

Chapter 1 TAIL PLANE TRIM AND FEEL TRIM

(Including Mods.196, 217, 218, 238, 353, 354, 399, 503 and 608)

(Completely revised)

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Introduction

1. This chapter contains a description of the aircraft tail plane standby trim, and feel trim systems. Circuit operation is described in detail and circuit and routeing diagrams are included. The hydraulic operation of the system is fully explained in Book 1,

Sect.3 and in A.P.4604H, Vol.1. The equipment used to provide these services are listed in Table 1, together with the publications to which reference should be made for more detailed descriptions and servicing instructions.

Modifications

2. This chapter includes the following modifications, which are listed together with their purpose and effect on this chapter.

(1) Mod.196- To introduce Pressure Switch T.P.543 in lieu of Pressure Switch

T.P.397, (Artificial feel trim circuit), and Pressure Switch T.P.397 in lieu of Pressure Switch T.P.299 (Hydraulic failure warning circuit). This modification, which also introduces changes in the air change pressure and in the settings of various valves, eliminates spurious hydraulic failure warnings.

(2) Mod.217— To introduce segregation of normal (feel trim) and standby trim circuits. To fulfil this requirement an additional relay (R25) is fitted in the rear cockpit and the circuit to the standby trim switches changed.

(3) Mod.218— To introduce double pole switching into the feel spring locking solenoid circuit. A microswitch (No.2 switch port elevator) is introduced into the negative cable from the solenoid to ensure that the solenoid cannot be energized unless both the positive and negative micro switches are operated.

(4) Mod.238— To provision for Jaguar actuator part No.500/1/00257/300. This actuator is an improved version of that fitted to very early aircraft. This modification is partly superseded by Mod.608.

(5) Mod.353— To introduce feel trim position indicators in the front and rear cockpits, also a plug and socket break connector in the feel spring locking solenoid circuit.

(6) Mod.354— To introduce relay Type D.4600 (Ref.No.5CW/9137) in lieu of relay Ref.No.5CW/6724 or Ref.No.5CW/6852. This modification replaces the original standby trim circuit relays located in the rear fuselage with high temperature

duty relays.

(7) Mod.399— To make provision for and introduce standby tail trim control at the control column hand grips. This modification is embodied concurrently with Mod.217.

(8) Mod.503— To make provision for and introduce microswitches Type I.H.S. N3 in lieu of Type V3M/LR. This modification introduces a fully sealed type of switch to replace the No.2 port elevator switch introduced by Mod.218.

(9) Mod.608— To introduce actuator 500/1/03657/300 in lieu and by conversion of actuator 500/1/00257/300. This is a covering airframe modification for Plessey Mod.532.

Other modifications affecting this chapter are described in the appendices following this chapter.

DESCRIPTION

Longitudinal control

3. During normal flight longitudinal control is exercised through the 'flying tail' which consists of the tail plane and the elevators locked together and moved as one unit. A Hobson hydraulic servo unit is provided to move the 'flying tail', thus permitting the use of a conventional control column which without powered servo assistance could not be easily moved by manual effort in the higher speed ranges. If the necessity arises the elevators can be unlocked from the tail and manually controlled.

4. The Hobson servo control consists of two identical screw jacks connected to the tail plane linkages and driven through gearing by a hydraulic motor. The fluid supply to the motor is controlled by mechanical signals that emanate from movements of the control column. A standby electric motor also attached to the servo unit can be used as a trimming drive to actuate the screw jacks independently of the hydraulic control.

5. When the tail plane is under servo control 'feel' loads on the control column are simulated by an 'artificial feel' spring unit. The unit consists of a tubular telescopic rod containing coil springs with a linear actuator forming an extension to the spring unit. The end of the telescopic unit is anchored to the tail control quadrant, the actuator plunger is connected to the control rods linked to the elevators. When the elevators are locked to the tail plane the control rods are also locked. Rotational movement of the quadrant will extend or compress the telescopic spring unit producing an artificial load on the control column. The actuator plunger can be extended or retracted by remote control from the cockpits to increase or relieve the loads experienced.

6. If a failure in hydraulic pressure occurs, two brake plungers in the servo unit will automatically lock the hydraulic motor when the pressure has fallen to a predetermined minimum. The standby electric motor can now be used to enable the incidence of the tail to be trimmed to an angle suitable for flight under manually controlled elevators.

7. The hydraulic system is so designed that when the hydraulic pressure is failing, a change-over valve will operate to retain a reserve of hydraulic pressure in the tail plane accumulator and also to connect the accumulator through a separate pipe line to the Hobson unit only. A pressure operated switch in the main hydraulic supply is connected to the standard warning system. The failure of the main hydraulic pressure will trigger the warning system and illuminate the warning caption HYD. This will warn of impending total failure of the hydraulic tail plane control and that the reserve accumulator pressure must be used to bring the aircraft to a condition suitable for manually controlled flight.

8. The pressure switch besides completing the warning circuit also isolates the control circuit for the feel trim actuator. This effect is not immediately manifest because a second and parallel pressure switch in the reserve pressure pipe line between the accumulator and the control unit is operated by accumulator pressure. This pressure switch will maintain the feel trim circuit in an operable condition until the reserve pressure is exhausted. The switch will then revert to open circuit and the feel trim circuit will be finally isolated. (The brake plungers of the control unit will also be released to lock the hydraulic motor).

9. The brief period during which the trim actuator circuit is maintained operable is provided to enable the pilot to adjust the effective length of the spring feel unit. This will give him an adequate control

movement of the elevators in each direction and is done by reference to the feel trim position indicators (Mod.353, Sect.7,B, Chap.9).

10. The elevators can now be unlocked; this action operates three microswitches located in the elevators to complete two circuits.

(1) A solenoid lock attached to the artificial feel spring unit is energized to lock the telescopic action and prevent lost motion in overcoming the springs.

(2) The microswitches also complete the secondary warning circuit to illuminate the warning caption ELEV and indicate that the elevators are not fully locked.

11. In normal flight the artificial feel load on the control columns is adjusted through finger switches fitted in the control column hand grips. In the abnormal flight condition described in paras.7-10 the feel-trim circuit is automatically isolated. A change-over switching circuit (Mod.399) enables control of the standby tail trim motor to be transferred to the hand grip finger switches.

12. In addition to these switching arrangements, alternative standby trim switches are fitted in the cockpits. These switches are for use if the control column handgrip switches or the change-over circuit fails. The standby trim switches must be used when the trim motor is supplied from the standby battery. When control of either the feel trim or the standby tail trim

circuits is selected to the control column hand grips, overriding control is given to the occupant of the rear cockpit.

13. The angular position of the tail plane related to tail plane datum is given in both cockpits by tail plane position indicators, (Sect.7,B, Chap.5). The amount and direction of artificial feel trim applied is given in both cockpits by feel trim position indicators (Sect.7,B, Chap.9).

Artificial feel trim actuator

14. The linear actuator which provides artificial feel trimming adjustment has an integral series wound split field 28V.d.c. motor, designed for reversible operation, and a gear box which converts the motor rotational drive to a linear plunger movement. An electromagnetically released brake provides rapid retardation when the motor supply is removed and locks the actuator when the motor is at rest. Limit switches automatically cut off the motor supply at the two terminal positions of the actuator plunger.

15. A threaded spigot extends from the gear box end plate and is screwed and locked into the piston tube of the spring unit. The actuator plunger terminates in a fork end eye fitting by which it is attached to the elevator controls swivel plate assembly.

16. The spring locking solenoid is bolted

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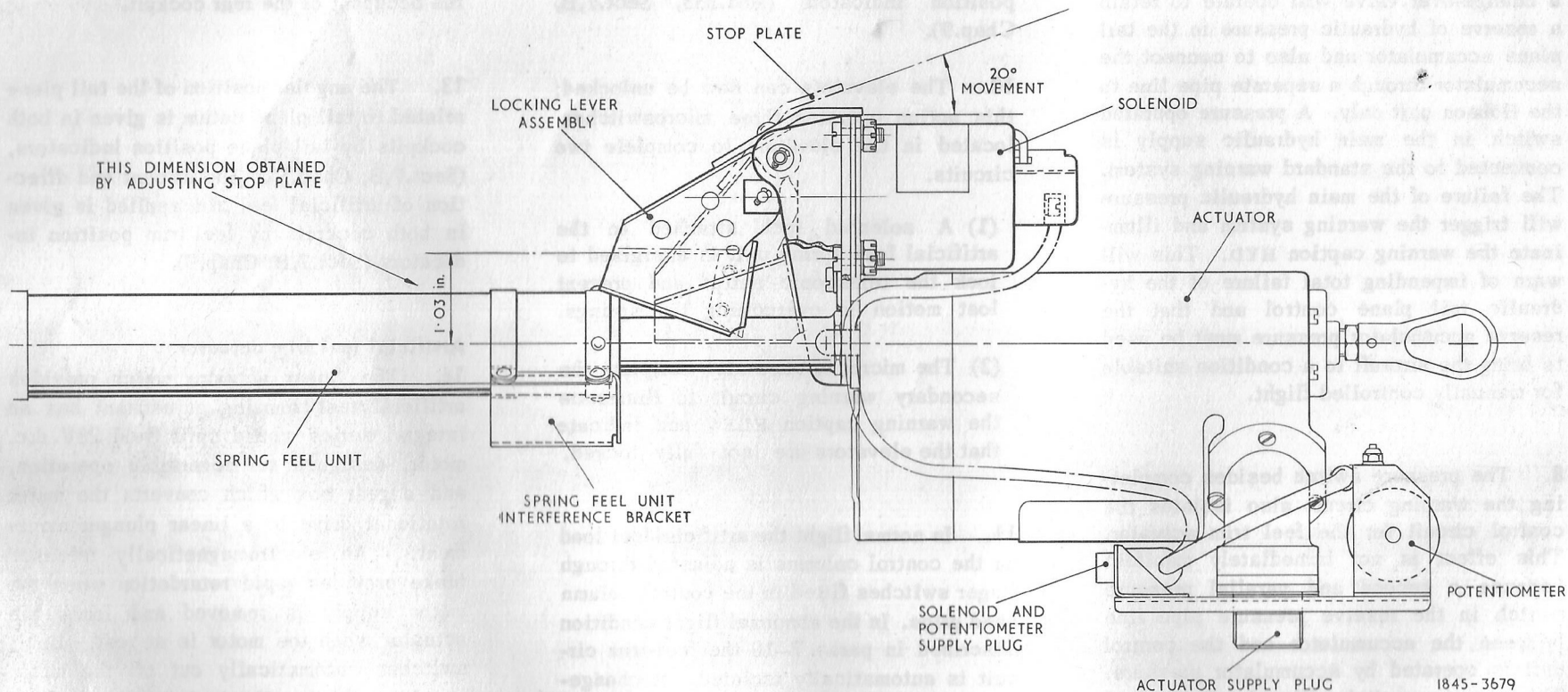


Fig. 1. Feel trim actuator and locking solenoid

to a bracket secured to the gear box end plate. A lever, fitted with a semi-circular stop plate is hinged to an extension of the solenoid bracket, the solenoid plunger is also linked to the stop plate lever. When the solenoid is energized the stop plate is moved into a position that will restrict the telescopic action of the spring unit in one direction. The stop plate movement to-

gether with angular and dimensional references is shown in fig.1.

17. The supply control circuits to the actuator are completed through a plug connector fitted to the actuator body. The plug connector also serves as the attachment point for a bracket to which the transmitting

potentiometer for the feel trim indicators is fitted. A second plug connected which serves both the locking solenoid and the potentiometers is mounted on this bracket.

Tail plane standby trim motor

18. The standby motor fitted to the Hobson tail plane control unit is a totally enclosed

machine comprising a split field series motor, speed reduction gearing, electromagnetically released brake, and four limit switches. The final output drive into the control unit is by splined shaft. The four limit switches are connected in pairs, one main and one emergency switch to each pair. When the tail plane reaches the designed limit of angular movement, the operation of only one switch of the relevant pair will switch off the motor supply and actuate the brake.

19. The motor is secured to the Hobson unit by four studs which pass through the motor end plate and four nuts. The electrical connections to the motor field, armature and brake are completed through a four pole plug attached to the motor body. The connections to the limit switches are made through a terminal block located beneath the motor end cover.

20. When operated in the 'hydraulic power OFF' condition the motor provides a maximum of 12deg. of trim to the tail plane incidence, if operated in the 'hydraulic power ON' condition a small reduction in this maximum travel will be experienced. When the motor is at the extreme of nose down trimming travel, (i.e. at datum) all limit switches are open.

