

Chapter 4

FLYING CONTROLS

(Completely revised)

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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 airworthy 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 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 underside 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 of the column 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 on the forward face of the column. The chain and link system incorporates an adjustable spring feel unit (fig.1 and 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.7) 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, incor-

porate 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 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 bar 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 forward 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 to the pilot's control when operating the controls in power. The aileron spring feel unit (*fig.1 and 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 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 up or down in the threaded bore of the mounting, according to the direction of rotation 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 lb., 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. The elevator spring feel unit (*fig.2 and fig.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*)

8. To enable the incidence of the tail plane to be varied in flight, it is hinged at the rear spar (*Sect.3, Chap.3*) to a pivot at the top of frame 55 and a projection on its leading edge picks up with the operating rod of an electrically operated actuator mounted in the dorsal fin, below the

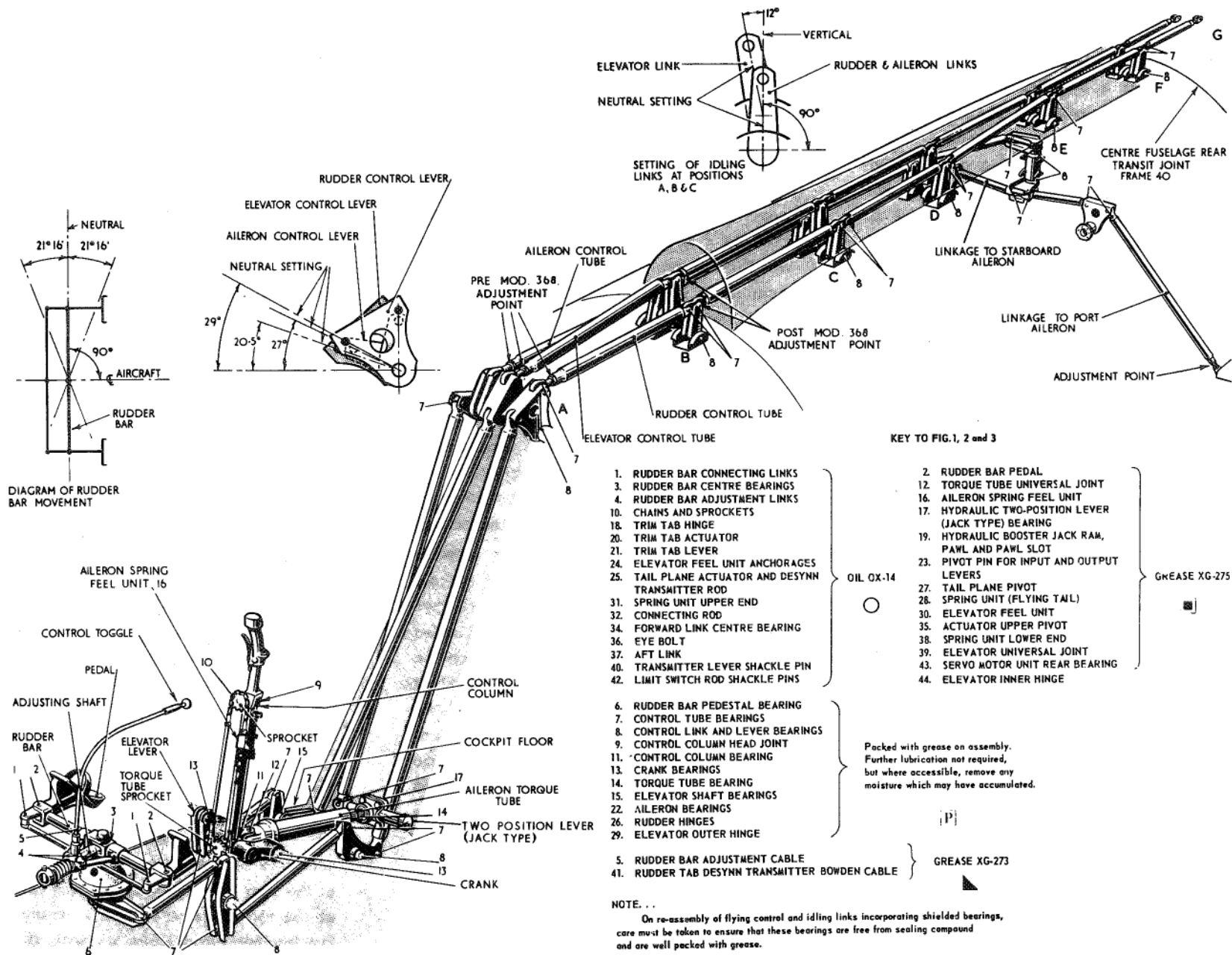


Fig.1 Flying controls with lubrication points (1)

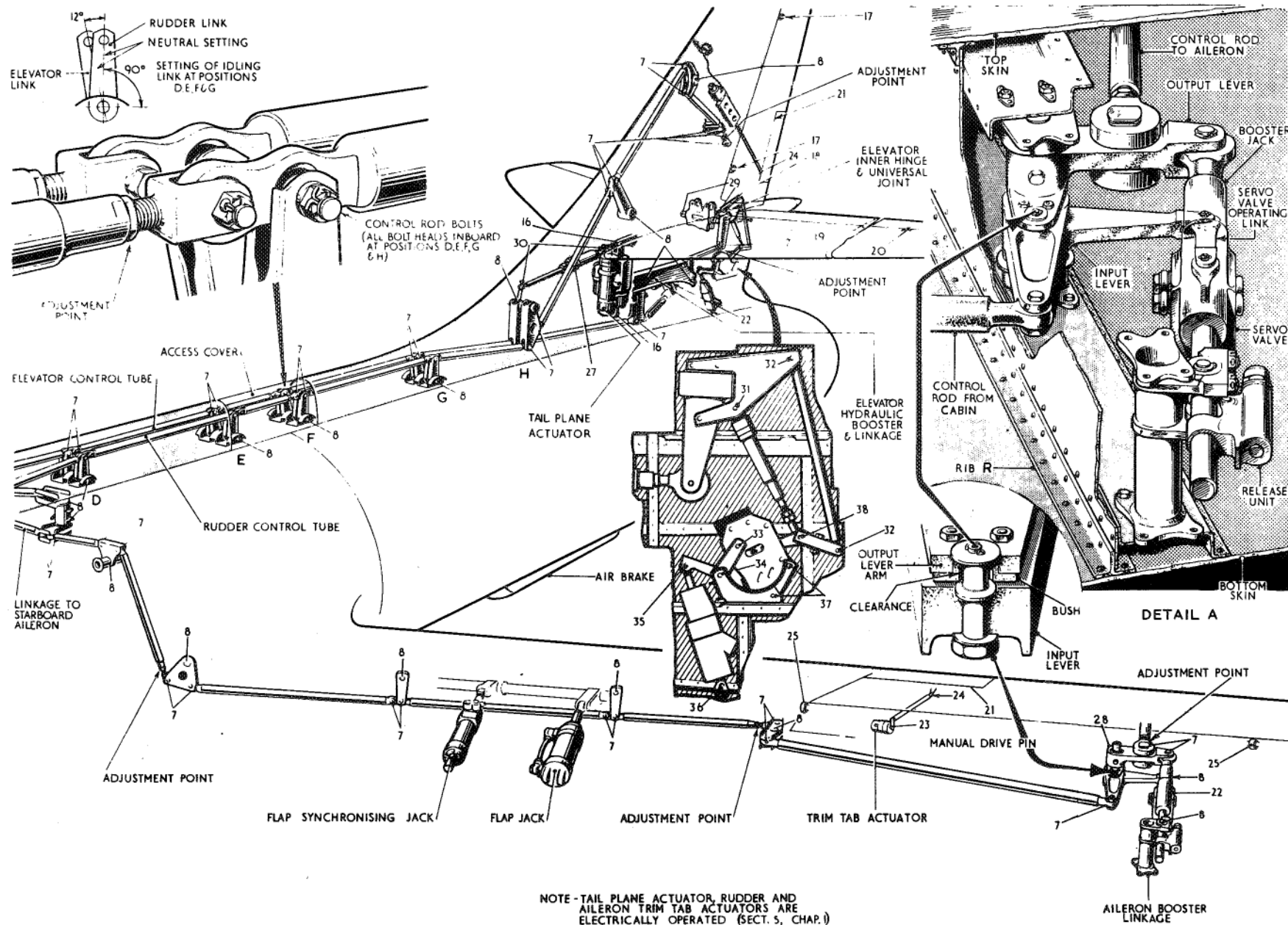


Fig.2 Flying controls with lubrication points (2)

