Chapter 3 TAIL UNIT

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LIST OF ILLUSTRATIONS

Introduction

1. This chapter contains a description of the tail unit, together with the servicing necessary to maintain the structure in a serviceable condition. Illustrations depicting the method of slinging and dismantling the unit into its major components are also included.

DESCRIPTION

General

2. The tail unit *(fig. 1)* consists of a conventional fin, rudder, tail plane and elevator assembly mounted on the lower fin structure, which is an integral part of the rear fuselage. The incidence of the tail plane may be varied in flight by means of an electrically-operated actuator, and hydraulic power boost is provided for operating the elevators. An interconnection between the full power elevators and tail plane actuator makes provision for operation of the units as an electrically-operated flying tail, which may be cut out by operation of a switch in the cabin if desired. The rudder incorporates an electrically-operated trimming tab. An anti-buffet fairing, mounted on the rear end of the structure, extends aft between the two halves of the elevator just below the rudder. The lower part of the fin structure is described in Sect.3, Chap.1, while the tail plane, rudder and elevator controls, together with the operation of the electrically-operated flying tail, are described in Sect.3, Chap.4.

Fin

3. The fin is constructed in two portions, the lower portion being an integral part of the rear fuselage. The upper fin consists of front and rear spars, nose ribs, interspar ribs and a rudder shroud, the whole being covered with a light-alloy skin. The rudder shroud structure, aft of the rear spar, carries the two rudder hinges.

Fin attachments

4. The upper portion of the fin is attached to the lower fin and rear fuselage structure by fittings bolted to the front spar, inter-spar bottom rib and rear spar, these engage with further fittings carried at the top of frames 52 and 55. The front attachment fittings consist of a pair of stampings provided with forked eye-ends which are bolted to the front spar and bottom interspar rib of the fin structure. These fittings engage with fork-ended stampings which are bolted to the top of frame 52, the assembly being secured by

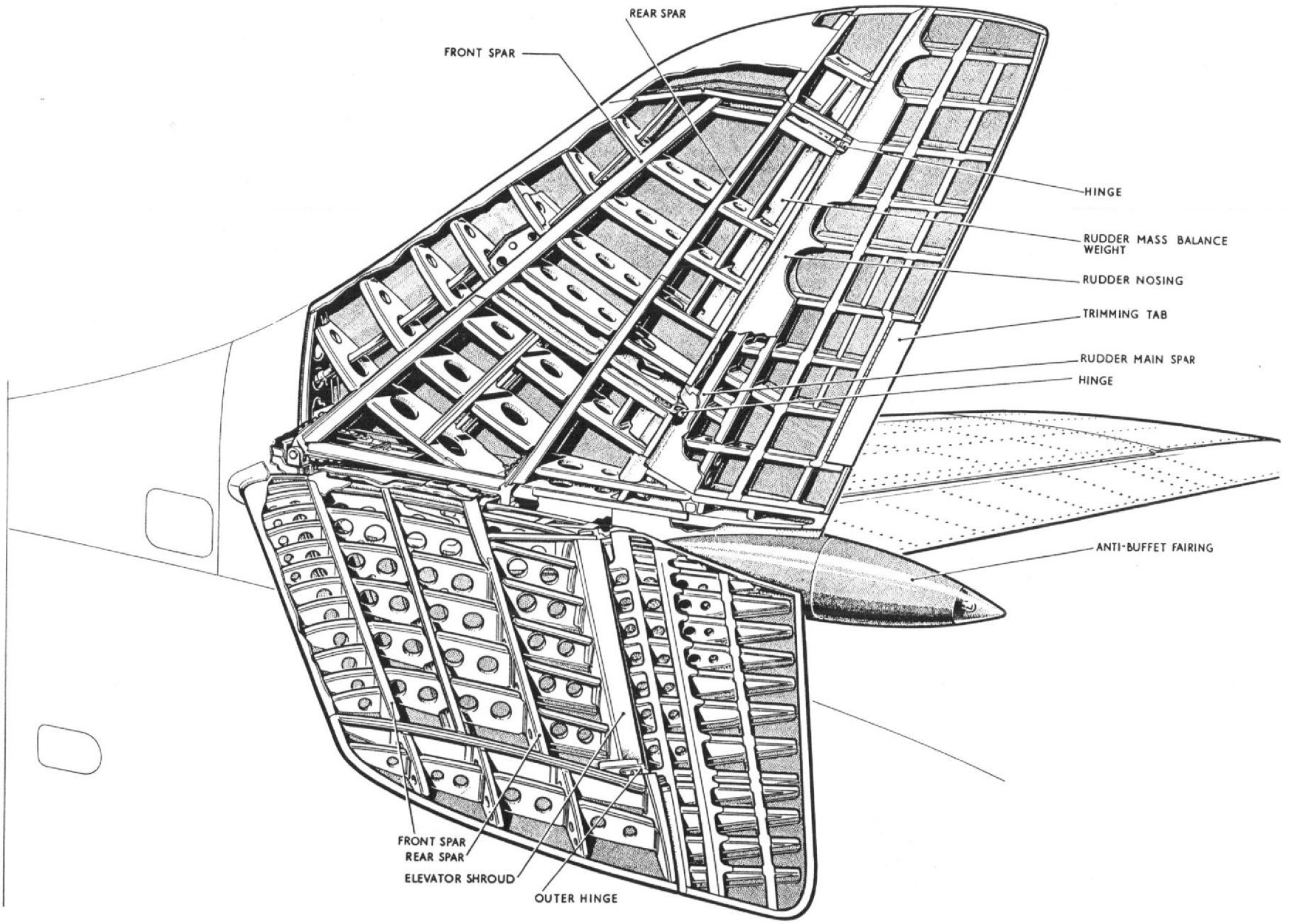


Fig. 1 Tail unit

special bolts. The rear attachment fitting also consists of a pair of stampings having forked eye-ends. These are bolted to the rear spar and bottom interspar rib, one on each side of the centre line. These fittings engage with fork-ends at the top of a large attachment stamping bolted to frame 55 and the assemblies are secured by special bolts. The stamping bolted to frame 55, incorporates a trunnion on each side, on which the tail plane pivots.

Rudder

5. The rudder is hinged to the upper fin structure at two points and consists of a main spar, sub-spars, nose ribs, main ribs and a trailing edge section. The structure which is strengthened by stiffeners, is covered with a light-alloy skin and incorporates distributed mass-balance and a small trimming tab which operates in conjunction with an autostabilizer. The hinge blocks and operating lever are bolted to the main spar and the mass balance weights project forward on brackets attached to the rudder nosing, which is formed by the main spar and nose ribs. The trimming tab is hinged at the lower trailing edge of the rudder and is operated by a small electric actuator housed in the fin. The actuator is coupled by means of its lead screw to the autostabilizer servo motor casing, which is capable of longitudinal movement in its cradle mounting aft of the spar. Thus, the actuator utilizes the servo motor casing as a link in its control run to the tab, and by selection, provides the datum point from which the autostabilizer operates to control yaw. A description of the actuator and autostabilizer assembly, is given in Sect.3,Chap.4.

