

CHAPTER 4
FLYING CONTROLS
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* (~~To be issued later~~)

Introduction

1. This chapter contains a general description of the flying controls, together with control surface adjustment, lubrication and servicing information necessary to maintain the controls in an efficient condition. Illustrations showing the run of the control tubes and control surface settings are also included. For descriptive and servicing details of the Desynn indicators and transmitters reference should be made to A.P.1275A, Vol.1.

Description

General

2. Normal stick and rudder bar type flying controls with push-pull tube transmission are installed in this aircraft and in addition, the tail plane incidence is varied by an electric actuator. Hydraulic booster jacks, operated by the aircraft's hydraulic system (Sect.3, Chap.6) are provided to fully augment the pilot's effort when applying the ailerons and elevators. These may be disconnected in flight, if an emergency should

make this necessary, by operation of switches on the central instrument panel. They are also automatically disconnected in the event of a hydraulic failure. When disconnected the booster jack units function as normal control tubes, thus enabling manual operation of the control surfaces to be effected. The rudder and port aileron incorporate small electrically-operated trimming tabs and conventional split trailing edge flaps are provided on the undersurface of each outer wing, together with an air brake hinged to the underside of the rear fuselage.

Control column (fig.1)

3. The control column has a pivoted upper portion which moves laterally and independently to control the ailerons, while both portions move as one complete unit fore and aft to control the elevators. The upper portion carries a hand grip which accommodates the gun firing, camera and other control switches, together with the wheel brake control lever. A sprocket is attached to the upper portion, at the knuckle joint, to transmit the lateral movement to an aileron torque tube sprocket at the bottom of the column, via a chain and link system enclosed in a guard in the forward face of the column. The chain and link system incorporates an adjustable spring feel unit (fig.1 & 3) which is described in para.7. The lower portion of the column incorporates the aileron control stops (fig.7) and is terminated by an inverted tee-shaped plug-end bolted to two cranks which are themselves bolted to small torque shafts carried in bearings at both sides of the fuselage keel member below the cabin floor. The starboard shaft is longer than that on the port side and carries a lever which is connected to a control tube extending aft to a further lever system located in bearings on the starboard side of the keel member between frames 10 and 11; from this point the control tubes extend upwards behind the seat and aft to the elevators. The lower portion of the column also incorporates the aileron torque tube sprocket,

which is carried at the forward end of a shaft passing through the tee-shaped plug-end and connected to the aileron torque tube by a universal joint. The aileron torque tube is carried in bearings attached to the underside of the cabin floor and frame 11. Assembled to the aileron torque tube is a two-position hydraulic jack which acts as the lever to transmit the motion of the torque tube to further control tubes which extend upwards behind the seat and aft to the ailerons. The jack is fully extended when the ailerons are in power, but is retracted when the ailerons are in manual to reduce the effort required by the pilot to operate them. The elevator spring feel unit (para.8) is fitted in the dorsal fin, but whereas it is similar in principle to that of the aileron feel unit, it is not adjustable in flight.

Rudder bar (fig.1)

4. The rudder^{BAR.} is mounted on a vertical spindle which is free to rotate in a pedestal casting secured to the cabin floor. The spindle incorporates an adjustable stop (fig.5) which protrudes through a slot in the pedestal and so limits the rudder bar movement. The bar consists of two separate arms with a fork at each end, the inboard forks interlace to fit over the spindle while the outboard forks carry the foot pedals. A rudder bar adjusting shaft is splined to the top of the spindle between the inboard forks of the rudder bar arms and carries a slide with a spring-loaded plunger which engages in one of a number of holes in the adjusting shaft. This slide is attached to each rudder bar arm by a short link and a spring is located between the slide and a stop on the forward end of the adjusting shaft. The pedals, which consist of light-alloy stampings, incorporate bearings to fit the outboard forks of the rudder bar and each pedal extends forward to form a lever which is connected by a link rod to a support plate projecting forward from the pedestal. These link rods are provided to maintain the pedals in the same angular position

relative to each other when the rudder is operated. Movement of the pedals is transmitted to the operating lever at the bottom of the spindle via the short links, slide and adjusting shaft.

5. The rudder bar is adjusted for leg reach by means of a control toggle on the leg panel in the cabin, which is in contact with the spring-loaded plunger in the slide on the adjusting shaft by a Bowden cable. Operation of this control disengages the plunger from its hole in the adjusting shaft thus allowing the rudder bar arms to be swung forwards against the pressure of the spring or swung backwards by the spring. When adjustment is complete the control is released to allow the plunger to engage with the nearest hole in the shaft, thus locking the bar in the desired position.

Control tubes

6. Apart from the lateral movement of the upper portion of the control column, which is transmitted to the aileron torque tube below the cabin floor by a sprocket and chain system, all movement of the column and rudder bar is transmitted to the control surfaces by a series of control tubes carried on idling links which are hinged to the structure. The run of the control tubes is illustrated in fig. 1, 2 and 4.

Spring feel units

7. The aileron and elevator control systems are each provided with a spring feel unit to give feel to the pilot's control when operating the controls in power. The aileron spring feel unit (fig. 1 & 3) consists of a cylindrical casing which contains a spring-loaded spindle, the spring, when assembled, being adjusted to a nominal load of 7 lb. by means of an adjuster nut on the lower end of the spindle. The spindle is free to move endwise in either direction in the casing against the tension of the spring. The spring feel unit is mounted on the lower portion of the control column in such a manner that

the spring loaded spindle of the unit forms part of the chain and link system between the upper and lower sprockets of the control column while the cylindrical casing is anchored to the mounting by which the unit is attached to the column itself. Thus, while the casing remains fixed in relation to the column, the spindle is free to move against the spring to give artificial feel to the pilot's control when operating the ailerons in power. Since the anchorage of the casing to the mounting is in the form of a screw thread, it follows that the datum point will be dependent upon the amount the unit is screwed into the mounting, and this has been utilised to form a means of adjusting the datum point to which the control column and ailerons are centred. Adjustment is by means of a control spindle which is fitted parallel to the spring feel unit in its mounting. Turning a knob at the top of the spindle rotates the spindle together with an integral pinion at its base which, being in mesh with an integral gear on the outer periphery of the spring casing, rotates the casing in the threaded bore of the mounting, thus compressing the spring or permitting it to extend, according to the direction of the operation of the control knob. In this manner, the datum is varied to suit individual requirements. The unit is initially adjusted so that when the spring is at its nominal loading of 7 lbs, the control knob is in the neutral position i.e. dowel in housing registered in the depression on the top face of the pinion and the white (neutral) line on the control knob facing forward.

8. The elevator spring feel unit (item 30, fig. 2 and 11) is fitted in the dorsal fin between the flying controls idling links in the region of frame 49 and a lever assembly which is linked to the junction of the tail plane actuator and tail plane lever. In principle, the elevator spring feel unit is similar to that of the unit for the ailerons, but incorporates an additional spring at either end of the unit, these allowing a limited movement of the control column before the main spring comes into action, thus ensuring that

there is a smooth change-over at the neutral point. Unlike the aileron feel unit, the elevator feel unit is not adjustable in flight.

Tail plane incidence control - normal (fig.2 and 4)

9. To enable the incidence of the tail plane to be varied in flight, it is hinged at the rear spar (Sect.3, Chap.3, Fig.6) to a pivot at the top of frame 55 and a projection on its leading edge picks up with the operating rod (Sect.3, Chap.3, Fig.13) of an electrically operated actuator mounted in the dorsal fin, below the tail plane, between two beams extending from the top of frame 51 to frame 52. The actuator incorporates internal non-adjustable limit switches to control its range of movement and is provided with a standby motor to maintain operation should the main motor or the electrical control circuit fail. The main motor is controlled by a switch located on the control column and the standby motor by a separate control circuit energized by a switch located under a guard cover on the cabin port shelf. Raising this cover, to enable the switch to be operated, automatically isolates the control column switch circuit. The incidence of the tail plane is shown on an indicator located on the port side of the centre instrument panel. The operation and circuit of the actuator and indicator is described in Section 5, Chap.1 of this volume.

Electrically operated flying tail (Post Mod.390)

9A. The electrically operated flying tail consists essentially of the interconnection of the full power elevator with the tail plane trimming actuator, the interconnection being in the form of a follow-up linkage so that a given control column displacement provides a pre-determined amount of tail plane and elevator movement in the manner described in the following paragraphs.

9B. A pantograph type of linkage, housed in the dorsal fin aft of the booster unit and below the tail plane, is attached to the elevator and carries a switch arm which has one end floating between two opposed micro-switches fitted in a special mounting.

Movement of the elevator relative to the tail plane causes the switch arm to operate one of the micro switches which, in turn, energizes the tail plane actuator to move the tail plane and also return the switch arm to its position central between the two micro-switches, leaving the elevator deflected relative to the new position of the tail plane. As long as the switches remain in the same location, there is, therefore, a definite relationship between the tail plane and elevator angle for all positions of the control column. If the switches are moved to a different position, however, the relationship is changed and made to suit the requirements of flight at any given speed. The switch mounting is linked so as to vary the ratio between the tail plane and elevator travel for a given control column movement. In order to prevent a continual hunting of the tail plane actuator, the elevator has a range of movement of approximately $1\frac{3}{4}$ deg. through which it can move without operating the switches.

9C. The pantograph type of linkage attached to the elevator incorporates a spring unit in the form of a telescopic strut (fig.12), so that a full and unrestricted control column travel can be obtained when either of the micro switches are fully depressed, which condition can arise when either the control column is moved faster than the rate at which the tail plane can follow-up or the tail plane reaches the end of its travel.

9D. Trimming for hands-off flight is accomplished by means of a small electric actuator, one end of which is anchored to structure below the switch carrier while the other end is anchored to the switch carrier itself, operation of the actuator varying the position of the switch carrier for a given tail plane position. Operation of a thumb switch on the control column handgrip moves the tail plane actuator simultaneously with the switch carrier actuator, the movement of the latter being such that it maintains the switch arm central between the micro-switches with the elevator trailing as the tail plane

moves to its new trim position. While trimming, the micro-switches serve as limit switches to maintain the two actuators in step.

9E. Artificial feel is provided for by a spring feel unit which provides a control column force dependent on elevator movement relative to the tail plane, the spring feel unit being anchored to the tail plane and not to the main (fixed) structure of the airframe. Therefore, for any tail plane angle, elevator deflection relative to the tail plane, requires deflection of the spring of the spring feel unit.

9F. A switch in the cabin is provided to cut out the electrical flying tail linkage in order to permit reversion to normal full power elevator control with trimmable tail plane. Emergency functioning following hydraulic or electrical failure, is identical with that of the system prior to Mod.390, but the flying tail interconnection can still be used with manual elevator if desired. The interconnection does not function when the standby electric tail plane trimmer is in use.

