D4
RECEIVER

TECHNICAL NOTES

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Preface

THE reception by Dealers of the preliminary A4 "Technical Notes" has encouraged us to provide similar aid for Dealers who are handling the D4.

We are taking this opportunity of reiterating our previous warning to make absolutely certain of a tight fit and **perfect** electrical contact between the mains socket and the connecting plug of the D4, or any Direct Current receiver.

Chief Engineer.

THE CIRCUIT

The Murphy D4 is a 4-valve D.C. Mains set working on the supersonic heterodyne principle. The accompanying schematic diagram (fig. 1 page 8) shows the circuit.

The first valve, V1, is a combined oscillator and first detector. It is a pentode ; oscillations are set up between the " screen " or auxiliary grid and the anode (by the coils L9, L11, etc., and condenser C1C). The incoming signals are tuned by the band-pass filter L3, L7 and condensers C1A and C1B, and go to the control grid of V1. This amplifies them, and in the anode circuit they are mixed with the local oscillations and rectified, the result being an I.F. signal at 117k/c.

The coils L13 and L14 are tuned to this frequency and form the first I.F. transformer : V2 is a multi-mu valve acting as I.F. amplifier. Its output is passed on by the second I.F. transformer L15, L16 to the second detector V3 : both I.F. transformers are really band-pass filters.

You will see that gramophone working is possible by using the jack provided. On inserting the plug, V3 becomes an amplifier with about 3V bias ; when used as second detector it is biassed to 7V, and becomes an anode bend rectifier. The pick-up is completely isolated from earth and chassis and is therefore quite safe to handle.

V3 is resistance coupled by R8 to the power valve V4. R9 is a decoupling resistance, R10 the grid leak of V4, and R11 and R12, with C25, form an H.F. filter to reduce in value the radio or I.F. voltage in the output.

V4 is the power valve—a pentode—and C27 and R13 form a tone-correcting circuit. R13 is made variable, and acts as tone control.

The actual controls of the set are thus 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 about the diagram which call for attention.

First, the condenser C7, between grid and anode of V1. It was found that although the local oscillation is set up between anode and screen of V1 a little of the energy got through to the grid and so back to the aerial, causing radiation. To avoid this C7, which is really a neutralising condenser, is introduced. C7 is not an ordinary condenser at all : but the two leads concerned are held together for an inch or so. You will see this between the assemblies V.958 and W.953 below the chassis.

Second, R7, the volume control. This is the usual grid bias control for a multi-mu valve ; but to make sure that it is powerful enough for very strong stations, the far end of the variable resistor is taken back to the aerial terminal, so when the volume control is turned to minimum, we not only put large bias on V2, but we also put a low resistance across the aerial coils, and so cut down the input.

Third, C21 and C26. These are just R.F. bypass condensers to keep R.F. out of the output circuit.

Fourth, supply circuits. The heater circuits of the valves are connected in series with the loudspeaker field and the voltage dropping resistance. The latter being suitably adjusted for any particular mains voltage.

Examination of the circuit diagram shows that the smoothing choke is included in the negative mains lead ; since there is a voltage drop across this choke, the end farthest from the negative main must be at a positive potential, and this end is connected to the chassis. Hence, if the cathode of any particular valve is also connected to chassis, it will be connected to the positive end of the grid bias voltage source. The grid return lead of the valve can now be given a negative bias by tapping off at any point along the smoothing choke. In the actual receiver a tapped resistance is included for the purpose of providing bias and condensers C19, C20 and C24 are used for decoupling and smoothing the bias voltage.

THE PILOT LIGHT

The pilot lamp is connected in series with the mains lead and carries the total set current. Hence if the lamp fails the receiver circuit is broken and the set cannot be used until a new lamp is provided. For this reason **it is particularly important to ensure that good electrical contact is made between the mains plug and socket;** otherwise large voltage fluctuations will be developed which will not only cause crackles, but may burn out the lamp.

