GROUP 3.B

# ELECTRICALLY OPERATED INSTRUMENTS

(Including Mods.256, 390, 1231 and 1393)

**Note . . .**

*The Airstream Direction Detector, described in paras.14–19 and illustrated in Figs.7 and 8, is removed from Mk.11 G.A. aircraft by Modification 1393.*

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## TABLE



## LIST OF ILLUSTRATIONS

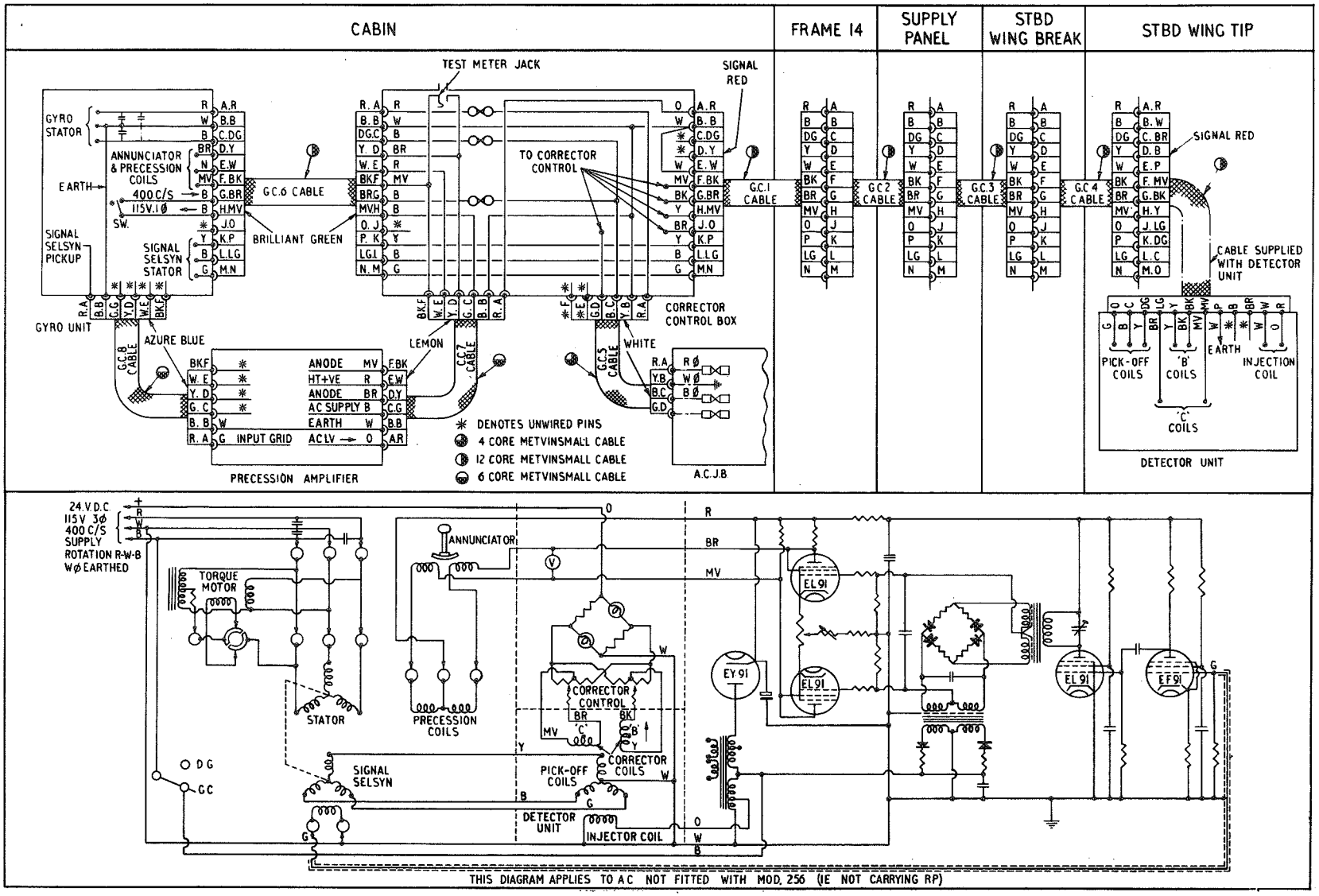


**Fig.1 Gyro compass (routeing and theoretical – pre Mod.256)**

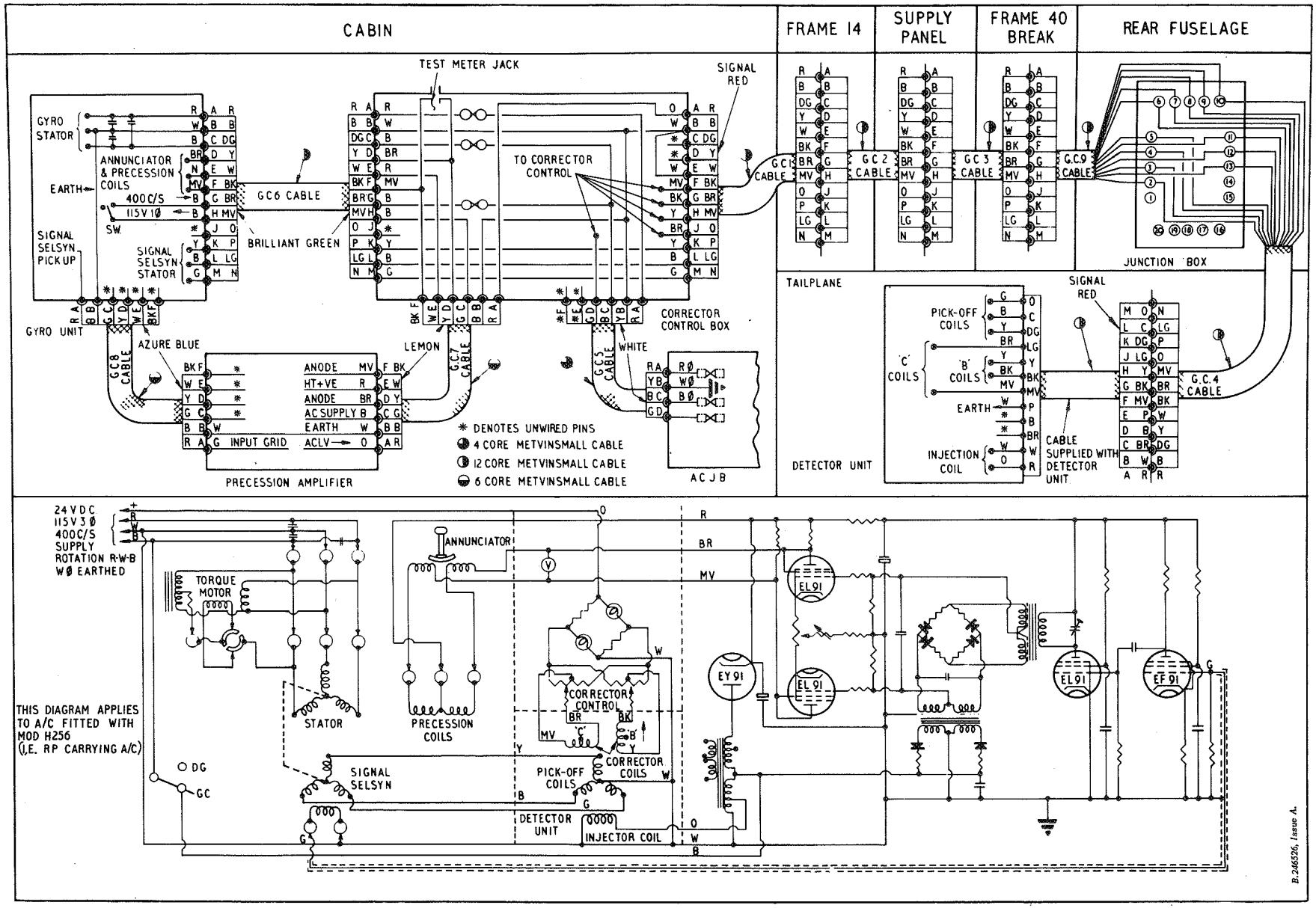


**Fig.2 Gyro compass (routeing and theoretical - post Mod.256)**

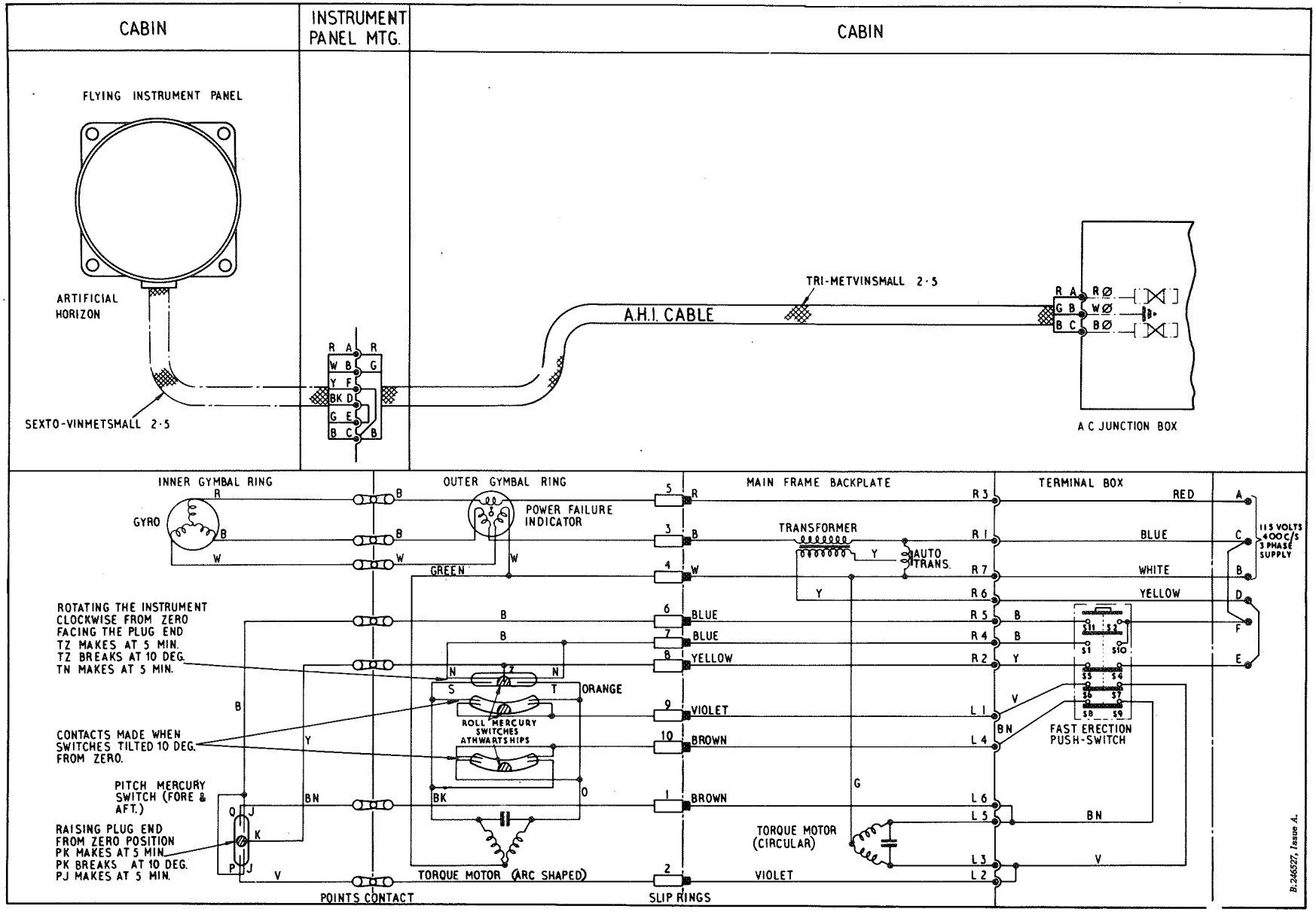


**Fig.3 Artificial horizon (routeing and theoretical)**

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**Introduction**

1. This group contains a description of the aircraft's electrically-operated flying instruments and includes routeing and theoretical diagrams of these installations. For a general description of the instrument installation reference should be made to Group 1.A. The location and access to all the instruments and associated equipment is given in Group 1.C. Detailed information on the standard components used will be found in the appropriate Air Publications listed in Table 1.

