Chapter 4 FLYING CONTROLS

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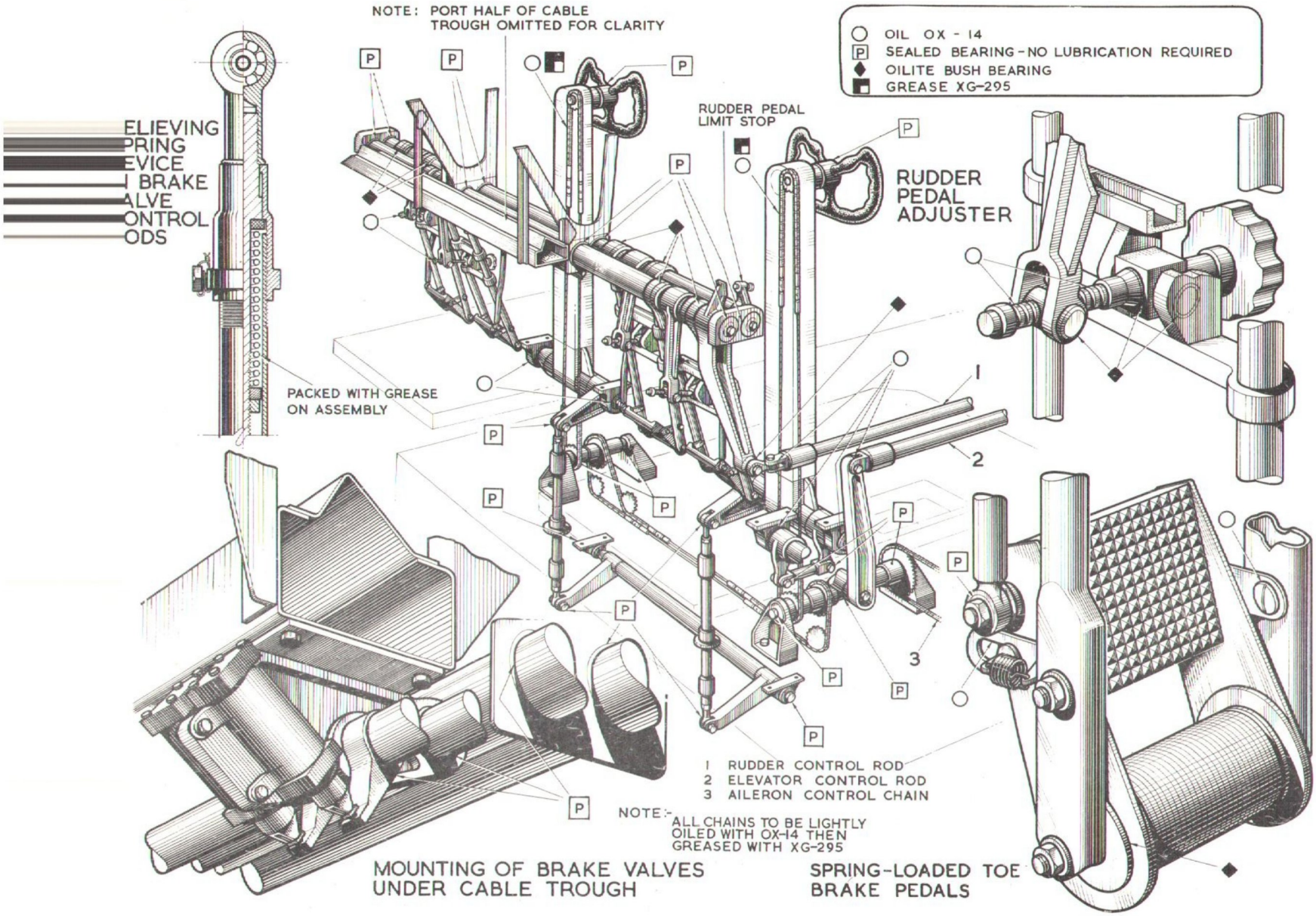

Fig.1. Flying controls in cockpit

(◀ Lubrication amended ▶)

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DESCRIPTION AND OPERATION

Introduction

1. The flying controls consist of:-

(1) Ailerons - operated by a hand wheel on the control column.

(2) Elevators - operated by a fore-and-aft movement of the control column.

(3) Rudders - operated by pendulum type rudder pedals, mounted forward of the pilots' instrument panel.

(4) Trim tabs - actuated by hand wheels on the two control gearboxes, one of which is located outboard of each pilot's seat.

Provision is made for locking the rudders by remote control from the cockpit and the system is so arranged that ailerons and elevators cannot be locked until the rudders have been locked. This latter operation also restricts the throttle control lever movement to give only taxying r.p.m.

2. Hydraulically operated flaps are positioned in three sections on the underside of each main plane, and, in addition to manual flying controls, the aircraft is equipped with a Mk.9 automatic pilot.

MAIN AND TAB CONTROLS

Flying controls in cockpit (fig.1)

Control columns

3. Each of the two control columns houses a sprocket and chain operated by the aileron hand wheels. At each end of the chain is an adjustable turnbuckle which also serves to convert the control run at this point to cable. Each control column has an access door on its aft face through which the turnbuckles are reached. Fore-and-aft movement of the control columns is synchronised by a cross-shaft mounted transversely under the floor, and two connection tubes (the starboard being adjustable) carried between cranks on the cross-shaft and on the inboard ends of the control column shaft. Fixed angle bracket stops, located fore and aft of each control column, define its maximum forward and rearward travel.

Hand wheels

4. Each hand wheel shaft carries a sprocket at its forward end, connected to a layshaft located directly below each control column. Sprockets on the two layshafts are interconnected by chains and tie-rods which pass under the floor. Control tension and hand wheel synchronisation are effected by the turnbuckles in the control columns and by turnbuckles between the two layshafts.

Rudder pedals

5. Movement of the rudder pedals is transferred to two transverse shafts and synchronisation of pedal movement is effected by sets of gears, located at the outer end of each shaft and immediately outboard of the port support brackets. The support brackets are bolted to the roof of the nose section at formers E and F. Adjustment of the rudder pedals, to suit individual pilots, is effected by operation of a hand wheel mounted on each separate rudder pedal. Each pedal is also equipped with a toe operated brake pedal, the left and right pedals controlling the port and starboard wheel brakes respectively.

6. Four brake relay valves are mounted under an electric cable trough, which is fitted across the rear of the nose section. The operation of this system is described in Chapter 7 of this section.

CONTROLS IN FUSELAGE

Aileron Controls (fig.2)

7. The aileron control layshaft under the port control column has a sprocket at its aft end and carries a chain which passes aft round two idler sprockets located to port at former C. Forward of former B, the controls change to tie-rods, and to cable immediately forward of the front spar. Turnbuckles are provided to give adjustment at this point for centralising the hand wheel in relation to the controls. The two cables then pass through holes in the front spar and over pulleys aft of the spar, reverting, forward of the rear spar, to chains which pass through the spar and around idler sprockets to starboard. The tie-rods connect the chains to the upper and lower ends of a rocker lever assembly to which are secured the aileron push-pull tubes.

8. The automatic pilot aileron servomotor is fitted forward of the centre of the rear spar, and drives a sprocket coupled by a chain to the forward side of the rocker lever assembly. The push-pull tubes pass to port and starboard along the rear face of the rear spar to suspension levers at each centre plane intermediate plane joint. Push pull tubes then pass along the intermediate trailing edge, with adjusters outboard of rib 9, to points opposite the division between each inner and outer aileron and are connected to the aileron control linkages. The bearings for the push-pull rods in the main plane are similar to those for the rudder and elevator push-pull rods in the fuselage (fig.3, detail B).

Elevator controls (fig.3)

9. A transverse shaft, carrying the port control column, extends beyond the outer edge of the first pilot's floor and carries a lever which is connected to the forward end of the elevator control push-pull rod. This runs aft in bearings composed of three rollers set at 120 deg. (detail B) and has an adjustable connection situated between formers 4 and 5. Immediately forward of former 14 is an offset connection to bring the rods inside the formers, (detail A) and aft of former 30 is a connector

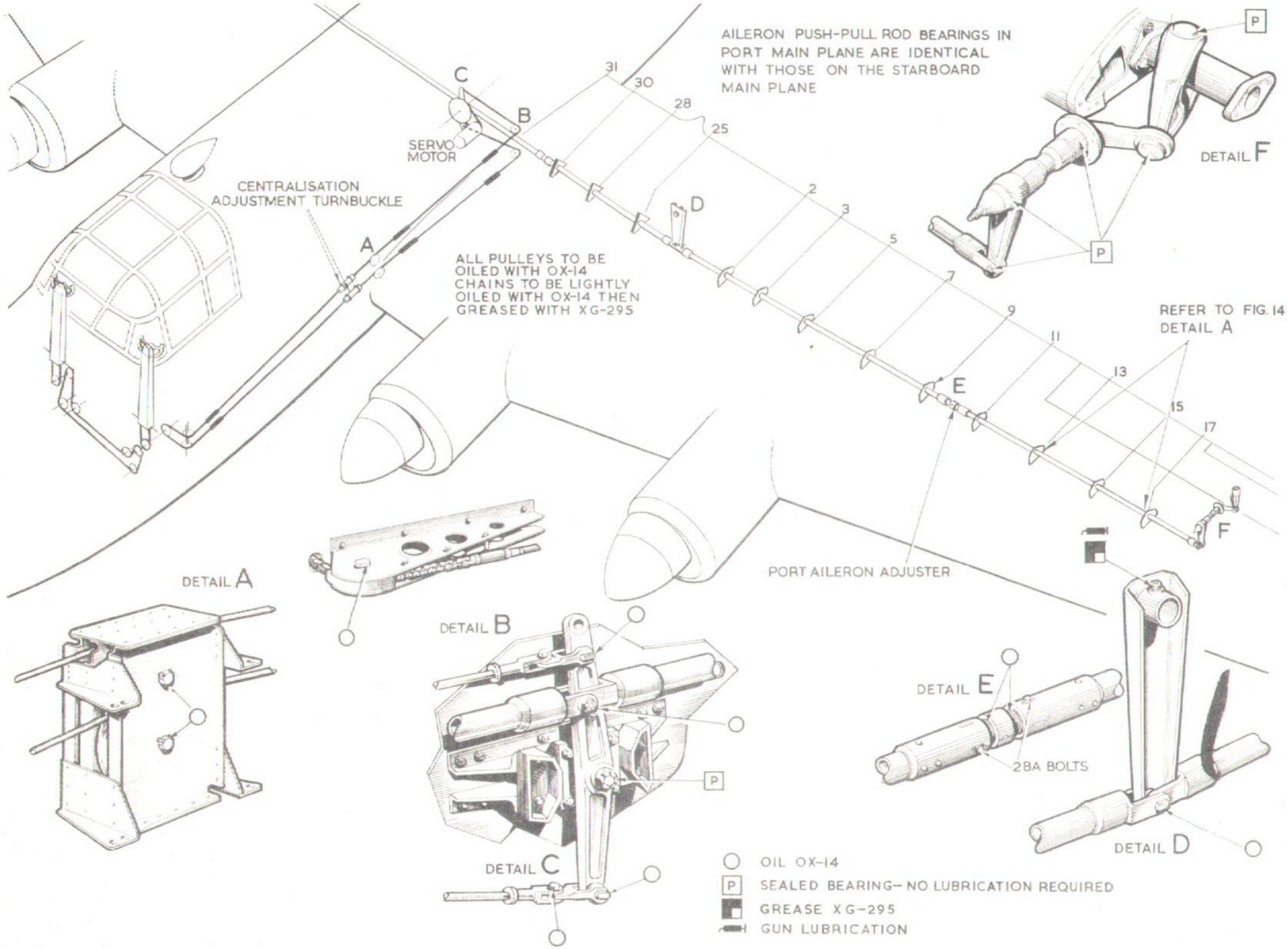

Fig. 2 Aileron controls

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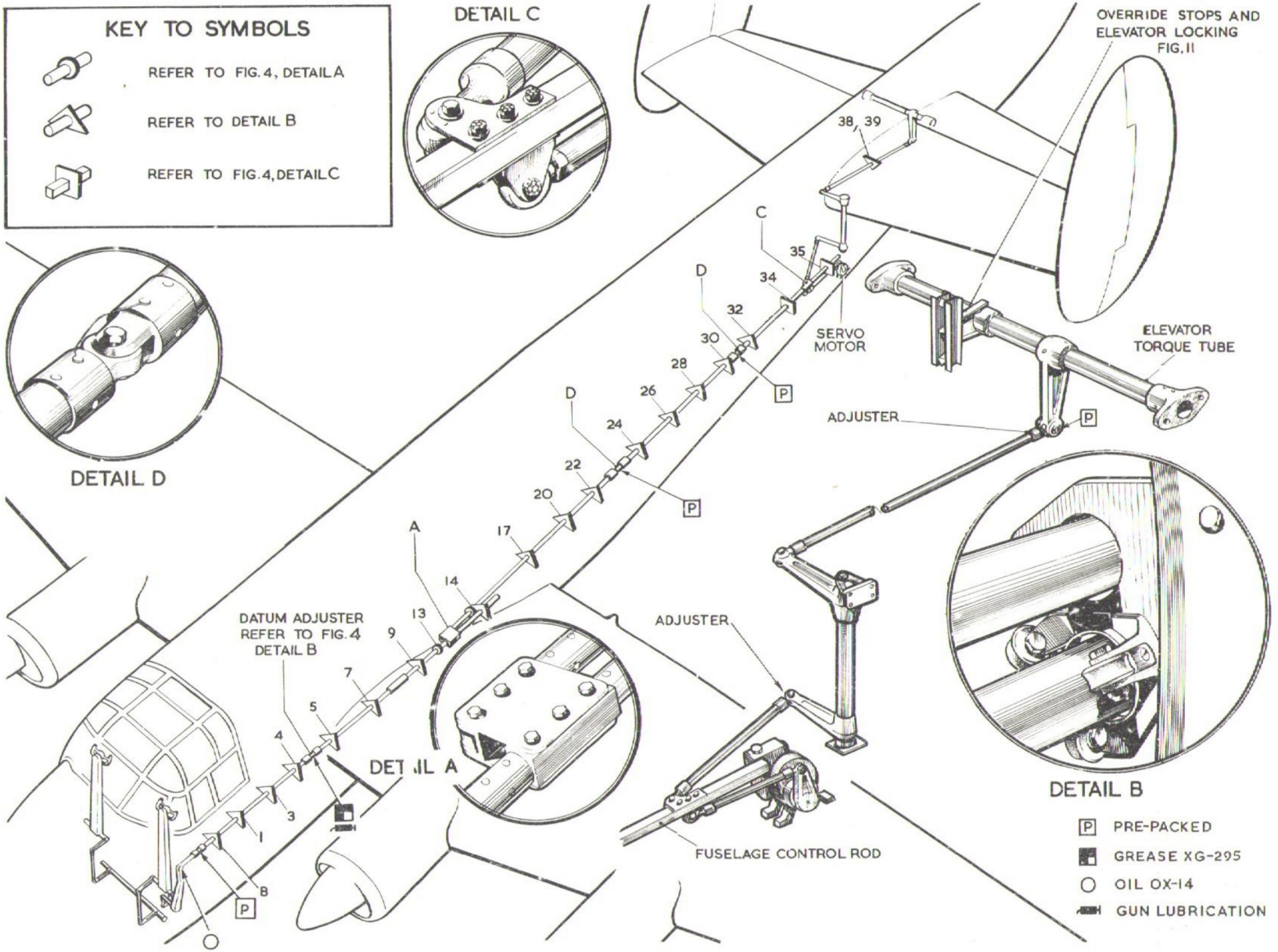

