Chapter 4D FLYING CONTROLS - RUDDER

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

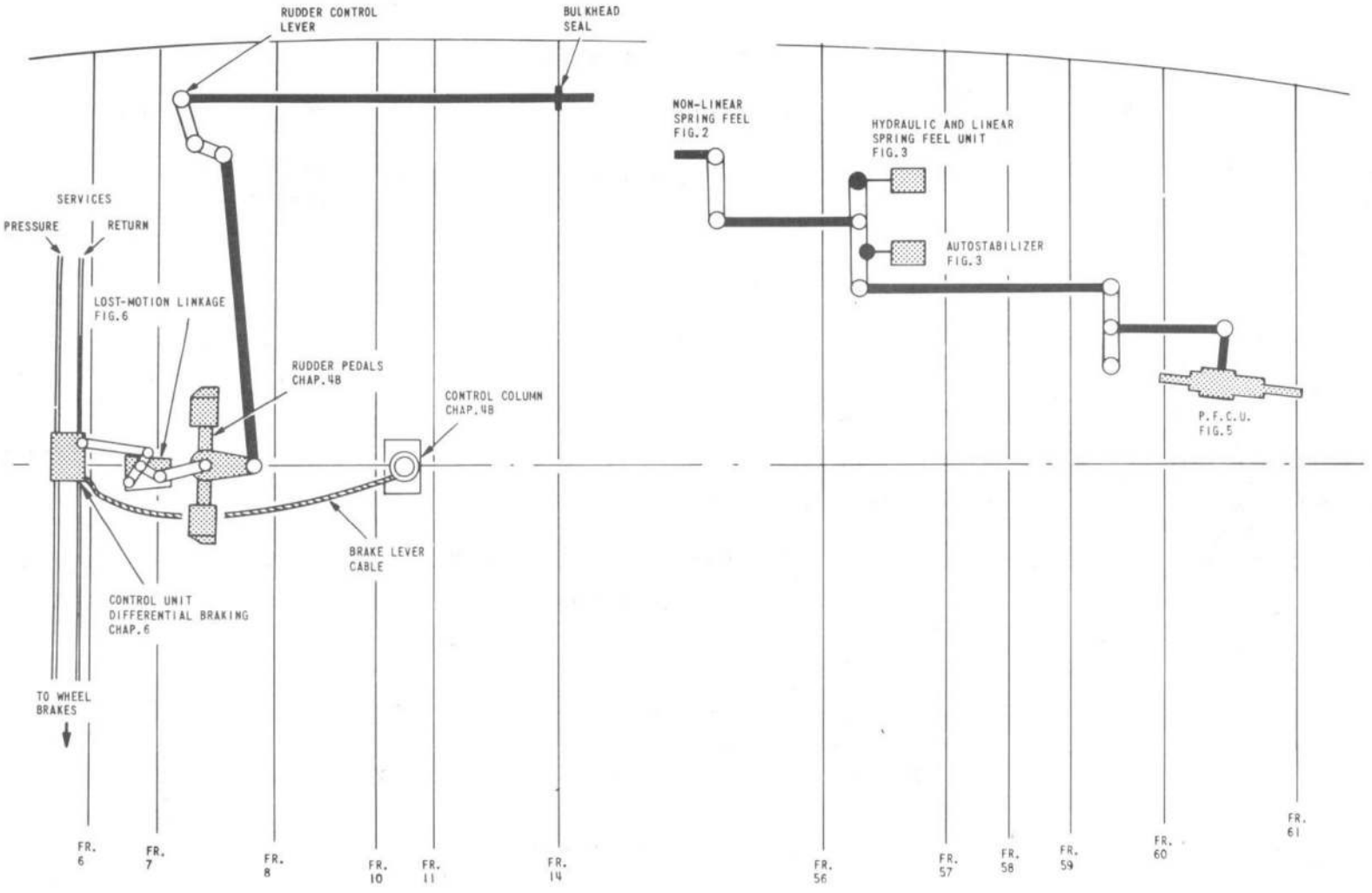


FIG.1. SYSTEM LAYOUT (MECHANICAL)

◀ AMENDED ANNOTATION ▶

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 rudder pedal. 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 shaft-vanes.

Artificial feel

Hydraulic feel

4. A sense of feel is primarily produced by a hydraulic feel unit linked into the control run *(fig.3)* 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

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 will move 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 the event of hydraulic failure, continue functioning to provide spring feel and centring action.

Trimming

9. The electrically-operated trim actuator is controlled by dual switches on the port console. Extension or retraction of the actuator ram displaces

