Chapter 2

RADAR INSTALLATION

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Introduction

1. This chapter describes the radar equipment installed in this aircraft, including the necessary servicing information required to maintain the installation in an efficient condition. Information on the removal of the various components, together with illustrations showing the location and interconnection of the equipment, are also included. For a detailed description and technical information on the equipment used, reference should be made to the Air Publications listed in Table 1.

Note . . .

Mod.1369 removes the A.R.I.5848 installation and introduces A.R.I.23134/3 which is described in Appendix 1.

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
A.R.I.23013 Transmitter-receiver, Type 8193 Junction box, Type 8196 Mounting rack, Type 8202 Aerials (Transmitter and receiver), Type 91 Aerial switch unit, Type 514 Control unit, Type 8197	A.P.114J-0700-1
Aerials (D.F.), (H.S.A. Design).	
A.R.I.5848 Transmitter-receiver, Type 4585 Aerials, Type 100A or 100B Aerial, Switch unit, Type 6850 Control unit, Type 927 Coder Unit, Type 6466 Coder Control Panel, Type 6465	A.P.114J-0800-1
A.R.I.5820 Radar head, Type 2 Ranging unit, Type X1219 Junction box, Type 370 Junction box, Type 4493 Junction box, Type 4497	A.P.114R-0100-1

DESCRIPTION

General

2. The radar equipment consists of an A.R.I. 23013 *(D.M.E.)* navigation aid, an A.R.I.5848 *(I.F.F.)* and an A.R.I.5820 radar ranging installation. The transmitter-receivers of the D.M.E. and I.F.F. installations are carried on a radio mounting structure extending between frames 16 and 19 on the port side of the radio bay in the front fuselage *(Sect.6, Chap.1)*. The radar head of the radar ranging installation is located in the nose of the aircraft, while the ranging unit is situated just forward of frame 6 in the front fuselage. All the installations are remotely operated by control units situated in the cabin and the location of the radar equipment is illustrated in fig.1 and 2.

A.R.I.23013

3. This is a Rebecca Mk.8 interrogator-responder installation, which operates in conjunction with a ground transponder and shows on a meter the range and heading of the aircraft with relation to the ground transponder. It is used as an aid to navigation. The installation employs a transmitter-receiver, complete with a junction box, which are both clamped into a sliding S.B.A.C. mounting rack located at the forward end of the top platform of the radio mounting structure in the radio bay. The transmitter-receiver uses separate aerials for transmission and reception. The transmitting aerial projects downwards from the engine starter access door on the underside of the centre fuselage,

while the receiving aerial projects from the engine access door also on the underside of the centre fuselage. The installation also employs two direction finding aerials, which are located one in each air intake. The receiving aerial and the port air intake aerial are connected to the transmitter-receiver via a aerial switch unit mounted on the rear face of frame 16 adjacent to the transmitter-receiver. The installation is remotely operated by a control unit situated on the cabin starboard shelf and the range and heading meter is mounted on the starboard instrument panel.

4. The installation operates on a choice of eight spot frequencies between 200 to 235 Mc/s. The selection of the spot frequencies is made by turning switches in the control unit. The transmitter and receiver frequencies are selected so that the transmitter and receiver are not working at the same frequency. This arrangement reduces the possibility of errors from ground reflection. The electrical supply circuit of the installation is described in Sect.5, Chap.1, Group H.1.

A.R.I.5848

5. This is a Mk.10 I.F.F. installation, the basic purpose of which is to enable the aircraft automatically to identify itself as friendly when challenged by appropriately equipped air, sea and ground forces. The installation embodies a transmitter-receiver, which is carried on a shock-absorber type mounting rack located at the aft end of the top platform of the radio mounting structure in the radio bay. The installation uses two aerials, each of which is automatically connected, in turn, to the transmitter-receiver by an aerial switch unit. One aerial is situated on the top of the front fuselage just forward of the windscreen and the other is mounted between frames 22 and 23 on the underside of the centre fuselage. The aerial switch is mounted on a plate attached to the aft face of frame 16 on the port side of the aircraft, adjacent to the D.M.E. transmitter-receiver, in the radio bay.

6. The installation is remotely operated by a single-pole ON-OFF I.F.F. master switch, an I.P. switch and a control unit, which are all located on the windscreen starboard platform. The installation employs a coder unit, which is mounted on a mounting tray fitted with anti-vibration mountings to a carrier attached to frame 16 in the radio bay. The coder is operated by a coder control panel situated on the cabin starboard shelf.

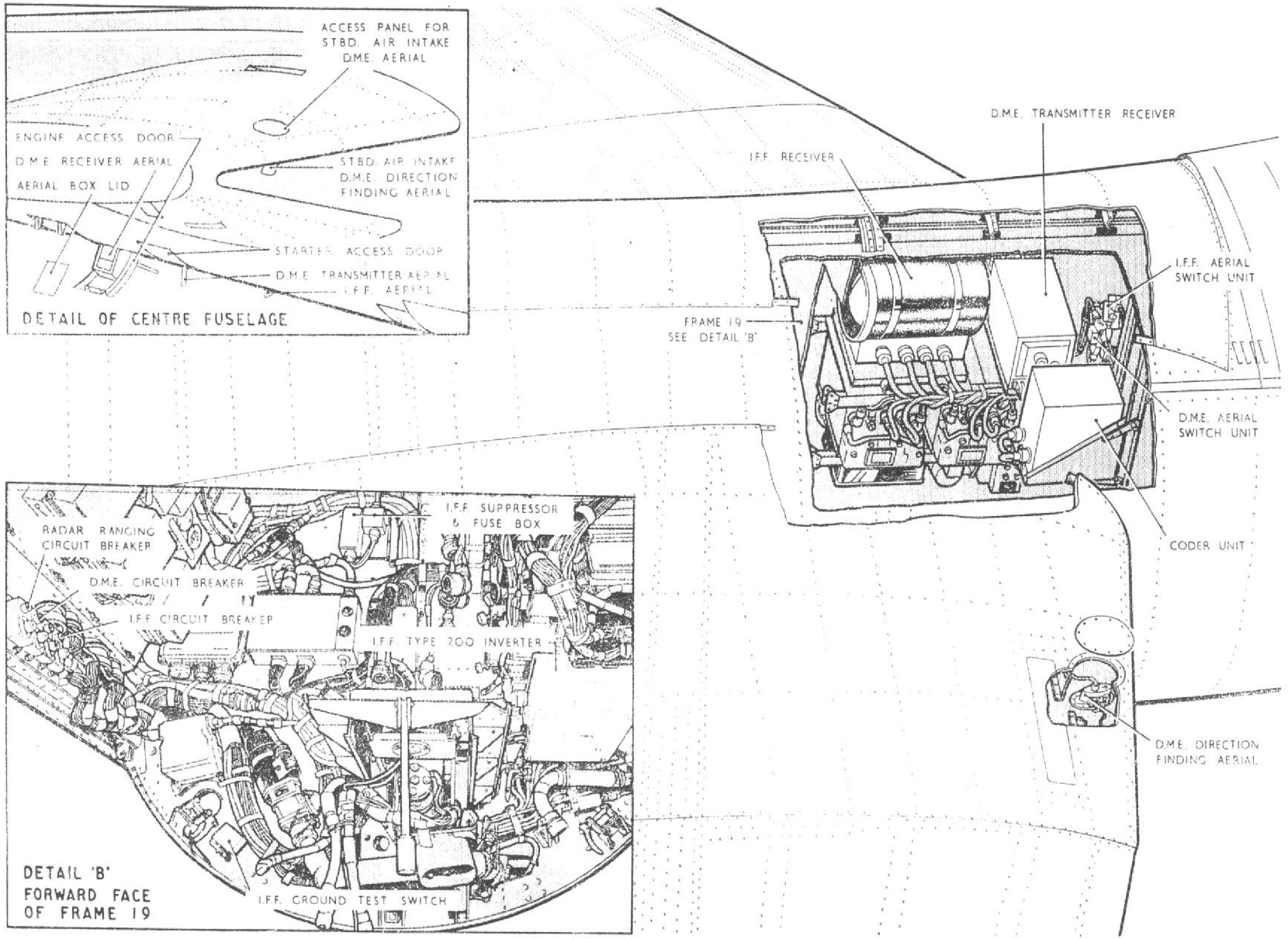
7. The power supply for the installation is obtained from an inverter and its associated control panel, which are both mounted on the underside of the radio mounting structure in the radio bay. The inverter, obtains its d.c. supply from a circuit breaker mounted below the aircraft's electrical supply panel on the starboard side of the radio bay. The inverter is switched on by the I.F.F. master switch and its output is taken to the transmitter-receiver via a suppressor and fuse. The suppressor and fuse are mounted together on the forward face of the starboard fuel tank access door on frame 19.

