

# FERRANTI

## CONSTRUCTIONAL

### AMPLIFIERS



Details for the construction of Amplifiers for operation from Batteries, A.C. Mains, or D.C. Mains. each capable, in conjunction with a good electrical Pickup and Speaker, of giving reproduction very nearly true to life, and unsurpassed by that provided by any other Amplifiers or other combination of components commercially available at the present day.

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*Second Edition, March, 1932.*

**Price 3d.**



# FERRANTI

## CONSTRUCTIONAL AMPLIFIERS.

The Amplifiers, the construction of which is hereinafter described, have each been designed especially for use in conjunction with an electrical pickup for the reproduction of gramophone records. The pickup should provide a moderately large input with little distortion, and the Marconiphone Pickup is specially recommended. These Amplifiers are also ideal for Radio reproduction, in which case the first valve should, in every case, be connected as the detector.

The Mains types are also suitable for television purposes.

The Amplifiers, which are each of the 3-stage type, are as follows:—

**Battery or Eliminator Operated Type B.E.** An Amplifier designed for entire Battery operation or for use in conjunction with an H.T. Supply Unit; provided with a Push-Pull Output stage, giving an undistorted output of 1,000/2,500 milliwatts, according to the valves used.

**D.C. Mains Type D.C.2.** An Amplifier designed for entire operation from D.C. mains. Employs D.C. Mains Valves and has a Push-Pull Output stage giving a maximum undistorted output of 2,500 milliwatts.

**A.C. Mains Type A.C.5.** An Amplifier for entire operation from A.C. mains, 200/250 volts 40/100 cycles. Provided with a straight output stage, using one LS6a Valve giving an undistorted output of 5,000 milliwatts.

**A.C. Mains Amplifier Type A.C.6.** An Amplifier for entire operation from the A.C. mains, 200/250 volts 40/100 cycles. Provided with a Push-Pull Output stage, using two LS5a Valves giving a maximum undistorted output of 6,250 milliwatts.

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The overall amplification curves of the A.C. and D.C. mains operated Amplifiers from the input to the output terminals are shewn in Fig. 1, and indicate a truly remarkable performance, seldom, if ever, approached by other Amplifiers commercially available.

Curves for the Battery operated types are similar when using valves with similar characteristics.

It should be observed that the vertical amplification scale is drawn to indicate voltage amplification directly, and not in the form of decibels, and that if drawn in the latter manner, each of the curves would be represented by a horizontal line, the departure from perfection being negligible.



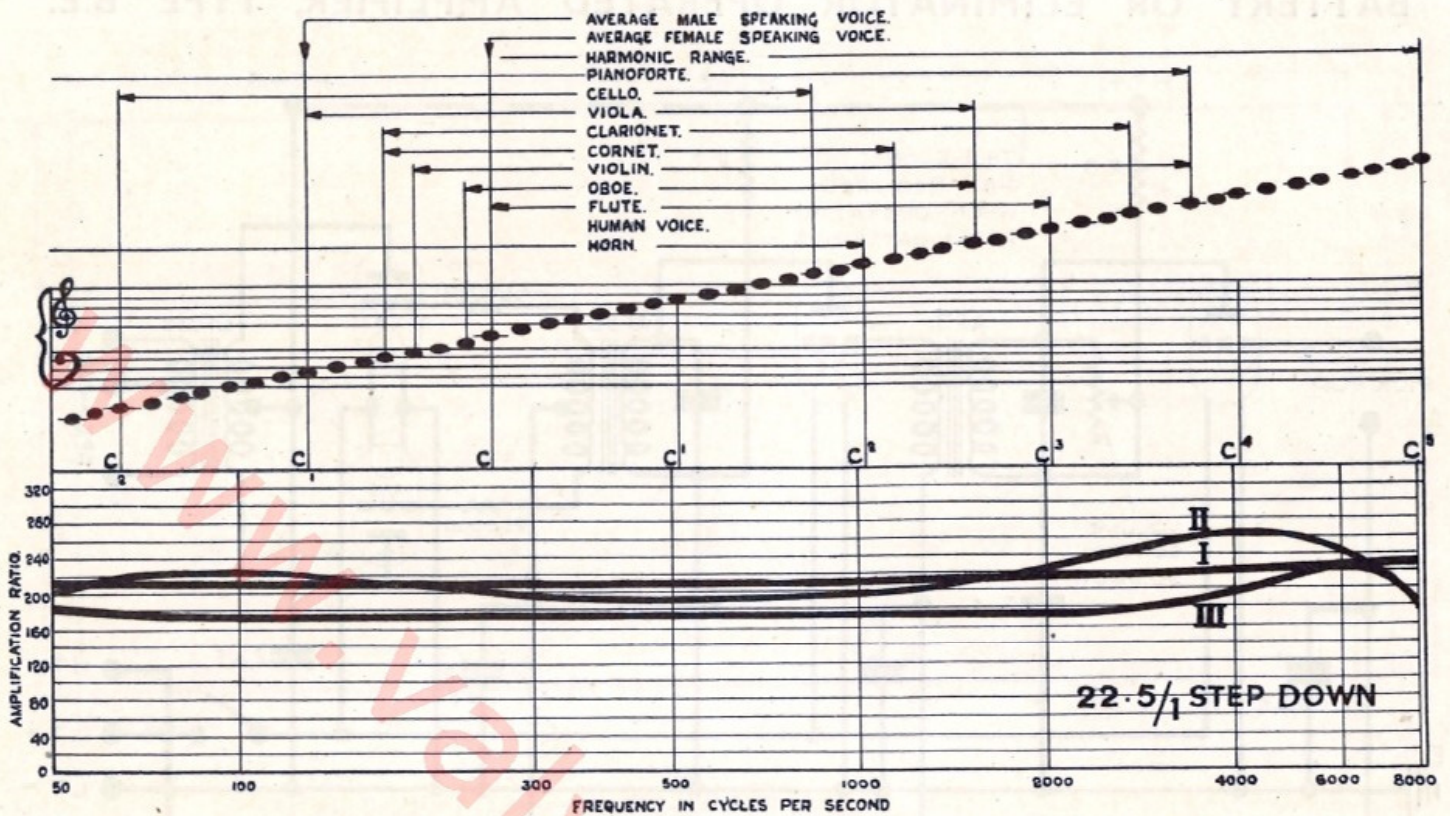


Fig. 1.

- CURVE I. Overall amplification curve of type D.C.2 Amplifier.
- CURVE II. Overall amplification curve of type A.C.5 Amplifier.
- CURVE III. Overall amplification curve of type A.C.6 Amplifier.

**“ WARNING.”**

With regard to the Amplifiers type D.C.2, A.C.5 and A.C.6 ; the attention of constructors is drawn emphatically to the fact that as these make use of the supply mains, the voltages available are considerable, being up to 250 volts D.C. in the type D.C.2, and approximately 1,000 volts A.C. in the case of the types A.C.5 and A.C.6, which voltages are dangerous to life. It is therefore essential that the constructional details indicated be followed implicitly, not only as regards the components and lay-out shewn, but especially in connection with the safety cabinet and safety switch, so as to prevent absolutely the possibility of shocks, accidental or otherwise, by either authorized or unauthorized persons, and also to enable the apparatus to comply with the requirements of the Institution of Electrical Engineers.

If the apparatus is built as herein described, it is perfectly safe to use, but FERRANTI Ltd. accept no responsibility for any accident or injury that is received in any way whatsoever when employing these Amplifiers.



**BATTERY OR ELIMINATOR OPERATED AMPLIFIER, TYPE B.E.**

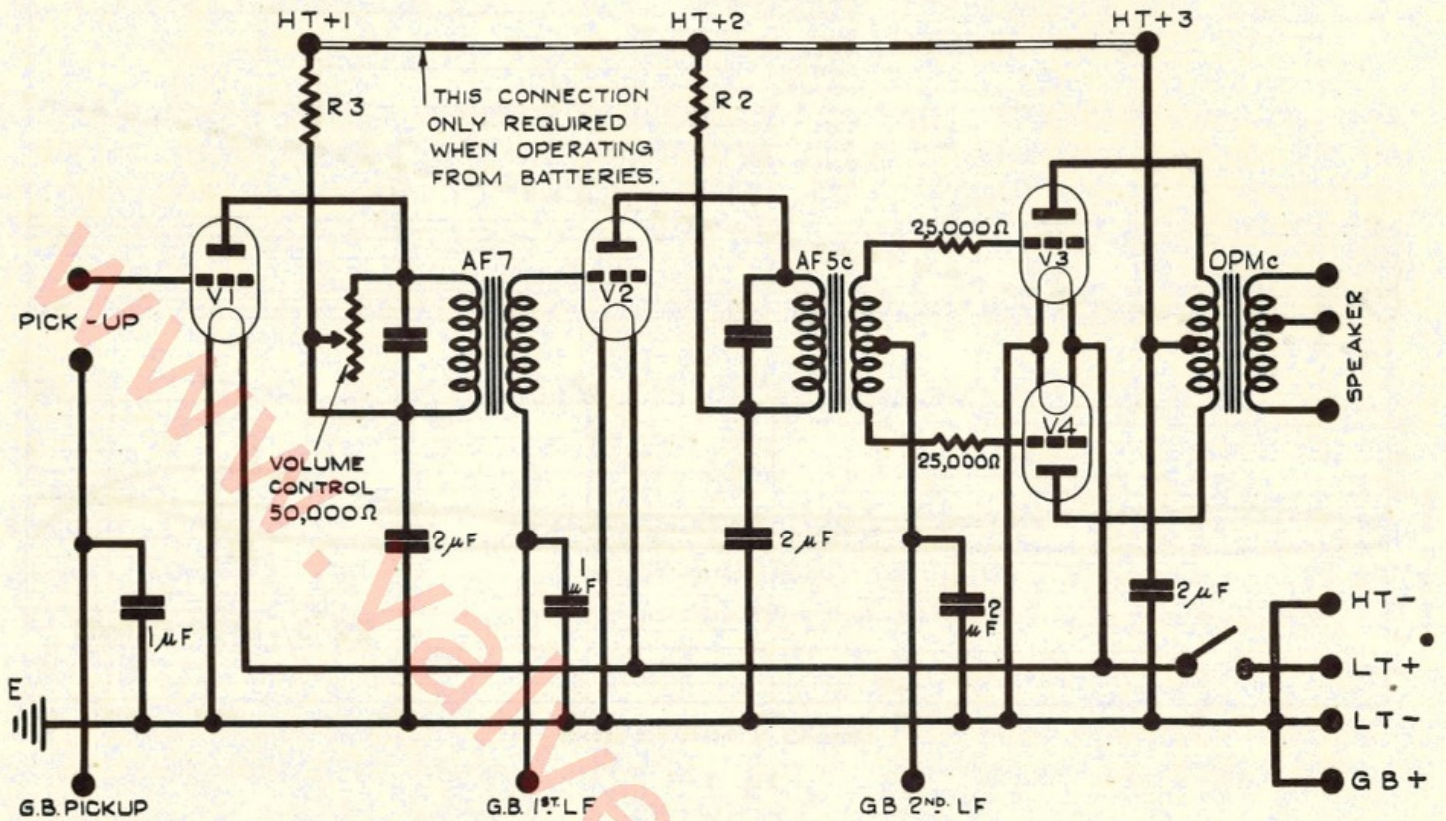


Fig. 2. The theoretical circuit of the type B.E. Amplifier.

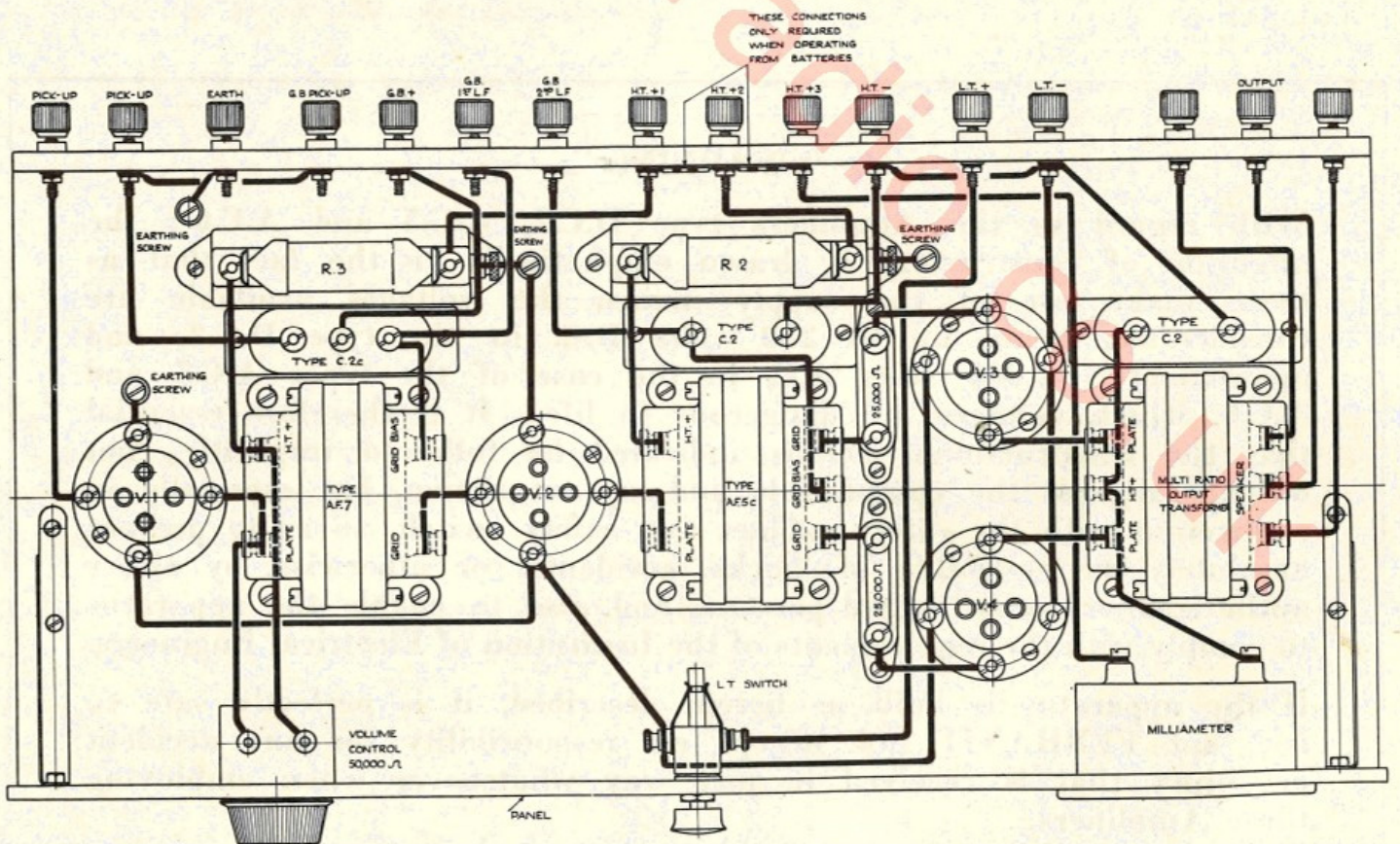


Fig. 3. The lay-out and wiring of the components of the type B.E. Amplifier.



