Chapter 3 TAIL UNIT

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DESCRIPTION

1. The tail unit comprises the fuselage rear end aft of the fin front spar, the fin, rudder, fixed portion of the tail plane, variable-incidence tail plane and elevators. All these components are covered with stressed light alloy skin. The leading edges of the fin and the tail plane have thermal de-icing ducts which exhaust to atmosphere through gauze-covered vents on the lower outboard surfaces of the variable-incidence tail plane, and perforated vents on each side of the fin di-electric tip. The lower fin is faired into the fuselage by drag angles on each side of its base, riveted to a dorsal fin forward of the front spar and a rudder stub aft of the rear spar.

Rear fuselage

2. The rear fuselage, of similar construction to the remainder of the fuselage (*Chap.* 1) has two built-in heavy frames for attachment of the fin front and rear spars. The portion aft of the rear spar frame is of cross-braced monocoque construction, at the aft end of which is the rear radome.

Fin (*fig.* 1 *and* 2)

3. The fin comprises a lower portion, an upper portion and a di-electric moulded tip. Two spars of angle-boom and plate-web construction with Z-section stiffeners carry the chordwise ribs. The fin stressed skins are stiffened by Z-section stringers and U-section intercostal members. The spar booms extend below the drag angles and are bolted to two heavy frames in the fuselage. The rear spar carries the rudder hinges and

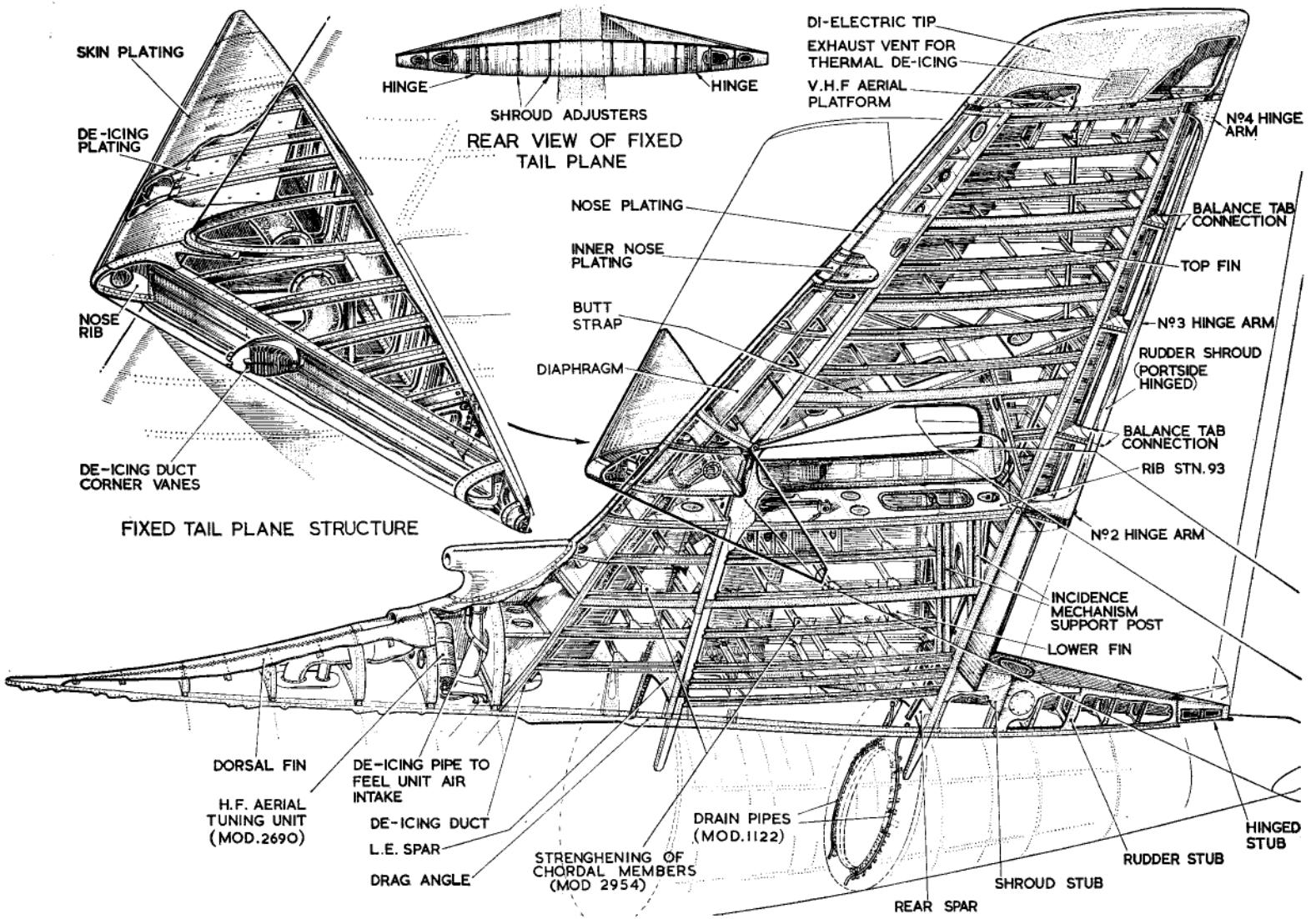

Fig. 1. Fin and fixed tail plane structure

Chordal members strengthened, Mod. 2954

a hinged shroud for the rudder leading edge beaks and air seals. In the lower fin there are chordal and intercostal members ◀ strengthened, post-Mod. 2954, by reinforcing liners and gusset plates; there is also ▶ a diaphragm forward of the front spar. The tail plane fixed portion is bolted and riveted to the lower fin, being built around and protruding forward of the leading edge profile skin. Vortex generators, attached to the skin of both portions of the fin aft of the front spar, reduce the effect of buffet on the

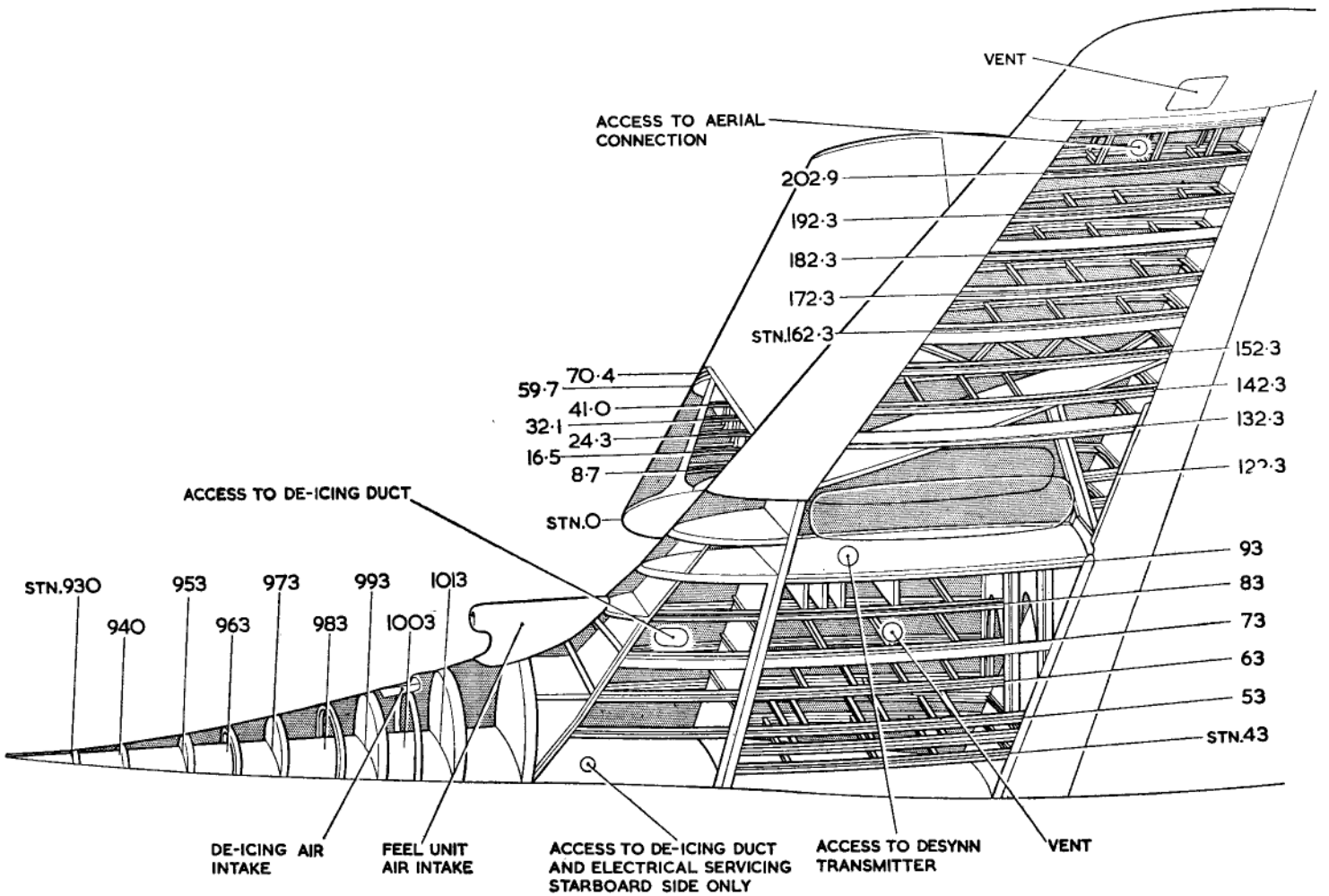

Fig. 2. Fin and fixed tail plane access panels and stations diagram

rudder. There is a large reinforced opening between the spars at the junction of the upper and lower portions of the fin to accommodate the variable-incidence tail plane. Water drain pipes (Mod. 1122), leading downwards from the fuselage upper plating forward of the aft spar and terminating above the fuselage lower plating, are clipped to the aft spar frame forward face. On a platform at the apex of the top fin is a VHF aerial covered by the di-electric tip which is bolted to the chordal joint plate, and dielectric panels below the feel unit air intake enclose an H.F. aerial tuning unit and its associated matching unit (Mod. 2690).