Control column hand grip trim switches

21. The control column hand grips are described in Sect.6,A, Chap.2, the two press button trim switches fitted in the hand grip

are ganged together for simultaneous operation but may be separated by a separator button for testing purposes. The switch cables are integral with the hand grip assembly; in the front cockpit the cable is connected to T.B.AY on the forward face of the control column pedestal, in the rear cockpit the cable is connected to T.B.AZ on the nose wheel arch.

Trim control change-over switches

22. In the front cockpit two switches (labelled STICK TRIM CHANGE-OVER) are located side-by-side on the port console shelf. The switches are operated together as a pair, forward to select NORMAL trim and aft to select STANDBY trim at the control column hand grip switches. In the rear cockpit the change-over switches (similarly labelled) are located on a bracket angled between the port shearwall and frame 9. The operating sense for these switches is upwards to select NORMAL trim at the hand grip switches.

23. Each switch has an integral toggle lock which is effective in the NORMAL position only. In order to select STANDBY the toggle must be raised against a light spring pressure and the selection made. A light pressure applied to the switch toggles in the reverse direction will cause them to revert to the NORMAL position.

Standby trim switches

24. The standby trim switches are located on the port console shelves in each cockpit.

These are paired, three position, centre OFF, momentary contact switches, positioned side-by-side to be operated together by a fore and aft movement of the switch toggles. A hinged guard plate fitted to each pair of switches is recessed to hold both switch toggles in the OFF position and so prevents inadvertent operation. When the guard plate is lifted a forward pressure applied to both switches together will produce NOSE DOWN trim and a backward pressure NOSE UP trim.

Relay installations

25. Eleven relays are employed in the feel trim and tail trim circuits, these are grouped on panels located in convenient positions in the aircraft. The circuit function of the relays is described in para.34-43.

Rear cockpit

26. Relays R17, R18, R19, and R20 are assembled on a rectangular panel located behind the rear seat between the frequency regulator and the F.I.S. navigation display amplifier. The panel is attached to a support frame which consists of a short crossbeam bolted at the aft end to frame 12 bulkhead and rivetted to a supporting strut at the fore end. The strut is bolted to the cockpit floor, thus the support frame can be removed as a complete assembly when necessary. The relay panel is secured by two screws to the frame crossbeam and is supported at its lower edge by two dowel pins fitted in a floor channel member.

27. The connecting cables for the relays

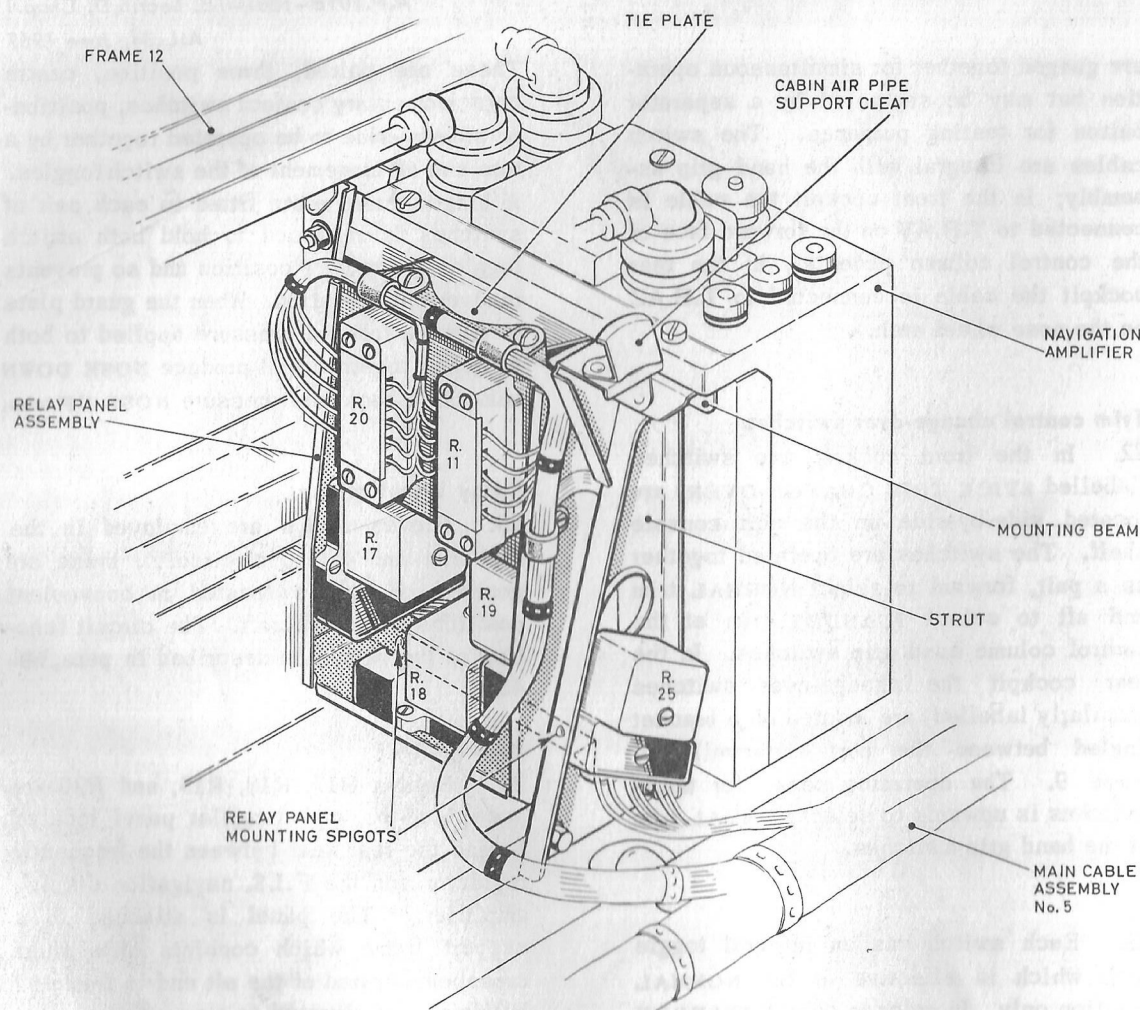


Fig. 2. Relay panel – rear cockpit

are cleated to the panel and then routed into cable loom No.5 which runs athwart the cockpit floor. The connecting cables are of sufficient length to allow the relay panel to be removed from its mounting on to the cockpit floor without disconnection.

28. Relay R25 (Mod.217) is bolted to the forward face of the relay panel support strut. Relay R27 (Mod.399) is mounted on a bracket attached to the starboard shear-wall just forward of frame 11. The connecting cables for these two relays are routed

into cable loom No.5

Rear fuselage

29. Relays R21 and R22 together with T.B.BG are mounted on a single panel located in the rear fuselage on frame 26. This panel is bolted to the forward face of the frame on the port side, just above the centre line. The forward going cables from T.B.BG are routed into the spine with cable loom No.29 to the rear fuselage plug and socket transport break No.2.

30. Relays R28, R29 and R30, together with T.B.BC are mounted on a single panel secured to the aft face of frame 22B on the starboard side. The forward going cables are taken from T.B.BC to the rear fuselage plug and socket transport break No.4 fitted in frame 22B above the relay panel. An access door for the relay panel is fitted in the starboard fairing below the heat exchanger cooling air intake. Access to the No.4 transport break is through the fairing removable top panel.

Elevator locks microswitches

31. Each elevator is locked to the tail plane by two locking assemblies designated the inboard and outboard locks. The locks can be released from the cockpits but are normally retained in the locked condition by coil springs fitted to the outboard locks. The 'elevators not fully locked' warning microswitches are located adjacent to the outboard locks and are operated by the outboard locks mechanisms.

32. A second microswitch in the port tail

plane (No.2 port microswitch) is also actuated by the lock mechanism. It is connected to complete the negative return for the artificial feel solenoid lock (Mod.218). This microswitch assembly is superseded by a fully sealed type of switch (Mod.503). This modification does not effect the circuit operation but the switch cable identification '1.CE' is changed to read 'COM.CE' and cable identification '2.CE' is changed to read 'NC.CE'.

Hydraulic pressure switches

33. The two hydraulic pressure operated switches are located in the rear fuselage on the port side immediately aft of the hydraulic accumulator. The precise location of these switches and connection into the hydraulic system is described in Book 1, Sect.3, Chap.6. Each switch consists essentially of a microswitch actuated by hydraulic pressure applied to a diaphragm fitted within the switch body. The switches which have a pressure differential 'make and break' characteristic, are fully described in the A.P. listed in TABLE 1. The operating pressures with modification applicability are given in TABLE 2.

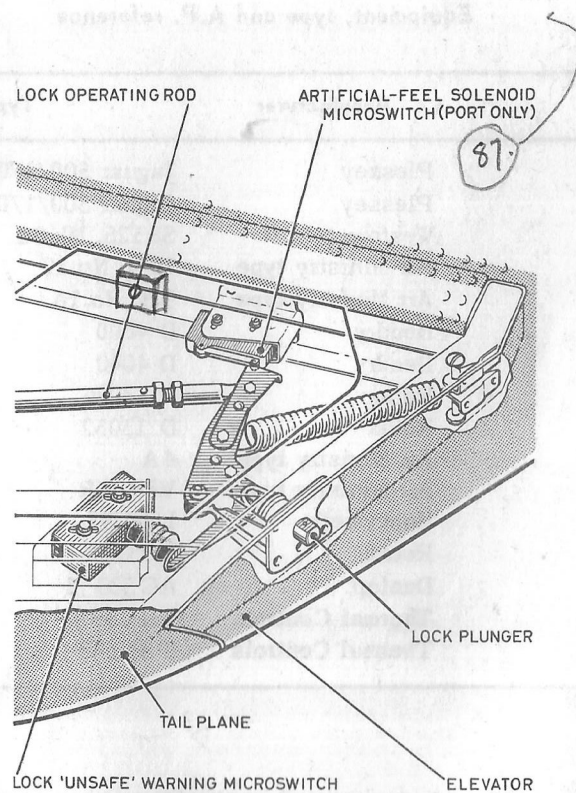


Fig. 3. Elevator outboard locks

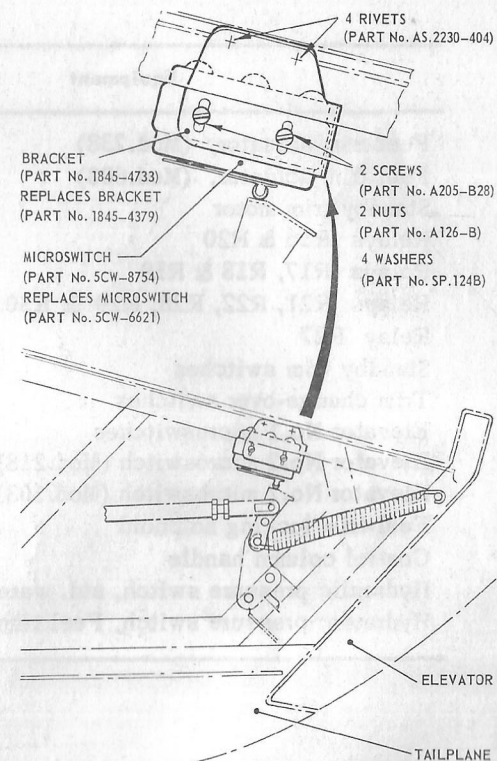


Fig. 4. No.2 microswitch in port tail plane (Mod.503)

TABLE 1
Equipment, type and A.P. reference

Equipment	Manufacturer	Type	A.P. reference
Feel trim actuator, (Mod.238)	Plessey	Jaguar 500/1/00257/300	A.P.4343D, Vol.1, Bk.3, Sect.14
Feel trim actuator, (Mod.608)	Plessey	Jaguar 500/1/03657/300	A.P.4343D, Vol.1, Bk.3, Sect.14
Standby trim motor	Western	SS 125, Mk.30	A.P.4343D, Vol.1, Bk.2, Sect.3
Relays R16 & R20	Air Ministry type	10 B, No.12	A.P.4343C, Vol.1, Bk.2, Sect.3
Relays R17, R18 & R19	Air Ministry type	9 B, No.1A	A.P.4343C, Vol.1, Bk.2, Sect.3
Relays R21, R22, R28, R29 & R30	Hendry	D 4600	A.P.4343C, Vol.1, Bk.2, Sect.3
Relay R27	Hendry	D 4040	A.P.4343C, Vol.1, Bk.2, Sect.3
Standby trim switches	Rotax	D 13085	A.P.4343C, Vol.1, Bk.1, Sect.1
Trim change-over switches	Rotax	D 13052	A.P.4343C, Vol.1, Bk.1, Sect.1
Elevator No.1 microswitches	Air Ministry type	4 A	A.P.4343C, Vol.1, Book 1, Sect.2
Elevator No.2 microswitch (Mod.218)	Air Ministry type	V3M/LR	A.P.4343C, Vol.1, Book 1, Sect.2
Elevator No.2 microswitch (Mod.503)	Honeywell	L.HS.N3	A.P.4343C, Vol.1, Book 1, Sect.2
Feel-trim locking solenoid	Rotax	D 533-1	A.P.4343E, Vol.1, Book 1, Sect.1
Control column handle	Dunlop	AC 533 1	A.P.4343, Vol.1
Hydraulic pressure switch, std. warning	Thermal Controls	T.P. 397	A.P.1275A, Vol.1, Sect.24
Hydraulic pressure switch, Feel trim	Thermal Controls	T.P. 543	A.P.1275A, Vol.1, Sect.24

OPERATION

Artificial feel trim control (fig.5)

34. For the purpose of this description it is assumed that longitudinal control of the aircraft is through the tail plane control unit, normal hydraulic pressure is available and that the elevators are locked to the tail plane. The theoretical circuit (fig.5) is shown with these conditions existing and the STICK TRIM CHANGE-OVER switches selected to NORMAL, i.e. the artificial feel actuator can be controlled from the control column switches in either cockpit. The change-over relay R27 is de-energized.

