Chapter 2

MAIN PLANE

LIST OF CONTENTS

DESCRIPTION	Para.
Introduction	1
General	3
Front spar	6
Rear spar	8
Ribs	9
Skin plating	13
Leading edge assembly	14
Trailing edge assembly	15
Vortex generators	17
Ailerons	18
Elevators	19
REMOVAL AND ASSEMBLY	
General	21
Removal of aileron	23
Removal of elevator	24

LIST OF ILLUSTRATIONS

	Fig.
Rib positions	1
Outer wing structure	2
Wing tip (port side)	3
Aileron	4
Elevator	5
Removal of aileron	6
Removal of elevator	7

DESCRIPTION

Introduction

1. A general description of the outer wing structure is given in this chapter, together with illustrations showing the general structure assembly and various details. Further detailed information and illustrations are given in Vol.6 of this publication.

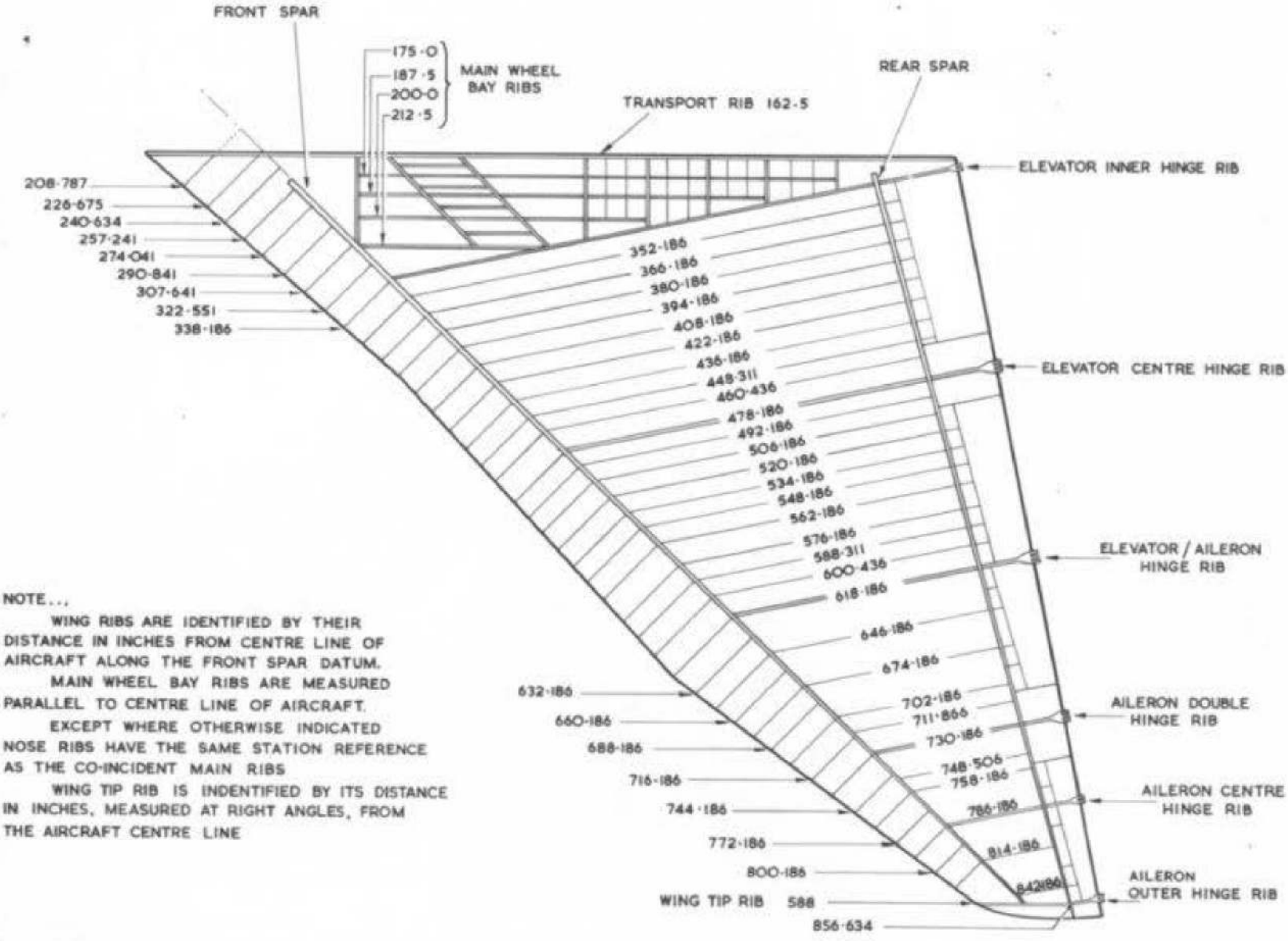
2. Descriptive and other details of the centre section, which is integral with the fuselage, have been included in Section 3, Chapter 1 of this book since the description of the main plane portion of the centre section structure cannot conveniently be separated from that of the fuselage portion.