Fixed tail plane (*fig.* 1 *and* 2)

4. In plan, this portion of the tail plane is triangular, the spar forming the base and the swept-back leading edge the other two sides. The spar and the main leading edge members are of angle booms and stiffened sheet webs. Ribs connect the spar to the leading edge members and support the skin. The space between the leading edge main members and the leading edge profile skinning forms a

thermal de-icing duct (*fig.* 3). Bifurcated ducts fitted with corner vanes connect the fin de-icing duct to the fixed tail plain leading edge ducting. The thermal de-icing ducting of the fixed tail plane leading edge is connected to the leading edge ducting of the variable-incidence tail plane by two flexible couplings bolted to the outboard rear face of the fixed tail plane spar. Attached to the skin aft of the fixed tail plane rear spar are turnbarrel adjusters enabling the shroud gap between the fixed and the variable-incidence tail planes to be adjusted.

Variable-incidence tail plane (*fig.* 4 *and* 5)

5. The variable-incidence tail plane is swept back and is constructed as a single unit. The trailing edge member is built up of angle at the top and bottom edges of a plate web. Diaphragm ribs complete the section of the tail plane from the trailing edge to the leading edge. Spanwise channel-section stringers fan out from the centre to the tip of the tail plane on the top and bottom surfaces for attachment of the flush-riveted stressed skin. Vortex generators are fitted to the tail plane top and bottom surfaces. Hot air from the de-icing system is exhausted to atmosphere through gauze-covered vents on the underside at the outboard ends near the trailing edge.

6. The variable-incidence tail plane is hinged at two points to the tail plane fixed portion (*fig.* 6) and the trailing edge is supported and operated by a screwjack. Two torsion links connect the trailing edge to the fin structure. The gap in the fin, which allows the trailing edge to rise and fall, is faired in by built-up tapered fairings attached to the tail plane top and bottom skins. At the rear of both upper and lower fairings, two large apertures provide access to the elevator stops and the balance mechanism; there are also two small apertures in the top fairing for access to the elevator lock unit. Leather air seals are fitted to the inboard face of the fin gap surround. On the tail plane trailing edge, covered by shrouds, the lowermost of which

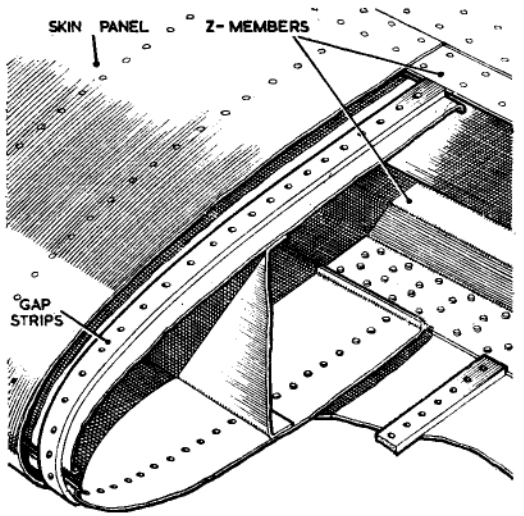

Fig. 3. Typical de-icing duct section

is hinged, are eight elevator hinges, four each side. The elevator torque tube is mounted centrally at the tail plane trailing edge, its ends passing through leather air seals on the failring.

Elevators (*fig.* 7 *and* 8)

7. The elevators are similar in construction, the main difference being that the starboard elevator has a trim tab and the port elevator a balance tab, which has the same chord as the trim tab but a greater span.

8. Each elevator is constructed with a heavy-gauge torsion box which extends the full length of the elevator and incorporates the four hinge points (*fig.* 9 *and* 10). A series of beaks are riveted to the forward face of the torsion box and fabric air seals connect the beak leading edges to the tail plane trailing edge. The elevator horn inboard rib is built on to the outboard end of the torsion box, and mass balance weights (*fig.* 11) are carried in the forward portion of the horn; a boundary member and diaphragm ribs support the horn skin. The elevator torque tube connection is a machined fitting at the root end of the torsion box.

9. The torsion box trailing edge is faired to the tab mounting member with a light pre-stressed skin, suitably supported by diaphragm ribs. The three operating mechanisms for the port elevator balance tab are installed at the three inboard hinge positions. The starboard elevator trim tab is hinged at four positions, and is operated, through levers, rods and two spigots, by an electric actuator in the elevator root end. A close-fitting shroud covers the gap between the tabs and the elevator trailing edge.

Rudder (*fig.* 12 *and* 13)

10. This is of normal aerofoil section and diminishes in chord and thickness towards the tip which is separated from the main rudder by a di-electric strip. The diaphragm ribs are attached to the spar and are covered with a heavy gauge skin; the 'D' section box formed by the spar and the leading edge skin carries the operating torque shaft at the root end (*fig.* 15) and the three hinge points (*fig.* 14) for attachment to the fin. The remainder of the skin covering is of light gauge and pre-stressed. ◀Five beaks attached to the leading edge are fitted with adjustable external mass-balance weights in their leading edges and, post-Mod. 3007, fixed internal mass-balance weights.▶Fabric air seals are attached to the beak leading edges and the structure of the fin trailing edge member. Forward of and attached to the root end of the spar is a built-up structure which limits the rudder travel, incorporates the control locking arm, carries the trim tab actuator, Desynn transmitter and physical stops, and acts as a balance weight. Two control tabs are attached to the rudder trailing edge and extend from the root end to the di-electric strip; the lower tab is an electrically-controlled trim tab and the

