

Group 4 FLIGHT CONTROLS**LIST OF CONTENTS**

DESCRIPTION AND OPERATION	<i>Para.</i>	<i>Elevator trim control</i>	<i>Para.</i>	<i>Air brake control</i>	<i>Para.</i>
<i>Introduction</i>	1	<i>Pre-Mod. 2143</i>	65	<i>Tailplane incidence control</i>	
<i>Flap control</i>	2	<i>Post Mod. 2143</i>	69	<i>Pre-Mod. 2123</i>	79
<i>Air brake control</i>	20	<i>Elevator trim indicator</i>	70	<i>Post Mods. 2123 and 2353</i>	79A
<i>Tailplane incidence control</i>	30	❖		<i>Aileron trim control</i>	80
<i>Pre-Mod. 2123</i>	31	SERVICING		<i>Rudder trim control</i>	81
<i>Post Mod. 2123 pre-Mod. 2353</i>	44	<i>Introduction</i>	74	<i>Elevator trim control</i>	82
<i>Post Mod. 2353</i>	60	<i>Ground operational limits</i>	75	<i>Elevator trim indicator</i>	83
<i>Aileron trim control</i>	61	<i>Flap main control</i>	76	<i>Periodic checks</i>	84
<i>Rudder trim control</i>	63	<i>Flap control emergency</i>	77	<i>Average times for operations on the ground</i>	85

LIST OF ILLUSTRATIONS

Schematic diagrams	<i>Fig.</i>	<i>Trim tab control</i>	<i>Fig.</i>	<i>Tailplane incidence control (post Mod. 2123 pre-Mod. 2353)</i>	<i>Fig.</i>
<i>Flap control</i>	1	<i>Elevator trim indicator</i>	7	<i>Tailplane incidence control (post Mod. 2353)</i>	12
<i>Air brake control</i>	2	Routeing diagrams		<i>Rudder and aileron trim control</i>	13
<i>Tailplane incidence control (pre-Mod. 2123)</i>	3	<i>Flap actuation</i>	8 (1) and (2)	<i>Elevator trim control (pre-Mod. 1915)</i>	14
<i>Tailplane incidence control (post Mod. 2123 pre-Mod. 2353)</i>	4	<i>Air brake control</i>	9	<i>Tailplane incidence limit switch box</i>	15
<i>Tailplane incidence control (post Mod. 2353)</i>	5	<i>Tailplane incidence control (pre-Mod. 2123)</i>	10 (1) and (2)		

RESTRICTED

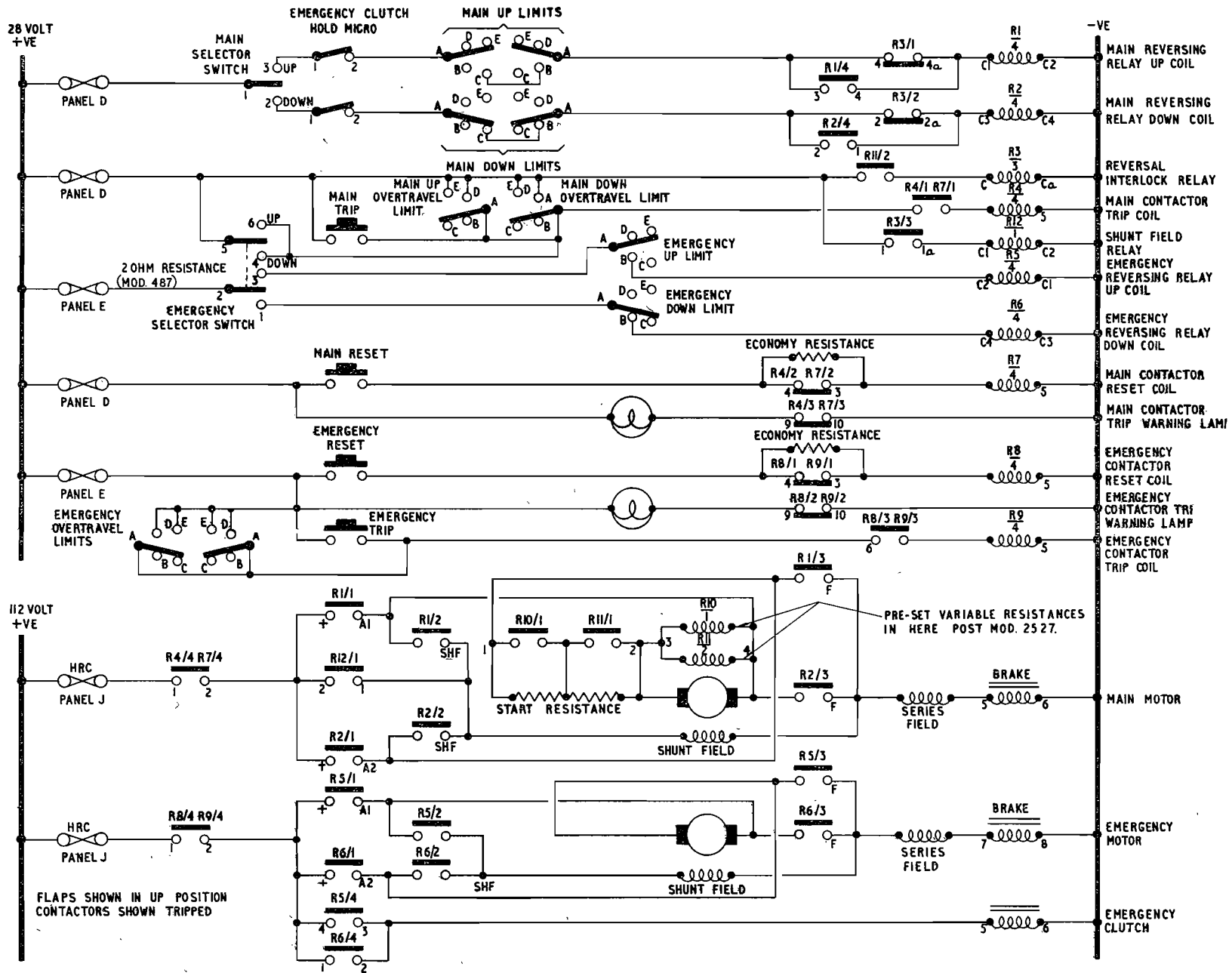


Fig. 1 Flap control

RESTRICTED

Warning

Voltages in excess of 100 volts a.c. or d.c. can be dangerous under certain circumstances. Personnel should, therefore, ensure that the electrical system is electrically safe before any servicing is attempted. Where it is essential that tests or adjustments are to be made with the electrical power switched on, the greatest care must be exercised.

DESCRIPTION AND OPERATION**Introduction**

1. Information on the layout and interpretation of the schematic wiring diagrams can be obtained from the General Information Group contained immediately after Section 5 marker page. Also to be found in the General Information Group are all the general modifications applicable to all aircraft.

Flap control (fig. 1)

2. The flaps are normally operated by a compound-wound electric motor, driving the flap torque tube through a gearbox mounted on the rear face of the rear spar. In the event of failure of the normal motor, a similar, emergency motor is used to drive the gearbox. Both motors have brake units acting on their drive shafts, the emergency motor having, in addition, a clutch which keeps it disengaged from the gearbox until such time as the motor is required for use.

Note . . .

Mod. 721 will be introduced later, to reduce the movement of the flaps when underwing nacelles are fitted. Change-over plug and sockets will be fitted to the flap gearbox; the plug being connected to the appropriate socket according to whether or not the nacelles are fitted.

3. Normal control gives 60 deg. of flap movement and is effected by means of a manually operated lever on the starboard side of the control pedestal. The lever is spring returned to the centre position and is coupled to a three-position rotary switch giving UP, DOWN and centre OFF positions. Assume the flaps to be in the up position when the down limit switches will be closed. If the selector switch is placed

to DOWN and held, a supply, from a fuse on panel D, is connected through the two closed down limit switches and the closed down emergency hold-off micro switch (all built into the gearbox) and normally closed contacts, R3/2, of the reversal interlock relay, Type S2, to the down operating coil R2 of the main reversing relay on the flap and air brake control panel.

4. The reversing relay operates:—

(1) To connect (R2/1) a 112-volt supply from a H.R.C. fuse on power panel J via the main contactor (R7/4) on the control panel, to the two stage starter resistance unit on the control panel and thence to the motor armature.

(2) To connect (R2/2) the same 112-volt supply from the main contactor to the shunt field.

(3) To connect (R2/3) the negative side of the armature through the series field to the brake and thence to the negative line.

(4) To close its contacts (R2/4) in parallel with those (R3/2) of the reversal interlock relay so that the reversing relay down coil R2 remains energized when contacts R3/2 open.

5. The motor starts to run, the brake solenoid releasing the brake the moment the motor is energized. As the motor speed increases, so does its back e.m.f. which, on attaining 40 volts, is sufficient to operate the 1st stage starting relay R11, this operates to:—

(1) Short circuit (R11/1) the 1st stage starting resistances.

(2) Connect (R11/2) a supply from panel D to the coil of the reversal interlock relay. The motor continues increasing speed and back e.m.f. and at 75 volts the 2nd stage

starting relay R10 is energized to short circuit (R10/1) the 2nd stage starting resistance and allow the motor to run on full voltage.

Note . . .

Mod. 2527 introduces a start unit Ref. No. U2303 in lieu of start unit Ref. No. 5CW/5704. Operation of the start unit and voltage values of 1st and 2nd stage resistance coils are as pre-Mod. 2527. Two pre set variable resistances are now in series with each stage operating coils. These resistances are pre-set and should not be adjusted.

6. The reversal interlock relay operates to break the lines to the main reversing relay and down coils, these contacts, R3/1 and R3/2 are in parallel with the reversing relay hold in contacts R1/4, R2/4; it also closes (R3/3) to connect a supply, from panel D, to the coil of the shunt field relay R12 which closes to connect (R12/1) the 112-volt supply from the main contactor to the shunt field, in parallel with the reversing relay field contacts.

7. The motor will continue running until either the switch is released, or the flaps reach their down limit, when the down limit micro-switches will be opened. In either case, the supply to the reversing relay down coil, R2, will be disconnected, which in turn disconnects the motor supply and de-energizes the brake solenoid. The motor field will be maintained by the shunt field relay (R12/1) until the back e.m.f. of the motor has fallen, R11 the 1st stage relay then drops out so disconnecting the shunt field relay coil R12, thus disconnecting the shunt field supply (R12/1).

8. If the switch has not been released and the motor continues to run after the flaps have reached their down limit, due to the limit switches failing or the reversing relay contacts having become welded in, an over-travel micro switch built into the gearbox will be closed to connect another 28-volt supply to the trip coil R4 of the motor contactor, via its closed reset coil contacts R7/1, thus interrupting the motor supply and lighting (R4/3) the contactor reset warning lamp, adjacent to its reset button, on the rear face of the starboard console.

9. Operation of the reset button energizes the contactor reset coil R7 at 28 volts from a fuse on starboard fuse panel E, so remaking the contacts (R7/1-4) and bringing the main flap motor and reversing relay into circuit again. This contactor can only be reset by reversing the direction of the flap travel by the emergency motor and by moving the emergency selector switch, before pressing the main contactor reset button, otherwise the contactor will only trip out again immediately. Resetting of the contactor will be indicated by the warning lamp going out.

10. When the selector switch is placed to UP, the operation will be the same as described above except that the reversing relay up coil will be energized via the closed up limit switches.

11. In the case of the pilot changing his mind when using the flaps, the reversal interlock relay stops the motor from being reversed until its back e.m.f. has fallen sufficiently to permit reversal without the risk of damage.

