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Don't miss the index!

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1. Work out the page numbers you want to print. If you want to print the whole document, then within "Bookmarks" (see above), first click on "**Front**", and note the page number given at the bottom of the Acrobat window – this will give you the page number of the first page to be printed. Similarly click on "**End of A4 printable copy**", to determine the last page to be printed.

2. Select "File – Print" or click on the printer icon. This will bring up the print dialog box.

3. Select the correct printer if necessary.

4. In the area marked "Print Range" click on the radio button marked "Pages from..", then enter the first and last page numbers worked out in step 1 into the "from" and "to" boxes.

5. In the "Page Handling" area, next to "Page Scaling", select "Fit to paper". The press "OK"

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Please get in touch with me at archivist@vmarsmanuals.co.uk.

Richard Hankins, VMARS Archivist, Summer 2004

CONCISE DETAILS OF RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

Purpose of Equipment ... Designed for use in aircraft with transmitters of the T.1154 class. Also used in some A.S.R. launches, radio vehicles, and ground installations. Provides communications and direction-finding facilities.

Type of Wave ... ... C.W., M.C.W., and R.T.

Frequency Range ... 18·5 Mc/s to 3·0 Mc/s; 1,500 kc/s to 600 kc/s; 500 kc/s to 75 kc/s

Types R.1155L and N only: 18·5 Mc/s to 600 kc/s; 500 kc/s to 200 kc/s

All versions use an I.F. of 560 kc/s

Maximum Sensitivity ... Input of 10 micro-volts at 210 kc/s gives output in excess of 50 milliwatts
Input of 9 micro-volts at 16 Mc/s gives an equivalent output

Selectivity ... ... Approximately 4 kc/s to 6 kc/s total bandwidth for 6 db attenuation

Output Impedance ... 5,000 ohms

Valves ... ...

Function	*Description*	*Type*	*Stores Ref.*
Visual D/F switching	Two triode-hexodes	V.R.99A	10E/757
R.F. amplifier	Variable-mu pentode	V.R.100	10E/278
Frequency-changer	Triode-hexode	V.R.99	10E/277
I.F. amplifier	Two variable-mu pentodes	V.R.100	10E/278
A.V.C. and B.F.O.	Double diode triode	V.R.101	10E/280
Speech diode, visual meter limiter and output	Double diode triode	V.R.101	10E/280
Visual meter switching	Double triode	V.R.102	10E/279
Tuning indicator		V.I.103	10E/305

Power Input ... ... Omni and A.V.C. approx. 45 watts
Visual D.F. approx. 50 watts

Power Output ... ... Max. 200 milliwatts into 5,000 ohms impedance

Stores Ref. R.1155, 10D/98; R.1155A, 10D/820; R.1155B, 10D/13045; R.1155C, 10D/1105; R.1155D, 10D/1331; R.1155E, 10D/1332; R.1155F, 10D/1333 R.1155L, 10D/1477; R.1155M, 10D/1597; R.1155N, 10D/1667

	Length	*Width*	*Height*
Approx. Overall Dimensions	$16\frac{7}{16}$ in.	$9\frac{3}{8}$ in.	$11\frac{3}{8}$ in.

Weight ... ... Aluminium versions approx. 26 lb.
Steel versions approx. 32 lb.

Associated Equipment ... Transmitters, T.1154 series
Resistance units, types 47 and 52 and 52A
Aerial switch unit, type J
Visual indicator, type 1
Impedance matching units, type 12, 13 or 15
Power units, types 32, 32A, 32B, 33, 33A, 33B, 34, 34A, 35, 35A, 114, 115, 268, and 380

CHAPTER 2

RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

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LIST OF ILLUSTRATIONS

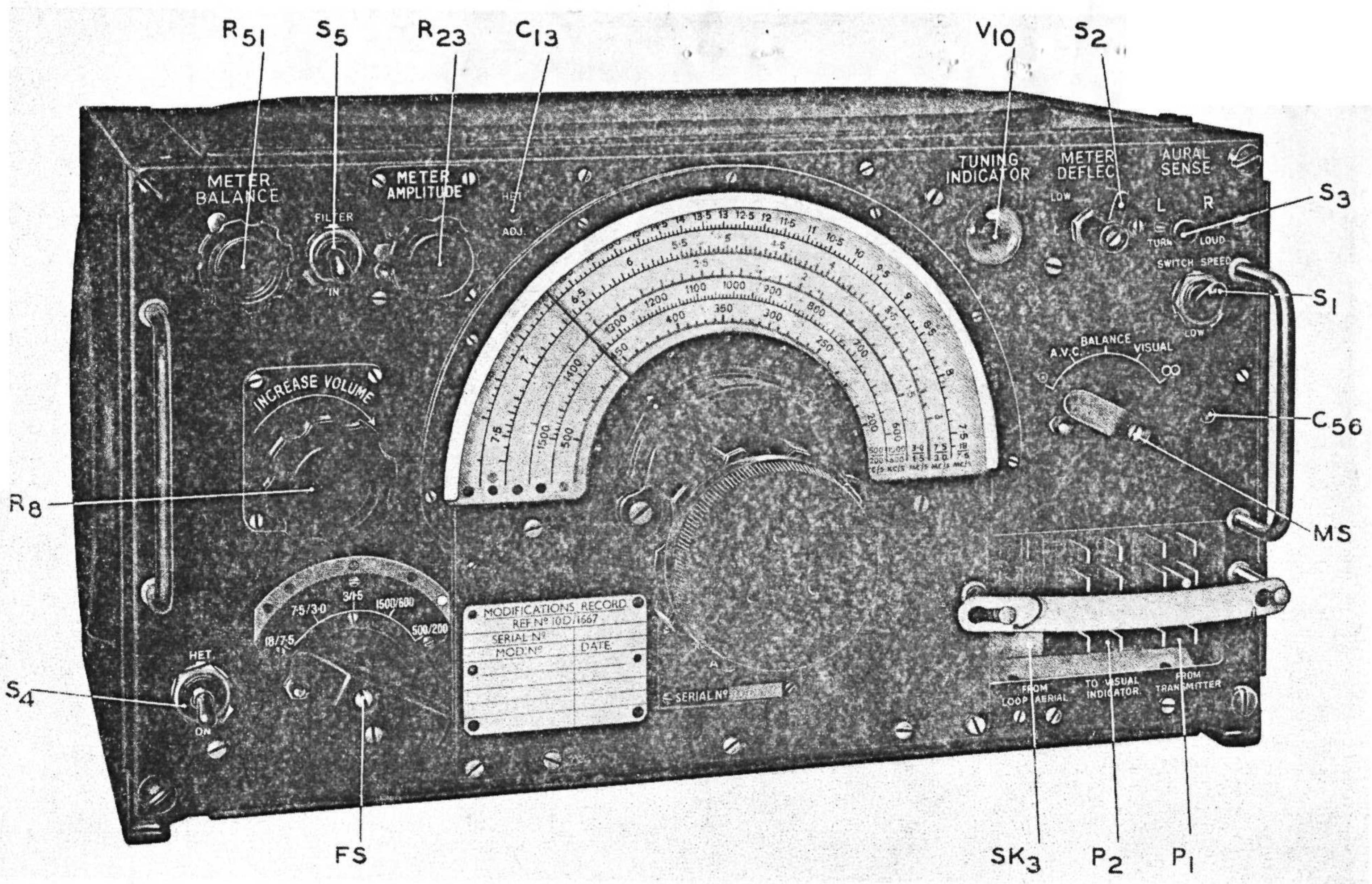


FIG. 1.—RECEIVER R.1155N

CHAPTER 2

RECEIVERS, Types R.1155, R.1155A, B, C, D, E, F, L, M, and N

INTRODUCTION

1. The receivers of the R.1155 class have been designed primarily for use in aircraft, in conjunction with transmitters of the T.1154 class described in Chapter 1 of this publication. A separate publication (A.P.2548B) deals with the installation of the receivers R.1155L and R.1155N in Air-sea rescue launches. The parent type is the receiver R.1155, and later developments are indicated by the use of a suffix letter. The main points of difference are shown in the following table:—

Receiver type	*Type of case*	*Remarks*	*Frequency coverage*
R.1155	Aluminium	—	18·5 Mc/s to 3 Mc/s 1,500 kc/s to 600 kc/s 500 kc/s to 75 kc/s
R.1155D	Steel		
R.1155A	Aluminium	Filters fitted to prevent interference from M.F. transmitters (R.1155M is for use only at ground schools)	
R.1155E	Steel		
R.1155M	Aluminium		
R.1155B	Aluminium	As A or E, but H.F chokes added to prevent interference from radar transmitters	
R.1155F	Steel		
R.1155C	Aluminium	As A, but modified for H.F. D.F. Obsolete	
R.1155L	Aluminium	As B or F, but frequency ranges altered	18·5 Mc/s to 600 kc/s 500 kc/s to 200 kc/s
R.1155N	Steel		

Facilities

2. Provision is made for the reception of signals over a wide frequency band which is covered in five ranges. These ranges are as follows:—

Range No.	*Receivers R.1155 and R.1155A, B, C, D, E, F, M*	*Receivers R.1155L and R.1155N*
1 (H.F.)	18·5 Mc/s to 7·5 Mc/s	18·5 Mc/s to 7·5 Mc/s
2 (H.F.)	7·5 Mc/s to 3·0 Mc/s	7·5 Mc/s to 3·0 Mc/s
2A (H.F.)	not applicable	3·0 Mc/s to 1·5 Mc/s
3 (M.F.)	1,500 kc/s to 600 kc/s	1,500 kc/s to 600 kc/s
4 (M.F.)	500 kc/s to 200 kc/s	500 kc/s to 200 kc/s
5 (M.F.)	200 kc/s to 75 kc/s	not applicable

Modulated and unmodulated signals can be received on all ranges. Direction finding and homing on certain ranges (mentioned in para. 36) may be carried out by aural or visual means.

Power supplies

3. Detailed descriptions of the airborne power units are given in A.P.1186D, Vol. I, Sect. 8, and the ground power units are described in A.P.1186E, Vol. I, Sect. 6. When airborne, the power supplies are provided by a rotary transformer power unit driven from the aircraft electrical system. This power unit is also the L.T. supply for the associated transmitter of the T.1154 class. Switching on and off the receiver power supplies of a T.1154/R.1155 installation is normally effected by the *transmitter* master switch. The several types of power unit available for inputs of 12 volts and 24 volts are listed in para. 88 of this chapter.

4. For ground installations, a power unit type 114 may be used. This operates directly from 230-volt 50 c/s mains. Alternatively, a power unit type 115 may be used to provide, from 230-volt 50 c/s mains, the input for the power unit type 34, or 34A. On mobile installations, e.g., W.T. portable stations and radio vehicles, the L.T. supply is usually from accumulators and the H.T. supply from a power unit type 380.

Aerials

5. The receivers may be worked on either fixed or trailing aerials for communications; a fixed aerial, is normally used for the H.F. ranges, and a trailing aerial for the M.F. ranges. A suitable loop aerial, such as type 3, is required for direction finding purposes. Aerial switching is interlocked with that of the associated transmitter by a separate switching device, normally the aerial switching unit, type J. In some installations an aerial plug board may be used instead of the type J switch.

VALVE TYPES							
V_1	VR.99 A	V_4	VR.99	V_7	VR.101	V_{10}	V.I.103
V_2	VR.99 A	V_5	VR.100	V_8	VR.101		
V_3	VR.100	V_6	VR.100	V_9	VR.102		

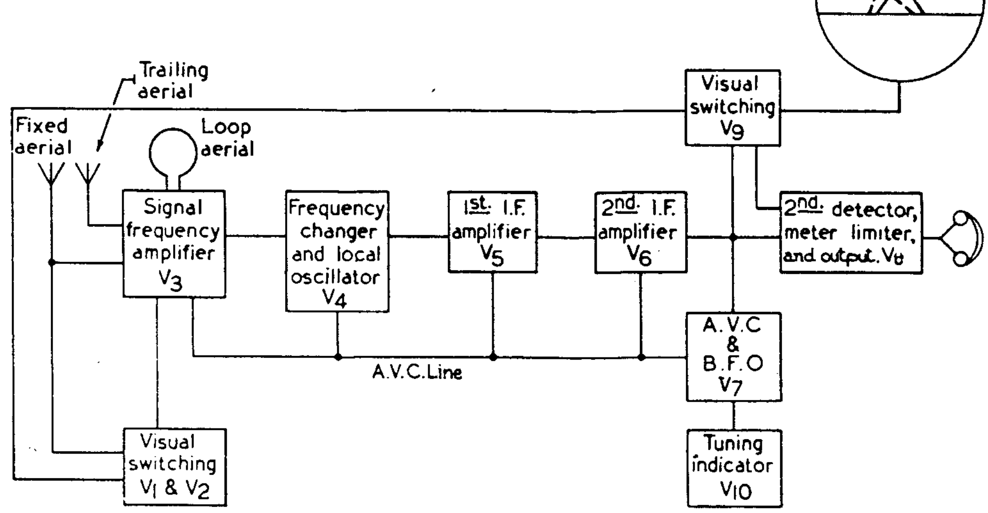


FIG. 2.—SCHEMATIC DIAGRAM

GENERAL DESCRIPTION

6. A ten-valve super-heterodyne circuit is employed, a schematic diagram of which is shown in fig. 2. The communications circuit comprises the valves V_3, V_4, V_5, V_6, V_7, V_8, and V_{10}. For direction finding the valves V_1, V_2, and V_9 are brought into use. The triode-hexode valves V_1 and V_2 electronically switch the input from the H.F. aerial into phase and antiphase relationship with the loop aerial at a predetermined frequency. Valve V_9 switches the rectified output to a visual indicator, type 1, in synchronism with the aerial switching. The input to the visual indicator is limited by one of the diode portions of the double-diode-triode valve V_8. More detailed information is given in paras. 7 to 53, which should be read in conjunction with figs. 3 to 14.

Note.—Paras. 10 to 29 deal with the basic communications circuit of the R.1155 and R.1155D (fig. 3). Variations in the communications circuits of later types are dealt with in paras. 30 to 35. In later sections of the chapter variations in different types are dealt with as they arise.

Frequency range switch

7. This switch is designated FS on the circuit diagrams and illustrations in this chapter. It is an Oak-pattern switch with four wafers, each having front and rear contacts. In the diagrams the individual wafers are annotated "w", "x", "y", and "z", with "f" or "r" added to indicate respectively the "front" or "rear" section of the wafer. Thus FS_{xf} indicates the front section of wafer "x" of the frequency range switch. The functions of this switch are to select the appropriate aerial for the range in use, to select the correct coils for the grid and anode circuits of the R.F. amplifier valve V_3 and the R.F. oscillator portion of the triode-hexode valve V_4, and to regulate the grid bias on the H.F. ranges to preserve constant amplification. The individual wafers involved are "w" (loop aerial input and grid bias adjustment), "x" (aerial and grid coils of valve V_3), "y" (anode coils of valve V_3 and grid coils of hexode portion of valve V_4) and "z" (grid and anode coils of triode portion of valve V_4).

Master switch

8. This switch is designated MS on the circuit diagrams and illustrations, and the wafer sections are denoted by subscripts used in the same manner as already described for the frequency range switch. There are five wafers, "a" (visual indicator, and manual and automatic volume control switching), "b" (fixed and trailing aerial circuits, and D.F. biasing), "c" (D.F. switching valves), "d" (communications aerial input) and "e" (loop aerial).

9. The five positions of the master switch provide the following facilities:—

(i) ⦿ ("OMNI") .Normal reception for communications purposes. The gain of the R.F. amplifier, frequency-changer and I.F. stages is manually controlled by a potentiometer $R_{8(1)}$. The A.V.C. circuit is inoperative.

(ii) A.V.C. The automatic volume control operates on the R.F. amplifier, frequency-changer and I.F. stages. Manual volume control is by the potentiometer $R_{8(2)}$ which controls the audio input to the output stage.

(iii) BALANCE. This position is used when balancing the two needles of the visual indicator used for D.F. purposes to allow for slight differences in the constants of the switching valves and associated circuits.

(iv) VISUAL. The visual indicator circuits, including valves V_1, V_2, and V_9 are switched into circuit. A.V.C. is provided.

(v) ∞ ("FIGURE-OF-EIGHT"). In this position bearings may be taken aurally, using the switch S_3 for the determination of sense. A.V.C. is disconnected.

COMMUNICATIONS CIRCUITS, R.1155 and R.1155D

Aerial connections

10. The fixed aerial is connected to pin 1 of the 8-pin plug P_1, and the trailing aerial to pin 2 of the same plug. The fixed resistors R_{62} and R_{63} are connected across the aerials and earthed at their junction to provide leaks to prevent static charges accumulating on the aerials.

R.F. amplifier stage

11. The communications circuit commences at the R.F. amplifier stage, the basis of which is a variable-mu H.F. pentode valve V_3. For ranges 1 and 2 the fixed aerial is connected through the condenser C_{102} and coil L_2 or L_3 to the control grid of V_3. Similarly, the trailing aerial is connected through condenser C_{100} and coil L_4, L_5, or L_6 on ranges 3, 4, and 5. Switch sections MS_{bf}, MS_{df}, FS_{xf} and FS_{xr} perform the necessary switching. On all ranges the coils are tuned by a variable condenser C_{84}, which is ganged with condensers C_{83} and C_{82}, for ease of operation. Each grid coil has a pre-set trimmer condenser. These condensers are numbered C_{57} to C_{61}, and in addition C_{110} is used on range 1 (coil L_2) and in certain circumstances C_{109} is fitted on range 5 (coil L_6).

12. The variable-mu characteristic of the valve V_3 enables the gain to be controlled by varying the grid bias. In certain positions of the master switch this is done manually, and in others automatic volume control is provided. The screen voltage of V_3 is obtained from a potential divider comprising the resistors R_{43}, R_{44}, and R_1. Associated with these are the by-pass condensers C_{95}, C_{39}, and C_1. Bias for the control grid of the valve V_3 is provided by a resistance network in the A.V.C. circuit. By returning this network to the junction of R_3 and R_4, which are across R_1, a standing negative bias of 3·6 volts is provided during no-signal periods.

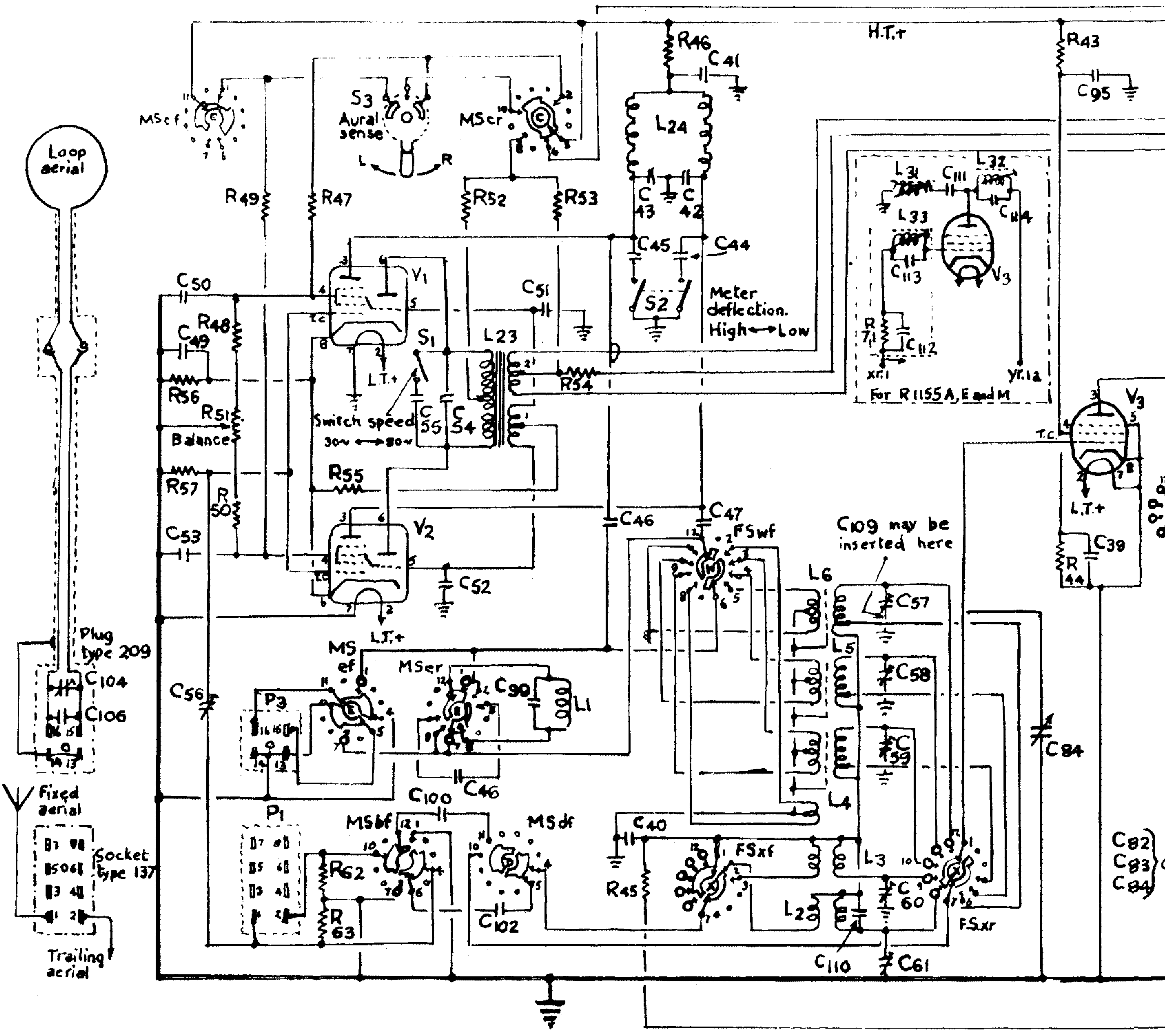
Frequency-changer stage

Hexode section

13. The triode-hexode valve V_4 operates as a frequency-changer. The output of the R.F. amplifier stage is inductively coupled to the signal grid of the hexode portion by one of the R.F. transformers L_7, L_8, L_9, L_{10} or L_{11}. Selection of the appropriate circuit for each range is made by the switch sections FS_{yf} and FS_{yr}. On all ranges the tuning of the grid circuit is effected by the variable condenser C_{83}. The secondary of each R.F. transformer is trimmed by one of the pre-set condensers C_{62} to C_{66}. A coil L_{12} and condenser C_{67} form a filter tuned to the I.F. of 560 kc/s. This filter is included in the circuit on ranges 3, 4, and 5, to eliminate possible instability due to feedback at the I.F.

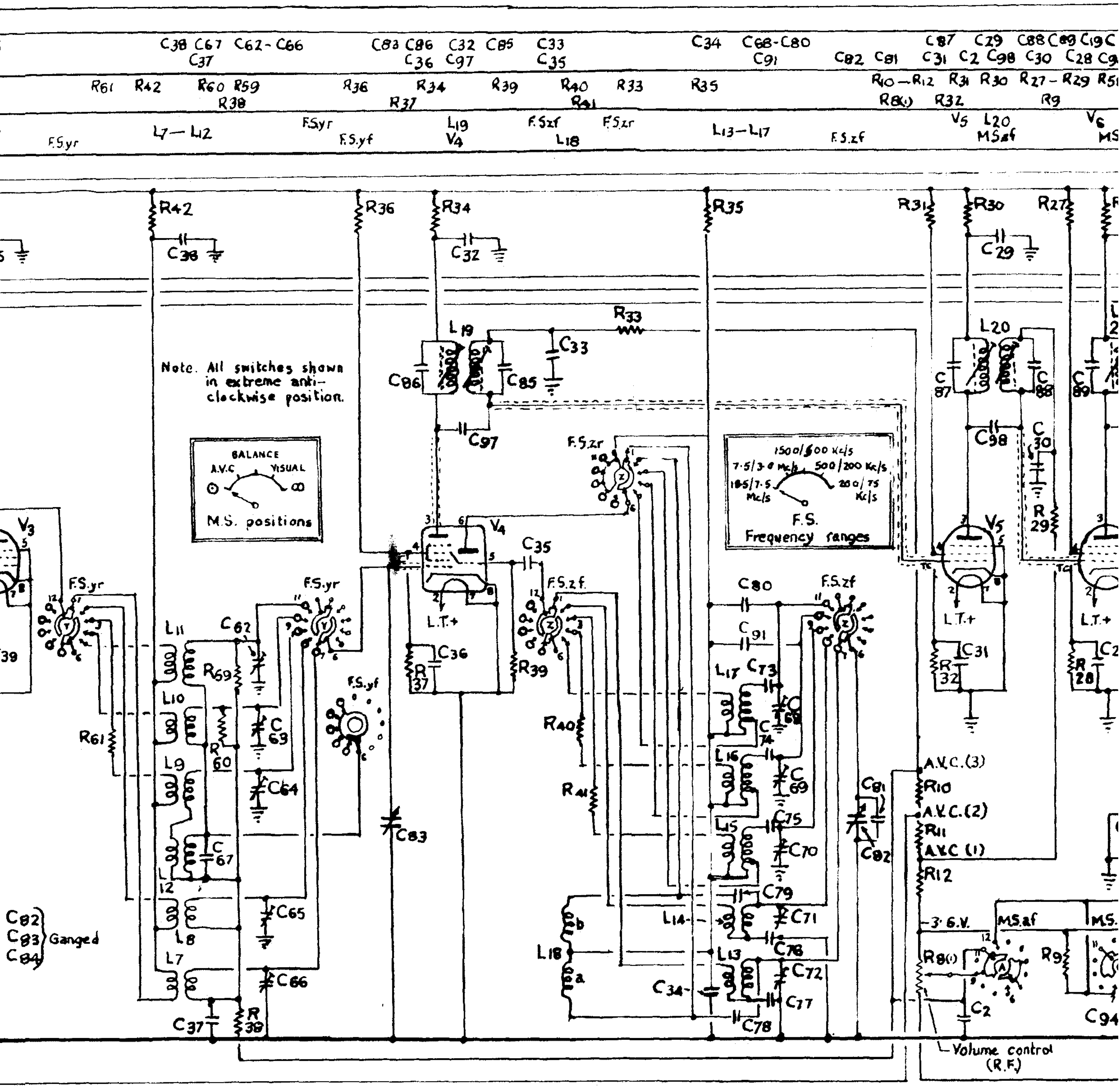
14. The incoming signal frequency is admitted at the signal grid G_1 of the hexode portion. The screen grids G_2 and G_4 are connected and form a screening electrode for the injector grid which is internally joined to the grid of the triode portion. This triode functions as an R.F. oscillator at a frequency greater than the signal frequency by 560 kc/s. The signal and oscillator frequencies are

C104 C106	C50 C56 C49 C53	C55 C54 C100 C48	C102 C99	C51 C52	C40 — C47	C57—C61 C109—C114	C84 C95 C39
	R56 R48—R51 R57	R47 R55 R62 R63	R52	R53 R54	R46 R45	R71	R43 R44
	MS.cf P3 P1	V1 S3 S1 MS.ef V2 MS.bf	MS.er L23 MS.df	MS.cr L1	L24 FS.wf S2 FS.xf	L4—L6 L31—L33 FS.xr	V3

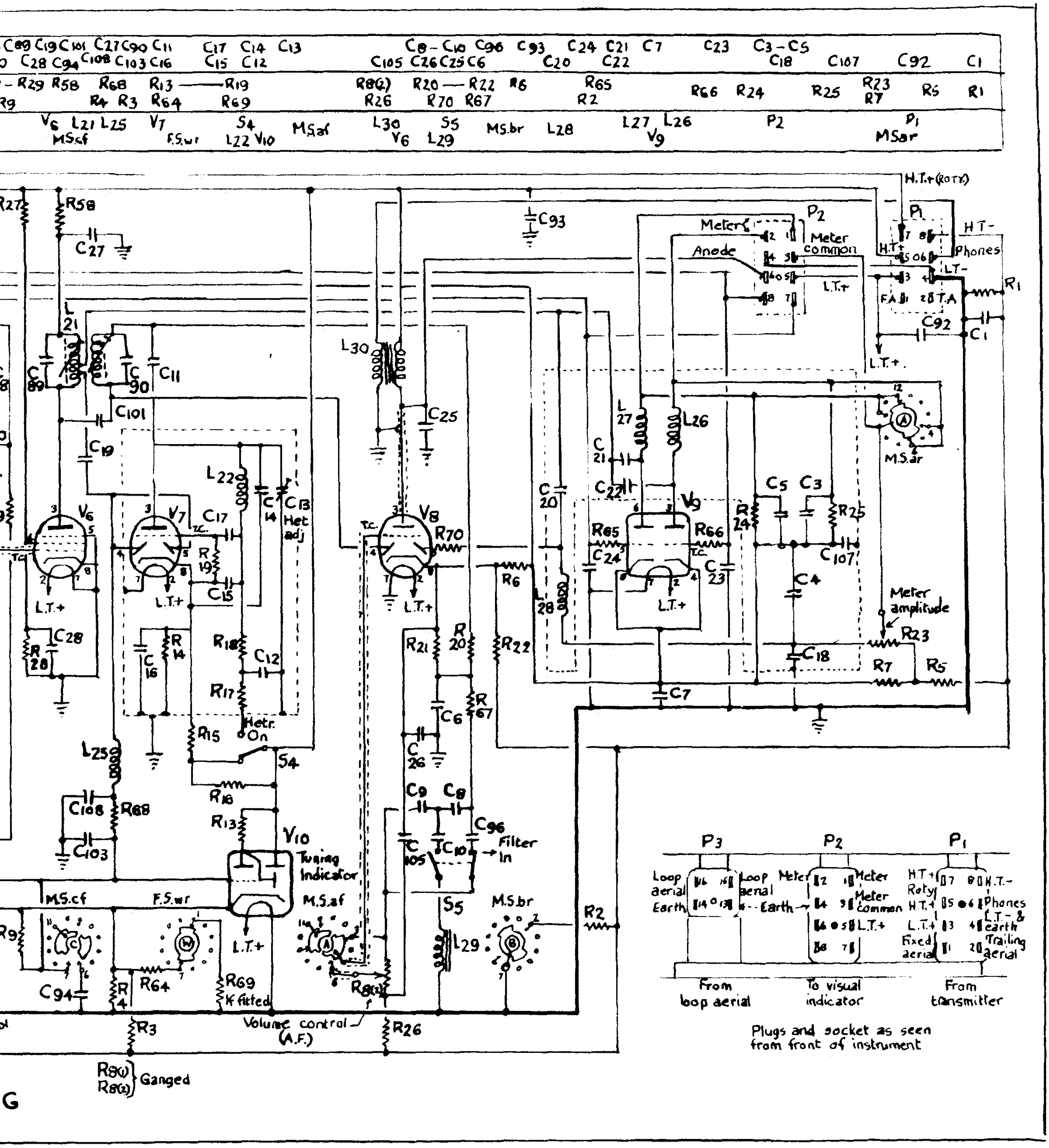


Note. Switch contacts shown thus O, denote front (f) a rear (r) contacts connected.

Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

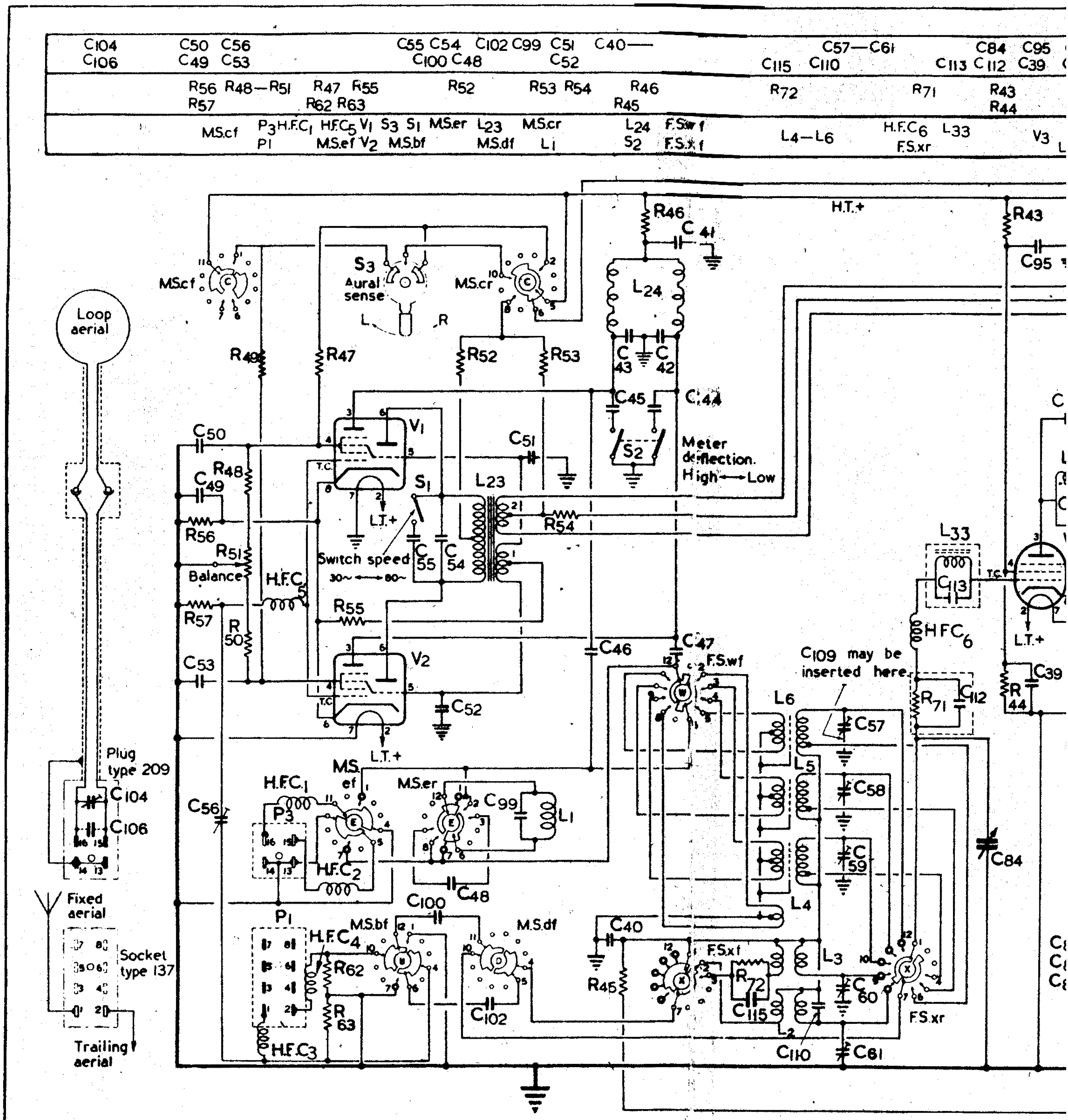


R.1155 AND R.1155D CIRCUIT DIAGRAM INCLUDING R.1155 A, R.1155 E, AND R.1155 M MODIFICATIONS



H.T.+ (ROTY.)
Meter
Anode
Meter common
L.T.+
H.T.-
Phones
L.T.-
F.A.
T.A.
M.S.ar
Meter amplitude
Het adj
Hetr. On
Tuning Indicator
Filter In
M.S.cf
F.S.wr
M.S.af
M.S.br
K fitted
Volume control (A.F.)
R8(1)
R8(2)
Ganged
P3
P2
P1
Loop aerial Earth
Loop aerial
Earth
Meter
Meter common
L.T.+
H.T.+ Roty.
H.T.+
Phones
L.T.- & earth
Fixed aerial
Trailing aerial
From loop aerial
To visual indicator
From transmitter
Plugs and socket as seen from front of instrument

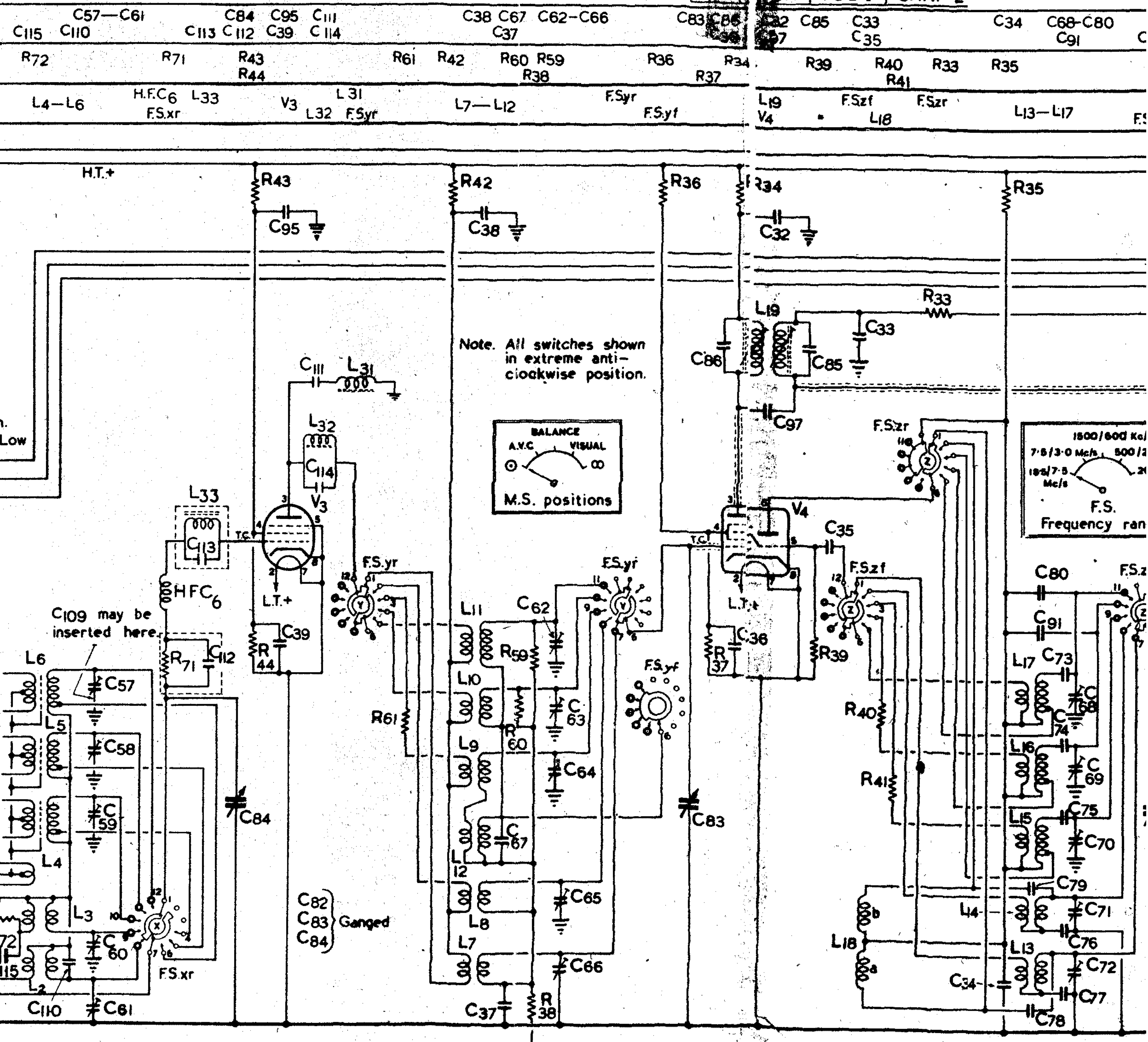
G



Note. Switch contacts shown thus ⊙, denote front (f) & rear (r) contacts connected.

Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

FIG. 3A



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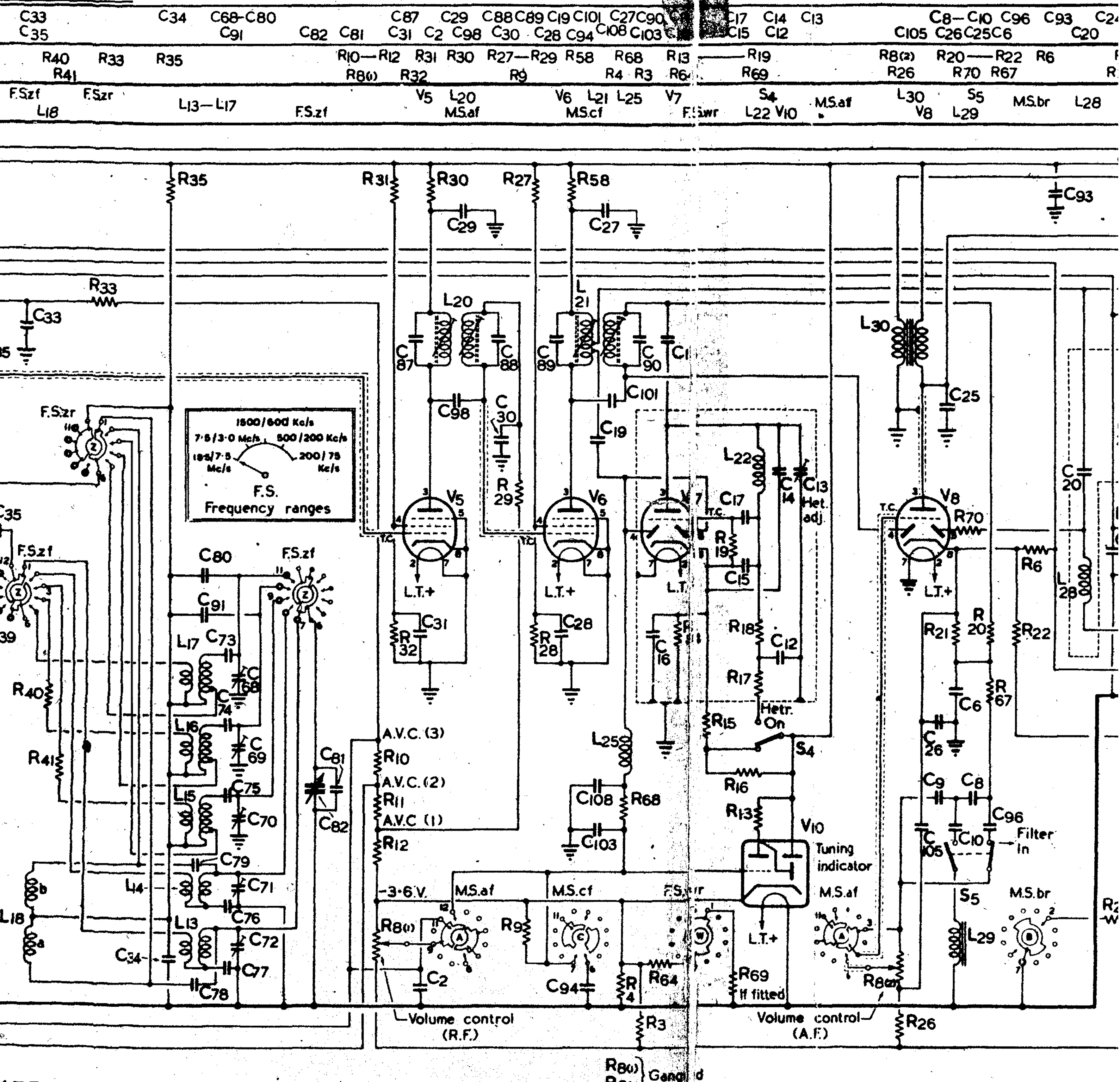
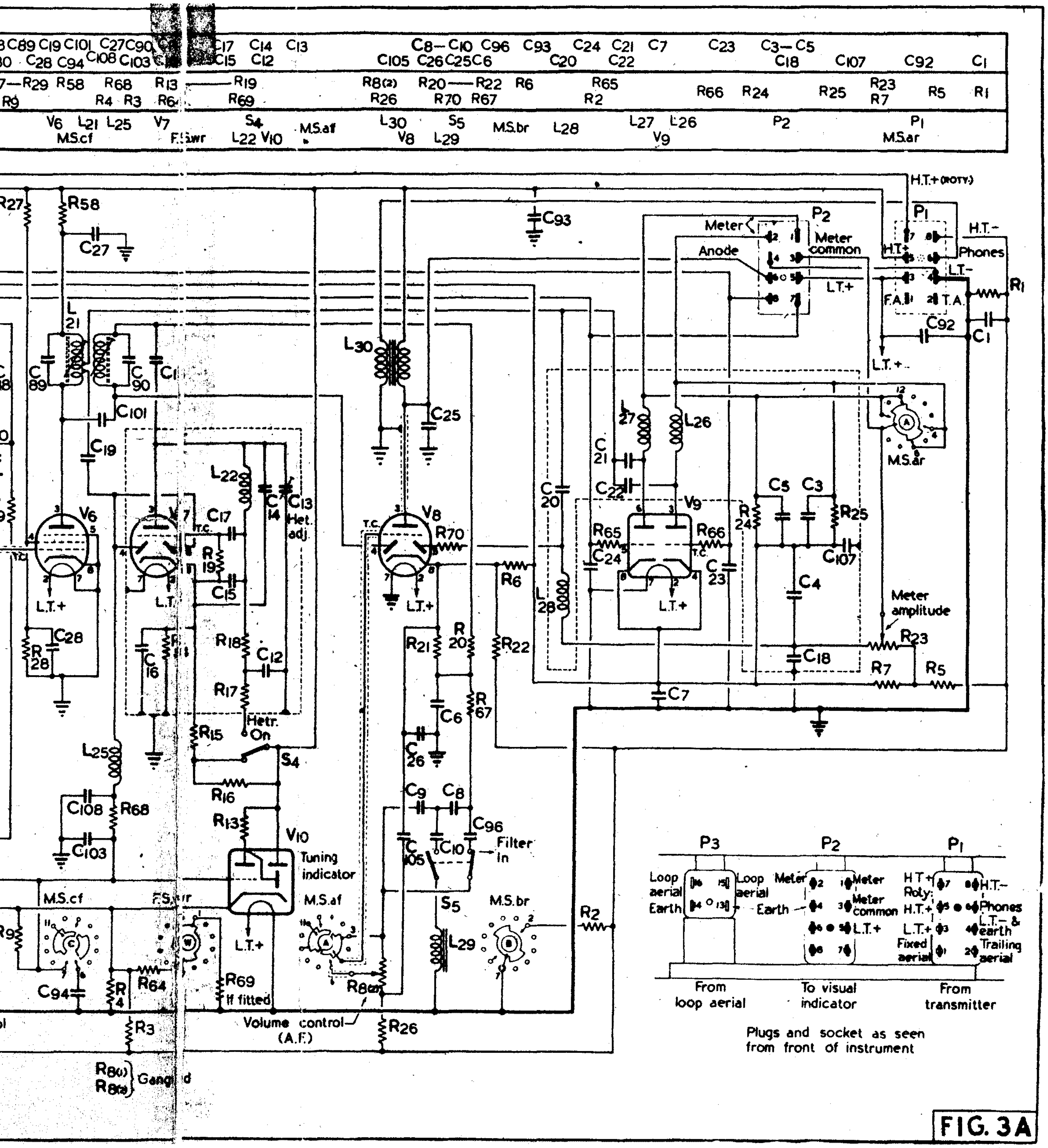
R.1155B AND R.1155F CIRCUIT DIAG



155F CIRCUIT DIAGRAM

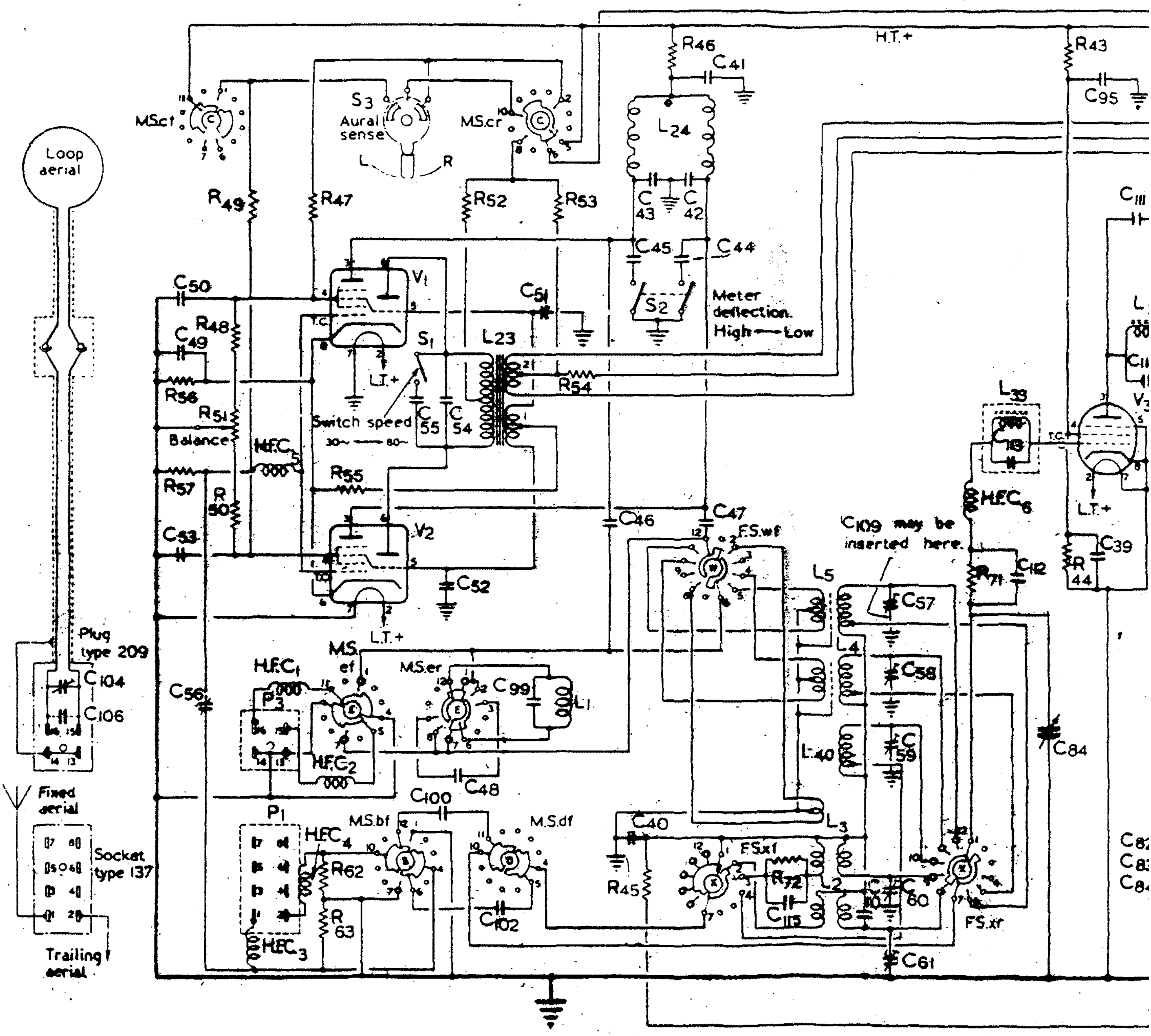


C8—C10 C96 C93 C24 C21 C7 C23 C3—C5
C105 C26 C25 C6 C20 C22 C18 C107 C92 C1
R58 R68 R13 R19 R8(2) R20—R22 R6 R65
R4 R3 R64 R69 R26 R70 R67 R2 R66 R24 R25 R23 R7 R5 R1
V6 L21 L25 V7 S4 L30 S5 M.S.br L28 L27 L26 P2 P1
M.S.cf F.S.wr L22 V10 M.S.af V8 L29 V9 M.S.ar
H.T.+ (ROTY.)
Meter
Anode
Meter common
L.T.+
H.T.-
Phones
L.T.-
F.A.
T.A.
Het. adj.
Hetr. On
Tuning indicator
Filter In
Meter amplitude
If fitted
Volume control (A.F.)
Ganged
Loop aerial
Earth
H.T.+ Roty.
Fixed aerial
L.T.- & earth
Trailing aerial
From loop aerial
To visual indicator
From transmitter
Plugs and socket as seen from front of instrument

FIG. 3A

This leaf issued in reprint, September 1947

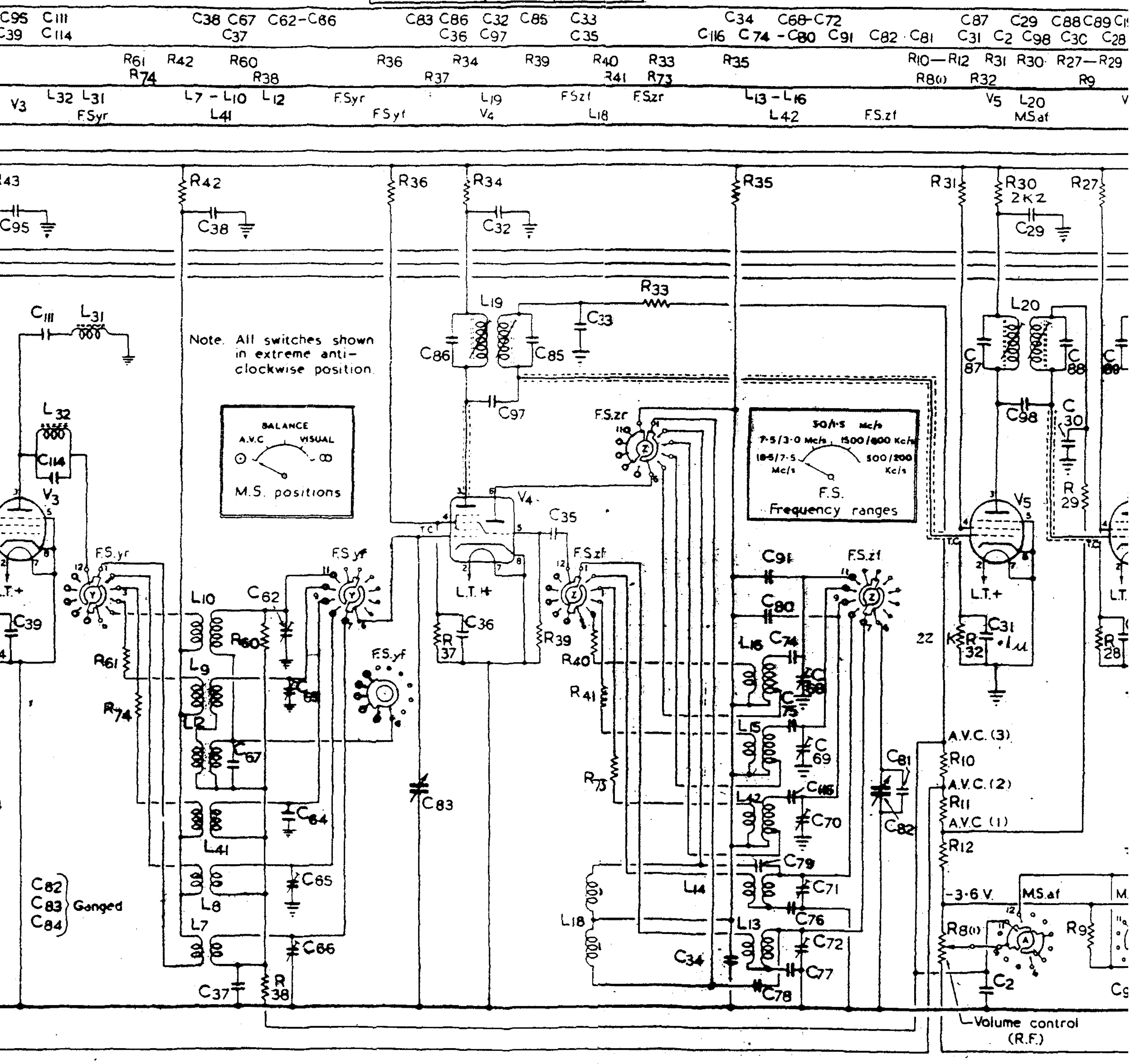
C104 C106	C50 C56 C49 C53		C55 C54 C102 C99 C51 C100 C48 C52	C40 — C47		C115	C57 — C61 C110	C112	C113	C84	C95 C39	C
	R56 R48 — R51 R57	R47 R55 R62 R63	R52	R53 R54	R46 R45	R72		R71		R43 R44		
	MS.cf	P3 HFC1 - HFC5 V1 S3 S1 MS.er L23 P1 MS.ef V2 MS.bf MS.df	MS.cr L1	L24 F.S.wf S2 F.S.xf		L4 — L5 L40		HFC6 F.S.xr L38		V3		L



.Note. Switch contacts shown thus o, denote front (f) & rear (r) contacts connected.

Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

FIG. 4



R 1155 L AND R 1155 N CIRCUIT DIAGRAM

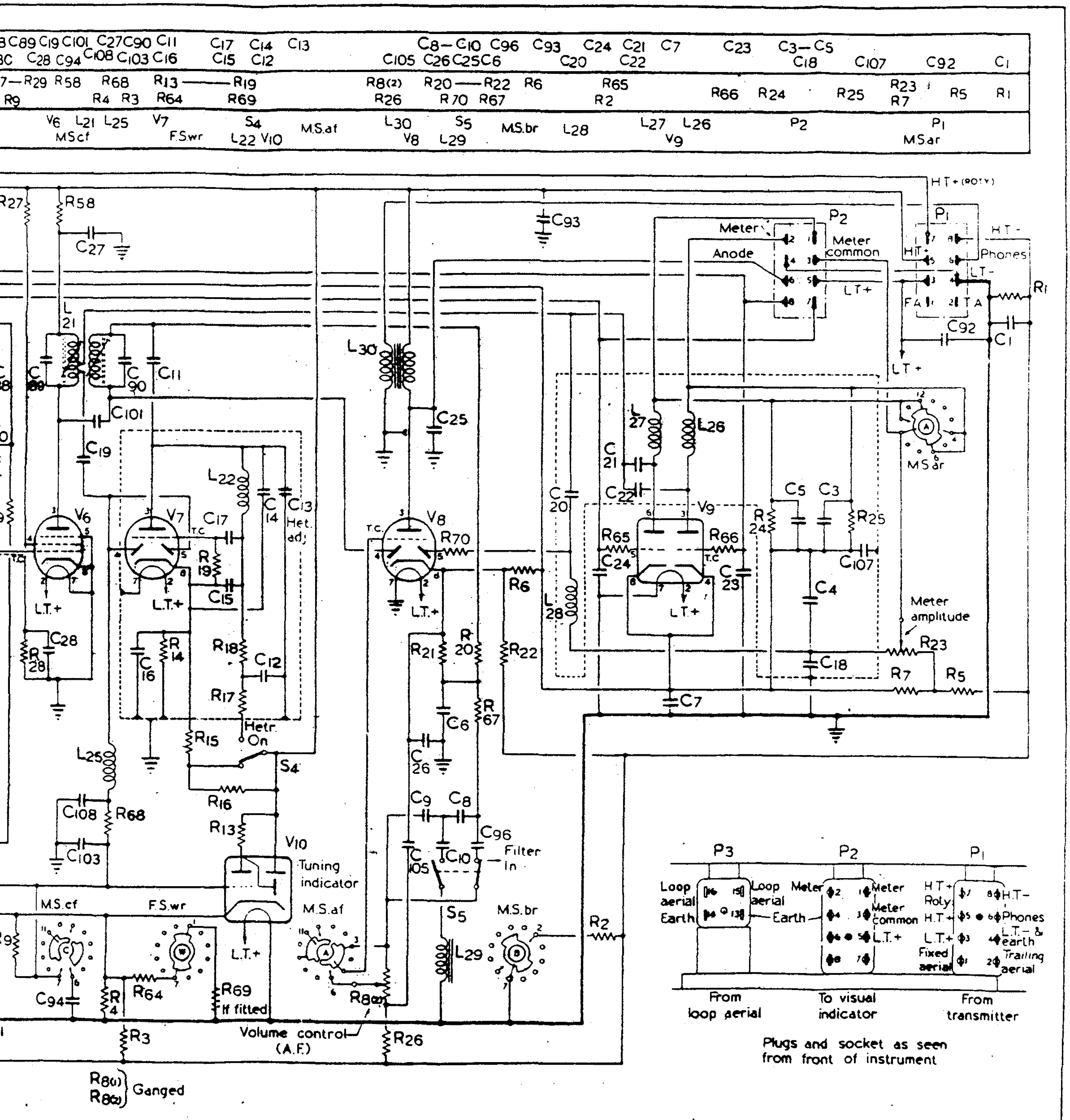


FIG. 4

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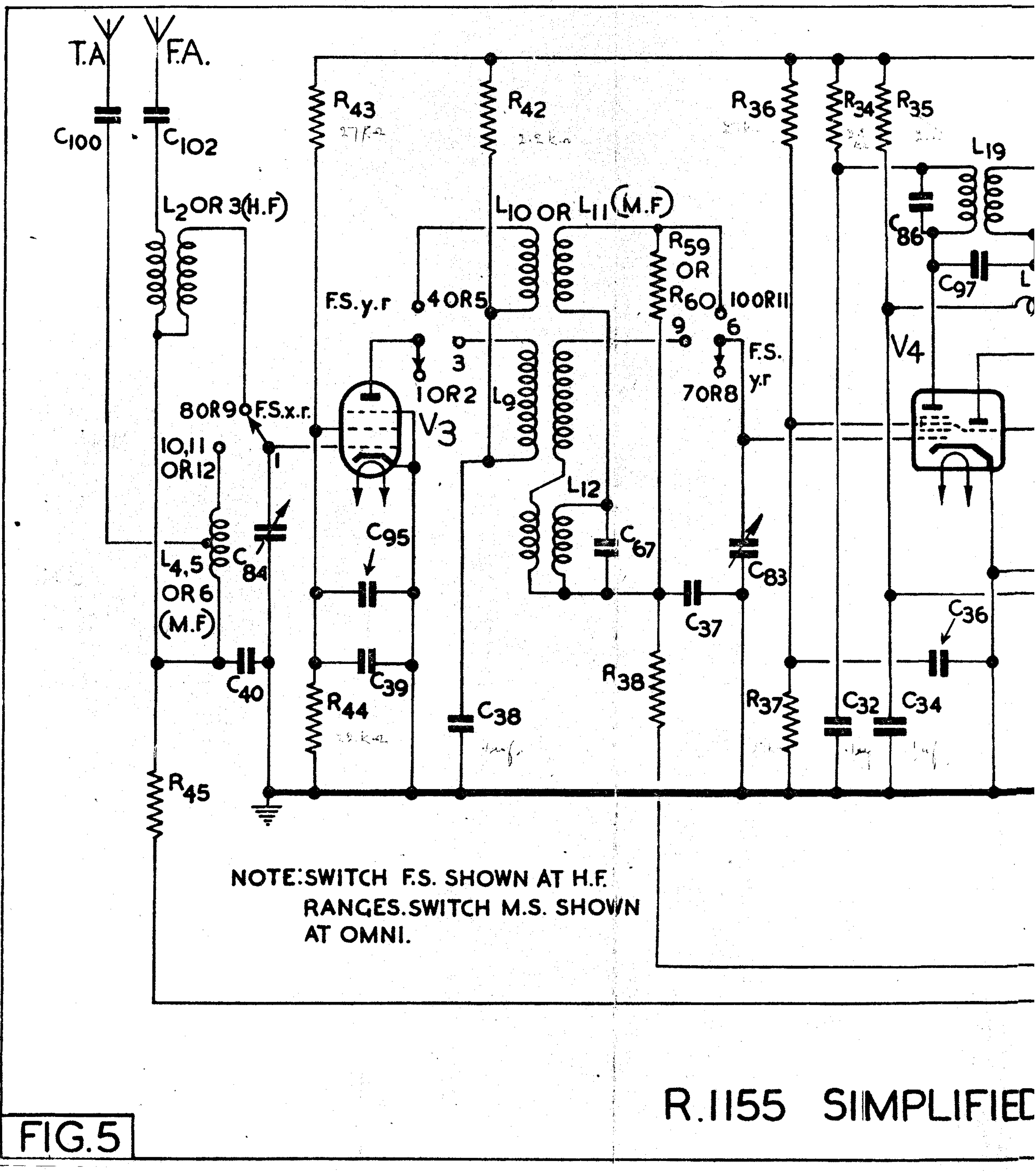
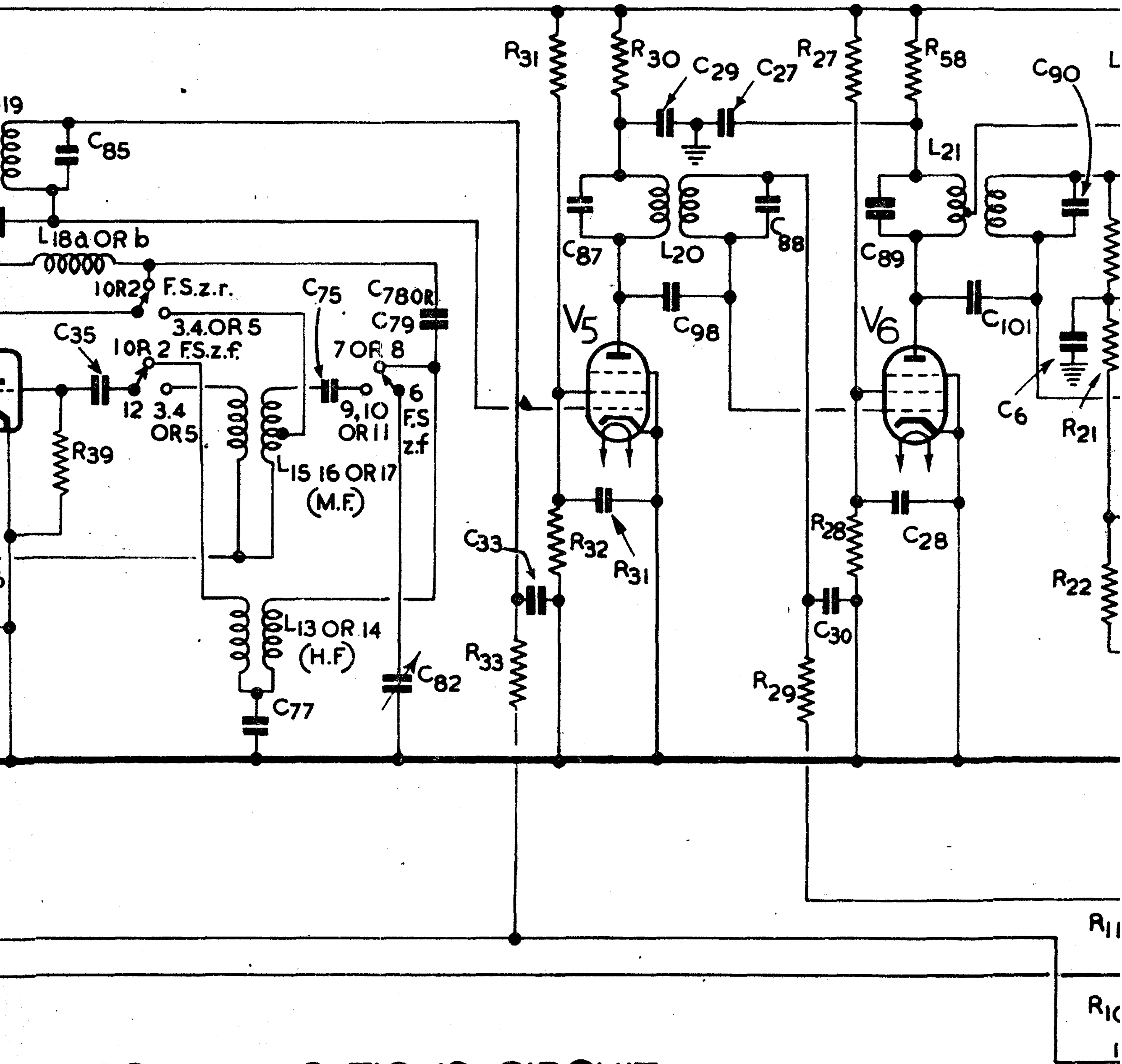