General

3. Each outer wing is a two-spar cantilever structure with main ribs between spars, port and starboard units being bolted to the shackles on the centre section (Sect.3, Chap.1). In plan view, the outer wings have a sweep back of approximately 50 degrees on the leading edge and a slight sweep back on the trailing edge; the trailing edge is straight but the leading edge, for aerodynamic reasons, is shaped as shown in fig.1. The outer wings combine with the centre section to give a delta planform, the assembly having sufficient depth in the vicinity of the root break joint to accommodate the engines and the alighting gear.

4. As the aircraft has no conventional tail unit, the elevators are mounted in the outer wings and extend from the centre section-to-wing break joint to a main rib slightly more than halfway along each trailing edge, the ailerons extend from this rib to the wing tips. As a safety precaution the elevators and ailerons are each divided into two half sections, each half being operated by a separate electro-hydraulic powered control unit, as described in Section 3, Chapter 4, of this book. The control surface leading edges are sealed to the main plane with silicone proofed glass cloth sheeting to provide internal balances which relieve the operating loads.

5. The main-wheel unit mountings are located at the inboard ends of the outer wings, a full description of their installation being given in Section 3, Chapter 5 of this book.



NOTE...

WING RIBS ARE IDENTIFIED BY THEIR DISTANCE IN INCHES FROM CENTRE LINE OF AIRCRAFT ALONG THE FRONT SPAR DATUM.

MAIN WHEEL BAY RIBS ARE MEASURED PARALLEL TO CENTRE LINE OF AIRCRAFT.

EXCEPT WHERE OTHERWISE INDICATED NOSE RIBS HAVE THE SAME STATION REFERENCE AS THE CO-INCIDENT MAIN RIBS

WING TIP RIB IS INDENTIFIED BY ITS DISTANCE IN INCHES, MEASURED AT RIGHT ANGLES, FROM THE AIRCRAFT CENTRE LINE

Fig. I. Rib positions

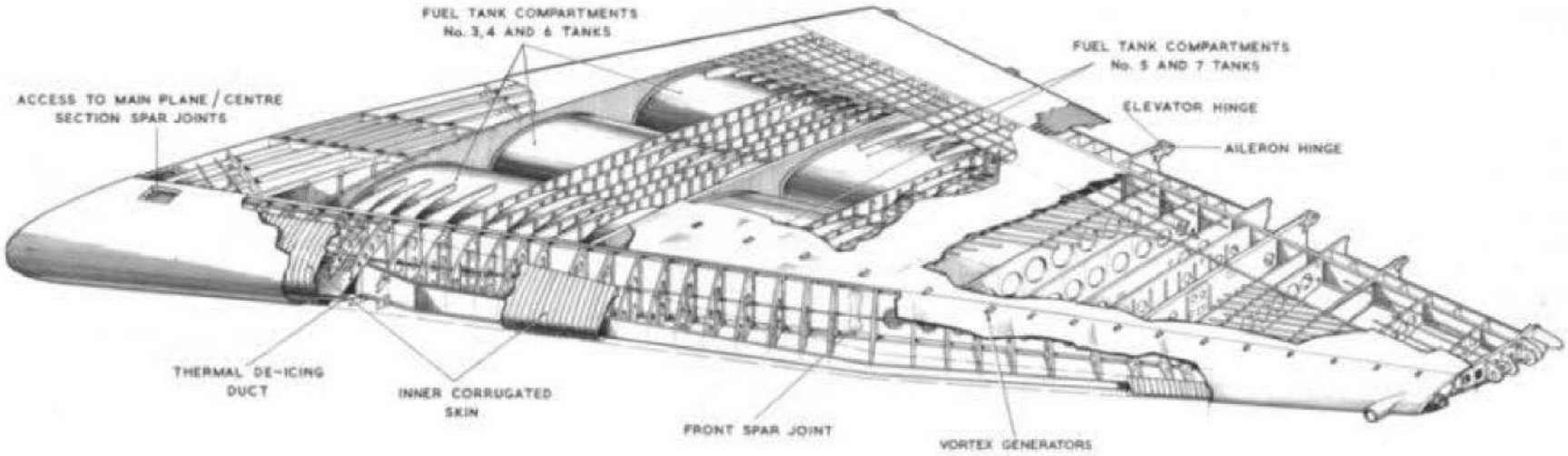


FIG.2. OUTER WING STRUCTURE.