12. Assume that the flap motor is running to lower the flaps and it is decided to raise them, the switch is placed to UP, this breaks the supply to the main reversing relay down coil. The up coil cannot be energized because the line between the UP position of the switch and the up coil is broken by the reversal interlock relay, energized when the 1st stage starter relay R11 operated. Although the motor is disconnected by the reversing relay, its shunt field remains

energized through the contacts R12/1 of the shunt field relay, kept energized by the reversal interlock relay.

13. As the motor slows down its back e.m.f. falls. When the back e.m.f. falls to approx. 28 volts the 1st stage starter relay R11 drops out and its contacts R11/2 break the supply to the reversal interlock relay which in turn breaks (R3/3) the supply to the shunt field relay to de-energize (R12/1) the shunt field and connects (R3/1) the supply to the main reversing relay up coil R1. Thus the motor reversing relay can operate to reverse the motor and start to raise the flaps.

14. In the event of a failure of the normal motor, the emergency motor is brought into use and gives 45 deg. of flap travel. The emergency selector switch on the control pedestal is a double-pole centre-off switch with UP and DOWN positions.

15. As soon as either position is elected, one pole, supplied from panel D, is connected to the normal motor contactor trip coil R4, and the contactor is tripped out. The circuit and operation is similar to that for the normal motor but is completely independent, having its own contactor and reversing relay on the flap control panel, with reset warning lamp and reset button on the rear face of the port console.

16. The reversing relay coils are supplied from panel E through a resistance mounted in the port console, interposed (by Mod. 487) between the fuse and the selector switch; the resistance is set to 2 ohms.

17. There is only one up limit and one down limit micro switch (instead of two for the normal motor) built into the gearbox and there is one up and one down overtravel limit switch. The emergency motor is kept disengaged from the gearbox by an electro magnetic clutch until such time as the motor is energized. The operating coil of the clutch is connected to the reversing relay and operates at 112 volts. The coil is energized as soon as the reversing relay contacts R5/4 and R6/4, close.

18. When the clutch is released, it opens two micro switches which are connected in series with the normal motor selector supplies between the selector switch and the up and down limit micro switches, thus further ensuring that the normal motor cannot be operated whilst the emergency motor is running. There is no automatic reversal control when using the emergency system.

19. Both the normal and emergency system contactors may be tripped, as well as reset, from the cockpit by means of push-switches mounted on the pilot's instrument top panel.

Two Desynn indicators on the instrument centre panel show the actual position of the flaps (*Chapter 6*).

Note . . .

If the main motor has failed and the emergency system overrides, then the flaps cannot further be operated since the overtravel limit switches cannot be reset, thus keeping the contactor tripped.

Air brake control (fig. 2)

20. The air brakes are operated by a reversible compound-wound electric motor driving the air brake torque shaft through a gearbox mounted on the rear face of the rear spar. Built into the gearbox are two series connected in limit switches and two series connected out limit switches, as well as one extreme or overtravel in and out limit switch. The motor has an electro-magnetic brake unit operating on its drive shaft.

21. Control is by a 2-position rotary switch, mounted in the port side of the control pedestal and operated by a lever with two positions IN and OUT.

22. Assume the air brake to be in the in position. when the out limit switches will be closed. Then, if the selector switch is placed in the OUT position, a 28-volt supply from the starboard fuse panel D will be connected, via the out limit switches, to the out operating coil R2 of the reversing

RESTRICTED

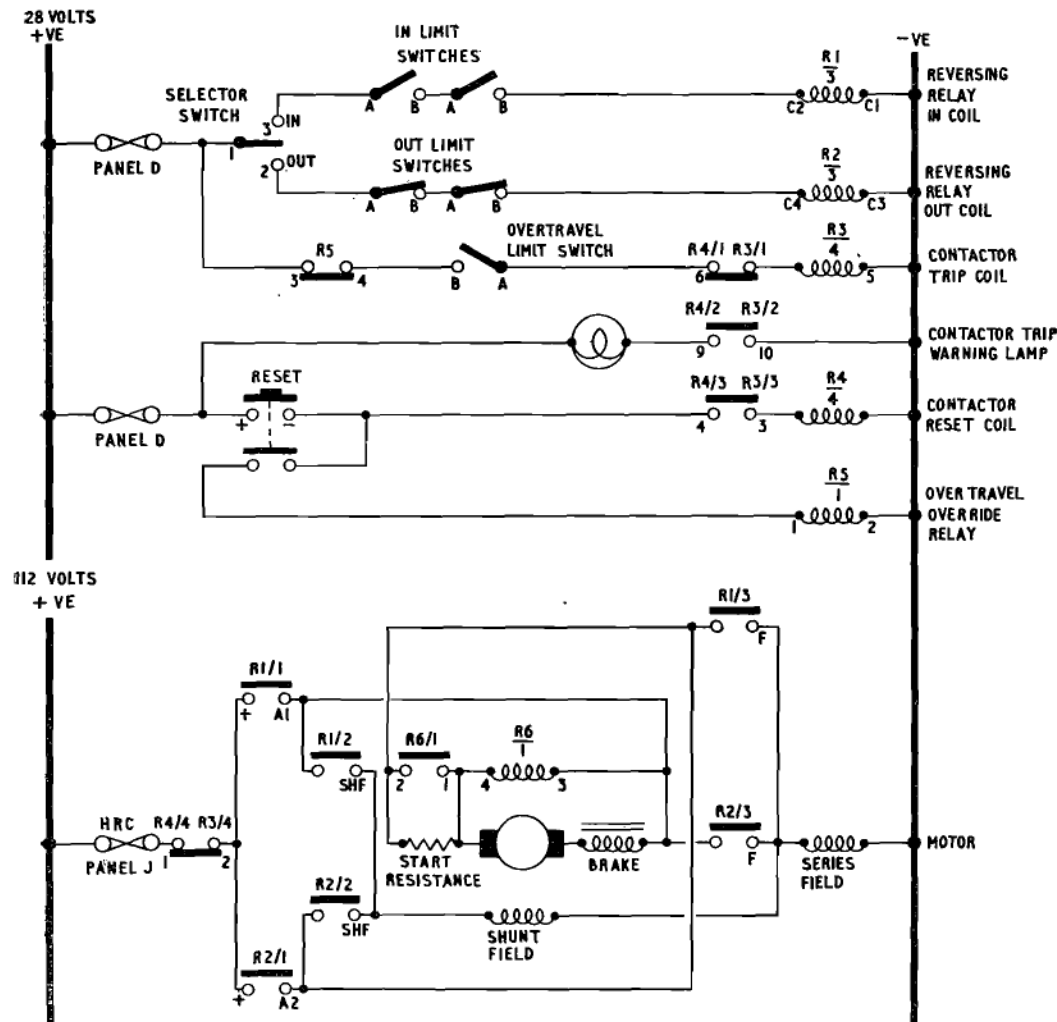


Fig. 2. Air brake control

relay, mounted on the dive brake control panel.

23. The relay out contacts R2/1-3, will be closed, connecting a supply of 112 volts from a H.R.C. fuse on power panel J, via contacts R4/4, of the main contactor on the air brake control panel, to the starter resis-

tance unit on the control panel and thence to the motor armature, the brake solenoid and to the series field, which is connected to the negative line.

24. The starter unit has a voltage sensitive relay connected across the motor armature and the brake solenoid in series, this relay

operates as the back e.m.f. of the armature builds up, due to increasing motor speed, and short circuits R6/1 the starting resistance. The brake solenoid releases the brake simultaneously with the motor starting.

25. The motor will continue to run until the air brakes are fully out when the out limit switches will be operated to disconnect the reversing relay out coil R2 from its supply, which in turn disconnects (R2/1-3) the motor from its supply and de-energizes the brake solenoid, thus applying the brake.

26. If the selector switch is now placed to the IN position, the circuit will operate as described above, except that the reversing relay "in" coil R1 will be operated via the now closed "in" limit switches, and the motor will be reversed.

27. If the motor continues to run after the air brakes have reached the limits of their travel in either direction, due to the normal limit switches failing or the reversing relay contacts having become welded in, the extreme or overtravel limit switch will be operated. This switch connects the 28-volt supply from the selector switch to the trip coil R3 of the main contactor switch via contacts R5/1 of the overtravel override relay, Type P2, on the air brake control panel. The main contactor is thus tripped and lights (R3/2) a red warning lamp mounted on the rear of the starboard console.

28. Before the reset button, on the rear of the starboard console, is pressed to reset the contactor, the air brake selector switch must be placed into its opposite position otherwise the contactor will immediately trip out again.

29. To prevent damage to the contactor if the reset button is pressed before the selector switch has been placed in its opposite position, whilst the air brakes are in the overtravel position, the overtravel override relay R5 is

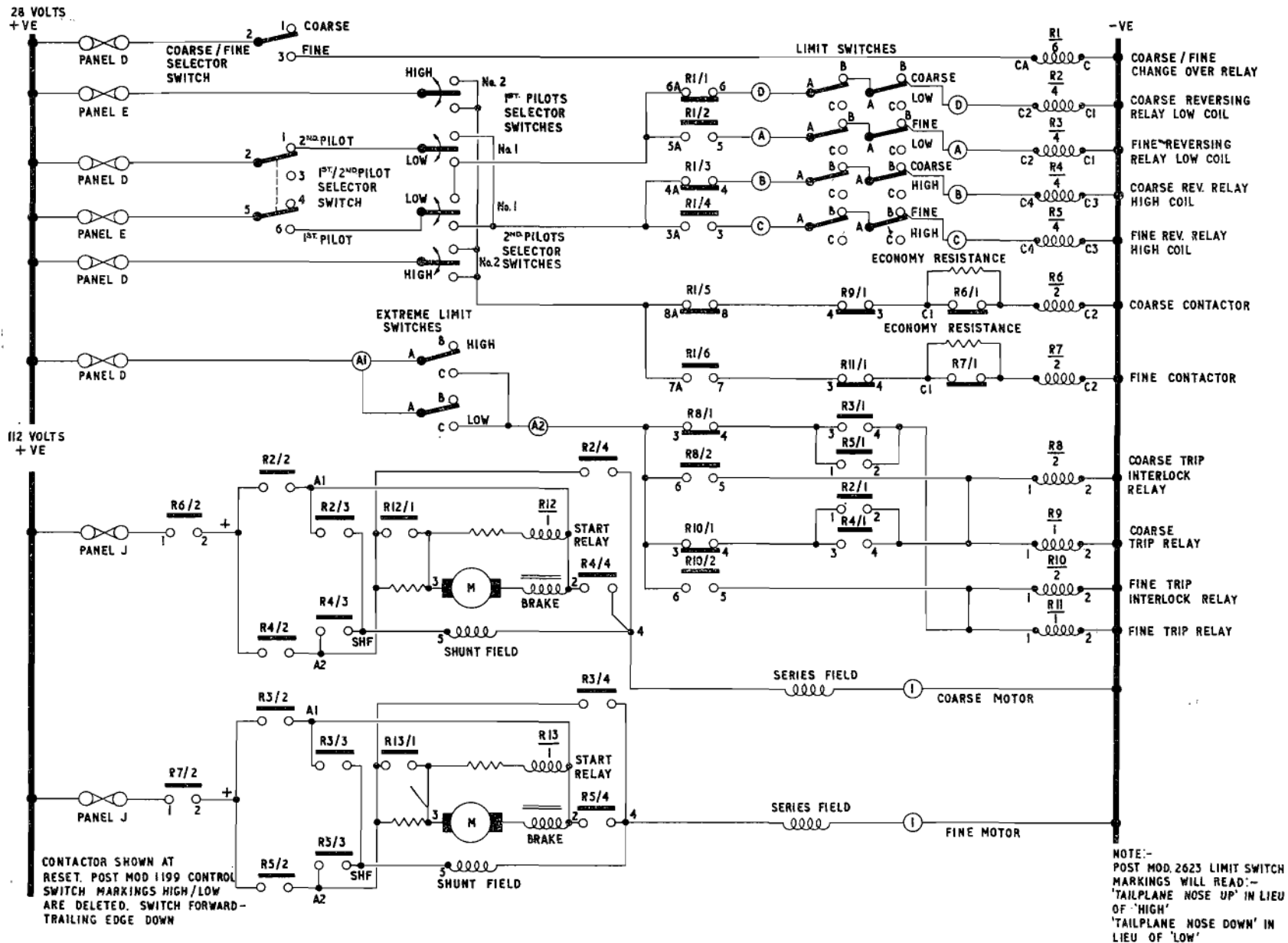


Fig. 3. Tailplane incidence control (pre-Mod. 2123)

energized, this disconnects (R5/1) the contactor trip coil R3, from its supply between the overtravel limit switch and the fuse. Thus, when resetting the contactor after the air brakes have reached the overtravel position, the selector switch must first be placed into its opposite position and then the reset button pressed and held, until sufficient time has elapsed for the motor to reverse and move the air brakes in the opposite direction, thus opening the overtravel micro switch. After this the reset button may be released and contactor will hold in.