It will be noticed that the brightness of the pilot light varies slightly with the position of the volume control. Also, the pilot light may be seen to flicker if the tuning condenser is swung through a strong carrier, or if severe local interference is taking place.

In order to understand the cause of these effects the following points must be considered. In the first place, since the pilot lamp is in series with the D.C. supply. Any variation taking place in either the heater or the H.T. current will also vary the pilot lamp current, and hence affect its brightness. Now variation of the volume control alters the current taken by V2, and very strong intermittent signals cause a surge of anode current, so that in each case the receiver current is varied and the pilot lamp is affected.

Due to the above effect, local interference produces the same symptoms—(crackles and pilot light flickering) as a faulty electrical contact. Hence, if these symptoms occur, it is necessary to make a further test before the cause of the trouble can be found. The simplest check is to remove the aerial and earth connections ; if the disturbance stops then outside interference was obviously the cause. If it continues however, the trouble may be due to a loose pilot lamp or a bad contact in the mains plug.

PRACTICAL LAYOUT

Now as to the practical layout of the set. It differs from the A3 and A8 in one important respect. The loud-speaker is not part of the chassis, but is fixed to the cabinet. The field and speech coil leads are flexible, with plug and socket connections 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. Note carefully the peculiar order of the valves, to avoid mistakes in fitting new ones. The actual valves used are :—

Left hand	V4	DC2/PEN.
Second	V1	DC2/PEN.
Third	V2	DC2/SGVM
Right hand	V3	DC3/HL

On turning the chassis over, we get the " worms-eye " view shown in Fig. 3. Most of this is clear enough ; but there are four component assemblies that call for special notice, and we also give separate illustrations of them.

W.953. This is a block of ten condensers and ten resistors. Fig. 4 shows how it is arranged, looking at the left side where the tags show. The numbers on the condensers and resistors show where they are in the circuit, by referring to the schematic (Fig. 1).

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

V.958. This lies between V1 and V4. Its connections are shown in Fig. 6.

V.957. This lies behind V3 and is shown in detail in Fig. 5.

W.872. This is found behind the second I.F. coils and is illustrated in Fig. 7.

Returning to Fig. 3, note the position of C7, which as already explained, is formed by running two leads together for an inch or so. The trimmers C2, C4, C8 for medium waves and C3, C5 and C9 for long waves are also shown.

The I.F. trimmers C13, C14, C17, C18 are on the back edge of the chassis, *and are on no account to be touched*, as they can only be set by special methods in the factory.

VOLTAGES AND CURRENTS

There are several important points in connection with the voltage and current values on the D4 Receiver. It has already been mentioned that the valve heaters and pilot lamp are in series and it should be added that the heater current is rather critical and must be exactly 0.1 amps. (within $\pm 2\frac{1}{2}\%$). This is allowed for automatically when the correct mains socket is selected. On the other hand, it will be seen from the circuit diagram that the H.T. voltage is not controlled by the mains regulating resistance, but simply depends on the D.C. supply voltage.

The following table of voltages is given as a guide only—variations up to about 20% may occur without seriously detracting from the efficiency of the receiver. The voltages given are those obtained with a " 1000 ohms-per-volt " meter having a range of 0-250 volts ; however if a meter with a rather smaller resistance is employed, it is possible to obtain similar readings **provided that it is used on a much higher range.** For example if an Avometer, having a resistance of " 200 ohms-per-volt," is used it must be set on the 0-1200 volt range for all readings.

The appended readings were taken on 240 volt D.C. mains, and if the receiver is used with a different input voltage a correction should be applied to everything except the heater voltages and current. For example, if used on 200 volt mains the input voltage is about 17% low and hence all readings must be reduced in about the same proportion.