Fig.2. Outer wing structure

FRONT SPAR

6. The front spar is built up from an upper and lower boom of machined, extruded stepped T-section aluminium alloy with a plate web between. Bolted to the rear faces of the spar booms are small brackets which form the attachments for the interspar ribs. Secured to the root ends of the booms with 1⅛ in. dia. B.S.F. joint pins are steel reinforcing plates which are bushed to accommodate the centre section shackle pins. On assembly the 1⅛ in. dia. pin nuts are torque loaded 124 (min) - 170 (max) lb.ft., and together with the plates are coated with PX-9 against rust.

7. The plate web is built up from five sections of aluminium alloy sheet joined together with strengthening plates. The sections diminish in thickness towards the wing tip, being of 9, 13, 13, 16 and 18 s.w.g. respectively. Riveted to the web plates are vertical angle-section stiffeners which also form the attachments for the leading edge nose rib sub-assembly. The spar web has flanged holes towards the outboard end to permit the exit of air from the leading edge de-icing system.

REAR SPAR

8. The rear spar is similar in construction to the front spar, consisting of machined extruded booms and web plates. The plate web is built up of four sections of aluminium alloy sheet, three sections being of 12 s.w.g. and the outer section of 16 s.w.g. thickness. Bolted to the forward faces of the spar booms are small brackets for the attachment of interspar ribs. Vertical angle-section members riveted to the rear face of the web form the attachments for the shroud diaphragms in the trailing edge section.

RIBS

9. The front and rear spars are connected by six heavy section main ribs flanked by secondary ribs. The main ribs are constructed from an upper and lower channel section boom joined by a double web-plate and extensively reinforced with lipped channel section stiffeners to carry the control surface hinge loads.

10. Between the three inner main ribs are light-alloy ribs of rolled angle section booms joined by a web-plate to which vertical top-hat section stiffeners are riveted. Large elliptical holes in the webs of these ribs have their edges reinforced with angle members to carry the light-alloy skinning which forms the fuel tank tunnels.

11. Outboard of the third main rib, the secondary ribs are constructed of angle-section edge members, with plate webs and vertical top-hat section stiffeners.

12. Inboard of the first main rib is the main-wheel unit retraction bay, which occupies a space extending longitudinally from its front bulkhead aft of the front spar to its rear bulkhead approximately half-way towards the rear spar, and transversely at the rear from the break joint rib to the first main rib. At the forward end the bay extends transversely from the break joint rib to a heavy longitudinal rib, adjacent to the first main rib and forming the larger portion of the bay outer wall. The upper structure inboard of the first main rib consists of longitudinal ribs, with intercostals at stringer No.12 and 17 positions. On the lower surface, removable panels of honeycomb construction are fitted to provide access to the interior of the wing.

SKIN PLATING

13. Over the area between the spars the covering consists of sub-assembled skin panels running span-wise and having their stringers riveted to the skin plating in the detail production stage. The attachment brackets of the stringers are then riveted to the ribs and the edges of the skin panels butt-jointed on T-section stringers.

LEADING EDGE ASSEMBLY

14. The leading edge assembly is constructed of nose ribs riveted to the front spar and covered with a double skin. Channel-section ribs are fitted up to rib 380·186 and outboard of this point plate ribs with vertical stiffeners are used. The leading edge outer skin is of 14 s.w.g. aluminium alloy, riveted to which is the inner skin, corrugated to distribute warm de-icing air. De-icing air is ducted along the whole of the leading edge, the ducting being wedge-shaped and open at its forward end as far as rib 380·186. At this point the upper and lower sides of the wedge-shaped duct terminate, the warm air passage from here outboard being formed by the continuing rear side of the original duct and the leading edge double skin.

TRAILING EDGE ASSEMBLY

15. Aft of the rear spar, the trailing edge assembly consists of extensions to the six main ribs which carry the hinges of the control surfaces. Between the hinge ribs and riveted to the rear spar are diaphragm members, which, together with transverse angle section members form the attachment for the curved portion of the shroud.

16. On the upper surface of the trailing edge are fixed shroud panels of double skin construction consisting of an outer light-alloy skin plate with an inner corrugated skin. On the lower side are the hinged shroud panels, which are also of double skin construction.

