Chapter 7

A.R.I.23172

(Completely revised)

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Introduction

1. This chapter deals with the installation and general functioning of A.R.I.23172, introduced by Mod.2117. The installation, which is an integral part of the T.F.R. (terrain following radar) system, consists of a low level radio altimeter which provides low level height and guidance information. The installation also provides low level height information for use with the T.F.R. system to enable the aircraft to fly at low level over varying terrain.

NOTE...
With the introduction of Mod.2263 the autopilot Mk.10B is disconnected from the autolanding system.

2. A location diagram for the major components is provided at Fig.1. A routing chart and connector table will be found at the end of the text.

3. Detailed information on the T.F.R. system will be found in Sect.9, Chap.7 of this book. Descriptive and servicing details of the A.R.I.23172 will be found in A.P.116B-0203-1. This publication should be read in conjunction with the information contained in this chapter.

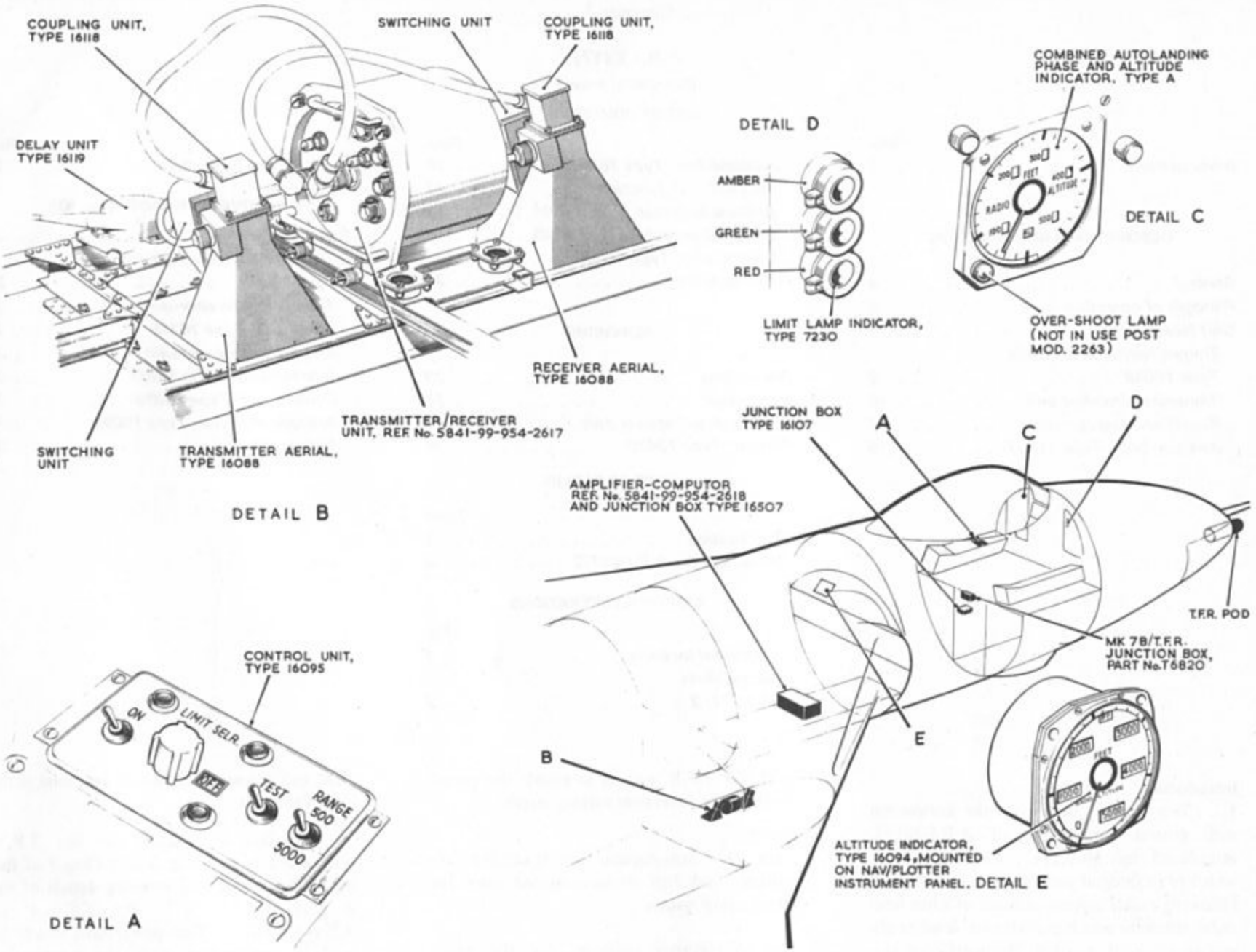

Fig. 1. Component location.
◄ Mod. 2263 ►

General

4. The installation consists of a transmitter/receiver unit housed in a pressurized cast alloy case which is mounted adjacent to two 'horn' aerials fitted in the lower part of the starboard air intake. The altimeter can operate on two ranges, one of 5 000 feet and one of 500 feet, both of which are selected at the control unit. The control unit also provides facilities for selecting fixed heights at which to fly within the range of 50-5 000 feet. Deviation from the selected height is shown by 'high' – 'on' – 'low' lamp indicators located on the pilot's instrument panel.

Principle of operation

5. The system is based on the asdic technique. The A.R.I., operates within the frequency band of 4 200 to 4 400 MHz and is frequency modulated at 300 Hz.

6. A signal is transmitted from the aircraft to the ground and is reflected by the ground back to the aircraft receiver. Part of the transmitted signal is fed directly into the receiver, as a reference signal, where it is mixed with the reflected signal. Due to the time taken for the reflected signal to travel to the ground and back to the receiver, a frequency difference will exist between the reflected signal and the reference signal. Consequently when the two signals are mixed together, a 'beat note' is produced, the frequency of which is proportional to aircraft height, i.e., the higher the aircraft the higher the beat note frequency.

7. The beat note signal is fed from the receiver into an amplifier where it is amplified and converted into a d.c. voltage that is proportional to the aircraft height.

Unit location

8. The installation consists of ten main units, which are located as shown in Table 1, and described in the paragraphs that follow.

Transmitter/receiver aerials, Type 16088