Fig. 3. Elevator controls
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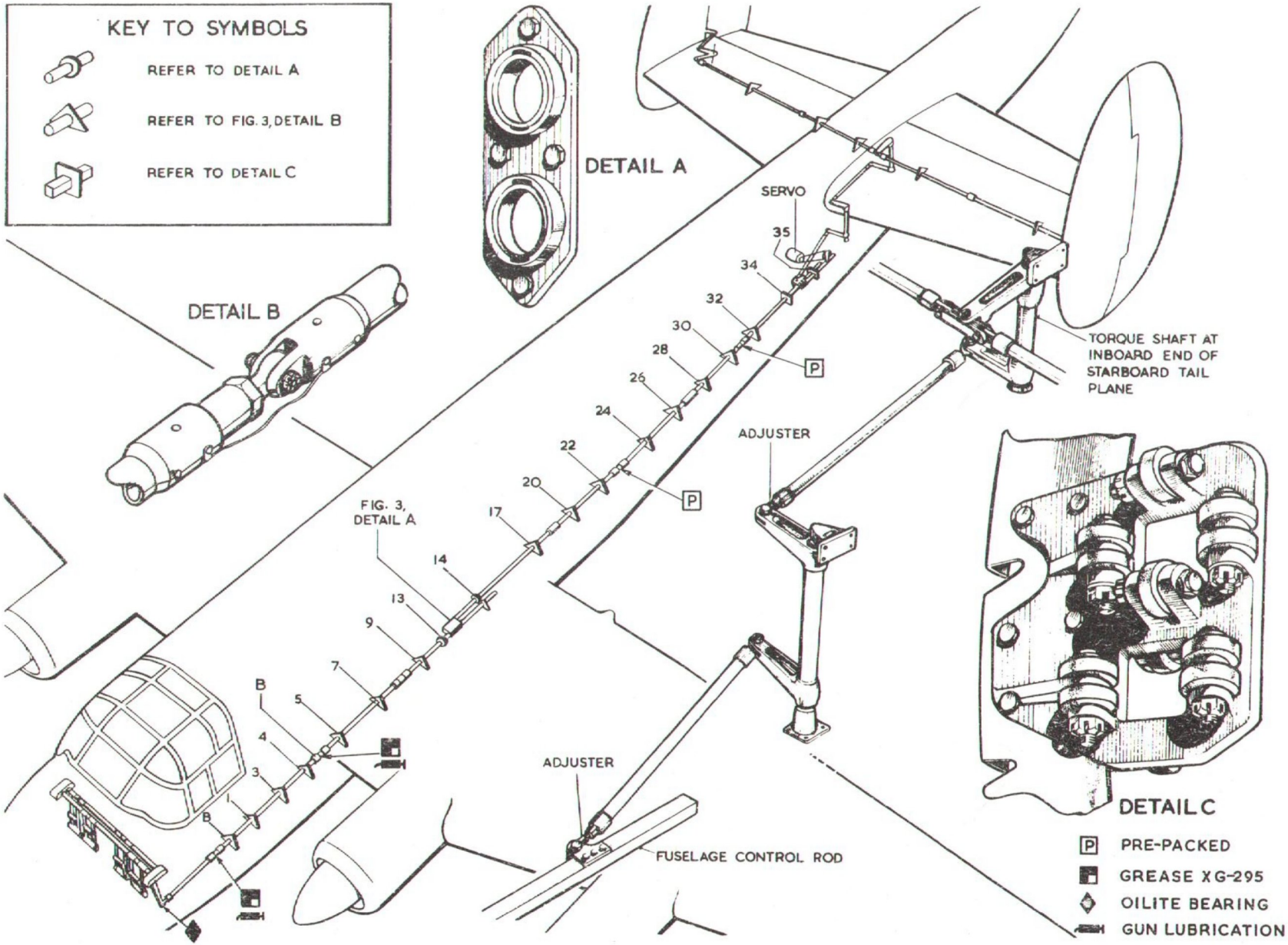

Fig. 4 Rudder controls

(detail D) at which the datum measurement is made. Between formers 34 and 35 is a connection for a link tube which conveys the movement of the push-pull rods to a lever at the lower end of a vertical torque shaft, situated aft of former 35. At the top end of this shaft is another lever from which a connecting-rod passes aft to a lever integral with a torque tube joining the two elevator spars.

10. The torque tube embodies a maximum travel lever which limits the elevator movement in conjunction with fixed over-ride stops fitted at former 41. This lever is also used for locking the elevators. Adjusters are provided at the rear of the fuselage, as shown in detail C, at the forward end of the link tube from the fuselage push-pull rod and at the connection to the elevator torque tube. The automatic pilot elevator servo-motor is connected to the push-pull rods just aft of former 35 (fig.3).

Rudder controls (fig.4)

11. At the port end of the forward transverse rudder pedal shaft is fitted a rudder push-pull control operating lever. At 180 deg. to this main lever (and integral with it) is a lug which abuts against an adjustable rudder pedal stop when the rudder pedals have reached the end of their predetermined travel. Attached to the main lever, and following a similar run to the elevator controls, is a train of push-pull rods passing through three-roller type bearings with a datum adjustment between formers 4 and 5 (detail B). An adjustable link tube is fitted to the fuselage control rod between formers 34 and 35 which conveys the movement of the push-pull rods to a lever at the lower end of a vertical torque shaft situated at former 36.

12. To the rear of former 35 is located the automatic pilot servo motor assembly

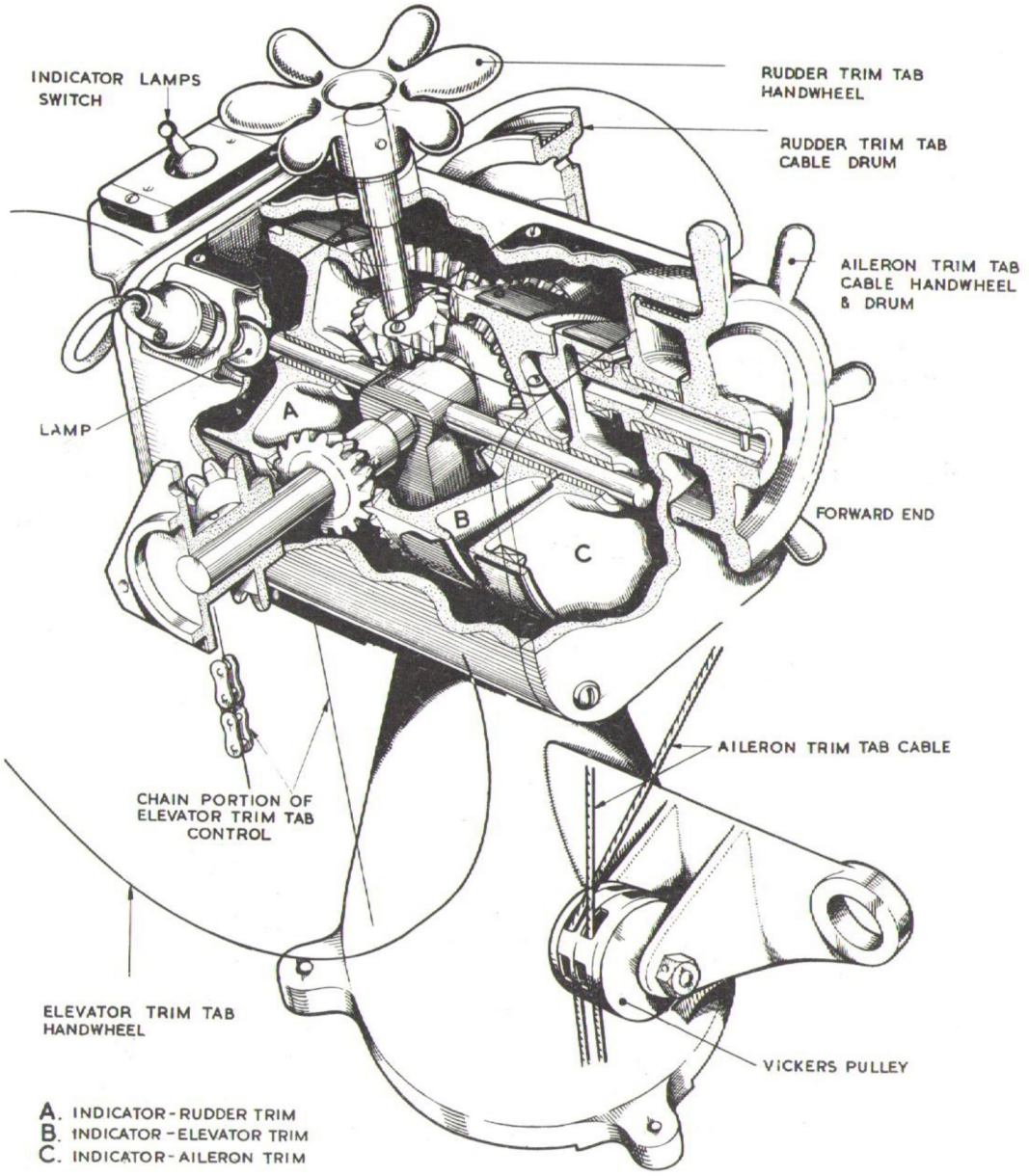

Fig.5. Trim tab control gearbox

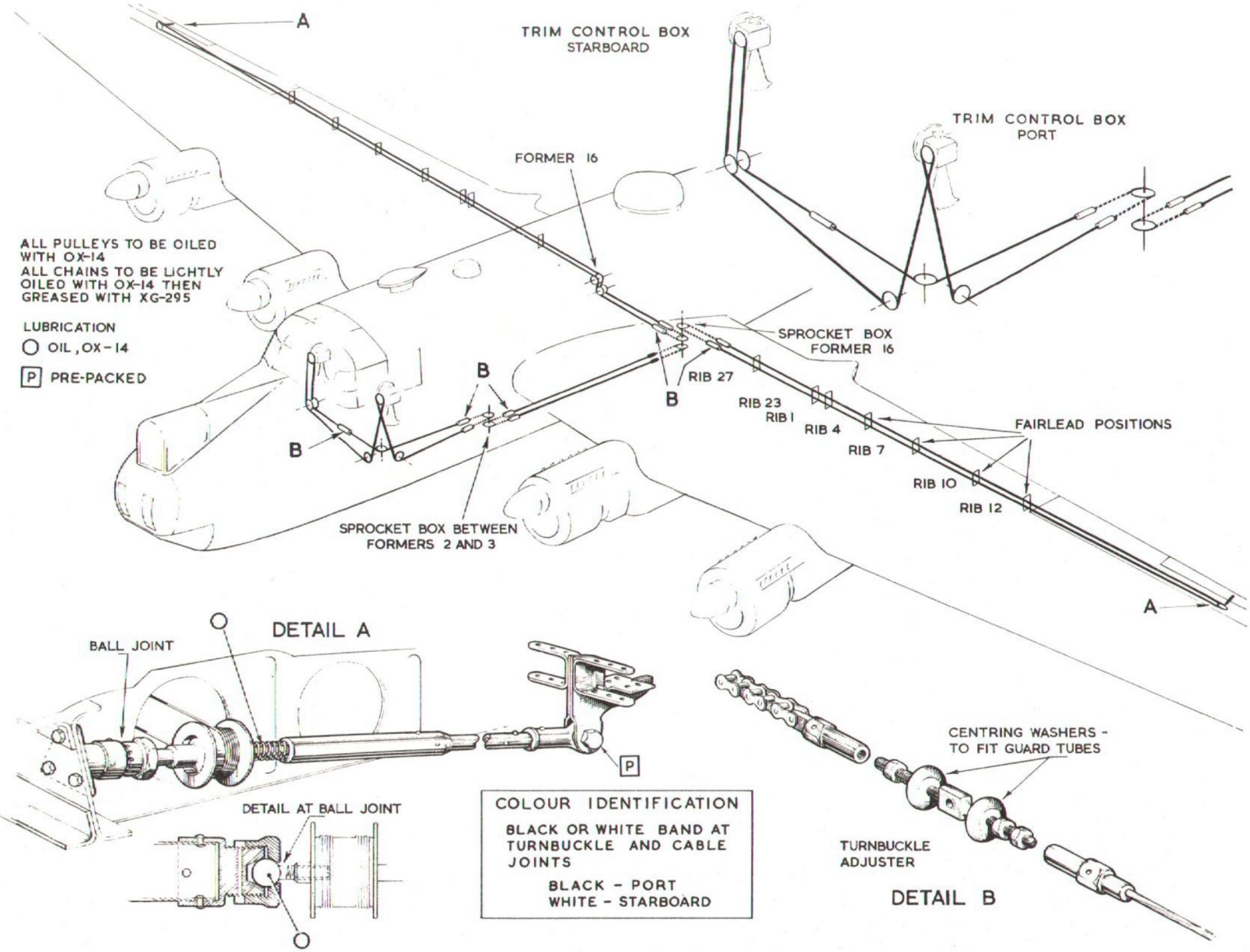

Fig. 6 Aileron trim controls

(*Lubrication amended*)

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from which a link is connected to the fuselage push-pull controls between formers 34 and 35. At the upper end of the vertical torque shaft is a lever conveying movement through another adjustable link tube to the lower lever of a final shorter vertical torque tube carried in bearings inboard of rib 1 of the port inboard side of the tail plane. The lever at the upper end of this torque tube is set at 90 deg. to the lower lever and is connected to the inner ends of two push-pull rods running to port and starboard in the tail plane, where the end of each rod connects to a bell-crank. A rudder control rod from the opposite arm of each bell-crank transmits movement to a control lever at the inboard side of each rudder, and actual rudder movement is obtained through a torsion bar on the forward face of the rudder post (fig.9).

13. A system of levers and a second (lighter) torsion bar assist rudder movement by moving the 'blow-off' spring tab at the trailing edge of each rudder in the opposite direction. The adjusters for synchronising the rudders are at the outboard ends of the tail plane push-pull rods and at the forward end of each rudder control rod. An adjustment for the 'blow-off' spring tab is provided at the rear end of the spring-tab control rod.

Trim tab controls

14. These auxiliary control surfaces are inset in the ailerons, elevators and rudders (Chap.2 and 3), and are controlled from two gearboxes in the pilots' cockpit.

Controls in cockpit (fig.5)

15. These consist of a gearbox mounted on a conical pedestal secured to each of the pilot's floors, outboard of the seats. On the right-hand side of each box is the elevator trim hand wheel, on the top is the rudder trim hand wheel and forward is the aileron trim hand wheel. The trim setting indicators can be seen through windows in the top of the boxes and show from front to rear:-

(1) Aileron trim
(2) Elevator trim
(3) Rudder trim

A switch at the rear end of each box controls the internal indicator lighting.

Aileron trim (fig.6)

16. The cable drum, at the forward end of each box, carries a continuous cable which runs below the floor from the starboard drum, up to the port drum, and aft to a sprocket box which offsets the cable run to a position below the floor at former 3. The control run incorporates lengths of chain which mesh with sprockets and continues aft in fairleads and guide tubes to a further sprocket box at former 16, from which cables are run to port and starboard. The two pairs of cables pass through fairleads in the main plane trailing edge and the ends are secured to bobbins at the forward end of each aileron trim tab operating screw jack (detail A). Adjusting turnbuckles are provided as shown in the illustration (detail B).

Elevator trim (fig.7)

17. A sprocket at the right-hand side of each gearbox drives a chain connected to cables which follow a similar path to that of the aileron trim control cable to former 16A. At this point, two pulleys give an upward slant to the cables, and, at former 22, two pulleys bring the run horizontal at a higher level. At former 33 a further upward slant is made by pulleys, and from former 37 the run is again horizontal to former 42 where the cables pass vertically downward over two pulleys. Two pulleys close below give a change of direction to port and to starboard to the tab operating gears (detail A). Turnbuckles are provided as illustrated.