Tail plane

6. The tail plane is an all-metal cantilever structure of swept back design, which is constructed in one piece. It is provided with incidence control, which is interconnected with the full power elevator to form an electrically-operated flying tail. Basically, the structure consists of front and rear spars with nose ribs, interspar ribs and tail ribs, together with an elevator shrouding; the complete assembly being covered with a light-alloy skin. The unit is anchored at the front spar to an electrically-operated actuator and is hinged at the rear spar on trunnions at the top of frame 55. Operation of the actuator, therefore, raises or lowers the leading edge to provide variable incidence. The elevator shroud structure carries the inner and outer hinges for each elevator. A description of the inter-connection between the actuator and full power elevator, which provides for operation of the units as an electrically-operated flying tail, will be found in Sect. 3, Chap. 4

Tail plane attachments

7. The tail plane is mounted on the lower fin and rear fuselage structure by fittings bolted to the front and rear spars. The forward fitting consists of a large lever which is bolted to the forward face of the front spar centre section member at the centre-line rib and is anchored at its forward extremity to the extensible shaft of the incidence controlling actuator situated in the lower fin structure between frames 51 and 52. The rear fittings consist of hinge blocks secured to mounting blocks which are bolted to the tail plane rear spar and hinge ribs on each side, just outboard of the centre-line rib. These hinge blocks pivot on trunnions projecting from each side of the fin and tail plane attachment stamping bolted to the top of frame 55.

Elevators

8. Each elevator consists of a main and subspar, together with nose ribs, interspar ribs, tail ribs and a trailing edge member, the complete structure being covered with a light-alloy skin which is additionally strengthened by a top and bottom stiffener. The main spar carries the outer hinge, together with the inner hinge and interconnection assembly. The outer hinge consists of an adjustable ball race mounted in a bearing block bolted to the tail plane structure. The inner hinge and interconnecting assembly consists of a fork-end bolted to the inner extremity of the spar which pivots in a split bush type bearing carried in a block and cap assembly bolted to the tail plane structure. The elevators are interconnected by a split lever bolted to the fork-ends of the interconnecting assembly to form a universal joint and operating lever, which is connected to the hydraulic booster jack unit by a control tube. The nosing, between the inner and outer hinges is filled internally with lead to form a distributed mass balance. An interconnection in the form of a follow-up linkage between the elevator and the tail plane actuator provides for operation of the units as an electrically-operated flying tail. A description of the system, together with details of its operation, will be found in Sect. 3, Chap. 4

SERVICING

General

9. The servicing of the systems is described in the relevant chapters of this volume covering the system concerned. The structure, access panels and fasteners should, however, be examined in a similar manner to that described in Sect. 3, Chap. 2, and reference should be made to Sect. 3, Chap. 4 for the recommended procedure for rigging and setting the control surfaces.

Lubrication

10. It is necessary to lubricate the tail plane pivots when replacing or fitting a new tail plane (*para. 16*), otherwise the only lubrication necessary is that required for the control surface hinges and operating gear which is described in Sect. 3, Chap. 4.

REMOVAL AND ASSEMBLY

General

11. The removal of the fin, rudder, tail plane and elevators is described in the following paragraphs. In general, the assembly of the components is a reversal of the removal procedure, but where there is any special assembly feature it is covered in the paragraph concerned.

Removal of rudder

12. Disconnect the trim tab operating shaft at the rudder hinge connection—*fig. 2(2)*.

Remove the bolt from the rudder lever connection—*fig. 2(3)* and *fig. 3*—on the starboard side of the rudder.

Attach the sling (*fig. 4*).

Remove the top hinge bearing cap—*fig. 2(1)*.

Remove the bottom hinge bearing cap—*fig. 2(4) and fig. 3.*

Remove the rudder.

Note . . .

On replacement of the rudder the bolts must be fitted with the heads on top.