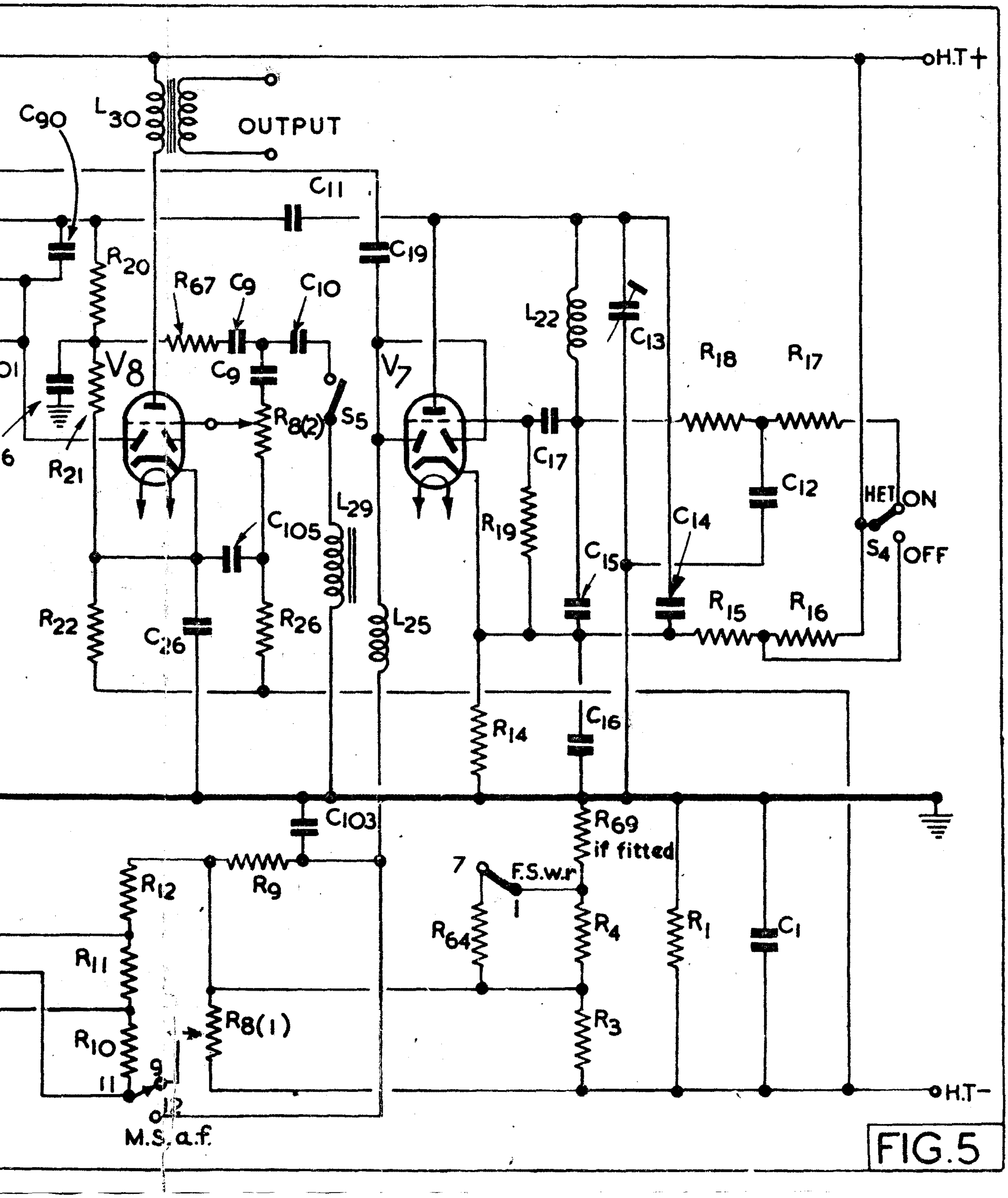
NOTE: SWITCH F.S. SHOWN AT H.F. RANGES. SWITCH M.S. SHOWN AT OMNI.

R.1155 SIMPLIFIED

FIG.5



TIED COMMUNICATIONS CIRCUIT.


H.T+
L30
C90
OUTPUT
C11
C19
R20
R67
C9
C10
V8
C9
V7
R8(2)
S5
R21
C17
L22
C13
R18
R17
C12
C105
L29
R19
C14
HET
ON
S4
OFF
C15
R22
C26
R26
L25
R15
R16
R14
C16
C103
R69
if fitted
R12
R9
7
F.S.w.r
1
R64
R4
R1
C1
R11
R8(1)
R3
R10
9
11
12
H.T-
M.S. a.f.
FIG.5

electronically mixed in the hexode portion and voltages at the difference frequency (560 kc/s) are developed across the anode load, which consists of the coil L_{19} and the condenser C_{86}. The screen derives its voltage from the potential divider comprised of R_{36}, R_{37}, and R_1, with the associated condensers C_{36} and C_1.

Triode section

15. The triode section of the valve operates as an R.F. oscillator and consists of a tuned anode circuit loosely coupled to an untuned grid circuit. The grid windings of the coils L_{13}, L_{14}, L_{15}, L_{16}, and L_{17} are selected for each range by the switch FS_{2f}. The anode windings of L_{13} to L_{17} are similarly switched into the anode circuit by switch sections FS_{2r} and FS_{2f}. On ranges 3, 4, and 5 the oscillator is series-fed, the anode being connected to a tap on the secondary of the coil L_{15}, L_{16}, or L_{17}. On ranges 1 and 2 the oscillator is parallel-fed through the choke L_{18a} or L_{18b} and coupling condenser C_{78} or C_{79}. L_{18a} and L_{18b} resonate at a frequency just below the lowest frequency in their respective bands. Each tuned circuit is tracked to the signal circuits with pre-set parallel trimming condensers C_{68} to C_{72}, and fixed series padding condensers C_{73} to C_{77}. C_{81} determines the minimum capacitance of C_{82}.

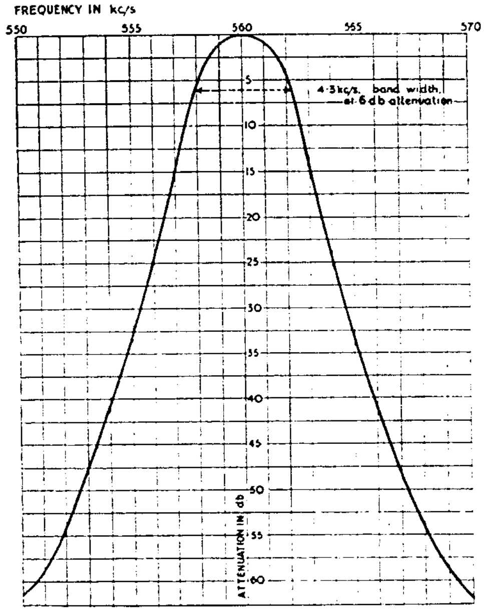


FIG. 6.—I.F. RESPONSE CURVE

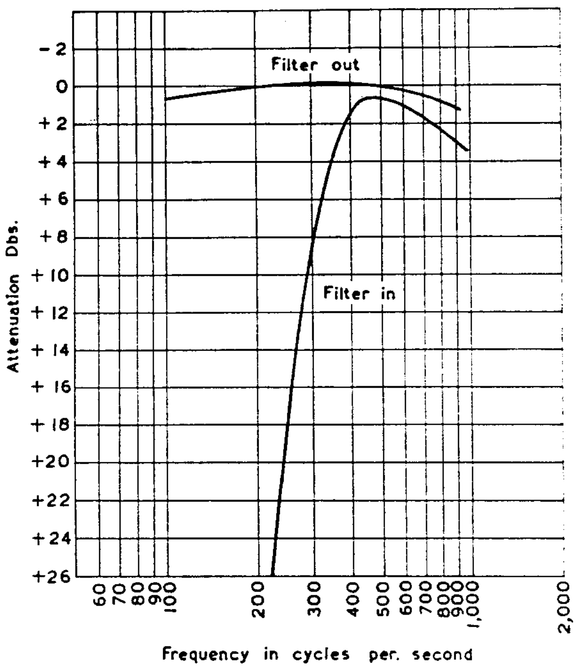


FIG. 7.—A.F. FILTER CHARACTERISTICS

I.F. stages

16. The receiver includes two stages of I.F. amplification employing three band-pass coupling units. The peaked response of this coupling is shown in the curve in fig. 6. Very little inductive coupling exists between the tuned circuits of the band-pass units, the coupling being effected by the small condensers C_{97}, C_{98}, and C_{101}. The coils are adjusted to the I.F. of 560 kc/s by means of iron-dust cores. The primary of the first I.F. transformer, with its associated fixed condenser C_{86} forms the anode load of the hexode portion of the valve V_4. Decoupling is effected by the resistor R_{34} and condenser C_{32}. The secondary is connected as the grid circuit of V_5, the resistor R_{33} and condenser C_{33} providing decoupling of the grid bias. The two I.F. valves, V_5 and V_6, are variable-mu H.F. pentodes, and on A.V.C. their control grids are biased to full and one-tenth A.V.C. voltages respectively. The I.F. transformer units between V_5 and V_6 and between V_6 and V_8 are similar to that already described for the V_4–V_5 coupling.

Detector and output stages

17. The output from the I.F. amplifier valve V_6 passes to the I.F. transformer unit L_{21} and is taken to one diode of a double-diode-triode valve V_8. This diode acts as a detector, and the triode section functions as the output valve. The use of a second diode will be dealt with in describing the D.F circuits (see para. 48). The rectified voltage from the diode detector is developed across two resistors R_{20} and R_{21}. The resistor R_{20}, in conjunction with a condenser C_6, forms part of a

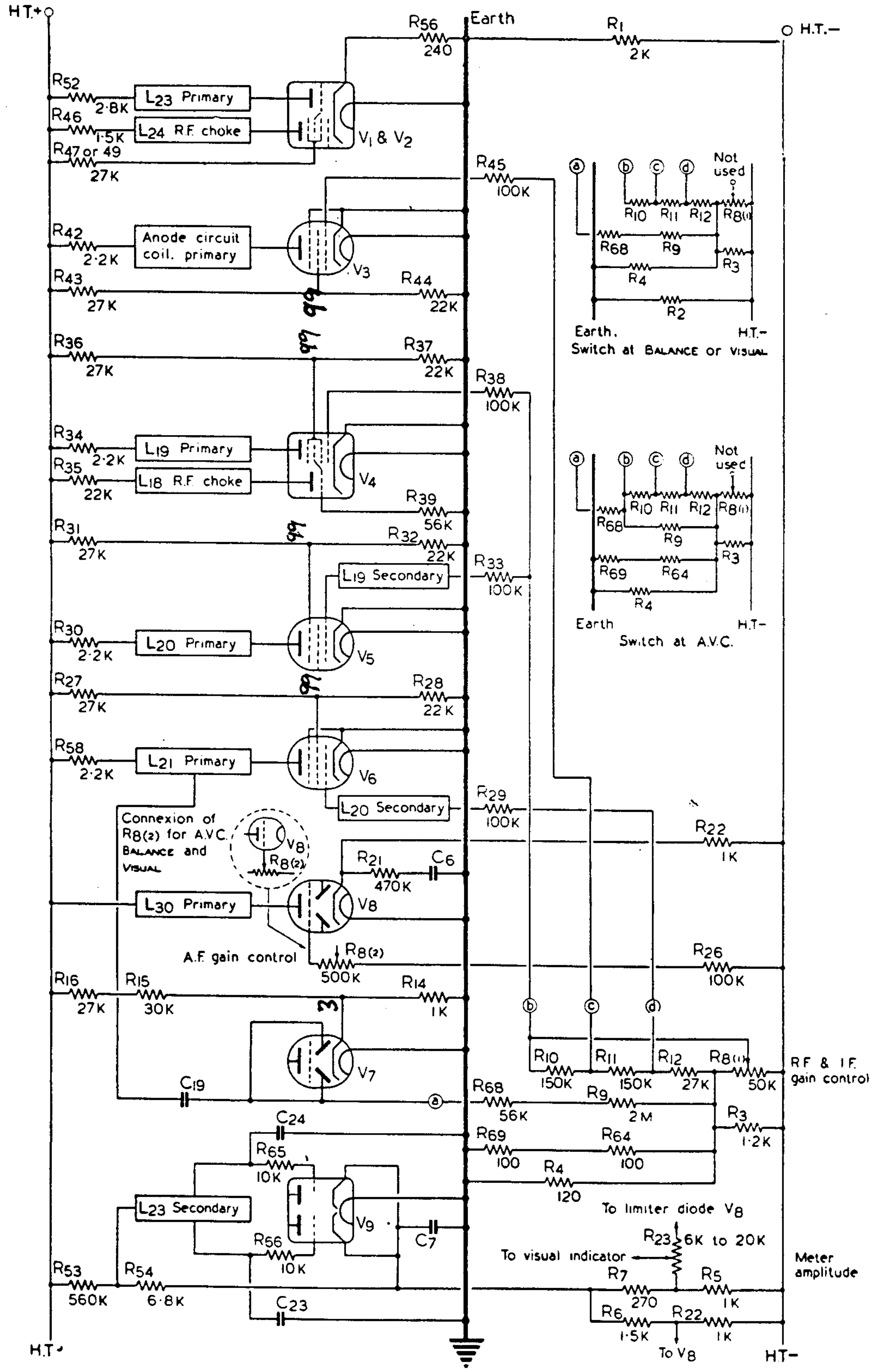


Fig. 8.—Biasing and feed arrangements

R.F. filter system to prevent R.F. being passed to the A.F. circuit. A condenser C_{26} with R_{22} decouples the cathode. The A.F. passes through a network comprising the resistor R_{67} and two series condensers C_8 and C_9 to a potentiometer $R_{8(2)}$, the moving contact of which is connected to the grid of the valve V_8. The voltage developed across $R_{8(2)}$ is admitted at the grid of V_8, the anode load of which is the primary of the output transformer L_{30}, by-passed by a condenser C_{25} and connected direct to the H.T. positive input pin 5 of plug P_1.

18. Before the potentiometer $R_{8(2)}$ there is an A.F. filter network composed of the condenser C_{10}, and an A.F. choke coil L_{29}. The A.F. filter network, which may be switched in or out of circuit by the switch S_5, prevents the greater proportion of the frequencies below 300 c/s from reaching the volume control $R_{8(2)}$ and the output stage. The filter removes part of the noises due to the aircraft electrical and ignition systems. The A.F. filter characteristics are given in fig. 7 and the input/output characteristics in fig. 9.

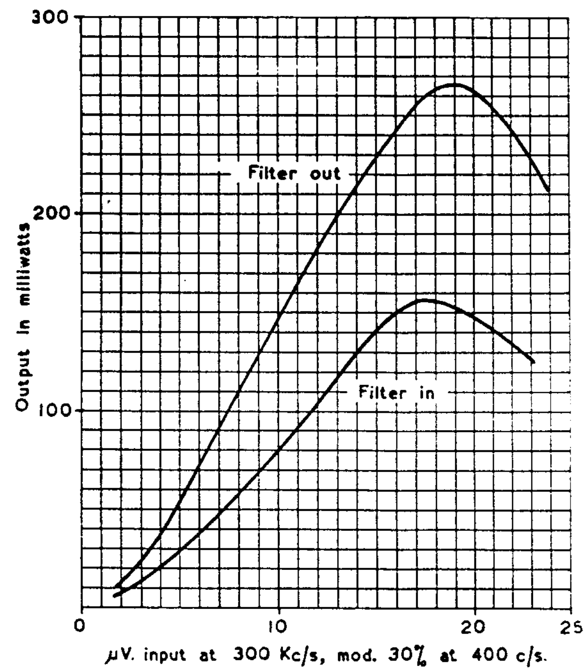


FIG. 9.—INPUT/OUTPUT CHARACTERISTICS

Manual volume control

19. Manual control of the gain of the R.F. and I.F. valves V_3, V_4, V_5, and V_6 is effected by the application of varying degrees of grid bias to their respective grids by the potentiometer $R_{8(1)}$. When the master switch MS is in the OMNI position the grid of the output valve V_8 is joined through the section MS_{af} to the top end, that is, further from the H.T. negative, of the A.F. volume control $R_{8(2)}$ and the variable slider is out of circuit. The full A.F. voltage is therefore applied to the grid of V_8. The automatic volume control (A.V.C.) system is inoperative.

20. With the switch at OMNI the circuits are:—

(i) A fixed potentiometer, consisting of the resistors R_{10}, R_{11}, and R_{12}, is connected, through the switch contacts MS_{af}, to the slider of the manual R.F. gain control $R_{8(1)}$.

(ii) The A.V.C. diodes of V_7 (strapped together) are connected, through the load resistor R_9, to a point 3·6 volts negative along the resistors R_3 and R_4, the rectified voltage across R_9 operating the tuning indicator V_{10}.

(iii) On ranges 1 and 2 the switch FS_{WT} connects R_{64}, (and R_{69} if fitted) across R_4 to reduce the minimum bias voltage and also the delay on the operating voltage of the indicator V_{10}.

21. The chassis is approximately 30 volts positive with respect to H.T. negative. The method by which this figure and that of the 3·6 volts negative, previously mentioned, are assessed may be understood from fig. 8. The effective resistance of the potentiometer networks across the supply, having regard to the switch positions, gives a basis for calculation. (Effective resistance should not be confused with the values given in the list of components.) The resistor R_1 has, at a minimum, $R_3 + R_4$ in parallel with it and these form a potential divider so that 26·4 volts are across R_3 and 3·6

volts across R_4. The manual volume control $R_{8(1)}$ is connected across R_3 and any voltage between $-3 \cdot 6$ and -30 can be applied to V_5 and V_4 for grid bias. This voltage is broken down by means of the potential divider R_{10}, R_{11}, and R_{12} for connection to V_6 and V_3.

Automatic volume control

22. Automatic control of the gain of the valves V_3, V_4, V_5, and V_6, is effected by the strength of the received signals when the master switch MS is in the A.V.C. position. Manual control of the A.F. from the detector diode of V_8 to the output valve, that is, the triode of V_8, is also provided from the potentiometer $R_{8(2)}$. The controls of $R_{8(1)}$ and $R_{8(2)}$ are ganged for operation and the panel knob is labelled VOLUME CONTROL. The position of the master switch MS determines which of the potentiometers is operative:—OMNI for $R_{8(1)}$, A.V.C. for $R_{8(2)}$. The received signal applied to the grid of the R.F. amplifier valve V_3 is amplified by the I.F. amplifier valves V_5 and V_6. The amplified I.F. voltage appears across the primary winding of the third I.F. transformer L_{21}. This primary winding is tapped, and a proportion of the R.F. voltage is led to the strapped diodes of the double-diode-triode valve V_7. Rectification takes place and the rectified current flows through a series R.F. choke L_{25}, and a resistance-capacitance filter and decoupling circuit composed of R_{68} and the condensers C_{108} and C_{103}.

23. At the A.V.C., BALANCE, and VISUAL positions, the switch section MS_{af} disconnects the slider of $R_{8(1)}$ and connects the fixed potentiometer R_{10}, R_{11}, and R_{12} across the A.V.C. diode load resistor R_9. This diode has a delay of 3·6 volts due to the drop across R_4 in series with R_3. On ranges 1 and 2 this delay is reduced to 2·4 volts by switching R_{64} (and R_{69}, if fitted) across R_4. The rectified current flows through R_{10}, R_{11}, and R_{12}, with R_9 in parallel, back to the cathode *via* R_4. The voltage developed across R_9 and the network R_{10}, R_{11}, and R_{12}, is divided to suit V_3 and V_6. On BALANCE and VISUAL, C_{94} is shunted across R_9 to give a longer time constant and reduce the flicker of the tuning indicator V_{10}.

24. Approximately one-half the full value of the biasing voltage is applied to the R.F. amplifier valve V_3 through the line A.V.C.2, tapping the junction of R_{10} and R_{11}. The grid-return circuit includes the resistance-capacitance circuit of R_{45} and C_{40} to prevent back-coupling between V_3, and V_4, V_5, and V_6, and has a time-constant which is much longer than the lowest incoming signal frequency. The frequency-changer V_4 and the first I.F. amplifier V_5 receive full A.V.C. bias voltage from the top end of the resistor R_{10} through the line A.V.C.3 and decoupling combinations R_{38}–C_{37} and R_{33}–C_{33} respectively. The second I.F. valve V_6 receives approximately one-tenth of the bias voltage through the circuit R_{29}–C_{30}.

25. The A.V.C. is subjected to a voltage delay of approximately 13 volts, that is, it does not come into operation until the received carrier reaches the predetermined level of strength represented by 13 volts. This delay is partly accomplished by running the cathode of V_7 positive with respect to its diode anodes by means of resistors R_{14} and R_{15} which are connected between H.T. positive and earth. An additional resistor R_{16} is introduced for C.W. reception (i.e. when the switch S_4 is ON) to reduce this delay voltage. The full delay voltage is a composition of the voltage produced here and the standing bias on the R.F. valves (see para. 26). The voltage delay assists in giving an A.V.C. characteristic which, for a change in input signal of 80 db. results in a change in output of approximately 8 db.

26. None of the A.V.C. controlled valves is automatically biased by cathode resistors. To preserve a standing bias during no-signal periods, therefore, the resistance network of R_{12}, R_{11}, and R_{10} is returned to a point which is 3·6 volts negative with respect to the cathodes. On ranges 1 and 2 (H.F.) this standing bias is reduced by approximately 2·4 volts in order to preserve reasonably constant amplification over all ranges. This is done by introducing the resistors R_{64}, (and R_{69}, if fitted) into the circuit by means of switch section FS_{WT}.

Beat frequency oscillator

27. In addition to providing A.V.C. the valve V_7 also acts as a beat frequency oscillator, the triode section of the valve being used for this purpose. The oscillatory circuit is of the series-fed Colpitts type, and consists of a coil L_{22} and the condensers C_{14} and C_{15}. The frequency of this oscillator can be varied over a range of approximately 3 kc/s by means of a pre-set trimming condenser C_{13}. This condenser can be adjusted by inserting a screwdriver through a small port in the front panel. Automatic bias is developed across the grid leak resistor R_{19}. The grid coupling condenser is C_{17}. The oscillatory circuit is tuned to approximately half the I.F., that is, to 280 kc/s, and the second harmonic of this is used to heterodyne the I.F. signal. The use of the second harmonic prevents the oscillator from being locked by incoming I.F. signal. The output from the oscillator is coupled through the condenser C_{11} to the signal diode of the valve V_8. The I.F. signal is also applied to this diode and the A.F. beat frequency voltage appears across the load resistor R_{21}.

Tuning indicator

28. Correct tuning of the receiver is indicated by a minimum angle of shadow in the tuning indicator valve V_{10}. This indicator gives a varying angle of shadow on a fluorescent "target" anode, the angle being dependent upon the voltage developed across the resistor R_9, which is the A.V.C. diode load.

29. The tuning indicator valve operates as follows:—Connected to the triode anode is a "deflector" wire which protrudes into the path of the electron stream between the cathode and the target anode. In the absence of a signal the voltage across the resistor R_9 is small, and therefore the negative voltage applied to the grid of the indicator valve is small, resulting in a high current through the valve. This current produces a large voltage drop across R_{13}, in consequence of which the potential of the triode anode is considerably less than that of the target anode. The deflector wire therefore has a repelling action on the electrons approaching the target anode, and a V-shaped shadow is produced. When the receiver is correctly tuned, the voltage across R_9 reaches a maximum, the grid bias increases and the anode current falls. The reduced current results in a smaller volts drop across R_{13} and the potential of the triode anode rises to a voltage comparable with that of the target anode. In this condition, therefore, the deflector wire has a much smaller influence on the electron stream, and the V-shaped shadow on the target anode narrows to a minimum.

COMMUNICATIONS CIRCUITS, OTHER VERSIONS

R.1155A, R.1155E, and R.1155M

30. These types differ from the R.1155 and R.1155D in the R.F. amplifier stage, where filters have been introduced to prevent interference from certain M.F. broadcasting stations having a carrier frequency near to the I.F. of the receiver (560 kc/s). Receivers bearing the suffix letter M are identical with the R.1155A except that a corrosive flux was used in error during production. Receivers type R.1155M are to be used at ground schools only.

31. The three filters are the grid rejector circuit, L_{33} and C_{113}, the anode rejector circuit, L_{32} and C_{114}, and the anode acceptor circuit L_{31} and C_{111}. In addition, an assembly consisting of the resistor R_{71} in parallel with condenser C_{112} is inserted to minimise the effects of the added capacitance introduced by the grid rejector circuit. The circuit changes will be seen by reference to fig. 3, where the modifications are shown as an inset on the full circuit diagram of the R.1155.

R.1155B and R.1155F

32. The circuit of these types incorporates the filter circuits of the R.1155A and, in addition, the six R.F. chokes annotated HFC_1 to HFC_6 in fig. 3A. These chokes are introduced to filter unwanted frequencies due to certain radar transmitters. As will be seen by reference to the circuit, fig. 3A, HFC_1 to HFC_4 are in series with the aerial leads, HFC_5 is in the common grid circuit of the L.F. switching valves V_1 and V_2, and HFC_6 in the grid lead to the R.F. amplifier valve V_3. A further slight alteration to the circuit is involved by the fitting of the condenser C_{115} in parallel with the resistor R_{72} between contact 3 of switch section FS_{xf} and the primary of L_3.

R.1155C

33. The R.1155C was a modified version of the R.1155A and was produced for use in Coastal Command aircraft engaged on certain duties necessitating D.F. facilities on Range 1. As this special requirement no longer exists the receivers have been declared obsolete, but some may still be found in service for normal communications purposes. The R.1155C required a special loop aerial in addition to that normally used, and the receiver embodied a new dummy loop circuit for ranges 1 and 2 in addition to the L_1 and C_{99} combinations used on the other ranges. These changes involved alterations also to the switching circuits. In view of the small number of receivers affected and the fact that they are obsolete, no circuit diagram is given.

R.1155L and R.1155N

34. The R.1155L and R.1155N are developments from the R.1155B and R.1155F to meet requirements for reception on the 1·5 to 3·0 Mc/s band. The frequency coverage therefore differs from that of the rest of the R.1155 series, range 5 (200 kc/s to 75 kc/s) having been omitted and range 2A (3·0 Mc/s to 1·5 Mc/s) inserted. Thus these types have a continuous frequency coverage from 18·5 Mc/s to 200 kc/s with the exception of the band between 600 kc/s and 500 kc/s. The changes have necessitated considerable alterations in the R.F. amplifier, frequency-changer, and R.F. oscillator stages, and a circuit diagram is given in fig. 4. Apart from the changes in these stages the circuit remains basically that of the R.1155B.

35. It will be seen that the coils L_6, L_{11}, and L_{17} (range 5) have been removed from the circuit of the R.1155B. Range 3 and 4 coils have been repositioned in the circuit diagram and alterations

have been made in the wiring of the switch sections FS_{wf}, FS_{xf}, FS_{xr}, FS_{yf}, FS_{yr}, and FS_{zf}. Three new coils L_{40}, L_{41}, and L_{42} have been introduced for the new range 2A. Other components re-positioned are the resistors R_{40}, R_{41}, R_{60}, and R_{61}, and the condensers C_{74}, C_{75}, C_{80}, and C_{91}. New resistors, R_{73} and R_{74}, and a condenser C_{116} have been added, and R_{59} and C_{73} have been removed.

THE DIRECTION-FINDING CIRCUITS

36. The change from the communications circuit to the direction-finding circuit is made by the master switch MS, of whose five positions the three labelled BALANÇE, VISUAL, and ∞ (figure-of-eight) are for this purpose. Simplified diagrams of the D.F. circuits are given in figs. 10 to 13. The receiver may be used for direction finding on ranges 2, 3, 4, and 5. The D.F. ranges of the L and N versions are ranges 2, 3, and 4. On the R.1155C (now obsolete) D.F. was possible on ranges 1, 2, 3, 4, and 5. With a suitable loop aerial used in conjunction with the H.F. aerials the following facilities are available:—

(i) Determination of bearing of a given transmitter, with sense discrimination by visual or aural means.