Rudder trim (fig.8)

18. These are similar to the elevator trim controls. The hand wheel at the top of the box and the drum on the left-hand side of each trim control gearbox actuate the cables. The trim tab is located at the top of the cut-out in the rudder trailing edge, and final movement is completed by a screw operated tab operating jack (detail A).

Balance tabs

Aileron balance tabs

19. A balance tab is fitted to each aileron, and is operated by an adjustable connecting tube between a fork formed on the hinge arm, at rib 22, and a lever on the tab which has six attachment holes to give different settings. The correct method of adjusting the connecting rods is described in the SERVICING section of this chapter.

Elevator balance tabs

20. These tabs are operated in the same manner as those for the ailerons, from a lever integral with the underside of the centre elevator hinge on each side of the tail plane. This lever is connected by an adjustable tube to an arm, mounted on the underside of the outboard end of each tab.

Rudder spring tab control linkages (fig.9)

21. The lower tab of each rudder has an operating arm on its outboard face which is coupled by an adjustable rod to a lever at the lower end of a spring tab torsion bar on the forward face of the rudder post. When the rudder controls are moved, whilst there is airflow over the rudder surfaces, consequent resistance causes the rudder torsion bar to twist up to 7 deg. each way. The turning movement at the top of the bar is transmitted by levers to the spring tab through the torsion bar and the tab is turned up to 18 deg. to give assistance to rudder movement. To give increasing foot-load as the aircraft speed rises, the tab torsion bar allows the tab to 'blow-off'

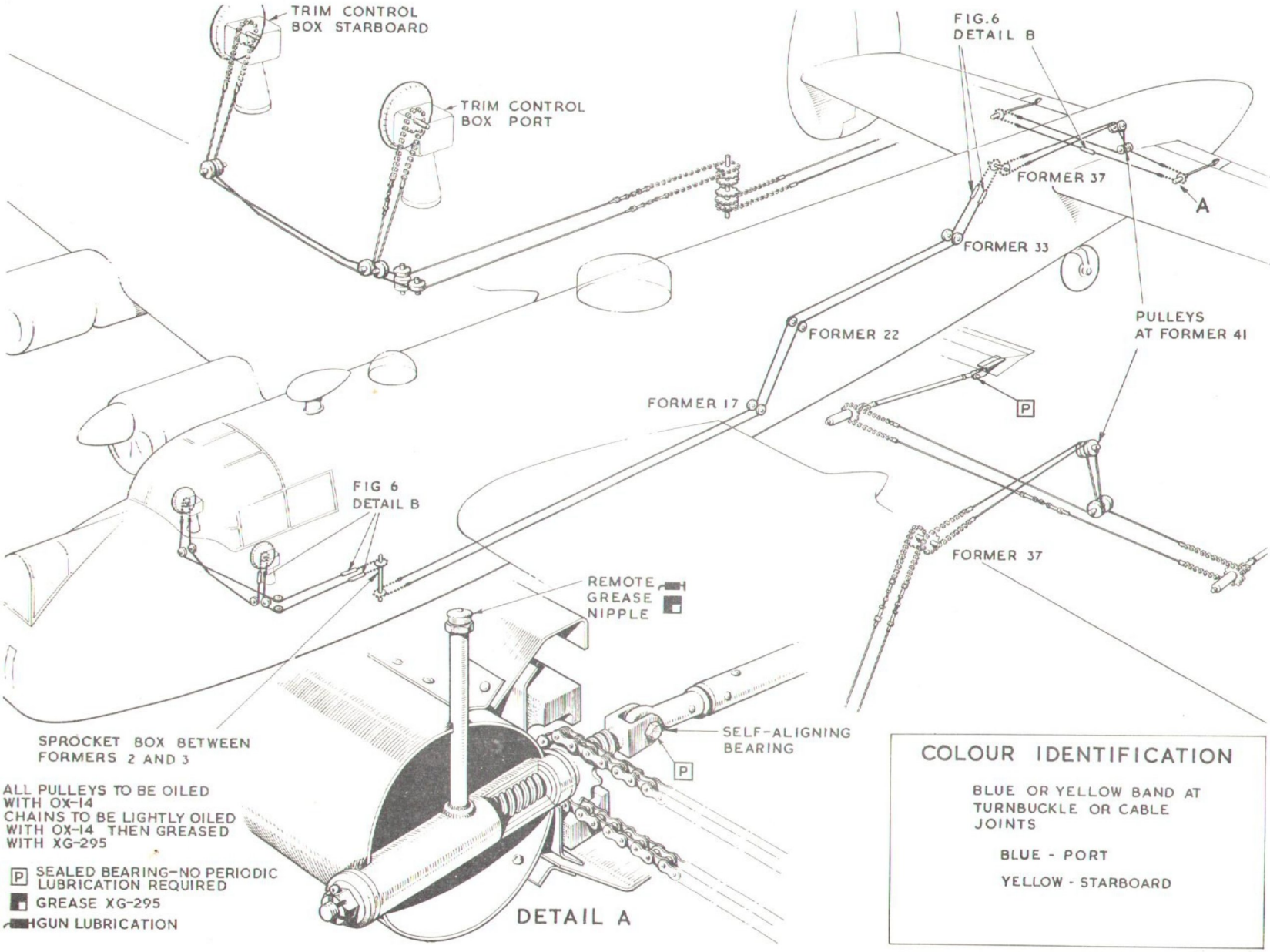

Fig. 7. Elevator trim controls

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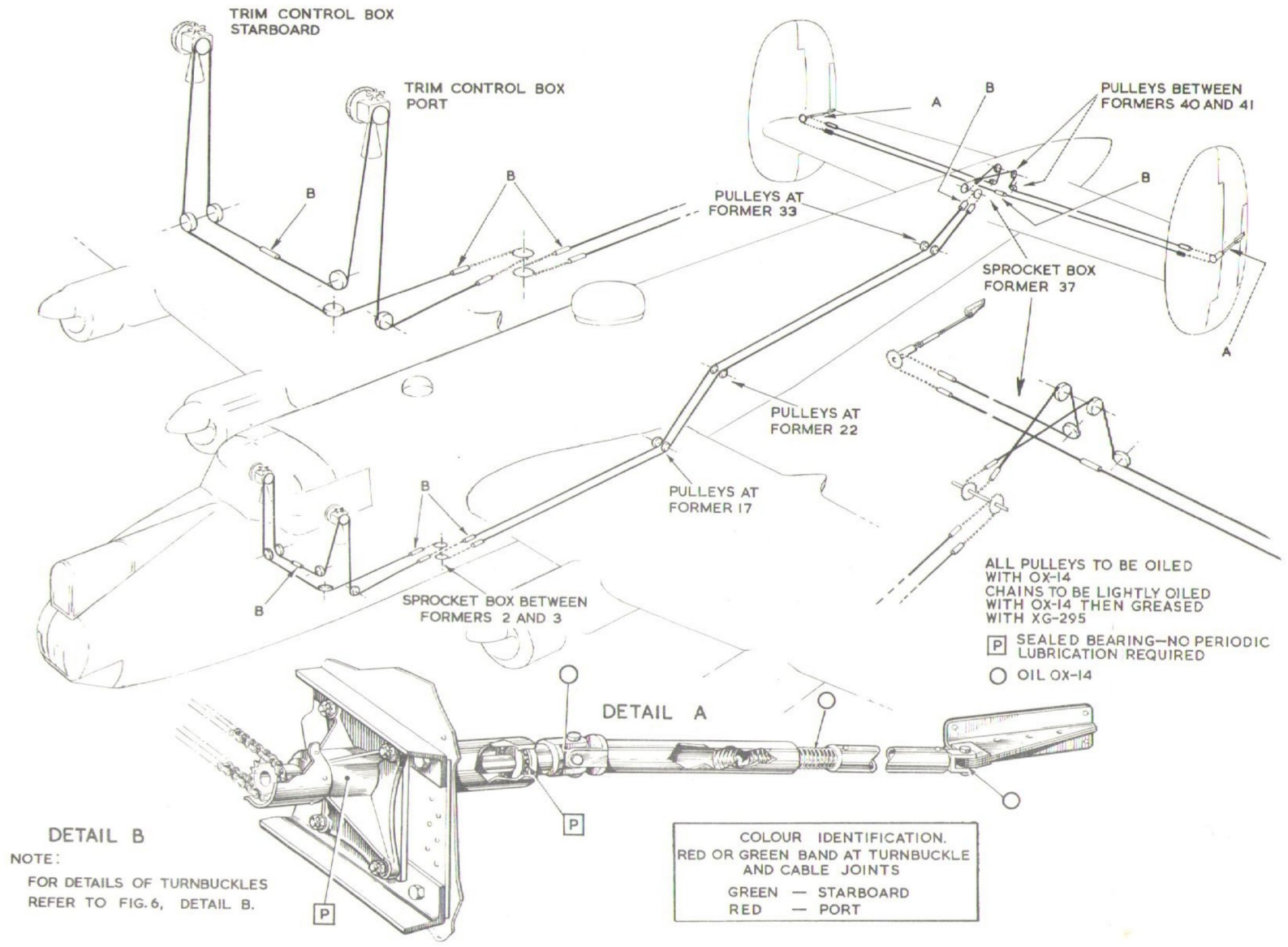

Fig.8. Rudder trim controls

(decrease its angle) and progressively decrease its assistance to movement of the rudder.

CONTROL LOCKING SYSTEMS

Rudder locking system (fig.10)

22. This aircraft is equipped with a flying control locking system for the internal locking of all control surfaces and the rudder controls in the cockpit. A locking handle located on the first pilot's engine control pedestal introduces interference with the throttle levers which prevents the engine r.p.m. exceeding taxying power with the rudders locked. In addition to the locking of the rudders by remote cockpit control, both the elevators and ailerons are locked with manually inserted locking pins. These pins cannot be inserted until the rudders have been locked and the rudders cannot be unlocked until the elevator and aileron controls have had their respective locking pins removed.

NOTE . . .

When the pawl catch for releasing the rudder locking control lever is disengaged, the lever must return to the unlocked position without any appreciable effort on the part of the operator. Force must never be used, and should the lever not return to the unlocked position easily, a check must be made to ensure that the aileron and elevator locking pins have been removed.

Control in cockpit

23. Carried by self-lubricating bushes on the throttle lever spindle of the first pilot's engine control pedestal is a stirrup-type lever with a lower cross-member to limit the movement of the throttle levers when the control is pulled back to lock the rudders. This governs the throttle openings to taxying r.p.m. The operating lever is held in the 'rudders locked' position by a pawl which engages with a combined catch and rear stop on the slotted casing at the top of the pedestal. A label, located on the lower cross-members. is inscribed as follows:-

CAUTION - CHECK THAT THE ELEVATOR AND AILERON LOCKING PINS ARE OUT BEFORE RELEASING RUDDER LOCK. To revert to the 'rudders unlocked' position, the pawl is disengaged by lifting a small lever inset on the underside of the handgrip. In addition to locking the rudders, the control also brings into operation a locking device located at the forward end of the first rudder push-pull tube, which locks the rudder pedals.

WARNING . . .

Any attempt to apply the lock without centralising the rudders can result in damage to the system. The method of applying the lock, which includes certain precautions to be observed, is described in Sect.1, Chap.1. This method must be used by all personnel when locking the controls.

Controls in fuselage and tail plane

24. Three locking pin assemblies are embodied, one for the forward end of the rudder push-pull rod system, and the other two for locking the leading edge of each rudder in relation to its associated fin post. A train of push-pull rods, carried in twin-roller-type bearings and by intermediate levers at changes of level and direction, connects the control lever to the locking pins.

25. At the inboard end of the port half of the tail plane is a rocker lever which moves the two push-pull rods in the two halves of the tail plane in opposite directions. Each rod is connected to a bellcrank in each fin from which a rod transmits the movement to a lever on a locking pin housing on the fin post. When the locking pins are engaged, they slide into rectangular bushed holes in blocks fitted one inside the leading edge of each rudder. Two integral rudder stop brackets are incorporated in this block and act in conjunction with a block on the fin post through which the locking pin projects.

