

## Chapter 4 FLYING CONTROLS

### LIST OF CONTENTS

	Para.		Para.		Para.
<b>General</b> ... ..	1	Elevator control severing ... ..	46	Testing the release of the feel unit ...	80
Control handwheels ... ..	2	Elevator control severing for parking	47	100 lb test at feel unit lever ...	81
Adjustment of chain drive ... ..	6A	Elevator control emergency severing ...	49	Test with load lever ... ..	82
Pilot's control arm and handwheel removal ... ..	7	Controls severing check ... ..	51	Elevator feel unit removal ... ..	83
Pilot's control arm and handwheel assembly ... ..	8	Elevator lever removal ... ..	52	Elevator feel unit cylinder removal ...	84
Controls pedestal ... ..	9	Elevator lever assembly ... ..	53	Elevator autopilot servomotor ... ..	85
Throttle lever friction clamp ... ..	16	Lever group, elevator/rudder, at cabin bulkhead ... ..	54	<b>Tail plane</b>	
Autopilot unit ... ..	17	Power control unit ... ..	55	Tail plane incidence mechanism ... ..	86
Automatic pilot ... ..	18	Elevator stops and power unit settings	57	Reduction gearbox ... ..	88
Automatic stabilizer ... ..	19	Elevator and rudder power unit removal ... ..	58	Gearbox removal ... ..	90
Controls at Stn. 449-783 ... ..	20	Anti-oscillation linkage ... ..	59	Gearbox assembly ... ..	91
Power units ... ..	21	Anti-oscillation linkage initial neutral setting ... ..	60	Limit switch gear ... ..	92
<b>Artificial feel units</b> ... ..	22	Anti-oscillation linkage neutral setting check ... ..	61	Screwjack ... ..	94
Operation ... ..	23	Elevator trim indicator unit ... ..	62	Screwjack removal ... ..	96
Feel unit lever and release mechanism	25	Elevator out-of-trim lights ... ..	64	Screwjack assembly ... ..	97
Feel unit cylinder ... ..	28	Elevator trim indicator setting ... ..	65	Screwjack lubrication ... ..	98
Feel unit release runs ... ..	30	Compensating lever mechanism ... ..	66	<b>Rudder controls</b>	
Testing feel unit pipes, cylinders and joints for leaks ... ..	31	Elevator stop mechanism and balance weights ... ..	67	Rudder pedals ... ..	99
Checking the functioning of the feel units ... ..	32	Elevator tab mechanisms		Rudder pedal removal ... ..	101
Feel unit load deflecting/friction tests	33	Balance tab—port elevator ... ..	69	Rudder pedal assembly ... ..	102
Checking static friction in controls ...	34	Balance tab setting ... ..	70	Controls ... ..	103
Backlash in control surface tabs ... ..	35	Trim tab—starboard elevator ... ..	71	Control stop unit—input ... ..	105
Lock run setting ... ..	36	Trim tab and desynn setting ... ..	72	Setting the rudder input rod ... ..	106
Control surface movements ... ..	37	Elevator locking controls ... ..	73	Setting the rudder input stop ... ..	107
Lubrication ... ..	38	Pre-Mod. 474 ... ..	74	Power unit ... ..	108
Special tools ... ..	39	Post-Mod. 474 ... ..	76	Rudder stops and power unit settings	109
<b>Elevator controls</b>		Preloading the elevator feel unit piston spring ... ..	78	Rudder power unit removal ... ..	110
Handwheel setting ... ..	40	Elevator feel unit lever neutral setting	79	Anti-oscillation linkage ... ..	111
Elevator handwheel adjustment ... ..	41			Rudder torque tube ... ..	112
Controls ... ..	42			Rudder balance tab mechanism ... ..	113
Control stop unit—input ... ..	43			Setting the rudder balance tab ... ..	114
Setting the elevator input rod ... ..	44			Rudder trim tab mechanism ... ..	115
Setting the elevator input stop ... ..	45			Trim tab and desynn setting ... ..	116

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	Para.
<i>Pre-loading the rudder feel unit piston spring</i> ... ..	121
<i>Testing the release of the feel unit 100 lb test at feel unit lever</i> ...	122
<i>Test with load lever</i> ... ..	123
<i>Rudder feel unit desynn setting</i> ...	124
<i>Rudder feel unit actuator check</i> ...	125
<i>Rudder feel unit removal</i> ... ..	126
<i>Rudder feel unit cylinder removal</i> ...	127
<i>Rudder autopilot servomotor</i> ...	128
<i>Rudder autopilot servomotor</i> ...	129
<b>Aileron controls</b> ... ..	130
<i>Aileron gearbox</i> ... ..	133
<i>Aileron gearbox removal</i> ... ..	134
<i>Power unit and mounting</i> ... ..	135
<i>Aileron stops and power unit settings</i>	136
<i>Aileron power unit removal</i> ... ..	137
<i>Aileron controls aft of rear spar</i> ...	138
<i>Feel unit lever and release mechanism</i>	139
<i>Aileron feel unit actuator check</i> ...	141
<i>Artificial feel unit cylinder</i> ... ..	142
<i>Preloading the aileron feel unit piston spring</i> ... ..	143
<i>Aileron feel unit lever neutral setting</i>	144
<i>Testing the release of the feel unit 100 lb test at feel unit lever</i> ...	145
<i>Test with load lever</i> ... ..	146
<i>Aileron feel unit desynn setting</i> ...	147
<i>Aileron feel unit removal</i> ... ..	148
<i>Aileron feel unit cylinder removal</i>	149
<i>Aileron locking mechanism</i> ... ..	150
<i>Lock unit</i> ... ..	151
<i>Aileron lock catch bracket adjustment</i> ... ..	152
<i>Lock run microswitch setting</i> ...	153
<i>Aileron trim tab operation</i> ... ..	154
<i>Trim tab and desynn setting</i> ... ..	155
<i>Aileron and balance tab mechanism</i>	156
<i>Balance tab setting</i> ... ..	157
<i>Aileron autopilot servomotor</i> ...	158
<i>Aileron autopilot servomotor</i> ...	159
<b>Flap controls</b> ... ..	160
◀ <i>Assembling flap operating unit rear thrust bearing</i> ... ..	162A▶
<i>Assembling No. 1 flaps</i> ... ..	163
<i>Assembling No. 2 and 3 flaps</i> ... ..	164
<b>Dive brakes</b> ... ..	165
<i>Dive brake setting</i> ... ..	166

## LIST OF ILLUSTRATIONS

	Fig.
<i>Flying controls</i> ... ..	1
<i>Controls in cockpit</i> ... ..	2
<i>Handwheel mechanism</i> ... ..	3
<i>Controls pedestal</i> ... ..	4
<i>Feel release and control locks</i> ...	5
<i>Controls in rear fuselage</i> ... ..	6
<i>Control surface locking</i> ... ..	7
<i>Feel unit assemblies</i> ... ..	8
<i>Feel units release controls</i> ... ..	9
<i>Master curves for feel unit load deflection tests</i> ... ..	10
<i>Load deflection/friction test</i> ... ..	11
<i>Tab backlash gauge</i> ... ..	12
<i>Adjustable points and movements in flying controls</i> ... ..	13
<i>Elevator feel unit mechanism</i> ... ..	14
<i>Elevator controls parking and severing mechanism—1</i> ... ..	15
<i>Elevator controls parking and severing mechanism—2</i> ... ..	16
<i>Lever group at cabin bulkhead</i> ...	17
<i>Elevator and rudder power unit settings</i>	18
<i>Elevator and rudder power unit removal</i> ... ..	19
<i>Anti-oscillation linkage</i> ... ..	20
<i>Elevator power unit—output rod movement</i> ... ..	21
<i>Elevator trim indicating unit</i> ... ..	22
<i>Elevator stop mechanism and balance weights</i> ... ..	23
<i>Elevator balance weight roller guides</i>	24
<i>Port elevator balance tab mechanism—1</i> ... ..	25
<i>Port elevator balance tab mechanism—2</i> ... ..	26
<i>Starboard elevator trim tab mechanism</i>	27
<i>Elevator lock mechanism, pre-Mod. 474</i> ... ..	28
<i>Elevator lock mechanism, post-Mod. 474</i> ... ..	28A
<i>Elevator feel unit lever neutral setting</i>	29
<i>Pre-loading the feel unit cylinder piston spring</i> ... ..	30
<i>Testing release of elevator feel unit—1</i>	31

	Fig.
<i>Testing release of elevator feel unit—2</i>	32
<i>Variable incidence tail plane actuating mechanism</i> ... ..	33
<i>Tail plane incidence reduction gearbox</i>	34
<i>Functional diagram of tail plane actuating mechanism</i> ... ..	35
<i>Tail plane incidence limit switch gear</i>	36
<i>Tail plane incidence screwjack</i> ...	37
<i>Tail plane sling for screwjack removal</i>	38
<i>Handwheel and tail plane adjustment diagram</i> ... ..	39
<i>Tail plane incidence actuating mechanism lubricating system</i> ...	40
<i>Rudder pedals</i> ... ..	41
<i>Rudder balance tab mechanism</i> ...	42
<i>Rudder trim tab mechanism</i> ... ..	43
<i>Rudder lock and stop mechanism</i> ...	44
<i>Aileron controls aft of rear spar</i> ...	45
<i>Aileron power unit settings</i> ... ..	46
<i>Aileron rigging target</i> ... ..	47
<i>Aileron rigging adjustment diagram</i> ...	48
<i>Aileron power unit removal</i> ... ..	49
<i>Aileron locking mechanism</i> ... ..	50
<i>Aileron lock unit</i> ... ..	51
<i>Starboard aileron trim tab mechanism</i>	52
<i>Aileron and balance tab controls</i> ...	53
◀ <i>Detail of rear thrust bearing</i> ... ..	53A▶
<i>Flap unit No. 1</i> ... ..	54
<i>Inboard guide rail eccentric at flap No. 1</i> ... ..	55
<i>Flap units No. 2 and 3</i> ... ..	56
<i>Flap unit No. 4</i> ... ..	57
<i>Flap unit No. 5</i> ... ..	58
<i>Flap control telescopic tie-rod</i> ...	59
<i>Position of serrated shaft in flap drive</i>	60
<i>Flap assembly to aircraft</i> ... ..	61

## LIST OF TABLES

	Table
<i>Maximum permissible backlash in tabs</i>	1
<i>Control surface movements</i> ... ..	2
<i>Ground equipment</i> ... ..	3

## GENERAL

1. Side-by-side dual controls are fitted to this aircraft (fig. 1 and 2), the surfaces being operated through a system of push-pull rods and power control units. One power unit serves the elevator and rudder and another serves the ailerons; a full description of the power units will be found in A.P.4603A and B. In the event of failure of one hydraulic generator in a power unit, the remaining generator will operate the affected controls at full effort but at half speed. If both

generators fail in a power unit the affected controls will automatically revert to manual operation. In an emergency, the operation of the hood jettison lever disengages the elevator controls and throws the handwheel forward to clear the pilot's legs when he is ejected.

### Control handwheels (fig. 3)

2. The handwheels are of the rams horn type, and are mounted on a curved light-alloy cast arm. A portion of this arm, approximately from its centre point to its

outer extremity, is enclosed in a rectangular plate metal control box. This box, which is rigidly attached to the aircraft structure, houses a square shaft which is rotatable. The shaft is attached at its forward end to the aileron control gearbox, and at its aft end in a bearing housing. In the lower out-board end of the control box is mounted a bearing tube which runs parallel to the square shaft; this tube also incorporates the spring which throws the handwheel clear of the pilot's legs when the hood jettison lever is operated.

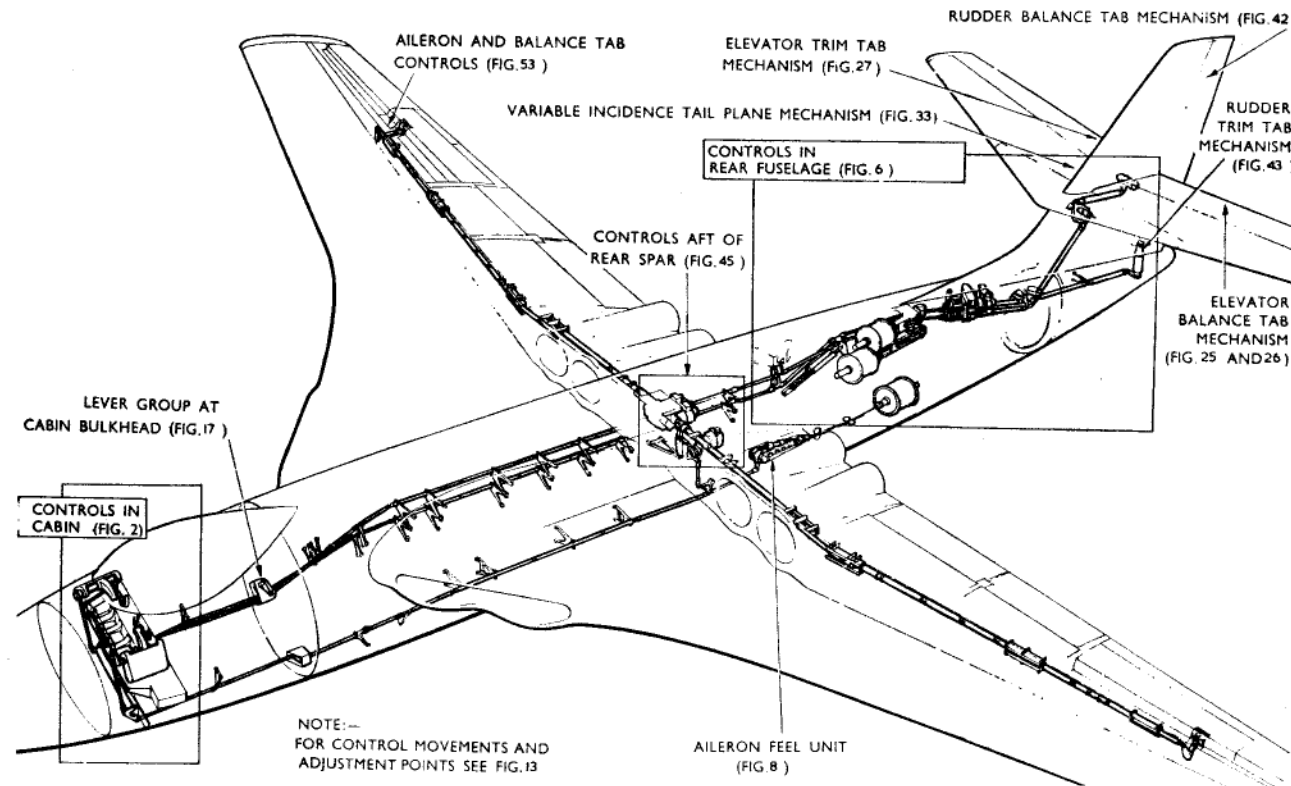


Fig. 1. Flying controls

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3. The centre portion of the curved arm houses needle roller bearings which roll along the square shaft as the handwheel is moved forwards or backwards. Also formed into the casting at this central point, is the housing for the ball joint of the handwheel setting screw. The lower outboard end of the arm is formed into a semi-circular yoke, and two rollers which, by their engagement with each side of the bearing tube, prevent any vertical movement of the arm.

4. Both handwheels incorporate squeeze type brake levers, and, on the outboard horn, a multiple switch unit (Sect. 1, Chap. 1). The 1st pilot's handwheel is fitted with a brake parking lever and a R.A.T.O. firing button on the inboard horn.

5. Each handwheel is mounted on a serrated shaft at the inboard end of the curved arm and is secured with a locknut and circlip. The shaft houses the brake push rod and carries two chain pulleys which are located by a pin in the flange of the splined carrier; the serrations in the bore of the carrier locate in corresponding serrations on the shaft, the whole being locked in place by a locknut.

6. A chain drive, anchored to these pulleys, passes over further pulleys (mounted in the arm) which are provided with eccentric adjusting pins; the drive is secured to pulley flanges machined in the tube which moves along the square shaft.

#### Adjustment of chain drive (fig. 3)

6A. The chain drive, from the sliding tube on the square shaft to the handwheel shaft, should be adjusted by first tightening the chains as much as possible, selecting the most appropriate hole in the handwheel-shaft pulley flanges. Final adjustment should then be made at the idler pulleys eccentric bolt and bush as follows:—

- (1) Bend down the locking tab and remove the  $\frac{1}{4}$  in. B.S.F. nut from the eccentric bolt.
- (2) Remove the locating pins from the eccentric bolt and the eccentric bush.
- (3) Using a spanner on the two flats, adjust both the bolt and bush until any slack in the chain drive is taken up.
- (4) Fit a new tab washer, Ref. No. 28W/9419136, and tighten and lock the securing nut.
- (5) Using as a guide the locating pin holes in the bolt head and the bush flange, drill new  $\frac{1}{16}$  in. dia. holes in the handwheel arm casting and drive home the locating pins.

#### Pilot's control arm and handwheel removal

7. To remove a pilot's handwheel and control arm proceed as follows:—

- (1) Disconnect all electrical connections at the nearest terminals.
- (2) Slacken the brake cable stop nut at the stop bracket on the arm. Remove the bracket.
- (3) Slacken the handwheel parking cable by unscrewing the knurled adjuster and free the ball end of the cable from the cable end fitting. Thread the cable back until it is free of the arm.
- (4) Remove the taper pin securing the adjuster wheel to the handwheel setting rod.
- (5) Unscrew the ball seating of the handwheel setting rod from the arm.
- (6) Move the elevator lever aft until the split bush under the ball joint can be removed.

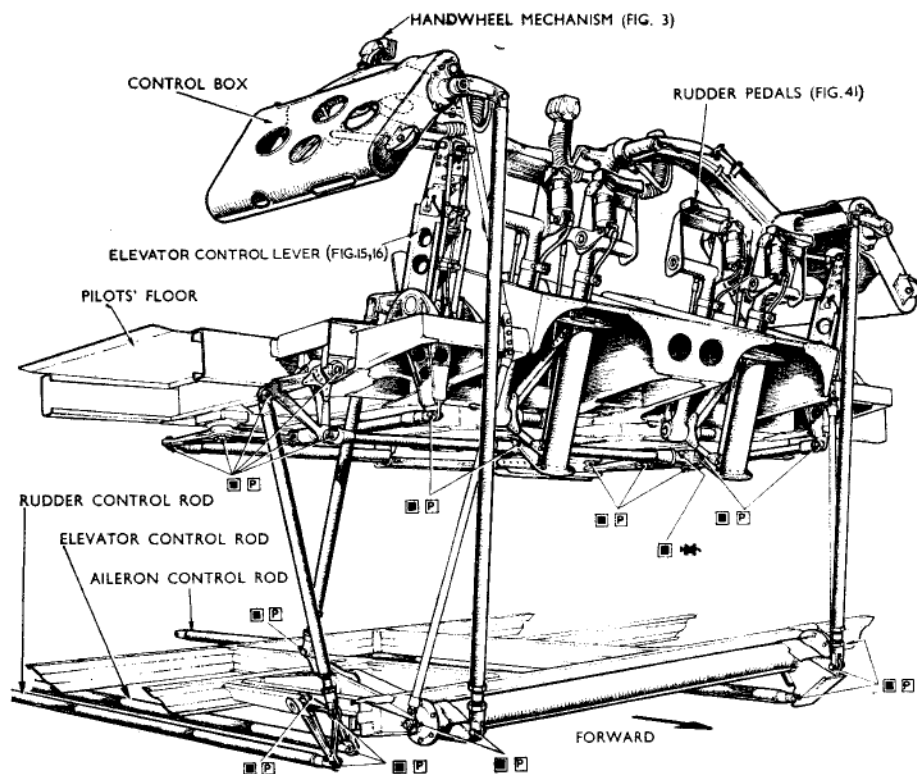


Fig. 2 Controls in cockpit

(7) Move the lever forward until the handwheel setting rod ball is free of the handwheel arm.

(8) Pull the handwheel right back. Remove the four bolts securing the end bearing housing of the square handwheel shaft to the aft face of the control box and remove the bearing housing.

(9) Remove the split pins from the retaining ring securing the square handwheel shaft to the aileron gearbox.

(10) Hold the handwheel arm with one hand and with the other hand pull the square shaft out of the controls box until it is free of the handwheel arm.

(11) Disconnect the two brake levers, remove the handwheel retaining nut circlip and unscrew the nut. The handwheel can then be withdrawn from the arm, giving access to permit inspection of cables. If the handwheel is to be completely removed, the cables must be disconnected at the nearest connector block (*Book 2, Sect. 5, Gen. Inf.*).

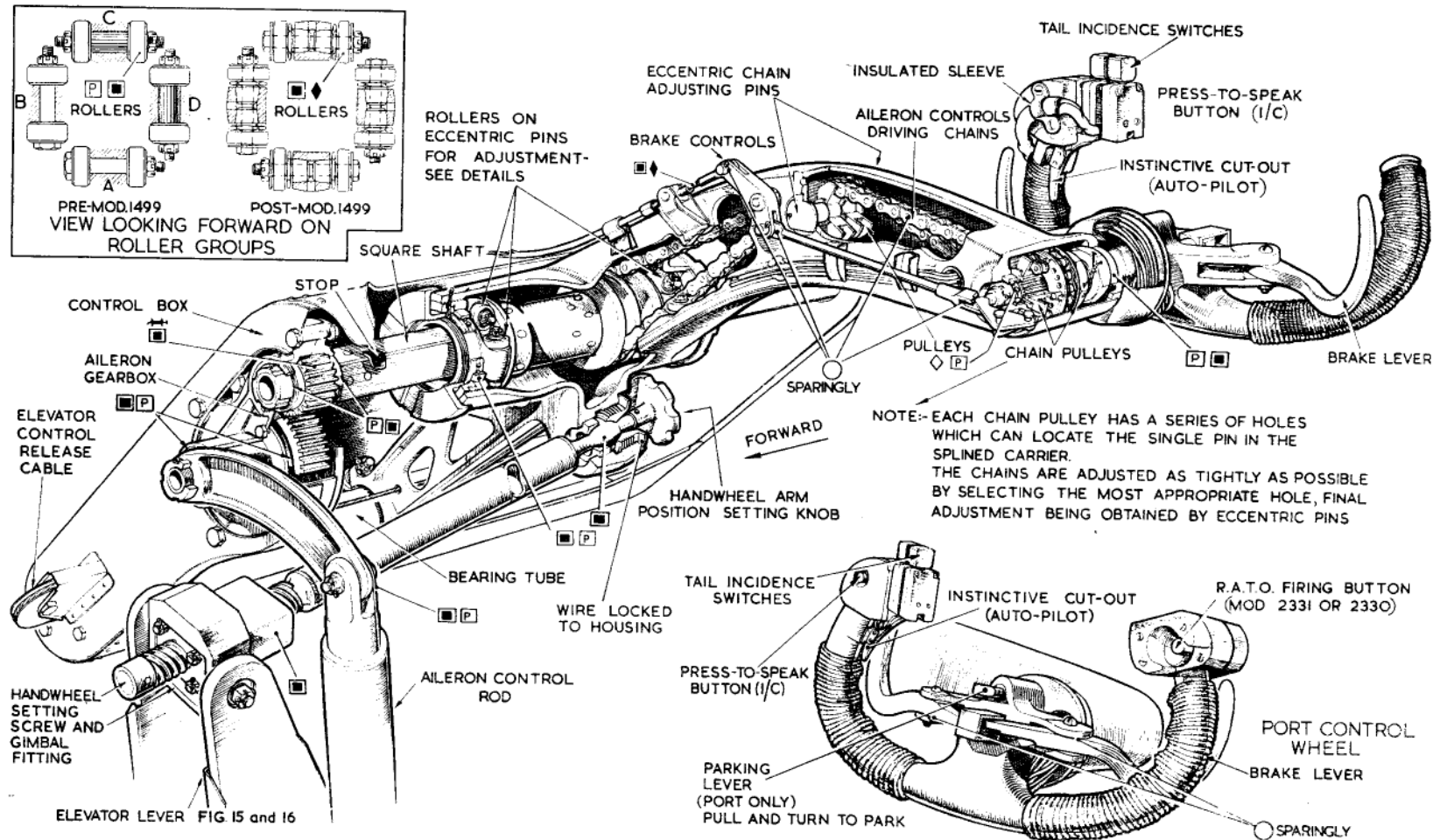


Fig. 3. Handwheel mechanism

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### Pilot's control arm and handwheel assembly

8. To assemble the pilot's handwheel arm in the controls box, reverse the procedure as given in the previous paragraph, ensuring that the tension in the parking release cable will permit smooth operation of the parking mechanism. When assembling the handwheel to the control arm, it is imperative that the electrical cables are run correctly; the relevant instructions given in Book 2, Sect. 5, Gen. inf., MUST be adhered to.

### Controls pedestal

9. The controls pedestal (fig. 4) is mounted centrally on the pilot's floor. Details of the electrical components and instruments are given in Sect. 5.

10. The pedestal is of plate construction. Housed between the side walls is a common shaft which carries four hand levers, one for each throttle valve and H.P. cock control; the levers are numbered 1 and 4 port to starboard, corresponding to the engine operated. Each lever carries a push-pull rod which passes down the pedestal to connect with the lever group, in the aft lower portion, from which control rods extend aft through the fuselage.

11. Movement of each hand lever operates the engine throttle valve and, when the lever is pulled back and the hand lever latch lock is raised, closes the H.P. fuel cock. A rod from each throttle lever is connected to one of a set of four levers incorporating cams which operate microswitches; these switches bring a warning horn and lamp into operation when all four throttle levers are pulled back to less than  $\frac{1}{4}$  open, with the alighting gear *not* locked but in the down position.

12. On the starboard side of the pedestal is the controls locking handle which is retained in the "free" (vertical) position by a catch mounted on the starboard outboard face of the throttle pedestal side plate. This "free" position is indicated by a green band on a

white background on the pedestal. When the locking handle is pulled to the horizontal position (indicated by a red band on a white background), cams on the lock handle cross-shaft trip four ganged microswitches, mounted below the cross-shaft, thus cutting the four power unit motors. A linkage in the pedestal, connected to the lock run under the pilot's floor, operates the control surface locks. Further linkage connected to the lock handle cross-shaft operates a restricter bar, on the pedestal forward face, preventing the throttles from being opened for take-off while the flying controls are locked, but allowing sufficient movement for taxiing.

13. The flap lever, at the extreme right of the hand lever group, is connected by a push-pull rod incorporating a centralizing unit, to a switch unit on the inside of the pedestal side wall.

14. The dive brake lever, on the extreme left of the hand lever group, is connected by a push-pull rod to a switch unit on the inside of the pedestal side wall.

15. The feel unit release levers (fig. 5) are mounted on the pedestal port side, the lever lower ends being covered by a gate plate. From the bottom of each lever a chain extends round an idler sprocket and down the side of the pedestal to the underside of the pilots' floor, whence it continues aft through the fuselage.

### Throttle lever friction clamp (fig. 4)

16. Throttle lever friction is controlled by either of two levers, one at each side of the controls pedestal and mounted on a common shaft; the lower end of the starboard lever is linked to an adjustable lever, attached to which is a boss screwed to the end of the shaft carrying the dive brake, throttle and flap levers. The shaft is screwed into an end fitting pinned at the port side of the pedestal. The clamp arm has 12 equally-spaced holes to enable friction adjustment to be made on assembly.

### Autopilot unit

17. The autopilot unit, incorporated in the flying controls, consists of the controlling units in the cabin and three automatic servos connected to the rudder, elevator and aileron controls respectively. The units in the cabin comprise an amplifier unit (on the aircraft port side under the pilot's floor) connected to a control unit mounted at an angle on the throttle pedestal rear face. The heading selector on the port console in the cabin is connected to the amplifier unit, the approach coupling unit and the bomb coupling unit. Also connected to the amplifier unit are the gyro unit, the roll error cut-out, and the power factor unit. Fitted to the outboard horn of each pilot's handwheel is an instinctive cut-out switch. The remote trim indicator is mounted on the centre instrument panel. For a more comprehensive description of the autopilot system refer to Book 3, Sect. 5, Chap. 6, Group 2.

### Automatic pilot

18. Reference should be made to Book 3, Sect. 5, Chap. 6, Group 2, of this publication and A.P.1469D, Vol. 1, for servicing instructions and functional tests relating to the automatic pilot.

### Automatic stabilizer

19. The autostabilizer system is fitted to detect yaw movements and to suppress them by operating the rudder control. The system is controlled by a three-position (ON—STAND-BY—OFF) switch on the controls pedestal. All the remaining units, with the exception of the servomotor, are mounted on a readily-detachable panel fitted to the port leg of the radio crate table. The servomotor is mounted on, and is integral with, the rudder/elevator power unit in the rear fuselage. A full description of the stabilizer is given in A.P.1469S, Vol. 1, Sect. 6, Chap. 1. No mechanical adjustments are necessary; the electrical tests are to conform with those given in A.P.4377A, Vol. 1, Book 3, Sect. 5, Chap. 6. For the removal of the motor together with the rudder/elevator power unit, see para. 58 and fig. 20 of this Book 1.

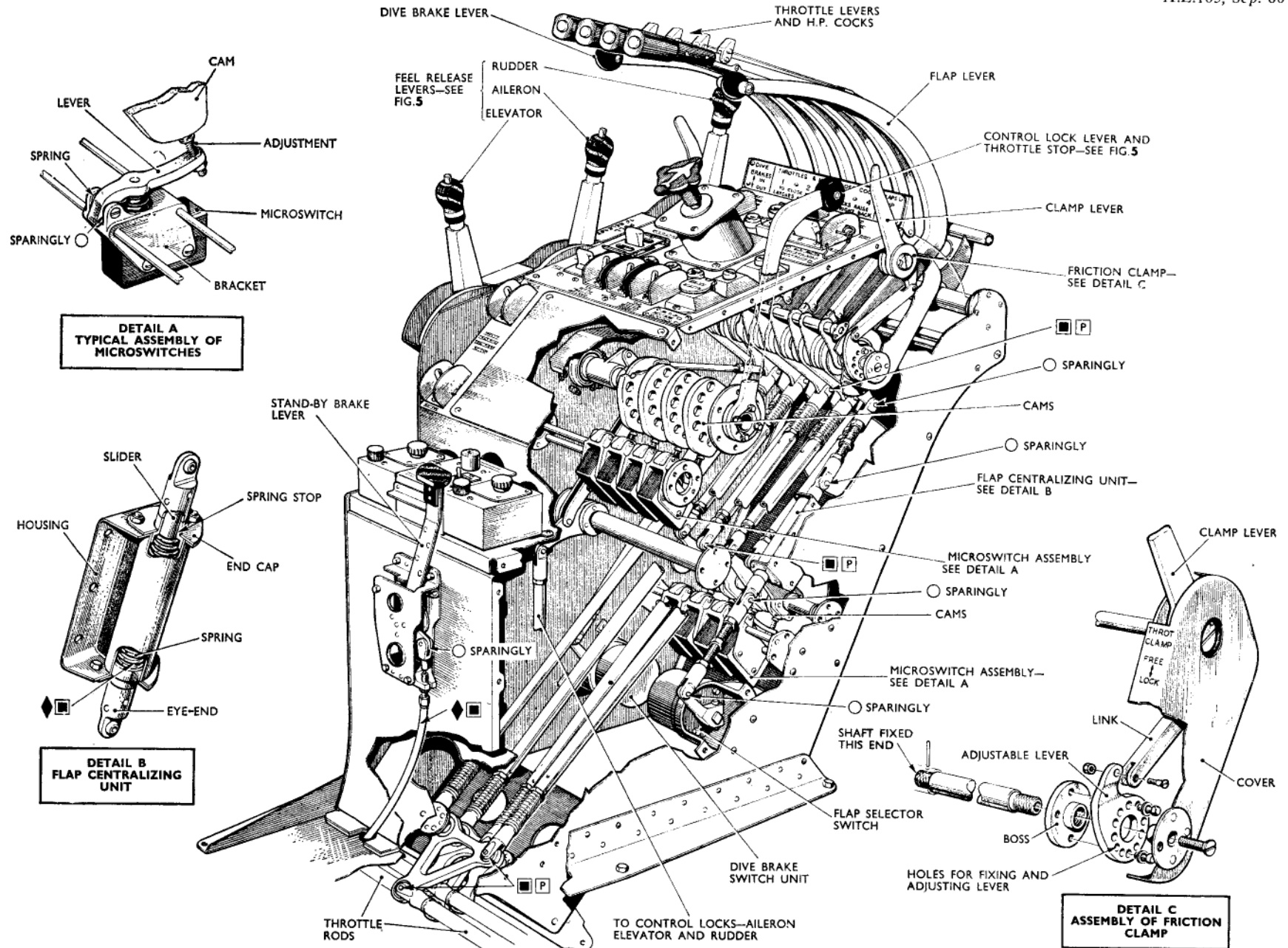
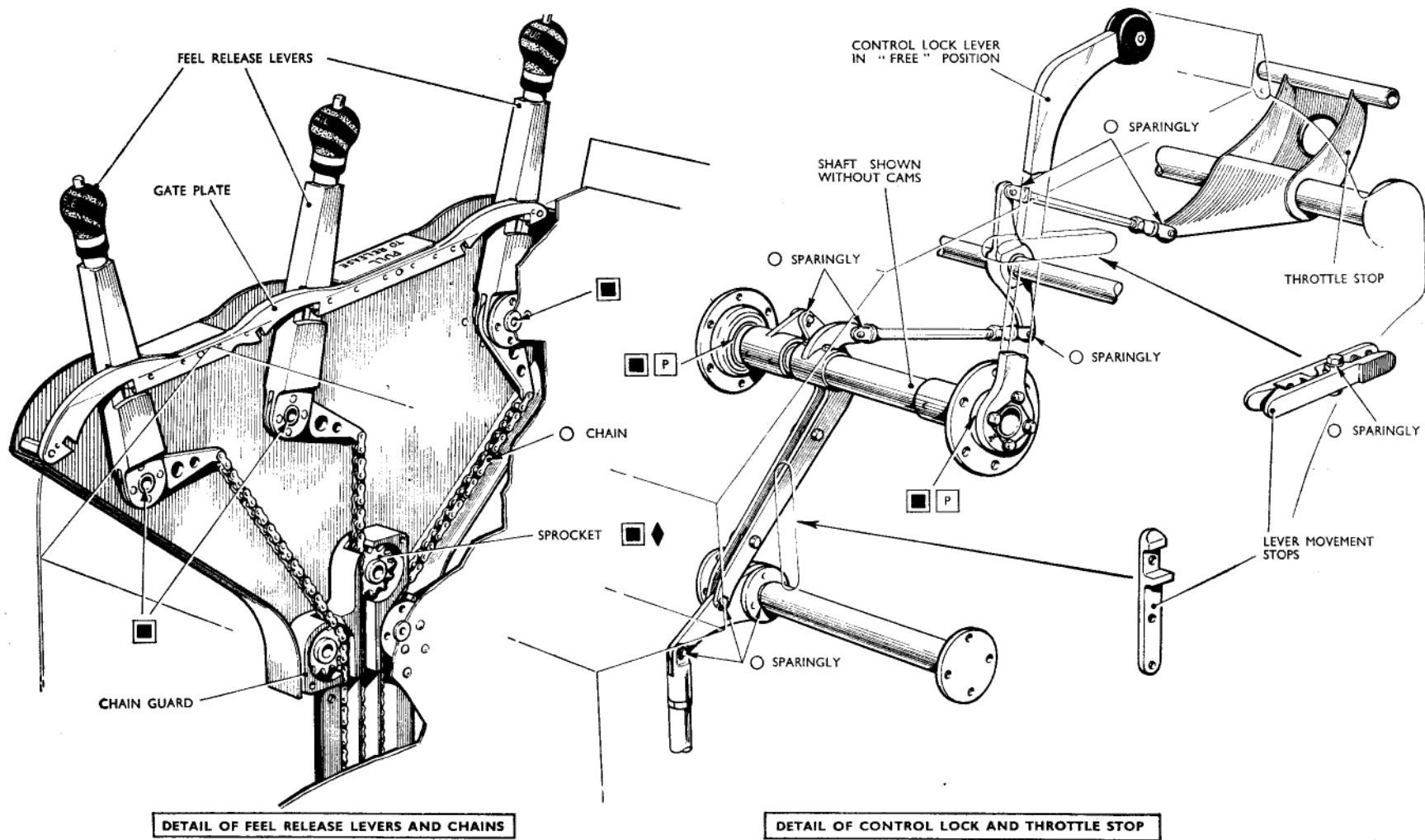


Fig. 4. Controls pedestal

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**Fig. 5. Feel release and control locks**

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**Note . . .**

The automatic stabilizer must NOT be operated whilst the rudder channel of the autopilot is engaged.

**Controls at Stn. 449-783**

20. The control tube joints (fig. 13) must be adjusted to bring all levers simultaneously to their neutral position by fitting the appropriate joint collars. The collars are in three thicknesses, Pt. No. 66033/141, 143 and 145. Should it be necessary to completely dismantle a control run, it should be noted that the longer end of the threaded joint piece Pt. No. 70633-3, must face aft.

**Power units**

21. The servicing of the power units is fully described in A.P.4603A and B, Vol. 1.

**Artificial feel units (fig. 8 and 14)**

22. In the following paragraphs, the artificial feel unit in the elevator control system (fig. 14) is described in detail, those in the rudder and aileron systems being similar. When a control surface is moved from a trimmed position, a restoring moment is exerted by the tension in the chain connecting the cylinder piston rod with the feel unit lever. This tension is proportional to the square of the indicated speed, and the movement of the feel unit lever about its pivot is roughly proportional to the control deflection, so that the restoring moment, and hence the pilot's feel, is a function of speed and control deflection. Thus, although the feel is artificial, it is similar to that obtained ideally on a manually controlled aircraft.

**Operation**

23. The control rod from the lever group at the cabin bulkhead continues aft along the side of the fuselage and at Stn. 948 is connected to a double-ended lever attached to a chain pulley which is splined to a flanged

shaft. This shaft is bolted to a torque tube assembly carrying the feel unit lever and release mechanism. The torque tube assembly is mounted vertically in an attachment bracket secured to the fuselage structure.

24. The bracket is constructed of two flanged plates separated by a pulley mounting bracket and, at the forward end, a saddle mounting for the feel unit cylinder. The aft end of the bracket carries an autopilot unit which is connected to the chain pulley on the double-ended elevator lever.

**Feel unit lever and release mechanism (fig. 9 and 14)**

25. The feel unit operating lever, of lipped channel plate construction, is mounted on the vertical torque tube in the feel unit mounting bracket. It operates in conjunction with the elevator control lever, but can be disengaged by an emergency release to allow the elevator controls to be operated without the feel unit.

26. At the forward end the feel unit lever upper and lower plates are slotted to house an adjustable serrated slide, attached by a chain to the feel unit piston. The feel unit lever is attached by an adjustable connecting rod to two semi-circular plates mounted on the torque tube (*pre-Mod.* 1141) (fig. 1). These plates carry the feel unit release mechanism, and a cable (attached to the spring-loaded geometric lock through an adjustable linkage) passes through the torque tube and along the fuselage to the cabin control. When the control is operated, the catch is withdrawn from engagement with the semi-circular plates, thus allowing the elevator to be operated without feel. When Mod. 1141 is incorporated, a spring-loaded catch is attached to the adjustable linkage and engages two lugs on the return spring housing to prevent it from compressing and so opening the geometric lock.