35. D.C. positive supplies from fuses F49 and F69 are available at the front cockpit control column switches. When these switches are operated to adjust the feel trim actuator the safety relay R17 is energized, using an earth return through the change-over switches. An actuator directional control relay (either R18 or R19, depending on the control switches depressed) will be energized. The actuator circuit using a supply from fuse F68 is completed through the energized relay R17 and the energized directional control relay.

36. If control is exercised from the rear cockpit the over-ride relay R25 and the

selected directional relay (R18 or R19) will be energized from fuse F67. The supply from fuse F69 to the front cockpit switches will be interrupted preventing front cockpit control action.

37. When hydraulic pressure fails, the falling pressure will cause the warning pressure switch to trigger the standard warning system using the supply from fuse F49. At approximately the same time a change-over valve operates to retain pressure in the hydraulic accumulator and connect this reserve pressure to the Hobson unit. The reserve hydraulic pressure is also applied to the feel trim pressure switch to complete an alternative supply

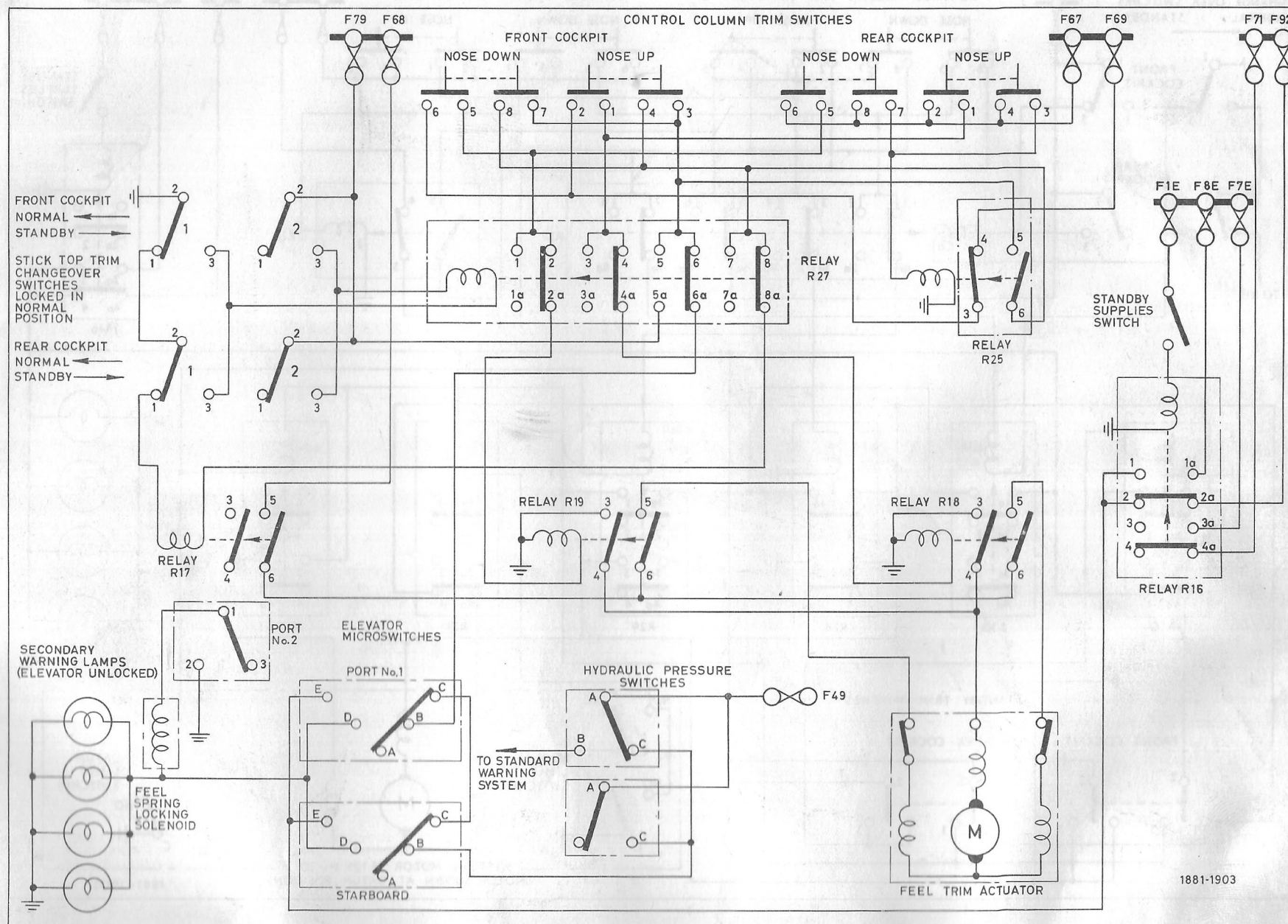


Fig. 5. Artificial feel trim (theoretical)

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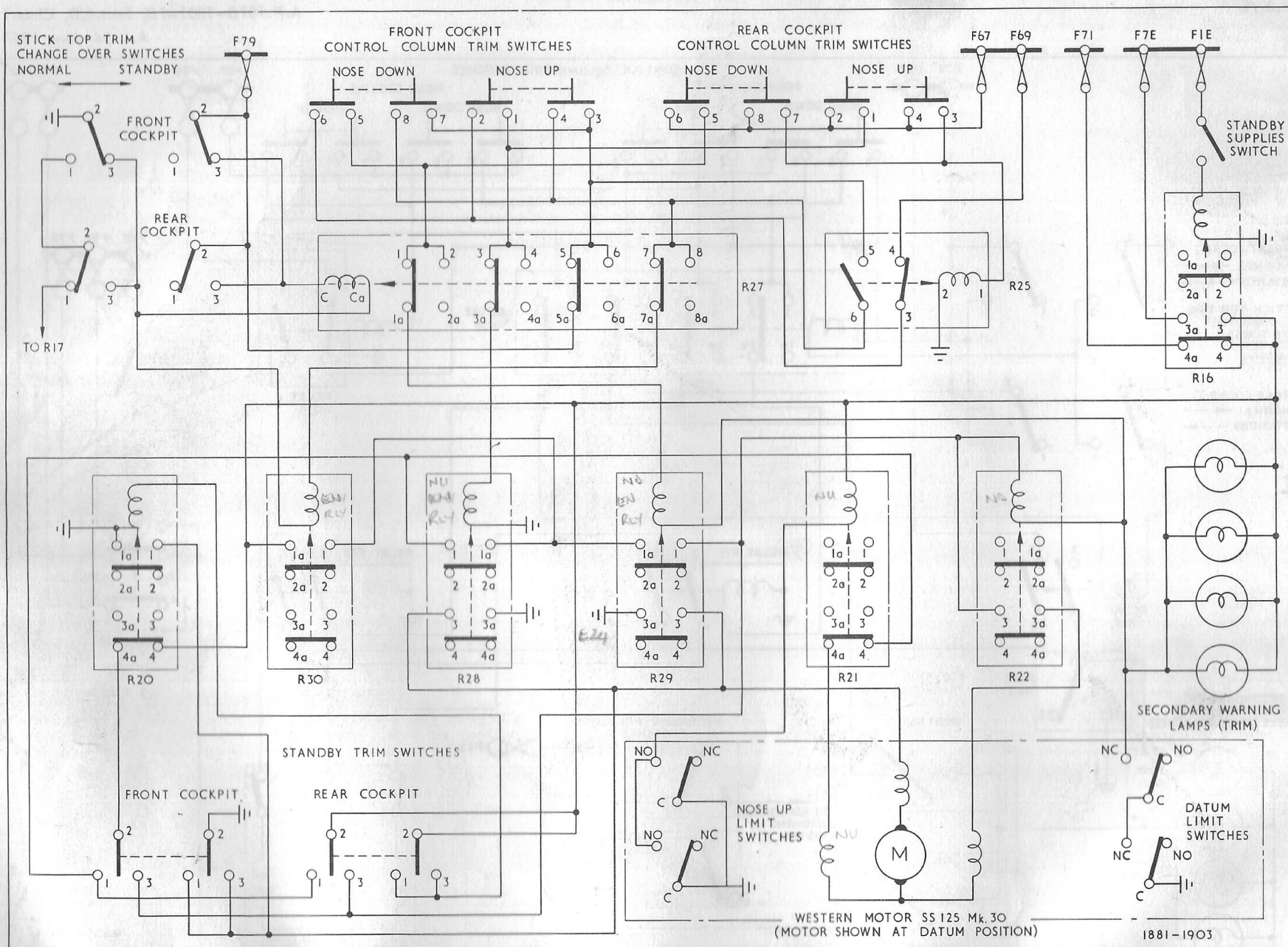


Fig. 6. Standby tail trim (theoretical)

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circuit for feel trim control from fuse F49. When the reserve hydraulic pressure has been used the feel-trim pressure switch reverts to open circuit so isolating the feel trim control.

38. The action of unlocking the elevators from the tail operates the elevator locks microswitches. The operation of either the port No.1 or the starboard lock microswitches interrupts the energizing circuit for relay R17 so rendering the feel trim circuit inoperative. These two microswitches (operating in parallel) also complete circuits to energize the spring locking solenoid and illuminate the secondary warning captions ELEV. These circuits are supplied from fuse F92, the solenoid circuit negative is returned to earth through the port No.2 microswitch. When the standby supplies switch is operated the supply is from fuse F8E.

Standby tail trim control (fig.6)

39. The theoretical circuit is shown with the front cockpit change-over switches selected to STANDBY and with a d.c. positive supply from fuse F79 energizing the change-over relay R27. (A similar circuit would function if the change-over selection had been made using the rear cockpit switches). Two d.c. positive supplies are now available at the front cockpit control column switches; a supply from fuse F69 routed through the closed contacts of the over-ride relay R25, and a supply from fuse F79 routed through the contacts of the change-over relay (R27).

40. When 'nose up' tail plane trim is applied using the control column switches, relays R28 and R30 will be energized. A supply circuit is now completed from fuse F71 through the closed contacts of relays R30, R28 and R21 to the standby trim motor, the negative return from the motor being through the earth contacts of relay R28.

41. The motor will operate in the direction that will close the datum limit switches, to illuminate the secondary warning caption TRIM. The motor will continue to operate until either the control column switches are released or maximum trim has been applied and the UP limit switches close. This will energize relay R21, interrupting the supply to the motor.

42. If NOSE DOWN trim is now applied a supply circuit is completed through the energized relays R30, R29 and R22 to run the motor in the reverse direction, the earth return for relays R29 and R22 being through the closed motor datum limit switches. When the motor reaches datum the limit switches will be opened de-energizing these relays and extinguishing the warning caption TRIM.

43. In a supply failure emergency the motor can be operated using a supply from the standby battery. Control should then be exercised from the console standby control switches and the change-over switches selected to NORMAL. The control relays will then be energized from the standby battery.

SERVICING

WARNING:

The standby trim motor is rated to run for not more than one minute in every four minutes. The motor must not be run unless it is correctly connected to a serviceable aircraft control circuit or to a test rig wired up in accordance with the aircraft circuit. The supply voltage must not fall below 21 volts on load. The motor internal limit switches control external relays which must operate correctly otherwise the motor will continue to run and cause extensive damage to the limit switches and mechanism.

General servicing

44. For general servicing instructions refer to Sect.6,A, Chap.2, for servicing instructions applicable to individual components refer to the publications listed in TABLE 1. The system is tested as detailed below.

