A24
RECEIVER
TECHNICAL NOTES

MURPHY RADIO LTD.
WELWYN GARDEN CITY, HERTFORDSHIRE
TELEPHONE: WELWYN GARDEN 800

025/1/35.

THE CIRCUIT

The Murphy A24 may be described as a four valve set in so far as it contains four valve sockets—omitting the mains rectifying valve. However, owing to the use of high efficiency valves and to the fact that some of the valve envelopes contain multi-electrode systems, the A24 should be classified according to its performance rather than the apparent number of valves employed.
The accompanying schematic diagram (Fig. 2, page 9) shows the circuit.

In order to discriminate between two valve systems contained in the same envelope, distinguishing names will be given to them. Thus the two valves enclosed within the V1 envelope will be spoken of as V1Pen. and V1Triode respectively ; similarly the components of V3 will be referred to as V3 Triode and V3 Diodes. Examination of the circuit diagram shows the position of the special valves employed in this receiver : these are V1, and V3. V1 combines an R.F. pentode and triode oscillator, whilst V3 comprises a double diode rectifier and a triode L.F. amplifier. The remaining valves V2 and V4 are both high slope pentodes, the former being specially designed for R.F. amplification and the latter being an extremely sensitive output valve.

Refering again to the circuit diagram it is seen that the aerial is coupled to a band pass tuning arrangement (L3, L7, C1A, C1B, etc.) which incorporates an image frequency suppression circuit (Lo, Co). From the secondary of the aerial band pass tuning circuit signals are passed on to the grid of V1 Pen., where they are rectified and mixed with the local oscillations generated by V1 Triode, thus producing an I.F. signal at 117 k.c. This signal is fed through the I.F. transformer L15, L16 to the I.F. amplifier V2 and thence through the I.F. transformer L17, L18 to the detector V3 diode (A1).

At this point the signal encounters the amplified A.V.C. system and as this is fairly complicated a brief description will be given here. The central idea behind this system being to arrange the circuits in such a manner that the D.C. voltage produced by the rectification of the I.F. carrier acts as a bias to V3 triode, thus altering its anode current and hence producing a bias voltage which supplies the A.V.C. voltage to V1 Pen. and V2. In order to apply the above scheme several special features have to be included, as follows. An additional smoothing arrangement for the H.T. supply to V3, i.e., R14, R15, C24, C25. Also a potentiometer device R10, R11, R12, C22, arranged so that the maximum A.C. signal voltage applied to the grid of V3 triode is only about one-third of the D.C. voltage produced by the rectification of the carrier. The reason for the latter arrangement is to prevent overloading of the V3 triode when biassed to the bottom part of its curve.

In the anode circuit of V3 triode is a heterodyne filter L19, L20, C29, C26, C27, and C28 and this gives a very sharp audio cut off. It will be noticed that the volume control potentiometer R19 is fitted to the L.F. part of the receiver and hence can be used to control gram., as well as radio. C33, R21 forms the tone control, R21 being adjustable.

The H.T. is supplied by a full wave rectifier U.12 ; a tuned filter circuit L14, C35 and the speaker field, with condensers C34, C36 and C37, providing the majority of the smoothing for the receiver. The only circuit not included in this arrangement is that supplying the cathode of V3 this is provided for by the resistance condenser combination R14, R15, C24 and C25 mentioned above.

The actual controls of the set are four in number :

(1) Upper central knob : Ganged tuning condenser.
(2) Left-hand knob : Volume control.
(3) Central knob : Tone control.
(4) Right-hand knob : On-off and wave-change switch.

There are one or two special points in this receiver which call for attention.

Item (1) The position of the following components should be noticed ; the image frequency suppressor condenser Co, the band pass coupling L5, L6 and I.F. trimming condensers C15, C16, C17 and C18. All these items are mounted underneath the chassis and may be seen in Figure 4.

Item (2) The action of the gramophone jack should also be noticed ; the feature here is the fact that when the plug is inserted into the jack the cathode circuit of the preceeding valve V2 is disconnected. This is done to prevent break-through of radio signals on gramophone reproduction.

Item (3) The potential of V3 cathode ; from the circuit diagram it is seen that (in the absence of signals) the cathode of V3 is considerably positive with with respect to chassis. Furthermore, it should be noticed that the actual potentials on V3 vary considerably with the strength of the H.F. signal. For further information reference should be made to the table of voltages and currents.

DISMANTLING

To remove the chassis from the Cabinet, first take off all control knobs. Then loosen the four screws at the corners of the wooden back (it is unnecessary to remove them altogether) and the back will come off.

Take out the Loudspeaker plugs from the sockets on the left, and also the field plugs from the socket strip on the mains transformer. Then with a quarter inch Whitworth box spanner remove the three hex-headed holding-down screws. This must be done working from below, with the set projecting over the edge of the bench.

The chassis will now slide out.