VORTEX GENERATORS

17. Sixteen vortex generators are

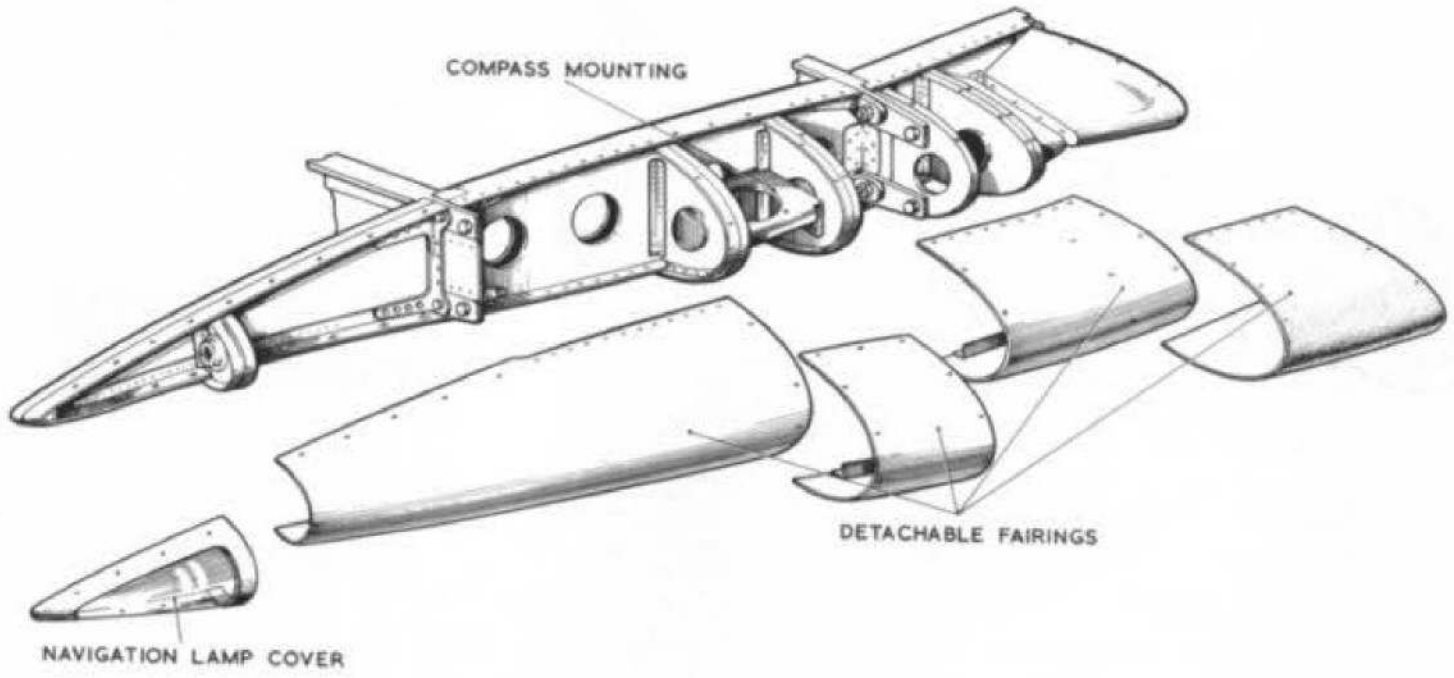


Fig. 3. Wing tip (port side)