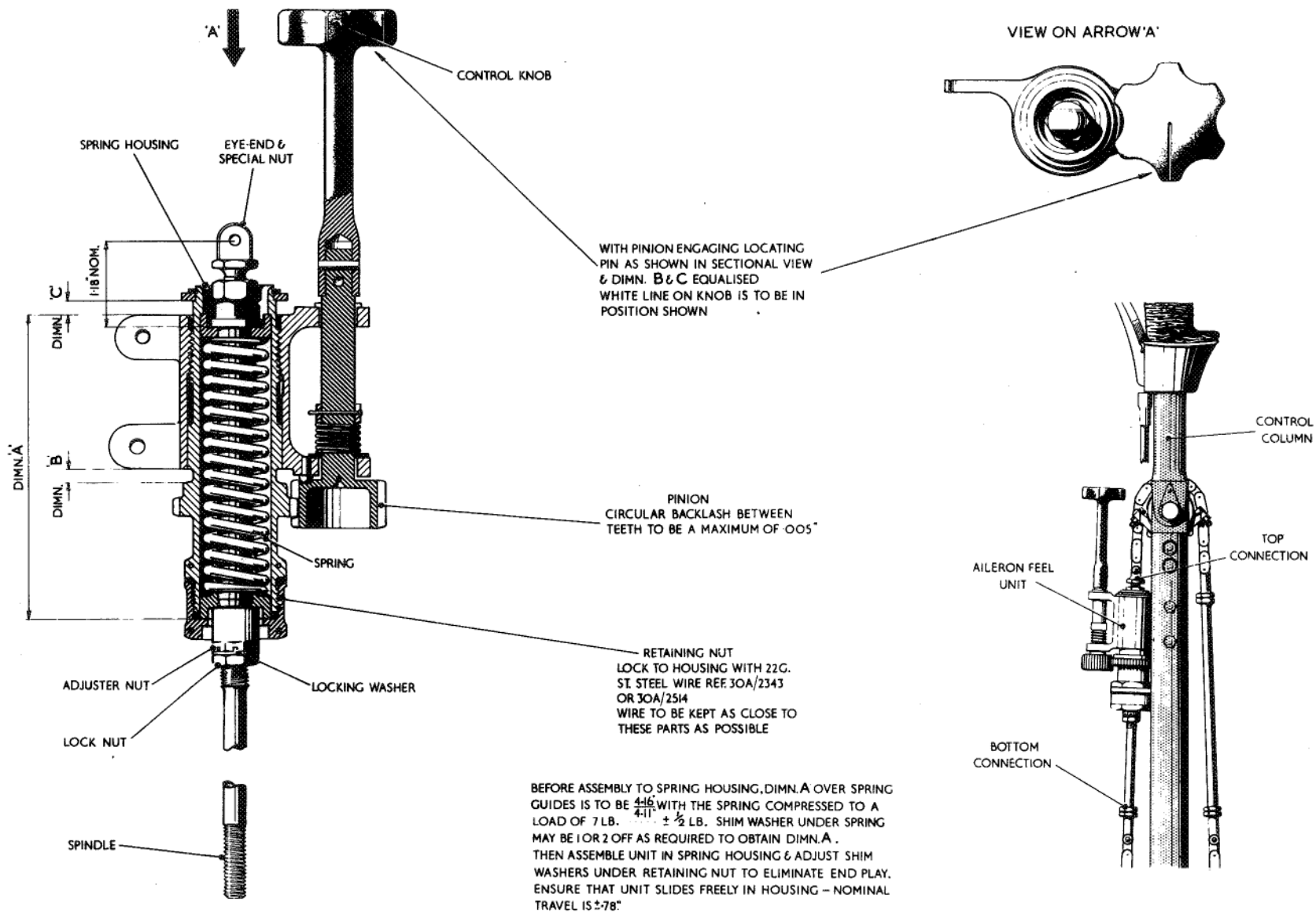


Fig.3 Aileron feel unit

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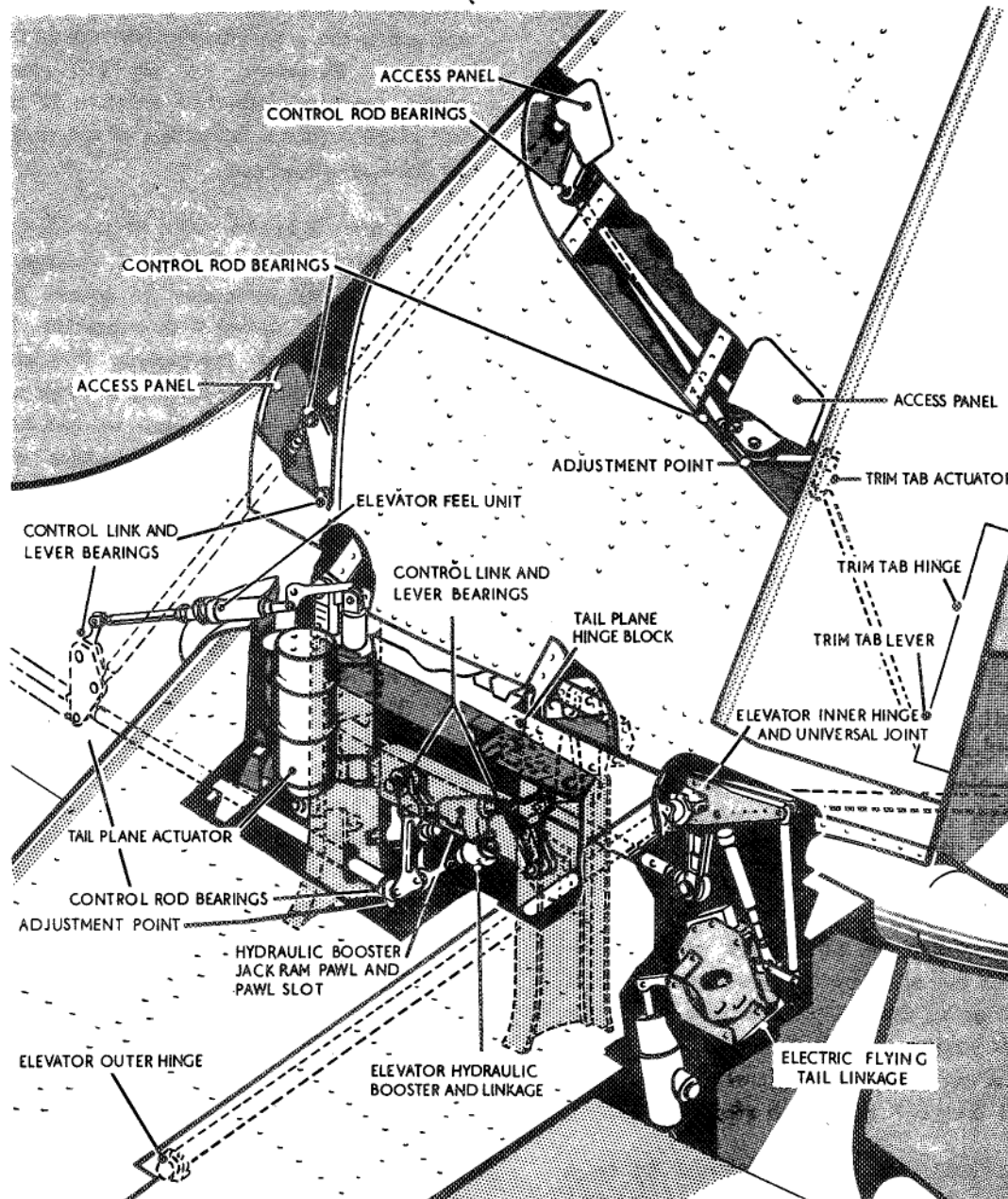


Fig.4. Controls in tail plane, fin and rudder

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 enables the switch to be operated, thus isolating 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 Sect.5, Chap.1 of this volume.

Electrically operated flying tail (Post-Mod.390)

9. 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 predetermined amount of tail plane and elevator movement in the manner described in the following paragraphs.

10. 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 central position 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 position, there is 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 $1\frac{1}{4}$ deg. through which it can move without operating the switches.