27. Desynn transmitters mounted at the rear of the feel unit attachment brackets, are connected by adjustable linkages to the aileron and rudder feel unit levers. Indications of the feel unit lever positions are transmitted to instruments on the centre panel in the cabin. The elevator feel units are not provided with feel trim actuators, therefore no indication of the lever position is given.

**Feel unit cylinder (fig. 8)**

28. The feel unit cylinder consists of a sheet metal drum sealed at each end with a domed cap and is covered with an electrically-heated muff. The forward cap has a vent connection for static air and the aft an inlet for air under pressure (this is reversed in the case of the aileron cylinder). Both end caps embody a sealed housing through which a piston rod slides. The seal between the dome-shaped piston and the cylinder wall is maintained by a tapered cylindrical rubber bag, the smaller end attached to the periphery of the piston, the larger to the cylinder end, dividing the drum into the static and pressure compartments. In the static compartment, a drain cock is fitted at each end.

29. The piston is spring-loaded and on the pressure side is attached by a chain to the feel unit lever. The spring has two functions; it prevents the controls from falling onto their stops when the aircraft is on the ground and it also provides adequate feel at low speeds.

**Feel unit release runs (fig. 9)**

30. The feel runs must be adjusted to give full movement at the feel unit lever and in order to obtain this it is necessary to observe certain precautions. The setting of the runs between the release handles on the throttle pedestal and the pressure bulkhead is governed by the pressure seal. With the handles in the released position the locknuts on the rods passing through the seal must

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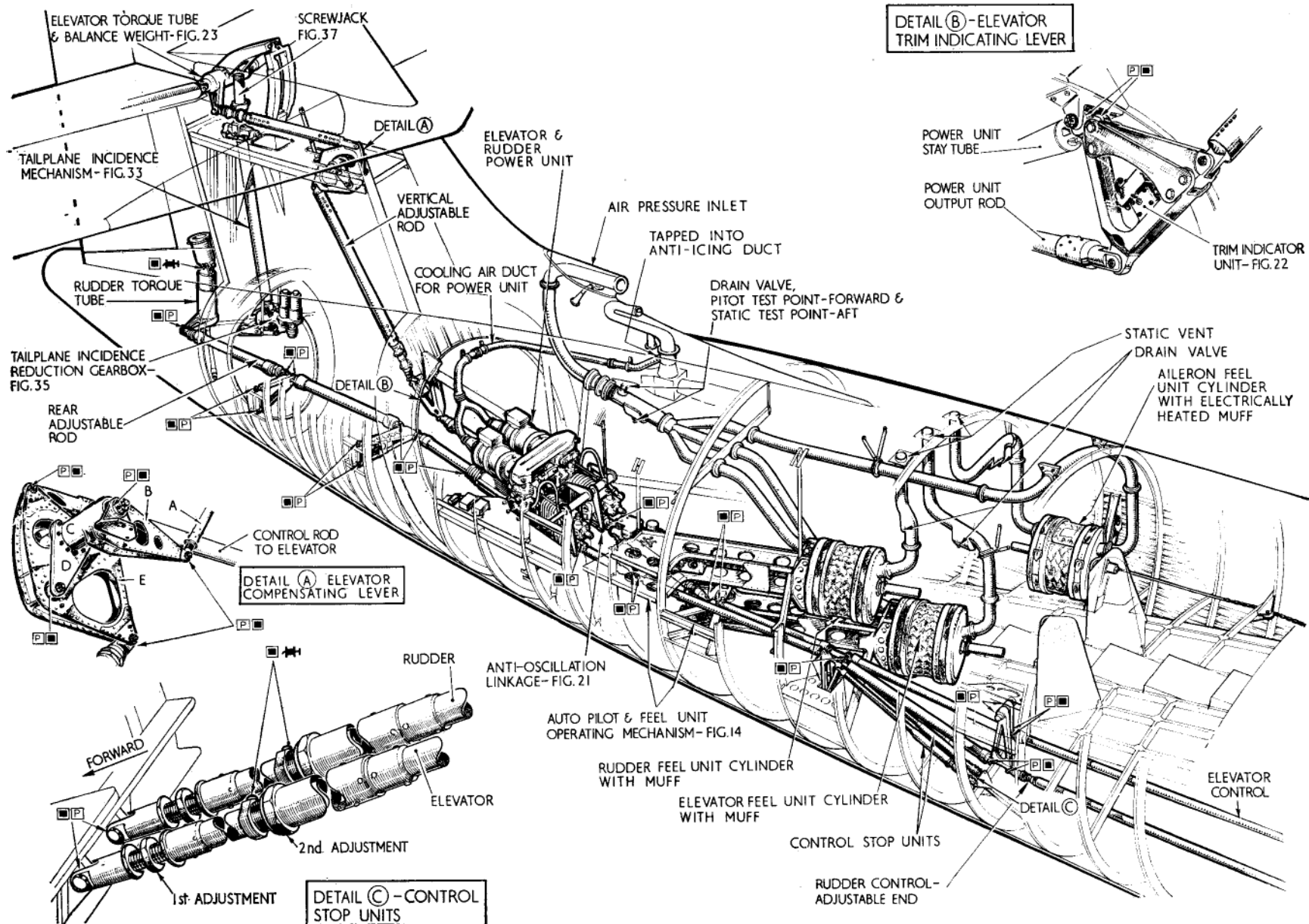


Fig 6. Controls in rear fuselage

◀Post-Mod. 1915 trim indicator unit deleted▶

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not bottom on the lock plates at the rear end of the seal; this ensures that when the feel levers are in the engaged position the lock-nuts will not bottom at the front end. At Stn. 370 the run is adjusted to give equal movement of the bell crank, ensuring that the rod ends do not foul the rubbing strip on the bomb bay bulkhead. A row of holes is provided in the bell crank to enable the leverage to be adjusted to obtain the required movement of the run. Whilst adjusting the run it is necessary to check, in the engaged and released positions, that the cable ends or locknuts are not entering fair-leads or pulley guards. Provision for further adjustment must be left at the last tie-rod before the feel unit lever (or turnbuckle in the aileron run); these points must be used as the master adjustment points should the runs require adjustment whilst servicing the aircraft.

#### Testing feel unit pipes, cylinders and joints for leaks

31. Connect a specially sensitive A.S.I. to the pitot unions in the air inlet pipe at Stn. 1013. Using the coupling adapter Ref. No. 26SR/95297, connect the nozzle of a ground trolley air compressor to the feel units air-intake mouth situated at the fin forward base, and pressurize the system to 4 lb/in<sup>2</sup>. Check the flow by means of the A.S.I.; it must not exceed a reading of 2 knots.

#### Note . . .

*It is important that the system must not be pressure tested until the feel units have been set as described in para. 78, 121 and 143.*

#### Checking the functioning of the feel units

32. Following the installation of a new feel unit, after dismantling the unit, or at the usual servicing time, the following checks must be made: —

(1) Connect the pressure side of a sensitive A.S.I. to the pitot union in the air inlet pipe at Stn. 1013, leaving the static side of the A.S.I. open to atmosphere.

(2) Using the coupling adapter 26SR/95297, connect the nozzle of a ground trolley cabin pressure testing rig to the feel unit air-intake mouth at the fin forward base and pressurize the system to the equivalent of 390 knots.

(3) Check the pipe joints, feel unit cans and static vents in the fuselage roof for excessive leakage.

(4) After setting the spring preloads as described in para. 78, 121 and 143, apply a gradually increasing pressure, starting from zero, noting the speed at which the piston rod starts to move. These speeds should be: —

Aileron	... 75 knots	} +10
Elevator	... 54 knots	
Rudder	... 105 knots	

#### Feel unit load deflection/friction tests

33. The following test applies to each of the three control surfaces: —

(1) Apply to the respective feel units (para. 32(2)) pressures equivalent to the following speeds: —

Rudder	... 130 knots
Elevator	... 70 knots
Aileron	... 120 knots

(2) Apply and record the following loads and resultant deflection up to a maximum possible in one direction (fig. 11): —

Rudder	... Increments of 10 lb
Elevator	... Increments of 5 lb
Aileron	... Increments of 5 lb

Test rigs, made up locally and held at all User Units, should be used for applying a steady load by known weights in preference to spring balances.

(3) From (2) record loads and deflections in decreasing order down to zero load (fig. 11).

(4) Continue in opposite directions as in operation (2) (fig. 11 (c)).

(5) Return to zero as in operation (3) (fig. 11 (d)).

#### Note . . .

*From these records a hysteresis loop is obtained.*

(6) With the feel unit in neutral, i.e., with the lever in line with the centre line of the feel unit can, record surface deflection.

(7) From the resultant curves, friction and out-of-balance can be determined and the curves checked against the master curve (fig. 10).

(8) The mean curve must lie within the boundaries of the master curve and should be approximately parallel to the ideal mean curves (fig. 10).

#### Checking static friction in controls

34. Using a spring balance, check the forces required at the control hand wheel and rudder bar to operate the controls with the feel units disconnected. The load required to operate the controls (the average of readings taken in both directions) must not exceed: —

Control	Friction load	
	Power on	Power off
Elevators	10	30
Ailerons	8	30
Rudder	10	40

#### Backlash in control surface tabs (fig. 12)

35. With the exception of the elevator tab (para. 35A), measurement of backlash in trim tab or balance mechanisms may be checked at the trailing edge of the tab adjacent to the falsework. Using the back-

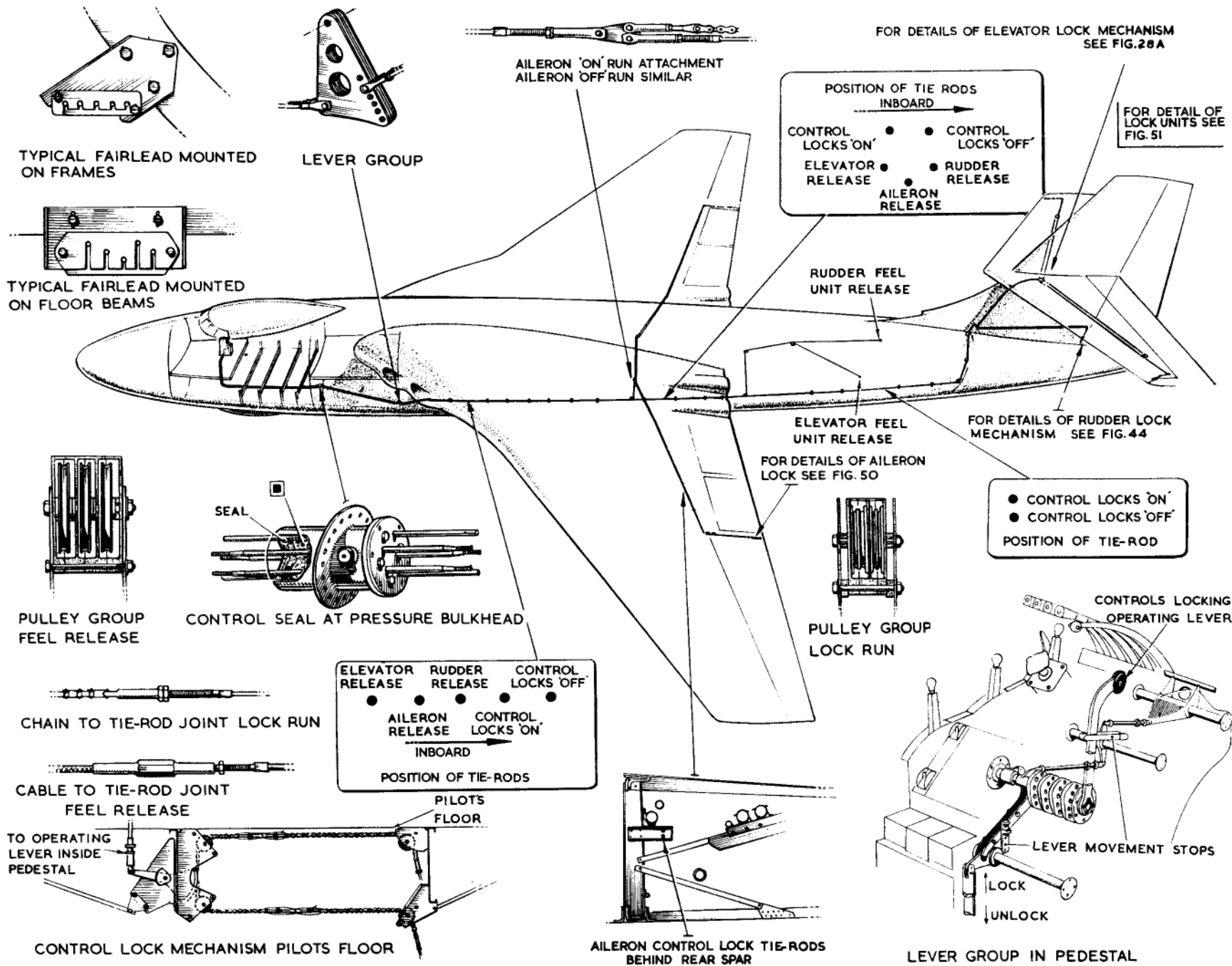


Fig. 7. Control surface locking

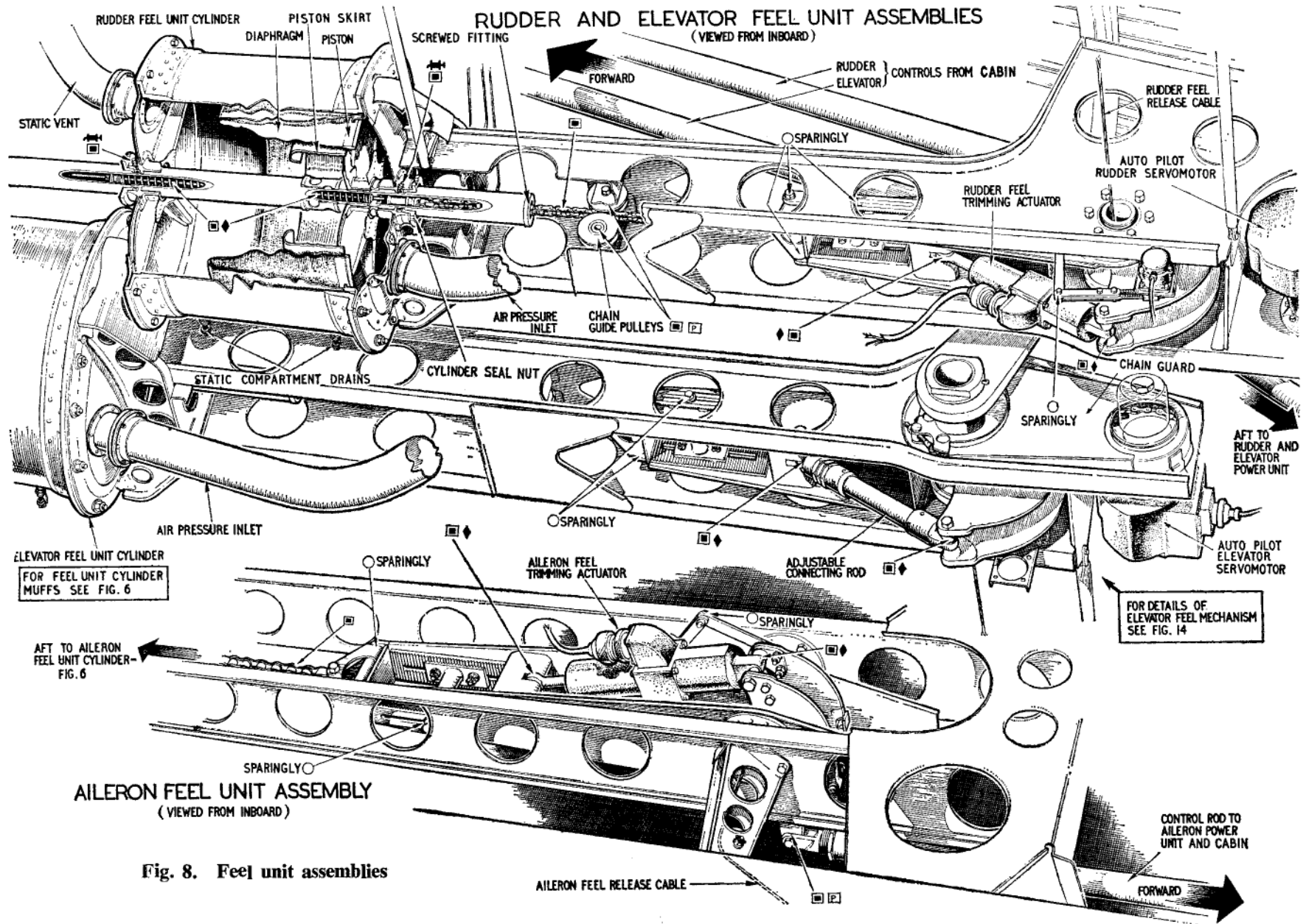


Fig. 8. Feel unit assemblies

lash gauge Ref. No. 26SR/95454, attached to the more suitable end of the trailing edge of the tab, apply through a spring balance

attached at the tab as close as possible to the trailing edge a load of ten pounds to overcome the friction and take up the back-

lash. Gently reduce the loading to five pounds and read off the tab deflection on the gauge. Apply the loading in the opposite

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direction and again read off the tab deflection. The backlash in each direction can then be calculated by subtracting 0.010 in. from each of the deflection readings obtained. If after subtracting the 0.010 in. the backlash in either direction exceeds the maximum permissible (Table 1) the tab control system is to be checked from the tab back to the connection on the control surface or to the actuator, referring to Vol. 6, Part 3, for permissible worn clearances. The control surface locks are sufficient to hold the elevator surfaces during backlash checks. For backlash checks on the aileron and rudder tabs use the clamp Ref. No. 26SR/95455. When the backlash gauge is used on the rudder trim tab it is necessary to remove the tab trailing edge cord.

**TABLE 1**  
Maximum permissible backlash in tabs

Tab	Linear (max.)
Rudder (port)	0.036 in.
Rudder (stbd.)	0.036 in.
Elevator (up)	0.036 in.
Elevator (down)	0.036 in.
Aileron (up)	0.112 in.
Aileron (down)	0.112 in.

**35A.** The elevator tab backlash must be measured as described in para. 35 at each of the three positions where the operating mechanism is attached to the tab. A suitable bracket made up locally and a dial test indicator should be used in place of the gauge Ref. No. 26SR/95454. The bracket is to be attached to the elevator top surface, using the existing fairing attachment screws, after removing the fairings over the adjustable connecting rods.

**35B.** To measure elevator tab backlash proceed as follows:—

- (1) Lock the elevators, using the control surface locks.
- (2) Remove the bolts securing the tab operating rods at the intermediate and outer stations.
- (3) Attach a spring balance and a dial test indicator (D.T.I.) as closely as possible to the inner operating rod position.
- (4) Measure the tab deflection as described in para. 35.
- (5) Refit the bolt securing the intermediate operating rod to the tab, and remove the bolt securing the inner operating rod.

(6) With the D.T.I. and spring balance moved as closely as possible to the intermediate rod position, repeat operation (4).

(7) Refit the bolt securing the outer operating rod to the tab, and remove the bolt securing the intermediate operating rod.

(8) With the D.T.I. and spring balance moved as closely as possible to the outer operating rod position, again repeat operation (4).

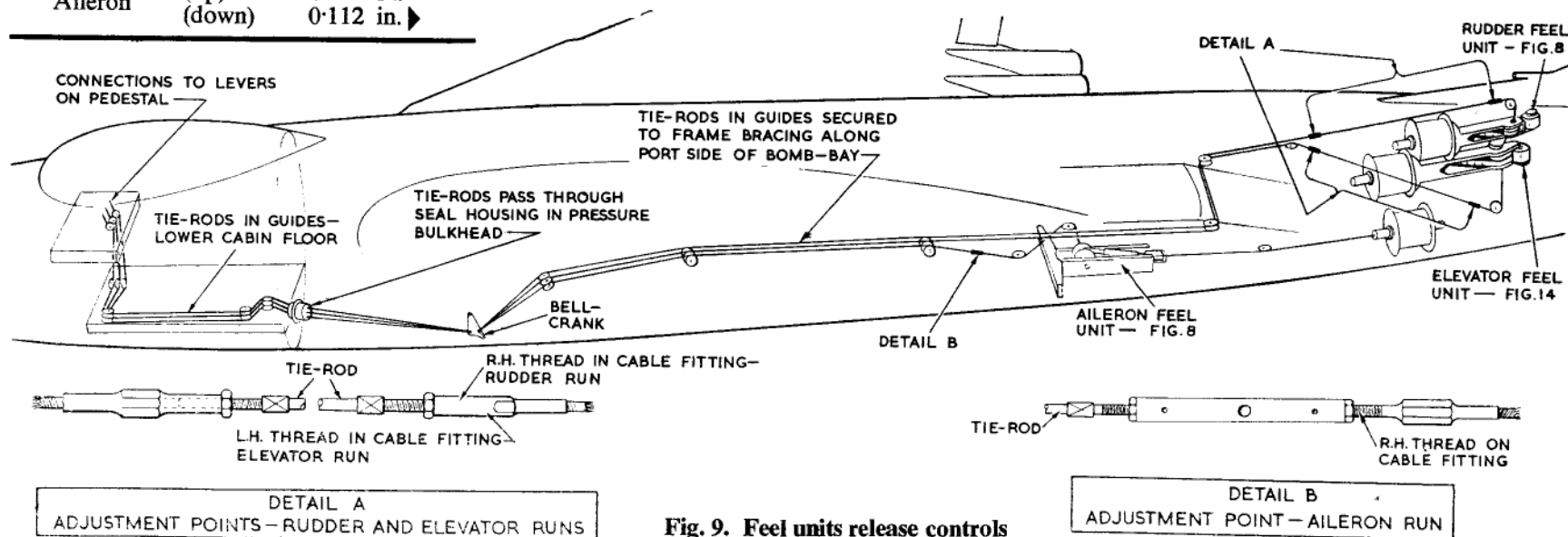
(9) Remove the D.T.I. and spring balance, and refit and lock the bolts securing the three tab operating rods. ▶

### Lock run setting

Note . . .

*When the lock handle in the cabin is pulled to the ON position whilst the power units are running, the controls must not be moved until the four power control failure warning lamps, situated above the port console, light up indicating that the power units have run down.*

**36.** The lock run must be adjusted to give a movement of 2.5 in. measured on either tie-



**Fig. 9. Feel units release controls**

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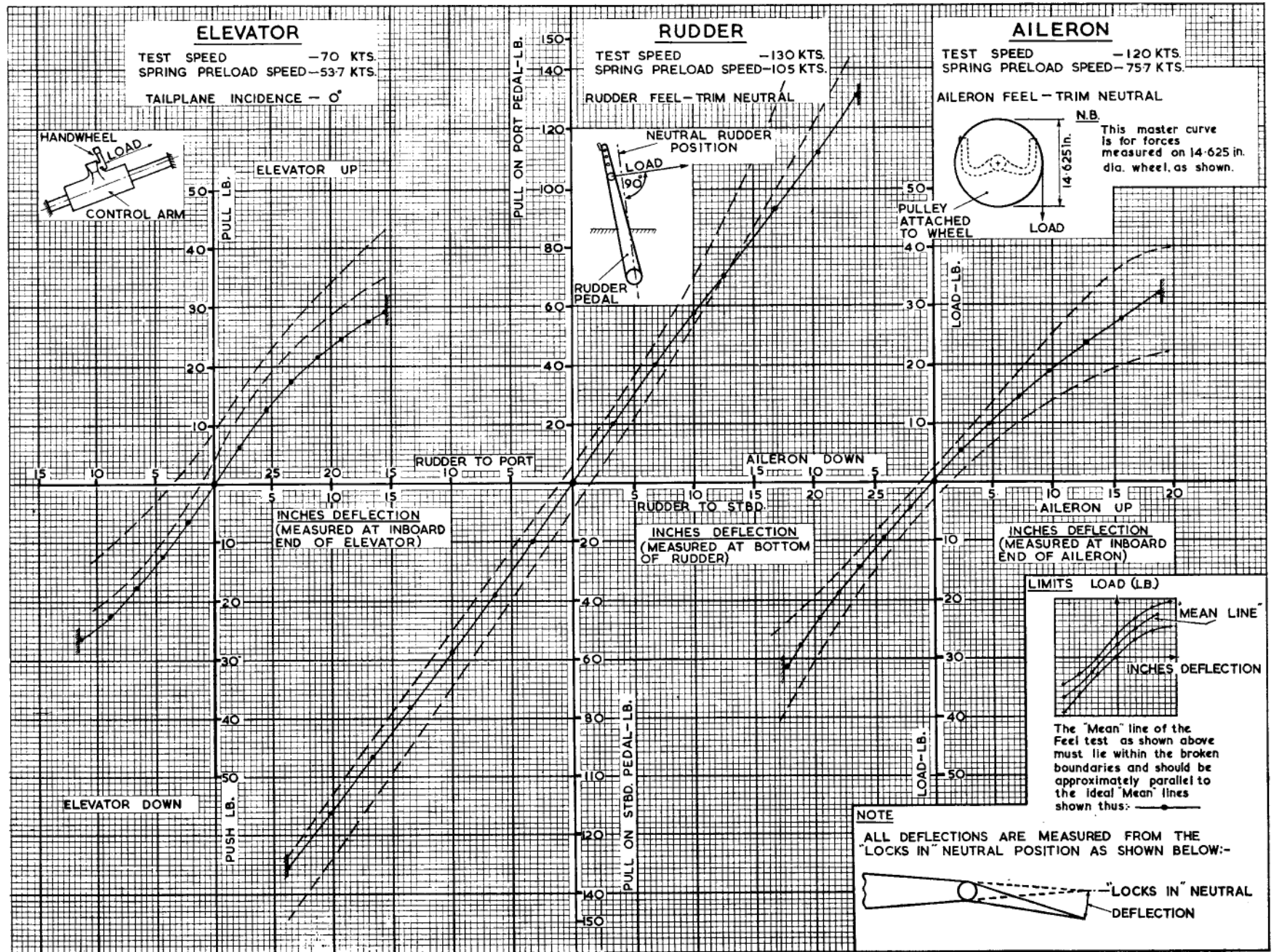


Fig. 10. Master curves for feel unit load deflection tests

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rod on the fin spar frame at Stn. 1065, otherwise full travel of the lock units will not be obtained. To obtain this condition it is necessary to use the leverage adjustment on the bell crank at Stn. 370 and to ensure that the tension of the aileron lock run, across the rear spar to the lock units, is less than the tension of the fuselage lock run. The adjustment of the run from the throttle pedestal to the pressure bulkhead is governed by the pressure seal, it being necessary to ensure that with the locks in either the ON or OFF positions the locknuts on the rods passing through the pressure seal do not

bottom on either the front or rear lock plates of the seal. Throughout the run, ensure that the chain ends are not entering the pulley guards when the control is in the ON and OFF positions. Check that with the locks in the ON position there is a minimum engagement of 0.25 in. of the elevator lock plunger and also a minimum engagement of 0.2 in. of the rudder lock lever with the rudder beak.

### Control surface movements

37. The movement of the control surfaces should be checked against the figures quoted in Table 2. Any adjustment of the flying controls (fig. 13) must not affect the range of movement of the control rods, otherwise the automatic pilot will be deranged. After replacement of any control rod, check for full and free movement of the relevant control surface by manual and power operation of the controls. The adjustment points for the flying controls together with the control rod movements are shown in Fig. 13.

### Lubrication

38. A key to the lubrication symbols used on the illustrations will be found on the back of the Contents Marker Card at the front of the book.

### Special tools

39. For a list of tools special to this aircraft, reference should be made to Table 3 at the end of this chapter.

## ELEVATOR CONTROLS

### Handwheel setting

40. A connecting rod having a ball joint and a setting knob at one end and a threaded portion at the other end, connects the pilot's control arm to the elevator lever. The threaded portion of the connecting rod screws into the gimbal on the elevator lever (fig. 3). By rotating the knob just below the control arm front face, the pilot can adjust the arm and control wheel to a comfortable position.

### Elevator handwheel adjustment (fig. 3)

41. The screwed seating in the ball joint of the handwheel position adjusting rod must be adjusted to give easy rotation of the shaft with no backlash. To adjust the rollers on the square shafts of the handwheels refer to the details in fig. 3 and proceed as follows:—

- (1) *Pre-Mod. 1499.*—Loosen bolt B and tap through until serrated bolt C can be withdrawn and rotated the required amount. Loosen bolt A and tap through until serrated bolt D can be withdrawn and rotated the required amount.
- (2) *Post-Mod. 1499.*—Loosen bolts and taper cones in housing and rotate the eccentric inner race the required amount.

### Note . . .

*The rollers must be adjusted to give smooth running on the shaft without play. All rollers must bear on the square shaft.*

### Controls

42. The elevator control lever units, one for each pilot's control, are constructed of two channel-section plates mounted within two similar plates (fig. 15 and 16), all being pivoted about a hinge tube mounted in brackets on the pilot's floor. The inner plates, joined at the top by a gimbal mounting, are located in the outer plates by a spring loaded pin, otherwise they would be free to move with respect to the outer plates. The unit as a whole is pivoted about a hinge tube mounted in cast brackets on the pilot's floor. The two pilots' lever units are interconnected by bell-crank levers and a control rod under the pilots' floor (fig. 2). A lever mounted at the pivot point of the 2nd pilot's elevator lever unit, is connected by means of a control rod to the main control run through the fuselage.

### Control stop unit—input

43. The control stop unit (fig. 6) which limits the input movement being transmitted to the power unit, consists of a cylinder working on an operating tube fitted with a piston. The unit is anchored at one end to

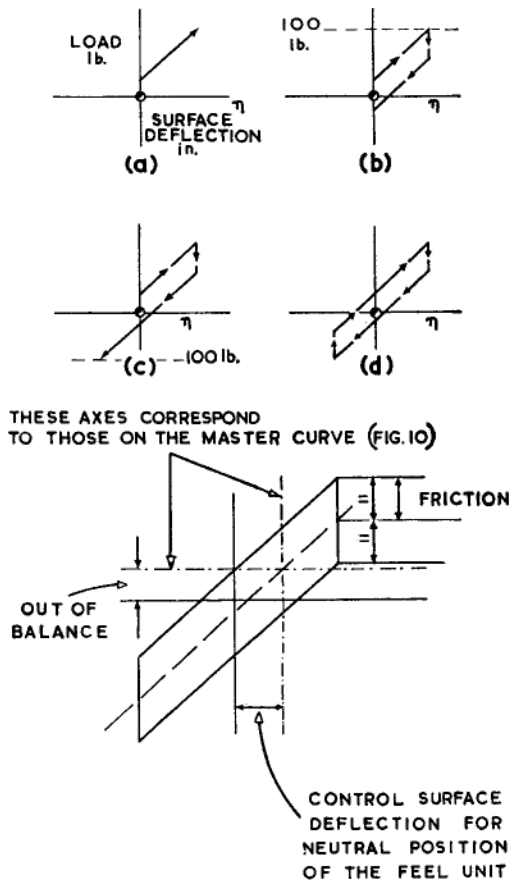


Fig. 11. Load deflection/friction test

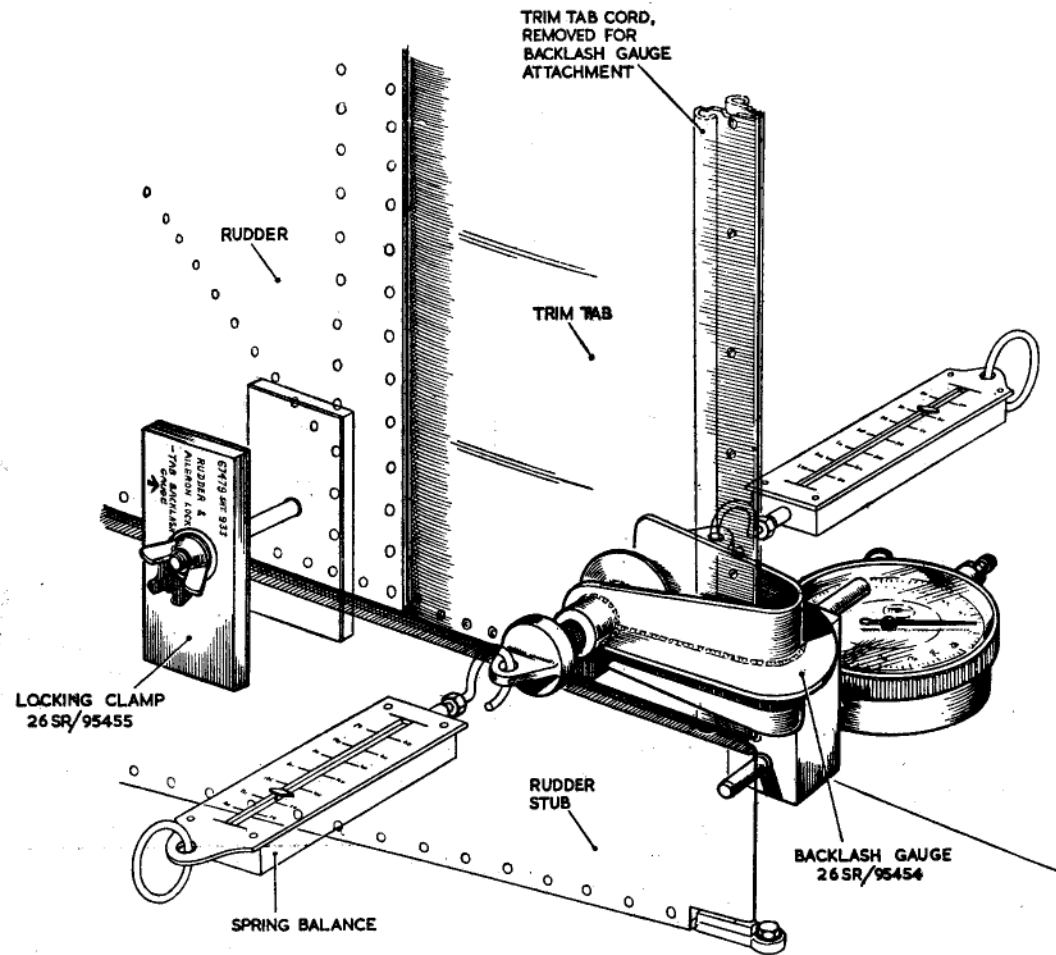


Fig. 12. Tab backlash gauge

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the fuselage structure and at the other to a lug on the triangular lever at Stn. 903. The length of stroke of the unit is adjusted to stop movement of the power unit piston and hence movement of the control surface, at the correct angular displacement of the surface, and should not require to be re-adjusted.

### Setting the elevator input rod

44. Before setting the input stop it is necessary to set the length of the adjustable input control rod between the feel unit lever and the power unit in the following manner:—

- (1) Hold the power unit on the neutral line (para. 106 (1)) of the setting rig indicator plate.
- (2) Operate the feel release lever in the cabin, moving it to the release position.
- (3) Adjust the length of the input rod so that a line taken through the rod centre line is at right angles to a line taken from the centre of the input rod attachment bolt to the centre of the torque tube assembly (fig. 14). Lock the input rod nuts.

### Setting the elevator input stop (fig. 6)

45. Loosen all locknuts on the input stop rod, switch on the power unit and proceed as follows:—

- (1) Set the tail plane to the maximum incidence position (para. 86).
- (2) Pull the input rod forward and set the first adjuster (fig. 6, detail C) so that the setting rig pointer is 0.05 to 0.075 in. outside the extreme travel line marked on the indicator plate (para. 5, operation (10)). Tighten the locknuts.
- (3) Set the tail plane to the minimum incidence position (para. 86).

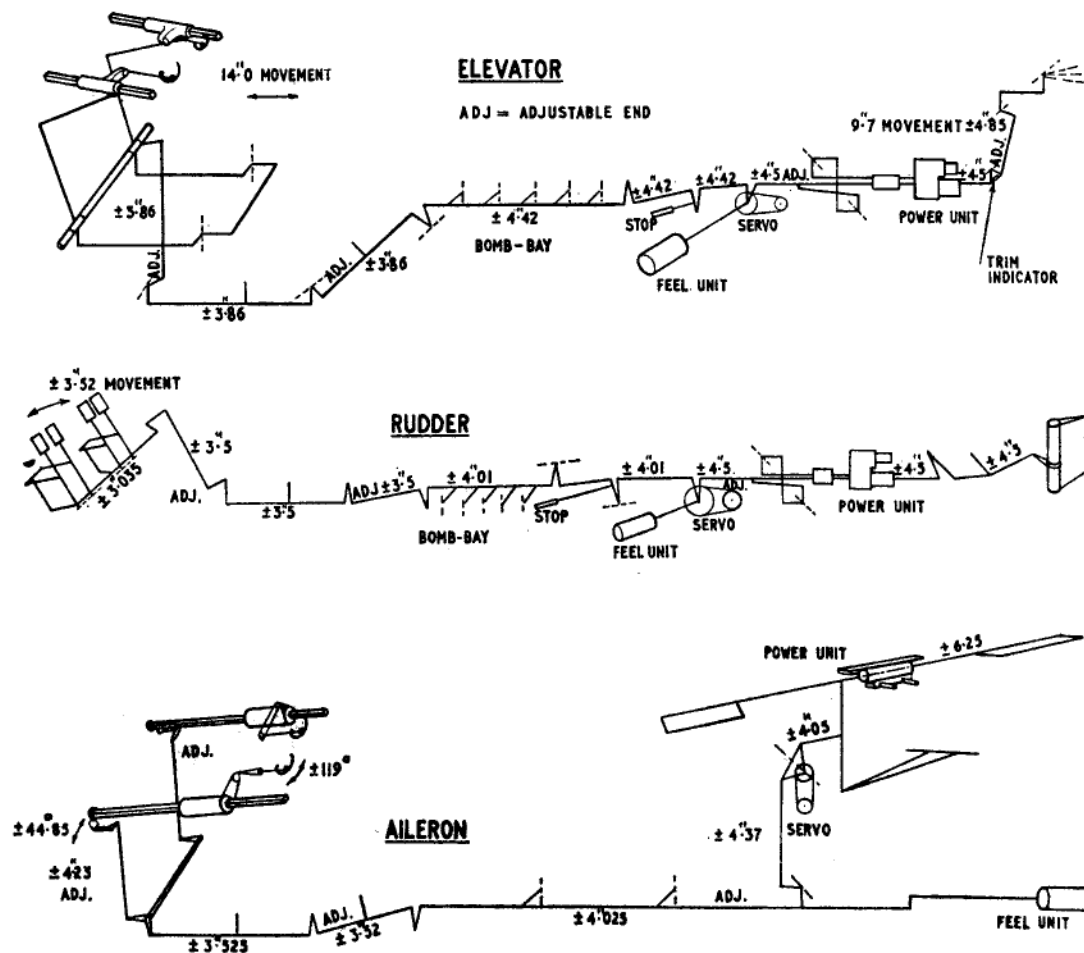


Fig. 13. Adjustable points and movements in flying controls

- (4) Push the input stop rearwards and set the second adjuster (fig. 6, detail C) so that the setting rig pointer is 0.05 to 0.075 in. outside the extreme travel line

marked on the indicator plate (para. 57, operation (10)). Tighten the locknut and, if necessary, re-drill to fit the circlip.