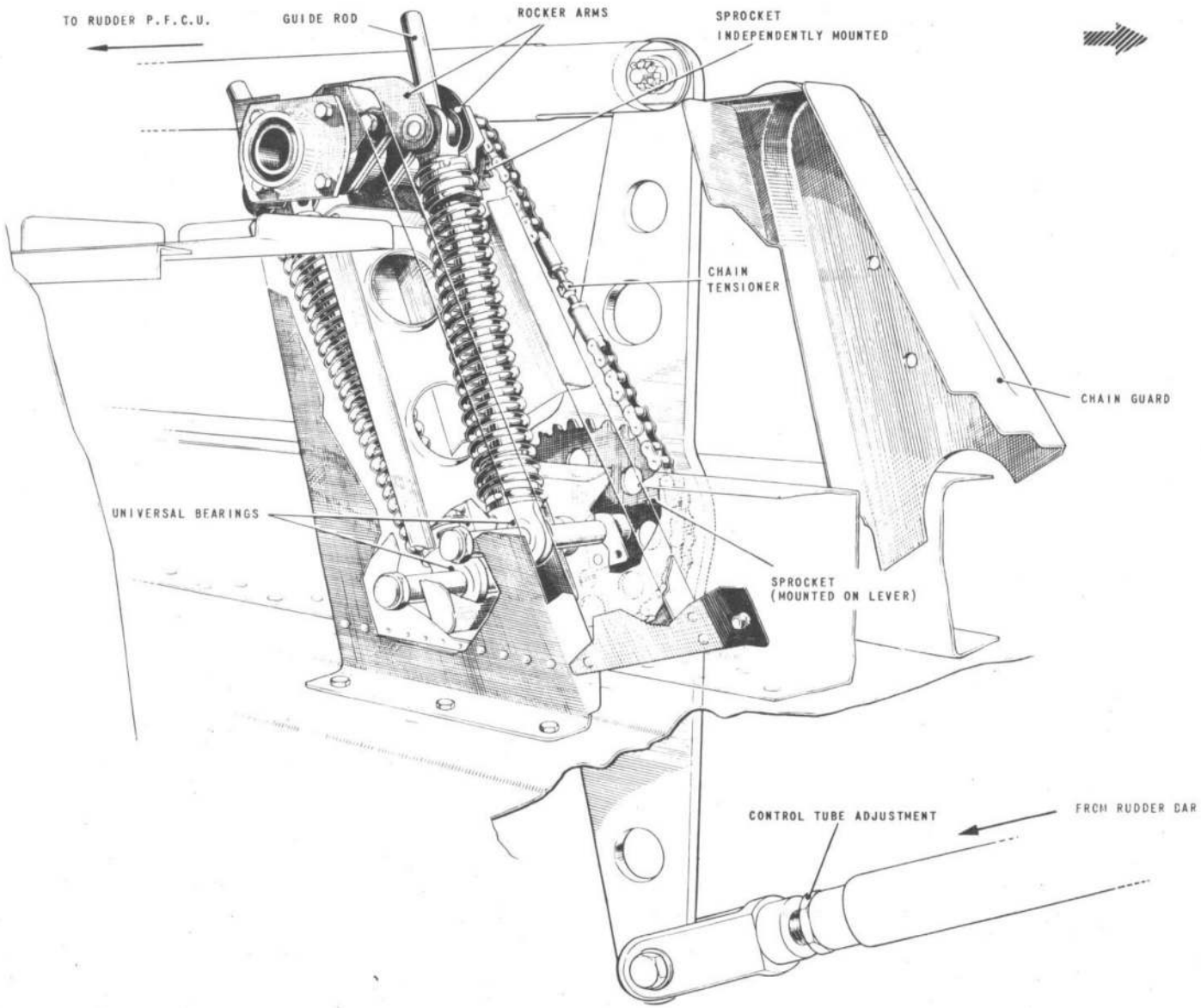


FIG. 2. NON-LINEAR SPRING FEEL MECHANISM

A2089-1

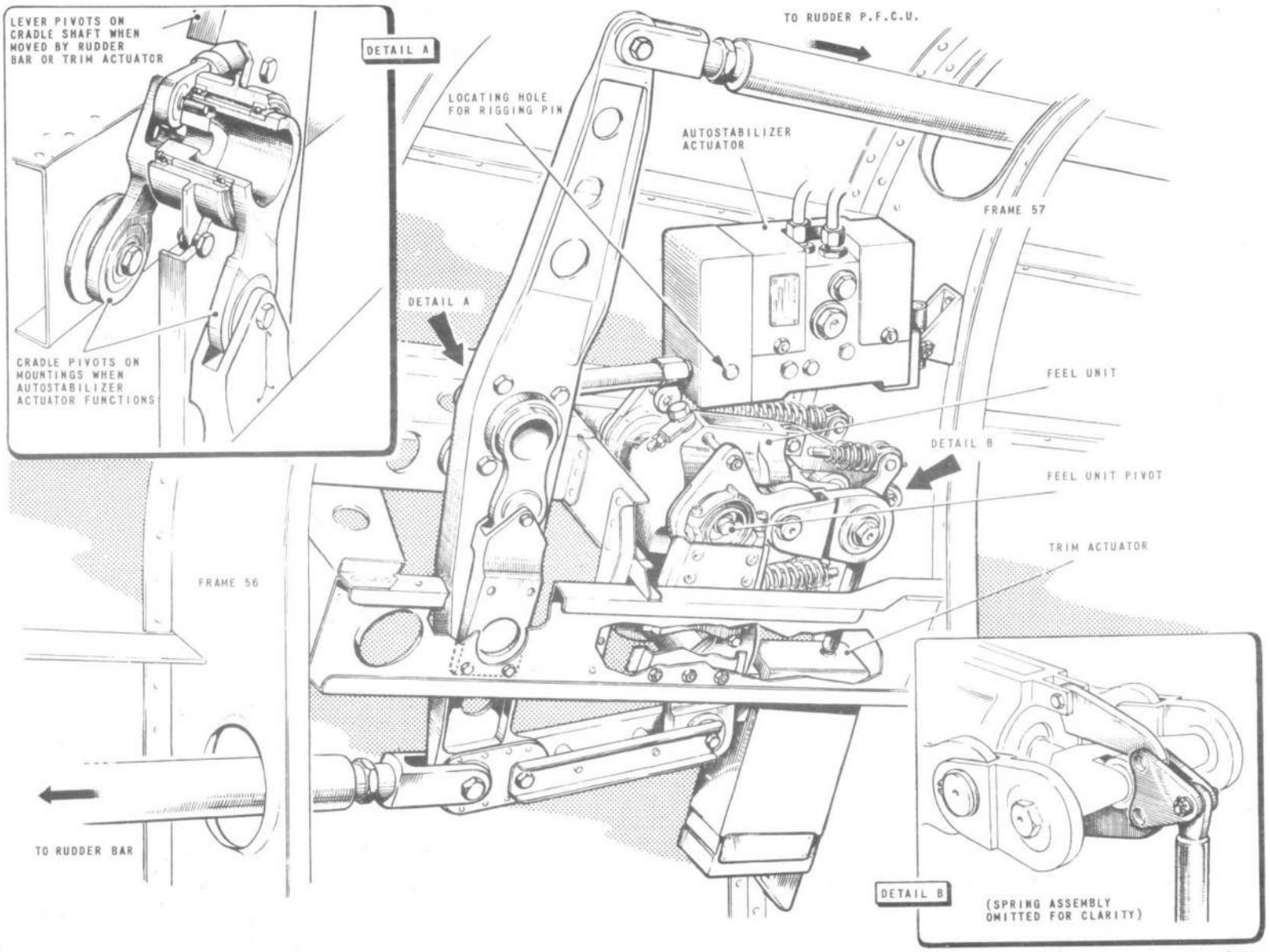
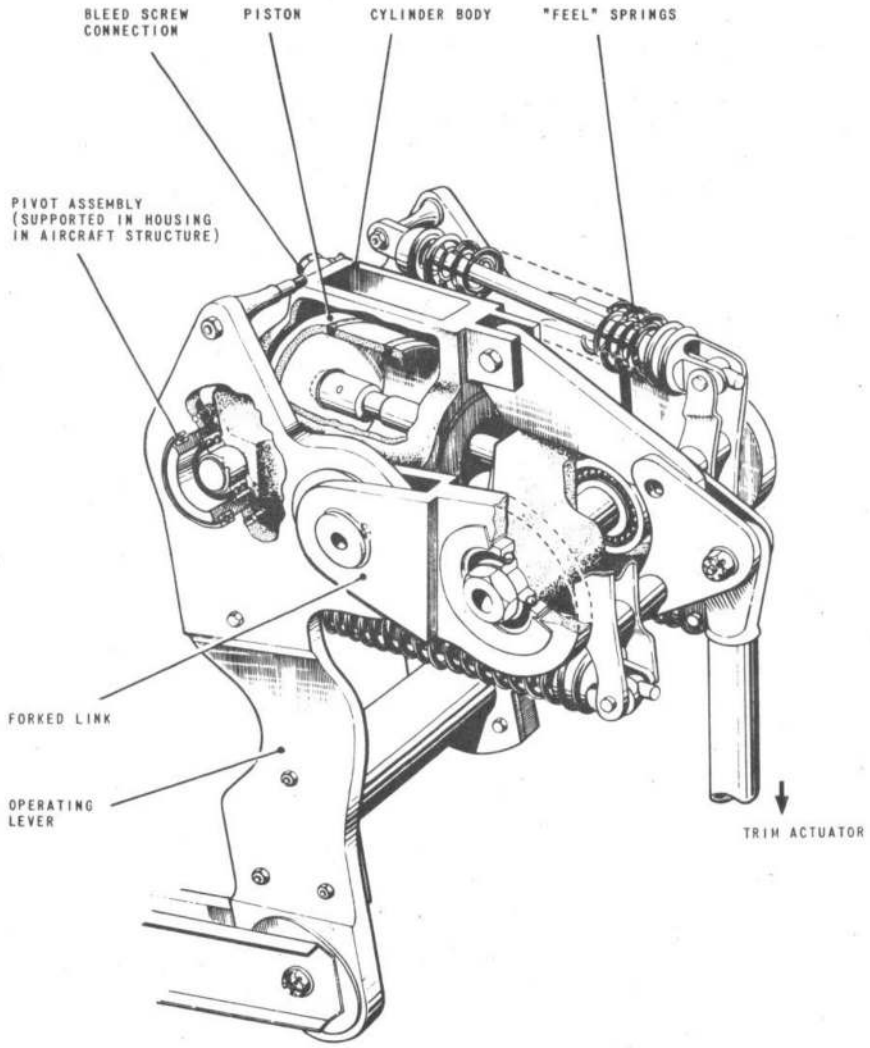


FIG. 3. FEEL, TRIM, AND AUTOSTABILIZER-ACTUATOR INTERCONNECTION



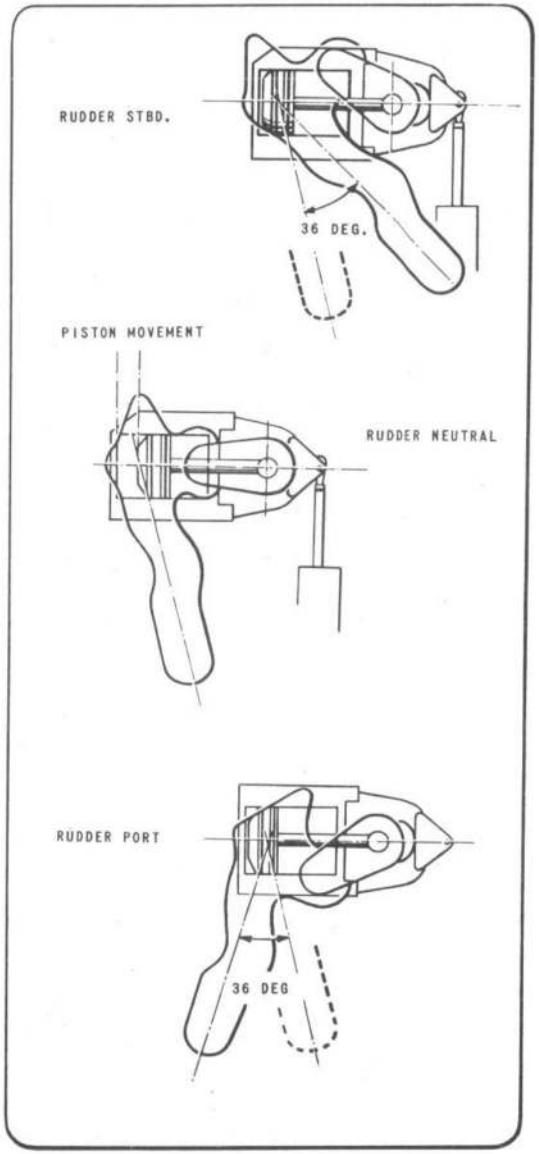


FIG. 4. HYDRAULIC FEEL UNIT

A2091-1

the feel unit *(fig.3)* 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

10. The autostabilizer actuator is operated by pressure from the services hydraulic system in response to amplified electrical signals from the autopilot. 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.