(ii) Homing on to a transmitter by fixing the loop aerial in relation to the aircraft and maintaining course so that the two needles of the visual indicator type 1 intersect on a line marked centrally on the face of the instrument.

37. The loop aerial normally used is the type 3, which has a nominal inductance of 100 μH, and self-capacitance when installed of 20 $\mu\mu$F. In order to effect a match between this aerial and the receiver a small pre-set condenser C_{104} is built into the loop lead terminating plug. When the total loop and lead capacitance is too small to enable tuning to be effected by C_{104} alone, the fixed condenser C_{106} may be inserted in parallel with C_{104}. The procedure to be adopted for matching is described in para. 72. When a loop aerial other than type 3 is employed a suitable impedance matching unit, such as the type 12, 13, or 15 should be used to enable the input tuned circuits to gang correctly with the other tuned circuits. These units are dealt with in Appendix 1.

General principles

38. Direction finding is accomplished either by visual or aural means. The aural method used follows the well-known practice of swinging the loop for a minimum, and then sensing by superimposing fixed aerial voltages on the loop voltages. (The theory of this system of direction finding is covered in Chapter XVI of A.P.1093.) The method used for direction-finding by visual means employs a principle known as the "switched heart". Before the circuit is dealt with in detail this principle should be understood; its features are briefly as follows.

39. A push-pull oscillator operating at either 30 c/s or 80 c/s is used to switch the fixed aerial in such a manner that its voltages are applied alternately in phase and in anti-phase with the instantaneous voltage due to the loop. The same oscillator simultaneously switches the rectified output from the detector stage alternately to the two pairs of moving coils which operate the indicator needles of a visual indicator. Thus one needle is moved to an extent proportional to the fixed aerial voltage plus the loop voltage, and movement of the other is proportional to the fixed aerial voltage minus the loop aerial voltage. Therefore, when the loop aerial is swung until the voltage induced in it is nil, both the needles will rise to the same extent. This will be when the loop is at right-angles to the bearing of the transmitter. This state of affairs is indicated by the point at which the crossed needles intersect falling on a vertical white line painted on the face of the instrument. For homing, the loop is set in relation to the aircraft—usually athwartships—(see para. 103 with regard to other settings) and the pilot swings the aircraft until the two needles cross on the vertical line, thereafter maintaining course by keeping the point of intersection of the needles on this line. Since the voltage actuating each needle is represented by a cardioid curve (see diagram C of fig. 14) it will be clear that any deviations from course will cause one needle to fall and the other to rise, as a result of which the point of intersection will move off the vertical line. The significance and use of such movements for sense determination is explained in paras. 52 and 99.

L.F. oscillator for D.F. switching

40. The triode portions of the triode-hexode valves V_1 and V_2 are connected as a push-pull oscillator. The frequency of this oscillator is determined by the constants of the tuned circuit consisting of the primary winding of the L.F. transformer L_{23} and the two fixed condensers C_{54} and C_{55}. When the switch S_1 is open the oscillatory frequency is 80 c/s. Closing the switch S_1 throws the condenser C_{55} into circuit and thereby lowers the frequency to 30 c/s. The higher frequency is used when D.F. is being carried out on a W.T. signal, and the lower frequency when R.T. signals are being used. The lower frequency causes negligible interference with R.T. intelligibility but is too low a switching frequency for W.T. signals.

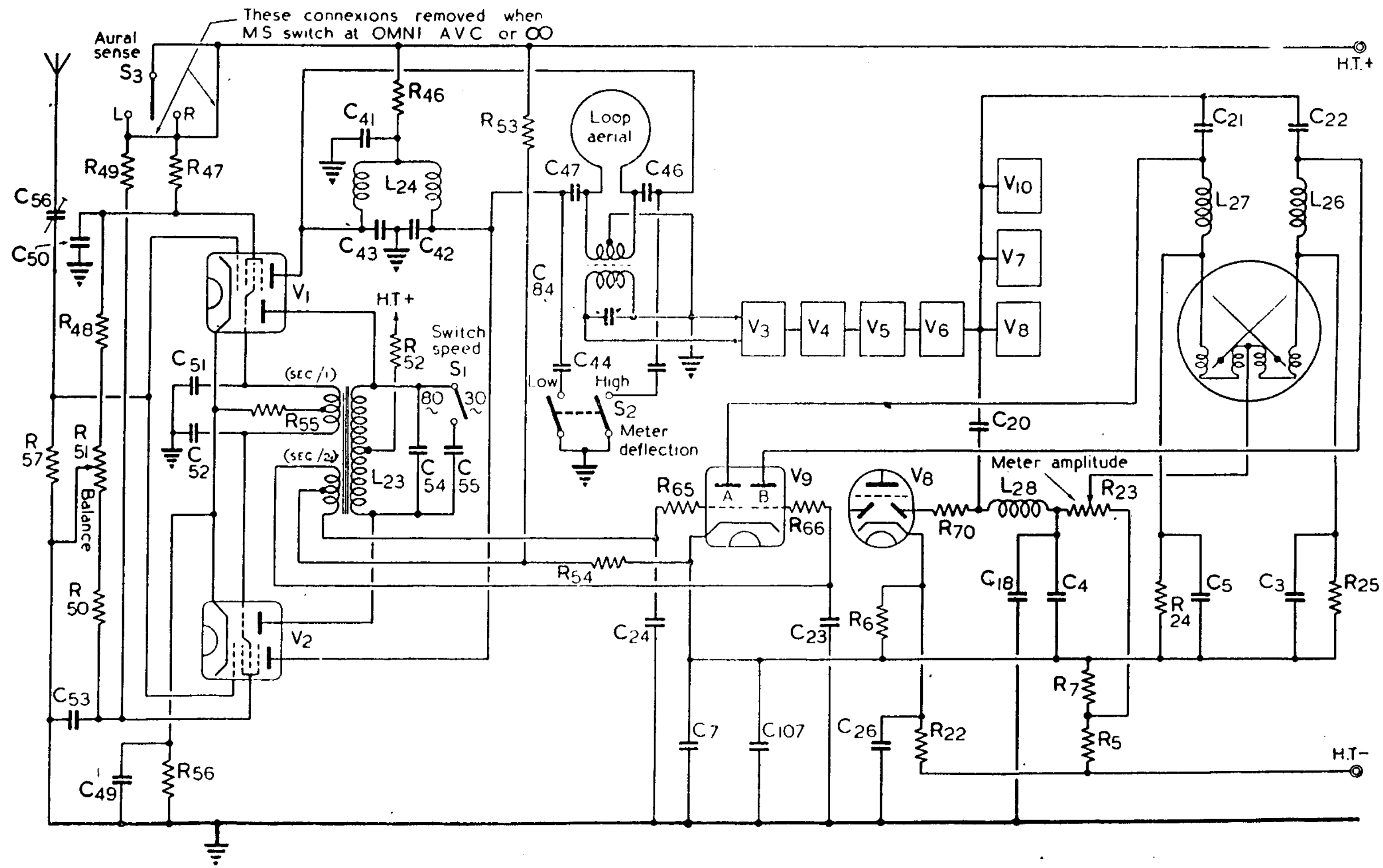


FIG. 10.—SIMPLIFIED VISUAL D.F. CIRCUIT

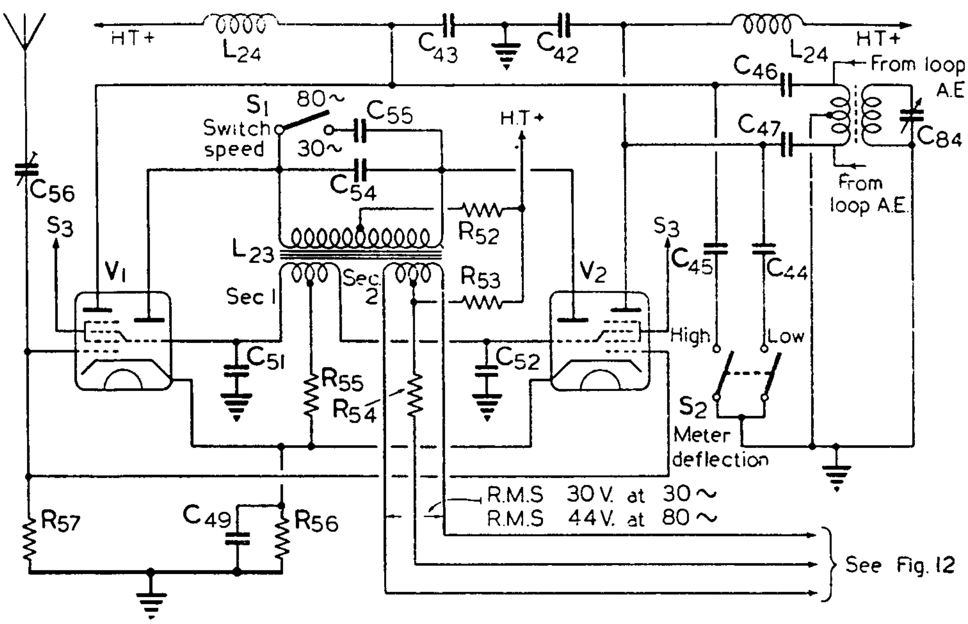


FIG. 11.—L.F. OSCILLATOR SWITCHING CIRCUIT

Aerial switching

41. The use of the centre-tapped secondary winding SEC 1 of L_{23} has the effect of simultaneously applying equal, but anti-phase, voltages to the oscillator grids of V_1 and V_2. During a positive half-cycle the grid is held only slightly positive due to grid current developing a biasing voltage across the resistor R_{55}. In the negative half-cycle the full secondary voltage is applied to the oscillator grids. Since these grids are connected to the injector grids (G_3) of the respective hexode portions, the effect is to bias the hexodes to cut-off during alternate half-cycles at the oscillator frequency. The fixed-aerial voltage is therefore applied through V_1 to C_{46} during one half-cycle, and during the next half-cycle, when the valve V_1 cuts off, the aerial voltage is applied through V_2 to C_{47}. As the two condensers C_{46} and C_{47} are at opposite ends of the loop aerial (and of the coil across it, which forms the primary of an R.F. transformer) the oscillator serves to switch the fixed aerial voltages at the oscillator frequency alternately into phase and anti-phase with the loop aerial input. The resultant voltages are applied to the grid of V_3 by inductive coupling to the grid circuit of the range in use.

42. The H.T. positive feed to the anodes of the triode sections is via a voltage dropping resistor R_{52} and the centre tap of the primary winding of L_{23}. The hexode anodes are fed through the R.F. choke assembly L_{24} and the dropping resistor R_{46}. The associated by-pass condensers are C_{41}, C_{42}, and C_{43}. A suitable screen voltage is provided by the two potentiometers R_{47}, R_{48}, and R_{51}, or R_{49}, R_{50}, and R_{51}, the by-pass condensers being C_{50} and C_{53}. The cathode bias is provided by the resistor R_{56} by-passed by C_{49}. R_{57} provides a grid return for the hexodes.

Visual indicator switching

43. The basic principles of operation of the visual indicator have been explained in paras. 38 and 39, and the switching circuit employed to operate the visual indicator, type 1, will now be dealt with in detail. Simplified circuits are given in figs. 12 and 13.

44. The amplified signal voltages are applied to the anodes of the double-triode valve V_9. It is convenient to regard the two sections A and B of V_9 as diodes which are switched into and out of operation by the grids G_1 and G_2. The grids are connected to a secondary winding SEC 2 of the L.F. transformer L_{23} and, by a similar arrangement to that used in the oscillator stage, equal but anti-phase voltages are applied to the two grids of V_9 in synchronism with the aerial switching. The voltage applied to the grids of V_9 is approximately 30 volts (R.M.S.) at 30 c/s or 44 volts at 80 c/s. The resistors R_{53} and R_{54} constitute a potentiometer connected between H.T. positive and the cathode of V_9. The grid returns of V_9 are connected to the junction of these two resistors and consequently the grids are at a potential positive with respect to the cathode, reducing the valve impedance and increasing sensitivity.

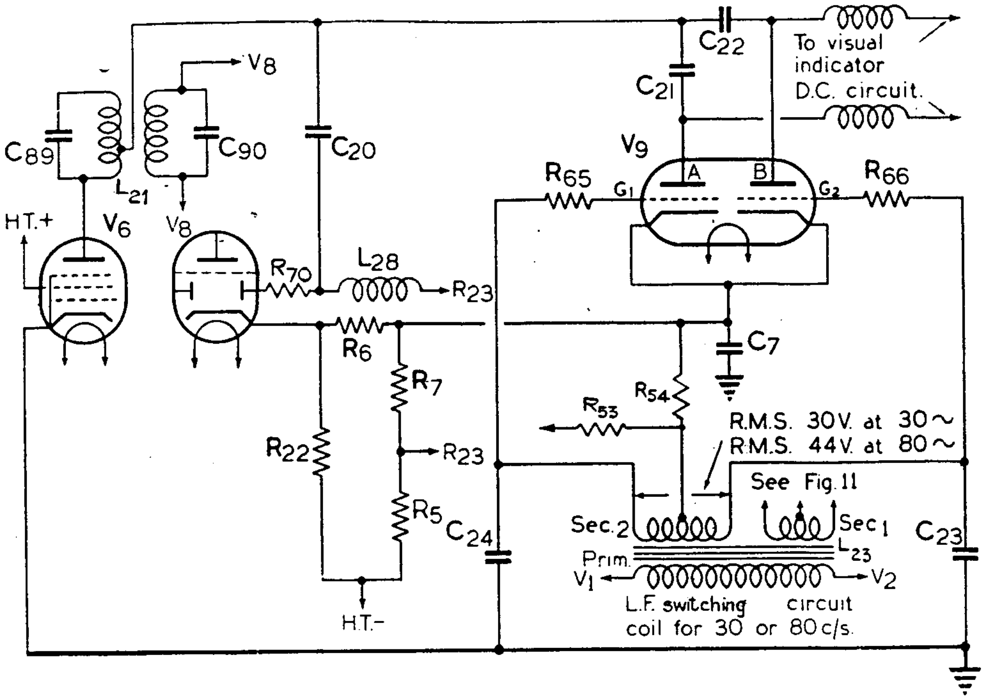


FIG. 12.—VISUAL INDICATOR SWITCHING CIRCUIT

45. It will be seen from fig. 13 that the diodes A and B rectify the signal impulses, but owing to the switching voltage applied to the grids of V_9 from the L.F. transformer L_{23} they are alternately conducting and non-conducting according to the condition of the grid. Since this switching is synchronised with the aerial switching the output of one diode will be proportional to the fixed aerial voltage plus the loop voltage, and the output of the other diode will be proportional to the fixed aerial voltage minus the loop voltage as stated in para. 39. The pulsating D.C. output produced through diode A will tend to charge the fixed condenser C_5 which is across the anode load resistor R_{24} and will at the same time flow through the two left-hand coils of the visual indicator and the variable resistor R_{23}. The effect will be to actuate the needle which points to the right, causing it to rise. Collapse of the needle during the alternate (negative) half-cycle of the switching voltage is prevented by the charge on C_5, which tends to discharge through the circuit VPZW. In a similar manner the needle which points to the left is operated by diode B and its associated load R_{25} and condenser C_3, with the common resistor R_{23}. When the charges on the condensers C_5 and C_3 are equal the needles will rise by equal amounts and will therefore intersect on the central line marked on the instrument, but when the charges are unequal the needles will rise to different heights giving an intersection to left or right of the centre line according to which section is passing the greater current. In addition, when the charges on C_5 and C_3 are unequal there is a tendency for current to flow between V and X via P (see fig. 13), a circumstance which assists the differential action of the needles.

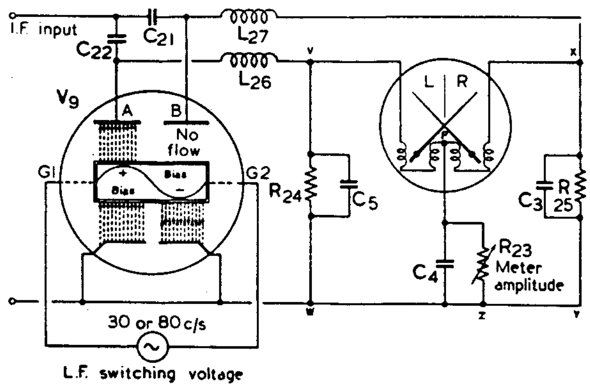


FIG. 13.—SIMPLIFIED VISUAL INDICATOR SWITCHING CIRCUIT

Meter amplitude

46. The sharpness of a bearing is determined by the relative amplitudes of the fixed and loop aerial voltages. When these are equal the sharp minimum shown in curve C of fig. 14 is obtained.

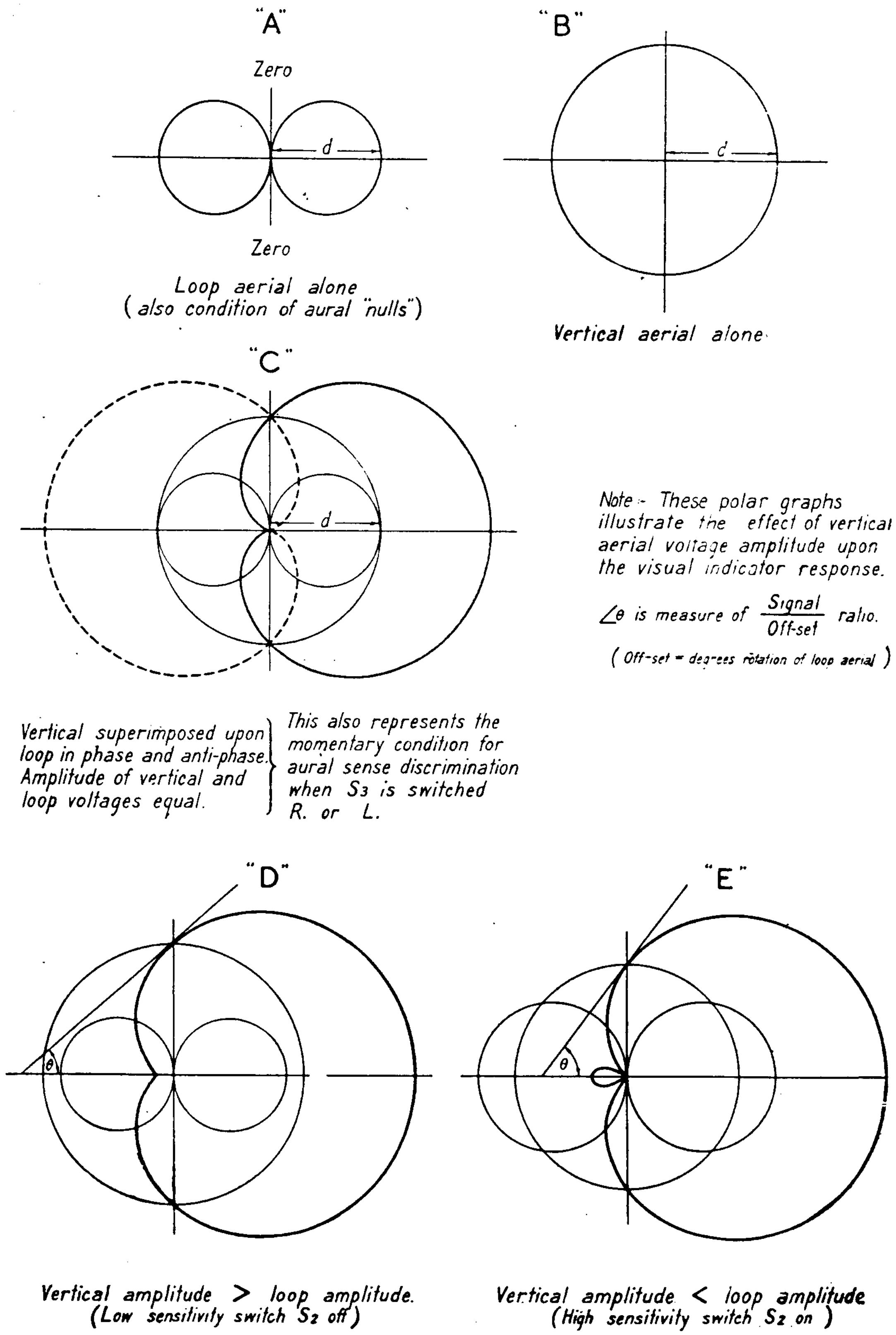


FIG. 14.—POLAR DIAGRAMS

When the fixed aerial voltage is greater than the loop aerial voltage the minimum is less sharp, as will be seen by the flattening of the cardioid curve D of fig. 14. When the loop voltage is the greater an additional lobe is introduced into the polar diagram, and two minima are obtainable (curve E of fig. 14). The two condensers C_{42} and C_{43} are provided to reduce the amplitude of the fixed aerial voltages to the correct value for a sharp minimum.

47. When using the visual indicator for homing this sharp minimum is a disadvantage, as a very small deviation off course causes a considerable movement of the needles, with consequent strain upon the pilot in maintaining course. To eliminate this difficulty a meter sensitivity switch is provided. This switch has two positions HIGH and LOW, indicating high and low sensitivity respectively. In the LOW position the switch introduces the further condensers C_{44} and C_{45} in parallel with C_{42} and C_{43} respectively, reducing the fixed aerial voltage relative to the loop voltage. This results in a less sharp minimum and homing is therefore simplified.

The diode limiter valve

48. It has already been explained that the pulsating D.C. output from V_9 is fed through the R.F. chokes L_{26} and L_{27} to the actuating coils of the visual indicator. In order to prevent the needles rising due to noise output in the absence of a signal, a delay bias is provided between cathode and anode. One diode of the double-diode-triode valve V_8 is fed through a condenser C_{20} from a tapping on the primary winding of the I.F. transformer L_{21}. The rectified output from V_8 flows via a swamp resistor R_{70}, and the R.F. choke L_{28} to the meter amplitude control, which is the variable resistor R_{23}. The cathode of V_8 is biased by the resistor R_{22}. Any current injected at R_{23} tends to drive both needles downwards without interfering with the differential action of the circuit. The action of the normal A.V.C. alone is insufficient to keep the intersection point of the needles on the scale for the possible range of signal variation.

49. The limiter delay voltage is supplied across the resistors R_6 and R_7 and is about 4 volts. It does not come into action until the peak voltage applied to the common point of C_{20}, C_{21}, and C_{22} exceeds the delay voltage. This limiter device is effective for changes up to 80 db and, given a correct setting of R_{23}, the point of intersection will not move beyond the limits of the scale.

Visual indicator balancing circuit

50. Accuracy of indication depends on the balancing of the two input switching valves V_1 and V_2 and their associated circuits. Balance is achieved by the potentiometer R_{51}. When the master switch MS is in the BALANCE position the loop aerial is disconnected and earthed by MS_{ef}, and a dummy loop consisting of a coil L_1 and condenser C_{99} is connected in its place (see fig. 3). As the dummy loop does not pick up signals any deflection of the point of intersection of the visual indicator needles is due to lack of symmetry in the circuit. To correct this the potentiometer R_{51} is adjusted until the intersection point coincides with the central indicating line of the instrument.

51. After renewal of one of the valves V_1 or V_2 it may be found to be impossible in some receivers to effect balance within the limits of the balance control knob. In such a case it will be necessary to replace one of the valves with another whose characteristics are such that they will permit a balance. The unmatched valve displaced is not to be discarded but is to be matched with another V.R.99A for future use.

Visual sense determination

52. The direction of movement of the visual indicator needles reflects the angle of the plane of the loop aerial relative to the path of the incident wave. Orientation of the loop is such that, having obtained a bearing by turning it so that the needles cross on the white line, a reduction in loop reading by a few degrees will cause the needles to fall to the ***right*** if the sense is ***correct***. If the needles fall to the left when the loop reading is reduced the bearing is 180° out, i.e. it is a reciprocal. For homing the sense test is to swing off course to the left. If the needles move to the ***right*** the sense is *correct*.

Aural D.F.

53. For aural D.F. the fixed aerial is disconnected by the master switch MS_{bf}, and the loop aerial gives a figure-of-eight polar diagram as shown in curve A of fig. 14. The switch section MS_{cr} breaks the H.T. supply to the L.F. oscillator, rendering the switching circuits inoperative. The volume control is switched, changed from automatic to manual by MS_{af} and MS_{cf}. To overcome the 180° ambiguity which results from the use of a loop aerial alone, the three-position switch S_3 is operated. This switch applies H.T. to the screens of one or other of the hexode portions of V_1 or V_2 thus coupling the fixed aerial through to the loop circuit, and producing a cardioid polar diagram. Sense determination by aural means is described in paras. 104 to 106.

CONSTRUCTIONAL DETAILS

54. The control panel of a receiver, type R.1155N is shown in fig. 1. Illustrations of the R.1155 are given in fig. 15, which is a view of the upper deck of the chassis, and fig. 16 which shows the chassis underside view. The diagram of fig. 17 gives the location of components. To facilitate search this diagram is gridded and a reference table is provided. The additional filtering components incorporated in later models may be seen from figs. 18 and 19, which are illustrations of a R.1155B. The receiver is removed from its case by loosening the four screws at the corners and by pulling the handles. All cable connections to the receiver are terminated in plugs and sockets which are non-reversible and non-interchangeable. Cables are, wherever possible, metal braided, the braiding being earthed to reduce interference from external sources. Details of the cables and connections are given in Table A overleaf. The receiver case, chassis, and panel are of metal, and are earthed to the main bonding system of the aircraft.

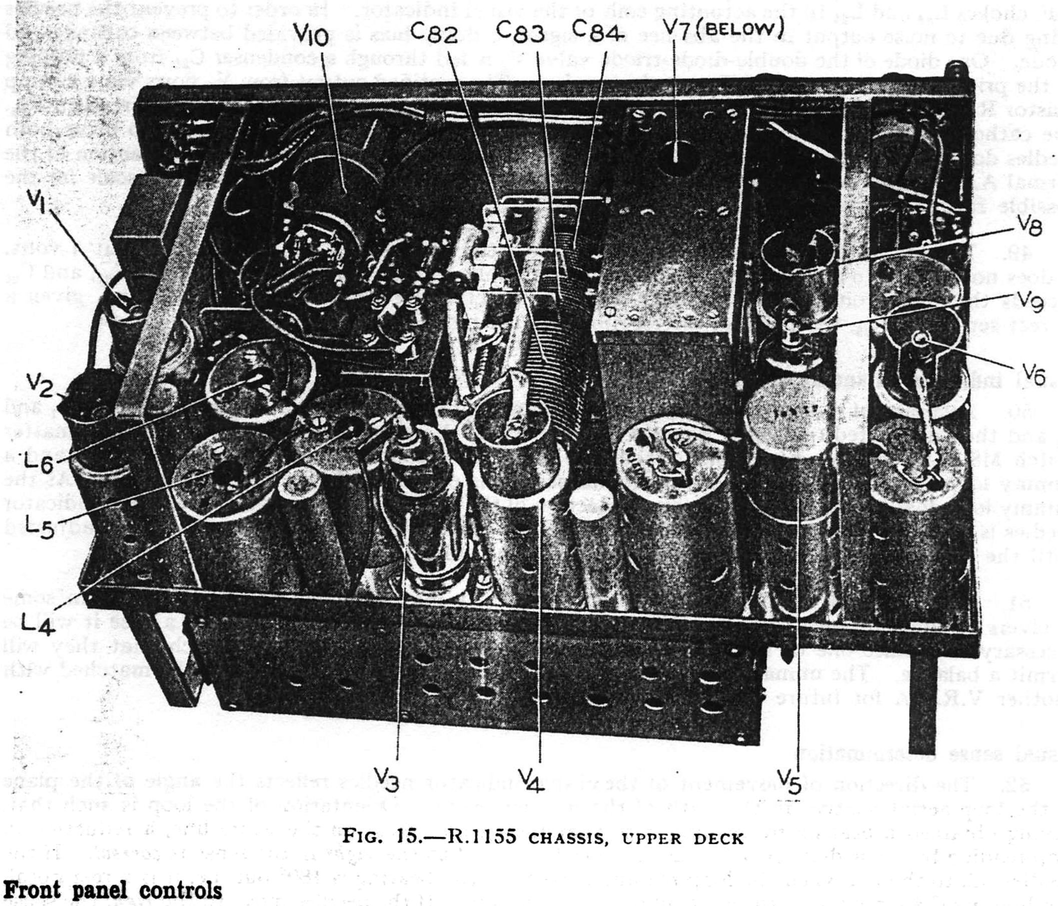


FIG. 15.—R.1155 CHASSIS, UPPER DECK

Front panel controls

55. Referring to fig. 1, a metal strip and metal posts hold the cable connector plug and sockets securely to the receiver. The calibrated tuning dial, which differs as to type in certain models, shows the frequency to which the receiver is tuned by a pointer. The tuning control has two speeds, and is coupled to a three-gang condenser comprising C_{82}, C_{83}, and C_{84}. In some models the drive used is the Drive, slow motion, Type 13, in which instance the outer knob gives a direct drive and the inner knob a 100:1 ratio drive for fine tuning. Other models have a Type 35 drive with 4·5:1 (inner knob) and 80:1 (outer knob) ratios. The exact point of correct tuning is shown by minimum shadow in the tuning indicator, V_{10}, located at the top right-hand side of the tuning scale.

56. The tuning dial has five scales, one for each of the five ranges, each scale being calibrated in Mc/s or kc/s. Originally, the tuning scales of the R.1155 were coloured over those portions which corresponded to the blue, red, and yellow colouring of the controls of the three ranges of the T.1154.

As a result of the introduction of new ranges in later models of both the receiver and the transmitter it may be found that this correspondence of colour does not exist between the receiver and transmitter of some installations. In some models of the receiver all the scales are printed in black.

57. The master switch MS has five positions labelled ⊙ ("OMNI"), A.V.C., BALANCE, VISUAL, and ∞ ("FIGURE-OF-EIGHT"). Details of these positions are given in paras. 9 and 91.