Elevator hydraulic booster controls (fig.2 and 4)

10. The elevator hydraulic booster jack and linkage system is located between frames 52 and 55 just below the tail plane. The gear is carried in a channel sectioned beam bolted to cast brackets mounted on the frames and consists of a hydraulic booster jack, release unit, servo valve and operating link, together with an input and output lever (A.P.4601A, Vol.1, Sect.2, Chap.1, Fig.1). The elevator control tube from the control column is connected to the extreme end of the input lever and the control tube to the elevator is connected to the output lever.

11. The hydraulic power may be disconnected in flight, if an emergency should make this necessary by operation of a switch situated on the port side

of the centre instrument panel. A dolls-eye indicator located on the port instrument panel will show that the power is disengaged. In the event of a hydraulic failure, an accumulator in the circuit provides power to give at least 2 control column reversals and when exhausted the power control is automatically disconnected. The operation and circuit of the cut-off switch and indicator as well as the standby manual control and batteries (Mod.502) are described in Sect.5, Chap.1 of this volume.

Aileron hydraulic booster controls (fig.2)

12. Each aileron hydraulic booster jack and linkage system is located in the outer wing in a bay formed by ribs R and S, a diaphragm and the rear spar (Sect.3, Chap.2, Fig.1), the assembly being carried on two sets of mountings bolted to a beam attached to the skin and the outboard face of rib R. Apart from the hydraulic booster unit, the linkage consists of an input and output lever assembly mounted on one set of mountings and a release unit and micro switch assembly, which supports the booster unit, carried on the second set of mountings. The input and output levers, although mounted on the same bearings in the mountings, are not directly connected and interconnection, for the purpose of manual operation in the event of hydraulic failure, is derived by a manual drive pin protruding upwards from the input lever into an integral flange on the output lever. There is a diametrical clearance between the pin and flange to provide lost motion for valve operation. The aileron control tube from the control column is connected to the extreme end of the input lever and the control rod to the aileron is connected by a fork-end, approximately midway along the output lever. The servo is operated by a link attached to a subsidiary lever integral with the input lever.

13. The method of disengaging the hydraulic power and the emergency means of operation, via an accumulator, is similar to that for the elevator control

system as described in para.11 of this chapter. At least 2 control column reversals are available before the accumulator is exhausted.

Operation of booster jacks

14. The operation of the elevator and aileron booster jacks is similar and is described in A.P.4601A, Vol.1, Sect. 1, Chap.1, and Sect.2, Chap.1.

Rudder trim tab (fig.2 and 4)

15. This tab is located in the trailing edge at the bottom of the rudder and is controlled by a small electrically-operated actuator bolted to the forward face of the rudder spar just above the operating lever. A shaft, within the rudder, transmits the movement via an eccentric driven by the actuator to a small lever attached to the tab. The actuator is controlled by a combined aileron and rudder trim switch situated on the forward portion of the cabin port shelf and the tab position is shown on a combined aileron and rudder tab position indicator also located on this shelf. The rudder portion of this indicator is operated by a Desynn transmitter bolted to nose rib F in the leading edge of the fin, which is actuated by a Bowden cable attached to a lever on the actuator. The operation and circuit of the actuator and Desynn system is described in Sect.5, Chap.1 of this volume.

Aileron trim tab (fig.2)

16. A small tab to enable fine adjustments of lateral trim to be made in flight is provided in the inboard trailing edge of the port aileron. The tab is controlled by a small electrically-operated actuator bolted to the forward face of the aileron spar between nose ribs 2 and 3. An operating rod, within the aileron, transmits the movement via an eccentric driven by the actuator to a small lever attached to the tab. The actuator is controlled by the combined aileron and rudder trim switch situated on the cabin port shelf. The trim switch control knob may be

locked by a pivoted lever carried on a mounting bracket attached to the switch. This lever is shaped so that, when in the locked position, it grips the control knob spindle to prevent sideways movement. The lock does not interfere with rotation of the knob for rudder tab control, as it is only intended to prevent inadvertent operation of the aileron tab when flying in power. The lever is retained in the locked or unlocked position by a spring-loaded plunger, which is carried on the mounting bracket and engages with holes in the lever. The setting of the tab is shown on the combined aileron and rudder tab position indicator also located on this shelf, the aileron portion of which is actuated by a Desynn transmitter, located adjacent to the actuator and operated by a Bowden cable attached to a lever on the actuator. The operation of the actuator and Desynn system is described in Sect.5, Chap.1 of this volume.

Landing flaps (fig.2)

17. Hydraulically-operated landing flaps (Sect.3, Chap.2) extend along the undersurface of each outer wing from the root to just inboard of the aileron and are controlled by a lever type selector switch situated on the port instrument panel. This switch operates an electro-hydraulic solenoid valve, located in the port wheel bay, via a follow-up drum switch, situated in the port wing root. A flap position indicator, situated on the centre instrument panel adjacent to the selector switch, is operated by a Desynn transmitter, which is situated in the port wheel bay and connected to the flap and follow-up gear by a Bowden cable. The flaps are synchronised by a hydraulic interconnection, which is described in Chap.6 of this section and the operation of the flap control gear, together with the circuit is given in Sect.5, Chap.1 of this volume.

Air Brake

18. A hydraulically-operated air brake flap (Sect.3, Chap.1) is mounted on the underside of the rear

fuselage by two extended hinges pivoted in channel fittings situated one on each side of the fuselage between frames 45 and 46. The flap, which is designed so that it embraces the underside of the fuselage when in the up position, is extended and retracted by a hydraulic jack housed in a sealed-off cut away extending from frame 47 to frame 50 in the bottom of the rear fuselage. The installation is controlled by a thumb switch, incorporated in the end of the throttle twist grip, which operates two electro-hydraulic solenoid valves located in the rear fuselage on the port side adjacent to frame 50. A dolls eye magnetic indicator situated on the port side instrument panel adjacent to the undercarriage warning lamp and controlled by a micro switch situated on frame 47 is provided to indicate when the air brake is extended. To prevent damage, due to the limited ground clearance, the control circuit is electrically interconnected with the undercarriage in such a manner that it is impossible to extend the air brake while the undercarriage is lowered. If the undercarriage is selected down while the air brake is extended, this interconnection will automatically retract the air brake. The same condition is also obtained when the undercarriage emergency lowering system is used by the action of a micro switch located below the cabin port shelf and operated by the undercarriage emergency air valve. It should be noted that air brake 'in' must not normally be obtained by selecting undercarriage down. To enable the installation to be tested on the ground with the undercarriage down, a spring return test switch is incorporated on the air brake control relay box located just aft of the hood control switch in the cabin. Operation of this switch permits partial extension of the air brake and operation of the magnetic indicator by means of a micro switch located adjacent to the air brake port hinge to show that the installation is operating satisfactorily. The operation of the air brake hydraulic circuit is described in Sect.3, Chap.6 of this volume and a description of the electrical control circuit will be found in Sect.5, Chap.1 also of this volume.

SERVICING

Lubrication

19. The lubrication points for the flying controls are indicated by numerals on fig.1 and 2, the type of lubricant to be used at each point being given in the key to fig.1. All shielded ball bearings are packed with anti-freeze grease before assembly and apart from the removal of any moisture that may have accumulated they should not require further attention.

Functioning checks for power controls and flying tail plane

20. The hydro boosters are precision mechanisms which must be kept scrupulously clean. When disconnected during servicing, all pipe ends and unions on the units must be blanked off to prevent the ingress of dirt or moisture. After servicing, the booster system must be primed and bled as described in Sect.3, Chap.6 of this volume. To ensure that the elevator and aileron power controls are operating satisfactorily the aircraft should be jacked up, the elevator feel unit disconnected at the forward end and tied up clear of the elevator feel connecting lever and the following tests carried out, preferably following the main hydraulic functioning tests:-

Power off

- (1) With tailplane neutral and tailplane jack selector switch at "MANUAL", lock elevator input linkage at valve and check that the backlash at the control column is a maximum of 1/16".
- (2) Measure elevator movement up and down. Measure aileron movement up and down, port and starboard.
- (3) Measure force in pounds at stick grip to just move elevator from the central position up and down. This should be a maximum of 2 lb. up and 4 lb. down. Measure force in

pounds at stick grip to just move the ailerons from the centre position, port and starboard. This should be 5 lb. maximum.

21. For these tests the hydraulic rig should be run at a speed equivalent to 1350 pump r.p.m. Check accumulators are charged to 1575 lb. per sq.in. The main hydraulic pressure should not fall below 2700 lb. per sq.in. when functioning the controls normally.

Power on

- (1) With rig pump running select "Power On" holding switches "ON" until locks are engaged. Check that boosters engage on moving the stick and that magnetic indicators clear when locks are in. Check that the aileron indicator does not clear until both aileron locks are engaged.
Check that locks remain engaged on releasing switches.
- (2) Select "Power Off" and check that boosters disengage. Hold the stick deflected so that the aileron ram slots are misaligned with their pawls. Hold the aileron power switch "On" and engage one aileron lock by moving the aileron by hand. Release switch and check that both pawls are fully out. Repeat, moving the other aileron.
- (3) Select aileron power "on" and engage locks. Release switch. Press the emergency aileron power control disengaged button momentarily and check that both pawls are fully out.
- (4) Hold the stick deflected so that the elevator ram slot is misaligned with the pawl. Select elevator power "On" and release switch. Check that the pawl is fully out.
- (5) Select elevator power "on" and engage lock. Release switch. Press the emergency elevator power disengaged button momentarily and check that the pawl is fully out.

- (6) Select "Power On", re-engage locks, then measure force in pounds at stick grip to just move elevator from the central position, up and down, (maximum 2 lb). Measure force in pounds at stick grip to just move ailerons from the central positions, port and starboard (maximum 3 lb). Ensure that stick loads for full aileron deflection, port and starboard, are within 3 lb. of each other.
- (7) With controls in power, disconnect electrical ground supply and check that both ailerons and elevator remain in power. Re-connect electrical ground supply.
- (8) Measure aileron movement up and down port and starboard. Check that, with control column at neutral, that there is no aileron down-float and not more than $\frac{1}{2}$ deg. up-float.
- (9) Turn aileron feel knob fully clockwise and check aileron angles, stick free (Port down and starboard up, $3\frac{1}{2}$ deg. minimum). Repeat with control turned fully anti-clockwise. Centralise feel knob.
- (10) Stop hydraulic pump and, after 1 minute, measure number of complete cycles for aileron before pawl disengages. This should be approximately 2 cycles. Repeat for elevator circuit (2 cycles Pre Mod.468, 1 $\frac{1}{2}$ cycles when Mod.468 is incorporated). A complete cycle consists of neutral to one extreme, back through neutral to the other extreme and back to neutral.
- (11) Re-start pump to build up system pressure, stop pump, move controls and check that pawl remains engaged at 550 lb. per sq.in. and disengages by 150 lb. per sq.in. Check for both ailerons and elevator.
- (12) Re-start pump, check for system stability by jerking the stick and then letting go; the stick should come to rest and not oscillate. This test should be carried out independently for elevator and ailerons.