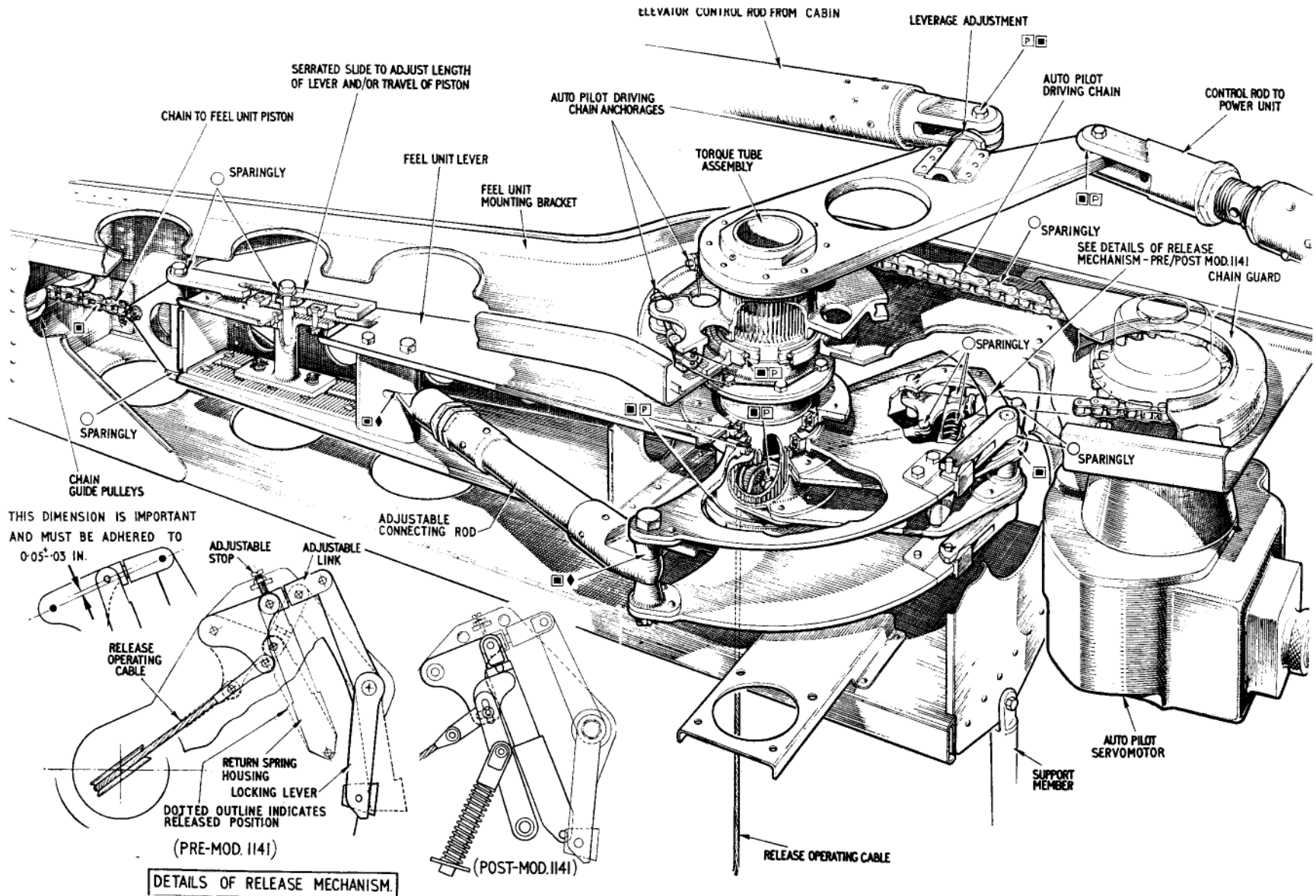


Fig. 14. Elevator feel unit mechanism

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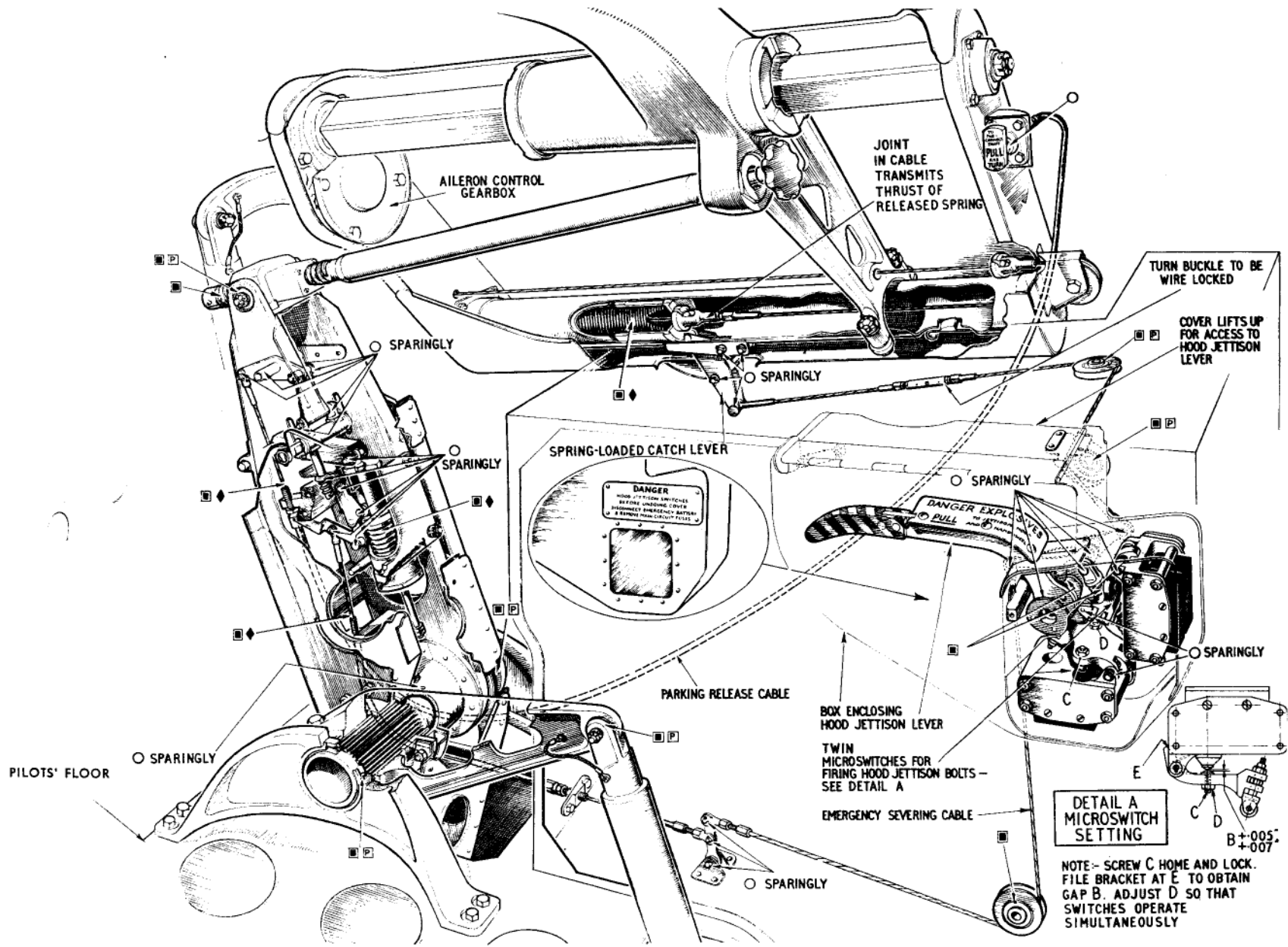


Fig. 15. Elevator controls parking and severing mechanism—1

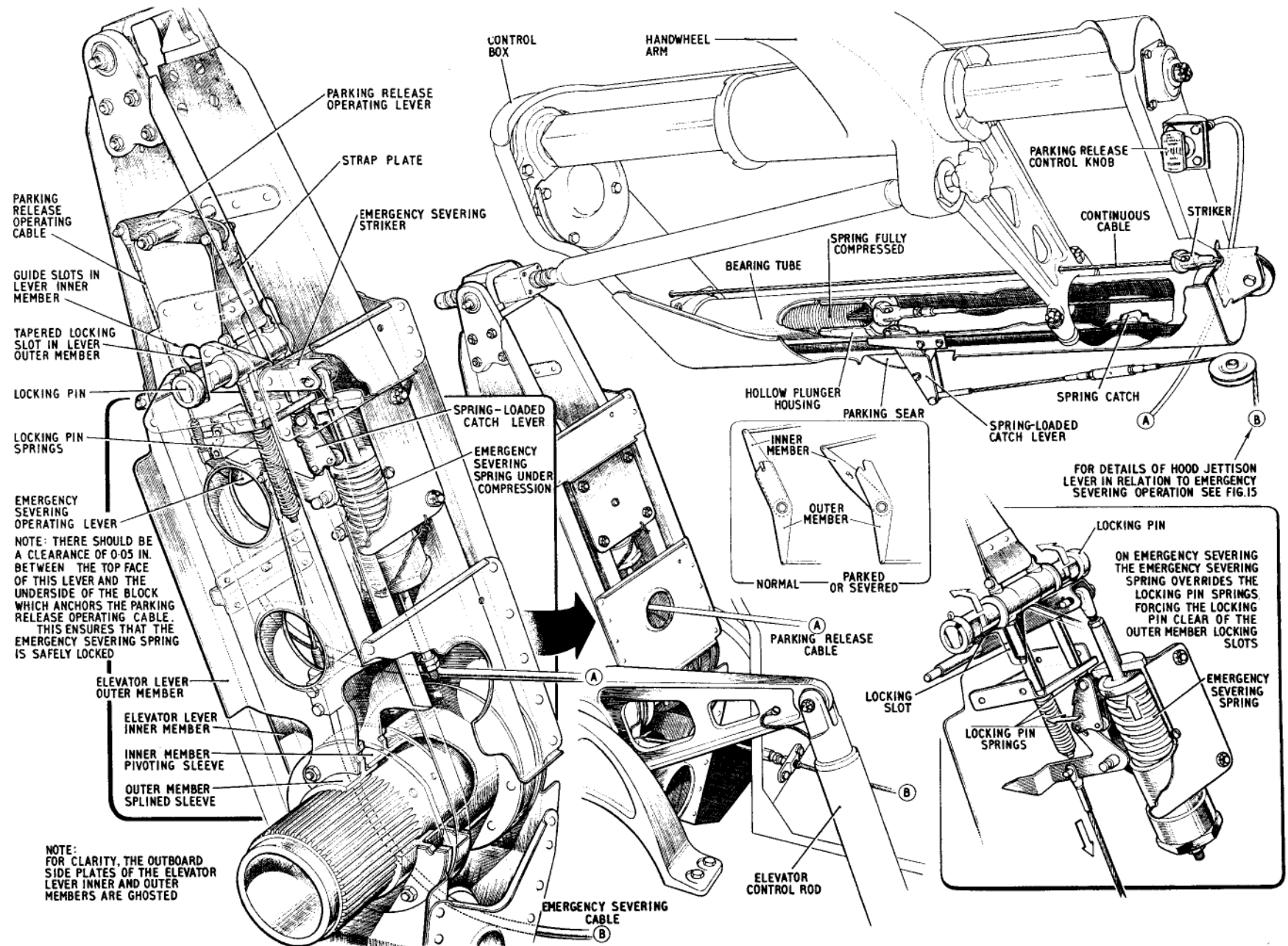


Fig. 16. Elevator controls parking and severing mechanism—2

### **Elevator control severing**

**46.** A severing mechanism is provided in each pilot's elevator controls to enable him either to "park" his handwheel or throw it clear of his legs when his ejection seat is operated. The severing mechanism is housed in each elevator lever unit assembly and connected directly to the control handwheel. The lever unit inner member (*fig. 15 and 16*) is locked inside the outer by a spring-loaded locking pin, thus forming a rigid lever. The pin, on which it is mounted, projects through slots in the inner member side plates and engages open-ended slots in the outer member side plates. By moving the pin up the inner member slot, it disengages from the outer member slot and severs elevator control.

### **Elevator control severing for parking (*fig. 15 and 16*)**

**47.** By pulling and turning the release knob on the control box inboard end, the inner member of the lever unit directly operated by the handwheel is disconnected from the outer member, enabling the handwheel arm to be pushed forward to the full extent of its travel.

**48.** A lever mounted in the inner member upper portion, is attached to the operating cable at one end and a strap plate secured by a pin to two eyebolts at the other. The eyebolts, which pass through and are secured to the locking pin, also pass through distance tubes and a spring retaining plate riveted to the elevator lever. The plate holds a spring in compression on each eyebolt shank, thus keeping the eyebolts in tension and the locking pin secure in the elevator lever outer member slot.

### **Elevator control emergency severing (*fig. 15 and 16*)**

**49.** When the hood jettison lever is pulled, the control arm is automatically severed from the elevator control system by disengaging the two members of the elevator lever-unit, and the arm is thrown forward under the action of a powerful spring. The

control cannot be re-engaged in flight after using this system; for testing however, the controls can be re-engaged as described in para. 51. The bearing tube, mounted in the control box, contains a spring which is located at its free end in, and held in compression by, a hollow plunger locked in position by a spring-loaded catch, the catch engagement being limited by a stop plate. A continuous cable passes through the tube, round a pulley on each side of the control box and through the end of the control arm, the ends being anchored to the hollow plunger. A flexible cable connected to the hood jettison lever, withdraws the catch lever to release the bearing tube spring and drive the plunger down the tube. This brings a striker on the continuous cable into contact with the handwheel curved mounting arm lower end, pushing it forward until at its most forward position a spring catch engages and locks the plunger.

**50.** The elevator lever unit locking pin emergency release is a self-contained unit consisting of a tubular container with a screw cap at one end and is mounted adjacent to the ordinary release mechanism. A long eyebolt passes through the container and carries a hollow plunger which is locked to the shank by a nut. A distance tube separates the plunger from the bolt eye-end. A coil spring in the container is retained at one end in the hollow plunger and held in compression by a pivoted catch lever. A pin in this lever engages the operating lever which is cable-operated by the hood ejection lever. The eye-bolt is pinned to a channel-section emergency severing striker which is pivoted at one end, and runs diagonally across the elevator lever unit bearing against the underside of a sleeve on the elevator lever locking pin. Hood jettison lever operation disengages the catch lever, and the container spring forces the locking pin out of engagement with the elevator lever unit outer member, freeing the control arm.

### **Controls severing check (*fig. 15 and 16*)**

**51.** The controls severing mechanism should be operated periodically when the aircraft is on the ground. Before commenc-

ing this operation, refer to the LETHAL WARNING at the front of the book. In addition, the following safety precautions must be observed :—

*Pre-Mod. 2004.*—Remove fuse No. 3 from the essential services fuse block in the battery bay; also trip the Type "A" hood detonation circuit in this bay.

*Post-Mod. 2004.*—Trip the circuit breaker and remove the two fuses from the hood detonation relay panel at the rear of the pilots' hood coaming.

### **Note . . .**

*The emergency circuit is operated from its own battery and mere removal of the external supply and switching OFF the internal batteries is not sufficient to render the system "safe".*

To check the controls severing mechanism, lift the cover on the hood jettison box and pull slowly on the jettison lever, ensuring that :—

- (1) The hood firing microswitches make simultaneous contact in the main circuit.
- (2) The handwheel control is severed at the elevator lever.
- (3) The hood firing microswitches make simultaneous contact in the emergency circuit.
- (4) The handwheel is thrown forward and locked in this position.

After the last operation there should be a minimum of 0.3 in. free movement at the jettison lever. If a microswitch is replaced, after checking that the clearances given in *fig. 15* are obtained, the above procedure must be re-checked. To re-engage the controls, push down the emergency severing striker on the elevator lever, until the emergency severing operating lever can be pushed into place. Free the plunger, now locked at the aft end of the control arm bearing tube, by releasing the spring catch, and pull back the control handwheel until the catch at the forward end of the bearing tube engages the plunger. Ensure by visual

inspection that the catch lever roller is fully engaged with the spring-loaded plunger in the control arm bearing tube.

**Note . . .**

*When the linkages are set up and the micro-switches are free, ensure that all fuses are replaced and the circuit breaker is reset.*

**Elevator lever removal (fig. 15 and 16)**

52. Refer to the LETHAL WARNING at the front of the book and para. 51 before removing either the first or second pilot's elevator lever, then proceed as follows :—

- (1) Remove the four bolts attaching each bearing plate to the top of the elevator lever. This will free the gimbal mounting complete with the threaded connecting rod.
- (2) Remove the split pin and pin securing the Bowden cable to the parking release operating lever near the top of the elevator lever and let the cable hang free.
- (3) Loosen the bolt securing the cable guide and turn the guide until it is free of the cable.
- (4) Loosen the stop nut and ease the cable through the slot in the stop bracket.
- (5) Remove the split pin and pin securing the Bowden cable to the emergency severing lever, and let the cable hang free.
- (6) Loosen the stop nut and ease the cable through the slot in the stop bracket.
- (7) Disconnect the control rod from the bottom end of the lever, by removing the nut, bolt and washer. (On the starboard elevator lever, disconnect the control rod from the main control lever).
- (8) Remove the bolts (four to each bracket) securing the lever mounting brackets to the pilots' floor. The elevator lever is then free to be withdrawn.

**Elevator lever assembly**

53. Refer to the LETHAL WARNING at

the front of the book and para. 51 before assembling either lever; the assembly of an elevator lever is the reverse of the removal procedure.

**Lever Group, elevator/rudder, at cabin bulkhead (fig. 17)**

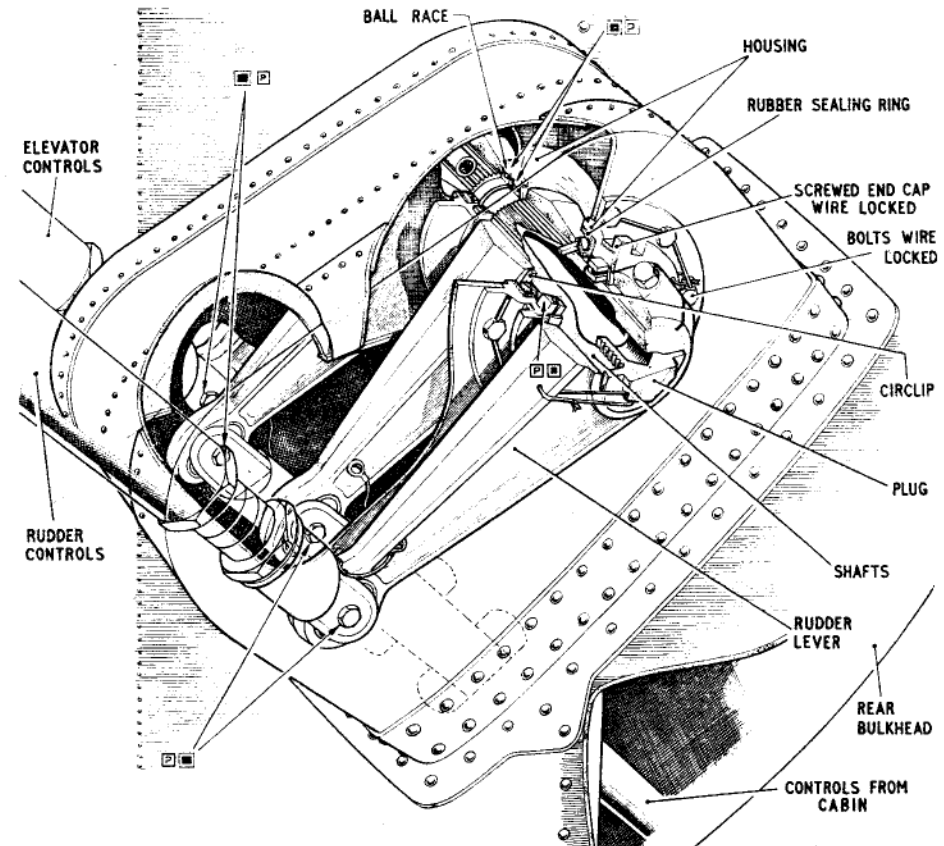
54. The controls pass through the rear cabin bulkhead via a bank of four levers on two hollow serrated shafts plugged at both ends by screwed caps. The shafts rotate in sealed bearings mounted in a box on the bulkhead rear face.

**Power control unit**

55. A control rod from the double-ended

lever at Stn. 948 (fig. 14) connects to the power unit mounted in the rear fuselage at Stn. 1013 (fig. 6). This unit embodies two similar control systems for the elevator and rudder. Fluid flow from pumps in the power unit is used to operate a jack which in turn operates the control surfaces through a system of rods and levers.

56. The basis of the power control system is a variable delivery hydraulic generator feeding into the jack, the stroke control of the generator being displaced by an amount proportional to the difference between the actual and the desired control surface movement.



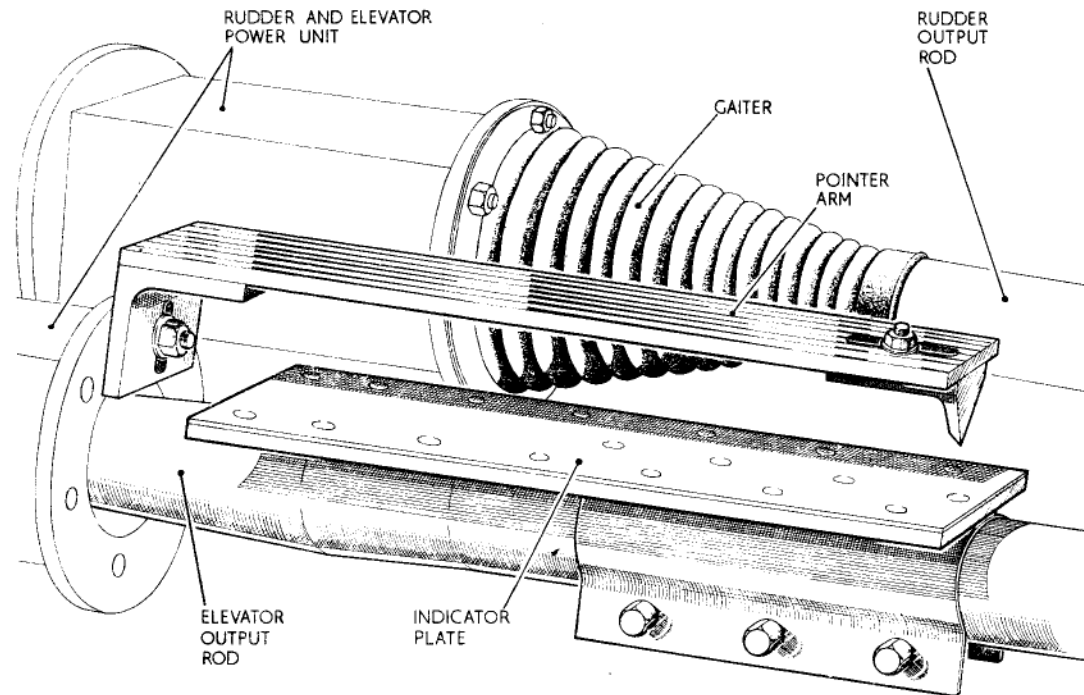
**Fig. 17. Lever group at cabin bulkhead**

**Elevator stops and power unit settings**  
(fig. 18)

57. Complete operations (1) to (9) inclusive as described in para. 109 and then proceed as follows :—

(10) Set the tailplane to the maximum incidence position. Push in the power unit output rod until the elevator is on the "up" stop and reset the vertical adjustable rod until the fixed pointer assumes a position approximately 0.375 in. inside the extreme travel line.

(11) Set the tail-plane to the minimum position. Pull out the output rod until the elevator is on the the "down" stop and the pointer assumes a position approximately 0.375 in. inside the extreme travel line; any discrepancy between this and the dimension referred to in operation (10) should be balanced by resetting the vertical adjustable rod. Mark these positions on the indicator plate.



**Fig. 18. Elevator and rudder power unit settings**

(12) Lock up all adjustable rods, re-check the travels and control surface positions, remove the setting rig and refit the gaiter.

**Elevator and rudder power unit removal**  
(fig. 19).

58. The following procedure should be adhered to when removing the elevator and rudder power unit:—

(1) Remove the detachable section of the de-icing ducting above the power unit. Fit the ball end of the hoist rail into the key bracket on the side of the fuselage at Stn. 1033, allowing the ball end to drop down in the slot.

(2) Support the hoist rail free end by locating the sling hooks in the anchor plates mounted in the fuselage roof.

(3) Fit the hoisting beam to the pick-up lugs on the power unit, using pip pins.

(4) Attach a 5 cwt. pulley block to the sliding runner on the hoist rail, and to the hoisting beam lug.

(5) Disconnect the elevator and rudder control rods from the power unit pistons at the input end of the power unit.

(6) Disconnect the corresponding control rods from the output end of the power unit.

(7) Disconnect the anti-oscillation linkage from the power unit by removing the attachment bolts.

(8) Adjust the lifting hoist until it is just taking the weight of the power unit. Remove the aft drip tray and the cooling ducting from the power unit motors.

(9) Disconnect all electrical services.

(10) Remove the three bolts securing the power unit to the mounting shelf.

(11) Disconnect the seven power unit mounting stay tubes by removing the bolts from the flanged joints midway along each tube. Start with the lower stay tubes and finish with the two vertical tubes.

(12) Remove the bolts securing each group of stay tubes to the power unit. The power unit is then free of all mountings and is suspended on the hoist gear only. Wheel a suitable low loading truck under the hatch.

(13) Slowly lower the power unit, tilting it to clear the sides of the hatch, until it is resting on the truck.

**Anti-oscillation linkage** (fig. 20)

59. The purpose of this linkage is to prevent oscillation in the structure building up and operating the power unit valve gear and so prevent unwanted control surface movements. Control rod movement is transmitted through a system of levers and rods to a toothed sector and bevel pinion in the power unit valve gear.

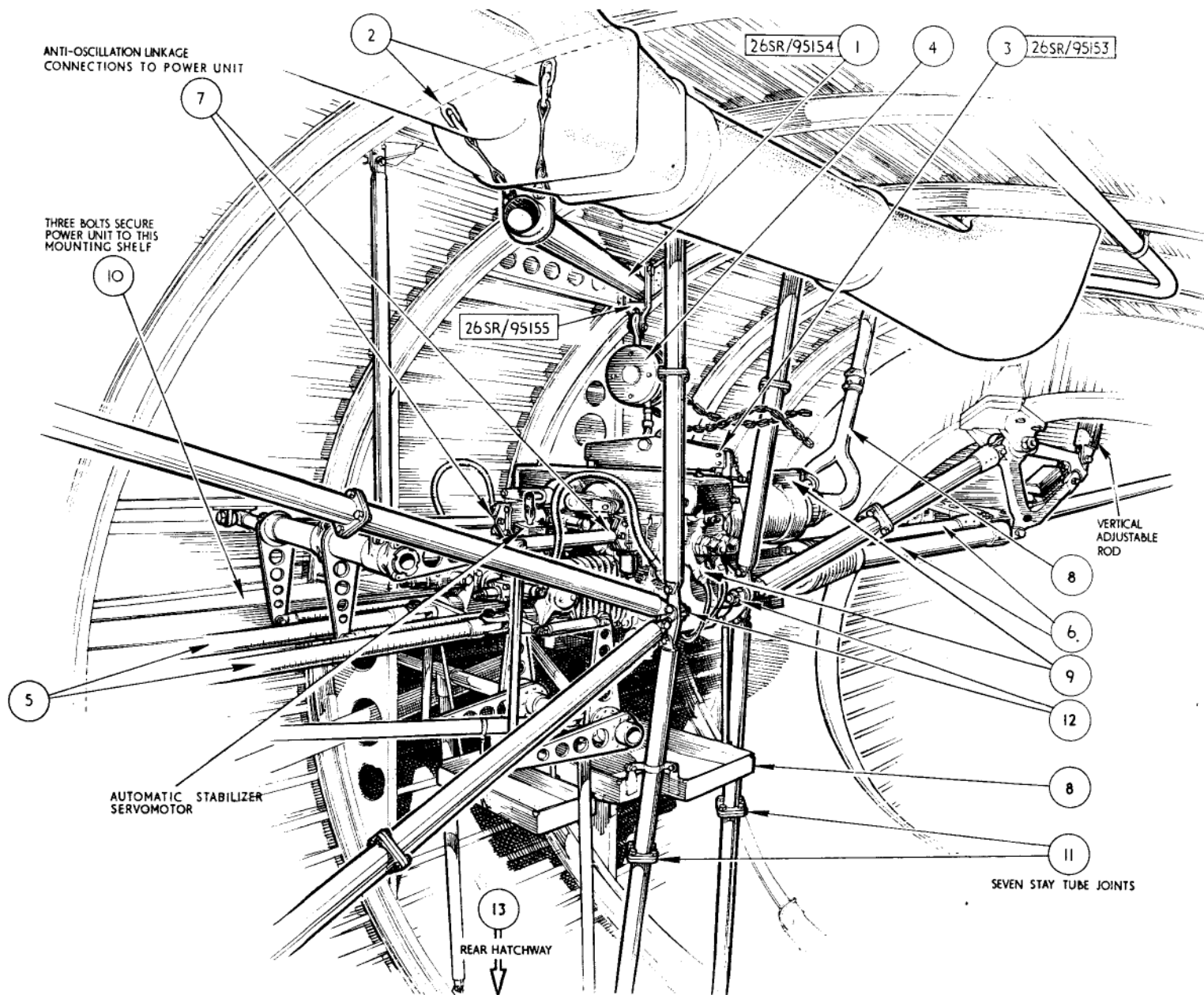


Fig. 19. Elevator and rudder power unit removal

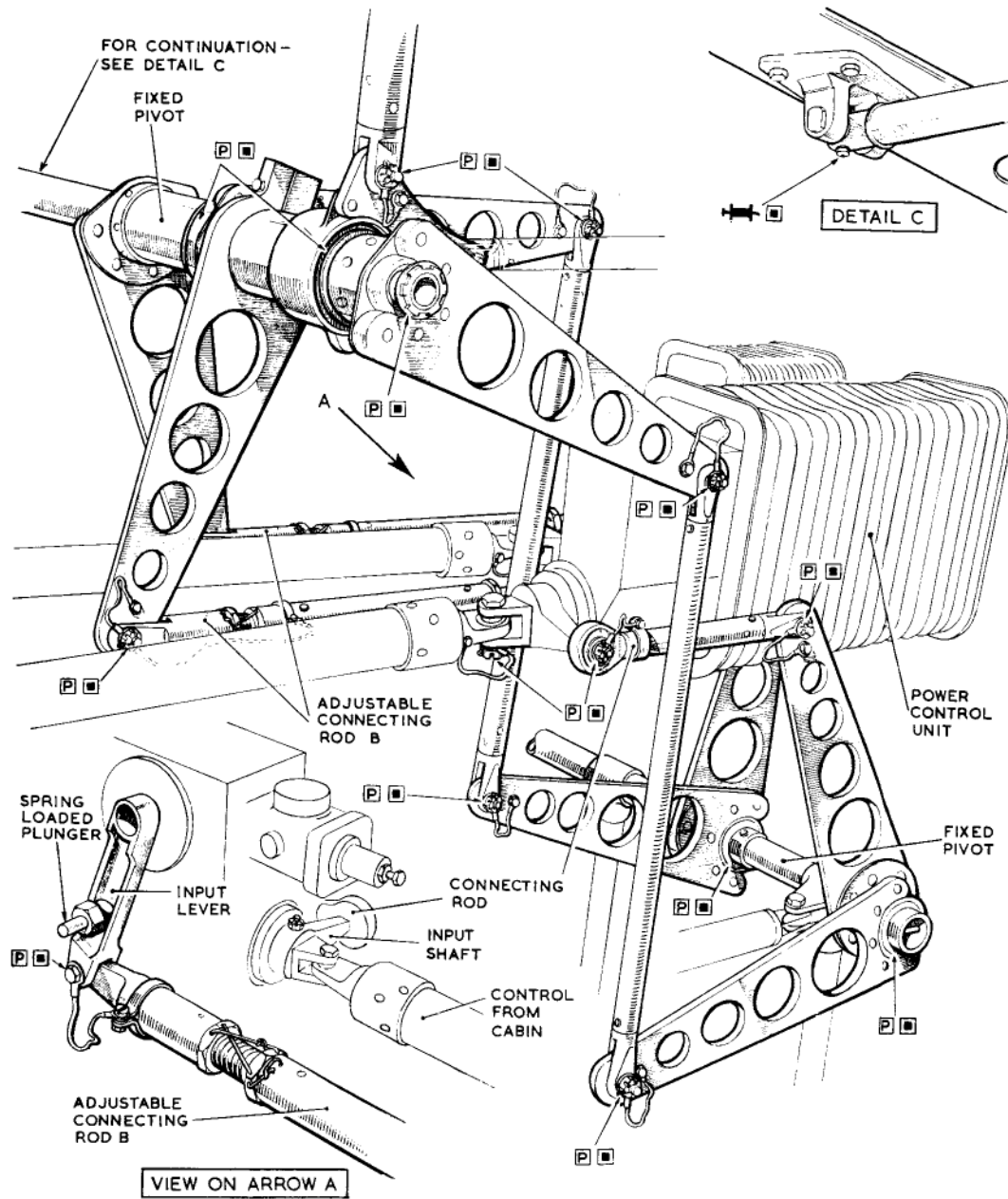


Fig. 20. Anti-oscillation linkage.

**Anti-oscillation linkage initial neutral setting**  
(fig. 20)

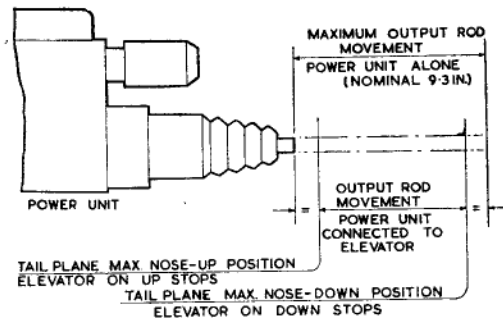
60. The following procedure is used to obtain the rudder power unit setting, the elevator linkage being set by a similar procedure. With the controls in manual, move the output rod until the setting rig pointer is over the indicator plate centre line (para. 109 (1) and (2)) and hold the rod in this position. Apply finger pressure to the spring-loaded plunger on the input lever of the power unit differential gearbox and adjust the length of the anti-oscillation linkage input rod until the plunger engages with the aperture provided in the gearbox casting.

**Note . . .**

If more control surface movement is obtained in manual than in power it is probably due to incorrect assembly of the linkage and the lever group on the linkage top cross-shaft should be removed and reversed.

**Anti-oscillation linkage neutral setting check**

61. With all rudder and elevator rods connected, run the rudder feel actuator to its mid position. Engage the rudder and elevator feel units, and secure the feel levers in the neutral position.



**Fig. 21. Elevator power unit—output rod movement**

**Note . . .**

Either of two methods may be used to lock the levers i.e., by using a coupling adapter 26SR/95297 and a cabin pressure testing trolley to load the feel unit air-intake to the equivalent of 390 knots, or by using suitably protected wedges in the lightening holes of the unit to position and hold the lever neutral. Three operators will be required for the check, one at each of the following positions and all suitably equipped for inter-communication with each other.

(a) In the cabin, to operate the power control switches as directed.

(b) At the power unit, to make control rod adjustments.

(c) At the rudder trailing edge, to check the control surface movement and request the necessary adjustment.

Proceed as follows:—

- (1) Remove the locking wire and loosen the adjustable connecting rod locknuts at B.
- (2) Switch on the rudder power unit and check for “jump” at the rudder trailing edge.
- (3) Tighten all control rod locknuts and, after re-checking, wire-lock the nuts.

**Elevator trim indicator unit (fig. 22)**

62. The control rod from the power unit ram transmits movement to the elevator trim indicating lever which is mounted at Stn. 1078.7 (Detail B, fig. 6). The lever is a triangular-shaped frame one arm of which is pivoted in ball races at its inner end, while the outer end, which transfers the control movement to the rod rising to the elevator,

is free to float on a shouldered bolt in the main part of the lever. This free movement is geared up by a linkage in the indicator unit which is mounted on an arm of the lever frame, and the movement is transmitted through a lever, to actuate warning lamp switches.

63. On actuation, the switches operate warning lamps in the cabin. This ensures that excessive elevator control loads are indicated to the pilot so that he can trim out accordingly.

**Elevator out-of-trim lights**

64. *Control wheel test procedure.*—Engage the control locks and the two pilots’ control wheels, disengage the elevator feel and ensure that the power control units are “off”. Attach a spring balance to a suitable position on the control wheel and proceed with the check as follows:—

- (1) Pull back the control wheel and note the force (1b) when the nose-up light comes on.
- (2) Push the control wheel slowly forward and note the force (1b) when the nose-up light goes off.
- (3) Push the control wheel further forward and note the force when the nose-down light comes on.
- (4) Pull back the control wheel and note the force when the nose-down light goes off.

The following limits are permissible.

Nose up	(pull) light ON	30 ± 10 lb
	(push) light OFF	0 ± 15 lb
Nose down	(push) light ON	30 ± 15 lb
	(pull) light OFF	15 ± 15 lb

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### Elevator trim indicator setting (fig. 22)

65. To adjust and test the elevator trim indicator proceed as follows: —

(1) Disconnect the vertical adjustable rod from the elevator trim indicating lever assembly, disconnect the elevator power unit input control rod at the feel unit and switch on the power unit.

(2) Remove the switch cover plate from the elevator trim indicator unit.

(3) Loosen the spring adjusters and the contact screws.

(4) Loosen the coil assembly securing bolts so that they are just free to move, and move both assemblies away from the striker lever.

(5) Adjust the sleeve, keeping both ends of the operating rod upright, so that the striker lever is central. In this condition the articulated lever, when moved through its full travel, which is governed by a slotted hole, should give equal movement each way to the striker lever. Lock the sleeve and recheck the operation.

(6) Adjust the springs so that a minimum load of 25 lb, applied through a suitable spring balance at the point A, is required to move the articulated lever through its full travel each way. Check that the lever returns to its central position. Lock the spring adjusters and recheck the operation.

(7) Set the adjustable contacts so that they "make" under a load of  $20 \pm 5$  lb in either direction. Lock the contacts and re-check the operation.

(8) Adjust the coil assemblies so that they will hold the armature on the contacts at a load of  $20 \pm 5$  lb and break the contacts at a load of  $0 \pm 4$  lb. Tighten the coil assembly securing bolts, ensuring that

both cores have an equal clearance from the armature.

(9) Check that the making load is  $20 \pm 5$  lb, and that the breaking load is  $0 \pm 4$  lb ten times each way to prove consistency of setting.

(10) Replace and secure the switch cover.

**Note . . .**

*Should the above adjustments and tests*

*fail to eradicate the faults in the indicator system, the complete elevator trim indicating lever assembly must be renewed.*

(11) switch off the power unit and re-connect the controls.