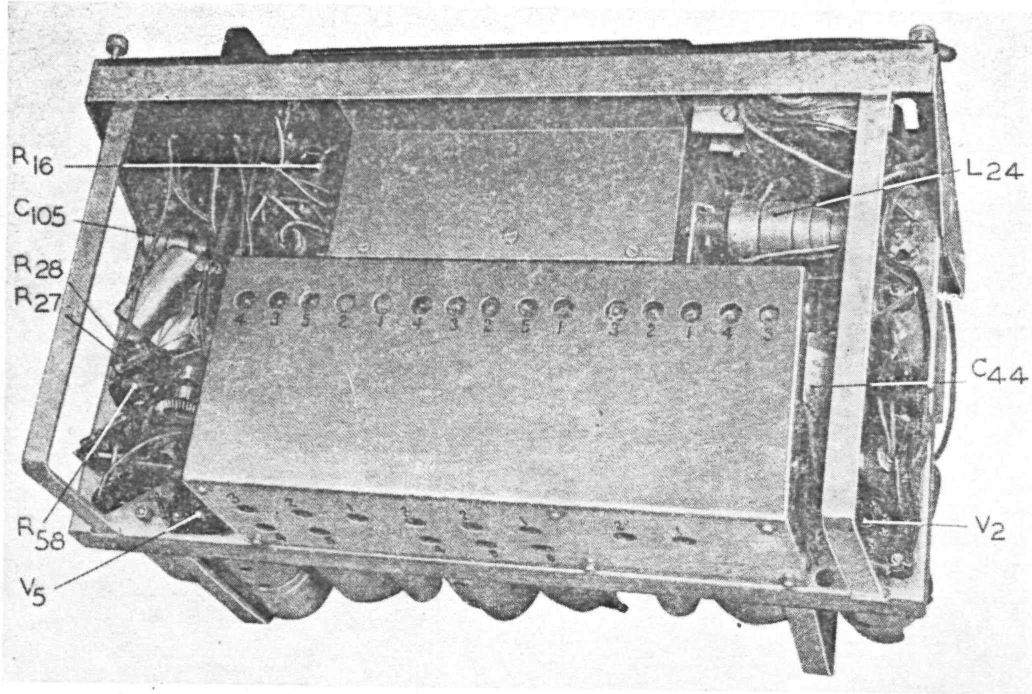


FIG. 16.—R.1155 CHASSIS, UNDERSIDE

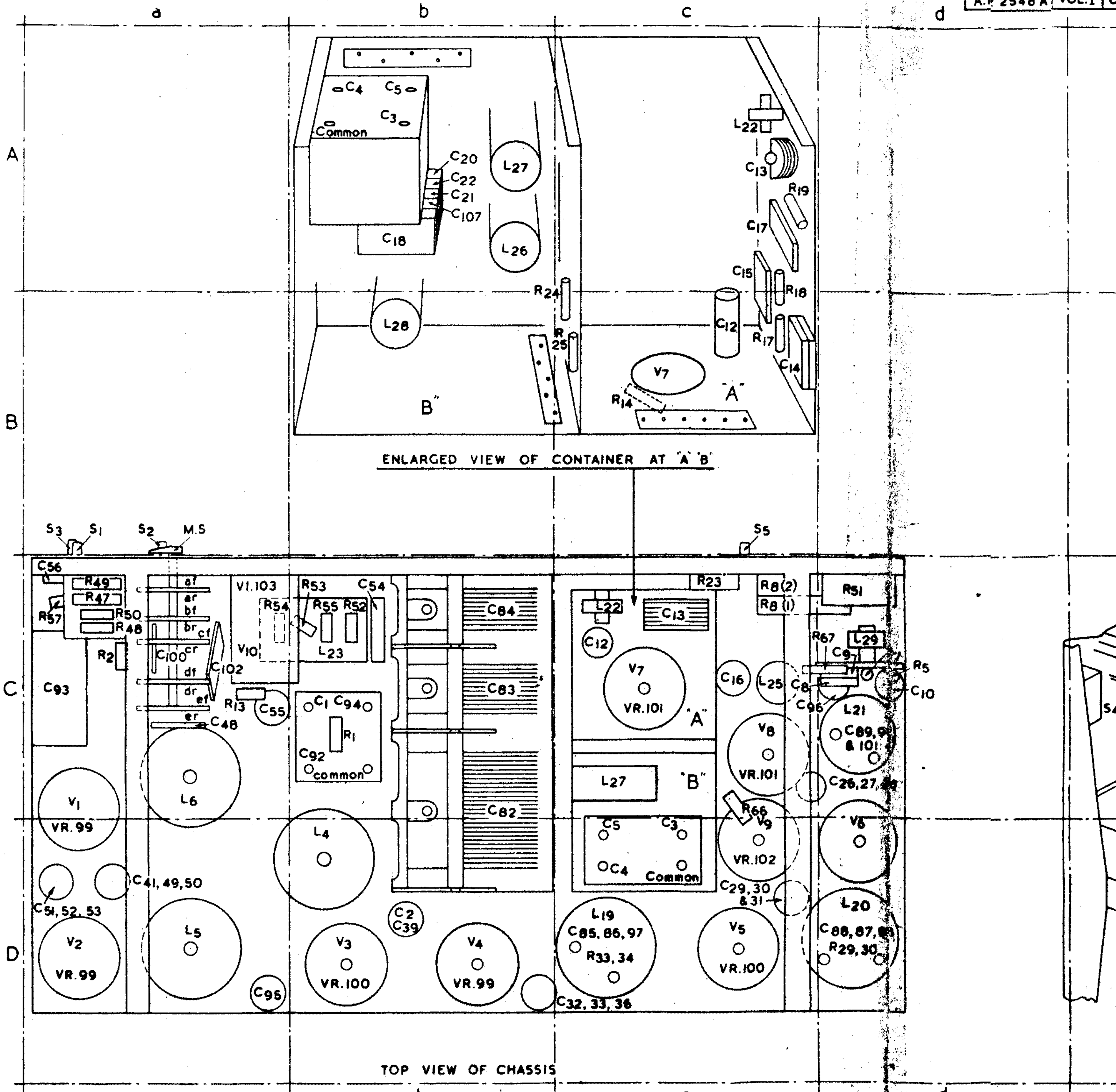
58. The frequency range switch FS is at the lower left-hand side of the tuning scale and selects the five frequency ranges. Its five positions are engraved with the numerical band coverage, It is composed of one switch type 368 for oscillator wafer, one switch type 369 for anode wafer. one switch type 370 for aerial wafer, and one switch type 371 for the loop aerial wafer.

59. The remaining front panel controls include the L.F. filter switch S_5, the meter amplitude control R_{23}, the heterodyne switch S_4, the meter sensitivity switch S_2, and the meter frequency switch S_1. The aural sense switch S_3 has three positions and is spring-loaded to cause it to revert to the centre position when not held to the left or to the right.

60. Screwdriver adjustment is provided for the condensers C_{13} and C_{56}. The condenser C_{13} varies the B.F.O. frequency and is adjustable between capacitance limits of from 5 $\mu\mu$F to 60 $\mu\mu$F. The fixed aerial input to the switching valves V_1 and V_2 and thence to the loop aerial is adjusted when the receiver is installed, by means of C_{56} which is variable between 8 $\mu\mu$F and 115 $\mu\mu$F.

Chassis layout

61. The panel is attached to a metal tray, braced top and bottom by strips returned to the panel upper and lower edges. The strips provide an equalising fit into the receiver container. The upper deck view in fig. 15 shows the chassis with valves in position. For the purposes of this illustration the screening container of the valve V_3 has been removed. The disposition of the components can be seen in the location diagram of fig. 17, which is drawn from the R.1155 chassis. This diagram, when studied in conjunction with figs. 15, 16, 18, and 19 and the relevant portions of the text, should serve also for the later models of the receiver.

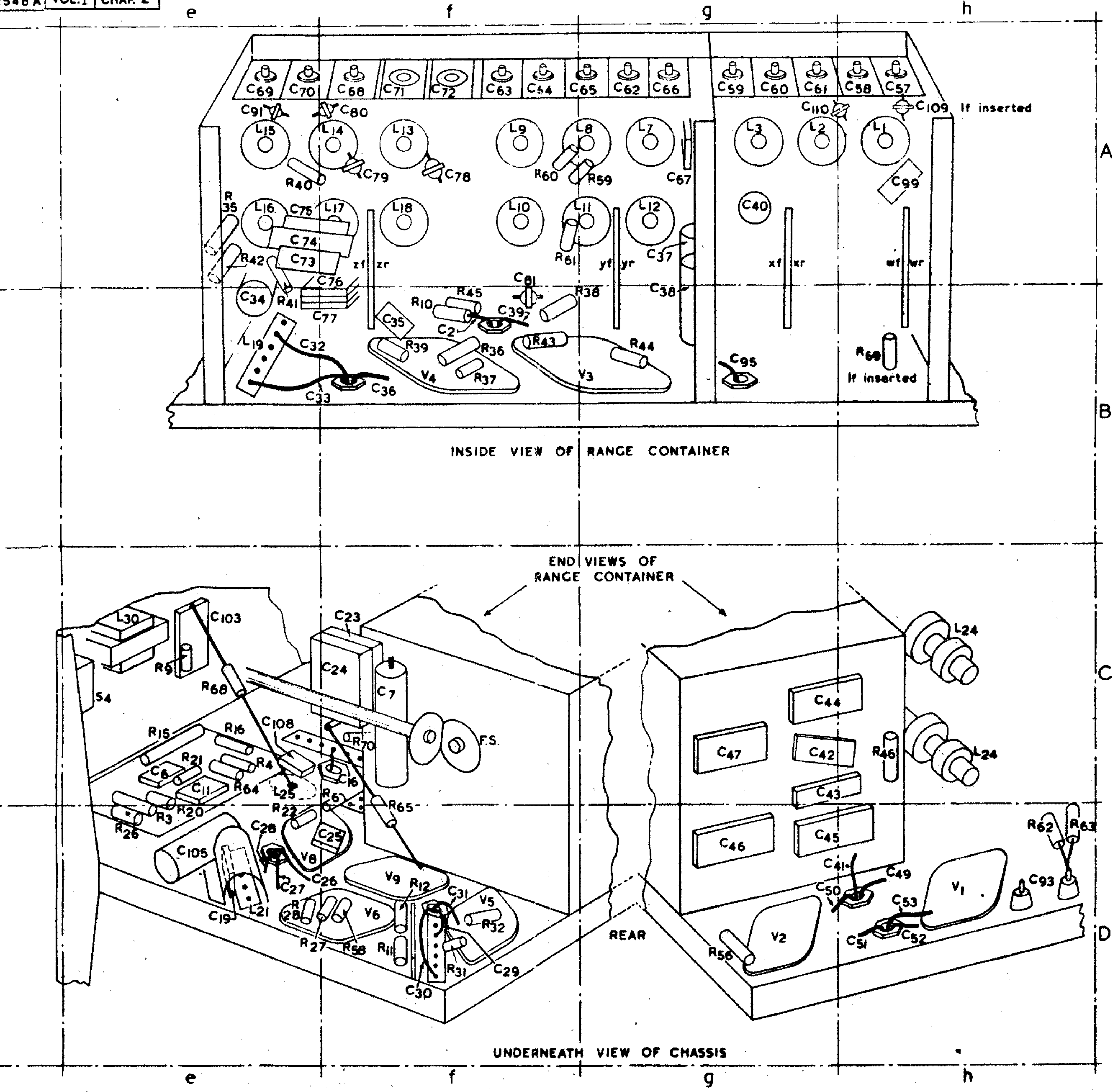


ENLARGED VIEW OF CONTAINER AT 'A' 'B'

TOP VIEW OF CHASSIS

COMPONENTS LOCAT

FIG. 17



S LOCATION DIAGRAM

FIG. 17

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62. An underside view of the chassis is given in fig. 16. The aerial circuit, anode circuit, and local oscillator coils, associated condensers and resistances, and the wafers wr–wf, xr–xf, yr–yf, and zr–zf of the frequency range switch FS are contained inside the large screening case at the bottom of fig. 16. Near the top edge of this container and, reading from left to right, are the adjustment ports for the trimmer condensers C_{69}, C_{70}, C_{68}, C_{71}, C_{72}, C_{63}, C_{64}, C_{65}, C_{62}, C_{66}, C_{59}, C_{60}, C_{61}, C_{58}, and C_{57}. The location of components on the underside of the chassis and within the screening can is shown in detail in fig. 17.

63. The additional filtering components included in the receivers types R.1155A and R.1155B are shown in the two illustrations, figs. 18 and 19. These illustrations are respectively, chassis upper deck and chassis underside views of the R.1155B and show the complete arrangements for suppression of M.F. broadcasting and radar interference. There is only a limited number of receivers in service containing M.F. suppression only and as the components, with one exception, are in the same relative positions in both types it is unnecessary to give illustrations of both.

64. Referring to fig. 18 the screening can (1), mounted over the three D.F. aerial coil assemblies on the upper side of the deck, contains the grid rejector filter unit, comprising a coil L_{33}, with a condenser C_{113}. In the R.1155A this can also contains a condenser C_{112}, and a resistance R_{71}. In the R.1155B these two components are located in the H.F. coil box under the deck and are connected between the choke HFC_6 and the switch section FS_{xr}. The choke HFC_5 connected between the aerial tuning condenser C_{56} and the control grids of V_1 and V_2 is mounted on a bracket adjacent to the top caps of V_1 and V_2. The illustration of fig. 19 shows the H.F. coil box with the cover removed to enable the positions of these components to be indicated.

65. When using figs. 15 to 19 in connection with the R.1155L and R.1155N, paras. 34 and 35 should be consulted with regard to the removal, re-positioning, or addition of the items affected by the altered frequency ranges of these models.

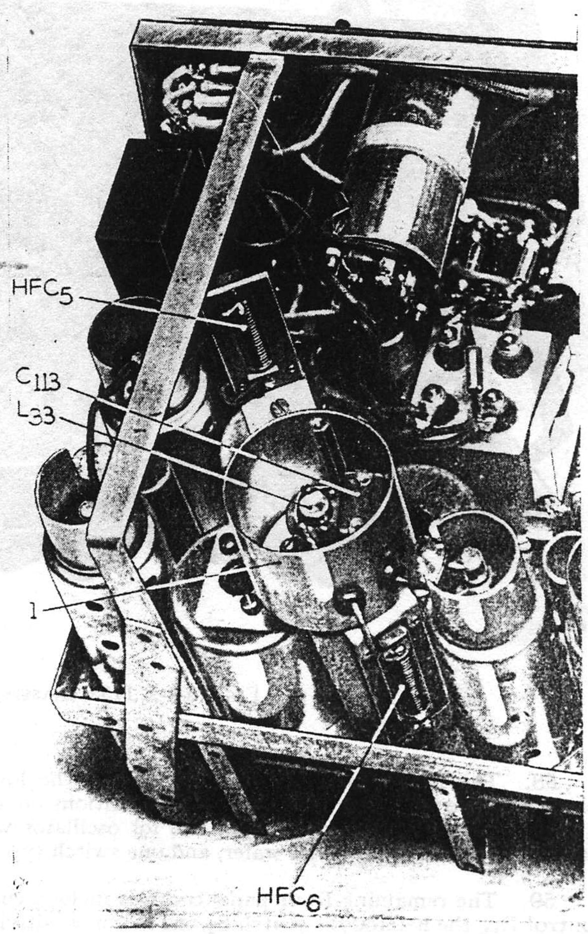


FIG. 18.—R.1155B CHASSIS, UPPER DECK

INSTALLATION

66. The following notes on the installation of the receiver duplicate, to some extent, the installation paragraphs included in Chap. 1, on the transmitter T.1154. This is unavoidably due to the interdependence of the transmitter and receiver when used in aircraft. From the typical installation diagram given in fig. 21 it will be realised that the transmitter is the main focal point of the wiring. The power unit connectors, and also the fixed and trailing aerials and connections from the receiver, plug into the transmitter. In laying out the equipment in the aircraft the receiver is placed in a convenient position for operation and where possible it is at desk level. The transmitter is mounted above or to one side of the receiver. The tuning scales of the receiver are to be easily visible and the controls accessible to the operator.

Receiver position

67. The receiver is normally positioned horizontally, but if space is limited it may bemounted vertically. The receiver is secured by mountings, type 54, and as these will be 90 deg. out when the

receiver is mounted vertically, a sponge rubber pad (mounting, type 55) may be inserted between the table and the bottom of the receiver. The receiver may be either table-mounted or back-mounted, depending upon the aircraft layout. From 1½ in. to 2 in. is left between the receiver and the table or between the transmitter and the receiver (if mounted one above the other) to permit freedom of movement for the suspension fittings. Clearance around the receiver and transmitter cases should be sufficient to allow for removal and replacement of plugs and sockets and of the chassis. The transmitter case retaining screws must also be accessible. The equipment is not provided with internal illumination and is to be put in such a position that the natural illumination is good. For night work artificial illumination is provided and this is adjustable for direction and intensity.

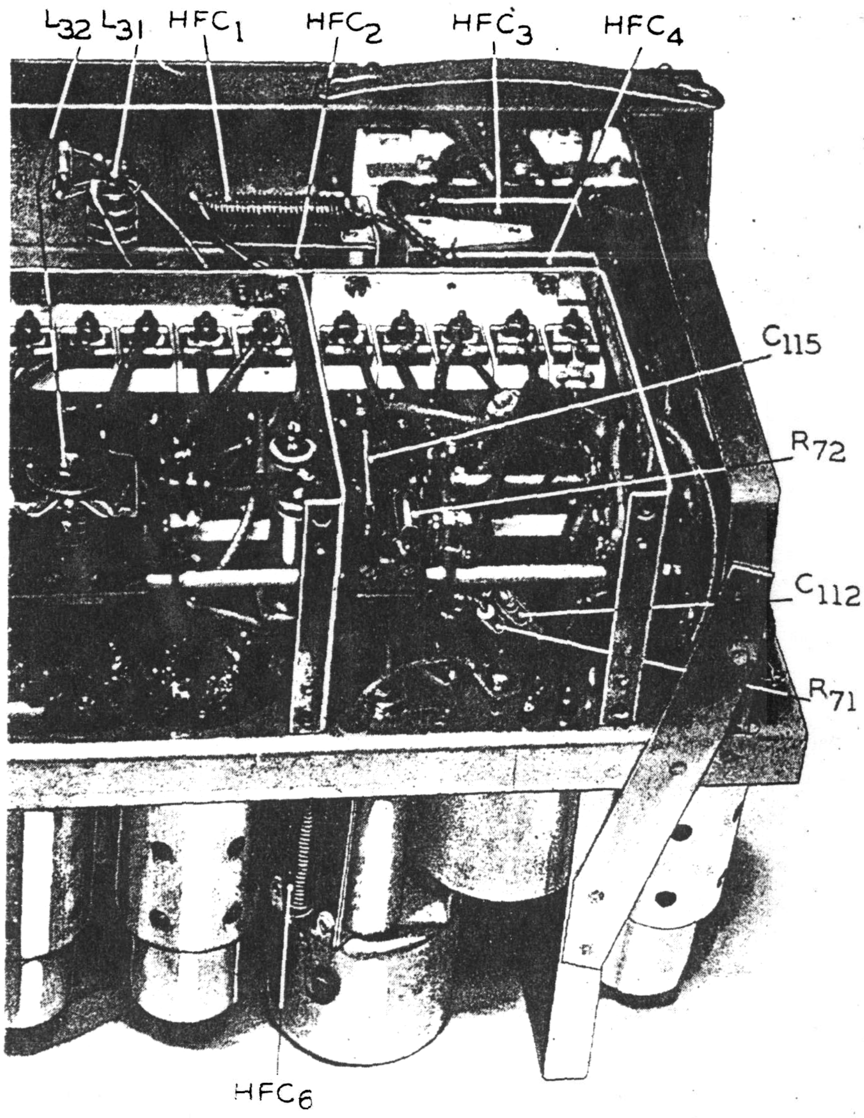


FIG. 19.—R.1155B CHASSIS, UNDERSIDE

Power unit position

68. The H.T. and L.T. power units, the latter of which is used to supply the receiver, are placed in an accessible position. Instructions on the installation of the power units, power cables and fuses, the L.T. dropping resistors, types 47 and 52 or 52A and the positioning of apparatus with respect to the aircraft compass, are given in Chap. 1 of this publication dealing with the transmitter T.1154 group. The receiver should be at least 24 in., and the visual indicator at least 18 in. from the compass to ensure negligible interference.

Aerial switch position

69. The aerial switching unit, type J, or the aerial plug board, which may be used as an alternative to the switching unit, is positioned between the transmitter and the aerial lead-in points so that the "run" of the aerial leads is clean and short. Instructions on the switch unit, the aerial plug board, internal aerial leads and other relevant details are given in Chap. 1.

D.F. loop aerial and impedance matching

70. The D.F. circuits of the receiver have been designed to work with a D.F. loop, type 3, which has a nominal inductance of 100 μH and a self-capacitance, when installed, of 20 $\mu\mu$F. When loops having constants widely differing from these figures are used, it is necessary to use an impedance matching unit with a series or shunt coil between receiver and loop.

71. Two small condensers C_{108} and C_{104}, the latter adjustable, are contained within the plug type 209 which connects the D.F. loop to the receiver. The condenser C_{104} should be adjusted for maximum sensitivity. The fixed condenser C_{106} should be wired in circuit only if the length of low-loss cable between loop and receiver is less than 12 ft. The position of the adjustment of C_{104} can be seen on the diagram of the plug type 209 in fig. 22. The screwdriver used for adjusting C_{104} should have an insulated shaft to prevent short-circuiting to the receiver metal casing.

72. The procedure for matching the receiver input to the capacitance of the loop aerial lead is as follows:—

(i) Set the aerial switch, type J, to D.F. (If the aerial plug board is in use set the plug marked FIXED AE to the group marked H.F.) As no D.F. interlock is provided by the aerial plug board care must be taken to avoid transmission when the receiver master switch is in the D.F. positions. Set the receiver master switch MS to FIGURE-OF-EIGHT.

(ii) Tune receiver to suitable signal on range 3 at the 1,500 kc/s end of the scale, and turn the loop to a position giving *maximum* signals in the telephones.

(iii) Adjust the trimmer condenser C_{104} to the position which gives maximum signals. Observe the tuning indicator V_{10} for minimum shadow during this operation.

(iv) Remove the loop plug, type 209, from the receiver and note the position of the rotor plates in the condenser C_{104}. If it is found that the plates are in a position between maximum and minimum capacitance the adjustment is satisfactory and the plug should be replaced.

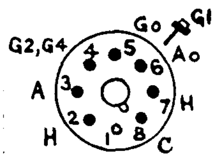
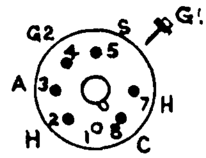
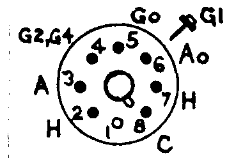
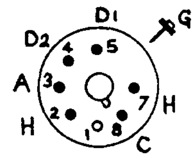
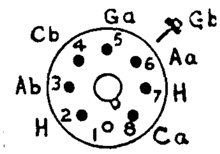
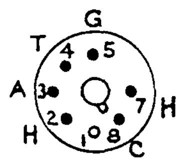
Circuit Ref.	*Valve Type*	*Base Connections*
V_1, V_2	VR99A	
V_3, V_5, V_6	VR100	
V_4	VR99	
V_7, V_8	VR101	
V_9	VR102	
V_{10}	VI 103	

FIG. 20.—VALVE CONNECTIONS

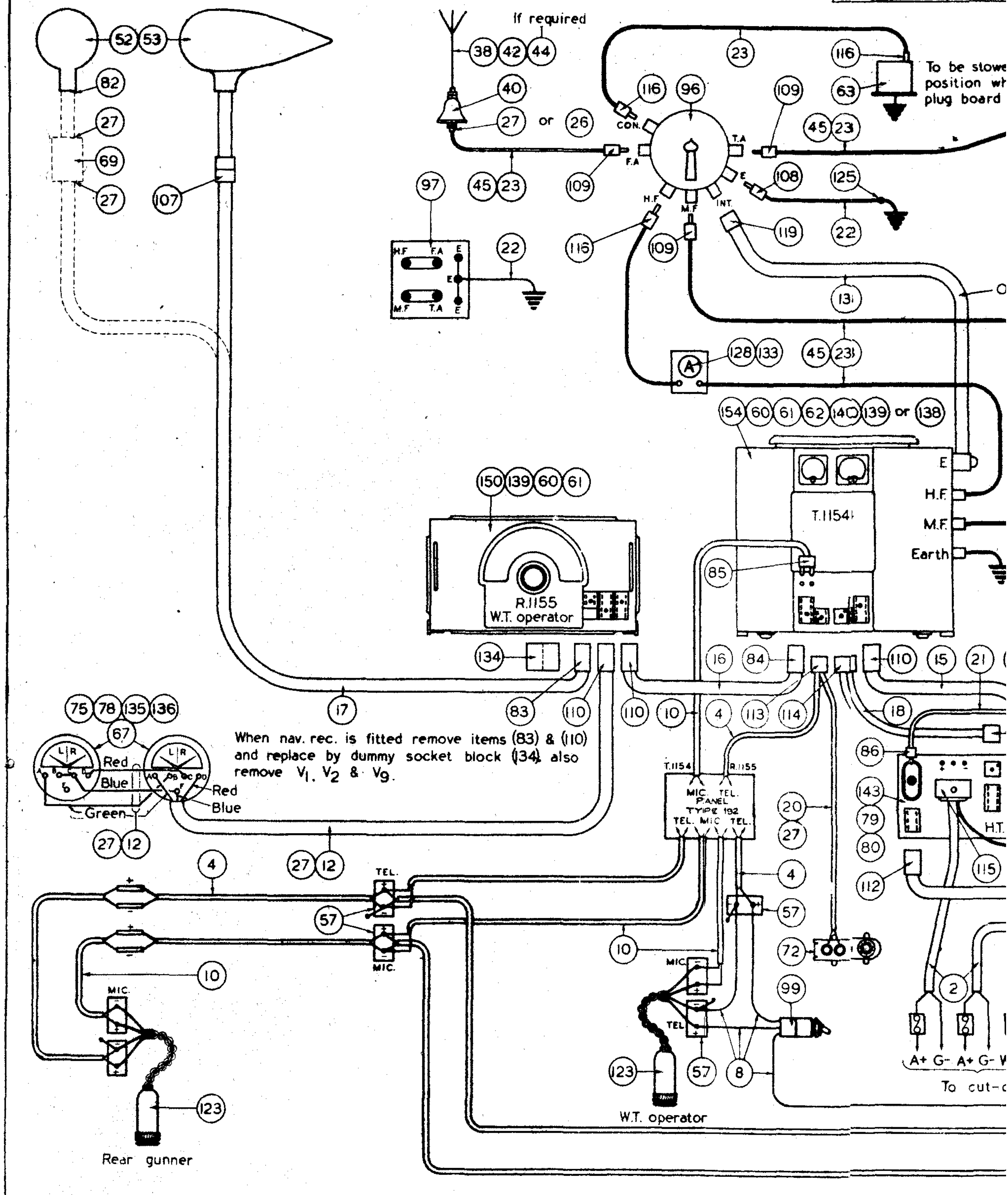
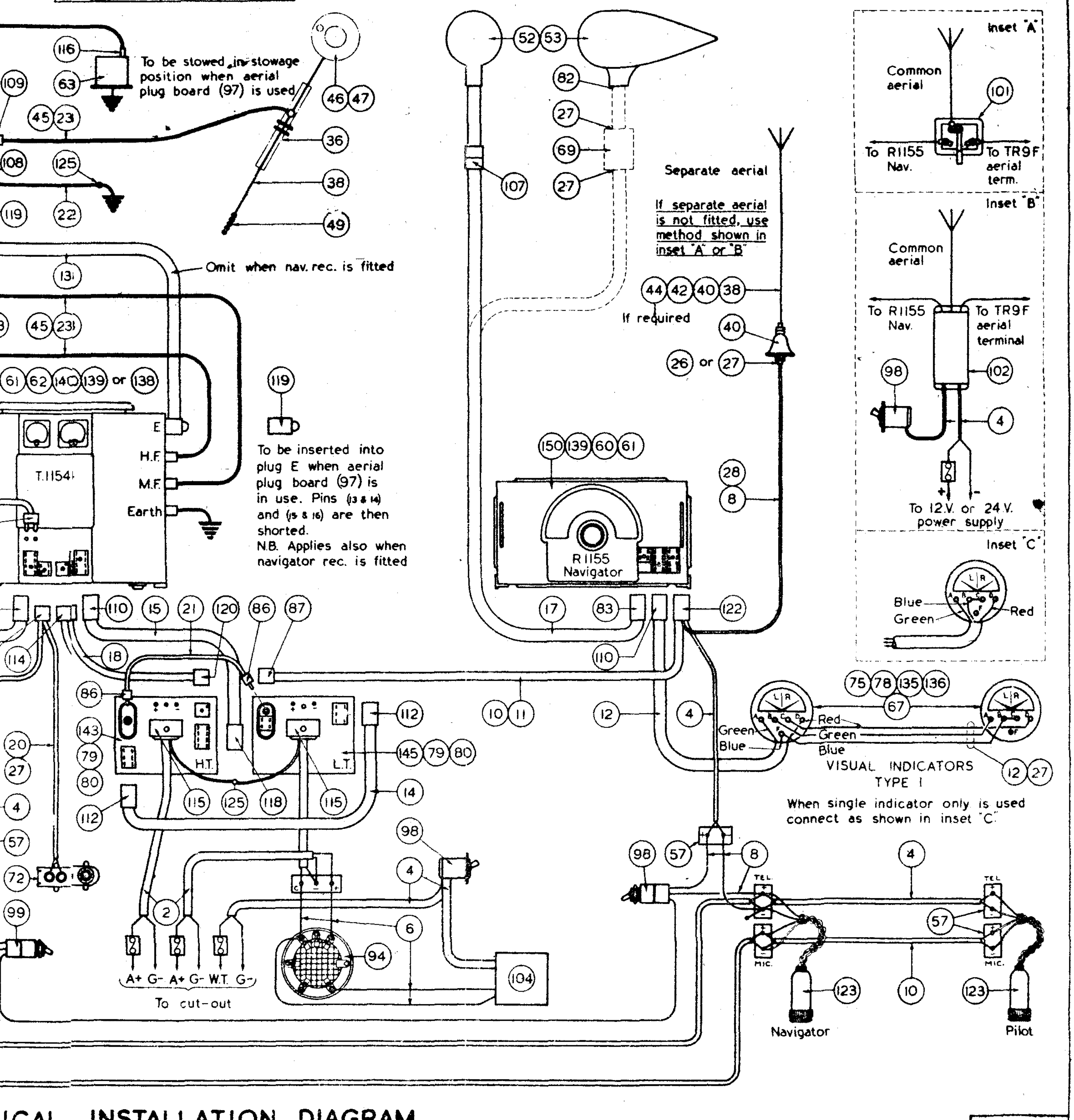


FIG. 21

TYPICAL INSTALLAT



...ICAL INSTALLATION DIAGRAM

FIG. 21

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(v) If it is found that the rotor plates are fully meshed it is an indication that insufficient capacitance adjustment is obtainable and additional capacitance should be added by removing the insulated covering from the leads running across the paxolin strips from the lower pair of tags to the top pair of tags, and by soldering the leads to the middle pair of tags adjacent to the leads.

(vi) If examination shows that the rotor plates are in the position of minimum capacitance it is an indication that too much capacitance is in circuit. The additional capacitance of the fixed condenser C_{106} should be removed by reversing the procedure outlined in (v) above. Unsolder the connecting wires from the middle pair of tags and cover the wires with suitable insulation to prevent contact with the middle pair of tags.

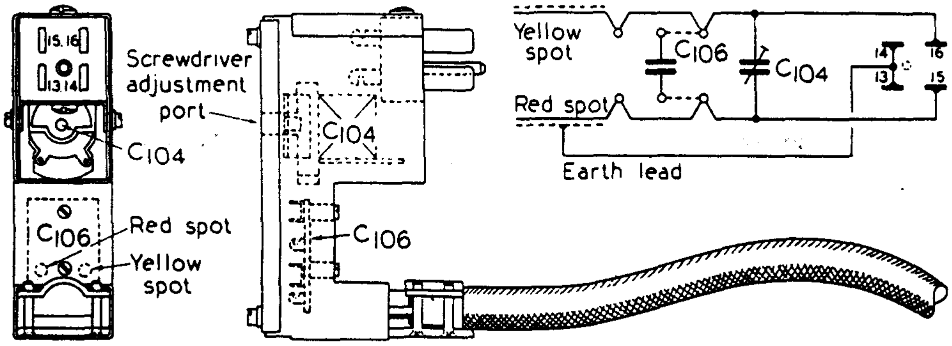

FIG. 22.—PLUG, TYPE 209

73. When a loop aerial type 1 is installed, an impedance matching unit, type 12, is used. When the receiver is installed on Hampden aircraft fitted with the retractable loop, an impedance matching unit, type 13, is used. When installed in aircraft fitted with the Bendix type loop, a matching unit, type 15, is used. The position of the impedance matching unit, with the maximum permissible length of cable between the loop and the receiver, is indicated in the installation schedules. The lengths between loop and matching unit, when installed, and between matching unit and receiver must, naturally, depend upon the position of the matching unit. In paras. 74 and 75 general principles governing the position are given.