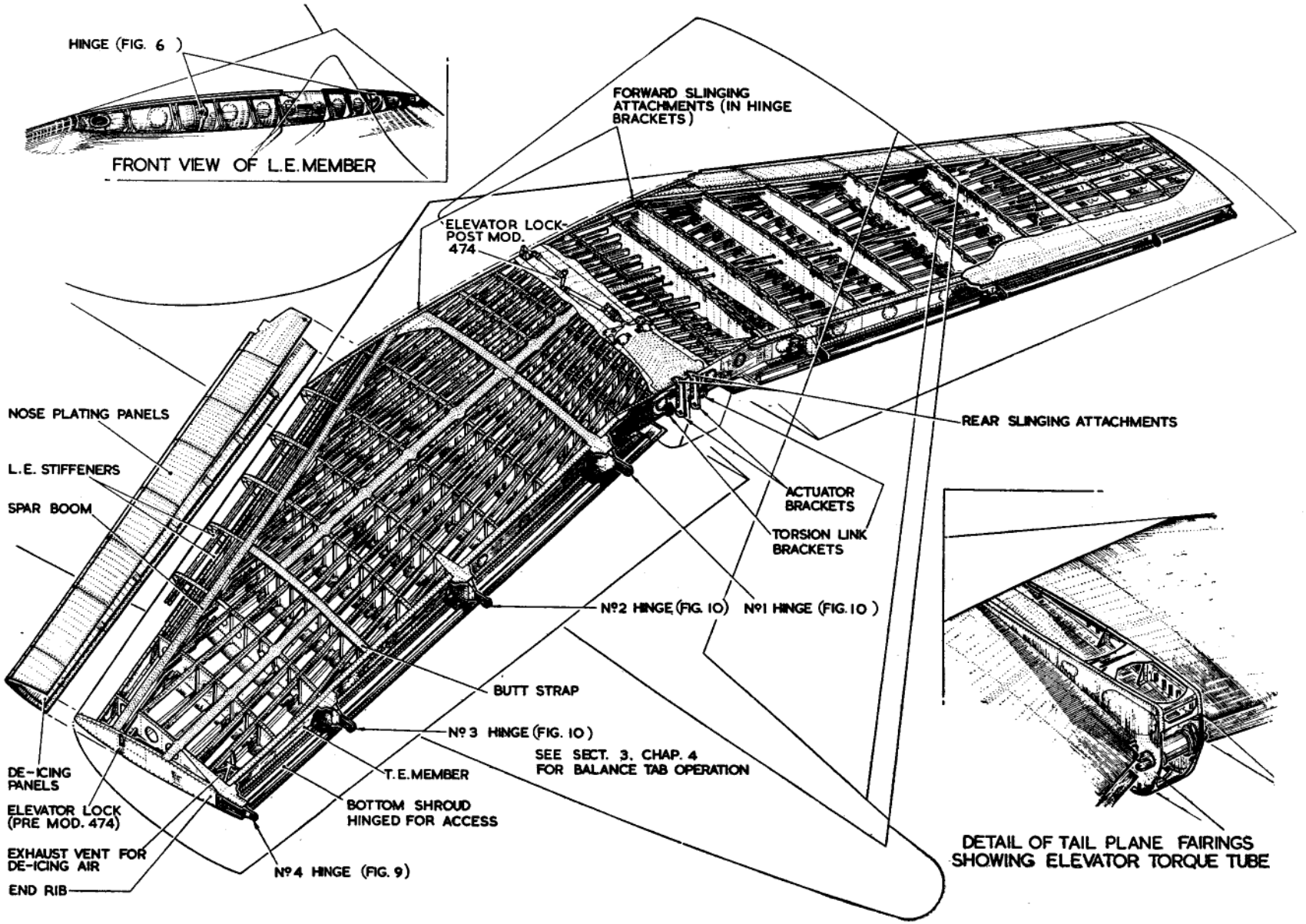

Fig. 4. *Variable-incidence tail plane structure*

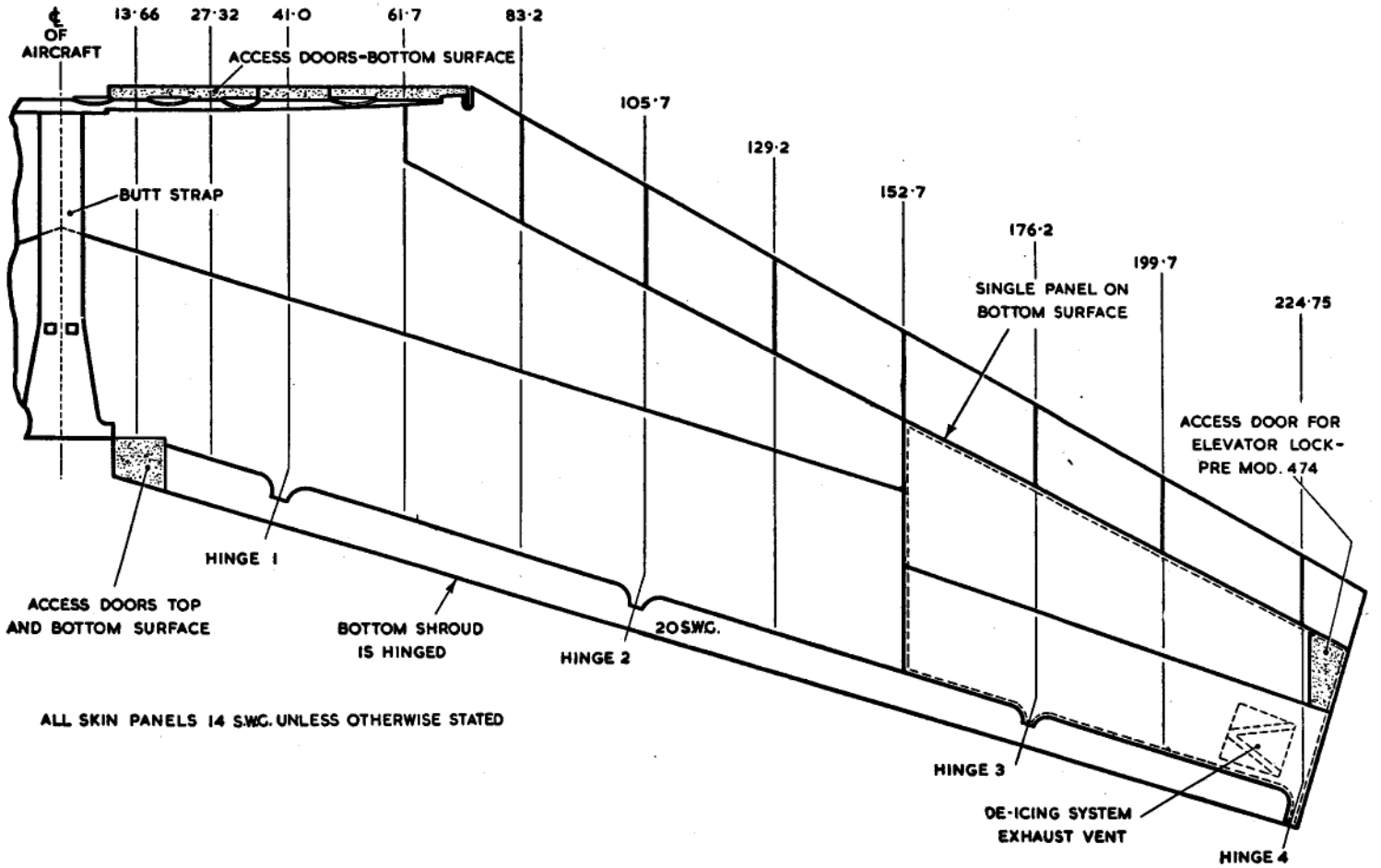

Fig. 5. *Variable-incidence tail plane plating, access panels and stations diagram*

upper is a mechanically-controlled balance tab.

Rudder stub

11. The stub is constructed of metal-covered rectangular frames and is attached by riveted drag angles to the rear portion of the fuselage and is removed with it. The stub fills the space between the rudder and the rear of the fuselage and is tapered in plan and elevation. The rearmost portion is hinged and can be raised when the rudder is moved to either side to enable the rear radome to be opened. The rudder torque tube passes through the stub, and access panels are provided on each side for servicing this control and the electrics.

SERVICING

Lubrication

12. The points requiring lubrication and the types of lubricant to be used are shown in the relevant illustrations, the Ref. and N.A.T.O. Code numbers being given on the back of the Contents marker card at the front of this book.