## DESCRIPTION

**Equipment details**

**Gyro compass (Code C)**

2. The gyro unit of the Type GM4F gyro compass installation is situated centrally on the lower section of the centre instrument panel. The gyro unit is an electrically operated directional gyro, which is orientated in the earth's magnetic field by a remote detector unit which, in aircraft pre Mod.256, is located in the starboard wing tip and, in aircraft post Mod.256 is located in the port side of the tail plane. The instrument gives a continuous indication of the aircraft's magnetic heading at all times throughout flight. The installation, which also incorporates a precession, amplifier and a corrector control box, is supplied with d.c. for compass correction and three-phase a.c. from the a.c. supplies circuit described in Sect.5, Chap.1, Group E.1. The precession amplifier and corrector control box are both located on the starboard side of the cabin. Routeing and theoretical diagrams of the installation are given in fig.1 and 2, but for a full description of the compass and the principle of operation, reference should be made to the Air Publications listed in Table 1.

**TABLE 1**

**Equipment type and Air Publication reference**

| Equipment | Air Publication |
|---|---|
| Gyro compass<br>Gyro unit, Type A or B<br>Detector unit, Type A<br>Corrector control box<br>Precession amplifier, Type A | A.P.1275B, Vol.1, Sect.11 |
| Artificial horizon, Mk.4, A or Mk.4E<br>Turn and slip indicator, Mk.2A | A.P.1275A, Vol.1, Sect.13 |
| Tail plane position indicator, Type 587FL<br>Tail plane position transmitter, Type 227FL<br>Rudder and aileron trim indicator, Type 501FL<br>Rudder tab position transmitter, Type 470FL<br>Aileron tab position transmitter, Type 568FL<br>Flap position indicator, Type 473FL<br>Flap position transmitter, Type 132FL | A.P.1275A, Vol.1, Sect.16 |
| Airstream direction detector Mk.2 | A.P.1275, Vol.1, Sect.27 |
| A.D.D. master switch C.W.C., Type XD.778 No.4 | A.P.4343C, Vol.1, Book 1, Sect.1 |

**Artificial horizon (Code H)**

3. The artificial horizon is located on the centre instrument panel just above the gyro-compass and provides a continuous indication of the aircraft's attitude in roll and pitch in relation to the natural horizon. The instrument is an electrically-