8. To enable the upper or lower aerial to be selected for test purposes, a single-pole changeover switch marked UPPER, LOWER and FLIGHT is provided in the radio bay. The switch is mounted on a bracket attached to the forward face of frame 19, below the starboard fuel tank access door. The switch is fitted with a spring-loaded safety cover to retain it in the FLIGHT position on the completion of testing or servicing.

9. The installation operates in the 1000 to 1120 Mc/s. band and uses a different frequency channel for transmission and reception. The power supplies are described in Sect.5, Chap.1, Group H.1.

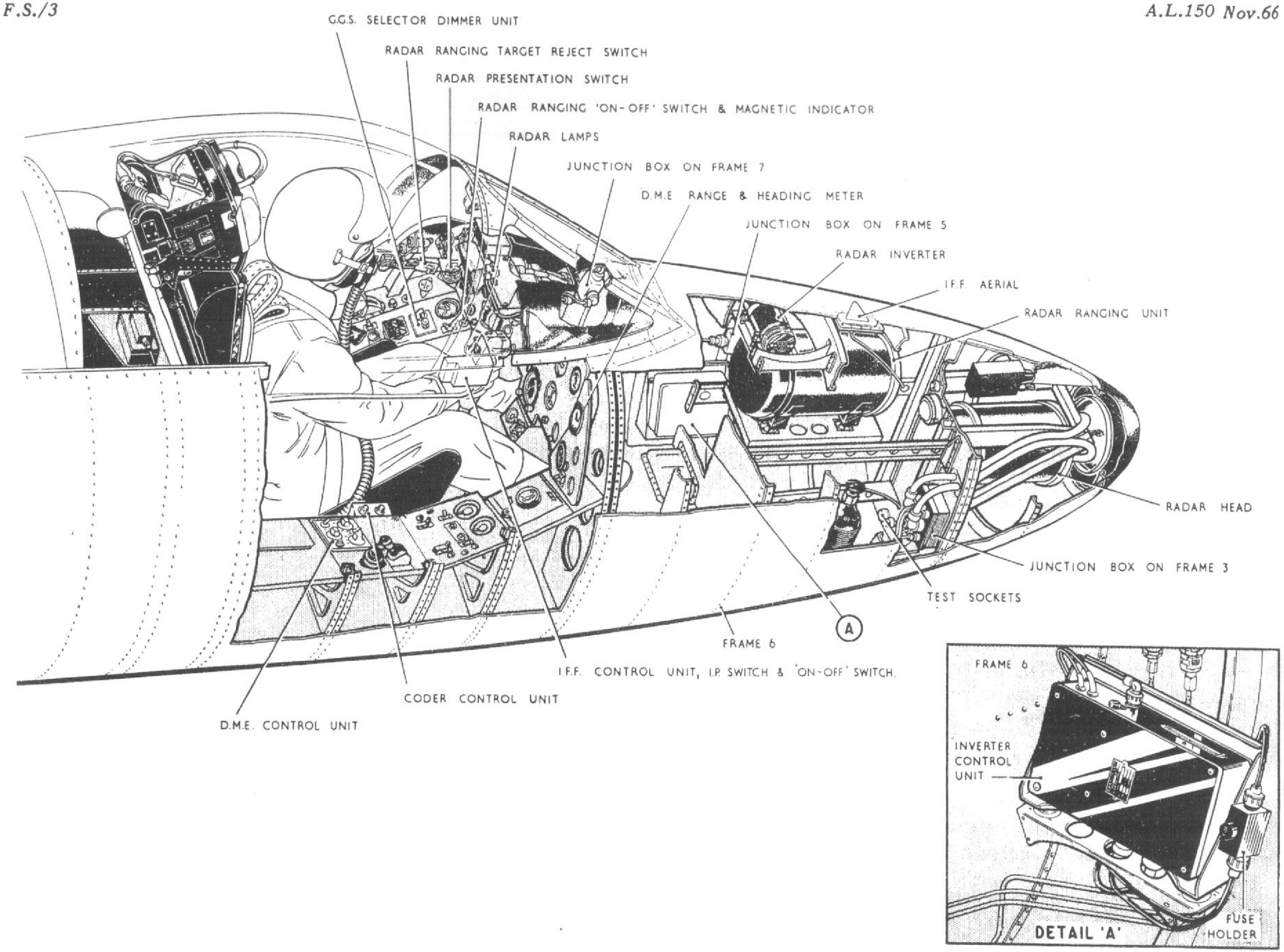
A.R.I.5820

10. This is a radar ranging installation for use in conjunction with the gyro gun sight, which is described in Sect.5, Chap.2, Group 4A. The ranging installation employs a radar head and a ranging unit, which are interconnected by a junction box. The radar head is carried on a mounting structure extending forwards from frame 3 in the nose of the aircraft, while the ranging unit is located between frames 4 and 6 on a mounting structure at the top of the nose wheel bay. The junction box is bolted to the rear face of frame 3 on the starboard side below the ranging unit. The power supply for the installation is obtained



T.P.6710

Fig. 1 Radar installation - location (1)



T.P. (E) 8972

Fig. 2 Radar installation - location (2)

◄ Mod.1268 ►

from No.2 inverter in the a.c. supplies circuit Sect.5, Chap.1, Group E.1 and from an inverter which is mounted on two bearers extending across the top of the nose wheel bay between frames 5 and 6, just above the ranging unit. The inverter is protected from an overload by a fuse carried in a fuse-holder mounted on the inverter's control panel mounting bracket. The control panel is mounted on a carrier attached to the port side of frame 5 and the forward face of frame 6.

11. The equipment is switched on by a switch located on the forward portion of the cabin port shelf and a magnetic indicator adjacent to the switch is provided to show when the installation is operating. Two lamps, mounted on the starboard side of the gyro gun sight, are provided to indicate when the radar has locked-on to a target and when the aircraft is within the correct firing range. A target reject switch is located in frame 9 above the cabin port shelf.

12. The radar ranging and gyro sight are interconnected by Type 4493 and 4497 junction boxes, which are located on the port side of frames 5 and 7 respectively. A radar presentation switch, which is connected into the installation via the Type 4497 junction box, is mounted on a bracket attached to the windscreen port platform below the lighting screen.

13. To enable the installation to be checked for correct operation, test sockets with shorting plugs and a test switch are provided. The test sockets are located on the rear face of frame 3 and the test switch is situated on the rear portion of the cabin port shelf. The radar head and ranging unit are cooled by the circulation of spent air taken from the cabin pressurization system *(Sect.3, Chap.8)* before final discharge to atmosphere. The inverter is cooled by air from the camera ram air duct, situated in the nose of the aircraft. A connection, for the introduction of cooling air when ground testing the installation, is provided in the port side of the front fuselage skin. The electrical supply circuit of the installation is described in Sect.5, Chap.1, Group H.1. When the radar head and ranging unit are not installed, special ballast weights *(para.59)* must be fitted in lieu.

Interconnection

14. The various components of each radar installation are interconnected, as shown in fig.3 by a number of connectors strapped and clipped to the aircraft structure. These connectors are of the metal-braided and non-braided type fitted with standard and miniature plug and socket type breakdown points.

OPERATION

General

15. For the guidance of servicing personnel a brief description of the operating procedure for the various radar installations installed in this aircraft, will be found in the following paragraphs.

16. The setting-up and operating instructions are given in detail in A.P.2914AG, Vol.1, but for those who do not require this amount of detail the following summary is given.

17. The installation has two modes of operation, the first is searching for a transponder and the other is locked to a transponder. The first is indicated by the range pointer of the range and heading meter taking 17 seconds to rise slowly from zero to 200 nautical miles; when the full scale has been swept, the pointer returns quickly to zero and a new sweep commences. When the equipment is switched to the 20 mile position, the search period is only three seonds. The second mode of operation is indicated by the word ON showing in the window of the range and heading meter, simultaneously the sweeping action of the range pointer will change to one which is locked to the range at which interrogation takes place. After the equipment is locked to a transponder, the range shown by the meter will vary in accordance with the range variations of the aircraft from the transponder.

18. Each transponder radiates a code pulse for identification by the pilot and if he finds that the code signal is not that of the transponder on which he means to home he can release the equipment from the locked-to-transponder state by depressing the stroke release push-switch on the control unit. The installation will then return to the searching condition.

19. All control of the installation is achieved by use of a control unit situated on the cabin starboard shelf and the range and heading meter located on the starboard side of the centre instrument panel. The control unit contains six separate switches as follows:-

(1) Function and range switch, marked OFF - SB-200 - 20 - BAT - BAH.

(2) Transmitter tuning switch, marked TX.

(3) Receiver tuning switch, marked RX.

(4) Code switch, marked CODE ON-OFF.

(5) Aerial selector switch, marked O/R-H.

(6) Strobe release push-switch, marked STROBE.

20. The function and range switch is a six position rotary switch, which selects the following operating conditions:-

(1) OFF - all power switched off.