74. On installations using the loop aerial, type 3, the length of cable connector Duradio No. 20 fitted with plug, type 209, and socket, type 63, should not be less than 6 ft. nor more than 20 ft. On installations using the loop aerial, type 1, the length of cable connector Duradio No. 20 should not be less than 5 ft. nor more than 18 ft. The matching unit should, preferably, be as near to the loop as possible. The position of the matching unit, when the Hampden retractable loop is used, should be as near the loop as possible and the position of the unit affects the maximum permissible length of cable. The length of Duradio No. 20 between the loop and the receiver should not be less than 4 ft. If the matching unit is not more than 7 ft. from the receiver a maximum total length of 22 ft. from loop to receiver is permissible. If the unit is not more than 3 ft. from the loop, the cable should not exceed 18 ft. total length, from loop to receiver.

75. When the Bendix loop is installed the matching unit, type 15, should be, preferably, as near as possible to the receiver. The length of Duradio No. 20 between loop and receiver should not be less than 4 ft. If the matching unit is not more than 6 ft. away from the receiver, the total length of cable from receiver to loop should not exceed 20 ft. If the unit is not more than 2 ft. from the loop, the total length of cable between receiver and loop should not exceed 17 ft.

Fixed aerial input

76. The fixed aerial input to the switching valves V_1 and V_2 is adjusted, on installation, by inserting a screwdriver into the small port on the right-hand side of the master-switch MS. This is indicated on fig. 1 as C_{56}. Once adjusted, the condenser needs no further attention. An insulated screwdriver should be used in order to avoid the possibility of short-circuiting the trimmer to earth. The procedure is as follows:—

(i) Set the aerial switch, type J, to D.F. (If plug board in use set the plug marked FIXED AE to group marked H.F.) Set the meter deflection switch S_2 to HIGH and receiver master switch to FIGURE-OF-EIGHT.

(ii) Tune the receiver to a suitable signal on range 4 and rotate the loop to a position which gives the ***minimum*** signals in the telephones. The signal selected should be one the bearing of which remains constant. This may be checked by turning the master switch to VISUAL and noting that the needles of the visual indicator remain steady. The volume control R_8 should be adjusted to give the lowest possible signal strength, consistent with accurate observation, during this and other adjustments.

(iii) Set the receiver master switch to BALANCE and adjust balance control R_{51} and meter amplitude control R_{23} to a position which causes the visual indicator needles to intersect along the white centre line on the dial face.

(iv) Return the receiver master switch to FIGURE-OF-EIGHT and rotate the loop 30 deg. from the position previously obtained for (ii) above.

(v) Operate the aural sense switch S_3 to L and R and hold the switch to the side which gives the *weaker* signal.

(vi) With the aural sense switch held in the position selected as at (v) adjust the trimmer C_{56} so that minimum signals are obtained. Observe the tuning indicator V_{10} during this operation as correct adjustment is indicated by ***maximum*** shadow.

The visual indicator, type 1

77. It is usual to install two visual indicators, type 1, one on the pilot's instrument panel for "homing" purposes and the other in a convenient position for the operator of the receiver and D.F. loop. These indicators are provided with a dim, but independent, illumination so that they may be used at night. The indicators are mounted on a sprung panel, or otherwise protected against jars and vibrations, as their movements are extremely fragile. The methods of wiring to the visual indicator when either one or two of these instruments is installed are shown as part of the typical installation diagram, fig. 21.

78. The mounting, type 119, is used with the visual indicators, and filament lamps, jack, type G.P.O. No. 3 (12 volts) or G.P.O. No. 3 (24 volts) with lampholders, type 61, are provided when required. The following points should be noted when fitting the visual indicators:—

(i) The instruments are mounted in the retaining strap so that they are suspended horizontally. The side brackets of the mounting, type 119, are adjusted as necessary. A minimum clearance of $\frac{1}{32}$ inch is allowed between the face of the instrument and the rubber cushion of the mounting.

(ii) Not less than 9 in. of loose cable is left between the indicator and the first cable fixing point.

(iii) The instrument retaining strap is tightened by means of a screw.

Setting up the D.F. loop

79. The polarity of the leads connecting the visual indicators to the receiver must be correct as indicated in fig. 21. This must be carefully checked. Similarly, the connections from the receiver to the D.F. loop must be checked. If the loop, type 3, is used and has been installed with the red end of the cradle toward the rear and the cursor reading at 180 deg. on the black marking of the scale ring, then the sense of the visual indicators should be correct. If a D.F. loop, other than the type 3, is used it should be stated quite clearly on a label in the aircraft how the loop scale must be adjusted so that the sense is correct. The following procedure should be adopted to ensure that the sense is correct:—

(i) Turn the master switch to FIGURE-OF-EIGHT. Tune the receiver to a suitable signal in range 3 or 5. This signal should be definitely identified and the relative position of the transmitting station, with respect to the aircraft, known.

(ii) Set the loop to the approximate bearing of the station and finally adjust for minimum or zero signal to give the exact bearing.

(iii) Turn the meter deflection sensitivity switch S_2 to LOW. Hold the aural sense switch S_3 to R and reduce the loop scale reading. The signals should rise in strength.

(iv) If the signals decrease in strength it will indicate that the installation has been incorrectly made and the loop and associated circuits should be checked.

(v) The above test should be repeated with the master switch at VISUAL. If sense is *correct*, the visual indicator meter needles will swing to the *right*.

After installation of a new apparatus, when making a test flight, the routine for visual D.F. sense discrimination should be carried out in order to determine whether the loop connections are correct. It is necessary to check on a station the position of which relative to the aircraft is known.

Loop centre tap

80. The receiver is designed to work on loops having no centre tap. As the receiver aerial coils are centre-tapped to earth, the loop centre-tap is unnecessary. Since it is possible that the tap may not have been removed with new installations a check should be made as follows:—

(i) Remove loop plug at receiver and connect a test-meter, type E across contacts 15 and 16 using the OHMS range. This should give a low resistance reading.

(ii) A reading should then be taken from contact 15 or 16 to 14 and 13. Open circuit should be indicated.

(iii) If a reading is obtained at (ii) it indicates that the loop has not had the centre tap removed, or that one side is earthed. The necessary action as indicated in para. 81 should be taken in these circumstances.

(iv) Adjust the loop lead capacitance (*see* para. 72).

81. The following is the sequence of operations for the removal of the loop centre tap:—

(i) Remove the fabric strips from around the centre seam of the streamlined housing.

(ii) Remove and retain the six screws securing the tail and centre section of the housing.

(iii) Withdraw the tail portion of the housing. The loop winding will now be exposed.

(iv) Identify the loop winding inner terminations and remove the connection from one winding termination, inner, to the metal centre piece.

(v) Remove the connection from the other winding termination, inner, to the spill on the corner fixing screw.

(vi) Connect the winding terminations, inner, by a short length of 18 s.w.g. tinned copper wire (Stores Ref. 5E/1779) encased in insulating tubing, grade E (Stores Ref. 5F/1910).

(vii) Disconnect the loop plug from the receiver and using a test-meter, type E, check the loop circuit as follows:—

(*a*) Plug the negative lead into the OHMS socket and connect the test meter between the loop winding and earth. The test-meter should not show a deflection.

(*b*) Connect the test meter across the loop winding outer terminations and it should register full-scale deflection.

(viii) Replace the tail piece of the loop housing and secure it by the six screws.

(ix) Re-seal the centre seam, using 2 in. wide cotton tape (Stores Ref. 32B/409), approximately 10 ft. long, and special adhesive, Boscolyn lacquer (Stores Ref. 33C/590).

Navigator-operated receivers

82. In certain aircraft an additional receiver is installed for the exclusive use of the navigator for D.F. purposes. The D.F. loop which is normally connected to the communications receiver is now connected to the navigator-operated receiver. The existing loop connector is dispensed with and a new connector fitted, the length of this varying to suit individual installations. The typical installation diagram of fig. 21 includes this navigator-operated receiver.

83. The visual indicator, previously located and wired in a position accessible to the W/T operator, is removed and mounted at the navigator's station, a suitable connector being used. The visual indicator is connected to the navigator-operated receiver. The visual indicator provided for the use of the pilot will remain. A dummy socket (Stores Ref. 10H/1938) is provided for the purpose of blanking out the D.F. loop and visual indicator connections on the communications receiver. Existing remote controls may have to be repositioned or removed and where no remote controls exist these may have to be provided.

84. To provide for sense indication a separate fixed aerial is required for use with the navigator-operated installation. In certain circumstances it may be necessary to utilise one of the existing fixed aerials and a change-over switch.

85. In order to overcome any difficulty which might arise over signal identification, means are provided to enable signals to be switched from the navigator back to the W.T. operator. This is accomplished by means of two switches, type 170, suitably wired. One switch is controlled by the navigator whilst the other is controlled by the W.T. operator. When the navigator's switch is set to the D.F. position his telephones are connected to the output of the additional receiver. Should it be necessary for the W.T. operator to identify the signal, the operator's switch is set also to the D.F. position. Normal intercommunication facilities are established when the switches are set to the I/C position.

86. The modifications to the power unit, to enable the additional power for the navigator-operated receiver, entail the fitting of a relay unit to the L.T. power unit and a single pole socket to the H.T. power unit. These modifications are described in Chap. 1 of this publication. It is recommended that V_1, V_2, and V_3 be removed from the *wireless operator's* receiver to reduce the load on the L.T. power units when two receivers are installed.

87. It has been found that in certain navigator-operated receivers, type R.1155, some valves are not connected to the H.T. supply. This is due to the omission of a lead between pins Nos. 5 and 7 of the socket, type 299, which is fitted at the receiver end of the cable between the L.T. power unit and the receiver. If, upon examination, the socket, type 299, is found deficient in this respect, the following procedure should be adopted:—

(i) Withdraw the socket, type 299, from the receiver and remove its cover.

(ii) Connect a 1 in. length of 18 s.w.g. tinned copper wire, encased in grade E insulating tubing, between pins No. 5 and No. 7.

(iii) Replace the cover of the socket.

(iv) Replace the socket in the receiver.

Power units

88. Installation instructions in connection with the airborne power units and the procedure for adjustment of the resistance unit, type 47 (12-volt) or type 52 or 52A (24-volt) which is connected between the aircraft electrical supply and the L.T. power unit, supplying the receiver L.T. and H.T., can be found in the chapter on the transmitter, type T.1154, Chap. 1 of this publication. Any of the L.T. power units listed in the concise details sheet at the beginning of this chapter may be in use, those bearing the suffix letter A being for use when a navigator-operated receiver is installed. Details of types 34A and 35A are as follows:—

Type	Stores Ref.	Input		Outputs				Rated Watts
				L.T.		H.T.		
		Volts	Amps.	Volts	Amps.	Volts	mA.	
34A	10K/13065	10·3	24	7	13	217	110	115
35A	10K/13066	18·5	12	7	13	217	110	115

The receiver D.C. feed varies according to the master switch position ranging from 48 mA at OMNI with volume control at a minimum to 69 mA or more at BALANCE or VISUAL with maximum setting of volume control.

OPERATION

89. The operation of the receiver will be facilitated by reference to fig. 1 which shows the front panel controls, plugs, and socket. The operator should first satisfy himself that all valve top cap connectors are making secure contact. The plugs and sockets should be securely engaged and the retaining bar should be in position on the posts provided. The receiver socket and plugs are grouped at the bottom right-hand corner and, from left to right, they are:—Socket SK_2, FROM LOOP AERIAL; plug P_2, TO VISUAL INDICATOR; plug P_1 FROM TRANSMITTER.

90. For communications reception the fixed aerial is normally used on the H.F. ranges 1, 2, and 2A, and the trailing aerial on the M.F. ranges 3, 4, and 5. By operating the aerial selector switching unit, type J, or the aerial plug board, the fixed or trailing aerial can be used on all ranges. This ensures continuity of communication should one of the aerials become unserviceable. For D.F. the fixed aerial and loop aerial are used. D.F. reception, using visual and aural methods, is available on all ranges except range 1 and 2 A. (In the R.1155C only, range 1 may also be used for D.F. purposes.) The operator should ensure that the correct matching unit, for the type of loop aerial being used, is installed, as specified in para. 73.

Controls

91. The receiver has three main communications controls:—

(i) The tuning control with frequency-calibrated scales, the frequency being indicated by a pointer on the scale. The exact point of resonance is shown by a minimum shadow on the tuning indicator V_{10}. The scale colour code is based on that of the transmitter, type T.1154, frequencies outside the transmitter ranges being indicated in black, but see para. 56.

(ii) The frequency range switch FS selects the desired range 1 to 5.

(iii) The master switch MS has five positions which perform the following functions:—

● (OMNI). The R.F. and I.F. gain is manually controlled by the volume control, which actuates the ganged potentiometers $R_{8(1)}$ and $R_{8(2)}$. In this position of the master switch the potentiometer $R_{8(1)}$ is in circuit. This position is used for W.T. reception and for back-tuning between the transmitter and the receiver.

A.V.C. The R.F. and I.F. gain is automatically controlled. In this position of the master switch the potentiometer $R_{8(2)}$ is in circuit giving manual control over the A.F. gain. This position is used for R.T. reception.

BALANCE. This position is used in conjunction with the meter balance control R_{21} for balancing the visual indicator before D.F. is carried out.

VISUAL. For homing by visual means. This position may also be used for taking bearings by visual means in lieu of the normal aural method.

∞ (FIGURE-OF-EIGHT). For aural D.F. reception, using the switch S_3 for sense discrimination.

92. The receiver secondary controls are:—

(i) INCREASE VOLUME (R_8)—Adjusts input to grid of V_8 when MS is at A.V.C. and adjusts bias of R.F. and I.F. stages when MS is at OMNI and FIGURE-OF-EIGHT.

(ii) HETERODYNE SWITCH (S_4)—Switches in the B.F.O. valve V_7 for C.W. reception.

(iii) METER AMPLITUDE (R_{22})—Varies height of visual indicator needles when setting up to D.F. balance. May also be used for occasional adjustment of the needles on weak signals.

(iv) METER BALANCE (R_{21})—Adjusted with MS at BALANCE and must not be adjusted with MS at any other position. Balance is indicated when two needles of the visual indicator intersect on the centre line.

(v) METER SENSITIVITY SWITCH (S_2)—Effects maximum deflection of visual indicator needles at 25 deg. off course for "homing" purposes (LOW) or maximum deflection of 10 deg. off minimum when taking bearings by visual indicator (HIGH).

(vi) METER FREQUENCY SWITCH (S_1)—Causes L.F. switching oscillator (V_1 and V_2) frequency to be either 80 c/s (HIGH) for W.T. or 30 c/s (LOW) for R.T.

(vii) AURAL SENSE SWITCH (S_3)—Spring loaded. Used for sense determination when aural D.F. reception is employed.

(viii) FILTER SWITCH (S_5)—Used to eliminate the switching frequency when monitoring visual D.F. and for elimination of aircraft electrical noises and also to reduce background noises when listening to R.T. transmissions from aircraft.

Setting up heterodyne oscillator

93. To bring the B.F.O. valve V_7 into operation for receiving C.W. the switch S_4 is used. It is first necessary to set up the heterodyne oscillator and this is accomplished as follows:—

(i) Turn the aerial selector switching unit, type J, to the position M.F. ON FIXED or, if using an aerial plug board, connect the fixed aerial to M.F.

(ii) Put the transmitter master switch to STAND BI and the receiver master switch MS to A.V.C.

(iii) Switch on the B.F.O., using S_4.

(iv) The frequency range switch FS should be at range 3 and a convenient R.T. transmitting station tuned in until the minimum shadow is seen in the tuning indicator V_{10}.

(v) Insert a screwdriver into the HET.ADJ. port giving access to C_{13} and slowly adjust the condenser until a suitable note is heard in the telephones. A variation of approximately 3 kc/s can be effected.

Back-tuning

94. In the absence of a crystal-monitor the "back-tune" method can be used to facilitate the setting up of the transmitter "spot" frequencies. The receiver frequency range switch FS is set to the RANGE in which the required transmitter frequency occurs. Set the receiver to the required frequency and set the master switch to OMNI. Set the volume control R_8 about half-way. With the transmitter master switch at TUNE, press the morse key and swing the master oscillator dial until maximum signal strength, that is, minimum shadow, is indicated in the tuning indicator V_{10},

adjusting the receiver volume control R_8 as necessary. Adjust the transmitter output in the normal manner and recheck the M.O. tuning by reference to the receiver tuning indicator V_{10}. Send a series of dots and observe flicker in V_{10}.

95. It will be realised that it is possible to set up the receiver exactly to a click-stopped "spot" frequency on the transmitter by means of back-tuning. The transmitter should first be independently tuned to the required frequency. Set the receiver frequency range switch to the required range in which transmitter frequency occurs. Set the receiver master switch to OMNI with volume control half-way. Set the transmitter master switch to TUNE, press the key, and adjust the receiver tuning for minimum shadow in V_{10}.

Note.—If the edges of light on the tuning indicator overlap during tuning operations, reduce the volume control. If the shadow cannot be reduced, increase volume control.

Normal communication

96. The aerial switching unit, type J, is turned to NORMAL (when using aerial plug board the fixed aerial is connected to H.F. and the trailing aerial to M.F.). The transmitter master switch is at STAND BI. Turn up the receiver volume control until background noise is heard. Put the receiver master switch MS to OMNI and V_{10} should show a green light. Turn the receiver frequency range switch FS to the required range and adjust the receiver frequency. If working C.W., switch on the heterodyne by S_4. Whilst sending signals a 1,200 c/s side-tone should be heard in the telephones. Listening-through can be tested, with the morse key up, by listening for signals or receiver background noise. The tuning indicator V_{10} will flicker to dots and dashes when transmission is taking place if the receiver is tuned to the same frequency as the transmitter.

Note.—In heavy static, or thunder conditions, the fixed and trailing aerials should be earthed. This condition is met by turning the aerial selector switching unit, type J, to EARTH (when using an aerial plug board connect the plugs of both aerials to the EARTH sockets provided). Reception is still possible, using ranges 2 to 5, in conjunction with the loop aerial. Turn the frequency range switch FS to the required range. Turn the master switch MS to FIGURE-OF-EIGHT and tune in the signal. Rotate the loop aerial to the position of maximum strength, noting the V_{10} shadow. Adjust the volume control.

D.F. bearings using visual indicator

97. Frequency ranges 3, 4, and 5 (occasionally 2) are used. On the R.1155C all ranges, including range 1, may be used. Only the *black* scale on the loop should be used. First, turn the aerial selector switch to D.F. or, if using aerial plug board connect the trailing aerial to M.F. and the fixed aerial to H.F. If an aerial plug board is fitted, care must be taken by the operator to see that the transmitter switch is at STAND-BI and that the key is not pressed. Turn the transmitter master switch to STAND-BI and the receiver frequency range switch FS to the required range. Turn the receiver master switch to OMNI.

98. Tune in the signal as for normal communication and adjust the volume to a low level. Turn the receiver master switch to BALANCE. Adjust the visual indicator needles by the meter balance control R_{51} so that they intersect exactly along the centre line on the dial face. If necessary, adjust the needles to a suitable working height by rotating the meter amplitude control R_{23}. Turn the meter sensitivity switch S_2 to HIGH. Turn the switch S_1 to HIGH for W.T. or LOW for R.T. and the filter switch S_5 to IN. Readjust balance by the meter balance control R_{51}. Turn the master switch MS to VISUAL. The indicator needles should now operate. Turn the loop aerial until the indicator needles intersect along the centre line on the dial face.

99. Check for sense by reducing the scale reading of loop. If indicator needles swing to the *right*, sense is *correct*. If to the left, sense is incorrect. When sense is correct, turn the loop back to the position on *black* scale, to which needles intersect along the centre line on the dial face, and note reading. If sense is incorrect, rotate through 180 deg. to determine bearing. The routine may be easily remembered by the "RRR rule":—Reduce reading; Right deflection; Right sense.

Homing, using visual indicator

100. The sequence of operations detailed in paras. 97 and 98, up to that in which the master switch MS is turned to VISUAL, should be carried out prior to the following. The loop is then set to loop scale reading zero, that is, athwartship. The meter deflection (sensitivity) switch S_2 is positioned at LOW and the master switch MS to BALANCE. The balance is readjusted by R_{51} and the master switch put to VISUAL. The pilot should now be asked to alter course until the needles intersect along the centre line on the visual indicator dial face. There may be occasions when it is not known whether the "homing" transmitter lies ahead or astern of the aircraft, and sense discrimination must then be carried out as described in the next paragraph.

101. After the aircraft has been set to a course which causes the needles to intersect on the centre line the course is off-set a few degrees to the left; if the station is ahead, the needles will intersect on the right; if the station is astern, the needles will intersect on the left and the course should be altered by 180 degrees. This sense discrimination may, if desired, be carried out by reducing the loop scale reading by, say, 10 deg. instead of altering the aircraft's course. Sense will be indicated in the same manner. Care should be taken to ensure that the loop is restored to zero after sense determination. During "homing," balance should be checked every ten minutes. If necessary, make adjustments to the meter amplitude R_{23} and re-check the balance after this operation.

102. It should be remembered that "homing" by visual indication is only in the nature of an "aid to navigation" and that normal navigation should not be neglected whilst it is being used. The aircraft should, for example, be prevented from drifting if there is a cross wind. The homing method, when properly used, will always bring the aircraft to the source of transmission, but unless the standard navigational methods are observed, the course flown may be increased, beyond the point-to-point distance, due to wind.

103. A method of off-setting the loop to the fore-and-aft line of the aircraft in order to traverse a true point-to-point course if possible, but this is dependent upon very accurate information as to cross wind, speed and direction. When flying over the home station the indicator needles will collapse for a few seconds, indicating that the station is directly below. After passing the station the sense will reverse and if the instructions given are observed the course of the aircraft can be reversed until the station is again directly below. When homing on a keyed transmitter, it is necessary to note that the indicator needles collapse symmetrically down the centre scale as the distant transmitter is keyed. If the needles do not collapse symmetrically it will indicate that signals are being received with interference and resulting false indication of course. When homing, signals should be monitored from time to time to ensure that the desired frequency is not subject to interference.

Aural D.F.

104. When using the aural method of D.F. the fixed aerial is disconnected, the loop being the sole source of signal pick-up. The meter switching circuits of V_9 are inoperative. Volume control is effected manually, the A.V.C. system being out of circuit.

105. The routine for aural D.F. is as follows:—The aerial selector switching unit is turned to D.F. or, when using the aerial plug board the trailing aerial is connected to M.F. and the fixed aerial to H.F. The range switch FS is turned to the required range and the master switch MS to OMNI. The meter deflection switch S_2 is placed at LOW and the required signal tuned in. The volume control is then readjusted and the tuning re-checked on the tuning indicator V_{10}.

106. The master switch MS is then turned to the FIGURE-OF-EIGHT position, the loop is swung to the position of *minimum* signal and the volume control adjusted to obtain a zero. The loop scale reading for this zero signal should be observed. To check for sense, reduce the scale reading of the loop, putting the sense switch S_3 to the R position. If the signal strength rises the sense is correct. If the signal strength decreases the sense is wrong, and the loop should be turned through 180 deg. and the zero signal setting noted. The L and R positions of S_3 permit the operation of V_1 or V_2 by applying H.T. to the screens. This, of course, brings in the fixed aerial signals for application to the loop aerial circuit.

PRECAUTIONS AND SERVICING

Ground testing

107. The following procedure should be adopted for ground testing the R.1155. Having set the aerial switching unit to the NORMAL position the frequency range switch should be placed at either range 1, 2, or 2A. The master switch is then positioned at either OMNI or A.V.C. Having turned the transmitter master switch to STAND-BI the L.T. power unit should start up and, in a few seconds, the tuning indicator should glow. The telephones are then inserted and the reception of signals checked.

108. To receive on the M.F. ranges 3, 4, and 5 the aerial switching unit is set to the position engraved M.F. ON FIXED AERIAL. If a check of D.F. reception is made the aircraft should be clear of all metal obstructions such as hangars, before verifying sense of bearings. To carry out this test the aerial switching unit should be placed to D.F. With the aerial switching unit in this position or in the EARTH position, the H.T. power unit should remain inoperative in all positions of the transmitter master switch.

109. On installations fitted with the aerial plug board, the fixed aerial socket must be connected to the H.F. plug in order to receive on the H.F. ranges 1, 2, and 2A. To receive on ranges 3, 4, and 5, the fixed aerial socket should be connected to the M.F. plug. When using visual D.F., it should

D.C. RESISTANCE TABLE

Component	Test Points	Resistance in ohms
I.F. Coils		
L_{19} prim.	V_4 anode to R_{34}, C_{32}	2 approx.
sec.	V_5 grid to R_{33}, C_{33}	2 approx.
L_{20} prim.	V_5 anode to R_{30}, C_{29}	2 approx.
sec.	V_6 grid to R_{29}, C_{30}	2 approx.
L_{21} prim.	V_6 anode to R_{58}, C_{27}	2 approx.
sec.	V_7 diode to R_{20}, C_{11}	2 approx.
B.F.O. Coil		
L_{22}	Fixed plates C_{13} to R_{18}, C_{17} or C_{15}	5
A.F. oscillator trans.		
L_{23}, prim.	V_1 osc. anode to V_2 osc. anode	7,970
L_{23}, sec.	V_1 osc. grid to V_2 osc. grid	355
L_{23}, 2nd sec.	P_2 pins 7 and 8	331
Anode chokes V_1, V_2		
L_{24}	V_1 anode to R_{46}, C_{41}	550
L_{24}	V_2 anode to R_{46}, C_{41}	550
A.V.C. choke		
L_{25}	V_7 diode to C_{108}, R_{68}	135
Visual meter chokes		
L_{26}	V_9 anode to C_3, R_{25}	135
L_{27}	V_9 anode to C_5, R_{24}	135
Limiter diode choke		
L_{28}	R_{70}, C_{20} to C_4, R_{23}	135
L.F. filter choke		
L_{29}	S_5 to earth	2,020
Output transformer		
L_{30}, prim.	V_8 anode to pin 5, power plug P_1	1,528
L_{30}, sec.	P_1 pin 6 to earth	1,063
Aerial circuit		
Range 1 input	FS xr1 to C_{40}, R_{45}	Less than 1
Range 2 input	FS xr1 to C_{40}, R_{45}	Less than 1
Range 2A input	FS xr1 to C_{40}, R_{45}	Less than 1
Range 3	FS xr1 to C_{40}, R_{45}	2

Component	Test Points	Resistance in ohms
Range 4 input	FS xr1 to C_{40}, R_{45}	6
Range 5 input	FS xr1 to C_{40}, R_{45}	57
Aerial circuits		Less than 1 to earth
V_4 input circuits		
	V_4 grid to C_{37}, R_{38} junction	
Range 1	Switch to Range 1	Less than 1
Range 2	Switch to Range 2	Less than 1
Range 2A	Switch to Range 2A	Less than 1
Range 3	Switch to Range 3	3·5
Range 4	Switch to Range 4	11·0
Range 5	Switch to Range 5	78·0
V_4 osc. circuit		
	V_4 osc. grid C_{35} (zf contact 12) to joint R_{35}, C_{34}	
Range 1	Switch to Range 1	Infinity
Range 2	Switch to Range 2	Infinity
Range 2A	Switch to Range 2A	500
Range 3	Switch to R_3	1,600
Range 4	Switch to R_4	1,650
Range 5	Switch to R_5	0.5
H.F. Ranges 1 and 2	FS zf12 to zf6	0·5
Ranges 2A, 3, 4, 5	FS zf12 to zf6	Infinity
Oscillator anode coil		
Range 3	C_{34}, R_{35} to C_{73}	2·5
Range 4	C_{34}, R_{35} to C_{74}	4·5
Range 5	C_{34}, R_{35} to C_{73}	8·5
Oscillator anode coils tap check		
Range 1	FS zr6 to C_{35} or zf12	Infinity
Range 2	FS zr6 to C_{35} or zf12	Infinity
Range 2A	FS zr6 to C_{35} or zf12	500
Range 3	FS zr6 to C_{35} or zf12	1,600
Range 4	FS zr6 to C_{35} or zf12	1,600
Range 5	FS zr6 to C_{35} or zf12	1·5

VOLTAGE TESTS, ETC.

Measure	Test Points	Voltage and Resistance
L.T. volts	Withdraw meter plug P_2 Measure across contacts 4 and 5	6 to 7·5 v.
H.T. volts	Measure across contacts 4 and 6	200 v. approx.
Standing bias on V_3, V_4, V_5 and V_6	Remote end of R_{12} and chassis Vol. control to OMNI max. position	−3 v. M.F.
	Remote end of R_{12} and chassis Vol. control to OMNI max. position	−1·5 v. H.F.
D.C. resistance between H.T.+ and H.T.−	Withdraw P_1 from chassis Measure between pin 5 and pin 8	9,500 ohms.
A.F. oscillator	Withdraw plug P_2 Measure between pins 7 and 8 using A.C. range of Testmeter	28 v. at 30 c/s 35 v. at 80 c/s

COLOUR CODE

Wiring Red, H.T. positive; Yellow, H.T. negative; Blue, L.T. positive; Black, earth; Green, grids

SWITCHES

w is aerial input
x is grid V
y is anode V_3
z is grid and osc. V_4

be remembered that the aerial plug board does not break the H.T. power unit relay circuit in any position and therefore the transmitter master switch *must* be kept at STAND-BI.

110. When the aircraft nominal supply is 12 volts the minimum permissible voltage with the L.T. power unit running is 10·5 volts. When the aircraft supply is 24 volts the minimum permissible voltage with the L.T. power unit running is 21 volts. The minimum filament voltage permissible for normal functioning of the receiver is 5·7 volts. If reception fails or signals are weak, when the filament voltage is between 5·7 and 6 volts, the frequency changer valve V_4 should be renewed.

Starter trolley batteries

111. As the current drawn by the T.1154–R.1155 equipment will discharge the aircraft batteries very rapidly, ground tests are to be carried out using the larger batteries on a starter trolley. It is usual for equipment to be so arranged that plugging in the trolley starter service leads to the normal point automatically isolates the aircraft starter accumulator and connects the W.T. equipment to the trolley accumulator.

Visual indicator

112. Should either of the visual indicators, type 1, be rendered unserviceable, operation can be carried out with a single instrument. The windings are connected in series, and connections A and B, C and D on the unserviceable indicator should be short-circuited to enable the serviceable one to operate.

113. Water or dampness will affect the readings on the visual indicators if allowed to remain on the terminals of the instrument. The back of the indicators should therefore be wiped dry before use. Periodical observations should be made to check that the pilot's and operator's indicators are giving approximately equal readings. If not approximately equal the pair should be tested against a known serviceable indicator and the faulty instrument renewed. When carrying out these checks the receiver master switch should be in the BALANCE position.

Trouble location

114. Trouble location charts, figs. 23 and 23A, are included and these should assist in the rapid localizing of faults. Various circuit continuity tests are also included for the checking of burnt-out or deteriorated components. A necessary preliminary to the rapid solution of difficulties is a familiarity with the location of the various components and this will be assisted by the location diagram, fig. 17.

Test apparatus

115. Ground tests of the R.1155 are normally carried out by means of the test rigs, types 22 or 22A. For the use of civilian repair organizations and Maintenance Units a special test set, type 65, is provided for bench testing. This, however, is not a normal service issue. By means of this unit all the test conditions necessary for communications and D.F. reception can be simulated and are easily selected for each particular test by means of switches. The test rig, type 22, comprises a single panel carrying a visual indicator, four switches for selecting the test conditions, four plugs for connecting the unit to the receiver and power supplies, and terminals for the connection of a signal generator, output meter, and telephones. The test set, type 65, is described in Sect. 5, Chap. 18 of A.P.1186, Vol. I.

Valve data

116. The following table gives the type and function of each valve. All the valves are fitted with international octal bases. A diagram of the base connections is given in fig. 20.

