

**Group 2—FLYING INSTRUMENTS****LIST OF CONTENTS**

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*A List of Appendices appears at the end of the Group▶*

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## 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. This Group contains brief descriptive and servicing notes on the flying instrument installations. For detailed information on all items of equipment reference should be made to the relevant Air Publications.

2. 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 card. Also to be found in the General Information group are all the general modifications applicable to all types of Valiant aircraft.

### RATE OF CLIMB INDICATORS

3. These instruments, mounted on the port and starboard blind flying panels, give the rate of climb or descent in feet per minute and are connected to the static system.

### TURN AND SLIP INDICATORS

(fig. 1)

4. Two turn and slip indicators are fitted on the pilot's instrument panel, one on the port and one on the starboard blind flying panel. They are each connected, via a Type Q3 relay R1, with two supplies obtained from the starboard fuse panel D. The relay is operated to connect (R1/1) one supply as soon as the flight instrument master switch is selected to ON. If the relay coil supply should fail, the relay is de-energized and the second supply is connected (R1/2) to the indicator.

### ARTIFICIAL HORIZON (fig. 2)

Note . . .

*The artificial horizon instruments must be handled with great care and must be removed from the blind flying panels before the panels are fitted to, or removed from, the aircraft.*

5. The artificial horizon instruments are mounted one on each blind flying panel. They are supplied with 115 volts 3-phase a.c. from the a.c. supplies power distribution box mounted on the radio crate.

### Supply failure indicator (Mod. 2982)

(fig. 2A)

5a. Failure of the supply to this instrument is indicated by a phase failure indicator on the a.c. manual change-over switch box, mounted above the voltage trimmer panel at the A.E.O.s position. If the indicator shows failure of the supply, it means that initially the supply from the instrument inverter (Type 100A) has failed and that the automatically switched alternative supply from the No. 2 radar inverter (Type 350) has either failed or is not getting through (e.g. dirty contacts on the a.c. selector relay or failure of the relay to operate satisfactorily).

5b. Failure of the No. 2 radar inverter will be indicated by its warning lamp, in which case, the No. 3 inverter should be switched in to take its place (see Chapter 1, Group 3). Failure of the a.c. selector relay to operate, or dirty contacts reducing the voltage output from the relay, can be overcome by selecting the ARTIFICIAL HORIZON SUPPLY CHANGE-OVER switch from NORMAL to EMERGENCY.

### Supply change-over switch (Mod. 2982)

(fig. 2A)

5c. This switch is mounted in the a.c. manual change-over switch box, mounted above the voltage trimmer panel at the A.E.O.s position. The switch is connected in parallel with the contacts of the a.c. selector relay so that if the relay fails to operate or the output from the relay is reduced in voltage, due to dirty or otherwise bad contacts (para. 5b), the switch can be selected to EMERGENCY to overcome the trouble and maintain the supply to the artificial horizons.

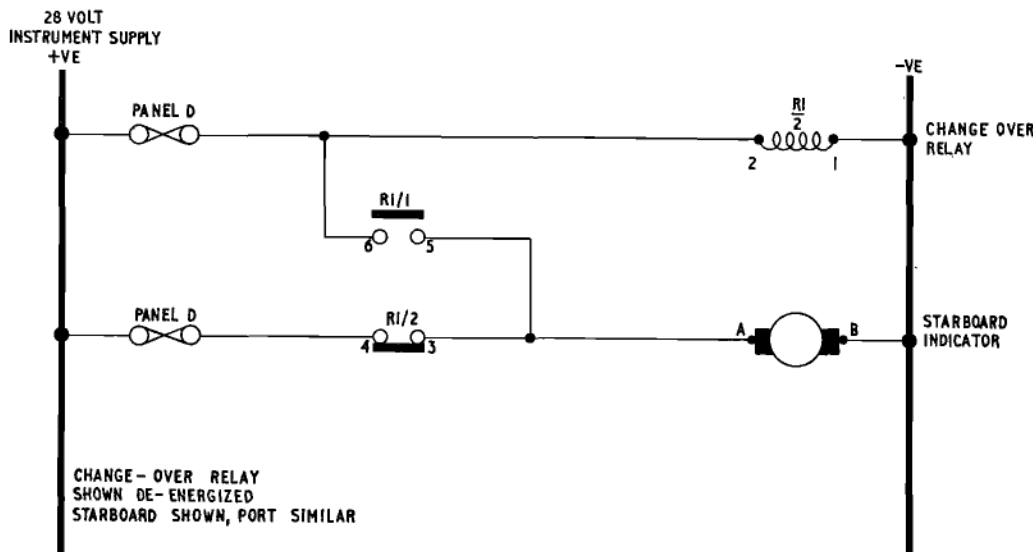


Fig. 1. Turn and slip indicator

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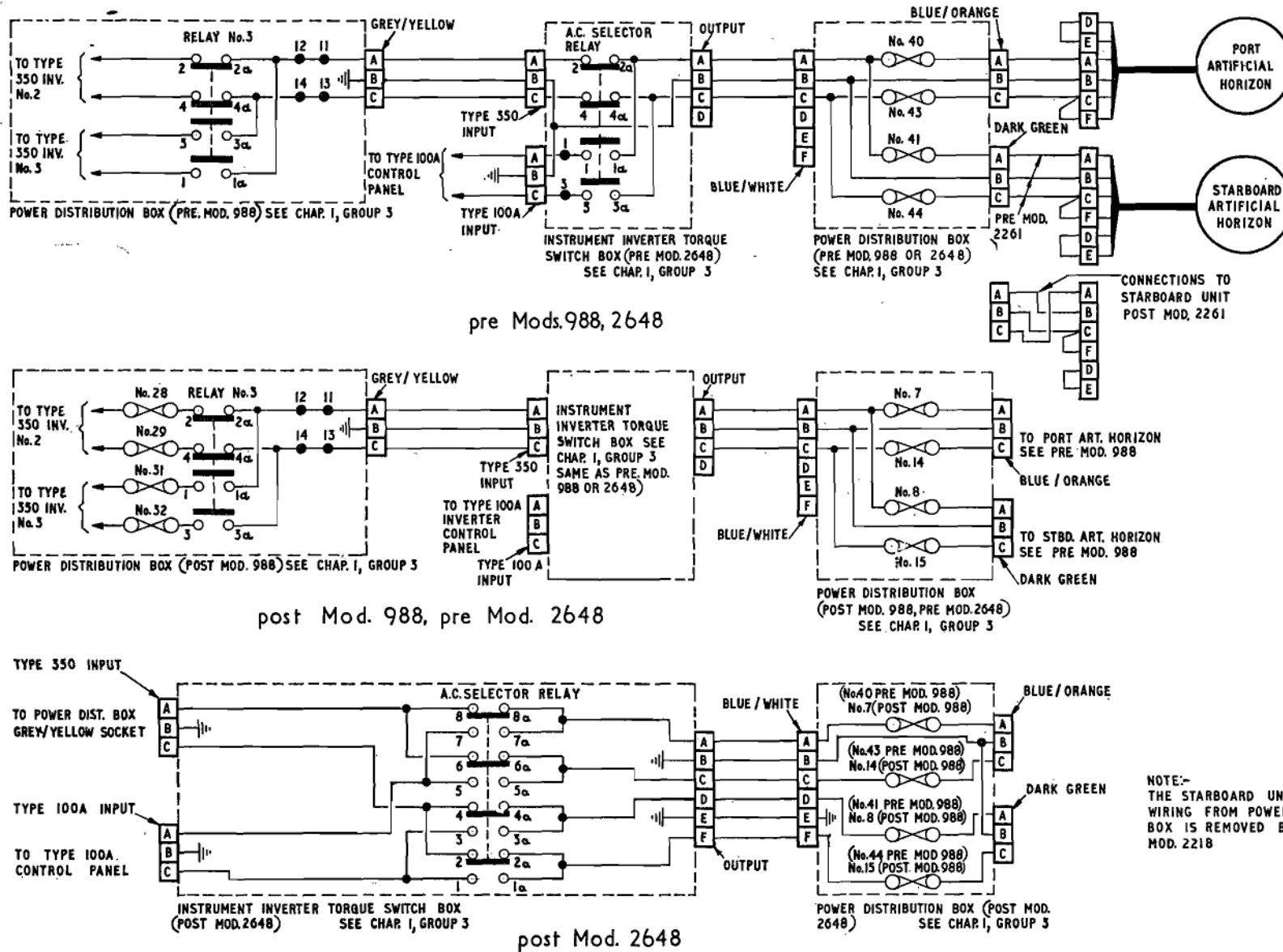


Fig. 2. Artificial horizon

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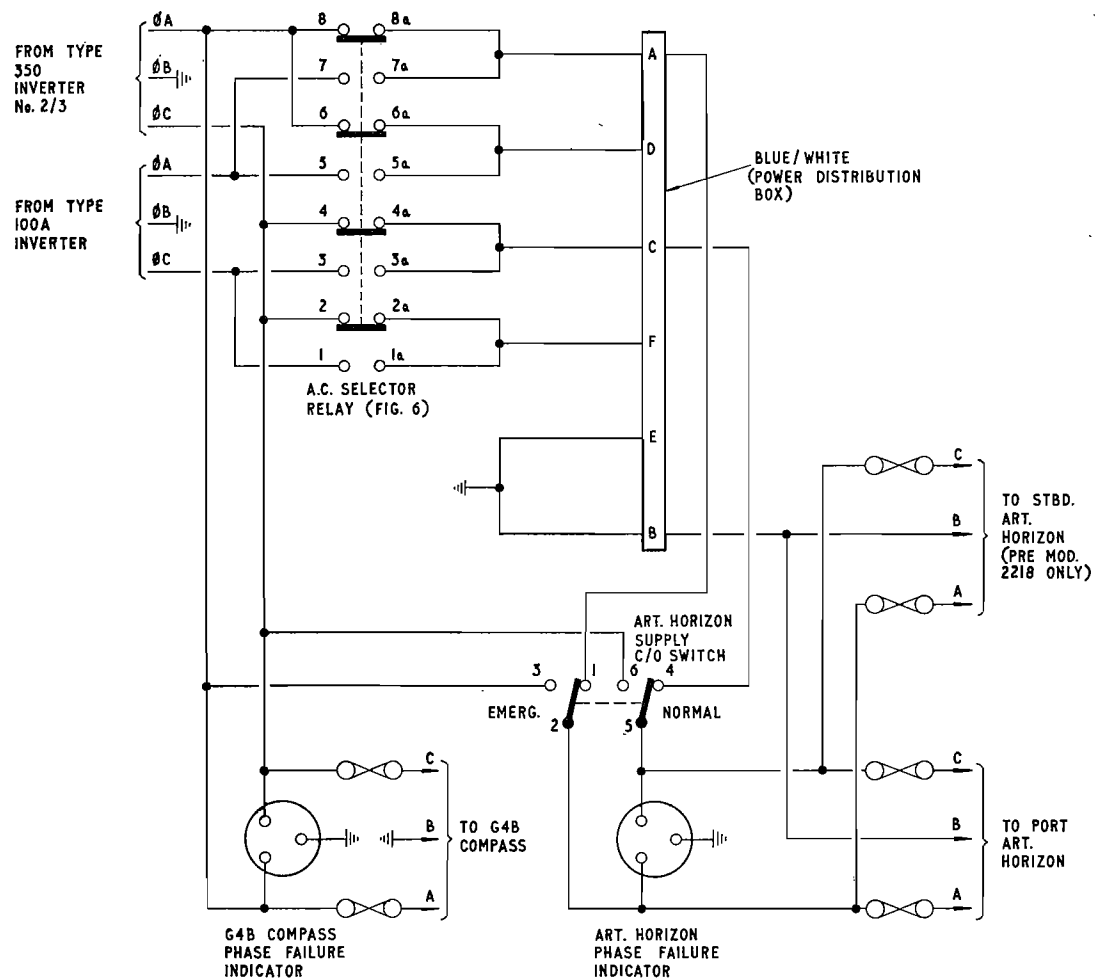


Fig. 2A. A.C. Manual change-over switch (Mod. 2982)

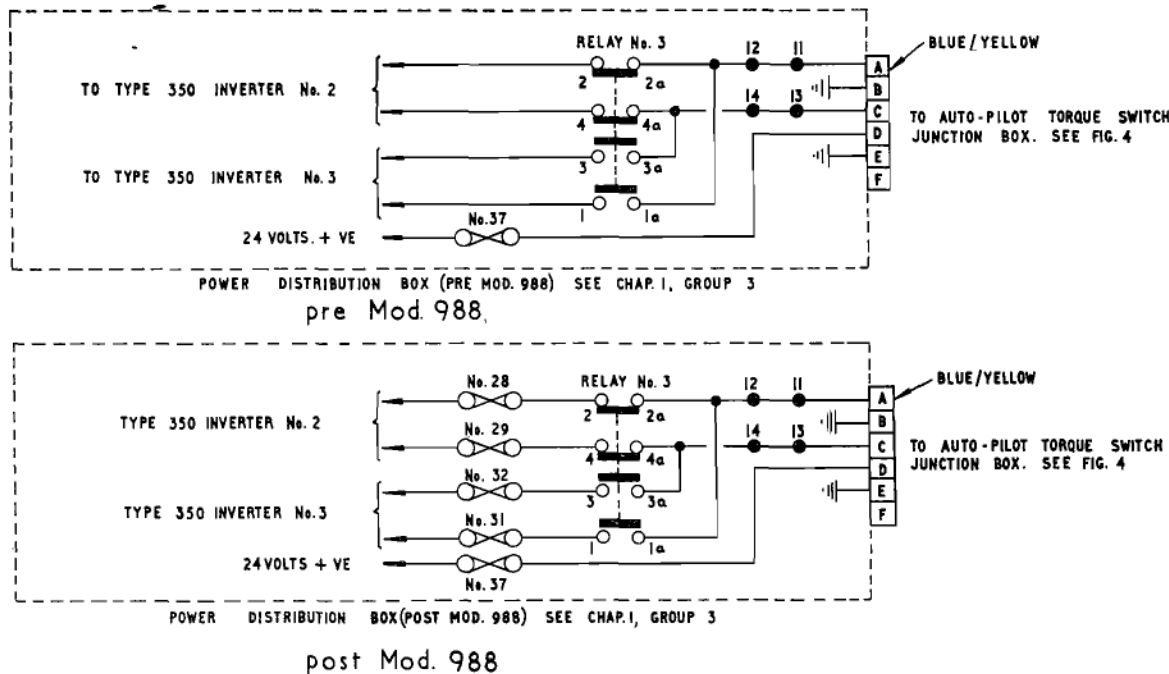


Fig. 3. Auto-pilot Mk. 10 power supplies

### ACCELEROMETER

6. On aircraft post Mod. 1656 an accelerometer is fitted on the port side of the cockpit between the front of the port coaming panel and the instrument top panel.