### Compensating lever mechanism

66. The control from the elevator trim indicator lever is connected through a compensating lever mechanism (fig. 6, detail A) to a lever on the elevator torque tube. As the

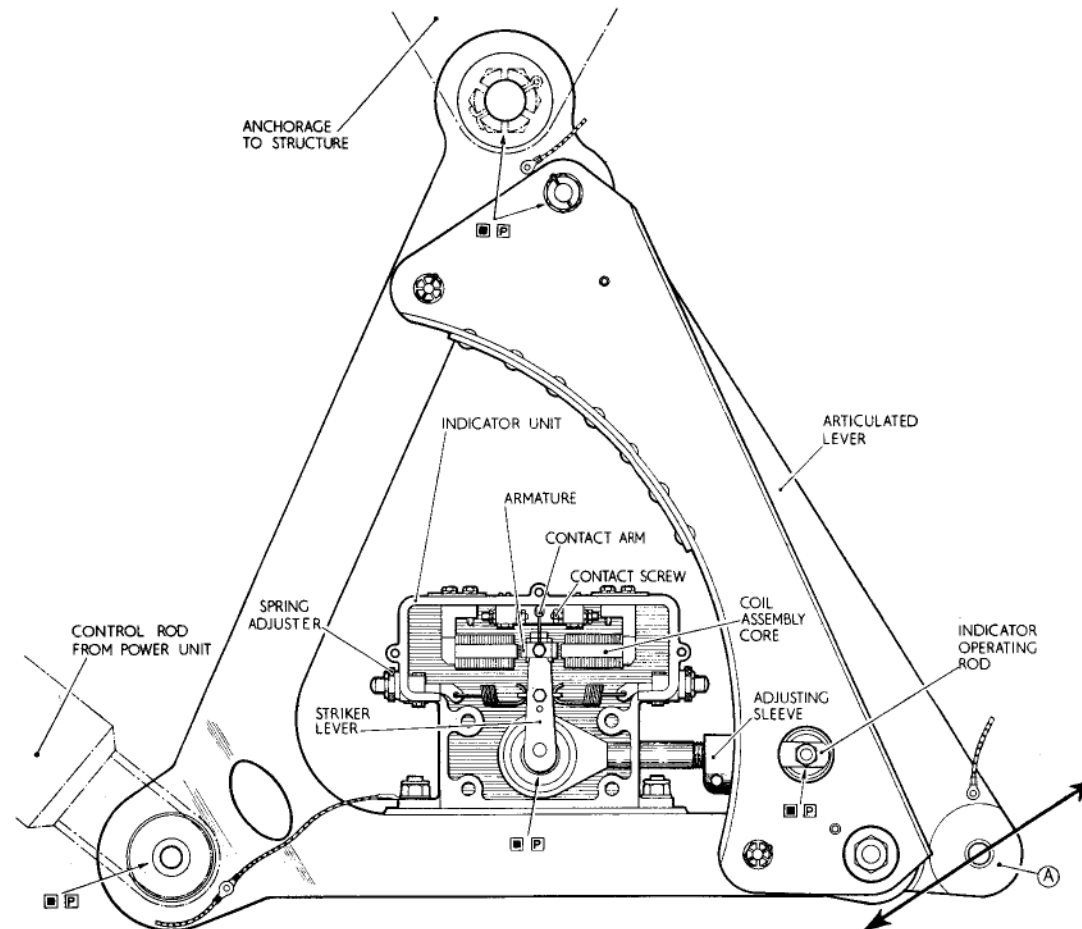


Fig. 22. Elevator trim indicator unit

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tail plane incidence is changed, rod A (attached to the tail plane) moves, rotating lever B about the torque tube C (mounted in the fin structure). This in turn, through lever D which is attached to the torque tube C and the pivot bolt of lever E, moves lever E and actuates the control rod to the elevator. Any change in the tail plane incidence is thus accompanied by a corresponding movement of the elevator.

### Elevator stop mechanism and balance weights (fig. 23)

67. The elevator torque tubes are coupled in the fin by a short torque tube fitted with a universal joint at each end. On its underside the torque tube carries a lever connecting it with the elevator control rod and, attached to two lugs on the top surface, an

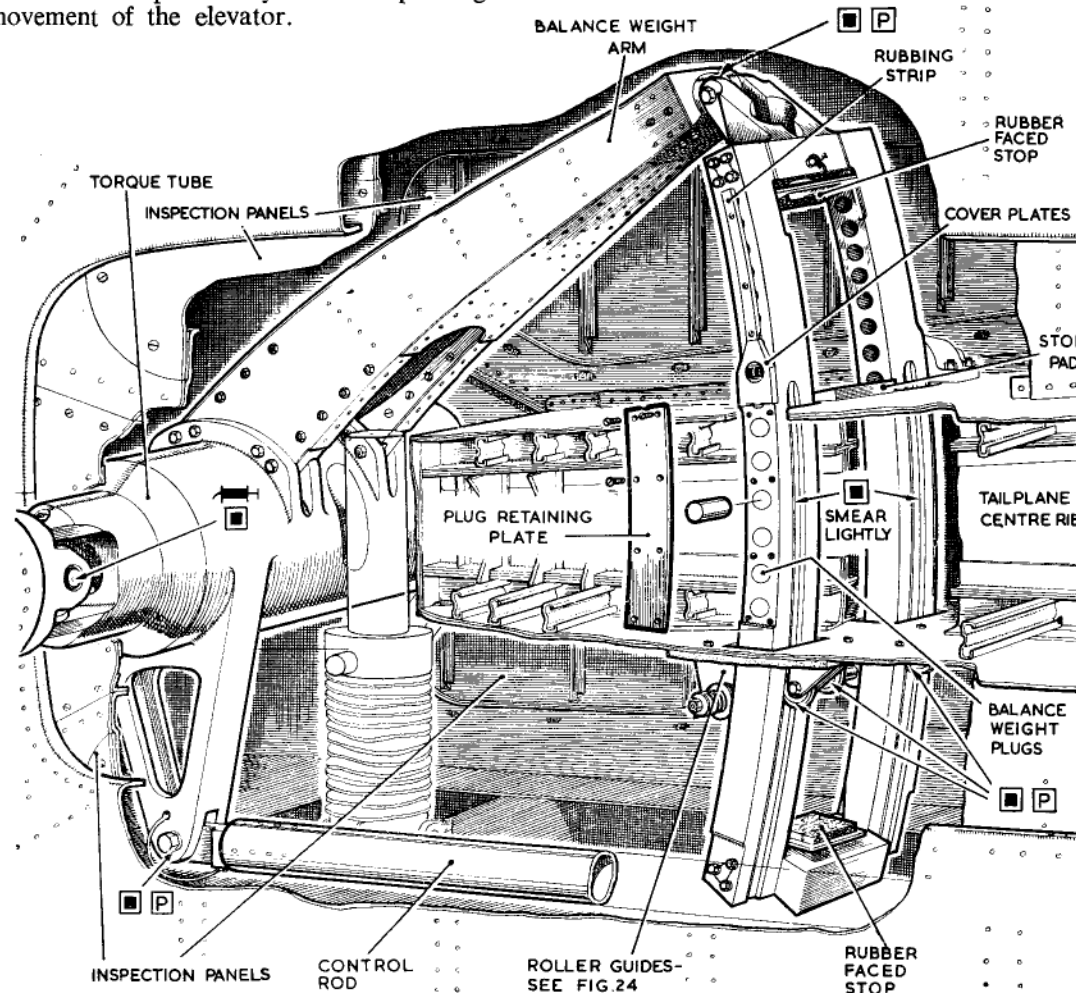


Fig. 23. Elevator stop mechanism and balance weights

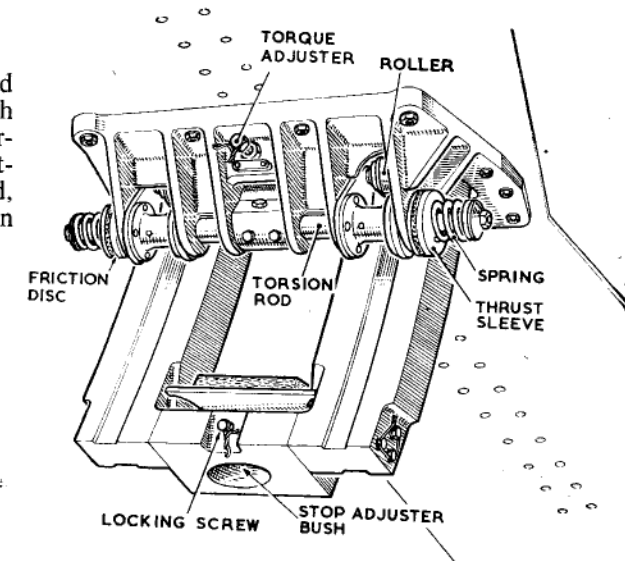


Fig. 24. Elevator balance weight roller guides

arm carrying two bronze balance weights. They are joined at the top by a fork-end, and at the bottom by a block; both top and bottom end fittings incorporate an adjustable rubber-faced stop pad.

68. A series of holes are provided in the sides of each balance weight to take lead plugs for additional weight, the plugs being retained by detachable plates. The balance weights pass through apertures in the tail plane skin. Between the top skin apertures is a stop pad which engages the pad at the top end of the weights when the elevator has reached its fully-up position; a similar pad on the underside engages the stop pad on the lower end of the weights when the elevator reaches its fully-down position. The underside of the tail plane carries an assembly of four rollers (fig. 24) mounted on a cast base-plate; a roller engages depressions in the front and rear face of each balance weight. The rear rollers are held against the balance weights by a spring-loaded torsion rod, the torque in which can be varied by turning

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*Trim tab—starboard elevator (fig. 27)*

71. The trim tab is electrically operated by an actuator mounted on the starboard elevator detachable root and controlled by a switch on the port console in the cabin. The actuator operating rod connects to one end of a bell-crank lever pivoted in a bracket mounted

on the rear face of a longitudinal channel member in the elevator. The other end of the bell-crank lever is attached to a connecting rod which in turn actuates the tab operating spigot. This locates in a housing in the trim tab and transforms the lateral movement of the connecting rod into vertical movement of

the trim tab. A channel-section triangular member is attached at one end to the actuator mounting brackets by two clevis pins, a stop spindle being bolted to the other end. The spindle passes through a hole in the bell-crank lever adjacent to the attach-

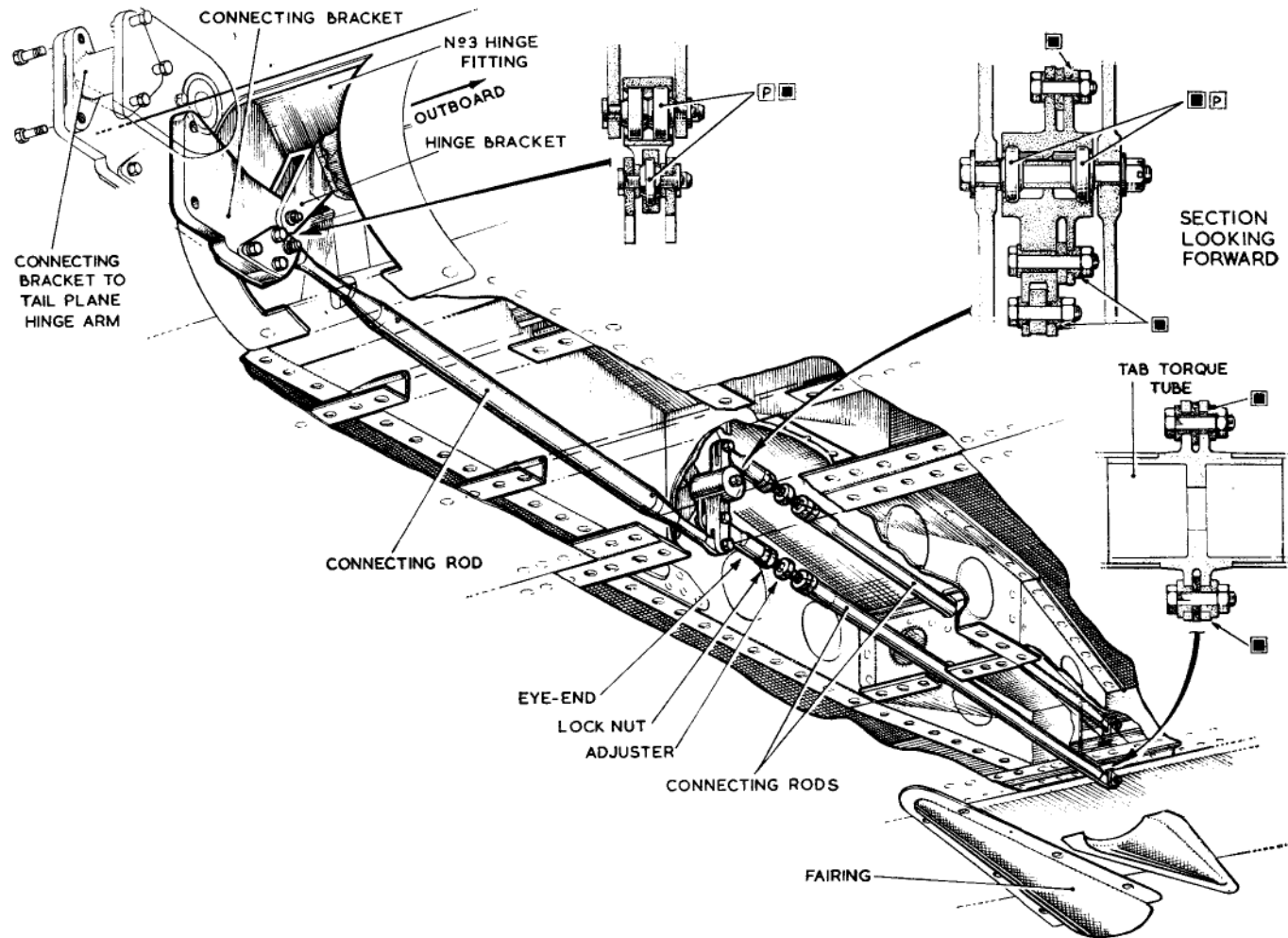


Fig. 26. Port elevator balance tab mechanism—2



ment point of the actuator operating rod and carries the adjustable physical stops. These are provided to restrict excessive movement of the trim tab in the event of failure of the actuator limit switches. The limit micro-switches are mounted on brackets attached to the elevator structure on each side of the trim tab operating lever and are operated by adjustable contact screws. A desynn transmitter, mounted on a bracket on the detachable root, is connected to the bell-crank lever by an adjustable linkage, and relays movement to the tab position indicator on the port console in the cabin adjacent to the trim tab operating switch.

#### Trim tab and desynn setting (fig. 27)

72. The method of setting the elevator trim tab and its desynn indicator is as follows :—

- (1) Run the actuator to the middle position of its ram stroke.
- (2) Adjust the connecting rod, between the actuator bell-crank and the trim tab mechanism operating lever, so that the trim tab lies neutral. The neutral position may be checked by laying a straight edge along the upper and lower surfaces of the elevator and aligning the trim tab to the straight-edge.
- (3) Lock the connecting rod.
- (4) Adjust the two microswitches to limit the trim tab travel in accordance with Table 2.
- (5) Adjust the physical stops so that there is a gap of  $0.03 \pm 0.005$  in. between the stops and the bell-crank after the limit switches have cut the circuit.
- (6) Run the trim tab to neutral and adjust the serrated connecting link, between the actuator bell-crank and the arm of the desynn transmitter, until the needle of the indicator on the port console in the cabin reads neutral.
- (7) Run the trim tab to the limit of travel each way and check that the correct movement is being indicated. If the range of movement of the indicator is too short or too long adjust as in para. 133 (9).

#### Elevator locking controls

73. This description of the elevator locking deals with the locks in the tail plane only. For a continuation of the controls and their association with the rudder and aileron locking, reference should be made to fig. 7 and para. 151.

#### Pre-Mod 474 (fig. 28)

74. Port and starboard elevator locking arrangements are similar and are operated from a central sprocket. The starboard side only is described. A lock unit mounted on the inner face of the tail plane end rib houses a spring-loaded plunger tube, the aft end of which is slotted and houses a roller; the

forward end has a fork end attached to a toggle lever pivoted in a lug on the lock unit body. Attached to a third point on the toggle lever is a connecting link carrying the locking pin, which, when in the locked position, rides up a metal ramp-shaped block mounted on the inboard face of the elevator horn until, as the controls are centred, it drops into a slot in the ramp block.

75. A lever hinged at one end to a lug on the lock unit body, passes through a slot in the aft end of the plunger tube. The back of the lever is formed into a cam which bears against the roller mounted in the tube. The other end of the lever is connected by a tie-rod to a bell-crank lever at Stn. 224.75. The

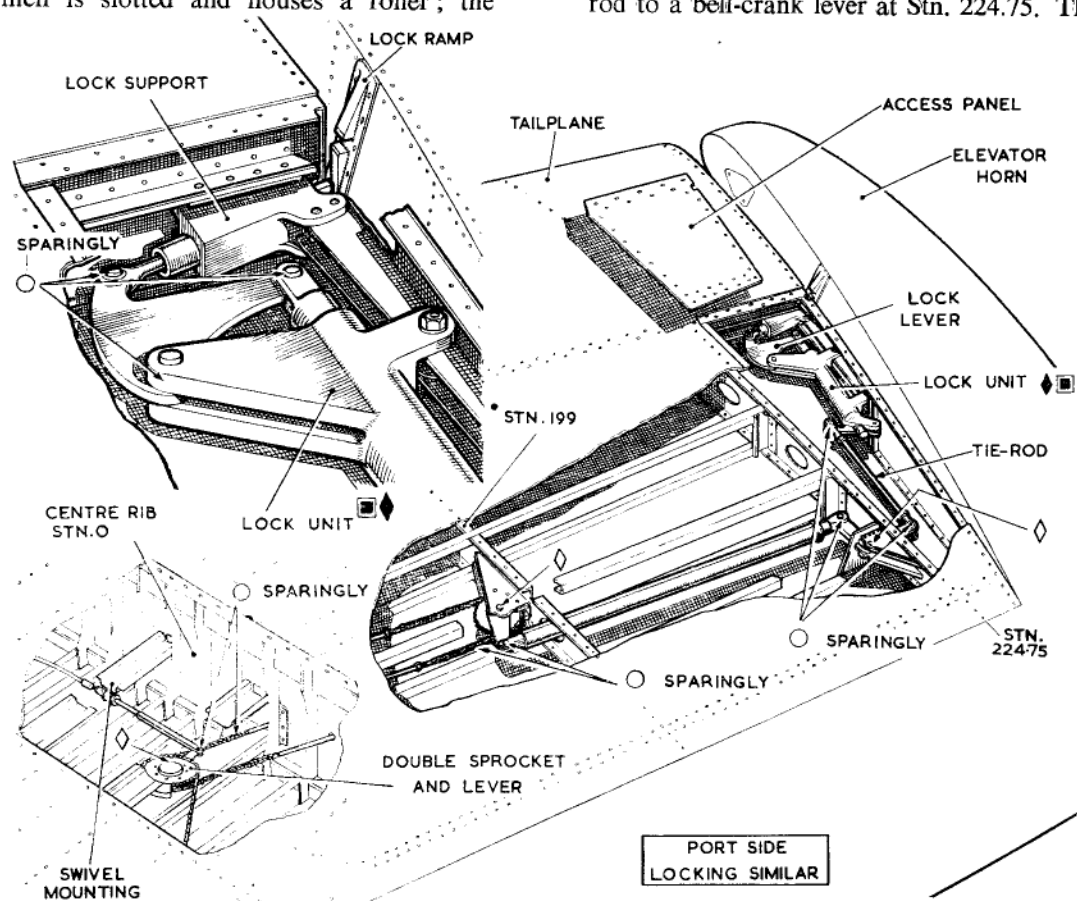


Fig. 28. Elevator lock mechanism, pre-Mod. 474

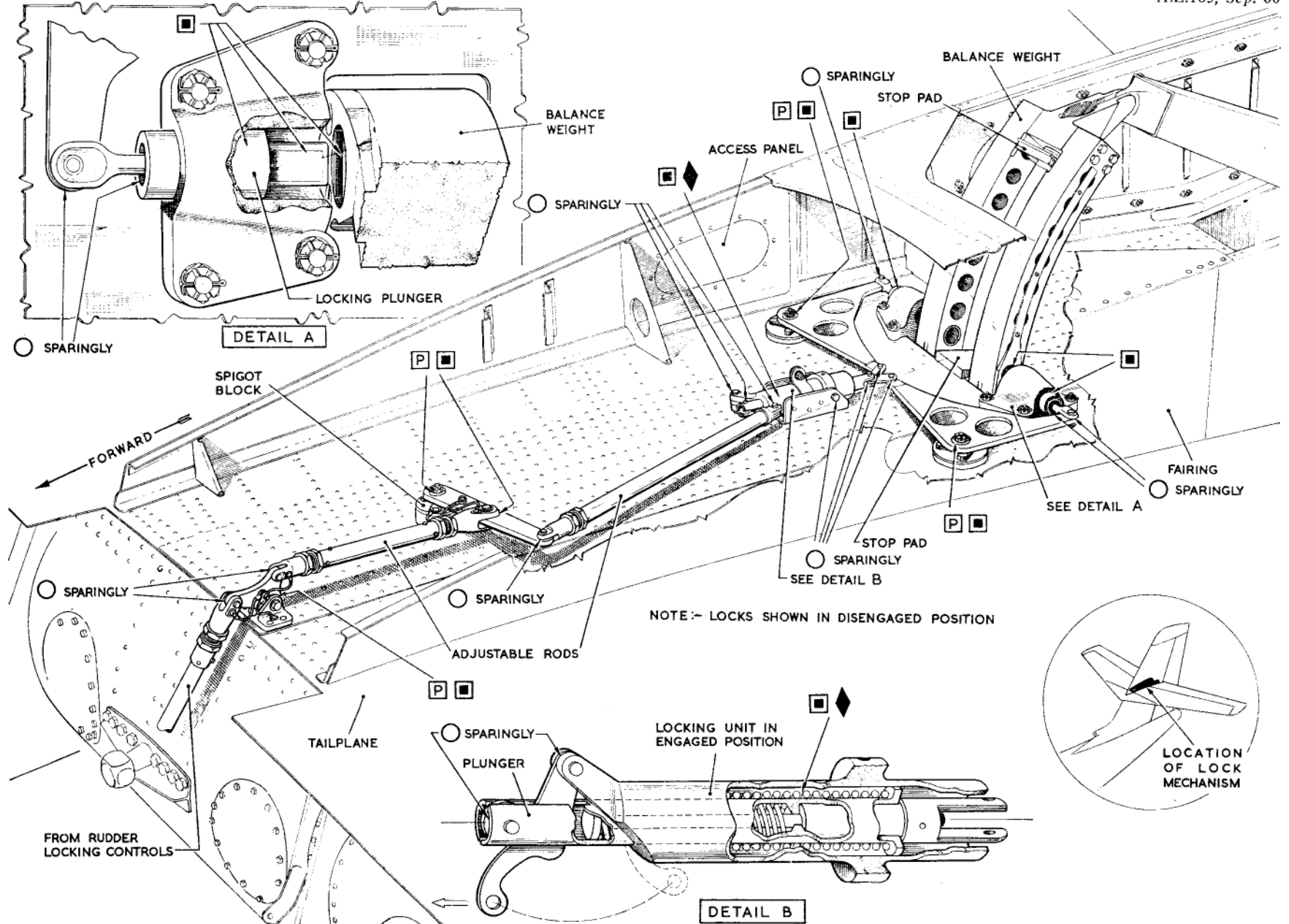


Fig. 28A. Elevator lock mechanism, post-Mod 474

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control continues in the form of a connecting rod to a lever and sprocket Stn. 199.7. This sprocket and a similar one on the port elevator locking mechanism are connected by chain and tie-rods to a double sprocket mounted centrally in the tail plane. From a lever on the double sprocket a cable continues the locking mechanism to the torque shaft lever assembly on the fin front spar. This lever assembly is also connected to the rudder locking mechanism and to the cable control from the cockpit.

*Post-Mod. 474 (fig. 28A)*

**76.** The locking mechanism is located on the tail plane butt strap and consists of a lock unit, mounted centrally on the butt strap, and two locking plungers which, in the "locks engaged" position, enter two sockets one on each side of the balance weight lever. The lock unit houses a spring-loaded plunger tube (fig. 51), the forward end of which is slotted and houses a roller. The aft end is fitted with a fork-end which, through connecting links and quadrants, couples the lock unit to the locking plungers.

**77.** A lever, hinged at one end to a lug on the lock unit body, passes through a slot in the forward end of the plunger tube. The back of the lever is formed into a cam which bears against the roller mounted in the tube. The other end of the lever is connected, through an adjustable rod, to a lever mounted on a spigot block on the buttstrap centre line just forward of the lock unit. From the spigot block an adjustable connecting rod attaches to a bell-crank lever on the forward end of the buttstrap. From this point a series of adjustable rods connect to the rudder locking controls at the lower fin front spar.

#### Preloading the elevator feel unit piston spring

**Note . . .**

*In every case where the piston rod is pulled out, this operation is to be performed slowly to prevent reversal of the diaphragm bag seal.*

**78.** (1) Release the through bolt in the pivot post, to allow the chain yoke to move to the limit of its serrated slide.

**Note . . .**

*It is important that only the centre through bolt, securing the chain yoke serrated slide to the pivot post, be slackened. No adjustment is to be made to the position of the pivot post.*

(2) Set the piston rod so that it protrudes 0.75 in. from the feel can chain end, measuring from the face of the can seal nut to the face of the screwed end fitting on the piston rod (fig. 30).

(3) Using a length of tube of suitable diameter, pass it down the piston rod free end and compress the spring until the chain end piece is felt to touch the screwed end fitting on the piston rod, at the same time maintaining the dimension obtained in operation (2).

(4) Adjust the yoke by its serrated plates until the chain is taut and tighten the centre through bolt in the pivot post.

(5) Set the spring end stop to 2.3 in. measured from the piston rod free end to the face of the spring retaining piece as shown at Y in fig. 30.

(6) Check that the yoke joining the serrated plates clears the end of the lever. The spring is then preloaded.

(7) Pull slowly on the piston rod free end until it is felt to come up against the stop; check that the piston rod protrudes 0.75 in. at the chain end of the feel can.

#### Elevator feel unit lever neutral setting (fig. 29)

**79.** To set the elevator feel unit lever neutral proceed as follows:—

(1) Run the tail plane to the max. incidence position and move the elevator feel release lever in the cabin to disengage the feel.

(2) Move the control locks to the ON position.

(3) Connect the air rig to the feel units as described in para. 32 (1) and (2) and pressurize the system to the equivalent of 390 knots.

(4) Take a reading with a suitable clinometer on the top surface of the port elevator just outboard of the root end.

(5) Move the control locks to the OFF position.

(6) Move the elevator downwards until the clinometer is registering the reading taken in operation (4) plus 1 deg. and lock the elevator in this position, using a wood wedge between the root end and the fin.

(7) Move the elevator feel release lever to the engaged position.

(8) Adjust the length of the connecting rod on the feel unit lever until the wedges enter their slots without deflecting the lever.

(9) Lock the connecting rod.

#### Testing the release of the feel unit

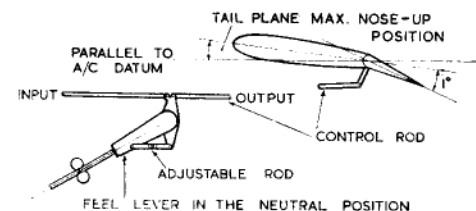
**80.** The method of testing the release mechanism of each feel unit lever is given in the following paragraphs.

**Note . . .**

*All tests must be made with the power off.*

*100lb. test at feel unit lever (fig. 31 and 32).*

**81.** (1) With the control on either of the input stops, apply a load of 100 lb. to the chain yoke pivot on the feel unit lever in a direction normal to the lever centre line.



**Fig. 29. Elevator feel unit lever neutral setting**

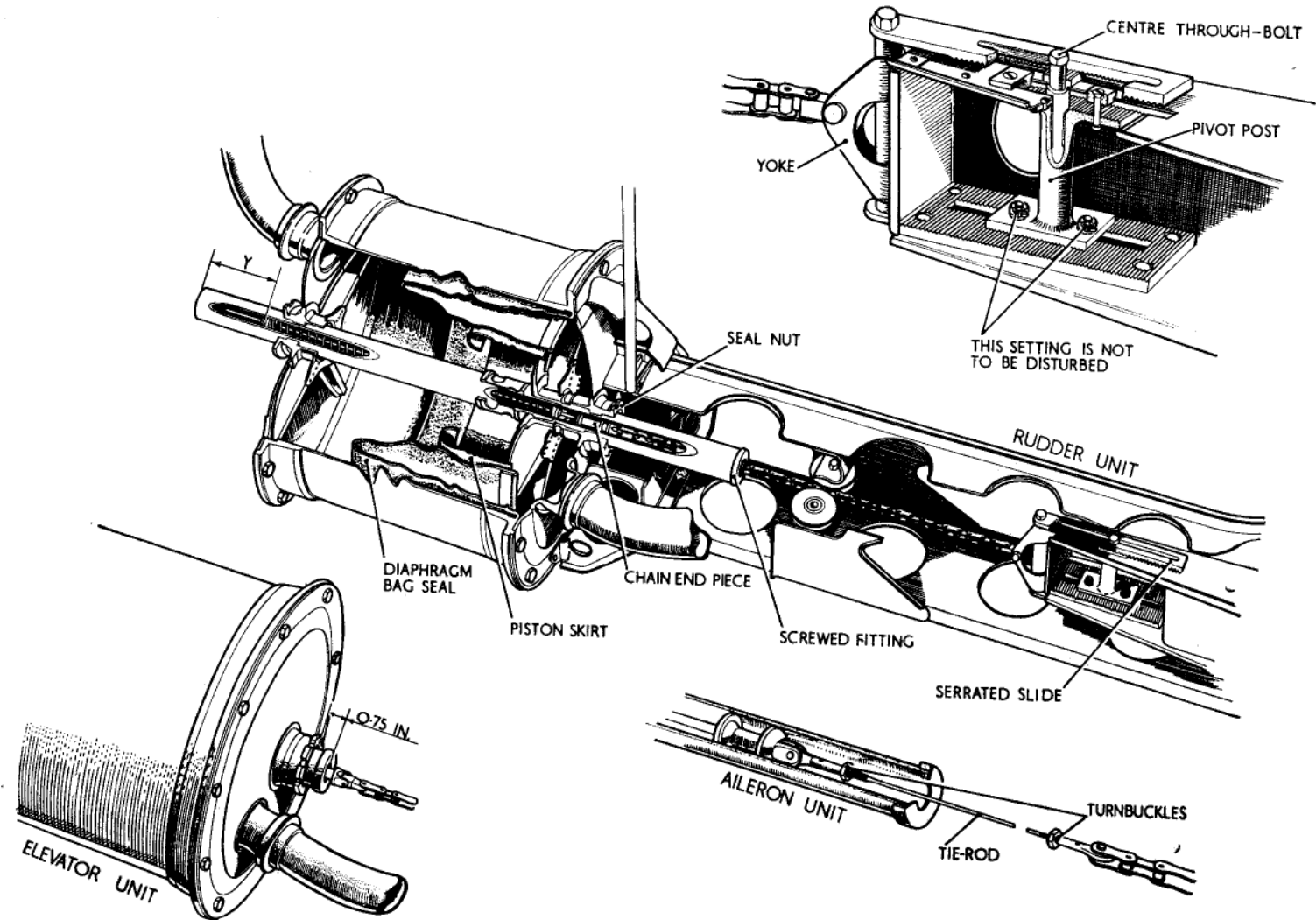
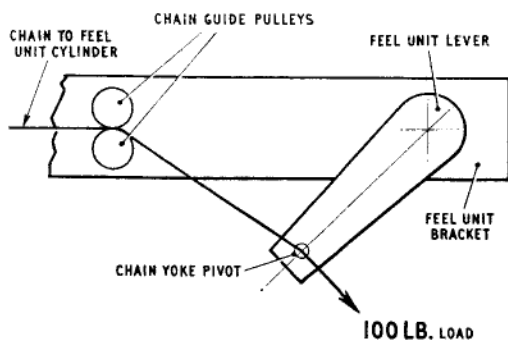


Fig. 30. Pre-loading the feel unit cylinder piston spring

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**Fig. 31. Testing release of elevator feel unit—1**

(2) Maintaining the load on the chain yoke pivot, check that there is no tendency for the wedges to disengage; operate the feel release lever in the cabin and check that the mechanism breaks cleanly.

(3) Repeat the test with the control on the other input stop.

**Note . . .**

*If there is any movement of the wedges whilst making the above checks do not proceed until this has been rectified.*

*Test with load lever*

**Note . . .**

*Test load lever 26SR/95429 is used to test the elevator and rudder feel unit release.*

**82.** (1) Fit the elevator release test disc Pt. No. 67479-5753 to the end of the release test load lever Pt. No. 67479-5745 to which the pivot-block assembly Pt. Nos. 67479-5747/5749/5751 has previously been attached; it is not necessary to dismantle the pivot-block.

(2) Offer up the test load lever assembly to the release lever mechanism so that the pivot block enters the feel lever axis, with the flats on the block facing the split pin in the feel lever torque tube, and the release test disc enters the lightening hole in the feel lever arm.

(3) Tighten the pivot assembly nut so as to spread the special washers and so secure the test load lever in the feel lever axis.

(4) With the feel release mechanism engaged, and a pressure equivalent to 390 knots in the feel can, apply a load, through a suitable spring balance, of 106 lb to the test load lever and check that there

is no tendency for the wedges to disengage.

(5) Maintaining the load on the test load lever, operate the feel release lever in the cabin, and check that the release mechanism breaks cleanly.

(6) Repeat operation (4) and (5), applying the load in the opposite direction.

**Elevator feel unit removal**

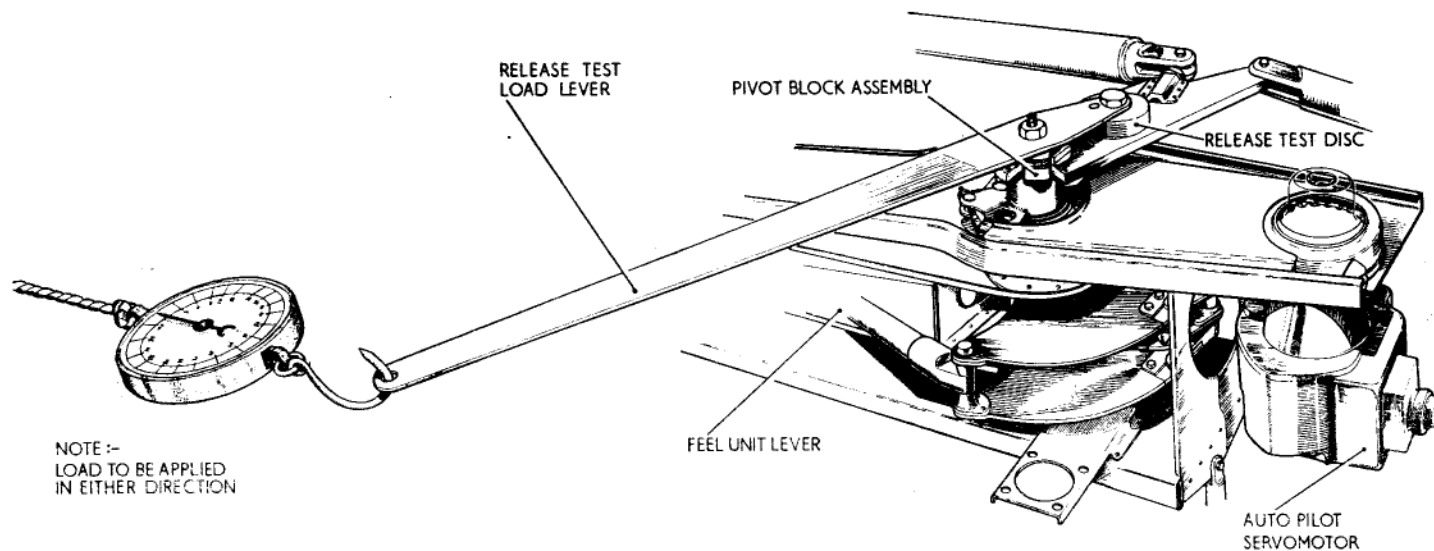
**83.** To remove the elevator feel unit proceed as follows :—

(1) Disconnect the control rods from the feel unit lever.

(2) Remove the chain cover and the pins securing the two anchorages of the auto pilot operating chain to the chain pulley, and remove the chain.

(3) Disconnect the feel lever release cable at the first joint.

(4) Using a length of tube of suitable diameter, pass it down the free end of the cylinder piston rod and compress the spring. Disconnect the chain from the feel unit cylinder by removing the bolt at the chain attachment to the end of the feel unit lever.



**Fig. 32. Testing release of elevator feel unit—2**

- (5) Remove the six bolts securing the upper bearing housing to the mounting bracket.
- (6) Remove the six bolts securing the flange of the short splined torque tube to the flange of the main torque tube.

**Elevator feel unit cylinder removal**

84. Proceed as follows :—

- (1) Disconnect the electrical services and remove the muff.
- (2) Using a piece of tube of suitable diameter, pass it down the free end of the cylinder piston rod and compress the spring. Disconnect the chain from the piston by removing the nut and bolt.
- (3) Remove the nuts and bolts securing the front and rear ducting to the cylinder inlets, taking care to retain the sealing washers and reinforcing rings.
- (4) Remove the four nuts and bolts securing the feel unit cylinder to the mounting bracket and remove the cylinder.

**Elevator autopilot servomotor (fig. 8 and 14)**

85. This servomotor is mounted on the elevator feel unit lever. The servomotor mounting plate is bolted to the feel unit lever mounting bracket rear end. A sprocket and torque limit switch are bolted to the servomotor shaft which passes through an aperture in the feel unit mounting bracket. The sprocket is connected to the feel unit torque tube by a chain attached to eye bolts passing through trunnions mounted in a pulley splined onto the torque tube. The two eye bolts, secured by double locknuts and locking wire, are used for adjusting the chain tension which must be such that no undue friction is added to the feel unit lever. The auto-pilot servo chain and sprockets are covered by a two piece guard which is bolted to the feel unit lever mounting brackets.

**Note . . .**

To remove the servomotor, disconnect all electrical services, remove the retaining nuts and bolts and withdraw the servomotor from the feel unit assembly. On replacement, ensure that the chain is evenly disposed around the sprocket and adjusted to eliminate backlash.

**TAIL PLANE**

**Tail plane incidence mechanism (fig. 33, 34 and 35)**

86. The tail plane incidence is varied by a screwjack which is rotated by one of two electric motors through a gearbox and torque shaft drive. The motors are coupled through a common gearbox on their mounting; they work independently of each other, and only one motor at a time is selected to give either fine or coarse drive. The motor mounting is bolted to a reduction gearbox, a splined shaft from the motor gearbox engaging in the reduction gearbox drive. Control is by switches on the outboard horns of the pilots' handwheels, a selector switch being provided to enable either pilot to take control.

**Note . . .**

The following correlated position of switches, controls, etc., should be thoroughly appreciated before commencing work on the system.

<i>Flight deck control handwheel</i>	<i>Tail plane position</i>	<i>Tail plane incidence</i>	<i>Tail plane switchbox markings</i>	<i>Aircraft change of attitude in flight</i>
Switch forward (pre-Mod. 1199 position marked HIGH (speed))	Trailing edge down	Maximum (positive)	Tail plane NOSE UP	Nose down
Switch back (pre-Mod. 1199 position marked LOW (speed))	Trailing edge up	Maximum (negative)	Tail plane NOSE DOWN	Nose up

87. The motors and reduction gearbox are mounted in the rear fuselage and the screwjack is mounted in the fin structure. The screwjack is lubricated by ZX-26 from a Ki-gass pump mounted below the oil tank at the forward end of the gearbox casing.

**Reduction gearbox (fig. 34)**

88. The gearbox consists of a split cast magnesium alloy casing, housing a driving pinion meshing a spur gear giving a ratio of approximately 4½ to 1. The pinion shaft is hollow and serrated internally at the top to receive the drive from the motor gearbox.

89. The spur gear is bolted to a flange on a vertical torque tube. The tube is splined internally for a portion of its length, and houses a splined shaft carrying a flanged coupling; this is bolted to the baseplate of a universal coupling at the bottom end of the torque shaft which drives the screwjack. A bevel wheel is keyed to the bottom of the torque tube and engages a bevel pinion in the switch gear mounted on the underside of the gearbox casing.

