PART 2

CHAPTER 9 — FLIGHT CONTROLS SYSTEMS

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Illustrations

General Description

1. The control surfaces are power-operated. Control about the three axes is through dual control columns and rudder pedals. The interconnected control columns have interconnected hand-wheels which are adjustable for height. Each pair of rudder pedals is interconnected and adjustable; the pedals carry toe pedals for operating the wheel brakes.

2. To ensure safe operation, the control surfaces are divided into separate sections and the method of control about each axis can be achieved in two ways. For lateral control there are four electro-hydraulically powered ailerons supplemented by six hydraulically-powered spoilers. Longitudinal control is achieved by four electro-hydraulically powered elevators and a hydraulically-powered variable-incidence tailplane. Directional control is by three electro-hydraulically powered rudders and the aileron/spoiler combination.

3. Each aileron, elevator and rudder section is operated by a self-contained power control unit (PCU). No connection exists between the individual sections of the control surfaces apart from the common mechanical control systems extending to the power control units. A power control unit isolates itself from the system if it fails. Should a power control unit run-away to full deflection, the remaining sections are capable of neutralising the run-away with reserve power available until the faulty unit is disengaged.

4. The spoiler sections normally operate differentially with the ailerons and provide approximately half the rolling power. When the spoiler sections are used as speedbrakes all sections operate together. If there is a complete AC electrical power failure, the spoilers and tailplane are capable of maintaining adequate flight control. Tailplane incidence can be controlled manually or automatically by the auto-pilot.

5. Hydraulically-operated, electrically-controlled Fowler-type flaps and leading edge slats normally operate together but can be operated independently. Safeguards against asymmetric failure are provided. Power is supplied by both hydraulic systems.

6. Each power control unit can be locked, thus locking the associated control surface when the aircraft is parked. A unit may also be locked in flight if a particular power control unit and section is switched out. Under these circumstances the section will trail and be locked in that position by the power unit.

7. The position of all control surfaces and failure warning for the artificial feel simulator units and power control units is shown on panels on the flight deck.

8. A duplicated feel system is provided, the function of which is to provide a representative load at the pilot's controls, for elevators, ailerons and rudders, to replace that lost due to the use of powered flying controls with zero load feed-back. The system also provides reaction forces when using the auto-pilot, to give a torque limiting datum.

9. An elevator auxiliary feel strut, stowed on the flight deck, must be fitted if one feel unit fails; the purpose of the continued flight is to return the aircraft to base.

10. Two independent auto-pilots are fitted. Both auto-pilot systems are of equal authority and either one can be selected for use at any time.

11. A stall warning and protection system is fitted which operates a stick-shaker and a stick knocker on each control column as a pre-stall warning, and when nearer the stall, sounds a horn and pushes the control column forward.

◀ 12. An intermittent horn warning is activated when all four throttles are set within the half to 80% open range on the ground with the flight controls not correctly set/functioning for take-off. ▶

POWERED FLYING CONTROL UNITS

Description

13. Eleven basically similar powered flying control unit (PCU's) are provided; each operates one section of the split surface controls, and is self-contained with its own fluid supply.

The units are divided into two basic types:

a. Slave units which operate with mechanical input only.

b. Master units which incorporate additional valves and electrical equipment and are capable of receiving mechanical signals or electrical signals derived from the auto-pilot system. They are located on the inner sections of both aileron and elevator and the two lower sections of the rudder. The top rudder unit does not conform with either of these types but is designed to accept mechanical and auto-stabilisation signals only.

14. The main components of each unit are an electrically-driven hydraulic generator, a servo control valve, a hydraulic ram and a differential lever assembly. Fluid level in each unit is checked by connecting a test box to a connection in the hydraulic service panel.

15. The units are controlled by eleven NORMAL/ ISOLATE switches, one for each unit, on the POWER CONTROL UNITS panel at the engineer's station. In the ISOLATE position the units are locked. A warning light beside each switch comes on when servo pressure is below normal, due to failure or isolation of a PCU.

16. The PCU's operate simultaneously with movement of the pilots' controls. If a PCU fails and is isolated, the affected control surface is moved to a position slightly to one side of neutral and is locked in that position by the PCU. The associated spring-loaded control rod collapses to allow control to be applied to the other PCU's. Failure or isolation of a PCU is indicated by the master warning light on the pilots' centre panel coming on. The light may be cancelled by pressing it in. The warning light on the engineer's panel remains on until the PCU concerned is serviceable and/or re-engaged.

17. *Location of Controls and Indicators—PCU's* (See **Table 1**)

FEEL SIMULATION

Description

18. The feel simulator maintains a representative load, varying with airspeed and altitude, at the pilots' controls for the rudder, elevators and ailerons. It also provides the necessary reaction forces when the auto-pilot is functioning to give a torque limiting datum. The system is duplicated except for certain linkages and is contained as one unit in the nose-wheel bay.

19. Each half of the self-contained duplicated system consists of a reservoir, a two-stage electrically-driven hydraulic pump, an accumulator, aileron, elevator and rudder control valves, and three jacks. Pitot and static connections are made to the control valves. The jacks are connected by linkages to the pilots' controls.

20. The following items are fitted to the outer case of the unit:

a. Oil filler valve and oil level indicator.

b. Bleed screws for each control channel.

c. Charging valve for supply line accumulators.

21. Control is by two NORMAL/ISOLATE switches, one for each half of the system, on the flight controls panel. Two adjacent O/HEAT warning lights, one for each half of the system, come on to indicate an overheat condition. Two FEEL FAIL warning lights on the pilots' centre panel indicate a fluid pressure failure. When a feel motor is switched to NORMAL, fluid under pressure is metered, as a function of airspeed and altitude, by the control valves, to the jacks which hold the linkage under a tensile load. Displacement of the pilots' controls extend the jacks against hydraulic pressure, resulting in resistance (feel) at the controls.

22. *Location of Controls and Indicators—Feel Simulation.* (See **Table 2**)

Elevator Auxiliary Feel Strut

23. An elevator auxiliary feel strut is provided for use should elevator feel fail. The feel strut is a spring strut which is normally stowed under an ELEV. AUX./FEEL STOWAGE cover at the rear of the centre console.

24. To install the strut, after removal from its stowage, spring-loaded catches at each end of the strut (released by adjacent levers) are sprung into position over pins in brackets on the co-pilot's control column and on the front of his right-hand seat rail. *The end of the strut with the larger diameter, (marked TOP), is attached to the control column.*

25. The spring strut increases elevator feel when one feel unit is inoperative. The increase is not significant for small elevator deflections but becomes more noticeable for larger angles. If both feel units are inoperative, the spring strut provides a measure of feel—considerably lighter than normal. When the strut is fitted, following a double feel failure, the standby yaw damper should normally only be used.

Table 1. Location of Controls and Indicators—PCU's

Item	*Location*	*Marking/Indication*
PCU motor switches (11)	Flight controls panel at engineer's station	POWER CONTROL UNITS LEFT AILERONS—OUTER, INNER RIGHT AILERONS—INNER, OUTER LEFT ELEVATORS—OUTER, INNER RIGHT ELEVATORS—INNER, OUTER RUDDERS—UPPER, MIDDLE, LOWER All switches are marked NORMAL/ ISOLATE
PCU motor failure warning lights (11)	Flight controls panel at engineer's station	FAIL (Red)
PCU fail master warning light	Pilots' centre panel	POWER CONTROLS (red)

Table 2. Location of Controls and Indicators — Feel Simulation

Item	*Location*	*Marking/Indication*
Feel simulator pump motor switches (2)	Flight controls panel at engineer's station	FEEL MOTORS No. 1 NORMAL/ISOLATE No. 2 NORMAL/ISOLATE
Feel simulator pump overheat warning (2)	Flight controls panel at engineer's station	FEEL MOTORS O/HEAT (amber) No. 1; No. 2
Feel simulator failure warning lights (2)	Pilots' centre panel	FEEL FAIL (red)

Table 3. Location of Controls and Indicators — Aileron System

Item	*Location*	*Marking/Indication*
Control column hand-wheel (2)	One in front of each pilot	Interconnected and adjustable for reach
Aileron position indicators (4)	Forward roof panel	WING control surface position indication. Pointers indicate position of sections.
Aileron/spoiler disconnect lever	Centre console	AILERON DISCONNECT (Guarded by LIFT latch.) AILERON/ SPOILERS
Aileron trim switches (2)	Centre console	AILERON TRIM—LOWER LEFT WING/LOWER RIGHT WING
Aileron upset switch A	Pilots' centre panel	AILERON UPSET — ARM A/ NORM/TEST
Aileron upset switch B	Pilots' centre panel	AILERON UPSET — ARM B/ NORM/TEST
Aileron upset left magnetic indicator	Pilots' centre panel	LEFT — UP/NORM (cross-hatch during operation)
Aileron upset right magnetic indicator	Pilots' centre panel	RIGHT — UP/NORM (cross-hatch during operation)
Aileron trim indicator	Pilots' centre panel	AILERON — LOWER LEFT/ WING/LOWER RIGHT

26. *Location of Controls and Indicators—Aileron System.* (See Table 3)

Controls in Fuselage

27. The two control column hand-wheels are interconnected and operate mechanical control systems which control the aileron PCU's and spoiler jacks. The hand-wheels can be disconnected; when disconnected the left hand-wheel operates the aileron system, the right hand-wheel the spoiler system. About half the rolling power is obtained from the spoilers.

28. Each control column is pivoted below the flight deck floor and consists of an upper column housing carrying the hand-wheel, pivoted on a lower column housing. A knob below the handwheel varies the height of the hand-wheel. The hand-wheel, through gears, turns a torque shaft. A roller chain, which passes round a sprocket wheel on the torque shaft, continues to the base of the lower column, where it is directed to the right and left. The ends of the chain are attached to a transverse rod.

29. The inboard end of the transverse rod of each control column is linked by a telescopic rod and disconnect mechanism. Plungers in the disconnect mechanism are withdrawn by operating the AILERON DISCONNECT lever on the centre console.

30. The outboard end of the left-hand transverse rod is linked to a three-armed lever assembly. One arm is linked to the feel unit and the other arm is linked by the trim strut to a cable tensioner. A cable/tie-wire circuit connects the cable tensioner to a triple pulley in the left main undercarriage bay

Controls in Wings

31. Looped cable-tie-wire assemblies extend outboard from two pulleys of the triple pulley unit to the cable tensioners in each wing. The tensioner in the wing is linked by a rod to a swinging arm, the fulcrum of which can be altered by the upset strut, to give aileron upset. The swinging arm is also connected to two collapsible spring-loaded control rods, one extending inboard to the master PCU, the other extending outboard to the slave PCU. The inboard rod embodies solenoid-operated locks which lock the rod when the auto-pilot is controlling that master PCU.

Aileron Upset

32. The ailerons are normally up-rigged $2\frac{1}{2}°$ and may be mechanically deflected upward a further $8\frac{1}{4}°$ (with the flaps retracted) whenever the aircraft weight is in excess of 290,000 lb. at heights below 24,000 ft.

33. An aileron upset strut is fitted to each of the left and right aileron control runs in each wing. The struts, when operated, alter the fulcrum position of an operating lever.

34. Each strut assembly is fitted with two electrically-operated motors which are independent of each other but are connected to a differential gearbox to operate the strut. The strut can be operated by one motor, the other acting as a standby.

35. The motors are powered by two separate electrical systems; System A controls one motor in each wing and System B the other.

36. The systems are controlled by two ARM/NORM/TEST switches, one for System A and one for System B. The overriding control of each system is the flap selector lever which renders the aileron upset systems inoperative when the flap lever is in any position other than UP. The TEST setting, however, can be used with the flap in any position.

37. Two magnetic indicators are adjacent to the control switches; they show NORM for the left and right ailerons when the struts are in the normal position, UP when the aileron upset is complete and cross-hatch during operation.

37A. The systems are linked with the TOCW horn, which sounds if one switch is not set to ARM, or aileron upset is already applied before take-off. (See Part 2, Chapter 6, Para. 26 c(4) of this Book and Part 2, Chapter 9, Paras. 3 and 4 of Pilot's Notes (Flying)).

37B. Before every take-off, one switch must be set to ARM after the flaps have been set for take-off; otherwise the TOCW horn sounds. After take-off, at weights below 290,000 lb. set the switch to NORM before selecting flaps up. At weights above 290,000 lb. when the flaps are selected up, check that both magnetic indicators show cross-hatch, and then both show UP within 15-20 seconds.

Trim Strut

38. The ailerons do not embody a trim tab, but an electrically-actuated strut fitted into the control system deflects the ailerons for trim purposes.

39. The strut consists of two independently supplied electrically-operated linear actuators fitted one at each end of a tube. Two AILERON TRIM switches on the centre console, which are spring-loaded to centre, control the actuators. Operating the switches singly or together gives two speeds of operation. The trim state is indicated on the AILERON trim indicator on the centre panel.

RUDDER SYSTEM

Table 4. Location of Controls and Indicators — Rudder System

Item	*Location*	*Marking/Indication*
Rudder pedals (4)	Two in front of each pilot	Interconnected
Rudder pedal adjustment controls (2)	One on wall panel at each pilot's station	PULL TO ADJUST/RUDDER PEDALS/RELEASE TO LOCK
Rudder position indicators (3)	Forward roof panel	Control surface position indication. Pointers indicate position of rudders
Rudder trim hand-crank	Centre console	RUDDER TRIM. Dial indications, plus or minus 170 deg.
Yaw damper switches (2)	Centre console	DAMPER 1: DAMPER 2
Standby yaw damper switch	Left side of centre console	STANDBY YAW DAMPER-ON/OFF

40. *Location of Controls and Indicators—Rudder System.* (See Table 4)

Controls in Fuselage

41. The duplicated and interconnected rudder pedals which are provided with individual adjustment for reach, incorporate toe-operated brake units. A set of rudder pedals is adjustable for leg reach after operation of a PULL to ADJUST/RUDDER PEDALS/RELEASE TO LOCK control forward of the nosewheel steering control handle on the associated side. Each pair of rudder pedals is connected to a separate cable tensioner below the flight deck floor. Two cable and tie-wire circuits extend aft from the cable tensioners to a cable drum assembly at the base of the fin rear spar.

42. Control rods from the left-hand rudder pedals are connected to the feel simulator unit in the nosewheel bay.

Controls in Fin

43. Movement of the cable drums at the base of the fin is transferred to two levers. The left-hand lever operates the lowest PCU and rudder section, and the right-hand lever the centre and upper PCU's and rudder sections. A spring box is incorporated in the input linkage to each PCU to ensure that an inoperative PCU will not affect the system. The lowest and middle spring boxes incorporate a solenoid lock which operates when the aircraft is under auto-pilot control.

44. A centring device, spring-loaded to resist extension or compression, prevents an uncontrolled input into the PCU's if a disconnection occurs. The centring device is anchored to the structure at one end and to the upper PCU at the other end.

Trim Control

45. The rudder trim mechanism is controlled from a hand-crank, with a dial indicator assembly, mounted on the centre console. Rotation of the hand-crank is transmitted through drive shafts to an operating jack in the feel simulator. The jack repositions the toggle linkage so that the rudder sections remain deflected with zero feel force.

Yaw Dampers

46. Three separate yaw damper systems are installed in the aircraft. (See Chapter 2, Paras. 13-16—Autopilot, in this Part.)

ELEVATOR SYSTEM

47. *Location of Controls and Indicators—Elevator System.* (See Table 5)

Controls in Fuselage

48. The interconnected control columns are each connected to a cable tensioner. The left column is also linked to the feel simulator unit and is connected to a spring-loaded balance strut which counterbalances the weight of the control column and acts as limit stops.

49. Cable/tie-wire circuits extend from the two cable tensioners under the flight deck to two cable quadrants in the fin bullet.

Controls in Tailplane and Bullet

50. The left-hand cable quadrant is linked by levers and rods to the inboard master PCU's and the right-hand cable quadrant is linked in a similar manner to the outboard slave PCU's. Collapsible spring boxes

Table 5. Location of Controls and Indicators—Elevator System

Item	*Location*	*Marking/Indication*
Control columns (2)	One in front of each pilot	Interconnected and adjustable
Elevator position indicators (4)	Forward roof panel	TAILPLANE. Control surface position indication. Pointers indicate position of elevator sections.

are fitted into the linkage to all the PCU's. The spring boxes for the inboard PCU's have a solenoid locking facility for use when the aircraft is under auto-pilot control. The PCU's are pivot-mounted to the tail-plane trailing edge member and each is directly coupled to one of the four elevator sections.

TAILPLANE TRIMMING SYSTEM

51. *Location of Controls and Indicators—Tailplane Trimming System.* (See Table 6)

Controls in the Forward Fuselage

52. The variable-incidence tailplane is controlled manually by the pilots or automatically by the auto-pilot, to adjust the pitch trim of the aircraft.

53. Duplicate manual and auto-trim control operate independent electro-hydraulic tailplane Systems A and B. Hydraulic power is supplied by the main hydraulic systems. Each pilot's control consists of two levers, one (a rate lever) mechanically controls a hydraulic selector valve and the other (an arming lever) electrically controls a hydraulic arming valve. The 1st pilot is provided with a subsidiary pair of levers which are mechanically coupled to the co-pilot's levers. The arrangement is that the 1st pilot controls the tailplane through Systems B or A and the co-pilot through System A. A centralising unit spring-loads the levers to the central off position which is marked by a red line on the quadrant. Each pair of levers is interconnected but can be disengaged by hand pressure; the levers are then free to operate independently. Moving a pair of levers forward gives a nose-down trim change; moving them back produces a nose-up trim change.