11. The pantograph type of linkage attached to the elevator incorporates a spring unit in the form of a telescopic strut (fig.12) which permits full and unrestricted control column travel even when either of the micro-switches are fully depressed; this 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.

12. Trimming for hands-off flight is accomplished by means of a small electric

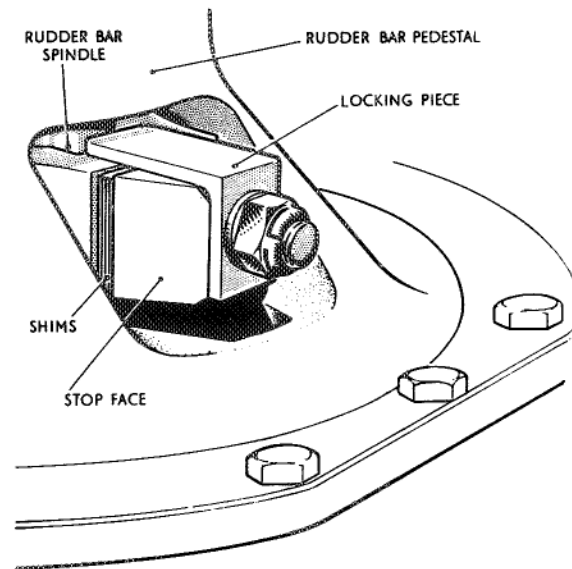


Fig.5. Rudder control stops

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 varies 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 centrally 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

13. 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.

14. 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)

15. 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). 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.

16. 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

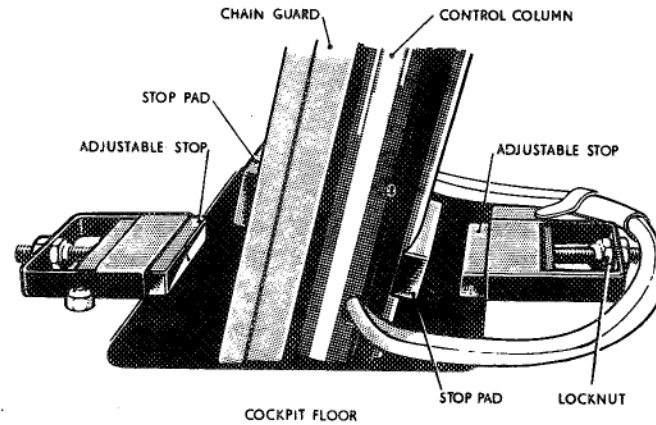


Fig.6. Elevator control steps

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

Aileron hydraulic booster controls (fig.2)

17. 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), 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 valve is operated by a link attached to a subsidiary lever integral with the input lever.

18. 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.16 of this chapter. At least two complete control column reversals are available before the accumulator is exhausted.

Operation of booster jacks

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

Rudder trim tab (fig.2 and 4)

20. 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)

21. 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 the port 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)

22. Hydraulically-operated landing flaps

(Sect.3, Chap.2) extend along the under-surface of each outer wing from the wing 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 on the port wheel bay and connected to the flap and follow up gear by a Bowden cable. The flaps are synchronized by a hydraulic interconnection, which is described in Chapter 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

23. An 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 to embrace 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

24. 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 on 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

25. 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 the tail plane neutral and tail plane jack selector switch at OFF, lock elevator input linkage at valve and check that maximum backlash at the control column is 1/16 in.
- (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 5 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.

26. For these tests the hydraulic rig should be run at a speed equivalent to 1,350 pump r.p.m. Check that the accumulators are fully charged. The main hydraulic pressure should not fall below 2,700 lb. per sq.in. when operating the controls normally.

Power on

- (1) With rig pump running select POWER ON, holding switches ON until locks are engaged. Check that the boosters engage on moving the stick and that the magnetic indicators clear when the 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 the 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.

TABLE I

Trim	Control Column Position	Tailplane Incidence		Elevator Angle Rel. to Tailplane	
		Max.	Min.	Max.	Min.
1. Neutral	Neutral	0	0	0	0
	Fully forward	As Max., t/p. control OFF *		7 deg. down	5½ deg. down
	Fully aft.	As Min., t/p. control OFF *		20½ deg. up	19 deg. up
2. Full Positive	(a) Fully forward	As Max., t/p. control OFF *		7 deg. down	5½ deg. down
	(b) Moved aft until tailplane just moves.	As reading at 2(a) +0 -2 min.		1.3/8 deg. up	1.1/8 deg. up
	(c) Moved aft to tailplane zero.	0	0	8 deg. up	7 deg. up
	(d) Fully aft.	- 1 deg. 52 min. - 2 deg. 12 min.		21½ deg. up	20 deg. up
	(e) Moved fwd. until tailplane just moves.	As reading at 2(d) +2 -0 min.		17 deg. up	15½ deg. up
	(f) Moved fwd. to tailplane zero.	0	0	6½ deg. up	5½ deg. up
3. Full Negative	(a) Fully forward	+ 10 min.	- 20 min.	9½ deg. down	8½ deg. down
	(b) Moved aft until tailplane just moves.	As reading at 3(a) +0 -2 min.		8½ deg. down	7½ deg. down
	(d) Fully aft.	As Min., t/p. control OFF *		20½ deg. up	19 deg. up
	(e) Moved fwd. until tailplane just moves.	As reading at 3(d) +2 -0 min.		2½ deg. down	½ deg. down

* These figures should be identical with those obtained when checking in accordance with the instructions laid down in para.33, sub-para.(2) and (3).

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- (8) Measure aileron movement up and down port and starboard. Check that, with the control column at neutral, there is no aileron down float and not more than $\frac{1}{2}$ deg. up float. Check for full and free movement of two-position aileron jack on selecting aileron power OFF and ON.
- (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 3 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 return smoothly to neutral 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 feel unit centres control column accurately when stick is deflected $\frac{1}{2}$ in. from centre and released.
- (15) Repeat (10) above after rest periods of one minute, three minutes and five minutes, then check:-
 - (a) That initial control column load does not increase after one minute of rest.
 - (b) 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 tail plane neutral, fully positive and fully negative. Return tail plane to neutral.

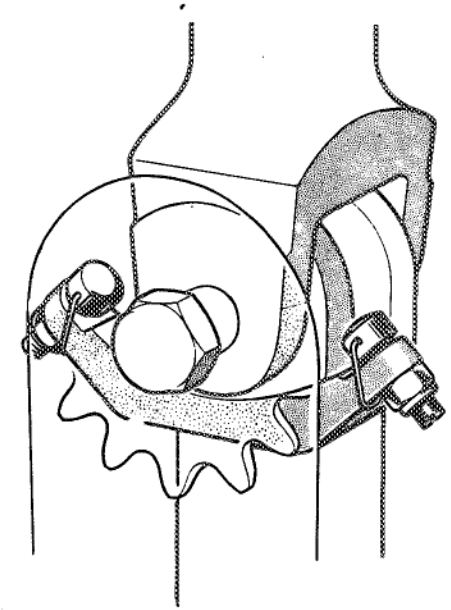


Fig.7. Aileron control steps

- (19) Move the tail plane jack selector switch to ON and, with neutral trim, measure tail plane and elevator angles at stick fully forward, fully aft.
- (20) Push up the control column trimming switch until extreme (fully positive) trim is obtained. Move stick aft until tail plane just moves and check that the elevator is $1\frac{1}{4}$ degrees \pm $\frac{1}{8}$ degree up. If it is not, trim slightly down and fully up again, until this angle is obtained. Measure tail plane and elevator angles with stick:-
 - (a) Fully forward.
 - (b) Moved aft until tail plane just moves.

