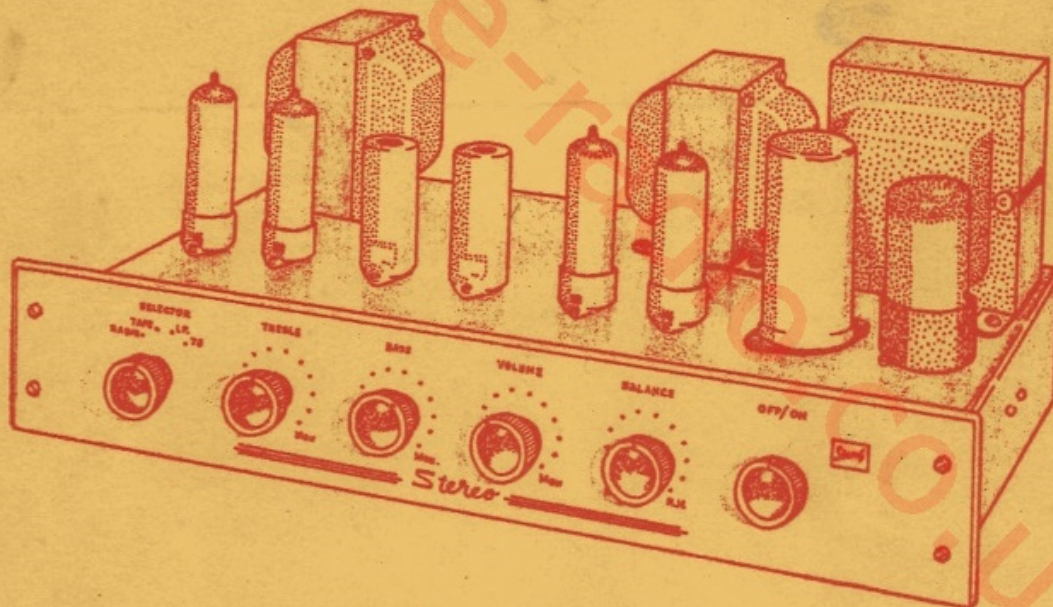


Stern's

COMPLETE ASSEMBLY DATA AND DIAGRAMS FOR THE CONSTRUCTION OF THE "10 PLUS 10" STEREOPHONIC POWER AMPLIFIER WITH MATCHING CONTROL UNIT

- * Stern's presentation of a MULLARD design.
- * The most advanced audio circuitry available. Based on the well known MULLARD 5-10.
- * Reproduction of the highest fidelity.
- * Naturally the choice for the Connoisseur.
- * Simple stage by stage assembly drawings for the "do it yourself" enthusiast.

THE TEN-PLUS-TEN WITH CONTROL UNIT



! 10 Watts per channel.

! Detachable Control Unit. Optional.

! Frequency Response 3 c/s to 60 Kc/s at 50 mW.

! Total Harmonic Distortion better than 0.2%

! Intermodulation distortion at IOW = 0.6%

STERN - CLYNE

LIMITED

Incorporating Stern Radio - Premier Radio - Clyne Radio

Head Office and Mail Order Dept.: 3-5, Eden Grove, Holloway, London, N.7. Tel.: North 8161/6

3/-

INTRODUCTION ...

The new Mullard triode-pentode valve - the ECI86 is designed specifically for AUDIO applications, and is particularly suitable for use in STEREOPHONIC Amplifiers. It has a high overall gain, achieved partly by a high amplification factor in the triode section and by a high value of mutual conductance in the pentode section. This together with other outstanding design features, make it very suitable to incorporate in modern "high quality circuits".