Except where otherwise stated voltages are to chassis:—

Mains voltage. 240 V.
Total heater voltage, across *a b* 115 V.
Across C.30 : 215 V.
V4 Anode : 190V. 36 mA.
V4 Screen : 215V. 6 mA.
V3 Anode : (Gram. Plug not in, no signals) 162V. 0.2 mA.
V2 Anode : (Vol. control at max.) 215V. 6.5 mA.
V2 Screen : (Vol. control at max.) 70 to 85V. 2 to 3 mA
V2 Grid : -0.5 to - 40 V., as vol. control varies.
V1 Anode : 60V. 3 mA.
V1 Screen : 44V.

Consumption from supply mains 37 watts, this varies slightly with the mains voltage.

IMPORTANT.

The D.C. valves employed require different heater voltages and if any mistake is made in the particular valves inserted in the chassis, **all four valves are liable to be damaged.**

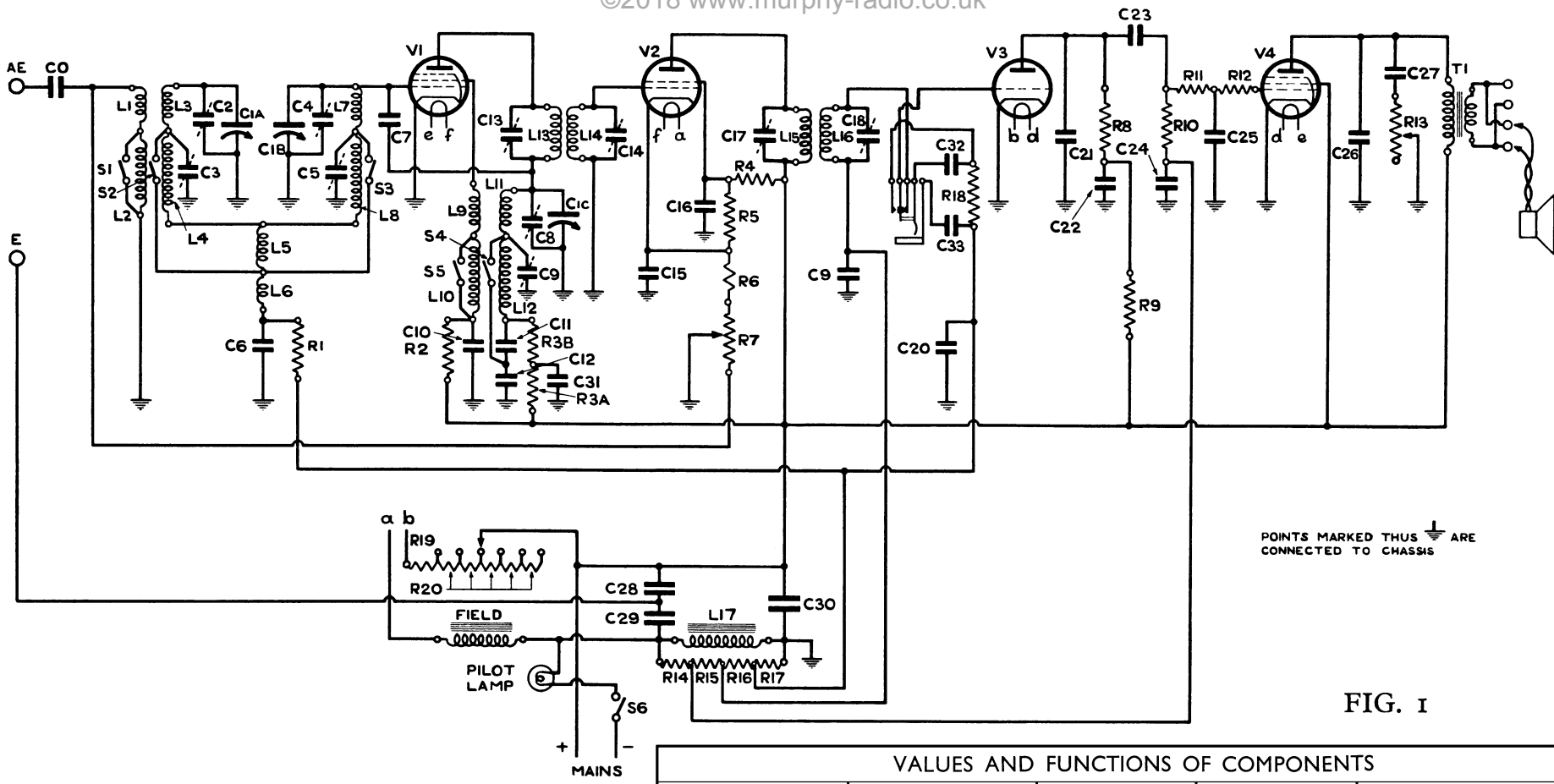


FIG. 1

CIRCUIT DIAGRAM and DATA for D4 RECEIVER

SUBJECT TO ALTERATION WITHOUT NOTICE

DRAWING D4—2

RESISTANCE of TRANSFORMER WINDINGS, Etc.	
T1	PRIMARY 700 OHMS SECONDARY 0·15 OHMS.
	SPEECH COIL 2 OHMS. FIELD COIL 450 OHMS.

VALUES AND FUNCTIONS OF COMPONENTS

CONDENSERS		CONDENSERS		RESISTANCES		INDUCTANCES		VALVES		
No.	Value	No.	Value	No.	Value	No.	OHMS.(D.C)	No.		Type
C0	.01 MFD.	C16	0.1 MFD.	R1	50,000 Ω	L1	0.8 Ω	V1	OSC & 1ST DET.	DC/2PEN
