AIR PUBLICATION
116B-0408-1
(Formerly A.P.2534E, Vol. 1)

GROUP 116 : RADIO
SUB-GROUP B : NAVIGATION AND LANDING AIDS (AIR)

INSTRUMENT LANDING SYSTEM (ILS) AIRBORNE ARI 18011

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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(Ministry of Defence)

FOR USE IN THE
NAVAL SERVICE
ROYAL AIR FORCE

(Prepared by the Ministry of Aviation)

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Each leaf, except the original issue of preliminaries, bears the date of issue and the number of the Amendment List with which it was issued. For amendment up to and including AL31, new or amended technical matter will be indicated by black triangles positioned in the text thus: ◄-------► to show the extent of amended text, and thus: ►◄ to show where text has been deleted. For amendments AL32 onwards, changes to the text are identified by triangles thus: ►-------◄. When a Part, Section, or Chapter is issued in completely revised form the triangles will not appear.

The reference number of this publication was altered from AP 2534E, Vol. 1 to AP 116B-0408-1 in December 1965. No general revision of page captions has been undertaken, but the code number appears in place of the earlier AP number on new or amended leaves issued subsequent to that date.

LIST OF ASSOCIATED PUBLICATIONS

	Old AP	AP Code
I.L.S. (Ground) - FGRI.18017 ...	2534F	116C-0401
I.L.S. (Air) First line test equipment:		
Test set Type M39	-	116B-0410
Test set Type M41	-	116B-0411
Test set Type 391	part of 2534G	116B-0412
I.L.S. (Air) Bay test equipment:		
Test rig (installation) Type 5 ...	part of 2534G	116B-0413
Signal generator Type 69 ...	part of 2534G	116B-0414
Signal generator Type 62 and 62A	2563BN	116B-0416
Mixer unit Type 20	part of 2534G	116B-0415
I.L.S./VOR signal generator Type M58 ...	part of 2534G	116B-0417

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PRELIMINARIES

LEADING PARTICULARS

General description

Airborne installation of three receivers for reception of I.L.S. localizer, glidepath and marker transmissions.

Function

Airfield approach aid.

Operating principles

The vertical pointer of a crossed-pointer meter indicates lateral deviation from the line of the runway and the horizontal pointer indicates deviation from the angle of approach; the aircraft is flown to hold the pointers crossed at the centre. Marker signals received at three fixed points along the approach path operate a flashing light or are heard as audio tones.

Operating frequencies

Localizer : any of twelve spot-frequencies from forty channels spaced at 50 kHz, in the range 108.1 MHz to 111.95 MHz.

Glidepath : any of twelve spot-frequencies from forty channels spaced at 150 kHz, in the range 329.15 MHz to 335 MHz.

Marker : fixed-tuned at 75 MHz.

Type of receiver

Localizer - double superhet with first i.f. at 28.6 MHz and second i.f. at 2 MHz.

Glidepath - double superhet with first i.f. at 54 MHz and second i.f. at 6.6 MHz.

Marker : low-gain TRF.

Construction

The localizer and marker receivers are carried in three sub-assemblies, making up the receiver R.1964; the glidepath-receiver is formed from three sub-assemblies, making up the receiver R.1965; local oscillators for both glidepath and localizer receivers are carried in the separate control unit.

Versions

R.1964 : Basic localizer and marker receiver.

R.1964A : As R.1964, with the addition of a.g.c. output to assist in the calibration of ground I.L.S. system.

R.1964B : As R.1964, but power unit changed to permit vertical mounting.

R.1965 : Basic glidepath receiver.

R.1965A : As 1965, with the addition of a.g.c. output to assist in the calibration of the ground I.L.S. system.

R.1965B : As R.1965, but power unit changed to permit vertical mounting.

Main items of installation

Description	Stores Ref.	Alternative Installation Description
Localizer receiver Type R.1964	10D/17818	Type R.1964B
Glidepath receiver Type R.1965	10D/17819	Type R.1965B
Control unit Type 705	10L/263	Type 705A
Junction box Type 157	10D/17815	Type 157A
Junction box Type 158	10D/17816	Type 158A
Junction box Type 159	10D/17817	Type 159A
Junction box Type 164	10D/17921	
Indicator electrical Type 7	10Q/61	
Voltage regulator Type 60	5U/5418	

Test equipment

Test set Type 391	10S/16374
Test rig (installation) Type 5	10S/16378
Mixer unit Type 20	10D/17844
Signal generator Type 69	10S/16377
Signal generator Type 62	10S/16318
Signal generator CT.53	10S/16160
Signal generator Type 56 (or CT.218)	10S/647 (10S/16780)

Sizes and weights of principal units

	Weight lb	Width	Size in Height	Depth
R.1964 or R.1964B	17·75	5·9	7·75	14·8
R.1965 or R.1965B	16·25	5·9	7·75	14·8
CU.705 or CU.705A	1·75	5·7	3·8	4·2
JB.157 or JB.157A	2·8	11·8	5·5	4·0
JB.158 or JB.158A	1·5	5·8	5·5	4·0
JB.159 or JB.159A	1·5	5·8	5·5	4·0

PART 1

PART 1

GENERAL INFORMATION

PART 1

LIST OF CONTENTS

PRODUCTION MODIFICATIONS

Receiver Unit Type 118 (10P/13185)

The capacitor 4C2 in the inductor unit Type 184 (10C/18641), being no longer available, is changed on later equipments from a 2-32pf to a 3-14·5pf capacitor of a new type, and capacitor 4C1 in the same unit is changed from 8·2pf to 10pf for the same reason.

The new capacitor (4C2) is fitted on a small bracket so that it is still accessible as before. The inductor unit Type 186 (10C/18643) is changed to inductor unit Type 16348 (10C/26424) on later equipments. This has become necessary because the crystal rectifier Type 2X103G (4 MR2) fitted in the inductor unit Type 186, is no longer available. These inductor units are physically and electrically directly interchangeable.
The following circuit diagrams refer:

Part 1, Chap. 3, Fig. 19
Part 3, Chap. 2, Fig. 6

R.F. Unit Type 74 (10D/17823)

The capacitors 10C1 and 10C2 in the inductor unit type 181 (10C/18638) being no longer available are changed on later equipments, from 1·5—21·5pf and 8·2pf to 3–14·5pf and 10pf respectively. Circuit diagram Part 3, Chap. 3, fig. 4 refers.

Receiver Unit Type 117 (10P/13184)

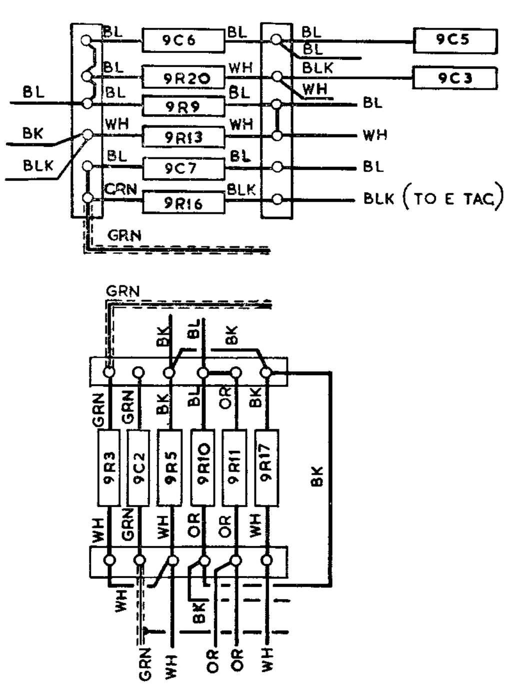
The capacitor 3C32 in the filter unit Type 392 (10C/13188) being no longer available is changed on later equipments from a 2–22pf to a 3–14·5pf capacitor of a new type, with a 5·6pf capacitor in addition, connected in parallel with it. The new capacitor (3C32) is fitted on a small bracket so that it is still accessible as before. The following diagrams refer:

Part 1, Chap. 3, fig. 14
Part 3, Chap. 2, fig. 4
Part 3, Chap. 2, fig. 7

L.F. Unit Type 5 (10P/17284)

Because of the increase in permitted length of the capacitors supplied for use in the positions 9C2, 9C6 and 9C7 to 1¾ in. instead of 1½ in., the layout of the underchassis components has been altered as shown in illustration.

LAYOUT PRIOR TO INTRODUCTION OF CHANGE 3998-64



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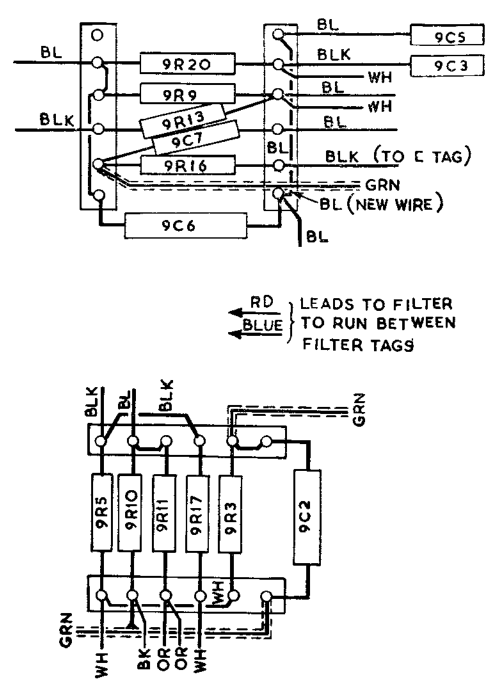

L.F. Unit Type 5 change

Chapter 1

INTRODUCTION

(completely revised)

CONTENTS

OUTLINE OF I.L.S. AIRBORNE

1 The receiving equipment described in this publication is a landing approach aid installed in aircraft as ARI.18011. It operates on transmissions from ground beacons and provides the pilot of an equipped aircraft with visual indications of the aircraft's position relative to the runway touch-down point.

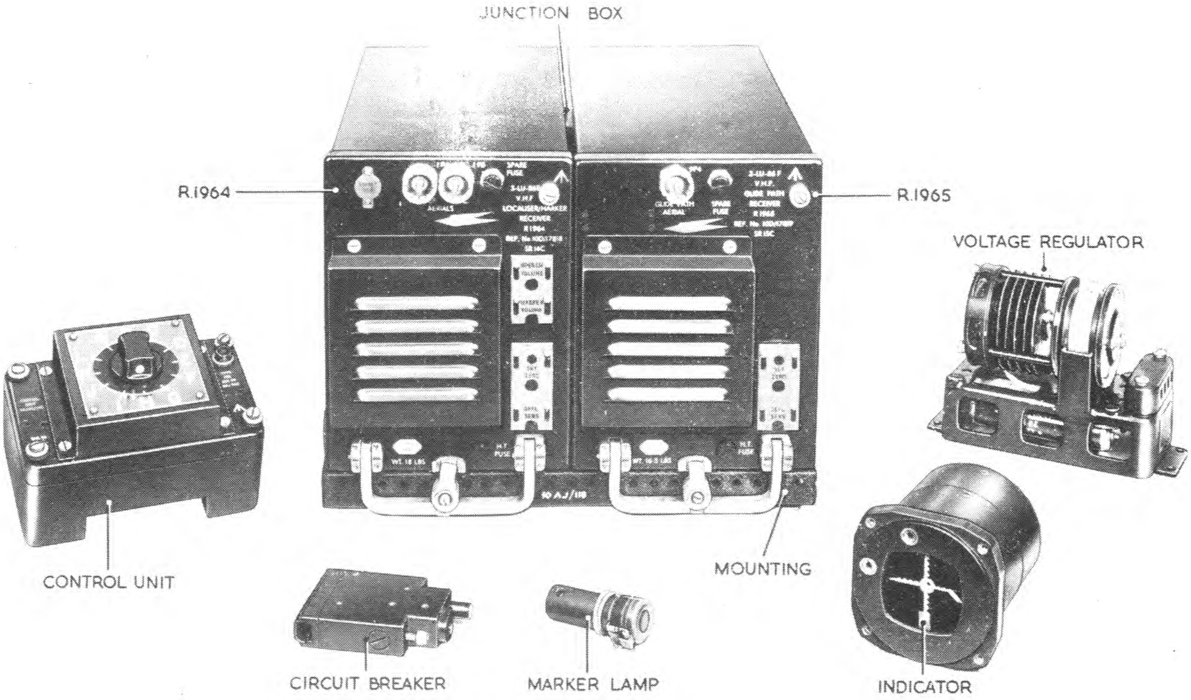

Fig. 1 Major items of I.L.S. airborne equipment

2 The complete system (that is the ground beacons and the airborne equipment considered together) is known as the Instrument Landing System (I.L.S.). It is a Service version of the system as used in Civil Aviation, and both Service and Civil systems are developments of the American SCS-51 system. The differences between the Service and Civil versions are differences in detail only, which do not preclude the use of Service airborne equipments on Civil beacons or Civil airborne equipments on Service beacons.

3 Three receivers are used in the airborne equipment. A localizer receiver provides indications of lateral deviations from the approach path; that is, it shows the aircraft's position in the horizontal plane relative to the line of the runway. A glidepath receiver provides indications of deviations from the vertical path to the runway; that is, it shows the aircraft's position relative to the correct angle of approach to the runway. A marker beacon receiver indicates aurally or on a flashing lamp the approximate distance to the touchdown point at two fixed positions along the approach.

4 The localizer receiver operates at any one of twelve spot-frequencies in the range from 108.1 MHz to 111.95 MHz; the tuning range of the receiver actually extends beyond this upper limit to 118 MHz, but no application for this extended range is at present foreseen. The glidepath receiver operates at any one of twelve spot-frequencies in the range from 330.95 MHz to 334.7 MHz. The marker receiver is fixed-tuned at 75 MHz.

5 The separation between adjacent localizer channels is 50 kHz, and that between the glidepath channels is 150 kHz; a total of 40 localizer channels and 40 glidepath channels is available. A single, twelve-position switch on a pilot's control unit, fitted remote from the receivers, controls selection of both the glidepath and localizer channels.

6 A common audio circuit provides a telephone output from the localizer and marker receivers. The audio signals consist of coded identification signals or emergency voice signals from the localizer receiver, and the characteristic marker beacon tones from the marker receiver.

7 The signals produced by the localizer and glidepath receivers are particularly suited for operating automatic following devices, and when applied to an auto-pilot they enable an automatic let-down to be carried out to within about 150 ft of the ground. Auto-pilots Mk. 10 and 12 are provided with the necessary coupling units which make them suitable for operating off I.L.S.

8 The major items in the airborne equipment are shown in fig. 1. One main unit (receiver Type R.1964) contains the localizer and marker receivers, the other (receiver Type R.1965) contains the glide-path receiver. The control unit (Type 705) carries the channel selector control and the local oscillator circuits for the localizer and glidepath receivers. Vertical and horizontal pointers displaying the localizer and glidepath receiver output are combined in a cross-pointer movement in the indicator unit.

9 Other parts of the installation include junction boxes, three separate aerials, and a marker indicating lamp. The separate aerials are of different types to accommodate the different frequency ranges involved and the needs of different aircraft. In some slow flying aircraft traditional types of rod, sword and wire aerials are used; in other aircraft, including all high-speed types, suppressed aerials are used in which the external surfaces of the aircraft's structure form important parts of the reception system.

10 The equipment operates from aircraft DC supplies of 26·5V nominal. A direct input from the DC source operates a rotary transformer (motor-generator) in each unit to provide HT. A second input is taken through a voltage regulator to provide a stabilized source at between 18V and 20V, nominally 19V, to supply the valve heaters. The direct power consumption is about 140 watts, and the stabilized consumption is about 90 watts, making a total of 230 watts.

11 The ambient temperature range in which the equipment is designed to operate is from minus 35 deg. Celsius to plus 55 deg. Celsius (about minus 30 deg. F. to plus 130 deg. F.). A forced air cooling system is used in the two receiver units to allow the upper limit to be maintained. All units are fully tropicalized, but, because operational requirements limit the use of the equipment to low altitudes, they are not pressurized.

SUMMARY OF INSTRUMENT LANDING SYSTEM

12 The Instrument Landing System provides a radio guide along a prescribed approach path to a runway, and enables a fitted aircraft to descend to a low altitude without sight of the ground. Thus, in conditions of bad visibility, a successful approach can be made to a point at which sight of the ground or landing lights will permit a landing to be made. The layout of an airfield with I.L.S. radio paths is shown in fig. 2.

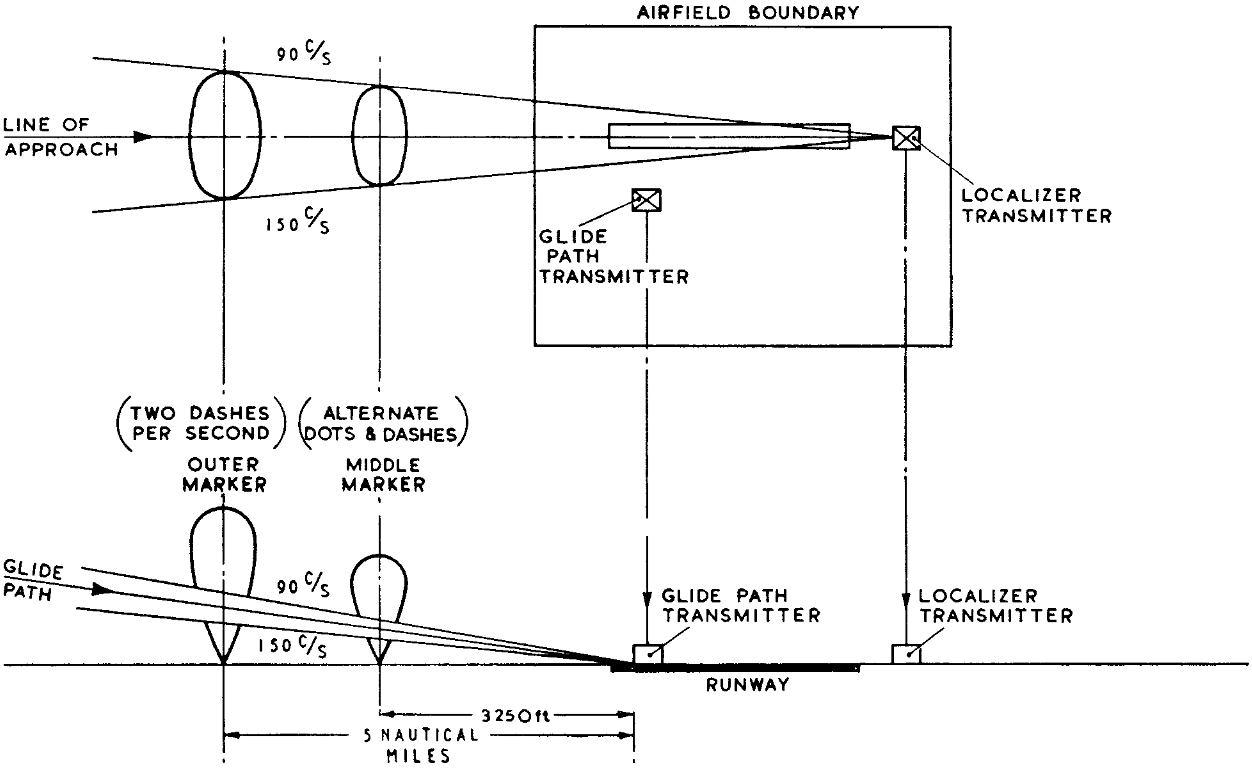

Fig. 2 Layout of I.L.S. ground system

Localizer

13 The line of approach to the runway in the horizontal plane is marked by a localizer beacon sited at the far end of the runway. The radiation pattern of this beacon in the horizontal plane is characterized by two major lobes which overlap along a line passing through the centre and along the length of the runway, as shown in fig. 3. The right-hand lobe (looking towards the transmitter from the touch-down end of the runway) carries a modulation at 150 Hz, and the left-hand lobe carries a modulation at 90 Hz. At the centre of intersection of the two lobes, along the equisignal, there are equal amplitudes of the modulation side-bands, and the carriers of the two lobes are equal and in phase.

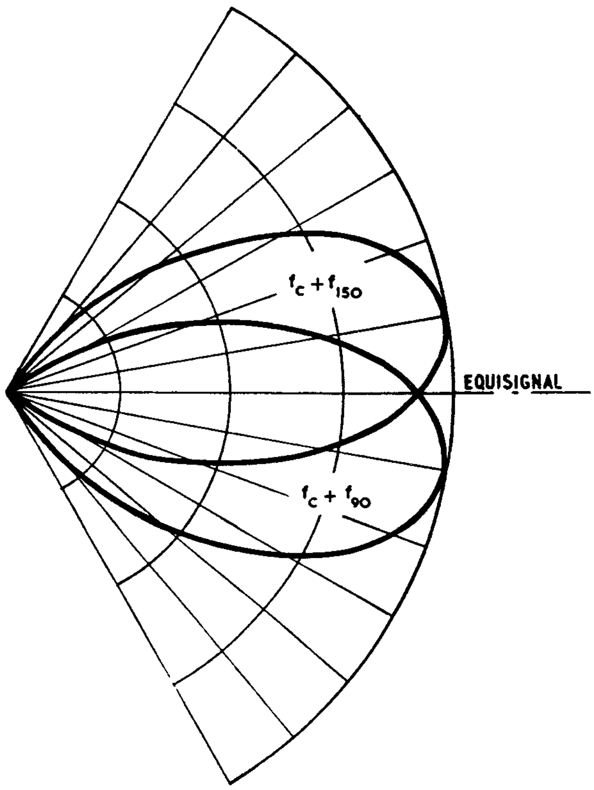

Fig. 3 Radiation-pattern of localizer transmission

14 An aircraft in the range of the beacon receives a signal with a predominant modulation of either 150 Hz or 90 Hz when flying to the right or left respectively of the correct line of approach, and a signal with equal levels of the two modulations when flying exactly along the approach path. For angles of deviation from the line of approach of up to 4 deg. the difference between the levels of the two modulations is proportional to the angle.

15 The airborne receiver of the localizer transmissions produces two DC outputs whose levels are dependent upon the modulation levels of the received signals. These outputs are connected in opposition to provide a single DC source which is positive or negative according to which modulation level is the greater, and zero when the levels are equal. The deviation from the line of approach is therefore indicated by the magnitude and polarity of this DC output.

16 The final output is fed to a moving-coil meter unit in the indicator to control the position of a vertical pointer. Left deflections of the pointer result when the aircraft is to the right of the approach path, right deflections when to the left, and centre-zero shows when the aircraft is on the path. A warning flag is also controlled by the output to appear over the end of the pointer when weak, zero, or faulty reception (one modulation signal missing) makes the pointer reading misleading.

17 An identification signal is transmitted by the localizer beacon to provide identification of the complete I.L.S. ground installation. It takes the form of a 1,000 Hz note keyed in accordance with a prearranged code to distinguish each separate installation, and it is radiated in both lobes as an additional modulation on the localizer carrier. The 1,000 Hz tone which appears in the output stages of the localizer receiver is separated from the 150 Hz and 90 Hz localizer tones and is amplified in an audio circuit for presentation on the aircraft's inter-com system. In emergency the identification tone is switched out at the beacon and voice signals substituted, thus providing a ground-to-air channel of communication at the frequency of the localizer channel.

18 The localizer beacon has a range of about 25 miles at a height of 2,000 ft.; and at distances within this range, deviations of 2½ deg. from the line of approach produce full-scale deflection of the indicator pointer independently of the actual range.

Glidepath

19 The approach path in the vertical plane, that is the angle of approach to the touch-down point, is marked by a glidepath beacon whose aerials are sited at the side of the runway at the approach end. The radiation pattern in the vertical plane has two major lobes overlapping along the descent path and meeting the ground at the approximate touch-down point as shown in fig. 4. Measures are taken in the design of the aerial system to correct the radiation pattern to ensure that the descent path is a straight line down to the runway.

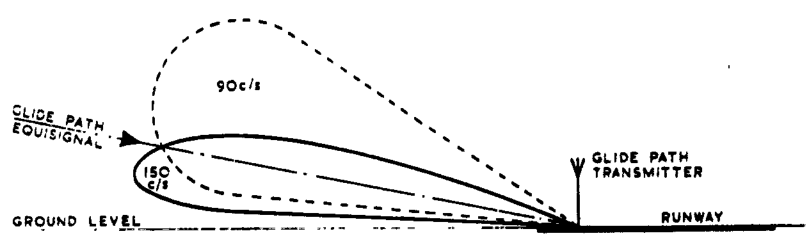

Fig. 4 Radiation-pattern of glidepath transmission

20 The upper lobe of the glidepath transmission carries a 90 Hz modulation and the lower lobe carries a 150 Hz modulation; the modulation depths in both lobes are the same at about 45 percent. At points along the glidepath the field strengths of the two lobes are the same, and at points above and below the glidepath the field strength of one or the other of the lobes pre-dominates.

21 An aircraft in the range of the glidepath transmission will thus receive a strong 90 Hz modulated signal and a weak 150 Hz modulated signal when flying above the glidepath, equal strengths of the two signals when on the glidepath, and a strong 150 Hz modulated signal and a weak 90 Hz modulated signal when below the glidepath. For small deviations from the glidepath angle the difference between the strengths of the two signals at a particular deviation is proportional to the angle.

22 The glidepath receiver is generally similar to the localizer receiver, and its output is also a DC potential whose value depends upon deviations from the correct path. The horizontal pointer of the indicator is controlled by the output to indicate up-deflections when the aircraft is below the glidepath, down-deflections when the aircraft is above the glidepath, and centre-zero when the aircraft is on the glidepath. A warning flag is also controlled by the output to appear over the end of the pointer when weak or zero signals, or faulty reception, make the pointer reading misleading.

23 At an angle of elevation equal to a third of the glidepath angle the glidepath beacon has a range of about 15 miles, and within this range full-scale deflection of the pointer is produced by deviations of approximately ½ deg. up and ¾ deg. down from the glidepath angle. The glidepath angle will differ between installations, but will normally be about 3 deg.; the sensitivity of the glidepath indicator will also differ with differing glidepath angles.

Markers

24 Two marker beacons are placed along the approach-path to the runway, as shown in fig. 2. Each beacon transmits a fan-shaped vertical radiation-pattern in a narrow beam. The beacons are referred to as outer marker and middle marker, and their siting positions are at five miles and 3,250 ft respectively from the approach end of the runway. Provision is also made for an inner marker at the airfield boundary, but this beacon is not normally used.

25 Each marker is distinguished by a characteristic tone modulation on its carrier, and as a further distinction the tones are keyed. The outer marker is modulated at 400 Hz and keyed for two dashes per second; the middle marker is modulated at 1,300 Hz and keyed with alternate dots and dashes.

26 The marker transmissions are received on a marker receiver in the aircraft and displayed both aurally, over the aircraft's intercom system, and visually, as a coded blinking of the marker indicator lamp. The aural signals consist of the complete marker characteristic modulations of keyed tones, but the lamp is operated from the modulation keying only. The maximum altitude for reliable reception is about 3,000 ft with suppressed aerials and a little greater with external aerials.

GENERAL DESCRIPTION OF I.L.S. RECEIVERS

27 The basic requirements of the I.L.S. receiving system is shown in fig. 5, and the outline of the receiving installation in fig. 6. The localizer receiver translates deviations from the horizontal approach path marked by the localizer beacon into right and left deflections of a vertical

pointer; the glidepath receiver translates deviations from the vertical approach path marked by the glidepath beacon into up and down deflections of a horizontal pointer; and the marker receiver translates the distance indicating signals of the three marker beacons into the ordered blinking of a lamp.

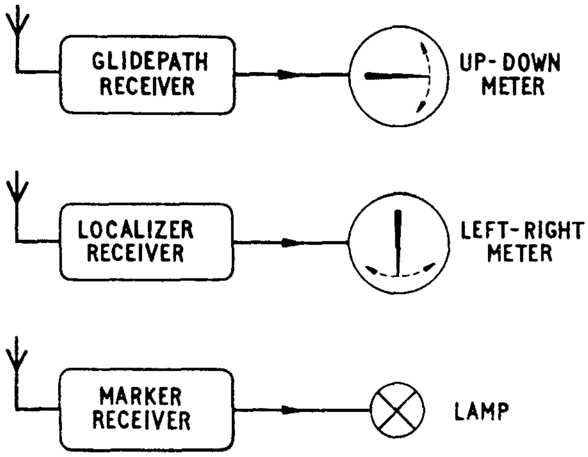

Fig. 5 Basic receiving system

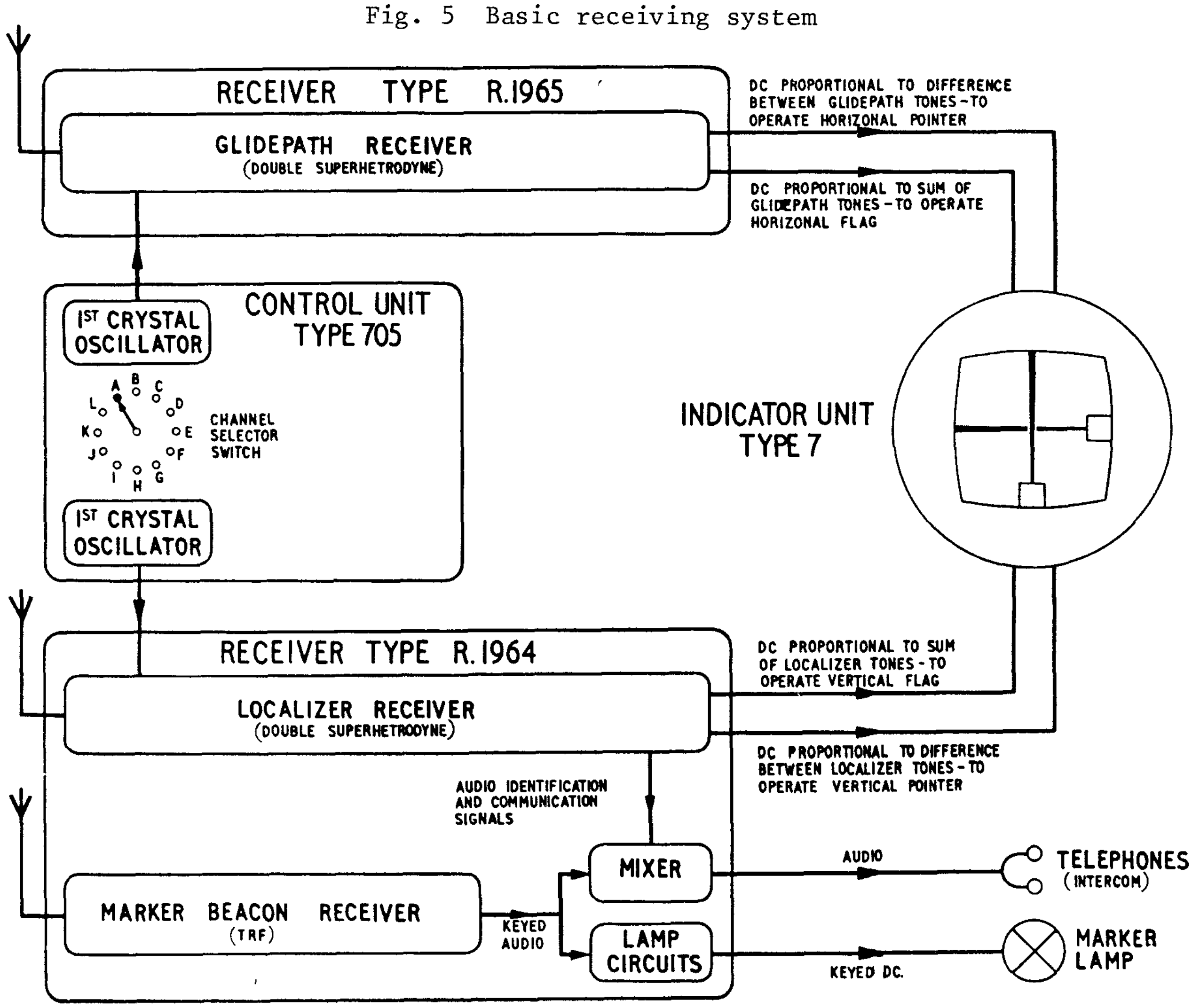

Fig. 6 Outline of receiving installation

Localizer

28 The localizer receiver is a double superhet operating over the VHF band from 108 MHz to 118 MHz. The first local oscillator (in the control unit Type 705) is crystal controlled; the channel switch in the control unit selects crystals which allow for operation at twelve spot frequencies. The first IF is at 28·6 MHz and the second IF is at 2 MHz.

29 The detected output is filtered to remove all but the localizer 150 Hz and 90 Hz tones, and the output of tones only is amplified. The two tones are then separated in sharply tuned filters, and rectified to produce two DC outputs. The levels of the DC outputs are directly proportional to the modulation depths of the original received tones.

30 The localizer pointer is operated from a parallel combination of the two levels which gives an output proportional to the difference between them; the localizer flag operates from a series combination in which the two outputs add together.

31 An audio channel which cuts out all frequencies below 300 Hz is also taken from the detector. This channel carries the output of identification or voice signals and is fed into the aircraft telephone system.

Glidepath

32 The glidepath receiver is also a double superhet; its operating range is from 329 MHz to 335 MHz. The first local oscillator is crystal controlled, and the channel switch (common with that of the localizer) selects crystals for operation at twelve spot frequencies. The first IF is at 54 MHz, and the second IF is at 6·6 MHz.

33 The detected output comprising 90 Hz and 150 Hz glidepath tones is amplified, and the tones are separated in sharply tuned filters, and rectified to produce two DC outputs. The output levels are proportional to the received strengths of the 90 Hz and 150 Hz input signals.

34 The glidepath pointer is operated from a parallel combination of the two DC levels, and the pointer is deflected in proportion to the difference between them. The glidepath flag operates from a series combination in which the two levels add together.

Markers

35 The marker receiver is a T.R.F. fixed tuned at 75 MHz. The detected signal of keyed tones is amplified and fed through two output circuits for aural and visual presentation. The aural channel includes a mixer in which the marker signals are introduced into the audio output circuit of the localizer receiver. For visual presentation the audio is rectified, and, after amplification, DC pulses representing the marker keying operate a blinker lamp through a relay.

TEST EQUIPMENT

36 Several items of test equipment are supplied exclusively for the purpose of servicing I.L.S. airborne equipment. They are:-

36.1 Test set Type 391

36.2 Test rig (installation) Type 5

36.3 Signal generator Type 69.

Test-set Type 391

37 First line servicing requirements are satisfied by the test set Type 391 which is used for tests of I.L.S. installations in the aircraft. The test set includes a signal generator (test oscillator Type 9), output control devices and extension connectors on a reel. A 24V DC power supply is required. In a normal set-up the test set and accumulators providing the operating power will be mounted on a trolley.

38 Signals at localizer, glidepath, and marker frequencies are provided by the test oscillator; they may be radiated directly from built-in aerials for tests of the installation including receiving aerials, or fed through the extension connectors for checking the receivers only. The order of modulation of the signals can be controlled to simulate actual beacon transmissions and permit the indicator circuits to be set up.

Test-rig (installation) Type 5

39 For second and third lines of servicing a bench assembly is provided in the test installation Type 5. Mountings to carry receivers, control unit, and indicator are fitted in a case, together with items of test equipment, junction boxes and connectors. The case is opened on the bench and an equipment to be tested is fitted into the mountings. A 24V DC power supply is required.

40 Connectors supplied with the installation allow the sub-assemblies in the receiver units to be operated separately on the bench. The test equipment includes meters which are used for checking the power supply and the deflection sensitivity of the indicators, and a mixer unit Type 20 which is used to extend the range of the signal generator Type 62 to cover glide-path and marker frequencies.

Signal generators

41 Test signals at second and third lines of servicing are provided from a rack-mounted assembly of two signal generators and their separate power units. A signal generator Type 62 provides the VHF signals and a signal generator Type 69 provides the tone modulation. The signal generator Type 62 is a general purpose instrument, but the Type 69 is designed specifically for I.L.S. use.

RECEIVERS R.1964A AND R.1965A

42 Receivers Types R.1964A and R.1965A differ from the receivers R.1964 and R.1965 only by the embodiment of modifications Nos. 3488/2 and 3489/2 respectively. These modifications provide an extension of the internally developed a.g.c. voltages from the receivers to certain airborne calibration equipment. No actual circuit change is involved and the general appearance of the modified receivers is as shown in fig. 1.

RECEIVERS R.1964B AND R.1965B

43 These receivers are electrically identical with the receivers R.1964 and R.1965 but a different rotary transformer is used to make the "B" versions suitable for vertical mounting in certain aircraft. The l.f. units of the "B" versions differ only in the identification markings on the receiver front panels. In appearance the R.1964B and R.1965B are similar to the R.1964 and R.1965 shown in fig. 1.

COMPOSITION OF I.L.S. RECEIVERS

44 The composition of the various airborne receivers is as follows:

- 44.1 Receiver R.1964 (5826-99-635-2827).
  - 44.1.1 L.F. unit Type 4 (10D/17822).
  - 44.1.2 Receiver unit Type 117 (5826-99-635-2829).
  - 44.1.3 Receiver unit Type 118 (10P/13185).
  - 44.1.4 Power unit Type 797 (10K/16691).
- 44.2 Receiver R.1965 (5826-99-635-2825).
  - 44.2.1 L.F. unit Type 5 (10D/17824).
  - 44.2.2 Receiver unit Type 119 (5826-99-635-2830).
  - 44.2.3 R.F. unit Type 74 (10D/17823).
  - 44.2.4 Power unit Type 797 (10K/16691).
- 44.3 Receiver R.1964A (10D/19903).
  - 44.3.1 L.F. unit Type 4 (10D/17822) modified.
  - 44.3.2 Receiver unit Type 117 (10P/13184) modified.
  - 44.3.3 Receiver unit Type 118 (10P/13185).
  - 44.3.4 Power unit Type 797 (10K/16691).

44.4 Receiver R.1965A (10D/19904).

44.4.1 L.F. unit Type 5 (10D/17824) modified.

44.4.2 Receiver unit Type 119 (10P/13186) modified.

44.4.3 R.F. unit Type 74 (10D/17823).

44.4.4 Power unit Type 797 (10K/16691).

44.5 Receiver R.1964B (5826-99-635-2828).

44.5.1 L.F. unit Type 4A (10D/21528).

44.5.2 Receiver unit Type 117 (5826-99-635-2829).

44.5.3 Receiver unit Type 118 (10P/13185).

44.5.4 Power unit Type 11953 (10K/20718).

44.6 Receiver R.1965B (5826-99-635-2826).

44.6.1 L.F. unit Type 5A (10D/21529).

44.6.2 Receiver unit Type 119 (5826-99-635-2830).

44.6.3 R.F. unit Type 74 (10D/17823).

44.6.4 Power unit Type 11953 (10K/20718).

BOXES, JUNCTION TYPES 157A, 158A AND 159A

45 These junction boxes differ from the types 157, 158 and 159 respectively, mainly by the embodiment of modification No. 5977. Circuits are given Part 3, Chap 4, Fig. 5. This modification provides electrical damping on the indicator outputs by the use of 6 capacitors (750μF each) in series-parallel (3 in parallel, in series with another 3 in parallel) connected by their positive terminals across the indicator output terminals 6P2/A and 6P2/B in the case of box, junction Type 158A (10D/23722) and terminals 11P1/C and 11P1/D for box, junction Type 159A (10D/23723). A total of 12 capacitors consisting of 2 sets of 6, each set being connected in the manner described above, is connected across a pair of output terminals, either 12P7/A and B or 12P7/C and D in the combined junction box, junction Type 157A, (10D/23721).

Two of the above units, namely, boxes, junction Type 157A and Type 158A have been further modified by the embodiment of modification No. 6451, the purpose of which is to provide an input plug to carry power supplies for the lighting of the Plasteck type illuminated front panel of the control unit Type 705A.

Circuit diagram Fig. 5, Vol. 1, Part 3, Chap. 4, refers.

CONTROL UNIT TYPE 705A (10L/16749)

46 This unit was introduced by Draft Informatory Leaflet Mod. No. 5505 and has since been manufactured. Apart from the addition of 2 pairs of lamps to illuminate the new Plasteck type front panel which is incorporated, the unit is the same electrically as the control unit Type 705. The diagonally opposite lamps constitute a pair and each pair is separately fed.

Circuit diagram Fig. 3A, Vol. 1, Part 3, Chap. 4, refers.

CONTROL, RECEIVER TYPE M30 (10L/16834)

47 On Lightning aircraft Marks 1, 1A, 2 and 4, the control units Type 705 (10L/263) have been converted by Mod. No. 9498, to control, receiver Type M30 by changing the cap which is fitted to the power warning lamp, to an optical dimming type. The lamp is dimmed by turning the cap.

Chapter 2

OPERATIONAL DATA

CONTENTS

CONTROLS

1 Two controls only are used in operating the I.L.S. airborne equipment. They are a main power switch and a channel selector switch, mounted separately at readily accessible positions in the pilot's cockpit.

Power switch

2 The main power switch is a single-pole on-off switch connected in the main aircraft DC supply to the equipment. When the switch is made, all three functions (localizer, glidepath, marker) are switched on and a visible indication is provided by the lighting of a lamp behind a red window in the control unit Type 705.

Channel selector

3 The channel selector is a continuous-action rotary switch on the front of the control unit Type 705 (fig. 1). The twelve positions are identified by the letters "A" to "L" set around the control knob. The letters and a pointer line on the control knob are fluorized to permit viewing in the ultra-violet cockpit lighting. A perspex plate fitted over the letters protects the fluorizing against deterioration through dirt or abrasion.

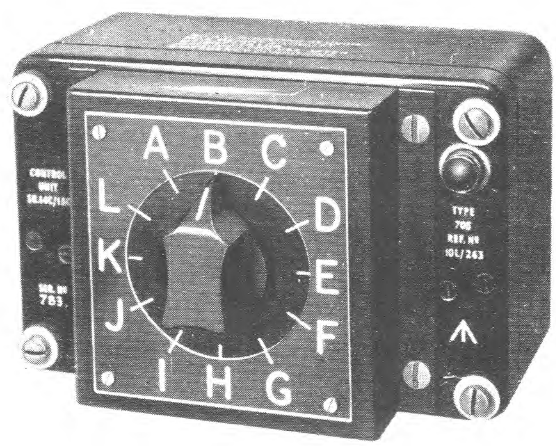

Fig. 1 Control unit

4 Each position of the switch brings two crystals into circuit, and selects particular reception frequencies for the localizer and glidepath receivers. The marker receiver is fixed tuned and is not affected by the operation of the switch.

5 In normal operational use of I.L.S., crystals are chosen before flight to permit reception of the beacons fitted at those airfields which will be potential landing grounds on return. The crystal frequencies, which are shown in Table 1, are dependent upon the frequencies of the beacon transmissions, and are calculated as follows:

(1)

$$f_{cl} = \frac{f_l - 28.6}{8} \times 1{,}000$$

where f_{cl} = localizer crystal frequency in kHz
f_l = localizer beacon frequency in MHz

(2)

$$f_{cg} = \frac{f_g - 54}{18} \times 1{,}000$$

where f_{cg} = glidepath crystal frequency in kHz
where f_g = glidepath beacon frequency in MHz.

TABLE 1 BEACON AND CRYSTAL FREQUENCIES

I.L.S. Channel	Localizer Frequency (MHz)		Glidescope Frequency (MHz)	
	Operating	Crystal	Operating	Crystal
1	108.1	9.9375	334.7	15.59444
2	108.15	9.94375	334.55	15.58611
3	108.3	9.9625	334.1	15.56111
4	108.35	9.96875	333.95	15.55277
5	108.5	9.9875	329.9	15.32777
6	108.55	9.99375	329.75	15.31944
7	108.7	10.0125	330.5	15.36111
8	108.75	10.01875	330.35	15.35277
9	108.9	10.0375	329.3	15.29444
10	108.95	10.04375	329.15	15.28611
11	109.1	10.0625	331.4	15.41111
12	109.15	10.06875	331.25	15.40277
13	109.3	10.0875	332.0	15.44444
14	109.35	10.09375	331.85	15.43611
15	109.5	10.1125	332.6	15.47777
16	109.55	10.11875	332.45	15.46944
17	109.7	10.1375	333.2	15.51111
18	109.75	10.14375	333.05	15.50277
19	109.9	10.1625	333.8	15.54444
20	109.95	10.16875	333.65	15.53611
21	110.1	10.1875	334.4	15.57777
22	110.15	10.19375	334.25	15.56944
23	110.3	10.2125	335.0	15.61111
24	110.35	10.21875	334.85	15.60277
25	110.5	10.2375	329.6	15.31111
26	110.55	10.24375	329.45	15.30277
27	110.7	10.2625	330.2	15.34444
28	110.75	10.26875	330.05	15.33611
29	110.9	10.2875	330.8	15.37777
30	110.95	10.29375	330.65	15.36844
31	111.1	10.3125	331.7	15.42777
32	111.15	10.31875	331.55	15.41944
33	111.3	10.3375	332.3	15.46111
34	111.35	10.34375	332.15	15.45277
35	111.5	10.3625	332.9	15.49444
36	111.55	10.36875	332.75	15.48611
37	111.7	10.3875	333.5	15.52777
38	111.75	10.39375	333.35	15.51944
39	111.9	10.4125	331.1	15.39444
40	111.95	10.41875	330.95	15.38611

6 The beacon frequencies are allocated in pairs to the I.L.S. ground installations so that a localizer at some particular frequency will always be associated with a glidepath beacon at a particular frequency. For example, as seen from Table 1, the localizer beacon operating at 108.1 MHz will always operate in conjunction with a glidepath beacon at 334.7 MHz.

7 As will be seen from the table, the spacing between localizer channels is 50 kHz; a total of 40 different channels is available in the band from 108.1 to 111.95 MHz. The spacing between glidepath channels is 150 kHz; 40 glidepath channels are available in the band 329.5 to 335.0 MHz.

8 It should be noted that although the number of different I.L.S. pairs is limited by the localizer-frequency allocation to 40, the actual number of I.L.S. ground installations is not so limited. Any number of installations can operate on each pair of frequencies if the distance between any two of the installations is sufficiently great to preclude interference.

9 The crystals, 24 in number, are fitted behind a cover on the front panel of the control unit. They are mounted in sockets arranged around the spindle of the selector switch. The localizer crystals are cut for frequencies in the range 9.9375 MHz to 10.41875 MHz in steps of 6.25 kHz; the glidepath crystals are cut for frequencies in the range 15.59444 MHz to 15.386111 MHz.

10 Identifying letters are moulded into the crystal mounting panel (fig. 2) to indicate the receiver and channel associations of each crystal. The two crystals for each channel are mounted adjacently, with the socket for the localizer crystal marked "L" and that for the glidepath crystal marked "G". A third, larger, letter between the "L" and the "G" identifies the channel concerned, that is the switch position in which the crystals are brought into circuit.

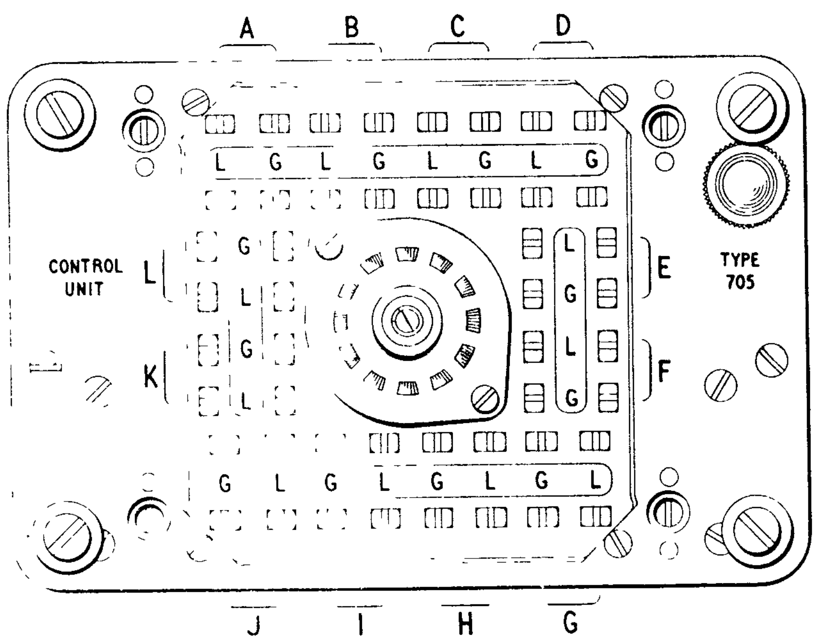

Fig. 2 Crystal positions

11 To change a crystal, proceed as follows:

11.1 Cross Refer to Table 1 Page 2 for required crystal frequency.

11.2 Loosen the four Oddie fasteners at the sides of the crystal cover on the front panel of the control unit.

11.3 Pull the cover away - the control knob does not require to be removed separately, but comes away with the cover.

11.4 From fig. 2, identify the crystal, rock it to loosen the pins from the sockets, and remove.

11.5 Fit the new crystal.

11.6 Note the position of the flat on the spindle of the switch and turn the control knob for the corresponding flat inside the coupling sleeve to be in the same relative position.

11.7 Fit the cover in position, taking care to locate the coupling sleeve properly over the spindle.

11.8 Press home the Oddie fasteners to secure the cover.

11.9 Carry out full instrument landing system function test.

Preset controls

12 Preset controls for operational (first line) setting-up of the equipment are the audio channel presets on the front panel of the R.1964 and the circuit breaker in the battery input circuit. Other presets, on the front panels of both receivers and inside their dust covers, are adjusted at second and more advanced lines of servicing only.

13 The audio-channel adjustments are as follows:

13.1 Localizer audio, 3R66 (SPEECH VOLUME). Located behind the sliding cover at the centre right-hand of R1964 front panel. This controls the audio output-level of either station identification or emergency voice signals from the localizer receiver.

13.2 Marker audio, 3R67 (MARKER VOLUME). Located beneath 3R66 (see above), behind the same sliding cover. This controls the audio output of the marker receiver.

14 The circuit breaker is a thermal switch normally fitted near the point where the I.L.S. supply is taken from the aircraft power circuit. A large pushbutton on the front of the switch is pressed to make the circuit, and remains partially recessed into the body of the switch unless tripped. A manual tripping-control is a small pushbutton immediately beneath the main button.

15 Presets for setting up the indicator presentation are as follows:

15.1 Localizer pointer-sensitivity, 1R17 (DEFL SENS). Located behind the sliding cover at the lower right-hand side of the R1964 front panel. This controls the deflection of the localizer pointer for given deviations from the line of approach.

15.2 Localizer pointer zero, 1R7 (SET ZERO). Located above 1R17 (see above), behind the same sliding cover. This balances the output of the localizer receiver to produce a centre-zero reading of the localizer pointer when on the line of approach.

15.3 Localizer flag sensitivity, 1R8. Located at the rear of the R1964 mounting frame (LF unit Type 4), at the left-hand side when viewed from the rear. This controls the level of signal required from the localizer receiver, to cause the disappearance of the localizer alarm flag.

15.4 Glidepath pointer sensitivity, 9R1 (DEFL SENS). Located behind the sliding cover at the lower right-hand side of the R1965 front panel. This controls the deflection of the glidepath pointer for given deviations from the glide angle.

15.5 Glidepath pointer zero, 9R8 (SET ZERO). Located above 1R8 (see above), behind the same sliding cover. This balances the output of the glidepath receiver to produce a centre-zero reading of the glidepath pointer when on the correct glide angle.

15.6 Glidepath flag sensitivity, 9R2. Located at the rear of the right-hand side of the R1965 mounting frame (LF unit Type 5). This controls the level of signal required from the glidepath receiver to cause the disappearance of the glidepath alarm flag.

16 Other presets are as follows:

16.1 Marker receiver gain, 4R15 (MARKER GAIN). Located behind the swinging cover at the top left-hand corner of the R1964 front panel. This controls the gain of the marker receiver, and sets the output level of both marker audio and lamp circuits.

16.2 Marker relay sensitivity, 4R26. Fitted at the rear of the marker receiver sub-chassis (receiver unit Type 118) in R1964. This controls the sensitivity of the marker lamp circuit, to ensure that the lamp follows the coding of the marker signals.

16.3 Glidepath gain, 8R43. Located on the side of the glidepath receiver sub-chassis (receiver unit Type 119), and visible at the top right-hand side of the assembly in R1965. This controls the gain of the glidepath receiver (third and fourth lines only).

Protection of presets

17 The sliding covers over the front panel indicator controls (SET ZERO and DEFL SENS) of the two receivers can be locked and sealed as a precaution against unauthorized adjustment. In the locked condition, a pin projects through one of the guide slots in the cover and acts as a stop on the cover's upward movement; access to the presets is thereby prevented. A length of wire is twisted through a hole at the end of the pin and is secured with a lead seal.

18 If the seal is broken and the wire removed, the pin withdraws automatically into the body of the unit, leaving the cover free to be slid upwards to expose the presets. The seal cannot be renewed without first removing the dust cover. After a normal servicing adjustment to the

indicator controls, the covers are sealed. Subsequent tampering will then be immediately indicated if the seal is missing and the pin is not visible.

19 The precaution of sealing the indicator controls is taken to reduce the possibility of mis-adjustments which can readily arise if other than the recommended setting-up procedure is carried out. The importance of this matter can not be over-stressed, because the slightest mis-adjustment can be responsible for misleading results from the equipment and lead to operational inaccuracies capable of seriously endangering an aircraft attempting an I.L.S. approach.

20 The front panel audio presets do not have such a critical influence on the operational effectiveness of the equipment and in consequence free access to them is permitted. The MARKER GAIN control is however an exception, and although brought out with free access on the front panel, it must not be adjusted except at advanced lines of servicing.

PRESENTATION

Indicator (fig. 3)

21 The indicator unit (indicator, electrical Type 705) is a crossed pointer instrument fitted in the pilot's cockpit. The vertical pointer pivots from the top and is operated by an output from the localizer receiver; the horizontal pointer pivots from the left-hand side and is operated by an output from the glidepath receiver. The zero positions of both pointers are along the lines of two rows of dots (one vertical, one horizontal) originating from a circle at the centre of the indicator scale. The pointers, dots, and circle are fluorized so that they can be viewed in the ultra-violet cockpit lighting.

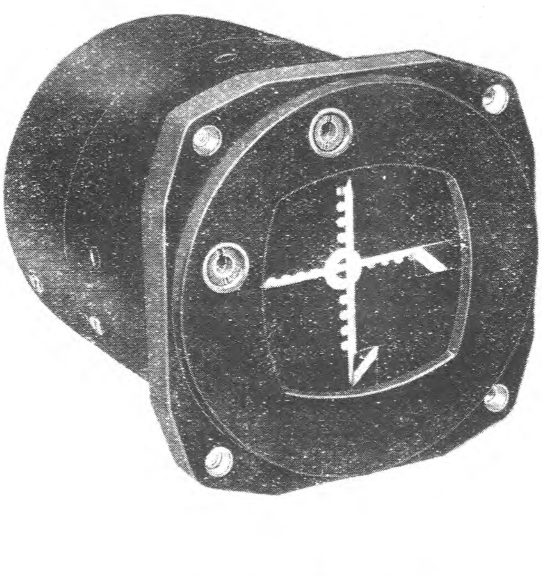

Fig. 3 Indicator unit

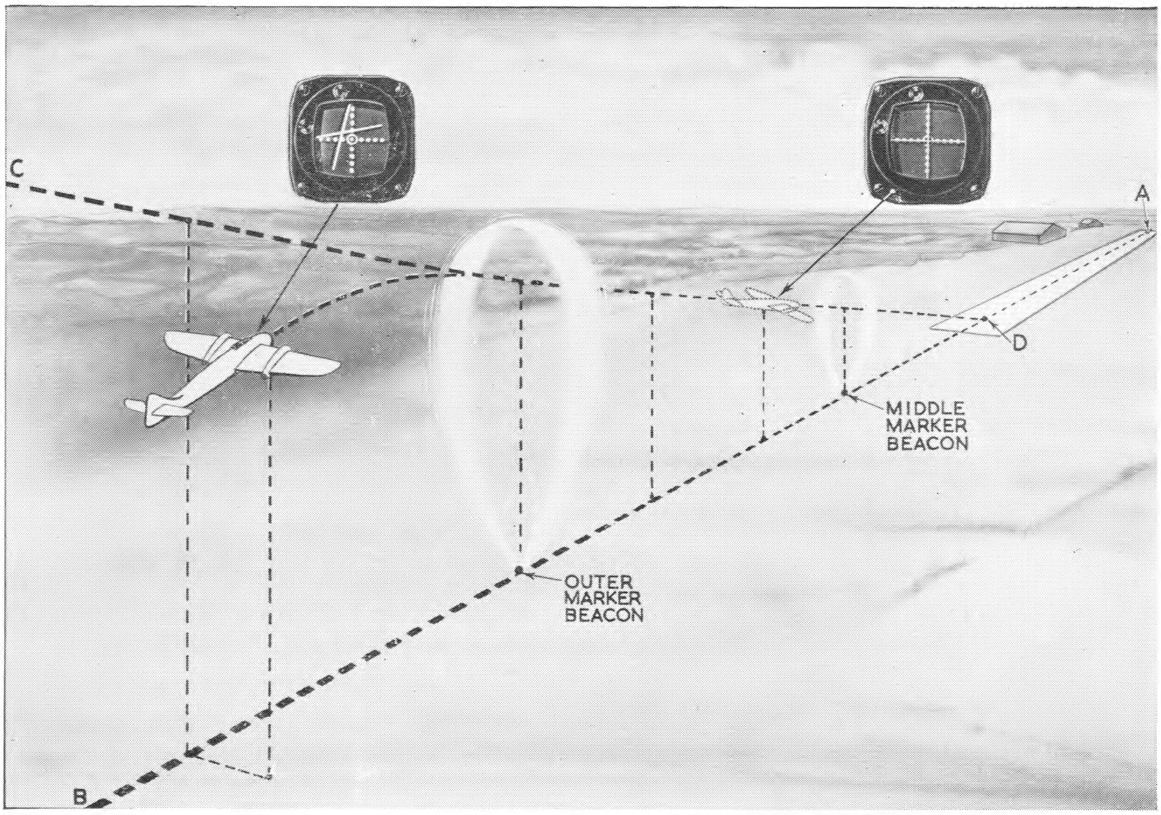

Fig. 4. ILS approach illustrated

23. When an aircraft is to the right of the line of the runway, the vertical pointer takes up a position to the left of the centre; when the aircraft is to the left, the pointer reads to the right; when the aircraft is exactly along the line of the runway, the pointer is vertical at the centre-zero position. ◀ For a 5° beam ▶ a full-scale deflection of the pointer to the outside dot, at either side, represents a deviation from the line of $2\frac{1}{2}°$; the scale is linear and the spacing between dots (the edge of the circle is to be considered as a dot for this purpose) is therefore equivalent to deviations of $\frac{1}{2}°$. ▶◀

24. When the aircraft is above the approach path, that is its approach angle is greater than the required approach angle, the horizontal pointer takes up a position below the centre of the indicator scale; when the aircraft is below the approach path, the pointer reads above the centre; when the aircraft is on the approach path in elevation the pointer is horizontal at the centre zero position. The pointer deflection is not linear, but full-scale deflection up indicates a deviation from the approach angle equal to 0·25 of the approach angle and full scale down indicates a deviation equal to 0·15 of the approach angle. This is shown in the calibration diagram fig. 7.

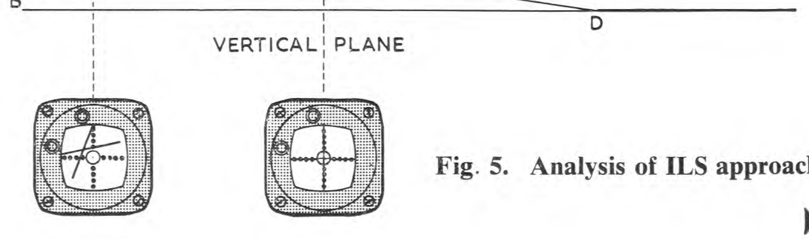

Fig. 5. Analysis of ILS approach

25. During an approach therefore the pointers take up positions indicating the direction the aircraft must fly in order to meet the correct approach path; that is, the aircraft must fly towards the pointers. When both pointers are crossed at the centre of the scale the aircraft is on the approach path, and flying control of the aircraft is directed towards keeping the pointers in that position.

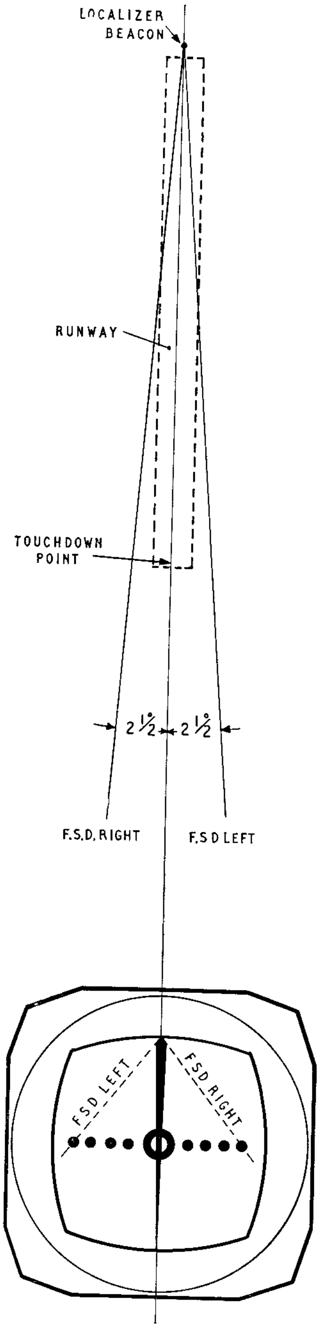

Fig. 6. Calibration of vertical pointer

26. Although the desirable approach condition is that the pointers shall be crossed exactly at the centre, in practice some tolerance is permitted. The limits are set by the circle at the centre of the indicator scale, and are such that if the crossing point is within the circle the limits of the approach path are not exceeded. It should be noted that the limits for the vertical pointer (set by the left- and right-hand sides of the circle) represent the angular width of a runway at the touchdown point. The limits for the horizontal pointer are arbitrary.

27. The localizer beam width used differs between installations within the limits of 4° and 6°. Fig. 6 shows that for a 5° beam the indicator calibration represents 10 per cent. "dot" deflection. For other beam widths the angular indications are pro rata.

28. Interpretation of the ILS pointer readings can therefore be summarized as follows:—

(1) Pointer left — fly left (because aircraft is to right of line of approach)

(2) Pointer right—fly right (because aircraft is to left of line)

(3) Pointer high — fly up (because aircraft is below approach path)

(4) Pointer low—fly down (because aircraft is above approach path).

Flight towards the pointers therefore always produces a decreasing deflection.

29. False glidepath courses are however radiated along the true line of approach, but as they are all greater than 10°, they are so widely different from the correct approach angle of 3° ± 0·1° that difficulties of misinterpretation are not likely.

Alarm flags

30. A flag movement marked with a fluorized diagonal bar is fitted at the bottom of the indicator scale, and a second similar movement is fitted at the right-hand side. The first flag appears above the end of the vertical pointer and is operated by the localizer receiver; the other appears above the end of the horizontal pointer and is operated by the glidepath receiver.

31. When signals are not being received both flags are completely visible. During a normal ILS approach, the signal strength increases as the touch-down point is neared, and the flags move clockwise until out of sight behind the front cover of the indicator. When the bars on the flags disappear from view, the signals are above the predetermined level at which flight directives can be taken from the positions of the pointers.

32. The flags provide an indication of the serviceability of the complete ILS system (that is the ground and air installations considered together), and prevent misleading conclusions being drawn from the pointer positions. For example, if the localizer receiver failed completely, the localizer pointer would read centre-zero because of lack of signals; the possible conclusion that the aircraft is on the correct line of approach is however not drawn because the alarm flag comes into view. Similarly, if the 90 c/s tone in the localizer beacon fails, the vertical pointer would tend to read full-scale deflection left irrespective of the aircraft's position, but the conclusion that flight to the left is required is prevented by the appearance of the alarm flag.

Zero reader

33. ILS localizer and glidepath signals, (and their corresponding alarm signals) are also fed to a separate flight aid known as the " zero reader flight director Type Z.L.2." This equipment includes an indicator, control unit, course selector, gyro unit, and computing unit, and is described in detail in A.P.1275B, Vol. 1, Sect. 9. The indicator is a crossed-pointed parallel-motion instrument on which signals from the ILS receivers can be displayed in controlled combination with information derived from the attitude, altitude, and heading of the aircraft. A particular flight path (such as out-bound flight and final approach) can be selected on the zero reader control unit, and the aircraft follows the required path if it is flown to keep the pointers of the indicator crossed at the centre.

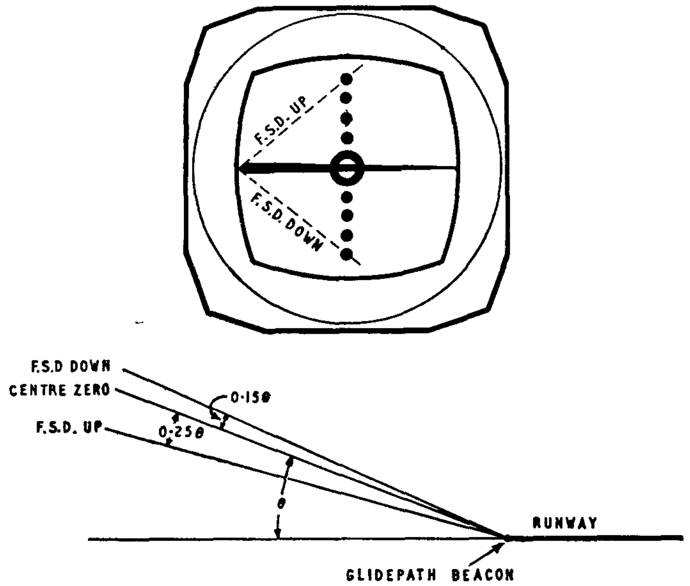

Fig. 7. Calibration of horizontal pointer

Marker lamp

34. The output of the marker receiver controls a marker lamp fitted in the pilot's cockpit. As the aircraft passes over the marker beacons in the closing stages of the landing approach, the lamp is blinked in accordance with the keyed coding of the individual beacons. The outer marker beacon is passed over at about 5 miles from the touchdown point and the lamp is blinked at a rate of two dashes per second; the middle marker is passed over at a distance of 3,250 ft and the lamp is blinked with alternate dots and dashes.

35. The zones of radiation from the marker beacons are strictly limited to the immediate vertical surroundings of each beacon as indicated in fig. 4. Reception of the beacons is thus confined to the short periods taken by the aircraft in passing through these zones. In practice, this means that for an aircraft travelling at about 96 knots, the outer marker is received for a period of about twelve seconds and the middle marker is received for about six seconds.

Aural presentation

36. An audio output from the localizer-marker receiver (R.1964) is heard over the aircraft intercom circuits. In a normal ILS approach an identification tone will be heard from the localizer beacon, consisting of a 1000c/s note keyed with identifying Morse letters. In emergency, the identification signals may be switched out and voice signals substituted to provide a channel of communication between the beacon (or the airfield control) and the aircraft; no provision is made for replies to be made from the aircraft.

37. The marker signals will also be heard as the beacons are passed over. They are:—

Outer marker—400c/s tone keyed two dashes per second

Middle marker—1,300c/s tone keyed alternate dots and dashes each $\frac{2}{3}$ sec.

Automatic operation

38. ILS is used as an essential part of the Automatic Landing System (described in *A.P.*2534*R*). The ILS signals are used by the auto-pilot for flight control to keep the aircraft within the limits of the approach path until it has descended to 150 feet. *Below* this height, the flight control signals are derived from the radio altimeter and leader cable equipment instead of ILS.