### AUTOMATIC PILOT Mk. 10 (Mod. 785)

Note . . .

Mod. 2585 introduces a control unit Ref. No. 6T/207 incorporating Mod. AP/E30.

7. A Mk. 10 automatic pilot is fitted and is operated by means of a control panel situated at the aft end of the control pedestal; a heading selector is fitted on the port console, thus the main control is accessible to both pilots while the heading selector can only be operated by the first pilot. An auto-pilot instinctive cut-out switch is fitted to each pilot's control handwheel.

8. The control panel has the following controls and indicators located on it:—  
POWER switch and associated (black/amber pre-Mod. 2585) black/black and white stripes (post Mod. 2585) magnetic indicator.

ENGAGE switch and associated (black/green pre-Mod. 2585) white/black (post Mod. 2585).

RUDDER, ELEVATOR and AILERON channel switches.

Auto-pilot trim indicator.

N.B.S. link switch marked BOMB.

Track switch marked TRACK.

Height lock switch marked ALT.

Bank control knob and scale.

Pitch controller marked CLIMB and DIVE.

9. The pitch control switch is a five-position toggle switch spring loaded to the middle (off) position. The bank control knob is

not spring loaded but has a zero bank location (central position). The rudder, aileron and elevator channel switches are conventional, two position, toggle switches. The remainder of the switches are of the pull (on) push (off) type.

10. The heading selector comprises a combined compass/repeater, operating from the G4B compass, and course setting knob and an alter heading press button.

11. The controls on the control panel function as follows:—

#### (1) POWER switch

When the power switch is pulled electric power is connected to the auto-pilot. After approximately 60 seconds, the auto-pilot gyros will have run up to speed and the system will be 'at readiness' for coupling to the aircraft controls. Confirmation of this will be given by the power switch's magnetic indicator changing from BLACK to AMBER (pre-Mod. 2585) or BLACK to BLACK AND WHITE STRIPES (post Mod. 2585).

#### (2) ENGAGE switch

Provided that the rudder, aileron and elevator channel switches are on, pulling the engage switch will couple the auto-pilot to the controls, whereupon the IN magnetic indicator will go GREEN (pre-Mod. 2585) or WHITE (post Mod. 2585) and the READY indicator should show BLACK. The controls can be disengaged from the auto-pilot by pushing the engage switch in.

#### (3) Channel switches

If a control channel switch is selected off, its particular control surface will be disconnected from the auto-pilot and the IN and READY magnetic indicators will show WHITE and BLACK-and-WHITE respectively (WHITE pre-Mod. 2585). Reconnection is made by selecting the channel switch on again. If all three channel switches are at off at the same

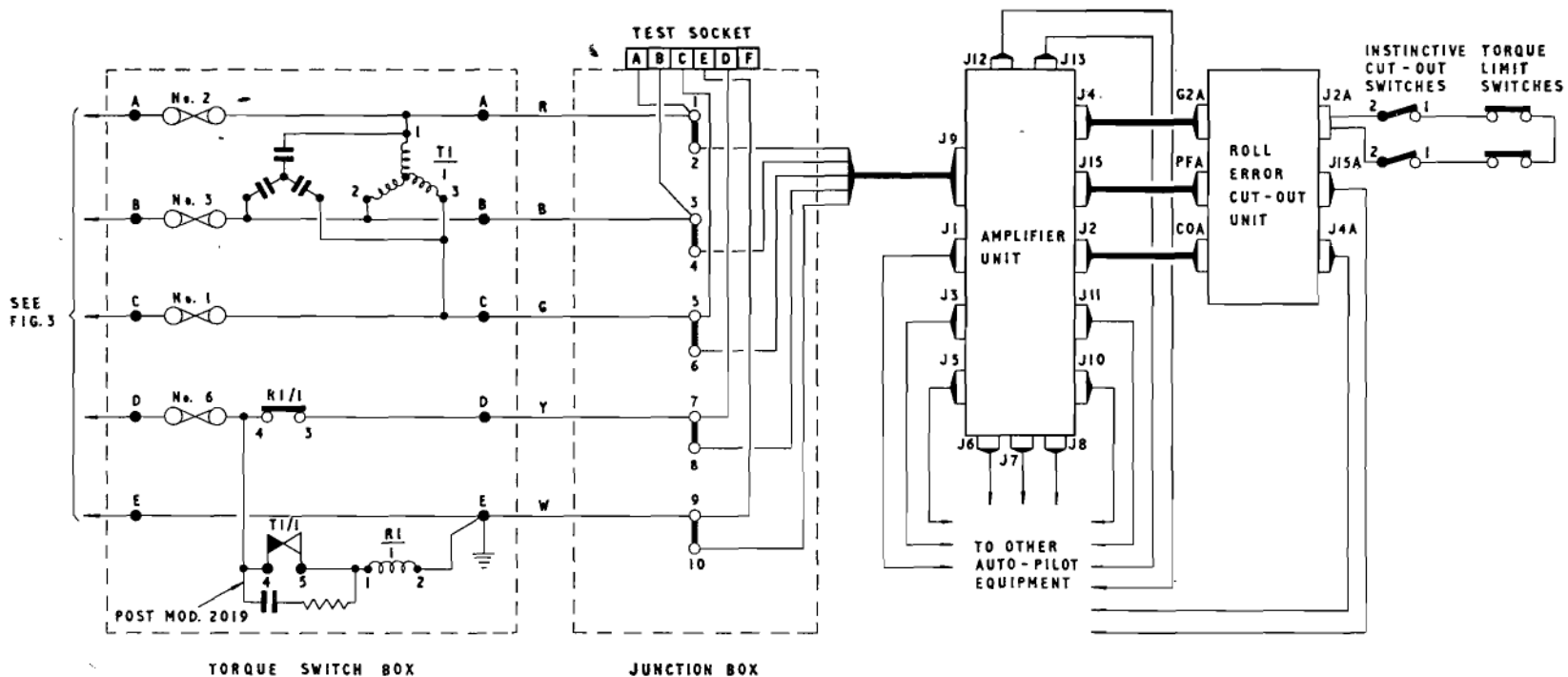


Fig. 4. Auto-pilot Mk. 10

time, their control surfaces cannot be reconnected to the auto-pilot simply by selecting them on again and the normal engage method (by pulling out the engage switch when all three channel switches are on), will have to be used.

(4) *Auto-pilot trim indicator*

The indicator position is governed by the load being carried on the auto-pilot elevator servo-motor and is therefore an indication of the aircraft trim on its own elevator trim control. The indicator must be in the WHITE sector before the auto-pilot is engaged. It must be kept in the WHITE sector during flight by adjusting the aircraft trim as necessary, on the tailplane trimmer.

(5) *Height-lock switch*

The prevailing Barometric height is maintained by the auto-pilot when the ALT. switch is pulled.

(6) *N.B.S., Track and Glide path switches*

The Bomb switch, when pulled, links the N.B.S. equipment to the auto-pilot which then controls the aircraft according to the signals produced by the N.B.S. The other two switches, when pulled, link their respective I.L.S. signals to the auto-pilot which then controls the aircraft according to the I.L.S. localizer and glide path beams.

(7) *Bank control knob*

The aircraft can be turned at a pre-set angle of bank by selecting the control knob to the bank required. The bank will remain on the selector figure and the aircraft will maintain the turn at that angle of bank until a different angle is selected, or the knob returned to the central position, when the aircraft will resume straight flight.

(8) *Pitch control*

The pitch control switch is operated in

the natural sense, i.e., moving the switch forward produces nose-down pitch, and vice-versa. The switch is spring-loaded to the middle (OFF) position, light pressure produces a slow rate of change in aircraft attitude and heavier pressure will cause a fast rate of attitude change.

(9) *Heading selector*

With the track switch on the control unit OFF, course can be pre-selected on the heading selector and the aircraft will turn on to the selected heading when the pre-select turn button is depressed.

◀ 11A. A remote trim indicator, added by Mod. 2062, is mounted on the centre instrument panel. This indicator operates in parallel with that on the central control panel the connections being made at a junction box adjacent to the amplifier. ▶

12. Torque switches are fitted by Mod. 2181 in the elevator and rudder channels of

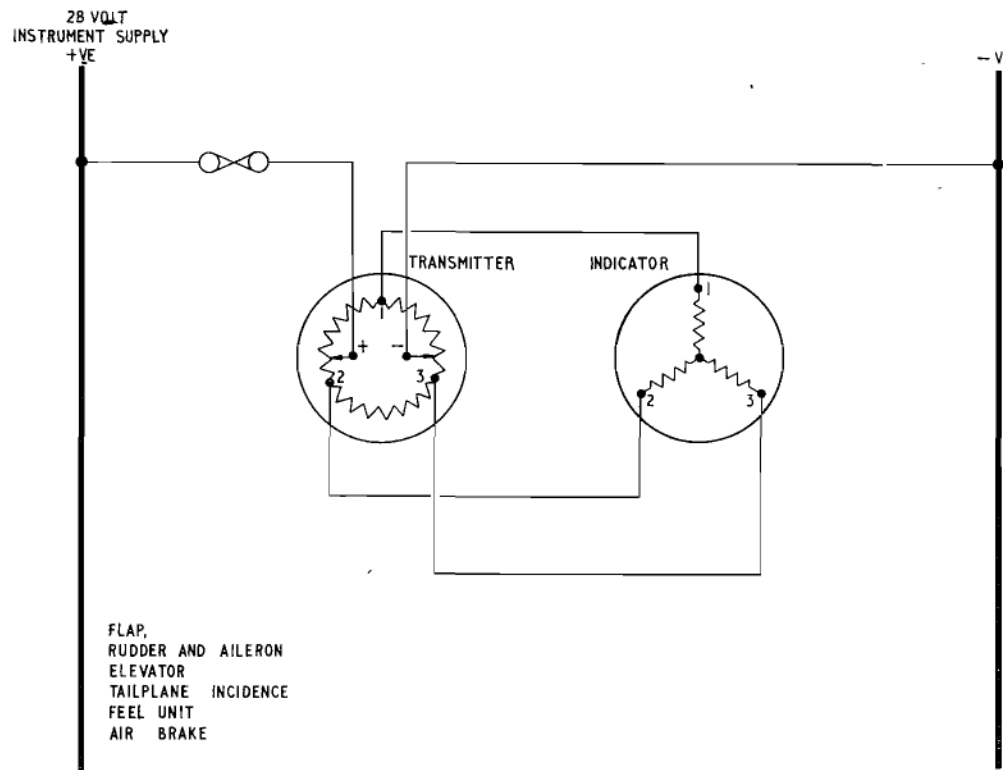


Fig. 5. Position indicator circuit

the auto-pilot to guard against auto-pilot runaway, they will operate within two seconds of a runaway occurring and thus prevent any danger from the sudden or over-application of the elevator or rudder control. The aileron channel is not yet fitted with a safety device and should it runaway it will have to be cut out by the operation of the instinctive cut out switch on the control column, the aileron channel switch, the ENGAGE switch or the POWER switch.

13. Power supplies of 24 volts d.c. and 115 volts 3-phase a.c. for the auto-pilot are taken from the power distribution box on the radio crate and are fed via the torque switch junction box (fig. 4) to the amplifier

which feeds the complete installation. The torque switch is connected across the 3-phase lines so that if the a.c. should fail the torque switch will operate (T1/1) to disconnect the supply to relay R1. Relay R1 operates (R1/1) to disconnect the d.c. supply to the equipment.

#### GENERAL NOTE ON POSITION INDICATORS

14. The following position indicators operate on the Desynn principle:—

Aileron trim tab	Rudder feel unit
Rudder trim tab	Elevator trim tab
Aileron feel unit	Tailplane incidence
Elevator feel unit	Air brake
Flap	

The indicators become operative when the flight instrument master switch is selected to ON.

#### Flap position indicators (fig. 5)

15. Two position transmitters are mounted, one at the port and one at the starboard centre wing flap positions and are directly connected to their relative position indicators mounted on the pilot's instrument centre panel. Both instruments are supplied from a single fuse on the starboard fuse panel D.

#### Aileron and rudder trim tab position indicators (fig. 5)

16. The aileron trim tab position transmitter is situated close to its associated actuator at the inboard end of the starboard aileron. The rudder trim tab position transmitter is situated near its associated actuator in the base of the rudder. Each transmitter is directly connected to the relative half of a double indicating unit mounted on the port console. The supplies to the transmitters are taken from the port fuse panel E.

#### Elevator trim tab position indicator (fig. 5)

17. The elevator trim tab position transmitter is fixed to the inboard rib of the starboard elevator and is mechanically linked to the operating gear. It is directly connected to an indicator unit mounted on the port console. The supply is fed from the starboard fuse panel D.

#### Tailplane incidence position indicator (fig. 5)

18. The tailplane incidence position transmitter is fixed to the inboard rib of the starboard tailplane and is mechanically linked to the operating gear. It is directly connected to an indicator unit mounted on the pilot's centre instrument panel. The supply is fed from the starboard fuse panel D.