The "10 plus 10" Watt Stereophonic Power Amplifier circuit is the latest audio design by the MULLARD Applications Research Laboratory, and has been produced specifically to utilise this new MULLARD valve. The performance of the Amplifier is exceptionally good and it can justifiably be placed in the "High Fidelity" category. The use of the ECI86 valves means that the cost of the Amplifier is considerably less than Amplifiers of similar performance currently available. The circuit described is strictly to the MULLARD specification, and to ensure that the exacting final test specification of a wide frequency response with very low distortion is achieved, only top grade components are used. The Amplifier is built on a soundly constructed aluminium chassis finished in silver hammer, and in incorporates two specially wound GILSON output transformers with sectionalised secondary windings to allow for matching to 3.75 - 7.5 - or 15 ohms loudspeaker loads. Because of the high voltage gain of the ECI86 every consideration has been given to careful layout; this ensures stability and a low hum level as well as ease of construction.

A separate fully comprehensive Passive Control Unit for optional fitting to the Power Amplifier chassis, or for remote fixing to cabinet is also described in this Manual. This small and compact unit incorporates all the controls and switched inputs for Pick-Up, Radio and Tape Replay, assembled in a totally enclosed aluminium case which is finished in silver hammer to match the Amplifier. The sensitivity of the Unit is sufficient for use with Crystal or Ceramic pick-up heads but for the more ambitious installations or if a magnetic pick-up such as the DECCA ffss is to be used, we recommend the use of our MULLARD Dual Channel Pre-Amplifier (Separate publication. STEREOPHONIC Two Stage Dual Channel Pre-Amplifier. Price 3/6d.) which has adequate sensitivity and greater flexibility for all applications. A very attractively designed Perspex front panel completes the presentation of the Control Unit; this is clearly engraved to classify the functions of the controls, and the STERN nameplate is illuminated when the equipment is switched on.

Here then is a most outstanding "High Fidelity" Stereophonic Amplifier that can be used with a choice of either the simple PASSIVE CONTROL UNIT or alternatively the versatile Dual Channel PRE-AMPLIFIER. Engineers will appreciate the high standards of reliability and design efficiency, not only from the circuitry but from its compactness and accessibility. The easy to follow "Stage by Stage" drawings and instructions have been carefully produced for Simplicity. We are confident, therefore, that even the inexperienced constructor will have no difficulty in building the Amplifier and achieving the same degree of technical excellence as the manufactured product.

In conclusion, the quality of reproduction achieved will to a great extent depend on the limitation of the loudspeakers selected. We strongly recommend therefore, that most careful consideration should be given to the importance of purchasing "high quality" Loudspeaker units, even although the cost may appear high compared with the amplifying equipment.

STEREOPHONIC SOUND ...

The word monaural is commonly used to depict conventional sound reproduction in which a single pick-up head is used. Monaural means, literally, of one ear and a monaural effect is that of listening with one ear, where no impressions of space or position are conveyed to the listener. Stereophonic reproduction of sound is the most recent of the many advances which have been made towards realism and fidelity. It must be understood, however, that stereophony is not a new invention. As far back as 1931 E.M.I. engineers perfected a system for the simultaneous recording of two separate sound tracks on a single disc, but due to difficulties in recording techniques, pick-up designs etc., the idea was not then applied commercially. The basic principles of a stereophonic sound system are shown pictorially in Fig. 6 and it will be seen from this that the recording engineer uses two microphones in the same way that we use our ears, each microphone is arranged to make a sound track independent of the other microphone, but at

precisely the same time. If we arrange to listen to one track at a time they would in fact appear to be the same, but there are subtle differences because the microphones are carefully positioned relative to the medium being recorded. Hence stereophonic sound conveys to the listener the exciting senses of movement, the feeling of light and colour of the concert hall. In addition to this a stereophonic system can be operated at a lower level of sound intensity without losing a sense of reality, whereas with monaural system there is often a position in the volume level where the music seems to lose its presence.

LOUDSPEAKERS ...

Only a general guide can be given as to the placement of the loudspeakers to complete the stereophonic sound installation. Much will depend on the type of loudspeakers and cabinets chosen and also on the acoustics of the room in which the equipment is to be used. Some experimenting on the part of the listener will therefore be necessary in positioning the loudspeakers for the best results. The most common successful stereo speaker arrangement, is the one in which the two speakers face outwards from a short wall of the listening room (See Fig. 7) with the speakers between six and twelve feet apart, the actual distance being arrived at by experiment. The optimum position for obtaining the best stereophonic effect will be at a point equidistant from the two speakers. We recommend a good quality stereophonic record to be used for your tests and that the same track or section of the record is used for each change of speaker position. It is also important to ensure that the loudspeakers are correctly phased. This is achieved by reversing the leads connected to one speaker and again conducting the listening test. The speakers are correctly phased when the sound appears to come from a wide source rather than from two separate loudspeakers.

