Chapter 4D FLYING CONTROLS – RUDDER

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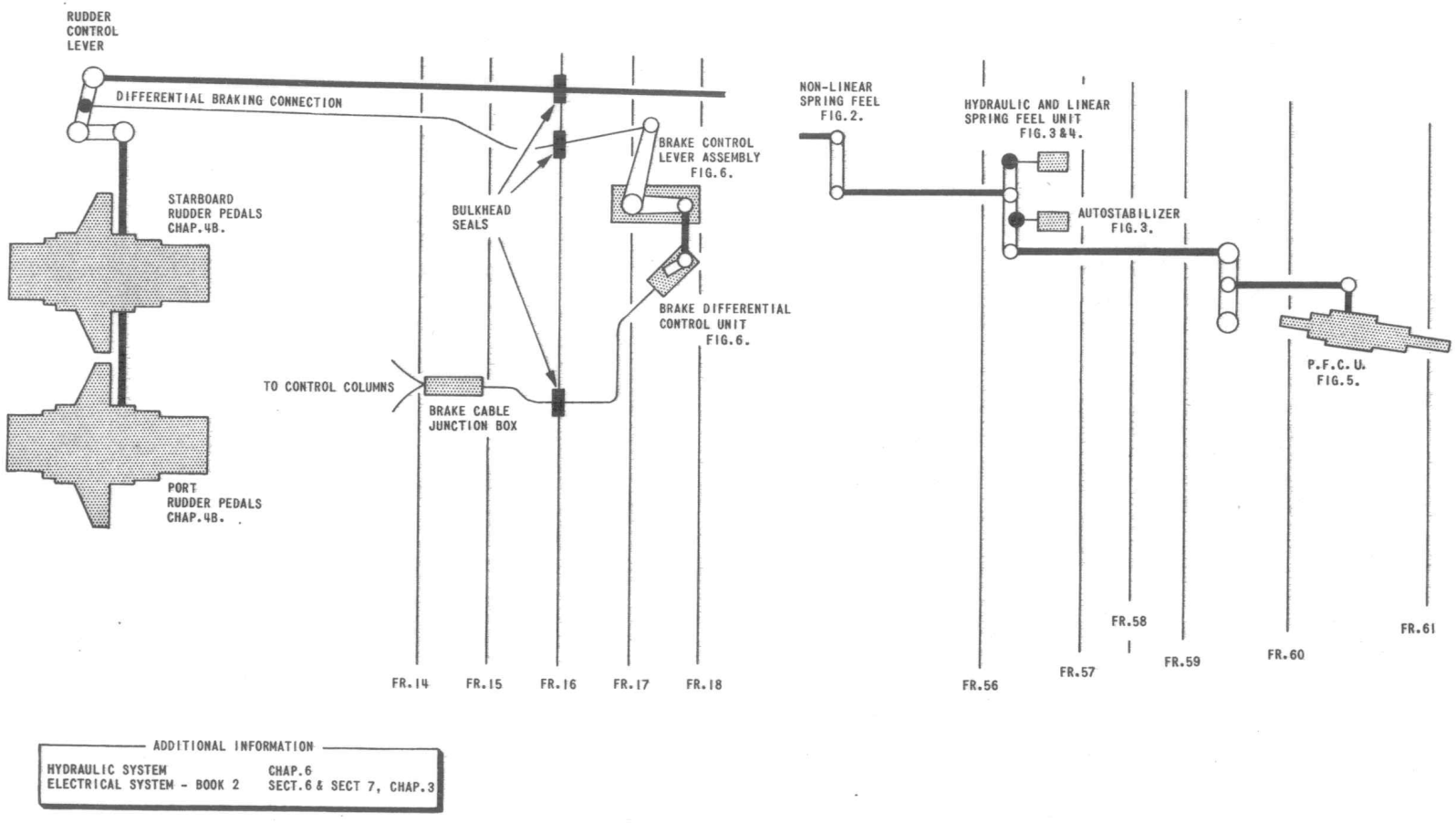

ADDITIONAL INFORMATION

HYDRAULIC SYSTEM	CHAP.6
ELECTRICAL SYSTEM - BOOK 2	SECT.6 & SECT 7, CHAP.3

FIG. 1. SYSTEM LAYOUT (MECHANICAL)

E2101-2

DESCRIPTION

General information

1. The rudder is moved by a p.f.c.u. which is controlled through a rod-and-lever system connected to the rudder pedals for normal rudder operation; through an electro-hydraulically operated autostabilizer for flight control system signals, and through a cockpit switch-controlled, electrically-operated, actuator for out-of-trim corrections. Inertia forces, set up in the control run due to rapid changes in forward speed, are off-set by a balance weight fitted to the port pedal in each rudder bar assembly. A hydraulic damper, which also constitutes the upper hinge, damps any tendency toward rudder flutter. Artificial feel is provided by a spring feel unit and a combined spring-and-hydraulic feel unit *(fig.2 and 4)*, the latter being subject to pressure from the feel simulator.

P.f.c.u.

2. The p.f.c.u. is fitted with the ram connected to the fuselage and the body extension connected to the rudder-operating lever. Follow-up movement of the control unit body, in response to movement of the input-valve lever by the control run, progressively re-centralizes the input-valve lever and automatically stops rudder movement when the original signal is satisfied.

Rudder damper unit

3. The damper unit, which also forms the upper hinge of the rudder, is a simple vane-type hydraulic shock absorber. The damper is filled with oil and movement of the centre-shaft, connected to the rudder via a splined end-fitting, moves the shaft-vanes towards fixed vanes on the inside of the damper casing. The movement of the shaft-vanes is resisted by the trapped oil which can escape only through restricted orifices in the vanes. When fitting a damper unit reference must be made to the Warning in Chap.3, fig.5.

Artificial feel

Hydraulic feel (fig.3 and 4)

4. A sense of feel is primarily produced by a hydraulic feel unit linked into the control run to impose loading on the rudder bar. The feel unit is subjected to metered hydraulic pressure from the feel simulator control unit *(Chap.6)*. As this pressure varies relative to the speed and altitude of the aircraft, so the feel unit imposes a varying feel sense on the rudder bar.

Linear spring feel (fig.4)

5. The linear spring feel unit consists of two pairs of double-coil springs attached to the hydraulic feel unit, and assists in providing centring forces and a sense of feel to the rudder bar; it continues to do so should hydraulic failure occur.

Non-linear spring feel (fig.2)

6. The non-linear spring feel unit, connected by chains and sprockets to the lever located between frames 50 and 51, applies centring forces and a sense of feel to the rudder bar. Spring-loaded rocker arms mounted on a shaft are displaced when the shaft is rotated by the lever, the resultant spring tension and compression loads offering a calculated resistance to rudder bar displacement.

Hydraulic feel cancellation

7. Hydraulic feel, on both rudder and tail-plane controls, can be cancelled by operation of the feel selector switch. An alighting gear DOWN selection automatically cancels rudder hydraulic feel; conversely, feel is automatically restored when an UP selection is made.

Hydraulic feel unit *(fig.4)*

8. The major components of the hydraulic feel unit are a cylinder body containing a piston assembly, with an operating lever assembly pivoting on the cylinder body. Movement of the operating lever is transmitted through a crank lever to move the piston. The cylinder body is held by the trim actuator ram so that movement of the operating lever displaces the piston which is held at one extreme of its travel (its neutral position) by hydraulic pressure. When the rudder pedals move the operating lever either way from the trimmed position, it displaces the piston against the hydraulic pressure. When the load is removed from the rudder pedals, the piston moves back to its neutral position, returning the rudder and rudder pedals to their trimmed position. Additionally, springs attached to the extension of the cylinder body and to the operating lever, assist the hydraulic pressure and, in hydraulic failure, continue functioning to provide spring feel and centring action.