#### Feel unit position indicators (fig. 5)

19. The rudder and aileron feel control position transmitters are mounted near their

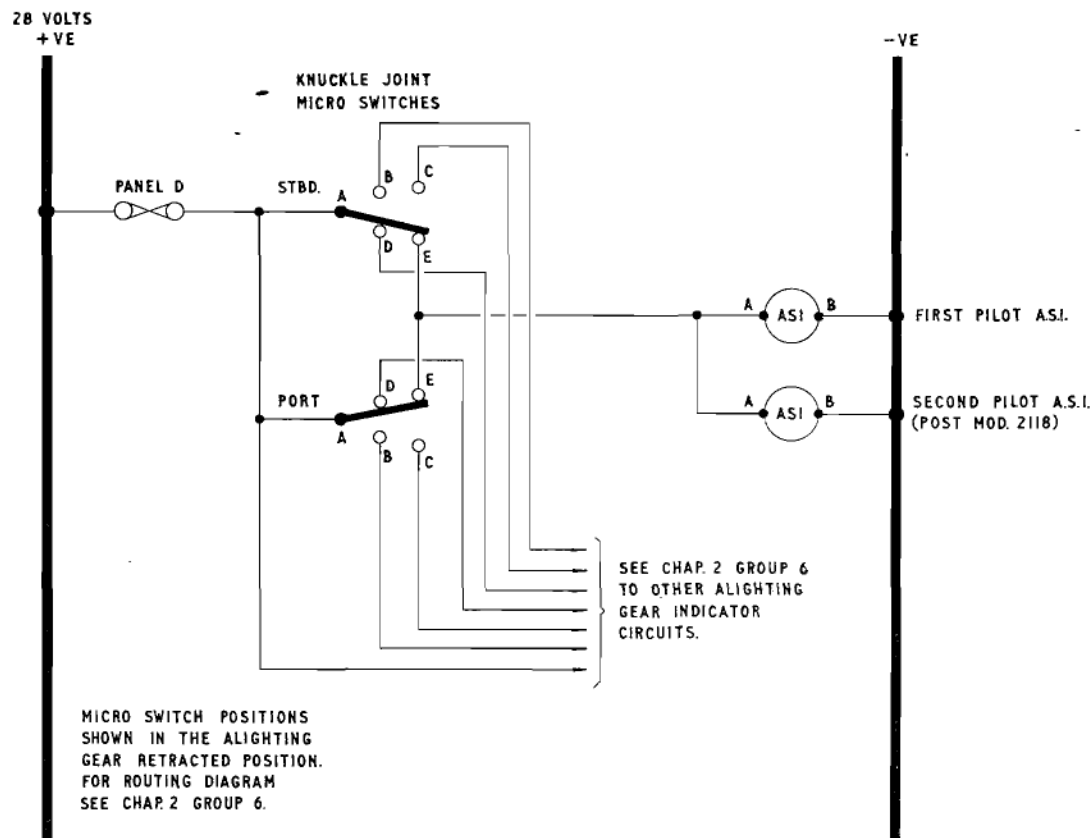


Fig. 6. Air speed indicators

respective mechanisms in the rear fuselage and each is directly connected to its own indicator on the pilot's centre instrument panel. Their supplies are taken from the starboard fuse panel D.

#### Air brake position indicator (Mod. 1608)

(fig. 5)

20. The air brake position transmitter is mounted on the air brake gear box at the rear spar and is directly connected to an indicator unit mounted on the pilot's instrument centre panel. The supply to the transmitter is taken from the starboard fuse panel D.

#### AIR SPEED INDICATORS (fig. 6)

Note . . .

*Mod. 1800 introduces an airspeed indicator Ref. No. 6A/4380 in lieu of airspeed indicator Ref. No. 6A/3147 at the first pilot's position. Mod. 2118 introduced an airspeed indicator Ref. No. 6A/4380 in lieu of airspeed indicator Ref. No. 6A/3147 at the second pilot's position.*

21. Both the airspeed indicators incorporate an undercarriage warning device, consisting of an oscillating flag which appears on the instrument dial when the aircraft speed falls below a certain speed and the undercarriage is in any position other than the fully locked down position. The supply to the indicators

is taken from the main port and starboard undercarriage knuckle micro switches (See Chap. 2, Group 6, for routing diagram.)

Note . . .

*PIN 'A' + VE. If the electrical connections to the instrument are reversed the instrument will be damaged.*

#### ZERO READER FLIGHT DIRECTOR

22. The system combines altitude, heading altitude and radio approach information and transmits it to two indicators (For a detailed description see A.P.1275A, Vol. 1), mounted one on the port and one on the starboard blind flying panels. The required flight path is selected by means of the control panel and course selector combined into one unit and mounted in the centre at the bottom of the pilot's top fuel panel. The system will function either as a flight instrument, a radio navigational aid, or an approach indicator when making landing approaches using the instrument landing systems (ILS). The system gives a visual indication of deviation from flight path only, the handling of the aircraft and its airspeed being always under the pilot's control. Heading, roll and pitch signals are continuously received by the flight computer, mounted in the radio crate, while altitude signals can be fed to the computer by selection of the appropriate control on the control panel.

23. Two supplies of 115 volts, 3-phase, 400 c.p.s. are fed to the system from the power distribution box. One supply is taken direct to the rotor of the horizon gyro unit and the other supplies the system via the junction box, mounted behind the starboard blind flying panel. As the horizon gyro unit has a separate supply the flight director equipment can be switched OFF and the horizon gyro unit will continue to operate on an electric gyro horizon.

#### Flight director indicator

24. The indicator incorporates a warning device consisting of two flags marked OFF. These flags appear at 3 o'clock and 6 o'clock on the indicator face when either the power

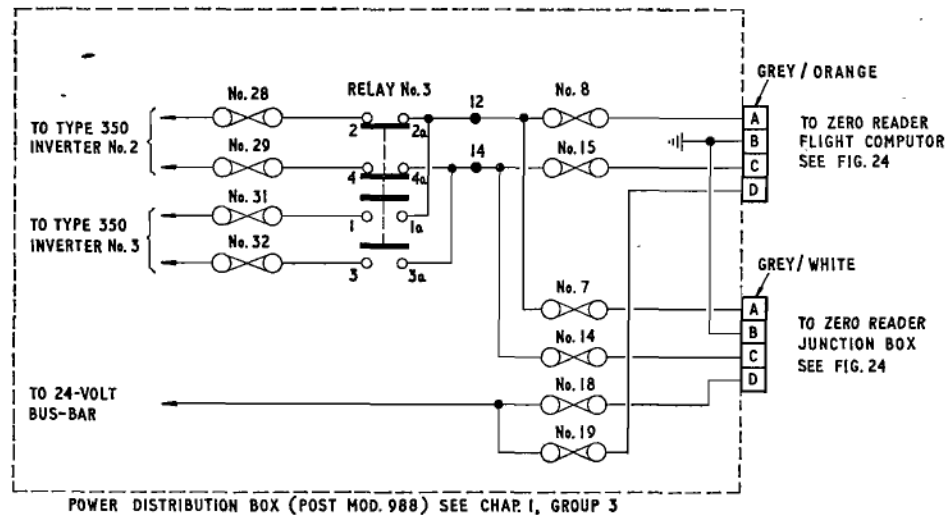


Fig. 7. Zero reader Type ZL2 power supplies

supplies or the computer H.T. fails, or when any of the I.L.S. receiver warning outputs (if fed to the computer) fall below 270 micro-amps.

#### Course selector and control panel

25. This unit enables the pilot to select any desired flight path. The course selector is fitted with two pointers. The heading pointer is a repeater of the aircraft gyro compass while the course pointer is controlled by the course setting knob fitted to the instrument. When a change of course is desired and the course pointer is moved to the desired setting, a signal is transmitted to the pilot's indicator, indicating to the pilot in which direction to fly the aircraft. The control panel has the following four controls which are electrically interlocked:—

##### TEST button

The test button is only operative when the main selector switch is selected to OVERSHOOT. Providing that the pitch and roll channels are operating satisfactorily, when the test

button is pressed, the horizontal and vertical pointers of the flight indicator will move upwards and to the left and the warning flags will appear.

##### ALTITUDE switch

The altitude switch has two positions, ON, OFF (sprung to OFF) and is marked ALT. The switch enables the altitude control to be engaged when the main selector switch is selected LEFT (blue), FLT. INST. RIGHT (blue). When the main selector switch is selected to GLIDE PATH or OVERSHOOT electrical interlocks allow the altitude switch to return to OFF. The switch is held in the ON position by a solenoid, but if the aircraft rises or falls above a certain amount from the engaged altitude, the solenoid will be de-energized and the switch returned to OFF.

##### PITCH pointer control

The PITCH knob controls a potentiometer and enables the pilot to set-in the desired angle of pitch when the fore and aft trim of

the aircraft is altered. Electrical interlocks allow this control to be used only when the main selector switch is at LEFT (blue) FLT. INST. and RIGHT (blue), and automatically return it to ZERO if the main selector switch is selected to GLIDE PATH or OVERSHOOT. It will also return to ZERO if the ALT. switch position is altered.

##### SELECTOR switch

This switch enables signals for any desired flight path to be selected.

#### Flight computer

26. Connections are provided on the computer for the aircraft gyro compass system and I.L.S. Signals from the gyro compass, I.L.S., horizon gyro unit and an internal altitude control are fed into the computer and then transmitted to the pilot's indicator which indicates to the pilot how the aircraft controls should be operated to achieve and follow the desired flight path.

#### Horizon gyro unit

27. This unit, mounted on the starboard blind flying panel, apart from being a normal gyro horizon, provides pitch and roll signals for the flight director. The horizon can be used as a normal gyro horizon when the flight director is switched OFF (*para.* 23).

#### AUTO STABILIZER Mk. 2 (Mod. 2252)

28. The auto-stabilizer system is fitted to detect yaw movements and suppress them by operating the appropriate flying control. The system is controlled by a three position ON, STAND-BY and OFF switch mounted on the pilot's control pedestal. All the auto-stabilizer equipment, with the exception of the servo motor, is mounted on a readily detachable panel. The panel is secured to the port leg of the navigator's table and protected by a guard rail, while the servo motor is mounted near the rudder and elevator control motors in the rear fuselage.

29. Power supplies of 151 volts a.c., 3-phase, 400 c.p.s. and 24 volts d.c. are fed from the

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power distribution box, via the T4 bomb sight fuse and junction box, to the amplifier unit. The monitor unit is connected into the starboard pitot and static system.

**30.** The system consists of a gyro unit which detects the rate of yaw movement of the aircraft. A gimbal arm moving a wiper over a potentiometer, connected across a 24-volt d.c. supply, transmits a d.c. signal to the monitor unit via the phase advance unit.

**31.** The monitor unit consists of three units. An air speed mechanism, height unit, and a contacting machmeter. Signals received by the monitor unit, from the gyro unit, are varied according to the indicated air speed, height and Mach number, within certain limits, and then transmitted to a magnetic amplifier contained in the amplifier unit.

**32.** The magnetic amplifier increases the signal strength sufficient to energize a relay built into the amplifier unit. The relay is a centre stable type, polarized to respond in whichever direction the signal dictates. On operating, the relay connects a supply to energize one of two slave relays incorporated in the slave relay unit.

**33.** The slave relay, on operating, connects a supply to the armature of the servo motor which then operates the rudder. The two slave relays effect the reversal of the current through the armature thereby reversing the rotation of the servo motor.

**34.** The servo motor is a separately excited d.c. motor and incorporates a position feed-back potentiometer. When the servo motor is running the feed-back potentiometer transmits a signal, in opposition to the input signal, to the magnetic amplifier. With the control switch

selected to ON the gyro signal controls the servo motor. When the switch is selected to OFF the servo motor remains in the position it occupied when the switch was selected to OFF. With the switch in the STAND-BY position the gyro signal is disconnected from the servo-motor allowing it to return to its mid-stroke position due to positional feed-back.

**35.** A phase advance unit is incorporated in the system to counteract electrical and mechanical delays throughout the whole auto-stabilizer system. Delay occurs in response to the gimbal system, servo-motor mechanisms, relays and magnetic amplifier, and finally in the build-up of restoring forces on the rudder.

**36.** For detailed information on the Auto-stabilizer Mk. 2 system on Valiant aircraft, reference should be made to A.P.1469S, Vol. 1, Sect. 6.

**Table 1**  
**List of equipment**

Instrument	No. off	Type, Mk. or Ref. No.	Location
Accelerometer (post Mod. 1656)	1	Mk. 2, 6A/3451 (post Mod. 1656, pre-Mod. 2316) Mk. 2A, 6A/4825 (post Mod. 2316)	Cockpit—port side
Pilot's compass (pre-Mod. 2791)	1	Type P.12	Above centre windcreens
Pilot's compass (post-Mod. 2791)	2	Type E2B, 6B/2754	Under pilot's fuel panels
Flap position indicator	2	Smiths 533FL (pre-Mod. 1161) Smiths 589FL (post-Mod. 1161)	Instrument centre panel
Flap position transmitter	2	Type B 1—Clockwise 6A/2131 1—Anti-clockwise 6A/2132	Port and starboard wing centre flap positions
Rate of climb indicator	2	Mk. 3A Mk. 3B or 3C (pre-Mod. 1602) Mk. 4 (post-Mod. 1602)	Port and starboard blind flying panels
Artificial horizon	2	Mk. 3 (pre-Mod. 1602) Mk. 4, 6A/3063 (post-Mod. 1602)	Port and starboard blind flying panels
◀Phase failure indicator (Art. horizon and G4B compass (Mod. 2982)	2	5Q/170	A.C. manual change-over switch box, above voltage trimmer panel▶
Turn and slip indicator	2	Mk. 2, 6A/2945	Port and starboard blind flying panels

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Table 1—continued

Instrument	No. off	Type, Mk. or Ref. No.	Location
Machmeter	2	Mk. 1A or 1B	Port and starboard blind flying panels
Air speed indicator	3	Mk. 9 H(P) (pre-Mod. 1800)	Port and starboard blind flying panels— radio crate
	1	6A/4380 (post Mod. 1800) KAB. 1402 (post Mod. 2561) 6A/3360 (post Mod. 2580) (B/K Mk. 1 only) 6A/4380 (post Mod. 2118) KAB.1402 (post Mod. 2561) 6A/3146 (post Mod. 1800)	Port blind flying panel
	1		Starboard blind flying panel
	1		Radio crate
Altimeter	2		Mk. 19A, 6A/2944 (pre-Mod. 2683) Mk. 19B, 6A/5040 (post Mod. 2683)
Auto-pilot (post Mod. 785):—		Mk. 10	
Gyro unit	1	6T/201	Under pilot's floor—port side
Amplifier	1	6T/204	Under pilot's floor—port side. (Pre-Mod. 1648) starboard side (post Mod. 1648)
Amplifier mounting	1	115 EAP (pre-Mod. 1648) Type 'B' 6T/349 (post Mod. 1648)	Under pilot's floor—port side (pre-Mod. 1648) Starboard side (post Mod. 1648)
Approach coupling unit	1	Type 'A' 6T/209 (pre-Mod. 1648) Type 'B' 6T/347 (post Mod. 1648)	Under pilot's floor—port side
◀ Bombing coupling unit	1	6T/217 Type 'A' (pre-Mod. 2869) 6T/1649 Type 'B' (post Mod. 2869)	Under pilot's floor—starboard side ▶
B.C.U. mounting	1	132 EAP (pre-Mod. 1648) Type 'B' 6T/351 (post Mod. 1648)	Under pilot's floor—starboard side
◀ B.C.U. link setting card	1	6T/447 Type 'A' (pre-Mod. 2869) 6T/1668 Type 'B' (post Mod. 2869)	Adjacent to bombing coupling unit ▶
Power factor unit	1	6T/212	Under pilot's floor—port side
Central controller	1	6T/207	On control pedestal panel
Heading selector	1	6T/211	Starboard blind flying panel
Instinctive cut-out switch	2	LHE-A-1	On port and starboard control columns
Torque switch	1	Type B (pre-Amend 2333) EAP.2340 (post Amend 2333)	In torque switch box on radio crate
Rudder servo	1	6T/202	Rear fuselage—near rudder feel unit
Aileron servo	1	6T/203	Behind rear spar—near aileron P.U. gearbox