C1A	GANG .0005	C17	70/140 MMFDS.	R2	300,000 Ω	L2	8.5 Ω	V2	I.F.	DC2/S.G. V.M.
C1B	GANG .0005	C18	70/140 MMFDS.	R3A	25,000 Ω	L3	4.5 Ω	V3	2ND DET.	DC3/H.L.
C1C	GANG .0005	C19	0.5 MFD.	R3B	25,000 Ω	L4	22 Ω	V4	POWER	DC2/PEN
C2	5/70 MMFDS.	C20	0.1 MFD.	R4	20,000 Ω	L5	2.7 Ω			
C3	5/70 MMFDS.	C21	.001 MFD.	R5	20,000 Ω	L6	0.4 Ω			
C4	5/70 MMFDS.	C22	1.0 MFD.	R6	200 Ω	L7	4.5 Ω			
C5	5/70 MMFDS.	C23	.025 MFD.	R7	8,000 Ω	L8	22 Ω			
C6	0.1 MFD.	C24	50 MFDS.	R8	50,000 Ω	L9	6.5 Ω			
C7	SEE FOOTNOTE	C25	.0002 MFD.	R9	25,000 Ω	L10	13 Ω			
C8	2½/15 MMFDS.	C26	.002 MFD.	R10	150,000 Ω	L11	4.0 Ω			
C9	5/70 MMFDS.	C27	.025 MFD.	R11	100,000 Ω	L12	15 Ω			
C10	0.1 MFD.	C28	0.5 MFD.	R12	100,000 Ω	L13	95 Ω			
C11	1373 MMFDS.	C29	0.5 MFD.	R13	50,000 Ω	L14	95 Ω			
C12	2000 MMFDS.	C30	4.0 MFDS.	R14	30,000 Ω	L15	95 Ω			
C13	70/140 MMFDS	C31	1.0 MFD.	R15	20,000 Ω	L16	95 Ω			
C14	70/140 MMFDS.	C32	0.1 MFD.	R16	15,000 Ω	L17	326 Ω			
C15	.01 MFD.	C33	0.1 MFD.	R17	15,000 Ω					
				R18	500,000 Ω					
				R19	291 Ω					
				R20	97 Ω					

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.

C7—This Condenser consists of two pieces of connecting wire bound together for approx. 1½".