Controls in the Tail

54. When a manual selection is made, on the flight deck, micro-switches in the centre console isolate the auto-trim control and energise the arming selector valve in the tail. At the same time the rate lever operates the manual selection valve in the tail through a cable/tie-wire system.

55. Hydraulic fluid at system pressure then flows through valves to release the brake plates that clamp the motor drive shaft and drives the hydraulic motor on the screw jack gearbox. The screw jack, depending on the direction of rotation, drives the operating nut and attached tailplane up or down about the fulcrum point.

56. A pressure-sensing switch, in the hydraulic motor return line, operates when the pressure exceeds a predetermined figure, and cuts off the fluid supply to the system. At the same time the system TAIL TRIM OVERRUN warning light comes on and the brake clamp to the motor drive shaft is applied.

57. The hydraulic motors operate independently; a fault in one system can be overcome by returning the manual control levers for that system to the mid-position and operating the other system.

58. Limit switches cut on the hydraulic supply at the normal tailplane incidence range. Overrun limit switches cut off the hydraulic supply and operate both system overrun warning lights. Pressing the re-arm push-button of the serviceable system, breaks the overrun circuit, puts out the warning light and restores the hydraulic supply to the system. If at the same time selection is made with the appropriate rate/arming levers, the tailplane can be brought within the normal operating range.

59. A TAIL TRIM indicator on the pilots' centre panel operates from a transmitter on the tailplane Graduated markings are also on the fin trailing edge.

Auto-trim Operation

60. The two auto-trim control systems operate independently, No. 1 system operating TPI System B and No. 2 system operating TPI System A. The auto-trim system can only operate when the manual levers are in the mid-position.

61. The auto-trim control system utilises the same electro-hydraulic components except that auto-trim limit switches replace the manual stop switches Choke valve are also introduced into the system to limit the speed of operation.

Table 6. Location of Controls and Indicators — Tailplane Trimming System

Item	*Location*	*Marking/Indication*
Tail trim levers (2 pairs)	Left side of centre console	TAIL TRIM—NOSE DOWN/NOSE UP. Outer pair in circuit with hydraulic system B. Inner pair in circuit with hydraulic system A.
Tail trim levers (1 pair)	Right side of centre console	TAIL TRIM—NOSE DOWN/NOSE UP. In circuit with hydraulic system A.
Tailplane trim indicator	Centre instrument panel	TAIL TRIM—NOSE UP (14°)/NOSE DOWN (3°)
Overrun warning lights (2)	Flight controls panel at engineer's station	TPI OVERRUN SYSTEM A, SYSTEM B (and press-to-test)
Overrun re-arm buttons (2)	Flight controls panel at engineer's station	TPI OVERRUN SYSTEM A—PUSH TO RE-ARM SYSTEM B—PUSH TO RE-ARM

Table 7. Location of Controls and Indicators — Spoiler/Speedbrakes

Item	*Location*	*Marking/Indication*
Spoiler switches (3)	Flight controls panel at engineer's station	SPOILERS—INNER/ISOLATE MIDDLE/ISOLATE OUTER/ISOLATE
Spoiler position indicators (6)	Forward roof panel	SPOILERS. Control surface position indication. Pointers indicate position of sections.
Speedbrakes lever	Centre console	SPEEDBRAKES—OFF/10°/20°/30°/40°/50°
Aileron spoiler disconnect lever	Centre console	AILERON DISCONNECT— AILERON/SPOILERS (Guarded by LIFT latch)

SPOILER/SPEEDBRAKES

62. *Location of Controls and Indicators—Spoilers/Speedbrakes.* (See Table 7)

Spoiler Control System

63. The wheel on the right control column is connected by rods, chains and levers to a tensioner. A spring feel unit is attached to one of the levers, and this unit, together with the feel simulator, provides feel loads in the lateral control system and self-centring to the spoiler system after disconnection from the aileron system.

64. A cable/tie-wire circuit from the tensioner extends aft to a triple pulley assembly in the right main undercarriage bay. Cable circuits connect from the triple pulley unit to the mixing box in each wing. The output from the mixing box is linked to a torque shaft which in turn is linked by three spring struts to three synchronising layshafts. Each layshaft connects the two jacks at each spoiler, of which there are three to each wing.

65. The jacks are powered by the main hydraulic systems. System B supplies the inner and outer pairs of jacks in each wing and System A each middle pair.

66. The spoiler sections operate differentially with the ailerons through the interconnected control column hand-wheels or through the right hand-wheel when the control columns are disconnected. If both lateral control and speedbrake control are applied simultaneously the spoilers on the side of

the up-going aileron rise to the angle called for, depending on the amount of aileron and speedbrake required. The spoiler on the side of the down-going aileron extends only the amount called for as a speedbrake.

67. At speeds in excess of 345 knots, over the height band 20,000 to 30,000 feet, the rate of roll of the aircraft is reduced due to partial aileron reversal. Under normal conditions the spoilers give more than adequate control but, with the speedbrakes extended, the amount of spoiler surface deflection available for roll control is restricted. To ensure that adequate deflection of the spoilers for roll control is available, *at all heights*, the speedbrake deflection as speedbrake—is mechanically limited to a surface deflection of 25° at speeds in excess of 345 knots. (See para. 71 below.)

Speedbrake Control System

68. The speedbrake control lever on the centre console is fitted with a friction device. The lever is linked by rods, tensioners and cable/tie-wire circuits to the mixing box in each wing.

69. The mixing box contains a cam track which is connected to the lateral control circuit. A 'dwell' portion on the cam track allows small aileron movements without accompanying operation of the spoilers.

70. The spoiler/speedbrake jack assembly consists of a jack, by-pass valve, pressure relief valve and rotary control valve. The rotary control valve is controlled by the mixing box.

71. Movement of the speedbrake control lever on the centre console causes simultaneous movement of the speedbrakes in each wing. Speedbrake control is mechanically limited to a maximum of 25° at speeds in excess of 345 knots in order to provide a reserve of spoiler surface deflection to give adequate roll control at all heights. (See para. 67 above.) The mechanism is activated by a speed-sensitive switch, monitored by the pitot-static system of No. 2 feel system (right side) which controls an electrically-operated actuator sited below the centre console on the flight deck. At speeds in excess of 345 knots the actuator brings in a baulk to restrict the speedbrake lever to the 25° setting; if the speedbrakes are already deflected in excess of 25°, when 345 knots is exceeded, the speedbrake lever is automatically returned to the 25° setting.

72. If a rotary control valve seizes in the open position the jack runs away and will be out of line with the other spoiler/speedbrakes. This can be seen on the position indicators and may give a one-wing low effect. Setting the appropriate spoiler switch, on the flight controls panel, to ISOLATE allows the affected control surface and its counterpart on the opposite wing to blow back.

Position Transmitters

73. One transmitter for each spoiler is on an access panel adjoining the spoiler to which it is mechanically linked. The transmitter is electrically connected to the appropriate SPOILERS position indicator on the pilots' roof panel.

SLAT SYSTEM

Description

74. The slats are fitted in four sections to the leading edge of each wing. Control is through a lever on the centre console, normally linked to the flap lever by a spring-loaded plunger. The slats can only be selected fully IN or fully OUT.

75. The system is powered by both hydraulic Systems A and B. A 28-volt DC supply is provided for the normal and overtravel systems, and a ▶◀ 115-volt AC supply for the asymmetric control and test equipment.

76. Micro-switches, operated by the slat lever on the centre console, form part of the electrical control system which includes the slat selector valve. The selector valve directs fluid to the hydraulic motors which drive a gearbox and selector drum. The gearbox through torque shafts drives screw jack assemblies; there are two screw jacks for each slat section. Each slat is provided with a 'hold-down' unit. This comes into operation when the slats are retracted to prevent the slats 'bowing' away from the wing leading edge. The unit consists of a roller attached to the centre of each slat section which engages a throated guide rail on the main structure when the slat is retracted.

77. Hand-winding facilities are provided for ground servicing.

78. *Location of Controls and Indicators—Slat System.* (See Table 8)

Overtravel Protection

79. Overtravel switches, operated by strikers that are driven by the torque shaft system, operate when the slats go beyond the normal IN and OUT positions. The selector valve operates two micro-switches which activate the isolate indicator, and four switches

Table 8. Location of Controls and Indicators — Slat System

Item	*Location*	*Marking/Indication*
Slat selector lever	Centre console	IN/OUT
Slat position indicators (2)	Pilots' centre panel	SLAT — IN/OUT
Slat magnetic indicators (2)	Flight controls section of engineer's hydraulic panel	SLAT — IN/OUT
Slat isolate indicators (2)	Flight controls section of engineer's hydraulic panel	Magnetic indicator. In-line: cross-line
Slat asymmetry test switches (2)	Rear roof panel	SLAT ASYMMETRY — TEST/NORMAL

operated by the overtravel mechanism operate to isolate hydraulic Systems B and A in sequence.

Asymmetric Sensing

80. Synchros, at the outboard ends of the torque shafts, together with asymmetric sensing units, sense any asymmetric condition in the transmission and will de-energise the isolate valve to isolate both systems; at the same time both isolate magnetic indicators on the engineer's hydraulic panel show cross-line. Holding the SLAT ASYMMETRY switch on the rear roof panel to TEST and then making a selection with the slat lever should result in no slat movement if the system is operating correctly.

Fail-safe System

81. If an 'out of phase' movement occurs between either Nos. 1 and 2 slats on the right wing or Nos. 1 and 2 slats on the left wing, micro-switches are operated which isolate both systems; at the same time both isolate indicators on the engineer's hydraulic panel show cross-line.

Slat Position Indication

82. *Slat Position Indication — Pilots' Centre Panel.* Potentiometers driven from the outboard ends of the left and right torque shaft systems operate two SLAT — IN/OUT gauge-type indicators, one for each side.

83. *Slat Position Indication — Engineer's Station.* Two magnetic indicators, one for each side, on the hydraulics panel, show IN or OUT, according to slat movement and are blank when de-energised.

Isolate Indicators

84. Two magnetic indicators, one for each side, on the engineer's hydraulics panel are provided to indicate hydraulic fluid flow in the slat system. They show in-line when fluid is flowing and cross-line when there is no flow.

FLAP SYSTEM

Description

85. The flaps are fitted in five sections under the trailing edge of each wing. Control is through a telescopic lever on the centre console which must be lifted before the lever can be moved. There are detent positions at the UP (0 deg.), TO (20 deg.), APP (35 deg.) and LDG (45 deg.) settings. The flaps can only be moved from one setting to the next when lowering but can be raised in one movement from the LDG to the TO setting. The flap lever is linked by a spring-loaded plunger to the slat lever.

86. Hand-winding facilities are provided for ground servicing.

87. a. The system is powered by both hydraulic Systems A and B. Both systems normally operate together, but if a fault develops in either system, the faulty system can be isolated by use of the

associated ISOLATE switch. The flaps can then be operated by the other system, but at half the normal rate.

b. Asymmetric operation, or overrunning of the flaps causes the isolate valves to automatically close and the isolate lights to come on; the flaps may be reset by setting the ISOLATE switches to ISOLATE and then back to NORMAL, thus breaking a hold-in circuit.

c. The normal and overtravel control systems are supplied by 28-volt DC and the asymmetric control and test equipment with ▶◀ 115-volt AC.

88. Micro-switches operated by the flap control lever are connected to solenoids in the flap selector valves. The selector valves allow fluid under pressure from Systems A and B to pass to the two hydraulic motors on the gearbox. Torque shafts extend from the gearbox to each wing and drive other gearboxes that are on each side of each flap section. These gearboxes drive screwshafts on which are mounted flap trolleys that move the flaps. The angle of the flaps is controlled by cam tracks. When a flap selection is made and the flaps reach the selected position, the selector valve is closed by limit switches actuated by the selector drum. At the same time the hydraulic motors are hydraulically locked by lock valves.

89. *Location of Controls and Indicators—Flap System.* (See Table 9)

Overtravel Protection

90. Micro-switches in each wing are operated if the flaps go beyond the normal UP or DOWN positions. When the micro-switches are operated the isolate valves cut-off the fluid supply to the hydraulic motors and the flap ISOL warning lights come on and the magnetic indicators show cross-line.

Manual Isolation

91. Setting either flap isolate switch on the flight engineer's panel to ISOLATE de-energises the isolate valve solenoid and causes the adjacent ISOL light to come on and the flap-isolate magnetic indicator to show cross-line for the associated system.

Asymmetric Sensing

92. Four synchros driven by the inner and outer screw shafts in each wing are electrically coupled inner to inner and outer to outer, the synchros together with two sensing units detect a transmission failure which would cause asymmetrical operation of the flaps. The sensing units cause both isolate valves to shut off the hydraulic supplies. Flap movement then ceases, indicated by the flap indicators and by the flap isolate indicators and warning lights.

93. A test switch in each circuit simulates flap asymmetry. Confirmation of the test is obtained by reference to the isolate magnetic indicators and warning lights. After testing, the isolate switches must be set to ISOLATE and then back to NORMAL to reset the system.

Fail-safe System

94. Micro-switches, one in each wing, stop flap operation if the 'take-off' (20 deg.) limit switches fail to operate.

Position Indication

95. A transmitter, fitted to the outboard gearbox drive unit in each wing, operates gauge-type FLAP indicators, one for each side, on the pilots' instrument panel.

PCU FAILURE WARNING SYSTEM

Description

96. Warning of PCU failure is given to both pilots by the POWER CONTROLS red light on the centre instrument panel coming on. The light remains on until the fault is rectified or the lamp is momentarily pressed.

97. Each PCU contains a pressure-operated switch which is associated with an individual FAIL warning light on the flight controls panel at the engineer's station. The lights are parallel-connected to both the pilots' POWER CONTROLS warning light and the No. 3 warning horn circuit.

98. Warning of feel simulation failure is given by two FEEL FAIL warning lights on the pilots' centre panel—located above the PCU failure warning light. The lights, which are linked to pressure switches in the two feel simulator pump units, are parallel-connected to the warning horn circuit.

99. *Location of Control and Indicators — PCU Failure Warning System.* (See Table 10)

Table 9 — Location of Controls and Indicators — Flap System

Item	*Location*	*Marking/Indication*
Flap selector lever	Centre console	FLAPS — UP/TO/APP/LDG
Flap position indicators (two)	Pilots' centre panel	FLAP — UP/T.O/APP/LANDING AL 16
Flap selector valve indicators (two)	Flight controls section of engineer's hydraulic panel	Magnetic indicators, one for each system. When energised indicate UP or DOWN according to flap position. No indication when de-energised
Flap isolate switches (two)	Flight controls section of engineer's hydraulic panel	NORMAL/ISOLATE
Flap isolate indicators (two)	Flight controls section of engineer's hydraulic panel	Magnetic indicators. SYSTEM A: SYSTEM B. One for each system. In-line: cross-line
Isolate warning lights (two)	Flight controls section of engineer's hydraulic panel	SYSTEM A: ISOL. (amber—press-to-test) SYSTEM B: ISOL. (amber—press-to-test)
Flap asymmetry test switches (two)	Rear roof panel	FLAP ASYMMETRY INNER — TEST/NORMAL OUTER — TEST/NORMAL

Table 10 — Location of Controls and Indicators — PCU Failure Warning System

Item	*Location*	*Marking/Indication/Description*
PCU failure master warning light	Pilots' centre panel	POWER CONTROLS (red)
Feel simulator failure warning lights (two)	Pilots' centre panel	FEEL FAIL (red)
Warning horn	Panel A	TOCW HORN RESET. Isolated from flight control system when airborne
	Centre console	Horn cancel button
PCU failure warning lights (11)	Flight controls panel at engineer's station	FAIL (red)

Operation

100. When a PCU fails, the POWER CONTROLS warning light comes on; simultaneously, the associated PCU failure warning light also comes on. Pressing the POWER CONTROLS warning light holder in, momentarily, cancels the warning light. The PCU failure warning light on panel B remains on.

TAKE-OFF CONFIGURATION WARNING SYSTEM

Description

101. A take-off configuration warning (TOCW) system causes a horn to sound intermittently when all four throttles are set within the half open to 80% open range on the ground and the flight controls are not correctly set/functioning for take-off.

Operation

101A. The TOCW horn sounds if one or more of the following conditions is not satisfied:

a. Flaps at take-off setting.

b. Slats out.

c. Airbrakes in.

d. Tailplane trim within take-off range.

e. One aileron upset switch at ARM.

f. Ailerons normal (nil upset applied).

g. All PCU (11) functioning.

h. Both feel units functioning.

101B. The warning horn can be cancelled by pressing the TOCW HORN button, on the centre console, provided the throttles are retracted to below the half-open setting or advanced beyond the 80% open setting.

CONTROL SURFACE POSITION INDICATION

Description

102. A control surface position indicator on the forward roof panel displays a rear horizontal view of the aircraft on which are 17 separate indicators showing the individual positions of the four elevator sections, the three rudder sections, the four aileron sections and the six spoiler sections.

103. *Location of Indicators — Control Surface Position.* (See **Table 11.**)

Operation

104. All the transmitters and indicators are electrically-operated from the 28-volt DC supply. Movement of the control surface is imparted to the transmitter variable resistance which alters the balance of current flow to the indicator causing movement of the indicator pointer.