- (13) Check controls for ease of movement in all directions; check that system is free from any sluggishness, lumpy or jerky movements or other undesirable effects. Check aileron controls over full range of aileron feel trimmer.
- (14) Check that aileron spring centres control column accurately when stick is deflected $\frac{1}{2}$ an inch from centre and released.
- (15) Repeat (10) above after rest periods of one minute, three minutes and five minutes, then check:-
- That initial control column load does not increase after one minute of rest.
 - That it does not exceed a maximum of 6 lb. for a rest period of 5 minutes.
- (16) Re-attach elevator spring feel unit.
- (17) Check that the elevator spring feel unit returns the control column within 0.3 in. of central, after deflecting it with one finger on top of the grip.

NOTE...

Ensure that elevator is not permitted to foul its shroud.

- (18) Measure elevator movement up and down with tailplane neutral, fully positive and fully negative. Return tailplane to neutral.
- (19) Move the tail plane jack selector switch to "AUTO" and with neutral trim, measure tail plane and elevator angles at stick fully forward, fully aft and neutral.
- (20) Push up the control column trimming switch until extreme (full high-speed) trim is obtained. Measure tail plane and elevator

angles with stick:-

- Fully forward.
 - Moved aft until tail plane just moves.
 - Move aft until tail plane is at zero incidence.
 - Fully aft.
 - Moved forward until tail plane just moves.
 - Moved forward until tail plane is at zero incidence. Check that, at tail plane neutral, the elevator "UP" angle with stick moving aft is $1\frac{1}{2}$ deg. to 2 deg. greater than with stick moving forward.
- (21) Push the trim switch down until extreme trim is obtained. Measure tail plane and elevator angles as in sub-para. 20 (a), (b), (d) and (e).
- (22) Trim neutral and check for smooth operation over the stick movement range, moving the stick at a constant speed giving a time of operation from stop to stop of approximately $3\frac{1}{2}$ seconds. Check for system stability by jerking the stick and letting go.
- (23) Move the tail plane jack selector switch to "MANUAL" and ensure that the tail plane remains locked during elevator movement.
- (24) Run hydraulic rig at a speed corresponding to 1950 pump r.p.m. Move controls at approximately one stir per 2 seconds (a stir is a circular movement of the top of the control column combining extreme travel of both ailerons and elevators) while making the following selections:
- Undercarriage down.
 - Undercarriage up.

RESTRICTED

- (c) Undercarriage up, flaps up
 (d) With undercarriage and flaps up, air brake out and in.

Hydraulic pressure at all these conditions must not fall below 1000 lb. per sq.in. The main hydraulic pressure should not drop below 2,700 lb. per sq.in. when functioning the controls normally.

- (25) If high-speed tail plane actuator is not fitted, check that locking guard is fitted to hold tail plane jack selector switch in "MANUAL", on completion of testing.

Typical tail plane and elevator angles with the tail plane jack selector switch in "AUTO", and with Type A.1603 tail plane actuator fitted, are as follows:-

<u>Trim</u>	<u>Control Column Position</u>	<u>Tailplane Incidence</u>	<u>Elevator Angle Rel. to Tailplane</u>
Neutral	Neutral	0	0
	Fully forward	+ 2 deg. : 30 min.	6 deg. down
	Fully aft	- 2 deg. : 30 min.	20 deg. up
	Neutral	- 0 deg. : 25 min.	0
Full high-speed	(a) Fully forward	+ 2 deg. : 30 min.	6 deg. down
	(b) Moved aft until tail plane just moves.	+ 2 deg. : 30 min.	1 deg. : 30 min. up
	(c) Moved aft to tail plane neutral.	0	7 deg. : 45 min. up
	(d) Fully aft.	- 1 deg. : 56 min.	21 deg. up
	(e) Moved fwd. until tail plane just moves.	- 1 deg. : 56 min.	16 deg. up
	(f) Moved fwd. to tail plane neutral.	0	6 deg. up
Full low-speed	(a) Fully forward.	+ 0 deg. : 10 min.	9 deg. down
	(b) Moved aft until tail plane just moves.	+ 0 deg. : 10 min.	7 deg. : 15 min. down

<u>Trim</u>	<u>Control Column Position</u>	<u>Tailplane Incidence</u>	<u>Elevator Angle Rel. to Tailplane</u>
	(d) Fully aft.	- 2 deg. : 30 min.	20 deg. up
	(e) Moved fwd. until tail- plane just moves.	- 2 deg. : 30 min.	2 deg. down

Typical tailplane and elevator angles in "AUTO" with Type A.1606 (high-speed) actuator fitted are as above with the following exceptions.

<u>Trim</u>	<u>Control Column Position</u>	<u>Tailplane Incidence</u>	<u>Elevator Angle Rel. to Tailplane</u>
Neutral	Fully aft	- 2 deg. : 52 min.	20 deg. up
Full low-speed	(d) Fully aft.	- 2 deg. : 52 min.	20 deg. up
	(e) Moved fwd. until tail- plane just moves.	- 2 deg. : 52 min.	2 deg. up

Power control stability check

22. A stability check of the power controls should be made after any adjustment of the hydraulic booster units or control runs. A simple method of carrying out this check is as follows:-

- (1) Connect a hydraulic ground rig to the aircraft's external test connections and with the ground pump running at a speed equivalent to the engine idling speed, select power operation for the ailerons and elevators.
- (2) Hit the control column hard over in all directions.
- (3) Stable operation will be indicated by the control column remaining in the position to which it has been hit, with no tendency to travel through its full range.

- (4) Instability will be immediately apparent by the behaviour of the aircraft, which will vibrate with a noise similar to a knocking water pipe.
- (5) In the case of instability immediately switch off the power and investigate the cause by re-adjustment of hydraulic booster units.
- (6) Check the controls for ease of movement in all directions, check that the system is free from any sluggishness, lumpy or jerky movements or other undesirable effects.

Control surface settings

23. The angular and linear ranges of the control surfaces and tabs, together with their tolerances, are given in fig.10. After any adjustment to the controls, care must be taken to ensure that there is no excessive

friction at any point as this will impair the handling qualities of the aircraft. Static friction figures for ailerons and elevators are given in para.20. The procedure for the adjustment of the control surfaces is given in the following paragraphs.

Rudder

24. To adjust the setting of the rudder, proceed as follows:-

- (1) Set the rudder bar at neutral with the aid of the rigging fixture (fig.9).
- (2) If necessary, remove the cover from the spine member just aft of the cabin and the rudder operating lever access door and adjust the control tubes forward of the idling link in the spine member and at the eye-end connected to the rudder lever. Take care to ensure that any adjustment in the length of the control tubes is taken up by equal amounts at each end.
- (3) Release the rudder bar and check that the full range of movement can be obtained, as given in fig.10, with the rudder bar against its stops (fig.5) which may be adjusted by shimming as necessary. When adjustment is satisfactory, tighten all lock-nuts.
- (4) Replace the spine member cover and the rudder operating lever access door.

Rudder trimming tab

25. The rudder trimming tab actuator is adjusted after the initial test flight to the correct tab angle to give neutral handling in the air with the cabin indicator set to neutral and this angle is quoted in the aircraft's form 700. Normally no further adjustment should be necessary, but the operation should be checked as follows:-

- (1) Set the rudder bar in the neutral position by means of the rigging fixture (fig.9).
- (2) Connect an external electrical supply (Sect.5, Chap.1) to operate the tab without discharging the aircraft's batteries.
- (3) Operate the tab to PORT and check that its travel corresponds with the figure given in fig.10.
- (4) Operate the tab to STARBOARD and check that its travel corresponds with the figure given in fig.10.
- (5) Set the tab to the angular position as given in the aircraft's form 700, using the cabin control, and check that NEUTRAL is registered on the Desynn indicator in the cabin. If the indicator is in error, refer to A.P.1275A, Vol.1, for details and adjustments.

NOTE...

If necessary, the movement of the tab may be adjusted by adding to or removing the shims from between the actuator and the rudder spar.

Elevators

26. To adjust the settings of the elevators, it is first necessary to rig them in the normal way, i.e. in the manual condition, as detailed below, before any hydraulic power is employed. If this procedure is not adhered to, damage may result due to inadequate clearance in the control runs etc.

- (1) Set the control column in the neutral position with the aid of the rigging fixture (fig.9). Set aileron feel unit to neutral.

- (2) Set the tail plane incidence to neutral (fig.10), and tail plane jack selector switch to manual.
- (3) Disconnect the upper ends of the flying tail switchgear spring unit and connecting rod and tie up clear of the elevator lever.
- (4) Check that, with the elevators neutral, the idling links between frames 17B and 18, and between 40B and 41 are positioned at 12 deg. forward of the vertical. If not, adjust at the first horizontal control tube behind the seat, at the rear transport joint and at the elevator booster unit output tube connected to the elevator operating lever.
- (5) Remove the rigging fixture.

NOTE...

The rigging fixture must always be removed before hydraulic power is applied.

- (6) Check that the control column load with spring feel unit disconnected does not exceed that quoted in para.20. If excessive friction is experienced, its source should be investigated and the cause eliminated.
- (7) Check that the control run is free from backlash, other than that of the 'lost motion' in the servo valve, taking particular care at the elevator universal joint and operating lever.
- (8) Adjust the control column stops (fig.6) at the bottom of the control column to give the range of elevator movement as quoted in fig.10 with the tail plane

in the neutral position.

27. After the above operations have been completed the elevator movement should be checked in the power condition using a hydraulic test rig, connected to the external supply connections, with its pump running at half speed which is approximately equivalent to the engine idling speed. Ensure that the 'Micronic' filter is in circuit. If pipe-lines have been disconnected it is also desirable to flush the hydraulic pipe-line prior to connecting it to the booster unit. It will not normally be necessary to adjust the servo valve as the 'lost motion' is embodied in the valve, but care must be taken to ensure that the valve eye-end is screwed in sufficiently as determined by the inspection hole in the valve stem. The procedure for checking the elevators in power is as follows:-

- (1) Ensure that the control column is free.
- (2) Disconnect the pipe at the release unit of the hydraulic-booster unit and blank off. With the test rig running, hydraulic power can now be applied to the booster unit by placing the switch in the cabin to the ON position. On moving the control column, the booster jack ram should slide freely through the release unit, thus checking the ram clearance and function of the booster unit.
- (3) Reconnect the pipe to the release unit and engage lock by applying hydraulic pressure. Check that the valve eye-end is screwed in sufficiently to register in the safety hole.
- (4) Adjust the control column stops, if necessary, to ensure that the booster jack does not 'bottom'. This can be noticed by a stickiness on moving the control column from extreme positions. To obviate this, the control surface movements may be slightly reduced.