**Gearbox removal**

90. To remove the tail plane incidence gearbox proceed as follows :—

- (1) Disconnect the electrical leads and lubricant pipes.

(2) Remove the four bolts from the universal coupling flange. Fit a suitable clamp, made locally, to the torque shaft and tie it to the aircraft structure so as to prevent rotation of the torque shaft.

**Note . . .**

The gearbox complete weighs approximately 90 lb. and it should be supported by a rope sling from the adjacent aircraft structure before proceeding further.

(3) With the gearbox securely supported, remove the four mounting bolts. There are two bolts in each mounting bracket.

(4) Slowly lower the gearbox and carry it to the hatch in the fuselage between Sin. 973 and 1013.

(5) The gearbox can be lowered from the aircraft through this hatch, using the block and tackle equipment (fig. 19) for removing the elevator and rudder power unit.

**Gearbox assembly**

91. Before commencing installation of the tail plane incidence gearbox the following conditions and settings must be achieved :—

(1) The gearbox must be in the datum position, i.e., with the red lines on the yoke coupling the gearbox body in alignment. If the lines are obliterated, this position can be determined as follows :—With the Ki-Gass pump on the left, turn the yoke coupling so that the pair of bolt holes at 2.4 in. centres are facing the operator. Paint in the red lines.

(2) If the limit switch gear assembly has been removed it must be refitted as follows :—

(a) With the gearbox in the datum position as defined in (1), assemble the switch gear carrier plate to the base of the gearbox, using the four 1/4 in. B.S.F. bolts provided, ensuring that the shorter bolts are fitted at the end nearer the pump.

(b) The switch contact plate is to be set at 0.3 in. from the end of its travel

corresponding to the nose-down position of the tail plane.

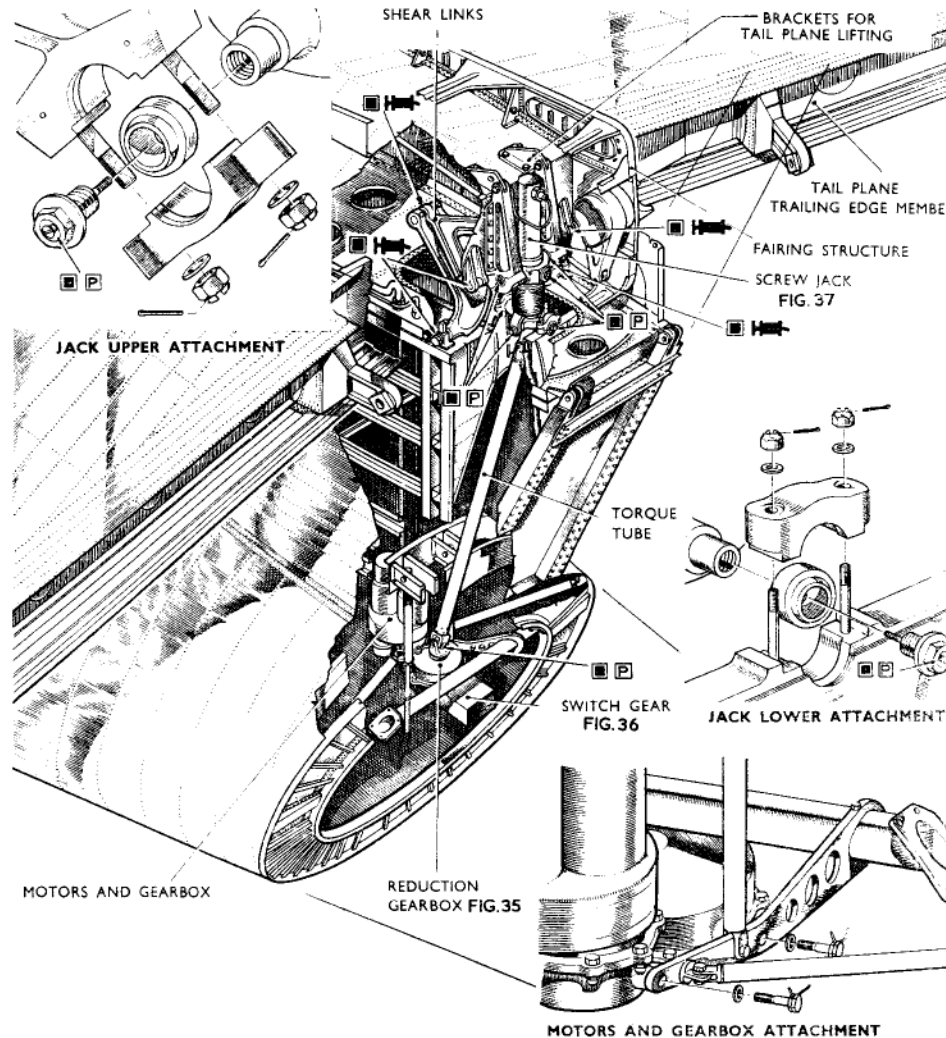
(c) End float on the switch gear screw spindle is to be taken up by using shims Pt. No. 67429-1505, as required, inserted beneath the switch gear bevel pinion.

(d) Backlash between the bevel pinions is taken up by laminated shims on the mounting bolts ; shims Pt. No. 66029-

1051 one each side of shim Pt. No. 66029-1049 are inserted between the carrier plate and the base of the gearbox at each bolt position and adjusted as necessary.

(3) With the gearbox and switch gear set up as in (1) and (2) the microswitches are to be set as follows :—

(a) With the switch contact plate at 0.3 in. from the end of its travel, corres-



**Fig. 33. Variable incidence tail plane actuating mechanism**

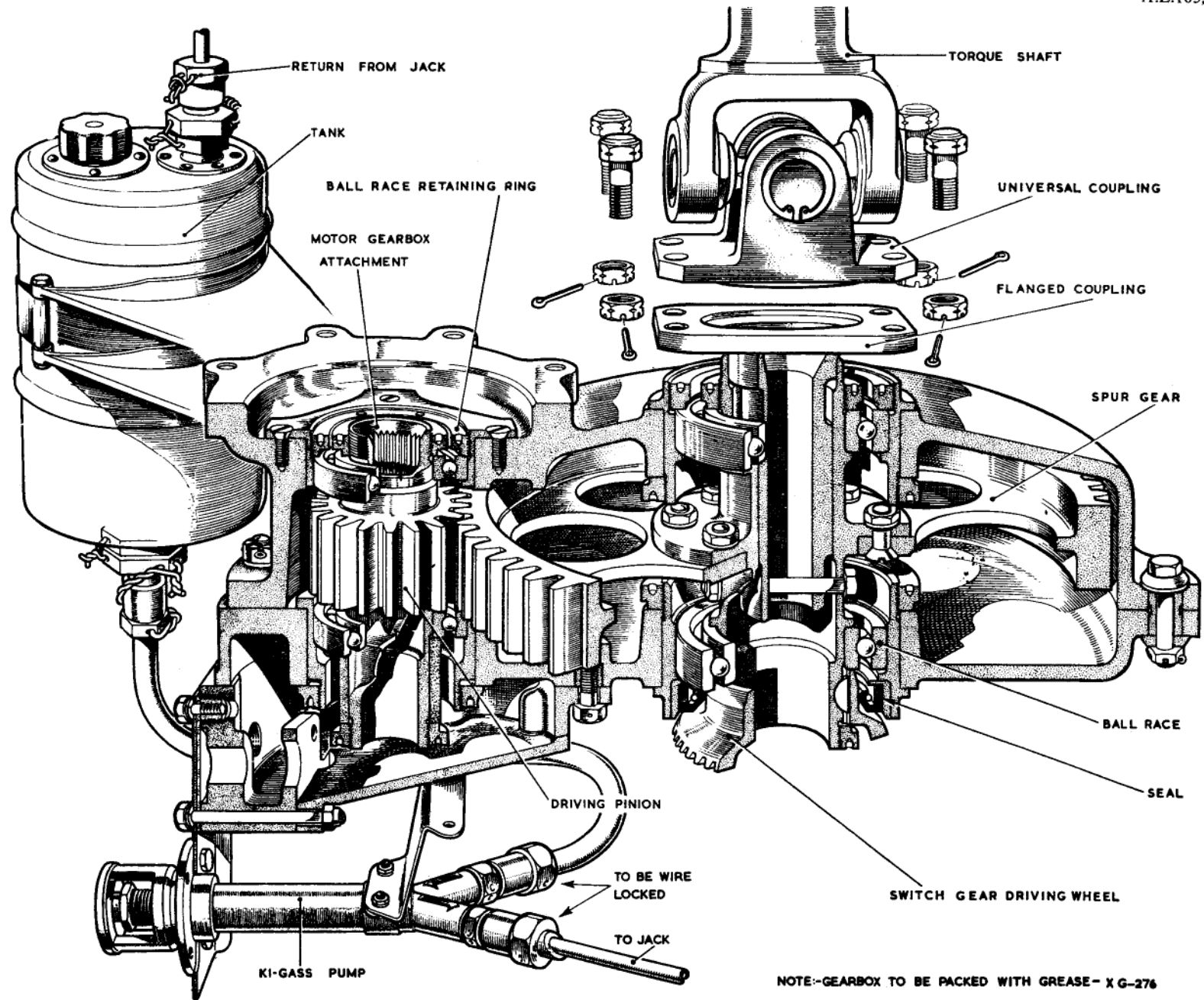


Fig. 34. Tail plane incidence reduction gearbox

ponding to the nose-down position of the tail plane, the coarse and fine travel limit switches are to be set to operate.  
 (b) At an overrun position of  $0.04 - 0 + 0.02$  in. on the setting at 3 (a) the extreme limit switch for the nose-down position of the tail plane is to be set to operate.

(4) The tail plane nose-down condition is now set. To set the gear for the nose-up position of the tail plane, rotate the gearbox through 11 turns  $+214$  deg. and proceed as follows : —

- (a) Set the tail plane nose-up position coarse and fine travel limit switches to operate.
- (b) At an overrun position of  $0.04 + 0.02 - 0$  in. on the setting at 4 (a) the extreme limit switch for the tail plane nose-up position is to be set to operate.

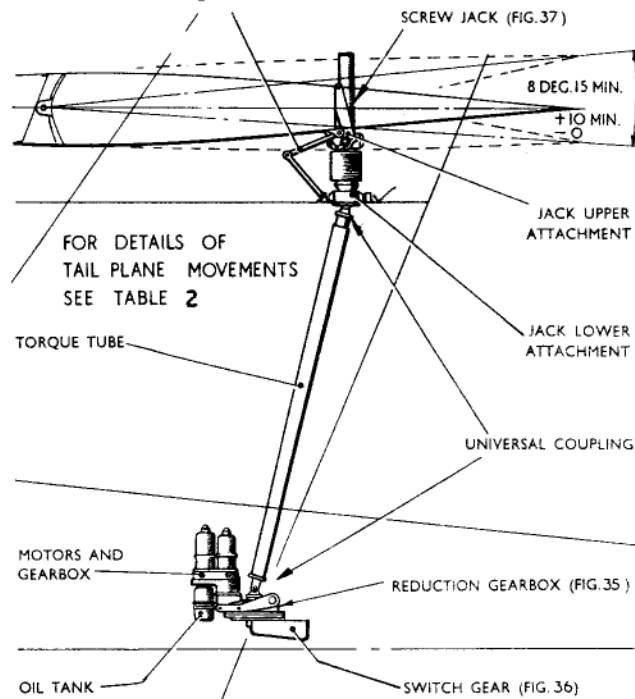


Fig. 35. Functional diagram of tail plane actuating mechanism

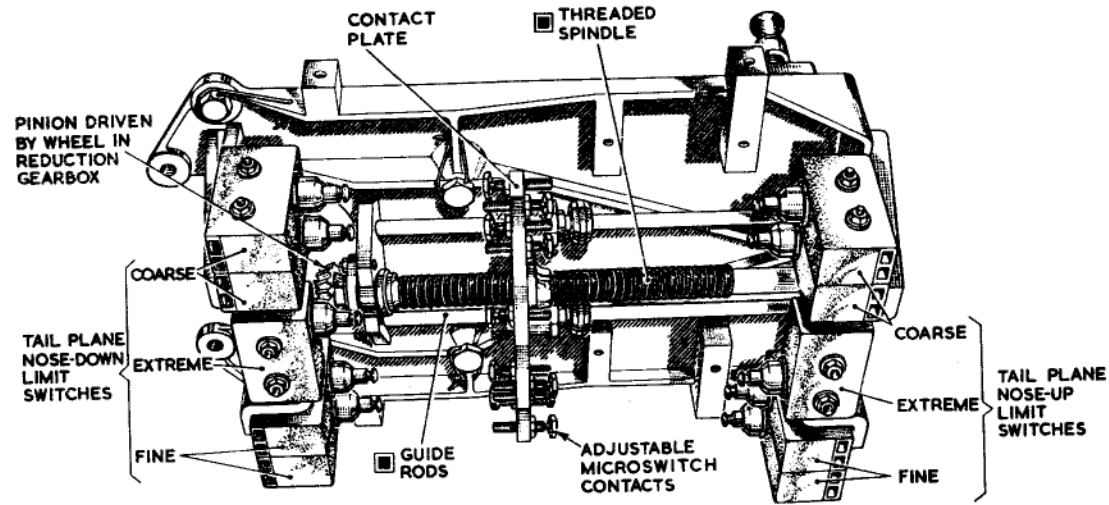


Fig. 36. Tail plane incidence limit switch gear

(5) Rotate the gearbox back to the tail plane nose-down position. Extend the tail plane jack to  $18.25 + 0 - 0.14$  in. as detailed in para. 97. Install the gearbox in the aircraft, reversing the procedure detailed in para. 90, ensuring that the red lines on the torque shaft and gearbox are in line.

**Limit switch gear (fig. 36)**

92. The switch gear is a self-contained unit mounted in a box under the reduction gearbox. It consists of a cast alloy base plate with two lugs at the forward end and a wall at the rear end. The base plate is cut away at the forward end to allow for the insertion of the reduction gear bevel wheel. A lug at the end of the cut-away houses two guide rods and a threaded spindle which are anchored in the end wall.

93. A bevel pinion is mounted on the threaded spindle forward end and meshes with the reduction gear bevel wheel (fig. 34). Threaded onto the spindle is a contact plate, carried by the guide rods; hence as the pinion is rotated the contact plates move

along the guide rods. Microswitches mounted at each end of the switch gear are operated by adjustable contacts on each side of the contact plate to cut the supply to whichever motor is operating when the tail plane reaches its full travel.

#### Screwjack (fig. 37)

94. The screwjack is attached by its lower trunnion to fin rib 93 and by its upper trunnion to brackets on the tail plane trailing edge member. Shear links connecting the tail plane to the fin provide lateral stability. The screwjack is operated by a universally-jointed torque tube from the reduction gearbox.

95. The jack unit consists of an acme-threaded screw engaging a nut in the upper trunnion assembly. The lower end of the screw is retained in roller races in a fork end attached to the lower trunnion mounting. The races are retained in position by a nut on the end of the jackscrew, the nut and the splined flanged coupling, which picks up the torque tube, being locked by a bolt. A leather gaiter is attached to the bottom of the top trunnion and to the side of the bottom trunnion. A metal cover bolted to the top trunnion encloses the jack screw and is connected to the oil tank mounted on the reduction gearbox casing.

#### Screwjack removal

96. To remove the tail plane incidence screwjack proceed as follows : —

- (1) Set the tail plane to the maximum incidence position.
- (2) Remove the top access panels, port and starboard, on the tail plane fairing.
- (3) Disconnect the oil drain pipe from the jack top cover.
- (4) Set the tail plane to the minimum incidence position.
- (5) Remove the bottom access panels, port and starboard, on the tail plane fairing.
- (6) Lock the elevators.

(7) Remove the four access panels, top and bottom, at the trailing edge of the tail plane adjacent to the fin and, using the sling Ref. No. 26SR/95420, support the tail plane assembly.

(8) Remove the tail plane incidence gearbox as described in para. 90.

(9) Withdraw the torque shaft from the splined end of the coupling on the jack.

(10) Disconnect the oil feed pipe from the fitting on the nut housing.

(11) Remove the four trunnion bearing caps.

(12) Collapse the screwjack by winding the screw fully home into the nut housing.

(13) Withdraw the jack through the torque shaft aperture and lower fin.

#### Note . . .

*The screwjack weighs approximately 60 lb. and care must be exercised in carrying out the withdrawal operation.*

(14) Replace the four trunnion bearing caps on their respective mountings.

#### Screwjack assembly

97. To assemble the screwjack in the fin proceed as follows : —

(1) Remove the four trunnion bearing caps from the mounting.

(2) Pass the jack up through the lower fin and torque shaft aperture.

(3) Secure the jack in position by fitting the four trunnion bearing caps.

(4) Extend the jack by screwing out until the distance between centres of the spigots on the upper and lower trunnion mountings measures  $18.25^{+0}_{-0.14}$  in. This is done,

using the gauge illustrated in fig. 37 which can be made up from local resources.

(5) Insert the torque shaft into the jack coupling splined end, ensuring that the red line on the torque shaft coincides with that on the coupling.

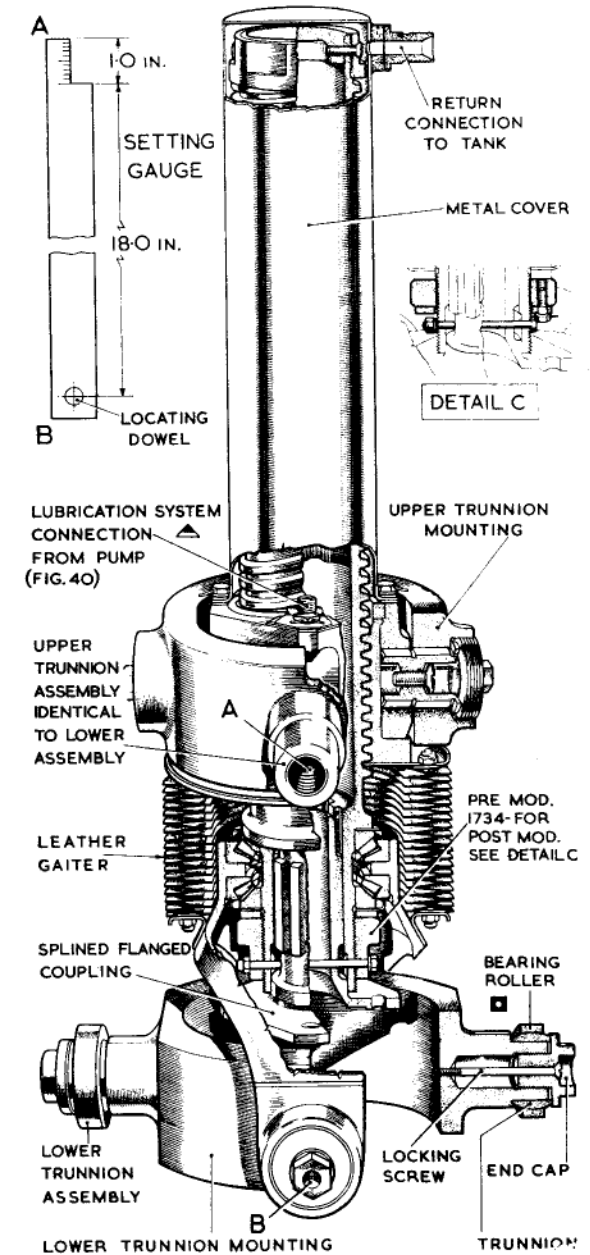


Fig. 37. Tail plane incidence screwjack

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- (6) Reassemble the tail plane incidence gearbox as described in para. 91.
- (7) Remove the slings and bars.
- (8) Refit the oil drain pipe to the jack top cover and the oil feed to the fitting on the nut housing.
- (9) Prime the screwjack system with lubricant ZX-26 as described in para. 98.
- (10) Refit the access panels.
- (11) Unlock the elevators.
- (12) Check the operation of the tail plane incidence mechanism (Table 2).

#### Screwjack lubrication

98. The tail plane incidence screwjack must be primed with lubricant ZX-26 as follows :—

- (1) Set the tail plane to the maximum incidence position so that the screwjack is fully collapsed.
- (2) Half fill the tank on the gearbox.
- (3) Disconnect the return pipe to the tank and operate the Ki-gass pump below the tank until the lubricant flows out of the return pipe.
- (4) Reconnect the return pipe to the tank.
- (5) Top up the tank to the half-full level.
- (6) Operate the screwjack three times to circulate the lubricant.
- (7) At intervals of one week, or after 20 flying hours, whichever is the shorter period:—
  - (a) Set the tail plane to the maximum incidence position.
  - (b) Pump in lubricant for eight strokes of the Ki-gass pump.
  - (c) Top up the tank to the half-full level.

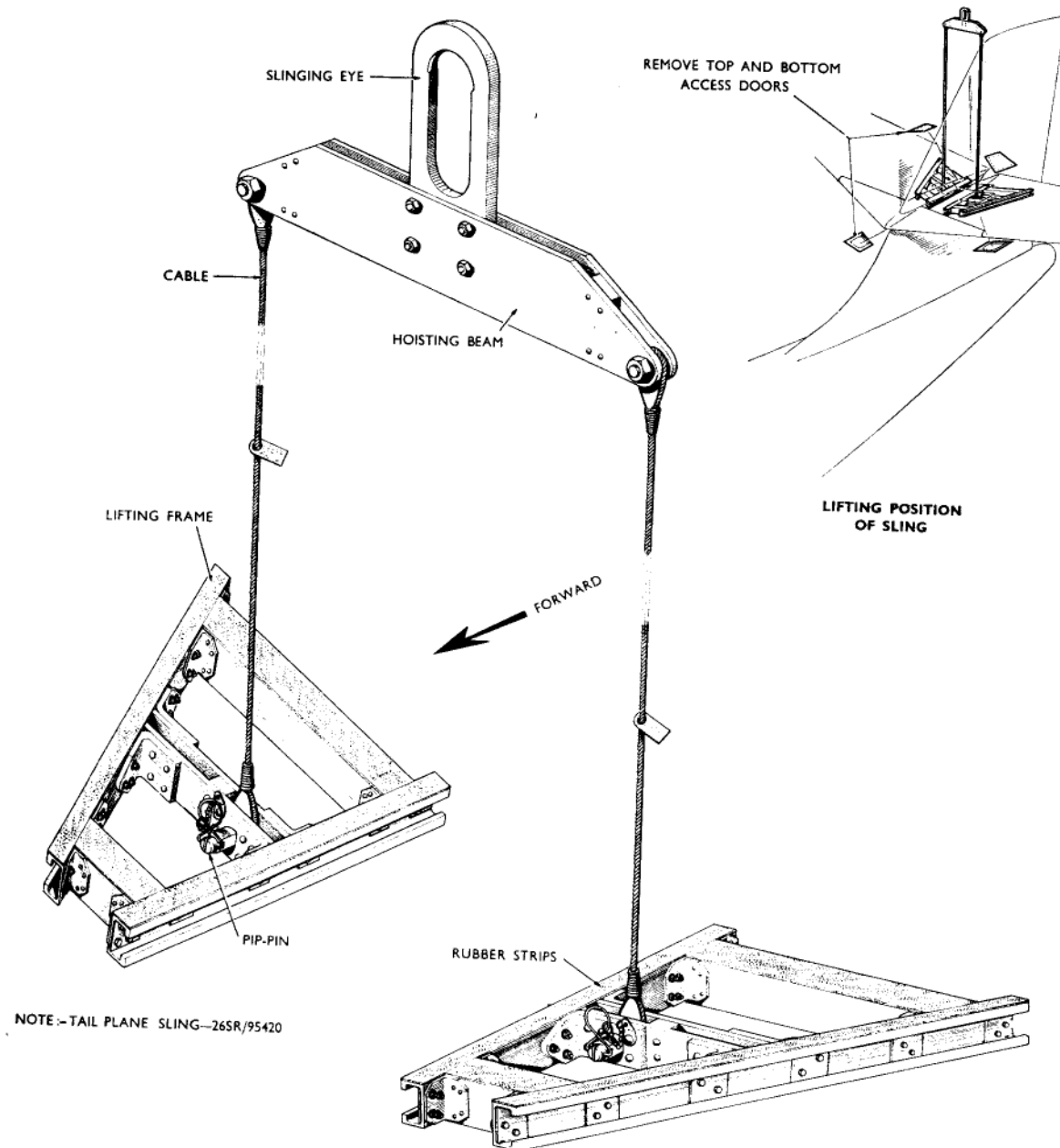
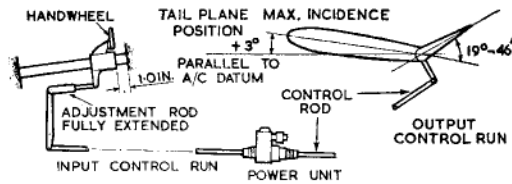


Fig. 38. Tail plane sling for screwjack removal

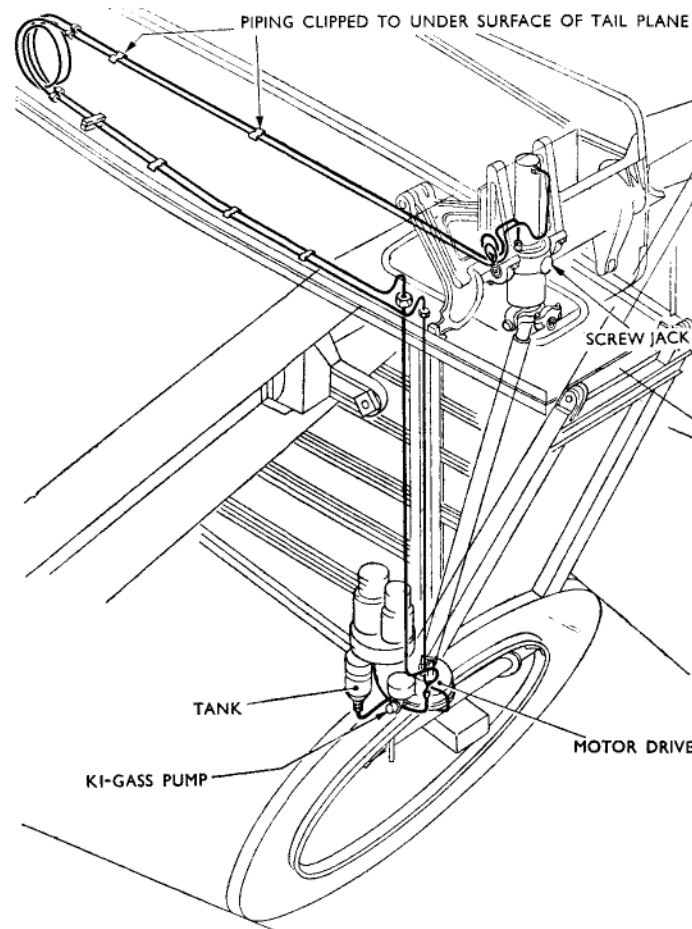


**Fig. 39. Handwheel and tail plane adjustment diagram**

## RUDDER CONTROLS

### Rudder pedals (fig. 41)

99. Each pair of rudder pedals incorporates an adjustment for leg reach by the operation of a handwheel which can be adjusted in flight. A vertical shaft from each pedal is mounted in ball race housings on a bearing tube attached to the pilots' floor forward face. Also attached to this bearing



**Fig. 40. Tailplane incidence actuating mechanism lubricating system**

tube is a triangular-shaped frame, the vertical tubular member of which houses a spigot at each end. The spigots form a pivot for a torque tube which has a double-ended lever riveted to a flange at the top end, and a single lever bolted to a flange at the bottom end. A link tube from each end of the double-ended lever is connected to its corresponding rudder pedal shaft. A double link arrangement from the top spigot connects with the adjusting mechanism. The single lever at the bottom of the torque tube is attached to the connecting rod between the two pilot's pedal assemblies.

100. Differential braking can be applied by the operation of special pedals attached to each rudder pedal assembly. Reference should be made to Sect. 3, Chap. 6 for information on the brake system.

### Rudder pedal removal (fig. 41)

101. The following instructions are for the removal of the port rudder pedal assembly complete; the removal of the starboard assembly is similar. Proceed as follows:—

- (1) Disconnect the brake pipeline at the lower joint and drain the fluid into a suitable container. Blank the pipe ends.
- (2) Disconnect the link from the leg reach adjusting gear lever.
- (3) Disconnect the interconnecting rod and bondings from the rudder torque tube lever.
- (4) Remove the three bolts attaching each mounting bracket to the pilot's floor. The assembly is then free to be removed.

### Rudder pedal assembly

102. The assembly of the pedals is essentially the reverse of the removal procedure. The brake system should be primed as laid down in Sect. 3, Chap. 6.

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## Controls

103. The rudder control is taken from the second pilot's rudder pedal torque tube lever to a triangular lever on the underside of the pilot's floor (fig. 2); and then by a ver-

tical connecting rod, is transferred down to a lever beneath the crew's floor. Hence the control continues along the starboard side of the cabin to the lever group (para. 54) on the aft face of the pressure bulkhead.

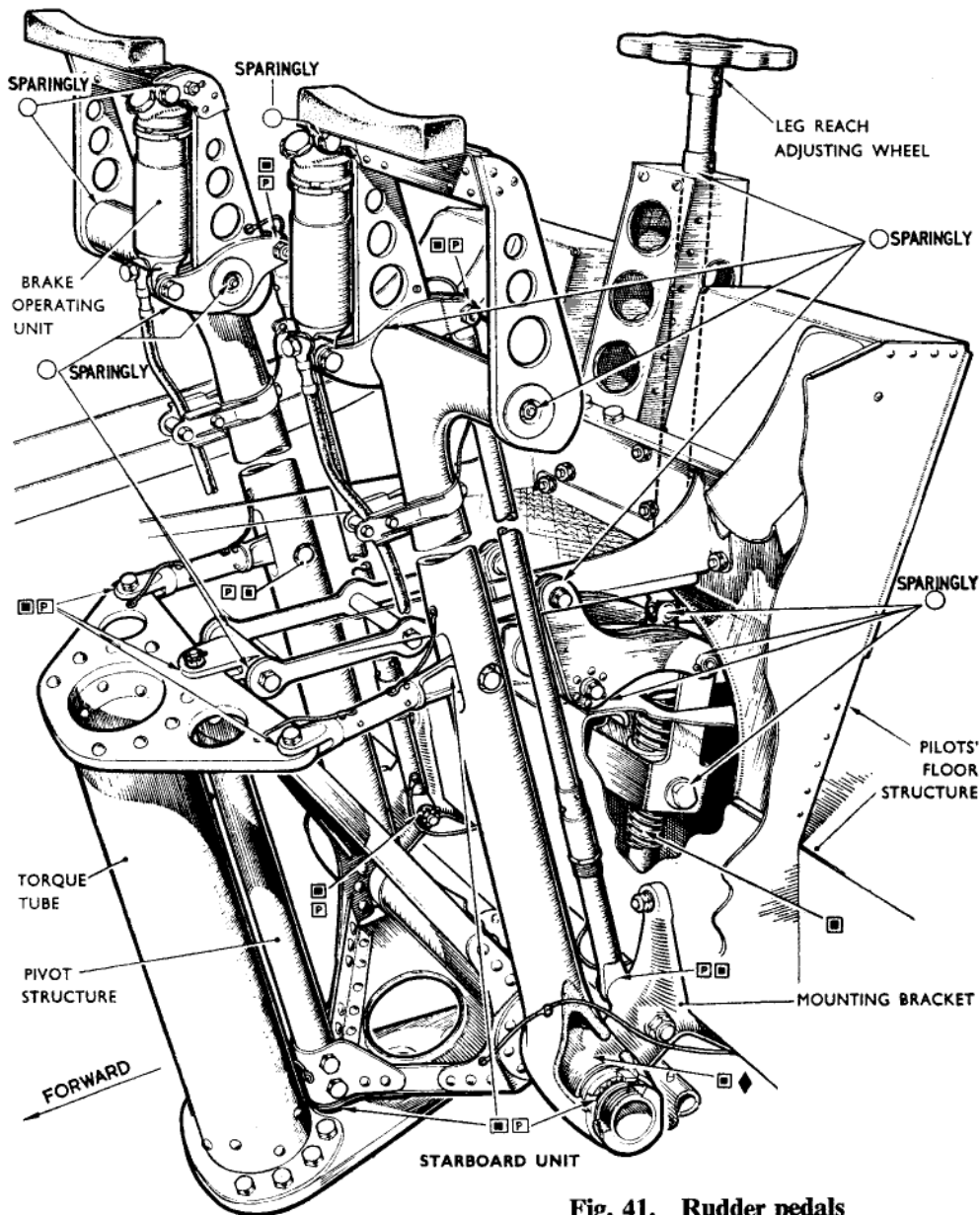


Fig. 41. Rudder pedals

## ◀Note . . .

*If the bonding wire at the top of the vertical connecting rod fouls the pilot's brake lever and guide assembly, the wire should be disconnected from the rear face and reconnected to the front face of the bell-crank lever. ▶*

104. The control, supported at intervals by idler levers, continues along the fuselage to Stn. 903 where it connects to the forward end of the triangular lever, the apex of which is pivoted on a transverse bearing tube. From the rear of this lever the control continues to the feel unit lever assembly.

## Control stop unit — input

105. The control stop unit, which limits the input movement transmitted to the power unit, consists of a cylinder working on an operating tube fitted with a piston. The unit is anchored at one end to the fuselage structure and at the other to a lug on the triangular lever at Stn. 903. The length of stroke of the unit is adjusted to stop movement of the power unit piston, and hence movement of the control surface, at the correct limits of angular displacement of the surface, and should require no readjustment.

## Setting the rudder input rod

106. Before setting the input stop it is necessary to set the length of the adjustable input control rod between the feel unit lever and the power unit in the following manner:—

- (1) For the rudder input rod, run the feel unit lever actuator to the limit of its travel in both directions and measure the ram stroke. Halve this measurement, which is the neutral setting of the actuator, and run the actuator to this position.
- (2) Hold the power unit on the neutral line of the setting rig indicator plate. To release the wedges (para. 61), pull on the feel unit lever release cable and allow the lever to take up its neutral position. Adjust the input rod until the wedges enter their slots without deflecting the feel unit lever.

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- (3) Lock the nuts on the input rod.

#### Setting the rudder input stop (fig. 6)

**107.** Slacken all locknuts on the input stop rod, switch on the power unit and proceed as follows :—

- (1) Pull the input stop rod forward, and set the first adjuster (*detail C*) so that the setting rig pointer is 0.05 to 0.075 in. outside the extreme travel line marked on the indicator plate in para. 109 (10). Tighten the locknuts.
- (2) Push the input stop rearwards, and set the second adjuster (*detail C*) so that the setting rig pointer is 0.05 to 0.075 in. outside the extreme travel line on the indicator plate. Tighten the locknut and re-drill, if necessary, to fit the circlip.

#### Power unit

**108.** The power unit for the rudder controls is mounted at the side of the elevator power unit at Stn. 1013 in the rear fuselage, the two units being linked (*para. 55 and 56*).

#### Rudder stops and power unit settings (fig. 18)

**109.** With the controls in manual and using the rudder and elevator unit setting rig, Ref. No. 26SR/95355, proceed as follows :—

- (1) Remove the power unit gaiter and attach the pointer. Pt. No. 67479-5323, to the power unit, using the top centre screw of the gaiter attachment screws.
- (2) Centralize the rudder and attach the indicator plate, Pt. No. 67479-5325, to the power unit output shaft, so that it is approximately central under the pointer.
- (3) Disconnect the rudder input control rod at the forward end of the power unit.
- (4) Set the control surface stops to limit travel in accordance with Table 2.
- (5) Disconnect the output control rod behind the first lever at the rear of the power unit.

(6) Pull out the power unit output shaft to the full extent of its travel and mark the position of the fixed pointer on the indicator plate.

(7) Push the output shaft to the full extent of its travel back into the power unit body and mark this position on the indicator plate.

(8) Reconnect the output control rod to the lever at the rear of the power unit.

(9) Mark on the plate the centre position of the two extreme travel marks made in operations (6) and (7).

(10) Check the control surface movement and reset the rear adjustable rod (*fig. 6*) so that the rudder travel, as shown by movement of the indicator plate relative to the fixed pointer, is divided equally between the two extreme travel marks on the plate. Mark the plate to show the limits of this travel. These two lines will be inside the extreme travel marks.

#### Note . . .

*When setting the rudder movement in accordance with Table 2 it is necessary to set the stops to limit the travel to 23.25 in., otherwise excessive compression of the surface stops will be required to reach the lower limit in power.*

(11) Reconnect the rudder input control rod at the power unit forward end.

#### Rudder power unit removal (fig. 19)

**110.** For details of the rudder power unit removal refer to para. 58.

#### Anti-oscillation linkage

**111.** A description of this linkage is given in para. 59 ; for details of the initial neutral setting and the initial neutral setting check refer to para. 60 and 61 respectively.

#### Rudder torque tube (fig. 6)

**112.** From the power unit the controls, supported by idler levers, continue to the

torque tube mounted in the rear fuselage. The torque tube is supported by a tubular structure which engages two lugs of a V-shaped bearing plate mounted on the torque tube. The latter is supported at the top by a hinge fitting which is anchored to the rear fuselage structure. The end of the hinge, which houses a ball race, enters a slot in the torque tube and is secured by a hinge bolt inserted from the top of the tube and located in a threaded bush. The top of the torque tube is connected to the rudder hinge through a universal joint (*Sect. 3, Chap. 3, fig. 15*).

#### Rudder balance tab mechanism (fig. 42)

**113.** The balance tab mechanism works on a parallel-link motion and operates in conjunction with the rudder movement. Two adjustable connecting rods, anchored at one end to a double-ended lever on the balance tab torque tube, are attached to a lever assembly in the rudder structure. A connecting link from this assembly connects to a double-ended lever pivoted in the nose of the rudder. Adjustable connecting rods are attached one to each end of the lever, and are pinned at their forward end to brackets on the fin shroud.

#### Setting the rudder balance tab

**114.** To set the rudder balance tab neutral proceed as follows :—

- (1) Set the rudder neutral.
- (2) Adjust the lengths of the connecting rods, using two special spanners Ref. No. 26SR/95456/95469, so that the balance tab lies neutral. Check this with a straight edge.
- (3) Lock the connecting rods and check that they are not under a load as described in para. 70 (3).
- (4) Move the rudder to its limit of travel in each direction and check that the travel of the balance tab is in accordance with Table 2.