Chapter 3

TECHNICAL INFORMATION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

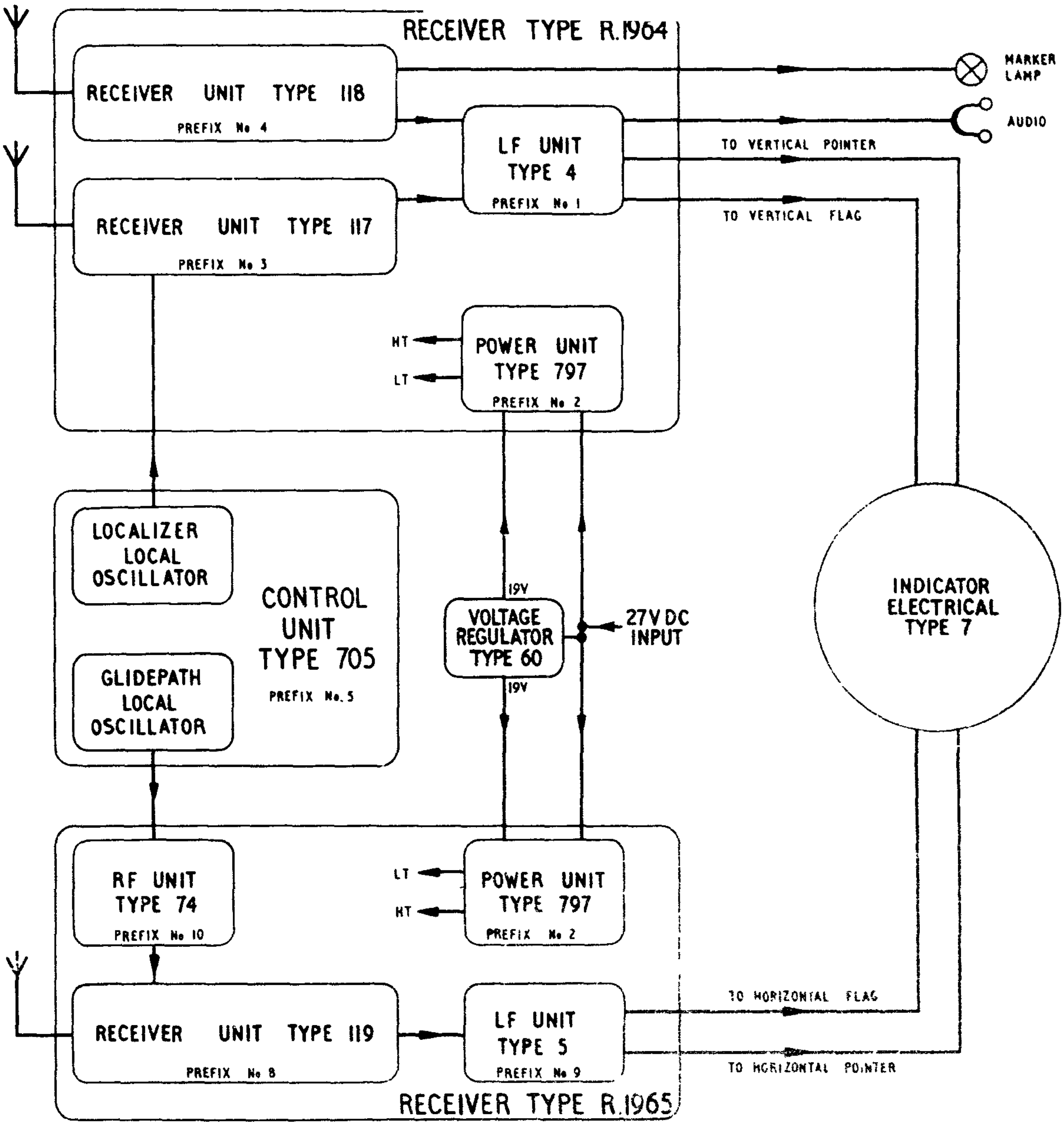

Fig. 1. Basic block diagram of ILS airborne

OUTLINE OF ILS RECEIVERS

1. Fig. 1 shows in outline the associations between the several sub-assemblies making up the ILS airborne receiving equipment. Each sub-assembly is identified by a prefix number which is used throughout this description for the purpose of unit identification. As an example, a reference to 8R41 indicates resistor R41 in sub-assembly 8, that is in the receiver unit Type 119.

Receiver Type R.1964

2. The receiver Type R.1964 is the localizer-marker receiver. Its sub-assemblies are:—

Receiver unit Type 117 (prefix 3)
Receiver unit Type 118 (prefix 4)
LF unit Type 4 (prefix 1)
Power unit Type 797 (prefix 2)

3. The greater part of the double-superhet circuit of the localizer receiver is carried on the receiver unit Type 117 (*fig.* 2). The circuit elements include SF stage, first mixer, frequency multiplier for first local oscillator, first IF amplifier, second mixer, second local oscillator, second-IF amplifier, detector, and AGC. A low-pass filter feeds a low-frequency output consisting of 90 c/s and 150 c/s localizer tones to an indicator output stage in the LF unit; a second output containing station identification signals is taken to an audio output circuit in the LF unit.

4. The receiver unit Type 118 (*fig.* 3) is the marker receiver. It includes SF amplifier, detector, AF amplifier, AF rectifier, and DC amplifier circuits. An audio output is passed to the LF unit and is mixed with the localizer audio signals in the common audio output stage; a coded DC output operates the marker lamp.

5. The mixer and common output stage for the localizer and marker audio signals, and the indicator output circuits for the localizer tones are carried in the LF unit Type 4 (*fig.* 4). The

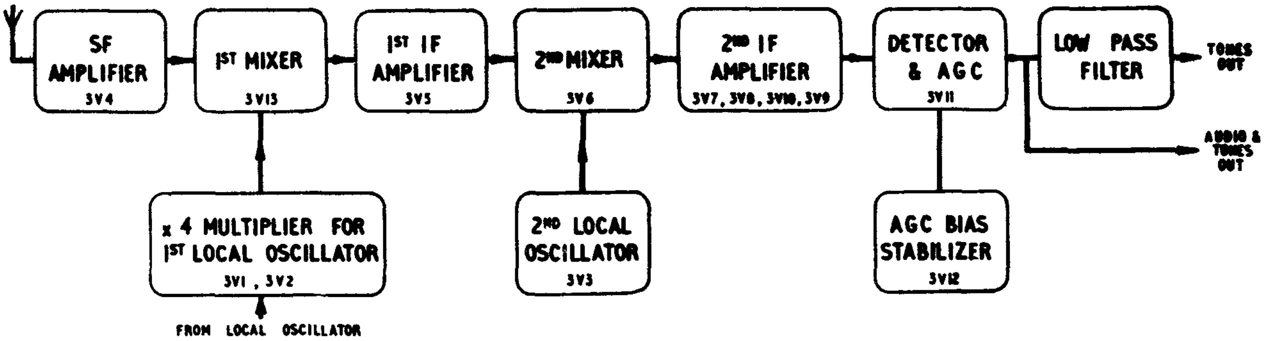

Fig. 2. Block diagram of receiver unit Type 117

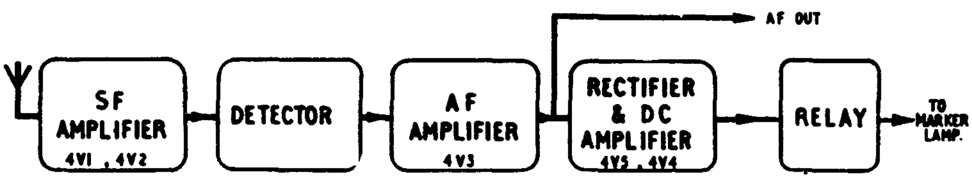

Fig. 3. Block diagram of receiver unit Type 118

indicator output circuit includes filters and rectifiers which provide DC outputs to operate the movements of the vertical flag and pointer in the indicator. The LF unit forms the framework on which the other units of the R.1964 are mounted.

6 HT, for the localizer and marker receivers in the R.1964 and for the oscillator circuits in the control unit Type 705, is provided by the power unit Type 797; the HT is generated in a rotary transformer operating on the aircraft DC supply (nominally 27V). Heater supplies in the R.1964 and the control unit are provided in a series-parallel arrangement from a regulated 19V source.

Receiver Type R.1965

7. The receiver Type R.1965 is the glidepath receiver. Its sub-assemblies are:—

- Receiver unit Type 119 (prefix 8)
- RF unit Type 74 (prefix 10)
- LF unit Type 5 (prefix 9)
- Power unit Type 797 (prefix 2)

8. The greater part of the double-superhet circuit of the glidepath receiver is carried on the receiver unit Type 119 (*fig.* 5). This circuit elements include, signal-frequency amplifier, first mixer, first-IF amplifier, second mixer, second local oscillator, second-IF amplifier, detector, and guard AGC. The detected output consists of 90 c/s and 150 c/s glidepath tones.

9. The output of the glidepath first local oscillator is amplified and frequency multiplied in the RF unit Type 74 (*fig.* 6). The local oscillator itself is contained in the control unit.

10. The indicator output circuits for the glidepath tones and a tone-operated AGC circuit are carried in the LF unit Type 5 (*fig.* 7). The output circuit includes filters and rectifiers which provide DC outputs to operate the movements of the horizontal flag and pointer in the indicator. The LF unit forms the framework on which the other units of the R.1965 are mounted.

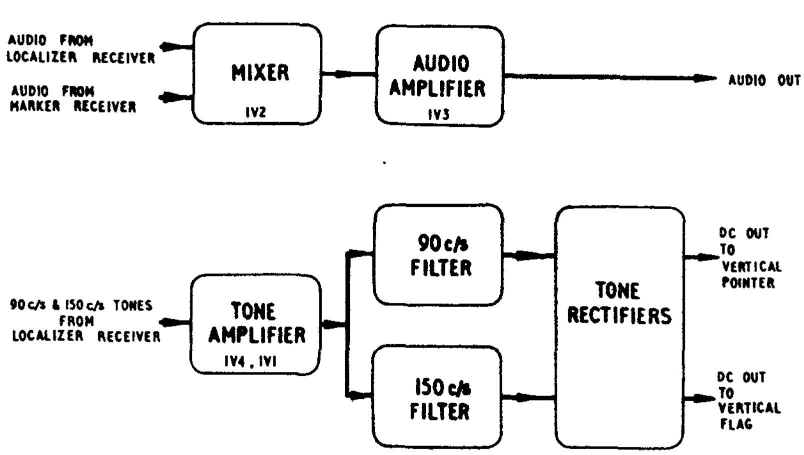

Fig. 4. Block diagram of LF unit Type 4

11. A power unit Type 797, identical with that in the R.1964, provides HT in the R.1965. The power requirement for HT is taken direct from the 27V supply. Heater power is taken in a series-parallel circuit from the 19V regulated source.

Control unit Type 705

12. The control unit Type 705 (prefix 5) (*fig.* 8) carries the first local oscillators for the localizer and glidepath receivers. The two oscillators are crystal controlled and a single switch, which selects one of twelve crystals for each oscillator, is the sole tuning control for the equipment.

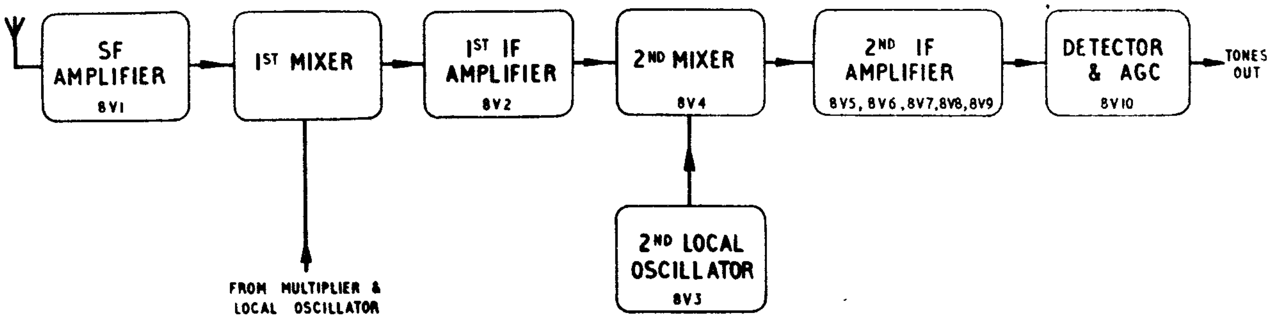

Fig. 5. Block diagram of receiver unit Type 119

Detailed circuit description

13. The circuit is described in detail under the four headings of localizer receiver, glidepath receiver, marker receiver, and power supplies. The description of each receiver is based first on a block diagram and then on a separate circuit diagram. The power supplies are described with reference to separate drawings of the HT and LT circuits.

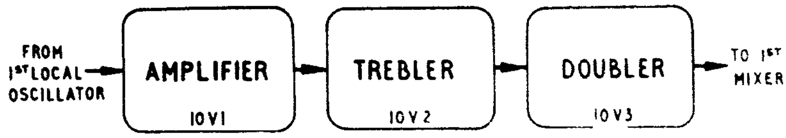

Fig. 6. Block diagram of RF unit Type 74

14. Each receiver has been considered as an electrical whole, and, in general, attention has not been paid to the physical positions of the different circuit elements. Thus, for example, the circuits responsible for producing the localizer information have been treated as an entity and the path from aerial to indicator has been drawn on a single diagram. As a result the circuits can be seen functionally, and this despite the fact that the components concerned are distributed in up to eight units and sub-assemblies linked, in some instances, by aircraft connectors, and associated physically with the components of the other receivers.

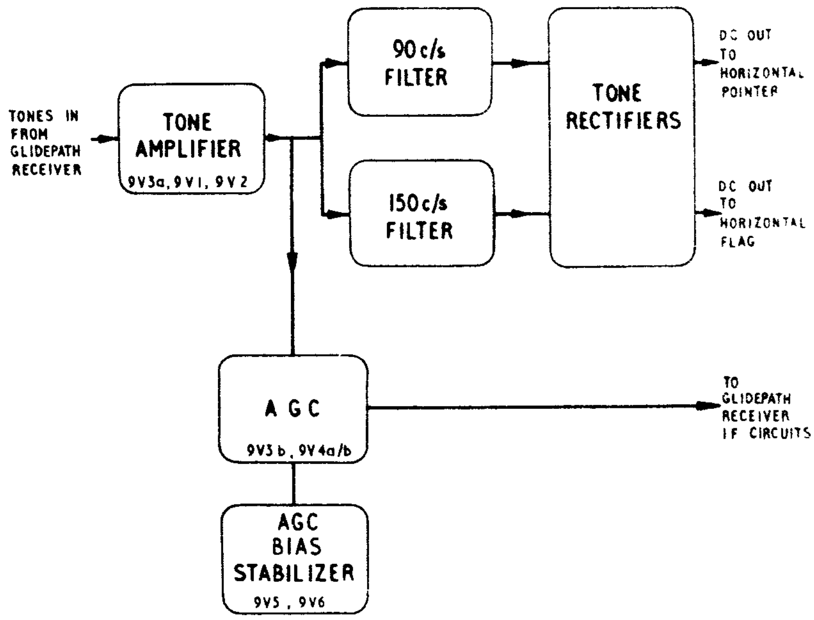

Fig. 7. Block diagram of LF unit Type 5

15. To permit the circuits to be presented in this way, use has been made of the detached-contact system of drawing plug and socket connections. Each plug and socket point has therefore:—a prefix number identifying the particular unit on which the plug or socket is to be found: a " P " or " J " reference indicating the particular plug or socket in the unit: and a number or letter indicating the particular point on the plug or socket concerned.

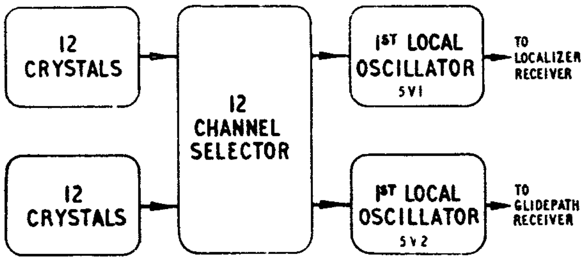

Fig. 8. Block diagram of control unit Type 705

16. The position of the plugs and sockets on the units are identified in fig. 9. The alternative installations, " side-by-side " using a combined junction box and " separate " using two separate junction boxes, as shown. The differences between the two installations, as far as the circuit is concerned, are that first, the plug and socket nomenclature of the junction boxes is different (i.e. the plug carrying the DC input to the R.1964 is 12P1 in the " side-by-side " installation and 6P5 in the " separate " installation) and second, that an additional connector is used in the " separate " installation so that additional plug and socket points must be shown.

17. Separate circuit diagrams to show these differences have not been provided, but, instead all relevant details have been incorporated on each of the main circuit drawings. In practice this merely means that certain plug and socket points and a few components are annotated twice : items in the "side-by-side" installations are shown normally, and items in the "separate" installation are shown bracketed. For the extra plug and socket points found only in the "separate" installation, the bracketed references only are given.

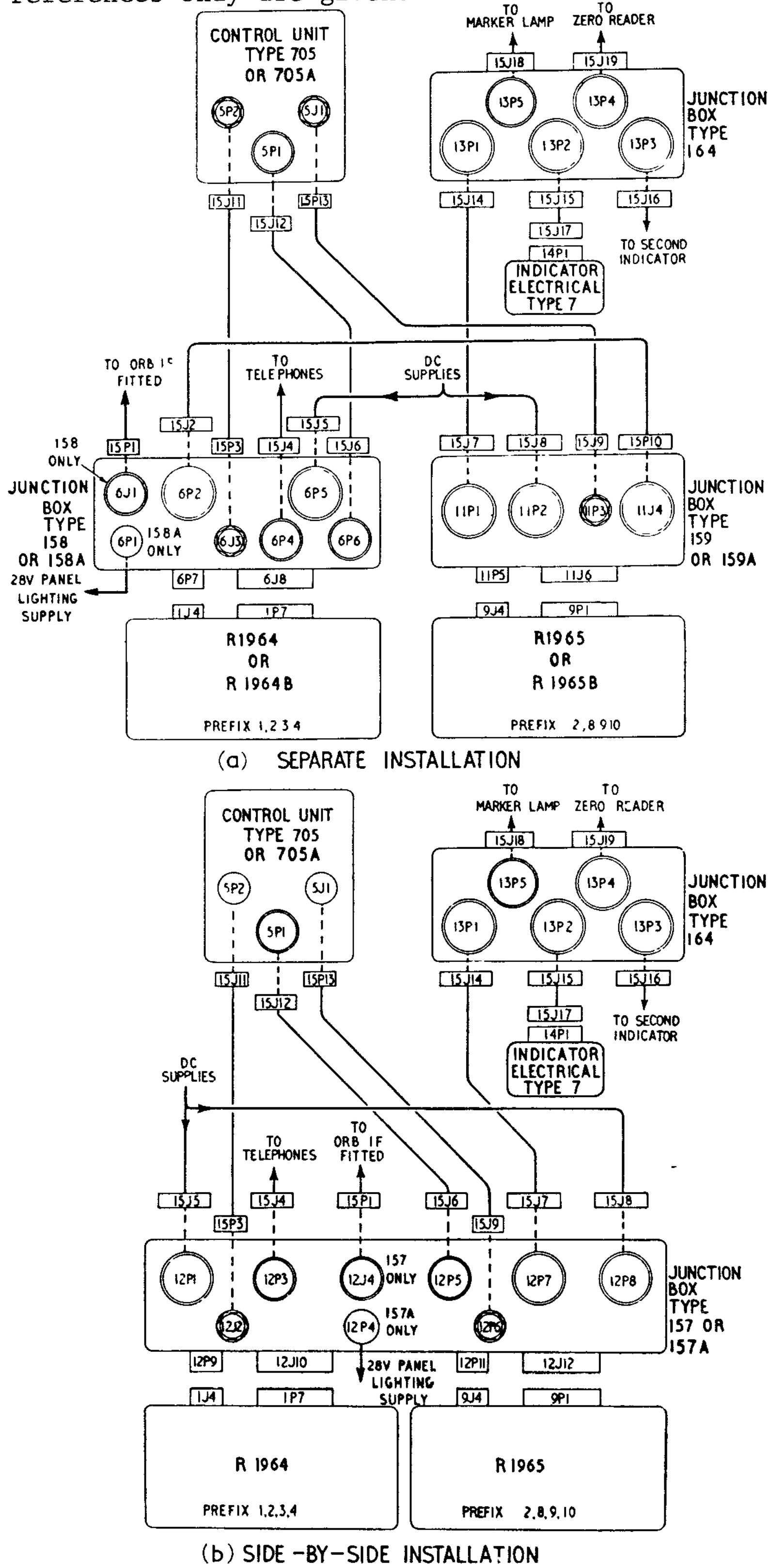

Fig. 9 Plug and socket identification on installation

18 Thus, as shown in fig. 14, the output point of the localizer audio circuit feeds through a socket which is identified as "12J10/2" to show its reference in the junction box Type 157 of the "side-by-side" installation, and as "(6J8/2)" to show its reference in the junction box Type 158 of the "separate" installation. As an example of single referencing, the output to the indicator vertical pointer in the localizer circuit goes through a plug identified as "(6P2/B)" which is therefore to be found only in the junction box Type 158 of the "separate" installation.

LOCALIZER RECEIVER

Nature of signals

19 Localizer transmitters operate in 50 kHz-spaced channels in the VHF band from 108.1 MHz to 111.95 MHz. A localizer transmission consists of two lobes overlapping about the line of approach, one lobe consisting of carrier with 90 Hz modulation, the other of carrier (at the same frequency) and 150 Hz modulation. As transmitted, each modulation is at a depth of 40 per cent, but, because the carriers of the two lobes combine in the overlap zone, the effective modulation depths of the two modulations vary in this region.

20 Graph A of fig. 10 shows the modulation characteristics of a typical localizer transmission. The horizontal axis shows angular deviation in degrees from the line of approach, and the vertical axis shows the depth of modulation represented by the two sets of sidebands at the stated angles of deviation. As the angle varies from $6\frac{1}{4}$ deg. right to $6\frac{1}{4}$ deg. left, the 150 Hz level falls from about 40 per cent to zero, and the 90 Hz level rises from zero to about 40 per cent. Along the line of the runway the modulation depth represented by each set of sidebands is the same as 20 per cent.

21 When the differences between the modulation depths are plotted we get graph B of fig. 10. Over the angle representing deviations from the line of approach of $2\frac{1}{4}$ deg. each side, as shown by the dotted lines, the difference falls from $15\frac{1}{2}$ per cent to zero and then rises again to $15\frac{1}{2}$ per cent, with on the one side the 90 Hz predominating and on the other side the 150 Hz predominating.

22 A secondary modulation, radiated omni-directionally, is also transmitted by the localizer beacons. Normally it consists of an identification signal made up of a Morse-keyed modulation tone at 1,000 Hz, and repeated at regular intervals, but provision is made for this signal to be substituted by voice modulation for communication purposes in emergency.

AGC requirements

23. The localizer receiver is required to translate the differences in depth of the 90 Hz and 150 Hz modulations into deviations of a centre-zero vertical pointer. For a modulation difference of greater than $15\frac{1}{2}$ per cent with the 150 Hz modulation predominating the pointer shows full-scale-deflection to the left, and for a similar difference with the 90 Hz modulation predominating the pointer shows f.s.d. to the right. For modulation differences between the two extremes the pointer deflection is proportional to the modulation difference, that is to the deviation from the line of approach.

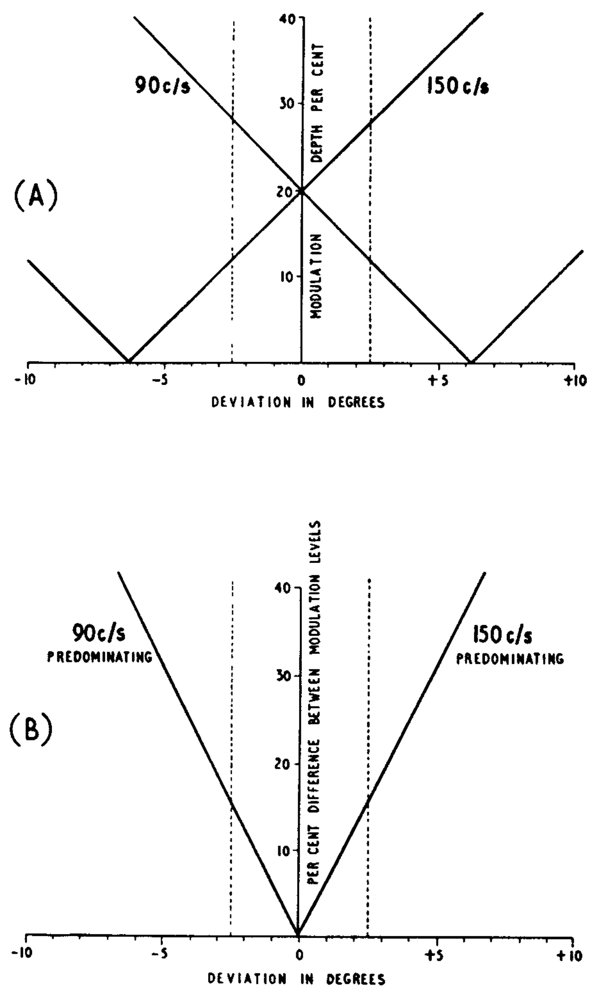

Fig. 10 Modulation characteristics of localizer

24 In order to satisfy these conditions, the receiver output must be dependent only upon the relative modulation depths of the two sideband tones and must be independent of the strength of the received signal. A high level of AGC is therefore necessary in order to reduce the gain of the receiver once the input signal strength is above a predetermined level, and in practice the receiver output for a given modulation difference is sensibly constant for all input levels of greater than about 10μV.

25 Thus, within the operating range of a localizer transmission, the receiver output tends to be independent of the received signal strength, and therefore of the range, and dependent only upon the differences between the modulation depths of the two sideband tones, and therefore the deviation from the line of approach.

Selectivity

26 The receiver is designed to operate over the frequency range from 108.1 MHz to 118 MHz, but only the localizer transmitter range is used. The narrow spacing of the localizer channels (50 kHz) demands a high order of adjacent channel selectivity, and to prevent interference from other bands second channel rejection mu

27 These considerations are best satisfied by a double-superhet type of receiver which confers the following advantages:

27.1 A low intermediate frequency can be used in the second-IF amplifier, maing it comparatively easy to produce a narrow bandwidth and thus satisfy the requirements of adjacent channel selectivity.

27.2 A high intermediate frequency can be used in the first-IF stage, making for a high order of second channel rejection.

27.3 The input circuit can be preset tuned to cover the whole required band (because selectivity considerations are satisfied by the IF circuits), and channel selection can thus be carried out by control of the first local oscillator only.

27.4 The gain of the receiver is spread over three stages at different frequencies, and the gain at any one frequency is thereby reduced; the danger of oscillatory feedbacks is thus lessened and the receiver is highly stable.

Outline of localizer circuit

28 The outline of the localizer circuit is shown in the block diagram of fig. 11. The first stage is a signal-frequency amplifier fixed-tuned to cover the complete localizer band; its output together with a local oscillator signal is fed to a mixer stage in which the first-IF at 28.6 MHz is produced. The local oscillator signal is produced in a crystal oscillator which operates at one-eighth of the final mixing frequency, and which is controlled by a channel selector switch to provide any of twelve spot frequencies; frequency multiplication takes place in steps of times-two in the oscillator stage itself and in two multiplier valves.

29 The first-IF amplifier is a single valve feeding, together with the output from a second local oscillator, into a second mixer stage. The second local oscillator is crystal-controlled at 15.3 MHz and its output is frequency doubled at 30.6 MHz, so that the output of the mixer is at the difference frequency of 2 MHz. The second i.f. amplifier includes five stages; the overall bandwidth is 23 kHz at not more than 6 dB down.

30 The second-IF is detected and is also used to produce an AGC potential which is fed back into the IF stages. The detected output consists of 90 Hz and 150 Hz tones derived from the localizer modulation sidebands, together with a Morse-coded 1,000 Hz tone representing the identification signals. The localizer tones are separated from the 1,000 Hz tone in a low-pass filter and are then amplified and separated from one another in two separate peak-tuned filters. The separated 90 Hz and 150 Hz tones are then rectified and combined to produce DC signals for operating the localizer pointer and alarm flag in the indicator.

31 An audio amplifier, including a mixer stage in which marker signals are introduced, amplifies the 1,000 Hz tone and feeds it as an audio output to the aircraft telephone circuits.

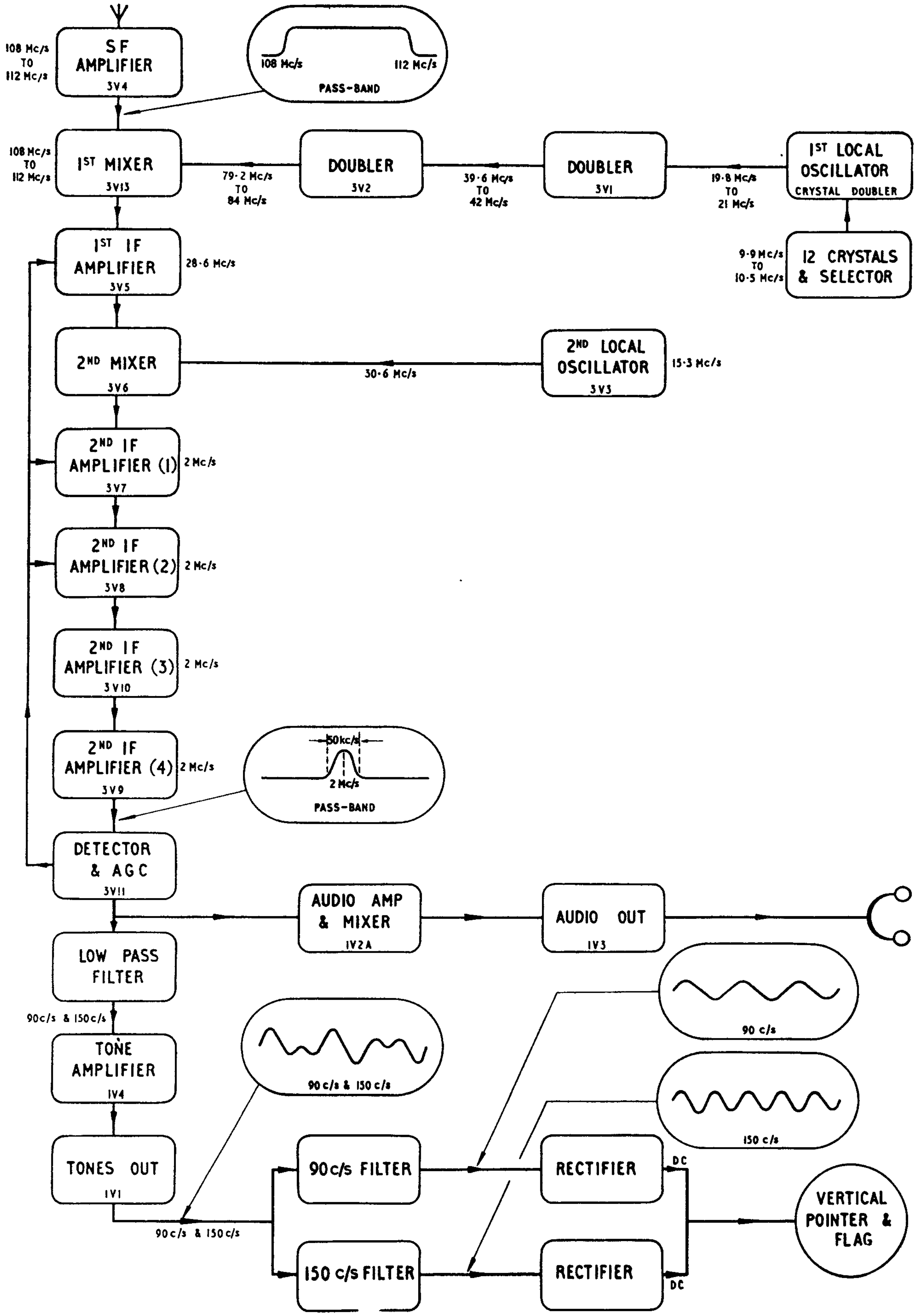

Fig. 11 Block diagram of localizer receiver

Signal-frequency stage (fig. 14)

32 The localizer aerial connects through a coaxial plug (1P5) and a short coaxial lead to 3J1 in the input tuned circuit. It feeds a bandpass filter made up of two series-resonant circuits in parallel across the input, and a third series-resonant circuit in series with a final parallel-tuned circuit. A resistor (3R37) is shunted across the aerial input to provide a DC return path and thus prevents the build-up of static on the aerial system.

33 The first series-resonant circuit (3C29, 3L30) is tuned to about 103 MHz to set the lower cut-off limit of the passband; the second (3C30, 3L31) sets the upper limit at about 123 MHz. The third series-resonant circuit (3L32, 3C31) and the grid tuned circuit are both tuned to the mid-band frequency at about 113 MHz. The input to the grid circuit is tapped on 3L10 in order to provide a correct terminating impedance to the external aerial circuit and reduce the damping effect of the aerial impedance.

34 The first valve 3V4 (pentode, CV138), is a conventional signal-frequency amplifier with a bandpass transformer in its anode circuit providing coupling to the following first mixer stage. The transformer covers the SF range from 108 MHz to 118 MHz. The preset tuning adjustments (3C37, 3C38) act as variable capacitances over part of their ranges and as variable inductances otherwise; a large frequency variation is thus possible with only a relatively small circuit capacitance.

First mixer

35 The first mixer is a diode detector 3V13 (part of double diode CV140: second diode not used). The SF signal is fed from a tap on the secondary of 3L12 to the diode anode, and the mixing signal is fed in series through 3L12. The earth return of the diode anode is through the coupling coil (3L6) which feeds the mixing signal from the local oscillator multiplier.

36 A series-resonant circuit comprising 3L33 and 3C118 is connected from one end of 3L12 to earth. It is tuned to approximately 132 MHz to prevent breakthrough of signals at and around this frequency. Strong signals of this order, in the absence of the rejector circuit, are capable of passing through the SF stage and beating with the second harmonic of the output of the local oscillator multiplier, to produce an interfering signal on certain channels.

First local oscillator

37 The local oscillator valve 5V1 (pentode, CV138) is a crystal oscillator and doubler. The oscillator action takes place between the cathode, grid, and screen electrodes, and electron coupling is used into the anode doubling circuit.

38 The crystal is connected between grid and earth, and the screen is earthed through 5C4; the crystal is therefore effectively connected between grid and screen; the cathode is taken to a capacitive tap across the crystal. The circuit can be compared to that of a Colpitt's-type oscillator, and in fact its action is similar to that of such a circuit.

39 The cathode resistor (5R3) provides a small standing bias between grid and cathode; further bias is developed from the flow of grid current through 5R1. The second cathode resistor (5R4) does not provide bias, but it isolates the cathode from earth at RF whilst, at the same time, permitting the flow of anode current.

40 Twelve crystals can be selected by the channel switch; their frequencies will be as listed under the heading "Localizer crystal frequency" in Table 1 (Chapter 2) of this publication for the particular operating channel.

41 The anode circuit of 5V1 is preset tuned by the primary of 5T1 to select the second harmonic of the crystal frequency. The output at the secondary of the transformer is thus in the range from 19.875 MHz to 20.8375 MHz, depending upon the crystal in use.

Multiplier

42 A coaxial line between the control unit and the junction box and a short coaxial lead in the LF unit connect the local oscillator output from 5P2 to the input of a two stage multiplier at 3J2. The input circuit to the first stage is a bandpass filter (3L1, 3L2); the input point is tapped down the primary (3L1) to provide a matched termination to the line.

43 The first valve 3V1 (pentode, CV138) is biased normally by 3R3 in the cathode circuit, but the input signal is sufficient to run the valve to grid current; the negative potential developed across 3R1 biases the grid back to create the non-linear working conditions necessary for the production of harmonics.

44 A bandpass filter (3L3, 3L4) in the anode circuit of 3V1 is broadly tuned at 40 MHz, so that second harmonics of the input signal in the range 39.75 MHz to 41.675 MHz are selected. This signal is fed to the grid of 3V2 (CV138) which, in a circuit similar to that of the first doubler, produces a further frequency doubling. The output at four times the frequency of the input is selected in a bandpass transformer (3L5, 3L6) tuning over the range from 79.5 MHz to 83.35 MHz. The capacitor 3C17 connected across taps on the winding of the transformer increases the coupling between the windings, and controls the width of the passband.

First IF amplifier

45 The output of the first mixer appears in a bandpass filter (3T1) in the cathode circuit of the diode. This transformer is tuned to 28.6 MHz and it selects that SF channel whose frequency is 28.6 MHz greater than the frequency of the local oscillator signal. The passband of the subsequent circuits is 23 kHz at not more than 6 dB down, so that if other channels are being received through the wide passband of the SF circuits they do not generate an IF signal.

46 The output of 3T1 is fed to the grid of the first-IF amplifier 3V5 (pentode, CV454). This valve is connected in a conventional amplifying circuit with cathode bias and an AGC feed to the grid; it is the only amplifier at the frequency of the first-IF. The anode circuit of 3V5 contains a further first-IF tuned transformer (3T2) feeding into the second mixer stage.

Second mixer

47 The second mixer 3V6 (pentode, CV131) operates as a leaky-grid detector with two parallel inputs on its grid. A cathode resistor (3R32) provides a small standing bias to prevent the valve overheating in the event of failure of the second local oscillator.

48 The first-IF input at 28.6 MHz is taken from a tap on 3L16; the use of the tap instead of the full winding prevents excessive damping of the tuned circuit by the low input impedance of the grid. The mixing input, from the second local oscillator, is at a fixed frequency of 30.6 MHz; the amplitude of this signal is sufficient to drive the valve to grid current, and the resulting flow through 3R60 biases the valve back to the non-linear working condition required for detection. The mixed output at the anode is at the difference frequency of 2 MHz.

Second local oscillator

49 The second local oscillator is 3V3 (pentode, CV138) in a crystal-doubler circuit. A 15.3 MHz crystal is used in a Colpitt's-type circuit of similar design to the first local oscillator. The anode circuit is preset tuned to 30.6 MHz (the second harmonic of the crystal frequency) and an output at this frequency is taken to the grid of the second mixer through 3C23.

Second IF amplifier

50 The 2 MHz output of the second mixer is amplified in a cascade circuit of three almost identical stages using 3V7, 3V8 and 3V10 (pentodes CV131), in which bandpass transformers (3T3, 3T4, 3T5) are used for intervalve coupling, and a fourth RC-coupled stage uses 3V9 (pentode CV138). The 23 kHz receiver passband is shaped mainly in the second IF transformers which are designed to attenuate by 60 dB signals from adjacent localizer channels (spaced 50 kHz either side of the wanted channel at the second IF of 2 MHz).

51 The input to the final IF amplifier stage is untuned because the stage is required to produce gain only and not to contribute to the shape of the IF response. Outputs from the anode circuit are taken from a final IF transformer (3T6). An output to the detector stage is taken from the second tuned circuit, and an output to the AGC circuit is taken direct from the anode of the final IF amplifier stage.

Detector and AGC

52 The final detector is a diode valve 3V11b (part of double diode CV140). Its input is taken from the transformer secondaries. The detected output signals appear across a diode load consisting of two parallel resistance chains. The first chain (3R74, 3R70) feeds a low-pass filter (3L25, 3C100) which discriminates against all frequencies above 300 Hz and thus passes only the lower-frequency localizer tones at 90 Hz and 150 Hz. The second chain (3R51, 3R66, 3R76, 3R59) produces an output at the slider of 3R66 which contains the complete AF content of the received signal, including both localizer tones and the identification signals.

53 The AGC diode 3V11a is fed with the full output of the second-IF amplifier. It is cathode biased to about 35V to prevent operation on weak signals. The bias voltage is derived from a potential divider across the HT supply consisting of a diode 3V12 (gas-filled cold-cathode sub-miniature diode, CV2213) in series with 3R64, and the potential across the diode is further divided in 3R65 and 3R57; the presence of the diode stabilizes the bias potential and ensures that changes in the level of the HT supply do not affect the point at which AGC operation begins.

54 The AGC diode load is 3R62, and the AGC feed is taken through a smoothing circuit (3R61, 3C98). AGC is applied to control 3V5 in the first-IF stage, 3V7 and 3V8 in the second-IF amplifier, and an AF amplifier (1V4) in the tone output circuit.

55 The delay potential on the AGC valve holds off AGC operation until the IF output signal is of at least 35V peak amplitude; this condition arises when the input signal at the aerial is between 10μV and 20μV. For aerial signals of greater amplitude the AGC operates, and because of the high degree of AGC feedback and the use of post-detector control (on 1V4) the tone output tends to remain constant despite wide variations in signal strength at the aerial. Thus the proportions of the two tones making up the tone output will not depend on the input signal strength but only on the relative levels of the modulation sidebands in the input signal, and the course sensitivity (change in indicator pointer reading for given deviation from line of approach) will remain constant at all useful ranges.

Audio output channel

56 The audio output from the slider of 3R66 is taken to the grid of a triode amplifier 1V2a (part of double triode, CV455). The anode of this valve is connected in parallel with the anode of the associated valve 1V2b, which receives an input on its grid from the audio output stage of the marker receiver; localizer and marker signals (if any) will thus appear together in the common load resistor 1R14. Both the localizer tones and the identification signals are fed from 3R66, but the input coupling components to 1V2a (1C4, 1R11) and the further coupling circuit (1C9, 1R19) to the audio output stage are chosen to ensure little gain at frequencies below 250 Hz so that the localizer tones are attenuated, and only the identification (or emergency voice) signals are amplified and fed to the output stage.

57 The audio output valve is 1V3 (pentode, CV138) connected as a cathode-follower, and with a high degree of feedback coupling between the anode and cathode circuits through a transformer (1T1) which forms the cathode load. The feedback regulates the output impedance to provide a low-impedance source to the external circuit; the maximum output of about 450 mW is developed with an external load of 33 ohms, but the normal working level is less than 225 mW.

Indicator circuit

58 The low-pass filter in the detector diode load circuit passes only the 90 Hz and 150 Hz tones to the input of a tone amplifier consisting of 1V4 (pentode, CV131) and 1V1 (pentode, CV138). Both valves are triode connected. The response of the circuit is maintained constant, so that both tone frequencies are amplified equally, by the omission of decoupling capacitors from the cathode biasing resistors (1R4, 1R6).

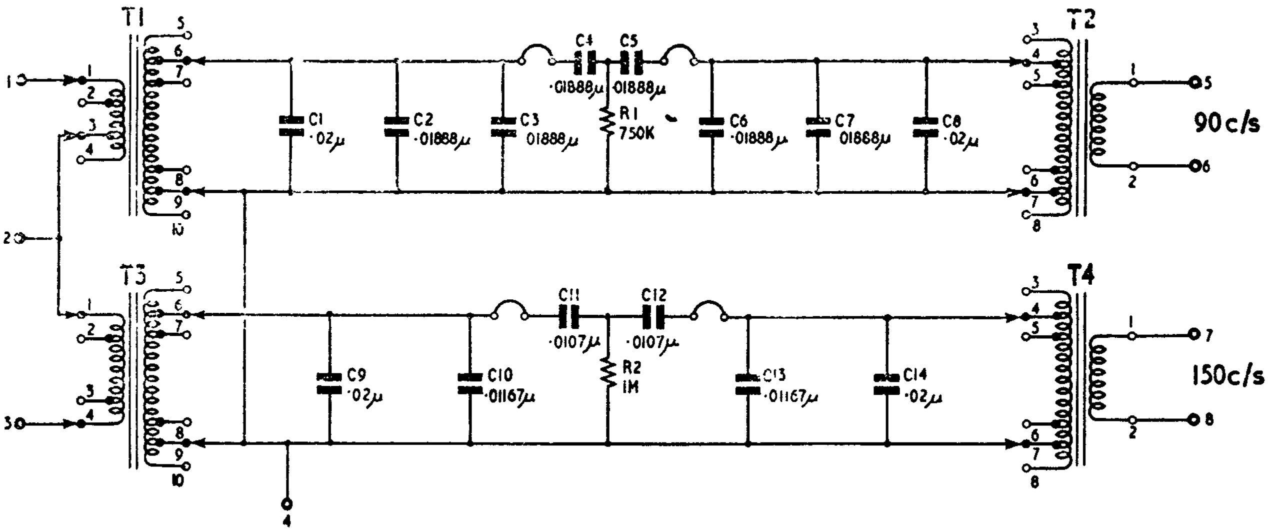

Fig. 12 Circuit of tone filters

59 The anode load of the output valve contains two filter networks in series. Each filter consists of a tuned transformer, an RC filter, and a further tuned transformer. The lower filter (nearest the anode) is tuned to pass 150 Hz and its response falls sharply at lower frequencies; the second filter is tuned to 90 Hz and its response falls sharply at the higher frequencies. The localizer tones are thus separated to appear as 150 Hz and 90 Hz sine-waves at the output terminals of the two filters respectively.

60 The filters shown in the main circuit diagram (fig. 14) are simplified to show only the outline details of their electrical construction. Their actual circuit is shown in fig. 12. The filters are built into a hermetically-sealed container and in practice can not be serviced other than by complete renewal. The transformer winding are tapped to provide for tuning adjustments in manufacture, and links between the filters and transformers are also used for a similar purpose.

61 The separated tone outputs of the filters are next fed into a further hermetically-sealed unit containing two metal-rectifier bridge circuits. Each bridge rectifies its tone input and produces a DC output which is fed into a resistive network, shown in outline in fig. 13a, to feed the meter movements of the vertical pointer and alarm flag in the indicator, electrical, Type 7.

62 The two load resistors (1R24, 1R25) of the rectifier circuits form a bridge circuit with the DC sources represented by the rectifiers; the pointer and flag movements are connected across the network (fig. 13b and 13d). If the circuit feeding the pointer is considered alone, as in fig. 13b, it will be seen that the rectifiers are connected in such a way that currents from the two sources tend to pass in opposition through the movement. In consequence, if identical DC levels are produced at the rectifiers (because the 90 Hz and 150 Hz tones are of equal amplitude) equal and opposite currents tend to be passed through the movement, and in practice no current flows and the pointer is undeflected. For other than identical levels an unbalance current flows in the movement whose direction is governed by the greater of the two levels and whose magnitude is

dependent upon their relative amplitudes; the pointer is thus deflected to a degree dependent upon the difference between the levels of the received 90 Hz and 150 Hz tones, that is upon the aircraft's deviation from the line of approach.

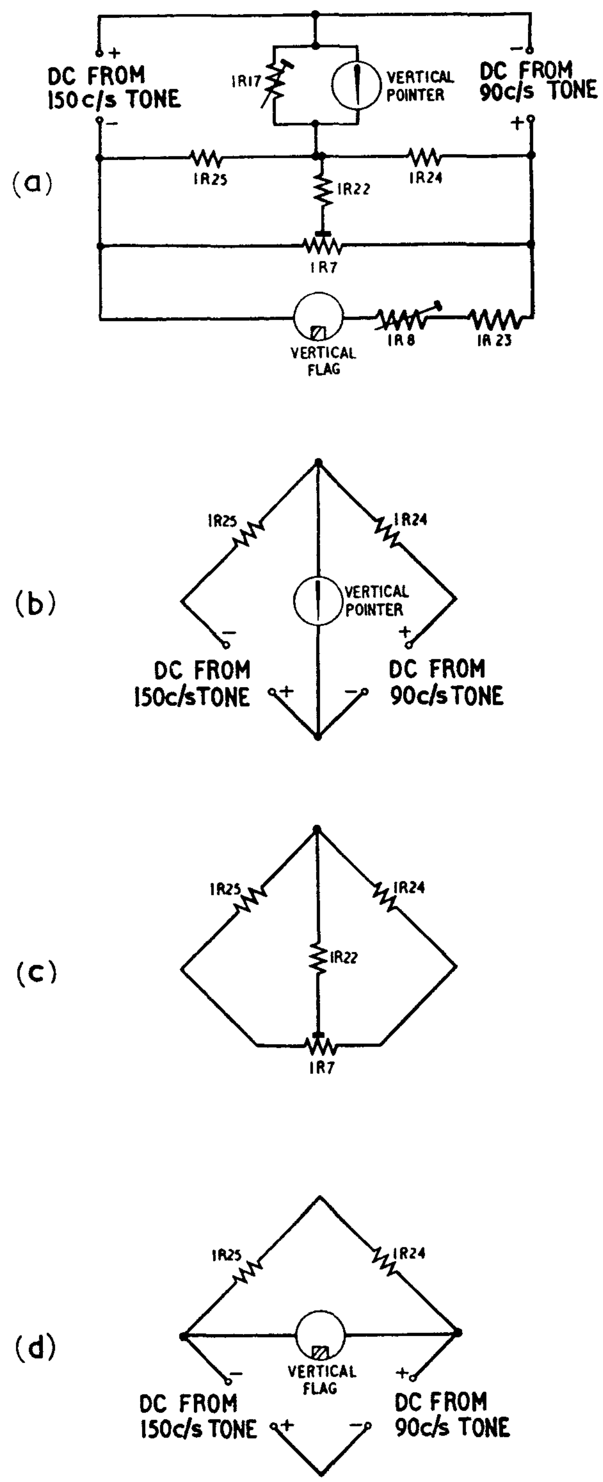

Fig. 13 Simplified diagrams of indicator circuit

63 A subsidiary bridge (fig. 13c) is formed with the two fixed resistors 1R24, 1R25, by a preset control 1R7. The slider is adjusted in practice for the condition whereby equal tone levels at the receiver input produce a zero deflection of the pointer, and it does this by altering the relative values of 1R24, 1R25. It should be noted that this balanced condition is not necessarily the same as the condition of equal outputs from the two rectifiers, because of the possibility of unequal amplification in the receiver of the two tone frequencies. A further preset (1R17) is shunted across the pointer movement to regulate the proportion of unbalance current that passes through; it is used to control deflection sensitivity.

64 The two DC sources are effectively in series to feed the movement of the alarm flag (fig. 13d). The flag is pulled completely out of sight when 400μA passes through its movement, and this condition will not arise until the received signal is sufficiently strong to operate the AGC (that is the tone output level is no longer dependent upon the received signal strength) and both tones are present. A preset resistor (1R8) provides control of the sensitivity of the flag movement.

Duplicate indicators

65 Three indicators can be supplied from the output circuit. In practice these might consist of two ILS indicators and a zero reader. The pointer movements of the indicators are parallel connected, and the series movements are series connected. When less than the maximum number are being used, dummy loads are introduced into the circuit; thus once the presets have been set up for use with the maximum number, re-adjustments will not be necessary should the receiver be used with less.

66 Two shunt resistors are included in the pointer circuit, and these (6R1 or 12R5, and 6R2 or 12R6) are both out of circuit when three indicators are in use; the second (6R2 or 12R6) is in circuit with two indicators, and the first (6R1 or 12R5) is in circuit with only one indicator. The flag circuit is unloaded with three indicators, has 6R4 or 12R7 in series with two indicators, and has 6R4 of 12R7 together with 6R3 or 12R6 when only one is used. If less than the maximum number of indicators is being used, shorting links are connected across the unused plug points on the indicator junction box to maintain the flag circuit to the other indicators.

GLIDEPATH RECEIVER

Nature of signals

67 The glidepath transmitters radiate a double field pattern made up of a series of lobes bearing 150 Hz modulation and a second series of lobes bearing 90 Hz modulation. The main lobes of both patterns intersect along the required glidepath angle which may be at any angle between 2 deg. and 4 deg. The modulation depths in both patterns are constant at about 45 per cent.

68 The graph A of fig. 16 shows the field characteristics of a typical glidepath transmission at either side of the glidepath angle, in this case of $2\frac{1}{4}$ deg. The horizontal axis shows the angle of elevation, and the vertical axis shows the relative strengths of the two fields at the given angles. As the angle varies from about $1\frac{3}{4}$ deg. to about $2\frac{3}{4}$ deg. the strength of the 150 Hz-modulated field falls almost linearly, and the strength of

the 90 Hz-modulated field increases almost linearly. At the glidepath angle of 2¼ deg. the field strengths are equal.

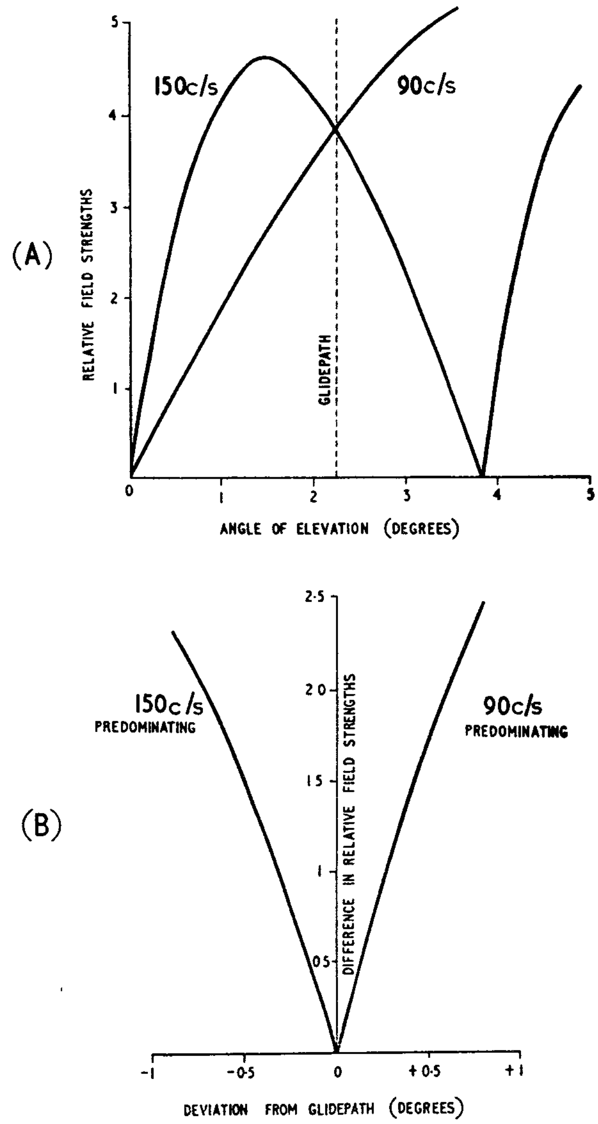

Fig. 16 Field characteristics of glidepath transmitter

69 When differences between the strengths of the fields at plotted we get the graph B of fig. 16. Over the angle from 1¾ deg. to 2¾ deg. the difference falls from a value of 1.6 to zero and then rises to 1.8, with first the 150 Hz predominating and then the 90 Hz. The glidepath receiver is required to measure these differences in field strength and display them as deflections of a centre-zero horiztonal pointer; a centre reading corresponds to reception at elevations equal to that of the glidepath angle; readings above centre will depend upon deviations below the required angle, and readings below centre will depend upon deviations above the required angle.

AGC requirements

70 For satisfactory operation it is necessary that a particular angle shall produce a particular pointer deflection at all useful ranges. This requirement is satisfied if the output depends on the relative field strengths of the two signals instead of their absolute strengths, and the necessary conditions can be established if a high order of AGC is applied. In practice the AGC operates to keep the sum of the detected- and amplified-output of the modulation tones constant for a wide range of inputs, and the difference between the tones making up this standard level is then constant for a given angle at all ranges.

Selectivity

71 The selectivity requirements of the glidepath receiver, as with the localizer receiver, are for adequate adjacent channel rejection, and a minimum of spurious signals due to second channel interference. The first condition is satisfied by a bandwidth that is narrow in comparison with the 150 Hz spacing of the glidepath channels, and the second by the use of a high intermediate frequency. The conflicting needs of narrow bandwidth and high IF can not readily be met by a normal superhet, and, as with the localizer, a double superhet is used.

Outline of glidepath circuit

72 The outline of the glidepath receiver circuit is shown in the block diagram of fig. 17. The first stage is a signal-frequency amplifier fixed-tuned to cover the complete glidepath band; its output together with that of a local oscillator signal is fed to a mixer stage in which the first-IF at 54 MHz is produced. The local oscillator signal is generated at one-eighteenth of the final frequency in a crystal trebler circuit which is controlled by a channel switch (common to that operating on the localizer) to provide any of twelve spot frequencies; the local oscillator circuit includes an amplifier, a trebler, and doubler stages.

73 The first-IF amplifier is a single stage feeding, together with the output of a second local oscillator, into a second mixer. The local oscillator is crystal controlled at 15.8 MHz and its output is frequency trebled to 47.4 MHz. The mixer output is thus at the difference frequency of 6.6 MHz. The second-IF amplifier includes five valves and has a response giving an overall bandwidth of 29 kHz at not more than 6 dB down.

74 The detected signals consist of 90 Hz and 150 Hz waveforms representing the glidepath tones. They are amplified together and then separated in two sharply tuned filters. The separate 90 Hz and 150 Hz outputs are then rectified and mixed to produce DC signals for operating the glidepath pointer and alarm flag.

NOTES

* ADJUSTABLE SLUG IN COIL ALTERS BOTH INDUCTANCE AND CAPACITANCE

UNBRACKETED PLUG AND SOCKET IDENTIFICATIONS REFER TO SIDE-BY-SIDE INSTALLATION WITH JUNCTION BOX TYPE 157

BRACKETED PLUG AND SOCKET INDENTIFICATIONS REFER TO SEPARATE INSTALLATION WITH JUNCTION BOX TYPE 158 AND JUNCTION BOX TYPE 159

THE FOLLOWING MODIFICATIONS ARE INCORPORATED
A5689/2
A5690/3

FORMERLY AD6207A/MIN ISSUE I

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ISSUE Prepared by MOD(PE)

[ILS airborne (ARL. 18011)] Localizer receiver R1964-circuit

Fig. 14

[ILS airborne (ARI. 18011)] Glidepath receiver R1965 - circuit

Fig.15

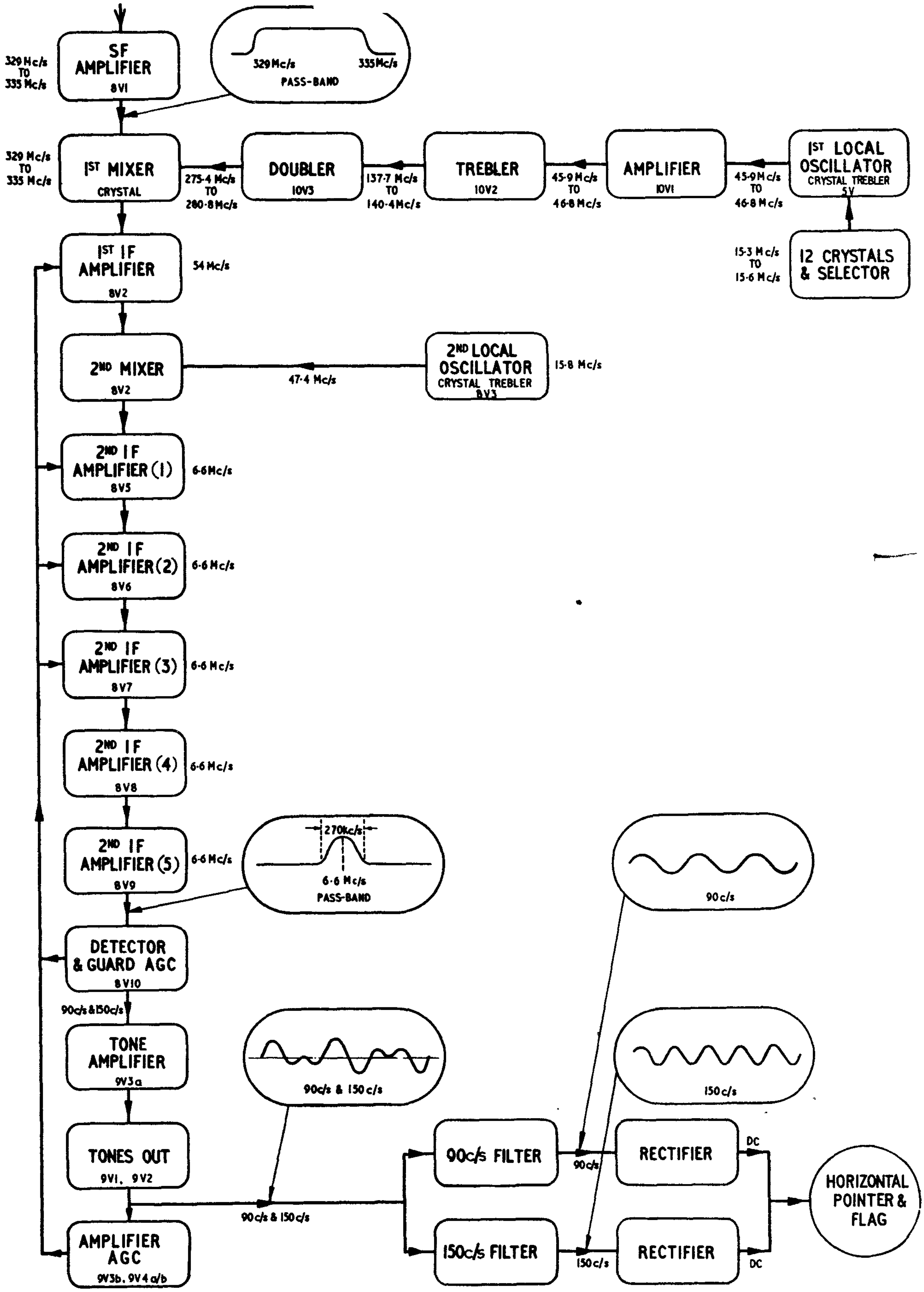


Fig. 17. Block diagram of glidepath receiver

75. The main AGC is produced from the audio tones in a delaying and DC amplifying circuit, and a guard AGC which operates only when the modulation is not being received is produced from the second-IF output.

Signal-frequency stage *(fig. 15)*

76. The glidepath aerial connects through a coaxial plug (9P4) and a short coaxial lead to the receiver input at 8J1. The input circuit consists of a fixed-tuned bandpass filter (8T1) preset to cover the glidepath band from 329 Mc/s to 335 Mc/s. The input is tapped to the primary winding of the filter, and the output is taken from a tap on the secondary to the cathode of the signal-frequency amplifier 8V1 (triode, CV417). The tappings are necessary to ensure a correct matching of the aerial system and optimum signal-to-noise ratio.

77. The first stage is a grounded-grid cathode-input amplifier, with cathode bias provided by 8R1. A second bandpass filter (8T2) forms the anode load of 8V1 and couples the amplified glidepath signals to the first mixer. The overall response of the first stage extends over the full glidepath frequency range so that there is no separation of glidepath channels in the signal applied to the mixer.

First mixer

78. Glidepath signals from 8L4 (the secondary of 8T2) are fed to two germanium crystal-diodes (8W1 and 8W2) in a balanced-modulator type of circuit. A second input to the crystals is a mixing signal derived from the first local oscillator via the tuned circuit 8L5, 8C9, and a centre tap on 8L4.

79. The balanced-modulator circuit is completed by the primary (8L6) of the first-IF input transformer (8T3) whose centre-tap is returned to earth through the diode load resistors (8R4, 8R5); a test point is connected to 8R5 to permit mixer current to be monitored. The two crystal circuits are therefore in a push-pull arrangement with respect to the signal-frequency input and in parallel to the mixing-signal input.

80. A crystal oscillator and frequency multiplying circuit provides the mixing signal, which is of large amplitude as compared with the received signal. It is in the range from 275 Mc/s to 281 Mc/s, and may be any one of twelve spot frequencies.

81. In the mixing process the positive half-cycles of the mixing signal operate over the forward characteristic of the crystals and the negative half-cycles operate over the reverse characteristic. The crystals are therefore primed to appear as low and high impedances over alternate half-cycles of the mixing signal. Glidepath signals appearing during the low impedance periods are thus passed through both crystals with a minimum of attenuation, and signals during the high impedance periods suffer a high order of attenuation.

82. The output in the primary (8L6) of the transformer 8T3, therefore, consists of half-cycle pulses at the mixing frequency of amplitude proportional to the glidepath signals. A component of this output signal is at the difference frequency of 54 Mc/s, and the output transformer (8T3) is tuned to this frequency to provide the first-IF signal.

83. A feature of the balanced modulator type of mixer is that the mixing signal cancels in the two halves of the output transformer, and its fundamental and even harmonics do not form components of the output. Radiation from the circuit is consequently reduced, thereby reducing the generation of spurious whistles, and an improvement in noise factor is also obtained.

First local oscillator

84. The first local oscillator valve is 5V2 (pentode, CV138) in a crystal oscillator and trebler circuit. The oscillatory action takes place between the cathode grid, and screen, in a Colpitt's-type circuit of identical design to that of the localizer local oscillator.

85. Twelve crystals can be selected by the channel switch 5S1; they may be at spot frequencies in the range 15·2944 Mc/s to 15·611 Mc/s. The act of channel selecting is accomplished entirely by switching-in a crystal. The channel selected by any crystal is at a frequency eighteen times the crystal frequency plus the first-IF of 54 Mc/s. That is:—

$$f_c = (18 \times f_x) + 54$$

where f_c = channel frequency in Mc/s
f_x = crystal frequency in Mc/s

86. The anode circuit of 5V2 is preset-tuned by the primary of 5T2 to select the third harmonic of the crystal frequency. This produces an output from the secondary at a frequency in the range from 45·9 Mc/s to 46·8 Mc/s approximately.

Multiplier

87. A coaxial connector carries the local oscillator output from 5J1 on the control unit, to the junction box and through a short coaxial lead to 10J1 on the frequency multiplier. The first stage of the multiplier uses pentode 10V1 (CV138) in a straight amplifying circuit. The grid and anode loads are single-winding circuits peak-tuned at 46·38 Mc/s, but with a flat response which covers the required input range from about 45·9 Mc/s to 46·8 Mc/s.

88. The output of 10V1 is taken from the anode coil (10L2) to the grid of a trebler 10V2 (CV138). The input is sufficient to drive into grid current and bias the valve back to a non-linear operating condition. The anode load is a single tuned circuit peaked at 139·15 Mc/s, but the response is sufficiently broad to permit selection of third harmonics in the range from about 137·7 Mc/s to 140·4 Mc/s.

89. The output of the trebler is taken from a tap on 10L3 to the grid of a doubler 10V3 (CV138). This valve also operates under non-linear conditions due to the input driving into grid current and biasing the valve back. The anode circuit is peaked at the mixer input centre frequency of 278·3 Mc/s and its response covers the second harmonic range from about 275·4 Mc/s to 280·8 Mc/s.

90 Test points are fitted in the grid returns of each of the three valves in the multiplier to permit the flow of grid current to be monitored.

91 The output of the multiplier is taken from a tap on 10L4 through 10J2 and a short coaxial connector to 8J2 and the first mixer input circuit. The final mixing signal at eighteen times the frequency of the local oscillator is fed into the balanced modulator from a tuned circuit peaked at 278.3 MHz.

First-IF amplifier

92 The first-IF signal is selected from the components of the mixing process in a bandpass transformer (8T3), the primary of which forms part of the balanced mixer circuit. The transformer is tuned to a centre-frequency at 54 MHz so that only that signal-frequency whose frequency is 54 MHz greater than the frequency of the local oscillator input at the mixer is selected. The passband of the subsequent circuits is 270 kHz (plus and minus 135 kHz for response to be 6 dB down) so that if other channels are being received through the broad passband of the SF circuit they do not generate an IF signal.

93 The output of 8T3 is fed to the grid of the first-IF amplifier valve 8V2 (pentode, CV454). This valve, which is the only valve operating at the first-IF, is in a conventional AGC controlled amplifying circuit. A second bandpass transformer (8T4) feeds the first-IF output to the second mixer stage.

Second mixer

94 The second mixer 8V4 (pentode, CV138) receives the first-IF signal and the second local oscillator output in parallel at its grid. The mixing frequency of 47.4 MHz beats with the 54 MHz IF and the difference frequency of 6.6 MHz is selected in a bandpass transformer (8T5) in the anode circuit.

Second local oscillator

95 The second local oscillator is 8V3 (pentode, CV138) in a crystal trebler circuit of the same basic Colpitt's-type design as the first local oscillator 5V2. The crystal is cut for 15.8 MHz and the anode circuit is tuned to select the third harmonic at 47.4 MHz.