Table 1—continued

Instrument	No. off	Type, Mk. or Ref. No.	Location
Elevator servo	1	6T/202 (pre-Mod. 2182) Type D, 6T/354 (post Mod. 2182)	Rear fuselage—near elevator feel unit
Junction box	1	VA.70636-Sht. 7	Pilot's floor beam
Auto-pilot torque switch J.B.	1	VA.67436-Sht. 345	Radio crate
Elevator servo mounting	1	Type A (pre-Mod. 2182) Type B, 6T/536 (post Mod. 2182)	Rear fuselage—near elevator feel unit
Azimuth controller (post Mod. 2140)	1	6T/400	Bomb aimer's compartment
Roll error cut-out (post Mod. 2424)	1	6T/401	Rear of bomb aimer's compartment
Rudder torque limiter (post Mod. 2182)	1	C35, 6T/358	Rear fuselage
Elevator torque limiter (post Mod. 2181)	1	C40, 6T/357	Rear fuselage
◀ Remote trim indicator (post Mod. 2062)	1	6T/218, Type A (pre-Mod. 2895) 6T/1676, Type B (post Mod. 2895)	Centre instrument panel ▶
Remote trim junction box (post Mod. 2062)	1	◀ 6T/403, Type A ▶	Under pilot's floor, adjacent to amplifier
Auto-stabilizer (Mod. 2251)		Mk. 2	
Amplifier unit	1	6S/69	Navigator's crate
Slave relay unit	1	6S/33	Navigator's crate
Phase advance unit	1	6S/63	Navigator's crate
Gyro unit	1	Type A.6S/1	Navigator's crate
Suppressor	1	5CY/5151	Navigator's crate
Air speed monitor	1	6S/64	Navigator's crate
Switch	1	6S/53	Control pedestal
Servo motor	1	6S/62	Rear fuselage. On rudder/elevator power unit
Zero-reader flight director (Mod. 2218)	1	Type ZL.2	
Flight computer	1	6A/3122	Port radio crate
◀ Junction box	1	Type D, 6A/6125	Rear of starboard blind flying panel ▶
Course selector control panel	1	6A/4417	Centre below fuel panel
◀ Horizon gyro unit	1	Mk. 4 6A/5797 (pre-Amend 2897) Mk. 4B, 6A/6178 (post Amend 2897)	Starboard blind flying panel ▶

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TABLE 1—continued

Instrument	No. off	Type, Mk. or Ref. No.	Location
Indicator	2	6A/3119	Port and starboard blind flying panels
Aileron trim tab position transmitter	1	6A/2133 (pre-Mod. 1809) 6A/2131 (post-Mod. 1809)	Starboard aileron
Rudder trim tab position transmitter	1	6A/2133 (pre-Mod. 1809) 6A/2131 (post-Mod. 1809)	Base of rudder
Aileron and rudder trim tabs position double indicator	1	521 FL	Port console
Tailplane incidence position transmitter	1	Type B, 6A/2132	Inboard rib of starboard tailplane
Tailplane incidence position indicator	1	211 FL 524 FL (pre-Mod. 1600) 584 FL (post-Mod. 1600)	Instrument centre panel
Rudder feel unit transmitter	1	Type C, 6A/2133	Rear fuselage on rudder feel unit mechanism
Aileron feel unit transmitter	1	Type C, 6A/2134	Rear fuselage on aileron feel unit mechanism
Rudder and aileron feel unit indicators	2	Aileron 522 FL Rudder 523 FL	Instrument centre panel
Air brakes position indicator (Mod. 1608)	1	593 FL	Instrument centre panel
Air brakes position transmitter (Mod. 1608)	1	6A/2133	Air brake gear box

## SERVICING

### Introduction

37. For detailed information on the servicing of all items of equipment, reference should be made to the relevant Air Publications.

38. A detailed description of all the general tests to be applied to all aircraft electrical circuits, can be obtained from the General Information group contained in Book 2, immediately after Section 5 marker card.

### RATE OF CLIMB INDICATORS

39. During servicing, care must be taken to exclude any particles of dust, etc., which may tend to block the small hole in the choke system, thus causing the instrument to give high readings.

### TURN AND SLIP INDICATORS

40. (1) Connect a 28-volt d.c. supply to the external connection.
- (2) Disconnect the starboard indicator.
- (3) Connect a 28-volt test lamp across pins A and B.
- (4) Remove fuse No. 105 from fuse panel D.
- (5) Select the flight instrument master switch to ON, and check that the test lamp lights.
- (6) Select the flight instrument master switch to OFF and check that the test lamp goes out.

(7) Replace fuse No. 105 and remove fuse No. 85 from fuse panel D.

(8) Repeat items 5 and 6.

(9) Replace all fuses that have been removed. Remove the test lamp and reconnect the indicator.

(10) Repeat the above items for the port indicator using fuses Nos. 104 and 84, in panel D, in lieu of fuses Nos. 105 and 85.

### ARTIFICIAL HORIZON

Note . . .

*The artificial horizon instruments must be*

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handled with great care and must be removed from the blind flying panels before the panels are fitted to, or removed from the aircraft. -

41. (1) Connect a 28-volt d.c. supply to the external connection.
- (2) Select the flight instrument master switch to ON and check that the indicator sets-up in the horizontal position.
- (3) Select the flight instrument master switch to OFF.

#### PHASE FAILURE INDICATOR AND SUPPLY CHANGE-OVER SWITCH

(Mod. 2982)

- 41a. (1) Switch on the instrument inverter (Type 100A) and Nos. 2 and 3 radar inverters (Type 350).
- (2) Check that the indicator indicates normal working conditions.
- (3) Switch off the instrument inverter, check that the indicator momentarily flickers and then shows normal working conditions.
- (4) Switch off No. 2 radar inverter, indicator should indicate supply failure.
- (5) Disconnect 100A or 350 INVERTER OUTPUT plug and socket on the instrument inverter torque switch box.
- (6) Switch radar inverter emergency switch to No. 2 fail, then select the ARTIFICIAL HORIZON SUPPLY CHANGE-OVER switch to EMERGENCY; the indicator should now indicate restoration of normal working conditions.
- (7) Switch off No. 3 radar inverter and return the radar inverter emergency switch to its normal (central) position. Return the ARTIFICIAL HORIZON CHANGE-OVER switch to NORMAL.
- (8) Reconnect the 100A or 350 INVERTER OUTPUT plug and socket on the instrument inverter torque switch box.

#### POSITION INDICATORS

42. All position indicator transmitters are to be set-up in accordance with the instructions given in A.P.4377A, Vol. 1, Book 1.

#### Note . . .

When handling the position transmitters the ratchet arm must be restrained when returning to its normal position. If the ratchet arm is allowed to spring back to its normal position, the setting of the transmitter will be altered.

The functioning of the indicators can be checked when their relative equipment is functioned.

#### AIRSPPEED INDICATORS

43. The operation of the undercarriage warning flags should be tested in conjunction with the pitot—static and undercarriage retraction tests. The warning flags should operate when any of the undercarriages is in any position other than the fully locked DOWN position, and pressures equivalent to 0 to 164 knots are in the pitot system.

#### AUTOMATIC PILOT Mk. 10

44. Check the security of all the units in their mountings and ensure that the units are free to move on their anti-vibration mountings. Check that all flexible bonding leads are undamaged. For details of the instinctive cut-out switches on the pilot's handwheels refer to the General Information group immediately following the Section 5 marker card in Book 2.
45. Check the a.c. and d.c. supplies on the output side of the auto-pilot torque switch box. Switch OFF the a.c. supply, leaving the d.c. supply ON and check the operation of the torque switch relay, Type Q, to ensure that in cases of a.c. failure the d.c. is automatically switched off.
46. Carry out pin-to-pin continuity and open circuit checks on each connector and test for short circuits between pins. Engage the auto-pilot, observing all precautionary instructions.
47. Carry out function checks from the control unit as follows:—

#### Note . . .

When carrying out the checks, in items (10) and (11) below, note the following:—  
When either the pitch or bank control is operated, particularly the bank control, the control surfaces will continue to move even if they pass the position selected

on the control. This is because the aircraft, being on the ground, cannot move to cancel the error signal caused by operating either control. Checks only ensure that the controls cause the correct movement of the control surfaces. If the control surfaces are allowed to move to their stops, no damage will ensue as the servo motor clutches will slip. This condition, however, should be kept to a minimum. If torque limiters are fitted, the elevator or rudder servos will cause the auto-pilot to trip should the control surfaces reach their stops.

- (1) Ensure that No. 2 radar inverter is running.
- (2) Pull the POWER switch, wait approximately 60 seconds for the READY magnetic indicator in front of the switch to show AMBER (pre-Mod 2585) or BLACK and WHITE stripes (post Mod. 2585).
- (3) Switch IN the rudder, aileron and elevator channel switches.
- (4) Check that the trim indicator on the control panel is within the white sector. Post Mod. 2062 also check the remote trim indicator.
- (5) Check that the aircraft controls are unlocked and in "power".
- (6) Holding the controls central, pull the ENGAGE switch and check that the IN magnetic indicator shows GREEN (pre-Mod. 2585) or WHITE (post Mod. 2585) and the READY magnetic indicator shows BLACK. Press lightly on all three controls to check that the auto-pilot is properly engaged.
- (7) Operate the instinctive cut-out switch on the 1st pilot's control hand-wheel, check that the controls become free, the IN indicator shows BLACK and the READY indicator shows AMBER (pre-Mod. 2585) or BLACK and WHITE stripes (post Mod. 2585) re-engage the auto-pilot. Repeat the check for the 2nd pilot's cut-out switch.
- (8) Test the rudder, aileron and elevator switches in turn by checking that selection of OFF disengages the associated control and causes the READY indicator to show AMBER (pre-Mod. 2585) or BLACK and WHITE stripes

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(post Mod. 2585), and that re-selection to ON restores the previous condition.

(9) If Mod. 2181 is fitted, engage artificial feel and check the operation of the elevator and rudder torque limiters by applying a steady force to the relevant controls, in both directions, until the auto-pilot cuts-out.

(10) Check that movement of the pitch control forward and back produces corresponding movement of the control column.

(11) Check that displacement of the bank control knob produces movement of the control handwheels and rudder pedals in the correct direction.

**Note . . .**

*The rudder pedal movement is very slight.*

(12) Check that forward and backward pressure on the control column produces corresponding nose heavy and tail heavy deflection on the trim indicators.

(13) Check that the reading on the heading selector agrees with that on the G4B compass master indicator.

(14) Push power switch OFF.

(15) When checks have been completed return all switches to the off position and remove external supplies.

**AUTO-STABILIZER Mk. 2**

48. For detailed information of the servicing of the Auto-stabilizer Mk. 2 installation, reference should be made to A.P.1469S, Vol. 1, Sect. 6.

**Note . . .**

*The auto-pilot system must not be operating whilst the following checks are carried out.*

(1) Connect 28-volt and 112-volt d.c. supplies to the external connections.

(2) Select No. 2 inverter switch to ON.

(3) Select the auto-stabilizer control switch to STAND-BY. Check that the rudder centralizes.

(4) Select the control switch to ON. Check

that when the rear of the fuselage is moved to starboard, the rudder moves to starboard. Check that when the rear of the fuselage is moved to port, the rudder moves to port.

(5) Return the control switch to OFF.

**Note . . .**

*Item 4 can be achieved by operation of the nosewheel steering, i.e. steer to port and the rear fuselage will move to starboard; steer to starboard and the rear fuselage will move to port.*

**ZERO READER FLIGHT DIRECTOR  
TYPE ZL2.**

49. For detailed information on the servicing procedure for the Zero Reader Flight director reference should be made to ◀A.P.1275A, Vol. 1, Sect. 23.▶

(1) Connect 28-volt and 112-volt d.c. supplies to the external connections.

(2) Select to ON No. 2 inverter.

(3) Allow at least 30 secs. for the valves to warm up then check that the OFF flags are clear from the indicator face.

(4) Select the main selector switch to FLT. INST.

(5) Synchronize the G4B compass with the aircraft heading.

(6) Align the course and heading pointers on the course selector. Check that the horizon gyro unit bank angle pointer is at ZERO and that the vertical pointer on the indicator is exactly in the centre position.

(7) Turn the course setting knob anti-clockwise. Check that the vertical pointer, on the indicator, moves to port.

(8) Turn the course setting knob clockwise, and check that the vertical pointer, on the indicator, moves to starboard.

(9) Select the ALT. switch, on the control panel, to OFF.

(10) Turn the pitch pointer control, on the control panel, anti-clockwise, and check that

the horizontal pointer, on the indicator, moves upwards.

(11) Turn the pitch pointer control clockwise and check that the horizontal pointer moves downwards.

(12) Select the I.L.S. equipment on and allow time for the valves to warm up.

(13) Select the main selector switch to blue RIGHT.

(14) Align the course and heading pointers on the course selector. Check that the vertical pointer, on the indicator, is deflected in the same direction as the vertical pointer on the I.L.S. meter.

(15) Select the main selector switch to OVERSHOOT and check that the course and heading pointers are approximately aligned.

(16) Press the control panel TEST push switch and check that the horizontal and vertical pointers of the indicator move upwards and to the left respectively (intersection of the pointers should be in the top left quadrant of the dial). Also check that both the OFF flags appear on the indicator.

(17) Release the TEST push switch and check that the horizontal and vertical pointers return to their original positions and that the OFF flags disappear.

(18) Return the main selector switch to FLT. INST., PITCH control switch to ZERO and ALT. switch to OFF.