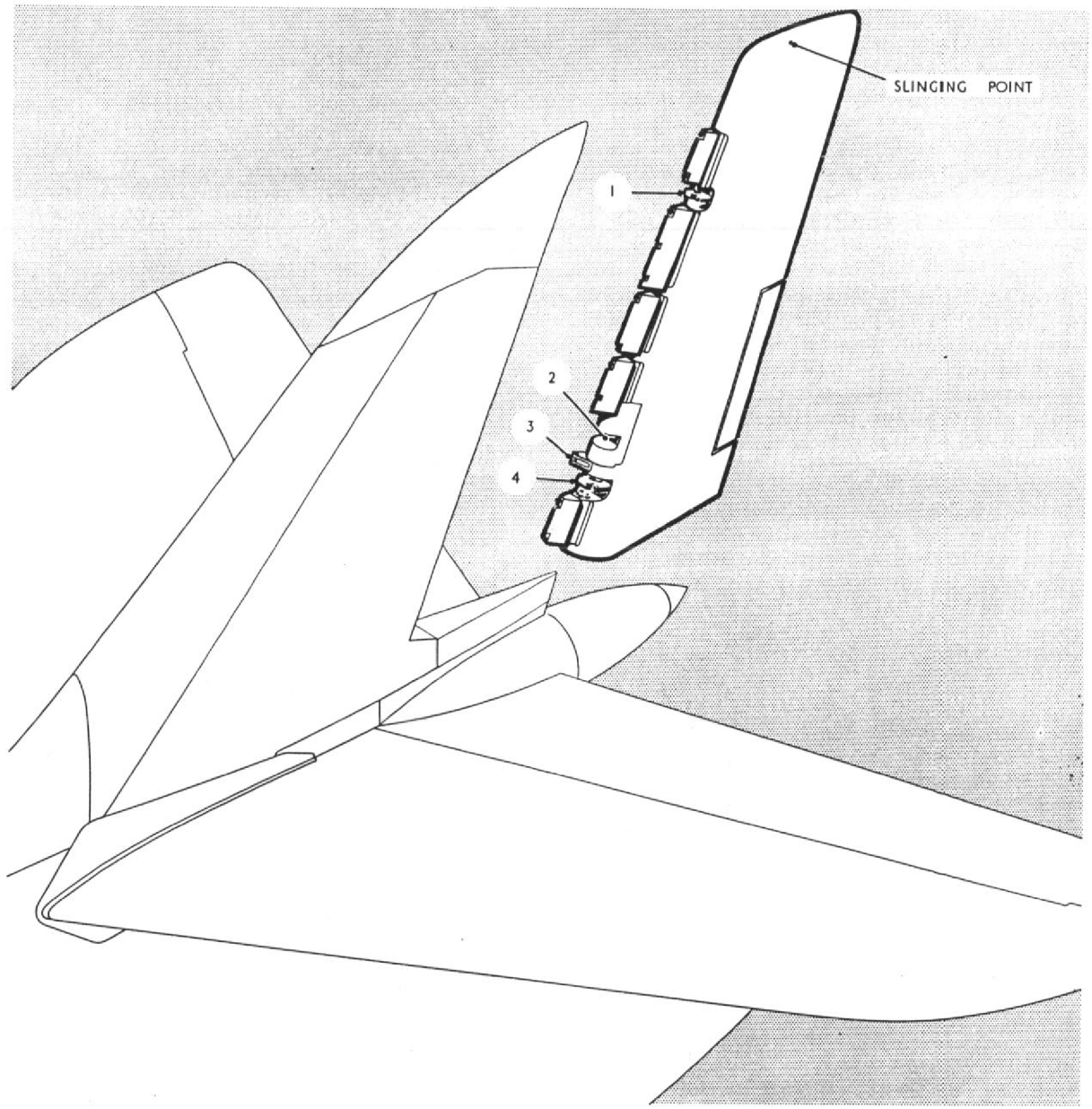


Fig. 2 Removal of rudder

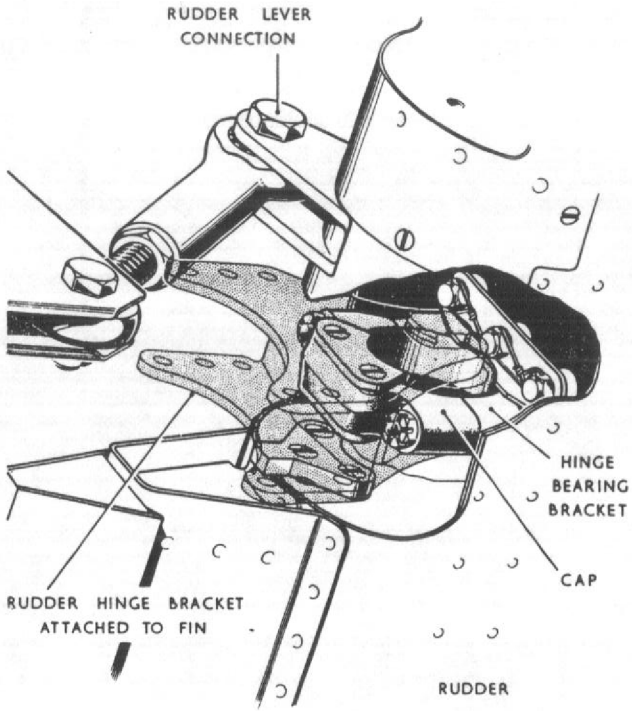


Fig. 3 Rudder operating lever and bottom hinge

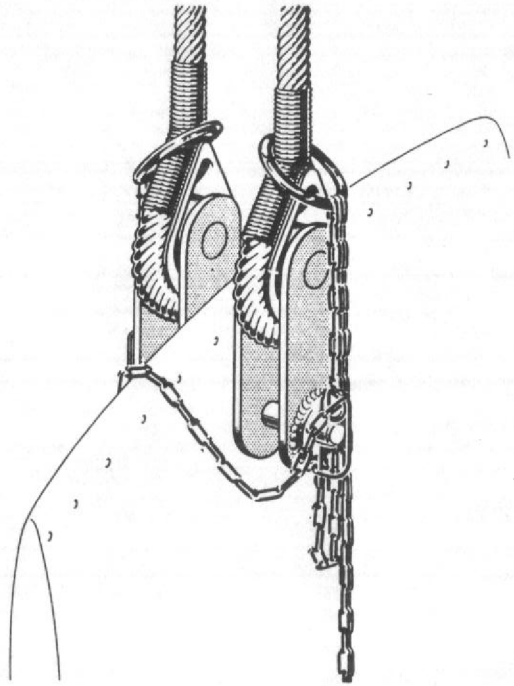


Fig. 4 Attachment of rudder sling

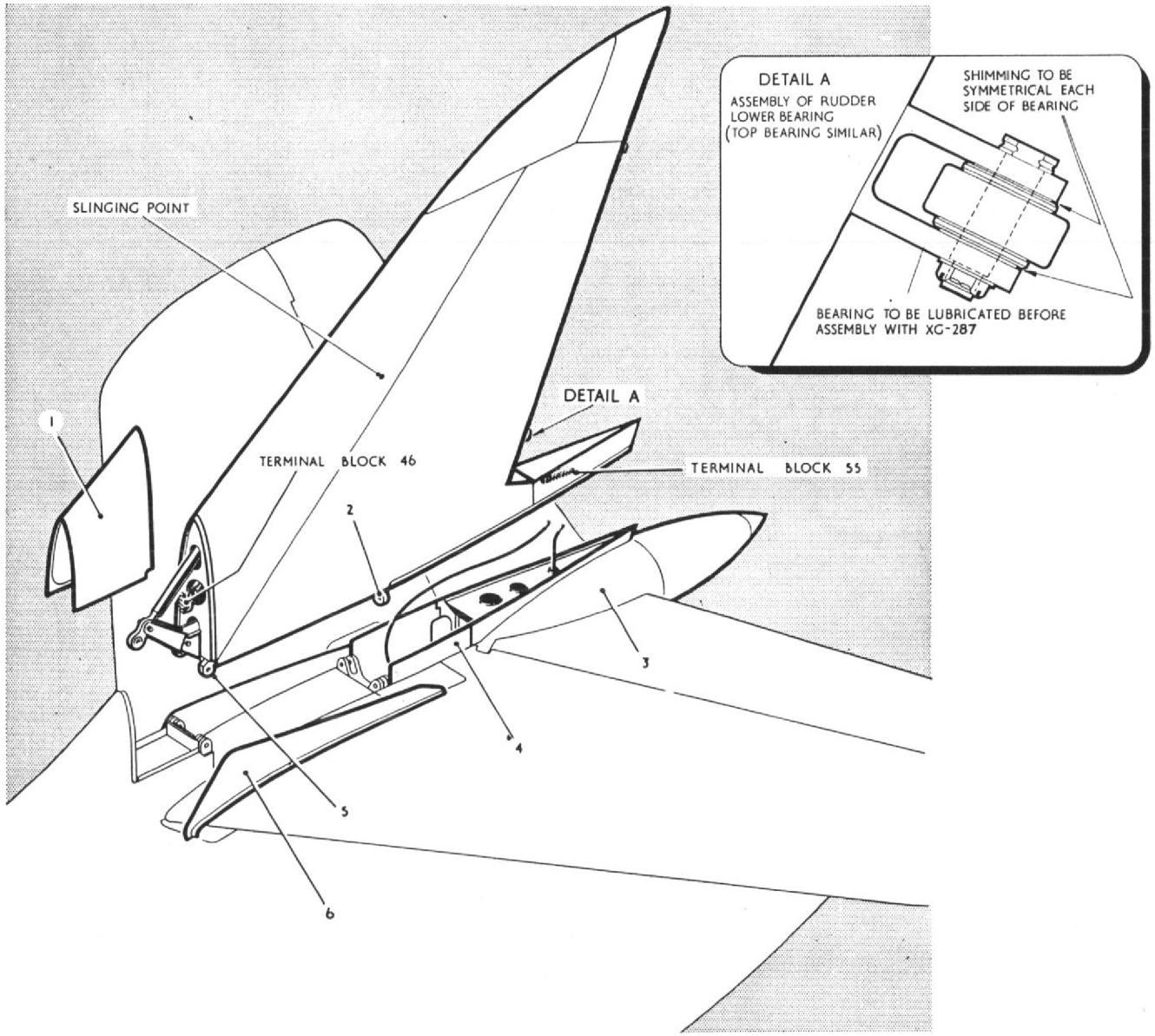


Fig.5. Removal of fin

Removal of fin

13. Remove the following:—

(*a*) rear end detachable portion of the fin

(*b*) rudder

(*c*) anti-buffet fairing—*fig. 5(3)*

(*d*) top tail plane fairings, port and starboard—*fig. 5(6)*

(*e*) access panels, port and starboard—*fig. 5(4)*

(*f*) access panel in leading edge of fin—*fig. 5(1)*.

Disconnect all electrical cables leading away from the fin at terminal blocks 46 and 55.

Disconnect the flying controls leading away from the fin.