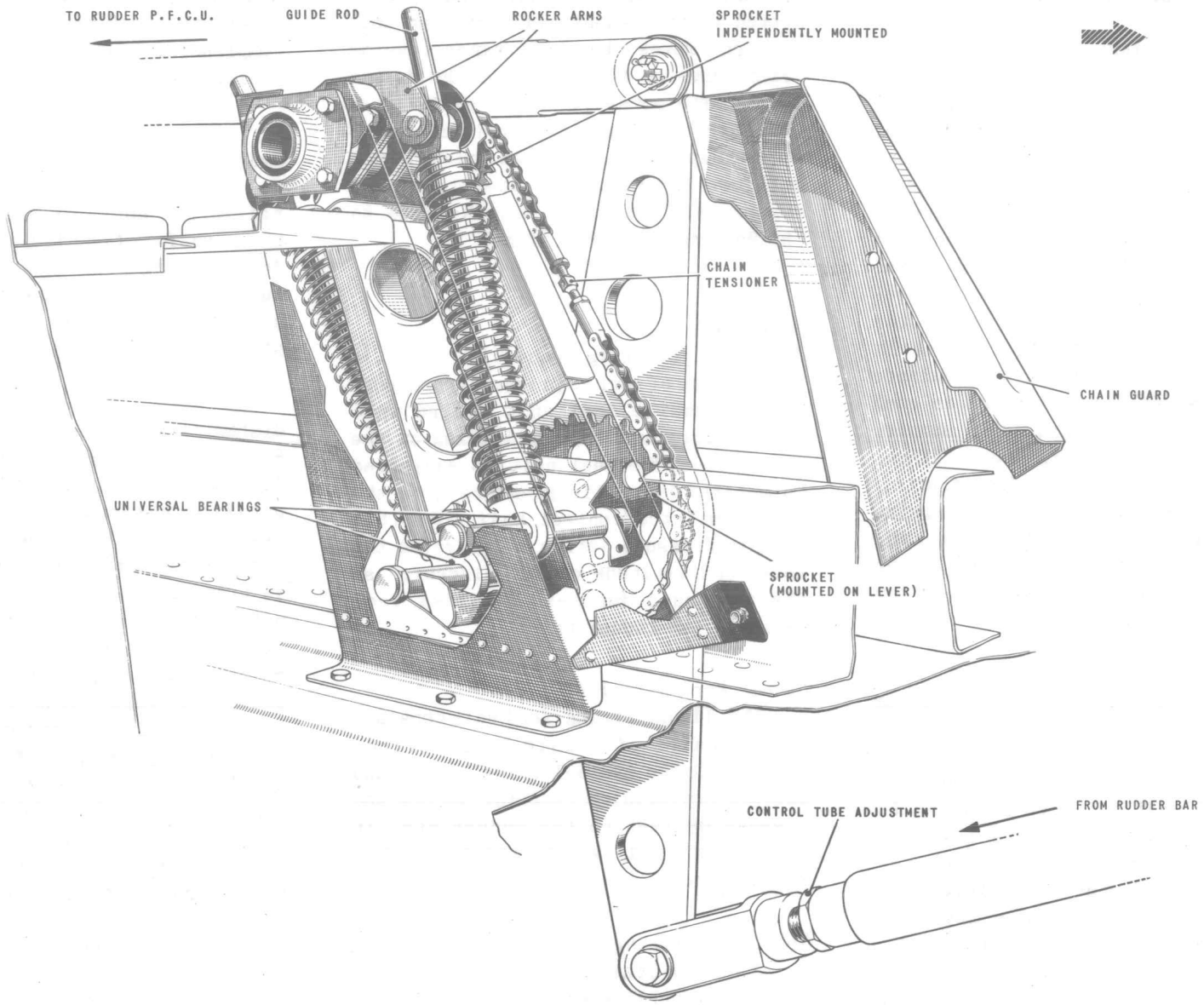

FIG.2. NON-LINEAR SPRING FEEL MECHANISM

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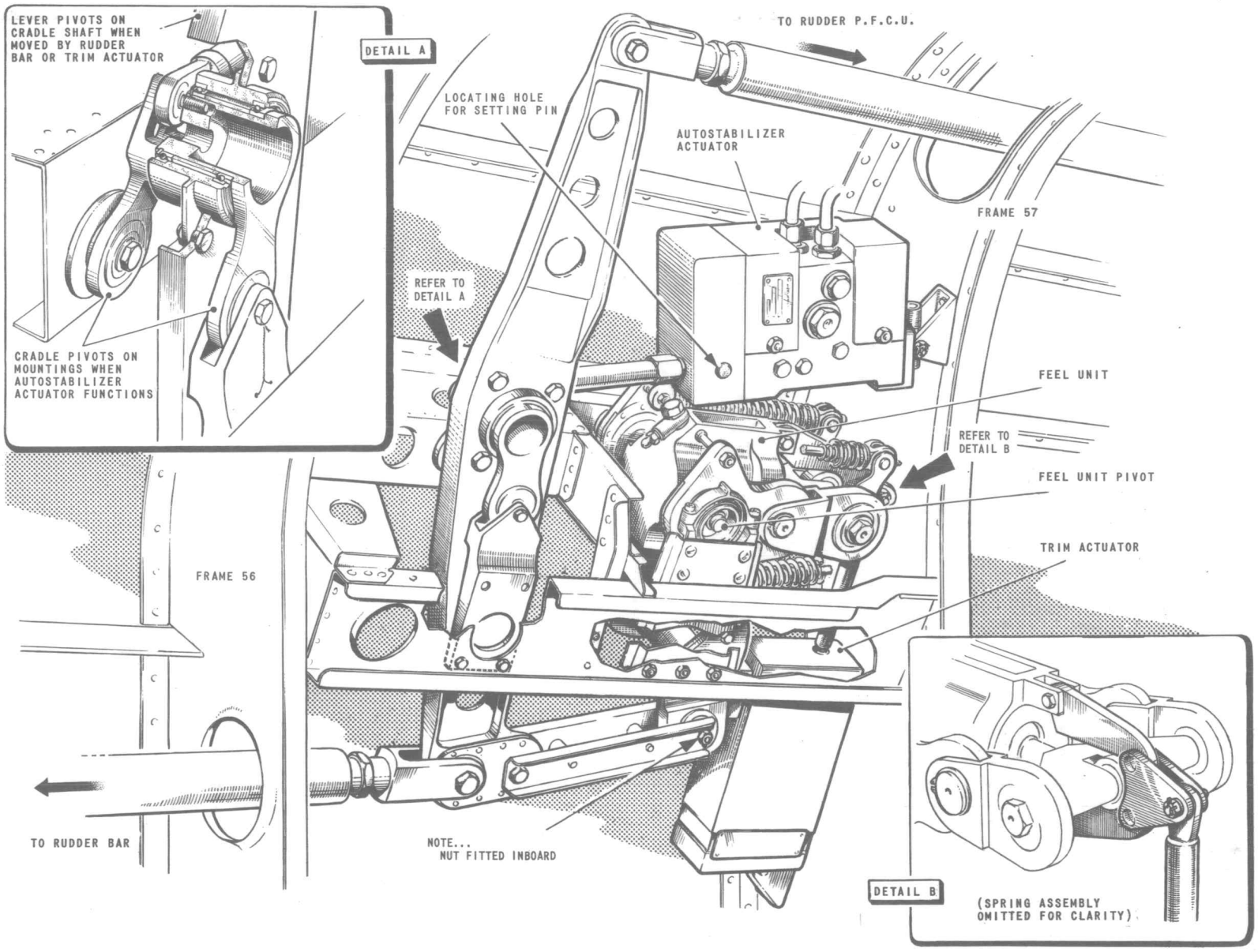