**BLIND-FLYING PANELS**

50. Provision is made for setting-up the blind-flying panels with the aircraft axis, the frame work to which the blind flying panels are fitted being adjustable. An adjusting screw is fitted, behind the instrument centre panel, to the top member of the frame work. Movement of this adjustment enables the blind-flying panels to be tilted forward or to the rear. The blind-flying panels are to be set-up in accordance with the instructions given in A.P.4377A, Vol. 1, Book 1, Sect. 1, Chap. 1.

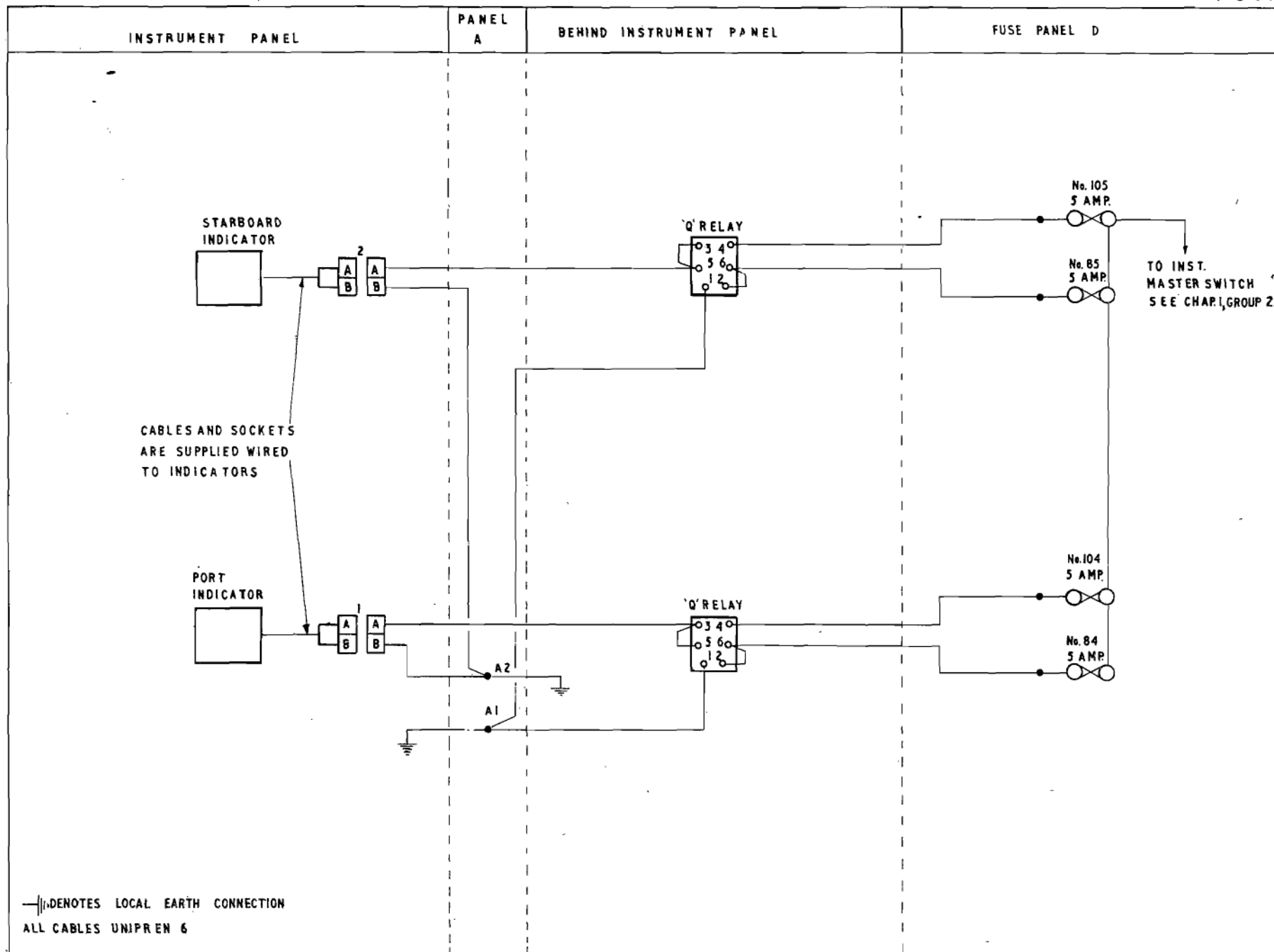


Fig. 8. Turn and slip indicators  
R E S T R I C T E D

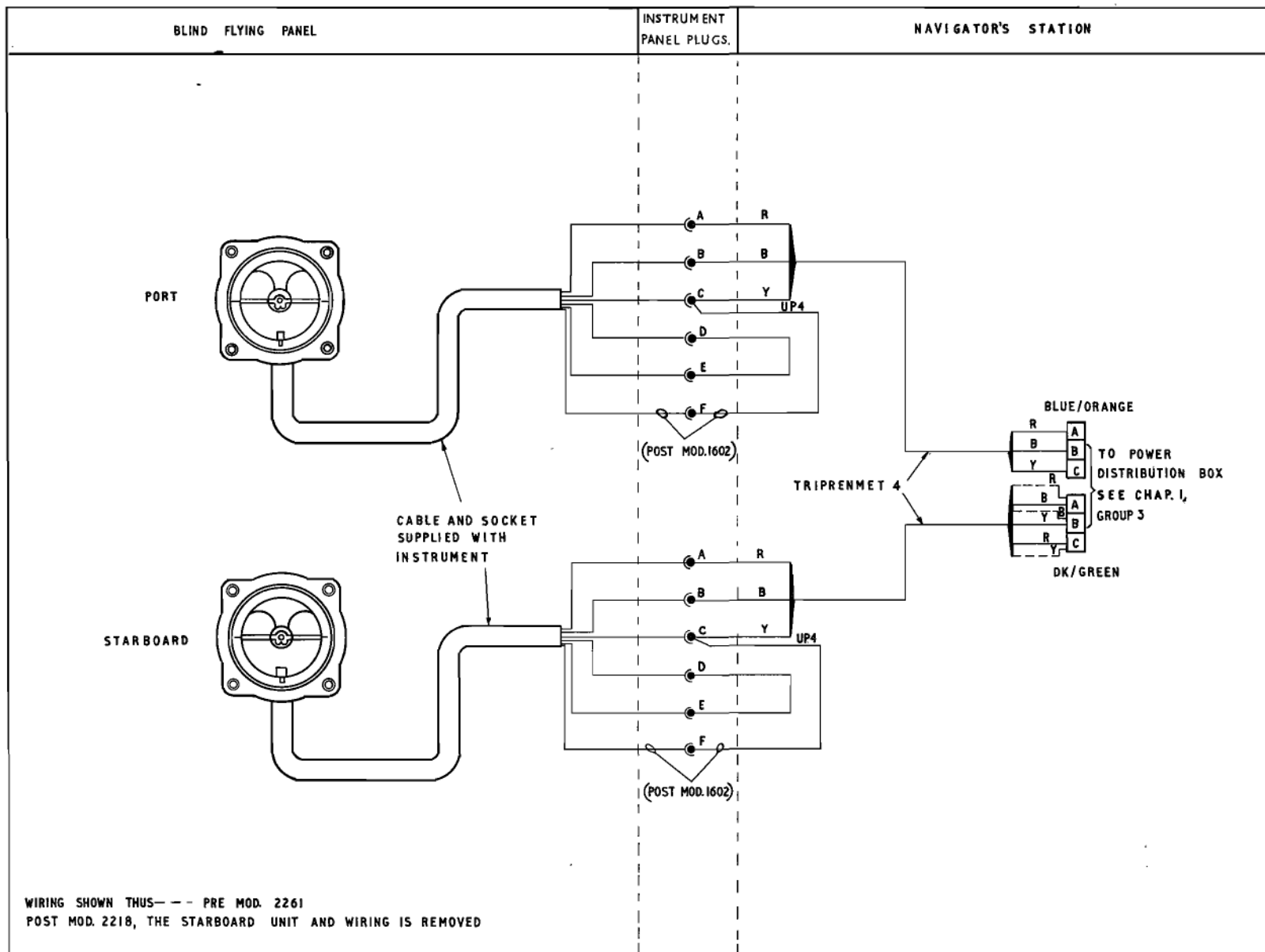


Fig. 9. Artificial horizon  
R E S T R I C T E D

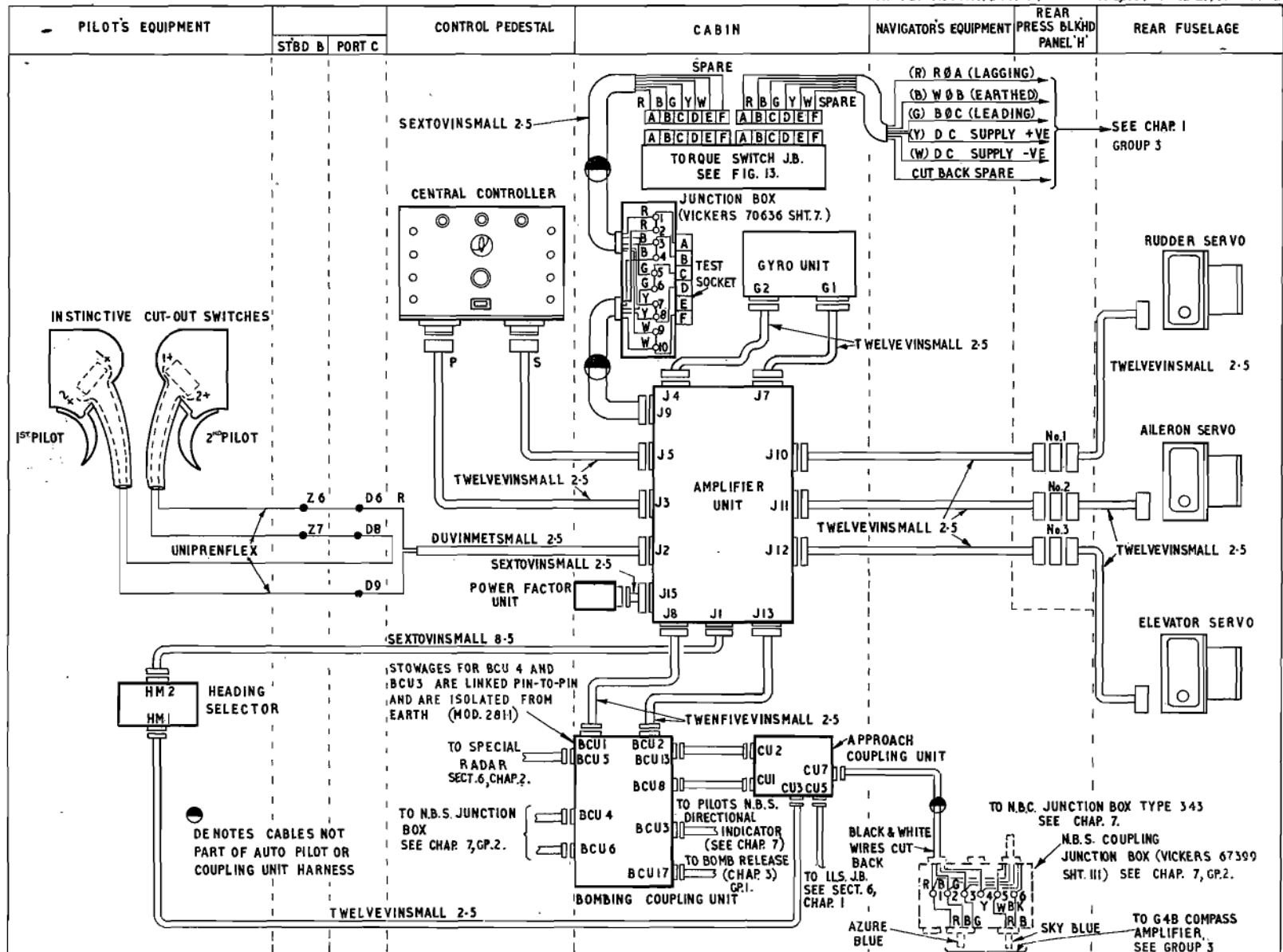


Fig. 10. Automatic pilot (pre Mod. 2181)

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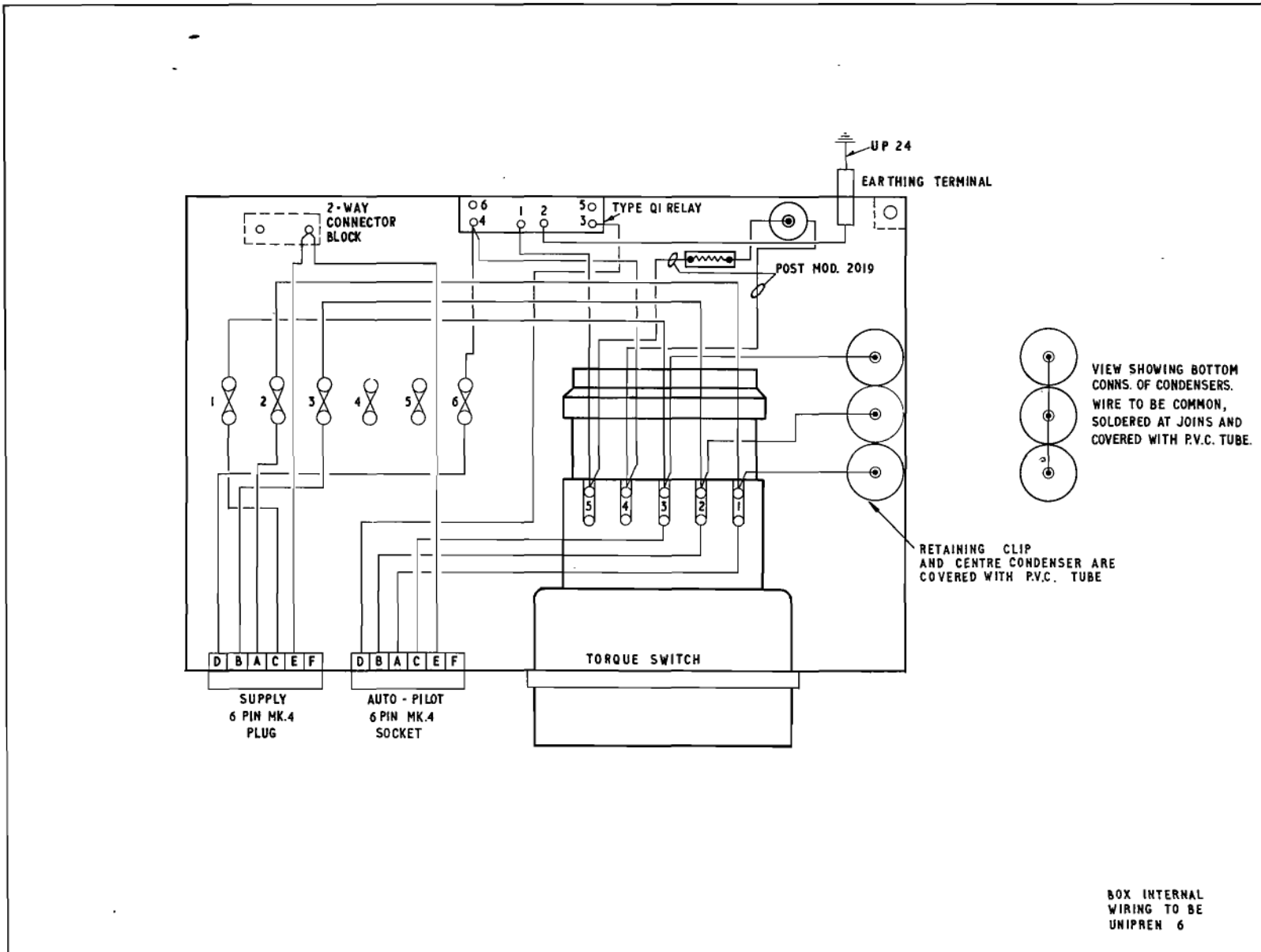


