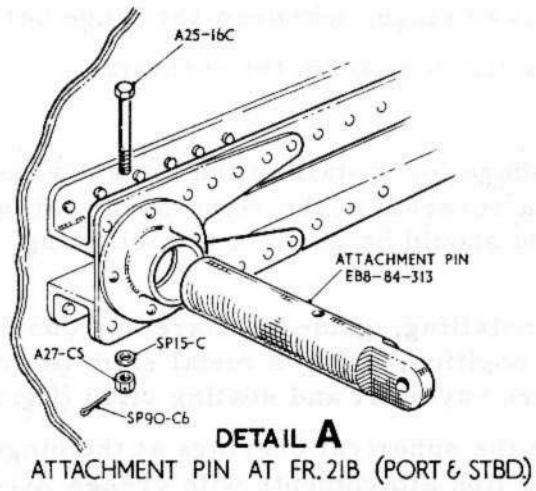
Shims removed from the position forward of the hinge bracket must be fitted under the head of the hinge bolt to prevent end-float.

- (4) When installing the 'closed' microswitch, refer to Sect. 5, Chap. 1, for the correct electrical connections and instructions for adjusting the switch.

## Flare bay doors (Post Mod 4838)

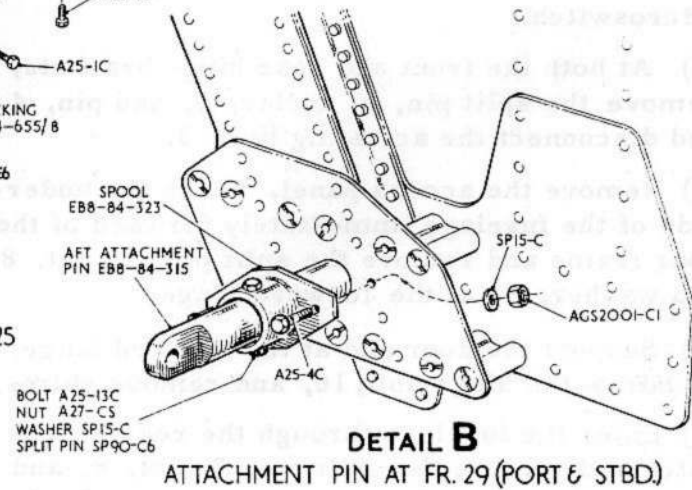
222. On aircraft embodying this modification the flare bay doors are removed and the fixed fittings shown in fig. 37 are installed.

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LOCATION	PLATES X & Y
FR. 22 PORT	EB8-84-665
FR. 22 STB'D	EB8-84-663
FR. 26 PORT	EB8-84-659
FR. 26 STB'D	EB8-84-661

DETAIL C  
SUPPORT PLATES INSTALLATION



DETAIL B  
ATTACHMENT PIN AT FR. 29 (PORT & STBD)

DETAIL D  
SHEER SPIGOT  
BETWEEN FR. 24 & FR. 25

Fig. 37. Mod. 4838 fittings—removal installation

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Chapter 2 MAIN PLANE  
(Completely revised)

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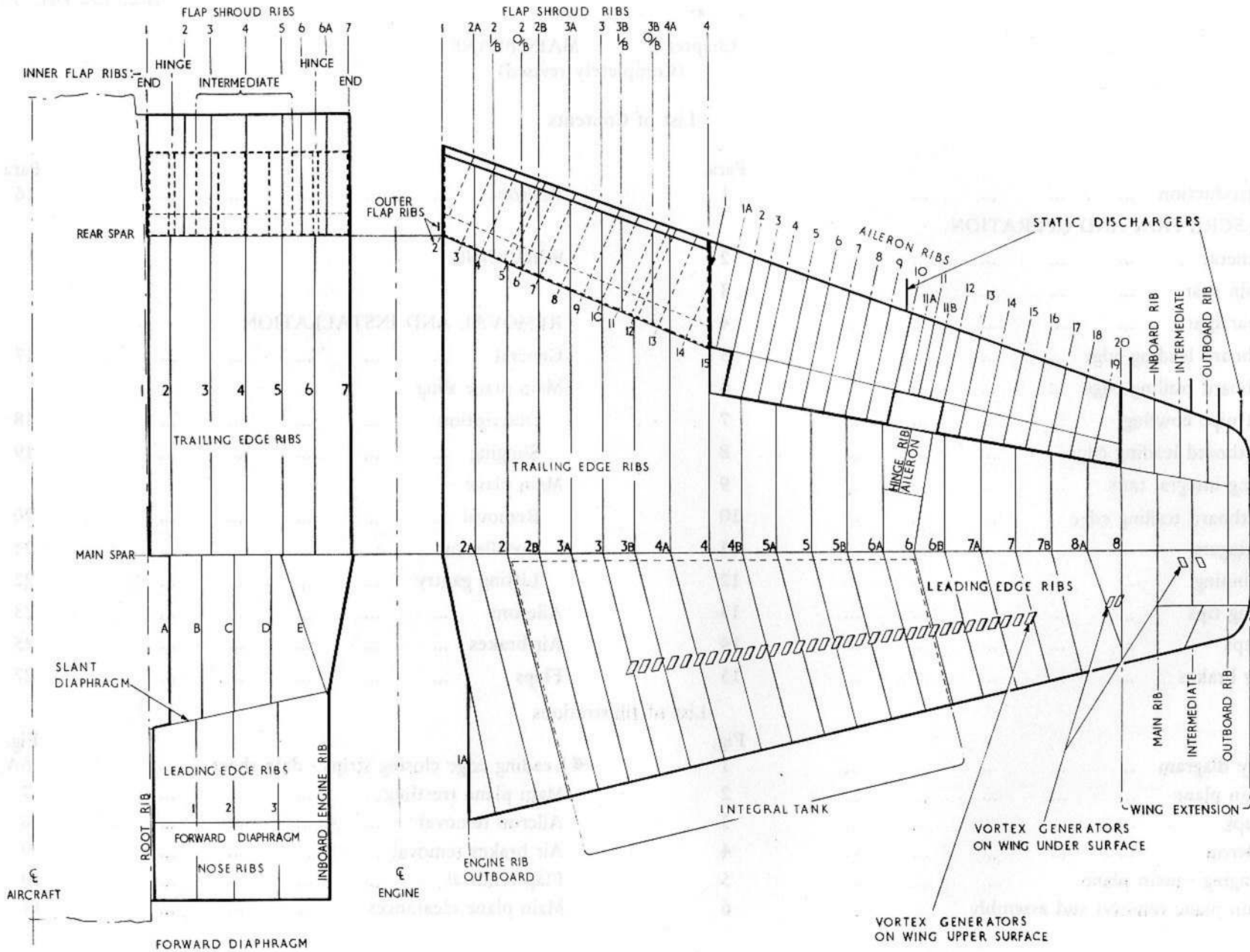


Fig.1 Key diagram  
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### Introduction

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

### DESCRIPTION AND OPERATION

#### General (fig. 2)

2. The main plane is a cantilever structure having a main spar and sectional rear spar; the port and starboard wing units are mounted direct on the sides of the fuselage. In place of a conventional centre section,

reinforced spar frames form a continuation of the main spar where the main plane units are attached to the fuselage (Sect. 3, Chap. 1). In plan view, the main plane units have a parallel chord inboard of the engine bay and taper to the tip outboard of the engine bay. The basic structure consists of a torsion-box formed by the main and rear spars, chordwise inter-spar flanged ribs, and the upper and lower between-spar skinning, which is stiffened by spanwise stringers. To this is added the inner and outer leading edge assemblies, the detachable wing tip, the flap shrouds, the air brake installation and the ailerons and flaps; the latter are carried on hinges mounted on the aft face of the rear spar. The ailerons have a centre

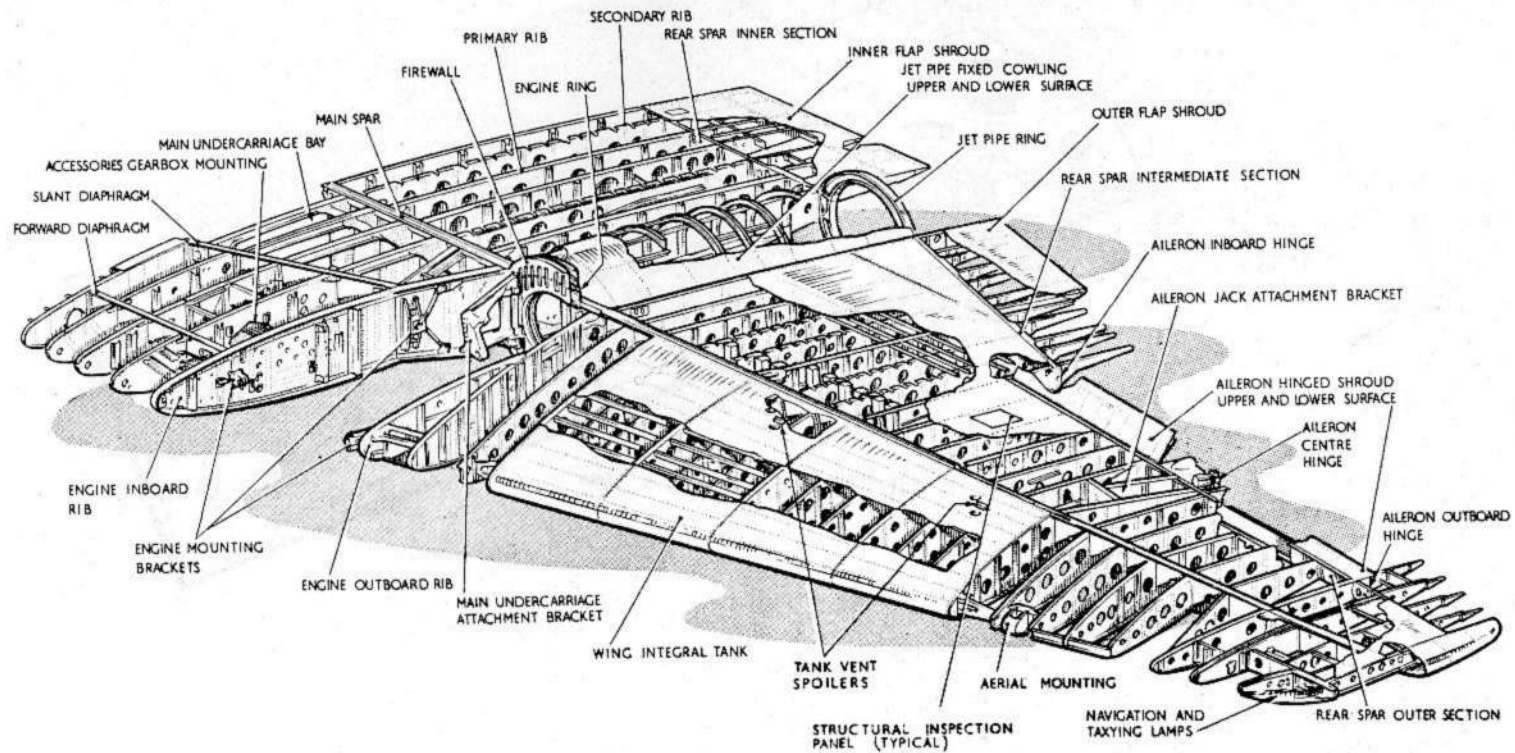


Fig. 2 Main plane

◀(MOD 4829)▶

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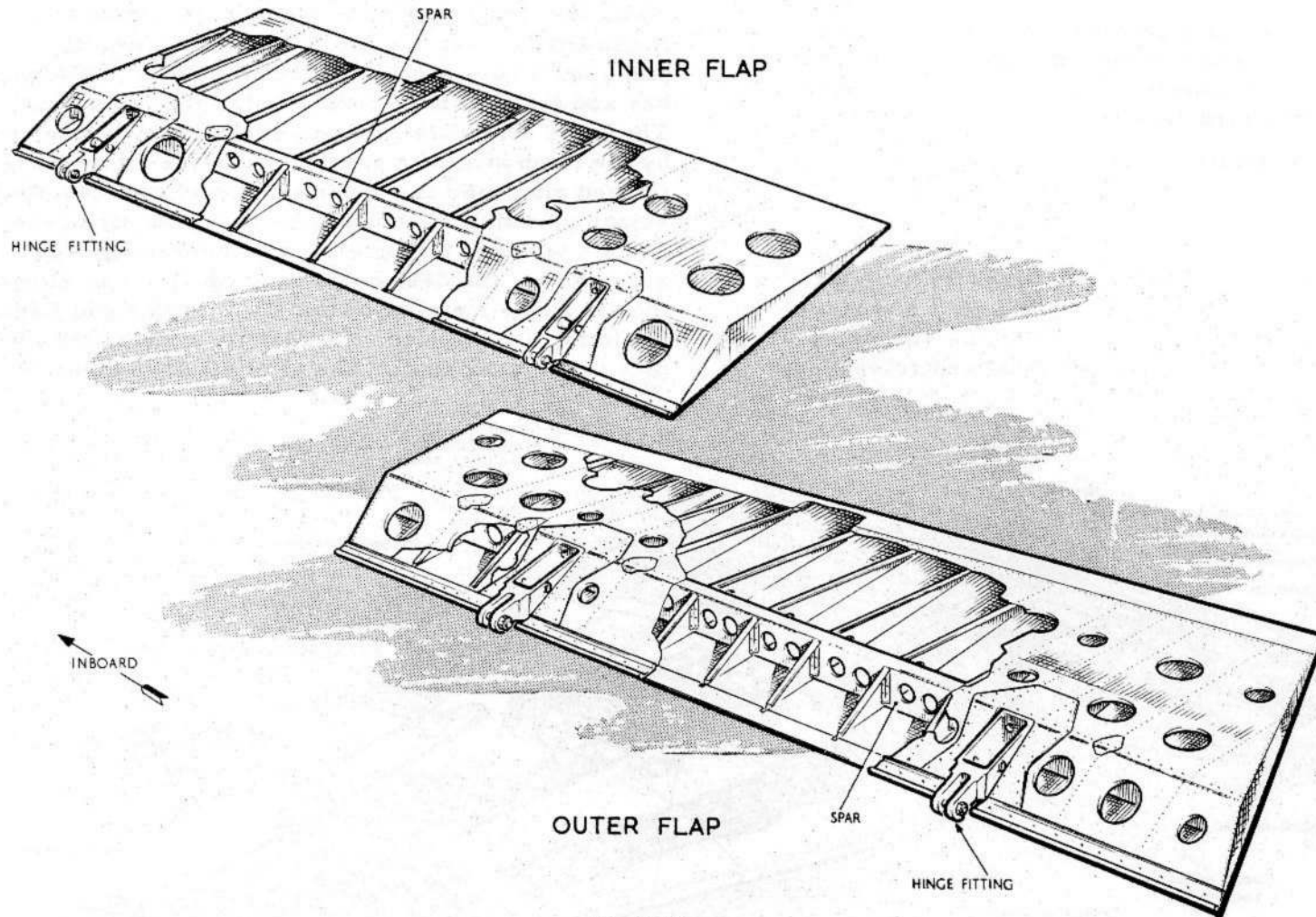


Fig.3 Flaps

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main hinge and pin and socket hinges at their extremities. A light-alloy casting is mounted on a transverse flanged diaphragm between ribs 6 and 6A of the outer wing trailing-edge, for the attachment of the aileron operating jacks. An integral fuel tank forms part of the structure forward of the main spar between ribs 2 and 6.

#### Main spar (fig. 2)

3. The main spar is a built-up beam having a plate web and machined light-alloy booms; the section changes from a stepped T-section at the root, to a plain T-section at the tip. Lightening holes in the web inboard of rib 8A, are reinforced by ring plates; outboard of rib 8A they have integral pressed flanges. Between the engine inboard rib 7 and the engine outboard rib 1, the web is cut away, leaving the booms as continuous members; these are reinforced fore-and-aft by forged rings, each of which is

faced by a flanged stainless steel firewall.

#### Rear spar (fig. 2)

4. The rear spar is built up of plate webs stiffened by vertical angle section members and T-section extruded flanges, and is divided into three sections. The inner section extends outboard from the wing root to the engine inboard rib 7, where it is joined to the intermediate section by the forged I-section jet pipe ring. The intermediate section which is in way of the outboard flap, extends outboard from the engine outboard rib 1, to outboard trailing edge rib 4. The outer section in way of the aileron extends from outboard trailing edge rib 4 to the tip; the web being curved to form the front wall of the aileron pressure balance box. Adjustable stops are fitted to the spar to limit aileron movement when the ailerons are not connected to the flying controls.

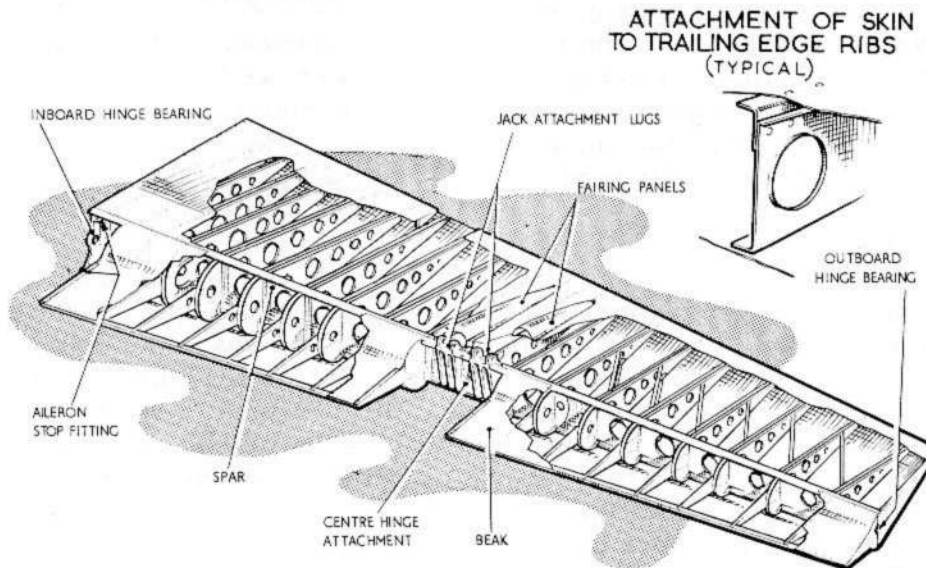


Fig. 4 Aileron

Inboard leading edge (fig. 2)

5. Forward of the main spar, the leading edge houses the main undercarriage unit when retracted. The undercarriage bay structure consists of arched ribs fitted between the main spar and a diaphragm which slants forward and inboard from the engine inboard rib to the root, forming the front wall of the bay. The upper surface of the bay ribs is plated over with light alloy sheet, the aperture in the lower surface being closed after retraction of the undercarriage by a fairing on the leg and a door hinged to the fuselage (Sect. 3, Chap. 5). The leading edge forward of the slant diaphragm is made up of leading edge and nose ribs separated by a forward diaphragm running parallel to the main spar. The ribs are made up of plate web with angle flanges, and are reinforced by top-hat section members. The forward diaphragm is made up of reinforced plate web and T-section extruded booms. Heavy gauge reinforced removable panels in the upper surface of the leading edge give access to the engine accessories gearbox and generator, together with the cabin air conditioning equipment housed in the leading edge. The engine inboard and outboard ribs are reinforced to carry the engine mounting brackets, and the main undercarriage attachment brackets.

Inboard trailing edge (fig. 2)

6. The inboard trailing edge between the main and rear spars is built up of primary and secondary ribs and transverse stringers. The primary ribs have flat plate webs with flanged lightening holes and T-section extruded booms, the secondary ribs having pressed angle flanges. Trailing edge ribs 3 to 6 are braced with vertical top-hat section members on which the oxygen bottles are mounted; access to the oxygen bottles is provided by removable panels in the undersurface.

Jet pipe cowling (fig. 2)

7. The fixed upper and lower sections of the jet pipe cowling, extending fore-and-aft between the engine ring and the jet pipe ring, are constructed of flanged formers and chordwise stringers, covered with light alloy sheeting.

Outboard leading edge (fig. 2)

8. The outboard leading edge forward of the spar is built up of a series of primary and secondary ribs at right angles to the leading edge and includes the wing integral tank (para. 9). The primary ribs have flat plate webs, flanged lightening holes and extruded T-section booms. The secondary ribs are of shallower depth to allow transverse stringers to pass outside their flanges, and outboard to rib 4A have extruded bulb-angle booms, while between ribs 4 and 5 they have plain pressed flanges.

Wing integral tank (fig. 2)

9. Between leading edge ribs 2 and 6, a fuel tank is formed by the wing structure and a convex wall fitted immediately forward of, and parallel to, the main spar. The tank is divided by the primary ribs into four bays, each bay being covered by a one-piece metal skin extending from the spar upper boom, around the leading edge, to the lower boom. For details of the tank structure reference should be made to Sect. 4, Chap. 2. Located by spigots on the web of the main spar, the tank is secured to the top and bottom flanges of the spar booms, and around the outboard flange of rib 2 and the inboard flange of rib 6, by countersunk screws. The tank may be removed as a unit from the main plane.

Outboard trailing edge (fig. 2)

10. The ribs between the main and rear spars are a continuation of, and of similar construction to, the leading edge ribs, and have similar transverse stringers. Provision is made at the junction of the main spar and rib 3 for the installation of a pylon mounting.

Stringers (fig. 2)

11. Outboard of the engine and jet pipe bays, transverse stringers of bulb-angle section, are slotted into the primary ribs but pass outside the secondary rib flanges. Inboard of these bays the stringers are fitted between the primary ribs and are slotted into the secondary ribs.

Skinning (fig. 2)

12. The skin plating aft of the spar is butt-jointed along the centre line of the main ribs, reinforcing strips being interposed between the rib flanges and the skin. Transverse joints are made along spanwise T-section bulb-angle stringers. The leading-edge panels are wrapped chordwise round the leading edge.

Wing tips (fig. 2)

13. The detachable wing tips are built up of top and bottom light alloy skin sheeting riveted to short pressed flanged ribs, and seam welded along the chord line. A boundary angle is spot welded to the inboard edges of the sheeting, and the trailing edge tip is reinforced by a laminated sheet fibre former. The leading edge tip is of transparent moulded plastic and houses the taxiing and navigational lamps. The complete tip is attached to the wing extension outboard rib by countersunk head bolts around the boundary angle.

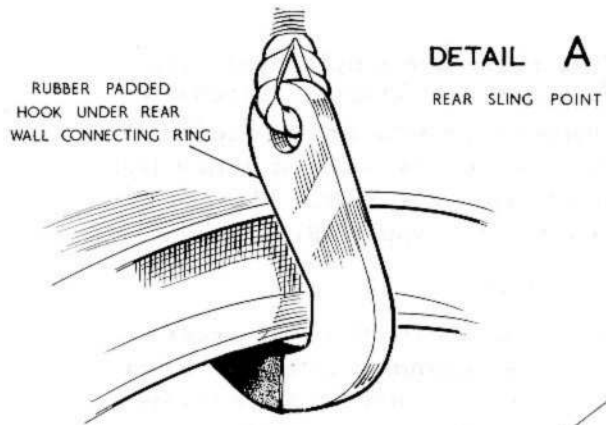
Flaps (fig. 3)

14. The split trailing edges are single-spar structures carried on pin and socket hinges. Pressed flanged nose and trailing edge ribs are riveted to the spar, and the whole structure is covered with a light alloy skin riveted to the spar and ribs. Flanged lightening holes are cut in the upper skin surface.

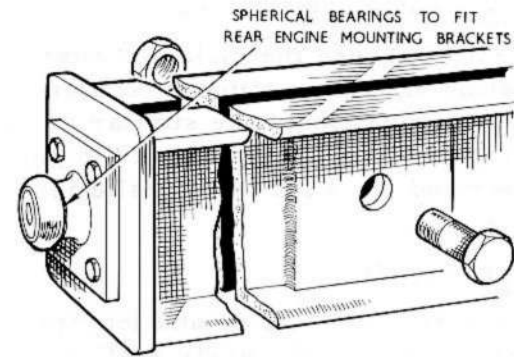
Air brakes (Sect. 3, Chap. 4)

15. The three position (IN-MID-OUT) air brakes assemblies consist of drag channels attached to centrally pivoted rocker arms mounted on a transverse torque tube. These assemblies are housed, one in each outer wing, aft of the main spar, each being operated by a single hydraulic jack mounted on the aft face of the main spar. The function of the jacks is described in Sect. 3, Chap. 6. The torque tube is in three sections, connected at outboard trailing-edge ribs 3A and 3B, and is carried in central and end bearings. Annular plates attached to the webs of outboard trailing-edge 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 the removal and installation of the torque tube (para. 25). The port assembly incorporates a position indicator transmitter, and the starboard assembly a drum switch; this controls the electrical power supply (Sect. 5, Chap. 1) to the solenoids when the MID position is selected. In the normal IN position the ends of the drag channels lie flush with the upper and lower wing surfaces; when the OUT position is selected nine of the channels protrude through the upper surface of the wing, and twelve through the lower surface.

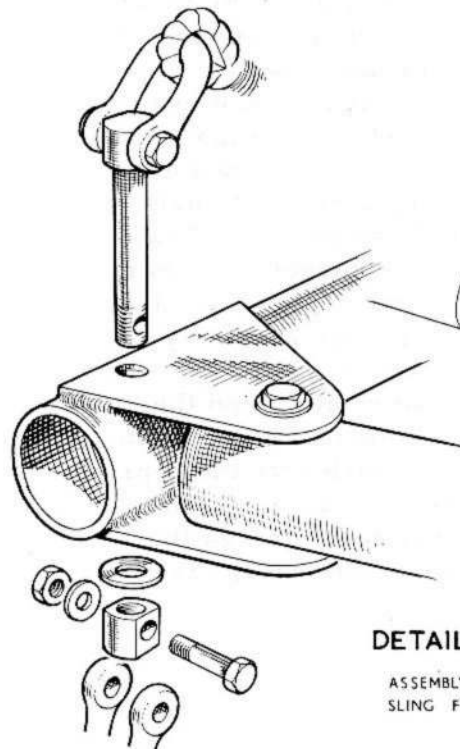
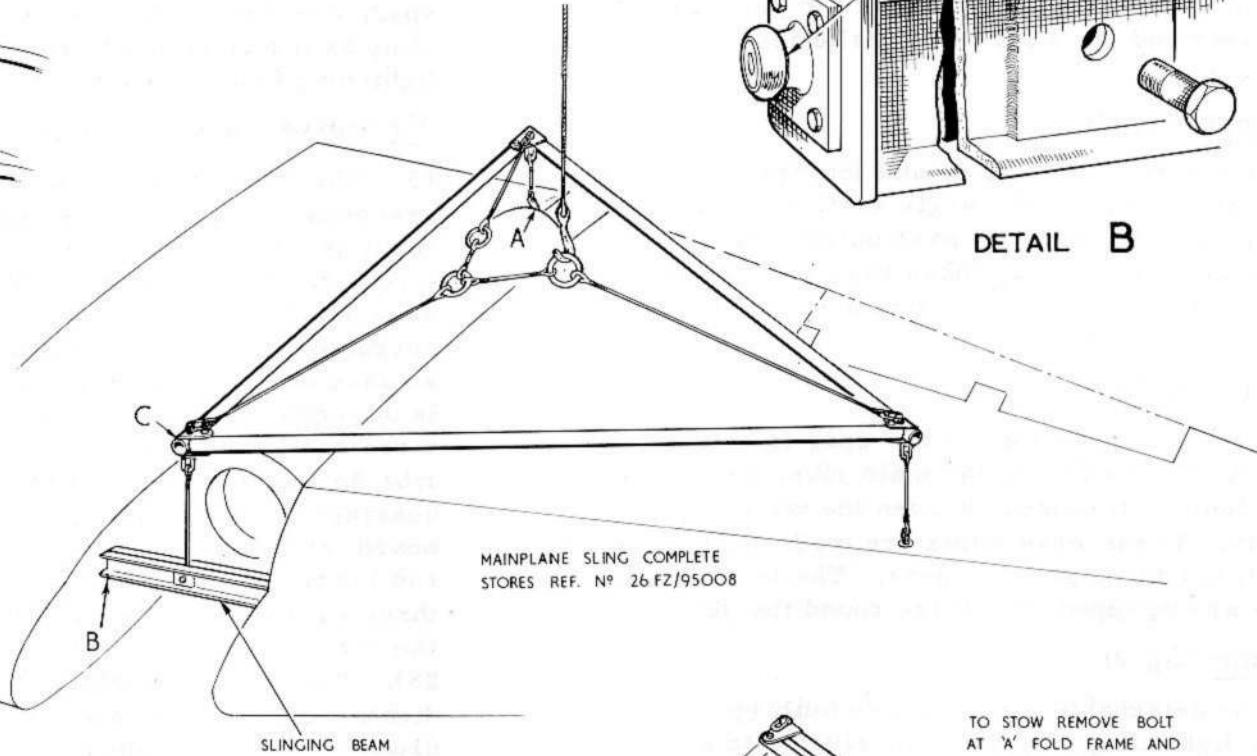
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SLING ASSEMBLY  
FOR MAIN PLANE LESS THE FOLLOWING:-  
ENGINE, JET PIPE, GENERATOR,  
FLAP,AILERON, WING TIP TANKS,  
UNDERCARRIAGE AND MAIN U/C DOOR



**DETAIL B**



TO SLING STARBOARD  
MAINPLANE, UNCOUPLE SHACKLES  
AT EACH CORNER OF FRAME AND  
REVERSE CABLE ASSEMBLIES TURN  
FRAME OVER

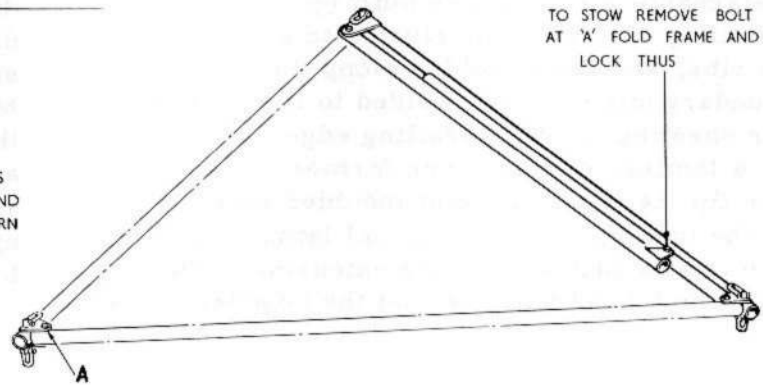


Fig.5 Slings-main plane

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Aileron (fig. 4)

16. Each aileron is of all-metal single -spar construction. Trailing edge ribs and D-shaped nose ribs, which are fitted with extensions to form a beak at the leading edge, are attached to the spar. The ribs are of pressed construction, the trailing edge ribs being fitted with angle-section upper flanges. Flanged lightening holes are provided in the ribs and the spar web. The whole unit is covered with light alloy sheeting riveted to the rib and spar flanges. Mass balance is effected by heavy alloy strips fitted between the beak ribs. The ailerons are mounted on a central main hinge between outboard trailing edge ribs 6 and 6A, and in-board and outboard pin and socket hinges at ribs 4 and 8. The aileron jacks are attached on each side of the central hinge position to a fitting on the aileron spar, the attachments being shrouded by detachable fairing panels on the aileron upper surface. Upper and lower surface shrouds, fitted to the outer plane rear spar and hinged to facilitate servicing and removal of the ailerons, form, with the rear spar, a pressure balance box in which the aileron beak moves.

## SERVICING

## Note...

Nine inspection panels (shown typically in fig. 2A) are rivetted in position on the upper surface of the outer wing and are located to facilitate inspection of the structure as and when required.

## REMOVAL AND INSTALLATION

## Note...

Whenever an aircraft component which can effect longitudinal trim is replaced, renewed or adjusted, a light trim check must be made as described in Sect. 3, Chap. 4.

General

17. The ground equipment referred to is listed in Sect. 2, Chap. 4, Tables 1 and 2.

Main plane sling

## Description (fig. 5)

18. The main plane sling is a triangular folding tubular frame, with a reversible cable assembly to enable it to be used for slinging either port or starboard main planes (less engines and jet pipes). The sling is attached to the main plane by a beam fitted at the engine rear mounting brackets, a hook at the jet pipe on the rear spar, and an eye-bolt at the slinging point in the upper surface of the main plane. Three eyes are provided in the slinging cables for attachment to the hoist in order to maintain the balance of the component, with or without ailerons and flaps. When the complete main plane is being slung, the hoist is attached to the single eye to which the three cables are spliced; when a main plane without ailerons or flaps is being slung, the slinging eyes in the rear and outboard cables are both passed over the hook of the hoist.

Slinging (fig. 5)

19. To sling a main plane proceed as follows:-

- (1) Remove the engine, jet pipe fairing and jet pipe (Sect. 4, Chap. 1).
- (2) Remove the caps from the engine rear mounting brackets.

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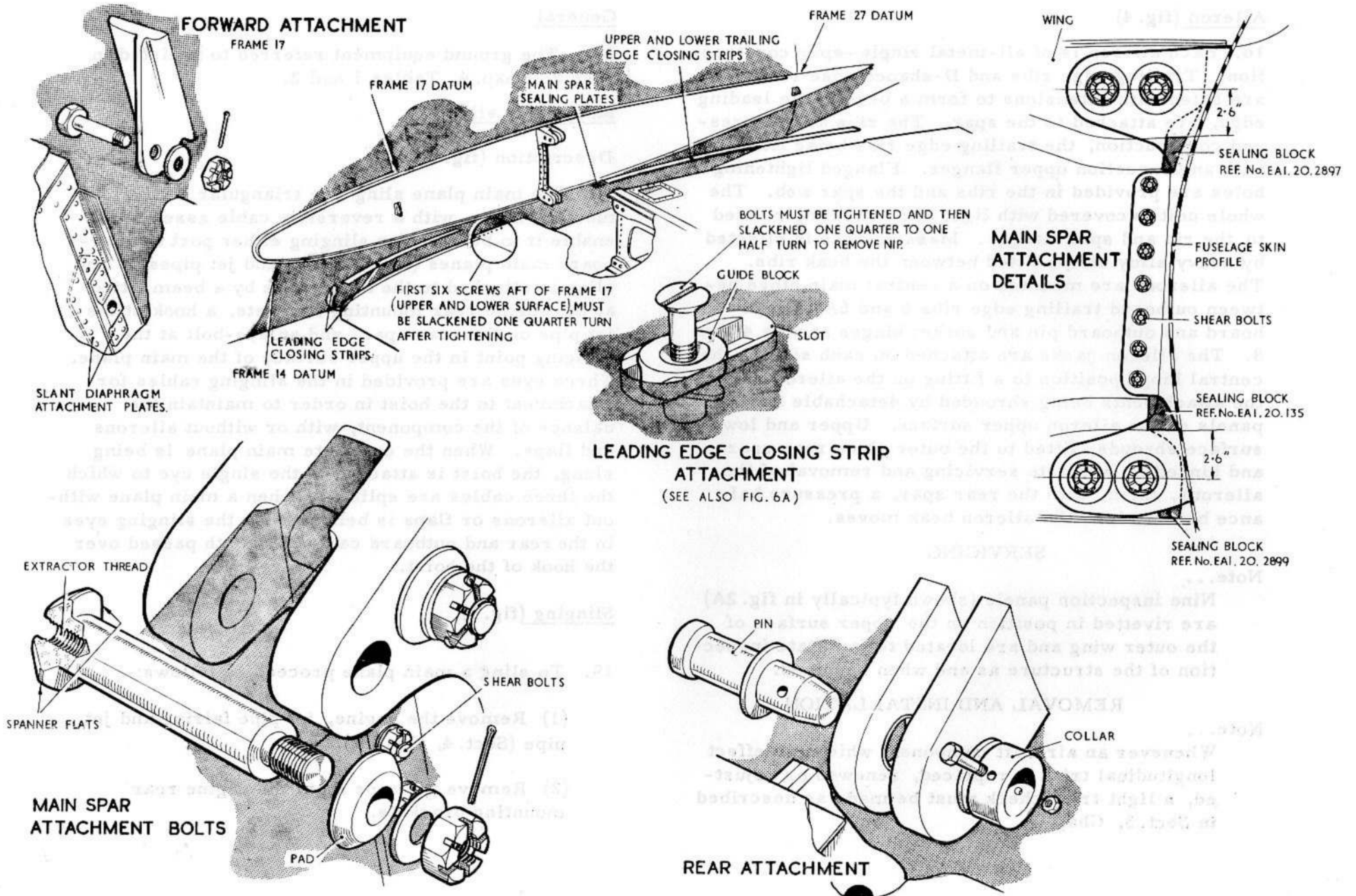


Fig. 6 Main plane - removal and assembly ◀(REF TO FIG. 6A ADDED)▶

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(3) Fit the slinging beam across the engine bay with the spherical ends of the beam resting on the lower halves of the engine mounting brackets; replace and tighten the caps on the engine rear mounting brackets.

(4) Insert the eye-bolt in the slinging point in the upper surface of the wing.

(5) 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. 18).

(6) 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 jet pipe ring at the rear spar, and the hook on the cable at the outboard apex of the frame through the slinging eye in the main plane.

#### Main plane

Removal (fig. 6)

Note. . .

Before commencing removal operations, refer to the Lethal Warning card at the beginning of this

volume and ensure that all relevant precautions have been taken.

20. To remove a main plane, proceed as follows: -

(1) Ensure that the battery master switch is off.

(2) Exhaust all hydraulic fluid pressure, refer to Chap. 6.

(3) Drain the integral fuel tanks and the wing tip tanks (if fitted); refer to Sect. 4, Chap. 2.

(4) Remove the wing tip tank, if fitted. Refer to Sect. 4, Chap. 2.

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

(6) Jack and trestle the aircraft as described in Sect. 2, Chap. 4.

(7) Attach the main plane sling, refer to para. 19 and fig. 5. Take the weight of the main plane with a suitable crane or gantry.

(8) Remove the aileron, refer to para. 23 and fig. 8.

(9) Remove the flaps, refer to para. 27 and fig. 10.

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- (10) Remove the main undercarriage doors and undercarriage units, refer to Chap. 5.
- (11) Remove the necessary upper and lower access panels, refer to Sect. 2, Chap. 4.
- (12) Remove the self-tapping screws from the main spar sealing plates and remove the plates.
- (13) Remove the 2BA attachment bolts and guide blocks from the leading edge closing panels (forward of frame 17) and remove the panels.
- (14) Remove the 2BA attachment screws, 6 locking washers and gusset plates from the upper and lower trailing edge closing strips and re-

remove the strips.

- (15) Remove the stiffnuts, plain and spring washers and 2BA screws attaching the main plane upper skin sheeting to the fuselage boundary angle and on the lower surface six stiffnuts, washers and 2BA screws immediately aft of frame 17, and the five stiffnuts, 2BA bolts and washers immediately forward of the main spar.
- (16) Disconnect the engine control rods at the wing root, refer to Sect. 4, Chap. 1
- (17) Disconnect and blank off the following hydraulic pipes:-

Port wing	System	Starboard wing
SS, SP, SB, TGO, TGF, AC	'Services' system	SS, SP, SB, SR
PWB, WBR, AC	Wheel brakes	SWB, WBR
UD, UDE, UR	Alighting gear	UD, UDE, UR
FD, FR	Flaps	FD, FR
ABO, AB1	Air brakes	ABO, AB1
IAP, CR, CP, CR, AC	Port 'Controls' system	CR, IAP
CR, OAP, AC	Starboard 'Controls' system	OAP, CR, CP, CS, CR

(18) Disconnect the following fuel and air pipes at the wing root:-

- (a) Main fuel delivery pipe.
- (b) Fuel and air pipes to the wing tip tank.
- (c) Recuperator fuel bleed to No. 5 tank.
- (d) Recuperator fuel, air relief and pressure pipes.

(19) Disconnect the intercomm. cable at the T. B. in the main wheel well bay - starboard only.

(20) Disconnect the cables to the following aerials refer to Sect.6,Chap.1 & 2 for typical disconnections:-

Aerial Type 237 (ARI 18011) - at the starboard inner wing trailing edge.

Aerial Type 238 (ARI 18011) - at the starboard wing root.

Aerial Type 239 (ARI 18011) - at the wing root - port and starboard.

Aerial Type 7165 (ARI 18090) - at the inner wing trailing edge starboard only.

Aerial Type 7165 (ARI 18090) - at the inner wing trailing edge starboard only.

Aerial Type 501 (ARI 5851 1 cable and waveguide - port wing root.

(21) Disconnect the following electrical cables where indicated:-

Port wing	Disconnection point	Starboard wing
P9, P13 C41, C42, E1 C7, C7X	Wing root break J.B.1 J.B.7 J.B.8	S10, S14, 1N1B  C8
C11	J.B.11 J.B.12	C12
N2F N2Q N2OA	Engine master fuel cock Recuperator fuel cock	N2M N2R N2S
C31, C103 C101	General Connector block (leading edge diaphragm)	C32, C104 C102
C35, C37 NIP	Voltage regulator Fuel flow transmitter	C36, C38 NIS

(22) Disconnect the bonding leads and release the couplings on the following pipes at the wing root.

The cold air pipe to the mixing valve - port and starboard.

The transverse pipe from the water extractor - port only.

The hot air duct - port only.

The camera heating pipe - starboard only.

The de-misting pipes - port only.

(23) Disconnect the fire extinguisher pipe at the wing root, refer to Sect. 4, Chap. 5.

(24) Disconnect the oxygen pipe at the wing root trailing edge, refer to Sect. 3, Chap. 10.

(25) After making a final check to ensure that all services have been disconnected remove the split pin, slotted nut, special washer and bolt from the forward attachment point (frame 17).

(26) Remove the nut, washer and bolt from the collar at the rear attachment point and remove the collar and pin.

(27) Remove the split pins, slotted nuts, washers and shear bolts at the main spar web, and the split pins, slotted nuts, washers and pads from the two upper and two lower attachment bolts.

(28) Ensure that the sling and gantry are correctly positioned, take up the load and then remove the main attachment bolts by means of the special extractor.

(29) The main plane is now free and should be lifted clear and placed on the trestles.

#### Installation (fig. 6)

21. Before assembling a main plane to the fuselage ensure that the sealing blocks Part No. EA1.20.2897 (upper) and EA1.20.135 (lower) are securely attached with rubber resin cement Ref. No. 33C/1173 within the forks of the centre section spar fitting as shown in the detail, then proceed with the assembly as follows:-

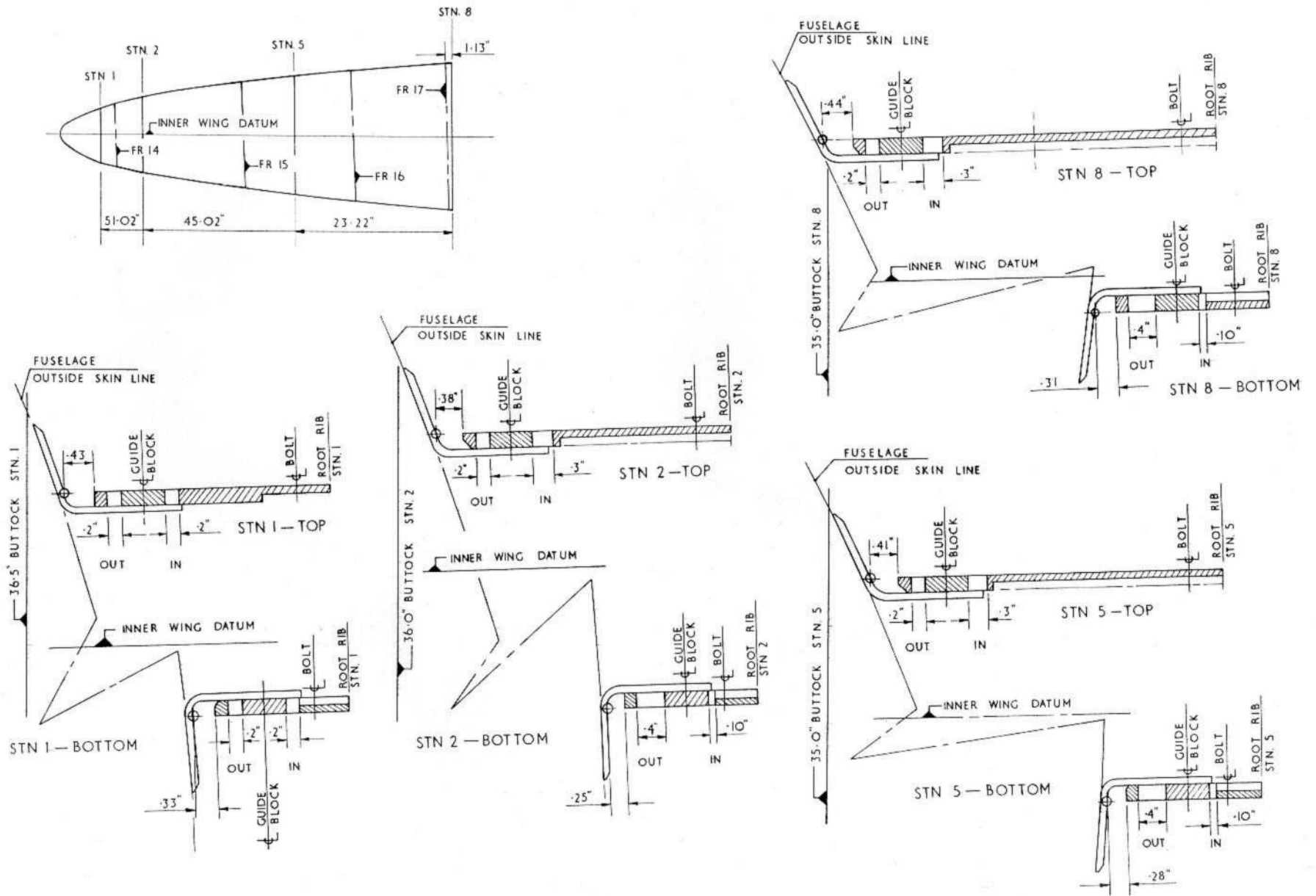
(1) Align the wing and after lubricating the threads of the bolts and nut faces liberally with light machine oil, insert the upper and lower main spar attachment bolts. Fit the washers, pads and slotted nuts. The nuts must be tightened alternately applying a torque of 1500 lb/in to ensure that tightening one bolt does not slacken the other unduly. Finally lock by means of the split pins.

(2) Attach a sealing block, Part No. EA1.20.2899 with rubber resin cement, hard up to the forward face of the lower spar boom and the fuselage side, fit the seven shear bolts, washers and slotted nuts at the spar web, and lock with split pins.

(3) Fit the rear attachment pin and collar, fit the 2BA bolt in the collar and after fitting the washer and nut, tighten the nut and peen the bolt over to lock.

(4) Fit the forward attachment bolt, washer and slotted nut, and lock with a split pin.

(5) Remove the main plane sling and gantry or crane.



◀ Fig 6A. Leading edge closing strips — data sheet ▶

- (6) Fit the flaps and aileron (figs. 10 and 8 respectively), then connect up the electrical cables, aerials and relevant piping in the most convenient order.
- (7) Attach the upper and lower trailing edge closing panels with 2BA screws, and corner gussets adjacent to the main spar, adding locking washers to each of the six upper and lower bolts at the gusset positions.
- (8) Ensure that the slots are thoroughly clean and very lightly smeared with grease XG276, then fit the forward leading edge closing panels inserting the guide blocks and attachment screws, and fit the top surface forward closing panel in a similar manner.

Note...

It is important that the clearance dimensions at stations 1, 2, 5 and 8 (fig. 6A) are accurately maintained, when the closing strips are screwed in position, to permit freedom of movement between the wing skin and fuselage. When the closing strips are fitted the clearance dimensions between them and the fuselage at stations 1, 2, 5 and 8 are to be as shown in fig. 6A. If it is necessary to trim the closing strip to achieve these dimensions the correct profile must be maintained by blending in the dimensions to give a smooth and even edge. Finally, the attachment screws are to be tightened and then slackened  $\frac{1}{4}$  to  $\frac{1}{2}$  turn to ensure that the closing strip is free to slide on the guide blocks giving a movement of the wing skin relative to the boundary angle as indicated by the IN and OUT dimensions on fig. 6A. ►

- (9) Working from the main spar forward, attach the upper wing skin to the fuselage angle by means of 25 - 2BA screws,

washers and stiffnuts; the six remaining bolts aft of frame 17 require a spring washer in addition to the 2BA washer.

- (10) The lower surface skin immediately aft of frame 17 is similarly attached by 2BA screws, plain and spring washers and stiffnuts. These six bolts and the six in the upper surface must be slackened one-quarter turn after initial tightening to allow freedom of movement between wing and fuselage. Finally fit five 2BA bolts, washers, and stiffnuts immediately forward of the main spar (lower surface skin).

- (11) Fit the upper and lower main spar sealing plates with self-tapping screws.

- (12) Fit the main undercarriage unit and doors, connect up all relevant pipe lines, electrics and controls as detailed in Sect. 3 Chap. 5.

- (13) Fit the engine and jet pipe, connect all relevant pipe lines, electrics and controls as detailed in Sect. 4, Chap. 1.

- (14) Fit the wing tip tanks, if required, and connect all relevant pipe lines as detailed in Sect. 4, Chap. 2.

- (15) Ensure that all relevant pipe lines, electrics and controls in the fuel system are complete and test the system as detailed in Sect. 4, Chap. 2.

- (16) First ensure that all hydraulic pipe lines and accessories are connected, then fill, prime and bleed the system and function test all services as detailed in Sect. 3, Chap. 6.

- (17) Connect and test all air system pipe lines as detailed in Sect. 3, Chap. 8.

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(18) Connect and test all oxygen system pipe lines as detailed in Sect. 3, Chap. 10.

(19) Carry out function and continuity test of the electrical system as detailed in Sect. 5, Chap. 1.

(20) Fit all access panels, ensure that the under-carriage is locked down and remove jacks and trestles.

Lifting gantry (fig. 7)

22. The main plane lifting gantry consists of four upright supports and two main plane lifting beams with extension adapters.

This gantry is only suitable where a level floor, is available, and may be used for raising a main plane for assembly to a fuselage or lowering when dismantling an aircraft. Refer to A.P. 2817A, Vol. 1, Sect. 8, Chap. 6 for a full description of the assembly and operation of the gantry.

Ailerons

23. Removal (fig. 8) - To remove an aileron proceed as follows:-

(1) Exhaust all hydraulic fluid pressure in the port and starboard 'controls' system (Sect. 3, Chap. 6).

(2) Remove the countersunk-head screws, 4, from the extremities of each hinged shroud and open the shrouds.

(3) Remove the countersunk head screws from the shroud, 5 over the aileron jack attachments at the central hinge position and remove the shroud.

(4) Disconnect the hydraulic jacks by removing the split pins 11, nuts 12, washers 10 and bolts 13. (Detail C).

(5) Disconnect the centre hinge by removing the four attachments bolts 15 and packing 14 (Detail C).

(6) Remove the aileron outboard hinge access panel 6 (Detail B).

(7) Lower the flaps, and supporting the aileron at the inboard and outboard ends, remove the stiffnut, 2, and locking bolts, 1, from the inboard hinge, and remove the hinge pin, 3, (detail A) by means of the special extractor.

(8) Remove the stiffnut, 7, and locking bolts, 8, from the outboard hinge, and remove the hinge pin 9, by means of the special extractor (Detail B).

24. Installation. - To install an aileron proceed in the reverse order to the removal operations. The setting of the aileron stops, located at the inboard hinge rib No. 4, should not be altered when rigging the ailerons. The only function of these stops is to limit the aileron movement when the ailerons are disconnected from the flying controls. When fitting a new aileron it may be necessary to fit new sealing strips in which case the new strips will need filing to suit the aileron nose shape. After installation check that the clearances are within the limits stated in fig. 11.

Note...

The procedure for the removal and installation of the aileron jacks is described in Sect. 3, Chap. 6.

Air brakes (fig. 10)

25. Removal - To remove the port or starboard air brakes proceed as follows:-

(1) Exhaust all hydraulic fluid pressure in the services system.

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

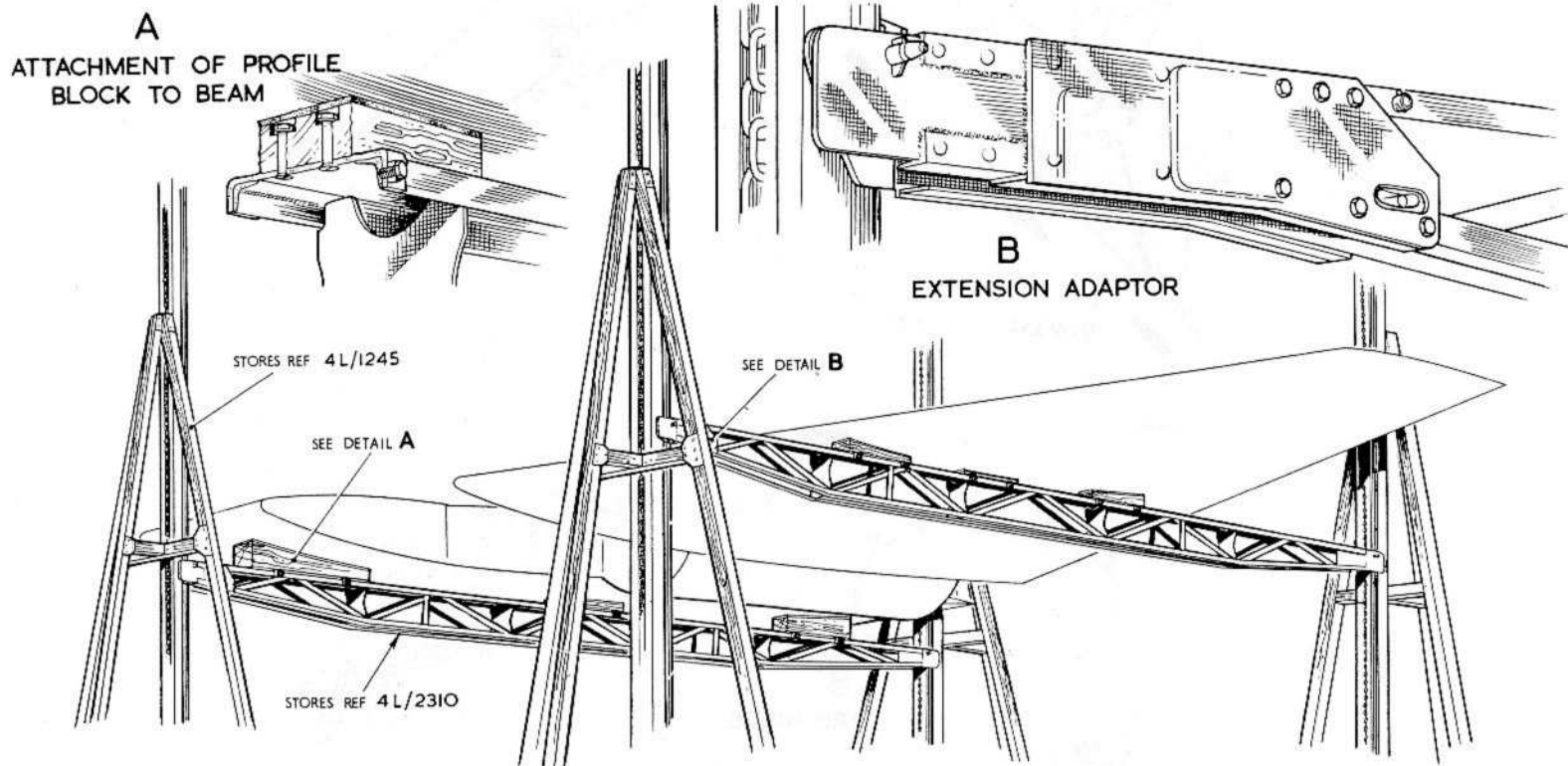


Fig.7 Main plane trestling

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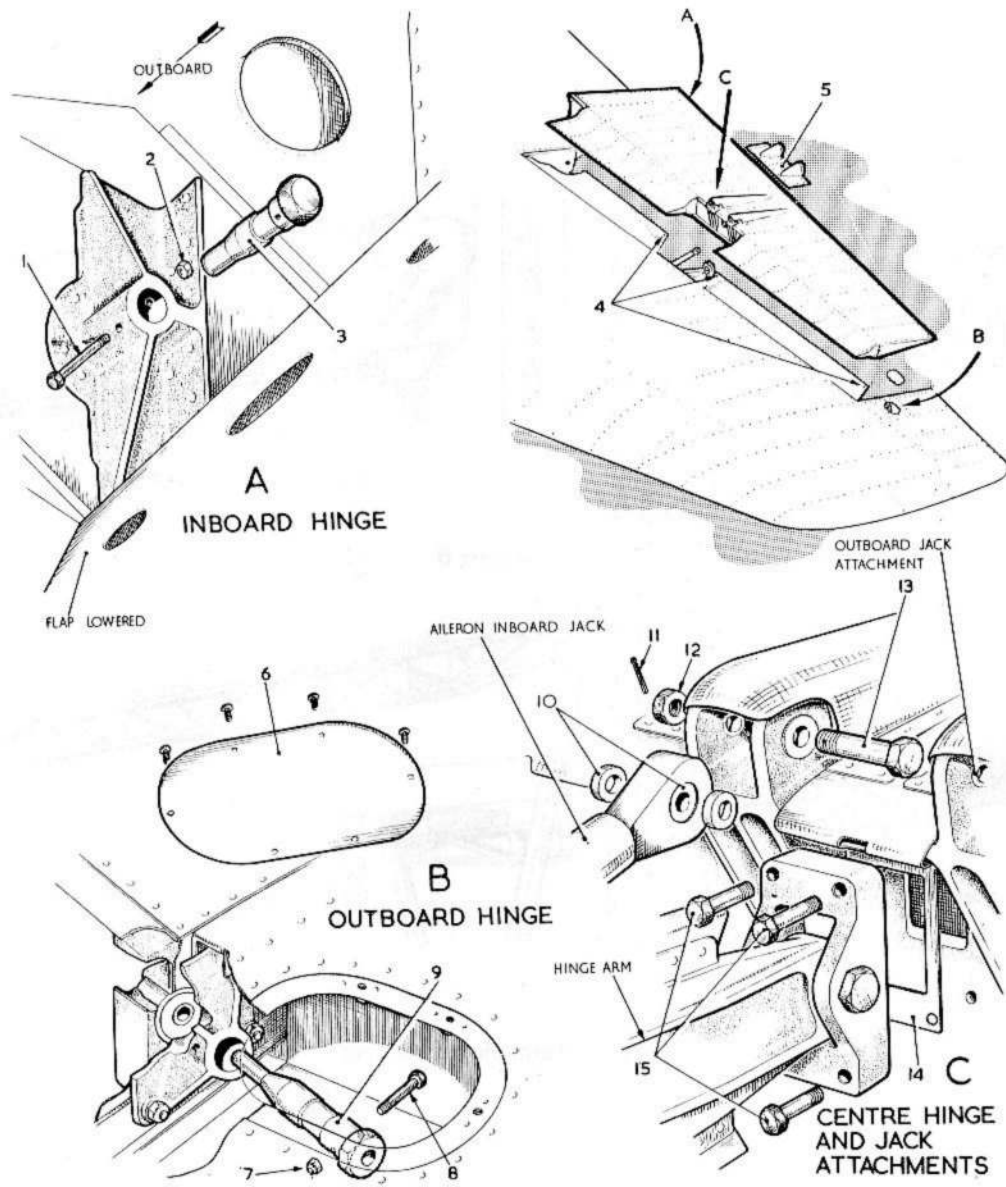


Fig. B Aileron removal

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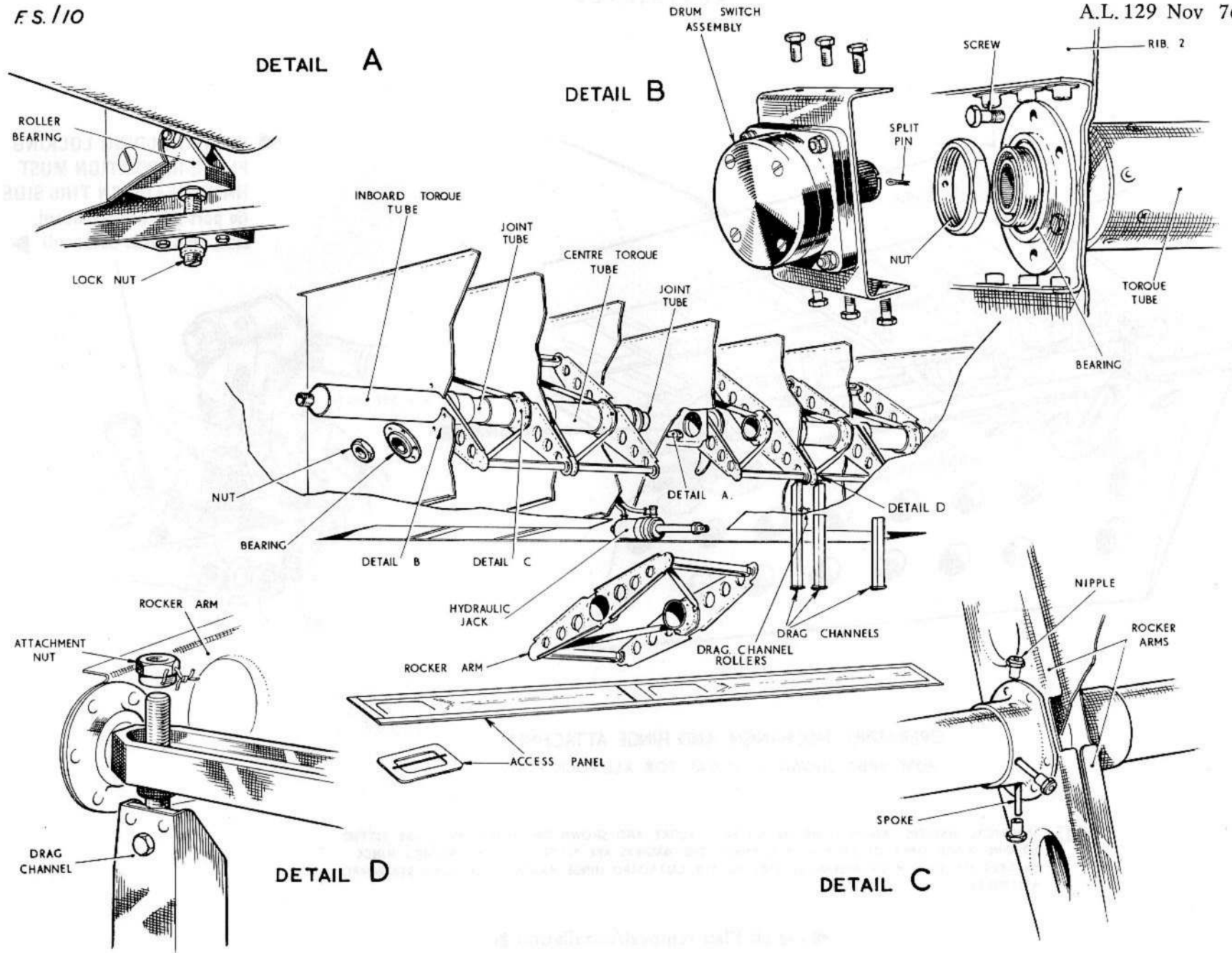
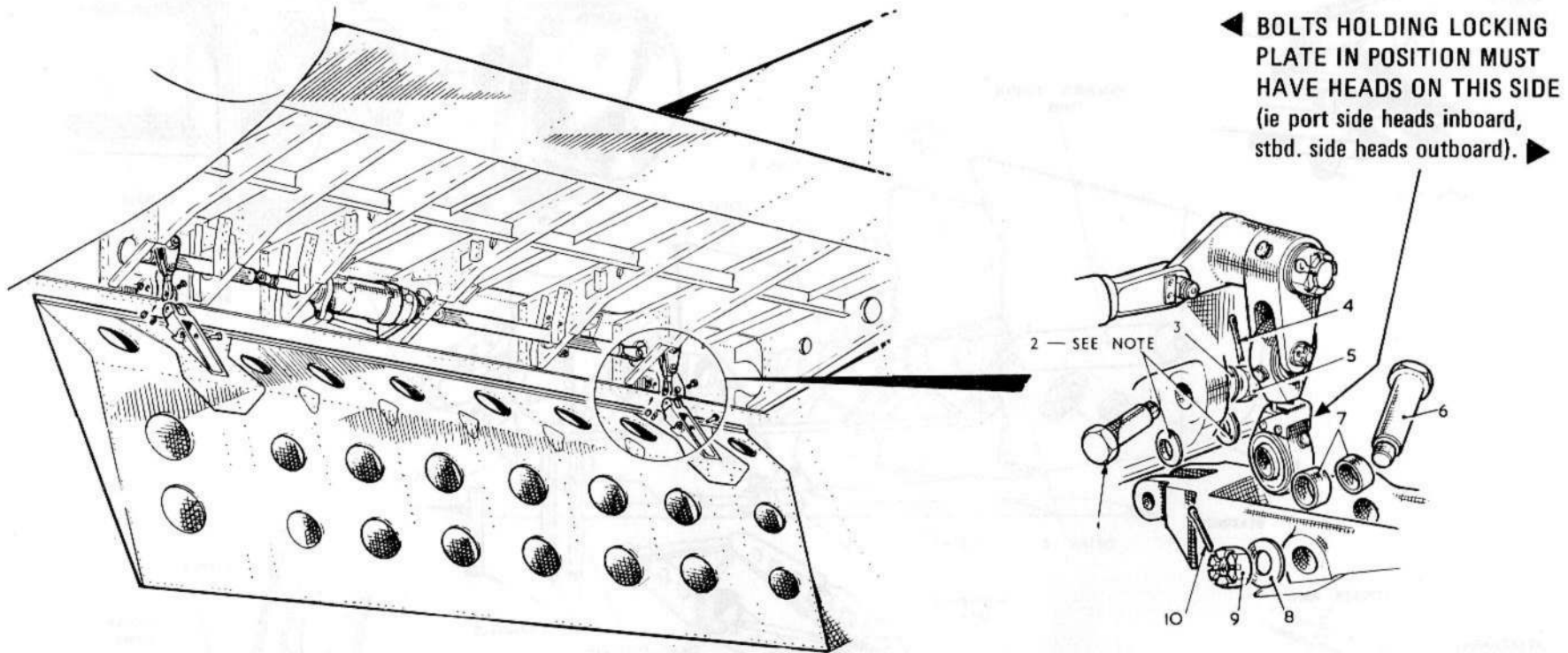


Fig. 9. Air brakes removal RESTRICTED

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OPERATING MECHANISM AND HINGE ATTACHMENT.  
PORT INNER SHOWN — TYPICAL FOR ALL FOUR FLAPS.

**NOTE** SPHERICAL WASHERS, WHICH ELIMINATE LATERAL FLOAT, AND SHOWN ON DETAIL AS 2, 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.

◀ Fig.10 Flap removal/installation ▶

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- (3) Disconnect the hydraulic jack from the lever on the rocker arm assembly.
- (4) Disconnect and remove the position indicator transmitter (port) or the mid-position drum switch (starboard). (Sect. 5, Chap. 1).
- (5) Remove all drag channels from their rocker arms by unlocking and removing their attachment nuts (Detail D).
- (6) Remove the nipples and spokes from the rocker arm assemblies and joint tubes (Detail C).
- (7) Slacken the lock-nut on the adjustable roller on the bearings at rib 3, and lower the roller to its full extent (Detail A).
- (8) Remove the nut from the end of the torque tube at rib 2, and the screws securing the annular plate of the bearing at rib 2 and remove the bearing.
- (9) Slide the inner and centre sections of the torque tube inboard towards rib 1, removing the rocker arm assemblies and the joint tube from the main plane as they are released.
- (10) Separate the centre and inner sections of the torque tube, removing the rocker arm assemblies and joint tube as they are released.
- (11) Move the centre section of the tube to rib 3, and, pivoting it on the adjustable roller, remove the tube from the main plane.
- (12) Remove the inner and outer sections of the tube in a similar manner to the centre section together with the remaining rocker arm assemblies as they are released.

26. Installation. - To install an air brake proceed in the reverse order to the removal operations, ensuring that the rocker arm attachment nuts are wire-locked.

#### Flaps

27. Removal (fig. 10). To remove a flap proceed as follows:-

- (1) Fully lower the flaps.
- (2) Support the flap and disconnect the operating mechanism at each end by removing the split pin, 10, nut, 9, washer, 8, bolt, 6, and distance pieces, 7.
- (3) At each end, remove the split pin, 4, nut, 5, washer, 3, and hinge bolt, 1, and remove the flap.

#### Note...

With reference to fig. 10, care should be taken to avoid losing the two spherical washers 2 which are seated within the double lugs at the inboard hinge brackets - port assemblies, and the outboard hinge brackets - starboard assemblies.

28. Installation. To install a flap, the sequence of operations should be carried out in the reverse order to the removal. After installation check that the clearances are within the limits stated in fig. 11.

#### Note...

The procedure for the removal and installation of the flap jacks is described in Sect. 3, Chap. 6.

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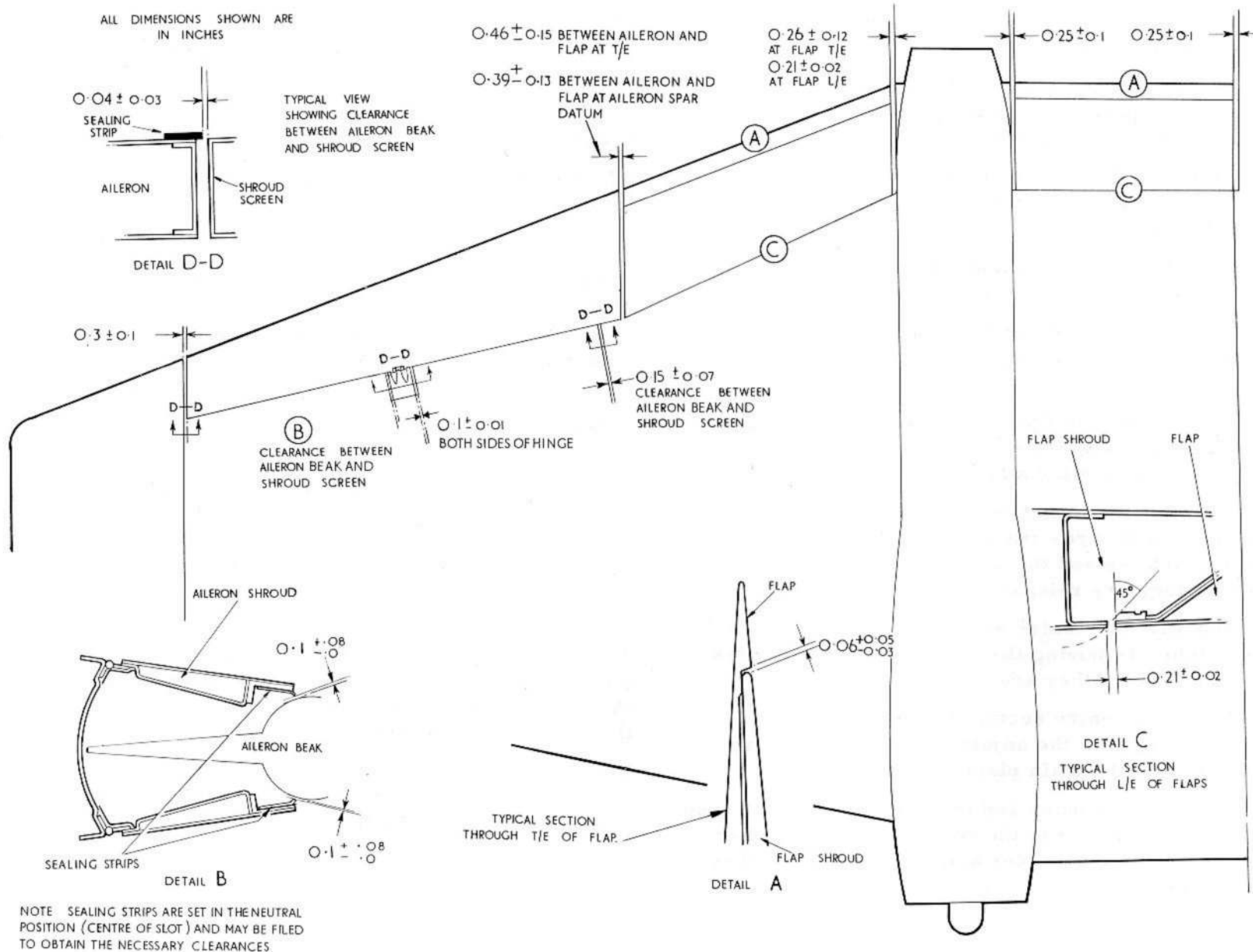


Fig.11 Main plane clearances

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Chapter 3 TAIL UNIT

(Completely revised)

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## Introduction

1. This chapter gives descriptive and servicing information on the tail unit construction, and the removal and assembly of the main components, including where necessary, the method of jacking, trestling and slinging. The disposition of spars and ribs within the structure is illustrated in fig. 1.

## DESCRIPTION AND OPERATION

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 connected at the 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 by angle section members, join

the main and false spars, the ribs being slotted to accommodate bulb angle-section spanwise stringers. The leading-edge ribs are of similar construction and are continuations of those aft of the main spar, the root ribs being faced with spruce strips. Each unit is covered with a light alloy skin riveted to the ribs, stringers and spars. A forged light alloy centre section connects the port and starboard units at the spars, while the false spars are joined directly to each other, thus forming a plated triangular aperture, the rear end of which carries the elevator inboard hinge brackets and travel stop pads. The complete tail plane is hinged on two brackets, secured to the fuselage at the rear of frame 42, by fork-end hinge brackets on the forward face of the centre forging, and is supported near the false spar, by an electrical actuator (Sect. 3, Chap. 4). A spring sealing strip, located along the upper edge of each closing plate forms a seal between the tailplane and the fuselage; and sealing plates (fig. 3) fitted above each

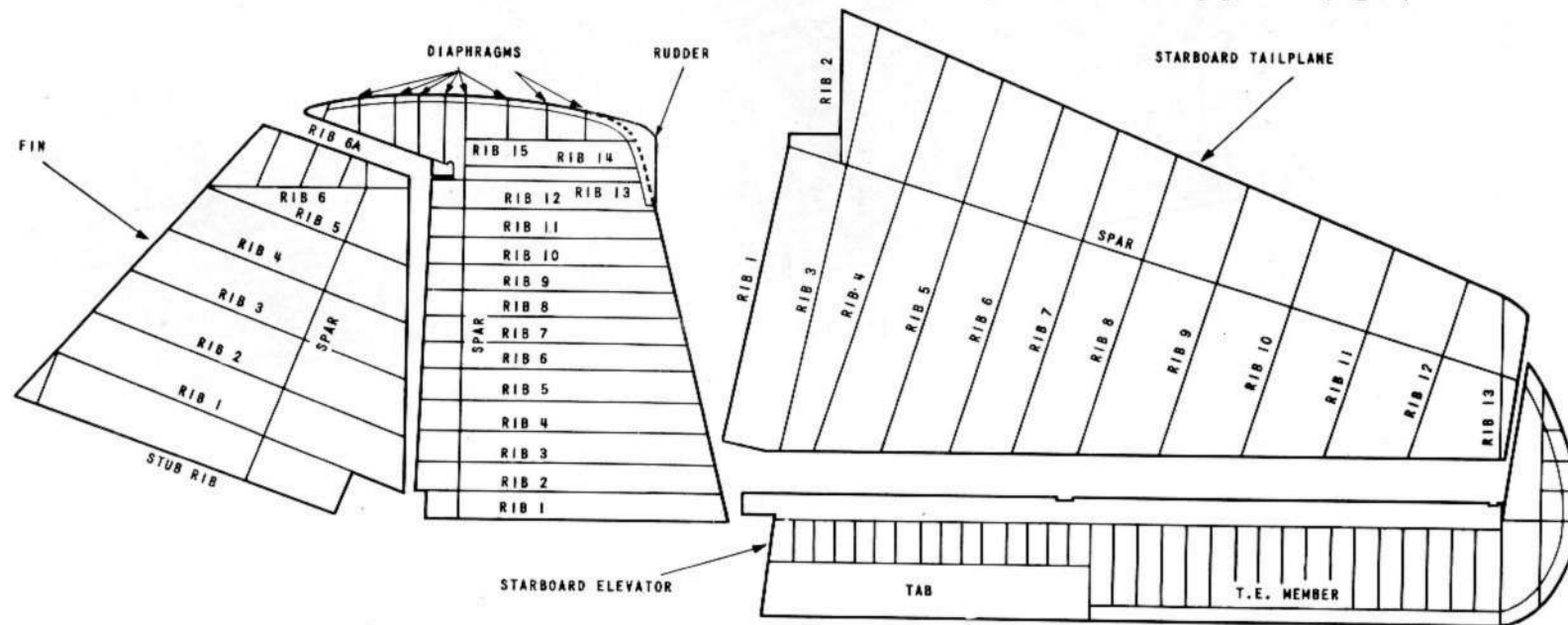


Fig. 1 Key diagram

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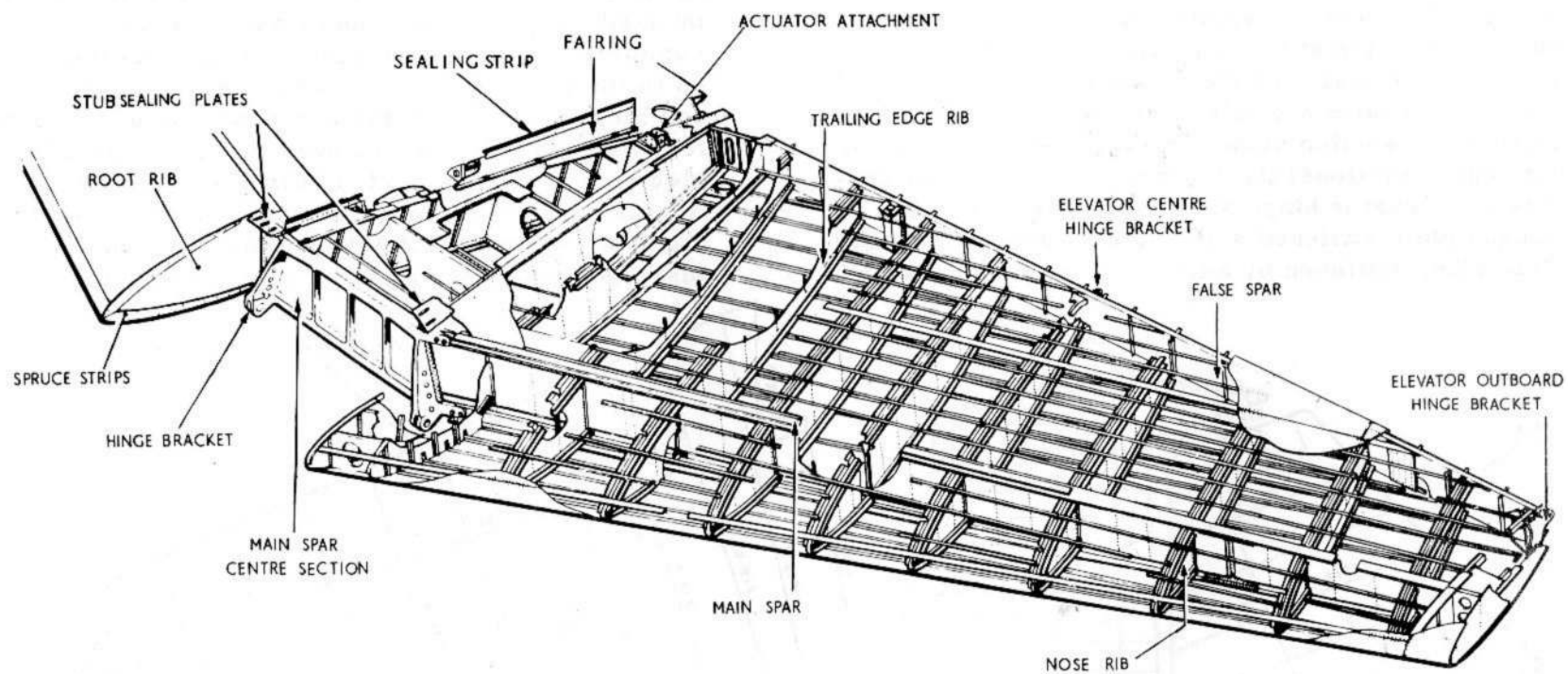


Fig.2 Tail plane

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hinge bracket enter between two plates on each tail plane stub to effect a seal between the tail plane and stub structure.

#### Elevators (fig. 4)

3. The port and starboard elevators are structurally similar components, interconnected by coupled vertical torque levers at the spar roots. They are attached to the tail plane centre section by hinge bolts and ball-race brackets at the roots, and to the tail plane trailing edges by open ended pins at the centres and outboard extremities to facilitate removal. The basic structure of each component consists of a D section spar forming the leading edge and a trailing area of flanged ribs supporting a light alloy skin. The inboard ribs are cut back at the trailing edge to accommodate the tab and are bounded by a plate web

to which the tab hinge brackets are attached; the skin sheeting is extended beyond the web to form the shroud over the tab leading edge. A removable mass balance bob weight mounted on each elevator spar is carried on an arm which bolts through the spar root.

#### Elevator spring and balance tabs (fig. 4)

4. The spring tab (port) and geared balance tab (starboard), are attached to the elevators by bolt hinges inboard and three bearing pins intermediate and outboard. The structure of both tabs is similar, consisting of a tubular spar and press-formed ribs supporting a fluted light alloy skin of restricted thickness, reduced and riveted. The tabs are balanced by steel tubes attached to the spar and projecting into the elevator interior. Six such weights are mounted on the starboard tab and two only, at the outboard end on the port tab.

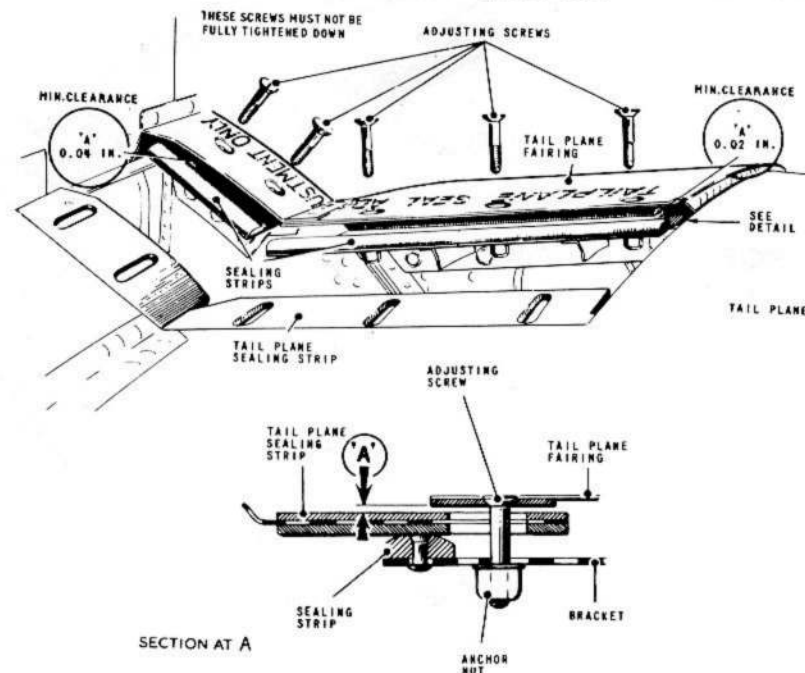


Fig.3 Tail plane seals

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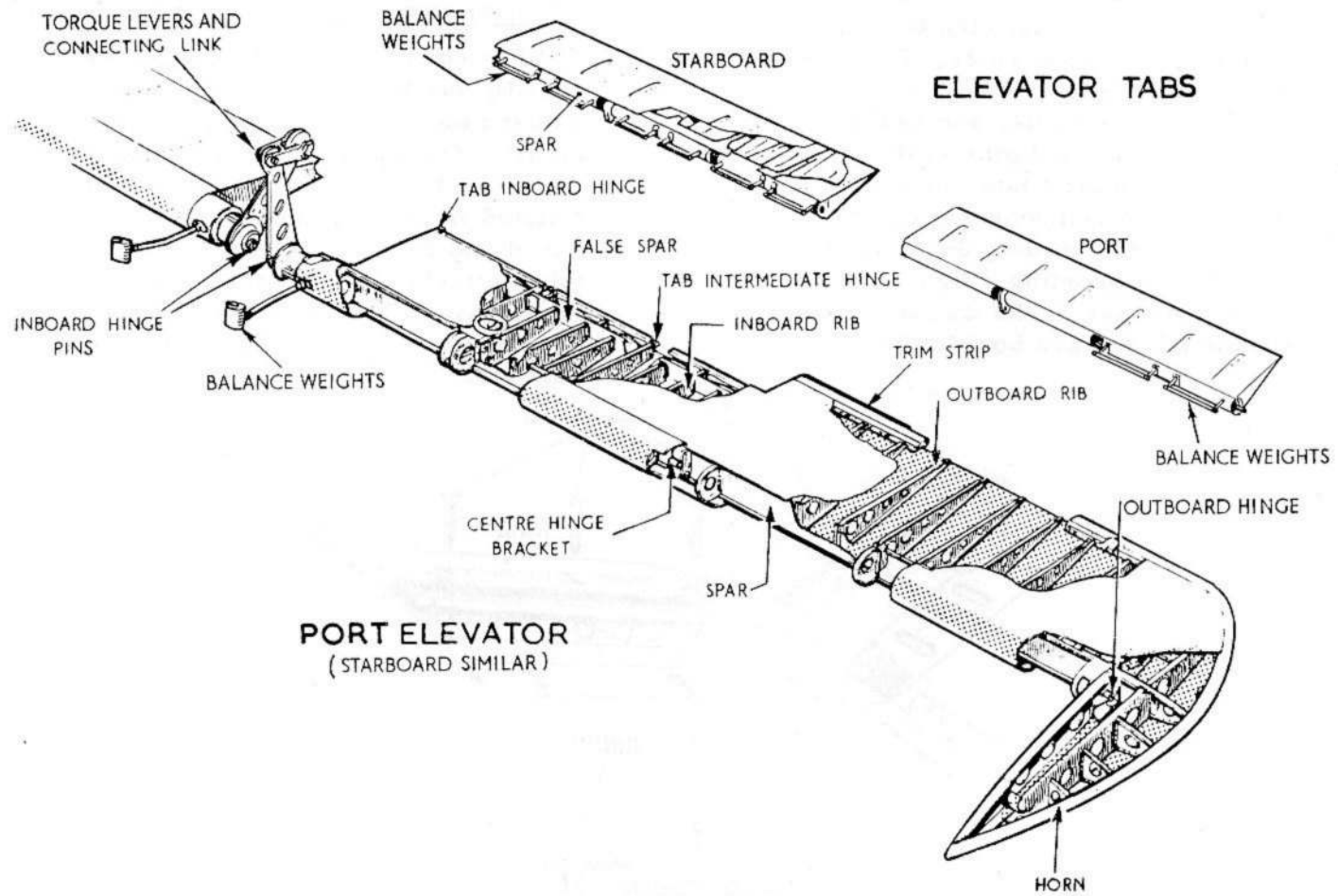


Fig.4 Elevator and tabs

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A.P. 101B-0409-1, Sect. 3, Chap. 3  
A.L. 122, April '73

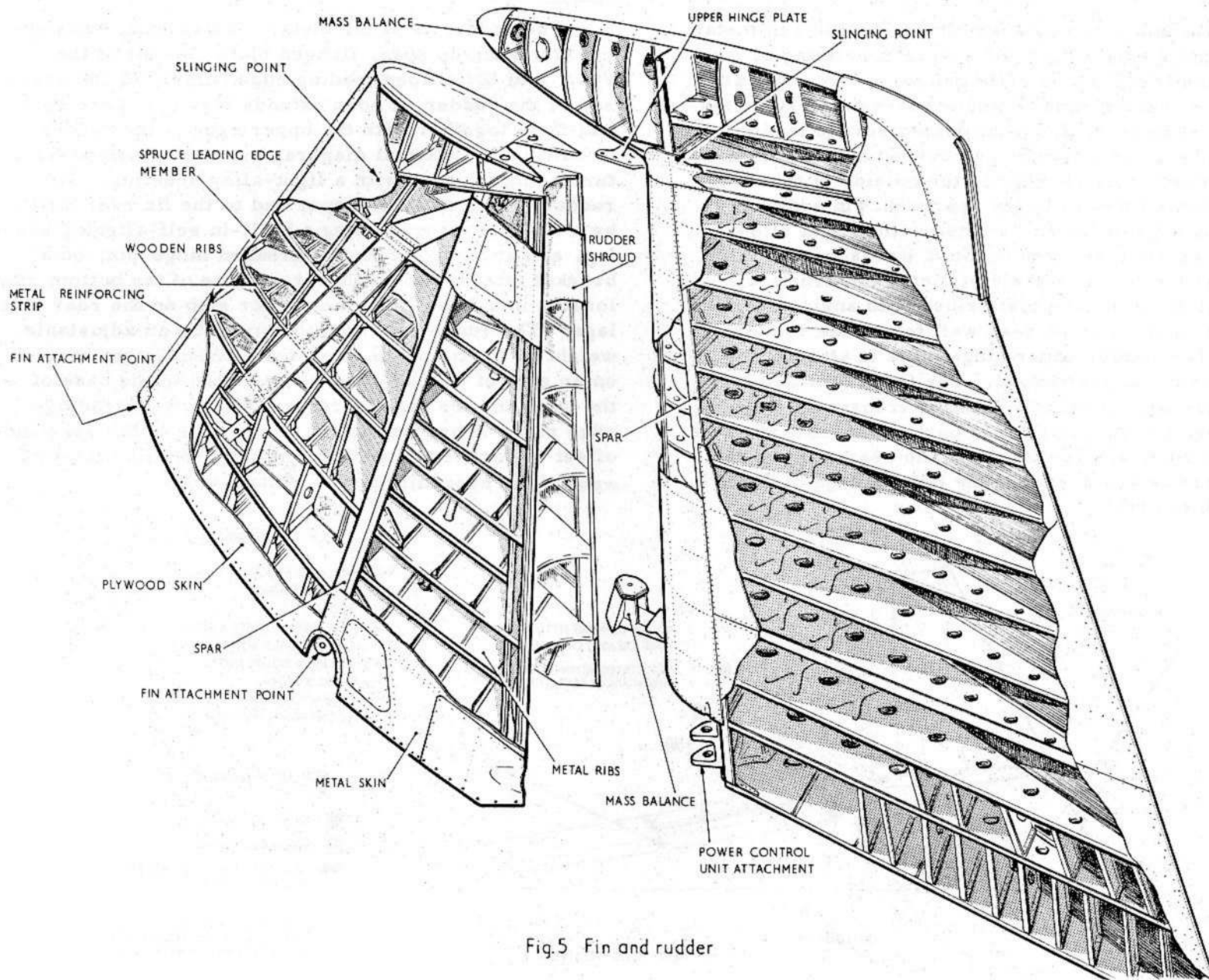


Fig.5 Fin and rudder

◀ ( MOD 4806 ) ▶

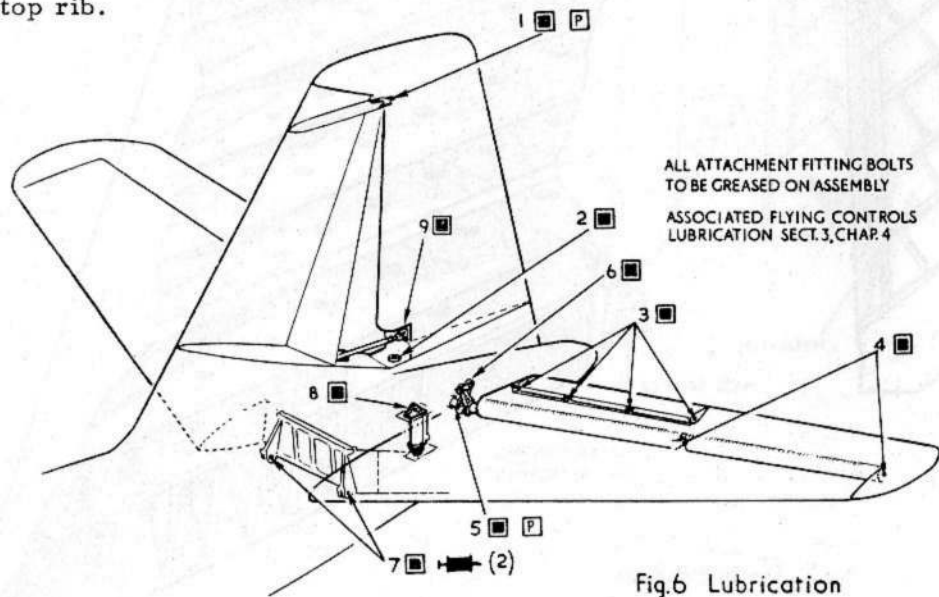
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Fin (fig. 5)

5. The fin is a composite structure of wood and metal, built around a single light-alloy spar consisting of T-section booms and a web plate reinforced by angle sections. The leading edge is formed by wooden ribs reinforced by stiffeners, and a laminated spruce leading-edge member, the whole being covered by a plywood skin, reduced at its aft edge to the outside of the T-section booms forward of the spar web. In addition, the leading edge of the fin is fitted with a light alloy re-inforcing strip secured by No. 2 woodscrews. Aft of the spar the fin is entirely of metal construction, being built up of flanged plate ribs, with angle section stiffeners, and a curved rear wall forms the rudder shroud. The rudder upper hinge plate is attached to rib 6 at the top of the shroud. The fin is attached to the tail fuselage fin stub by a bolted transverse angle in the nose, two tongue fittings port and starboard at the main spar root, a bolted angle at the rear diaphragm and the screws which secure the bottom edge of the skin to the stub top rib.

Rudder (fig. 5)

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 edged ribs. At the upper end of the rudder, a horn extends forward of the spar, and this, together with the upper edge of the rudder, is built up by vertical diaphragms, the complete structure being covered with a light-alloy sheeting. The rudder is hinged at its upper end to the fin rear wall by a bracket incorporating a built-in self-aligning bearing, and at its lower end a threaded hinge pin, on a bracket attached to the lower surface of the bottom rib, locates in a bearing in the rudder stub on the rear fuselage. The rudder is mass-balanced by an adjustable weight in the tip of the horn and a fixed weight carried on an arm of welded steel sheet bolted to the base of the spar and the undersurface of the bottom leading-edge rib. A bracket bolted to the base of the spar and offset to port is the attachment point for the actuating arm of the hydraulic power control unit.



## KEY TO DIAGRAM

- 1 RUDDER UPPER HINGE
- 2 RUDDER LOWER HINGE
- 3 TAB HINGES
- 4 ELEVATOR INTERMEDIATE AND OUTBOARD HINGES
- 5 ELEVATOR INBOARD HINGES
- 6 TORQUE LEVER COUPLING
- 7 TAIL PLANE HINGES
- 8 TAIL PLANE ACTUATOR ATTACHMENTS
- 9 POWER CONTROL ATTACHMENT

## KEY TO SYMBOLS

- GREASE XG- 287
- PREPACKED BEARING
- ▬ GUN LUBRICATION (2) INDICATES NUMBER OF POINTS.

FOR REF NO'S AND N.A.T.O CODE  
NO'S REFER TO THE REVERSE SIDE  
OF THE CONTENTS MARKER CARD

## SERVICING

Lubrication

7. The lubrication points, type of lubricant to be used and the method of application are shown in fig.6

Access panels

8. The positions of access panels and inspection covers are given in Sect.2, Chap. 4.

## REMOVAL AND INSTALLATION

## Note...

Whenever an aircraft component which affects, or can affect, longitudinal trim is removed and refitted, renewed or adjusted, a flight trim check must be carried out in accordance with the instructions given in Sect. 3, Chap. 4, to ensure that the aircraft trim is within the stated limits.

General

9. The following paragraphs in conjunction with figs. 7 to 12 give the procedure for removing the tail unit components. Installation is generally a straight forward reversal of the removal operations but specific differences are detailed where necessary. It is envisaged that, to facilitate handling, the elevators will usually be removed prior to removing a tail plane, although it is permissible to remove a tail plane with the elevators attached- therefore, the procedure for both methods is given. The slinging arrangement is identical for either case.

ElevatorSlinging

10. The method of slinging the components of the tail unit is shown in fig. 7. The tail plane is hoisted with the sling Ref. 26FZ/95009 and ring bolts for tail plane attachment. The fin and rudder are hoisted with the sling strop Ref. 26FZ/95084. Note that with the tail

plane in its installed position a maximum lift of six inches only is available, and care must be taken to avoid contact with the rudder stub underside as the tail plane is withdrawn.

Removal

11. The elevators are man-handled off the tail plane as separate components after disconnection of the centre coupling, control rod and inboard hinges. Jacking the aircraft is not essential but tail steady trestling is advisable.

(1) Set the tail plane incidence to its mid-travel position (disconnect electrical connections Sect. 5, Chap. 1, Group C).

(2) Remove the tail fuselage box and rear fairings (Sect. 3, Chap. 1).

(3) Disconnect the elevator control tube from the port elevator lever assembly (detail A 1 and 2).

(4) Remove the access panel covering the starboard balance tab rod connection and disconnect the rod at the adjusting screw (detail B).

(5) Port and starboard balance weights (Detail A, 3 and 4). Remove the split pins, nuts and washers from the weight arms and partially withdraw the weights against the tail plane diaphragm.

## Note...

The balance weights are stamped with the Serial No. of their respective elevator. The weight of the port and starboard mass balance varies in the redesigned elevators and tabs introduced by Mod. 3892 and 4026. The weight of the port assembly is 30 lb. 6 +<sup>2</sup>/<sub>4</sub> oz. and that of the starboard assembly is -<sup>4</sup>/<sub>4</sub> 30 lb. 15 +<sup>2</sup>/<sub>4</sub> oz.

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- (6) Disconnect the coupling link, from the starboard elevator torque lever, (detail A5).
- (7) Port and starboard inboard elevator hinges (Detail A6). Remove the bolts, nuts and washers (3 off) from the hinge bearing attachment brackets. If required remove the split pins nuts and bearings from the elevator hinge pins.
- (8) Remove each elevator by moving outboard and aft to clear the centre and outboard hinges and the balance weight arm.

Installation

12. Re-assembly of an elevator to the tail plane is in general a reversal of the foregoing removal procedure, but the following details should be noted:-

- (1) To facilitate alignment of the centre and outboard hinges, inspection holes (detail F) are provided at these positions. The holes are closed by plugs which are removed by screwing a 4BA bolt into the threaded hole in the plug and pulling the plug out. Replace the plug by removing the 4BA bolt and pushing the plug into the aperture until it is flush with the control surface.
- (2) When re-coupling the elevator torque levers the aft connecting bolt (detail A5) is to be fitted with the bolt head to port.
- (3) When re-ifting the mass balance arm and weight assemblies ensure that they are correctly related to their respective elevators.
- (4) After fitting the elevator check the shroud and horn gaps with the dimensions shown on fig. 12 detail H.
- (5) When re-connecting the geared balance tab

the connecting screw must be screwed into the lever and connecting rod simultaneously to achieve correct adjustment for the tab movement as detailed in Sect. 3, Chap. 4, fig. 12).

Elevator tabs

13. Removal, starboard tab (fig. 9)
  - (1) Disconnect the forward end of the connecting rod (detail B) at the screw connector.
  - (2) Remove the split pin, nut and washers from the tab connection of the rod (detail D) and free the rod from the attachment lugs.
  - (3) Extract the three bolts securing the inboard hinge to the elevator and remove the hinge from the elevator (detail E) together with the tab.

Note...

If a new tab is to be fitted the hinge pin Pt. No. EA1.31.63 must also be removed for use with the new tab. Wire lock after assembly.

- (4) Raise the tab and move it inboard and aft to clear the outboard and intermediate hinges.
14. Removal, port tab (fig. 9)
  - (1) Disconnect the forward end of the tab connecting rod from the operating lever (detail C) and the aft end from the tab attachment lugs (detail D) and free the rod from the attachments.
  - (2) Detach the inboard hinge and remove the tab as detailed in para. 13 (3) and (4).
15. Installation, port and starboard tabs (fig. 9)

The procedure is generally the reverse of the removal sequences, but note that:-

  - (1) If a new tab is being fitted, the hinge pin Pt. No. EA1.31.63 taken from the original tab is to be used and wirelocked after hinge assembly.

(2) When installing an elevator tab ensure that the tab connecting rod (detail D) is bolted to the attachment lugs by a special bolt (Part 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 follows:-  
 Spring tab - port. The thin plain washer and shim (Part No. EEAS. 27. 8. 4) must be positioned between the ball-race and the outboard lug, and the other plain washer between the nut and the inboard lug.

Balance tab - starboard. The thin plain washer must be positioned between the ball race and the outboard lug. The shim between the ball-race and the inboard lug, and the other plain washer between the nut and the inboard lug. Lock the

nut with a split pin. Should it prove necessary to tap the bolt through the ball race in the connecting rod, the tapping must be as light as possible to avoid fracturing the attachment lugs.

(3) To ensure correct adjustment of the balance tab, the connecting screw (3) must be screwed into the operating lever and the connecting rod simultaneously.

(4) After fitting a new tab, check the shroud and end gaps with fig. 12 detail G.