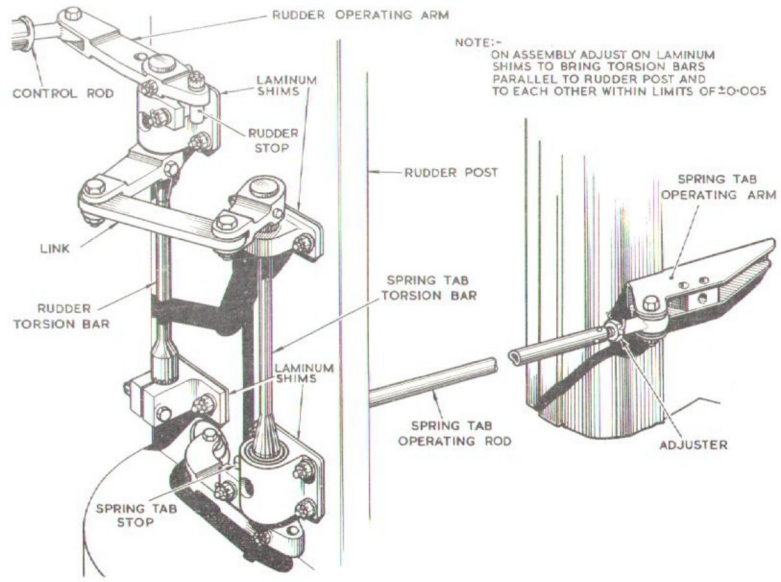

Fig.9. Rudder spring tab control linkage

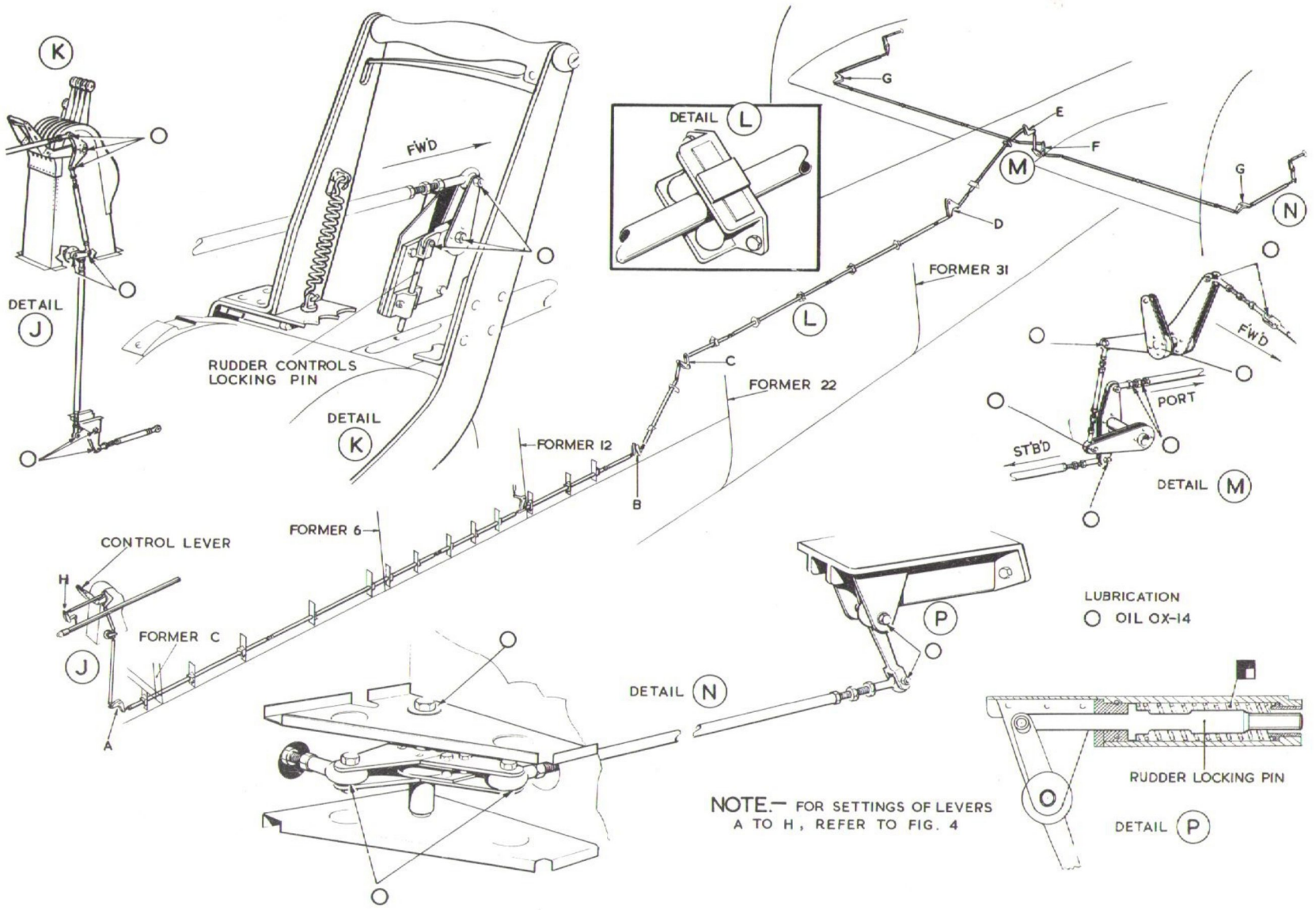

Fig. 10. Rudder locking system

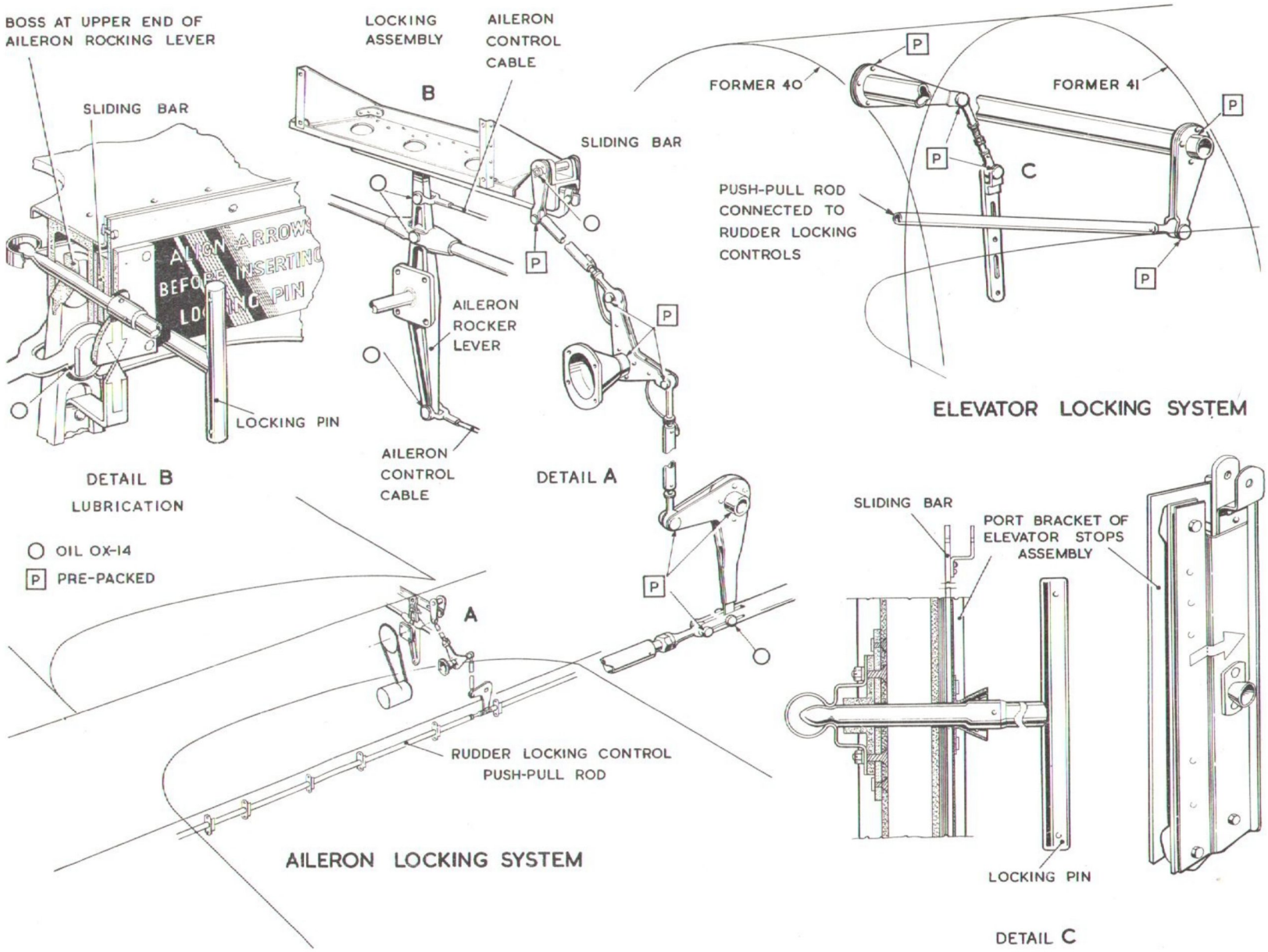

Fig. 11. Aileron and elevator locking systems

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Aileron and elevator locking systems (fig.11)

26. These controls are provided with manually inserted locking pins. The aileron locking point is at the centre of the aft face of the rear spar inside the fuselage and the elevator locking point is aft of the tail plane rear spar, also inside the fuselage. Neither of these pins can be inserted until the rudders have been locked and the rudders cannot be unlocked before the pins are removed.

Aileron system

27. Aft of the rear spar, a bell-crank on the port side of the fuselage is connected to the rudder-locking push-pull control rod system. This bell-crank in turn, operates a further system of push-pull rods and levers coupled to a sliding bar in which a hole registers, when the rudders are locked, with a hole in a locking assembly bolted to the aft face of the spar web.

28. Another hole, in a boss at the top of the aileron control rocker lever, also registers with these holes when the ailerons are neutral, and a locking pin can then be inserted. Access to the locking point is gained by opening an access door which carries a label inscribed AILERON LOCKING. Adjacent to the hole, in which the locking pin is inserted, is a label inscribed ALIGN ARROWS BEFORE INSERTING LOCKING PIN. The arrows below the locking pin are clearly shown in the illustration.

Elevator system

29. In this system, movement of the rudder locking system is transmitted by push-pull rods, a transverse shaft and levers, to a bar which slides up and down in a guide on the outboard side of the port elevator stop bracket. This bracket is bolted to the aft face of the rear spar of the tail plane. Two arrows and an inscribed label, as for the aileron locking points, are provided. A locking pin, interchangeable with that for locking the ailerons, can be inserted in a hole in the port elevator stop bracket when the rudders are locked and the ailerons are in the neutral position, as indicated by the arrow.

FLAPS SYSTEM

Control system (fig.12)

30. A three-position gate lever switch, on the pilot's panel, controls a flap selector valve mounted on a platform, secured to the floor aft of the rear spar. Movement of the flaps is effected hydraulically.

Flap jack

31. The flap jack, which has a double ended piston rod, is also mounted on the platform mentioned in the preceding paragraph. A flap operating tube is secured to each end of the piston rod. The operation of the selector circuit and the associated hydraulic circuit are described in Chapter 6 of this Section.

Operating system

Push-pull operating tubes

32. The flaps are operated by push-pull tubes in conjunction with operating links. Ball joint connectors, join the operating tubes to the ends of the flap jack piston rod and, each tube operating the outboard sections, is connected to the inner tube, by a ball joint connector.

Flap operating links

33. These are pivoted at the upper end on steel pins carried on bobbins and located by internal circlips inside the operating tubes. In the flap spars are eye-bolts which are free to rotate in their bushings and there is a fork joint between these and the lower adjustable ends of the rods. There are four links for the inner section, six for the outer section and three for the flap extension on each side.

Drum switch

34. The flap drum switch is connected by a telescopic lever to the inner end of the port inboard connector. The operation of this switch is described in Chapter 6 of this section.

Flap position indicator

35. The position of the flaps is indicated to the pilot by an indicator located on the main instrument panel. It is operated electrically in conjunction with a transmitter fitted at rib 30 of the port centre section trailing edge. An adjustable linkage, to adjust correct synchronisation with the flap positions, is fitted between the transmitter and a bracket on the port inboard flap section.

LUBRICATION

◀ 36. All points on the airframe which require periodic lubrication are shown in the illustrations. Grease XG-295, and oil OX-14, being used as indicated when specified in the Volume 4. The ball bearings marked with the letter P in a square in the fuselage, wing trailing edge, and tail plane are filled with grease and sealed on assembly, and do not require periodic lubrication. With reference to fig.6, 7 and 8, the previously specified oil should be used sparingly on all the chains, pulleys, and pinned joints of the trim tab controls. All chains should be lightly greased with XG-295 after being oiled. The three-roller type bearings have oilite bushes, and do not require periodic lubrication. ▶

SERVICING

SETTING THE CONTROLS

37. Data for setting the controls are given in fig.16 to 26 and in the following paragraphs. Further details of the location of turnbuckles are given in the first part of this chapter under DESCRIPTION.

Ailerons (fig.16)

NOTE . . .