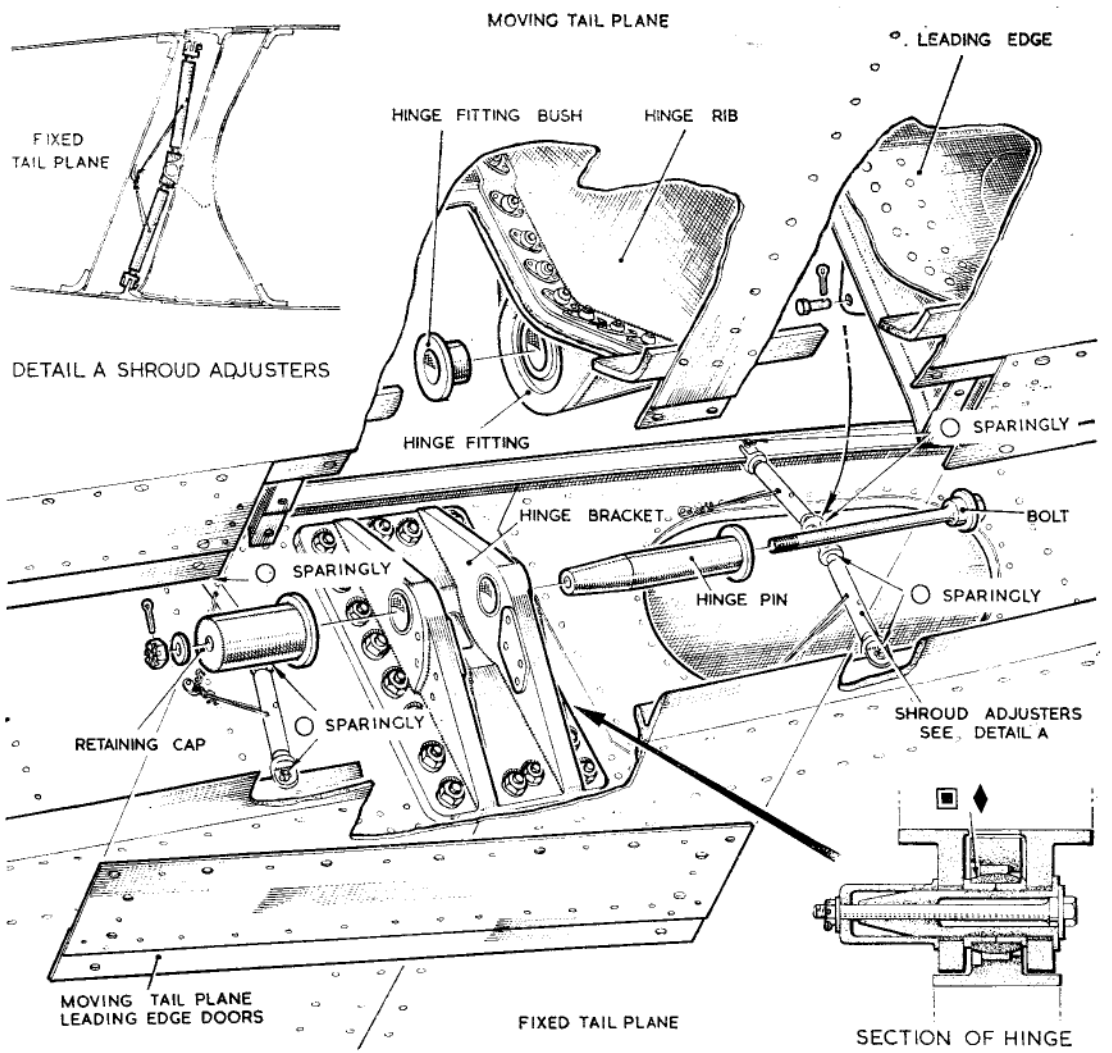

Fig. 6. Variable-incidence tail plane hinge

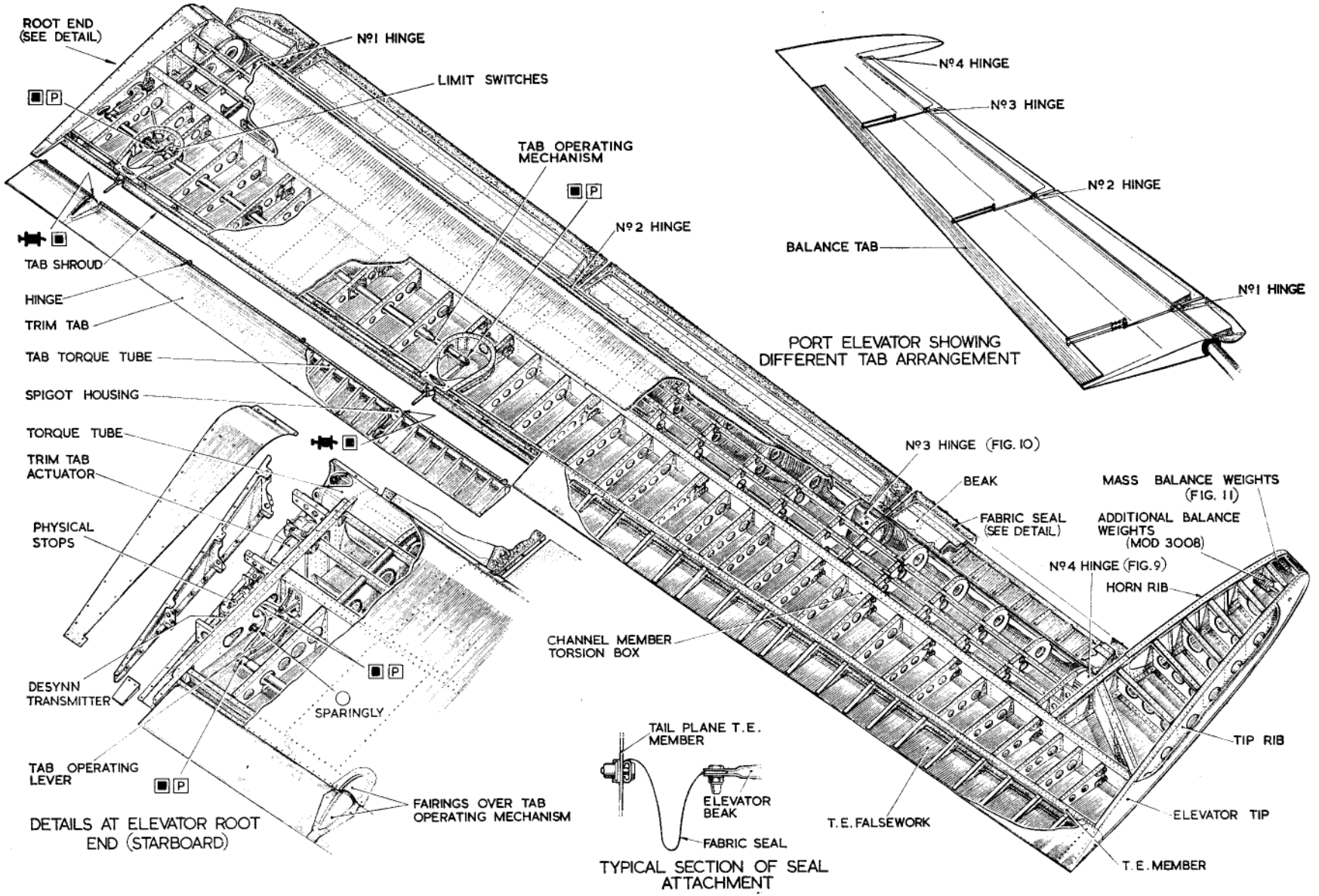

Fig. 7. Elevator structure

◀ *Additional horn balance weights* ▶

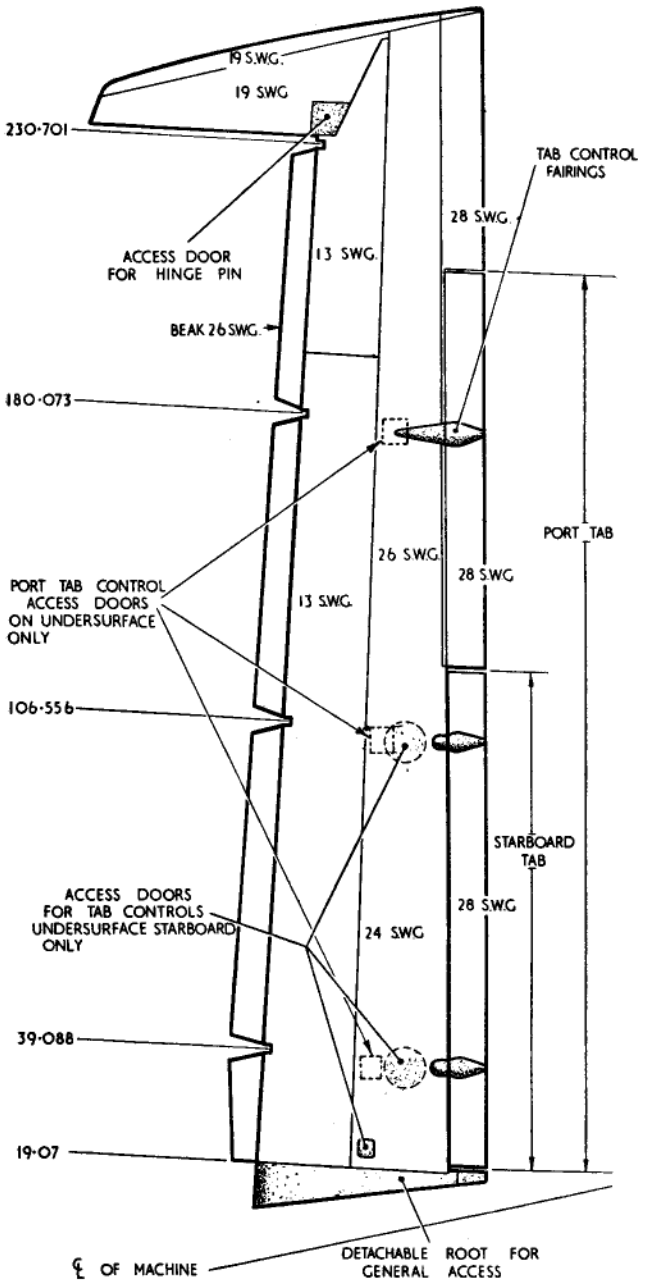

Fig. 8. *Elevator plating, access panels and stations diagram*

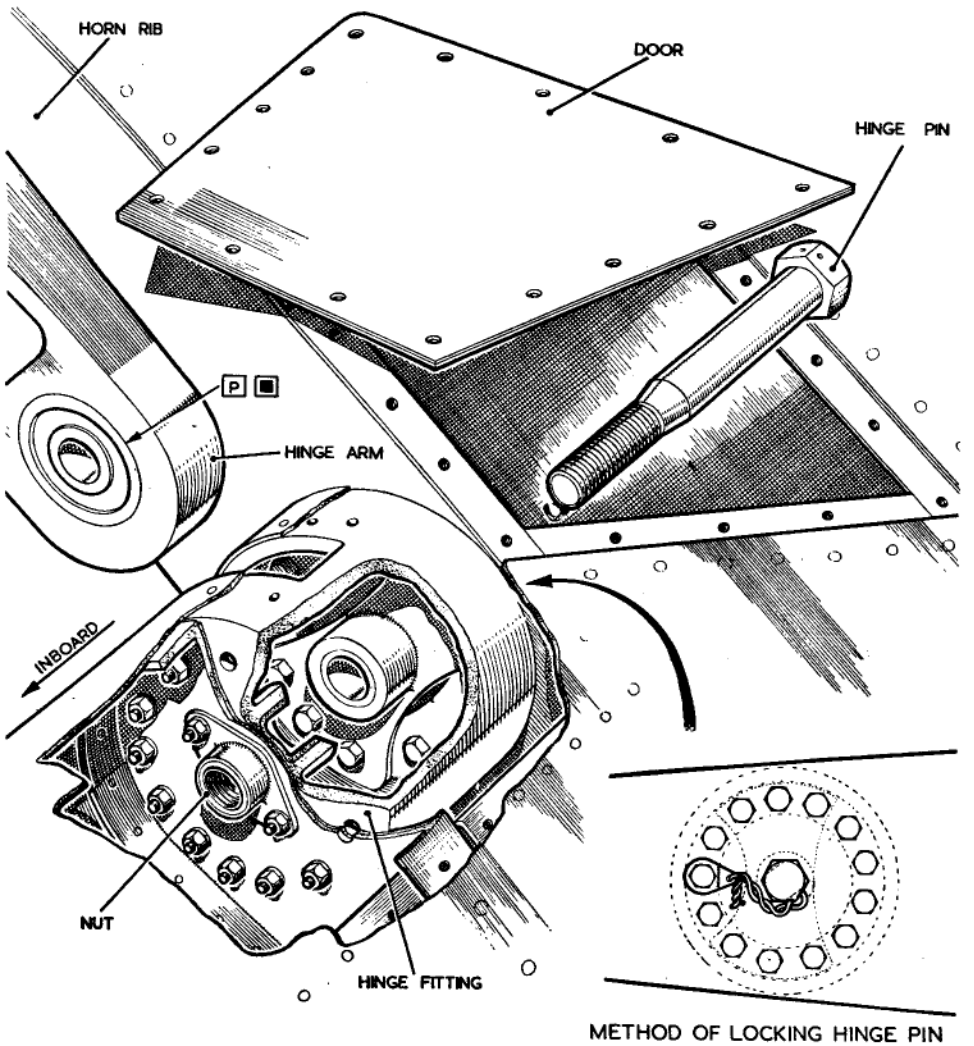

Fig. 9. *Elevator hinge No. 4*

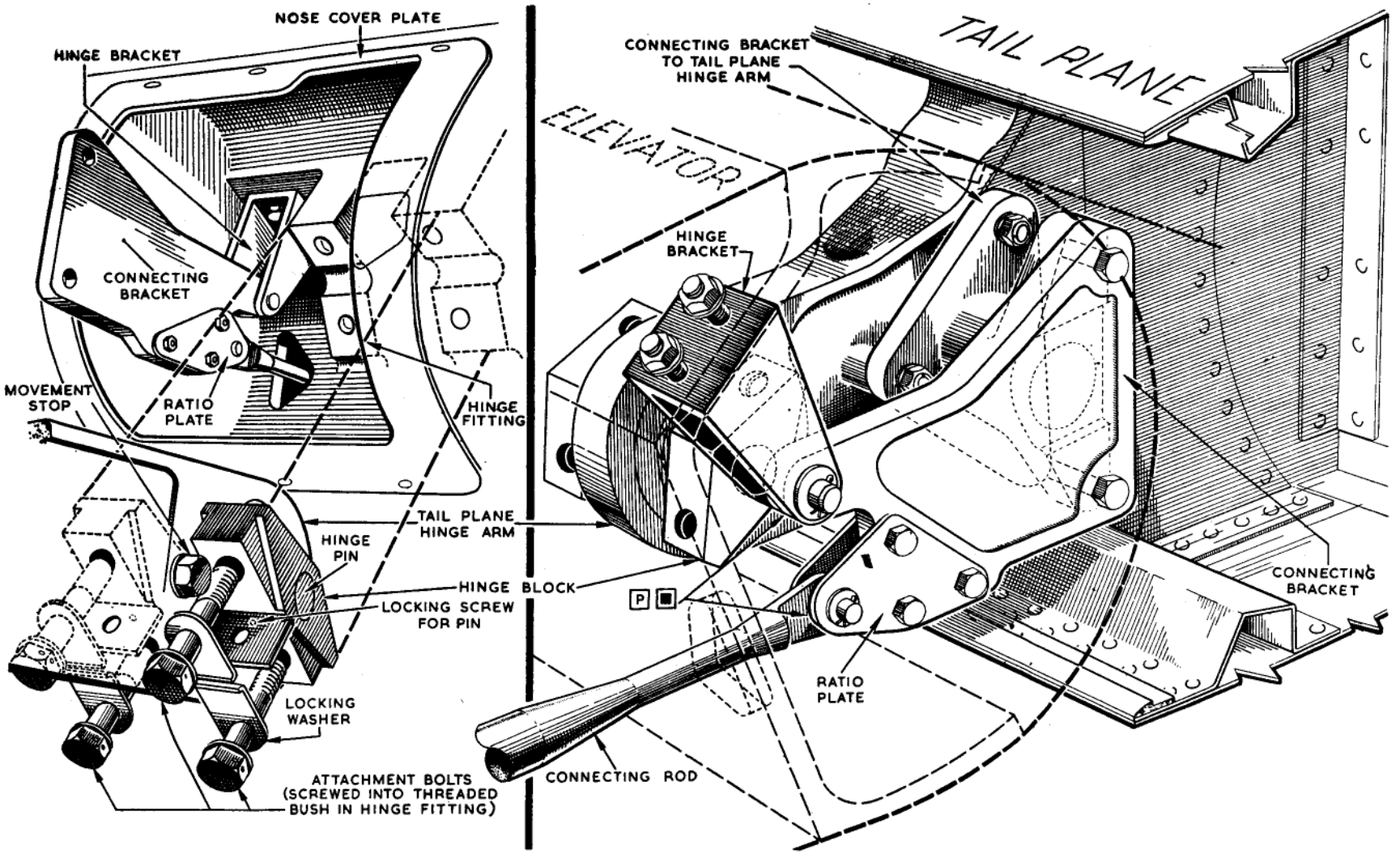

Fig. 10. *Elevator hinges No.* 1, 2 *and* 3

Note . . .

When disconnecting or fitting radar equipment the normal precautions must be observed (Sect. 6, Chap. 2). When refitting any tail surface it should be checked for alignment (Sect. 2, Chap. 4) and the control movement should be checked in accordance with the instructions given in Sect. 3, Chap. 4. When refitting any part, the sequence of operations is the reverse of that given for removal unless otherwise stated. Care should be taken to replace the approved type of bonding.

Removal of elevator

13. (1) Set the tail plane to the neutral position.

(2) Open the hinged shroud along the underside of the tail plane trailing edge.

(3) Remove top and bottom surface access panels: —

(a) At the root end of the tail plane trailing edge.

(b) At the root end of the elevator.

(4) Remove the root end rib from the elevator.

(5) Remove the hinge covers top and bottom, at hinges 1, 2 and 3.

(6) Remove the access panel, on the top surface, just outboard of No. 4 hinge.

(7) Lock the control handwheel in the forward position, using a locally-made tool (bent or welded aluminium plate) to drop over the square shaft of the pilot's controls.

(8) Remove the screws attaching the fabric seals to the tail plane.

(9) Lock the control handwheel in the aft position.

REMOVAL AND ASSEMBLY

(10 To remove only the starboard elevator, disconnect the electrics from the trim tab actuator.

(11) To remove only the port elevator, disconnect the balance tab linkage at hinges 1, 2 and 3.