HETERODYNE FILTER

If a fault is suspected in the heterodyne filter it must be dismantled before its components can be checked ; the procedure is as follows. First unsolder the blue and white filter leads from their respective tags underneath the chassis, next undo the four screws that hold the filter case in position, then lift the filter case away, threading the leads through the grommet in the chassis. Finally, the filter can be removed from its case by first unscrewing the three fixing screws and then gently pulling the assembly outwards, releasing the leads meanwhile. The relative positions of the coils and condenser can then easily be seen by comparing the actual assembly and the circuit diagram.

Note that the number of the set is given on the name plate fixed to the cabinet back ; it is repeated on the chassis itself (see Fig. 3). If by any chance two sets are taken down at the same time make sure that each back and cabinet are kept together, so that when replacing the chassis they may be returned to their correct cabinets.

PRACTICAL LAYOUT

The practical layout of the A24 differs in several respects from the A4. The most noticeable difference being the new position of the wave-length indicator, this being mounted on the chassis instead of on the cabinet ; a second important innovation is the clip fastening of the pilot lamp which enables it to be easily removed for replacement. As before the Loudspeaker is not part of the chassis but is fixed to the Cabinet and the field and speech coil leads are flexible, with plug and socket connection to the chassis.

Fig. 2 is a plan of the chassis. It shows the components that are above the base, and also the fittings on the back edge. The sequence of the valves is similar to that obtaining in the circuit diagram. The actual valves used are :—

Left hand	V1	Mazda AC/TP (met).
Second	V2	„ AC/VP1 (met).
Third	V3	„ AC/HL/DD (met).
Right hand	V4	„ AC/2 Pen (clear).
Back right hand	V5	Marconi or Osram U12.

In order that the details of the wiring of the components enclosed within the coil cans may be clearly seen, diagramatic views of these assemblies are shown in Figures 5, 6, 7, 8 and 9 ; the views being obtained by looking at the coils from the top with the cans removed. In reading these diagrams care must be taken to see that the coloured tracers in the external connecting wires correspond exactly to the colours given in the illustrations. Otherwise confusion may arise owing to the diagram and the actual assembly being looked at from different angles.

A special illustration of the heterodyne filter is not shown as the wiring is quite straightforward and follows the circuit diagram closely. Detailed instructions for removing this filter for examination are given on page 3, in the section entitled " Dismantling."

On turning the chassis over, we get the " worm's eye " view shown in Fig. 3. Most of this is clear enough, but there are three component assemblies that call for special notice and we also give separate illustrations of these.

W.1421. This is a block of eight condensers and eight resistors. Fig. 1 shows how it is arranged looking at the side where the tags show. The numbers on the condensers and resistors show where they are in circuit, by referring to the schematic diagram (Fig. 2).

The arrow heads show where all the external connections go to, so that by the aid of the diagram one can change the assembly and put in a spare without error in re-wiring. (The common point of five of the condensers is earthed external to the case—see connection to tag E).

V.1529. This lies behind V1, the internal and external connections can be seen in Fig. 10.

V.1530. This lies between V4 and V5, the internal and external connections can be seen in Fig. 11.

VOLTAGES AND CURRENTS

The following table of voltages is given as a guide only—considerable variations may occur without seriously detracting from the efficiency of the receivers.

Owing to the particular circuit employed in the A24, the various voltages depend to some extent on the strength of the applied signal. For this reason the valve tests were all made with no signal being received, except V3. In the latter case readings were taken with and without a strong signal, in order to give an idea of the change of voltage to be expected under working conditions.

Except where otherwise stated voltages are to chassis ; they are those obtained with a " 1000 ohm per volt " meter, having a maximum D.C. range of 250 volts.

Mains transformer H.T. secondary, i.e., grid or anode socket of rectifier to negative side of C34 : 350V(A.C.).

C34 + tag :	240V.	
C37 + tag :	225V.	
V4 anode :	210V	25mA.
V4 screen : 225V 6mA.		
V3 Triode anode—No signal :	130V	2.4mA.
Strong Signal :	185V	1.4mA.
V3 Cathode, No signal.	30V	
Strong Signal. (Polarity reverses)	−12V	

V3 Diode anodes D.A.1 and D.A.2. No signal : zero volts.

Strong signal : O — **12V** approx, depending on strength of signal and resistance of voltmeter.

V3 Grid, No reading on voltmeter owing to high resistances in circuit (R9, R10, etc.).

N.B. If a valve adaptor is used L16 must be shorted inside the coil can, to prevent V2 oscillating, before the following readings are taken.

V2 Anode :	224V	9mA.
V2 Screen :	225V	3mA.
V2 Grid : No reading on voltmeter owing to high resistance in circuit (R8)		
V1 Pentode Anode :	195V	3.5mA.
V1 Pen. suppressor grid :	190V	1.3mA.
V1 Triode anode :	40-70V	1.5mA.

TRIMMING

A modulated oscillator is highly desirable for trimming the A24 receiver : if this is not available only the radio frequency circuits can be adjusted and sets with faulty I.F. trimming must be returned to the Factory.