- (5) Hold the control column at neutral and with the tail plane at neutral incidence, check that the elevator is at neutral, if not re-adjust on the output link.
- (6) Check that the range of elevator movement as given in fig.10 is still obtained with the tail plane in the neutral position and feel unit connected and adjusted as described in para.40.
- (7) On completion of adjustment, lock the selector valve tab washer.
- (8) Check the controls for ease of movement. There should be no tendency for the control column to move on when released after movement and once set the circuit should be stable.
- (9) Check that the release unit pawl is engaged at 550 lb./sq.in. Adjust the micro switch to indicate lock engagement when the clearance between the bottom face of the release unit pawl and the horizontal face of the ram slot is 0.035 in. max./0.030 in. min. Use the hand pump section of the hydraulic rig for this operation. Release pressure and check that pawl is free at 150 lb. per sq.in.
- (10) Check that the control column load does not exceed that quoted in para.20, with feel unit disconnected.
- (11) Re-attach switch gear spring unit and connecting rod to elevator lever. Ensure that the links of the mounting bracket for the switch carrier are free to rotate after the locking plates are fitted and adjust the lower switch position to make contact
- at 0.02 in. \pm 0.005 in. before max. downward movement of stop pin. Tighten fixing bolts.
- (12) Disconnect aircraft electrical supply to datum trim actuator and connect separate supply. Tail plane jack selector switch and elevator booster switch should be at "MANUAL", and tail plane at neutral. The tail plane and datum trim actuators should have been tested.
- (13) Trip the main tail plane actuator circuit breaker on the port cockpit shelf. Fully extend datum trim actuator. Move the tail plane jack selector switch to "AUTO".
- (14) With control column held at neutral by the spring feel unit, contact E on upper micro switch will be made (a lamp (1) connected from terminal A to earth should be on) and contact E on the lower micro switch broken (a lamp (2) between A and earth should be off). Raise elevator by hand until the upper micro switch just opens (lamp (1) off) and read elevator angle. Raise elevator further until the lower micro switch just closes (lamp (2) on) and read elevator angle. Adjust micro switch adjusting screw to make the difference in reading $1\frac{3}{4}$ deg. of elevator movement.
- (15) Select elevator power 'on', engage release unit lock, and, by moving control column, re-check the elevator angular movement in both directions between opening one micro switch and closing the other. The backlash must be $1\frac{3}{4}$ deg. \pm $\frac{1}{4}$ deg. of elevator movement. Re-adjust as necessary and lock adjusting bolt.

- (16) Re-connect datum trim actuator aircraft supply and with stick free and tail plane jack selector at "AUTO" re-engage main tail plane circuit breaker. Check that tail plane moves to fully positive incidence. If tail plane stops short of fully positive, shorten spring unit as required.
- (17) Move control column aft and check that tail plane actuator begins to retract before elevator angle is $1\frac{3}{4}$ deg. relative to tail plane. If angle exceeds this value, lengthen spring unit as required.
- (18) Trim to fully negative incidence, stick free. Check the tail plane remains in this position when trim switch is released. If fully negative incidence is not obtained, lengthen spring unit as far as possible, consistent with obtaining fully positive incidence. Secure spring unit lock nut by wire locking as shown in fig.12.
- (19) Move tail plane jack selector switch to "MANUAL" and with control column neutral check that full tail plane movement is obtainable on operating trim switch.
- (20) Move the tail plane jack selector switch to "AUTO", stick free, and note any tail plane movement that occurs. Re-select "MANUAL" and inch the actuators by operating the control column trim button sharply without disturbing the control column; then with the stick free, select "AUTO" and note tail plane

movement. Repeat this cycle six times. The greatest tail plane movement that occurs on a selection of "AUTO" must not exceed fifteen minutes of arc.

Tail plane incidence - (Normal)

28. The tail plane actuator is manufactured to give the required range of travel for incidence control and as internal limit switches are incorporated no further adjustment may be made, but the following operation checks should be carried out to ensure that the correct travel is obtained:-

- (1) With jack selector switch in manual, connect an external electrical supply (Sect.5, Chap.1) to operate the tail plane by means of the cabin controls without discharging the aircraft's batteries.
- (2) Operate the control column switch to increase the incidence to the upper limit and check that the tail plane's position corresponds to the figure given in fig.10.
- (3) Operate the control column switch to decrease the incidence to the lower limit and check that the tail plane's position corresponds to the figure given in fig.10.
- (4) Operate the control column switch to set the tail plane in its neutral position and check that the Desynn indicator in the cockpit registers neutral.
- (5) Raise the guard from over the emergency switch on the cabin port shelf and using

this switch repeat operations 2, 3 and 4.

NOTE...

If with the tail plane neutral, the indicator is not registering neutral, remove the actuator access door, slacken the lock-nuts at the fork-ends on the rod connecting the Desynn transmitter to the actuator and screw the rod in or out of the fork-ends, as required, until the indicator registers neutral.

Ailerons

29. To adjust the settings of the ailerons, it is first necessary to rig them in the normal way i.e. in the manual condition, as detailed below, before any hydraulic power is employed. If this procedure is not adhered to, damage can result due to inadequate clearance in the control runs, etc.

- (1) Set the control column in the neutral position with the aid of the rigging fixture (fig.9) and set aileron feel unit to neutral.
- (2) Check that the aileron control cross tube and idling links in the centre fuselage just aft of the rear spar are symmetrical about the centre line. If not, adjust at the first horizontal control tube behind the seat.
- (3) Check that the control tubes and idling links in the run behind the flaps, in both wings, are also symmetrical. If not, adjust at the ends of the cross tubes in the centre fuselage; obtaining access at the stub wings.
- (4) The output levers from the hydraulic booster units to the ailerons are now adjusted so that the aileron trailing edges have

approximately 0.2 in. upfloat.

NOTE...

This upfloat is required since the aileron overbalance will put the 'lost-motion' bush on one side of its pin. When power is applied the pin will centralise itself in the bush and bring the ailerons back to neutral. Any final adjustment will be made at the output lever when power is selected.

- (5) If two-position aileron jack lever is fitted, proceed with operations (6) to (12).
- (6) Disconnect control tube at ram end of jack lever and adjust booster links in input system so that they are symmetrical, using the setting locks (RT.353499 and 353462-3). Adjust output links so that aileron trailing edge has approximately 0.20 in. upfloat. Check that the centre fuselage idling links are vertical and, if not, adjust at the ends of the sloping cross tubes in the stub wings.
- (7) With the two-position jack retracted (in manual), clamp the jack in the horizontal position. Set the spring feel unit adjustment knob in the neutral position and disconnect the control column chain link from the eye-end at the top of the spring feel unit. Adjust the eye-end and also chain rods, without disturbing the spindle of the spring feel unit, until the control column is in the neutral position.
- (8) Re-connect chain link, ensuring that the chain rods are in 'safety'. Remove the clamp from the two-position jack lever and check that the control column is still 'neutral'. If it is not, re-adjust chain as before until 'neutral' is obtained. Check that the jack lever remains horizontal.

- (9) With aileron setting locks still in, and control column in 'neutral', adjust and re-connect control tube removed in (6) above, ensuring that all adjustable positions are in 'safety'. Check that the angular position of the top lever is $22\frac{1}{2}$ deg.
- (10) Adjust the control column stops (fig.7) at the knuckle joint to give approximately ± 11 deg. (± 6 deg. Post Mod. 457 two position aileron jack lever) of aileron movement.
- (11) Remove the rigging fixture.

NOTE...

The rigging fixture must always be removed before hydraulic power is applied.

- (12) Check that control column load in either direction does not exceed that quoted in para.20. If excessive friction is experienced, its source should be investigated and the cause eliminated. It is very important that friction is almost non-existent in the input control run as its presence will cause the 'feel' in power to be unsatisfactory.
- (13) Check that the control run is free from backlash, other than that of 'lost-motion', taking particular care at the sprockets and chain system. Also check that the control column movement is easy; do not overtighten the chains as this will cause an undesirable 'feel'.
- (14) Check that the release unit pawls are engaged at 550 lb. per sq.in. Adjust the micro switches to indicate lock engage-

ment when the clearance between the bottom face of the release unit pawl and the horizontal face of the ram slot is 0.035 in. max. to 0.030 in. min. Use the hand pump for this operation.

30. After the above operations have been completed the booster unit servo-valves must be brought into adjustment with their respective lost motion bush assemblies. This adjustment is made at the servo-valve spindles while the valves are under hydraulic pressure maintained by an external supply rig.

Ensure that a Micronic filter is in circuit and that, if pipe lines have been disconnected, the hydraulic power line is flushed prior to its connection to the booster unit.

Preliminaries

- (1) Arrange a pointer on the top portion of the control column so that it extends about 10 ins. above it, (a piece of stiff wire attached by masking tape to the hand-grip is suitable), so that, viewed from the wing tips, the pointer can be seen against a strip of tape stretched horizontally across the windscreen arch. Two points, each about 5 in. from the centre, should be clearly marked on this strip.

Open the servo-valve tab washers (fig.13) and unscrew the locknuts. Attach a dial-spanner and an indicator (Part No. A.214535 and A.214536 respectively) to the port servo-valve spindle, and threaded eye-end respectively. The spring feel unit must be in circuit and the stick must be free in manual for the full range between the lateral stops on the control column.

Switch on the hydraulic rig.

Engage the locks by pushing up or pulling down on the aileron trailing edges.

Operate the ailerons through 20 full reversals to expel any air in the circuit.

Adjustments

- (2) Turn the dial anti-clockwise until the stick pointer begins to move to the left. Check the movement by a small clockwise movement of the dial.
- (3) By fine movements of the dial halt the stick pointer at the left Hand Mark on the strip across the windscreen arch.
- (4) Now turn the dial anti-clockwise as slowly as possible until the stick pointer begins to creep very slowly to the left. While it is creeping read the dial and record on a form such as that shown in table 1.
- (5) Repeat 3 and 4 until a series of readings within .03 of a turn are obtained.

NOTE...

Inconsistent readings indicate that air or foreign matter is present in the system.

- (6) Turn the dial clockwise a little until the pointer begins to creep to the right. Read and record. Return the pointer to the L.H. Mark and repeat to obtain consistent readings.
- (7) Calculate the mid-point between the above two sets of readings and record on form.
- (8) Rotate the dial through approximately $2\frac{1}{2}$ turns (the stick will return to centre early in this movement) and adjust the pointer against the Right Hand Mark. Repeat 4 to 7 for this mark.
- (9) Calculate the mid-point between the figure obtained in 7 above and the figure obtained in 8.

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NOTE...

The number of turns between these two points is normally between 2.30 and 2.90. Record on form. Turn back dial anti-clockwise (about $1\frac{1}{2}$ turns) on to this reading. Tighten up the lock-nut and turn over the tab washer.

- (10) Transfer the dial-spanner and indicator to the starboard wing and repeat 2 to 9.

NOTE...

On this wing, movement of the dial causes the stick pointer to move in the opposite sense, so for "Left Hand Mark" read "Right Hand Mark" and for movements of the stick to the left read "Right" and vice versa.

- (11) Remove the dial and indicator from the wing and the pointer from the cabin.
- (12) Obtain the full range of aileron movement, as given in Fig.10 by adjusting the stops (fig.7) on the control column.
- (13) Adjust the control column stops to ensure that the booster jack does not "bottom". If necessary, a slight reduction in the control surface movements may be accepted.
- (14) Set the control column to neutral, but do not lock in position. Adjust each aileron to neutral at the output links while still under power. Acceptable limits for neutral on each aileron are:-
UP $\frac{1}{2}$ deg, DOWN 0 deg., i.e. no down-float being permitted.
- (15) Check the controls for ease of movement. Movement should be smooth throughout the range and the control column should return

H.A.L.8.

to neutral when released.