(12) Remove the hinge block bolts and retaining plate at hinges 1, 2 and 3. Do not disturb the hinge pins.

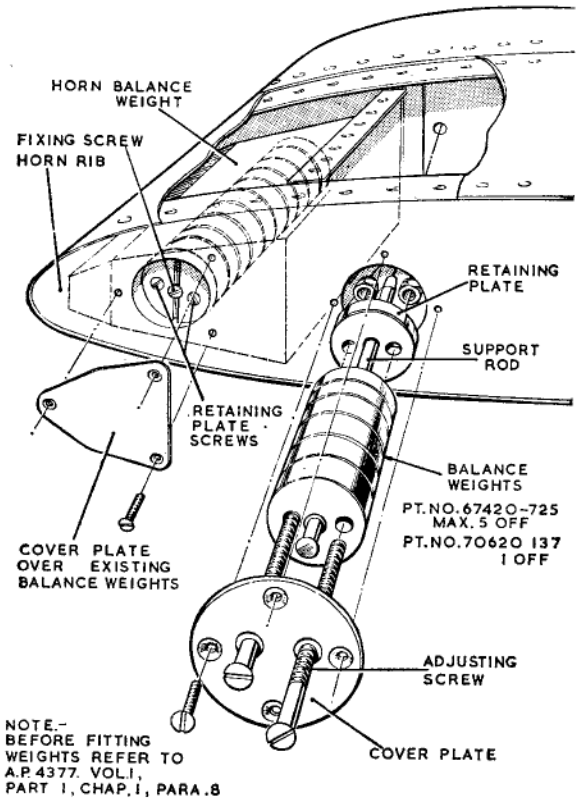

Fig. 11. Elevator mass-balance weights

(13) Lock the controls, by fitting a bar and tie-plates on the opposite elevator horn.

(14) Sling the elevator and take the weight.

◀(15) Remove and retain the two grease nipples from the tapered bolts securing the elevator torque tube to the fin.

(16) Remove and retain the nuts and washers from the tapered bolts.

(17) Separate the two portions of tool, Pt. No. 70679 Sht. 1015 (introduced by Mod. G.E.2795), and position them around the torque tube, omitting the reaction plug, Pt. No. 70679-5861. Couple the two portions together and tighten the bolts.

(18) Ensure that stud, Pt. No. 70679-5863, is centralized on the torque tube tapered bolt and screw in the tool centre bolt until one tapered bolt is free.

(19) Slacken the extractor tool and remove the loosened tapered bolt.

(20) Fit the reaction plug to the extractor, position it in the vacant taper-bolt hole and re-tighten the extractor coupling bolts.

(21) Screw in the extractor centre bolt to remove the remaining tapered bolt.

(22) Remove the tool.▶

(23) Remove the bolt from No. 4 hinge.

(24) Carefully ease out the outboard end, which will tend to drop and must be supported, and then withdraw the elevator completely (*See Notes overleaf*)

Elevator removal notes . . .

Retain all hinge block bolts and retaining plates, universal joint pins and bushes, and fabric seal screws and washers with the tail plane. Ropes may be used either at root or tip for steadying purposes during lowering.

Elevator assembly notes . . .

After assembly of a port elevator, adjust and lock the balance tab linkage at hinges 1, 2 and 3. After assembly of a starboard elevator, set and check the trim tab. Access is through panels in the underside of the elevator.