9. The aerial assembly consists of two rectangular aerial horns, one for the transmitter and one for the receiver. Mounted on top of the horns are the coupling units which contain the waveguide – to – coaxial matching circuits which are required to couple the aerials to the transmitter and receiver connecting cables. Fitted on the side of the horns are the switch units. These units contain the electro-mechanical actuators which insert probes into the horns to connect the 'in-flight' test delay unit across the aerial system.

Transmitter/receiver unit

10. The transmitter receiver unit is a self-contained unit housed within a pressure sealed cast alloy case. The transmitter contains a power unit, R.F. generator, waveguide cavity. A modulation motor is driven from a special stable 300 Hz oscillator, and rotates a double-vane butterfly paddle assembly inside the waveguide cavity. The action of the paddle assembly, frequency modulates the transmitter carrier mechanically at 300 Hz and thereby causes a deviation of 100 MHz (low range 500 ft.) or 10 MHz (high range 5 000 ft.) about the carrier frequency. The receiver contains a balanced mixer and a pre-amp. which mixes the reflected and directly fed signals from the transmitter and amplifies the beat note thereby produced. The receiver is fed with the necessary power supplies from the transmitter power unit.

Amplifier-computor unit

11. The amplifier-computor unit is a self contained unit housed in a light alloy case. The unit, is completely transistorized except for the power unit and consists of the following sub-units:-

Power unit
Amplifier unit
Height counter unit
Limit light counter unit
Computor unit

The power unit, which is supplied from the aircraft 200-volt system, provides the necessary stabilized power supplies for the amplifier and counter units. The amplifier unit contains a six-stage amplifier with a push-pull output. Both counter units incorporate triggering circuits, multivibrator and a push-pull (counting) full wave rectifier output stage.

12. Signals from the receiver pre-amp are fed into the unit where they are amplified and coupled into the triggering circuits of the counter units. The triggering circuits operate in conjunction with the multivibrators to produce a square-wave signal which is rectified at the output stage to a d.c. voltage. As the signal from the receiver pre-amp is proportional to aircraft height, so it follows that the d.c. voltage produced in each counter unit is also proportional to aircraft height.

13. The output from the height counter unit is fed, via junction boxes, Type 16507 and 16107, to the autopilot elevator channel, and the altitude indicator, Type 16094, on the plotter's instrument panel.

14. The output from the limit light counter unit is fed to the electrical indicator, Type 7230, via the junction box and the LIMIT SELR (limit selector) switch on the control unit. Selecting a height at the LIMIT SELR switch inserts a load across the output from the limit light counter unit. The value of this load is such that the voltage applied to the indicator, Type 7230, is proportional to the selected height.

Junction box, Type 26507

15. The junction box is an integral part of the amplifier-computor unit rack mounting. Two sockets and one plug are mounted on the junction box which connect the amplifier-computor to the appropriate units in the installation.