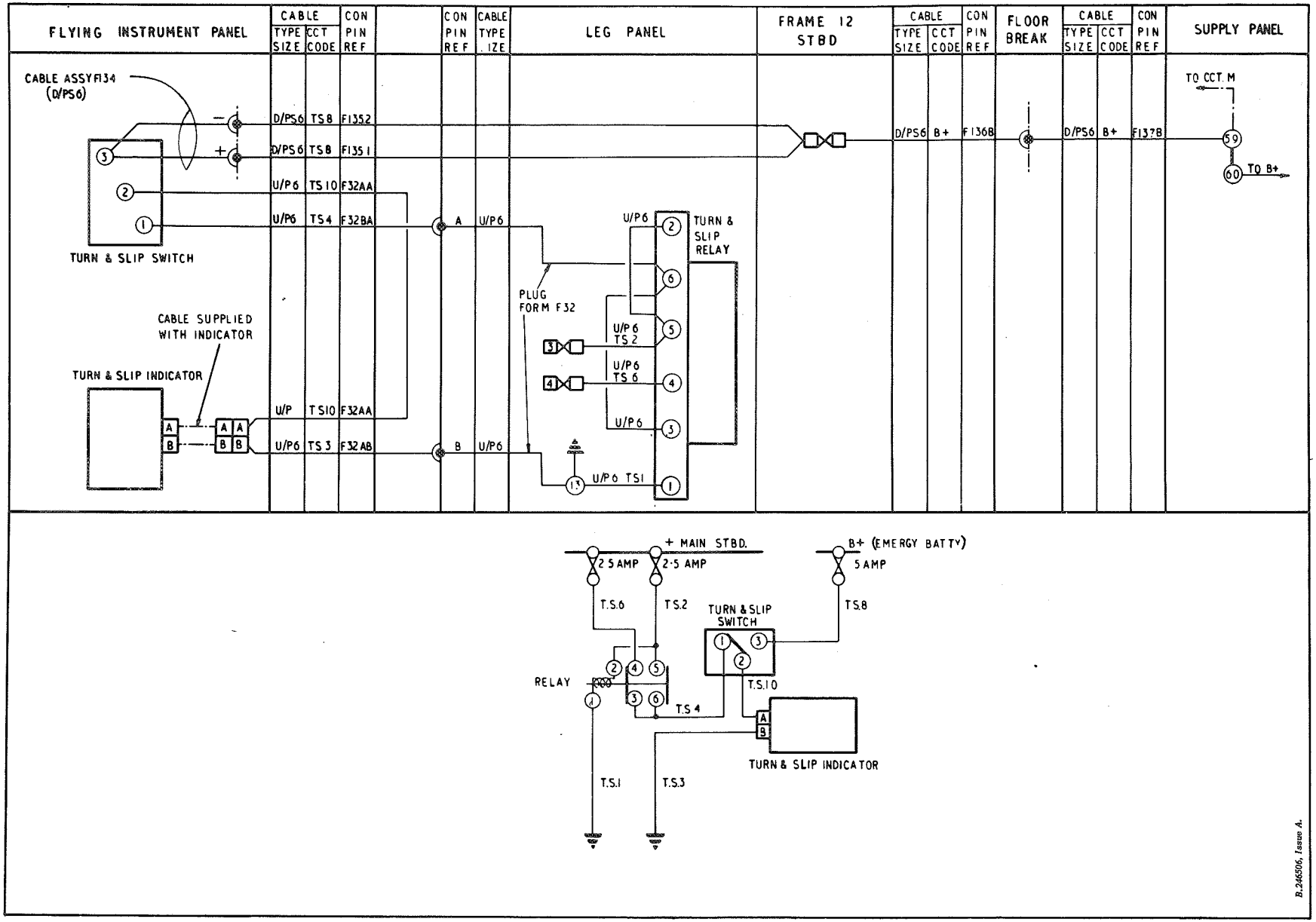


**Fig.4 Turn and slip indicator (routeing and theoretical)**

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operated gyroscope, the gyro unit being basically a three-phase induction motor.

4. The artificial horizon is fed with a three-phase a.c. supply from the a.c. junction-box in the a.c. supplies circuit as described in Sect.5, Chap.1, Group E.1. For a detailed description of the installation together with the principle of operation reference should be made to A.P.1275A, Vol.1, Sect.13. A routeing and theoretical diagram of this installation is given in fig.3.

5. When the a.c. supplies are connected, the gyro rotates and eventually attains operational speed. Manual fast erection of the gyro may be attained by the use of the fast erection push switch located on the artificial horizon. This switch allows the pilot to re-erect the gyro should it topple, due to a sharp manoeuvre of the aircraft, and should not be used until the aircraft is once again in level flight. The fast erection switch should not be used on the ground unless the gyro has attained operational speed.

**Turn and slip indicator** *(Code TS)*

*General*

6. This indicator is fitted on the starboard side of the centre instrument panel just below the rate of climb indicator. It is provided to indicate the aircraft's lateral attitude in relation to level flight and to indicate skid, side slip or correct bank during a turn. The indicator is an electrically-operated instrument which is normally supplied from the aircraft's 28 volt d.c. supply or, should this supply fail, from the standby batteries *(Sect.5, Chap.1, Group B.1)*.

*Normal supply*

7. The normal supply, which is operating immediately the battery master switch is placed in the ON position, is provided with duplicated fuses located in the leg panel. The supply from the fuses to the instrument is controlled by a relay also located in the leg panel.

*Emergency supply*

8. Should the normal d.c. supply fail, the standby batteries may be brought into use by placing the NORMAL/EMERGENCY turn and slip switch to the EMERGENCY position. This switch is located adjacent to the turn and slip indicator.

**Operation**

*Normal supply*

9. The operation of the normal supply circuit is such that when the battery master switch is placed in the ON position, the turn and slip relay is energized, via the normal circuit fuse. Contacts of this relay, which are made while the relay is energized, feed the supply from the normal fuse and through the turn and slip switch to operate the indicator. If the normal fuse fails, the relay will immediately be de-energized, thus making the other set of contacts, which are fed from the standby fuse and also connected, via the turn and slip switch, to the indicator. The indicator is now supplied from the standby fuse and remains in operation with no apparent indication of fuse failure.

**Note . . .**

*Due to the fuse change-over facility of this circuit, it is important to check that the normal and standby fuses are both serviceable before each flight.*

*Emergency supply*

10. The emergency supply is provided as a standby in the event of an electrical fault developing in the normal d.c. supply to the indicator. A separate 24 volt supply (B+) from the standby batteries passes through a fuse to contact 3 of the turn and slip supply switch. Placing the switch in the EMERGENCY position makes contacts 3-2 and breaks contacts 1-2 of the switch, thus isolating the normal supply and connecting the emergency supply to the indicator. A circuit diagram of the turn and slip indicator installation is given in fig.4.

**Tail plane position indicator** *(Code TD)*

11. The incidence of the tail plane is shown on an indicator situated on the port side of the centre instrument panel. The indicator is operated by a Desynn transmitter located in the dorsal fin just above the tail plane actuator and linked to the actuator by a short operating rod. A routeing and theoretical diagram of the electrical circuit is given in fig.5. Details of the Desynn system will be found in the Air Publications listed in Table 1.