TRIMMING

It is important to realise that the I.F. trimmers, C13, C14, C17, C18, cannot be adjusted without special apparatus, and any D4 receiver with faulty I.F. trimming must be returned to factory.

For trimming the other circuits of the D4, the following apparatus is required :—

(1) D.C. milliameter, 0-1 mA, with adaptor for valve.

(2) 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 1/16-inch of the tip of the blade exposed.

Trim as follows :—

(1) Put the milliameter in the anode circuit of V3. Do all the adjustment by watching the meter, not by listening.

(2) Tune a fairly strong station between 220—230 m : identify it definitely, and look up its wave-length in " World Radio." Compare with the reading on the set. If it is correct, go on at once to (3) below.

If not correct, adjust the tuning control to exactly the right wave-length of the station, and then trim on C8 until you get the biggest meter reading.

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

(4) Do not touch the main tuning control. Trim C4 to best output : go back to C2 and see if it needs further adjustment and go on checking C2 and C4 alternately until you get no improvement.

(5) Switch to long waves. Get on to Oslo, or the nearest station you can to 1,000 metres. Check its wave-length in " World Radio " against the setting : if correct go on to (6). If not, set the tuning to the right wave-length, and trim on C9 to max. meter reading.

(6) Leave the tuning control set, and do as in (3) and (4) above, but working on C3 and C5 instead of C2 and C4.

If the test signal is sufficiently strong to deflect the m.a. needle beyond the calibrated portion of the scale, rotate the volume control in an anti-clockwise direction to bring the needle to a useful part of the scale.

The point of exact resonance, i.e., the highest meter reading, is quite critical, consequently care is necessary if accuracy is to be obtained.