Attach the sling to the fin (*the same sling as for the rudder is used—fig. 4—with a special pin*).

Lower the tail plane to the fully negative position.

Remove the rear attachment bolts, port and starboard—*fig. 5(2) and fig. 6.*

Remove the front attachment bolts, port and starboard—*fig. 5(5) and fig. 7.*

Lift off the fin.

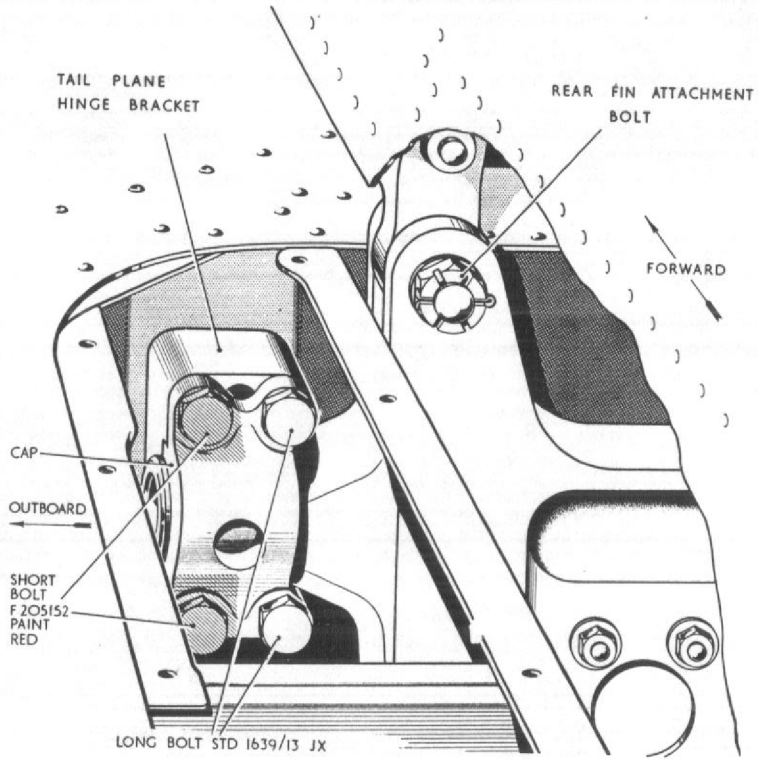


Fig. 6 Rear fin attachment and tail plane hinge bracket and cap

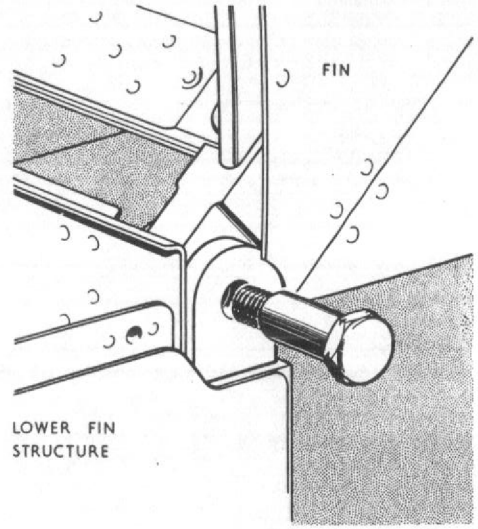


Fig. 7. Fin attachment—front

Note . . .

During assembly of the fin, ensure that there is a clearance of 0·02 ins. between the top and bottom tail plane fairings and the fin structures. This is essential to prevent scoring of the fin during tail plane movement.