(5) The tab movements are to be checked with the dimensions given in Flying Controls Sect. 3, Chap. 4 and the flight trim check procedure is to be applied.

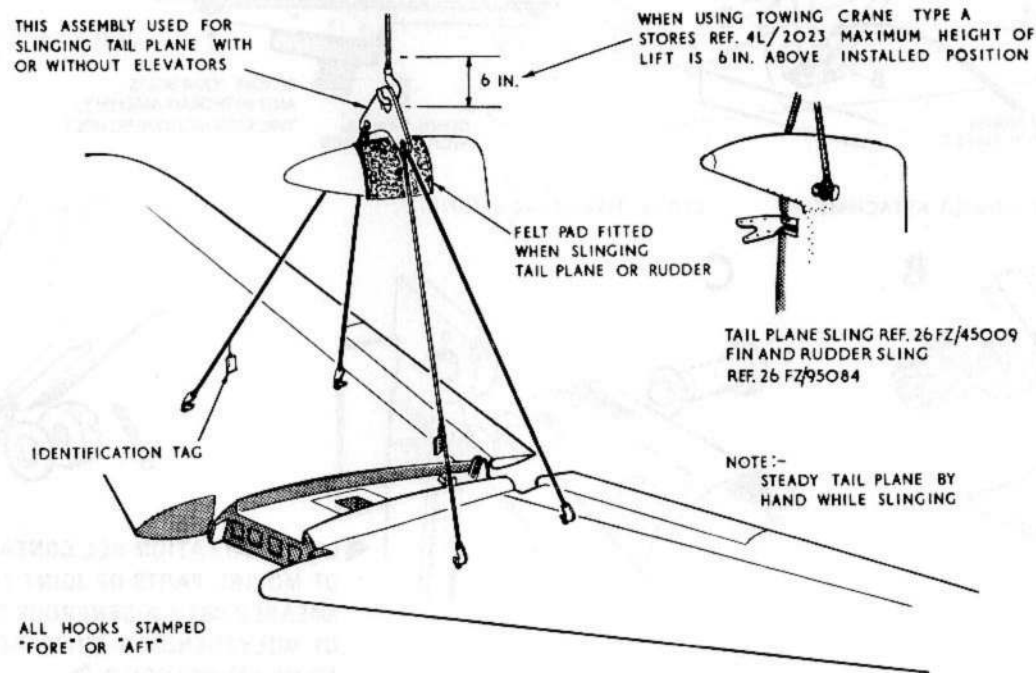


Fig.7 Tail unit slinging

RESTRICTED

FOR TAIL PLANE WITH ELEVATOR ATTACHED, REMOVAL;  
REMOVE THIS CONTROL ROD FROM THE AIRCRAFT

FRAME 42  
LEVER ASSEMBLY

ELEVATOR TORQUE  
LEVER ASSEMBLY

FOR DETAIL OF  
SEALING PLATES  
SEE FIG. 3

ACCESS HOLE COVER  
(REF. PARA. 18-1)

REMOVE 'UP TRAVEL'  
MICROSWITCH TAPPETS

'DOWN TRAVEL'  
MICROSWITCHES

REMOVE FOUR BOLTS  
AND WITHDRAW ASSEMBLY  
THROUGH LIGHTENING HOLE

FOR CLEARANCE DIMENSIONS  
ON INSTALLATION REFER TO  
FIG. 12

TAIL PLANE ACTUATOR  
REMOVAL SECT. 3, CHAP. 4

STRUT LOWER ATTACHMENT

STRUT TOP ATTACHMENT

HINGE ATTACHMENT

ACTUATOR LOWER ATTACHMENT

ON INSTALLATION ALL CONTACT FACES  
OF MOVING PARTS OF JOINT TO BE  
SMEARED WITH A GENEROUS COATING  
OF MOLYBDENUM DI-SULPHIDE GREASE  
TO MP 437 METHOD 2

◀ Fig. 8 Tail plane removal/installation ▶

RESTRICTED

Tail plane

## 16. Removal - with elevators removed (fig. 8)

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

(2) Set the tail plane incidence to its mid-travel position (disconnect electrical connections Sect. 5, Chap. 1, Group C).

(3) Remove tail fuselage box and cone fairings (Sect. 3, Chap. 1).

(4) Extract the five adjustment screws from the stub sealing plates on each side of the aircraft (fig. 3).

(5) Assemble the lifting equipment, attach the tail plane sling (fig. 7) and apply a slight tension.

(6) Remove the top microswitch and bracket assembly ('down travel' limit switches, fig. 8E) and withdraw the complete assembly through the rudder stub lightening hole. Do not disturb the switch settings.

Remove the adjustable tappets from the tail plane lower surface ('up travel' limit switches, Sect. 3, Chap. 4, fig. 22).

(7) Disconnect and remove the tail plane actuator details A and B.

(8) Remove the split pin, nut, washers and bolt from the top attachment of the fuselage bracing strut (detail C) at frame 42 (access via servicing panel on port fin stub).

(9) Lift the tail plane with the sling to its minimum incidence position and remove the split pin, nut, washers and bolt from the lower anchorage of the strut, (detail B), withdraw the strut through the bottom of the tail plane.

(10) Remove the split pin, nut and washer from each of the tail plane hinges at frame 42 (detail D).

(11) Adjust the sling lifting position as necessary and withdraw the hinge bolts. Lift the tail plane upward and aft to clear the hinge brackets and withdraw it from the aircraft. Note the lifting height restriction (fig. 7) and manhandle the tail plane to avoid fouling the rudder stub.

## 17. Removal - with elevator attached

The procedure of para. 16 sub-paras (1) to (11) applies with the following additional operation:-

(1) At any convenient stage after (5) disconnect the elevator control tube from the port elevator torque lever (fig. 8, detail A) and from the lever assembly on the bulkhead at frame 42. Remove and retain the control tube for subsequent re-assembly.

## Note...

It is suggested that after this control tube has been removed, control surface clamps should be fitted to facilitate handling during tail plane removal.

Before removing the tube, measure and record the pin centre length to ensure that the rod adjuster has not been disturbed when re-fitting.

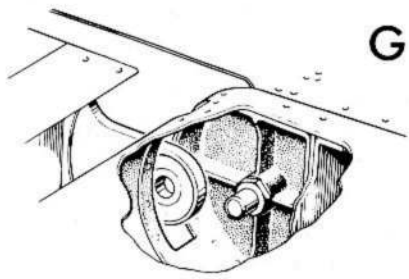
## Installation

18. The procedure for installing a new or refitted tail plane is in general, the reverse of the foregoing removal instructions with the following additions:-

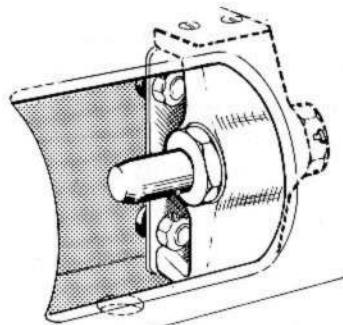
(1) Before offering up the tail plane, check on the rudder stub port side, that the bottom cover plate of the circular access hole is fitted and secured, (access to this plate is not possible

RESTRICTED

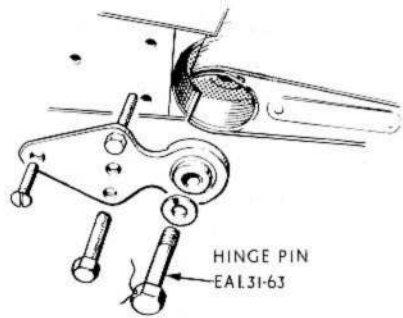
ELEVATOR OUTBOARD HINGE



ELEVATOR CENTRE HINGE



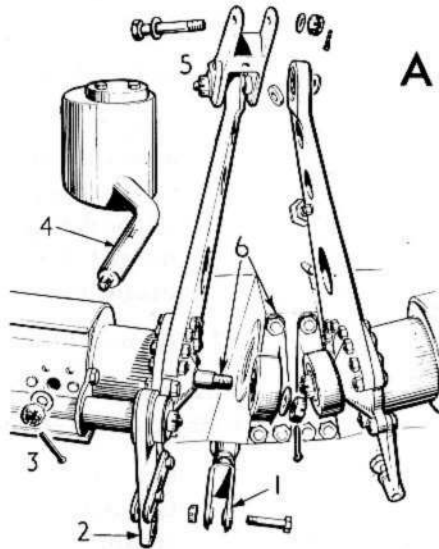
INSPECTION HOLE PLUG



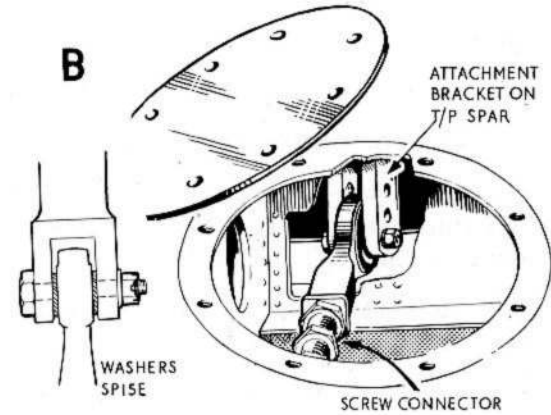
HINGE PIN  
EAL31-63

TAB INBOARD HINGE

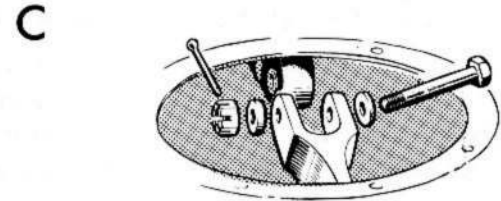
INBOARD-ELEVATOR HINGE AND LEVERS



STARBOARD TAB LEVER CONNECTION

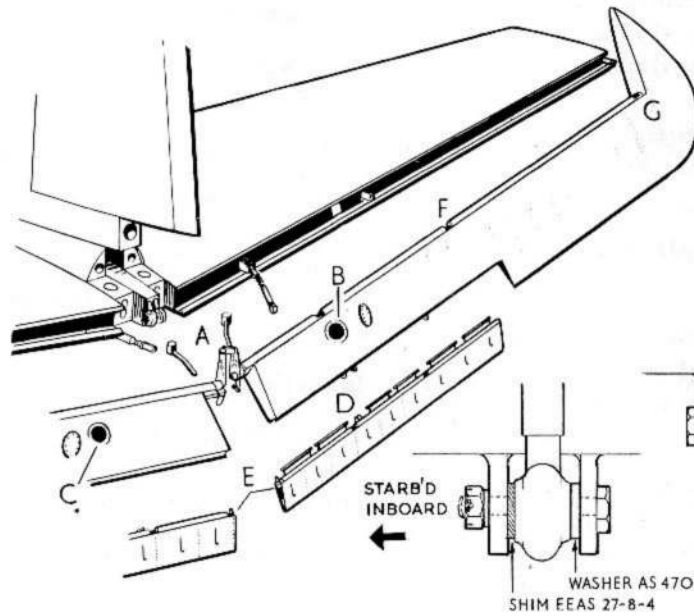


PORT TAB LEVER CONNECTION



TAB CONTROL ROD CONNECTIONS

INTERMEDIATE HINGE



STARB'D  
INBOARD

PORT  
INBOARD

WASHER AS 470 C  
SHIM EEAS 27-8-4

SHIM EEAS 27-8-4  
WASHER AS 470 C

TAB ROD ATTACHMENT

TAB  
LUG

EAL 31-65

Fig.9 Elevator and tab removal

RESTRICTED

with the tail plane in position).

(2) The following clearance requirements are to be checked with the dimensions detailed in fig. 12.

(a) Before installation of the tail plane actuator check the clearance between the sealing plate on the underside of the tail plane and the closing strip on the fuselage (detail C).

The clearance required is  $0.1 \text{ in.} + 0.05$   
 $- 0$

To facilitate this check, ensure that the lower microswitch tappets are screwed fully home and set the tail plane (with the sling) to 5 deg. 42 min. incidence as measured at the starboard inboard rigging position (Sect. 2, Chap. 4). At this incidence the sealing plate and closing plate are adjacent over most of their length and the clearance can be ascertained.

(b) With the tail plane actuator installed (Sect. 3, Chap. 4) set the tail plane to 3 deg. 15 min.  $\pm$  2 min. (this is the neutral 'take-off' position on the cockpit indicator) and check the following clearances:-

(c) Between the trailing edges of the tail plane stub and the leading edges of the tail plane (detail D), the clearance required is 0.05 in.  
 $+ 0.05$   
 $- 0.0$

(d) Between the tail plane stub and the tail plane root rib 2 (detail A) the clearance required is 0.1 in.  $+ 0.05$ . If this dimension  
 $- 0.04$   
is not obtained the clearance may be achieved by adding to, or facing off, the spruce packing on the tail plane root rib.

(e) Between the tail plane and the forward face of the rear cone (detail E) the clearance required is 0.1 in.  $+ 0.05$   
 $- 0.0$

(f) Between the tail plane upper surface root fairing and the fuselage (detail B) the clearance required is 0.2 in.  $+ 0.05$  Note that the clear-  
 $- 0.0$   
ance between the seal support rivet heads and the fin must not be less than 0.08 in.

(g) Tail plane stub seals both side of aircraft (detail F) the clearances required are:-

(i) At the curved seal (two bolts) 0.04 in. minimum.

(ii) At the flat seal (three bolts) 0.02 in. minimum.

Note...

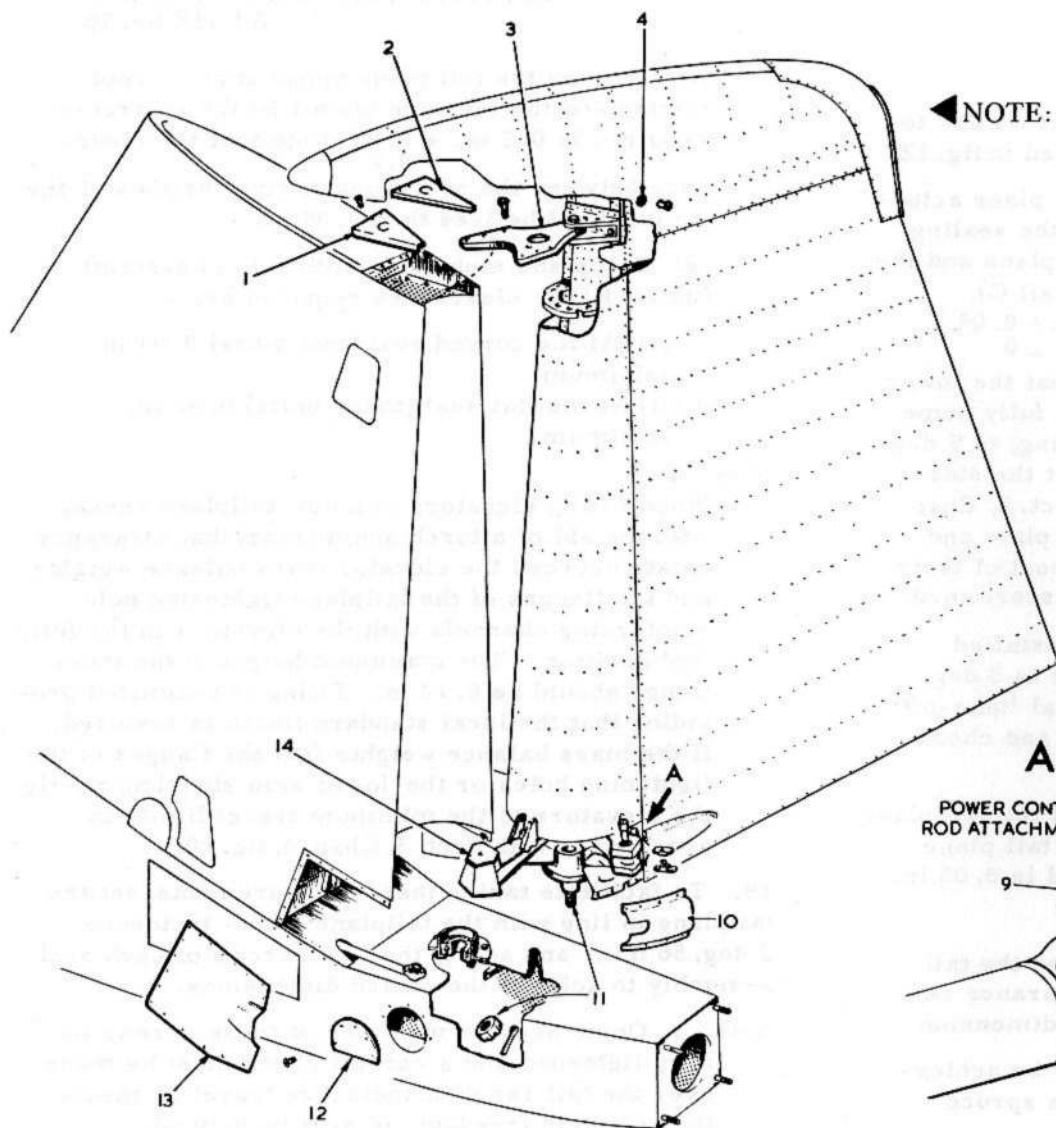
When fitting elevators to a new tailplane check, with the aid of a torch and mirror, that clearance exists between the elevator mass balance weights and the flanges of the tailplane lightening hole reinforcing channels with the elevators in the fully 'up' position. The maximum height of the inner flange should be 0.12 in. Filing is permitted providing that the local standard finish is restored. If the mass balance weights foul the flanges of the lightening holes or the lower skin sheeting re-rig the elevators to the minimum travel limits in accordance with Sect. 3, Chap. 4, fig. 10.

19. To facilitate taking these measurements, set the tailplane in line with the tailplane stub - incidence 3 deg. 56 min. and adjust the five screws of each seal assembly to achieve the quoted dimensions.

Note... On no account must any of these screws be fully tightened and a careful check must be made over the full range of incidence travel to ensure the complete freedom of seal movement.

Reset the tailplane incidence in accordance with Sect. 3, Chap. 4, para. 155 and 156.

RESTRICTED



◀NOTE: Aircraft to pre AS2989 standard incorporate a metal seal ring in the lower hinge assembly. Aircraft to post AS2989 standard incorporate a felt seal at the same point. When a rudder is installed check that on pre AS2989 standard aircraft no additional felt washer is fitted. On post AS2989 standard aircraft check that the felt washer is saturated with oil OM150 and the assembly is packed with grease DTD825. ▶

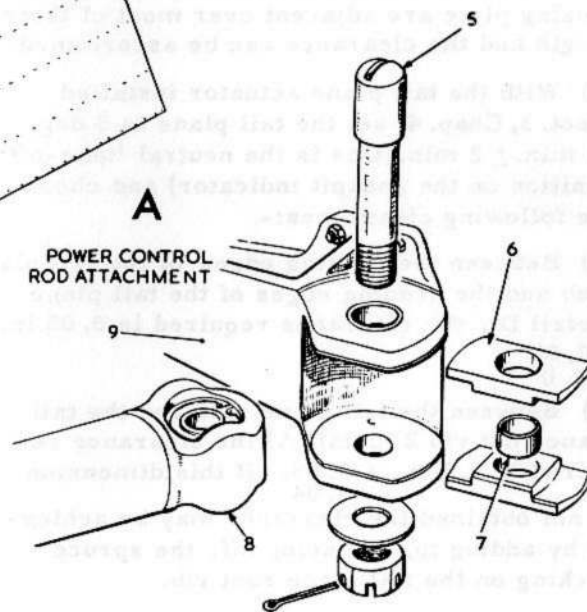


Fig. 10 Rudder removal  
RESTRICTED

Rudder

## 20. Removal (fig. 10) - To remove the rudder:-

- (1) Screw a 4BA bolt into the spring-loaded plugs, 4, on the port and starboard sides of the rudder, and remove the plugs by pulling outward. Fit the sling, Ref.No.26FZ/95084, to the rudder and take up the slackness in the sling.
- (2) Remove the fairing, 10, at the base of the rudder and the access panel, 13, at the base of the fin.
- (3) Disconnect the power control unit jack operating 8, from the bracket, 9, at the base of the spar by removing special bolt, 5, pressure pads, 6, and distance piece, 7.
- (4) Turn the rudder to port and remove port closing plate, 1.
- (5) Turn the rudder to starboard and remove starboard closing plate, 2.
- (6) Remove the rudder lower hinge access panel, 12, on the port side of the rudder stub.
- (7) Remove split pin and special nut from the lower hinge pin, 11.
- (8) With rudder turned to starboard remove the three bolts from the starboard side of the upper hinge plate, 3.
- (9) Turn rudder to port and remove the three bolts from the port side of the upper hinge plate, 3. The rudder is then free to be removed by sling.

## Note...

Care must be taken when lifting the rudder to ensure that the lower mass-balance weight, 14,

does not foul the underside of the fin trailing edge.

21. Installation - The procedure for installing the rudder is in general the reverse of the foregoing removal operations. The following clearance requirements are to be checked with the dimensions given in fig. 12. Refer also to note on fig.10.

- (1) Between the top of the fin and the rudder horn; this should be 0.30 in.  $\pm$  0.14 (detail J).
- (2) Between the base of the rudder and the rudder stub; this should be  $0.25 + 0.05$  in. at the forward hinge end tapering uniformly to  $0.15 + 0.05$  in. at the trailing edge (detail K).
- (3) Between the rudder and fin shroud (detail L) 0.05 in.  $\pm$  0.02.

## Note...

(a) If the clearances at the top and bottom of the rudder are not obtained, remove the shim Pt.No. EA1.12.201 from between the lower bearing housing and the rudder stub, and substitute a solid packing of the same overall dimensions and material (L73) but with a thickness of 17 to 12 s. w. g. as required.

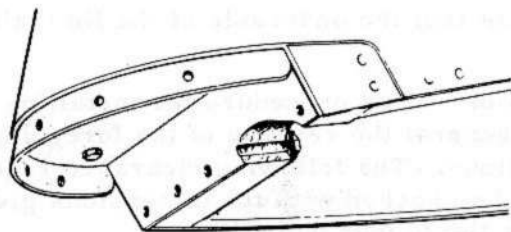
(b) Rudders supplied as spares have a 0.1 in. trimming allowance along the base outer skin to enable the base clearances to be accomplished should adjustment of the bearing housing shim prove unsuccessful.

Fin

## 22. Removal (fig. 11)

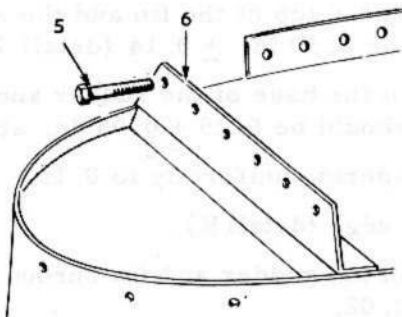
- (1) Remove the rudder (para. 20).
- (2) Remove access panels 1 (Hydraulics) 2, (fin post fittings) and 3, (forward stub attachment).

RESTRICTED

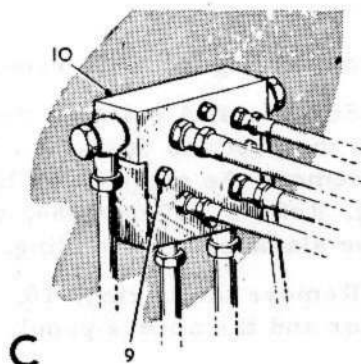
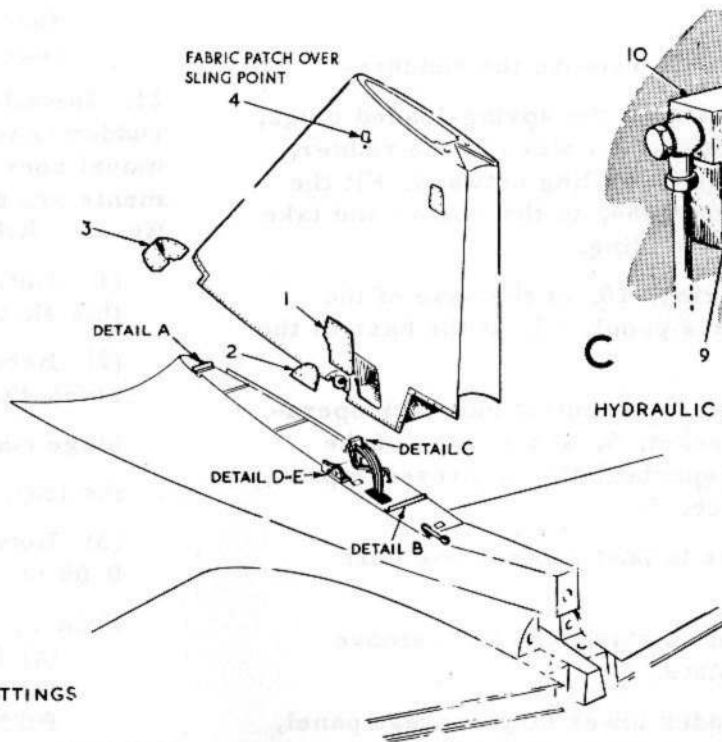


A

FIN STUB ATTACHMENT FORWARD

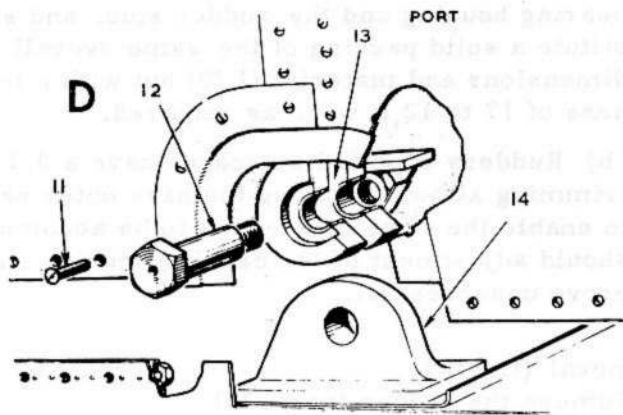


FIN POST FITTINGS



C

HYDRAULIC JUNCTION BLOCK



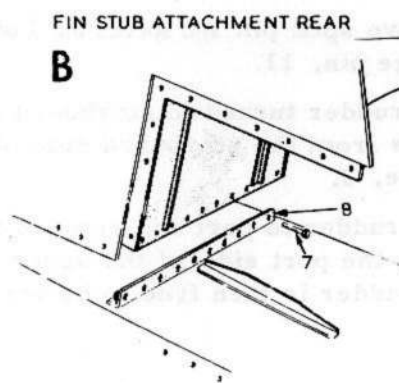
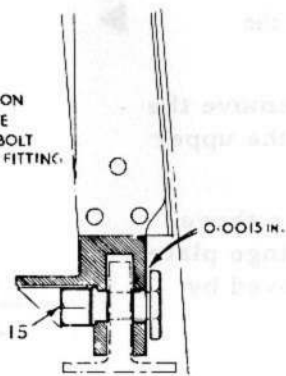
D

PORT

STARBOARD

E

INSTALLATION CLEARANCE BETWEEN BOLT HEAD AND FITTING



B

FIN STUB ATTACHMENT REAR

Fig.11 Fin removal RESTRICTED

Strip off the fabric patch 4, port and starboard to expose the sling hole.

(3) Fit the sling (Ref. No. 26FZ/95084 (fig. 7) taking up the slack.

(4) Detail A, extract the six 2 BA bolts, 5, securing the fin to the forward attachment angle, 6, on the fin stub.

(5) Detail B, extract the ten 2 BA bolts, 7, securing the fin rear diaphragm to the rear stub angle, 8.

(6) Detail C, extract the four 2BA bolts, 9, securing the hydraulic junction block, 10, to the fin spar web and detach the block clear of the fin spar. Do not disconnect the hydraulic pipes.

(7) Detail D, extract the one hundred and two countersunk screws, 11, securing the fin skin to the stub.

(8) Detail D, adjust the sling tension as appropriate and withdraw the port and starboard fin post attachment bolts, 12, to free the fin post lugs, 13, from the stub fitting, 14. Lift the fin as near vertically as possible to avoid side loading on the fittings during separation.

### 23. Installation (fig. 11)

(1) Fit the sling. Lower the fin carefully on to the stub attachment fittings (detail D. 14), align the bolt holes and insert the port and starboard attachment bolts, 12. Do not tighten the bolts at this stage.

(2) Detail A, secure the forward attachment to the stub angle with the six bolts, 5.

(3) Detail B, secure the rear attachment to the stub angle with the ten bolts, 7.

(4) Detail C, refit the hydraulic junction block, 10, with the four bolts, 9.

(5) Detail D, 11, refit the skin attachment screws.

(6) Screw home the port fin post attachment bolt, 12, do not overtighten.

Detail E, screw home the starboard attachment bolt until the nut, 15, is drawn against the bush of the lug fitting. Final tightening of this bolt is achieved when a clearance of 0.0015 in. is obtainable between the bolt head and fitting lug.

(7) Replace the access panels 1, 2 and 3, remove the sling and dope a new fabric patch over the sling attachment holes. Refit the rudder and check the clearances (fig. 12).

#### Note...

When a new fin is being fitted it will be necessary to position and align the fin (sub. paras. 1, 2 and 3) for marking off, and then to remove it for drilling and trimming.

RESTRICTED

J RUDDER HORN TO FIN

ALL DIMENSIONS IN INCHES

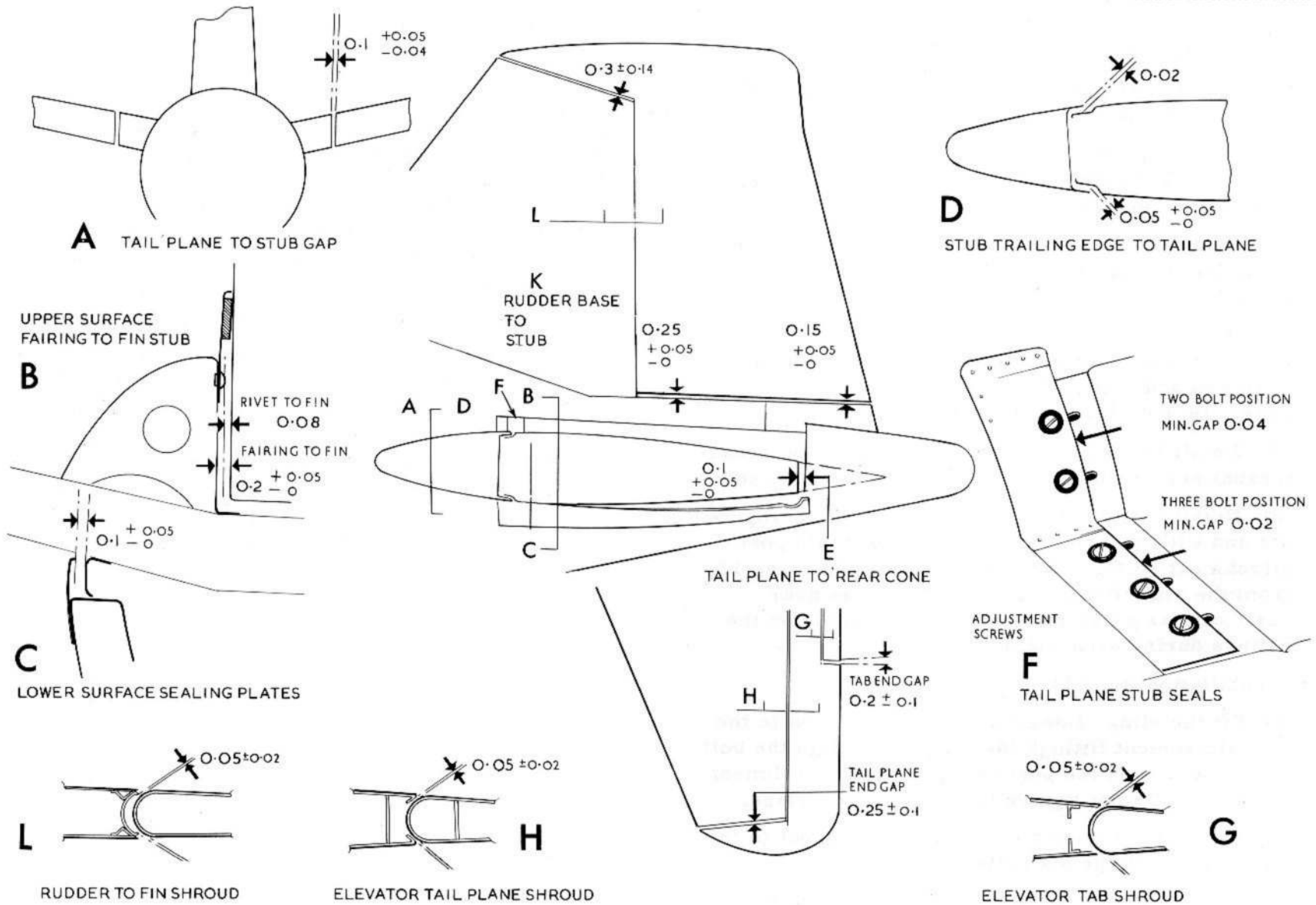


Fig.12 Tail unit installation clearances

RESTRICTED

## Chapter 4 FLYING CONTROLS

(Completely revised)

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## GENERAL INFORMATION

1. For convenience, this chapter has been divided into groups of paragraphs, each group covering a system or component. Accordingly, gaps will be found in the paragraph numbering.
2. Hydraulic power is provided for operating the ailerons and rudder, but the elevator is mechanically operated, with balance tab assistance only. Conventional runs of push-pull tubes and levers connect the pilot's controls to the aileron and rudder jack input valves, and to the elevator operating lever. Artificial feel in the aileron control is provided by a torsion rod incorporated in the control columns. Q-feel, i. e. feel proportional to equivalent airspeed, is provided in the rudder controls by a hydraulically-operated feel jack where the pressure is regulated by a pitot-static controlled feel simulator.
3. To insure against hydraulic system failure, three separate systems, the general services system and port and starboard controls systems, provide the hydraulic power for flying control operation. In the rudder controls, the power supplies to the jack and feel unit are duplicated and provided with automatic changeover control, the primary supply being obtained from the general services system and the secondary supply from the port controls system. Each aileron is operated by two jacks, the two controls systems each operating one jack on each aileron.
4. To obtain equal sensitivity of control at high and low altitudes, the aileron controls are geared to provide two movement ranges, the gear change being operated by an electrical actuator controlled by the pilot. Yaw damping in the rudder controls is applied

- by the Mk. 3 autostabilizer equipment. A Mk. 10 automatic pilot system is installed with provision for coupling to the I. L. S. for automatic approach.
5. Trim tabs are not fitted to the ailerons or rudder. Provision is made to adjust the artificial feel to accommodate variations in the neutral positions of the pilot's controls to effect trimming. Elevator trim is effected by ground adjustment of the trailing edge fixed spoilers (ref. para. 162 and 163).
  6. The variable-incidence tail plane is operated by a pilot-controlled electrical actuator, and the trailing edge flaps and air brakes by hydraulic jacks.
  7. For details of the hydraulic systems, refer to Chap. 6 of this Section. The electrical circuits related to the flying controls are given in Sect. 5, Chap. 1. Details of the installation of the autostabilizer and Mk. 10 automatic pilot equipment are given in Sect. 5, Chap. 2. For information on the components of the autostabilizer equipment, refer to A. P. 1469S, Vol. 1 and for the Mk. 10 automatic pilot to A. P. 112C-0801-1.

## Note...

The fork end fittings of the flying control tubes are machined with a counter bored recess on the outer face of one of the lugs concentric with the bolt holes. This recess is provided to accommodate the nut when the tubes are connected. Should the bolt be reversed on assembly, i. e. fitted with the bolt head in the recess, it may foul the air-frame 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 be located in the recess in the fork end. ▶

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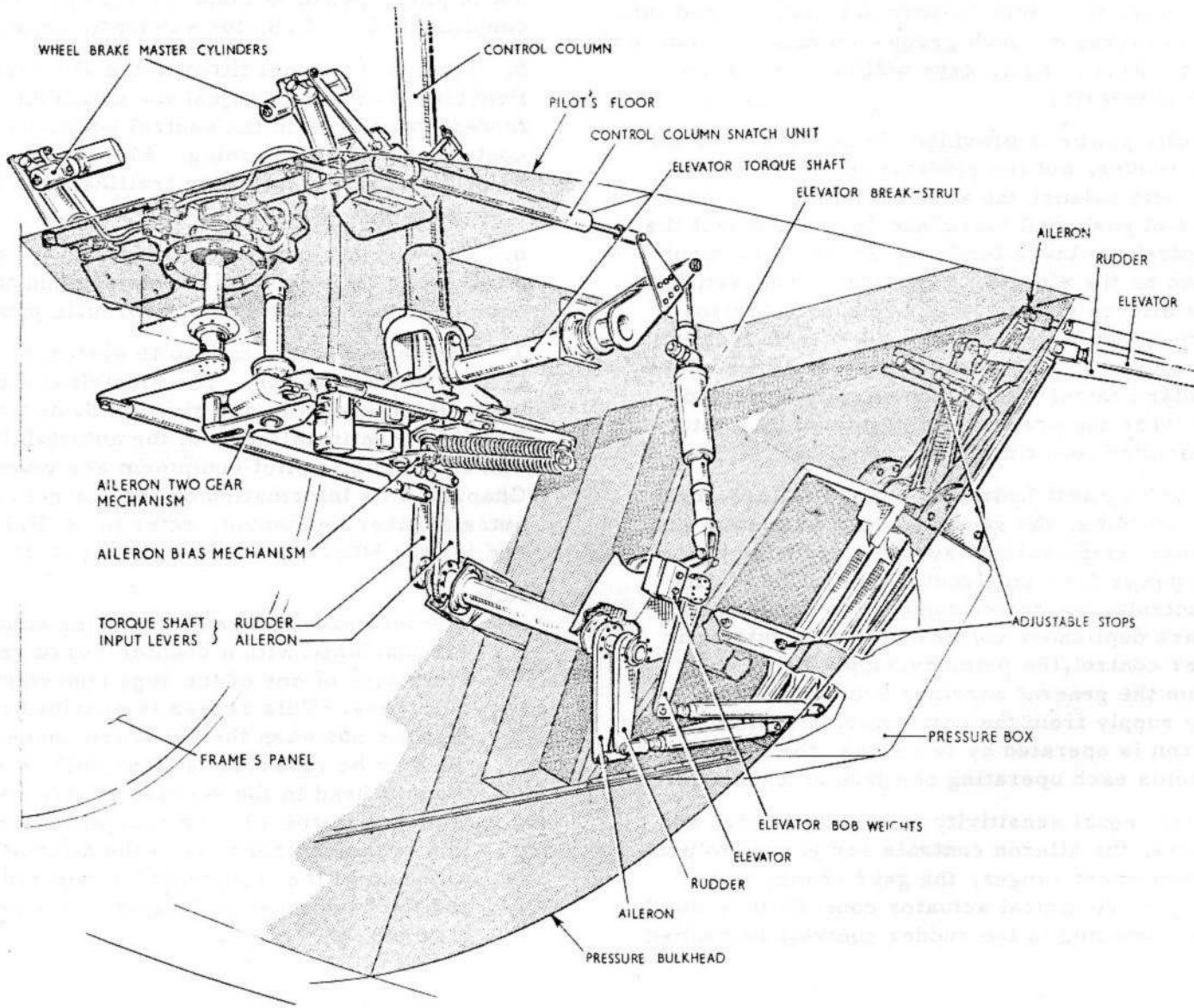


Fig.1 Controls in front fuselage

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## PILOTS CONTROLS

## DESCRIPTION AND OPERATION

8. Fig. 1 illustrates the installation of the primary surface controls in the forward fuselage. For the location in the pilot's station of the various control switches, indicators, etc., reference should be made to Sect. 1, Chap. 1.

Control column (fig. 2)

9. The control column is pivoted on ball-races in a cast support bracket mounted on the floor structure below the pilot's floor. Basically, it consists of a tubular member to which are riveted a top casting and base yoke. A horn-type handwheel is bolted to a flanged housing which is splined to a bevel gear pinion on a shaft in the top casting. Movement of the handwheel is transmitted to the aileron torque tube within the tubular member of the column by the pinion which meshes with a gear sector riveted to the torque tube. A universal joint at the control column pivot links the torque tube to a short shaft mounted in the support bracket, and a lever, fitted to the base of this shaft, transmits the torque tube movement to the aileron column run.

10. A torsion rod, fitted centrally within the aileron torque tube, provides artificial feel in the aileron controls. The rod is rigidly secured at its lower end to the base of the torque tube and, at its upper end, to an attachment fitting which is bolted to the top casting of the control column.

11. Fore-and-aft movement of the control column is transmitted to the elevator controls by a lever fitted to the outboard end of the torque shaft secured to the base-yoke of the column.

Control column emergency displacement

12. A snatch unit, fitted within the port console at the pilot's station, is connected to the lever at the

outboard end of the elevator torque shaft on the control column. Its purpose is to move the control column forward and to hold it against the instrument panel to provide an unobstructed exit for the pilot in his ejection seat when abandoning the aircraft. A break-strut, interposed in the elevator control run between the lever on the elevator torque shaft and the lever at the pressure bulkhead, is parted simultaneously with the release of the spring operated snatch unit. Thus severed, the elevator controls are not affected directly by movement of the control column under the action of the snatch unit. A detailed description of the snatch unit is given in para. 90 and of the break-strut, in para. 100.

13. Both the snatch unit and break-strut are operated by cartridge gas pressure from the cartridge in the firing unit operated by the seat ejection firing mechanism. A description of the cartridge gas system is given in Chap. 1 of this Section.

Rudder bar

14. 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 shaft protruding 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 by the torque shaft and a horizontal lever at the bottom of the shaft to the rudder control run. A toe-operated hydraulic master cylinder embodied in each rudder pedal is in circuit with the wheel brake control valve (Sect. 3, Chap. 6).

## SERVICING

Lubrication

15. The lubrication points, type of lubricant used,

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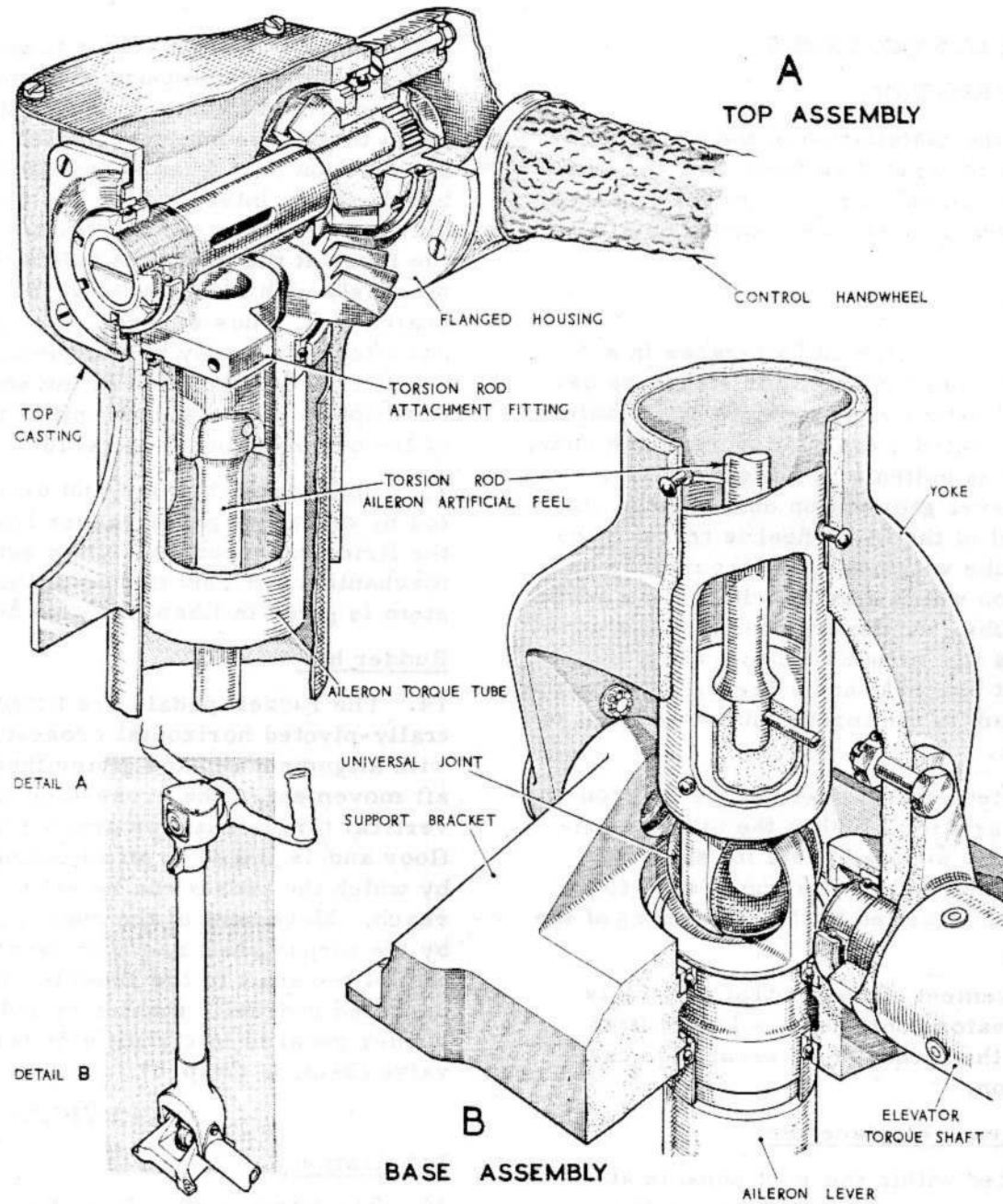


Fig.2 Control column  
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and method of application are shown in fig. 23.

#### REMOVAL AND INSTALLATION

##### Control column

##### WARNING:

BEFORE ENTERING THE COCKPIT, PERSONNEL MUST ENSURE THAT ALL RELEVANT SAFETY PRECAUTIONS DETAILED IN THE LETHAL WARNING CARD AT THE BEGINNING OF THIS VOLUME HAVE BEEN OBSERVED.

##### Removal

16. To remove the control column:-

- (1) Separate two halves of dust cover by fully opening zip-fasteners and remove two cover plates at base of column.
- (2) Remove access panels from inboard side of the port console.
- (3) Remove side panel between pilot's upper and lower floor levels.
- (4) Disconnect control column electrical cables from terminal block beneath pilot's floor, forward of base of control column.
- (5) Disconnect aileron control tube from the lever at base of control column by removing split pin, slotted nut and bolt.
- (6) Disconnect aileron control tube from 2-gear actuator and carefully remove tube.
- (7) Remove split pin, slotted nut, washer and bolt securing double lever assembly to bias actuator ram.
- (8) Remove split pins, nuts and washers from five 2 B.A. bolts securing double lever assembly

support bracket, using a suitable means to hold tension of bias springs until bolts are withdrawn.

- (9) Remove six split pins, slotted nuts, washers and bolts attaching aileron lever to base of column.
- (10) Remove double lever spring yoke, springs and aileron lever complete.
- (11) Disconnect elevator break-strut and control column snatch unit (para. 95) from lever assembly within port console.
- (12) Remove six 2 B.A. bolts and washers from bracket which supports elevator torque tube assembly at its outboard end.
- (13) Remove split pin, slotted nut, washer and bolt attaching elevator torque tube to yoke at base of column.
- (14) Remove four  $\frac{1}{4}$  in. bolts from control column support bracket.
- (15) Slide elevator torque tube assembly outboard until tube is withdrawn from bearing in control column yoke and remove column.

##### Installation

17. (1) The sequence of operations for installing the control column is the reverse order of that for removal. The various connections should be lubricated on assembly as shown in fig. 23.
- (2) Check clearances between elevator torque shaft bolts or spokes and nipples, and vertical U-section frame adjacent to control column mounting.

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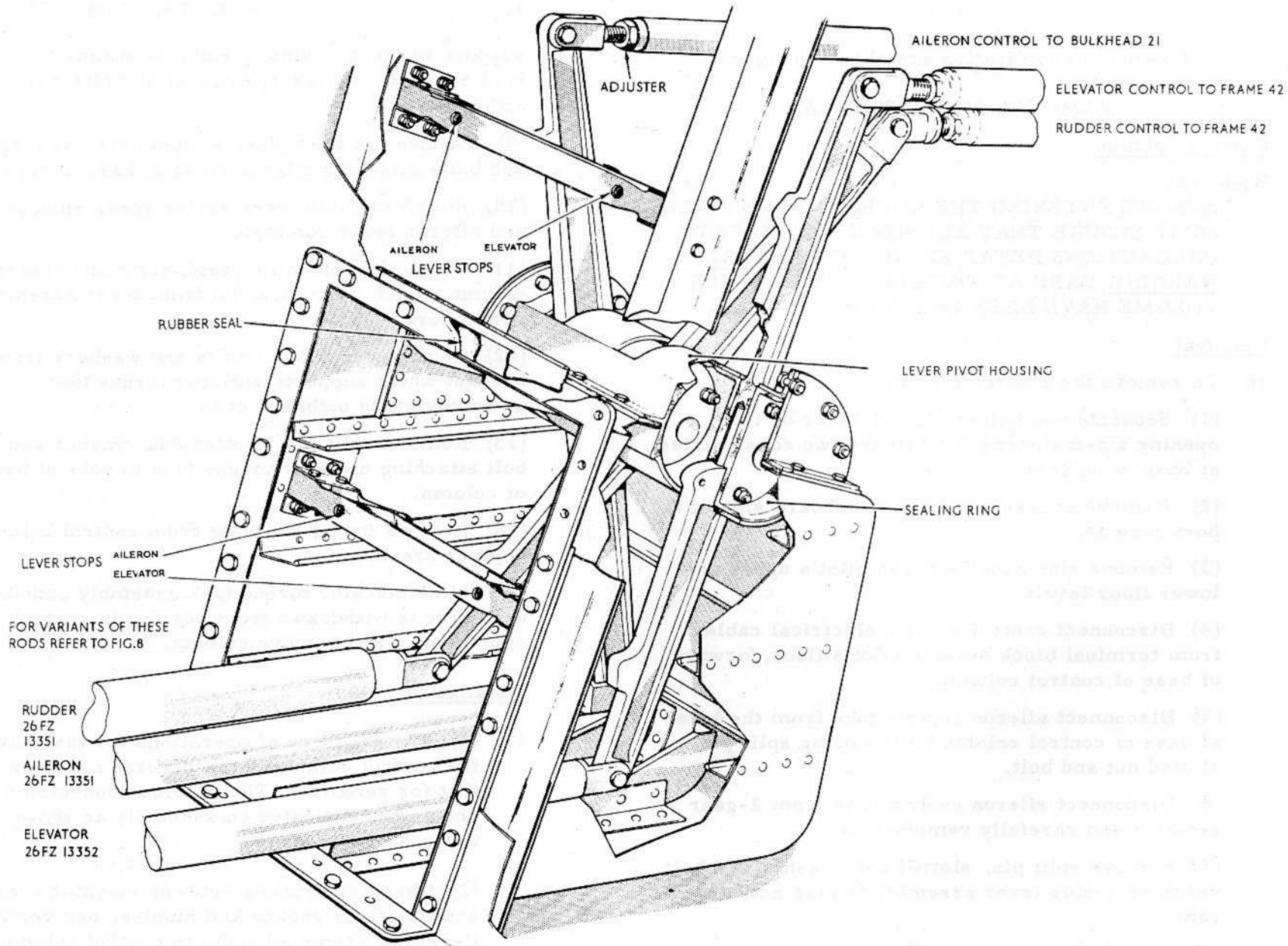


Fig.3 Pressure box lever assemblies

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(3) The spring retaining bolts Part No. EB8-45-1369 used at the forward (actuator) yoke, must be fitted with the bolt heads on the underside of the yoke to avoid fouling the double lever assembly.

### Rudder bar

#### Removal

18. To remove the rudder bar:-

- (1) Operate the toe brakes until all hydraulic pressure in the wheel brakes accumulator is exhausted.
- (2) Disconnect and blank off the hydraulic pipes PWB and SWB at the ninety degree connections to the flexible pipes forward of the pedestal.
- (3) Disconnect the control tube from the rudder control lever at the base of the vertical torque shaft by removing the split pin, slotted nut, washer and bolt.

(4) Remove the two 3/8 in. BSF nuts, bolts and four saddle washers attaching the control lever to the base of the vertical torque shaft and remove the lever.

(5) Remove the eight 1/4 in. bolts securing the rudder bar pedestal to the pilot's floor and remove the rudder bar assembly.

#### Installation

19. The sequence of operations for installing the rudder bar is in the reverse order of that for removal. Should it be necessary to fit new saddle washers these may be filed to clear the vertical torque shaft bearing housing. After installation the wheel brakes hydraulic system should be primed, bled and function tested as described in Chap. 6. The various components should be lubricated on assembly as shown in fig. 23.

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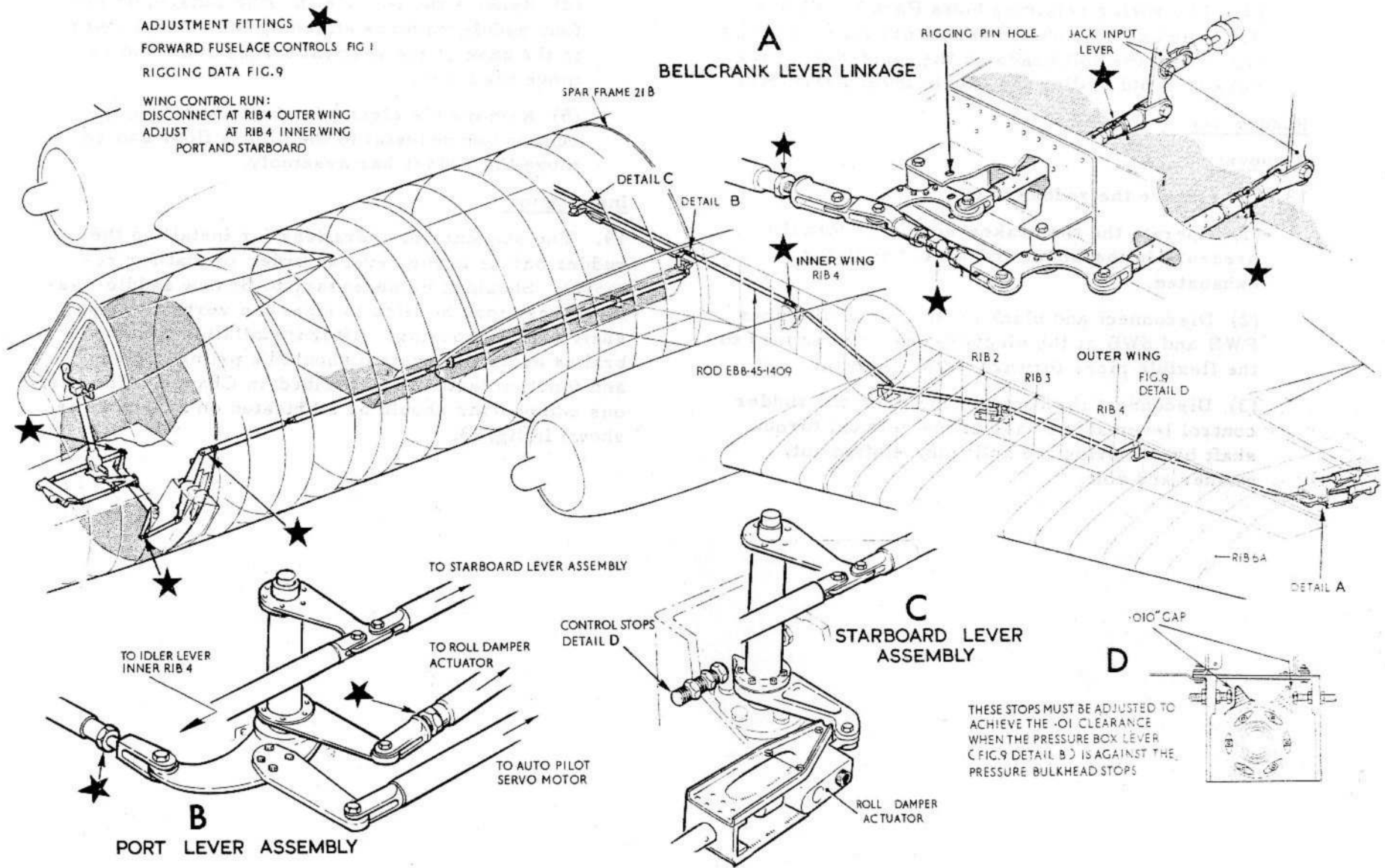


Fig.4. Aileron controls

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## AILERON CONTROLS

## DESCRIPTION AND OPERATION

Control run (fig. 4)

30. Movement of the control column handwheel is transmitted to the lever at the base of the column. This lever is connected by a push-pull tube to a centrally pivoted lever incorporating the two-gear actuator. From a sliding shackle connected to the actuator, the run is continued aft by push-pull tubes and levers to a lever assembly mounted on the rear face of the spar frame bulkhead, and thence into each wing to a linkage connecting two bellcrank levers. These levers, mounted on the main-plane structure immediately forward of the aileron operating jacks, are connected by push-pull tubes to the jack input levers, one lever to each jack. The push-pull tubes in the fuselage are supported on roller guides secured to brackets on the fuselage structure. In the wings the tubes are supported at the joints by levers. Adjustable control stops are provided at the pressure bulkhead to limit lever movements within the required travel range.

Aileron two-gear control (fig. 5)

31. The aileron controls are geared to provide a restricted movement range at the ailerons in addition to the normal full range, the restricted range being applicable to high altitude flight in low gear.

32. An electric actuator, mounted on a centrally pivoted lever below the pilot's floor forward of the control column, operates the gear change, which is effected by increasing or decreasing the effective length of the inboard arm of the centrally pivoted lever. This lever consists of upper and lower lever plates interspaced by a spool at the pivot and spacing blocks

at the end of the arms. Lugs, integral with the spacing block at the outboard arm, provide attachment for the control tube from the control column and the anchorage for the actuator. At the inboard arm, the lever plates are slotted, and a pin, connecting a fork-end on the actuator operating rod with a shackle linked to the control run, is free to slide in the slots.

33. The actuator is controlled by a two-position switch on the pilot's starboard console. The switch is labelled LOW ALT.-HIGH ALT. When LOW ALT. (high gear) is selected the actuator is fully extended, and the sliding pin at the end of the slots furthest from the lever pivot. This gives the maximum

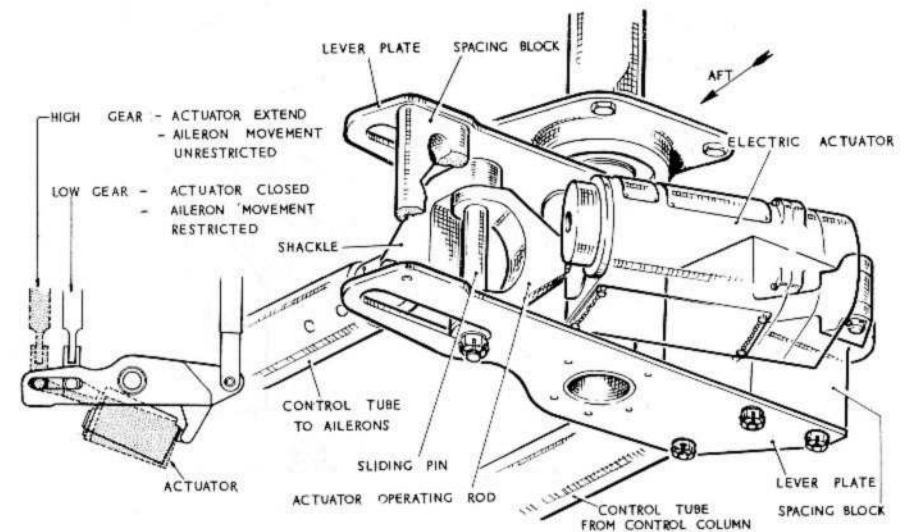


Fig. 5 Aileron two-gear mechanism

effective length of the lever arm, and the full movement range of the ailerons. On moving the switch to HIGH ALT. (low gear) the actuator closes and moves the sliding pin to the opposite end of the slots, thus decreasing the effective length of the lever arm and restricting the movement range of the ailerons.

Aileron operating jacks

34. Each aileron is operated by two hydraulic jacks, Fairey Type A.H. 797. These jacks, situated one in-board and the other outboard of the aileron centre hinge rib in the outer wing, are attached to a machined fitting in the outer wing and to lugs protruding from

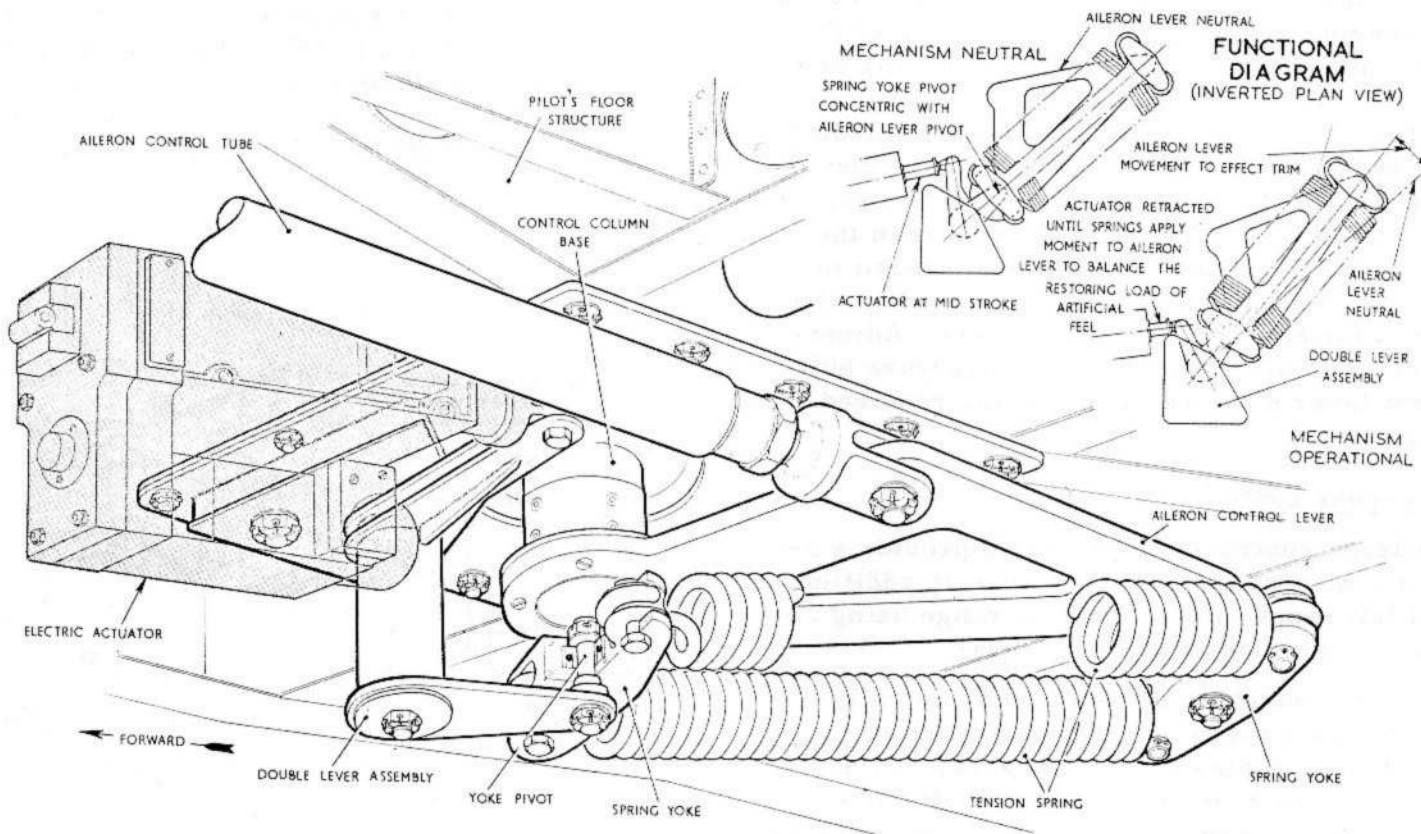


Fig.6 Aileron bias mechanism

the upper surface of the aileron at the spar position. Push-pull tubes link the jack input levers to the aileron control run. A description of the relevant hydraulic systems is given in Chap. 6 of this Section and details of the hydraulic jacks are given in A. P. 4601A, Vol. 1.

#### Aileron bias mechanism (fig. 6)

35. When bias is applied to the ailerons to maintain straight and level flight, the aileron movement is required to be represented by a change in the neutral or trimmed position of the handwheel. To compensate for the restoring action of the artificial feel torsion rod, and thus provide 'hands off' trim, a spring-powered mechanism, operated by an electrical actuator, is incorporated in the controls.

36. This mechanism, mounted beneath the pilot's floor, is connected to the aileron control lever at the base of the control column. It consists of a pair of tension springs connected at both ends to centrally pivoted yokes, one yoke pivoted on the aileron control lever and the other on the lower lever of a double lever assembly mounted on the floor structure adjacent to the control column. The actuator body is pivoted on the floor structure forward of the control column and the operating rod is connected to the upper lever of the double lever assembly.

37. The relationship between the upper and lower levers of the double lever assembly is such that when the actuator is at its mid-position i. e. half extended, the mechanism applies no load to the aileron controls when the handwheel is centralised. Operation of the actuator in either direction will rotate the double lever assembly and displace the spring assembly relative to the aileron lever, thereby creating a movement about the aileron lever pivot. Thus, when aileron bias is applied, the actuator is operated in the appropriate direction until the moment balances the restoring load of the artificial feel torsion rod. The

actuator is controlled by a three-position switch at the pilot's station; details of the electrical circuit are given in Sect. 5, Chap. 1.

#### SERVICING

Note...

Removal of the spring bias mechanism is described in para. 16.

#### Access panels

38. The positions of access panels and inspection covers are given in Sect. 2, Chap. 4.

#### Lubrication

39. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

#### Aileron rigging - control column and lever templates

40.(1) Refer to Command Mod: CANBERRA/0480/NEAF INTRODUCTION OF STANDARD RIGGING EQUIPMENT

Rigging of the aileron control run requires special facilities for setting the control column handwheel (fig.2), the lever of the two-gear mechanism (fig.5) and the aft upper lever at the pressure box (fig.3). Templates for the control column and pressure box lever and a centring plug for the aileron two-gear mechanism are to be manufactured by user units, for which purpose the explanatory text and drawing are available under the above mentioned modification.

(2) In addition to the above equipment, two other templates are required for use at the lever assembly positions at Frame 21B and at Rib 4 in the outer wing. Details of these are given in fig.7 and 7A.

#### Aileron control rods - length variants

41.(1) Owing to the existence of some aircraft in which certain control rods are of non-standard length, it is necessary, before attempting to rig the controls to ascertain if the aircraft concerned is in this

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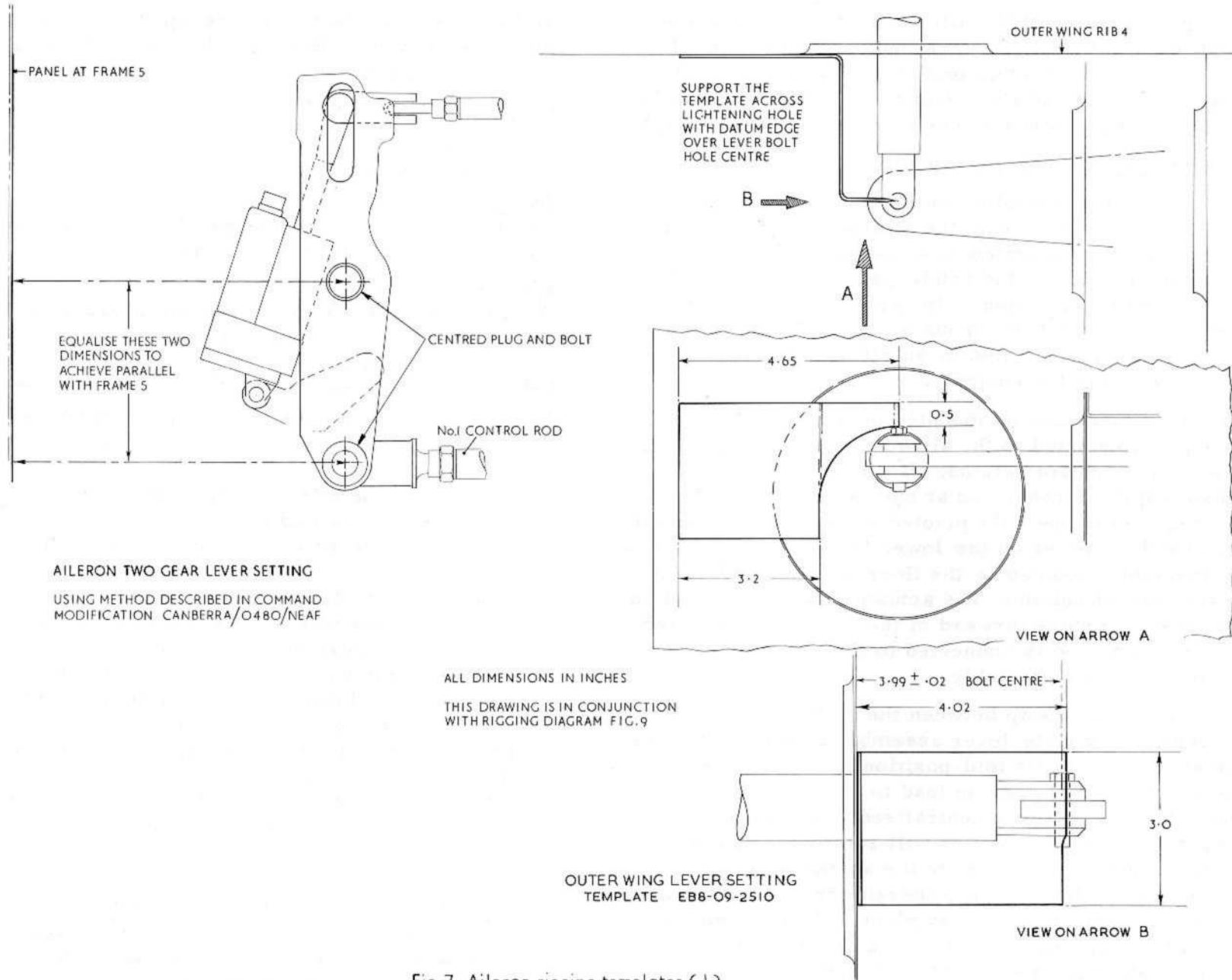


Fig.7 Aileron rigging templates (1)

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A.P. 101B-0409-1, Sect. 3, Chap. 4  
A.L. 112, Jan. '71

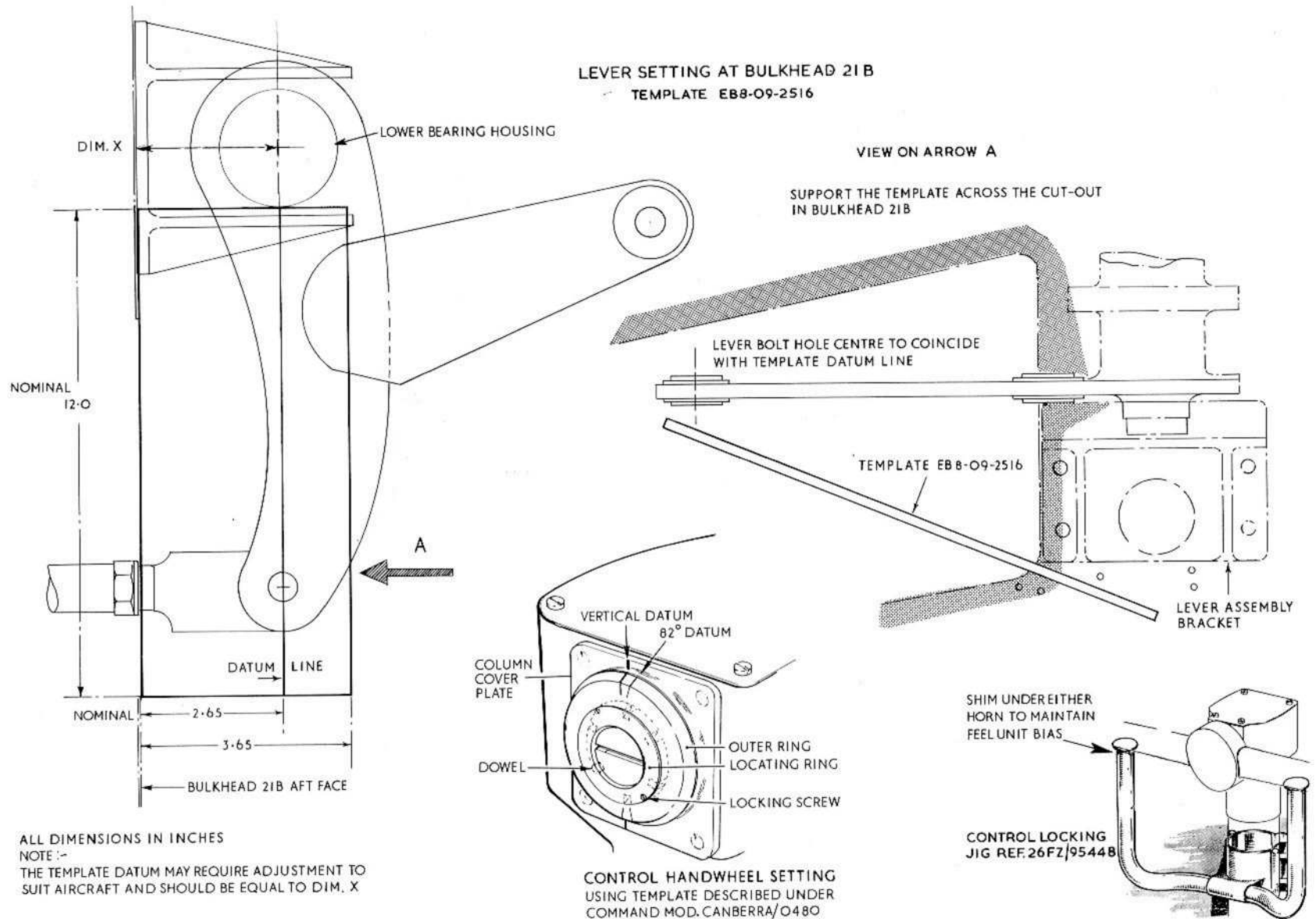


Fig.7A Aileron rigging templates (2)

◀ (CONTROL LOCKING JIG ADDED) ▶

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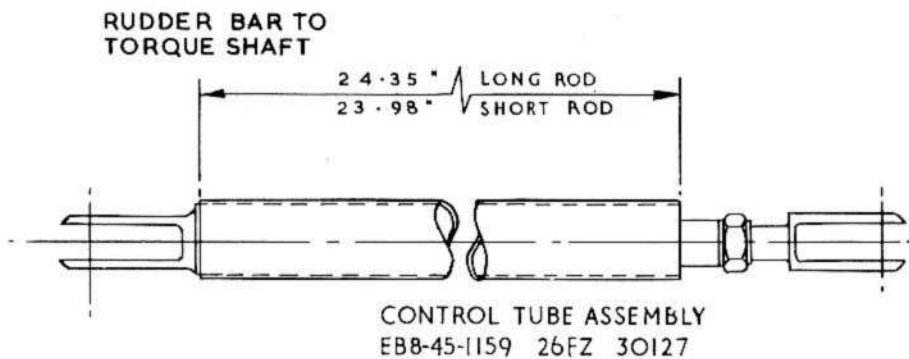
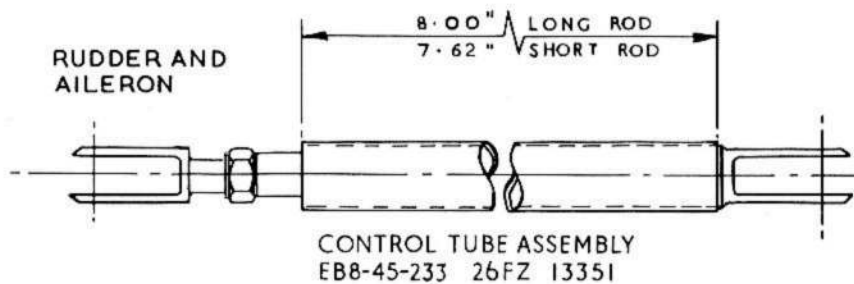
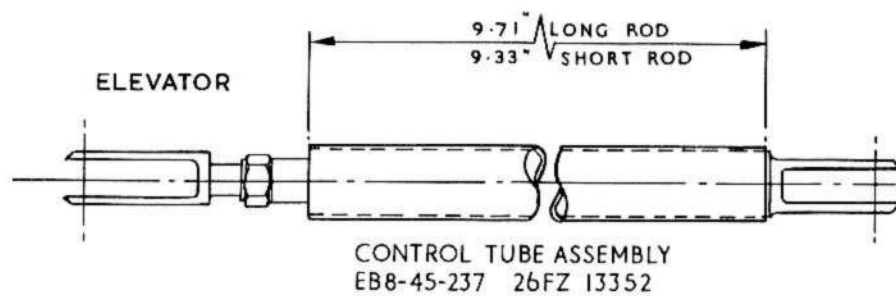


Fig.8 Control rod length variants

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category. ST1/Canberra/423 Sept. 69 has been issued to user units for appropriate action and the Form 700 should be consulted for evidence of compliance.

(2) For the aileron control circuit the rod involved is Pt. No. EB8-45-233 Ref. 26FZ/13351 (Rigging diagram fig. 9) and the alternative rod lengths which may be encountered are shown in Fig. 8. Alternative neutral settings for the torque shaft lever are provided for rigging adjustment to suit.

(3) ST1/Canberra/423 also provides for the embodiment of modification No. 4401 where necessary, in which case the rod in use will have been fitted with a new adjuster end to Dwg. SMD. 1281. The rod assembly becomes Pt. No. EB8-45-1633.

#### Setting the aileron controls (fig. 9)

42. An electrical supply must be available; when an external supply is to be used the aircraft battery isolation switch at the pilot's station must be OFF. Two hydraulic servicing trolleys are required, one connected to each of the controls hydraulic systems as described in Chap. 6 of this Section. To check and correct the setting of the aileron controls:-

Note...

The setting of the aileron control surface stops, located in each main plane at the aileron inboard hinge, Rib 4, should not be altered. The correct position for these stops is screwed right in and the lock-nut tightened.

(1) With both hydraulic servicing trolleys stopped, exhaust all fluid pressure in the controls systems by operating the ailerons until all movement ceases.

(2) Disconnect the control rod at the input lever of each aileron jack.

◀ (3) Select LOW ALT. on the aileron two-gear control switch, check that the actuator moves the control rod to the outer extremity of the gear lever slot. ▶

◀ (4) (a) To set the control column handwheel to neutral:-

- (i) Disconnect aileron control rod No. 1
- (ii) Establish whether handwheel is at 90° to control column or has a slight bias caused by the spring feel unit.
- (iii) Fit the aileron handwheel locking jig (26FZ/95448).
- (iv) Reconnect aileron control rod No. 1.

NOTE: When fitting the control lock it may be necessary to shim one horn of the jig to maintain the bias condition of (ii). ▶

(5) Refer to fig. 6 of this chapter and neutralize the aileron bias mechanism as shown in the Functional Diagram.

(6) To establish the torque shaft lever neutral position:-

- (a) Slacken off the adjuster lock-nuts of the control rods between the two-gear lever and torque shaft lever, and the torque shaft output lever and pressure box lever; disconnect these two rods from the torque shaft levers.
- (b) Refer to Fig. 9 Detail B and first ascertain if control rod EB8-45-233 as fitted, is the long

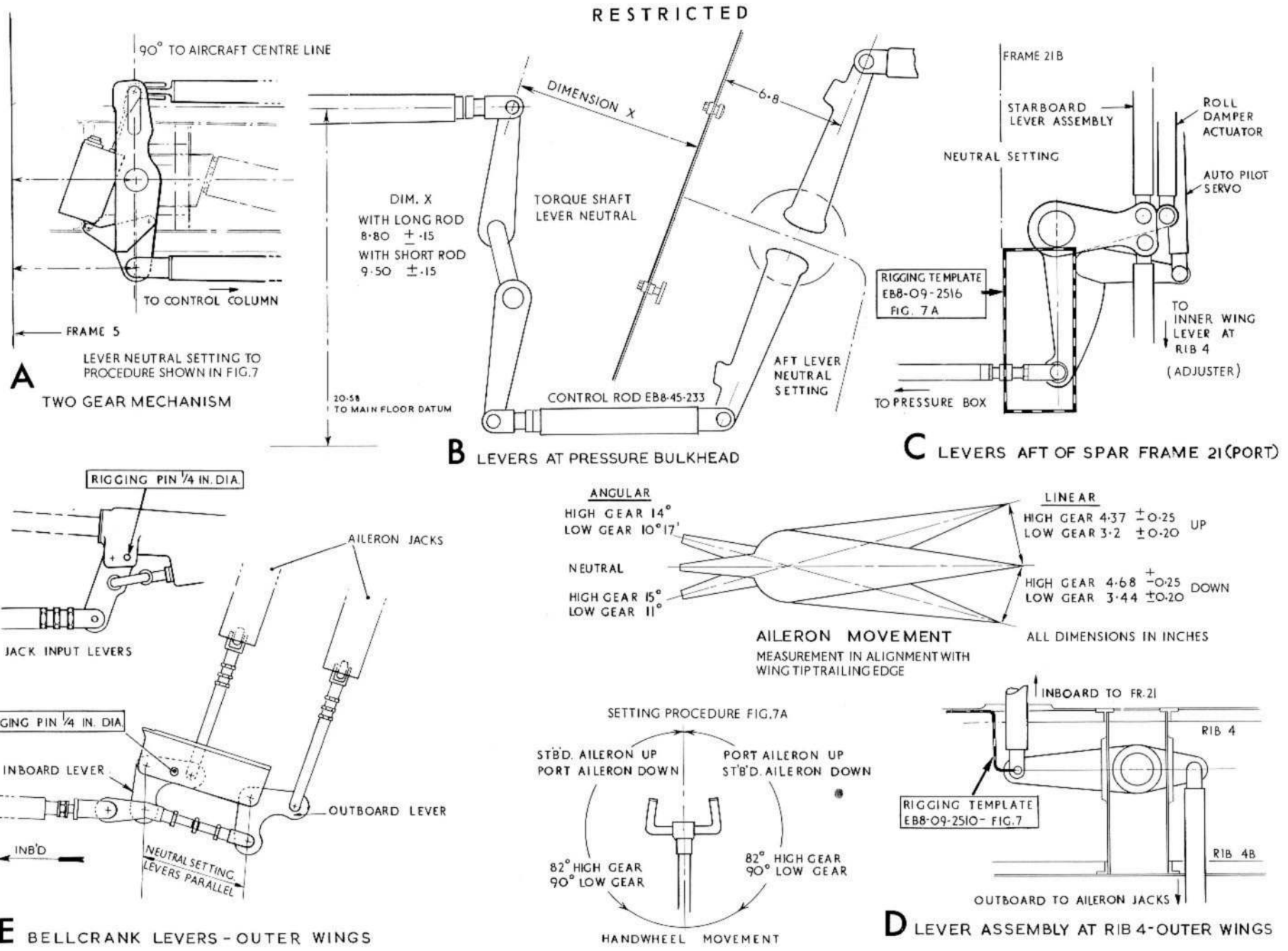


Fig.9 Aileron controls - rigging  
 (MISC. AMENDMENTS)  
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or short version. Check with para. 41 and fig. 8 as necessary.

(c) Set the torque shaft lever to dimension X as appropriate and adjust the control rod from the two-gear lever to suit.

(d) Disconnect the aft control run from the top of the pressure box lever and set the lever to the 6.8 in. neutral position using the template (LQ/1702/41 item 2) referred to in Command Mod. Canberra/0480. Adjust the control rod EB8-45-233 to suit and re-connect the aft control run.

(7) To establish the neutral position of spar frame 21B lever assembly (fig. 9 detail C).

(a) Disconnect the forward control run from the lever at frame 21B (fig. 9 detail C).

◀ (b) Check that the servometer actuator of the roll damper is neutralized (system OFF) and if necessary adjust the overall pin centre length of the rod and actuator to the correct dimension i. e. 43.7 in.

(c) Set the control lever to the neutral position using the template EB8-09-2516 as shown in fig. 7A, adjusting the forward control rod connector to suit.

(8) To establish the neutral position of the outer wing lever (fig. 9, detail D and fig. 7).

(a) Disconnect the control rod from the lever at OUTER WING RIB 4 (fig. 4).

(b) Position the template EB8-09-2510 against the web of OUTER WING RIB 4 and set the lever pin centre to coincide with the template datum pointer. Any adjustment required to achieve the lever neutral is to be made on control rod. EB8-45-1409 at the idler lever

assembly at INNER WING RIB 4 (fig. 4). ▶

Note...

(1) If a new aileron jack has been fitted or the centre adjustment of a jack has been disturbed or is suspected the jacks must be checked and re-set if necessary in accordance with para. 43 before continuing the rigging procedure.

(2) When refitting an aileron jack, it is essential that new attachment bolts Pt.No. EB8-20-4527 and new nuts Pt.No. EB8-20-4329 are used and locked with split pins.

(9) To establish the aileron jack neutral positions (P and S).

(a) Refer to fig. 9 detail E; disconnect the aileron control rod from the bellcrank lever linkage and insert a  $\frac{1}{4}$  in. dia. rigging pin through the bracket and lever.

(b) Check that the bellcrank levers are in parallel, adjusting the interconnecting link if necessary.

(c) Set both aileron control surfaces to neutral i. e. with the trailing edges aligned with the wing tip trailing edge, and insert the  $\frac{1}{4}$  in. dia. rigging pins through the jack input levers, adjusting the link rods as necessary.

(d) Re-connect the aileron control rods to the bellcrank lever assemblies, adjusting the rods to enable the connecting bolts to be inserted with the minimum of force. Tighten the adjuster lock nuts.

(10) Proving the rigging

(a) Remove all the rigging pins from the jack lever assemblies.

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- ◀ (b) Remove the handwheel locking jig and fit the control setting template (fig. 7A). ▶
- (c) start the servicing trolleys and pressurize the two hydraulic controls systems.
- ◀ (d) Operate the control column handwheel and check that the full range of aileron movement is obtainable within the limits given in fig. 9 using the template and instructions given in para. N1 of Command Mod/Canberra/0408/NEAF and fig. 7A. It may be necessary to adjust the control stops at the pressure bulkhead at this stage.

(11) Finally, check the control circuit to ensure that all rod adjusters are in 'safety' and the nuts wire-locked. Check the bellcrank and output linkage (fig. 9E) for correct wire locking of the three adjusters. The 22SWG locking wire is to pass through the fork end, the hole in the turnbuckle centre and the 1/16th hole in the input lever, as introduced by ST1/CANBERRA/437. ▶

Setting the aileron jacks

43. Ensure that the controls hydraulic systems are exhausted of all fluid pressure and proceed as follows for each pair of jacks:-

- (1) With the other jack disconnected, check and adjust each jack in turn as follows:-
  - (a) Check that the aileron movements obtained with the jack bottoming in either direction are equal about the neutral position, i. e. with the aileron trailing edge aligned with the wing tip trailing edge.
  - (b) Adjust the jack centres at the eye-end of the jack ram as necessary to obtain these conditions.
- (2) Check that with either jack, the aileron move-

ments are equal about the neutral position to within  $\pm 0.025$  in. of the jack travel.

Note...

This represents  $\pm 21$  min. of aileron angular travel or  $\pm 0.207$  in. of linear travel measured at the outboard trailing edge of the aileron.

- (3) Connect both jacks and ensure that the connections and adjustment points are locked securely.
- (4) Set the aileron controls in accordance with the instructions given in para. 42.

Static friction

44. The maximum allowable static friction in the aileron controls is 1.5 lb. This force may be measured in the following manner:-

Disconnect the first aileron push rod beneath the pilot's floor and at the input lever of the four power control units and attach a spring balance Ref.No. 21C/2165 to the rod. The maximum reading taken when the balance is pulled sufficiently to move the control should be 1.5 lb.

Roller guides- aileron control circuit

45. To check and adjust for suspected tightness at roller guide assemblies:-

- (a) Find the maximum dia. of the affected tube and adjust the rollers to give a clearance of 0.0015 in. between the tube and any one roller; tighten the locking screws and re-check.
- (b) Find the slackest position of tube travel and check that at this position the following clearances are not exceeded:-
  - At fairlead nearest to any lever assembly - tol. up to 0.006 in.;
  - at any other fairlead - tol. up to 0.012 in.

No lubrication is to be applied to any control tube at the roller guide assembly, or to the roller guides.

#### Aileron bias mechanism

46. To check and correct the setting of the aileron bias mechanism, proceed as follows:-

(1) Operate the electrical actuator (controlled by the aileron trim switch at the pilot's station) until the aileron trim indicator on the pilot's instrument panel indicates 'N'.

(2) With the ailerons neutral, check that the pivot point of the spring yoke on the double lever is concentric with the pivot point of the aileron lever at the base of the control column (fig. 6).

If it is not, proceed as follows:-

(a) Remove the actuator and set it to the mid position of the working stroke. Check that with the actuator in this position the aileron trim indicator indicates 'N' (Sect. 5, Chap. 1).

(b) With the actuator still set at the mid position install it in the aircraft, adjusting the fork-end on the actuator arm to obtain the neutral position, of the spring yoke, described in sub-para. 2.

(c) Check that the fork-end is in safety and tighten the lock-nut securing the fork-end.

(3) Operate the actuator and check that the mechanism gives  $3\frac{1}{2}$  deg.  $\pm$  20 min., of aileron movement in each direction with no load applied to the handwheel.

#### Aileron two-gear actuator

47. The pin centres of the actuator are set before installation to  $6.562 \pm 0.01$  in. retracted and no further adjustment is necessary. For adjustment of the indicator microswitch refer to Sect. 5, Chap. 2, Group C.

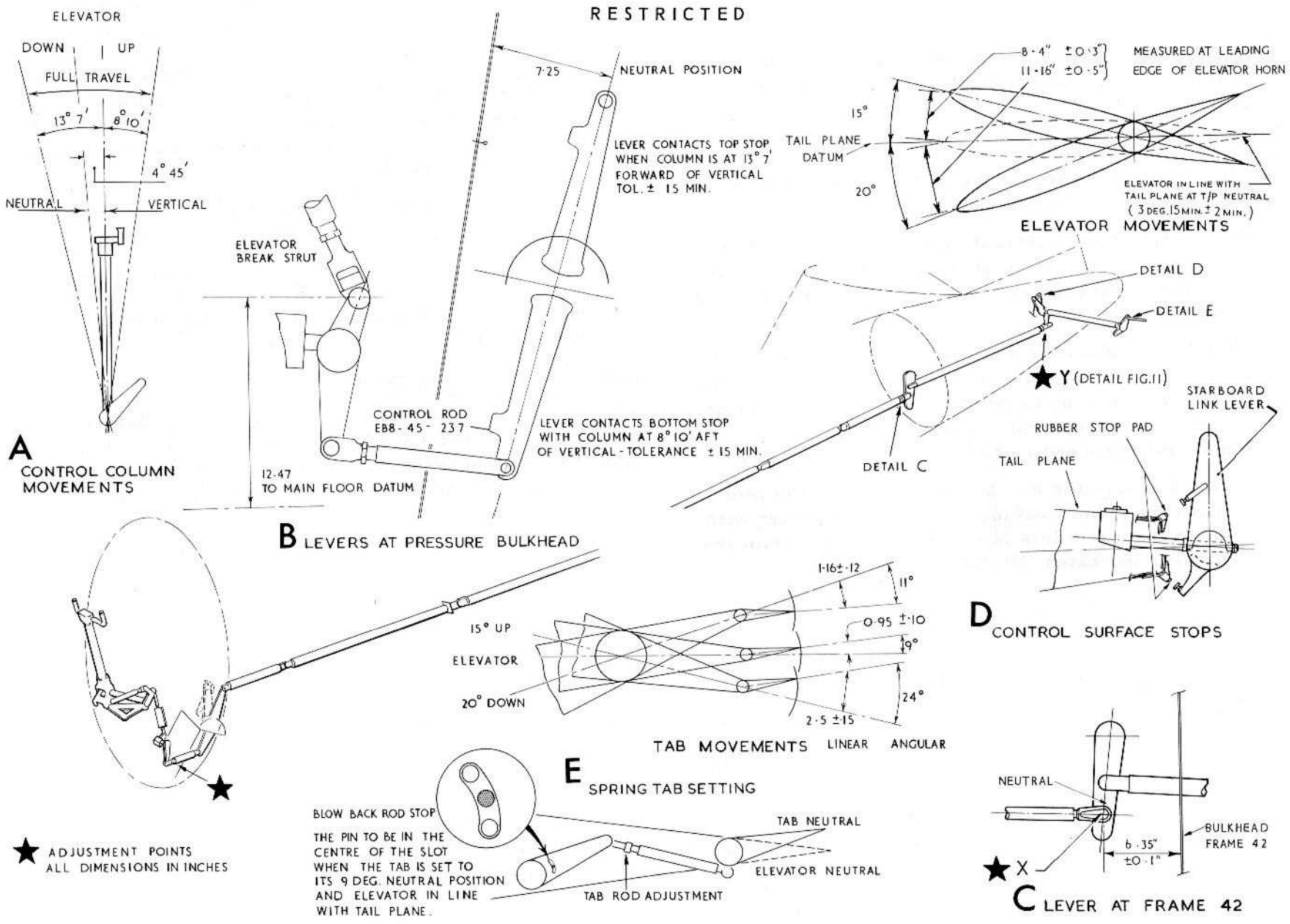


Fig. 10 Elevator controls - rigging RESTRICTED

## ELEVATOR CONTROLS

## DESCRIPTION AND OPERATION

Control run (fig. 10)

50. From the lever on the torque tube secured to the control column, the fore-and-aft movement of the column is transmitted by the break-strut to a lever assembly mounted on the pressure bulkhead, and thence by push-pull tube to a centrally-pivoted lever mounted immediately aft of the bulkhead. Push-pull tubes, supported on roller guides secured to brackets on the fuselage structure, continue the run aft to a lever mounted on the rear bulkhead in the rear fuselage. A further push-pull tube links this lever with the operating lever and spring tab mechanism on the port elevator. Movement of the port elevator is transmitted to the starboard elevator by a coupling link between levers fitted to the inboard end of both elevator spars. Adjustable control stops are provided at the pressure bulkhead to limit lever movements within the required travel range.

Spring tab mechanism (fig. 11)

51. The function of the spring tab is to relieve the pilot of heavy physical loads on the elevator controls by providing assistance which is relative to the air load acting on the elevator, but controlled automatically to prevent excessive control surface movement.

52. The spring tab mechanism consists of a torsion tube and torsion blow-back rod which are assembled co-axially and secured by bolts, through flanges at their inboard ends to the elevator operating lever. Mounted in the leading edge of the port elevator aft of the hinge line, the mechanism is supported at the inboard end on a ballrace fitted in a bracket bolted to the coupling lever on the end of the spar. At the

outboard end, the torsion tube is rigidly clamped to a mounting piece secured to the spar. The torsion blow-back rod, which extends beyond the outboard end of the torsion tube, is secured to a lever pivoted on a spigot integral with the mounting piece. An adjustable push-pull tube links the lever to the tab at the elevator trailing edge.

53. When the elevator controls are operated, the movement is transmitted to the elevator through the torsion tube which, due to the air load on the elevators, will deflect under the pilot's effort. The angular change, relative to the elevator, of the operating lever due to this deflection, is transmitted by the blow-back rod to the lever at its outboard end and thence to the tab. The tab will then move in the opposite direction to the parent surface but, since the blow-back rod is also a torsion spring, the rod will deflect under the influence of the air load acting on the tab. Thus as the aircraft speed increases, an increasing restriction is applied to the tab movement. This action prevents excessive loads on the aircraft structure during high speed flight. A stop pin on the elevator operating lever operates in a slotted link connected to the coupling lever and limits the deflection of the torsion tube. The deflection of the blow-back rod is limited by another stop pin, fitted to the torsion tube mounting piece, operating in a slot in the lever on the blow-back rod.

Geared balance tab mechanism (fig. 12)

54. The geared balance tab, inset in the trailing edge of the starboard elevator, is operated automatically by the movement of the elevator. The mechanism consists of a connecting rod which is connected at its rear end to the tab and at its forward end to an

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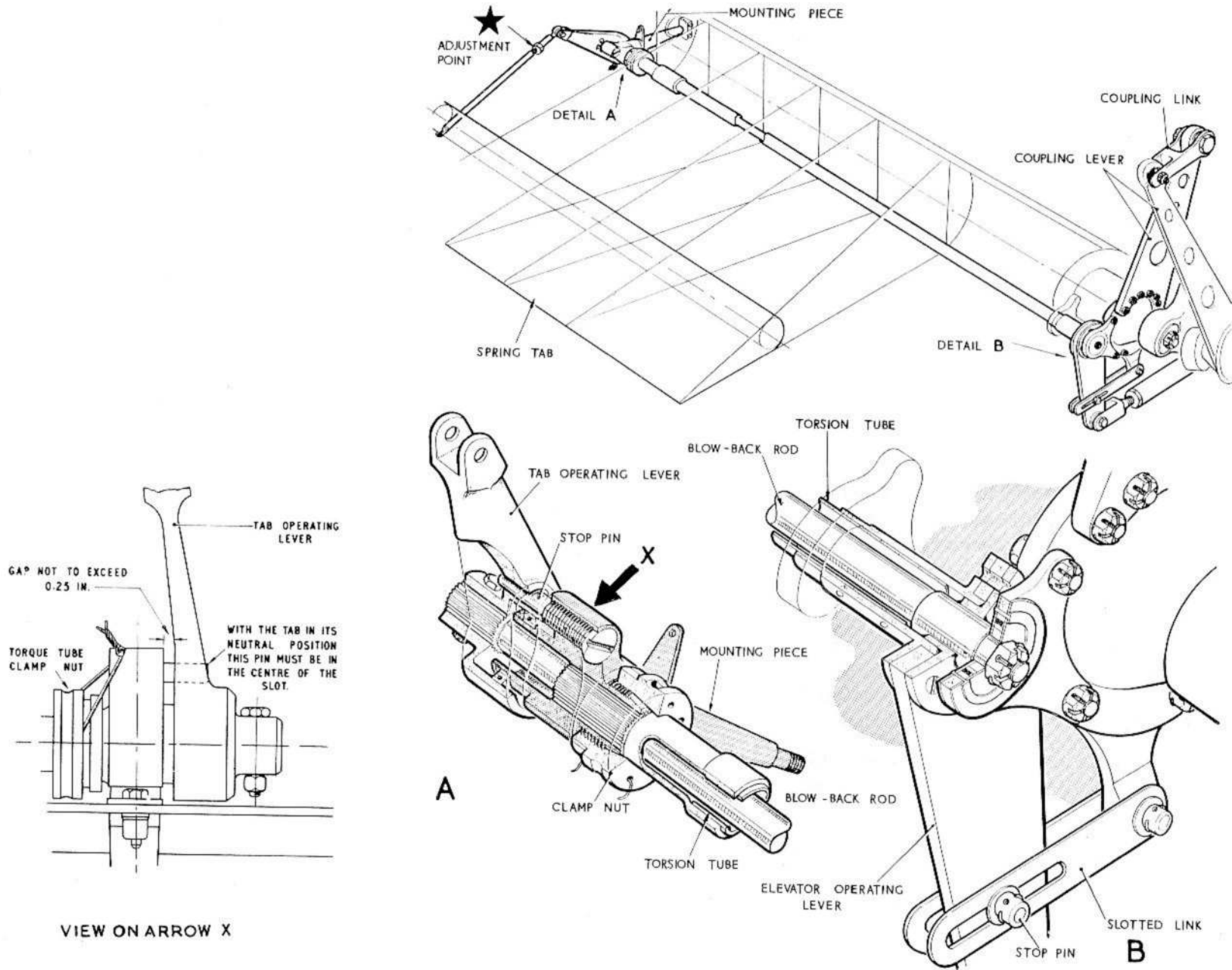


Fig. II Elevator spring tab mechanism

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adjustable end-piece attached to a bracket secured to the tail plane. Access to the adjuster is provided by a detachable panel in the upper surface of the elevator.

SERVICING

Access panels

55. The positions of access panels and inspection covers are given in Sect. 2, Chap. 4.

Lubrication

56. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

Control column neutral rigging jig (fig. 13)

57. To ensure that the control column and rudder bar are secured in the neutral position while setting the controls, the neutral rigging jig (Ref. No. 26FZ/95447) must be fitted. The jig consists of a triangular frame of tubular construction. Hinged clamps are welded to the base of the side members and a third clamp is attached by a quick-release pin to an adjusting screw at the apex of the frame. To fit the jig, attach the frame to the rudder bar by the clamps at the base and to the control column tube by the clamp at the apex. Turn the adjusting screw to set the control column to the neutral position.