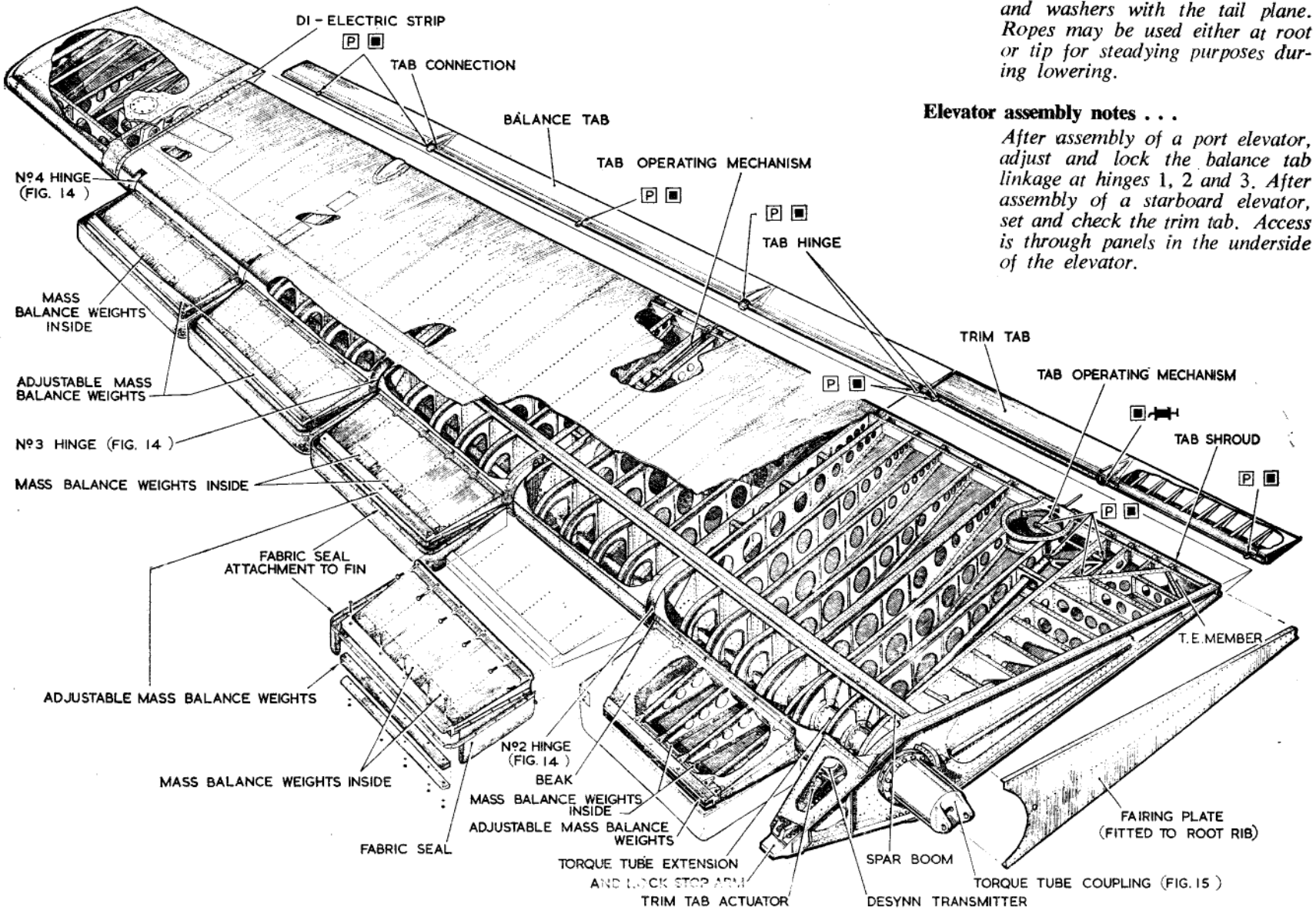

Fig. 12. Rudder structure

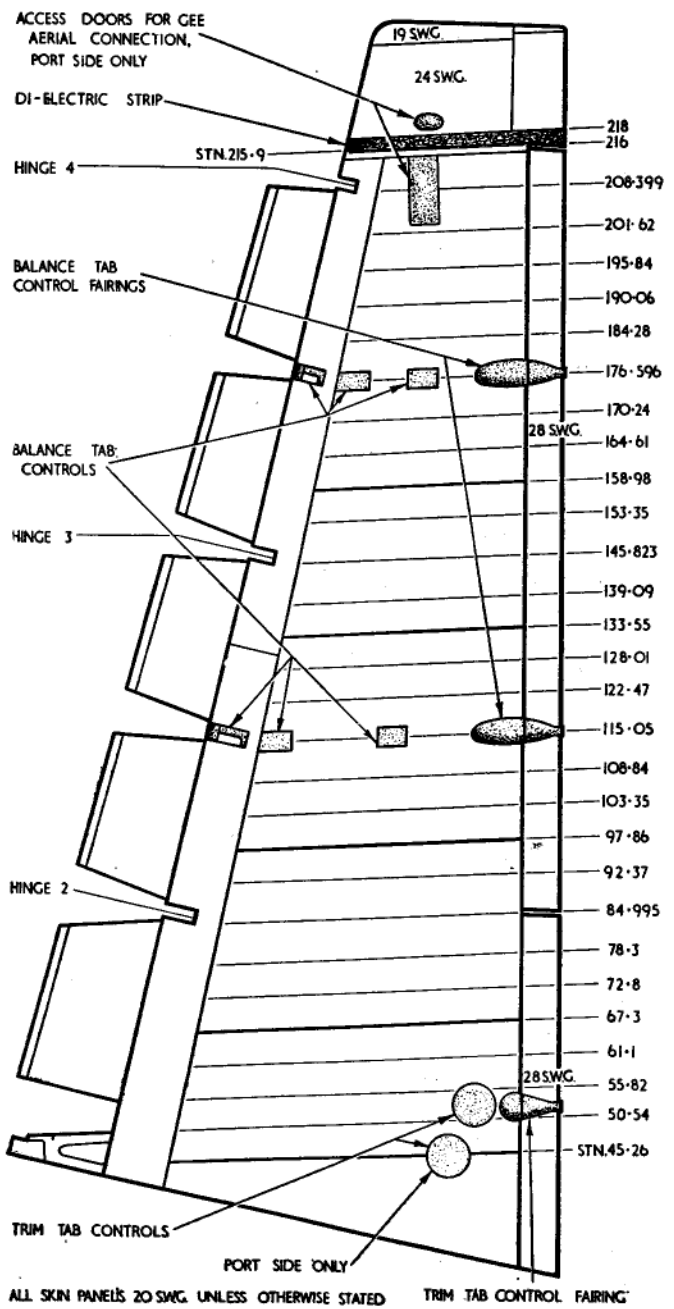

Fig. 13. *Rudder plating, access panels and stations diagram*

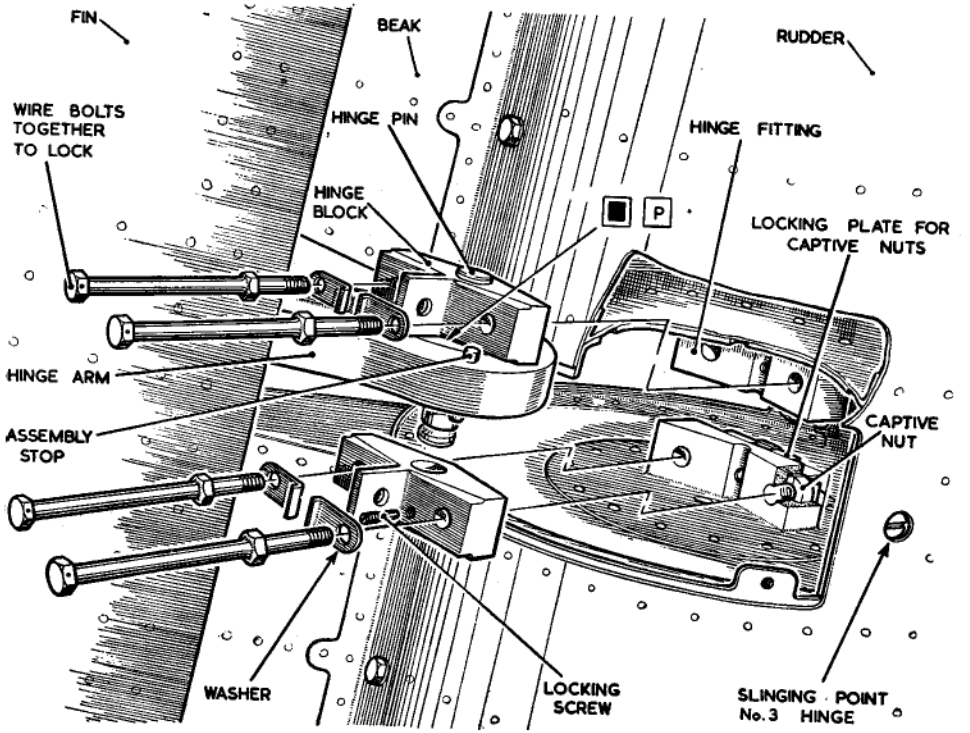

Fig. 14. *Rudder hinges No. 2, 3 and 4*

Removal of rudder

14. (1) Remove the circular access panel, port side, rudder root end fairing, and disconnect the trim tab actuator wiring.

(2) Remove the large access panel, port side, rudder root end fairing, and unclip the wiring from the rudder stub structure.

(3) Open the access doors at the port side of the fin trailing edge and remove the hinge covers.

Note . . .

It will be necessary to operate the tail plane to the maximum nose-down position in order to open the middle panel.

(4) Detach the fabric seal from the rudder beak and replace the beak parts.

(5) Remove the bolts securing the torque tube to the base of the rudder, *leaving two or three bolts loosely in position.*

(6) Swing the rudder to starboard and remove all hinge block bolts from No. 2 and 3 hinges (*fig.* 14). Remove the two bolts on the starboard side at No. 4 hinge block.

(7) Disconnect the balance tab linkages.

(8) Remove the square panel, port side of rudder tip, and disconnect the aerial lead.

(9) Remove the rudder tip and withdraw the aerial lead from the rudder.

(10) Sling the rudder and take the weight.

(11) Remove the two remaining bolts from No. 4 hinge block and the bolts left in position in the torque tube flange at operation (5).

Note . . .

Operation (9) *is a precautionary measure, but whether the rudder tip is removed or not, the rudder should be prevented from swinging heavily aft on removal of these bolts.*

(*A.L.* 89, *June* 58)

Removal of A.R.I.5800 radar head

15. (1) Remove the large lower access panel and the two smaller access panels around the rear fuselage rear frame.

(2) Disconnect the electrical services which are exposed after removing the large access panel (*operation* (1)).

(3) Through the apertures of the panels removed (*operation* (1)), remove the four bolts securing the radar head to the rear fuselage rear frame.

(4) Withdraw the radar head rearwards.

Note . . .

The radar head weighs 56 lb. and care must be taken to support it when the bolts are removed.

Removal of upper fin (rudder previously removed)

16. (1) Attach a sling and lifting gear (*fig.* 18).

(2) Disconnect the radar cables in the fuselage below the fin.

(3) Remove the bolts at the fore-and-aft skin joints.

(4) Take the weight on the lifting gear.

(5) Remove the front and rear spar joint bolts (*fig.* 19).

(6) Lift the top fin slowly, easing the radar cables out of the lower fin conduit as the upper portion is lifted.

Removal of variable-incidence tail plane (rudders, elevators and upper fin previously removed)

17. The variable-incidence tail plane is removed as follows:—

(1) Set the tail plane to the nose-down position to expose access doors.

(2) Disconnect the electrical services.

(3) Remove the tail plane leading edge doors situated between the fixed and movable portions of the tail plane assembly. These are three flat doors on each side and a semi-circular door at the leading edge of the movable tail plane.

(4) Attach the sling and lifting gear (*fig.* 20).

(5) Disconnect the torque shaft from the tail plane actuator by removing the four bolts at the lower universal coupling.