- (16) Select ailerons in manual and ensure that 7 deg. minimum up and down aileron movement is obtained. The maximum allowable difference between PORT and STARBOARD movement is 1 deg. The maximum allowable difference between UP and DOWN is also 1 deg.

NOTE...

The aircraft should fly laterally trimmed in power with the ailerons spring feel unit control knob within $\frac{1}{4}$ of a turn from the zero setting. Out of trim involving more than this should be investigated for correct circuit rigging and aileron contours etc.

Aileron trimming tab

31. The trimming tab in the trailing edge of the port aileron is adjusted after the initial test flight to the angle noted by the pilot at 300 kts. to give neutral handling in the air with the cabin indicator set to neutral and this angle is quoted in the aircraft's form 700. Normally no further adjustment should be necessary, but the operation should be checked as follows:-

- (1) Set the control column in the neutral position by means of the rigging fixture (fig.9).
- (2) Connect an external electrical supply (Sect.5, Chap.1) to operate the tab actuator without discharging the aircraft's batteries.
- (3) Operate the tab to the UP position and check that its travel corresponds to the figure given in fig.10.
- (4) Operate the tab to the DOWN position and check that its travel corresponds to the figure given in fig.10.

H.A.L.8.

- (5) Set the tab to the angular position as given in the aircraft's form 700, using the cabin control, and check that NEUTRAL is registered on the Desynn indicator in the cabin. If the indicator setting is more than a needle thickness from neutral, re-set to neutral by removing the needle and replacing it in the neutral position. Ensure that the needle is tight on the spindle, using shellac if necessary. Repeat these procedures whenever an aileron or trimmer tab is replaced, or any adjustment is made to the aileron circuit. If a new indicator is fitted, ensure that the needle is at zero with the trimmer tab at the basic setting.

Landing flaps

32. Check that the flaps open to the dimensions given in fig.10 and that they close just as the operating jack pistons reach the limit of their stroke. If necessary, adjust the jack piston rods for length by slackening off the lock-nuts and screwing the eye-bolts in or out as required. After adjustment, ensure that the lock-nuts are securely locked. When making this adjustment, it is also necessary to check the flap synchronising jacks as described in para.33. The linkage for the drum switch and flap position indicator transmitter should also be checked and adjusted, as described in para.34.

Checking flap synchronising jacks

33. To ensure that these jacks do not 'bottom' before the flaps are fully up, when the flap jacks have been correctly adjusted as described in para.32 and with the flaps fully down it is necessary to check that the dimension given in fig.8 is obtained. If not, proceed as follows:-

- (1) Disconnect each synchronising jack from the flap levers.
- (2) Fully extend the synchronising jacks by use of the handpump and check that the dimension given in fig.8 is obtained between the points indicated.

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- (3) Slacken off the lock-nuts and adjust the eye-end of each jack until the holes coincide with the holes in the flap levers. Tighten the lock-nuts.
- (4) Re-assemble the jacks to the flap levers.
- (5) Provided that the above instructions are correctly carried out, the synchronising jacks will not 'bottom' before the flap jacks when the flaps are fully up.

NOTE...

If the dimension given in fig.8 cannot be obtained when the jacks are fully extended, the affected jack or jacks must be removed from the aircraft and replaced with fully serviceable components.

Adjustment of flap position transmitter and drum switch

34. After ensuring that the flap movements are satisfactory, the flap position transmitter and drum switch should be checked and, if necessary, the linkage adjusted. The procedure is as follows:-

- (1) Lower the flaps to their fully down position.
- (2) Check that the flap position indicator in the cabin is indicating fully down.
- (3) If not, adjust the length of the cable between the flap position transmitter lever arm and the levers connected to the flap and drum switch, located in the port wing just inboard of tail rib C, until the correct indication is obtained.
- (4) With the flaps still fully down, check that the line on the drum switch indicator plate is in line with the figure 3 on the switch cover.

- (5) If not, slacken off the lever on the drum switch spindle and turn the spindle until the indicator line and and figure 3 coincide. Retighten the lever on to the spindle.
- (6) Raise the flaps to their fully up position and check that the flap position indicator is indicating up.
- (7) If not, lengthen or shorten the lever arm of the flap position transmitter until the correct indication is obtained.

NOTE...

It is recommended that the indication obtained in operation (6) be noted as a guide to the adjustment required. If the indicator overshoots the up position, lengthen the lever arm. If it fails to reach it, shorten the lever arm.

- (8) Check the operation of the flap position indicator and drum switch by lowering the flaps to each position, in turn, and using the dimensions given in fig.10, check that the flap angle shown on the position indicator agrees with the dimensions obtained.

Air brake, jack adjustment

35. To ensure that the air brake structure is not strained, by contact with the fuselage before the hydraulic operating jack is fully retracted, it is essential that a nominal gap of 0.13 in. is maintained at the closest point between the air brake and fuselage structure when the jack is fully retracted. This gap is obtained by adjustment of the length of the jack ram as follows:-

- (1) Jack up the aircraft as described in Sect.2, Chap.4 and retract the undercarriage.
- (2) After ensuring that the area below the air brake is free from obstruction, select air brake out by operation of the control on the throttle twist grip and operate the handpump until the air brake is fully extended.
- (3) Select air brake in to release the hydraulic pressure from the jack and slacken off the lock-nut at the bottom of the jack ram.
- (4) Lengthen or shorten the jack ram, as necessary, by rotating it in the required direction with a spanner on the hexagon at the end of the ram.
- (5) Retract the air brake by use of the handpump and check that the required clearance is now obtained. If not, repeat operations (2) (3) and (4) until clearance is correct.
- (6) After adjustment, re-tighten the locknut on the jack ram, retract the air brake, lower the undercarriage and remove the aircraft from the jacks.

Air brake, forward micro switch (ground test)

36. This micro switch is operated by the air brake port hinge via a small lever pivoted to a bracket attached to the port hinge fitting. The switch controls the operation of the air brake when testing the installation on the ground while the undercarriage is down and allows partial extension of the air brake to check that the installation is functioning satisfactorily. The switch is mounted in a bracket

with a slotted hole to permit adjustment and is adjusted on initial assembly so that it operates when the air brake is extended approximately 10 to 15 deg. i.e. sufficient to enable the indicator micro switch to operate and give indication in the cabin by means of the magnetic indicator. If, when checking the operation of the air brake as described in Sect.3, Chap.6 of this volume, the above conditions are obtained, no further adjustment of the switch should be necessary.

Air brake, rear micro switch (indicator)

37. This micro switch is operated by a plunger supported in a tube attached to the fuselage skin just forward of frame 47. The switch plunger is actuated by a leaf spring, riveted to the inside of the air brake structure, when the air brake is in the retracted position. The switch controls the operation of the magnetic indicator in the cabin, which gives a black indication when the air brake is retracted and white when extended. The switch is mounted in slotted holes in a bracket attached to frame 47 and is adjusted on initial assembly so that a clearance of 0.02 is obtained between the switch and operating plunger when the air brake is extended. If the magnetic indicator operates satisfactorily when testing the installation on the ground as described in Sect.3, Chap.6, no further adjustment of the micro switch should be necessary.

Air brake, undercarriage emergency air valve micro switch

38. This micro switch is operated by the lever of the undercarriage emergency air valve when in the valve closed position. The switch controls the automatic retraction of the air brake, should the air brake be extended when the undercarriage emergency lowering system is employed. The switch is mounted in slotted holes in a bracket attached to the air valve and is adjusted on initial assembly so that when the air valve lever is in the position of maximum

travel with the valve closed, the switch plunger is depressed 0.12 in. No further adjustment should, therefore be necessary, apart from checking that the above condition is obtained.

Aileron spring feel unit

39. The aileron spring feel unit should be adjusted as described in fig.3.

Elevator spring feel unit

40. The elevator feel unit should be adjusted as follows:-

- (1) Screw adaptor into housing until dimension A (fig.11) is 0.035 in. approximately.
- (2) Apply load in direction of arrow X until the thrust collar has moved not more than 0.002 in. Under this load, dimension A must have reduced 0.002 in. to 0.005 in.

A.P.4347F, Vol.1, Sect.3, Chap.4.

- (3) If necessary adjust adaptor to obtain this condition and fit laminum washer (Pt. No. F.206976), thickness to suit. Lock adaptor to housing with 22 s.w.g. stainless steel locking wire DTD.161 or 189, with ends of wire finished with lead steel.
- (4) Adjust overall length of unit between pin centres to a nominal length of 28.25 in. by means of the eye-end and lock-nut on the tube assembly. Re-lock after adjustment.

LUBRICATION KEY TO FIG. 1 AND 2

- 2 Rudder bar connecting links
- 3 Rudder bar centre bearings
- 4 Rudder bar adjusting links
- 10 Chains and sprockets
- 16 Tail plane actuator and Desynn transmitter rod.
- 21 Trim tab hinge
- 23 Trim tab actuator
- 24 Trim tab lever
- 30 Elevator feel unit anchorages
- 31 Spring unit upper end
- 32 Connecting rod
- 34 Forward link centre bearing
- 36 Eye-bolt
- 37 Aft link

Oil OX - 14
Stores Ref. 34B/100590

- 1 Rudder bar pedal
- 12 Torque tube universal joint
- 18 Elevator universal joint
- 19 Elevator inner hinge
- 22 Hydraulic booster jack ram, pawl and pawl slot.
- 27 Elevator and aileron feel units
- 28 Pivot pin for input and output levers
- 29 Tail plane pivot
- 33 Forward link, inner bearing
- 35 Actuator upper pivot
- 38 Spring unit, lower end

Grease XG-275
Stores Ref. 34B/100513

- 6 Rudder bar pedestal bearing
- 7 Control rod bearings
- 8 Control link and lever bearings
- 9 Control column head joint
- 11 Control column bearing
- 13 Crank bearings
- 14 Torque tube bearing
- 15 Elevator shaft bearings
- 17 Rudder hinges
- 20 Elevator outer hinge
- 25 Aileron bearings

Pack with grease on assembly
Further lubrication not required
and where accessible remove any
moisture which may have collected.

- 5 Rudder bar adjusting cable

XG-273 Stores Ref. 34B/423151

NOTE...

On re-assembly of flying control and idling links incorporating shielded bearings care must be taken to ensure that these bearings are free from sealing compound and are well packed with grease.