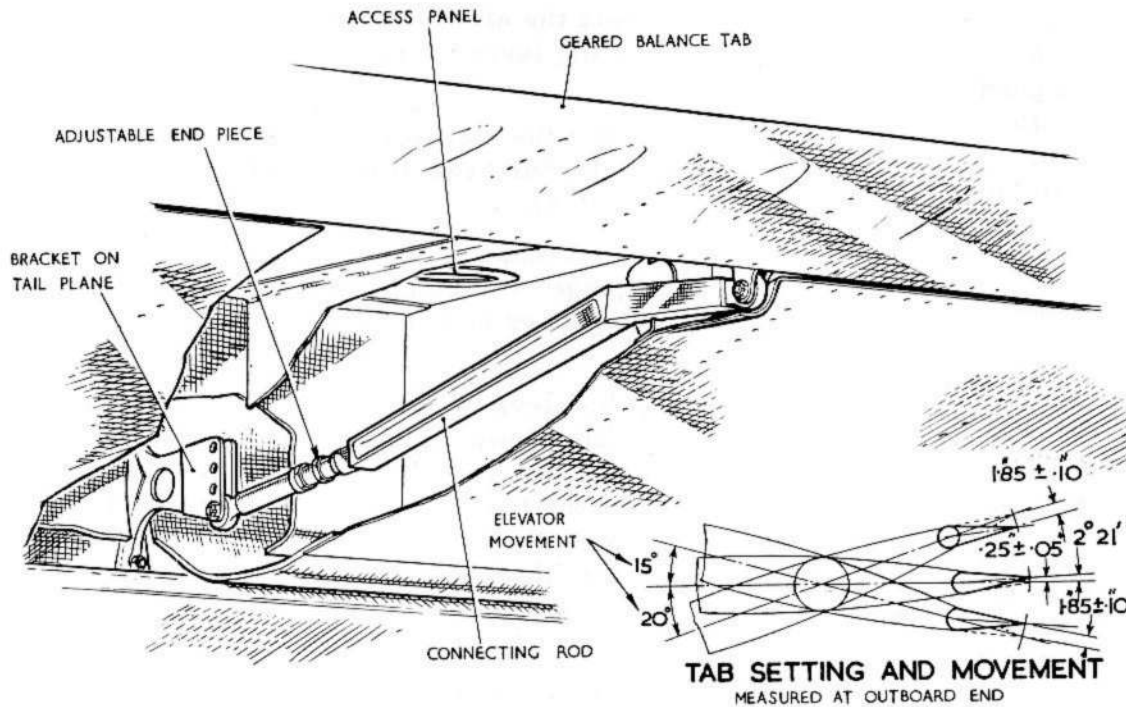


Fig. 12 Elevator geared balance tab

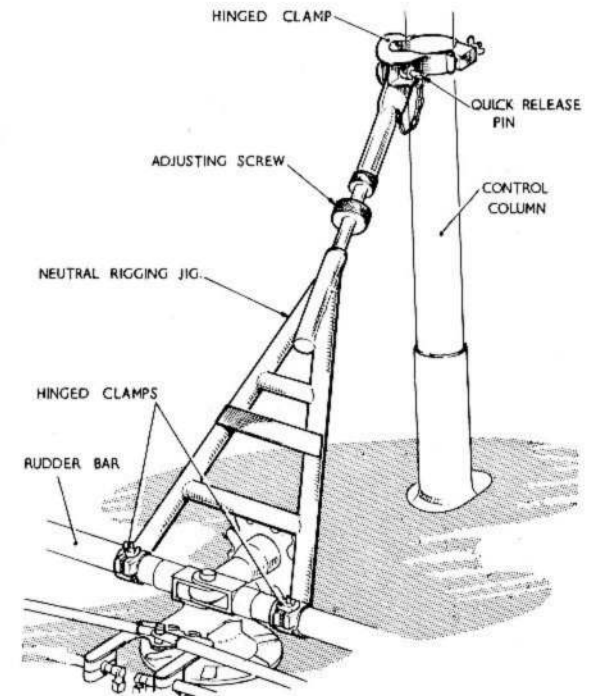


Fig. 13 Control column and rudder bar rigging jig

## Setting the elevator controls

## Note...

(1) Access to the elevator control stops in the tail fuselage is provided by the removal of the cone and box fairing as shown in Sect. 3, Chap. 1 fig. 10.

(2) Before attempting to disconnect any control tube from the lever assemblies, it is recommended that the elevator bob weights should be removed and replaced after rigging the control run. These weights (16 lb.) are attached to an arm on the torque shaft assembly (fig. 1) by two bolts and assistance will be required to manipulate them in the restricted space.

(3) To facilitate achievement of the neutral setting for the elevator aft lever at the pressure box (fig. 10, Detail B) a template, designed for user unit manufacture, is described in the leaflet issued under Command modification, Canberra /0480 NEAF. The template is to be made up and used at the appropriate stage of the following procedure.

58. To check and correct the setting of the elevator controls:-

- (1) Jack and trestle, and level the aircraft laterally and longitudinally as described in Sect. 2, Chap. 4.
- (2) Refer to fig. 10, Detail A. Set and lock the control column at the neutral position, 4 deg. 45 mins. forward of the true vertical.
- (3) Detail B. Disconnect the after (pressure box) lever at its forward connection to the torque shaft assembly and at its top connection to the aft control run, (Check procedure with para. 57 Note 2).

(4) Re-insert the connecting bolt into the top hole of the lever and fit the template (para. 57, Note 3) over the bolt and against the rear face of the pressure bulkhead at 90 deg. Adjust the connection to the torque shaft lever to achieve the 7.25 in. dimension shown in Detail B, and lock the adjustment at this position.

(5) Unlock the control column and move it 13 deg. 7 min.  $\pm$  0 deg. 15 min. forward of vertical; adjust the upper stop bolt on the pressure bulkhead until it contacts the upper arm of the lever.

(6) Move the control column 8 deg. 10 min.  $\pm$  0 deg. 15 min. aft of vertical and adjust the lower stop bolt on the pressure bulkhead until it contacts the lower arm of the lever.

(7) Reconnect the elevator control tube to the upper end of the lever aft of the pressure bulkhead.

(8) Disconnect the elevator control tube from the lever on the bulkhead at frame 42 (fig. 10, detail C, point X).

(9) Set the tail plane in its take-off position (incidence gauge reading at the inboard gauge position, starboard tail plane, 3 deg. 15 min.  $\pm$  2 min.)

(10) Move the elevator down (manually) and adjust the elevator lower limit stop at the starboard elevator link lever (fig. 10, detail D) to give the elevator horn an upward movement of 15 deg., linear dimension, 8.4 in.  $\pm$  0.3 in. measured from the leading edge of the elevator horn.

(11) Move the elevator upwards (manually) and adjust the elevator upper limit stop at the

starboard elevator link lever (fig. 10, detail D) to give the elevator horn a downward movement of 20 deg., linear dimension, 11.16 in.  $\pm$  0.5 in. measured as for sub-para. (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.

(12) With the tail plane in its take-off position (sub-para. (9)), lock the elevator in its neutral position, i. e., in line with the chord line of the tail plane, by fitting clamps between the elevator horn and the tail plane.

(13) Adjust the spring tab control tube in the port elevator until the tab is in its neutral position, i. e. 9 deg. up relative to the elevator (linear dimension 0.95 in.  $\pm$  0.10 in. measured at the outboard trailing edge of the tab) with the stop in the centre of the slot in the tab actuating arm (fig. 10, detail E).

(14) With the tail plane, elevator and spring tab in their neutral positions, set the control lever on the bulkhead at frame 42 to its neutral position by adjusting the control tube at point Y.

(15) Lock the control column in the neutral position (sub-para. 2), reconnect the control tube to the lever on the bulkhead at frame 42, adjusting the rear end of the control tube (point X) as necessary.

(16) Remove the elevator clamps fitted at operation (12), unlock the control column and

move it forward until the movement is arrested by the stop pin reaching the end of the slot in the tab actuating arm, and measure the upward movement of the spring tab; this should be 2.5 in.  $\pm$  0.15 in. measured at the outboard trailing edge of the tab.

(17) Similarly, move the control column aft and measure the downward movement of the spring tab; this should be 1.16 in.  $\pm$  0.12 in. measured as in sub-para. (16). Ensure that all adjustment points are locked securely and the control tube couplings do not foul the roller guides at any point of the control column movement.

Setting the geared balance tab (fig. 12)

59. To adjust the geared balance tab on the starboard elevator, proceed as follows:-

(1) Lock the elevator in its neutral position by applying suitable clamps between the elevator horn and the tail plane.

(2) Remove the elevator tab control access panel on the upper surface of the elevator.

(3) Loosen the locking nuts of the adjuster between the tab connecting rod and the attachment end piece.

(4) Operate the adjuster until tab chord line is 2 deg. 21 min. up relative to the elevator chord (linear dimension, 0.25 in.  $\pm$  0.05 in. measured at the outboard trailing edge of the tab). Re-lock the adjuster lock-nuts.

(15) Remove the lock fitted at sub-para. (1); move the elevator through its full travel in both direc-

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tions and check that the tab movements are within the limits stated in fig. 12.

Static friction

60. The maximum allowable static friction in the elevator controls is 6.5 lb. This force is measured with a spring balance (Ref. No. 21C/2165) applied to the control column. Due to the elevators being out of balance, it is necessary to push the control column forward and allow it to move back again, taking the maximum and minimum readings of the balance respectively. The static friction in the control is half the difference of the two readings.

Roller guides adjustment - elevator control run

61. (1) Adjust the rollers at each fairlead until all

three rollers are in contact with the control tube.

(2) Rotate the tube through the maximum radial movement allowed by the self-aligning bearings at the same time moving the tube endwise over the area of traverse. Find the point of maximum diameter, tighten the roller locking screws with the rollers just in contact at this point and check for absence of backlash.

(3) Again, move the control tube endwise and radially to find the slackest point of travel and check at this point the following clearances are not exceeded:-

(a) At a fairlead nearest to lever motion  
0.006 in.

(b) At any other fairlead 0.012 in.

## RUDDER CONTROLS

## DESCRIPTION AND OPERATION

Control run (fig. 14)

70. From the lever on the base of the rudder bar torque tube (para. 14) the movement of the rudder pedals is transmitted by push-pull tubes and levers to a centrally-pivoted lever mounted just aft of the pressure bulkhead. From this lever, the run is continued aft by push-pull tubes to a lever assembly mounted on the rear bulkhead in the rear fuselage, the push-pull tubes being supported on guide rollers secured to brackets on the fuselage structure. The final linkage to the control valve lever on the rudder operating jack, is made by the autostabilizer servomotor. The operating rod is connected to the jack and the body to a bellcrank lever which is linked to the lever assembly on the rear bulkhead by a vertical push-pull tube. Adjustable stops, mounted on the bellcrank lever bracket (detail B), operate by limiting the movement of the bellcrank lever.

Rudder operating jack

71. The rudder is operated by a hydraulic power control unit, Hobson Type 101, Mk. 3 mounted in the fin stub. The unit is attached at its forward end to a fitting on the rear bulkhead at frame 42, and the rear end to the operating lever at the base of the rudder leading edge. A description of the relevant hydraulics systems is given in Chap. 6 of this Section, and details of the power control unit are given in A. P. 4604E, Vol. 1.

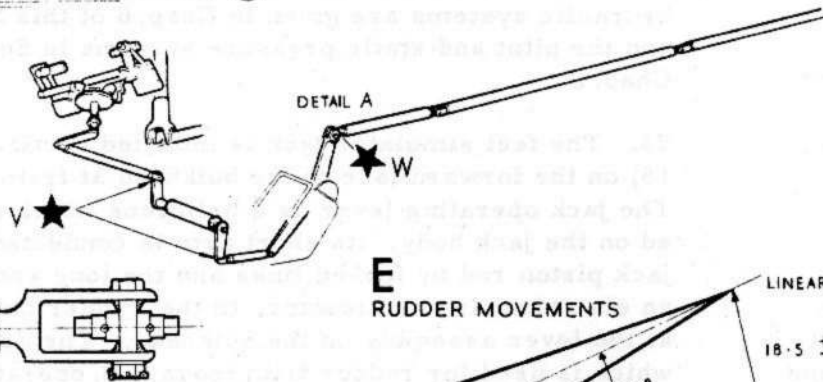
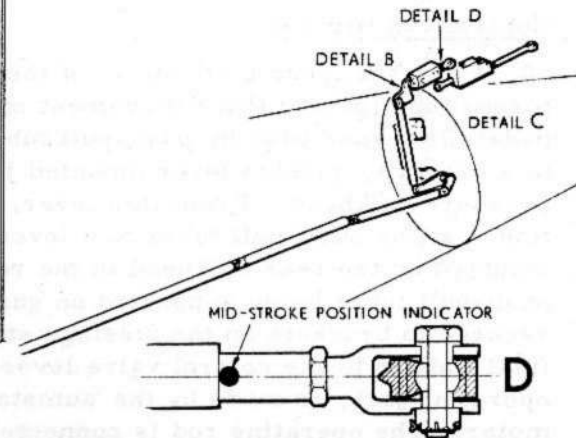
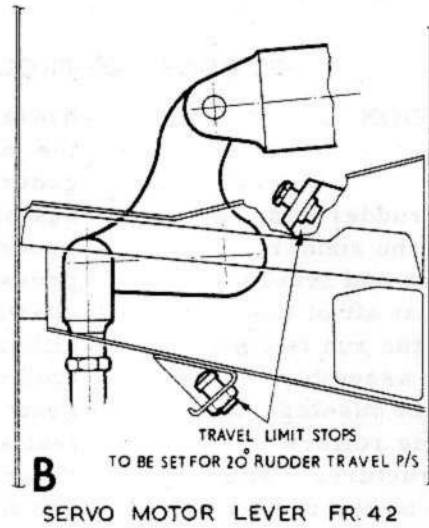
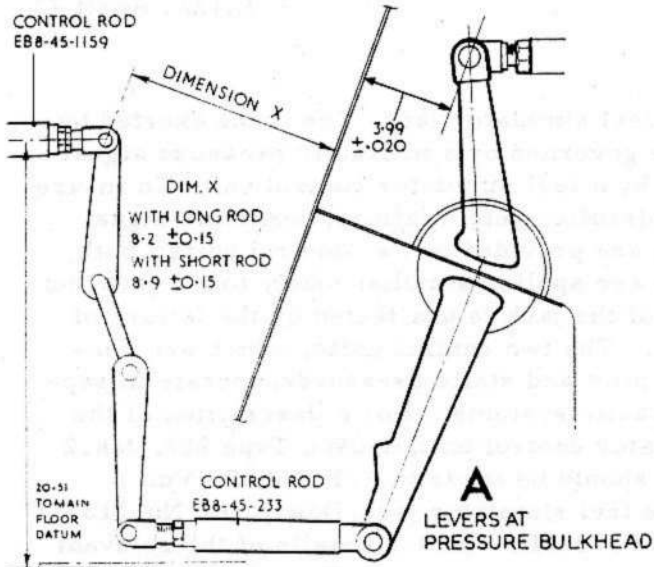
Artificial feel

72. Artificial feel, proportional to the square of the airspeed, is applied to the rudder controls by a

hydraulic feel simulator jack. The force exerted by the jack is governed by a hydraulic pressure signal generated by a feel simulator control unit. To insure against hydraulic system failure, duplicate signal pressures are provided by two control units; both pressures are applied simultaneously to the jack, but operation of the jack is unaffected by the failure of either one. The two control units, which are controlled by pitot and static pressures, operate in separate hydraulic systems. For a description of the feel simulator control unit, Hobson Type 207, Mk. 2 reference should be made to A. P. 1803P, Vol. 1 and for the feel simulator jack, Dowty, Pt. No. 11897Y A. 01 to A. P. 1803D, Vol. 1. Details of the relevant hydraulic systems are given in Chap. 6 of this Section, and the pitot and static pressure systems in Sect. 5, Chap. 2.

73. The feel simulator jack is mounted vertically (fig. 15) on the forward face of the bulkhead at frame 42. The jack operating lever is a bellcrank which is pivoted on the jack body; its short arm is connected to the jack piston rod by forked links and the long arm, by an electrical linear actuator, to the rudder controls at the lever assembly on the bulkhead. The actuator, which is used for rudder trim (para. 74), operates as a fixed push-pull rod for feel simulation. When the rudder controls are neutral, no force is applied to the controls by the jack, because in this position the forked links and short lever arm are in line. When the linkage is displaced by movement of the controls, the force exerted by the jack in conjunction with the direction of loading applies a moment about the jack operating lever pivot. Thus, a force, approximately proportional to the displacement is applied to the rudder

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★ ADJUSTMENT POINTS  
ALL DIMENSIONS IN INCHES

NOTE:  
WHEN MOD 4401 IS EMBODIED,  
THE "LONG ROD" DIMENSION IN  
DETAIL A MUST BE WORKED TO  
WHEN RIGGING THE RUDDER.

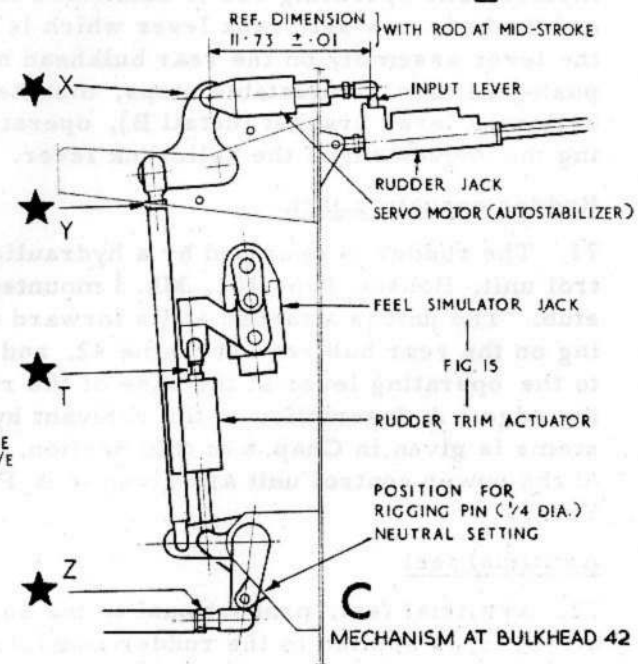


Fig. 14 Rudder controls - rigging  
◀(NOTE ADDED RE MOD 4401)▶

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controls through the actuator to resist the pilot's efforts.

#### Rudder trim

74. Movement of the rudder from the existing neutral to trim the aircraft while in flight is represented by a change in the neutral or trimmed position of the rudder pedals. To relieve the pilot of the load applied in this new position by the feel simulator jack, the neutral position of the jack relative to the controls may be changed correspondingly by means of the electrical actuator, which forms the link between the jack and the controls (fig. 15). The actuator is operated in the appropriate direction until the jack force acting on the controls is reduced to zero, i. e. the actuator is extended or retracted until the jack linkage is returned to the neutral position. The actuator is controlled by a three-position switch mounted in the pilot's station; details of the electrical circuit are given in Sect. 5, Chap. 1.

### SERVICING

#### Access panels

75. The positions of access panels and inspection covers are given in Sect. 2, Chap. 4.

#### Lubrication

76. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

#### Rudder bar neutral rigging jig (fig. 13)

77. To ensure that the rudder bar is secured in the neutral position while setting the controls, the neutral rigging jig must be fitted. A description of the jig and the method of fitting are given in para. 57.

#### Setting the rudder controls (fig. 14)

78. Before commencing setting operations, connect

a hydraulic servicing trolley to the services hydraulic system and pressurize the system as described in Chap. 6 of this Section.

Note...

When disconnecting the rudder push-pull tube at the lever from the pressure box aft of the pressure bulkhead, tie up and support the tube to prevent damage to the ball race.

79. To check and correct the setting of the rudder controls (fig. 14). ▶

(1) With the hydraulic servicing trolley stopped, exhaust all fluid pressure in the system as follows:-

(a) With the electrical supply OFF, exhaust the pressure in the rudder primary system by operating the rudder until no further movement is obtained.

(b) Switch ON the electrical supply and exhaust the pressure in the rudder secondary system by again operating the rudder until no further movement is obtained.

(2) Disconnect the autostabilizer servomotor at the input lever on the rudder jack.

◀ (3) Set the rudder bar to neutral, fit the rigging jig No. 26FZ/95447 and disconnect the rudder trim actuator from the feel jack at point T. ▶

(4) Refer to fig. 14, detail A and check the control rod EB8-45-233 for a possible long or short variant (refer to para. 41 and fig. 8). Disconnect the control rods from the torque shaft and pressure box levers. Set the neutral position of the torque shaft lever to the appropriate X dimension and the pressure box (aft) lever to the neutral  $3.99 \pm .02$  in. dimension shown in the illustration. Adjust the control rods at points V

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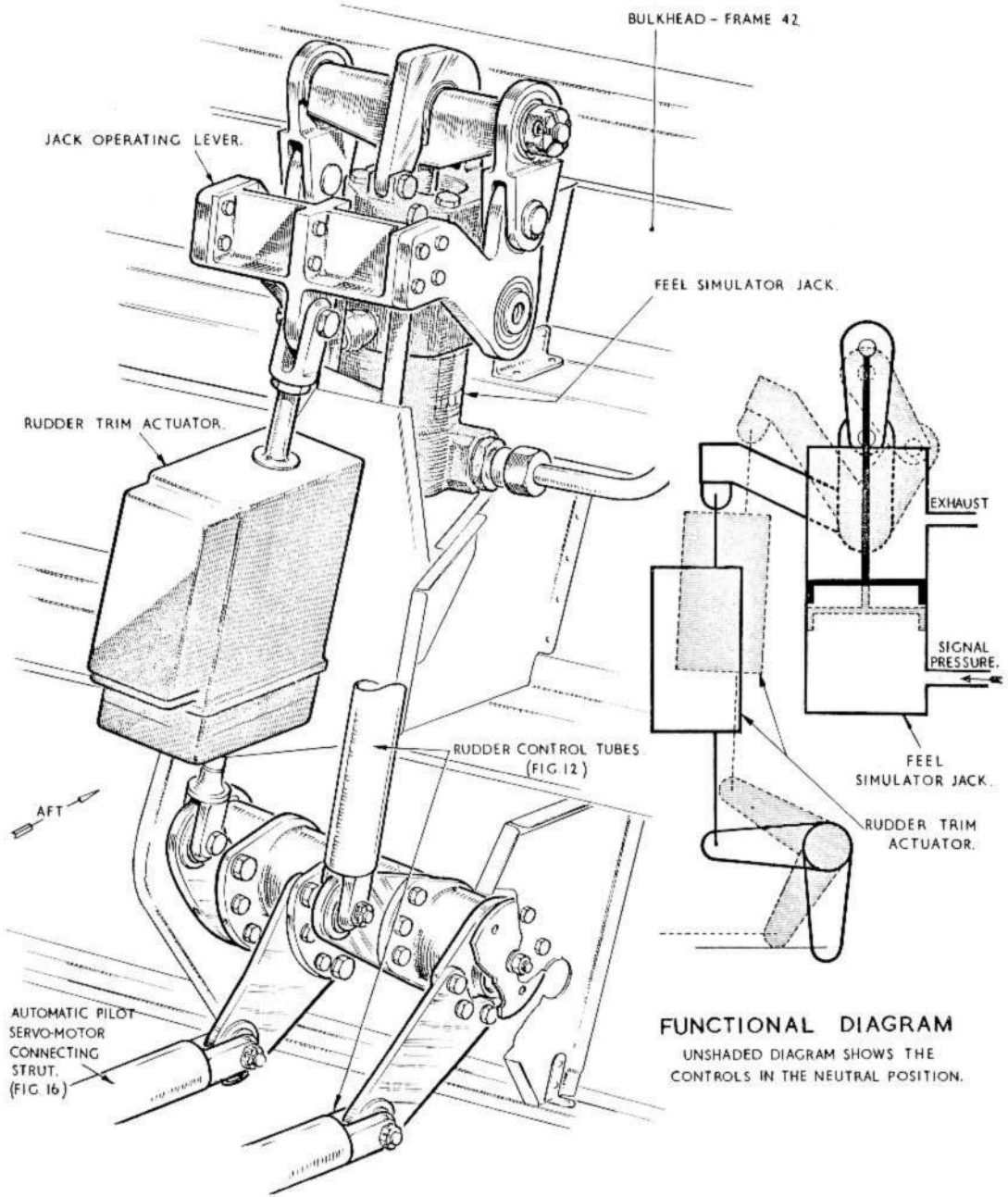


Fig.15 Rudder feel simulator jack and trim actuator

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and W and reconnect them to the levers.

(5) Set the lever assembly at frame 42 to neutral (detail C) by adjusting the control tube at point Z and insert the rigging pin in the bottom hole with a distance tube between the lever and the rigging lug, and clamp securely.

(6) Check that the rudder movements obtained with the jack bottoming in each direction are equal; adjust the jack centres as necessary.

(7) Disconnect the autostabilizer servomotor at point X (detail C) and check that it is in mid-stroke; the black dot on the connecting rod (detail D) must be just fully visible and the centres adjusted to 11.73 in.  $\pm$  0.01 in. (Refer to Sect. 5, Chap. 2, Group C).

(8) Connect the servomotor to the input lever of the jack.

(9) Re-make the connection at point X.

(10) Inflate the 'services' accumulators and pressurize the system by means of the hydraulic servicing trolley, and at point Y adjust the connecting rod between the bellcrank lever and the lever assembly at frame 42, to obtain rudder neutral.

(11) Remove the rigging pin and neutral rigging jig.

(12) Operate the rudder controls and check that the rudder movement in each direction is within the limits shown in detail E and that the controls respond smoothly.

(13) Adjust the limit stops at the bellcrank lever at frame 42 (detail B) as necessary to restrict the rudder travel to 20 deg. each way.

◀ (13A) Connect the rudder trim actuator and set the actuator in accordance with para. 80. ▶

(14) Ensure that all adjustment points are locked securely and that the control tube couplings do not foul the roller guides at any part of the rudder movement.

#### Setting the rudder trim actuator

◀ 80. Using an external supply with the battery isolation switch (pilot's station) OFF, proceed as follows:-

(1) Pressurize the system using the servicing trolley.

(2) Check the actuator for electrical functioning.

(3) Set the actuator to mid-stroke as follows:-

(a) Operate the rudder controls and trim as required until the rudder at rest is in neutral position i. e. with the rudder trailing edge in line with the tail cone fairing.

(b) From position (a) operate trim fully to port and then fully to starboard, noting the linear range of movement on either side of rudder neutral.

(c) Halve the difference between port and starboard trim range to obtain the trim neutral.

(d) Trim the rudder from rudder neutral to trim neutral. This position sets the trim actuator in mid-stroke.

(4) Adjust the trim actuator fork-end until the rudder returns to its neutral position.

(5) Adjust the indicator on the pilot's instrument panel to indicate N.

(6) Finally check that the range of movement of rudder controls and trim controls are within the limits (fig. 14). ▶

◀ ▶  
Static friction

81. The maximum allowable static friction in the rudder controls is 1 lb. To measure this force proceed as follows:-

- (1) Disconnect the control run from the input to the power control unit at the layshaft lever.
- (2) Disconnect the rudder trim actuator from the layshaft lever.
- (3) Apply spring balance (Ref. No. 21C/2165) tension to the rudder pedals achieving just sufficient force to initiate movement in either direction from neutral. Maximum reading should be 1 lb.

Roller guides - adjustment

82. To check and adjust for suspected tightness at

roller guide assemblies:-

- (1) Find the maximum diameter of the affected tube by radial and endwise movement through the rollers and adjust the rollers to give a clearance of 0.0015 in. between the tube and any one roller at the maximum tube diameter over the traversed area. Tighten the roller locking screws and re-check.
- (2) Similarly, find the slackest position of tube travel and check that at this position the following clearances are not exceeded:-

At a fairlead nearest to any lever assembly - tolerance up to 0.006 in.

At any other fairlead - tolerance up to 0.012 in.  
No lubrication is to be applied to tubes or rollers.

## CONTROL COLUMN SNATCH UNIT

## DESCRIPTION AND OPERATION

Construction (fig. 16)

90. The control column snatch unit consists of a spring-loaded hollow piston fitted within a tubular casing which, at the forward end, is attached to the aircraft structure by a retaining pin through a collar, and at the rear end is supported by a housing plate and bracket. When the unit is cocked, the spring is compressed against the closed rear end of the casing by the piston which is retained in the cocked position by a sear. The sear, which is spring-loaded by a return spring to the cocked position, is pivoted in a bracket welded to the top of the casing. A roller fitted to the sear projects through a slot in the casing and bears against the head of the piston. A release lever, also pivoted in the bracket, is connected to the sear, the lever being operated by a piston in a valve body riveted to the bracket.

91. A snatch rod, connected to the elevator control lever on the torque shaft at the base of the control column, passes forward through the centre of the piston spring, a fairlead within the piston and the piston head, to terminate at a shouldered end-fitting carrying a rubber cushion. The rod is free to move within the piston and is of sufficient length to allow full, fore-and-aft movement of the control column.

Operation

92. The snatch unit is operated by cartridge gas simultaneously with the elevator break strut. The gas enters the valve body of the sear bracket and acts on the valve piston. The piston moves within the body and extends the ram and operates the release lever which raises the sear. Under the influence of the spring within the tubular casing, the hollow pis-

ton is propelled along the interior of the casing and connects with the end-fitting of the snatch rod; further extension of the spring moves the snatch rod forward and, through the elevator control, moves the control column forward against the instrument panel.

## SERVICING

Lubrication

93. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

Cocking the snatch unit

94. The procedure for cocking the snatch unit is given in fig. 16.

## REMOVAL AND INSTALLATION

## WARNING...

ALL THE RELEVANT SAFETY PRECAUTIONS AS DETAILED ON THE LETHAL WARNING MARKER CARD AT THE BEGINNING OF THIS VOLUME MUST BE CARRIED OUT BEFORE ANY REMOVAL OR INSTALLATION WORK IS UNDERTAKEN.

Removal

95. To remove the snatch unit proceed as follows:-

- (1) Remove the side panels from the port console in the pilot's station.
- (2) With the control column held firmly in the neutral position, discharge the snatch unit by operating the sear release lever protruding from the bracket on the unit casing.
- (3) Disconnect the pipe at the valve body and blank

off the pipe end and union in the valve body.

(4) Disconnect the snatch rod from the elevator control lever.

(5) Remove the split pin from the retaining pin at the forward end of the tubular casing and withdraw the retaining pin from the collar.

(6) Withdraw the snatch unit by moving it forward and into the cabin.

Installation

96. The procedure for installing the snatch unit is a reversal of the removal operations. After installation, cock the unit as instructed in fig. 16.

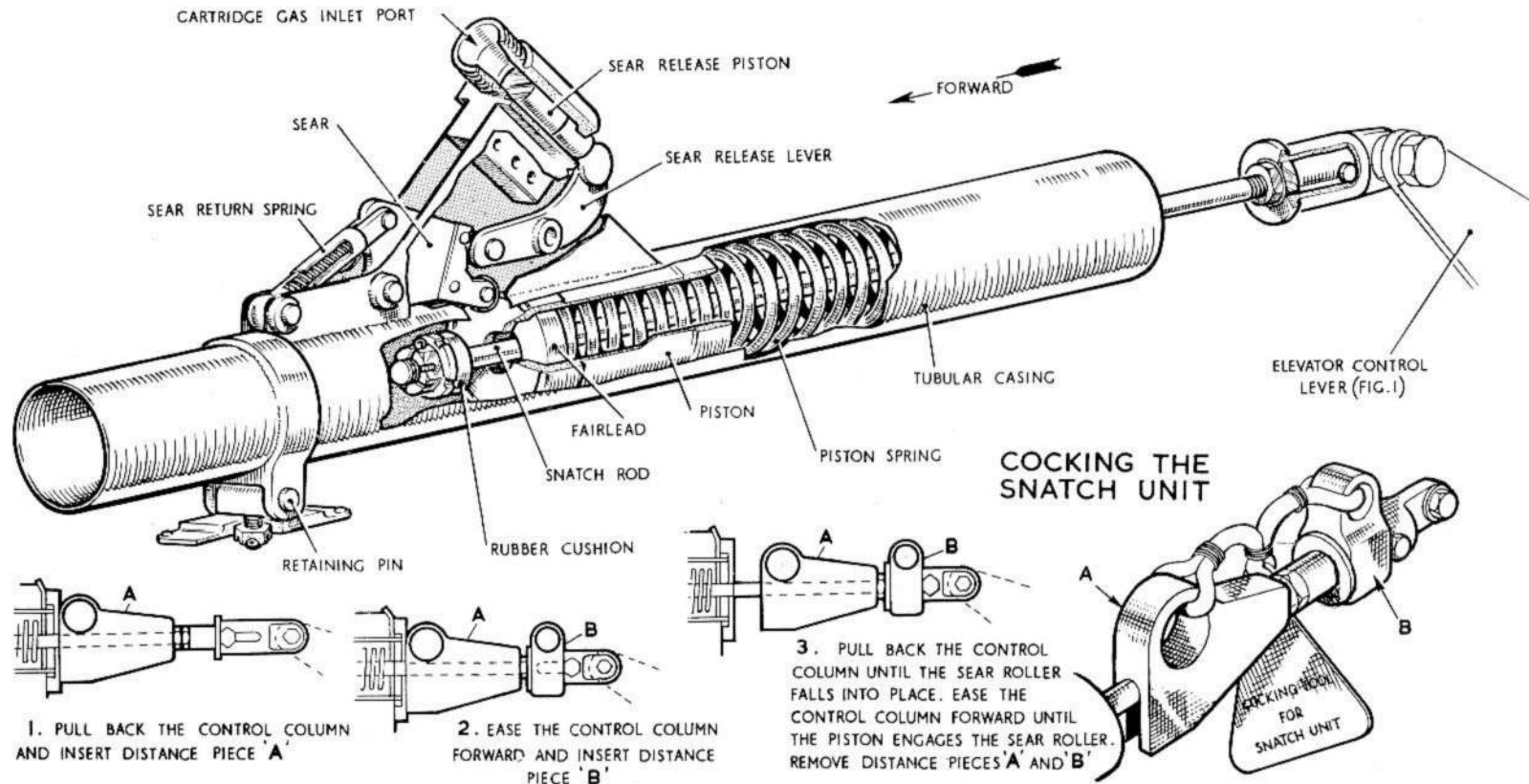


Fig. 16 Control column snatch unit

## ELEVATOR BREAK-STRUT

## DESCRIPTION AND OPERATION

General

100. The break-strut consists of a break-mechanism fitted between two fork-ends, each of which incorporates a trunnion attachment fitting. At one end, the fork-end is screwed into the break-mechanism, thus providing for a small adjustment to the strut length before final assembly. At the opposite end, the fork-end, which is mounted on thrust ballraces, is free to rotate about a spindle projecting from the break-mechanism.

Break mechanism - description (fig. 17)

101. The break mechanism comprises two assemblies, one male and the other female, secured by an internal lock mechanism.

Male assembly

102. This assembly consists of a bush and piston housing, both of light alloy, together with a piston, piston stop ring and lock tongue. The bush, which is machined to slide into the female assembly, is threaded internally at one end to accommodate the piston housing and shouldered at the other to form an abutment for the lock tongue flange. A ring-nut, fitted externally on the bush, acts as a stop for the female assembly. A grub-screw locks the ring-nut and also penetrates the bush to lock the piston housing which is screwed into the bush. Four diametrically opposite slots for a C-spanner are cut into the bush at the piston housing end.

103. The lock tongue is of the standard type used in internal locks. It is of tempered steel in the form of a hollow cylinder which is flanged at one end

and divided at the other by slots extending almost to the flange, into twelve prongs. These prongs are shaped externally to engage with the latch ring in the female assembly and machined internally to receive a latch bolt. The lock tongue, together with the piston stop ring are secured in the bush by the piston housing, the prongs of the tongue protruding from the end of the bush.

104. The piston, having six circumferential pressure grooves positioned at intervals along its length, is of steel with a polished chrome finish. It slides in the bore of the piston housing, the steel piston stop ring, fitted between the housing and the lock tongue, limiting its travel. Cartridge gas is admitted to the piston through a standard pipe connection fitted to a port in the piston housing.

Female assembly

105. Consisting essentially of a light-alloy sleeve and spindle fitting, the assembly contains the latch ring, latch bolt, both of which are of steel, and indicator components of the strut lock mechanism. The spindle fitting consisting of a hollow cylindrical plug carrying the swivel fork-end spindle, is secured by a lock-nut screwed into the sleeve and retains the latch ring against a shoulder in the sleeve bore.

106. The latch bolt, consisting of a hollow barrel containing a coiled compression spring, slides within the hollow plug of the spindle fitting the spring seating on the inner face of the plug. An external indicator plate and a support, which is keyed into the latch bolt, are secured by a bolt to the latch bolt. The support passes through slots in the sleeve and spindle fitting and limits the movement of the latch

bolt when the unit is uncocked. Two arrow-heads on the indicator plate align with two lines (engraved on the sleeve and labelled LOCK) when the strut is locked correctly.

#### Lock mechanism engagement

107. The male and female assemblies are joined by the engagement of the lock tongue in the male assembly with the latch ring in the female assembly. The lock tongue prongs are expanded and held in position by the insertion of the latch bolt into the lock tongue.

#### Break mechanism - operation

108. The break mechanism is operated by gas pressure from a cartridge explosion; the gas is admitted to the mechanism through the port in the piston housing, acts on the piston causing it to move in the housing and to depress the latch bolt from the lock tongue. A movement of the control column is then sufficient to cause the lock tongue prongs to compress and pass through the latch ring, allowing the strut to break.

### SERVICING

#### Breaking for servicing

109. The strut can be broken for servicing by operating the break mechanism by hydraulic fluid pressure applied through the gas inlet connection. When this method is used, all traces of hydraulic fluid must be removed as described in para. 114 (6).

#### Cocking

110. To cock the break mechanism, proceed as follows:-

- (1) Mate the two assemblies together by inserting the bush carefully into the sleeve, ensuring that the latch bolt is locating correctly through the piston stop ring.

- (2) Press the two assemblies together steadily until the lock tongue prongs are forced to compress by the chamfer on the latch ring.

- (3) Continue pressing and the tongue will then pass through the latch ring and at the same time depress the latch bolt against the spring.

- (4) On clearing the latch ring, the lock tongue prongs will again expand and release the latch bolt, which, under the action of the spring will slide into the tongue and lock it in engagement with the latch ring.

#### Dismantling (fig. 17, Details A & B)

111. Ensure that the internal lock has been broken (para. 109) and clamp the strut sleeve, with the lock indicator upward, in a vice provided with suitably shaped blocks; proceed with the break-down as follows:-

##### Detail A. fork end and spindle assembly

- (1) Remove the split pin, nut, washer and shear pin from the spindle fork end trunnion and remove the trunnion.

- (2) Remove the split pin, nut and washer securing the fork end to the spindle, (the spindle will be prevented from turning by the engagement of the lock indicator assembly).

- (3) Hold the thrust ballrace firmly in the cup of the fork end and withdraw the fork end barrel from the spindle lock nut and off the spindle. Invert the fork end and carefully drop the ballrace out of the cup.

- (4) Unscrew the lock indicator retaining bolt and remove the washer, indicator plate and support, from the slot in the sleeve.

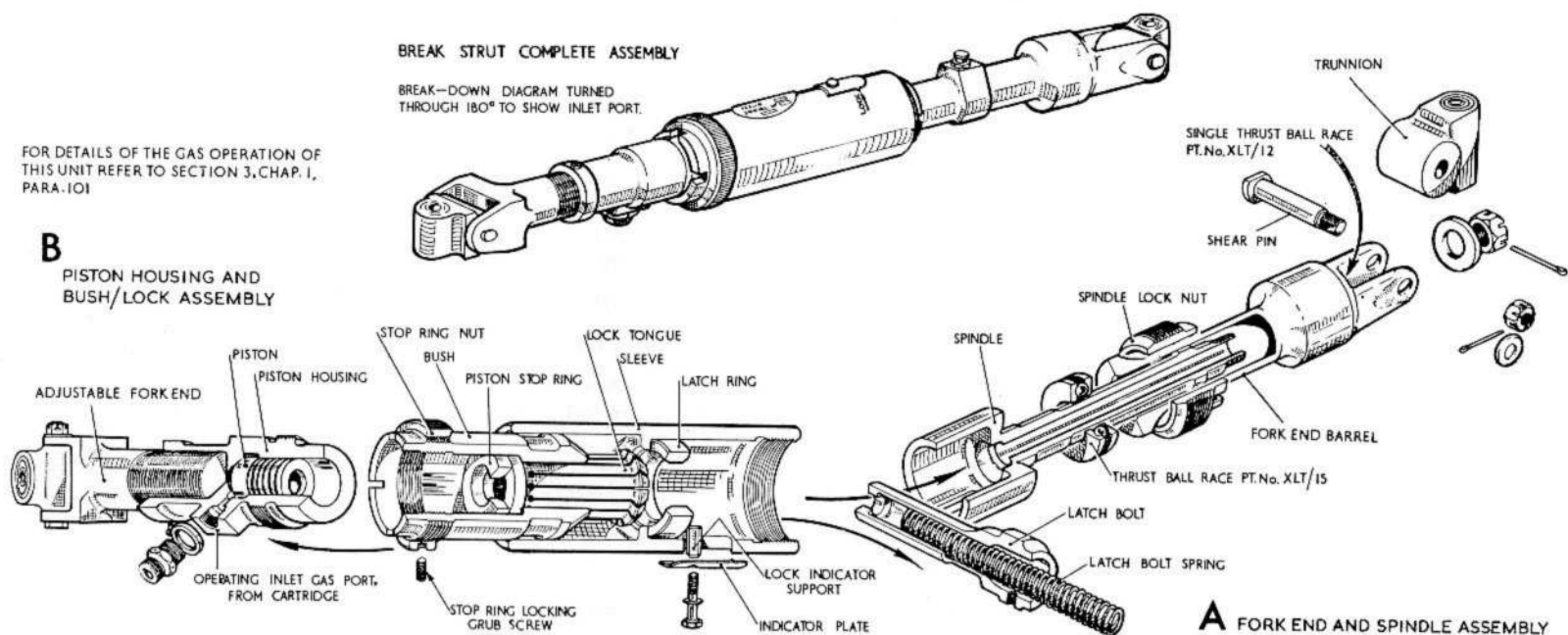


Fig. 17 Elevator break strut (Pt.No.350000 x 3)

(5) Break the locking wire of the spindle lock nut and remove the nut from the sleeve ('C' spanner).

(6) Withdraw the spindle and thrust ballrace from the sleeve and carefully remove the ballrace from the spindle.

(7) Withdraw the latch bolt and spring assembly from the latch ring, lock tongue and piston stop ring. Extract the spring from the latch bolt if required.

(8) Extract the latch ring from the sleeve.

Detail B. piston housing and bush/lock assembly

(9) Exert a straight steady pull on the piston housing assembly to withdraw the bush and lock tongue

from the sleeve. Remove the sleeve and clamping blocks from the vice.

(10) Clamp the piston housing between the protected vice jaws with the bush stop ring lock screw upward and the bush portion of the assembly free of the jaws.

(11) Extract the bush stop ring locking screw (this screw also locks the piston housing into the bush), and unscrew and remove the bush from the piston housing ('C' spanner).

(12) Withdraw the piston stop ring from the bush.

(13) Push the lock tongue into the bush by compressing the prongs and extract the tongue from the bush.

(14) Withdraw the piston from the housing cylinder.

#### Examination

112. Wash all parts in Trichloroethane (Ref. No. 33D/452 or 220 1949), dry with a clean lintless cloth and proceed as follows:-

- (1) Examine all parts for corrosion.
- (2) Test the latch bolt spring for fatigue. It should depress to a length of 3.7 in. under a load of 12.5 lb.  $\pm$  0.625 lb.

#### Assembly

113. Secure the sleeve of the break mechanism with the lock indicator slot uppermost in suitable clamp blocks held in the jaws of a vice, smear all moving parts with oil OX - 14 and proceed as follows:-

- (1) Insert the latch ring into the sleeve with the 30 deg. chamfer towards the internal shoulder of the sleeve.
- (2) Insert the spring into the latch bolt.
- (3) Fit the latch bolt into the cylindrical end fitting of the spindle, depressing the spring and ensuring that the tapping for the lock indicator support bolt coincides with the slot in the spindle.
- (4) With the latch bolt firmly held against the spring, insert the spindle into the sleeve until it is fully home against the latch ring, and ensure that the slots are aligned.
- (5) Fit the lock indicator support through the slots into the key way in the latch bolt. Fit the indicator plate to the support and secure with the washer and bolt.
- (6) Assemble the first thrust ballrace part No.

R. & M. XLT/15 in grease to the spindle, using grease XG - 278.

(7) Place the internal nut over the spindle and screw into the sleeve and wire-lock to the sleeve.

(8) Slide the fork-end fitting over the spindle.

(9) Assemble the second thrust race, part No. R. & M XLT/12, in grease, to the spindle, using grease XG - 278.

(10) Secure the fork-end to the spindle with the washer, slotted nut and split pin. Tighten using a torque spanner set to 12 lb.ft.

(11) Position the trunnion in the fork-end and secure with shear pin, washer, slotted nut and split pin.

(12) Lubricate the spindle through the grease nipple in the fork end with grease XG - 278.

(13) Remove the sleeve and spindle assembly from the vice and substitute the piston housing for assembly as follows.

(14) Insert the piston, conical end first, into the cylinder in the housing.

(15) Place the lock tongue, prongs first, into the widest end of the bush and press home until the flange on the tongue abuts on the shoulder in the bush.

(16) Fit the piston stop ring into the bush with the chamfered inner diameter facing the tongue.

(17) Slide the bush over the cylinder end of the piston housing, screw up and tighten using a C-spanner in the slots in the bush.

(18) Remove the piston housing from the vice.

(19) Mate the two assemblies together as described in para.107.

### Testing

114. Fit the unit in a test rig capable of applying a tensile load of 1230 lb. to the unit, using a jack with an annular area of 1 sq.in. Connect a hand pump, accumulator and pressure gauge to the inlet connection. Use hydraulic fluid OM-15, and proceed as follows:-

(1) Apply a load of 1230 lb (1230 p.s.i. at test jack) to the unit. Using the hand pump, slowly apply a pressure to the inlet until the lock tongue disconnects. The pressure should not exceed 1230 p.s.i.

(2) Re-cock the unit and check that the latch bolt has assumed the locked position (shown by the lock indicator as described in para. 106).

(3) Check that the clearance between the stop ring nut on the bush, and the sleeve is 0.0015 in.

(4) Repeat test (1) (2) (3) ten times. If satisfactory, assemble the grubscrew locking the stop ring nut.

(5) Check the length of the unit, it should be a nominal length of 17.25 in. between centres. An adjustment of + 0.01 in is available if necessary.

(6) Pour oil OX - 14 in at the inlet connection and then drain out. This is to remove all traces of hydraulic fluid which is neither a preservative nor a lubricating oil. Assemble protection cap A.G.S. 596/C and seal S.P.880 to the inlet connection

### Note..

When a new break strut is fitted the following locking procedure must be observed:-

(1) Fit the break strut in the aircraft screwing the adjustable fork end in or out (see fig.17) as required.

(2) Remove the strut, taking care to avoid altering the adjustment, and open up the 1/8 in. pilot hole to receive a spoke (Pt No.EEAS-38-2A) which is manufactured from item 28R 6124.

(3) Secure spoke by two nipples (Pt.No.EEAS-37-14A, Sect.26FZ 1095).

◀ (4) When finally installing the break strut in the aircraft it should be noted that it is attached at the upper end by a special 'D' bolt (Pt No.EB8-45-511) which is locked by a web on the elevator lever. If this web has been removed the break strut must be attached by a bolt A112-17-E, a washer SP13/E and a castellated nut A110-E-S locked by a split pin SP9/C8 as required by Mod 5001. When a bolt of this type is fitted the direction of the head is unimportant. ▶

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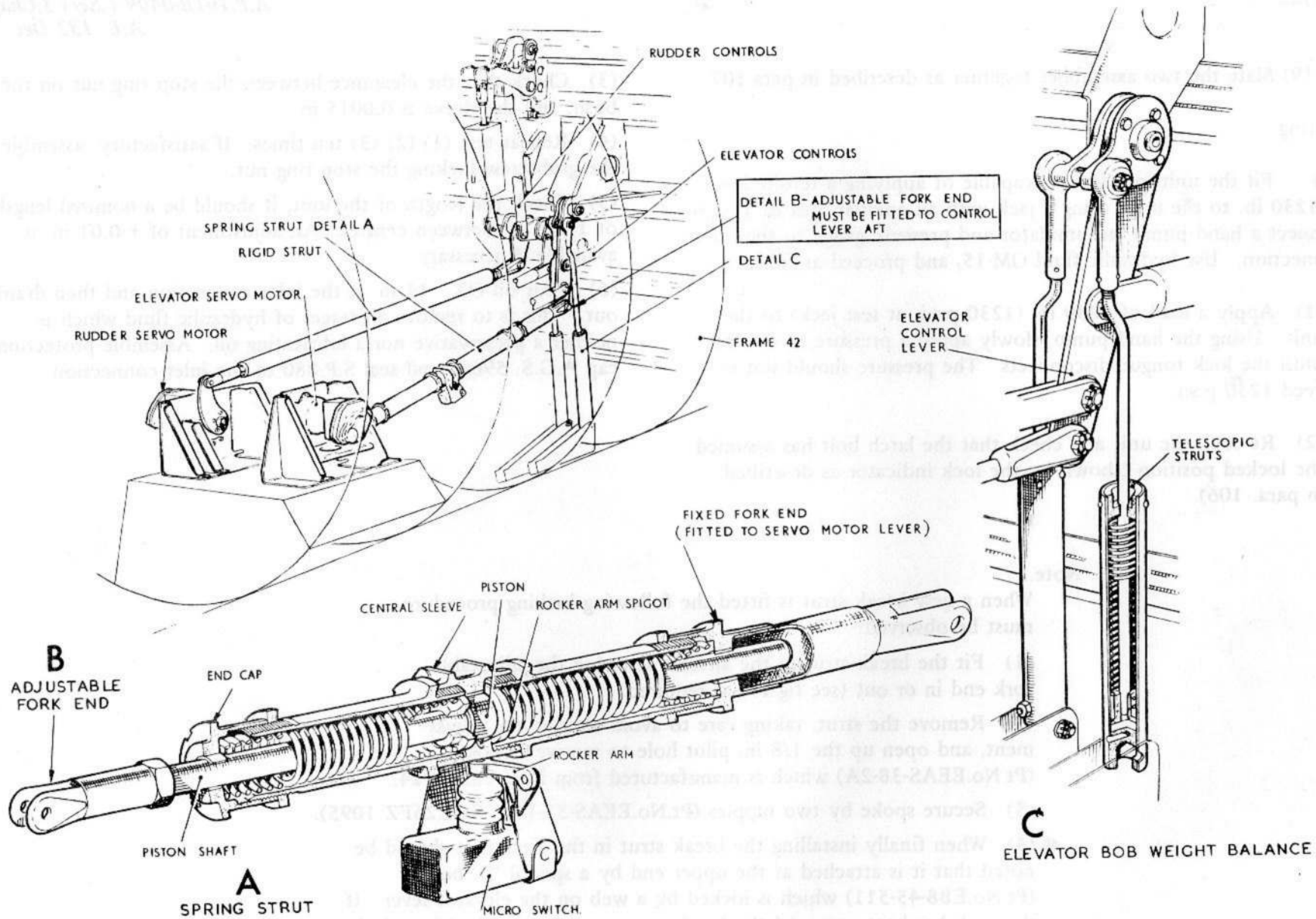


Fig.18 Automatic controls in rear fuselage

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## AUTOMATIC PILOT

## DESCRIPTION AND OPERATION

General

120. A Mk. 10 automatic pilot (A. P. 112C-0801-1) is installed in the aircraft; a description of the installation is given in Sect. 5, Chap. 2.

Linkage to control runs

121. A lever is bolted to the output flange on each servomotor mounting. In the aileron controls this lever is connected by an adjustable push-pull tube to the lever assembly aft of the main spar frame bulkhead (fig. 4, detail B). In the elevator controls the link between the lever on the servomotor and the control run is made by a spring strut (para. 122), and in the rudder controls by a rigid strut. The rudder servomotor is connected to the lever assembly at frame 42 and the elevator servomotor to the lower connection on the elevator lever, also at frame 42 (fig. 18).

Elevator spring strut (fig. 18)Construction

122. The spring strut, which acts as a safety device to prevent excessive loads being applied to the controls by the servomotor consists of a piston, mounted centrally on a piston shaft, operating in the central sleeve of an external barrel. Two pre-loaded compression springs, housed within the barrel and retained by screwed end-caps, oppose movement of the piston in either direction. At one end, the strut attachment fork-end is fitted to the piston shaft and at the other, to a tubular extension fitted to the screwed end-cap on the barrel. A spigot, integral with a rocker arm which is hinged to a bracket riveted to

the central sleeve, passes through a hole in the central sleeve of the barrel and bears against the piston. The rocker arm contacts and depresses a microswitch mounted on the bracket.

Operation

123. The spring strut operates as a solid strut when the loads applied to it in either direction are below the pre-loading of the compression springs. When a load in excess of the spring pre-loading is applied to the strut, the spring, against which the piston is acting in accordance with the direction of the load, will compress and permit the piston to move with the central sleeve. When the load is sufficiently high to permit the piston to move beyond its contact with the rocker arm spigot, the microswitch is released. This operation of the microswitch disengages the automatic pilot (Sect. 5, Chap. 2) enabling the pilot to take control of the aircraft.

Elevator bob-weights

124. To safeguard against automatic pilot runaway at certain C. G. positions, two bob-weights are bolted to an arm secured to the pivot of the elevator lever torque shaft assembly mounted on the forward face of the pressure bulkhead (fig. 1). The bob-weights are balanced by a pair of spring-loaded telescopic struts which are anchored to brackets on frame 41, and connected by a lever to the pivot of the elevator control lever forward of the bulkhead (fig. 18) at frame 42.

## SERVICING

Elevator spring strut

125. The operating particulars of the spring struts are as follows:-

- (1) The springs are pre-loaded to 30.5 lb.  $\pm$  0.50 lb.
- (2) The microswitch must operate after 0.37 in.  $\pm$  0.04 in. movement by the piston.  
- 0
- (3) Loading at the microswitch operating position must not exceed 35 lb.

126. The strut must be removed from the aircraft and checks carried out on the bench, using appropriate test gear. If the strut is dismantled it must be packed with grease XG-278 on assembly. Adjustment to the loading of the springs is made by slackening the lock-nuts and screwing the end-caps in or out. After adjustment, the centre-line of the pick-up holes in the fork-end on the barrel must be at right-angles to the rocker arm spigot hole in the central sleeve of the barrel. If difficulty is experienced in setting the springs, lock-nuts, similar to those used for locking the end-caps, may be inserted between the spring housing and the central sleeve. When final adjustments have been made, the end-cap lock-nuts must be tightened and wire-locked to the end-cap. Instructions for setting the microswitch is given in Sect. 5, Chap. 2.

#### Setting the automatic pilot servomotor controls linkage

##### Aileron

127. To set the aileron servomotor controls linkage proceed as follows:-

- (1) Set the aileron controls as described in para. 42 and fit the neutral rigging jig (fig. 7A).
- (2) Move the lever, on the output flange of the servomotor, to its mid-travel position between the two fixed stops.

(3) Connect the non-adjustable fork end of the servomotor controls link rod to the aileron lever assembly at the spar frame bulkhead and the adjustable fork end to the servomotor lever.

(4) Remove the neutral rigging jig, and, by movement of the aileron controls, ensure that the full travel of the ailerons is not limited in either direction.

(5) Make any necessary adjustment to the length of the link rod, and tighten the lock nut at the fork end of the link rod.

##### Elevator

128. To set the elevator servomotor linkage proceed as follows:-

- (1) Set the elevator control run as described in para. 58 and fig. 10, and fit the control column jig to lock the controls in neutral.
- (2) Set the lever on the elevator servomotor output flange to its mid-travel position between the two fixed stops.
- (3) Fit the spring strut (fig. 18) between the servomotor lever and the aft lever assembly at frame 42.

Note...

It is important that the strut be attached with the adjustable fork end to the aft lever assembly and the non-adjustable end to the servomotor.

Do not tighten and lock the attachment bolts at this stage.

- (4) Remove the neutral rigging jig and by movement of the controls, check that the full elevator travel movement is obtainable in both directions. Any adjustment necessary is to be made at the strut adjustable fork end.

- (5) Tighten and lock the strut attachment bolts and the adjustable fork locking nut.
- (6) Check the operation of the disengagement micro-switch and re-set as necessary (Sect. 5, Chap. 2)

#### Rudder

129. To set the rudder servomotor controls linkage proceed as follows:-

- (1) Set the rudder controls as described in para. 79.
- (2) Fit the rudder bar neutral rigging jig and a rigging pin at the lever assembly at frame 42.

- (3) Set the lever on the output flange of the rudder servomotor to its neutral position mid-way between the fixed stops.
- (4) Attach the adjustable fork-end of the rigid strut to the lever assembly at frame 42, and the non-adjustable fork-end to the servomotor lever.
- (5) Remove the rudder bar neutral rigging jig and the rigging pin from the lever assembly at frame 42, and by movement of the rudder controls ensure that full rudder travel is obtained in each direction. Any adjustment necessary to the length of the rigid strut must be made at the adjustable fork-end, and the fork-end finally locked in position.

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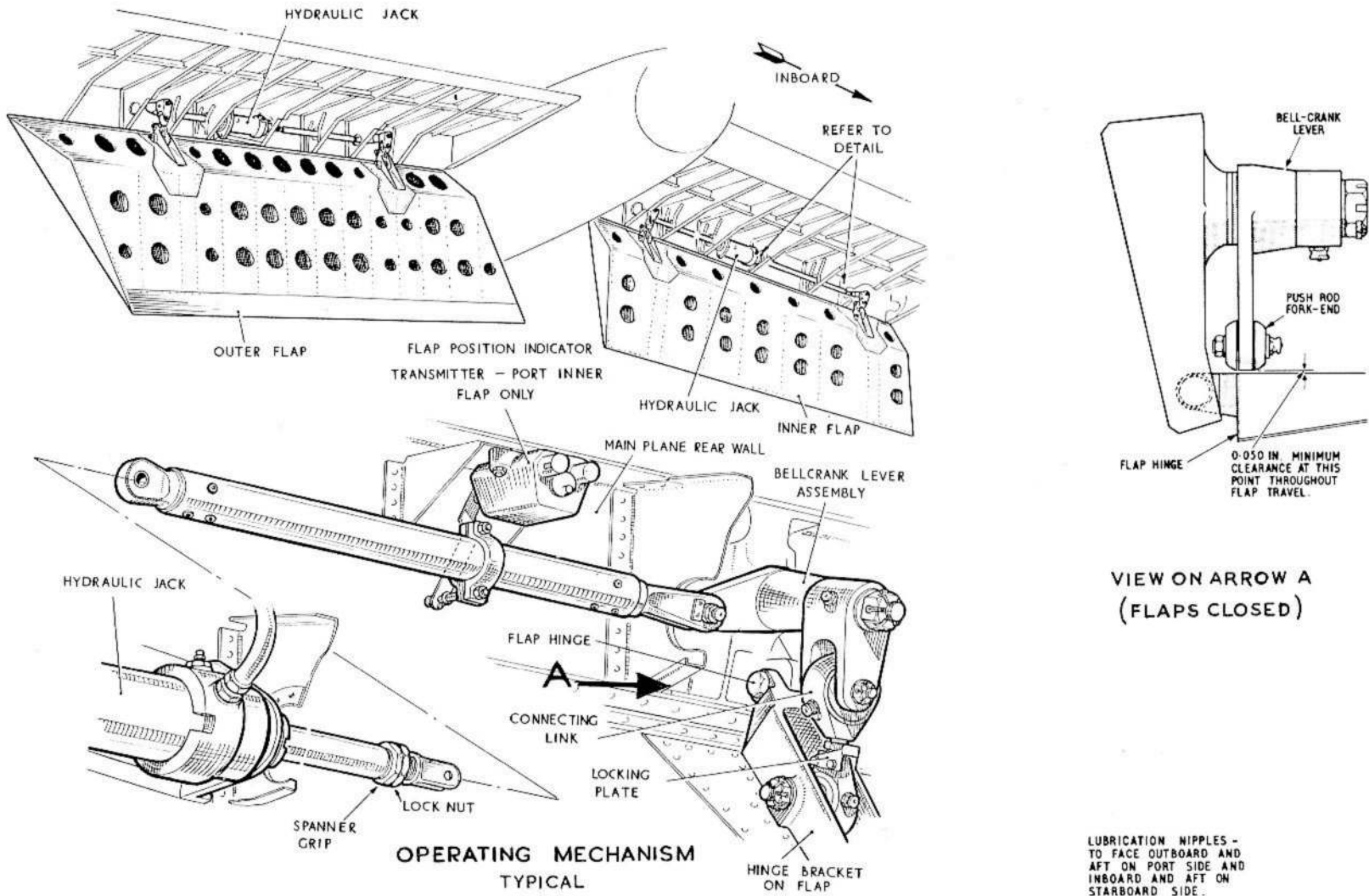


Fig.19 Trailing edge flap controls

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## TRAILING EDGE FLAP CONTROLS

## DESCRIPTION AND OPERATION

Flap operating mechanism (fig. 19)

130. Each of the four trailing edge flaps is operated by a double-acting hydraulic jack with a piston rod at each end. A description of the hydraulic system is given in Chap. 6 of this Section.

131. At each flap, the hydraulic jack is mounted between inboard and outboard bell-crank lever assemblies which are pivoted on the flap hinge brackets on the main plane rear wall, and connected by adjustable links to the hinge brackets on the flap. The jack piston rods are connected to the lever assemblies by push-pull tubes.

132. The flaps are controlled by a two-position (UP-DOWN) switch on the undercarriage control panel at the pilot's station. No intermediate flap position is provided, the flap movement being determined by the full extent of the jack travel. When the flaps are up, the jacks are fully extended on the inboard side. The transmitter for the flap position indicator at the pilot's station is operated by the port inner flap mechanism, the transmitter operating arm being connected to a collar on the inboard push-pull tube. For information on the relevant electrical circuit, reference should be made to Sect. 5, Chap. 2.

## SERVICING

Lubrication

133. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

Setting the flaps

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

- (1) Check the distance between the pin centres of the flap jack piston rods; it should be 18.3 in. This is a manufacturer's setting and adjustment should not normally be necessary. If adjustment is necessary, proceed as follows: -
  - (a) Remove the locking wire from the lock-nut and the spanner grip at the end of the piston rod.
  - (b) Slacken the lock-nut
  - (c) Adjust as necessary, by turning the eye-bolt at the end of the piston rod one complete turn at a time.
  - (d) Tighten the lock-nut and re-lock it to the spanner grip.
- (2) With the flaps down, remove the locking plates from the links connecting the flaps to their operating levers, and slacken slightly all link adjustment screws (fig. 19).
- (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 these points until, when the jacks are bottoming, the flaps bear,

without undue pressure, on the underside of the main plane.

(5) The movement of the flaps from fully-up to fully-down is as stated in fig. 20. Maximum permissible backlash is 0.3 in.

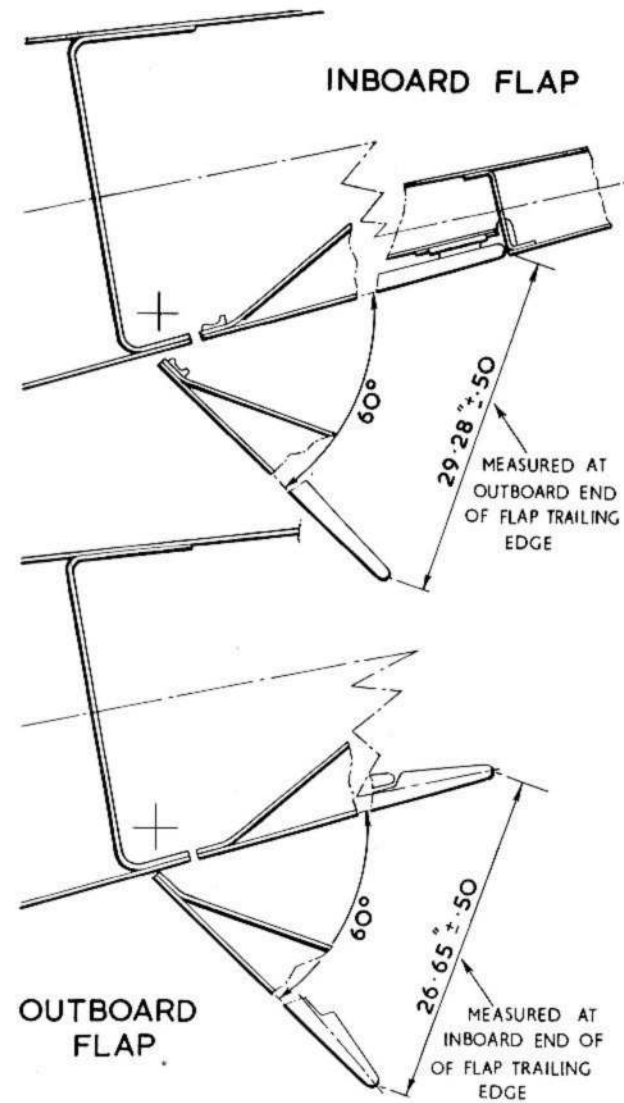


Fig.20 Trailing edge flap movements

## AIR BRAKE CONTROLS

## DESCRIPTION AND OPERATION

General

140. Air brakes, consisting of twentyone finger-type drag channels, are installed in each main plane, out-board of the engines and aft of the main spar. In the 'out' position, nine of the drag channels protrude through the upper surface of the wing and twelve through the lower surface. A complete description of the mechanism is given in Chap. 2 of this Section.

Air brake controls (fig. 21)

141. The air brakes are controlled by a three position switch (IN-MID-OUT), mounted on the port coaming rail at the pilot's station and operated by two hydraulic jacks, one in each wing. The jack bodies are attached to the main spar and the piston rods are connected to levers situated centrally on the spanwise torque tubes.

142. When the brakes are 'in' the jacks are fully extended. When OUT is selected, the jacks move through their full travel to the fully retracted position. For the mid-position, the jacks are stopped at an intermediate position by closing all the valves in the hydraulic selector, thereby creating a hydraulic lock. Operation of the hydraulic selector, when MID is selected, is controlled by a drum switch mounted at the inboard end of the air brake torque tube in the starboard wing, the switch spindle being rotated by a splined driving bush(detail A) in the torque tube end. A complete description of the hydraulic system for the air brakes is given in Chap. 6 of this Section, and details of the relevant electrical circuits connected with the drum switch are given in Sect. 5, Chap. 1, Group C.

143. A position indicator for the air brakes is incorporated in the combined trim indicator mounted on the pilot's instrument panel. The transmitter for the indicator is operated by the port air brake torque tube, the switch mounting being similar to that for the drum switch in the starboard wing.

## SERVICING

Lubrication

144. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

Setting the air brakes

145. To set the air brake mechanism, proceed as follows:-

- (1) Remove the panels from the underside of each main plane giving access to the air brake mechanism (Sect. 2, Chap. 4).
- (2) Set the handpump GROUND/FLIGHT selector cock to GROUND and, using the aircraft handpump, fully extend the air brake jacks.
- (3) Check the dimension between the pin centres of the piston rod and jack body, which should be 24.02 in., adjustment being effected by unlocking and rotating the eye-end of the jack piston rod.
- (4) Check that all the drag-channel end plates are flush with the main plane skin
- (5) Check the operation of the drum switch and adjust as necessary to obtain the MID position as described in Sect. 5, Chap. 1.
- (6) A wiring diagram for the indicator transmitter is given in Sect. 5, Chap. 2, Group C.

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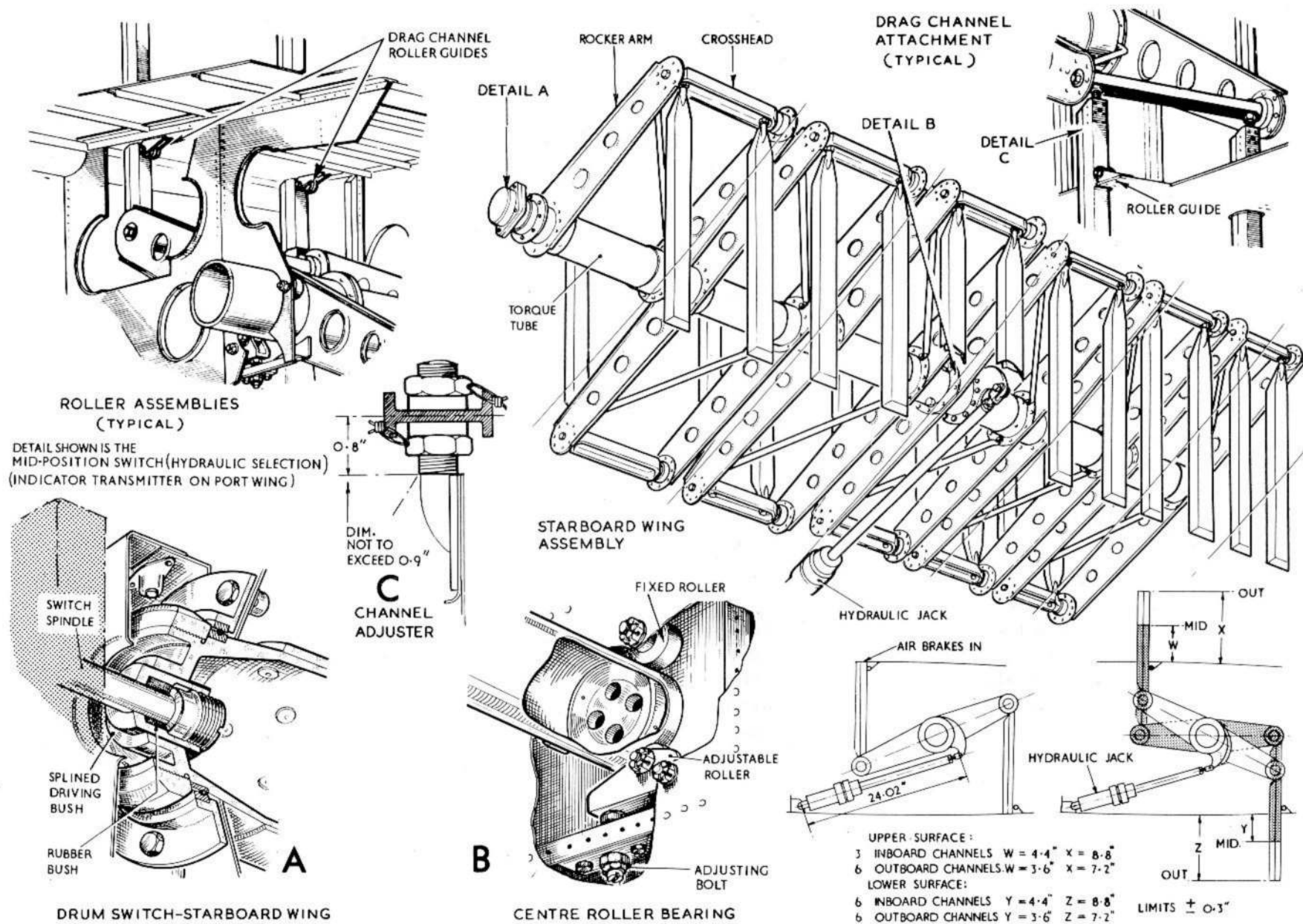


Fig. 21 Air brake controls

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(6) Fully extend the jack, select MID and OUT, and check that the drag channel extension in each position agrees with the dimensions given in fig. 21.

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

(8) Set the hand pump GROUND/FLIGHT selector cock to FLIGHT and wirelock.

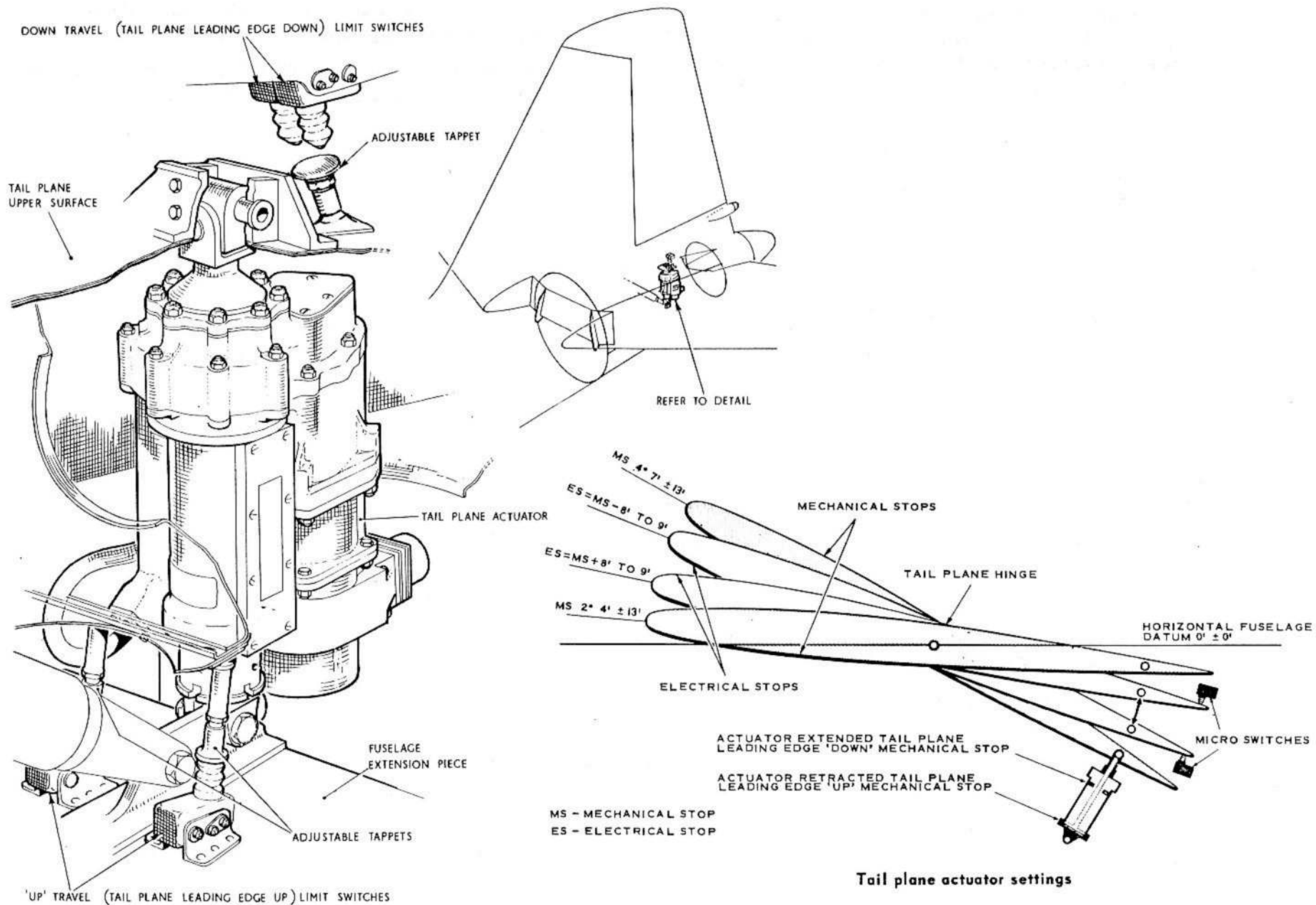


Fig.22 Tail plane incidence controls

## TAIL PLANE INCIDENCE CONTROLS

## DESCRIPTION AND OPERATION

General

150. The variable incidence tail plane is hinged at its main spar centre-section on two brackets attached to the rear fuselage at frame 42. An actuator, pivoted on the fuselage extension piece and connected to a bracket assembly on the upper surface of the tail plane centre section near to the trailing edge, forms a strut, the length of which may be varied in flight, between the tail plane and the fuselage. Extension of the actuator decreases the tail plane incidence.

151. The actuator, which operates at one speed only, may be operated by either of two motors. Each motor is controlled by a pair of three-position switches, one pair mounted on the port console in the pilot's station and the other on the right handgrip of the control column handwheel. In each pair of switches, one controls the direction of movement of the actuator and the other the power supply. Thus to obtain movement of the actuator, both switches must be operated together. For detailed information on the actuator refer to A.P. 4343D, Vol. 1, Book 3, Sect. 14, Chap. 91.

152. Microswitches, operated by tappets on the tail plane, stop the actuator at the limits of the tail plane movement. These switches are mounted on the rudder stub and fuselage extension piece, one switch at each position for each motor. A full description of the relevant electrical circuits is given in Sect. 5, Chap. 1.

153. A position indicator for the tail plane is incorporated in the combined trim indicator on the pilot's instrument panel. Full details of the instrument and electrical circuits are given in Sect. 5, Chap. 2.

## SERVICING

Lubrication

154. The lubrication points, type of lubricant to be used, and method of application are shown in fig. 23.

Tail plane actuator setting

155. The following instructions are given in the sequence in which the setting must be carried out; the actuator itself should not be adjusted.

## Note...

(a) All tail plane angles are to be measured on the STARBOARD tail plane at the inboard rigging position (Sect. 2, Chap. 4, fig. 6) using the incidence gauge Ref. No. 26 FZ/95115, and inclinometer. The latter should not be disturbed during the actuator setting procedure and all readings should be related to the initial setting.

(b) The aircraft is to be jacked and trestled, (Sect. 2, Chap. 4) and levelled laterally and longitudinally using the straightedge Pt. No. EB8.09.2511 which is to be manufactured from local resources in accordance with fig. 25.

◀ Owing to the existence of aircraft on which the original levelling datum pads at frames 29 and 31A are unusable, (STN/Canberra/72 refers), the straightedge and clinometer are to be used at alternative rigging pads at frames 34 and 37. These pads are identified as follows:-

(c) For lateral levelling - Brackets Port Ref. 26FZ/9914 and starboard Ref. 26FZ/9915, situated immediately aft of the rear access hatch. In practice it may be found necessary to disconnect two connectors on the Radio Altimeter Mk. 7B Computer to accommodate the straightedge.

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**NOTE :** ALL BALLRACES AT CONTROL TUBE JOINTS AND LEVER CONNECTIONS AND BEARINGS ARE PRE-PACKED [P] UNLESS STATED OTHERWISE. REFER ALSO TO KEY FOR NOTE REGARDING RENEWAL OF PRE-PACKED BEARINGS.

NO GREASE OR OIL IS TO BE APPLIED TO THE ROLLER GUIDES OF THE FLYING CONTROL PUSH-PULL TUBES.

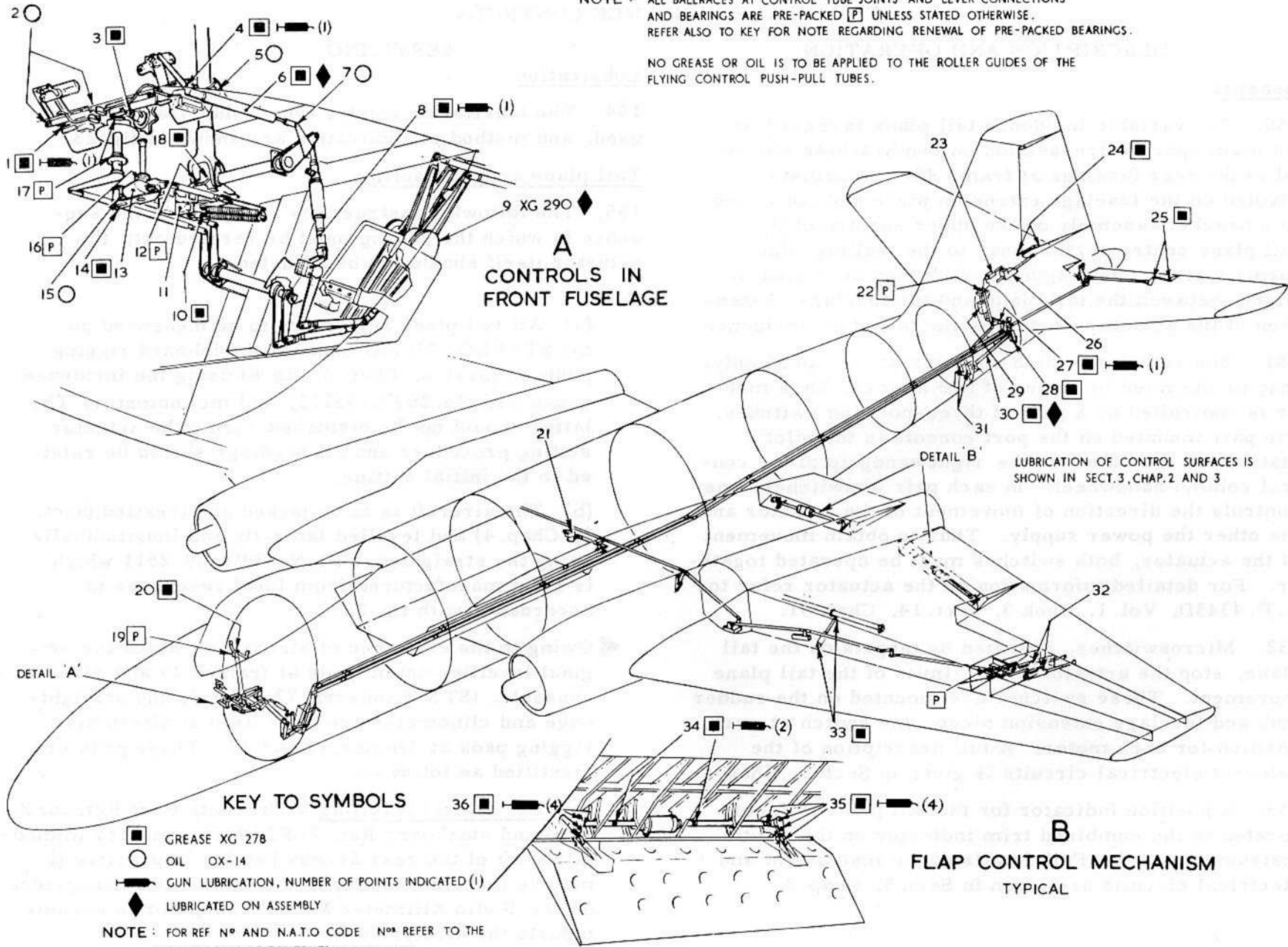


Fig. 23 Lubrication-flying controls  
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## Key to fig. 23 (LUBRICATION - FLYING CONTROLS)

- |      |  |      |  |
|------|--|------|--|
| 1    | Wheel brake toe pedal linkage                                  | 19   | Ballraces in control column top casting                    |
| 2    | Rudder bar linkage   | 20   | Bevel gearing in control column top casting                |
| 3    | Rudder bar adjustment screw                                    | * 21 | Aileron servomotor (refer to A. P. 112C-0801-1)            |
| 4    | Wheel brake toe pedal linkage                                  | 22   | Feel simulator jack, ballraces                             |
| 5    | Snatch unit sear operating mechanism                           | * 23 | Autostabilizer (refer to A. P. 1469S)                      |
| 6    | Snatch unit piston and casing interior                         | 24   | Balance tab operating rod connections                      |
| 7    | Snatch rod connection  | 25   | Spring tab operating rod connections                       |
| 8    | Elevator break-strut   | 26   | Rudder powered control unit (refer to A. P. 105D-0410-16A) |
| 9    | Grease grooves in control lever sealing rings                  | 27   | Lever assembly torque shaft bearings                       |
| 10   | Aileron bias mechanism, moving parts                           | 28   | Bob-weight balance telescopic struts                       |
| * 11 | Aileron bias mechanism actuator (refer to A. P. 4343D)         | * 29 | Rudder trim actuator (refer to A. P. 4343D)                |
| 12   | Ballraces in control column base yoke and bottom casting       | 30   | Elevator spring strut                                      |
| * 13 | Aileron two-gear actuator (refer to A. P. 4343D)               | 31   | Rudder and elevator servomotors (refer to A. P. 1469E)     |
| 14   | Aileron two-gear mechanism lever slots                         | * 32 | Aileron operating jacks (refer to A. P. 4601A)             |
| 15   | Aileron two-gear mechanism shackle and control rod connections | 33   | Air brake jack connections                                 |
| 16   | Aileron two-gear mechanism spindle bearing                     | 34   | Flap operating linkage, inboard                            |
| 17   | Rudder bar torque shaft bearings                               | 35   | Flap jack connections                                      |
| 18   | Control column universal joint                                 | 36   | Flap operating linkage, outboard                           |

## Note...

Pre-packed bearings. - When renewing pre-packed ballraces, existing grease must be washed out and the bearings re-packed with grease XG-278.

## Note...

Type 101 Mk. 3 rudder powered control unit incorporates a grease nipple, on the pick-up lever, to provide lubrication for the bearing at the connection to the autostabilizer servomotor.

## Note...

Items indicated \* require no in situ lubrication - these units are internally lubricated during bay servicing.

(d) For longitudinal levelling - Brackets Port Ref. 26FZ/9914 at frame 34 and Bracket Starboard Ref. 26FZ/9915 at frame 37. Space restriction in this position may necessitate either slackening the clips of the fuel vent pipe and easing it away from the frames, or removing a short section of the pipe to accommodate the straightedge. ►

156. To set the tail plane actuator (angle of incidence) proceed as follows:-

(1) Level the aircraft laterally by positioning the straightedge across the datum pads at frame 34, ► and adjust the aircraft jacking to obtain a clinometer reading of 0 deg.  $\pm$  0 min.

(2) Level the aircraft longitudinally by positioning the straightedge across the starboard datum pads at frames 34 and 37 - clinometer reading 0 deg.  $\pm$  0 min. It is most important that this degree of accuracy is achieved at this stage of procedure as any deviation will adversely affect subsequent incidence measurements. ►

(3) Ensure that the microswitch tappets of the actuator assembly (fig. 22) are screwed fully home and that the microswitches are set to give the minimum distance between the switches and tappets to facilitate subsequent adjustments.

(4) Retract the actuator (subject to cockpit control) toward its mechanical down stop until the tail plane leading edge UP incidence angle is 4 deg. 7 min.  $\pm$  13 min. relative to the fuselage datum (fig. 22).

(5) Extend the actuator slightly to reduce this angle by 8 min  $\pm$   $\frac{1}{0}$  min.

(6) Adjust the 'up' limit microswitch tappets to trip and stop the actuator at this position (cockpit indicator NOSE DOWN). Tighten the tappet locking nuts.

(7) Extend the actuator toward its mechanical up stop until the tail plane leading edge DOWN incidence angle is 2 deg. 4 min.  $\pm$  13 min. relative to the fuselage datum (fig. 22).

(8) Retract the actuator slightly to reduce this angle by 8 min.  $\pm$   $\frac{1}{0}$  min.

(9) Adjust the 'down' limit microswitch tappets to trip and stop the actuator at this position (cockpit indicator NOSE UP). Tighten the tappet locking nuts.

(10) Using each motor in turn, re-check the operational angle of incidence of the tail plane at both the up and down positions of the actuator and ensure that the indicator on the pilot's instrument panel registers neutral when the tail plane angle is 3 deg. 15 min.  $\pm$  2 min.

#### FLIGHT TRIM CHECKS

##### General information

157. Whenever an aircraft component which affects longitudinal trim is removed, renewed, or adjusted, a flight trim check must be carried out to ensure that the aircraft, using full aircraft 'nose down' trim, can be trimmed 'hands off' between 425 and 450 knots in level flight. Components likely to affect longitudinal trimming are:- ►

Main plane(s), rear fuselage, tail plane, tail-plane actuator, elevator and elevator tabs.

MINISTRY OF DEFENCE

Feb. 72.

FLYING CONTROLS  
FLIGHT TRIM CHECKSADVANCE INFORMATION LEAFLET No. 1/72

Insert this leaflet in Sect. 3, Chap. 4 to face FS. 30

FLIGHT TRIM CHECKS WHILE SFI/CANBERRA/83 APPLIES

Note...

References in this leaflet refer to this Chapter only, i.e. A.P. 101B-0409-1, Sect. 3, Chap. 4.

The existing trim check calls for the aircraft to be in trim with full available trim applied at a speed within the range 425 to 450 knots IAS. If the aircraft's trim speed is outside this range, prescribed action to the trailing edge angle strips is to be taken. Chap. 4 shows that if the max. trim speed of the aircraft is 450 knots the trim position of the tail plane at 400 knots is 3 min. less than the max. 'nose-up' setting and if the max. trim speed is 425 knots the trim position at 400 knots will be  $1\frac{1}{2}$  min. less than the max. 'nose-up' setting.

The recommended trim check for aircraft limited by SFI/Canberra/83 therefore is:-

- (1) Fly the aircraft to 400 knots IAS and trim out 'hands off' on the tailplane trimmer; maintain trimmer setting fixed and return to base. (See Para. 161, Case (2) for associated information).
- (2) After landing measure set tail plane angle and the full 'nose-up' tail plane angle (see para. 163 for associated information). If the difference in angle is between  $1\frac{1}{2}$  min. and 6 min. (note that 6 min. includes 3 min. tolerance quoted in para. 163) no action is required. If the angle is greater than 6 min. check the lower trailing edge strip and if metal has previously been removed, replace and recheck. Alternatively, if intact, remove from the upper strip 0.01 in. for every 1 min. difference in excess of 6 minutes.

For the case where the max. trim speed of the aircraft is less than 400 knots IAS follow the procedure given in para. 162 and adjust lower edge of the strip using fig. 24. Fly the aircraft again and if 'hands off' trim cannot be achieved below 400 knots use the check procedure indicated at (1) and (2) above.

Continued overleaf

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Continued from overleaf

Note...

- (1) The information contained in this leaflet will be incorporated by normal amendment action in due course.
- (2) If, after receipt of this leaflet, an amendment list with a prior date and conflicting information is received, the information in the leaflet is to take precedence.

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158. Before the first flight test, examine the elevator trailing edge trimming strips Pt. No. EA1. 31. 677 and, if they are bent, kinked or damaged, remove them and fit new ones. Bowing, where the strip follows the line of the elevator trailing-edge, is acceptable. In carrying out a trim check the aircraft should be flown in smooth conditions with a crew of 2 and without wing-tip tanks. The procedure to be adopted is given in the following paragraphs.

#### Loading procedure

159. First refer to Sect. 2, Chap. 3A for C. G. and loading instructions. Load the aircraft with 11 200 lb. of fuel, disposed as at Stages 5/6 in the fuel management drill in Pilot's Notes. For start-up, taxiing and take-off, use the switching shown under Stages 1/2, i. e. normal procedure. Immediately after take-off, change switching to Stage 6 and thereafter follow the fuel management drill.

#### Note...

If more than 11 200 lb. of fuel is required, it should be loaded in accordance with the right-hand columns of the fuel drill in Pilot's Notes, but flight trim checks should not be carried out until Stage 6 of the fuel management drill has been reached.

160. There are alternative means of adjusting the C. G. of the aircraft to the required position for take-off and maintaining it constant during flight. These involve unbalancing the normal fuel arrangement by filling fuel in the ratio of about  $2\frac{1}{2}$  in the top tanks (No. 1, 2, 3, 4) to 1 in the rear tank (No. 5) while putting the required quantity in lieu of nose ballast, in the belly tank (No. 6). Fuel is then used from top and rear tanks during flight in such a manner that the ratio between them is maintained within a calculated tolerance. Fuel being carried as ballast is not, of course,

to be used without checking the effect of this on the aircraft C. G.

#### Flight procedure

161. Operating the fuel system as described in para. 159, climb to 5 000 ft. (1013 millibars altimeter 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 aircraft 'nose-down' trim. Record the speed. Increase the speed slowly beyond this point to ensure that a push force develops.
- (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.

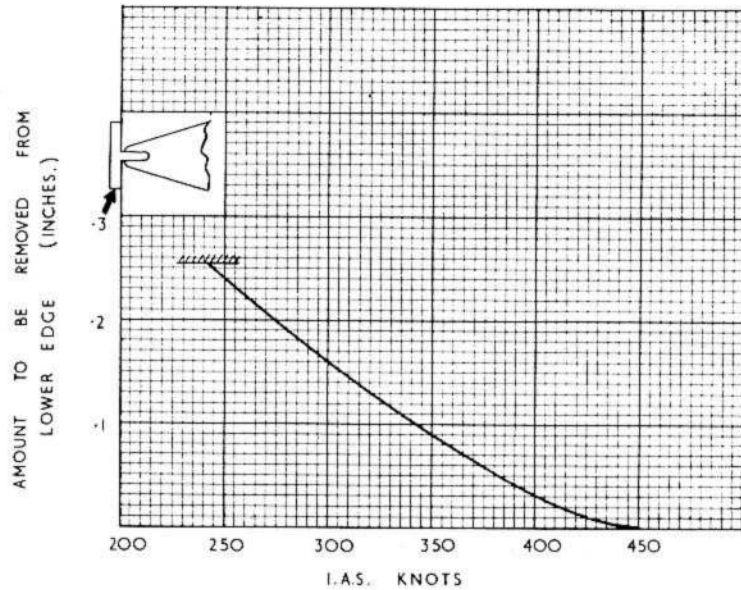
#### Note...

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 about 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

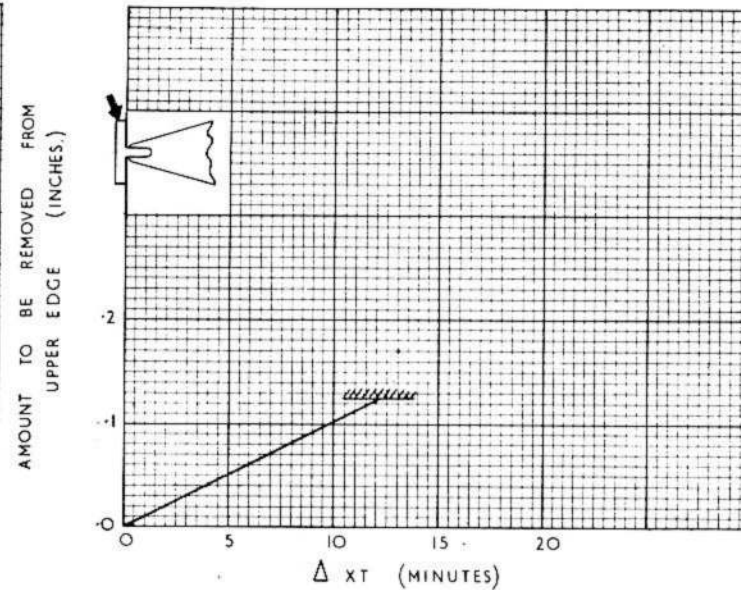
162. Case 1. For an aircraft in the Case 1 category of para. 161.

- (1) Check that metal has not been previously removed from the upper edge of the strip (total strip depth 0.62 in.  $\pm$  .010 in. when new). If



MAX. I.A.S. AT WHICH AIRCRAFT CAN BE TRIMMED "HANDS OFF" USING FULL AIRCRAFT NOSE DOWN TRIM.

**A** LOWER TRIMMING STRIP GRAPH



$\Delta XT$  = FULL NOSE UP TAIL PLANE ANGLE ON ELECTRICAL STOPS AS MEASURED BY INCIDENCE BOARD ON THE GROUND, MINUS TAIL PLANE ANGLE REQUIRED TO TRIM CLEAN AIRCRAFT "HANDS OFF" AT 450 KNOTS AT 5,000 FT.

**B** UPPER TRIMMING STRIP GRAPH

Fig.24 Elevator trailing edge trimming adjustment

metal has been removed renew the strip and recommence flight tests.

If upper edge of strip is intact:-

(2) Refer to fig. 24 detail A and read off the amount of metal to be removed from the elevator strips according to the speed reached; remove this amount from the lower edge of the strips on both elevators, along the whole length of the strips.

(3) Refuel the aircraft and repeat the flight

check, noting the new steady trim speed with full aircraft 'nose-down' trim. Record the speed. Again increase speed beyond this point to check if the aircraft still requires a push force on the control column at, or approaching 450 knots.

(4) Repeat (2) and (3) above until the aircraft, using full aircraft 'nose-down' trim is trimmed 'hands off' between 425 and 450 knots in level flight. Should this check indicate that the strips have been over-adjusted, resulting in a slight

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pull force on the control column at 450 knots, carry out the flight procedure as in para. 161, Case 2, and subsequently check the tail-plane trim incidence as in para. 163 (1) and (2).

(5) If the tail-plane angle required to trim at 450 knots is not more than 3 min. from the electrical stops, then the trailing-edge strip adjustment is satisfactory. If it is more than 3 min. renew the strip and recommence the tests.

Note...

There is no restriction on the amount of lower edge of the strip which may be removed; the whole of these portions may be removed if found necessary.

Example

Consider an aircraft which, in its first check flight can be trimmed 'hands off' at 355 knots, with full aircraft 'nose-down' trim. From fig. 24 detail A it is found that 0.085 in. must be removed from the lower edge of the strips. After the second flight (assuming the aircraft is now in trim at 400 knots) a further 0.035 in. should be removed from the strips. This procedure should be repeated until the aircraft satisfies the trim requirements laid down in para. 162 (4).

163. Case 2. For an aircraft in the Case 2 category of para. 161.

(1) Place the aircraft in rigging position as described in para. 164, without disturbing the tail trimmer setting, measure the tail-plane incidence (this was the angle found necessary to trim 'hands off' at 450 knots).

(2) Without removing the inclinometer, run the actuator on to its 'up' electrical stop. Record the difference in angle between the 'hands-off-450-knots' position and the electrical stops.

(3) The aircraft trim may be considered satisfactory if the difference in angle is no more than 3 min.

(4) If the difference in angle is greater than 3 min., check that metal has not been previously removed from the lower edge of the strip. (Total strip depth should be 0.62 in.  $\pm$  0.010 in.). If metal has been removed renew the strip and recommence flight tests. If lower edge of strip is intact then:-

(5) Refer to fig. 24 detail B and read off the amount of metal to be removed from the upper edge of strips corresponding to the difference in angle found in (2). Remove the required amount of metal from both elevator strips, along the whole length of the strips.

(6) Repeat the flight trim check and adjustments as necessary.

Note...

Should subsequent checks indicate that the strips have been over-adjusted, resulting in a push force on the column below 425 kts., renew the trailing-edge strips and recommence flight tests.

#### Rigging procedure

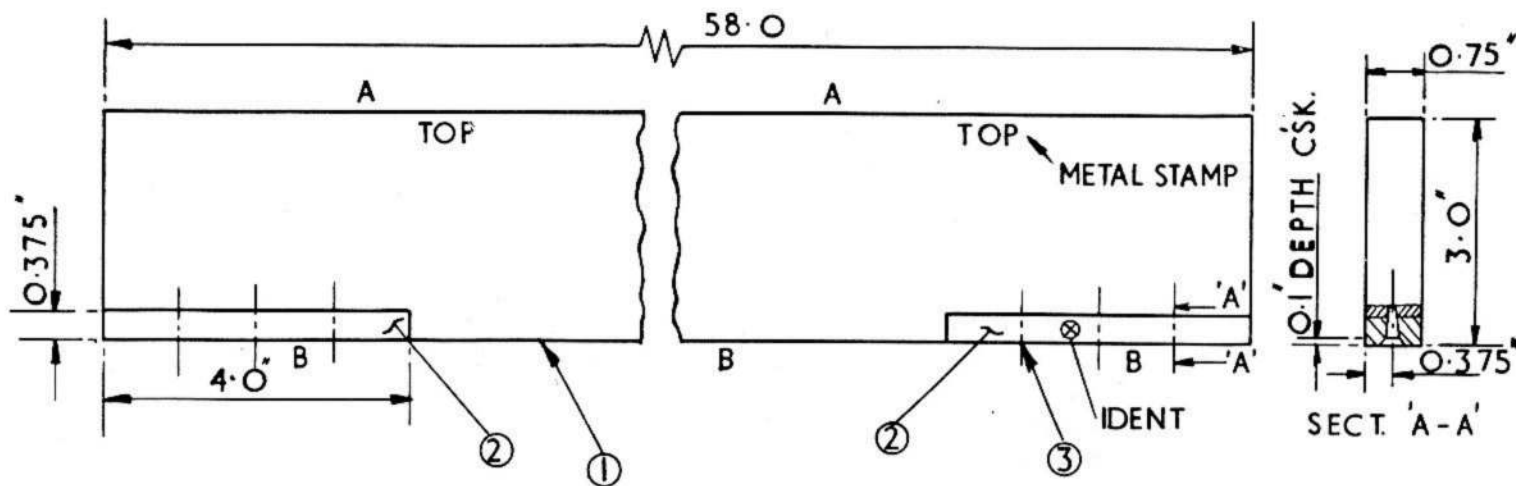
164. The procedure for rigging is as follows:-

(1) All angles are to be measured on the star-board tail plane at the inboard rigging board position, relative to horizontal fuselage datum.

(2) Jack and trestle the aircraft as described in Sect. 2, Chap. 4 and level in accordance with para. 155 of this chapter.

(3) During tail-plane rigging operations the inclinometer should not be disturbed and readings should be related to its initial setting.

No. EB8-O9-2511



1. MAIN BODY - MAHOGANY
2. STEEL INSERT PLATE - MATERIAL S3-2 OFF
3. 6 OFF S.P. WOODSCREW No. 8 X 1 1/4" C'SK. HEAD, BRASS S.P. 61/ DIO.