Tailplane incidence control

Note . . .

To minimize inadvertent tripping of the main contactors, Mod. 1811 has been introduced. This removes the wiring for the overtravel limit switches from the switch box plugs and sockets and adds a 2-way connector block in lieu.

30. Mounted in the rear fuselage, at the fin rear spar bulkhead, is the tailplane incidence control gearbox. The gearbox is driven by one or other of two compound-wound electric motors provided to give coarse or fine control, each motor being fitted with an electro-magnetic brake. A switch box, mounted under the gearbox, contains coarse and fine motor tailplane nose up and tailplane nose down (high and low, pre-Mod. 2623) limit switches and overtravel limit switches. The tailplane is pivoted at its front spar. Pre-Mod. 1199 the control switches in the control handwheels are marked HIGH and LOW. When HIGH is selected on the selector switch the trailing edge of the tailplane is lowered thus giving a nose down change of trim. Post-Mod. 1199 the switch positions are unmarked and are operated in the same sense as the main elevator control. For ease of description HIGH (switch forward) and LOW (switch to rear), switch positions will be referred to in the descriptive test. Switch positions are as follows:—

Pre-Mod. 1199

HIGH (Speed)—trailing edge down—nose down trim.

LOW (Speed)—trailing edge up—nose up trim.

Post-Mod. 1199

Switch forward—trailing edge down—nose down trim.

Switch to rear—trailing edge up—nose up trim.

Pre-Mod. 2123 (fig. 3)

31. Control is by one or other of two 3-position spring-return centre off, selector switches, mounted one on each control handwheel. Switch markings HIGH and LOW are deleted by Mod. 1199. The operative switch is selected by a guarded double pole two-position 1ST PILOT/2ND PILOT, selector switch on the control pedestal. Also on the control pedestal is the guarded double pole two-position, COARSE/FINE selector switch.

32. Assume that the 1st pilot has control and that it is desired to raise the tailplane using coarse control. When the 1st pilot's selector switch is placed in the LOW (pre-Mod. 1199) position, a supply from a fuse on the starboard fuse panel D, via the 1ST PILOT/2ND PILOT selector switch, which is in the 1ST PILOT'S position, is connected to the low coil R10 of the coarse motor reversing relay, on the tail plane incidence control panel, via the coarse/fine selector switch and the closed coarse tailplane nose down (pre-Mod. 2623) low limit micro switches.

33. The relay operates and connects a 112-volt supply, from a fuse on power panel J, to the coarse motor shunt field (R10/2-3) and to the coarse motor starter resistance unit (R10/2) via the coarse motor contactor (R1/4) on power panel J.

34. From the starter resistance unit, the supply is taken to the brake solenoid, which releases the brake, and the motor armature and (R10/4) to the series field, thence to the negative line. The starter unit contains a resistance in series with the motor armature and a relay R11 which is connected in parallel with the armature and brake solenoid. The relay is operated when the back e.m.f. of the armature has risen sufficiently, due to in-

creasing speed, and short circuits (R11/1) the starting resistance, allowing the motor to operate on full voltage.

35. The motor will continue to run until the pilots' selector switch is released or the tailplane reaches its limit of travel when the tailplane nose down (pre-Mod. 2623) low limit switches will open. In either case, the supply to the reversing relay "low" coil R10 will be interrupted, disconnecting the motor from its supply and applying the brake.

36. Operation of the circuit is similar for lowering the trailing edge of the tailplane except that the raise coil R8 of the reversing relay would be energized and the motor reversed.

37. The "fine" motor has an identical system of control to that of the "coarse" motor, but is completely independent, having its own supply contactor, reversing relay and limit switches. Circuit operation is as described for the "coarse" circuit.

38. If the tailplane should continue to move after the limit of its travel has been reached, in either direction, one of the two extreme limit switches, which are connected in parallel, will be closed thus connecting a separate 28-volt supply, from a fuse on the starboard fuse panel D, to one side of the two sets of contacts, one normally open (R3/1, R5/2) and one normally closed (R3/2, R5/1) on each of the two trip interlock relays, Type Q3, mounted on the tailplane incidence control panel.

39. The coil of the trip interlock relay associated with the motor being used, is energized through the normally closed contacts of the other motor trip relay and the closed subsidiary contacts of the particular motor reversing relay. At the same time, the trip coil of the contactor for the motor is energized, thus disconnecting the motor from its supply.

40. When the interlock relay operates, it closes one set of contacts to hold itself in, and opens the other set to prevent the supply from operating the trip coil of the contactor

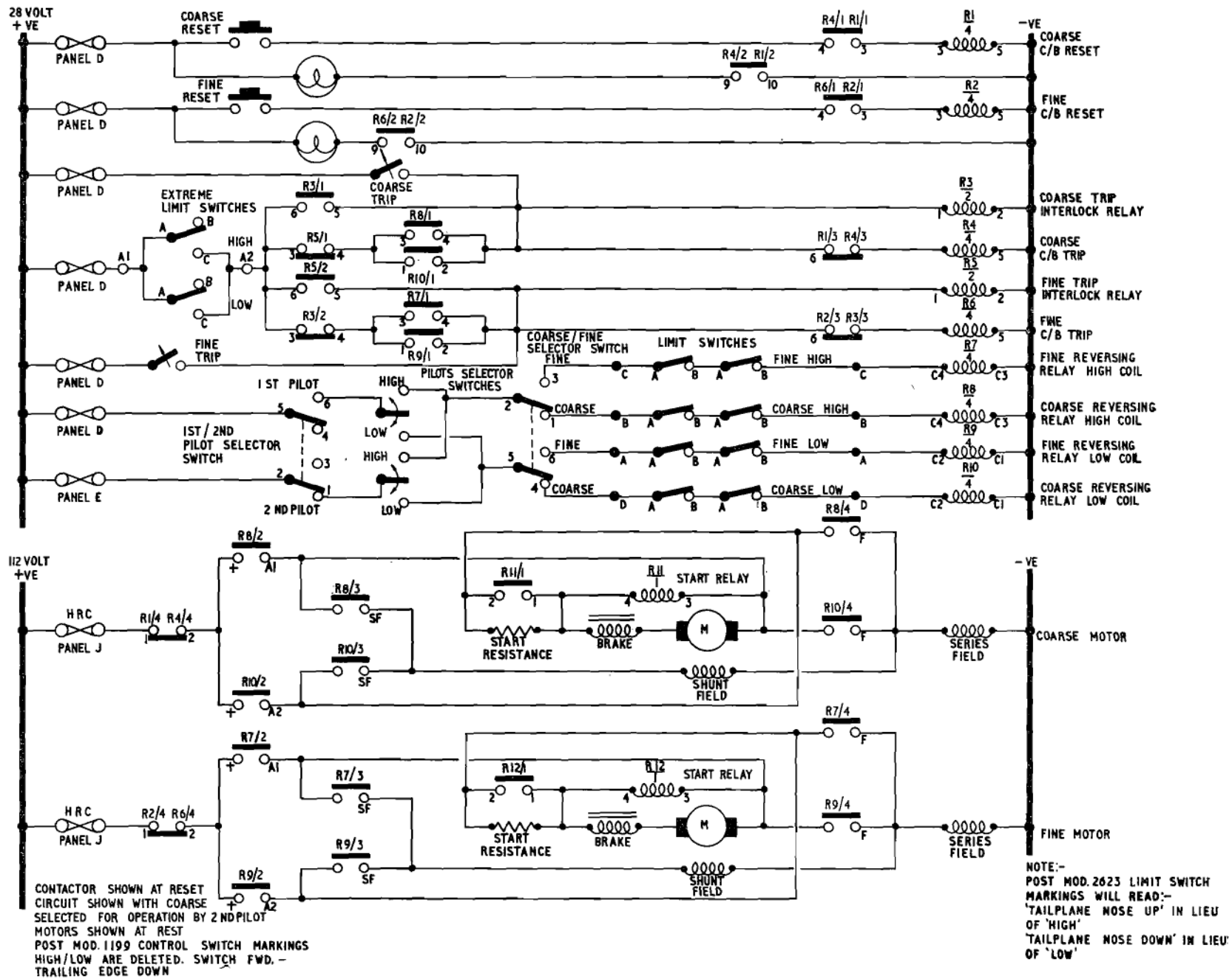


Fig. 4. Tailplane incidence control (post-Mod. 2123, pre-Mod. 2353)

RESTRICTED

for the other motor if its reversing relay should be operated. It also prevents the supply from operating the other interlock relay.

41. When the contactor for the motor concerned has tripped, a warning lamp will show red on the rear face of the starboard console. The reset switch is adjacent to the lamp but, should an attempt be made to reset the contactor whilst the tailplane is in the over-travel position, the contactor will be tripped out again immediately.

42. To bring the tailplane back to within its normal operating limits, it will be necessary to put the coarse/fine switch to its opposite position first, and then to hold the operating switch (high/low) in its opposite position, when the other motor reversing relay will operate. When the tailplane has moved sufficiently the extreme limit switch will open, the trip interlock relay will be de-energized and the tripped contactor may be reset when its warning lighting will go out.

43. On the control pedestal are two single-pole, spring off, contactor trip switches, one for each of the coarse and fine motors to provide for manual tripping if required. Position indicators are fitted to give continuous indication of the tailplane incidence (Chapter 6).

Post-Mod. 2123 pre-Mod. 2353 (fig. 4)

44. Mod. 2123 introduces main contacts Ref. No. 5CW/4388 in lieu of contactors Ref. No. 5CW/4781 and two pole switching on the pilots' handwheels together with the necessary circuit alterations to suit. Reset and trip switches are no longer provided.

Note . . .

Although the two switches on the pilots' handwheels are operated simultaneously they are not strapped.

45. Control is by one or other of a pair of 3-position switches, spring returned to the central position. Two switches are on each

control handwheel. Switch markings HIGH and LOW are deleted by Mod. 1199. The operative switches are selected by a guarded double pole two position, 1ST PILOT/2ND PILOT, selector switch on the control pedestal. Also on the control pedestal is the guarded double pole, two position, COARSE/FINE selector switch.

46. Assume that the 1st pilot has control and that it is desired to raise the tailplane using coarse control. When the 1st pilot's selector switches are placed to LOW (pre-Mod. 1199) a supply from panel E, is connected by switch No. 2 through the normally closed contacts R1/5 of the coarse/fine change-over relay, Type S4, on panel H and the closed contact R9/1 of the coarse trip relay, Type Q3, on panel H to the coil R6 of the coarse contactor on panel J via its contact R6/1. The contactor operates R6/1 to introduce an economy resistance into its coil circuit and R6/2 to connect a 112-volt supply from panel J to the coarse motor reversing relay.