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 aircraft 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)*

General information

12. To provide full differential braking for half rudder pedal movement a lost-motion assembly is fitted between the rudder pedals and the brake differential control unit. The assembly consists of a lever, moved by the rudder pedals, at the base of the rudder bar pivot shaft, a link assembly connecting the lever to a slotted lever which pivots on a slotted cam plate, a tension spring connected to the lever and link assembly which endeavours to hold the latter in the neutral position, and a push-pull rod connecting the other end of the slotted lever to the brake differential control unit.

Operation

13. Movement of the lever pushes, or pulls, the link assembly to move the slotted lever. The spigot, connecting the link to the slotted lever, simultaneously follows the profile of the slot in the cam plate and moves the slotted lever about its pivot. As movement continues the spigot moves up or down the slot in the slotted lever until at half rudder pedal movement the spigot has reached the maximum radius of the cam-plate slot, which now alters direction. In this position (associated brake full-on) the slots in the slotted lever and cam plate coincide so that the former and the brake control unit push-pull rod remain stationary if movement of the rudder pedals continues beyond the half-travel point.

Note...

The rear portion of the slot in the cam plate is longer than the front. This is for ease of assembly only; the spigot will not traverse the full length of the slot.

SERVICING

WARNING

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

Lubrication *(fig.7)*

14. The nomenclature and reference and N.A.T.O. code numbers of the lubricants are given on the back of the contents marker card at the front of this book. Ball-bearings in the assemblies are prepacked with grease and do not normally require attention. Where oil is specified it is to be applied sparingly. All control rods are designed to run dry in their roller guides and should not be lubricated.