In the following paragraphs, it is assumed

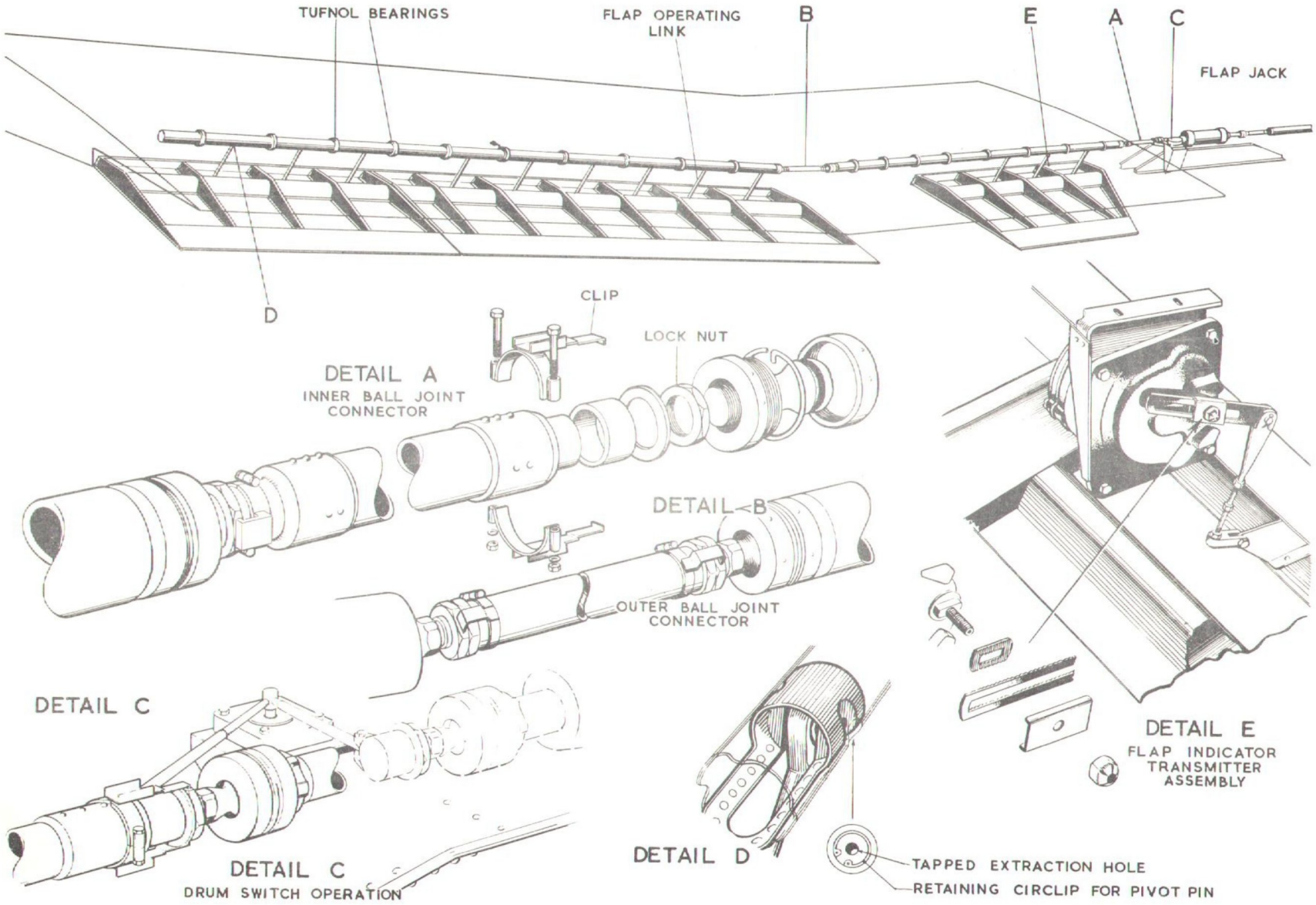

Fig.12. Flap control system

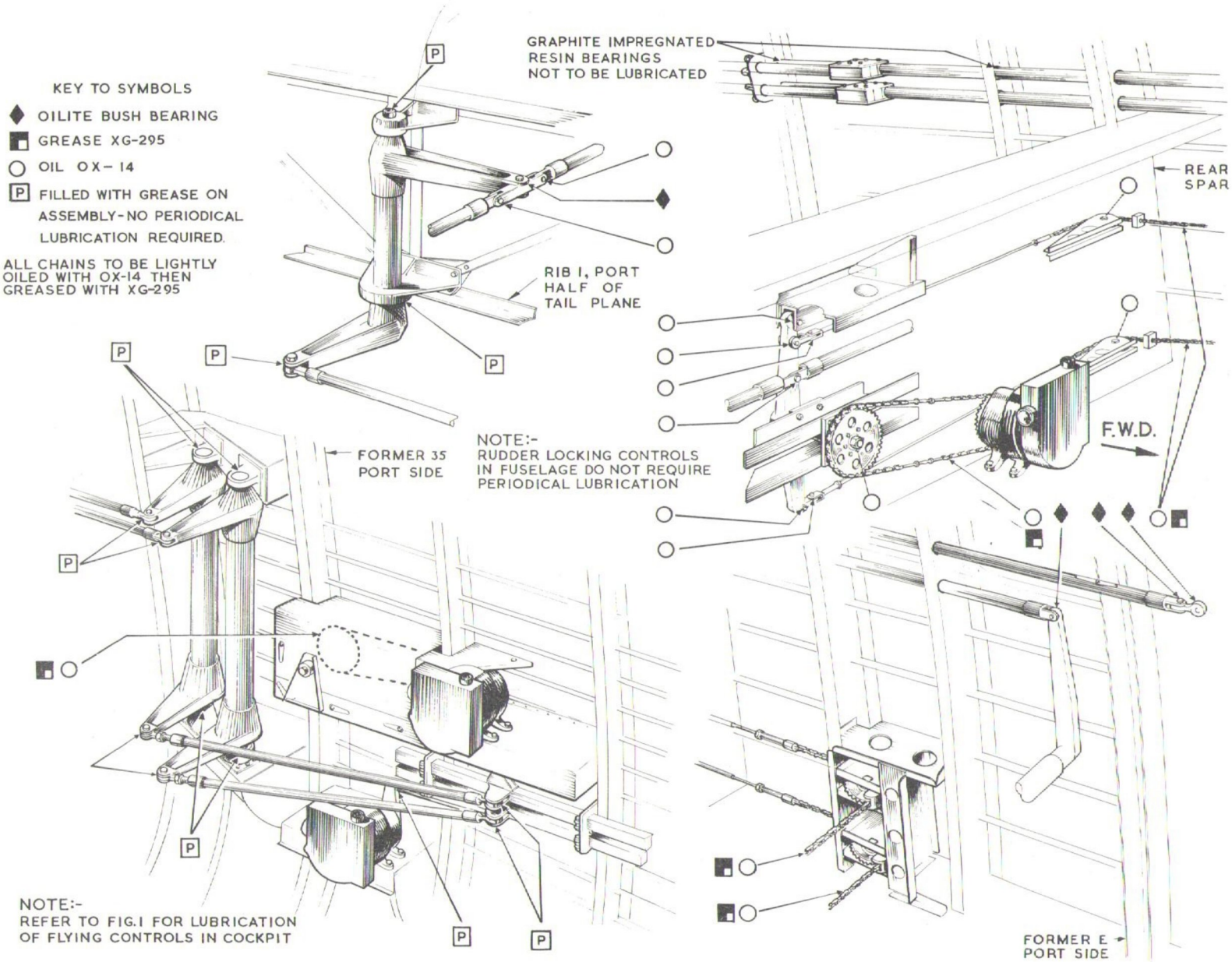

Fig.13. Lubrication of flying controls in fuselage

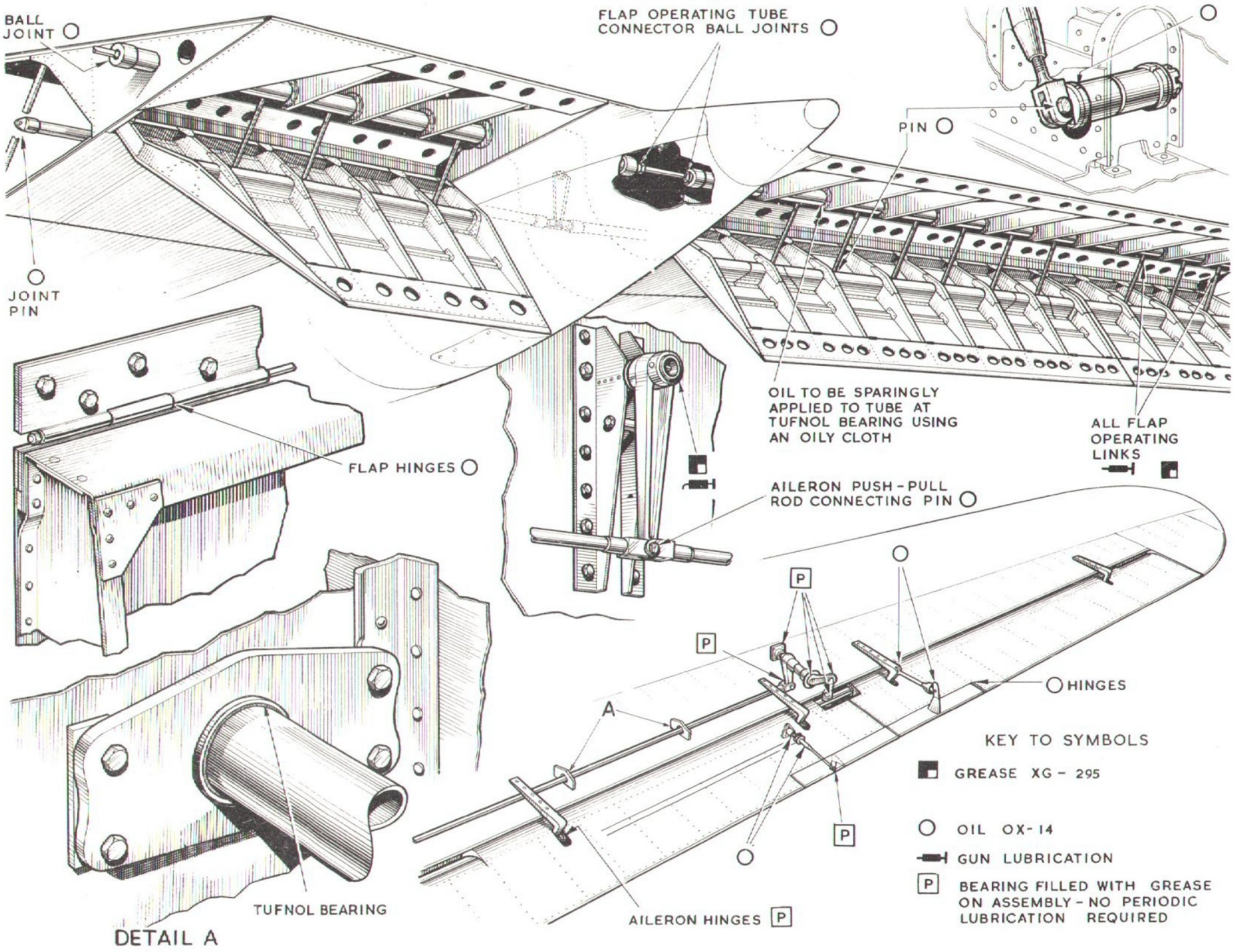

Fig.14. Lubrication - main plane
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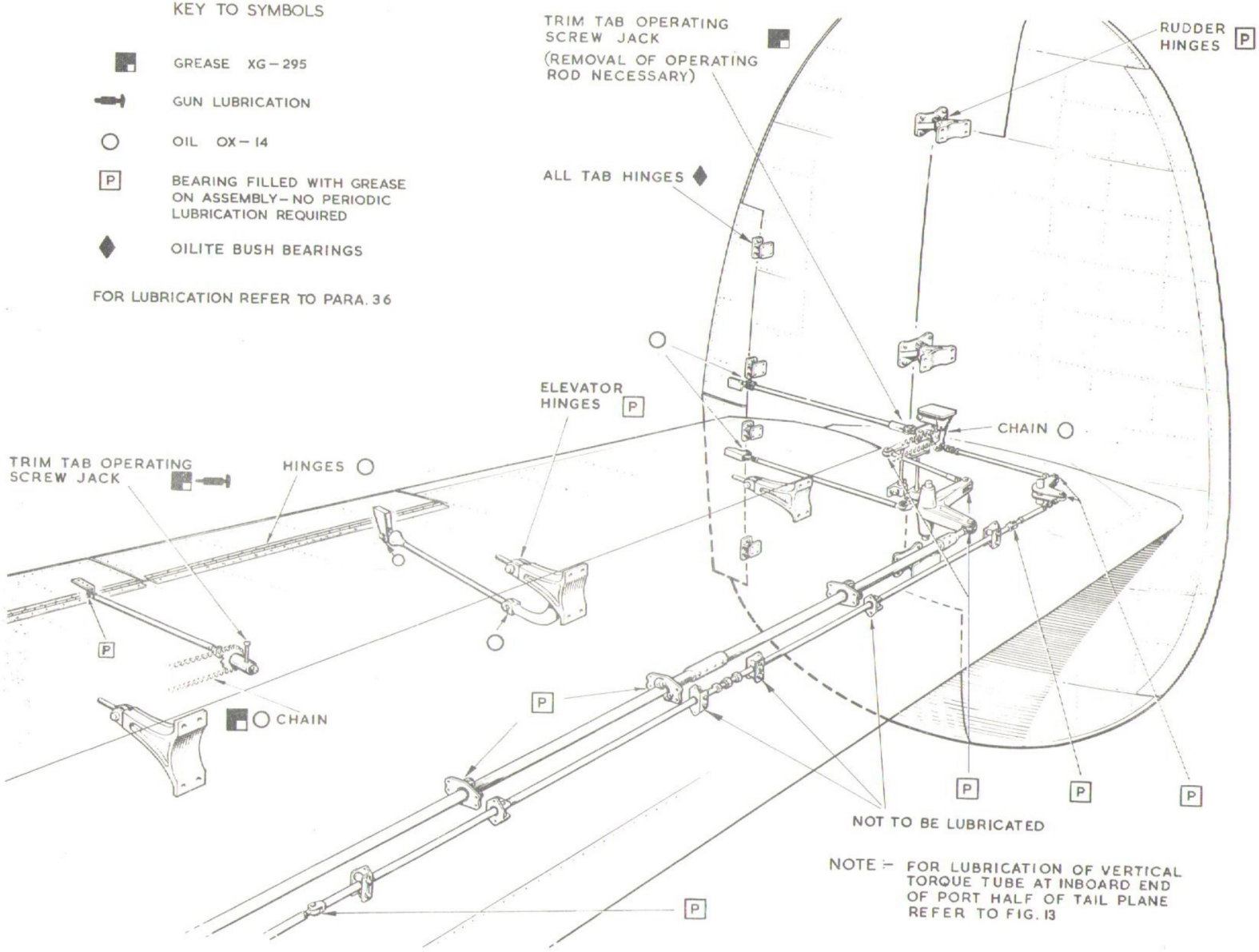

Fig. 15. Lubrication – tail plane

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that the aileron and elevator control locking systems are already connected to the rudder locking systems and correctly rigged. If this is not so, the instructions regarding locking the controls should be read to mean locking the controls in question only. The controls should then be set as follows.

38. Before setting the ailerons, the control surfaces locking system must be applied as described in para.22 (i.e., lock the rudders and insert the manually inserted locking pins in their respective sockets). The two sections of each aileron must be fitted initially with their undersurface contours as nearly as possible continuous with those of the main plane, and with the aileron and main plane trailing edges in line. To obtain this condition, up to ⅛ in. of packing may be inserted under the aileron hinge brackets where they are bolted to the trailing edge. Additional packing, up to, but not exceeding ⅛ in. may be inserted, if found necessary, after flight testing. The controls should then be set as follows:-

(1) Check the rigging of the ailerons, altering if necessary, the settings of the adjustable screw joints in the push-pull rods between ribs 9 and 11 in each intermediate main plane section (fig.2, detail E).

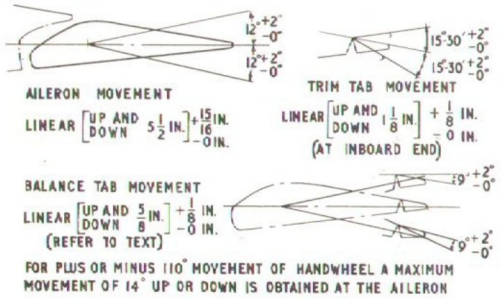

Fig.16. Aileron and tab movements

Access doors are provided in the undersurface. Remove the 2 B.A. locking bolt from each end of the adjuster and turn the centre portion until the required setting has been obtained. The two wing tip trailing edges may be packed up to allow for any slight aileron twist. When the correct setting has been obtained refit the 2 B.A. locking bolts to the adjuster.

(2) Set the pilots' hand wheels; if necessary, first synchronise them by adjustment of the turnbuckles located behind the access door of each control column, and then correct both to the neutral position by adjustment of the centralisation adjustment turnbuckles located immediately forward of the front spar.

(3) Check the friction load on the control system which must not exceed 8 lb. applied tangentially at the outside of one of the handgrips on either of the hand wheels.

Trailing edge cords (fig.17)

39. One foot lengths of trailing edge cord , 34/E5628 consisting of light alloy, rolled-edge strip, are fitted at the inboard end of each aileron, two on the upper, and two on the lower surface. These chords may be increased in length as described in para.60.

Trim tabs (fig.16)

40. With the aileron control locked, set the trailing edge of the tabs in line with the trailing edge on each aileron and adjust the cockpit control box indicator hand wheel to read 0 deg. Access to the starboard tab turnbuckles is in the bomb bay between formers 16 and 16A in the rear section. The port tab turnbuckles are reached from inside the fuselage (port side) between formers 16 and 16A.

Balance tabs (fig.16)

41. With the controls locked as before, set the aft ends of the operating rods in the third hole of the six, provided above the tab in the operating arm, on the top surface of each tab. The forward ends of the control rods are now adjusted so that the trailing edge of each tab is in line with that of the aileron. It is with this setting that the movements given in the illustrations are obtained. This initial setting may have to be altered after flight testing.

Elevators (fig.18 and 19)

42. Before assembly, check the alignment of the elevator hinge brackets, right through the fuselage section, using a length of twine through the bolt holes. Shims should be used to correct the alignment if necessary.

43. With the elevators assembled and locked, check their neutral setting using the gauge Ref.No.26FP/325, as shown in fig.19. After initial setting, adjustment of the push-pull rods in the fuselage is not normally required, but the following procedure for rigging the whole system between the elevators and the control column is given for guidance where necessary:-

(1) First jack and trestle the aircraft for rigging (Sect.2, Chap.4). Any adjustment necessary for setting the control column, in relation to the neutral elevator position, is normally made at the adjustable connection between

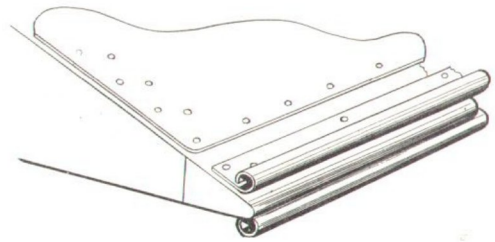

Fig.17. Aileron trim cords

formers 4 and 5, provided that any such adjustment is within the safety range. Further adjustment may be made, if necessary, in the lengths of the two link tubes at the rear of the fuselage. The elevator must be locked to give the datum.

(2) The rearmost of these link tubes is connected between the lever on the horizontal elevator torque tube and the upper lever on the fuselage vertical torque tube, aft of former 36, and has a nominal length of 6 ft. 9-25/32 in. When this tube is connected at both ends, the axis at the bolt hole in the lower lever on the vertical torque tube should be 15½ in. (nominal) from the forward face of former 37, or 3½ deg. forward of the transverse plane containing the axis of the vertical torque tube.

(3) The nominal length of the link tube between the vertical torque tube lower lever and the fuselage push-pull controls is 2 ft. 7-27/32 in. When this is connected at both ends, the axis of the connecting bolt at its forward end should be 8½ in. (nominal) from the forward face of former 35, and its fore-and-aft travel, corresponding to full elevator movement (fig.18), must be 1-61/64 and 3-21/32 in. forward and aft respectively.

(4) With the elevator neutral, the centre-line of the control columns should be 3-3/4 deg. forward of vertical. This angle is obtained by use of the adjuster between formers 4 and 5 and checked with an inclinometer at the aft face of the control column.