Junction box, Type 16107

16. The junction box, Type 16107, is the main interconnecting unit for the various major components of the installation. Each component is connected to the junction box, via a multi-pole plug and socket, where inter-connection and distribution is carried out, the signals being finally fed to the appropriate component via the respective plug and socket.

Mk.7B/T.F.R. junction box

17. For the switching conditions of the Mk.7B/T.F.R. junction box refer to Sect.9, Chap.7, Para.21 to 23.

Altitude indicator, Type 16094,

18. The altitude indicator, Type 16094, is fitted to the plotter's instrument panel and is a completely sealed unit housed in a cast alloy case. The indicator is fully described in A.P.116B-0203-1.

Electrical indicator, Type 7230

19. Three electrical indicator lamps indicate the height of the aircraft relative to the height selected at the control unit (para.4). The lamps, which are coloured amber, green and red, provide the following indications:-

Amber	Above height (more than 5%)
Green	On height (within 5%)
Red	Below height (more than 5%)

All three lamps incorporate a press-to-test facility.

20. The three lamps are normally fitted to a panel and the assembly is supplied as an indicator, Type 7230. On Vulcan aircraft, however, the mounting is not used and the lamps are fitted directly to the pilots' instrument panel.

Control unit, Type 16095

21. The control unit provides full remote control of the transmitter/receiver and amplifier unit, together with facilities for carrying out a functional check on the entire installation. The following switches are mounted on the front panel of the unit:-

ON – OFF switch
LIMIT SELR. switch
TEST switch
RANGE switch

The ON-OFF switch controls the power supplies to the installation. The LIMIT SELR. (limit selector) switch selects heights at which to fly, the selected height being shown in the 'window' adjacent to the switch. The RANGE switch selects the range the equipment is required to operate on.

Power supplies

22. The installation is fed with two supplies, one of 200-volt, 3-phase 400 Hz and one of 28-volt d.c. The 200-volt supply is connected from fuses 282R a B, in panel 27P to terminals A and C respectively of T.B.1088. The supply is then fed, via the respective plug, to the transmitter/receiver and amplifier units. The 28-volt d.c. supply for these units is connected from fuses 656 and 657 in panel 3P, via plug 170, to terminals A and B of T.B.1089. The supply is then fed via the appropriate plug to the respective unit. The control unit is also supplied from the 28-volt d.c. system via fuses 658 and 659 in panel 13P.

SERVICING

Precautions

23. Servicing personnel in particular are warned that a.c. or d.c. voltage in excess of 100 volts can be dangerous, to the extent of causing personal injury, fatal or otherwise. It is essential that the closest attention is given to servicing instructions where safety matters are concerned. It is also essential that maximum co-operation is employed between trades mutually concerned in servicing operations.

Installation

24. The setting up, operating and servicing instructions for the A.R.I. and its components will be found in A.P.116B-0203-1. The security of all components should be checked regularly. All connectors, plugs, sockets and terminal blocks should be examined for damage and ingress of dirt and moisture.

Transmitter/receiver unit

25. With a suitable pressure gauge check that the internal pressure of the unit is 5 p.s.i. above atmospheric. A Schrader valve is provided to renew the pressure by means of a hand pump, which should incorporate a desiccator unit.

Test set, Type 13430

26. A test set is available whereby a complete check can be carried out on the installation. Full details of this test set and the methods of using it will be found in A.P.116B-0203-1.

Functional ground check

27. The following ground check should be carried out at those periods laid down in A.P.101B-1902-4. With supplies of 200 volt, 3 phase, 400 Hz and 28 volt d.c. connected to the aircraft proceed as follows:-

(1) At the control unit switch ON the installation and allow a few minutes for the equipment to warm-up and stabilize. Select the 500 feet range at the RANGE switch and the 50 feet position at the LIMIT SELR. switch. The altitude indicator on the plotter's instrument panel should read slightly below zero.

(2) At the electrical indicator, Type 7230, check the lamps for serviceability by operating the press-to-test facility. Replace any unserviceable filaments.

(3) At the control unit depress the TEST switch. A reading of approximately 60 ft. should appear on the altitude indicator on the plotter's instrument panel. The amber lamp of the electrical indicator should also be lit.

(4) Select the 100 ft. position on the LIMIT SELR. switch. At the electrical indicator note that the amber lamp is extinguished and the red lamp is illuminated.

(5) Return the LIMIT SELR. switch to the OFF position. The red lamp on the electrical indicator should extinguish.