(2) SB - standby switching; power is applied to all valve heaters, frequency changing motor circuits, aerial switching relay and the strobe lock indicator.

(3) 200 - long range operating position; searching takes place over a range of 200 nautical miles, each search sweep taking 17 seconds.

(4) 20 - short range operating position; searching takes place over a range of 20 nautical miles, each search sweep taking 3 seconds.

(5) BAT - in this position the equipment is ready for operation with any B.A.B.S. Mk.4 beacon, the frequencies of which are selected with the transmitter-receiver selectors.

(6) BAH - A second B.A.B.S. operating position is provided for use with the B.A.B.S. beacon sited at the aircraft's home station. The frequencies of the home B.A.B.S. beacon are pre-tuned in the equipment, so that a fully clockwise turn of the function switch will override the transmitter and receiver tuning positions and automatically tune to the home B.A.B.S. beacon.

Note . . .

Selection of the BAT and BAH positions automatically connects the omi-directional aerial to the equipment, overriding the setting of the aerial selector switch (para.23).

21. The transmitter tuning switch selects any one of eight spot interrogator channels which are identified by the letters A to H and the receiver tuning switch likewise selects any one of eight spot responder channels, which are identified by the numbers 1 to 8.

22. The code switch is an ON-OFF toggle switch which when in the ON position, allows coding signals from a transponder to which the responder has been locked to be fed into the pilot's headset circuit.

23. The aerial selector switch is a two-position toggle switch. In the O/R *(omni-range)* position the omni-directional aerial in in use. It is used for B.A.B.S. approaches but does not have to be selected for this purpose with the aerial selector switch, since positioning the main function switch to BAH or BAT automatically selects the omni-directional receiving aerial. In the H *(homing)* position, switching between the directional aerials takes place at a rate of 20 c/s and the heading indicator shows any deviation from a true course laid on the transponder.

24. The strobe release push-switch releases the locking circuit and allows the equipment to fall back into the searching mode. If there is no other beacon within the reception range, the meter will continue to search up to maximum, fall to zero and then search to the original range indicated when the equipment will again lock to the beacon.

25. When homing, the heading pointer in the meter will show a zero reading when the aircraft is heading both towards or away from the transponder. To resolve this ambiguity, the aircraft should make a right-hand turn. If the aircraft is heading

towards the transponder, the meter pointer will deviate to the left; if the aircraft is heading away from the transponder, the pointer will deviate to the right. If the aircraft makes a left-hand turn, the meter indications will be reversed.

A.R.I.5848

26. The setting-up and operational instructions for this installation are given in full detail in A.P.2887N, to which reference should be made when information is required.

A.R.I.5820

27. The setting-up and operating instructions for this installation are given in full detail in A.P.2917E, but for those who do not require this amount of detail, the following summary is given.

28. The installation operates in conjunction with the gyro gun sight to provide continuous range information of a target within the limits of the radar beam from the nose of the aircraft.

29. The installation is switched on by an ON-OFF switch marked G.G.S., RADAR RANGE and a magnetic indicator, which is marked RADAR SUPP. IND., is located adjacent to this ON-OFF switch to indicate when the installation is being supplied and is ready for operation. The gyro gun sight supply is independent of the radar ranging installation and the sight must be switched on separately by means of the gun sight master switch. It must also be noted that the ranging installation will only control the range mechanism of the gun sight when the gun sight selector-dimmer control unit is set to the G or G and F positions. The throttle twist grip, used for a manual range control of the gun sight, will normally override the ranging installation when set to the minimum range position.

30. An ON-OFF switch marked RADAR PRESENTATION is also provided to disconnect the ranging installation from the range mechanism of the gun sight to counteract the effect of a target using "window". If a target uses "window" within the range of the gun sight, it is possible that the radar equipment will lock-on the "window". In these circumstances it will be impossible to retain control of the sight by means of the twist grip because the range of the "window" will always be shorter than that of the target. When the radar presentation switch is set to the OFF position, the radar equipment operates normally, but the output from the cathode-follower is disconnected from the gunsight and manual range control of the sight may be accomplished by means of the twist grip in the usual manner.

31. When following a target, the radar equipment will lock-on to it when it is within a range of 1,500 yards and within the beam. This is indicated by the lighting of a green lamp mounted on the sighting head of the gun sight. When the range decreases to within firing range, as adjusted when setting up the installation, the orange lamp on the sighting head will light to indicate that the guns should be fired.

32. The installation is provided with a spring loaded target reject switch marked IN and OUT. This switch is used to check that the installation has locked-on to the desired target and to unlock the installation from an unwanted target, ground reflection or cloud with a large water content. When the switch is moved to the IN position, the strobe circuits in the ranging unit are moved inwards in range from the unwanted target and then continue to search inwards regardless of whether the switch is released or not. If they do not encounter another target before reaching minimum range they are flashed out to maximum range and the normal search cycle continues. When the switch is operated to the OUT position, the strobes are moved outwards in range and continue to search outwards to maximum range. The strobes will remain at maximum range as long as the switch is held, but when it is released, the strobes will resume the normal inwards search.

33. The test switch marked NORMAL and TEST is provided to enable the radar ranging installation to be supplied during ground servicing without energizing any of the other a.c. operated equipment.

When this switch is placed in the TEST position, relays in the a.c. supplies circuit are energized to isolate the a.c. operated instruments and enable No.2 inverter to supply the radar ranging installation. When the servicing is completed, the test switch must be returned to the NORMAL position.

SERVICING

General

34. Servicing of the radar installation is fully covered in the relevant Air Publications listed in Table 1. Any units suspected of being unserviceable should be carefully checked in situ and if found to be faulty, removed from the aircraft and taken into the workshop for rectification action as necessary. The location of the radar equipment is illustrated in fig.1 and 2, interconnection in fig.3, while wiring diagrams of the power supplies will be found in Sect.5, Chap.1, Group H.1.

Power supply

35. If a fault is reported in the radar installations, the power supply should first be checked, in conjunction with the routeing and theoretical diagrams given in Sect.5, Chap.1, Group H.1, to ensure that the trouble is not located in the aircraft's electrical system. The voltage, both on and off load, must be tested and a check made to ensure that the connectors carrying the supply to the equipment are correctly assembled.

Cables and connectors

36. Servicing of cables and connectors consists of the standard continuity and insulation resistance tests and of a periodical examination throughout their entire length for any signs of damage of deterioration of the insulation. If any signs of these defects are found, the complete cable or connector must be replaced. All the clips and straps securing the connectors to the structure must also be examined for signs of looseness and rectified as necessary to prevent chafing. All the plug and socket connections must be checked to ensure that they are fitted correctly and that the fixings are tightened securely.

A.R.I.23013, A.R.I.5848 and A.R.I.5820

37. For a detailed description of the servicing necessary to maintain these installations in an efficient condition, together with information on testing and fault diagnosis, reference should be made to the relevant Air Publications listed in Table 1. The test sets to be used and the ancillary equipment required are also quoted in these publications.

Final check

38. After servicing the radar installations, ensure that the equipment is left switched OFF and that all access doors, and panels, removed to gain access, are correctly replaced and secured.

REMOVAL AND ASSEMBLY

General

39. The recommended procedure for removing the majority of the components comprising the radar installation is given in the following paragraphs. The method of assembly is, in general, the reverse of the removal sequence, but when there is any special assembly feature it is covered by a note in the appropriate paragraph. Before removing or replacing any component, the aircraft's electrical system must be rendered safe, as described in Sect.5, Chap.1, Group A.1.

A.R.I.23013 Transmitter-receiver, complete with junction box.

40. The recommended method of removing this transmitter-receiver and junction box is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Disconnect the two connectors from the transmitter-receiver and the seven connectors from the junction box. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the units.