Fig.13. Auto-pilot torque switch box  
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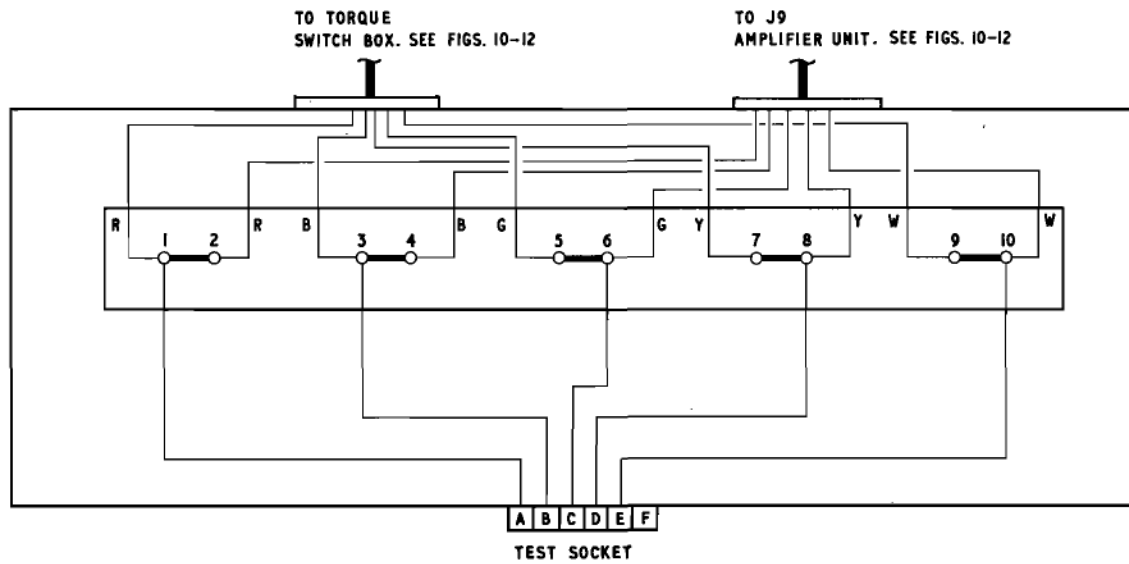


Fig. 14 Auto-pilot Mk. 10 junction box  
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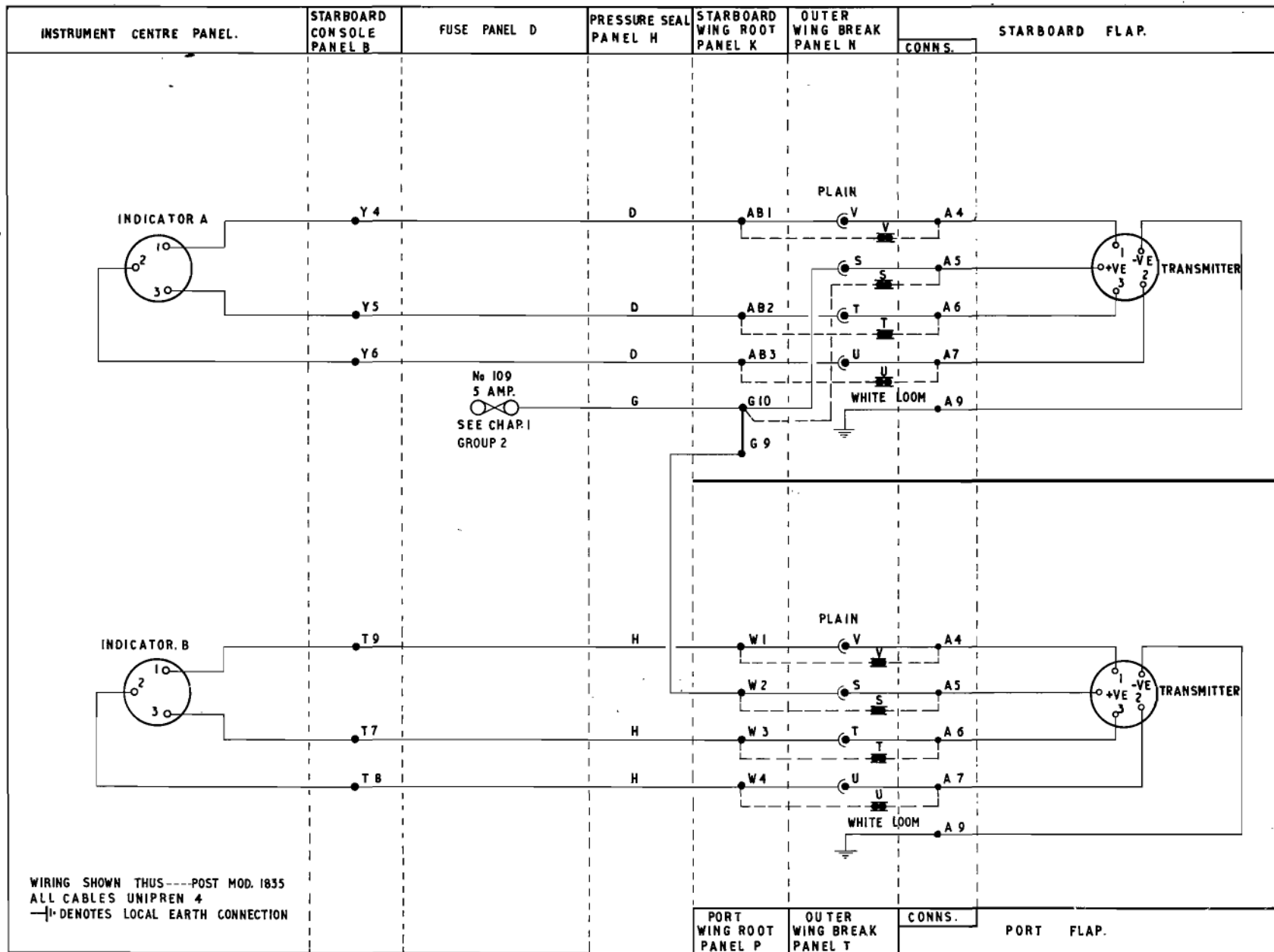


Fig. 15. Flap position indicators (pre Mod. 1785)  
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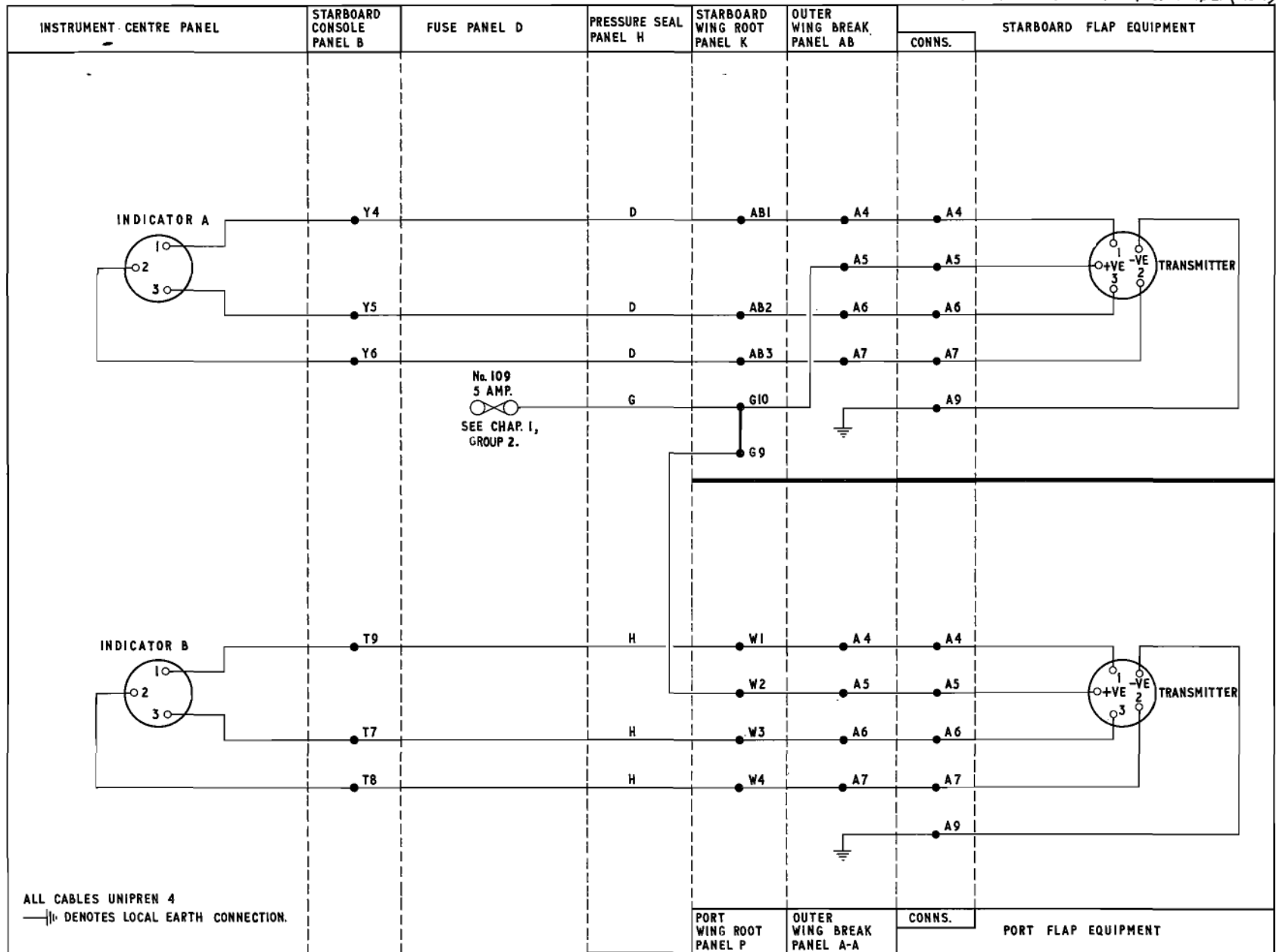


Fig. 16. Flap position indicators (post Mod 1785)  
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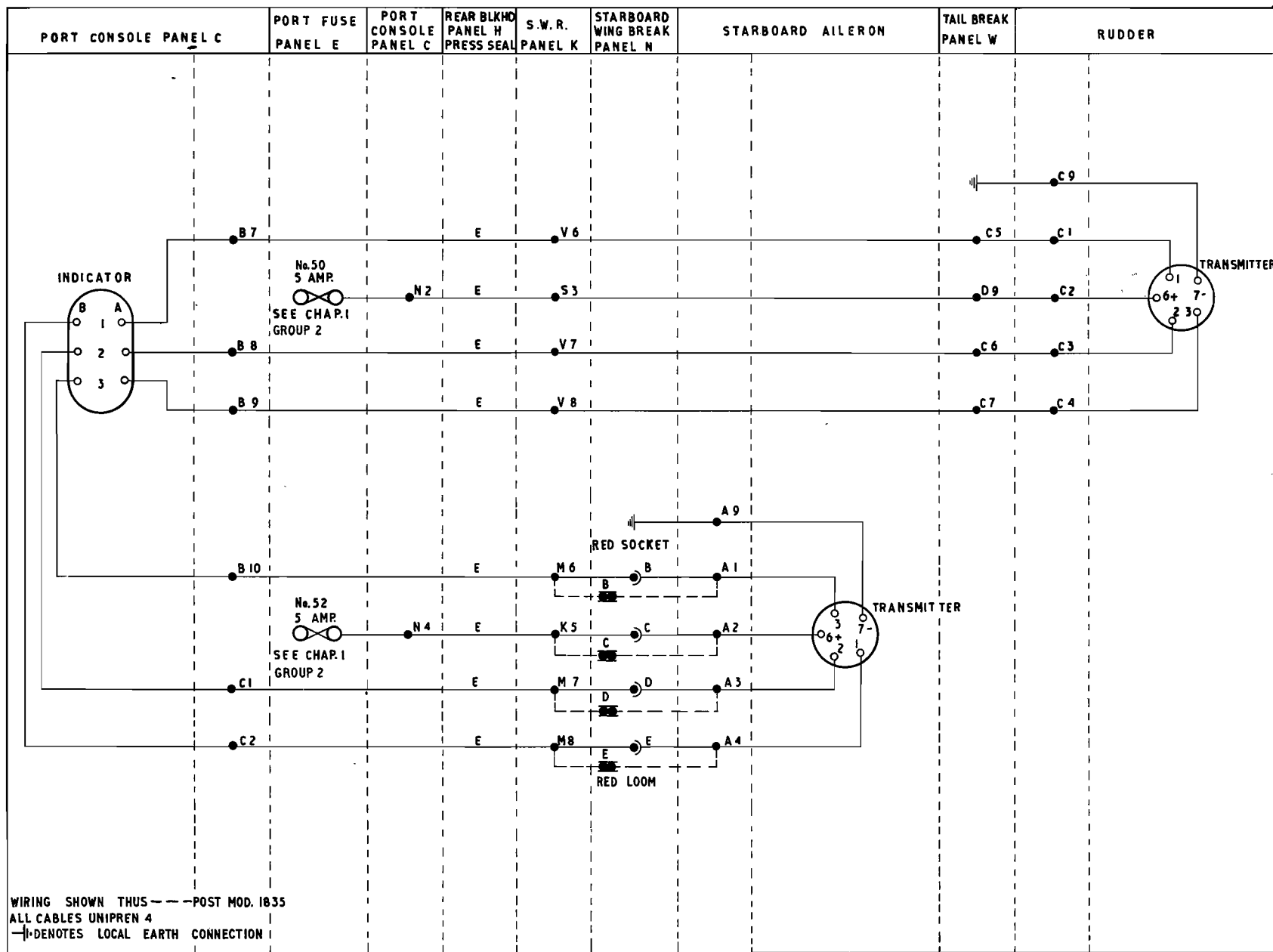