FIG. 3. FEEL, TRIM AND AUTOSTABILIZER - ACTUATOR INTERCONNECTION

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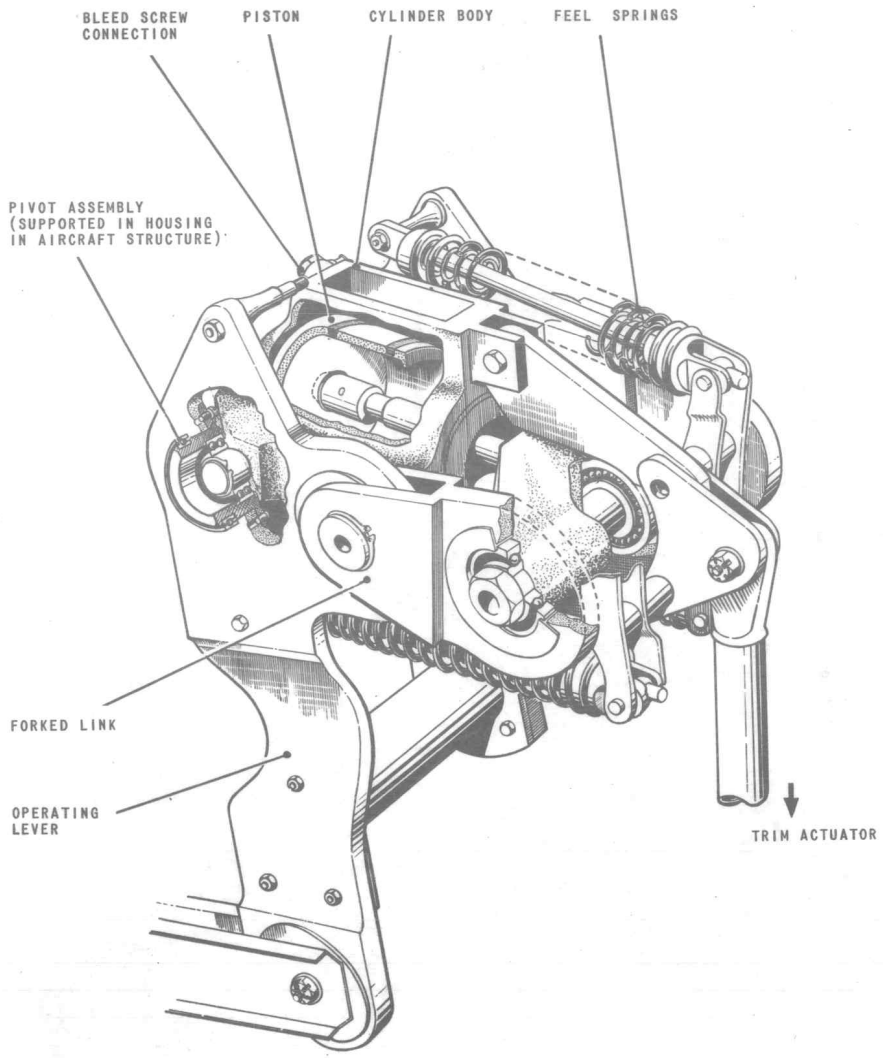
◀ BOLT REVERSED. NOTE ADDED ▶



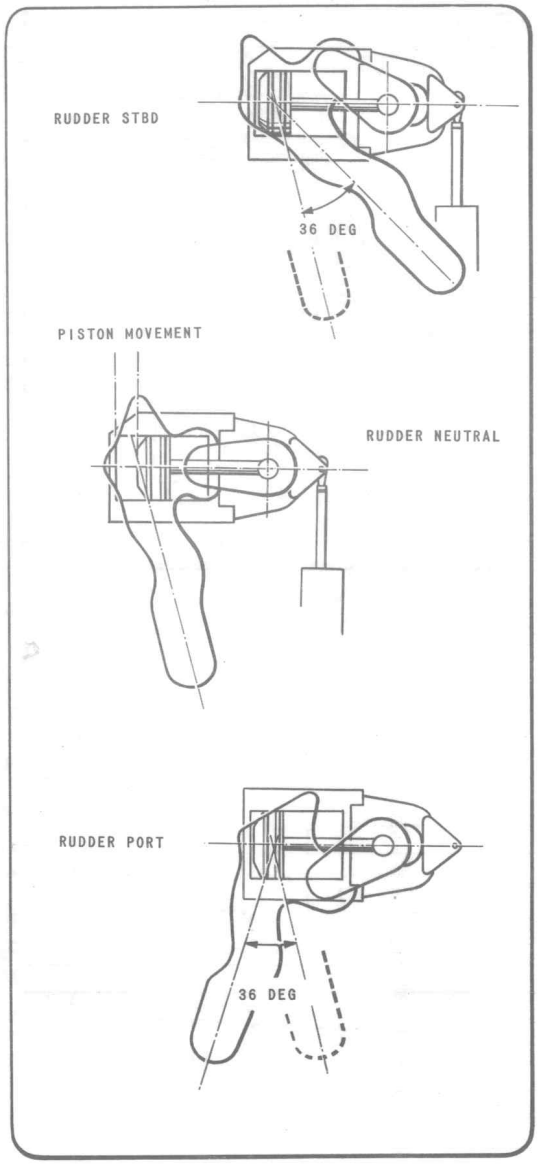


FIG.4. HYDRAULIC FEEL UNIT

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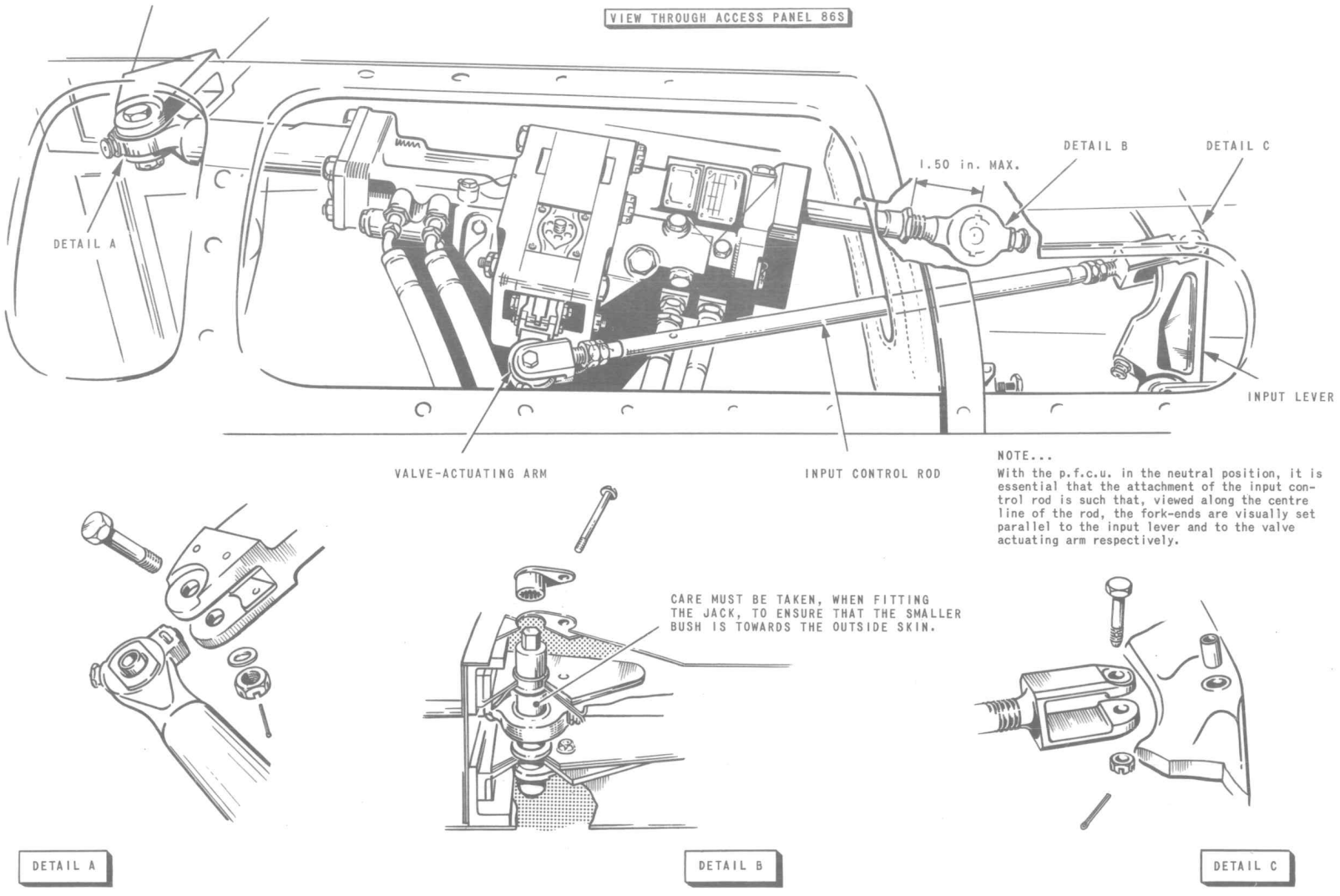