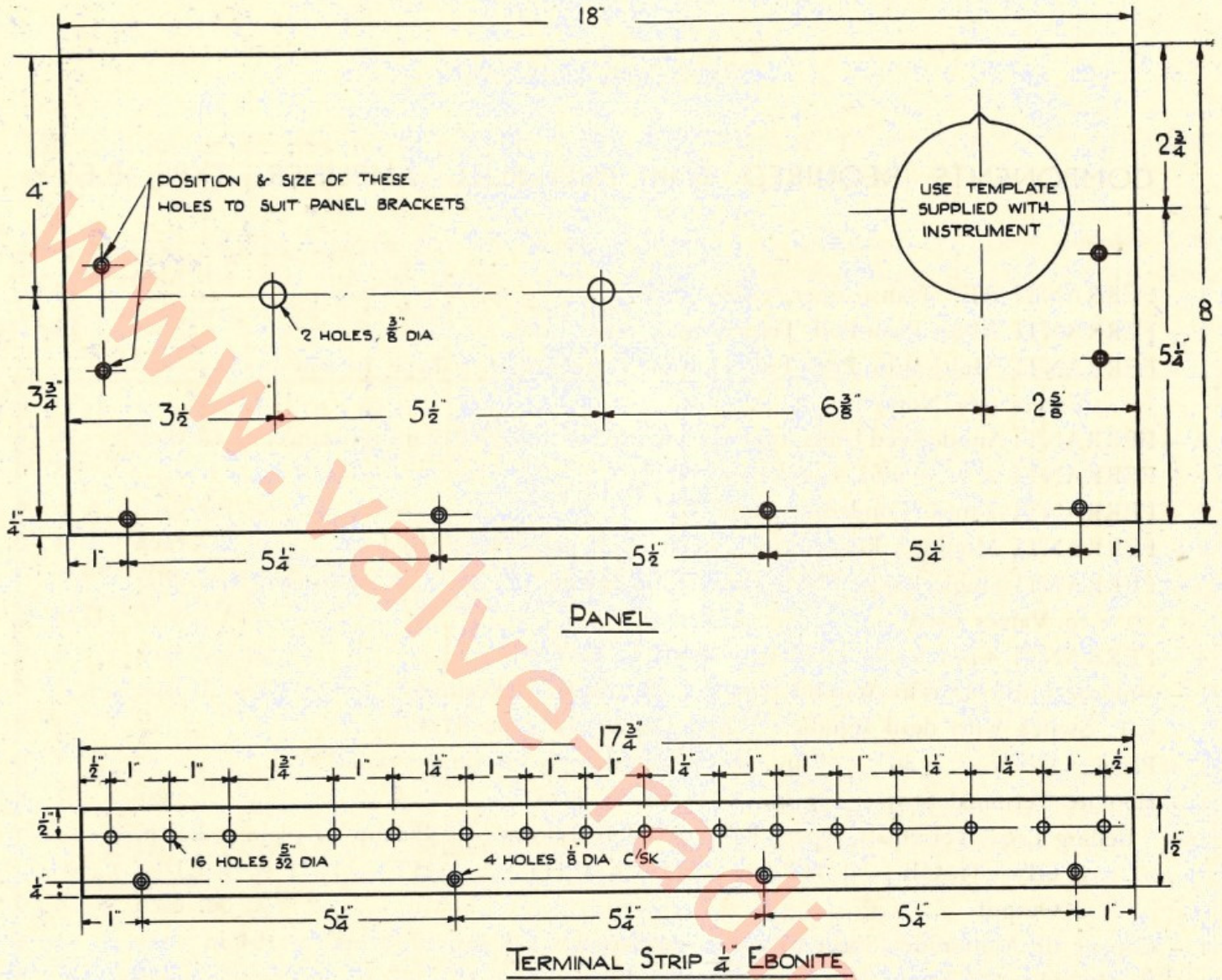


Fig. 4.

Fig. 4 shews the dimensions and drilling particulars of the panel and terminal strip required for the type B.E. Amplifier.

*Note :* The baseboard on which this Amplifier and all the other Amplifiers described are mounted should preferably be covered with a sheet of aluminium or copper, about 18's gauge being a suitable thickness, and this is assumed in all the practical layouts shewn.

The connections shewn dotted in both of the preceding diagrams should be omitted when obtaining H.T. from a Mains Unit, thus giving a separate H.T. feed to each stage. The FERRANTI Radio Mains Units, types E1 and E4, form ideal sources of H.T. supply for the above Amplifier.



COMPONENTS REQUIRED FOR PUSH-PULL AMPLIFIER, TYPE B.E.

	£	s.	d.
1 - FERRANTI AF7 Transformer, ratio 1/1.75 ... ..	1	10	0
1 - FERRANTI AF5c Push-Pull Transformer, ratio 1/3.5 ... ..	1	14	0
1 - FERRANTI Multi-ratio Push-Pull Output Transformer. Type to suit Speaker and Valves (see Note) ... ..	1	6	6
2 - FERRANTI Anode Feed Units, type 1, each fitted with 20,000 ohms resistance, @ 7/3 each	14	6	
1 - FERRANTI 2 × 1 mfd. Condenser, type C2c ... ..	3	9	
2 - FERRANTI 2-mfd. Condensers, type C2 ... .. @ 3/3 each	6	6	
2 - FERRANTI Moulded Resistances, 25,000 ohms each, with Holders ... @ 2/- each	4	0	
1 - FERRANTI Single Range Flush Type Milliammeter, 0/50 or 0/100 milliamps, according to Valves used ... ..	1	15	0
4 - FERRANTI 4-pin Valve Holders ... .. @ 1/3 each	5	0	
1 - Volume Control, Wire-Wound type, 50,000 ohms: "Watmel" ... ..	5	6	
1 - L.T. Switch with dead spindle. "Red Diamond" type RD49 ... ..	1	3	
1 - Panel: 18 in. × 8 in. × ¼ in., dry polished 3-ply or similar wood ... .. say	1	0	
1 - Ebonite Terminal Strip: 17¾ in. × 1½ in. × ¼ in. ... .. say	1	6	
16- "Belling Lee" Terminals, type "R," marked as follows:—2 Pickup or plain, 1 Earth, 3 GB—, 1 GB+, 1 HT+1, 1 HT+2, 1 HT+3, 1 HT—, 1 LT+, 1 LT—, 3 Output ... .. @ 3d. each	4	0	
1 - Copper or Aluminium Sheet to cover baseboard: 17¾ ins. × 8 ins. × .04 in., say	1	6	
1 - Baseboard: 17¾ in. × 8 in. × ½ in. wood ... .. say	6		
2 - Panel Brackets ... .. say 6d. each	1	0	
Quantity of ¾ in. and ½ in. No. 4's round head brass wood screws ... ..			
<i>Note.—The earthing screws shown in the drawings are ordinary round head wood screws, the wire being looped under the screw head and screwed down.</i>			
Quantity of ½ in. No. 4's counter-sunk head brass wood screws... ..			
Quantity of Insulated 18's gauge Copper Wire, or Tinned 18's gauge Copper Wire and Systoflex ... .. say	1	0	
Price, exclusive of Valves, Batteries, and Cabinet ... ..	£8	17	0



**VALVES REQUIRED.**

The following are the most suitable valve combinations to employ, although other valves having similar characteristics may be used if desired.

In the case of the valves for the Output stage, in general, the best results will be obtained by the use of those valves which have the biggest grid swing and, in consequence, take the largest grid bias.

1st L.F.	2nd L.F.	POWER.
<b>2-Volt Types.</b>		
Marconi L210. Mullard PM2DX Cossor 210LF.	Marconi L210 Mullard PM2DX Cossor 210LF.	Marconi P240. Mullard PM252. Cossor 230XP.
<b>4-Volt Types.</b>		
Marconi L410.	Marconi L410.	*Marconi PX4.
<b>6-Volt Types.</b>		
Marconi L610. Mullard PM6D. Cossor 610LF.	Marconi L610. Mullard PM6D. Cossor 610LF.	Marconi P625A. (Marconi P625 if 250 volts are available). Mullard PM256A. Cossor 610XP (for up to 150 volts). Mazda P650.

\*The 4-volt combination of Valves shewn will consume approximately 100 milliamps and, in consequence, will need very large H.T. Accumulators, or, preferably, an H.T. Supply Unit, to provide the H.T. The FERRANTI type E1 Mains Unit is suitable.

**OUTPUT TRANSFORMER REQUIRED.**

The ratio of the Output Transformer required naturally depends on the Output Valves used and the impedance of the Speaker employed, but, in general, with high-resistance Speakers of the ordinary Cone or Inductor type, as well as high-resistance Moving Coil Speakers, the FERRANTI type OPM1c will be suitable, whilst with low impedance Moving Coil Speakers, such as the FERRANTI Moving Coil Speaker, the OPM6C will generally be necessary.

Full details regarding all FERRANTI Push-Pull Transformers, together with details for estimating Output Transformer ratios in special cases are given in our Push-Pull list, No. W.512, which will be forwarded on request.



D.C. MAINS OPERATED AMPLIFIER, PUSH-PULL TYPE D.C.2.

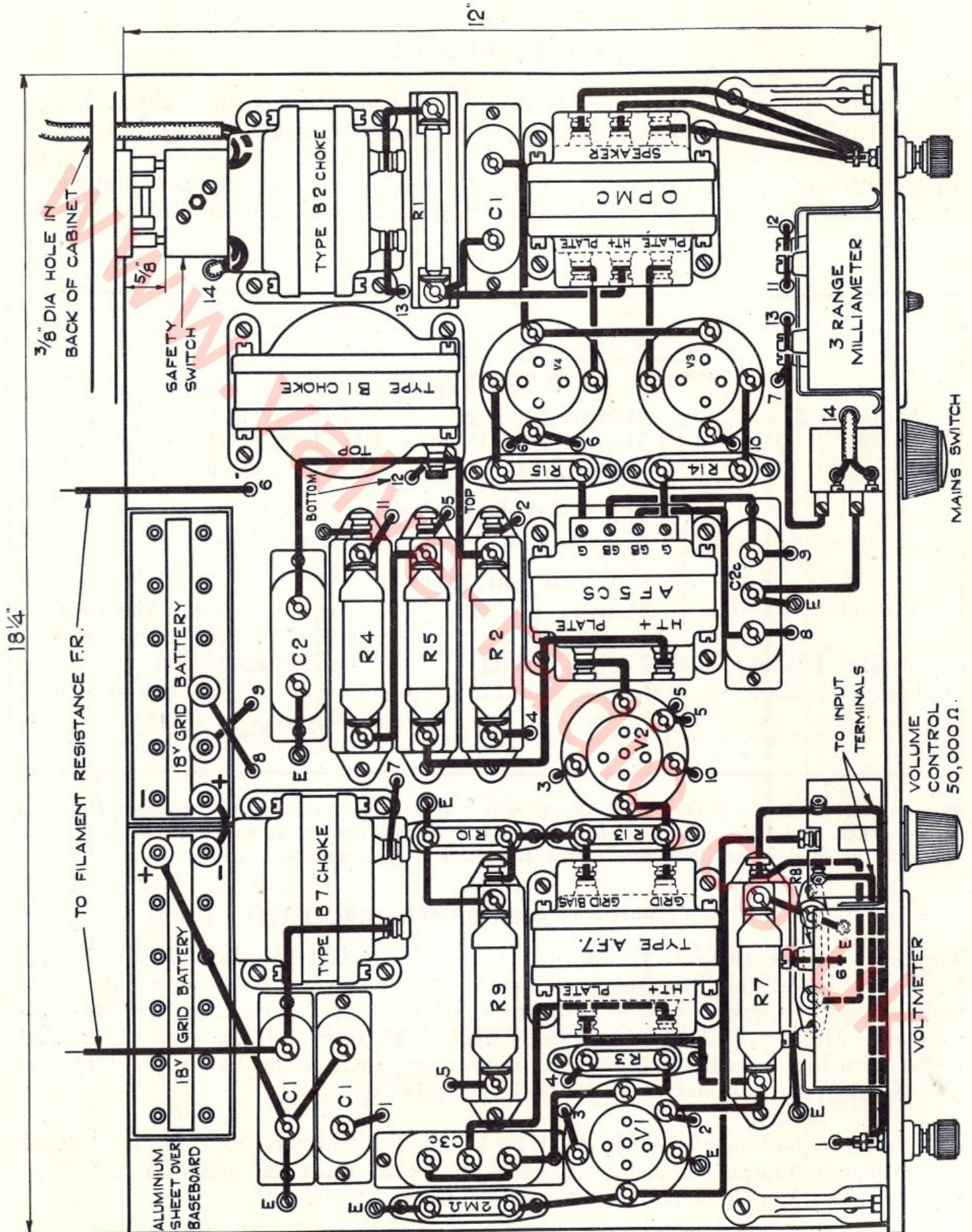


Fig. 5. The lay-out and wiring of the components of the type D.C.2 Amplifier.