AC POWER-SUPPLIES

Powered Flying Control Units

105. The PCU motors and feel simulator pump motors are supplied from the Generator and Auxiliary AC busbars. Normally the No 1 and No 3 generators are paralleled and supply the AC power for electrical System A. The No 2 and No 4 generators are also paralleled and supply the AC power for electrical System B. Failure of a generator results in the automatic paralleling of the remaining generators in order to maintain maximum power distribution. The SSB switch on the AC electrical panel is set to MANUAL SPLIT during take-off and landing to override the automatic paralleling facility to ensure two separate AC systems during these periods.

106. If all main generator supplies fail, the Elrat generator can be selected to supply the Emergency and Auxiliary AC busbars. This results in certain of the PCU motors being automatically transferred to the Emergency busbar. Timer units sequence the transfer of the PCU motors to avoid shock-loading the Elrat generator.

◀107. Power distribution to the PCU motors and sequence transfer when Elrat is selected is shown in **Table 12.**) ▶

108. Individual NORMAL/ISOLATE switches on the POWER CONTROL UNITS panel at the engineer's station control the individual PCU motors. The switches are spring-loaded to the centre off position.

109. Latched-type relays control the connection of the busbar supplies to the PCU motors. Timer units sequence the transfer of certain PCU motors to the emergency busbars when the Elrat is operating.

Feel Simulator Pump Motors

110. The No 2 feel simulator pump is supplied from the Auxiliary AC busbar and the No 1 feel simulator pump motor from the No 4 generator AC busbar. When the Elrat is operating, only the No 2 feel simulator pump motor is operative. It is not automatically sequenced and therefore must be switched manually. Individual FEEL MOTORS — NORMAL/ISOLATE switches on the POWER CONTROL UNITS panel at the engineer's station are used to control each feel simulator motor.

STALL PROTECTION SYSTEM

Stall Protection — General

111. The stall protection system provides during the various phases of approach to the stall:

Automatic ignition on all four engines.

Stall warning by the operation of a stick shaker and a stick knocker on each control column.

Stall identification by the sounding of a klaxon for each system, followed by operation of a ram to move the control columns forward.

112. *Controls and Indicators — Stall Protection System.* (See **Table 13.**)

Table 11. Location of Indicators — Control Surface Position

Item	*Location*	*Marking/Indication Description*
Control surface position indicator	Forward roof panel	Gives individual positions of the four elevator, three rudder, four aileron and six spoiler sections.

Table 12. Power Distribution to the PCU Motors

PCU motor	*Generator supply bus-bar*	*Condition when Elrat is Operating*	*Time unit delay*
Left outer aileron	No. 1	Isolated	—
Left inner aileron	No. 2	Operative	4·5 to 5·5 seconds
Right inner aileron	No. 3	Operative	6·5 to 8 seconds
Right outer aileron	No. 4	Isolated	—
Left outer elevator	No. 1	Isolated	—
Left inner elevator	No. 2	Operative	Instantaneously transferred
Right inner elevator	No. 3	Operative	1·1 to 1·5 seconds
Right outer elevator	No. 4	Isolated	—
Lower rudder	No. 2	Isolated	—
Middle rudder	No. 1	Isolated	—
Upper rudder	No. 4	Operative	2·7 to 3·3 seconds

NOTE: The normal control circuits for the PCU motor relays are taken from the generator sub bus-bars.

113. The three system FAIL warning lights operate together.

114. The nitrogen pressure LP red warning light normally comes on to indicate that pressure has fallen to 32 PSI.

115. Setting the dump valve lever to DUMP permits venting of ram nitrogen pressure to atmosphere should the solenoid-operated valves fail in the open position. This action causes the FAIL warning light on the forward roof panel to come on but cancels the warning lights on the pilots' panels.

Automatic Ignition

116. Automatic ignition is signalled from the lower two of four probes (Ferranti-type), located on each side of the forward fuselage. It is switched on at a predetermined incidence, which is modified by slat position and mach number and remains on as long as the incidence is at or above this value. Indication of igniter operation is shown on the engine start panel. The system is brought into operation earlier whenever the slats are in or whenever 0·74M is exceeded.

117. The system, which is physically shared with but electrically isolated from the stall identification system, consists of two computer units, two mach switches and two angle of incidence probes. One of the two igniters on each engine (4) is coupled to its associated computer, thus providing a completely duplicated and independent system.

118. The three-position TEST AUTO-IGNITION switch is used to override the oleo cut-off relays and feeds a test signal into the selected computer unit, bringing into operation one igniter on each engine.

Stall Warning

119. Stall warning is signalled by the upper two of the four fuselage-mounted probes, one for each stick shaker/knocker. It is signalled at a predetermined incidence which is modified by a combination of flap position, slat position and rate-of-change of incidence, and remains on as long as the incidence is at or above this value.

120. The system consists of two computer units, two lift rate modifiers, two angle of incidence probes, two stick shaker motors and two stick knocker motors.

Table 13. Controls and Indicators—Stall Protection System

Item	*Location*	*Marking/Description*
Stall identification test switch	Forward roof panel	TEST. STALL IDENTIFICATION-No. 1/OFF/No. 2. (Spring-returned to OFF)
Stall warning test switch	Forward roof panel	TEST. STALL WARNING-No. 1/OFF/No. 2. (Spring-returned to OFF)
Auto-ignition test switch	Forward roof panel	TEST. AUTO IGNITION-No. 1/OFF/No. 2. (Spring-returned to OFF)
Valve operated indicator lights (2)	Forward roof panel	VALVE A. VALVE B (Red)
System fail warning lights (3)	Forward roof panel (1) First pilot's panel (1) Co-pilot's panel (1)	SYSTEM FAIL (Red) Adjacent to each pilots' ASI
Nitrogen reservoir LP warning light	Forward roof panel	LP (Red). (Press-to-test)
Nitrogen reservoir low pressure gauge	Forward roof panel	NITROGEN-0-80 PSI
System operated lights (2)	First pilot's panel (1) Co-pilot's panel (1)	STALL IDENT (Amber) Adjacent to each pilot's ASI
Nitrogen bottle high pressure gauge	Right outer sill panel	STALL IDENTIFICATION HP NITROGEN 0-2,000 PSI
Dump valve lever	Centre console	STALL DUMP VALVE-NORMAL/DUMP
Stall identification warning probe heater ammeters (4)	Engine control panel at engineer's station	STALL IDENT. PROBE HEATER-No. 1/No. 2 DC AMPS. (0 to 6 amp.) STALL WARNING. PROBE HEATER-No. 1/No. 2 DC AMPS (0 to 6 amp.)
Pressure head heater and No. 1 stall identification probe heater switch	Forward roof panel	PITOT HEAD HEATERS. CAPTAIN-ON
Pressure head heater and No. 2 stall identification probe heater switch	Forward roof panel	PITOT HEAD HEATERS-AUTO-PILOT 2. ART FEEL 2-ON

121. One stick shaker and one stick knocker is mounted on each control column and is connected to the respective computer unit and lift rate modifier, thus providing duplicated and independent indication of stall warning.

122. The three-position TEST STALL WARNING switch is used to override the oleo cut-off relays and provides a test signal into the selected computer unit, bringing into operation the stick/knocker motors.

Stall Identification

123. The stall identification system is signalled by the two fuselage-mounted probes which signal auto-ignition. It is signalled at a pre-determined incidence set at a level which is always above the stall warning value. This predetermined incidence is modified by a combination of flap position, slat position and rate-of-change of incidence. The stall identification system operates only if armed by a prior stall warning signal, and remains in operation as long as the incidence is at or above the modified level. If incidence is held above the stall warning value, but below the stall identification value for longer than 60 seconds, the arming signal is cancelled which causes the system FAIL light on the forward roof panel and the warning lights adjacent to the ASI on each pilots' panel to come on; the *stall identification will not operate if incidence is subsequently increased*. The system reverts to normal operation once the stall warning signal is cancelled by resuming normal flight.

124. The stall identification system is pneumatically-powered from an HP nitrogen bottle which feeds a "stick-pusher" ram through a reducing valve, an LP reservoir and two solenoid-operated selector valves. A gauge on the forward roof panel indicates the pressure in the low pressure reservoir and

another on the right sill panel indicates the pressure in the HP bottle. Minimum HP pressure for flight is 500 PSI. When pressure falls to 32 PSI, the LP red light on the forward roof panel comes on.

125. Both solenoid-operated selector valves are opened by a stall identification signal. The opening of each valve is indicated by the associated red light on panel E coming on, and the subsequent movement of the ram is indicated by the STALL IDENT. amber light adjacent to the airspeed indicators on each pilot's panel also coming on.

126. Removal of the stall identification signal causes the valves to close, thus venting ram pressure to atmosphere. All lights then go out.

127. The SYSTEM FAIL light on the forward roof panel comes on when:

a. A stall identification signal is given without prior stall warning signal.

b. A stall warning signal is not followed within 60 seconds by a stall identification signal.

c. A malfunction of, or loss of power to, the lock-out circuit.

d. The stall warning dump valve lever is operated.

128. The stall identification system consists of two lift rate modifiers, two solenoid-operated valves, interlock relays and delay unit, two warning horns and two angle-of-incidence probes which are shared with but electrically isolated from the auto-ignition system.

129. When the stick shakers operate, a priority circuit receives signals from each of the computer units of the stall warning system. The first signal received is passed to the interlock relays to arm the solenoid valves circuit. The second priority circuit receives signals from each of the computer units of the stall identification system. The first signal received is passed to the interlock relays and, providing that the sequence is correct, completes the circuit to the solenoid valves.

130. The signal from either of the probes is fed to the appropriate computer unit and, when the signal is at a particular value, the unit supplies a 28-volt DC output. The value of the signal may be changed by combinations of the flap and slat position compensation. The signal is passed through the lift rate modifier so that a quick rate of change of the probe angle will cause an advanced signal, provided that it has been preceded for 0·7 seconds by a stick shaker signal.

131. The computer unit output passes through the priority circuit to the stall identification relay in the interlock circuit to give a signal to the solenoid valves which will open to move the control column ram forward. The warning horn in each system sounds when the respective stall warning and stall identification computer units both signal, which is simultaneous with control column movement.

132. If the stall identification signal is received by the interlock circuit prior to an arming signal from the stall warning circuit, the system is locked out and the system failure light will come on and the control column will not move. Removal of the stall identification signal and the subsequent signalling in the correct sequence is required before the system will function correctly.

133. If the stall warning signal is received by the interlock circuit, arming the solenoid valve circuit, but is not followed within 60 seconds by a stall identification signal, the system is locked out, the system failure light will come on and the control column will not move.

134. The three-position TEST STALL IDENTIFICATION switch provides a test signal to the computer unit of the stall identification system. It overrides the oleo relays and provides a signal to the stall identification portion of the interlock unit which, not having been armed by a stall warning, will lock out and cause the system fail light to come on. The appropriate warning horn circuit will be partly completed.

Incidence Probes

135. Four slotted conical probes are mounted, two on either side of the forward fuselage, and project into the airstream. Each probe can rotate about its own axis through 50° in pitch, 4° of which are above fuselage datum. The probe detects the direction of airflow and transmits to the computer unit a voltage, picked off from gauged potentiometers, proportional to the angle between the airflow and the fuselage datum.

136. When the aircraft angle of incidence is steady, pressure acts equally on the two probe slots, but as the angle of incidence changes, differential pressures are set up which, applied to the opposite sides of a paddle wheel, causes the wheel to rotate the probe until the pressures are again equal, i.e. the direction of flow bisects the angle between the slots.

137. Ice protection for the probes is provided by heaters supplied from the No. 1 essential 28-volt DC supply. The left probe heaters are controlled by the first pilot's pressure head heater switch and the right probe heaters by the No. 2 auto-pilot pressure head heater switch.

138. The heater supplies are monitored by separate ammeters on the engineer's engine panel. When the aircraft is on the ground, the current is limited by a resistor in series with the power supply.

Nitrogen System

139. Nitrogen is stored at 1,500 PSI in a reservoir, the associated charging valve and stop valve being accessible through the forward access panel. The reservoir must be recharged when pressure falls below 400 PSI. Nitrogen is piped via a stop valve, pressure-reducing valve and non-return valve to a low pressure reservoir at 44 PSI. Gauges monitoring the high and low pressure are on the right sill panel and forward roof panel, respectively. A low pressure switch operating at 32 PSI and closing at 47 PSI causes the LP warning light on the forward roof panel to come on. A relief valve in the low pressure line vents at 52 PSI to prevent too great a pressure build-up in the system.

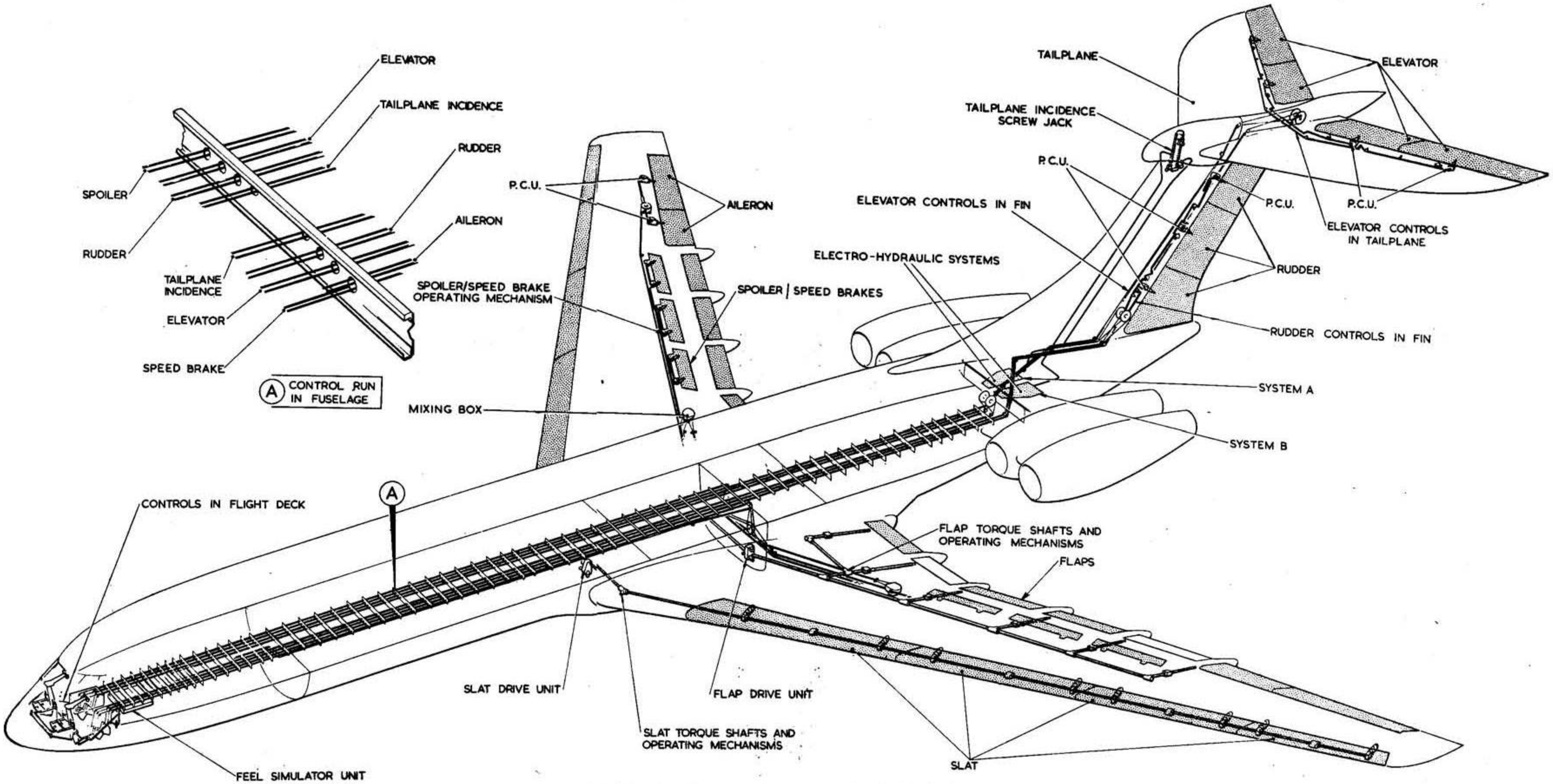
140. Low pressure nitrogen is fed to solenoid valve A and from there through solenoid valve B to a control ram which operates on the control column linkage. A dump valve operated from a lever on the centre console is coupled to this part of the circuit; when operated, pressure in the line is released thus preventing further operation of the stick pusher until the lever is reset.