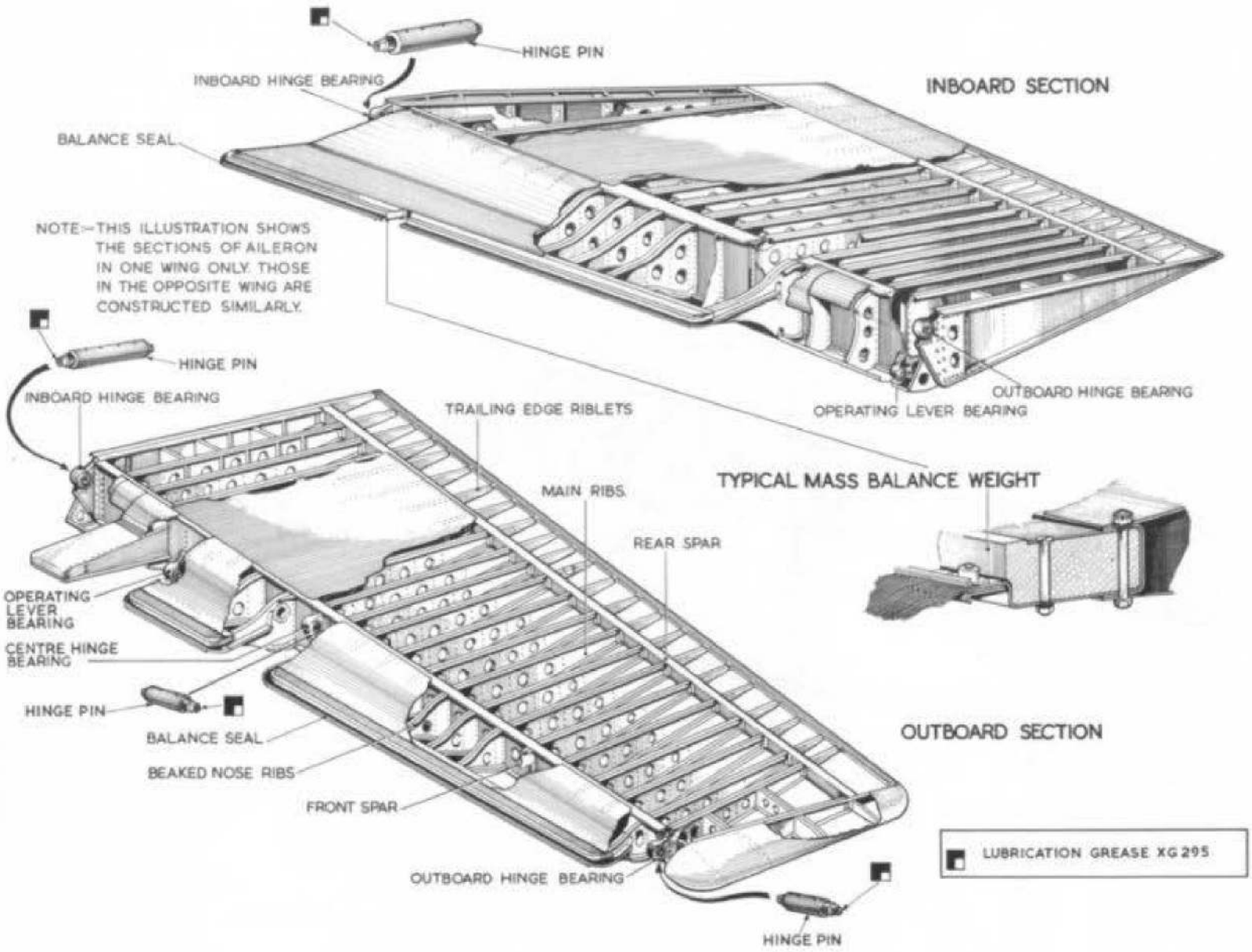


Fig. 4. Aileron

RESTRICTED

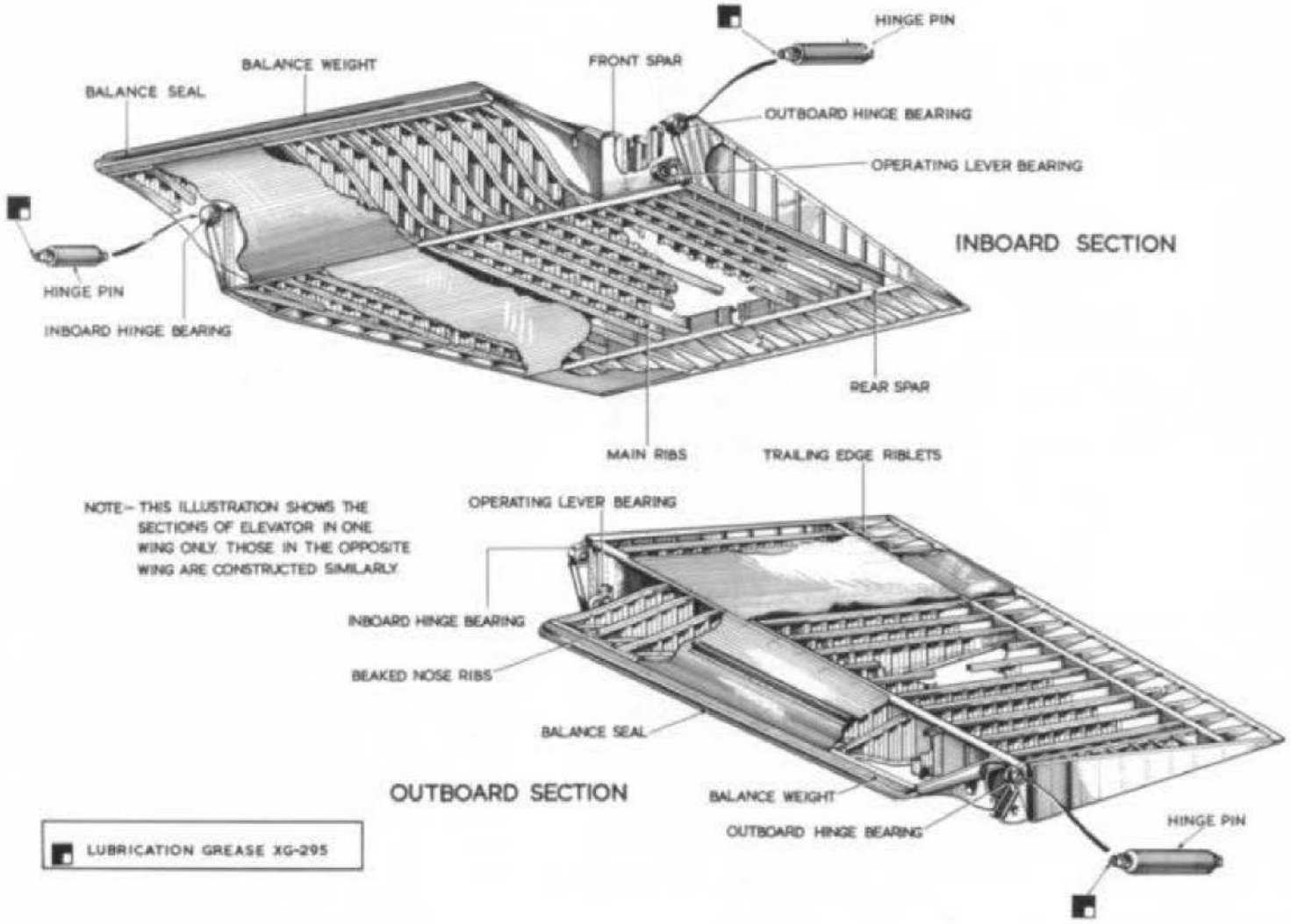


Fig. 5. Elevator

attached to the top surface of each outer wing at an angle of 20 ± 1 deg. outboard to the line of flight. The generators are set in two lines, one behind the front spar running inboard from wing rib 618·186 and the other forward of the front spar running outboard from wing rib 618·186.

AILERONS

18. Each aileron is divided into two half sections (para.4), each section being carried on the wing trailing edge by a pin and self aligning roller race hinge at each end, the outer half also has a central main hinge of a similar type. The sections are built up of forward and rear spars with pressed ribs between. The front spar, which also carries beak nose ribs, consisting of an upper and lower stepped T-section extruded boom joined by a plate web with channel section reinforcing members. The rear spar, a channel-section member, forms the attachment on its forward face for the main ribs, on the rear face are flanged trailing edge riblets. Between the spars the ribs are pressed members with flanged lightening holes and angle section members on their edges for the attachment of the skin plating, which is of magnesium alloy except the bottom trailing edge skins which are of aluminium alloy. Mass balancing of the aileron is effected by mild steel and lead weights bolted to the leading edge. Information on aileron mass balancing is given in Sect.3, Chap.4.

ELEVATORS

19. The elevators, like the ailerons, are each divided into half sections, each section being carried on the wing trailing edge by a pin and self-aligning roller race hinge at each end. The sections are each built up of a main front spar and an auxiliary rear spar, nose ribs, interspar ribs and tail ribs. The forward main spars each consist of an upper and a lower T-section extruded boom, joined by a web built up of five sections of light alloy plate of varying thickness connected by strap plates. Vertical angle-section members are riveted to the forward and aft faces of the spar. The auxiliary spars are of magnesium alloy channel section.