Replenishing the rudder damper unit

15. Refer to Chap.3.

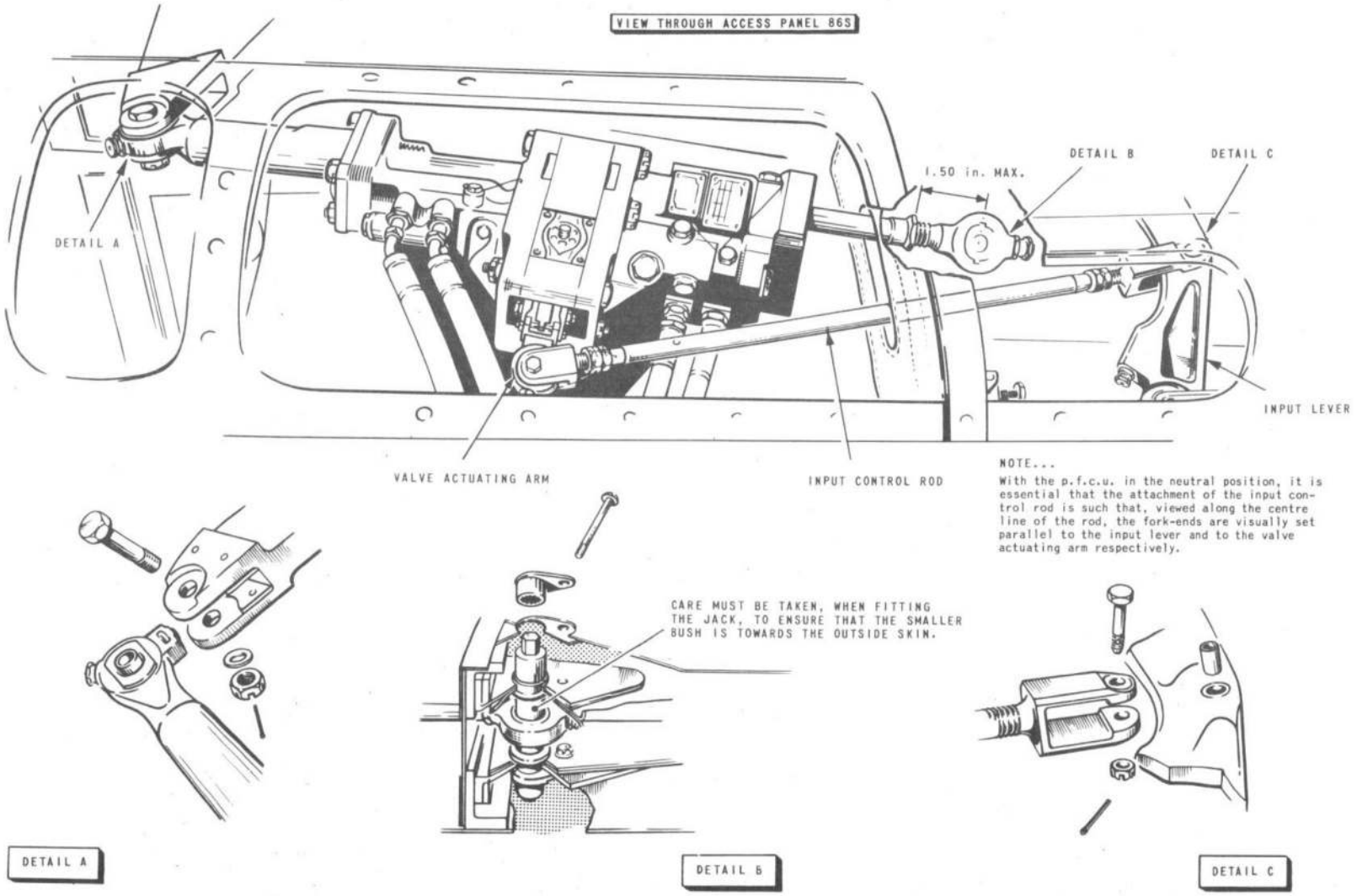


FIG.5. P.F.C.U. INSTALLATION

A2092-3

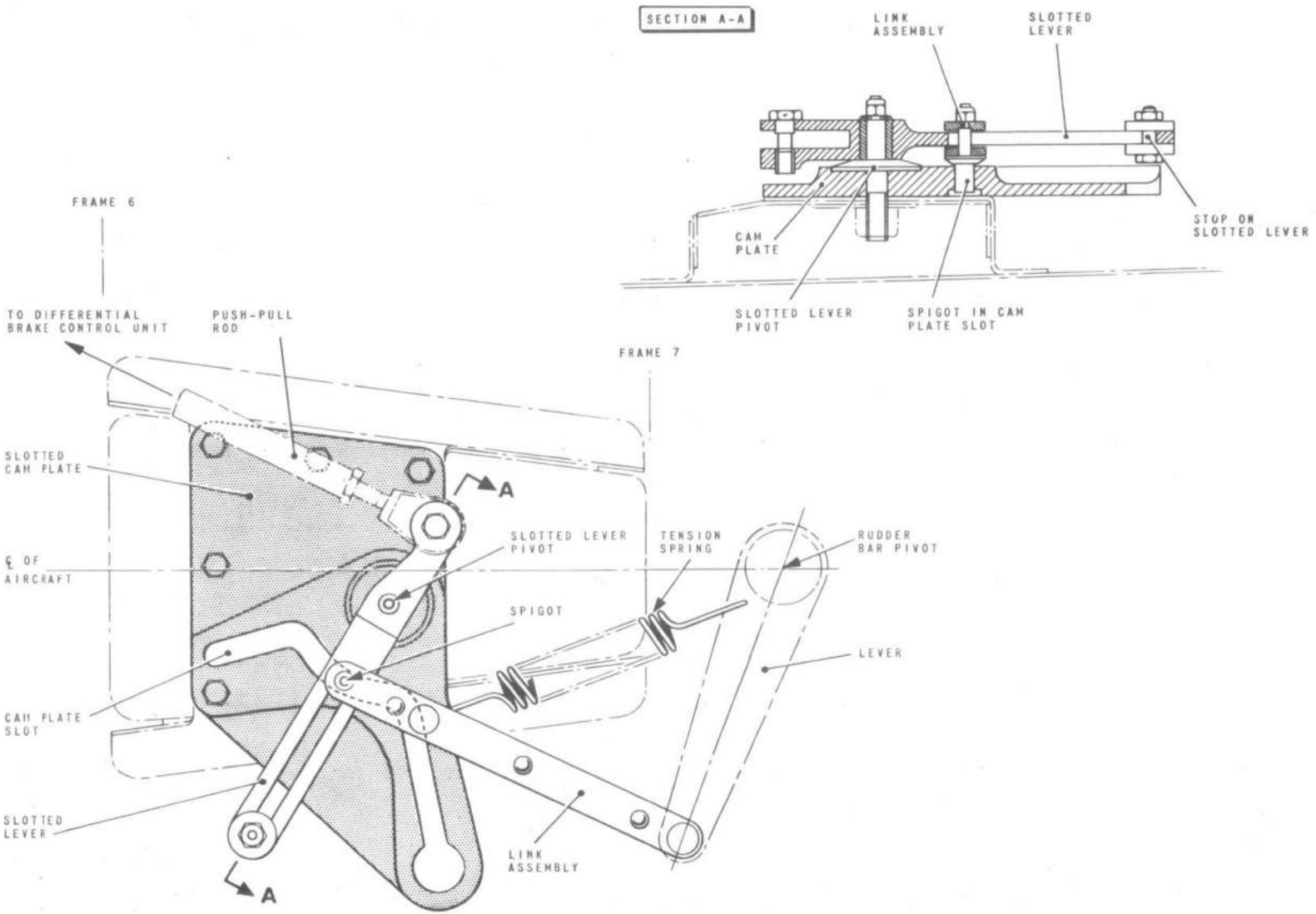


FIG. 6. DIFFERENTIAL BRAKING LOST-MOTION ASSEMBLY

82092-1

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

16. To rig the differential braking mechanism:-

(1) Remove floor plate forward of rudder pedestal.

(2) Fit neutral setting rig to rudder pedestal *(Chap.4B)*.

(3) Remove special-to-type bolt from slotted lever and push-pull rod adjustable fork-end.

(4) Slacken locknut on push-pull rod (hold rod to prevent torque being applied to fixed fork-end).

(5) Screw adjustable fork-end in or out to bring pointer on differential braking unit to neutral.

(6) Tighten locknut, refit and wire-lock special-to-type bolt, and refit floor plate.

(7) Remove neutral setting rig. Carry out brake functioning tests *(Chap.6)*.

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, 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

19. If it is necessary to break down the control system, fit the neutral-setting rig and/or rigging 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
Pitch and roll/yaw switches 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.