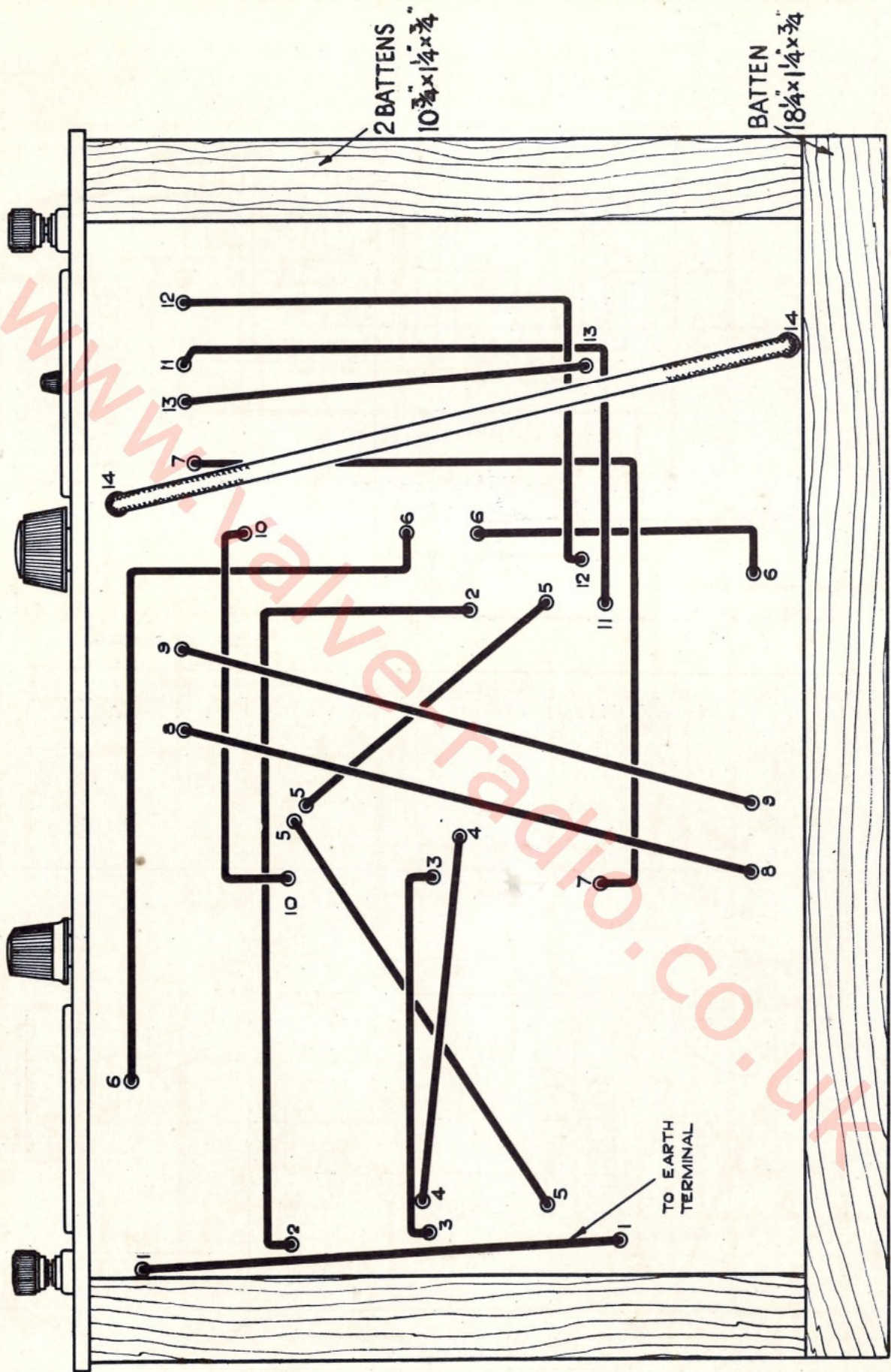


Fig. 6. The under baseboard wiring of the type D.C. 2 Amplifier.



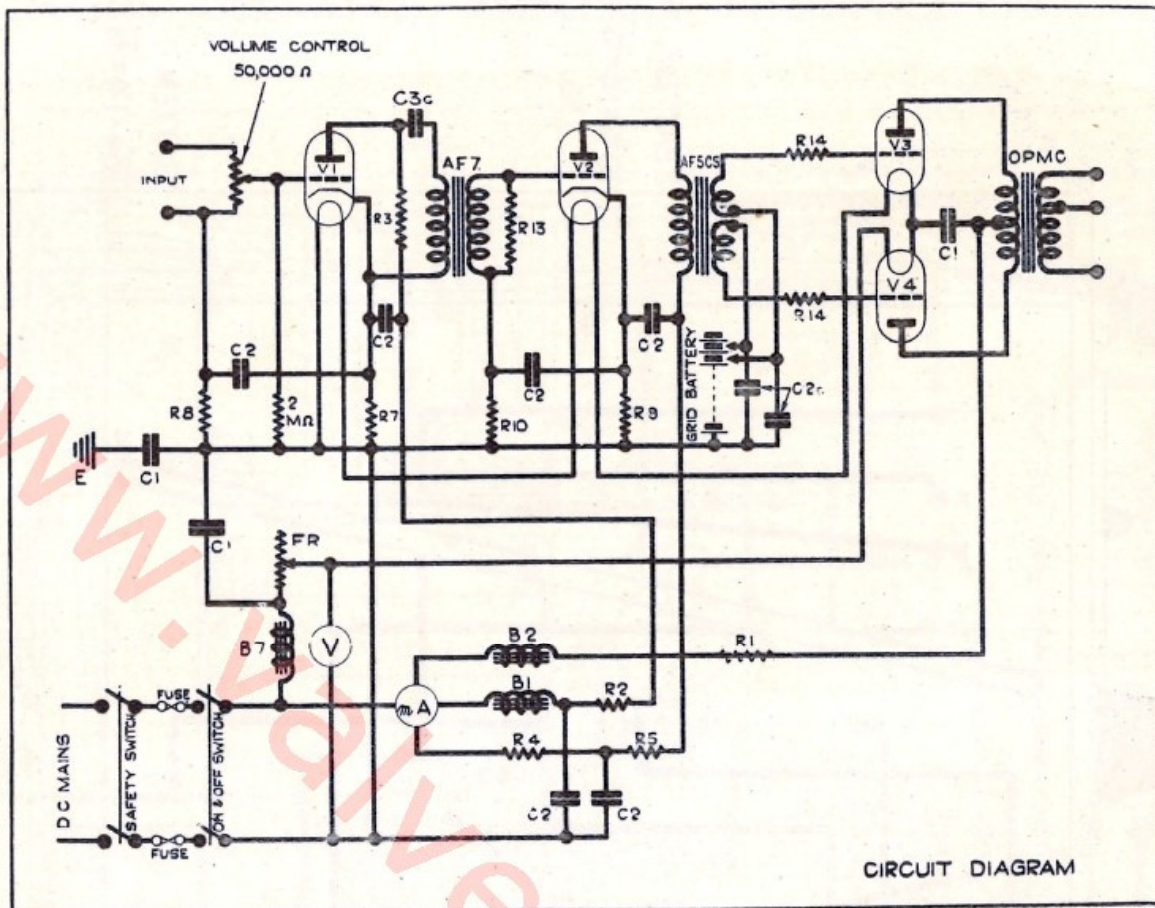


Fig. 7. The theoretical circuit of the type D.C. 2 Amplifier.

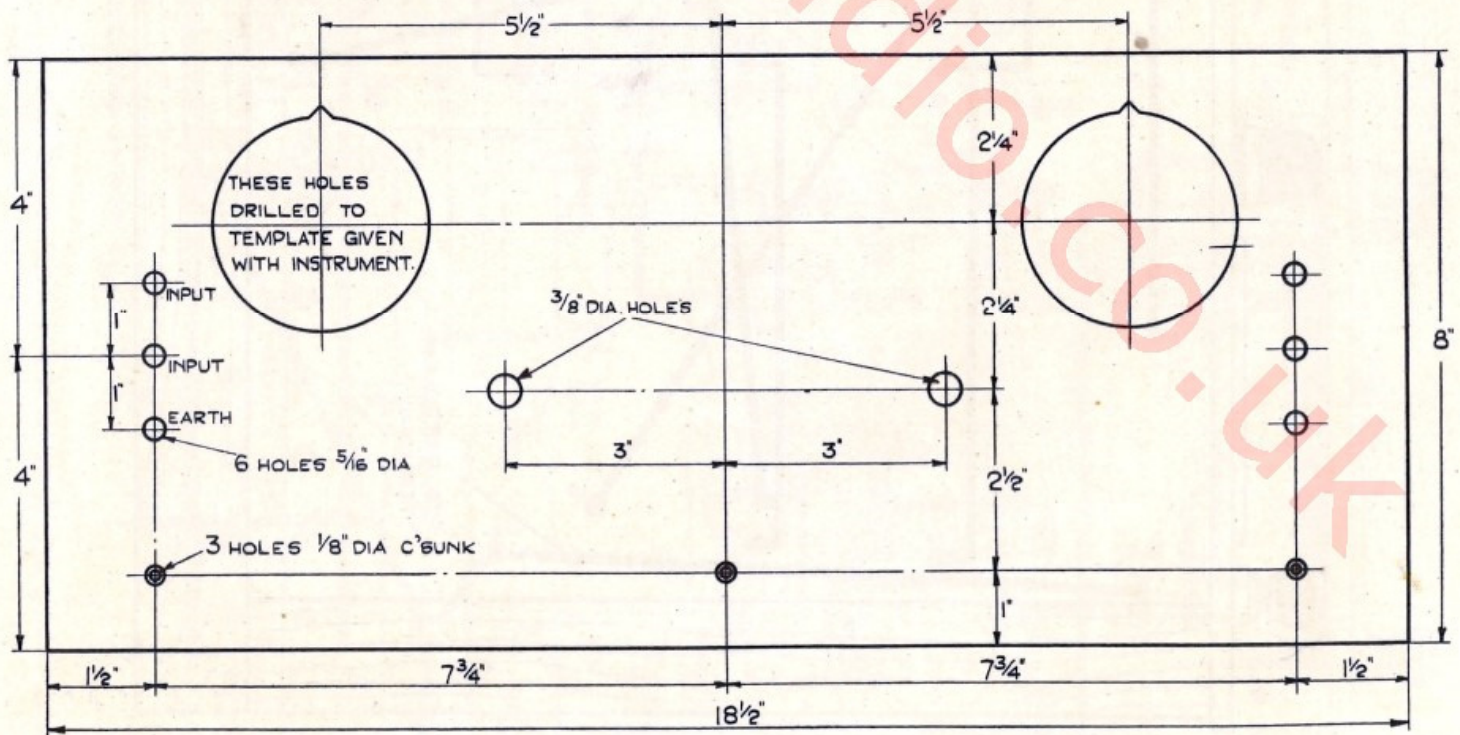


Fig. 8. The dimensions and drilling particulars of the panel for the type D.C. 2 Amplifier.



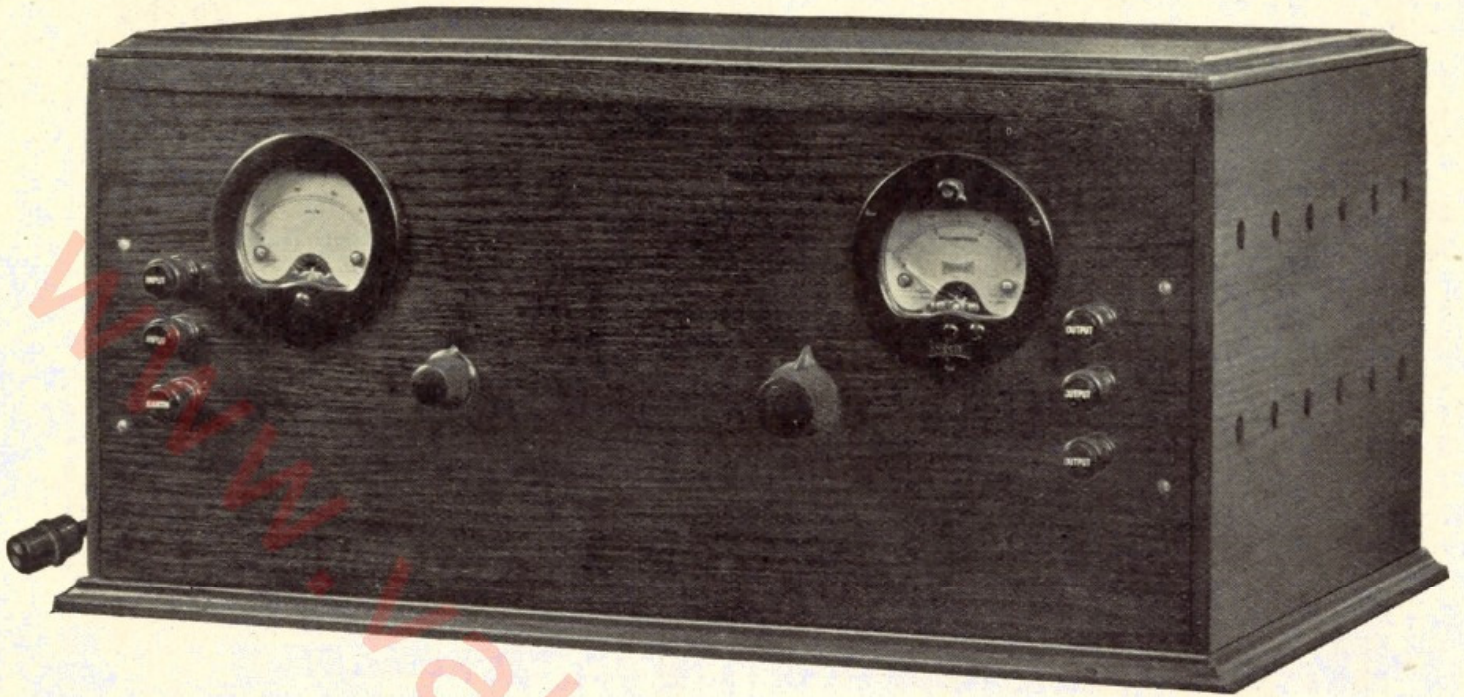


Fig. 9. D.C. Mains Amplifier, Type D.C.2. Exterior view.