(5) Should the adjustment obtainable at the connection between formers 4 and 5 be insufficient, further adjustment must be made to the lengths of the two links at the rear of the fuselage. This may entail altering the rotational setting of the vertical torque tube. Any such

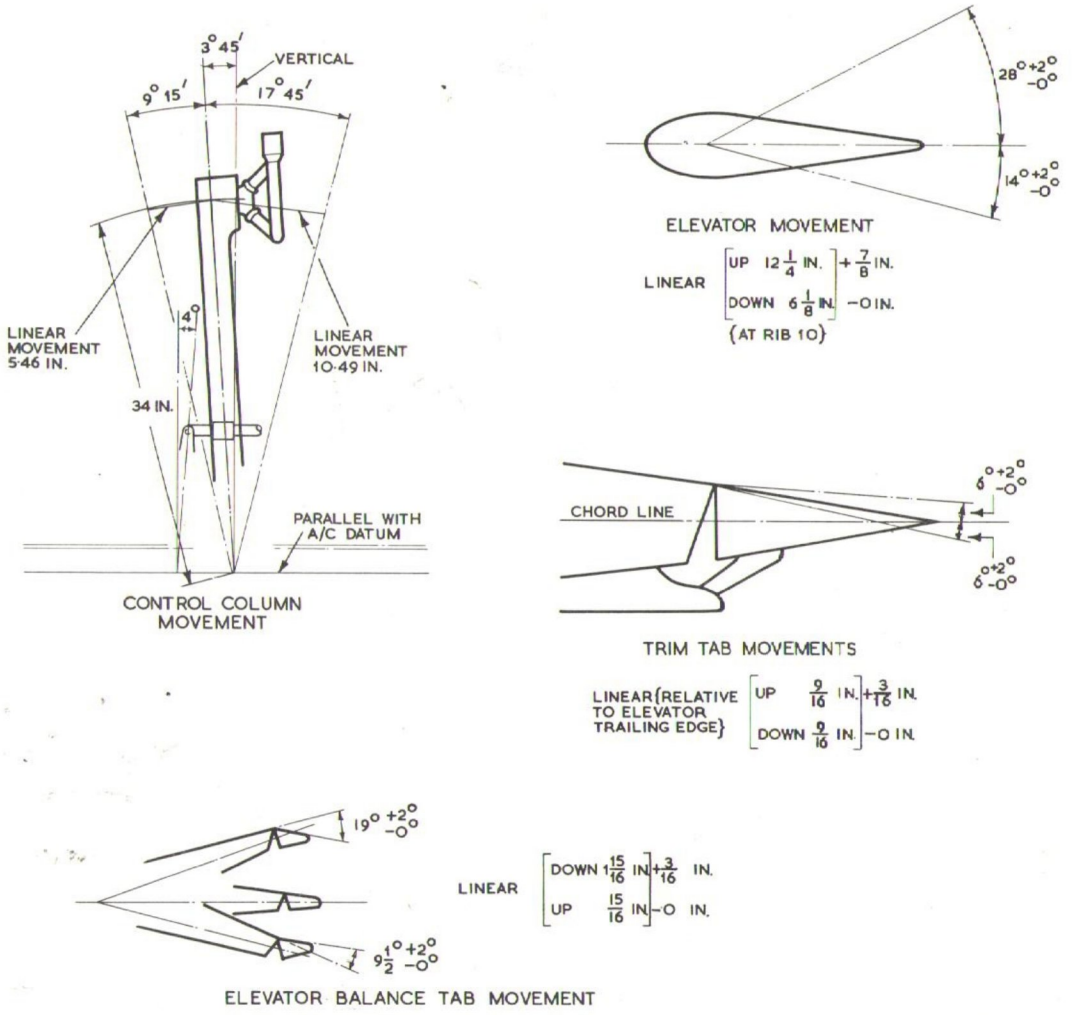

Fig.18. Elevator and tab movements

alteration must be kept to a minimum to preserve the nominal angular settings of the levers as far as possible.

(6) Check that the operating lever of the auto pilot servo motor is at right-angles to the control rod connecting it to the fuselage push-pull controls, and adjust the control rod if necessary.

Trim tabs (fig.18)

44. With the controls locked as previously stated, set the trim tab trailing edge in line with the elevator trailing edge with the indicator in the cockpit gearbox reading 0 deg. Adjustment is provided in the fuselage, aft of the tail plane rear spar and at the port side of the fuselage, between formers 36 and 37.

Balance tabs (fig.18)

45. Lock the controls and set the trailing edges of the tabs in line with the elevator trailing edges to give the normal neutral position. The normal position for the aft ends of the control rods is at the centre hole in the operating arm on each tab. This position gives the movements shown in the illustration.

Rudders and spring tabs (fig.20, 21 and 22)

46. The setting of the rudders must be carried out in conjunction with that of the spring tabs as follows:-

Setting the controls in the fuselage

(1) Ensure that the rudder pedal stops are correctly adjusted (fig.20). Lock the rudder pedals in their neutral position, using the rudder locking lever in the cockpit, with the fuselage and tail plane locking control run disconnected from the bellcrank on the outboard side of the first pilot's engine control pedestal. Check that the axis of the bolt connecting the aft end of the fuselage push-pull rod to the link tube between the fuselage controls and the vertical torque tube is 8 3/4 in. from the forward face of former 35. (This setting is obtained by use of the adjuster between formers 4 and 5). Also note the length of the link tube which must be 3 ft. 3 1/16 in. nominal.

(2) With the link tube connected to the fuselage push-pull rod attachment and to the vertical torque tube lower lever, check that the axis of the connecting bolt attaching it to the end of the lower lever of the vertical torque tube assembly is 6 15/32 in. forward of the front face of former 37.

(3) If necessary, adjust the link tube to give this setting.

(4) With the rearmost link tube, nominal length 3 ft. 5 37/64 in., connected between the upper lever on the vertical torque tube and the lower lever of the torque shaft at the inboard end of the port half of the tail plane, check that the upper lever lies fore-and-aft.

(5) Adjust the rearmost link tube, if necessary, to give this setting..

Checking spring tab operation

(6) Both rudders must be checked for correct spring tab movement (fig.21).

(7) This is effected by turning the rudder torsion bar operating arm (this may be considered to be the rudder operating arm) through 7 deg. 36 min. each side of neutral. With this movement, there should be a corresponding tab movement of 18 deg. with a clearance of 0·025 to 0·080 in. between the stops at the lower end of the spring torsion bar. The spring tab movement is checked at the upper end of its trailing edge in relation to the lower end of the trim tab trailing edge with the trim tabs set neutral.

Setting the rudders

(8) Assemble both rudders and check that the stops on the rudder and fin post allow them full movement (fig.21).

(9) Adjust the rudder-operating control rods to the correct nominal length of 26 3/4 in. and couple them to the rudder-operating arms and to the bellcrank inboard of rib 13 in the tail plane.

(10) Set and maintain the port rudder in the neutral position, using setting gauge Ref.No.26FP/327, as shown in fig.22. Adjust the outer end of the transverse push-pull rod in the tail plane until the connecting bolt can easily be inserted to couple it to the bellcrank. Repeat this operation for the starboard rudder.

WARNING . . .

It is essential that the connecting bolts can be inserted without causing any movement of the rudder-operating arms and consequent twist of the torsion bar to which these are connected.

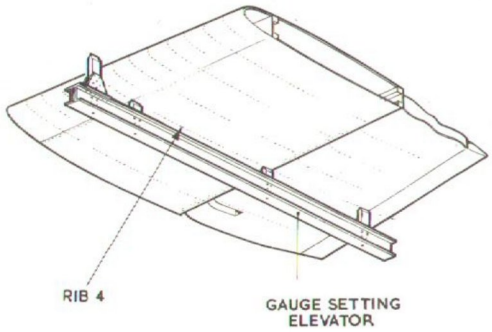

Fig.19. Setting the elevators

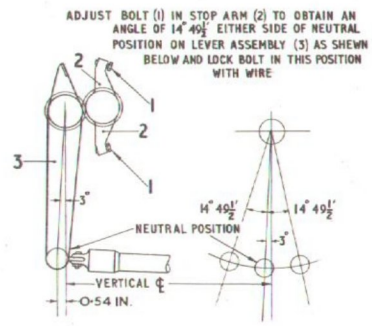

Fig.20. Setting rudder pedal stops

(11) Steadily push both rudders over to starboard. If the lengths of all control rods between the two rudders are correct, movement of both rudders over their full movement will not apply any load to either rudder torsion bar, and both tabs will remain neutral to the rudders.

(12) If, towards the full limit of movement, it is found that the spring tab on either rudder is beginning to move, it means that there is too much linear travel of the control rod coupled to the torsion bar operating lever and that further movement beyond this point is twisting the rudder torsion bar operating the tab (*Sect.* 3, *Chap.* 3).

(13) This must be corrected by altering the adjustment of controls to the rudder concerned. Disconnect the operating rod and the transverse push-pull rod from the bell-crank. Shorten the rudder control rod by one turn of the threaded adjuster and correspondingly lengthen the transverse push-pull rod. This will ensure that the rudders can both be set neutral when the controls are coupled up.

(14) Check the rudders over their full travel as before and make a further adjustment if any tab movement persists.

(15) Couple the link tube in the fuselage to the vertical torque tube.

Final check

(16) Fully operate the rudders. This should give full tab movement each way of 18 deg.—0 deg. ($3\frac{3}{8}$ in.—0 in.).

(17) Re-connect the fuselage and tail plane locking control run to the bell-crank on the outboard side of the first pilot's engine control pedestal.

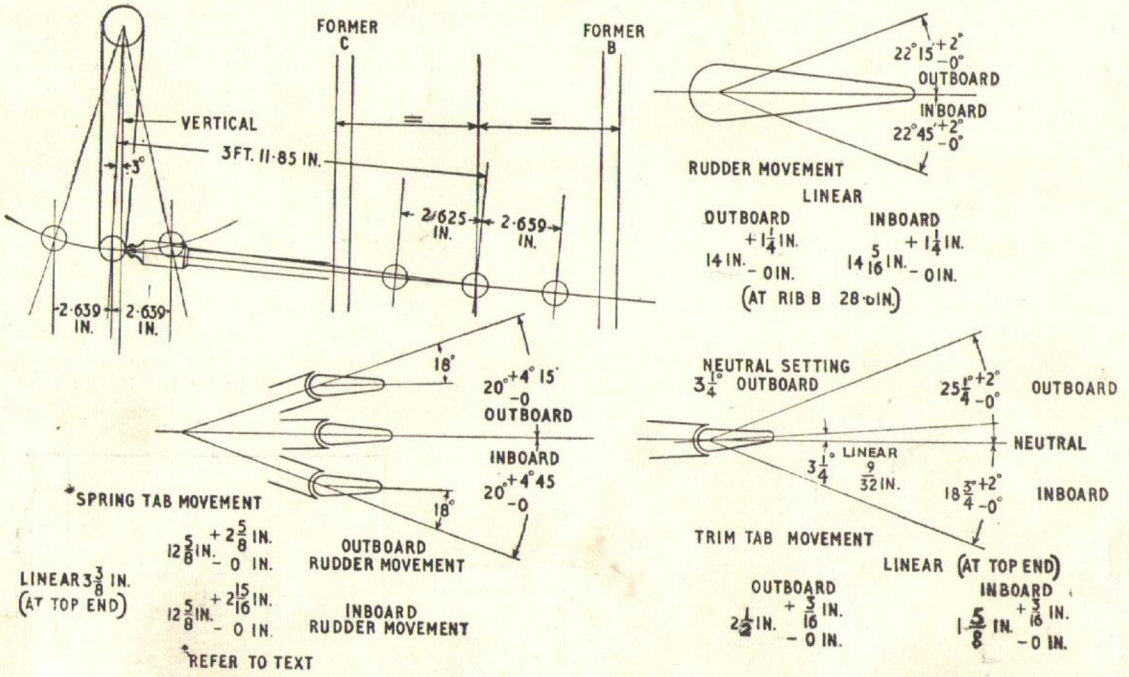

Fig. 21. Rudder and tab movements

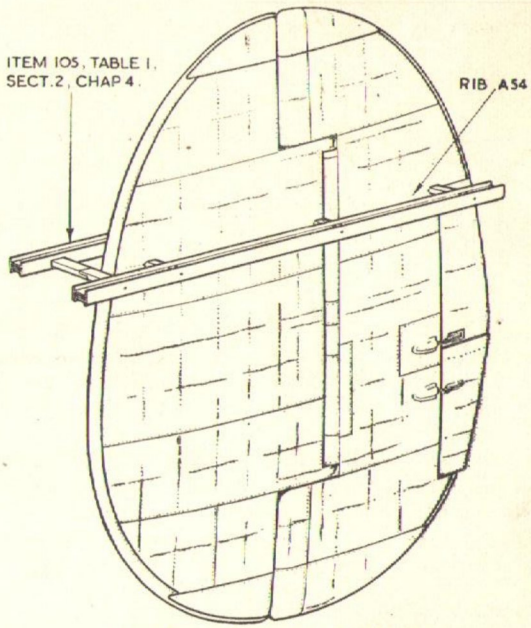

Fig. 22. Setting the rudders

Note . . .

Provided that full tab movement is obtainable on both rudders when they are held off their stops at any angle between 20 deg. and full movement, the rigging is acceptable.

Trim tabs (fig. 21)

47. With the control pedals locked as before, set the trim tabs as shown in the illustration, with the indicator on the control gearbox in the cockpit reading 0 deg. This setting may be obtained by adjusting the turnbuckles on the port side of the fuselage between formers 36 and 37 in the rear section. Further adjustment, if required, may be made at the turnbuckles between the tail plane spars at the centre of the fuselage and outboard of tail plane rib No. 13 on each side.

Trim tab control cables (*fig. 23*)

48. The trim tab cables should be checked with a tensiometer, Mk. 3 (Stores Ref. 1C/6134). Elevator and rudder trim cables

should have a tension of between 12 and 17 lb. on the 5 cwt. scale ; aileron trim cables are to be just taut with no appreciable tension. If necessary, adjustment may be made at the turnbuckles. After adjustment, ensure that, at full travel, the turnbuckles do not foul the fairleads. A system of colour identification is used at cable and turnbuckle joints and at chain and cable joints fitted to trim tab runs. The turnbuckles are coloured as follows :—

Ailerons	.. ..	Black/white
Elevators	.. ..	Blue/yellow
Rudders..	.. ..	Red/green

Flaps (*fig. 24 and 26*)

49. The procedure detailed in the following paragraphs assumes that the flap-operating push-pull tubes have been initially connected as described in para. 73. If this is not the case, check the outer flap-operating tube connectors and ensure that they are initially set as described there before setting the flaps as a complete rigging operation.

Connecting the flaps to the flap-operating tubes

Note . . .

The settings given in the following paragraphs are to be used as a datum when setting the flaps. Variation of the settings may be necessary to ensure correct alignment of the flap trailing edge with the main plane trailing edge. The setting of $1\frac{3}{8}$ in. is the MAXIMUM extension of any link consistent with a safe amount of thread engagement. When raising the flaps to check this alignment it is essential to ensure that no interference is caused between the flaps and the main plane trailing edge.

WARNING

No attempt must be made to extend or disconnect the connecting link between the flap operating tube and the flap jack piston rod, or the connecting link between the inner and outer flap operating tubes, on the starboard side of the flap jack, with the flaps in the UP position. Extension of these links with the flaps in the UP position would produce further movement of the flaps towards the main plane trailing edge, causing an excessive compression load to be placed on the starboard flap operating tube and resulting in damage to the tube.

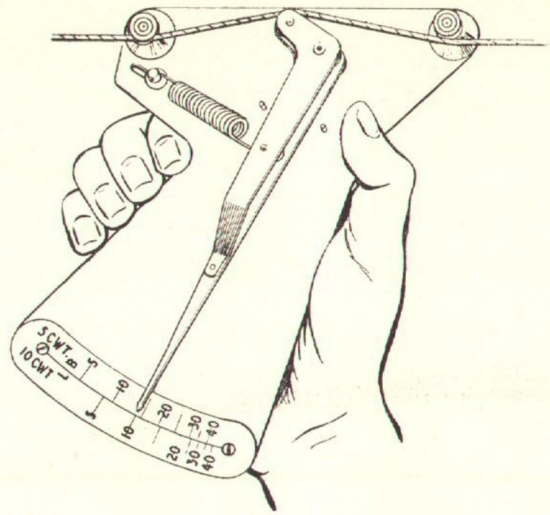

Fig. 23. Using Mk. 3 tensiometer

50. Ensure that the bomb doors are closed and fit the inboard flap section operating links, with their adjustments set to $1\frac{1}{8}$ in. (*fig.* 24), between the operating tubes and the flap spars. If necessary, it is permissible to vary the setting of the two outer links to ensure alignment of the flap trailing edges with the main plane trailing edges when they are fully raised. Next, adjust the six operating links for each outer flap section as follows :—

Link No. (counting outboard)	Setting (inches)
1	1
2–5	$1\frac{1}{16}$
6	$1\frac{1}{8}$

Connect these links between the flaps and operating tubes and check the alignment of the trailing edges, making further adjustments, if necessary. Finally repeat this procedure for the outer extension flap section, setting the innermost link for each to $1\frac{1}{4}$ in. and the outer links up to $1\frac{3}{8}$ in.