FIG.5. P.F.C.U. INSTALLATION

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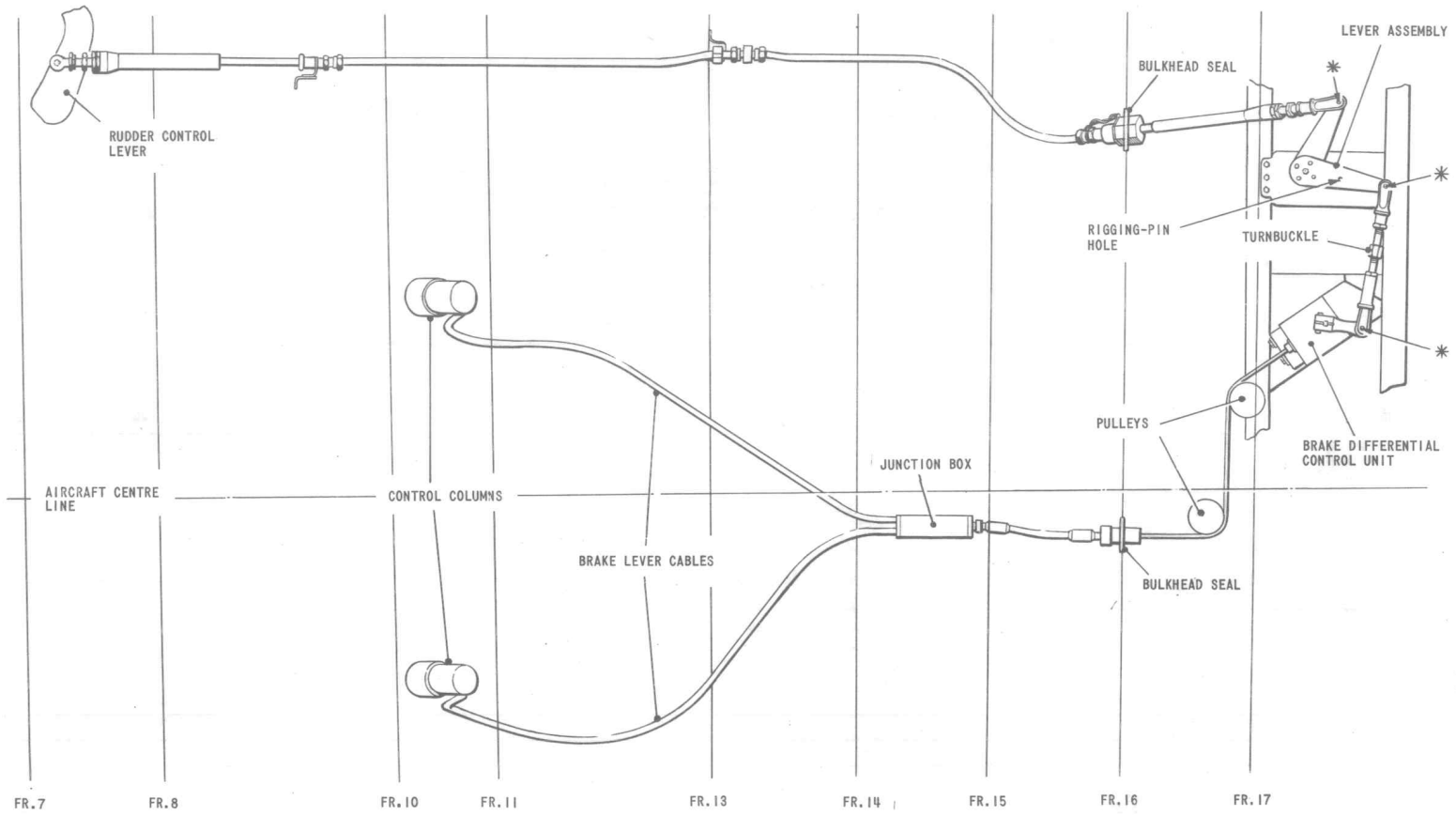


NOTE...

1. BOLTS INDICATED THUS * MUST BE FITTED HEAD UPPERMOST
2. CABLE RUNS MUST BE CHECKED AFTER SERVICING TO ENSURE NO KINKS OR SHARP BENDS EXIST

FIG. 6. DIFFERENTIAL BRAKING MECHANISM

E2082-2

Trimming *(fig.3)*

9. The electrically-operated trim actuator is controlled by two dual switches above the port and starboard consoles respectively. Extension or retraction of the actuator ram displaces the feel unit which acts as a cranked lever. The interconnection of the feel unit with the vertical lever, forward of frame 57, causes the control run to the rudder bar, and to the rudder control unit, to be moved.

Autostabilizer actuator *(fig.3)*

10. The autostabilizer actuator is operated by pressure from the services hydraulic system is response to amplified electrical signals from the auto-pilot. The body of the unit is connected to the airframe structure, and the ram is secured to the cradle assembly at the lever assembly forward of frame 57 *(para.11)*. Linear movement of the ram moves the control rods to the rudder control unit without displacing the rudder bar.

10A. Jury struts may be fitted in place of an unserviceable autostabilizer actuator when no replacement item is available, and otherwise serviceable aircraft are required to fulfil operational requirements *(para.35)*.

Feel, trim, and autostabilizer-actuator interconnection *(fig.3)*

11. The hydraulic feel unit, the trim actuator and the autostabilizer actuator, are interconnected at a lever assembly between frames 56 and 57 on the starboard side of the fuselage. The lever can be displaced by independent movement of the rudder bar, autostabilizer actuator, or the trim actuator. Movement of the rudder bar, or of the trim actuator operating through the feel unit, turns the lever about its fulcrum on the cradle shaft *(detail A)*, the latter being held by the autostabilizer actuator ram. Movement of the autostabilizer actuator, however, displaces the cradle shaft, pivoting the cradle assembly about its mounting to the air-craft structure and moving the lever which pivots about its connection to the rudder bar control rods. Opposing the pilot's input connection, at the lower end of the lever, a link connects to the lever arm of the feel unit; the trim actuator is connected to the body of this unit, so that linear movement of the actuator ram moves the vertical lever about its fulcrum as when displaced by movement of the rudder pedals.

Differential braking mechanism *(fig.6)*

12. The differential braking mechanism is linked into the control run by a Teleflex cable connected to the rudder control lever between frames 7 and 8 and a lever assembly between frames 17 and 18. The lever assembly is connected to the differential brake control unit by a turnbuckle which is used for setting the control unit in relation to the lever assembly. A second cable, from the control unit, passes through a pressure seal at frame 16, down the aircraft centre-line and enters a junction box between frames 14 and 15. From the junction box two cables run forward one to each brake control lever on the control columns. The differential control unit, lever assembly and cable assemblies aft of the pressure bulkhead are accessible behind access panel 14S; the remaining assemblies are accessible in the cockpit.

◀ **Cooling**

12A. The area between frames 56 and 57 containing the rudder hydraulic feel unit and by-pass valve is subject to high temperature generation. Cooling air is introduced via a ram-air cowl mounted on access panel 76S to maintain an acceptable component working temperature. ▶

SERVICING

WARNING

The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cockpit or performing any operation upon the aircraft.

Note . . .

1. Use the starboard rudder pedals for all functioning checks unless otherwise stated.

2. Whenever servicing trolleys are being used to operate hydraulic systems, air pressure of 16-18 lb/in^2 must be applied to the reservoirs.

Lubrication

13. Details of lubrication are shown in fig.7 and the key to lubricant and application symbols, together with their full designations, are to be found in Leading Particulars. All control rods are designed to run dry in their roller guides and are not to be lubricated.

Tools and equipment

14. For tools and equipment used in servicing and removal and assembly operations refer to Table 5.

Replenishing the rudder damper unit

15. Refer to Chap.3.

TABLE 1 CONTROLS RIGGING

CHECKS

(A) Operate tail plane until all pressure is exhausted from tail plane and rudder, No.1 and No.2 controls accumulators (rate not to exceed one stroke between stops in five seconds.)

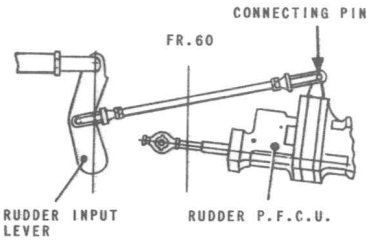
(B) Remove pin connecting input control rod to valve actuating lever.

(C) Fit neutral setting rig to stbd. rudder bar.

(D) Connect hydraulic servicing trolleys to controls and services systems and an electrical servicing trolley.

① ADJUSTMENTS IF NECESSARY

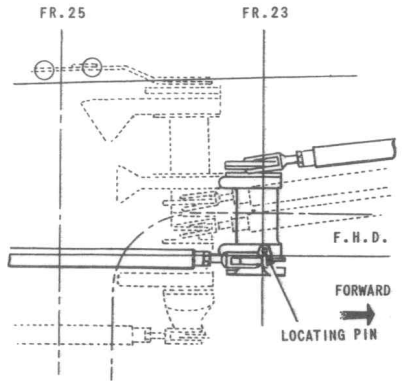
(B)



(C) Refer to Chap.4B for fitting neutral setting rig.