Operation and Testing of the System

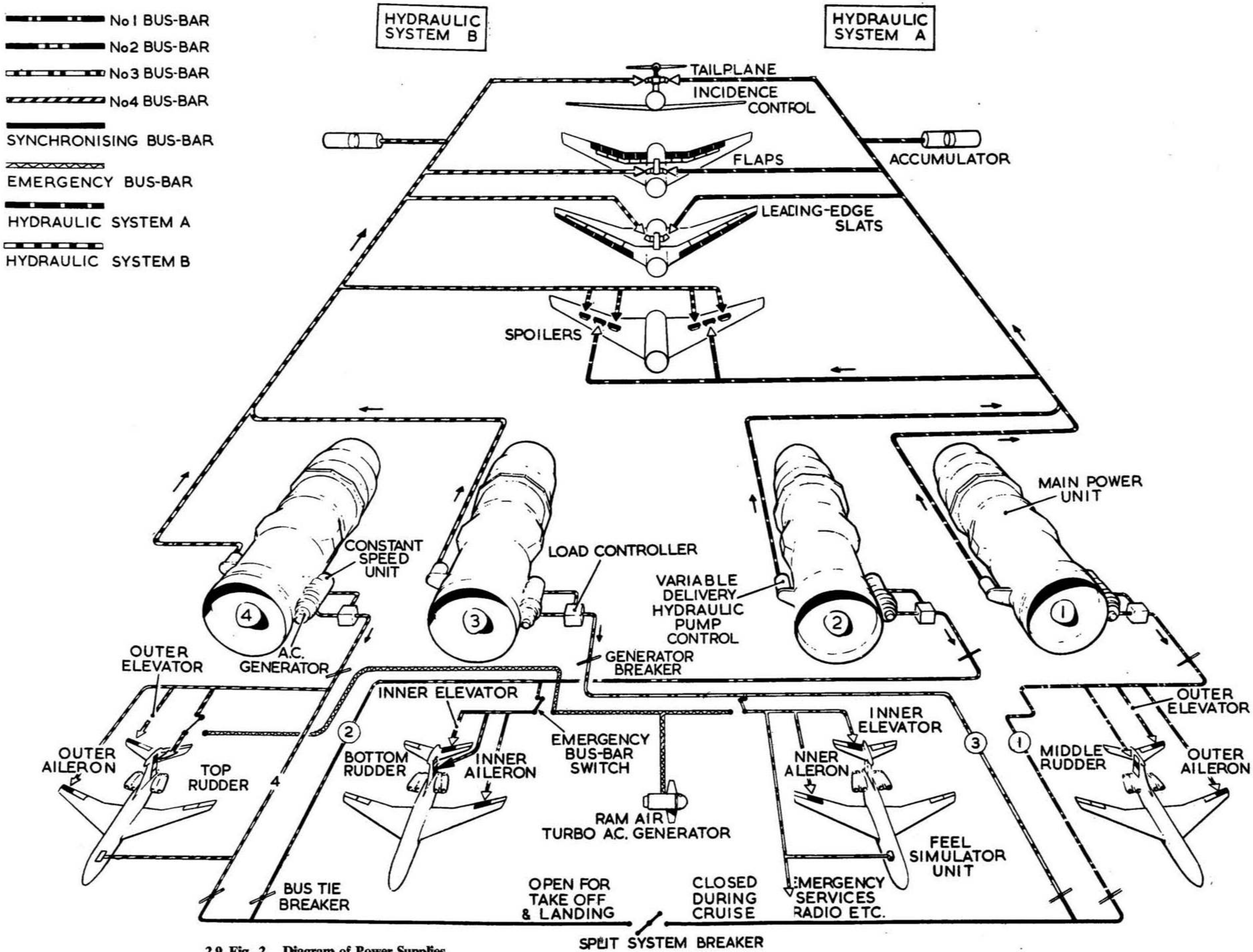
141. Both auto-ignition systems, stall warning systems and the stall identification systems are always operative, except when the FAIL light is on. Either stall warning system arms the stall identification system but each klaxon requires signals from its associated shaker and identification probe circuit.

142. To test the system, the TEST STALL WARNING switch must be held to either No. 1 or No. 2; this ensures correct sequence in the interlock circuit. The TEST STALL IDENTIFICATION switch should then be held to either No. 1 or No. 2 to operate the control column ram. The stick shaker on the appropriate control column should operate and the system operated lights come on. When both No. 1 STALL WARNING and No. 1 STALL IDENTIFICATION test switches are held at No. 1, the klaxon for that system sounds. Similarly, when both No. 2 STALL WARNING and No. 2 STALL IDENTIFICATION test switches are held at No. 2, the klaxon for that system sounds.

143. Selecting AUTO-IGNITION No. 1 or No. 2 causes one igniter per engine to operate, indicated by the IGNITERS ON amber lights on the engine start panel coming on.

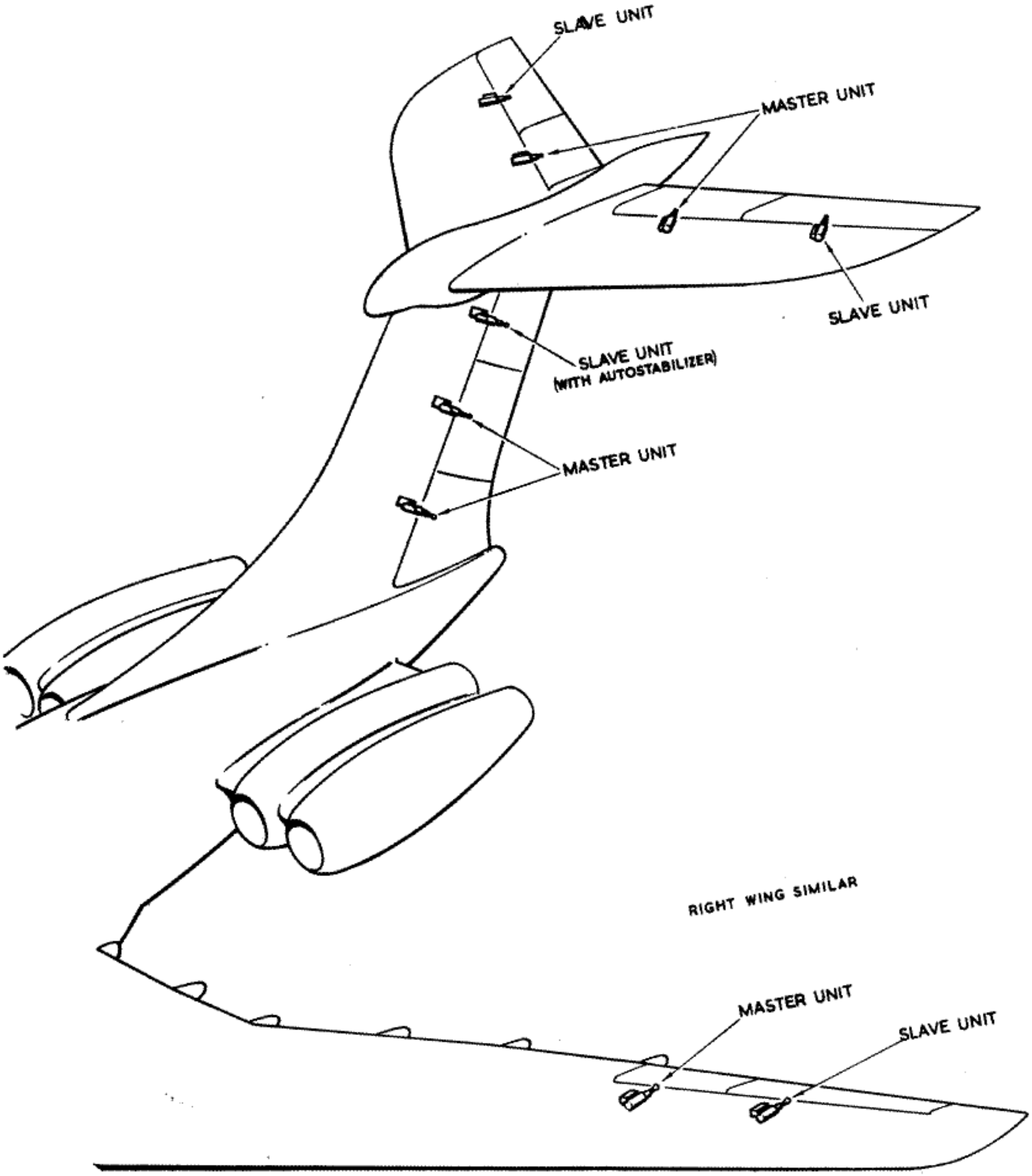


2.9 Fig. 1. General Arrangement of Controls



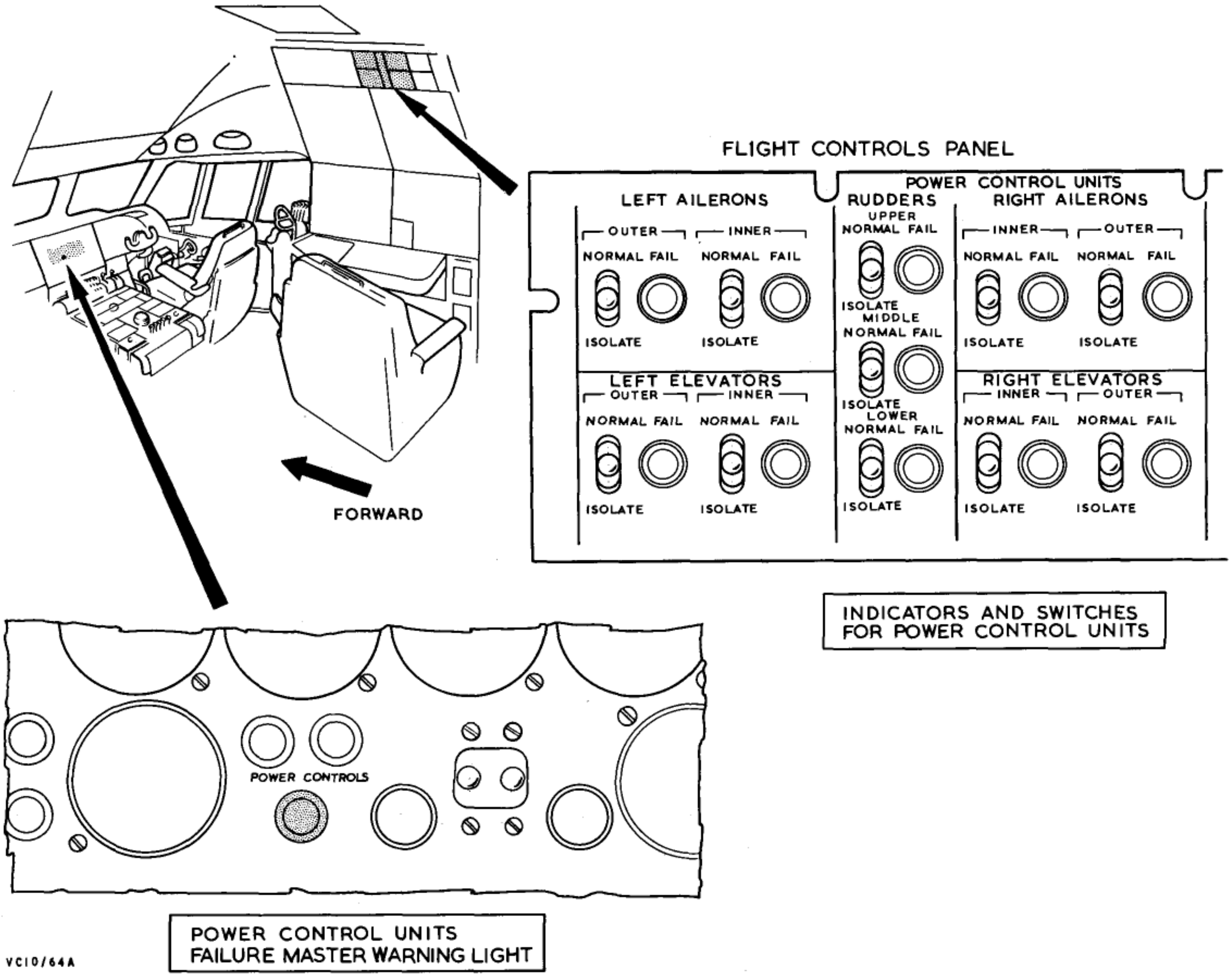
2.9 Fig. 2. Diagram of Power Supplies

[redacted]



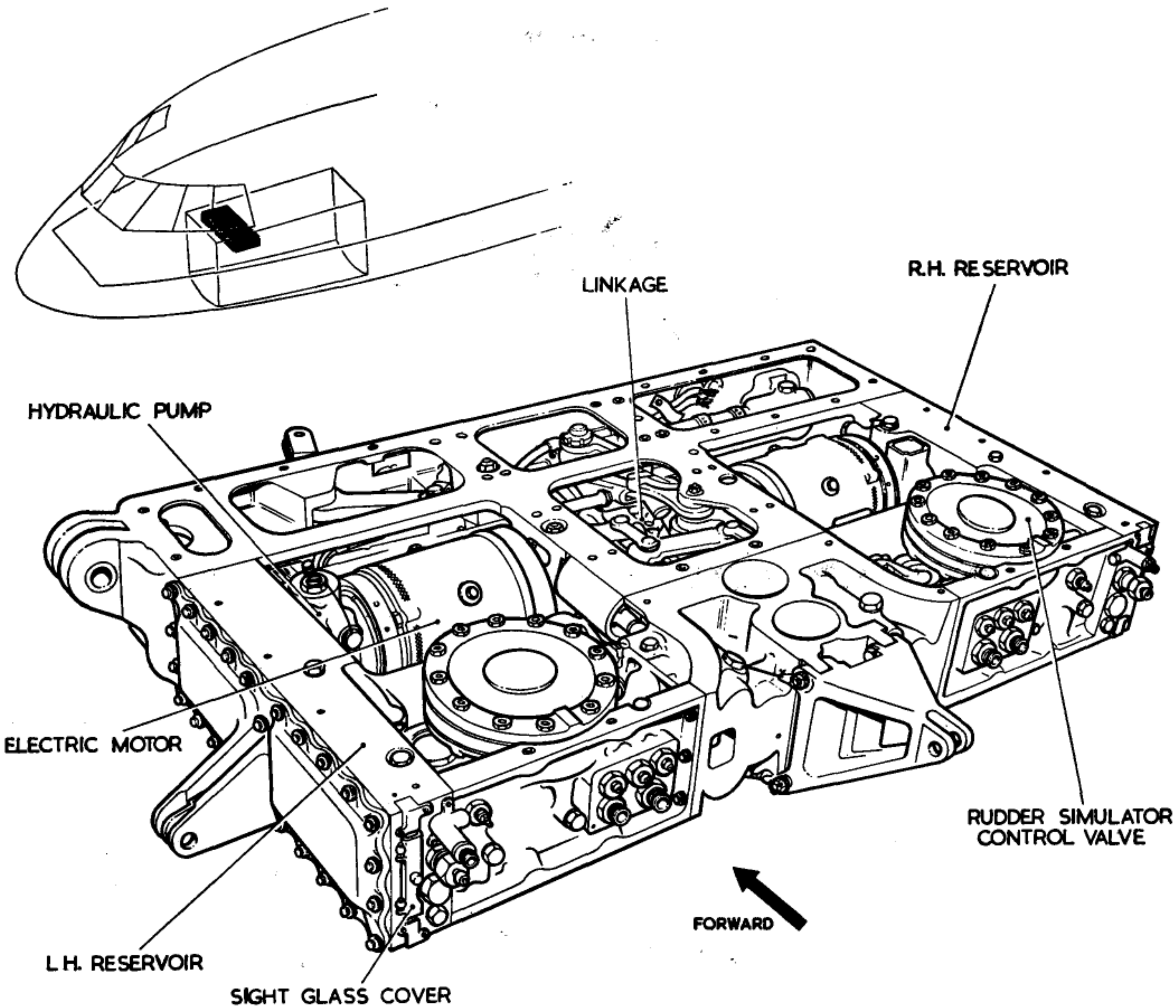
2.9 Fig. 3. Location of Power Control Units

[redacted]