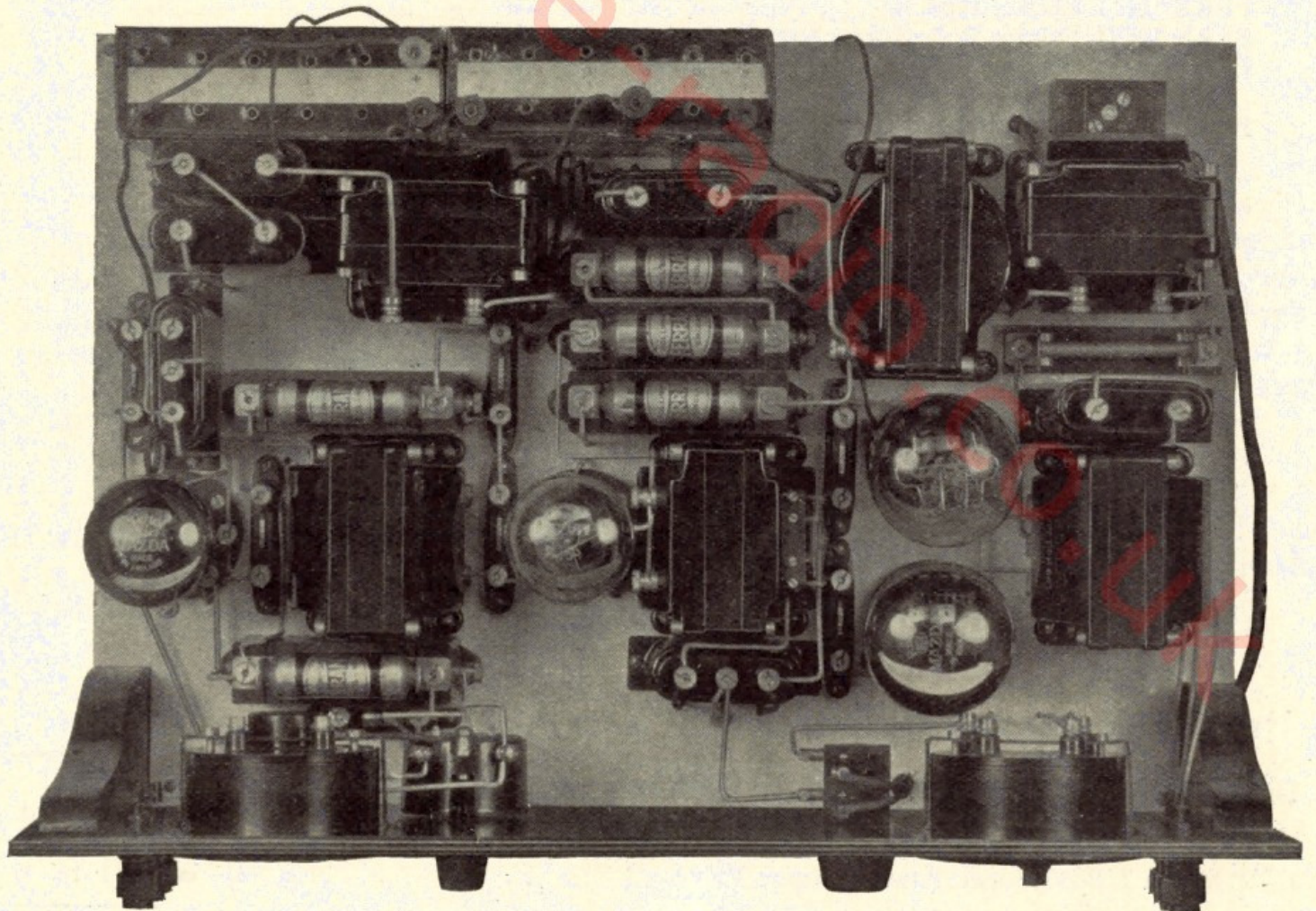


Fig. 10. D.C. Mains Amplifier, Type D.C.2. Interior view.



COMPONENTS REQUIRED FOR PUSH-PULL AMPLIFIER, TYPE D.C.2.

	£	s.	d.
1 - FERRANTI AF7 Transformer, ratio 1/1.75	1	10	0
1 - FERRANTI AF5cS Push-Pull Transformer, ratio 1/3.5	1	14	0
1 - FERRANTI Multi-ratio Push-Pull Output Transformer. Type to suit Speaker and Valves (see Note)	1	6	6
5 - FERRANTI Anode Feed Units, type 1, without resistances	1	1	3
1 - FERRANTI Wire-Wound Resistance with Holder: 500 ohms (or Shorting Bar—6d.: see Note)			4 0
1 - FERRANTI Wire-Wound Resistance, without Holder, 5,000 ohms			3 0
2 - FERRANTI Wire-Wound Resistances, without Holders, 10,000 ohms each. @ 3/- each			6 0
2 - FERRANTI Wire-Wound Resistances, without Holders, 650 ohms each. @ 3/- each			6 0
1 - FERRANTI Moulded Resistance, with Holder, 20,000 ohms			2 0
2 - FERRANTI Moulded Resistances, with Holder, 100,000 ohms each @ 2/- each			4 0
1 - FERRANTI Moulded Resistance, with Holder, 125,000 ohms			2 0
2 - FERRANTI Moulded Resistances, with Holder, 25,000 ohms each @ 2/- each			4 0
1 - FERRANTI Moulded Resistance, with Holder, 2 megohms			2 0
1 - FERRANTI 2-mfd. Condenser, 750 volts D.C. test, type C2			3 3
3 - FERRANTI 2-mfd. Condensers, 1,050 volts D.C. test, type C1 @ 4/9 each	14	3	
1 - FERRANTI 2 x 1 mfd. Condenser, 750 volts D.C. test, type C2c			3 9
1 - FERRANTI 2 x 0.1 mfd. Condenser, 1,200 volts D.C. test, type C3c			3 0
2 - FERRANTI 5-pin Valve Holders @ 1/6 each			3 0
2 - FERRANTI 4-pin Valve Holders @ 1/3 each			2 6
1 - FERRANTI Choke, type B1	1	1	0
1 - FERRANTI Choke, type B2	1	1	0
1 - FERRANTI Choke, type B7	1	1	0
1 - FERRANTI Double-Pole Safety Switch, with double-pole fuses			7 6
1 - FERRANTI Flush Type Voltmeter, Moving Iron pattern, reading 0-25 volts. List No. 554F	1	9	0
1 - FERRANTI 3-Way Flush Type Moving Coil Milliammeter, reading 0-6-6-60 milliamps. List No. 154SF	2	15	0
1 - "Wearite" Mains Switch, Double-Pole Type G42			2 6
1 - "Watmel" Wire-Wound Volume Control Potentiometer: 50,000 ohms			5 6
6 - "Belling Lee" type "B" Terminals, marked:—3 Output, 2 Input, and 1 Earth. @ 6d. each			3 0
5 - Wander Plugs: "Igranic" Springmore type. 1 Red and 4 Black @ 3d. each			1 3
2 - 18-volt Grid Bias Batteries, "Sieman's" type G4 @ 2/9 each			5 6
1 - Variable Mains Resistance, "Zenith" type EC47206. (Manufacturers: The Zenith Electric Company, Limited, Zenith Works, Villiers Road, Willesden Green, London, N.W.2)			1 16 0
1 - Copper or Aluminium Sheet to cover baseboard: 18 in. x 12 in. x .04 in. say	1	6	
1 - Baseboard: 18 1/4 in. x 12 in. x 1/2 in. wood say			6
1 - Panel: 18 1/2 in. x 8 in. x 1/4 in., dry polished 3-ply or similar wood say	1	0	
2 - Panel Brackets say 6d. each			1 0
Quantity of 3/8 in. and 1/2 in. No. 4's round head brass wood screws } say			6
Quantity of 1/2 in. No. 4's counter-sunk head brass wood screws } say			6
Quantity of insulated 18's gauge Copper Wire, or Tinned 18's gauge Copper Wire and Systoflex say			1 0
Price, exclusive of Valves and Cabinet	£19	8	3

The following are the Valves required, no other types at present available being suitable without suitable modifications in the design.

	£	s.	d.
2 - "Mazda" DC/HL Valves @ 15/- each	1	10	0
2 - "Mazda" P650 Super Power Output Valves @ 18/- each	1	16	0

Total price, including Valves, but exclusive of Cabinet £22 14 3



The undermentioned are the values and positions of the various FERRANTI Resistances shewn in Figs. 5 and 6.

R1.	500 ohms	Wire-Wound or Shorting Bar.
R2.	5,000 ohms	Wire-Wound.
R3.	20,000 ohms	Moulded.
R4.	10,000 ohms	Wire-Wound.
R5.	10,000 ohms	Wire-Wound.
R7.	650 ohms	Wire-Wound.
R8.	100,000 ohms	Moulded.
R9.	650 ohms	Wire-Wound.
R10.	100,000 ohms	Moulded.
R13.	125,000 ohms	Moulded.
R14.	25,000 ohms	Moulded.
R15.	25,000 ohms	Moulded.

Filament Resistance, F.R. 472 ohms : "Zenith" type E.C. 47206.

NOTE: The 500 ohm Wire-Wound Resistance R1 is required only when the D.C. mains voltage is 240/250, and in all other cases it should be omitted and replaced by Shorting Bar—Price 6d.

### OUTPUT TRANSFORMER REQUIRED.

The ratio of the Output Transformer required naturally depends on the Output Valves used and the impedance of the Speaker employed, but, in general, with high-resistance Speakers of the ordinary Cone or Inductor type, as well as high-resistance Moving Coil Speakers, the FERRANTI type OPM1c will be suitable, whilst with low impedance Moving Coil Speakers, such as the FERRANTI Moving Coil Speaker, the OPM6c will generally be necessary.

Full details regarding all FERRANTI Push-Pull Transformers, together with details for estimating Output Transformer ratios in special cases are given in our Push-Pull list, No. W.512, which will be forwarded on request.



**A.C. MAINS OPERATED AMPLIFIER—STRAIGHT TYPE A.C.5.**

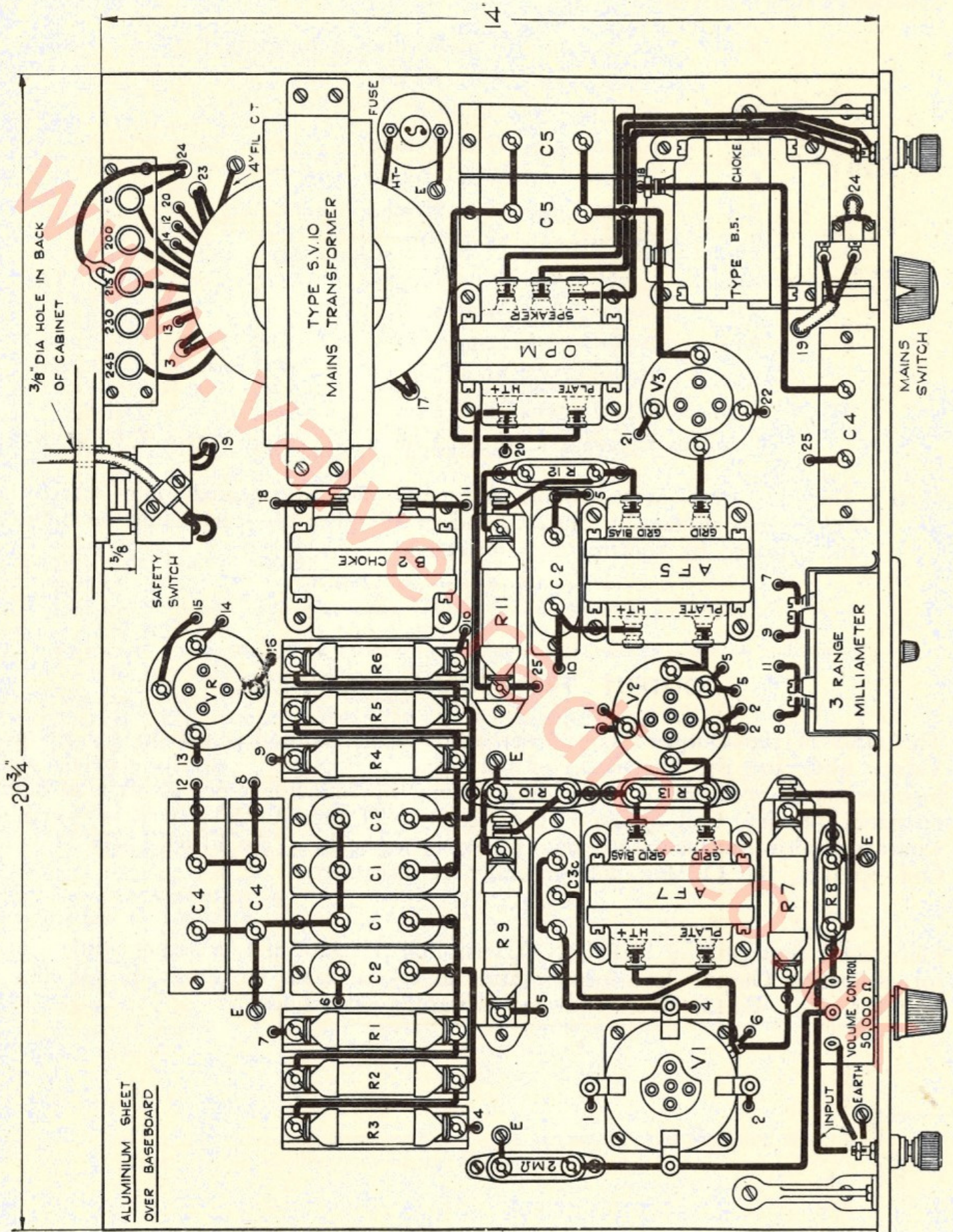


Fig. 11. The lay-out and wiring of the components of the type A.C. 5 Amplifier.



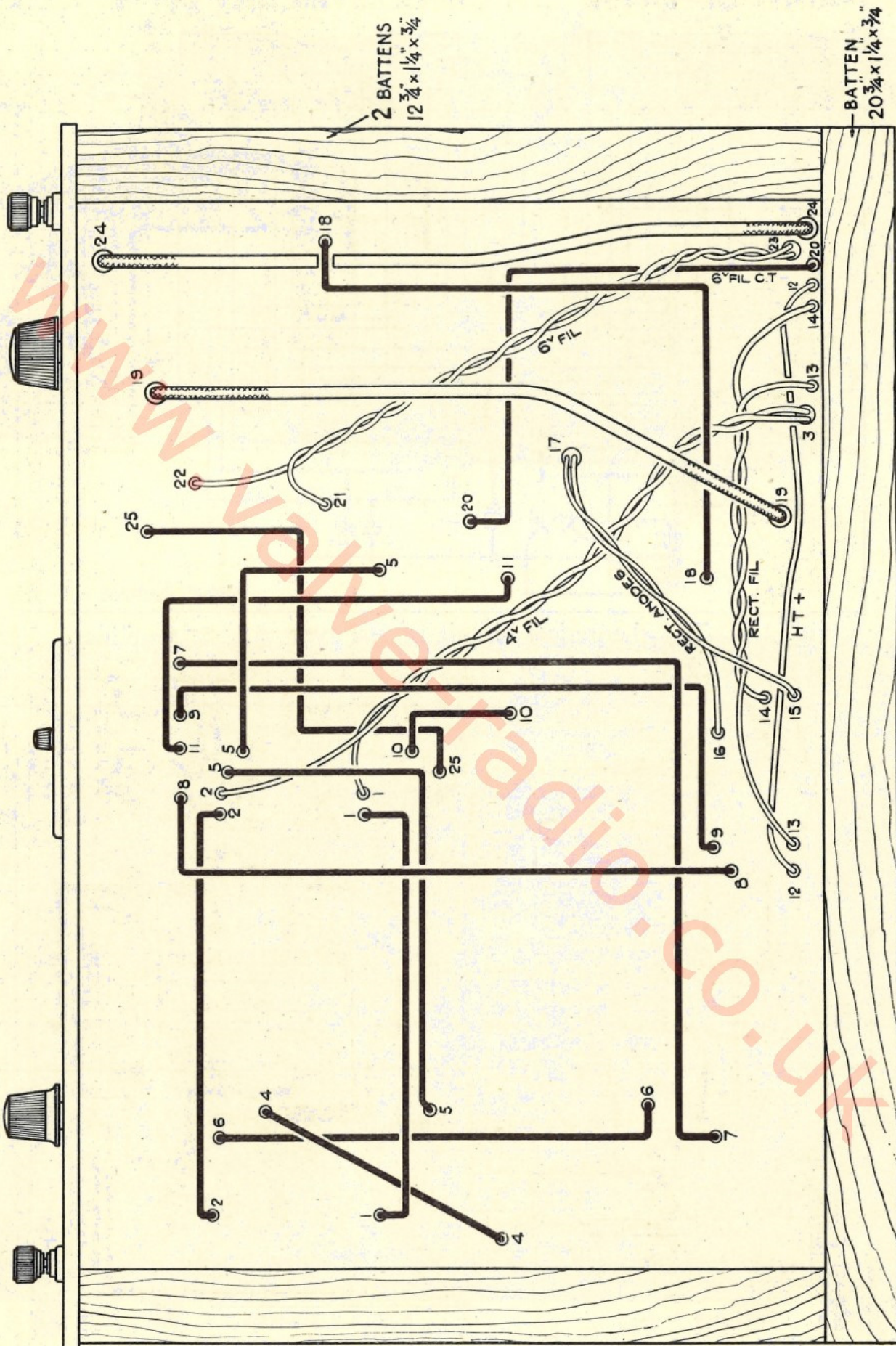


Fig. 12. The under baseboard wiring of the type A.C. 5 Amplifier.