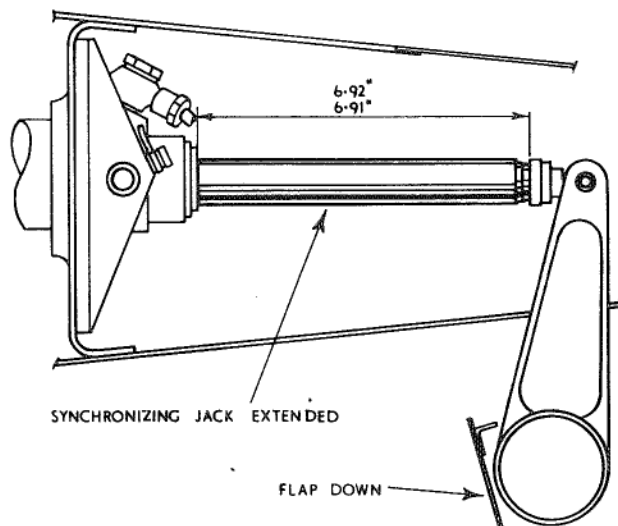


Fig.8. Flap synchronizing jack adjustment

- (c) Moved aft until tail plane is at zero incidence.
- (d) Fully aft.
- (e) Moved forward until tail plane just moves.
- (f) Moved forward until tail plane is at zero incidence. Check that the difference between elevator readings at (c) and (f) is $1\frac{1}{2}$ degrees to 2 degrees.
- (21) Push the trim switch down without biasing the stick until extreme (*full negative*) trim is obtained. Measure tail plane and elevator angles as in sub-para.20 (a), (b), (d) and (e).
- (22) Trim to 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 OFF 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:-

- (a) Undercarriage DOWN.
- (b) Undercarriage UP.

- (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 1,000 lb. per sq.in. The tail plane and elevator angles with the tail plane main control and elevator power switches ON, and with the A.1607 actuator fitted, should be as shown in Table 1.

Power control stability check

27. 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 returning smoothly to neutral, 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 that of 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

28. 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.25. The procedure for the adjustment of the control surfaces is given in the following paragraphs.

Rudder

29. 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 at the lever in the spine member and at the eye-end connected to the rudder lever. 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 given in fig.10 can be obtained with the rudder bar against its stops (fig.5); adjusted by shimming as necessary. When adjustment is satisfactory, tighten all locknuts.
- (4) Replace the spine member cover and the rudder operating lever access door.

Rudder trimming tab

30. The rudder trimming tab actuator is adjusted after the initial test flight to give neutral handling in the air with the cabin indicator set to neutral; this angle is quoted in the aircraft's form 700. Normally no further adjustment should be necessary; the operation should, however, 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 or removing shims from between the actuator and the rudder spar.

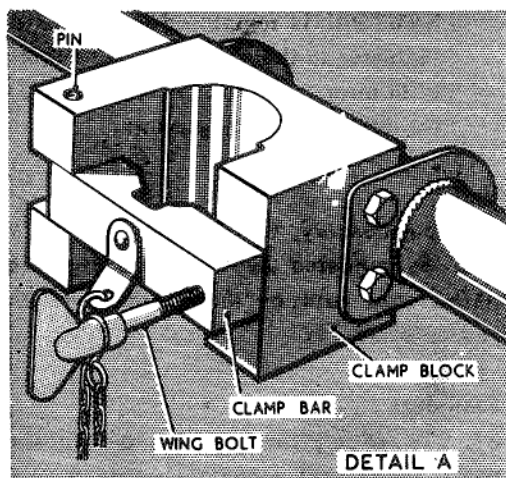
Elevators

31. 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.

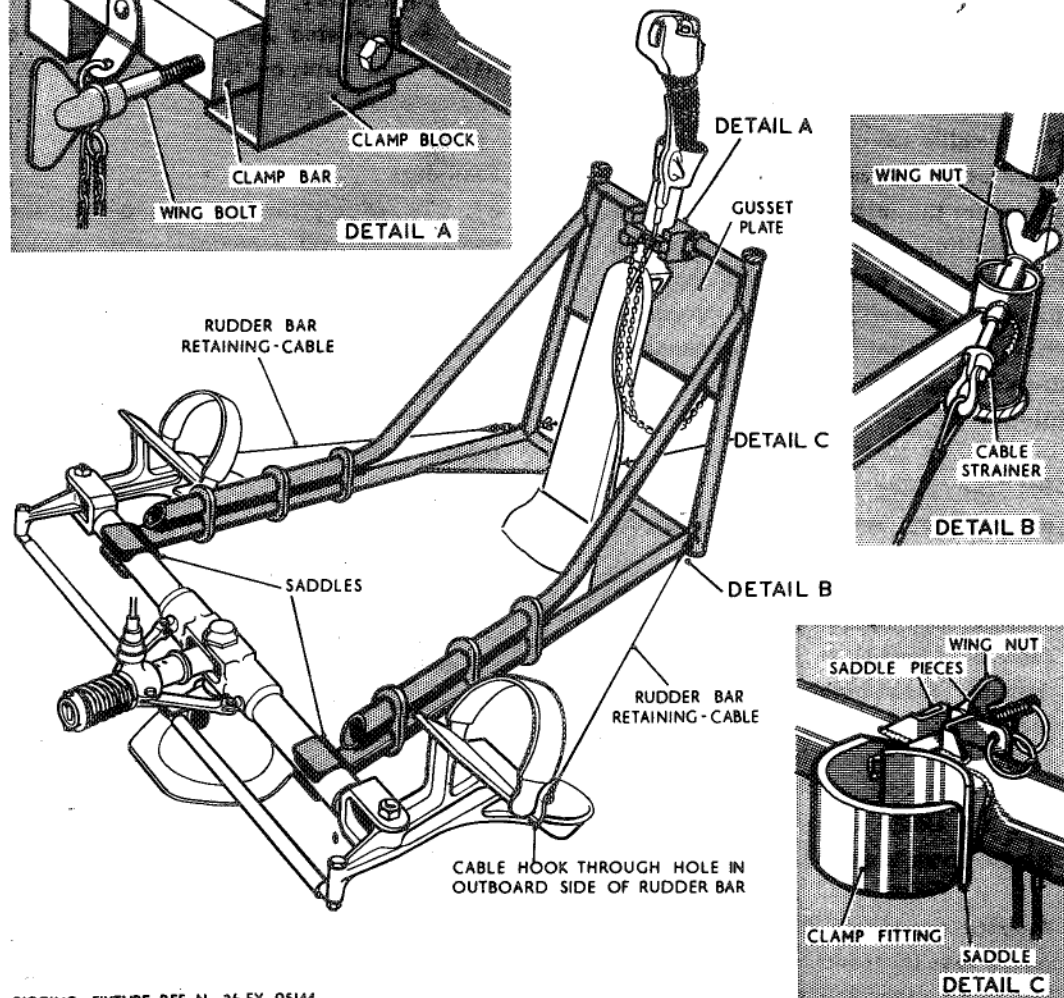
WARNING

When making adjustments to the elevator servo valve, spanners must only be used on the eye-end flats and lock nut and not on the flats of the valve spindle. Finally, an examination must be made to ensure that the pin securing the two halves of the two-piece spindle has not sheared during the process of adjustment.

- (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



THE FOLLOWING INSTRUCTIONS ARE PRINTED ON THE REAR FACE OF THE GUSSET PLATE
 IMPORTANT: RUDDER BAR CONTROL ON LEG PANEL IS TO BE UNLATCHED WHEN USING THIS RIGGING FIXTURE. PIN ON RUDDER BAR MUST BE OUT OF ENGAGEMENT



RIGGING FIXTURE REF. No.26 FX 95144.

Fig.9. Rigging fixture

(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 does not exceed that quoted in para. 25. 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 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

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as quoted in fig.10 with the tail plane in the neutral position.

32. 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 operation of the booster unit.
- (3) Reconnect the pipe to the release unit and engage the lock by applying hydraulic pressure. Check that the

valve eye-end is screwed in sufficiently to register in the safety hole.

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, if necessary.

- (5) Hold the control column at neutral and, with the tail plane at neutral incidence, check that the elevator is at neutral; if not, readjust 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 the feel unit connected and adjusted as described in para.45.
- (7) On completion of adjustment, lock the selector valve tab-washer, after observing the WARNING in para.31.
- (8) Check the controls for ease of movement. The load to move the elevator to be a maximum of 2 lb. in either direction. 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 as described in para.46.