20. The interspar main ribs have channel-section booms and corrugated section webs of magnesium alloy, with longitudinal reinforcing strips at the top and bottom of the webs. Control ribs 17 and 20 have a T-section extruded lower boom and a double angle section upper boom of light alloy with a magnesium alloy flat plate web, and vertical angle section stiffeners. Hinge ribs 18 and 19 have an extruded T-section upper boom and a double angle section lower boom with a light alloy plate web and vertical angle section stiffeners. Beaked nose ribs attached to the main spar have light alloy channel-section booms and magnesium alloy corrugated webs, and magnesium alloy tail ribs with a single light alloy stiffener are attached to the rear of the auxiliary spar. Mass balancing of the elevators is effected by mild steel and lead weights bolted on the leading edge. Information on elevator mass balancing is given in Sect.3, Chap.4.

REMOVAL AND ASSEMBLY

General

21. Recommended procedures for the removal of an aileron and an elevator are given in para.26 and 27 and shown in fig.7 and 8. No procedure is given for the removal of the main outer wing, as this operation is covered in Vol.6 of this publication. Care must be exercised during removal operations to avoid damage to components and removed aerofoils must not be placed on any surface which could cause scratches or other damage to the skin covering.

22. The replacement procedure for ailerons or elevators is a reversal of the removal process. After assembly, power units must be filled and bled in accordance with instructions in A.P.4603C (ailerons) and A.P.4603D (elevators), and ailerons and elevators checked for correct movement and for full and free travel. All hinge pins must be lubricated using grease XG-295.

REMOVAL OF AILERON

23. For removal of an aileron proceed as follows:-

(1) Lower the bottom hinged shroud panels.

(2) Disconnect the balance sealing fabric from the aileron leading edge.

(3) Disconnect, at the aileron, end, the interconnection rods between the aileron and its associated power unit.

(4) Remove the screwed plugs (Pt.No. 10/H2378) at the lifting points and fit the sling eyebolts.