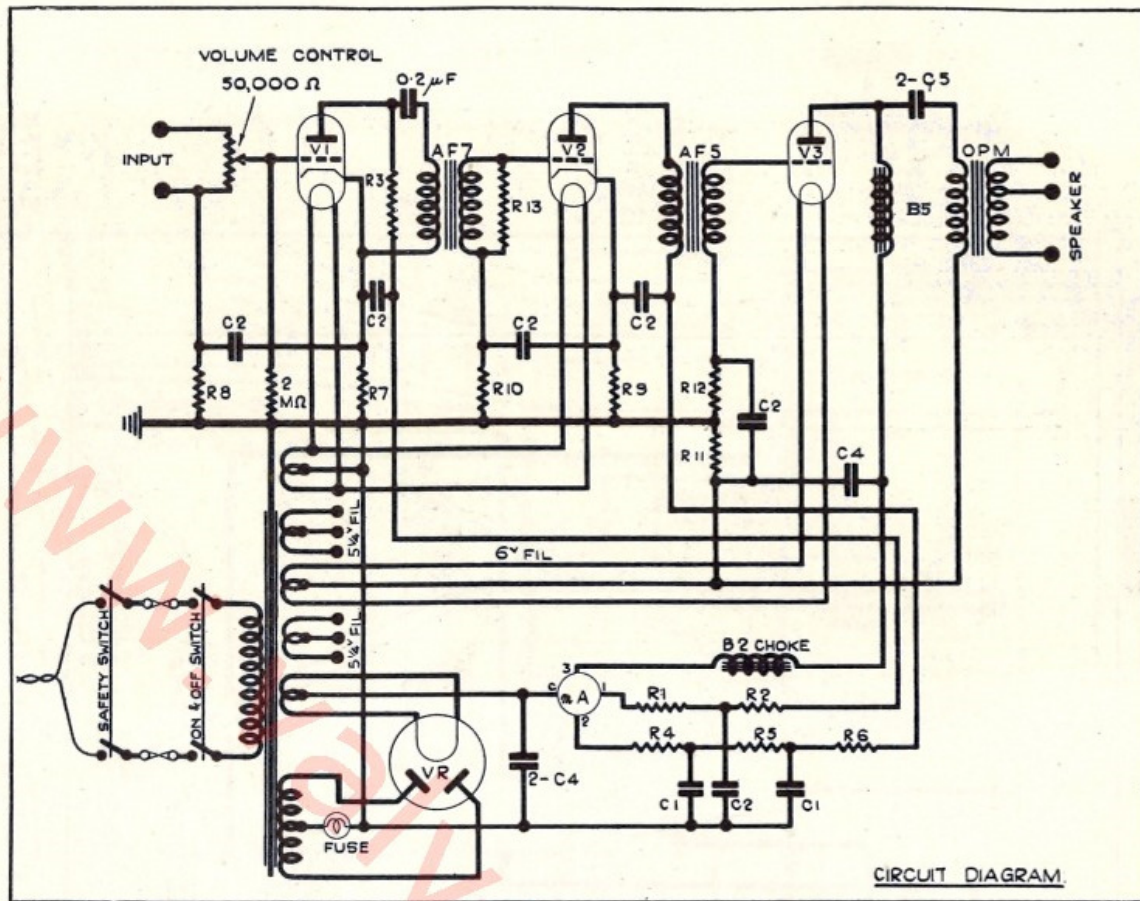


Fig. 13. The theoretical circuit of the type A.C. 5 Amplifier.

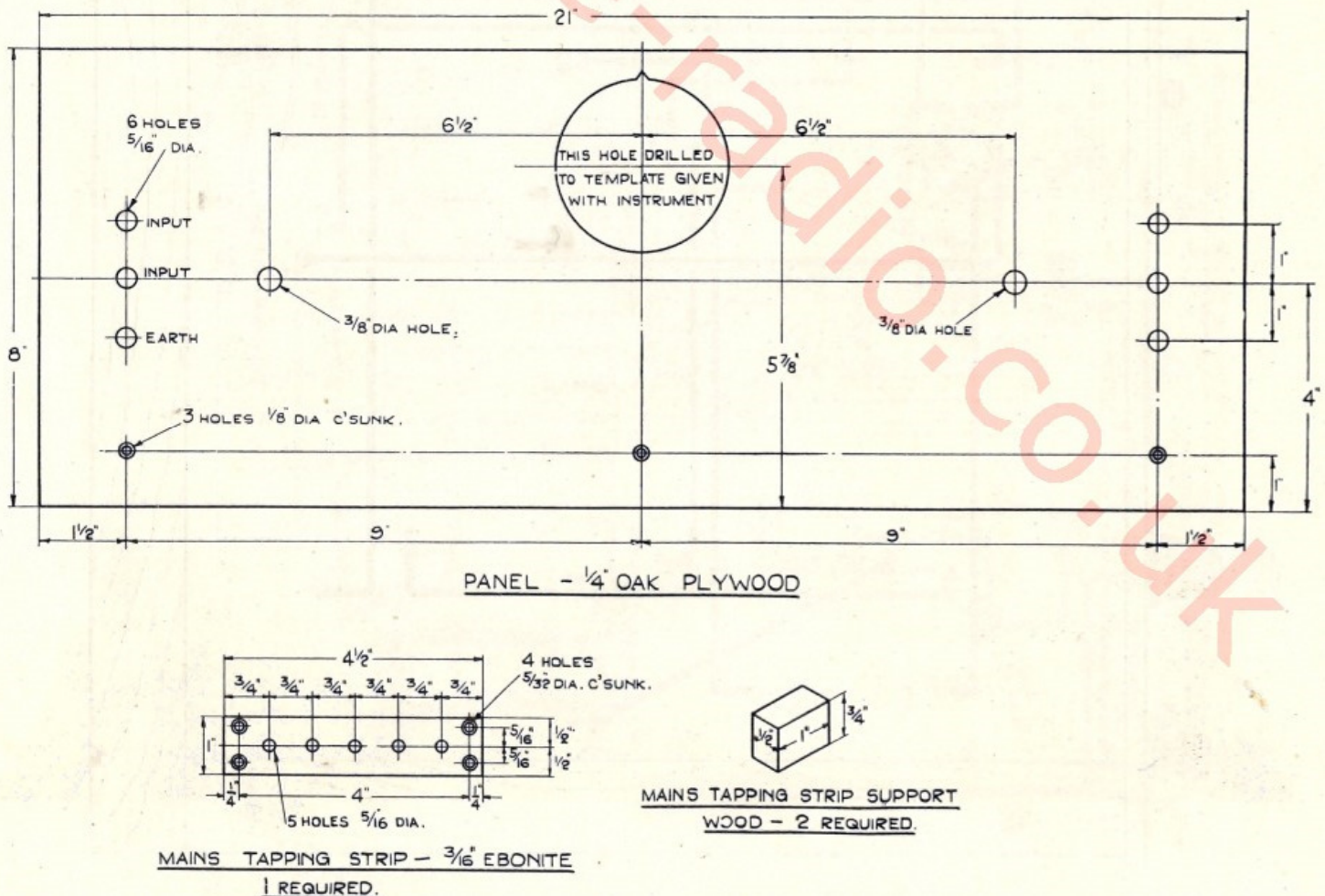


Fig. 14. The dimensions and drilling particulars of the panel and mains tapping strip for the type A.C. 5 Amplifier.





Fig. 15. A.C. Mains Amplifiers, Types A.C.5 and A.C.6. Exterior view.

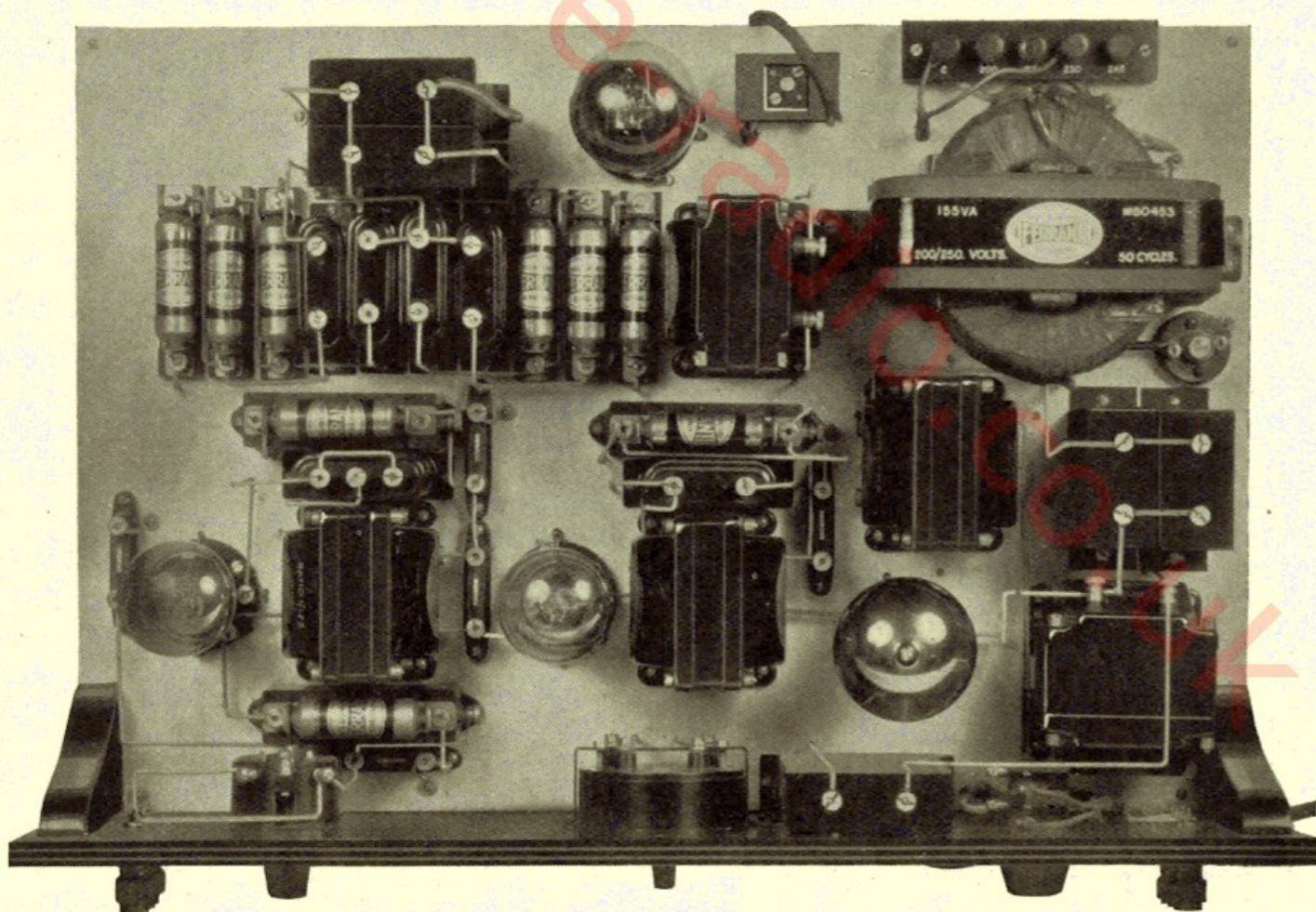


Fig. 16. A.C. Mains Amplifier, Type A.C.5. Interior view.



COMPONENTS REQUIRED FOR STRAIGHT A.C. AMPLIFIER, TYPE A.C.5.