- (10) Check that the control column load does not exceed that quoted in para.25 with the feel unit disconnected.
- (11) Re-attach the switch gear spring unit and the connecting rod to the 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 maximum downward movement of the stop pin. Tighten the fixing bolts.
- (12) Disconnect aircraft electrical supply to the datum trim actuator and connect a separate supply. Tail plane jack selector switch and elevator booster switch should be at OFF, and the 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 cabin shelf. Fully extend datum trim actuator. Move the tail plane jack selector switch to ON.
- (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 D to earth should be on) and contact E on the lower micro-switch broken (a lamp (2) between D and earth should be off). Connections may be made at T.B.79, terminals 5 and 4 respectively. 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 $1\frac{1}{4}$ 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 $1\frac{1}{4}$ deg. \pm $\frac{1}{4}$ deg. of elevator movement. Readjust as necessary and lock adjusting bolt.
- (16) Re-connect the datum trim actuator to the aircraft electrical supply, and with the stick free and the tail plane jack selector switch ON, re-engage the main tail plane circuit breaker. Check that the tail plane moves to fully positive incidence. If the tail plane stops before reaching fully positive, shorten the spring unit as required.
- (17) Move the control column aft and check that the tail plane actuator begins to retract before the elevator angle is +2 to 3 deg. relative to the tail plane. If the angle exceeds this value, lengthen the spring unit as required.
- (18) Trim to fully negative incidence with the stick free. Check that the tail plane remains in this position when

the trim switch is released. Negative incidence is not obtained. Lengthen the spring unit as far as possible, consistent with obtaining fully positive incidence. Secure spring unit lock-nut by wire lock, as shown in fig.12.

- (19) Move the tail plane jack selector switch to OFF, and with the control column at neutral, check that full tail plane movement is obtainable when the trim switch is operated.
- (20) Move the tail plane jack selector switch to ON, stick free, and note any tail plane movement that occurs. Re-select OFF and inch the actuators by operating the control column trim button sharply without disturbing the control column; then with the stick free, select ON and note the tail plane movement. Repeat this cycle six times. The greatest tail plane movement that occurs on selection of ON must not exceed 15 minutes of arc.
- (21) At neutral trim and with tail plane main control and elevator power switches OFF, raise the elevator by hand until the upper micro switch is open, then lower slowly and check that when the switch closes there is a clearance of at least 0.015 in. between the pin F.219509 and the upper edge of the hole in the switch carrier side plate (A.220794).

Tail plane incidence (normal)

33. 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 operational checks should be carried out to ensure that the correct travel is obtained:-

- (1) 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) With the jack selector switch OFF 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 cabin 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.

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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

34. 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 the 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 should be adjusted so that the aileron trailing edges have approximately 0.2 in. up-float.

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 centralize 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 the two-position aileron jack lever is fitted, proceed with operations (6) to (12).
- (6) With control tube (Part No.A.206734) disconnected, extend the adjustable eye-end on control tube (A.209620, Post Mod.368) or (A.180426 Pre-Mod.368) until it is just in safety.
- (7) Fit aileron lock (Part No.A.201031) and check that the control tubes and idling links in the run behind the flaps, in both wings, are symmetrical. If they are not, adjust at the ends of the cross tubes (Part No.A.169525) in the centre fuselage.
- (8) With the two-position jack aileron lever retracted (in manual), connect control tube (Part No.206734), allowing the jack to attain its natural position. Adjust the aileron output

rods so that the aileron trailing edges have approx. 0.2 in. upfloat.

- (9) Set the spring feel unit adjustment knob to neutral and disconnect the control column chain link from the eye-end at the top of the spring feel unit. Adjust the eye-end and the chain rods, without disturbing the spindle of the spring feel unit, until the control column is in the neutral position.
- (10) Re-connec the 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 not, re-adjust the chain as before until neutral is obtained.
- (11) Remove the aileron rigging lock, select 'power', and pressurize the hydraulic system by means of an external supply trolley.
- (12) Check that the control column is still in neutral.
- (13) Disconnect the external supply trolley. Set the control column stops so that 7 deg. minimum up and down aileron movement is obtained in manual. The maximum permissible difference between port and starboard movement is 1 deg. The maximum permissible difference between up and down movement is also 1 deg. Check that plus and minus 13 deg. of aileron movement is available in power. Neutral limits

on each aileron in power are UP ½ deg., DOWN 0 deg., i.e. no down float is permissible in power.

(14) Release the control column and check that the load at the middle of the control column handgrip to move the control column in either direction is less than 5 lb. If it exceeds this value, disconnect the input circuit at the booster units and check that the load at the middle of the handgrip to move the control column in either direction is less than 1½ lb. Check for friction at the aileron hinges by ensuring that, with output disconnected, the ailerons readily upfloat.

(15) Adjust the control column stops so that, temporarily, ± 6 deg. of aileron movement is obtained.

35. 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.

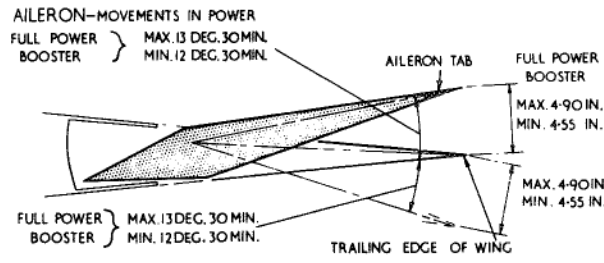
Preliminaries

(1) Open the servo-valve tab-washers on the port wing units and unscrew the locknuts. Attach a dial-spanner and an indicator (Part No.A.227530 and A.214536 respectively) to the port

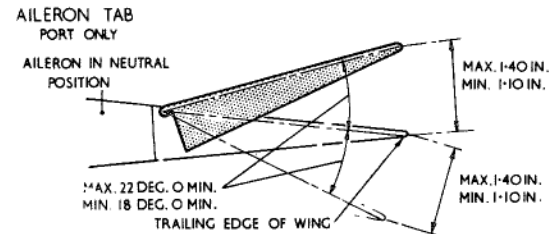
servo-valve spindle, and threaded eye-end respectively (fig.13). The spring feel unit must be in circuit and the stick must be free in manual for the full range between the lateral stops on the control column.

TABLE 2

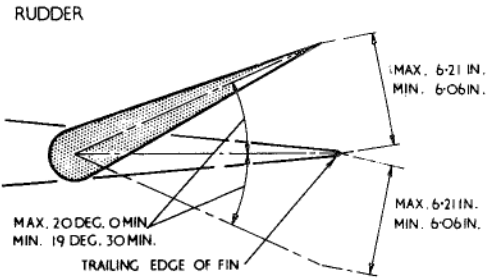
ADJUSTMENT OF SERVO-VALVE SPINDLE				ADJUSTMENT OF SERVO-VALVE SPINDLE			
PORT WING				STARBOARD WING			
A/C No.....				A/C No.....			
Aileron in UPPER SECTOR		Aileron in LOWER SECTOR		Aileron in UPPER SECTOR		Aileron in LOWER SECTOR	
Spindle turned Anti-clockwise (PANEL A)	Spindle turned Clockwise (PANEL B)	Spindle turned Anti-clockwise (PANEL C)	Spindle turned Clockwise (PANEL D)	Spindle turned Anti-clockwise (PANEL A)	Spindle turned Clockwise (PANEL B)	Spindle turned Anti-clockwise (PANEL C)	Spindle turned Clockwise (PANEL D)
MID-POINT OF ABOVE 2 SETS OF READINGS		MID-POINT OF ABOVE 2 SETS OF READINGS		MID-POINT OF ABOVE 2 SETS OF READINGS		MID-POINT OF ABOVE 2 SETS OF READINGS	
.....						
MID-POINT OF ABOVE TWO READINGS (i.e. FINAL SETTING OF ADJUSTMENT)				MID-POINT OF ABOVE TWO READINGS (i.e. FINAL SETTING OF ADJUSTMENT)			
DATE.....				DATE.....			