CIRCUIT DESCRIPTION ...

Reference to the theoretical diagrams will show that the circuit is very similar to the well known Monophonic MULLARD 5-10 Amplifier. Only one channel and the COMMON Power Supply are shown in the Theoretical diagrams and similarly only one channel is referred to in the circuit description. The other is identical. The complete Amplifier uses two MULLARD low noise Pentode valves, Type EF86, four MULLARD Audio Triode Pentode valves type ECL86 and a full wave rectifier valve type GZ34. The input sensitivity for an output power of 10 Watts is 2.3 milli-volts without feedback and 23 milli-volts with feedback. The sensitivity of the complete Amplifier with Passive Tone Control Unit is 230 milli-volts. The frequency response and phase shift characteristics of the Power Amplifier are shown in Fig. 1 and referred to in the technical specification. The loop gain and loop phase-shift characteristics are given in Fig. 2.

Input Stage V1L ...

The input stage uses an EF86. The voltage gain of the stage is approximately 120 times. The stage is capacitively coupled to the phase splitter.

Phase Splitter V2L - 3L ...

This stage uses the triode sections of two ECL86 valves in a "long tailed" pair. Fixed bias to the grids is provided by a potential divider across the h.t. supply. The voltage gain is approximately 24 times per half.

Output Stage V2L - 3L ...

The push pull output stage uses the pentode sections of the two ECL86 valves operating under class AB conditions with distributed loading (20% taps). With an anode to anode load of 9K ohms and an anode to cathode voltage of 300 volts the distortion without feedback is less than 2% for outputs up to 10 Watts. Specially manufactured GILSON output transformers are used to comply with the proto-type specification. Total primary inductance 100H, leakage inductance (whole primary with secondary short circuited) 21 mH. The transformer is free from any pronounced resonance up to 50 Kc/s. Sectionalised secondary windings are provided, and allow for matchings to different loudspeaker loads. The prototype Amplifier was arranged for 15 ohms loudspeakers and all test specifications relate to that figure. The output impedance of the Amplifier measured at the 15 ohms terminals is 1.4 ohms for an output of 1 Watt at 1 Kc/s. This low value of output impedance is maintained over the frequency range of 30 c/s to 15 Kc/s. The damping factor is 10.7. The total harmonic distortion with an input signal of 1 Kc/s is plotted against output power in Fig.4.

Negative Feedback ...

Overall negative feedback of approximately 20 dB is applied from secondary winding of the output transformer to the cathode circuit of the input stage. Coupling time constants which are considerably greater than the transformer time constant ensure low-frequency stability. A "phase advance" network in the feedback path gives adequate high-frequency stability.

The Amplifier design is such that more than 17 dB of negative feedback is effective over a frequency range of 30 c/s to 30 Kc/s.

POWER SUPPLIES V4 ...

The power supply which is common to both channels of the amplifier is conventional. It uses a large Mains Transformer (ANDEC) which has a tapped primary winding for operation on 200/250 volt A.C. 50 cycles per second mains supplies. A full wave rectifier MULLARD type GZ34 provides A.C. rectification. A resistive-capacitive network ensures adequate filtering C14 of the triple 50 mfd condenser being connected as the reservoir capacitor; the other two sections C10 L & R provide smoothing for the left and right hand channels respectively. When the Amplifier is used with the Dual Channel Pre-Amplifier, a separate filter network R24-C14 is added. One side of the transformer primary is broken via the octal socket. This provides a convenient point for the connection of the Mains On/Off Switch, normally located in the Control Unit or Pre-Amplifier. An A.C. Mains "take off" block connected across the switched side of the primary winding is terminated on the rear of the chassis, for connecting a gramophone motor. The mains transformer has only sufficient reserve of power to supply the Dual Channel Pre-Amplifier. TUNER UNITS etc. must therefore be supplied by a separate power unit.