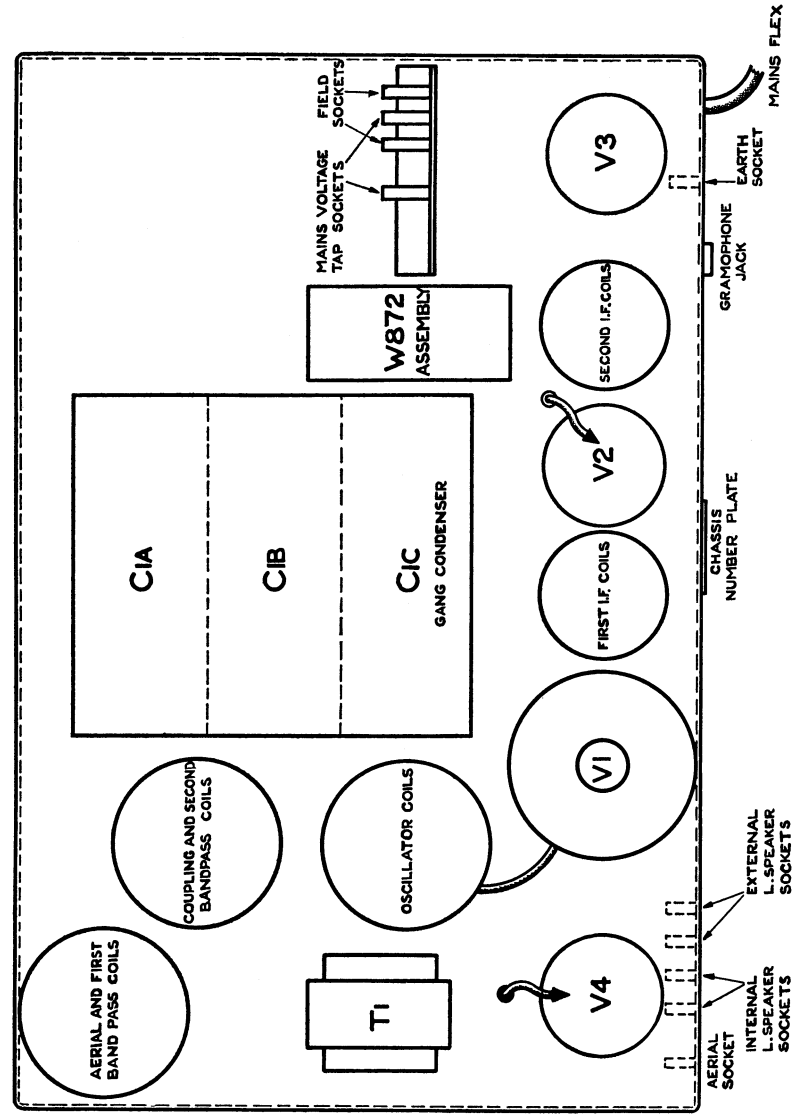


FIG. 2 PLAN OF CHASSIS

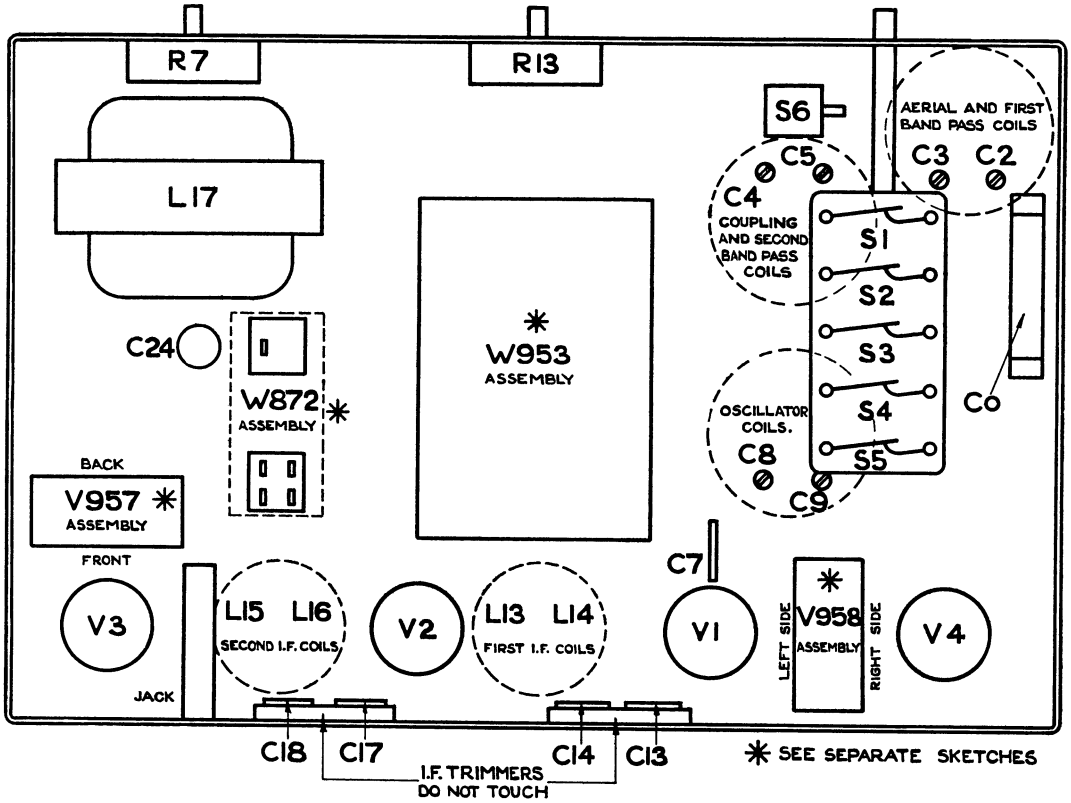