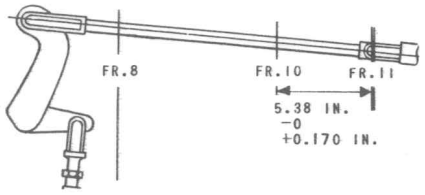
CHECKS

(A) Fit a locating pin in non-linear gearing mechanism (access panel 26S)

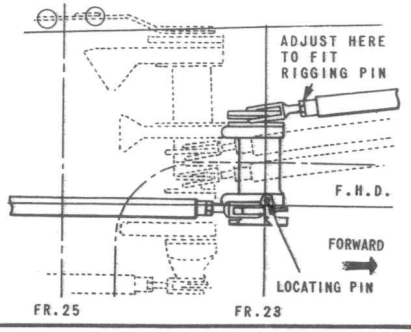


② ADJUSTMENTS IF NECESSARY

(A) If pin will not enter, check lever at fr.7-8 for correct setting and adjust control rod if necessary.

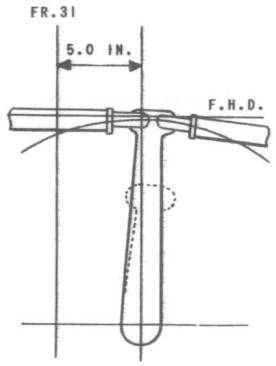


If pin will still not enter, adjust control rod at non-linear gearing mechanism.

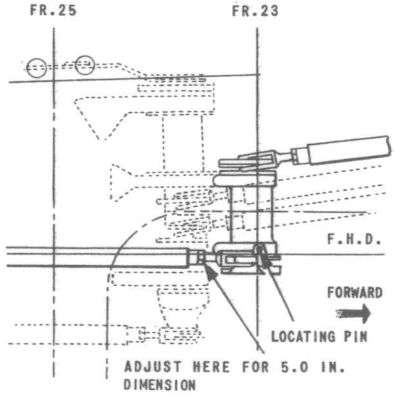


③

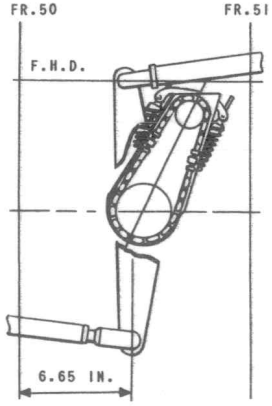
(A) Check setting of lever at fr.31



(A) If setting is incorrect adjust control rod connected to lower lever on non-linear gearing mechanism.



(A) Check setting of lever at fr.50-51.



④

(A) If setting is incorrect:-

Disconnect both control rods from lever and remove chain guard from spring assembly.

Slacken 4 B.A. locknuts on chain tensioners and adjust i.e. shorten one and lengthen the other until the correct setting is obtained.

Reconnect, adjusting if necessary lower control rod and then connect upper control rod.

Secure locknuts and wire-lock tensioners; refit chain guard over assembly.

Note...

Total movement of chains, midway between sprockets, when moved towards each other to be 0.10 in. maximum

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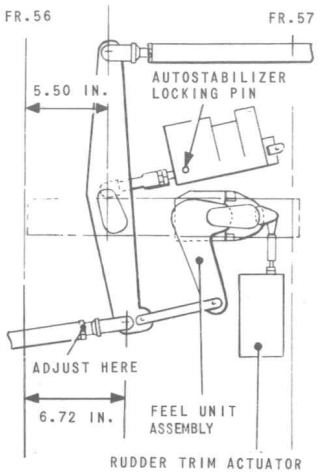
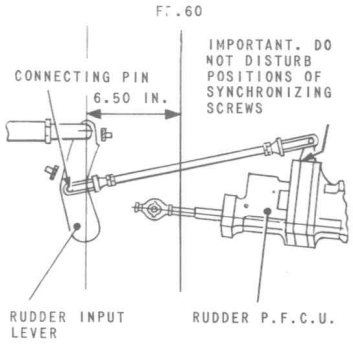
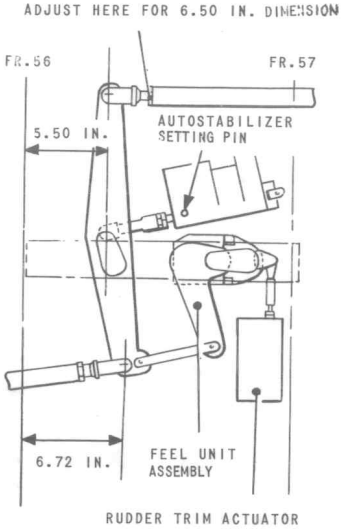
TABLE 1 CONTROLS RIGGING CONTINUED

CHECKS		ADJUSTMENTS IF NECESSARY	
(A) Centralize autostabilizer (para.25) and check setting of lever at fr.56-57.	5	(A) If setting is incorrect:- Disconnect autostabilizer from lever. Disconnect trim actuator from feel unit. Apply hydraulic pressure to centralize feel unit. Adjust lower control rod to obtain 6.72 in. dimension. Set lever to 5.50 in. dimension. Adjust length of autostabilizer and trim actuator ram extensions to suit and reconnect to lever.	
(A) Check setting of rudder input lever.	6	(A) If setting is incorrect adjust control rod connecting to lever at fr.56-57.	
With no hydraulic pressure in system and rudder travel gauge fitted, check rudder movement. (A) Disconnect input control rod. (B) With the p.f.c.u. relay valve input lever in fully forward position move rudder to starboard until p.f.c.u. bottoms; angle should be 22½° maximum. (C) Repeat (B) moving rudder to port (p.f.c.u. lever fully aft). (D) Move rudder to neutral position and centre p.f.c.u. relay valve. (E) Reconnect input control rod to rudder input lever adjusting length if necessary.	7	(B) If rudder travel is not equal port and starboard adjust p.f.c.u. eye-end centres accordingly (REFER TO FIG.5 FOR CRITICAL MEASUREMENT). (C) If rudder travel is not equal port and starboard refer to (B). (E) Refer to Note, fig.5.	
With controls and services systems servicing trolleys connected and running:- (A) Check that rudder is in neutral position (Refer to para.22) (B) Remove neutral setting rig from rudder bar and locating pin from non-linear gearing mechanism. (C) Screw out limit stops on both rudder bars. (D) Slowly apply port rudder and ensure that 22½° travel is obtained. No fouling or straining to take place. (E) Repeat (D) applying starboard rudder	8	(A) If rudder moves to port or starboard repeat checks in(7)	







Maximum movement 22½° each way,:-
i.e. chordal dimension of 5.85 ± 0.15 in.
measure each side at lower end of rudder

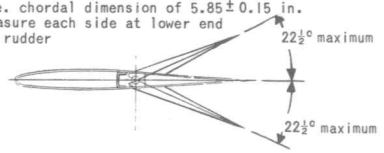


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TABLE 1 CONTROLS RIGGING CONTINUED

CHECKS

To check operational travel:-

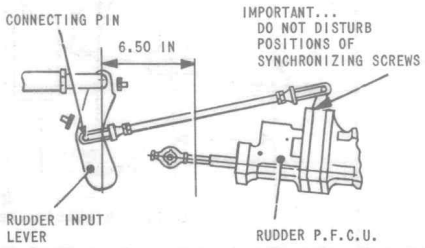
(A) Jack and trestle the aircraft. Pressurize controls and services hydraulic systems. Retract alighting gear. Select "feel" ON.

(B) On starboard rudder bar apply port rudder and adjust rudder bar limit stop to obtain $21\frac{1}{2}° \pm 35'$ operational travel of rudder.

(C) Adjust port rudder bar limit stop in sympathy.

(D) When (A) and (B) are satisfied adjust appropriate input lever stop inserting a 0.020 in. feeler gauge. DO NOT COMPRESS THE STOP.

(E) Repeat (A), (B), (C) and (D) applying starboard rudder.



ADJUSTMENTS IF NECESSARY

9

(A) Disconnect electrical servicing trolley and use slave battery.

(D) NOTE...
These steps to be set with rudder at $21\frac{1}{2}°$ operational travel with 'power on'.