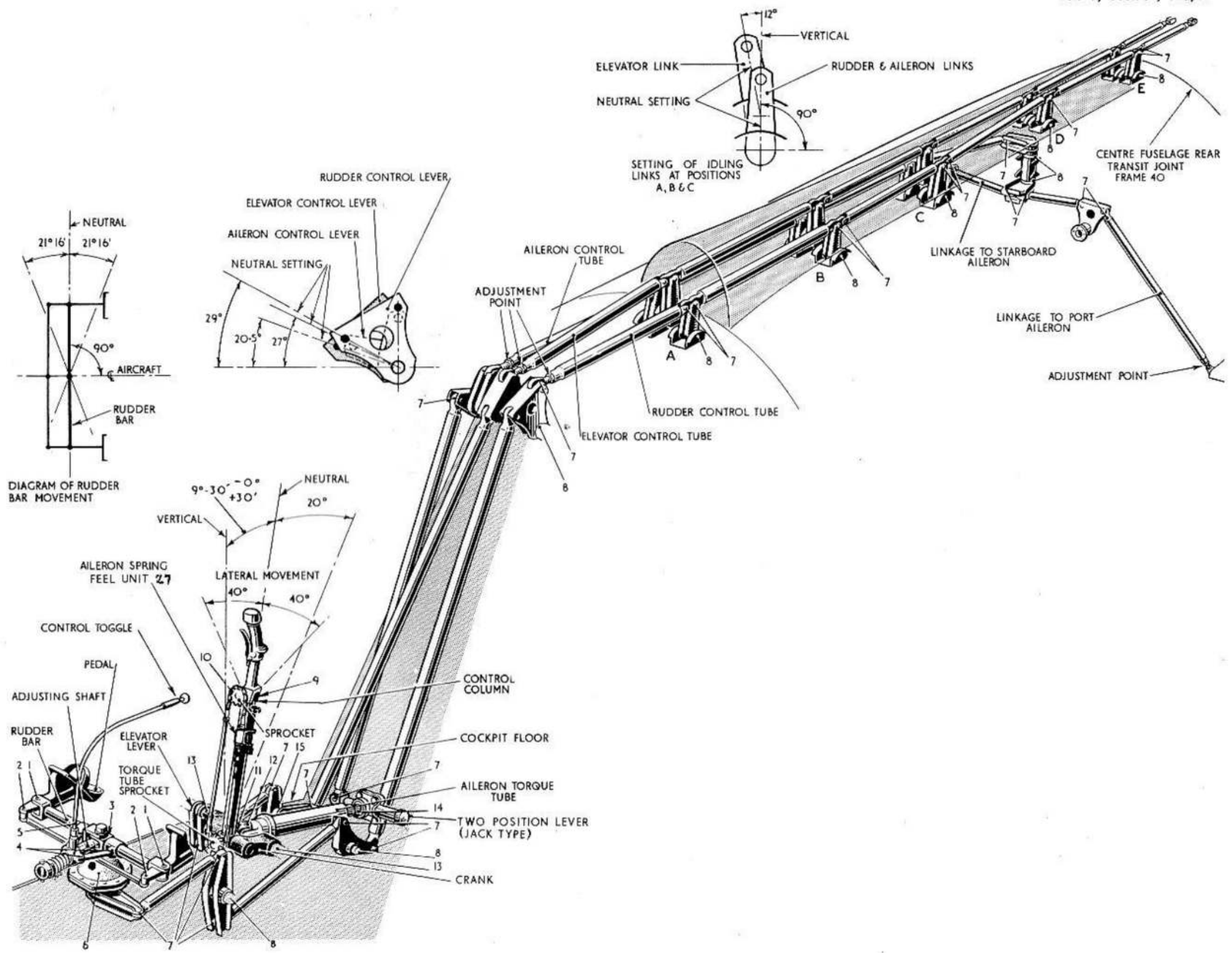


FIG. 1 FLYING CONTROLS, WITH LUBRICATION POINTS (1)

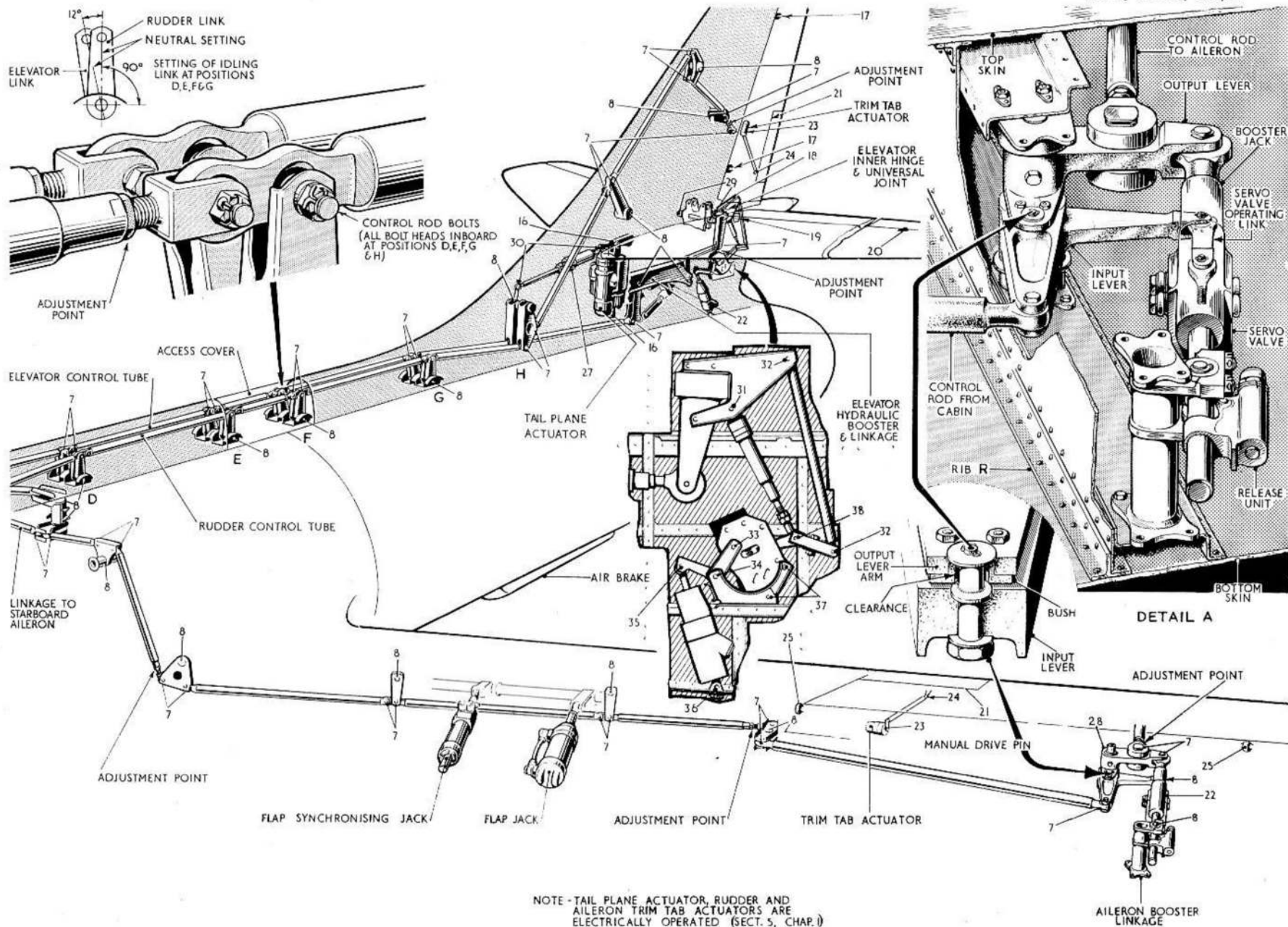


FIG. 2 FLYING CONTROLS, WITH LUBRICATION POINTS (2)