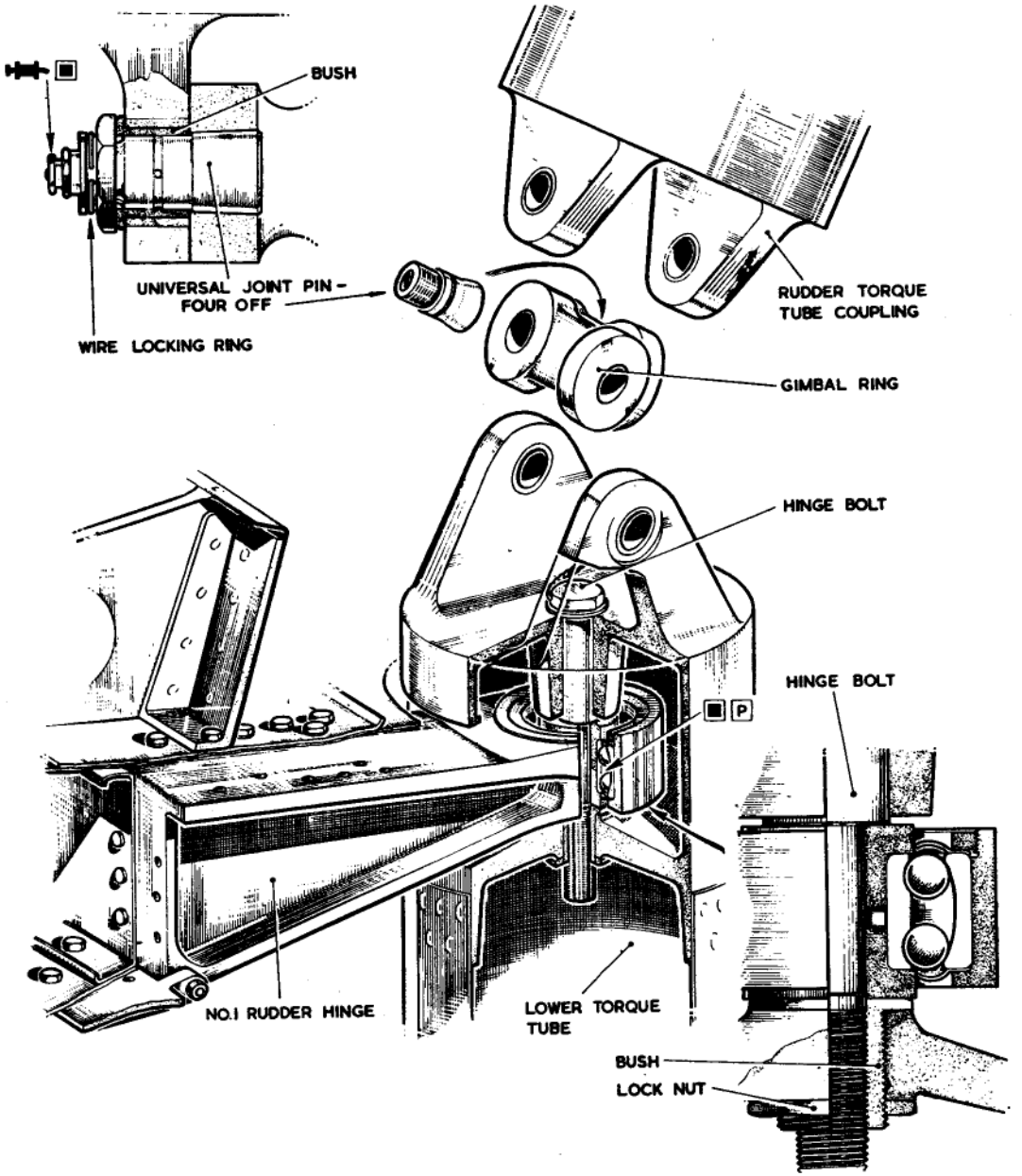

Fig. 15. *Rudder hinge No.* 1 *and torque tube connection*

(6) Disconnect the tail plane jack lubricating pipes at their forward ends and at the screwjack.

(7) Support the weight of the tail plane with the lifting gear.

(8) Partially collapse the tail plane screwjack to obtain access to the leather gaiter between the jack and torque tube.

(9) Release the Jubilee clips securing the top and bottom of the gaiter and slide the gaiter down on the torque shaft.

(10). Remove the torque shaft from the jack.

(11). Remove the bearing caps and disconnect the screwjack from the lower fin.

(12) Disconnect the elevator control rod at the elevator torque tube.

(13) At the tail plane, disconnect the small compensating rod between the lever group and the tail plane.

(14) Disconnect the shear link at the elbow joint by removing the long bolt through the joint together with its slotted nut and washer. Remove the four lock screws, slide off the two caps and screw out the threaded cups. These components must be placed in a suitable bag and tied to the remaining half link. The shear link is accessible through doors on the tail plane fairing.

(15) Disconnect the Desynn transmitter link at the undersurface of the tail plane.

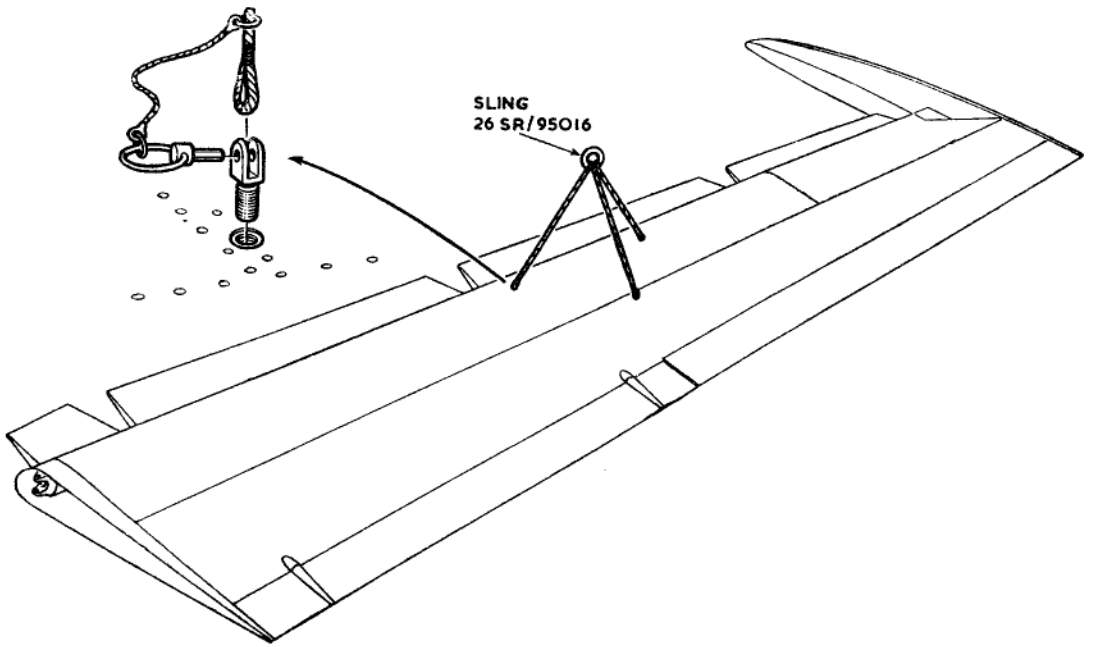

Fig. 16. Slinging the elevator

(16) Disconnect the flexible de-icing pipes at the tail plane leading edge, accessible through doors on the undersurface.

(17) Remove the shroud adjuster pins on the leading edge, accessible underneath the tail plane (*fig.* 6).

(18) Pre-Mod. 474.—Disconnect the elevator link and the locking control cable underneath the tail plane and forward of the centre line.

Post-Mod. 474.—Remove the clevis pin and bonding wire from the locking control lever at the leading edge on the top surface of the tail plane.

(19) Remove the bolts, retaining caps and nuts, and remove the hinge pins.

(20) Take away the variable-incidence tail plane and place it on suitable trestles.

(21) Refit the bearing caps to the jack-supporting trunnions.

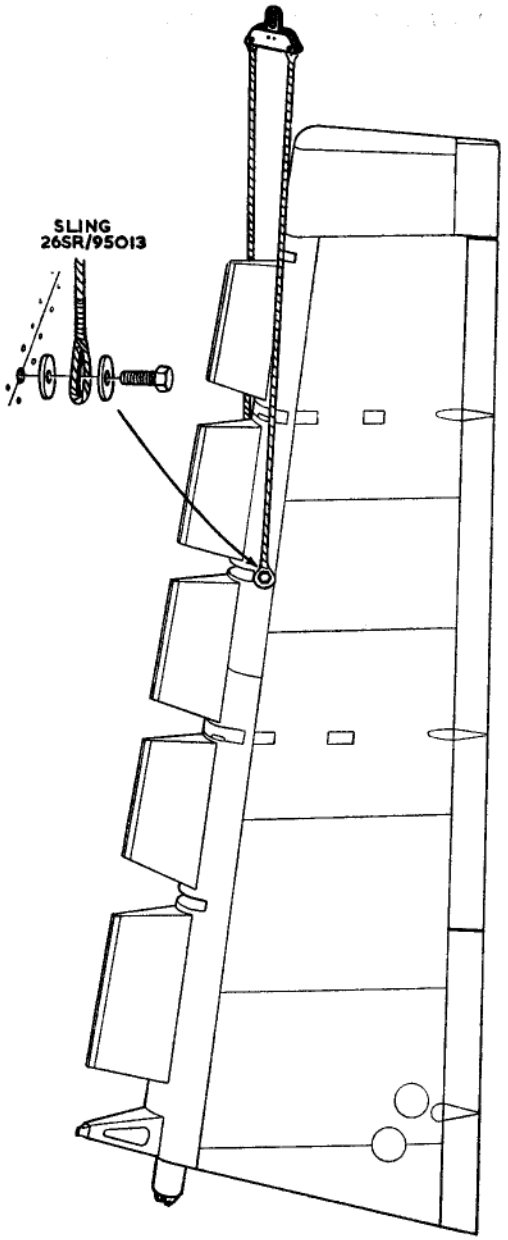

Fig. 17. Slinging the rudder

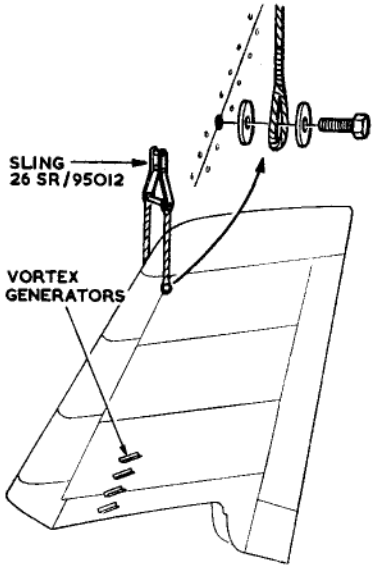

Fig. 18. Slinging the upper fin

Assembly of variable-incidence tail plane

18. Attach the sling and reverse the removal procedure, taking care when fitting the torque shaft that the red lines on screwjack and shaft coincide. Check the assembly for freedom of movement and correct operation.