The Passive Control Unit ...

Consists of a separate completely enclosed unit which is normally fitted (by six 4BA nuts and bolts) directly to the front of the Power Amplifier Chassis. If more convenient, however, the unit may be mounted in any position remote from the Amplifier. For this application, extended leads are necessary to feed the A.C. Switch, Indicator Lamp and the Volume Controls. To ensure minimum H.F. loss due to lead capacitance, the leads should not be extended beyond three feet.

Twin input sockets are provided for Pick-Up 78 - L.P.; Tape Replay; and Radio Tuners, each position being separately selected by the switch S1 which incorporates a following earthing ring to minimise breakthrough between inputs. The response characteristics of the Tone Controls are shown in Fig.3 and referred to in the technical specification. The Bass-Treble-Volume controls are dual ganged potentiometers and the Balance Control consists of a dual ganged potentiometer, one track obeying a logarithmic law and the other an anti-logarithmic law. For a technical description of this type of control, reference should be made to "MULLARD" Circuits for Audio Amplifiers. (Price 8/6d.)

A miniature lamp wired into the heater circuit illuminates the "STERN" name-plate on the control panel and serves as a warning indicator when the equipment is switched ON. The input sensitivity is 230 milli-volts at approximately 500K ohm impedance. Stereophonic Crystal Pick-Ups will therefore fully drive the Amplifier to 10 Watts, per channel as will the audio output of our Stereophonic Tape Pre-Amplifier model STP/1.

USING THE DUAL CHANNEL PRE-AMPLIFIER. ...

Power Supplies ...

The mains transformer ANDEC TSAM/9 is specially designed for the Amplifier. It has, therefore, only a small reserve of H.T. and L.T. power, which is adequate only to supply the requirements of the Dual Channel Pre-Amplifier. (H.T. 250/300 volts at 6 milli-amps and L.T. 6.3 volts at 1 Amp). If additional equipment, such as Radio Tuner Unit is to be used, a separate POWER SUPPLY will be necessary. On NO account must a Tuner Unit be connected to the OCTAL "take off" socket on the Dual Channel Pre-Amplifier, or the Power Amplifier, otherwise the current drawn from the 10 + 10 Power Unit will be exceeded and damage may occur.

Sensitivity ...

Due to the high input sensitivity of the Amplifier, the Audio output from each channel of the Pre-Amplifier must be attenuated with a simple resistive network, positioned precisely as illustrated in the Dual Channel Pre-Amplifier Manual.

POWER AMPLIFIER	DRIVE REQUIRED	ATTENUATOR IN EACH CHANNEL	
10 + 10	23 mV.	Ra 820 K Grey-Red-Yellow	Rb 100 K Brown-Blk-Yellow

HUM & MULTIPLE EARTHS ...

In Audio equipment it is advisable to have only one direct connection to the chassis and this should be made close to the Audio input sockets. With a number of connections to the chassis eddy currents can be set up in the chassis and hum voltages can be induced in the sensitive sections of the equipment by magnetic fields associated with these currents. For this reason a single Earth Line or 'Bus Bar' is incorporated for each channel. It is most important that the earthing arrangements are adhered to.

To maintain a low level of hum when two or more separate chassis are used together (such as the 10 + 10 Power Amplifier and the Dual Channel Pre-Amplifier) the chassis of the two units should be joined at ONE point only. This connection is arranged to be via the outer screened braiding of the AUDIO CABLES and as this is the ONLY earth or negative return between the units we recommend that the equipment be disconnected from the MAINS SUPPLY before removing the Audio co-Axial plugs from the Amplifier or Pre-Amplifier otherwise an electric shock may be experienced.