FEATURE	CHACTERISTIC	TOLERANCE	DATUM
FACE 'A'	PARALLELISM	0.020"	FACE 'B'
FACE 'A'	STRAIGHTNESS	0.010"	—
FACE 'B'	STRAIGHTNESS	0.010"	—

CLEARANCE HOLE IN PLATE - 0.173" (4.4<sup>m</sup>/m)  
 TREAT MAHOGANY WITH TWO COATS  
 POLYURATHENE VARNISH  
 P.T. FOR STEEL PLATES - D.S. 30-02-011  
 (PHOSPHATING)  
 IDENT TO D.S. 30-04-20/1  
 (METAL DIE HAND STAMPING)

FIG. 25 LEVELLING STRAIGHTEDGE

No. EB8-O9-2511

## ALIGHTING GEAR

(Completely revised)

## List of Contents

	Chapter
Main Undercarriage ... ..	5A
Nose Undercarriage ... ..	5B

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.

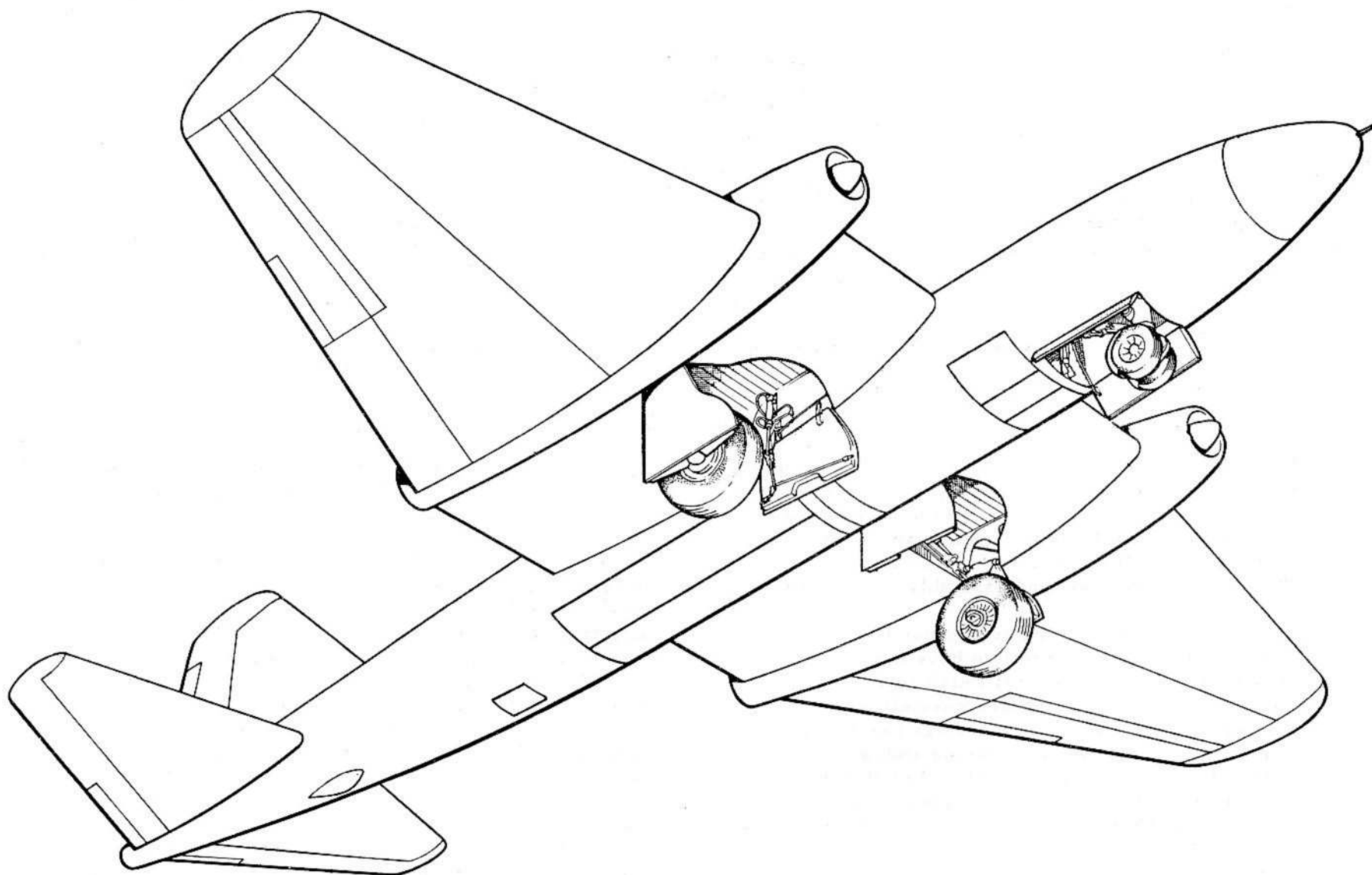
2. The tricycle alighting gear consists of two main units which retract inward into bays in the main planes and a single nose unit which retracts rearward into a bay in the fuselage nose aft of the pressure bulkhead. Each main undercarriage has a single wheel mounted on an inward facing stub axle which incorporates a hydraulically operated plate brake and a Maxaret brake control unit. Details of the wheels and wheel brake units are given in A. P. 2337, Vol. 1, and a description of the wheel brake hydraulic system is given in Chap. 6 of this section.

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 clockwise rotation (as far as it will go) of the knobbed sleeve of the UP push-button, followed by depression of the button. An emergency lowering system, operated by a red painted handle positioned above the push-buttons, provides for the manual selection of DOWN and the opening of a separate hand pump-powered supply to the alighting gear jacks- thus catering for both electri-

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Alighting gear

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cal and hydraulic failure. Reference should be made to Chap. 6 of this Section for a description of the hydraulic and emergency lowering systems and to Section 5, Chap. 1, for details of the relevant electrical circuits.

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.

Chapter 5A MAIN UNDERCARRIAGE  
(Completely revised)

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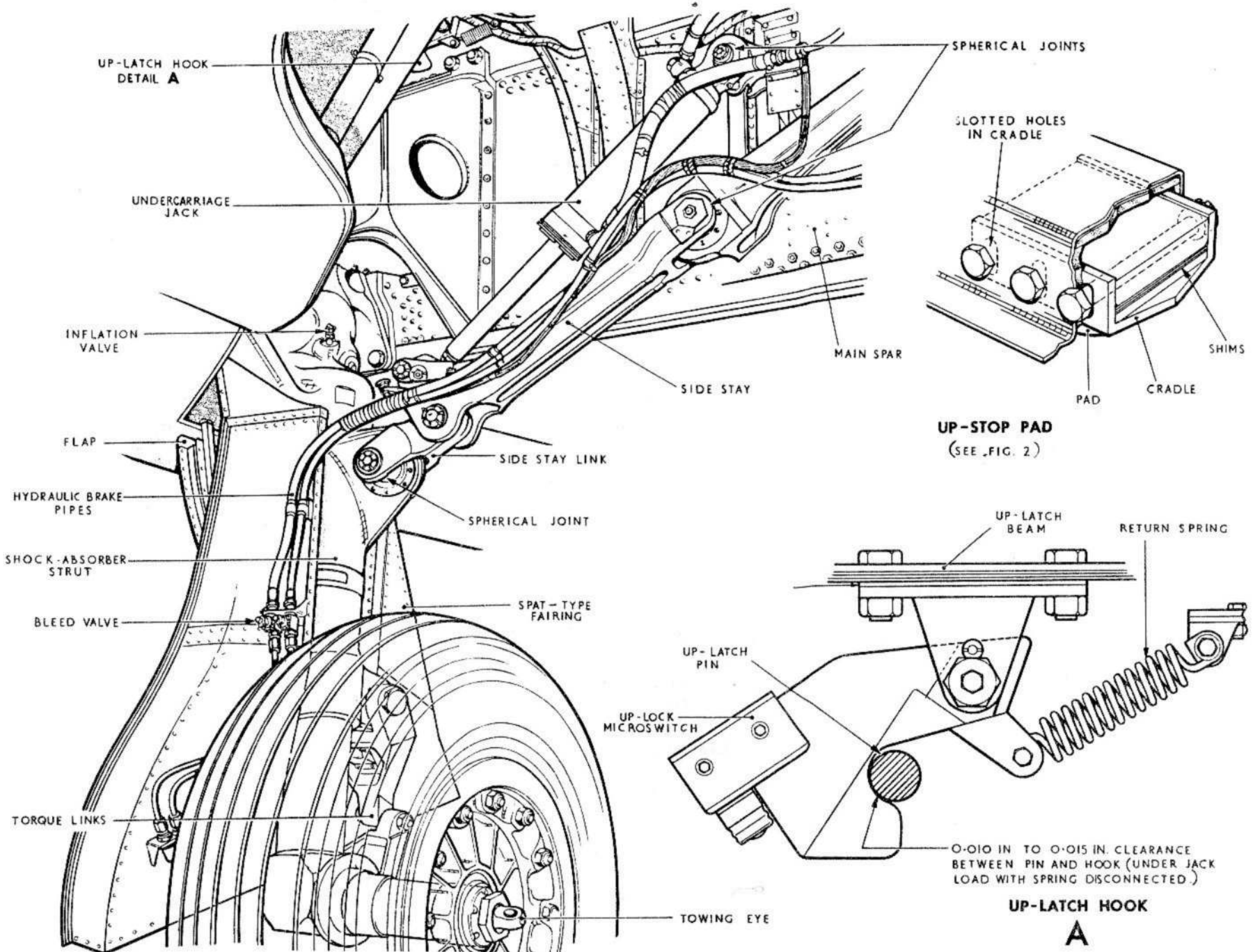


Fig.1 Starboard undercarriage

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## DESCRIPTION

## General (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 undercarriage down-lock mechanism. The undercarriage jack is attached by a spherical joint to the main plane structure and to the locklever 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 undercarriage housing when the undercarriage is retracted. The unit is fully described in A. P. 1803P, Vol. 1, Sect. 6, Chap. 4.

## 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-like 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 undercarriage 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 to a bracket on the front face of the main spar, and the lower end, which is the 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 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. 2)

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 underface 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 undercarriage DOWN is selected the initial movement of the jack releases the lock. The bolt connecting the eye-end of the jack piston rod to the side stay is fitted in slotted holes in the side-stay fork and moves across the holes as the jack extends. The eye-end of the jack contacts the end of the hook and, a protrusion above the centre-line of the eye, pushes the

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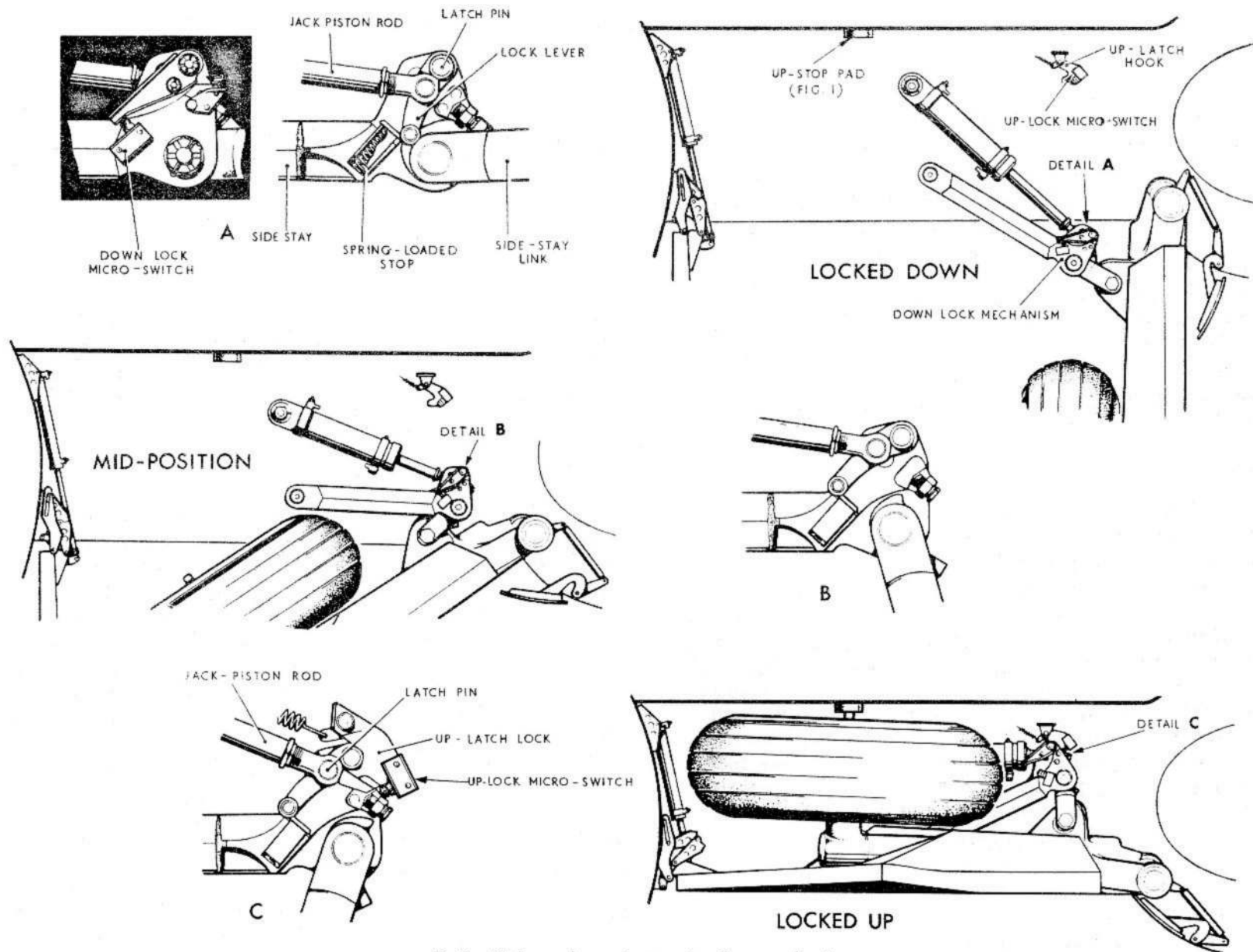


Fig.2 Main undercarriage retraction mechanism

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hook out of engagement. The undercarriage falls under gravity for the first part of its travel during which time the jack attachment bolt 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 hooked end of the side-stay link (fig. 6).

Down lock mechanism (fig. 2).

6. The down-lock mechanism, on the outboard end of the side stay, consists of a lever pivoted on the latch pin and a spring loaded stop. In the locked position, a roller on the end of the lever engages a lip on the end of the side-stay link and is retained in this position by the stop. The lock is operated by the hydraulic jack which is connected at its piston rod end to the lock lever. When the jack reaches the end of its travel on lowering the undercarriage, the lever is pushed over the stop against the action of the stop spring and engages the lip on the link, the stop extending to lock the lever. When the unit is retracted, the initial closing action of the jack withdraws the lever from the lip on the link and releases the lock. The 'down' microswitch in the alighting gear indicator circuit (Sect. 5, Chap. 1) is mounted on the side of the latch pin bracket. A striker arm secured to the latch pin depresses the switch when the down lock lever engages the lip on the side stay link.

Door operating mechanism (fig. 3 and 4)

7. Each main undercarriage door is hinged at two points to brackets on the fuselage side. Forward and rear spring-loaded shoot-bolts, mounted near the outboard edge of the door, lock the door in the closed position, and jointed check links, attached to the fuselage side and lugs on the door forward hinge

bracket butt when the door is in the fully open position. The door and shoot bolts are operated by a vertically-mounted hydraulic jack, which is attached to a bracket on the fuselage side and connected at its piston-rod end to a lock lever pivoted in the forward hinge bracket on the door. Movement of the lock lever, which is connected by push-pull rods and a bell-crank lever to the shoot bolts, is limited by a pin fitted through the webs of the hinge bracket and a slot in the lock lever.

Engine cowl flap

8. A small flap, the movement of which is restricted by a check cable, is situated in the engine lower cowl-ing and is mechanically connected to the undercarriage main pivot by an adjustable tie-rod. The flap allows the main undercarriage leg, when lowered, to move outboard into a recess in the skin of the engine cowl-ing and, on retraction, fits in the recess and fairs off the cowl-ing.

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 pumps 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

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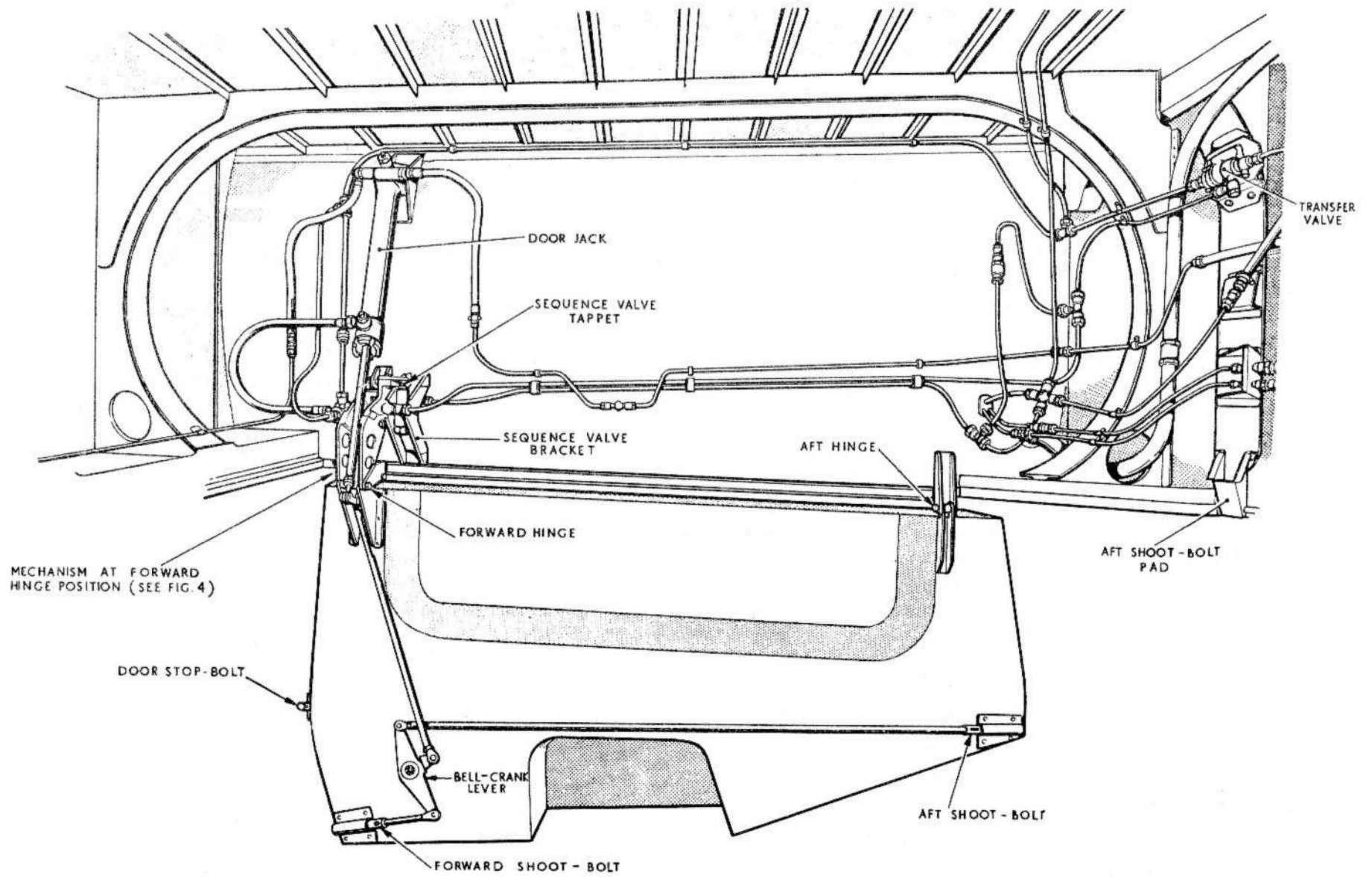


Fig.3 Main undercarriage door-operating mechanism

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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. 1803D, Book 3A, Sect. 9, Chap.67.

Principle of operation (fig. 2)

#### Raising

10. When UP is selected, hydraulic pressure is applied simultaneously to the undercarriage jacks and door jacks, but only the undercarriage jacks operate because sequence valves in the return lines from the door jacks are closed when the units are down. The initial retracting movement of the undercarriage jacks releases the down locks (para. 6) and continued retraction raises the units until they engage the up-lock latch hooks (para. 4). At this point, trip screws on the side stays depress the plungers of the door jack sequence valves and open the valves. Return fluid in the door jacks is then released permitting the jacks to retract, the initial movement moving the shoot bolts to the locking position (para. 7). When the door commences to move, the undercarriage jack sequence valve is closed as the joint in the check links break. The doors are finally locked in the closed position by the shoot bolts when the jack is fully retracted.

#### Lowering

11. When DOWN is selected, hydraulic pressure is again applied simultaneously to the undercarriage jacks and door jacks but, since the undercarriage jack sequence valves are closed when the units are retracted, only the door jacks operate. The initial extension of the door jacks withdraws the shoot bolts (para. 7) and continued extension moves the doors to the fully open position. At this point, the undercarriage jack sequence valves are depressed and opened by the trip lever on the check links, thus releasing the return fluid in

the undercarriage jacks. The initial extension of these jacks releases the up-locks(para. 4) and continued extension lowers the units, closing the door jack sequence valves at the commencement of the movement. When the units are fully lowered, the final extension of the jacks engages the down locks (para. 6). Transfer valves are incorporated in the undercarriage hydraulic circuit; on lowering the units, fluid expelled from the undercarriage jacks is diverted through these valves to the 'down' line to assist the pumps in meeting the immediate demands of the circuit. Thus, a smooth and continuous lowering movement is obtained. When the undercarriage is raised, the transfer valves close, ensuring that the pump supply is confined to the 'up' line only.

#### 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.

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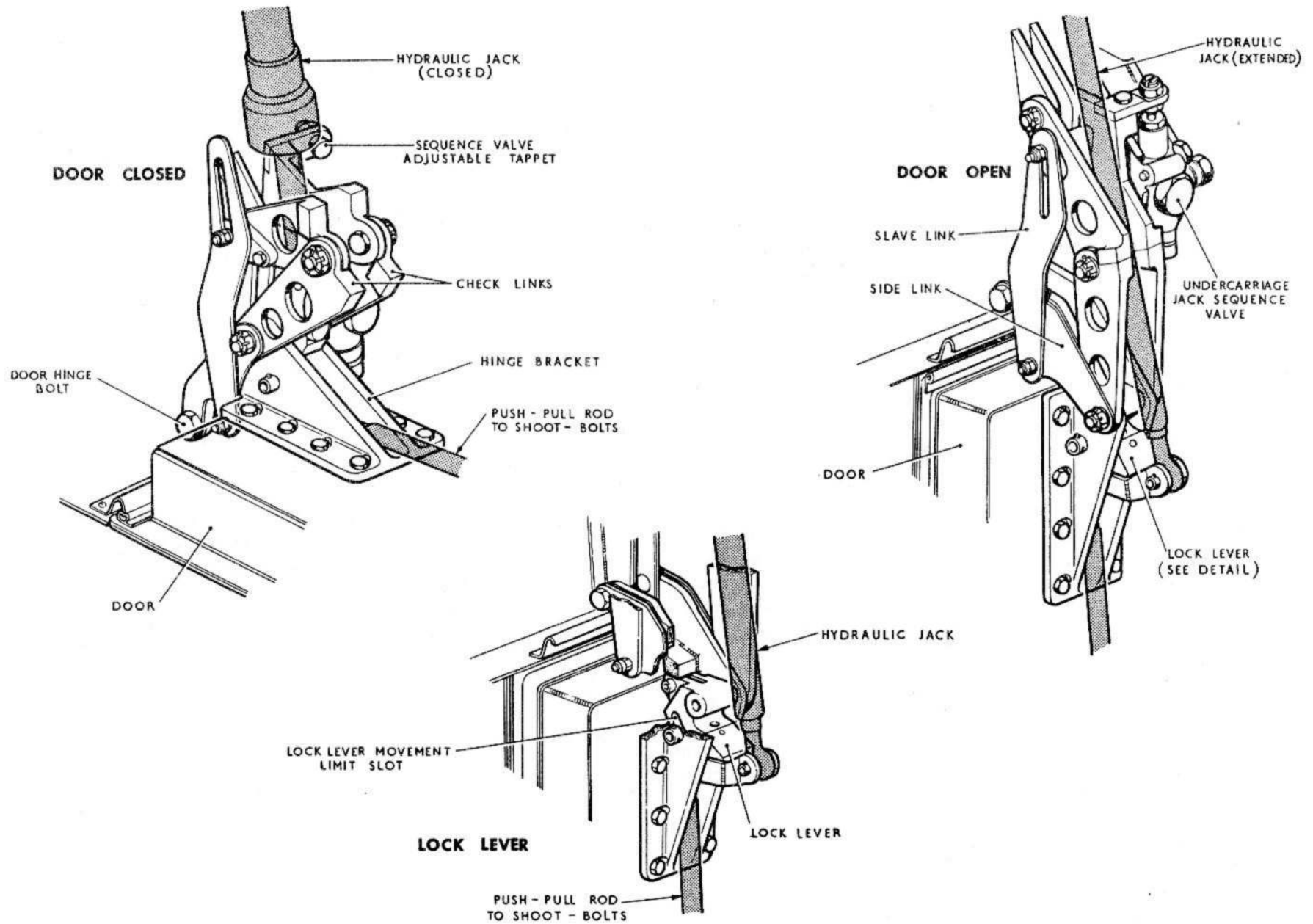


Fig.4 Undercarriage door-operating mechanism

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## General information

13. The following paragraphs provide information on checking and correcting the oleo legs oil level and air pressure.

## Checking and correcting the oil level

14. An inflation adapter Ref. No. 4G/4131 fitted with a pressure gauge Ref. No. 4G/3028 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 air-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 air 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 air pressure to zero through the air release valve in the adapter.
- (7) With the release valve still open, compress the leg fully, using a pillar jack Ref. No. 4Q/2657, adapter Ref. No. 4Q/2321 and bracket Ref. No. FZ/95413.
- (8) Close the inflation valve by rotating the gauge in a counter-clockwise direction, and close the adapter air release valve.
- (9) Remove the cap from the adapter inflation point, and connect an oleo charging pump Ref. No. 4G/257 to the inflation point.
- (10) Open the undercarriage inflation valve and pump in hydraulic fluid OM-15, allowing the leg 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 undercarriage leg by means of the pillar jack. Close the inflation valve.

NOTE...

- (1) If no fluid is expelled, repeat operations(7) to (11).
- (2) Pillar jacks should be raised slowly and carefully to ensure that only excess fluid is expelled.
- (12) Carry out operations detailed in para. 15. The correct inflation pressures for varying all-up weights are given in Sect. 2, Chap. 2.

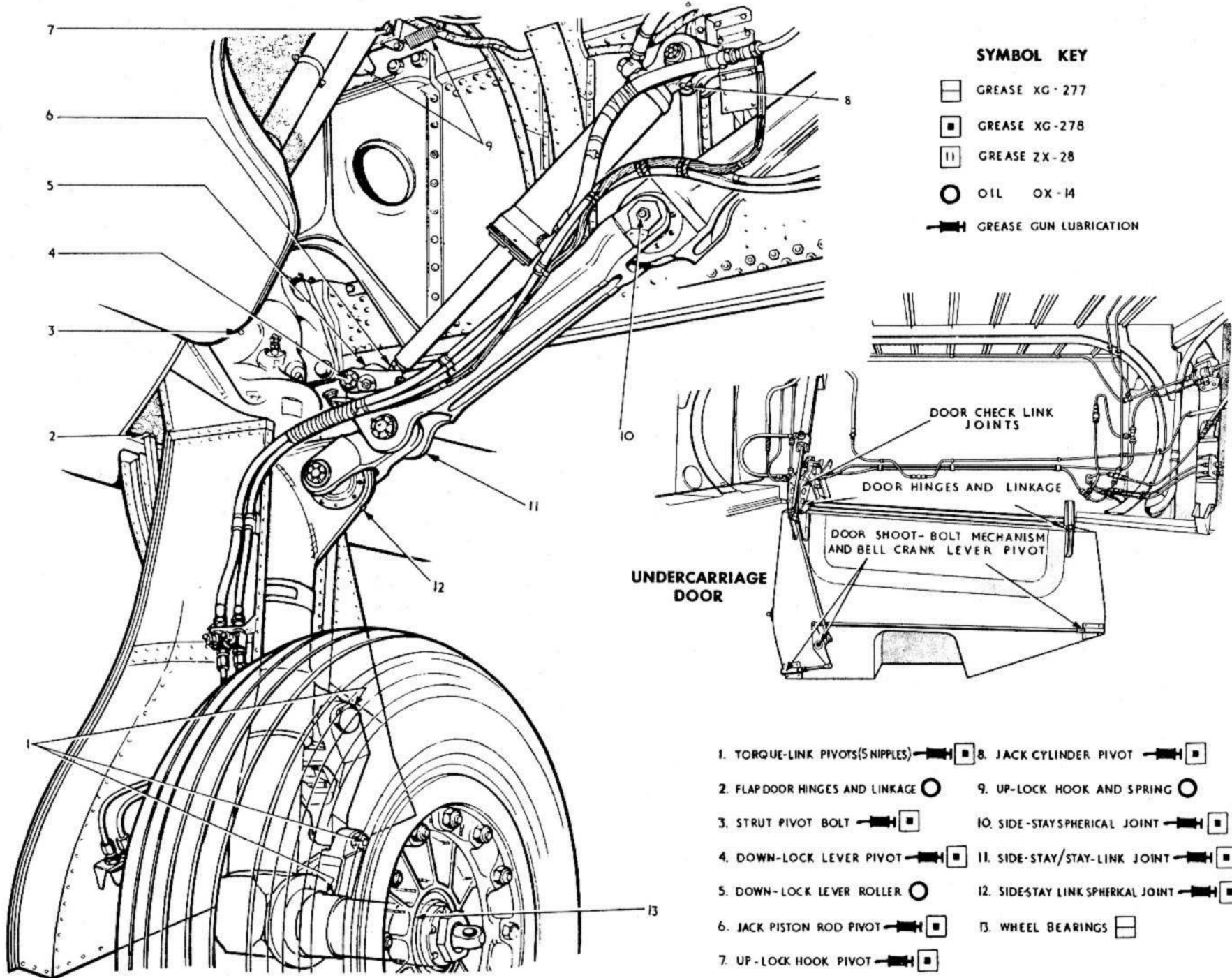
## Checking and correcting air pressure

15. An inflation adapter (Ref. No. 4G/4131), fitted with a 0-2 500 lb. per sq. in. pressure gauge (Ref. No. 4G/3028), is used when checking and correcting the oleo leg inflation pressure. A full description of the inflation adapter, and general instructions for use are given in A. P. 1464G, Vol. 1, Part 2, Sect. 5, Chap. 10.

To check and correct the air pressure:-























- (1) Jack and trestle the aircraft (Sect. 2, Chap. 4)
- (2) Check that the adapter air release valve is closed, by turning the knurled knob as far as it will go in a clockwise direction.
- (3) Turn the gauge in an anti-clockwise direction until a stop is reached; do not strain against the stop.

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**SYMBOL KEY**

-  GREASE XG-277
-  GREASE XG-278
-  GREASE ZX-28
-  OIL OX-14
-  GREASE GUN LUBRICATION

- 1. TORQUE-LINK PIVOTS(SNIPPLES)  
- 2. FLAP DOOR HINGES AND LINKAGE 
- 3. STRUT PIVOT BOLT  
- 4. DOWN-LOCK LEVER PIVOT  
- 5. DOWN-LOCK LEVER ROLLER 
- 6. JACK PISTON ROD PIVOT  
- 7. UP-LOCK HOOK PIVOT  
- 8. JACK CYLINDER PIVOT  
- 9. UP-LOCK HOOK AND SPRING 
- 10. SIDE-STAYS SPHERICAL JOINT  
- 11. SIDE-STAY/STAY-LINK JOINT  
- 12. SIDESTAY LINK SPHERICAL JOINT  
- 13. WHEEL BEARINGS 

**Fig.5 Lubrication diagram**

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(4) Tighten the cap at the adapter inflation point.

(5) Remove the cap from the inflation valve at the top of the undercarriage outer sleeve and screw on the adapter assembly, taking care not to upset the position of the gauge.

Note...

Before checking the air pressure, the following points should be noted:-

(a) Correct air pressure is dependent upon the oil level being correct (para. 14).

(b) The inflation valve on the strut is of the non-return type, therefore a reading will be obtained on the adapter gauge without slackening the valve.

(6) Turn the air pressure gauge in a clockwise direction until a stop is reached and a reading obtained. For correct inflation pressure refer to Sect. 2, Chap. 2

(7) Should the gauge indicate more than the required pressure, air should be released from the air release valve until the correct pressure is indicated.

If the air pressure is below the required amount:-

(8) Turn the gauge in an anti-clockwise direction until a stop is reached.

(9) Connect the tubing of a high pressure air supply (Ref. No. 4G/4221) to the inflation point of the adapter, using high pressure air charging apparatus as described in A. P. 1464G, Vol. 1, Part 2, Sect. 5, Chap. 17.

(10) Turn the pressure gauge in a clockwise direction until a stop is reached.

(11) Introduce air into the oleo leg from the high pressure air supply until the correct pressure is indicated on the gauge. When using an air bottle, care should be taken to open the valve as slowly as possible, and it should never be opened completely when a fully-charged air bottle is being used.

(12) Cut off the air supply.

(13) Turn the air pressure gauge in an anti-clockwise direction until a stop is reached.

(14) Disconnect the air supply connection from the adapter inflation point.

(15) Remove the inflation adapter from the inflation valve and replace the blanking cap.

(16) Lower the aircraft to the ground and remove the jacks and trestles.

#### Lubrication

16. The lubrication points, type of lubricant to be used and method of application are shown in 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 undercarriage must be function-tested.

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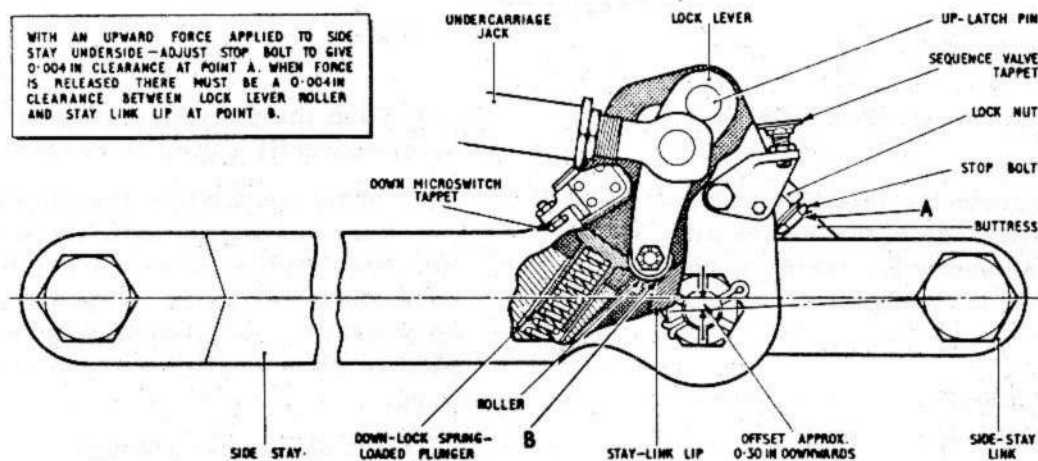


Fig. 6. Side-stay and stay-link alignment

Side stay and stay link alignment (fig. 6)

18. The side stays and stay links are in their correct alignment when the joint pin 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 adjustment be necessary, proceed as follows:-

- (1) Jack and trestle the aircraft as instructed in Sect. 2, Chap. 4.
- (2) Remove the lifting pin attaching the end-fitting of 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, and adjust the side-stay stop-bolt until the clearance between the stop-bolt and its abutment face on the stay-link measures 0.004 in.

▲ Tighten and wirelock the stop-bolt locknut. ▶

- (4) Release the force applied to the underside of the side stay and 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 may 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.
- (5) Extend the jack and replace and lock the lifting pin attaching the jack piston-rod end fitting to the downlock lever.

Jack settings

Main jack

19. The length of the stroke of the hydraulic jack must be checked after any servicing which may have affected its travel. If adjustment is necessary, proceed as follows:-

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

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- (2) Remove the lifting pin attaching the end-fitting of 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 (Sect. 3, Chap. 6). Disconnect the hydraulic pipes and connect the jack to a hydraulic test rig.
- (5) Pump the jack to the fully extended position.
- (6) Loosen the lock-nut on the jack piston-rod and adjust the length of the fully extended jack until the distance between the jack pin-centres exceeds the pick-up centres by  $0.15 + 0$  in.  
 $- 0.05$
- (7) Tighten and wire-lock the lock-nut on the jack piston-rod.
- (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 lifting pin.
- (9) Remove the rig and reconnect the hydraulic pipes to the jack. Prime and bleed the jack and function test the undercarriage (Sect. 3, Chap. 6).

Note...

The permitted travel of the jack piston-rod is  $11.22 \text{ in} \pm 0.045 \text{ in}$ .

#### Door jack

20. The pin centres of the door jack are nominally set at  $16.21 \text{ in} \pm 0.25 \text{ in}$ . This setting should not require alteration unless the overrides require adjustment. To adjust the settings, proceed as follows:-

- (1) Ensure that all hydraulic pressure is exhausted (Sect. 3, Chap. 6).

- (2) Remove the pin attaching the lower end of the door jack piston-rod to the lock lever.
- (3) Check the movement of the slave link (fig. 4) 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 with the door fully down. At the same time, examine the sequence valve to ensure that the plunger is only depressed 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; adjustments to the sequence-valve trip screw should be made as detailed in para. 23. There must be adequate clearance between the bottom of the slot and the eccentric bolt when the door is fully up, and the slave link must not foul anywhere throughout its travel.
- (4) Disconnect the hydraulic pipes at the door jack and connect it to a hydraulic test rig.
- (5) Remove the locking wire from the lock-nut and the splined nut at the end of the jack piston-rod and slacken the lock-nut.
- (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, it should be increased 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 lock-nut 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 0.020 in. If the override is greater or appreciably less, it should be adjusted by varying the amount of packing between the two parts of the lock lever; the packing is made up of 0.003 laminations (fig. 13).

(12) 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.

(13) With the door fully open, check again that the 0.020 in. maximum override is present by applying hand pressure to the lower inside edge of the door, it should be possible to rotate the pin securing the piston-rod to the lock lever.

(14) Disconnect the test rig, and reconnect the pipes to the jack. Bleed the air from the jack, and test the functioning of the undercarriage and door as instructed in Sect. 3, Chap. 6.

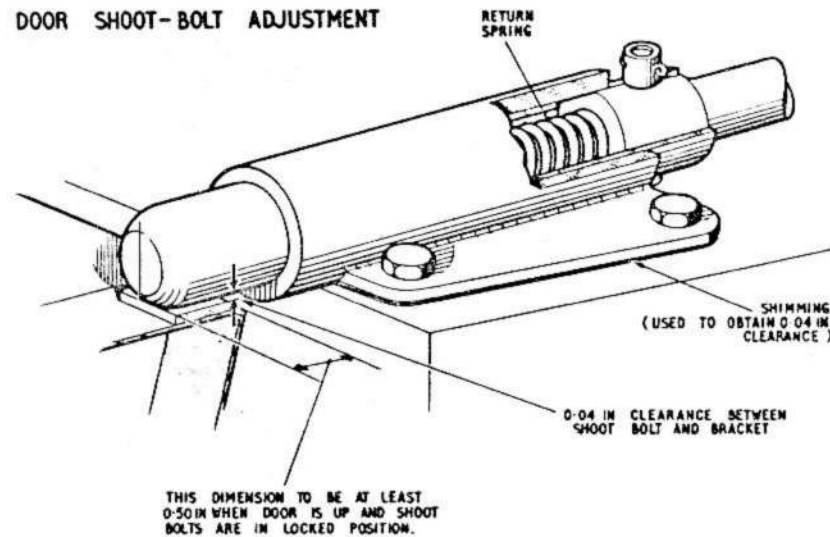
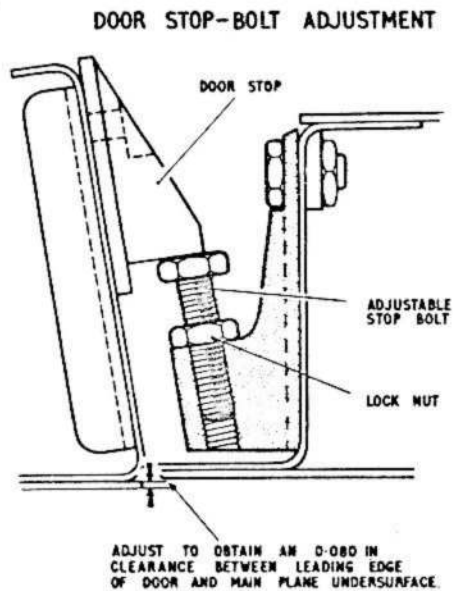


Fig. 7. Door adjustment points

## Door shoot bolt setting (fig. 7)

21. The operation of the door shoot-bolts must be checked after any servicing which may have affected their setting. With the aircraft jacked, the alighting gear down and the wheels clear of the ground, proceed as follows:-

- (1) Disconnect the door jack by removing the pin attaching the lower end of the door jack piston-rod to the lock lever.
- (2) Manually close the door and slacken the lock-nut at the fork end of the tie-rod between the lock lever and bell-crank lever.
- (3) Disconnect the tie-rod 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 minimum engagement shown in fig. 7 is achieved for each shoot-bolt; with the door unlocked there should be a clearance of 0.11 in. between the shoot-bolts and the pads with which they engage.
- (4) When the correct adjustment has been made, tighten the lock-nut on the tie-rod and reconnect the tie-rod to the bell crank lever.
- (5) Reconnect the door jack piston-rod to the lock lever.
- (6) Manually operate the door jack sequence valve and operate the hydraulic hand pump to test the operation of the door; recheck the adjustments.
- (7) Lower the aircraft to the ground.

## Door setting (fig. 7 and 13)

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. inside the wing contour; the door hinge shimming may also require adjustment to obtain this figure (para. 36). 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. 7).

## 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.  $\pm$  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 block (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 micro-switch must be adjusted (fig. 10).

#### Up-stop block setting (fig. 1)

25. A rubber or Tufnol block in the roof of the wheel well receives the impact made by the wheel axle towing eye when the undercarriage is retracted. This block is adjusted to obtain the correct clearance between the up-latch hook and up-latch pin (para. 24) by varying the shims between the block and bracket. When the undercarriage is fully raised adjust the shims beneath the block to give a clearance of 0.01 in. to 0.015 in. between the up-latch hook and up-latch pin (fig. 1). Access to the hook when the undercarriage is raised is gained through a panel in the main plane upper surface (Sect. 2, Chap. 4).

#### Torque-link tolerance and adjustment (fig. 9)

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 0.001 in. to 0.010 in. is allowed due to cumulative wear (Sect. 2, Chap. 6, App. 1). If the clearance exceeds 0.010 in., it must be rectified by adding a new bearing washer Ref. No. 26FZ/715 to bring about the original tolerance of 0.001 in. to 0.004 in.

#### 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. 10.

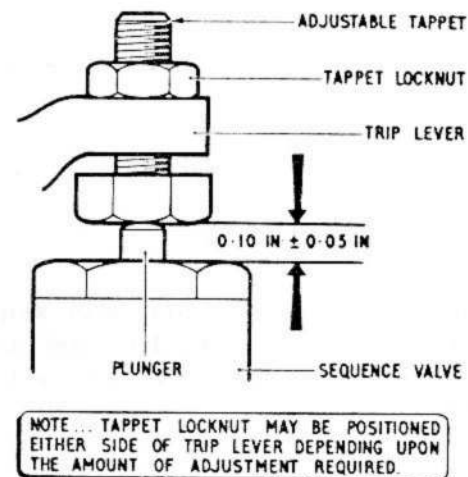


Fig. 8. Sequence-valve adjustment

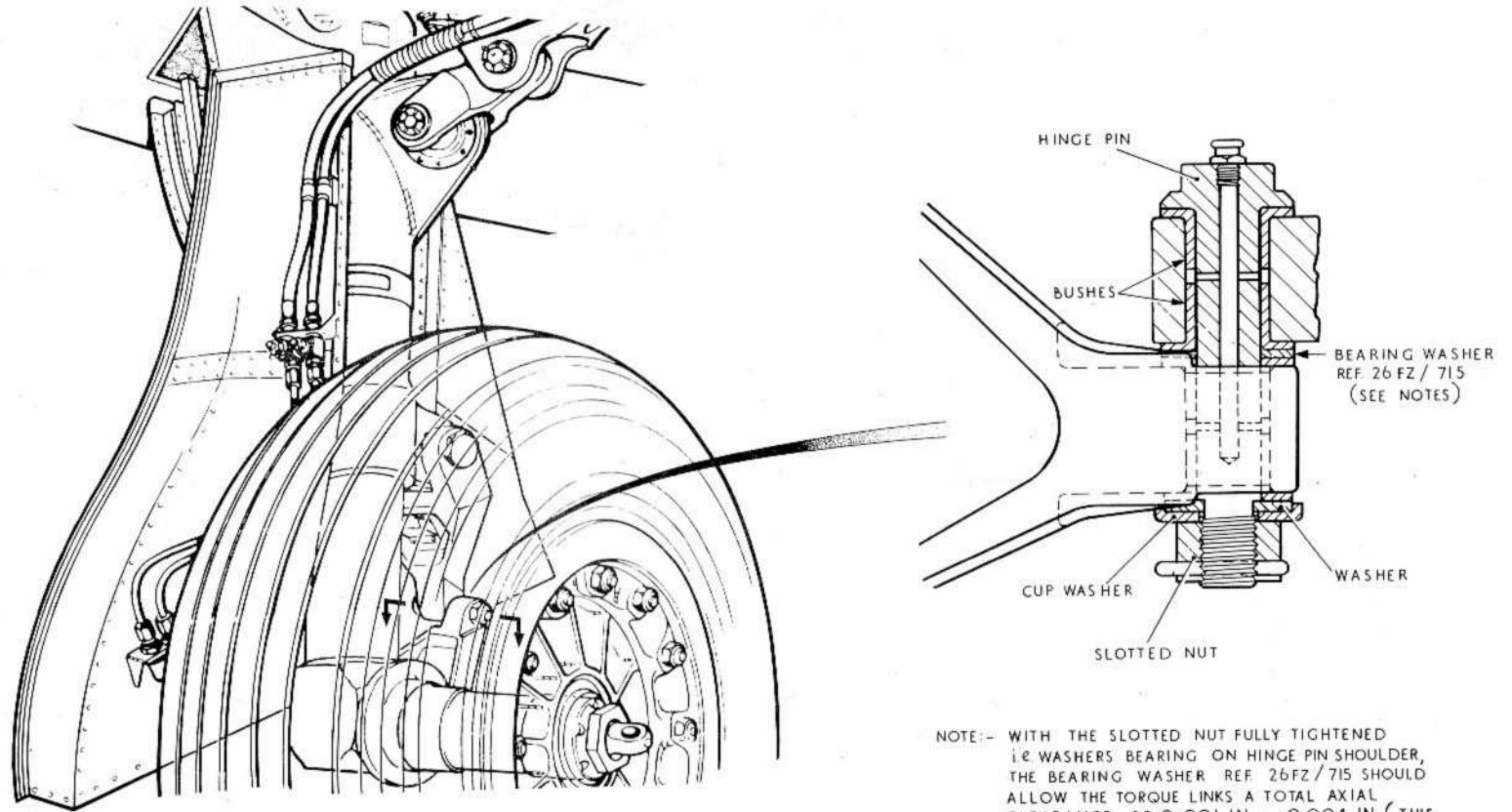
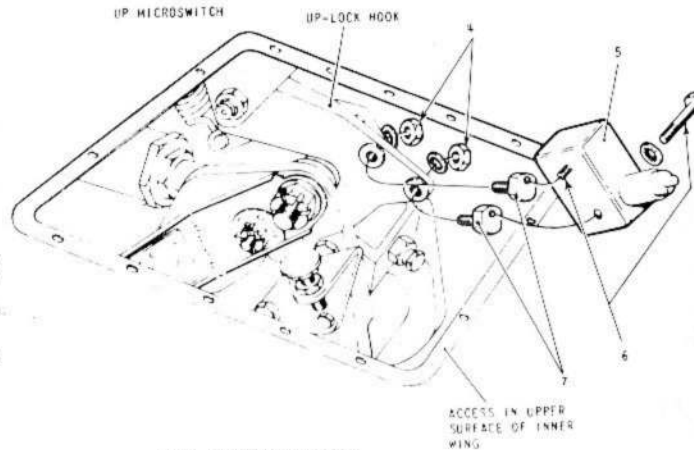


Fig.9 Torque link tolerance

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UP MICROSWITCH ADJUSTMENT WITH U/C IN THE UP POSITION

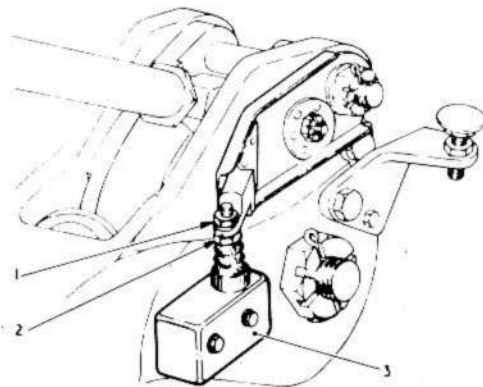
- 1 JACK AND TRESTLE THE AIRCRAFT WITH THE WHEELS CLEAR OF THE GROUND (SECT. 2, CHAP. 4).
- 2 CONNECT A 24 VOLT POWER SUPPLY TO THE EXTERNAL SUPPLY SOCKET AND CHECK THAT THE GREEN LIGHT IS ON.
- 3 REMOVE THE APPROPRIATE ACCESS PANEL FROM THE UPPER SURFACE OF THE MAIN PLANE INNER WING (SECT. 2, CHAP. 4).
- 4 SLACKEN THE NUTS (4) AND THE MICROSWITCH ATTACHMENT BOLTS (6) AND 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 (I.E. PARALLEL WITH THE ADJACENT BACK EDGE OF THE HOOK).
- 5 TIGHTEN THE ATTACHMENT BOLTS (6) AND NUTS (4).
- 6 USING THE AIRCRAFT HYDRAULIC HAND PUMP, FULLY RETRACT THE MAIN U/C (SECT. 3, CHAP. 6) AND APPLY FULL JACK PRESSURE. ENSURE THAT THE RED LIGHT COMES ON DURING THE OPERATION.
- 7 CHECK THAT WITH THE U/C UP-LOCK FULLY ENGAGED (SECT. 3, CHAP. 5A FIG. 1) THE RED LIGHT HAS GONE OFF.
- 8 MAINTAIN FULL JACK PRESSURE AND THROUGH THE ACCESS PANEL APERTURE LIFT THE HOOK CLEAR OF THE UP LATCH PIN AND CHECK THE RED LIGHT COMES ON. RETURN THE HOOK TO THE ENGAGED POSITION AND CHECK THE RED LIGHT HAS GONE OFF.
- 9 IN THIS CONDITION, CHECK THAT THE GAP BETWEEN THE MICROSWITCH BARREL AND THE SIDESTAY OPERATING FACE IS BETWEEN 0.08 IN. (14 S.W.G.) MIN. AND 0.13 IN. (10 S.W.G.) MAX. USING A FEELER PLATE OF THE APPROPRIATE THICKNESS.



- 10 IF THE MAX. GAP IS IN EXCESS OF 0.13 IN., SLACKEN THE NUTS (4) AND TURN THE ECCENTRIC BOLT HEADS (7) IN SEQUENCE (COUNTER-CLOCKWISE, PORT U/C; CLOCKWISE, STARBOARD U/C) TO DEPRESS THE MICROSWITCH PLUNGER FURTHER INTO THE OVERTRAVEL WITHIN THE LIMITS OF OP. 9.
- 11 EXHAUST THE JACK PRESSURE AND SELECT U/C DOWN (SECT. 3, CHAP. 6). USING THE AIRCRAFT HYDRAULIC PUMP, PUMP SLOWLY UNTIL THE D-DOOR UNLOCKS, PULL THE D-DOOR OPEN BY HAND TO THE USELAGE SIDE, OPERATING THE U/C DOWN SEQUENCE VALVE. CHECK THAT THE RED LIGHT DOES NOT COME ON.
- 12 IF DURING OP. 11 THE RED LIGHT COMES ON, REPEAT PROCEDURE DETAILED IN OP. 10.
- 13 SELECT U/C UP AND RETURN THE U/C TO THE FULLY RETRACTED POSITION.
- 14 RECHECK THE PLUNGER GAP TO OP. 9.

UP MICROSWITCH

DOWN MICROSWITCH



- 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 GIVE ANOTHER COMPLETE TURN.
- 5 TIGHTEN LOCKNUT (1) AND ENSURE THAT SOME PLUNGER MOVEMENT REMAINS (0.02" MIN)

NOTE AFTER ANY ADJUSTMENT OF THE UP OR DOWN MICROSWITCHES AN UNDERCARRIAGE RETRACTION TEST MUST BE MADE AND THE WARNING LIGHTS CHECKED.

THROTTLE MICROSWITCH

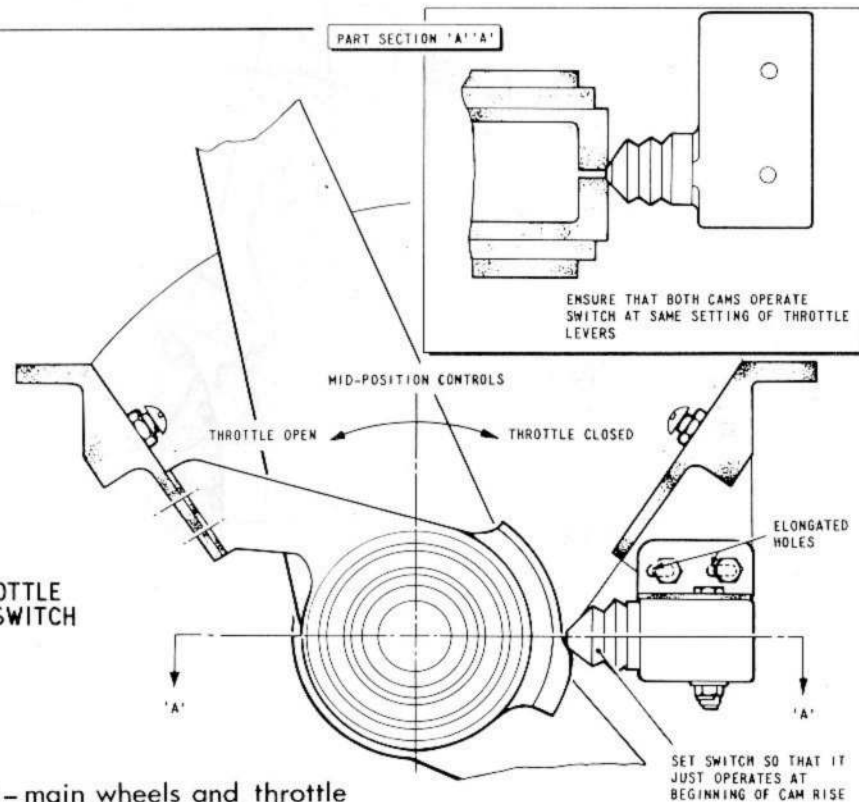


Fig.10. Microswitch adjustment - main wheels and throttle

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## Leg-fairing alignment (fig. 11)

28. The undercarriage leg 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. 2662B, Scheme 9.1.2) must be applied to all filed surfaces.

## New engine cowl flap-door fitting and adjustment

29. The flap-door is adjusted by means of the operating rod which connects it to the top of the shock-absorber strut. Adjustment is made until the flap-door is flush with the engine cowl skin when the undercarriage is fully retracted. When fitting a new flap-door the following procedure is to be adopted:-

- (1) Attach the flap-door to the engine cowl and connect the operating rod and check cable.
- (2) Remove the Tufnol blocks.
- (3) With the lower rear engine cowl fitted and the undercarriage retracted, file the trim allowance of the flap-door to ensure a butt fit on the cowl skin with the door flush.

## Note...

The correct protective treatment (A. P. 2662B, Sect. 1, Chap. 3) must be applied to filed surface.

- (4) Remove the top engine cowl, connect the operating rod to the shock-absorber strut bracket and adjust the operating rod until the flap-door is closed.
- (5) Fully slacken the check cable tension rod.
- (6) Lower the undercarriage.
- (7) Partially retract the undercarriage and fit the Tufnol blocks.

## Note...

Tufnol blocks are to be filed and trimmed to suit.

- (8) Lower the undercarriage.
- (9) With the flap-door in the open position, adjust the check cable tension rod until it is finger-tight and then slacken back one turn. Lock the tension rod.
- (10) Tighten the nut and peen over the bolt attaching the check cable to the flap door arm.

## REMOVAL AND ASSEMBLY

## General information

30. The following paragraphs present a guide to the recommended methods of removing and installing the principal components of the alighting gear.

## Note...

Ensure that all fluid pressure has been exhausted from the hydraulic systems (Sect. 3, Chap. 6) before disconnecting a hydraulic pipe. Blanking devices and/or covers must be fitted to all pipe ends, adapters, etc., as they are detached or removed. Care must be taken during installation to restore locking, bonding or sealing to its original condition.

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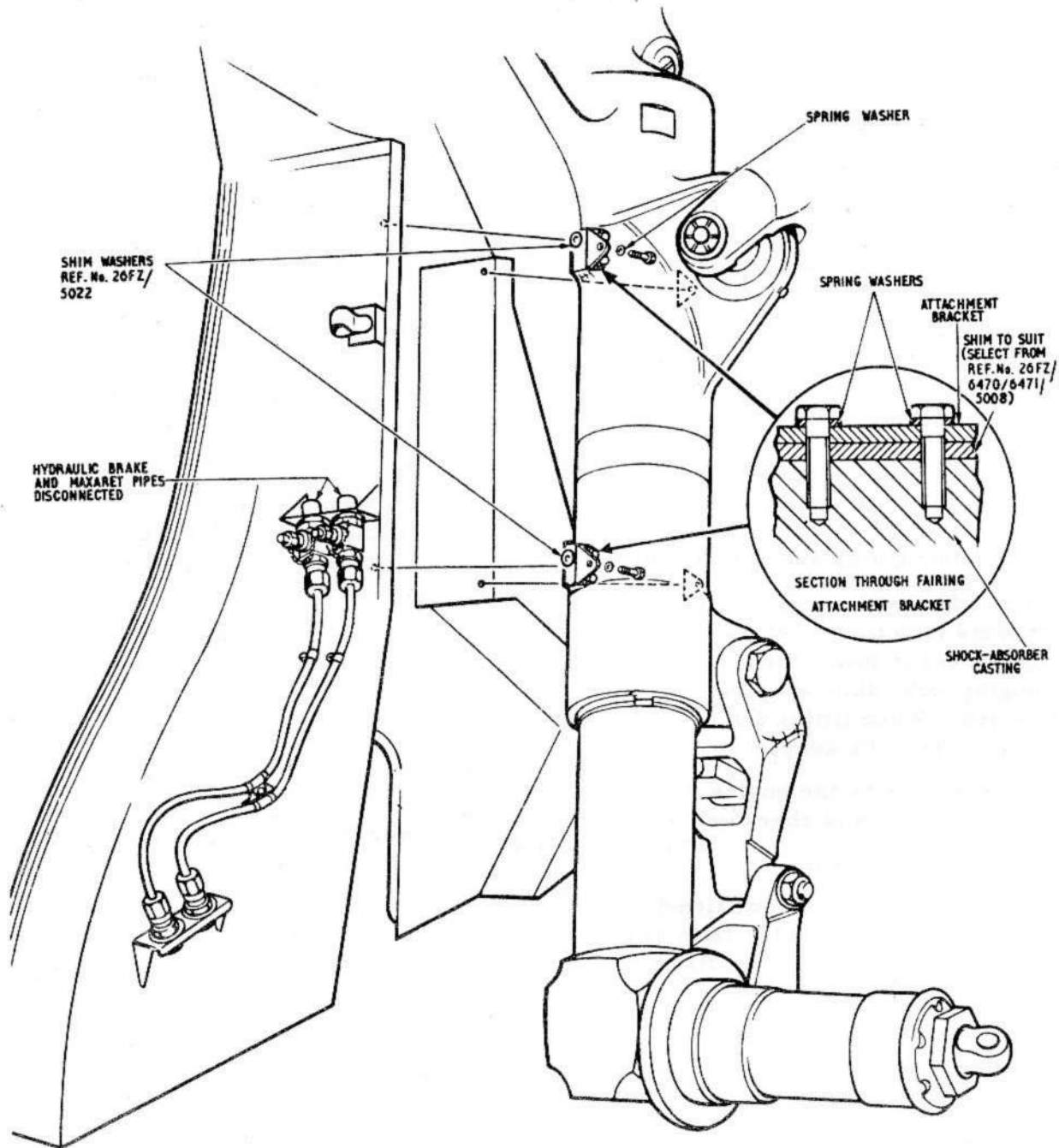


Fig. 11 Leg-fairing removal and assembly

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## Undercarriage (fig. 12)

## 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).
- (3) Remove the wheel and if necessary the brake unit (fig. 14) from the wheel axle. Blank off exposed hydraulic pipes and apertures.

## 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.

- (4) Remove the bolt from the oleo leg end of the flap door connecting rod (detail B).
- (5) Remove the engine bottom rear cowl (Sect. 4, Chap. 1).
- (6) Disconnect the wheel brake flexible hydraulic pipe from its connection at the bleed valve bracket on the spat fairing (fig. 12). Blank off exposed pipe ends.
- (7) Unclip the flexible hydraulic pipe from the top of the fairing.
- (8) Disconnect the flexible hydraulic pipe from the bracket at the bottom of the fairing. Blank off exposed pipe ends.
- (9) Remove the four fairing attachment bolts from the brackets of the shock-absorber strut,

remove the fairing and retain the shimming (fig. 11).

## 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.

- (10) Remove the hydraulic jack as instructed in Sect. 3, Chap. 6.
- (11) Disconnect the electrical cables from the down lock microswitch (detail A).
- (12) Remove the hydraulic pipes and electrical cables from the side stay. Coil and stow the electrical cables.
- (13) Remove the split nut from the stay-link bolt at the spherical joint on the shock-absorber strut casting, and withdraw the bolt (detail A).
- (14) Support the side stay and link and remove the locating plate from the side stay spherical pivot bolt (detail C).
- (15) Withdraw the side-stay pivot bolt and remove the side stay and link from the aircraft.
- (16) Remove the split pin from the slotted nut on the shock-absorber strut main pivot bolt and, using spanner Ref. No. 26FZ/95060, remove the nut. With the nut removed, withdraw the locking plate (detail B).
- (17) Support the strut and, using spanner Ref. No. 26FZ/95059, withdraw the strut pivot bolt (detail B). Remove the shock-absorber strut from the aircraft.

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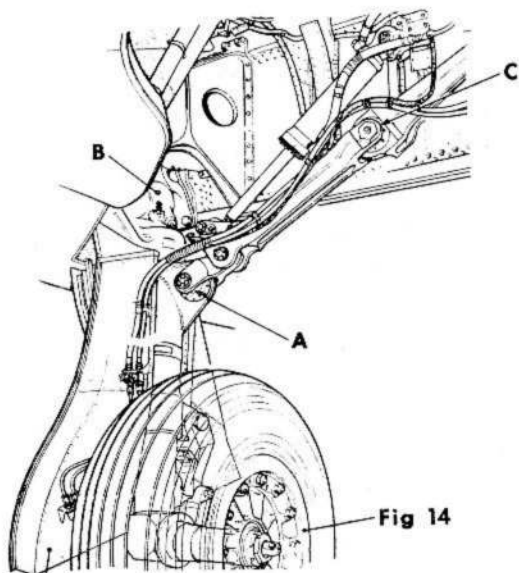
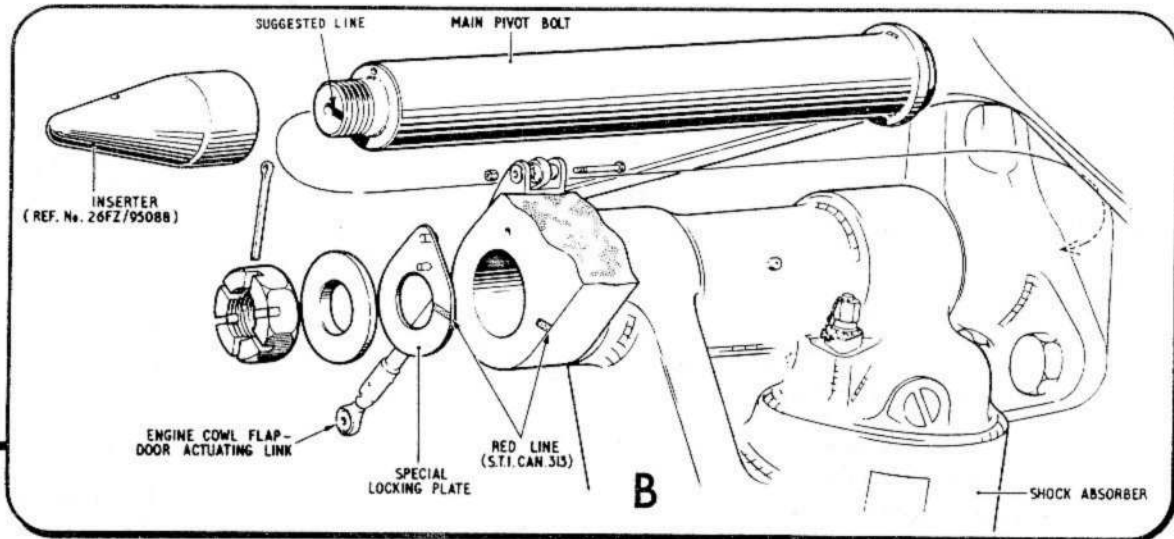
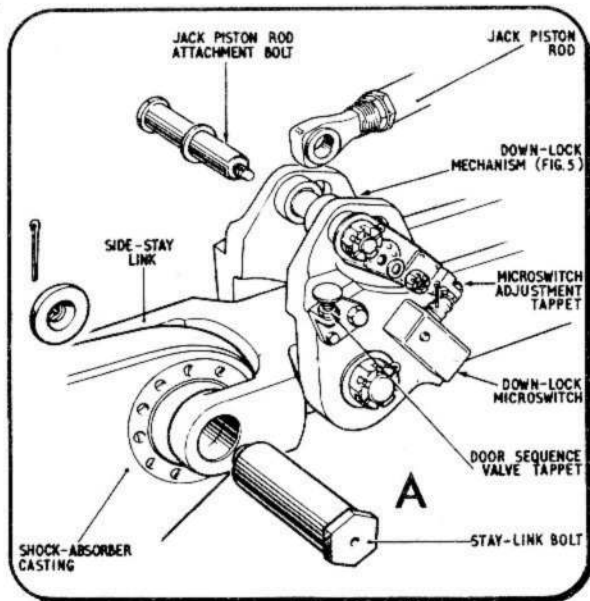


Fig 11

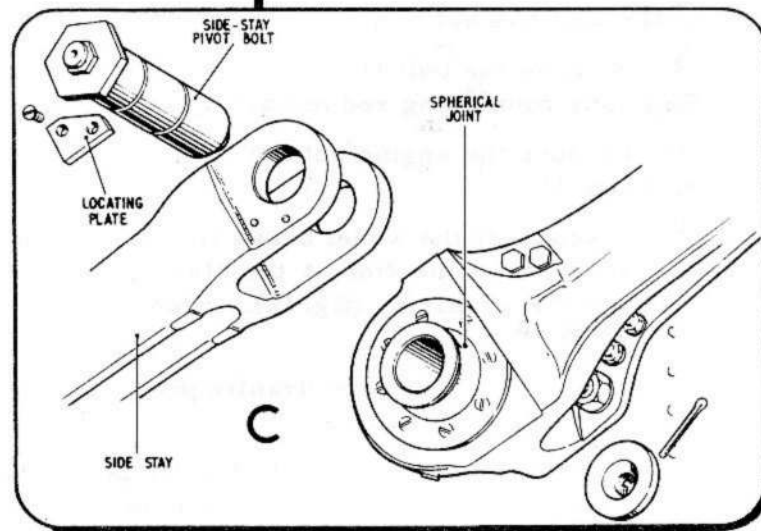


Fig. 12 Undercarriage removal and assembly

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## Note...

- (1) Should difficulty be encountered when removing the main pivot bolt, it may be found advantageous to screw inserter Ref.No.26FZ/95088 (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.
- (2) Access to the head of the main pivot bolt can be gained through a panel in the main-plane undersurface (Sect. 2, Chap. 4).
- (3) Care must be taken when handling a shock-absorber strut when the brake unit has not been removed.

## Assembly (fig. 12)

32. To assemble the undercarriage and its components:-

- (1) Fit the wheel to the axle (para. 38).
- (2) With inserter Ref. No. 26FZ/95088 (detail B) screwed on to the threads of the main pivot pin, assemble the shock-absorber strut, less spat-type fairing, to the main-plane pick-up point.
- (3) Remove the inserter and fit the pivot bolt locking plate, washer, slotted nut and split pin to secure the pivot bolt. (Shim as required between the washer and locking plate to align the split pin hole with the nut slots).

Note... On refitment of the main pivot bolt locking plate, check that the red line (S. T. I. CAN.313) 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 introduced by S. T. I. CAN. 313 will enable a check to be made, before tightening the nut, to ensure that the pivot bolt and locking plate are in line.

- (4) 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 C).
- (5) Fit the undercarriage jack at its main spar pivot attachment and lock the slotted nut with a split pin.
- (6) Connect a hydraulic test rig Ref.No. 4F/1685 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 pick-up point centres on the stay-link lock lever bolt (para. 19). Wire-lock the piston rod locknut.
- (7) 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.
- (8) Uncouple the up-latch hook return spring.
- (9) With the hydraulic test rig connected to the main jack, raise the undercarriage (2750 p. s. i.) 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 block in the wheel-well roof (para. 25).

## Note...

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).

(10) Lower the undercarriage and reconnect the up-latch hook return spring.

(11) Release the locknut of the sequence valve tappet on the side-stay knuckle joint, and screw the tappet as far as possible into the casting.

(12) 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.

(13) Check the up microswitch setting and adjust if necessary (fig. 10).

(14) Partly raise the undercarriage and attach the spat-type fairing to the shock-absorber strut in the reverse order of its removal (para. 31).

(15) 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).

(16) Lower the undercarriage and reconnect and clip the brake hydraulic pipes to the side-stay and leg fairing, leaving the clips partly tightened. Wire-lock the unions.

(17) Reconnect and clip the microswitch cables to the side stay and hydraulic pipes as shown in Sect. 5, Chap. 1, Group G. Leave the clips partly tightened.

(18) Check the setting of the down-lock microswitch and adjust if necessary (fig. 10).

(19) 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.

(20) Using the hydraulic test rig, raise and lower the undercarriage to check no setting has been disturbed.

(21) Disconnect the test rig and connect the hydraulic pipes to the undercarriage jack. Wire-lock the unions.

## Note...

Upon completion of the wiring and piping installation and before final tightening of the securing clips.

(1) Using the hand pump, fully retract and lower the undercarriage (Sect. 3, Chap. 6).

(2) Check that, at all points of travel (and with the undercarriage locked up and down), all pipes and cables are safely routed, do not chafe and are not trapped or stretched.

◀(22) Tighten all securing clips and tape the brake hydraulic pipes as detailed in Servicing Procedure S.P. 207 contained in A.P. 4326J, Vol. 5, Part 1, Bk. 3, Sect. 2, Chap. 1. ▶

(23) Prime and bleed the jack and brakes.

(24) Test the functioning of the undercarriage and brakes (Sect. 3, Chap. 6).

(25) 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.

Undercarriage door (fig. 13)

Removal

33. 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 front door hinge.
- (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

34. 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. 35).

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 AP101A-0600-6, scheme 9.1.2.

- (4) Adjust the door stop-bolt (para.22) until the door leading edge is 0.08 in inside the wing contour out-of-wind. If necessary adjust the shimming between the door forward hinge bracket and door (para.36).
- (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.36).
- (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 the list which follows, select the correct bolt and number of plain washers. Ensure that the bolt tail, when fully tightened, protrudes 0.02 in minimum.

Door locking lever bolt and shim details

Shim thickness (in.)	Bolt Part 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. 29W/9419403.

- (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 nuts, bolts, pins, and unions are correctly locked. ►

#### Door check links (fig. 13)

35. The door check link mechanism should not normally require any attention apart from normal periodic lubrication. 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 straight forward and requires no explanation.

#### Assembly notes and functioning:

- (1) Jack and trestle the aircraft (Sect. 2, Chap. 4) and remove the main undercarriage D-door jack lock lever bolt.
- (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. fulcrum bolts Ref. No. 26FZ/21081 are positioned with the heads on the inner faces of the links with the spacing washer between the hinge and the check links 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) Fit the slave link and adjust to the dimensions given on fig. 13.
- (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. 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 down position.

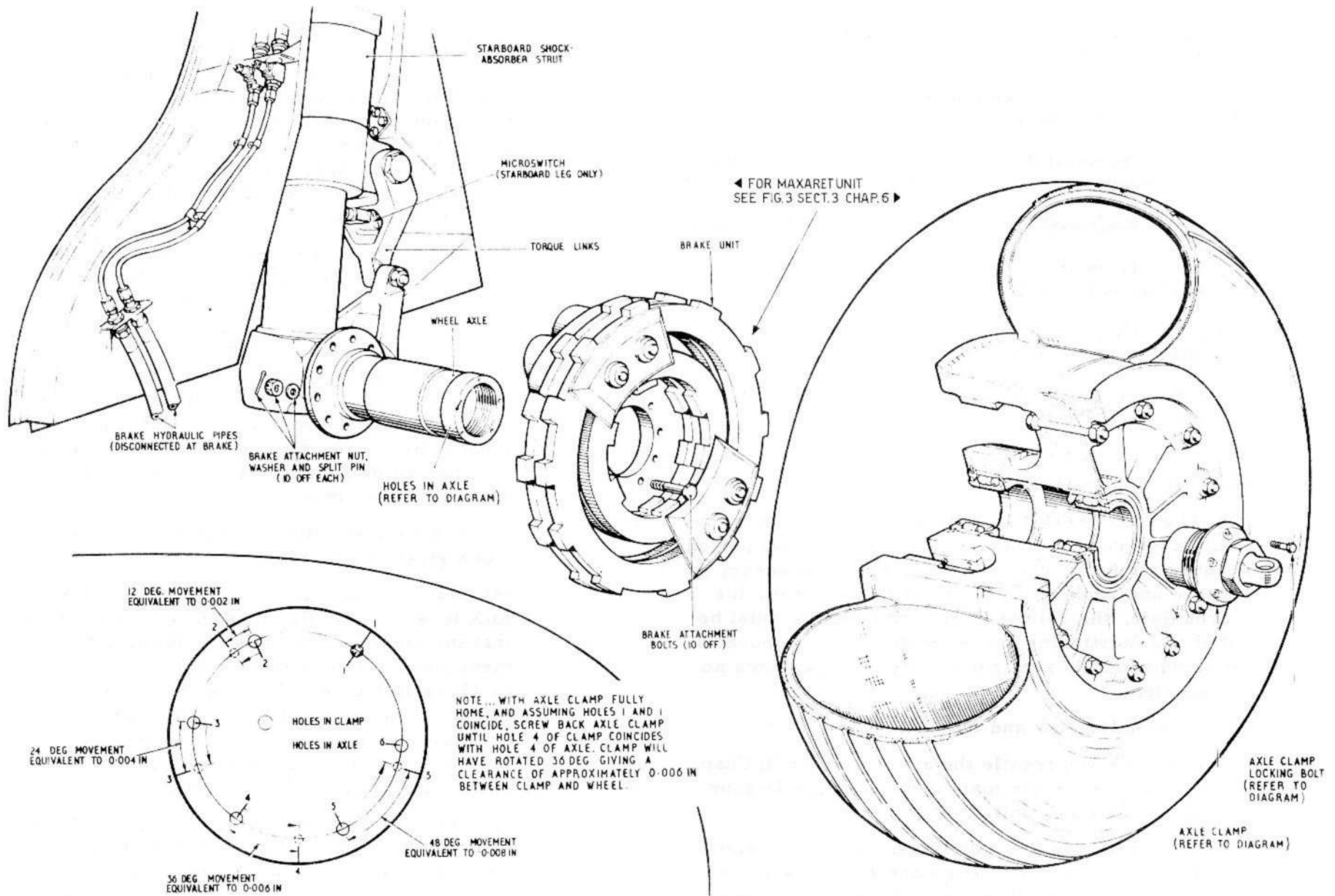


DIAGRAM SHOWING RELATIONSHIP BETWEEN HOLES IN AXLE CLAMP AND AXLE

Fig 14 Wheel and brake removal and assembly

(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.

Note. . .

With the check link fulcrum bolts removed, there will be no clearance between the top of the slave link slot and the eccentric bolt shank when the door is in the down position.

(7) Pull the door in an outboard direction and ensure that the mechanism is firm and that the sequence valve plunger is still depressed.

(8) 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.

(9) 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.

(10) Refit the main undercarriage jack lock lever bolt (para. 32).

(11) Function-test the undercarriage (Chap. 6).

#### Door hinges (fig. 13)

36. The amount of thread of a hinge bracket attachment bolt which passes into its anchor nut is critical. It is, therefore, important that, during re-assembly of the hinge brackets, the following notes be carefully observed.

Note. . .

Before re-assembly the hinges must be checked for excessive wear (A. P. 101B-0400-6, Part 1, Chap. 3).

(1) Forward hinge - the packing and shimming between the bracket and the door, plus the washer(s) Ref. No. 28W/9419475 (each 0.048 in. thick) used under the head of a bolt, must add up in thickness to between 0.15 in and 0.2 in. by choosing the appropriate number of washers for each bolt position.

Example:

With packing and full shimming (0.1265 in. total) fitted, one washer only is required under each bolt head. Without packing or shimming fitted, three washers are required under each bolt head.

(2) Aft hinge - the packing and shimming between the bracket and the door, plus the washer(s) Ref. No. 28W/9419475 (each 0.048 in. thick) used under the head of a bolt, must add up in thickness to between 0.2 in. and 0.25 in. by choosing the appropriate number of washers for each bolt position.

Example:

With packing and full shimming (0.1265 in. total) fitted, two washers are required under each bolt head. Without packing or shimming fitted, four washers are required under the head of the upper bolt and five washers under the heads of the four lower bolts.

Wheel

Removal (fig. 14)

37. To remove a wheel from the undercarriage, proceed as follows:-

(1) Jack the undercarriage as instructed in Sect. 2, Chap. 4.

(2) Ensure that the aircraft parking brake is

off (Chap. 6).

- (3) Unlock the brake piston rods by depressing the locking collar to free it from engagement with the cover plate. 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 Ref. No. 26FZ/95292 remove the wheel from the axle.

#### Assembly

38. When re-assembling the wheel it is important that the wheel bearing and brake clearances are correctly adjusted. To obtain these clearances the following sequence of operations must be observed:

- (1) Ensure that the wheel bearings are lubricated with grease XG-277.

Note...

Care must be exercised to avoid shock loads being transmitted to the Maxaret unit.

- (2) Slide the wheel on to the axle and when it is fully engaged with the brake tenons, free the brakes by depressing the locking collar and unscrewing the piston rods about two turns.
- (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 in. between the clamp and the wheel.  
- 0.000

Note...

Six locating holes for the locking bolt 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 contact is made between the brake plates and friction pads (about two turns). Screw back one and a quarter turns plus the amount necessary to engage the locking device (A. P. 2337, Vol. 1).
- (7) Function-test the operation of the brakes (Chap. 6).
- (8) Check the adjustment of the Maxaret unit in accordance with A. P. 1803S, Vol. 1.

Brake unit (fig. 14)

#### Removal

39. (1) Jack the undercarriage (para. 32).
- (2) Ensure that all hydraulic pressure is exhausted (Chap. 6).

- (3) Remove the wheel (para. 37).
- (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

40. (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. 38).
- (4) Function-test the operation of the brakes (Chap. 6).

Chapter 5B NOSE UNDERCARRIAGE  
(Completely revised)

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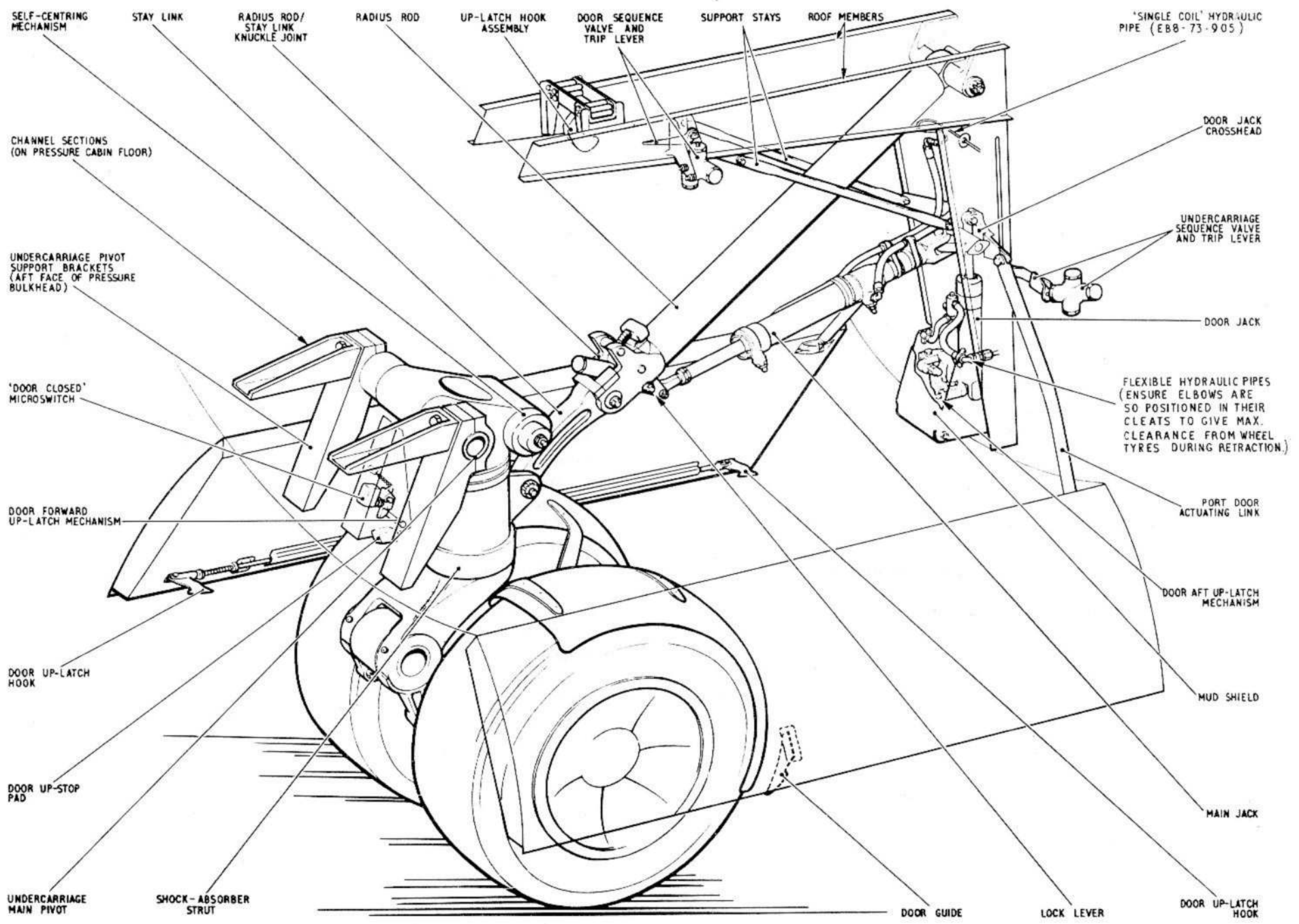


Fig.1 General view, looking aft

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## DESCRIPTION

## General information (fig. 1 and 2)

1. The nose undercarriage is the 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 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-timed 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 on 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 taxiing. 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 is a high tensile steel tubular strut incorporating at one end a fork fitting and, at the other, an eye-fitting; both fittings, which are of light alloy, are secured to the strut with threaded spokes and nipples. Components of the undercarriage lock mechanism are fitted to the fork; these include the down lock lever and spring-loaded latch pin, the up-latch pin, the 'up' and 'down' microswitches and up microswitch operating finger. The forged steel stay link, which connects the radius rod to the undercarriage main leg, is attached to the radius rod fork by a pivot pin. Forged integrally with the link at the radius-rod end are two lugs, one forming a stop which butts against a stop plate on the radius rod when the undercarriage is down, and the other a hook employed in the undercarriage down lock (para.8).

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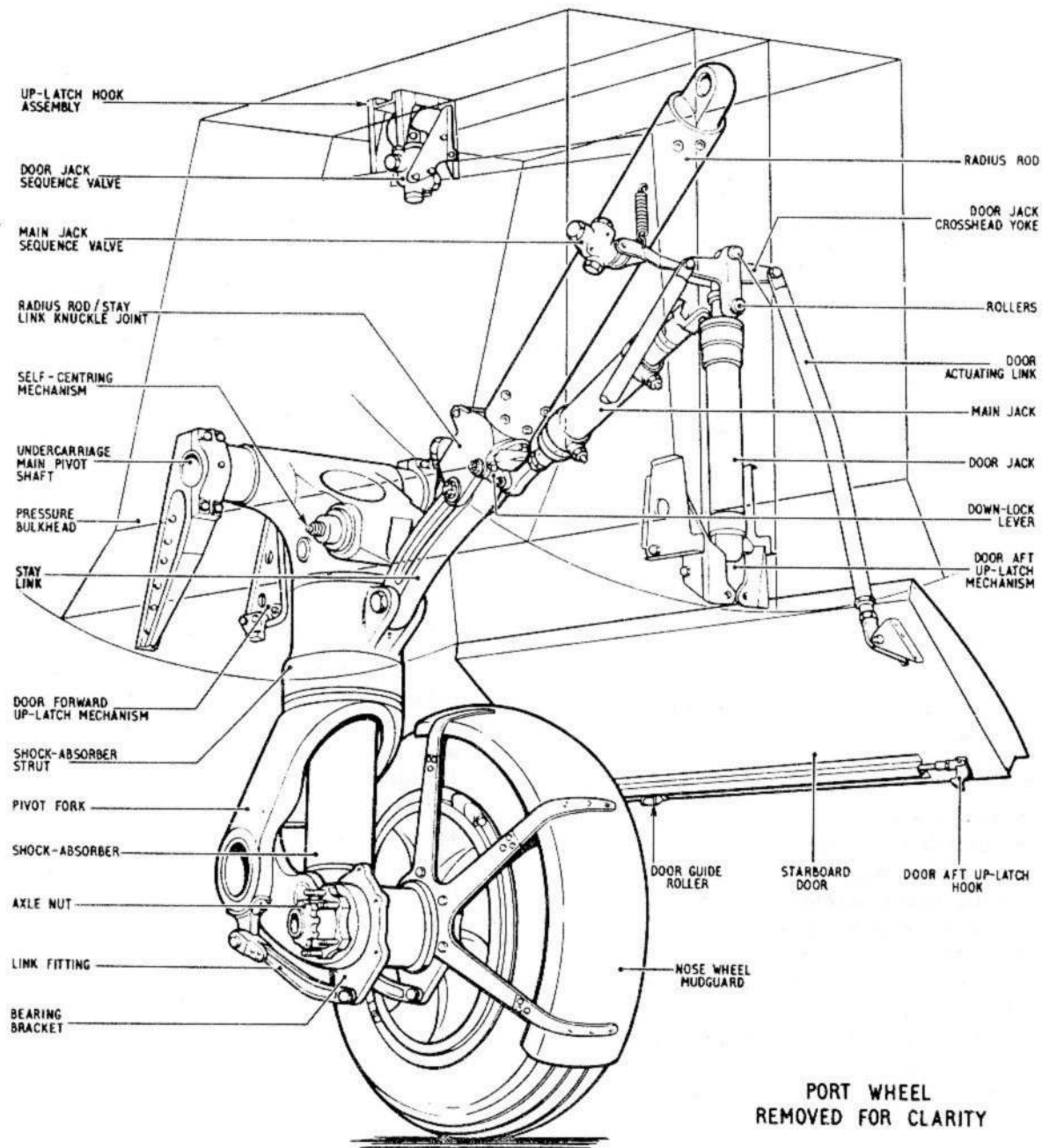
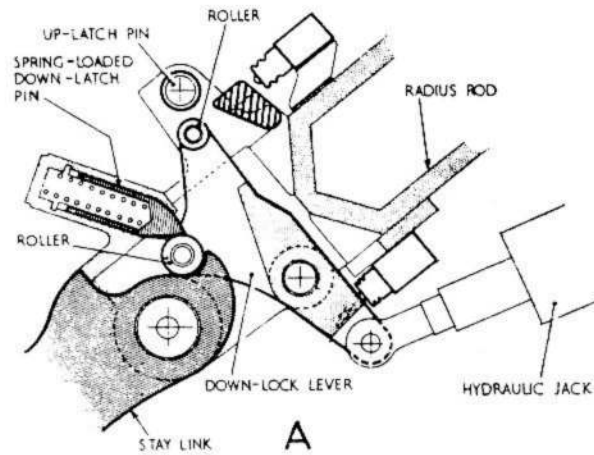
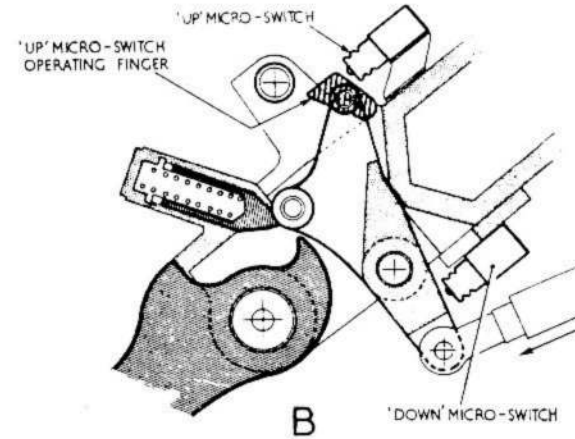


Fig. 2 General view, looking forward  
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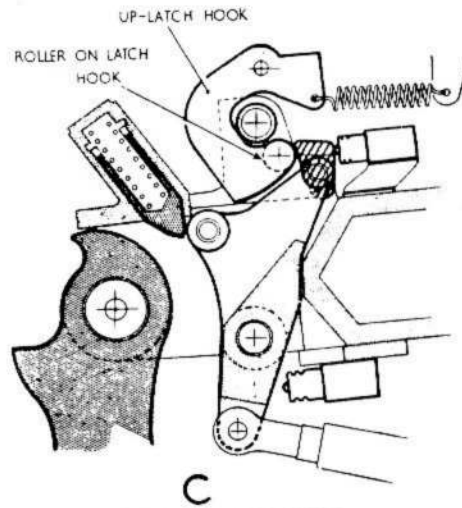
**A**  
**DOWN LOCK ENGAGED**

HYDRAULIC JACK FULLY RETRACTED, LOCK LEVER ROLLER ENGAGED WITH STAY LINK HOOK AND RETAINED BY DOWN LATCH PIN. DOWN MICRO-SWITCH DEPRESSED.



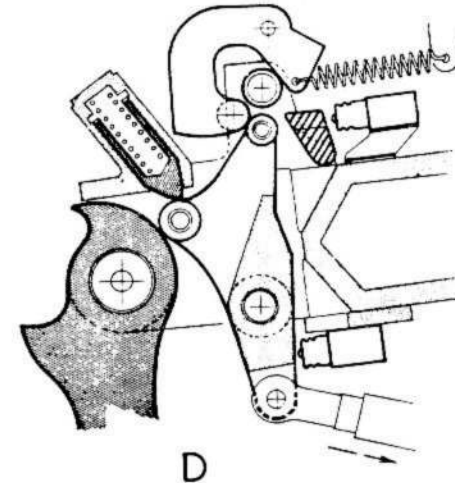
**B**  
**DOWN LOCK RELEASED**

LOCK LEVER MOVED ABOUT PIVOT BY INITIAL EXTENSION OF HYDRAULIC JACK. BOTH 'UP' AND 'DOWN' MICRO-SWITCHES RELEASED.



**C**  
**UP LOCK ENGAGED**

HYDRAULIC JACK FULLY EXTENDED, UP-LATCH HOOK ENGAGED WITH UP-LATCH PIN AND RETAINED BY HOOK. SPRING ROLLER ON UP-LATCH HOOK CONTACTING 'UP' MICRO-SWITCH OPERATING FINGER AND DEPRESSING SWITCH.



**D**  
**UP LOCK RELEASED**

LOCK LEVER MOVED ABOUT PIVOT BY INITIAL RETRACTION OF HYDRAULIC JACK; LOCK LEVER ROLLER CONTACTING UP-LATCH HOOK MOVES HOOK ABOUT PIVOT TO RELEASE UP-LATCH PIN. BOTH 'UP' AND 'DOWN' MICRO-SWITCHES RELEASED.

**Fig. 3 Undercarriage locking mechanism**

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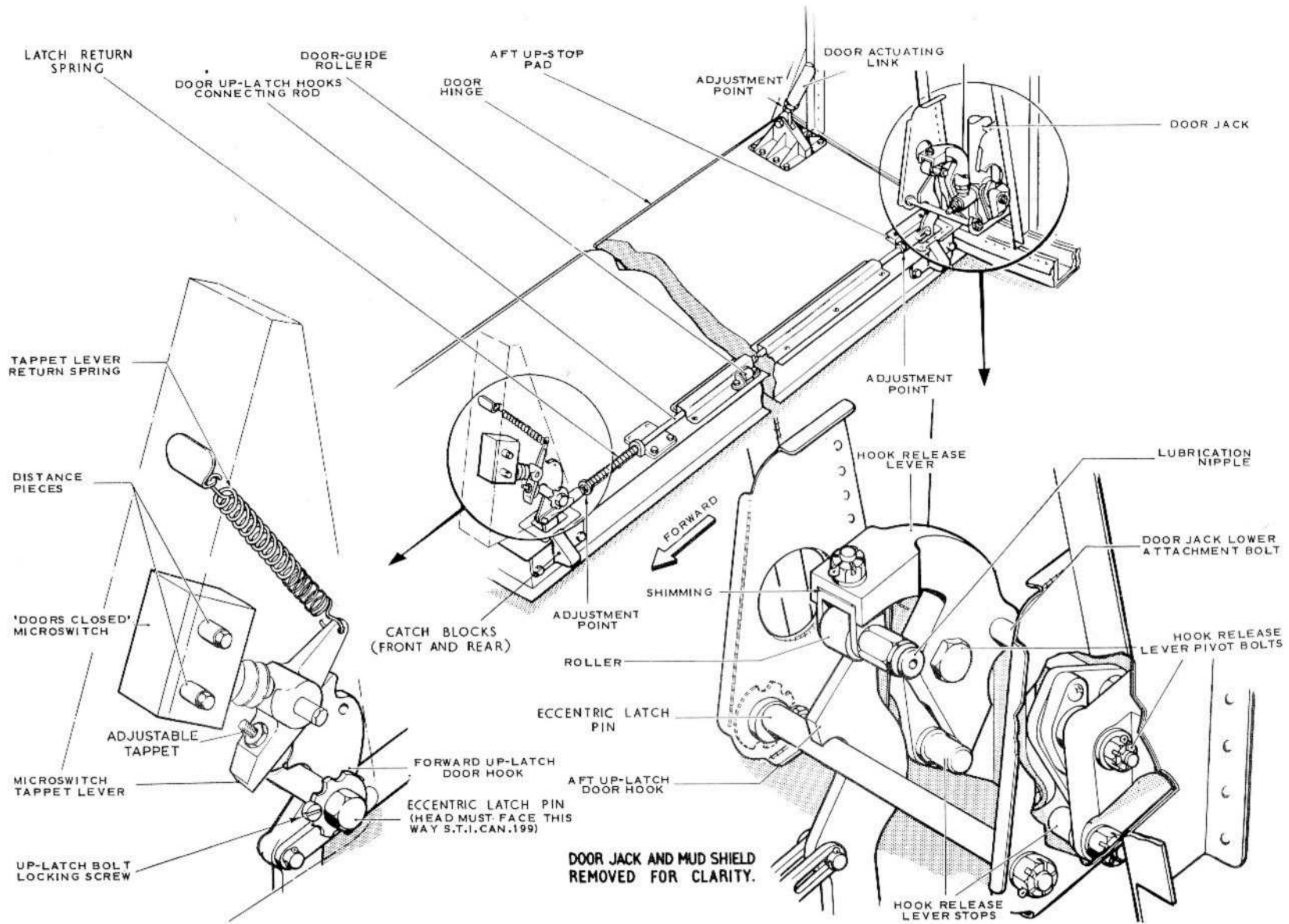


Fig. 4 Starboard door locking mechanism

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### 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. 3)

7. The nose undercarriage is locked 'up' by a latch hook which engages the latch pin on the radius rod fork. The latch hook assembly, consisting of the latch hook, an adjustable stop screw (which determines the locking position of the hook) and two up-stop pedestals, mounted on each side of the latch hook, is mounted between the two support beams in the roof of the undercarriage bay. A spring connected to an extension on the latch hook and to the fuselage structure, retains the hook in its locking position.

The retracting and lower sequences are as follows:-

#### Retracting

7A. When the undercarriage is retracting, the latch hook is moved about its pivot by the latch pin; as the pin rides over the nose of the hook, the hook, under the action of its spring, resumes its locking position and engages the latch pin. The up-travel of the undercarriage is limited by the latch pin lugs on the radius rod contacting the up-stop pedestals. The 'up' microswitch, in the alighting gear position indicator circuit (Sect. 5, Chap. 1) is mounted on the radius rod. When the latch hook engages the latch pin, a roller on the side of the hook contacts the switch operating finger and depresses the switch.

### Lowering

7B On selecting DOWN, the initial retraction of the hydraulic jack moves the down-lock lever about its pivot until the forward roller on the lever passes the spring-loaded down latch pin and bears against the hook lug on the stay link. During this movement, the upper roller on the lever contacts the nose of the up-latch hook and moves the hook about its pivot, releasing the up-latch pin and 'up' microswitch.

### Down lock mechanism (fig. 3)

8. The down-lock mechanism, fitted to the radius rod fork, consists of a lock lever, pivoted in the fork, and a spring-loaded latch pin. In the locked position, the forward roller on the lock lever engages the hook lug on the stay link and is retained in this position by the spring-loaded latch pin. The lock is operated by the hydraulic jack which is connected at its piston-rod end to the lock lever. When the undercarriage reaches its lowered position, the lock lever forward roller, which during the lowering movement has been bearing against the stay link hook lug, engages the hook. As the roller engages, the lower arm of the lock lever contacts and depresses the 'down' microswitch in the alighting gear indicator circuit (Sect. 5, Chap. 1). On selecting UP, the initial extension of the hydraulic jack moves the lock lever about its pivot until the lever bears against the end of the radius rod fork, releasing the lock and the 'down' microswitch.