APPARATUS REQUIRED

(1) An insulated screwdriver. The blade should be either covered with sleeving or wrapped with insulating tape for about an inch from the tip, leaving only 1/16th-inch of the tip of the blade exposed.

(2) 0-1.5v. or 0-50v. A.C. voltmeter. Alternatively a 0-5 milliammeter.

If an 0-1.5 voltmeter is used it must be connected directly across the speech coil of the Loud Speaker : if, however, an 0-50 voltmeter is used this must be connected in series with a 1.0 mfd condenser and the two together then connected across T1 primary. Alternatively they may be connected between V4 anode and chassis. The 0-5 milliammeter should be connected in the anode circuit of V3, i.e., in place of the lead between the H tag on the W.1421 assembly and C.37.

GENERAL INSTRUCTIONS FOR TRIMMING

(*a*) Cut out the A.V.C. by short circuiting R.16—tags B & D on the W.1421 condenser bank assembly (Fig. 1).

(*b*) Set the manual volume control at its maximum position, this ensures that, provided the receiver is worked at a normal volume level, overloading will not take place in the H.F. stages.

(*c*) Make all trimming adjustments with the greatest possible care, bearing in mind that the operation is essentially critical and that faulty trimming will completely spoil the performance of a receiver.

TRIMMING BY MEANS OF A BROADCAST SIGNAL

(1) Tune in a fairly strong station between 200-220m: identify it definitely and look up its wavelength in the *World Radio*. Compare with the reading on the set. If it is correct, go on at once to (2) below. If not correct, adjust the tuning control to exactly the right wave length of the station, and then trim on C6 till you get the biggest meter reading :

(2) Trim C2 to increase the reading if possible.

(3) Do not touch the main tuning control. Trim C4 to best output ; go back to C2 and see if it needs further adjustment, then continue checking C2 and C4 alternatively until no improvement is obtained.

(4) Switch to long waves. Tune in Oslo or the nearest station to 1,100m. available. Check its wave-length in *World Radio* against the setting, if correct go on to (5). If not set the tuning to the right wave-length, and trim on C7 to maximum meter reading.

(5) Leave the tuning control set, and do as in (2) and (3) but working on C3 and C5 instead of C2 and C4.

TRIMMING BY MEANS OF A MODULATED OSCILLATOR

(1) Tune the oscillator to 220m. and switch to internal modulation. Connect the output of the oscillator to the aerial and earth of the receiver (*via* the dummy aerial if this is provided). Now tune the set to receive this 220m. signal at maximum strength and adjust the oscillator output to give about half scale deflection on the meter. Check the reading on the set, if it is exactly 220m. go on at once to (2) below. If it is not correct adjust the receiver dial to 220m. and then trim C6 for maximum meter reading.

(2) Trim C2 to increase the reading, if possible.

(3) Do not touch the main tuning control. Trim C4 to best output : go back to C2 and see if it needs further adjustment, then continue checking C2 and C4 alternatively until no improvement is obtained.

(4) Switch to long waves. Tune the oscillator to 1,100m. and tune the set to receive this signal at maximum strength, again adjusting the oscillator output to give a reasonable deflection on the meter. Check the reading on the set, if it is exactly 1100m. go on at once to (5) below. If it is not correct adjust the receiver dial to 1100m. and trim C7 for maximum output.

(5) Leave the tuning control set and adjust as in (3) and (4) but working on C3 and C5 instead of C2 and C4.

I.F. TRIMMING

When I.F. trimming is necessary it should be carried out before the R.F. trimming, as, however, the latter is somewhat simpler it will probably be done first whenever the general symptoms indicate faulty trimming. However, if R.F. trimming does not clear the trouble and I.F. trimming has to be resorted to, then, when this is complete the R.F. circuits must be re-trimmed.

First switch the receiver to medium waves and short circuit L9 or L11 to prevent V1 oscillating. Then tune the oscillator to 117K.C. and feed its output (via the dummy aerial) to the input circuit of V2. That is, connect the A & E terminals on the oscillator to the grid of V2 and chassis, respectively. The output control is set to give a small deflection on the indicator and trimmers C18, C17 are adjusted (in turn) until a maximum reading is obtained. This is followed by the adjustment of C16 and C15, the oscillator output in this case being transferred to the grid of V1 Pen and chassis. When all four circuits have been trimmed for resonance the adjustment is complete and the R.F. circuits can be proceeded with.

ADJUSTING THE IMAGE FREQUENCY SUPPRESSOR

This operation differs from normal R.F. and I.F. trimming in two important particulars, in the first place the maximum possible output is required from the oscillator and in the second place the adjustment is for minimum and not maximum speaker response. The latter condition necessitates the use of the ear as an indicator, as in this special case an aural test is far more sensitive than the use of a meter. The actual adjustment is fairly simple, the oscillator is tuned to 333m. and the receiver to 450m. ; these being the conditions under which the set will receive a weak " image " signal from the oscillator. Hence, when this image signal is heard, it is necessary to adjust carefully the erinoid screw (situated on top of the band pass secondary coil) until the absolute minimum signal is heard in the speaker. Under these conditions the image frequency suppression system will be correctly adjusted.