	£	s.	d.
1 - FERRANTI Mains Transformer, type SV10, 160 v.a., 200/250 volts 40/60 cycles ...	4	10	0
1 - FERRANTI AF7 Transformer, ratio 1/1.75 ...	1	10	0
1 - FERRANTI AF5 Transformer, ratio 1/3.5 ...	1	10	0
1 - FERRANTI Multi-ratio Output Transformer. Type to suit Speaker and Valves (see Note)	1	2	6
1 - FERRANTI Output Choke, type B5 ...	1	7	6
1 - FERRANTI Choke, type B2 ...	1	1	0
3 - FERRANTI Anode Feed Units, type 1, without Resistances ... @ 4/3 each	12	9	
2 - FERRANTI Wire-Wound Resistances without Holders, 650 ohms each, @ 3/- each	6	0	
2 - FERRANTI Wire-Wound Resistances, with Holders, 30,000 ohms each, @ 4/- each	8	0	
4 - FERRANTI Wire-Wound Resistances, with Holders, 15,000 ohms each, @ 4/- each	16	0	
1 - FERRANTI Power Resistance, 1,500 ohms, without Holder ...	5	0	
2 - FERRANTI Moulded Resistances, 100,000 ohms each, with Holders ... @ 2/- each	4	0	
1 - FERRANTI Moulded Resistance, with Holder, 50,000 ohms ...	2	0	
1 - FERRANTI Moulded Resistance, with Holder, 125,000 ohms ...	2	0	
1 - FERRANTI Moulded Resistance, with Holder, 2 megohms ...	2	0	
2 - FERRANTI 4-pin Valve Holders ... @ 1/3 each	2	6	
1 - FERRANTI 5-pin Valve Holder ...	1	6	
3 - FERRANTI 2-mfd. Condensers, type C4, 2,250 volts D.C. test ... @ 9/6 each	1	8	6
2 - FERRANTI 2-mfd. Condensers, type C5, 1,500 volts D.C. test ... @ 7/- each	14	0	
2 - FERRANTI 2-mfd. Condensers, type C1, 1,050 volts D.C. test ... @ 4/9 each	9	6	
3 - FERRANTI 2-mfd. Condensers, type C2, 750 volts D.C. test ... @ 3/3 each	9	9	
1 - FERRANTI 2-mfd. Condenser, type C3c, 2 x 0.1 mfd, 1,200 volts D.C. test ...	3	0	
1 - FERRANTI Double Pole Safety Switch, with Double Pole Fuses ...	7	6	
1 - FERRANTI 3-way Flush Type Moving Coil Milliammeter, reading 0-12-12-120 milliamps.; List No. 155SF ...	2	15	0
1 - "Wearite" Mains Switch, Double Pole type G42, with Terminals ...	2	6	
1 - "Watmel" Wire-Wound Volume Control Potentiometer, 50,000 ohms ...	5	6	
1 - 5-pin Anti-microphonic Valve Holder, "Artic" type (Manufacturers: The Artic Fuse and Electrical Manufacturing Company, Limited, Birtley, Co. Durham) ...	2	9	
<i>Note: In the event of difficulty being experienced in obtaining this Valve Holder, a standard FERRANTI 5-pin Valve Holder may be employed.</i>			
6 - "Belling Lee" type "B" Terminals, marked:—3 Output, 2 Input, and 1 Earth. @ 6d. each	3	0	
5 - "Belling Lee" ditto, type "R," plain ... @ 3d. each	1	3	
1 - Ebonite Terminal Strip, 4½ in. x 1 in. x ¼ in ... say		6	
2 - Panel Brackets ... say 6d. each	1	0	
1 - "Magnum" H.T. Auto Fuse, with 0.5 amp. Fuse Bulb ...	1	3	
1 - Panel, 21 in. x 8 in. x ¼ in. Dry polished 3-ply or similar wood ... say	1	0	
1 - Baseboard, 20¾ ins. x 14 ins. x ½ in. Wood ... say		6	
1 - Copper or Aluminium Sheet to cover Baseboard, 20¾ ins. x 14 ins. x .04 in. ... say	2	0	
Quantity of ⅜ in. and ½ in. No. 4's round head brass wood screws ... } say		6	
Quantity of ½ in. No. 4's counter-sunk head brass wood screws ... }			
Quantity of insulated 18's gauge Copper Wire, or Tinned 18's gauge Copper Wire and Systoflex (about 40 ft.) ... say	1	0	
Price, exclusive of Valves and Cabinet ...	£21	12	9

The following are the Valves required, and no other types should be employed unless their characteristics are identical.

	£	s.	d.
2 - "Marconi" MHL4 Valves ... @ 15/- each	1	10	0
1 - "Marconi" LS6a Valve ...	1	10	0
1 - "Marconi" Rectifying Valve, type U14 ...	1	2	6

Total price, including Valves, but exclusive of Cabinet ... £25 15 3



The undermentioned are the values and positions of the various FERRANTI Resistances shewn in Figs. 11 and 12.

R1.	30,000 ohms	Wire-Wound.
R2.	30,000 ohms	Wire-Wound.
R3.	15,000 ohms	Wire-Wound.
R4.	15,000 ohms	Wire-Wound.
R5.	15,000 ohms	Wire-Wound.
R6.	15,000 ohms	Wire-Wound.
R7.	650 ohms	Wire-Wound.
R8.	100,000 ohms	Moulded.
R9.	650 ohms	Wire-Wound.
R10.	100,000 ohms	Moulded.
R11.	1,500 ohms	Power type.
R12.	50,000 ohms	Moulded.
R13.	125,000 ohms	Moulded.

#### OUTPUT TRANSFORMER REQUIRED.

The ratio of the Output Transformer required naturally depends on the Output Valves used, and the impedance of the Speaker employed, but, in general, with high-resistance Speakers of the ordinary Cone or Inductor type, as well as high-resistance Moving Coil Speakers, the FERRANTI type OPM1 will be suitable, whilst with low impedance Moving Coil Speakers, such as the FERRANTI Moving Coil Speaker, the OPM6 will generally be necessary.

Full details regarding all FERRANTI straight Output Transformers, together with details for estimating Output Transformer ratios in special cases are given in our Push-Pull list, No. W.512, which will be forwarded on request.



A.C. MAINS OPERATED AMPLIFIER—PUSH-PULL TYPE A.C.6.

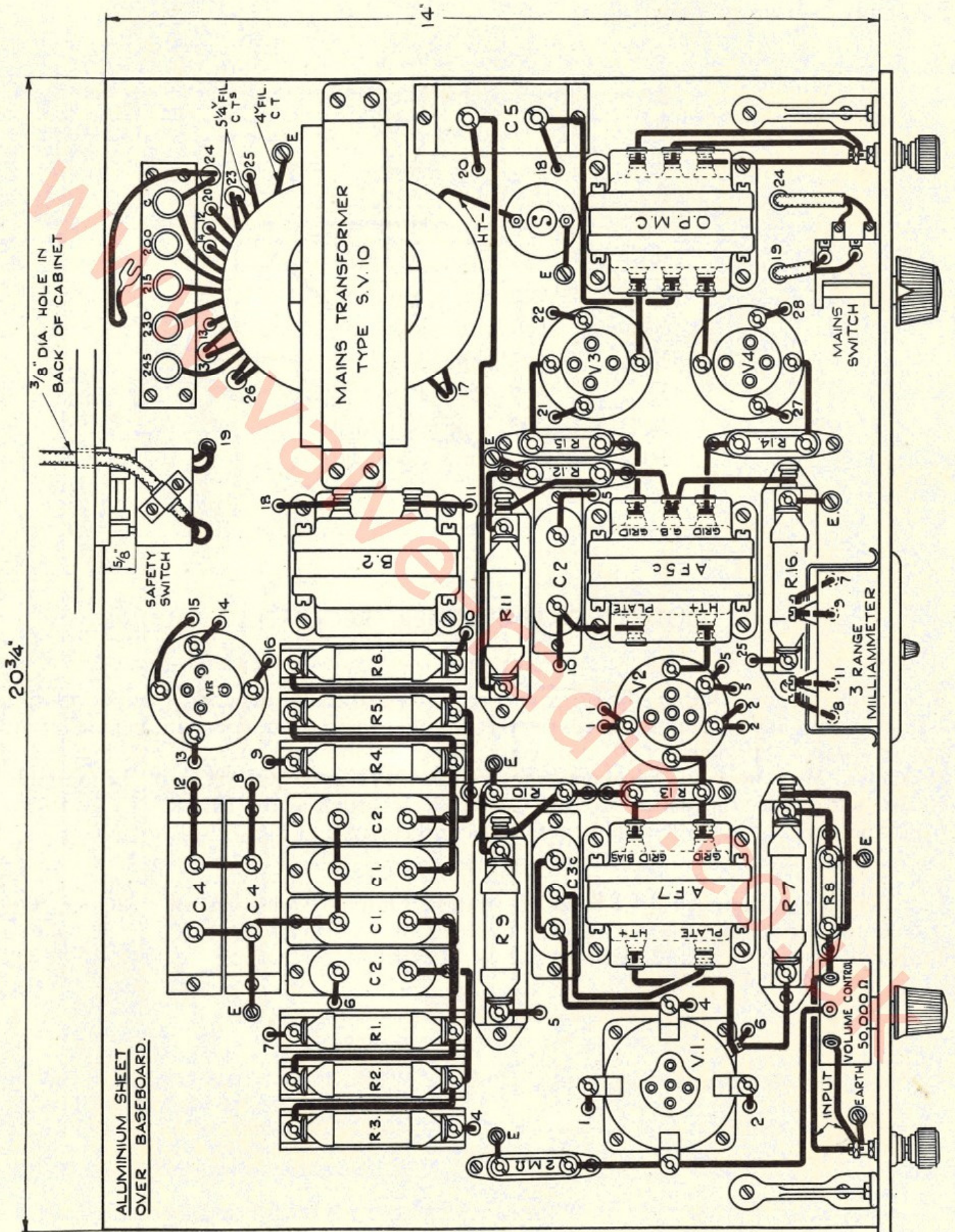


Fig. 17. The lay-out and wiring of the components of the type A.C. 6 Amplifier.



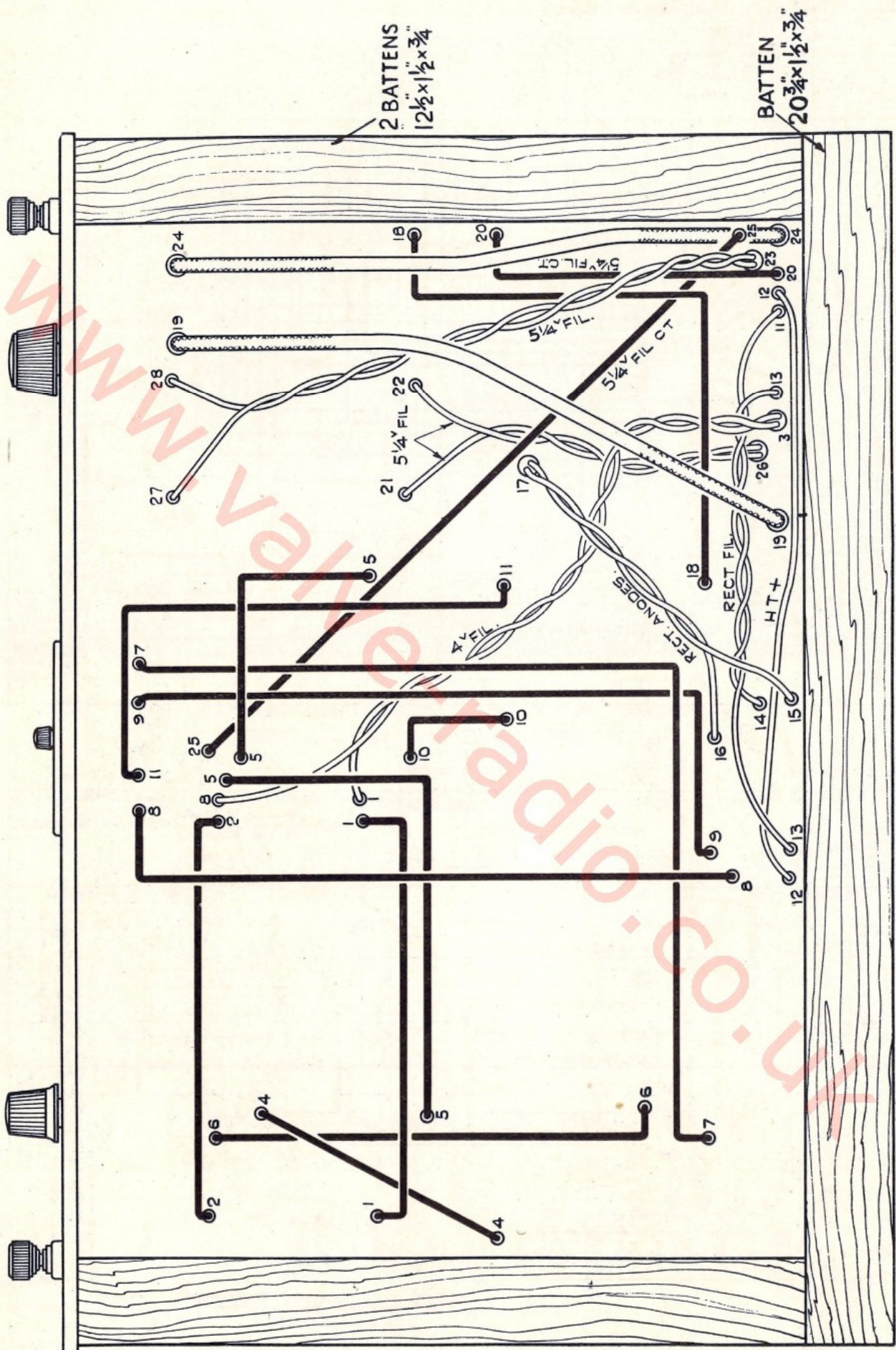


Fig. 18. The under baseboard wiring of the type A.C. 6 Amplifier.