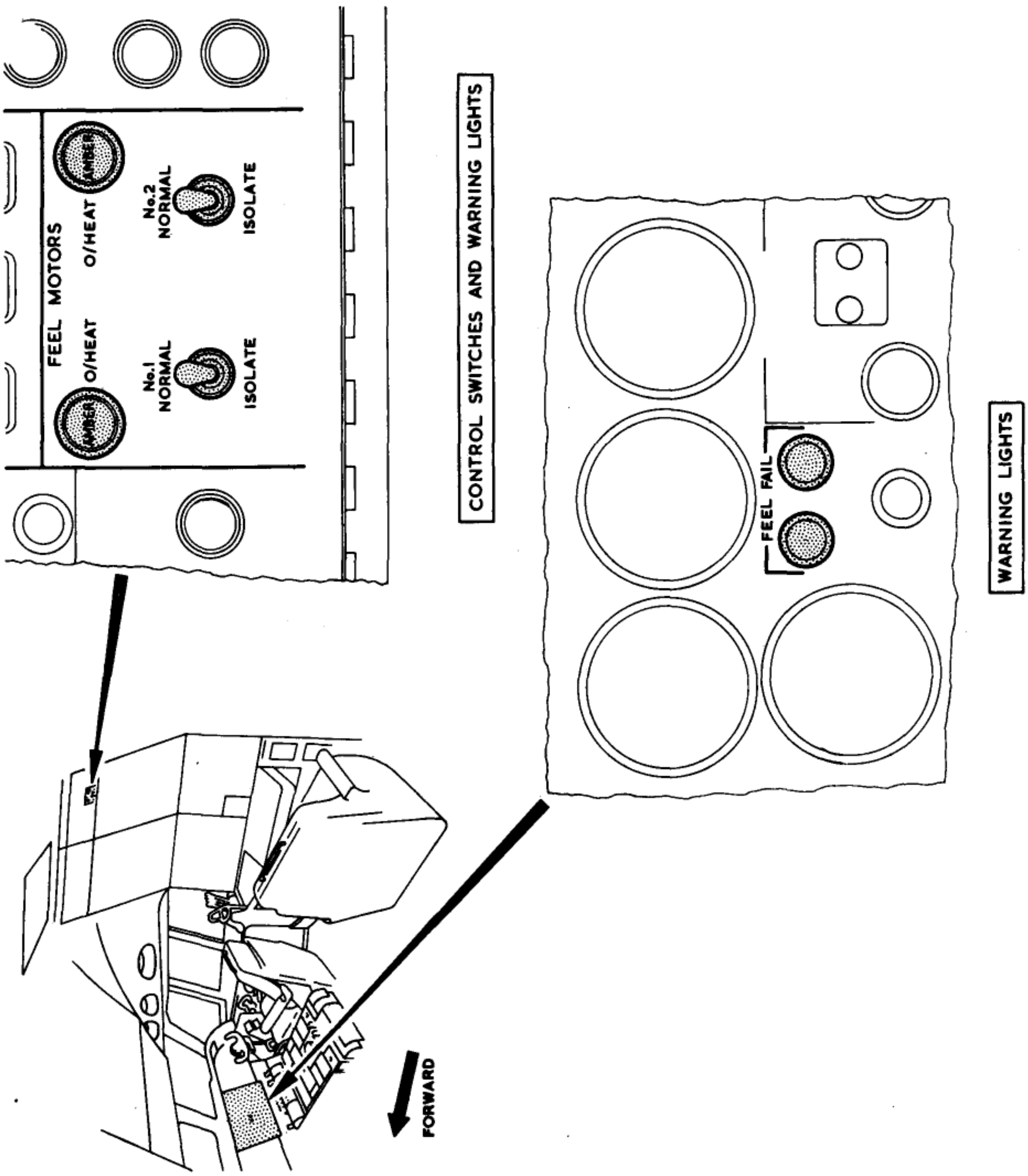


2.9 Fig. 4. PCU's — Controls and Indicators

◀*Minor Amendments*▶

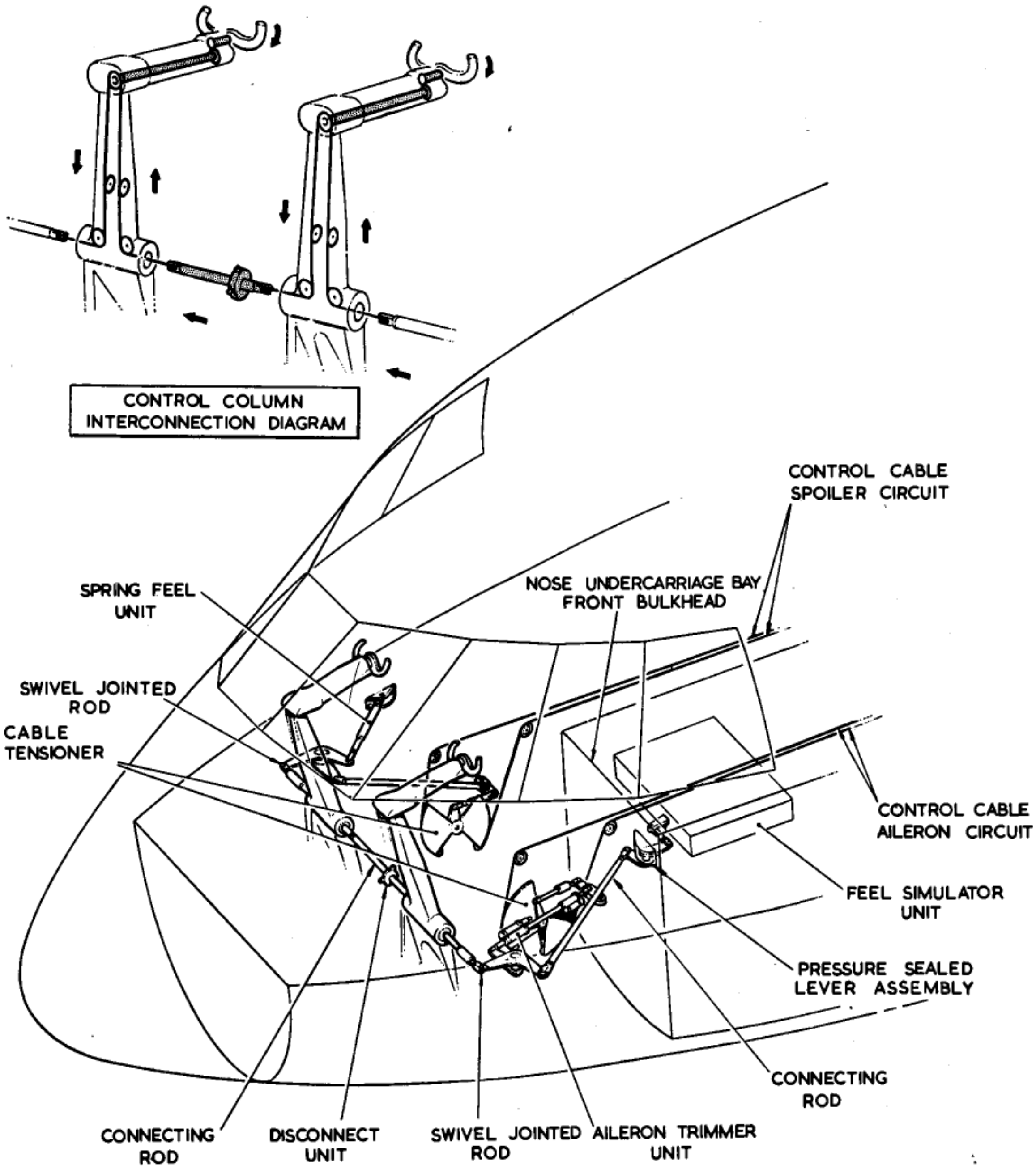


2.9 Fig. 5. Feel Simulation Unit



2.9 Fig. 6. Controls and Indicators Feel Simulation

[redacted]



2.9 Fig. 7. Controls in Forward Fuselage (Ailerons and Spoilers)

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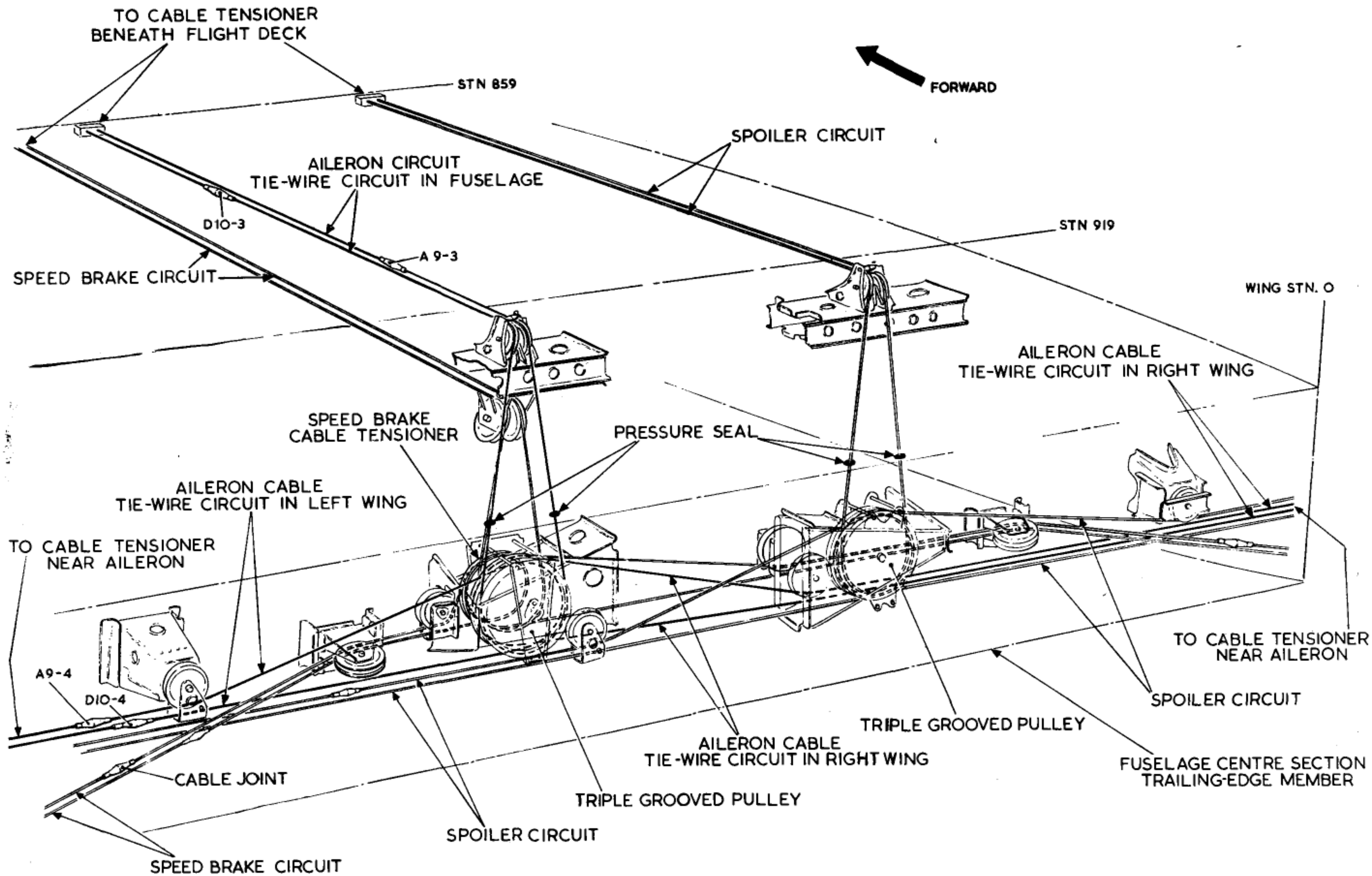
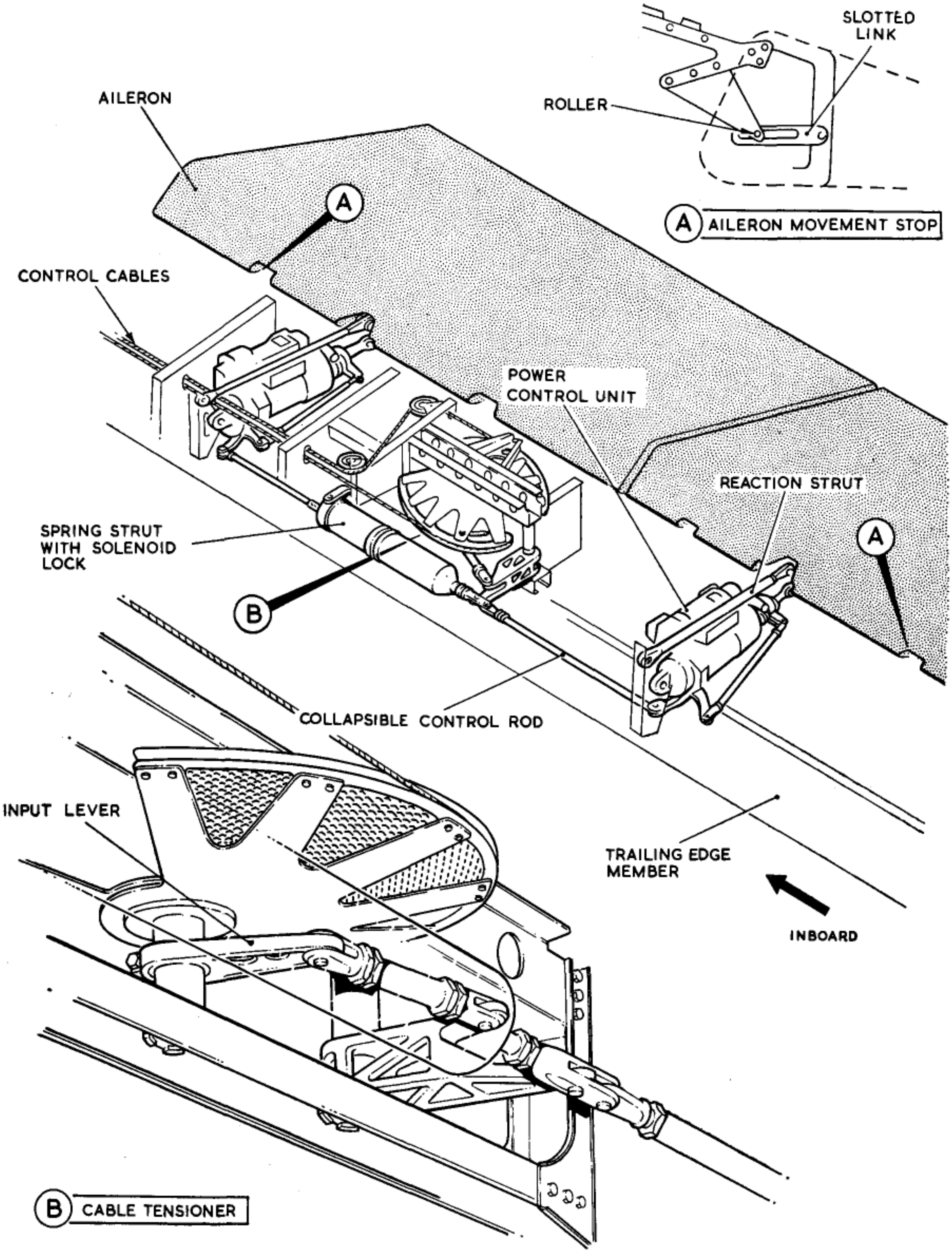


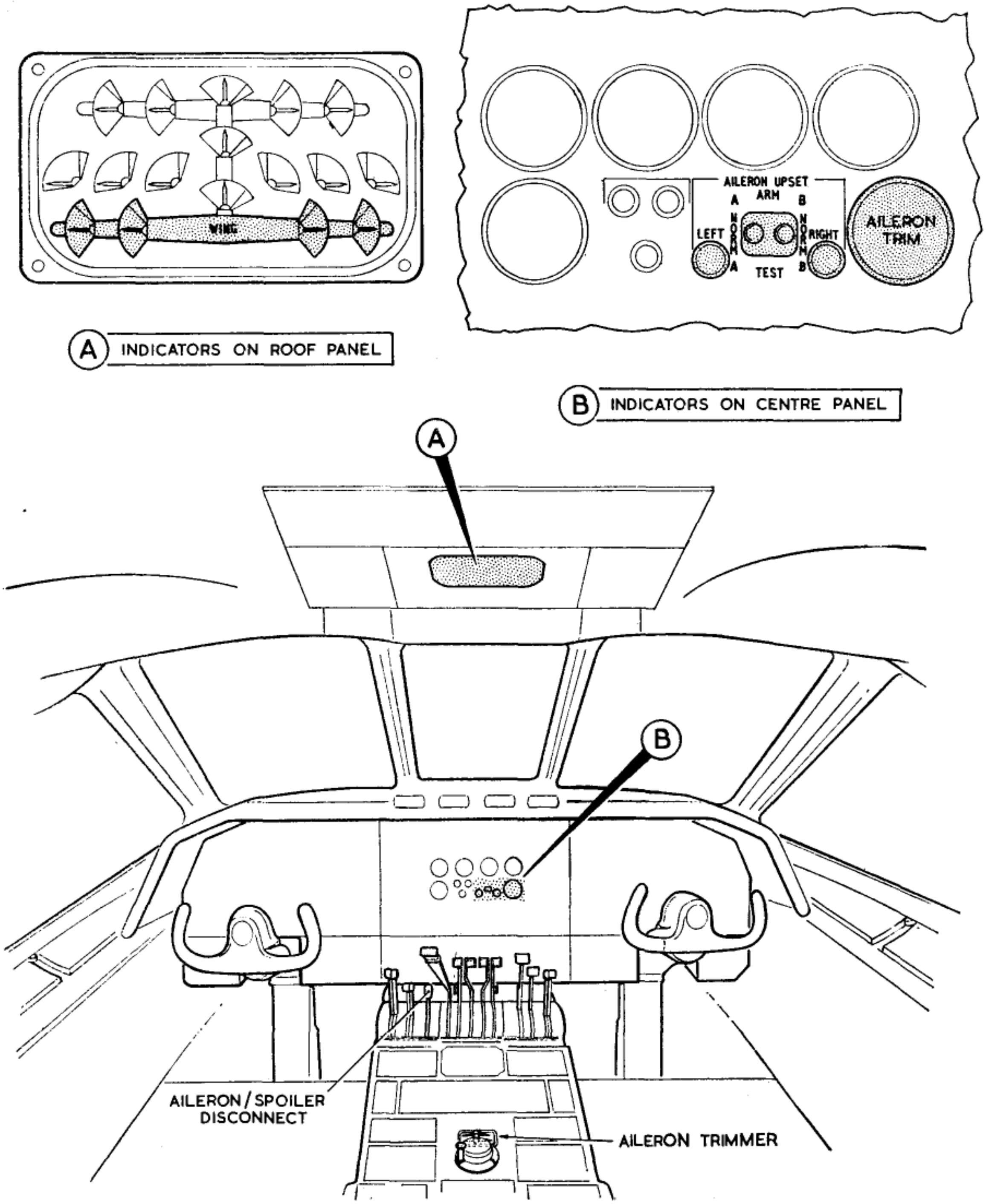
2.9 Fig. 8. Controls in Centre Section (Ailerons and Spoilers)