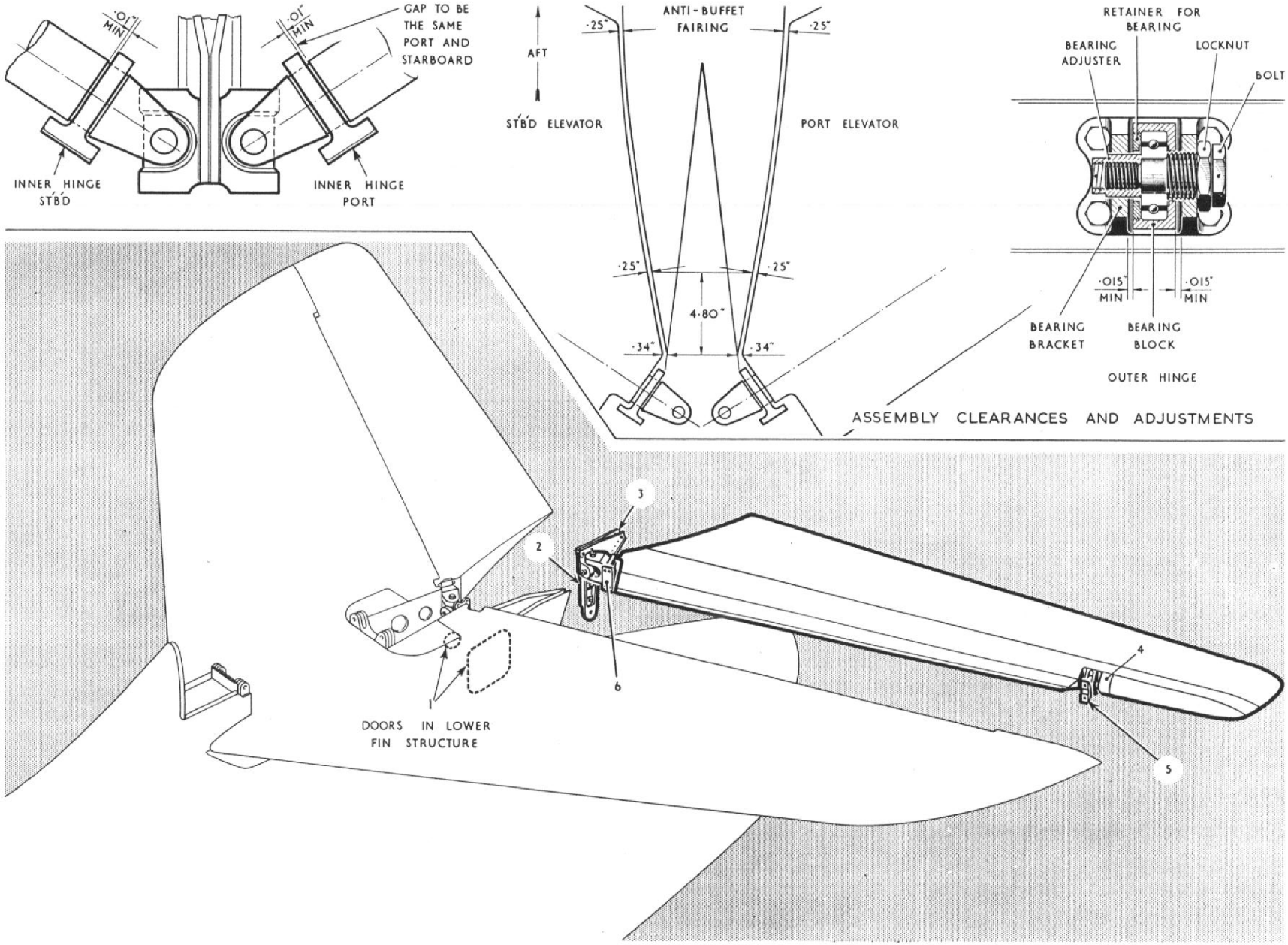


Fig. 8 Removal of elevator

Removal of elevator

14. The removal of the port elevator is described (*the removal of the starboard elevator is similar*). Either the port or the starboard elevator may be removed first but it is not advisable to remove the port and starboard elevators while attached to each other. The elevators may be removed without first removing either the rudder or the fin. If however they have been removed, the first operational sequence below will have been carried out, in which case proceed with the next operation.

Remove the anti buffet fairing—*fig. 5(3)*—and access panels—*fig. 5(4)*.

Remove the access doors—*fig. 8(1)*—to the elevator control split lever—port and starboard, and disconnect the control rod at the split lever—*fig. 9*.

Remove the pins securing the upper ends of the spring unit—*fig. 9(4)*—and the connecting rod—*fig. 9(3)*—to bracket—*fig. 8(3) and fig. 9(2)*—on the split lever.

Remove the four bolts—*fig. 9(1)*—from the elevator control split lever—*fig. 8(2)*—connecting the port and starboard elevators and take off the bracket—*fig. 8(3) and fig. 9(2)*. *The tail plane must be in the fully negative position to allow the removal of the bottom bolt on the split lever.*

Remove the two nuts attaching the outer hinge bearing block—*fig. 8(5)*—to the tail plane.

Remove the four nuts attaching the inner hinge bearing block—*fig. 8(6) and fig. 9*—to the tail plane and remove the elevator with the inner and outer bearing blocks attached. There is no provision for slinging the elevator.

Assembly of Elevators

15. The assembly of an existing elevator is the reversal of the removal procedure, but when fitting a replacement elevator the following points must be noted:—

Elevators to modification 708 standard have additional metal stiffeners riveted to the bottom skin and the gauge of the bottom skin has been increased from 26 s.w.g. to 24 s.w.g., it is therefore important that port and starboard elevators to the same modification standard are fitted i.e. both pre-mod. 708 or both post-mod. 708, preferably the latter.

When offering up the elevator the bolts attaching the bearing blocks of the inner and outer hinges should be fitted but not fully tightened until the split lever has been assembled and bolted up tight.

It will be necessary to adjust the outer locating hinge of the replacement elevator to comply with the requirements given in fig. 8. This adjustment is accomplished by screwing the hinge bolt (*assembled with head outboard*) of the outer hinge assembly in or out of the bearing bracket as required. After adjustment the adjuster and hinge bolt must be locked to the bearing bracket with 18 s.w.g. nickel alloy wire.

It is possible to adjust the outer hinge without removing the access door—*fig. 8(4)*—if the special spanners (*Pt. No. F.199406 and F.199407*) are used through the gap between the hinge and access door.

When fitting the spring unit and connecting rod ensure that the washers—*fig. 9(4a)*—are fitted as described in Sect. 3, Chap. 4.

After fitment of the elevator, check, with the tail plane at zero incidence, that the minimum gaps (*as quoted on fig. 8*) are obtained.