**Rudder and aileron tab position indicators** *(Code RD and AD)*

12. The settings of the rudder and aileron trim tabs are shown on a trim indicator

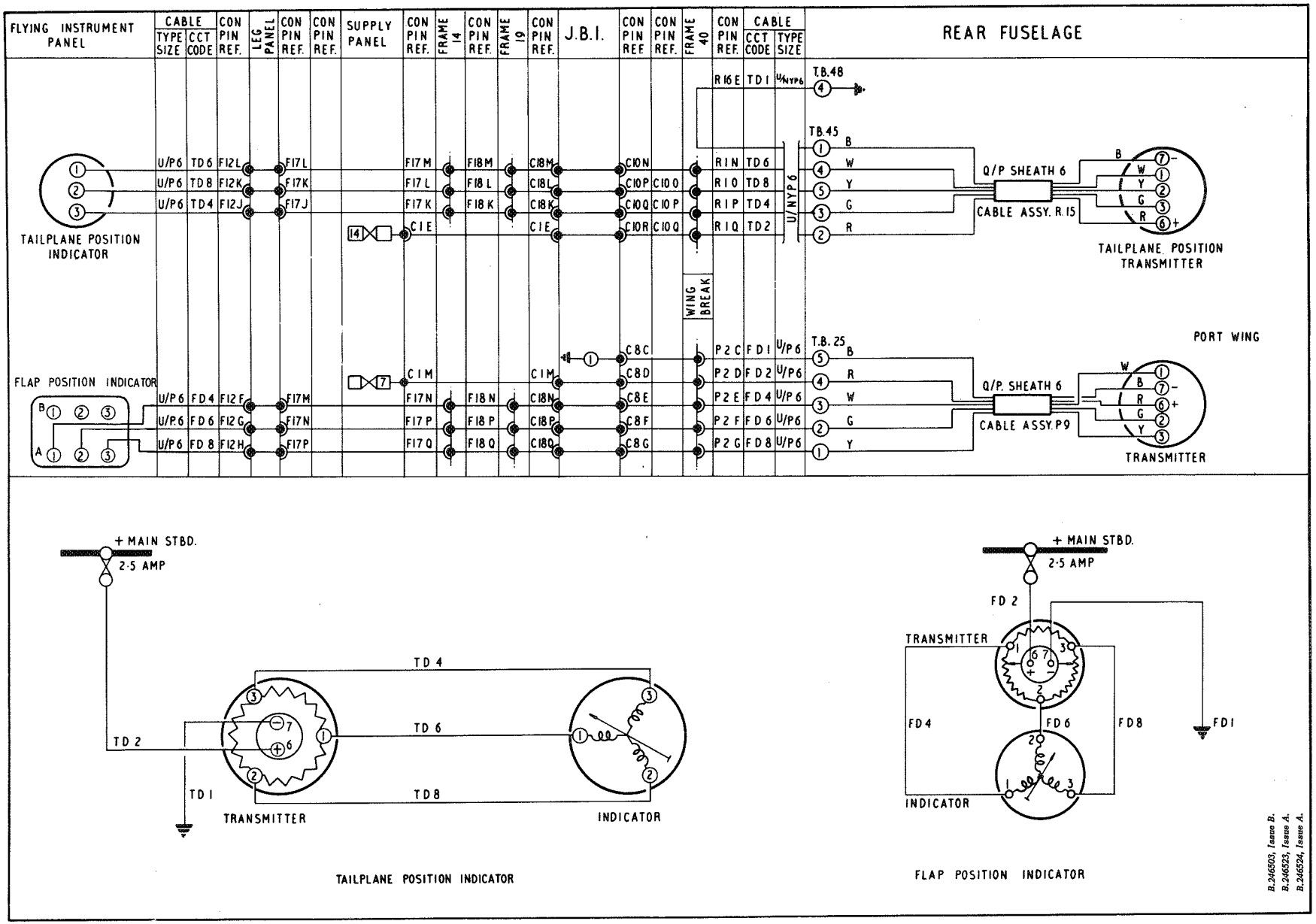


**Fig.5 Tail plane and Flap position indicators (routeing and theoretical)**

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located just forward of the trim switch on the cabin port shelf. The rudder portion of the indicator is operated by a Desynn transmitter, which is bolted to nose rib F in the leading edge of the fin and the aileron portion of the indicator is actuated by another Desynn transmitter located adjacent to the tab actuator in the aileron structure. Both transmitters are actuated by cables connected to levers on the tab actuators. Routeing and theoretical diagrams of the electrical circuits of the indicators are given in fig.6.

**Flap position indicator** *(Code FD)*

13. This indicator is located on the port side of the centre instrument panel just below the machmeter and is operated by a Desynn transmitter located in the port wheel bay. This transmitter is linked to the flap drum switch and interconnecting levers by a Bowden cable. A routeing and theoretical diagram of the electrical circuit is given in fig.5.

◀ **Airstream direction detector** *(Mod. 1231)*

14. The airstream direction detector installation, introduced by Mod.H1231, enables the pilot to fly at the optimum approach angle, whilst concentrating his attention outside the cabin. The complete installation comprises a probe unit which transmits aircraft angle of attack information to the cabin mounted indicator, and to the indicator lights box via the three tone audio generator. The indicator and indicator lights provide a visual warning to the pilot, whilst the audio generator also gives an aural warning through the pilot's telephone circuit via a radio circuit and an audio control unit. An ON/OFF master switch is also incorporated for the installation and interconnection of components is by multi-pin plugs and sockets.

15. The stainless steel probe projects horizontally into the airstream on the port side of the fuselage centre line between frames 6 and 7 and is protected by a cylindrical metal cover. It is formed in two passages with the outer casing slotted to allow the airstream to pass to the inner end of the probe unit to a paddle chamber. Variations in angle of attack cause the paddle and probe to rotate, moving the wiper arms of two potentiometers which are attached to the inner end of the probe. Signals from the first potentiometer are used to operate the angle of attack indicator and the signals from the second potentiometer pass to the three tone generator for operation of the lights box and audio warning circuit. The probe has a 50 deg. movement and contains a 28V d.c. thermostatically controlled anti-icing heater. The mounting of the probe unit incorporates a vernier adjustment ring for accurate setting of the probe on initial installation.