### Door operating mechanism

9. The two doors are hinged to the underside of the fuselage, one each side of the undercarriage bay, and open outward and downward. They are operated by a single hydraulic jack mounted vertically, piston rod to the top, at the rear of the bay, the jack body being attached to the door latch release lever (para. 11) at the

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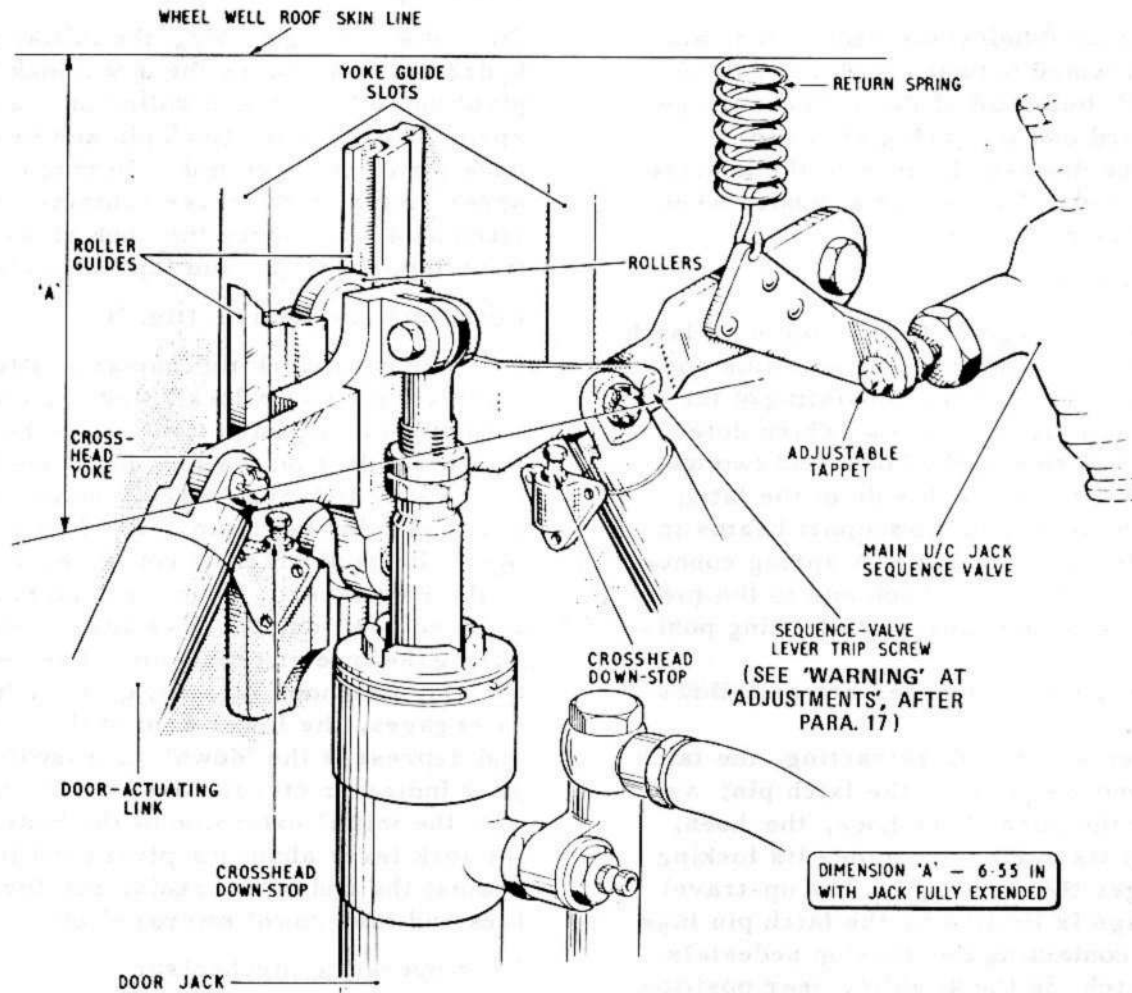


Fig. 5. Door jack crosshead arrangement

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bottom of the bulkhead. The jack piston rod is connected to a crosshead yoke (fig. 5) which is mounted on rollers running in a pair of guide rails fitted to the bulkhead between the two vertical support beams, the arms of the yoke extending through slots in the beams. Movement of the yoke in the guide rails, under the action of the jack, is transmitted to the doors by tubular actuating links connected to the arms of the yoke and brackets on the rear end of the doors, the jack extending to close the doors. Adjustable stop bolts, fitted to the vertical support beams, limit the downward travel of the yoke and pads, fitted to the arms of the yoke, operate, through spring-loaded levers and trip screws, the undercarriage jack sequence valves in the normal and emergency hydraulic circuits. Both doors are provided with front and rear up stops, the stop packings on the doors being adjustable by shimming to ensure a correct fit of the doors to the fuselage. The doors are shaped so that the forward ends close before the aft ends.

#### Door latching mechanism (fig. 4)

10. The doors are secured in the closed position by front and rear latches on the starboard door. The port door is held in the closed position by two bevelled catch blocks, fitted to the edge of the starboard door, which mate with corresponding inverted catch blocks on the edge of the port door. Each of the latches on the starboard door consists of a latch hook, pivoted in the door, which engages a latch pin mounted on the adjacent bulkhead. The latch hooks are connected together by a rod which is spring-loaded to retain the hooks in the locking position. A micro-switch, in the alighting gear position indicator circuit (Sect. 5, Chap. 1), is depressed when the doors are closed by a cam on a lever which is operated through a trip screw by the forward latch hook.

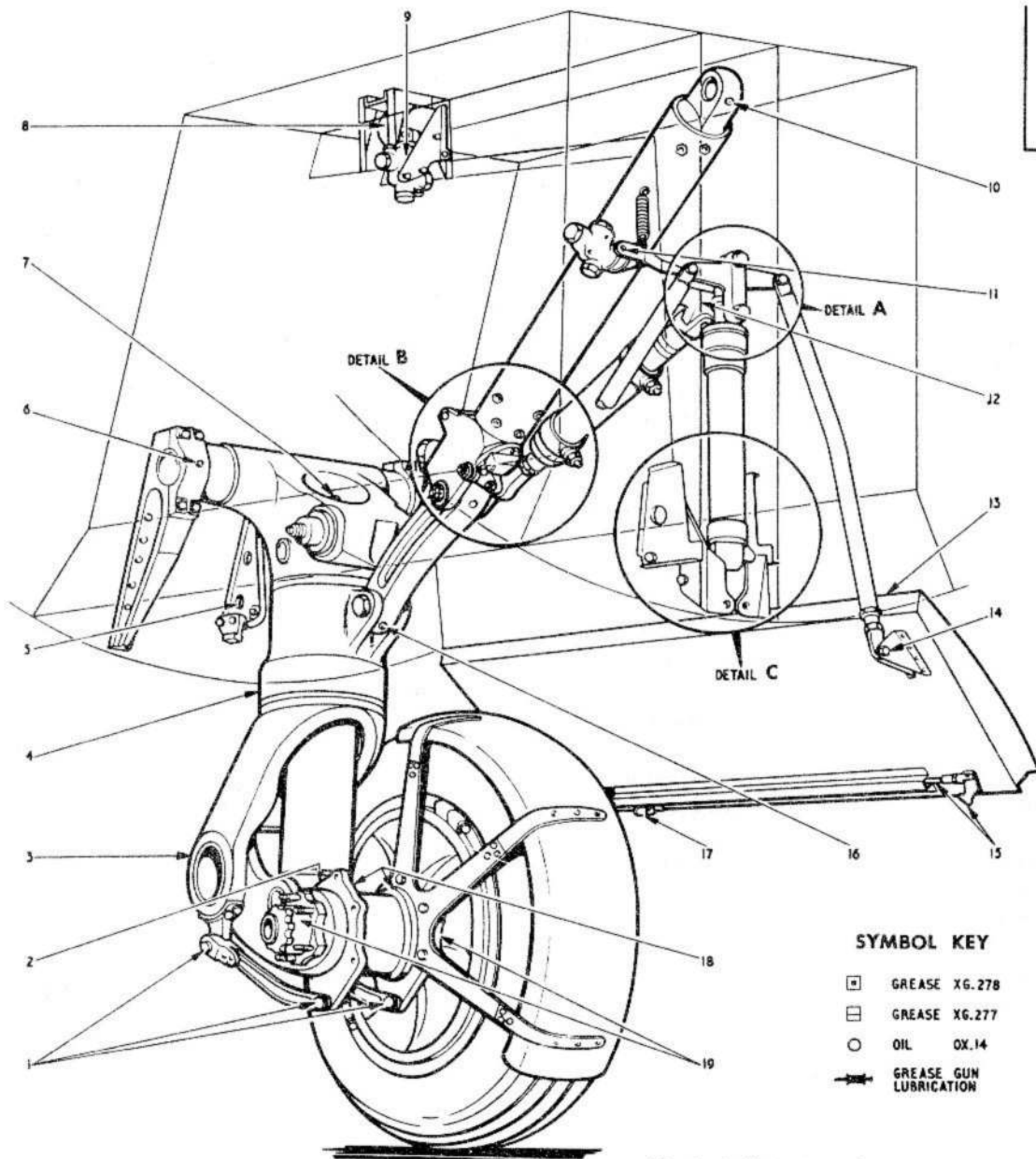
11. To open the doors, the latch hooks are disengaged from the latch pin by a hook release lever mounted on brackets secured to the rear bulkhead in the undercarriage bay. The release lever is pivoted about its centre, the lower arm being connected to the door jack pivot pin and the upper arm carrying a striker roller. On selecting alighting gear DOWN, an upward movement of the door jack body, due to the initial retraction of the jack, moves the release lever about its pivot causing the striker roller to contact and release the rear latch hook out of engagement with its latch pin, the movement of the rear latch hook releasing the front hook simultaneously. Continued retraction of the jack brings the lower arm of the release lever into contact with the bulkhead and, thus provided with this positive reaction point, opens the doors. When the undercarriage is raised, the initial extension of the door jack moves the release lever about its pivot until the lower arm contacts a stop on the lever bracket, thus providing a positive reaction point for the jack. Continued extension of the jack closes the doors. During the final closing movement, the latch hooks contact their latch pins and are moved rearward until the doors are fully closed; then, under the action of the connecting rod spring, resume their locking position engaging the latch pins.

#### Principle of operation

##### Raising

12. When UP is selected, hydraulic pressure is applied simultaneously to both undercarriage and door jacks, but only the undercarriage jack operates because a sequence valve in the door jack return line was closed when the unit was down. The initial extension of the jack releases the down lock (para. 20) and continued extension raises the unit until it engages the up-latch hook (para. 7). At

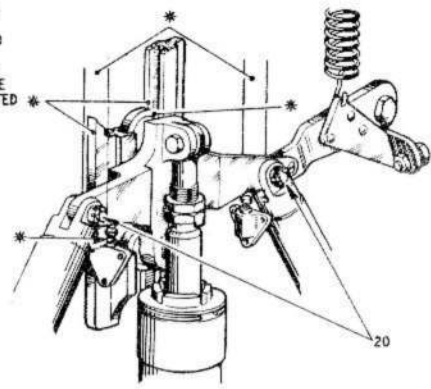
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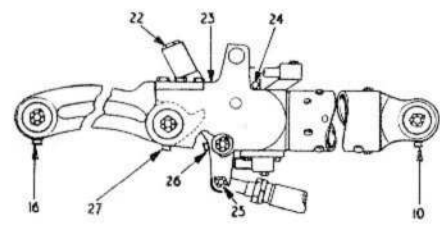
**SYMBOL KEY**

- ▣ GREASE XG.278
- ▢ GREASE XG.277
- OIL OX.14
- GREASE GUN LUBRICATION

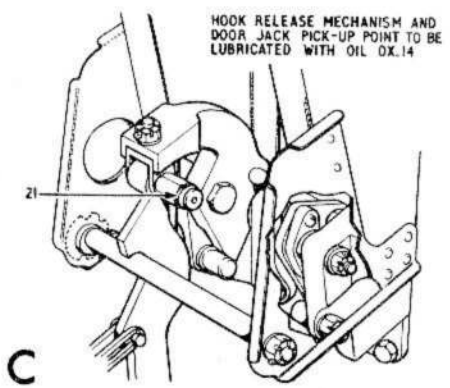
CROSSHEAD ROLLERS, ROLLER GUIDES, AND YOKE GUIDES DENOTED THUS \* ARE TO BE THOROUGHLY WASHED DOWN WITH KEROSENE AND LIBERALLY LUBRICATED WITH OIL OX.14



**A**



**B**



**C**

HOOK RELEASE MECHANISM AND DOOR JACK PICK-UP POINT TO BE LUBRICATED WITH OIL OX.14

Fig.6 Lubrication diagram  
RESTRICTED

## KEY TO FIG. 6 (LUBRICATION DIAGRAM)

1	LINK PIVOTS	○	15	DOOR LATCH HOOKS AND CONNECTING ROD	○
2	SHOCK-ABSORBER ATTACHMENT	→→□	16	STAY-LINK PIVOT	→→□
3	TORQUE-LINK PIVOTS (2 NIPPLES)	→→□	17	DOOR GUIDE ROLLER	○
4	PIVOT FORK BEARING	→→□	18	MUDGUARD ATTACHMENT BEARINGS (2 NIPPLES)	→→□
5	FORWARD UP-LATCH TAPPET RETURN SPRING AND PIVOT	○	19	WHEEL BEARINGS	→→□
6	MAIN PIVOT BEARINGS (2 NIPPLES)	→→□	20	ACTUATING-LINK PIVOTS	○
7	SELF-CENTRING MECHANISM	→→□	21	HOOK RELEASE LEVER ROLLER	→→□
8	UP-LATCH HOOK MECHANISM	○	22	SPRING HOUSING (UPPER PART ONLY)	□
9	DOOR SEQUENCE-VALVE MECHANISM	○	23	LOCK LEVER ROLLERS	□
10	RADIUS ROD PIVOT	→→□	24	MICROSWITCH TAPPET AND LEAF SPRING	○
11	UNDERCARRIAGE SEQUENCE VALVE MECHANISM	○	25	JACK PISTON ROD PIVOT	→→□
12	UNDERCARRIAGE JACK PIVOT	→→□	26	LOCK-LEVER PIVOT	→→□
13	DOOR HINGES	○	27	RADIUS ROD/STAY LINK PIVOT	→→□
14	ACTUATING-LINK PIVOTS	○			

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this point, the radius rod contacts the door jack sequence valve trip lever, which depresses the valve plunger and opens the valve, thus releasing the return fluid in the door jack. The door jack then extends, closing the undercarriage jack sequence valves during its initial movement.

Lowering

13. On selecting DOWN, hydraulic pressure is again applied to both the undercarriage jack and door jack, but since the undercarriage jack sequence valves were closed when the unit was retracted, only the door jack operates. The initial retraction of the jack releases the door latches (para. 10) and continued retraction opens the doors. During the final movement of the jack, the pads on the arms of the cross-head yoke contact the undercarriage sequence valve levers, which depress the valve plungers and open the valves, thus releasing the return fluid in the undercarriage jack. The initial retraction of the undercarriage jack, releases the up-latch hook (para. 7) and continued retraction lowers the unit and engages the down lock. At the commencement of the lowering movement, the radius rod releases the door jack sequence valve lever and closes the valve.

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.

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 new one 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 renewed.

Checking and correcting shock-absorber oil pressure

16. If the shock-absorber leg 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 nose of the aircraft (Sect. 2, Chap. 4).
- (2) Remove the plug from the charging valve at the lower end of the shock-absorber.
- (3) Attach a flexible charging adapter (Ref. No. 27Q/14103) to the charging valve and attach a universal lubricating gun (Ref. No. 1B/4467), filled with fluid OM-15, to the adapter.
- (4) Charge the shock-absorber, by operating the gun, to a pressure of 1,500 lb. p. s. i.

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(5) Remove the lubricating gun and adapter and replace the plug in the charging valve.

(6) Lower the aircraft and recheck the leg extension dimensions (Sect.2, Chap.2).

#### Lubrication

17. The lubrication points, type of lubricant to be used and method of application are shown in fig.6.

#### ADJUSTMENTS

#### General information

◀ **WARNING: IF THE SEQUENCE-VALVE TRIP SCREW (FIG.5) IS DISTURBED IT MUST BE RESET AND CORRECTLY LOCKED USING A NEW SPLIT PIN.** ▶

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 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 GROUND/FLIGHT selector valve to GROUND isolates the main undercarriage units and prevents them retracting (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 alignment (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. This dimension is governed by the jack length and, for that reason, can be measured only when the jack is connected and under hydraulic pressure with its overrides previously set (para.20). 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) Select GROUND on the GROUND/FLIGHT selector valve and partly raise the undercarriage by operating the aircraft hand pump.

(2) Remove the stop-plate by unscrewing its securing bolts and adjust the shimming Ref. No.26FZ/6146 as necessary. Refit the stop-plate.

(3) Select FLIGHT on the GROUND/FLIGHT selector and fully lower the undercarriage by operating the aircraft hand pump.

(4) Release the hydraulic pressure and applying an upward force to the radius rod/stay link joint, check that the 0.004 in. clearance has been obtained (fig.7).

#### Jack travel adjustments

#### Undercarriage jack

20. The correct setting between the jack pin centres

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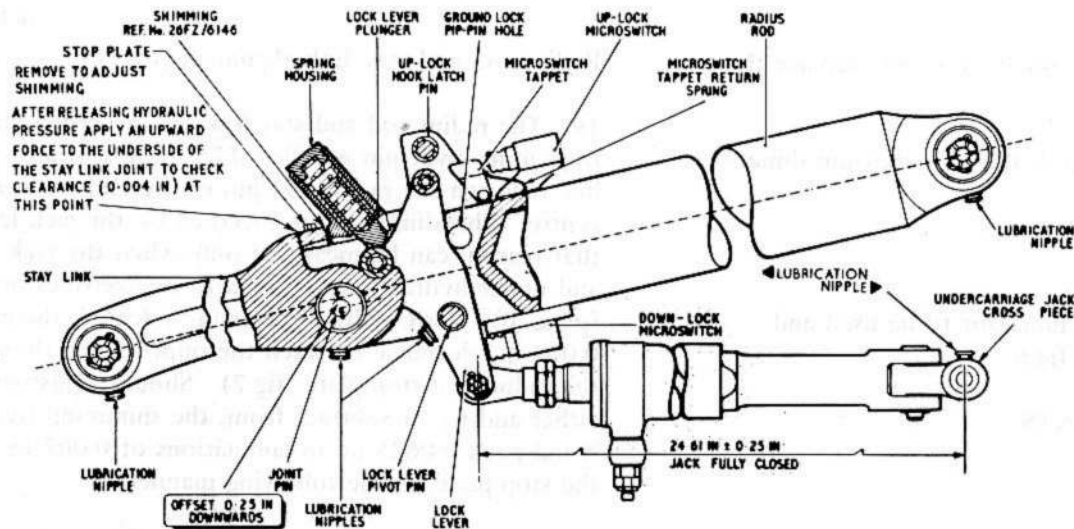


Fig 7 Radius rod / stay link alignment

is 24.61 in. when the jack is fully retracted. If adjustment is necessary, proceed as follows:-

- (1) Jack and trestle the aircraft (Sect. 2, Chap. 4).
- (2) Disconnect the jack piston-rod from the lock lever by removing its attachment bolt.
- (3) Disconnect the radius rod from the shock-absorber strut by removing the stay link lower pivot bolt (para. 27).

Note...

The radius rod assembly must not be allowed 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 Ref.No. 26FZ/30521 situated on the

aft bulkhead immediately below the radius rod upper pivot attachment (fig. 1).

- (4) Unlock the nose undercarriage GROUND/FLIGHT selector and select GROUND (Sect. 3, Chap. 6), and operate the hydraulic hand pump to fully extend the jack.

Note...

The main undercarriage units are isolated and will not retract.

- (5) Loosen the lock-nut on the jack piston-rod and, with the radius rod pushed hard against the up-latch stops, adjust the length of the jack until the distance between the jack pin centres exceeds the distance between the centre of the piston-rod attachment hole

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in the lock lever, and the centre of the jack attachment hole in the fuselage structure, by 0.18 in.  $\pm$  0.02 in. Do not reconnect the jack at this stage.

(6) Reconnect the radius rod to the strut in the DOWN position.

(7) Select FLIGHT on the selector, and operate the hand pump to fully close the jack.

Note...

It is essential 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. 16.

(8) Check that the distance between the centre of the piston-rod attachment hole in the lock-lever, and the centre of the jack attachment hole in the fuselage structure, exceeds the distance between the jack pin centres by 0.22 in.  $\pm$  0.04 in.  $\blacktriangleleft$   $\blacktriangleright$  - 0.05 in.

Note...

Check that the lock lever is correctly positioned by inserting the quick-release locking pin (Sect. 2, Chap. 1) in the hole in the lower end of the radius rod. Remove the locking pin before continuing with the adjustment.

(9) With the nose undercarriage GROUND/FLIGHT selector at GROUND, apply pressure to extend the jack until the piston-rod eye and the hole in the lock lever are in alignment, then fit the connecting bolt.

(10) Tighten the lock nut on the jack piston-rod, and wire-lock.

(11) Reselect the GROUND/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 0.004in. (fig. 7). Should adjustment be necessary refer to para. 19.

(12) Lock the ground-operated selector in the FLIGHT position.

Door jack

21. The distance between the pin centres of the door jack when fully closed must not exceed 16.21in.  $\pm$  0.25in; the jack piston rod travel is 9.19in.  $\pm$  0.06in. 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 6.55in. 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, (Chap. 6). Disconnect the actuating links from the door (para. 28).

(2) Select GROUND on the nose undercarriage GROUND/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.

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(4) Adjust the jack length by turning the eye-end one half turn at a time, re-inserting 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 6.55in. is obtained (fig. 5, dimension A).

(5) Tighten and wire-lock the piston rod lock-nut.

(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;  $54.50\text{in} \pm 0.50\text{in}$ . measured between the outer edges of their outer skins.

(9) Refit the undercarriage jack to the aircraft (Chap. 6).

Note...

Ensure that the lower ends of the two flexible hydraulic pipes (UD and UDE) which connect to the shuttle valve on the door jack, are positioned in their cleats on the mud shield to provide the maximum possible clearance between their elbow unions and the wheel tyres during undercarriage retraction.

Up-latch mechanism (fig. 8)

22. The following information covers the installation of a replacement up-latch hook and/or bracket assem-

bly. 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 (para. 28).

(4) Disconnect the jack piston rod from the radius rod lock lever (Chap. 6).

Note...

The radius rod assembly must not be allowed 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 Ref. No. 26FZ/30521 situated on the aft bulkhead immediately below the radius rod upper pivot attachment (fig. 1).

(5) Remove the pivot pin attaching the radius rod stay link to the undercarriage strut (para. 27).

(6) 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.

(7) Assemble the hook bracket, less shims, to

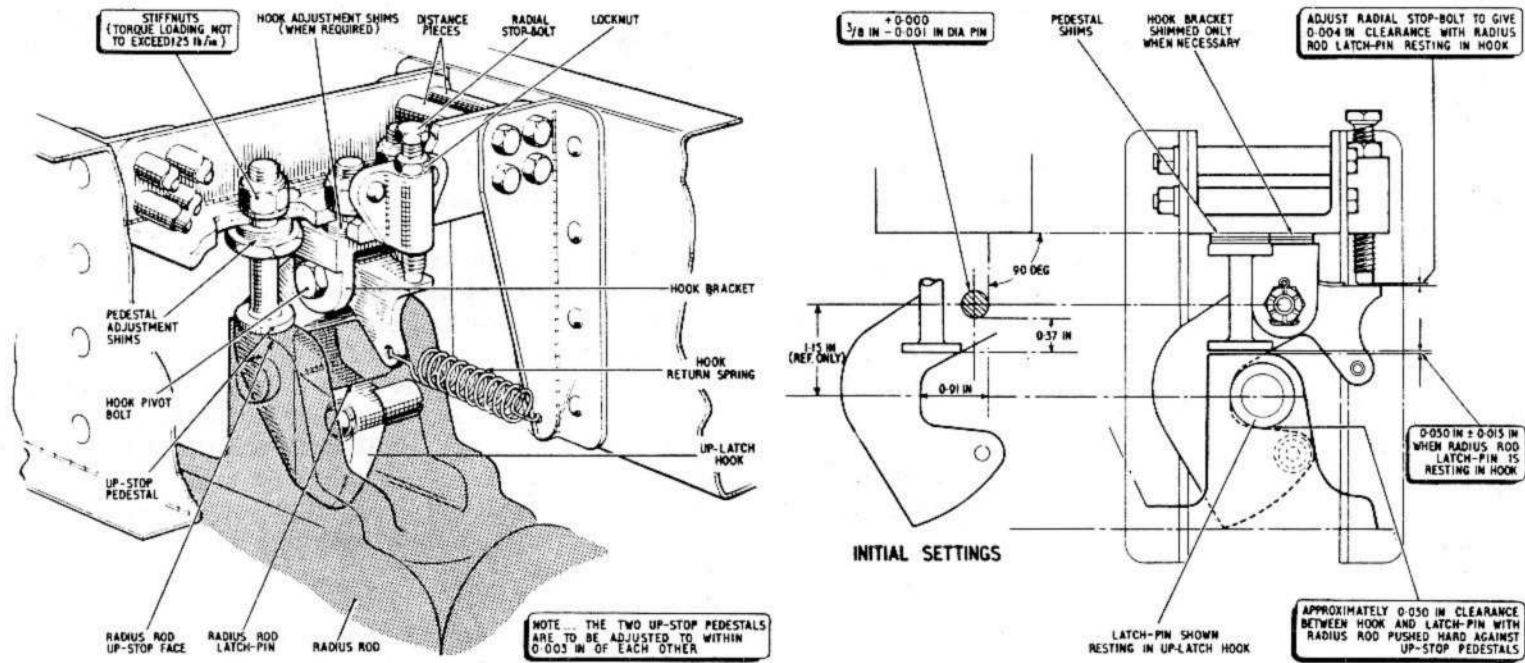


Fig. 8. Up-latch hook setting (1)

the well roof structure and secure with a stiffnut.

(8) Assemble the up-stop pedestals, complete with shims, and secure with stiffnuts.

Note...

The torque loading on the hook and pedestal stiffnuts must not exceed 125 lb. in.

(9) Refer to fig. 8 and, with a  $\frac{3}{8}$  in.  $\pm 0.000$  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.

(10) Manually raise the radius rod until the latch pin rests in the hook.

(11) 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.

(12) With the latch-pin still resting in the hook, adjust the up-stop pedestals to give a clearance

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of 0.050 in.  $\pm$  0.015 in. between the pedestals and the radius rod stop faces.

Note...

(a) 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.

(b) The two up-stop pedestals are to be adjusted to within 0.003 in. of each other.

(13) Manually push the radius rod hard up against the up-stop pedestals and support it in that position.

(14) Check, and if necessary adjust, the jack override (para. 20). Connect the jack to the radius rod lock lever. (Chap. 6)

(15) Select the GROUND/FLIGHT selector valve to FLIGHT and, by using the aircraft hand pump, force the radius rod against the up-stop pedestals and adjust the sequence valve (para. 24).

(16) 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. 30). Check that the radius rod lock lever is engaged.

(17) Select the GROUND/FLIGHT selector valve to GROUND and fully close the jack under pressure. Check its closed override (para. 20) and connect the jack to the lock lever (para. 30).

(18) With the wheels fitted to the undercarriage stub axles, raise the undercarriage under hydraulic pressure.

(19) 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).

(20) Place a jack or trestle beneath the strut allowing a clearance of approximately 1 in. between the strut and the jack or trestle.

(21) Using the aircraft hand pump, lower the door jack until its crosshead 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.

(22) Take a second measurement from the same point in the roof, to the nose-wheel 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 is incorrect, it can be corrected by adjusting the shimming beneath the up-stop pedestals.

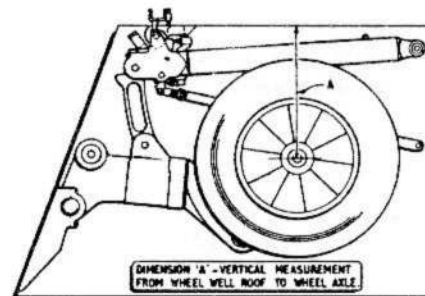


Fig. 9. Up-latch hook setting (2)

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.

(23) 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.

(24) Refit the box cover over the up-latch mechanism in the upper equipment compartment.

(25) 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, catch blocks, 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 procedure must be adopted, as the sequence in which the settings are made is as important as the settings themselves. To set the nose undercarriage doors:

- (1) Jack and trestle the aircraft (Sect. 2, Chap. 4).
- (2) Remove, and mark for re-identification, both door actuating links.
- (3) For ease of access remove the landing wheels and mudguards.

(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-wind' 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.

Note...

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)

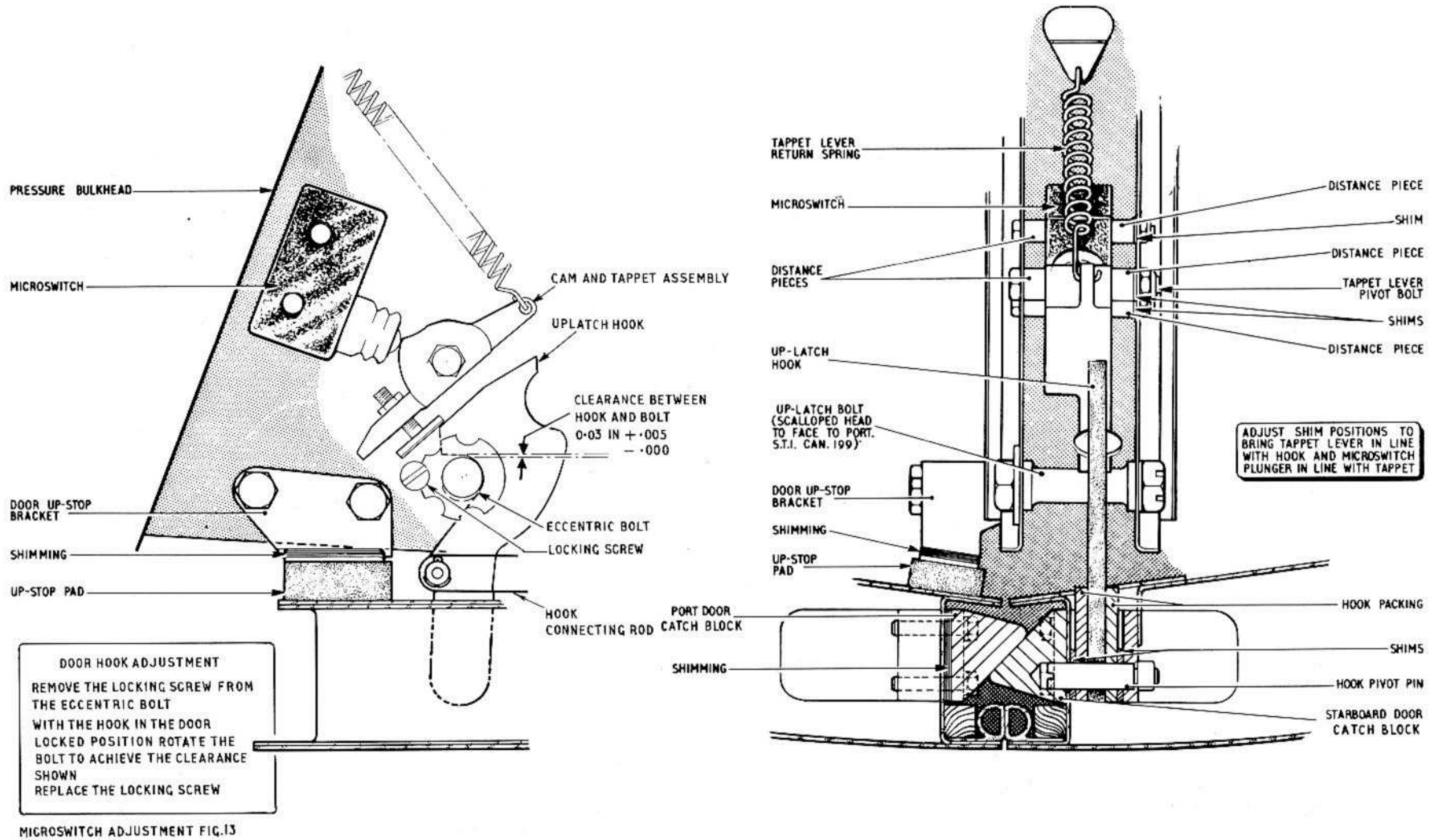


Fig.10. Door forward up-latch hook setting

◀ MICROSWITCH LEVER ASSEMBLY CHANGED ▶

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 pin 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. (fig. 10). If adjustment is required, remove the locating screw from the scalloped head of the up-latch bolt (fig. 5) and revolve the bolt until the correct clearance is obtained. Refit the locating screw.

Note...

To obviate any possibility of a foul occurring between the threaded portion of the locating screw and the microswitch tappet return spring, the up-latch bolt must be fitted with its head inboard facing port.

(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 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

and note that the nosewheel door aft latch has a 0.5 in. radius at the tip. ▶

(i) Remove the catch block 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) Re-assemble 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 re-assemble 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 remove 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 hook lip 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.

(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 downstops are correctly set (para. 21) and fully close the jack. The two tails of the hook release lever should abut the lever

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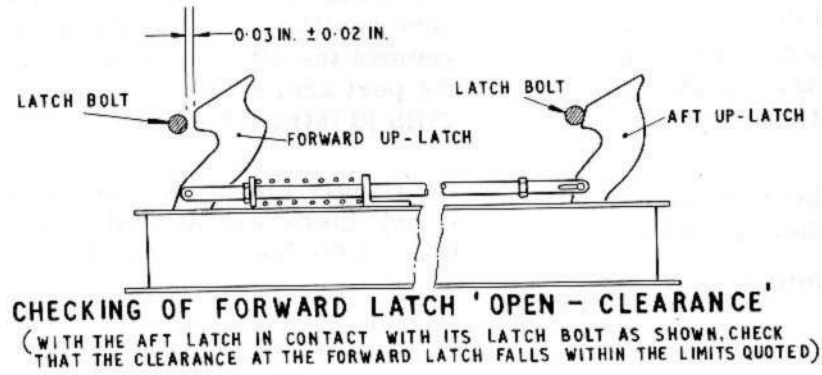
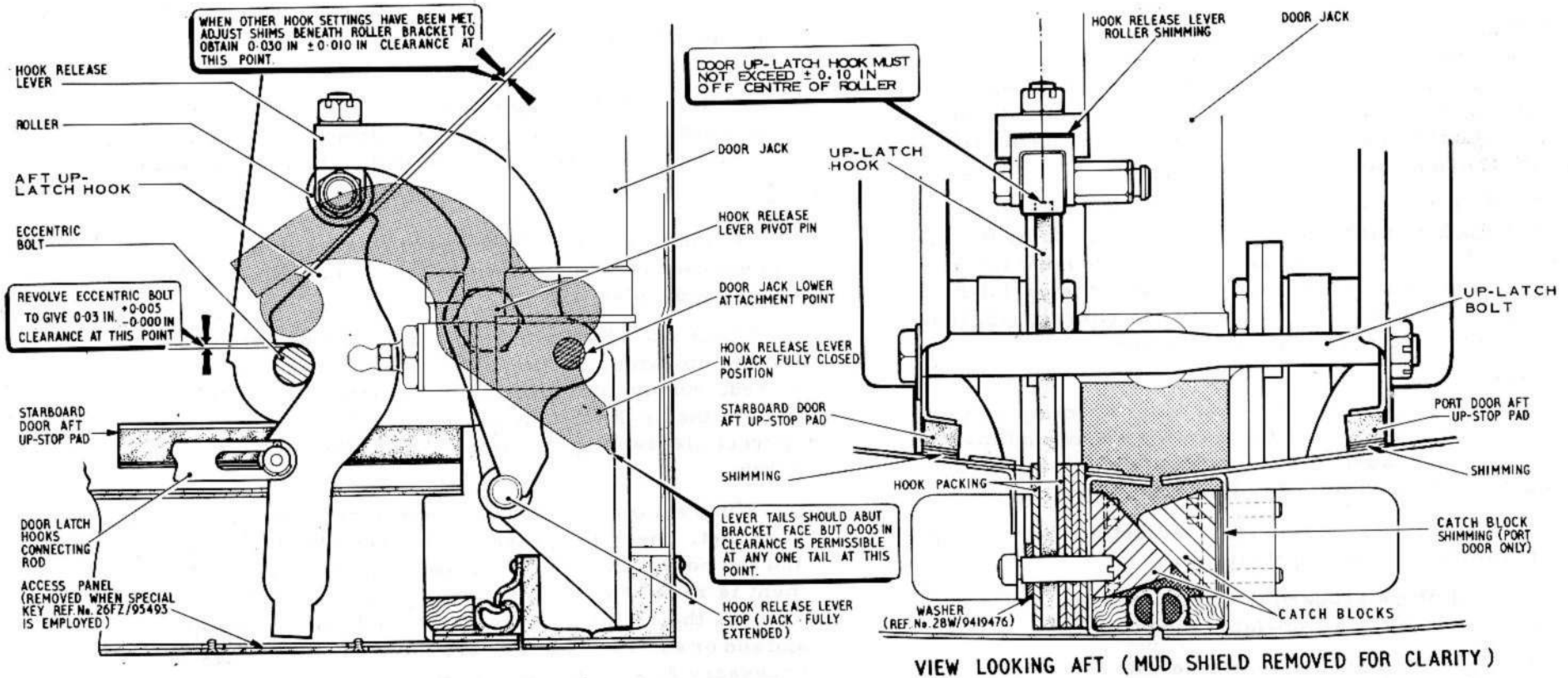


Fig.11. Door aft up-latch hook setting

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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-wind'. If the doors do not fit flush with each other adjust the shims beneath the port door catch blocks (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 key Ref. No. 26FZ/95493

(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-wind' condition is maintained.

(22) Check that the door microswitch functions correctly (fig. 13).

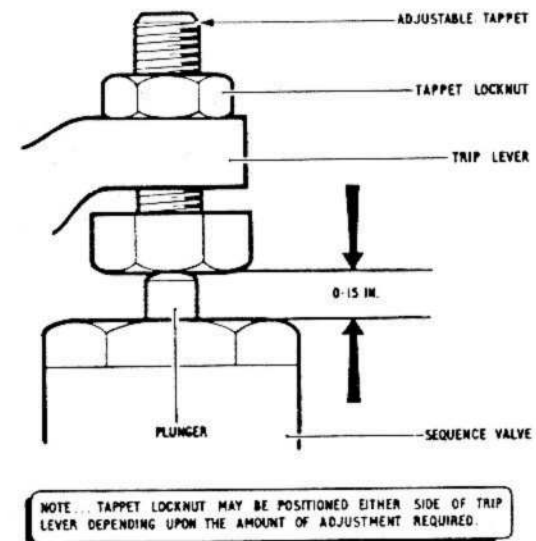
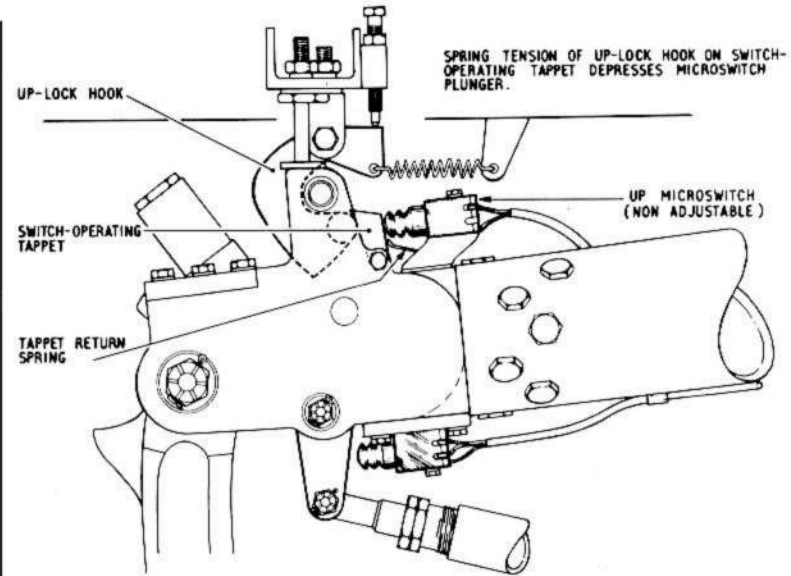
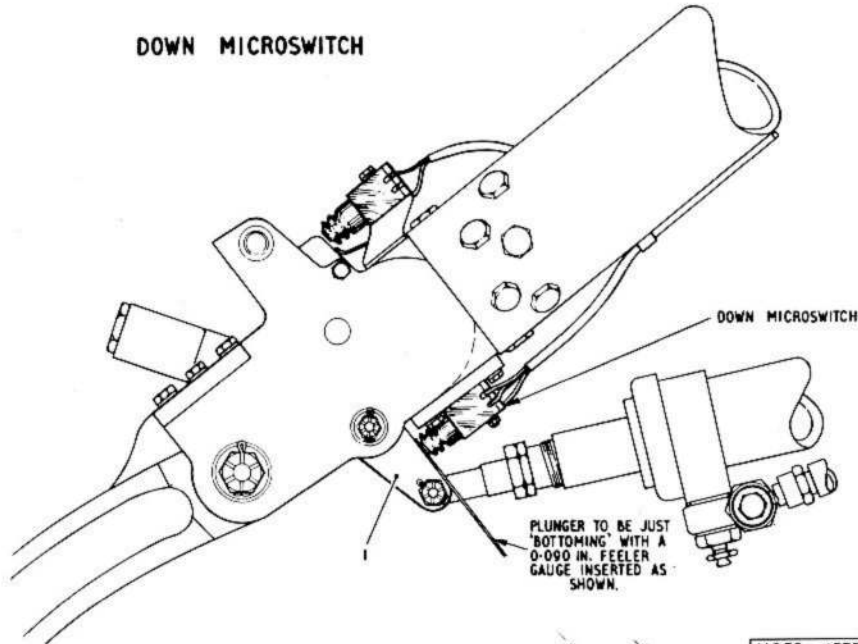


Fig. 12. Sequence valve setting

DOWN MICROSWITCH



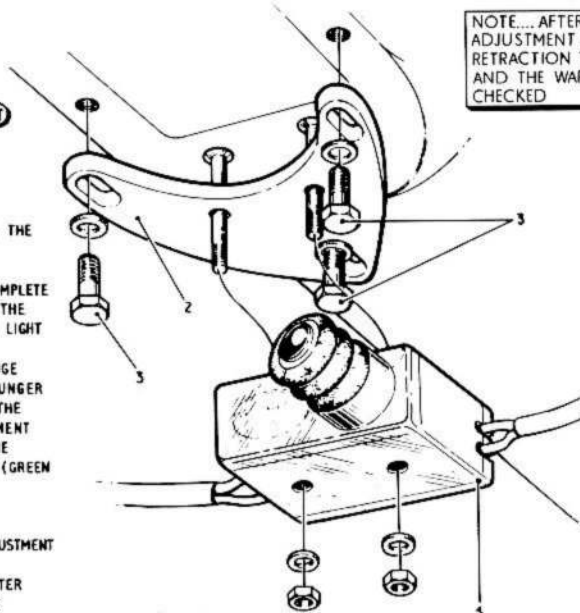
NO PROVISION IS MADE FOR ADJUSTING THE UP MICROSWITCH. IF SATISFACTORY OPERATION IS NOT OBTAINED WHEN THE UP-LOCK HOOK IS CORRECTLY ADJUSTED SECT.3 CHAP.5 THE SWITCH MUST BE REPLACED WITH ONE OF KNOWN SERVICEABILITY.

UP MICROSWITCH

NOTE.... AFTER ANY MICROSWITCH ADJUSTMENT AN UNDERCARRIAGE RETRACTION TEST MUST BE MADE AND THE WARNING LIGHTS CHECKED

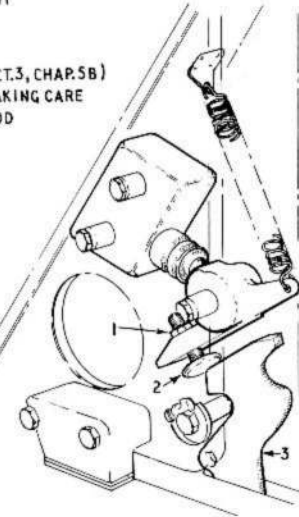
DOWN MICROSWITCH ADJUSTMENT

- 1 CONNECT A 24 VOLT SUPPLY TO THE EXTERNAL SUPPLY SOCKET.
- 2 SLACKEN THE BOLTS (3)
- 3 MOVE ATTACHMENT PLATE (2) COMPLETE WITH MICROSWITCH (4) AFT TO THE LIMIT OF ITS TRAVEL. (GREEN LIGHT OFF)
- 4 INSERT A 0.090 IN. FEELER GAUGE BETWEEN THE MICROSWITCH PLUNGER AND LOCK LEVER (1): MOVE THE MICROSWITCH (4) AND ATTACHMENT PLATE (2) FORWARD UNTIL THE PLUNGER IS JUST 'BOTTOMING' (GREEN LIGHT ON).
- 5 TIGHTEN THE BOLTS (3)
- 6 ENSURE THAT SOME PLUNGER MOVEMENT REMAINS WHEN ADJUSTMENT IS FINALISED. (.02" MIN.)
- 7 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 AN EXTERNAL 24V SUPPLY
- 3 DISCONNECT PORT DOOR ACTUATOR LINKAGE (SECT.3, CHAP.5B)
- 4 RAISE THE NOSE WHEEL ONLY (SECT.3 CHAP.6) TAKING CARE TO AVOID DAMAGE BY THE DISCONNECTED LINK ROD
- 5 SLACKEN TAPPET LOCKNUT 1
- 6 SCREW TAPPET 2 AWAY FROM DOOR LATCH 3 (SWITCH PLUNGER RELEASED RED LIGHT ON)
- 7 SCREW TAPPET 2 TOWARDS LATCH 3 UNTIL A DEFINITE CLICK IS HEARD AND GIVE ONE MORE COMPLETE TURN (PLUNGER DEPRESSED RED LIGHT OFF)
- 8 TIGHTEN LOCKNUT 1 AND ENSURE THAT SOME PLUNGER MOVEMENT REMAINS (.02 MIN)
- 9 RECONNECT THE DOOR LINKAGE AND PROCEED WITH RETRACTION TEST



DOOR MICROSWITCH

Fig.13 Microswitch adjustment - nose wheel

◀ DOOR MICROSWITCH LEVER ASSEMBLY CHANGED ▶

(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 undercarriage jack sequence valves must be adjusted with the undercarriage down and the doors fully open. The door jack sequence valve must be adjusted when the undercarriage is fully retracted, the doors being disconnected from the actuating links to provide access. The procedure for adjusting the actuating tappets is as follows:-

- (1) Slacken the locknut.
- (2) Adjust the tappet as necessary to obtain 0.15in. clearance between the striking face and the body of the valve.
- (3) After adjustment, check the operation of the valve and tighten the locknut.

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.

#### REMOVAL AND ASSEMBLY

##### General information

26. The following paragraphs detail the removal and assembly operations for the nose undercarriage and its main components. The sequence of operations

for assembling the undercarriage must be strictly adhered to, and checks and subsequent adjustments are to be made at the stated operation.

Note...

Ensure that all fluid pressure has been exhausted from the hydraulic systems (Sect. 3, Chap. 6) before disconnecting a hydraulic pipe. Blanking devices and/or covers must be fitted to all pipe ends, adaptors, etc., as they are detached or removed. Care must be taken during assembly to restore locking, bonding or sealing to its original condition.

Undercarriage and undercarriage doors mechanism removal.

Note...

The undercarriage and doors mechanism can be removed independently of each other.

Undercarriage (fig. 14)

27. To remove the nose undercarriage and components, proceed as follows:-

- (1) Jack and trestle the aircraft (Sect. 2, Chap. 4).
- (2) Remove the three bolts and washers securing each mudguard to its bearing bracket and remove the mudguards.
- (3) Remove the six stiffnuts and washers which secure the starboard landing wheel and remove the wheel.
- (4) Carry out the following instructions to remove the port landing wheel:-

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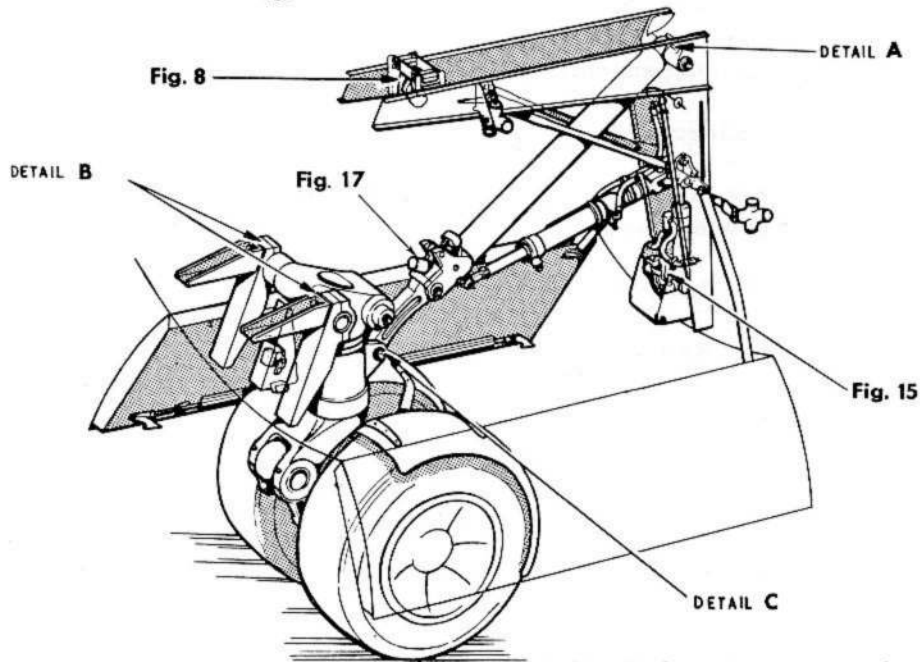
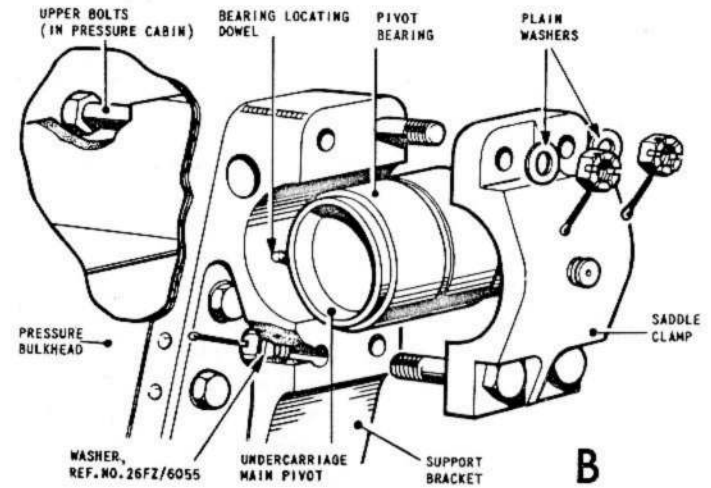
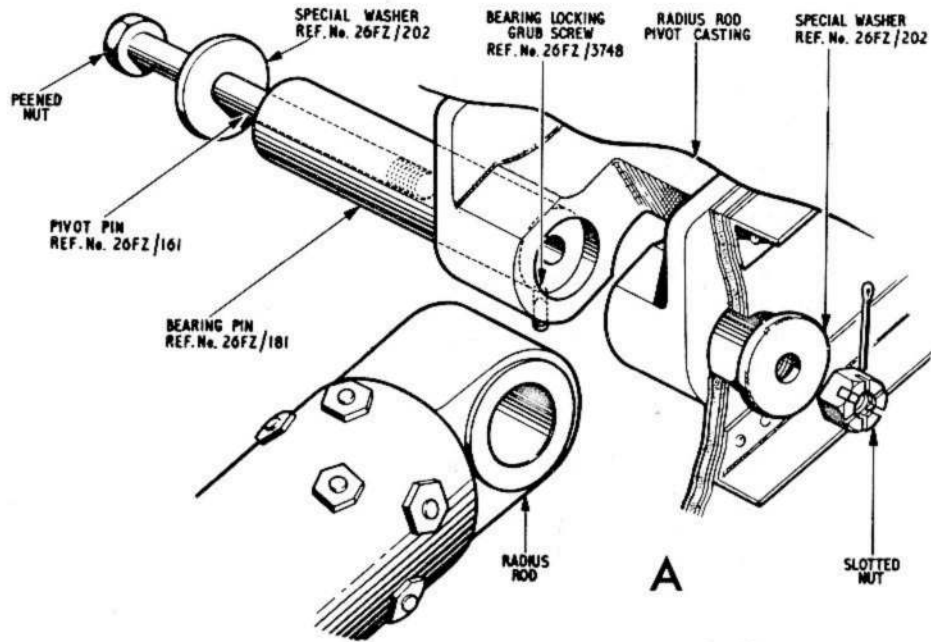
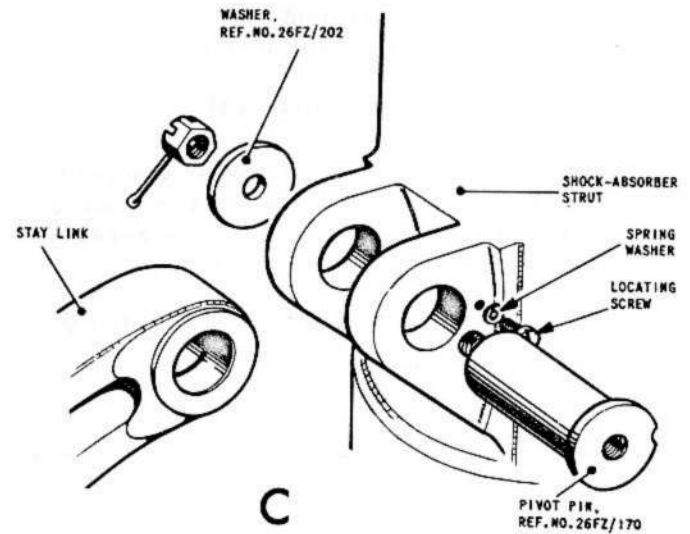


Fig.14 Undercarriage removal and assembly



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(a) Remove the split pin and slotted nut which secures the axle nut locking plate to the axle end fitting, and remove the plate.

(b) Remove the five stiffnuts and washers which secure the wheel to the axle and remove the spacing ring and wheel.

(5) Remove the undercarriage jack (Sect. 3, Chap. 6).

(6) Disconnect the electrical cables from the two microswitches on the radius rod knuckle-joint (Sect. 5, Chap. 1, Group G). Remove the three cable clips from the radius rod tube.

(7) Remove the split pin, slotted nut and special washer from the stay link pivot pin on the shock-absorber strut (fig. 14, detail C).

(8) Remove the locating grub screw from the head of the stay link pivot pin and, using an extractor, withdraw the pivot pin. Support the radius rod assembly.

Note...

The radius rod assembly must not be allowed 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)

(9) Remove the split pin, slotted nut and special washer from the radius rod upper pivot pin (fig. 14, detail A).

Note...

The head of the pivot pin is a plain nut which is, and must remain, peened.

(10) 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.

(11) 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. 14, detail B).

Note...

The heads of the four upper attachment bolts are accessible from inside the pressure cabin.

(12) Withdraw the lower bolts and remove the saddle clamps. Remove the undercarriage.

Door mechanism

28. (1) Remove the split-pins, slotted nuts and 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. Note the number and location of any packing washers between the mud shield and box section (fig. 15).

(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 (Chap. 6).

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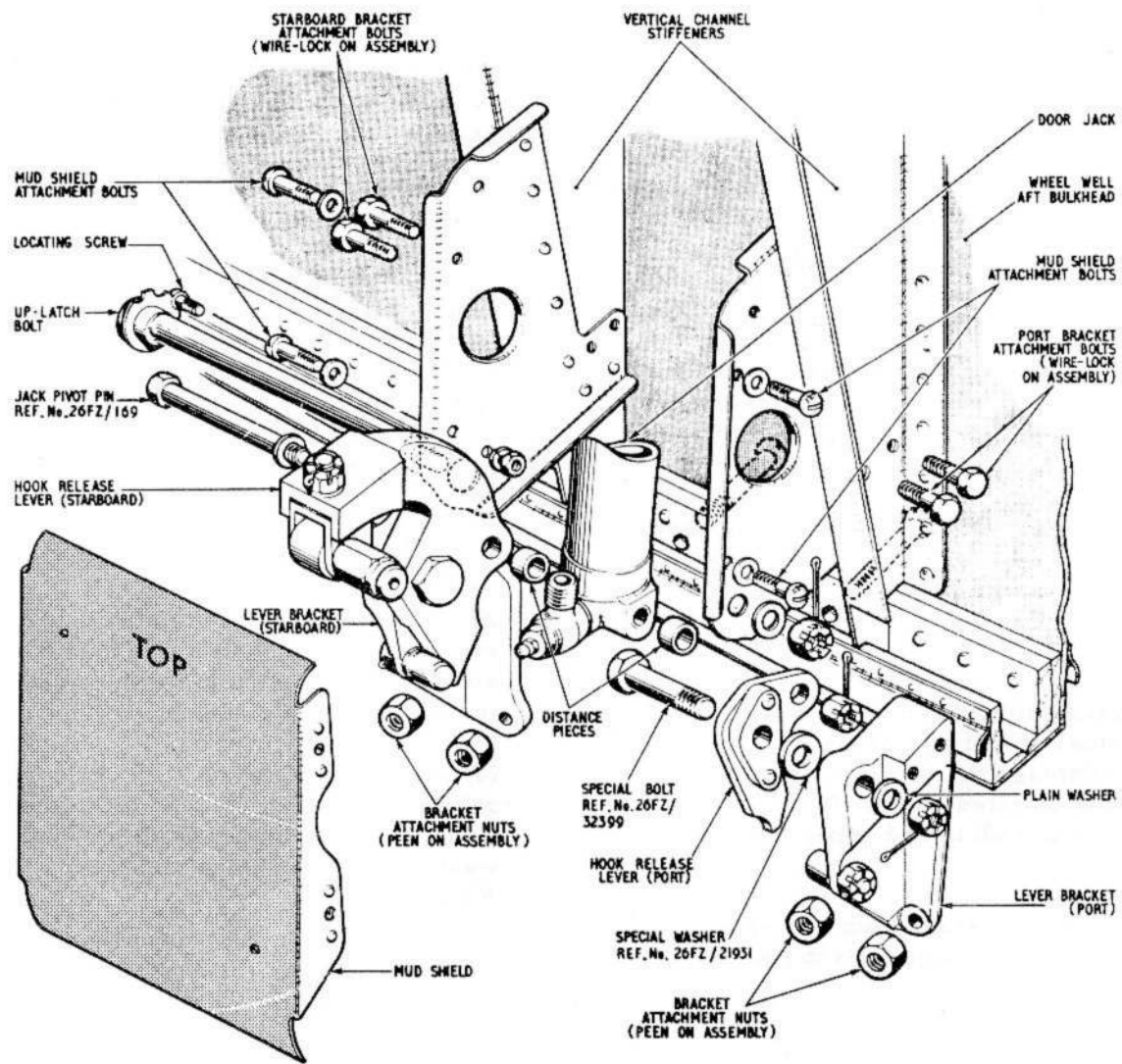


Fig. 15 Hook release mechanism and door jack removal

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## Note...

It is necessary to remove the undercarriage jack from its aft pivot (Chap. 6) 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. 15).

(6) Remove the two  $\frac{1}{4}$  in. countersunk bolts attaching the bottom of each release lever bracket to the aft bulkhead (fig. 15).

## 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 complete by lifting over the frame channel (fig. 15).

## Note...

When this operation is made with the undercarriage jack still in situ and disconnected from its aft pivot 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. 15).

(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. 15).

(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 and 15)

## 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 not 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. 15).

## Note...

The washer Part No. EA1.10.1407 fitted between each lever and bracket may be filed on assembly to

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obtain free movement of the lever. Protective treatment (A. P. 2662B, Scheme 9.1.2), must be applied to filed surfaces.

- (3) Fit the door jack lower pick-up point to the hook release lever mechanism, using the pivot pin Ref. No. 26FZ/169, distance pieces, washer, slotted nut and split pin (fig. 15).
- (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.
- (6) Bolt the hook release lever brackets to the aft bulkhead using the four  $\frac{1}{4}$  in. countersunk bolts. Peen the nuts (fig. 15)
- (7) Fit the two 2 BA bolts to secure each release lever support bracket to the vertical channel stiffeners (fig. 15). 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. 15).
- (9) Refit the capping strip to the lower lip of the aft bulkhead using the countersunk screws and stiff-nuts (fig. 15).
- (10) 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.
- (11) 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, in their original positions.

Note...

Ensure that the lower ends of the two flexible hydraulic pipes (UD and UDE) which connect to the shuttle valve on the door jack, are positioned in their cleats on the mud shield to provide the maximum possible clearance between their elbow unions and the landing wheel tyres during undercarriage retraction.

- (12) Reconnect the door-actuating links to the doors using the bolts, slotted nuts and split pins.

Note...

The preceding operations will, upon completion, necessitate a thorough check of 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. 14, detail B). Fit the four bolts, washers, slotted nuts and split pins which secure the removable half of each saddle clamp.

Note...

The heads of the four upper saddle clamp bolts are accessible from inside the pressure cabin.

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(3) Refit the radius rod to its upper pivot point by inserting the bearing pin. Slide the pivot pin, 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.

Note...

The radius rod assembly must not be allowed 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).

(4) Reconnect the stay link to the lugs on the undercarriage strut, using the pivot pin and washer, slotted nut and split pin. Refit and tighten the locating grub screw at the head of the pivot pin (fig. 14, detail C).

(5) Reconnect the electrical cables to the two micro-switches on the radius rod/stay link knuckle joint. Reclip the cables to the radius rod tube (Sect. 5, Chap. 1, Group G) and ensure they will not foul when the undercarriage is retracted.

(6) Assemble the undercarriage jack at the structure end only and connect the hydraulic piping to the jack (Chap. 6). The grease nipple is to be positioned at the top of the cross piece when the jack is installed in the aircraft. ▶

NOTE...

The hydraulic fluid pipes must be 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. 16).

(7) Prime and bleed the jack and pipelines (Chap. 6) and fully close the jack, using the aircraft hand pump.

(8) 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.

(9) Connect the jack piston rod to the radius rod lock lever using the pivot bolt, slotted nut and split pin.

(10) 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.

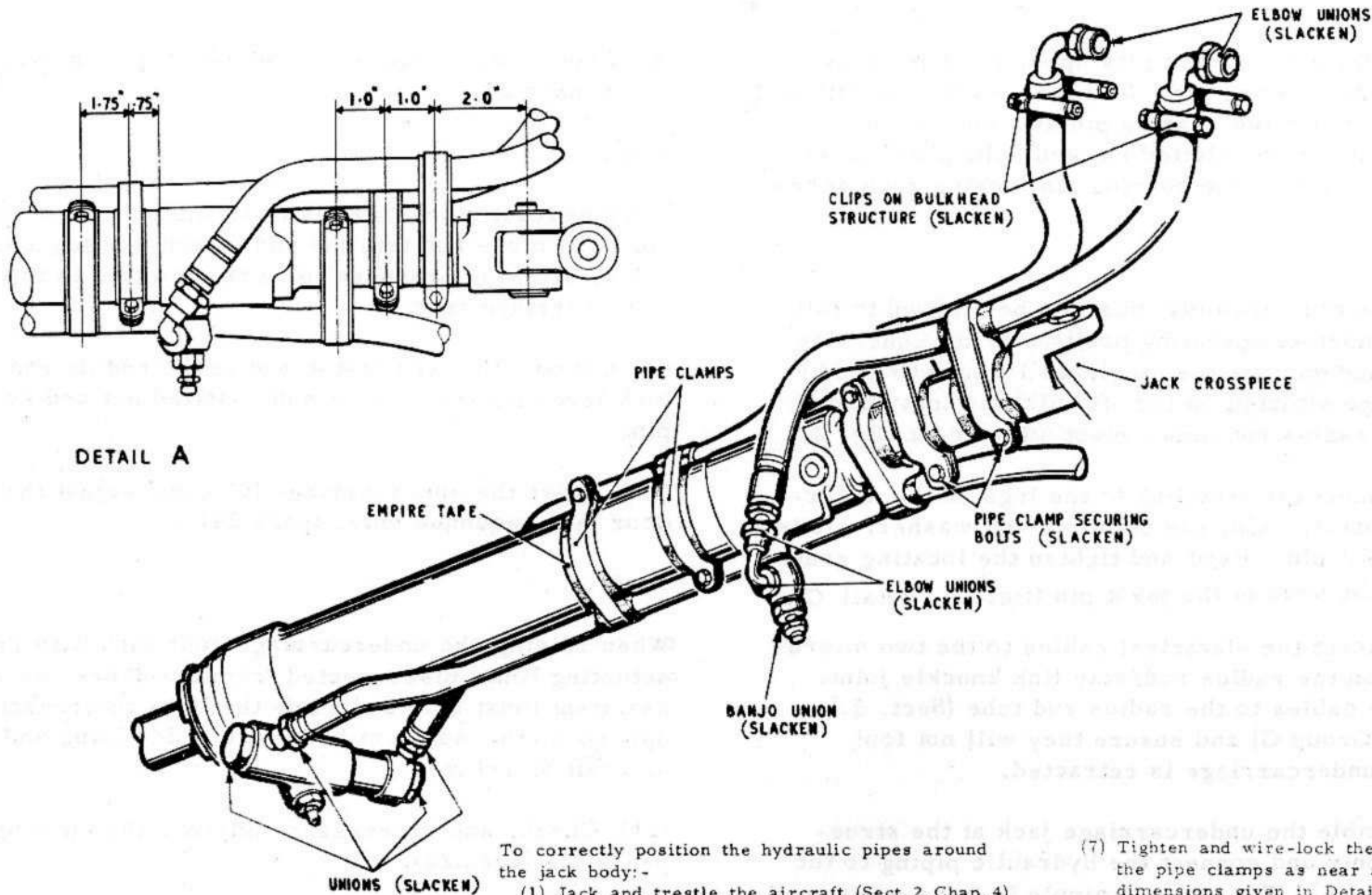
(11) Check, and if necessary adjust ; the up-stop pedestals (para.22).

(12) Ensure that the up-latch hook is engaging the radius rod latch pin. Adjust if necessary (para. 22).

(13) Lower the undercarriage and fit the landing wheels and mudguards.

(14) Fit the starboard door-actuating link (para. 30) and raise the undercarriage. Ensure that the undercarriage and undercarriage door mechanism is operating correctly.

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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 and banjo unions and clips on the bulkhead structure
- (5) Slacken the five pipe clamp securing bolts
- (6) Move the radius rod through its operating arc of travel and allow the three 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 and no strain is put on the pipe end fittings

- (7) Tighten and wire-lock the unions and secure the pipe clamps as near as possible to the dimensions given in Detail A. 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. Particular attention to be taken 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.16 Undercarriage jack hydraulic pipes clipping

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(15) Check, and if necessary adjust, the undercarriage and undercarriage door microswitches. (fig. 13).

(16) 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-wind' (para. 23).

(17) 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.

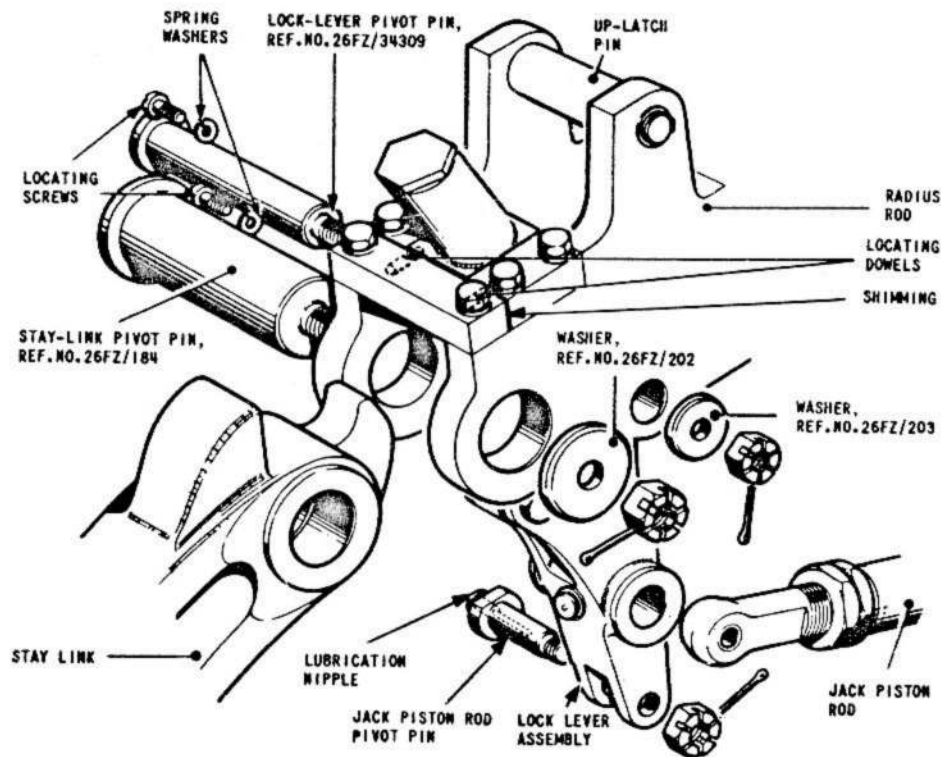


Fig. 17 Assembly of stay link to radius rod

## CHAPTER 6

## HYDRAULIC SYSTEM

(Completely revised)

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Introduction

1. This chapter gives descriptive and servicing information on the main hydraulic systems together with instructions for the removal and installation of certain components. Detailed information on the majority of the components is given in the A. P. 1803 series; references to these publications are quoted in the key to fig. 17. Certain components, not covered in this series, are included in this chapter, each component being dealt with separately and completely under its own main heading as indicated in the List of Contents.

## DESCRIPTION AND OPERATION

General

2. Three separate systems provide power for the operation of the several hydraulic services and the powered flying controls. One system, referred to generally and throughout this publication as the 'services' system, operates the undercarriage, wheel brakes, flare bay doors, flaps, air brakes and camera doors, and provides the primary supply for rudder power operation and feel simulation. The two other systems, known as the port and starboard 'controls' systems, provide power for the operation of the ailerons, the port 'controls' system providing, in addition, a secondary supply for rudder power operation and feel simulation.

3. Two diagrams of the main hydraulic systems are provided, one (fig. 1) a condensed diagram which is included with the descriptive text to assist the reader in understanding the function of the systems, and the other (fig. 17) a comprehensive diagram for use in diagnosing faults. Installation drawings, which

show the location and shape of the components and the run of pipe lines, are given for each individual service; these illustrations are included with the descriptive text, but are linked by a common item numbering system for the components with the comprehensive diagram (fig. 17), e. g. item 131 on fig. 17 will be the same number when shown on any other illustration.

Engine-driven pumps

4. The three hydraulic systems are powered by four Integral, Type 180, Mk. 27, hydraulic pumps mounted on the engine-driven accessories gearboxes, two on the port gearbox and two on the starboard. One pump on each gearbox provides power for the services system and the other for one of the controls systems, each of which takes its description, port or starboard, from the side its pump is mounted.

5. The pumps are of the two-stage type, incorporating a built-in off-loading mechanism which progressively off-loads the pump with increasing line pressure, over a narrow pressure band below the maximum operating pressure. At maximum pressure (2750 p. s. i.) the delivery ceases and the pump continues to run while absorbing only the power required to overcome internal friction and to circulate cooling fluid through a by-pass at a very low pressure. For a full description of the pumps, reference should be made to A. P. 1803J, Vol. 1.

Accumulators

6. Included in the three hydraulic systems are eight accumulators as follows:-

- (a) Services (for the undercarriage, flare bay doors, flaps, air brakes and camera doors).

- (b) Wheel brakes
- (c) Aileron inboard jacks
- (d) Aileron outboard jacks
- (e) Rudder jack, primary
- (f) Rudder jack, secondary
- (g) Rudder feel simulation, primary
- (h) Rudder feel simulation, secondary

All the accumulators are charged with nitrogen to the pressures stated in the Leading Particulars. Accumulators (a), (b), (c) and (d) are mounted in the centre fuselage on the spar frame bulkhead, and accumulators (e), (f), (g) and (h) in the rear fuselage. Each group of four is provided with a common charging valve and pressure gauge which are mounted together with a multiple inflation cock. Those for the accumulators in the centre fuselage are mounted in the port main undercarriage bay, and for the accumulators in the rear fuselage, in the port side of the fuselage just inside the rear fuselage entrance hatch. The multiple inflation cocks each incorporate four cocks one for each accumulator in a group, thus, each accumulator is charged or checked individually by opening the appropriate cock. Full instructions for charging the accumulators are given later in this chapter.

## SERVICES SYSTEM

### Supply (fig. 2)

7. The system may be operated by the engine-driven pumps (11 and 136), the hand pump (162) at the pilot's station or by external pumps on servicing trolleys. The external pumps are connected, after disconnecting the engine-driven pumps, to the Avery couplings (7, 8 and 9 starboard and 138, 139 and 140 port) in the inner wing leading edge.

### Engine-driven pumps supply

8. The engine-driven and external pumps draw fluid from the header tank (para. 180), mounted in the fuselage on the bulkhead at frame 13, and deliver it through non-return valves (6 and 135) to the supply line, and thence, through the filter (129), to the various selectors and accumulators (131, 134, and 47) for the services, brakes and rudder jack. At a pressure just below the maximum operating pressure, the pumps are unloaded progressively as line pressure increases by operation of the off-loading mechanism. While the pumps are running off-load, a proportion of the by-passed fluid circulates in the pumps to assist in cooling and excess fluid is returned at low-pressure through the by-pass outlets, non-return valves (10 and 137) and micronic filter (144) to the header tank. A relief valve, set to operate at 2750 p. s.i. is incorporated in each pump.

9. Indication of the fluid pressure at the services accumulator is given by a pressure gauge (4) mounted on the starboard console at the pilot's station. The gauge is operated by a pressure relay (179) connected to the supply line of the primary feel simulator control unit.

### Hand pump supply

10. The hand pump (162) draws fluid from the header tank (143) through a connection in the base; the positioning of this connection in relation to the engine-driven pump suction (fig. 28) ensures a fluid supply for the hand pump in the event of fluid loss due to leakage in the system. The hand pump delivery line is connected directly to a GROUND/FLIGHT selector valve (95) and the alighting gear emergency down selector (94). It is also connected through non-return

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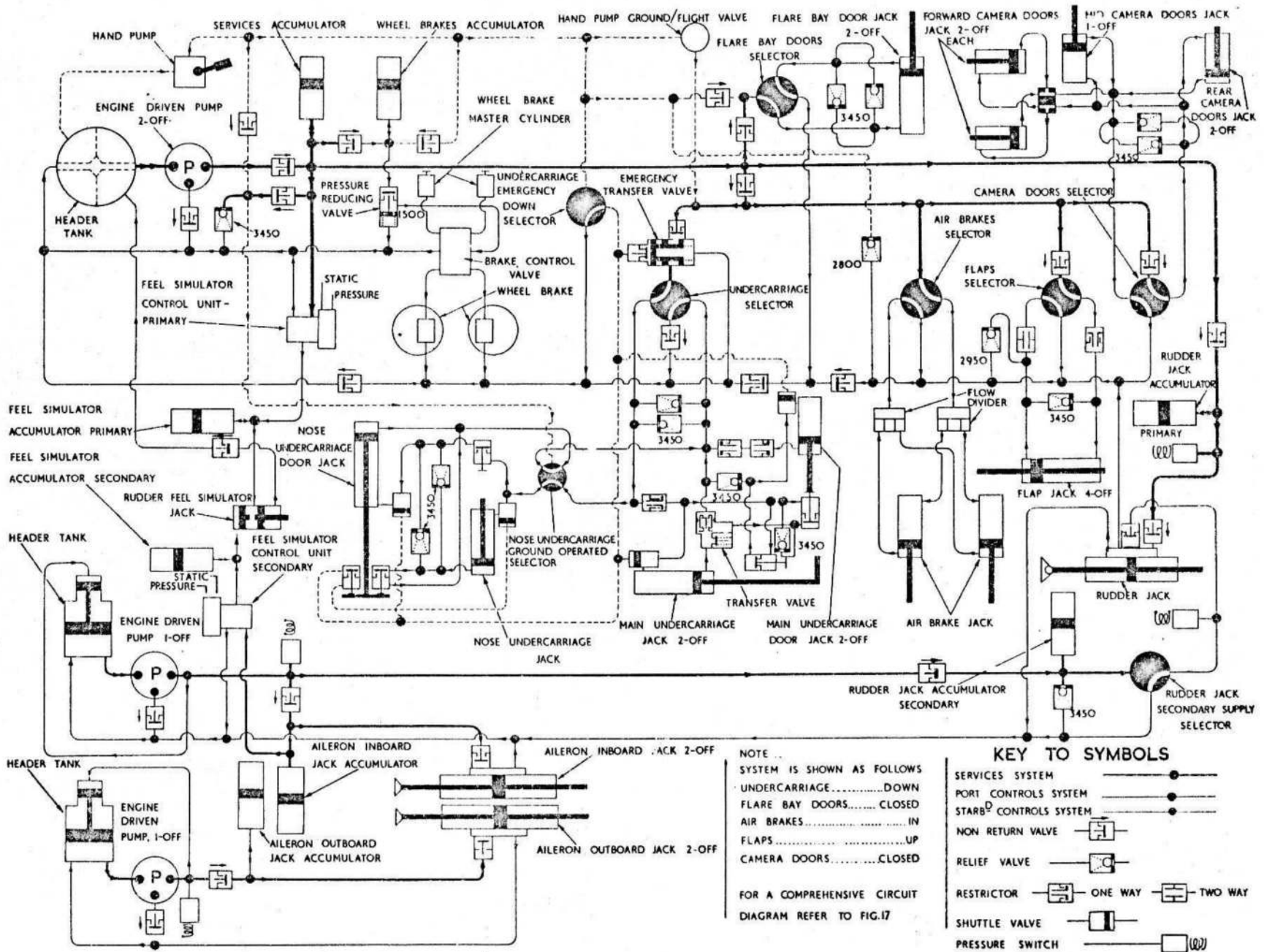
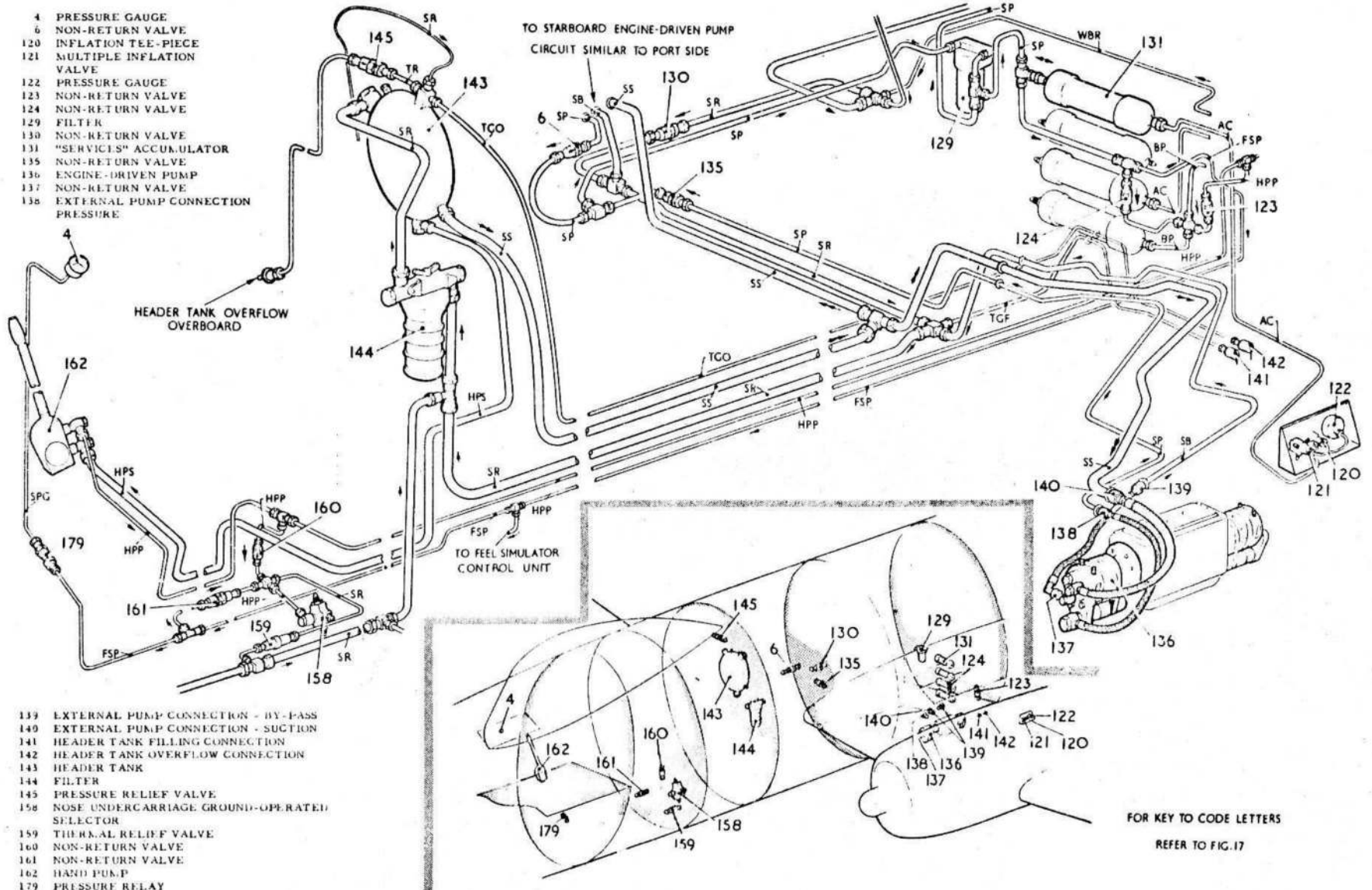


Fig. 1 Hydraulic system condensed diagram

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KEY TO FIG. 2  
(Refer also to Key to Fig. 17)

- 4 PRESSURE GAUGE
- 6 NON-RETURN VALVE
- 120 INFLATION TEE-PIECE
- 121 MULTIPLE INFLATION VALVE
- 122 PRESSURE GAUGE
- 123 NON-RETURN VALVE
- 124 NON-RETURN VALVE
- 129 FILTER
- 130 NON-RETURN VALVE
- 131 "SERVICIS" ACCUMULATOR
- 135 NON-RETURN VALVE
- 136 ENGINE-DRIVEN PUMP
- 137 NON-RETURN VALVE
- 138 EXTERNAL PUMP CONNECTION PRESSURE



- 139 EXTERNAL PUMP CONNECTION - BY-PASS
- 140 EXTERNAL PUMP CONNECTION - SUCTION
- 141 HEADER TANK FILLING CONNECTION
- 142 HEADER TANK OVERFLOW CONNECTION
- 143 HEADER TANK
- 144 FILTER
- 145 PRESSURE RELIEF VALVE
- 158 NOSE UNDERCARRIAGE GROUND-OPERATED SELECTOR
- 159 THERMAL RELIEF VALVE
- 160 NON-RETURN VALVE
- 161 NON-RETURN VALVE
- 162 HAND PUMP
- 179 PRESSURE RELAY

FOR KEY TO CODE LETTERS  
REFER TO FIG. 17

Fig.2 Services hydraulic system - supply

KEY TO FIG. 3

(Refer also to Key to Fig. 17)

- 33 WHEEL BRAKE, STARBOARD
- 34 MAXARET ANTI-SKID UNIT, STARBOARD
- 81 MAXARET ANTI-SKID UNIT, PORT
- 82 WHEEL BRAKE, PORT
- 120 INFLATION TEE-PIECE
- 121 MULTIPLE INFLATION VALVE
- 122 PRESSURE GAUGE
- 123 NON-RETURN VALVE
- 124 NON-RETURN VALVE
- 134 BRAKES ACCUMULATOR
- 172 WHEEL BRAKE CONTROL VALVE
- 173 PRESSURE GAUGE
- 174 PRESSURE RELAY
- 177 MASTER CYLINDER, STARBOARD
- 178 MASTER CYLINDER, PORT
- 180 PRESSURE REDUCING VALVE

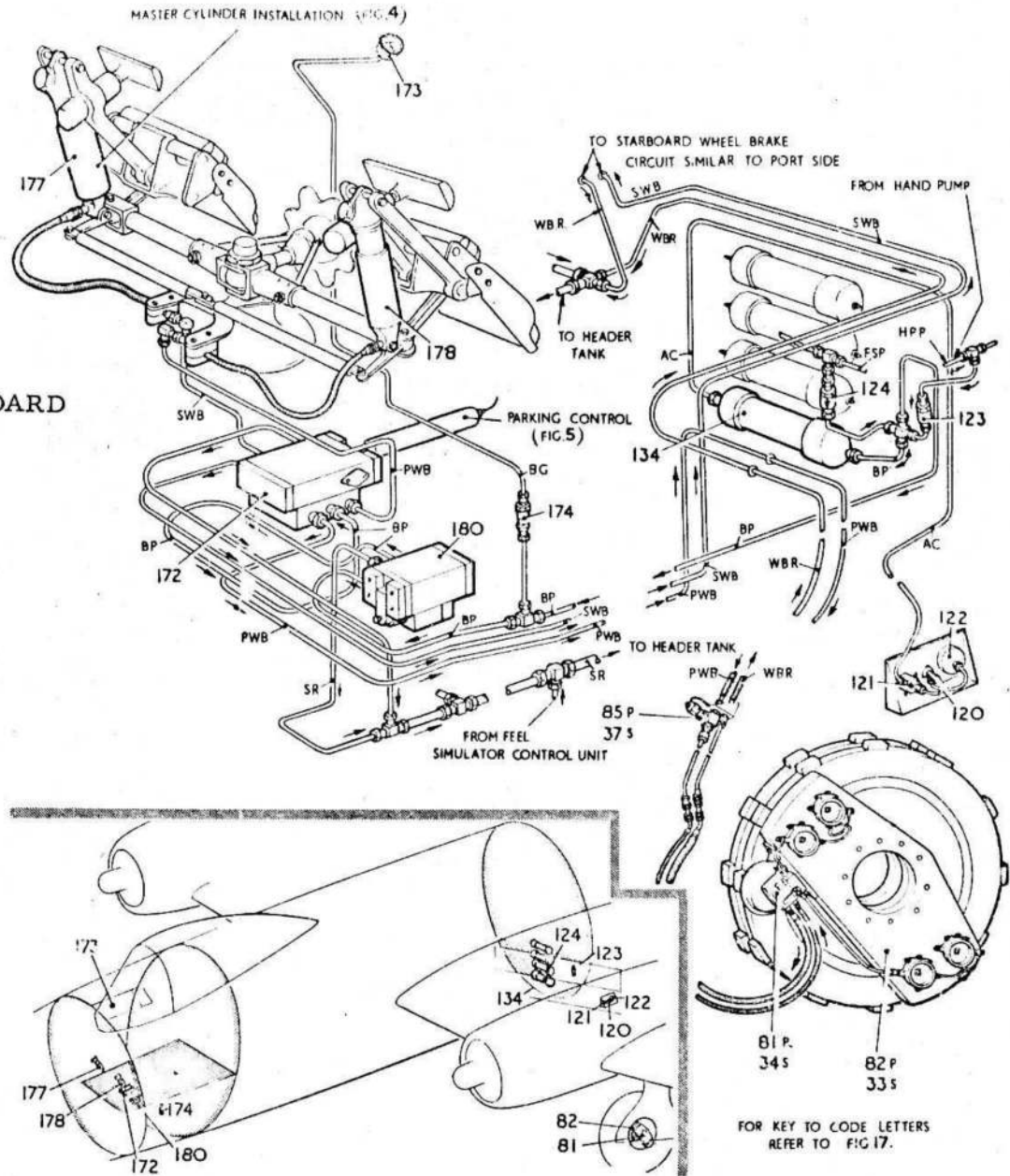


Fig.3 Wheel brake circuit

valves (160, 123 and 89) to the nose undercarriage, ground-operated selector valve (158), the brakes accumulator (134) and the flare bay doors selector. The GROUND/FLIGHT selector connects the hand pump delivery to the alighting gear, air brakes, flaps and camera doors selector when set to GROUND, but isolates these services when at FLIGHT. Thus during flight, only the wheel brakes, alighting gear emergency down and flare bay door circuits may be operated by the hand pump. A relief valve (86), set to operate at 2800 p. s. i. is connected to the hand pump delivery line.

#### Wheel brake circuit (fig. 3)

##### Supply

11. The supply of fluid to the wheel brake units is controlled by a Dunlop Mk. 3 control valve (172), mounted on the underside of the pilot's floor just aft of frame 5, and two Dunlop Maxaret anti-skid units (34 and 81) mounted one on each wheel brake unit. The control valve is operated for normal use by hydraulic pressure from master cylinders (para. 14), mounted on the rudder pedals, and for parking by a lever on the port console in the pilot's station; this lever is connected to the control valve by Bowden cable (para. 15).

12. A fluid pressure of 2750 p. s. i. is built up in the brake accumulator by the pumps. From the accumulator, pressure is applied through a reducing valve (180) (reducing the pressure to 1500 p. s. i.) to the control valve (172) and thence to Maxaret and brake units. Exhaust fluid from the reducing valve, control valve and Maxaret units is returned to the header tank through the main return line and micronic filter (144). Should the engine-driven pumps fail,

sufficient pressure is stored in the brakes accumulator for six applications of the brakes.

13. Indication of the fluid pressure at the brakes accumulator is given by a pressure gauge (173) mounted on the starboard console at the pilot's station. The gauge, operated by a pressure relay (174), is connected to the pressure line from the brakes accumulator near to the reducing valve inlet. Test connections (37 and 85) fitted into the pressure lines to the brake units at the undercarriage legs, are provided for the attachment of a Turner inflation adapter and gauge for checking the pressure at the brake units during ground testing.

##### Control

14. The master cylinders (177 and 178) provide the pressure necessary to operate the brake control valve and allow system pressure to the brake units. Each cylinder (fig. 4) is operated by a spring-loaded toe-pedal fitted to one link of a pair pivoted on the rudder pedal; the cylinder, which is also pivoted on the rudder pedal casting, being connected to a spindle fitted between the links. A striker arm fitted to one end of the link pivot pin and a stop spigot on the rudder pedal, limit the stroke of the master cylinder, adjustment being provided by a striker bolt in the striker arm. Provision is made for reach adjustment by notches in the toe-pedal spring-box barrel.

15. The parking control lever, Dunlop Pt. No. A. H. O. 1090, mounted on the port console at the pilot's station, is connected by Bowden cable to a spring box and thence to the parking lever on the control valve (fig. 5). At the spring box, the Bowden cable is connected to an outer plunger which slides in a cylindrical housing against a return spring. A second plunger,

fitted within the outer plunger, is connected by an adjustable fork-end to the parking lever on the control valve. A compression spring, retained by an annular disc in the open end of the outer plunger, acts against the inner plunger. When the control lever is moved to ON, the outer plunger slides within the barrel, compressing its return spring and the compression spring acting on the inner plunger. The action of the compression spring moves the inner plunger to open the brake supply valve, the spring being designed to apply to the plunger sufficient load to maintain a constant fluid pressure of 1500 p. s. i. at the brake units. On moving the control lever to OFF, the spring load is released and the fluid pressure at the brakes is dissipated through the exhaust valve to the header tank.

#### Alighting gear circuit (fig. 6 and 7)

16. For normal operation, the supply of fluid to the jacks operating the alighting gear units and under-carriage bay doors is controlled by an electrically-operated four-way selector. In an emergency, the alighting gear may be lowered using the hand pump, through a separate circuit, to the appropriate sides of the jacks; this circuit is controlled by a mechanically-operated selector.

#### Normal operation - general

17. Fluid, from the system supply (para. 7). passes through a non-return valve (88) and the emergency transfer valve (93) to the supply inlet on the four-way

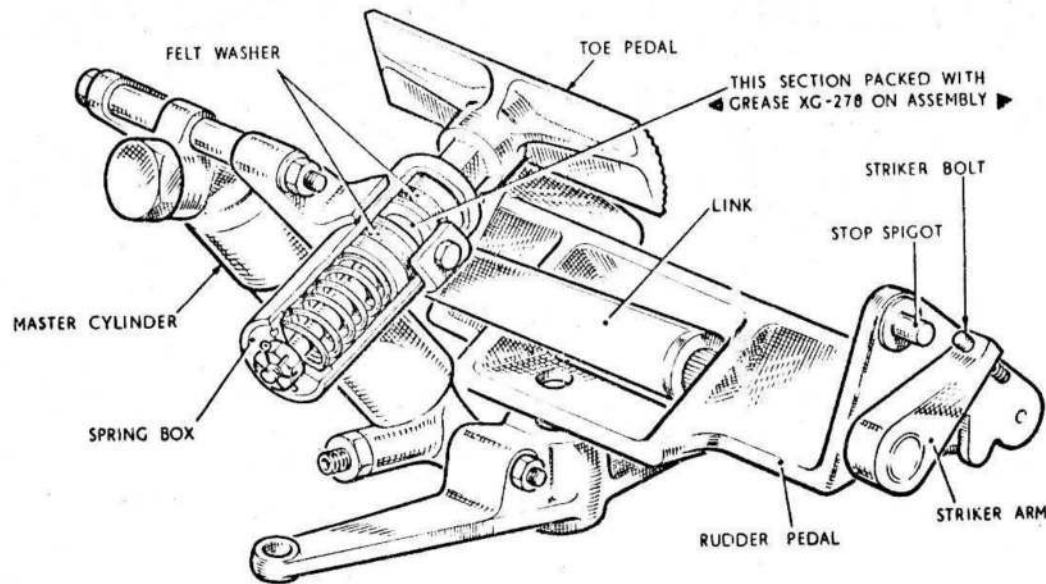


Fig. 4 Wheel brake master cylinder

selector (96). Controlled by UP and DOWN push-buttons, mounted on the vertical panel at the forward end of the port console at the pilot's station, the selector is electrically-operated to direct the supply flow to either the alighting gear 'UP' or 'DOWN' line and the return flow to the other. Details of the relevant electrical circuits are given in Sect. 5, Chap. 1 and, for a description of the selector valve operation, reference should be made to A. P. 1803D, Vol. 1, Book 3.

18. When UP is selected, excessive pressure in the 'up' line is relieved to return through the 'down' line by the thermal relief valve (107). Similarly, when DOWN is selected, excessive pressure is relieved to return through the 'up' line by the thermal relief valve (108). Both valves are set to operate at 3450 p. s. i.

#### Normal operation - main undercarriage

19. When DOWN is selected, the supply flow is directed to the 'down' line, and the 'up' line is opened to return. Fluid pressure is then applied through the 'down' line direct to the undercarriage jacks (30 and 97) and through sequence valves (32 and 99) to the door jacks (24 and 106), but no movement is obtained from the undercarriage jacks until the door jacks have extended and opened the sequence valves (23 and 103). This is due to the fitment in the 'up' line, between the undercarriage jacks and the selector, of transfer valves (29 and 100) which divert the return fluid from the undercarriage jacks to the 'down' line through the sequence valves (23 and 103). Fluid expelled from the door jacks is returned to the header tank through the 'up' line and selector, the flow being restricted to provide smooth operation by

one-way restrictors (25 and 104). Excessive pressure in the 'down' line to the jacks is relieved to return through the 'up' line and selector by thermal relief valves (28, 28A, 101 and 101A), set to operate at 3450 p. s. i.

20. When the door jacks have extended and opened the sequence valves (23 and 103), the fluid in the 'up' side of the undercarriage jacks is released through the transfer valves to the 'down' line and the jacks extend and, at the same time, close the sequence valves (32 and 99). The supplementing of the 'down' line delivery with return fluid assists in reducing the time required to complete the lowering.

21. On selecting UP, the flow to the jacks is reversed and fluid pressure is applied through the 'up' line direct to the door jacks and through the transfer valves to the undercarriage jacks. No movement is obtained from the door jacks until the undercarriage jacks have closed and opened the sequence valve (32 and 99), thus releasing the fluid in the 'down' side of the door jacks. Return fluid from the undercarriage jacks is returned to the header tank through one-way restrictors (25A and 102A) in the 'down' line and through the selector. Excessive pressure in the 'up' line to the undercarriage jacks is relieved to the 'down' line through thermal relief valves incorporated in the transfer valves.

22. With the opening of the sequence valve (32 and 99), fluid in the down side of the door jacks is released to return through the 'down' line and selector. Flow through the 'up' line to the door jacks is restricted by variable flow valves (27 and 102) to provide smooth operation. When the jacks commence to close, the sequence valves (23 and 103) are closed.

RESTRICTED

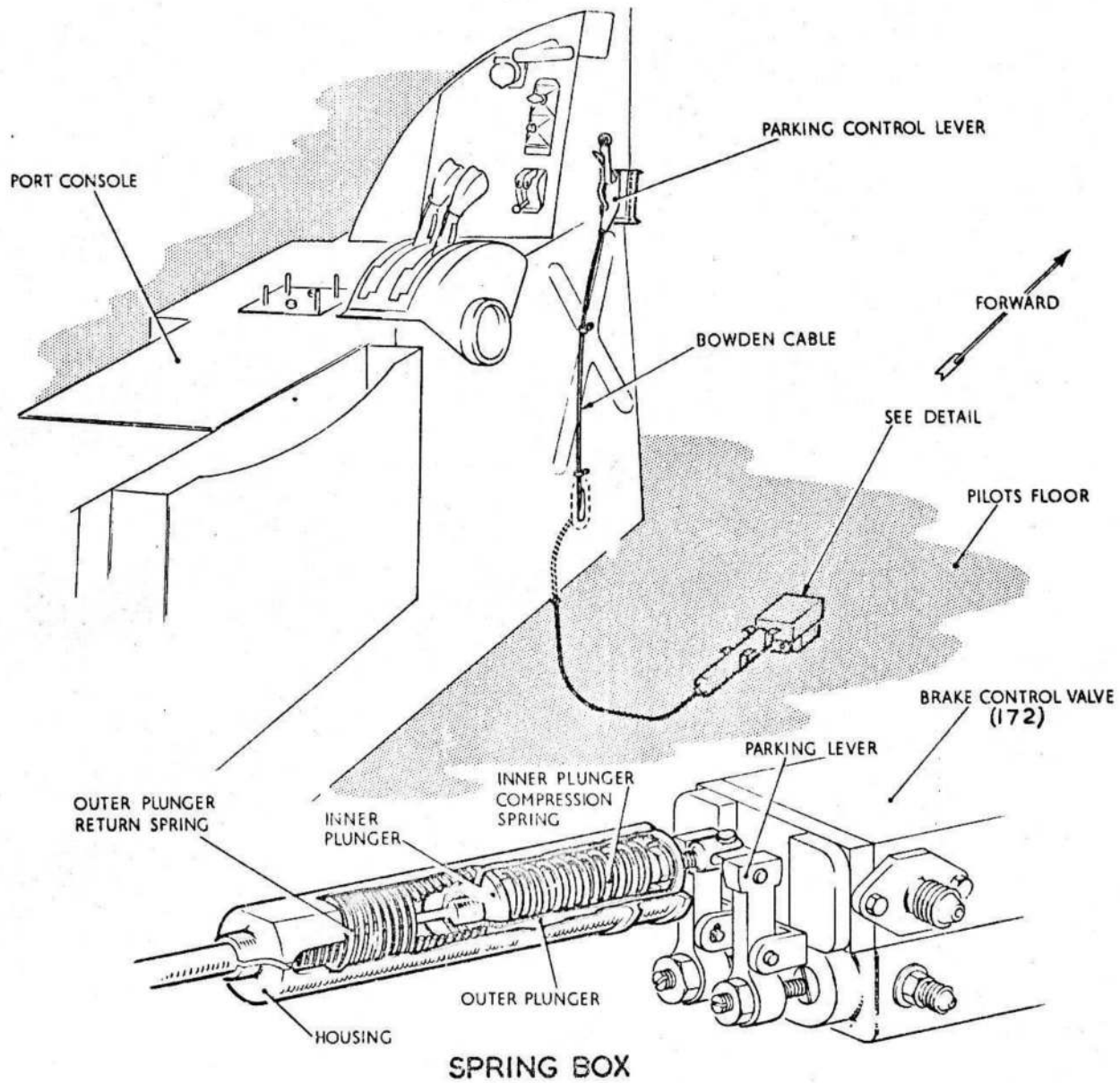
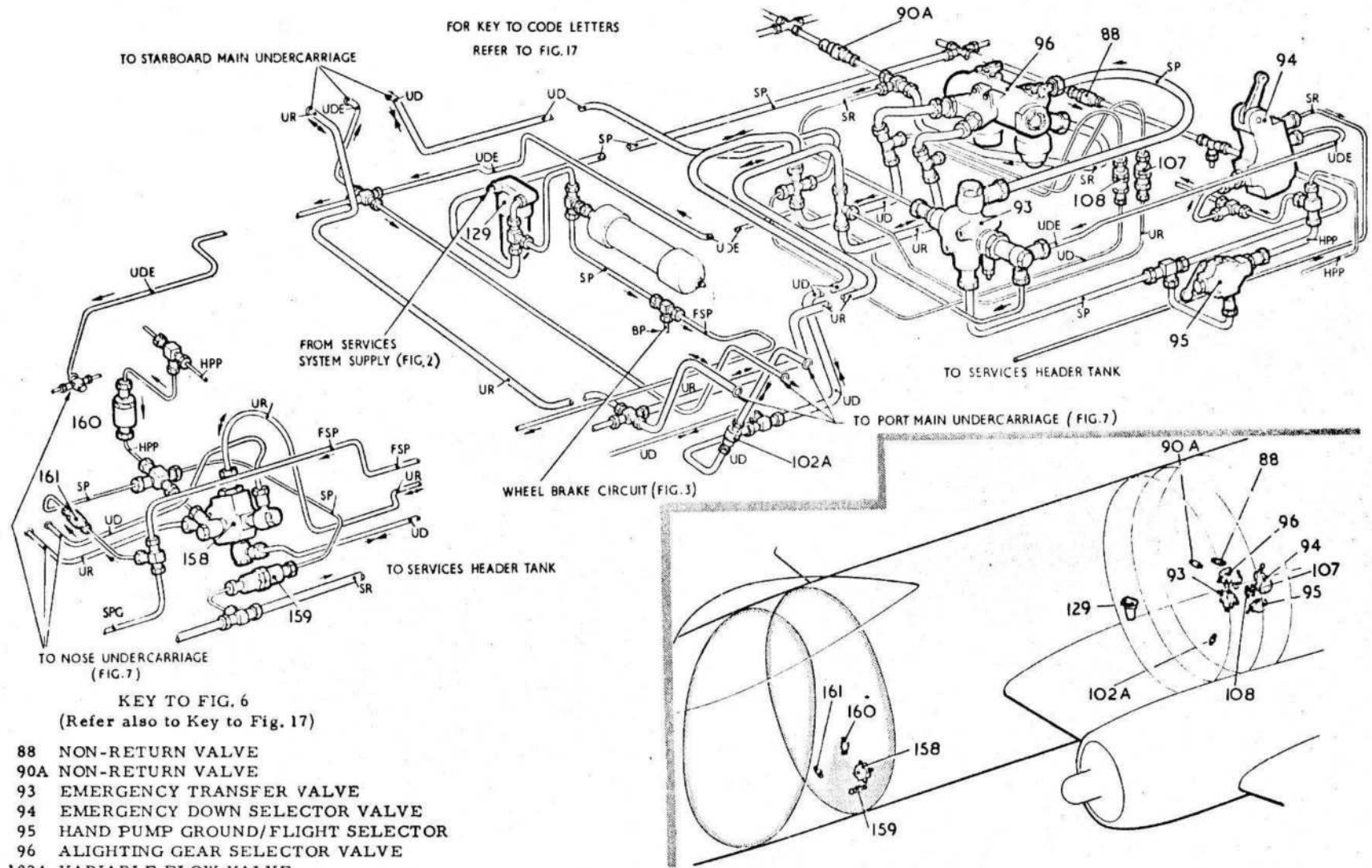


Fig.5 Wheel brake parking controls

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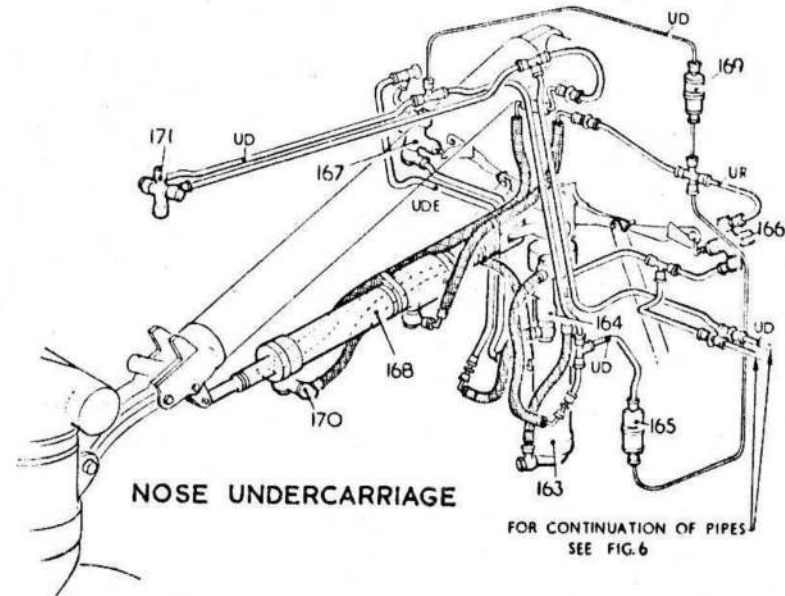
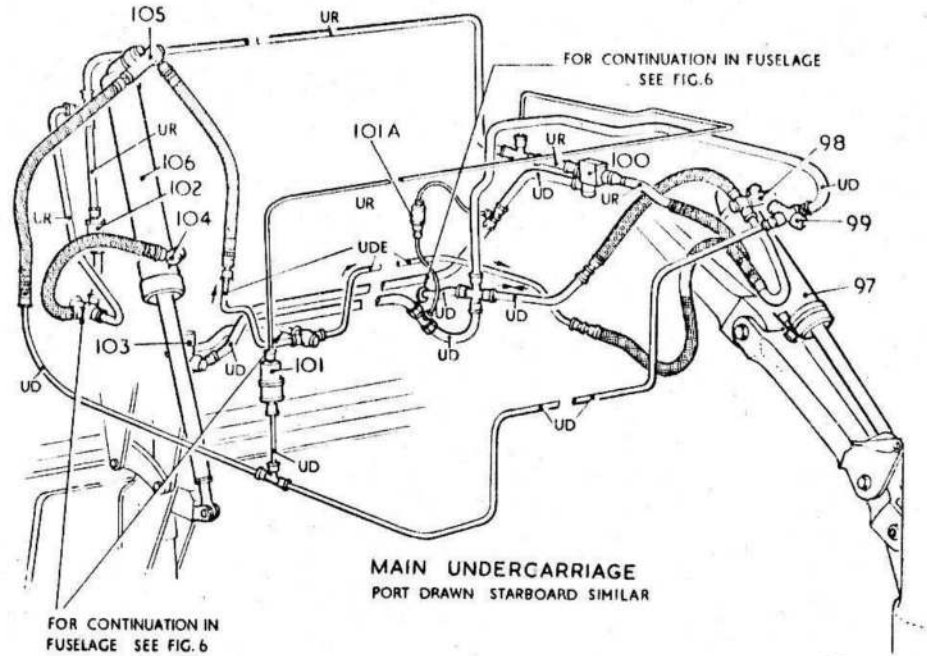
KEY TO FIG. 6  
(Refer also to Key to Fig. 17)

- 88 NON-RETURN VALVE
- 90A NON-RETURN VALVE
- 93 EMERGENCY TRANSFER VALVE
- 94 EMERGENCY DOWN SELECTOR VALVE
- 95 HAND PUMP GROUND/FLIGHT SELECTOR
- 96 ALIGHTING GEAR SELECTOR VALVE
- 102A VARIABLE FLOW VALVE
- 107 THERMAL RELIEF VALVE
- 108 THERMAL RELIEF VALVE
- 129 FILTER
- 158 NOSE UNDERCARRIAGE GROUND-OPERATED SELECTOR
- 159 THERMAL RELIEF VALVE
- 160 NON-RETURN VALVE
- 161 NON-RETURN VALVE

Fig.6 Alighting gear circuit

KEY TO FIG. 7  
(Refer also to Key to Fig. 17)

- 97 MAIN UNDERCARRIAGE JACK
- 98 SHUTTLE VALVE
- 99 SEQUENCE VALVE
- 100 TRANSFER VALVE
- 101 THERMAL RELIEF VALVE
- 101A THERMAL RELIEF VALVE
- 102 VARIABLE FLOW VALVE
- 103 SEQUENCE VALVE
- 104 RESTRICTOR
- 105 SHUTTLE VALVE
- 106 MAIN UNDERCARRIAGE DOOR JACK
- 163 NOSE UNDERCARRIAGE DOOR JACK
- 164 SHUTTLE VALVE
- 165 THERMAL RELIEF VALVE
- 166 SEQUENCE VALVE
- 167 SEQUENCE VALVE
- 168 NOSE UNDERCARRIAGE JACK
- 169 THERMAL RELIEF VALVE
- 170 SHUTTLE VALVE
- 171 SEQUENCE VALVE



FOR KEY TO CODE LETTERS  
REFER TO FIG. 17

Fig. 7 Alighting gear circuit (2)

23. A full description of the transfer valve ref. 1-00032-001, the function of which is similar to that of ref. C. 86967 is given in A. P. 1803D, Vol. 1, Book 3A.