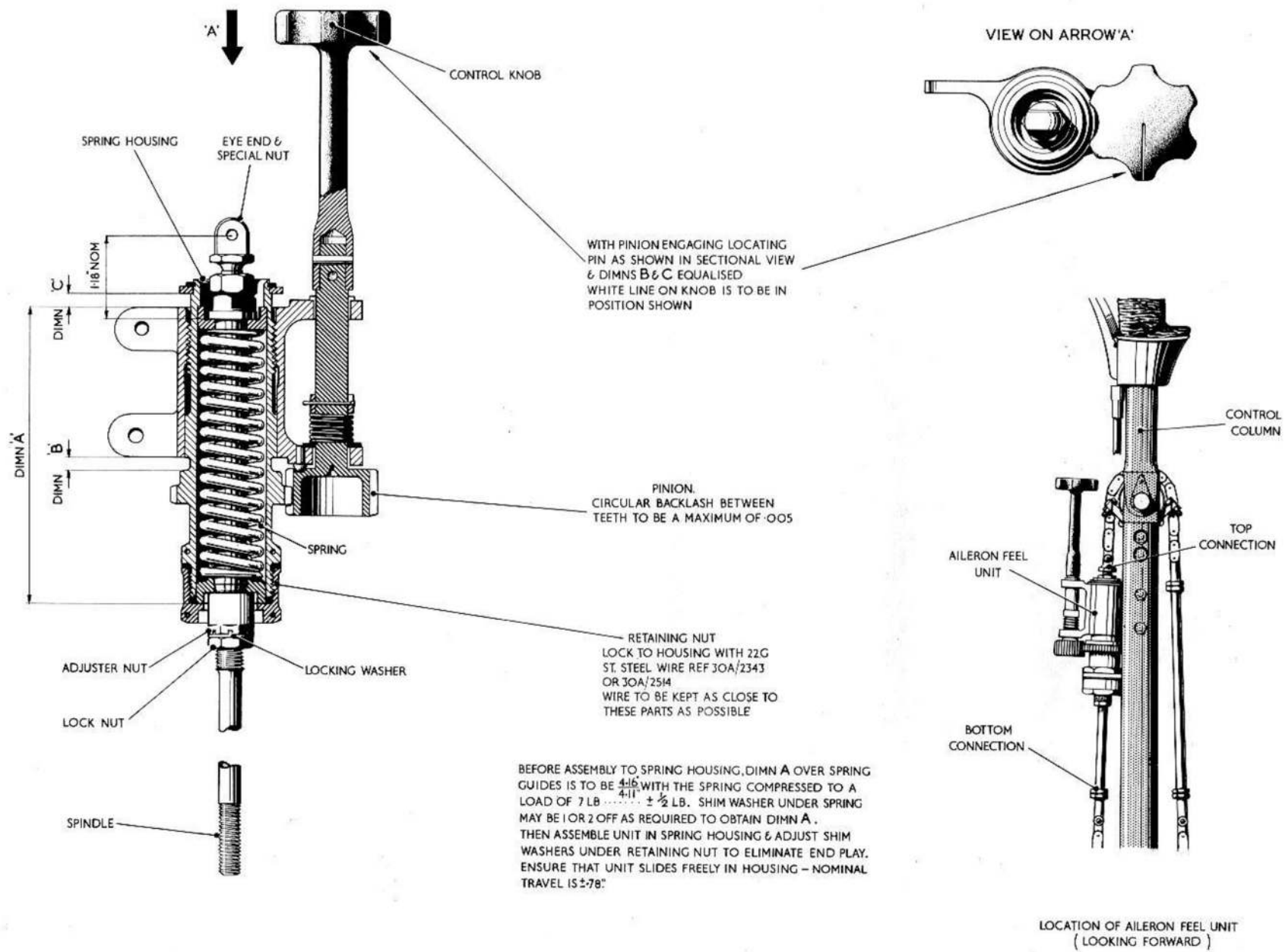


FIG. 3 AILERON FEEL UNIT

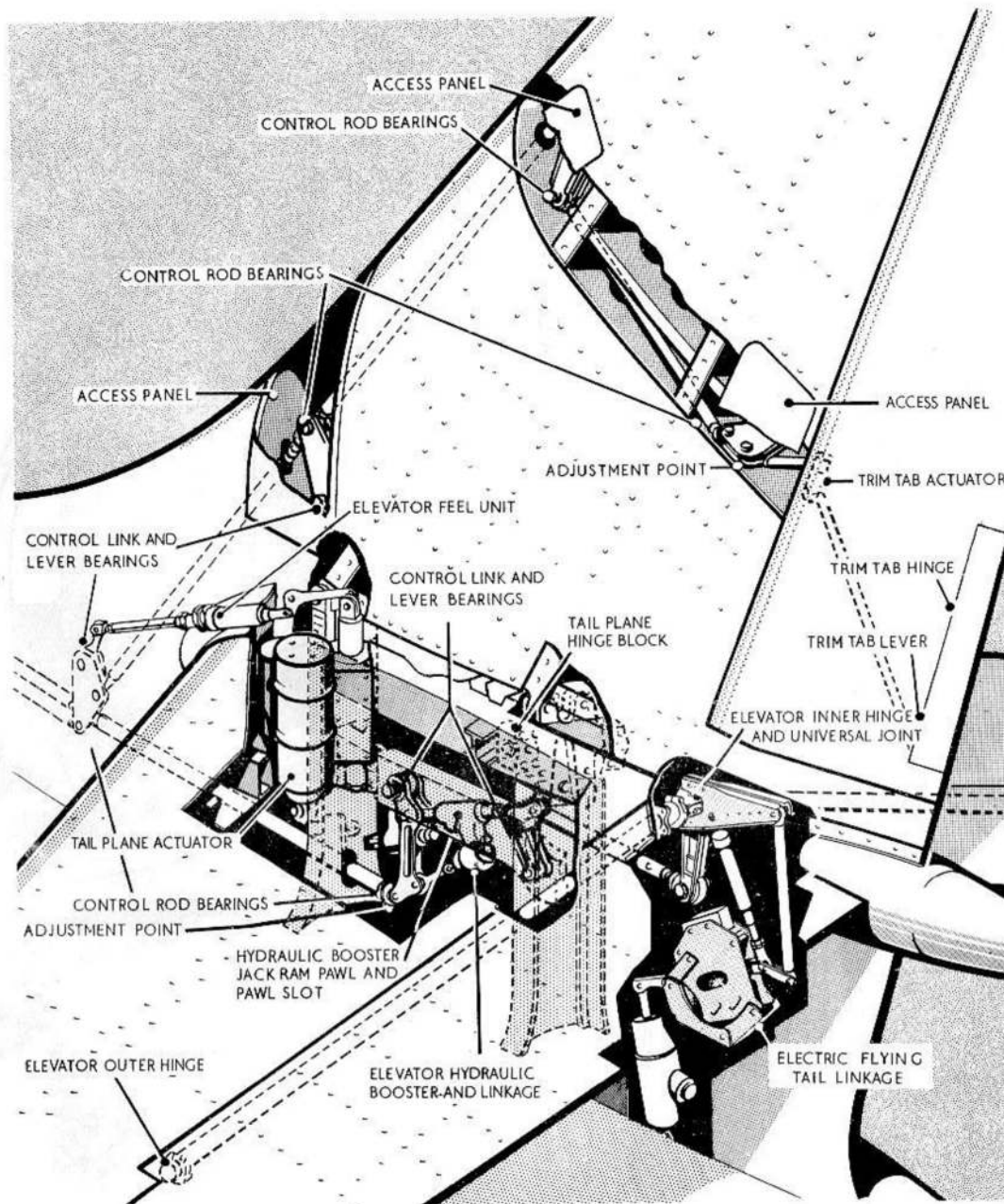


FIG. 4 - CONTROLS IN TAIL PLANE FIN AND RUDDER

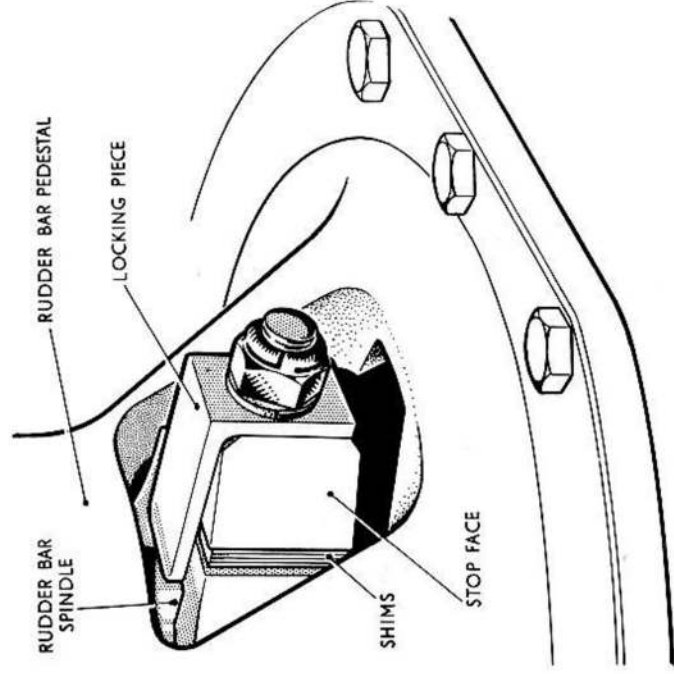


FIG. 5 RUDDER CONTROL STOP

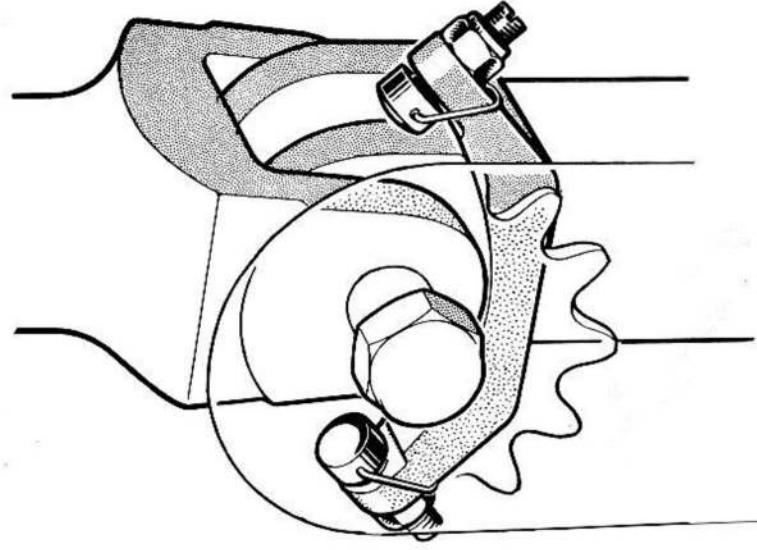


FIG. 7 AILERON CONTROL STOPS

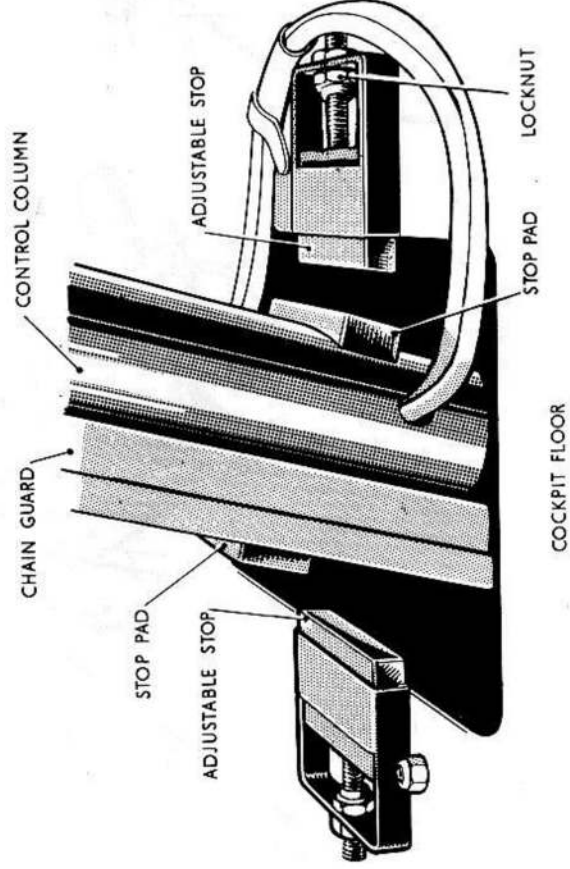
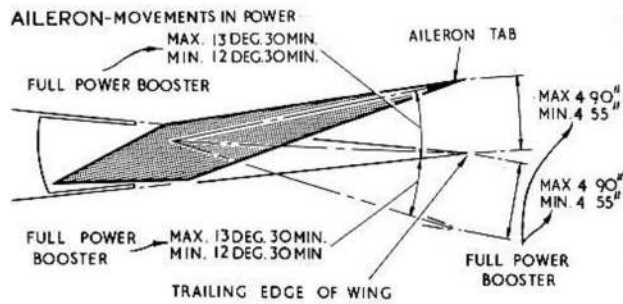
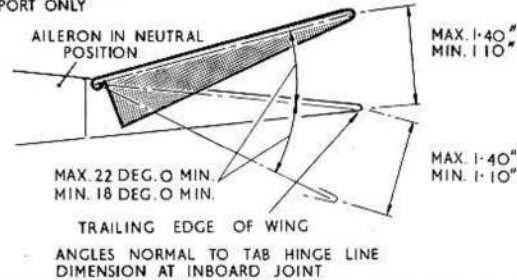


FIG. 6 ELEVATOR CONTROL STOPS



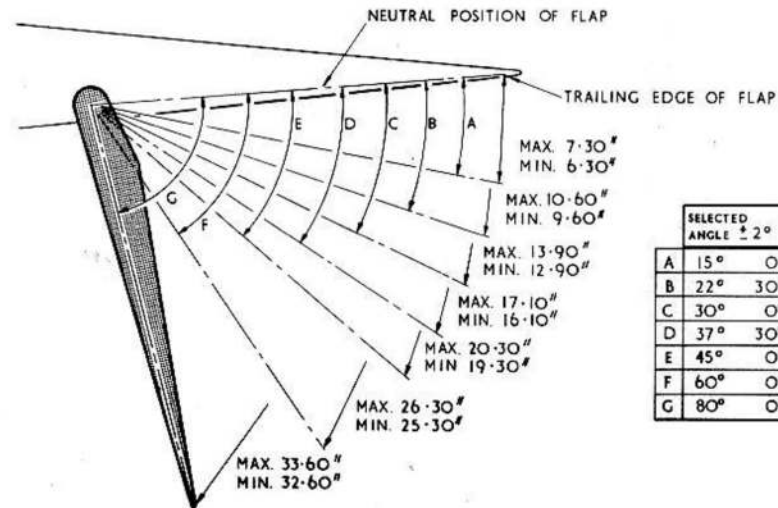
ANGLES NORMAL TO AILERON HINGE LINE
 DIMENSIONS AT JOINT OF AILERON AND WING
 MAX PERMISSIBLE BACKLASH MEASURED AT TRAILING EDGE - 40"