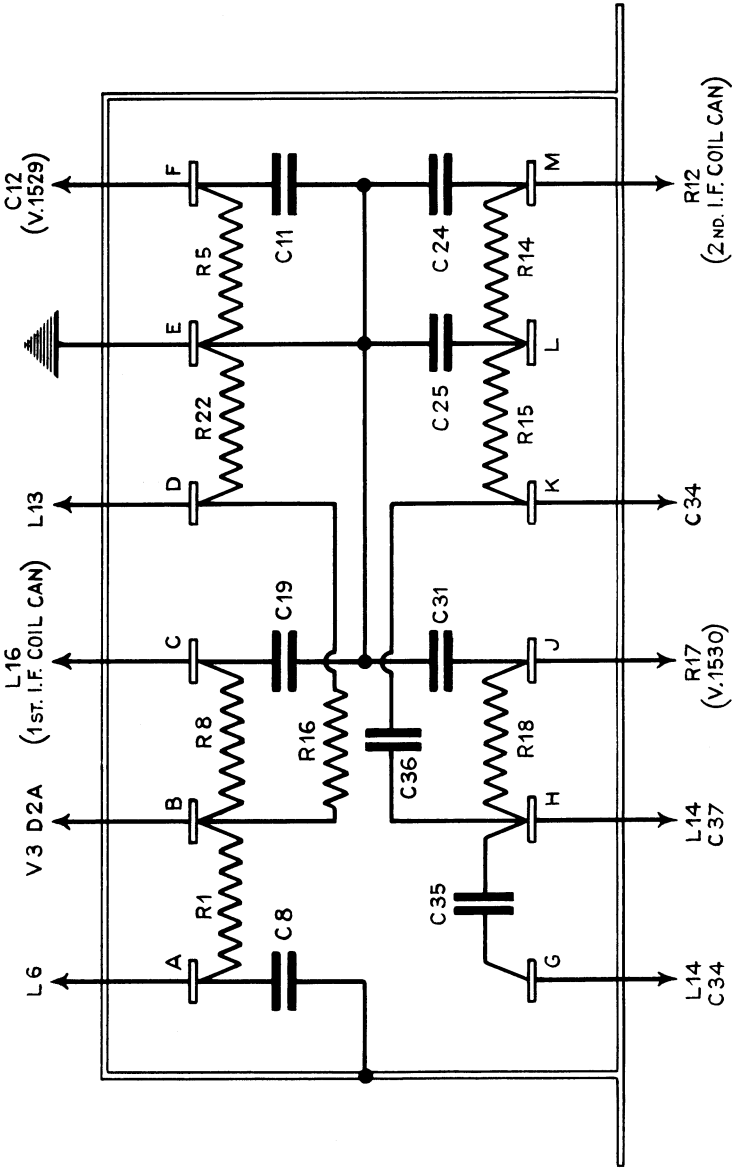
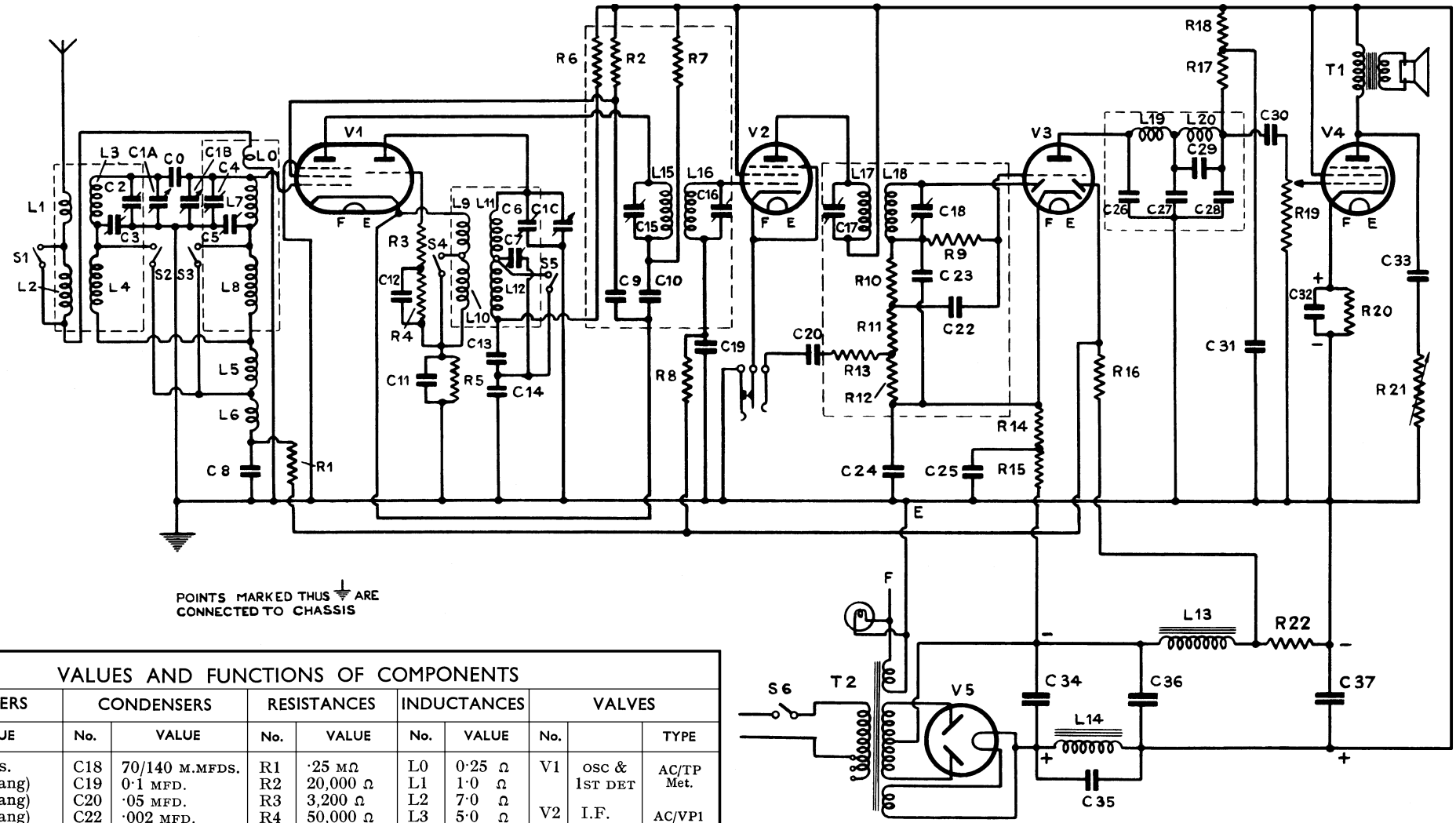