(3) Remove the two pip-pins from the mounting channels and using the handle on the transmitter-receiver, withdraw the transmitter-receiver, junction box and mounting rack care-

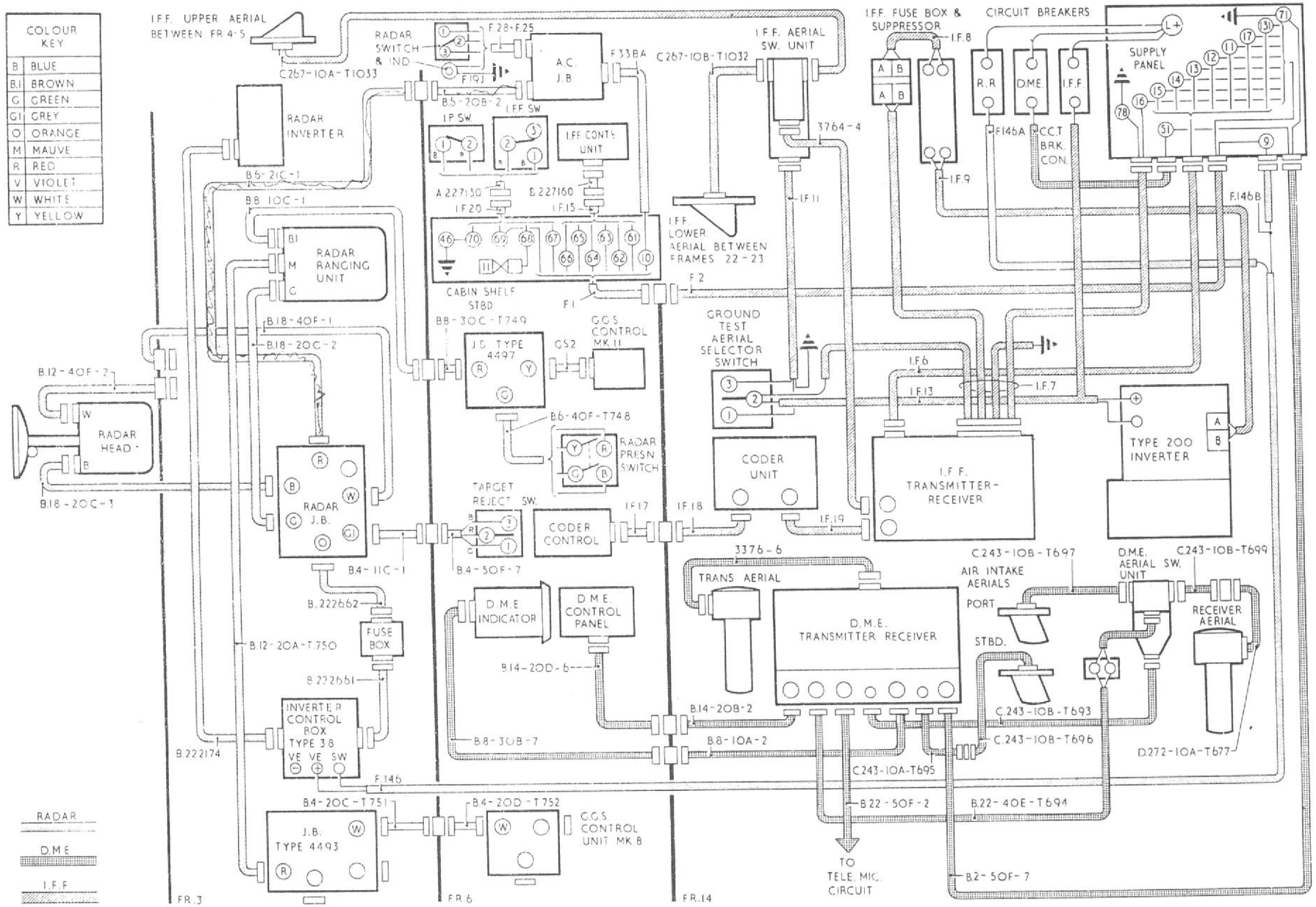


Fig.3 Radar installation - interconnection

fully along the mounting channels until clear of the fixed mounting structure. Remove the assembly from the aircraft.

(4) If required, the transmitter-receiver may be removed without disturbing the junction box and mounting rack. The method is as follows:-

(5) Disengage the two connectors from the transmitter-receiver and disconnect the two locking devices securing the set to the mounting rack.

(6) Using the handle on the transmitter-receiver, pull the set inboard sharply in order to disengage the junction box connecting plug and still using the handle, carefully withdraw the set from the mounting rack and remove it from the aircraft.

Control unit, Type 8197

41. The recommended procedure for removing this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Remove the four screws securing the control unit mounting frame to the cabin starboard shelf.

(3) Raise the control unit and mounting frame to gain access to the plug and socket connection. Disconnect this connection and fit approved caps and covers to the plug and socket.

(4) The control unit and mounting frame may now be removed from the aircraft. To remove the control unit from the mounting frame it is only necessary to remove the four screws attaching the unit to the frame.

Type 91 aerials

42. The procedure for removing either of these aerials is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Open the engine starter access door for the removal of the transmitter aerial or the engine access door for the removal of the receiver aerial.

(3) Gain access to the aerial bollard by removing the cover plate from the inside of the access door.

(4) Remove the moulded cover from the aerial bollard by unscrewing the four retaining nuts.

(5) Disconnect the aerial connector from the top of the aerial rod and release the aerial connector from the aerial bollard by removing the two nuts securing the strap and saddle block.

(6) The aerial may now be removed from the access door by unscrewing the eight screws securing the aerial bollard to the door structure.

Note . . .

When assembling the aerial to the access door, ensure that an effective electrical contact is made between the aerial connector saddle collar and attachment screws.

Direction finding aerials

43. The recommended method of removing either of these aerials is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Remove the aerial access door from the top leading edge of the stub wing.

(3) Disconnect the aerial connector from the plug and socket assembly adjacent to the aerial mounting.

(4) Unlock the two wing nuts on the eye bolts securing the aerial fitting to the air intake skin.

(5) Slacken off the wing nuts, disengage the eye bolts from the aerial fitting and remove the aerial, complete with connector, through the access hole in the top skin of the stub wing.

Note . . .

When assembling the aerial, ensure that an effective electrical contact is obtained between the aerial mounting flange and air intake skin. Also ensure that the wing nuts are locked with 22 s.w.g non-corrodible wire to Spec. D.T.D.189 or 161.

Aerial switch unit, Type 514

44. To remove this switch unit, proceed as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Disconnect the three connectors from the switch unit and fit approved caps and covers to the plugs and sockets. stow the connectors clear of the unit.

(3) Disconnect the two leads attached to the switch unit from the terminal block adjacent to the unit.

(4) The switch unit may now be removed from the aircraft by releasing the two nuts and bolts securing it in position.

A.R.I.5848 receiver

45. To remove this receiver proceed as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Disconnect the connectors from the receiver and fit approved caps and covers to the plugs and sockets. Stow the connectors clear of the set.

(3) Unscrew and disengage the two knurled catches securing the receiver to the mounting rack and pull the receiver inboard to release the two retaining spigots at the rear of the receiver.

(4) Remove the receiver from the aircraft.

Inverter Type 200

46. The recommended method of removing this component is covered in the removal of the gun firing panel as described in Sect.5, Chap.1, Group A.2 of this volume.

Aerials, Type 100A or 100B

47. The recommended method of removing these aerials is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Gain access to the aerial and disconnect the aerial connector from the socket at the base of the aerial unit.

(3) Remove the nuts and washers from the screws securing the aerial to the fuselage structure and withdraw the aerial into the fuselage taking care to retain the sealing washer and bonding strips.

(4) Remove the aerial from the aircraft.

Note . . .

When assembling the aerial, ensure that the bonding strips are replaced on the attachment screws before the sealing washer is fitted. When the aerial is in position, bend the bonding strips around the aerial base and place them under the nuts and washers on the screws securing the aerial in position.

Aerial switch unit, Type 6850

48. To remove the switch unit, first render the aircraft electrically safe and then remove all the connectors from the unit. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the unit. The unit may now be removed by unscrewing the three bolts securing it to the mounting plate.

Coder unit

49. The recommended procedure for removing this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Disconnect the cables from the unit and fit approved caps and covers to the plugs and sockets. Stow the connectors clear of the unit.

(3) Unscrew the knurled screw and disengage the clamping plate holding the unit mounting rack and remove the unit from the mounting tray.

Coder control unit

50. The recommended procedure for removing this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Disconnect the electrical connection from the bottom of the control unit and fit an approved cap and cover to the plug and socket.

(3) Release the control unit from the cabin starboard shelf by removing the two screws securing the retaining strap.

(4) Remove the control unit from the aircraft.

I.F.F. master switch

51. The recommended method of removing this switch is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.2, Group A.1).*

(2) Remove the two screws securing the switch to the mounting angle.

(3) Disconnect the cables from the back of the switch, insulate their bare connections with adhesive tape and remove the switch from the aircraft.

Control unit, Type 927

52. The recommended method of removal of this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Remove the I.F.F. master switch as described in para.51.

(3) Disconnect the electrical connector and fit an approved cap and cover to the plug and socket.

(4) Release the control unit from its mounting bracket by removing the four nuts and screws securing it in position.

I.P. switch

53. The recommended procedure for removing this switch is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Remove the two screws securing the switch to the mounting bracket.

(3) Disconnect the cables from the back of the switch, insulate their bare connections with adhesive tape and remove the switch from the aircraft.

Radar head, Type 2

54. The recommended method for removing this component is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Gain access to the radar head by removing the nose piece *(Sect.3, Chap.1).*

(3) Disconnect the two connectors at the radar head. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the unit.

(4) Disconnect the cooling air pipe from the port side of the radar head. Mask off the end of the air pipe and the entry into the radar head to prevent the ingress of foreign matter.

(5) Disengage the two catch assemblies retaining the radar head in its mounting rails and remove the component from the aircraft by carefully withdrawing it forward along the rails until it is clear of the structure.