Serviceability tests

45. In order to carry out the tests detailed ensure that the flying controls and the elevator microswitches have been correctly set up, (Book 1, Sect.3, Chap.6). External hydraulic and electrical power supplies are required and the standby battery replaced by a fully charged ground test battery. Check that the STICK TRIM CHANGE-OVER switches set to NORMAL and that the elevators are locked to the tail plane. Carry out a hydraulic power check and ensure that the tail plane responds in the correct sense to the movements of the control column.

46. The angular movement of the tail plane will be indicated by the tail plane position indicators (Sect.7,B, Chap.5). The amount and direction of artificial feel-trim applied to the tail controls will be shown on the feel-trim position indicators.

Normal feel trim

47. Check that the STICK TRIM CHANGE-OVER switches are selected to NORMAL and then in succession from each cockpit, operate the trim switch separator button on the control column handle. Check that when each part of the separated trim switch is operated there is no change in the feel trim. On completion of the test in each cockpit re-set the switch separator button.

48. Operate the front cockpit control column switches 'forward' and check that feel-trim is applied in a NOSE DOWN direction. Operate the switches 'backward' and check that feel-trim is applied in a 'NOSE UP' direction. Repeat these tests from the rear cockpit and on completion check that operation from the rear cockpit will over-ride the operation of the front cockpit switches.

49. Unlock the elevators from the tail and check that:-

(1) The secondary warning captions ELEV are illuminated in both cockpits.

(2) The spring feel unit locking solenoid operates. This may be checked visually through the inspection panels on the

underside of the rear fuselage.

(3) The normal feel trim circuit is inoperative. i.e. that there is no response to operation of the control column switches.

(4) With the standby battery selected the locking solenoid and the warning caption lamps are supplied from the standby battery. Remove and refit fuse FE8 to prove this circuit.

50. Select the standby battery switch to NORMAL and relock the elevators. Check that the warning captions ELEV are extinguished and that the spring locking solenoid is de-energized. Switch OFF the hydraulic test rig and check that the standard warning HYD is given when the main hydraulic pressure has fallen to below 1850lb/sq.in. Operate the control column to exhaust the tail plane accumulator and check that normal feel trim ceases to operate when the accumulator has been exhausted. Unlock the elevators (captions ELEV illuminated).

Standby tail trim

51. Select the front cockpit STICK TRIM CHANGE-OVER switches to STANDBY, (relay R27 energized).

(1) Operate the trim switches backward and check that the warning captions TRIM are illuminated and that the tail plane moves approximately 12deg. in the nose up direction and then stops.

(2) Operate the trim switches forward and

check that the tail plane moves approximately 12deg. in the nose down direction and stops, the warning captions are extinguished indicating that the trim motor has returned to datum.

(3) During tests (1) and (2) check that the motor will stop at intermediate positions when the switches are released.

(4) Operate one change-over switch to NORMAL (the other switch remaining at STANDBY) and check that the standby trim circuit is inoperative from the control column switches. Reset the change-over switch to STANDBY and then repeat the test with the other switch selected to NORMAL.

52. Ensure that the front cockpit STICK TRIM CHANGE-OVER switches are set to NORMAL and select the rear cockpit STICK TRIM CHANGE-OVER switches to STANDBY. Repeat para.51 operations (1) to (4) from the rear cockpit. Check that control from the rear cockpit will over-ride the front cockpit control. Select the rear cockpit change-over switches to NORMAL.

53. Operate the STANDBY SUPPLIES switch to STANDBY and using the console STANDBY TRIM switches in each cockpit check that the standby trim motor continues to function satisfactorily.

54. Return all switches to NORMAL, switch OFF and disconnect all external supplies. Fit a fully charged serviceable standby battery.

Feel trim actuator

55. This actuator is an integral part of the artificial feel unit which is a decisive component in the tail plane flying controls. The artificial feel unit must only be removed and reassembled as described in Bk.1, Sect.3, Chap.4. The actuator is manufactured to give the required range of plunger travel and since the internal limit switches are preset, no further adjustment may be made.

56. If a replacement actuator is fitted the overall length of the feel unit is contingent on the correct positioning of the fork end eye fitting on the plunger, for details see Sect.3, Chap.4. The fork end fitting is also connected by an adjustable linkage to the feel trim position potentiometer. The potentiometer linkages must be set up as described in Sect.7,B, Chap.9.

Standby trim motor

57. The electric motor is secured to the hydraulic unit by four studs and can be easily withdrawn from these after removal of the four securing nuts and washers. The assembly of the motor is the reverse of the removal procedure, with the exception that the splined shaft should be coated with anti-fretting grease XG-284.

58. To ensure that the available travel of the electric motor is set relative to a datum in the aircraft for the correct pilot's control-tail plane relationship, the electric motor must be offered up to the control unit when the re-setter mechanism and screw jacks have been correctly set and after the motor has been run to the extreme of the aircraft nose-down trimming position (TRIM caption extinguished). It should be noted that when the electric motor is being refitted it must be synchronized as described below.

WARNING:

Refer to the warning given at the beginning of SERVICING.

59. With the electric motor fitted temporarily to the unit, proceed as follows:-

(1) Measure the length of the unit hydraulic valve resetter screw (dimension 'x').

(2) Measure the length of the unit screw jacks (dimension 'y').

(3) Check that the measured dimension 'y' agrees with that given by the graph against the measured dimension 'x'. If the two values of 'y' do not agree, operate the unit by the trim switches to change the length of the screw jacks. Where dimension 'y' will not correspond with dimension 'x' before the motor reaches its limit switches, the motor must be disengaged from the unit without disconnecting the leads.

(4) Whilst still electrically connected to the aircraft, operate the motor for one to two seconds away from its limit switches.

(5) Refit the motor to the unit and again run until dimension 'y' agrees with dimension 'x' as stated on the graph (Sect.3, Chap.4) repeating the above instructions as necessary.

(6) When the 'x' and 'y' dimensions are correct, disengage the motor from the Hobson unit and, while still electrically connected to the aircraft, operate the aircraft switches in the nose-down sense until the 'trim' caption is extinguished.

(7) Lubricate the shaft with anti-fretting grease XG-284. Fit the motor, tighten the securing nuts on to plain washers and wire-lock the nuts together in pairs using 22 s.w.g. stainless steel locking wire.

(8) Operate the tail planes electrically, checking that their range of movement is 16 to 17 deg. normal to hinge line (12 deg. in line of flight). The supply voltage must not fall below 21 V, otherwise the relays may fail to operate.

60. When this operation has been correctly completed check that the secondary warning caption TRIM in each cockpit is not illuminated and that the tail plane position indicators correctly indicate the setting of the tail plane.

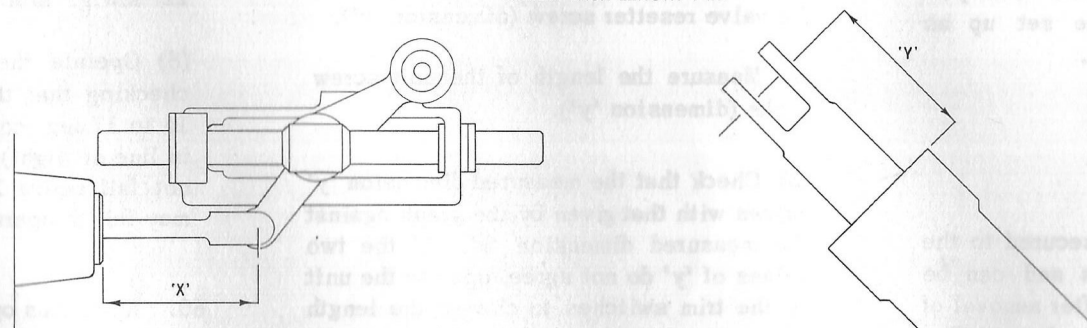
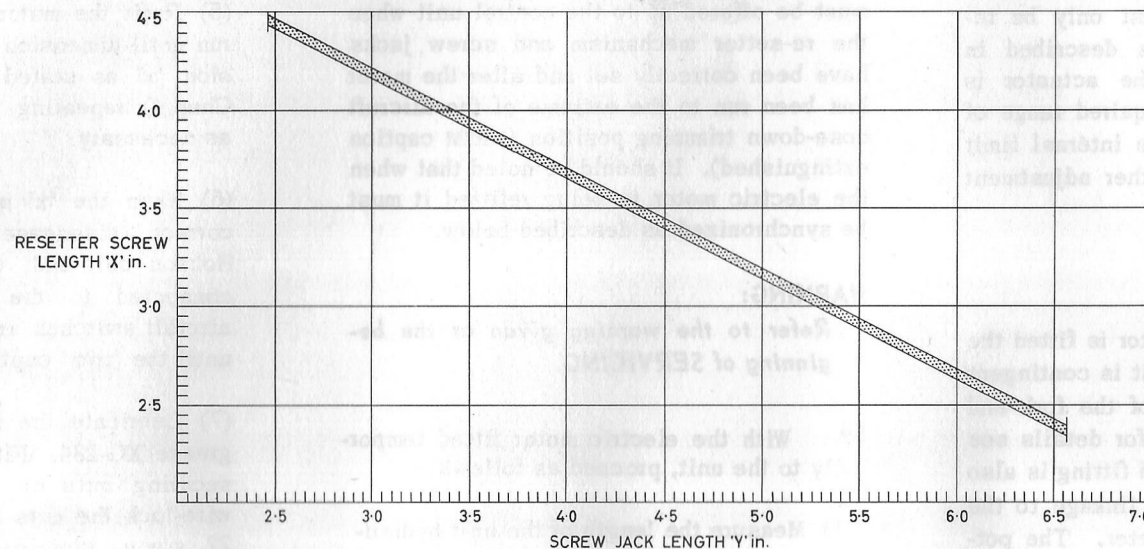


Fig. 7. Trim motor 'datum' setting dimensions

Elevator lock microswitches

61. The elevator lock microswitches are set up after the lock control gear has been correctly adjusted. The microswitches are adjusted by slackening the two bolts and nuts which secure the switch to the mounting bracket, moving the switch to obtain the

desired operation and then tightening the nuts and bolts. Proceed as follows :-

◀ plungers are withdrawn .070 in. +0-.010 in. from the fully locked condition. ▶

(1) Set the 'elevators unlocked' warning microswitches to illuminate the secondary warning captions 'ELEV' when the lock

(2) With the lock plungers positioned as above adjust the port No.2 microswitch to energize the feel spring locking solenoid.

TABLE 2

Hydraulic pressure switch settings (Mod.196)

Standard warning pressure switch, Part No. T.P.397

Installed operating pressure

With the hydraulic pressure falling, the warning lamps will be illuminated when the tail planes accumulator pressure falls below 1800 lb/sq.in.

Feel trim pressure switch, Part No. T.P.543

Installed operating pressure

Contacts 'break' and feel trim circuit becomes inoperative when hydraulic power to the power operated flying control for the tail unit has fallen to 1280 lb/sq.in.