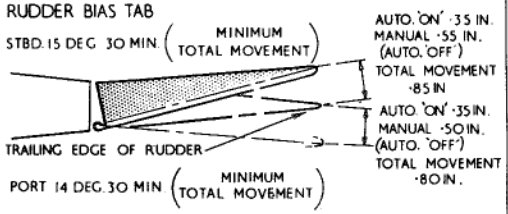
ANGLES NORMAL TO AILERON HINGE LINE DIMENSIONS AT JOINT OF AILERON AND WING
 MAX. PERMISSIBLE BACKLASH MEASURED AT TRAILING EDGE .15 IN. (IN POWER)
 MOVEMENTS IN MANUAL—APPROX. 6 DEG. LESS



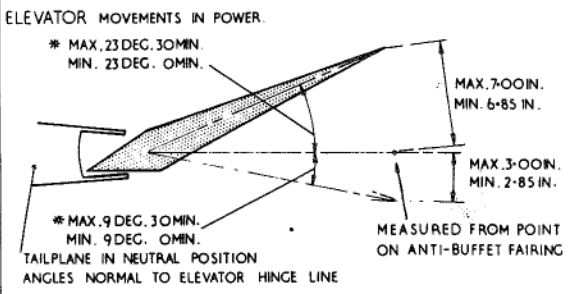
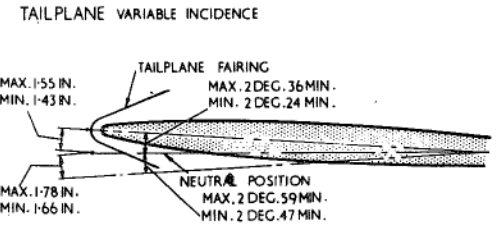
ANGLES NORMAL TO TAB HINGE LINE, DIMENSION AT INBOARD JOINT
 NOTE — A MAXIMUM ADJUSTMENT OF ± .40 IN. AT TRAILING EDGE IS NOT TO BE EXCEEDED ON THE TAB NEUTRAL POSITION WHEN THE INDICATOR IN CABIN IS SET AT ZERO



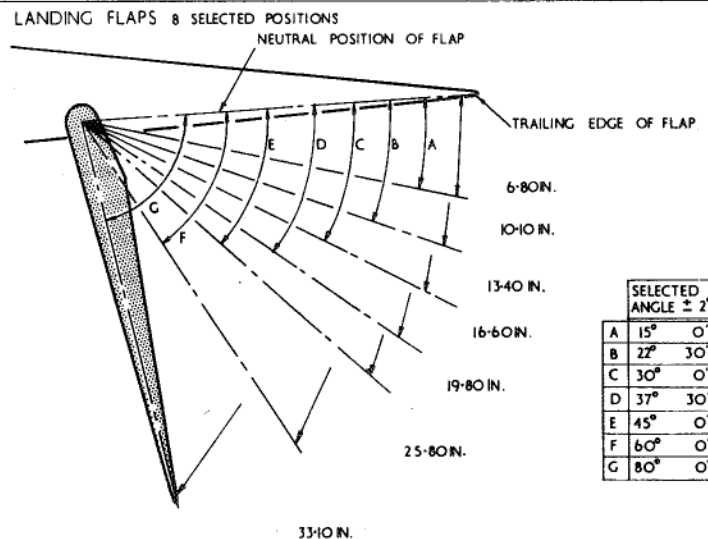
ANGLES NORMAL TO RUDDER HINGE LINE DIMENSIONS AT LOWER JOINT OF FIN AND RUDDER
 MAX. PERMISSIBLE BACKLASH MEASURED AT TRAILING EDGE .20 IN.



ANGLES NORMAL TO TAB HINGE LINE DIMENSIONS ± .05 IN.



BACKLASH AT EXTREME TRAILING EDGE WITH ELEVATORS IN NEUTRAL POSITION TO BE MAX. .13 IN. .03 IN. MIN.
 * ANGLES APPLY WITH SPRING FEEL UNIT CONNECTED



SELECTED ANGLE ± 2°	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

MAXIMUM TOLERANCE AT EACH POSITION ± 0.75 IN.

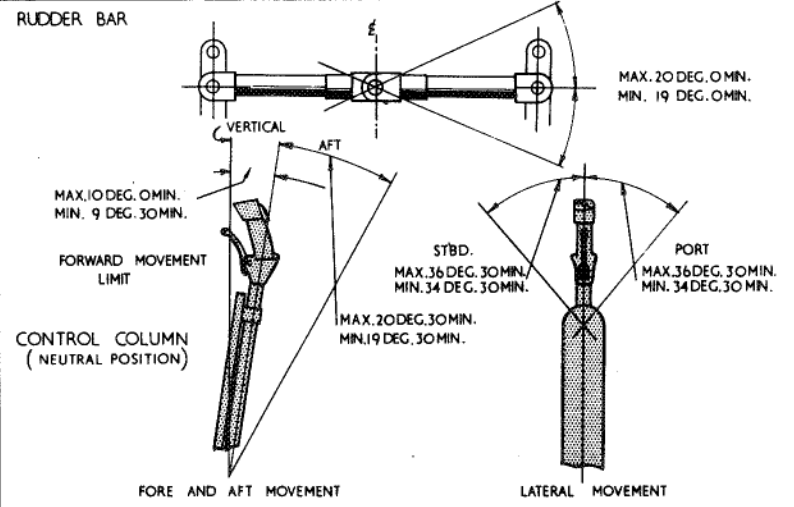


Fig10 Control Surface Settings

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- (2) Switch on the hydraulic rig.
- (3) Engage the locks by pushing up or pulling down on the aileron trailing edges.
- (4) Operate the ailerons through 20 full reversals to expel any air in the circuit. If the system is maladjusted to the extent that the control column will not operate the ailerons in power, make temporary adjustments at the valve spindles to render operation possible.

Adjustments

- (1) Turn the dial anti-clockwise, causing the aileron concerned to rise. When the trailing edge of the aileron is about $2\frac{1}{2}$ in. above its neutral position, halt it by a small clockwise movement of the dial.
- (2) Turn the dial anti-clockwise again until the aileron begins to creep up slowly. While it is still creeping, read the dial and record in Column A of a form such as is shown in Table 2.
- (3) By means of a small clockwise movement of the dial, return the aileron to the position of $2\frac{1}{2}$ in. above the neutral setting and repeat operations (1) and (2) until a series of three readings within 0.03 of a turn are obtained. (*Inconsistent readings indicate that the aileron is being allowed to creep at different speeds, or that air is still present in the system*). Record the readings and enter the average figure at the foot of Column A.
- (4) Once again halt the aileron $2\frac{1}{2}$ in. above the neutral position and then turn the dial clockwise a little until the aileron creeps down towards the neutral position, at the same time ensuring that the same creep speed is maintained throughout the operation. Read the dial and record in Column B.
- (5) Calculate the mid-point between Columns A and B and record in the panel below them.
- (6) Rotate the dial through approximately $2\frac{1}{2}$ turns. (*The aileron will come down to neutral in the first half-turn*). Halt the aileron about $2\frac{1}{2}$ in. below the neutral position and repeat operations (2) to (4) for this position in the lower sector. (*While turning clockwise, 100 must be added to the reading each time the 'zero' passes the indicator*). Calculate the mid-point between Columns C and D and record in the panel below them.
- (7) Finally, calculate the mid-point between the final figures obtained in operations (5) and (6). (*The difference between the mid-point of Columns A and B should be between 230 and 290*). Record at the foot of the form. Check the figure by adding up Columns A, B, C and D and dividing by four. Turn the dial back (anti-clockwise) about $1\frac{1}{4}$ turns onto this reading. Tighten up the lock-nut and turn over the tab washer.
- (8) Obtain the full range of aileron movement, as given in fig.10 by adjusting the stops (*fig.7*) on the control column.
- (9) 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.
- (10) 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 $\frac{1}{2}$ deg. up and 0 deg. down, i.e., no down float is permitted in power.
- (11) Check the controls for ease of movement. Movement should be smooth throughout the range and the control column should return to neutral when released.
- (12) 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 distance between "up" and "down" movement is also 1 deg.

Note . . .

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

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Aileron trimming tab

36. 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 level flight with the cabin indicator set to neutral; 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.
- (5) Using the cabin control, set the Desynn indicator to read zero and check that the trimming tab is set to the correct angular position as given on the aircraft's form 700. If it is not, adjust the length of the rod connecting to the trimming tab until the correct setting is obtained. Repeat these procedures whenever an aileron or trimming 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 trimming tab at the basic setting.

WARNING

When setting the Desynn indicator to neutral, the trim tab must not exceed the limits shown on fig.10, i.e. ± 0.40 in. from neutral with the aileron at its neutral setting as described in para.36, sub-para. (1).

Landing flaps

37. 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 synchronizing jacks as described in para.38. The linkage for the drum switch and flap position indicator transmitter should also be checked and adjusted, as described in para.39.

Checking flap synchronizing jacks

38. 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.37, 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 synchronizing jack from the flap levers.
- (2) Fully extend the synchronizing jacks by use of the handpump and check that the dimension given in fig.8 is obtained between the points indicated.

- (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) Reassemble the jacks to the flap levers.⁸
- (5) Provided that the above instructions are correctly carried out, the synchronizing 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

39. 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 figure 3 coincide. Re-tighten 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

40. 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 the clearance is correct.
- (6) After adjustment, re-tighten the lock-nut 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)

41. This micro switch is operated by the air brake port hinge arm 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)

42. 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

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a clearance of 0.02 in. 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

43. This micro switch is operated by the lever of the undercarriage emergency air valve when the valve is in the 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

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

Elevator spring feel unit

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

- (1) Screw adapter into housing until dimension A (*fig.11*) is 0.085 in. approx.
- (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 to 0.002 in. to 0.005 in.