Note . . .

The wing nuts of the catch assemblies should only be slackened sufficiently to allow the button to swing clear. Do not detach completely. On re-assembly, care must be taken to ensure that the wing nuts are tightened only to "finger tightness" to prevent shearing of attachment studs.

Radar unit X.1219

55. To remove this unit proceed as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1)*

(2) Gain access to the nose wheel bay and disconnect the two connectors from the forward end of the ranging unit. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the unit.

(3) Disconnect the cooling pipe from the port side of the ranging unit. Mask off the end of the air pipe and the entry into the ranging unit to prevent the ingress of foreign matter.

(4) Taking the weight of the unit, withdraw the spring-loaded catch pins securing the mounting tray to the mounting beam. Still supporting the tray and ranging unit, allow them to swing down, under control, to their full extent.

(5) To remove the ranging unit from its mounting tray, support the unit and disengage the two catch assemblies retaining it in the tray. Carefully withdraw the unit from the tray and remove it from the aircraft.

Junction box, Type 370

56. The recommended procedure for removing the radar junction box is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Gain access to the nose wheel bay and disconnect the seven connectors from the junction box. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the junction box.

(3) The junction box may now be removed from the structure by removing the four bolts securing it to the rear face of frame 3, taking care to retain the washers.

Inverter, Type 206

57. The recommended method for the removal of this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.2, Group A.1).*

(2) Gain access to the nose wheel bay and remove the ranging unit as described in para.55. Disconnect the cooling air pipe from the port side of the inverter. Mask off the end of the pipe and the entry into the inverter to prevent ingress of foreign matter.

(3) Disconnect the connector and fit an approved cap and cover to the plug and socket and stow the connector clear of the inverter.

(4) Unscrew the four nuts and bolts clamping the four saddle clips, encircling the inverter, to the mounting structure. Remove the bonding strip and stow it clear of the inverter. The inverter may now be removed from the aircraft.

Note . . .

On re-assembly of the mounting brackets and inverter, ensure that the bonding wire is replaced in position under the saddle clamp.

Control unit, Type 38

58. The recommended method for removing this unit is as follows:-

(1) Render the aircraft electrically safe *(Sect.5, Chap.1, Group A.1).*

(2) Gain access to the nose wheel bay and disconnect the connectors from the control unit. Fit approved caps and covers to the plugs and sockets and stow the connectors clear of the unit.

(3) Unscrew the four bolts securing the control unit to its mounting carrier. The control unit may now be removed from the aircraft.

Radar ballast

59. Ballast weights representing the radar head Ref.No.26FX/3964 (Mod.H.21) and the ranging unit Ref. No.26FX/3963 (Mod.H.21) or Ref.No.26FX/8599 (Mod. 637), are supplied to special order only for fitment when this radar equipment is not installed. These weights incorporate stowage points for the electrical cables and cooling air pipes and are carried on the mounting structures normally used by the radar equipment. The assembly of the weights is similar to that for the radar equipment, which is the reversal of the removal instructions given in para.54 and 55, with the exception that the retaining catches, which normally engage with the radar equipment, should in the case of the ballast weights, pass through the holes in the forward plates of each weight and engage with the chamfered portion at the lower edge of each hole.

D.M.E. ballast

60. A ballast weight *(Ref.No.26FX/5227)* representing the D.M.E. set is supplied to special order only (Mod.246) for fitment when the aircraft is flown without this set fitted. The weight, which is carried on the mounting rack normally used by the set, is assembled to the rack in a similar manner to that of the set. When the weight is assembled, the thumb nuts and the clamps on the mounting must be tightened securely and wire-locked and the connectors, which are normally assembled to the set, must be suitably taped and stowed.

Appendix 1. MOD. 1369

(IFF/SSR 1520 – ARI 23134/3)

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DESCRIPTION

Introduction

1. This appendix contains the description and method of operation of the ARI 23134/3 (IFF/SSR – Identification Friend or Foe/Secondary Surveillance Radar) as fitted to the Mk.9 aircraft by Mod.1369, together with the servicing required to maintain the equipment in an efficient condition and the method of removal and assembly of the installation components. Illustrations of the equipment location, control unit switches, system interconnections and pulse forms and codes of the system are included. Further information on the installation may be obtained from the A.P.'s listed in Table 1 and the power supplies are described in Chap.1., Group H.1, App.2.

DESCRIPTION

General

2. The ARI 23134/3 is the airborne equipment which forms part of an IFF/SSR system. The purpose of the system is to enable the aircraft to self identify rapidly and automatically when challenged by suitably equipped ground

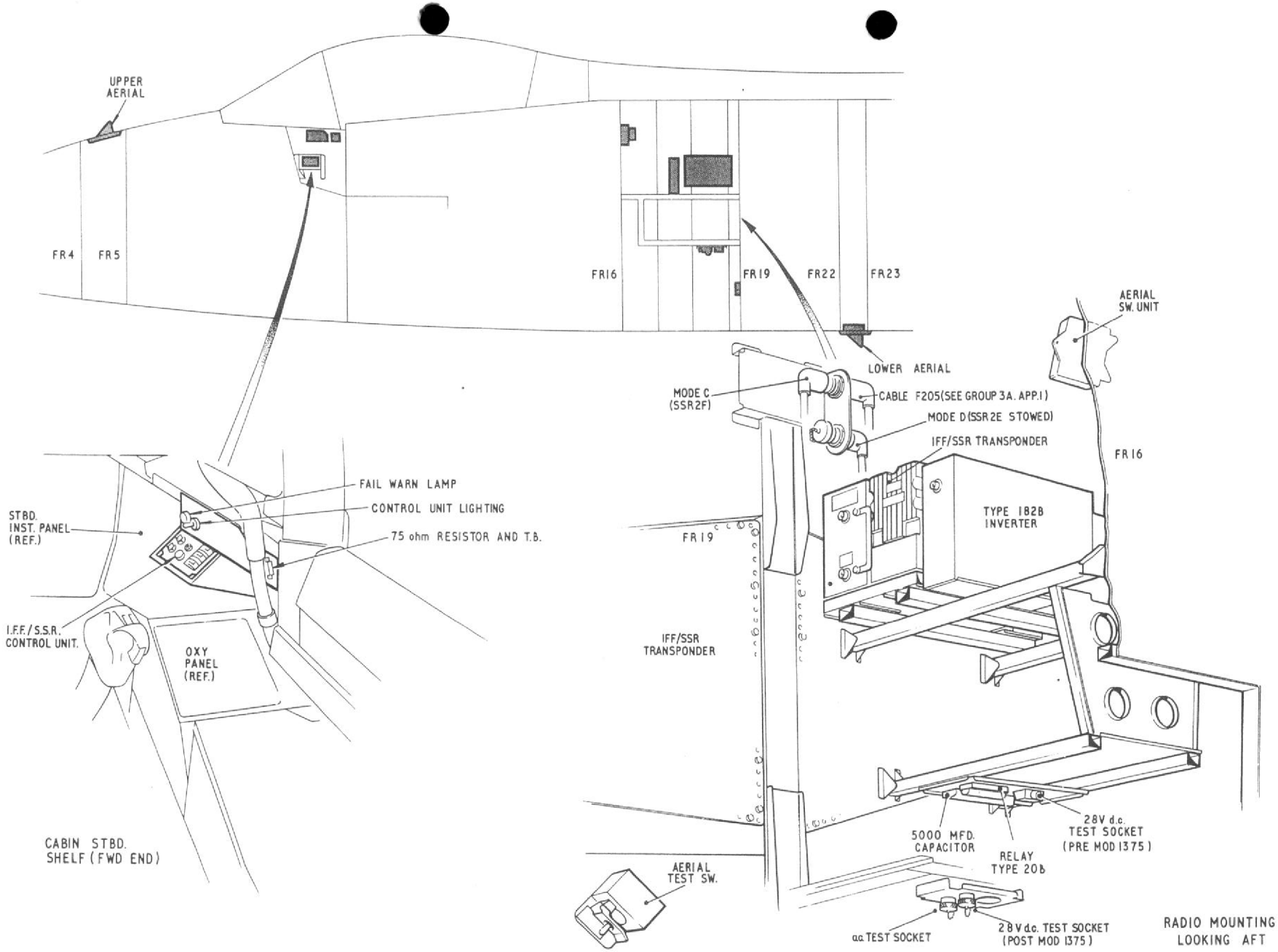

Fig. 1 Location of equipment

(Mod.1375 added)

T.P.(E) 23015

stations. When interrogated by a military (IFF) or a civilian (SSR) ground radar station the airborne equipment will respond by transmitting the appropriate signal. The ARI 23134/3 is designed for spot frequency operation on the two separate frequencies within the 950 MHz to 1150 MHz bands allocated to the system. One channel is employed for reception of the interrogating signals and the other for transmitting replies.