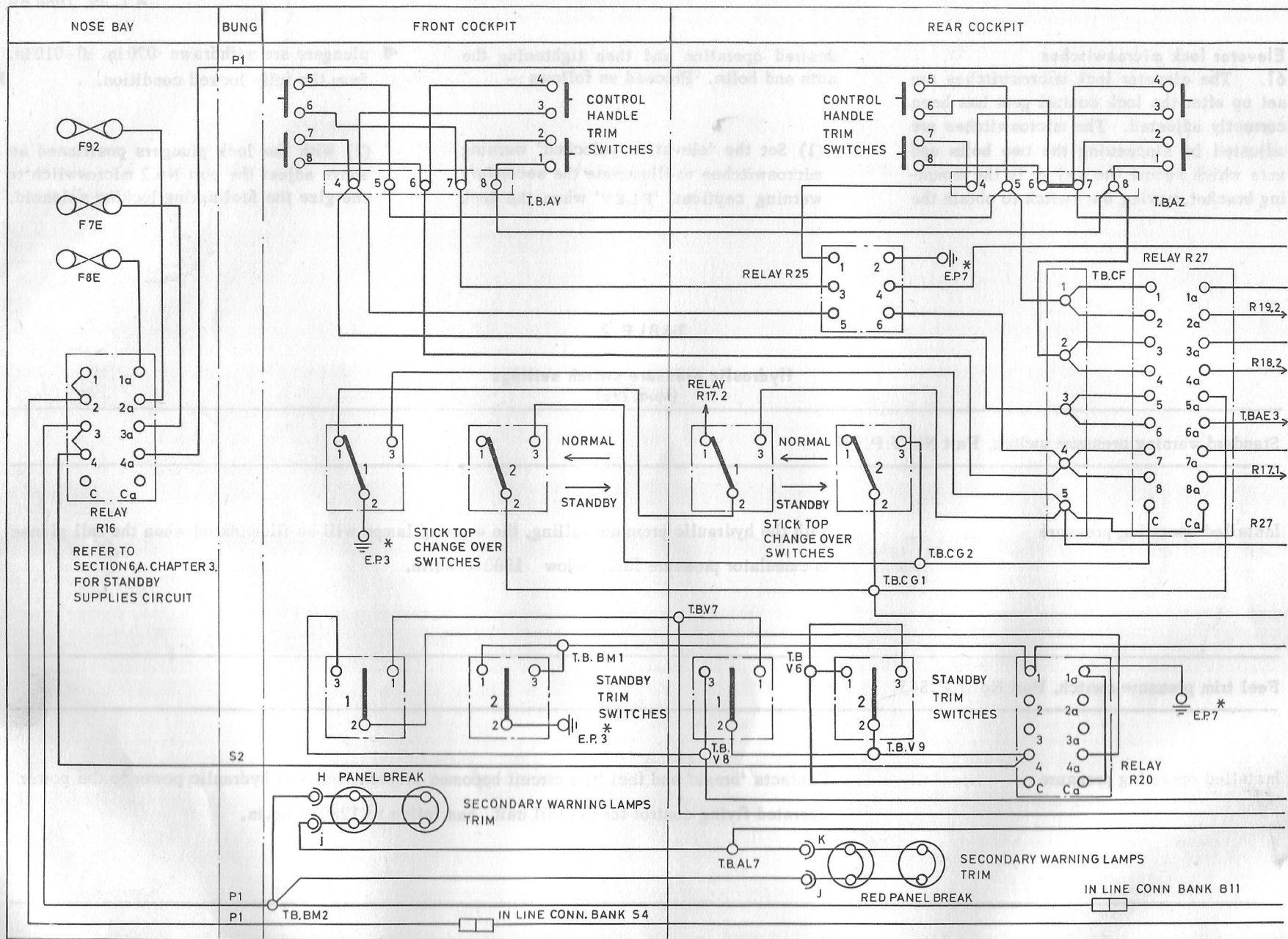


Fig. 8 (1). Standby tail trim (routing)

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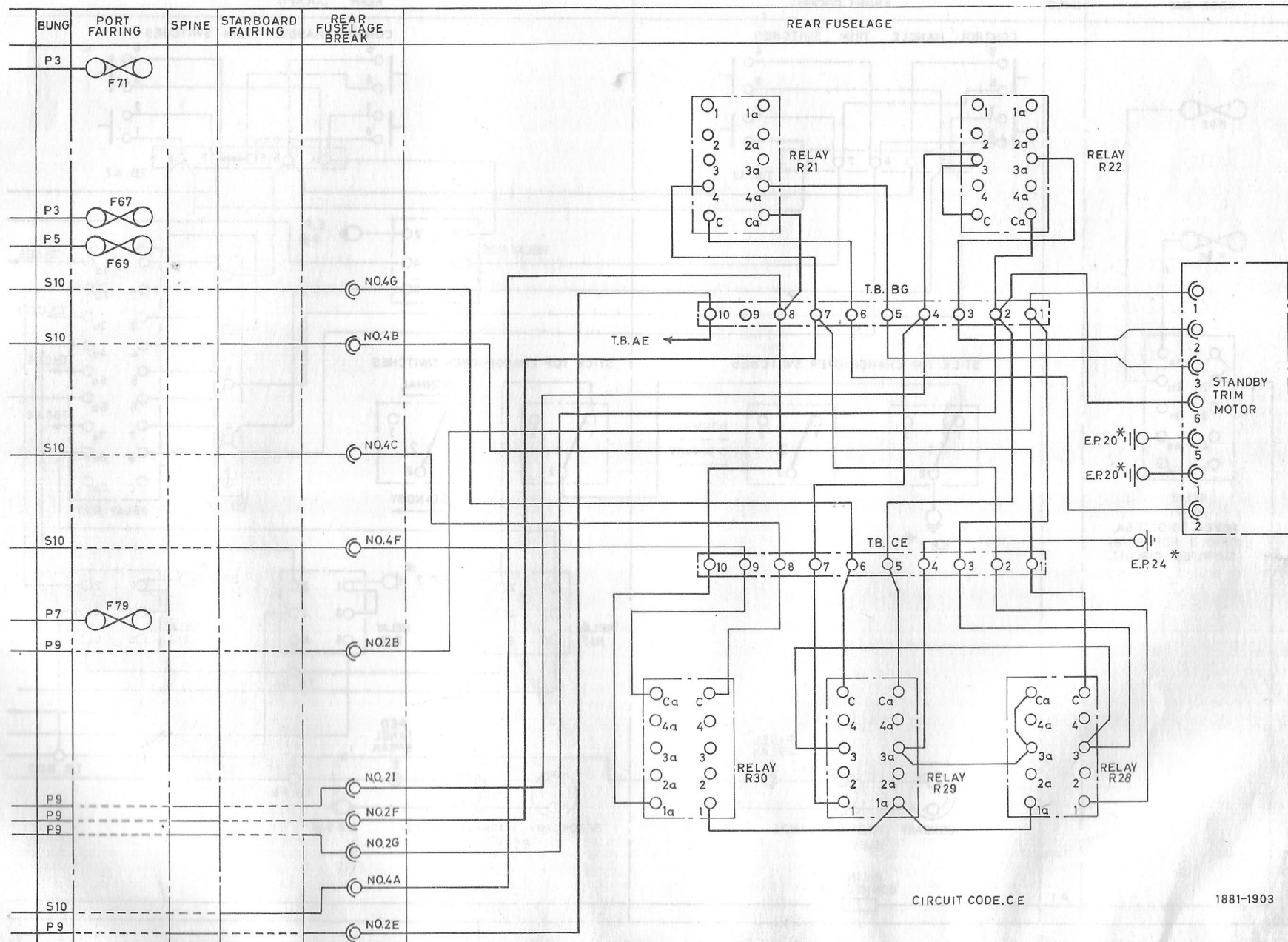


Fig. 8 (2). Standby tail trim (routing)

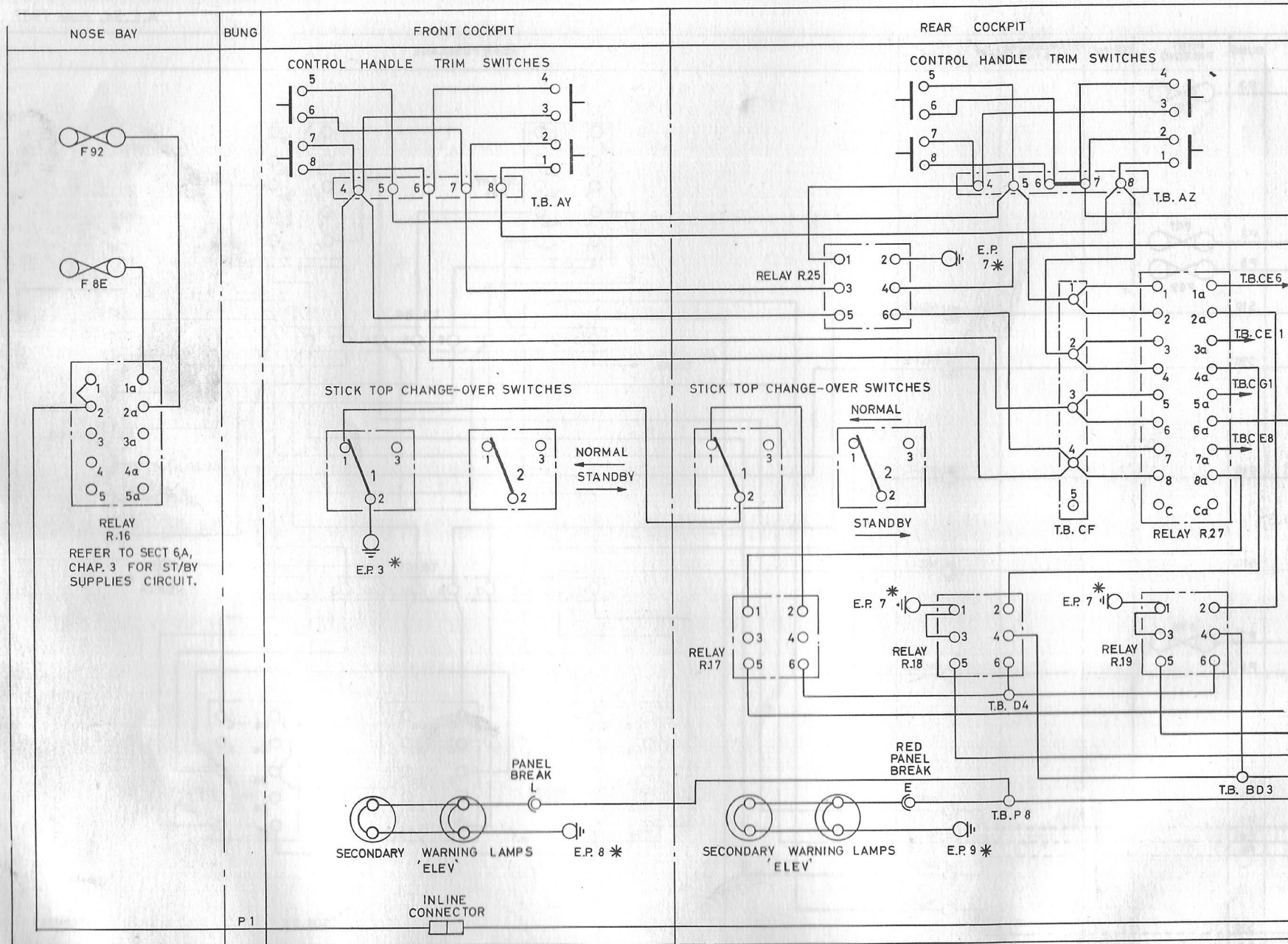


Fig. 9 (1). Artificial feel trim (routing)

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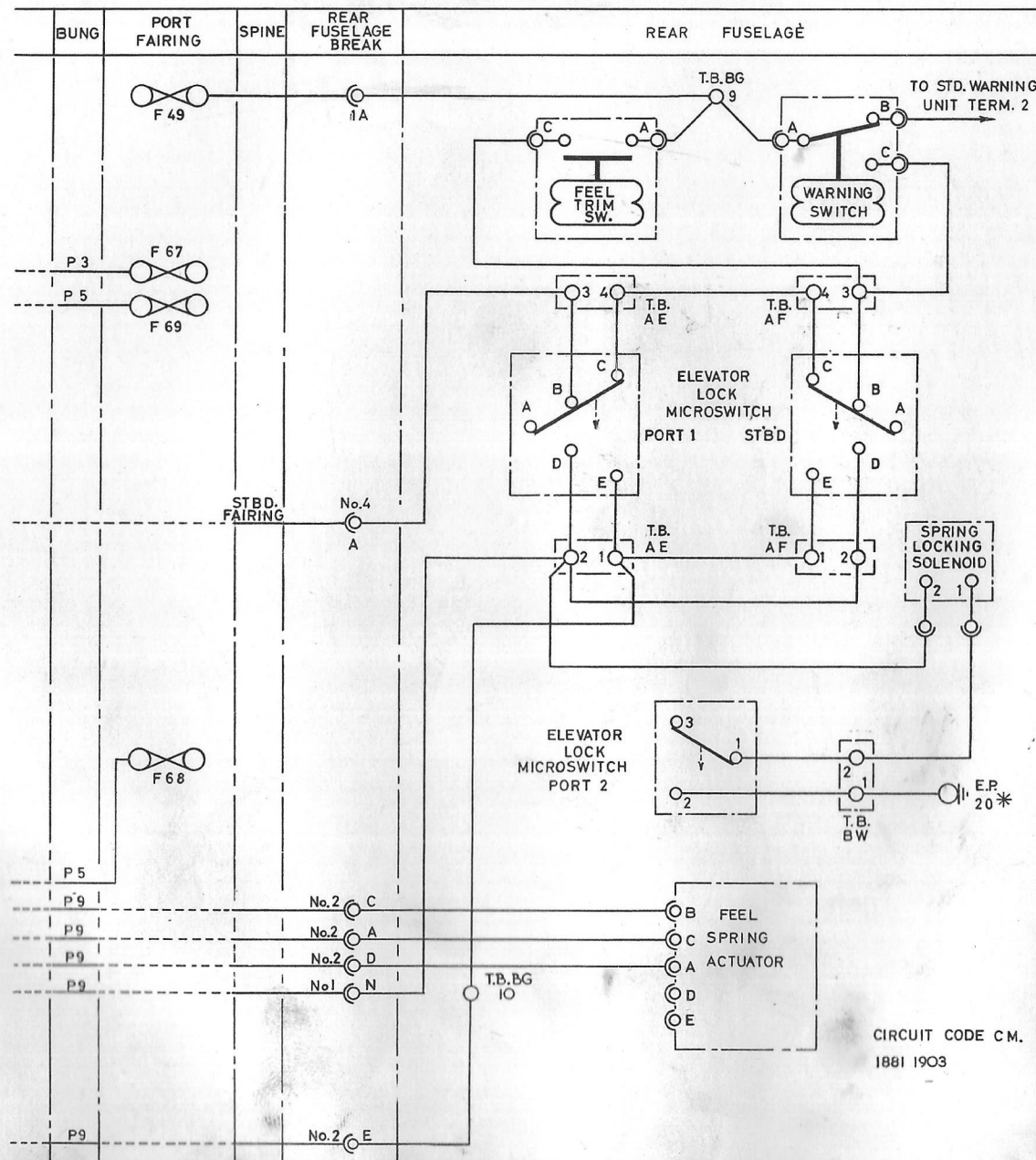


Fig. 9(2). Artificial feel trim (routing)

◀(Basic alteration)▶

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Appendix 1 HYDRAULIC PRESSURE FAILURE WARNING PRESSURE SWITCH
(Modification 604)

1. This appendix details the effect on this chapter of Mod.604 — to introduce pressure switch TP.759 in lieu of pressure switch TP.397 (5CW/8066) in the hydraulic circuit. This modification is designed to overcome the intermittent functioning of both the audio warning and the 'attention getter' lamps on receipt of a hydraulic failure warning.