FIG. 3

UNDERSIDE OF CHASSIS

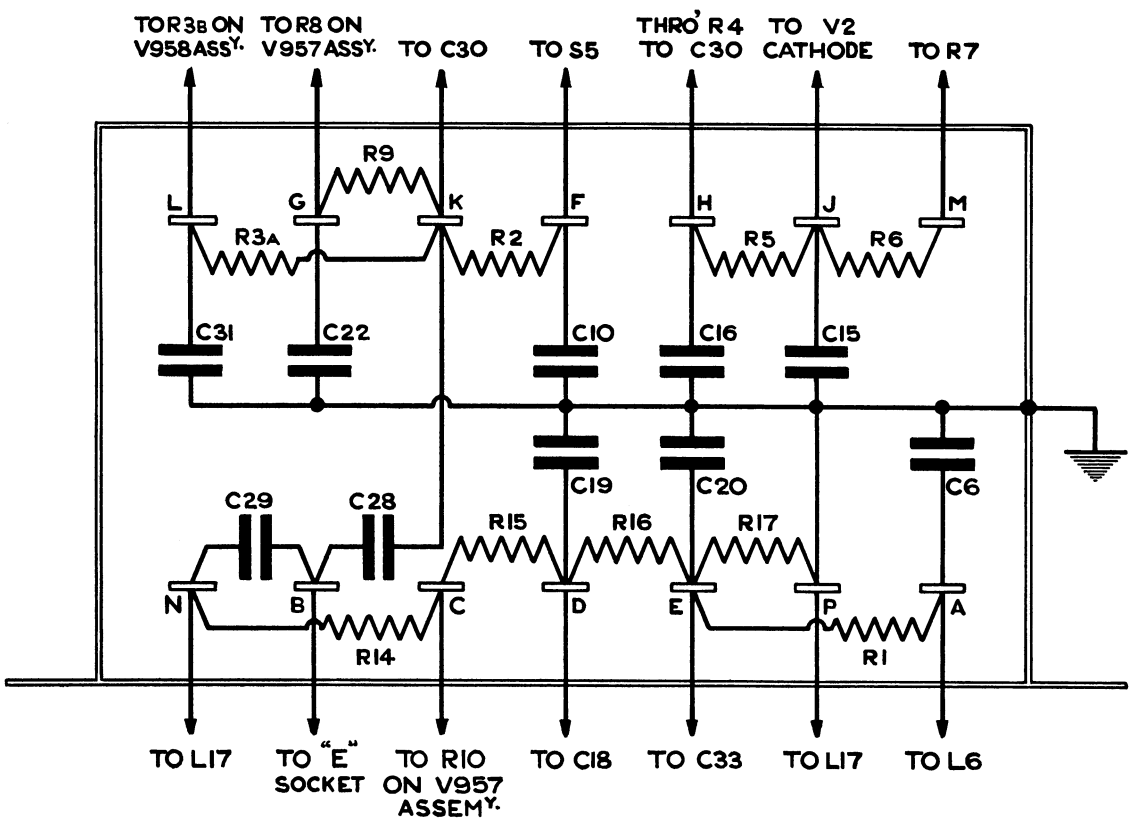
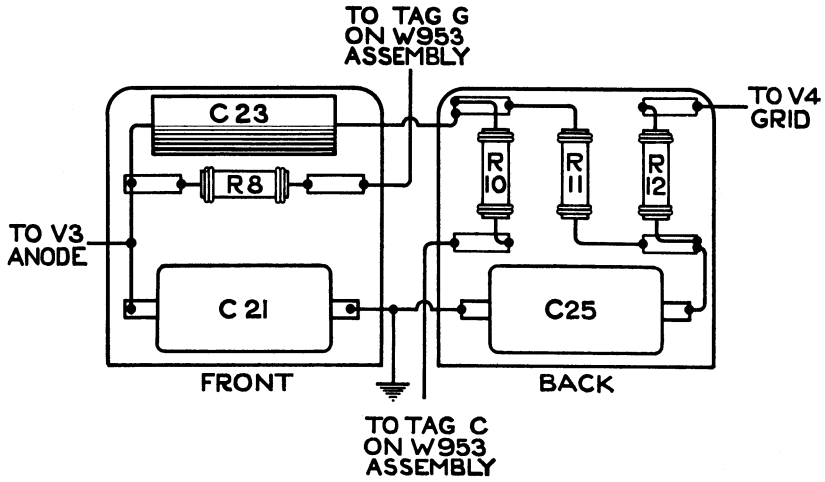