Setting the flaps

51.

Inner flaps

(1) Select flaps UP and operate the hand pump until one inboard flap is fully up. Inspect the flap jack and note whether, at the relevant end of the piston-rod, the jack is within $\frac{1}{16}$ in. of the end of its stroke. Adjust the outer end of the associated inner flap-operating tube connector as necessary. Ensure during this operation that no interference is caused between the flaps and main plane trailing edges.

(2) Adjust the outer end of the other connector to bring the other inboard flap just up to the main plane trailing edge.

Outer and extension flaps

(3) Measure in inches the droop of the outboard and extension flaps and then lower all flaps until easy access can be obtained to the outboard ends of the outer operating tube connectors. Shorten the port connector and lengthen the starboard connector by two turns (approximately) per inch droop of the corresponding outer and extension flap section.

(4) Raise the flaps again, until any one or more of the outer and extension flap sections touches the main plane trailing edge. If any droop or interference is noted on an outer or extension flap section, lower the flaps and alter the length of the flap operating links concerned to line up the complete outer system as a unit (one complete turn on

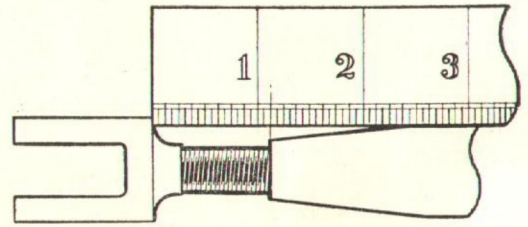

Fig. 24. Method of setting flap operating links

each link adjuster increases, or decreases, the setting of the flap trailing edge by about $\frac{1}{4}$ in. with the flaps up or nearly up). No link adjuster should be shortened by more than two turns. Larger adjustments should be gained by lengthening others. Finally adjust connectors until all flap sections meet the main plane trailing edge evenly with the flap jack within $\frac{1}{16}$ in. of the end of its stroke. Adjust the relevant operating links and connectors if necessary.

(5) If necessary, adjust the flap drum switch at this stage, before introducing the necessary flap interference. This will normally be necessary if the distance of the telescopic tube operating collar relative to the jack piston-rod has been disturbed. For this reason, adjust only the outboard end of the port inner ball joint connector when setting the flaps. The following paragraph should be read as part of these instructions.

Setting the flap drum switch (fig. 25A)

51A. In this paragraph the procedure given is for the complete operation applicable to a replacement drum switch. Certain parts, as will be evident on reading it, are applicable to the re-adjustment which may be necessary in the circumstances indicated in sub-para. (5) of the previous paragraph.

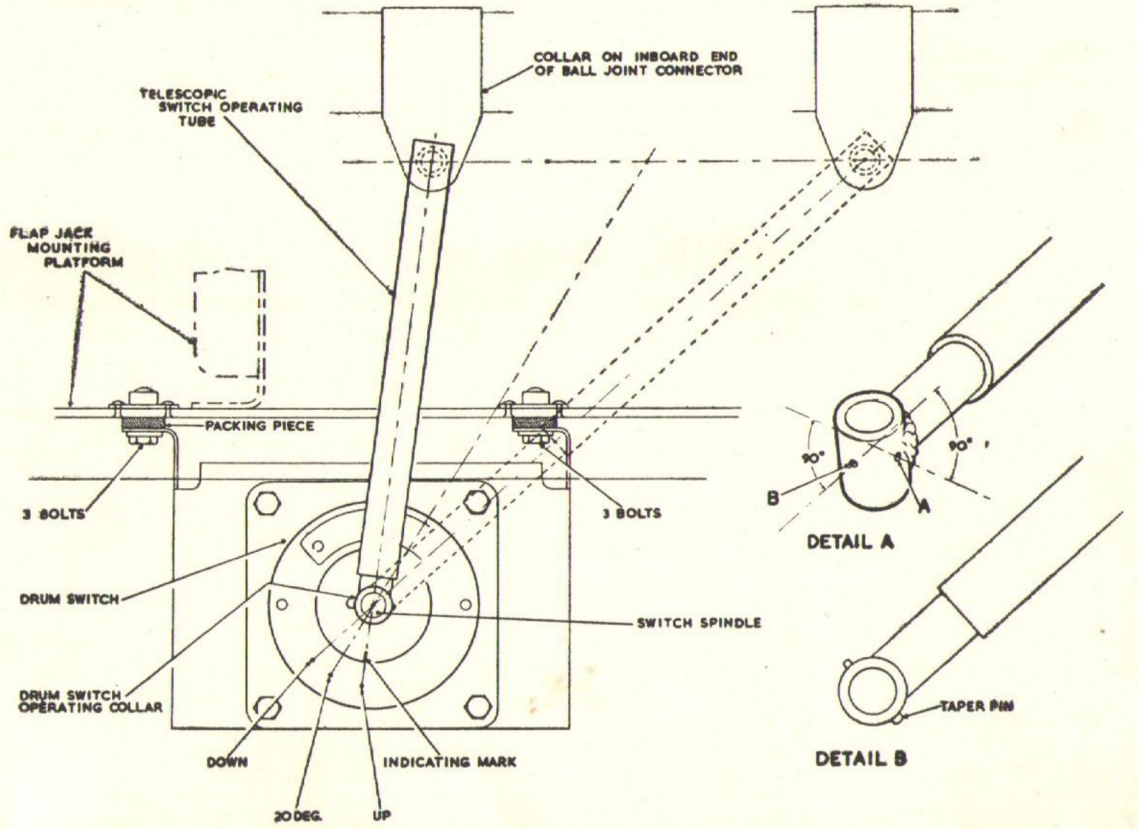

Fig. 25A. Setting the flaps drum switch

(1) When the replacement switch (*Stores Ref.* 5C/4308) has been fitted, and a replacement telescopic tube (*Stores Ref.* 26FP/810) has been obtained (the latter is always required when it is necessary to re-set it relative to the switch spindle) proceed as follows:—

(2) Remove the 1 in. interference from the flap control system (*para.* 52, reversed procedure) and check that the flaps meet the wing trailing edge evenly with the jack at its full permissible travel.

(3) Remove fuse D.7 and, using the manual operating button on the selector valve, lower the flaps fully. Check that the linear travel exceeds $26\frac{3}{4}{}^{+\frac{1}{16}}_{0}$ in. under these conditions.

(4) Drill and tap two 6BA holes in the end collar of the new telescopic tube as shown in detail A of the illustration and attach its other end to the loose operating collar on the associated ball-joint connector. Slip the tapped collar over the switch spindle and screw a suitable 6BA bolt into each tapped hole. These bolts are to act as set screws during the preliminary stages of setting the switch, but are not to be tightened at this stage.

(5) With the flaps still down and with the jack piston at its fullest port travel, rotate the switch spindle by using the inner indicating disc pin (this engages with two raised tags on the disc) as a lever, until the line on the disc is approximately opposite the "down" dot on the outer surround (*fig.* 25A) and the switch is felt to *just make at the "down" contact.*

(6) Tighten both set screws to locate the spindle firmly in the collar.

(7) Replace fuse D.7 and select UP (pilot's panel) to raise the flaps fully. If the flaps meet the trailing edge correctly,

the range movement allowed by the drum switch is correct. If so, select TAKE-OFF (linear travel $12\frac{5}{8}$ to $13\frac{3}{4}$ in.) and then DOWN (re-check linear travel —sub-para. (3)). Then carry out the checks described in sub-para. (9) and proceed as detailed in sub-para. (11) and (12). If the flap movement is incorrect, follow the procedure detailed in sub-paras. (8) to (12).

(8) If the correct "up" position of the flaps is not obtained, do not check the "take-off" position yet. At this stage it should be realised that the full range of movement of the flaps is governed by the distance travelled by the switch contact "arm" between just "making" the "up" and "down" contacts and not by the distance of arc between their two centre points. Further, the "take-off" position will differ by approximately, 1 in. (inner sections) according to whether the flaps are raised or lowered, owing to the contact arm of the switch meeting a different side of the "take-off" contact. The position when selected from "up" is the one quoted in sub-para. (7) and the other position should be ignored.

(9) If the travel of the flaps is too small, the transmitted movement to the switch is too great, or, if the latter movement is too small, the flap movement will tend to be too much and the flap jack will bottom at one end, or both ends, without the control valve magnet coils being de-energised. It is, therefore, necessary to ensure that, at each selected position of the flaps, the coil magnets are de-energised when the flaps reach the selected attitude. Since the tendency will normally be for the switch movement to be too great, trouble of this kind will not normally be encountered but checks must always be made to ensure that it is not present, as it is the job of the drum switch to limit the flap travel and this must not be achieved by bottoming of the jack in either direction.

(10) If the switch movement is too small, the ratio of its movement can be increased by:—

(a) Increasing its forward distance from the forward face of the flap jack platform. Normally, two packing pieces (*fig.* 25A) are fitted under the securing flanges of the switch mounting brackets where they are secured each by three bolts. If these are fitted, the bracket position should be satisfactory if combined with:—

(b) Increasing the obliquity of the telescopic operating tube. This may be sufficiently increased by moving the centre tube part of the ball joint connector assembly complete with the telescopic tube operating collar as far outboard as possible. To do this, hold the centre tube and carefully slacken both locking nuts, meanwhile holding, by using suitable spanners, the "square" nut integral with each ball end fitting of the assembly to prevent alteration of its setting. When the centre tube is free to rotate, rotate it, still holding the ball ends by the two spanners, to move it outboard until all but two threads of the outer ball end fitting are inside the tube. It is necessary to leave two threads as $1\frac{3}{4}$ threads are required for the application of 1 in. interference later. If the switch movement is too small, reverse the above procedure.

(11) When the drum switch has been correctly set to allow the necessary range of flap movement and de-energise the magnet coils, a final check must be made as detailed in sub-para. (9). Then remove the set screw A and, using its threaded hole as a pilot hole, drill right through the collar and spindle using a $\frac{1}{8}$ in. drill.

Note . . .
The switch spindle is hard material and it is, therefore, most essential to use a sharp, perfectly centred drill and a $\frac{1}{4}$ in. capacity electric hand drill. Then open up the hole with a size OO taper reamer and fit a new taper pin, 2/A.G.S.213. Remove set screw B.

(12) Finally, re-apply 1 in. interference on the flaps and re-fit the locking clips to the port inner ball joint connector.

Setting for interference

52.

(1) Lower the flaps two inches, measured at the centre plane trailing edge. Adjust both connectors at the ends of the flap jack piston-rod to raise the

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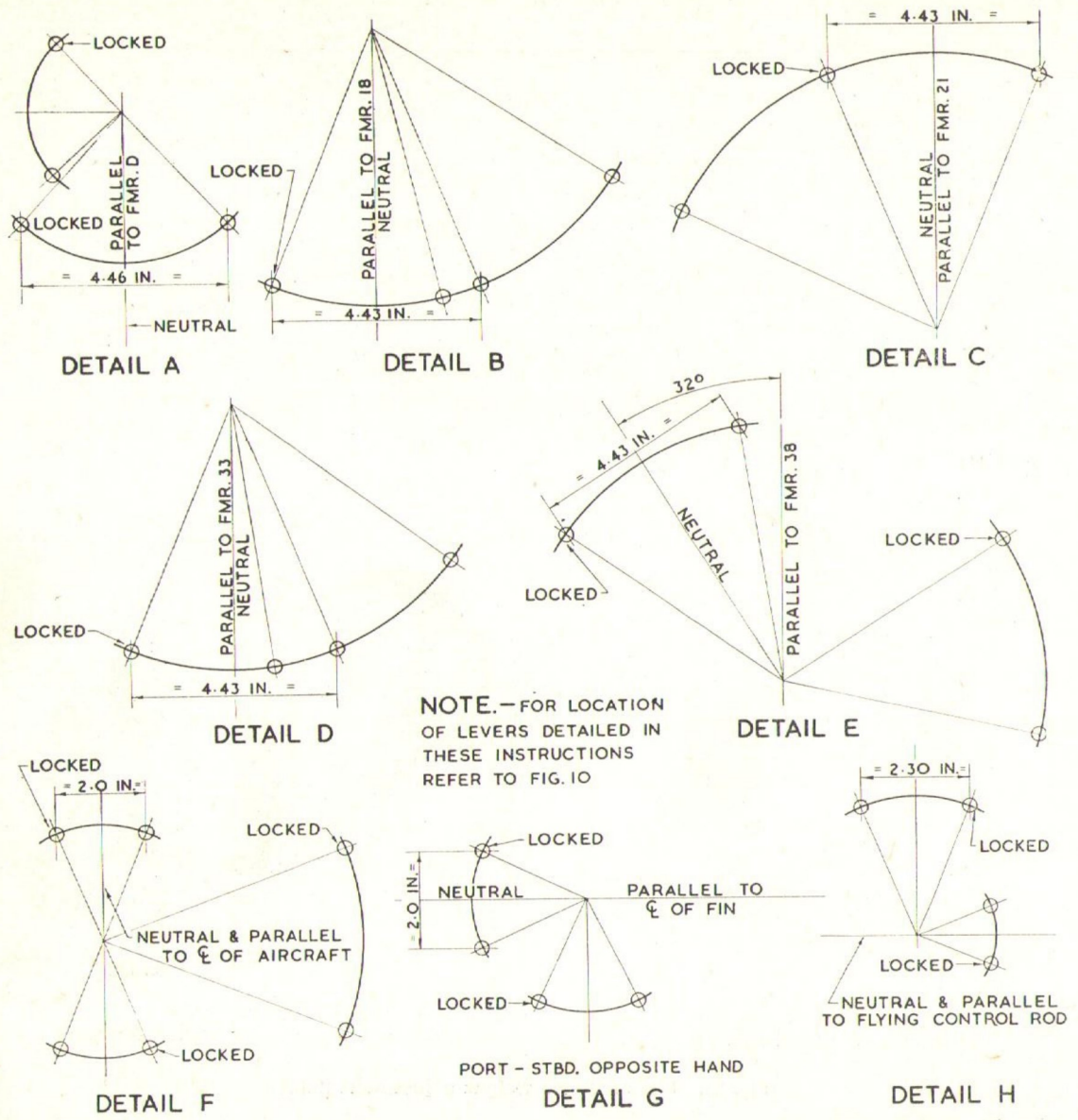

Fig. 25. Rudder locking system rigging instruction

1. Disconnect push-pull system at upper arm of bell-crank at bottom of outboard face of first pilot's engine control pedestal.

2. Disconnect system from locking pins at upper arm of bell-crank on locking handle shaft and at actuating levers pivoted from locking pin housings in fins.

3. Set lever A to its neutral position (lower arm vertical), connect up the control tube to this arm and tie the tube to maintain the lever at its neutral position.

4. Check visually that lower arm of lever referred to in (1) is at right-angles to control tube between it and lever A. Adjust control tube if necessary.

5. Using the turnbuckles throughout the system, connect up all levers and set them each in their neutral position working from B to G.