2. The intermittent functioning of the standard warning system was caused by transient hydraulic pressures. This characteristic was further emphasised by the incorporation of Mod.504 to the standard warning system. The new pressure switch operates at the same falling pressure as the previous switch but incorporates a damper which prevents transient pressure changes effecting the switch operation.

Appendix 2 FEEL TRIM ACTUATOR

◀ (Alt. Gnat 630/11, Plessey Mod.687) ▶

◀ Introduction

1. This appendix details the effect on this chapter of Plessey Mod.687. This modification introduces a feel trim actuator Part No. 500/1/04800/300 fitted with a re-designed plunger and fork end fitting. The plunger end is manufactured with a female thread and is pre-drilled through its diameter for the fitment of a 3/32 in. dia. taper pin. The fork end fitting is manufactured with a male thread and is not drilled when supplied.

Assembly sequence

2. The actuator increases or decreases the operative length of the feel spring unit, and for correct operation is contingent on the correct positioning of the fork end. When fitting the actuator to the feel spring unit piston rod ensure that the piston rod seats down by using laminated shims (Part No. FOS 34/H). Lock with locking plate Part No. 1845/3645, and wire lock the locking plate securing screw. ▶

3. Adjust the position of the fork end fitting to obtain the nominal overall length for the feel spring unit as described in Sect.3, Chap.4. Fit and adjust the linkage to the feel trim potentiometer to obtain the geometric movement described in Sect.7,B, Chap.9, App.2. Using the pre-drilled hole

in the actuator plunger as a drilling guide, drill, ream and fit a 3/32 in. taper pin to secure the fork end to the actuator plunger.

4. Refit the feel spring unit to the aircraft and check for correct operations as detailed in Sect.3, Chap.4.

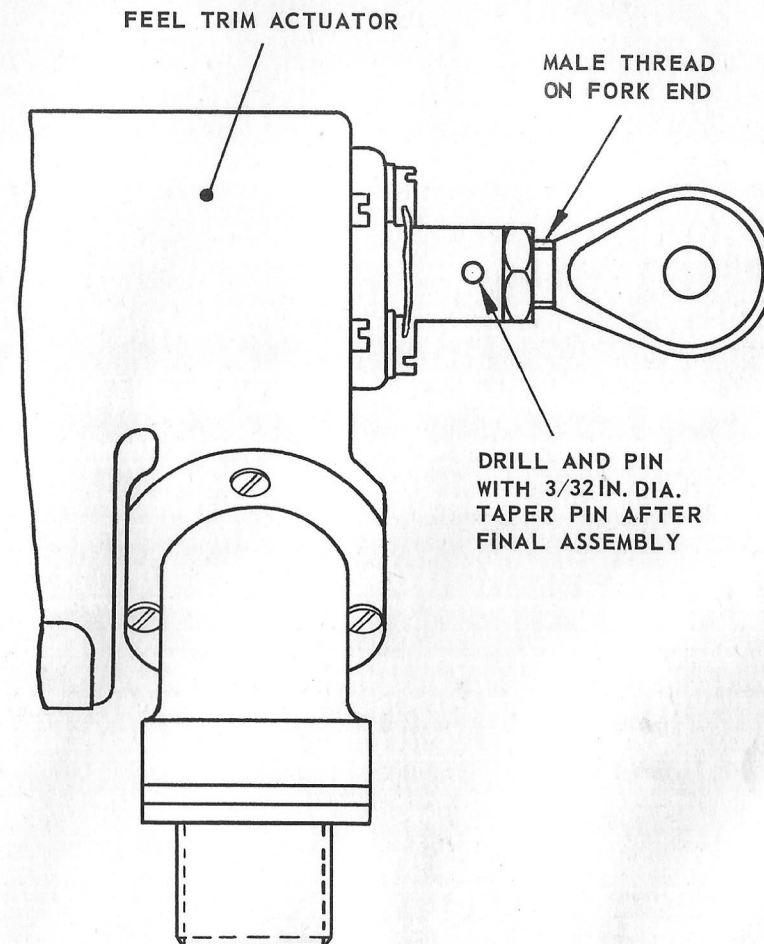


Fig. 1. Actuator fork end fitting

Appendix 3 STANDBY TRIM (Modification 623)

Introduction

1. This appendix describes the effect on this chapter of Mod.623: To make provision for and introduce relay Type 9B 2A in lieu of relay Type 9B 1A (circuit reference R17) and a new diode Type GJ4M into the standby trim circuits. This modification is applicable to aircraft embodying Mod.399 only.

2. Mod.399 provides for control of artificial feel trim and standby tail trim through the trim switches fitted in the control column handles. Selection of the required service is through duplicate switches fitted to the port consoles of each cockpit. When switch selection is made to NORMAL (either cockpit) feel trim is available at the control column handles. When switch selection is made to STANDBY, tail trim is available at the control column handles. Irrespective of the service selected, or of the cockpit in which selection is made, over-ride control is always given to the occupant of the rear cockpit.

3. In addition to the tail trim control available at the control column handles an alternative tail trim control is provided by switches fitted in the cockpit port consoles. When these switches are used over-ride control is again with the occupant of the rear cockpit. In the Mod.399 circuit configuration there is no parallel alternative control for feel trim.

4. When tail trim is selected to control column switch control the application of over-ride control unavoidably interfered with the free movement of the control columns. The purpose of Mod.623 is to integrate the two separate tail trim circuits so that rear cockpit over-ride control can be exercised from the control column or the console switches.

Description

5. The circuit changes relate to relays R17, R20 and R25, the new relay Type 9B 2A, fitted in lieu of the existing relay R17, has a different contact arrangement. The application of this relay to the artificial feel trim circuit is unchanged and circuit operation remains as described in Chap.1. Relay R17 is energized by a supply derived from fuse F49 whenever the control column switches are used in the feel trim mode, over-ride control is provided by relay R25.

6. When tail trim is selected to control column switch control, circuit operation also remains as described in Chap.1. Rear cockpit over-ride action operates through relay R25 which is energized by the supply from fuse F67 via the control column switches.

7. When tail trim is applied from the console switches rear cockpit over-ride control is provided by relay R20. With

control operated from the front cockpit the trim motor is supplied from fuse F71 through the N/C contacts of R20. When tail trim is operated from the rear cockpit R20 is energized to interrupt the front cockpit control and the motor is supplied from fuse F71 through an alternative route.

8. The circuit changes introduced by this modification cause the two over-ride relays R20 and R25 to be energized simultaneously by action applied at either the rear cockpit control column or at the console switches. The revised circuit is shown in Fig.1 and operates as follows:-

(1) Normal-Standby switches (either cockpit) set to STANDBY, R27 is energized and R17 is de-energized.

(2) Standby tail trim applied at rear cockpit control column, R25 energized directly and R20 energized through the N.C. contacts of R17. Both relays supplied from fuse F67.

(3) Standby tail trim applied at rear cockpit console, R25 energized directly and R20 energized through the N.C. contacts of R17. Both relays supplied from fuse F71.

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9. When standby tail trim is operated using the emergency battery supply, i.e. relay R16 energized, the diode Type GJ4M prevents feed back to the main d.c. busbars.

Installation

10. Relays R11, R17, R19 and R20 are located behind the rear seat between the frequency regulator and the F.I.S. amplifier. The new relay R17 (Type 9B 2A) is a direct replacement of the Type 9B 1A relay. The diode (Type GJ4M) is mounted on a Paxolin plate located between R11 and R20 and is secured to the plate by the 4BA (-ve) terminal screw. The diode connecting cables are identified CM RECT + (6 B.A. eye terminal) and CM RECT - (4B.A. eye terminal).

Serviceability tests

11. The tests detailed in Chap.1 are applicable when this modification is embodied. Additional tests to ensure that the over-ride facilities operate correctly must be carried out.

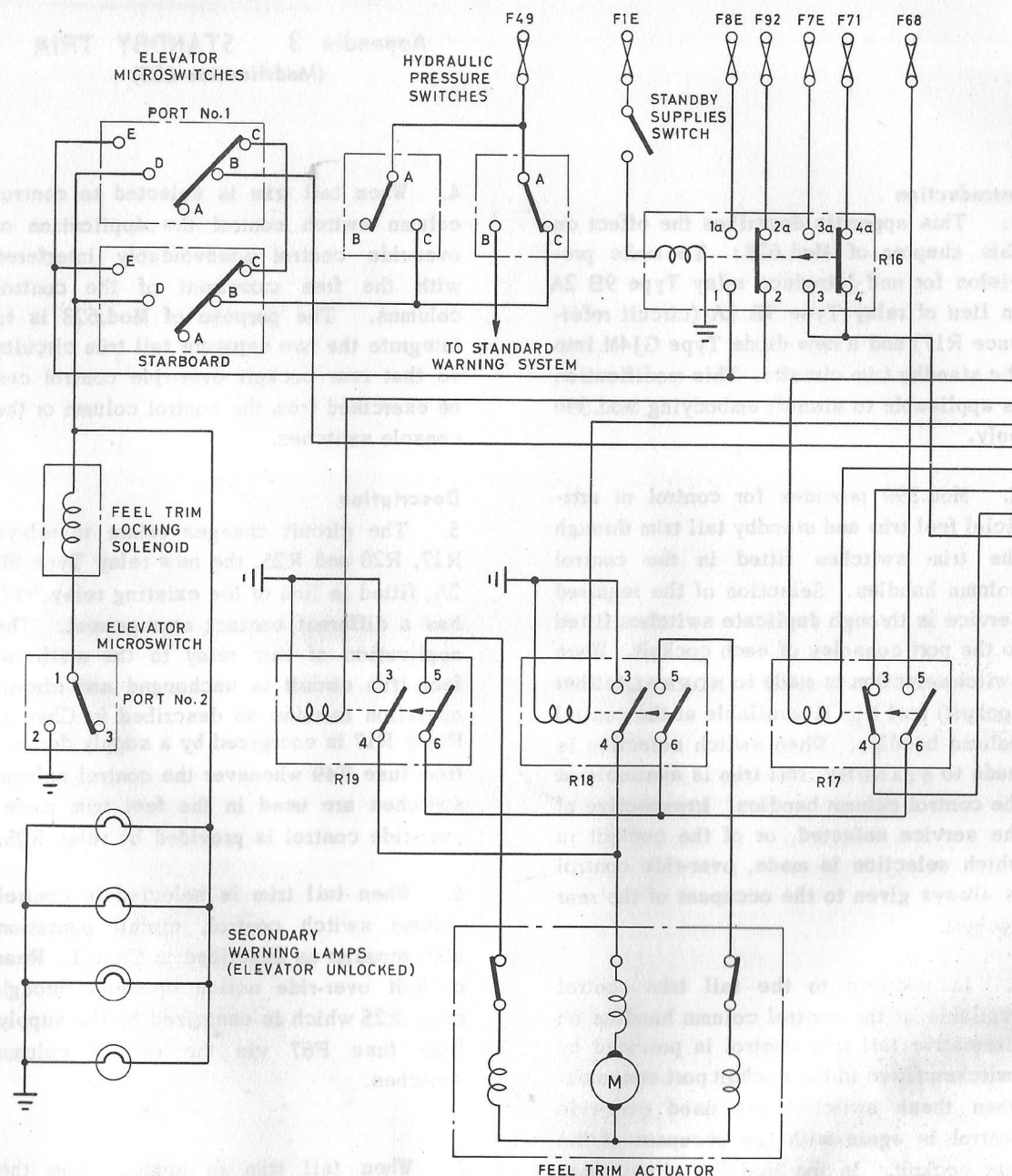


Fig. 1(1). Feel trim and standby trim (theoretical)