[redacted]



2.9 Fig. 9. Controls in Wing (Aileron)

[redacted]



2.9 Fig. 10. Controls and Indicators (Ailerons)
◀ARM Switch Markings▶

[redacted]

[redacted]

[redacted]

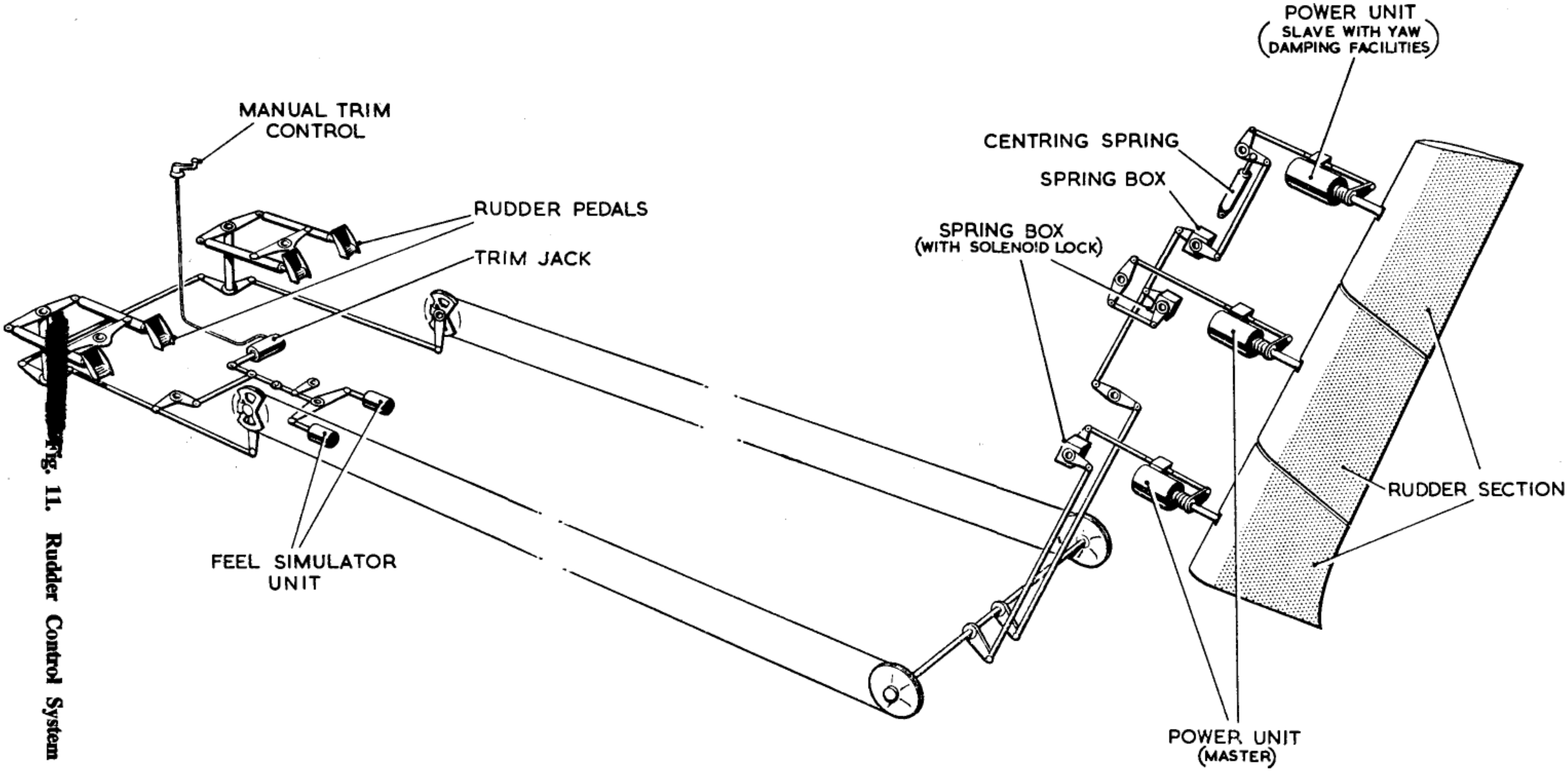
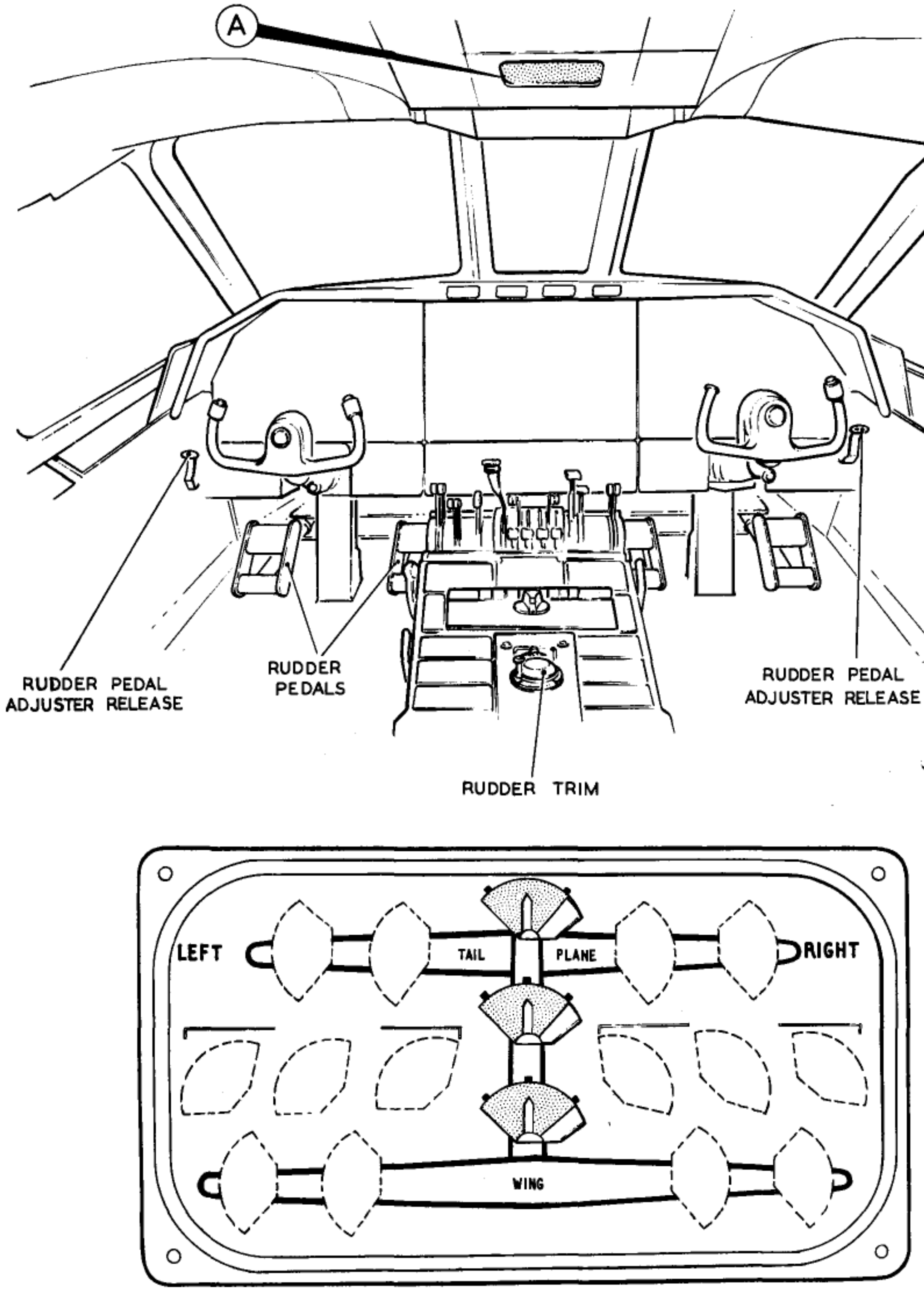
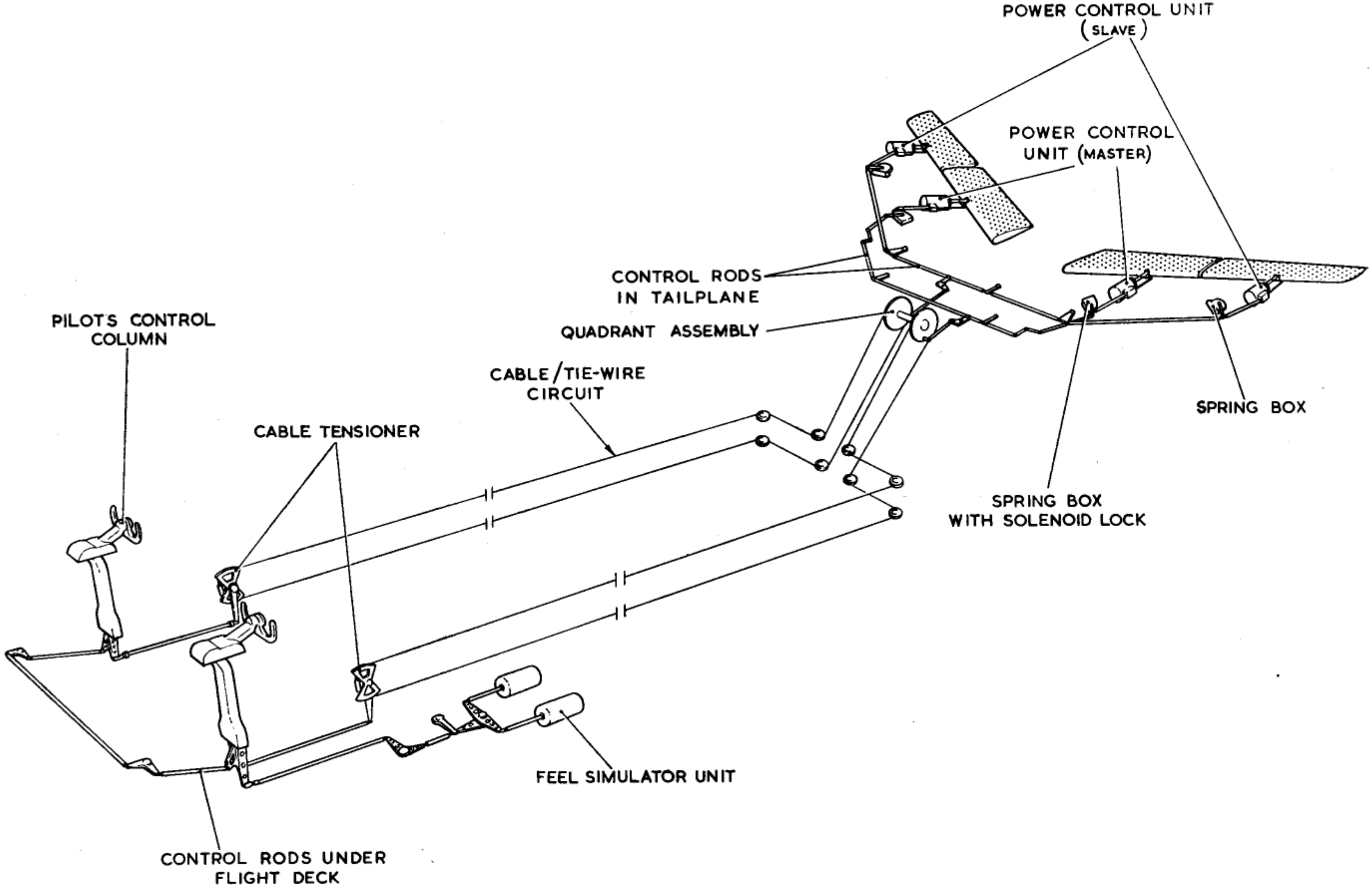


Fig. 11. Rudder Control System



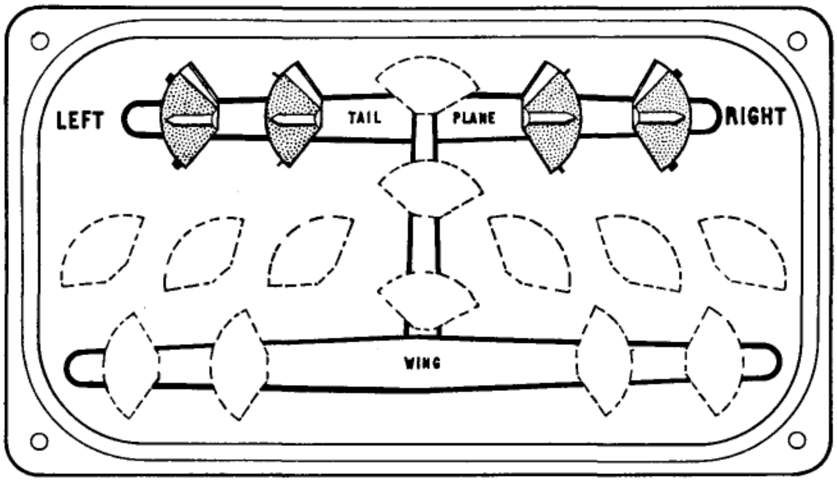
(A) INDICATORS ON ROOF PANEL

2.9 Fig. 12. Controls and Indicators (Rudder)

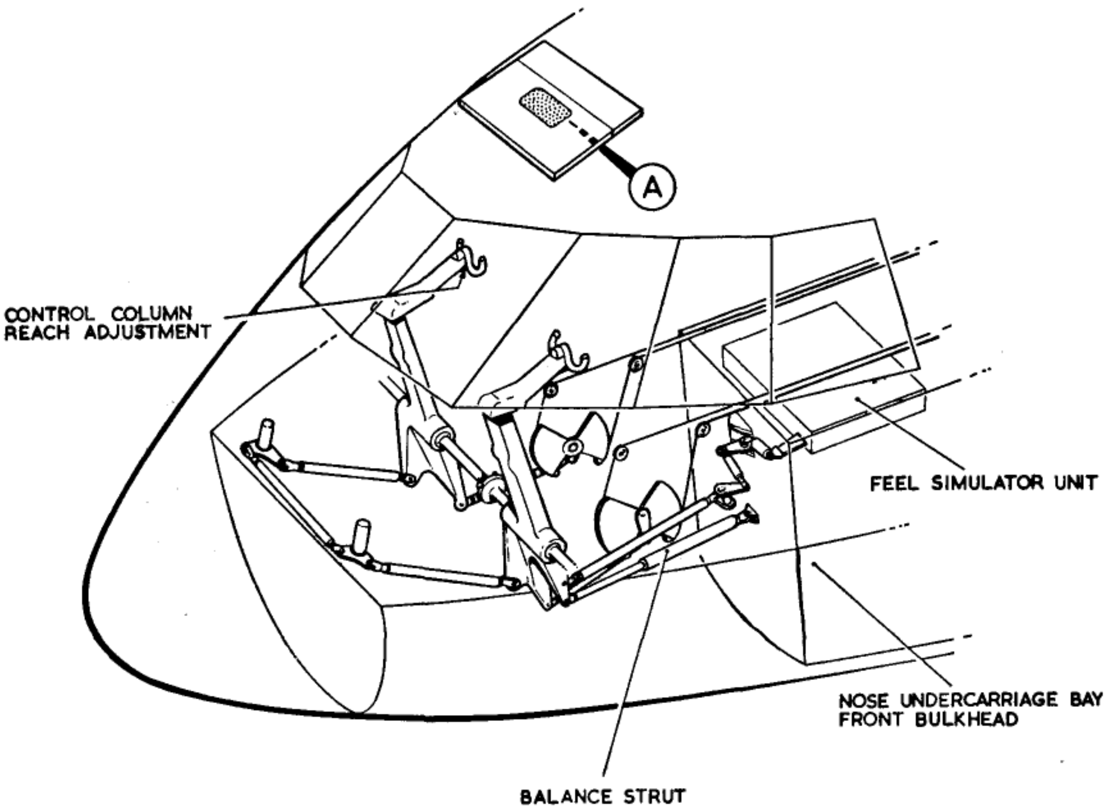


2.9 Fig. 13. Elevator Control System

[redacted]