- (3) If necessary adjust adapter to obtain this condition and fit laminum washer (Pt.No.F.206976), thickness to suit. Lock adapter to housing with 22 s.w.g. stainless steel locking wire DTD.161 or 189, with ends of wire finished with lead seal.
- (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.

Note . . .

The length of the unit under load may vary between 27.75 in. and 29.25 in. The unit must operate smoothly between these limits.

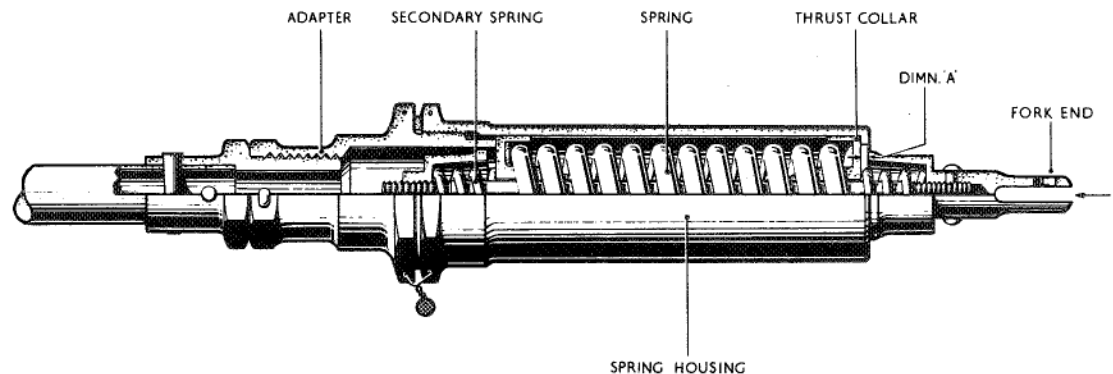


Fig. 11. Elevator spring feel unit

**Setting of hydro-booster release unit
micro switches**

46. If an aileron or elevator booster, or a release unit micro switch is changed, or is being replaced after removal, the release unit micro switches must be adjusted and set as follows:-

*Aircraft with Pye type switches
(Pre-Mod.684)*

- (1) Render the aircraft electrically safe (Sect.5, Chap.1).
- (2) Remove the access panels (Sect.2, Chap.4, fig.2) as necessary to gain access to the appropriate unit (aileron or elevator booster assemblies).
- (3) Disconnect and blank off the hydraulic pipe to the banjo attachment on the release unit.
- (4) Connect up hydraulic and electrical rigs (fig.14).
- (5) Ensure that the ram slot and mating parts of the pawl, the micro switch button and its mating face, are clean and free from grease.
- (6) Insert the 0.035 in. slip gauge (fig.14) between the pawl and the bottom of the ram slot. By means of the rig handpump (fig.14) apply a hydraulic pressure of 550 to 650 lb. per sq.in. so that the slip gauge is just clamped by the pawl. Set the micro switch to indicate engagement, i.e., lamp 1 (and lamp 2 when used) should be illuminated. Lamp 3 should be out. Lock adjustment bolts.

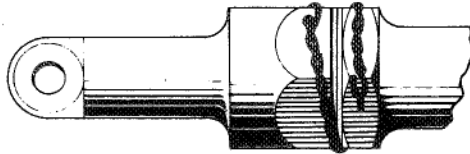
- (7) Release pressure, re-apply a pressure of 550 to 650 lb. per sq.in. and check that the setting is unchanged.
- (8) Release pressure and replace the 0.035 in. slip gauge with the 0.040 in. slip gauge. Apply a pressure 550 to 650 lb. per sq.in. so that the gauge is clamped by the pawl and check that the switch does not operate, i.e., lamps 1 and 2 remain out and lamp 3 illuminated. If the switch operates, repeat operations (6), (7) and (8) until the correct setting is obtained.
- (9) Release pressure slowly and check that at 150 lb. per sq.in. the pawl is clear of the ram slot, disregarding the lead-in to the slot.
- (10) Switch off, disconnect the test equipment and restore the system to normal. Top up the hydraulic reservoir and bleed the circuit. Check the hydraulic reservoir for correct level again and, if necessary, top up again.
- (11) Check the fail/safe characteristics of the aileron booster units port and starboard, as follows:-
Hold the control column 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 the switch and check that both pawls are fully out and that the indicator in the cabin shows power failure. Repeat this test sequence for the opposite aileron.

*Aircraft with Downmic switches (modified
to Hawker Pt.No.F.230401 - Post Mod.684)*

- (a) Proceed with operations (1) to (5) inclusive.
- (b) Insert the 0.043 in. slip gauge between the pawl and the bottom of the ram slot. By means of the handpump, apply a hydraulic pressure of 550-650 lb. per sq.in. so that the slip gauge is clamped by the pawl. Move the micro switch in by turning the knurled knob until lamps 1 and 2 just illuminate. Move the micro switch out until disengagement is indicated, i.e., lamp 3 should be illuminated, and lamps 1 and 2 out. (If more than ¼ turn of the knob is required on moving the micro switch out, the switch should be examined for excessive differential, max. 0.015 in.). Lock the micro switch in position.
- (c) Release pressure, then re-apply a pressure of 550-650 lb. per sq.in. with the 0.043 in. test gauge still in place. Depress the micro switch plunger by hand until lamps 1 and 2 are illuminated. Release plunger slowly and check that lamp 3 is illuminated and that lamps 1 and 2 are out when the plunger is resting on the release unit ram. Ensure, by moving the plunger sideways, that it is fully out.
- (d) Release pressure and replace the 0.043 in. slip gauge by the 0.038 in.

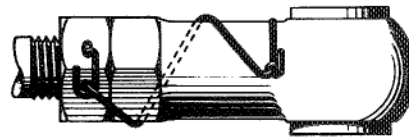
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METHOD OF LOCKING TOP EYE-END TO SPRING HOUSING WITH DTD 189 OR 161 22G ST. STEEL LOCKING WIRE



DETAIL 'A'

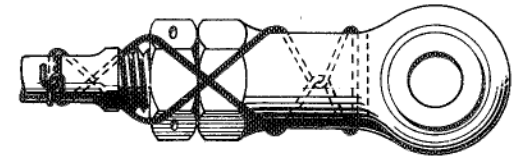
METHOD OF LOCKING EYE-END TO LOCK NUT WITH DTD 189 OR 161 22G ST. STEEL LOCKING WIRE



(VIEW ON ARROW)

DETAIL 'B'

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



DETAIL 'C'

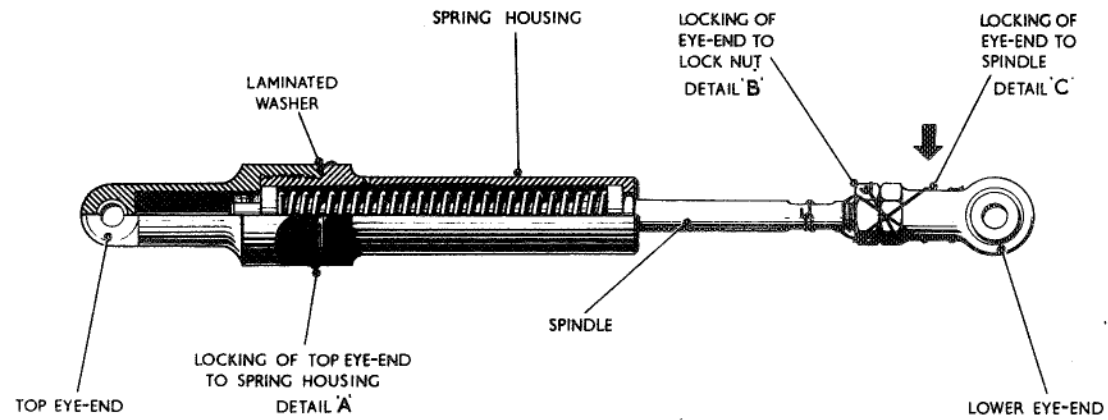


Fig.12 Spring unit - Flying tail switch gear

slip gauge. Re-apply a pressure of 550 to 650 lb. per sq. in. and depress the micro switch plunger by hand until lamps 1 and 2 are illuminated. Release plunger slowly and check that lamps 1 and 2 remain illuminated and that lamp 3 is out when the plunger is resting on the ram.