16. Power supply for the installation is from a 10 amp. fuse in the cabin starboard shelf via the A.D.D. MASTER switch. This single pole switch is mounted on a bracket on the starboard glare shield and when selected ON, passes a supply to a 5 amp. circuit breaker which protects the circuit for heating the probe, and to three 2.5 amp. fuses which protect the 28V supplies to the angle of attack indicator, the three-tone generator, and the indicator lights respectively. The 5 amp. circuit breaker and three 2.5 amp. fuses are contained in the A.D.D. J.B. which is mounted on a bracket attached to the starboard side of the seat rail. This J.B. is also the main earthing point for the A.D.D. installation. Theoretical and routeing electrical circuits are shown in figs.7 and 8.

17. The A.D.D. controller is mounted on the starboard longeron in the cabin adjacent to the MASTER switch and its function is to provide on/off switching and volume control necessary for control of the approach aid part of the installation. The on/off switch controls the 28V d.c. supply and the volume control knob forms part of an attenuator circuit operating into the three-tone generator.

18. The A.D.D. indicator and indicator light box are mounted adjacent to each other on a bracket attached to the top of the port instrument panel, so situated as to be in the pilot's angle of vision when concentrating on an approach to landing. ▶

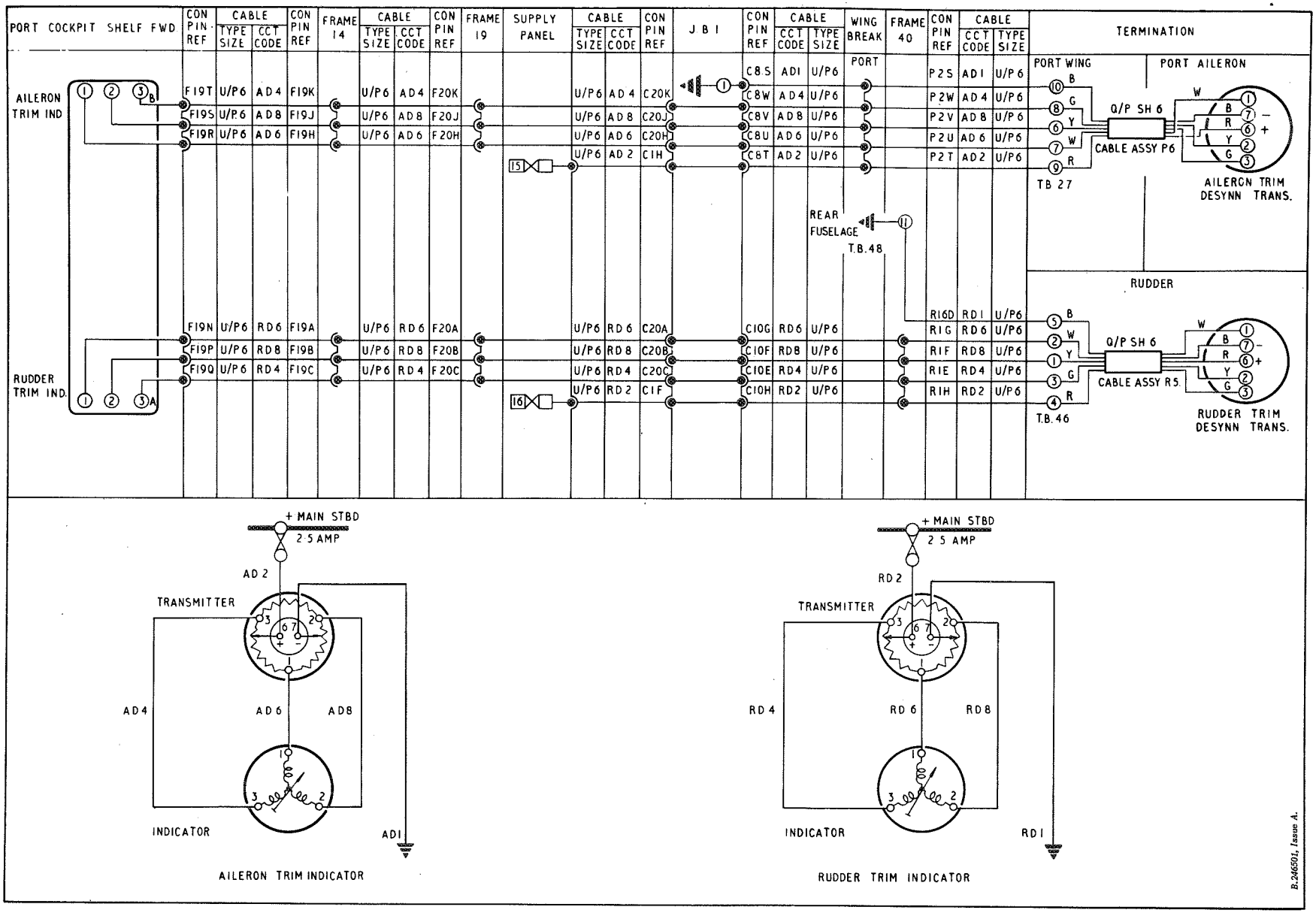


**Fig.6 Rudder and aileron tab position indicators (routeing and theoretical)**

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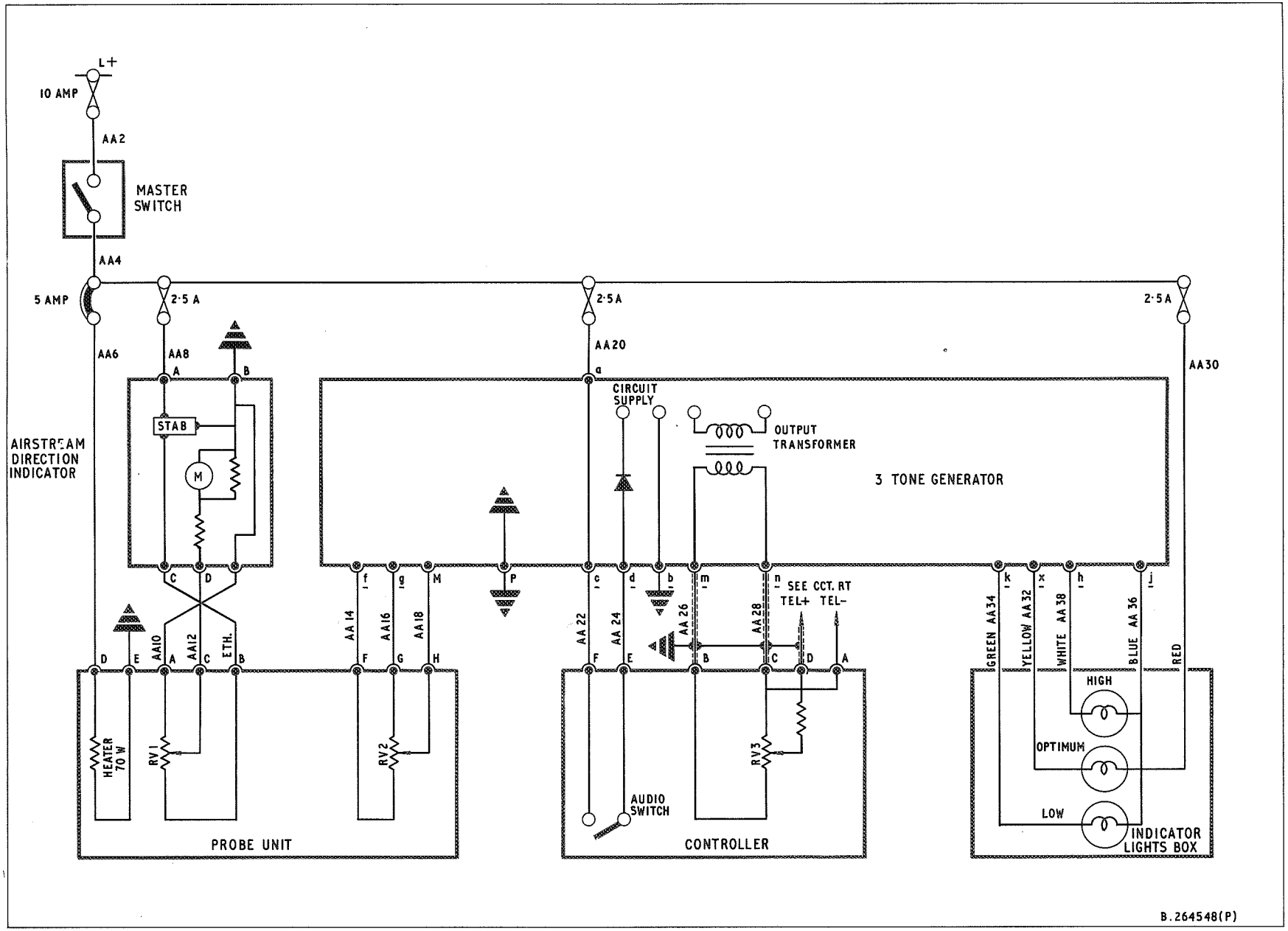


Fig.7 Airstream direction detector (theoretical)