6. Connect the control tube mentioned in (1) to upper arm of lever on lower part of outboard face of first pilot's engine control pedestal.

7. Pull back the control handle and, leaving it locked in that position, check that lever A is in the locked position, adjusting, if necessary, control tube between lever on locking handle shaft and lever at base of pedestal.

8. Make a pencil mark 9/16 in. from end of locking pin (*fig.* 10, *detail* K) and set lever with pin in rudder control tube to pencil mark. Adjust control rod (*fig.* 10, *detail* K) to enable it to be connected to control handle lever (*fig.* 10, *detail* J).

9. Using a suitable system of wedging, set lever of each fin post locking pin assembly in fully locked position (against the spring) and adjust fin control tube until it can be connected to lever. Engagement of locking pin in block on rudder leading edge should be $\frac{3}{4}$ in. minimum.

10. Replace the locking control lever, check operation of rudders and that rudder locking pins are fully home in housings, and that rudder control tube locking pin in cockpit is well clear of control tube.

11. Apply lock to check operation. Rudder pedals must be neutral before control lever can be fully back.

12. With rudders locked, set the aileron and elevator locking systems as described in the text.

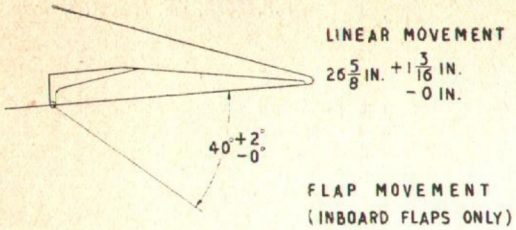

Fig. 26. Flap movement

flaps one inch, ensuring that the flap jack retains the original setting. This means that when the flap jack is moved to the fully up position there will be one inch interference at all flap sections. Now lower the flaps and check that all sections reach their full down movement (*fig.* 26).

(2) Check that the lock-nuts on all of the four connectors are tight and fit the locking clips as shown in fig. 12.

Setting the rudder locking controls (*fig.* 25)

53. Instructions for setting these controls are given in the illustration which should be used in conjunction with fig. 10. All neutral lines indicated in fig. 25 are either vertical or horizontal except that of detail E, for which an angular setting is given. In all cases sufficient accuracy of setting should be achieved if visual estimation or a small set square is used to check the right-angle between the centre lines of each lever and its associated control tubes in the mid travel position.

Setting the aileron and elevator locks

54. With the rudders locked, set the sliding bar in each locking assembly (*fig.* 11) with the hole positioned to allow insertion of the locking pin. This is done by adjustment of the control rods from the take-off levers in the rudder locking control system, setting all levers to give the maximum movement of the sliding bars when the rudder locking lever is released.

MASS-BALANCING

55. The movable control surfaces are mass-balanced to prevent flutter or vibration. Accuracy of balance is vital to the safety of the aircraft and should be checked as described in the following paragraphs if it is

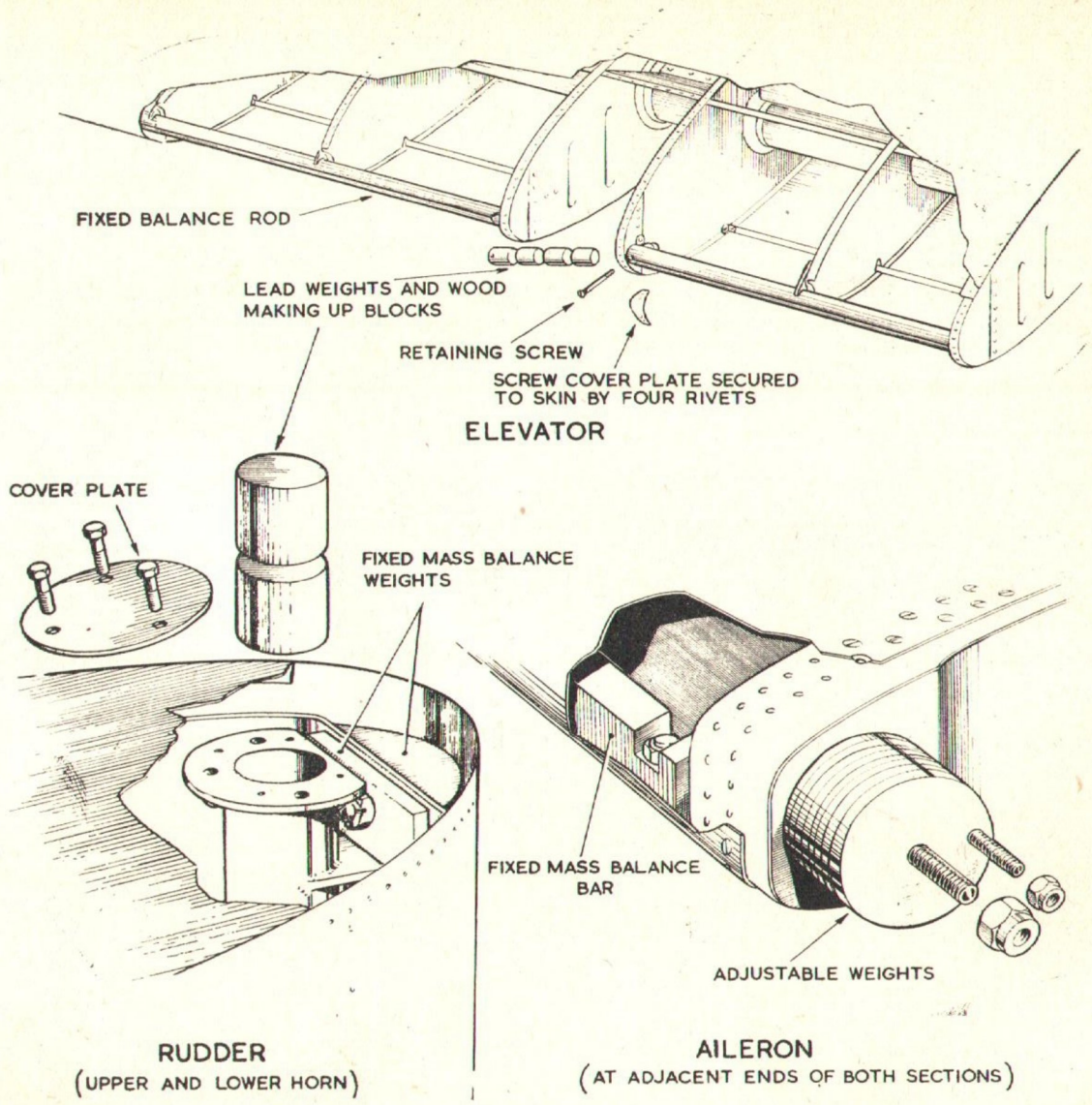

Fig. 27. Mass balance weight adjustment point

believed that it may have been affected by repairs or other causes. Control surfaces must be checked with trim and balance tabs fitted. The tab operating rods are included in the mass and should be fitted to the tabs and secured in a fore-and-aft position close to the control surface skin.

Ailerons (fig.27)

56. Each inboard and outboard portion of the aileron should be balanced separately, and, when correctly mass-balanced, each should be nose heavy. To check that mass-balance is adequate, a ¼ lb. weight should be hung from the trailing edge, at rib 7 on the inner portion and at rib 22 on the outer portion. Each section, which should be conpletely free to float, should then be in static balance or nose heavy. If, with the weight in position, the half aileron is tail heavy, disc weights, Part No.167/F5360, should be added to the peg provided at the control forging until the required balance is obtained. The peg is located, in each case, at the end where the operating mechanism is attached.

Elevators (fig.27)

57. Each of the elevators should be checked separately for mass balance and, for this purpose, must be mounted on the inboard and outboard hinges only, the centre hinge being left free. This prevents the balance being upset by any slight spring which may be present due to the hinges not being absolutely in line. The mass balance is corrected by increasing or decreasing the weight, carried in the mass balance tube, in the leading edge between the datum inboard hinge and the inner end of the elevator. To open the tube, remove the screw and the plug at the hinge end. The lead weights (Ref. No.26EA/10539) inside can then be pushed out by inserting a rod in the hole at the inner end of the tube. If the number of lead weights is changed, the number of wooden plugs (Ref.No.26EA/430) must be correspondingly changed. The elevators are correctly mass-balanced when either of the following conditions applies:-

(1) A weight not exceeding ½ lb., when placed on the trailing edge at rib 3, i.e., at a distance of 37 in. from the hinge centre, lowers the trailing edge to the horizontal.

(2) The reading on a spring balance placed at the same position does not exceed 1 lb. to raise the trailing edge to the horizontal.

Rudders (fig.27)

58. Each rudder has two mass-balance tubes, one in each horn, which are opened by removing a cover plate at the hinge end (Sect.3, Chap.3, fig.2). Lead weights and wooden plugs similar to those used in the elevators (para.57) are fitted to give correct balance. To check the balance, support the rudder by the top and bottom hinges with the hinge line horizontal. The balance is correct when the rudder floats with the leading and trailing edges at the same level, to obtain this a weight, not exceeding 1 lb. 8 oz., may be applied at the bottom end of the trim tab trailing edge. As with the elevators, any change in the number of lead weights must be accompanied by a corresponding change in the number of wooden plugs.

ADJUSTMENT AFTER FLIGHT TESTING

59. After the aircraft has been test flown, any adjustment required should be made in accordance with the instructions contained in the following paragraphs. For convenience, reference is made to the port wing only, but the instructions are applicable to either wing if the word starboard is substituted for port when necessary.

Aileron adjustments

60. There are three adjustments possible:-

(1) To improve the self-centring properties of the aileron control, the ailerons may be set with up to ⅜ in. droop by adjustment of the push-pull rods in the main plane.

NOTE . . .
Differential droop of up to ¼ in. is permitted.

(2) If the aileron is too light, it can be made heavier, and the feel improved, by increasing the length of the trailing edge cords from 2 ft. up to 3 or 4 ft. maximum (fig.17).

(3) The aileron control may be made progressively lighter if the aft ends of the balance tab connecting rods are moved to holes in the control arms, nearer the tabs, to increase their movement. Any of the six holes may be used as required. If it is necessary to use the lowest hole, the distance piece normally fitted there should be moved to the top hole.

Corrections for lateral trim

61. Symptoms and the relevant corrections are given below:-

(1) If the aircraft flies port wing low with the control wheel left-hand down, the ailerons require adjustment.

(a) Provided the correction on the manually-operated trim tab control does not exceed two graduations, a slight adjustment of the aileron balance tabs will be sufficient. The port balance tab should be set "up" two turns of the adjustable forward end of the control rod and the starboard balance tab two turns "down" if the original setting will allow. If the original settings do not allow adjustment, the ailerons must be adjusted as follows:-

(b) If the correction on the manually-operated trim tab control exceeds two graduations, it will be necessary to pack up the starboard aileron; e.g., if the aircraft requires five graduations trim to starboard, to fly level, the starboard aileron must be packed up with 1/8 in. taper packing strips. The maximum quantity of packing which it is possible to insert is ¼ in. (this includes packing fitted to obtain alignment of the ailerons

with the main plane trailing edge). For a small variation, thinner packing will be required. Care must be taken to see that the hinge arm securing bolts are long enough to pass through the anchor nuts.

(2) If the aircraft flies port wing low with the control wheel central, the cause is an error in wing incidence. The whole of the main plane incidence should be carefully checked to ensure that it is within the permitted tolerance given in Sect.2, Chap.4. If it is not, the intermediate and outer plane incidence, relative to that of the centre section, can be altered by removing the centre section to intermediate plane spar joint web plates. and after setting the incidence, fitting new web plates, which are undrilled, on the inboard side, and drilling from the existing holes in the spar webs.

(3) If the aircraft flies level with the control wheel right-hand down, the aircraft is port wing low on the wing incidence and starboard low on ailerons, one condition counteracting the other.

(a) The wing incidence error should first be corrected, as described in sub-para-(2).

(b) If any correction has been made to the outer plane incidence as a whole, the aircraft must be test flown before any further adjustments are made, as altering the incidence may affect the trim of the aileron. If necessary, they may then be adjusted as described in sub-para.(1).

(4) If the aircraft flies port wing low, with the control hand wheel left-hand down, and, after trimming the aircraft laterally level, by means of the aileron trim tab control, the hand wheel is right-hand down, the cause is port wing low due to wing incidence error and port wing low due to aileron trim.

(a) The wing incidence error should first be corrected as described in sub-para.(2).

(b) If any correction has been made to the intermediate and outer plane incidence as a whole, the aircraft must be test flown before any further adjustments are made, unless it is considered that the condition of the port wing low on ailerons is sufficiently pronounced to justify packing the starboard aileron first.

Correction for fore-and-aft trim

62. Should it be found that the aircraft flies nose or tail heavy, necessitating adjustment of the manually-operated trim control for correction, a check on the neutral position of the tabs will probably indicate that either the balance tabs or the trim tabs require further slight adjustment. DOWN if the aircraft flies nose heavy and UP if tail heavy. If it is now found that, to trim the aircraft in level flight at cruising speed, the trim tabs must be adjusted by more than 1 to 1½ graduations on the indicator, the balance tabs should be set on the ground to provide the necessary correction. The adjustment required will be approximately ⅞ of the linear displacement of the trim tab trailing edge from its neutral setting of 0 deg. and in the same direction. Before setting the tabs, the rudders and elevators must be locked in the neutral position as described in Sect.2, Chap.1.

Flaps

63. The flaps must not droop in flight. The setting of the flaps to introduce interference and prevent droop is described in para.52. If, however, there is droop in flight, it is eliminated on the ground as follows:-

(1) After lowering the flaps, raise them until one or more flap sections are just touching the main plane trailing edge and note, in inches, the amount of droop in any of the sections which are not touching the main plane trailing edge.

(2) If the droop at an outer extension flap section is constant along its length, adjust all associated operating links by an equal amount, or, if the droop is uneven, set the links individually to suit. None of the links must be shortened by more than approximately two threads below the nominal setting of 1 in. (fig.24) and it may be necessary to lengthen them elsewhere.

NOTE . . .

A complete turn on a link adjuster alters the position of the portion of the flap trailing edge aft of it by approximately ¼ in.

(3) If the droop is at an outer flap section, and is constant, set both this and its associated extension in line by adjusting the operating links as above and adjusting the outer flaps operating tube connector to bring the whole outer length of flap in line with the inner section.

(4) If droop occurs at an inner section, lower the whole outer run in line by use of the outer connector.

(5) After adjustments have been made and all sections just touch the main plane trailing edge when subsequently raised sufficiently, alter the adjustment at the outer ends of the inboard connectors to allow the flap to droop just enough to move the flap jack to the fully UP position. Bring the flaps up by this adjustment until they all meet the main plane trailing edge without any interference.

(6) Finally introduce 1 in. interference as described in para.52.

Checking flap interference

64. The only certain method of ensuring that the correct amount of interference is applied to the flaps is to remove it by adjustment of the outer ends of the inner flap-operating tube connectors and applying it correctly as described in para.52.

edge rib instead of passing through the hole provided.

(2) Select flaps on the manual operating button of the flap selector valve and pump the flap jack to the fully up position by means of the hand pump. Measure the distance from the red line on the relevant end of the jack piston rod to the face of the cylinder. At this position the jack piston is bottoming on the cylinder at the end of its stroke. With the jack within $\frac{1}{16}$ in. of this position connect the inner flap operating tubes to the ends of the flap jack piston rod.

(3) Pump the flap jack to the down position and connect the port outer flap-operating tube to the associated link previously adjusted to its maximum safe length.

(4) Pump the flap jack to the up position and connect the starboard outer flap-operating tube to the link at that side, previously adjusting the link to its minimum length.