#### Normal operation - nose undercarriage

24. When DOWN is selected, pressure is applied through the 'down' line and ground selector (para. 26) to the undercarriage jack (168) and thence through the sequence valve (171) to the door jack (163). Fluid from the 'up' side of the undercarriage jack returns to the selector through a sequence valve (166) operated by the door jack and, until the door jack has retracted and closed this valve, no movement of the undercarriage jack is obtained. Fluid from the 'up' side of the door jack returns to the header tank through the ground selector and alighting gear selector. With the opening of the sequence valve (166), the undercarriage jack retracts, the initial movement closing the sequence valve (171). Excessive pressure in the 'down' line is relieved to the 'up' line through a thermal relief valve (169) set to operate at 3450 p. s. i.

25. On selecting UP, the flow to the jacks is reversed and fluid pressure is applied through the 'up' line and ground selector to the door jack and thence, through the sequence valve (166), to the undercarriage jack. The return flow from the door jack must pass through the sequence valve (171) and, since this valve remains closed until the undercarriage jack is extended, no movement is obtained from the door jack until the undercarriage is retracted. With the opening of the sequence valve (171), the door jack extends, the initial movement closing the sequence valve (166). Excessive pressure in the

'up' line is relieved to the 'down' line through a thermal relief valve (165) set to operate at 3450 p. s. i.

#### Nose undercarriage ground selector

26. This selector (158), which enables the 'up' and 'down' lines from the alighting gear selector to be reversed at the nose undercarriage jacks, provides for independent retraction of the nose undercarriage while the aircraft is on the ground. The selector valve is of the type requiring a constant pressure, and this is applied through non-return valves (160 and 161) from the hand pump supply and system supply. Excessive pressure in the lines between the non-return valves and the selector is relieved to the system return by a thermal relief valve (159) set to operate at 3450 p. s. i.

#### Hand pump operation - normal

27. The hand pump supply is isolated from the alighting gear normal circuit when the aircraft is in flight, by the hand pump GROUND/FLIGHT selector (95). When the aircraft is on jacks the alighting gear may be raised and lowered (using the hand pump) by setting the GROUND/FLIGHT selector to GROUND; this connects the hand pump supply to the alighting gear normal selector.

#### Emergency lowering system

28. This system, controlled by a handle mounted on the vertical panel at the forward end of the port console at the pilot's station, provides for manual operation of the alighting gear normal selector (96) to DOWN and the opening of the emergency lowering selector (94), thus catering for both electrical and hydraulic failure. After operating the emergency lowering control, the alighting gear will be lowered in the normal manner by system pressure if the failure is due to an electrical fault only, but in the event of a hydraulic

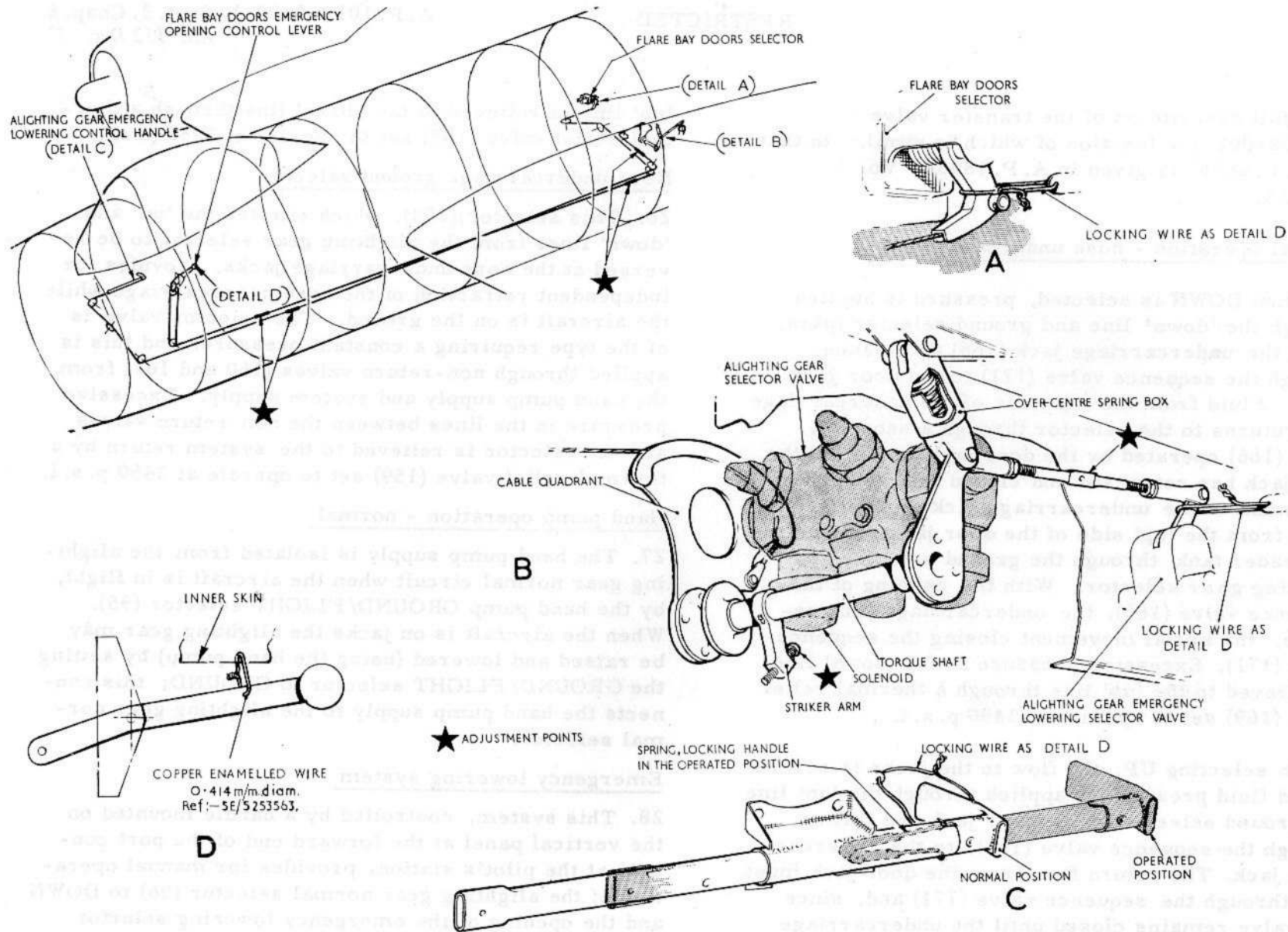


Fig. 8 Alighting gear and flare bay doors emergency controls

◀ MOD. 5008 ▶

F.S./9

failure, the hand pump must be used.

29. The emergency lowering control handle is connected by cable (fig. 8) to a quadrant fitted to one end of a torque shaft mounted immediately below the alighting gear normal selector (96). A lever, fitted to the other end of the torque shaft, is connected by an adjustable tie-rod to the operating lever on the emergency lowering selector (94). An over-centre spring box is connected to the lever on the torque shaft to bias the control in both the on and off positions. Secured to the torque shaft, between the quadrant and the lever, is a striker arm incorporating an adjustable striker bolt.

◀ The control handle and the emergency valve selector lever are locked in the normal position with enamelled copper wire (0.414 mm. dia.) Ref 5E/5253563 (Fig. 8) which, when broken, indicates that the system has been used. ▶

30. When the control handle is pulled, the lock is broken and the emergency selector lever is moved to the 'open' position. Simultaneously, the striker bolt on the striker arm contacts and manually operates the appropriate solenoid on the appropriate solenoid on the alighting gear normal selector to obtain a DOWN selection. In the event of an electrical failure only, fluid from the system supply will then be directed through the normal selector to the 'down' line and the alighting gear will be lowered in the normal manner.

31. If the failure is in the hydraulic system, the hand pump must be operated. Fluid under pressure from the hand pump is then applied through the emergency selector (94) to the emergency transfer valve (93), and through shuttle valves (26, 31, 98, 105 and 164) to the door jacks and main undercarriage jacks. Application of pressure to the transfer valve,

operates a slide valve which closes off the system supply to the alighting gear and vents the normal selector supply line to tank. The sequence of jack operation as described in para. 19 and 24 is maintained throughout emergency lowering except for the application to the nose undercarriage jack of hand pump pressure, which is directed through a sequence valve (167) and shuttle valve (170) after the doors have opened.

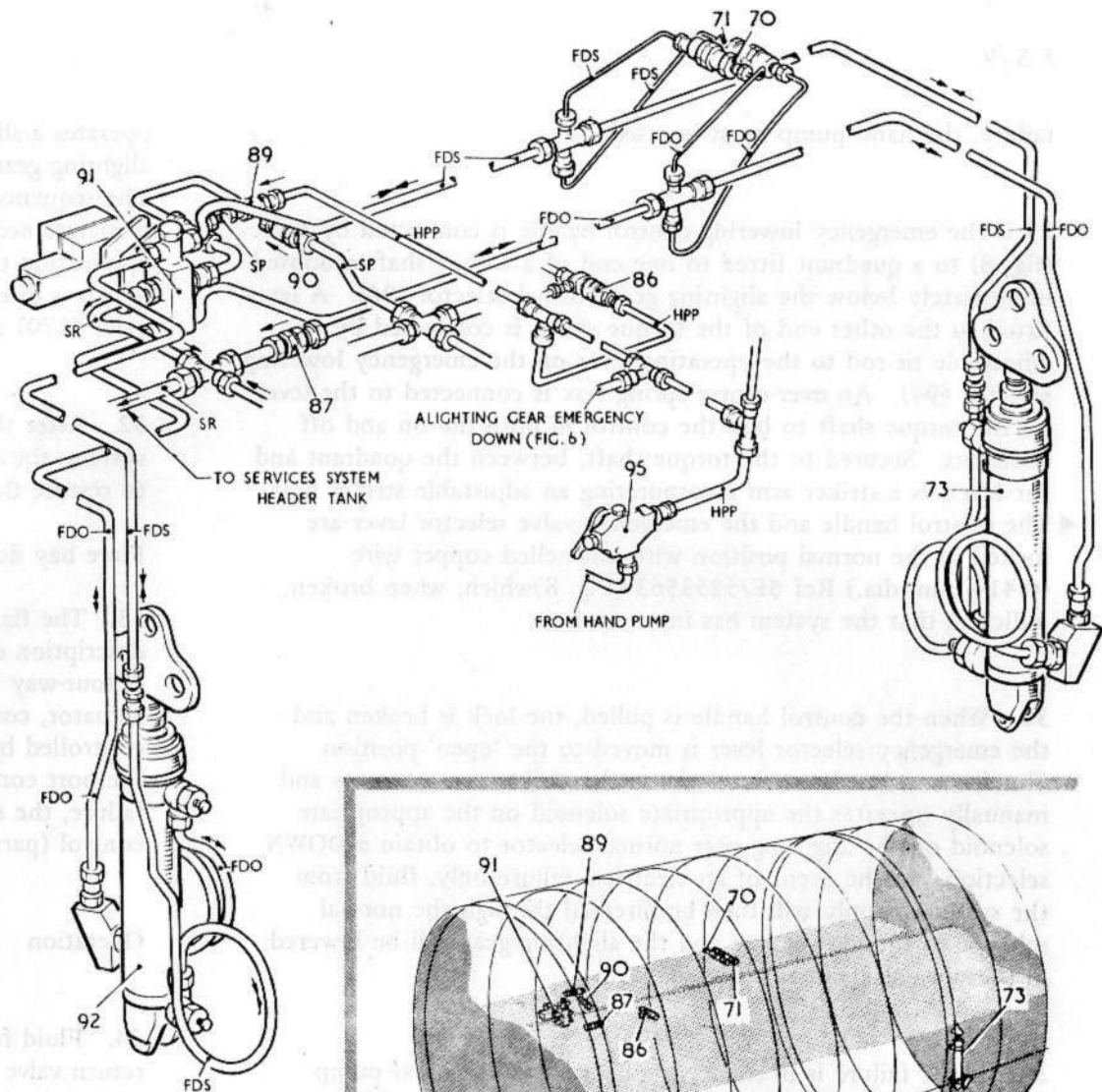
32. After the alighting gear has been lowered by the emergency system, the servicing procedures given in para. 109 are necessary to restore the system to normal.

Flare bay doors circuit (fig. 9)

33. The flare bay doors are operated by two hydraulic jacks, a description of the mechanism being given in Chap. 1 of this Section. A four-way rotary selector (91), operated by an electric rotary actuator, controls the fluid flow to the jacks, the actuator being controlled by a two-position, OPEN-CLOSED switch mounted on the port console at the pilot's station. In the event of an electrical failure, the selector may be operated to open the doors by a manual control (para. 36).

Operation

34. Fluid from the system supply (para. 7) passes through a non-return valve (90) into the selector where it is directed, in accordance with the selection made, to the 'open' or 'closed' line to the jacks. The other line, carrying the return flow from the jacks, is opened through the selector to the system return line. After OPEN is selected, excessive pressure is relieved through the 'closed' line to the system return line by a thermal relief valve (71).

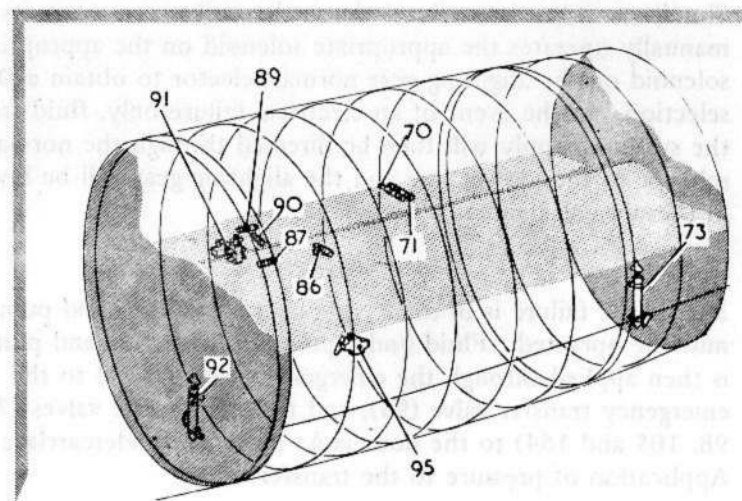


**KEY TO FIG. 9**

(Refer also to Key to Fig. 17)

- 70 THERMAL RELIEF VALVE
- 71 THERMAL RELIEF VALVE
- 73 FLARE BAY DOOR JACK - AFT
- 86 PRESSURE RELIEF VALVE
- 87 NON-RETURN VALVE
- 89 NON-RETURN VALVE
- 90 NON-RETURN VALVE
- 91 FLARE BAY DOORS SELECTOR VALVE
- 92 FLARE BAY DOOR JACK - FORWARD
- 95 HAND PUMP GROUND - FLIGHT SELECTOR

FOR KEY TO CODE LETTERS REFER TO FIG. 17



**Fig.9 Flare bay doors circuit**

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Similarly, after CLOSED is selected, excessive pressure is relieved through the 'up' line by a thermal relief valve (70). Both valves are set to operate at 3450 p.s.i.

35. The flare bay doors may be operated both in flight and on the ground by operation of the hand pump, the supply from the pump being connected through a non-return valve (89) to the system supply line to the selector.

Emergency opening control (fig. 8)

36. The control lever for opening the flare bay doors in an emergency, i.e. in the event of an electrical failure, is mounted on the port side of the fuselage at the pilot's station. It is connected by cable to a lever on the flare bay doors selector; the lever is spring-loaded in its off position. The control handle is locked in the normal position and the selector lever in the OFF position with enamelled copper wire (0.414 mm. dia.) Ref. 5E/5253563 (Fig. 8) which, when broken, indicates that the emergency system has been used. ▶

Trailing edge flaps circuit (fig. 10)

37. Each of the four trailing-edge flaps is operated by a double-acting hydraulic jack with a piston rod at each end; a description of the flap mechanism is given in Chap. 4 of this Section. A four-way rotary selector (66), operated by an electrical rotary actuator, controls the fluid flow to the jacks. The actuator is controlled by a two position switch (UP-DOWN) mounted below the alighting gear push-buttons on the vertical panel at the forward end of the port console at the pilot's station.

Note... Fig. 10A identifies piping introduced to effect re-routing requirements on aircraft incorporating Mod 4838.

Operation

38. Fluid from the system supply (para. 7) enters the selector (66) through a non-return valve incorporated in the selector. It is then directed, in accordance with the selection made, to the 'up' or 'down' line to the jacks. The other line, carrying the return flow from the jacks, is opened through the selector to the system return line. A two-way restrictor (67) is incorporated in the down line and a one-way restrictor (67A) in the up line to ensure gradual movement of the flaps. When the flaps are down, excessive pressure in the jacks, caused by gust loads, is relieved to the system return line, to protect the main plane structure, by a pressure relief valve (68) connected to the 'down' line; the valve is set to operate at 2950 p.s.i. Excessive pressure in the 'up' line is relieved to the 'down' line through a thermal relief valve (69), set to operate at 3450 p.s.i.

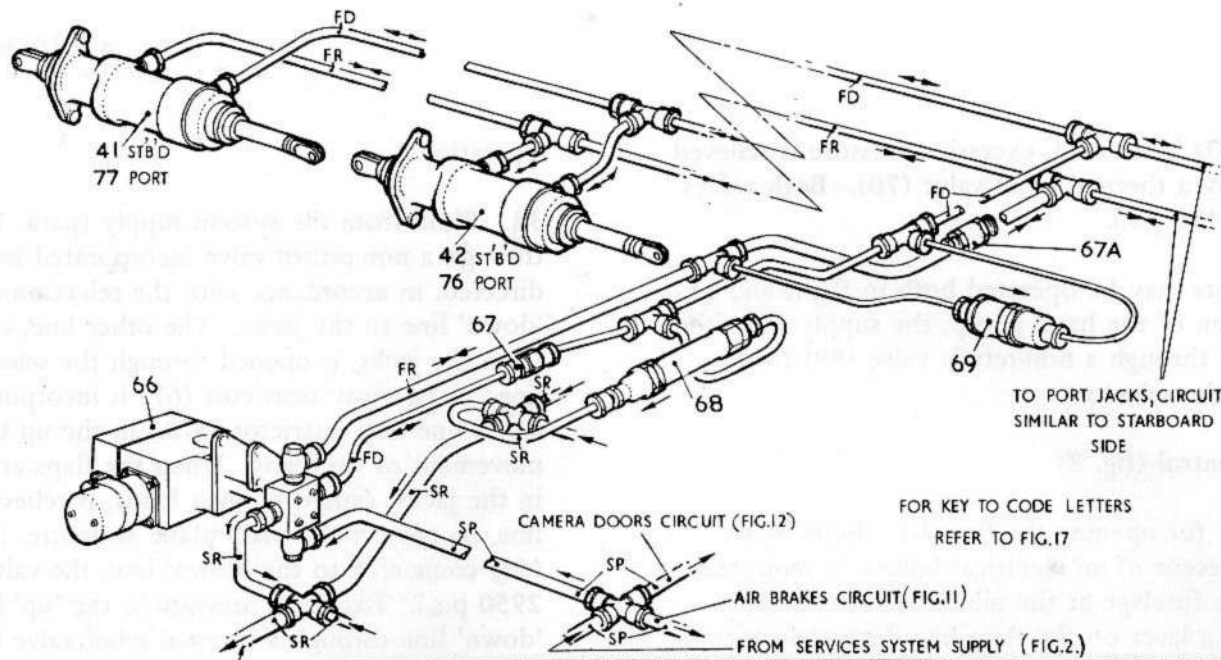
39. The flaps cannot be operated by the hand pump when the aircraft is in flight since the hand pump delivery is isolated from the flaps circuit by the GROUND/FLIGHT selector valve (95). When on the ground, the hand pump may be used by setting the GROUND/FLIGHT selector valve to GROUND.

Air brakes circuit (fig. 11).

40. The air brakes are operated by two hydraulic jacks one in each main plane; a description of the mechanism and its operation is given in Chap. 2 and 4 of this Section. An electrically-operated, four-way selector (74) controls the fluid flow to the jacks, the selector being controlled by a three-position switch, IN-MID-OUT, mounted on the anti-reflection screen coaming at the pilot's station.

Operation

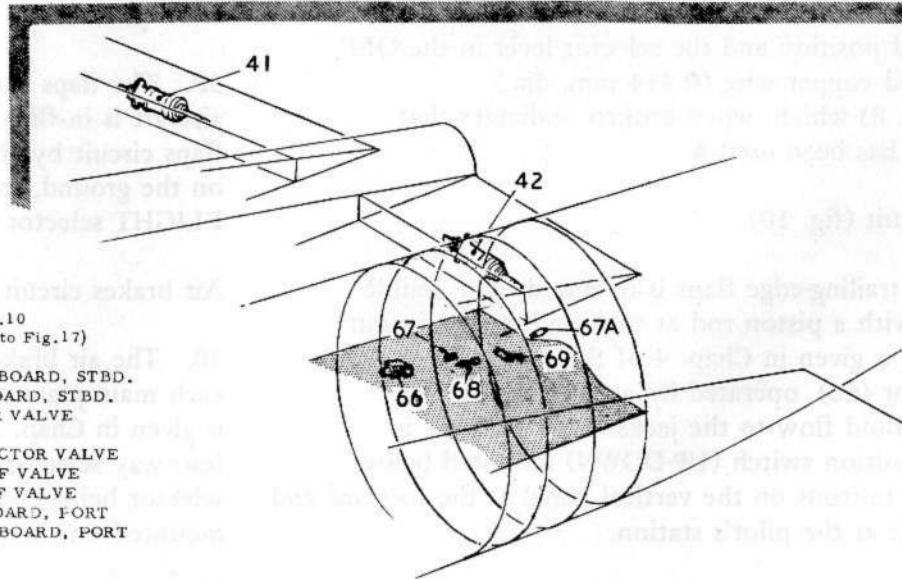
41. The selector (74) is operated by two solenoids,



TO PORT JACKS, CIRCUIT  
SIMILAR TO STARBOARD  
SIDE

FOR KEY TO CODE LETTERS  
REFER TO FIG.17

TO SERVICES SYSTEM  
HEADER TANK

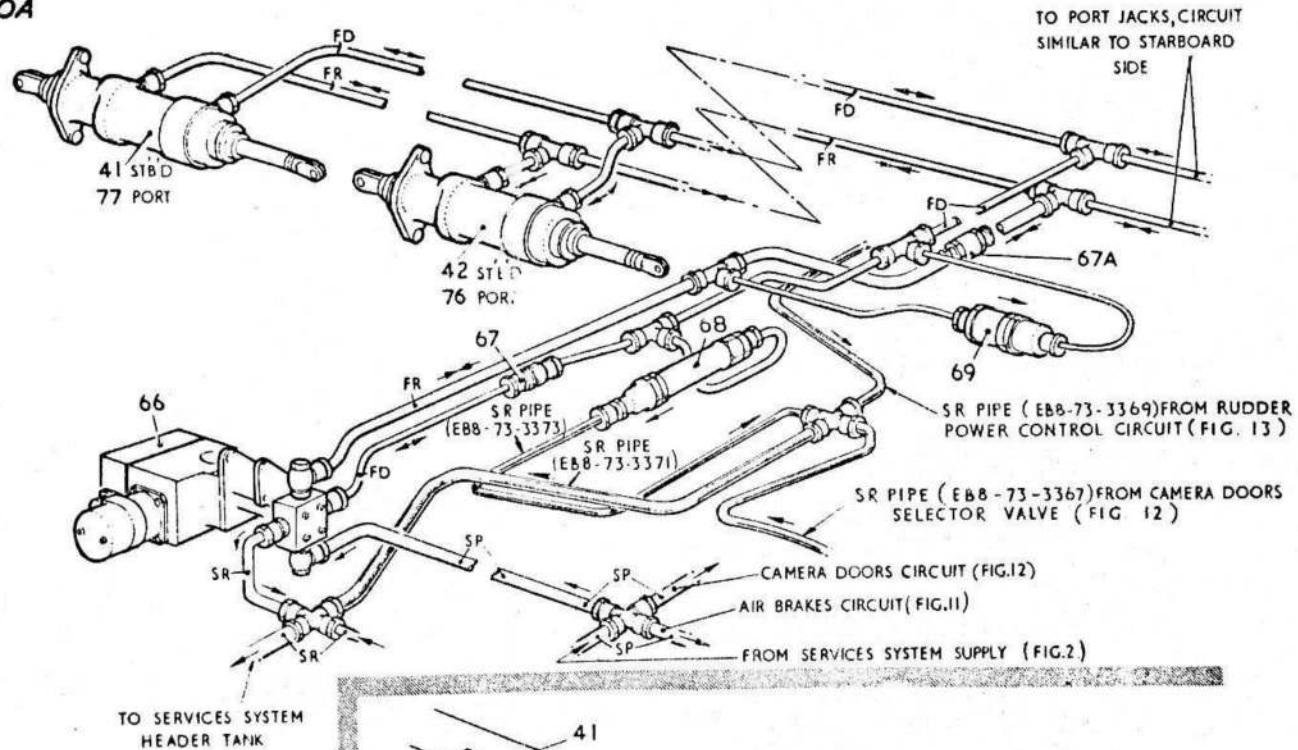


KEY TO FIG.10  
(Refer also to Key to Fig.17)

- 41. FLAP JACK, OUTBOARD, STBD.
- 42. FLAP JACK, INBOARD, STBD.
- 66. FLAPS SELECTOR VALVE
- 67. RESTRICTOR
- 67A. ONE-WAY RESTRICTOR VALVE
- 68. PRESSURE RELIEF VALVE
- 69. THERMAL RELIEF VALVE
- 76. FLAP JACK, INBOARD, PORT
- 77. FLAP JACK, OUTBOARD, PORT

Fig.10 Trailing edge flap circuit  
◀ ( PRE-MOD. 4838 ) ▶

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KEY TO FIG. 10  
(Refer also to Key to Fig. 17)

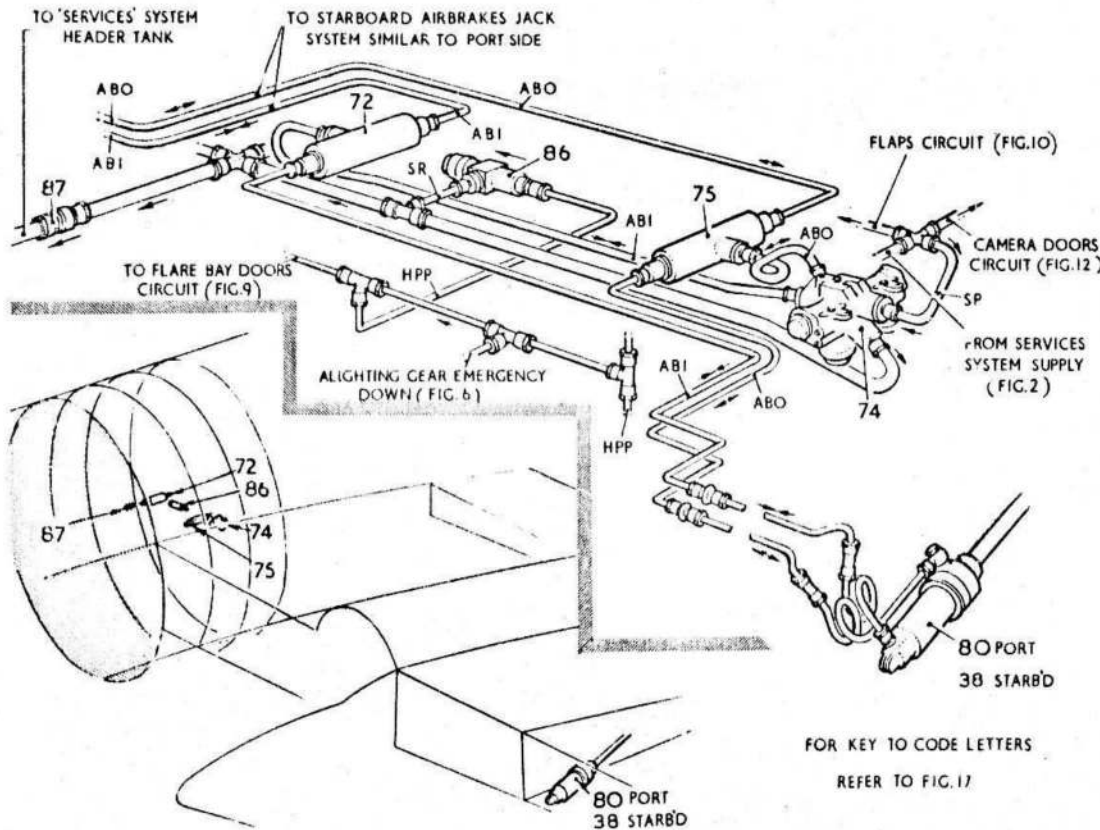
- 41. FLAP JACK, OUTBOARD, STBD.
- 42. FLAP JACK, INBOARD, STBD.
- 66. FLAPS SELECTOR VALVE
- 67. RESTRICTOR
- 67A. ONE-WAY RESTRICTOR VALVE
- 68. PRESSURE RELIEF VALVE
- 69. THERMAL RELIEF VALVE
- 76. FLAP JACK, INBOARD, FORT
- 77. FLAP JACK, OUTBOARD, PORT

Fig. 10A Trailing edge flap circuit  
◀ (POST MOD. 4838) ▶

and when IN or OUT is selected, one is energised and the other de-energised. When OUT is selected, the appropriate solenoid is energised and fluid from the system supply (para. 7) is directed to the 'out' line and through a flow divider (75) to both jacks (38 and 80). The flow divider ensures synchronous movement of the jacks. Return fluid from the jacks passes through the 'in' line and flow divider (72) to the selector and thence to the system return line.

The jacks move to fully closed for the OUT position of the air brakes. When IN is selected, the flow to and from the jacks is reversed and the jacks move to fully extended for the IN position of the air brakes.

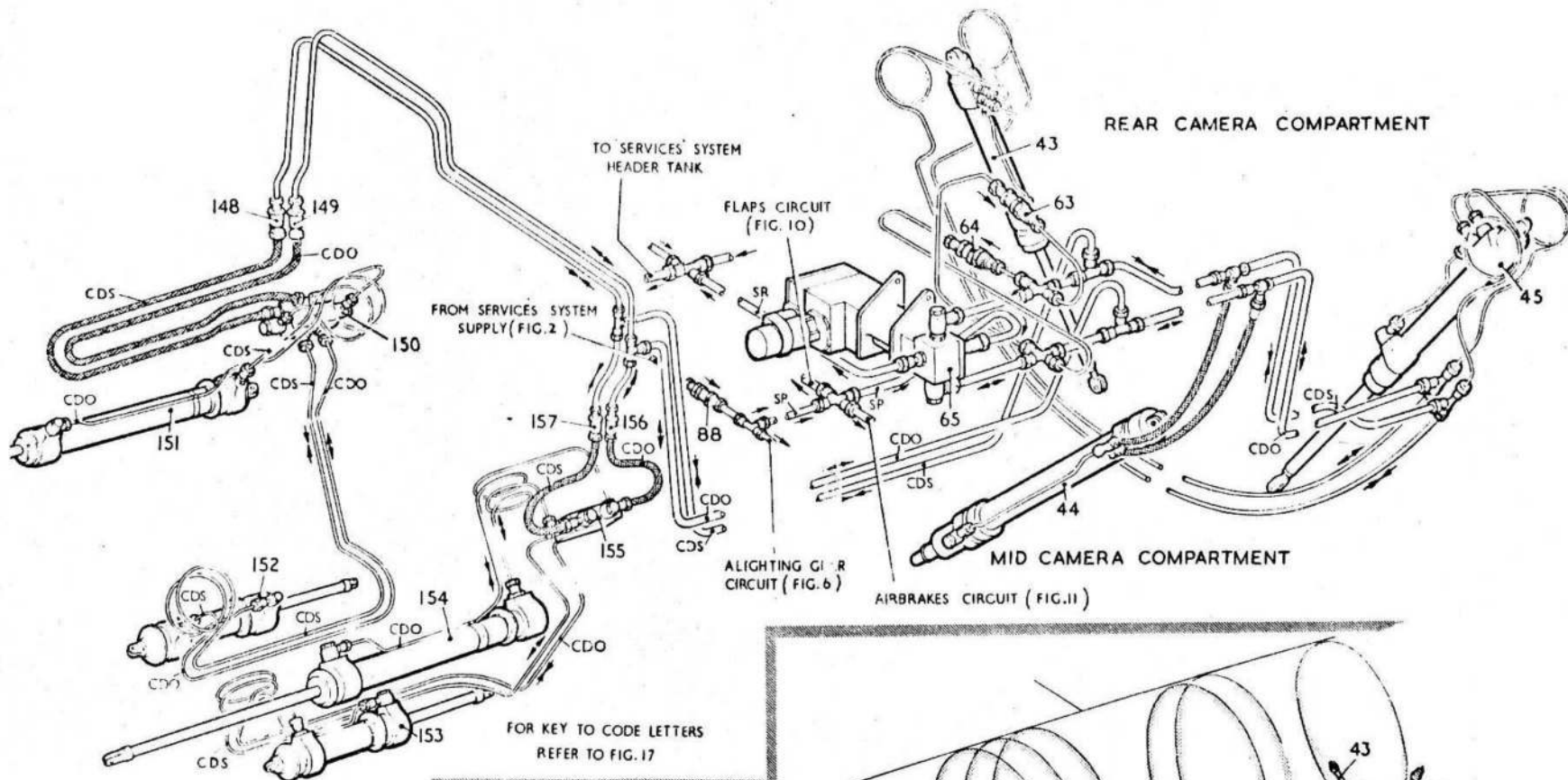
42. When MID is selected, the electrical power supply to the selector solenoids is controlled by a drum switch operated by the starboard air brake mechanism (Chap. 4). The electrical circuit (Sect. 5, Chap. 1) is



KEY TO FIG. 11  
(Refer also to Key to Fig. 17)

- 38 AIR BRAKE JACK, STBD.
- 72 FLOW DIVIDER
- 74 AIR BRAKES SELECTOR VALVE
- 75 FLOW DIVIDER
- 80 AIR BRAKE JACK, PORT
- 86 PRESSURE RELIEF VALVE
- 87 NON-RETURN VALVE

Fig. 11 Air brakes circuit



FRONT CAMERA COMPARTMENT

KEY TO FIG. 12

(Refer also to Key to Fig. 17)

- 43 REAR CAMERA DOOR JACK
- 44 MID CAMERA DOOR JACK
- 45 REAR CAMERA DOOR JACK
- 63 THERMAL RELIEF VALVE
- 64 THERMAL RELIEF VALVE
- 65 CAMERA DOORS SELECTOR VALVE
- 148 AVERY COUPLING
- 149 AVERY COUPLING
- 150 JUNCTION BLOCK
- 151 FORWARD CAMERA DOOR JACK
- 152 FORWARD CAMERA DOOR JACK
- 153 FORWARD CAMERA DOOR JACK
- 154 FORWARD CAMERA DOOR JACK
- 155 JUNCTION BLOCK
- 156 AVERY COUPLING
- 157 AVERY COUPLING

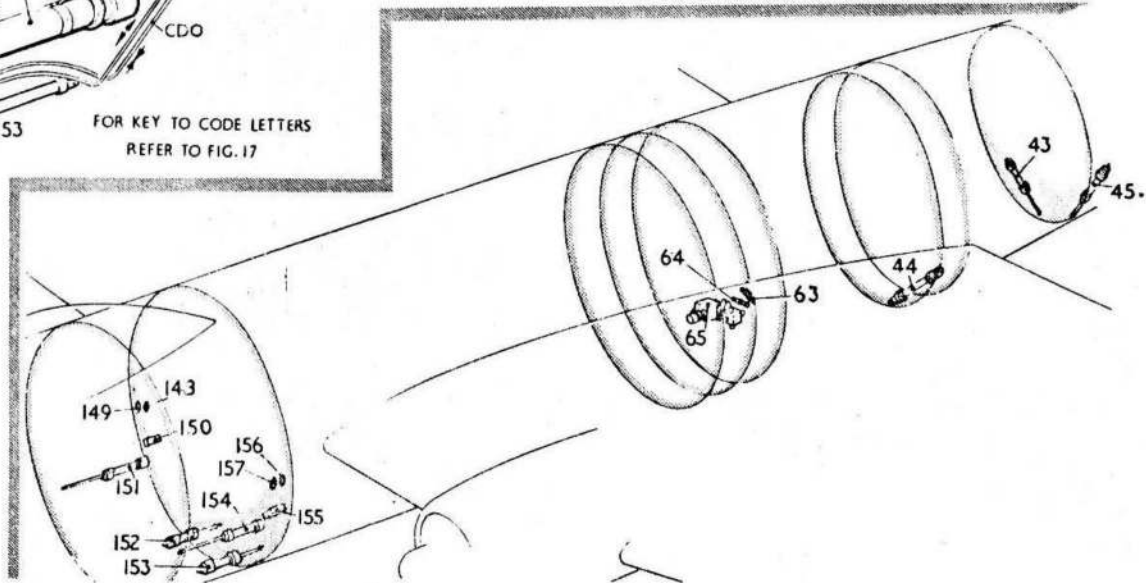


Fig.12 Camera doors circuit

so arranged that, when the air brakes are OUT, a hydraulic IN selection is made and vice versa. The hydraulic circuit and jacks will then operate in accordance with the selection made until the air brakes reach the MID position. At this position, the drum switch will break the power supply to the selector and de-energise both solenoids, closing all the valves in the selector and forming a hydraulic lock which will stop the jacks at the MID position.

43. The air brakes cannot be operated by the hand pump when the aircraft is in flight since the hand pump delivery is isolated from the circuit by the GROUND/FLIGHT selector valve (95). When on the ground, the hand pump may be used by setting the GROUND/FLIGHT selector valve to GROUND.

#### Camera doors circuit (fig. 12)

44. Four hydraulic jacks (151, 152, 153 and 154) operate the camera doors in the front camera compartment, one (44) in the mid compartment and two (43 and 45) in the rear compartment; a description of the door mechanisms is given in Chap. 1 of this Section. When the doors are closed, the jacks in the forward and rear compartment are extended; but in the mid compartment, the jack is retracted when the doors are closed. A four-way rotary selector (65), operated by an electrical rotary actuator, controls the fluid flow to the jacks. The actuator is controlled by a two-position switch (OPEN-CLOSED) mounted on the camera console at the navigator's station.

#### Operation

45. Fluid from the system supply (para. 7) enters the selector (65) through a non-return valve incorporated in the selector. It is then directed, in

accordance with the selection made, to the 'open' or 'closed' lines to the jacks. The other line, carrying the return flow from the jacks, is opened through the selector to the system return line. Excessive pressure in a jack line is relieved to the opposite line through thermal relief valves (63 and 64) which are set to operate at 3450 p. s. i.

46. The camera doors cannot be operated by the hand pump when the aircraft is in flight since the hand pump delivery is isolated from the circuit by the GROUND/FLIGHT selector valve (95). When on the ground, the hand pump may be used by setting the GROUND/FLIGHT selector valve to GROUND.

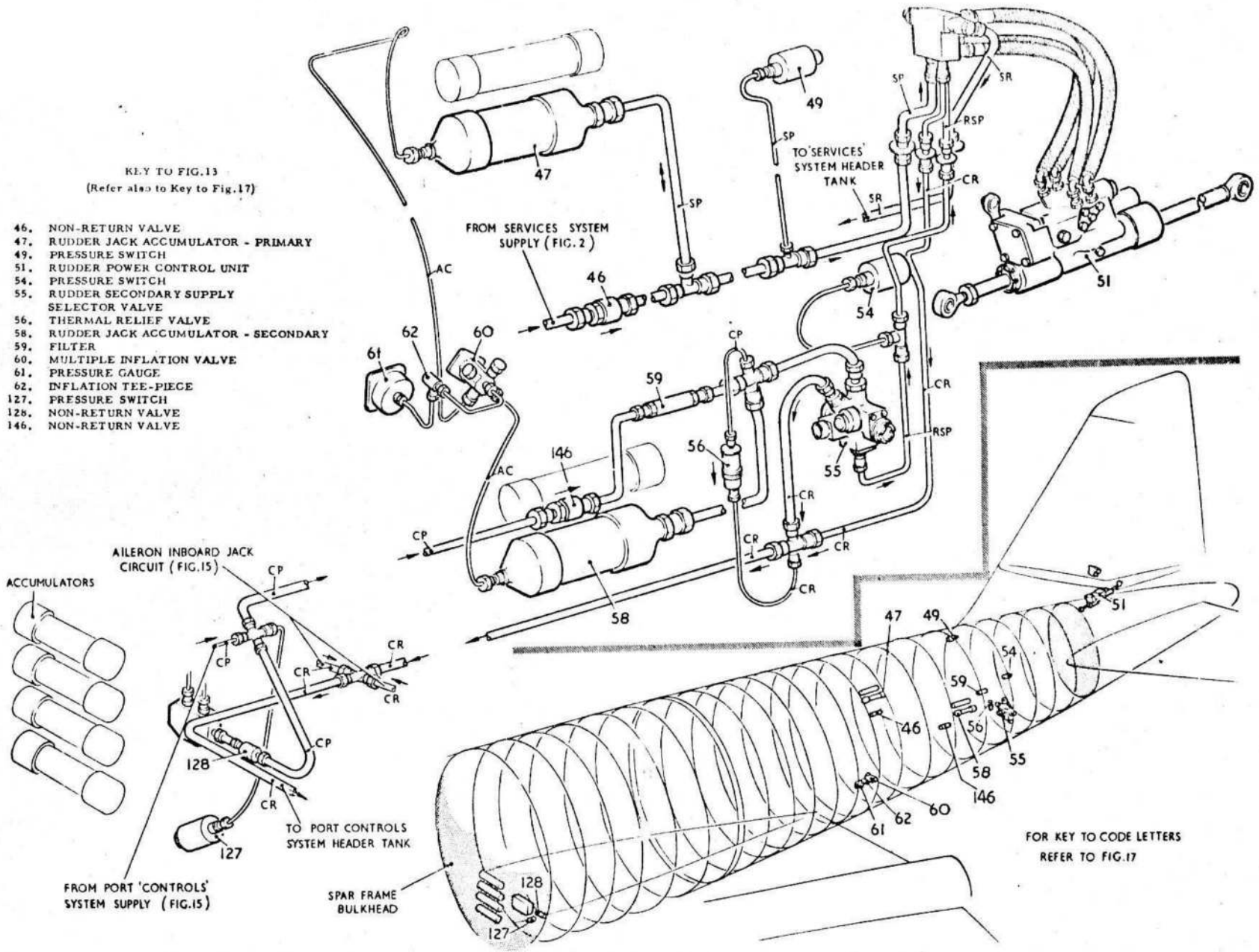
#### Rudder power control circuit (fig. 13)

47. The rudder is operated by a Hobson, Type 101, Mk. 3 power control unit (51) mounted in the fin stub. A description of the rudder controls is given in Chap. 4 of this Section and of the power control unit in A. P. 105D-0410-16A.

48. Primary power for the operation of the power control unit is provided by the 'services' system. Secondary power, provided by the port 'controls' system, becomes available automatically, should the primary supply fail.

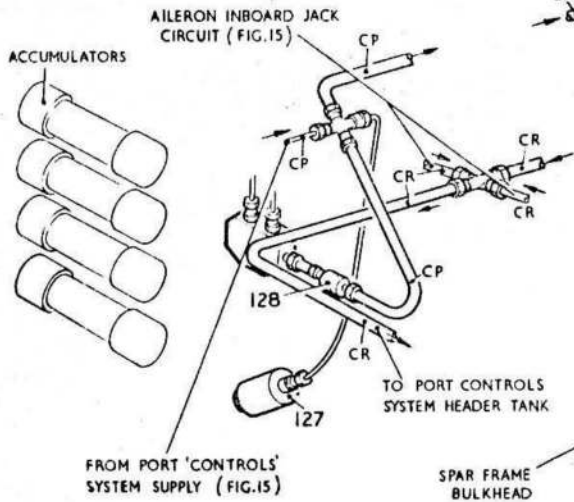
#### Power supply

49. Pressure is built up in the rudder jack primary accumulator (47) by the 'services' system supply (para. 7) through a non-return valve (46), and in the rudder jack secondary accumulator (58) by the port 'controls' system supply (para. 62). From the accumulator, the supplies are connected to the control valve on the power control unit through non-return valves



KEY TO FIG.13  
(Refer also to Key to Fig.17)

- 46. NON-RETURN VALVE
- 47. RUDDER JACK ACCUMULATOR - PRIMARY
- 49. PRESSURE SWITCH
- 51. RUDDER POWER CONTROL UNIT
- 54. PRESSURE SWITCH
- 55. RUDDER SECONDARY SUPPLY SELECTOR VALVE
- 56. THERMAL RELIEF VALVE
- 58. RUDDER JACK ACCUMULATOR - SECONDARY
- 59. FILTER
- 60. MULTIPLE INFLATION VALVE
- 61. PRESSURE GAUGE
- 62. INFLATION TEE-PIECE
- 127. PRESSURE SWITCH
- 128. NON-RETURN VALVE
- 146. NON-RETURN VALVE



FOR KEY TO CODE LETTERS  
REFER TO FIG.17

Fig.13 Rudder power control circuit

incorporated in the control valve, the primary supply being connected directly to the control valve and the secondary through a solenoid-operated selector valve (55).

50. The solenoid-operated selector valve is controlled by an electro-hydraulic pressure switch (49) connected to the primary supply line between the accumulator and the power control unit. When the pressure in the primary supply line is at 1800 p. s. i. or above, the electrical contacts in the pressure switch will be open, the selector valve solenoid will be de-energised and the valve closed. Should the pressure in the primary supply fall below 1800 p. s. i. the pressure switch contacts will close, thus completing the electrical circuit to the selector valve to energise the solenoid and open the valve. To prevent the pressure switch hunting, a pressure differential of  $250 \pm 50$  p. s. i. between closing and opening of the electrical contacts in the switch is provided, i. e. the contacts will not re-open until a pressure of  $2050 \pm 50$  p. s. i. has built up in the primary circuit.

51. Operation of the power control unit by either supply is similar. When the rudder controls are operated, the fluid is directed to the appropriate side of the jack piston, and fluid from the opposite side of the piston is returned to the header tank through the return line of the system supplying the power. In the secondary supply, the line between the selector valve and the power control unit, is vented to tank through the selector valve and system return line when the selector valve is closed. Excessive pressure in the supply line to the selector valve is relieved to the return line through a thermal relief valve (56), set to operate at 3450 p. s. i.

#### Fail/safe indicators

52. Indication to the pilot of failure in the hydraulic supplies to the rudder and aileron controls is given by two pairs of warning lamps, one pair for each control. In each pair is one amber light and one red, the amber light indicating a 50 per cent. failure and the red a 100 per cent. failure. The lamps, mounted on the anti-reflection screen coaming, are controlled by electro-hydraulic pressure switches connected to the supply lines to the power control units. In the rudder controls circuit, these switches are connected, one (49), to the primary supply line between the accumulator and power control unit (this switch also controls the secondary supply selector valve, (para. 50) and another (54) to the secondary supply between the selector valve and power control unit.

53. Should the pressure in the primary supply fall below 1800 p. s. i. the electrical contacts in the pressure switch (49) will close and complete the supply to both the 50 per cent. and 100 per cent. rudder failure warning lights and open the secondary supply selector valve (55) (para. 50). When the pressure in the secondary supply line builds up to 1800 p. s. i. the contacts in the pressure switch (54) will open and break the supply to the 100 per cent. failure warning light, leaving only 50 per cent. warning indication. Under normal conditions, the pressure build-up time in the secondary supply is approximately 0.01 seconds and it is improbable that during the changeover the 100 per cent. warning light will indicate. Should the build-up fail to occur due, perhaps, to failure of the selector valve to open or failure of the port 'controls' system (para. 68), both lights will come on indicating a 100 per cent. rudder failure.

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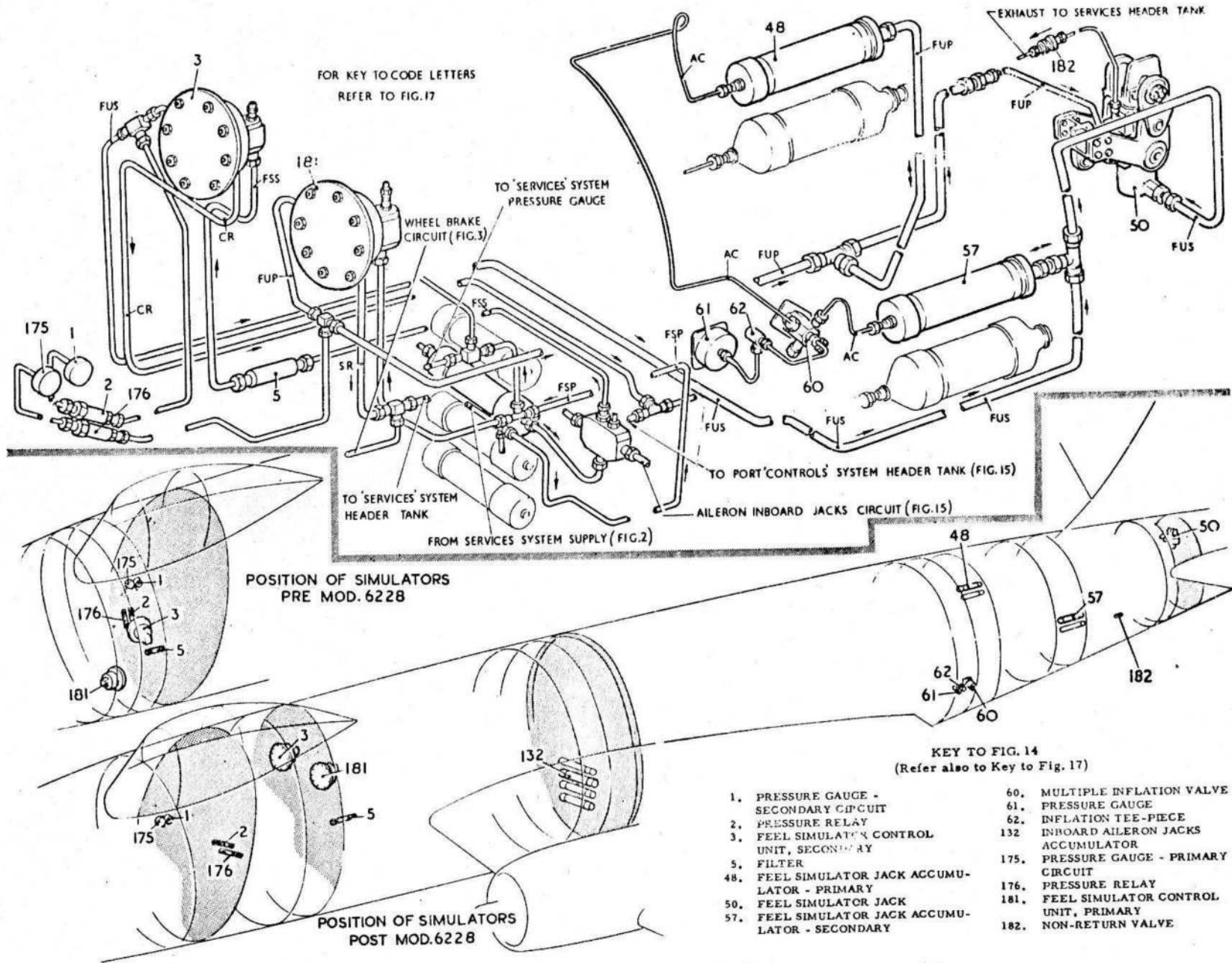


Fig. 14 Rudder feel simulation circuit

RESTRICTED

54. In the port 'controls' system, a pressure switch (127) is connected to the common supply line to the aileron inboard jack and secondary rudder circuits. Should the pressure in the system fall below 1800 p. s. i. the electrical contacts in the switch will close and complete the supply to the 50 per cent. warning lights for both aileron and rudder. A subsequent failure of the primary rudder supply will then produce a 100 per cent. rudder failure warning.

55. All the pressure switches have a pressure differential of  $250 \pm 50$  p. s. i. between opening and closing of the electrical contacts to prevent hunting. A full description of the relevant electrical circuits concerned with the fail/safe indicators is given in Sect. 5, Chap. 1.

#### Rudder feel simulation circuit (fig. 14)

56. Artificial feel, proportional to the square of the air speed, is applied to the rudder controls by a hydraulic feel simulator jack (50). The force exerted by the jack is governed by a hydraulic pressure signal generated by a feel simulator control unit. To insure against hydraulic system failure, duplicate signal pressures are provided by two control units; both pressures are applied simultaneously to the jack, but the operation of the jack is unaffected by failure of either one.

57. The feel simulator control units (3 and 181) Hobson, Type 207, Mk. 2, are controlled by pitot and static pressure. The unit governing the primary pressure signal, operates in the 'services' hydraulic system, and that governing the secondary signal pressure, operates in the port 'controls' system. A description of the control units is given in A. P. 4604Z,

Vol. 1, whilst the feel simulator jack is covered in A. P. 1803D, Vol. 1. Details of the pitot and static pressure systems are given in Sect. 5, Chap. 2.

#### Operation

58. Each of the feel simulator control units (3 and 181) is subject on opposing sides to pitot and static pressure in the manner of an air speed indicator. The resultant dynamic force acts on one end of a valve and is reacted through the valve by a hydraulic pressure. This latter is termed signal pressure and is metered by the valve from the parent system supply. The control unit (181) in the primary circuit obtains its supply from the 'services' system, and that (3) in the secondary circuit from the port 'controls' system, this supply passing through a filter (5) before entering the control unit. When dynamic/signal pressure balance prevails across the valve its ports are closed, but with any air speed change or control column displacement the valve moves to modify the signal pressure until balance is restored. Exhaust fluid from the control unit is returned to the header tank of the parent system.

59. From each control unit, the signal pressure is applied to an accumulator, (48) primary, (57) secondary, and thence to the feel simulator jack (50). The primary is applied to the upper piston in the jack and the secondary to the lower. To avoid the possibility of back pressures from other services affecting the operation of the jack, the jack exhaust is connected to the 'services' system header tank through a separate line. Details of the jack linkage to the rudder controls are given in Chap. 4 of this Section.

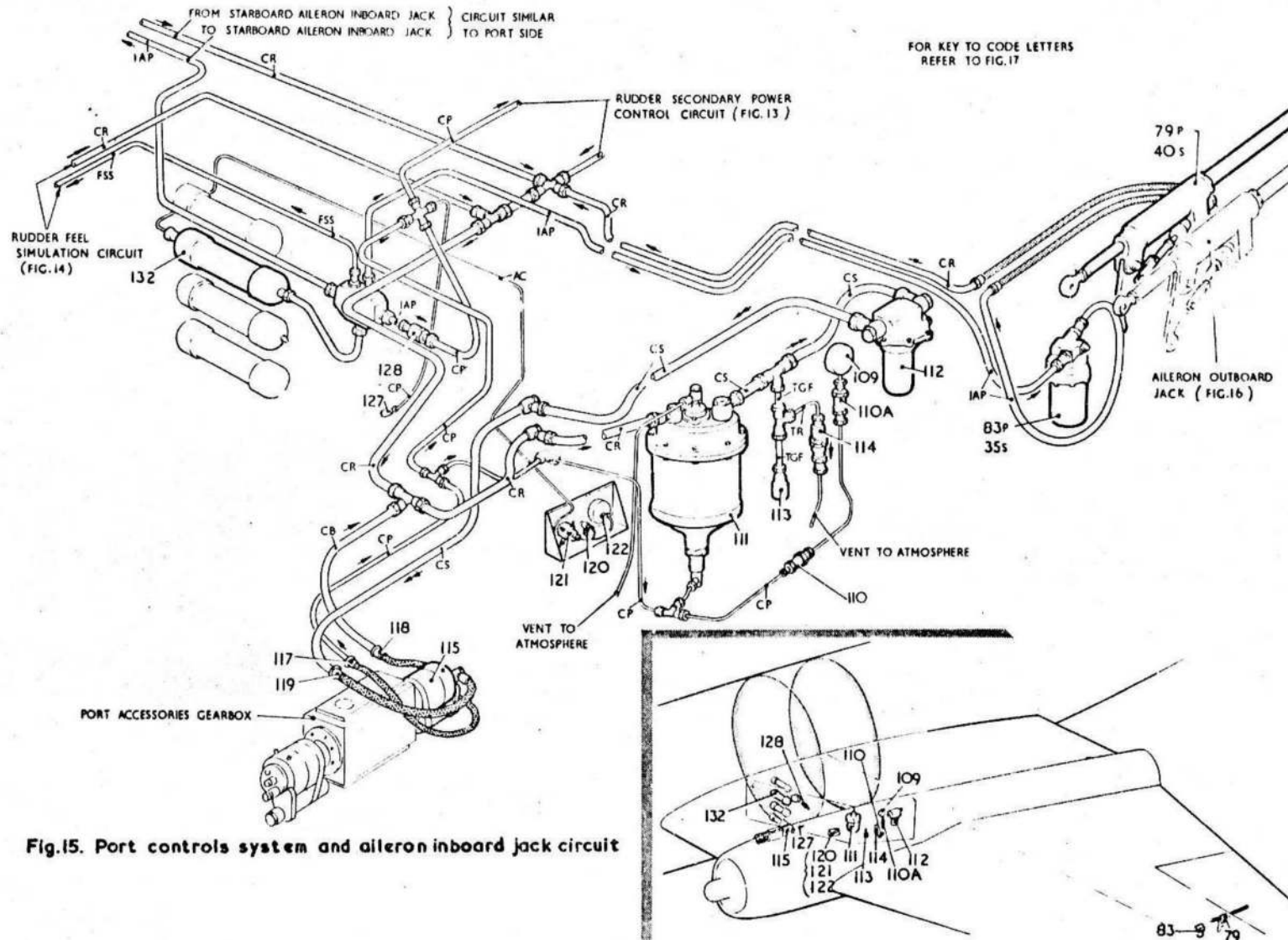


Fig. 15. Port controls system and aileron inboard jack circuit

- 35 FILTER
- 40 AILERON JACK, INBOARD, STARBOARD
- 79 AILERON JACK, INBOARD, PORT
- 83 FILTER
- 109 PRESSURE GAUGE
- 110 PRESSURE RELAY
- 110A CHOKE
- 111 HEADER TANK
- 112 FILTER

- KEY TO FIG. 15 (Refer also to Key to Fig. 17)
- 113 TANK FILLING CONNECTION
  - 114 PRESSURE RELIEF VALVE
  - 115 ENGINE-DRIVEN PUMP
  - 117 EXTERNAL PUMP CONNECTION, )
  - ) PRESSURE
  - 118 EXTERNAL PUMP CONNECTION, ) Port
  - BY-PASS                          ) "controls"
  - 119 EXTERNAL PUMP CONNECTION, ) system
  - SUCTION                          )

- 120 INFLATION TEE-PIECE
- 121 MULTIPLE INFLATION VALVE
- 122 PRESSURE GAUGE
- 127 PRESSURE SWITCH
- 128 NON-RETURN VALVE
- 132 INBOARD AILERON JACKS ACCUMULATOR

60. Indication of the signal pressure in each circuit is given by a pressure gauge, (175) primary, (1) secondary, mounted at the pilot's station. The gauges are operated by pressure relays connected to the signal pressure lines.

## CONTROLS SYSTEMS

### General

61. The port 'controls' system, powered by an engine-driven pump mounted on the port accessories gearbox, operates the aileron inboard jacks and provides secondary power for the powered rudder circuit (para. 47) and rudder feel simulation (para. 56). Powered by an engine-driven pump mounted on the starboard accessories gearbox, the starboard controls system operates the aileron outboard jacks only. Each system may be operated, after disconnecting the engine-driven pump, by an external pump connected to the Avery couplings (117, 118 and 119 port, and 13, 14 and 15 starboard) in the inner wing leading edge.

### Supply circuit (fig. 15 and 16)

62. For each system the supply circuit is similar. The engine-driven pump (12 or 115) or external pump draws fluid through a filter (19 or 112) from a header tank (20 or 111), mounted in the main undercarriage bay aft of the accessories gearbox, and delivers it to the system supply line and the secondary piston in the header tank. The fluid pressure acting on the header tank secondary piston is transferred to the primary piston, thereby pressurising the fluid content of the tank to ensure the maintenance of a positive head at the services. A relief valve (17 or 114), set to operate at between 35 to 40 p. s. i. is connected to the

suction line from the tank.

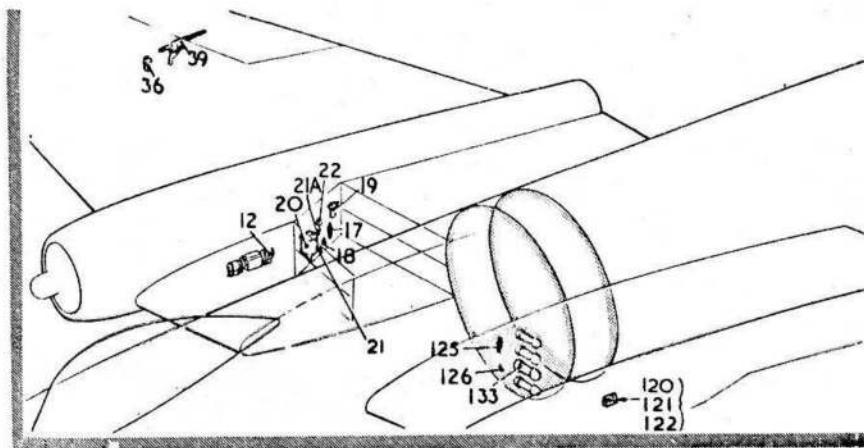
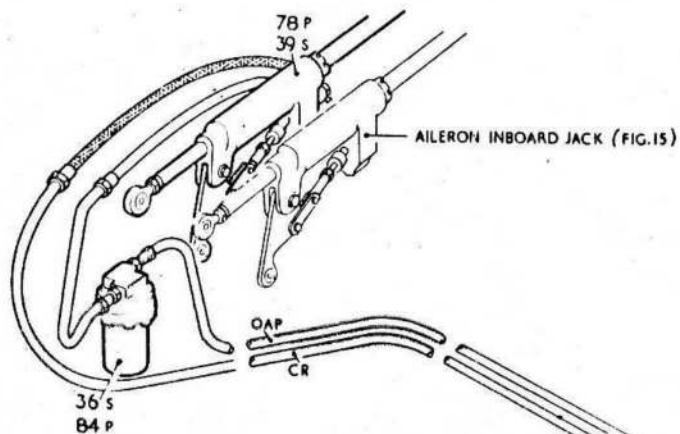
63. At a pressure just below maximum operating pressure, the pump is unloaded progressively, as line pressure increases, by the operation of the off-loading mechanism (para. 5). While the pump is running off-load, a proportion of the by-passed fluid circulates in the pumps to assist cooling and excess fluid is returned at low pressure through the by-pass outlet and non-return valve (16 or 116) to the header tank.

64. In the port 'controls' system, the supply line is connected through a non-return valve (128) to the aileron inboard jack circuit (para. 66) and secondary rudder feel simulation circuit (para. 56) and through a filter (59) to the secondary rudder power control circuit (para. 47). The supply line in the starboard 'controls' system is connected through a non-return valve (125) to the aileron outboard jack circuit.

65. Indication of the pressure in the supply line for each system is given by a pressure gauge (22 or 109) mounted near to the header tank in the main undercarriage bay. The gauge is operated through a choke (21A or 110A) by a pressure relay (21 or 110) connected to the header tank pressurisation line.

### Aileron inboard jack circuit (fig. 15)

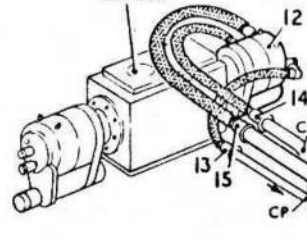
66. Pressure is built up in the aileron inboard jacks accumulator (132) by the port 'controls' system supply through a non-return valve (128). From the accumulator, the supply is connected to the control valve on both the port and starboard jacks (79 and 40) through non-return valves incorporated in the control valves. Filters (83 and 35) are fitted in both jack supply lines. When the aileron controls are operated, fluid is directed to the appropriate sides of the jack pistons; fluid from the



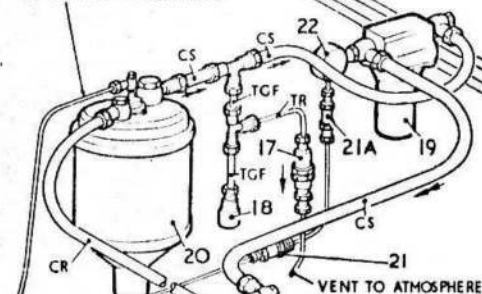
KEY TO FIG. 16  
(refer also to Key to Fig. 17)

- 12. ENGINE-DRIVEN PUMP
- 13. EXTERNAL PUMP
- 14. EXTERNAL PUMP
- 15. EXTERNAL PUMP
- 17. PRESSURE RELIEF VALVE
- 18. HEADER TANK FILLING CONNECTION
- 19. FILTER
- 20. HEADER TANK
- 21. PRESSURE RELAY
- 21A. CHOKE
- 22. PRESSURE GAUGE
- 36. FILTER
- 39. AILERON JACK

STARBOARD ACCESSORIES  
GEARBOX

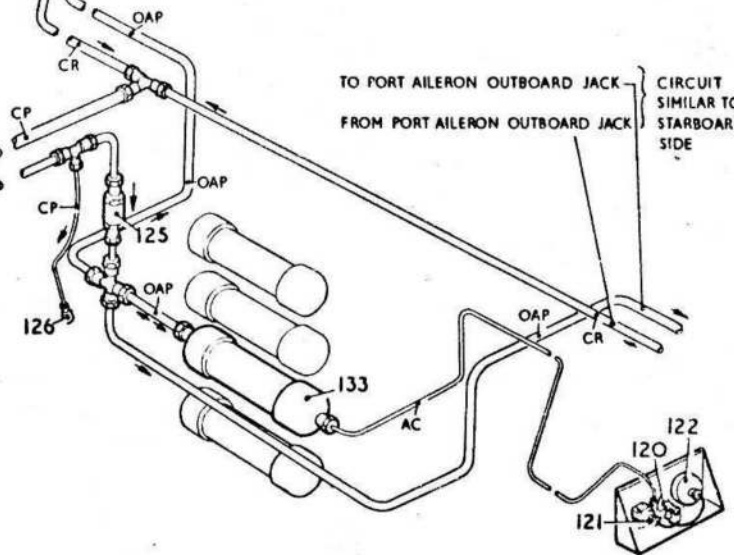


VENT TO ATMOSPHERE



FOR KEY TO CODE LETTERS REFER TO FIG. 17

TO PORT AILERON OUTBOARD JACK } CIRCUIT  
FROM PORT AILERON OUTBOARD JACK } SIMILAR TO  
STARBOARD SIDE



KEY TO FIG. 16 (cont'd)

- 78. AILERON OUTBOARD JACK, PORT
- 84. MICRONIC FILTER
- 120. INFLATION TEE-PIECE
- 121. MULTIPLE INFLATION VALVE
- 122. PRESSURE GAUGE
- 125. NON-RETURN VALVE
- 126. PRESSURE SWITCH
- 133. AILERON OUTBOARD JACKS ACCUMULATOR

Fig. 16 Starboard controls system and aileron outboard jack circuit

opposite sides is returned through the control valves to the header tank (111).

#### Aileron outboard jack circuit (fig. 16)

67. Pressure is built up in the aileron outboard jacks accumulator (133) by the starboard 'controls' system supply through a non-return valve (125). From the accumulator, the supply is connected to the control valves on both the port and starboard jacks, (78 and 39) through non-return valves incorporated in the control valves. Filters (84 and 36) are fitted in both jack supply lines. Operation of the jacks is similar to that of the inboard jacks, the exhaust fluid from the jacks returning to the header tank (20).

#### Fail/safe indicators

68. Warning lamps, as described in para. 52, are provided to indicate to the pilot failure in the hydraulic supplies to the aileron and rudder controls. For the aileron jacks circuits, the pressure switches (126 and 127) are connected one to each 'controls' system main supply line. Should the pressure in either system fall below 1800 p. s. i., the electrical contacts in the appropriate pressure switch will close and complete the supply to the aileron 50 per cent. failure warning light. Closing the pressure switch contacts also completes a supply to energise an electrical relay, setting the relay so that, should the other 'controls' system fail, the closing of the second pressure switch contacts will complete a supply to the aileron 100 per cent. failure warning light. Failure of the port controls system will also produce a 50 per cent. rudder failure warning, since the pressure switch (127) is in the common supply line to the aileron and rudder circuits (para. 54).

## SERVICING

### Precautions

69. The following precautions must be observed during servicing, dismantling and installation of any part of the hydraulic system: -

- (1) Extreme cleanliness of fluid, containers used for fluid, and the internal surfaces of all components and pipe lines is essential. All pipe ends exposed during servicing operations must be blanked off to prevent the ingress of foreign matter.  
Hydraulic fluid, OM-15, should be used for cleaning purposes.
- (2) Hydraulic fluid has a deleterious effect on paint, rubber, electric cables, etc., and care must be taken to keep it from contact with materials of this nature.
- (3) Ensure that all fluid pressure has been exhausted from the system before the removal of a component or the disconnection of a pipe line, otherwise injury to personnel may result.
- (4) Ensure that all unions are free from leaks and wire-locked correctly.
- (5) Under no circumstances should pressure be applied to the feel simulator inlet connection when any point between the unit and tank is blanked off.

Pipe identification

70. The British Standard system of schematic identification (uncoloured) (B. S. S. M. 23 issue 1) is used on all hydraulic pipes. Further identification of hydraulic pipes is provided by code letters; these are marked on a narrow tape alongside the main tape to indicate the function of the pipes and the services to which they belong. The code is given on fig. 17.

Direction of flow

71. Standard tapes, indicating the direction of fluid flow, are attached to pipes adjacent to components, especially non-return valves, restrictors, relief valves, etc., which could be assembled the wrong way round.

Charging the accumulators

72. Of the eight accumulators included in the three hydraulic systems, all are charged with nitrogen, four through a common charging valve mounted on a panel in the port main undercarriage bay, and four through a similar valve on the port side of the fuselage just inside the rear fuselage entrance hatch. Mounted on the panel with each charging valve are a pressure gauge and a multiple inflation cock which incorporates four cocks, one for each accumulator served by the charging valve.

Multiple inflation cock

73. The cocks, incorporated in the multiple inflation cock, are operated by a key spanner which is attached by a chain to the body of the multiple unit and stowed when not in use in a grommet on the mounting panel. The spanner consists of a cruciform handle

incorporating at the centre a flat blade on a spigot. Two of the handle arms are machined to form square ended keys. To open a cock, proceed as follows:-

- (1) Engage the flat blade of the key spanner with the slots in the valve lock-nut and unscrew the lock-nut to the limit allowed by the common stop fitted centrally between the cocks.
- (2) Insert one of the square-ended keys, on the spanner handle, into the key-hole in the valve guide and unscrew the guide to open the valve.

To close a cock, the procedure is a reversal of that for opening. After use, the key spanner must be stowed in the grommet provided.

Exhausting the fluid pressure

74. Before charging the accumulators or checking the nitrogen pressure, all fluid pressure must be exhausted as follows:-

- (1) Services accumulator:- May be exhausted by operating the flaps or flare bay doors until no further movement is obtained or by carrying out the instructions (sub-para. 4) for exhausting the rudder jack primary accumulator.
- (2) Wheel brakes accumulator:- Is exhausted by repeated applications of the brakes.
- (3) Aileron inboard and outboard jack accumulators:- Operate the ailerons until no further movement is obtained.

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KEY TO FIG. 17 - HYDRAULIC SYSTEM - COMPREHENSIVE DIAGRAM

Item No.	Description	Part No.	A. P. Reference	Item No.	Description	Part No.	A. P. Reference
1	SECONDARY FEEL SIGNAL PRESSURE GAUGE	6A/2689	112G-0400-1	38	AIR BRAKES JACK, STARBOARD	1.03035.001	
2	PRESSURE RELAY	ACM18798	105B-0715-1	39	AILERON OUTBOARD JACK, STARBOARD	AH797/2	4601A
3	SECONDARY FEEL SIMULATOR CONTROL UNIT	HOBSON TYPE 207, Mk. 2	4604Z	40	AILERON INBOARD JACK, STARBOARD	AH797/2	4601A
4	'SERVICES' SYSTEM SUPPLY PRESSURE GAUGE	6A/2693	112G-0400-1	41	OUTBOARD FLAP JACK, STARBOARD }	07016Y. C01	1803D
5	MICRONIC FILTER	7038	1803P	42	INBOARD FLAP JACK, STARBOARD }		
6	NON-RETURN VALVE	1.00071.004	1803D	43	REAR CAMERA DOOR JACK, STARBOARD	1.00525.001	1803D
7	EXTERNAL PUMP CONNECTION, SUCTION	'SERVICES' SYSTEM STARBOARD		44	MID CAMERA DOOR JACK	C8244Y	1803D
8	EXTERNAL PUMP CONNECTION, BY-PASS			45	REAR CAMERA DOOR JACK, PORT	1.00525.001	1803D
9	EXTERNAL PUMP CONNECTION, PRESSURE			46	NON-RETURN VALVE	UMC706	1803P
10	NON-RETURN VALVE	INTEGRAL TYPE 158	1803J	47	RUDDER JACK ACCUMULATOR, PRIMARY	11843Y. A01	1803D
11	ENGINE-DRIVEN PUMP, 'SERVICES' SYSTEM, STARBOARD	INTEGRAL TYPE 180 Mk. 27	1803J	48	FEEL SIMULATOR JACK ACCUMULATOR, PRIMARY	8795	1803T
12	ENGINE-DRIVEN PUMP, STARBOARD 'CONTROLS' SYSTEM	INTEGRAL TYPE 180, Mk. 27	1803J	49	PRESSURE SWITCH	TP290	
13	EXTERNAL PUMP CONNECTION, PRESSURE	'STARBOARD 'CONTROLS' SYSTEM		50	FEEL SIMULATOR JACK	11897Y. A01	1803D
14	EXTERNAL PUMP CONNECTION, BY-PASS			51	RUDDER POWER CONTROL UNIT	HOBSON TYPE 101 Mk.3	105D-0410-16A
15	EXTERNAL PUMP CONNECTION, SUCTION			52	NON-RETURN VALVE }	INCORPORATED IN ITEM 51	
16	NON-RETURN VALVE	INTEGRAL TYPE 158	1803J	53	NON-RETURN VALVE }		
17	PRESSURE RELIEF VALVE	D8283Y. Mk. C	1803D	54	PRESSURE SWITCH	TP290	
18	HEADER TANK FILLING CONNECTION			55	RUDDER SECONDARY SUPPLY SELECTOR VALVE	C7437Y. Mk. E	1803D
19	FILTER	27B/1407			Alternative	1.00137.003	
20	HEADER TANK	A11147Y	1803D	56	THERMAL RELIEF VALVE	C4603Y. Mk. E	105B-0738-16
21	PRESSURE RELAY	ACM18798	105B-0715-1	57	FEEL SIMULATOR JACK ACCUMULATOR, SECONDARY	8795	1803T
21A	CHOKE	6A/1230	112G-0400-1	58	RUDDER JACK ACCUMULATOR, SECONDARY	11843Y. A01	1803D
22	STARBOARD 'CONTROLS' SYSTEM PRESSURE GAUGE	6A/2693	112G-0400-1	59	MICRONIC FILTER	7039	1803P
23	SEQUENCE VALVE	D401Y. Mk. M	1803D	60	MULTIPLE INFLATION VALVE	7021	1803P
24	MAIN UNDERCARRIAGE DOOR JACK - STBD.	08246Y. C01	1803D	61	ACCUMULATOR INFLATION PRESSURE GAUGE	6A/2693	112G-0400-1
25	ONE-WAY RESTRICTOR VALVE	06209Y. B01	1803D	62	INFLATION TEE-PIECE	700511	
25A	VARIABLE FLOW VALVE	03371Y. B01	1803D	63	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16
26	SHUTTLE VALVE	7014	1803P	64	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16
27	VARIABLE FLOW VALVE	03371Y. B01	1803D	65	CAMERA DOORS SELECTOR VALVE	C408Y. Mk. L	1803D
28	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	66	FLAPS SELECTOR VALVE	00408Y. A58	1803D
28A	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	67	RESTRICTOR VALVE	D657Y	1803D
29	TRANSFER VALVE	1.00032.001		67A	ONE-WAY RESTRICTOR VALVE	8165/32	1803T
30	MAIN UNDERCARRIAGE JACK, STARBOARD	07017Y. C01	1803D	68	PRESSURE RELIEF VALVE	01034Y. A36	
31	SHUTTLE VALVE	7015	1803P	69	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16
32	SEQUENCE VALVE	D401Y. Mk. J	1803D	70	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16
33	WHEEL BRAKE UNIT, STARBOARD	AH9781	2337	71	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16
34	MAXARET ANTI-SKID UNIT	AC. 11514	1803S	72	FLOW DIVIDER	8076/052	1803T
35	MICRONIC FILTER	7039	1803P	73	FLARE BAY DOOR JACK, AFT	1.00522-001	1803D
36	MICRONIC FILTER	7039	1803P	74	AIR BRAKES SELECTOR VALVE	C7402Y. Mk. G	4343E
37	TEST CONNECTION	A. 58			Alternative	1.00112.001	
				75	FLOW DIVIDER	8076/052	1803T
				76	INBOARD FLAP JACK, PORT	07016Y. C01	1803D
				77	OUTBOARD FLAP JACK, PORT	07016Y. C01	1803D
				78	AILERON OUTBOARD JACK, PORT	AH797/2	4601A
				79	AILERON INBOARD JACK, PORT	AH797/2	4601A
				80	AIR BRAKES JACK, PORT	1.03035.001	
				81	MAXARET ANTI-SKID UNIT	AH11516	1803S
				82	WHEEL BRAKE UNIT, PORT	AH9780	2337
				83	MICRONIC FILTER	7039	1803P
				84	MICRONIC FILTER	7039	1803P
				85	TEST CONNECTION	A58	

## RESTRICTED

Item No.	Description	Part No.	A. P. Reference	Item No.	Description	Part No.	A. P. Reference
86	PRESSURE RELIEF VALVE	C484Y. Mk. E	1803D	133	AILERON OUTBOARD JACKS ACCUMULATOR	11843Y. A01	1803D
87	NON-RETURN VALVE	D5240Y	1803D	134	BRAKES ACCUMULATOR	11843Y. A01	1803D
88	NON-RETURN VALVE	UMC706	1803P	135	NON-RETURN VALVE	1. 00071.004	1803D
89	NON-RETURN VALVE	UMC704	1803P	136	ENGINE-DRIVEN PUMP 'SERVICES' SYSTEM PORT	INTEGRAL TYPE 180 Mk.27	1803J
90	NON-RETURN VALVE	UMC706	1803P	137	NON-RETURN VALVE	INTEGRAL TYPE 158	1803J
90A	NON-RETURN VALVE	D5240Y	1803D				
91	FLARE BAY DOORS SELECTOR VALVE	00408Y. A55	1803D	138	EXTERNAL PUMP CONNECTION, PRESSURE		
92	FLARE BAY DOORS JACK, FORWARD	1. 00522. 001	1803D	139	EXTERNAL PUMP CONNECTION, 'SERVICES' BY-PASS SYSTEM PORT		
93	EMERGENCY TRANSFER VALVE	.7022	1803P	140	EXTERNAL PUMP CONNECTION, SUCTION		
94	ALIGHTING GEAR EMERGENCY DOWN SELECTOR	5006	1803P	141	HEADER TANK FILLING CONNECTION		
95	HAND PUMP GROUND/FLIGHT SELECTOR	00408Y. A58	1803D	142	HEADER TANK OVERFLOW CONNECTION		
96	ALIGHTING GEAR SELECTOR VALVE	C7446Y. Mk. A	1803D	143	HEADER TANK		
	Alternative	1. 00146. 002		144	MICRONIC FILTER	C5655Y. Mk.D	1803D
97	MAIN UNDERCARRIAGE JACK, PORT	07017Y. C01	1803D	145	PRESSURE RELIEF VALVE	1-02677-001	1803D
98	SHUTTLE VALVE	7015	1803P	146	NON-RETURN VALVE	UMC706	1803P
99	SEQUENCE VALVE	D401Y. Mk. K	1803D	147	NON-RETURN VALVE	8557	1803T
100	TRANSFER VALVE	1. 00032. 001		148	AVERY COUPLING		
101	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	149	AVERY COUPLING		
101A	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	150	JUNCTION BLOCK		
102	VARIABLE FLOW VALVE	03371Y. B01	1803D	151	FORWARD CAMERA DOOR JACK, STARBOARD	6008	1803P
102A	VARIABLE FLOW VALVE	03371Y. B01	1803D	152	FORWARD CAMERA DOOR JACK, STARBOARD	6009	1803P
103	SEQUENCE VALVE	D401Y. Mk. L	1803D	153	FORWARD CAMERA DOOR JACK, PORT	6009	1803P
104	ONE-WAY RESTRICTOR VALVE	06209Y. B01	1803D	154	FORWARD CAMERA DOOR JACK, PORT	6008	1803P
105	SHUTTLE VALVE	7014	1803P	155	JUNCTION BLOCK		
106	MAIN UNDERCARRIAGE DOOR JACK, PORT	08246Y. C01	1803D	156	AVERY COUPLING		
107	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	157	AVERY COUPLING		
108	THERMAL RELIEF VALVE	C8697Y. Mk. A	105B-0738-16	158	NOSE UNDERCARRIAGE GROUND-OPERATED SELECTOR	01183Y. B06	1803D
109	PORT 'CONTROLS' SYSTEM PRESSURE GAUGE	6A/2693	112G-0400-1	159	THERMAL RELIEF VALVE	C4603Y. Mk. E	105B-0738-16
110	PRESSURE RELAY	ACM18798	105B-0715-1	160	NON-RETURN VALVE	UMC703	1803P
110A	CHOKE	6A/1230	112G-0400-1	161	NON-RETURN VALVE	UMC703	1803P
111	HEADER TANK	A11147Y	1803D	162	HAND PUMP	77C/1275	1803G
112	FILTER	27B/1407		163	NOSE UNDERCARRIAGE DOOR JACK	08246Y. C01	1803D
113	HEADER TANK FILLING CONNECTION			164	SHUTTLE VALVE	7014	1803P
114	PRESSURE RELIEF VALVE	D8283Y. Mk. C	1803D	165	THERMAL RELIEF VALVE	C8697Y. Mk.A	105B-0715-1
115	ENGINE-DRIVEN PUMP, PORT 'CONTROLS' SYSTEM	INTEGRAL TYPE 180 Mk.27	1803J	166	SEQUENCE VALVE	C401Y. Mk.G	1803D
116	NON-RETURN VALVE	INTEGRAL TYPE 158	1803J	167	SEQUENCE VALVE	C401Y. Mk.G	1803D
117	EXTERNAL PUMP CONNECTION, PRESSURE PORT			168	NOSE UNDERCARRIAGE JACK	08214Y. C01	1803D
118	EXTERNAL PUMP CONNECTION, 'CONTROLS' BY-PASS SYSTEM			169	THERMAL RELIEF VALVE	C8697Y. Mk.A	105B-0738-16
119	EXTERNAL PUMP CONNECTION, SUCTION			170	SHUTTLE VALVE	7014	1803P
120	INFLATION TEE-PIECE	700511		171	SEQUENCE VALVE	C401Y. Mk.H	1803D
121	MULTIPLE INFLATION VALVE	7021	1803P	172	WHEEL BRAKE CONTROL VALVE Mk. 3	AC12702	1803S
122	ACCUMULATOR INFLATION PRESSURE GAUGE	6A/2693	112G-0400-1	173	WHEEL BRAKE ACCUMULATOR PRESSURE GAUGE	6A/2693	112G-0400-1
123	NON-RETURN VALVE	UMC704	1803P	174	PRESSURE RELAY	ACM18798	105B-0715-1
124	NON-RETURN VALVE	UMC704	1803P	175	PRIMARY FEEL SIGNAL PRESSURE GAUGE	6A/2689	112G-0400-1
125	NON-RETURN VALVE	UMC706	1803P	176	PRESSURE RELAY	ACM18798	105B-0715-1
126	PRESSURE SWITCH	TP290		177	WHEEL BRAKE MASTER CYLINDER, STARBOARD	ACM18988	1803S
127	PRESSURE SWITCH	TP290		178	WHEEL BRAKE MASTER CYLINDER, PORT	ACM18986	1803S
128	NON-RETURN VALVE	UMC706	1803P	179	PRESSURE RELAY	ACM18798	105B-0715-1
129	FILTER	(B)H793		180	PRESSURE REDUCING VALVE	AC13708	
130	NON-RETURN VALVE	D5240Y	1803D	181	PRIMARY FEEL SIMULATOR CONTROL UNIT	HOBSON TYPE 207, Mk. 2	4604Z
131	SERVICES ACCUMULATOR	11843Y. A01	1803D	182	NON-RETURN VALVE	H. 2004/4	
132	AILERON INBOARD JACKS ACCUMULATOR	11843Y. A01	1803D				

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- (4) Rudder jack primary accumulator:- Switch OFF the electrical supply and operate the rudder until no further movement is obtained. These operations will also exhaust the services accumulator.
- (5) Rudder jack secondary accumulator:- Exhaust the rudder jack primary accumulator (sub-para. 4), switch ON the electrical supply and operate the rudder until no further movement is obtained.
- (6) Feel simulator jack accumulators:- The procedure for exhausting the fluid pressure in the primary and secondary accumulators is identical to that given for charging the accumulators in para. 77.

Services, wheel brakes and aileron jacks accumulators

75. These are charged through the valve in the port main undercarriage bay. To charge the accumulators, proceed as follows:-

- (1) Exhaust all fluid pressure as instructed in para. 74.
- (2) Remove the blanking nut and connect a nitrogen bottle to the charging valve and proceed as follows for each accumulator in turn.
  - (a) Open the appropriate cock in the multiple inflation cock as instructed in para. 73 (each cock is marked to indicate the accumulator it serves).
  - (b) Charge the accumulator to the pressure quoted in the Leading Particulars.

(c) Close the cock in the multiple inflation cock.

- (3) When all accumulators are charged to the correct pressure, disconnect the nitrogen bottle, replace the blanking nut on the charging valve and stow the key spanner in the grommet provided.

Rudder jack accumulators

76. The rudder jack primary and secondary accumulators are charged through the valve in the rear fuselage. The procedure for charging these accumulators is identical to that given for services, wheel brake and aileron jack accumulators in para. 75.

Feel simulator jack accumulators

77. The feel simulator jack primary and secondary accumulators are charged through the valve in the rear fuselage but, due to the low inflation pressure, gauge, Ref. No. 4G/3026, must be used to check the pressures and not the gauge on the aircraft. The procedure for charging the accumulators is as follows:-

- (1) Remove the blanking nut and connect a Turner inflation adapter, Ref. No. 4G/4131, fitted with a gauge, Ref. No. 4G/3026, to the charging valve.
- (2) Ensure that all pressure has been bled from the aircraft pressure gauge.
- (3) Connect a nitrogen bottle to the inflation adapter and proceed as follows for each accumulator in turn.

- (a) Open the appropriate cock in the multiple inflation cock as instructed in para. 73 (each cock is marked to indicate the accumulator it serves).
  - (b) Charge the accumulator to 300 p. s. i. to exhaust all fluid pressure and reduce the pressure slowly to the required setting quoted in the Leading Particulars.
  - (c) Close the cock in the multiple inflation cock.
- (4) When both accumulators are charged to the correct pressure, disconnect the nitrogen bottle, remove the inflation adapter, replace the blanking nut on the charging valve and stow the key spanner in the grommet provided.

## SERVICES SYSTEM

### Filling the header tank

78. The 'services' system header tank, mounted on the port side in the top of the front camera compartment, is filled through a connection in the port main under-carriage bay using a hand pump. The correct fluid level is obtained by filling the tank until fluid flows from an overflow connection beside the filling connection. The tank must be filled with the fluid specified in the Leading Particulars. To prevent overfilling, it is important that the hydraulic system satisfies the following conditions prior to filling.

- (1) Alighting gear down
- (2) Flare bay doors open.

- (3) The services, wheel brakes, rudder jack primary and feel simulator jack primary accumulators exhausted of all fluid pressure as instructed in para. 74.

The positions of the other services operated by the system are not important.

79. To fill the tank, proceed as follows: -

- (1) Remove the blanking cap (marked FILL) from the filling connection and connect a hand pump to the connection.

NOTE:The hand pump connecting hose will require an Avery half-coupling, type A. V. A. 54/B.

- (2) Remove the blanking cap (marked OVERFLOW) from the overflow connection and connect a hose of sufficient length to enable the overflow to be directed into a suitable container.

NOTE:This hose will also require an Avery half-coupling type A. V. A. 54/B.

- (3) Pump in fluid (approximately 2.5 gall. for an empty tank) until it flows from the overflow connection.
- (4) Disconnect the pump and overflow hoses and replace the blanking caps on the aircraft connections.

NOTE:The appropriate spanner must be used to ensure that the blanking caps are screwed up tight.

Draining the header tank

80. To drain the header tank, proceed as follows:-

- (1) Exhaust the services, brakes, rudder jack primary and feel simulator jack primary accumulators as instructed in para. 74.
- (2) Ensure that an electrical supply is ON and select flare bay doors OPEN. Using the hand pump, build up sufficient pressure to open the doors fully.
- (3) Move the hand pump GROUND/FLIGHT selector valve to GROUND.
- (4) Select flaps DOWN (if in the UP position) and, using the hand pump, build up sufficient pressure to lower them fully.
- (5) Select flare bay doors CLOSED, and allow them to assume a neutral position.
- (6) Have ready a suitable container (approximately 3 gall. capacity), remove the hand pump suction-line banjo connection at the base of the tank and drain the tank from this point.

Priming the system

81. The fluid level of the header tank must be maintained while priming operations are being carried out; if it is permitted to fall too low, air may be drawn into the system the removal of which will necessitate further priming. The following paragraphs give instructions for priming the system, or any circuit

within the system, without alteration to the circuits. By making certain changes in the circuits, the aircraft hand pump may be used to prime the whole system; details of the changes and the method of priming are included in the instruction for pressure testing given in para. 96.

Preparation

82. (1) Jack and trestle the aircraft as instructed in Sect. 2, Chap. 4.
- (2) Ensure that the accumulators are inflated with nitrogen to the pressures quoted in the Leading Particulars (para. 72).
- (3) Check that the alighting gear is DOWN, ground-operated nose wheel selector in the FLIGHT position, flare bay doors, OPEN, flaps DOWN, airbrakes IN, wheel brakes in 'parked' condition and camera doors OPEN.

Engine-driven pump supply and rudder jack primary circuits.

83. Proceed as follows:-

- (1) Disconnect the 'services' engine-driven pumps at the Avery couplings in each inner wing.
- (2) On each side in turn, depress and open the self-sealing valve in the suction coupling; hold open until fluid free from air issues from the coupling and then allow the valve to close.
- (3) At the port side only, connect a hand pump, Ref. No. 27Z/1, to the suction and pressure couplings.

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- (4) At each of the following points in turn and in the order given, slacken the connection and operate the hand pump until fluid free from air issues from the loose connection; remake each connection before passing to the next:-
  - (a) Outlet side of non-return valve (6) in pressure line from starboard side.
  - (b) Pressure line connection to services accumulator (131).
  - (c) Pressure line connection to brakes accumulator (134).
  - (d) Constant pressure line connection to nose undercarriage ground-operated selector (158).
  - (e) Pressure inlet connection at the flare bay doors selector (91).
  - (f) Pressure inlet connection at the alighting gear selector (96).
  - (g) Pressure inlet connection at rudder jack primary accumulator (47).
  - (h) Pressure inlet connection at the pressure switch (49) in the rudder jack primary supply line.
  - (j) Primary pressure inlet at the rudder jack (51).
- (5) Move the rudder to the extent of its travel in one direction and the rudder bar to the extent of its travel in the opposite direction to that of the rudder. Operate the hand pump until the rudder moves through its full travel.
- (6) Move the rudder bar to the extent of its travel in the opposite direction and again operate the hand pump until the rudder moves through its full travel.
- (7) Prime the services system pressure gauge (4) and feel circuit pressure gauge (175) as instructed in para. 94.
- (8) Disconnect the pressure inlet (F. U. P.) and exhaust (S. R.) lines at the feel simulator jack. With a short length of pipe, connect these two lines together and operate the hand pump until the exhaust line is filled back to the header tank.
- (9) Disconnect the pipes and, with the minimum amount of fluid loss, reconnect the exhaust line to the jack.
- (10) Operate the hand pump until fluid flows from the pressure inlet pipe and reconnect it to the jack.
- (11) Slacken the pressure inlet connection at the feel jack primary accumulator and operate the hand pump until fluid free from air issues from the loose connection; remake the connection.
- (12) Disconnect the hand pump from the port side and connect it to the starboard side.

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- (13) Slacken the outlet connection on the non-return valve (6) in the pressure line from the starboard side and operate the hand pump until fluid free from air issues from the loose connection; remake the connection.
- (14) Disconnect the hand pump.
- (15) Prime the engine-driven pumps (para. 84) and reconnect them to the Avery couplings.

#### Engine-driven pump

84. (1) Connect the engine-driven pump suction line to the Avery coupling on the suction line in the leading edge.
- (2) Slacken the bleeder screw in the side of the pump.
- (3) Tighten the bleeder screw when fluid free from air issues from it.
- (4) Depress and open the valve in the coupling on the pump pressure line and fill the line with fluid from a clean container.
- (5) Connect the by-pass and pressure lines to the appropriate Avery coupling in the leading edge.

#### Hand pump

85. To prime the aircraft hand pump, mounted at the pilot's station, slacken the suction connection at the hand pump; tighten the connection when fluid free from air issues from it.

#### Hand pump delivery line

86. (1) At each of the following points in turn and in the order given, slacken the connection and operate the hand pump until fluid free from air issues from the loose connection; remake each connection before passing to the next.
  - (a) Constant pressure line connection to the nose undercarriage ground-operated selector (158).
  - (b) Pressure inlet connection at brakes accumulator (134).
  - (c) Inlet connection at the pressure relief valve (86).

#### Flare bay doors circuit

87. Ensure that an electrical supply is available and proceed as follows: -

- (1) Secure the doors in the open position and disconnect the actuator links from the door hinge brackets (Sect. 3, Chap. 1).
- (2) With the hand pump GROUND/FLIGHT selector valve (95) at FLIGHT and the door jacks closed, select flare bay doors CLOSED.
- (3) Slacken the bleeder screws at the 'closed' line (F. D. S.) connections to the jacks and operate the hand pump until fluid free from air issues from the screws; tighten the bleeder screws.
- (4) Slacken the bleeder screws at the 'open' line (F. D. O.) connections to the jacks and operate

the hand pump until the jacks are fully extended.