47. With the 1st pilot's switches at LOW (pre-Mod. 1199), a further supply from panel D, via the 1ST PILOT/2ND PILOT switch at 1ST PILOT, is connected by switch No. 1 through normally closed contacts R1/1 of the coarse/fine change-over relay and the two series coarse tailplane nose down (pre-Mod. 2623) low limit switches in the tailplane switch box to the "low" coil R2 of coarse reversing relay mounted on the tailplane incidence control panel in the rear fuselage.

48. When the reversing relay operates, the 112-volt supply from panel J, via the "coarse" contactor R6, is connected by R2/2 to the coarse motor brake solenoid and motor armature, to the starting relay R12 with its series resistance and through its contacts R2/3 to the motor shunt field. Contact R2/4 closes the negative circuit from the motor armature and starting resistance through the motor series field and thence to earth.

49. The starting relay coil R12 is connected across the motor armature and is

energized, when the motor armature back e.m.f. has risen sufficiently due to increasing speed, to short circuit R12/1 the starting resistance, allowing the motor to run on full voltage.

50. The motor will continue to run until the pilots' selector switches are released or the tailplane reaches its limit of travel when the tailplane nose down (pre-Mod. 2623) low limit switches will open. In either case, the supply to the coarse reversing relay "low" coil R2 will be interrupted, disconnecting the motor from its supply and applying the brake. When the pilots' selector switches are released, the 28-volt supply to the coarse contactor R6 is interrupted and the contactor trips.

51. Operation of the circuit is similar for lowering the trailing edge of the tailplane except that the "high" coil R4 of the reversing relay is energized via the coarse tailplane nose up (pre-Mod. 2623) "high" limit switches and the motor is reversed.

52. The "fine" motor has an identical system of control to that of the coarse motor, but is completely independent. The circuit is common only at the selector switches, and has its own supply contactor, reversing relay and limit switches. Circuit operation is similar to that of the "coarse" motor. The "coarse" motor circuits are isolated, and the "fine" motor circuits are made, by the coarse/fine change-over relay which is energized by a supply from panel D when the COARSE/FINE selector switch is at FINE.

53. If the tailplane continues to move after the normal limit of its travel is reached, one of the two extreme limit switches, which are connected in parallel, will be closed, thus connecting a supply from panel D to the positive side of the contacts of the trip interlock relays, Type Q3, mounted on the tailplane incidence control panel. One contact of each relay, R8/1 and R10/1, is normally closed and the other, R8/2 and R10/2 is normally open.

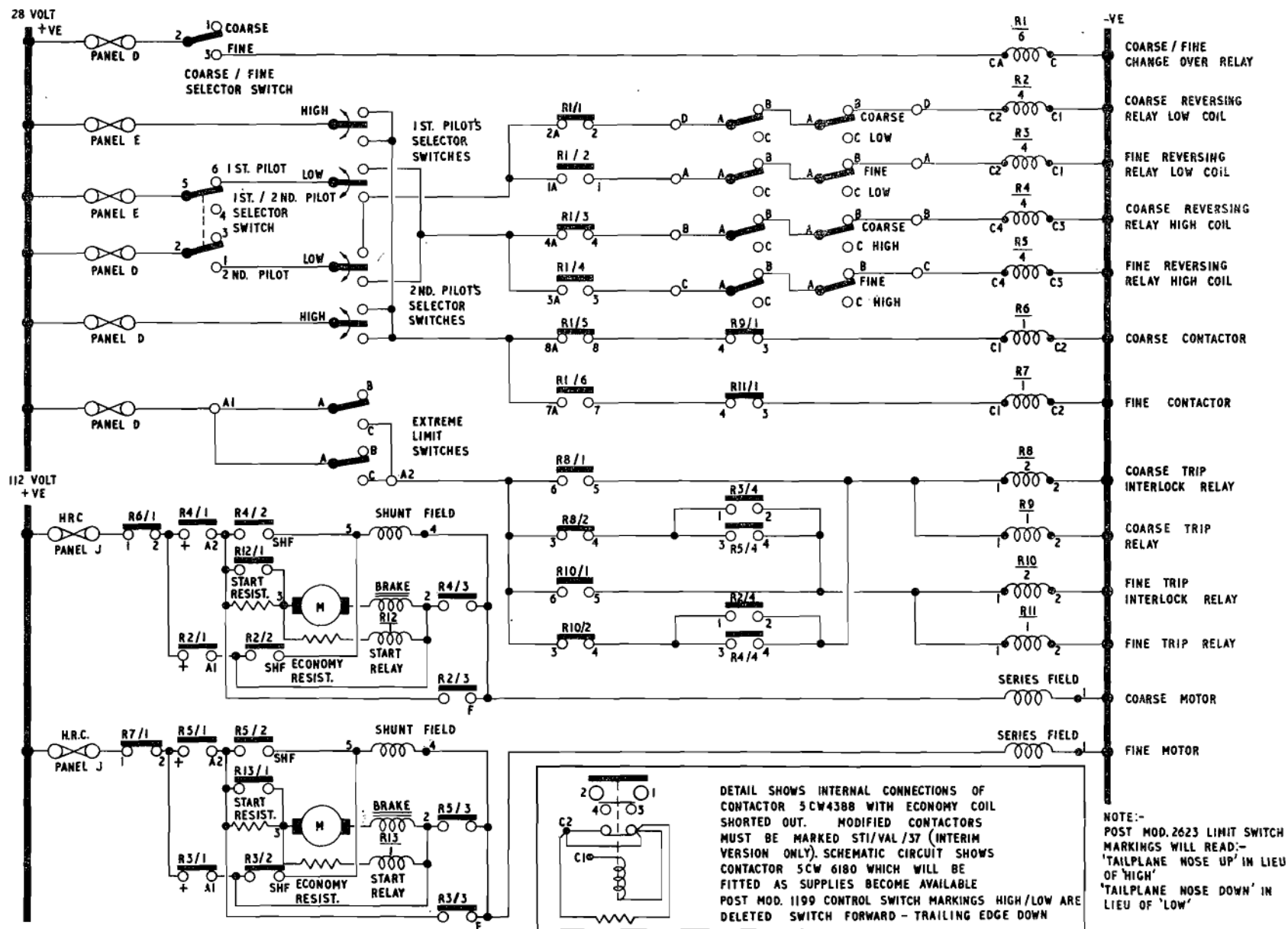


Fig. 5. Tailplane incidence control (post-Mod. 2353)

54. The coil of the trip interlock relay associated with the motor in use is energized through the normally closed contacts of the other motor trip interlock relay and the closed subsidiary contacts of the reversing relay for the motor in use. At the same time, the coil of the trip relay for the motor in use is energized, and this in turn interrupts the supply to the associated contactor coil.

55. Thus if the tailplane overruns the tailplane nose down (pre-Mod. 2623) low limit whilst running on coarse control, the tailplane nose down (pre-Mod. 2623) low extreme limit switch will connect its supply, through contact R10/1 of the fine trip interlock relay and the "low" contact R2/1 of the coarse motor reversing relay to the coil R8 of the coarse trip interlock relay and the coil R9 of the coarse trip relay, Type Q3, mounted on panel H.

56. The coarse trip interlock relay closes its contact R8/2 to connect a hold-in supply from the tailplane nose down (pre-Mod. 2623) low extreme limit switch to its coil R8 and to the coil of the trip relay R9 and opens its contact R8/1 to prevent the supply from being connected to the fine trip interlock and trip relays when the fine reversing relay is energized (R5/1) to bring the tailplane back into its operating limits.

57. The coarse trip relay opens its contact R9/1 to break the supply to the coarse contactor coil R6 which is thus de-energized to trip R6/2 the supply to the coarse motor. The contactor cannot be re-energized until the hold-in supply to the trip and trip interlock relays is broken when the tailplane nose down low extreme limit switch is opened by the tailplane being brought back into its normal operating limits.

58. To bring the tailplane back into the normal operating limits it will be necessary to select the other motor, in this case FINE, on the COARSE/FINE selector switch and then to hold the pilots' selector switches in the opposite position, in this case HIGH (pre-Mod. 1199). The tailplane will then come back into

its operating limits, in this case under fine control. When the tailplane has moved sufficiently, tailplane nose down (low) the extreme limit switch will open to break the hold-in supply to the coarse trip and trip interlock relays R8 and R9. The trip relay R9 resets to allow the coarse contactor to be energized when required and the trip interlock relay R8 resets to re-connect the fine extreme trip relay circuits so that in case of over-travel the fine control system will be tripped.

Note . . .

Mod. 2358 introduces switch SP.C/O Ref. No. 5CW/6104 in lieu of Ref. No. 5CW/5850 on the pilots' handwheels.

59. A position indicator, fitted to the centre instrument panel, gives continuous indication of the tailplane incidence and is calibrated against markings on the fin above and below the tailplane (*Chapter 6*).

Post-Mod. 2353 (fig. 5)

60. Mod. 2353 introduces main contactors Ref. No. 5CW/6180 in lieu of contactors Ref. No. 5CW/4388. Type S4 relay connections 1 and 1A; 2 and 2A, are used in place of 5 and 5a; 6 and 6a. The new contactors do not incorporate an economy resistance for their operating coils. When HIGH or LOW (pre-Mod. 1199) is selected on either the 1st or 2nd pilot's selector switches a supply is taken direct from panel D or E to the coarse or fine contactor operating coils R6 and R7, via contacts R1/5 and R1/6 in the coarse/fine change over relay R1 and their respective trip relays R9 and R11. The contactors on operating make one pair of contacts only R6/1 and R7/1 and connect a 112-volt d.c. supply to their respective reversing relays. Operation of the circuit is the same as described previously for post-Mod. 2123.

Aileron trim control (fig. 6)

61. The starboard aileron has a trim tab which is operated by a split-field actuator with built-in electro-magnetic brake and limit switches. A supply of 28 volts from a fuse on the port fuse panel E, is connected through

the aileron trim master switch on the port console, to the aileron, rudder and elevator trimming switch also on the port console. Sideways movement of this switch connects the supply to the up or down field of the actuator as required.

62. The actuator will continue to move as long as the trimming switch is held in the appropriate trimming position, or until it reaches the limit of its travel when the limit switch will open, to disconnect the supply. In either case, when the supply is disconnected, the actuator brake solenoid will become de-energized and the brake applied. Actuator positions are as follows:—

Aileron down—tab up—actuator extended.

Aileron up—tab down—actuator retracted.

Actuator terminal "B"—extend field.

Actuator terminal "C"—retract field.

Note . . .

To minimize the chance of inadvertent operation of the actuator due to fault conditions, and the effect on the aircraft's flight if it should happen, STI/VALIANT/5 and Mods. 1812 and 1814 have been introduced. These replace the actuator CZ.63696 by actuator CZ.63696/A which has reduced travel, provide negative as well as positive switching at the trim switch and isolate the wiring from the wing break panel N plugs and sockets. When the trimming switch is operated, both positive and negative connections are made to the actuator. Mod. 1808 introduces a fully modified actuator CZ.63696/B in lieu of the interim actuator CZ.63696/A.

Rudder trim control (fig. 6)

63. The rudder has a trim tab controlled by a split-field actuator built into its base. The actuator has a built-in electro magnetic brake and limit switch. A supply from a fuse on the port fuse panel E, is connected through the rudder trim master switch to the aileron rudder and elevator trimming switch both on the port console. Rotary movement of this switch connects the supply to the port or starboard field of the actuator as required.