FIG. 4

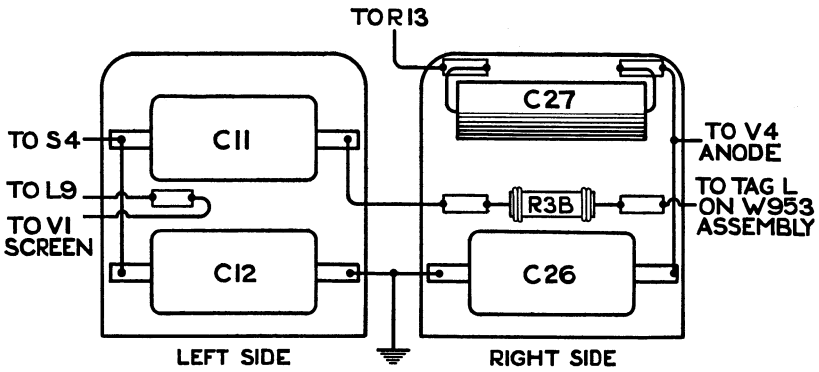
W953 CONDENSER AND RESISTANCE ASSEMBLY

FIG. 5



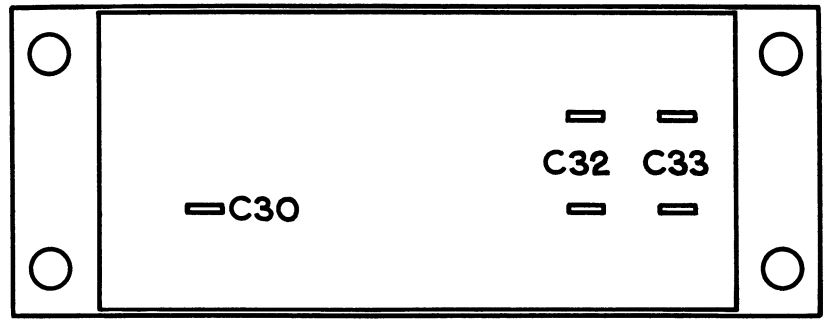
V957 ASSEMBLY

FIG. 6



V958 ASSEMBLY

FIG. 7



W872 ASSEMBLY

DISMANTLING

To remove the chassis from the cabinet, first take off the control knobs. Then loosen the two screws at the top of the wooden back, pull out the top and lift a little, and the back will come off.

Take out the L.S. plugs from the sockets on the left and also the field plugs from the socket strip on the mains resistance panel. The three holding down screws are protected by rubber caps and these must be removed before the screws can be reached. These caps are sprung into position and can be prised out with a screwdriver or similar instrument. Then with a $\frac{1}{4}$-inch Whitworth box spanner remove the screws by working from underneath, with the set projecting over the edge of the bench.

The chassis will now slide out.

If it is desired to remove the loud-speaker, first take out the chassis as above. Then turn the cabinet on its face, and remove the four screws in the two metal plates on the cross-bar holding it. The speaker is then free.

Note that the Number of the set is given on the nameplate fixed to the cabinet back ; it is *repeated* on the chassis itself (see Fig. 2). If by any chance you have two sets down together, see that each chassis goes back into its own cabinet. This is important ; for the tuning *indicator* is on the *cabinet*, and the *scale* on the *chassis* : if the chassis is assembled in a cabinet that does not belong to it, the calibration may be wrong.

Warning.

The earth connection itself is insulated from the chassis, but if the positive main happens to be earthed there will be the full mains voltage between earth and chassis. Hence Dealers are warned against allowing any part of the chassis to be exposed to possible handling by the customer.