Second-IF amplifier

96 The second-IF at 6.6 MHz is amplified in a cascade circuit of five valves, 8V5 (CV131), 8V6 (CV131), 8V7 (CV454), 8V8 (CV138), and 8V9 (CV138). Untuned RC coupling is used between the last two valves; all the other stages, including the output from the final amplifier to the detector, use bandpass-coupled transformers.

97 The overall response of the glidepath receiver is controlled mainly by the second-IF stages, and the passband of 29 kHz (at 6 dB down) is achieved with an adjacent channel selectivity such that signals due to adjacent localizer channels, which would produce signals spaced 150 kHz from the required second-IF at 6.6 MHz are attenuated by at least 50 dB. The stage containing 8V8 is untuned because it provides gain only and is not required to contribute to the shape of the IF response.

98 All the second-IF valves are cathode-biased, and 8V5, 8V6, and 8V7 are fed additionally with AGC on their grids. The bias on 8V7 is regulated by a variable cathode resistor 8R43 to provide for preset adjustment of the glidepath receiver gain. A CV454 valve is used for 8V7 because it allows a flatter AGC characteristic to be obtained than that possible with the normal variable-μ valve CV131.

Detector and guard AGC

99 The IF output of 8T9 is fed to the anodes of the two diodes of 8V10 (double-diode, CV140). Diode a is the detector and diode b the guard AGC generator. The detector output in the form of 90 Hz and 150 Hz glidepath tones is developed across the load resistor 8R61, 8R62. A test point is connected to 8R62 to permit the diode current to be monitored.

100 The cathode of the AGC diode is positively biased from a potential divider (8R57, 8R63) across the HT line; the anode of the diode is connected into the main AGC circuit through 8R65. Signals must have a peak amplitude of at least 10V at the detector before the AGC diode will conduct, and thus no AGC is produced by 8V10b on weak signals. With stronger signals a further AGC circuit, operating on the amplified AF tones, feeds a negative potential on to the AGC line, and as this potential appears as a negative bias at the anode of 8V10b also, even if the IF input does exceed the cathode bias, 8V10b will still not conduct. If, however, through some defect in the glidepath transmitter, a large signal without modulation is being received, the tone-developed AGC cannot operate, and 8V10b will then conduct and develop a bias potential, the guard AGC, which prevents overloading.

Indicator circuit

101 The 90 Hz and 150 Hz tones are amplified in a two-stage RC coupled circuit consisting of triode 9V3a (part of diode-triode, CV137) and two triode-connected pentodes 9V2 and 9V1 (CV138) in parallel. The cathode bias resistors of both stages are not decoupled, and as a result negative feedback is introduced, and the gain of the circuit tends to be the same at the two tone frequencies.

102 The amplified tones at the anodes of 9V1/9V2 are separated in two sharply tuned filters, and then rectified in separate bridge circuits to produce two DC outputs. The filters and rectifiers are identical with those of the localizer receiver (para. 58).

103 The two DC outputs are connected in a series-parallel arrangement to the movement of the horizontal flag and pointer in the indicator, electrical, Type 7. The circuit is similar to that feeding the localizer flag and pointer (fig. 13). The preset 9R8 balances the bridge formed between 9R23, 9R24 and the two DC sources, and enables the pointer to be set at the centre-zero when the tones are of equal amplitude. The second preset 9R1 is a shunt across the coil of the pointer movement; it allows the deflection sensitivity (deflection for a given difference in level between the tones) to be adjusted. A third preset 9R2 controls the current in the alarm flag and sets the minimum level at which the combined output will completely withdraw the flag.

104 Series dummy load resistors are connected into the flag circuit and parallel resistors in the pointer circuit. As with the localizer, these resistors are disconnected or shorted out in accordance with the number of indicators in use (para. 65).

Main AGC

105 The signal at the anodes of the tone output valves is rectified in the triple-diode circuit of diode 9V3b and double-diode 9V4 (CV140) to provide the main AGC potential. Onset of the rectifying action is retarded by a delay potential so that AGC is not produced until the peak level of the tone output reaches about 40V; for higher output levels an increasing level of bias is fed into the AGC line to control the gain of IF valves.

106 The first diode (9V3b) is connected in a normal type of delayed AGC circuit in which the signal is fed to the anode and the delay is provided by a voltage at the cathode. The other diodes (in 9V4) form a voltage doubler on the tone signal and control the voltage at the cathode of 9V3b.

107 When a signal is not being received the cathode capacitor 9C3 is charged through 9R20 and 9R9 to the potential of about 120V existing at the junction of 9R14 and 9V5 (gas diode, CV2213) and all the diodes are non-conductive. When a signal is received the tone signal applied through 9C6 to the common anode-cathode connection of 9V4 is rectified, and the charge of 9C3 is reduced until the potential across it falls by twice the peak value of the input signal.

108 If the signal has a peak value of say 41V the voltage at the cathode is reduced from 120V by 82V to 38V, so that at the peaks of the input through 9C5 to the anode of 9V3b, the anode tends to rise to 3V above the cathode. The diode therefore conducts and a negative potential develops across the load resistor 9R10. If the signal is less than 40V the combination of all in cathode potential and peak rise at the anode is insufficient to cause the diode to conduct, and no current flows through 9R10, so that the potential across it remains zero.

109 For all signals of greater peak amplitude than 40V a negative potential is produced at the AGC line; its value is equal to three times the peak level of the tone signal minus 120V. The AGC therefore increases at three times the rate of increase of signal and results in the output being stabilized to approximately the level of 40V.

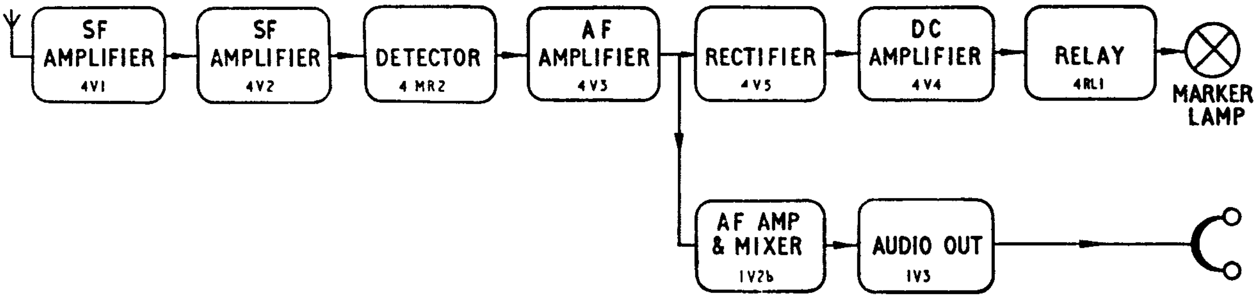


Fig. 18 Block diagram of marker receiver

110 The static bias for the circuit is provided by a potential divider consisting of 9R14, 9V5, and 9V6 across the HT line. The return of 9V6 is taken to the 19V stabilized heater supply. The stability of the potential provided by this circuit is of the greatest importance in maintaining a constant deflection sensitivity.

MARKER RECEIVER

General information

111 Marker beacons operate at a fixed frequency of 75 MHz and radiate keyed MCW signals in which the coding and frequency of the modulation identifies the position of each beacon relative to the runway. Modulation is in the form of audio tones keyed with Morse symbols.

112 In normal operation the maximum range at which reception is required is limited to the distance represented by the height of the aircraft when on or near the correct approach path and when passing over the beacons. This distance will not usually exceed about 5,000 ft., so that a simple TRF receiver satisfies all requirements.

113 A block diagram of the marker receiver is shown in fig. 18. It will be seen to consist of a two-stage signal-frequency amplifier, a detector, an AF amplifier feeding a telephone output through the common audio circuit of the localizer receiver, an audio detector, and a lamp-operating DC amplifier. The circuit of the complete marker receiver is given in fig. 19.

Signal-frequency circuits

114 The marker aerial connects through a coaxial plug (1P4) and a short coaxial lead to the receiver input point at 4J1. The input circuit is a single-winding circuit peak-tuned at 75 MHz, with the input taken to a tap on the coil provides an output feed to the first signal-frequency amplifier 4V1 (CV138).

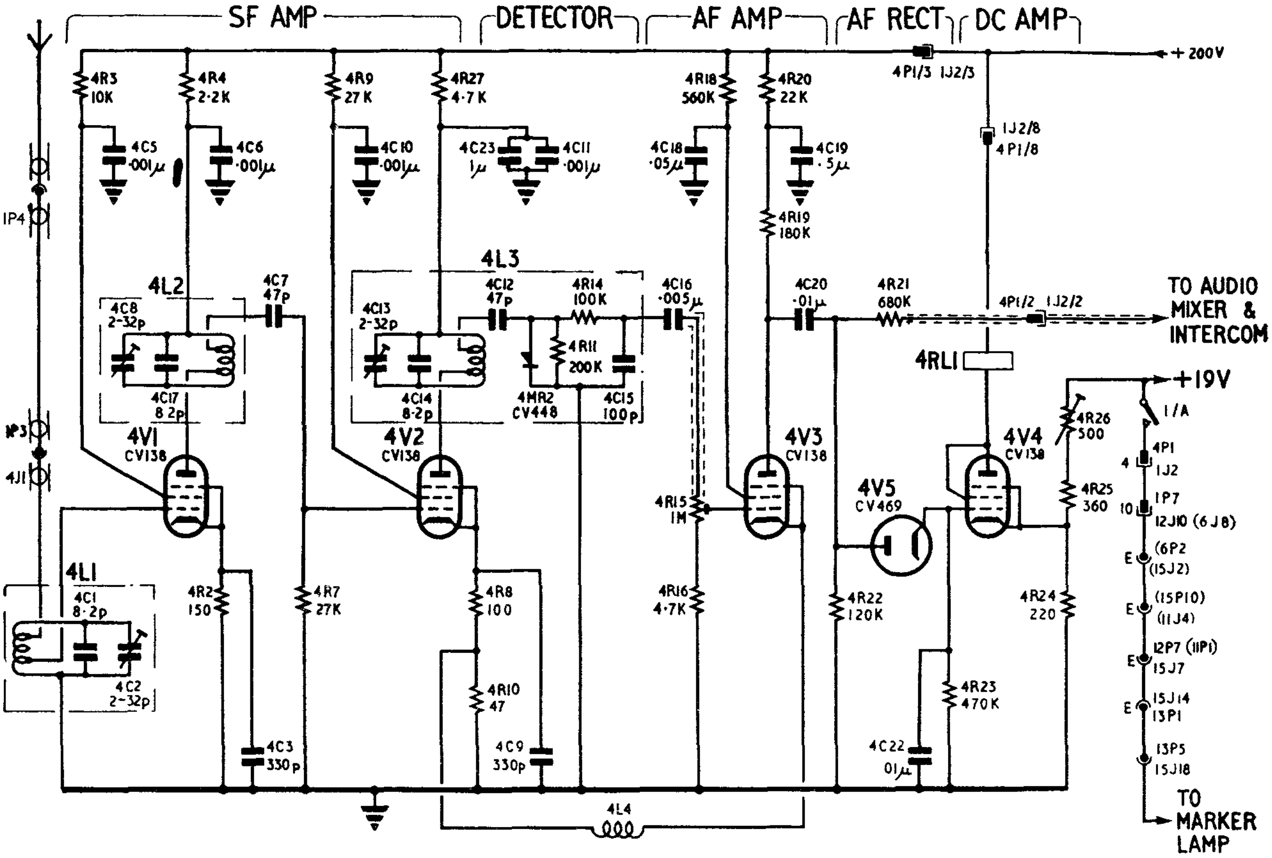


Fig. 19. Marker receiver—circuit

115. A second tuned circuit forms the anode load of 4V1. The anode connects to a tap on the coil (4L2) and a second tap provides the output through 4C7 to the second signal-frequency amplifier 4V2 (CV138). A third tuned circuit forms the anode load of 4V2 and provides the signal-frequency output to the detector.

116. The three tuned circuits are preset, by adjustable cores in the coils, to 75 Mc/s, and provide an overall bandwidth of 1 Mc/s for a response 8 dB down on the centre frequency. The input and output taps on the coils are arranged to provide correct matching between the several circuits in order to avoid damping and to maintain the bandwidth.

117. The bias for 4V1 is provided by a cathode resistor (4R2) and that for 4V2 is provided by two resistors in series (4R8 and 4R10); 4R10 is common to the cathode circuit of the AF amplifier valve 4V3. When the detected AF signal at the grid of 4V3 is passing through its positive half-cycles the potential across 4R10 due to the flow of current in 4V3 is increasing, and when the AF signal is passing through its negative half-cycles the potential across 4R10 decreases. The gain of 4V2 therefore decreases and increases as the audio rises and falls.

Detector and AF amplifiers

118. The 75 Mc/s output of the second SF-amplifier is applied to a germanium crystal diode (4MR2). The diode conducts during the positive periods of the carrier input so that an output in the diode load circuit (across 4C15) is a negative-going signal following the shape of the carrier modulation envelope.

119. The AF content of the detector output is fed to the grid of an amplifier valve 4V3 (CV138). The proportion of signal is controlled by a preset potentiometer (4R15), the marker gain control. The cathode bias for the valve is derived from the common cathode resistor with 4V2, 4R10.

120. Because the detector is connected to produce a negative-going output, the positive half-cycles of the audio signal applied to 4V3 are produced during the periods when the modulation envelope of the carrier is decreasing in amplitude, and the negative half-cycles are produced when the carrier envelope is increasing in amplitude. A rising potential is thus being introduced into the cathode circuit of 4V2 during envelope-decreasing periods of the carrier, so that the gain of the valve is reduced and the amplitude of the output is also reduced. A falling potential is introduced into the cathode circuit during envelope-increasing periods of the carrier, so that the gain of the stage is increased and the amplitude of the output is also increased. The resulting feedback action produces an effective increase in the apparent modulation depth of the input signals.

121. Amplified audio signals in the an of 4V3 are fed through 4C20 to the grid of a further amplifier 1V2b in the LF unit Type 4 (*fig.* 14). The level of input to 1V2b is controlled by 3R67 in the potentiometer formed by 4R21, 1R18, and 3R67. The anode load of 1V2b is common to the localizer audio amplifier 1V2a and so the marker AF signals appear in the input to the audio output valve 1V3, and are fed into the aircraft telephone circuits.

Lamp circuit

122. The marker AF signal is also fed to the anode of a rectifier 4V5 (diode, CV469), whose load circuit (4R23, 4C22) is of long time-constant. The rectified output appears at the grid of 4V4 (CV138) as positive DC pulses which follow the coding of the original marker signals.

123. 4V4 is a DC amplifier. It is normally non-conducting due to the bias voltage at the cathode derived from the 19V heater supply through 4R26 and 4R25. Each pulse at the grid causes anode current to flow and relay 4RL1 in the anode circuit to operate. The contacts of the relay therefore close for the duration of each input pulse and an external lamp connected in the heater supply circuit is switched on. The tripping level of the relay is controlled by the bias adjustment (4R26) on the valve.

POWER SUPPLIES

Control circuit (*fig. 20*)

124. The ILS receivers operate on aircraft battery supplies at the nominal level of 27V DC. A single feed is taken from an aircraft power point through a control circuit common to both receiver units; thereafter separate lines are used to feed the two units.

125. The positive line of the common feed includes a thermal circuit breaker and the pilot-operated ON/OFF switch. After the switch, two lines supply the 27V to the receiver units, and a third line feeds a voltage regulator. The output of the regulator at 19V supplies the heater circuits of both units.

126. The circuit breaker is a Type A thermally-operated switch rated to trip and open the circuit when more than a pre-determined current is passing through the switch. It consists of a single-pole switch manually closed in normal operation by a press button, and held in the operating position by a mechanical locking system; the internal connection to the switch contacts includes a bi-metal strip which expands and trips the locking mechanism on over-heating and so releases the switch; a second press button is provided to permit the switch to be tripped manually if desired. A preset adjustment on the tripping mechanism is set normally for tripping to take place when 15A is passing.

Voltage regulator

127. The voltage regulator Type 60 consists of a carbon pile assembly in series with an operating solenoid across the 27V supply. The nominal voltage drop across the pile is 8V, so that the voltage across the solenoid circuit is normally 19V; if the supply voltage rises, more current flows in the solenoid and the plunger in the carbon pile (which is controlled in position by the core of the solenoid) is moved in such a way as to reduce compression in the pile; the resistance of the pile is thus increased and the voltage drop across the pile increases. The rise in supply voltage tends therefore to appear mainly across the pile, and the potential across the solenoid circuit tends to remain constant at the required level of 19V.

128. The resistor in series with the solenoid is a preset adjustment on the current flow through the solenoid. It is used to set the stabilized level to the required 19V.

HT—R.1964

129. A rotary transformer Type 797 (prefix 2) provides HT in the R.1964. The 27V input circuit (*fig.* 21) includes an RF filter which prevents feedback of commutation noise into the supplies; a further filter is included in the HT output line to prevent noise injection into the receiver circuits.

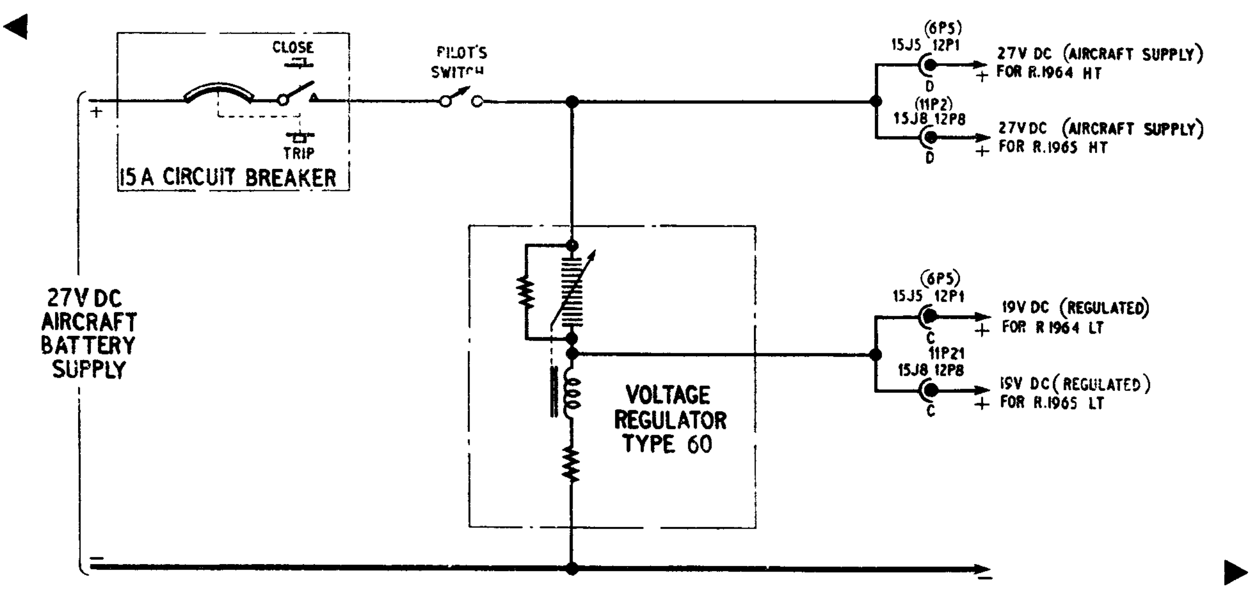


Fig. 20. Power control circuit

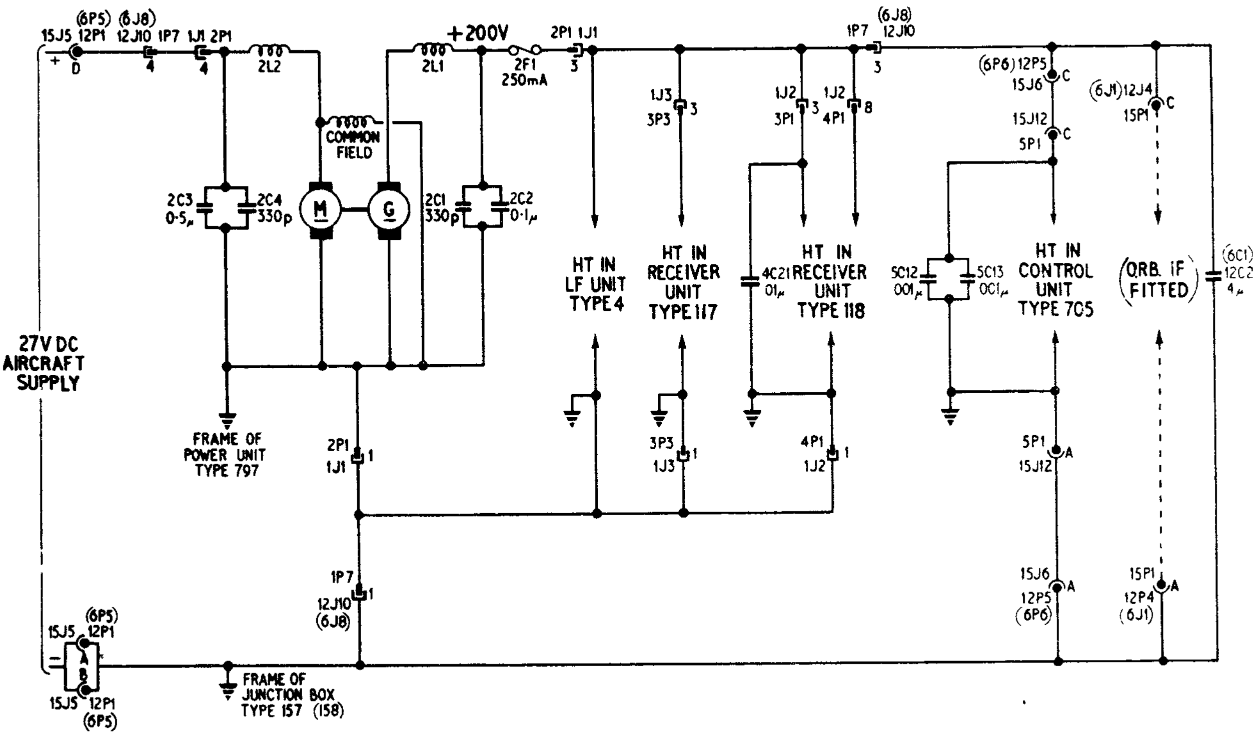


Fig. 21. R.1964 HT supplies

130. The transformer consists of a 27V DC motor and a 200V DC generator in which a single stator winding provides a common field, and the two rotor windings are on a common armature with separate commutators, one at each end. A fan is fitted on the LT commutator end of the armature to provide a forced draught for cooling the receiver unit as a whole.

131. The HT output appears on pin 3 of the plug 2P1, and it is coupled into the LF unit Type 4 through 1J1. The distribution of HT to the receiver units Type 117 and 118, as shown also on fig. 21, takes place through the plug and socket interconnections on the LF unit; and further distribution to the control unit Type 705 and to a possible, but unused, application in an O.R.B. unit, takes place through the junction box.

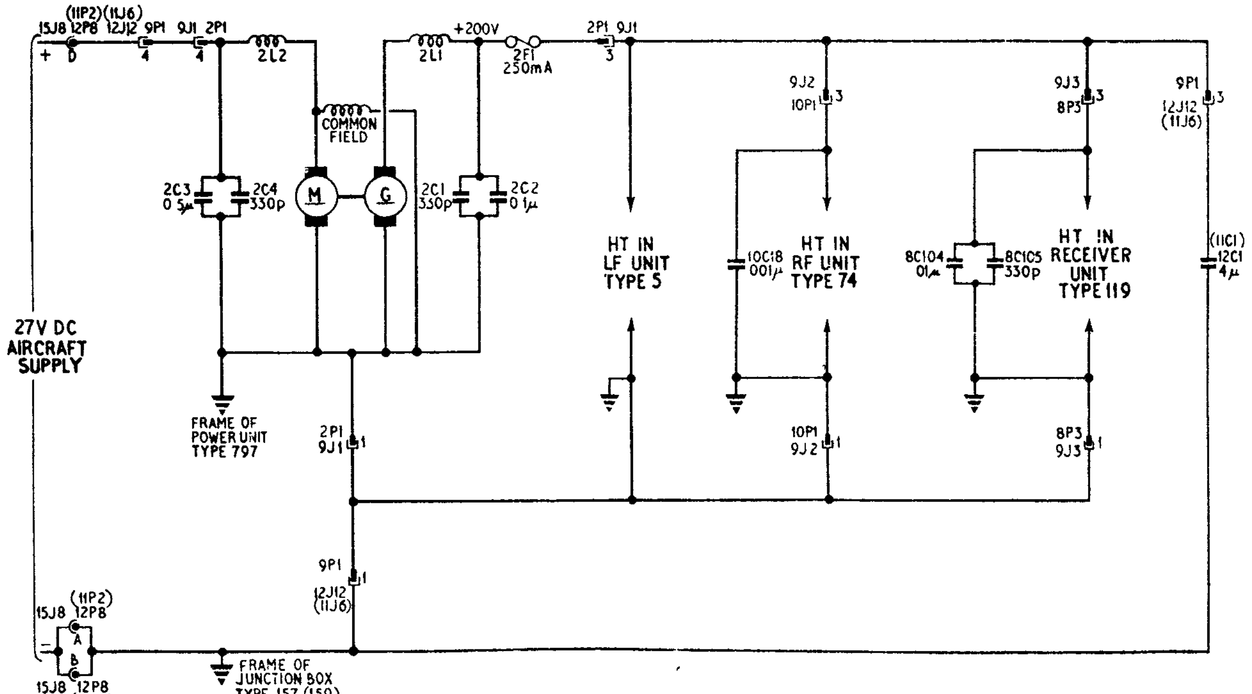


Fig. 22. R.1965 HT supplies

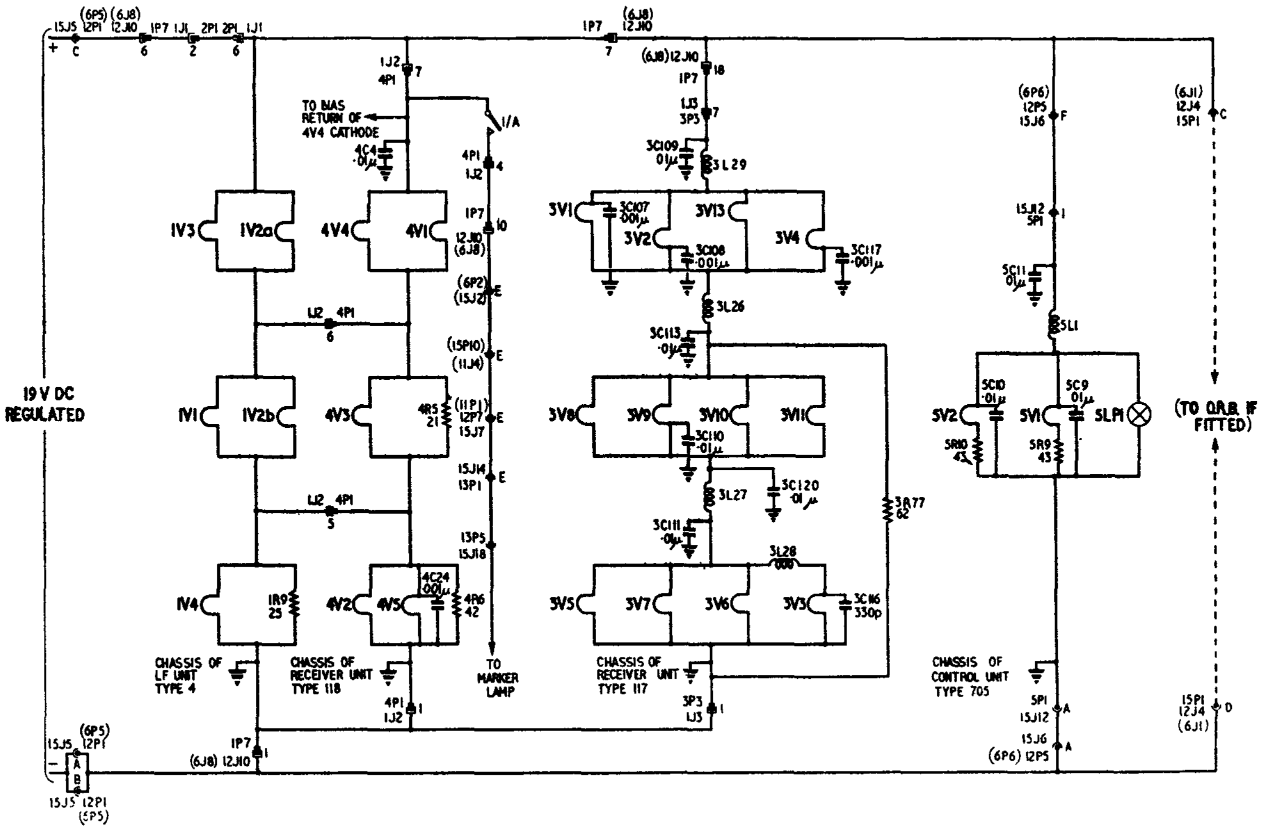


Fig. 23. R.1964 LT supplies

132. In general a decoupling circuit is provided separately in each unit taking HT, but a common smoothing circuit is provided by a 4 μF capacitor (12C2 or 6C1) fitted in the junction box.

HT—R.1965

133. The HT circuit of the R.1965 is shown in fig. 22. HT is generated as in the R.1964 by a rotary transformer Type 797. The output at 200V is distributed through the plug and socket interconnections on the LF unit Type 5, and a feed is also taken into the junction box to a capacitor, 12C1 or 11C1, which provides smoothing. No external circuits are provided with HT from the R.1965

LT—R.1964

134. The LT circuit of the R.1964 is shown in fig. 23. The 19V regulated supply is brought into the LF unit Type 4 through the junction box and is fed in a complex series-parallel arrangement to the valve heaters in the receiver units and the control unit. Provision is also made on the junction box for the 19V supply to be fed to an O.R.B. unit if fitted.

135. The heaters of the twelve valves in the receiver unit Type 117 are connected in three parallel groups of four, and the three groups are then connected in series; each heater requires 6·3V, so that the complete chain requires approximately 19V. The valves in the first group (3V1, 3V2, 3V13, 3V4) draw 0·3A each, so that the total required drain down the chain is 1·2A. The second and third groups each consist of two valves drawing 0·3A and two drawing 0·2A, a total of 1·0A, so that a bleeder (3R77) is connected across them to draw the excess 0·2A. Chokes and capacitors decouple the sets of heaters from one another, and the heater of the second local oscillator (3V3) is separately isolated by 3L28.

136. The heaters of four valves in the LF unit Type 4 and five in the receiver unit Type 118 are also connected in a chain of three 6·3V circuits. In the first parallel group of valves, three (1V3, 4V4, 4V1) each draw 0·3A and one section of the centre-tapped heater of 1V2 draws 0·15A; a total drain of 1·05A. In the next group 1V1 and 4V3 each draw 0·3A, the second half of the heater of 1V2 draws 0·15A, and a bleeder (4R5) draws 0·3A to make up the total to 1·05A. In the third group of heaters, 1V4 takes 0·2A, 4V2 takes 0·3A, 4V5 takes 0·15A, a bleeder (1R9) takes 0·25A, and a second bleeder (4R6) takes a further 0·15A to make up the total to 1·05A.

137. The heaters of the two valves (5V1, 5V2) in the control unit each requires 6·3V at 0·3A, and they are connected in parallel across the supply, each in series with a dropping resistor (5R10, 5R9). The pilot lamp (5LP1) is rated at 24V, but it is connected in parallel with the valve circuits across the 19V supply.

138. The LT supply for the marker indicating lamp is derived from the 19V source in the receiver unit Type 118. The feed includes the switch contacts of the marker relay. The same 19V source also provides cathode bias for the relay control valve 4V4.

LT—R.1965

139. The LT circuit of the R.1965 is shown in fig. 24. The 19V regulated supply is brought into the LF unit Type 5 through the junction box, and connected in a complex series-parallel arrangement which brings all the valves in the LF unit Type 5, the receiver unit Type 119, and the RF unit Type 74 into three series groups. In the first group, the valves (10V3, 9V1, 8V2, 8V1, 8V10) each take 0·3A, and the bleeders 9R21 and 8R73 take 0·3A and 0·1A respectively; the total chain current is therefore 1·9A. The second chain is similar with 10V2, 9V2, 8V9, 8V8, and 8V7, each taking 0·3A, and the bleeders 9R22 and 8R74 taking 0·3A and 0·1A respectively. In the third chain 10V1, 9V3, 9V4, 8V4, and 8V3, each take 0·3A, and 8V6 and 8V5 each take 0·2A; making up the required total of 1·9A.

140. Each group of heaters in the receiver unit Type 119 is isolated by a choke, and the heaters of the RF valve, second detector, and second local oscillator are separately isolated. The three feeds to the valves in the RF unit Type 74 are also decoupled by separate chokes and capacitors.

141. The 19V supply in the LF unit Type 5 is also used to increase the bias potential in the AGC delay circuit. Two cold-cathode discharge valves are connected in series with a resistor 9R14 from the HT positive line to the LT line, so that the stabilized potential of just over 100V across the valves is added to the 19V heater supply to produce the required bias potential at about 120V.

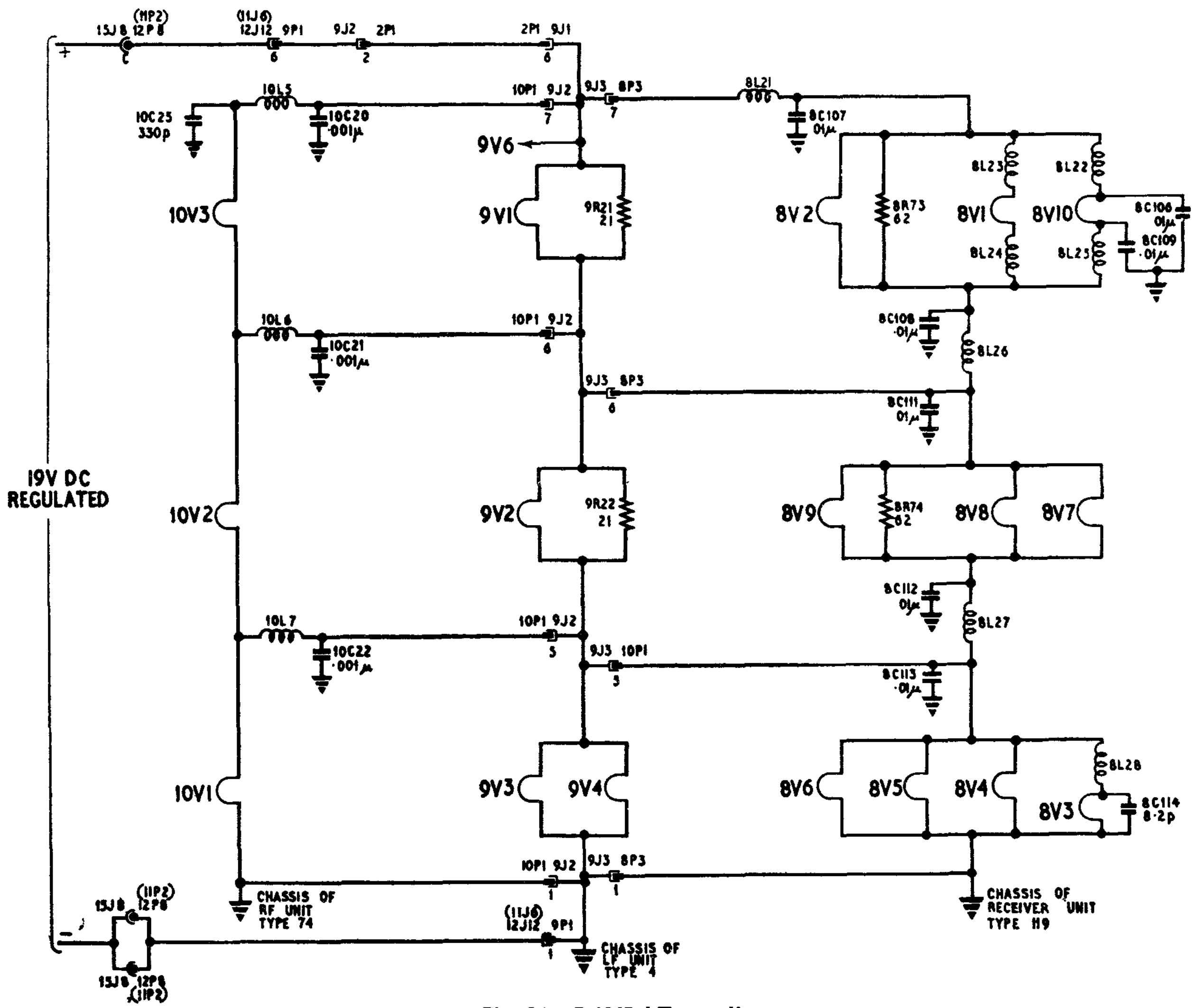


Fig. 24. R.1965 LT supplies

Chapter 4

CONSTRUCTIONAL DETAILS AND INSTALLATION

CONTENTS

ILLUSTRATIONS (Cont'd)

RECEIVER TYPES R.1964, R.1964A AND R.1964B

1 The major assemblies used in the construction of the Localizer and Marker receivers Types R.1964, R1964A and R.1964B are tabulated below.

Description	Unit prefix	R.1964 5826-99-635-2827		R.1964A 10D/19903		R.1964B 5826-99-635-2828	
		Type No	Ref	Type No	Ref	Type No	Ref
L.F. unit	1	4	10D/17822	4	10D/17822	4A	10D/21528
Power unit	2	797	10K/16691	797	10K/16691	11953	10K/20718
Receiver unit	3	117	5826-99-635-2829	117	5826-99-635-2829	117	5826-99-635-2829
Receiver unit	4	118	10P/13185	118	10P/13185	118	10P/13185
Cover	-	697	10AP/128	697	10AP/128	697	10AP/128

LF unit Type 4

2 The LF unit Type 4 (fig. 2) carries the tone and audio output stages of the localizer and marker receivers and forms the mounting frame on which the other units are fitted. The structure consists of a flanged base with front and rear end plates attached and a side plate at the left-hand side (from the front). Construction throughout is of aluminium alloy. The front plate, which is also the receiver front panel, is finished externally with a smooth matt-black surface.

3 The tone and audio output stages are built on the rear and the left-hand side of the base plate. The tone output filters are in a hermetically sealed sub-assembly at the back, and a further scaled sub-assembly mounted behind the filter unit contains the tone rectifiers and certain associated circuit components. These sub-assemblies are supplied as units and are to be renewed in their entirety if faulty. They are:

3.1 Tone output filters. Filter unit Type 391 (10P/13187)

3.2 Tone rectifiers. Rectifier unit Type 18 (10D/17821)

4 Connections to the external circuits, except aerials, are carried on the rear end plate. A 20-way armoured plug (1P7) carries the power supplies and output services, and a miniature two-way socket (1J4) carries the RF input from the local oscillator circuit in the control unit. A short coaxial lead terminating in a coaxial plug (1P2) forms a flying lead between 1J4 and the local oscillator input socket 3J2 on the localizer receiver unit.

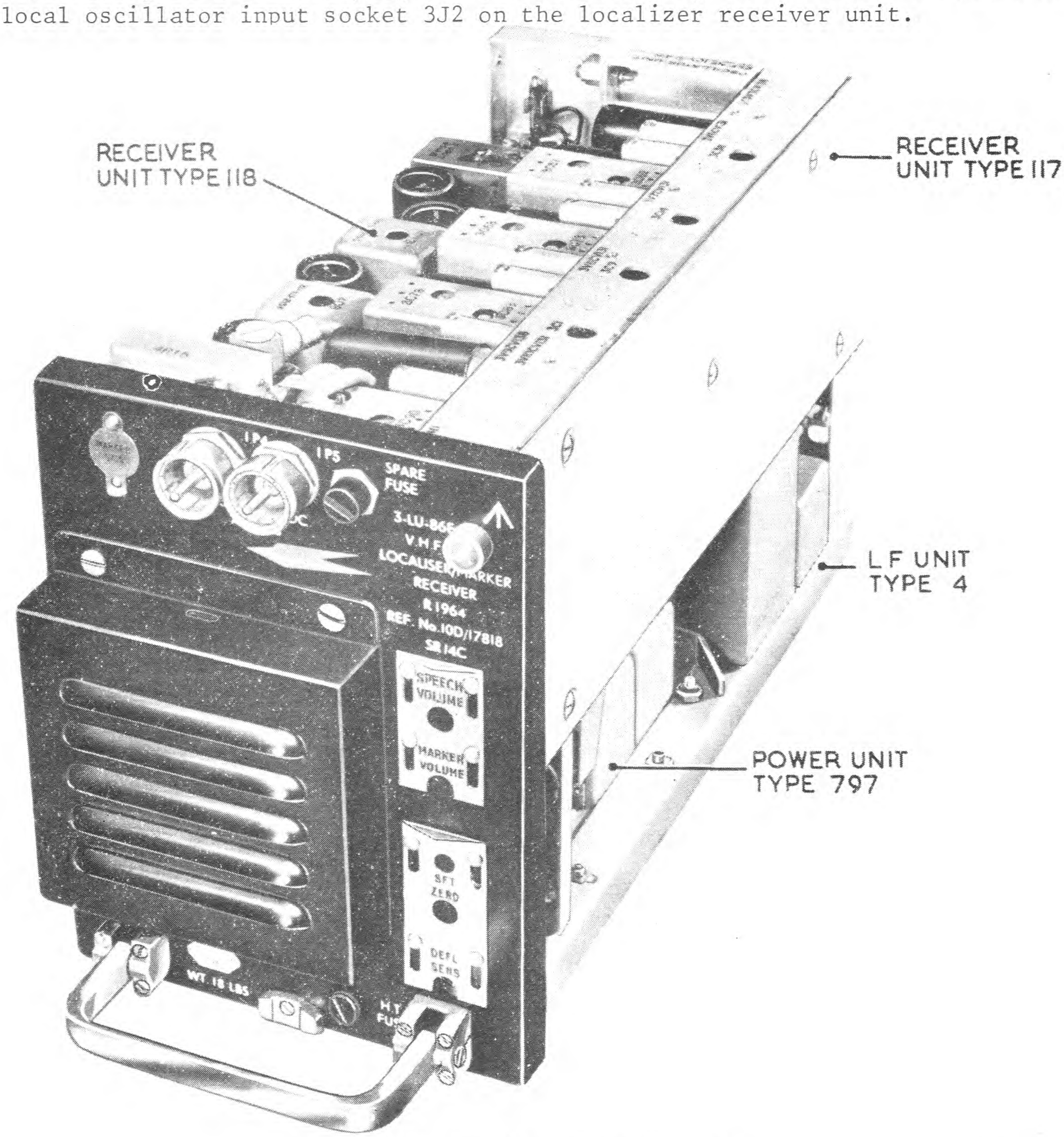


Fig. 1 Receiver Type R.1964

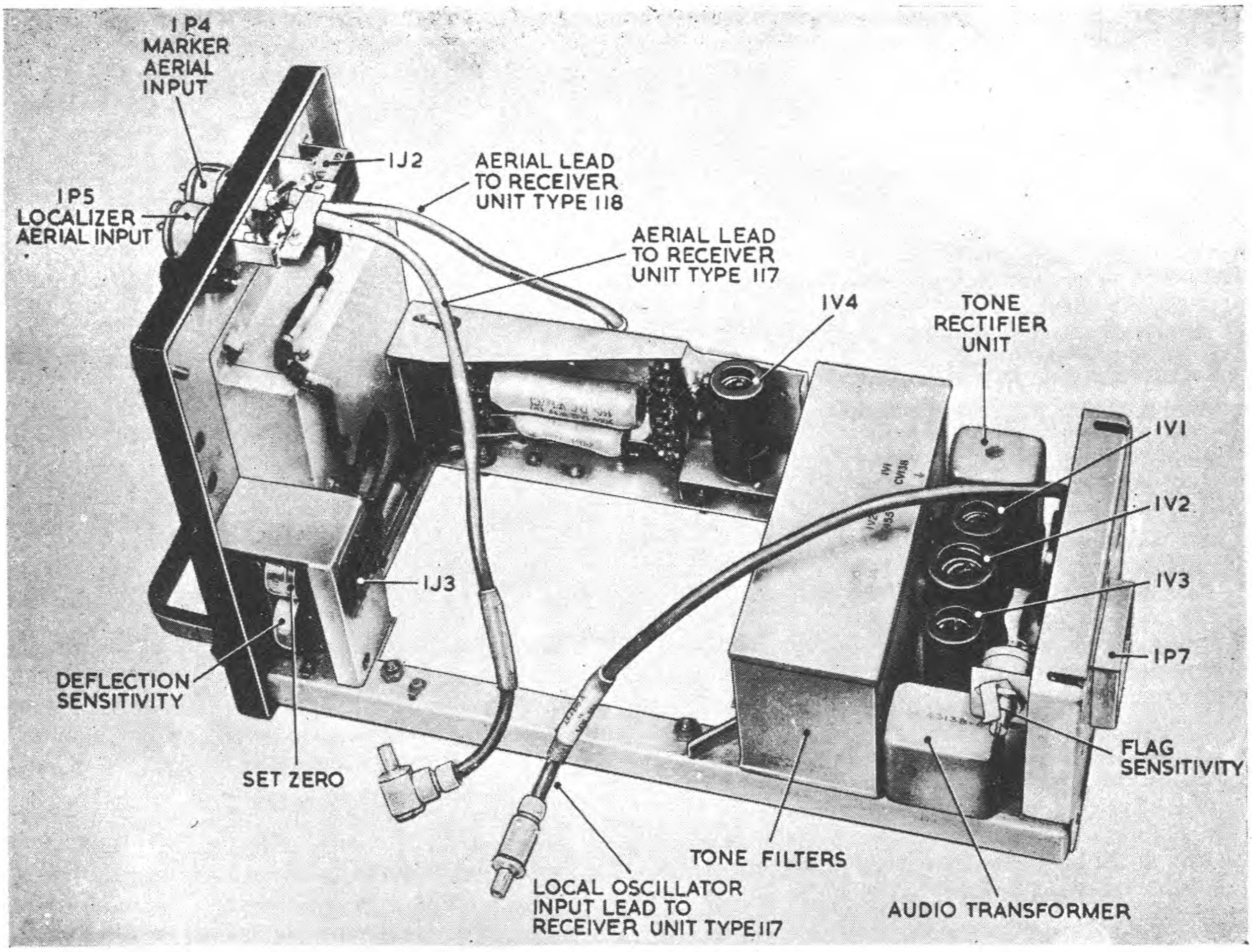


Fig. 2. LF unit Type 4

lead between 1J4 and the local oscillator input socket (3J2) on the localizer receiver unit.

5. Two holes at the sides of the rear end plate are sockets for locating pins on the junction box to which the R.1964 connects. A third hole at the top centre of the plate is the receptacle for the dust cover fixing screw.

6. Two presets (1R7, SET ZERO, and 1R17, DEFL SENS) are mounted behind the bottom right-hand corner of the front panel and are accessible through the front panel. A further preset (1R8, FLAG SENSITIVITY) is mounted at the side of the rear end plate and is accessible only when the outer dust cover is removed.

7. A Vokes air filter is fitted as a sub-assembly on the front panel. Air is drawn through louvres in the front cover of the filter under the influence of a forced draught, created by a fan in the power unit, and passes through the filter and into the body of the receiver.

8. The power unit fits through a hole in the base plate of the LF unit and occupies the space between the rear of the air filter and the tone filter unit. Four red-painted screws on the underside of the base plate are used to hold the power unit in position.

9. The two receiver units fit above the power unit with their rear ends supported on the rear end plate. The front of the receiver unit Type 117 is supported by a cover plate over the indicator presets, and the front of the receiver unit Type 118 is supported by a flange on the left-hand side plate of the LF unit. A red-painted captive screw on the front panel holds the front of the receiver unit Type 117 in position, and fixed red-painted screws on the front and rear of the receiver unit Type 118 and on the rear only of the Type 117, hold those points in position through slotted holes in the supporting members.

10. Two coaxial plugs (1P4 and 1P5) are fitted at the top of the front panel as input points for the marker and localizer aerials respectively. Short coaxial leads terminating in angle-entry coaxial plugs (1P3 and 1P1) provide the connections into the aerial input sockets (4J1 and 3J1) on the receiving units.

11. A sliding cover on the front panel obscures two holes through which the indicator presets can be adjusted. A locking device normally prevents he cover from being moved, and ensures that, once the controls have been set up, unauthorized adjustments cannot be made without exciting attention.

12. The device takes the form of a short length of spring-steel carrying at one end a short pin, and mounted at the other end to the rear of the front panel. In the locked state, the pin projects through a small hole in the front panel and also through one of the guide slots of the sliding cover. It is held in this position against the tension of the spring by means of a short length of wire twisted through a hole in the end of the pin and locked, in normal service, with a leaden seal. If the seal and wire are removed, the spring withdraws the pin through both the slot and the front plate and into the body of the receiver. Re-setting cannot be carried out unless the receiver is removed from its mounting and the outer dust cover is removed.

3. A second sliding cover on the front panel is not held by a locking pin. It obscures two further holes through which volume controls on the localizer receiving unit are accessible. A third cover at the top of the front panel obscures a single hole giving access to the gain control on the marker receiving unit.

4. A fuse holder carrying a spare HT fuse is fitted at the top of the front panel. The working HT fuse is found at the foot of the panel, but is fitted to the power unit and protrudes through the panel only when the power unit is in position.

5. Connections between the LF unit and the sub-assemblies are made through miniature Jones sockets mounted on the inside of the front panel. The socket for the power unit (1J1) is fitted beneath the air filter at the foot of the panel, and the socket for the receiver unit Type 117 (1J3) is found on the cover plate of the indicator presets. The socket for the receiver unit Type 118 (1J2) is mounted at the top left-hand corner of the rear of the panel.

6. The valves in the LF unit are:—

Ref.	*Type*	*Function*	*CV No.*
V1	Pentode	Tone output	138
V2	Double triode	Audio amplifiers and mixer	455
V3	Pentode	Audio output	138
V4	Pentode	Tone amplifier	131

Power unit Type 797

7. The power unit Type 797 (*fig.* 3) is made up of a flanged plate carrying a rotary transformer, input and output filters, connecting plug, and a fuse. The rotary transformer is a lightweight unit

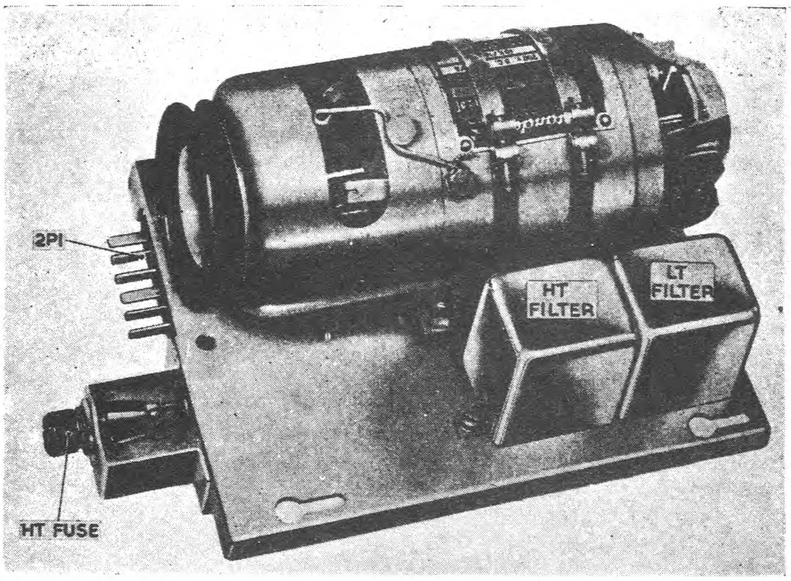


Fig. 3. Power unit Type 797

rated to give 28 watts HT at 200V on a 27V input. Transformers of the type shown in fig. 3 (rotary transformer Type 261, Stores Ref. 10K/16696) are being fitted in early production models of the power unit only, and an improved version (rotary transformer Type 264, Stores Ref. 10K/17072) will be fitted in later models and will also be used as a replacement (with appropriate modifications to the power unit) for the Type 261.

18. The power unit is mounted to the base plate of the LF unit from underneath. It is held in position on the underside of the LF unit by four red-painted fixed screws which bear against slotted holes in the plate of the power unit. The connecting plug (2P1) projects from the front flange and mates with a socket (1J1) on the LF unit. The fuse is fitted to a bracket on the front flange and projects through the front panel of the LF unit to be visible at the foot of the front panel. The fuse is a miniature cartridge type rated at 250mA (fuse Type 153, Stores Ref. 10H/18680).

19. The rotary transformer is held by two straps to a mounting plate which is fitted in turn to the base plate on resilient mounts. A fan is fitted on the transformer spindle to provide a draught which draws air through the Vokes filter on the front of the LF unit and forces it for cooling purposes through the rotary transformer and the inside of the receiver. The fan is at the LT-end of the commutator and is protected by an end cap which is held in position by spring clips on the Type 261 and by screws on the Type 264. A rubber ring on the end of the cap forms an air seal between the cap and the exit hole of the air filter, and the cap provides a duct to draw the air into the transformer. Holes are left in the cap to provide a by-pass air path into the main body of the receiver; the holes in the Type 264 cover are smaller than those in the Type 261 cover so that the Type 264 is much more effectively cooled.

20. The brushes are held in position by screw-type insulated caps. The HT brushes are directly accessible, but the LT brushes are protected by the end cover. In the rotary transformer Type 261 the HT brushes are "brushes, HT, Stores Ref. 10AD/264," and the LT brushes are "brushes, input, Stores Ref. 10AD/263." In the Type 264 an improved mounting system with trailing brushes is used, and results in increased life for the brushes.

21. The input and output filters are fitted as sub-assemblies which, if faulty, must be renewed as complete units. They are:—

Function	*Description*	*Stores Ref.*
Input filter	Smoothing unit Type 18	10AE/256
Output filter	Smoothing unit Type 19	10AE/257

Receiver unit Type 117

22. The receiver unit Type 117 (*fig.* 4) carries the greater part of the localizer receiver on a silver-plated aluminium alloy chassis. The overall dimensions, taking into account all projections, are:—

Length	12·3 in.
Depth	5·1 in.
Height	3·6 in.

23. The major components, including all but one of the valves, most of the tuned circuits, and most of the decoupling capacitors, are mounted above the chassis. The underside is protected by a cover plate held by five Oddie fasteners, and additional screening for the below-deck components of the multiplier (3V1, 3V2) and second local oscillator (3V3) circuits is provided by two separate and smaller plates.

24. The unit is mounted on its side, with its valves horizontal and pointing inwards, at the right-hand side (from the front) of the LF unit. It is supported on the frame of the LF unit, at the front, by a cover over the indicator presets (1R7, 1R8), and at the back by the rear end plate of the LF unit. A red-painted screw set in an anchor nut on the side flange near the end of the chassis holds the rear in position, and a red-painted captive screw on the front panel of the LF unit screws into a second anchor nut on the front flange of the receiving unit to hold the front in position. A bracket at the rear of the top of the chassis carries a further anchor nut which allows a red-painted captive screw on the receiver unit Type 118 to hold the two units together.

25. The siting position is such that the under-chassis covers may be removed and the under-chassis inspected whilst the chassis is in position. The valves cannot be removed unless either the chassis or the receiver unit Type 118 is first removed.

26. The power and output connections of the receiving unit are brought out on an eight-way Jones plug (3P3) fitted to a bracket along the left-side flange. The plug lies beneath the chassis when

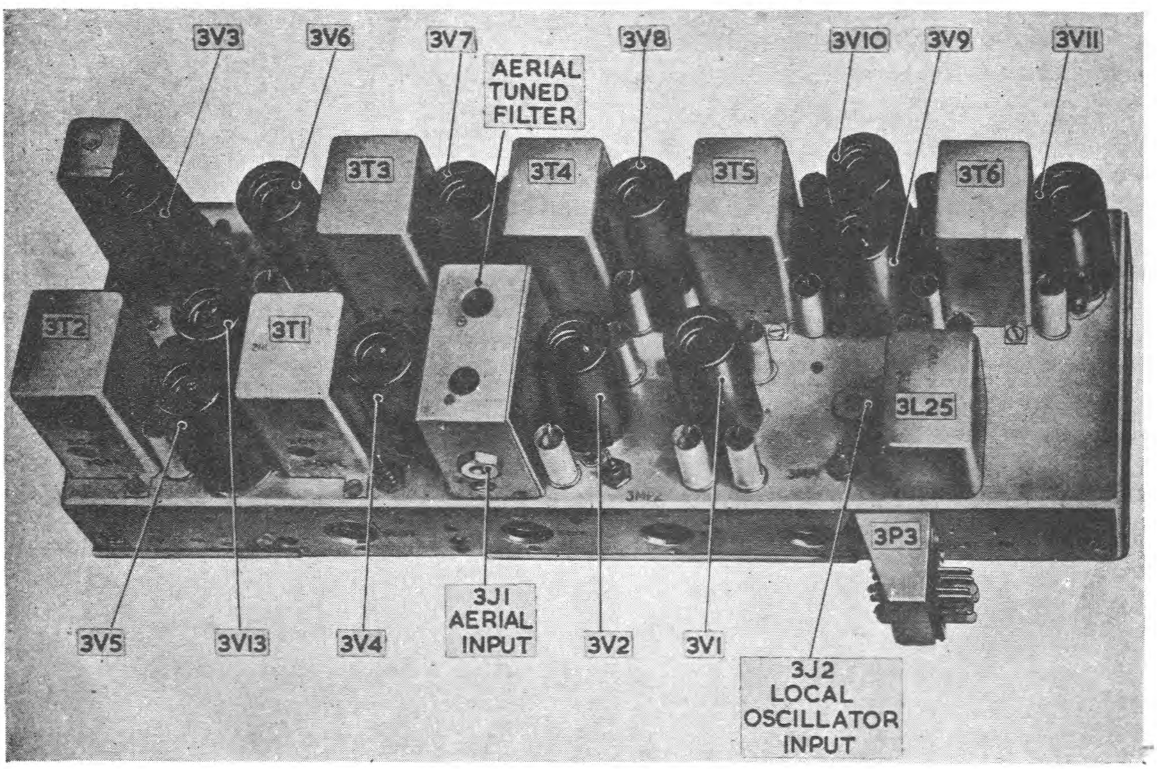


Fig. 4. Receiver unit Type 117

the unit is sited on the LF unit, and it mates with the socket (1J3) mounted behind the indicator presets. A coaxial socket (3J1) on the side of the aerial filter unit (on the top deck of the chassis) is the input point for 1P1 carrying the localizer aerial signals, and a second coaxial socket (3J2) on the top of the chassis near the front is the input point for the local oscillator signal on 1P2.

27. The above-deck IF transformers are of generally similar construction, with the two coils of each transformer mounted one above the other, and associated trimmer and fixed tuning capacitors mounted in front of each coil. The screening covers are provided with access holes for screwdriver adjustment of the trimmers, and each cover is earthed by spring strips which are mounted between the base of the coil and the chassis and which are clamped between the sides of the cover and the base when the cover is in position.

28. The below-deck tuning coils are not separately screened except by the partitions forming part of the chassis structure and the detachable underside covers. Their trimmers are integral parts of the coil structures and are found inside the coil formers. One plate of each trimmer is provided by the slug adjustment of the inductance and the other is formed by a silvered-metal lining on the inside of the former. The slug is screwed along a threaded spindle running axially along the centre of the former and connected to one end of the coil. The lining is connected to the other end of the coil.

29. With the slug fully in the former it is completely clear of the lining, and therefore inductance is at a maximum and capacitance at a minimum. As the slug is withdrawn the inductance decreases, and, with a progressively increasing insertion of the slug into the lining, an increasing capacitance is produced.

30. Each of the four formers with this type of tuning (3L1/2, 3L3/4, 3L5/6, 3L11/12) carries two trimmers, one of which is accessible for adjustment through the left-hand flange of the chassis, and the other is accessible through the right-hand flange and the central screening partition.

31. The same sort of tuning principle is used in the rejector circuit 3L33/3C118, also found below the chassis. The capacitor is formed by two metal rings around the end of the coil former. As the inductor tuning slug moves out of the coil from the position of maximum inductance it penetrates the former between the rings and the capacitance increases as the inductance decreases.

32. Two preset controls (3R66, SPEECH VOLUME, and 3R67, MARKER VOLUME) are mounted at the front of the under-chassis. They are normally accessible for adjustment through the front panel of the LF unit. The only under-chassis valve is 3V12, a sub-miniature cold-cathode diode mounted in a spring clip to the left-hand flange of the chassis and connected directly into the wiring.

33. The second local oscillator stage, which includes a plug-in crystal and 3V3, is mounted on a small sub-chassis at the end of the receiving unit. It is designed for easy removal for servicing purposes.

34. Four test points are brought out on insulated metal spills along the sides of the chassis. They provide the following monitoring facilities:—

Ref.	*Electrical position*	*Monitoring function*
3MP1	Across 3R2	Grid current in doubler 3V1
3MP2	Across 3R10	Grid current in doubler 3V2
3MP3	Across 3R23	Diode current in first mixer 3V13
3MP4	Across 3R59	Diode current in detector 3V11

35. Certain groups of components are fitted as sub-assemblies, which, if faulty, must be renewed complete. They are:—

Ref.	*Function*	*Description*	*Stores Ref.*
	Second local oscillator stage	Oscillator unit Type 333	10V/645
3T1,2	First-IF transformers	Inductor unit Type 189	10C/18653

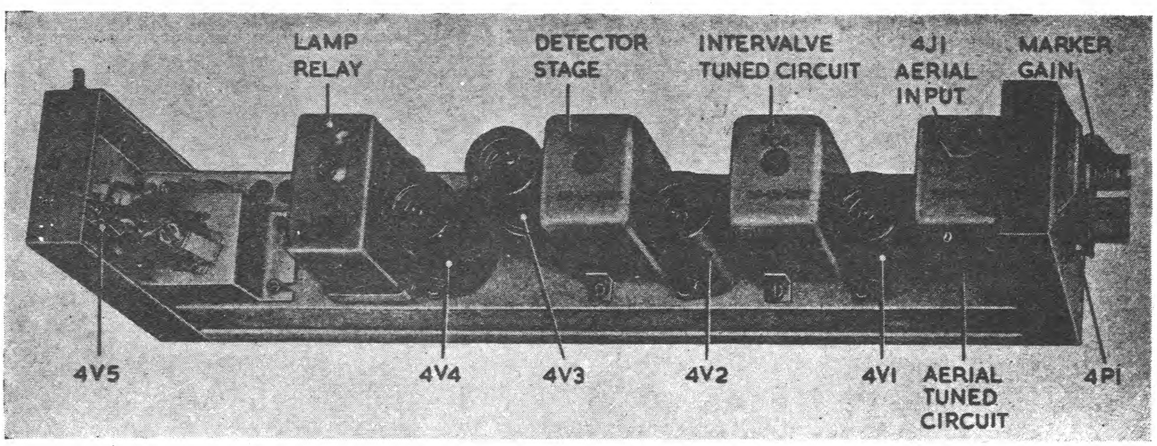


Fig. 5. Receiver unit Type 118

Ref.	Function	Description	Store ref.
3T3 3T4 3T5	Second IF transformers	Type RPT 1415 AA	5950-99-635-2831
3T6	Second IF transformers	Type RPT 1415 AB	5950-99-635-2832
	Aerial input filter	Filter unit Type 392	10P/13188

36 The valves in the receiver unit Type 117 are:-

Ref.	Type	Function	CV No.
3V1	Pentode	First local oscillator doubler	138
3V2	Pentode	First local oscillator doubler	138
3V3	Pentode	Second local oscillator	138
3V4	Pentode	Signal-frequency amplifier	138
3V5	Pentode	First-IF amplifier	454
3V6	Pentode	Second mixer	131
3V7	Pentode	First second-IF amplifier	131
3V8	Pentode	Second second-IF amplifier	131
3V9	Pentode	Fourth second-IF amplifier	138
3V10	Pentode	Third second-IF amplifier	131
3V11	Double diode	Detector and AGC	140
3V12	Cold-cathode gas diode	AGC bias stabilizer	2213
3V13	Double diode	First mixer	140

Receiver unit Type 118

37 The receiver unit Type 118 (fig. 5) is the marker receiver. It consists of a narrow strip-type chassis with flanged end plates, and with a protective screen covering the whole of the underside. The overall dimensions, taking into account all projections, are approximately:-

Length	11·8 in.
Depth	1·8 in.
Height	4·0 in.

38 It is mounted, with the valves vertical, alongside the receiver unit Type 117 at the left-hand side (from the front) of the LF unit Type 4. A sideplate near the front of the LF unit supports the front of the receiver unit, and the rear end plate of the LF unit supports the rear. Red-painted screws set in fixed nuts on the end flanges of the receiver unit hold it in position, and further security is provided by a red-painted captive screw on the rear end plate which secures the end of the unit to the receiver unit Type 117.

39 A preset potentiometer (4R16, MARKER GAIN) is mounted to project forwards from the front end plate; its slotted spindle is accessible as a screwdriver adjustment through a hole, normally protected by a sliding cover, on the front panel of the LF unit. A second preset (4R26) is mounted on the top of the chassis immediately forward of the rear end plate.

40 All the major components are mounted above the chassis. The tuned circuits are in separate screening cans, of which the first contains also the aerial input socket (4J1), and the last the detector circuit components including the germanium crystal-diode rectifier (4MR2). The audio detector valve, a sub-miniature base-less diode, is mounted in a clip on the inside of the rear end plate.

41 The power input point (4P2) is an eight-way Jones plug mounted on the front end plate below the gain control. When the receiver unit is mounted in position on the LF unit, the plug mates with 1J2 on the front panel.

42 The three signal-frequency tuned circuits in their screening cans are fitted as sub-assemblies which must be renewed in their entirety if any part is faulty. They are described as:-

Ref.	Function	Description	Stores Ref.
4L1	Aerial input circuit	Inductor unit Type 184	10C/18641
4L2	Intervalve tuned circuit	Inductor unit Type 185	10C/18642
4L3	Detector stage	Inductor unit Type 186	10C/18643

43 The valves in the receiver unit Type 118 are:-

Ref.	Type	Function	CV No.
4V1	Pentode	Signal-frequency amplifier	138
4V2	Pentode	Signal-frequency amplifier	138
4V3	Pentode	AF amplifier	138
4V4	Pentode	DC amplifier, lamp control	138
4V5	Miniature diode	AF detector	469
4MR2	Crystal diode	Signal-frequency detector	448

Note...

Either of germanium crystal Types 2 x 103G or 2 x 107G are fitted initially, in position 4MRz. All service renewals, however, will be effected with the CV448.

Cover Type 697

44 The cover Type 697 is the outer case, dust cover, and protective screen for the complete localizer/marker receiver. It is of aluminium construction and is finished on the outside with a smooth matt black surface. A captive screw on its rear plate secures it to the back of the LF unit. Louvres in the rear plate provide an exit for air drawn through the receiver by the action of the power unit fan.

RECEIVER TYPES R.1965, R.1965A AND R.1965B

45 The major assemblies used in the construction of the Glidepath receivers Types R.1965, R.1965A and R.1965B are tabulated below.

Description	Unit prefix	R.1965 5826-99-635-2825		R.1965A 10D/19904		R.1965B 5826-99-635-2826	
		Type No.	Ref.	Type No.	Ref.	Type No.	Ref.
LF unit	9	5	10D/17824	5	10D/17824	5A	10D/21529
Receiver unit	8	119	5826-99-635-2825	119	10P/13186	119	5826-99-635-2830
RF unit	10	74	10D/17823	74	10D/17823	74	10D/17823
Power unit	2	797	10K/16691	797	10K/16691	19953	10K/20718
Connector	-	3692	10HA/11383	3692	10HA/11383	3692	10HA/11383
Cover	-	698	10AP/129	698	10AP/129	698	10AP/129

LF unit Type 5

46 The LF unit Type 5 (fig. 7) carries the tone output and main AGC circuits of the glidepath receiver, and forms the mounting frame on which the other units are fitted. Its construction is almost identical with that of the localizer/marker mounting, the LF unit Type 4.