(6) Select the 5 000 ft. range and check that the additional zeros appear on the altitude indicator on the plotter's instrument panel. Depress the TEST switch and the above indicator should read 60 ft. (not 600 ft.).

On completion of the above checks, the TEST switch and the ON-OFF switch should be operated to the OFF position and the ground supplies disconnected from the aircraft.

REMOVAL AND INSTALLATION

General

28. Access to the major components is straightforward so no special instructions are required. Should it become necessary to remove or replace any component, all loose connectors should be secured to the adjacent aircraft structure to prevent damage.

Transmitter/receiver aerials, Type 16088

29. Removal of both aerials is similar. The aerials are removed by unscrewing the twelve counter-sunk screws. This allows the aerial cone to drop down. Care should be taken when lowering the aerials to ensure that the weight of the aerials is not taken on the co-axial cable. The aerials can then be removed by disconnecting the co-axial cable.

Transmitter/receiver unit

30. The transmitter/receiver unit is secured in an anti-vibration tray by dowels at the rear and two knurled locking nuts at the front. To

remove the unit disconnect the six connectors and remove the two knurled nuts at the base of the unit. Take hold of the two transport handles and slide the unit off its tray.

Delay unit, Type 16119

31. The delay unit is secured by three screws to a shelf located adjacent to the transmitter aerial. The unit is removed by disconnecting the two connectors and unscrewing the three securing screws.

Amplifier-computor unit

32. The amplifier-computor unit is secured in a tray by dowels at the rear and two knurled locking nuts at the front. To remove the amplifier-computor, unscrew the two knurled nuts at the base of the unit and, using the transport handle, slide the unit off its tray. On replacement, care should be taken to ensure that the locating dowels engage properly in order to align the plug at the rear of the unit with the socket on the tray.

Junction box, Type 16107

33. The junction box, Type 16107, is secured to the aircraft structure by four counter-sunk screws. To remove, disconnect the seven connectors and unscrew the four securing screws.

Control unit, Type 16095

34. The control unit is secured to the port console by four screws. Removal of these screws will allow the unit to be lifted up from the console. Located at the rear of the unit are two connectors which, when disconnected, enable the complete unit to be removed from the aircraft.

Altitude indicator, Type 16094

35. To remove this instrument from the plotter's instrument panel, access to the rear of the plotter's panel must first be gained by carrying out the instructions given in Sect.7, Chap.1 of this book. The instrument may then be removed from the panel by disconnecting the connector at the rear of the instrument and removing four securing screws.

Indicator lamps

36. To gain access to one or more indicator lampholders, unscrew the insulated cap at the rear of the lampholder, unsolder the connectors, release the retaining spring, and withdraw the lampholder through the panel.

37. When replacing the instrument panel, ensure that the Tufnol distance pieces are placed between the panel and support brackets, and that no cables have been damaged or trapped.

TABLE 1
Unit location

Unit	Type	Ref. No.	Location
Transmitter and receiver aerials	16088	10B/19424	Starboard air intake
Delay unit	16119	10D/22305	Starboard air intake
Transmitter/receiver unit	–	5841-99-954-2617	Starboard air intake
Amplifier-computor unit	–	5841-99-954-2618	Nose wheel bay (starboard crate)
Junction box	16507	10D/22437	Nose wheel bay (starboard crate)
Junction box	16107	10D/21788	First pilot's radar crate
Electrical indicator	7230	10Q/89	Pilots' instrument panel (stbd.)
Control unit	16095	10L/16720	Port console
Altitude indicator	16094	10Q/16459	Plotter's instrument panel

TABLE 2

Connectors for A.R.I.23172

Part No.	Cable form	Connecting
18/T.4909	Min. electric 6C	J.B.16107 to Indicator, Type 7230
3/T.4909	Min. electric 12C	J.B.16107 to Control unit, Type 16095
4/T.4909	Min. electric 4C	J.B.16107 to PL.1016
5/T.4909	Min. electric 4C	P.L.1016 to T.R. unit
8/T.4909	Uniradio 43	T.R. unit to J.B.16507
9/T.4909	Unipren 4	T.R. unit to T.R. aerials
11/T.4909	Min. electric 6C	T.B.1088 and 1089 to T.R. unit
*12/T.4909	Min. electric 12C	J.B.16107 to Autopilot
13/T.4909	Min. electric 4C	J.B.16507 to T.B.'s 1088 and 1089
14/T.4909	Uninyvin 22	Fuses 656 and 657 to PL.170
15/T.4909	Uninyvin 22	PL.170 to T.B.1089
17/T.4909	Min. electric 18C	PL.1017 to J.B.16507
21/T.4909	Min. electric 18C	PL.1017 to Mk.7B/T.F.R. J/B PL1
22/T.4909	Min. electric 18C	Mk.7B/T.F.R. J/B SK.3 to J/B 16107 PL2A
1/FR.733	Uninyvin 22	Control unit, Type 16095, to 3P fuses 658 and 659
2/FR.733	Uninyvin 22	Control unit, Type 16095, to earth connection
3/T.6195	Min. electric 6C	J.B.16107 to altitude indicator, Type 16094