Note . . .

The variable-incidence tail plane shroud rubs over the fixed tail plane skin, and ◀the shroud gap should not exceed 0·005 in.▶ Due to over-tightening of the shroud adjusters, however, excessive wear may become apparent; this condition can be alleviated by carefully reducing the tension in the shroud adjusters by a minimum amount. It is particularly important that ◀a gap no greater than 0·005 in. exists▶ throughout the range of movement from 0 deg. to the maximum nose-up setting (Sect. 3, Chap. 4, Table 1).

Removal of the rudder tip

19. (1) Disconnect the aerial through the access panel in the rudder.

(2) Remove the bolts around the lower edge of the di-electric strip and lift off the tip.

Removal of fin tip

20. (1) Disconnect the aerial through the access panel at the top port side of the fin.

(2) Remove the bolts securing the tip to the fin.

Removal of rudder trim tab

21. (1) Remove the bolts attaching the hinge arms to the rudder trailing edge member.

(2) Draw the tab to the rear to clear the operating spigot.

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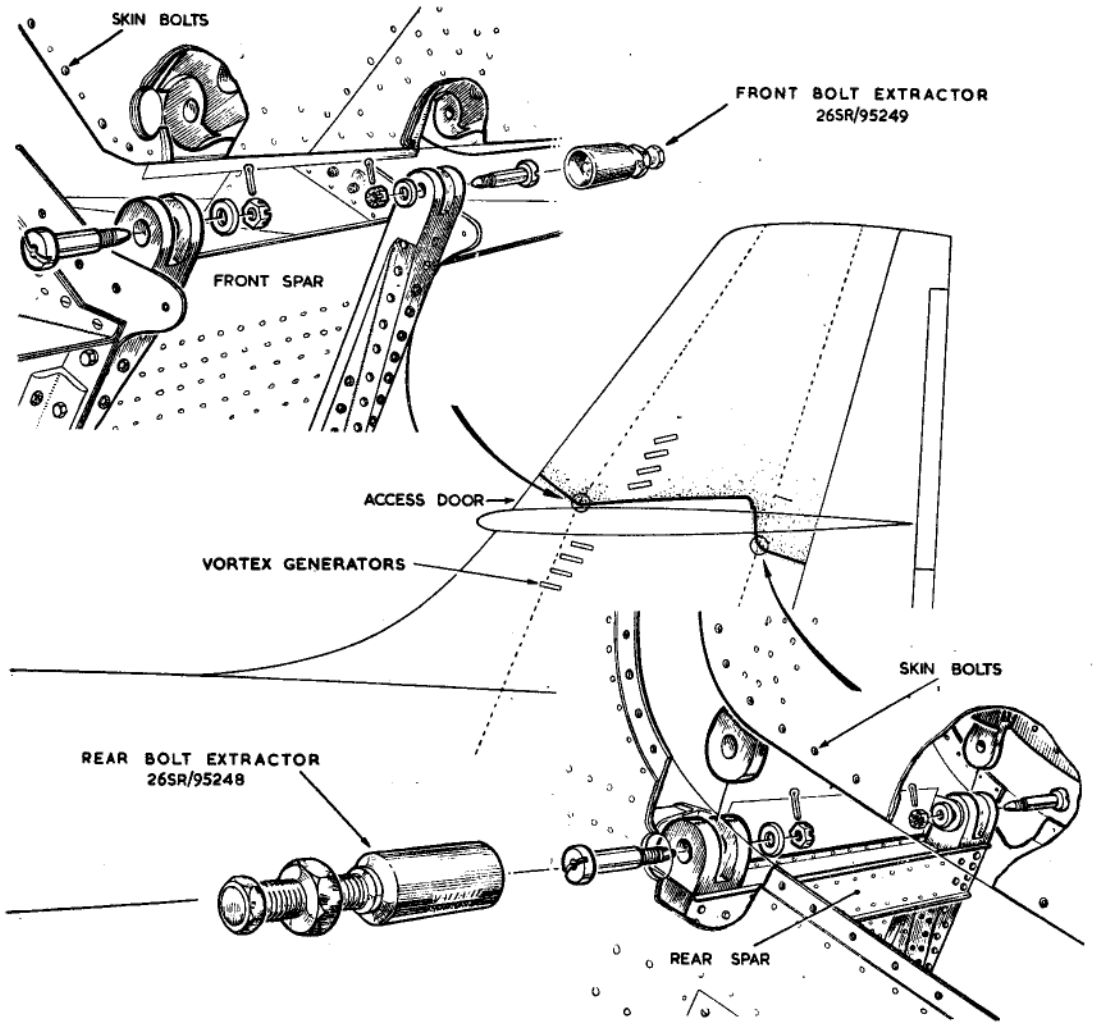

Fig. 19. *Attachment of the upper fin*

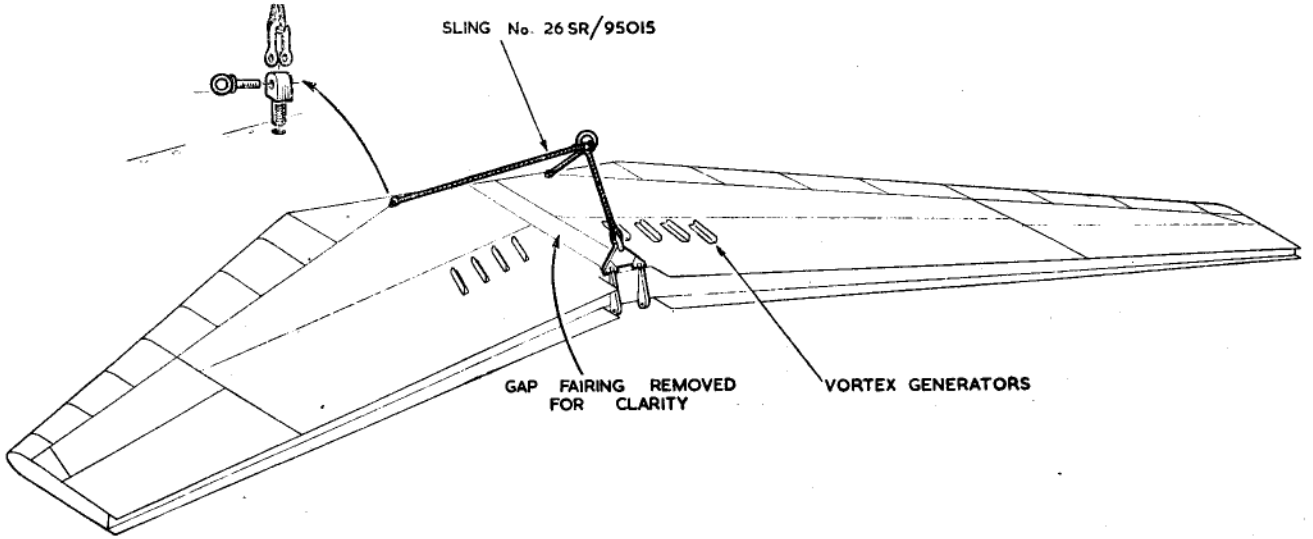

Fig. 20. *Slinging the variable-incidence tail plane*

Removal of rudder balance tab

22. (1) Remove the forward part of each control rod fairing.

(2) Remove the pins connecting the control rods to the tab arms.

(3) Remove the bolts attaching the hinge arms to the rudder trailing edge member.

Removal of elevator trim tab

23. (1) Remove the bolts attaching the hinge arms to the elevator trailing edge member.

(2) Draw the tab to the rear to clear the operating spigot.

Removal of elevator balance tab

24. (1) Remove the forward part of each control rod fairing (top and bottom).

(2) Remove the pins connecting the control rods to the tab arms.

(3) Remove the bolts attaching the hinge arms to the trailing edge of the elevator.

Table 1

Ground equipment

Ref. No.	Part No.	Description	Remarks
26SR/95420	67479-Sht.877	Sling, lifting, tail plane and elevator	For tail plane jack removal with tail plane installed
26SR/95424	67479-Sht.819	Ladder	For internal access to fin
26SR/95461	67479/6549	Spanners, special	For removal of rudder beak seals with rudder in situ
26SR/95462	67479/6547		
26SR/95463	67479/6551		
26SR/95456	67479-Sht.6325	Spanner, special	For adjusting rudder balance tab post-Mod. 2200
26SR/95469	67479/6545	Spanner, special	For adjusting rudder balance tab pre-Mod. 2200
26SR/95460	67479/6637	Spanner, special	For removing bolts; sealing curtains to elevators