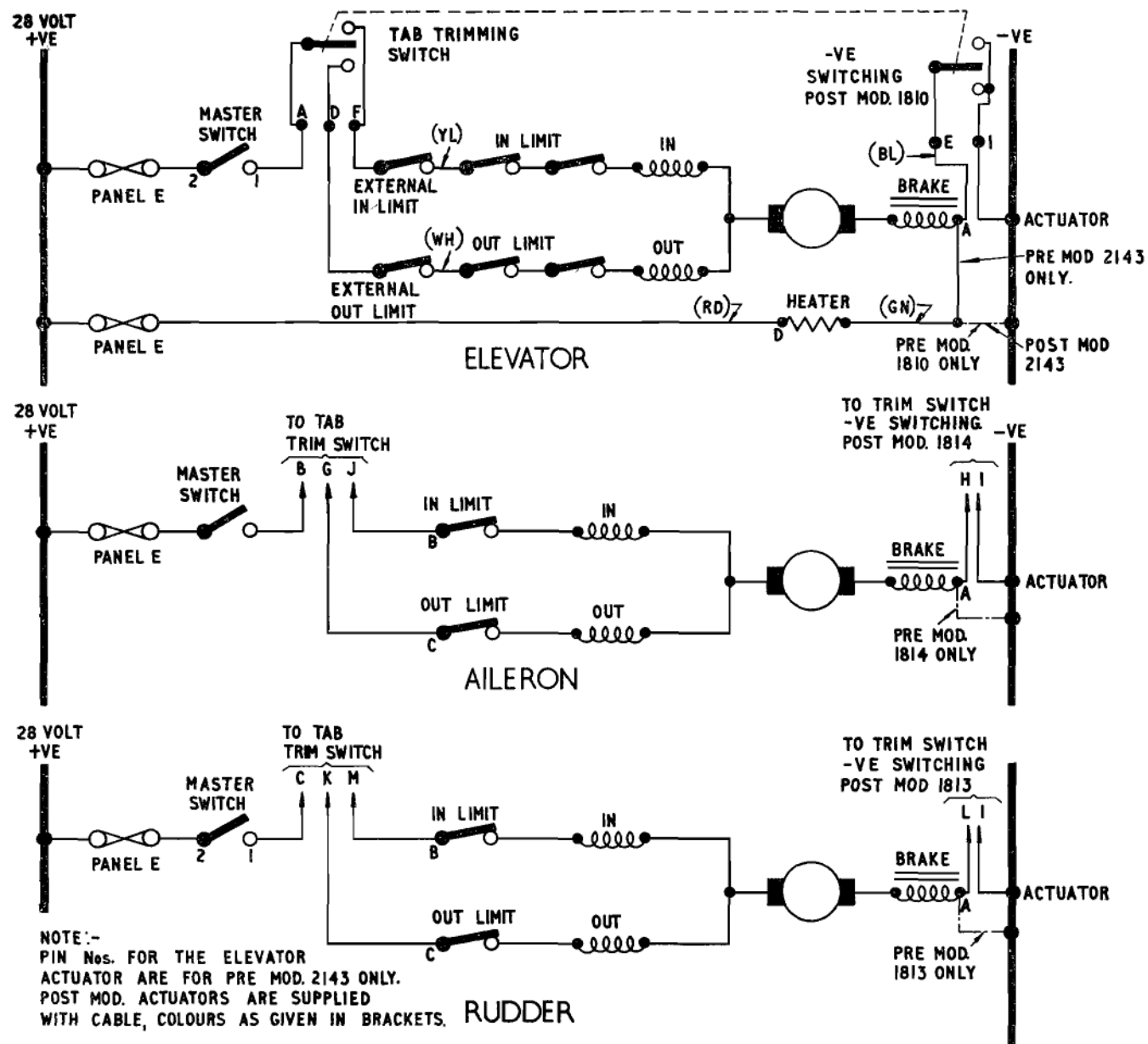


Fig. 6. Trim tab control

64. The actuator will continue to run as long as the trimming switch is held in the appropriate trimming position, or until it reaches the limit of its travel when the limit switches will open to disconnect the supply. In either case, when the supply is disconnected, the actuator brake solenoid is de-energized and the brake applied. Actuator positions are as follows:—

Rudder to port—tab to starboard—actuator extended.

Rudder to starboard—tab to port—actuator retracted.

Actuator terminal "B"—extend field.

Actuator terminal "C"—retract field.

Note . . .

To minimize the chance of inadvertent operation of the actuator due to fault conditions, and the effect on the aircraft's flight if it should happen, STI/VALIANT/6 and Mod. 1813 have been introduced. These replace the actuator CZ.64250 by actuator CZ.64250/B which has reduced travel and provides negative as well as positive switching at the trim switch. When the trimming switch is operated, both positive and negative connections are made to the actuator. Mod. 1809 introduces a fully modified actuator CZ.64250/C in lieu of the interim CZ.64250/B actuator.

Elevator trim control (fig. 6)

Pre-Mod. 2143

65. On the root rib of the starboard elevator is an electric actuator for adjusting the position of the elevator trim tab. The actuator has built-in electro-magnetic brake, heater and limit switches. There are also two limit micro switches built into the elevator structure.

66. Control is by a 2-position ON/OFF master switch and by backwards or forwards motion of the trimming switch. Both switches are mounted on the port console. That trimming is necessary and in which direction it is

to be applied is indicated by one of two amber (red, post Mod. 1174) indicating lamps on the instrument top panel; these lamps are controlled by the elevator trim indicator unit as described in para. 70 and will be fitted with night screens post Mod. 1174.

67. With the master switch in the ON position, a supply from the port fuse panel E is connected to the trimming switch. If the trimming switch is moved to the required position and held there, the supply is connected via the limit switches to the up or down field of the actuator as selected. The actuator motor armature is connected in series with the brake solenoid, so that the brake is released as soon as the supply is connected to the actuator.

68. The actuator will now move the tab in the direction selected, until either the trimming switch is released, or the tab reaches the limit of its travel when the limit switches will open, interrupting the supply to the motor and brake. The brake will be applied and the motor will stop. The internal heater element of the actuator is connected to the supply via a fuse on the port fuse panel E.

Note . . .

To minimize the chance of inadvertent operation of the actuator Mod. 1810 has been introduced. This provides negative as well as positive switching at the trim switch so that when the switch is operated both positive and negative connections are made to the actuator. Mod. 2081 alters the external limit switches so that the tab movement is restricted to 9 deg. up and 2 deg. down.

Post Mod. 2143 (fig. 6)

69. Mod. 2143 introduces actuator Ref. No. 5W/2666 in lieu of actuator Ref. No. 5W/293 and also provides for the heater negative to be taken direct to earth and not through the trim switch. The operation of the actuator circuit remains the same as pre-Mod. 2143.

Elevator trim indicator (fig. 7)

70. This is provided to enable the pilot to keep the elevator trimmed whilst flying with power controls so that in the event of sudden reversion to manual control there will be no excessive forces applied via the elevator to the control wheel.

71. The elevator trim indicator unit is built into the triangulated control lever joining the elevator control rod to the elevator power control unit. When a force of 15 to 17 lb. is applied to the unit in either direction, due to up or down out of trim forces on the elevator, one of two sets of contacts in the unit are closed to connect a supply from a fuse on the port fuse panel E, to the operating coil of the appropriate one of two Type Q1 relays mounted on panel W.

72. The relay closes and connects a supply, from the same fuse, to its associated indicator lamp on the pilots' instrument top panel, indicating that trimming of the elevator is necessary and in which direction it is required.

73. At the same time the supply is connected by the relay to the two series-connected hold-in coils of the trim unit. These hold-in coils act as a damper to the trim unit, ensuring that the indicator lamp will not flash on and off due to slight fluctuations of the out of trim load on the elevator. When, owing to the adjustment of the trim tab by the pilot, the out of trim force applied to the trim indicator unit has fallen to 3 to 5 lb. the contacts in the unit are broken, the indicator lamp goes out and the hold-in coils are de-energized. These lamps will be fitted with night screens post Mod. 1174.

73A and 73B ◀▶

SERVICING

Introduction

74. The General Information Group, contained in Book 2 immediately after Section 5 marker card, gives a detailed description of the general tests to be applied to all aircraft

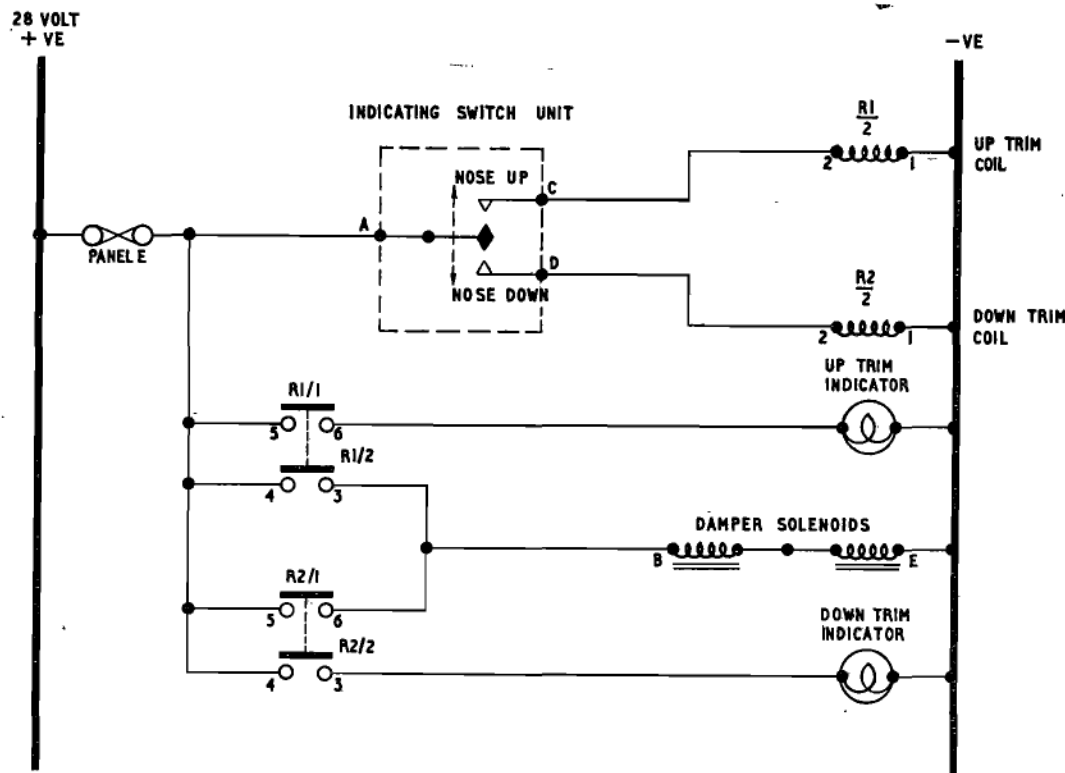


Fig. 7 Elevator trim indicator

circuits and the procedure to be adopted when servicing special circuits.

Ground operational limits

75. To prevent damaging the flap, air brake and tailplane incidence motors by overheating whilst they are being serviced on the ground, it is essential that they are not operated longer than the limits given below:—

Flap main motor

Series of three operations with five minutes between each operation.

30 minutes between series.

Flap emergency motor

One cycle every hour.

Air brake motor

Series of five cycles with two minute intervals between each cycle.

30 minutes between series.

Tailplane incidence motors

No limit to the number of operations in three minutes.

30 minutes between each three-minute period.

Flap main control

Note . . .

For setting instructions for the flap gearbox micro-switches, refer to Book 1, Sect. 3, Chap. 14.