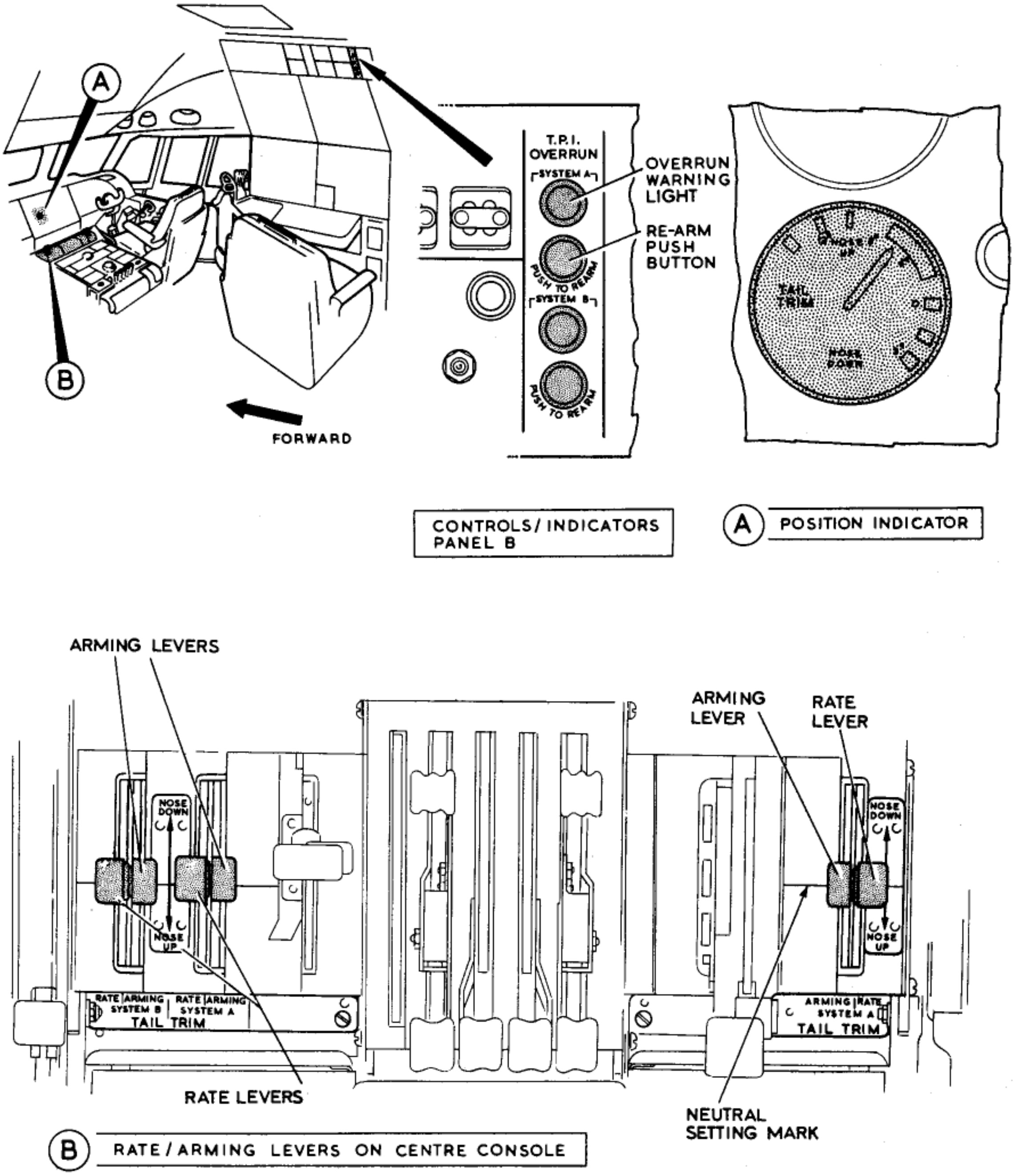


(A) CONTROL SURFACE POSITION INDICATOR



VC10/74A

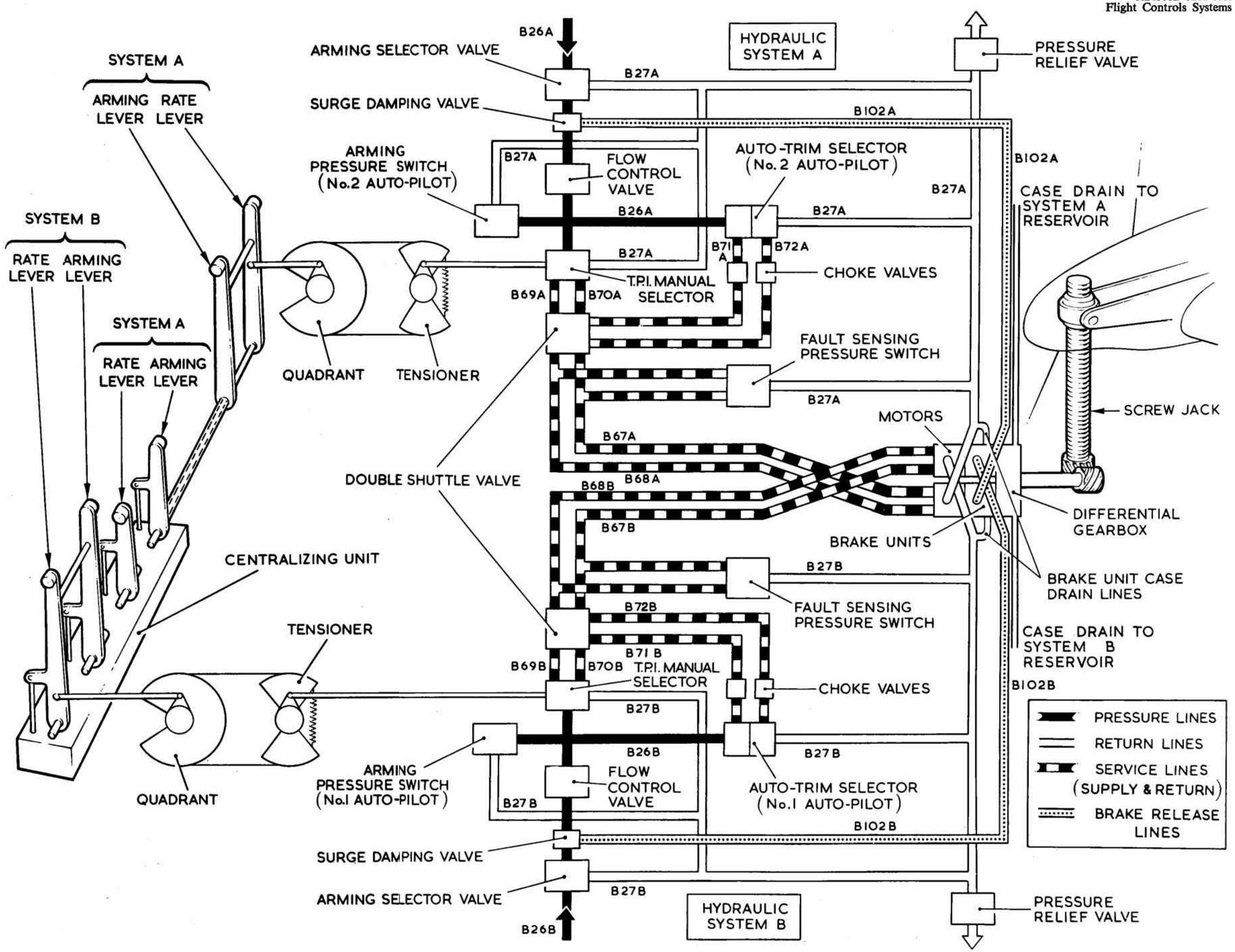
2.9 Fig. 14. Controls in Forward Fuselage (Elevators)



VC10/75A

2.9 Fig. 15. Controls and Indicators (Tailplane)

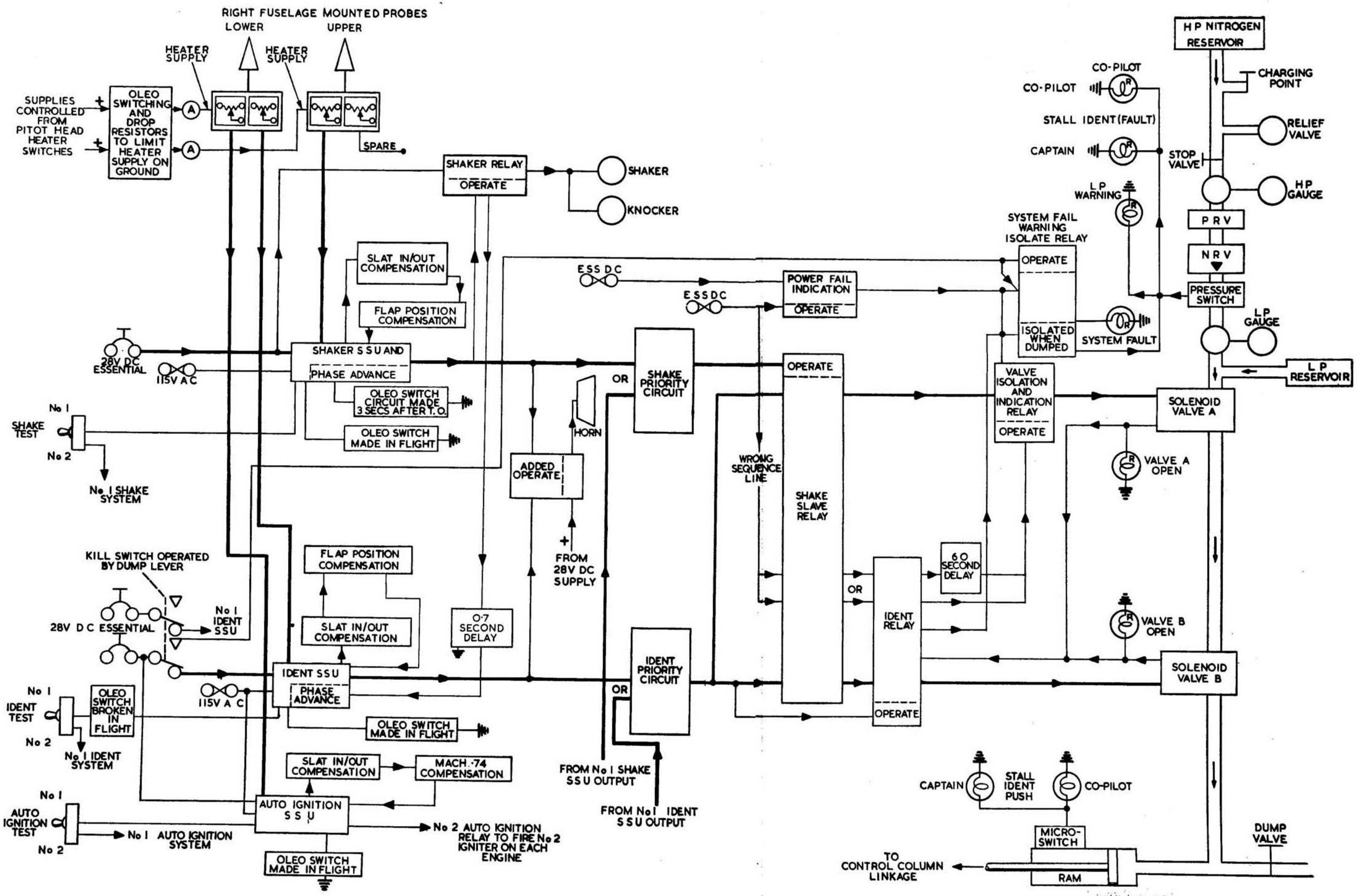
◀ *Position Indicator Corrected* ▶



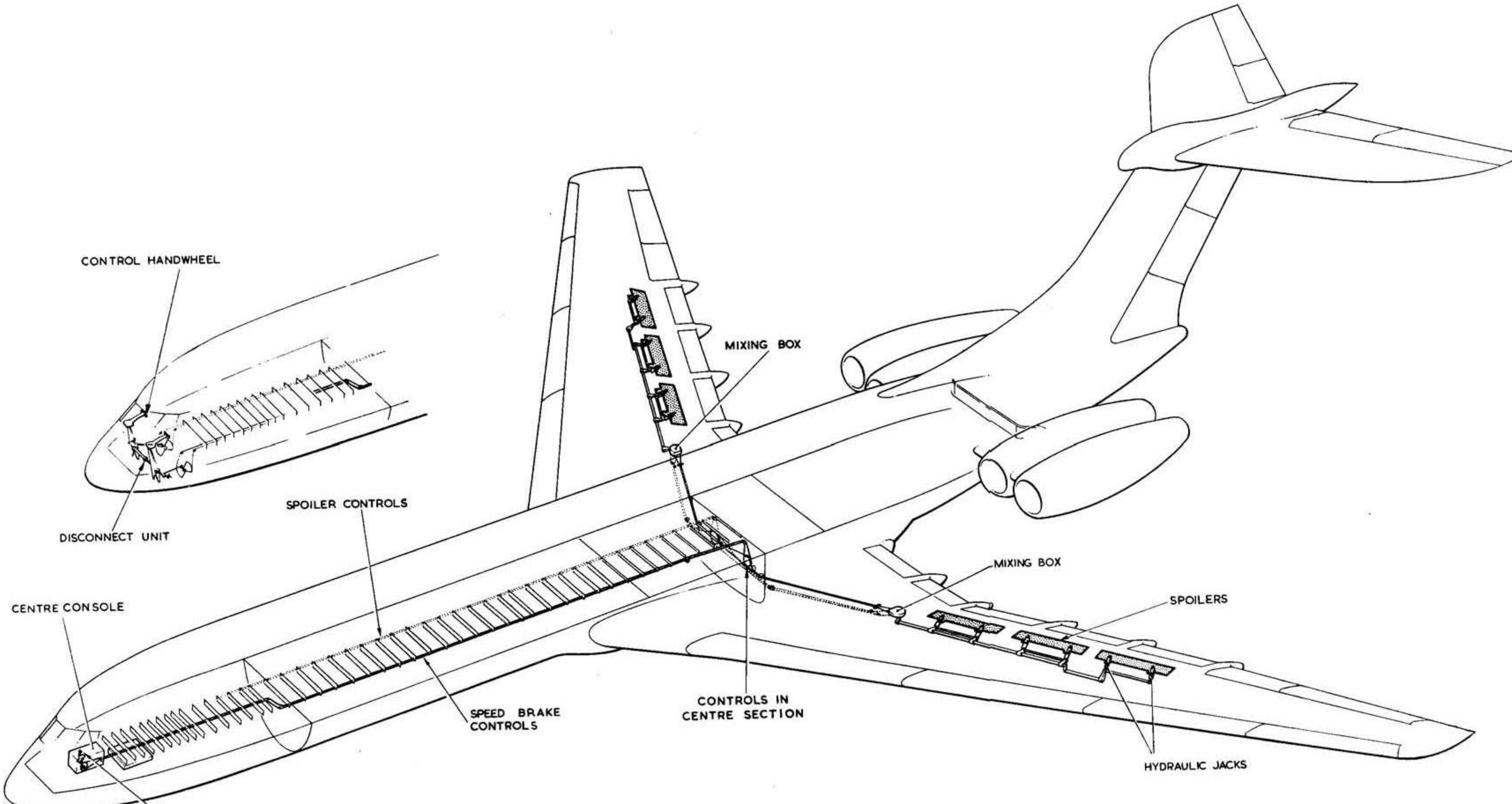
2.9 Fig. 16 Schematic of Tailplane System

◀ *Case Drains to Reservoirs Included* ▶

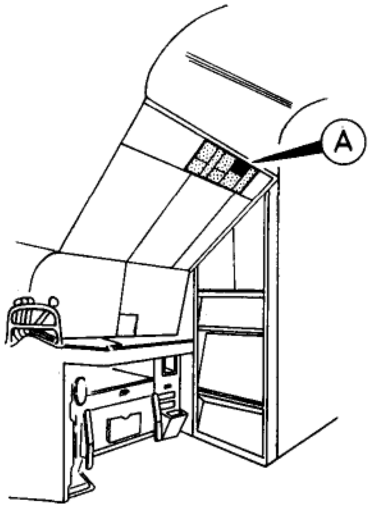
[redacted]



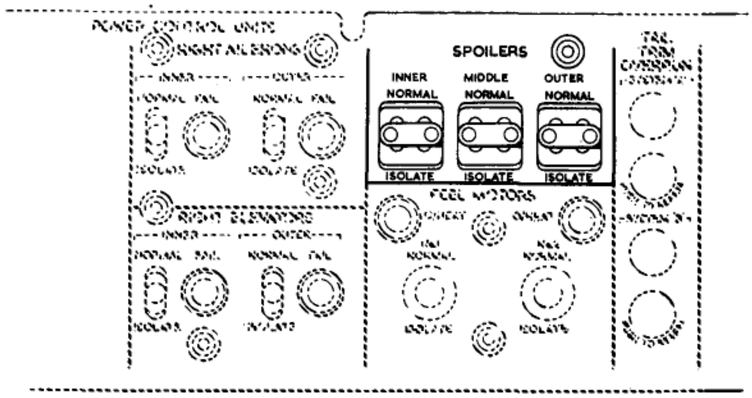
2.9 Fig. 17. [redacted] System



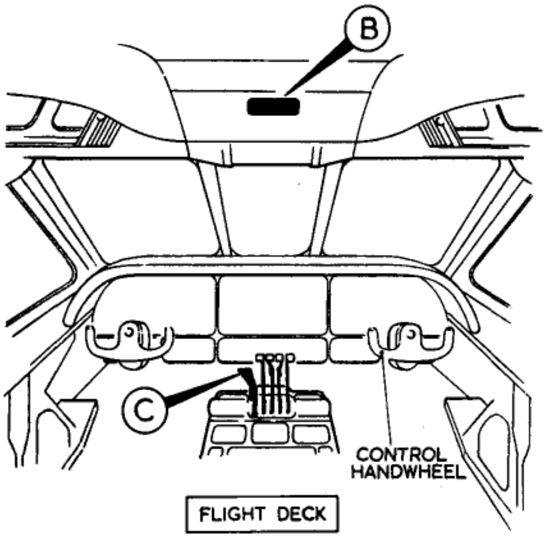
2.9 Fig. 18. Spoiler/Speed-brake Control System