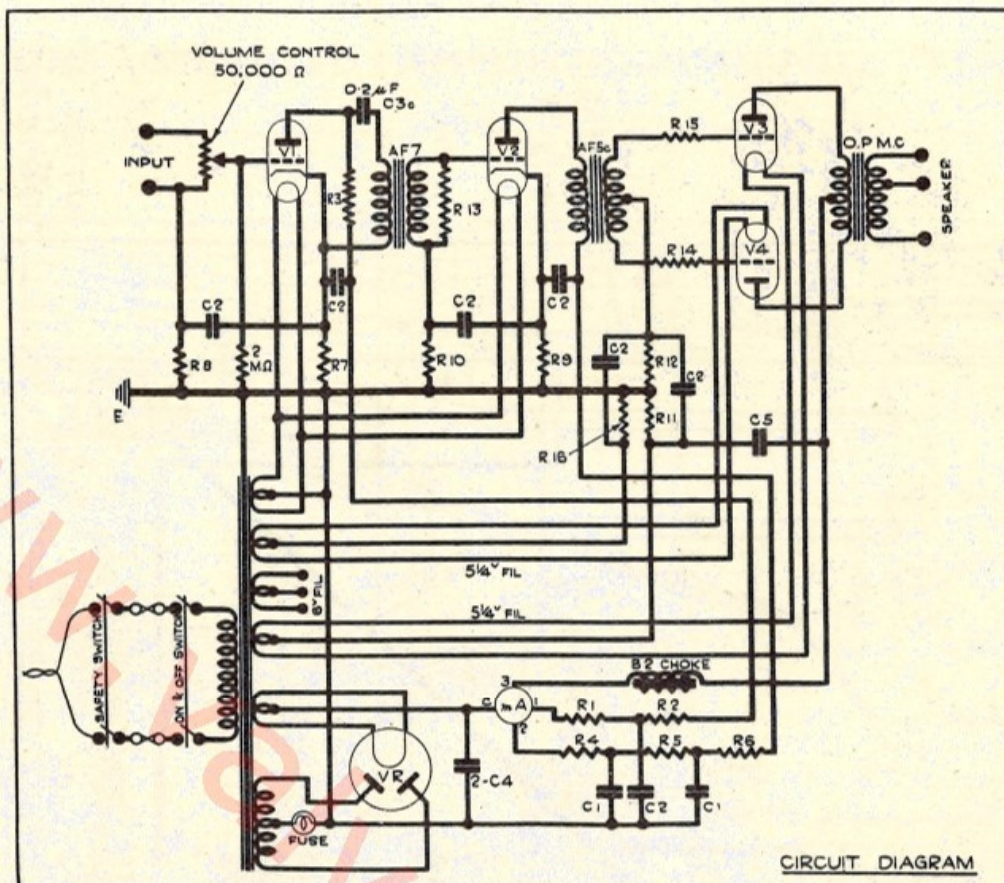
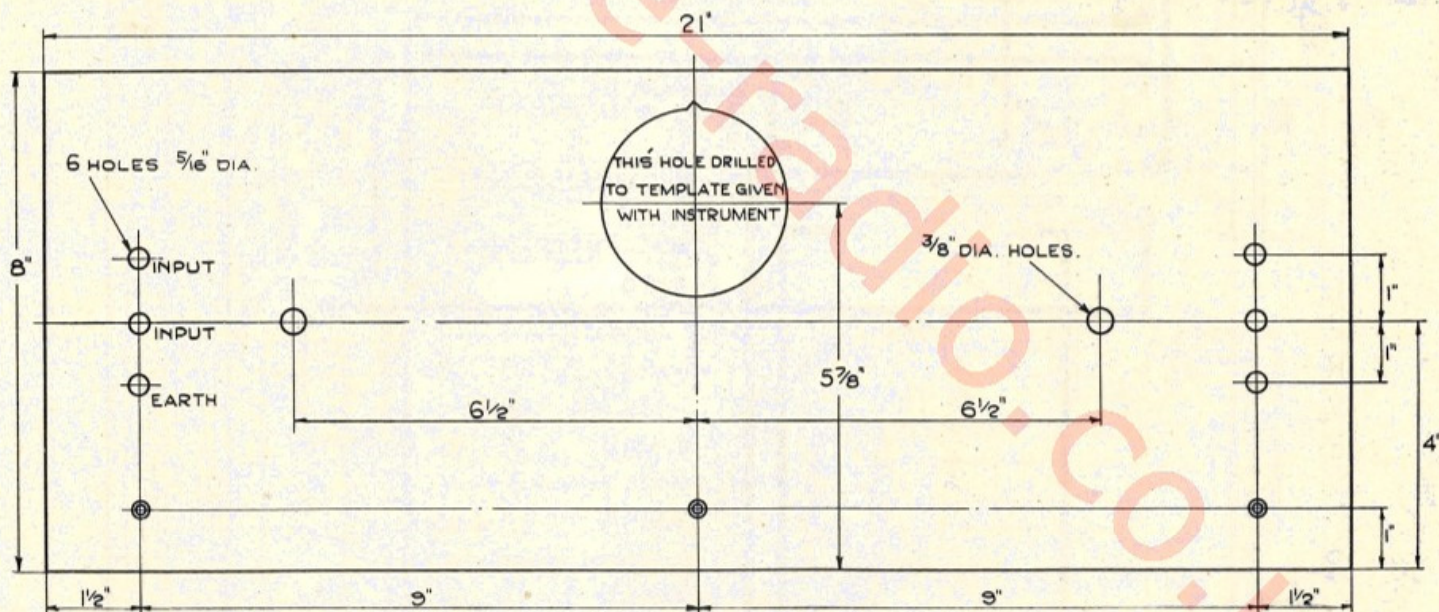
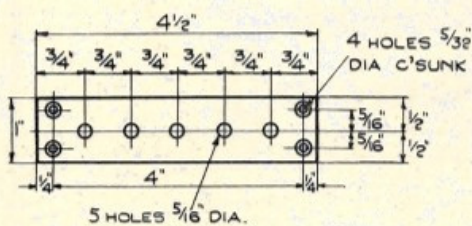


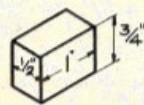
Fig. 19. The theoretical circuit of the type A.C. 6 Amplifier.



PANEL - 1/4" OAK PLYWOOD.



MAINS TAPPING STRIP - 3/16" EBONITE.  
1 REQUIRED.



MAINS TAPPING STRIP SUPPORT  
WOOD - 2 REQUIRED.

Fig. 20. The dimensions and drilling particulars of the panel and mains tapping strip for the type A.C. 6 Amplifier.



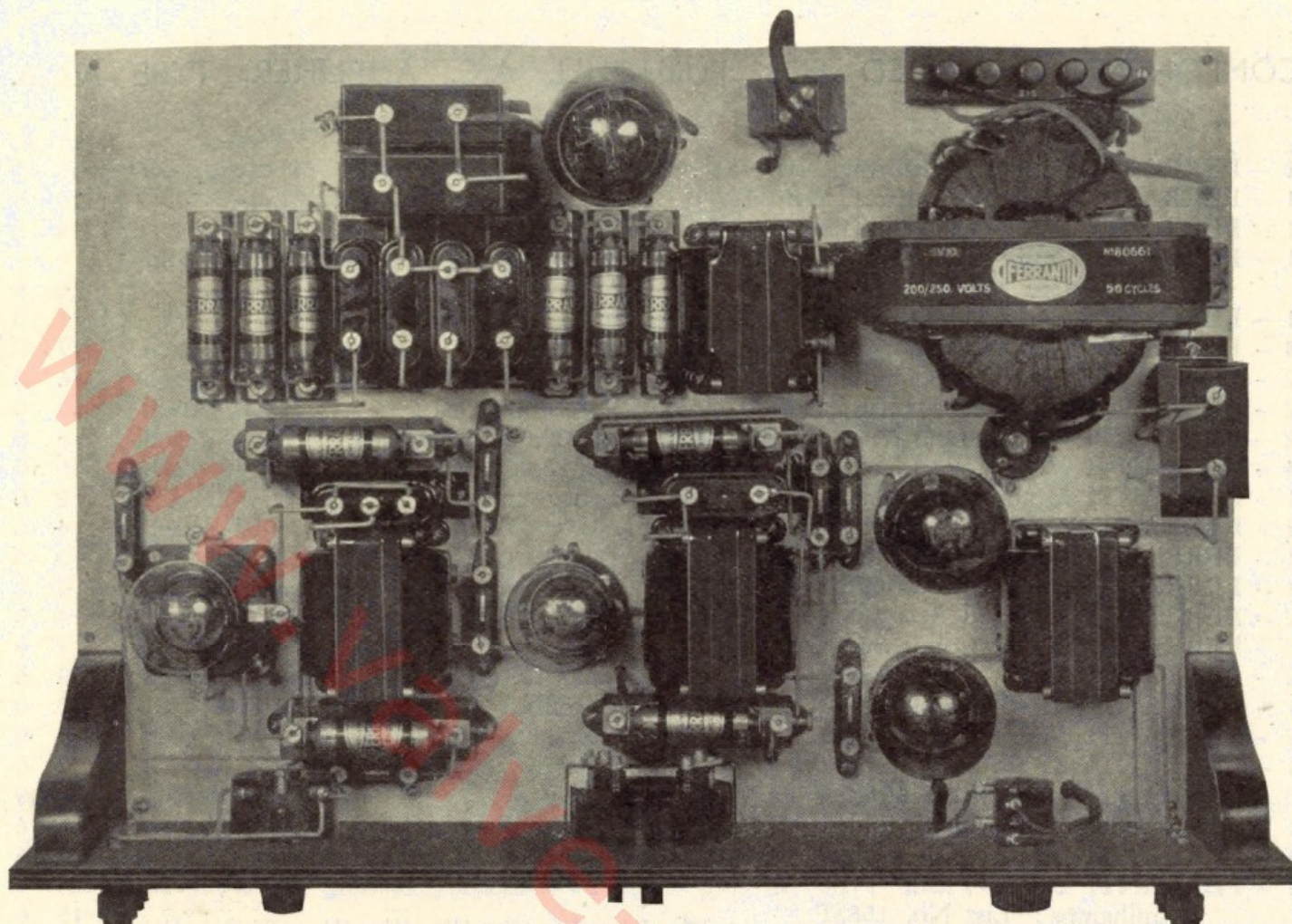


Fig. 21. A.C. Mains Amplifier, Type A.C.6. Interior view.  
Exterior view similar to Type A.C.5.

The undermentioned are the values and positions of the various FERRANTI Resistances shewn in Figs. 17 and 18.

R1.	30,000 ohms	Wire-Wound.	R9.	650 ohms	Wire-Wound.
R2.	30,000 ohms	Wire-Wound.	R10.	100,000 ohms	Moulded.
R3.	15,000 ohms	Wire-Wound.	R11.	3,000 ohms	Power type.
R4.	15,000 ohms	Wire-Wound.	R12.	50,000 ohms	Moulded.
R5.	15,000 ohms	Wire-Wound.	R13.	125,000 ohms	Moulded.
R6.	15,000 ohms	Wire-Wound.	R14.	25,000 ohms	Moulded.
R7.	650 ohms	Wire-Wound.	R15.	25,000 ohms	Moulded.
R8.	100,000 ohms	Moulded.	R16.	3,000 ohms	Power type.

#### OUTPUT TRANSFORMER REQUIRED.

The ratio of the Output Transformer required naturally depends on the Output Valves used and the impedance of the Speaker employed, but, in general, with high-resistance Speakers of the ordinary Cone or Inductor type, as well as high-resistance Moving Coil Speakers, the FERRANTI type OPM1c will be suitable, whilst the low impedance Moving Coil Speakers, such as the FERRANTI Moving Coil Speaker, the OPM6c will generally be necessary.

Full details regarding all FERRANTI Push-Pull Transformers, together with details for estimating Output Transformer ratios in special cases are given in our Push-Pull list, No. W.512, which will be forwarded on request.



COMPONENTS REQUIRED FOR PUSH-PULL A.C. AMPLIFIER, TYPE A.C.6.

	£	s.	d.
1 - FERRANTI Mains Transformer, type SV10, 160 v.a. 200/250 volts 40/60 cycles ...	4	10	0
1 - FERRANTI AF7 Transformer, ratio 1/1.75 ...	1	10	0
1 - FERRANTI AF5c Push-Pull Transformer, ratio 1/3.5 ...	1	14	0
1 - FERRANTI Multi-ratio Push-Pull Output Transformer. Type to suit Speaker and Valves (see Note) ...	1	6	6
1 - FERRANTI Choke, type B2 ...	1	1	0
4 - FERRANTI Anode Feed Units, type 1, without Resistances ... @ 4/3 each		17	0
2 - FERRANTI Wire-Wound Resistances, without Holders, 650 ohms each, @ 3/- each		6	0
2 - FERRANTI Power Resistances, without Holders, 3,000 ohms each ... @ 5/- each		10	0
2 - FERRANTI Wire-Wound Resistances, with Holders, 30,000 ohms each, @ 4/- each		8	0
4 - FERRANTI Wire-Wound Resistances, with Holders, 15,000 ohms each, @ 4/- each		16	0
1 - FERRANTI Moulded Resistance, with Holder, 2 megohms ...		2	0
2 - FERRANTI Moulded Resistances, with Holders, 100,000 ohms each ... @ 2/- each		4	0
1 - FERRANTI Moulded Resistance, with Holder, 125,000 ohms ...		2	0
1 - FERRANTI Moulded Resistance, with Holder, 50,000 ohms ...		2	0
2 - FERRANTI Moulded Resistances, with Holders, 25,000 ohms ... @ 2/- each		4	0
3 - FERRANTI 2-mfd. Condensers, type C2, 750 volts test ... @ 3/3 each		9	9
2 - FERRANTI 2-mfd. Condensers, type C1, 1,050 volts D.C. test ... @ 4/9 each		9	6
1 - FERRANTI 2-mfd. Condenser, type C3c, 2 x 0.1 mfd., 1,200 volts D.C. test ...		3	0
2 - FERRANTI 2-mfd. Condensers, type C4, 2,250 volts D.C. test ... @ 9/6 each		19	0
1 - FERRANTI 2-mfd. Condenser, type C5, 1,500 volts D.C. test ...		7	0
3 - FERRANTI 4-pin Valve Holders ... @ 1/3 each		3	9
1 - FERRANTI 5-pin Valve Holder ...		1	6
1 - FERRANTI Double Pole Safety Switch, with Double Pole Fuses ...		7	6
1 - FERRANTI 3-way Flush Type Moving Coil Milliammeter, reading 0-12-12-120 milliamps; List No. 155SF ...	2	15	0
1 - 5-pin Anti-microphonic Valve Holder, "Artic" type. (Manufacturers: The Artic Fuse and Electrical Manufacturing Company, Limited, Birtley, Co. Durham) ...		2	9
<i>Note: In the event of difficulty being experienced in obtaining this Valve Holder, a standard FERRANTI 5-pin Valve Holder may be employed.</i>			
1 - "Wearite" Mains Switch, Double Pole type G42, with Terminals ...		2	6
1 - "Watmel" Wire-Wound Volume Control Potentiometer, 50,000 ohms ...		5	6
1 - "Magnum" H.T. Auto Fuse, with 0.5 amp. Fuse Bulb ...		1	3
6 - "Belling Lee" type "B" Terminals, marked:—3 Output, 2 Input, and 1 Earth. @ 6d. each		3	0
5 - "Belling Lee" type "R" Terminals, plain ... @ 3d. each		1	3
2 - Panel Brackets ... say 6d. each		1	0
1 - Ebonite Terminal Strip, 4½ ins. x 1 in. x ¼ in. ... say		6	
1 - Panel, 21 ins. x 8 ins. x ½ in. Dry polished 3-ply or similar Wood ... say		1	0
1 - Baseboard, 20¾ ins. x 14 ins. x ½ in. ... say		6	
1 - Copper or Aluminium Sheet to cover Baseboard, 20¾ ins. x 14 ins. x .04 in., say		2	0
Quantity of ⅜ in. and ½ in. No. 4's round head brass wood screws ... } say		6	
Quantity of ½ in. No. 4's counter-sunk head brass wood screws ... }			
Quantity of insulated 18's gauge Copper Wire, or Tinned 18's gauge Copper Wire and Systoflex (about 40 ft.) ... say		1	0
Approximate price, exclusive of Valves and Cabinet ...	£20	11	3

The following are the Valves required, and no other types should be employed unless their characteristics are identical.

	£	s.	d.
2 - "Marconi" MHL4 Valves ... @ 15/- each	1	10	0
2 - "Marconi" LS5a Valves ... @ 25/- each	2	10	0
1 - "Marconi" Rectifying Valve, type U14 ...	1	2	6

Total price, including Valves, but exclusive of Cabinet ... £25 13 9



CABINETS.