CHECKS

To check trim range:-

(A) Jack and trestle aircraft and retract alighting gear.

(B) Apply pitot pressure representing 650 knots and with hydraulic pressure in controls and services systems and electrical power available select feel ON.

(C) Operate trim switch and check trim range of rudder port and starboard.

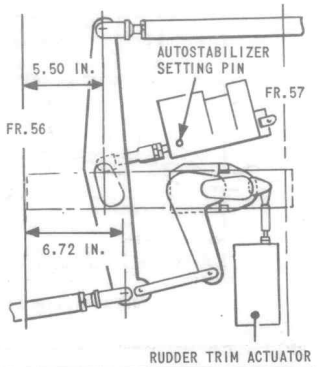
TRIM RANGE: 3.43° Travel of surface
i.e. 0.900 ± 0.05 in. chordal.
Measure at lower edge of rudder

ADJUSTMENTS IF NECESSARY

10

(B) Hydraulic pressure of 1000 lb/in^2 minimum is necessary to ensure that feel selector operates

(C) If trim range is incorrect centre rudder bars; disconnect trim actuator and adjust ram extension as necessary. Reconnect and lock trim actuator.



RUDDER OFFSET

11

(A) Set flying controls to neutral position.

(B) Disconnect p.f.c.u. at adjustable eye-end.

(C) Disconnect p.f.c.u. input control rod.

(D) Lengthen or shorten end-fitting of p.f.c.u. ram to obtain desired offset.

(E) Adjust input control rod to suit.

(F) Reconnect p.f.c.u. and input control rod.

(G) Check operational and trim travels of rudder MEASURED FROM NEW NEUTRAL POSITION.

Note...
Rudder offset, measured at trailing edge, must not exceed 0.30 in. port or starboard.

(D) Refer to Fig.5 for critical dimensions.

(E) Refer to Note, Fig.5.

(G) Refer to Check 9 and 10.

12

REMOVE SERVICING TROLLEY AND TRAVEL GAUGES. INSPECT ALL LIMIT STOPS, CONTROL ROD ADJUSTERS AND TURNBARRELS FOR CORRECT LOCKING AND WHERE APPLICABLE CORRECT THREAD ENGAGEMENT.

Rigging the differential braking mechanism *(fig.6)*

16. To rig the differential braking mechanism:-

(1) Fit neutral-setting rig to rudder bar *(Chap.4B)*.

(2) Lengthen or shorten cable connecting rudder-control lever to lever assembly so that rigging pin can be fitted at lever assembly.

(3) Lengthen or shorten turnbuckle to bring differential brake control unit pointer to neutral position.

(4) Lengthen or shorten each brake lever cable so that there is no slack in cables with brake levers fully off.

(5) Tighten all locknuts and wire-lock.

(6) Remove rigging pin and neutral-setting rig.

(7) Refer to Chap.6 and carry out brake functioning checks.

Controls rigging *(Table 1)*

Preparation

17. Remove the associated access panels *(Sect.2, Chap.4)*.

Servicing checks

18. For normal servicing checks refer to Table 1 and carry out checks 1C, 8A and B (ignore reference to rigging pin), 9, 10 and 12. If any of the conditions in these checks cannot be satisfied carry out the complete set of checks 1 to 10 and 12. Check for security, freedom of movement without noticeable backlash, lubrication and cleanliness.

Control run breakdowns

WARNING

In view of the possibility of fouls occurring in the control run if bolts are fitted incorrectly, particular attention is drawn to fig.6 and fig.8.

19. If it is necessary to break down the control system, fit the neutral-setting rig and/or locating pins, where possible, at both sides of the breakdown area. Upon completion of the work carry out checks for fouling or straining, freedom of movement, range of movement and security.

Complete rigging checks

20. To carry out full rigging checks, refer to Table 1 and execute all the listed operations.

Trim range checks

21. For trim range checks refer to Table 1 and carry out checks and any necessary adjustments detailed in check 10.

Offsetting the rudder

General information

22. If the aircraft log card *(Form 4801, Sect.C)* denotes that the rudder has been offset, this offset must be maintained at any subsequent rigging of the flying controls. Two methods of obtaining rudder offset are used, i.e. by adjustment of the p.f.c.u. or the fitting of a rudder trim strip.

Note...

It is not permissible to combine both methods to achieve directional stability.

By adjustment of the p.f.c.u.

23. Refer to Table 1, check 11.

By fitting a trim strip

24. If the rudder fitted to the aircraft has a trim strip attached it must be ensured that a replacement rudder has a similar strip fitted. For the method of fitting the rudder trim strip refer to Vol.6, Chap.4B of this Air Publication.

Autostabilizer actuator - neutral setting

25. Before the rudder controls are rigged for the neutral position, the autostabilizer actuator (access panel 84S) must be set to the neutral position as follows:-

(1) Check that the complete flight control system is installed and serviceable.

(2) Connect a.c. and d.c. electrical supplies to the aircraft *(Sect.2, Chap.2, fig.1)*.

(3) Set the following switches:-

Flight control system switch on control column handle	OFF
STAB switch on control unit	OFF
Instrument master switch	ON
Master switch on control unit	ON

(4) Remove the hydraulic system hand-pump handle from its stowage in the port wheel well, fit it to the pump (access panel 79P) and operate the pump to provide pressure for centring the actuator.

(5) Switch OFF the master switch on the control unit, and the instrument master switch.

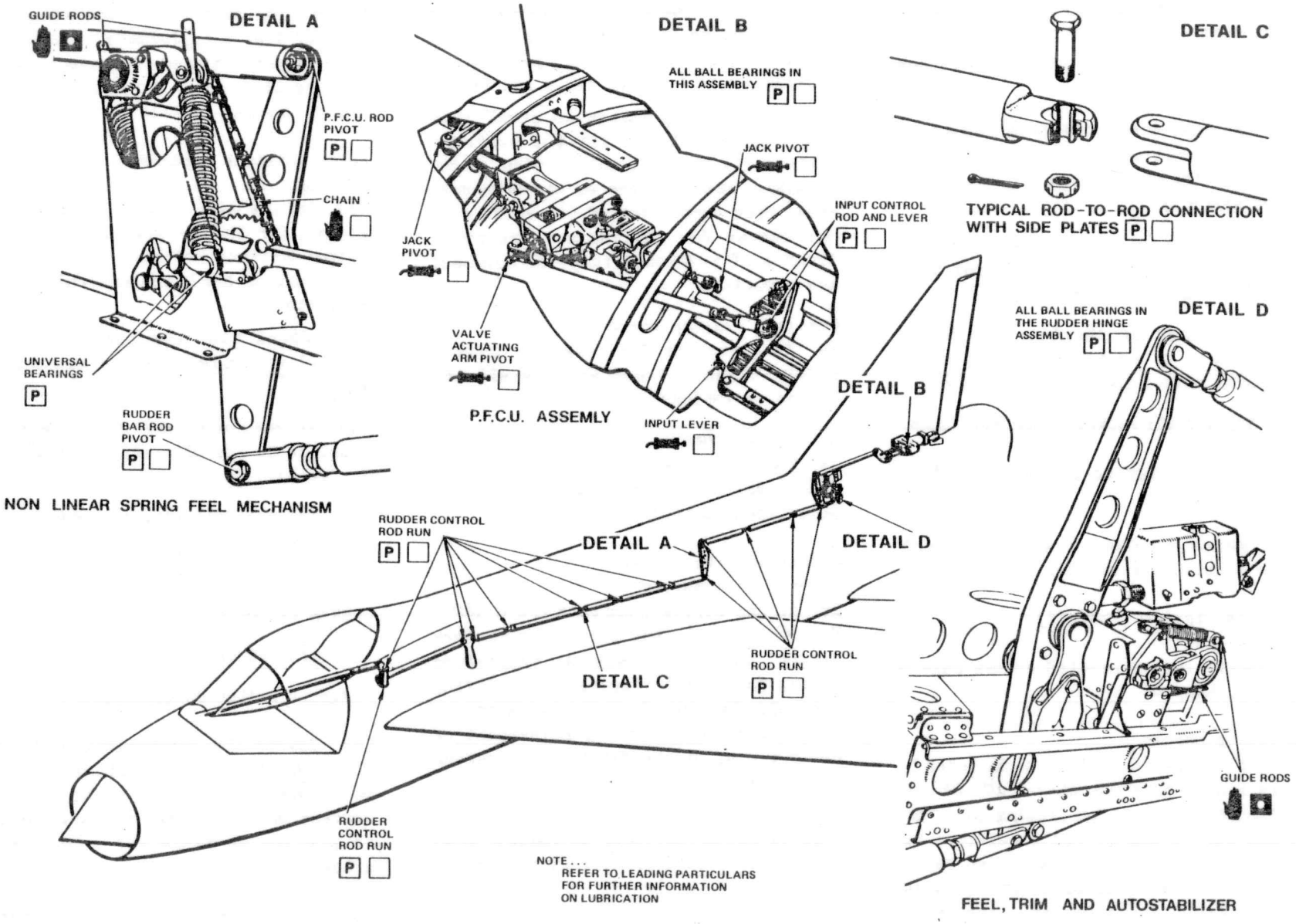


FIG.7. LUBRICATION OF CONTROLS

◀ REDRAWN ▶

(6) Check for centre position, using a setting pin through the hole in the body of the actuator *(fig.3)*. If the pin will not enter the actuator is unserviceable.