(Mod.623)

◀ (General amendment) ▶

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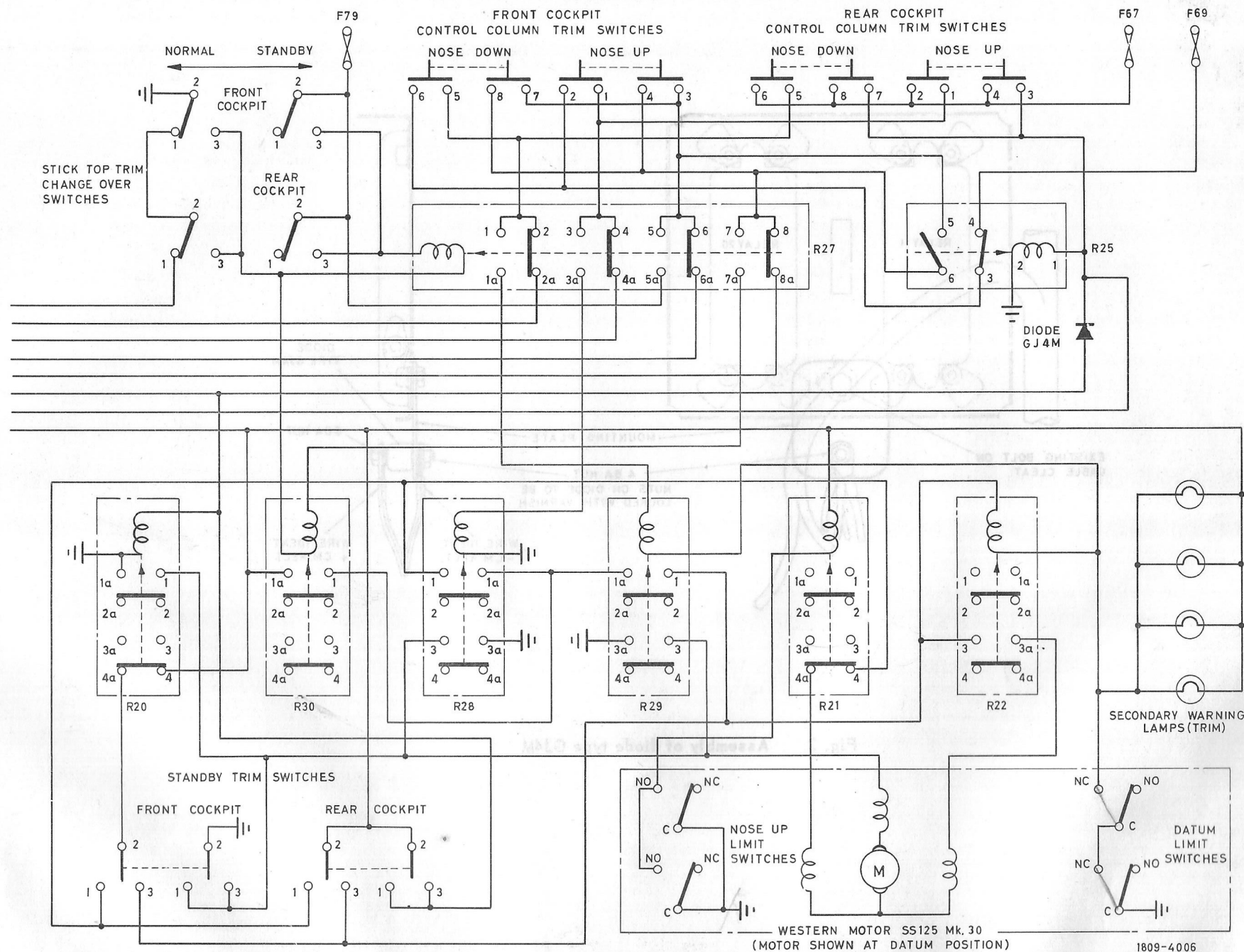


Fig. 1(2). Feel trim and standby trim (theoretical)
(Mod.623)

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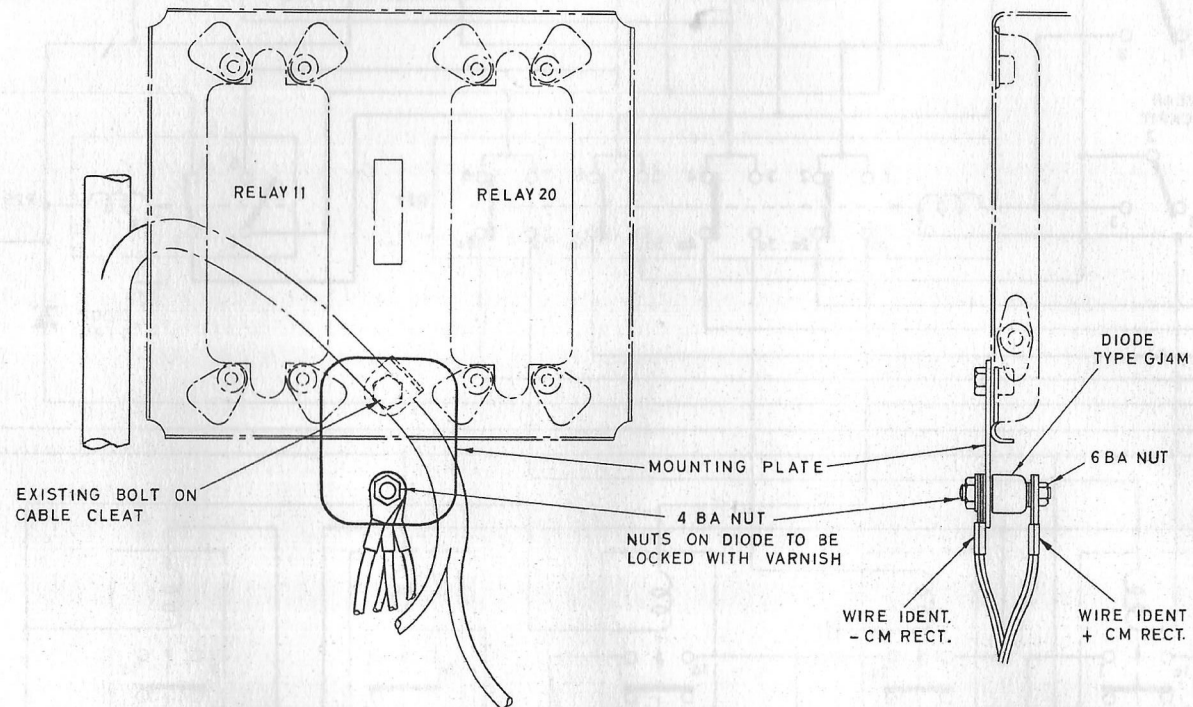


Fig. 2. Assembly of diode type GJ4M

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Appendix 4 FEEL TRIM SPRING LOCKING
(Modification 651)

Introduction

1. This appendix describes the effect on the chapter of Mod.651, which introduces a mechanism to delay the feel trim spring locking until the elevator unlocking is complete. This modification affects the port elevator No.2 microswitch and cam actuator which were introduced by Mod.218 and later amended by Mod.503.

Description

2. When the elevators are unlocked from the tail plane the artificial feel spring is locked by a solenoid actuated locking lever. The solenoid circuit is supplied from fuse F92 and incorporates double pole switching by separate microswitches connected into the supply and earth return cables. The supply circuit is completed through the parallel connected port and starboard elevator locks unsafe microswitches and returned to earth through the port No.2 microswitch.

3. The elevators are unlocked from the

tail plane by a cockpit controlled rod and lever assembly which withdraws the lock draw-bolts from the elevators. The initial travel of the draw-bolts from the elevators fully locked position actuates the locks unsafe microswitches to complete the secondary warning panels lamp circuits and illuminate the warning captions ELEV. The locks unsafe microswitches also complete the feel spring lock solenoid supply circuit. The completed unlocking movement of the control levers actuates the port No.2 microswitch to complete the solenoid earth return. The No.2 microswitch is actuated by a new cam of extended profile which maintains the microswitch contacts open until the draw bolt unlocking movement is complete.

4. The port No.2 microswitch is secured by two body bolts to a bracket which is attached to the tail plane rear spar. If necessary a laminated shim part No.1845-4867 is positioned between the bracket and the switch to ensure that the switch roller is aligned centrally with the cam face. The bracket inboard bolt hole is elongated to

provide a switch adjustment facility. The microswitch is mounted with its actuator roller inboard, when the switch is removed and refitted care must be taken to ensure correct orientation is maintained.

5. The port No.2 microswitch (Type 1HS-N3) is filled with an inert gas and hermetically sealed; routine servicing is restricted to examination for security and integrity of electrical connections. The switch is tested in conjunction with the tests for correct operation of the locking solenoid. The elevators locks unsafe warning microswitches are adjusted to illuminate the secondary warning captions ELEV when the lock draw-bolts are withdrawn .070in. +0-.010in. from the fully locked position. With the draw-bolts in this position the port No.2 microswitch actuator roller must be seated on the cam profile and its contacts must be open. When the draw-bolts are completely withdrawn and the elevators unlocked, the roller must clear the cam profile and the switch contacts must close to complete the solenoid earth return circuit.

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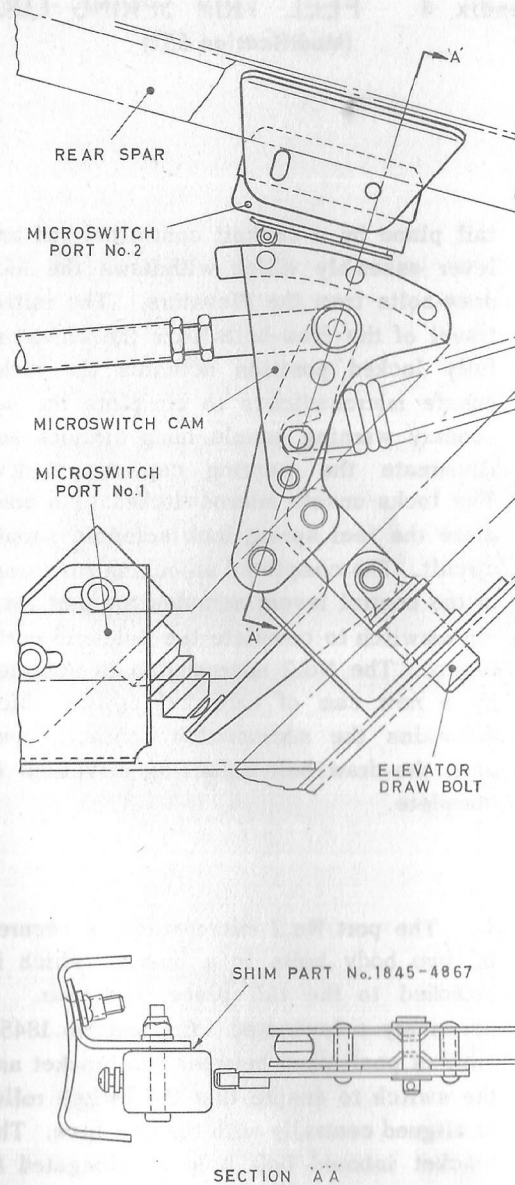


Fig.1 Tail plane port No.2 microswitch

actuating mechanism

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Appendix 5 FEEL TRIM SPRING LOCKING (Modification 714)

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Introduction

1. This appendix describes the effect of Mod.714 on the tail trim artificial feel circuit and includes theoretical and routeing diagrams of the circuit after incorporation of the modification.

Equipment

2. The effect of this modification on the aircraft equipment is to remove and discard the feel trim locking solenoid, locking lever assembly, interference bracket (Chap.1, Fig.1), and the artificial feel locking solenoid microswitch (Chap.1, Fig3). It should be noted that prior to this modification the port elevator lock microswitch and the artificial feel locking solenoid microswitch were known as Port No.1 and Port No.2 microswitches respectively. When this modification is embodied the elevator lock microswitch is known as the Port microswitch.

Mod.714

3. Modification 714 removes the artificial feel trim locking facility described in paras. 10(1), 16, 32 & 38 of Chap.1 in this Section and amended by Appendix 4 (Mod.651) to this Chapter.