47 As with the LF unit Type 4, the LF unit Type 5 carries the tone filters and rectifiers in sub-assemblies at the rear of the base plate, and indicator presets and the air filter are fitted on the front panel. The 20-way main connector plug (9P1) and the two-way local oscillator input socket (9J4) are fitted on the rear end plate, and the unit-connecting sockets (9J1, 9J2, 9J3) are also on the rear of the front panel.

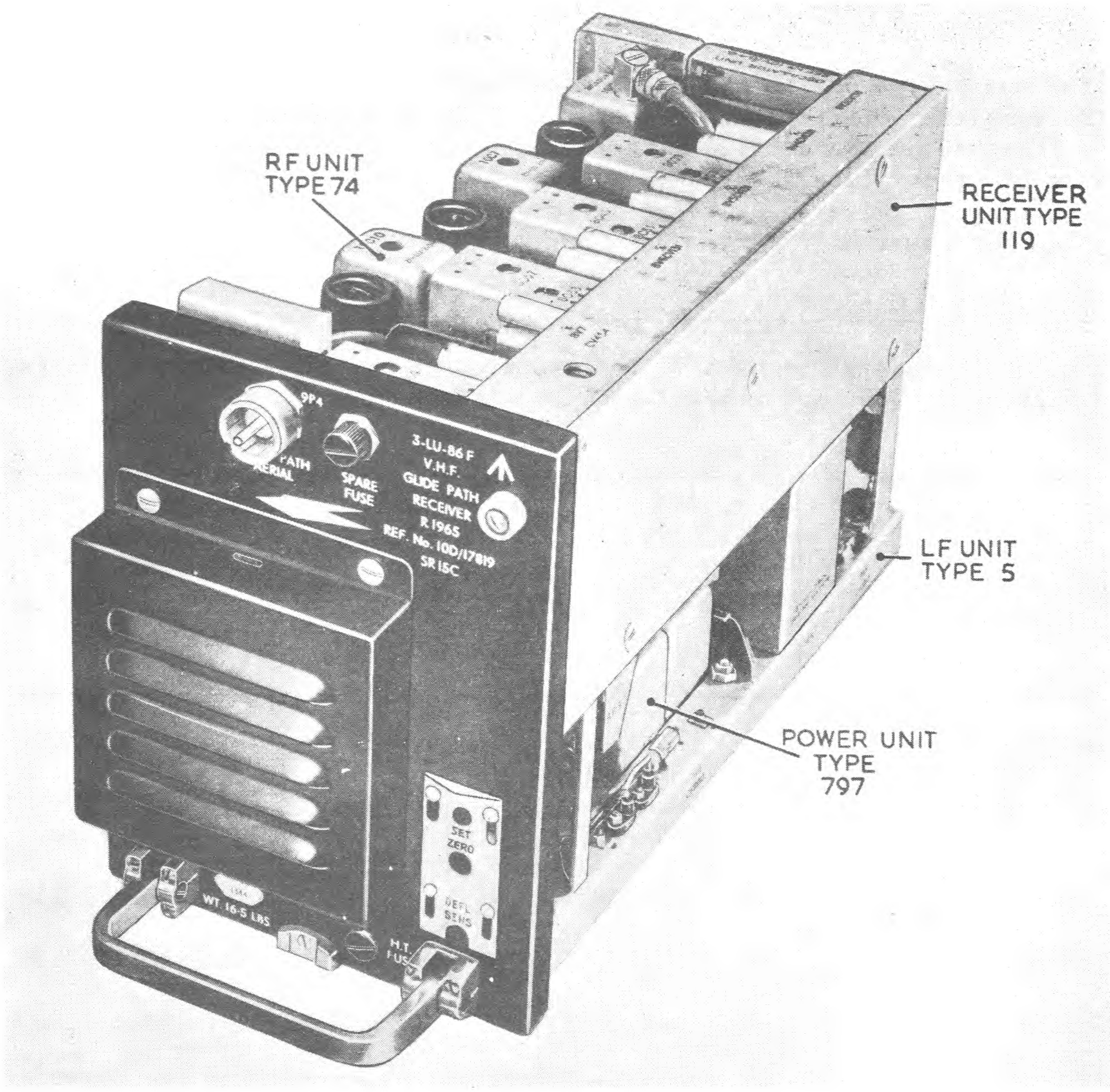


Fig. 6 Receiver Type R.1965

48 Differences lie in the mounting of additional diode valves (9V5, 9V6) in clips along the right-hand side of the base plate, the absence of certain preset access points, and of a second aerial plug on the front panel.

49 The two presets accessible at the front panel are the indicator presets (9R1,9R8) which are fitted behind a sliding cover which can be locked and sealed as described in para. 12. The front panel coaxial connection (9P4) is the glidepath aerial input point; it is connected through a short length of cable to a coaxial plug (9P5) which mates with the aerial input socket (8J1) on the glidepath receiver unit.

50 The power unit Type 797 is identical with that in the R.1964 and occupies the same relative position at the base of the LF unit. The siting of the receiver unit Type 119 and the RF unit Type 74 is the same on the LF unit Type 5 as the corresponding units, receiver unit Type 117 and receiver unit Type 118, in the LF unit Type 4.

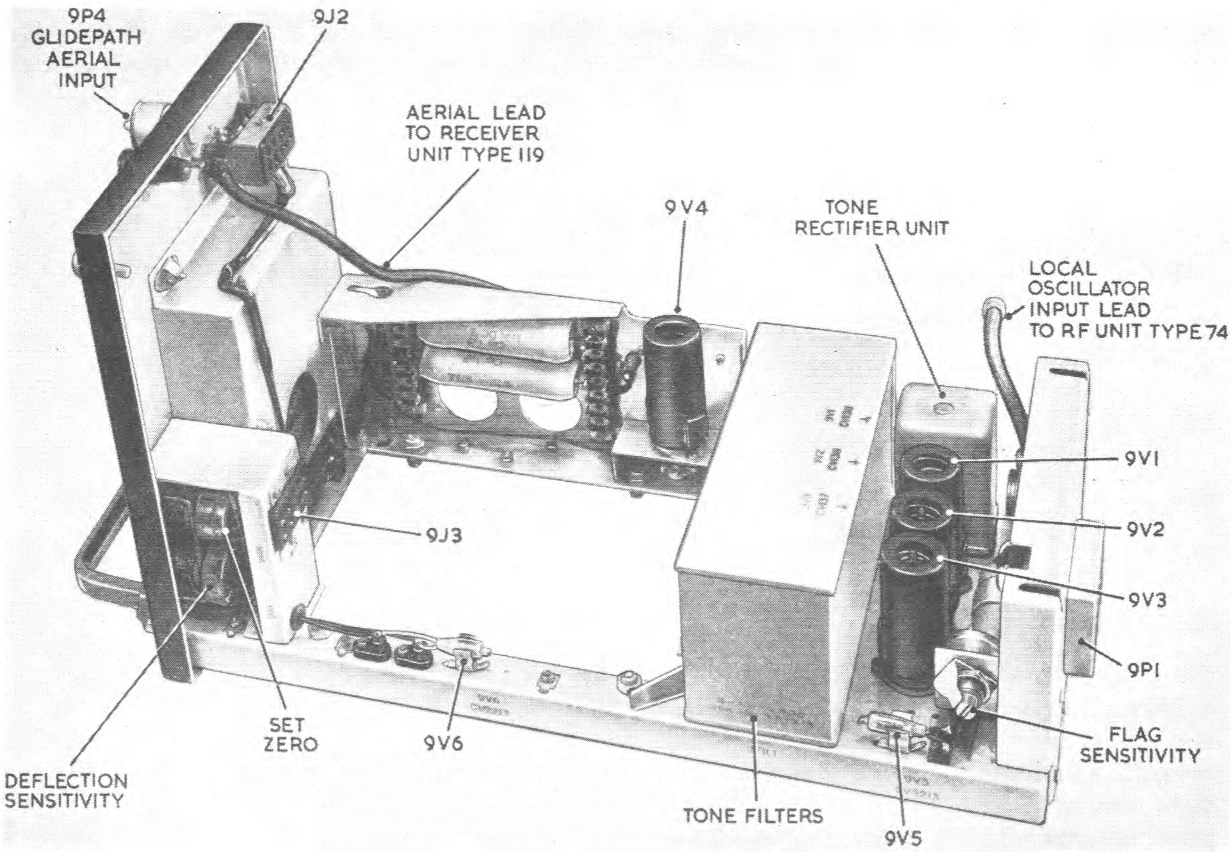


Fig. 7 LF unit Type 5

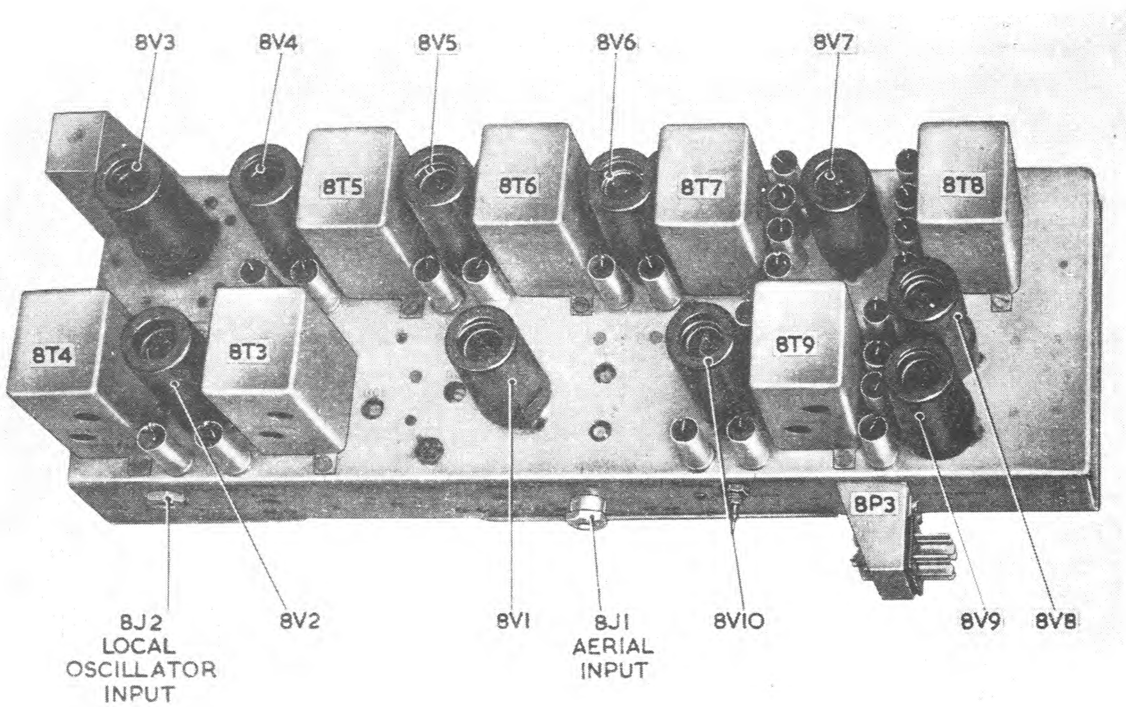


Fig. 8 Receiver unit Type 119

51 The tone output filters and rectifiers in the LF unit Type 5, which are to be renewed in their entirety if faulty, are identical with those detailed in para. 3. The valves are:-

Ref.	Type	Function	CV No.
9V1	Pentode	Tone output	138
9V2	Pentode	Tone output	138
9V3	Diode triode	Tone amplifier and AGC	137
9V4	Double diode	AGC doubler	140
9V5	Cold-cathode gas diode	AGC bias stabilizer	2213
9V6	Cold-cathode gas diode	AGC bias stabilizer	2213

Receiver unit Type 119

52 The receiver unit Type 119 (fig. 8) carries the greater part of the glidepath receiver. It is structurally similar to the receiver unit Type 117 and fits in the same relative position on the LF unit Type 5 as does the Type 117 on the LF unit Type 4. The underside is protected by a main clip-held cover plate and by three smaller local cover plates fitted over the second local oscillator stage, the aerial input stage, and the first mixer stage, respectively.

53 The power and output connections are brought to an eight-way Jones plug (8P3) which is fitted on the side of the chassis, and which mates with 9J3 on the LF unit. The aerial input point is a coaxial socket (8J1) fitted at the centre of the left-hand flange of the chassis (as viewed from the front), and the local oscillator input point (8J2) is a similar coaxial socket fitted further along towards the back of the same flange. Both sockets are underneath the chassis when it is in position on the LF unit.

54 Two test points are brought out on the chassis. They are :-

Ref.	Electrical position	Monitoring function
8MP1	Across 8R5	Current in first mixer 8W1, 8W2
8MP2	Across 8R62	Diode current in detector 8V10

55 The signal-frequency tuned circuits are found under the local screening covers beneath the chassis. Because of the high working frequencies involved they consist of short lengths of silvered wire or, in the instance of the first valve anode coil (8L3) of silvered-metal strip, shaped to form three sides of a rectangle and mounted from the soldering tags of the trimmer capacitor. Low-loss insulating blocks support the coils and space them in pairs as bandpass couplings.

56 The groups of components fitted as sub-assemblies to be replaced if faulty in their entirety are:

Ref.	Description	Nomenclature	Store ref.
8T1	Aerial input transformer	Type 178	10C/18985
8T2	Mixer input transformer	Type 179	10C/18986
8T3	First IF input transformer	Type 193	10C/18657
8T4	First IF output transformer	Type 192	10C/18656
8T5 8T6 8T7 8T8	Second IF transformers	Type RPT 1415AC	5950-99- 635-2833
8T9	Second IF output transformer	Type RPT 1415AD	5950-99- 635-2834
	Second local oscillator stage	Type 334	10V/646

57 The valves in the receiver unit Type 119 are:

Ref.	Type	Function	CV No.
8V1	Triode	Grounded-grid SF-amplifier	417
8V2	Pentode	First-IF amplifier	454
8V3	Pentode	Second local oscillator	138
8V4	Pentode	Second mixer	138
8V5	Pentode	First second-IF amplifier	131
8V6	Pentode	Second second-IF amplifier	131
8V7	Pentode	Third second-IF amplifier	454
8V8	Pentode	Fourth second-IF amplifier	138
8V9	Pentode	Fifth second-IF amplifier	138
8V10	Double diode	Detector and guard AGC	140
8W1	Crystal diode	First mixer	448
8W2	Crystal diode	First mixer	448

Note...

The germanium crystal 2 x 103G is fitted initially in positions 8W1 and 8W2, but all service renewals will be carried out with CV448.

RF unit Type 74

58. The RF unit Type 74 (*fig.* 9) is the frequency multiplier for the glidepath first local oscillator. It is structurally similar to the receiver unit Type 118 (marker receiver) and fits in the same relative position on the LF unit Type 5 as the Type 118 on the LF unit Type 4. A single cover plate screens the underside.

59. Power connections are made through an eight-way Jones plug (10P1) fitted at the end of the chassis. The coaxial input point (10J1) is at the top of the screening can of the input tuned circuit, which is at the end of the chassis. The coaxial output point (10J2) is fitted on the top of the chassis near the front. The lead carrying the frequency-multiplied output to the glidepath receiver is a separate connector (*item* (5) *of para.* 45) which does not form part of any of the actual units.

60. Test points are brought out at three positions along the left-hand side of the top of the chassis. They are:—

Ref.	*Electrical position*	*Monitoring function*
10MP1	Across 10R2	Grid current in 10V1
10MP2	Across 10R7	Grid current in 10V2
10MP3	Across 10R12	Grid current in 10V3

61. The three main tuned circuits are fully enclosed in screening covers, and are fitted as sub-assemblies which must be replaced in their entirety if faulty. They are:—

Ref.	*Function*	*Description*	*Stores Ref.*
10L1	Input tuned circuit	Inductor unit Type 181	10C/18638
10L2	Amplifier tuned circuit	Inductor unit Type 182	10C/18639
10L3	Trebler tuned circuit	Inductor unit Type 183	10C/18640

62. The final doubler and output tuned circuit is fitted beneath the chassis. It consists of a length of silvered wire bent to form three sides of a rectangle, and supported by its connections to the trimmer (10C15) and by a block of insulating material.

63. The valves in the RF unit Type 74 are:—

Ref.	*Type*	*Function*	*CV No.*
10V1	Pentode	Buffer amplifier	138
10V2	Pentode	Trebler	138
10V3	Pentode	Doubler	138

Cover Type 698

64. The cover Type 698 is the outer case, dust cover, and protective screen for the complete receiver Type R.1965. It is secured to the rear of the LF unit Type 5 by means of a captive screw. The rear of the cover is louvred to provide the exit for air drawn through the receiver by the power unit fan. It differs from the cover on the R.1964 in the positioning of the locating holes in the back; the two covers are therefore not interchangeable.

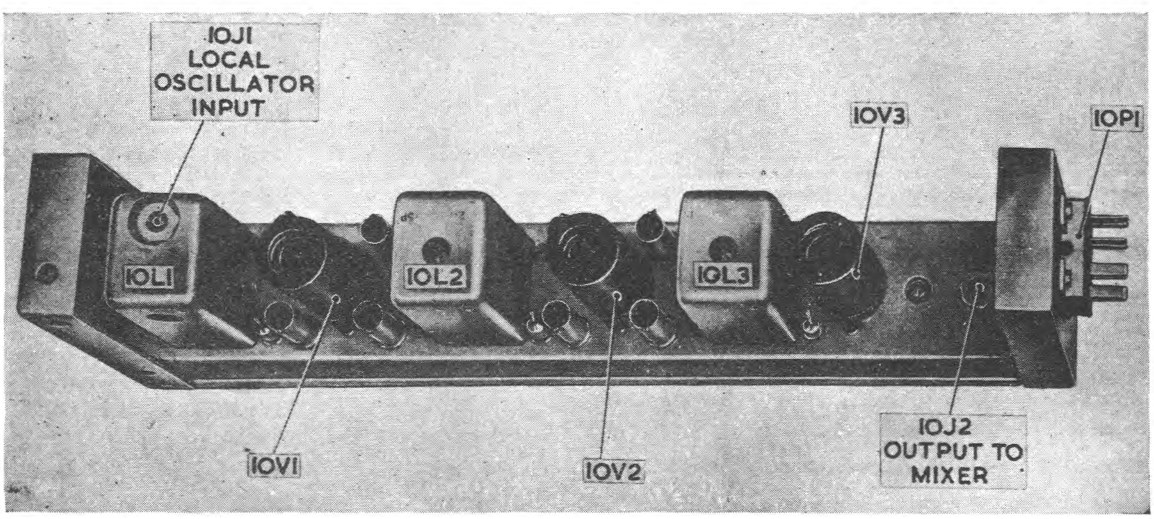


Fig. 9. RF unit Type 74

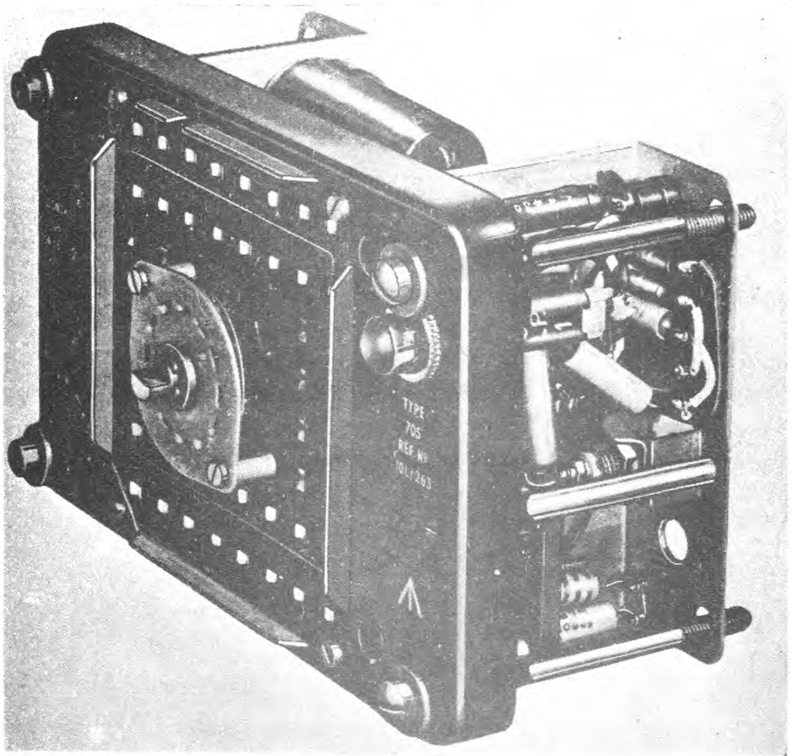


Fig. 10. Control unit Type 705—front view

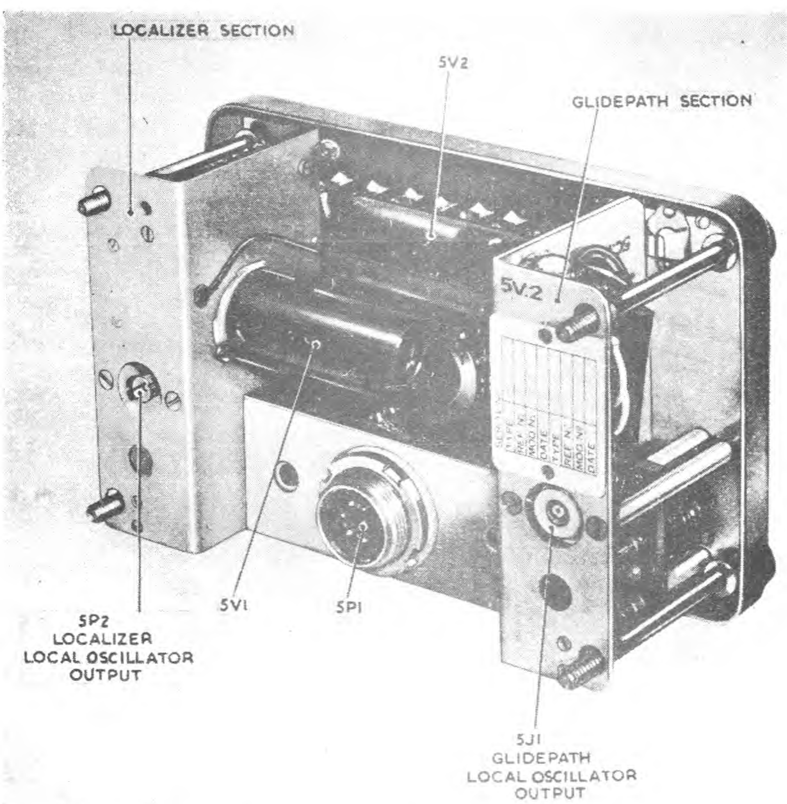


Fig. 11. Control unit Type 705—rear view

CONTROL UNIT TYPE 705

65. The control unit Type 705 (Stores Ref. 10L/263) is a separately mounted item containing the localizer and glidepath receiver local oscillator circuits and the channel selector switch. A general view of the unit is given in Chap. 2, and views of the unit with outer covers removed are shown in fig. 10 and 11.

65. The two oscillator stages are mounted separately on small chassis fitted vertically at the rear of the front panel. The valves lie horizontally across the back of the front panel and above a bracket carrying the six-pole Mk. 4 input power plug (5P1).

67. A coaxial socket (5J1) on the rear of the left-hand chassis (from the front) carries the glidepath local oscillator output. A coaxial plug (5P2) on the rear of the right-hand chassis carries the localizer local oscillator output.

68. The 24 crystals are fitted on a socket panel at the front of the front panel. The crystal selector switch is fitted behind the panel. A cover (cover Type 824, Stores Ref. 10AP/155) fits over the crystals in normal use; the switch control knob, together with a coupling shaft, are integral with the cover. The switch positions are identified by the letters A to L engraved on the front of the cover and filled with an ultraviolet-sensitive fluorescent paint. The crystal cover is held by four Oddie fasteners to the front panel of the control unit.

69. A dust cover (cover Type 822, Stores Ref. 10AP/153) fits over chassis assemblies and is held in position by two Oddie fasteners. The main fixing elements for the control unit are four screws set at the corners of the front panel and extending through the unit and out at the back; they are captive-type screws with heavy rubber washers at the front to provide a degree of resilience in the mounting.

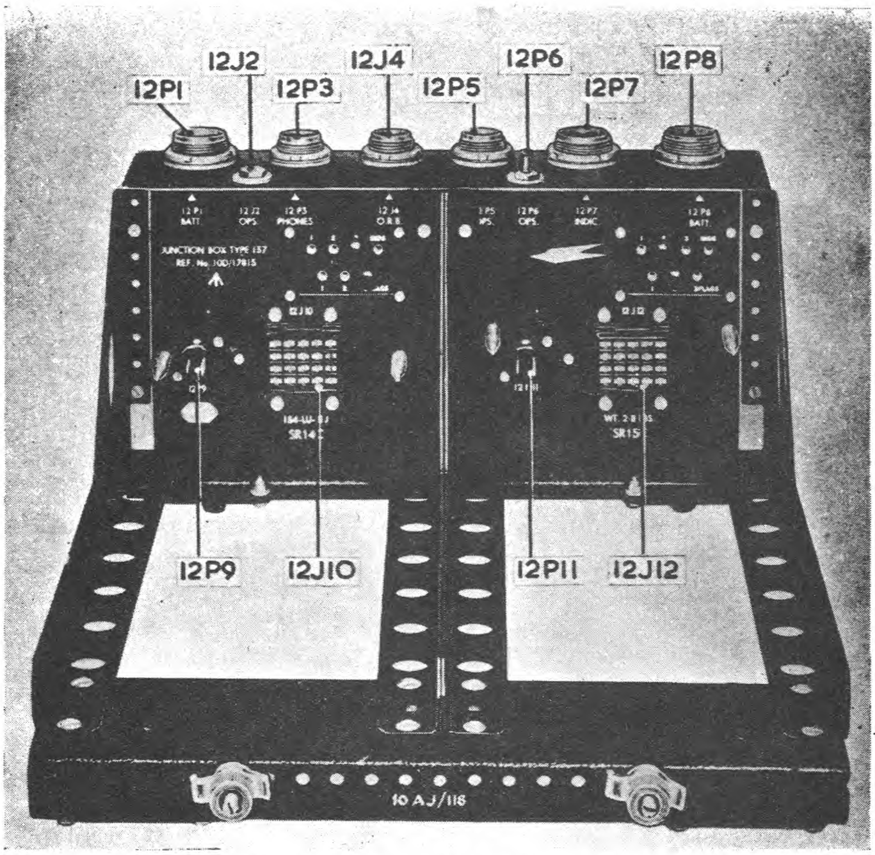


Fig. 12. Junction box Type 157 on mounting

JUNCTION BOXES

70. Four junction boxes may be used in ILS airborne installations. The junction box Type 157 provides for connections to both the R.1964 and the R.1965 when mounted together "side-by-side," and the junction boxes Type 158 and 159 provide separately for the two units otherwise. A junction box Type 164 is used for distribution of the output

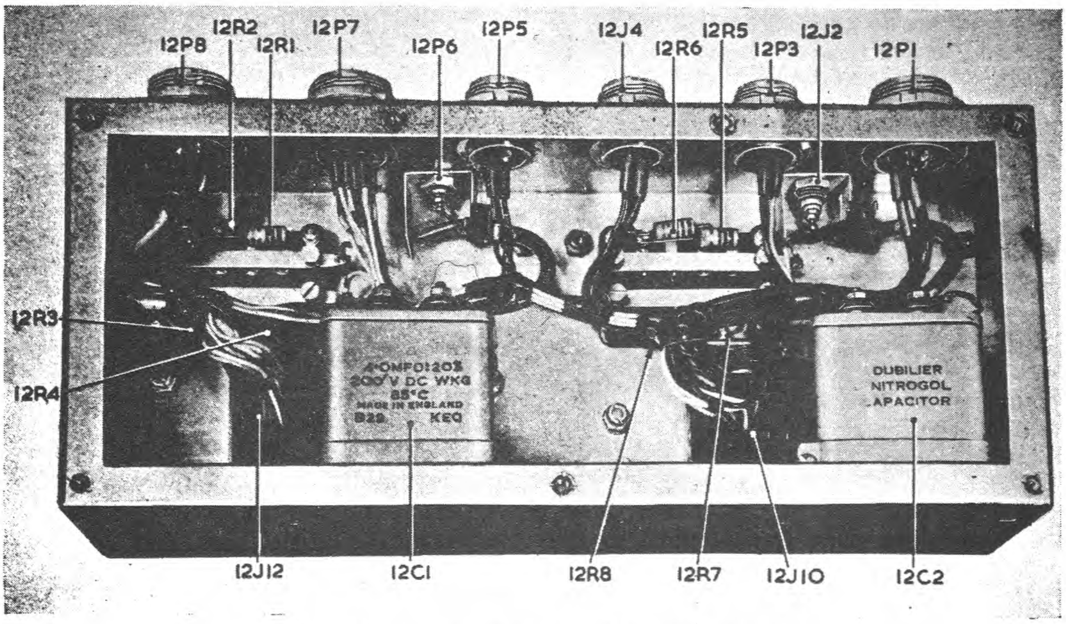


Fig. 13. Junction box Type 157—rear view

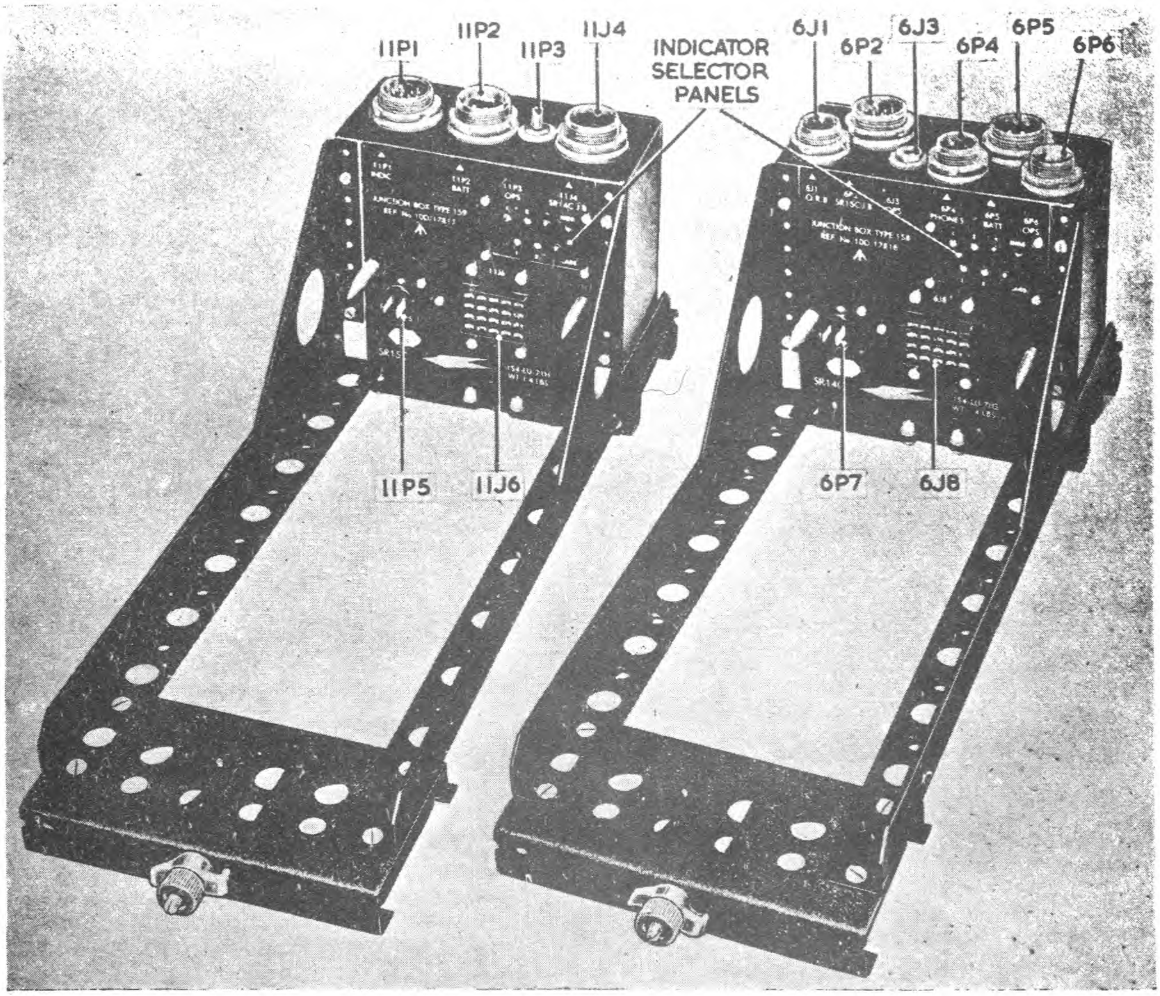


Fig. 14. Junction boxes Type 158 and 159 on mountings

signals to indicators and marker lamps, but in some early installations its functions will be carried out by a twelve-way terminal block.

Junction box Type 157

71. The combined junction box (Type 157, Stores Ref. 10D/17815) is shown in fig. 12 and 13. A 20-way socket (12J10) and a two-pin socket (12J9) at the left-hand side of the front panel provide connections to the R.1964, and a 20-way socket (12J12) and a two-way plug (12P11) at the right-hand side provide connections to the R.1965. Selector panels above the two 20-way plugs provide for the introduction of compensating resistors into the indicator and flag output circuits according to the number of indicators in use.

72. Four locating pins project from the front of the junction box to ensure that the receivers fit exactly to the box, and the plugs and sockets coincide with their counterparts on the receivers. Four Oddie sockets, one above each two-pin plug or socket and one below and to the right of each 20-way socket, provide for the fitting of extension leads between the box and the receivers for testing purposes.

73. The top plate of the junction box carries two four-way Mk. 4 plugs (12P1, 12P8), one six-way Mk. 4 plug (12P5), one six-way Mk. 4 socket (12J4), one 12-way Mk. 4 plug (12P7), one three-way Mk. 4 plug (12P3), a coaxial socket (12J2), and a coaxial plug (12P6). The rear plate may be removed to provide access to the wiring. Two capacitors which are accessible when the cover is removed provide additional smoothing for the HT supplies in the two receivers.

Junction box Type 158

74. The junction box Type 158 (Stores Ref. 10D/17816), which is equivalent to the left-hand section of the combined junction box, provides connections to the R.1964. It is shown in fig. 14 and 15. The only major difference between the facilities provided by this box as compared with the appropriate section of the junction box Type 157 is an additional 12-way Mk. 4 plug (6P2) which is used for interconnections to the R.1965 junction box. Of the other plugs and sockets, 6J1 is equivalent to 12J4, 6J3 to 12J2, 6P4 to 12P3, 6P5 to 12P1, and 6P6 to 12P5.

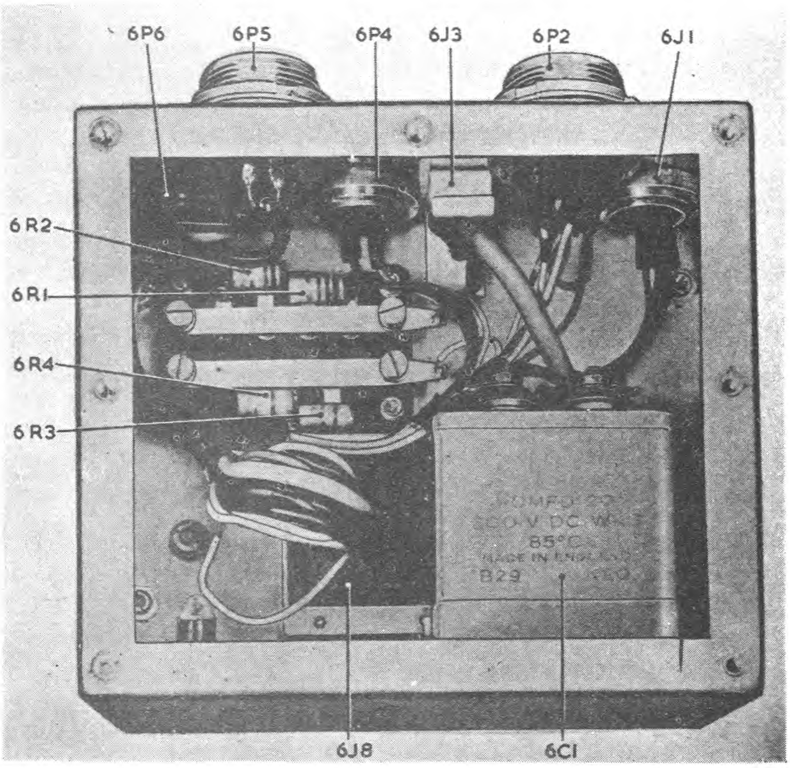


Fig. 15. Junction box Type 158—rear view

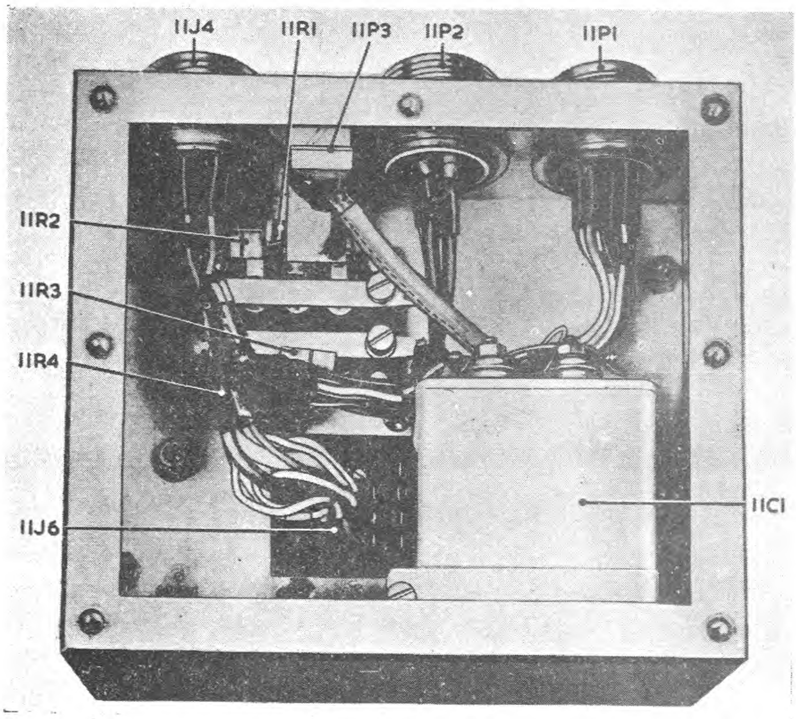


Fig. 16. Junction box Type 159—rear view

Junction box Type 159

75. The junction box Type 159 (Stores Ref. 10D/17817), which is equivalent to the right-hand section of the combined junction box, provides connections to the R.1965. It is shown in fig. 14 and 16. It differs from the appropriate section of the combined junction box only in the additional 12-way socket (11J4) used for interconnections to the R.1964 junction box. Of the other plugs and sockets, 11P1 is equivalent to 12P7, 11P2 to 12P8, and 11P3 to 12P6.

INDICATOR UNIT

76. The ILS signals are displayed on the indicator, electrical, Type 7 (Stores Ref. 10Q/61), a general view of which is shown in Chap. 2. In the simplified exploded view of this unit shown in fig. 17 the general details of its construction can be seen.

77. The two pointers and the two flags are operated by four moving-coil movements set around the edge of a circular mounting plate, with four wedge-shaped magnets providing a complete magnetic circuit between the four sets of pole pieces. A plate behind the movements carries shunt and dropping resistors wound on bobbins.

78. The whole assembly is fitted in a cylindrical cover with complete protection provided by an end cap carrying the input plug, and a front cap ɔw in which the pointers and flags are viewed. Two hermetically sealed zero adjusters on the pointers are fitted at the top left-hand corner of the front cover and are locked by the hollow screws visible from the front.

VOLTAGE REGULATOR

79. The voltage regulator Type 60 (Stores Ref. 5U/5418) is a normal type of carbon pile regulator with an output stabilized at about 19V. A general view is shown in fig. 18. The carbon pile and operating solenoid are mounted above a metal base in which are fitted two resistors. The carbon pile is surrounded by cooling fins. An end cover on the carbon pile protects a pressure adjustment on the pile, and a further preset control of the unit is provided by an adjustable contact on one of the resistors in the base.

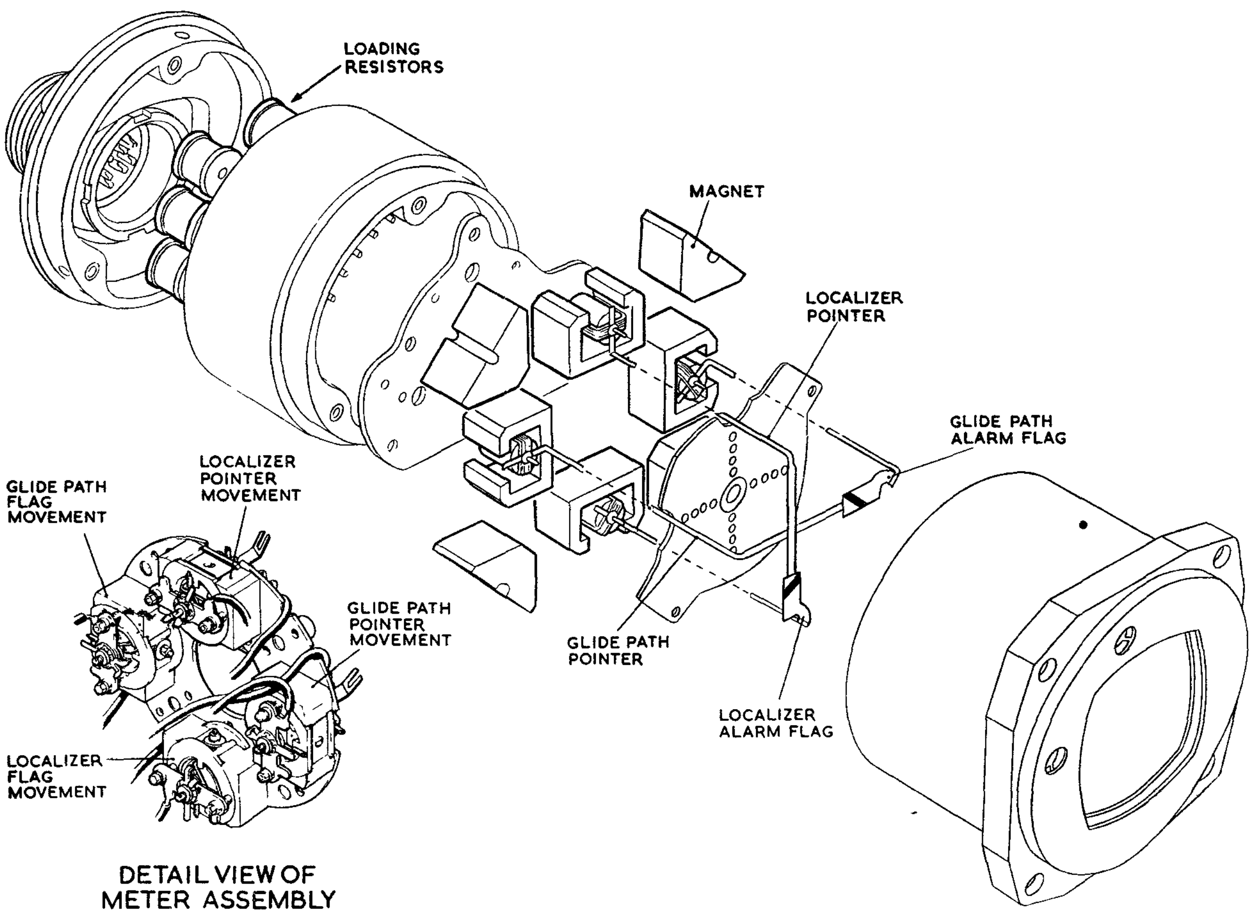


Fig. 17. Exploded view of indicator

TYPICAL INSTALLATIONS

80 Two typical I.L.S. airborne installations are shown in fig. 19. Actual installations will differ in minor detail according to the type of aircraft involved. The basic installations, however, will all conform more or less to those shown in fig. 19, and differences will consist, in the main, of variations in aerial system, connectors, and the number of indicators used.

81 The main items of equipment in I.L.S. installations are shown below. Items 1 to 11 are classed as removable equipment and are normally mounted so as to be readily accessible for removal for servicing purposes; other items which normally are not required to be moved are classed as fixed equipment.

Item	Description	Stores Ref.	Dimensions (in.)	Weight (lb.)
1	Receiver Type R.1964	5826-99-635-2827	5·9 x 14·82 x 7·75	16·5
2	Receiver Type R.1965	5826-99-635-2825	5·9 x 14·76 x 7·85	18
3	Indicator, electrical, Type 7	10Q/61	3·25 x 4·5 x 3·25	1·35
4	Control unit Type 705	10L/263	5·7 x 3·8 x 4·25	1·7
5	Junction box Type 157	10D/17815	12 x 4·01 x 5·62	2·8
6	Junction box Type 158	10D/17816	5·79 x 4·01 x 5·58	1·4
7	Junction box Type 159	10D/17817	5·79 x 4·01 x 5·62	1·4
8	Junction box Type 164	10D/17921	6·8 x 3 x 1·73	
9	Circuit breaker Type A, No. 1	5C/1560		
10	Voltage regulator Type 60	5U/5418		
11	Rotax switch	5C/4184		
12	Aerial system			
13	Terminal blocks, 2-way, Type B	5C/432		0·063
14	Terminal blocks, 3-way, Type B	5C/430		0·094
15	Terminal blocks, 12-way			
16	Lamp, warning, Type B (red)	5C/1553		0·125
17	Mounting Type 932	10AJ/117	6 x 17·25 x 5·05	1·375
18	Mounting Type 933	10AJ/118	12 x 17·25 x 5·05	2·75
19	Support Type 43	10AQ/154	6·9 x 3·4 x 1·25	

82 Dimensions are given in the order: length of front; depth from front to back; height. Except for items 17 and 18 they are overall figures which take into account all projections; for the mountings Type 932 and 933 the height figures refer to the frame of the units only and do not allow for the additional height of the resilient supports.

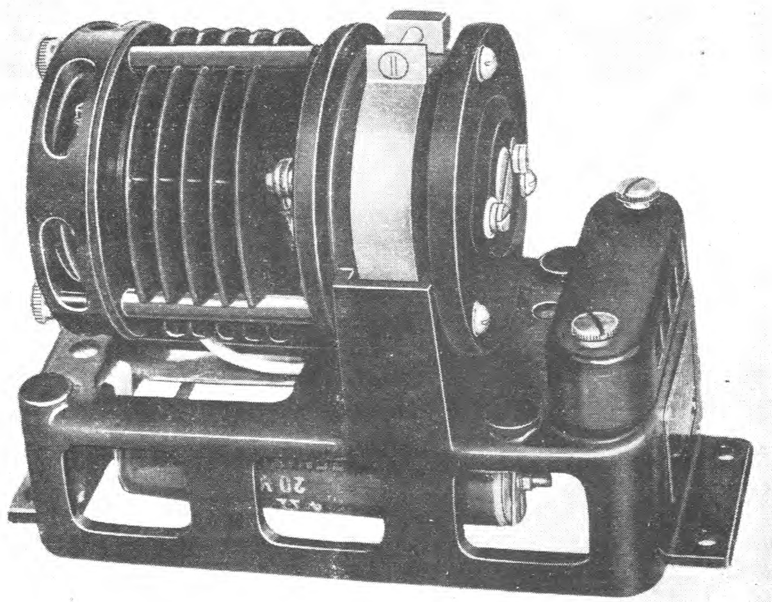


Fig. 18 Voltage regulator Type 60

83 The two receivers (items 1 and 2) are fitted in standard S.B.A.C. -type rack units. Two types of installation are possible; the first has the receivers mounted side-by-side on a double rack (item 18), and the second has the receivers mounted separately and apart each on a single rack (item 17). In the first instance the junction box will be item 5, and in the second case items 6 and 7 for the two receivers items 1 and 2 respectively.

84 The racks are fitted on their resilient mounts to the aircraft structure, and the junction boxes are secured to vertical flanges at the rear of the racks. Each receiver slides into its rack and is positioned accurately by locating pins which project from the front of the junction box; the pins are longer than the projecting parts of the connecting points on the junction box, and they are sited to ensure correct mating between the plugs and sockets at all times with a minimum of danger to plug pins. The spring-loaded carrying handle at the front of each receiver is held by a spring-loaded clamp on the front member of the rack to secure the receiver in the rack.

85 The racks may be sited at any reasonable point in the aircraft subject to the following conditions:-

85.1 They must be horizontal.

85.2 A clearance of at least 5 in. must be left above the junction boxes to permit the plugs and sockets to be removed.

85.3 A clearance of at least 0·5 in. must be left above each receiver to allow full freedom of movement of the rack on the resilient mounts.

85.4 Complete freedom of access must be possible to the front of the receivers with a clearance of at least 5 in. to allow for withdrawal of the aerial sockets.

85.5 Sufficient working space must be available in front of the receivers to permit their removal from the racks.

86 Item 19 is a mounting plate fitted to the aircraft's structure without resilient mountings at any convenient point in the pilot's cockpit. The control unit Type 705 (item 4) is screwed to the mounting by means of the captive screws which are set at the corners of the control unit and extend through the unit and into anchor nuts set in the flanges of the mounting. The design of the control unit and mounting takes account of the clearances required by the connectors, but it is necessary to remove the unit from the mounting before the connectors can be detached.

87 Item 8 is a junction box from which the indicators are fed. A clearance of at least 3·5 in. must be left above the plugs on the top of the box to permit the connectors to be removed. In early installation, particularly those in which only one indicator unit is fitted, a 12-way terminal block of any approved type (item 15) may be used instead of the junction box as a provisional measure.

88 Up to three indicator units (or equivalent devices such as a zero reader) may be used. A unit will normally be fitted for viewing by the pilot, and will be mounted from the rear of the instrument panel; it is held in position by four 4 BA screws which secure into anchor nuts set at the corners of the indicator unit front plate.

89 Compensation is necessary in the output circuits of the receivers if less than the maximum number of indicator units is fitted, and selector panels are fitted on the receiver junction boxes to provide for the necessary adjustments. Each selector panel carries two adjusting screws, one for the indicator pointer circuits (INDS) and one for the alarm flag circuits (FLAGS). If one indicator unit is used, all the adjusting screws are set in the positions marked "1", if two indicators are used the screws are set in the positions marked "2", and if three indicators are used the screws are set to "3". When less than three units are in use, additional compensation must also be provided to complete the alarm flag circuit (all flags are in series), and shorting links fitted in special connectors are provided for each unused output plug on the junction box.

90 The indicator input and output points on the junction box are all 12-way Mk. 4 plugs; the input plug is orientated to position 2, and the plugs for indicators 1 and 2 are set to position 3, and that for the third output (normally to the zero reader) is set to position 4.

Connectors

91 The main services from the receiver junction boxes to the control unit power supplies and indicators are wired with multi-core connectors terminated in Mk. 4 plugs and sockets. Connections carrying RF, such as aerial leads to the fronts of the receivers and the oscillator leads from the control unit to the junction boxes, are made with coaxial cables and coaxial plugs and sockets.

92 The connectors are in all instances service supply items bearing A.M. reference numbers. The length of cable in any particular connector will depend upon the type of aircraft involved, and therefore the Type and Stores Reference numbers of any particular connector will depend upon the type of aircraft.

93 Different types of connectors may be used as between pressurized and non-pressurized aircraft. The differences are dictated by the need for special breaks in connectors passing through certain bulk-heads in the pressurized applications.

94 The basic details of the connectors required in a typical installation are shown in the table at the end of this chapter. It should be noted that where a zero reader or a second indicator are not being used the connectors shown as items 13 and 14 are not required; specially wired sockets however must be fitted in their place in order to maintain the circuit conditions correctly (para. 89). The socket required in place of the zero reader connections is supplied as connector Type 3794 (Stores Rf. 10H/11993), and that supplied for the second indicator connections is connector Type 3793 (Stores Ref. 10H/11992). The sockets differ in their orientations but they are wired similarly, with points J and K and points L and M connected together.

95 The input sockets for the aerial connections to the receivers are quoted as sockets Type 523. These are straight-entry sockets, and where necessary they can be substituted by angle entry sockets, socket Type 628 (Stores Ref. 10H/18588). The type and reference of plugs and sockets at the aerial ends of the aerial connectors depend upon the type of installation, and details will be found in Chap. 5.

SETTING INDICATOR SELECTOR PANELS

96. The correct circuit conditions for a given number of flight instruments to be served with ILS information will depend upon the number of such instruments and on the settings of four screw-type selector switches on the installation junction box (or boxes). There is one such selector screw associated with each of the four basic outputs from the ILS receivers:—

(1) Localizer pointer

(2) Localizer flag

(3) Glidepath pointer

(4) Glidepath flag.

◀ The localizer screws (1 and 2) are situated on the junction box Types 158 or 158A or the left-hand side of junction box Types 157 or 157A; the glidepath screws are on the junction box Types 159 or 159A or the right-hand side of junction box Types 157 or 157A. The use of the alternative type of junction box is dependent upon the form of the installation. ▶

97. When zero reader and automatic pilot equipment is to be used in an ILS installation, the settings of the screw switches is to be made in ◀ accordance with Table 1. Due to the input ▶ requirements of the two controlled equipments referred to above, the zero reader is to be considered as equivalent to one pair of flag movements only, irrespective of the number of zero reader flight indicators fitted in the installations, whilst the auto pilot is to be considered as the equivalent of one pair of indicator movements only. The settings of the screw switches are to be made accordingly.

98. The screw switches are accessible on removal of the receivers from their mounting trays. To set up one of the screw switches, the relevant black-headed screw should be removed by hand and inserted in the hole whose number corresponds with the number of "instruments" (as indicated in ◀ Table 1) of the installation. It is to be noted ▶ that the holes adjacent to the engraving INDS on the junction boxes are not threaded to accept the screws and cannot therefore be used for setting up the output circuits.

Note . . .

Only one screw may be inserted in any one group of holes (e.g. Localizer panel FLAGS 1, 2, 3 *may contain only one screw and this must be in the appropriate position).*

◀ TABLE 1 ▶

Positions of screw switches on ILS junction boxes

Equipment in installation			Screw positions on JB*	
Indicators (ILS)	Zero reader	Auto pilot	INDS	FLAGS
1	—	—	1	1
2	—	—	2	2
3	—	—	3	3
1	1	—	1	2
2	1	—	2	3
1	—	1	2	1
2	—	1	3	2
1	1	1	2	2
2	1	1	3	3

*This applies to both localizer and glidepath switch panels.

TABLE 2

Details of typical connector set

Ref. on figs. 19 and 20	Type of cable	End A				End B			
		Connection point	Termination	Reference	Orientation	Connection point	Termination	Reference	Orientation
1	Twelvevin-metsmall 2·5	12P7 on JB.157 or JB.157A or 11P1 on JB.159 or JB.159A	Socket, 12-way Mk.4	Z.560180	0	13P1 on JB.164	Socket, 12-way Mk.4	Z.560182	2
2	Quadravinmet 16	12P1 on JB.157 or JB.157A or 6P5 on JB.158 or JB.158A	Socket, 4-way Mk.4	Z.560160	0	Power supply			
3	Duvinmetsmall 2·5	12P3 on JB.157 or JB.157A or 6P4 on JB.158 or JB.158A	Socket, 3-way Mk.4	Z.560100	0	Telephones			
4	Sextovin-metsmall 2·5	12P5 on JB.157 or JB.157A or 6P6 on JB.158 or JB.158A	Socket, 6-way, Mk.4	Z.560120	0	5P1 on control unit unit	Socket, 6-way, Mk.4	Z.560120	0
5	Quadravinmet 16	12P8 on JB.157 or JB.157A or 11P2 on JB.159 or JB.159A	Socket, 4-way, Mk.4	Z.560160	0	Power supply			
6	Uniradio 43 (5E/2243)	12J2 on JB.157 or JB.157A or 6J3 on JB.158 or JB.158A	Plug, Type 774	10H/19663	—	5P2 on control unit	Socket, Type 720	10H/19661	—
7	Uniradio 43 (5E/2243)	12P6 on JB.157 or JB.157A or 11P3 on JB.159 or JB.159A	Socket, Type 720	10H/19661	—	5J1 on control unit	Plug, Type 774	10H/19663	—
8	Uniradio 67	Marker aerial				1P4 on R.1964 or R1964B	Socket, Type 523	10H/3931	—
9	Uniradio 67	Localizer aerial				1P5 on R.1964 or R1964B	Socket Type 523	10H/3931	—

TABLE 2 (Continued)

Ref. on figs. 19 and 20	Type of cable	End A				End B			
		Connection point	Termination	Reference	Orientation	Connection point	Termination	Reference	Orientation
10	Uniradio 67	Glidepath aerial				9P4 on R.1965 or R1965B	Socket, Type 523	10H/3931	—
11	Twelvevin-metsmall 2·5	13P2 on JB.164	Socket, 12-way, Mk.4	Z.560183	3	Indicator unit	Socket, 12-way, Mk.4	Z.560180	0
12	Duvin-metsmall 2·5	13P5 on JB.164	Socket, 2-way, Mk.4	Z.560090	0	Marker lamp			
13	Twelvevin-metsmall 2·5	13P4 on JB.164	Socket, 12-way, Mk.4	Z.560184	4	Zero reader			
or 13A	—	13P4 on JB.164	Connector, Type 3794	10H/11993	4	—	—	—	
14	Twelvevin-metsmall 2·5	13P3 on JB.164	Socket, 12-way, Mk.4	Z.560183	3	Second indicator	Socket, 12-way, Mk.4	Z.560180	0
or 14A	—	13P3 on JB.164	Connector, Type 3793	10H/11992	3	—	—	—	
15	Twelvevin-metsmall 2·5	6P2 on JB.158 or JB.158A	Socket, 12-way	Z.560183	3	11J4 on JB.159 or JB.159A	Plug, 12-way	Z.560363	0
16	Quadravin-metsmall 2·5	6P1 on JB.158A or 12P4 on JB.157A	Socket, 4-way			Power supply for Plasteck lighting			
	Cable duvin 19	General wiring							

Note . . .

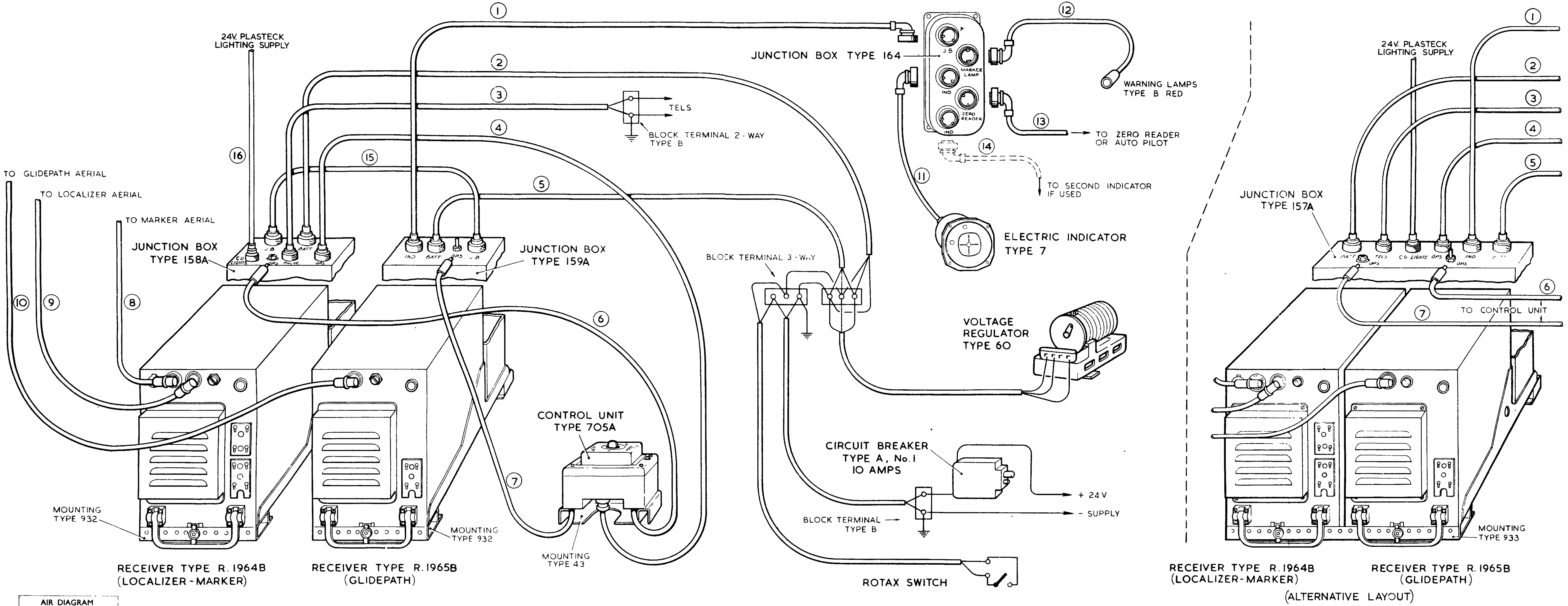
Items 13A and 14A are short circuit links for insertion in JB.164 when "zero-reader" or "second indicator" are out of circuit.

DETAILS OF TYPICAL CONNECTOR SET

Ref. on fig. 19	Type of cable	End A				End B			
		Connection point	Termination	Reference	Orientation	Connection point	Termination	Reference	Orientation
1	Twelvevin-metsmall 2·5	12P7 on JB.157 or 11P1 on JB.159	Socket, 12-way Mk.4	Z.560180	0	13P1 on JB.164	Socket, 12-way Mk 4	Z 560182	2
2	Quadravin-met 16	12P1 on JB.157 or 6P5 on JB.158	Socket, 4-way Mk.4	Z.560160	0	Power supply			
3	Duvin-metsmall 2·5	12P3 on JB.157 or 6P4 on JB.158	Socket, 3-way Mk.4	Z.560100	0	Telephones			
4	Sextovin-metsmall 2·5	12P5 on JB.157 *or* 6P6 on JB.158	Socket, 6-way, Mk.4	Z.560120	0	5P1 on control unit	Socket, 6-way, Mk.4	Z 560120	0
5	Quadravin-met 16	12P8 on JB.157 *or* 11P2 on JB.159	Socket, 4-way, Mk.4	Z.560160	0	Power supply			
6	Uniradio 43 (5E/2243)	12P6 on JB.157 *or* 11P3 on JB.159	Socket, Type 720	10H/19661		5P2 on control unit	Plug, Type 774	10H/19663	
7	Uniradio 43 (5E/2243)	12J2 on JB.157 *or* 6J3 on JB.158	Plug, Type 774	10H/19663		5J1 on control unit	Socket, Type 720	10H/19661	
8	Uniradio 67	Marker aerial				1P4 on R.1964	Socket, Type 523	10H/3931	
9	Uniradio 67	Localizer aerial				1P5 on R. 1964	Socket, Type 523	10H/3931	
10	Uniradio 67	Glidepath aerial				9P4 on R.1965	Socket, Type 523	10H/3931	
11	Twelvevin-metsmall 2·5	13P2 on JB.164	Socket, 12-way, Mk.4	Z.560183	3	Indicator unit	Socket, 12-way, Mk.4	Z.560180	0
12	Duvin-metsmall 2·5	13P5 on JB.164	Socket, 2-way, Mk.4	Z.560090	0	Marker lamp			
13	Twelvevin-metsmall 2·5	13P4 on JB.164	Socket, 12-way, Mk.4	Z.560184	4	Zero reader			
or 13A	—	13P4 on JB.164	Connector, Type 3794	10H/11993	4	—	—	—	
14	Twelvevin-metsmall 2·5	13P3 on JB.164	Socket, 12-way, Mk.4	Z.560183	3	Second indicator	Socket, 12-way Mk.4	Z 560180	0
or 14A	—	13P3 on JB.164	Connector, Type 3793	10H/11992	3	—	—	—	
15	Twelvevin-metsmall 2·5	6P2 on JB.158	Socket, 12-way	Z.560183	3	11J4 on JB 159	Plug, 12-way	Z 560363	0

Cable duvin 19 General wiring

Note.—Items 13A and 14A are short circuit links for insertion in JB.164 when "zero reader" or "second indicator" are out of circuit



I.L.S. Airborne installation — A R I. 18011 (later equipments)

Fig. 20.

AIR DIAGRAM
6121W/MIN.
ISSUE 1
PREPARED BY MINISTRY OF AVIATION FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

2066 281337 3430 5/63 VB 925/1

Chapter 5

AERIAL SYSTEMS

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Three aerials are required in an ILS airborne installation, one for each of the localizer, glidepath and marker receivers. For low-speed aircraft the localizer and glidepath aerials are combined in a single unit, aerial, aircraft, Type 236, and a further unit, aerial, aircraft, Type 243, is supplied for marker reception. For high speed aircraft, separate suppressed aerials, Types 238 and 239 are available for glidepath and localizer reception, and a further suppressed aerial, Type 237, is supplied for marker operation.

Aerial, aircraft, Type 236

2. The non-suppressed localizer-glidepath aerial Type 236 (*Ref. No.* 10*B*/16705) is illustrated in fig. 1 and details of its construction appear in fig. 2. The body of the unit is a streamlined metal tube supporting the aerial assembly at the top. A horizontal dipole at the front consisting of two 9in. long circular rods is the glidepath aerial, and a swept-back aerial at the rear consisting of two 27 in. blades is the localizer aerial. An insulated moulding isolates the rods from the metal body.

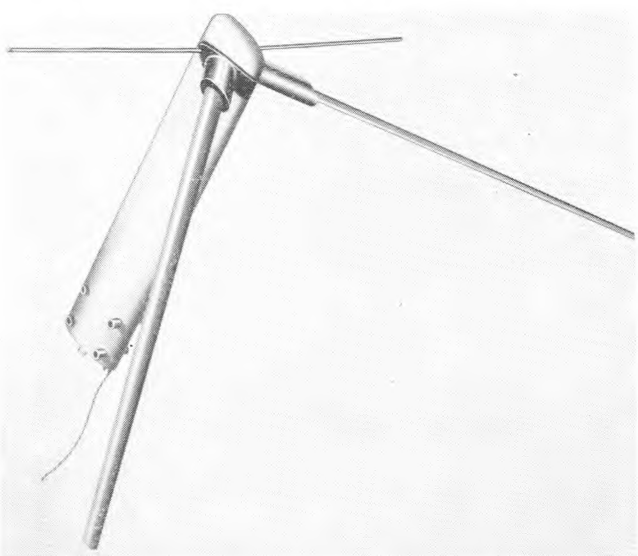


Fig. 1. Aerial, aircraft, Type 236

3. The aerial will normally be mounted on the centre line of the aircraft at the forward end, preferably on the underside, with its field of reception unrestricted both fore and aft. Other aerials (particularly v.h.f. types) and propellers must not be too near or the fore and aft field pattern of the localizer aerial, in particular, will be distorted. Four bushes, which extend through the lower end of the tube, provide for fixing the aerial to the aircraft structure.

4. A coaxial plug on the underside of the lower end of the supporting tube provides the output point of the localizer aerial, and an adjacent socket is the output point for the glidepath aerial. The metal frame of the aerial is earthed to the aircraft frame by a bonding pigtail clamped on the underside.