Note...
Do not leave the pin in position.

Functioning checks
Preparation

26. The checks detailed in para.27-31 may be carried out only after the controls system has been correctly rigged *(Table 1)*. The checks given in para.27 must be made, and the pressure and accumulator capacity tests given in Chap.6 satisfied, after a replacement rudder p.f.c.u. has been fitted; the checks given in para.27-31 must be carried out after a replacement feel unit has been fitted. Prepare the aircraft as follows:-

(1) Jack and trestle the aircraft *(Sect.2, Chap.4)*.

(2) Connect a Mk.3 hydraulic servicing trolley to No.1 ground test coupling (access panel 45P) of the services system and No.2 controls system (access panel 67P).

(3) Fit a pitot/static test set to the pressure head.

(4) Retract the alighting gear (this is necessary for all checks which require rudder feel).

Note...
1. *To ensure that feel is selected correctly when required, the services system must be pressurized to 1000 lb/in^2 minimum.*
2. *When it is necessary to retract the alighting gear for any checks, a slave battery, not the aircraft battery, must be used.*

(5) Set the rudder bars to the neutral position, operating the trim switch if necessary.

Smoothness, friction and centring checks

27. Start the hydraulic servicing trolley connected to No.2 controls system. Select feel OFF, *(refer to para.26 (4), Note 1)* and trim neutral then:-

(1) Move the rudder bars through their extremes of travel and allow them to return under restraint to the neutral position. Check carefully that consistent smoothness is felt throughout the full range of movement; the cause of any perceptible roughness must be traced and eliminated before proceeding with any further checks.

(2) Using a tubular spring balance check for excessive friction by slowly applying sufficient force to initiate movement of the control surface from neutral. The force required must not exceed:-

Port rudder bar assembly
Force applied at left hand pedal

8 lb

Starboard rudder bar assembly
Force applied at right hand pedal

6 lb

If a dial test indicator is used on the control surface the checks need only be executed once. When a dial test indicator is not used the mean of three checks, port and starboard, must be taken.

(3) Check for centring by displacing the rudder bars to one extreme and then allowing them to return under restraint, towards neutral. Disengage the feet carefully from the rudder pedals and measure the final out-of-centre position. Repeat the check to the opposite extreme. The final out-of-centre position must not exceed 0.4 in. either side of neutral.

(4) Start the hydraulic servicing trolley connected to the services system *(refer to para.26 (4), Note 1)*, select feel ON at zero knots I.A.S. and repeat instructions (1) and (3). The final out-of-centre position must not exceed 0.25 in. either side of neutral.

Spring feel checks

28.

(1) With no hydraulic pressure in No.1 controls system, run the hydraulic servicing trolley connected to the No.2 controls system. Select feel OFF *(refer to para.26 (4), Note 1)*.

(2) Set the rudder bars to the neutral position.

(3) Check that the forces required to displace the rudder bars agree with the figures given in Table 2.

TABLE 2
Spring feel loads

	STBD PEDAL	STBD PEDAL	PORT PEDAL	PORT PEDAL
Pedal forward displacement	1.5 in.	3.0 in.	1.5 in.	3.0 in.
Force in lb	60± 5	115± 10	60± 5	110± 10

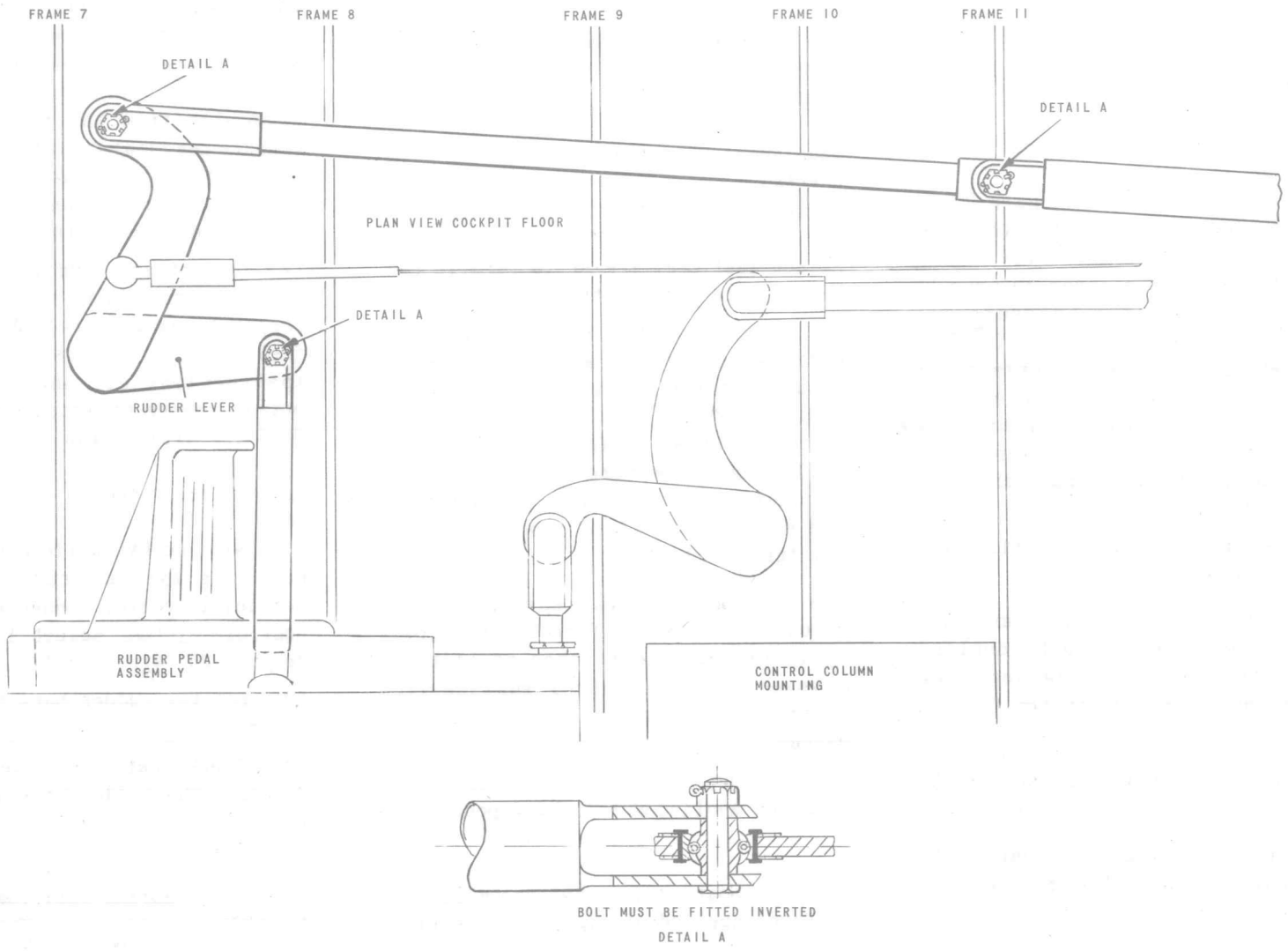


FIG. 8. LEVER ASSEMBLY - FRAMES 7 - 11

D2275-1

Feel performance check

29.

(1) Start the hydraulic servicing trolleys connected to the No.2 controls and the services systems.

(2) Set the rudder bars to the neutral position.