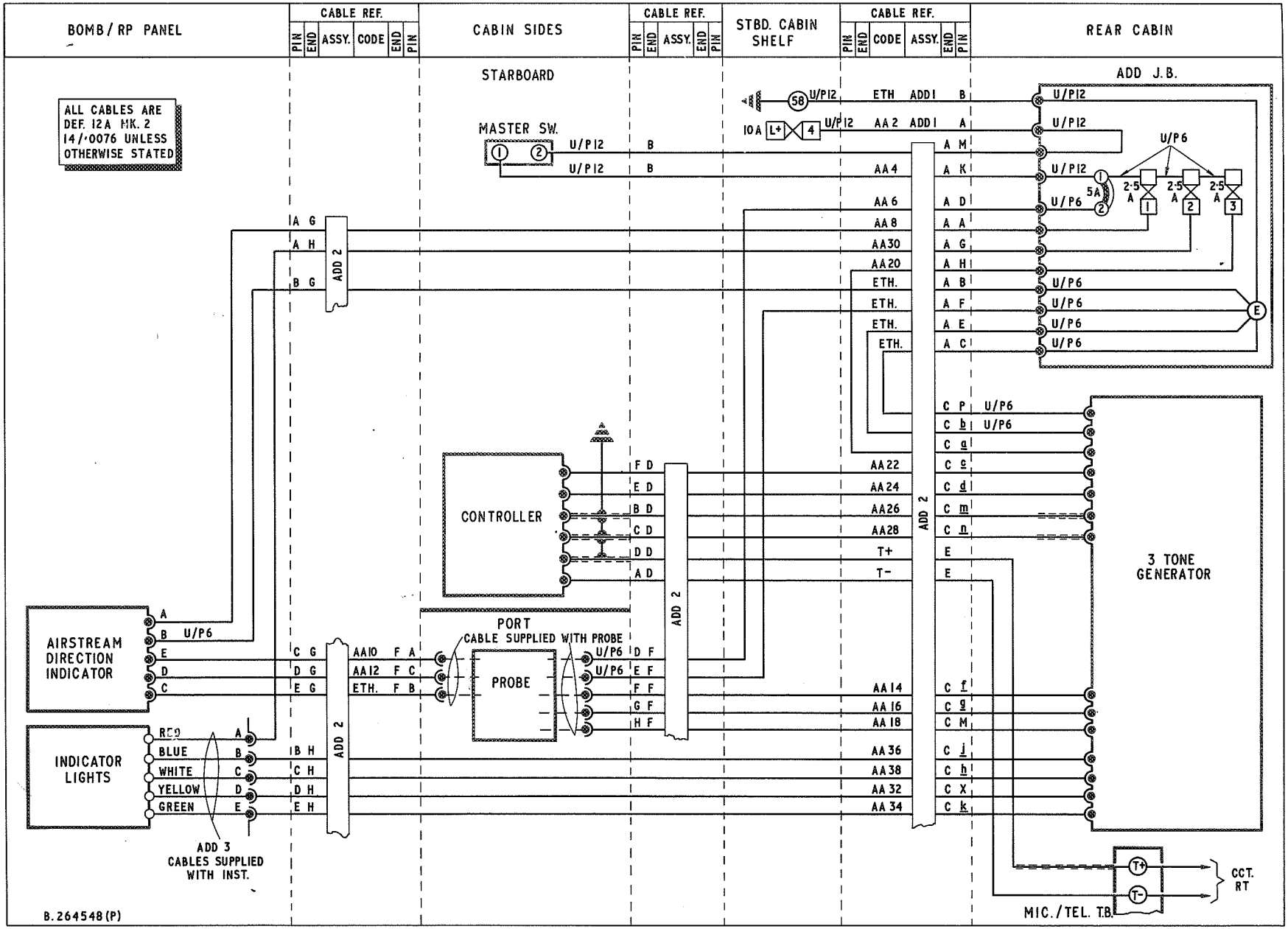


Fig.8 Airstream direction detector (routeing)

◀ The indicator, labelled ANGLE OF ATTACK has a 200 deg. needle movement reading from 0 deg. to 30 deg. angle of attack and receives its operating voltage signals from the first potentiometer on the probe unit. The indicator lights box consists of a visual display unit containing three lamps. The presentation is shown as an illuminated circle representing the optimum angle of attack and two illuminated arrowheads which indicate the direction of the airframe correction necessary to return to the optimum angle. The illumination brightness is manually controlled by an external lever which operates an optical dimming system consisting of fixed and moveable polaroid discs. The switching action to the lights box, which is produced by signals received from the three-tone generator is such that an overlapping action of both circle and arrowhead is obtained, allowing five indications with the three lamps. A detachable anti-glare hood is fitted to the lamp box.

19. The three-tone generator is mounted on a bracket on the upper starboard side of the pilot's seat rail above the A.D.D. junction box and electrical connections are made by a single multi-pin plug. The function of the generator is to provide an audio and lights sequence presentation of the angle of attack for the approach condition. The audio signal is fed to the pilot's headphones via the radio circuit, and the visual signal is shown by the lights in the indicator lights box. The generator has a 28V d.c. supply and receives its operating signals from the second potentiometer in the A.D.D. probe unit. For further information on the A.D.D. installation reference should be made to the Air Publication listed in Table 1. ▶

## SERVICING

### General

20. The servicing necessary to maintain the electrically-operated flying instruments in an efficient condition, and the standard serviceability tests, are contained in the relevant Air Publications listed in Table 1. The method of adjusting the linkages to the various Desynn transmitters is described in Sect.3, Chap.4. Before servicing or removing any of the electrically-operated instruments the aircraft must be rendered electrically safe, as described in Group A.1 of Sect.5, Chapter 1.

## REMOVAL AND ASSEMBLY

### General

21. The removal of the instrument panels carrying the electrically-operated flying instruments is described in Group 1.B. Once access has been obtained, the removal of the instruments from the panels should present no difficulty. Access to the rudder tab Desynn Transmitter may be gained by removing a door from the port side of the upper fin structure and access to the aileron tab transmitter is obtained by removing an access door from the upper surface of the aileron leading edge after the removal of the aileron.

◀ **WARNING:**

**Before any attempt is made to remove the three-tone generator or A.D.D. junction box, mounted on the pilot seat rail, reference must be made to the LETHAL WARNING card at the front of this Air Publication.**

### A.D.D. junction box

22. The recommended method of removal of this junction box is as follows:-

(1) Render the aircraft electrically safe as described in Sect.5, Chap.1, Group A.1 of this A.P.

(2) Unscrew A.D.D.1 and A.D.D.2 connections and fit approved blanking caps and covers.

(3) Undo the four screws securing the J.B. to its mounting and remove the box from the aircraft.

### Three-tone generator

23. To remove this generator from the aircraft, proceed as follows:-

(1) Render the aircraft electrically safe as described in Sect.5, Chap.1, Group A.1 of this A.P. ▶

(2) Unscrew multi-pin connector and fit approved cap and cover.

(3) Undo the four bolts securing the generator to its mounting bracket, withdraw the unit forward through its mounting and remove from the aircraft.

**Probe unit**

24. Once access has been gained to the port side of the nose wheel bay, the recommended procedure for removing the probe unit is as follows:-

(1) Render the aircraft electrically safe as described in Sect.5, Chap.1, Group A.1 of this A.P.

(2) Disconnect probe unit cable from cable end A.D.D.2F and fit blanking caps and covers.

(3) Note vernier setting on adjustment ring for re-assembly, support probe unit body and undo the six retaining bolts.

(4) Remove the vernier clamp ring then withdraw the probe unit inboard, being careful to keep it horizontal to prevent damage to the probe until it is clear of the aircraft skin.

(5) Remove the seal from inside of housing, replace ring clamp assembly and secure it loosely with the six retaining bolts.

(6) Fit a blanking cap to probe orifice in the aircraft skin and cover the probe unit housing to prevent ingress of dust and moisture.

(7) The probe unit, complete with vernier adjustment ring may now be removed from the aircraft.

**Note. . .**

*On re-assembly ensure a new seal is fitted to the inside of the probe unit housing and that the vernier adjustment ring is at the same setting as on removal before tightening down the six retaining bolts. The retaining bolts must be tightened down uniformly to avoid distortion of the vernier adjustment ring.*