FIG. 1. W. 142I. CONDENSER AND RESISTANCE ASSEMBLY

A 24—2

FIG 2.



VALUES AND FUNCTIONS OF COMPONENTS

CONDENSERS

No.	VALUE
C0	2 M.MFDS.
C1A	·0005 (gang)
C1B	·0005 (gang)
C1C	·0005 (gang)
C2	5/70 M.MFDS.
C3	5/70 M.MFDS.
C4	5/70 M.MFDS.
C5	5/70 M.MFDS.
C6	5/70 M.MFDS.
C7	5/70 M.MFDS.
C8	0·1 MFD.
C9	·001373 MFD.
C10	·002 MFD.
C11	0·1 MFD.
C12	·0003 MFD.
C13	·001373 MFD.
C14	·002 MFD.
C15	70/140 M.MFDS.
C16	70/140 M.MFDS.
C17	70/140 M.MFDS.

CONDENSERS

No.	VALUE
C18	70/140 M.MFDS.
C19	0·1 MFD.
C20	·05 MFD.
C22	·002 MFD.
C23	·00005 MFD.
C24	1·0 MFD.
C25	1·0 MFD.
C26	·002 MFD.
C27	·003 MFD.
C28	·001 MFD.
C29	·001373 MFD.
C30	0·1 MFD.
C31	3·0 MFD.
C32	50 MFD.
C33	·025 MFD.
C34	4·0 MFD.
C35	0·13 MFD.
C36	1·0 MFD.
C37	8·0 MFD.

RESISTANCES

No.	VALUE
R1	·25 MΩ
R2	20,000 Ω
R3	3,200 Ω
R4	50,000 Ω
R5	700 Ω
R6	100,000 Ω
R7	7,500 Ω
R8	·25 MΩ
R9	2 MΩ
R10	1 MΩ
R11	·5 MΩ
R12	99,000 Ω
R13	99,000 Ω
R14	30,000 Ω
R15	33,000 Ω
R16	·25 MΩ
R17	30,000 Ω
R18	7,000 Ω
R19	50,000 Ω
R20	150 Ω
R21	50,000 Ω
R22	55Ω

INDUCTANCES

No.	VALUE
L0	0·25 Ω
L1	1·0 Ω
L2	7·0 Ω
L3	5·0 Ω
L4	12 Ω
L5	2·75 Ω
L6	0·75 Ω
L7	5·0 Ω
L8	12 Ω
L9	1 Ω
L10	2·5 Ω
L11	4·0 Ω
L12	8·5 Ω
L13	2400 Ω
L14	315 Ω
L15	40 Ω
L16	40 Ω
L17	40 Ω
L18	40 Ω
L19	450 Ω
L20	370 Ω

VALVES

No.		TYPE
V1	OSC & 1ST DET	AC/TP Met.
V2	I.F.	AC/VP1 Met.
V3	2nd DET	AC/HLDD Met.
V4	Output	AC/2PEN
V5	Mains Rect.	Marconi U12

SWITCHES

No.	FUNCTION
S1	CLOSE FOR S.W.
S2	CLOSE FOR S.W.
S3	CLOSE FOR S.W.
S4	CLOSE FOR S.W.
S5	CLOSE FOR S.W.
S6	CLOSE FOR ON.