TABLE 1 CONTROLS RIGGING

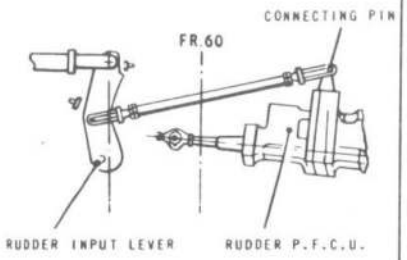
CHECKS

(A) Operate tail plane until all pressure is exhausted from tail plane and rudders No.1 and No.2 controls accumulators (rate not to exceed one stroke between stops in 5 seconds).

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

(C) Fit neutral setting rig and setting gauge (Table 5).

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



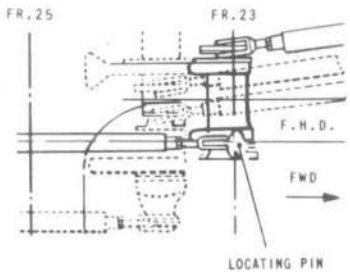
ADJUSTMENTS IF NECESSARY

1

(C) Rudder bar in neutral position (Chap.4B)

CHECKS

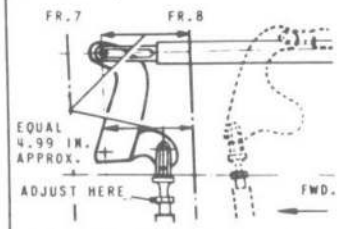
Fit locating pin in torque tube (access panel 26S)



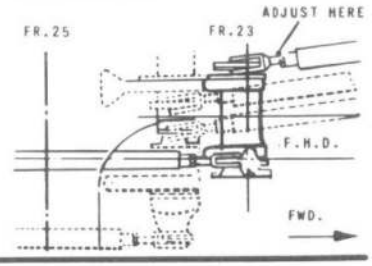
ADJUSTMENTS, IF NECESSARY

2

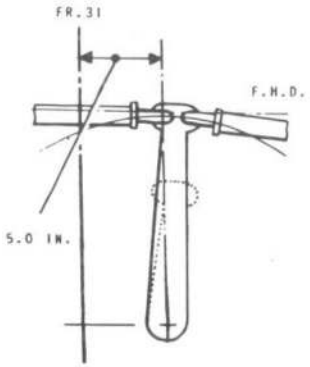
If pin will not enter, check lever at Fr.7-8 for correct setting and adjust control rod if necessary



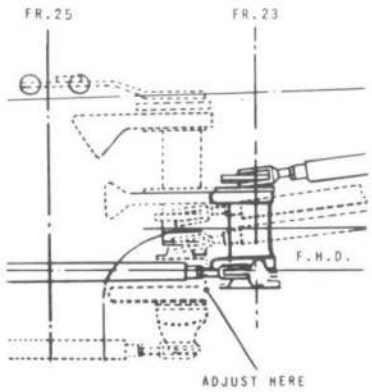
If pin will still not enter, adjust control rod at torque tube



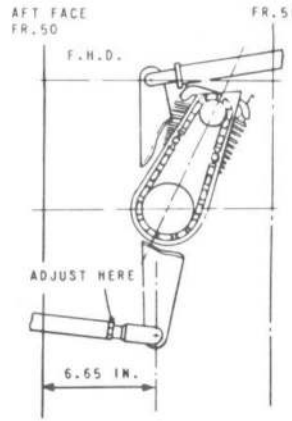
Check setting of lever at Fr.31



3 If setting is incorrect, adjust control rod connected to lower lever on torque tube



Check setting of lever at Fr.50-51



4 If setting is incorrect:-

(A) Disconnect both control rods from lever and remove chain guard from spring assembly

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

(C) Reconnect lower control rod, adjusting if necessary, and then connect upper control rod

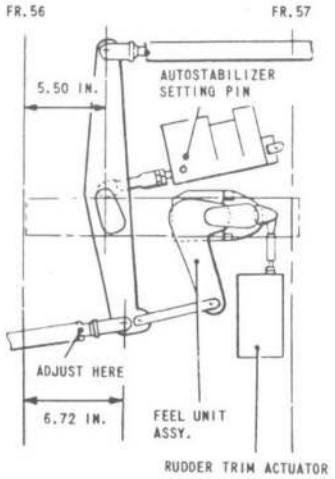
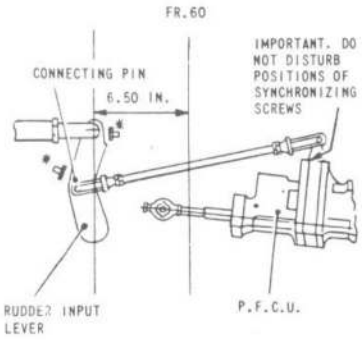
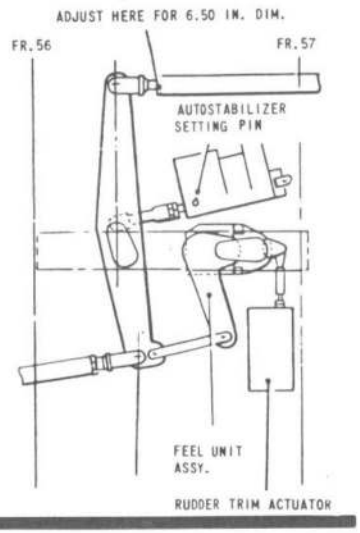
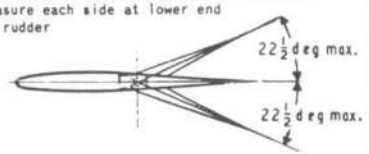
(D) Secure locknuts and wire-lock tensioners: refit chain-guard over assembly