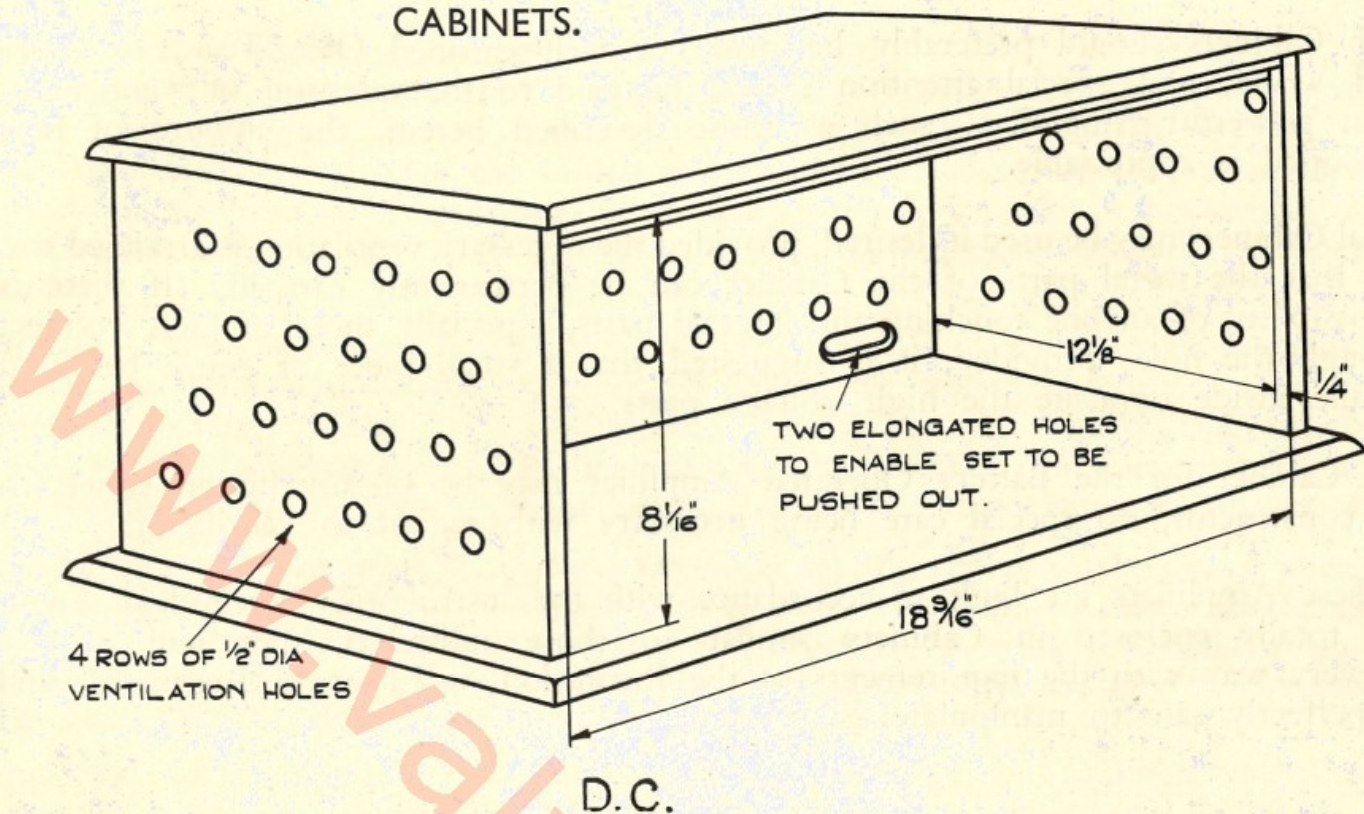


Fig. 22. The dimensions of a Cabinet suitable for the D.C. Mains operated Amplifier, type D.C.2. The L.T. Resistance should be mounted on the back of the Cabinet or in some other convenient position exterior to the Cabinet.

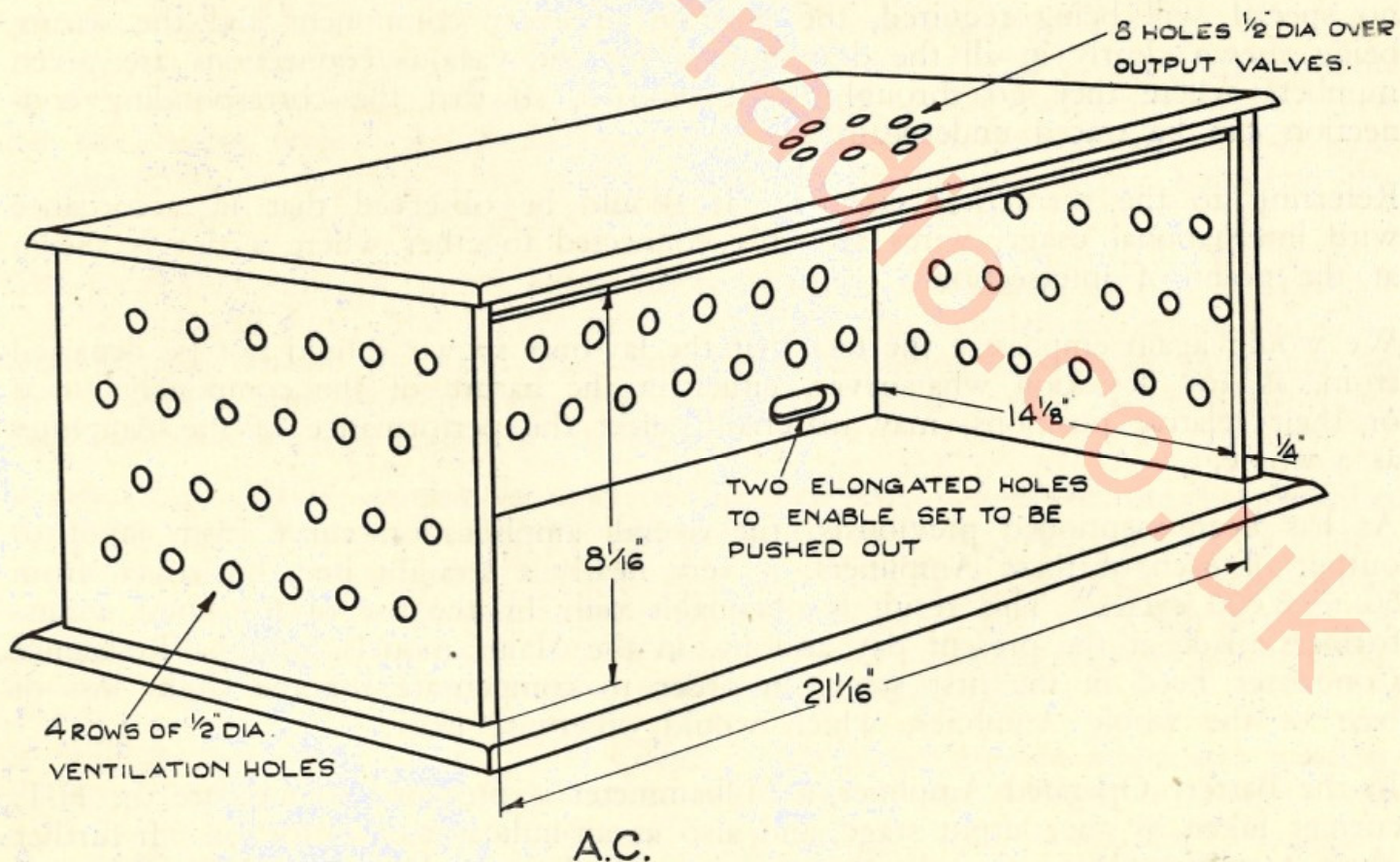


Fig. 23. The dimensions of a Cabinet suitable for containing the A.C. Mains Amplifiers, types A.C.5 and A.C.6.



Both Cabinets should preferably be made of well-seasoned Oak, Teak, or other hard wood, and special attention should be paid to the question of ventilation, as in powerful Amplifiers, such as those described herein, the amount of heat developed is appreciable.

Metal Cabinets may be used if desired, provided the necessary ventilation is arranged for, and that the metal parts of the Cabinet can be permanently earthed. If there is a possibility of anyone touching the internal parts, especially those of high voltage, through the holes provided, it is suggested that a small piece of gauze be fitted on the inside opposite the high voltage parts.

The Cabinet for the Battery Operated Amplifier may be of any design suited to the constructor, no special care being necessary with regard to ventilation.

If these Amplifiers are built in accordance with the instructions herein laid down, and totally enclosed in Cabinets similar to those indicated, they will comply in every way with the requirements of the Institution of Electrical Engineers, and be perfectly safe to manipulate.

## GENERAL.

The construction of any of these Amplifiers is perfectly simple and straightforward, no special skill being required, the position of every component and the wiring being shewn clearly in all the drawings, whilst the various connections are given numbers where they go through the baseboard, so that the corresponding connection can be traced underneath.

Referring to the theoretical circuits; It should be observed that in accordance with international usage, wires are only connected together where a dot is shewn at the point of intersection.

We would again emphasize the fact that the lay-outs shewn should not be departed from, as any deviation whatsoever, either in the nature of the components used or their relative positions, may materially affect the performance of the Amplifier as a whole.

As has been mentioned previously, the overall amplification curve from input to output of each of these Amplifiers, is very nearly a straight line, horizontal from 50 to 8,000 cycles. This result is obtainable only by the use of the finest Transformers made at the present day, and by, in the Mains models, using a Resistance Condenser Feed in the first stage, in order to compensate for the slight loss of bass of the whole Amplifier, which would otherwise exist.

In the Battery Operated Amplifier, a Milliammeter is provided to measure the H.T. current taken by the output stage, and also as an indicator of distortion. It further gives a continual visual indication of the state of the H.T. and L.T. Batteries, as well as of the emission of the Output Valves, and also enables the Output Transformer ratio to be chosen to give the optimum result.



The choice of the correct Output Transformer ratio is made as follows:—  
Assuming that the correct H.T., L.T. and Grid Bias voltages are being applied to the output valves, in accordance with their maker's instructions, then if when the Amplifier is overloaded the Milliammeter needle kicks persistently in an upward direction, the Output Transformer ratio is too low. If it kicks persistently in a downward direction, the ratio is too high, and the necessary alteration should be made.

The D.C. Mains Operated Amplifier is provided with a Voltmeter, which is connected across the valve heaters and filaments, to enable the voltages on the valves to be adjusted precisely. This is very important on D.C. mains, the voltage of which often varies as much as 10/15% during a day, and it should be borne in mind that a 5% over-running of the filament or the cathode of a valve may reduce its life by 50%.

Before switching on the D.C. Mains Amplifier, set the slider on the mains resistance right to one end as far as it will go, then, after switching on, slide gently along until the reading on the Voltmeter on the panel is 24 volts. The slider on the resistance should be moved as may be necessary from time to time to compensate for appreciable variations in the mains supply voltage.

The D.C. Mains Amplifier, as well as both the A.C. Mains Amplifiers, is provided with a special 3-way FERRANTI Milliammeter, which has been developed particularly for use in Amplifiers of this kind. The FERRANTI 3-way Milliammeter has three ranges, and is provided with a switch which enables the instrument to indicate the H.T. current taken by each stage of the Amplifier in turn. The movement of the instrument switch changes the range of the instrument at the same time, so that for the first and second stages the Instrument may read 0/6 or 0/12 milliamps, according to the particular instrument used, whilst the third position of the Instrument switch enables a reading of up to 120 milliamps to be taken for the output stage. In Mains Operated Amplifiers an Instrument of this kind is invaluable, as it gives an immediate check on all the Amplifying Valves in the Receiver, and enables any fault to be remedied immediately.

The Grid Bias supplies, in all cases, are thoroughly de-coupled, and in the case of the Battery and D.C. Mains energized Amplifiers, the Condensers across the Grid Bias batteries enable the Grid Bias tappings to be adjusted without switching off the Amplifier, and without damaging the Output Valves, thus enabling the Grid Bias adjustments most readily to be made.

In the A.C. Mains Amplifiers, and in the first two stages of the D.C. Mains Amplifier, Grid Bias is obtained by the automatic method, using suitable resistance in the cathode return leads. In the case of the A.C.6 Push-Pull Amplifier, an unusual arrangement is provided, each Output Valve being fed from a separate filament winding and provided with a separate bias resistance, so that in the event of one valve failing the other valve will not be destroyed.

It will be observed that the SV10 Mains Transformer has an additional winding giving 6 volts, this being required in the case of the Straight Amplifier, type A.C.5, the  $5\frac{1}{4}$  volt winding being used only for the A.C.6 Amplifier. According to which Amplifier is being constructed, the leads not required should be taped up, so as not to get short-circuited.



## OPERATION.

There are few special points to watch in connection with the operation of these Amplifiers, which have been designed so as to be very easy to manipulate.

In all the Amplifiers, the Valves should be fitted in their appropriate positions, a good earth connection being desirable in all cases, except sometimes in the case of the D.C. Mains Amplifier, when, owing to the peculiarities that are met with, in connection with D.C. supplies, the omission of the earth connection is sometimes an advantage. The Mains Operated Amplifiers will usually take from half a minute to one minute to get into operating condition, or while their valves are heating up.

It should be noted that in every Amplifier, it is possible, with a suitable input, to overload the output valves, and in certain cases it will be desirable to turn up the Volume Control only from one quarter to one half of the maximum permissible.

The Marconiphone, or similar good Pickup, giving a fairly large input, is recommended, and if the position of the Pickup and its Turntable is an appreciable distance from the Amplifier, the leads between the Pickup and the Amplifier should be lead or otherwise metal sheathed, the sheathing being earthed, to prevent pickup of stray interference. In such a case, if preferred, the 50,000 ohm Volume Control may be mounted with the Pickup and Turntable, instead of on the Amplifier panel, as shewn.

If desired, any of these Amplifiers may form the detector and low frequency portions of powerful, high quality Radio Receivers; in each case the Valve V1 would then be the detector. If the detector is arranged for grid detection, it is recommended that the Grid Condenser be .00015 mfd., and the Grid Leak 0.5 megohms.

The Mains Operated Amplifiers are also suitable for use in connection with Television reception, where large power output, undistorted over a wide range of frequencies, is an essential.

**If the Amplifiers are built in accordance with the instructions herein, and are correctly manipulated in conjunction with good Pickups and good Moving Coil Speakers, the reproduction obtainable is as good as the present knowledge of the science of musical reproduction permits.**

*Canadian Factory :*  
FERRANTI ELECTRIC  
LIMITED,  
TORONTO, ONTARIO, CANADA.

*Head Office and Works :*  
FERRANTI LTD.,  
HOLLINWOOD,  
LANCASHIRE.

*Office and Depot :*  
FERRANTI INC.,  
130, WEST 42ND STREET,  
NEW YORK, N.Y.

*Office and Depot :*  
BUSH HOUSE, ALDWYCH, LONDON, W.C.2.