- (5) Select flare bay doors OPEN and operate the hand pump until fluid free from air issues from the bleeder screws at the 'open' line connections to the jacks; tighten the bleeder screws and continue pumping until the jacks are fully closed.
- (6) Re-connect the actuator links to the door hinge brackets.

#### Alighting gear emergency lowering circuit

88. (1) Operate the alighting gear emergency lowering control and check that the emergency selector (94) is opened.
- (2) Slacken the bleeder screw in the emergency transfer valve (93) and operate the hand pump until fluid free from air issues from the bleeder screw; tighten the bleeder screw.
- (3) Slacken the bleeder screws at the shuttle valve connections to the undercarriage and door jacks at the main and nose undercarriage units. Operate the hand pump until fluid free from air issues from the bleeders and tighten the screws.
- (4) Re-set the alighting gear emergency control and ensure that the emergency selector is closed.

- (5) Bleed the emergency transfer valve (93) at the bleeder screw to allow the non-return valve to close.

#### Wheel brakes circuit

89. (1) Move the wheel brakes parking lever to 'off'
- (2) Prime the wheel brakes pressure gauge (173) as instructed in para. 94.
- (3) Fill the master cylinders (177 and 178) with hydraulic fluid OM-15.
- (4) Slacken the bleeder screws on the control valve (172).
- (5) Operate the master cylinders slowly until fluid free from air flows from the bleeder screws. Keep the master cylinders depressed and tighten the bleeder screws.
- (6) Top up the master cylinders.
- (7) Operate the hand pump until a pressure of approximately 2750 p. s. i. is built up in the system.
- (8) Disconnect the return pipe (W. B. R.) at the Maxaret units.
- (9) Remove the main undercarriage wheels.
- (10) Bleed the Maxaret units by applying brake pressure and allowing the units to self-bleed

by rotating the Maxaret unit wheels smartly, in the direction indicated by the arrow, and then stopping. Each time the wheel is stopped a small volume of fluid will be released from the exhaust connection. Repeat the rotation and stopping of the Maxaret unit until the fluid expelled is clear and free from air.

- (11) Re-connect the return pipes to the Maxaret units.
- ◀ (12) 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 the wheel abruptly and ensure that the brakes come 'off' immediately and the indicator rod pops out. Refit the main wheels. ▶
- (13) Fit a rubber hose,  $\frac{1}{4}$  in. i/d, over the bleeder screw on one of the brake unit cylinders. Have ready a container to catch the fluid and slacken the bleeder screw.
- (14) Press the master cylinders and keep pressed until fluid free from air flows freely from the bleeder screw; tighten the bleeder screw.
- (15) Repeat for all four cylinders on each brake unit.

#### Camera doors circuit

90. (1) Move the hand pump GROUND/FLIGHT selector valve (95) to GROUND.
- (2) Ensure that the camera doors are open and select camera doors CLOSED.
- (3) At each of the camera door jacks, slacken the bleeder screw or pipe connection, as appropriate, at the 'shut' line (C. D. S.) connection and operate the hand pump until fluid free from air

issues from the bleeder screw or loose connection; tighten the bleeder screw and connection.

- (4) At each jack, slacken the bleeder screw or pipe connection at the 'open' line (C. D. O.) connection and operate the hand pump until the doors are closed and the jacks have moved through their full travel.
- (5) Select camera doors OPEN and operate the hand pump until fluid free from air issues from the bleeder screws or loose connections at the 'open' line connections to the jacks; tighten the bleeder screws and connections.
- (6) Continue pumping until the camera doors are fully open.

#### Trailing edge flaps circuit

91. (1) Ensure that the hand pump GROUND/FLIGHT selector valve is at GROUND and the flaps are fully down.
- (2) Disconnect the flap mechanism from the flaps.
- (3) Select flaps UP and slacken the bleeder screws at the 'up' line (F. R.) connections to the jacks.
- (4) Operate the hand pump until fluid free from air issues from the bleeder screws; tighten the bleeder screws.
- (5) Slacken the bleeder screws at the 'down' line (F. D.) connections to the jacks and operate the hand pump until the jacks move through their full travel to the 'up' position.

- (6) Select flaps DOWN and operate the hand pump until fluid free from air issues from the bleeder screws at the 'down' line connections to the jacks; tighten the bleeder screws.
- (7) Continue pumping until the jacks move through their full travel to the 'down' position.
- (8) Re-connect the flaps to the mechanism.

#### Air brakes circuit

92. (1) Ensure that the hand pump GROUND/FLIGHT selector valve is at GROUND and the air brakes are fully in.
- (2) Select air brake OUT and slacken the 'out' line (A. B. O.) connections at the jacks.
- (3) Operate the hand pump until fluid free from air issues from the loose connections; tighten the connections.
- (4) Slacken the 'in' line (A. B. I.) connections at the jacks and operate the hand pump until the jacks are fully closed.
- (5) Select air brakes IN and operate the hand pump until fluid free from air issues from the loose connections; tighten the connections.
- (6) Continue pumping until the jacks are fully extended.

#### Alighting gear circuit

93. (1) Ensure that the hand pump GROUND/FLIGHT selector valve is at GROUND and the alighting gear is selected DOWN and the undercarriage units are fully down.
- (2) Operate the hand pump to build up pressure and then slacken the bleeder screws at the 'down' line (U. D.) connections to the main and nose undercarriage jacks to release air from the system.
- (3) Tighten the bleeder screws and repeat operation (2) several times until fluid free from air issues from the bleeder screws.
- (4) Tighten the bleeder screws.
- (5) Depress manually the sequence valves (171) in the nose undercarriage bay and (32 and 99) in the main undercarriage bays.
- (6) Operate the hand pump to build up pressure and then slacken the bleeder screws at the 'down' line (U. D.) connections to the main and nose undercarriage door jacks to release air from the system.
- (7) Tighten the bleeder screws and repeat operation (6) several times until fluid free from air issues from the bleeder screws.
- (8) Tighten the bleeder screws.

- (9) Turn the ring encircling the alighting gear UP selector button clockwise until the knobs on the ring are vertical, one above the other; press the button to select UP.
- (10) Slacken the bleeder screws at the 'up' line (U. R.) connections to the undercarriage and door jacks in the main and nose undercarriage bays. Operate the hand pump until fluid free from air issues from the bleeder screws.
- (11) Tighten the bleeder screws.
- (12) Re-set the ring encircling the UP selector button to its normal position as instructed in Sect. 5, Chap. 1 and select alighting gear DOWN.

#### Priming the pressure gauges

94. To prime the pressure gauge lines, other than those for the port and starboard 'controls' system gauges in the undercarriage bays, proceed as follows for each gauge:-

- (1) Disconnect the pipe at the gauge and connect a Ki-gass pump to the pipe line.
- (2) Disconnect the pipe at the inlet side of the pressure relay.
- (3) Fit the clamp, Ref. No. 27VA/3303, loosely on the body of the pressure relay.
- (4) Apply pressure with the Ki-gass pump and when the line has hardened, tighten the

clamp on the relay body between the two grooves. The clamp should be tightened just enough to slightly flex the body and grip the piston but not enough to cause permanent distortion.

- (5) Disconnect the Ki-gass pump and reconnect the pipe line to the gauge, but do not fully tighten the union nut.
- (6) Operate the hand pump (connected to the Avery couplings in the wing leading edge) until fluid free of air issues from the pressure relay inlet pipe, and then connect and tighten the pipe to the relay.
- (7) Operate the hand pump until fluid free of air issues from the loose connection on the gauge.
- (8) While fluid is still escaping tighten the gauge connection.
- (9) Remove the clamp.

94A. To prime the port and starboard 'controls' system pressure gauge lines proceed as follows for each gauge:-

- (1) Disconnect the pipe at the inlet side of the choke (21A or 110A) and connect a Ki-gass pump to the pipe line.
- (2) Disconnect the pipe at the inlet side of the pressure relay (21 or 110).
- (3) Fit the clamp, Ref. No. 27VA/3303, loosely to the body of the pressure relay body.

- (4) Apply pressure with the Ki-gass pump and, when the line has hardened, tighten the clamp on the relay body between the two grooves. The clamp should be tightened just enough to slightly flex the body and grip the piston but not enough to cause permanent distortion.
- (5) Disconnect the Ki-gass pump and reconnect the pipe line to the choke, but do not fully tighten the union nut.
- (6) Unscrew the two parts of the choke half a turn in order to allow fluid to by-pass the restriction.
- (7) Operate the hand pump (connected to the Avery couplings in the leading edge) until fluid free of air issues from the pressure relay inlet pipe, then connect and tighten the pipe to the relay.
- (8) Slacken the pipe connection to the gauge and operate the hand pump until fluid free of air issues from the loose connection, ignoring any leak from the choke.
- (9) When fluid is leaking freely, the connections should be tightened using the following procedure:-
  - (a) Tighten the pressure gauge connection.
  - (b) Tighten the choke connection from the pressure gauge.
  - (c) Tighten the two parts of the choke.
  - (d) Finally, tighten the choke inlet connection.

- (10) Remove the clamp from the pressure relay.

Action after priming

95. When all the circuits have been primed as described in the foregoing paragraphs, check the content of the header tank, check the accumulators and charge with nitrogen as necessary and operate the services several times to eliminate air from the system. Check the system for leakage.

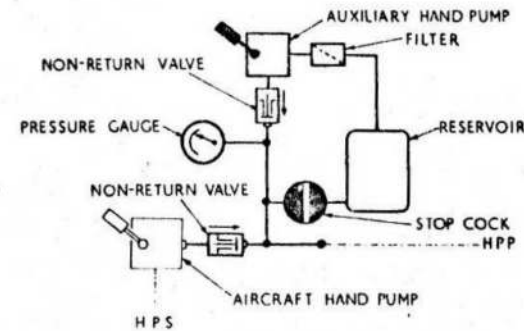


Fig.18 Services system auxiliary hand pump rig.

Pressure test of system

96. To pressure test the system, adhere to the instructions in the Note below and proceed in the sequence shown:-

NOTE:

- (a) The header tank must be kept topped up to the correct level during all bleeding operations.
- (b) The aircraft hand pump must be used for the operation of the jacks and bleeding.
- (c) The hand pump of the auxiliary rig (fig. 18) must only be used for building up pressure.
- (d) Under no circumstances should pressure be applied to the feel simulator inlet connection,

- when any point between the unit and the tank is blanked off.
- (e) When releasing pressure from the system a stop-cock on the auxiliary rig should be used to avoid a rapid rate of discharge of fluid due to accumulator pressure.
- (f) The hand pump GROUND/FLIGHT selector valve (95) must be set at FLIGHT throughout the test.
- (1) Jack the aircraft with the wheels clear of the ground as instructed in Sect. 2, Chap. 4.
  - (2) Uncouple the hand pump pressure pipe (H. P. P.) at the hand pump, and connect an auxiliary hand pump circuit as illustrated in fig. 18.
  - (3) Disconnect the pressure line (S. P.) and fit an additional length of clean piping to bypass each of the following components:-
    - Main filter (129) on forward face of frame 21B.
    - Non-return valve (90) fitted on the starboard side at frame 23.
    - Non-return valves (6 and 135) on the starboard side at frames 16 and 17.
  - (4) Uncouple the primary pressure (S. P.) and return (S. R.) at the connections to the rudder jack and connect them together with a length of clean pipe.
  - (5) Disconnect the rudder jack return line (S. R.) from the four-way piece in the flare bay between frames 24 and 25, and blank off.
  - (6) Uncouple the pressure line at the flaps pressure relief valve (68) between frames 24 and 25 in the flare bay, and blank off.
  - (7) Uncouple the pressure line at the hand pump relief valve (86) at frame 23 in the flare bay, and blank off.
  - (8) Charge the services, wheel brakes, rudder jack primary and feel simulator jack primary accumulators to the pressures quoted in the Leading Particulars as instructed in para. 75, 76 and 77.
  - (9) Fill the services header tank as instructed in para. 78.
  - (10) Prime and bleed the aircraft hand pump.
  - (11) Check that the selectors are in the following positions:-
    - Alighting gear, DOWN
    - Ground-operated nose undercarriage selector, FLIGHT
    - Flare bay doors, OPEN
    - Flaps, DOWN
    - Air brakes, IN
    - Camera doors, OPEN
    - Wheel brakes, 'parked'
  - (12) Fill the system and jacks with fluid until the hand pump begins to build up pressure.
  - (13) Check the jack and sequence valve settings (Sect. 3, Chap. 5).

- (14) Re-fill the header tank as instructed in para. 78.
- (15) With all the selectors at the positions stated in sub-para. (11) bleed all the jack lines and wheel brake units at their respective bleeders or connections at the individual jacks.
- (16) Operate the alighting gear emergency down control and bleed the emergency lines to the jacks; reset the emergency control (para. 109).
- (17) Bleed the primary feel simulator control unit (181) and the emergency transfer valve (93) at the bleeder screw.
- (18) Build up a preliminary test pressure of 2200-2750 p. s. i. with the auxiliary hand pump to ensure that the pressure lines are reasonably secure; hold the pressure for a few minutes and then release.
- (19) Disconnect the nose undercarriage door actuating links at the doors and tie back the doors in the open position.
- (20) Select alighting gear UP and, using the aircraft hand pump, retract the alighting gear as far as possible, leaving the jack bleeder screws accessible; bleed the main and nose undercarriage jacks.
- (21) Using the aircraft hand pump, fully retract the alighting gear, disconnecting the undercarriage door jacks from the doors as they commence to retract.
- (22) Fully retract the alighting gear door jacks and bleed them.
- (23) Select flare bay doors CLOSED and partially close the doors; bleed the jacks.
- (24) Fully close the flare bay doors. Ensure that the jacks are at the end of their strokes and are not straining the doors; check that there is 0.20 in. clearance between the metal face of the edges of the doors. The method of adjusting the flare doors is given in Sect. 3, Chap. 1.
- (25) 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.
- (26) Fully raise the flaps. Ensure that they are not strained when in the fully up position (Sect. 3, Chap. 4)
- (27) Select air brakes OUT, operate the air brakes fully out and bleed the jacks.
- (28) Select camera doors CLOSED and, using the aircraft hand pump, close the doors and bleed the jacks.
- (29) Bleed all pressure gauge lines as instructed in para. 94.
- (30) Using the auxiliary hand pump, apply a test pressure of 2750 p. s. i. Retain this pressure for 30 min. and then release. The maximum pressure drop must not exceed 150 p. s. i.

during the first 15 min.

- (31) Lower the flaps, close the air brakes, open the flare bay doors, open the camera doors and lower the alighting gear, recoupling the alighting gear door jacks to the doors before the jacks are fully extended. Re-connect the nose undercarriage door actuating links.

NOTE: If oscillations commence on lowering the alighting gear, pumping must cease immediately and operators stationed to hold the alighting gear doors fully open to keep the sequence valves open, then re-commence pumping.

- (32) Using the auxiliary hand pump, apply a test pressure as in sub-para. (30).
- (33) Re-connect the main filter (129), the non-return valves (6, 90 and 135), dis-connected in sub-para. (3)
- (34) Re-connect the primary pressure and return lines to the rudder jack and the rudder jack return line to the four-way piece.
- (35) Re-connect the relief valves (68) and (86).
- (36) Disconnect the auxiliary hand pump circuit and re-connect the hand pump pressure line.

#### Functioning test of services

##### Preparation

97. Before carrying out the tests given in para. 98 to

103, prepare the aircraft as follows:-

- (1) Jack the aircraft with the wheels clear of the ground as instructed in Sect. 2, Chap. 4.
- (2) Remove the panel in the upper surface of the inner wing above each accessories gearbox (Sect. 2, Chap. 4).
- (3) At each gearbox, disconnect the 'services' engine-driven pump at the Avery couplings.
- (4) Connect two Mk. 2A hydraulic servicing trolleys, each fitted with an Integral 180 Mk. 27, hydraulic pump, to the system, one to the port side and one to the starboard, at the Avery couplings in the inner wing leading edge.
- (5) Ensure that the L. P. cocks are closed and move the throttle levers to the open position.
- (6) Start both servicing trolleys and test the power circuit.
- (7) Test the functioning of the services as instructed in the following paragraphs. Carry out the test in conjunction with the electrical tests given in Sect. 5, Chap. 1.

NOTE: Except where otherwise stated, the hand pump GROUND/FLIGHT selector valve must be in the FLIGHT position for all power tests.

CAUTION: THE SELECTOR MUST BE SECURED IN THE 'FLIGHT' POSITION BY  
 ◀ MEANS OF A 2BA BOLT AND LOCK NUT. ▶

Alighting gear

98. (1) Using only the servicing trolley connected to the port side, retract and lower the alighting gear.
- (2) Using only the servicing trolley connected to the starboard side, retract and lower the alighting gear.
- (3) Using both servicing trolleys, retract and lower the alighting gear five times and check that the mechanical down and up locks, door locks and indicating lights function correctly. The time taken to retract and lower the alighting gear should be approximately up 8 secs. down 4 secs.
- (4) Stop the servicing trolleys, move the hand pump GROUND/FLIGHT selector to GROUND and raise the alighting gear using the hand pump.
- (5) Move the hand pump GROUND/FLIGHT selector to FLIGHT. Operate the alighting gear emergency down control and lower the alighting gear using the hand pump.

NOTE: To prevent oscillation when lowering the alighting gear by hand pump, station a man at each alighting gear door to hold the doors fully open to

ensure that the sequence valve controlling the lowering of the alighting gear remain open for the returning fluid.

- (6) Reset the emergency control (para. 109) and bleed the emergency transfer valve at the bleeder screw.
- (7) Set the ground-operated nose-undercarriage selector to GROUND and the hand pump GROUND/FLIGHT selector to GROUND. Retract the nose undercarriage using the hand pump. Set the nose undercarriage selector to FLIGHT and lower the nose undercarriage using the hand pump. Set the hand pump GROUND/FLIGHT selector to FLIGHT.
- (8) Using both servicing trolleys retract and lower the alighting gear three times.

Flare bay doors

- 99.(1) Using only the servicing trolley connected to the port side, close and open the flare bay doors once.
- (2) Using only the servicing trolley connected to the starboard side, close and open the flare bay doors once.
- (3) Using both servicing trolleys, close and open the flare bay doors and check the operation of the indicator at the pilot's station. The time taken to close and open the doors should be approximately open 2 secs., closed 3 secs.
- (4) Close the flare bay doors and stop the servicing

trolleys. Operate the flare bay doors emergency control and open the doors using the hand pump.

- (5) Re-set the flare bay doors emergency control (para. 111) and using both servicing trolleys, close and open the doors.

#### Trailing edge flaps

- 100.(1) Using only the servicing trolley connected to the port side, raise and lower the flaps once.
- (2) Using only the servicing trolley connected to the starboard side, raise and lower the flaps once.
- (3) Using both servicing trolleys, raise and lower the flaps, checking the operation of the port and starboard flaps and the position indicator at the pilot's station. The time taken to raise and lower the flaps should be flaps 'up' 18 seconds, flaps 'down' 14 seconds.
- (4) Stop the servicing trolleys and set the hand pump GROUND/FLIGHT selector to GROUND and, using the hand pump, raise and lower the flaps.
- (5) Set the hand pump GROUND/FLIGHT selector to FLIGHT and check that the flaps cannot now be operated by the hand pump.

#### Air brakes

- 101.(1) Using only the servicing trolley connected to

the port side, operate the air brakes OUT and IN once.

- (2) Using only the servicing trolley connected to the starboard side, operate the air brakes OUT and IN once.
- (3) Using both servicing trolleys, operate the air brakes OUT and IN, checking the synchronisation of the port and starboard brakes. Check that they can be moved between any two positions and that the position indicator shows the true position. At the MID position, the difference between the port and starboard air-brake drag channels must not exceed 0.5 in. The time taken to either extend or retract the drag channels should be  $1\frac{1}{2}$  seconds.
- (4) Stop the servicing trolleys and set the hand pump GROUND/FLIGHT selector to GROUND and, using the hand pump, operate the air brakes OUT and IN once.
- (5) Set the hand pump GROUND/FLIGHT selector to FLIGHT and check that the air brakes cannot now be operated by the hand pump.

#### Camera doors

- 102.(1) Using only the servicing trolley connected to the port side, open and close the camera doors once.
- (2) Using only the servicing trolley connected to the starboard side, open and close the camera doors once.

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- (3) Using both servicing trolleys, open and close the camera doors once and stop the servicing trolleys.
- (4) Set the hand pump GROUND/FLIGHT selector to GROUND and open and close the camera doors using the hand pump.
- (5) Set the hand pump GROUND/FLIGHT selector to FLIGHT and check that the camera doors cannot now be operated by the hand pump.

Wheel brakes

103. (1) Connect a Turner inflation adapter (Ref. No. 4G/4131) with a gauge (Ref. No. 4G/3029) to the wheel brake test connection at each undercarriage leg.
- (2) Start both servicing trolleys, release the parking brake lever and check that there is no pressure at the wheel brake units.
- (3) Fully depress both brake toe-pedals and check that there is a steady pressure of  $1500 + 150$  p. s. i. at each brake  
- 0
- (4) Using a suitably graduated spring balance apply a load of 85 lb. to the port toe-pedal and check that the port gauge reads  $1500 + 150$  p. s. i. and the starboard gauge reads zero.
- (5) Repeat operation (4) on the starboard brake and check the pressures.
- (6) Apply the parking brake and check that both

port and starboard gauges read  $1500 + 150$  p.s.i.  
- 0

- (7) Release the parking brake and check that there is no pressure at the brake units.
- (8) With the parking brake released, apply the following loads equally and directly to each toe-pedal.  
30 lb. 50 lb. 70 lb. 85 lb.  
As each load is applied, check that the difference between the pressures shown by the port and starboard test gauges does not exceed 50 p. s. i. for pressure measurement up to 1000 p. s. i. and 150 p. s. i. for pressure measurements from 1000 to 1500 p. s. i.
- (9) Remove the Turner inflation adapter and gauge from both test connections and replace the blanking nut on the connections.

104. After the functioning tests are satisfactorily completed, the following operations must be carried out:-

- (1) Disconnect the servicing trolleys and reconnect the aircraft engine-driven pumps at the Avery couplings.
- (2) Bleed the engine-driven pumps (para. 84) and top up the header tank as instructed in para. 78.
- (3) Re-seal the emergency control cables and re-lock and seal the emergency control handles as instructed in para. 109 and 111.
- (4) Wire-lock the nose undercarriage ground-

operated selector in the FLIGHT position, and set the hand pump GROUND/FLIGHT selector to FLIGHT.

#### Faults and remedies

105. The more common hydraulic faults and their remedies are listed in the following table; faults in individual components are covered in the appropriate A. P. 1803, Vol. 1.

#### Wheel brakes pedal adjustment (fig. 4)

106. Wheel brake pedal adjustment is obtained by selecting one of a series of six slots, in the barrel of the pedal spring box, to coincide with a bolt pas-

sing through the pedal link. To obtain the adjustment remove the nut and bolt and plain and spring washers, and slide the spring box barrel up or down to suit the requirements of the pilot. The normal setting is when the bolt is passed through the fifth groove below the pedal, this position is indicated when three grooves are visible above the link. After adjustment, fit the bolt and secure with the plain and spring washers and the nut. The movement of the pedal linkage and, therefore, the stroke of the master cylinder, is limited by a striker arm contacting a stop spigot on the side of the rudder pedal. Adjustment is obtained on the striker bolt in the striker arm.

Table 1 - Faults and remedies

Fault	Possible cause	Remedy
(1) Engine-driven pump and hand pump fail to operate the system	No fluid in the system Leakage in the system	Refill the system Correct the leak and refill the system
(2) Engine-driven pump drive shears	Pump dry Excessive pressure due to foreign matter in system ◀ ▶	Change the pump Drain the system and replenish with clean fluid
(3) All services inoperative by engine-driven pumps but services can be operated by the hand pump	Engine-driven pump drives sheared Foreign matter in the filter ◀ ▶	(See (2)) Remove the filter and clean it
(4) Spongy action on hand pump	Air in particular service Faulty non-return valves	Bleed the affected service and test Renew the affected non-return valves
(5) All services inoperative by hand pump	Hand pump worn or damaged	Renew the hand pump

Table 1 (contd)

Fault	Possible cause	Remedy
(6) Flaps droop, or spring back from the lowered position	Jack piston rod glands leaking Non-return valve in selector valve leaking Air in system	Renew the jack Renew the selector valve
(7) Flaps return to original position after moving	Jack piston rod glands leaking Leaking selector valve Leaking thermal relief valve	Bleed the system and test Renew the jack Renew the selector valve Renew the thermal relief valve
(8) No movement of flaps upon selection, with accumulator pressure correct	Actuator fuse blown	Renew fuse No.117
(9) Flaps on one side move in advance of those on the other side	Foreign matter in restrictor valve and pressure relief valve	Remove the restrictor valve and pressure relief valve, and clean them
(10) Flare doors droop	Air in system Jack piston rod glands leaking Non-return valve in selector valve leaking	Bleed the system and test Renew the jack Renew the selector valve
(11) No movement of flare doors upon selection, with accumulator pressure correct	Air in system Actuator fuse blown	Bleed the system and test Renew fuse No.163
(12) Alighting gear doors droop	Door jack piston rod glands leaking Non-return valve in selector valve leaking Air in system Incorrect setting of door jack sequence valves	Renew the affected jack Renew the selector valve Bleed the system and test Reset affected sequence valve
(13) No movement of alighting gear upon selection with accumulator pressure correct	Actuator fuse blown	Renew fuse No.155
(14) Wheel brakes inoperative with accumulator pressure correct	Broken Bowden cable Slack Bowden cable	Renew the Bowden cable Release the cable and adjust

Table 1 (contd)

Fault	Possible cause	Remedy
(15) Wheel brakes remain on after brake lever is released	Tight Bowden cable Frayed Bowden cable	Release the Bowden cable and adjust Renew the Bowden cable
(16) Air brakes inoperative upon selection, with accumulator pressure correct	Actuator fuse blown	Renew fuse No. 119
(17) Air brake drag channels protrude from main plane surfaces	Jack piston rod glands leaking Non-return valve in selector valve leaking Air in system	Renew the jack Renew the selector valve Bleed the system and test
(18) No movement of camera doors upon selection, with accumulator pressure correct	Actuator fuse blown	Renew fuse No. 255
(19) Incomplete movement of camera doors upon selection	Door jack piston rod glands leaking Non-return valve in selector valve leaking Air in system	Renew the affected jack Renew the selector valve Bleed the system and test
◀ (20) Loss of fluid from main services reservoir coupled with an overflow of oil from the port controls reservoir. ▶	Malfunction of a N.R.V. in the rudder P.F.C.U.	Renew rudder P.F.C.U. ▶
(21) Slow movement of services	Insufficient air in the appropriate accumulator due to leakage at inflation point	Stop the leak, re-inflate 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.

Wheel brakes parking control adjustment (fig. 5)

107. To check and correct the setting of the parking controls, proceed as follows:-

- (1) Connect Turner inflation adapters, Ref.No. 4G/4131, with gauges Ref.No. 4G/3029, to the test connections in the wheel brake piping at each main undercarriage leg.
- (2) Ensure that a pressure of 2750 p. s. i. is built up in the brakes accumulator.
- (3) Move the parking brake lever to 'on' and check that the pressure at each brake is 1500 + 150 p. s. i. Adjust the fork-end at -0 the spring box attachment to the parking link on the brake control unit as necessary.
- (4) Release the parking brake lever and check that there is no pressure at the brakes.
- (5) Remove the Turner inflation adapters and gauges and replace the blanking nuts on the test connectors.

Alighting gear emergency controls adjustment

108. To check and correct the setting of the alighting gear emergency lowering control proceed as follows:-

- (1) With the emergency lowering control handle in the normal position (fig. 8) check that the cable quadrant on the torque shaft assembly at the alighting gear normal selector is at the angle stated in fig. 19. If it is not, adjust the control cable at the

turnbuckles, the positions of which are indicated in fig. 8.

- (2) Check that the position of the operating lever on the emergency lowering selector is as stated in fig. 19. Adjust the length of the tie-rod between the torque shaft assembly and operating lever as necessary.
- (3) Operate the control by pulling the emergency control handle and check:-
  - (a) The operation of the emergency selector valve.
  - (b) The operation of the 'down' solenoid on the normal selector by the striker bolt on the torque shaft striker arm; adjust the striker bolt as necessary.
- (4) Ensure that all adjustment points are correctly locked and re-set the control as instructed in para. 109.

Re-setting the alighting gear emergency lowering control

109. To re-set the alighting gear emergency lowering control after operation, proceed as follows:-

- (1) Press the ends of the spring lock into the shaft and push the emergency lowering control handle back into the housing.
- (2) In the flare bay, override the over-centre spring and return the emergency selector valve lever to the normal position.
- (3) Bleed the emergency transfer valve (93) at the bleeder screw to release fluid trapped

between the non-return valve and the slide valve; this will allow the non-return valve at the emergency fluid inlet to re-seat. Leave the bleed screw open at this stage.

(4) Apply grease (XG. 278) to cables where they pass through seals in the pressure bulkhead.

(5) To obtain the correct 'retract' sequence after using the emergency lowering system, it is necessary first to select 'down' and pressurise through the normal system in order to return the shuttle valves to their correct position. Then close the bleed screw.

(6) Carry out a functional test of the re-set system as instructed in para. 98.

◀ (7) Finally, lock the control handle and the emergency selector valve lever in the normal position, with enamelled copper wire (0.414 mm. dia.) Ref 5E/ 5253563. ▶

Checking the header tank pressure relief line

109A. To check that the pipe line from the header tank to atmosphere is unobstructed, and that the pressure-relief valve in the line is functioning:-

(1) Proceed as in para. 78 and 79, but with the flare bay doors closed, to fill the header tank.

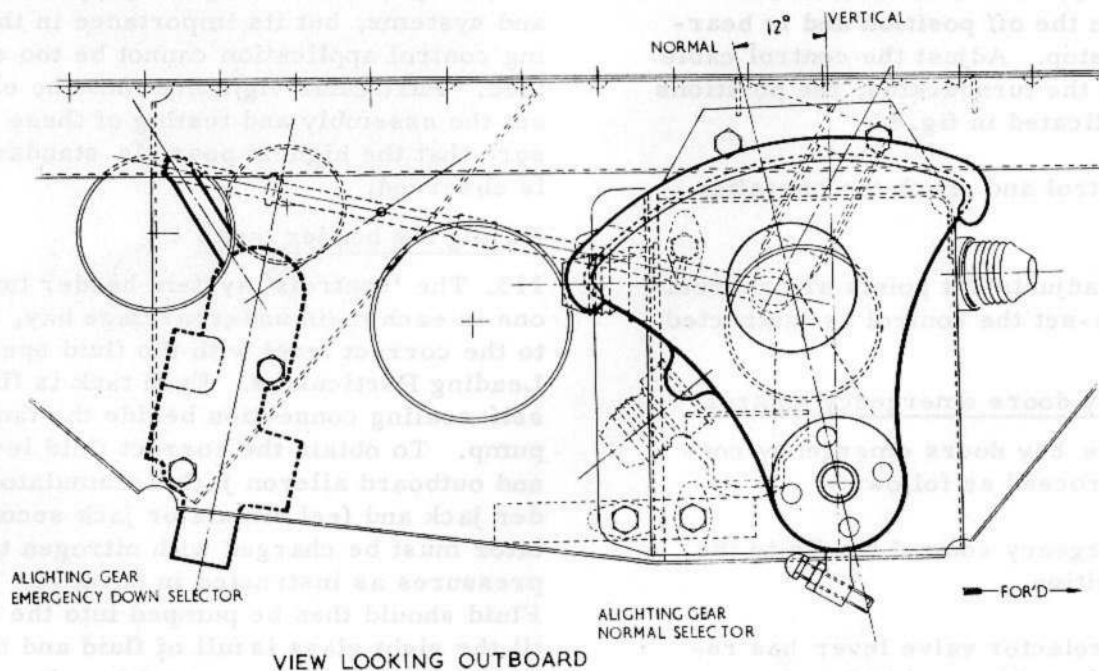


Fig.19 Alighting gear emergency controls setting

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- (2) After replacing the blanking caps on the overflow and filler connections, open the flare bay doors by means of the hand pump. Fluid returned from the flare bay door jacks will overflow the header tank, and the excess should be vented through the relief valve to the atmosphere.

Flare bay doors emergency opening control adjustment

110. To check and correct the setting of the emergency opening control, proceed as follows:-

- (1) With the emergency control handle in the normal (up) position, check that the selector valve lever is in the off position and is bearing against the stop. Adjust the control cable as necessary at the turnbuckles, the positions of which are indicated in fig. 8.
- (2) Operate the control and check the operation of the selector.
- (3) Ensure that all adjustment points are correctly locked and re-set the control as instructed in para. 111.

Re-setting the flare bay doors emergency control

111. To re-set the flare bay doors emergency control after operation, proceed as follows:-

- (1) Return the emergency control handle to the normal (up) position.
- (2) Check that the selector valve lever has returned to the off position and is bearing against the stop.

- (3) Re-pack the sealing washer in the pressure bulkhead as detailed in Sect. 3, Chap. 8.
- (4) Carry out a function test of the re-set system as instructed in para. 99.

- ◀ (5) Finally, lock the control handle in the normal position and the selector valve lever in the OFF position, with enamelled copper wire (0.414 mm. dia.) Ref 5E/5253563. ▶

CONTROLS SYSTEMS

Cleanliness

112. Cleanliness is a paramount requirement in the assembly and servicing of all hydraulic components and systems, but its importance in the powered flying control application cannot be too strongly emphasised. Particular vigilance must be exercised throughout the assembly and testing of these systems to ensure that the highest possible standard of cleanliness is observed.

Filling the header tanks

113. The 'controls' system header tanks, mounted one in each main undercarriage bay, must be filled to the correct level with the fluid specified in the Leading Particulars. Each tank is filled through a self-sealing connection beside the tank, using a hand pump. To obtain the correct fluid level, the inboard and outboard aileron jack accumulators and the rudder jack and feel simulator jack secondary accumulator must be charged with nitrogen to the correct pressures as instructed in para. 75, 76 and 77. Fluid should then be pumped into the header tank until the sight glass is full of fluid and the indicator at the base of the tank protrudes at least 0.10 in. It should be noted that the sight glass will fill before

the indicator moves. After filling, disconnect the hand pump and replace the blanking cap on the filling connection.

**NOTE:** The appropriate spanner must be used to ensure that the blanking cap is screwed up tight.

#### Filling and pressure testing the systems

##### Port 'controls' system

114. To fill and pressure test the systems, proceed as follows in the sequence shown:-

**NOTE:** The header tank must be kept topped up to the correct level during filling and bleeding operations.

- (1) At the 'port 'controls' engine-driven pump, disconnect the flexible pipes at the suction and pressure connections. Fit blanking caps to the pump connections.
- (2) Using additional lengths of clean piping, connect the flexible pipes to the suction and pressure connections on an auxiliary hand pump rig (fig. 20).
- (3) At the 'controls' return line (C. R.) four-way coupling, located on the port side of the flare bay at frame 22, disconnect and blank off the forward ( $\frac{1}{2}$  in. dia.) pipe.
- (4) Using an additional length of clean piping, connect the vacant connection on the coupling to the inlet side of a stop cock.
- (5) At the 'controls' return line, (C. R.) tee-piece, located on the port side of the belly tank bay at frame 19, disconnect and blank-off the aft pipe.
- (6) Using an additional length of clean piping,

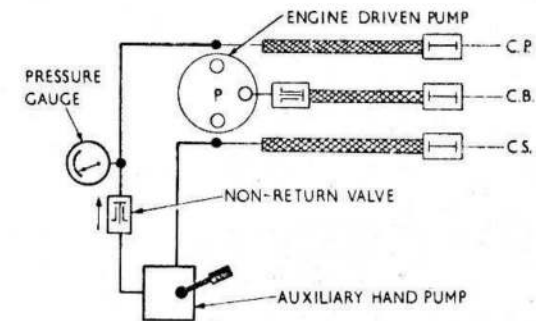


Fig. 20 Controls system auxiliary hand pump rig.

- connect the vacant connection on the coupling to the outlet side of the stop cock.
- (7) At the rudder jack, disconnect the secondary pressure and return lines and fit blanking caps to the jack connections.
- (8) Using an additional length of clean piping, connect the two flexible pipes together.
- (9) At both port and starboard inboard aileron jacks, disconnect the pressure and return flexible pipes and fit blanking caps to the jack connections.
- (10) Using an additional length of clean piping connect the two flexible pipes together.
- (11) Fill the port 'controls' header tank as instructed in para. 113.
- (12) Open the stop-cock in the return line (sub-para. 4) and manually operate the solenoid on the rudder secondary supply selector valve (55) to hold the valve open. At each of the following points in turn, slacken the connection and operate the hand pump on the auxiliary rig until fluid free from air issues from the loose connection; then remake the connection:-

- (a) Pressure connection (C.P.) at the header tank.
  - (b) Pressure connection at aileron inboard jack accumulator.
  - (c) Pressure connection to pressure switch (127).
  - (d) Pressure connection at the feel simulator jack secondary accumulator (57).
  - ◀ (e) Pressure connection at the rudder jack secondary accumulator (58). ▶
  - (f) Pressure connection to pressure switch (54).
- (13) Slacken the bleeder screw on the feel simulator jack and operate the hand pump until fluid free from air issues from the bleeder screw; tighten the bleeder screw.
- (14) Prime the port 'controls' system pressure gauge (109) and the secondary feel signal pressure gauge (a) as instructed in para. 94A.
- (15) Continue to hold open the rudder secondary supply selector valve, close the stop cock in the return line and operate the hand pump until the rig gauge shows 1000 p. s. i. Check that the pipes under test are secure.
- (16) Re-commence pumping until the rig gauge shows 2750 p. s. i. and hold for 30 min. The pressure drop for the first 15 min. should not exceed 150 p. s. i.
- (17) Release the pressure by slowly opening the stop cock in the return line.

- (18) Re-make the system and prime the engine-driven pump (para. 116) and aileron jacks (para. 117).

Starboard 'controls' system

115. To fill and pressure-test the system, proceed as follows in the sequence shown:-

NOTE: The header tank must be kept topped up to the correct level during filling and bleeding operations.

- (1) At the starboard 'controls' engine-driven pump, disconnect the flexible pipes at the suction and pressure connections. Fit blanking caps to the pump connections.
- (2) Using additional lengths of clean piping, connect the flexible pipes to the suction and pressure connections on an auxiliary hand pump rig (fig. 20).
- (3) In the starboard main undercarriage bay, disconnect pipe, Part No. EB8-73-2694 in the return line (C. R.) at the banjo union on the slant diaphragm, and at the pipe union between the banjo union and the header tank; remove the pipe and blank off the banjo union and pipe ends.
- (4) Using an additional length of clean piping, connect the vacant pipe union to the outlet side of a stop-cock.
- (5) At the 'controls' return line (C. R.) tee-piece, located on the starboard side of the flare bay

at frame 21, disconnect and blank off the forward ( $\frac{1}{2}$  in. dia.) pipe.

- (6) Using an additional length of clean piping, connect the vacant union on the tee-piece to the inlet side of the stop-cock.
- (7) At both port and starboard aileron outboard jacks, disconnect the pressure and return flexible pipes and fit blanking caps to the jack connections.
- (8) Using an additional length of clean piping, connect the two flexible pipes at each jack together.
- (9) Fill the starboard 'controls' header tank as instructed in para. 113.
- (10) Open the stop-cock in the return line (sub-para. 4). At each of the following points in turn, slacken the connection and operate the hand pump on the test rig until fluid free from air issues from the loose connection; then remake the connection:-
  - (a) Pressure connection (C.P.) at the header tank.
  - (b) Pressure connection (C.P.) at the aileron outboard jack accumulator.
  - (c) Pressure connection (C.P.) to pressure switch (126).
- (11) Prime the starboard 'controls' system pressure gauge (22) as instructed in para. 94A.
- (12) Close the stop-cock in the return line and

operate the hand pump until the rig gauge shows 1000 p. s. i. Check that the pipes under test are secure.

- (13) Re-commence pumping until the rig gauge shows 2750 p. s. i. and hold for 30 min. The pressure drop for the first 15 min. should not exceed 150 p. s. i.
- (14) Release the pressure by slowly opening the stop-cock in the return line.
- (15) Remake the system and prime the engine-driven pump (para. 116) and aileron jacks (para. 117).

#### Priming the engine-driven pumps

116. Proceed as follows for each pump:-

- (1) Slacken the bleeder screw in the side of the pump.
- (2) Carry out the header tank filling procedure (para. 113) and pump fluid into the tank until fluid free from air issues from the bleeder screw on the pump.
- (3) Tighten the bleeder screw.
- (4) Disconnect the pump pressure line at the Avery coupling in the leading edge; depress and open the valve in the coupling on the line to the pump and fill the line with fluid from a clean container.
- (5) Re-connect the pressure line to the Avery coupling.

Priming the aileron jacks

117. Proceed as follows for each jack: -

- (1) Disconnect the engine-driven pump (inboard jacks - port pump, outboard jacks - starboard pump) pressure and suction lines at the Avery couplings in the leading edge.
- (2) Connect an auxiliary hand pump rig to the Avery couplings.
- (3) Slacken the pressure inlet connection on the jack and operate the hand pump until fluid free from air issues from the connection; tighten the connection.
- (4) Move the ailerons to the extent of their travel in one direction and the control handwheel to the extent of its travel in the opposite direction to that of the ailerons. Operate the hand pump until the aileron moves through its full travel.
- (5) Move the control handwheel to the extent of its travel in the opposite direction and again operate the hand pump until the ailerons move through their full travel.
- (6) Top up the header tank (para. 113).

Functioning tests

118. The following paragraphs give, in addition to tests on the port and starboard 'controls' systems, instructions on testing the primary rudder and rudder feel circuits.

Preparation

119. Before commencing functioning tests, proceed as follows:-

- (1) Check that the flying controls have been set in accordance with the instructions given in Sect. 3, Chap. 4
- (2) Check that the relevant electrical circuits have been tested in accordance with the instructions given in Sect. 5, Chap. 1
- (3) Check that the pressure-head and static systems have been tested in accordance with the instructions given in Sect. 5, Chap. 2.
- (4) Check that all the accumulators have been charged with nitrogen to the correct pressures (para. 72) and the three hydraulic header tanks have been filled (para. 78 and 113).
- (5) Connect a test rig to the pressure-head system (Sect. 5, Chap. 2).
- (6) Connect an external electrical supply to the aircraft system.
- (7) Check the control circuits for minor faults as follows:-
  - (a) Disconnect the 'services' system port engine-driven pump at the Avery couplings in the leading edge and connect a Mk. 2A hydraulic servicing trolley to the system.

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- (b) Disconnect the starboard 'controls' system engine-driven pump at the Avery couplings in the leading edge and connect a Mk. 2A hydraulic servicing trolley to the system
- (c) Disconnect the rudder trim actuator from the lever on the torque shaft at frame 42; support the actuator clear of the controls.
- (d) Start the servicing trolley connected to the 'services' system and check that the rudder pedals and jack can be operated smoothly throughout their full travel, i. e. the force necessary to operate the pedals at any point should not exceed 2 lb.
- (e) Stop the servicing trolley and re-connect the rudder trim actuator.
- (f) Disconnect the aileron control rod at the lever at the base of the control column.
- (g) Start the servicing trolley connected to the starboard 'controls' system and, operating the aileron controls from the rod at the base of the control column, check that the controls and aileron jacks can be operated smoothly throughout their full travel, i. e. the force necessary to move the controls at any point should not exceed 1 lb.
- (h) Stop the servicing trolley and re-connect the control rod to the lever on the control column.

#### Starboard 'controls' system

120. To test, proceed as follows:-

- (1) Start the servicing trolley and pressurise the starboard 'controls' system only; check that the installation is secure and the aileron outboard jack accumulator is hydraulically charged.

- (2) Check that the aileron two-gear switch is at ◀ LOW ALT., (high gear) i. e., low altitude setting. ▶
- (3) Switch ON the electrical supply and check that the flying controls fail/safe indicators show 50 per cent. and 100 per cent. rudder failure and 50 per cent. aileron failure.
- (4) Operate the aileron controls slowly and check that the ailerons operate satisfactorily; then carry out a brief check at a high rate of aileron movement.
- (5) Stop the hydraulic servicing trolley and, commencing one minute after the pump has stopped, operate the aileron control to exhaust the pressure in the aileron system; whilst doing so, check the number of full aileron jack strokes available from accumulator storage; there should not be less than 4 strokes.
- (6) Check that flying controls 'fail/safe' indicators now show 50 per cent. and 100 per cent. failure for both ailerons and rudder.

#### Port 'controls' system

121. To test, proceed as follows:-

- (1) Disconnect the engine-driven pump at the Avery couplings in the leading edge and connect a Mk. 2A hydraulic servicing trolley to the system.
- (2) Start the servicing trolley and pressurise the port 'controls' system; check that the installation is secure and the aileron inboard

jack accumulator and the rudder jack and rudder feel secondary accumulators are hydraulically charged.

- ◀ (3) Check that the aileron two-gear switch is at LOW ALT. (high gear) - i.e. low altitude setting. ▶
- (4) Check that the electrical supply is switched ON and that the flying controls 'fail/safe' indicators show 50 per cent rudder and 50 per cent aileron failure.
- (5) Operate the aileron control slowly and check that the ailerons operate satisfactorily; then carry out a brief check at a high rate of aileron movement.
- (6) Fit a 4 lb. spring balance to the port side of the control handwheel and, with an observer at the port aileron trailing edge, increase the force in the spring balance steadily until a perceptible aileron displacement occurs. The force required at the spring balance should not exceed 1 lb. for each aileron gear setting.
- (7) Repeat operation (6) with the spring balance attached to the starboard side of the control handwheel; remove the spring balance.
- (8) Operate the rudder bar, commencing with a slow rate of pedal movement and check that the rudder and simulated feel operates satisfactorily.
- (9) Stop the servicing trolley and, commencing one minute after the pump has stopped, operate the aileron system; whilst doing so check the number of full aileron jack strokes available from accumulator storage. There should not be less than 4 strokes.

(10) Operate the rudder bar to exhaust the pressure from the secondary rudder jack accumulator and check the number of full strokes of the rudder jack available. There should not be less than 4 strokes.

(11) Check that the flying controls 'fail/safe' indicators now show 50 per cent. and 100 per cent. failure for both rudder and ailerons.

#### Primary rudder system

122. To test proceed as follows:-

- (1) Start the servicing trolley connected to the 'services' system and pressurise the 'services' system only; check that the installation is secure and the primary rudder jack accumulator is hydraulically charged.
- (2) Check that the electrical supply is switched ON and that the flying controls 'fail/safe' indicators show 50 per cent. rudder failure and 50 per cent. and 100 per cent. aileron failure.
- (3) Operate the rudder bar, commencing with a slow rate of movement, and check that the rudder and simulated feel operates satisfactorily.
- (4) Stop the servicing trolley and, commencing one minute after the pump has stopped, operate the rudder bar to exhaust the primary rudder system; whilst doing so check the number of full strokes of the rudder jack. There should not be less than 8 strokes.
- (5) Check that the flying controls 'fail/safe' indicators are now showing 50 per cent. and

100 per cent. failure for both rudder and ailerons.

Primary and secondary rudder systems

123. To test, proceed as follows:-

- (1) Start the servicing trolleys connected to the 'services' and port 'controls' systems and check that the accumulators are hydraulically charged.
- (2) Check that the electrical supply is switched ON and that the flying controls 'fail/safe' indicators show 50 per cent. aileron failure.
- (3) Stop the servicing trolley connected to the 'services' system. Operate the rudder bar and make the following checks:-
  - (a) That the pressure in the primary feel system remains relatively stable between 160 and 205 p. s. i.
  - (b) The pressure in the secondary rudder system is stable at 2750 p. s. i.
  - (c) The pressure in the secondary rudder feel system is stable between 170 and 210 p.s.i.

NOTE: The primary and secondary rudder system pressures are read at the accumulator gauges. The feel system pressures may be read at the accumulator gauges and also at the gauges in the pilot's station.

- (d) That the indicator pressure in the primary rudder system is between 1800 and 1850 p. s. i. when the changeover from primary to secondary occurs. The changeover is indicated by a 50 per cent. rudder failure

warning by the flying controls 'fail/safe' indicators and a loud noise as the secondary system selector operates.

- (e) That during the changeover the rudder bar continues to move freely without any observable lag of the rudder.
- (4) Start the servicing trolley connected to the 'services' system, operate the rudder bar and check that as the pressure in the primary system rises to 2000 p. s. i. approximately (indicated on the primary rudder jack accumulator gauge) the rudder control reverts from the secondary to the primary system; this will be indicated by the flying controls 'fail/safe' indicators showing only a 50 per cent. aileron failure.

(5) Stop the servicing trolley

Rudder feel simulation system

124. To test, proceed as follows:-

- (1) Adjust the rudder bar at the star-wheel to set the bar at the mid position; trim the rudder to neutral on the trim indicator.
- (2) Check that the primary feel simulation accumulator is charged with nitrogen to the correct pressure (para. 77).
- (3) Start the servicing trolley connected to the 'services' system and pressurise the system; check that the primary feel simulation pressure is relatively stable between 160 and 190 p.s.i.

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- (4) Release the pressure in the lower (secondary) end of the feel jack by opening the bleed-screw on the jack.
- (5) Connect a 100 lb. spring balance to the centre of the rudder bar starboard pedal and apply a load of 90 lb. at right angles to the pedal. Check that this gives a rudder bar deflection of  $15 \pm 1$  deg.
- (6) Transfer the spring balance to the port pedal and repeat operation (5).
- (7) Operate the test rig connected to the pressure head system to simulate a speed of 500 knots on the aircraft airspeed indicator.
- (8) Check that the feel system signal pressure reads  $1620 \pm 120$  p. s. i.
- (9) Check that the rudder bar is neutral and apply a load of 90 lb. at right angles to the port pedal. Check that this gives a rudder bar deflection of 4 deg.  $\pm 30$  min.
- (10) Transfer the spring balance to the starboard pedal and repeat operation (9).
- (11) Stop the servicing trolley and exhaust the pressure from the primary rudder system and slacken the F.U.P. pipe connection at the feel jack to release the pressure on the primary piston; tighten union.
- (12) Check that the secondary feel simulation accumulator is charged with nitrogen to the correct pressure (para. 77).
- (13) Start the servicing trolley connected to the port 'controls' system and pressurise the system; check that the secondary feel simulation pressure is relatively stable between 160 and 190 p. s. i.
- (14) Carry out operations(5), (6), (7), (8), (9) and (10) for the secondary system.
- (15) Lower the pressure in the pressure head system test rig slowly and remove the rig from the aircraft.
- (16) Start the servicing trolley connected to the services system and check that there is smooth operation of the pedals and rudder, commencing at a slow rate of pedal movement and then for a brief period at a higher rate.
- (17) Fit a 4 lb. spring balance to the centre of the rudder bar starboard pedal and, with an observer at the rudder trailing edge, increase the force in the spring balance until a perceptible rudder displacement occurs. The force required at the spring balance should not exceed 2 lb.
- (18) Repeat operation (17) with the spring balance fitted to the port pedal.
- (19) Stop the servicing trolleys, disconnect them from the aircraft and re-connect the engine-driven pumps.
- (20) Exhaust all pressure from the aileron and rudder systems (para. 128).

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Functioning checks during engine ground runs

125. The checks given in the following paragraphs are necessary to establish the following:-

- (1) The flying controls 'fail/safe' indicators function correctly in accordance with the relative sequence of engine stopping and starting.
- (2) The engine-driven pumps are operating correctly.
- (3) By inducing a rudder system changeover, the rudder secondary system is serviceable.

Flying controls 'fail/safe' indicators

126. The following table shows the warning indications for a typical engine starting and stopping sequence; it is for information only and the sequence need not be rigidly adhered to.

Engine-driven pumps and rudder changeover

- 127. (1) Start the starboard engine only.
- (2) With the ailerons stationary, check the starboard 'controls' system pressure gauge in the starboard undercarriage bay indicates a pressure between 2600 and 2800 p. s. i. and is free from undue oscillation
- (3) With the engine running at 50 per cent. rev/min

Table 2 - Fail/safe indicators

NOTE:

ON represents 'fail', OFF represents 'safe'

Condition	50 per cent. failure Amber lights		100 per cent. failure Red lights	
	Rudder	Aileron	Rudder	Aileron
Engines stopped and accumulators hydraulically exhausted	ON	ON	ON	ON
Start port engine ... ..	OFF	ON	OFF	OFF
Start starboard engine ... ..	OFF	OFF	OFF	OFF
Stop port engine and hydraulically exhaust aileron inboard jack accumulator ... ..	ON	ON	OFF	OFF
Stop starboard engine and hydraulically exhaust all accumulators (para. 74)	ON	ON	ON	ON
Start starboard engine ... ..	ON	ON	OFF	OFF
Start port engine ... ..	OFF	OFF	OFF	OFF
Stop starboard engine and hydraulically exhaust aileron outboard jack accumulator	OFF	ON	OFF	OFF
Stop port engine and hydraulically exhaust all accumulators (para. 74) ... ..	ON	ON	ON	ON

operate the aileron through their maximum travel at the rate of 2 strokes per second for 5 seconds, while keeping a continual check on the accumulator pressure gauge to ensure that the pressure does not fall below 2500 p. s. i. On completion of the aileron movement, check the pressure gauge during re-charging to see that the pressure does not exceed 2500 p. s. i.

**NOTE:** The pressures stated in (2) represent constant pressures relative to the pumps off-loading and relief valves and the above checks are to cover the functioning of these valves. However, at any time and particularly during the operation of the ailerons, 'peak' or 'pulse' pressures considerably above the maximum stated may be momentarily indicated by the gauge. Any such 'peak' pressure indications, provided they do not exceed 500 p. s. i. (3250 p. s. i. gauge reading) may be ignored.

- (4) With the same (50 per cent) engine rev/min, operate the ailerons through 2 complete cycles (4 strokes of the jack) over a period of 3 to 4 seconds. Check off-load pressure and pulse pressure on completing this movement. Pulse pressure should not exceed 500 p. s. i. (3250 p. s. i. gauge reading).
- (5) With the starboard engine running at idling r. p. m. operate the flaps and check that the time from flaps 'in' to flaps 'out' is 15 sec.
- (6) Repeat operation (5) at maximum rev/min and then stop the starboard engine.
- (7) Start the port engine only.
- (8) Check the 'controls' system pump by repeating operations (2), (3) and (4) but using the pressure gauge in the port undercarriage bay.
- (9) With the port engine at idling rev/min, simulate a failure of the rudder primary system by operating the rudder bar, using large pedal angles and a high rate of movement, and making a flare doors OPEN and CLOSED selection. Check that a changeover from primary to secondary occurs and the 'fail/safe' indicator shows 50 per cent. rudder failure.
- (10) When the conditions in (9) have been satisfied, operate the aileron and rudder and check that the port 'controls' pressure gauge indicates between 2500 and 2800 p. s. i. during the period of controls operation
- (11) Stop the rudder and aileron movements and, with the flare door selector at CLOSED, observe that the 50 per cent rudder failure indicator returns to the safe condition.
- (12) With the port engine running at idling rev/min, operate the flaps and check that the time from flaps 'in' to flaps 'out' is 15 sec.
- (13) Repeat operation (12) at maximum rev/min and then stop the engine.
- (14) Exhaust all pressure from the aileron and rudder systems (para. 128).

Exhausting aileron and rudder systems

128. After completing tests on the flying controls systems, all fluid pressure must be exhausted from the systems as follows:-

- (1) Switch OFF the electrical supply and operate the rudder until no further movement is obtained from the primary system.
- (2) Switch ON the electrical supply and operate the rudder until no further movement is obtained from the secondary system.
- (3) Operate the ailerons until no further movement is obtained.

Faults and remedies

129. The more common hydraulic faults and their remedies are listed in the table with para. 105; faults in individual components are covered in the appropriate Air Publications, which are listed at the beginning of this volume.

## REMOVAL AND INSTALLATION

General

130. The following paragraphs present a guide to the recommended methods of removing and installing the principal components of the main hydraulic system.

131. Blanking devices and/or covers must be fitted to all pipe ends, adapters, etc. as they are detached or removed. Care must be taken to restore locking, bonding or sealing.

132. Unless otherwise stated, there is no neces-

sity to drain the hydraulic system when breaking pipe joints or removing components. Blanking caps should be fitted at once to prevent excessive loss of fluid. The precautions given in para. 69 should be observed during the removal and installation of any part of the hydraulic system.

Engine-driven pumps

133. Instructions for removing and installing the engine-driven pumps are given in Sect. 4, Chap. 1.

'Services' system header tank (fig. 21)

134. To remove the 'services' system header tank:

- (1) Open the front camera compartment hinged fairings and remove the cameras if fitted.
- (2) Exhaust all fluid pressure in the 'services' system.
- (3) Drain the header tank as instructed in para. 80.
- (4) Disconnect the services return pipe (S. R.) 1.
- (5) Disconnect the air pressurisation pipe, 2.
- (6) Disconnect the tank relief pipe (T. R.) 3.
- (7) Disconnect the return pipe (S. R.) 4.
- (8) Disconnect the overflow pipe (T. G. O.) 5.
- (9) Disconnect the suction pipe (S. S.) 6.
- (10) Disconnect the hand pump suction pipe (H. P. S.) 7.

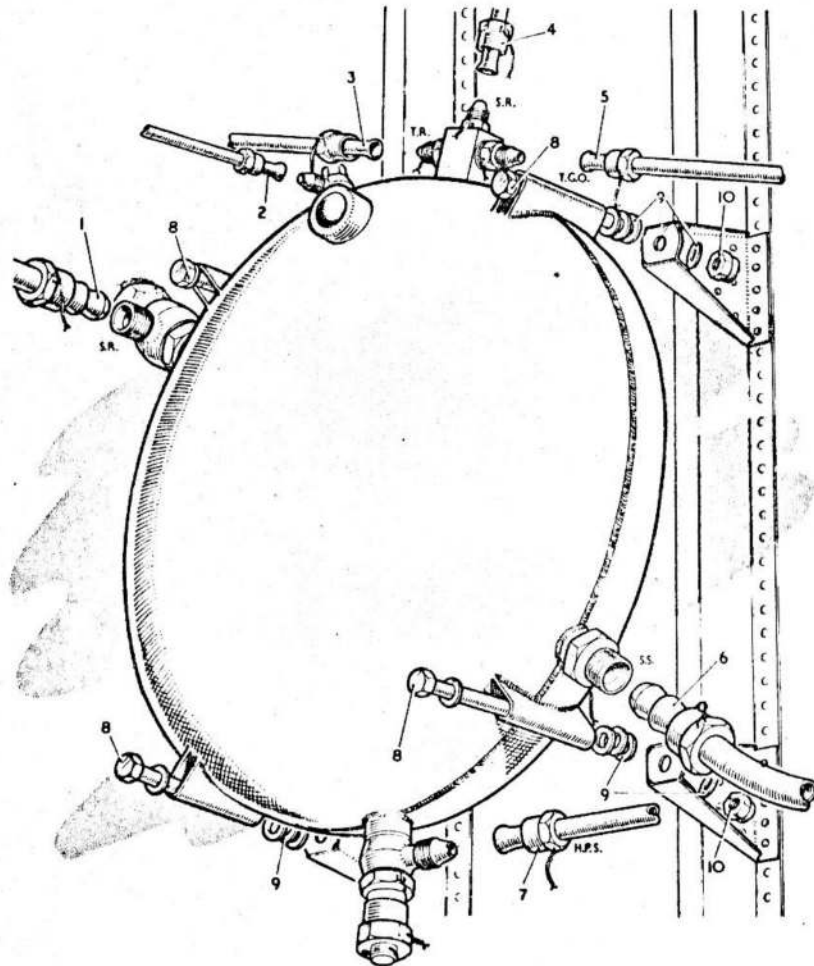


Fig. 21. "Services" system header tank removal.

(11) Support the tank and remove the stiffnuts, 10, washers, 9, and bolts, 8, securing the tank to the mounting brackets.

(12) Remove the tank.

135. The procedure for installing a tank is a reversal of the removal operations. All pipe unions must be wire-locked. After installation the tank should be filled as instructed in para. 78.

#### Hand pump

136. To remove the hand pump, mounted in the pilot's station, proceed as follows:-

- (1) At the hand pump body disconnect the suction (H. P. S.) and pressure (H. P. P.) pipes.
- (2) Remove the three  $\frac{1}{4}$  in. B. S. F. stiffnuts, washers and bolts securing the hand pump to the mounting bracket and remove the hand pump.

137. The procedure for installing a hand pump is a reversal of the removal operations. After installation prime and bleed the hand pump and delivery line as instructed in para. 85 and 86. Ensure that all pipe unions are wire-locked and free from leaks.

#### Forward accumulators

138. To remove any one of the accumulators mounted on the spar frame in the centre fuselage, proceed as follows:-

- (1) Exhaust all fluid pressure in the appropriate system.

- (2) In the port main undercarriage bay, remove the blanking nut from the accumulator charging valve and open the appropriate inflation cock (para. 72) slowly to discharge the nitrogen pressure in the accumulator.
- (3) Remove the access panel in the undersurface of the fuselage between the belly tank and the spar frame.
- (4) At the accumulator, disconnect the charging pipe (A. C.) and hydraulic pressure pipe.
- (5) Support the accumulator and release the two jubilee clips securing the accumulator to the mounting bracket; remove the accumulator.

139. The procedure for installing an accumulator is in general a reversal of the removal operations. After installation, ensure that the pipe unions are wire-locked and charge the accumulator with nitrogen to the correct pressure as instructed in para. 72.

#### Wheel brake control valve

140. To remove the wheel brake control valve, proceed as follows:-

- (1) Exhaust all fluid pressure in the services and brakes accumulators.
- (2) At the control valve, disconnect the following pipes:-
  - (a) Pressure to brakes (P. W. B.), two pipes.
  - (b) Pressure to brakes (S. W. B.), two pipes.
  - (c) Pressure to control valve (B. P.).
  - (d) Return to tank (S. R.).

- (3) Remove the split pin, washer and pin connecting the spring box to the parking control lever on the valve.
- (4) Remove the bolts securing the valve to the panel and remove the valve.

141. The procedure for installing a wheel brake control valve is a reversal of the removal operations. After installation, prime and bleed the wheel brakes circuit as instructed in para. 89. Set the parking control as instructed in para. 107, ensure that all pipe unions are wire-locked and test the wheel brakes circuit as described in para. 103.

#### Wheel brake unit

142. To remove a wheel brake unit, proceed as follows:-

- (1) Jack and trestle the aircraft as described in Sect. 2, Chap. 4.
- (2) Exhaust all fluid pressure in the brakes and services accumulators.
- (3) Remove the main wheel as instructed in Sect. 3, Chap. 5.
- (4) At the Maxaret unit, disconnect the pressure (P. W. B. or S. W. B.) and return (W. B. R.) pipes.
- (5) At each brake piston, unlock the piston rod by depressing the locking collar to free it from engagement with the cover plate and screw the piston rod in tight.
- (6) Remove the ten bolts securing the brake to

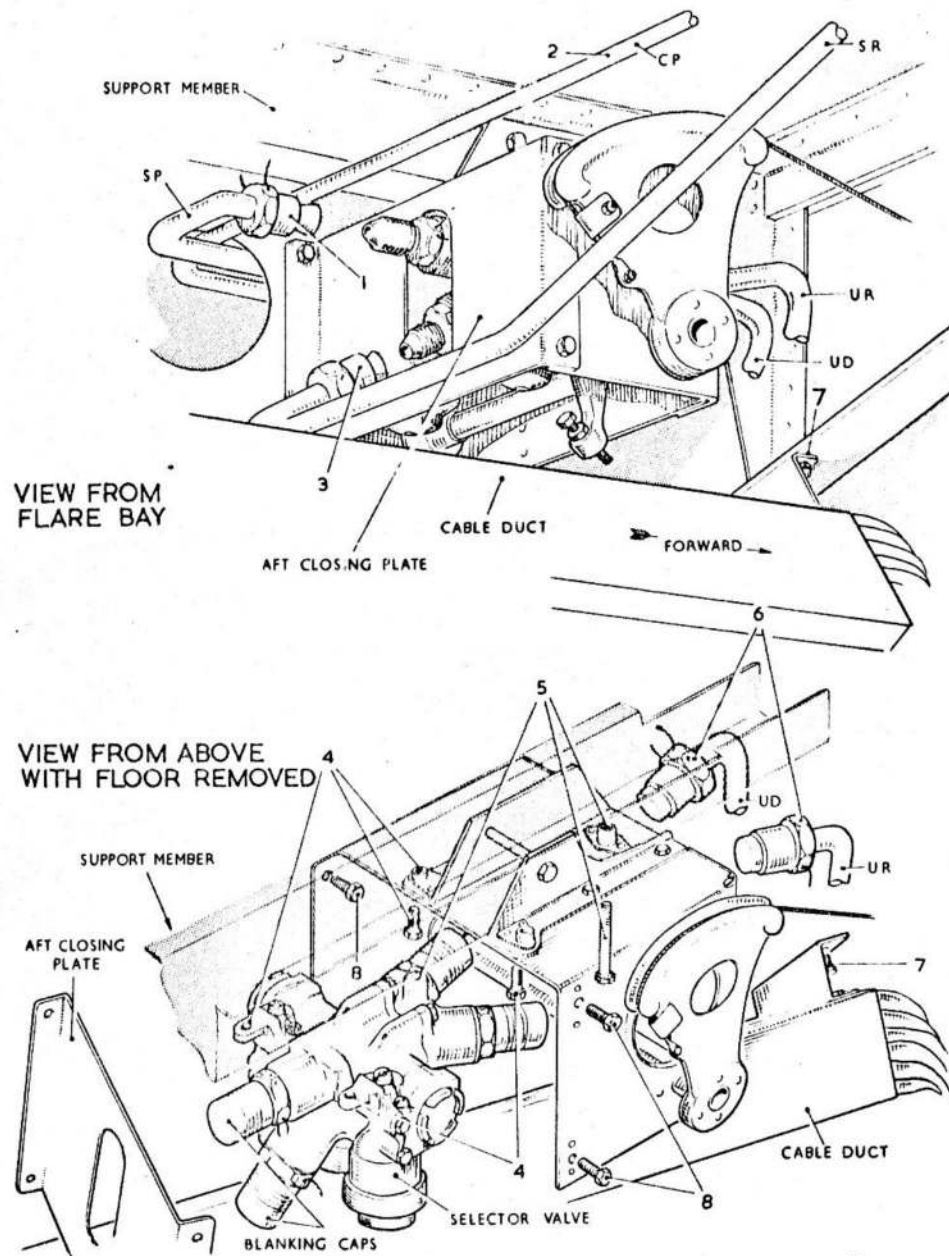


Fig.22 Aighting gear selector valve removal

the axle flange and remove the brake unit.

143. Ensure that the brake pistons are screwed up tight (para. 142 (5)) and install the brake unit in the reverse manner to removing. Before installing the main wheel, prime and bleed the wheel brakes circuit as instructed in para. 89. Test the circuit as described in para. 103.

#### Alighting gear selector valve (fig. 22)

144. To remove the alighting gear selector valve, proceed as follows:-

- (1) Jack and trestle the aircraft as described in Sect. 2, Chap. 4.
- (2) Open the flare bay doors.
- (3) Exhaust all fluid pressure in the 'services' and 'controls' systems.
- (4) Disconnect the 'controls' system main pressure pipe (C. P.) 2, at the four-way piece behind the alighting gear selector valve mounting bracket (forward end of flare bay, port side) and at the nearest union inboard of the selector valve. Blank off and retain the length of pipe.
- (5) Disconnect and remove the following pipes at the selector valve and at the nearest union inboard of the valve:-
  - (a) Main pressure (S. P.) 1.
  - (b) Return to tank (S. R.) 3.
 Blank off and retain the lengths of pipe.

- (6) At the selector valve, disconnect the up (U. R.) 6, and down (U. D.) pipes, 6.
- (7) Remove the four bolts, 8, securing the aft closing plate to the selector valve mounting bracket and remove the plate.
- (8) Remove the electrical cable duct attachment bolts, 7, at the three forward frames in the flare bay (two bolts at each frame).
- (9) Break the locking wire and, using a box spanner, remove the two rear bolts, 4, securing the selector valve to the mounting angles.
- (10) Support the selector valve, break the locking wire and remove the forward attachment bolts, 5, and remove the selector valve.

145. The procedure for installing a selector valve is a reversal of the removal operations. After installation, prime and bleed the alighting gear circuit as instructed in para. 93, ensure that all pipe unions and the selector valve attachment bolts are wire-locked and test the circuit as described in para. 98. Fill the port 'controls' system as instructed in para. 114.

#### Main undercarriage jack

146. To remove a main undercarriage jack, proceed as follows:-

- (1) Jack and trestle the aircraft as described in Sect. 2, Chap. 4.
- (2) Exhaust all fluid pressure in the services accumulator.

- (3) Unclip the flexible pipe (U. D. E. ) from the jack body.
- (4) Remove the banjo bolt attaching the shuttle valve to the jack body and remove the valve without disconnecting the two flexible pipes.
- (5) Remove the banjo bolt and disconnect the 'up' pipe (U. R. ) at the jack body.
- (6) Remove the split pin, nut, washer, and bolt connecting the jack piston rod to the undercarriage lock lever.
- (7) Support the jack, remove the split pin, nut, washer and bolt attaching the jack body to the spherical joint and remove the jack.

147. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 93.

#### Main undercarriage door jack

148. To remove a main undercarriage door jack, proceed as follows:-

- (1) Exhaust all fluid pressure in the services accumulator.
- (2) Remove the banjo bolt securing the shuttle valve to the jack body and remove the shuttle valve without disconnecting the flexible pipes.
- (3) Remove the banjo bolt and disconnect the 'up' pipe (U. R. ) at the jack body.
- (4) Remove the split pin, collar and pin connecting the jack piston rod to the lock lever at

the door hinge.

- (5) Support the jack, remove the split pin, collar and pin attaching the jack to the mounting bracket on the fuselage side and remove the jack.

149. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 93.

#### Nose undercarriage jack

150. To remove the nose undercarriage jack, proceed as follows:-

- (1) Jack and trestle the aircraft as described in Sect. 2, Chap. 4.
- (2) Exhaust all fluid pressure in the services accumulator.
- (3) Remove the banjo bolt attaching the shuttle valve to the jack body and remove the shuttle valve without disconnecting the two flexible pipes.
- (4) Remove the banjo bolt and disconnect the 'up' pipe (U. R. ) at the jack body.
- (5) Unclip the pipes from the jack body.
- (6) Remove the split pin, nut, washer and bolt connecting the jack piston rod to the down lock lever.
- (7) Support the jack, remove the split pin, nut, washer and bolt attaching the jack trunnions to the vertical support beams and remove the

jack complete with the trunnion.

◀ Note...

(a) Two washers, SP13/L, should be found as part of the assembly, one at each end of the cross-head, between it and the beams. Some aircraft have flanged bushes rivetted to the beams. They were fitted by the manufacturers to rectify oversize pivot holes. The flanges are equivalent in thickness to washers SP13/L.

(b) Where the assembly has a washer (or equivalent flanged bush) each side of the cross-head and the total gap does not exceed 0.015 in. re-lubricate and fit the split pin.

(c) Where the assembly is other than as defined in sub para (b) standard washers, SP13/L and/or locally manufactured washers are to be fitted at each end of the cross-head to equalize the two 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 SWG of sheet steel Spec. S520 or S521, but no washer is to be less than 30 SWG (0.012 in.)

(d) Re-lubricate the pivot, re-assemble, and lock the slotted nut with a new split pin. ▶

151. The procedure for installing a jack is, in general, a reversal of the removal operations. Before securing the pipes to the jack body, they should be set in accordance with the instructions given in Chap. 5 of this Section to avoid fouls with the door operating mechanism and structure. After installation fill and bleed the jack as instructed in para. 93.

◀ Note...

The cross-head is to be fitted so that the grease nipple is positioned on top when the jack is installed in the aircraft. ▶

Nose undercarriage door jack (fig. 23A.)

152. To remove the nose undercarriage door jack, proceed as follows: -

- (1) Exhaust all fluid pressure in the services accumulator.
- (2) Disconnect the down(U.D.)(4), emergency

down (U. D. E. ) (5), and up (U. R. ) (6), flexible pipes at the jack.

- (3) Remove the split pin (3), nut (2) and bolt (1) attaching the jack piston rod to the cross-head.
- (4) Remove the four fuselage attachment bolts (8) securing the jack mounting brackets.
- (5) Remove the two bolts (7) on each side securing the jack mounting brackets to the vertical support beams.
- (6) Remove the door latch bolt (9).
- (7) Remove the jack complete with mounting brackets.
- (8) Remove the split pin (12), nut (13), washer (11) and bolt (10) attaching the jack to the latch release lever and remove the jack.

153. The procedure for installing a jack is a reversal of the removal operations. After installation fill and bleed the jack as instructed in para. 93.

#### Flare bay doors jack

154. To remove a flare bay doors jack, proceed as follows:-

- (1) Open the flare bay doors.
- (2) Exhaust all fluid pressure in the services accumulator.

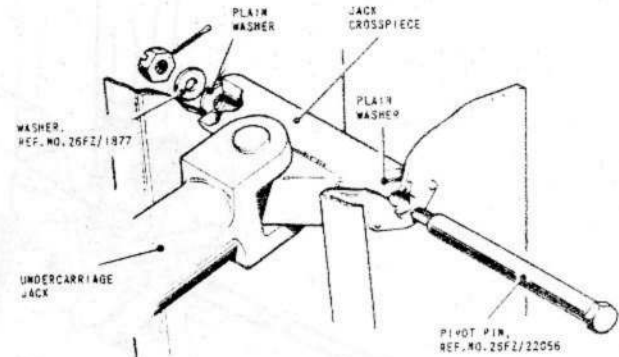
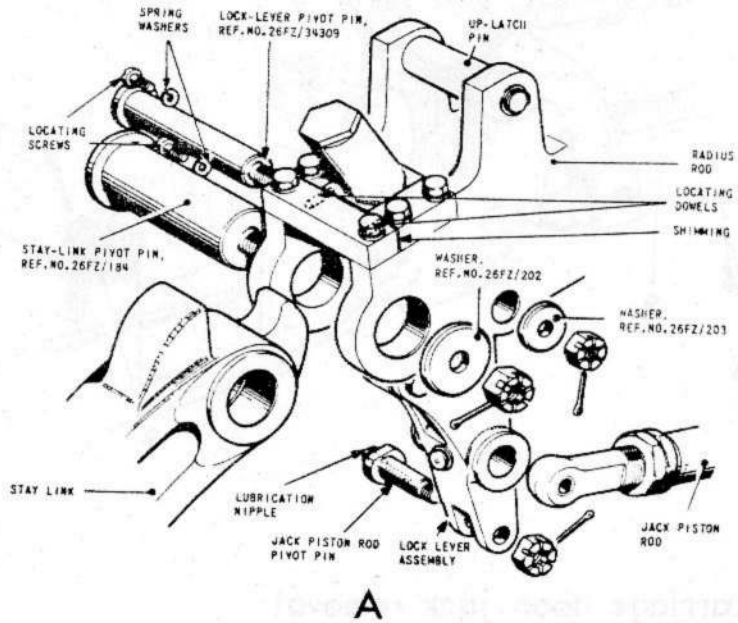
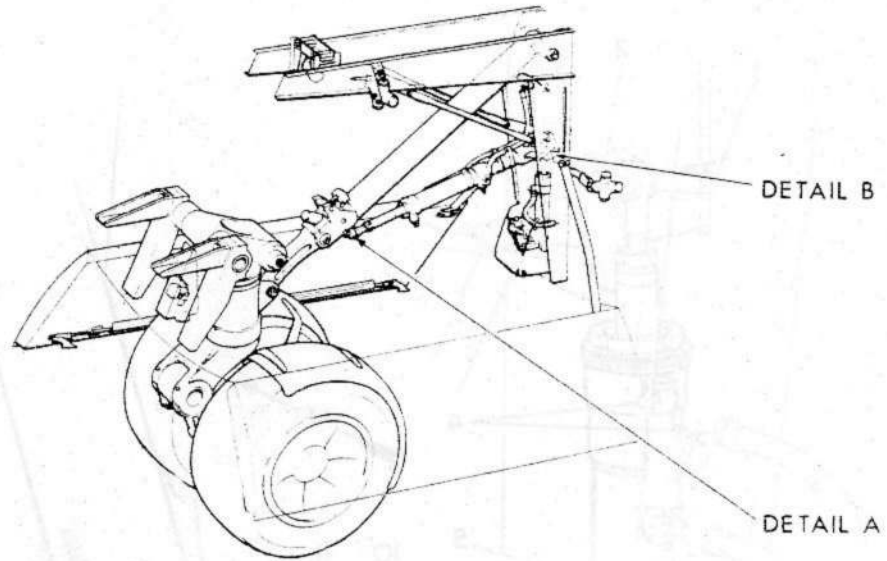
- (3) At the jack disconnect the open (F. D. O. ) and closed (F. D. S. ) pipes.
- (4) Disconnect the door actuating links from the link-end on the jack piston-rod.
- (5) Disconnect the jack link from the link-end on the jack piston rod.
- (6) Support the jack, remove the split pin, collar, washer and pin securing the jack body to the mounting bracket on the bulkhead and remove the jack.

155. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 87; adjust the doors, if necessary as instructed in Sect. 3, Chap. 1.

#### Flap jack (fig. 24)

156. To remove a flap jack, proceed as follows:-

- (1) With the flap in the fully down position exhaust all fluid pressure in the services accumulator.
- (2) At the jack disconnect the down (F. D. ) and up (F. R. ) pipes (3).
- (3) Remove the 2-B. A. bolts attaching the two plates (2) to the flap shroud ribs adjacent to the jack body and remove the plates.
- (4) Remove the split pins and washers from the pins (1) connecting each fork-end of the jack piston rod to the push-pull rods, and remove the pins.



A

B

Fig 23 Nose undercarriage jack removal.  
(New illustration)

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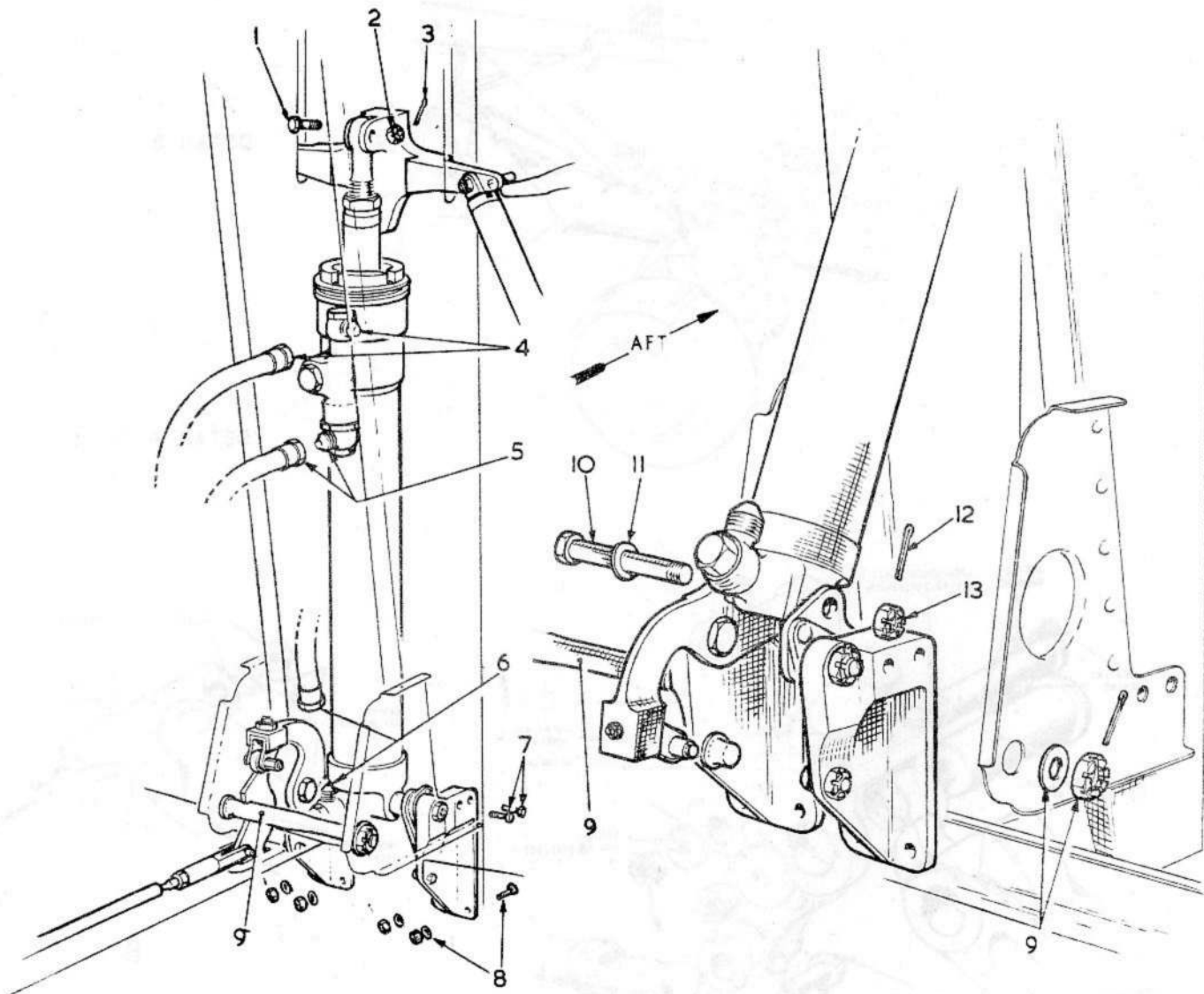


Fig 23A Nose undercarriage door jack removal

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- (5) Remove the two  $3/8$  in. B. S. F. bolts (4) securing the flanged end of the jack to the mounting bracket.
- (6) Remove the two  $5/16$  in. bolts (5) securing the ring mounting to the opposite end of the jack.
- (7) Remove the jack.

157. The procedure for installing a jack is, in general, a reversal of the removal operations but consideration must be given to the following special points: -

- (1) When the jack is fitted to the mounting bracket, it is essential that the washers

are correctly positioned as shown in fig. 25.

- (2) If necessary, the fork-ends of the jack piston rod should be adjusted to connect with the flap mechanism push-pull rods, the fork at the flanged end of the jack being adjusted first. After making this adjustment, check the dimension between the pin centre and the nearest face of the cylinder flange; this must be  $3.13 \text{ in} \pm 0.25 \text{ in}$ . When final adjustment of the opposite fork-end is completed, check the dimension between the jack pin centres; this should be  $18.3 \pm 0.25 \text{ in}$ . For checking purposes, jack travel is  $3.90 \text{ in} \pm 0.015 \text{ in}$ .

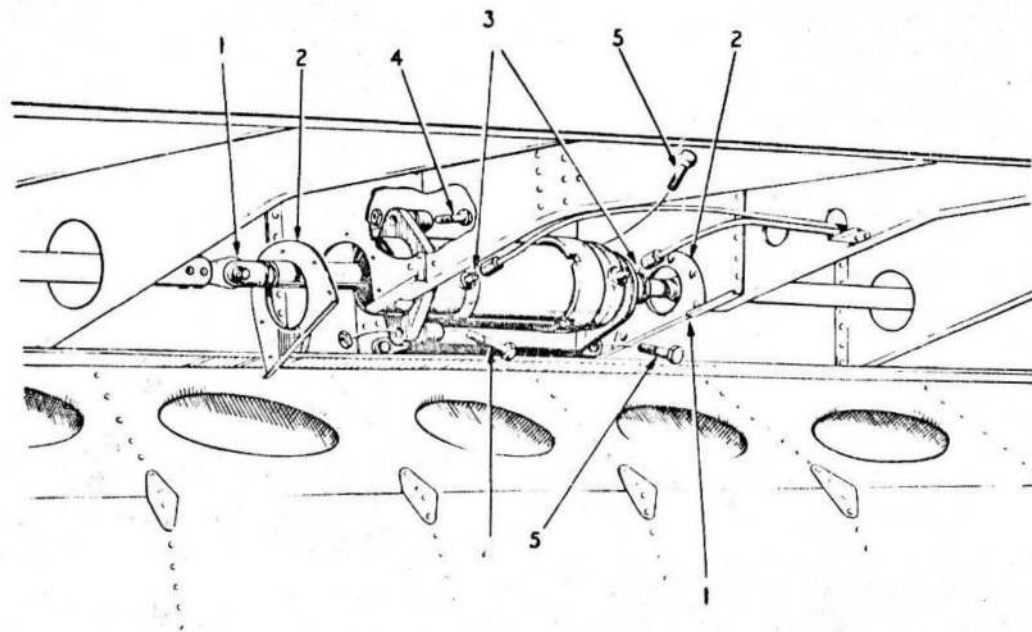


Fig. 24 Flap Jack removal

- (3) After installation of the jack, fill and bleed the flap circuit as instructed in para. 91.

Air brakes jack

158. To remove an air brakes jack, proceed as follows:-

- (1) Exhaust all fluid pressure in the services accumulator.
- (2) Remove the access panels in the under-surface of the main plane giving access to the air brakes (Sect. 2, Chap. 4)
- (3) Disconnect the in(A. B. I.) and out (A. B. O.) pipes at the jack.
- (4) Disconnect the jack piston rod at the lever on the rocker arm assembly.

- (5) Support the jack, remove the split pin, collar, washer and pin securing the jack to the bracket on the spar and remove the jack.

159. The procedure for installing an air brakes jack is a reversal of the removal operations. After installation fill and bleed the air brakes circuit as instructed in para. 92.

Front camera door jacks

160. To remove any one of the four camera door jacks in the front camera compartment, proceed as follows:-

- (1) Exhaust all fluid pressure in the services accumulator.
- (2) Open the appropriate hinged fairing at the front camera compartment.

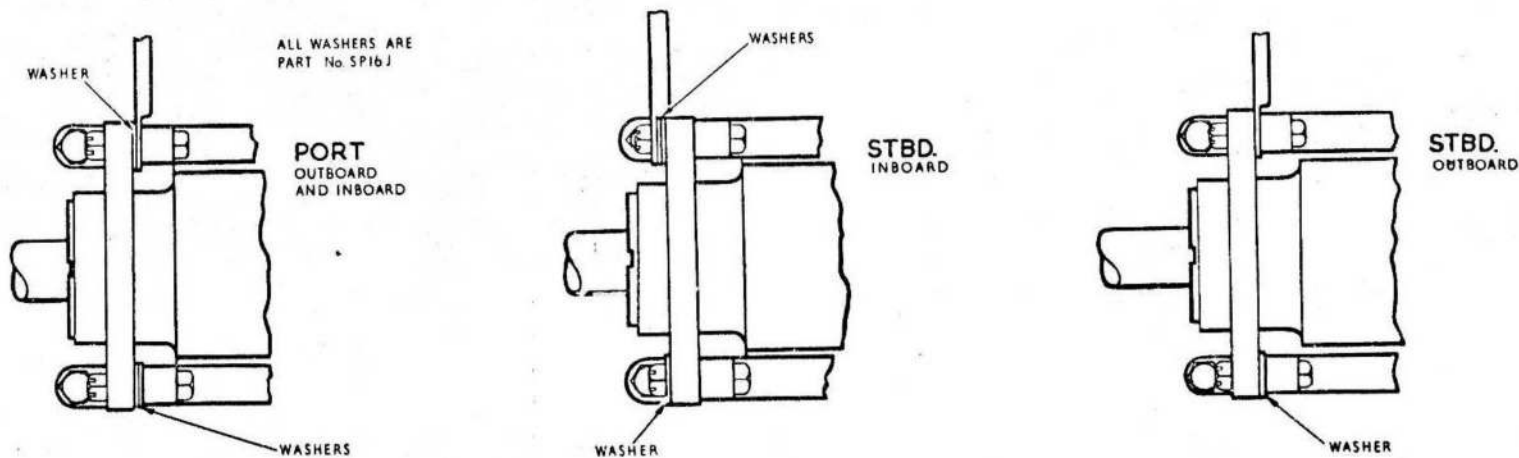


Fig. 25 Flap jack installation

A. L. 96, June 69

- (3) At the jack, disconnect the open (C. D. O.) and closed (C. D. S.) pipes.
- (4) Remove the split pin, nut, washer and bolt connecting the jack piston rod to the door actuating arm.
- (5) Remove the split pin, nut, washer and bolt securing the jack body to the attachment lug and remove the jack.

161. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 90.

#### Mid camera door jack

162. To remove the mid camera door jack, proceed as follows:-

- (1) Obtain access by entering the fuselage through the hatch in the undersurface of the rear fuselage.
- (2) Exhaust all fluid pressure in the services accumulator.
- (3) At the jack, disconnect the open (C. D. O.) and closed (C. D. S.) pipes.
- (4) Remove the split pin, nut, washer and bolt connecting the jack piston rod to the pivot arm.
- (5) Remove the split pin, nut, washer and bolt attaching the jack body to the trunnion fitting on the attachment lug and remove the jack.

NOTE: Do not remove the trunnion fitting from the attachment lug.

163. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 90.

#### Aft camera door jacks

164. To remove either of the two jacks, proceed as follows:-

- (1) Obtain access by entering the fuselage through the hatch in the undersurface of the rear fuselage.
- (2) Exhaust all fluid pressure in the services accumulator.
- (3) At the jack, disconnect the open (C. D. O.) and closed (C. D. S.) pipes.
- (4) Remove the split pin, nut, washer and bolt connecting the jack piston rod to the lug on the door.
- (5) Remove the split pin, nut, washer and bolt connecting the jack body to the attachment bracket on the fuselage side and remove the jack.

165. The procedure for installing a jack is a reversal of the removal operations. After installation, fill and bleed the jack as instructed in para. 90.

'Controls' system header tank

166. To remove either of the 'controls' system header tanks, mounted one in each main undercarriage bay, proceed as follows:-

- (1) Exhaust all fluid pressure in the appropriate 'controls' system.
- (2) Disconnect the following pipes at the tank:-
  - (a) Return pipe (C. R.)
  - (b) Suction pipe (C. S.)
  - (c) Vent pipe
  - (d) Pressure pipe (C. P.)

- (3) Release the turnbuckle on the retaining strap and remove the tank.

NOTE: The tank may be drained after removal through the return or suction connection in the top of the tank.

167. The procedure for installing a tank is a reversal of the removal operations. After installation fill the tank in accordance with the instructions given in para. 113.

Aileron jacks (fig. 26)

168. To remove any one of the four aileron jacks, proceed as follows:-

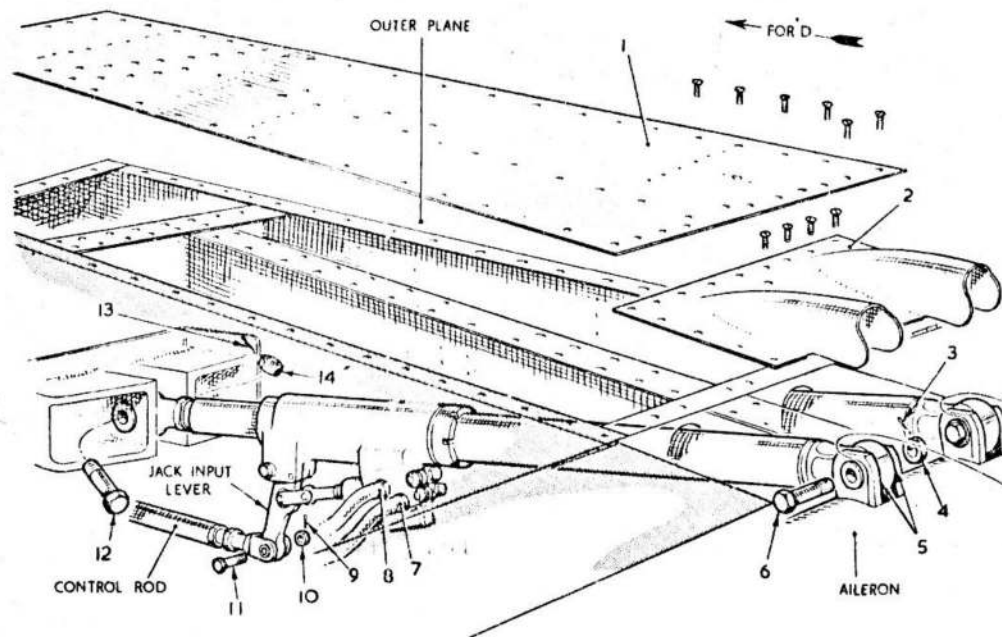


Fig. 26 Aileron jack removal

- (1) Exhaust all fluid pressure in the aileron jack accumulators.
- (2) Remove the two access panels (1 and 2) in the upper surface of the outer wing.
- (3) At the jack, disconnect the pressure (I. A. P. or O. A. P.) (7), and return (C. R.) pipes (8).
- (4) Remove the split pin (3), nut (4), washers (5) and bolt (6) securing the jack to the aileron attachment bracket.
- (5) Remove the split pin (9), nut (10) and bolt (11) connecting the control rod to the jack input lever.
- (6) Remove the split pin (13), nut (14) and bolt (12) securing the jack to the wing attachment bracket and remove the jack.

169. The procedure for installing a jack is, in general, a reversal of the removal operations but consideration should be given to the following points during installation:-

- (1) Ensure that the aileron control run is rigged correctly in accordance with the instructions given in Sect. 3, Chap. 4.
- (2) Set the jack in accordance with the instructions given in Sect. 3, Chap. 4.
- (3) After installation, prime the jack as instructed in para. 117 and test the system as instructed in para. 120 or 121.

#### Rudder jack (fig. 27)

170. To remove the rudder jack, proceed as follows:-

- (1) Exhaust all fluid pressure in the rudder jack primary and secondary accumulators.
- (2) Remove the two access panels (9 and 12) at the base of the fin, and the panel (18) in the fin stub.
- (3) Remove the fairing cover (14) over the jack attachment to the rudder.
- (4) At the jack, disconnect the following pipes:-
  - (a) Primary pressure (S. P.) (7).
  - (b) Primary return (S. R.) (11)
  - (c) Secondary pressure (R. S. P.) (10)
  - (d) Secondary return (C. R.) (8).
- (5) Remove the split pin (6), nut (5) and bolt (4) connecting the autostabiliser servo unit to the jack input lever.
- (6) Remove the split pin (15), nut (16), washer (17) and bolt (13) connecting the jack to the lever at the base of the rudder.
- (7) Remove the split pin (1), nut (2) and bolt (3) attaching the jack to the bracket in the fin stub and withdraw the jack through the access hole in the fin stub.

171. The procedure for installing a jack is, in general, a reversal of the removal operations but consideration should be given to the following points during installation.

- (1) Ensure that the rudder control run is rigged correctly in accordance with the instructions given in Sect. 3, Chap. 4.
- (2) Set the jack in accordance with the instructions given in Sect. 3, Chap. 4.
- (3) After installation, prime the jack as instructed in para. 83.

#### Rear fuselage accumulators

172. To remove any one of the accumulators mounted in the rear fuselage, proceed as follows:-

- (1) Exhaust all fluid pressure in the appropriate system.
- (2) At the charging panel on the port side of the

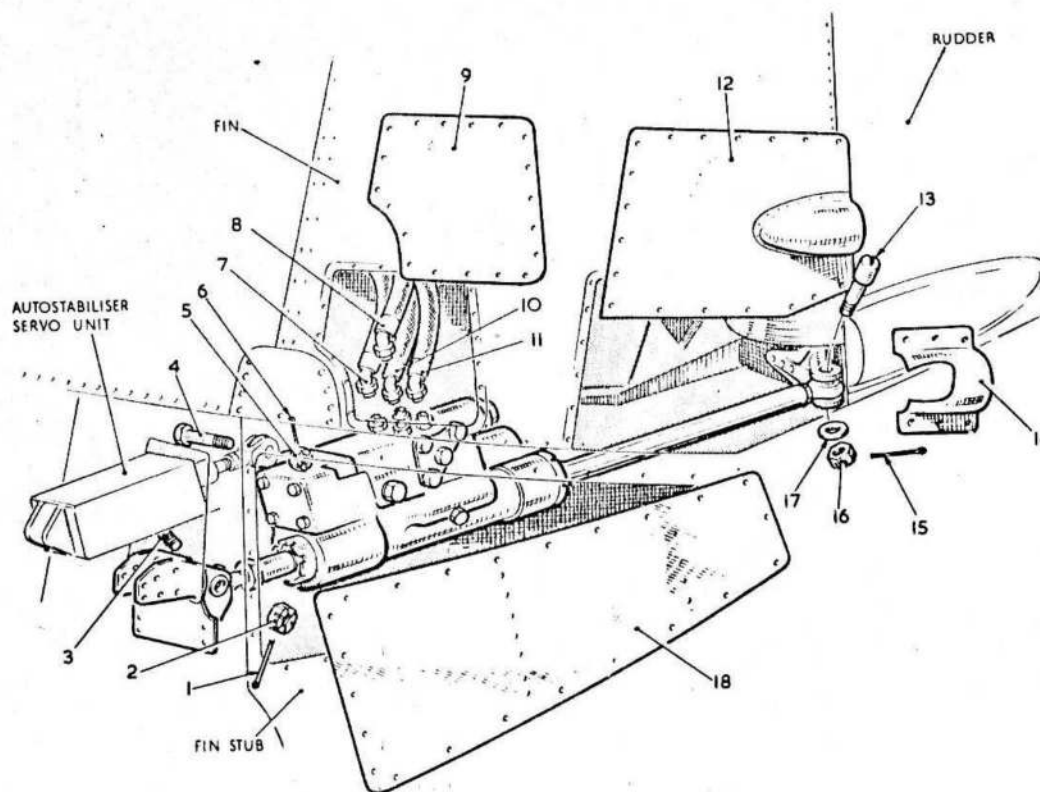


Fig. 27 Rudder jack removal

fuselage just inside the rear fuselage entrance hatch, remove the blanking nut from the accumulator charging valve and open the appropriate inflation cock (para. 72) slowly to discharge the nitrogen pressure in the accumulator.

- (3) At the accumulator, disconnect the charging (A. C.) and pressure pipes.
- (4) Support the accumulator, release the two jubilee clips securing the accumulator to the mounting bracket and remove the accumulator.

173. The procedure for installing an accumulator is, in general, a reversal of the removal operations. After installation, charge the accumulator with nitrogen to the correct pressure as instructed in para. 72.

#### Rudder feel simulator jack

174. To remove the feel simulator jack, proceed as follows:-

- (1) Exhaust all fluid pressure in the primary and secondary feel circuits.
- (2) Enter the fuselage through the entrance hatch in the rear fuselage.
- (3) At the jack, disconnect the following pipes:-
  - (a) Signal pressure, primary (F. U. P.)
  - (b) Signal pressure, secondary (F. U. S.)
  - (c) Return (S. R.).

- (4) Remove the split pin, nut, washer and bolt and disconnect the rudder trim actuator.
- (5) Remove the two  $\frac{1}{4}$  in. B. S. F. nuts, washers and bolts securing the forward end of the jack to the fork-end bracket.
- (6) Support the jack, break the locking wire and remove the eight bolts securing the jack body to the anchor bracket on the bulkhead at frame 42; remove the jack.

175. The procedure for installing a feel simulator jack is a reversal of the removal operations. After installation, prime the primary feel circuit as instructed in para. 83 and the secondary feel circuit as instructed in para. 114. Check that the rudder controls are rigged in accordance with the instructions given in Sect. 3, Chap. 4.

#### Rudder feel simulator control unit

176. To remove either the primary or secondary feel simulator control unit, proceed as follows:-

- (1) Exhaust all fluid pressure in the appropriate system.
- (2) Disconnect the pressure head and static pipes at the control unit.
- (3) Disconnect the following hydraulic pipes:-
  - (a) Supply pressure (F. S. P. primary, F. S. S. secondary).
  - (b) Signal pressure (F. U. P. primary, F. U. S. secondary).

(c) Return (S. R. primary, C. R. secondary).

- (4) Support the control unit, remove the three nuts, washers and  $\frac{1}{4}$  in. B. S. F. bolts attaching the unit to the mounting structure and remove the unit.

177. The procedure for installing a feel simulator control unit is a reversal of the removal operations. After installation, prime and bleed the feel simulation circuit as instructed in para. 83 for the primary circuit or para. 114 for the secondary circuit.

### 'SERVICES' SYSTEM HEADER TANK.

#### DESCRIPTION AND OPERATION

##### Construction (fig. 28)

178. The services header tank consists of a circular shell formed by dished half-shells welded together. Internally, the tank is quartered by two elliptical baffles at right angles to each other and welded together at the centre. The baffles are perforated with flanged holes and a clearance is provided between the baffle edges and the tank shell. Supporting the baffles are two internal pipes welded to diametrically opposed main suction and return connectors, which, in turn, are welded to the tank shell. The pipes are welded to one of the baffles and form its central stem, each terminates at a conical flow separator on the face of the other baffle. Six equally-spaced holes are provided in each separator and a truncated cone baffle, fitted to the flange of each separator, provides a narrow annulus embracing the separator.