3. The interrogating signal pulse from the ground radar station is fed to the aircraft transponder receiver which produces a pulse to modulate the transponder transmitter. The resultant transmission or reply pulse is received by the ground radar station and shown on a read-out scale and displayed with the radar echo on the C.R.T. but it appears at a slightly greater range due to a delay introduced by both the interrogating equipment and the aircraft transponder. The interrogating pulses are selectively coded and the transponder will decode these pulses and reply with the appropriate code. One operating mode enables the aircraft altitude to be transmitted automatically by the height encoding altimeter (Sect.5, Chap.2, Group3.A, App.1) (Post Mod. 1375)

Aircraft equipment

General

4. Most of the IFF/SSR installation components are mounted in the radio bay and comprise the transmitter/receiver (transponder), Type 182B inverter with associated 5000 mfd. capacitor, aerial switching unit and test switch. The supply relay is located adjacent to the capacitor. On pre Mod. 1375 aircraft the d.c. test socket is fitted adjacent to the supply relay. On post Mod. 1375 the d.c. test socket is mounted on a plate together with the a.c. test socket and the battery volts test socket, and located on the underside of the battery mounting. The control unit and failure warning lamp are on the cabin starboard wall and the two aerials are fuselage mounted. The exact position of all components is shown in Fig. 1.

Transmitter/receiver (transponder)

5. The transponder, on a shock absorber mounting, is positioned on the upper radio mountings on the starboard side of the fuselage forward of frame 19. Electrical connection is by a 98 way multi-pin plug and socket connection and a co-axial connector to the aerial switching unit. On the front of the transponder are the manual selection switches for setting Mode 2 (para.11). The transponder is designed to operate within the temperature range -55 deg.C to +125 deg.C at altitudes up to 100,000ft. and is pressurized with nitrogen or dry air to 4lb/in^2. Two CHARGE/CHECK/PURGE valves on the front panel are provided for this purpose.

Type 182B inverter, supply relay and test socket

6. The Type 182B static inverter which provides all 115V 400Hz, single phase a.c. requirements for the installation is mounted transversely on the upper radio mountings forward of the transponder. Electrical connection is to terminals at the outboard end of the inverter. The 5000 mfd. capacitor associated with the inverter is mounted on a tray on the underside of the lower radio mountings. Secured to the same tray is the supply relay and, on pre Mod. 1375 aircraft, the d.c. test socket. On post Mod. 1375 aircraft the d.c. test socket is fitted adjacent to the battery volts test socket and the a.c. test socket located on the underside of the battery mounting.

Aerial switching unit

7. This unit is mounted on the upper aft face of frame 16 in the radio bay. It contains solid state circuits which alternately switch the upper or lower aerial to the transponder. The switching operation is controlled by the selection of the aerial test switch. Interconnection to aerials is by co-axial cables and d.c. supply is by a plug and socket connector.

Note . . .

Failure of the d.c. supply, or a failure of the driver circuit, renders the switching action of the aerial switching unit inoperative. The transponder will then remain connected to the aerial socket marked UPPER. If one or both switching diodes fail, the transponder remains connected to the LOWER socket.

Aerial test switch

8. This three-position single-pole, switch is mounted on the lower starboard side of the front face of frame 19 and is normally locked in the central FLIGHT position by the spring loaded

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Transponder Type 16928 Control unit Type 16929 Aerial switching unit Type 16941 Aerials Type 100B (Ref. No. 10B/202075	A.P.114J–0101–16

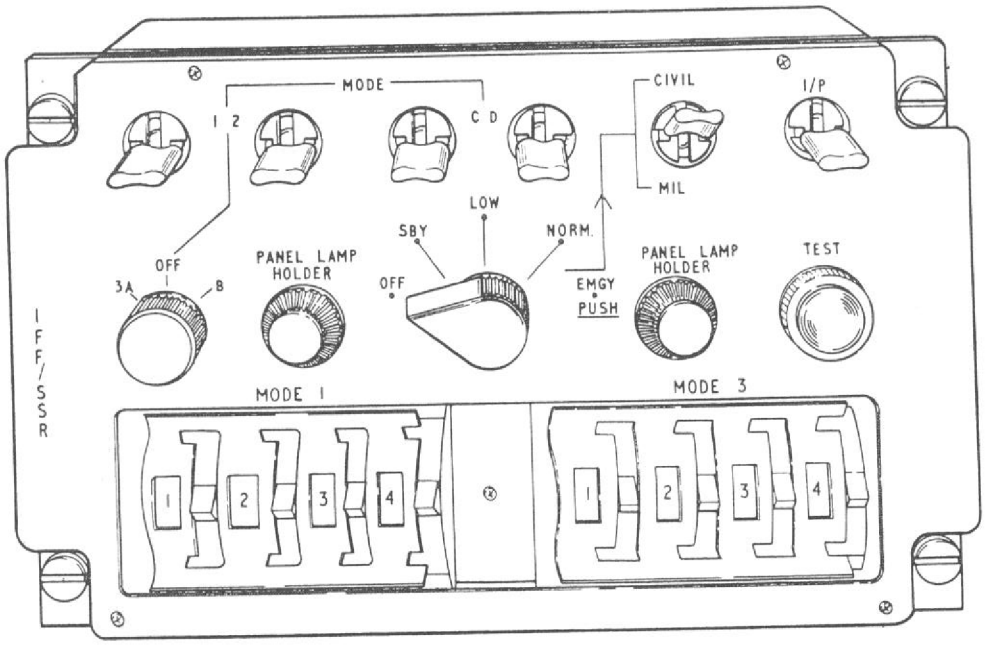

Fig. 2 Control unit

guard but may be selected to the UPPER or LOWER position during testing or servicing operations. The two latter selections refer to the aerial which is connected to the transponder. In the FLIGHT position switching of the aerials is controlled by the aerial switching unit.

Note . . .

The aerial test switch will not select the upper or lower aerial if the power supply is disconnected or if the aerial switching unit is faulty.

Aerials

9. Two fuselage mounted Type 100B aerials are used by the IFF/SSR installation. Electrical connection is by co-axial cable and the location of the aerials is shown in Fig.1.

Cabin equipment

10. The installation control unit is secured to a mounting bracket on the starboard wall of the cabin above the forward end of the shelf. This unit contains all switches necessary for operation of the installation in flight and the function of each switch is explained in the next paragraph. Electrical connection is by a multi-pin and socket connector and the control unit is secured in position by four quick release fasteners. Illumination of the control unit switch panel is by ten internal lamps controlled by a three-position BRIGHT/DIM switch mounted on the ancillary switch panel above the control unit. Also on this ancillary switch panel is the IFF/SSR FAIL warning lamp. This lamp has an amber lens and filament press-to-test facility. The 75 ohm resistor inserted in the DIM circuit of the control unit lighting is mounted on a terminal block situated behind a panel attached to the aft end of the ancillary switch panel.

Control unit switches

11. This paragraph describes the function of all switches on the IFF/SSR control unit.

(1) FUNCTIONAL CONTROL switch

The in-flight operation of the IFF/SSR installation is controlled by this switch which has a rotary action and five positions. The positions and functions of these positions are as follows:–

(i) OFF – Installation inoperative.

(ii) SBY – With this position selected, the IFF/SSR control relay is energized and supply from the IFF/SSR fuses is passed to the aerial switching unit and to the Type 182B inverter which will commence operating and supply 115V a.c. to power the transponder. The transponder will now accept interrogations only. After approximately one minute warming up time, the transponder is ready to transmit information when switched to NORM.

(iii) LOW – With this position selected, the transponder accepts selected interrogations and transmits information but the receiver sensitivity is reduced. This selection may be requested by ground radar to reduce clutter from long range replies.

(iv) NORM – In this position the transponder accepts selected interrogations and transmits information.

(v) EMGY/PUSH – (The switch is pushed and turned to this position). In this position the transponder accepts Modes 1, 2, 3A or 3B interrogations irrespective of their selection. Emergency transmissions are made of the selected code, followed by three repeats of the frame pulses. When switched from

OFF to EMGY/PUSH the transponder immediately attempts emergency transmissions but 50 sec. should be allowed for the transmitter to warm up. The amber failure lamp will flash until replies are transmitted.

(2) The equipment can reply to three military Modes numbered 1, 2 and 3 and four civil Modes lettered A, B, C and D. Modes 3 and A are identical.

(i) MODE 1 – This is selected by a two-position toggle switch, which when selected up enables the transponder to accept Mode 1 interrogations and to transmit information selected on the control unit Mode 1 selection switches.

(ii) MODE 2 – Selection is by a two-position toggle switch which when selected up enables the transponder to accept Mode 2 interrogations and transmit information selected by the code selection switches on the front of the transponder. (These switches are not accessible in flight).