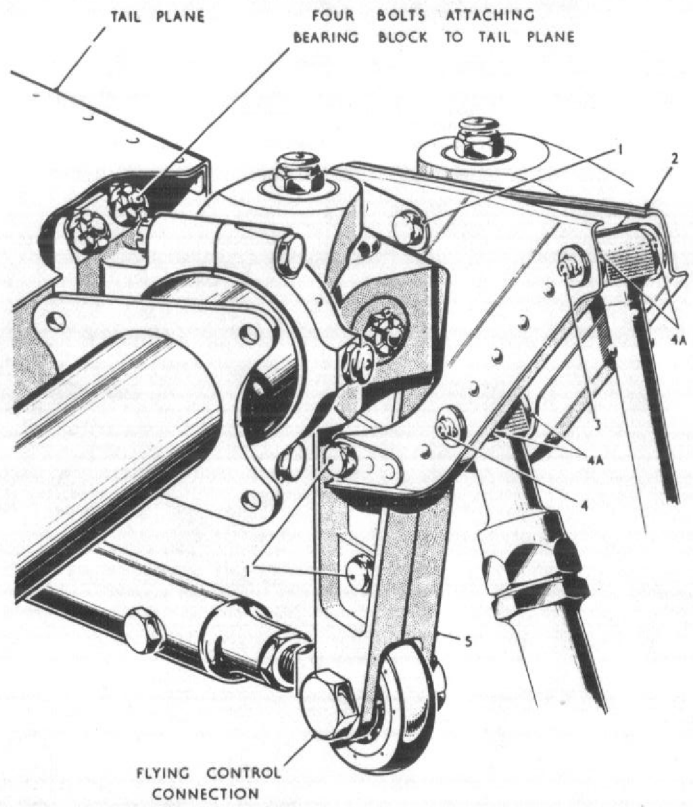


Fig. 9 Split lever connecting port and starboard elevators and inner hinge bearing

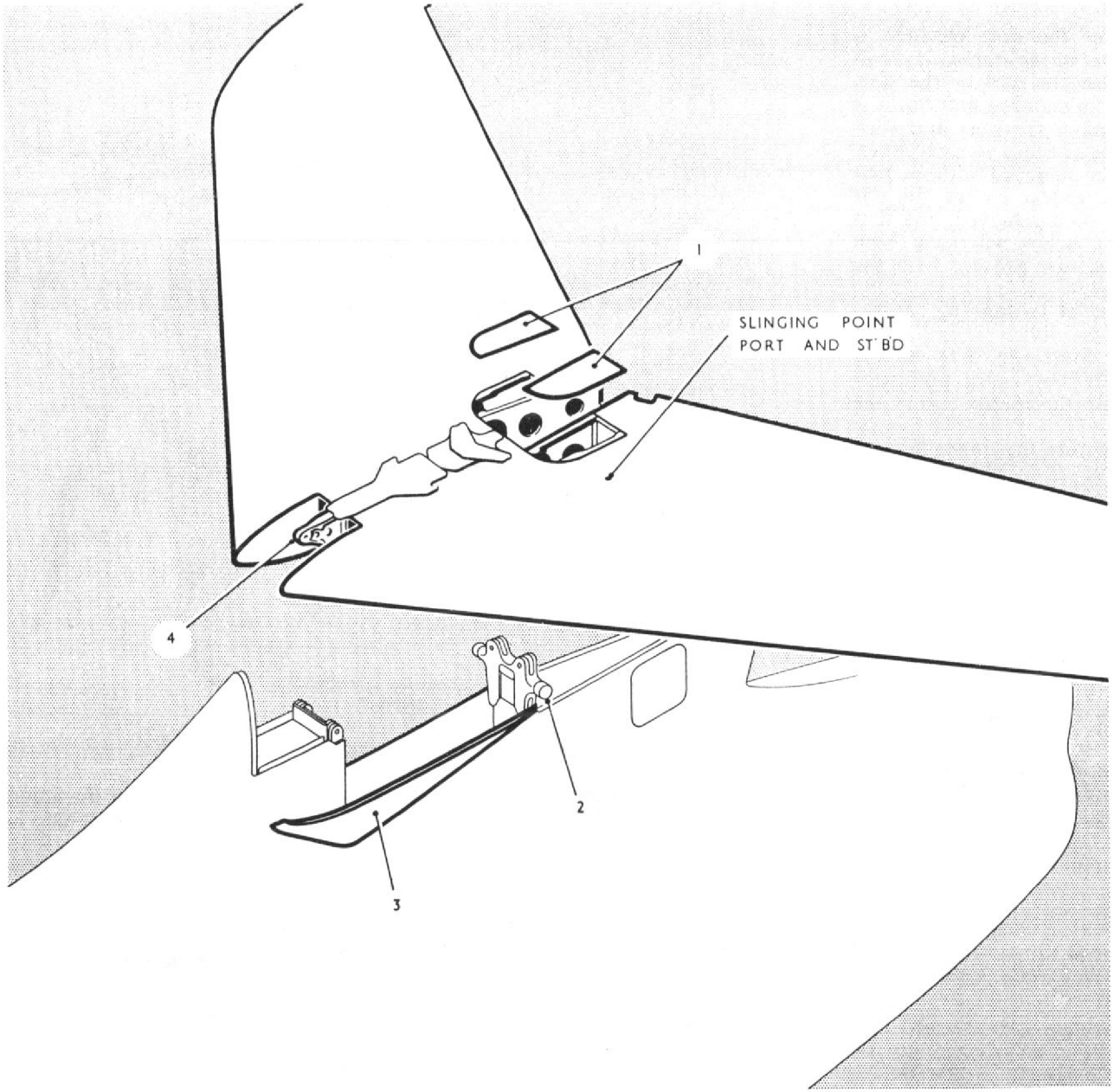


Fig. 10. Removal of tail plane

Removal of Tail Plane

16. Remove the rudder (*para. 12*).

Remove the fin (*para. 13*).

Remove the elevator (*para. 14*).

Remove the bottom tail plane fairing—*fig. 10(3)*—port and starboard.

Remove the two plugs from the lifting sockets on the upper surface of the tail plane, fit the eyebolts and attach the sling. The same sling as for fin and rudder is used but with special pins.

Disconnect the G.M. compass cable from the junction box at frame 52. Remove securing hooks of fairlead at frame 52 but do not remove fairlead from the cable.

Remove the pin from the Desynn transmitter connecting rod—*fig. 11*.

Remove the bolt attaching elevator feel unit lever and the jack lever—*fig. 10(4) and fig. 11* —on the tail plane to the actuator in the lower fin structure.

Remove the access panel—*fig. 10(1)*—port and starboard on the top surface and the access panels port and starboard on the under surface of the tail plane.

Unscrew the bolts at the hinge brackets—*fig. 6*—port and starboard and remove the caps. Push the tail plane forward until the hinge brackets can be turned—the port bracket in an anti-clockwise direction and the starboard bracket in a clockwise direction —and remove the brackets. The tail plane may now be lifted off.

The hinge brackets and caps are carefully matched and must be kept paired port and starboard.