(5) Fit the aileron sling Ref.No. 26DC/95018 (inboard aileron) or 26DC/95019 (outboard aileron) and attach to a suitable hoist or crane.

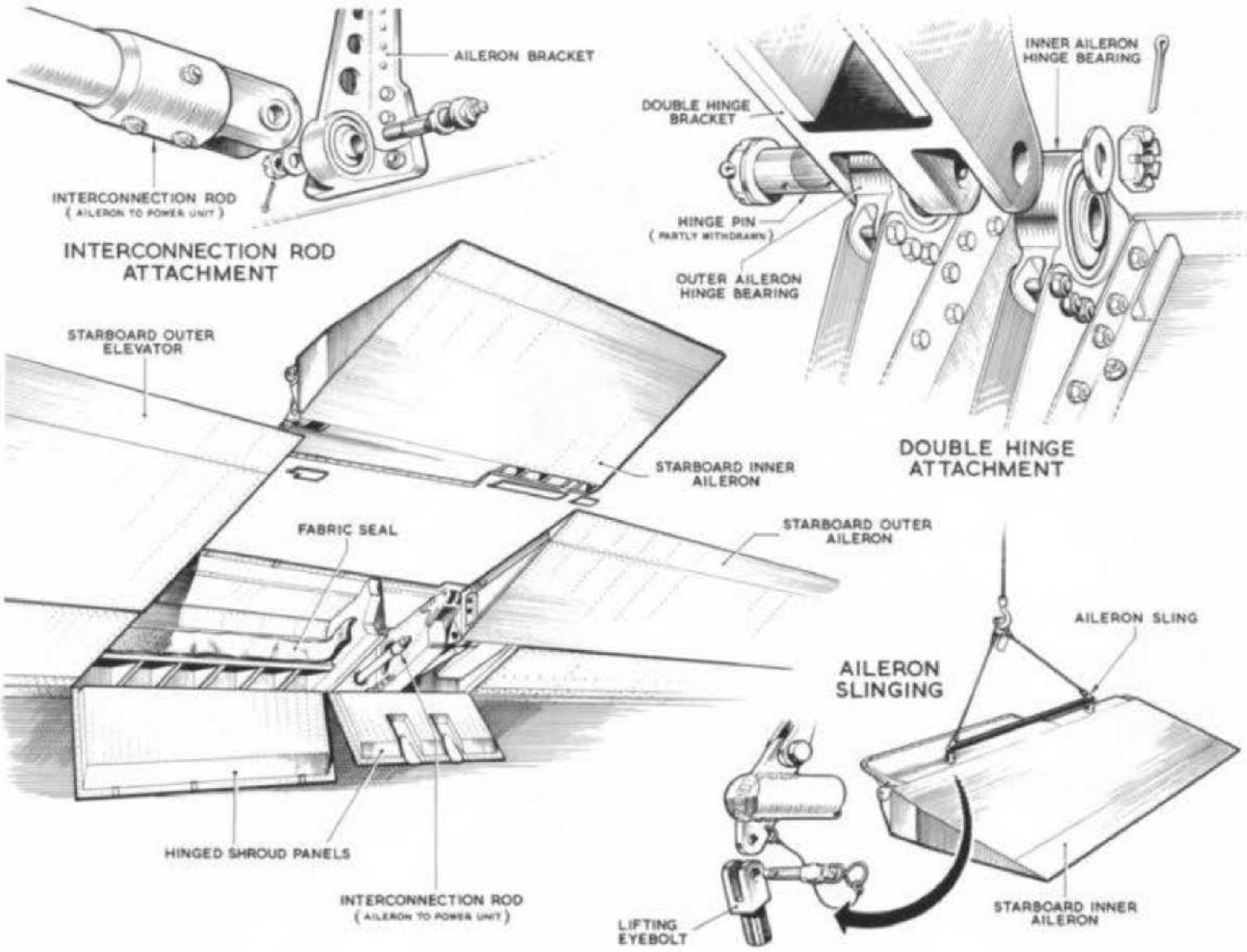


Fig. 6. Removal of aileron

RESTRICTED

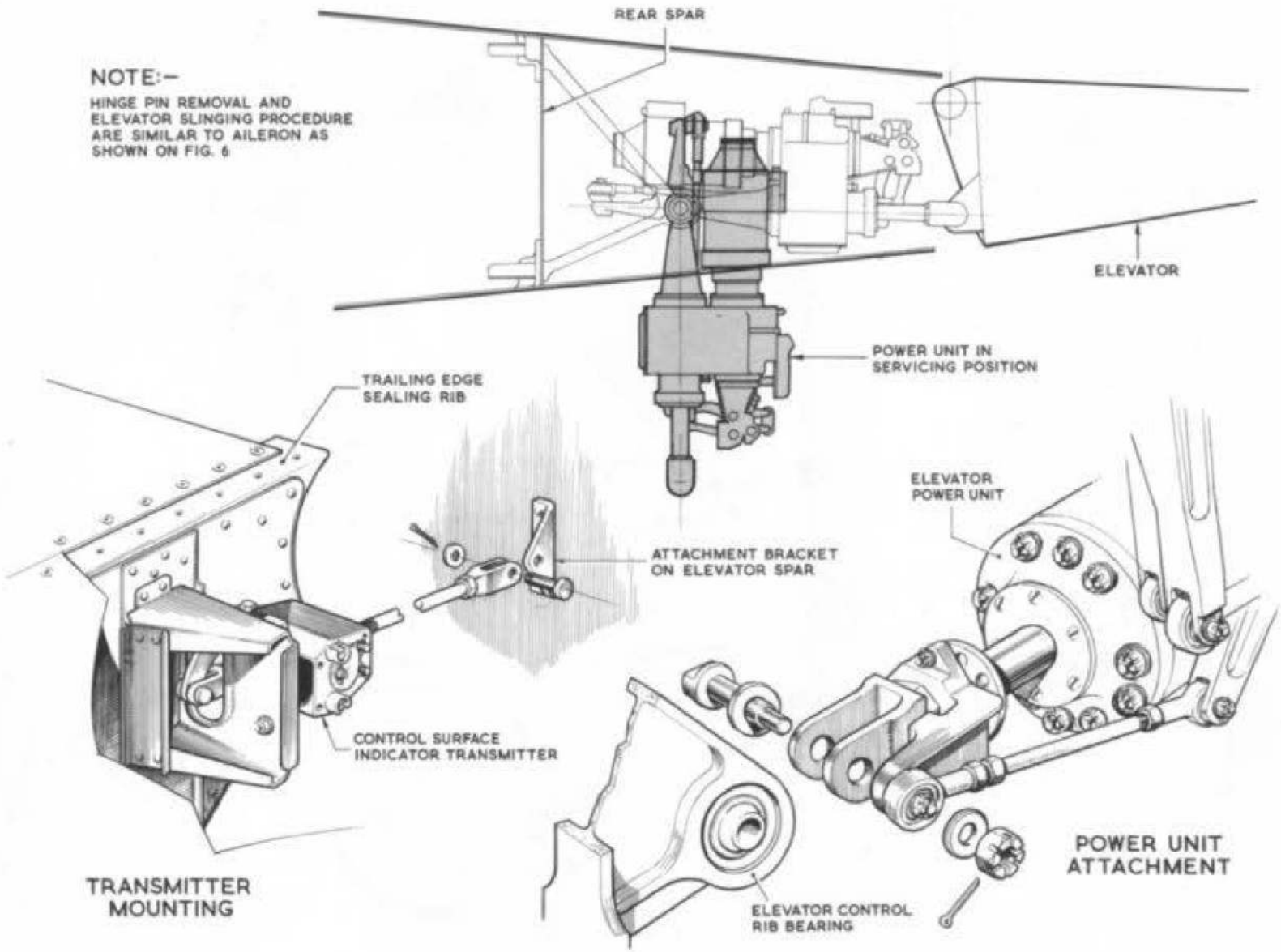


Fig.7 Removal of elevator

RESTRICTED

(6) Adequately support adjacent control surfaces.

(7) With the sling cables just tensioned withdraw the aileron hinge pins, ensuring that the double hinge pins are only withdrawn sufficiently to allow the removal of the required aerofoil.

(8) Remove the aileron.

REMOVAL OF ELEVATOR

24. As the major part of the procedure for the removal of an elevator is similar to that for an aileron, fig.7 may be used for reference, as well as fig.8 which illustrates any differences. The sequence of operations is as follows:-

(1) Lower the bottom hinged shroud panels and the power unit access doors.

(2) Remove the hinged access panels from the elevator in the region of the power unit.

(3) Disconnect the balance sealing fabric from the elevator leading edge and disconnect the control surface indicator transmitter rod at the control surface end.

(4) Disconnect the relevant power unit so that it is in the servicing position, i.e., depending from its main attachment (Sect.3, Chap.4 of this book on removal of elevator power units).

(5) Remove the screwed plugs (Pt.No. 10/H2378) at the lifting points on the elevator and fit the sling eyebolts.

(6) Fit the elevator sling, Ref.No. 26DC/95013 (inboard elevator) or 26DC/95014 (outboard elevator) and attach to a suitable hoist or crane.

(7) Adequately support adjacent control surfaces.

(8) With the sling cables just tensioned withdraw the elevator hinge pins, ensuring that the double hinge pins are only withdrawn sufficiently to allow removal of the required aerofoil.

(9) Remove the elevator.