(iii) MODE 3A – OFF – B – This is a three position rotary switch. Position 3A enables the transponder to accept Mode 3A interrogations and to transmit information replies selected on the control unit Mode 3 code selection switches. Position B enables the transponder to accept MODE B interrogations and to transmit selection on the control unit Mode 3 code switches. In the OFF position the transponder will not accept interrogations of Mode 3A or 3B.

(iv) MODE C – Selection is by a two-position toggle switch which when selected up enables the transponder to accept Mode C interrogations and will transmit altitude information ◀from the height encoding altimeter (Post Mod.1375).▶

(v) MODE D – Selection is by a two-position switch but operation of this Mode requires a separate coding unit which is not at present fitted. Cable SSR2E is blanked off at frame 19 and stowed.

(3) Code information may be selected on the control unit panel for Mode 1 and Mode 3A and B. Four switches are available on each of these Modes, providing code settings of 0000 to 7777, resulting in a combination of 4096 codes.

(i) MODE 1 – Code switches provide selection of Mode 1 information for transmission.

(ii) MODE 3 – Code switches provide selection of Mode 3A or 3B code information for transmission, depending upon which Mode is selected.

(4) MODE 2 – This information is pre-set before flight by switches on the transponder and is allocated for the particular aircraft to which it is fitted.

(5) The CIVIL-MIL switch operates only with the function control switch in the EMGY/PUSH position.

(i) CIVIL – In this position the transponder is automatically selected as code 7700 followed by three repeats of the frame pulses and operates only in the Mode 3A or B.

(ii) MIL – In this position the transponder's reply in Modes 1, 2 and 3A is the selected code followed by three repeats of the framing pulse.

(6) The I/P switch operates the IDENTIFICATION of POSITION facility in the transponder and will be requested by a ground station. The switch is biased to the central OFF position. On selecting the switch to the up position the I/P facility operates and is timed to continue for twenty seconds after the switch returns to the central position.

(7) TEST – The test button is a combined push switch and lamp incorporating a double filament with a green filter. When depressed, with the equipment operating, the self test facility of the transponder checks the receiver sensitivity, the transmitter power output level and the Mode serviceability.

Operation

General

12. With 28V d.c. power available at the bus-bar, selection of the FUNCTION control switch on the control unit from OFF to SBY will provide an earth return for the coil of the control relay which will close and complete the 28V d.c. circuit to the inverter which will commence to operate and supply 115V, 400Hz a.c. to power the transponder. It will also complete the d.c. circuit to the aerial switching unit. The IFF FAIL lamp will glow but after an initial 50 sec. warming up period, will go out if the installation circuits are working properly, and the IFF/SSR is ready for use.

Interrogation and reply

13. Interrogating pulses are transmitted in

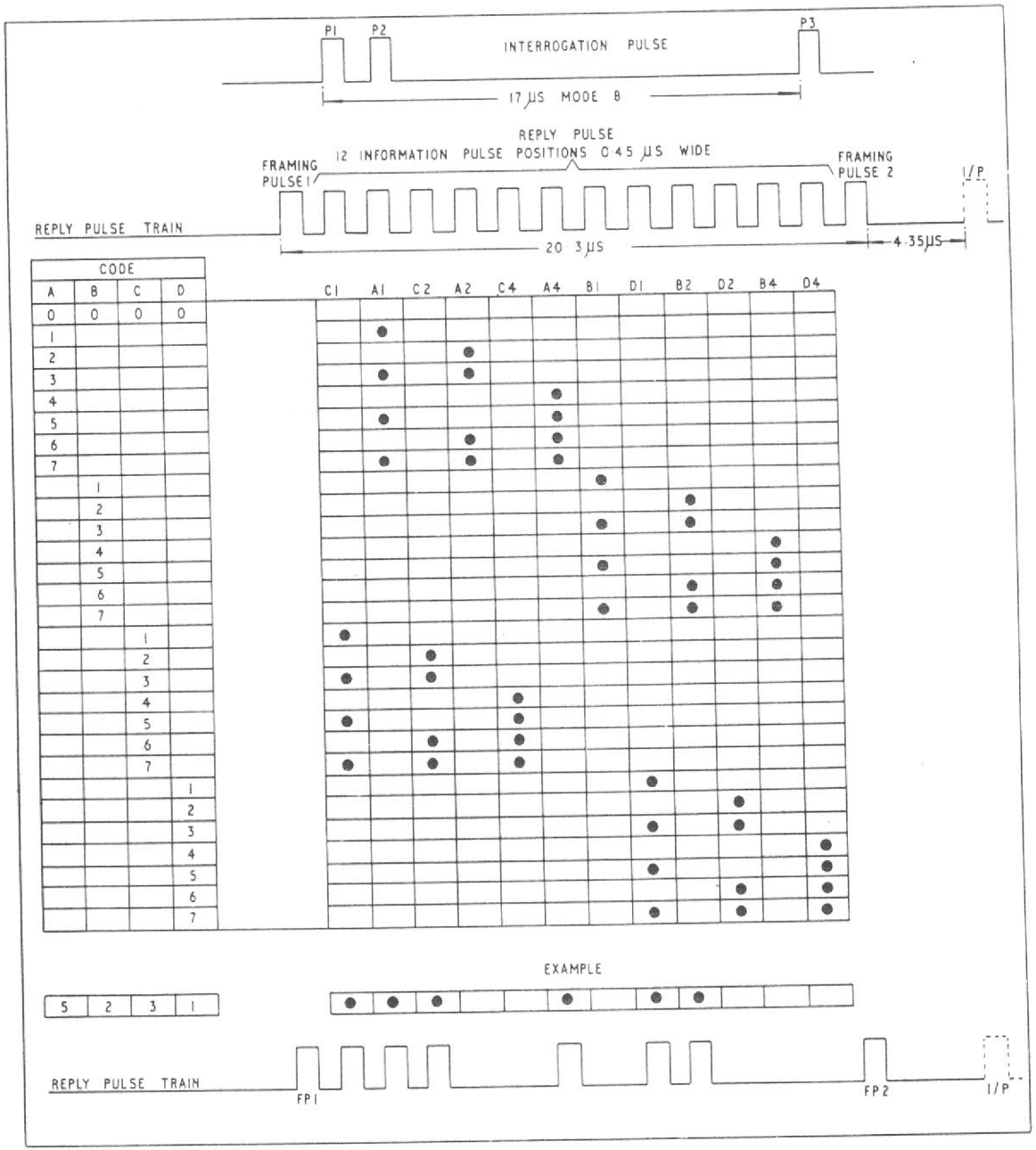

Fig. 3 Interrogation and reply pulse wave forms and codes

pairs by the ground station at a radiated frequency of 1030MHz. The time interval between the interrogating pulses is set to a particular value at the ground station. Six separate time intervals are used and these are defined as MODES which are listed in Table 2. The interrogating pulses initiate a coded pulse train reply from the transponder at a frequency of 1090MHz. The replies are known as CODES, which are pre-set on selector switches on the control unit and on the transponder. Every transponder reply contains two framing pulses spaced 20.3 μs apart. Between these are twelve information pulse positions. The presence or absence of any of the information pulses is determined by the setting of the code selector switches. Up to 4096 different codes can be permutated from the twelve positions.

Identification pulse

14. An additional pulse is provided 4.35 μs after the second framing pulse. This pulse is transmitted only when the I/P switch on the control panel is operated at the request of the ground control.

Suppression pulse

15. While the transponder is transmitting a reply to an interrogation a suppression pulse is emitted to inhibit the Tacan installation, which operates in the same frequency band. Conversely, when the Tacan installation is transmitting, a pulse from the Tacan suppresses the IFF/SSR installation.

Emergency

16. Two transponder codes are reserved for emergency use:—

Code 77 — Emergency
Code 76 — Loss of communication

When either code is set and the EMGY/PUSH

switch operated, a special read-out and alarm is given on the ground controller's display.

Sidelobe suppression

17. Because of the configuration of the ground equipment transmitting aerial, the transponder in the aircraft may be triggered by spurious sidelobes in addition to the interrogator beam. This effect is overcome by one of two methods. The methods are known as 2 pulse sidelobe suppression and 3 pulse sidelobe suppression. In the 2 pulse method it is arranged that the two interrogating pulses are transmitted on separate aerials, the interrogator aerial and the control aerial. A comparator circuit in the transponder compares the relative strengths of the pulses and either replies or not, according to the relative signal strengths. In the 3 pulse method the interrogating pulses P1 and P3 are transmitted on the interrogator aerial and a third pulse, P2, is transmitted on the control aerial and two microsec. after the P1 signal. The signal strengths of P1 and P3 are compared with that of P2 and the transponder will reply or not according to the relative signal strengths.

Failure warning lamp

18. During operation of the installation the amber failure warning lamp will glow in the following cases:–

(1) Function selector switch set to OFF.
(2) Function selector switch set to SBY and the transponder being interrogated (warning lamp will flash).
(3) If a fault occurs within the transponder.
(4) If the features of the self test check are not fulfilled.