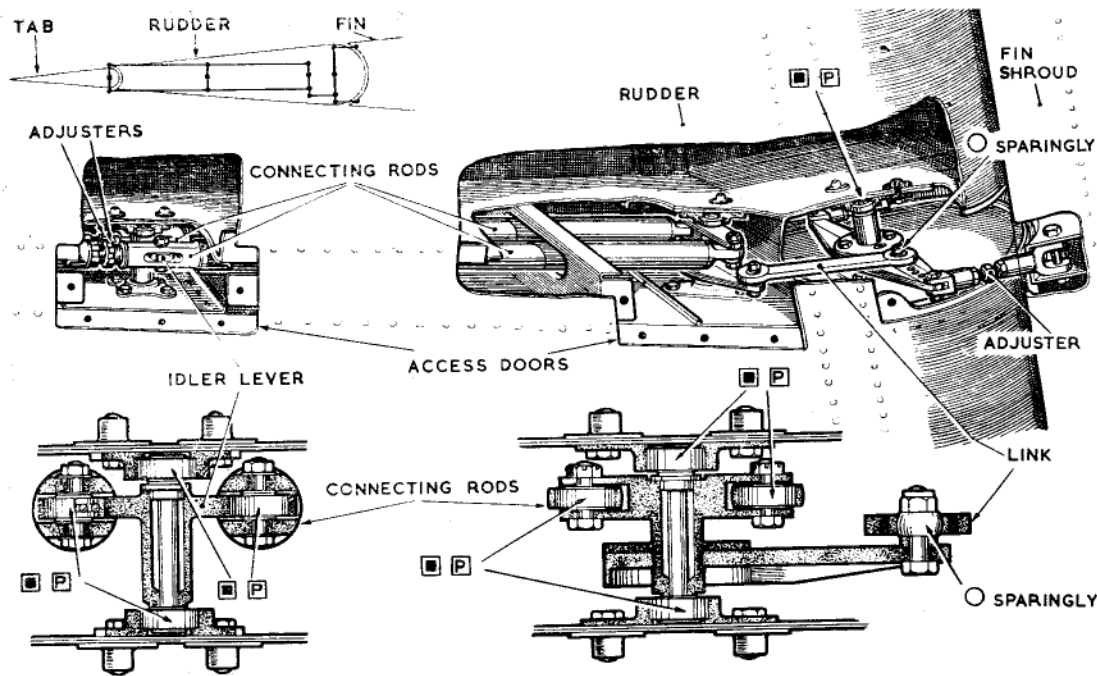


Fig. 42. Rudder balance tab mechanism

114A. After any adjustment to the tab operating mechanism, proceed as follows to ensure that no undue loading has been applied to the mechanism: —

- (1) Check that one clevis pin for each set of connecting rods can be rotated under light pressure.
- (2) If the pin cannot be freely rotated, adjust the parallel-motion adjustable connecting rods accordingly.

Note . . .

For details of permissible wear on the mechanism refer to Vol. 6, Part 3, Chap. 4, fig. 10.

#### Rudder trim tab mechanism (fig. 43)

115. The trim tab is operated by an electric actuator mounted in a beak formed by an extension of the root rib at the lower forward corner of the rudder. This beak,

covered with light alloy sheet, is wedge shaped and incorporates at its extreme end a stop and lock fitting. The actuator is anchored at its cylinder end by a bolt passing through the stop fitting. The actuator operating rod connects to an idler bell-crank lever pivoted on a bracket mounted on the beak plating; at the same point the trim tab operating rod is connected. Attached to the same arm of the bell-crank lever, above the operating rod, is a threaded physical stop spindle. This passes through an aperture in a stop bracket mounted on the beak plating and has adjustable stops with locknuts on each side of the stop bracket. Attached to the other arm of the bell-crank lever is an adjustable link connected to a desynn transmitter on a bracket bolted to the beak plating. A tab position indicator on the port console in the cabin and adjacent to the operating switch, is connected to the desynn transmitter.

#### Trim tab and desynn setting

116. The method of setting the rudder trim tab and its desynn indicator is as follows: —

- (1) Run the actuator to the limit of its travel each way and measure the ram stroke, bisect the stroke and run the actuator to this position.
- (2) Adjust the connecting rod, between the actuator idler lever and the rudder trim tab mechanism operating lever, so that the trim tab lies neutral. The neutral position may be checked by using a straight edge.
- (3) Lock the connecting rod.
- (4) Run the trim tab each way and check that the limit of travel is in accordance with Table 2.
- (5) Adjust the physical stops so that there is a gap of  $0.03 \pm 0.005$  in. between the stops and the bell-crank after the limit switches have cut the circuit.
- (6) To set the desynn indicator use the adjustable serrated link and proceed as in para. 70 (8) and (9).

#### Rudder control locking and stops (fig. 44)

117. This description of the rudder control locking mechanism deals only with the locks in the fin. For continuation of the controls and their association with the elevator and aileron locking see fig. 7.

118. A lock unit, mounted on the forward face of the fin rear spar, houses a spring-loaded plunger unit, the lower end of which is slotted and houses a roller and lever release; this lever is connected through control rods to the elevator and aileron control locks. The upper end of the spring-loaded plunger is fitted with a fork end to which is attached a toggle lever which pivots in a lug formed in the lock unit body. Attached to the third point on the toggle lever is a connecting link which in turn is attached centrally to double link plates of different lengths. The attachment is made through holes in a U-bracket on the forward face of the fin rear spar. Two links from the double link plates are pin-jointed to locking bars



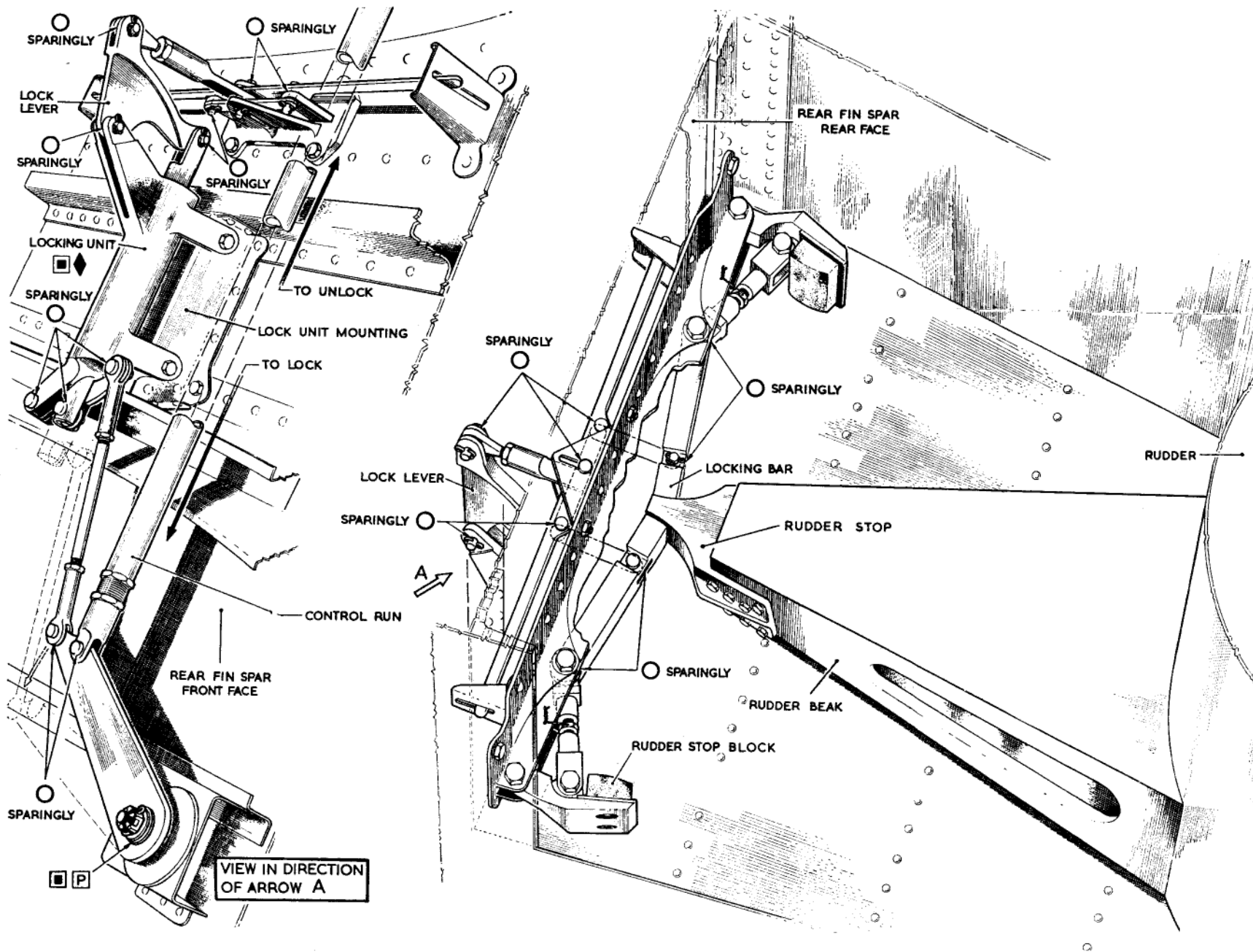


Fig. 44. Rudder lock and stop mechanism

pivoted in a channel on the rear face of the fin rear spar. When the locking control in the cabin is at LOCKED the square ends of these bars engage the stop-and-lock fitting on the rudder beak.

**119.** Pivoted in the channel carrying the locking bars are the rudder stops; these are adjustable by means of a turnbuckle type connecting rod attached by a fork end to the stop fitting, and by an eye bolt to the locking bar pivot bolt. Each stop consists of a rubber block attached by two bolts.

**Feel unit lever operation and release mechanism (fig. 8)**

**120.** The rudder feel unit and its operation is fundamentally the same as the elevator feel unit (*para. 22 to 27*), the main difference being that the rod connecting the feel unit lever to the release mechanism is replaced by an electric actuator controlled from a switch on the control pedestal in the cabin. The actuator trims the feel unit by returning the feel unit lever to the neutral position and so relieves the pilot of rudder pedal load.

**Pre-loading the rudder feel unit piston spring**

**Note . . .**

*In every case where the piston rod is to be pulled out, this operation is to be performed slowly to prevent reversal of the diaphragm bag seal.*

**121.** (1) Release the through bolt in the pivot post, to allow the chain yoke to move to the limit of its serrated slide, compress the piston spring by slowly pulling on the piston rod free end until the piston skirt bottoms on the feel can end plate; this can be felt by partially rotating the piston rod.

**Note . . .**

*It is important that only the centre through bolt, securing the chain yoke serrated slide to the pivot post, be slackened. No adjustment is to be made to the position of the pivot post.*

(2) Further compress the spring until the chain end piece is felt to touch the screwed end fitting on the piston rod.

(3) Keeping the spring compressed, measure the amount of piston rod protruding from the chain end of the feel can. This measurement is taken from the can seal nut face to the face of the screwed end fitting on the piston rod.

(4) Retaining the pull on the piston rod free end, and maintaining the chain end piece in contact with the screwed end fitting, adjust the length of the chain yoke serrated slide to increase the dimension obtained in operation (3) by 0.3 in. This will move the piston skirt away from the feel can end plate by an equivalent amount.

(5) Set the spring end stop to 2.3 in. measured from the free end of the piston rod to the face of the spring retaining piece, as shown at Y in fig. 30. The spring is now preloaded.

(6) Pull slowly on the piston rod free end until it is felt to come up against a stop, check that the amount of piston rod protruding at the chain end of the feel can agrees with the dimension obtained on completion of operation (4), and that the yoke joining the serrated plates clears the end of the lever.

**Testing the release of the feel unit**

**122.** The method of testing the release mechanism of the feel unit lever is given in the following paragraphs.

**Note . . .**

*All tests must be made with the power off.*

*100 lb. test at feel unit lever (fig. 32)*

**123.** This test is identical with that described in para. 81 to which reference must be made.

*Test with load lever*

**124.** (1) Fit the rudder release test disc

Pt. No. 67479-5755 to the end of the test load lever in place of Pt. No. 67479-5753 fitted for the elevator test.

(2) Remove the pivot-block assembly from the test load lever and insert it into the feel lever axis in the following order:—

(a) the pivot spindle, Pt. No. 67479-5747.

(b) the special washers (3 off), Pt. No. 67479-5749.

(c) the pivot block, Pt. No. 67479-5751, with the flats on the block facing the split pin in the feel lever torque tube.

This operation is necessary to enable the test load lever to be fitted without disturbing adjacent control rod settings.

(3) Offer up the test load lever so that the test disc enters the lightening hole in the feel lever arm and the lever engages the pivot-block spindle which is now protruding from the feel lever axis.

(4) Fit and tighten the nut on the pivot spindle so as to spread the special washers and secure the test load lever in the feel lever axis.

(5) With the feel release mechanism engaged, and a pressure equivalent to 390 knots in the feel can, apply a load, through a suitable spring balance, of 63 lb. to the test load lever and check that there is no tendency of the wedges to disengage.

(6) Maintaining the load on the test load lever, operate the feel release lever in the cabin and check that the mechanism breaks cleanly.

(7) Repeat operations (5) and (6), applying the load in the opposite direction.

**Rudder feel unit desynn setting**

**125.** To set the rudder feel unit desynn proceed as follows:—

(1) Connect the A.S.I. and the air supply to the feel unit system as described in para. 32 (1) and (2).

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- (2) Pull the feel release lever in the cabin to the "release" position.
- (3) Pressurize the feel system to the equivalent of 390 knots.
- (4) Switch on the instrument master switch.
- (5) Adjust the linkage between the feel unit lever mounting and the transmitter so that the needle on the indicator in the cabin reads neutral. Lock the bolts on the linkage and recheck the neutral.
- (6) Release the pressure from the system and engage the feel lever in the cabin.
- (7) Check the sense of the indicator by moving the controls manually in one direction, causing the indicator needle to move in the opposite direction.
- (8) With the feel unit lever actuator set to the neutral position of its ram stroke and moving the controls manually in each direction to the full extent of their travel, check that there is an equal travel of the needle of the indicator about its neutral point.

#### Rudder feel unit actuator check

**126.** To check the operation of the rudder feel unit actuator, proceed as follows:—

- (1) Using the control in the cabin, operate the actuator to the full limit of its travel in one direction.
- (2) By pushing on the end of the feel unit lever, return it to the neutral position, i.e., in line with the centre line of the cylinder.
- (3) Secure the lever in this position and check that the rudder has moved in the correct direction and through a distance of not less than 13 in., measured at the bottom end of the rudder.
- (4) Repeat this check for movement in the other direction.

#### Rudder feel unit removal

**127.** When removing the rudder feel unit, the following procedure should be adopted:—

- (1) Disconnect the control rods from the feel unit lever.

- (2) Remove the chain cover and the pins securing the two anchorages of the auto pilot operating chain to the chain pulley and remove the chain.
- (3) Disconnect the desynn transmitter linkage from the feel unit lever.
- (4) Disconnect the feel lever trimming actuator from the semi-circular levers by removing the bolt. (This need only be disconnected if the feel unit is being changed.)
- (5) Disconnect the feel lever release cable at the first joint.
- (6) Disconnect the electrical connection from the actuator by unscrewing the plug.
- (7) Using a length of tube of suitable diameter, pass it down the free end of the cylinder piston rod and compress the spring. Disconnect the chain from the feel unit cylinder by removing the bolt at the chain attachment to the end of the feel unit lever.
- (8) Remove the six bolts securing the upper bearing housing to the mounting bracket.
- (9) Remove the six bolts securing the flange of the short splined torque tube to the flange of the main torque tube.

#### Rudder feel unit cylinder removal

**128.** The removal procedure is exactly similar to that described in para. 84.

#### Rudder autopilot servomotor (fig. 8 and 14)

**129.** This servomotor is mounted on the rudder feel unit lever, the servomotor and mounting plate being bolted to the feel unit lever mounting bracket rear end. A sprocket and torque limit switch are bolted to the servomotor shaft which passes through an aperture in the feel unit mounting bracket. The sprocket is connected to the feel unit torque tube by a chain attached to eye-bolts passing through trunnions mounted in a pulley splined on to the torque tube. The two eye-bolts, secured by double locknuts and locking wire, are used for adjusting the chain tension which must ensure that no undue friction is added to the feel unit lever. The servomotor chain and sprocket are covered by a guard bolted to the feel unit lever mounting bracket.

#### Note . . .

*To remove the servomotor, disconnect all electrical services, remove the retaining nuts and bolts and withdraw the servomotor from the feel unit assembly. On replacement, ensure that the chain is evenly disposed around the sprocket and adjusted to eliminate backlash.*

### AILERON CONTROLS

**130.** Rotary movement of the handwheels is transmitted through shafts to the gearbox on the forward face of each control box (para. 132 and fig. 3). The control is then taken by vertical rods to a torque tube mounted in brackets on the forward face of the crew's floor structure (fig. 2). A single control rod, taken from a triangular plate bracket just inboard of the torque tube port end, passes under the crew's floor to a lever group on the rear face of the rear pressure bulkhead. This group is similar to the one employed for the rudder and elevator controls (para. 54).

**131.** The control rod, supported at intervals by idler levers, continues aft along the fuselage port side to the rear attachment of a triangular lever (fig. 45) mounted on a bearing tube attached spanwise between the fuselage wall and the bomb bay side wall structure. A further control rod is taken from the lever rear attachment to the aileron feel unit lever at Stn. 693. From the triangular lever forward attachment a vertical rod extends to the outboard attachment of the second triangular lever. Bolted to the inboard attachment (pivot) of this lever is a pulley which transmits a chain drive to an autopilot servo, the whole being mounted in a plate metal box on the rear spar rear face. From the lever upper attachment point a connecting rod is taken to the vertical aileron manual lever, the latter being pivoted at its lower end to a triangular-framed radius bar, which in turn pivots about two bolts securing it to the fuselage centre beam. The aileron manual lever top fork-end is attached to the power unit jack rod by two bearing pins located in ball races.

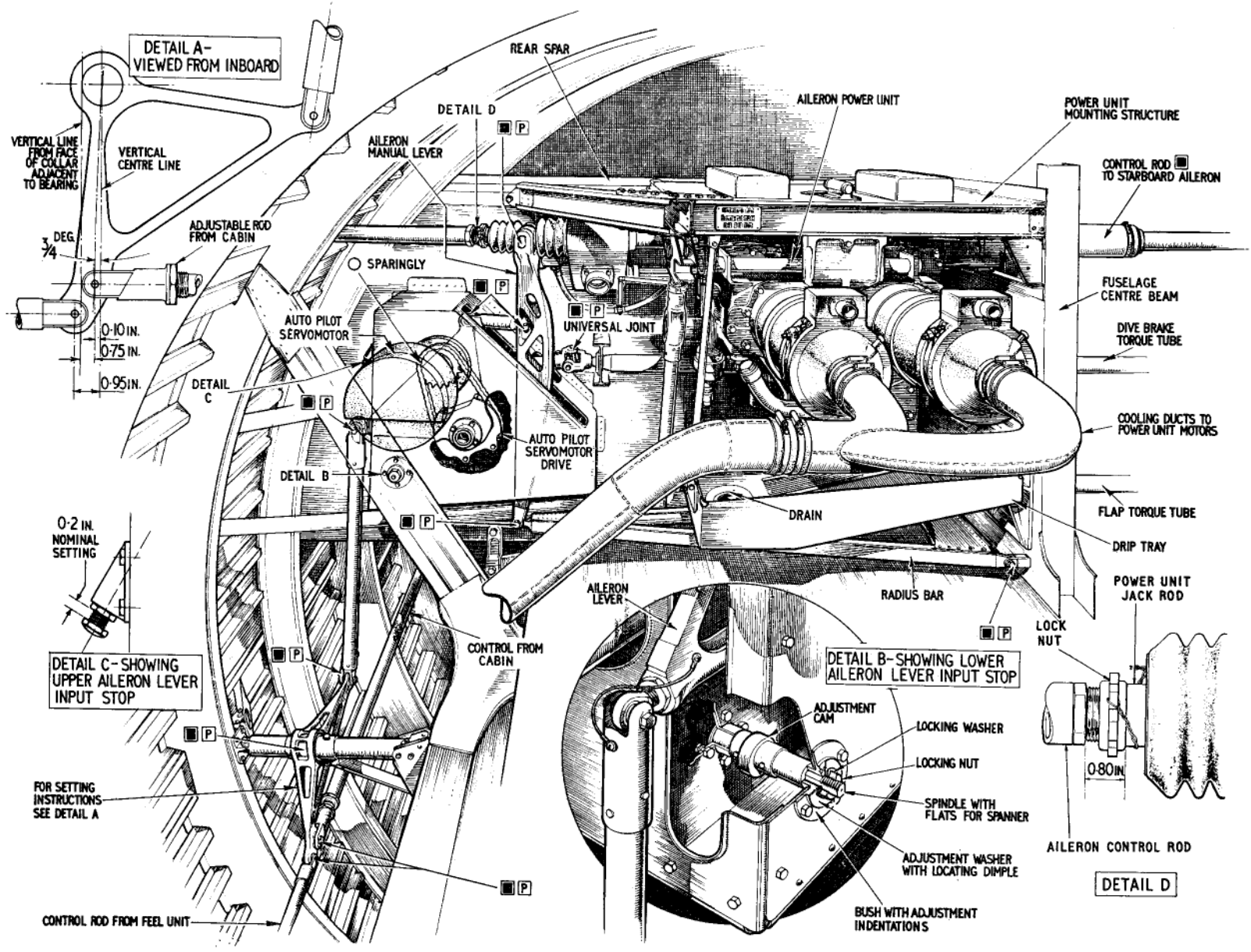


Fig. 45. Aileron controls aft of rear spar

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◀ **132.** The aileron control rods extend along the rear spar. At the port side, the end of the control rod is screwed into the power unit jack rod and secured by a lock nut (*fig. 45, Detail D*). The joint at the starboard side is of the fork and eye-end type, the aileron control rod being fitted with a wire-locked adjuster barrel and locknuts at an intermediate stage along its length. ▶

#### Aileron gearbox

**133.** The aileron gearbox is mounted on the forward face of the control box and consists of a cast alloy casing enclosing a quadrant gear wheel and pinion mounted in bearings. The pinion is mounted on the end of the square shaft, while the quadrant gear carries on its bearing shaft an arc-shaped lever which is connected to the aileron control tube. Thus, movement of the handwheel is transmitted through the chain drive, square shaft, gearbox and the arc-shaped lever to operate the control rods.

#### Aileron gearbox removal

**134.** To remove the aileron gearbox from the cockpit controls the following procedure should be adopted :—

- (1) Pull the handwheel right back.
- (2) Remove the four bolts securing the end bearing housing of the handwheel square shaft to the control box aft face, and remove the bearing housing.
- (3) Remove the nut, bolt and washer securing the aileron control tube to the gearbox lever.
- (4) Remove the split pin from the retaining ring securing the handwheel shaft to the aileron gearbox.
- (5) Slide the square shaft out of engagement with the gearbox.
- (6) Remove the four bolts securing the gearbox to the control box. Lift the gearbox aft into the control box and remove the pin securing the cable to the brake lever and slide the cable free of the stop.

#### Power unit and mounting

**135.** The aileron power unit (*fig. 45*) is mounted on the underside of a braced box structure attached to the rear spar rear face,

port side. The mounting inboard end is bolted to the fuselage centre beam. The mounting structure rear outboard edge is braced by members from the top structure and connected to the spar bottom boom by tubular members.

#### Aileron stops and power unit settings (*fig. 46, 47 and 48*)

**136.** Using the aileron power unit setting rig Ref. No. 26SR/95354 proceed, in manual control, as follows :—

- (1) Attach the indicator plate, Pt. No. 67479-5342, between the rear spar stabilizer members above the aileron adjuster and adjacent to the aileron power unit.
- (2) Loosen the locknuts of the aileron surface stops, using two set spanners Ref. No. 26SR/95033 and run back the stops. Loosen the nuts on the input stops and turn back the stops.
- (3) Loosen the locknuts on the aileron

control rod adjusters in the port and starboard falsework just outboard of rib 93, using two peg spanners Ref. No. 26SR/95312, and turn the adjusters until the rods are disconnected.

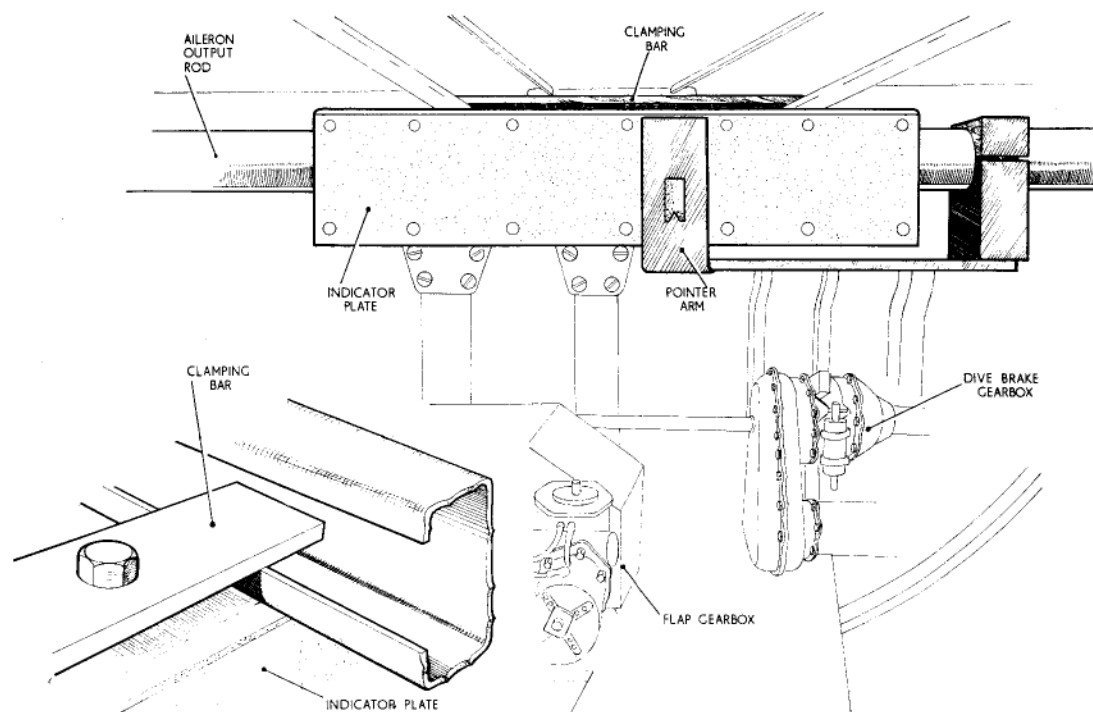
(4) Secure the pointer, Pt. No. 67479-5345, to the aileron control rod in the servicing bay so that the pointer is approximately in the centre of the indicator plate.

(5) Pull out the power unit output rod to the full extent of its travel and mark this position on the indicator plate.

(6) Push in the output rod to the full extent of its travel and again mark the indicator plate.

(7) Reconnect the aileron rod at the adjusters, leaving the locknuts loose.

(8) Fit the two targets (*fig. 47*) to the trailing edges of No. 5 port and starboard flap units, adjacent to the aileron inboard roots; secure the targets with masking tape.



**Fig. 46. Aileron power unit settings**

Run the aileron trim tab to neutral and, using the aileron rigging gauge Ref. No. 26SR/95255, set each aileron to neutral and mark this position on each target.

(9) Measuring from the neutral marks on the targets, set the "up" surface stops to limit the travel of the control surfaces in accordance with Table 2. Tighten the stop locknuts. The aileron settings, using only the up stops on the surfaces, are achieved by trial and error.

(10) Set the aileron control rod adjusters so that both ailerons align with the neutral marks on the targets. Operate each aileron to its "up" stop and check the position of the setting rig pointer. These should be equi-distant from the extreme travel marks on the indicator plate and two or more trial neutral settings may be needed. Mark on the indicator plate these positions which will be approximately 0.1 in. inside the extreme travel marks.

(11) Tighten the locknuts on the aileron control rod adjusters.

(12) Pre-set the lower input stop so that, with the port aileron raised, the "up" stop just fails to contact its bracket. Reverse the controls and repeat the adjustment to the upper input stop. Switch on the power unit. Operate the controls to raise the port aileron and adjust the lower input stop so that it arrests the movement of the aileron power unit at the point when the "up" stop makes contact with its bracket without loading it. Tighten the locknut and bend over the tab washer.

(13) Operate the controls to raise the starboard aileron and adjust the upper input stop as in operation (12). Tighten the locknut.

(14) With the port aileron raised and the bell-crank lever on the lower input stop, adjust the starboard aileron "down" stop to contact its bracket without loading it. Tighten the locknut. Reverse the controls and repeat this adjustment for the port aileron "down" stop.

(15) Recheck that the input stops are not causing the aileron stops to load their brackets and that the setting rig pointer is in line with the marks made on the indicator plate in operation (10). Recheck the control surface travel in accordance with Table 2, both in power and manual.

(16) Remove the targets and setting rig and check for freedom of the control runs.

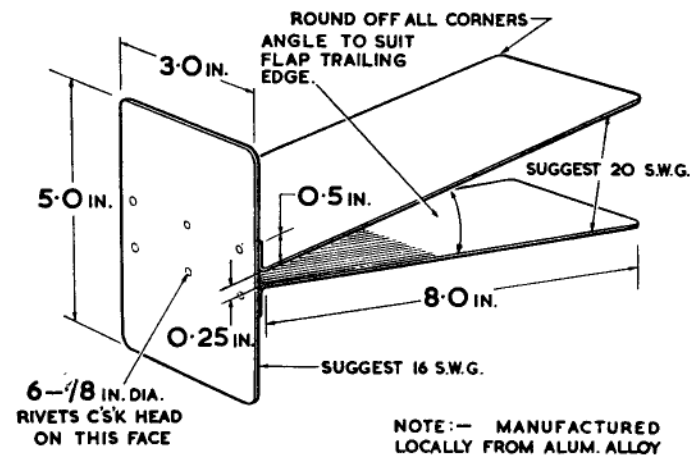
**Note . . .**

*It is important that the ailerons should be rigged and the input stops set at approximately the same temperature, otherwise, owing to the different coefficients of expansion between the steel aileron rods and the main-plane light alloy structure, a false setting will be obtained.*

**Aileron power unit removal (fig. 49)**

**137.** The following procedure should be adhered to when removing the aileron power unit :—

- (1) Remove the flap gearbox and main drive unit complete (Sect. 3, Chap. 14).
- (2) Place the floor shield 26SR/95204 in position at the port side of the hatch with the flanges of the shield bearing against the hatch boundary members.
- (3) Disconnect the following items from the aileron power unit :—
  - (a) All electrical services.
  - (b) Aileron control output shafts at each end of the power unit.
  - (c) The manual input lever.
- (4) Remove the following :—
  - (a) The cooling ducting.
  - (b) The drip tray.
  - (c) The radius bar.
  - (d) The mounting strut.
  - (e) The power unit electric motors.
- (5) After removing the power unit electric motors, fit blanking plates 26SR/95176 over the apertures.



**Fig. 47. Aileron rigging target**

- (6) Fit the handling bar 26SR/95177 in position over the blanking plates.
- (7) Place the jacking stool 26SR/95275 in position under the power unit. Secure the stool to the power unit by passing three bolts through the stool top plate and screwing them into the three feet of the power unit. Adjust the jacking stool legs to carry the weight of the power unit.
- (8) Remove the nuts from the studs carrying the power unit. Lower the power unit by adjusting the stool legs until the studs clear the structure.
- (9) Pull the power unit gently to the left

and slightly to the rear so that the starboard output assembly withdraws through the hole in the centre member. Slide the complete unit to the rear and towards the open hatchway, *taking care to keep the stool feet on the shield plate.*

(10) Attach the 5 cwt. pulley block to the hoisting rail in the fuselage.

(11) Attach the hoisting hook to the slinging shackle on top of the power unit and, while steadying the power unit by the handling bar, commence hoisting. Carefully manoeuvre the unit over the hatchway.

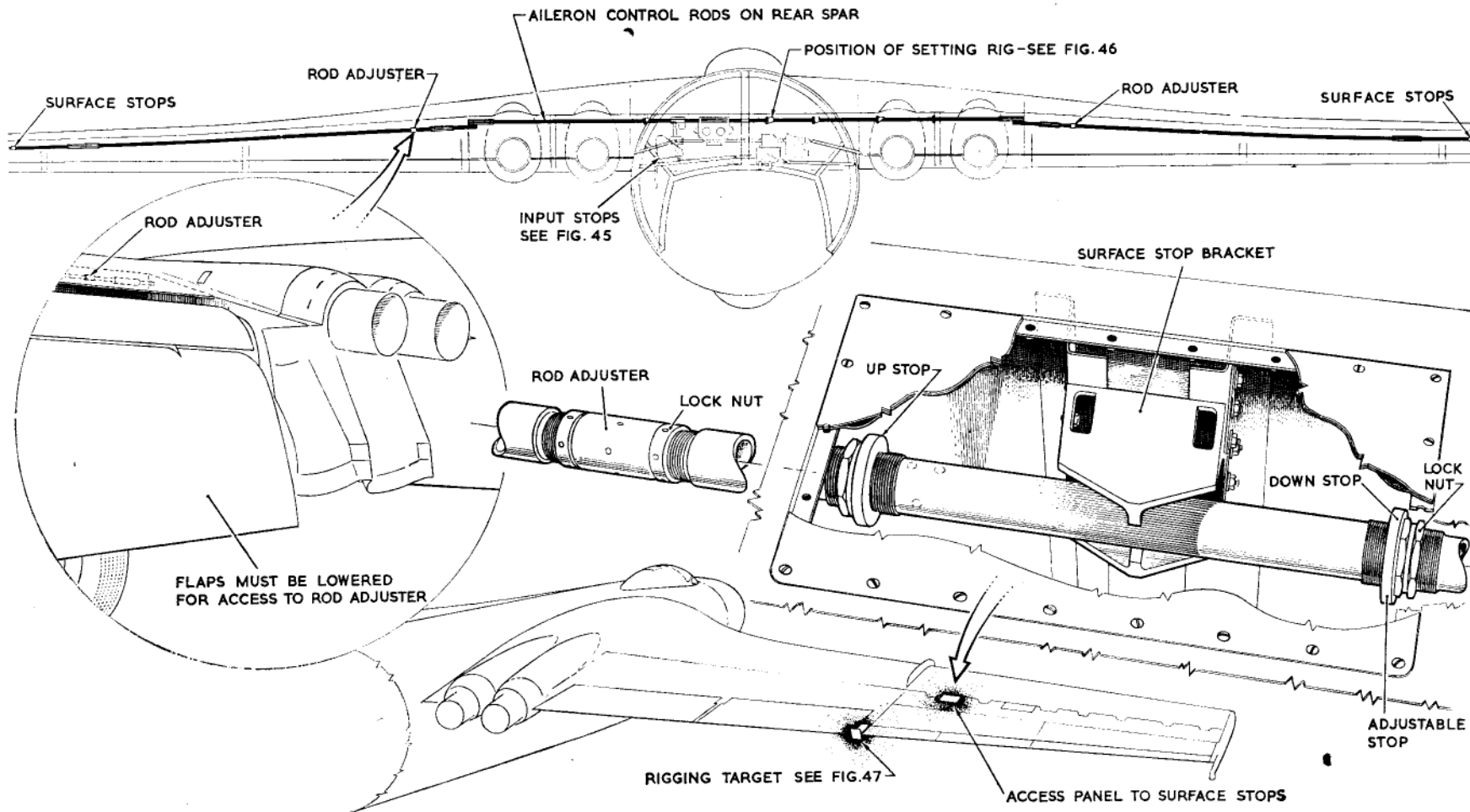
(12) Detach the stool from the power unit.

(13) *Using the handling bar only*, rotate the power unit so that its starboard end points downwards; hold it in this attitude and gently lower it through the hatchway; only allow the unit to hang free *after* it has passed through the hatchway.

(14) Lower the power unit onto a suitable trolley.

**Note . . .**

*The output shaft assemblies must not be handled during hoisting operations.*



**Fig. 48. Aileron rigging adjustment diagram**

### Aileron controls aft of rear spar

**138.** The setting of the aileron control lever, on the fuselage port side at Stn. 653 (fig. 45, detail A) must ensure equal movement at the power unit piston rod, no differential of autopilot servo, and equal movement of the artificial feel unit lever.

### Feel unit lever and release mechanism (fig. 8)

**139.** The aileron feel unit lever and its operation is fundamentally the same as the elevator feel unit lever (para. 22 to 27), the main difference being that the rod connecting the feel lever to the release mechanism is replaced by an electric actuator, controlled from a switch on the control pedestal in the cockpit. The controls pick-up lever is single-ended and is splined directly to the torque

shaft; it does not carry a chain pulley.

**140.** The actuator is brought into use, if required, after the aileron has moved from the trimmed position. The actuator trims the feel unit by returning the feel unit lever to the neutral position, and so relieves the pilot of load on the handwheel.

### Aileron feel unit actuator check

**141.** To check the operation of the actuator, proceed as described in para. 126 for the rudder, checking that the ailerons move in the correct direction and through a distance of not less than 11.8 in. UP and 9.07 in. DOWN, measured at the inboard end of the aileron. Repeat the check for movement in the opposite direction.

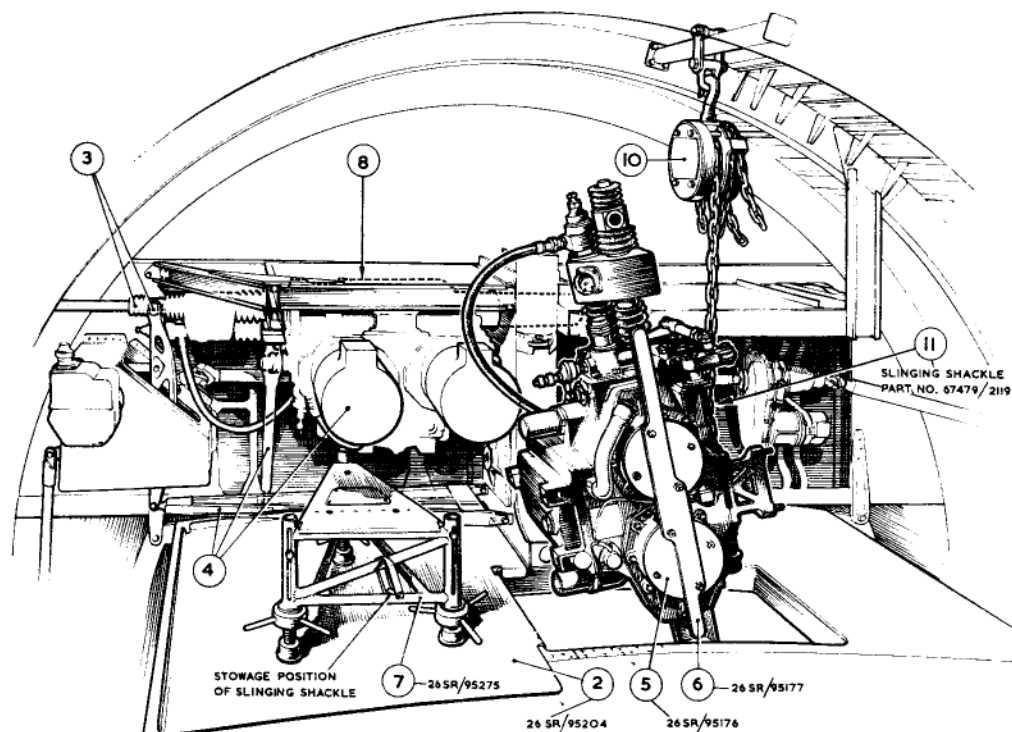


Fig. 49. Aileron power unit removal

### Artificial feel unit cylinder

**142.** The feel unit cylinder for the aileron controls is identical to those used for the elevator and rudder controls (para. 28) except that the unit faces in the opposite direction.

### Preloading the aileron feel unit piston spring

#### Note . . .

*In every case where the piston rod is to be pulled out, this operation is to be performed slowly to prevent reversal of the diaphragm bag seal.*

**143.** (1) Loosen the turnbuckles at the tie-rod between the feel can and the chain assembly and slowly compress the piston spring by pulling on the free end of the piston rod until the piston skirt bottoms on the feel can end plate. This can be felt by partially rotating the piston rod and feeling the piston skirt rubbing on the feel can end plate.

(2) Further compress the piston spring, by deflecting the tie-rod, until the chain end piece is felt to touch the screwed end fitting on the piston rod.