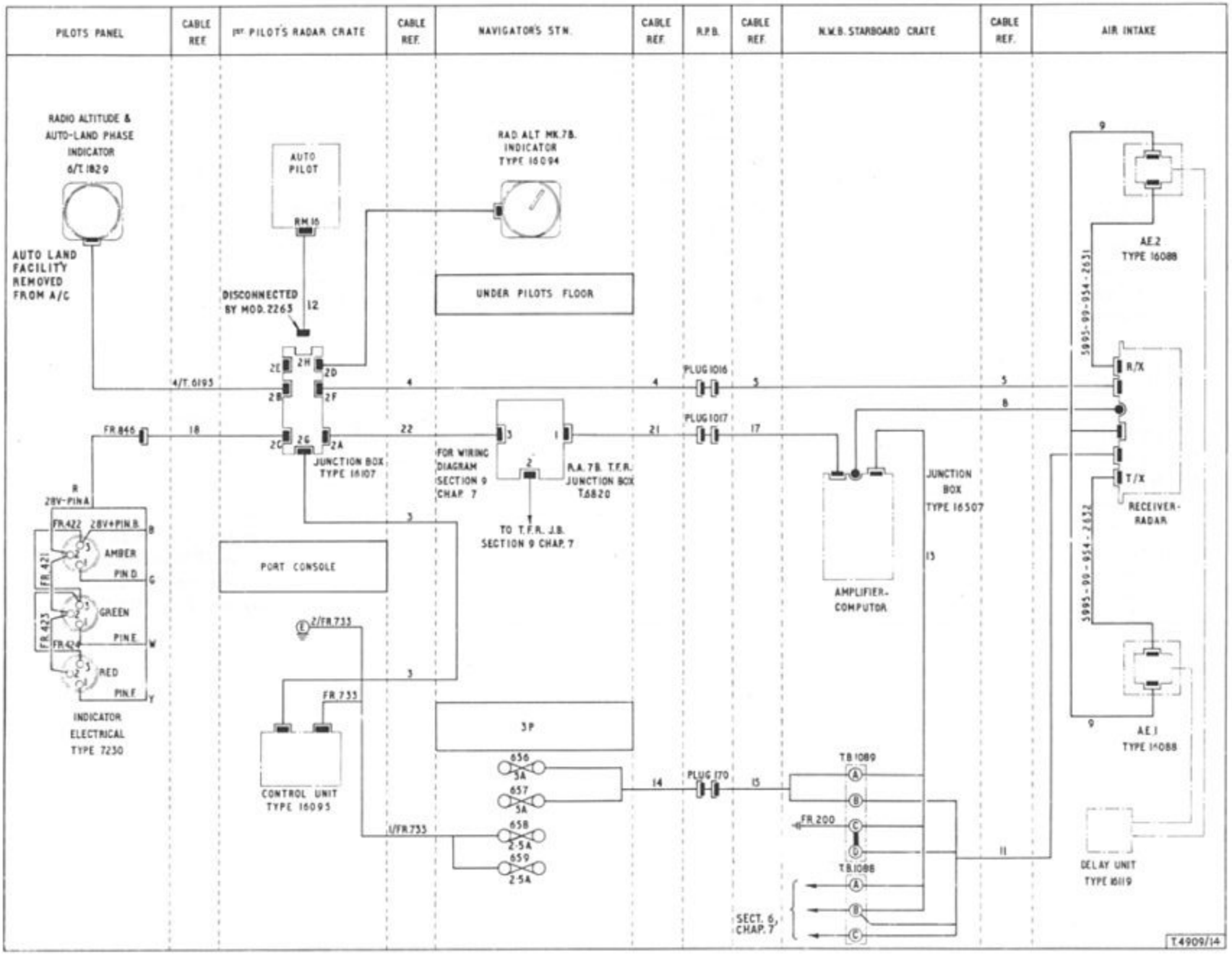

Fig. 2 A.R.I. 23172