Self test lamp

19. Correct functioning of the warmed-up equipment may be checked by use of the self test lamp/switch on the IFF/SSR control panel in the following manner:–

(1) On the control unit select 1, 2,C and D switches down.
(2) Select 1 and 3 code switches to 0000 and the CIVIL/MIL switch to MIL.
(3) With the function control switch at SBY, depress the TEST lamp and it should remain out and the amber FAIL WARN lamp should flash.
(4) Select the function selector to LOW. Depress the TEST lamp and it should glow, the amber FAIL lamp should flash. Should the amber lamp remain steady this is not a failure indication in the LOW selection.
(5) Select the function selector to NORM. Depress the TEST lamp and it should glow. The amber lamp should remain out.
(6) Select the function selector to EMGY/PUSH. Depress the TEST lamp and it should glow. The amber lamp should remain out.
(7) Select the function selector switch to OFF and note that the amber warning light comes on.

SERVICING

General

20. Servicing of the IFF/SSR installation is given in A.P.114J-0101-16. Any units suspected of being unserviceable should be carefully checked in situ, both for source of supply power and individual serviceability, before removal. Ensure every unit is secure and the plugs and sockets are properly mated and securely tightened. Cables and connectors should be examined along their entire length for signs of damage or deterioration. All clips securing the cables to the aircraft structure must be inspected for signs of looseness. Insecure clips should be tightened as necessary to prevent chafing.

Aerial switching unit

21. The aerial switching unit contains solid state components and it is therefore not possible to check the continuity and operation of this switch by d.c. or low frequency measurements. In particular the test unit used for aerial switches Type 6850 (ARI 5848) cannot be used to test this switching unit.

TABLE 2

Modes of operation

Mode	Time interval	Function
1	3 μ sec.	Military identification
2	5 μ sec.	Military identification
3A	8 μ sec.	Civil/Military identification
B	17 μ sec.	Civil identification
C	21 μ sec.	Automatic altitude
D	25 μ sec.	–

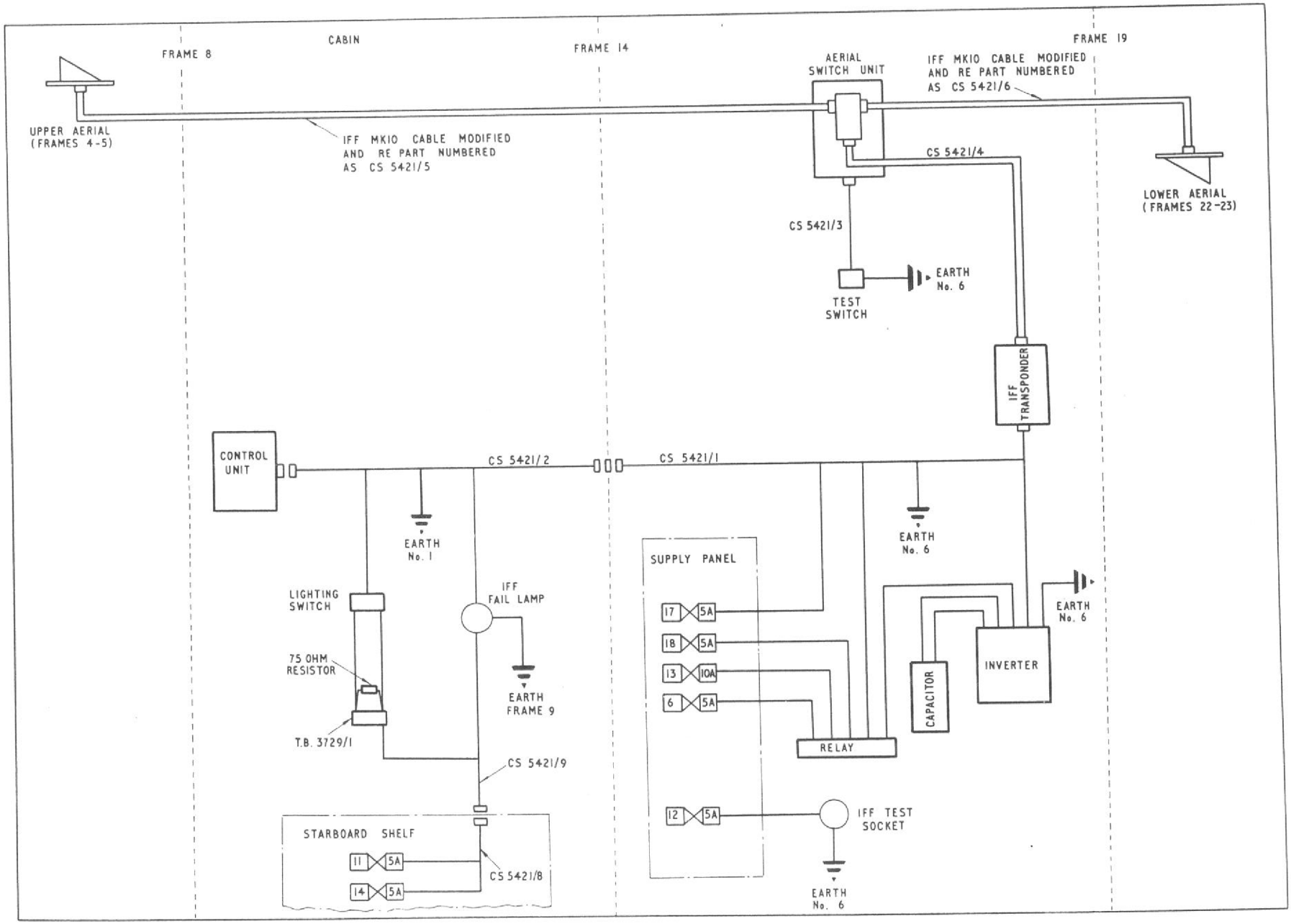

Fig. 4 Equipment interconnections

CAUTION . . .

Failure of the switching diodes in the aerial switching unit can occur if the peak R.F. voltage applied to the switch exceeds the diode breakdown voltage. It is essential therefore that R.F. power is applied to the switch only when the aerial terminals are correctly terminated either by a radiating aerial, or by a matched load.

Functional checks

22. A functional check of the installation can be made without special test equipment by using the built in self test equipment facility (para.19).

Test equipment

23. The ground test equipment required for the IFF/SSR 1520 airborne installation is laid down in SRIM 3729. A performance test will require Cossor Test Set CRM 554.

REMOVAL AND ASSEMBLY

General

24. No difficulty should be experienced when removing any of the components comprising the IFF/SSR installation and the assembly is in general a reversal of removal but where there is any special feature it is covered by a note in the appropriate paragraph. Before removing or installing any components, the aircraft electrical system must be rendered safe as described in Sect.5, Group A.1., and on assembly ensure all bonding and earth connections are made good and all cables clipped and secured.

Transponder

25. The following is the recommended procedure for removing the transponder from the aircraft:–

(1) Comply with safety regulations.
(2) Gain access to the radio bay.
(3) Remove electrical connectors from transponder and fit blanks. Stow cables clear of transponder.
(4) Undo and disengage the two knurled retaining catches at inboard end of transponder and pull transponder inboard until clear of mounting, being careful to support unit as it comes clear.
(5) Fit approved blanking caps and covers.

Aerial switching unit

26. The recommended procedure for removing the aerial switching unit from the aircraft is as follows:–

(1) Comply with safety regulations.
(2) Gain access to the radio bay.
(3) Disconnect the four electrical connectors, fit blanks and stow cables clear of unit.
(4) Remove the three bolts securing the unit to its mounting and remove the unit.

Aerials Type 100B

Upper aerial

27. Gain access to the upper aerial via the nosewheel bay and remove aerial assembly by the following procedure.

(1) Comply with safety regulation.
(2) Undo co-axial connector, fit blanking plug and stow clear.
(3) Undo six screws securing aerial assembly to structure, remove and retain bonding strip and ease aerial assembly clear of aircraft skin into nose bay being careful not to damage sealing washer.
(4) Remove assembly from aircraft.

Lower aerial

28. To remove this aerial, the recommended procedure is as follows:–

(1) Comply with safety regulations.
(2) On outside of aircraft locate aerial between frames 22-23 and remove assembly retaining screws.
(3) Pull aerial and fairing clear of aircraft skin sufficiently to gain access to aerial co-axial connector inside fuselage and undo connector.
(4) Remove aerial assembly from aircraft.

Note . . .

On assembly of aerials ensure good electrical contact between aircraft skin and aerial assembly by ensuring contact surfaces are clean and well mated.

Cabin equipment

29. The method of removal of the control unit, failure lamp, lighting switch and 75 ohm resistor from their mountings on the cabin starboard wall is self evident.

Aerial test switch

30. Removal of this unit from its mounting on the forward face of frame 19 is self evident once access is gained.