5. ◀Internal connections within the aerial body consist of a coaxial tube extending between the plug and the localizer aerial. A second tube, the (aerial rod) end of which is split, extends between the socket and the glidepath aerial. The starboard glidepath rod is connected to one half of the split outer tube, the starboard localizer coaxial tube. The port glidepath rod is connected to the other half of the split outer tube and also to the coaxial central conductor. The port localizer rod is connected to the outer of the localizer tube.▶

6. ◀The effective circuit of the localizer-glidepath aerial is shown in fig. 3: (a) shows the method of connection, (b) shows the effective circuit at radio frequencies. From (a) it will be seen that the distance from the aerials to the earth plate forming the base of the aerial assembly is a quarter-wavelength at the localizer frequency, so that the outer of the coaxial feed to the glidepath aerial, together with the outer of the feed to the localizer aerial, forms a quarter-wave stub, shorted by the base, across the localizer aerial. For the glidepath frequency, the split in the outer tube is $\lambda/4$

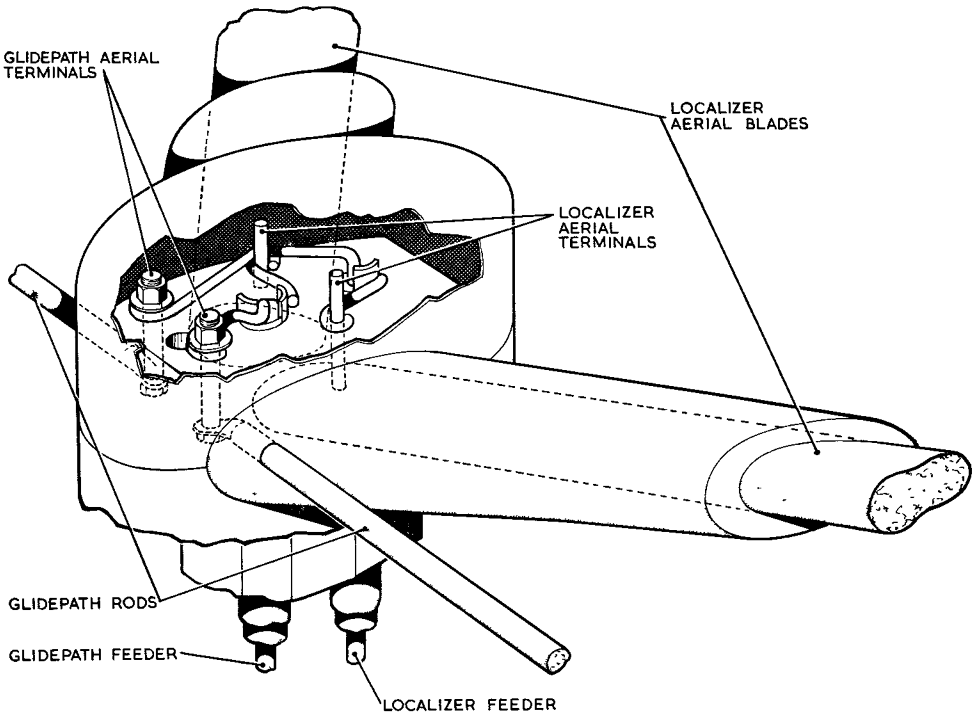


Fig. 2. Construction of localizer-glidepath aerial

long. The two sides of the split tube form a quarter-wave stub short-circuited by the tube at the point where the split ends.

7. The effective circuit as shown in (b) of fig. 3 is, in each instance, that of an aerial shunted by a quarter-wave stub. This is known as a Pawsey stub (*A.P.* 1093*E, Chap.* 4). The purpose of the stub is to improve the aerial matching over the frequency range and thereby extend the aerial bandwith.

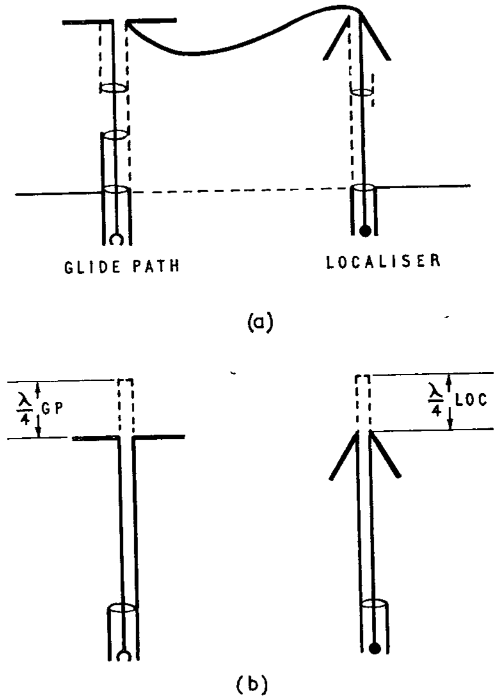


Fig. 3. Effective circuits of localizer-glidepath aerial

Note . . .
When this aerial was designed the intended operating band extended from 108 *Mc/s to* 118 *Mc/s.*

8. In operation, both aerial and stub are resonant at the centre frequency and the stub is effectively an open circuit. At all other frequencies the stub has a reactance of the opposite sign to that of the aerial and, over the range concerned, is of value such as to cancel out the reactance of the aerial. The aerial, therefore, presents a resistance loading to the feeder connection with a consequent improvement in the standing-wave ratio and a reduction of feeder losses.

9. This arrangement connects all the aerial rods and feeders directly to the aircraft frame as far as direct current is concerned and so prevents static charges from accumulating.

Aerial, aircraft, Type 243

10. The non-suppressed marker aerial Type 243 (*Ref. No.* 10*B*/16717) is illustrated in fig. 4. Two unequal lengths of stainless steel wire are connected together at a T-junction and their outer ends are secured through Tufnol blocks to securing hooks; one length (X) is $32\frac{1}{2}$ in. in length, the other is 38 in. The T-junction provides the aerial connection through a short rod to a standard type of v.h.f. aerial bollard.

11. The aerial is mounted beneath the underside of the aircraft along the centre line. Posts or brackets forming part of the aircraft structure support the two hooks at the ends and the rod of the bollard protrudes downwards through the aircraft skin to support the wire along its length.

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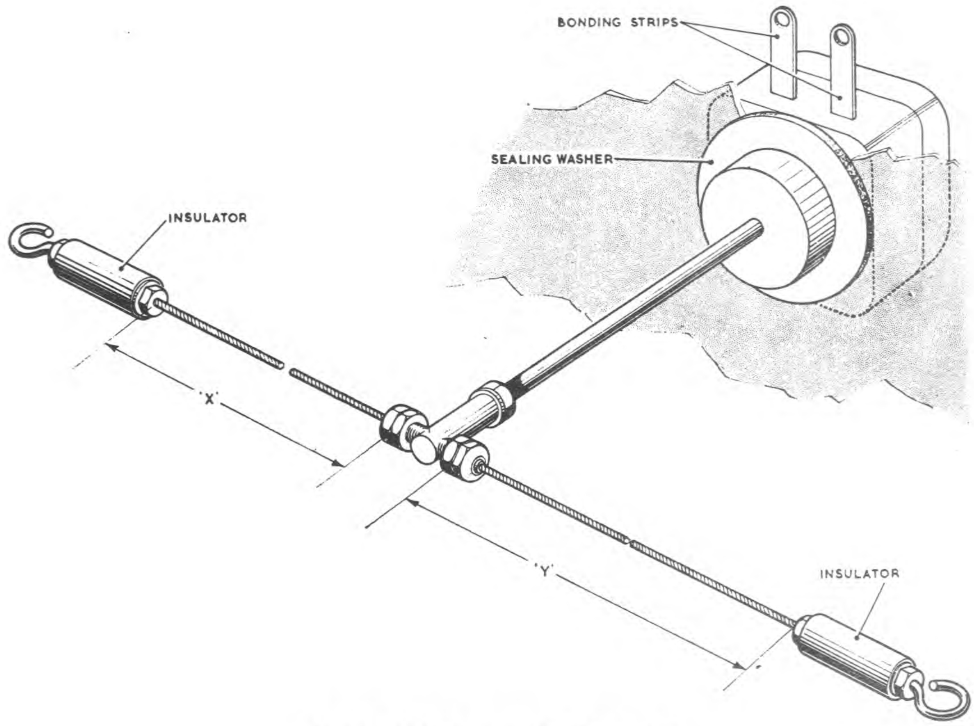

Fig. 4. Aerial, aircraft, Type 243

The wire is held taut about 6 in. away from and parallel to the aircraft skin. Either end of the aerial may be fitted nearest the nose, that is, the long or the short section may be foremost without altering the reception properties.

12. Inside the bollard the screwed end of the rod provides a connection point to which the inner of the coaxial cable to the receiver is secured. The outer screening of the cable is clamped at the cable entry point and is connected through two bonding strips to the aircraft frame.

13. The essential features of the aerial are shown in fig. 5. The two lengths of wire, together with the T-junction, form a continuous conductor of electrical length equal to half a wavelength. The point of connection through the T-junction is approximately 3 in. from the centre of the system so that the aerial operates as an off-centre-fed dipole or Windom aerial.

14. The position of the connection point ensures that the aerial is a correctly terminated load on the coaxial cable and that the losses in the feeder are minimized. The actual position is fixed in manufacture and adjustments are not necessary.

15. It should be noted that the particular method of connection does not produce better results than a normal centre-fed dipole, but is justified on the following grounds: —

(1) The closeness of the aerial to the effective earth formed by the underside of the aircraft greatly reduces the impedance of the aerial, so that a centre-connection could not readily be matched to standard feeder cable.

(2) By tapping along the length a voltage feed is obtained so that the wire does not have to be broken electrically (as it would for a centre, current, feed) and a more substantial mechanical design is possible.

Aerial, aircraft, Type 237

16. The suppressed marker aerial Type 237 (Stores Ref. 10B/16706) is illustrated in fig. 6 and 7. A shaped strip of silvered metal, 9 in.

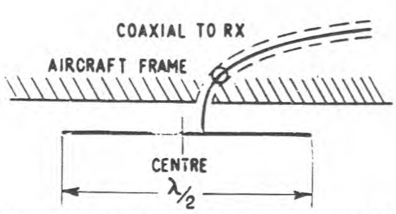

Fig. 5. Circuit of wire marker aerial

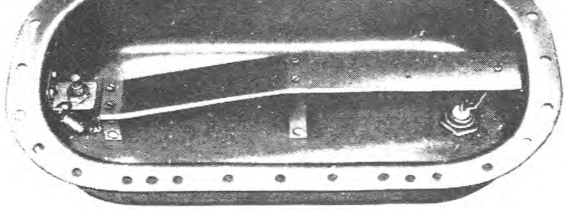

Fig. 6. Aerial, aircraft, Type 237

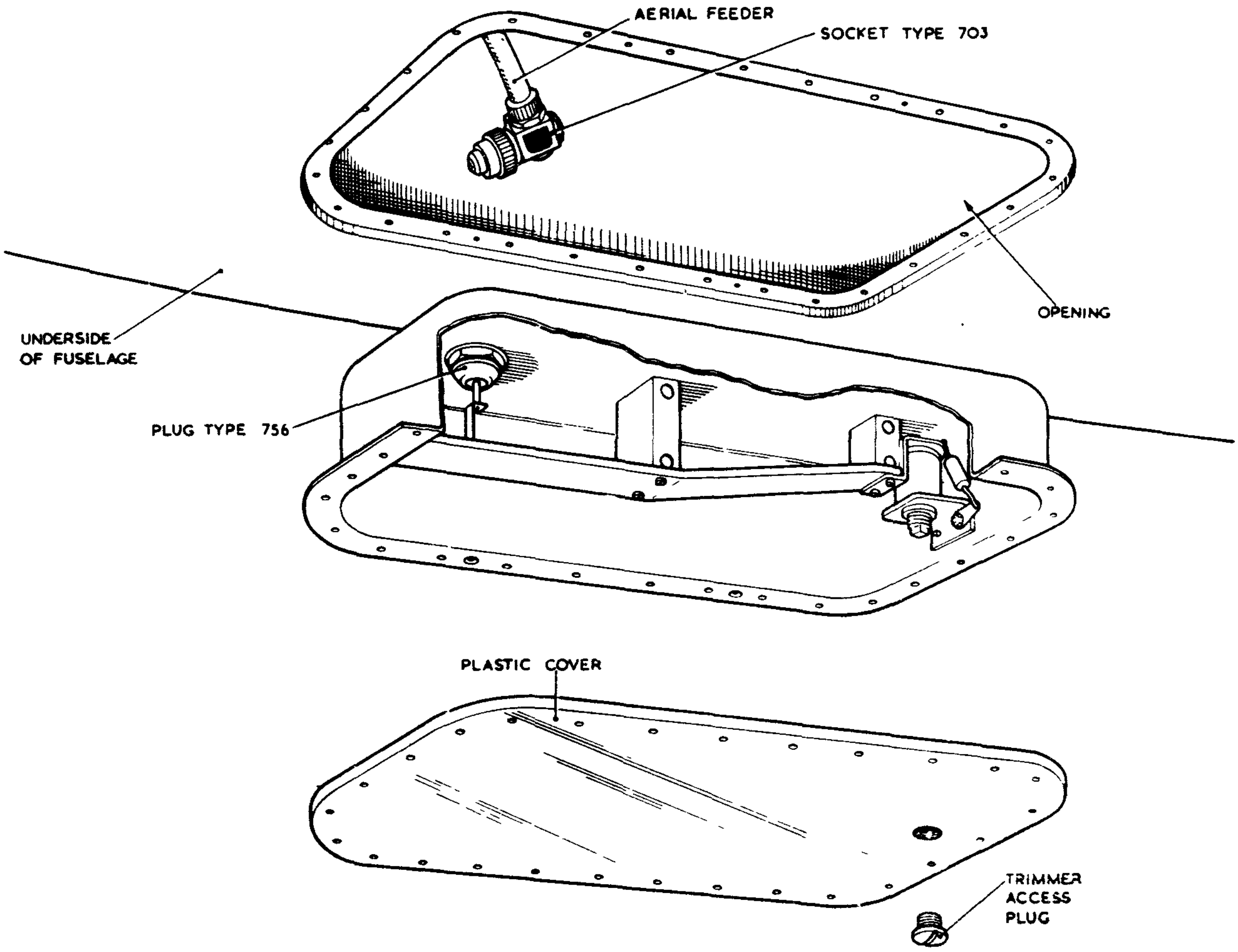

Fig. 7. Installation of suppressed marker aerial

in length, is mounted in a shallow metal dish, with one end connected physically to one side of the dish and the other end connected through a loading capacitance to the other side. The feed-off point is taken from the strip at a distance $\frac{13}{16}$ in. from the earthed end and is connected to a coaxial plug fitted through the dish. Two insulators hold the strip rigidly from the dish.

17. The aerial is required to be installed on the underside of a wing or fuselage of the aircraft with the face of the dish horizontal, and the aerial strip lying fore and aft. Either end of the strip may be foremost. A recess must be provided in the structure to accommodate the dish, and a plastic cover is fitted over the aperture to preserve the aerodynamic properties of the aircraft's surface and to protect the aerial. A screwed plug is fitted in the cover to allow access to a trimmer forming part of the loading capacitance when the cover is in position.

18. The aerial is described by the designer as a shunt-fed, capacity-loaded, shortened unipole; its length is very much shorter than a naturally resonant aerial (a dipole) and it is therefore resonated by the addition of the loading capacitance at the end. To allow for differences in aircraft characteristics which are reflected in the loading of the aerial, part of the capacitance is made preset (*fig.* 8). The tapping point is made to produce a matched termination to the aerial feeder.

19. The aerial is horizontally polarized and its field of reception is mainly vertically downwards, as is required for reception of marker beacons. It operates at the single marker frequency of 75 Mc/s and can be tuned by means of the preset trimmer to resonate exactly at this frequency in each individual aircraft. This adjustment is necessary to ensure an efficiency at the absolute maximum in an effort to compensate for the low pick-up produced because of the shortness of the aerial element.

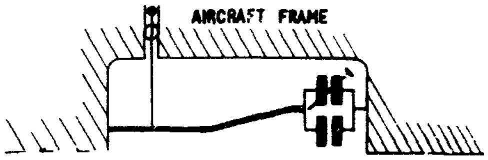

Fig. 8. Circuit of suppressed marker aerial

Chapter 6

TEST RIG (INSTALLATION) TYPE 5

CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The test rig (installation) Type 5 is a bench fitting for use in testing units of ILS airborne equipment (ARI.18011) at second and third lines of servicing. It provides wired-up rack mountings for the two ILS receivers, R.1964, and includes built-in control and test facilities. A general view of the test rig appears in fig. 1.

2. To use the test rig, ILS receivers are fitted in the rack mountings where they form part of a complete installation which can be operated under working conditions. Loose connectors are supplied as part of the test rig to allow the receivers to be operated while detached from the rack, and also to allow sub-units to be operated while detached from the parent assemblies.

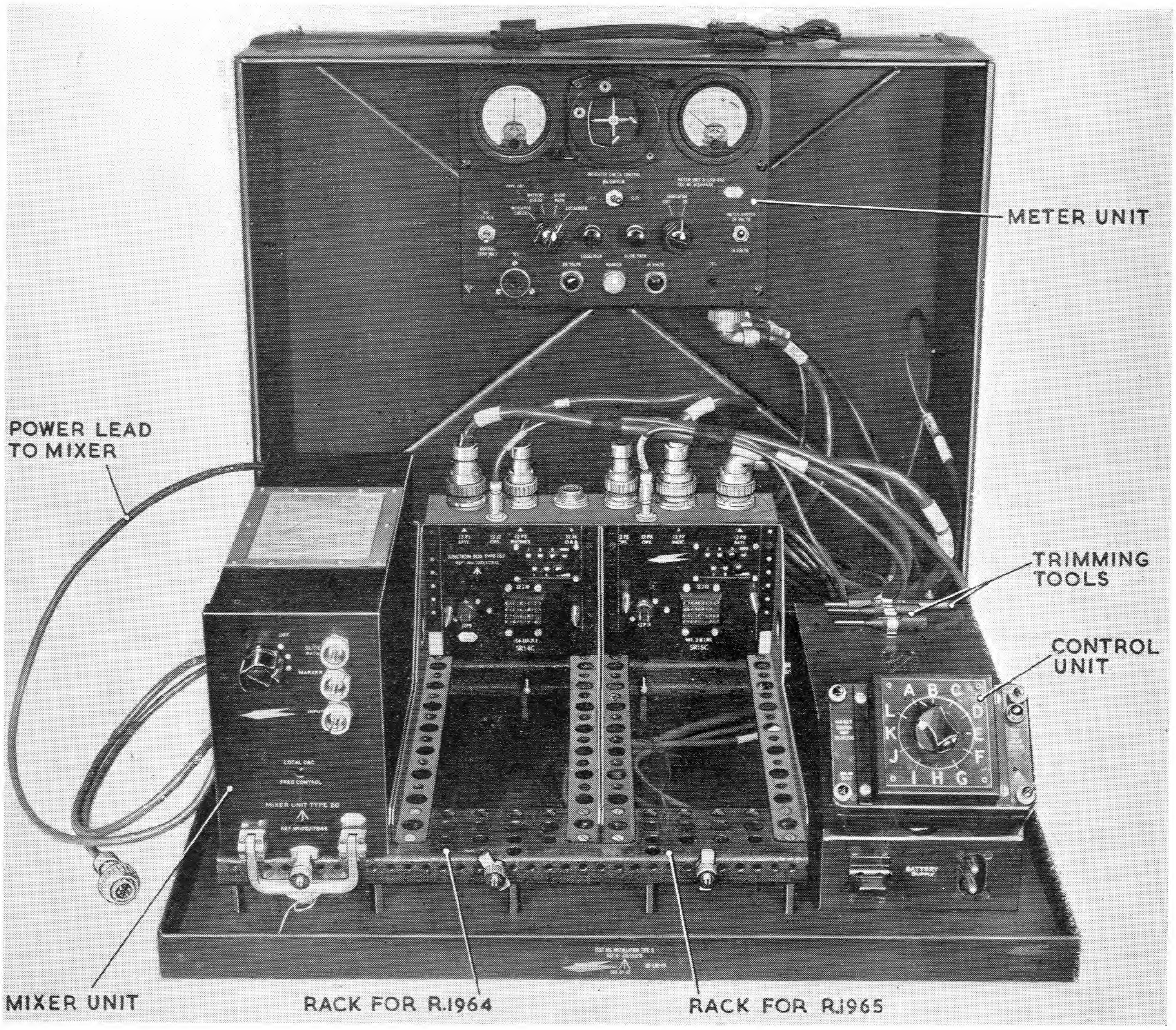

Fig. 1. Test rig (installation) Type 5

3. Control units, indicators and junction boxes of ILS installations may also be tested in the test rig by substitution for the similar components forming part of the control faciltities.

4. Signal generators Type 62 and 69 are used with the test rig to provide test signals. Because the range of the r.f. signal generator (the Type 62) covers only the frequencies of the localizer receiver, a mixer unit is fitted in the test rig to provide a frequency-changing action which extends this coverage. The mixer unit is a self-contained rack-mounted unit.

5. A d.c. power supply at the nominal level of 26V is required to operate the test rig (fig. 2). The power drain of about 250 watts is taken mainly by the two receivers. A voltage regulator is incorporated to produce the stabilized 19V d.c. supply for the valve heaters in the recivers. H.T. and l.t. for the mixer unit is taken from the power unit of an associated signal generator.

Details of equipment

6. The test rig (installation) Type 5 (10S/16378) consists of the following main items:—

Description	Stores Ref.
Outer case	
Mounting rack	
Junction box Type 157	10D/17815
Control unit Type 705	10L/263
Mixer unit Type 20	10D/17844
Meter unit Type 397	10S/14632
Voltage regulator Type 60	5U/5418
Trimming tool	10AG/46
Trimming tool	10AG/47
Trimming tool	10AG/48
Connector set	

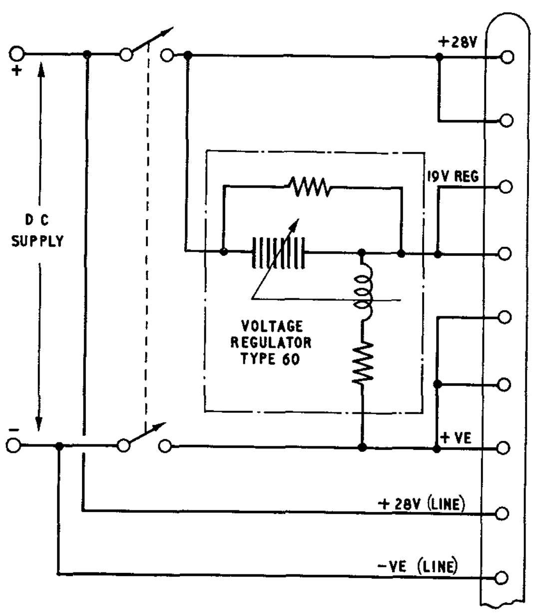

Fig. 2. Power supplies

7. The case consists of a metal base-plate covered and enclosed by a deep lid hinged to the back. Webbing straps are used to secure the lid in the closed position and also to form a carrying handle. The case when closed has the following dimensions:—

Width	21 in.
Height	18 in.
Depth	22 in.

In the closed condition (without receiver units in the rack) the test rig weighs 45 lb., and is readily transportable.

8. The mounting rack is a standard three-section S.B.A.C.-type rack fitted to the base-plate. The mixer unit fits in the left-hand section and the receivers R.1964 and R.1965 fit in the centre and right-hand sections respectively. Fitted at the rear of the two receiver sections is the junction box.

9. An assembly at the right-hand side of the rack provides support for the control unit and protection for the voltage regulator fitted beneath. It also carries the power input control circuits to the equipment as a whole.

10. Details of the power input circuit are shown in fig. 2. The 26V d.c. supply is brought to the input plug and is connected directly, through the terminal block, to poles A and C on P2 of the meter unit. Other 26V supplies are taken first through the test rig power switch to distribution points on the terminal block.

11. The voltage regulator is a standard carbon-pile assembly as described in A.P.2534E, Vol. 1. It derives a 26V input from the terminal block and provides a regulated output at 19V to the terminal block. Two connectors, in parallel, are connected between the terminal block and the main junction box to provide 26V and 19V supplies, separately, to the two receivers.

12. The meter unit is fitted to the inside of the lid such that when the lid is open it is readily

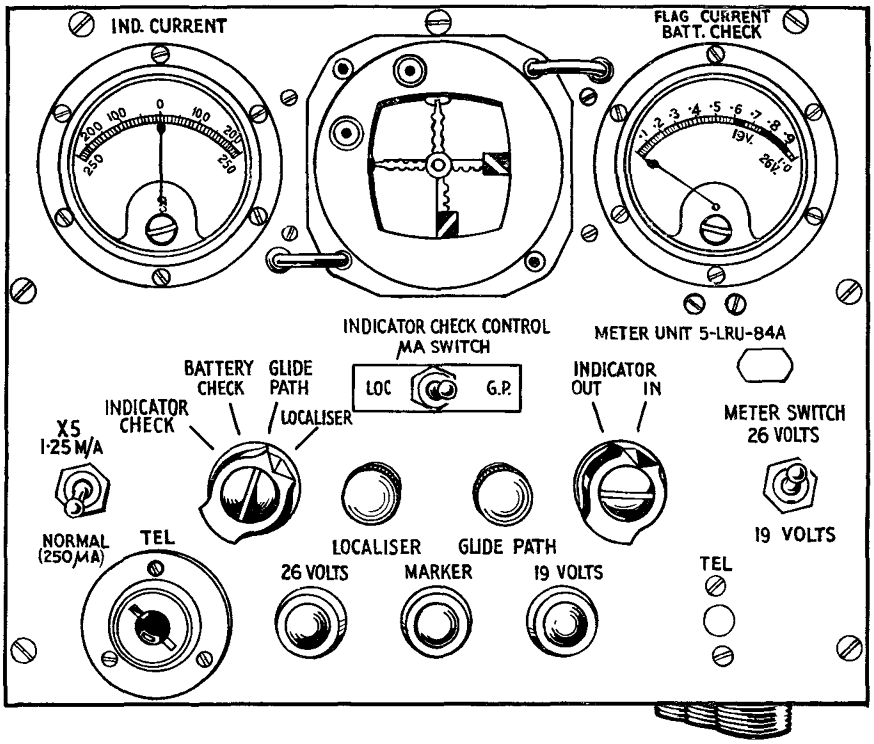

Fig. 3. Meter unit

visible above the two receivers in the rack. When the lid is closed (and the receivers are removed) the meter unit fits in the space between the mixer unit and the control unit.

13. The test rig may be used either as a transportable or fixed installation. In the first instance, the case is simply placed on a bench and opened but the lid occupies a considerable depth on the bench (at least 40 in.). Alternatively, the meter unit may be removed from the lid and fitted at some appropriate adjacent position; the lid can then be removed.

Mixer unit

14. The mixer unit Type 20 (described in A.P. 117E-0211-1) is a frequency changer taking an r.f. input in the localizer frequency range from the signal generator Type 62 and supplying an output in either the marker or glidepath frequency range. For marker operation, an input at 130 MHz gives an output at 75MHz and for glidepath operation an input between 123MHz and 138 MHz gives an output from 328MHz to 336MHz.

Meter unit Type 397

15. The indicator unit and marker lamp of the bench installation are fitted in the meter unit. Controls and meters in the unit allow the signals from the receivers to be measured and also permit the sensitivity of the indicator to be checked. The indicator unit is detachable to allow other indicators to be substituted and tested. Although only one indicator is fitted in the meter unit, dummy loads are included to make the loading in the receivers equivalent to the maximum of three

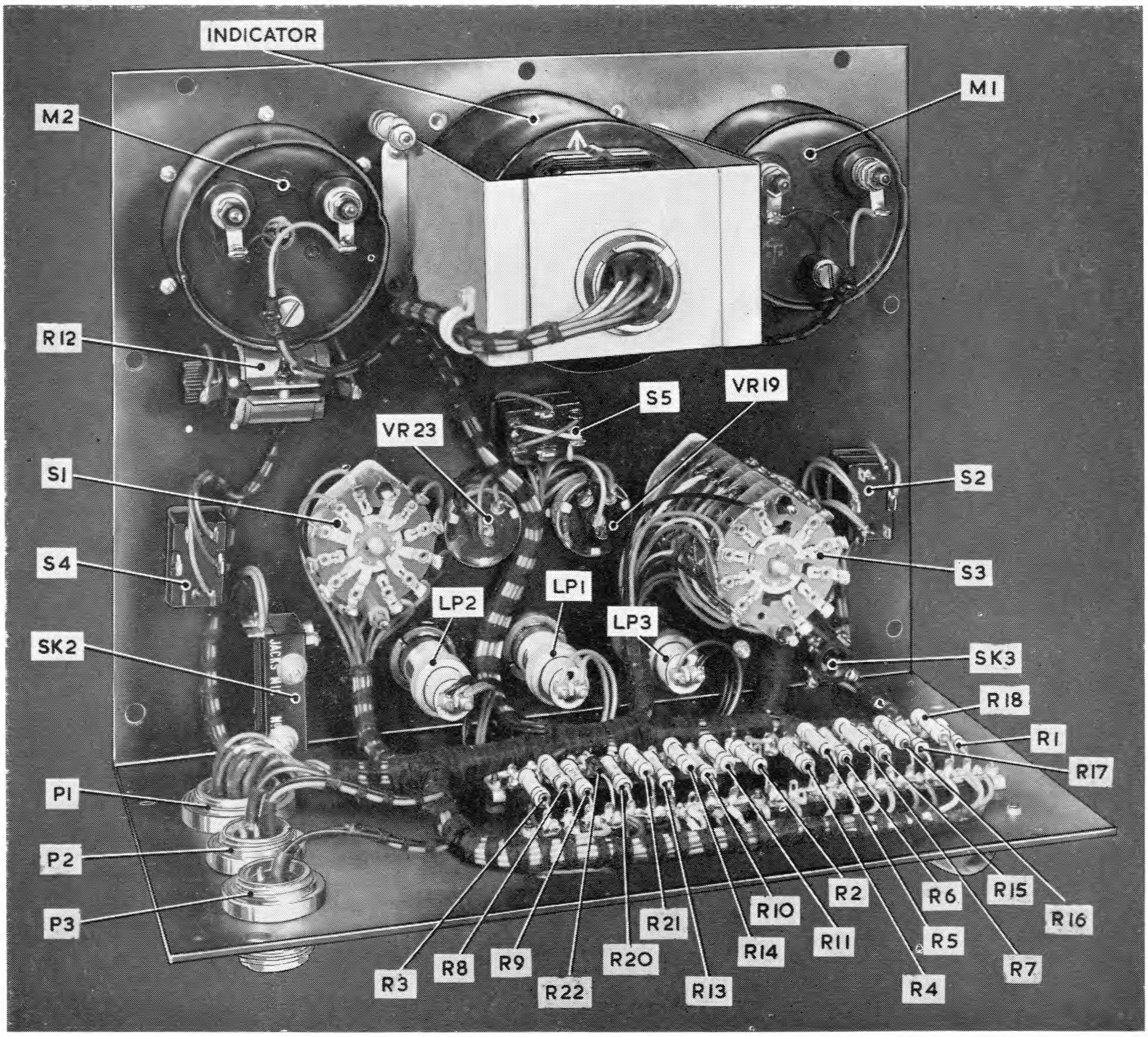

Fig. 4. Internal view of meter panel

indicators. Provision is also made for the 26V and 19V supplies to be checked.

16. The meter unit consists of an L-shaped panel fitted in a case to form a completely enclosed unit. Meters and switches and other operating facilities are fitted on the front of the panel, and the connecting plugs and small resistive components are fitted on the inside as shown in fig. 4.

17. At intervals of not less than one year, the panel meters in the meter unit Type 397 should be tested.

Equipment conditions

18. (1) Turn off the power supply switch on the test rig and remove the battery plug. Remove the meter unit from its case.

(2) Adjust the mechanical zero adjusting screws on the left hand and right hand panel meters until their pointers indicate at the zero marks on their scales.

(3) Turn the meter unit 397 controls to the following positions:—

Function switch	— INDICATOR CHECK
Indicator check control	— LOC
Localizer control	— $\frac{3}{4}$ anticlockwise
Indicator switch	— IN
X5/Normal switch	— NORMAL ($250\mu A$)

(4) Remove the lead from the positive terminal of the left hand panel meter and connect this lead to the positive terminal of a multimeter Type 12889 (Avometer model 9SX). Connect the negative terminal of the multimeter to the positive terminal of the panel meter.

(5) Set the multimeter to its $300\mu A$ d.c. range.

(6) Connect the battery plug but do *NOT* switch on the power supply switch.

Test procedure—left hand meter

19. (1) Adjust the LOCALISER control until the left hand panel meter indicates $200\mu A$ on the right hand side of its scale. Check that the multimeter indicates between the limits $190\mu A$ and $210\mu A$.

(2) Increase the panel meter reading to 250 μA, turn the meter multiplyer to $\times 5$ and check that the panel meter indicates 50 (i.e. 1/5th of full scale). Return the meter multiplyer to NORMAL.

(3) Reduce the panel meter indication to $150\mu A$ to the right. Check that the multimeter indicates between the limits of $140\mu A$ and $160\mu A$.

(4) Reduce the panel meter indication to zero, press the REV M.C button on the multimeter, and rotate the LOCALISER control to obtain panel meter indications of $150\mu A$ and $200\mu A$ on the left hand side of its scale. Check that the multimeter indicates between the limits of $140\mu A$ to $150\mu A$, and $190\mu A$ to $210\mu A$ respectively.

(5) Remove the battery plug and release the REV M.C. button on the multimeter.

(6) Disconnect the multimeter and reconnect the positive lead to the left hand panel meter.

Test procedure—right hand meter (current)

20. (1) Remove the lead from the negative terminal of the right hand panel meter and connect the lead to the negative terminal of the multimeter Connect the positive terminal of the multimeter to the negative terminal of the right hand panel meter.

(2) Set the multimeter to its 1mA d.c. range.

(3) Replace the battery plug but do *NOT* switch on the power supply switch.

(4) Adjust the LOCALISER control until the right hand panel meter indicates successively, 0·1, 0·2, 0·3, 0·4 and 0·5mA, and check that the multimeter indicates within the limits of $\pm 0{\cdot}02$mA of the panel meter indication.

(5) Remove the battery plug.

(6) Disconnect the multimeter and replace the negative lead on the negative terminal of the panel meter.

Voltmeter test—right hand meter

21. (1) Ensure that at least one receiver is fitted to the test rig. Failure to observe this may result in damage to the voltage regulator.

(2) Set the multimeter to its 30V d.c. range and connect it to measure the d.c. input voltage from the power supply to the test rig. Connect the power supply and switch on the power supply switch.

(3) Set the function switch on the meter unit Type 397 to the BATTERY CHECK position, and note the indication of the right hand panel meter on its 0-1·0 scale. (This will be a fraction of full scale, e.g. 0·84).

(4) To obtain the indicated battery voltage multiply this indication by 30 (full scale is 30 volts).

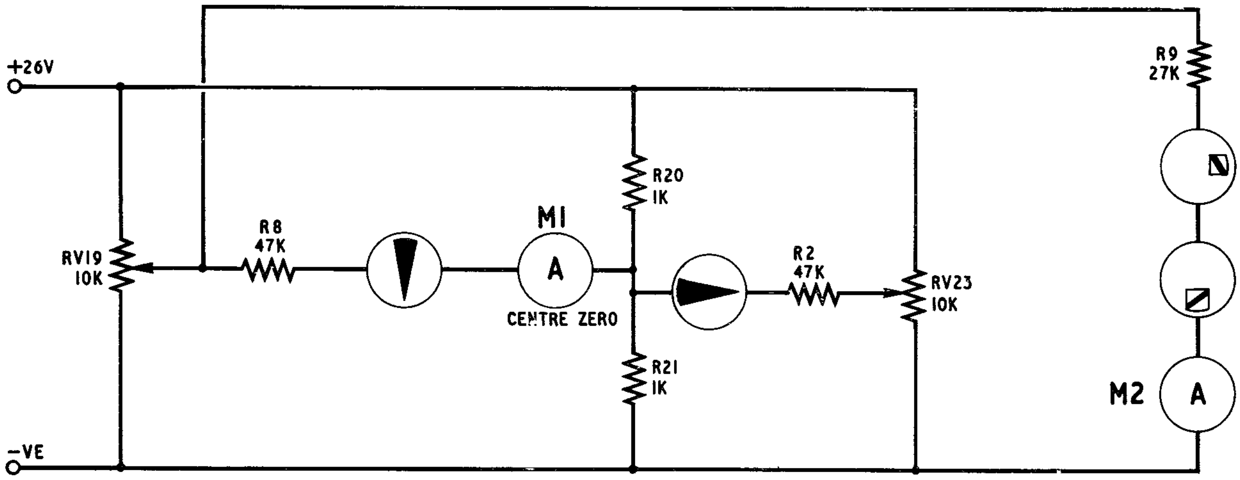

Fig. 5. Localizer indicator check: circuit

(5) Check that the reading on the multimeter lies within the limits of ±0·5 volts of the battery voltage indicated by the panel meter.

(6) Switch off. Disconnect the power supply and the multimeter.

22. A complete circuit of the meter unit appears in fig. 14. P1, P2, P3, are input plugs taking ILS signals, power supplies, and audio signals respectively from the circuit of the test rig, and SK1 is the point to which an ILS indicator is connected.

23. The main function switch is S3. This is a seven bank switch with 14 separate four-way switch sections; the four positions provide for the four operational possibilities as follows:—

(1) Indicator check.

(2) Battery check.

(3) Glidepath operation check.

(4) Localizer operation check.

Indicator check

24. In the INDICATOR CHECK position of S3 a further switch, S5, (INDICATOR CHECK CONTROL μA SWITCH) is brought into circuit and its functioning divides the indicator check operations into two separate actions; one with S5 in the localizer (LOC) position; the other with S5 in the glidepath (G.P.) position.

25. For localizer indicator check the switching produces the circuit of fig. 5. A potentiometer RV19 (LOCALISER) across the d.c. input supply allows a controlled potential to be produced and a fixed potentiometer (R21, R20) provides a centre tap across the supply. Adjustment of RV19 therefore produces a voltage controlled between +13V and −13V between the slider of RV19 and the

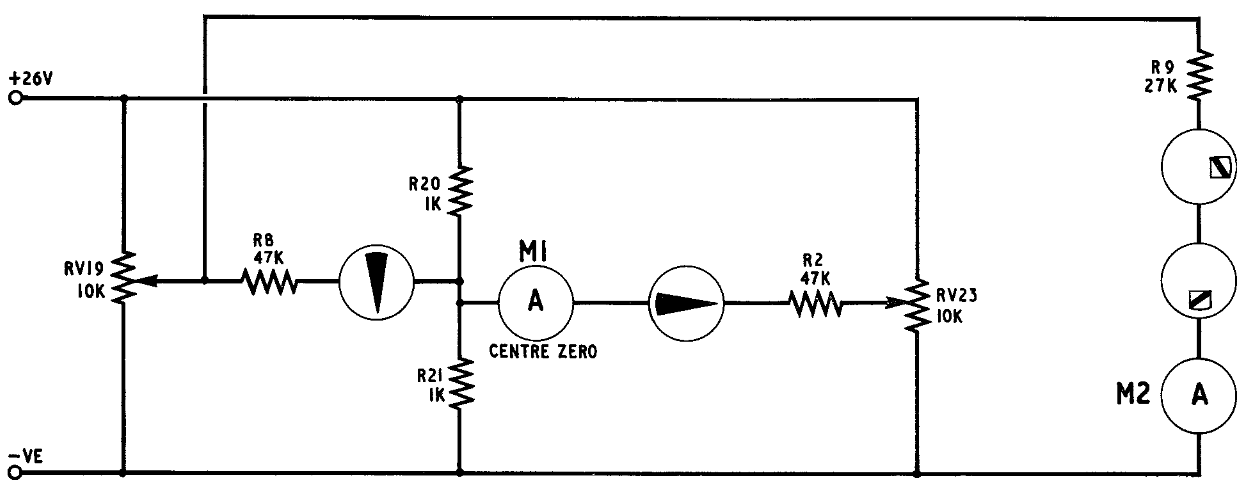

Fig. 6. Glidepath indicator check: circuit

centre tap. A further variable potentiometer RV23 (GLIDEPATH) also provides a similar range of potential relative to the centre tap.

26. The potential from RV19 is applied to a loading resistor (R8), the localizer pointer movement of this ILS indicator and the centre zero microammeter M1 in series, so that a controlled and measured positive or negative current can be passed through the localizer movement. The potential from RV23 is passed through a further loading resistor (R2) and the glidepath pointer movement so that a controlled, but not measured, current can be passed through the glidepath movement.

27. Under these same conditions the potential between the slider of RV19 and the negative supply line is applied through a loading resistor (R9), the glidepath flag movement, the localizer flag movement and milliameter M1 in series; thus a potential controlled between zero and 26V can be applied to the flag circuits.

28. On localizer indicator check, therefore, the deflection of the localizer pointer movement can be controlled, and the deflection sensitivity measured and at the same time the deflection of the glidepath pointer movement can be controlled but actual sensitivity can not be checked. Also the deflection sensitivity of both flag movements can be checked.

29. On glidepath indicator check, as shown in fig. 6, the situation is generally the same as that for fig. 5, but the micro-ammeter is switched to be in series with the glidepath pointer movement. Connections to the flag movements remain the same. For this condition then, the glidepath pointer sensitivity can be measured, the localizer pointer checked, and the flag sensitivities measured.

Battery check

30. For battery check M2 is converted by the addition of a series resistor R12 to be a 0-30V meter and the switch S4 (METER SWITCH) provides an input to the meter from either the 26V supply or the 19V regulated supply. The outline of the circuit appears in fig. 7. The series resistor is specially selected for each meter.

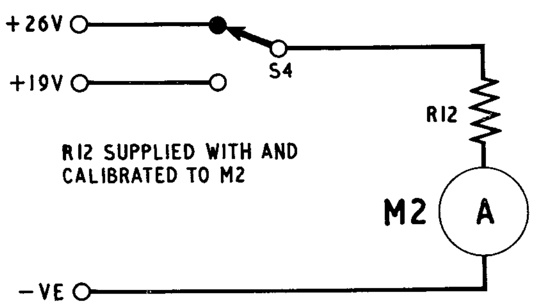

Fig. 7. Battery check: circuit

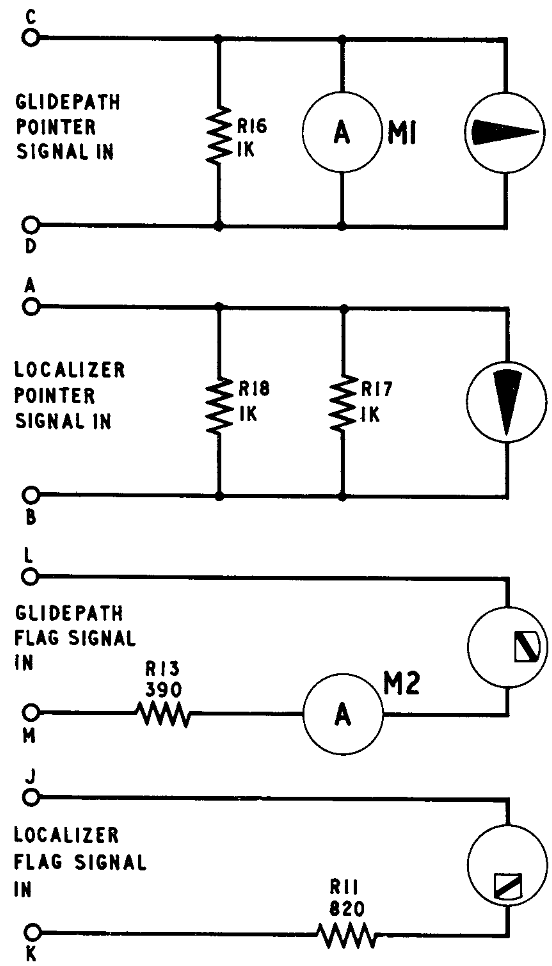

Fig. 8. Glidepath operation: circuit

Glidepath operation

31. For GLIDEPATH operation the simplified circuit is as shown in fig. 8. Four separate circuits are involved:—

(1) The pointer output of the glidepath receiver is fed to loading resistor R16, microammeter M1, and the glidepath pointer, in parallel.

(2) The pointer output of the localizer receiver is fed to loading resistors R18, R17, and the localizer pointer, in parallel.

(3) The flag output of the glidepath receiver is fed to the glidepath flag, milliameter M2, and loading resistor R13 in series.

(4) The flag output of the locaizer receiver is fed to the localizer flag and loading resistor R11 in series.

32. Thus the movements of the indicator are connected to the outputs of the receivers and the signals being applied to the glidepath movements are measured. Loading resistors are included in all circuits to make the loads imposed by the meter unit on the receivers equal to those of three indicators used together.

Localiser operation

33. For LOCALISER operation the simplified circuit is shown in fig. 9. The conditions are the same as those of fig. 8 with the following differences:—

(1) Micro-ammeter M1 is removed from the glidepath pointer circuit and loading resistor R15 substituted.

(2) R17 is removed from the localizer pointer circuit and microammeter M1 substituted.

(3) Milliameter M2 is removed from the circuit of the glidepath flag and R13 substituted by a larger resistor R10.

(4) Milliameter M2 is inserted in the circuit of the localizer flag and R11 substituted by a lower-value resistor R14.

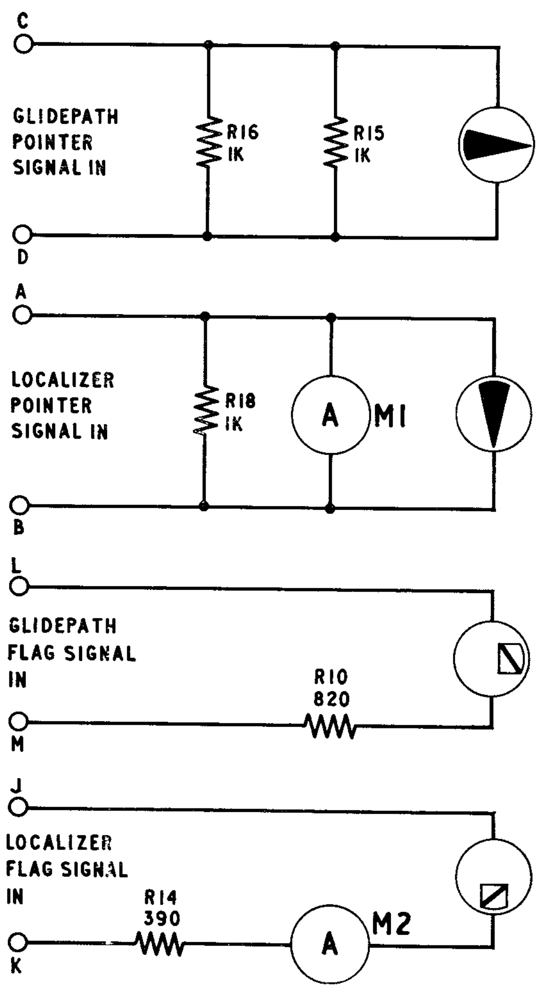

Fig. 9. Localizer operation: circuit

34. The movements of the indicator are therefore connected to the outputs of the receivers and the signals being applied to the localizer movements are measured. Changing the resistors ensures that the loading imposed on the receivers remains equal to that of three indicators.

Indicator switching

35. An ancilliary switching function is provided by the INDICATOR switch S1. This is a four-pole two-way switch connected in the input circuit to the indicator unit, with each pole in the circuit of one movement. In the normal IN position of the switch the indicator movements are connected normally and the operating conditions for indicator check, glidepath, and localizer operation are as previously stated.

36. In the OUT position the circuit to each movement is broken and a fixed resistor is connected in its place. Each resistor (R4, R5, R6, R7) has a value equal to the resistance of the movement it replaces, so that assuming the indicator is not faulty, operating S1 does not alter the currents drawn by the several circuits and the meters in the circuits do not alter. If however the resistance of any movement of the indicator is abnormal, the relevant meter will read differently and a faulty movement can be diagnosed directly.

Meter sensitivity

37. A further ancilliary switching function is carried out by S2. This is two-pole two-way switch in the input circuit to the micro-ammeter M1. In the NORMAL position of S2 the micro-ammeter is in circuit directly and its sensitivity is that of the basic 250-0-250μA movement. In the $\times$5 position of the switch a series resistor R1 is introduced into the circuit to the meter and a shunt resistor R3 is connected across the meter. This combination decreases the sensitivity of the meter by a factor of five and the meter measures over the range 1·25-0-1·25mA.

38. The $\times$5 position of S2 is used to increase the range of M1 when unbalanced outputs from the receiver are tending to overload the pointer circuits.

Lamps

39. Three lamps are fitted on the meter unit. One indicates when 26V power is on, a second indicates when 19V power is on, and the third is connected to the marker output of the R.1964. The marker lamp should light when a signal of an appropriate level is being received by the marker receiver.

Tel sockets

40. Two parallel connected telephone sockets are fitted on the meter unit. They are supplied with the audio output of the R.1964, and provide therefore

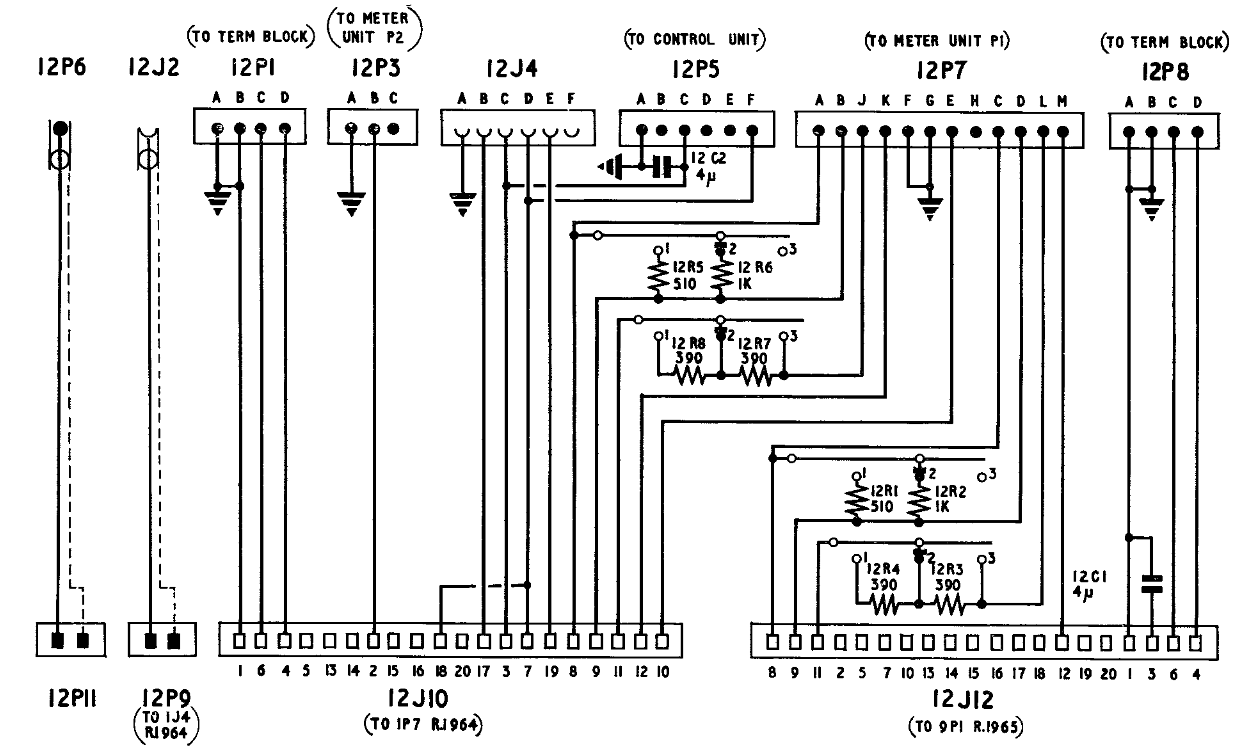

Fig. 10. Junction box Type 157: circuit

for the localizer audio and marker audio signals to be heard.

Junction box Type 157

41. The junction box is identical with the type fitted in working airborne ILS installations. It provides for interconnections between the receivers, control unit, display circuits, and power supplies. The indicator and flag selector boards on the junction box, which adjust the loading on the indicator circuits according to the number of indicators being used, are set to "3".

42. The test rig junction box is also fully described in A.P.2534E, Vol. 1, and reference should be made there for full details. The circuit diagram is however included here, in fig. 10, where it will be seen that the junction box provides for distribution of connections between the two receivers and other parts of the installation, and additionally contains smoothing capacitators on the receiver h.t. circuits and loading resistors in the indicator output circuits.

Control unit Type 705

43. The control unit fitted in the test rig (see fig. 1) is also of the type fitted in working installations. It contains the local oscillator circuits for the localizer and glidepath receivers and provides for the selection of twelve ILS channels.

44. The frequencies of the selected channels are determined by crystals fitted in the control unit. Each channel requires two crystals, one for localizer, one for glidepath. Crystals are not supplied with the control unit but must be ordered separately by the user. For general use, crystals covering the lowest, middle, and highest frequencies of both localizer and glidepath bands will be necessary to allow the tuning ranges of the receivers to be investigated. It will be noted that the ILS channel numbers of the relevant localizer channels are not the same as those for glidepath. Details of the crystals, whose Stores Ref. numbers are their frequences in kilocycles preceded by "10/AKL", are as follows:—

	Localizer			Glidepath		
	Channel	Beacon (MHz)	Crystal (kHz)	Channel	Beacon (MHz)	Crystal (kHz)
Lowest	1	108·1	9,937·5	4	329·3	15,294·4
Middle	20	110·0	10,175·0	13	332·0	15,444·4
Highest	39	111·9	10,412·5	23	335·0	15,611·1

45. Other crystals can be fitted as necessary to allow additional channels to be used; their frequencies can be found from the following formulae:—

$$f_{cl} = \left(\frac{f_l - 28{\cdot}6}{8} \right) \times 1{,}000$$

where f_{cl} = localizer crystal frequency in kHz

f_l = localizer beacon frequency in MHz

$$\text{and, } f_{cg} = \left(\frac{f_g - 54}{18} \right) \times 1{,}000$$

where f_{cg} = glidepath crystal frequency in kHz

f_g = glidepath beacon frequency in MHz

A list of localizer and glidepath beacon and crystal frequencies is given in A.P.2534E, Vol. 1.

46. The control unit is identical with that fitted in an actual ILS installation and is described in detail in A.P.2534E, Vol. 1. A circuit of the unit is shown in fig. 11.

47. The two valves in the control unit are separate crystal oscillators, one (5V1) providing the source of local oscillator signals for the localizer receiver, the other (5V2) providing the local oscillator source to the glidepath reciver. The circuits are almost identical Colpitts-type circuits, 5V1 operating in the range from 9·9MHz to 10·5MHz and 5V2 operating in the range from 15·3MHz to 15·6MHz. In the first valve, however, the anode circuit provides a frequency-doubled output, and in the second valve the anode circuit provides a frequency-trebled output. Each circuit has provision for twelve crystals to be selected.

Trimming tools

48. Three trimming tools supplied with the test rig are fitted in clips to the cover-plate above the voltage regulator at the left-hand. They are provvided for adjusting the trimmers and coils of the RF assemblies and as such are for use in third line servicing operations only.

49. Tools 10AG/46 and 10AG/47 are single-ended tools of generally similar appearance. The working end of 10AG/46 is a recessed slot and that of 10AG/47 is a recessed blade. They are

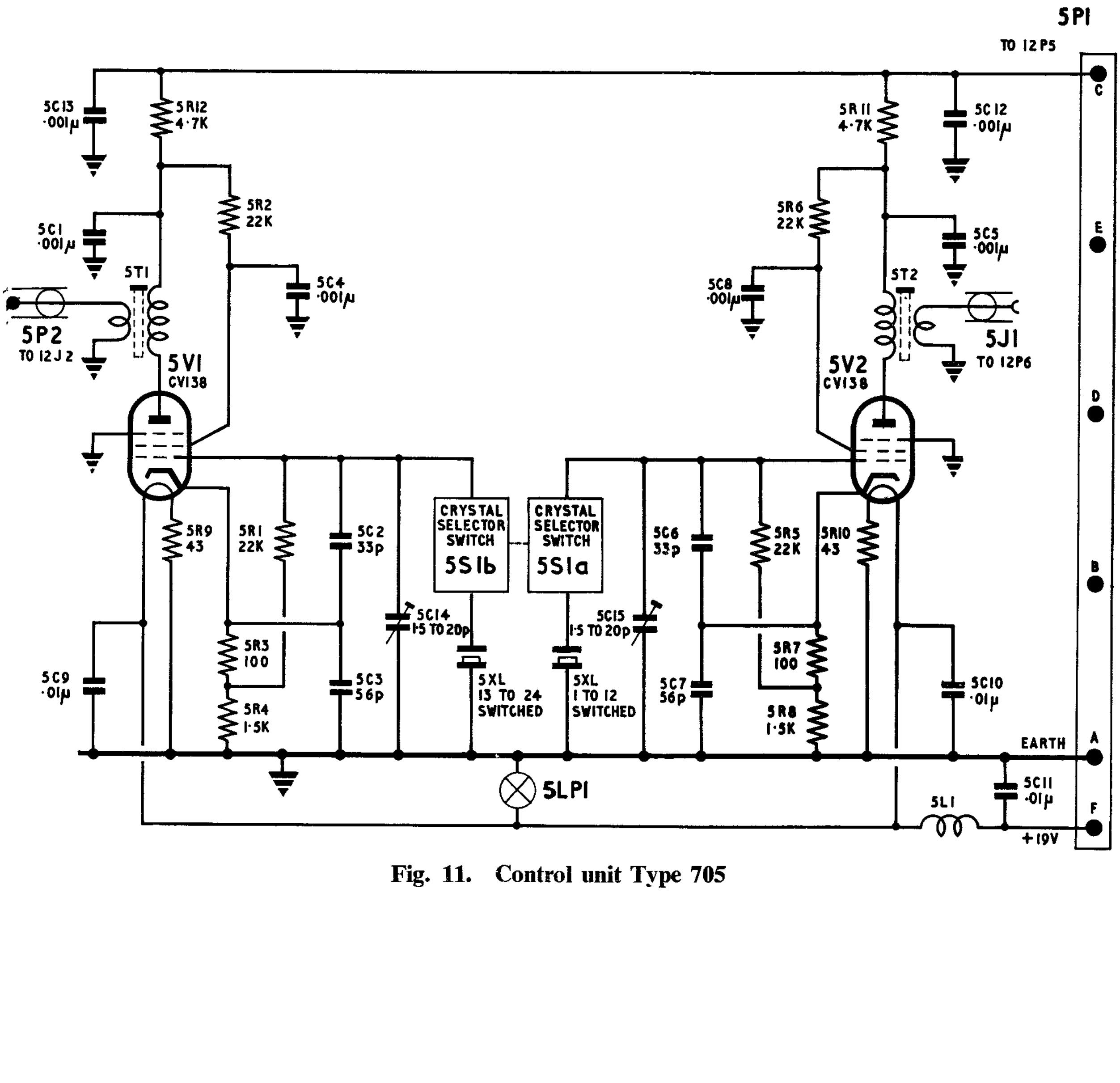

Fig. 11. Control unit Type 705

both provided for adjusting the cores of preset coils, 10AG/46 being suitable for the flat-ended type of screwed shafts, 10AG/47 being for the slot-ended type of screwed shafts (as the coils of the rf chassis of the test set Type 391).

50. Tool 10AG/48 is a long double-ended tool with a slot at each end. The large-diameter end is for adjusting the cores of the main rf coils in the receiver Type 117, while the small diameter end is for the small coil 3L33 in the same unit.

Connectors

51. Connectors supplied with the test rig can be divided into two sets. One group consists of leads forming the interconnections between the units of the bench installation proper; the second group are loose leads provided to facilitate servicing of the receivers.

52. Installation connectors are as follows:—

(1) B12/30B/2 (10HA/12663):—
multi-core lead with Mk. 4 terminations, running between P1 (twelve pole plug) on meter unit and 12P7 (twelve-pole plug on junction box: carries indicator connections.

(2) B4/52F/1 (10HA/12665):—
multi-core lead with one Mk. 4 termination running between P2 (six-pole plug) on meter unit and terminal block: carries power supplies to meter unit.

(3) B22/31A/1 (10HA/12664):—
multi-core lead with Mk. 4 terminations, running between P3 (three-pole plug) on meter unit and 12P3 (three-pole plug) on junction box: carries telephone circuits to meter unit.

(4) B20/50E (10HA/12661):—
multi-core lead with one Mk. 4 termination running between 12P1 (four-pole plug) on junction box and terminal block: carries power supplies to junction box for R.1964.

(5) B20/50E/2 (10HA/12660):—
multi-core lead with one Mk. 4 termination running between 12P8 (four-pole plug) on junction box and terminal block: carries power supplies to junction box for R.1965.

(6) 8B/30A/5 (10HA/12662):—
multi-core lead with two Mk. 4 terminations running between 12P5 (six-pole plug) on junction box and 5P1 (six pole plug on control unit: carries power supplies to control unit.

(7) Type 3979 (10HA/12655):—
coaxial lead with coaxial terminations running between 12P6 on junction box and 5J1 on control unit: carries glidepath local oscillator signal from control unit.

(8) Type 3980 (10HA/12656):—
coaxial lead with coaxial terminations running betwee 12J2 on junction box and 5P2 in control unit: carries localizer local oscillator signal from control unit.

(9) B6/40E/1 (10HA/12666):—
multi-core lead with one Mk. 4 termination and other end connected to fixed Jones socket (13J1) on mixer rack: provides for power input to mixer unit.

(10) Type3977 (10HA/12653):—
heavy-gauge twisted pair with heavy-duty two-pole socket at one end and bare-wire ends at the other: not strictly a fixed item but to be fitted by the user as the input lead between the power source and the test rig: shown at D in fig. 12.

53. Loose connectors are as follows:—

(1) Type 3983 (10HA/12659):—
light coaxial lead (Uniradio 43) with two-pole plug (Jones type) at one end and two-pole socket (Jones type) at the other: extension lead for local oscillator signal from junction box to receiver when receiver is operated away from rack (A in fig. 12).

(2) Type 3981 (10HA/12657):—
light coaxial lead (Uniradio 43) with coaxial plug at one end and coaxial socket at the other: extension lead on inter-unit coaxial connections inside receivers: two leads supplied (B1 and B2 in fig. 12).

(3) Type 10046 (10HA/13608):—
multi-core cable with six-pole plug (Jones type) at one end and six-pole socket (Jones type) at the other: extension lead permitting use of power unit detached from main receiver assembly (C in fig. 12).

(4) Type 3984 (10HA/12667):—
heavy multi-core cable with twenty-pole protected plug at one end and twenty-pole plug at the other: extension lead providing main connection between receiver and junction box when receiver is operated away from rack (E in fig. 12).

(5) Type 3986 10HA/12669):—
heavy coaxial lead with coaxial socket at each end: short connection between mixer unit and aerial input point on receiver (F in fig. 12).

(6) Type 3987 (10HA/12670):—
heavy coaxial lead with coaxial socket at each end: long connection between mixer unit and aerial input point on receiver (G in fig. 12).

(7) Type 3987 (10HA/12654):—
multi-core cable with eight-pole plug (Jones type) at one end and eight-pole socket (Jones type) at the other: extension lead permitting use of top chassis elements of receiver detached from main assembly: two leads supplied (H1 and H2 in fig. 12).

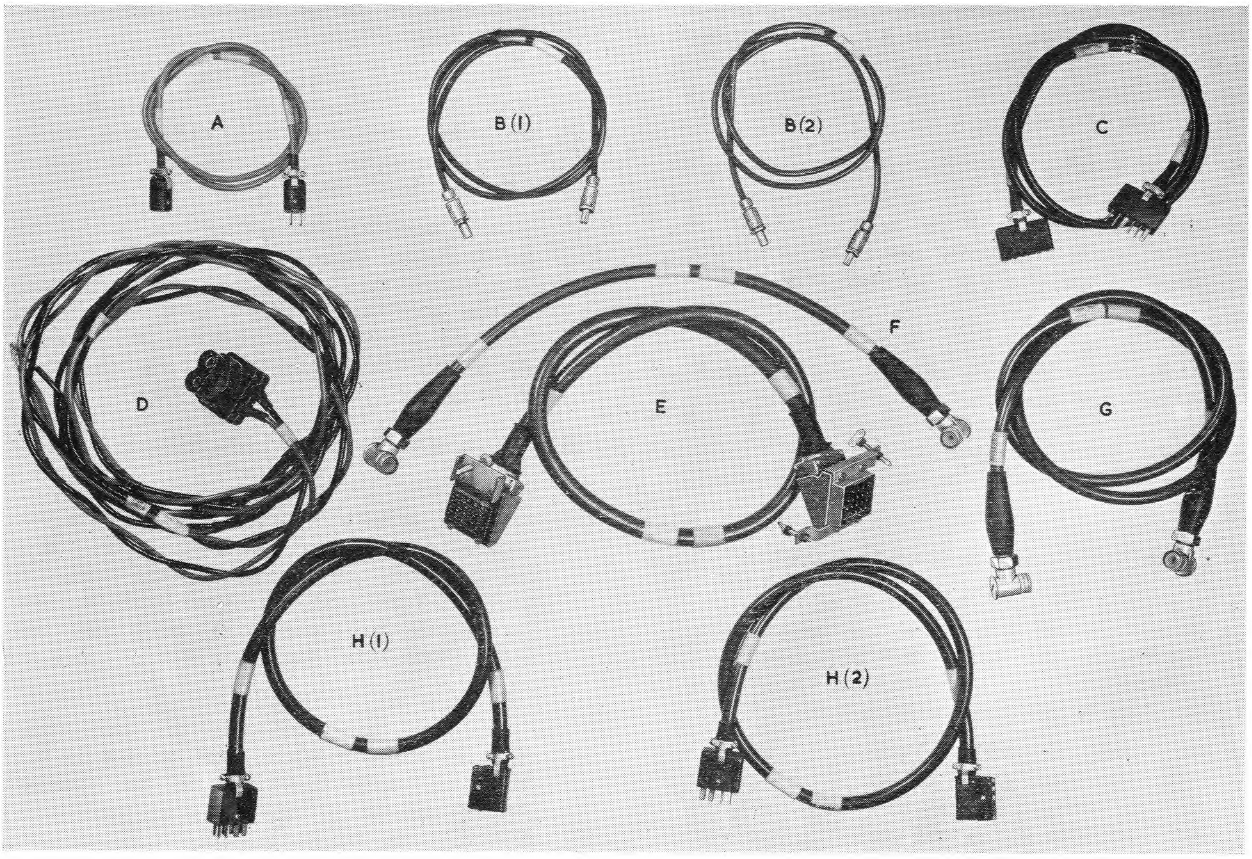

Fig. 12. Connectors

Controls and user facilities

54. User controls on the test rig are as follows:—

(1) BATTERY SUPPLY switch:
on-off switch at right-hand side below control unit: controls d.c. input to junction box and receivers under test, including regulated 19V supply: does not control main d.c. supply to meter unit.

(2) Channel selector:—
twelve-position rotary switch on control unit: selects localizer and glidepath channels in receivers under test in accordance with the crystals fitted in the control unit.

(3) Mixer unit switch:—
three-position rotary switch on mixer unit: in OFF position no output is provided from mixer unit: in central position a glidepath output is available at the GLIDEPATH plug: in clockwise position a marker output is available at MARKER plug.

(4) Function switch (fig. 3):—
The main control on the meter unit is a four-position rotary switch providing the following facilities:—

(a) INDICATOR CHECK:— the localizer and glidepath pointers of the indicator in the meter unit are connected separately across the d.c. supply and their deflections are controlled by separate LOCALISER and GLIDEPATH controls: the current through either pointer circuit is read on the left-hand meter (IND CURRENT) according to the position of the INDICATOR CHECK CONTROL μA SWITCH: the localiser and glidepath flags are connected in series with the right-hand meter (FLAG CURRENT BATT CHECK) and their deflections are also controlled by the LOCALISER control. In this position the sensitivity of the indicator movements can be checked.