(3) Select feel ON *(refer to para. 26 (4), Note 1).*

(4) With the pitot pressure rig connected but the system not pressurized (zero knots I.A.S.) check that the forces required to displace the rudder bars agree with the figures given in Table 3.

TABLE 3

Total feel loads at zero knots I.A.S.

	STBD PEDAL	PORT PEDAL
Pedal forward displacement	2.0 in.	2.0 in.
Force in lb	125 ± 15	120 ± 15

(5) With the pitot system pressurized to represent 500 knots I.A.S., repeat checks (1), (2), (3) and (4) and check that the forces required to displace the rudder bars to the positions given agree with Table 4.

TABLE 4

Total feel loads at 500 knots I.A.S.

	STBD PEDAL	PORT PEDAL
Pedal forward displacement	0.75 in.	0.75 in.
Force in lb	120 ± 15	110 ± 15

Interaction check

31.

(1) Start the hydraulic servicing trolleys connected to No.2 controls and the services system.

(2) Set the rudder bars to neutral and select feel ON *(refer to para.26 (4), Note 1).*

S.S.I. pulsing check

30.

(1) Start the hydraulic servicing trolleys connected to No.2 controls and the services system.

(2) Set the rudder bars to neutral.

(3) Select feel ON *(refer to para. 26 (4), Note 1).*

(4) Pressurize the pitot system to 250 knots I.A.S.

(5) Connect and switch on a.c. and d.c. supplies.

(6) Switch the instrument master switch ON.

(7) Allow two minutes for the OR946 system to stabilize.

Note...

If displays run away switch off immediately.

(8) Operate the rudder pedals to give approximately 15 deg of rudder movement port and starboard, at two strokes per second.

(9) Check that the strip speed indicator does not pulse more than 5 knots when carrying out (8).

(3) Attach a spring balance to the starboard control column, 15.5 in. from the column pivot and move the column aft to approximately 3 deg from the stop.

(4) Repeat operation (8) in para.30 and check that the pulse felt at the control column does not exceed 2 lb.

REMOVAL AND ASSEMBLY

Rudder

Removal and assembly

32. For removal and assembly of the rudder refer to Chap.3.

P.f.c.u.

Removal (fig.5)

33. Remove panel 86S and:-

(1) Release all hydraulic pressure from the tail plane and rudder, No.1 and No.2 controls systems accumulators by operating the tail plane (rate not to exceed one stroke between stops in five seconds).

(2) Connect a hydraulic servicing trolley to the No.1 or No.2 controls system ground couplings.

(3) Set the autostabilizer actuator to neutral *(para.25)* and operate the trolley hand pump and the rudder bar to set the rudder in the neutral position. Fit a locating pin in the vertical torque tube on spar 1.

(4) Release the air from the hydraulic fluid reservoirs (the release valve is located behind panel 63P). Disconnect the hydraulic connections to the control unit, and fit blanks to the pipes and control unit connections.

(5) Disconnect the input lever control rod from the control unit valve lever.

(6) Supporting the control unit, remove the nut and bolt connecting the end-fitting to the rudder-operating lever *(detail A)* and the pin connecting the ram fork-end to the fuselage anchorage *(detail B)*.

(7) Remove the control unit through the access panel aperture. If a replacement control unit is to be installed, do not move the ram of the unserviceable unit until the ram extension adjustment of the replacement unit has been checked *(para.34)*.

Assembly

34. Prior to installing a replacement control unit, set the length of the replacement unit to correspond with the length of the unserviceable unit.

(1) Prime the replacement control unit on a hydraulic test rig and measure the length of the ram between the fully-retracted and fully-extended position; set the ram to the mid-stroke position. Compare the measurement between attachment pin centres on the replacement control unit with the corresponding measurement on the unit removed; adjust, if necessary, on the eye-end of the replacement control unit to obtain agreement, then tighten the locknut.

(2) Check that the eye-end is in safety, i.e. that the distance from the forward face of the locknut to the pin centre does not exceed 1.50 in. *(fig.5)*.

(3) Fit the ram eye-end to its attachment fitting on the aircraft structure, securing by means of the special pin.

Note. . .

When fitting the ram eye-end to the structure, it is essential that the smaller of the two bushes is towards the outside skin.

(4) Connect the control unit body end-fitting to the rudder-operating lever with the special bolt, washer, nut and split pin.

(5) Connect and wire-lock the hydraulic couplings. Refer to Chap.6 for bleeding the systems.

(6) With a hydraulic servicing trolley connected to No.1 controls system, operate the trolley hand pump and move the control unit valve lever in the appropriate direction to move the rudder fully to port; check that the rudder travel is 21½ deg minimum. Repeat, moving the rudder to starboard.

(7) Connect an external air supply (16-18 lb/in^2) to the reservoir release valve (acccess panel 63P). Start the trolley and manually operate the control unit to centralize the rudder. Stop the trolley.

(8) Adjust, if necessary, the length of the rudder input rod and connect it to the input lever and the control unit valve lever. Start the trolley and check that the rudder remains in the neutral position. Refer to Note, fig.5.

(9) Finally tighten the locknut on the ram eye-end to 35 lb ft, using a torque loading spanner. Lock the pin securing the eye-end to the structure by fitting the cover plate. Tighten and wire-lock the locknuts on the rudder input rod.

(10) Remove the locating pin at the vertical torque tube. Check the operational travel of the rudder *(Table 1)*, and carry out smoothness, friction and centring checks *(para.27)* and pressure and accumulator capacity tests *(Chap.6)*.

(11) With a hydraulic servicing trolley connected to No.2 controls system, repeat the checks and tests called for in (10).

◀ **Jury strut**

Installation

WARNING

Fitment of a jury strut imposes a limitation on the aircraft handling as detailed in A.P.101B-1003-15. The appropriate entry must be made in the Aircraft Limitations Log (Form 703) for the attention of the pilot.

35. When fitting a jury strut in lieu of a rudder autostabilizer actuator install the strut as follows:-

Note. . .

The following essential actions are to be strictly observed when fitting a jury strut in lieu of the actuator:-

(a) The pin centre length of the jury strut and connecting rod is to correspond exactly to that of the actuator and connecting rod.

(b) Hydraulic pipes disconnected from the removed actuator are to be correctly blanked, locked, and leak tested, before flight. Electrical connections are to be stowed.

(c) Remaining channels are to be left operative. The dither level is to be checked and adjusted if necessary.

(1) Centralize the autostabilizer actuator *(para.25)*.

(2) Disconnect and remove the actuator complete with the connecting rod.

(3) Measure and record the pin centre length between the connecting rod eye-end and the defective actuator earth end attachment (or some other suitable fixed points).

(4) Remove the actuator from the connecting rod and assemble the jury strut to the connecting rod.

(5) Set the pin centre length of the jury strut and connecting rod to the dimension recorded in para.(3) above.

(6) Bolt the jury strut to the actuator mounting bracket, and reconnect the connecting rod to the lever assembly.

(7) Check the strut thread engagement in the connecting rod for safety. Tighten the locknut and wire-lock using locking wire 22 s.w.g. (Ref.No.30A/9437135). ▶

◀ **Rudder feel unit**

Installation

36. Prior to the installation of a rudder feel unit inspect the bleed adapter for correct assembly. Ensure that the adapter banjo union is assembled with the deeper step of the banjo union adjacent to the banjo bolt head. Failure to ensure the correct assembly of the bleed adapter could result in severe hydraulic oil leakage.
(Drg.EB2.45.2005 Issue 20 refers). ▶

TABLE 5

Tools and equipment

Ref. No.		Description	Application/Remarks
EB5.88.10221		Pin, rigging	Rigging differential braking mechanism
26DK/95127		Pin, locating	Control rigging
26DK/95134		Pin, setting	Autostabilizer setting
26DK/95828		Rig, neutral setting	Control column and rudder bar
26DK/95286		Gauge, rudder	Rudder travel checks
6C/2106		Sets, test, pitot-static Mk.3	
1A/4225		Balance, spring, 0-30 lb	Friction checks
1A/4404		Balance, spring, 0-200 lb	Hydraulic and spring feel checks
27KH/2753		Assembly, torque adapter	Removal/replacement of rudder p.f.c.u.
4F/3603		Trolley, hydraulic servicing Mk.3	
4F/3761	alternatives	Trolley, electrical servicing	15kVA/10kW, I.C.E. driven
4F/4257			
4F/3786		Trolley, electrical servicing	15kVA/10kW, electrically driven
4F/4258			
4F/5147			