76. (1) Check the circuit fuses and connect 28-volt and 112-volt d.c. supplies to the external connections.

(2) Operate the main contactor trip push button and see that the contactor trip warning lamp comes on.

(3) Operate the reset push and see that the warning lamp goes out.

(4) Select the main selector switch to DOWN and check that the flaps have moved to the down position. Also see that the pilots' indicator reads flaps down.

(5) Select the main selector switch to UP. Check that the flaps have moved to the up position and that the pilots' indicator reads flaps up.

(6) Disconnect the 9-pin socket at the flap gearbox and bridge pins 1 and 2 with a suitable piece of wire. Check that the contactor tripped warning lamp comes on.

(7) Remove the bridge. Reconnect the 9-pin socket and reset the contactor. Return all switches to OFF.

Flap control emergency

Note . . .

For setting instructions for the flap gearbox micro-switches, refer to Book 1, Sect. 3, Chap. 14.

77. (1) Operate the emergency contactor trip push button and see that the contactor trip warning lamp comes on.

(2) Reset the emergency contactor and check that the warning lamp goes out.

(3) Operate the emergency selector switch to DOWN. Check that the main contactor trip warning lamp comes on and remains on. Also check that the flaps have moved to the down position and the pilots' indicator reads flaps down.

(4) Operate the emergency selector switch to UP and check that the flaps have moved to the UP position and the pilots' indicator reads flaps up.

(5) Disconnect the 2-pin socket at the flap gearbox and bridge pins A and B with a suitable piece of wire. Check that the contactor tripped warning lamp comes on.

(6) Reconnect the 2-pin socket. Reset the emergency contactor and return all switches to OFF.

Air brake control

Note . . .

For setting instructions for the flap gearbox micro-switches, refer to Book 1, Sect. 3, Chap. 15.

78. (1) Check all circuit fuses and connect 28-volt and 112-volt d.c. supplies to the external connections.

(2) Bridge terminals A and B on the over travel micro switch and see that the contactor trip warning lamp comes on and stays on when the bridge is removed.

(3) Operate the reset push and see that the warning lamp goes out.

(4) Operate the selector switch to OUT and check that the air brakes have moved to the out position and that the pilots' indicator reads OUT.

(5) Operate the selector switch to IN and check that the air brakes have moved to the in position, and the pilots' indicator reads IN.

Tailplane incidence control

Pre-Mod. 2123

Note . . .

For setting instructions for the limit micro-switches in the T.P.1 switch box, refer to Book 1, Sect. 3, Chap. 4.

79. (1) Check all circuit fuses and connect 28-volt and 112-volt d.c. supplies to the external connections.

(2) Operate the FINE and COARSE reset switches and see that the warning lamps come on.

(3) Operate the FINE and COARSE reset pushes and see that the lamps go out.

(4) Bridge terminals A1 and A2 on the tailplane incidence switch box with a suitable piece of wire.

(5) Select to 1ST PILOT, 1st pilot's selector switch to HIGH (pre-Mod. 1199) forward (post Mod. 1199) and COARSE and check that the tailplane does not operate and the coarse warning lamp comes on.

(6) Select the 1st pilot's selector switch to LOW (pre-Mod. 1199) back (post Mod. 1199) and FINE. Check that the tailplane does not operate and the fine warning lamp comes on.

(7) Reset the circuit breakers.

(8) Repeat items 5 and 6 for the 2ND PILOT.

(9) Remove the bridge from terminals A1 and A2 and reset the circuit breakers.

(10) Select 1ST PILOT and COARSE. Select the 1st pilot's selector switch to HIGH then LOW (pre-Mod. 1199) forward then back (post Mod. 1199). Check that the tailplane moves to the correct position. Switch HIGH or forward, tailplane trailing edge is lowered.

(11) Select 1ST PILOT and FINE. Select the 1st pilot's selector switch to HIGH then LOW (pre-Mod. 1199) forward then back (post Mod. 1199). Check that the tailplane moves to the correct position. Switch HIGH or forward, tailplane trailing edge is lowered.

*A.P.4377A, Vol. 1, Book 2, Sect. 5, Chap. 2, Group 4
A.L.67, June 61*

(12) Repeat items 10 and 11 for the 2ND PILOT.

(13) Check that movement of the tailplane ceases when the pilots' selector switch is released.

The tailplane positions are as follows:—

HIGH (pre-Mod. 1199)—Tailplane trailing edge DOWN.

Switch forward (post Mod. 1199)—Tailplane trailing edge DOWN.

LOW (pre-Mod. 1199)—Tailplane trailing edge UP.

Switch back (post Mod. 1199)—Tailplane trailing edge UP.

Post Mods. 2123 and 2353

79A. Post Mod. 2123 there are no trip switches, reset switches or warning lamps provided in the circuit. Circuit checks for post Mod. 2123 are as above except that items 2, 3 and 7 do not apply. Post Mod. 2353 circuit checks are the same as for post Mod. 2123.

Aileron trim control

80. (1) Check the circuit fuses and connect a 28-volt d.c. supply to the external connection.

(2) Operate the aileron master switch to ON.

(3) Move the rudder, elevator and aileron trimming switch to the left, and check that the aileron trim tab has moved up the UP position.

(4) Move the trimming switch to the right, and check that the aileron trim tab has moved to the DOWN position.

(5) Return all switches to OFF.

Rudder trim control

81. Operations are the same as for aileron trim control except that the trimming switch

is moved in a rotary direction.

- Clockwise —trim tab LEFT.
- Anti-clockwise —trim tab RIGHT.

Elevator trim control

82. Operations are the same as for the rudder and aileron except that the trimming switch is moved in a fore and aft direction. Also check that the heater built into the actuator heats up.

- Switch forward —trim tab UP.
- Switch to rear —trim tab DOWN.

Note . . .

For setting instructions for the overtravel limit micro-switches, refer to Book 1, Sect. 3, Chap. 4.

Elevator trim indicator

83. (1) Check the circuit fuses and connect a 28-volt d.c. supply to the external connection.

(2) With control locks engaged, gently pull the elevator control and see that the nose up indicator lamp lights.

(3) With control locks engaged, gently push the elevator control and see that the nose up lamp goes out and the nose down lamp lights.

(4) Check there are no lights where the elevator control is in neutral.

Note . . .

For setting up the indicating switch unit to correspond with the required loads on the elevator, refer to Book 1, Sect. 3, Chap. 4.

Periodic checks

84. It is essential that periodic checks be carried out on the commutators of the flight control motors consisting of:—

- (1) Remove the commutator end cover.
- (2) Check that the commutator is clean and not pitted.
- (3) Check that there is no excessive play between the brushes and their holders.
- (4) Check the length of the brushes.

Minimum brush lengths

Tailplane incidence	0.44 in.
Elevator trim tab	0.25 in.
Flap main	0.55 in.
Flap emergency	0.50 in.
Air brake	0.50 in.

Average times for operations on the ground

85. Flaps

Normal up	30±4 seconds
Normal down	30±4 seconds
Emergency up	7.75±1 second
Emergency down	8.5±1 second