(b) BATTERY CHECK:— either the main d.c. input or the 19V regulated supply is connected to the right hand meter, according to the setting of the METER SWITCH, and the supply voltages can be checked: red sectors on the meter indicate the extreme limits within which the voltages must fall.

(c) GLIDEPATH:— the indicator pointers and flags are connected to the outputs of the localizer and glidepath receivers with the left-hand meter shunted across the glidepath pointer and the right-hand meter connected in series with the glidepath flag. The glidepath receiver pointer and flag outputs can thus be checked.

(d) LOCALISER:— as (c) but the meters are connected in the localizer pointer and flag circuits. The localizer receiver pointer and flag outputs can thus be checked.

(5) LOCALISER control:—
variable potentiometer controlling current through localizer pointer, localizer flag, and glidepath flag on INDICATOR CHECK operation: range is sufficient to produce deflection of localizer pointer over full width of scale and to fully deflect both flags.

(6) GLIDEPATH control:—
variable potentiometer controlling current through glidepath pointer on INDICATOR CHECK operation: provides for full-scale deflection of pointer.

(7) INDICATOR OUT/IN switch:—
two-position rotary switch: in the IN position the indicator is connected normally for the conditions controlled by the function switch: in the OUT position the movements of the indicator are replaced by fixed resistors: a change of meter reading between the IN and OUT positions shows that the resistance of the indicator movement concerned is incorrect.

(8) METER SWITCH:—
two-position toggle switch controlling the input to the right-hand meter in the BATTERY CHECK position of the function switch: in the 26 VOLTS position gives check of the main battery supply: in the 19 VOLTS position gives check of the regulated supply.

(9) INDICATOR CHECK CONTROL μA SWITCH:—
two-position toggle switch controlling the connection of the left-hand meter in the INDICATOR CHECK position of the function switch in the LOC position connects the meter in series with the localizer pointer: in the G.P. position connects the meter in series with the glidepath pointer.

(10) ×5—NORMAL switch:—
controls the sensitivity of the left-hand meter: in the NORMAL position gives a full-scale-from-centre deflection of 250μA and in the ×5 position makes this 1·25mA: when the receiver outputs are seriously unbalanced the ×5 position is used to prevent overloading the meter and indicator.

55. Other facilities on the meter unit are:—

(1) MARKER lamp:—
connected to the output of the marker receiver and lights when marker signals are received.

(2) 26 VOLTS lamp:—
red lamp lighting when the main supply is connected to the test rig: not affected by the BATTERY SUPPLY switch.

(3) 19VOLTS lamp:—
green lamp lighting when the regulated supply is on.

(4) TEL jacks:—
two jacks providing marker and localizer audio outputs: left-hand jack is for the plug of a normal aircraft-type headset: right-hand jack is for G.P.O. plug connection.

(5) IN. CURRENT meter:—
250-0-250μA centre-zero meter reading current through indicator pointer movements on INDICATOR CHECK operation, and voltage across movements on GLIDEPATH and LOCALISER operation: sensitivity is decreased to 1·25-0-1·25mA when ×5-NORMAL switch is in ×5 position.

(6) Indicator:—
the centre meter is a standard ILS indicator unit (indicator, electrical, Type 7 10Q/61): it is held in position by two spring clamps and is readily detachable to permit other indicators to be substituted for test purposes.

(7) FLAG CURRENT BATT. CHECK meter:—
0-1mA meter reading flag current on INDICATOR CHECK, GLIDEPATH and LOCALISER operation, and reading supply volts on a full-scale reading of 30V on BATTERY CHECK.

Use of test rig

56. The main function of the test rig is as a bench installation in which components of ILS airborne equipments can be tested. For normal second and third line use the following additional equipment is required:—

Description	Function
Signal generator Type 69 including	ILS tone and audio signal generator
Signal generator unit Type 7	
Power unit Type 843	
Signal generator Type 62 including	VHF signal generator
Signal generator unit Type 5	
Power unit Type 836	
Output meter Type 2	For measuring audio output
Signal generator Type 56	HF signal generator: first-IF range
Signal generator Type CT.53	VHF signal generator: second-IF range
Multimeter Type 1	

Preparing test rig

57. To prepare an ILS bench installation:—

(1) Place the test rig on the bench.

(2) Loosen the webbing strap and raise the lid.

(3) If the bench installation is to be permanent:—

(a) Remove meter unit from lid by removing eight screws holding rear of unit to top of lid.

(b) Remove lid by removing twelve screws (and nuts) holding rear flange to hinge at back of base-plate.

(c) Use the four brackets on the meter unit back plate to secure meter unit to a convenient support.

(4) Remove loose connectors from beneath the mounting rack.

(5) Connect up signal generators Type 62 and 69.

(6) Connect the lead from the rear of the mixer unit rack to the power unit of the signal generator Type 62.

(7) Select connector Type 3977 (twisted pair) from the loose connectors and connect between the test rig power input plug and the power source. The supply (d.c.) can be within the limits of 22·5V and 28·8V for general checking purposes (these are the operational limits of the equipment and are shown by the red sector on the test rig meter) but for actual setting-up, the supply must be between 26V and 28V.

(8) Check that indicator and flag selector panels on the junction box are set to position "3".

Note . . .

Do not set the test rig power switch to the ON position (down) unless at least one receiver is fitted in the rack. If the switch is made without a receiver in position the voltage regulator is operated without load and is liable to damage.

Testing indicators

58. Indicators can be tested without receivers being fitted in the racks and without the use of the signal generators. The procedure is:—

(1) Set the meter unit function switch to BATTERY CHECK and the METER SWITCH to 26V.

(2) Note that the right-hand meter reads within the right-hand red sector.

(3) Substitute the indicator to be tested for the indicator of the meter unit.

(4) Set the ×5-NORMAL switch to NORMAL, the INDICATOR switch to IN and the INDICATOR CHECK CONTROL switch to LOC.

(5) Set the function switch to INDICATOR CHECK.

(6) Adjust the LOCALISER control for a centre-zero reading of the left-hand meter: the localizer pointer should read centre-zero.

(7) Adjust the LOCALISER control for a meter reading of 150μA right: the localizer pointer should move to the fifth dot left (circle counts as first dot).

(8) Move the INDICATOR switch momentarily to the OUT position and note that the reading of the meter does not change.

(9) Adjust the LOCALISER control for a meter reading of 150μA left: the localizer pointer should read to the fifth dot right.

(10) Adjust the LOCALISER control to produce a reading of the right-hand meter of the range from zero to 0·45mA: note that both localizer and glidepath flags are out of sight at 0·45mA, and both are fully visible from 0·2mA downwards.

(11) Set the LOCALISER control for a reading of 0·2mA and momentarily move the INDICATOR switch to the OUT position: the reading of the meter should not change.

(12) Set the INDICATOR CHECK CONTROL switch to the G.P. position.

(13) Adjust the GLIDEPATH control for a centre-zero reading of the left-hand meter: the glidepath pointer should read centre-zero.

(14) Adjust the GLIDEPATH control for a meter reading of 150μA right: the glidepath pointer should read to the fifth dot up.

(15) Move the INDICATOR switch momentarily to the OUT position and note that the reading of the meter does not change.

(16) Adjust the GLIDEPATH control for a meter reading of 150μA left: the glidepath pointer should read to the fifth dot down.

Testing ILS receivers

59. Full details for testing ILS receivers are provided in AP.2534E, Vol. 1, and the following information details the action necessary to use the test rig for the purpose:—

(1) Remove the dust covers from the receivers (R.1964, R.1965) to be tested.

(2) Insert the R.1964 in the left-hand rack of the test rig. (The R.1965 is left out to allow access to the flag sensitivity preset on the R.1964).

(3) Press down the test rig power switch to put d.c. power on the receivers .

(4) Set the meter unit function switch to BATTERY CHECK and operate the METER SWITCH to check that the 26 VOLTS and 19 VOLTS supplies are within the required limits; the main supply should be between 26V and 28V.

(5) Set the INDICATOR switch to IN.

(6) Connect the output meter to a TEL jack of the meter unit.

(7) Connect the r.f. output lead of the signal generator Type 62 to the localizer aerial plug on the receiver R.1964.

(8) Set the meter unit function switch to LOCALISER.

(9) Set up the localizer receiver in accordance with the instructions of A.P.2534E, Vol. 1, note that the calbration of the signal generator Type 62 applies directly.

(10) Transfer the r.f. connector from the localizer aerial plug to the input plug on the mixer unit Type 20.

(11) Use the short coaxial lead (Type 3986, fig. 10 (F) to connect between the marker plug on the mixer unit and the marker aerial plug in the R.1964.

(12) Set the mixer unit control switch to the clockwise marker position and check the frequency of the mixer local oscillator to ensure that the marker output is exactly 75 MHz (para. 68).

(13) Set up the marker receiver in accord ance with the instruction of A.P.2534E, Vol. 1. The signal generator must be set for an output of 130MHz to produce a marker output from the mixer of 75MHz, and the level of signal fed from the mixer is that shown by the attenuator of the signal generator plus or minus an insertion factor stated on the mixer unit.

(14) Insert the R.1965 in the right-hand rack.

(15) Transfer the short coaxial lead (Type

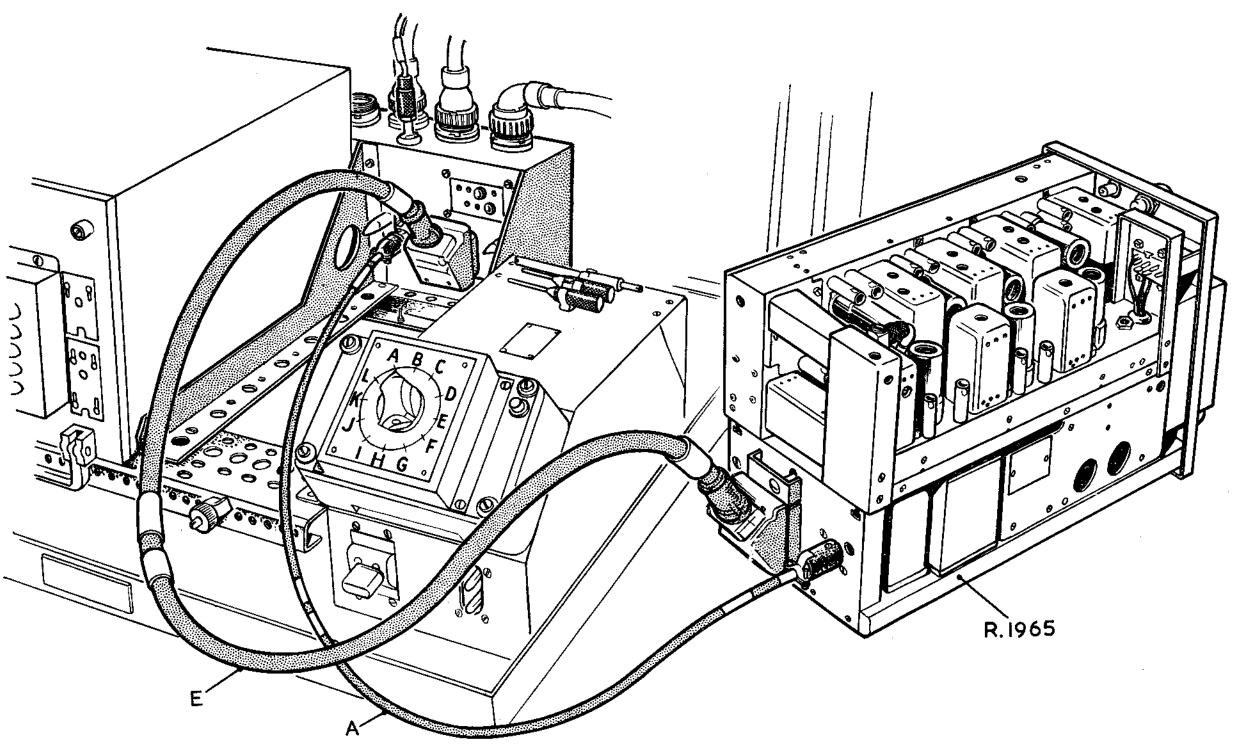

Fig. 13. Receiver operating out of rack

3986) to connect between the glidepath plug on the mixer unit and the glidepath aerial plug on the R.1965.

(16) Set the function switch on the meter unit to the GLIDEPATH position.

(17) Set the mixer unit control switch to the central (glidepath) position.

(18) Set up the glidepath receiver in accordance with the instructions in A.P. 2534, Vol. 1. The signal gnerator frequency must be found from a chart on the mixer unit, and the signal level is subject to an insertion factor shown also on the chart. To use the chart, note the required glidepath frequency on the left-hand vertical axis)and lay a straight-edge horizontally through this point. Note where the straight-edge cuts the straight-line graph and then lay the straight-edge vertically through this point. Where the straight-edge cuts the horizontal axis is the rquired input frequency. Without moving the straight-edge, note where it cuts the hand-drawn curve and then lay the straight-edge horizontally through this point. Where the straight-edge cuts the right-hand vertical axis is the required insertion factor.

Use of loose connectors

60. The compact design of the ILS receivers makes fault-finding and tuning operations impossible both when the receivers are confined in their mounting racks and when the sub-assemblies are in their fitted positions in the complete receivers. The loose connectors are provided therefore, first to allow the receivers to be operated away from their mounting racks, and second to allow individual sub-assemblies to be operated apart from the parent receiver.

61. Fig. 13 shows how connector Type 3984 (fig. 12(E) and connector Type 3983 (fig. 12(A)) are used to allow the R.1965 to be operated away from the rack. The first connector is held to the junction box by two long-shanked Oddie fasteners with wing heads, and is held to the receiver by a single captive screw. The ends of the second connector, which carries the local oscillator signal, are simple push fits on the plug of the junction box and the socket of the receiver.

62. The connectors Type 3984 and 3983 are also used on the R.1964 in exactly the same manner as described and illustrated for the R.1965. Only one each of these connectors is provided so that only one of the receivers can be operated apart from the rack at any one time.

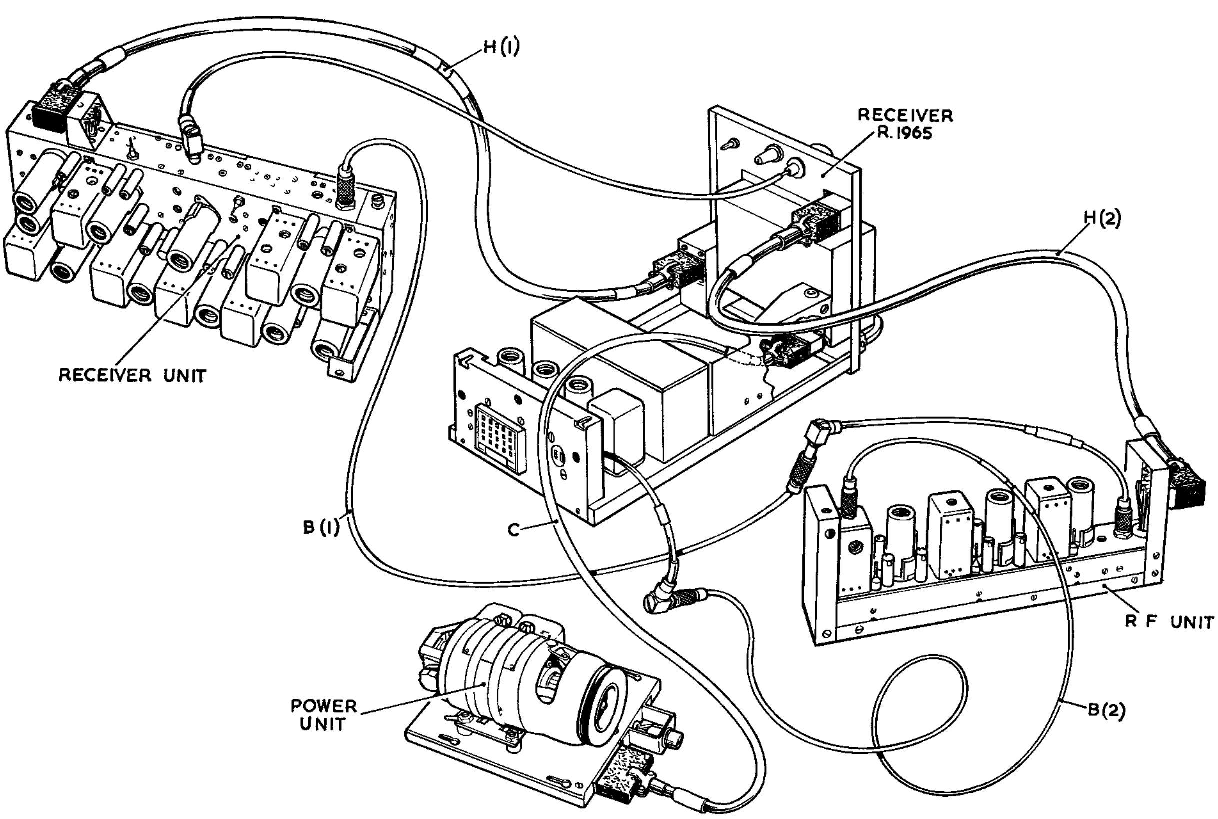

Fig. 14. Sub-assemblies detached from receiver

63. Individual units of a receiver can be detached and operated apart from the receiver with the receiver either in or out of the rack. Sufficient connectors are provided to allow all sub-assemblies of either receiver to be detached at the same time, but normally it will be convenient to have only one sub-assembly detached at a time. The condition of the R.1965 with all sub-assemblies detached appears in fig. 14.

64. The main sub-assembly of the R.1965 (receiver unit Type 119) uses one of the two connectors Type 3978 (fig. 12(H)) for its main power connections. If the unit is not drawn too far away from the main assembly the existing leads can be used for the aerial and local oscillator connections; otherwise, the two connectors Type 3981 (fig. 12(B)) are used to extend them. Exactly the same conditions obtain with the equivalent unit (receiver unit Type 117) in the R.1964.

65. The small sub-assembly of the R.1965 (RF unit Type 74) also uses a connector Type 3978 for its main interconnections. The existing coaxial connector between the RF unit and the adjoining receiver unit may be sufficiently long to be used direct, when the receiver unit is not detached, but the lead from the rear of the LF unit to the front of the RF unit will need extending by the addition of a connector Type 3981, as shown. The equivalent chassis on the R.1964 uses the same main connector. and the single coaxial connection (to the aerial input point) can be extended as necessary by use of a connector Type 3981.

66. The power unit of the R.1965 is extended on connector Type 10046 as shown in fig. 12. The situation is identical for the power unit in receiver R.1964.

67. If a connection between the mixer unit Type 20 and a receiver aerial plug is required when the receiver is detached from the rack, the connector Type 3986 (para. 59 (11)) may be inconveniently short. Connector Type 3987 should then be used.

Checking frequency of mixer local oscillator

68. The frequency accuracy of the mixer unit output is dependent first upon the accuracy of the input received from the signal generator Type 62, and second on the accuracy of the local oscillator in the mixer unit, and in each instance the crystal calibration facility of the signal generator Type 62 can be used to check the actual frequencies. Details of how to check the signal generator output are given in A.P.2563BN, Vol. 1, and a method of checking the mixer local oscillator is given below:—

(1) Connect power to the signal generator Type 62 and the mixer unit and leave switched on for a warming-up period of at least 30 minutes.

(2) Set the CALIBRATOR switch of the signal generator unit Type 5 to the 10MHz position.

(3) Set the mixer unit switch to the central (marker) position.

(4) Connect a pair of headphones to the TEL socket of the signal generator unit.

(5) Connect the MARKER output plug of the mixer unit to the CAL INPUT plug of the signal generator unit; leave the input plug of the mixer unit unconnected.

(6) Adjust the present FREQUENCY control on the front of the mixer unit until a beat is heard in the headphones; set for zero beat.

(7) Set the CALIBRATOR switch of the signal generator unit to the 1MHz position.

(8) Adjust the mixer FREQUENCY preset more finely for zero beat.

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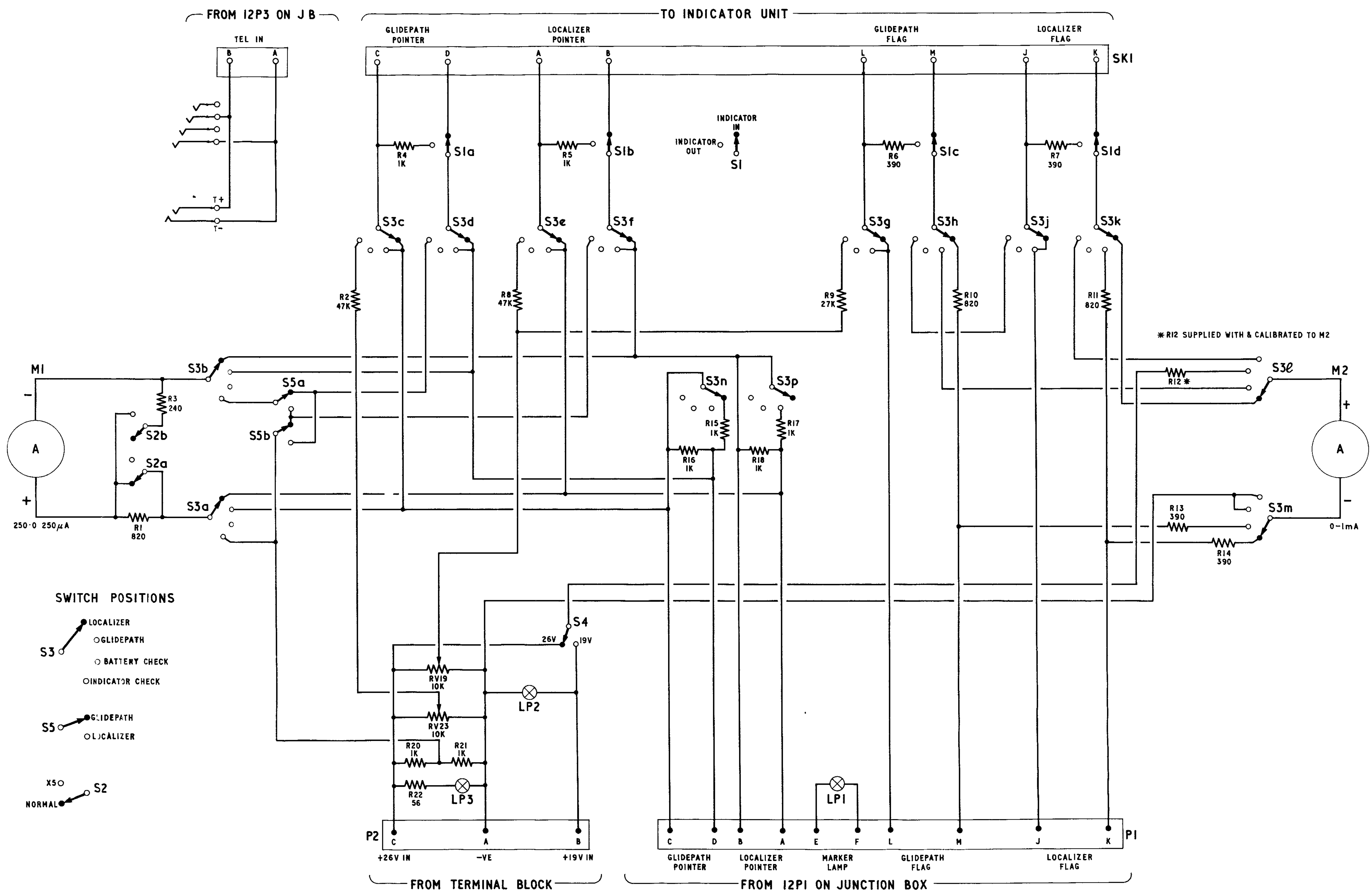


Fig.15 Meter unit Type 397 : circuit Fig.15

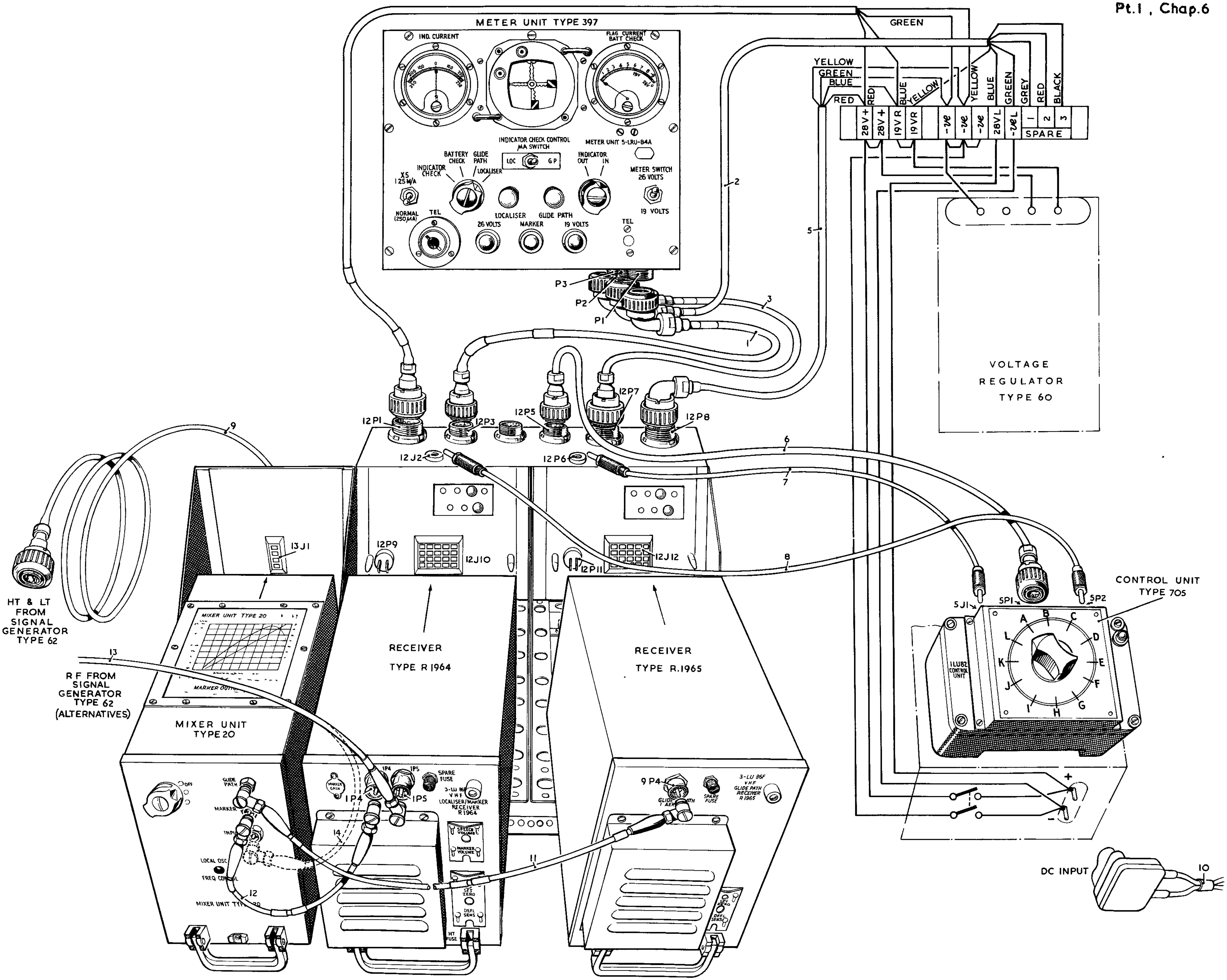


Fig.16
A.L.30, Dec, 68.

Layout of test rig (installation) Type 5

Fig.16

956/4 630724 373534 1859 2/69

PART 2

SERVICING

PART 2

LIST OF CHAPTERS

Note.—*A List of Contents appears at the beginning of each Chapter*

Chapter 1

DISMANTLING AND ASSEMBLING

(This Chapter supersedes that issued with A.L.7)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

RECEIVER TYPE R.1964

1. To obtain access to the units making up the R.1964:—

(1) Position the receiver on the bench with the front panel facing away.

(2) Identify the captive screw on the back of the dust cover above the 20-way plug (1P7) and unscrew completely.

(3) Turn the receiver round to obtain access to the front panel.

(4) Hold the dust cover firmly with one hand, and grasp the handle at the front with the other; pull the handle to withdraw the receiver assembly out of the cover.

Complete dismantling

2. With the cover removed, the three sub-assemblies (power unit Type 797, receiver unit Type 117, receiver unit Type 118) may be removed separately to allow access to the LF unit Type 4, which is the mounting frame. The sub-assemblies may be removed in any order, but the sequence recommended below permits the operation to be carried out with a minimum of difficulties.

3. These dismantling instructions should be read in conjunction with fig. 1 and 2. In these illustrations the positions of the fixing holes, screws, plugs and other items concerned in dismantling are identified by numbers which are referred to in the instructions. The sequence of the numbers is continuous between the two illustrations.

4. The first step towards complete dismantling is to remove the power unit Type 797; this is done as follows:—

(1) Position the receiver (with dust cover removed) on the bench with the underside uppermost and the front panel facing away.

(2) Remove the coaxial plug 1P1 which is accessible from the right-hand side of the chassis and connects to 3J1 on RU117.

(3) Loosen four red-painted screws at positions 12, 14, 19, and 22 on the underside of the power unit mounting plate (*fig.* 1).

(4) Grasp the two handling studs (20) and pull them towards the rear so that the mounting plate slides in the slots 13, 15, 18, 21, and the screws are freed; the power unit should then be in the position shown in fig. 1.

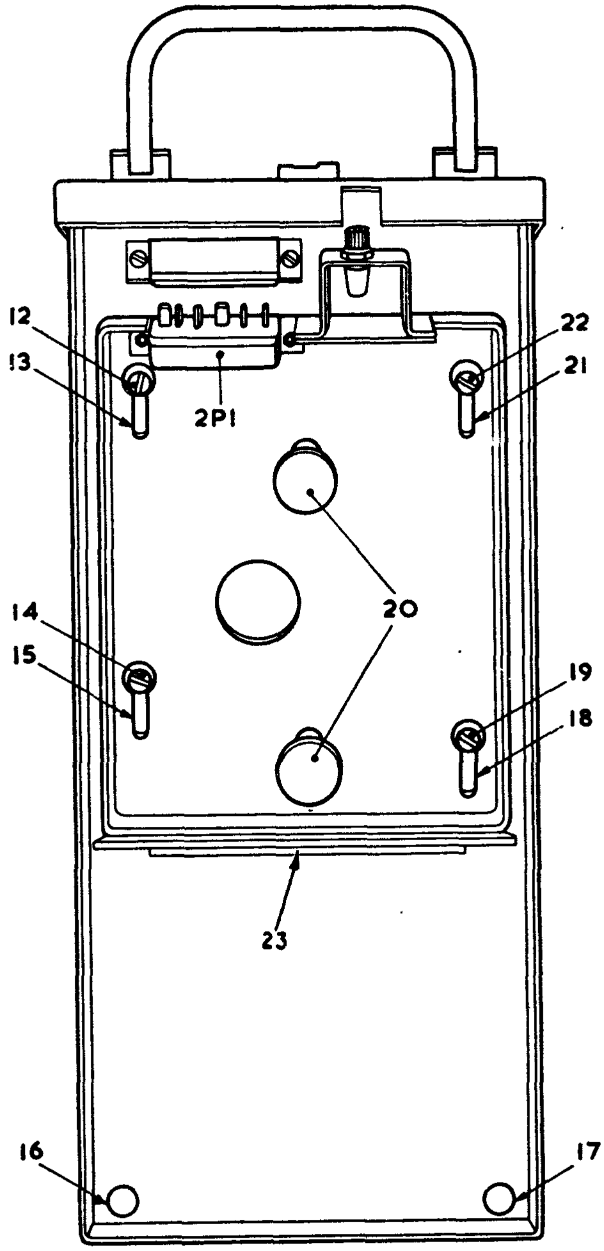


Fig. 1. Fixing points on underside of R.1964 or R.1965

(5) Raise the front end of the power unit by lifting the front handling stud.

(6) Raise the rear end by means of the rear handling stud and pull the unit backwards slightly until its rear edge slips over the flange (23) on the LF unit base.

(7) Lift both ends of the power unit together, and raise the unit forwards and upwards to remove it from the LF unit.

5. With the power unit removed and with the receiver still positioned with its underside uppermost:—

(1) Insert a long narrow-bladed screwdriver into the holes at 4 (*fig.* 2), and 16 and 17 (*fig.* 1), and loosen tł screws 2, 9, and 6 which secure the receiver units to the flanges at the front and rear of the LF unit.

:ceiver top-side up and position it with the front panel facing outwards.

(3) Loosen the red-painted captive screw (1) on the front panel, to free the front of the receiver unit Type 117 (11).

(4) Turn the receiver round for the front panel to face away.

(5) Insert a screwdriver through the hole (24) on the rear plate of the receiver unit Type 118 and unscrew the red-painted screw (5) which holds the two units together. The screw is captive to the rear plate of the receiver unit Type 118 and it must be loosened completely and pulled away, otherwise it tends to restrict the removal of the receiver unit Type 117.

(6) Remove the aerial plug 1P3 from the socket 4J1 on the front end of the receiver unit Type 118.

(7) Grasp the rear end of the receiver unit Type 118 with one hand and pull the unit away from the front panel, assisting the action as necessary by using the other hand to press against the front panel.

(8) The unit slides back to a limit set by the slot 3, that is for about ½ in. and to remove it completely it must be lifted, allowing the head of screw 2 to disengage from slot 3.

6. Complete freedom of access is now possible to the receiver unit Type 117. To complete the dismantling procedure remove the receiver unit Type 117 as follows:—

(1) Remove the local oscillator input plug 1P2 from the socket 3J2.

(2) Grasp the rear end of the receiver unit with one hand and hold the front panel of the LF unit with the other hand; pull the rear of the receiver unit away and remove it completely from the LF unit Type 4.

Removing power unit

7. To remove the power unit alone, follow the instructions given in para. 4.

Removing receiver unit Type 118

8. To remove the receiver unit Type 118 alone:—

(1) Loosen screws 2 and 6 and unscrew completely screw 5 (*through hole* 24, *fig.* 2).

(2) Remove plug 1P3.

(3) Pull the unit backwards and upwards and remove.

Removing receiver unit Type 117

9. To remove the receiver unit Type 117 alone:—

(1) Loosen screw 9 and unscrew completely screws 5 and 1.

(2) Remove the aerial plug 1P1 (with the power unit in position, removal of this plug calls for delicate use of the fingers in the restricted space available beneath the receiver unit).

(3) Pull the unit backwards for about ½ in. to clear the retaining screws and slightly outwards to give access to the inside of the chassis.

(4) Remove plug 1P2 and remove the unit.

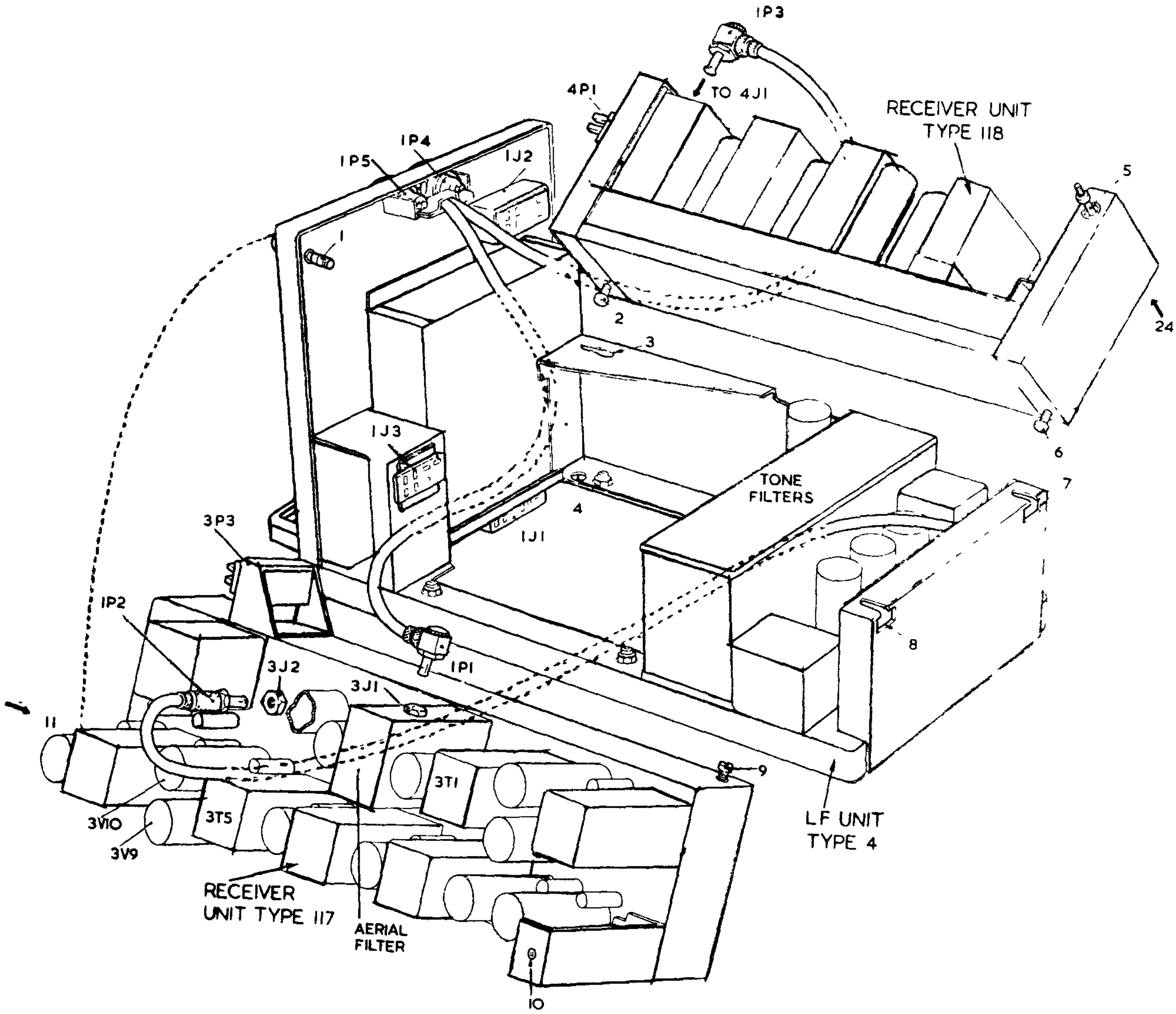


Fig. 2. Fixing points on R.1964

Assembling receiver Type R.1964

10. In general the assembling procedure is the reverse of the dismantling procedure, but special attention is necessary to route the coaxial connectors to the receiver unit Type 117. The procedure is:—

(1) Place the receiver unit Type 117 in position on the right hand side (from the front) of the LF unit Type 4.

(2) Press the unit forward until the Jones plug 3P3 mates with the socket 1J3, and the red-painted screw at the back (9) slides into the slot (8) on the rear plate of the LF unit.

(3) Tighten the red-painted captive screw (1) on the front panel.

(4) Position the localizer aerial plug 1P1 near the socket 3J1; route the cable between 3V9/3V10 and 3T5 so that it will not foul the receiver unit Type 118.

(5) Fit the localizer local oscillator plug 1P2 into the socket 3J2; route the cable beneath the receiver unit so that it passes beneath the coil and 3T1 and lies just to the outside of the aerial filter assembly.

(6) Place the receiver unit Type 118 in position alongside the Type 117 and push it forward until the plug 4P1 mates with the socket 1J2, and the siting screws 2 and 6 slide into place.

(7) Screw up the captive screw 5 to secure the two units together.

(8) Fit the marker aerial plug 1P3 into the socket 4J1.

(9) Turn the receiver over for the underside to face upwards and the front panel to face away.

(10) Screw up the fixing screws 2, 6 and 9 through the holes 4, 16 and 17 respectively.

(11) Position the power unit over its siting hole in the LF unit base plate, and lower the rear end of the rotary transformer through the hole.

(12) Position the rear end of the power plate over the flange 23 of the LF unit base plate

(13) Allow the front of the power unit to pass through the hole, assisting its passage if necessary by rocking the power unit chassis slightly.

(14) The rear end of the power unit should be guided into place.

(15) Slide the power unit forward until the Jones plug 2P1 mates with the socket 1J1 and the fixing screws slide into place.

(16) Tighten up the screws 12, 14, 19, and 22.

(17) Insert the coaxial plug 1P1 into the socket 3J1 of the receiver unit Type 117.

Assembling units separately

11. The receiver unit Type 118 may be assembled when the other two units are in position in the manner described in para. 10, sub-para. (8) to (10), and the manner of fitting is the same whether or not the other units are in position. Similarly with the power unit, para. (11) to (15) always apply. With the receiver unit Type 117, however, the method is slightly different.

12. To fit the receiver unit Type 117 when the other two units are in position the following procedure should be followed:—

(1) Fit the local oscillator input plug 1P2 into the socket 3J2.

(2) Route the lead to 1P2 to lie at the bottom of the receiver unit Type 118.

(3) Pull the lead carrying the localizer aerial plug 1P1 downwards beside the rotary transformer.

(4) Place the receiver unit in position on the LF unit Type 4 and check that the local oscillator lead is not fouled and the aerial lead is still visible beside the rotary transformer.

(5) Press the unit forward and tighten the captive screw 1 and the end fixing screw 9.

(6) Fit the aerial plug 1P1 into the socket 3J1.

13. In practice it may be found that a certain amount of manipulation is necessary to keep the wires routed properly whilst the unit is pushed into position and also whilst fitting the aerial plug. Thus, to simplify the procedure of assembling the receiver unit Type 117, the receiver unit Type 118 should first be removed. The assembling instructions of para. 10 should then be followed.

Access to receiver unit Type 117

14. The receiver unit Type 117 is mounted on its side on the LF unit Type 4. The base cover plate of the receiver unit is at the side of the assembly. If this base plate is removed by releasing the five Oddie fasteners on the plate, most of the under-chassis of the receiver unit is exposed to view. A small cover held by six 6 BA screws must be removed to allow access to the local oscillator multiplier stages, and a third cover, held by five 6 BA screws, screens the second local oscillator stage.

chassis tuned circuits are protected by screening covers held by two 4 BA screws. Each cover is earthed when in position by four spring strips affixed to the base plate of the transformer assembly. These strips clip between the base plate and the sides of the cover. It is of the greatest importance that when a cover is being fitted all four strips are clamped inside the cover. This matter is stressed because the covers can be fitted easily if one or more of the strips is left outside, but considerable manipulation is required normally if all four are to be taken in.

16. The process whereby a cover is fitted is dependent upon the difference in length between the side strips and the other two, the side strips being the longer. The procedure is:—

(1) Remove the valve or valves immediately adjacent to the transformer to afford easier access to the strips.

(2) Place the cover over the coil assembly.

(3) Use a small screwdriver to squeeze either of the two side strips against the coil base, and slip the edge of the cover over that strip.

(4) Squeeze the other side strip against the base, and slip the cover over it without allowing the first strip to spring free.

Note . . .

If a set of long, thin-bladed dividers is available, operations (3) and (4) can be carried out at the same time, and the cover can be fitted over both side strips in one action.

(5) Rock the cover forward slightly and squeeze the rear strip to the base so that the cover can be slipped over it.

(6) Rock the cover backward slightly and squeeze the front strip to the base so that the cover can be slipped over it.

(7) Press the cover down to the chassis and fit the two securing screws.

17. The aerial input filter must be detached in its entirety before its cover plate can be removed and access obtained to the internal components. The procedure is:—

(1) Disconnect the wires to the local oscillator multiplier transformer 3L5/3L6. They are:—

  (a) Blue lead from outside end of 3L5.

  (b) 10K resistor and 330 pF capacitor from inside end of 3L5.

  (c) Red end of twisted pair from inside end of 3L6.

  (d) Blue end of twisted pair from tap near inside end of 3L6.

(2) Remove two 6 BA countersunk screws holding the 3L5/3L6 former to the flange of the chassis and detach the former.

(3) Locate the grid pin on the holder of 3V4 and move aside the surrounding components to improve access.

(4) Unsolder the connections of the aerial filter coaxial cable from the grid pin and the adjacent earthing point.

(5) Pull the short length of coaxial cable through the grommet in the screening partition.

(6) Remove three 6 BA screws left accessible by the removal of 3L5/3L6 and remove the aerial filter unit.

The access cover to the filter is at the side and is held by four 8 BA screws.

18. The second local oscillator (oscillator unit Type 333) will normally be replaced in its entirety if faulty. The procedure for removal is:—

(1) Unsolder the three wires from a tag strip on the partition separating the oscillator unit from the main under-chassis. The wires are:—

   (a) Red wire to outside end of strip.

   (b) Clear wire to centre tag.

   (c) Brown wire to inside (nearest chassis) of strip.

(2) Withdraw the three wires through the hole in the chassis.

(3) Remove two 4 BA countersunk screws from the rear flange and one from the side flange of the main chassis at the corner by 3V3.

(4) Remove three 4 BA screws from the top plate of the oscillator unit.

(5) Withdraw the unit from the main chassis.

Access to receiver unit Type 118

19. The screening cover on the underside of the receiver unit Type 118 can be removed by extracting six 4 BA countersunk screws, three on each flange of the cover, to permit access to the under-chassis components.

20. The diode detector valve is fitted in a clip on the inside of the end flange of the chassis. Four leads into the valve must be unsoldered before it can be removed. They are:—

(1) Brown lead (heater) to brown lead on strip.

(2) Double blue lead (anode) to orange lead on strip.

(3) White lead (cathode) to green lead on strip.

(4) Brown lead (heater) to black lead (earth) on strip.

Access to power unit Type 797

21. The HT brushes are directly accessible when the power unit is detached from the receiver. For access to the LT brushes remove the screws securing the end cover of the rotary transformer Type 264. One of the screws is reached through a hole in the chassis of the power unit. The rotary transformer itself can be removed as follows:—

(1) Disconnect the wiring on the underside of the base plate:—

   (a) Two black leads and one brown lead from chassis.

   (b) Red lead from tag on filter, 2SU2.

   (c) Two black leads from tag on filter, 2SU1.

(2) Loosen the captive fixing screws on the two straps encircling the frame of the rotary transformer.

(3) Detach the rotary transformer.

22. When re-fitting a rotary transformer, it is to be positioned with the nameplate upwards and the impeller fan end of the transformer at the plug-and-fuse-end of the base plate. The two fixing straps are self-positioning by dimples which locate into holes in the underside of the transformer mounting plate.

RECEIVER TYPE R.1965

23. The glidepath receiver Type R.1965 is structurally similar to the R.1964, and in consequence the instructions for dismantling and assembling are very similar. To prevent unnecessary cross-referencing, however, separate instructions are provided, except for removal of the outer cover. The identifying numbers in fig. 3 correspond with those of fig. 2 where these points are similar.

Complete dismantling

24. To dismantle the receiver Type R.1965:—

(1) Remove the dust cover (*para.* 1) and the power unit. The instructions in para. 4 should be followed omitting operation (2).

(2) With the underside of the receiver assembly facing upwards, loosen the red-painted screws 2, 6 and 9 (*fig.* 3) through the access holes at 4 (*fig.* 3), 16 and 17 (*fig.* 1).

(3) Remove the aerial plug 9P5 from the socket 8J1 (*fig.* 3) and the local oscillator input plug 9P6 from the socket 8J2 on the underside of the receiver unit Type 119.

(4) Turn the receiver top-side up and position it with the rear panel facing away.

(5) Loosen the red-painted screw 1 on the front panel to free the front of the receiver unit Type 119.

(6) Turn the receiver round for the front panel to face away.

(7) Unscrew the red-painted screw 5 accessible through hole 24 in the rear plate of the RF unit Type 74.

(8) Remove the local oscillator input plug 9P3 from the socket 10J1 on the RF unit Type 74.

(9) Pull the RF unit Type 74 away from the front panel and remove the RF unit from the LF unit chassis. The lead to 9P6 will come away with the RF unit.

(10) Withdraw the receiver unit Type 119 from the front panel, disengage the screw 9 from the slot 8 and remove the receiver unit.

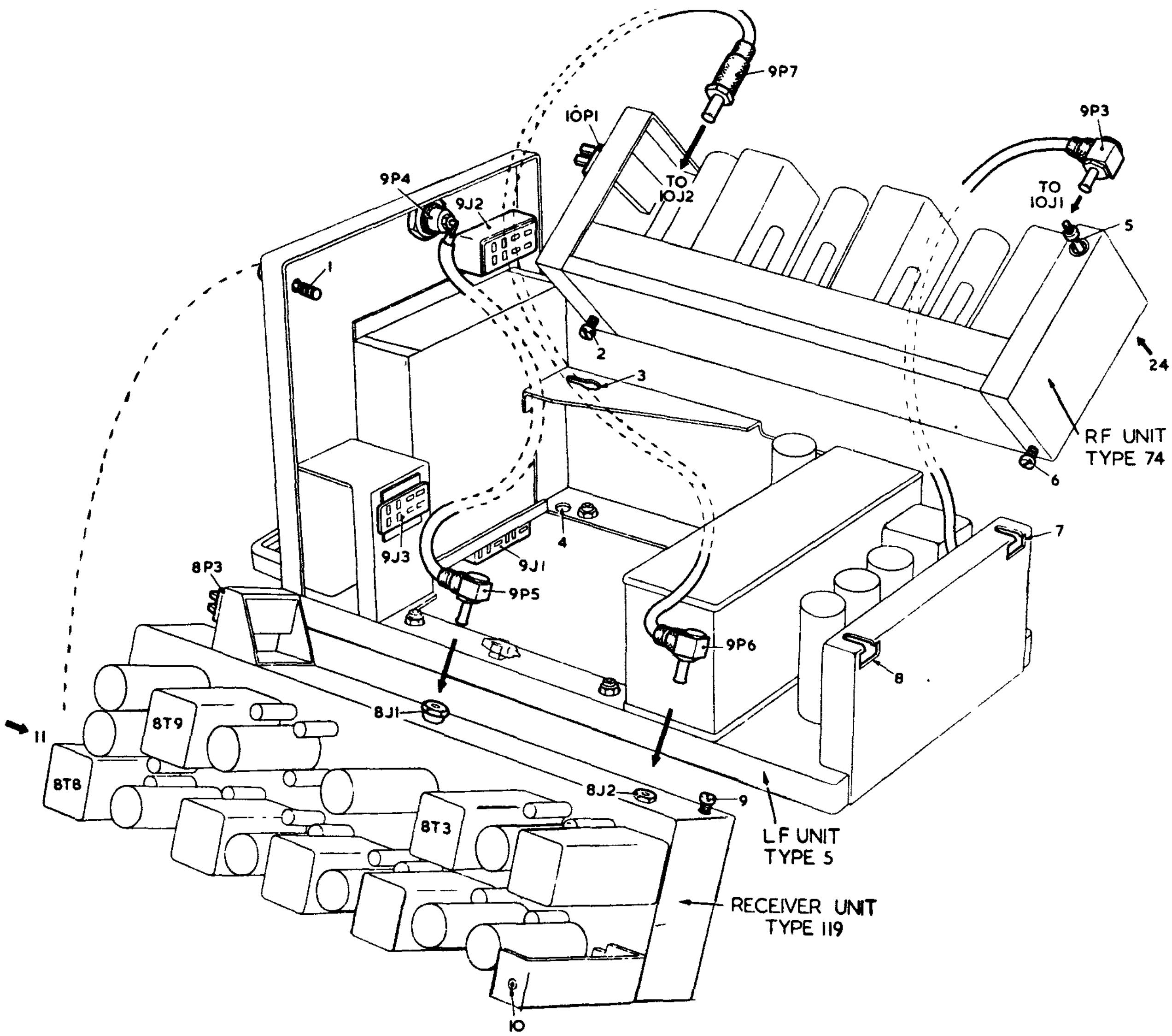


Fig. 3. Fixing points on R.1965

Removing power unit

25. To remove the power unit alone, follow the instructions given in para. 4 with the exception of sub-para. (2).

Removing RF unit Type 74

26. To remove the RF unit Type 74 alone:—

(1) Loosen screws 2 and 6 and unscrew completely the screw 5 through the hole 24.

(2) Remove plugs 9P3 and 9P7.

(3) Pull the unit backwards and upwards and remove.

Removing receiver unit Type 119

27. To remove the receiver unit Type 119 alone:—

(1) Loosen screw 9 and unscrew completely screws 1 and 5.

(2) Remove the aerial plug 9P5 and the local oscillator input plug 9P6.

(3) Pull the unit away from the front panel and remove.

Assembling receiver Type R.1965

28. In general the assembling procedure is the reverse of the dismantling procedure, but special attention must be paid to the routeing of the coaxial connectors. The procedure is:—

(1) Place the receiver unit Type 119 in position on the right-hand side (as viewed from the front) of the LF unit Type 5.

(2) Press the unit forward until the Jones plug 8P3 mates with the socket 9J3, and the red-painted screw 9 slides into the slot 8.

(3) Screw up the red-painted captive screw (1) on the front panel.

(4) Route the coaxial connector from the plug 9P4 on the front panel, beneath 8T8 and above 8T9, and fit the plug 9P5 into socket 8J1 on the flange of the receiver unit chassis; loop the excess length of cable underneath the flange to prevent the cable fouling the RF unit.

(5) Fit the angle-entry plug-end (9P6) of the free connector into the socket 8J2; route the connector beneath 8T3.

(6) Place the RF unit Type 74 at the side of the LF unit Type 5 and fit the local oscillator input plug 9P3 in position in the socket 10J1, and the straight-entry end (9P7) of the free connector in position in 10J2.

(7) Place the RF unit in position beside the receiver unit Type 119 and push the RF unit forward until the plug 10P1 mates with the socket 9J2.

(8) Check that the cables are not fouling, and press the excess lengths of cable into the gap between the two units.

(9) Screw up the captive screw 5 to secure the units together.

(10) Turn the receiver over for the underside to face upwards and the front panel to face away.

(11) Screw up the red-painted screws 9, 6 and 2.

(12) Position the power unit over its siting hole in the base plate of the LF unit Type 5, and lower the rear end of the rotary transformer through the hole.

(13) Position the rear end of the power unit base plate over the flange 23 (*fig.* 1).

(14) Allow the front of the power unit to pass through the hole, assisting its passage if necessary by rocking the power unit chassis slightly.

(15) The rear end of the power unit should be guided into place.

(16) Slide the power unit forward until the Jones plug 2P1 mates with the socket 9J1, and the fixing screws slide into place.

(17) Tighten up the fixing screws (12, 14, 19, 22, *fig.* 1).

Assembling units separately

29. To assemble the RF unit separately follow the instructions of para. 28, sub-para. (6), (7), (8), (9), and (10), and complete the operation by tightening the screws 2 and 6. To assemble the receiver unit Type 119 separately follow the instructions of para. 28 in the following order:—sub-para. (4), (1), (2), (3), (5), (10), and complete the operation by tightening screw 9. To assemble the power unit carry out the instructions of para. 28, sub-para. (12) to (17).

Access to receiver unit Type 119

30. As with the receiver unit Type 117, access to the under-chassis of the Type 119 is possible with the unit in position after a cover plate is removed. The cover plate is secured by five Oddie fasteners. The inner chassis screens (which differ slightly from those on the receiver unit Type 117) are:—

(1) Large screen—over the first-mixer and the first-IF stages—held by seven 6 BA screws.

(2) Smaller screen—over the aerial input stage —held by six 6 BA screws.

(3) Small screen—over the second-local oscillator stage—held by five 6 BA screws.

31. The second-local oscillator stage (oscillator Type 334, 8V3) is sited in the same relative position as the equivalent stage on the receiver unit Type 117, and its dismantling and assembling details, including wire coding, are the same as those given in para. 18. The instructions for fitting the coil screens are also as given in para. 15 and 16.

Access to RF unit Type 74

32. The RF unit Type 74 is generally similar to the receiver unit Type 118 and its underside is accessible on the removal of a screening cover held by six 4 BA screws, three on each side of the chassis flange.

CONTROL UNIT TYPE 705

33. Access to the control unit wiring and main circuit components requires the removal of the rear screening cover. The three connectors, 5P1, 5P2 and 5J1 must be removed from the control unit before undoing the cover fasteners. The cover is held by two Oddie fasteners at the rear, and can be pulled away to give complete freedom of access when the fasteners are unclipped.

34. The crystals are protected by a front cover fitted behind the control knob. For access four Oddie fasteners set around the cover must be unclipped, and the cover, together with the knob, may then be removed. When replacing the cover, the knob is turned for the flat on the inside of the coupling shaft to be in line with the corresponding flat on the switch spindle.

Chapter 2

SETTING-UP PROCEDURE

(This chapter supersedes that issued with A.L.13)

LIST OF CONTENTS

LIST OF REQUIRED TEST EQUIPMENT

	Stores Ref.		Stores Ref.
Test rig (installation) Type 5	10S/16378	*Multimeter Type 1*	10S/16411
Signal generator Type 62	10S/16318	*Output meter Type 2*	10S/11934
Signal generator Type 69	10S/16377	*Headset Type 9*	10AH/14

LIST OF ILLUSTRATIONS

Notes on signal generators

1. Signal generators Type 62 and 69 were designed particularly to satisfy the stringent test requirements of ILS airborne equipments; the Type 62 provides the RF signals and the Type 69 supplies modulation. The frequency range of the Type 62, however, covers only the localizer range direct, and an ancillary frequency-changer unit, the mixer unit Type 20, is supplied as part of the ILS test rig Type 5 to extend this range to cover the marker and glidepath frequencies.

2. Each signal generator is contained in two separate units, a signal generator unit and a power unit. In the Type 62 they are described as follows:—

Signal generator unit Type 5 (Stores Ref. 10S/16402)

Power unit Type 836 (Stores Ref. 10K/17071).

In the Type 69 they are:—

Signal generator unit Type 7 (Stores Ref. 10S/16416)

Power unit Type 843 (Stores Ref. 10K/17091).

For convenience in the following text the signal generator units will be described as S.G.U.5 and S.G.U.7 respectively.

3. It is of particular importance in ILS testing that the modulation levels of the test signals are accurately set to be the same as those of ILS beacons, and in consequence signal generators must be set up with special care to ensure this accuracy. In practice, however, the calibration accuracy of the S.G.U.5 modulation meter is highest near the centre of its range and setting up therefore must be carried out with this in view. Because modulation setting up must be carried out frequently throughout the ensuing procedures, the routines are given separately in para. 12 and 13 and reference must be made to these paras. whenever the modulation or carrier frequencies are changed in the actual receiver setting-up procedures. The local oscillator frequency of the mixer unit Type 20 must be checked at frequent intervals as the input frequency to the marker and glidepath receivers is dependent upon the mixer unit oscillator frequency. The procedure for adjustment of the mixer oscillator is given in para. 17 to 22.

Power supplies

4. A DC supply of 26V (nominal), 250W, is required for operating the test rig. The general working limits of the supply are from 22·5V to 29V, as shown by a red sector on the input meter, but for actual receiver testing the supply should be within the limits of 26V and 28V.

5. The signal generators require a 45 c/s to 65 c/s AC supply at a voltage in the ranges from 100V to 120V and 200V to 250V. HT and LT for the mixer unit Type 20 are derived from the power unit of the signal generator Type 62.

Preparation of test rig

6. Set up and connect the main bench installation as follows:—

(1) Check the mains tappings of the signal generator power units.

(2) Prepare the signal generator Type 62 by connecting the POWER SUPPLY plug of the S.G.U.5 to the SIGNAL GENERATOR socket in the power unit Type 836, and by connecting a mains supply to the plug marked 110/250V 50 c/s on the power unit.

(3) Set up the signal generator Type 69 by connecting the LT HT OUTPUT socket on the power unit Type 843 to the LT HT INPUT plug on the S.G.U.7 and by connecting a mains supply to the plug marked 110/250V 50 c/s on the power unit.

(4) Connect the output jack or terminals on the S.G.U.7 to the EXT. MOD. jack on the S.G.U.5.

(5) Connect the lead from the rear of the mixer unit Type 20 of the test rig (installation) Type 5 to the ILS FREQUENCY CHANGER socket on the power unit Type 836.

(6) Set the output meter Type 2 to the 500 mV, 30 ohms range and connect it to one of the TEL jacks on the meter unit of the test rig Type 5.

(7) Check that the power switch at the right-hand front corner of the test rig is off (up); if this switch is made when receivers are not fitted in the test rig the voltage regulator might be damaged.

(8) Connect the DC supply to the test rig.

(9) Switch on both signal generators and leave for a warming-up period of at least 15 minutes before use.

Checking indicator (electrical) Type 7

7. The ILS crossed pointer indicator can be tested in the meter unit of the test rig independently of the receiver side of the test rig. Thus it is not necessary to make the test rig power switch, or have receivers fitted in the rack, when an indicator is under test. The procedure for testing the indicator (electrical) Type 7 is as follows:—

(1) Remove the fitted indicator from the test rig and substitute the indicator to be tested.

(2) On the meter unit of the test rig set the function switch to BATTERY CHECK and the METER SWITCH to 26V: note that the right-hand meter reads within the right-hand sector.

(3) On the meter unit set the X5–NORMAL switch to NORMAL, the INDICATOR switch to IN, and the INDICATOR CHECK CONTROL switch to LCC.

(4) Set the meter unit function switch to INDICATOR CHECK.

(5) Adjust the LOCALIZER control on the meter unit for a centre-zero reading of the left-hand meter: the vertical (localizer) pointer should read centre-zero.

(6) Adjust the LOCALIZER control for a meter reading of 150 μA right: the vertical pointer should move to the fifth dot left (circle counts as first dot).

(7) Move the INDICATOR switch momentarily to the OUT position and note that the reading of the left-hand meter does not change; if the reading changes the resistance of the pointer movement is incorrect.

(8) Adjust the LOCALIZER control for a meter reading of 150 μA left: the vertical pointer should read to the fifth dot right.

(9) Adjust the LOCALIZER control to produce a reading of the right-hand meter over the range from zero to 0·45 mA: note that both localizer and glidepath flags start to move between 0·175 mA and 0·2 mA, and 0·225 mA are out of sight A1 /
between 0·4 mA and 0·425 mA.

(10) Set the LOCALIZER control for a reading of 0·45 mA and momentarily move the INDICATOR switch to OUT: the reading of the meter should not change.

(11) Set the INDICATOR CHECK control to the G.P position.

(12) Adjust the GLIDEPATH control for a centre-zero reading of the left-hand meter: the horizontal (glidepath) pointer should read centre zero.

(13) Adjust the GLIDEPATH control for a meter reading of 150 μA right: the horizontal pointer should read to the fifth dot down.

(14) Move the INDICATOR switch momentarily to the OUT position and note that the reading of the meter does not change.

(15) Adjust the GLIDEPATH control for a meter reading of 150 μA left: the horizontal pointer should read to the fifth dot up. Note that pointers and flags move smoothly and return to zero without sticking, and that the two pointers do not touch in the extreme positions, particularly when the localizer pointer is fully right and the glidepath pointer is fully down.

Setting-up localizer output circuits

8. To set up the localizer circuits of the R.1964:—

(1) Remove the dust cover from the receiver R.1964 to be tested and insert the receiver in the left-hand rack of the test rig.

(2) Set up the S.G.U.5 and S.G.U.7 for an output at 110 Mc/s modulated under localizer marker conditions at 90 + 150 c/s (*para.* 13) and with the S.G.U.7 DECIBELS switch set to "0" dB.

(3) On the S.G.U.5 set the ATTENUATOR for an output of 40 dB (1 mV).

(4) Use the coaxial connector provided with the signal generator Type 62 to connect between the RF OUTPUT plug of the S.G.U.5 and the LOC aerial plug (1P5) of the R.1964.

(5) On the control unit Type 705 in the test rig select the mid-band localizer channel at 110·0 Mc/s (ILS channel 20: localizer crystal at 10,175·0 kc/s).

(6) Switch on the power switch of the test rig to operate the R.1964.

(7) On the meter unit of the test rig set the function switch to BATTERY CHECK and the METER SWITCH to the 19V and 26V positions in turn: check that the 26V supply is between 26V and 28V and 19V supply reads within the appropriate red sector of the right-hand meter.

(8) On the meter unit set the INDICATOR switch to IN, check that the X5–NORMAL switch remains at NORMAL, and set the function switch to LOCALIZER.

(9) Tune the S.G.U.5 more accurately to the receiver frequency by turning the FREQUENCY control for a maximum reading of the right-hand meter (flag current) of the meter unit.

(10) At the right-hand rear of the R.1964 adjust the flag sensitivity preset (1R8) for a reading of 0·45 mA on the right-hand meter.

(11) Reduce the output from the S.G.U.5 until there is a sudden drop in the flag current: this indicates that AGC action has ceased.

(12) Retune the S.G.U.5 for maximum flag current, if necessary further reducing the RF output and further retuning to obtain the exact tuning point.

(13) Recheck modulation depth (*para.* 13).

(14) On the S.G.U.5 reset the ATTENUATOR for an output of 40 dB.

(15) Re-adjust the flag sensitivity (1R8) for a flag current of 0·45 mA.

(16) Turn the ATTENUATOR of the S.G.U.5 over a range from 0 dB to about 77 dB (100 mV and 15 μV) and note the flag current: for satisfactory AGC the current should remain reasonably constant over the whole range.

(17) Re-set the output of the S.G.U.5 to 40 dB (1 mV).

(18) Lift the lower preset cover on the R.1964 and adjust the top preset control (SET ZERO) for centre zero reading of the left-hand meter of the meter unit.

(19) On the S.G.U.7 set the DECIBELS switch to "+4".

(20) Adjust the lower preset (DEFL SENS) on the R.1964 for a deflection of 90 μA on the left-hand meter; the localizer pointer should deflect right.

(21) On the S.G.U.7 set the DECIBELS switch to "−4".

(22) The left-hand meter should read 90 μA and the localizer pointer should deflect left.

(23) On the S.G.U.7 set the FREQUENCY switch to "1,000" and adjust the S.G.U.5 for correct modulation depth as in para. 15.

(24) Lift the upper preset cover on the R.1964 and adjust the top preset (3R66) SPEECH VOLUME for a reading of 225 mW on the output meter Type 2.

Note . . .
The required SPEECH VOLUME *level will depend upon the type of aircraft in which the receiver is to be installed. If this is known the preset should be adjusted to the required operational level after it has been determined that 225 mW can be produced.*

Setting-up marker receiver

9. To set up the marker circuits of the R.1964 continue as follows:—

(1) On the mixer Type 20 of the test rig, set the control switch to the clockwise (marker) position.

(2) Transfer the output lead of the S.G.U.5 from the aerial plug on the R.1964 to the INPUT plug on the mixer unit Type 20.

(3) Connect the lead Type 3986 (short coaxial connector supplied with test rig) between the MARKER output plug of the mixer unit and the marker aerial plug (1P4) on the R.1964.

(4) Tune the S.G.U.5 to 130 Mc/s; refer to para. 17.

(5) Set up the S.G.U.5 and S.G.U.7 for localizer/marker modulation at 1,300 c/s: refer to para. 15.

(6) Adjust the S.G.U.5 ATTENUATOR for a reading on the output meter.

(7) Tune the S.G.U.5 for a maximum reading on the output meter.

(8) Note the marker insertion factor stated on the mixer unit chart and set the ATTENUATOR of the S.G.U.5 to 40 dB (1 mV) plus or minus the insertion factor (in dB's), so that the actual input to the marker receiver is 40 dB (1 mV).

(9) Check that the marker lamp is alight and that it extinguishes if the signal generator output is reduced by 3 dB: note that the lamp again lights when the output is increased to 40 dB (1 mV).

(10) It the lamp does not respond correct proceed as follows:—

(a) Switch off power to the R.1964 by operating the switch on the test rig.

(b) Identify the diode 4V5 at the rear of the chassis of the receiver unit Type 118 (marker unit).

(c) Identify the blue anode lead of 4V5 and its connection point on the tag strip below the valve.

(d) Connect the multimeter Type 1 set to the 25V AC range (or any valve-voltmeter) between this anode point and chassis.

(e) Switch power on to the R.1964.

(f) Open the preset cover at the top left-hand corner of the front of the R.1964 and adjust 4R15 (MARKER GAIN) for a reading of 4·5V on the multimeter.