Fig. 17. Rudder and aileron trim position indicators (pre Mod. 1785)

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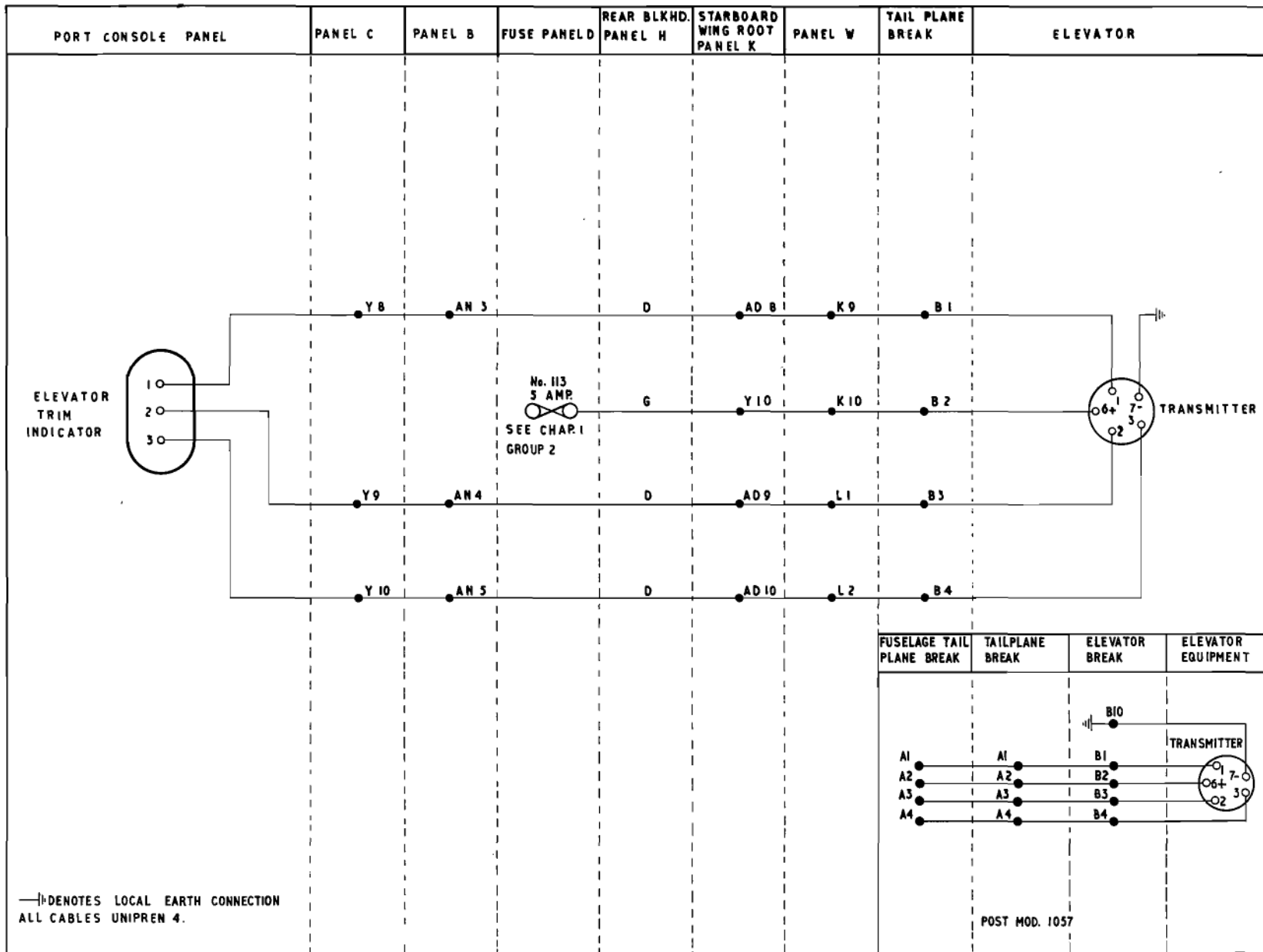


Fig. 19. Elevator trim tab position indicator (pre Mod. 1810)

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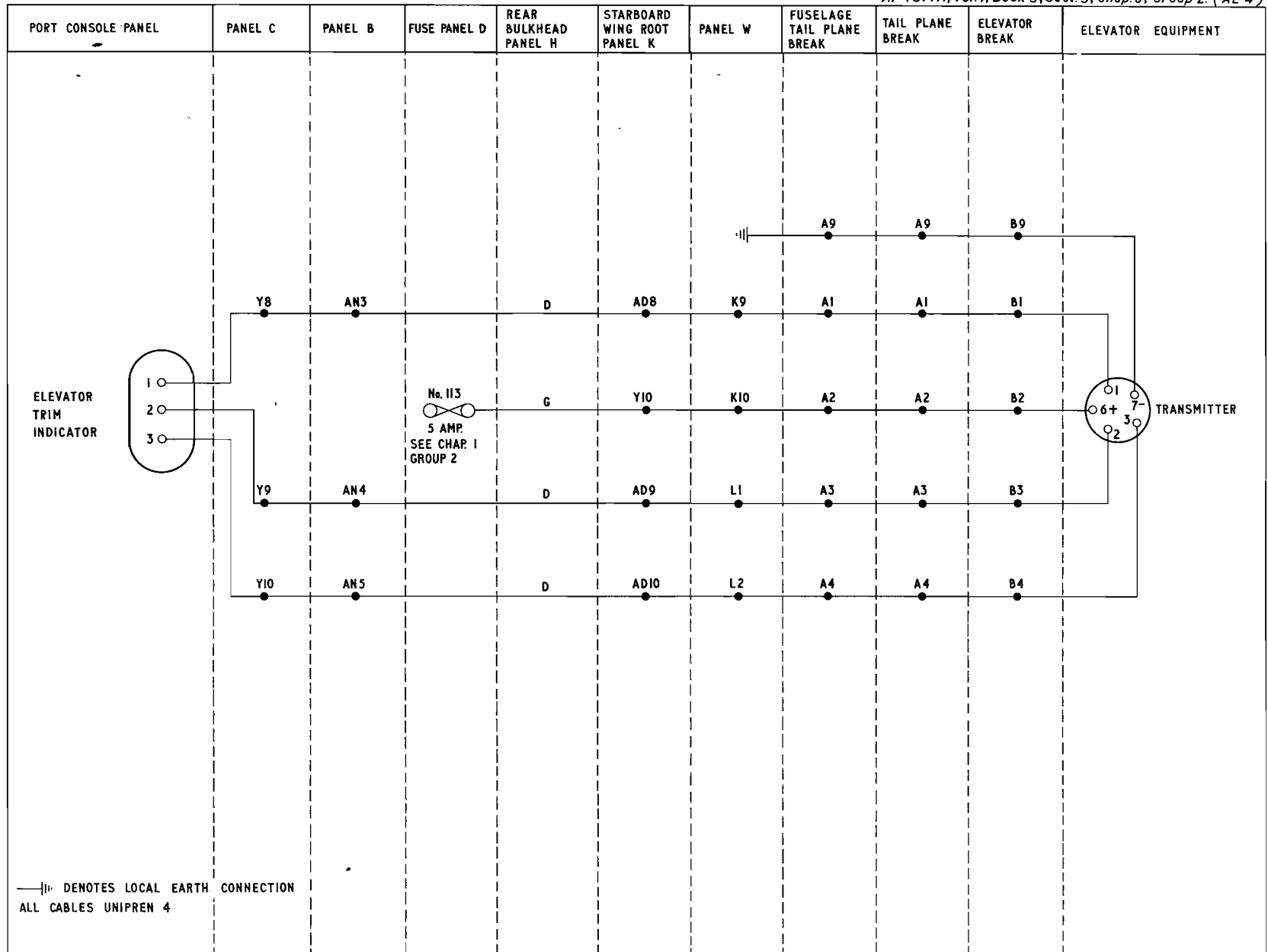


Fig. 20. Elevator trim tab position indicator (post Mod. 1810)

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(AL 4, May '58)

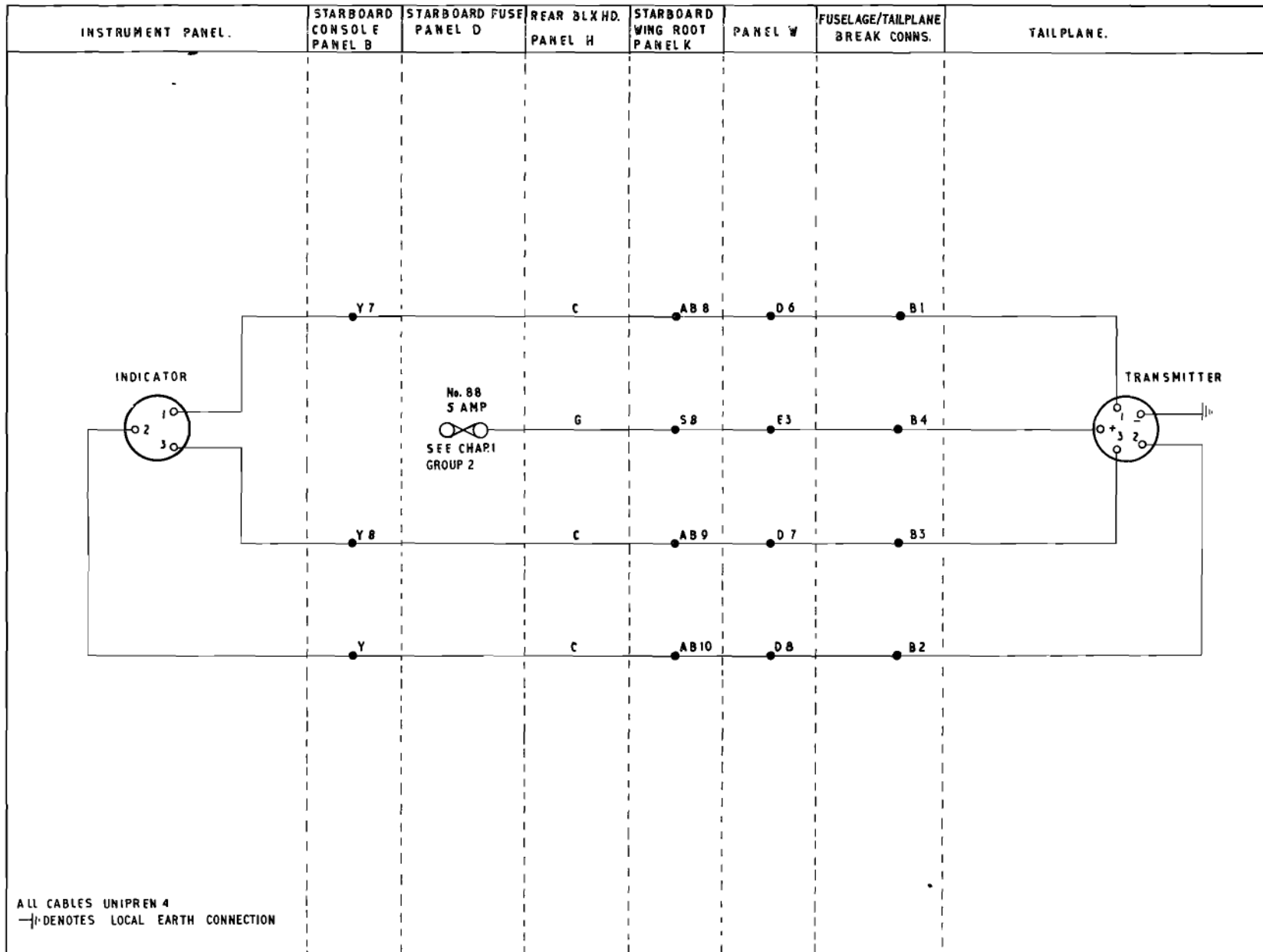


Fig. 21. Tail plane incidence position indicator  
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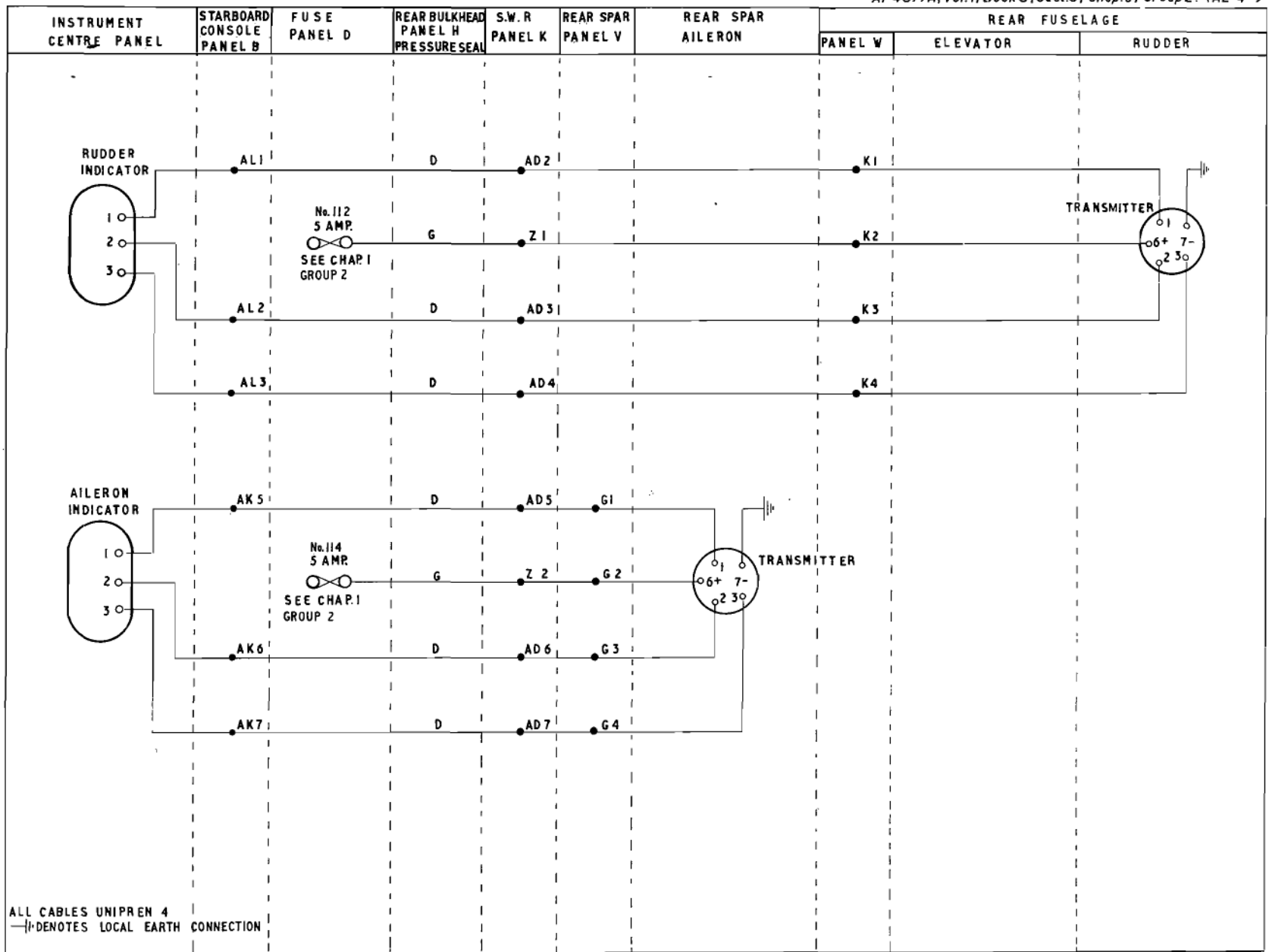