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

1-8407-1

◀ NOTE ADDED ▶

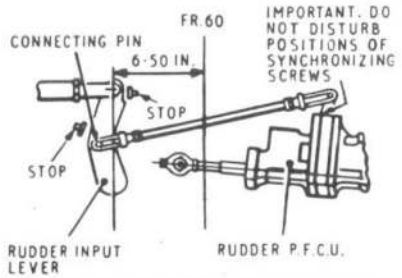
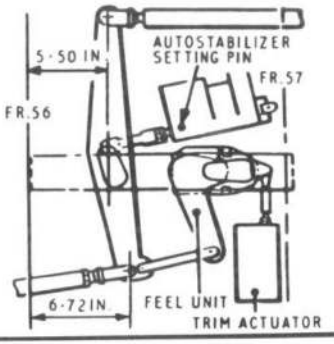
TABLE 1 CONTROLS RIGGING CONTINUED

	CHECKS	ADJUSTMENTS IF NECESSARY
5	(A) Centralize autostabilizer (para.25) and check setting of lever at fr.56-57. 	(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 re-connect to lever.
6	(A) Check setting of rudder input lever. 	(A) If setting is incorrect adjust the control rod connecting to lever at fr.56-57. 
7	With no hydraulic pressure in system check rudder movement. (A) Disconnect input control rod. (B) With 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 deg 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 valves. (E) Reconnect input control rod to rudder input lever adjusting length if necessary. Maximum movement 22½ deg each way :— i.e. chordal dimension of 5.85 ± 0.15 in. measure each side at lower end of rudder 	(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.
8	With controls and services systems servicing trolleys connected and running:- (A) Check that rudder remains 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 rudder bar. (D) Slowly apply port rudder and ensure that 22½deg travel is obtained. No fouling or straining to take place. (E) Repeat (C) and (D) applying starboard rudder.	(A) If rudder moves to port or starboard repeat checks in 7.

1-8408-1

◀ AMENDED ANNOTATIONS ▶

TABLE 1 CONTROLS RIGGING CONTINUED

CHECKS	ADJUSTMENTS IF NECESSARY
To check operational travel :- (A) Jack and trestle the aircraft. Pressurize controls and services hydraulic systems. Retract alighting gear. Select feel ON. (B) Apply port rudder and adjust rudder bar limit stop to obtain $21\frac{1}{2}\pm\frac{1}{2}$ deg operational travel of rudder. (C) When (A) and (B) are satisfied adjust associated input-lever stop inserting a 0·020 in. feeler gauge. DO NOT COMPRESS THE STOP. (D) Repeat (A), (B) and (C) applying starboard rudder 	9 (A) Disconnect electrical servicing trolley and use slave battery. (B) Fit rudder travel gauge (Table 5). Note... These stops to be set with rudder at $21\frac{1}{2}$ deg operational travel with power on.
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 deg 43 min. TRAVEL OF SURFACE, i.e. 0·900± 0·05 in. CHORDAL. MEASURE AT LOWER EDGE OF RUDDER	10 (B) Hydraulic pressure of 1000 lb/in² min is necessary to ensure that feel selector operates. (C) If trim range is incorrect centre rudder bar, disconnect trim actuator and adjust ram extension as necessary. Reconnect and lock trim actuator. 
11 RUDDER OFFSET (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 travel 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 in fig 5. (G) Refer to Check 9 and 10.
12 REMOVE SERVICING TROLLEYS AND TRAVEL GAUGE. INSPECT ALL LIMIT STOPS, CONTROL ROD ADJUSTERS AND TURNBARRELS FOR CORRECT LOCKING AND, WHERE APPLICABLE, CORRECT THREAD ENGAGEMENT.	

1-8409-1

◀ AMENDED ANNOTATIONS ▶

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

(6) Check for centre position, using the setting pin *(Table 5)* 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 the Mk.3 hydraulic servicing trolley *(Table 5)* to No.1 ground test coupling (access panel 45P) of the services system and No.2 controls system (access panel 67P).

(3) Fit the pitot/static test adapter to the pressure head and connect to the test rig *(Table 5)* by means of a rubber hose.

(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/in² minimum.

2. When it is necessary to retract the alighting gear for any checks, a slave battery, not the aircraft battery, should be used.

(5) For the purpose of these tests the loading point on the rudder pedals is at the pedal centres, i.e. a 9 in. arm.

(6) Adjust the rudder bar so that the radial arms *(Chap.4B, fig.3)* are in line with each other, then set the rudder bar in the neutral position, operating the trim switch if necessary.

Smoothness, friction, and centring checks
27.
(1) Start the hydraulic servicing trolley connected to No.2 controls system. Select 'feel' OFF, *(refer to para.26 (4), Note 1)*. Move the rudder bar through its extremes of travel and allow it 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 the tubular spring balance *(Table 5)*, check for friction by slowly applying, at the centre of each rudder pedal in turn, sufficient force to initiate movement of the control surface from neutral. The force required must not exceed:-

Port 4 lb Starboard 2 lb

(3) Check for centring by displacing the rudder bar to one extreme and then allowing it 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 2½deg 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 1½ deg 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 bar to the neutral position.

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

TABLE 2

Spring feel loads

	STBD PEDAL	STBD PEDAL	PORT PEDAL	PORT PEDAL
Pedal forward displacement	10 deg	20 deg	10 deg	20 deg
Force in lb	68 ± 5	130 ± 10	63 ± 5	128 ± 10

Feel performance check

29.

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

(2) Set the rudder bar 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 bar 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	15 deg	15 deg
Force in lb	158 ± 10	138 ± 10

(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 bar 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	5 deg	5 deg
Force in lb	135 ± 15	100 ± 15

A.S.I. pulsing check

30.

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

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

(8) Check that the strip speed indicator does not pulse more than 5 knots when carrying out (7).