Figure Ref.	Function	Type
V_1, V_2	Visual D.F. switching	Triode-hexode, V.R.99A
V_3	R.F. amplifier	Variable-mu H.F. pentode, V.R.100
V_4	Frequency-changer	Triode-hexode, V.R.99
V_5, V_6	I.F. amplifiers	Variable-mu H.F. pentode, V.R.100
V_7 V_8	A.V.C. and B.F.O. Second detector, visual meter limiter and output	Double diode triode, V.R.101
V_9	Visual meter switching	Double triode, V.R.102
V_{10}	Tuning indicator	V.I.103

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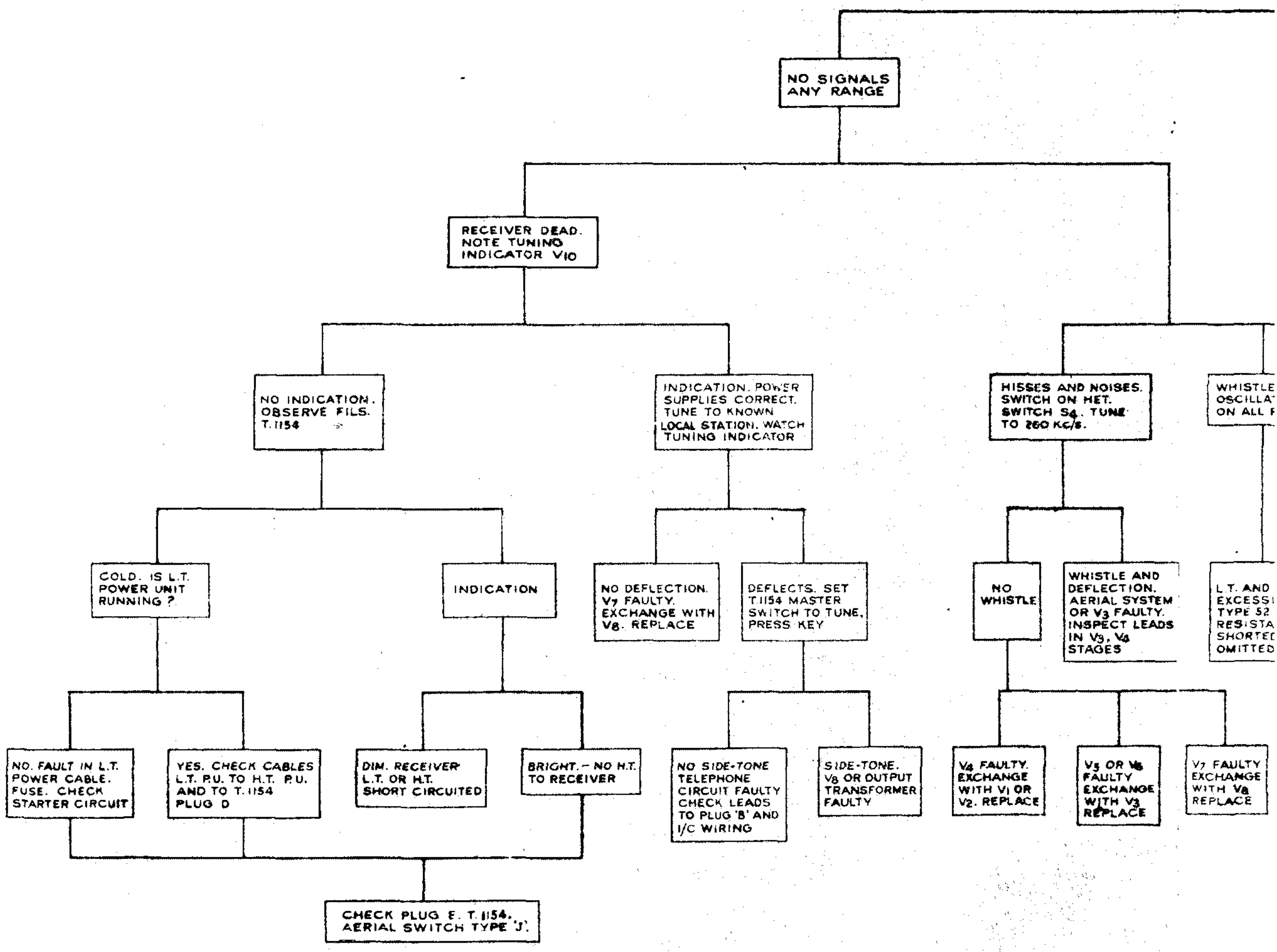
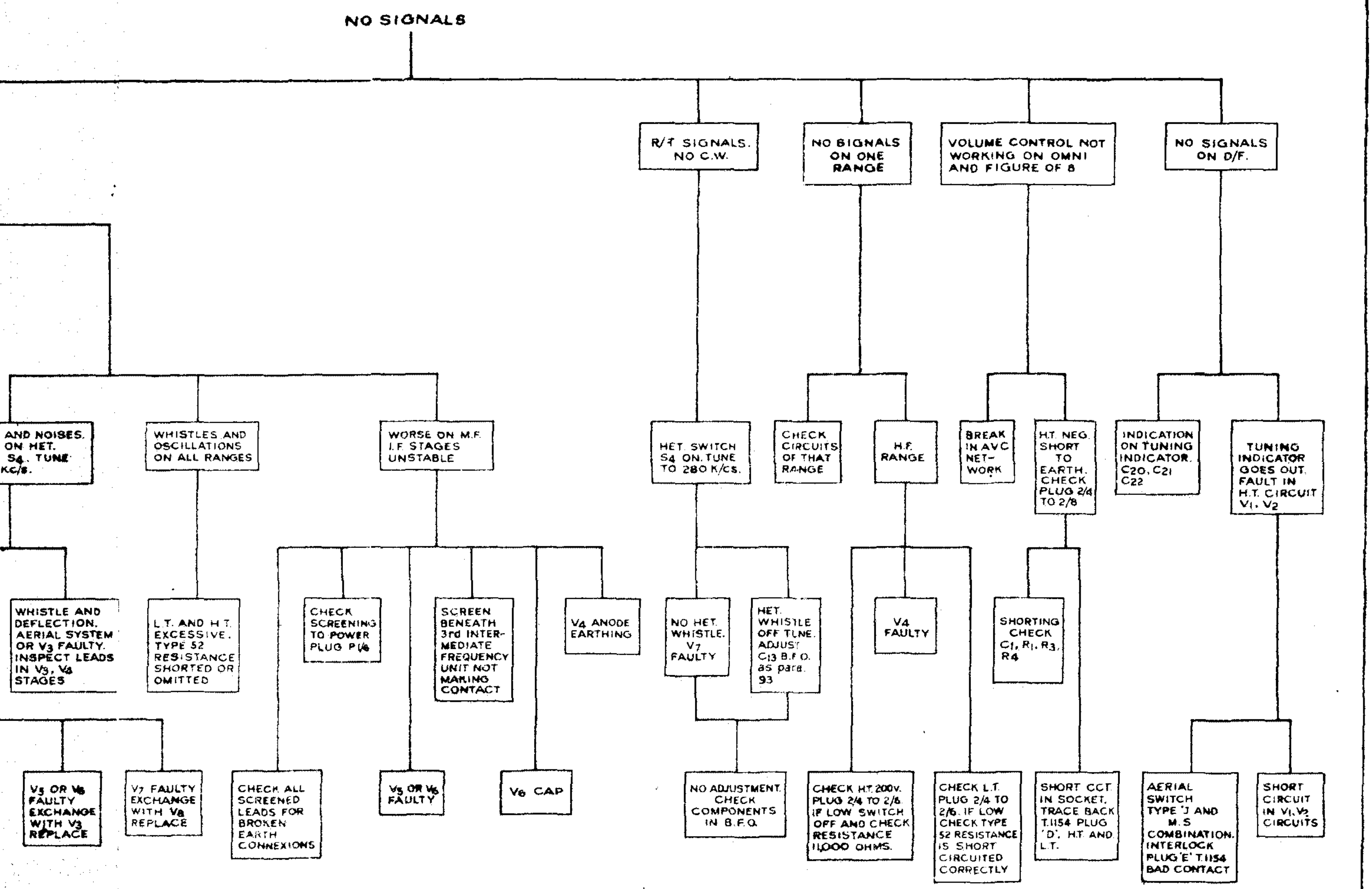


COMMUNICATION CIRCUITS

FIG. 23



...ON CIRCUITS — TROUBLE LOCATION CHART

FIG. 23

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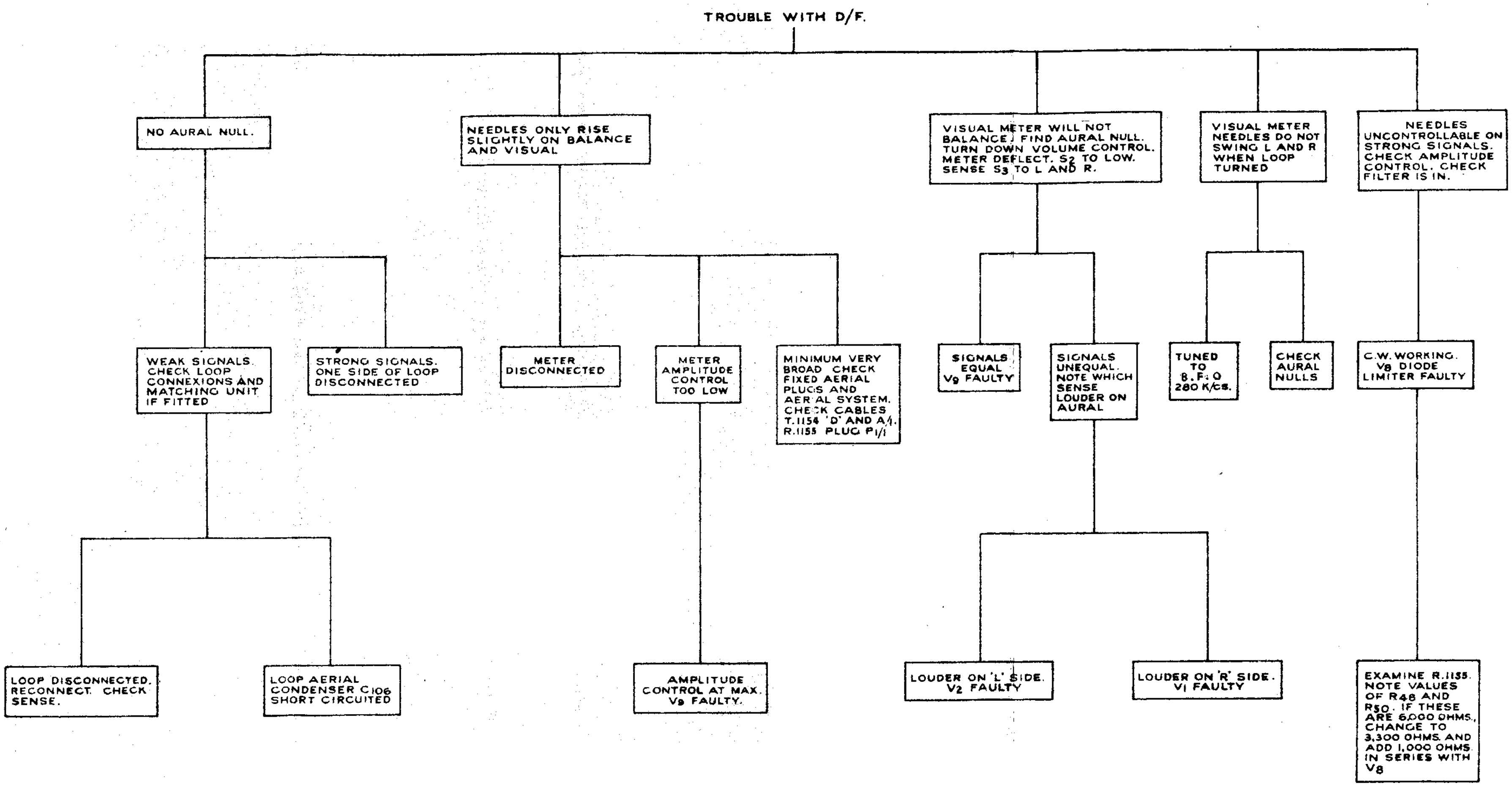


D. F. SWITCHING CIRCUITS — TROUBLE LOCATION CHART

FIG. 23a

FIG. 23a

Valve identification

117. The receivers R.1155 were originally issued with the valve positions marked with trade nomenclatures. Later issues of the receivers are marked with the standard numbers as indicated in col. 3 of the table in para. 116. To remove the difficulty arising when it is necessary to fit spare valves marked in one system into a receiver marked in the other system a valve identification label (Stores Ref. 10D/580) has been prepared. The sequence of operations for affixing the valve label is as follows:—

(i) Remove the receiver from its case.

(ii) Identify the flat screening box immediately behind the front panel and adjacent to the tuning condensers.

(iii) Use shellac varnish (Stores Ref. 33A/511) to fix the valve identification label on to the top screening plate so that it can be read from the front of the instrument, and so that it does not cover either the remaining four screws or the ventilation hole.

(iv) Apply a thin coat of shellac varnish over the label.

(v) Replace the receiver in its case.

Valve replacements

118. Certain valves, supplied as spares for this receiver, are too large in diameter to go into the screening cans as originally supplied. To overcome this difficulty the cans are now being manufactured without the longitudinal stiffening ribs. Where, however, it is found that the original cans remain, Units are to remove the ribs on all valve screening cans so that in the event of oversize valves being issued the cans may be ready to accommodate them. The method to be adopted is to remove the can from the receiver and, placing it on a round bar or pipe of suitable diameter, gently beat out the ribs from the outside. Should renewal of the valve V_4 be necessary, or should it be exchanged when pairing V_1 and V_2 (see para. 51) care must be taken that no valve having a metallised envelope is placed in the V_4 socket. The socket for the pin connected to the valve metallising is used to anchor a H.T. line, and the insertion of a metallised valve would short the H.T. supply via the earthed screen of the grid lead.

Removal of B.F.O. valve

119. Due to restricted space in early issues of the receiver, difficulty may be experienced in removing the B.F.O. valve V_7 without altering the adjustment of the B.F.O. tuning condenser C_{13}. Originally this condenser was a type 900 but this has been replaced in later models by a type 1525 and no difficulty will be experienced in removing, or inserting, the valve V_7 where this replacement has been made. The procedure to be followed when removing V_7 is as follows:—

(i) Remove the receiver from its outer case.

(ii) Remove the top cover of the oscillator unit, type 18, by withdrawing the six screws securing it. The valve V_7 and condenser, type 900, C_{13}, will now be exposed.

(iii) Using a suitable screwdriver, rotate the condenser, type 900, until the moving vanes are fully engaged with the fixed vanes. The valve can now be readily removed and replaced without fouling the condenser.

(iv) Replace the top cover of the oscillator unit and place the receiver in its outer case.

(v) Set up the B.F.O. as described in para. 93.

Prevention of frequency drift

120. Cases have occurred of excessive frequency drift in the beat frequency oscillator. This has been traced to (i) the overheating of the fixed silver-mica condensers in the B.F.O. compartment, causing alteration of capacitance and (ii) the presence of sulphur from the sorbo pad used to prevent the valve V_7 from touching the lid. The modification consists of drilling a ventilation hole in the B.F.O. compartment lid together with renewal, if necessary, of the valve identification label. The procedure is as follows:—

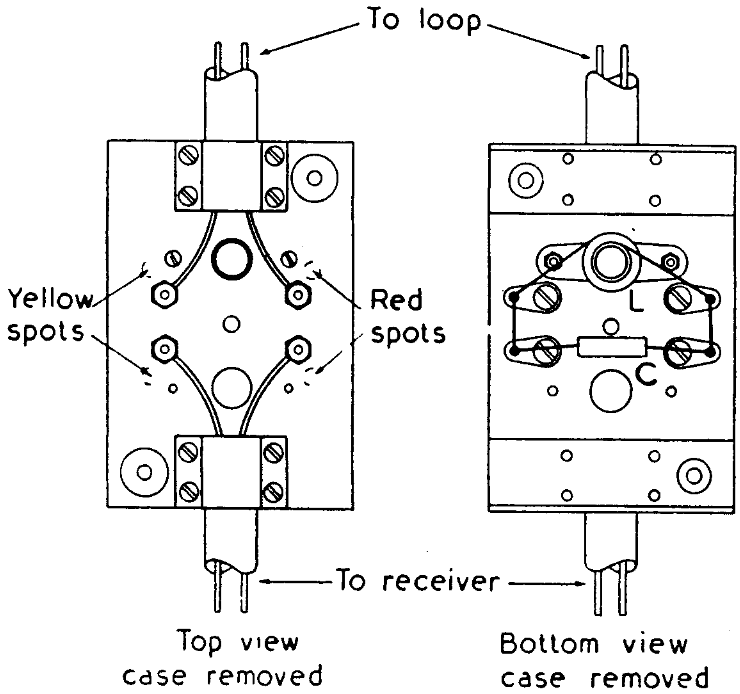
(i) Withdraw the receiver from its case.

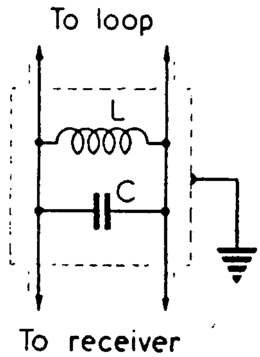
(ii) Remove the lid of the B.F.O. compartment situated immediately behind the front panel by withdrawing the six securing screws.

(iii) Remove the sorbo pad from the inside of the lid.

(iv) Cut a hole 1¼ in. dia. in the B.F.O. compartment lid, the centre of the hole being directly above the valve top cap, that is, approximately 1 in. from the long edge and 1⅞ in. from the short edge of the lid.

(v) Refit and secure the lid to the compartment.

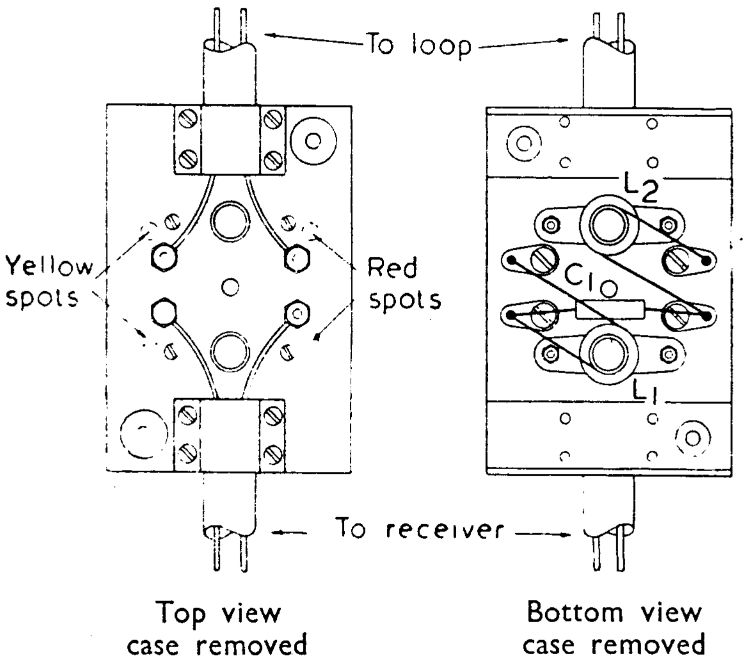


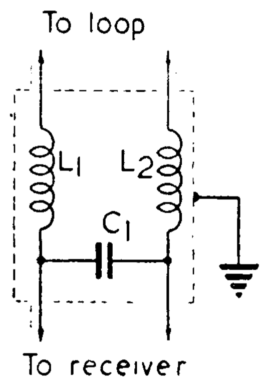


TYPE 12	
C	40 $\mu\mu$F
L	410 μH

TYPE 12

TYPES 13 & 15





TYPE 13	
C1	70 $\mu\mu$F
L1	20 μH
L2	20 μH
TYPE 15	
C1	70 $\mu\mu$F
L1	8·25 μH
L2	8·25 μH

Fig. 24.—The impedance matching units, types 12, 13, and 15

APPENDIX 1

ASSOCIATED EQUIPMENT

The impedance matching units, types 12, 13, and 15

1. The R.1155 is designed for use with the D.F. loop aerial, type 3, which has an inductance value of approximately 100μH and a self-capacitance of 20 $\mu\mu$F. Should the inductance placed across the loop terminals differ appreciably from this value, the input tuned circuit will not gang correctly with the other tuned circuits. As the receiver is required for use with loop aerials of widely differing values of inductance from the type 3, a matching unit is necessary with these loops. The impedance matching units, type 12 (Stores Ref. 10A/12148), type 13 (Stores Ref. 10A/12245) and type 15 (Stores Ref. 10A/12247) have been designed for application as indicated in para. 73. The matching unit consists of a small metal box containing a panel of bakelized linen carrying four terminals to which are connected the Duradio No. 20 screened cables from the loop and to the receiver. The matching coils and condensers are also mounted on this panel. The unit weighs about 12 oz.

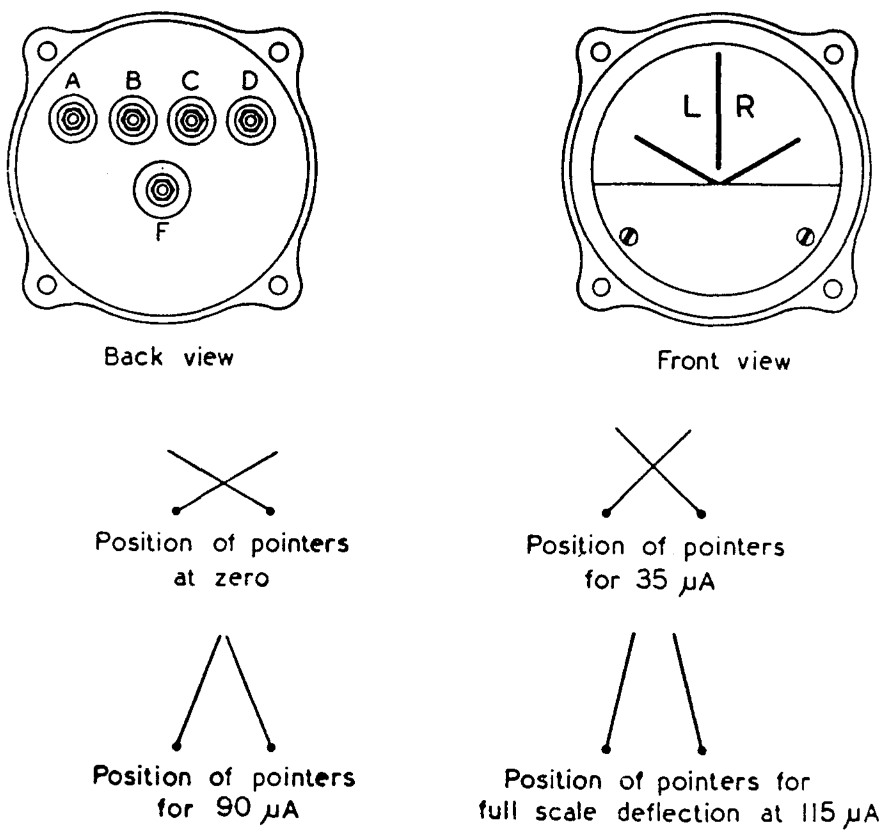


FIG. 25.—VISUAL INDICATOR, TYPE 1

2. The theoretical circuits and constructional details of the matching units are shown in fig. 24. The matching unit circuit depends upon whether it is required to reduce the inductance of the loop or to increase it. If a reduction in value is required a shunt unit (type 12) is used. This consists of one matching coil L with a condenser C both in shunt across the twin leads of the loop. If an increase in value is necessary the series units (types 13 and 15) are used. To preserve the symmetry of the loop two series coils L_1 and L_2, of equal inductance, are connected, one to each lead from the loop to the receiver. A condenser C_1 is connected in shunt across the receiver leads. The condenser brings the total capacitance of the circuit to the correct value.

3. The unit condenser C, type 12, has a capacitance of 40 $\mu\mu$F and the coil L consists of 150 turns of 38 d.s.c. wire on a former and is adjusted by a dust-iron screwed core to 410 μH. The unit condenser C_1, type 13, is 70 $\mu\mu$F and the coils L_1 and L_2 each consist of 29 turns of 30/48 litz wire adjusted to 20μH. The corresponding values for components of the unit, type 15, are 70 $\mu\mu$F and 8·25 μH. The four terminals are colour-coded by indicator spots of red and yellow and it is essential that due regard should be paid to these when fixing the cable ends.

The visual indicator, type 1

4. The visual indicator, type 1 (Stores Ref. 10Q/2) consists essentially of two D.C. milliammeter movements mounted side by side. The windings, which are connected in series, each have a resistance of 500 ohms. The current sources applied to opposite ends of the conjoint winding produce deflection of a heavily damped indicator needle in opposite sense. The intersection of the indicator needles follows a straight line between zero and 90 microamps current. Approximately 2·4 microamps are required to produce one degree scale deflection. The visual indicator is shown in fig. 25.

5. The visual indicator is contained in a circular metal screening case of, approximately, 3¼ in. diameter. The depth of the casing may vary in different models but the overall maximum depth is 3⅜ in. The instrument weighs 1 lb. 7 oz. Its general appearance is shown in the drawings of fig. 25 and a theoretical circuit forms part of fig. 13.

6. The indicator is fixed in position through four fixing lugs of 0·187 in. dia. and a space of 4·12 in. dia. by 4 in. deep should be allowed behind the panel for an anti-vibrational mounting. Five terminals, nominated A, B, C, D, and F, are mounted on the rear of the indicator. The terminal F is a binding post for securing the cable. The connections of terminals A, B, C, and D differ according to the number of indicators installed. The normal connections are shown in the installation diagram of fig. 21.

7. The mounting, type 119 (Stores Ref. 10A/12954) has been introduced for use with the visual indicator. The lampholder, type 61 (Stores Ref. 10A/13078), lamp, filament, 12 volts, jack type, G.P.O. No. 3 (Stores Ref. 5L/1150) or lamp, filament, 24 volts, jack type, G.P.O. No. 3 (Stores Ref. 5L/1898) are also used when required. The equipment required and the installation procedure are detailed in para. 78 and is the subject of leaflet A.P.1186/E85.

APPENDIX 2

LIST OF PRINCIPAL COMPONENTS

The following list of parts is issued for information only. When ordering spares A.P.1086 must be consulted.

CONDENSERS

Circuit Ref.	Capacity	Type	Stores Ref. No.	Remarks
$C_1 + C_{92} + C_{94}$	2·5 μF + 2·5 μF + 1·0 μF	892	10C/960	
$C_2 + C_{39}$	(0·1 μF + 0·1 μF) + 0·1 μF	1,662	10C/3399	
$C_3 + C_4 + C_5$	2·5 μF + 1·0 μF + 2·5 μF	894	10C/962	
C_6	100 μμF	895	10C/963	
C_7	0·005 μF	2,900	10C/5352	
C_8, C_9	0·001 μF	2,195	10C/4250	
C_{10}	0·004 μF	3,376	10C/11140	
C_{11}	100 μμF	895	10C/963	
C_{12}	0·1 μF	899	10C/967	
C_{13}	5 to 60 μμF var.	1,525	10C/3129	Pre-set
C_{14}	1,600 μμF	901	10C/969	2 of 800 μμF in parallel
C_{15}	4,550 μμF	917	10C/2005	
C_{16}	0·5 μF	902	10C/970	
C_{17}	100 μμF	918	10C/2006	
C_{18}	0·005 μF	2,900	10C/5352	
C_{19}	0·001 μF	4,356	10C/13364	
C_{20} to C_{24}	0·005 μF	2,900	10C/5352	
C_{25}	0·001 μF	4,356	10C/13364	
$C_{26} + C_{27} + C_{28}$	0·1 μF + 0·1 μF + 0·1 μF	1,662	10C/3399	
$C_{29} + C_{30} + C_{31}$	0·1 μF + 0·1 μF + 0·1 μF	1,662	10C/3399	
$C_{32} + C_{33} + C_{36}$	0·1 μF + 0·1 μF + 0·1 μF	1,662	10C/3399	
C_{34}	0·1 μF	899	10C/967	
C_{35}	200 μμF	904	10C/972	
C_{36}	—	—	—	See C_{32}
C_{37}, C_{38}	0·1 μF	899	10C/967	
C_{39}	—	—	—	See C_2
C_{40}	0·1 μF	899	10C/967	
$C_{41} + C_{49} + C_{50}$	0·1 μF 0·1 μF + 0·1 μF	1,662	10C/3399	
C_{42}, C_{43}	25 μμF	919	10C/2007	
C_{44}, C_{45}	240 μμF	920	10C/2008	
C_{46}, C_{47}	80 μμF	921	10C/2009	
C_{48}	200 μμF	3,556	10C/11658	
C_{49}, C_{50}	—	—	—	See C_{41}
$C_{51} + C_{52} + C_{53}$	0·1 μF + 0·1 μF + 0·1 μF	1,662	10C/3399	
C_{54}	0·05 μF	3,361	10C/11125	
C_{55}	0·5 μF	902	10C/970	
C_{56}	8–105 μμF var.	1,665	10C/3402	
C_{57} to C_{61}	5 × 4 to 40 μμF var	—	10C/3173	Condenser unit, type 34
C_{62} to C_{66}	5 × 4 to μμ40 var.	—	10C/3173	Condenser unit, type 34
C_{67}	0·002 μF	923	10C/2011	
C_{68} to C_{70}	3 × 4 to 40 μμF var.	—	10C/3174	Condenser unit, type 35
C_{71}, C_{72}	5 to 60 μμF var.	908	10C/976	
C_{73}	93 μμF	2,205	10C/4260	
C_{74}	255 μμF	925	10C/2013	
C_{75}	537 μμF	926	10C/2014	
C_{76}	1,670 μμF	927	10C/2015	
C_{77}	6,170 μμF	928	10C/2016	
C_{78}	20 μμF	429	10C/10948	
C_{79}	15 μμF	910	10C/978	
C_{80}	25 μμF	1,439	10C/3027	
C_{81}	15 μμF	910	10C/978	
$C_{82} + C_{83} + C_{84}$	—	4,597	10C/13984	Variable 3-gang, with scale to suit R.1155L and N only
		or 1,440	10C/3028	Other versions

CONDENSERS—*Contd.*

Circuit Ref.	Capacity	Type	Stores Ref. No.	Remarks
C_{85} to C_{88}	300 μμF	929	10C/2017	
C_{89}	600 μμF	903	10C/971	
C_{90}	300 μμF	929	10C/2017	
C_{91}	40 μμF	4,688	10C/14211	
C_{92}	—	—	—	See C_1
C_{93}	4 μF	911	10C/979	
C_{94}	—	—	—	See C_1
C_{95}	0·5 μF	902	10C/970	
C_{96}	0·02 μF	3,360	10C/11124	
C_{97}, C_{98}	2·2 μμF or 2 μμF	4,939 or 913	10C/14719 10C/2001	
C_{99}	100 μμF	918	10C/2006	
C_{100}	200 μμF	3,556	10C/11658	
C_{101}	4 μμF or 3·9 μμF	914 or 4,955	10C/2002 10C/14757	
C_{102}	0·001 μF	4,356	10C/13364	
C_{103}	0·005 μF	2,900	10C/5352	
C_{104}	75 μμF var.	900	10C/968	In plug, type 209
C_{105}	0·1 μF	3,362	10C/11126	
C_{106}	65 μμF	1,265	10C/2649	In plug, type 209
C_{107}	0·1 μF	3,381	10C/11157	
C_{108}	200 μμF	904	10C/972	
C_{109}	100 μμF	2,685 or 611	10C/4995 10C/96	Preferred
C_{110}	40 μμF	4,688	10C/14211	
C_{111}	8 μμF	1,729	10C/3503	
C_{112}	30 μμF	2,612	10C/4922	
C_{113}, C_{114}	160 μμF	2,613	10C/4923	
C_{115}	300 μμF	1,474	10C/3064	
C_{116}	1,320 μμF	925	10C/2013	R.1155L and N