(3) Keeping the spring compressed, measure the amount of piston rod protruding from the chain end of the feel can. This measurement is taken from the face of the can seal nut to the face of the screwed end fitting on the piston rod.

(4) Retaining the pull on the piston rod free end, and maintaining the chain end piece in contact with the screwed end fitting, adjust the length of the tie-rod to increase the dimension obtained in operation (3) by 0.3 in. This will move the piston skirt away from the feel can end plate by an equivalent amount.

(5) Set the spring end stop to 2.3 in., measured from the free end of the spring retaining piece as shown at Y in fig. 30. Whilst this setting is being carried out,

the feel unit lever must be held in the neutral position, otherwise the weight of the lever will give a false reading. The spring is then preloaded.

(6) Lock the turnbuckles and pull slowly on the piston rod free end until it is felt to come up against a stop, check that the amount of piston rod protruding at the chain end of the feel can agrees with the dimension obtained on completion of operation (4) and check that the yoke joining the serrated plates clears the end of the lever.

#### **Aileron feel unit lever neutral setting**

**144.** To set the aileron feel unit lever neutral to the aileron run proceed as follows :—

(1) Run the feel unit lever actuator to the limit of its travel in both directions and measure the ram stroke. Halve this measurement, which is the actuator neutral setting, and run the actuator to this position.

(2) Using the lever in the cabin disengage the aileron feel.

(3) Connect the air rig to the feel units as described in para. 32 (1) and (2) and pressurize the system to the equivalent of 390 knots.

(4) Set the ailerons to neutral, using the aileron rigging gauge Ref. No. 26SR/95255.

(5) Move the aileron feel release lever in the cabin to engage the feel, but DO NOT allow the wedges on the feel unit lever to engage. This can be prevented by pulling on the feel emergency release cable adjacent to the feel unit lever.

(6) Adjust the length of the connecting rod, between the feel unit lever and the aileron bell-crank lever, so that when the pull on the feel release cable is relaxed the wedges enter their slots without deflecting the control run.

(7) Lock the connecting rod.

#### **Testing the release of the feel unit**

**145.** The method of testing the release mechanism of the feel unit lever is given in the following paragraphs.

**Note . . .**

*All tests must be made with the power off.*

*100 lb. test at feel unit lever (fig. 32)*

**146.** This test is identical with that described in para. 81 to which reference must be made.

#### *Test with load lever*

**147.** (1) With the feel mechanism engaged and a pressure equivalent to 390 knots in the feel can, apply a load, through suitable spring balances, of 56 lb. to the port horn of both handwheels and check that there is no tendency for the wedges to disengage.

(2) Maintaining the load on the hand-wheel horns, operate the feel release handle in the cabin and check that the mechanism breaks cleanly.

(3) Repeat operations (1) and (2), applying the load to the starboard horn of both handwheels.

#### **Aileron feel unit desynn setting**

**148.** The method of setting the aileron feel unit desynn is exactly similar to that described for the rudder desynn in para. 125.

#### **Aileron feel unit removal (fig. 8)**

**149.** To remove the aileron feel unit proceed as follows :—

(1) Disconnect the control rod and its bonding from the feel unit vertical lever by removing the nut, bolt and washer.

(2) Disconnect the chain from the feel unit cylinder by removing the bolt at the chain attachment to the end of the feel unit lever.

(3) Unscrew and remove the electrical lead plug to the feel lever trimming actuator.

(4) Disconnect the feel release cable at the first joint adjacent to the guide pulley.

(5) Disconnect the desynn transmitter linkage.

(6) Disconnect the feel lever trimming actuator at its attachment to the semi-circular lever. (This need only be disconnected if the feel unit is being changed.)

(7) Support the feel unit lever by ropes from the aircraft structure and remove the six nuts and bolts securing each bearing housing of the feel lever assembly to the lever.

(8) Move the inboard bearing housing toward the centre of the lever to allow the whole lever mechanism to be withdrawn.

#### **Aileron feel unit cylinder removal**

**150.** The instructions given for the removal of the elevator feel unit cylinder (*para. 84*) should be followed when removing the aileron feel unit cylinder except that there are only four mounting bolts securing the aileron cylinder.

#### **Aileron locking mechanism (fig. 50)**

**151.** The control surfaces are locked from a lever on the control pedestal in the cabin. The control run (*fig. 7*) consists of tie-rods with chains where a change of direction is required. From the pedestal the control is taken through the floor, over a pulley and through a pressure seal in the rear bulkhead, to Stn. 640 where it connects to the forward point of a triangular link plate. The control continues from the rear of the link plate to the elevator and rudder locks; from the upper point of the link plate a chain drive is taken up, round a series of pulleys in brackets attached to the fuselage structure, to a similar link plate just aft of the rear spar. At this point the control diverges to the port and starboard aileron lock units in the main plane trailing edge structure, the units engaging catch brackets on the aileron sealing ribs.

#### *Lock unit (fig. 51)*

**152.** With the lock unit operating lever in the locked position, the springs in the unit are compressed so that, in the event of the locking control run breaking, the spring automatically unlocks the aileron.

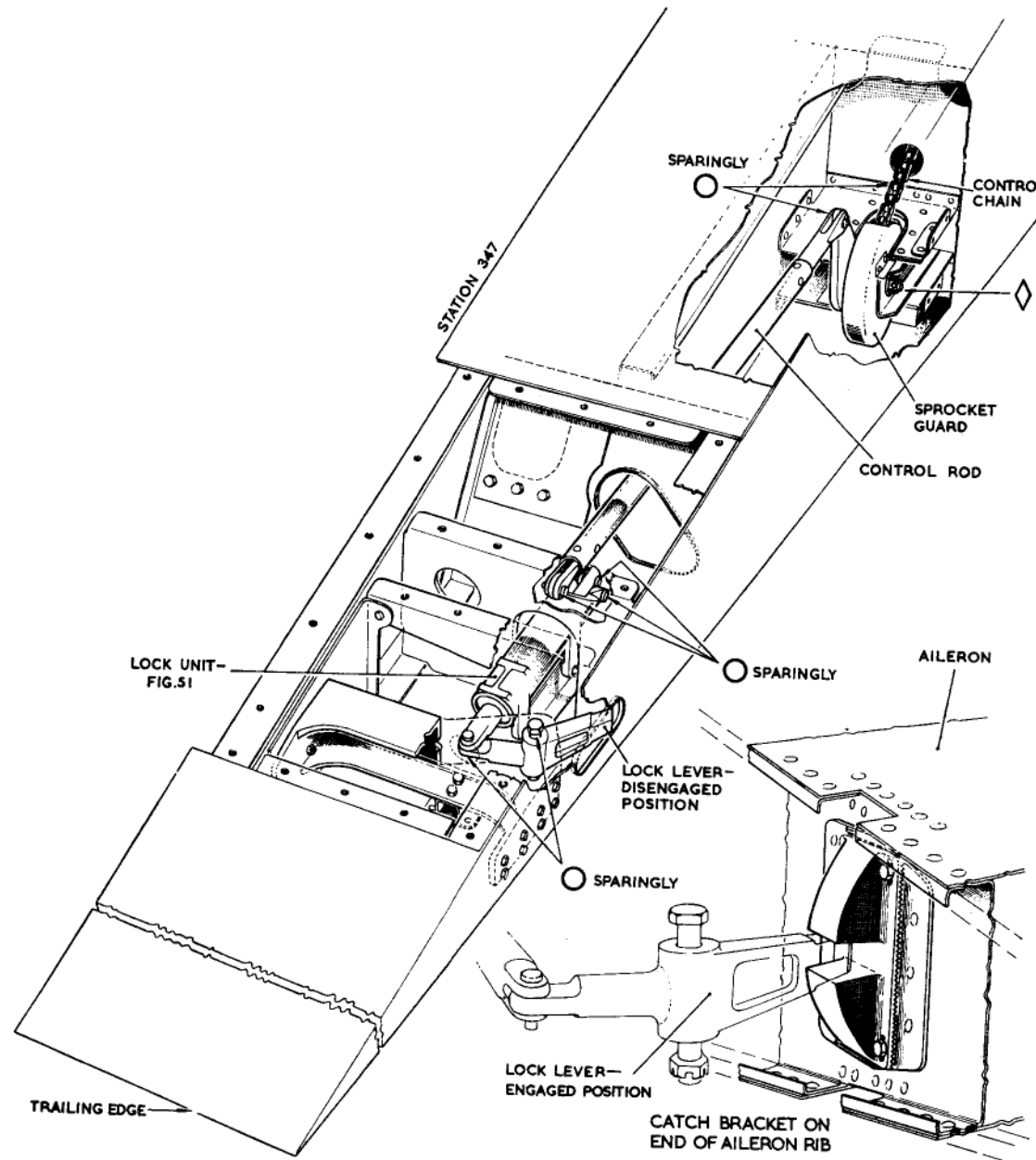


Fig. 50. Aileron locking mechanism

*Aileron lock catch bracket adjustment (fig. 50)*

**153.** Adjustable catch brackets are fitted to each inboard aileron root end rib and these must be adjusted so that they are equally disposed about either lock lever with the ailerons set neutral. With the locks in the ON position the lock lever must engage the catch bracket by a minimum of 0.25 in. and with the locks in the OFF position the lock lever must not protrude beyond the skin line of the trailing edge outboard rib diaphragm.

*Lock run microswitch setting*

**154.** The adjustment of the lock run microswitches in the throttle pedestal is to be such that the circuit to the power units is broken when the lock handle has been moved from the OFF position through an angle of 18 deg. minimum to 25 deg. maximum and that there is not less than 0.05 in. movement of the microswitch cam followers before the circuit is broken and not less than 0.02 in. movement of the followers after the circuit is broken.

*Aileron trim tab operation (fig. 52)*

**155.** The trim tab, on the starboard inboard aileron only, is electrically operated by an actuator in the aileron root end. The actuator ram end is connected to a triangular bell-crank lever attached to the aileron rib structure. From this lever, a connecting rod transmits movement, through a tab lever, to the tab-operating spigot housed in the trim tab. The stop lever is bolted to the bell-crank lever at the actuator ram attachment point and passes through an aperture in the aileron torque rib, terminating in an eye-end. The threaded stop spindle is attached by a clevis pin, between two brackets riveted to the aileron torque rib, and passes through the stop lever eye-end. Adjustable stops with locknuts are fitted to the stop spindle, one each side of the stop lever. An adjustable link on this lever is connected to a desynn transmitter on the aileron rib struc-

ture. The actuator is controlled by a switch located in front of the aileron trim indicator on the port console in the cabin.

#### Trim tab and desynn setting

**156.** (1) Set the aileron to its neutral position, using the rigging gauge Ref. No. 26SR/95255.

(2) Run the actuator to the limit of its travel each way and measure the ram stroke, bisect the stroke and run the actuator to this position.

(3) Adjust the connecting rod, between the actuator bell-crank and the tab mechanism operating lever, so that the tab lies at its true neutral which must be checked with straight edges.

(4) Lock the connecting rod.

(5) Run the trim tab each way and check that its limit of travel is in accordance with Table 2.

(6) With the trim tab run to its limit in one direction, adjust the physical stop so that there is a gap of  $0.03 \pm 0.005$  in. between the stop and the bell crank.

(7) Repeat operation (6), with the trim tab on its limit in the opposite direction.

(8) Run the trim tab to neutral and adjust the turnbarrel connected to the desynn transmitter until the indicator on the port console in the cabin reads neutral.

(9) Run the trim tab to the limit of its travel each way and check that the indicator reads "full travel" in each direction. If the indicator range of travel is too short or too long slacken off the centre bolt on the serrated arm attached to the transmitter and shorten the length of the arm to increase the travel or lengthen the arm to decrease the travel. When this adjustment is necessary readjust the turnbarrel to the desynn transmitter as in operation (8) and recheck the travel on the indicator.

(10) Wirelock the turnbarrel.

#### Aileron and balance tab mechanism

**157.** From the aileron power unit, the control rods extend along the rear face of the rear spar to the port and starboard ailerons. The control arrangements being similar, only the starboard side is described. At Stn. 93 the control rod passes through a guide assembly and continues along the rear spar to a further guide assembly at Stn. 347 (fig. 53). Here it connects to the aileron and balance tab mechanism by a torque tube lever. The aileron operating mechanism consists of a torque tube or skew bar, mounted in the main plane and aileron, with its axis chordwise and intersecting the aileron hinge line. At its mounting in the aileron it carries a trunnion fitting which is free to rotate in two bearings housed in a bracket on the aileron spar forward face. The torque tube, aft end angled to the main body, carries a balance tab operating mechanism consisting

of a lever bolted to the torque tube and coupled by a fork-end fitting to a bell-crank lever. Hence the movement is continued, via a connecting rod and tab lever to the tab operating spigot housed in the balance tab. Thus, movement of the torque tube lever produces a rotary action in the torque tube which is transformed into movement of the aileron, the balance tab spigot moving the balance tab proportionately.

#### Balance tab setting

**158.** To set the aileron balance tab neutral, proceed as follows:—

(1) Set the port aileron neutral, using the aileron rigging gauge Ref. No. 26SR/95255.

(2) Adjust the length of the connecting rod, between the balance tab mechanism bell-crank lever and the operating lever, so that the trailing edge of the tab is in line with the trailing edge of the aileron.

(3) Lock the connecting rod.

(4) Move the aileron to its limit of travel each way and check that the travel of the balance tab is in accordance with Table 2.

(5) Repeat the above operations for the starboard balance tab.

#### Aileron autopilot servomotor (fig. 45)

**159.** This servomotor is mounted on the plate box which encloses the aileron triangular lever (para. 131). The servomotor and mounting plate are bolted to the box rear face, with the motor shaft passing through an aperture in the box. On the motor shaft forward end is a sprocket connected by a chain to a pulley on the aileron triangular lever. The method of attaching and locking the chain is similar to that described in para. 85 and 128.

#### Note . . .

To remove the servomotor, disconnect all electrical services, remove the retaining bolts and withdraw from the plate box. On replacement of a servomotor, ensure that the chain is evenly disposed around the sprocket and adjusted to eliminate backlash.

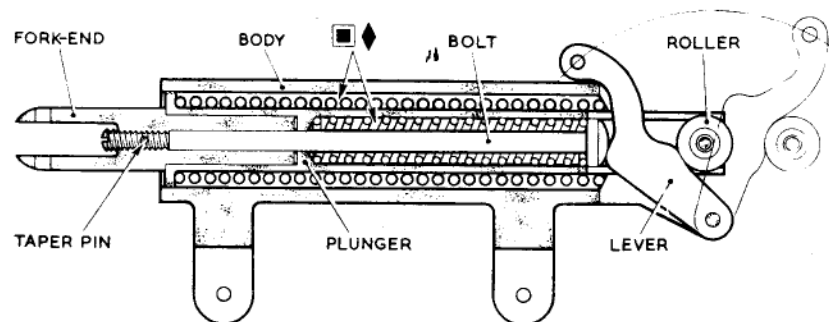


Fig. 51. Aileron lock unit

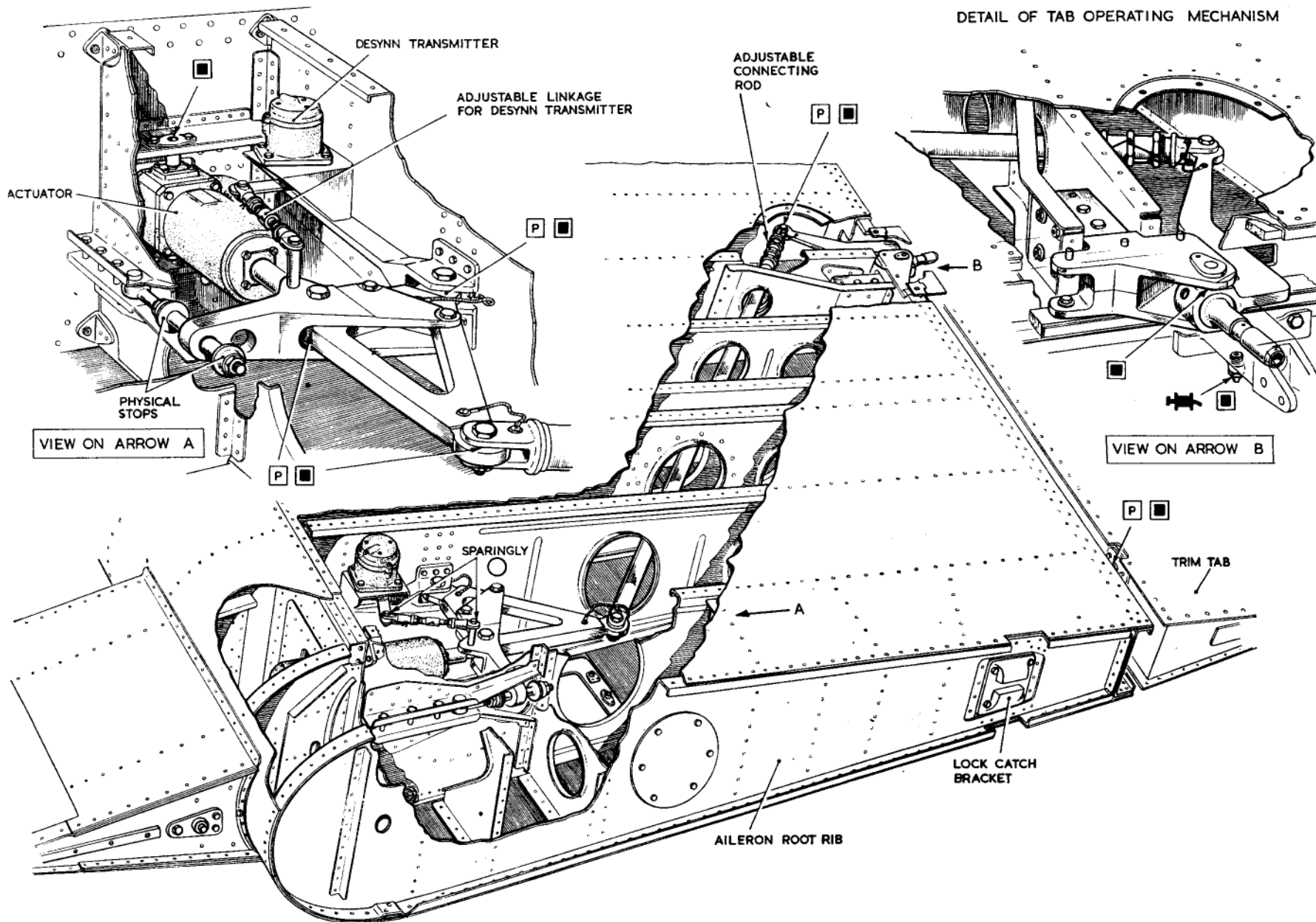


Fig. 52. Starboard aileron trim tab mechanism

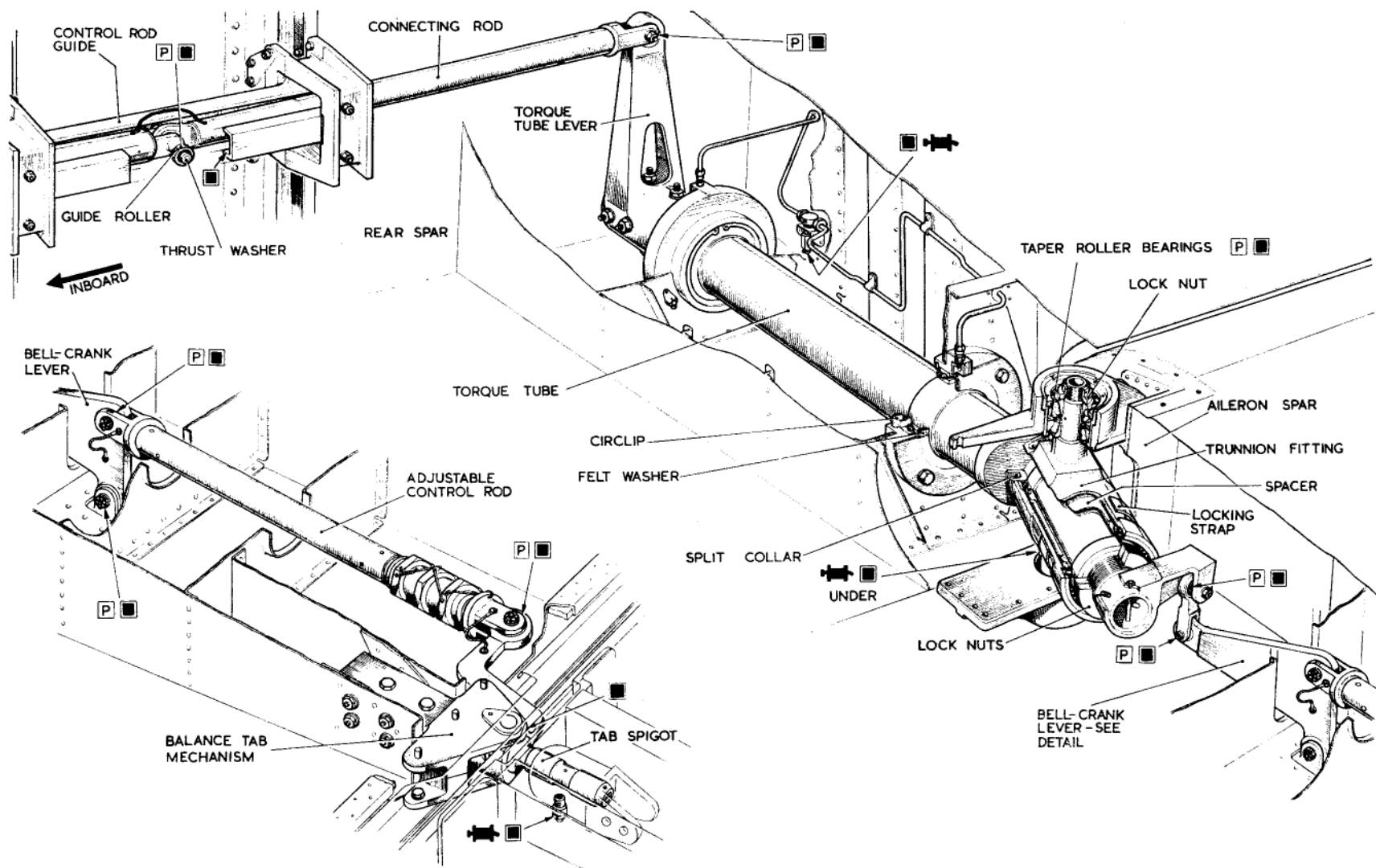


Fig. 53. Aileron and balance tab controls

**FLAP CONTROLS** (fig. 54, 56, 57, 58 and 59)

**160.** The flaps (Sect. 3, Chap. 2) are electrically operated by a motor-driven gearbox which, through universally-jointed torque tubes, rotates the screws in the geared flap units. Normal and emergency systems are provided, with independent motors and a solenoid-operated engagement clutch for the emergency motor. The gearbox main motor is controlled, through a centralizing unit and switch gear from a lever on the pilots' control pedestal. The emergency motor is controlled from a toggle switch on the control pedestal. The angles of the port and starboard flaps, are registered on desynn transmitters in the cabin; thus, a comparison of the two readings will reveal any asymmetry of the flaps.

**161.** The gearbox (Sect. 3, Chap. 14), mounted on the bomb-bay roof top surface just aft of the rear spar, is connected by serrated shafts and universal joints to the operating torque shafts which pass along the inner and outer main planes, aft of the rear spar. The operating torque shafts connect to the bevel gearboxes of the ten flap operating units, located as follows:▶

Flap unit (port and stbd.)	Location
No. 1	Inner plane, Stn. 5
No. 2	Outer plane, Stn. 93
No. 3	Outer plane, Stn. 105
No. 4	Outer plane, Stn. 240
No. 5	Outer plane, Stn. 347

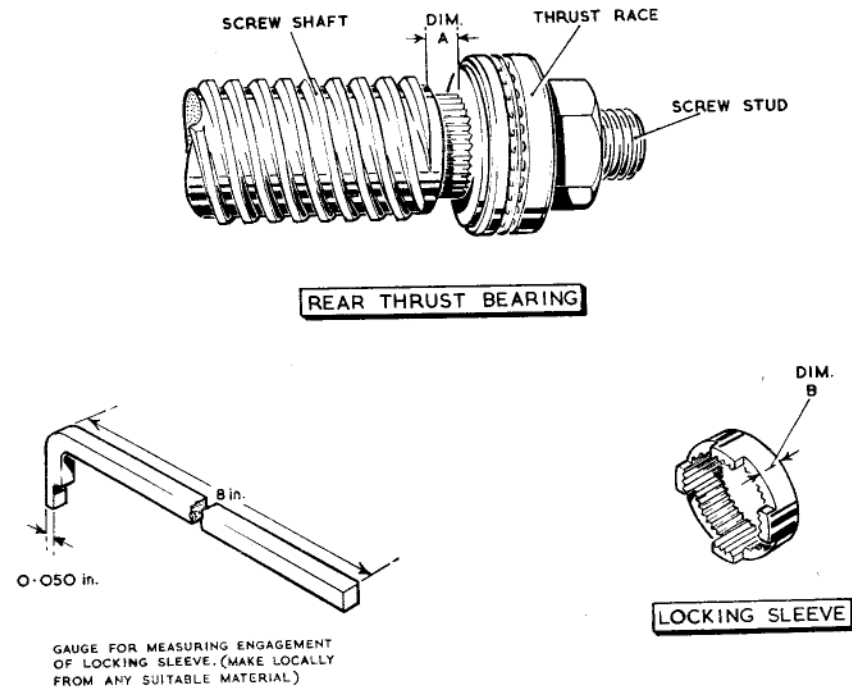
◀ Each flap operating unit (fig. 54, 56, 57 and 58) consists of a bevel gearbox driving a screw shaft housed in a guide tube secured to the trailing edge structure. The screw shaft, supported in bearings at each end of the guide tube; drives a yoke nut secured to the flap guide rail on the end of the flap. The yoke nut is mounted on the screw and located in a slot extending along the base of the guide tube; thus when the screw shaft is rotated the yoke nut (held against rotation in the guide tube slot) traverses along the shaft to raise or lower the flaps.▶

**162.** During the first 30 deg. of downward travel, the flaps are supported by rollers, mounted in the main plane trailing edge, running in guide rails on the ends of the

flap sections and by their attachments to yoke nuts on the screw shafts. At 30 deg. travel the telescopic tie-rods reach their maximum length and, from this position to fully down, act as radius rods. The conversion of the telescopic tie-rods to radius rods causes a rapid movement of the flaps from 30 deg. to fully down. The telescopic rod attachment at No. 3 flap unit is strengthened (Mod. 2867) by a reinforcing plate added to the inboard side plate to prevent structural damage in the vicinity of the rod attachment point.

**Assembling flap operating unit rear thrust bearing**

**162A.** Whenever flap operating units are



**Fig. 53A. Detail of rear thrust bearing**

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renewed or dismantled for servicing, the following check must be made:—

(1) With the flaps at 45 deg., rotate the flap operating unit screw shaft until one of the tongues of the locking sleeve, Pt. No. 66007-3687, is visible in the cut-out at the guide tube rear end.

(2) Using a suitable drift or punch, move the locking sleeve as far aft as possible.

(3) Lightly drift the bearing housing, Pt. No. 66007-7265, rearwards.

◀(4) Using a locally manufactured gauge (fig. 53A), measure the engagement of the locking sleeve tongues in the end of the screw shaft.▶

**Note . . .**

*Engagement must be 0.05 in. minimum. A unit with less engagement or one on which the engagement cannot be measured because of insufficient rearward movement of the bearing housing, must be rectified as described in para. 162B.*

**162B.** For port and starboard units No. 2 to 5, select flaps “fully down” and disconnect No. 2, 3 and 5 tie-rods at the flap attachments. No. 1 unit must be removed from the aircraft, this necessitating removal of the flap as detailed in Sect. 3, Chap. 2, para. 34. Then proceed as follows:—

(1) Remove the domed nut, Pt. No. 66007-7267, from the rear end of the unit.

(2) Remove the split pin, loosen the two rear nuts two complete turns and lock them together.

(3) Force the locking sleeve, Pt. No. 66007-3687, completely out of engage-

ment and, by applying a spanner to the rearmost nut, check that the screw stud, Pt. No. 66007-3685, is screwed fully home in the screw shaft.

(4) Remove the nuts, anti-rotation washer, Hoffman W1/B thrust race, bearing housing and locking sleeve.

◀**Note . . .**

*A Ransome and Marles LT/1B thrust race may be fitted as an alternative to the Hoffman W1/B, but if neither of these is available a Skefco/08 race may be used. When fitting the thrust race into the bearing housing (Pt. No. 70607-767) post-Mod. 2956 or (Pt. No. 66007-7265) pre-Mod. 2956, the chamfer on the Hoffman W1/B race (or the larger outer diameter on either of the other two races) must be fitted forward into the bearing housing.▶*

(5) Reassemble the bearing housing and thrust race, taking care to re-insert any shims which were fitted between them.

(6) By pulling rearwards on the yoke nut, ensure that the screw shaft is as far to the rear as the forward thrust bearing will allow.

(7) Ensure that the bearing housing and thrust race are fully home in the guide tube.

(8) Check the relation of the thrust race rear face to the shoulder of its locating diameter on the screw stud. If the race overhangs the shoulder remove the shims fitted in operation (5) and again check the relation of the thrust race to the shoulder. If the race does not now overhang proceed with operations (13) to (18), otherwise proceed as follows:—

(9) Measure the extent of overhang and add 0.010 in. to cater for the required minimum end float. Select the nearest

thickness packing washer (Pt. No. 70652-895 to 903) above this figure.

(10) Remove the screw stud and assemble on it the thrust race and the anti-rotation washer. With both nuts fitted and tightened as for final assembly, check that the thrust race can freely rotate. If the locknut split-pin hole does not re-align, slot one face of the nut to correspond with the existing split-pin hole in the stud and then drill through the other side of the nut.

**Note . . .**

*The depth of the slot in the nut must not exceed 0.20 in.*

(11) Remove the bearing housing.

(12) Fit the selected packing washer(s), carefully inserting them into the end of the screw shaft and ensuring that they are firmly bedded down.

(13) Remove the nuts, anti-rotation washer and thrust race from the screw stud and screw the stud into the end of the screw shaft.

(14) Refit the thrust race and anti-rotation washer, and secure with one nut. With the thrust race held against this washer, measure the distance between the end of the screw shaft and the thrust race forward face (fig. 53A, dimension A). This dimension minus 0.01 to 0.02 in (pre-Mod. 2956) or minus 0.002 to 0.005 in. (post-Mod. 2956) is the required width (fig. 53A, dimension B) of the locking sleeve to be fitted.▶

**Note . . .**

*If the existing locking sleeve is unsuitable a new sleeve Pt. No. 70652-905 must be fitted, its flat face being rubbed down as necessary to suit.*

(15) Remove the anti-rotation washer

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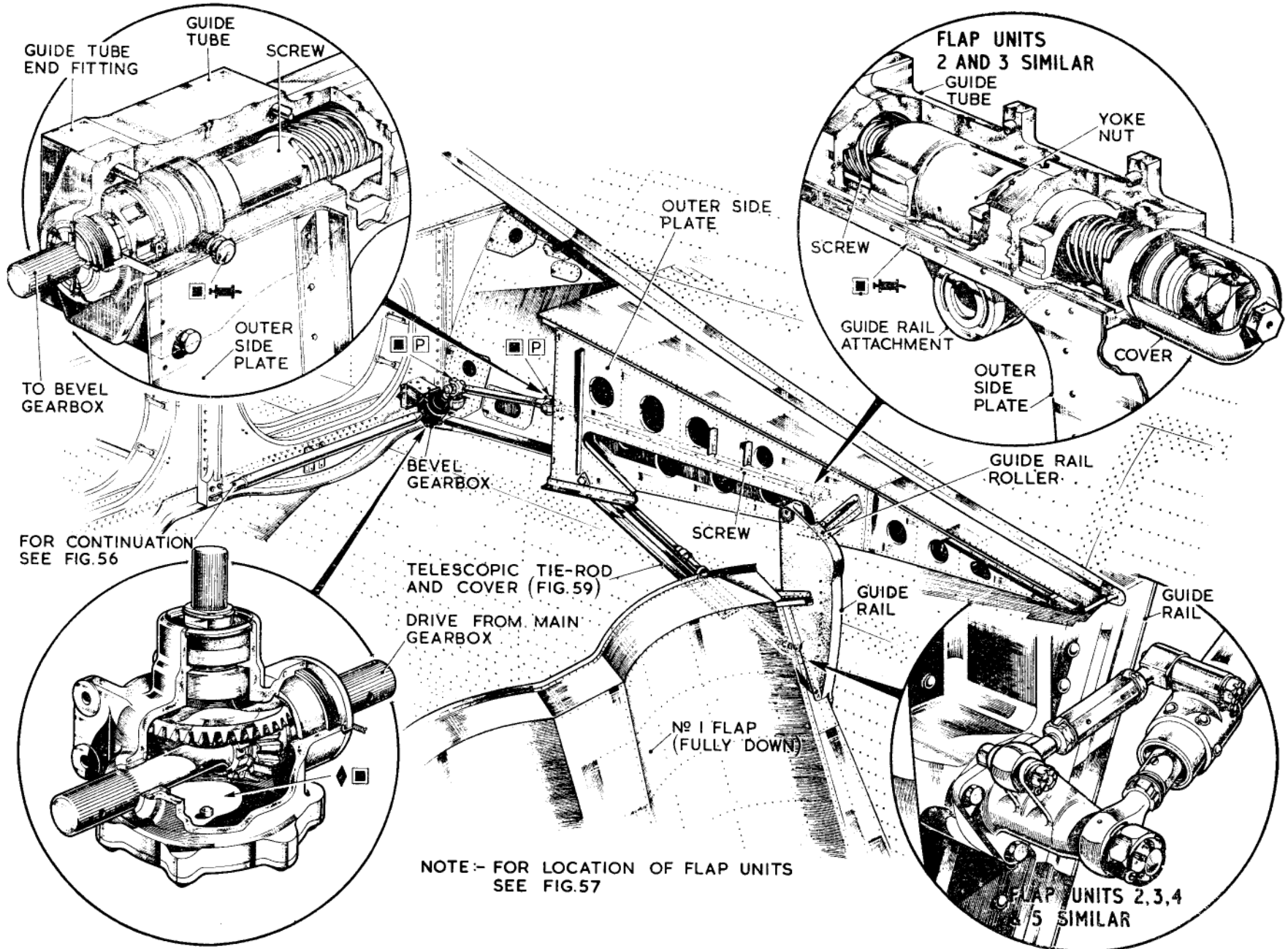


Fig. 54. Flap unit No. 1

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and thrust race, and refit them complete with bearing housing and locking sleeve; secure with one nut.

(16) Pull on the yoke nut to ensure that the complete assembly is as far aft as possible, and lightly drift the bearing housing rearwards. With a feeler gauge, measure the gap between the bearing housing and the guide tube counterbore which must be 0.01 to 0.026 in. To achieve this it may be necessary to insert a shim, Pt. No. 67407-7247 or 7249, between the housing and the thrust race.

**Note . . .**

*When drifting, ensure that the bearing housing is moved evenly as it may tilt slightly, thus contributing to a false reading.*

(17) Adequately lubricate the assembly with grease XG-275, tighten and split-pin the locknut, and refit the domed nut.

(18) Finally check to ensure that the locking sleeve end float is between 0.005 and 0.025 in., and that the locking sleeve tongues engage a minimum of 0.05 in. with the end of the screw shaft.

**Assembling No. 1 flaps**

**163.** When assembling a No. 1 flap it is recommended that the aircraft is standing on its wheels, with the main plane fuel tanks empty, and it is assumed that the aircraft is awaiting the replacement of a No. 1 flap only. Under these conditions proceed as follows:—

(1) Disconnect the main drive shaft to the flap gearbox, remove the end fitting

and replace it with the special serrated shaft, Ref. No. 26SR/95313, as shown in fig. 60. Disconnect the drive to the No. 2 and 3 flaps.

(2) Hand operate the main drive shaft until the yoke nuts are in a convenient position and attach the flap.

(3) Adjust the eccentrics of the yoke nut attachment shafts and the roller shafts to suit the best “tuck-up” position, consistent with profiles and trim lines. The most convenient method to commence adjustment is with the eccentrics positioned as follows:—

(a) The yoke nut shaft of the No. 1 flap unit in the forward position relative to the flap guide rail.

(b) The yoke nut shaft of the No. 2 flap unit in the aft position relative to the flap guide rail.

(c) The roller shaft on the No. 1 flap unit in the aft position.

(d) The roller shaft on the No. 2 flap unit in the forward position.

**Notes . . .**

*(i) It will be necessary to slew the flap to give the required working clearances, and practice has shown that the setting of the eccentrics as specified above gives the optimum starting point. Any necessary adjustment of the yoke nuts can be made by disconnecting the drive shaft between the unit gearboxes and the No. 1 or No. 2 flap unit.*

*(ii) When re-connecting the drive shaft it is necessary to ensure that the universal joints lie in the same plane.*

(4) Operate both yoke nuts down until the setting gauge, Ref. No. 26SR/95303, picks up with the roller and yoke nut of the No. 1 and No. 2 flap units. It may be necessary to slightly move one yoke nut relative to the other, to ensure that this requirement is met on both units simultaneously. The flap position will be approximately 28½ deg. down.

**Note . . .**

*Ensure that the 2.01 in. slot in the setting gauge is fitted over the castellated portion of the guide rail eccentric bush.*

(5) With the flap set to the position given in operation (4), insert the gauge pin (fig. 59) in the rod outer sleeve to ensure that both the inboard and outboard telescopic tie-rods are fully extended, and adjust the length of the ball end so that it will just assemble with the flap attachment. *Do not lift the flap trailing edge whilst making this adjustment.* Set the telescopic tie-rod locking sleeve by adjusting the turnbuckle link attachment to the flap.