Fig. 22. Feel unit position indicators  
R E S T R I C T E D

(AL 4, May '58)

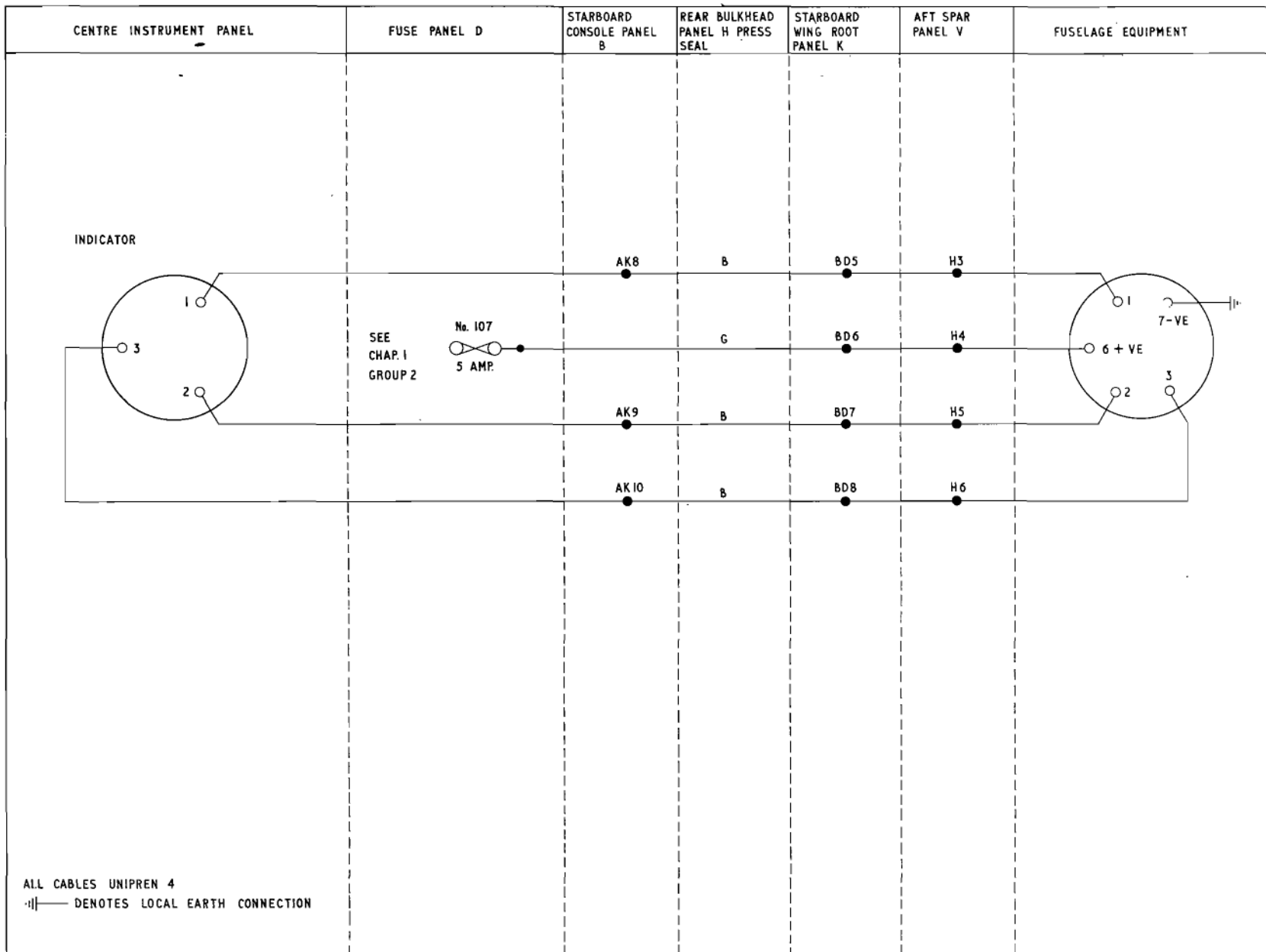


Fig. 23. Air brakes position indicator  
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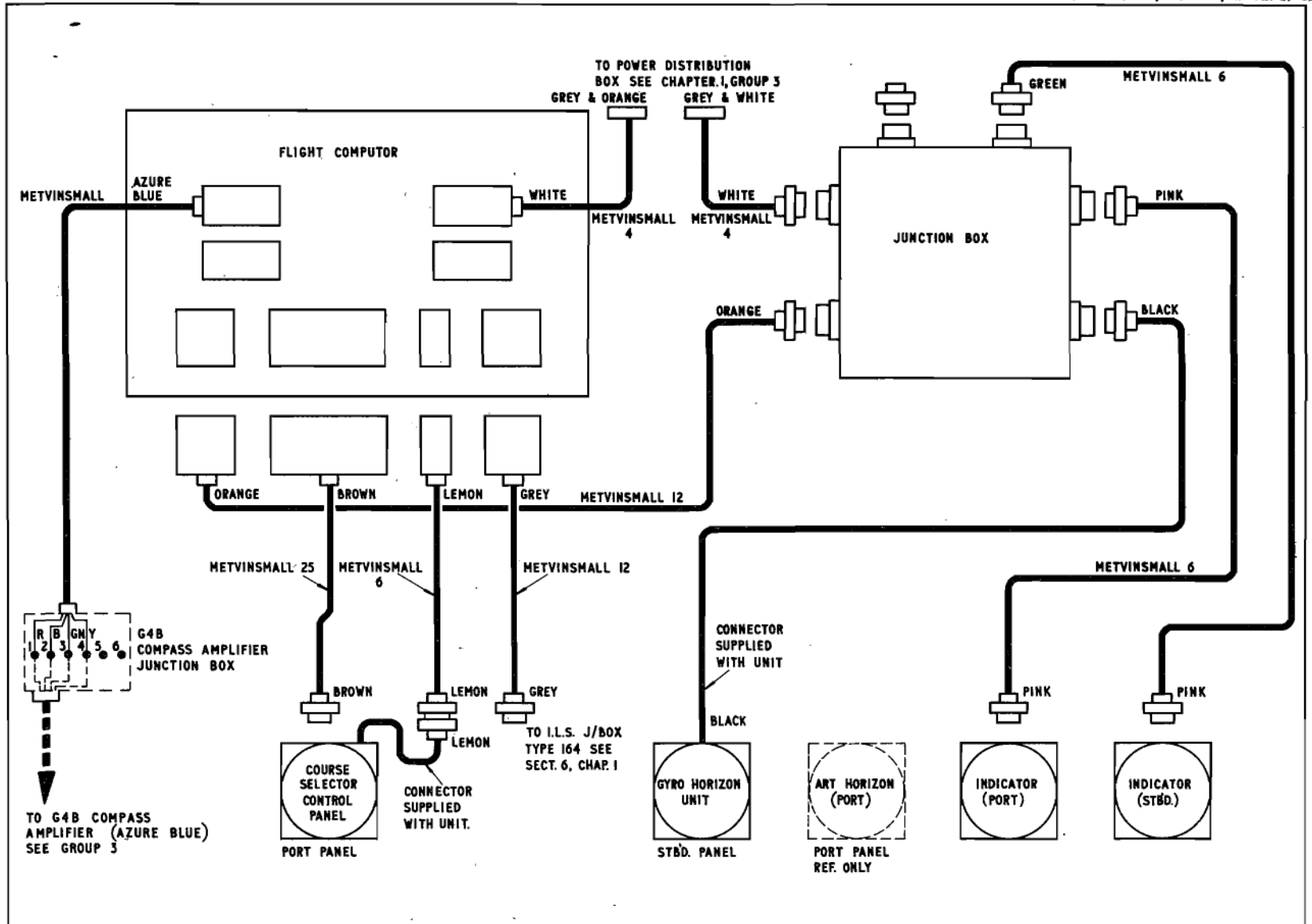


Fig. 24. Zero reader flight director type ZL2  
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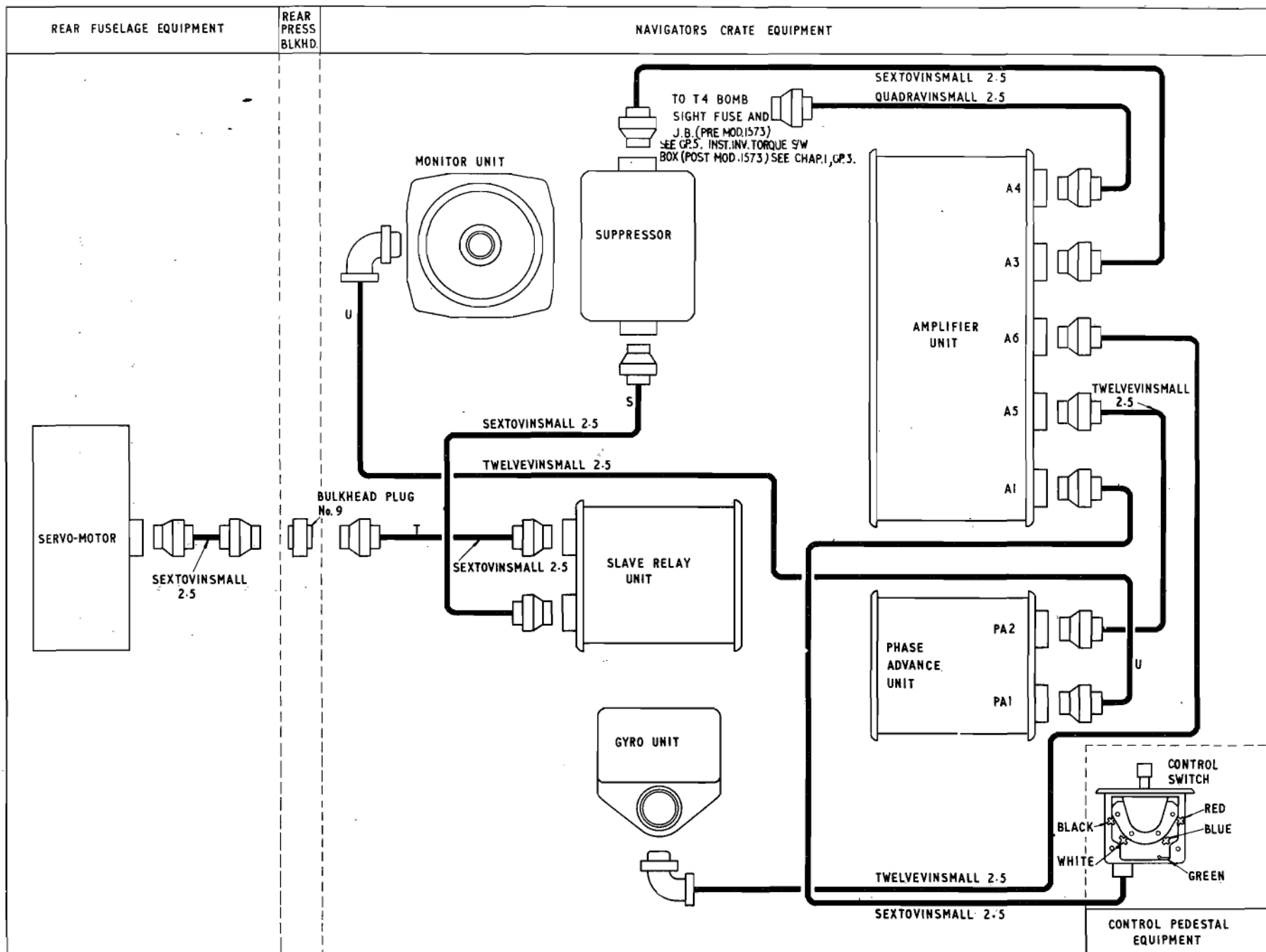


Fig. 25. Autostabilizer Mk. 2  
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## Appendix 1

### AIR SPEED INDICATORS (post Mod. 3093)

#### General

1. Post-Mod. 3093, the 2nd pilot's air speed indicator (*Group 2, Table 1*) is replaced by a sensitive air speed indicator (*Ref. 6A/3360*).

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## **Appendix 2**

### **RATE OF CLIMB INDICATORS (POST AMEND. 3158)**

1. Post amendment 3158, the 1st and 2nd pilots' rate of climb indicators are replaced by rate of climb indicators Mk. 3Q (Ref. 6A/7677).

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