RESISTANCE OF TRANSFORMER WINDINGS ETC.

T1	PRIMARY 650 Ω SECONDARY 0·25 Ω		SPEECH COIL 2 Ω	
T2	WINDING	50~ 200v.	50~ 100v.	25~ 200v.
	PRIMARY	200-214v. 24 Ω 215-232v. 26 Ω 233-250v. 29 Ω	100-109v. 5.5 Ω 110-120v. 6.0 Ω	200-214v. 36 Ω 215-232v. 39 Ω 233-250v. 43 Ω
	RECT. HEATER	0.6 Ω	0.6 Ω	0.9 Ω
	F.E.	0.6, 0.6 Ω	0.6, 0.6 Ω	0.9, 0.9 Ω
	H.T. SEC. F. 1	255 Ω	255 Ω	398 Ω
	H.T. SEC. F. 2	255 Ω	255 Ω	398 Ω

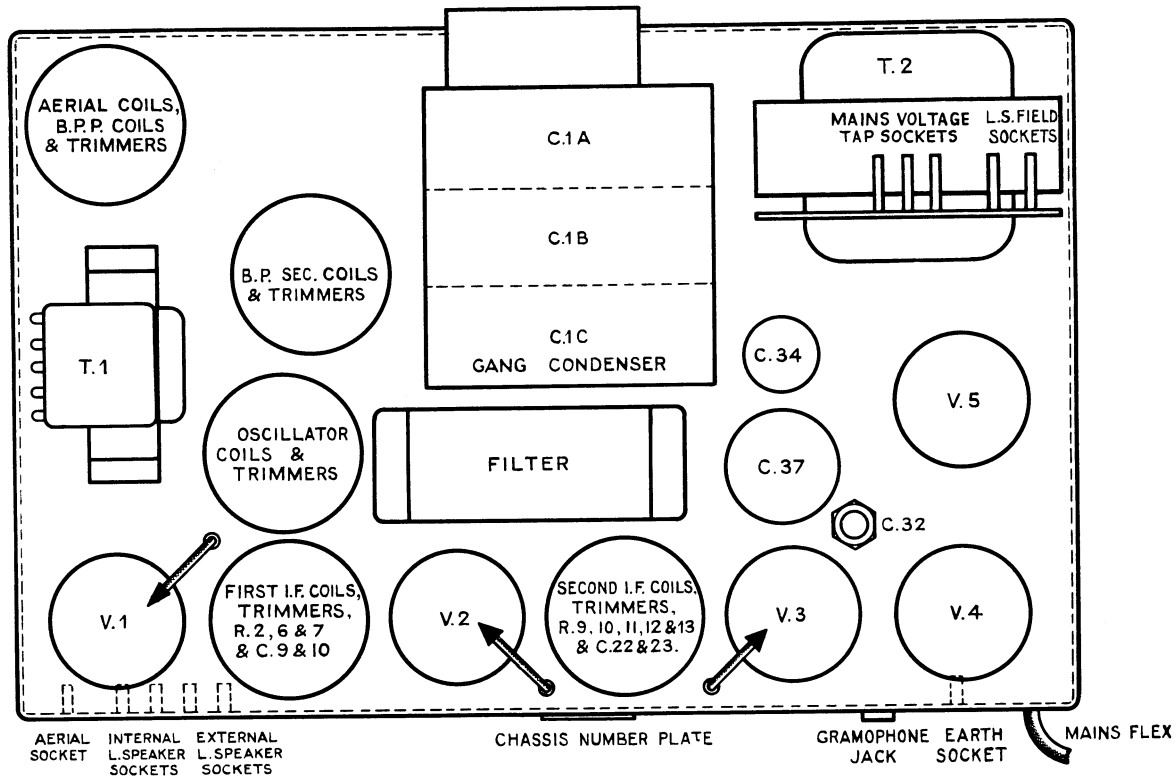


FIG. 3.