(6) Remove the gauge pins, raise the flap and ensure that there is a minimum working clearance of 0.2 in. from the fixed structure. It may be necessary to operate the No. 1 flap unit yoke nut by a minimum

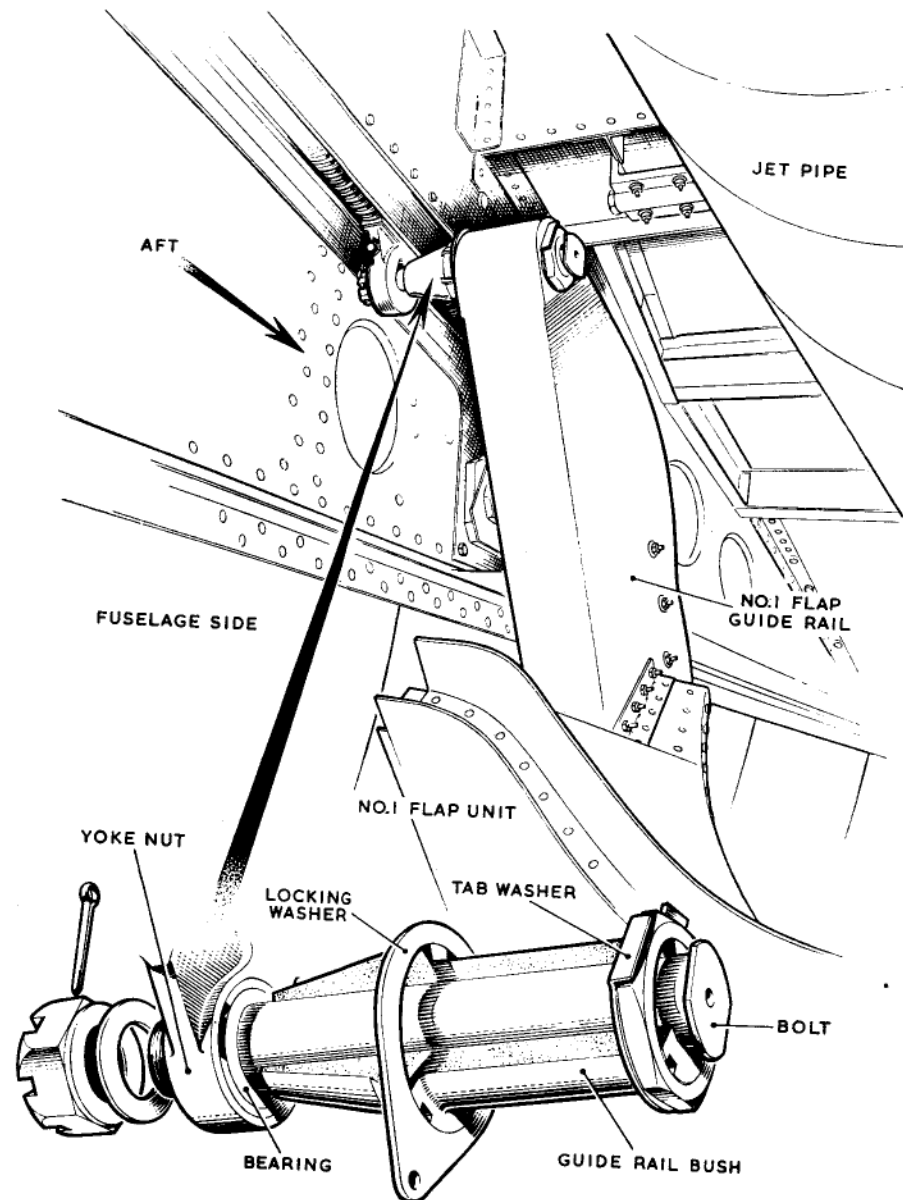


Fig. 55. Inboard guide rail eccentric at flap No. 1

amount *aft* to obtain this clearance, and re-adjust No. 1 telescopic tie-rod to suit, i.e., maintaining the same clearance between the roller and the guide rail *lower track* as would be obtained with the flaps set as in operation (5). The setting gauge, Ref. No. 26SR/95303, should be fitted to the No. 2 flap unit when making this adjustment.

**Note . . .**

The grub screws (fig. 59, item 14) should be locked by centre popping.

(7) Hand operate the flap with the gauge pins removed to ensure that correct functioning has been obtained.

(8) Hand operate No. 2 and 3 flaps to the rigging datum line marked on the top surface of No. 3 flap unit and the inboard end of No. 2 flap (fig. 61). Raise No. 1 flap to the point where it fouls the structure, then operate it DOWN  $1\frac{1}{2}$  turns of the main drive shaft. Re-connect the main drive between No. 1 flap and No. 2 and 3 flaps.

(9) Operate the flap gearbox to the NORMAL UP EMERGENCY position, using the flap EMERGENCY control in the cabin.

**Note . . .**

On completion of this operation an avometer should be used to check that the NORMAL UP EMERGENCY microswitch has tripped.

(10) Using the hand winding gear, operate the main flap drive shaft  $\frac{1}{4}$  turn UP from the flap datum position. Remove the special serrated shaft, Ref. No. 26SR/95313 (see operation (1)) and re-connect the drive shaft.

**Assembling No. 2 and 3 flaps**

164. The operations described below are primarily for personnel fitting new flaps or flap mechanisms. If these instructions are

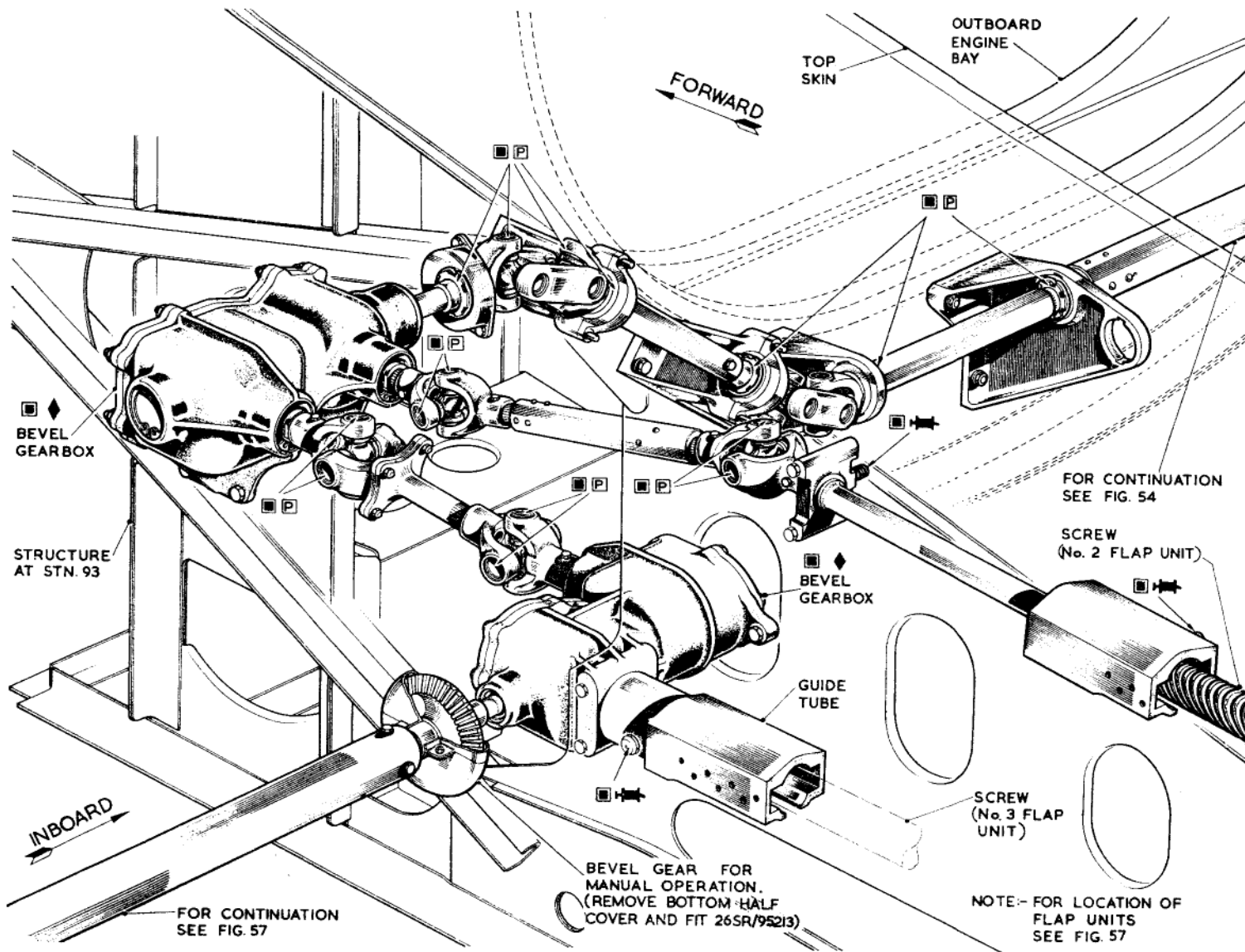


Fig. 56. Flap units No. 2 and 3

followed when replacing existing mechanisms, the operation of drilling and tapping the retaining nut can be ignored. It is recommended that the aircraft is standing on its wheels, with the main plane fuel tanks empty, and it is assumed that the aircraft is awaiting the fitting of No. 2 and 3 flaps, which are new. It is also assumed that the end fitting of the main drive shaft to the flap gearbox has been removed and replaced by the special serrated shaft, Ref. No. 26SR/95313 (fig. 60). The numbers in brackets on the left-hand side of the text denote the details numbered on fig. 61.

- (1) Remove the yoke nut attachments from the outboard end of No. 2 flap and the inboard end of No. 3 flap.
- (2) and (3) Untie the yoke nut acorn and place it in the yoke nut. Fit the attachments removed in (1) to the yoke nut, and shim to give freedom of movement with the minimum of slop. Remove the attachments from the yoke nut and refit them to their respective flaps, taking care to retain the shims in their appropriate positions.
- (4) Remove the ball-end from the telescopic tie-rod.
- (5) Remove the tie-rod attachment from the inboard end of No. 3 flap and fit it complete with the telescopic tie-rod ball-end to the outboard end of No. 2 flap; shim to give freedom of movement with minimum of slop. Drill through the pilot hole in the retaining nut on No. 3 attachment into the attachment of No. 2 flap. Remove the retaining nut and tap it 2 B.A. Replace the tie-rod attachment of No. 3 flap, retaining the shims in their respective positions.
- (6) Set the centre line of the yoke nuts to the 0 deg. flap position mark on the guide tube of each unit. If any adjustment is necessary it can be made by disconnecting the main drive shafts at the unit gearboxes.

#### Note . . .

*The object of aligning all the yoke nuts to the 0 deg. position is to ensure that, when assembled, the flaps will be in the correct position relative to the yoke nuts and gearboxes. Using the special ratchet spanner or winding gear on the torque tube, operate until the yoke nuts are in a convenient position for attaching the flaps (this should be about  $\frac{3}{4}$  in. or  $1\frac{1}{2}$  turns from the end of the screw). Sling the flaps (Sect. 3, Chap. 2) and attach them to the yoke nuts. Using the hand gear, operate the flaps towards the 0 deg. position, taking the weight of the flaps until the roller enters the guide rail through the opening at the rail forward end. Operate the flaps to a convenient position, slide the ball-end of the telescopic tie-rod attachment on No. 3 flap into the attachment on No. 2 flap and lock the retaining nut with a special 2 B.A. locking screw (Ref. No. 26SR/7406).*

- (7) Raise the flaps to the 0 deg. position and adjust the roller shaft eccentrics to suit the best position consistent with the profiles, trim lines and a minimum working clearance of 0.2 in. from the fixed structure.
- (8) Lower the flaps until the gauge, Ref. No. 26SR/95305, can be fitted between the yoke nut and the No. 4 unit guide roller, ensuring that the gauge locates around the threaded portion of the yoke nut attachment; the flaps will be at approximately 30 deg. With the flaps in this position, adjust as necessary the yoke nuts of No. 3 and No. 5 units by disconnecting the main drive shaft at the unit gearboxes until the gauges, Ref. No. 26SR/95304 and 95306, can be fitted.
- (9) With the flaps set as described in operation (8), attach the tie-rod to the ball-end on the attachment of No. 2

flap by rotating the tube (fig. 59, item 8) and continue to rotate until the gauge pin can be inserted through the outer sleeve. Using turnbuckle 12, adjust the locking sleeve 27 until its end face is in contact with the gauge pin. Attach No. 3 and 5 telescopic tie-rods and adjust in accordance with para. 163 operation (5).

#### Note . . .

*Do not lift the flap trailing edge whilst attaching and adjusting the telescopic tie-rods. The grub screw (fig. 59, item 14) should be locked by centre popping ◀ or post-Mod. 3042, by Locktite varnish to D.T.D. Spec. 900/4588 Grade A or B (Ref. No. 33H/179 or 175).▶*

- (10) Raise the flaps and adjust the roller engagement in the guide rail as shown. Lateral adjustment can be made at the yoke nut attachment to the flap at No. 4 unit.
- (11) To ensure structural clearance when setting the flaps, the flaps must be raised, using the hand winding gear, either to the point where a structural foul is encountered, or to when the flap trailing edge lines up with the trailing edge of the flap units, whichever condition is first obtained. The flaps should be then lowered  $1\frac{1}{2}$  turns of the main drive shaft. At this setting a rigging datum line must be marked on the No. 3 flap unit and the inboard end of No. 2 flap (fig. 61, item 11) as shown. This datum line corresponds with the setting of the switches in the NORMAL UP --MAIN position of the flap gearbox.

#### Note . . .

*Should a flap be removed for repair and it is not intended to refit it immediately to the aircraft, the rigging datum line must be obliterated.*

- (12) Operate the flap gearbox to NORMAL UP EMERGENCY position, using the

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flap EMERGENCY control in the cockpit.

**Note . . .**

*On completion of this operation an avometer should be used to check that the*

*NORMAL UP EMERGENCY microswitch has tripped.*

(13) Operate the main flap drive shaft  $\frac{1}{4}$  turn UP from the flap datum position

(see operation (11)), using the hand winding gear. Remove the special serrated shaft, Ref. No. 26SR/95313, and re-connect the drive shaft.

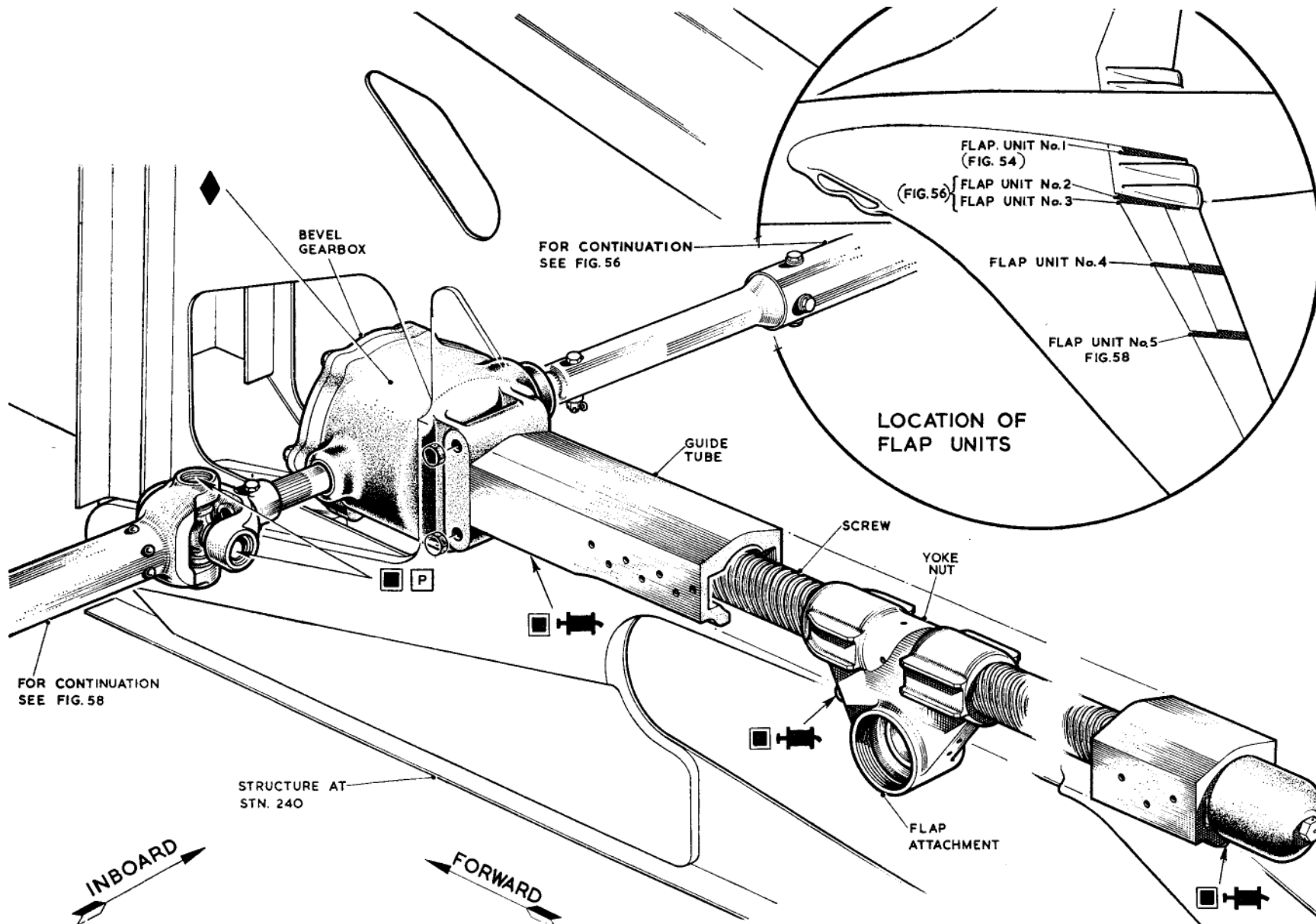


Fig. 57. Flap unit No. 4

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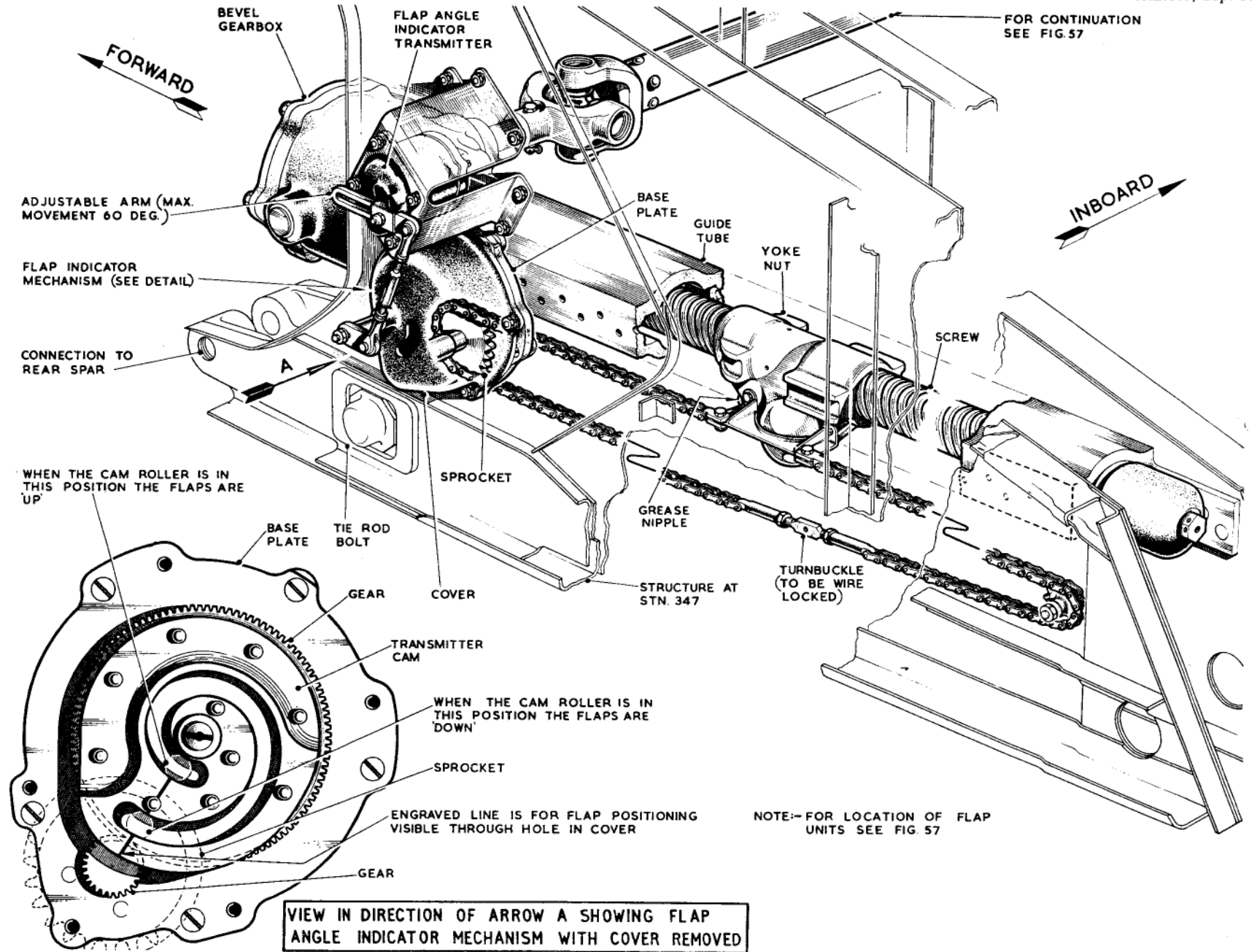


Fig. 58. Flap unit No. 5

## DIVE BRAKES

165. The dive brakes (Sect. 3, Chap. 2) are electrically operated through a motor-driven gearbox which, through universally-jointed torque tubes, rotates a screwjack connected to the dive brake operating rods. The dive

brakes are controlled from the three-position lever on the pilots' control pedestal. The gearbox (Sect. 3, Chap. 15) is mounted on the rear spar rear face on the starboard side of the aircraft, adjacent to the flap gearbox. It is connected by serrated shafts to the

operating torque tubes which pass along the inner plane aft of the rear spar.

### Dive brake setting

166. The procedure for setting the dive

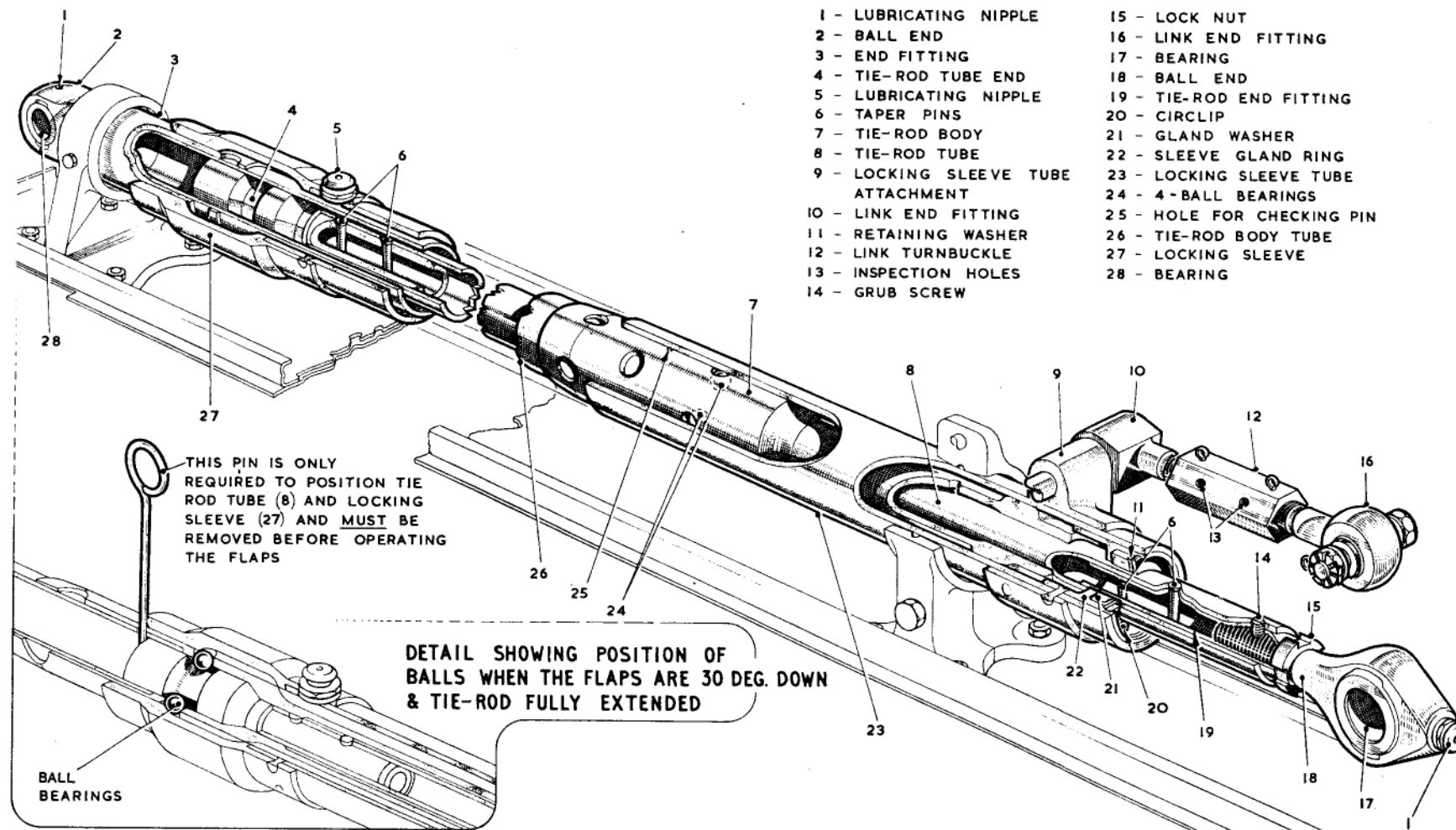


Fig. 59. Flap control telescopic tie-rod

brakes, port and/or starboard, is as follows:—

(1) Remove the falsework from beneath the outboard engine to gain access to the dive brake and torque tube assembly.

(2) Set the gearbox  $15 \begin{matrix} +2 \\ -0 \end{matrix}$  motor turns from the IN end-stop gear face.

(3) Remove the bolt from the inboard side of the screwjack universal coupling and slide the splined connecting shaft, between the coupling and the torque tube, into the torque tube. It is then possible to rotate the screwjack, by means of the universal coupling independent of and without disturbing the motor and gearbox setting.

**Note . . .**

*In lowering the dive brakes from the tuck-up position the screwjack must be rotated only  $17\frac{3}{4}$  turns of the universal coupling before commencing the following operations, otherwise structural foul will occur.*

(4) Slacken off the locknuts on the turn-buckle-type dive brake connecting rods and extend all the rods to the maximum possible safety length by completely unscrewing the ends if necessary and restarting each end simultaneously.

(5) Wind up the dive brakes by means of the universal coupling, note which portion touches first, then lock "up" the adjacent connecting rod.

(6) With the dive brakes in the position at operation (5), check that there is a clearance of  $0.55 \pm 0.2$  in. between the first operating sleeve from the inboard end of the connecting rod operating tube and the nearest bearing face, and that the

shoulder of the jack ram is now  $9.7 \pm 0.2$  in. from the end face of the jack body.

(7) If the requirement of operation (6) is satisfied, proceed to adjust the remaining connecting rods to bring the dive brakes to a light tuck-up position in the wing, i.e., no gap showing and up to one gauge thickness protrusion.

(8) Ensure that all connecting rods are in safety and all locknuts are tight, and the connecting rods do not foul the structure.

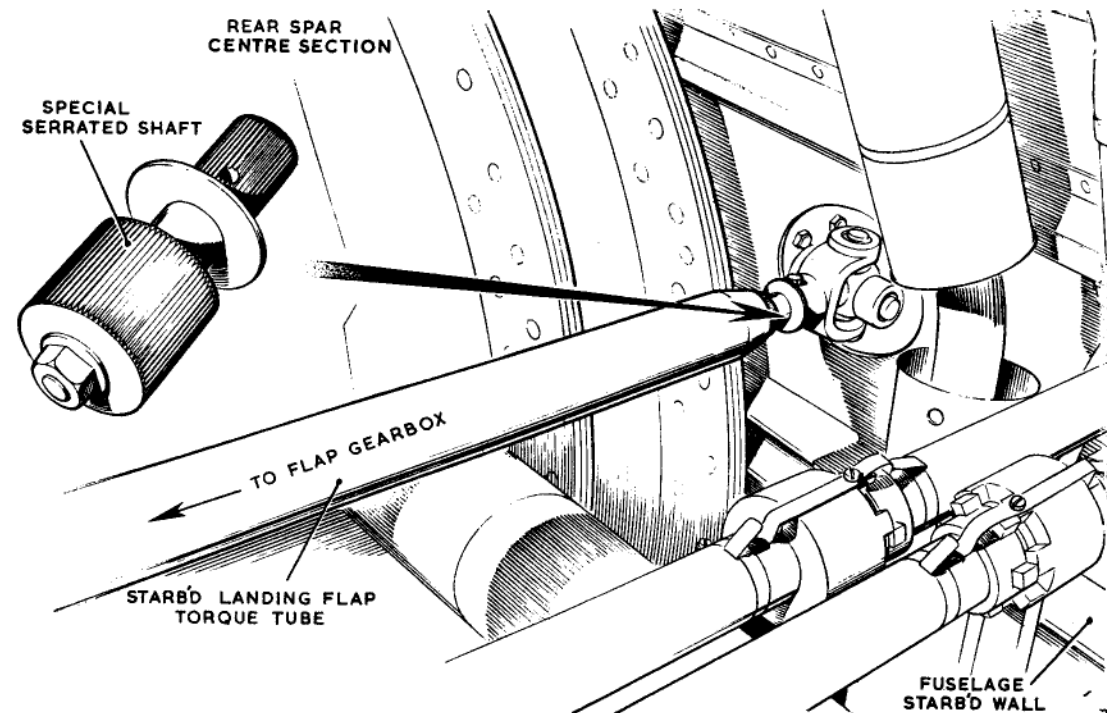
(9) Wind up the dive brakes to the tuck-up position and couple the splined connecting shaft to the universal coupling; fit the bolt removed in operation (3).

(10) Re-check the dimensions obtained in operation (6).

(11) On completion of all settings, and normal IN and OUT test under power, motor to the OUT position and then short-out the normal IN switches. Motor in to the stop gear at the IN end; the extreme limit switches must operate and shut off the motor.

**Note . . .**

*It is IMPORTANT that, in the event of the extreme limit switches failing to trip, the motor must be switched off within 3 sec. of the commencement of main clutch slip.*



**Fig. 60. Position of serrated shaft in flap drive**

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**Table 2. Control surface movements**

Control	Linear Movement from neutral	Angular Movement from neutral	Measured	Remarks	
Aileron	Up 18.59 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	21 deg. 25 min.	} Normal to hinge line at inboard end	} Relative to variable incidence tail plane datum	
	Down 12.45 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	14 deg. 18 min.			
Elevator (power on)	Up 14.08 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	20 deg. 0 min.	} Measured in line of flight, inboard end		
	Down 9.18 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	13 deg. 0 min.			
Elevator (power off)	Up 13.92 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	19 deg. 46 min.	}		
	Down 9.02 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	12 deg. 46 min.			
Rudder (power on)	Left or right 23.34 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	18 deg. 22 min.	} Normal to hinge line at bottom of rudder		
Rudder (power off)	Left or right 23.07 $\begin{matrix} +0.25 \\ -0 \end{matrix}$ in.	18 deg. 5 min.			
Trailing edge flaps	Trail when fully up $0.3 \pm 0.1$ in.		} At trailing edge of No. 4 flap unit		} Nominal setting. See assembly instructions in para. 164 (11)
		Infinitely variable 0 deg. to $58 \pm 1$ deg.			
		Emergency position (all flaps) $45 \pm 1$ deg.			
Dive brake		Operational angle $49 \begin{matrix} +3 \\ -0 \end{matrix}$ deg.			
Aileron trim tab (stbd.)	Up or down $1.39 \pm 0.05$ in.	6 deg. 40 min.	} Normal to hinge line at inboard end		
Aileron balance tab (port and stbd.)	Up 1.48 in.	7 deg. 9 min.			
	Down 2.22 in. } $\pm 0.12$ in.	10 deg. 42 min.			
Elevator trim tab (stbd.)	Up 1.11 in.	9 deg.			
	Down 0.25 in.	2 deg.			
Elevator balance tab (port)	Up 1.16 in.	9 deg. 31 min.			
	Down 1.79 in. } $\pm 0.12$ in.	14 deg. 42 min.			
Rudder trim tab	Left or right $0.48 \pm 0.05$ in.	4 deg. 36 min.	} Normal to hinge line at bottom end		
Rudder balance tab	Left or right 1.89 $\begin{matrix} +0.12 \\ -0 \end{matrix}$ in.	18 deg. 22 min.			
Variable incidence tail plane		Total movement $\begin{matrix} +10 \\ 8 \text{ deg. } 15 \end{matrix}$ min.	} Parallel to C/L of fuselage	} Aircraft in rigging attitude. The max. nose-up setting includes a possible fuselage droop of 0 deg. 25 min.	
		Max. nose-up setting 3 deg. 30 min.			
		Max. nose-down setting 5 deg. 20 min.			

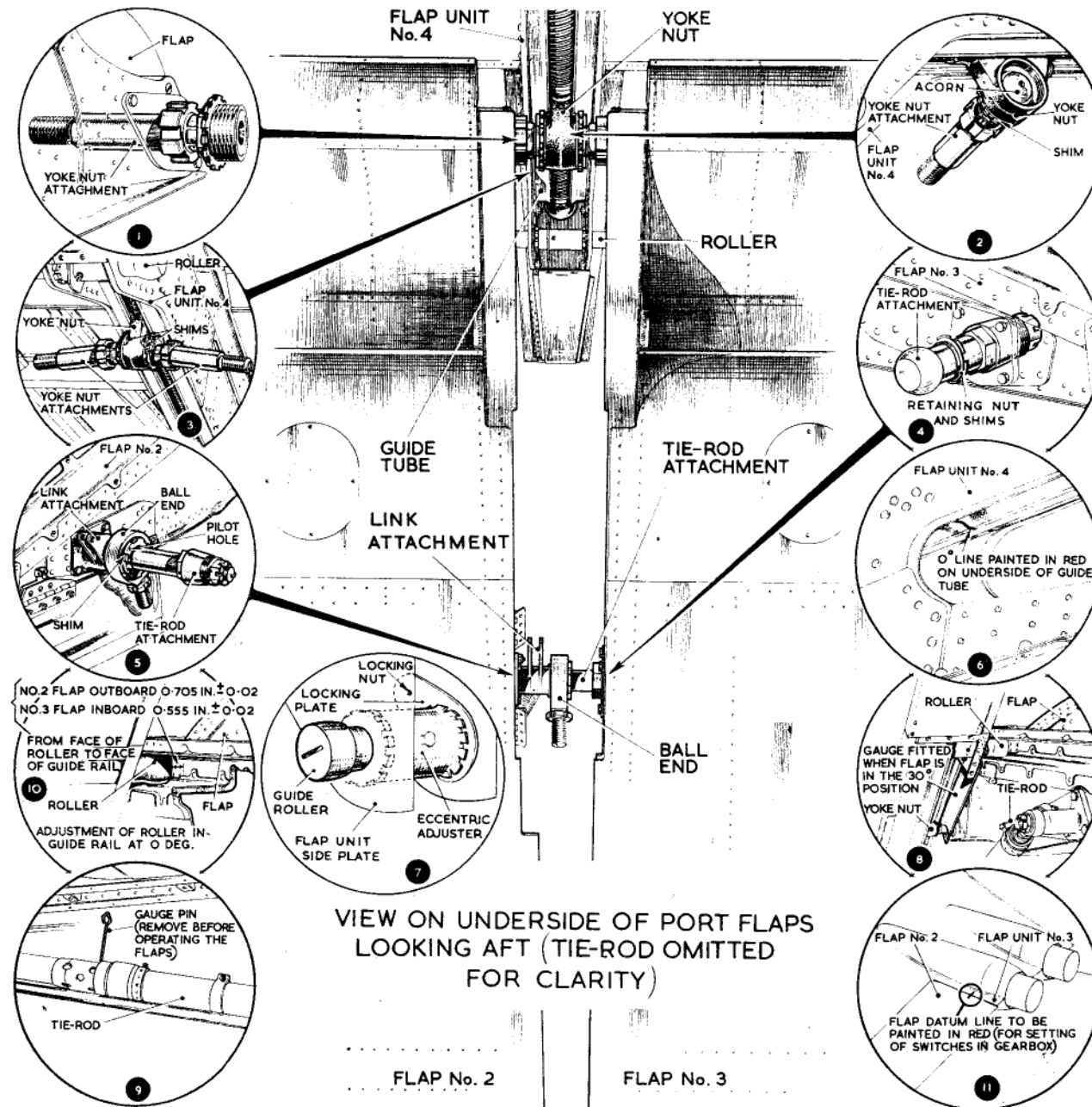


Fig. 61. Flap assembly to aircraft

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**Table 3. Ground equipment**

Ref. No.	Part No.	Description	Remarks
26SR/95154	67479 Sht. 237	Hoist, rail	For removal of rudder and elevator power unit
26SR/95155	67379 Sht. 21	Bracket, hoist attachment	
26SR/95153	67379 Sht. 13	Beam, slinging, power unit	
26SR/95204	67479/1877	Shield, floor	For removal of the aileron power unit
26SR/95275	67479 Sht. 621	Stool, jacking	
26SR/95176	67479/1613	Plate, blanking	
26SR/95177	67479/1615	Bar, handling	
26SR/95420	67479 Sht. 877	Sling, lifting tail plane and elevator	For tail plane jack removal with tail plane installed
26SR/95355	67479 Sht. 841	Rig, setting	For rudder and elevator power unit setting
26SR/95354	67479 Sht. 839	Rig, setting	For aileron power unit setting
26SR/95255	67479 Sht. 439	Gauge, aileron, rigging check	For testing rudder and elevator artificial feel system
26SR/95429	67479 Sht. 929	Lever, load testing	
26SR/95454	67479 Sht. 931	Gauge, backlash	For backlash checking, trim and balance tabs
26SR/95455	67479 Sht. 933	Clamp, locking	
26SR/95297	67479 Sht. 683	Adapter, coupling, ram air intake	For connecting air supply to the artificial feel system
26SR/95033	66079/5	Spanner, set	For adjustment and locking of aileron surface stops
26SR/95312	67479/1893	Spanner, set	For aileron rod adjustment
26SR/95456	67479/6325	Spanner, special	For rudder balance tab adjustment, Mod. 2200
26SR/95469	67479/6545	Spanner, special	For rudder balance tab adjustment, Mod. 2200
26SR/95460	67479/6637	Spanner, special	For removing elevator sealing curtain bolts
26SR/95461	67479/6549	Spanner, special	For removal of rudder beak seals with rudder in situ
26SR/95462	67479/6547	Spanner, special	
26SR/95463	67479/6551	Spanner, special	
26SR/95303	67479/4049	Gauge, setting No. 1 flap unit	
26SR/95304	67479/4051	Gauge, setting No. 3 flap unit	
26SR/95305	67479/4053	Gauge, setting No. 4 flap unit	
26SR/95306	67479/4055	Gauge, setting No. 5 flap unit	
26SR/95258	67479/3617	Screwdriver, special	Flap roller end caps
26SR/95259	67479/3565	Spanner, "C"	Eccentric bush No. 1 flap
26SR/95262	67479/3571	Spanner, "C"	Flap operating unit distance piece eccentric adjustment
26SR/95264	67479/3575	Spanner, "C"	Length adjustment locknut, No. 1 and 2 tie-rods
26SR/95214	67479/2277	Spanner, "C", D.E.	Flap gear, yoke attachment ring nuts
26SR/95182	67479/1889	Spanner, peg	Flap unit, shaft bearing nut
26SR/95260	67479/3567	Spanner, set	For yoke nut No. 3 and 5 flap unit
26SR/95261	67479/3569	Spanner, set	Yoke attachment nut, No. 3 and 5 flap units, and eccentric locknuts, No. 1 flap
26SR/95263	67479/3573	Spanner, set	Eccentric rollers locknut, No. 1 flap
26SR/95265	67479/3577	Spanner, set	Inner telescopic tube, No. 1 and 2 tie-rod
26SR/95266	67479/3579	Spanner, set	Inner telescopic tube, No. 3 and 5 tie-rod
26SR/95267	67479/3581	Spanner, set	Inner telescopic tube, No. 4 tie-rod
26SR/95268	67479/3583	Spanner, set	Eccentric bush locknut, No. 1 flap
26SR/95042	66079/1141	Spanner, special	Flap unit yoke attachment nut
26SR/95040	66079/1137	Spanner, special	Landing flap yoke
26SR/95213	67479 Sht. 335/337	Tool, special	Hand operation of flaps

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