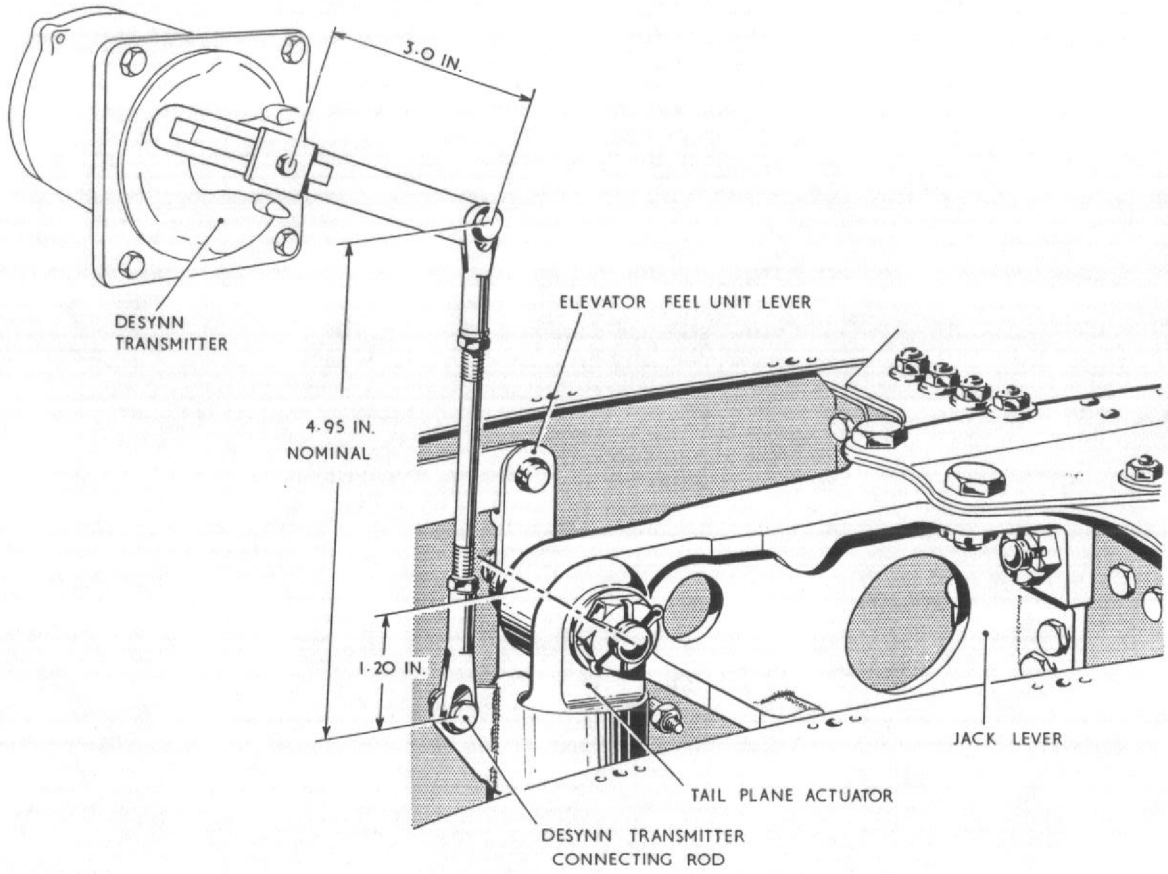


Fig. 11 Attachment of jack lever to tail plane actuator

Note . . .

During assembly of the tail plane, ensure that there is a clearance of 0.02 in. between the top and bottom tail plane fairings and the fin structure. This is essential to prevent scoring of the fin during tail plane movement.

On re-assembly, the tail plane pivots–fig.10(2)–must be smeared with grease XG–287.

◀ **Inspection of tail plane**

16A. Secondary airframe damage will occur when the tail plane actuator overruns the electrical limit switches. In all cases where this has or is suspected to have occurred a physical examination of the following sections of the tail plane is to be carried out:–

(1) The anti-buffet fairing *(fig.5, item 3)* and fixed fairings on the underside of the tail plane, port and starboard *(fig.10, item 3)* for damage and evidence of contact with tail plane or elevator.

(2) The cut out below the elevator inner hinge bearings for damage caused by contact with the hinges *(fig.12).*

(3) The angles forming the mountings for the tail plane position indicator desynn transmitter and compass correction junction box for damage caused by the elevator spring feel unit lever and its connection to the tail plane actuator *(fig.13).*

(4) The front end of the tail plane actuator ram housing, which locates the bronze guide bearing, for fractures.

Note . . .

When such evidence is found, following an overrun incident, the tail plane actuator is to be removed and examined for hair line cracks in the casting resulting from overloading. ▶

Removal of rudder bearings *(fig.5)*

17. To renew the rudder bearings on the fin, proceed as follows:–

(1) Remove rudder *(para.12)*

(2) Remove split pin, nut and washer from bearing securing bolt and remove bolt from bearing hinge together with worn bearing, chamfered washers and shim washers.

(3) Pack new bearing with grease XG–287.

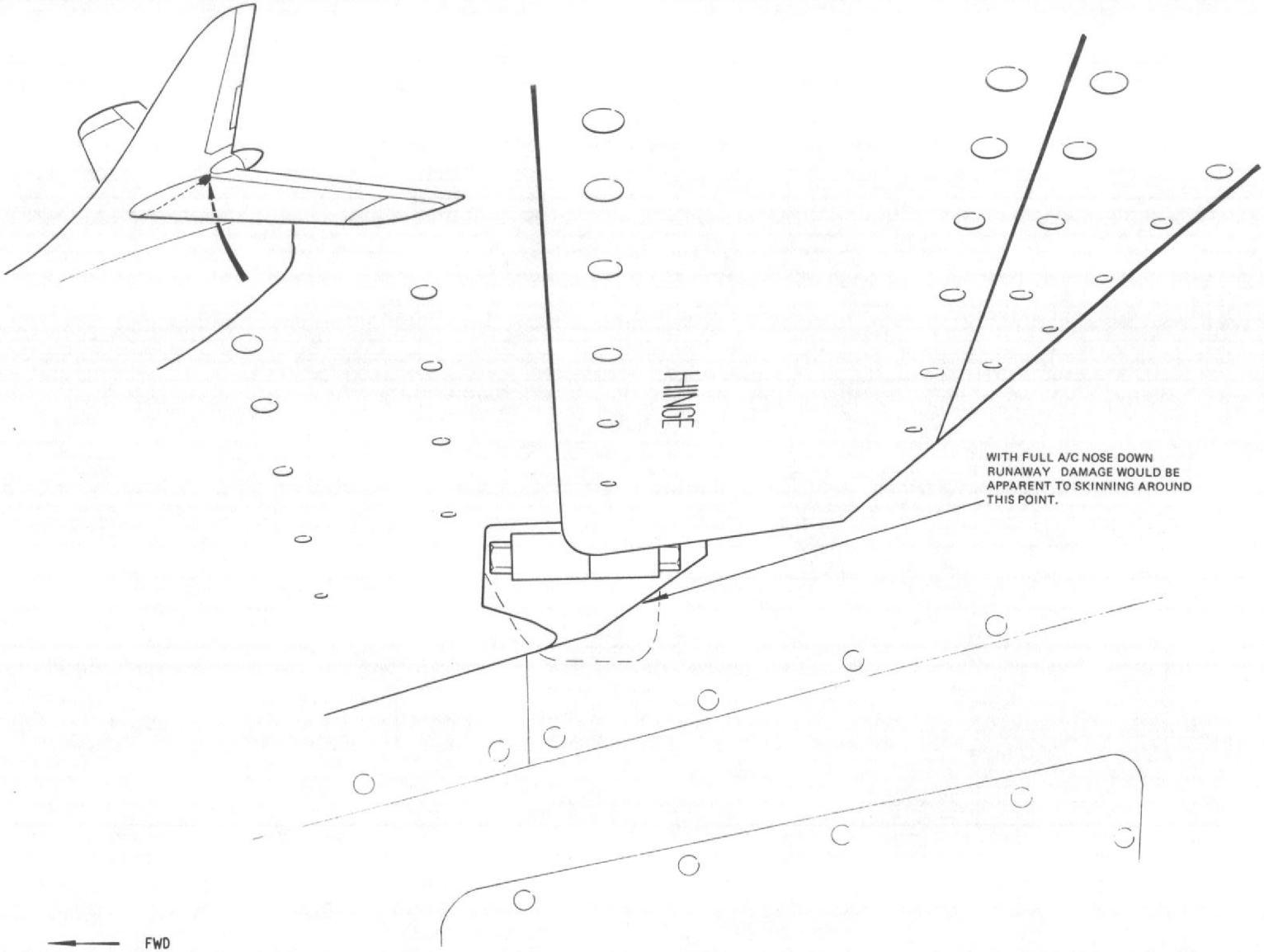
(4) Place new bearing and chamfered washers only in position and temporarily secure with bearing securing bolt, washer and nut. Tighten nut.