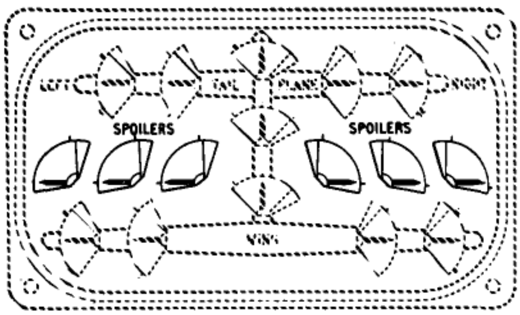
F/E's STATION



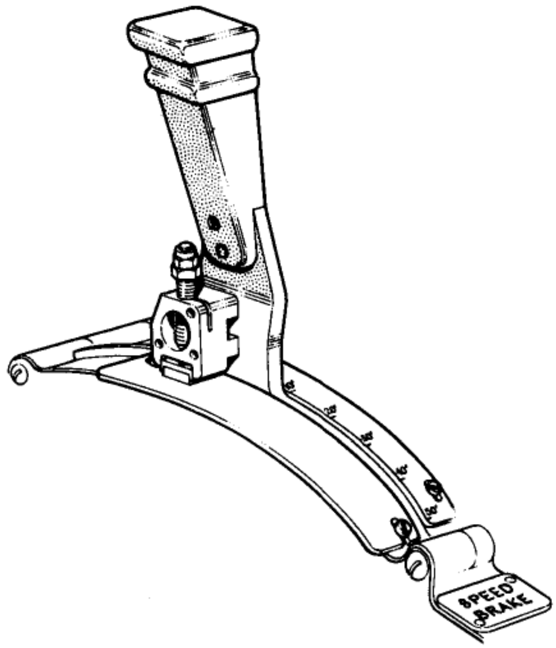
(A) FLIGHT CONTROL PANEL



FLIGHT DECK



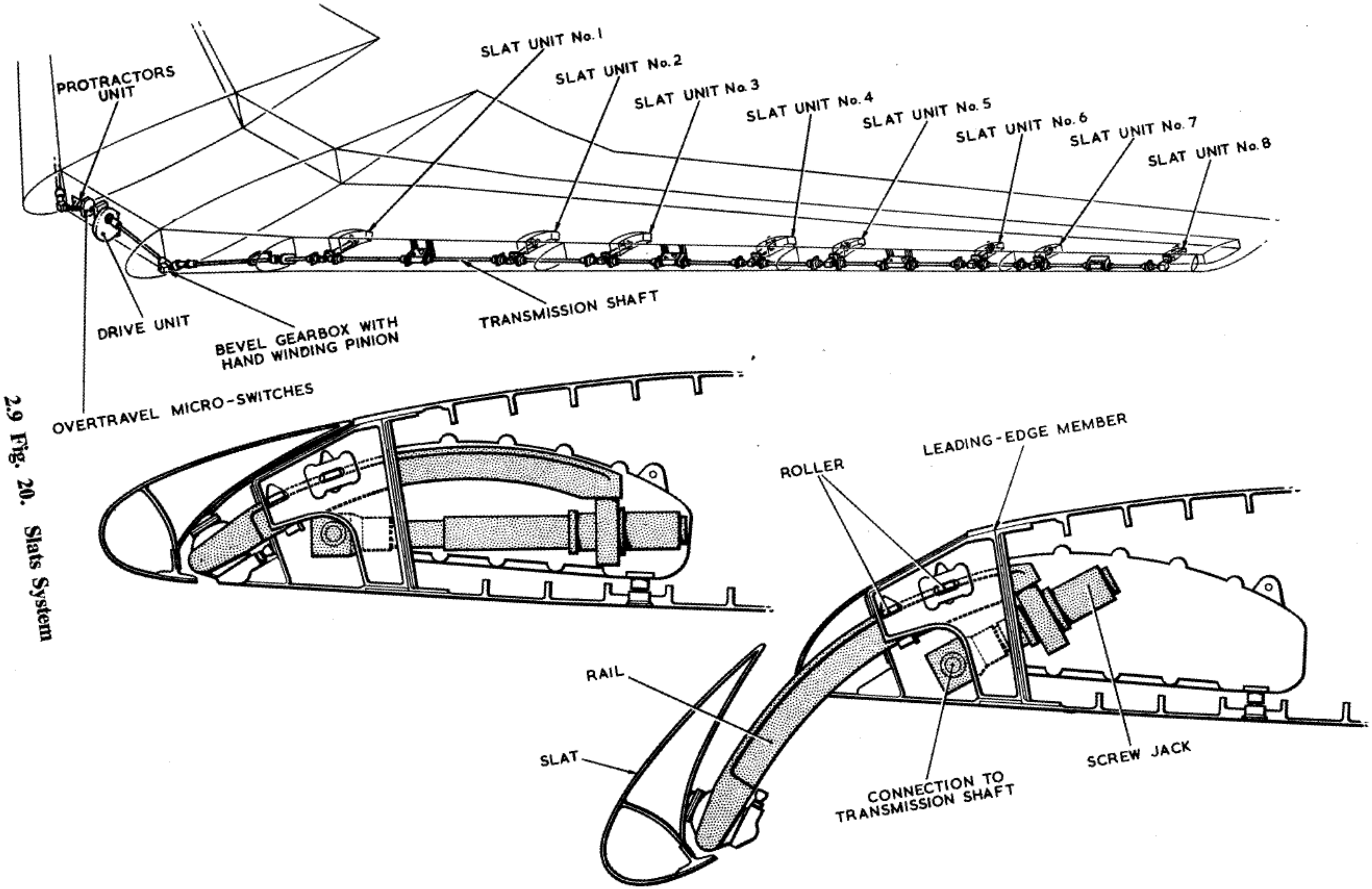
(B) CONTROL SURFACE POSITION INDICATOR



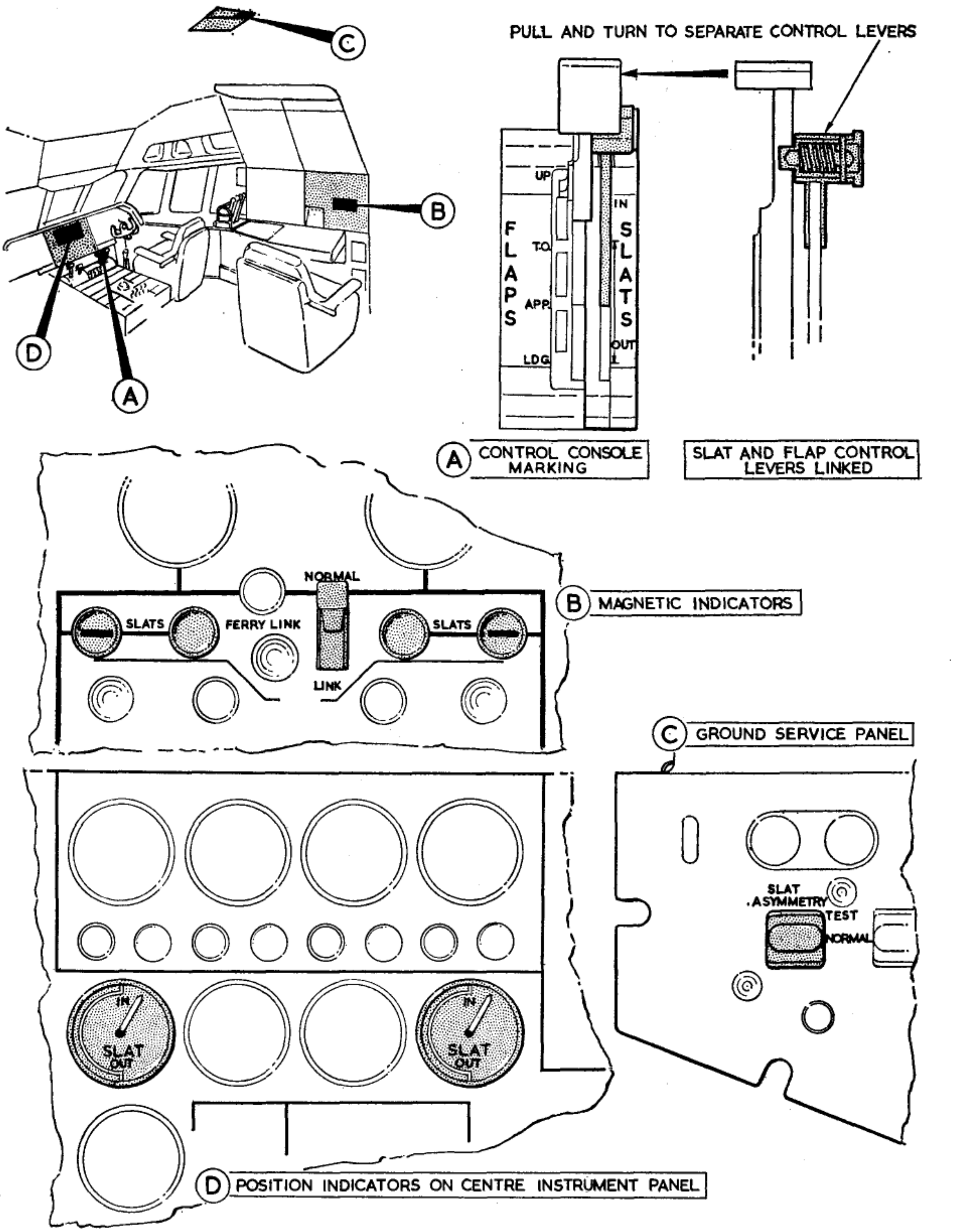
(C) SPEED BRAKE CONTROL LEVER

2.9 Fig. 19. Controls and Indicators (Spoilers)

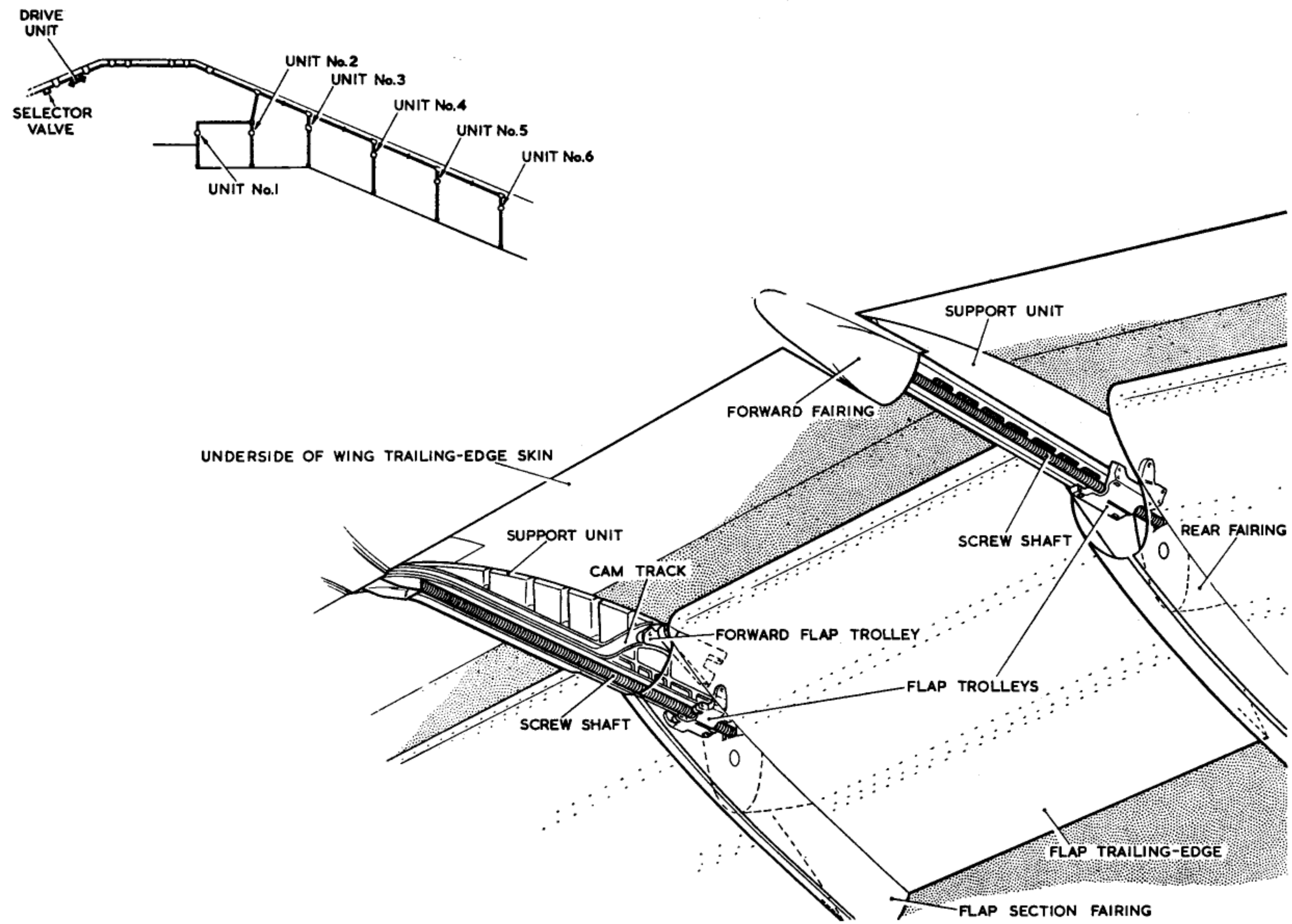
[redacted]



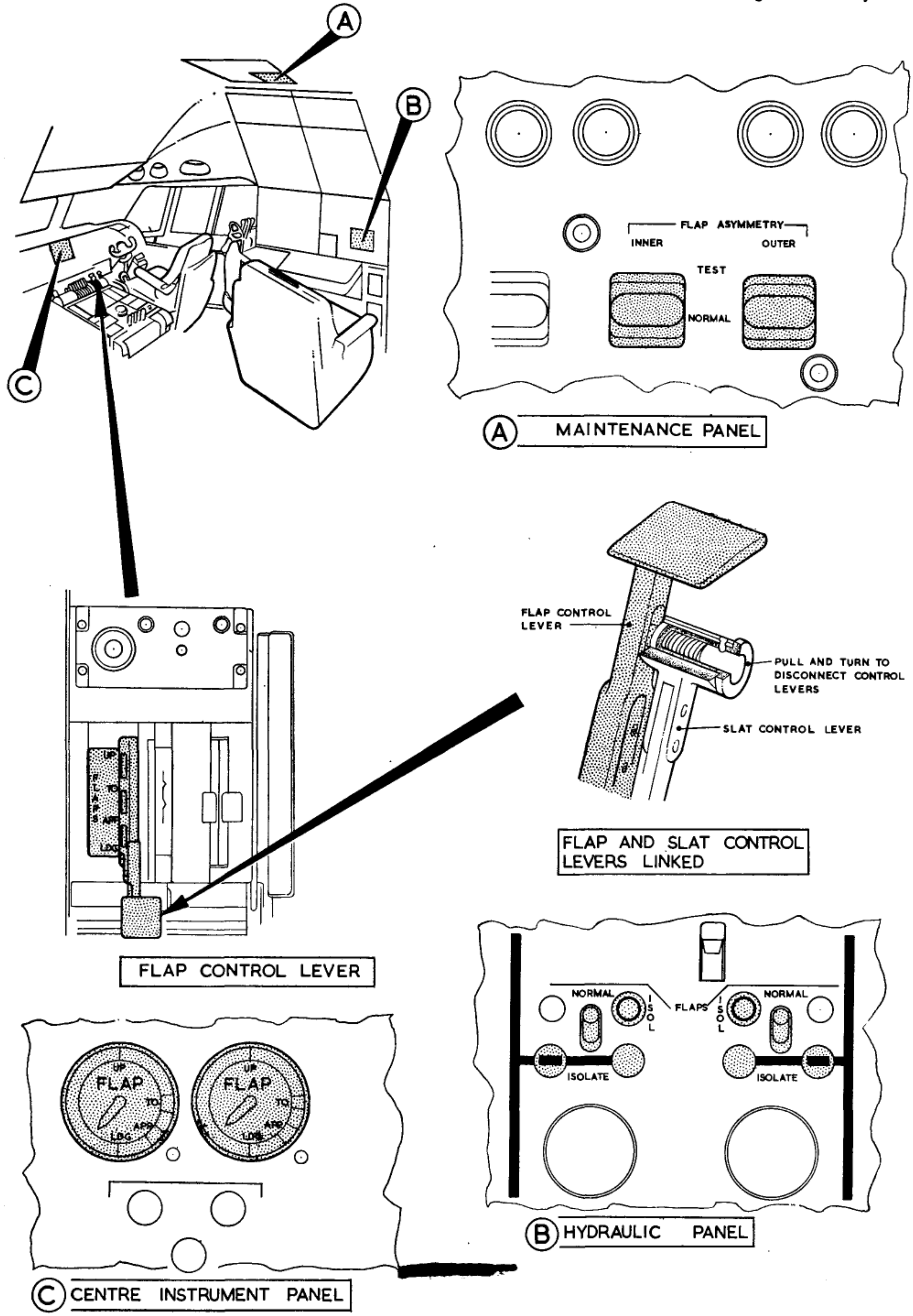
2.9 Fig. 20. Slats System



2.9 Fig. 21. Controls and Indicators (Slats)



2.9 Fig. 22. Flaps System



2.9 Fig. 23. Controls and Indicators (Flaps)