Interaction check

31.

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

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

(3) Attach spring balance Ref.No.1H/118 to the control column, 15.5 in. from the column pivot, and move the column aft to approximately 3 deg from the stop.

(4) Repeat operation (7) in para.30 and check that the pulse felt at the control column does not exceed 2 lb.

REMOVAL AND ASSEMBLY

P.f.c.u.

Removal (fig.5)

32. Remove panel 86S and:-

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

(2) Connect the hydraulic servicing trolley *(Table 5)* 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 the locating pin *(Table 5)* 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.33)*.

Assembly

33. 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 (access 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 fig.5, Note.

(9) Finally tighten the locknut on the ram eye-end to 35 lb ft, using the torque loading spanner *(Table 5)*. 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).

TABLE 5

Tools and equipment

Ref.No.	Description	Application/remarks
26DK/95127	Pin, locating	Controls, rigging
26DK/95134	Pin, setting	Autostabilizer setting
26DK/95503	Rig, setting, control column and rudder bar	
26DK/95286	Gauge, rudder travel checks	
27KC/2753	Assembly, torque adapter	Removal/assembly of rudder p.f.c.u.
1A/1275140	Balance, spring, 0-200 lb	Spring feel and hydraulic feel load checks
1H/118	Balance, spring, tubular	
4F/3603	Trolley, hydraulic servicing, Mk.3	C/w No.1, 2, 3 and 4 conversion kits
4F/3761 or 4F/4527	Trolley, electrical servicing	15 kVA/10 kW, I.C.E. driven
or		
4F/3786 or 4F/4258	Trolley, electrical servicing	15 kVA/10 kW, electrically driven
6C/1042139	Sets, test, pitot static	
6C/1990753	Adapter, Mk.9, pitot static system	

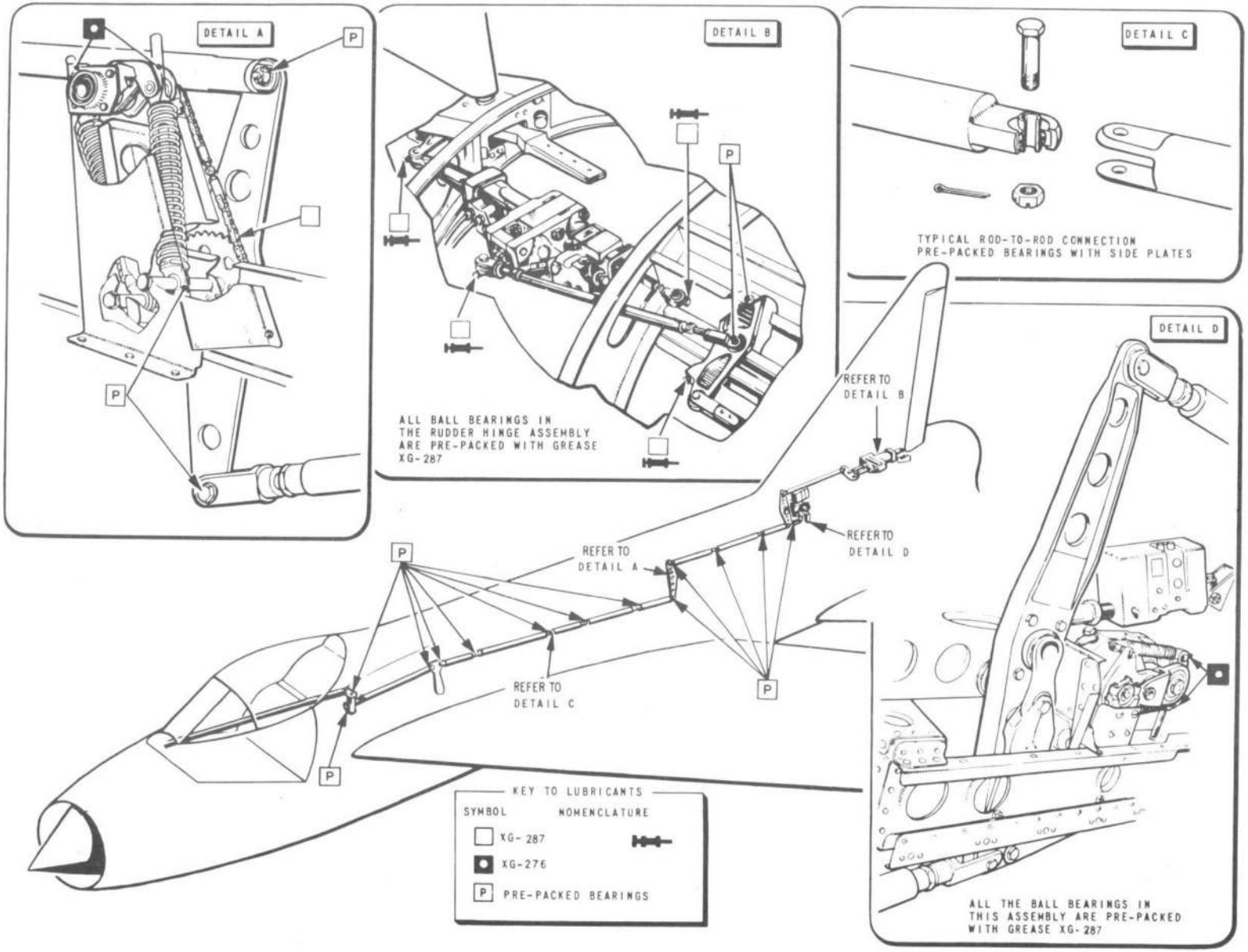


FIG. 7. LUBRICATION OF CONTROLS

◀ REVISED LUB. SYMBOL AND SPEC. No. ▶