(5) With one of the chamfered washers bearing against the hinge bracket and the bearing in close contact with both washers, measure the clearance between the second chamfered washer and the hinge bracket, this clearance divided by two gives the correct thickness for each of the two laminated shim washers.

(6) Remove nut, washer and bearing securing bolt, insert the correct size shim washers between each chamfered washer and hinge bracket, replace bearing bolt, washer and nut, tighten nut and lock with split pin. Ensure that bearing runs free.

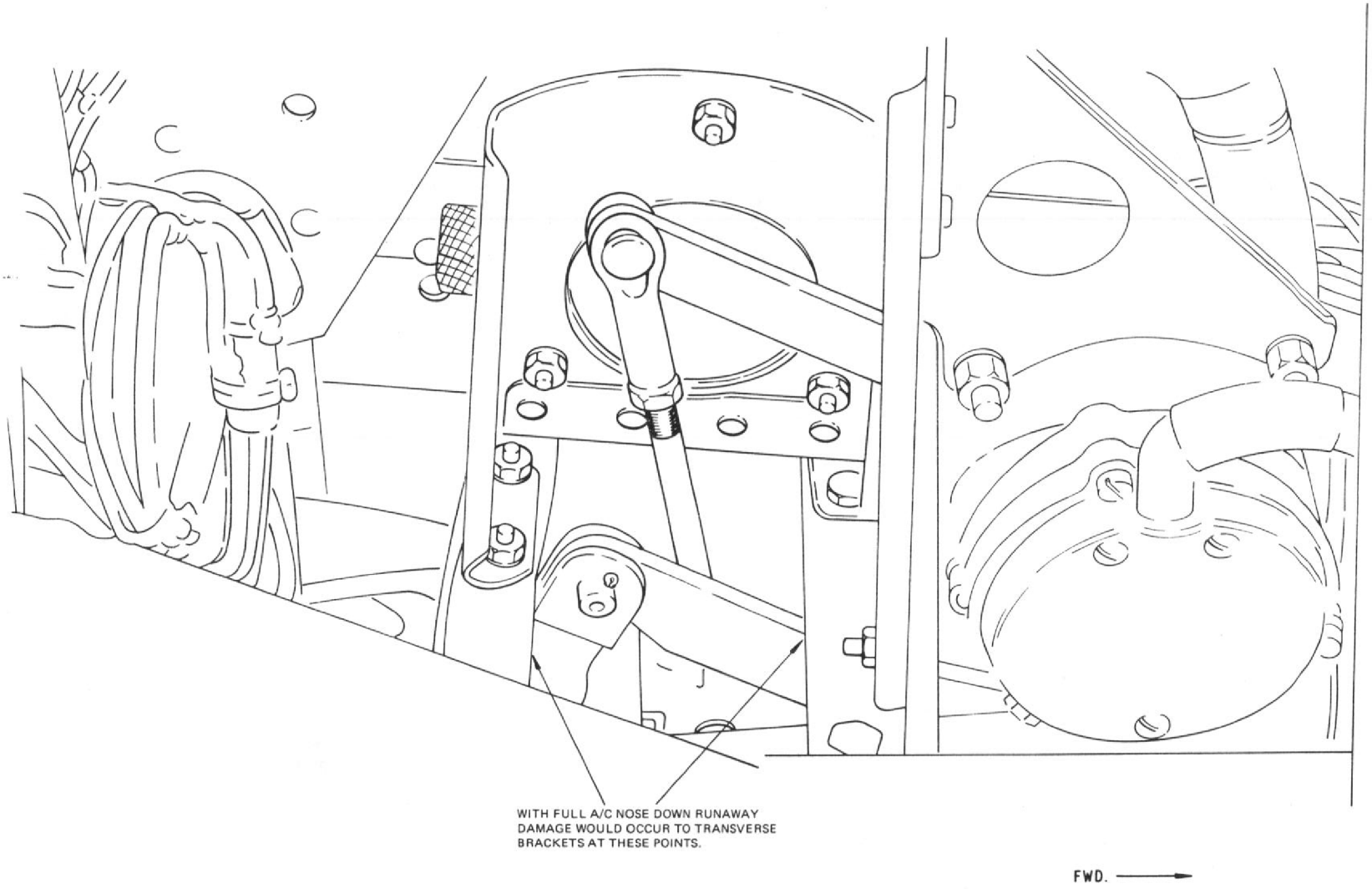
(7) Replace rudder in accordance with para. 12, but in the reverse order.

(8) Check the adjustment of the rudder and rudder trim tab *(Sect.3, Chap.4).*



VIEW ON UNDERSIDE INBOARD PORT ELEVATOR

Fig.12 Tail plane inspection (1)



VIEW ON STBD. SIDE OF FIN SHOWING DESYNN CONTROL ACCESS PANEL REMOVED

Fig.13 Tail plane inspection (2)