PLAN OF CHASSIS

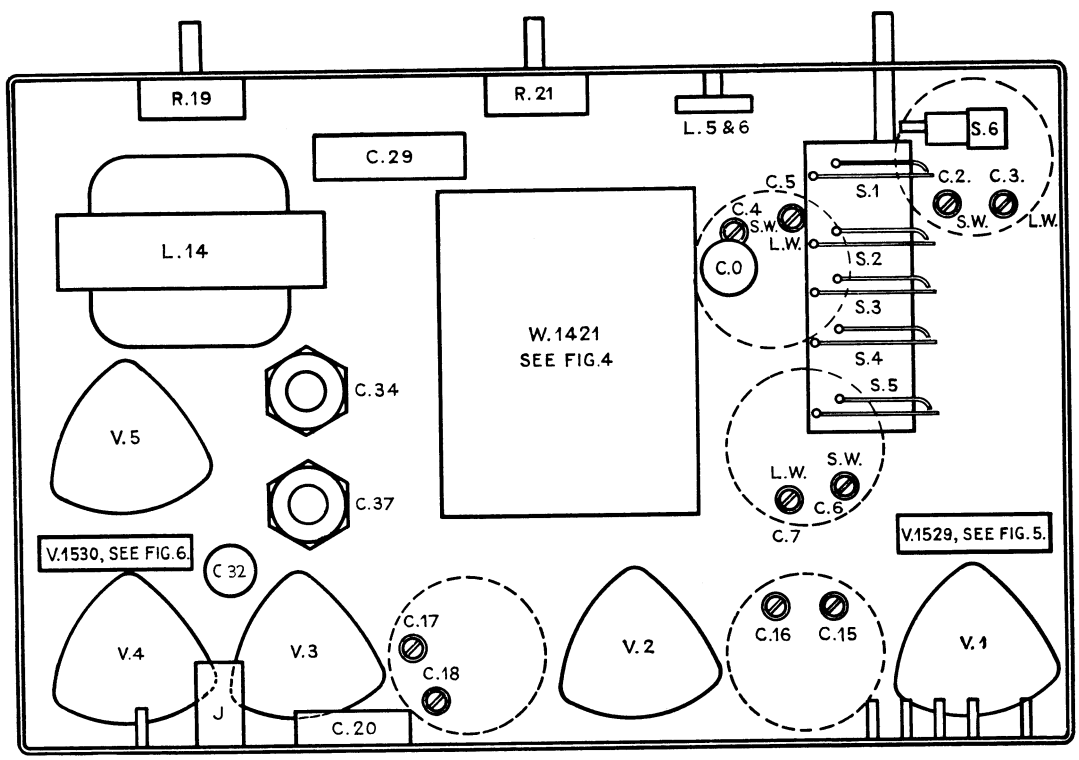
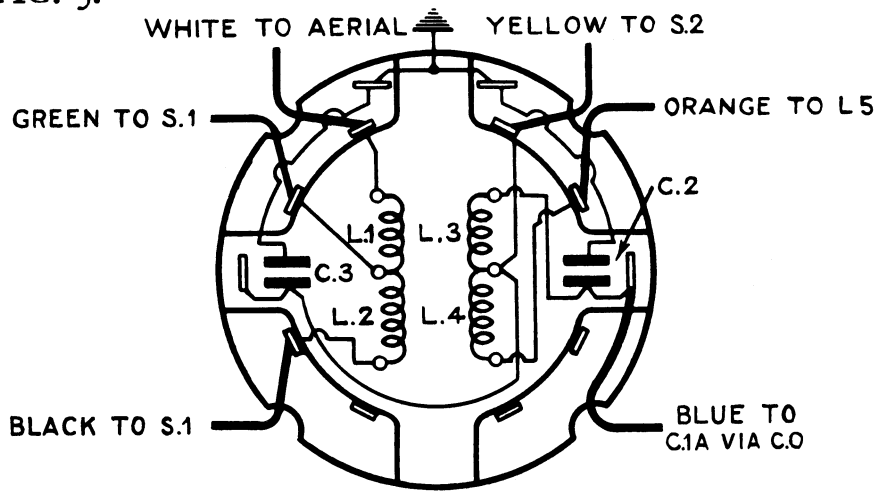


FIG. 4.

UNDERSIDE OF CHASSIS

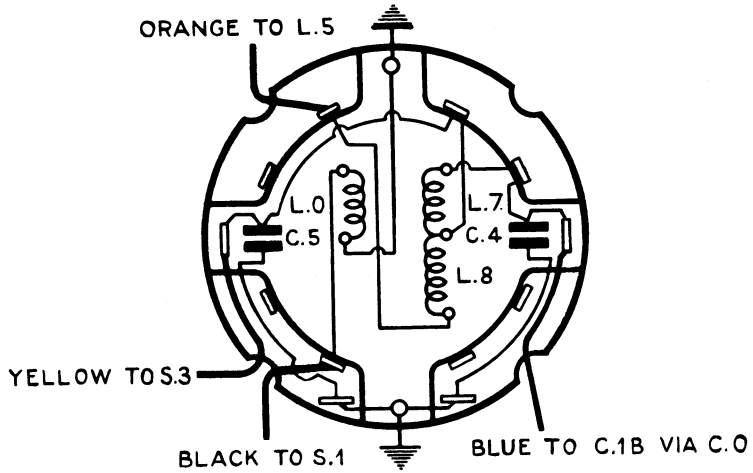
AERIAL COIL

FIG. 5.