Description

4. From a comparison of the theoretical and routeing diagrams in this appendix with the corresponding diagrams in Chap.1 (figs.5, 9(1) & 9 (2)) it can be seen that the artificial feel trim circuit remains as described in Chap.1 with the following exception (ref. Chap.1, para.10). When loss of hydraulic pressure

makes it necessary to unlock the elevators from the tailplane to obtain manual longitudinal control, the withdrawal of the elevator lock plungers operate only the two elevator lock microswitches, one in each wing, to illuminate the warning caption ELEV in both cabins. The artificial feel spring unit is not locked.

Operation

5. The operation of the artificial feel trim circuit remains as described in Chap.1 except that the action of unlocking the elevators from the tail unit now only illuminates the secondary warning ELEV caption in both cabins and does not complete the circuit for locking the artificial feel spring unit. (ref. para.38, Chap.1).

Servicing

6. Servicing of the tail plane trim and feel trim circuits remains as described in Chap.1 of this Section except that sub-para. 49(2) and 61(2) no longer apply.

Note...

With Mod.714 embodied, Appendix 4 to Chap.1 (Mod.651) will automatically become non effective as it applies to components removed by Mod.714.

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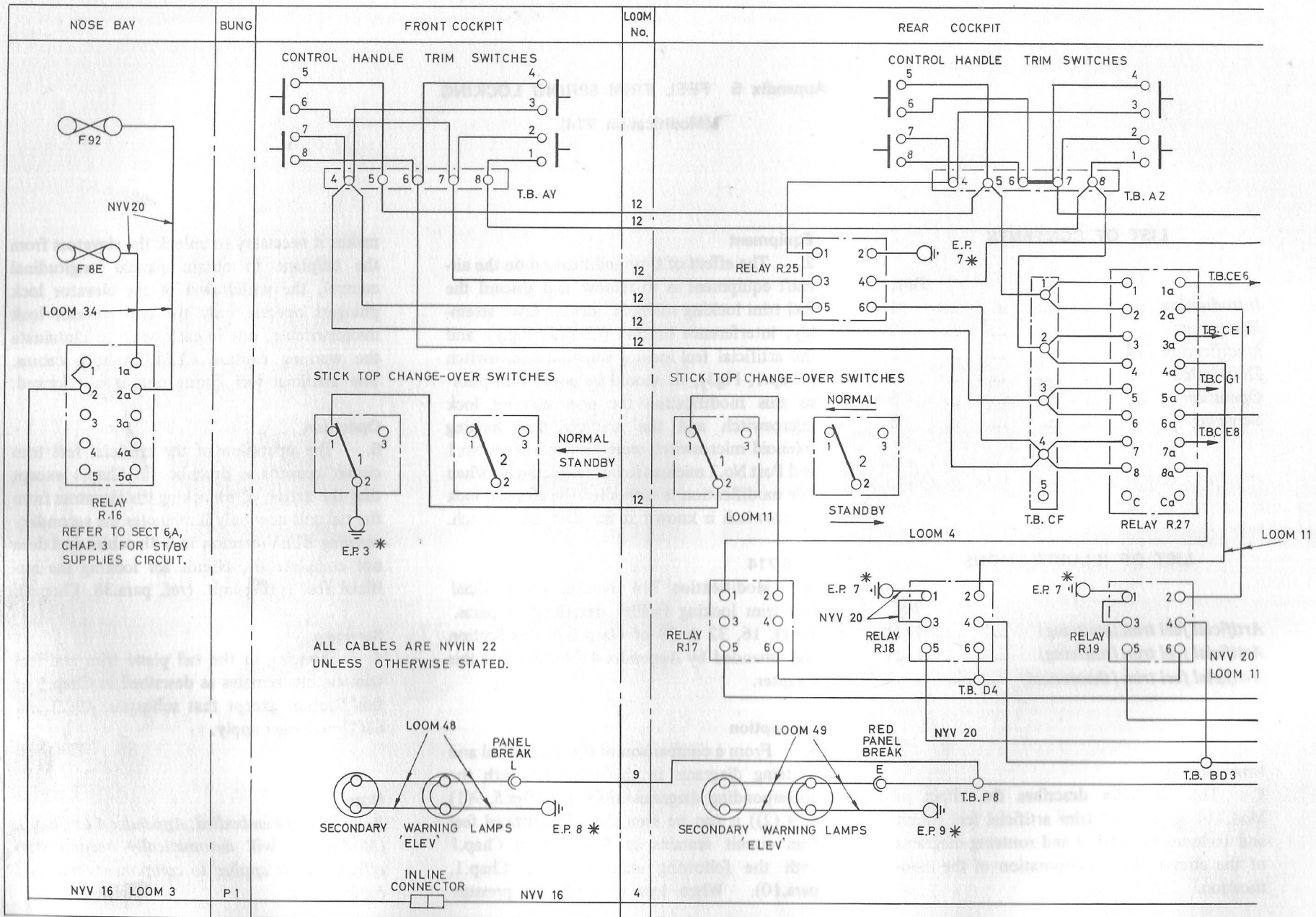


Fig.1 (1) Artificial feel trim (routeing)

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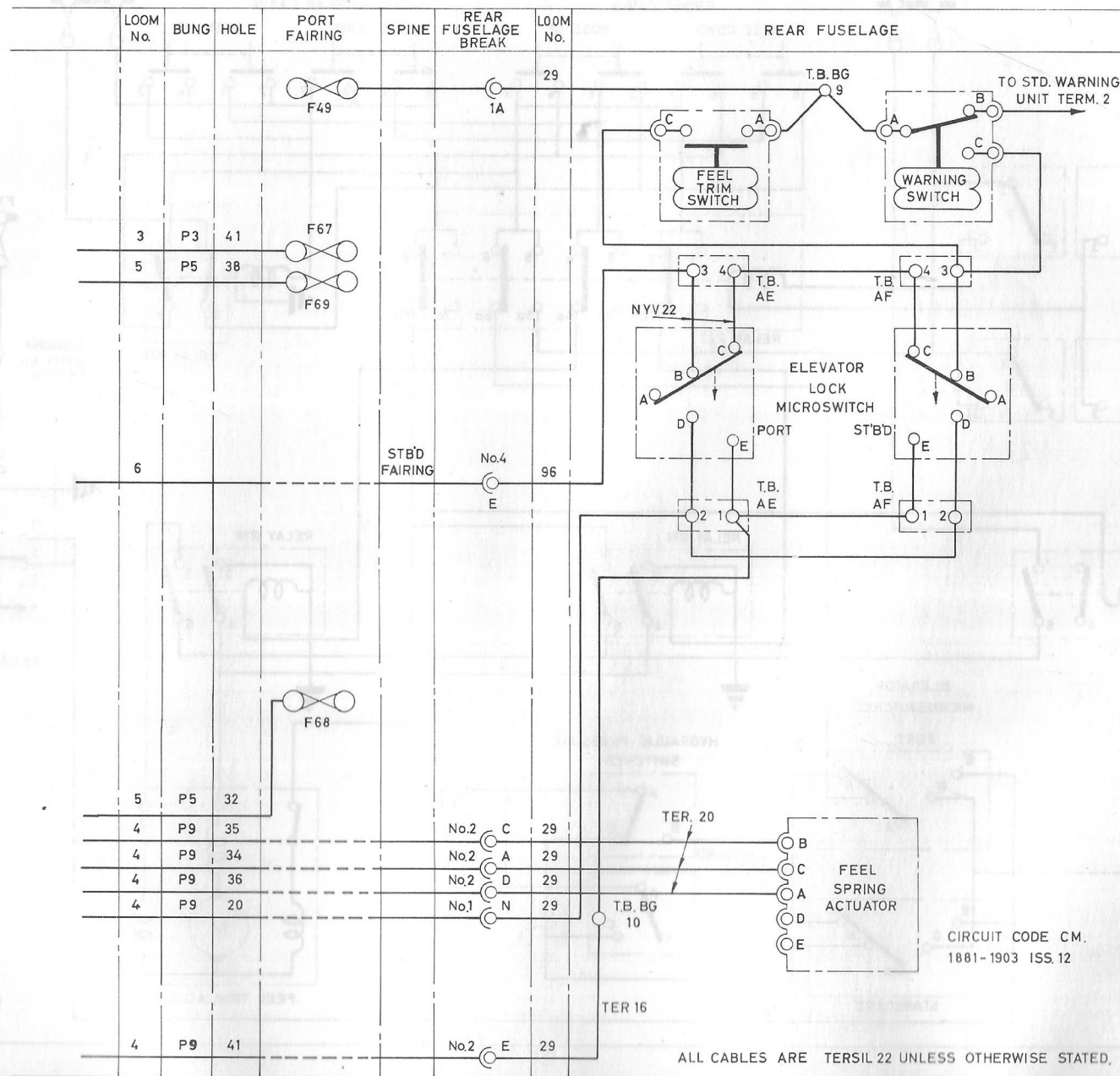
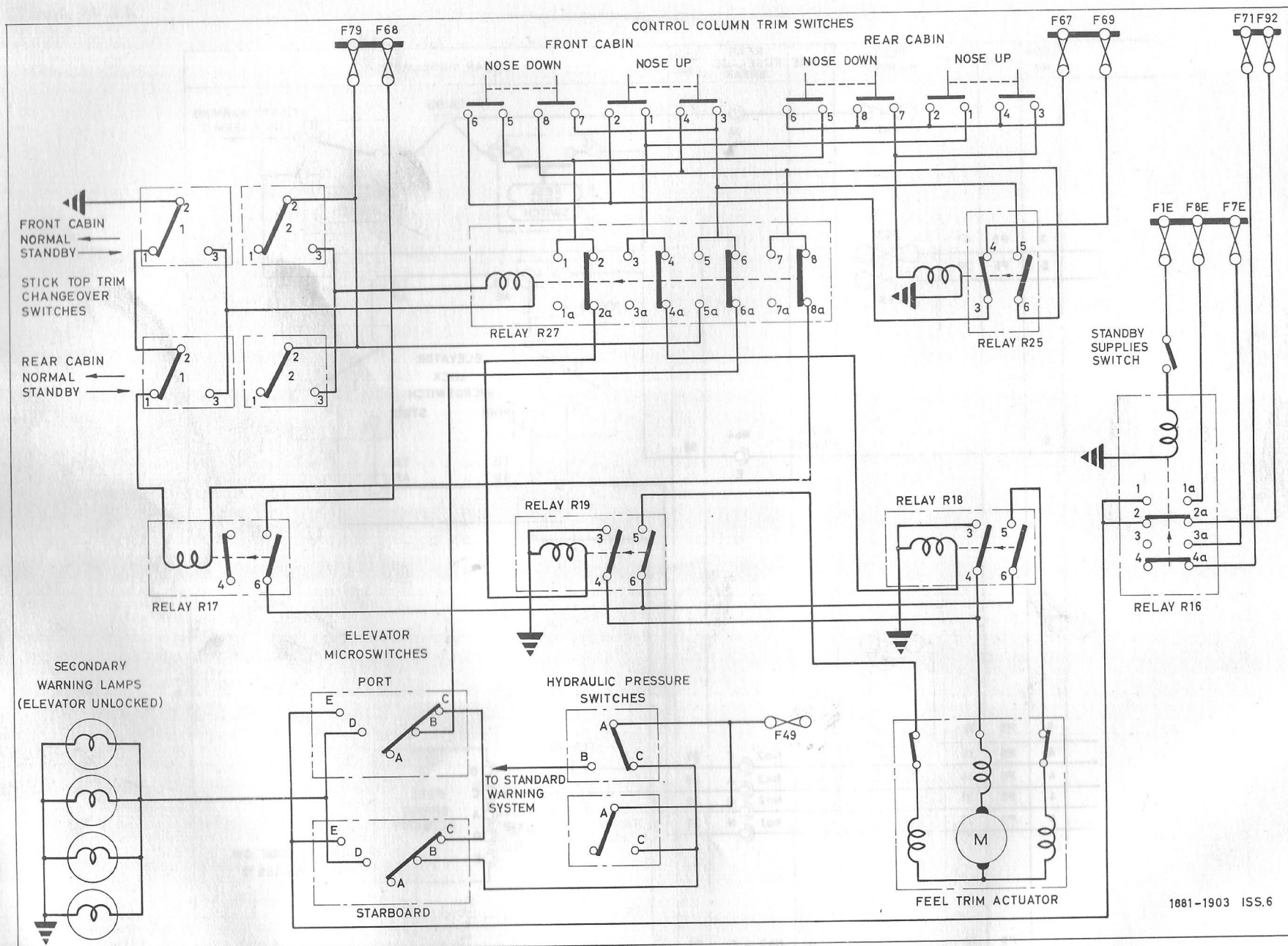


Fig.1 (2) Artificial feel trim (routing)

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Fig.2 Artificial feel trim (theoretical)

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