Tailplane incidence

Coarse	24± 8 seconds
Fine	45±10 seconds

Air brakes

In	2±1 second
Out	2±1 second

Rudder trim 6±2 seconds

Elevator trim 6±2 seconds

Aileron trim 8±2 seconds

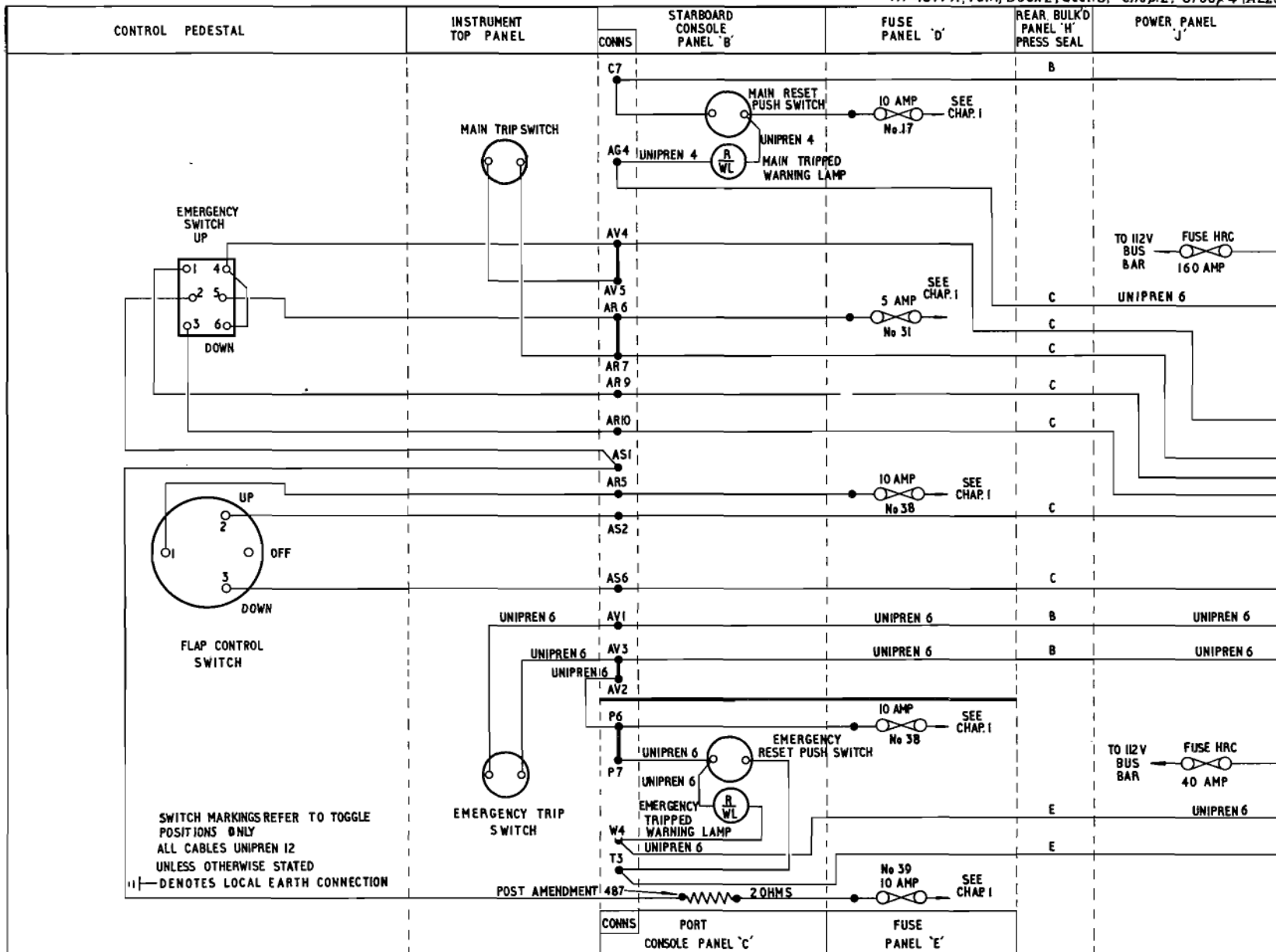


Fig.8 (I) Flap actuation.
 RESTRICTED

A.L. 28, JAN '58.)
 75836 SHT 122-D / 67484 SHT. 285-P
 67436 SHT. 122-A B

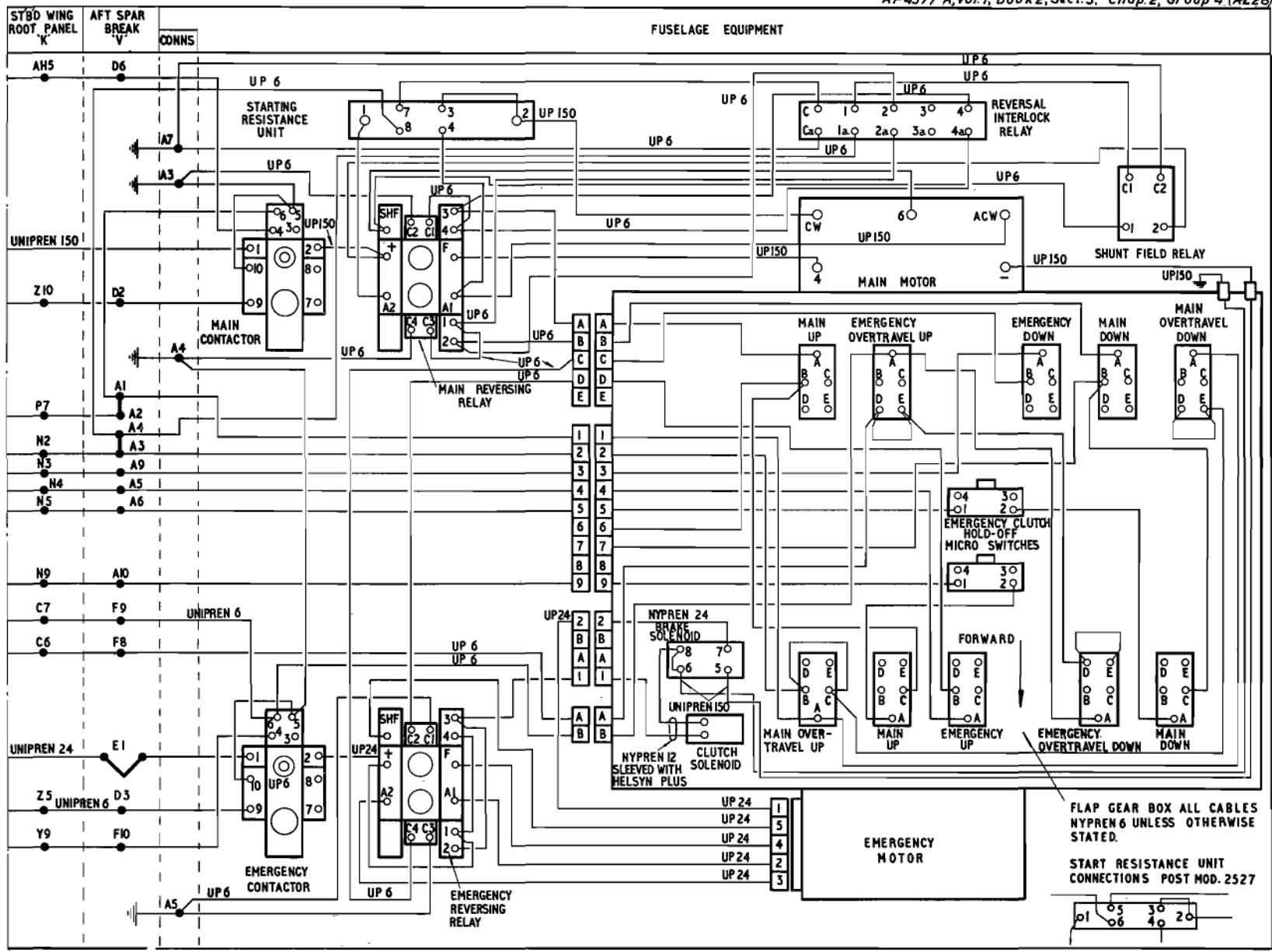


Fig.8(2) Flap actuation
RESTRICTED

(A.L. 28, JAN '58.)

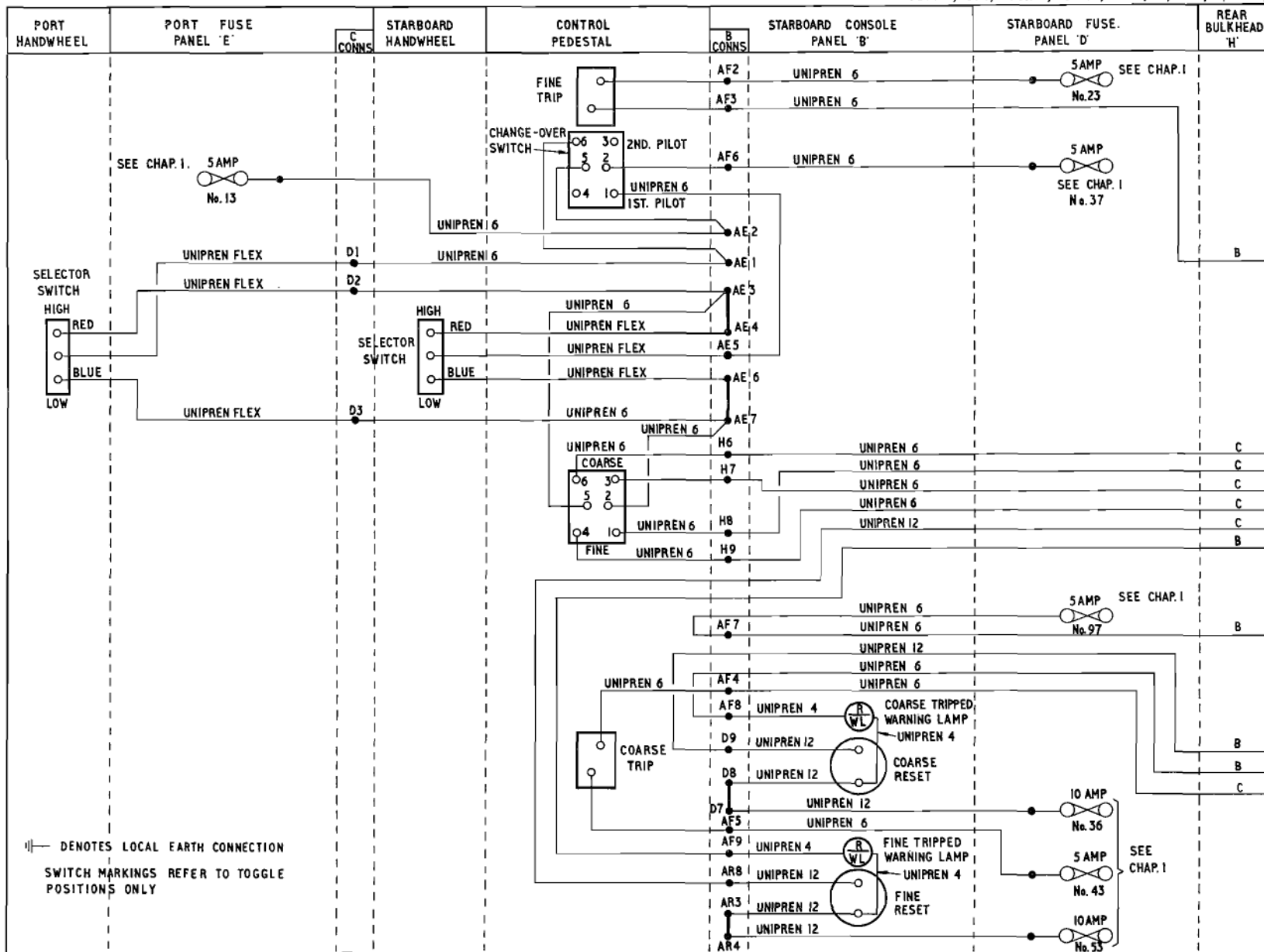


Fig. 10(1) Tailplane incidence control (pre Mod. 2123)
 RESTRICTED

(A.L. 28, JAN '58)

75836 SHT. 167-B
 67436 SHT. 167-AP

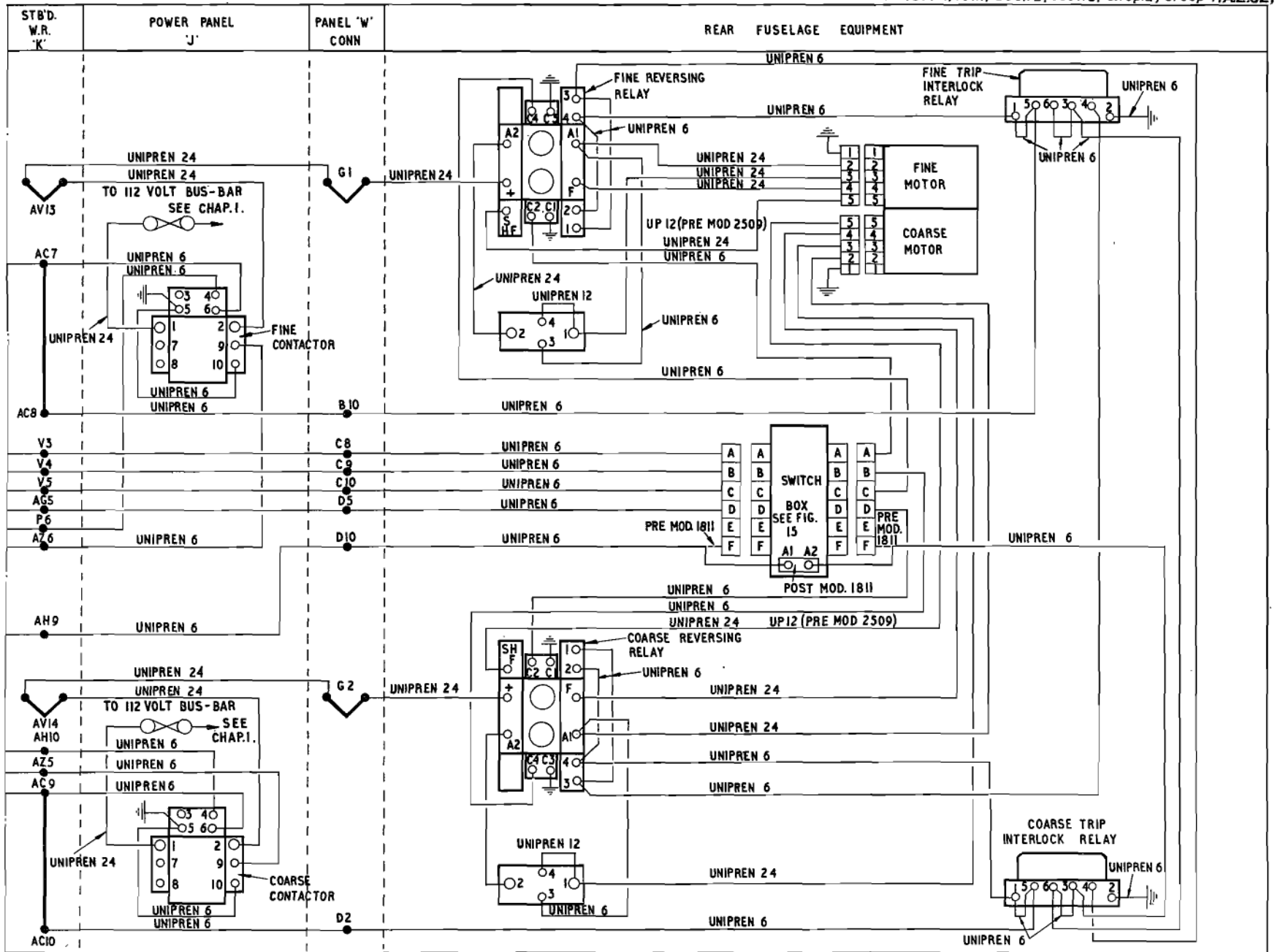


Fig. 10(2) Tailplane incidence control (pre Mod. 2123)