- (e) If the switch does not operate correctly, repeat operations (b), (c) and (d) until the correct setting is obtained. Release pressure slowly and check that at 150 lb. per sq.in. the pawl is clear of the ram slot, disregarding the lead-in to the slot.
- (f) Re-apply pressure slowly and check that by the time that a pressure 500 lb. per sq.in. is reached, the micro switch indicates engagement, i.e., lamps 1 and 2 are illuminated.
- (g) Proceed with operations (10) and (11) above.

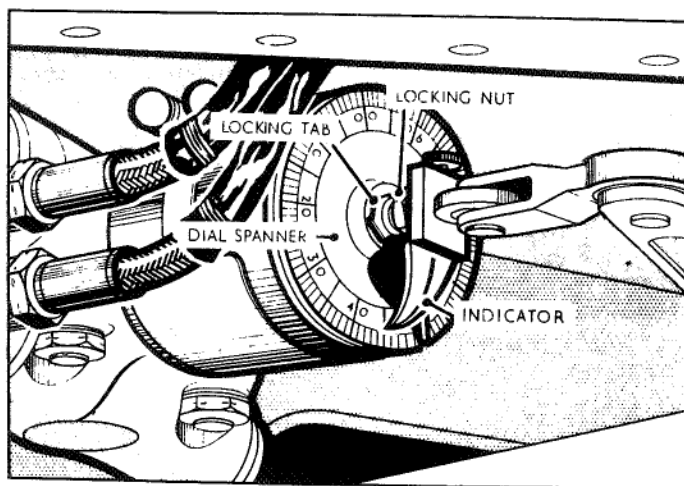


Fig.13. Adjusting aileron booster units

Replacement of flying tail switch gear micro switches

47. When it is found necessary to change either of the micro switches of the flying tail switch gear, the switch carrier must be removed from the aircraft. The procedure for the removal of the switch carrier and the replacement of the micro switches is as follows:-

- (1) Set the tail plane to zero incidence.
- (2) Render the aircraft electrically safe (Sect.5, Chap.1).

- (3) Remove the access panel from the port side of the fin beneath the tail plane.
- (4) Remove the tail cone (Sect.3, Chap.1).
- (5) Remove the bullet fairing.
- (6) Remove the pins securing the upper ends of the spring unit (Part No. B.211414) and the connecting rod (Part No. A.211409) to the lever (Part No. B.211413) on the elevator.
- (7) Remove the two bolts securing the guard to the switch carrier and remove the guard.
- (8) Remove the pin securing the ram eye-end of the datum actuator to the switch mechanism.
- (9) Disconnect the eight leads from the switch carrier at T.B.79 on the rear face of frame 56.
- (10) Disconnect the cable assembly R.18 from the datum actuator.
- (11) Connect an external electrical supply of 28 volts through a switch to pins A and C of a three pin socket (Ref. No.10H/19070) and plug into the datum actuator. Operate the switch to retract the actuator ram fully.
- (12) Remove the two bolts securing the switch carrier to the upper ends of the links on the mounting bracket.
- (13) Remove the nut and bolt securing the retaining channel and two pins securing the spring unit and connecting rod.

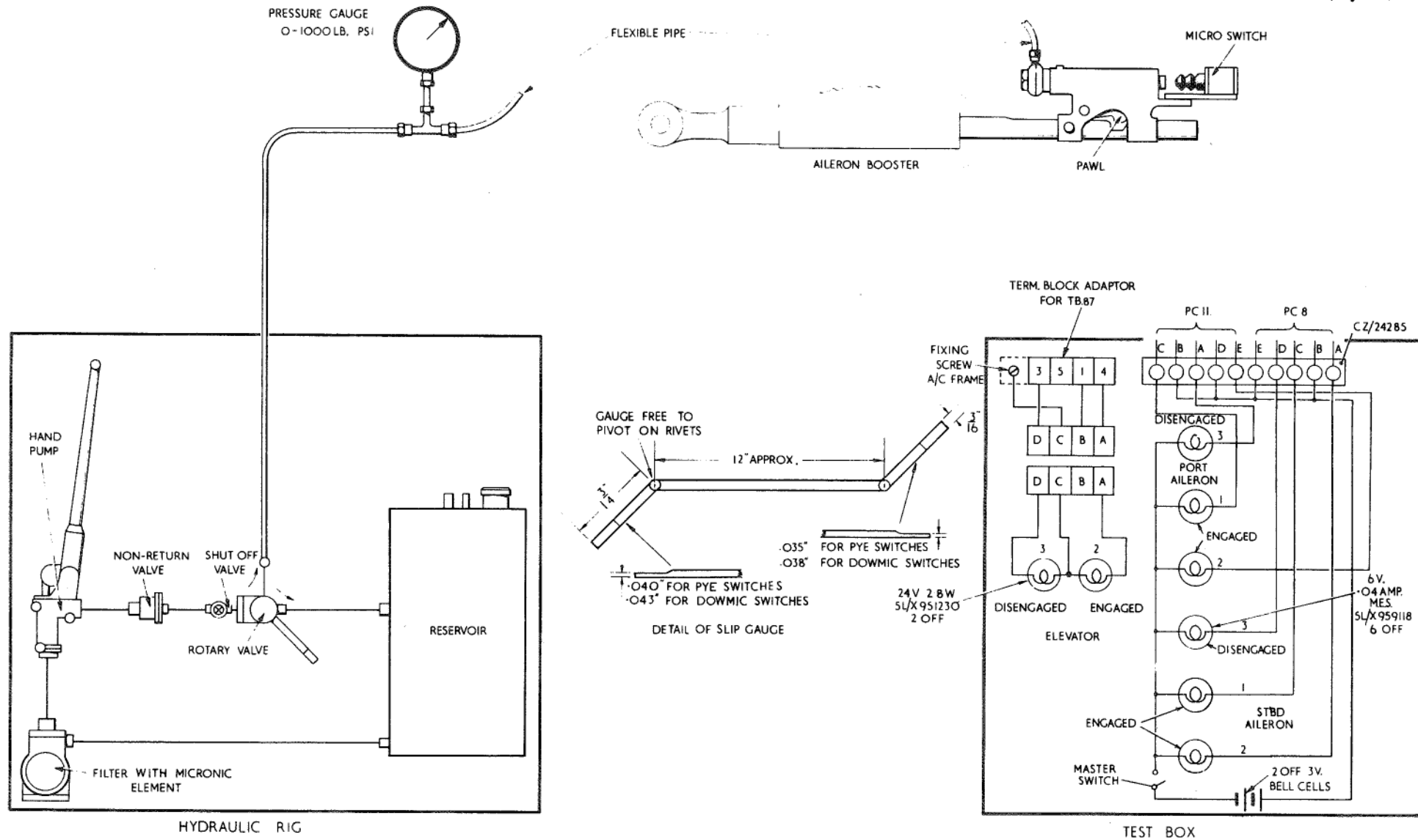


Fig.14 Setting of hydro-booster release unit micro switches

- (14) Remove the spring unit and connecting rod.
- (15) Remove the switch carrier complete with micro switches.
- (16) Replace the defective micro switch.
- (17) Set the lower micro switch to make contact when the stop pin (Part No. F.219509) is moving towards the switch and is 0.020 in. \pm 0.005 in. short of the fully downward position, using locally-manufactured round-section feeler gauges.
- (18) Tighten the switch securing bolts and
- check that the setting of the lower switch is unaltered.
- (19) Refit the switch carrier, spring unit and connecting rod to the aircraft and secure.
- (20) Connect an external electrical supply of 28 volts to pins A and B and, using a switch, fully extend the datum actuator, ensuring that the ram does not foul adjacent parts.
- (21) Reconnect the actuator ram eye-end and secure the pin.
- (22) Reconnect the eight micro switch
- leads at T.B.79. Ensure that the cable is not fouling the stop pin.
- (23) Re-attach the guard.
- (24) Carry out the operations detailed in para.32, sub-para.(12) to (21) and para.26, sub-para.(19) to (24) inclusive.
- (25) Disconnect external rigs.
- (26) Replace tail cone and bullet fairing.
- (27) Restore the aircraft electrical services to normal.
- (28) Replace the access panel on the port side of the fin beneath the tail plane and secure.

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