AILERON TAB
 PORT ONLY

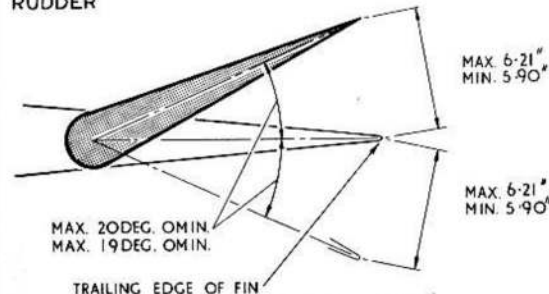


NOTE: A TOLERANCE OF $\pm \frac{1}{2}$ IN. AT TRAILING EDGE IS PERMITTED ON THE TAB NEUTRAL POSITION, WHEN INDICATOR IN C/PIT IS BEING SET AT ZERO

LANDING FLAPS - 8 SELECTED POSITIONS



RUDDER

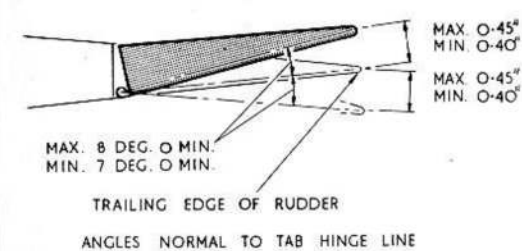


MAX. 20 DEG. 0 MIN.
 MAX. 19 DEG. 0 MIN.

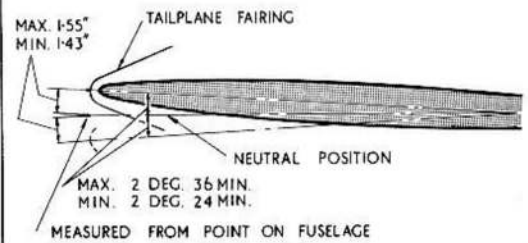
TRAILING EDGE OF FIN

ANGLES NORMAL TO RUDDER HINGE LINE
 DIMENSIONS AT LOWER JOINT OF FIN AND RUDDER
 MAX PERMISSIBLE BACKLASH MEASURED AT TRAILING EDGE - 20"

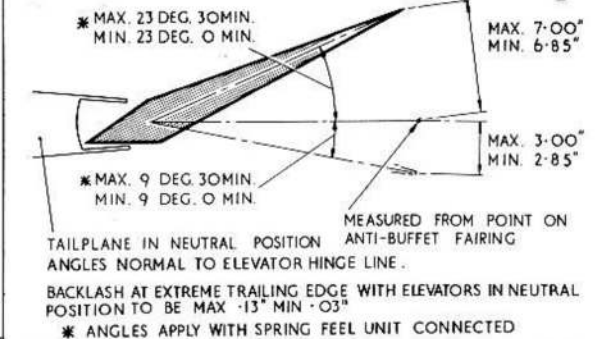
RUDDER BIAS TAB



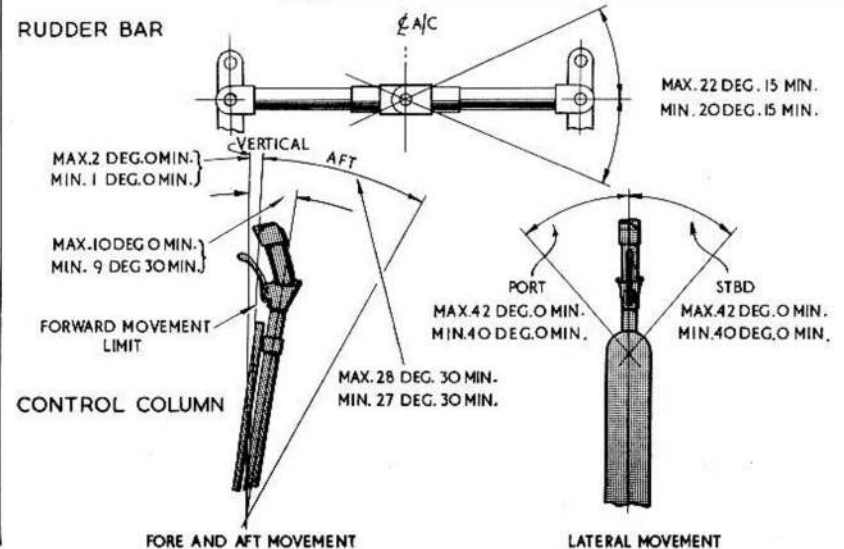
TAILPLANE VARIABLE - INCIDENCE



ELEVATOR-MOVEMENTS IN POWER



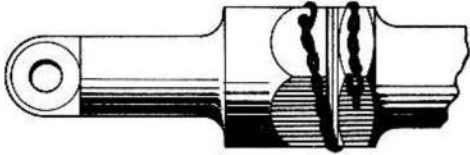
RUDDER BAR



SELECTED ANGLE $\pm 2^\circ$	DRUM SWITCH POSITION
A 15°	0' 1
B 22°	30' 2
C 30°	0' 3
D 37°	30' 4
E 45°	0' 5
F 60°	0' 6
G 80°	0' 7

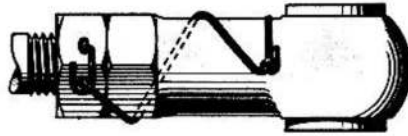
FIG. 10 CONTROL SURFACE SETTINGS

METHOD OF LOCKING TOP EYE END TO SPRING HOUSING
WITH DTD.189 OR 161 22G ST. STEEL LOCKING WIRE



DETAIL 'A'

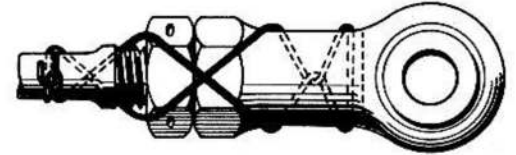
METHOD OF LOCKING EYE END TO LOCKNUT WITH
DTD 189 OR 161 22G ST. STEEL LOCKING WIRE



(VIEW ON ARROW)

DETAIL 'B'

METHOD OF LOCKING EYE END TO SPINDLE WITH
DTD 189 OR 161 22G ST. STEEL LOCKING WIRE



DETAIL 'C'

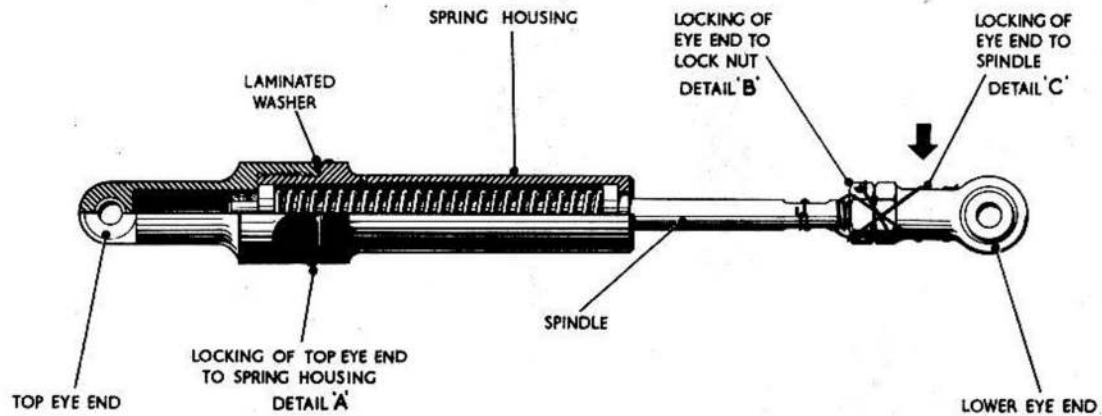


FIG.12. SPRING UNIT - FLYING TAIL SWITCH GEAR

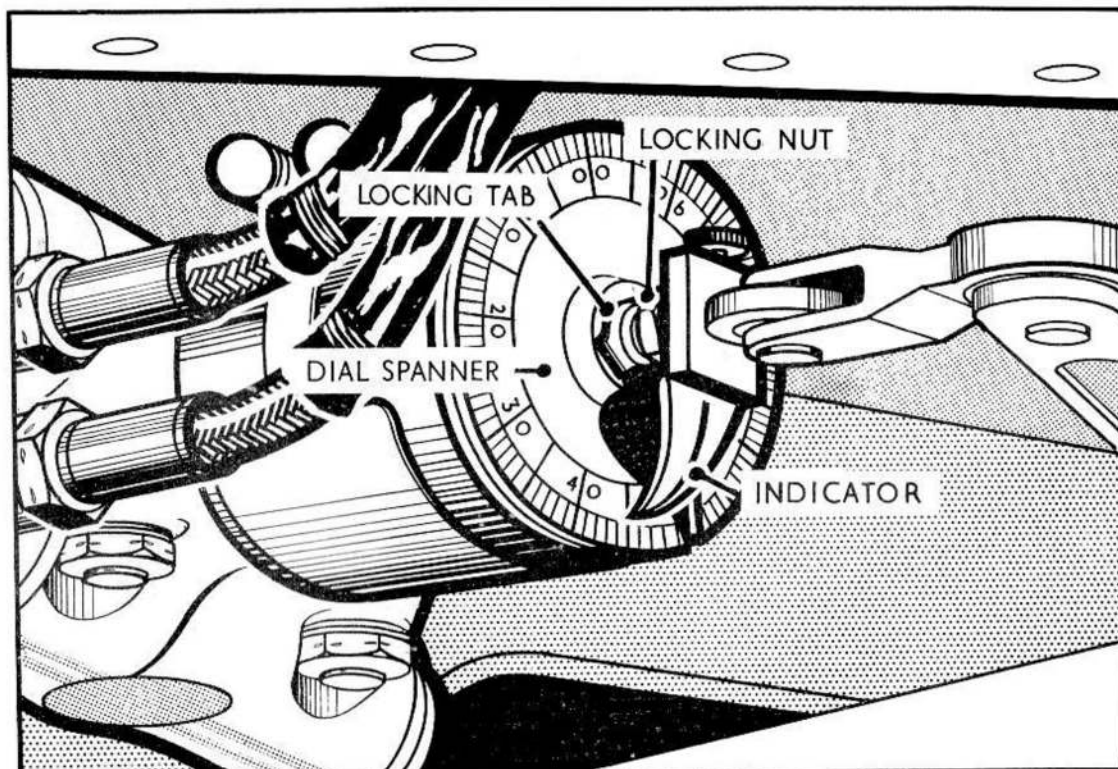


FIG.13. ADJUSTING AILERON BOOSTER UNITS

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