RESTRICTED

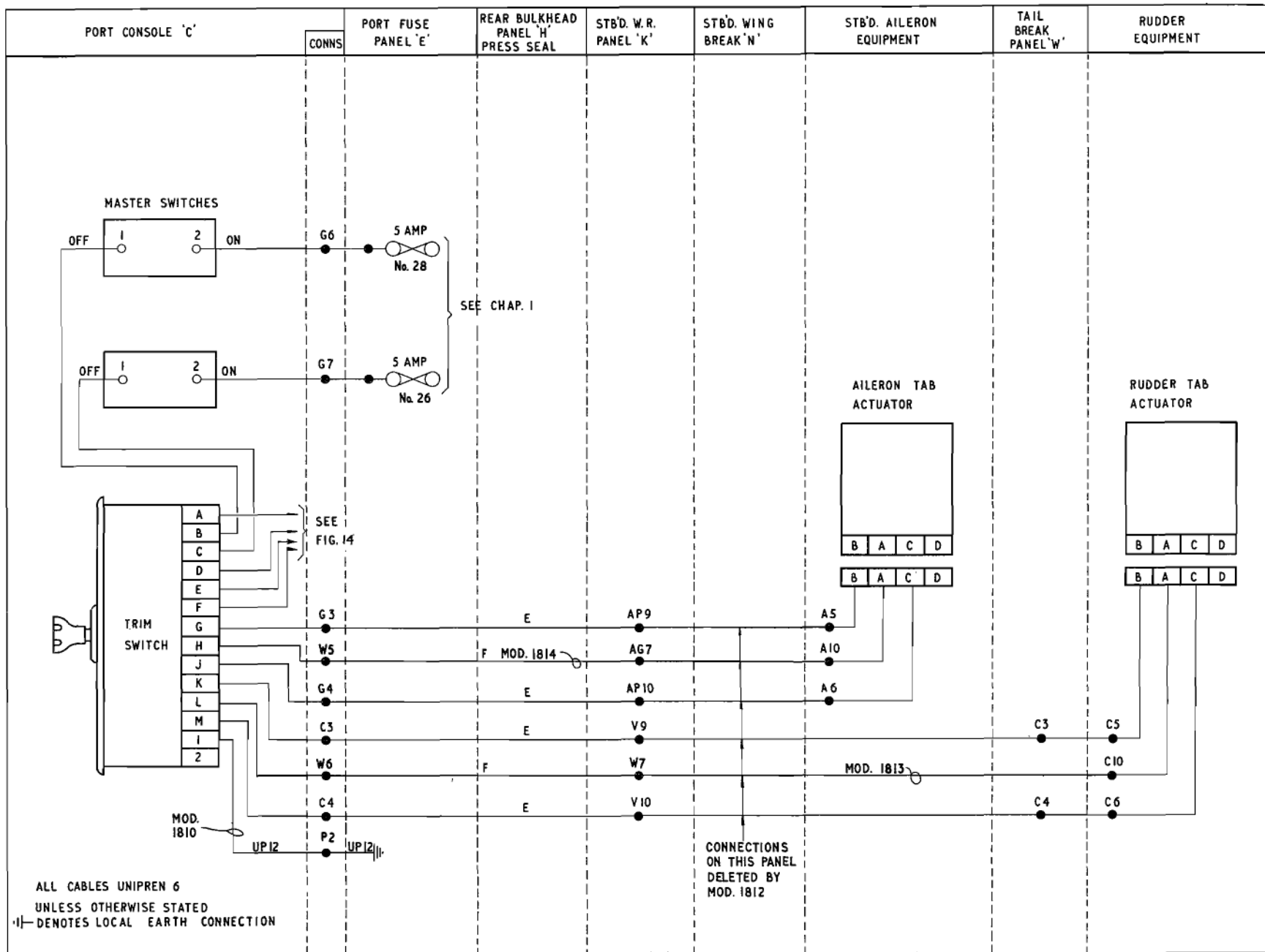


Fig. 13. Rudder and aileron trim control
RESTRICTED

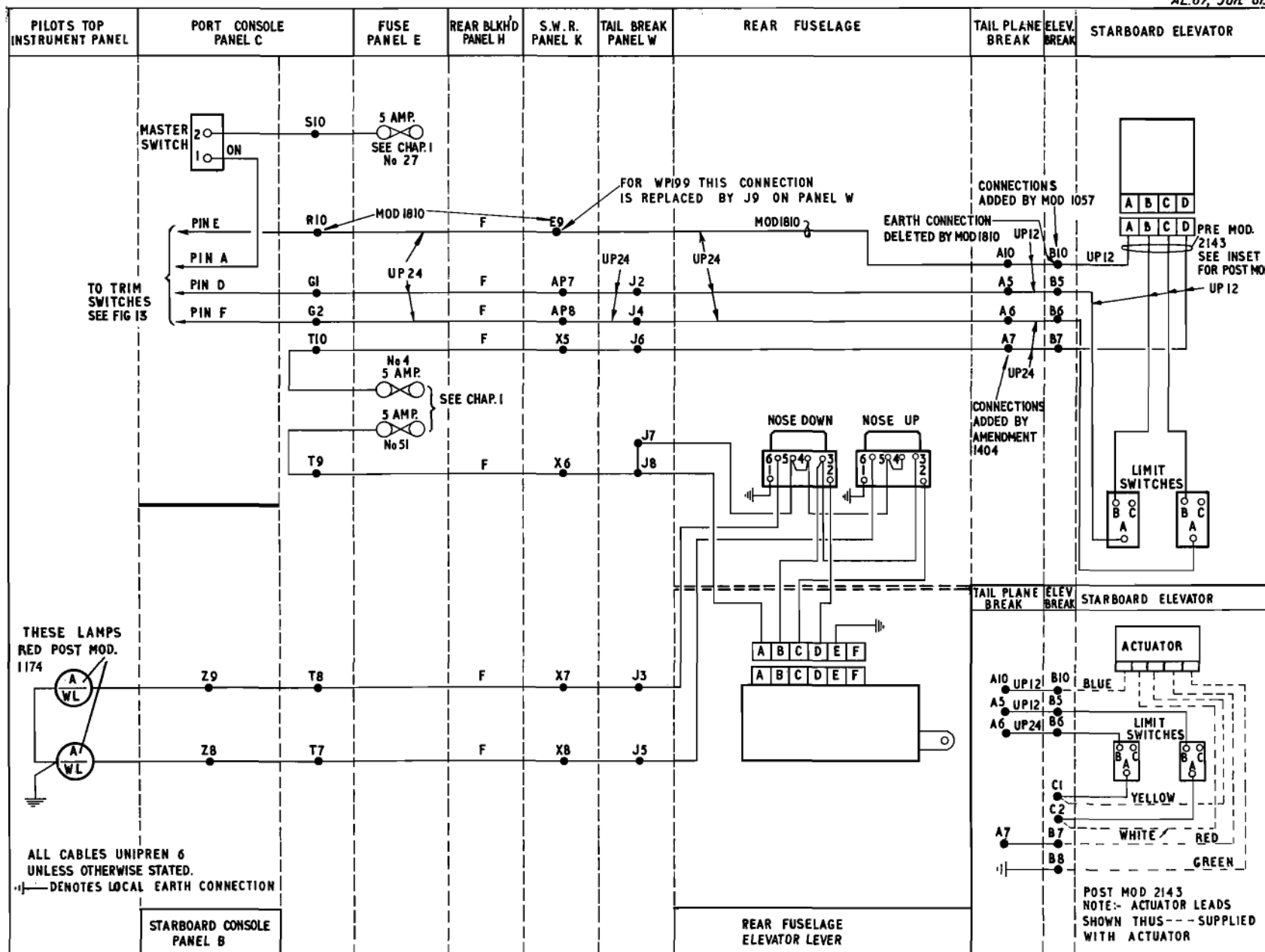


Fig.14. Elevator trim control
RESTRICTED

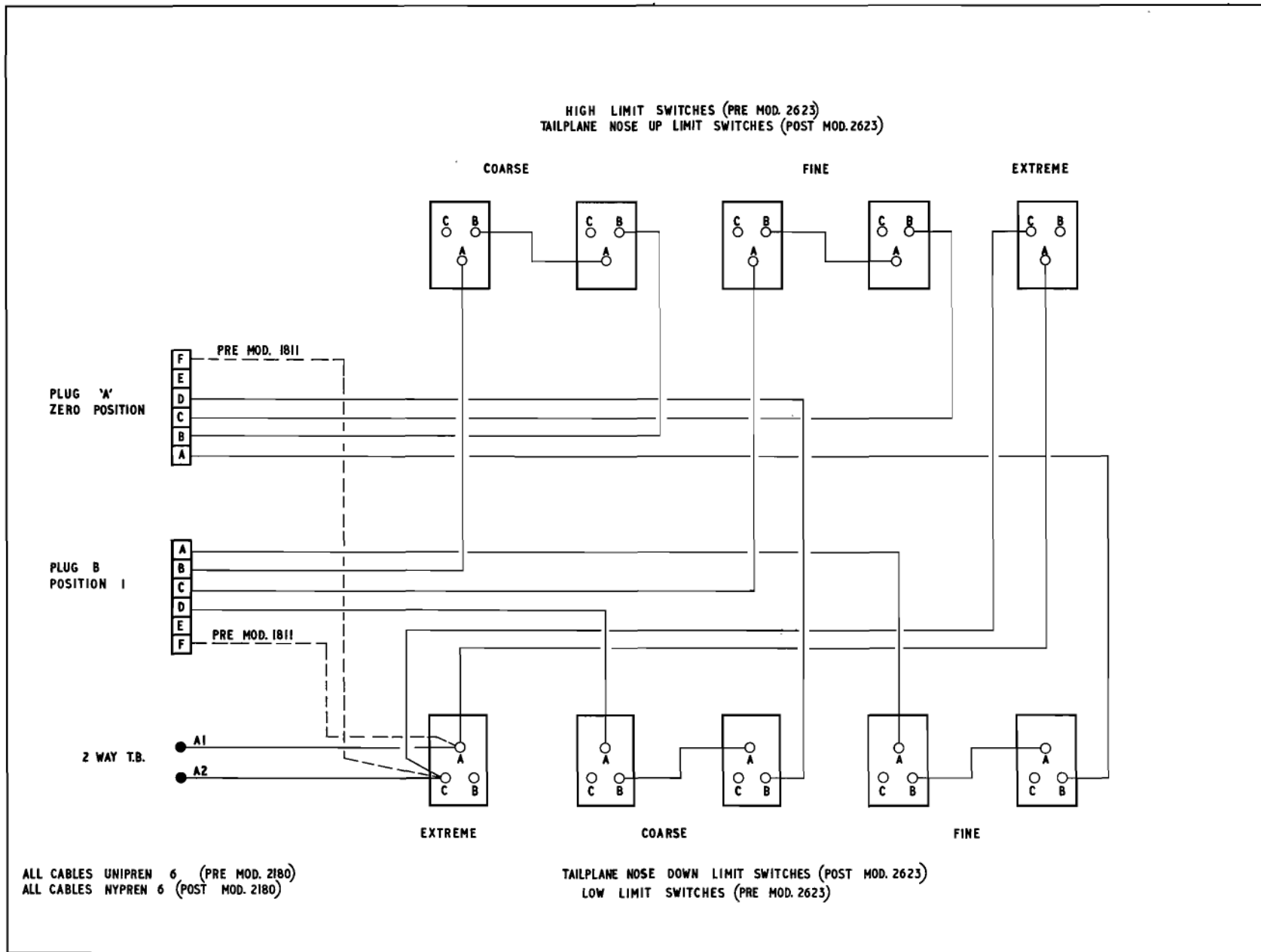


Fig. 15. Tailplane incidence limit switch box
RESTRICTED



This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.