(g) Turn preset 4R26 (rear of marker unit) until lamp goes out, then turn back until lamp just lights.

(h) Check that with RF input of 40 dB (1 mV) (insertion factor included) the lamp lights and that when this input is reduced by 3 dB the lamp goes out: repeat (f) and (g) as necessary to produce this condition.

(j) Disconnect the multimeter.

(11) Set the RF input again for 40 dB (1 mV) and adjust preset MARKER VOLUME (3R67) for an output meter reading of 225 mV. (*Refer to note after para.* 8 (24)).

Setting-up glidepath output circuits

10. To set up the indicator circuits of receiver Type R.1965:—

(1) Insert the R.1965 (with dust cover removed) in the rack beside the R.1964.

(2) On the meter unit of the test rig check that 26V and 19V supplies remain within the limits (*para.* 4).

(3) Set the function switch of the meter unit to the GLIDEPATH position.

(4) Set the switch on the mixer unit Type 20 to the central (glidepath) position.

(5) Transfer the lead Type 3986 to connect between the GLIDEPATH plug on the mixer unit and the AERIAL plug (9P4) on the R.1965.

(6) Refer to the mixer unit calibration chart and note the signal generator frequency required for a glidepath frequency of 332 Mc/s.

(7) Tune the S.G.U.5 approximately to the required frequency and set the ATTENUATOR for an output of 40 dB (1 mV).

(8) Set up the S.G.U.5 and S.G.U.7 for glidepath modulation at 90 + 150 c/s and with the S.G.U.7 switch set to "0" dB.

(9) Set the control unit to select the mid-band glidepath channel at 332 Mc/s (ILS channel 13: glidepath crystal at 15, 444·4 kc/s).

.5 more exactly to the glidepath frequency by tuning for maximum reading of the right-hand (flag) meter of the meter unit.

(11) At the right-hand rear of the R.1965 adjust the flag sensitivity preset (9R2) for a reading of 0·45 mA on the right-hand meter.

(12) Reduce the output from the S.G.U.5 until a sudden drop in flag current occurs: this indicates that AGC action has ceased.

(13) Retune the S.G.U.5 for maximum flag current, if necessary further reducing the signal generator output to obtain the exact tuning point.

(14) Recheck modulation depth (*para.* 13).

(15) On the S.G.U.5 reset the ATTENUATOR to 40 dB (1 mV).

(16) Re-adjust 9R2 (flag sensitivity) for a flag current of 0·45 mA.

(17) Note the insertion factor on the mixer unit Type 20 chart and turn the ATTENUATOR slowly over the range of 0 to 71 dB (100 mV to 30 μV) plus or minus the insertion factor of the mixer unit, and note that the flag current remains reasonably constant over this range (this checks the effectiveness of the AGC).

(18) On the S.G.U.5 reset the ATTENUATOR for an output of 40 dB (1 mV) plus or minus the insertion factor.

(19) On the R.1965 lift the preset cover and adjust the upper preset (SET ZERO) for centre-zero reading of the left-hand meter of the meter unit. The glidepath needle of the ILS indicator should be horizontal.

(20) On the S.G.U.7 set the DECIBELS switch to "−3".

(21) On the R.1965 lift the preset cover and adjust the lower preset (DEFL SENS) for reading of 135 μA on the left-hand meter of the meter unit: note that glidepath pointer is deflected up.

(22) On the S.G.U.7 set the DECIBELS switch to "+3".

(23) Check that the left-hand meter of the meter unit reads 135 μA and the glidepath point is deflected down.

(24) Switch off the test rig.

(25) Remove both receivers from the test rig, close the slides on their front panels, and lock by inserting wire through each locking pin, twist the wire ends together and solder.

(26) Refit covers on both receivers.

Warning on circuit alignment

11. Alignment of IF, RF, multiplier, and oscillator circuits must be done only at third-line servicing units and the trimmers concerned must not be touched in second and first-line routines. Alignment instructions are given in Vol. 6.

Setting modulation levels

12. Two separate routines are necessary for setting the modulation level of the signal generators, differing according to the type of modulation required. The first routine is followed when the modulation is required at 90 c/s, 150 c/s, or the combined 90 c/s and 150 c/s; that is when the tone circuits of the localizer and glidepath receivers are being set up. The second routine is for modulation at 300 c/s, 400 c/s, 1000 c/s, 1300 c/s, or 3000 c/s; that is when the localizer audio or marker audio and indicator circuits are being set up.

13. To set up the signal generators for tone modulation the procedure is as follows:—

(1) On the S.G.U.5 set the SEVICE switch to EXT. (external modulation condition), the MODULATION switch to SINE, tune to the required signal frequency, and adjust the SET CARRIER control for a reading of the CARRIER meter to the red line.

(2) On the S.G.U.7 set the OUTPUT SELECTOR to G.P. (glidepath), the FREQUENCY switch to 90 c/s and adjust the SET LEVEL control for a reading of the meter to the red line (10V on meter scale).

(3) On the S.G.U.5 adjust the SET MOD. control for a reading of 45 per cent on the MODULATION meter, and check that the carrier level remains correct.

(4) On the S.G.U.7 set the OUTPUT SELECTOR to LOC. and MKR. or leave on G.P., as necessary, and set the FREQUENCY switch to the required ILS tune frequency (90 c/s, 150 c/s, or 90 + 150 c/s).

14. For tone modulation, therefore, the system is first set up for 45 per cent modulation at 90 c/s under glidepath conditions, and the required tone is then selected, either on LOC. or G.P. settings, without further reference to the S.G.U.5 modulation meter. Because frequency selection in the S.G.U.7 automatically sets the output level to be appropriate to the required ILS modulation percentage (*refer to A.P.*2534G, *Sect.* 3, *Chap.* 1) correct modulation level is then ensured. If a modulation-level check is required at any time it must be done by repeating the above procedure and not by referring to the modulation meter.

15. To set up the signal generators for audio modulation the procedure is as follows:—

(1) As before set the S.G.U.5 SERVICE switch to EXT., the MODULATION switch to SINE, tune to the signal frequency, and adjust the SET CARRIER control for a CARRIER meter reading to the red line.

(2) On the S.G.U.7 set the OUTPUT SELECTOR to LOC. and MKR, the FREQUENCY switch to 1000 c/s, and adjust the SET LEVEL control for a reading of the meter to the red line.

(3) On the S.G.U.5 adjust the SET MOD. control for a reading of 30 per cent on the MODULATION meter, and check that the carrier level remains correct.

(4) On the S.G.U.5 set the FREQUENCY switch to the required audio frequency (300 c/s, 400 c/s, 1000 c/s, 1300 c/s, or 3000 c/s).

16. For audio modulation, therefore, the system is first set up for 30 per cent modulation at 1000 c/s under localizer/marker conditions, and the required frequency is then selected without further reference to the S.G.U.5 meter. The level switching associated with frequency selection in the S.G.U.7 then automatically ensures correct modulation level. As before, a modulation-level check must be done by repeating the procedure and not by reference to the modulation meter.

Tuning mixer unit Type 20

17. The calibration accuracy of marker and glidepath test signals is dependent on the frequency of an oscillator in the mixer unit Type 20. Before use, therefore, the setting of the mixer oscillator should be checked against the crystal calibrator of the signal generator Type 62, as follows:—

(1) Ensure that both signal generator Type 62 and the mixer unit have been switched on for at least 30 minutes.

(2) Set the CALIBRATOR switch of the S.G.U.5 to the 10 Mc/s position.

(3) Set the ATTENUATOR of the S.G.U.5 to the 0 dB (i.e., max. output) position and frequency to 130 Mc/s crystal-checked.

(4) Set the mixer unit control switch to the clockwise (marker) position.

(5) Connect a pair of headphones to the TEL socket of the S.G.U.5.

(6) Connect the MARKER output plug of the mixer unit to the CAL INPUT plug of the S.G.U.5: correct the input plug of the mixer unit via Connector Type 3986 R.F. OUTPUT of S.G.U.5.

(7) Adjust the preset FREQUENCY control on the front of the mixer unit until a beat is heard in the headphones: set for zero beat.

Note . . .

Difficulty is sometimes experienced in finding the beat note. Also, occasionally the frequency adjustment control of the mixer unit Type 20 needs excessive rotation to find the beat. If after adjustment of this control a correctly tuned receiver will not respond to signals in the normal manner, the following procedure (para. 18) must be adopted for the adjustment of the mixer unit frequency control.

18. The procedure described in the paragraphs is divided into three stages, thus:—

(1) Adjustment of the signal generator Type 62 to 130 Mc/s.

(2) Coarse adjustment of the mixer unit Type 20 frequency control using a marker receiver (R.1964).

(3) Fine adjustment of the mixer unit frequency control using the inbuilt crystal monitor of the signal generator Type 62.

Stage 1 (fig. 1)

19. The first stage is the adjustment of the signal generator Type 62 to a frequency of 130 Mc/s. The controls of the signal generator are to be set to the following positions.

(1)	ATTENUATOR	set to 0 dB
(2)	SERVICE	set to CW
(3)	CALIBRATOR	set to 10 Mc/s
(4)	MODULATION	set to SINE
(5)	SET CARRIER	adjust the CARRIER meter to read on red line

from the signal generator is to be connected to the CAL INPUT plug (*fig.* 1) via a short connector. Telephones should be inserted into the TEL. jack of the signal generator as shown in fig. 1.

20. With the equipment set up as in para. 19, rotate the FREQUENCY control of the signal generator towards 130 Mc/s on the frequency scale and search for a beat note in the telephones and adjust finely for zero beat.

Stage 2 (fig. 2)

21. With the signal generator Type 62 set up as in para. 20, remove the RF output connector and insert a connector between the RF OUTPUT plug of the signal generator and the INPUT plug of the mixer unit Type 20. Connect a lead from the MARKER output plug of the mixer unit Type 20 to the MARKER AERIAL plug (1P4) of the receiver R.1964. Remove the telephone plug from the signal generator and insert the plug into the TEL. jack of the test rig Type 5. This set-up is illustrated in fig. 2. Proceed as follows:—

(1) Note the frequency scale reading of the signal generator as set to produce 130 Mc/s (*para.* 20).

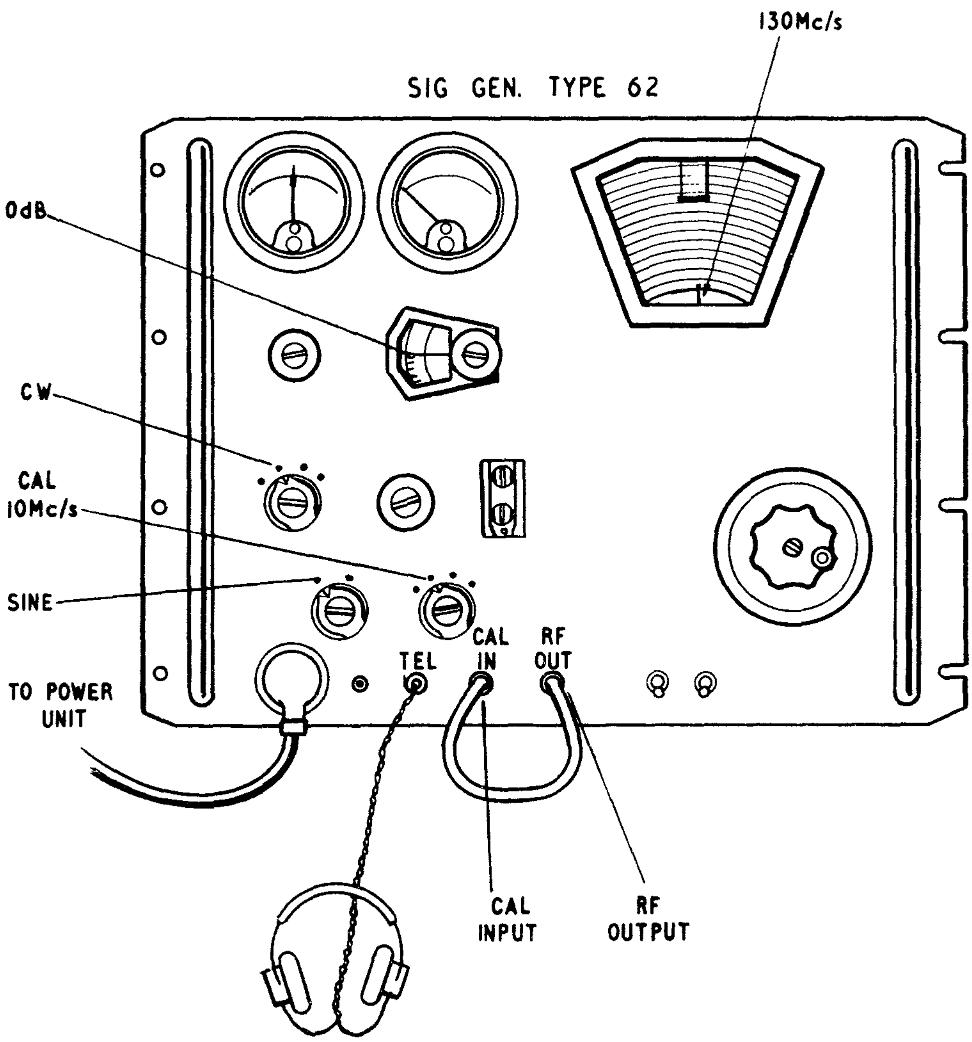


Fig. 1. Tuning mixer unit—stage 1

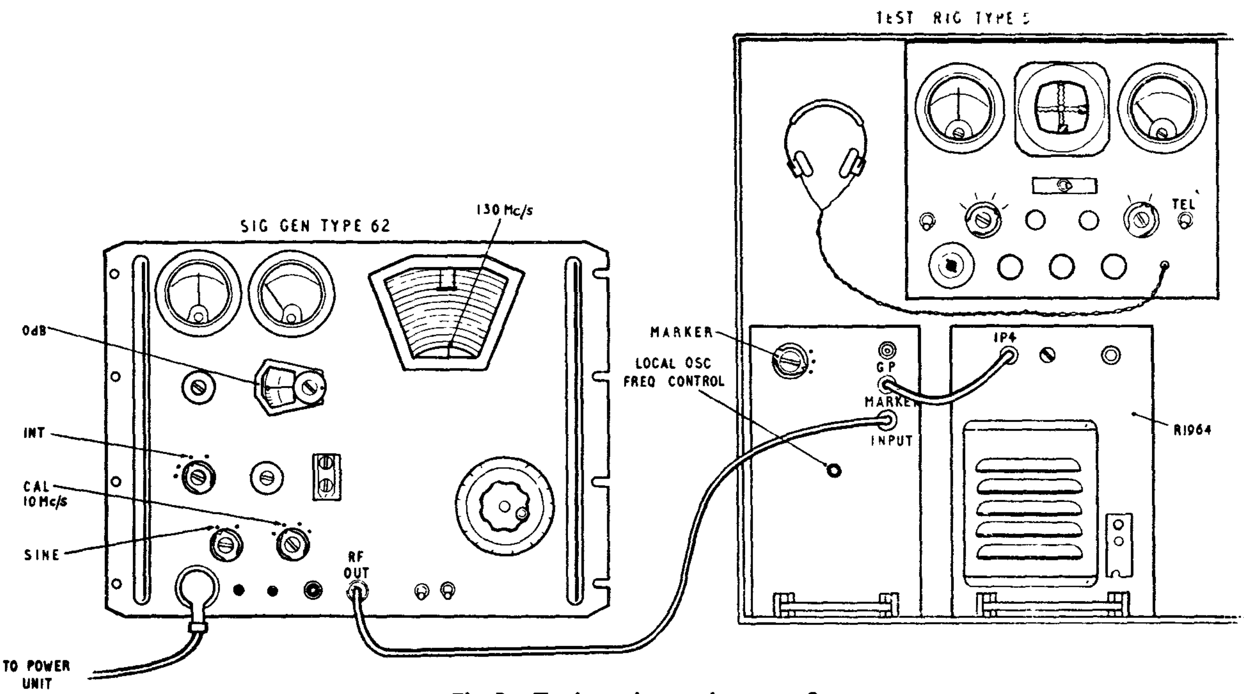


Fig. 2. Tuning mixer unit—stage 2

(2) On the signal generator switch the SERVICE switch to INT and adjust the SET MOD. control for a mod. depth of 30 per cent as indicated on the MODULATION meter. Switch ON the test rig Type 5.

(3) Adjust the FREQUENCY control of the signal generator to produce the maximum volume of sound in the telephones, reducing the setting of the signal generator ATTENUATOR as necessary.

(4) Adjust the FREQUENCY control of the signal generator towards the setting which gives 130 Mc/s (*sub-para.* (1)) to reduce the sound to a convenient level (or until the 130 Mc/s setting is reached). Adjust the LOC OSC FREQ CONTROL on the mixer Type 20 to produce the maximum sound in the telephones.

(5) Switch the SERVICE switch of the signal generator to CW and the ATTENUATOR to 0 dB.

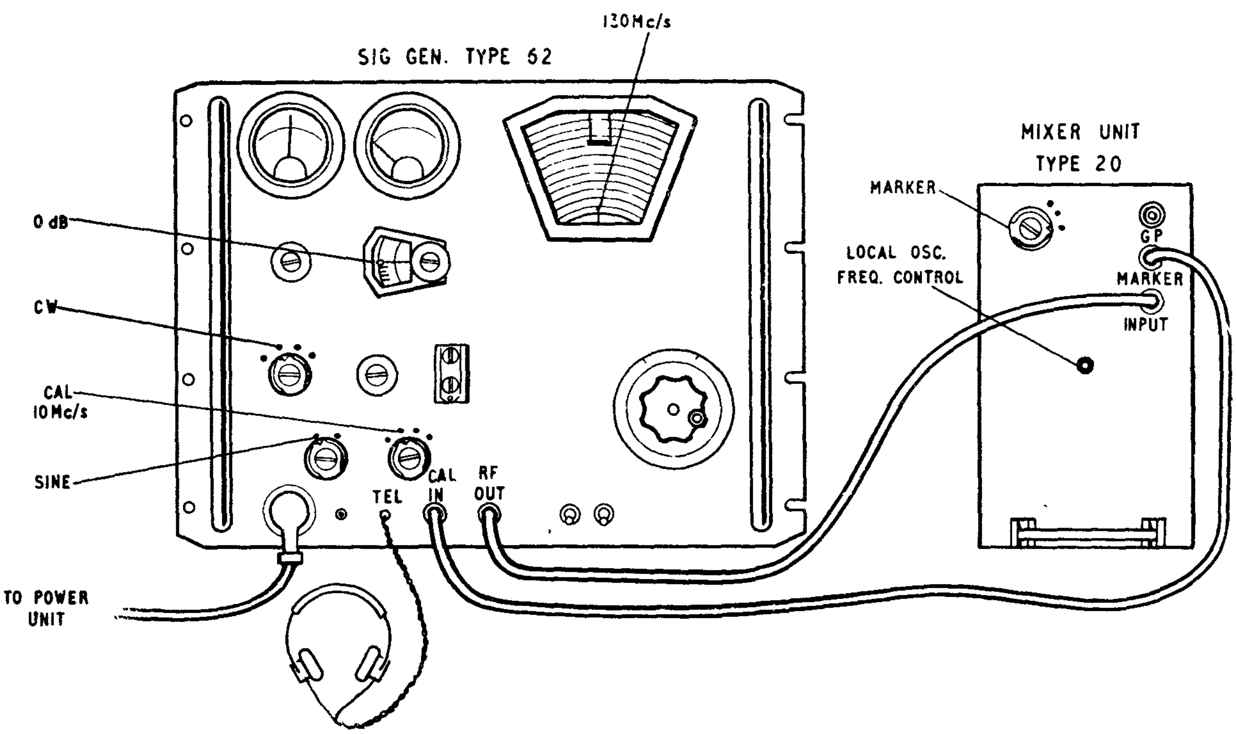


Fig. 3. Tuning mixer unit—stage 3

Stage 3 (fig. 3)

22. Transfer the connector from the plug 1P4 on the R.1964 to the CAL. INPUT plug of the signal generator Type 62 and transfer the telephone jack from the test rig Type 5 to the TEL. jack of the signal generator. Switch the SERVICE selector to CW and the ATTENUATOR to 0 dB. This set-up is shown in fig. 3. Proceed as follows:—

(1) With the FREQUENCY control of the signal generator, search for a beat note close to the setting found in para. 21 (1).

(2) Adjust the FREQUENCY control until the beat note is high in the direction towards the 130 Mc/s setting found in para. 21 (1).

LOC OSC FREQ CONTROL of the mixer unit Type 20 towards zero beat.

(4) Repeat operations (2) and (3) as often as necessary to produce zero beat at 130 Mc/s.

(5) Finally repeat the operations described in para. 17.

The settings so obtained may vary slightly with time and temperature, but any further corrections necessary may be made using the instructions contained in para. 17 only. It is only when the mixer unit frequency has been misadjusted or has drifted far from the correct point that the full procedure must be adopted.

PART 3

FAULT DIAGNOSIS

PAR
3

PART 3

LIST OF CHAPTERS

***Note.**—A List of Contents appears at the beginning of each Chapter*

Chapter 1

GENERAL FAULT-FINDING INFORMATION

LIST OF CONTENTS

Identification of defects

1. The ILS airborne equipment produces seven separate output functions, and most faults may be isolated to a particular part of the installation by reference to the functions affected, or by their combination. As a further aid to fault finding, particularly at advanced stages, it is usually of value to be able to define the degree of defectiveness, that is, to distinguish between complete and partial failures of the several functions. For the sake of simplicity, however, the fault locating procedure outlined in this chapter is confined only to those faults causing complete failure, but it can be assumed that the location of such faults will be a ready guide to the location of those other faults causing only partial failure of the same functions.

2. The seven output functions are:—

(1) Localizer pointer
(2) Localizer flag
(3) Glidepath pointer
(4) Glidepath flag
} Viewed on indicator

(5) Marker lamp

(6) Marker audio
(7) Localizer audio
} Heard in telephones

First-line fault finding

3. For the purposes of first-line fault finding, defects are classed under the following headings:—

(1) Power supplies
(2) Aerials
(3) Feeders
(4) Main assemblies
(5) Indicator.

4. Defects due to power supply faults (that is, to the common DC supply to both receivers) are usually characterized by complete failure of the equipment as a whole. Indications are that all seven functions are dead and that the operating whine of the receiver rotary transformers is absent. A first action should be to check that the circuit breaker is not tripped. A further common supply fault, causing failure of all functions but not of the rotary transformers, arises due to failure of the voltage regulator.

5. Isolation of a fault into the further classifications is carried out with the test set Type 391. Test signals are generated in this unit, and can be either radiated from test aerials or injected directly into the aerial plugs on the receivers to provide checks on the aerials and feeders. Full details of the use of the test set is given in Vol. 4.

6. If the aerials and feeders are proved not to be the source of the defect, a step-by-step substitution of the suspected items of the main assemblies should be carried out. Where the indicator is a possible source the check can be made by means of the resistance unit Type 416, which is part of the test set Type 391. A guide to the likely source of a fault is given below:—

Faulty function	*Defective unit*
Localizer pointer and flag	R.1964
Localizer pointer	(1) Indicator
	(2) R.1964
Localizer flag	(1) Indicator
	(2) R.1964

Faulty function	*Defective* ι
Localizer pointer, flag, and audio	(1) Control unit (2) R.1964
Localizer audio	R.1964
Marker audio	R.1964
Localizer and marker audio	R.1964
Marker lamp	(1) Marker lamp (2) R.1964
Marker lamp and audio	R.1964
Localizer pointer, flag, and audio; marker lamp and audio; glidepath pointer and flag	(1) Fuse on R.1964 (2) R.1964
Localizer pointer, flag, and audio; glidepath pointer and flag	(1) Control unit (2) R.1964
Glidepath pointer and flag	(1) Fuse on R.1965 (2) R.1965 (3) Control unit
Glidepath pointer	(1) Indicator (2) R.1965
Glidepath flag	(1) Indicator (2) R.1965

7. Where substitution or checking of the suspected units is unproductive, the defect is likely to be in the associated junction boxes and interconnections. In installations where the receivers use separate junction boxes it should be noted that the output services from the R.1964 are fed to the indicators through the junction box of the R.1965.

8. For all defects in which the localizer and glidepath pointer and flag functions are involved, a preliminary to fault finding must be a check that the indicator selector panels on the receiver junction boxes are correctly set for the number of indicators in use. Also, where the junction box Type 164 is fitted, it should be checked that shorting plugs are fitted in all the unused indicator output points of the junction box; the absence of any shorting plug will cause the alarm flags on both localizer and glidepath pointers to be inoperative.

9. Note that if a defect concerns only one, or at least not all of the localizer or glidepath channels, the source is likely to be found in the crystal, or crystals, for the channels concerned; these crystals are located behind the switch panel on the control unit. Where the symptom of a defect is oversensitivity of the glidepath or localizer pointers, indicated by an extreme narrowness of the flightpath, the source is likely to be in the AGC circuit of the R.1965 where the glidepath pointer is concerned, and in the AGC circuit of the R.1964 for the localizer pointer; to clear the defect the appropriate receiver should be renewed. Defects in which the glidepath or localizer pointers and flags are be caused by faulty crystals in the second local oscillator stages of the R.1965 or R.1964, and action should consist of substitution of the appropriate receiver.

Second-line fault finding

10. At second line, a faulty unit is introduced into a bench installation made up with a test rig (installation) Type 5 together with units of an ILS installation of known operational effectiveness. Fault finding is confined to the isolation of a defect into a sub-unit or in certain instances to major components assemblies and valves. Repair action is confined to the renewal of such sub-units, major assemblies, and valves. Actual repair of the faulty items will take place at third line.

11. The following list provides a guide to fault finding at second line level on the receiver Type R.1964:—

Faulty function	*Possible source*
Localizer pointer, flag, and audio; marker lamp and audio	Power unit Type 797 (common HT supply)
Localizer pointer, flag, and audio	Any stage in receiver unit Type 117
Marker lamp and audio	Stages V1, V2, V3, in receiver unit Type 118
Localizer audio and marker audio	Stages V2, V3, in LF unit Type 4
Localizer pointer and flag	Stages V4, V1, in LF unit Type 4
Localizer audio	Audio stage (3R66) in receiver unit Type 117 and V2 stage of LF unit Type 4
Marker audio	Stage V2 of LF unit Type 4
Marker lamp	Stages V5, V4, of receiver unit Type 118

12. Two output functions only, the glidepath pointer and flag, are operated by the receiver Type R.1965. As all the sub-units of this receiver contribute to correct operation, no direct guide to the location of a fault in a sub-unit can be obtained from a study of symptoms. Fault finding, therefore, must consist of the substitution of serviceable sub-units one by one, until the defect is cleared.

13. The control unit Type 705 contains the local oscillators (including controlling crystals) for both the localizer and glidepath receivers. If the localizer channel is defective because of the control unit, the stage 5V1 will be responsible. If the glidepath channel is faulty, the stage 5V2 will be responsible.

Third-line fault finding

14. At third lines of servicing all types of fault will be investigated, in general, on sub-units previously declared faulty at second line. The testing set-up will consist of a bench installation of the test rig (installation) Type 5 as used in second line.

15. Data to assist fault finding will b Chap. 2, 3 and 4. In these chapters are given circuits of the individual sub-units together with component location diagrams and tables; the tables provide a quick guide to the location of components by reference to grid lines on the chassis illustrations. Valve electrode potentials are shown on the circuits.

16. Potentials shown on the circuits are average figures representing typical values only. They may vary in practice over a range as wide as plus or minus 20 per cent. This range allows for differences between equipments, power supply levels, and meters. The figures quoted were taken with a test-meter Type F under no-signal conditions, and when the DC input supply was 26V.

17. A further guide to operation is provided by the test points fitted in the grid or diode circuits of certain stages. A milliameter or microammeter connected to a test point provides an indication of the current flowing in the circuit and in consequence an indication of the drive being applied from the previous stage. The readings are greatly the channel in use and are different with different crystals, but the figures given below show the broad limits over the full range.

(1) Receiver unit Type 117
 3MP1—0·2 mA to 1 mA
 3MP2—0·5 mA to 2 mA
 3MP3—3 mA to 6 mA
 3MP4—50 μA

(2) RF unit Type 74
 10MP1—130 μA to 150 μA
 10MP2—320 μA to 550 μA
 10MP3—100 μA to 120 μA

(3) Receiver unit Type 119
 8MP1—130 μA to 150 μA
 8MP2—30 μA to 50 μA

18. Certain major assemblies in all the sub-units are intended to be renewed in their entirety if faulty. In consequence, fault finding action in these assemblies is limited to determining that the assembly in question is in fact defective, and further action to define the fault to one particular component is unnecessary. The assemblies concerned are listed in Part 1, Chap. 4, para. 3, 21, 35, 42, 56 and 61.

Chapter 2

DATA ON R.1964

LIST OF TABLES

LIST OF ILLUSTRATIONS

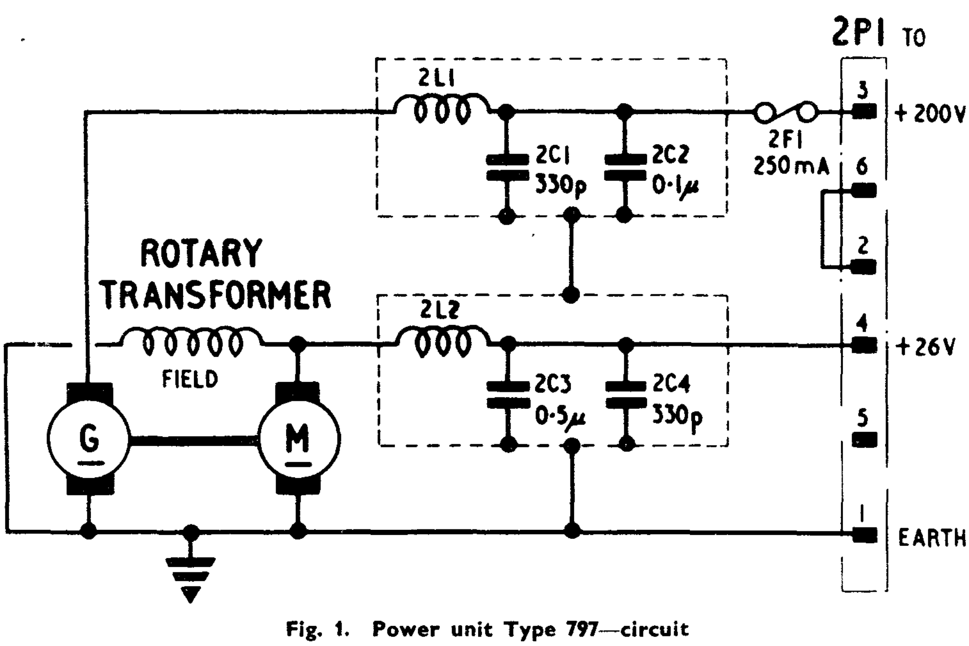


Fig. 1. Power unit Type 797—circuit

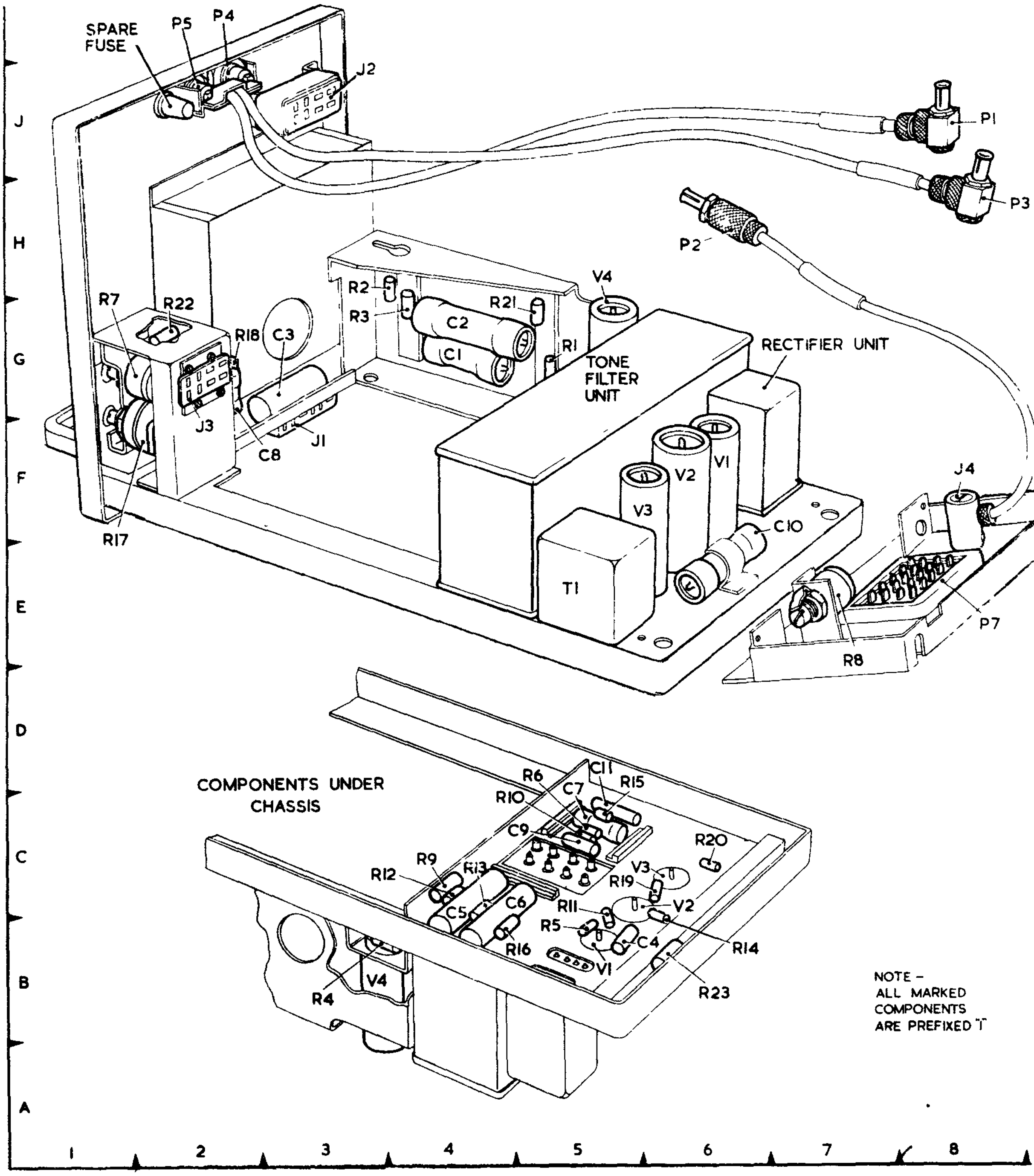


Fig. 2. LF unit Type 4—component positions

TABLE 1

LF unit Type 4—location of capacitors

Circuit Ref.	Value	Working voltage	Tolerance ± %	Grid location on fig. 2	Stores Ref.
1C1	2·0μ	150	25	G4	Z.116314
1C2	1·0μ	350	25	G4	Z.116313
1C3	0·1μ	350	25	G3	Z.115285
1C4	1,000p	300	20	B5	
1C5	0·1μ	350	25	C4	Z.115285
1C6	0·1μ	350	25	C4	Z.115285
1C7	0·5μ	150	25	C5	Z.116308
1C8	0·1μ	150	25	G2	Z.116302
1C9	1,000p	300	20	C5	
1C10	2·0μ	150	25	E6	Z.116314
1C11	0·005μ	350	25	C5	Z.115223

TABLE 2

LF unit Type 4—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 2	Stores Ref
1R1	3·3meg	¼	10	G5	Z.223205
1R2	22,000	¼	10	H3	Z.222172
1R3	22,000	¼	10	G3	Z.222172
1R4	4,700	⅛	5	B3	Z.219160
1R5	1meg	¼	10	B5	Z.223163
1R6	220	¼	10	C5	Z.221151
1R7	10,000	$\frac{1}{10}$	20	G1	10W/18167
1R8	20,000	$\frac{1}{10}$	20	E7	10W/18166
1R9	25	7	5	C4	Z.243401
1R10	1,500	¼	10	C5	Z.222025
1R11	470,000	¼	10	C5	Z.223121
1R12	15,000	¼	10	C4	Z.222151
1R13	15,000	¼	10	C4	Z.222151
1R14	68,000	¼	10	C6	Z.223016
1R15	1,500	¼	10	C5	Z.222025
1R16	470,000	¼	10	B4	Z.223121
1R17	5,000	$\frac{1}{10}$	20	F1	Z.261503
1R18	22,000	¼	10	G2	Z.222172
1R19	1meg	¼	10	C6	Z.223163
1R20	150	¼	10	C6	Z.221130
1R21	3·3meg	¼	10	G5	Z.223226
1R22	3,300	⅛	5	G2	Z.219148
1R23	3,300	⅛	5	B6	Z.219220

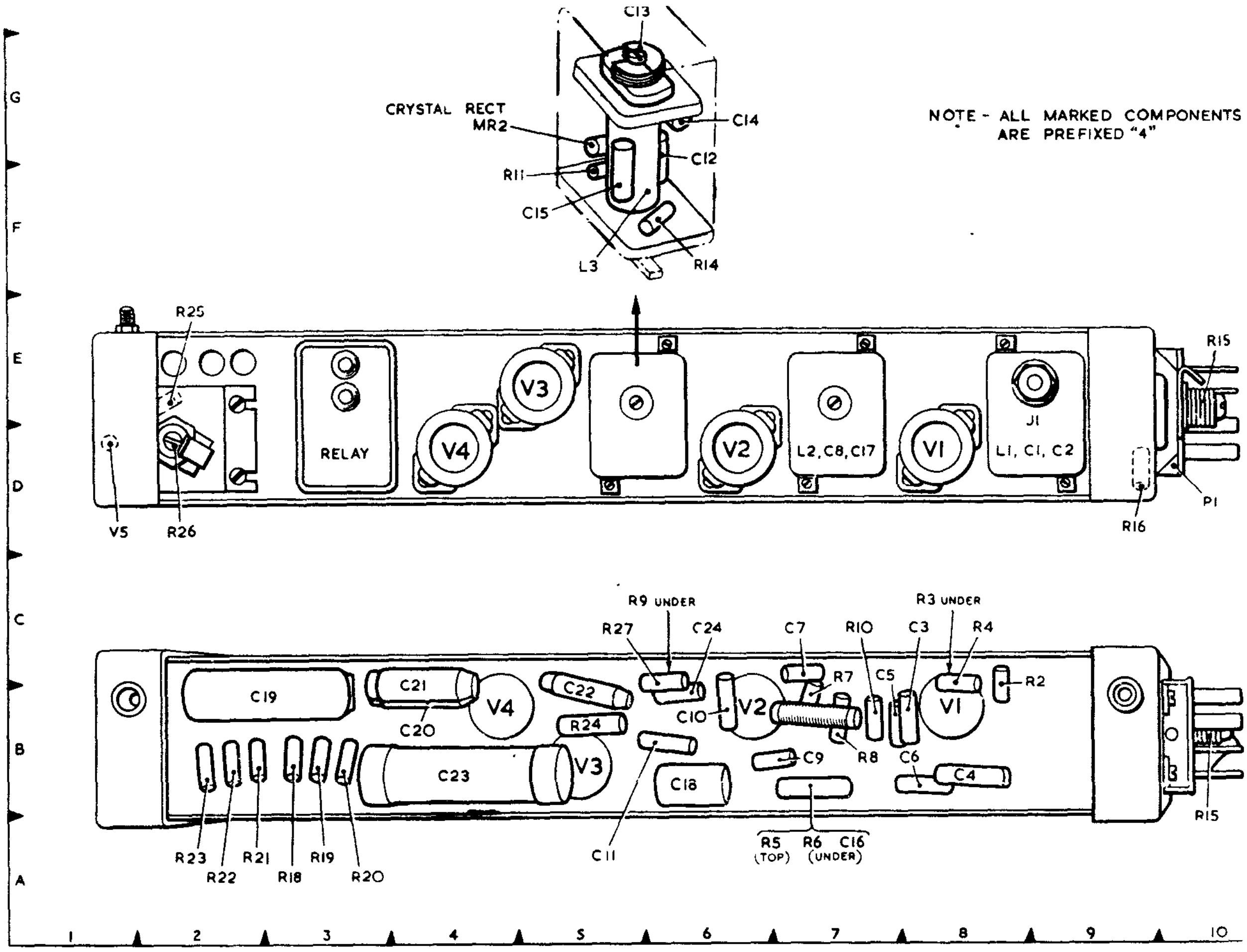


Fig. 3. Receiver unit Type 118—component positions

TABLE 3

Receiver unit Type 118—location of capacitors

Circuit Ref.	Value	Working voltage	Tolerance ±	Grid location on fig. 3	Stores Ref.
4C1	8·2p		½p	D9	
4C2	2 to 32p	350		D9	
4C3	330p	300	10%	B8	Z.132607
4C4	0·01μ	350	25%	B8	Z.115065
4C5	1,000p	300	20%	B7	Z.132630
4C6	1,000p	300	20%	B8	Z.132630
4C7	47p	500	5%	C7	Z.132288
4C8	2 to 32p	350		D7	
4C9	330p	350	10%	B7	Z.132607
4C10	1,000p	300	20%	B6	Z.132630
4C11	1,000p	300	20%	B6	Z.132630
4C12	47p	500	5%	F6	
4C13	2 to 32p	350		G6	
4C14	82p		½p	G6	
4C15	100p	500	10%	F5	

TABLE 3 *(continued)*

Circuit Ref.	Value	Working voltage	Tolerance ±	Grid location on fig. 3	Stores Ref.
4C16	0·005μ	350	25%	B7	Z.115223
4C17	8·2p		½p	D7	
4C18	0·05μ	350	25%	B6	Z.116301
4C19	0·5μ	350	25%	B2	Z.116310
4C20	0·01μ	350	25%	B4	Z.115065
4C21	0·01μ	350	25%	B4	Z.115065
4C22	0·01μ	350	25%	B5	Z.115065
4C23	1·0μ	350	25%	B4	Z.116313
4C24	1,000p	300	20%	B6	Z.132630

TABLE 4

Receiver unit Type 118—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 3	Stores Ref.
4R1					
4R2	150	¼	10	B8	Z.221130
4R3	10,000	¼	10	B8	Z.222130
4R4	2,200	½	10	B8	Z.222047
4R5	21	3	5	B7	Z.243402
4R6	42	3	5	B7	
4R7	27,000	¼	10	B7	Z.222184
4R8	100	½	10	B7	Z.221110
4R9	27,000	¼	10	B6	Z.222184
4R10	47	½	10	B7	Z.221068
4R11	200,000	¼	10	F5	
4R12					
4R13					
4R14	100,000	¼	10	F6	
4R15	1meg		10	E10	10W/18196
4R16	4,700	¼	10	D9	Z.222088
4R17					
4R18	560,000	¼	10	B3	Z.223133
4R19	180,000	¼	10	B3	Z.223070
4R20	22,000	¼	10	B3	Z.222172
4R21	680,000	¼	10	B2	Z.223142
4R22	120,000	¼	10	B2	Z.223049
4R23	470,000	¼	10	B2	Z.223121
4R24	220	¾	10	B5	Z.221153
4R25	360	1	5	E2	Z.243374
4R26	500	½	10	D2	Z.271501
4R27	4,700	½	10	B6	Z.222089

Receiver unit Type 117—location of capacitors

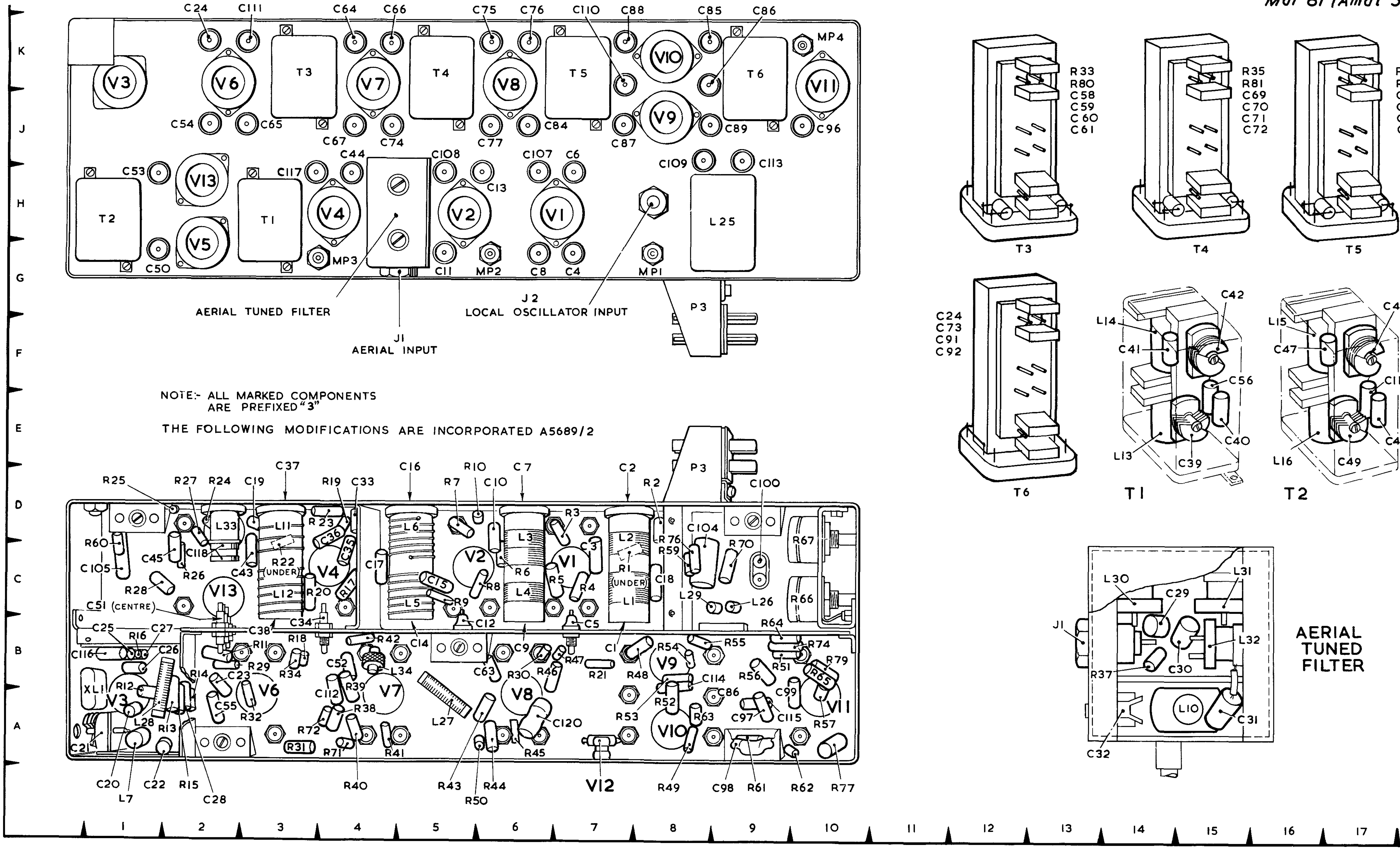
Circuit Ref.	Value	Working voltage	Tolerance ±	Grid location on fig. 4	Stores Ref.
3C1	(Part of coil assembly)			B7	
3C2	(Part of coil assembly)			D7	
3C3	47p	500	10%	C7	Z.132289
3C4	0·01μ	350	25%	G7	Z.115552
3C5	1,000p		20%	B7	
3C6	0·01μ	350	25%	H7	Z.115552
3C7	(Part of coil assembly)			D6	
3C8	1,000p	350	20%	G6	Z.132630
3C9	(Part of coil assembly)			B6	
3C10	330p	350	20%	C6	Z.132627
3C11	1,000p	350	20%	G5	Z.132630
3C12	1,000p		20%	B5	
3C13	1,000p	350	20%	H6	Z.132630
3C14	(Part of coil assembly)			B5	
3C15	330p	350	20%	C5	Z.132627
3C16	(Part of coil assembly)			D5	
3C17	2·2p	500	½p	C4	Z.132250
3C18	2·2p	500	½p	C8	Z.132250
3C19	330p	350	20%	D3	Z.132627
3C20	1,000p	350	20%	A1	Z.132630
3C21	1·5 to 20p	350		A1	
3C22	10p	500	10%	A1	Z.132253
3C23	4·7p	500	½p	B2	Z.132420
3C24	0·01μ	350	25%	K2	Z.115552
3C25	330p	350	20%	B1	Z.132627
3C26	47p	500	10%	B1	Z.132289
3C27	27p	500	5%	B1	Z.132279
3C28	47p	500	5%	A2	Z.132288
3C29	3·3p	500	½p	C14	
3C30	4·7p	500	½p	B15	
3C31	2·2p	500	½p	A15	
3C32	2 to 22p			A14	
3C33	330p	350	20%	D4	Z.132627
3C34	1,000p	350	20%	B4	
3C35	330p	350	20%	C4	
3C36	330p	350	20%	C4	
3C37	(Part of coil assembly)			D3	
3C38	(Part of coil assembly)			B3	
3C39	2 to 32p	350		E15	
3C40	15p	500	5%	E15	Z.132068
3C41	15p	500	5%	F14	Z.132068
3C42	2 to 32p	350		F15	
3C43	330p	350	20%	C3	Z.132627
3C44	0·01μ	350	25%	H4	Z.115552
3C45	330p	350	20%	C2	Z.132627
3C46	2 to 32p	350		F17	
3C47	15p	500	5%	F16	Z.132068
3C48	15p	500	5%	E17	Z.132068
3C49	2 to 32p	350		E17	
3C50	1,000p	350	20%	G2	Z.132630
3C51	1,000p	350	20%	B2	
3C52	330p	350	20%	B4	Z.132627
3C53	0·01μ	350	25%	H1	Z.115552
3C54	0·01μ	350	25%	J2	Z.115552
3C55	1,000p	350	20%	A2	Z.132630
3C56	8·2p	500	½p	E15	Z.132423
3C57	2 to 32p	350		J13	
3C58	22p	500	5%	J12	Z.132276
3C59	130p	350	2p	J12	
3C60	130p	350	2p	H13	
3C61	22p	500	5%	H13	Z.132276
3C62	2 to 32p	350		H12	
3C63	330p	350	20%	B6	Z.132627

Circuit Ref.	Value	Working voltage	Tolerance ±	Grid location on fig. 4	Stores Ref.
3C64	0·01μ	350	25%	K4	Z.115552
3C65	0·01μ	350	25%	J3	Z.115552
3C66	0·01μ	350	25%	K4	Z.115552
3C67	0·01μ	350	25%	J4	Z.115552
3C68	2 to 32p	350		J15	
3C69	22p	500	5%	J14	Z.132276
3C70	130p	350	2p	J15	
3C71	130p	350	2p	H15	
3C72	22p	500	5%	H15	Z.132276
3C73	2 to 32p	350		H14	
3C74	0·01μ	350	25%	J4	Z.115552
3C75	0·01μ	350	25%	K5	Z.115552
3C76	0·01μ	350	25%	K6	Z.115552
3C77	0·01μ	350	25%	J6	Z.115552
3C78	2 to 32p	350		J17	
3C79	22p	500	5%	J16	Z.132276
3C80	130p	350	2p	J17	
3C81	130p	350	2p	H17	
3C82	22p	500	5%	H17	Z.132276
3C83	2 to 32p	350		H17	
3C84	0·01μ	350	25%	J6	Z.115552
3C85	0·01μ	350	25%	K8	Z.115552
3C86	0·01μ	350	25%	J8	Z.115552
3C87	0·01μ	350	25%	J7	Z.115552
3C88	0·01μ	350	25%	K7	Z.115552
3C89	0·01μ	350	25%	J8	Z.115552
3C90	2 to 32p	350		E13	
3C91	8·2p	350	½p	E13	Z.132423
3C92	33p	500	5%	E13	Z.132282
3C93					
3C94					
3C95					
3C96	0·01μ	350	25%	J10	Z.115552
3C97	330p	350	20%	I9	Z.132627
3C98	0·05μ	250	25%	A9	Z.132627
3C99	47p	500	10%	A10	Z.132289
3C100	0·015μ	350	5%	C9	10C/18765
3C101					
3C102					
3C103					
3C104	0·1μ	250	25%	C8	Z.116303
3C105	0·01μ	350	25%	C1	Z.115552
3C106					
3C107	1,000p	350	20%	H6	Z.132630
3C108	1,000p	350	20%	H5	Z.132630
3C109	0·01μ	350	25%	J8	Z.115552
3C110	0·01μ	350	25%	K7	Z.115552
3C111	0·01μ	350	25%	K3	Z.115552
3C112	1,000p	350	20%	A4	Z.132630
3C113	0·01μ	350	25%	J9	Z.115552
3C114	330p	350	20%	B8	Z.132627
3C115	47p	500	10%	A9	Z.132289
3C116	330p	350	20%	B1	Z.132627
3C117	1,000p	350	20%	H3	Z.132630
3C118	(Part of coil assembly)			C2	
3C119	8·2p	500	½p	F17	Z.132423
3C120	0·1μ	150	25%	A6	

Receiver unit Type 117—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 4	Stores Ref.
3R1	10,000	¼	10	C7	Z.222130
3R2	680	¼	10	D8	Z.221214
3R3	150	¼	10	D7	Z.221130
3R4	10,000	¼	10	C7	Z.222130
3R5	4,700	½	10	C7	Z.222089
3R6	10,000	¼	10	C6	Z.222130
3R7	150	¼	10	D5	Z.221130
3R8	10,000	¼	10	C6	Z.222130
3R9	1,000	¼	10	C5	Z.222004
3R10	680	¼	10	D5	Z.221214
3R11	4,700	½	10	B2	Z.222089
3R12	5,600	½	10	A1	Z.222101
3R13	22,000	½	10	A2	Z.222173
3R14	22,000	¼	10	A2	Z.222172
3R15	1,500	¼	10	A2	Z.222025
3R16	150	¼	10	B1	Z.221130
3R17	27,000	½	10	C4	Z.222185
3R18	1,000	¼	10	B3	Z.222004
3R19	150	¼	10	D4	Z.221130
3R20	4,700	½	10	C3	Z.222089
3R21	1,000	¼	10	B7	Z.222004
3R22	1,000	¼	10	C3	Z.222004
3R23	150	¼	10	D4	Z.221130
3R24	220,000	¼	10	D2	Z.221151
3R25	22,000	½	10	D2	Z.222173
3R26	56,000	½	10	C2	Z.223008
3R27	100	¼	10	D2	Z.221109
3R28	4,700	¼	10	C1	Z.222088
3R29	1,000	¼	10	B2	Z.222004
3R30	1,000	¼	10	B6	Z.222004
3R31	56,000	½	10	A3	Z.223008
3R32	150	¼	10	A3	Z.221130
3R33	100,000	⅛	5	A3	Z.219256
3R34	4,700	½	10	B3	Z.222089
3R35	100,000	⅛	5	A5	Z.219256
3R36	100,000	⅛	5	A7	Z.219256
3R37	27,000	¼	10	B14	Z.221163
3R38	100,000	⅛	5	A4	Z.219256
3R39	22,000	½	10	B4	Z.222173
3R40	56,000	½	10	A4	Z.223008
3R41	390	¼	10	A4	Z.221184
3R42	4,700	¼	10	B4	Z.222088
3R43	100,000	⅛	5	A6	Z.219256
3R44	56,000	½	10	A4	Z.223008
3R45	390	¼	10	A6	Z.221184
3R46	22,000	½	10	B6	Z.222173
3R47	4,700	¼	10	B7	Z.222088
3R48	100,000	⅛	5	B8	Z.219256

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 4	Stores Ref.
3R49	390	¼	10	A8	Z.221184
3R50	100,000	¼	10	A6	Z.223037
3R51	680,000	¼	10	B9	Z.223142
3R52	5,600	½	10	A8	Z.222101
3R53	47,000	¼	10	B8	Z.222214
3R54	15,000	¼	10	B8	Z.222151
3R55	390	¼	10	B8	Z.221184
3R56	4,700	½	10	B9	Z.222089
3R57	150,000	⅛	5	A10	Z.219286
3R58					
3R59	2,200	¼	10	C8	Z.222046
3R60	100,000	¼	10	C1	Z.223037
3R61	680,000	¼	10	A9	Z.223142
3R62	470,000	¼	10	A10	Z.223121
3R63	10,000	¼	10	A8	Z.222130
3R64	270,000	¼	10	B9	Z.223091
3R65	100,000	⅛	5	B10	Z.219256
3R66	100,000	$\frac{1}{10}$	20	C10	Z.262173
3R67	100,000	$\frac{1}{10}$	20	D10	Z.262173
3R68					
3R69					
3R70	47,000	⅛	5	C9	Z.219232
3R71	100,000	¼	10	A4	Z.223037
3R72	100,000	¼	10	A4	Z.223037
3R73					
3R74	220,000	⅛	5	B9	Z.219280
3R75					
3R76	4,700	¼	10	C8	Z.222088
3R77	62	4	5	A10	Z.243339
3R78					
3R79	1meg	¼	10	B10	Z.223163



Receiver unit Type 117, component positions

Fig.4

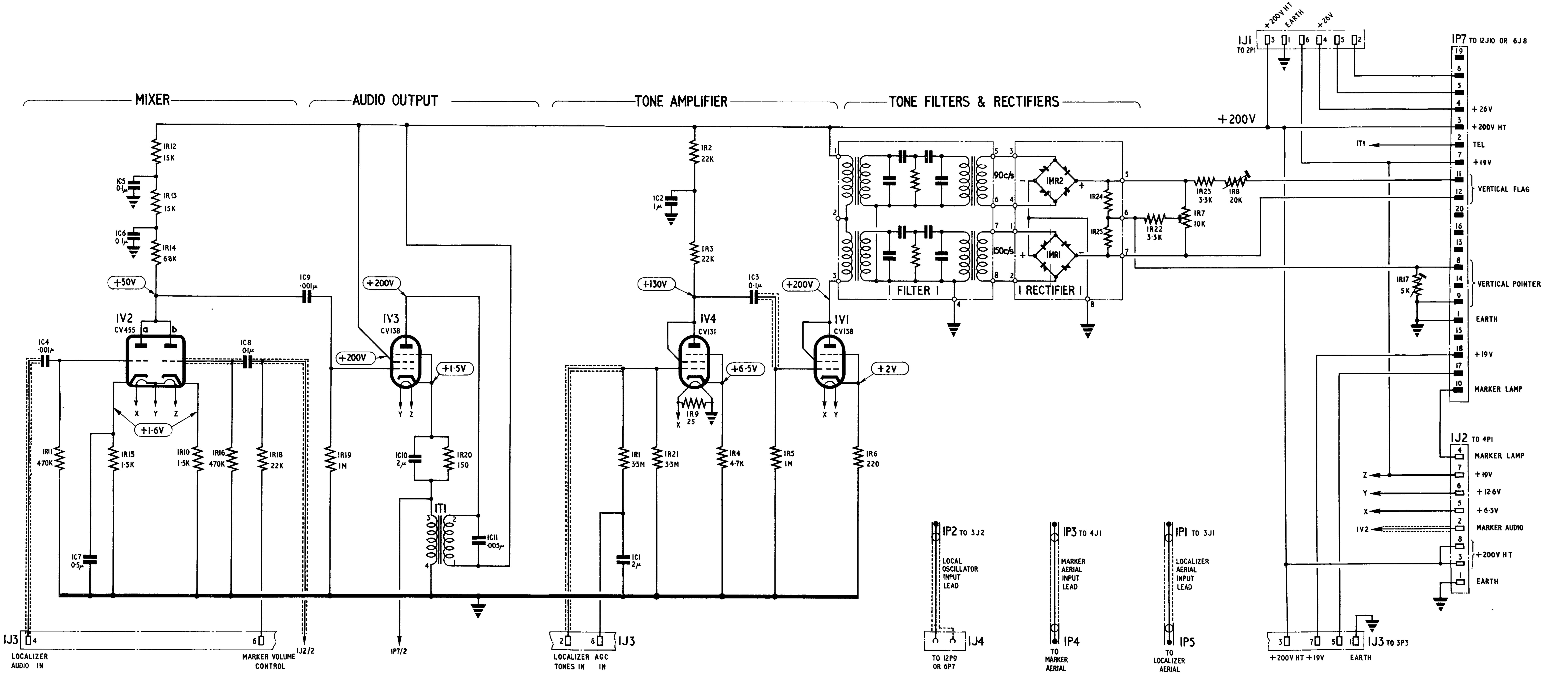


Fig. 5 LF unit Type 4-circuit Fig. 5

This leaf issued with A.L. No.