RESISTORS

Circuit Ref.	Resistance in ohms	Type	Stores Ref. No.	Remarks
R_1	2,000	1,001	10W/1001	4,700 ohms in some receivers
R_2, R_3	1,200	1,002	10W/1002	
R_4	120	1,003	10W/1003	
R_5	1,000	500	10W/11667	
R_6	1,500	592	10W/124	
R_7	270	860	10W/860	
$R_{8(1)}$ $R_{8(2)}$	50,000 500,000	1,000	10W/1000	Dual potentiometer
R_9	2,000,000	1,004	10W/1004	
R_{10}, R_{11}	150,000	478	10W/11382	
R_{12}	27,000	1,005	10W/1005	
R_{13}	1,000,000	480	10W/11384	
R_{14}	1,000	500	10W/11667	
R_{15}	30,000	1,007	10W/1007	
R_{16}	27,000	1,006	10W/1006	
R_{17}	1,500	1,082	10W/1082	
R_{18}	10,000	906	10W/777	
R_{19}, R_{20}	56,000	1,008	10W/1008	
R_{21}	470,000	989	10W/989	
R_{22}	1,000	500	10W/11667	
R_{23}	20,000	998	10W/998	Variable 6,000 to 20,000 ohms or may be resistance unit 10W/12616 (14,000 ohms variable plus 6,000 ohms in series) in some receivers
R_{24}, R_{25}	22,000	1,010	10W/1010	
R_{26}	100,000	993	10W/993	
R_{27}	27,000	1,006	10W/1006	
R_{28}	22,000	1,010	10W/1010	
R_{29}	100,000	993	10W/993	
R_{30}	2,200	875	10W/691	
R_{31}	27,000	1,006	10W/1006	

RESISTORS—*Contd.*

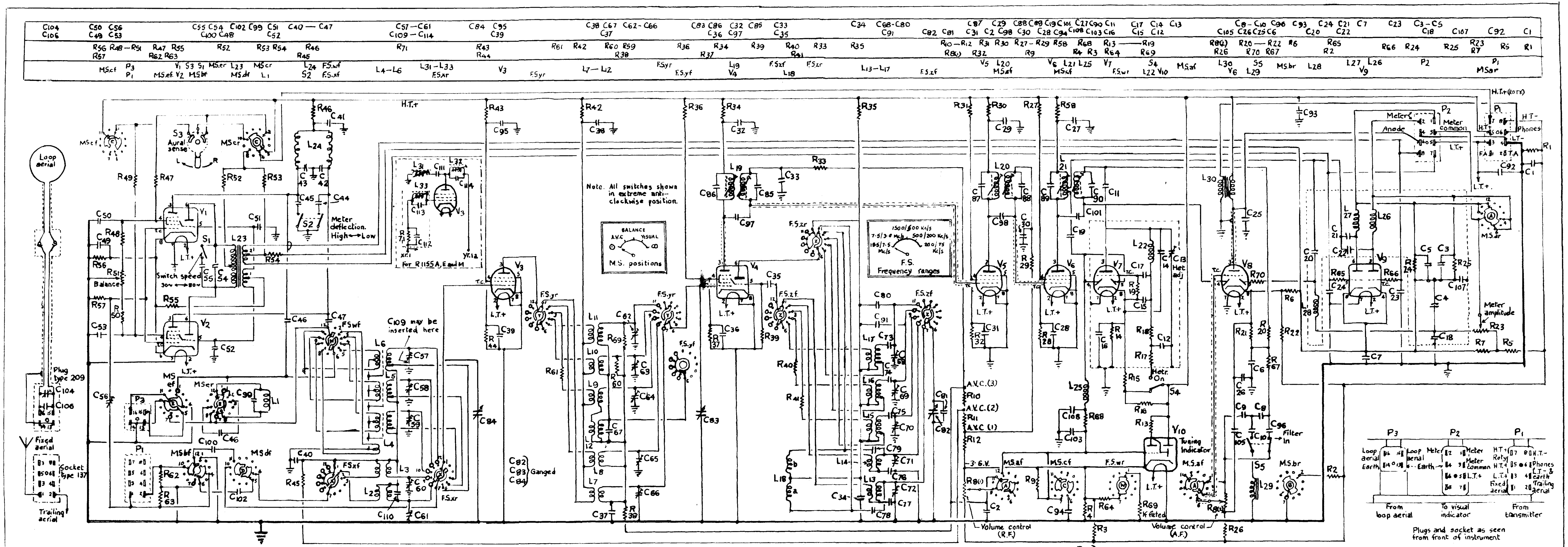
Circuit Ref.	Resistance in ohms	Type	Stores Ref. No.	Remarks
R_{32}	22,000	1,010	10W/1010	
R_{33}	100,000	993	10W/993	
R_{34}	2,200	875	10W/691	
R_{35}	22,000	1,278	10W/1278	
R_{36}	27,000	1,006	10W/1006	
R_{37}	22,000	1,010	10W/1010	
R_{38}	100,000	993	10W/993	
R_{39}	56,000	1,008	10W/1008	
R_{40}, R_{41}	1,500	1,082	10W/1082	
R_{42}	2,200	875	10W/691	
R_{43}	27,000	1,006	10W/1006	
R_{44}	22,000	1,010	10W/1010	
R_{45}	100,000	993	10W/993	
R_{46}	1,500	1,082	10W/1082	
R_{47}	27,000	1,006	10W/1006	
R_{48}	3,300	1,464	10W/1464	6,800 ohms in some receivers
R_{49}	27,000	1,006	10W/1006	
R_{50}	3,300	1,464	10W/1464	6,800 ohms in some receivers
R_{51}	20,000	999	10W/999	Variable
R_{52}	6,800	991	10W/991	
R_{53}	560,000	992	10W/992	
R_{54}, R_{55}	56,000	1,008	10W/1008	
R_{56}	240	995	10W/995	
R_{57}	560,000	992	10W/992	
R_{58}	2,200	875	10W/691	
R_{59}, R_{60}	220,000	855	10W/648	
R_{61}	1,200	6,492	10W/6492	
R_{62}, R_{63}	2,200	996	10W/996	
R_{64}	200 or 100	1,634 918	10W/1634 10W/2006	R_{64} is 100 ohms when R_{69} is fitted
R_{65}, R_{66}	10,000	505	10W/11671	
R_{67}	22,000	1,010	10W/1010	
R_{68}	56,000	1,008	10W/1008	Not always fitted
R_{69}	100	918	10W/2006	
R_{70}	1,000	500	10W/11667	
R_{71}	150,000	7,373	10W/7373	
R_{72}	68	8,076	10W/8076	
R_{73}	470	2,760	10W/9507	R.1155L and N
R_{74}	150	1,931	10W/1931	R.1155L and N

OTHER COMPONENTS

Circuit Ref.	Nomenclature	Stores Ref. No.	Remarks
	COILS, CHOKES, etc.		
L_1	Coil, Dummy Loop	10D/1644	
L_2	Coil, Aerial, Range 1	10D/1643	
L_3	Coil, Aerial, Range 2	10D/955	
L_4	Coil, D.F., Range 3	10D/161	
L_5	Coil, D.F., Range 4	10D/162	
L_6	Coil, D.F., Range 5	10D/163	
L_7	Coil, Anode, Range 1	10D/1635	
L_8	Coil, Anode, Range 2	10D/1636	
L_9	Coil, Anode, Range 3	10D/1637	
L_{10}	Coil, Anode, Range 4	10D/1638	
L_{11}	Coil, Anode, Range 5	10D/953	
L_{12}	Coil, Filter, I.F.	10D/957	
L_{13}	Coil, Oscillator, Range 1	10D/958	
L_{14}	Coil, Oscillator, Range 2	10D/1639	
L_{15}	Coil, Oscillator, Range 3	10D/1640	
L_{16}	Coil, Oscillator, Range 4	10D/1641	
L_{17}	Coil, Oscillator, Range 5	10D/1642	

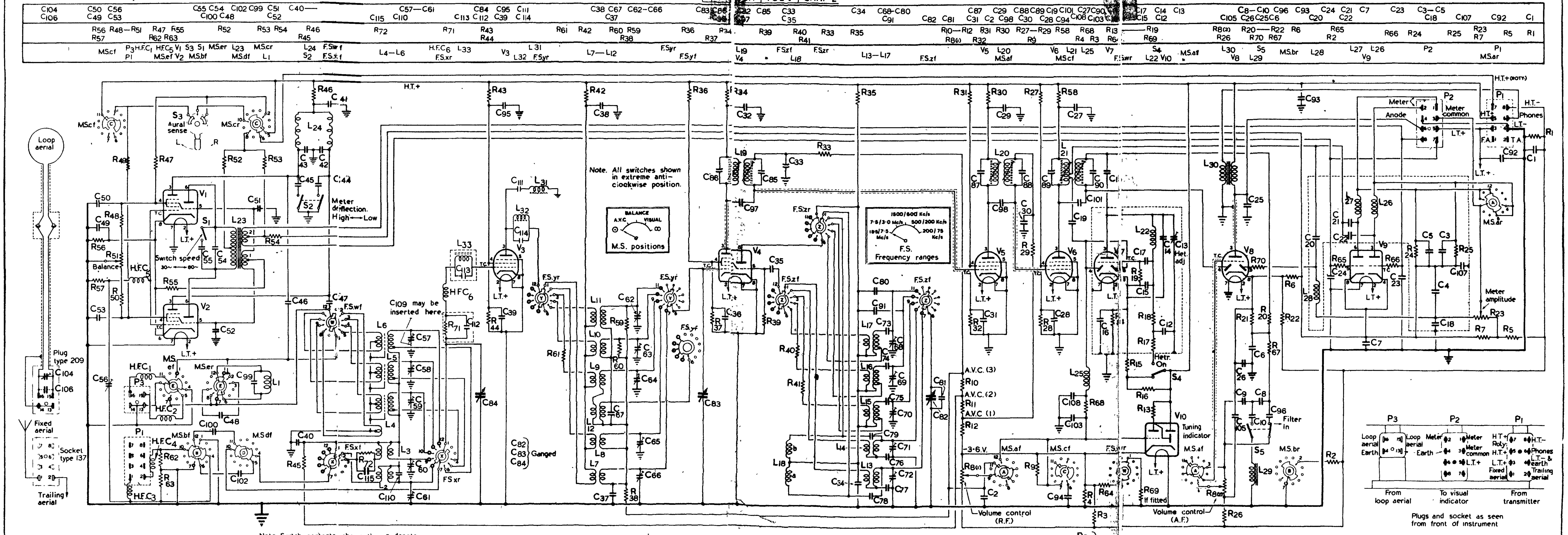
OTHER COMPONENTS—*Contd.*

Circuit Ref.	Nomenclature	Stores Ref. No.	Remarks
L_{18}	Coil, Oscillator Choke, Ranges 1 and 2	10D/1645	
L_{19}	Transformer, Type 130	10K/12136	1st I.F.
L_{20}	Transformer, Type 366	10K/251	2nd I.F.
L_{21}	Transformer, Type 131	10K/12137	3rd I.F.
L_{22}	Inductance, Type 507	10C/5920	
L_{23}	Transformer, Type 132	10K/12138	
L_{24}	Choke, H.F., Type 71	10C/583	
L_{25}	Choke, H.F., Type 94	10C/2186	
L_{26}	Choke, H.F., Type 83	10C/2019	
L_{27}	Choke, H.F., Type 83	10C/2019	
L_{28}	Choke, H.F., Type 83	10C/2019	
L_{29}	Choke, A.F.	—	
L_{30}	Transformer, Type 133	10K/12139	
L_{31}	Filter Unit, Type 46	10P/13007	Unit includes C_{111}
L_{32}	Inductance, Type 394	10C/4839	Part of Filter Unit, Type 45
L_{33}	Inductance, Type 393	10C/4838	Part of Filter Unit, Type 71
L_{40}	Coil, Aerial, Range 2A	10D/2031	R.1155L and N
L_{41}	Coil, Anode, Range 2A	10D/2032	R.1155L and N
L_{42}	Coil, Oscillator, Range 2A	10D/2033	R.1155L and N
	FILTER UNITS		
HFC_1, HFC_2	Filter Unit, Type 66	10P/13046	
HFC_3, HFC_4	Filter Unit, Type 65	10P/13045	
HFC_5	Filter Unit, Type 67	10P/13047	
HFC_6	Filter Unit, Type 67	10P/13047	
L_{32}, C_{114}	Filter Unit, Type 45	10P/13006	Anode rejector
L_{31}, C_{111}	Filter Unit, Type 46	10P/13007	Anode acceptor
L_{33}, C_{113}	Filter Unit, Type 76	10P/13058	Grid rejector
	SWITCHES		
FS wf, FS wr	Switch, Type 370	10F/156	Aerial wafer
FS xf, FS xr	Switch, Type 371	10F/157	Loop aerial
FS yf, FS yr	Switch, Type 369	10F/155	Anode wafer
FS zf, FS zr	Switch, Type 368	10F/154	Oscillator wafer
M.S.	Switch, Type 234	10F/158	Master switch
S_1, S_4, S_5	Switch, Type 152	10F/10338	
S_2	Switch, Type 235	10F/159	Meter deflection
S_3	Switch, Type 239	10F/163	Aural sense



Note. Switch contacts shown thus O, denote front (f) a rear (r) contacts connected.
Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

R.1155 AND R.1155D CIRCUIT DIAGRAM INCLUDING R.1155 A, R.1155 E, AND R.1155 M MODIFICATIONS



Note. Switch contacts shown thus o, denote front (f) & rear (r) contacts connected.
Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

R.1155B AND R.1155F CIRCUIT DIAGRAM

FIG. 3A

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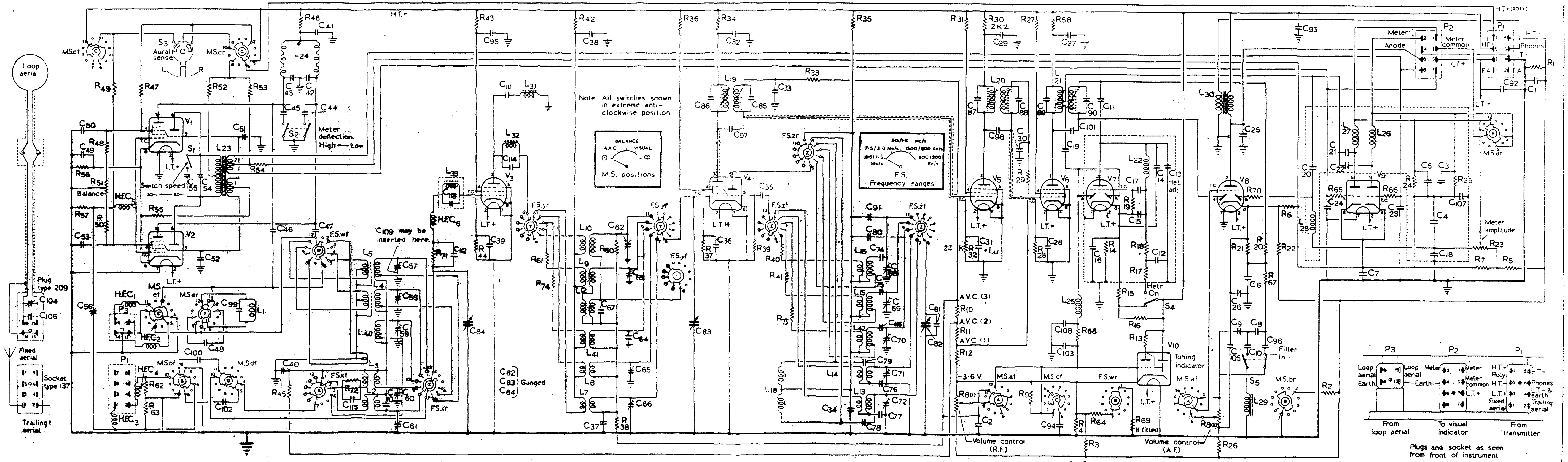
C104 C106 C50 C56 C49 C53 C55 C54 C102 C99 C51 C100 C48 C52 C40—C47 C115 C57—C61 C110 C112 C84 C113 C95 C39 C111 C114 C38 C67 C62—C66 C37 C83 C86 C36 C32 C97 C85 C33 C35 C34 C116 C68—C72 C74—C80 C91 C82 C81 C87 C31 C29 C2 C88 C98 C89 C19 C3C C101 C28 C27 C94 C90 C108 C11 C103 C16 C17 C15 C14 C12 C13 C105 C8—C10 C26 C25 C6 C96 C93 C20 C24 C22 C21 C7 C23 C3—C5 C18 C107 C92 C1

R56 R57 R48—R51 R62 R47 R63 R55 R52 R53 R54 R46 R45 R72 R71 R43 R44 R61 R74 R42 R60 R38 R36 R37 R34 R39 R40 R41 R33 R73 R35 R10—R12 R8(1) R31 R32 R30 R27—R29 R9 R58 R68 R4 R3 R13—R19 R64 R69 R8(2) R26 R20—R22 R70 R67 R6 R2 R65 R66 R24 R25 R23 R7 R5 R1

MS.cf P3 P1 HFC1—HFC5 MS.ef V1 V2 S3 MS.bf S1 MS.er L23 MS.df MS.cr L1 L24 S2 FS.wf FS.xf L4—L5 L40 HFC6 FS.xr L33 V3 L32 L31 FS.yr L7—L10 L41 L12 FS.yr FS.yf L19 V4 FS.zf L18 FS.zr L13—L16 L42 FS.zf V5 L20 MS.af V6 MS.cf L21 L25 V7 FS.wr S4 L22 V10 MS.af L30 V8 S5 L29 MS.br L28 L27 V9 L26 P2 P1 MS.ar



Note. Switch contacts shown thus ⊙, denote front (f) & rear (r) contacts connected.
Important. In order to avoid excessive crossing of connecting wires certain switch wafers have been duplicated.

R 1155 L AND R 1155 N CIRCUIT DIAGRAM

FIG. 4

FIG. 4

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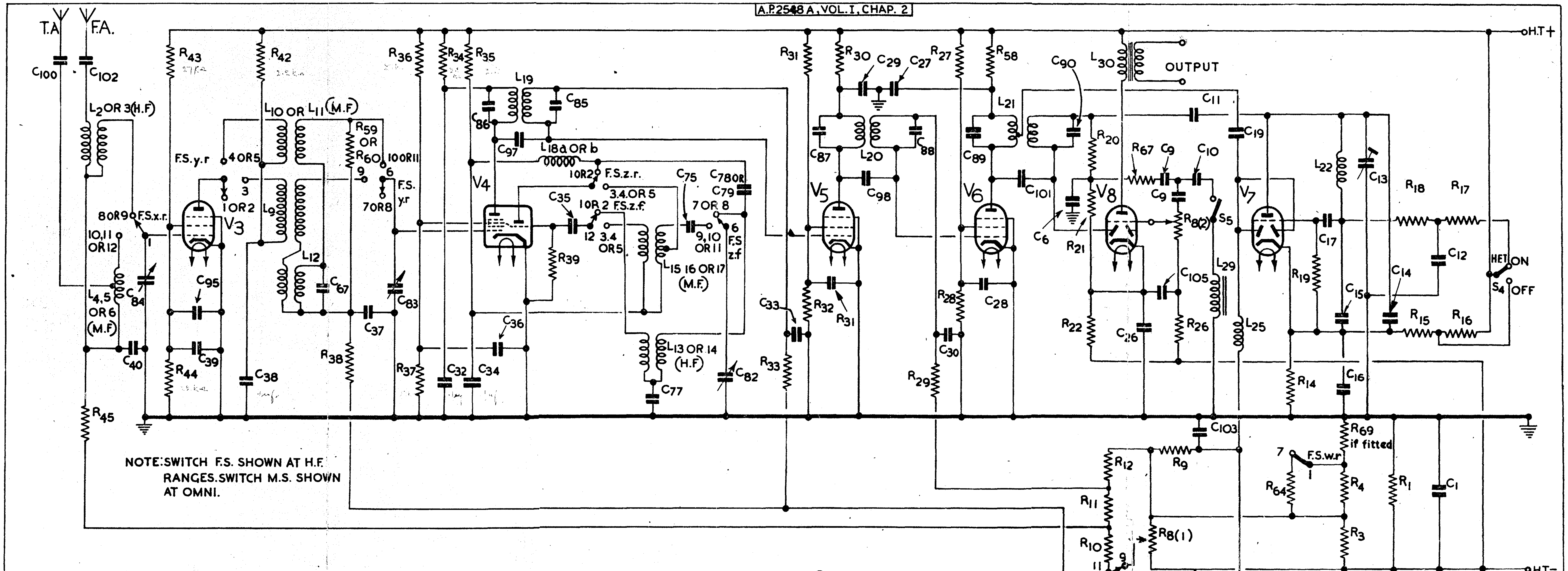

NOTE: SWITCH F.S. SHOWN AT H.F. RANGES. SWITCH M.S. SHOWN AT OMNI.

FIG. 5

R.1155 SIMPLIFIED COMMUNICATIONS CIRCUIT.

FIG. 5

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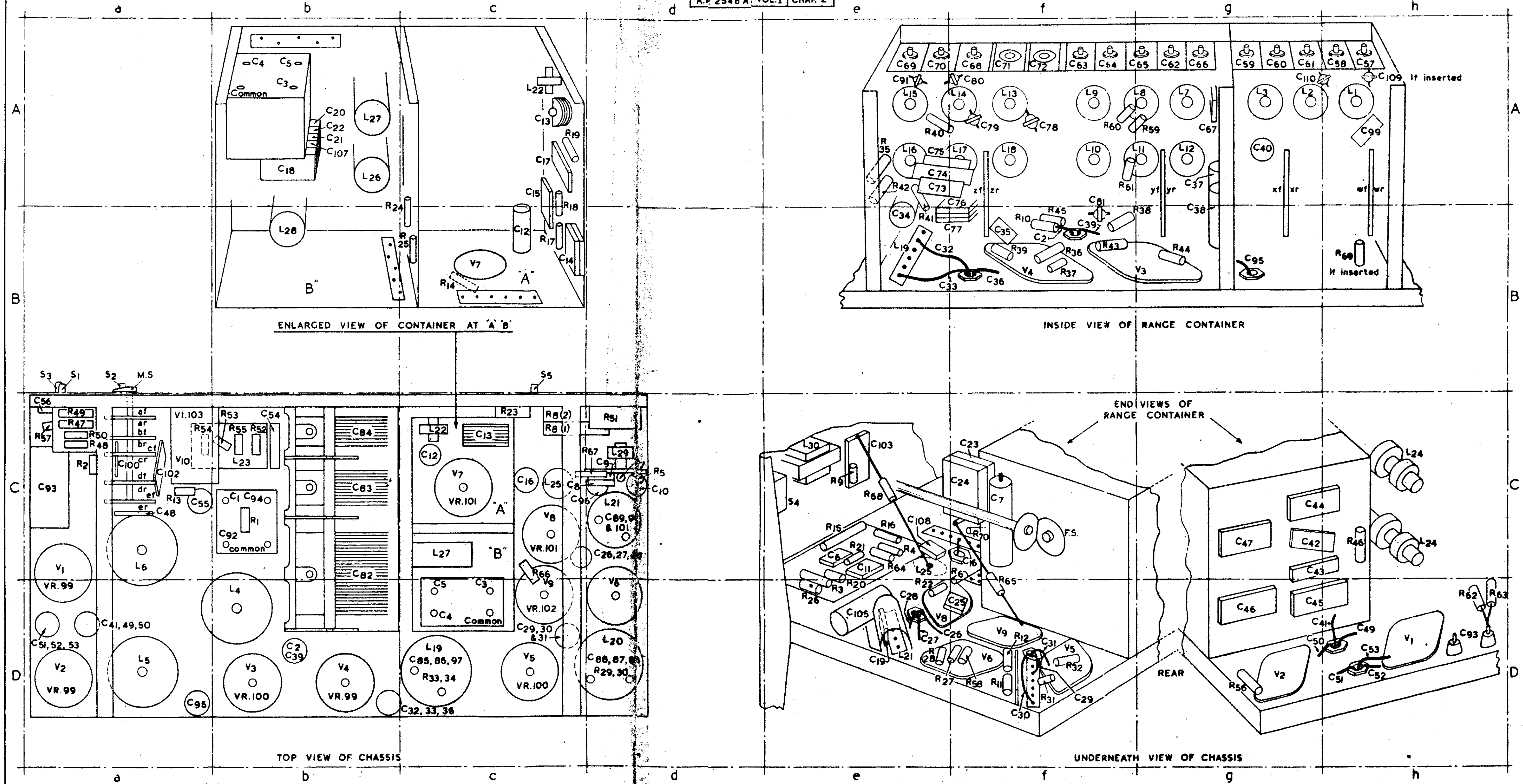

COMPONENTS LOCATION DIAGRAM

FIG. 17

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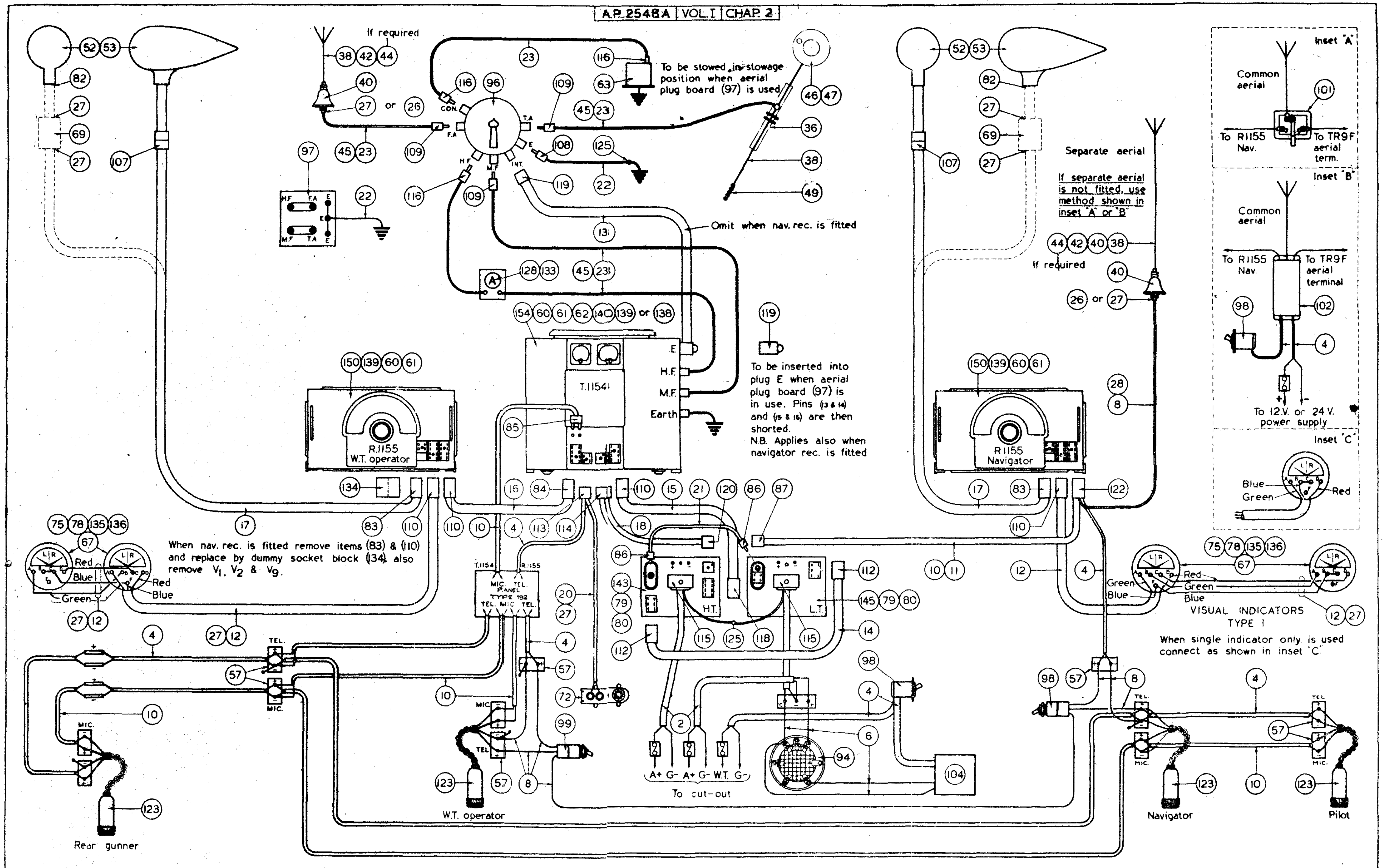

FIG. 21 TYPICAL INSTALLATION DIAGRAM FIG. 21

REPRINT PP5014 M42902/73M/C 12/47 1600 C & P Gp. 959

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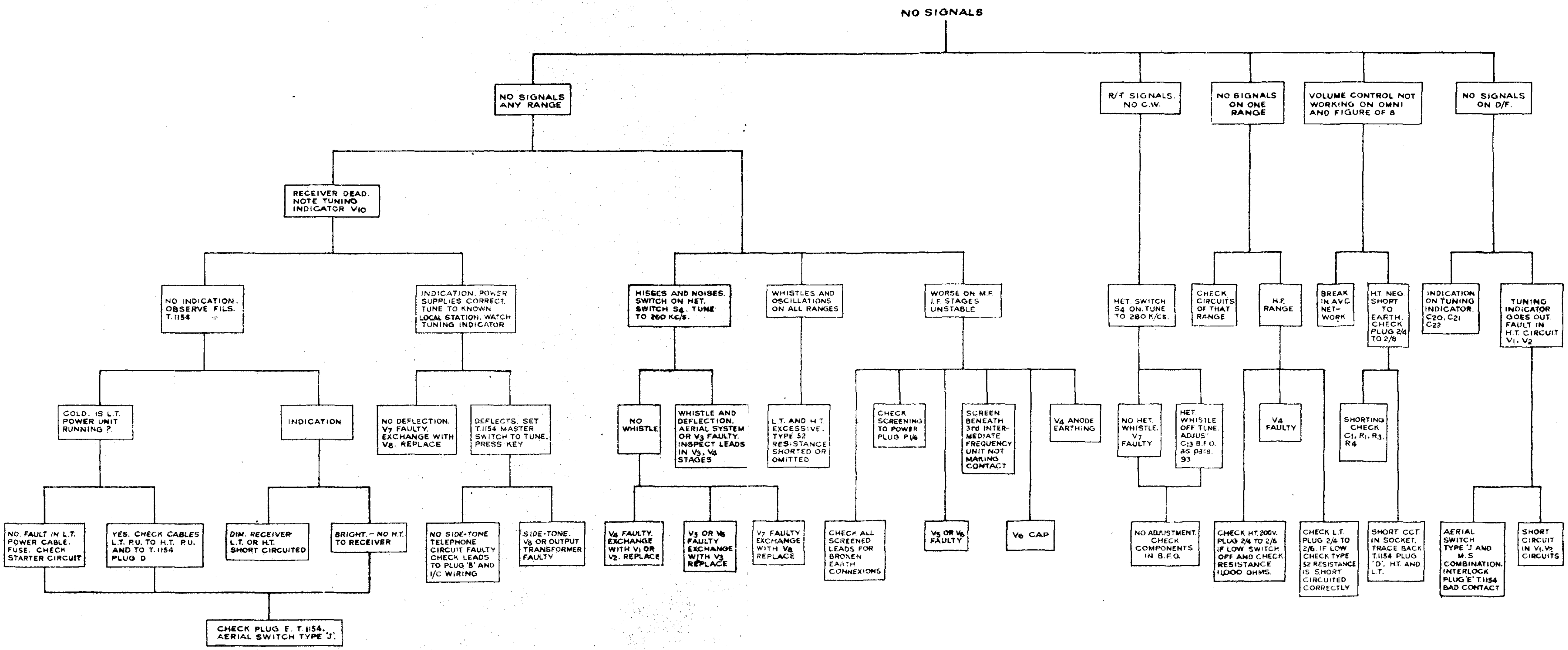

COMMUNICATION CIRCUITS — TROUBLE LOCATION CHART

FIG. 23

FIG. 23

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