179. In addition to the main suction and return connectors, tapped bosses are welded to the shell for the connection of the hand pump suction, air pressurisation, overflow, pressure relief and simulator exhaust pipes, the three last named pipes being connected

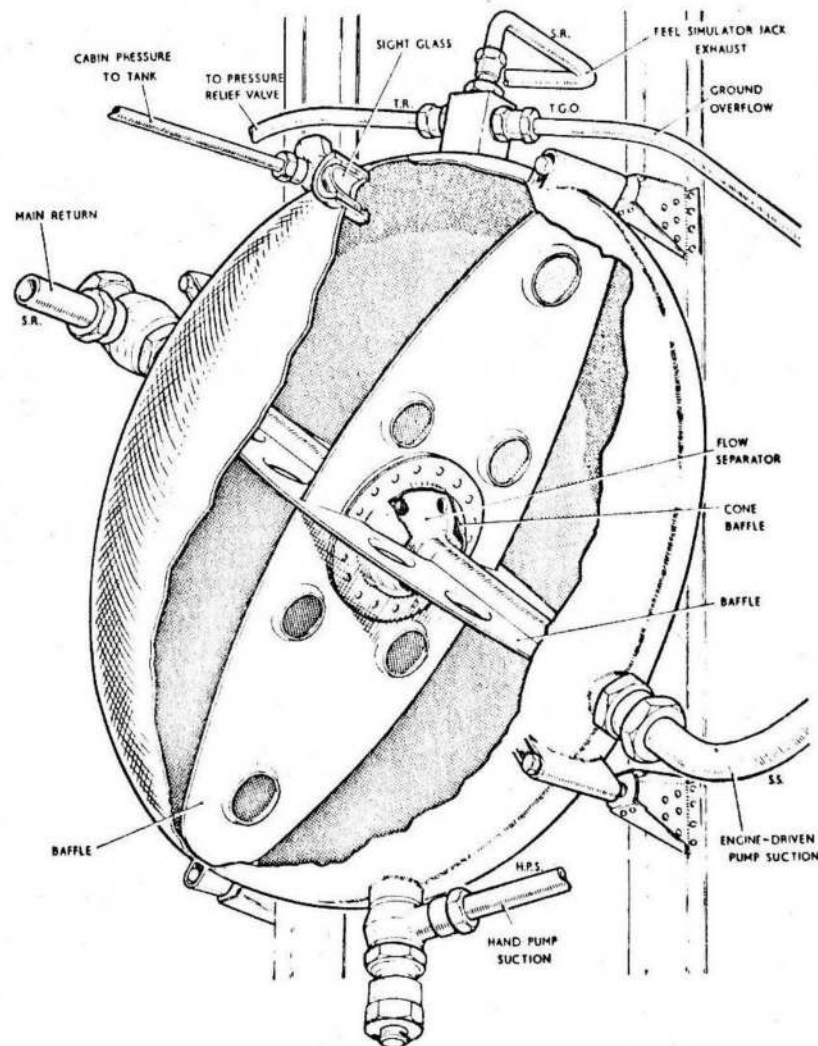


Fig. 28. Header tank—"Services" hydraulic system.

to a common boss at the top of the tank. Also welded to the tank shell are four V-shaped mounting brackets and a sight-glass.

#### Operation

180. The tank is filled with fluid through the main return connection from a remote coupling mounted in the port undercarriage bay, using a hand pump. No filter is fitted in the tank but when in situ, fluid passes through the filter in the return line before entering the tank. The correct fluid level is ascertained by filling until fluid flows from the overflow connection which, on the aircraft is piped to a coupling mounted adjacent to the filling coupling. Instructions for filling the tank in situ are given in para. 78.

181. The tank is subject to cabin pressure through a pipe which is open to the cabin at the pressure bulkhead and connected to the top of the tank. The pressure relief pipe from the common boss at the top of the tank incorporates a pressure relief valve (145 on fig. 2), designed to operate when the pressure in the tank exceeds 12 to 17 p. s. i. and terminates in an oil collector box (146 on fig. 2) mounted on the bulkhead in the forward camera bay. When the relief valve operates, a small quantity of fluid may be forced past the relief valve due to the build up of air pressure in the tank when the tank fluid level is raised. This is particularly liable to happen if the system fluid pressures are exhausted in the wrong sequence.

182. During engine-driven pump operation, fluid is drawn from the tank through the holes in the suction pipe separator and returned through the holes in the return separator. The truncated cone baffles are fitted to prevent aeration of the fluid at certain fluid levels and tank attitudes. The hand pump suction connection is at the base of the tank, thus ensuring a reserve of fluid for hand pump operation in the event of fluid loss in the system due to leakage.

#### SERVICING

##### General

183. Instructions for removing the tank from the aircraft are given in para. 134.

##### Pressure testing

184. Blank off all the connections on the tank other than the main return and overflow. Apply a coating of methylated spirits and french chalk to the outer surface of the tank and allow to dry. Connect a hand pump test rig incorporating a filter and pressure gauge to the main return connection. Fill the tank until fluid flows from the overflow connection and blank off the overflow connection. Apply a pressure of 20 p. s. i. There must be no leakage or permanent distortion.

## Chapter 8 AIR CONDITIONING AND DE-MISTING SYSTEMS

(Completely revised)

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### Introduction

1. This chapter deals with the following:- Camera heating and de-misting, Cabin pressure system, Cold air system, Canopy, Hatch and Hinged nose seals, Ventilated suit system, Cabin pressure control and Dry-air de-misting. The latter, for the pilot's canopy and navigator's windows, is completely separate from the main system and is dealt with separately in this chapter.

2. Details of the components of the systems, together with their Air Publications references, are given below:-

Component	Description	A. P.
Combined valve unit	Normalair	1275A
Master Unit	Normalair	1275A
Univalve	Dunlop	-
Control valve	Godfrey	4340
Heating control valve	Boulton Paul	-
Water extractor	Godfrey	4340
Heat exchanger	Marston	4340
Duct frost guard	Godfrey	4340
Constant flow valve	Normalair	4340
Secondary air cooler	Marston	-
Cold air unit	Godfrey	4340
Double mixing valve	Teddington	4303E
Primary air cooler	Marston	-

### DESCRIPTION AND OPERATION

#### General

3. Air for cabin heating, windscreen de-misting, camera heating and the ventilated suits, is obtained from the engine compressors. The air from each engine is controlled by a shut-off valve, located, one in port and one in the starboard compartment of the inner wing. The cabin pressure is controlled by a

master unit and combined valve unit, and the temperature is governed by a mixing valve, located in the leading edge of the port inner wing, which is operated by an actuator controlled by a switch mounted on the take-off panel on the pilot's starboard console. The temperature for camera heating is governed by temperature control valves, one each in the forward, centre and aft camera bay, and one mounted on the port side between panels 4 and 5.

#### Supply

4. Hot air from the engine compressors passes into a common duct from which a supply is taken to each of the different systems (fig. 2). The initial supply of hot air from each compressor is controlled by a solenoid valve, located close to the inboard engine rib in the leading edge of each main plane, a non-return valve is fitted between each of these and the engine compressor.

5. The temperature of the air to the cabin is governed by a mixing valve (fig. 3), electrically controlled by the cabin heat switch on the starboard instrument panel. By the use of this switch, the air can be delivered hot, cooled, or cold. By moving the switch to HOT, hot air is directed from the engine compressors through the mixing valve to the cabin, the air passes through a constant flow valve, water extractor, and non-return valve. By moving the switch to COLD, the hot air from the compressors, is directed through the primary cooler in the starboard main plane leading edge, to the mixing valve, the cold side of which allows the partly-cooled air to pass to the compressor side of the cold air unit. When it leaves the compressor side, the air passes through the secondary cooler installed in the port main plane leading edge, to the turbine stage of the cold air unit and then, through a duct frost guard, restrictor (see ventilated suits

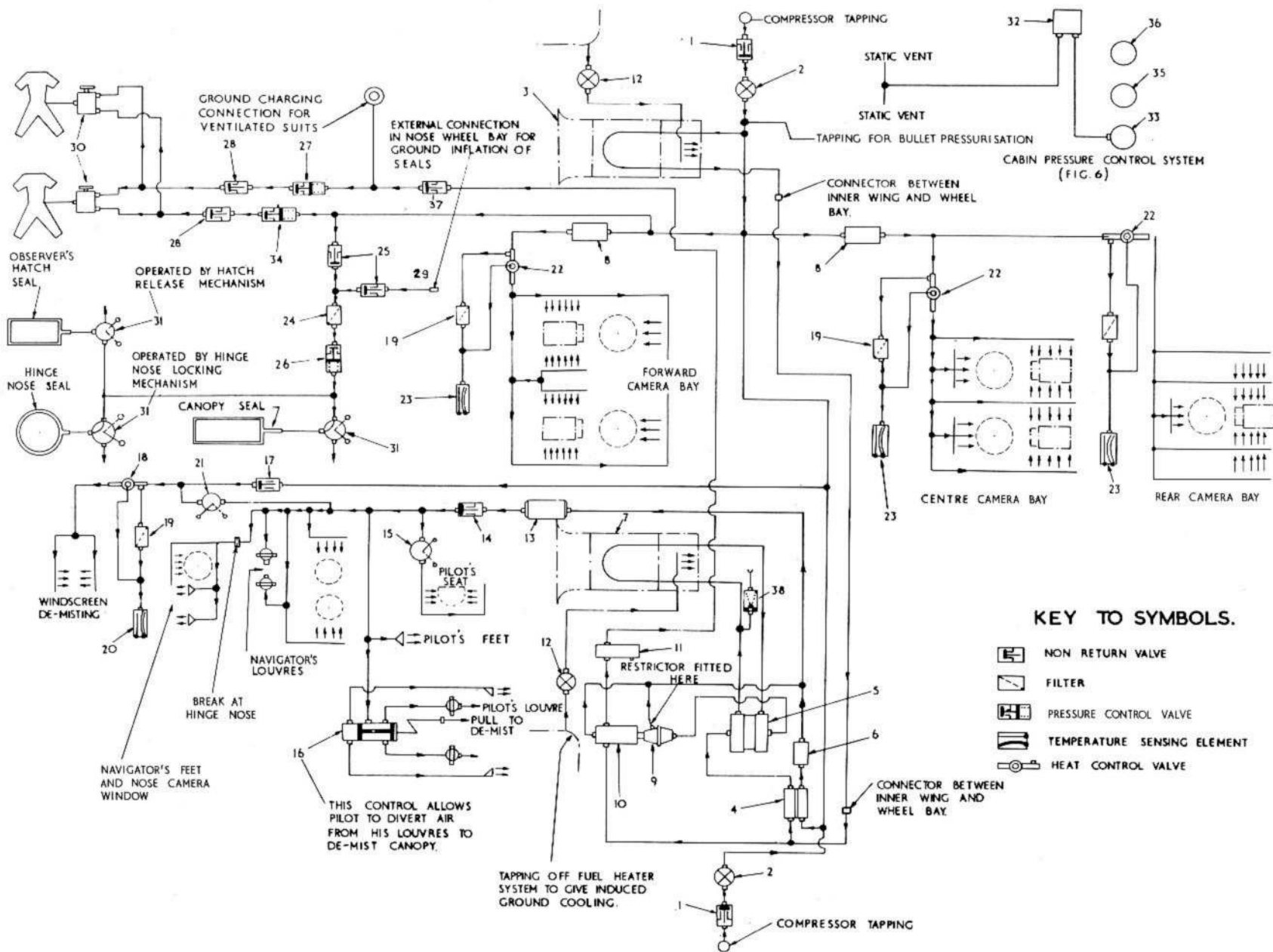


Fig. 1 Air conditioning  
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KEY TO FIG. 1  
(Air conditioning)

1	Non-return valve	20	Temperature sensing element
2	Shut-off valve	21	Control valve (manual)
3	Primary air cooler	22	Heat control valve
4	Double mixing valve	23	Temperature sensing element
5	Cold air unit	24	Filter
6	Constant flow valve	25	Non-return valve
7	Secondary air cooler	26	Pressure reducing valve
8	Constant flow valve	27	Pressure control valve
9	Duct frost guard	28	Non-return valve
10	Heat exchanger	29	Ground charging connection
11	Water extractor	30	Control valve
12	Shut-off valve	31	Univalve
13	Water extractor	32	Pressure controller
14	Non-return valve	33	Combined valve unit
15	Valve unit	34	Pressure control valve
16	Changeover valve	35	Relief valve
17	Non-return valve	36	Ground pressure connection
18	Heat control valve	37	Non-return valve
19	Filter restrictor	38	C. A. U. relief valve

para. 17) to the common delivery duct and so to the cabin.

6. A relief valve, with outlet to the secondary cooler outlet duct, is incorporated in the system, to prevent build-up of pressure in the cold air unit. The cabin heat control switch can be operated to give any desired temperature, it should be held to the HOT or COLD position, until the required temperature is obtained, and then returned to OFF. The temperature is registered on the cabin heat control indicator on the instrument panel.

#### Air coolers

7. The primary and secondary air coolers are installed in the starboard and port mainplanes respectively, between the fuselage and rib 1. 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.

#### Constant flow valve

8. The constant flow valve is used to regulate the supply of air to the cabin so that the mass flow remains sensibly constant despite variations of pressure at the source of supply; for full information refer to A. P. 4340, Vol. 1, Sect. 6, Chap. 2

#### Water extractor

9. In the air conditioning system the water extractor is installed downstream of the cold air unit. Charge air enters the water extractor from the cold air unit and is diffused over the coalescer, moisture coalesces in the form of large droplets. The water droplets are carried with the charge air to the collector, and, as the air passes over the surface of the collector tubes, are deposited on the tubes and run down the tube support casing. A series of holes in the support cas-

ing allows the water to pass into a sump, to be drained away through a drain and restrictor, full description is given in A. P. 4340, Vol. 1, Sect. 9, Chap. 2.

#### Duct frost guard

10. The duct frost guard is installed in the aircraft downstream of the cold air unit and upstream of the water extractor. When the air enters the inlet of the guard below freezing point, frost will commence to form on the gauze coalescer. This tends to restrict the passage of the air through the coalescer and a back pressure gradually builds up at the turbine outlet. The build-up results in a reduction in the pressure across the turbine sufficient to raise the temperature of the delivered air above freezing point. The formation of frost therefore creates a balanced condition whereby the restriction which it causes results in limiting the extent of the deposit. (A. P. 4340, Vol. 1, Sect. 13, Chap. 8).

#### Double mixing valve

11. The mixing valve is installed in the leading edge of the port inner wing. There are two carbon slide valves each with an inlet port, and both discharging through separate outlets. The valves are operated simultaneously, and are so arranged that when one slide is open the other is fully closed, both valves being half-way open at the mid position of the unit. Hot air is led to one inlet port and cold air to the other consequently the position of the valve will determine whether the air leaving the outlet is cold, hot, or at a temperature between these two extremes. The valve is operated by an electrical actuator controlled by the cabin heat switch mounted on the starboard instrument panel. The valve setting is indicated to the pilot by a Desynn transmitter which registers on the cabin heat indicator.

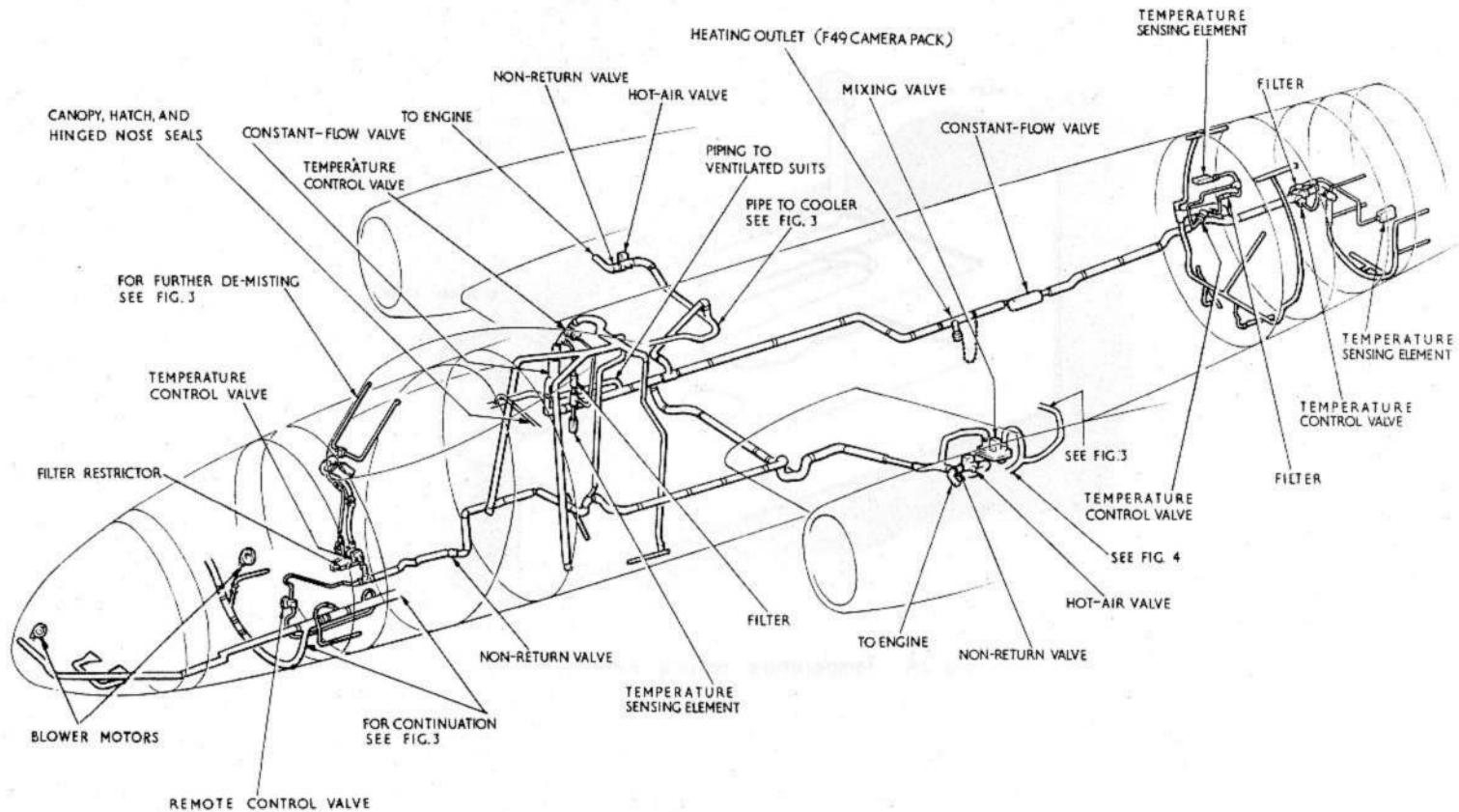


Fig.2. De-misting and camera heating

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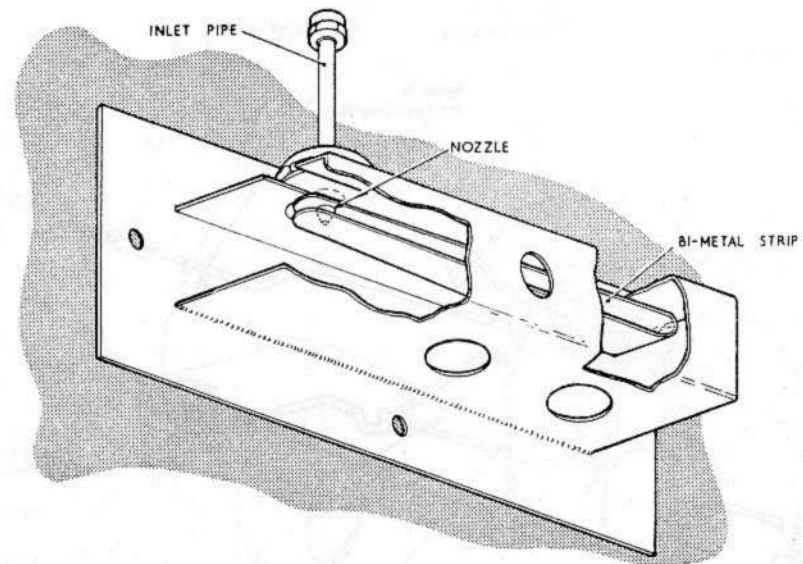


Fig 2A Temperature sensing element

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## Note...

- (1) No air will be supplied to the cabin unless the gate-valve switches are set to ON.
- (2) Should a fault arise in the supply from an engine, or should an engine fail, or be shut off, the gate-valve switch of that engine should be set to OFF.

Camera heating and de-misting (fig. 2)

12. Hot air, taken from the common transverse duct, is passed through lagged pipes and constant flow valves to each camera bay. The air is impelled through perforated spray pipes arranged around the compartment.

Temperature control

13. Separate piping incorporating a heat control valve, a filter restrictor and a temperature sensing element (fig. 2A) is connected from the respective hot air supply pipe to each camera bay. During normal operation the heat control valve is held open by a spring, allowing hot air to pass through it to the diffuser in the camera bay. A small amount of hot air is bled from the supply pipe 'upstream' of the heat control valve, and is taken via the filter restrictor to the sensing element where it escapes through a nozzle. A U-shaped bi-metal strip is attached at one end to the base of the nozzle so that its other end overlaps, but does not touch, the nozzle aperture. When the temperature in the bay reaches  $23^{\circ}\text{C} \pm 2^{\circ}$  the bi-metal strip will have deflected sufficiently shut off the escaping air. This creates a back pressure in the line to the heat control valve chamber sufficient to overcome the spring and close the valve. When the temperature in the bay falls again the bi-metal strip uncovers the nozzle to relieve the back pressure and allow the heat control valve to open and restore the supply of hot air. ▶

Windscreen de-misting

14. Hot air for windscreen de-misting is ducted from the common delivery pipe from the engine compressors, by a pipe passing along to the port side of the cabin, through a non-return valve and on to a tee-piece between frames 4 and 5. The supply pipe goes up to the windscreen, terminating in two spray pipes which are inside the windscreen interspace (fig. 2). A temperature control unit (para. 13) is connected to the supply pipe immediately above the tee-piece. From the tee-piece the supply goes to the cabin pressure pipe at frame 4, passing through a manually-operated control valve mounted on the port side of frame 3. By opening this valve, the navigator allows additional hot air to be ducted from the de-misting piping to his diffusers, and so obtains extra heat as required.

Cabin pressure and heating system

15. The common delivery duct running along the port side (fig. 3) terminates in a perforated spray pipe across the nose camera window; at frame C, a pipe is ducted off to supply two diffusers at the navigator's feet. At the hinged-nosebreak, a special valve housing is fitted to each pipe end and attached to support brackets; when the nose is closed, they mate and are sealed with a rubber sealing ring.
16. Between frames 7 and 8, a pipe is ducted off the supply line and goes to a spray pipe branching round the pilot's seat position (fig. 3) passing through a manually-operated valve, which enables the pilot to control the supply of hot air to this spray pipe. At frame 6 another pipe is ducted off, and goes to a changeover valve mounted on the starboard canopy coaming member (before this point is reached, a supply is diverted to a diffuser at the pilot's feet). From the changeover valve, the supply goes to two louvres, one on the port

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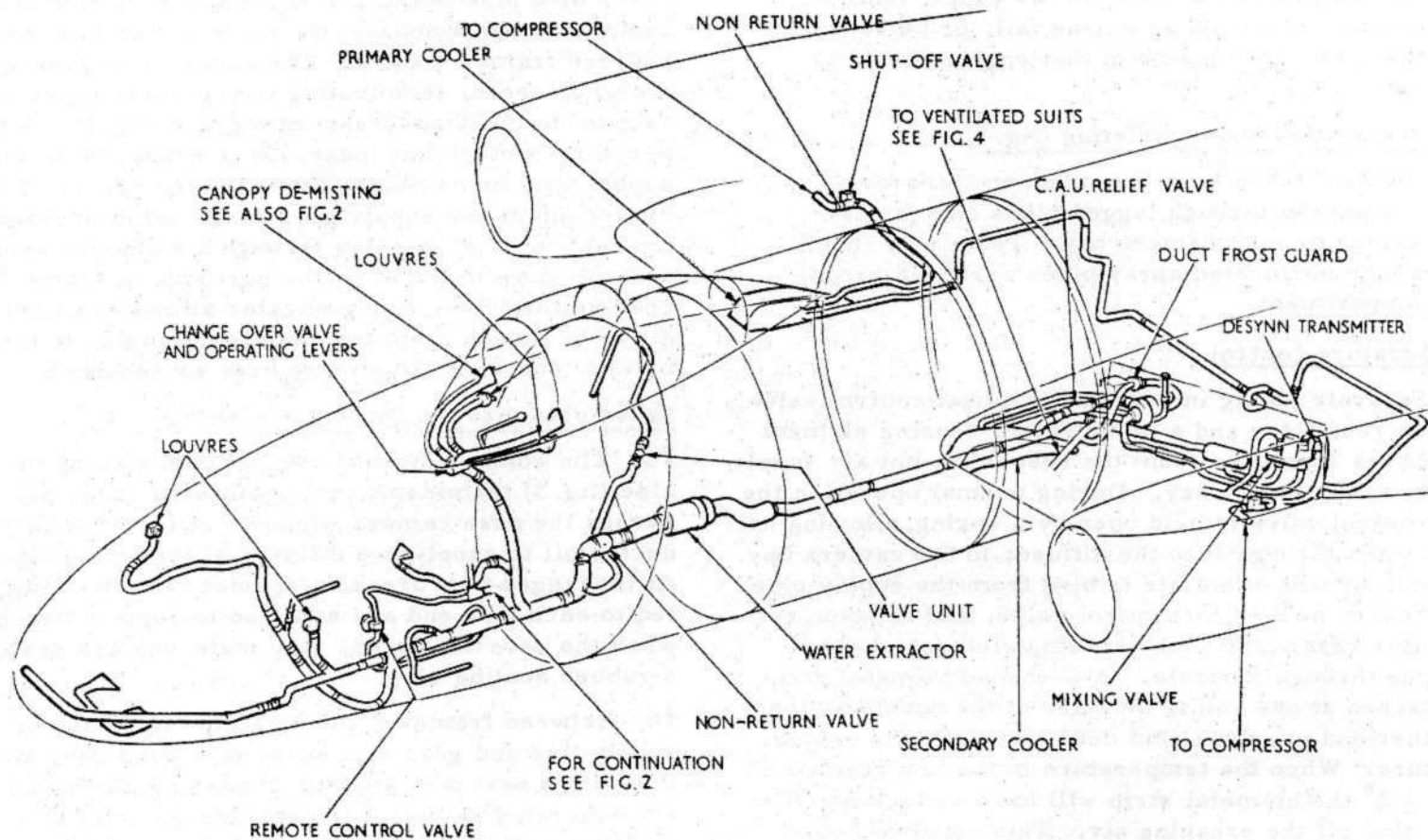


Fig. 3 CABIN PRESSURE AND HEATING SYSTEM

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and one on the starboard side of the canopy. Two further pipes are connected to the changeover valve and branch round the canopy to two diffusers positioned beside the louvres. The pilot can operate a lever which controls a simple piston arrangement inside the valve, and so diverts the air from his louvres to the diffusers to de-mist the canopy.

#### Ventilated suits system

17. In the port inner wing, a pipe is ducted off the primary air cooler supply and goes to a heat exchanger (for a general description, refer to A. P. 4340, Vol. 1, Sect. 2, Chap. 1). At this point, some air from the cold-air unit to the cabin pressure system is forced into the heat exchanger by means of a restrictor, (fig. 4); this further cools the supply. From the heat exchanger, the supply goes through a water extractor in the inner wing compartment, across the fuselage and through a non-return valve on the starboard side.

18. Between frames 13 and 14 a pipe is ducted off which goes to a ground charging connection on the starboard fuselage side; this enables air to be supplied to the suits when the aircraft is stationary. At this point a pipe is ducted off the camera heating pipe for the hot air supply, and just aft of frame 11, the hot and cold supply pipes are each connected to a pressure control valve. A small-diameter pipe is connected to the valve on the hot air and one to the valve on the cold-air supply; both these pipes go to a common tee-piece and from there a bleed pipe goes forward to a drain outlet on the starboard side of the pressure bulkhead.

19. From the main outlet on the pressure control valves, the hot and cold supply pipes continue along the starboard side of the fuselage each supply pass-

ing through a non-return valve. At frame 10, each supply pipe is forked, so that a supply of cold and hot air is taken to the pilot's suit, and the same to the navigator's .

20. The supply pipes to the pilot's suit go across the pressure bulkhead to a manually operated control valve, mounted on the structure at the starboard side of the pilot's seat. This valve, which enables the pilot to mix hot and cold air by means of a temperature control handwheel, is also fitted with a bleed pipe which discharges in a drain outlet at the rear of the pressure bulkhead. A full description is given in A. P. 4340, Vol. 1, Sect. 5, Chap. 15. From the valve, the temperature-controlled air is taken to a personal services connection, mounted on the starboard side of the pilot's seat, to which the ventilated suit is connected.

21. The supply for the navigator's suit goes along the starboard side of the aircraft to a manually-operated control valve (similar to the pilot's) which is mounted on the starboard side of the navigator's compartment; from the valve the supply is taken to a personal services connector on the navigator's seat, to which the suit is connected.

22. Full instructions for servicing and testing ventilated suits is given in A. P. 1182E.

#### Ground cooling

23. In both the port and starboard inner wing a pipe is ducted off the fuel heater system and, passing through a shut-off valve, terminates in an induction pipe in the primary and secondary coolers. By means of this arrangement, air can be drawn into the coolers when the aircraft is grounded, and so induces ground cooling.

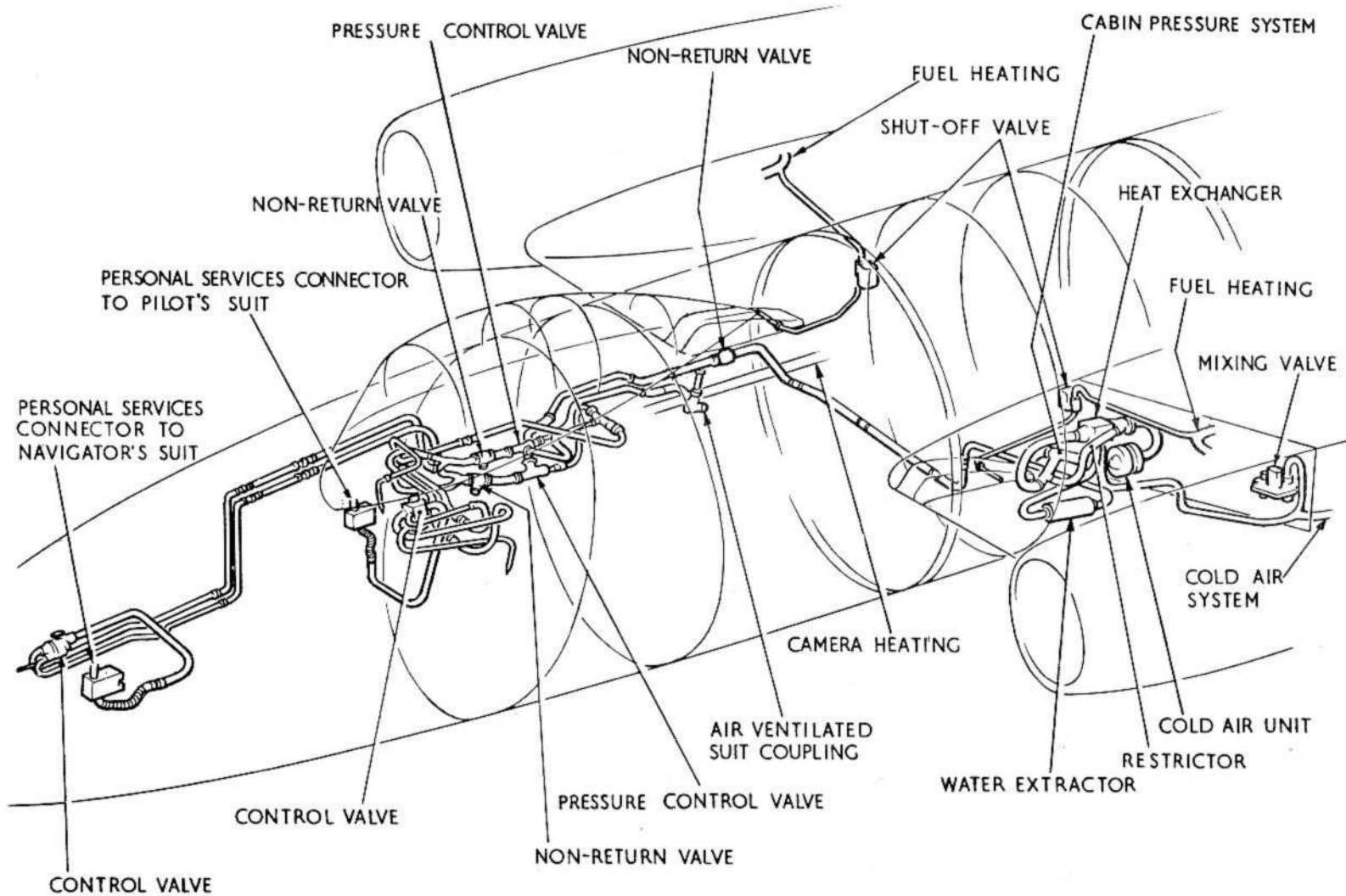


Fig. 4 VENTILATED SUIT SYSTEM

### Canopy hatch and hinged nose seals

24. The supply for the canopy hatch and hinged nose seals is taken from the ventilated suits system (see fig. 5). At frame 12 the pipe goes across the fuselage towards the port side and continues forward to the pressure bulkhead. At this point, the supply goes up through the equipment bay floor, up the aft side of the pressure bulkhead, passing through a non-return valve and on to a filter; before this point is reached, a pipe is taken, by means of a tee-piece, via a non-return valve to an external connection in the nose wheel bay, which is used for ground inflation.

25. Passing through the filter, the supply goes to a pressure reducing valve mounted on the aft side of the pressure bulkhead. Convenient to this, but on the forward side of the bulkhead, a breather is fitted, and connected to the reducing valve by a pipe, which means that the pressure to the valve is taken from the cabin. From the valve, the supply goes to a tee-piece, and branches across to a univalve which is positioned about the centre line of the pressure bulkhead near the top. The univalve, which is operated by the canopy release mechanism to deflate or inflate the canopy seal (Sect. 3, Chap. 1) combines an inlet and exhaust valve. The exhaust plunger is open at

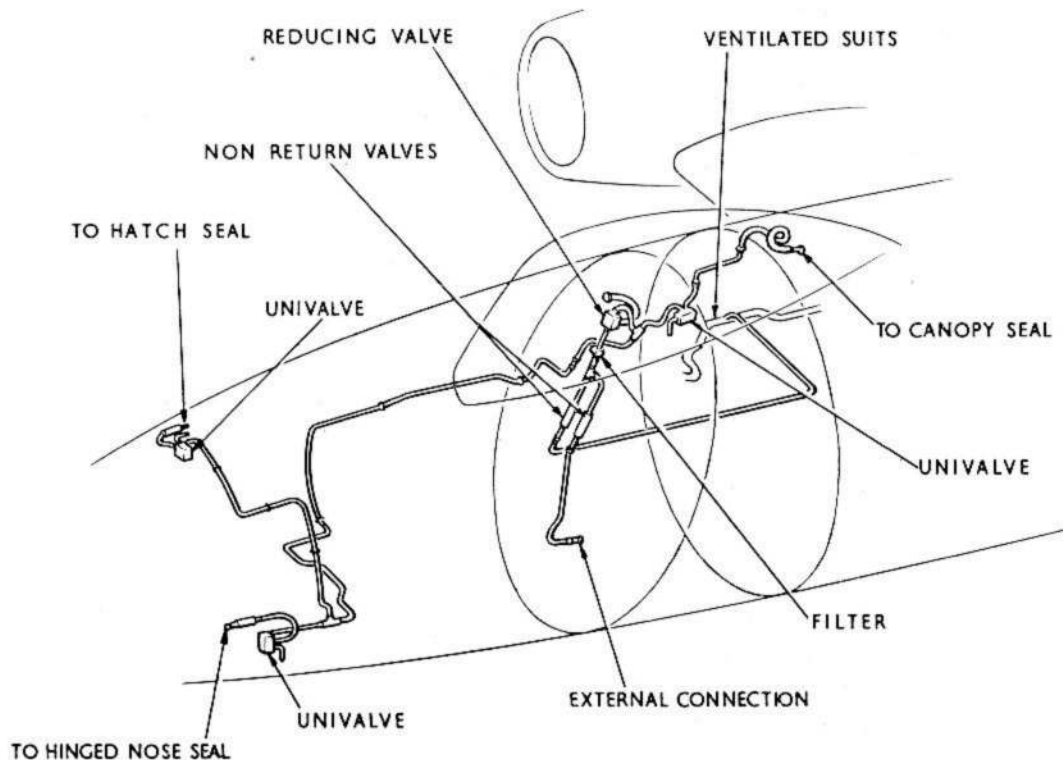


Fig. 5 CANOPY, HATCH AND HINGED NOSE SEALS

the lower end to provide passage for exhaust air. The opposite end engages a shaft, which is operated by a lever on the release mechanism. By rotation of the shaft the exhaust plunger is depressed to seal the exhaust valve and air passes through to the delivery. Movement in the opposite direction reverses the operation. Exhaust air is passed through the exhaust plunger to the exhaust connection. The delivery goes direct to the canopy seal from the univalve.

26. From the tee-piece, the supply pipe goes down and across the bulkhead to the starboard side, and just above the equipment bay floor, is taken through the bulkhead, continuing along the starboard side to a tee-piece at frame 2. From this point, one pipe is taken to the navigator's hatch seal (Sect. 3, Chap. 1) via a univalve, the other supply goes to the hinged nose seal (Sect. 3, Chap. 1) via a univalve; both these valves are identical with the one used on the canopy seal (para. 25).

#### Cabin pressure control system

27. Coming from the static vents (Sect. 5, Chap. 2) the cabin pressure control piping passes along the starboard side to the pressure bulkhead (fig. 6). Between frames 7 and 8 a tee-piece is fitted, from which a pipe is taken to an altitude switch on the port side near frame 12. Two drain outlets are incorporated, one at frame 4A and one on the sloping bulkhead. Before coming to the master controller, a tee-piece is fitted, which leads to a secondary feel simulator (Sect. 3, Chap. 4). The master controller, which is mounted on the face of the pressure bulkhead, in conjunction with the combined valve unit maintains a differential pressure in the cabin. 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.

Warning light contacts are incorporated and are to be set to close when the cabin differential pressure falls below  $2.65 \pm 0.1$  p. s. i. The warning light is positioned on the coaming in front of the pilot.

28. The combined valve unit, mounted on the rear of the pressure bulkhead, regulates the cabin pressure by controlling the rate at which the air is allowed to escape from the cabin. Two safety valves are incorporated in the combined valve unit, and should the cabin pressure rise above the required level, both will open and allow excess pressure to leak to atmosphere. An inward valve fitted in the combined valve unit will open in the event of a negative differential pressure developing, and allow air to enter the cabin from atmosphere. A ground pressurising connection and pressure gauging connection are also fitted on the bulkhead convenient to the combined valve unit and accessible from the nose wheel bay.

#### Note...

When Mod. 3100 is incorporated, an excessive drop in cabin pressure causes a pair of electrical contacts, in an altitude switch, to close and light a warning lamp mounted on the pilot's coaming panel; the lamp has a 'press-to-test' facility. The altitude switch, which is set to operate at 34 000 ft. is mounted below the pilot's floor. When Mod. 3720 is embodied, an electrically controlled dump valve is mounted on the aft face of the pressure bulkhead to improve the navigator's escape facility. Duplicated control switches and an amber 'Dump valve open' indicator lamp are installed at each crew station. A cabin pressure gauge and red 'Abandon A/C' warning light are also installed at the navigator's station. Test facility is provided for indicator and warning lamps.

## SERVICING

Preparation for ground servicing

29. The aircraft should be prepared for ground testing in the following manner:-

- (1) Check the operation of the warning light, which is fitted with a 'press-to-test' switch.
- (2) Check that the canopy and all the window air driers are fitted and vent blanks removed.

Ground testing

30. For the regulations and precautions applicable to pressurization tests in general, reference must be made to A.P. 3158, Vol. 2, Leaflet H and all officers and NCOs responsible for such tests must ensure compliance with these instructions together with any special orders for this particular aircraft type. ▶

With test rig

Note...

Whenever a joint in the cabin heating system has to be remade for any reason, the following assembly procedure must be used:-

- (a) Renew the Silastic hose.
- (b) Ensure that the gap between the ends of the pipes to be connected is 0.50 in. max., 0.10 in. max.
- (c) Fit the hose clips using clamping rings, Part No. EEAS66/14 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 0.07 in. max., 0.05 in. min.

31. The cabin pressure should be tested in the following manner:-

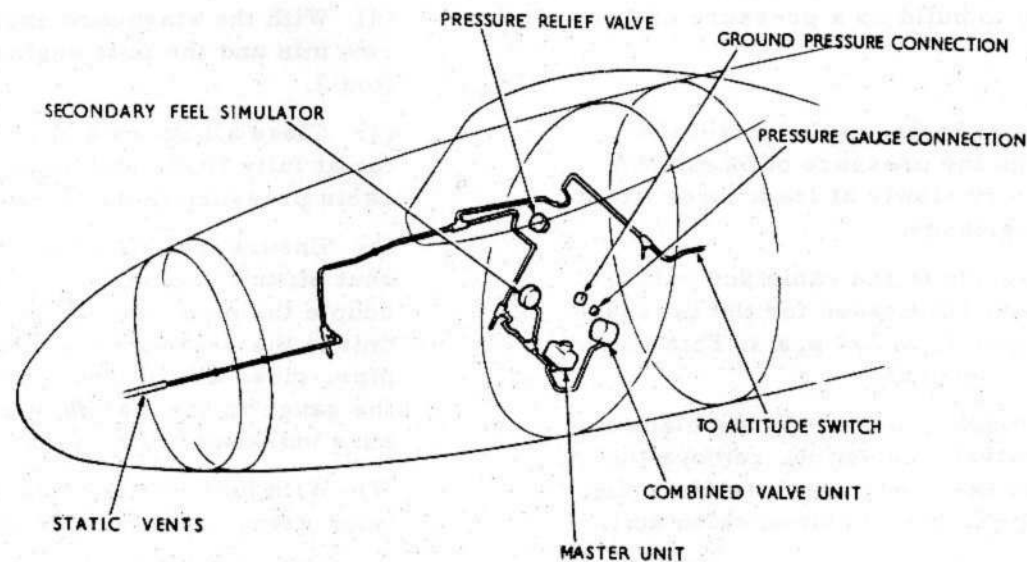


Fig. 6 CABIN PRESSURE CONTROL

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Using a Mk. 1C pressure cabin testing trolley (Ref. No. 4F/1714) instructions for the operation of which will be found in A.P. 2306G, Vol. 1.

- (1) Check that the operations laid down in para. 29 have been carried out.
- (2) Uncouple the pipe which connects the pressure controller and the combined valve unit, and blank off the pressure controller.
- (3) Connect the source of the air supply to the cabin ground testing connection and couple the gauge to the 1/8 in. B. S. P. test point at the rear of the pressure bulkhead in the nose wheel bay.
- (4) Inflate the hood seal until a pressure of 50 p. s. i. is obtained; it is important that the pressure is over 10 p. s. i.
- (5) Close the cabin doors and hatches, etc. run the testing trolley to build up a pressure of 4.0 p. s. i.

Note...

During pressure tests, each control that passes through the pressure bulkhead must be operated very slowly at least three times over its entire range.

- (6) Shut off the supply to the cabin and with a stop watch, note the time taken for the pressure to drop from 4.0 p. s. i. to 2.0 p. s. i. This should not be less than 75 seconds.
- (7) Remove the supply pipe, re-fit the blanking plug to the ground test connection, remove the blanking plug from the pressure controller, and re-connect the pipe to the combined valve unit.
- (8) Remove the pressure gauge and replace the

blanking plug.

With engines

32. The test procedure is as follows:-

Note...

With the temperature selected to fully COLD, the engines must not be ground run any longer than five minutes.

- (1) Check that the operations laid down in para. 29 have been completed.
- (2) In the cold-air unit, top up the oil level (OX-38) to the full mark on the dip-stick.
- (3) With the port engine running at 5 500 rev/min. and the starboard engine idling, progressively operate the cabin heat control switch and check that air enters the cabin when the pointer on the indicator registers on the dial of the instruments.
- (4) With the starboard engine running at 5 500 rev/min and the port engine idling, repeat operation 3.
- (5) Close all doors and hatches; with the selector at fully HOT, and both engines running, the cabin pressure is not to exceed 1.0 p. s. i.
- (6) Ensure that all pressure has been released, shut off the engines, open the canopy and uncouple the pipe connecting the combined valve unit to the pressure controller, blank off the pipe, close all the doors and hatches, and couple the gauge to the test point at the rear of the pressure bulkhead in the nose wheel bay.
- (7) With both engines running at 5 500/6 000 rev/min, carry out the following test:-
- (8) With the temperature at the fully HOT setting, check the time of the pressure rise to

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4.0 p. s. i. This is to be within 15 seconds.

(9) With the temperature set at fully COLD, check the time of the pressure rise to 4.0 p. s. i. This should be within 30 seconds.

(10) With the port engine idling and the starboard engine running at 5 500 rev/min check that the cabin pressure can be maintained for three minutes; repeat this test with the starboard engine idling and the port engine at 5 500 rev/min.

(11) Switch off the engine valve, and with the engine idling, check the time for the pressure to drop from 4.0 p. s. i. to 2.0 p. s. i. This should not be less than 75 seconds.

(12) At the change of the selector from HOT to COLD, check that there is a change of air temperature entering the cabin. Check and see that the air is entering at the louvres and diffusers.

(13) Check that air ceases to enter the cabin when the engine valve is switched off.

(14) Remove the pressure gauge and re-fit the blanking plug.

(15) Remove the blanking plug from the combined valve unit and re-connect the pipe to the pressure controller.

33. The following tests must always be carried out when hatches, windows, etc., have been removed from an aircraft, when renewals of or repairs to components affecting the pressure sealing of the cabin have been carried out or as specified in the relevant servicing schedule. The Mk. 1C cabin testing trolley (Ref. No. 4F/1714) is required.

(1) Check that the operations in para. 29 have been carried out.

(2) Check that all canopy and window air driers are fitted and the blank plugs removed.

(3) Uncouple the pipe between the pressure controller and the combined valve unit, and blank off the pressure controller.

(4) Connect the air delivery pipe to the cabin pressure test connection on the rear face of the pressure bulkhead in the nose undercarriage bay.

(5) Close the cabin door and all apertures and start the trolley.

(6) Inflate the cabin and record the pressure at which the safety valve 'cracks' open. This pressure should be 4.5 p. s. i. with an air flow of 10 pounds per minute. The pressure at which the valve closes should not be less than 4.15 p. s. i.

(7) Check the cabin structure for any signs of distortion and note any air leaks.

(8) Turn off the air supply to the cabin and record the time of the pressure drop from 4.0 p. s. i. to 2.0 p. s. i. This should not be less than 75 seconds.

(9) With safety and relief valves blanked off inflate the cabin to 5.3 p. s. i. and hold for 60 seconds.

(10) Check the cabin structure for any permanent distortion and air leaks.

(11) Remove the air supply connections, and refit blanking plugs.

## Note...

The hot and cold pressurising are to be regarded as two independent systems; times and pressures are to be recorded under both headings.

Sealing

34. Two alternative types of sealing, Bostic and Peratol, are used to seal the pressure cabin during manufacture, but when being repaired, Bostic should be used on all aircraft including those originally sealed with Peratol. Full particulars of Bostic sealing compound for repairing damaged sealing are given in A.P. 1464B, Vol. 1, Part 2, Sect. 4, Chap. 7, and full details of the method of application are given in A.P. 101B-0409-6, Part 1, Chap. 2.

Constant flow valves

35. The constant flow valves are set by the manufacturers and the only servicing which is permitted is the removal of the filter for cleaning. The filter is accessible when the knurled end-cap has been unscrewed and the end plate, together with its asbestos washer removed. For a general description refer to A.P. 4340, Chap. 2.

Master unit and combined valve unit

36. Servicing instructions for the master unit and combined valve unit are given in A.P. 1275A, Vol. 1 Sect. 20.

## Note...

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

37. Servicing instructions for the cold air unit will be found in A.P. 4340, Vol. 1.

Mixing valve

38. Servicing instructions for the two-way mixing valve are given in A.P. 4303E, Vol. 1.

Heat exchanger

39. The servicing instructions for the heat exchanger are given in A.P. 4340.

Water extractor

40. Full servicing instructions for the water extractor are given in A.P. 4340.

Temperature sensing element

41. No provision is made for adjusting the temperature setting of the sensing elements. Their operation may be checked in situ by using a remote reading thermometer the transmitting bulb of which is attached to the structure adjacent to the sensing element. When the camera bay doors are closed and an engine is run it should be noted that the temperature rises to  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and is maintained at approximately that figure. If the temperature fails to stabilise at this figure the sensing element must be replaced by a new or serviceable one. ▶

Ventilated suits system

42. The A.V.S. system is simple and trouble free and the use of a test set is rarely necessary. In the event of tests being required there is no difficulty in disconnecting one of the pipes in the port inner wing and attaching the test set Ref. No. 26FZ/95619 at this point.

F. S. /10

## REMOVAL AND ASSEMBLY

General

43. The following paragraphs give the recommended method of removing certain components in the system. Generally the assembly is the reverse of the removal, but where there are special assembly features, these are mentioned.

Constant flow valve

44. To remove the constant flow valve from the main plane.

- (1) Remove the access panels from the upper surface of the port main plane leading edge (Sect. 2, Chap. 4, fig. 3).
- (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 Jubilee Clips securing the valve to the mounting bracket and remove the valve.

45. To remove the constant flow valve from the flare bay.

- (1) Unscrew the inlet pipe adapter and disconnect the inlet pipe from the valve.

- (2) Remove the two half clamps at the outlet end of the valve.

- (3) Release the clips attaching the valve to the mounting bracket and remove the valve.

46. To remove the constant flow valve on frame 13.

- (1) Disconnect the pipe to the valve inlet.
- (2) Remove the two half clamps at the outlet end of the valve.
- (3) Release the clips attaching the valve to the mounting bracket and remove the valve.

Mixing valve actuator

47. To remove the mixing valve actuator.

- (1) Disconnect the aircraft electrical supply.
- (2) Remove the appropriate upper and lower access panels from the port main plane leading edge (Sect. 2, Chap. 4, fig. 2 and 3).
- (3) Remove the Plessey plug from the actuator socket.

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(4) Remove the nuts, plain and spring washers from the studs on the actuator and remove the actuator.

48. To assemble the actuator to the mixing valve.

(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 on the actuator drive.

(3) Offer up the actuator to the mixing valve ensuring that the master spline on the mixing valve drive shaft 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 nuts, plain and spring washers securing the actuator to the mixing valve.

(5) Test the operation of the assembly.

Mixing valve

49. To remove the mixing valve:-

(1) Remove the appropriate upper and lower access panels from the port main plane leading edge (Sect. 2, Chap. 4, fig. 2 and 3).

(2) Remove the actuator as instructed in para. 45.

(3) Remove the split pins, washers, and steel pins connecting the adjustable tie-rod to the follower lever and the Desynn transmitter operating lever, and remove the tie-rod.

(4) Remove the clamping rings at each of the following ports:-

- (a) Valve to primary cooler.
- (b) Valve to engine compressor
- (c) Valve to cold air unit
- (d) Valve to constant flow valve

(5) Remove the nuts and plain and spring washers attaching the valve to the mounting bracket, and remove the valve.

50. To assemble the mixing valve, proceed as follows:-

(1) Fit the valve to the mounting bracket, and fit and tighten the nuts, bolts, spring and plain washers.

(2) Fit the clamping rings connecting the pipes to the valve at the following ports:-

- (a) Valve to primary cooler
- (b) Valve to engine compressor
- (c) Valve to cold air unit
- (d) Valve to constant flow valve.

(3) Fit the actuator as instructed in para. 46.

(4) Position the mixing valve follower lever at its mid-position of travel.

(5) Position the adjustable Desynn transmitter lever in its mid-position of travel.

Note...

The lever should be initially set at 20 in. from the centre of the shaft to the connecting pin centre.

- (6) Connect the two levers, without disturbing the setting, by fitting the adjustable 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. each side of mid-position after adjustment has been made.
- (7) Fit the steel pins, washers, and split pins, and lock all adjustment points.
- (8) Test the operation of the assembly.

#### Primary air cooler

51. To remove the primary air cooler:-

- (1) Remove the access panel from the upper surface of the starboard main plane leading edge (Sect. 2, Chap. 4, fig. 3).
- (2) Disconnect the supply pipes at both the inlet and outlet ports of the cooler.
- (3) At the inlet and outlet ducts of the cooler, remove the four nuts, bolts and washers, securing the clamping bar to the joint straps and remove the clamping bar.
- (4) Remove the bolt which attaches the cooler to the top support bracket and remove the cooler by lifting it clear of the two bottom locating brackets.

#### Secondary air cooler

52. To remove the secondary air cooler:-

- (1) Remove the access panel from the upper surface of the port main plane leading edge (Sect. 2, Chap. 4, fig. 3).
- (2) Disconnect the relief valve pipe at the junc-

tion on the compressor to cooler pipe.

- (3) Disconnect the relief valve to outlet duct clamp.
- (4) Disconnect the supply pipes at the inlet and outlet ports of the cooler.
- (5) At the inlet and outlet ducts of the cooler remove the four nuts, bolts and washers securing the clamping bar to the joint straps and remove the clamping bar.
- (6) Remove the bolt attaching the cooler to the top support bracket, and remove the cooler by lifting clear of the bottom support brackets.

#### Cold air unit

53. To remove the cold air unit:-

- (1) Remove the access panel from the upper surface of the port main plane (Sect. 2, Chap. 4, fig. 3).
- (2) Remove the clamping rings at each of the following connections to the unit:-
  - (a) Unit to mixing valve
  - (b) Unit to duct frost guard
  - (c) Unit compressor to secondary cooler.
  - (d) Unit turbine to secondary cooler.
- (3) Disconnect the breather pipe from the unit.
- (4) Remove the bolts and washers securing the unit to the mounting brackets and remove the unit.

54. To install the cold air unit:-

- (1) Remove all blanking caps.
- (2) Position the unit in the aircraft and tighten the securing bolts and washers.

(3) Make the connections between the unit and the following ducts:-

- (a) Unit to mixing valve.
- (b) Unit to duct frost guard
- (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 on each side, between the halves of the clamp.

(5) Fit the breather pipe, and wire-lock the connection.

(6) After installation, remove the filler cap and fill the unit with oil, to the MAX. mark on the dipstick (use oil OX-38).

(7) Refit the filler cap.

Master unit

55. To remove the Master unit:-

- (1) Disconnect the electrical leads.
- (2) Disconnect the pipe to the combined valve unit at the base of the unit.

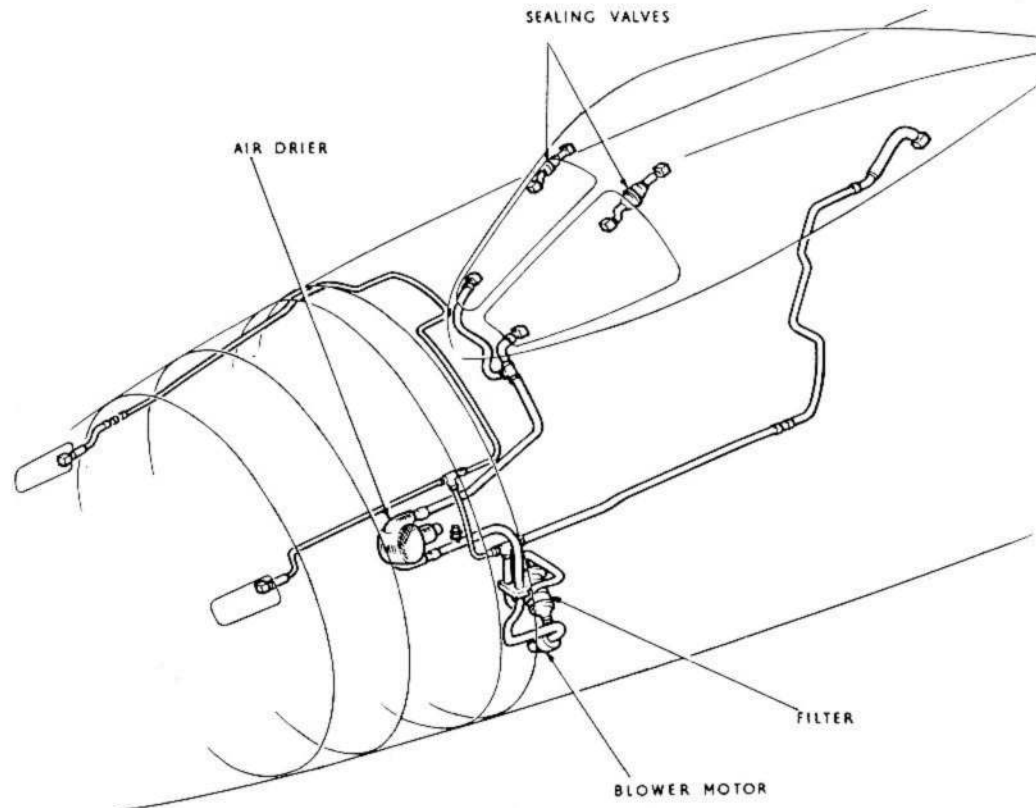


Fig. 7 DRY AIR DE-MISTING

(3) Disconnect the static pipe at the base of the unit.

(4) Remove the nuts, bolts and washers securing the unit to the mounting bracket, and remove the unit.

56. The installation of the Master unit is the reverse of the procedure for the removal given in para. 55. When the installation is complete, test the operation of the unit.

#### Combined valve unit

57. To remove the combined valve unit:-

(1) Remove the inlet grid of the unit by turning anti-clockwise and lifting clear of the three special bolts.

(2) Disconnect the pipe to the Master unit at the banjo union, and remove the banjo union by unscrewing the special bolt.

(3) Remove the three special bolts and eight bolts and washers securing the unit to the pressure bulkhead.

(4) Remove the unit from the rear face of the pressure bulkhead.

58. To install a combined valve unit:-

(1) Remove the inlet grid from the valve unit by rotating anti-clockwise and lifting it clear from the three special bolts.

(2) Remove the three special bolts, eight  $\frac{1}{4}$  in. B. S. F. bolts, and the special banjo bolt, noting their respective positions.

(3) Offer up the combined valve unit to the rear of the pressure bulkhead, ensuring that the

rubber sealing ring is fitted between the bulkhead and the valve unit.

(4) Secure the unit to the bulkhead by fitting the three special bolts, eight  $\frac{1}{4}$  in. B. S. F. bolts and the special banjo bolt, fitting both plain and spring washers as required. Ensure that the three special bolts, are in their correct positions, and that the washers are in their correct position on the special banjo bolt.

(5) Connect the pipe from the Master unit to the bano union and wire-lock the union. Check that all bolts are tight. Refit the inlet grid to the special bolts ensuring that the grid frame is rotated clockwise to the fullest extent of the keyhole slots.

(6) Test the Master unit as instructed in A. P. 1275A.

(7) Pressure test the cabin as instructed in para. 32 and 33.

#### Cold air unit relief valve

59. To remove the cold air unit relief valve:-

(1) Remove the access panel from the upper surface of the port main plane (Sect. 2, Chap. 4, fig. 3).

(2) Remove the half clamps at the inlet end of the valve.

(3) Remove the clamping ring and clip which secure the sleeve to the valve housing at the outlet end.

(4) Remove the jubilee clip securing the housing to the support bracket and remove the valve and the valve housing which are held together by a jubilee clip at the inlet end.

Heat exchanger

60. To remove the heat exchanger:-

- (1) Remove the access panel from the top surface of the port main plane (Sect. 2, Chap. 4, fig. 3).
- (2) At the base of the heat exchanger, disconnect the two pipes one of which comes from the primary cooler, and the other which goes to the water extractor.
- (3) Remove the jubilee clips at the inlet from the frost guard.
- (4) Remove the two clips at the outlet of the exchanger.
- (5) Unscrew the 4 bolts which secure the exchanger in position and remove the heat exchanger.

Duct frost guard

61. To remove the duct frost guard:-

- (1) Remove the access panel from the top surface of the port main plane (Sect. 2, Chap. 4, fig. 3).
- (2) Remove the half clamps at the inlet end of the guard.
- (3) Remove the half clamps at the outlet to the restrictor.
- (4) Unscrew the jubilee clips which secure the frost guard to the heat exchanger, and remove the frost guard.

Water extractor

62. To remove the water extractor:-

- (1) Remove the access panel from the upper surface of the port main plane (Sect. 2, Chap. 4, fig. 3).
- (2) Remove the half clamps at the inlet and outlet ports.
- (3) Unscrew the two jubilee clips which secure the extractor to the mounting bracket, and remove the water extractor.

Temperature control valves

63. To remove the temperature control valves in forward camera bay:-

- (1) Disconnect the inlet and outlet unions.
- (2) Disconnect the two unions on the piping to the sensing element.
- (3) Remove the four nuts, bolts and washers securing the valve to the mounting brackets, and remove the valve.

64. To remove the temperature control valve in the centre camera bay:-

- (1) Disconnect the unions at the outlet ends of the valve.
- (2) Disconnect the two unions on the piping to the sensing element.
- (3) Unscrew the four bolts attaching the valve to the mounting bracket and remove the valve.

65. To remove the temperature control valve in the aft camera bay:-

- (1) Disconnect the unions at the inlet and outlet ends of the valve.
- (2) Disconnect the two unions on the piping to the sensing element.

(3) Unscrew the bolts securing the valve to the mounting bracket, and remove the valve.

66. To remove the temperature control valve on the windscreen de-misting piping in pilot's cabin:-

(1) Disconnect the unions at the inlet and outlet ends of the valve.

(2) Disconnect the unions on the piping to the sensing element.

(3) Remove the attachment bolts and nuts securing the valve to the mounting bracket, and remove the valve.

### DRY AIR DE-MISTING

#### DESCRIPTION AND OPERATION

##### General

67. The pilot's canopy, quarter lights and the navigator's two windows are provided with dry air de-misting. A separate, self-contained air-drier circuit, incorporating an electrically driven blower motor, is used for this purpose. Fig. 7 illustrates the complete system.

##### Static air-drier

68. An air drier is installed in the aircraft between frames 3 and 4 on the port side. It is provided with an inlet and an outlet valve, and the drying medium is silica gel Spec. C. S. 2380.

##### Blower circuit

69. The interspaces of the pilot's canopy and quarter lights are provided with an air circulation and drier system operated by an electrical blower motor which is controlled by a switch on the control panel. A filter and air drier is also incorporated in the system, which forms a closed circuit. Air initially contained

in the canopy interspace is extracted, dried, and returned to the canopy.

70. A branch pipe is connected to the canopy system by means of a tee-piece at frame 4A. Going up frame 4 to another tee-piece, a supply of dry air is taken to the Navigator's port window. From the tee-piece, another pipe goes round frame 4A and along the starboard side to the Navigator's starboard window.

### SERVICING

#### Charging the air drier

Note...

Tell-tale crystals are supplied wrapped in polythene bags it is important that they are not left open to atmosphere. The crystals are blue in colour before moisture absorption.

71. The drier is fitted with a window through which the contents may be inspected, the contents should be changed when they assume a pink colour.

72. To re-charge the drier, unscrew and remove the four wing nuts and spring washers, remove the lid, take out the crystals, and replace with new ones.

#### Testing the air drier

73. The following equipment is required for testing the static air drier:-

(1) A test rig capable of applying an air pressure of 2 p. s. i. and a suction of 0.6 p. s. i.

(2) A 12 in. mercury U tube.

74. Before testing the air drier, it should be removed from the aircraft (para. 75) then proceed as follows:-

(1) Connect the air pressure pipe from the test rig to the canopy end of the drier with the mercury

tube interposed. Blank off the aperture at the other end of the drier.

(2) Apply a pressure of 2 p. s. i. and check that the complete assembly is airtight.

(3) Release the pressure and remove the blank from the end of the drier.

(4) Apply pressure and check that the outlet valve opens at 0.6 p. s. i. but that it is airtight below 0.3 p. s. i.

(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 p. s. i. and that it is airtight below 0.3 p. s. i.

(7) Disconnect the test rig and replace the drier in position in the aircraft.

#### REMOVAL AND ASSEMBLY

##### Air drier

75. To remove the air drier proceed as follows:-

(1) Remove the nose clips securing the two pipes to the air drier, and blank off the pipes.

(2) Unscrew the bolts attaching the air drier to the mounting platform, and remove the air drier.

##### Purolator filter

76. To remove the element from the filter, proceed as follows:-

(1) Disconnect the pipe at the top end of the filter by unscrewing the nipple, and blank off the pipe.

(2) Remove the hose clip attaching the filter to the blower motor.

(3) Remove the clips attaching the filter to the mounting bracket, and remove the filter.

(4) Release the base of the filter from the outlet case by slackening the wing nuts.

(5) Remove the filter element.

77. The assemble of the filter unit is the reverse of the procedure detailed in para. 76. Before assembly the ends of the filter should be light greased with lanolin.

##### Blower motor

78. To remove the blower motor, proceed as follows:-

(1) Disconnect the pipe coming from the air drier by releasing the two hose clips, and blank off the pipe.

(2) Disconnect the electrical cable at the suppressor.

(3) Disconnect the hose clip attaching the motor to the filter inlet.

(4) Remove the bolts attaching the blower motor to the mounting bracket, and remove the motor.

79. The assembly of the blower motor is the reverse of the procedure detailed in para. 78.

##### ◀ Camera heating piping (Post Mod 4838)

80. On aircraft embodying this modification the camera heating piping between frames 22 and 27A has been removed and the remaining pipes have been blanked off as shown in fig. 8.

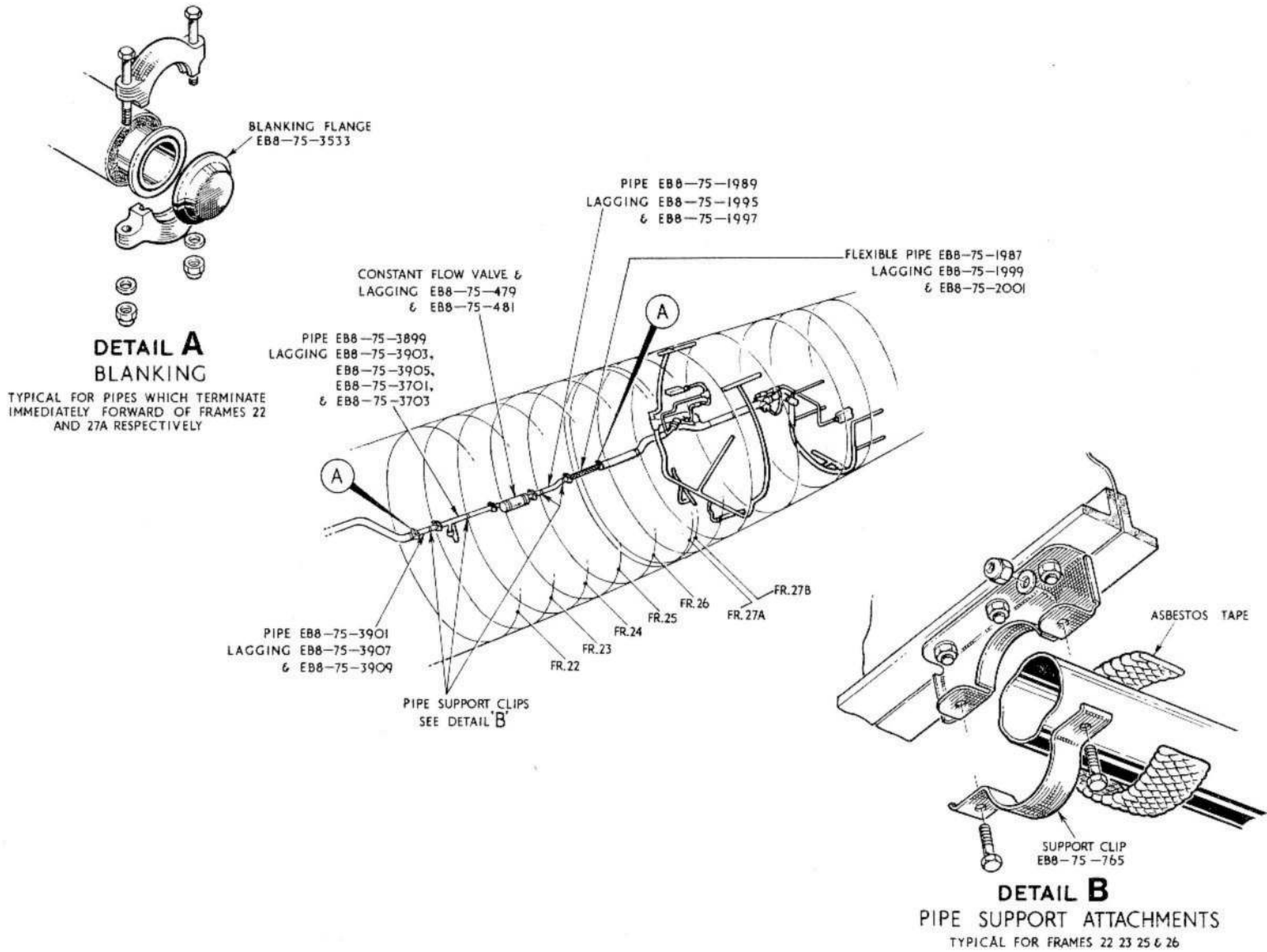


Fig. 8. Heating piping between frames 22 & 27A - removal/installation (Post mod. 4838)

◀ (NEW ILLUSTRATION) ▶

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Chapter 10 OXYGEN SYSTEM  
(completely revised)

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**WARNING...**

BEFORE ENTERING THE COCKPIT PERSONNEL SHOULD REFER TO THE LETHAL WARNING CARD AT THE BEGINNING OF THIS VOLUME AND ENSURE THAT ALL RELEVANT PRECAUTIONS HAVE BEEN TAKEN. RISK OF EXPLOSION, DUE TO ANY ASSOCIATION WITH OIL OR GREASE WITH OXYGEN AT PRESSURE, IS HIGH. REFER TO A.P. 1275G, VOL. 1

Introduction

1. The oxygen system is a pressure demand and inflation installation used in conjunction with a P. 2 mask, pressure jerkin and anti-G suit worn by each member of the crew. This chapter contains a description of the aircraft installation, the emergency sets, the servicing procedure and method of removal and installation of certain components. For a detailed description and the procedure for servicing the system components, refer to A.P. 1275A and G, Vol. 1.

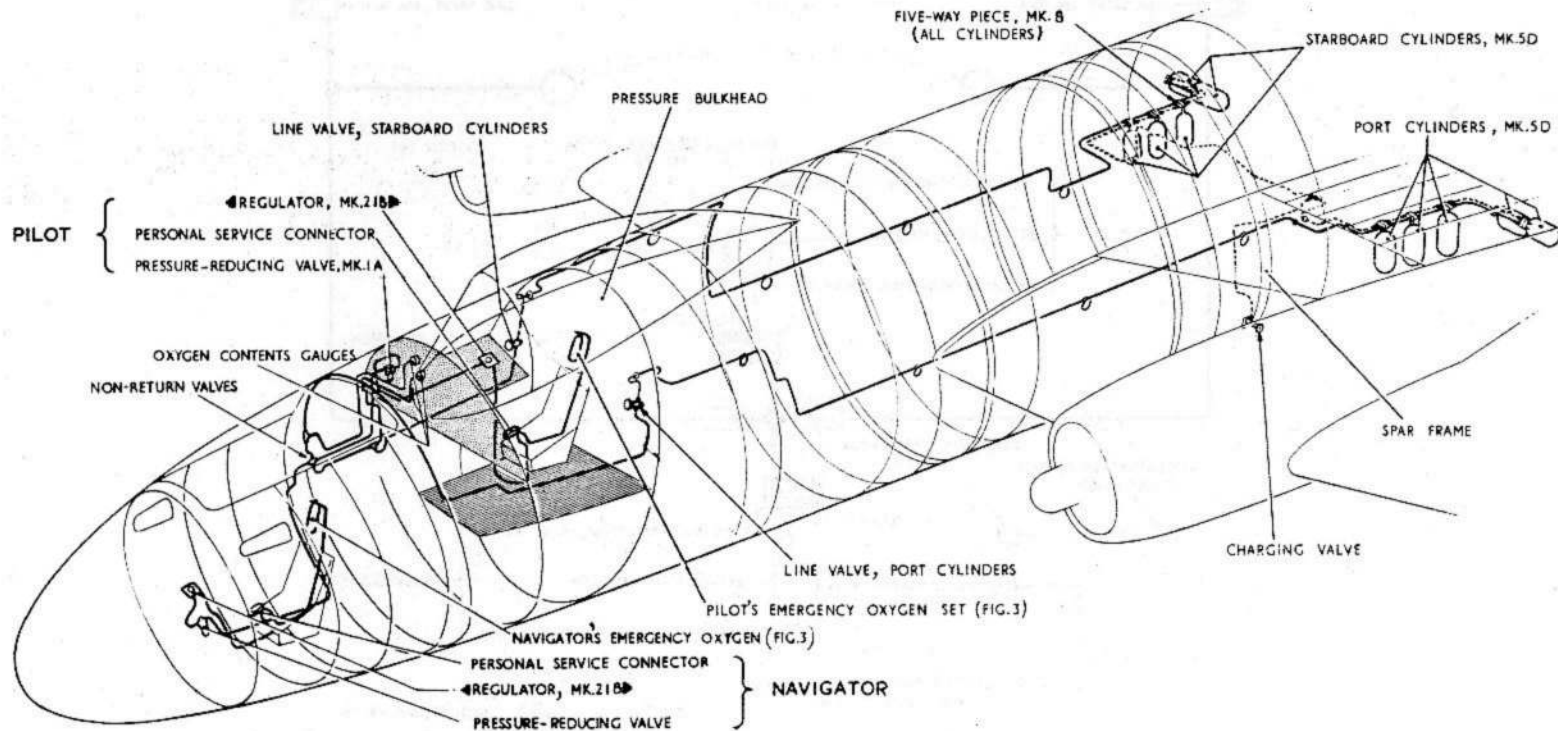


Fig.1. Oxygen system installation

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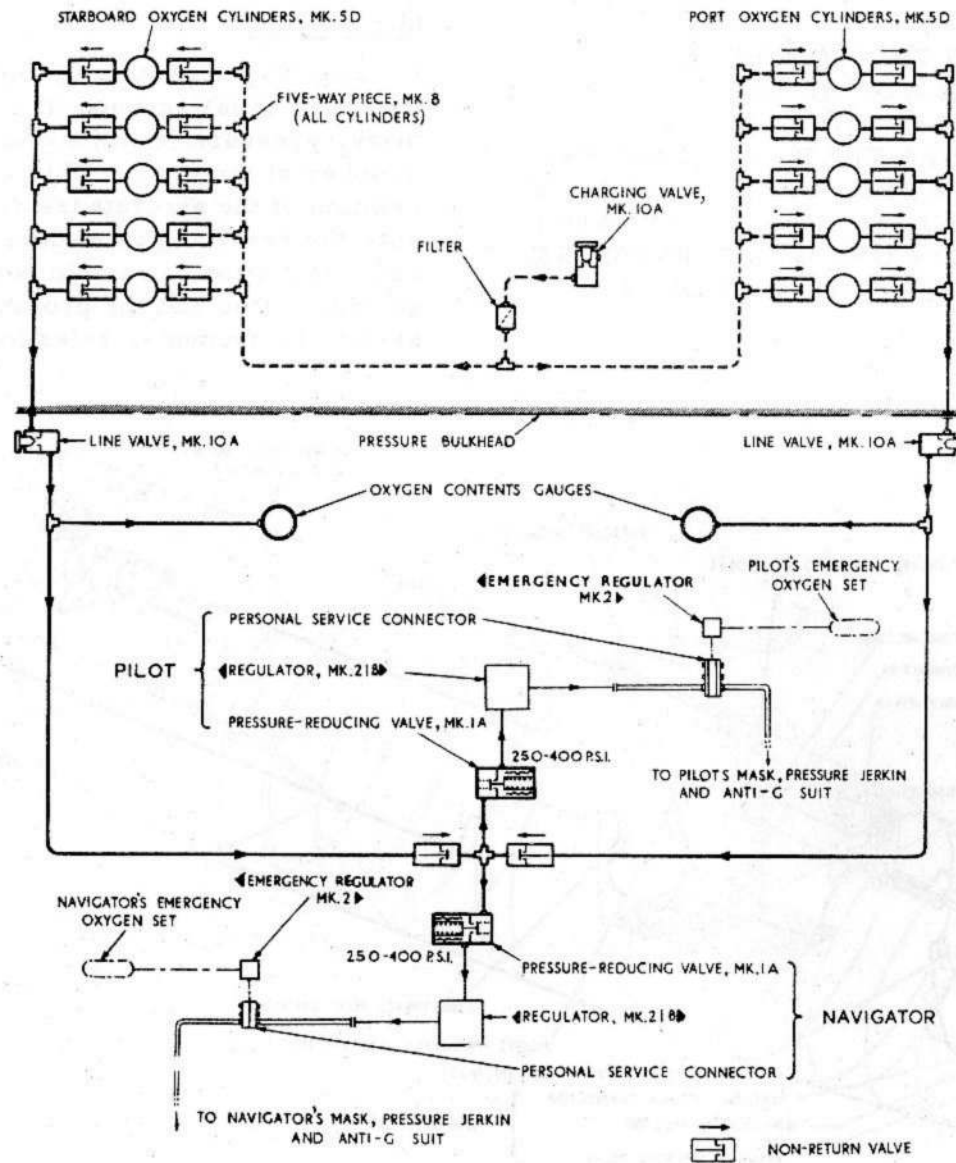


Fig. 2. Oxygen system diagram

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## DESCRIPTION

Oxygen cylinders (fig. 1 and 2)

2. Five 750-litre oxygen cylinders, Mk. 5D, are stowed in each inner wing aft of the main spar. Each cylinder is fitted with a Mk. 8 five-way piece incorporating inlet and outlet non-return valves. A charging valve, Mk. 10A, is connected through a common filter to the five-way piece on each cylinder, enabling them to be charged in situ. The valve is situated behind an access panel in the port side of the centre fuselage at the spar frame.

Supply (fig. 1 and 2)

3. The five cylinders in each group are connected by a single high-pressure line, incorporating a line valve, Mk. 10A, and oxygen contents gauge, and thence through a non-return valve to a common line connected to two pressure-reducing valves, Mk. 1A. The line valves, which are wire-locked in the open position, are mounted on the forward face of the pressure bulkhead, and the contents gauges are on the starboard instrument panel at the pilot's station.

4. Each pressure-reducing valve (reducing the pressure to between 250 and 400 p. s. i. ) is connected to one of two pressure demand and inflation regulators, Mk. 21B, one of which is mounted on the starboard console at the pilot's station, and the other on the starboard console in the navigator's station. From the regulators, which are wire-locked in the ON position, the oxygen is conducted by low-pressure rigid and flexible lines, through personal service connectors (para. 5), to the face masks, pressure jerk-in and anti-G suit. Remote electrical blinkers, operated by the regulators, are provided in addition to the blinkers on the regulators (Sect. 5, Chap. 2).

Personal service connectors

5. The personal service connectors form the junction between the crew member's service lines and the aircraft lines which supply oxygen, air ventilation for the suits and mic-tel.

6. The connectors are divided into three portions, aircraft, seat and man. The aircraft portion, which terminates the supply lines, is clamped to the seat portion, fitted to the starboard side of the ejection seat, and secured to the aircraft structure by a telescopic strut. When seated, the occupant removes the connector dust cover and clamps the main portion to the seat portion.

7. If the ejection seat is operated, the aircraft portion is retained in the aircraft by the telescopic tube, while the other portions are ejected with the seat. The emergency oxygen bottle supply (para. 8) is opened automatically as the seat leaves the aircraft and oxygen is fed through the seat portion of the connector to the mask and clothing.

Emergency oxygen installation (fig. 3)

8. An emergency oxygen system consisting of an emergency oxygen cylinder and release mechanism Mk. 3 and a demand emergency regulator Mk. 2 are fitted to the Martin-Baker ejection seats 3CS Mk. 2 and 4QS Mk. 2 (pilot's and navigator's stations respectively) to provide an emergency supply capable of meeting both pressure jerk-in inflation and breathing requirements of a user in the event of failure of the main supply (manual selection) or when abandoning the aircraft (automatic selection). Manual operation is achieved by pulling up on the operating knob which is located on the starboard front side of the seat pan, thus actuating the cable release mechanism to open the valve

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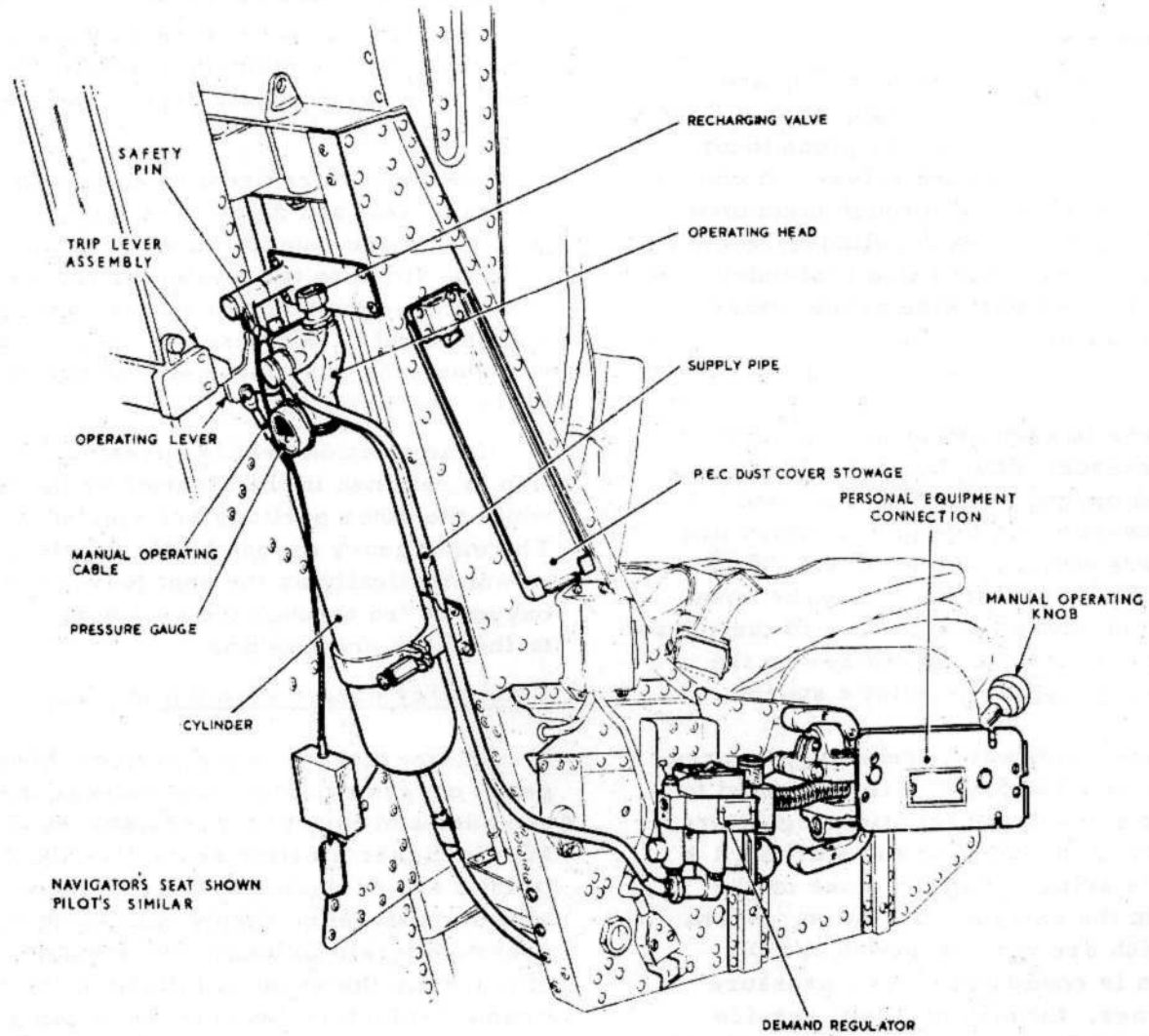


Fig. 3 Emergency oxygen installation - typical

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on the cylinder. An airframe-mounted trip lever provides for automatic operation by deflecting the bottle mounted operating lever to open on ejection. For details of the cylinder and release mechanism refer to A. P. 1275G, Vol. 1 (2nd edition), Part 2, Sect. 4, Chap. 11D and for details of demand emergency oxygen regulator refer to A. P. 1275G, Vol. 1 (2nd edition), Part 2, Sect. 1, Chap. 11.

## SERVICING

### General

9. To maintain the system in an efficient working condition, the installation must be kept free from oil, grease and moisture. With the cylinders fully charged, the system should be checked for leaks at all joints. It will be found that leakage 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.

### Charging the oxygen cylinders

10. Scrupulous cleanliness of all connections must be observed during charging operations. To charge the cylinders:-

- (1) Close the line valves on the pressure bulkhead.
- (2) Remove the blanking cap from the oxygen charging valve on the port side of the fuselage at spar frame 21.
- (3) Connect a high-pressure oxygen supply from an oxygen charging trolley, Mk. 2, and charge the cylinders to 1 800 p. s. i. in accordance with the instructions given in A. P. 2306U, Vol. 1 & 6, Sect. 5, Chap. 1.

- (4) When charging is completed, disconnect the charging trolley and replace the blanking cap on the charging valve. When the cylinders have cooled and the pressure has dropped to 1 800 p. s. i. open the line valves and wire-lock them in this position.

### Charging the emergency oxygen sets

11. The emergency oxygen sets cannot be removed from the aircraft without first removing the seat; the bottle, therefore, must be charged to 1 800 p. s. i. and mounted on the seat before installing the seat in the aircraft.

### Checking for leaks

12. When checking for leaks, ensure that a pressure of 1 700 to 1 800 p. s. i. is available in the cylinders. Apply a Teepol solution, as instructed in A. P. 1275G, Vol. 2, leaflet A4, to all joints and connections and open the line valves. After the check, all traces of the solution must be removed and the line valves wire-locked in the open position.

13. To check the non-return valves between the charging point and the bottles for leakage, connect the rig, illustrated in fig. 4, to the inlet side of the charging

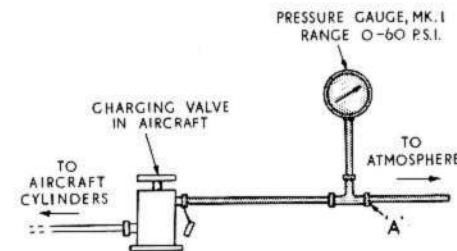


Fig. 4 Leakage test rig

valve, which should be in the closed position. At point A, fit a blanking union, Mk. 1 (Ref. No 6D/425) or Mk. 3 (Ref. No. 6D/1497) with the split pin removed and the blank nipple drilled with a 1/32 in dia. drill and opened out to 0.070 in. dia. with a No. 50 drill. Open the charging valve slowly. When it is fully open the pressure should not exceed 15 p. s. i. which indicates the maximum allowable leakage of 50 litres per minute.

14. To check the charging valve for leakage, close the valve, remove the non-return valve test rig and fit a length of rubber hose to the valve inlet. Check that no bubbles appear when the free end of the hose is immersed in water.

#### Low pressure test rig (fig. 5)

15. It is important that the pressure drop between the oxygen regulator and the jerkin tapping is not more than 1.8 in. water gauge when 120 N.T.P. litres

per minute are flowing through the system. Fig. 5 illustrates a low-pressure test rig suitable for connecting to the 7/8 in. dia. pipe immediately downstream from the oxygen regulator. A crew's portion of the P. S. C. Ref. No. 6D/2228 is required and must be connected to the seat during the test. The jerkin tapping Y-piece and the flexible hose to the mask must be removed.

#### Regulator flow tests

16. Connect a Normalair test rig T. E. 610 to the oxygen reducing outlet at each crew station and proceed as follows:-

- (1) Fit orifices bearing Ident No. 165L/M, 130 p. s. i. to both pilot's and navigator's test rigs.
- (2) Charge the cylinders to 5/8 full.
- (3) With an operator at each crew station, the valves must be opened simultaneously at a given

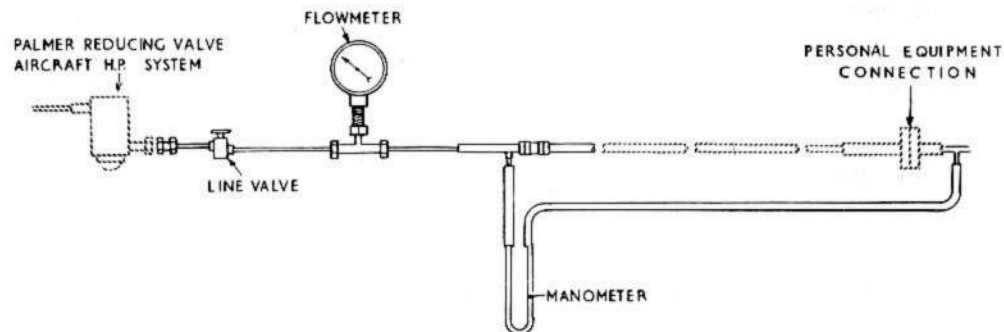


Fig. 5 Low pressure system test rig

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signal. Each operator must, by manipulation of the valve, maintain a pressure of 130 p. s. i. for a period of 5 min. 25 sec., and then the shut-off valves in both test rigs are to be closed. When the contents gauge has stabilized, check that the cylinder is not less than 3/8 full.

(4) The two valves must again be re-opened simultaneously and a line pressure of 130 p. s. i. maintained as long as possible. As the supply cylinder becomes discharged a point will be reached when the pressure must fall at one or other crew station; when this point is reached, both test rig shut-off valves must be closed. The cylinders should not be less than  $\frac{1}{4}$  full when Mk. 1 reducing valves are fitted or less than 3/16 full for Mk. 1A reducing valves.

(5) Fit orifices identified as 110 L/M, 130 p. s. i., to both pilot's and navigator's test rigs.

(6) Recharge the cylinders to 5/8 full.

(7) Both valves should again be opened simultaneously and a pressure of 130 p. s. i. maintained for 8 min. 5 sec., and the valves closed. The cylinders should register not less than 3/8 full.

(8) Repeat operation (4) and check that the oxygen cylinders are not less than 3/16 full (Mk. 1 reducing valves), or 5/32 full (Mk. 1A reducing valves).

#### Regulator check tests

17. The following test equipment is necessary:-

Suction tube	Ref. No. 6C/1015
Metering tube	Ref. No. 6C/1308
Flow tester Mk. 5A,	Ref. No. 6C/475

Note...

The partial pressure jerkin, headpiece and anti-G trousers must not be worn when carrying out the tests; mask only to be worn.

Proceed as follows:-

(1) With the line valves on the pressure bulkhead ON, the regulator valve ON, and the air inlet NORMAL, fit the suction tube to the socket on the outlet hose. With the mouthpiece open, apply suction to the regulator and simulate six breathing cycles.

(2) Move the air inlet control to 100% OXYGEN and repeat operation (1).

(3) Carry out checks in the sequence given in Table 1.

#### System flow tests

18. The free end of the metering tube must be kept clear of obstructions to allow an undisturbed discharge. The regulator gauge reading should not drop by more than 100 p. s. i. when applying tests.

(1) Connect the metering tube to the personal services connector adapter.

(2) Couple the rubber tube of the metering tube to the flow tester, Mk. 5A.

(3) Set the manual selector control of the regulator at EMERGENCY.

(4) Reading at flow tester must not be less than 2 litres/minute.

(5) Check that the magnetic indicators show white (indicating flow).

- (6) Set the manual selector control at JERKIN TEST.
- (7) Ensure that flow tester reading is not less than the calibrated value of the flow tester (calibrated at 1.1 in. W. G. pressure, as for Mk. 17 series regulators).
- (8) Check the magnetic flow indicators.
- (9) Return the selector control slowly to NORMAL. The BLACK portion of the indicator should then be exposed.

Note...

If the regulator continues to give a flow, move the selector to EMERGENCY and back to NORMAL several times. If the flow persists renew the regulator.

Emergency control check

19. Ensure that a load not exceeding 30 lb. is required to operate the emergency oxygen control knob.

REMOVAL AND INSTALLATION

Oxygen cylinders

20. To remove an oxygen cylinder:-
  - (1) Remove the large access panel in the under-surface of the inner wing trailing edge below the oxygen cylinders.
  - (2) Release the system pressure by gradually slackening the outlet union on the cylinder.
  - (3) When all the pressure is exhausted, disconnect all pipes at the cylinder five-way piece; blank off the pipe ends and cylinder connections.
  - (4) Release the tie-bolt at each retaining strap

and remove the cylinder.

21. The procedure for installation is, in general, a reversal of the removal operation.

Emergency oxygen sets

22. To remove an emergency oxygen set, the ejection seat must be removed from the aircraft (A. P. 109A-0001-5). Before fitting an emergency oxygen set ensure that it has been charged to 1800 p. s. i.

Lubrication

23. Refer to the WARNING preceding para. 1. The authorised lubricant for use on the screw threads of the oxygen equipment is graphited lubricating fluid, ZX-24. No other lubricant may be used. Instructions for lubrication will be found in A. P. 1275G, Vol. 1.

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TABLE 1  
Regulator check tests

Check	Regulator valve	Remarks
H. P. oxygen supply	OFF	System contents gauge reading FULL
Leak past regulator ON-OFF valve	OFF Suction tube (mouthpiece open) connected to adap- ter assembly	Set manual selector to EMERGENCY until regulator gauge reads zero. When selector is returned to NORMAL, gauge reading should remain at zero for 30 seconds.
Line reducing valve	ON	Gauge reading between 200 and 400 p. s. i.
Leakage past demand valve	OFF	Gauge reading must not drop more than 25 p. s. i. in one minute.
Manual selector	ON	Operate manual control to EMERGENCY MAST TEST and JERKIN TEST in turn. Flow from suction tube should be distinct in each case and magnetic indicators show WHITE. Return slowly to EMERGENCY and close mouthpiece of suction tube. Magnetic indicators should show BLACK. Open mouthpiece and return selector to NORMAL immedi- ately on completion of test.
Leak in supply hose and regulator back to demand valve.	ON Mouthpiece of suction tube closed	Set manual control at EMERGENCY, shut -off valve to OFF. Reading on regulator gauge must not fall to zero in less than 1 minute; should this happen, check the pipe- line between regulator and suction tube before rejecting regulator.
Air inlet shutter	OFF Inlet control setting: 100% OXYGEN	Apply suction to the suction tube and a distinct resistance should be felt; move the inlet control to NORMAL and resistance to suction should be negligible.
Regulator oxygen supply	ON Air inlet control: NORMAL	Using the suction tube, simulate two or three breathing cycles. The panel-mounted and remote magnetic indica- tors should operate in phase with the breathing. Remove suction tube.

Chapter 11 - EMERGENCY EQUIPMENT

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DESCRIPTION

Introduction

1. This chapter describes the emergency equipment in the aircraft and where necessary servicing details.

WARNING: BEFORE ENTERING THE PILOTS OR NAVIGATOR'S STATION, PERSONNEL MUST READ THE LETHAL WARNING MARKER CARD AT THE FRONT OF THIS VOLUME, AND ENSURE THAT ALL SAFETY PRECAUTIONS DETAILED THERE ARE STRICTLY OBSERVED.

Alighting gear emergency lowering control

2. The emergency control for lowering the alighting gear is a T-shaped, red-painted, handle mounted on the sloping panel at the forward end of the pilot's port console. The handle is connected by cable to a quadrant fitted at one end of a torque shaft mounted immediately below the alighting gear normal selector. A lever, fit-

ted to the other end of the torque shaft, is connected by an adjustable tie rod to the operating lever on the emergency lowering selector. An over-centre spring box is connected to the lever on the torque shaft to bias the control in both the 'ON' and 'OFF' positions. Secured to the torque shaft, between the quadrant and the lever, is a striker arm incorporating an adjustable striker bolt. The control handle is locked in the normal position to the sloping panel by 20 S.W.G. aluminium wire to B.S.S. L. 36 and a lead seal, and in the operated position by a wire spring incorporated in the tube of the handle. When the handle is pulled, the lock is broken and the emergency selector lever moved to the 'open' position; simultaneously, the striker bolt contacts and manually operates the appropriate solenoid on the alighting gear normal selector to obtain a DOWN selection.

Flare bay doors emergency control

3. The flare bay doors emergency control lever is mounted on the port side of the fuselage at the pilot's station. The lever is connected by cable to a lever on the flare bay doors selector; the lever is spring-loaded in its 'off' position. The control lever is locked in the normal position to the fuselage structure by 20 S.W.G. aluminium wire to B.S.S. L. 36 and a lead seal, the lock being broken when the lever is pulled.

Explosion protection

4. The No. 6 belly tank incorporates an explosion protection system which is fully described in Sect. 5, Chap. 2, and Sect. 7, Chap. 1.

Control column snatch unit

5. A snatch unit fitted within the port console at the pilot's station, is connected to the lever at the outboard end of the elevator torque shaft on the control column. The purpose of the snatch unit 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. A full description of the snatch unit is given in Sect. 3, Chap. 4, para. 90 to 96.

Elevator break-strut

6. A break-strut, interposed in the elevator control run between the lever on the elevator torque shaft and the lever on the pressure bulkhead, is parted simultaneously with the release of the spring-operated snatch unit. Thus severed, the elevator controls are not affected by movement of the control column under the action of the snatch unit. A full description of the break strut with instructions for removal and servicing is given in Sect. 3, Chap. 4, para. 100 to 114.

Cockpit hood jettison

7. The cockpit hood jettison mechanism is actuated automatically by operation of the seat ejection control and is operated by pressure from a cartridge gas system. The hood may also be jettisoned independently for ditching purposes, by means of a spring-loaded stirrup handle, which is screened to prevent inadvertent operation. A safety pin is inserted in the sear pin when the aircraft is on the ground, to prevent the sear being withdrawn from the auxiliary breech of the firing mechanism by inadvertent use of the stirrup handle and thus operating the firing mechanism to jettison the hood. This pin must be withdrawn before flight and stowed in the spring clip provided on the inside of the port equipment bay hatch. Access to the auxiliary breech is by way of the port equipment bay. The hood-operating mechanism is described and illustrated in Chap. 1 of this Section.

Navigator's escape hatch control

8. The navigator's escape hatch jettison lever, labelled HATCH JETTISON - PUSH, is mounted on a transverse torque tube and located on the starboard side below the forward end of the hatch. Forward operation of the lever withdraws the shoot bolts and allows two spring loaded rams to raise the forward end of the hatch into the slipstream. Above 20 000 feet the cabin pressure must be 'dumped' before the hood is jettisoned.

Dump valve switches

9. A pair of guarded and mechanically interlocked switches, labelled DUMP - NORMAL, is mounted on the navigator's starboard console, and a duplicate pair, wired in series, is mounted on the pilot's port console.

Abandon a/c warning

10. A guarded switch, labelled ABANDON - NORMAL, is mounted adjacent to and mechanically interlocked with the 'dump' valve switches. When operated to ABANDON a Red warning lamp lights at the navigator's station.

Ejection seats

11. A Martin Baker Mk. 3CS ejection seat is provided for the pilot and a Mk. 4QS for the navigator; the operation and servicing of both seats is given in  
◀ A.P. 109A-0001-1. ▶

First-aid

12. For the location of the first-aid stowage refer to Sect. 1, Chap. 3 of this volume.

Crash axe

13. For the location and stowage of the axe refer to Sect. 1, Chap. 3 of this volume.

Signal pistol

14. The Mk. 2 pressure cabin signal pistol located on the port side of the fuselage at the navigator's station is described and illustrated in Sect. 7, Chap. 1 of this volume. For servicing details reference should be made to A.P. 1641H.

Fire extinguishers

15. A fire extinguisher stowage is provided on the starboard side of the navigator's station adjacent to the first aid stowage; for details refer to Sect. 1, Chap. 2, fig. 2.

Emergency oxygen

16. An emergency oxygen cylinder is carried on the back of both the ejection seats. A control knob, located at the forward end of the starboard side of

each seat, is pulled 'up' to bring the emergency supply into operation. The system is fully described and illustrated in Chapter 10 of this Section.

Survival packs

17. Two Type A survival packs for use when the aircraft is crash-landed are carried in crates, mounted one on each side of the rear fuselage at frame 36. Access is by means of the rear fuselage access hatch. The pilot and navigator each have a type R personal pack comprising rations, dinghy, etc. These packs fit into the seat pans of the ejection seats. A description of both types  
◀ of pack will be found in A.P. 108E-0601-1 & 0602-1 ▶

Wing tip tank jettisoning

18. Provision is made for jettisoning the wing tip tanks by means of explosive detonators incorporated in the wing tip tank attachment bolts. The associated electrical circuit is described in Sect. 5, Chap. 1, and the procedure for the installation and removal of the detonators is described in Sect. 4, Chap. 2. Reference should be made to A.P. 1161F, Vol. 1, Sect. 7, for instructions on assembly of the detonators.

### SERVICING, REMOVAL AND INSTALLATION

General information

19. For details of servicing, removal and installation of the various items of emergency equipment refer to the respective chapters in this A.P. or to the specialist publication where quoted.

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