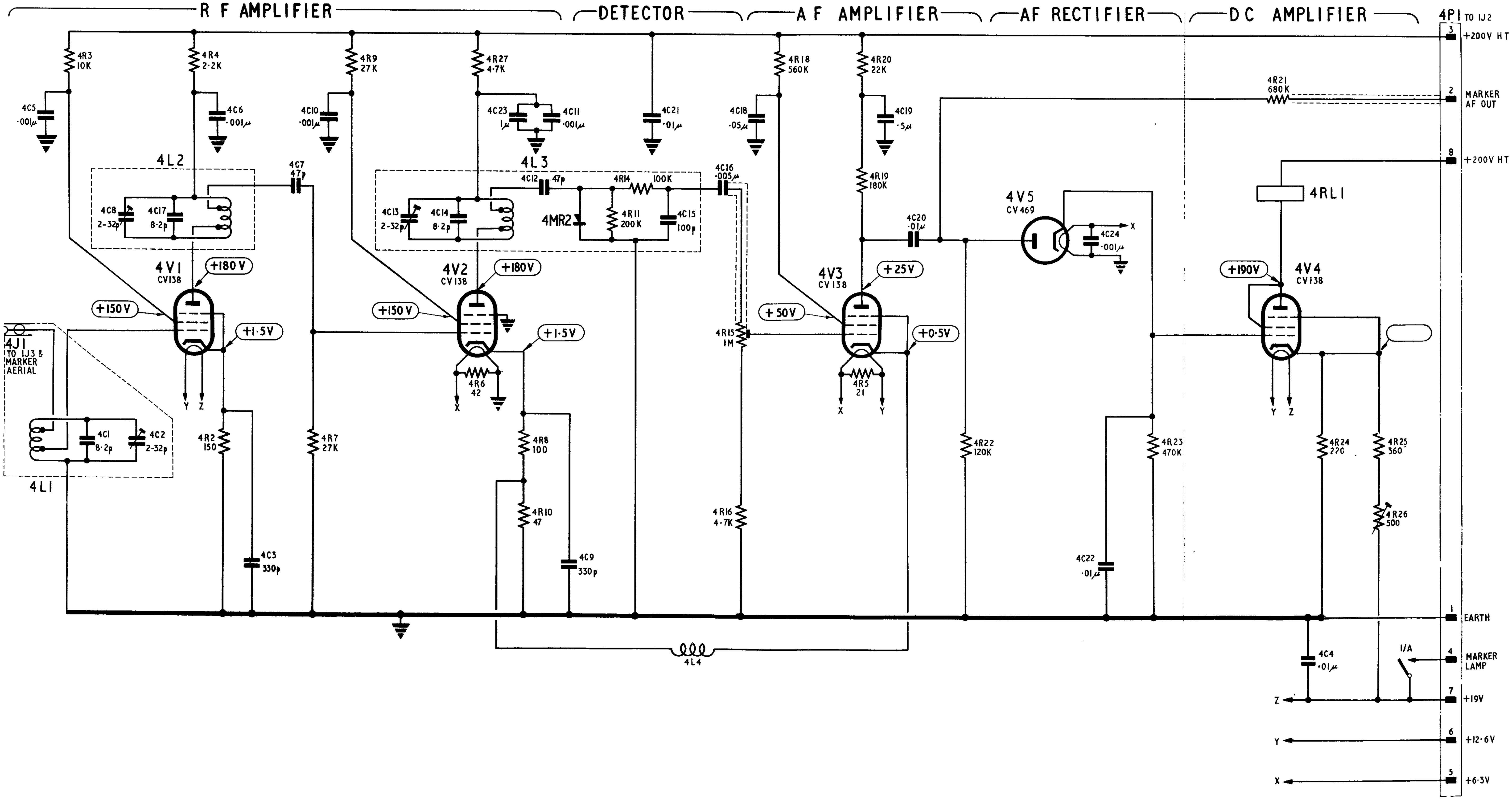


Fig.6 Receiving unit Type 118 - circuit Fig.6

Receiver Type 117 — circuit

Fig.7

Chapter 3

DATA ON R.1965

LIST OF TABLES

LIST OF ILLUSTRATIONS

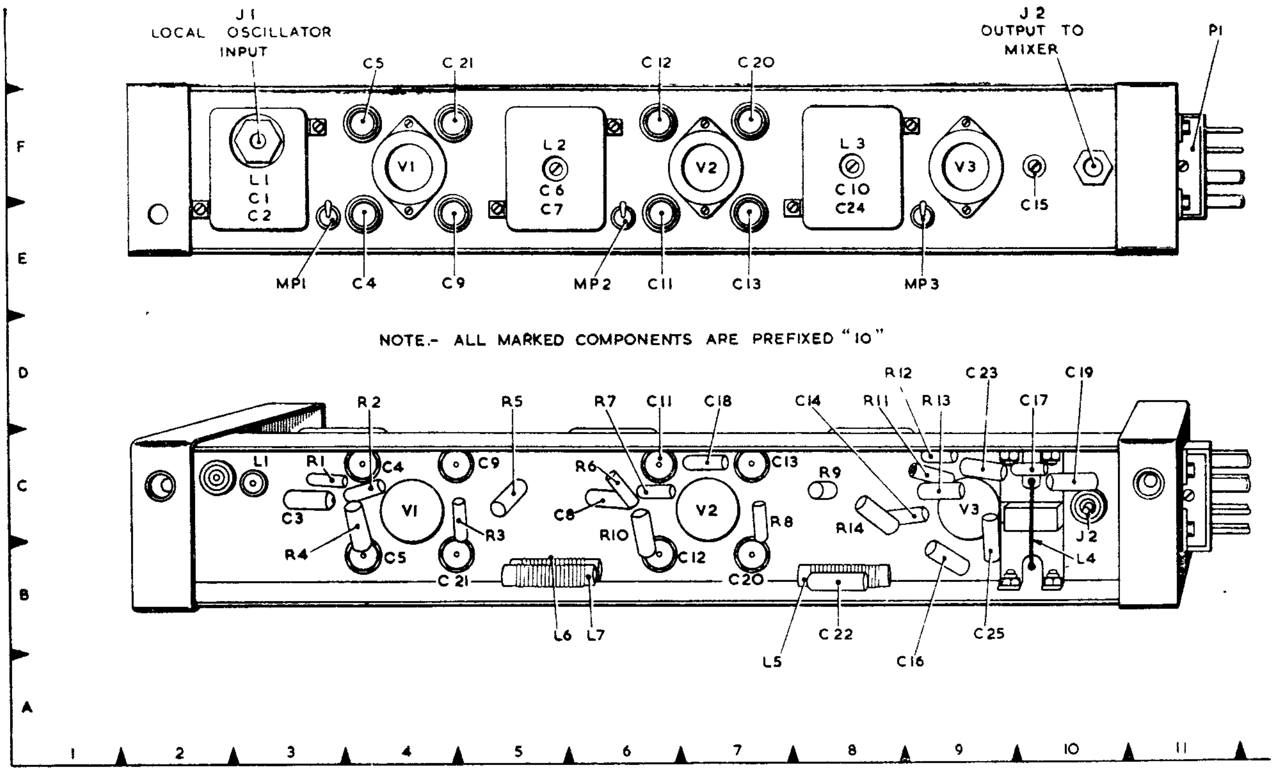


Fig. 1. RF unit Type 74—component positions

TABLE 1

RF unit Type 74—location of capacitors

Circuit Ref.	Value in picofarads	Working voltage	Tolerance ±	Grid location on fig. 2	Stores Ref.
10C1	1·5 to 21·5			F3	
10C2	8·2	500	½p	F3	
10C3	47	500	10%	C3	Z.132289
10C4	1,000	350	20%	E4	Z.132630
10C5	1,000	350	20%	F4	Z.132630
10C6	8·2	500	½p	F5	
10C7	1·5 to 20			F5	
10C8	47	500	10%	C6	Z.132289
10C9	1,000	350	20%	E4	Z.132630
10C10	1·5 to 21·5			F8	
10C11	1,000	350	20%	E6	Z.132630
10C12	1,000	350	20%	F6	Z.132630
10C13	1,000	350	20%	E7	Z.132630
10C14	47	500	10%	C9	Z.132289
10C15	1·5 to 8			F10	
10C16	330	350	20%	B9	Z.132627
10C17	33	500	10%	C10	Z.132283

TABLE 1 *(continued)*

Circuit Ref.	Value in picofarads	Working voltage	Tolerance ±	Grid location on fig. 2	Stores Ref.
10C18	1,000	350	20%	C7	Z.132630
10C19	47	500	10%	C10	Z.132289
10C20	1,000	350	20%	F7	Z.132630
10C21	1,000	350	20%	F5	Z.132630
10C22	1,000	350	20%	B8	Z.132630
10C23	33	500	10%	C9	Z.132283
10C24	100	500	10%	F8	
10C25	330	350	20%	B9	Z.132627

TABLE 2

RF unit Type 74—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 1	Stores Ref.
10R1	47,000	$\frac{1}{4}$	10	C3	Z.222214
10R2	680	$\frac{1}{4}$	10	C4	Z.221214
10R3	150	$\frac{1}{4}$	10	C4	Z.221130
10R4	27,000	$\frac{1}{2}$	10	C4	Z.222185
10R5	4,700	$\frac{1}{2}$	10	C5	Z.222089
10R6	47,000	$\frac{1}{4}$	10	C6	Z.222214
10R7	680	$\frac{1}{4}$	10	C6	Z.221214
10R8	150	$\frac{1}{4}$	10	C7	Z.221130
10R9	4,700	$\frac{1}{2}$	10	C8	Z.222089
10R10	27,000	$\frac{1}{2}$	10	B6	Z.222185
10R11	47,000	$\frac{1}{4}$	10	C9	Z.222214
10R12	680	$\frac{1}{4}$	10	C9	Z.221214
10R13	4,700	$\frac{1}{2}$	10	C9	Z.222089
10R14	27,000	$\frac{1}{2}$	10	C8	Z.222185

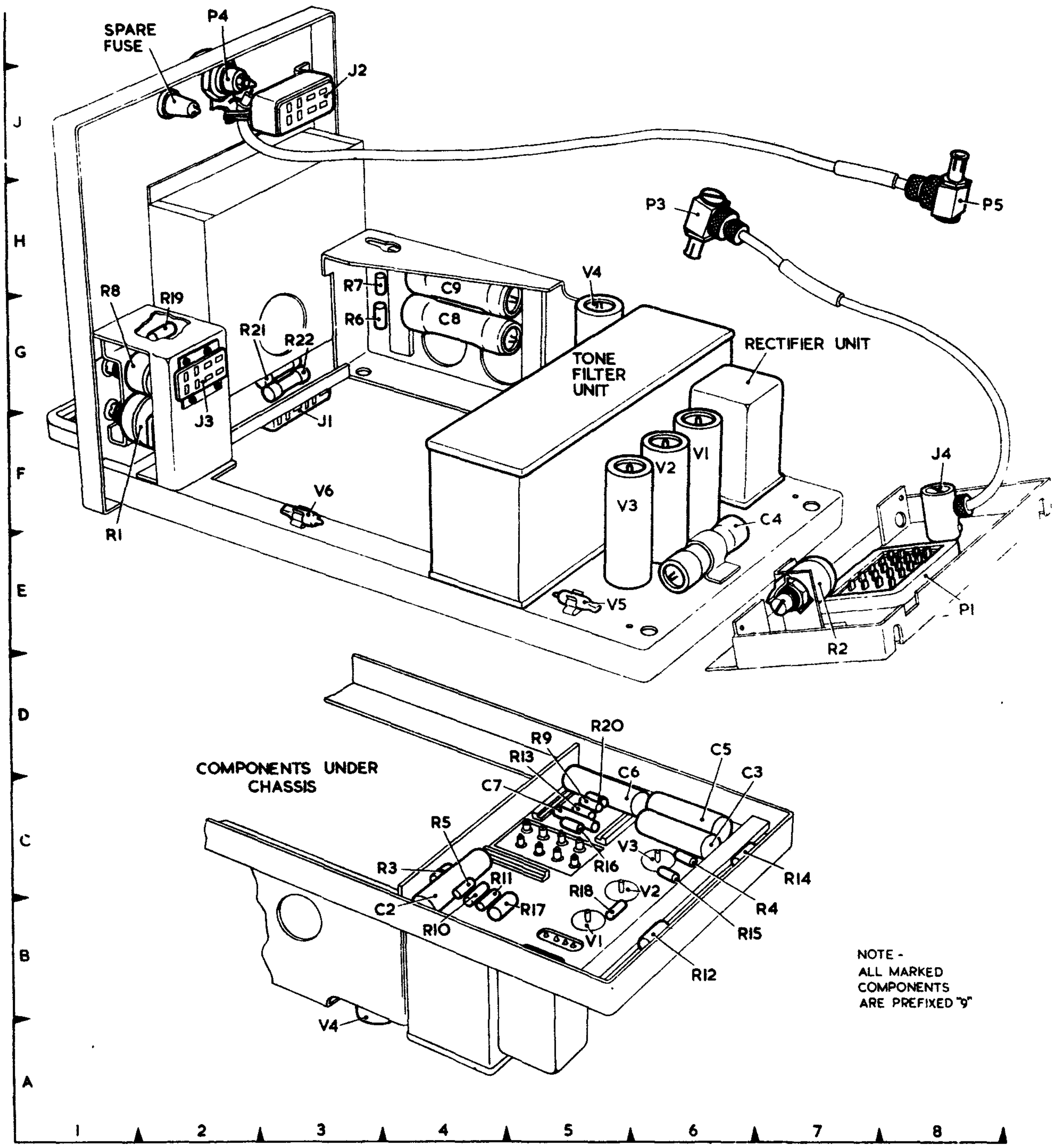


Fig. 2. LF unit Type 5—component positions

LF unit Type 5—location of capacitors

Circuit Ref.	Value	Working voltage	Tolerance ± %	Grid location on fig. 2	Stores Ref.
9C1					
9C2	0·1μ	350	25	C4	Z.115285
9C3	0·1μ	350	25	C6	Z.115285
9C4	2·0μ	150	25	E6	Z.116314
9C5	0·1μ	350	25	C6	Z.115285
9C6	0·1μ	350	25	C5	Z.115285
9C7	0·002μ	500	25	C5	Z.115034
9C8	1·0μ	350	25	G4	Z.116313
9C9	1·0μ	350	25	H4	Z.116313

TABLE 4

LF unit Type 5—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 2	Stores Ref.
9R1	5,000		20	F1	Z.261503
9R2	20,000		20	E7	10W/18166
9R3	2·2meg	¼	10	C4	Z.223205
9R4	2,700	¼	10	C6	Z.222058
9R5	27,000	¼	10	C4	Z.222184
9R6	47,000	¼	10	G3	Z.222214
9R7	47,000	¼	10	H3	Z.222214
9R8	10,000		20	G1	10W/18167
9R9	3·3meg	¼	10	C5	Z.223226
9R10	470,000	¼	10	C4	Z.223121
9R11	1meg	¼	10	B4	Z.223163
9R12	3,300	⅛	5	B6	Z.219148
9R13	2·2meg	¼	10	C5	Z.223205
9R14	220,000	¼	10	C6	Z.223079
9R15	47,000	¼	10	C6	Z.222214
9R16	2·2meg	¼	10	C5	Z.223205
9R17	240	⅛	5	B4	Z.219067
9R18	22,000	¼	10	B5	Z.222172
9R19	3,300	⅛	5	G2	Z.219148
9R20	3·3meg	¼	10	C5	Z.223226
9R21	21	2	5	G3	Z.243317
9R22	21	2	5	G3	Z.243317

Receiver unit Type 119—location of capacitors

Circuit Ref	Value	Working voltage	Tolerance ±	Grid location on fig. 3	Stores Ref.
8C1	1·5 to 8p			H5	
8C2	39p	500	10%	C5	Z.132286
8C3	1·5 to 8p			J5	
8C4	1,000p		20%	C3	10C/18616
8C5	330p	500	5%	C4	Z.132316
8C6	39p	500	5%	C4	Z.132286
8C7	1·5 to 8p			H4	
8C8	1·5 to 8p			H4	
8C9	1·5 to 8p			D3	
8C10	18p	500	½p	J14	Z.132431
8C11	2 to 32p			J13	
8C12	15p	500	5%	J14	Z.132271
8C13	39p	500	5%	C3	Z.132285
8C14	82p	500	½p	J13	Z.132423
8C15	2 to 32p			J14	
8C16	47p	500	10%	C3	Z.132289
8C17	1,000p	350	20%	H2	Z.132630
8C18	1,000p	350	20%	H2	Z.132630
8C19	1,000p	350	20%	J2	Z.132630
8C20	15p	500	½p	J13	Z.132271
8C21	1,000p		20%	C3	10C/18686
8C22	2 to 32p			J11	
8C23	15p	500	½p	J11	Z.132271
8C24	1,000p		20%	B3	10C/18686
8C25					
8C26	15p	500	½p	J12	Z.132271
8C27	2 to 32p			J11	
8C28	1,000p	350	20%	K2	Z.132630
8C29	0·01μ	350	25%	J2	Z.115625
8C30	15p	500	5%	J12	Z.132430
8C31	0·01μ	350	25%	J3	Z.115625
8C32	4·7p	500	½p	B3	Z.132430
8C33	2 to 32p			F16	
8C34	47p	500	5%	F15	Z.132288
8C35	27p	350	2%	F15	
8C36	27p	350	2%	E16	
8C37	47p	500	5%	E16	Z.132288
8C38	2 to 32p			E16	
8C39	330p	350	20%	B4	Z.132627
8C40	3·3p	500	5%	J11	Z.132419
8C41	0·01μ	350	25%	K4	Z.115552
8C42	1,000p	350	20%	K4	Z.132630
8C43	0·01μ	350	25%	J4	Z.115552
8C44	0·01μ	350	25%	J4	Z.115552
8C45	2 to 32p			F14	
8C46	47p	500	5%	F13	Z.132288
8C47	27p	350	2%	F14	
8C48	27p	350	2%	E14	
8C49	47p	500	5%	E14	Z.132288
8C50					
8C51	2 to 32p			E14	
8C52	330p	350	20%	B5	Z.132627
8C53	0·01μ	350	25%	K5	Z.115552
8C54	1,000p	350	20%	K6	Z.132630
8C55	0·01μ	350	25%	J5	Z.115552
8C56	0·01μ	350	25%	J6	Z.115552
8C57	2 to 32p			F12	
8C58	47p	500	5%	F12	Z.132288
8C59	27p	350	2%	F12	
8C60					
8C61	27p	350	2%	E13	
8C62	47p	500	5%	E12	Z.132288
8C63	2 to 32p			E12	

TABLE 5 *(continued)*

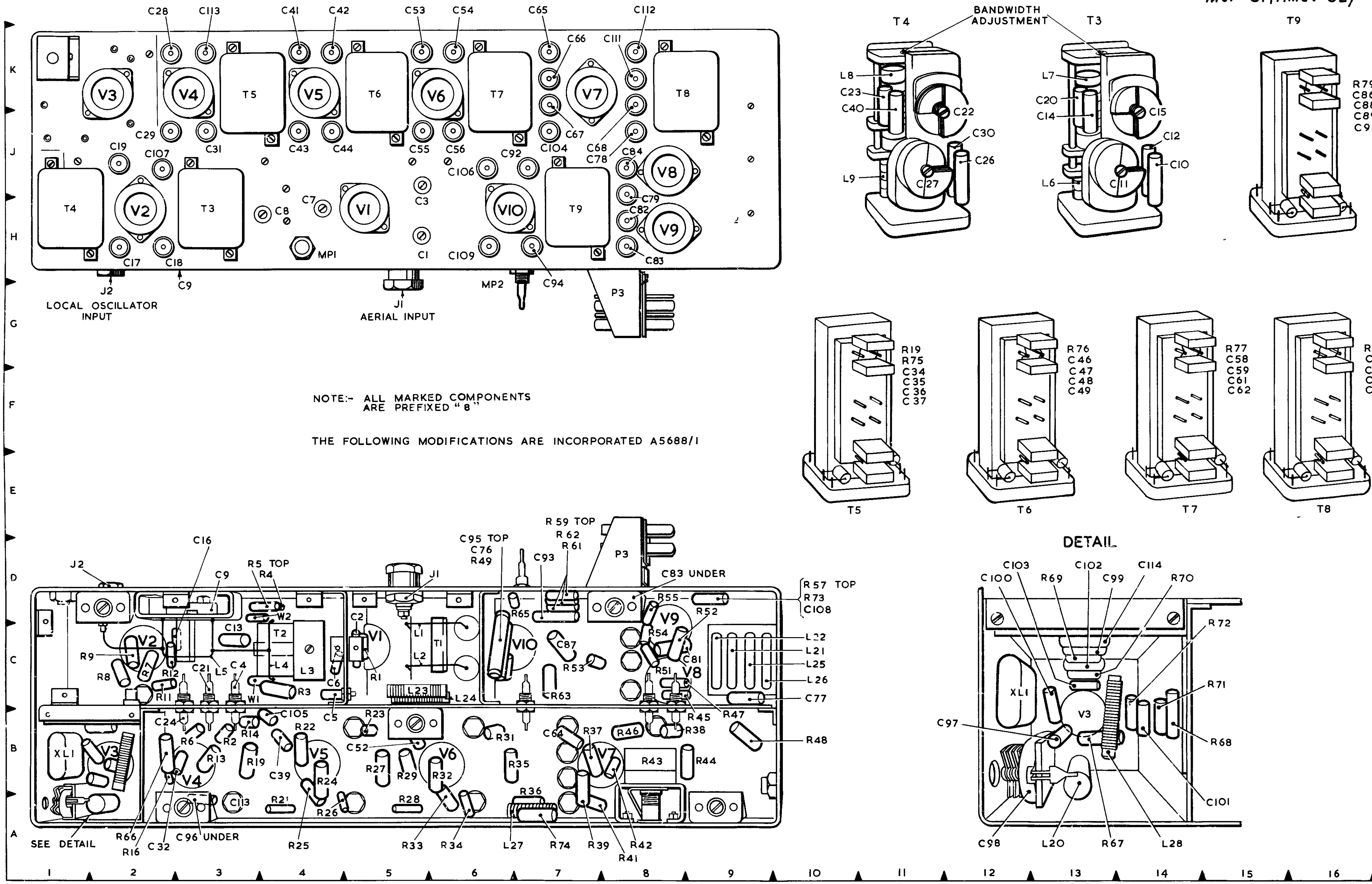
Circuit Ref	Value	Working voltage	Tolerance ±	Grid location on fig. 3	Stores Ref.
8C64	330p	350	20%	B7	Z.132627
8C65	0·01μ	350	25%	K7	Z.115552
8C66	1,000p	350	20%	K7	Z.132630
8C67	0·01μ	350	25%	J7	Z.115552
8C68	0·01μ	350	25%	J8	Z.115552
8C69	2 to 32p			F11	
8C70					
8C71	47p	500	5%	F10	Z.132288
8C72	27p	350	2%	F10	
8C73	27p	350	2%	E11	
8C74	47p	500	5%	E10	Z.132288
8C75	2 to 32p			E10	
8C76	0·01μ	350	25%	C6	Z.115552
8C77	1,000p	350	20%	C9	Z.132630
8C78	0·01μ	350	25%	J8	Z.115552
8C79	0·01μ	350	25%	H8	Z.115552
8C80					
8C81	330p	350	20%	C8	Z.132627
8C82	1,000p	350	20%	H8	Z.132630
8C83	0·01μ	350	25%	H8	Z.115552
8C84	0·01μ	350	25%	J8	Z.115552
8C85	2 to 32p			J16	
8C86	47p	500	5%	J15	Z.132288
8C87	47p	500	10%	C7	Z.132288
8C88	27p	350	2%	J15	
8C89	18p	500	5%	J16	Z.132273
8C90					
8C91	2 to 32p			J16	
8C92	330p	350	20%	J7	Z.132627
8C93	1,000p	350	20%	D7	Z.132630
8C94	0·01μ	350	25%	H7	Z.115552
8C95	0·01μ	350	25%	C6	Z.115552
8C96	1,000p	350	20%	A3	Z.132630
8C97	1,000p	350	20%	B13	Z.132630
8C98	1·5 to 20p			A12	
8C99	330p	350	20%	C13	Z.132627
8C100	13p	500	½p	B13	Z.132244
8C101	47p	500	5%	B14	Z.132288
8C102	12p	500	½p	C13	Z.132244
8C103	330p	350	20%	C13	Z.132627
8C104	0·01μ	350	25%	J7	Z.115552
8C105	330p	350	20%	B4	Z.132627
8C106	0·01μ	350	25%	J6	Z.115552
8C107	0·01μ	350	25%	J2	Z.115552
8C108	0·01μ	350	25%	D9	Z.115552
8C109	0·01μ	350	25%	H6	Z.115552
8C110					
8C111	0·01μ	350	25%	K8	Z.115552
8C112	0·01μ	350	25%	K8	Z.115552
8C113	0·01μ	350	25%	K3	Z.115552
8C114	330p	350	20%	C13	Z.132627

Receiver unit Type 119—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 3	Stores Ref.
8R1	150	$\frac{1}{4}$	10	C5	Z.221130
8R2	1,000	$\frac{1}{4}$	10	B3	Z.222004
8R3	4,700	$\frac{1}{2}$	10	C4	Z.222089
8R4	2,200	$\frac{1}{4}$	10	D4	Z.222046
8R5	680	$\frac{1}{4}$	10	D4	Z.221214
8R6	1,000	$\frac{1}{4}$	10	B3	Z.222004
8R7	22,000	$\frac{1}{2}$	10	C2	Z.222173
8R8	4,700	$\frac{1}{2}$	10	C2	Z.222089
8R9	56,000	$\frac{1}{2}$	10	C2	Z.223008
8R10					
8R11	220,000	$\frac{1}{4}$	10	C2	Z.223079
8R12	120	$\frac{1}{4}$	10	C2	Z.221121
8R13	22,000	$\frac{1}{2}$	10	B3	Z.222173
8R14	4,700	$\frac{1}{2}$	10	B3	Z.222089
8R15					
8R16	150	$\frac{1}{4}$	10	B2	Z.221130
8R17					
8R18					
8R19	22,000	$\frac{1}{8}$	5	B3	Z.219208
8R20					
8R21	100,000	$\frac{1}{4}$	10	A4	Z.223037
8R22	22,000	$\frac{1}{2}$	10	B4	Z.222173
8R23	4,700	$\frac{1}{2}$	10	B5	Z.222089
8R24	22,000	$\frac{1}{8}$	5	B4	Z.219208
8R25	56,000	$\frac{1}{2}$	10	A4	Z.223008
8R26	390	$\frac{1}{4}$	10	A4	Z.221184
8R27	22,000	$\frac{1}{8}$	5	B5	Z.219208
8R28	100,000	$\frac{1}{4}$	10	A5	Z.223037
8R29	22,000	$\frac{1}{2}$	10	B5	Z.222173
8R30					
8R31	4,700	$\frac{1}{2}$	10	B6	Z.222089
8R32	22,000	$\frac{1}{8}$	5	B6	Z.219208
8R33	56,000	$\frac{1}{2}$	10	A6	Z.223008
8R34	390	$\frac{1}{4}$	10	A6	Z.221184
8R35	22,000	$\frac{1}{8}$	5	B6	Z.219208
8R36	100,000	$\frac{1}{4}$	10	A7	Z.223037
8R37	22,000	$\frac{1}{2}$	10	B7	Z.222173
8R38	4,700	$\frac{1}{2}$	10	B8	Z.222089
8R39	22,000	$\frac{1}{8}$	5	B7	Z.219208
8R40					
8R41	56,000	$\frac{1}{2}$	10	A7	Z.223008
8R42	120	$\frac{1}{4}$	10	B8	Z.221121
8R43	5,000	$\frac{1}{2}$	10	B8	Z.272001
8R44	22,000	$\frac{1}{8}$	5	B9	Z.219208
8R45	27,000	$\frac{1}{2}$	10	C8	Z.222185
8R46	4,700	$\frac{1}{2}$	10	B8	Z.222089
8R47	4,700	$\frac{1}{2}$	10	C8	Z.222089
8R48	22,000	$\frac{1}{8}$	5	9B	Z.219208

TABLE 6 *(continued)*

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 3	Stores Ref.
8R49	470,000	¼	10	C6	Z.223121
8R50					
8R51	150	¼	10	C8	Z.221130
8R52	27,000	½	10	C8	Z.222185
8R53	4,700	½	10	C7	Z.222089
8R54	27,000	¼	10	C8	Z.222184
8R55	150	¼	10	D8	Z.221130
8R56					
8R57	430,000	⅛	5	D9	Z.219301
8R58					
8R59	47,000	¼	10	D7	Z.222214
8R60					
8R61	100,000	¼	10	D7	Z.223037
8R62	680	¼	10	D7	Z.221214
8R63	22,000	⅛	5	C7	Z.219208
8R64					
8R65	470,000	¼	10	D6	Z.223121
8R66	4,700	½	10	B2	Z.222089
8R67	4,700	½	10	B13	Z.222089
8R68	22,000	½	10	B14	Z.222173
8R69	150	¼	10	C13	Z.221130
8R70	27,000	¼	10	C13	Z.222184
8R71	1,500	¼	10	B14	Z.222025
8R72	22,000	¼	10	B14	Z.222172
8R73	62	2	5	D9	Z.243339
8R74	62	2	5	A7	Z 243339



Receiver unit Type 119 - component positions

Fig. 3

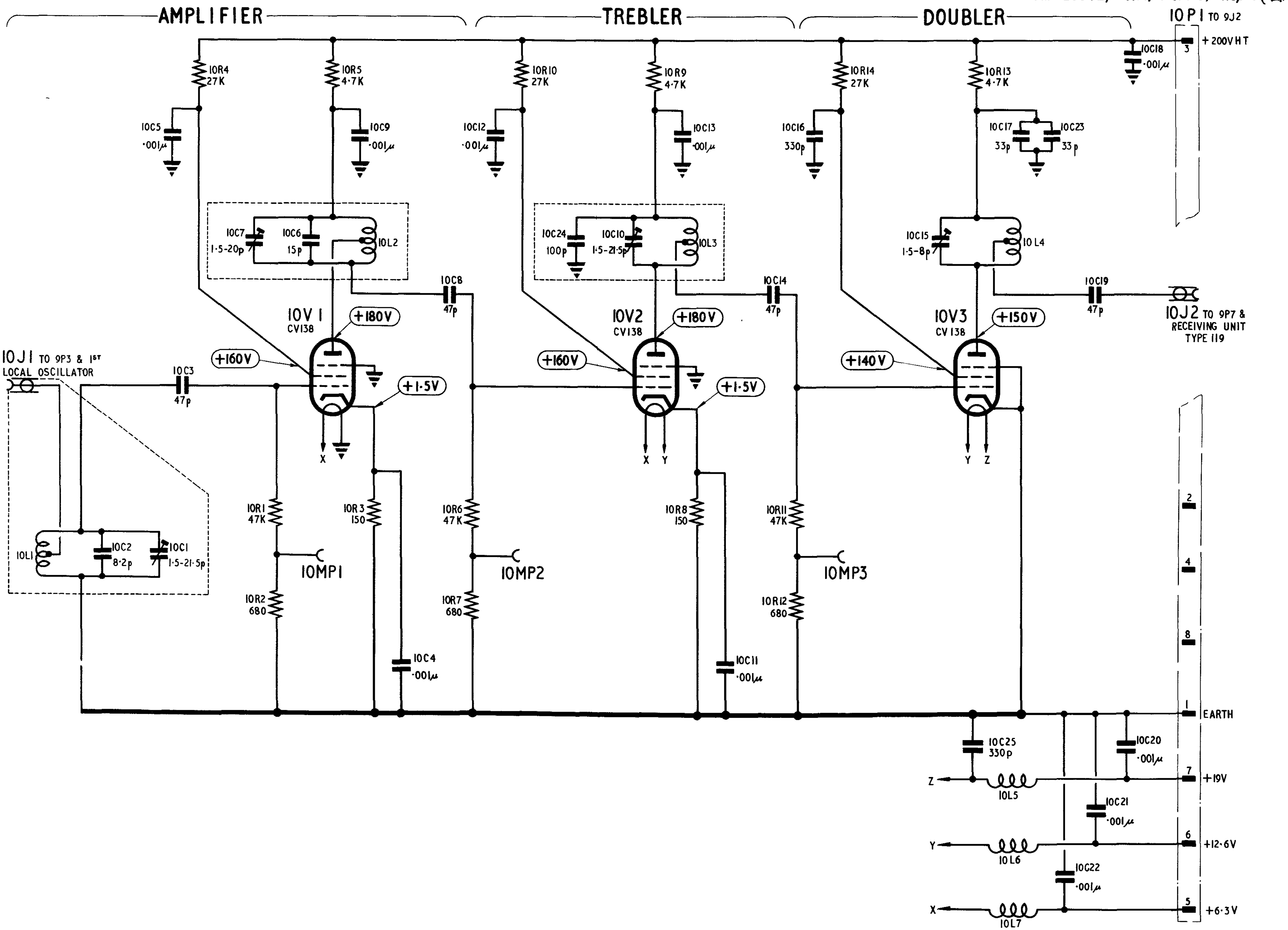


Fig. 4 RF unit Type 74 — circuit Fig. 4

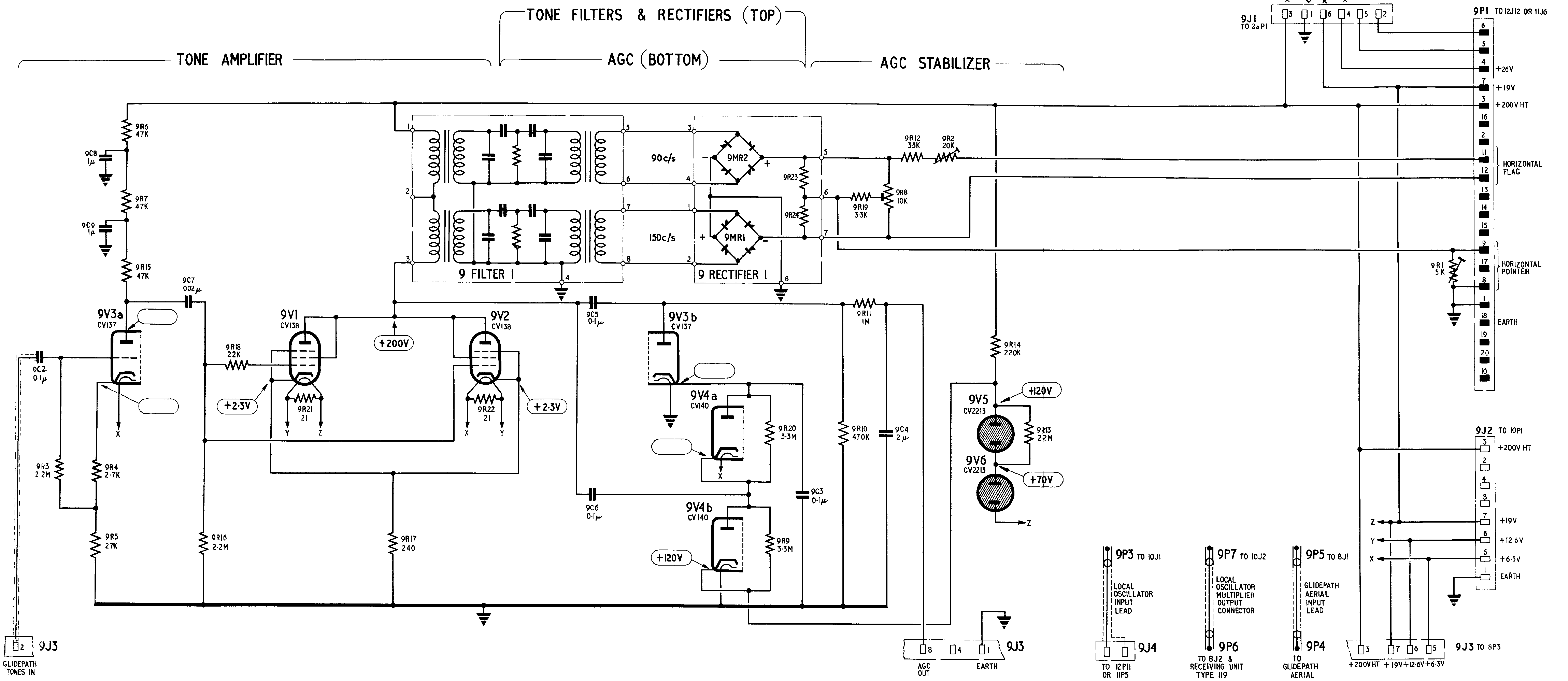


Fig.5 LF unit Type 5 — circuit Fig.5

Receiver unit Type 119 – circuit

Fig.6

Chapter 4

DATA ON MINOR UNITS

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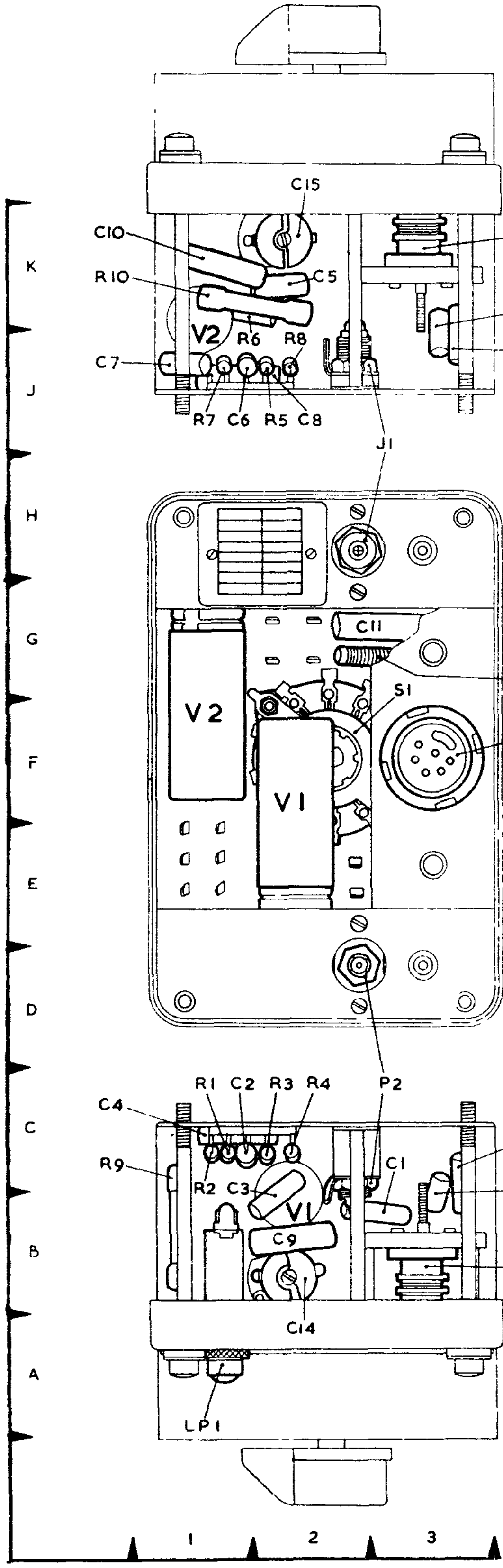


Fig. 1
Control unit Type 705—component positions

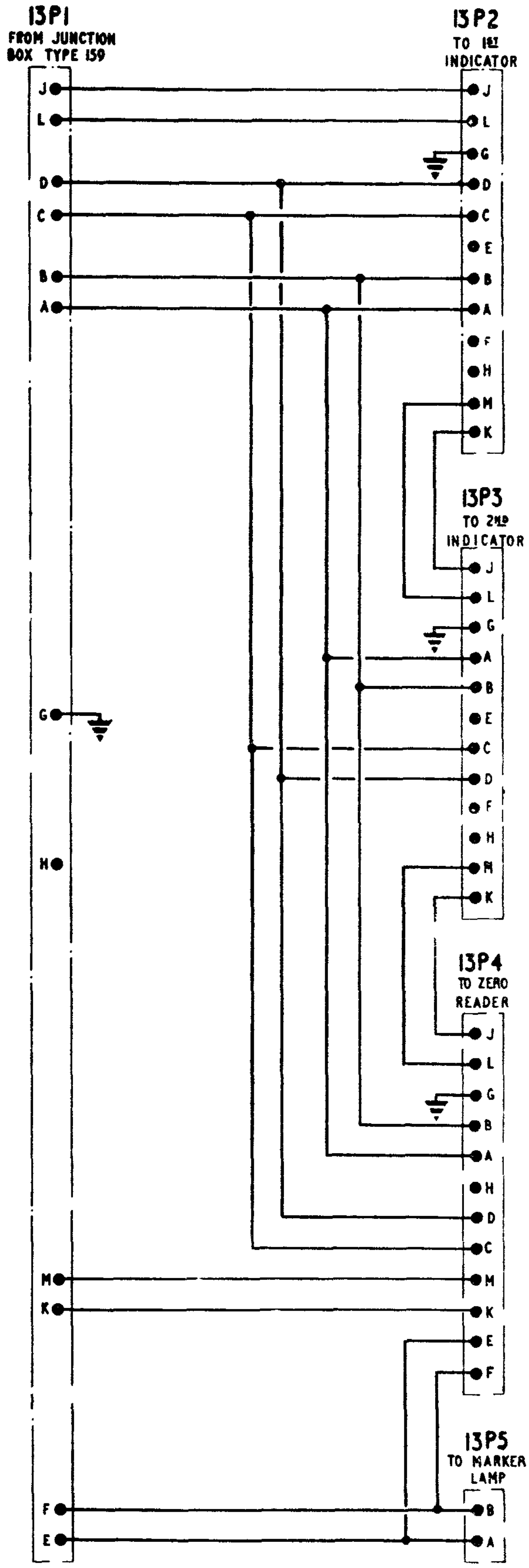


Fig. 2
Junction box Type 164—circuit

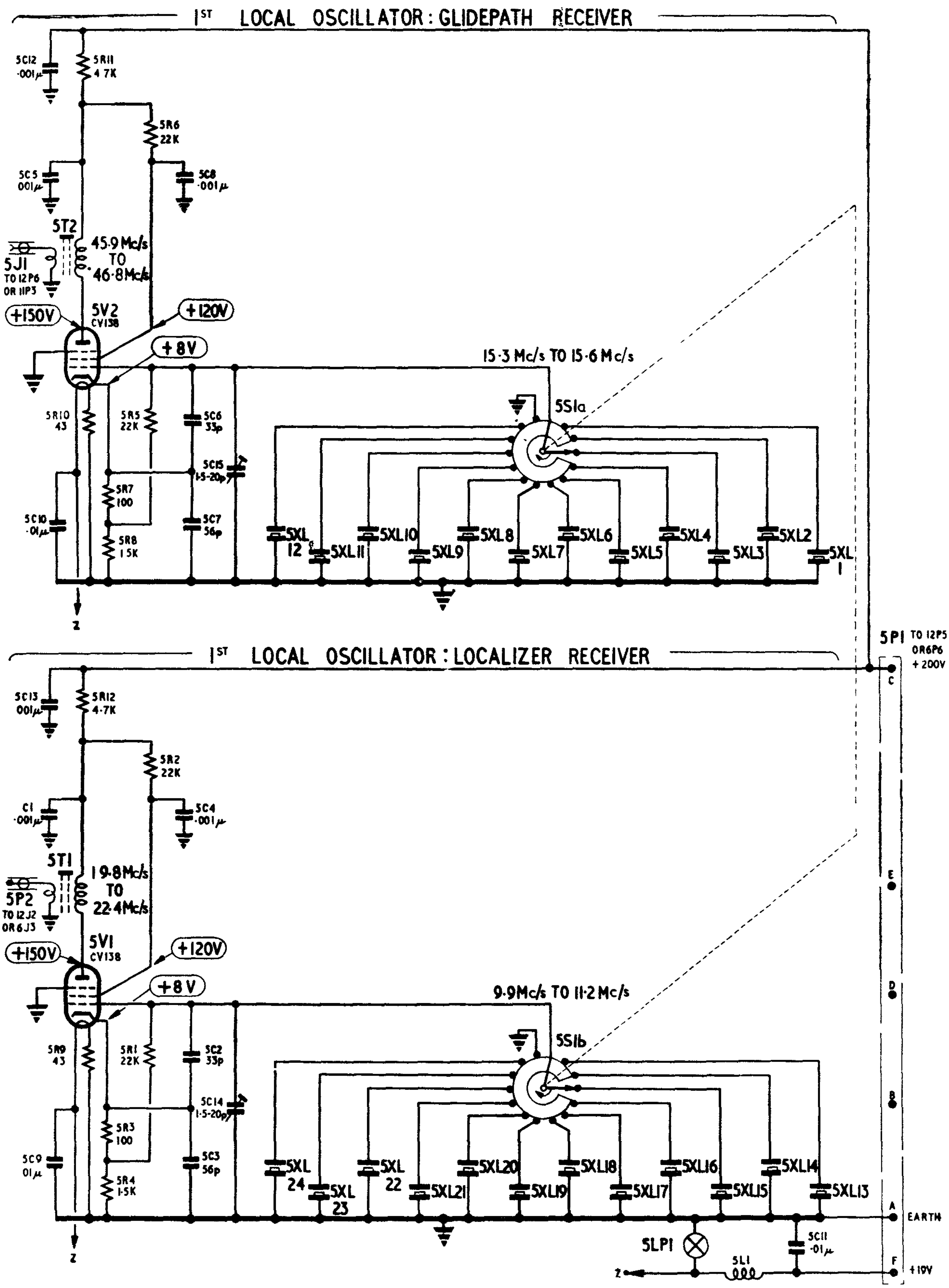
Control unit Type 705—location of capacitors

Circuit Ref.	Value	Working voltage	Tolerance ± %	Grid location on fig. 1	Stores Ref.
5C1	1,000p	300	20	B3	Z.132630
5C2	33p	500	10	C1	Z.132283
5C3	56p	500	10	B2	Z.132292
5C4	1,000p	300	20	C1	Z.132630
5C5	1,000p	300	20	K2	Z.132630
5C6	33p	500	10	J1	Z.132283
5C7	56p	500	10	J1	Z.132292
5C8	1,000p	300	20	J1	Z.132630
5C9	$0 \cdot 01\mu$	350	25	B2	Z.115035
5C10	$0 \cdot 01\mu$	350	25	K1	Z.115035
5C11	$0 \cdot 01\mu$	350	25	G2	Z.115035
5C12	1,000p	300	20	J3	Z.132630
5C13	1,000p	300	20	B3	Z.132630
5C14	$1 \cdot 5$ to 20p			B2	10C/18772
5C15	$1 \cdot 5$ to 20p			K2	10C/18772

TABLE 2

Control unit Type 705—location of resistors

Circuit Ref.	Value in ohms	Rating in watts	Tolerance ± %	Grid location on fig. 1	Stores Ref.
5R1	22,000	$\frac{1}{4}$	20	C1	Z.222172
5R2	22,000	$\frac{1}{4}$	20	C1	Z.222172
5R3	100	$\frac{1}{4}$	20	C2	Z.221109
5R4	1,500	$\frac{1}{4}$	20	C2	Z.222025
5R5	22,000	$\frac{1}{4}$	20	J2	Z.222172
5R6	22,000	$\frac{1}{4}$	20	K1	Z.222172
5R7	100	$\frac{1}{4}$	20	J1	Z.221109
5R8	1,500	$\frac{1}{4}$	20	J2	Z.222025
5R9	43	4	5	B1	Z.243061
5R10	43	4	5	K2	Z.243061
5R11	4,700	$\frac{1}{2}$	10	J3	Z.222089
5R12	4,700	$\frac{1}{2}$	10	B3	Z.222089



◀ **Fig. 3. Control unit Type 705—circuit** ▶

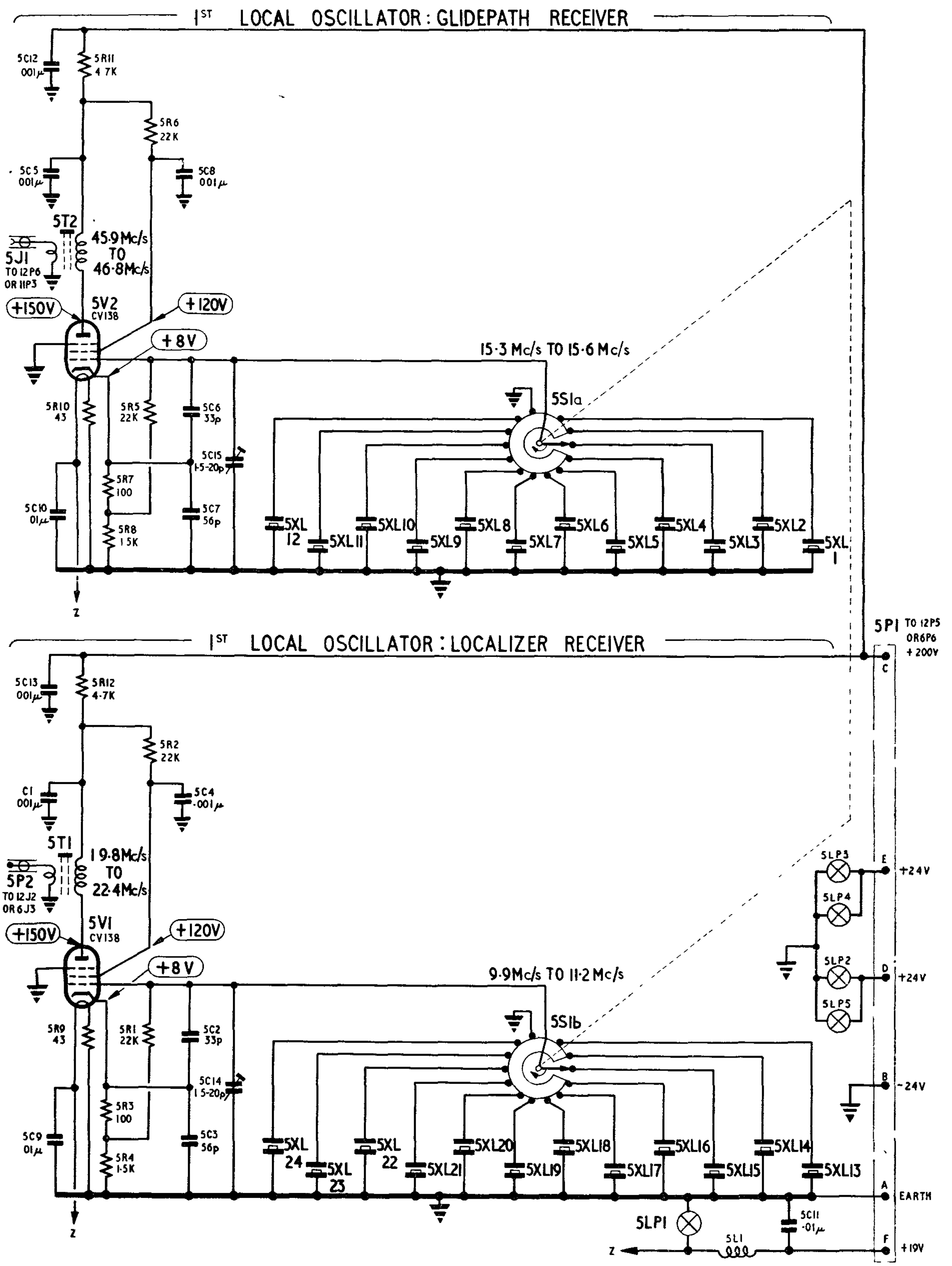


Fig. 3A. Control unit Type 705A

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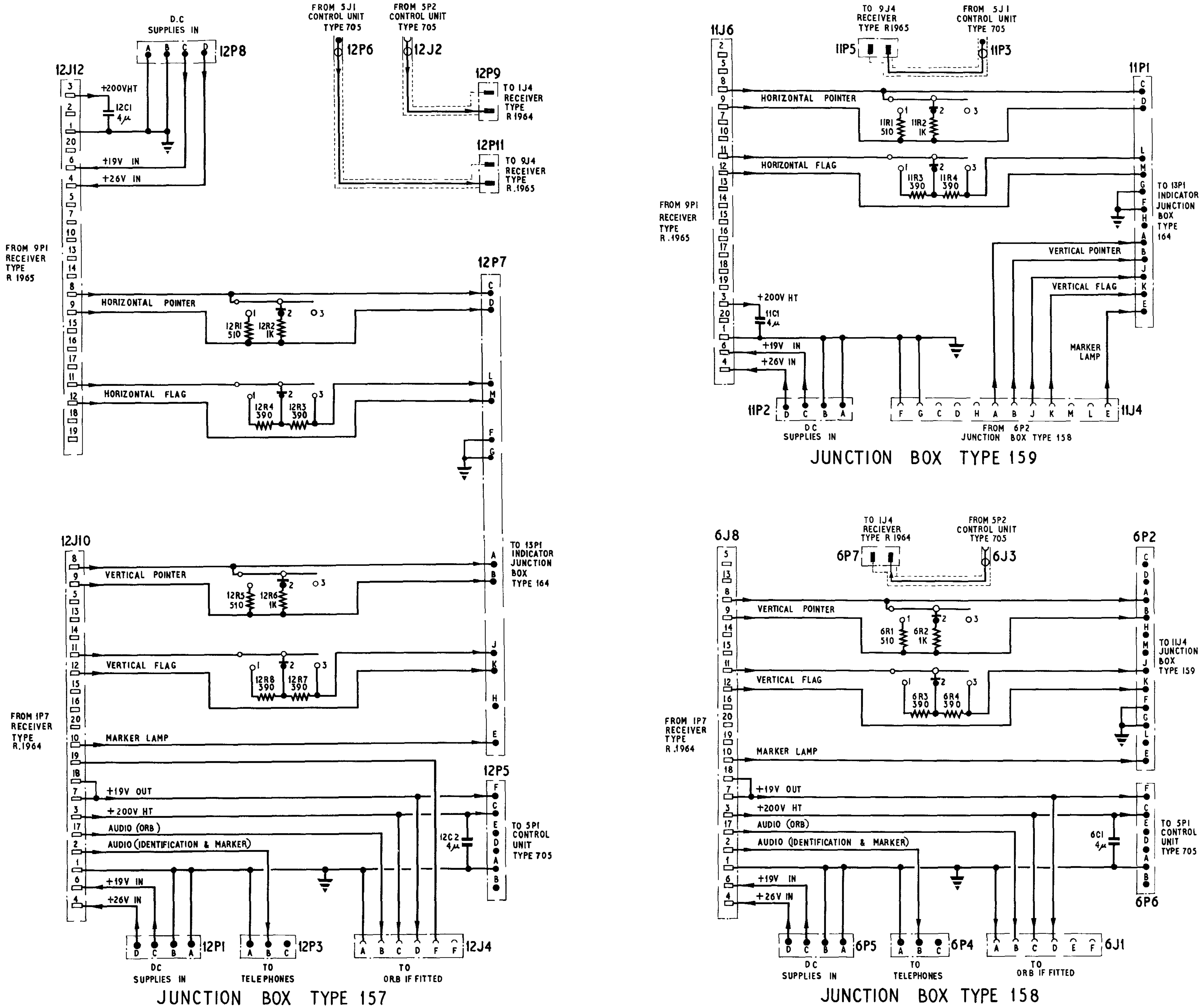

Fig.4 Junction box circuits Fig.4

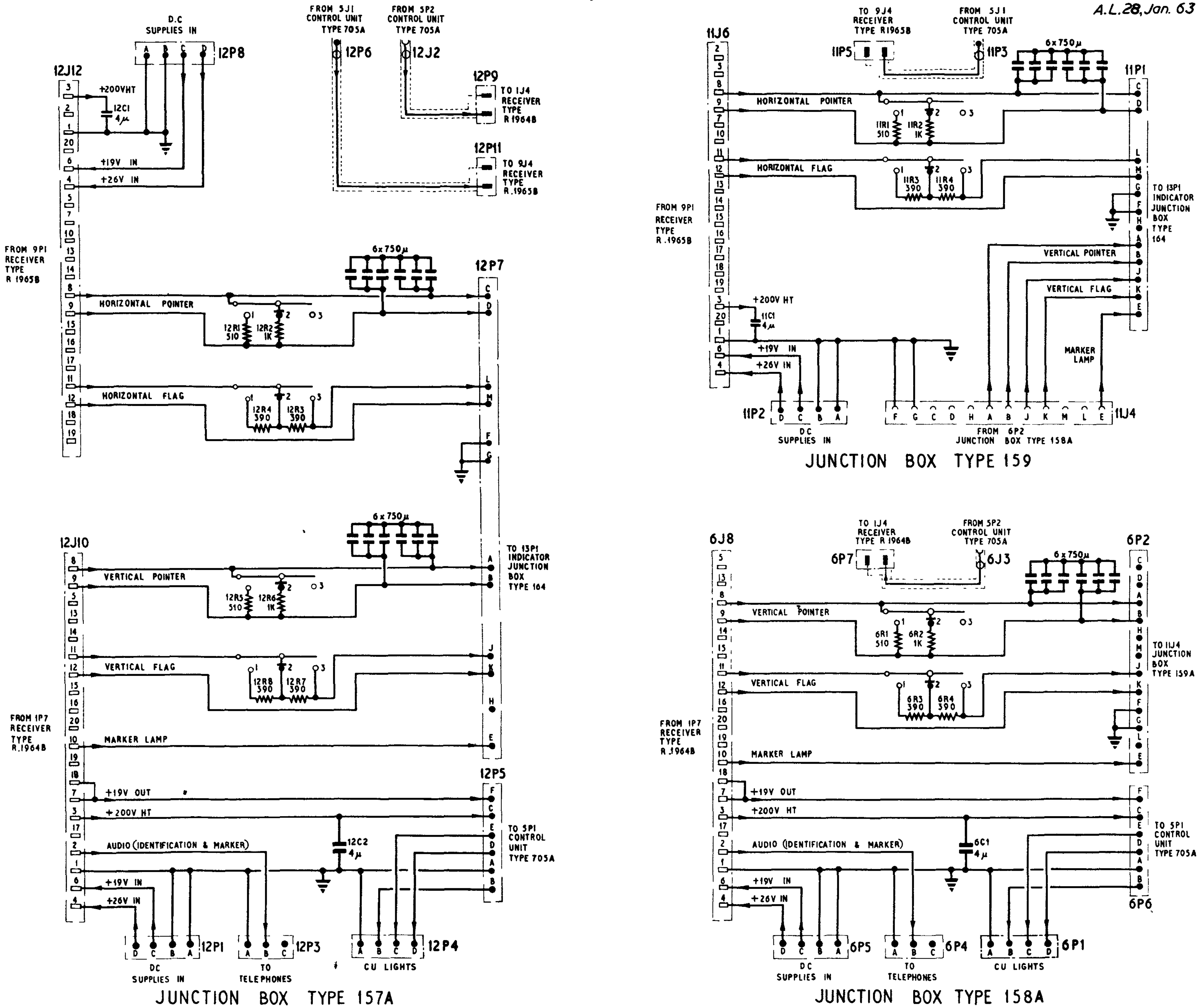

Fig. 5 Junction box circuits: (later equipments) Fig. 5

2066 281337 3430 5/63 VB 925/1

PART 4

SYSTEM INFORMATION

Chapter 1

FUNCTIONAL DIAGRAMS

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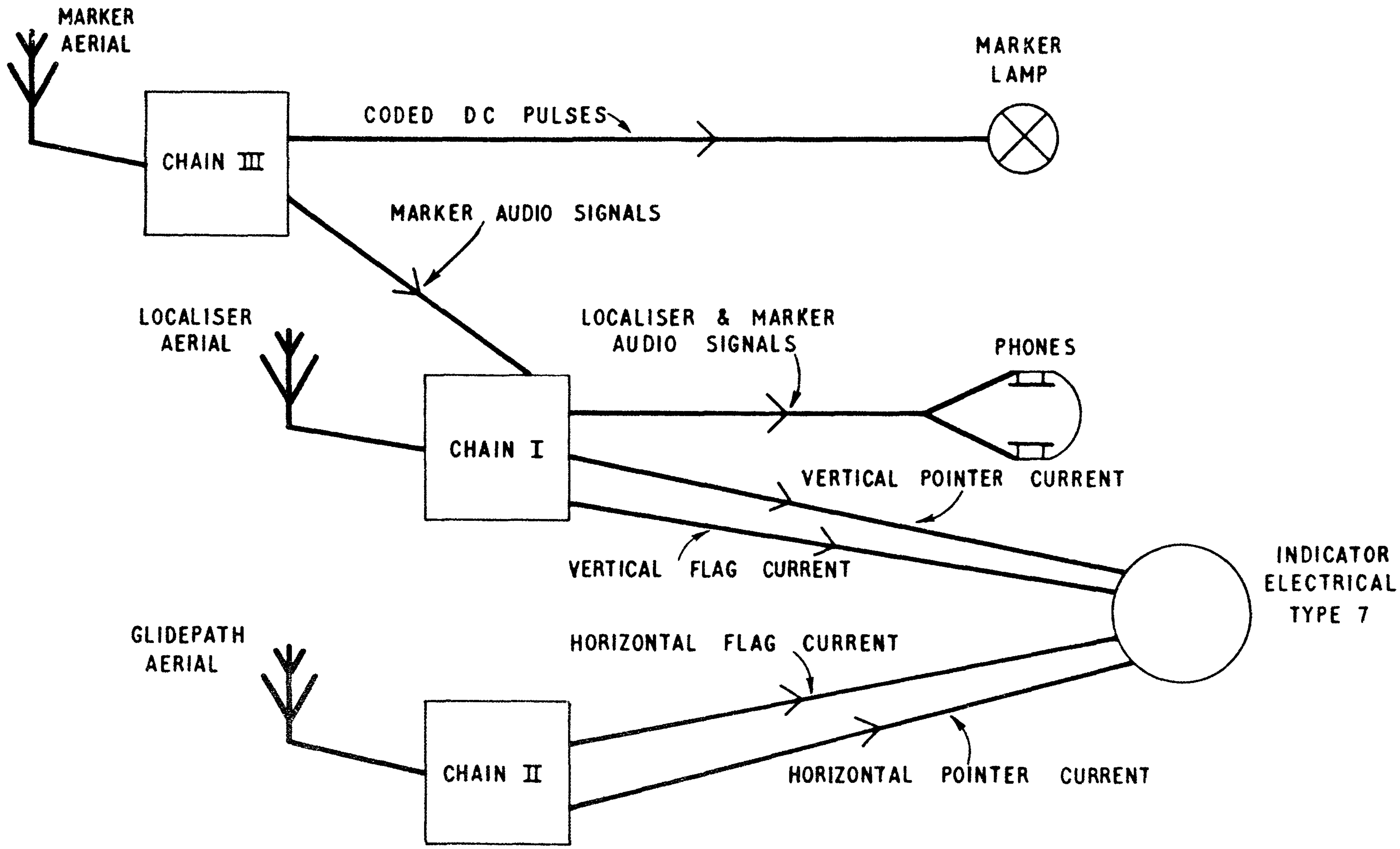


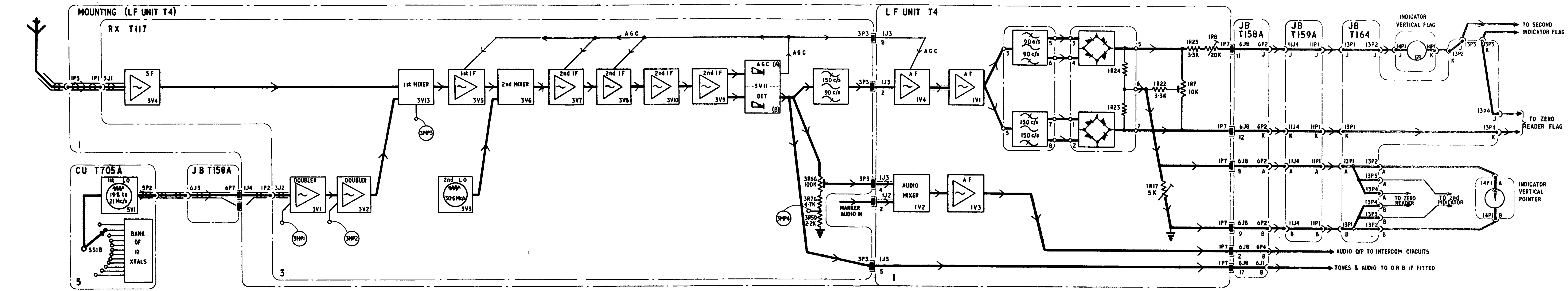
AIR DIAGRAM	
116B-0408-MD1	
ISSUE 1.	PREPARED BY MINISTRY OF AVIATION FOR PROMULGATION BY AIR MINISTRY

ARI.18011, I.L.S. (Airborne), functional block diagram

Fig. 1

D.87953. 572850. S.W. 3/66

NOTE:- JUNCTION BOX T157A REPLACES JUNCTION BOXES T158A & 159A IN SIDE BY SIDE INSTALLATIONS
SOCKET 6J8 ON JUNCTION BOX 158A CORRESPONDS TO SOCKET 12J16 ON JUNCTION BOX T157A
PLUG 11P1 ON JUNCTION BOX 159A CORRESPONDS TO PLUG 12P7 ON JUNCTION BOX T157A
SOCKET 6J1 ON JUNCTION BOX 158A CORRESPONDS TO SOCKET 12J4 ON JUNCTION BOX T157A
PLUG 6P4 ON JUNCTION BOX 158A CORRESPONDS TO PLUG 12P3 ON JUNCTION BOX T157A



CONTROLS

5S1B CHANNEL SELECTOR

3R66 SPEECH VOLUME CONTROL

1R17 DEFLECTION SENSITIVITY
1R7 SET ZERO
1R8 FLAG SENSITIVITY

TEST POINTS

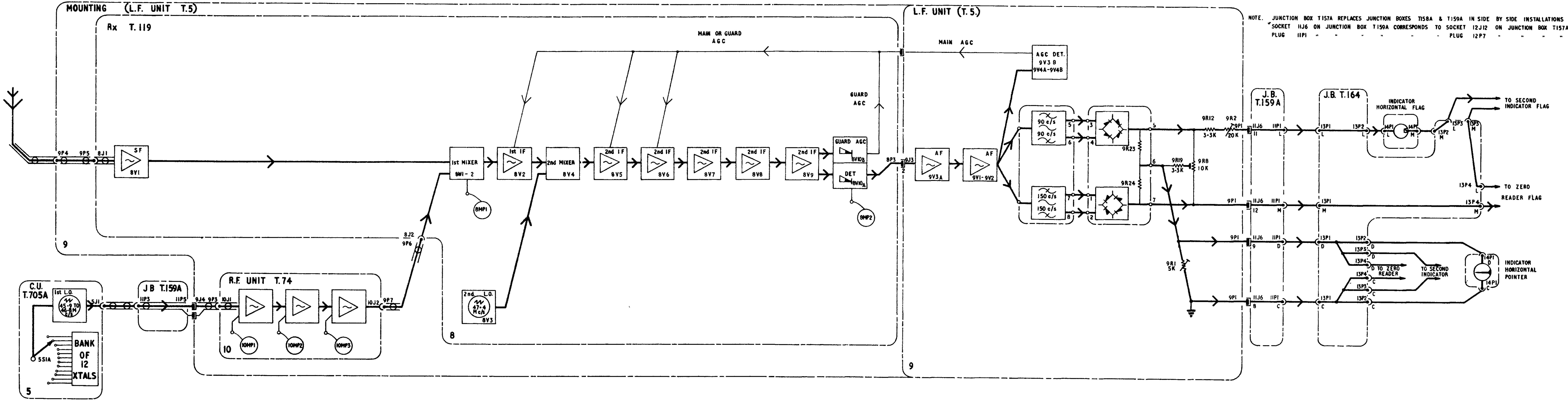
3MP1 0·2 mA to 1mA
3MP3 3mA to 6mA
3MP2 0·5mA to 2mA
3MP4 50μA

AIR DIAGRAM
116B-0408-MD2
ISSUE 1.
BY COMMAND OF THE DEFENCE COUNCIL FOR USE IN THE ROYAL NAVY/ROYAL AIR FORCE (Prepared by the Ministry of Aviation)

D.87953. 572850. S.W. 3/66

ARI. 18011, I.L.S. (Airborne), localiser receiver (Rx T117), Chain I : functional diagram

Fig. 2



NOTE. JUNCTION BOX T157A REPLACES JUNCTION BOXES T158A & T159A IN SIDE BY SIDE INSTALLATIONS
SOCKET 11J6 ON JUNCTION BOX T159A CORRESPONDS TO SOCKET 12J12 ON JUNCTION BOX T157A
PLUG 11P1 " " " " " PLUG 12P7 " " "

CONTROLS
5S1A CHANNEL SELECTOR

TEST POINTS

10MP1 130μA TO 150μA
10MP2 320μA TO 550μA
10MP3 100μA TO 120μA
8MP1 130μA TO 150μA
8MP2 30μA TO 50μA

9R1 DEFLECTION SENSITIVITY
9R8 SET ZERO
9R2 FLAG SENSITIVITY

AIR DIAGRAM
116B-0408-MD3
ISSUE 1.
BY COMMAND OF THE DEFENCE COUNCIL FOR USE IN THE ROYAL NAVY/ROYAL AIR FORCE (Prepared by the Ministry of Aviation)

D.87953. 572850. S.W. 3/66

ARI. 18011, I.L.S. (Airborne), Glidepath receiver (Rx T.1965), Chain II : functional diagram

Fig. 3

NOTE. JUNCTION BOX 157A REPLACES JUNCTION BOXES 158A & 159A IN SIDE BY SIDE INSTALLATION.
SOCKET 6JB ON JUNCTION BOX 158A CORRESPONDS TO SOCKET 12J10 ON JUNC. BOX 157A
PLUG 6P4 " " " " " PLUG 12P3 " " " "
PLUG 6P2 & PLUG 11P1 ON JUNCTION BOX 159A, BOTH CORRESPOND TO PLUG 12P7 ON JUNCTION BOX 157A

CONTROLS

4R15 MARKER GAIN CONTROL

4R26 RELAY TRIP LEVEL ADJUSTMENT
3R67 MARKER AUDIO LEVEL CONTROL

AIR DIAGRAM 116B-0408-MD4
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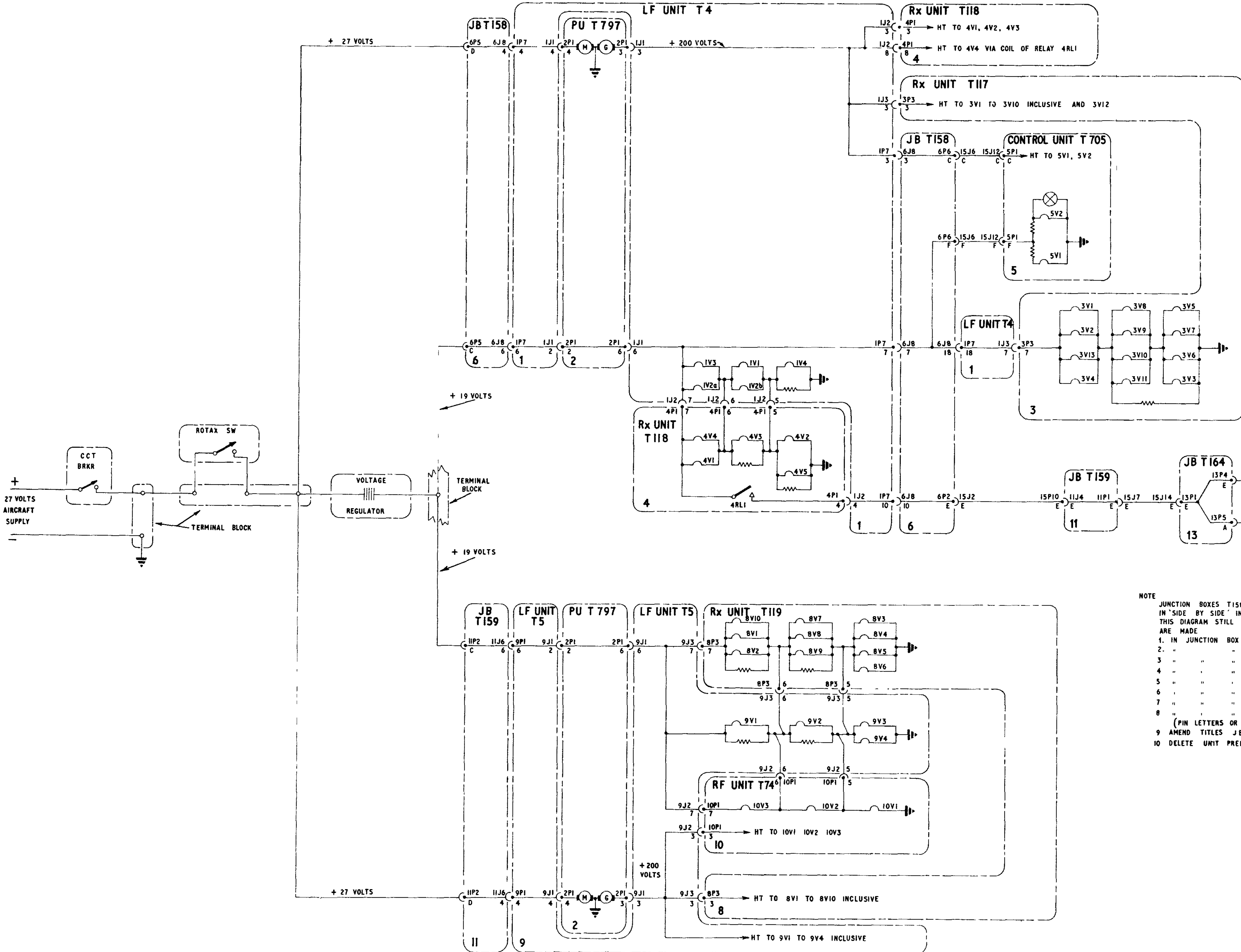
ARI.18011, I.L.S. (Airborne), Marker receiver (Rx 118), Chain III : functional diagram

Fig. 4



NOTE

JUNCTION BOXES T158 & T159 ARE REPLACED BY JUNCTION BOX T157 IN 'SIDE BY SIDE' INSTALLATIONS
THIS DIAGRAM STILL HOLDS GOOD IF THE FOLLOWING AMENDMENTS ARE MADE

1. IN JUNCTION BOX T158 AMEND SOCKETS LABELED 6J8 TO READ "12J10"
2. " " " PLUGS "6P2 " " "12P7"
3 " " " " " " 6P5 " " 12P1"
4 " " " " " 6P6" " " "12P5"
5 " " " T159 " 11P1 " "12P7"
6 " " " " " 11P2 "12P1
7 " " " " " SOCKETS " 11J4" " " "12J10
8 " " " " " " "11J6 " " "12J10

(PIN LETTERS OR NUMBERS REMAIN UNALTERED)

9 AMEND TITLES JB T158 & JB T159 TO READ JB T157'
10 DELETE UNIT PREFIX NUMBERS 6" & "11" AND INSERT "12"

AIR DIAGRAM
116B-0408-MD5
ISSUE 1.

BY COMMAND OF THE DEFENCE COUNCIL FOR USE IN THE NAVAL SERVICE/ROYAL AIR FORCE

D 87953 572850 S W 3,66

ARI.18011, I.L.S. (Airborne), Power supplies : functional diagram

Fig. 5