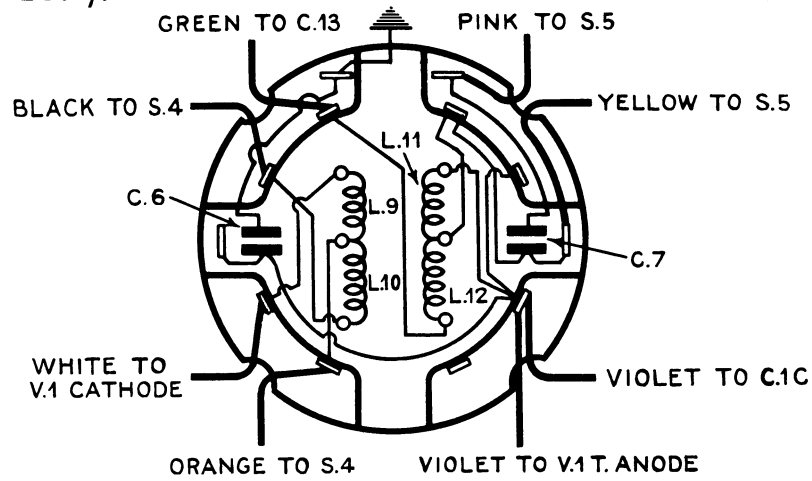
GRID COIL

FIG. 6.



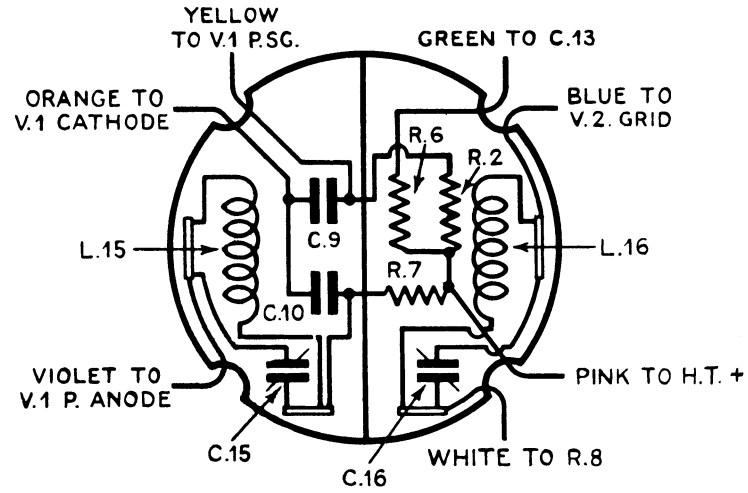
OSCILLATOR COIL

FIG. 7.



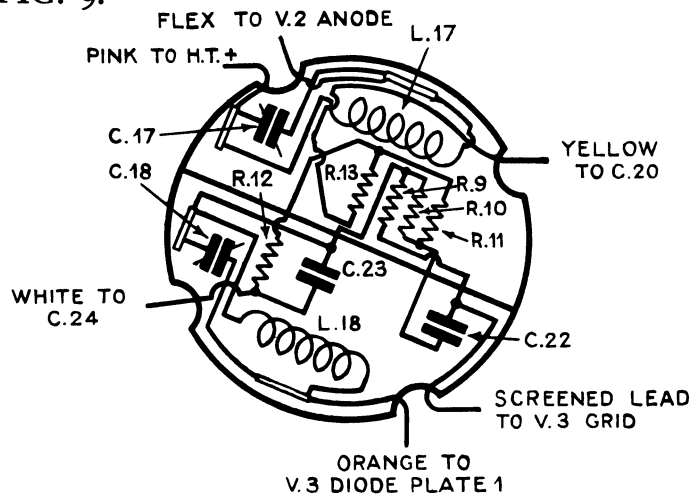
FIRST I.F. COILS

FIG. 8.



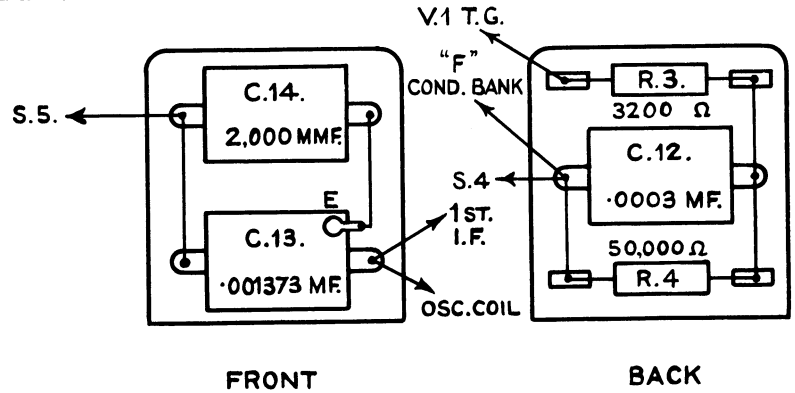
SECOND I.F. COILS

FIG. 9.



V1529 ASSEMBLY

FIG. 10.



V1530 ASSEMBLY

FIG. 11.