The Earth line connected to pin 1 of the Octal Socket on the Power Amplifier is taken up to the Pre-Amplifier and terminated to pin 1 of the spare Octal Socket. It will be observed that it is not connected to the Pre-Amplifier Bus-Bar or Chassis. This would normally be the inter-chassis connection for a Tuner Unit, but as the Amplifier has only a sufficient reserve of power to supply the PRE-AMPLIFIER the Tuner Socket must be left unused.

VENTILATION ...

When fitting the Power Amplifier into a cabinet it is important to provide free access of air in order to avoid overheating.

OPERATION ...

Before switching the Amplifier "ON" the following points should be carefully checked:-

1. Ensure that the valves are correctly positioned and well 'seated' in their bases.
2. Ensure that the voltage selector (located underneath the amplifier chassis) is correctly adjusted to your A.C. Mains Supply voltage.
3. Ensure that BOTH loudspeaker sockets are 'loaded' with loudspeakers of the correct impedance. (Damage will occur if the Amplifier is operated without loudspeakers or dummy resistive loads across each output socket.)
4. Ensure that the GREEN core of the 3 Core Mains Lead is connected to a good Earth, such as the earth pin of a 3-Way mains socket, or to a rising main water pipe.
5. For High Fidelity reproduction, the record player, tape deck, loudspeakers etc. should all be of the same high quality as the Power Amplifier.
6. Ensure that good quality insulated screened cable is used for all input connections to the Control Unit or Dual Channel Pre-Amplifier.
7. If hum is to be kept to a minimum the outer screened braiding of the pick-up lead must NOT be used for earthing any part of the motor or turntable assembly which should be earthed by a separate connection taken to the Mains earth point.

BUILDING THE AMPLIFIER ...

The drawings give simple stage by stage instructions for assembly and wiring of the Amplifier. No difficulty will be experienced by the home constructor if all these are followed precisely and in the sequence given, provided all components are exactly as specified.

Ensure that each connection is effected with neat and positive soldered joints and that all the wiring and components are positioned precisely as shown in the practical diagrams. This will avoid the possibility of instability that may result from indifferent wiring.

TOOLS ...

The main requirements are a small Soldering Iron of the Instrument Type, a screwdriver, a small pair of pliers or strong tweezers, a pair of side cutters and a reel of 18 swg Ersin Multicores Solder.

COMPONENTS ...

The wire ends of Condensers and Resistors should be trimmed to the required length by first arranging the component in its approximately correct position bending the leads as necessary and cutting them at the proper point, allowing of course, sufficient wire to make the solder joint. Sleeving should be used wherever necessary to prevent shorting to other components. Always observe the polarity of Electrolytic Condensers, the black ring round one end of paper condensers indicates "outside foil" and should be treated as the "Earthy End".

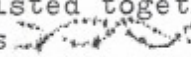
SOLDERING ...

It is most important to ensure good soldered joints. We recommend therefore that a small electric Iron of the instrument type be used. Use a good fluxcored solder, such as Ersin Multicore 18 swg. The best method is, where possible, to first secure the components or wire to the tag so that it will remain in position without having to hold it, then lay the point of the solder over the joint and apply the tip of the iron on top. The iron must never be applied for longer than is necessary to secure a good joint, otherwise overheating of the components or plastic wire will cause damage. Too much solder should be avoided as it will run down the tag and possibly form a short circuit to an adjacent tag. This can very easily happen when soldering the valve sockets as the pins are spaced close to one another, If the solder does not run easily, the tag or wire should be slightly scraped with a small blade and then the cleaned part should be well 'tinned' before actually soldering to its appropriate connecting point.

Remember that the golden rule for soldering is to ensure that the wires to be soldered Must be clean and then if the two surfaces to be joined are heated simultaneously and a good cored solder used, a perfect electrical joint will result.

GENERAL ...

Keep a continuous watch on the stage wiring and instructions and always check each stage, very carefully before proceeding to the next - it will be much easier to trace an incorrect connection in this way than having to find faults when the amplifier has been completed.

It will be observed that as the stage wiring progresses the wiring shown in the previous stage has been omitted for clarity. The heater wiring and any wires carrying A.C. must be lightly twisted together to avoid hum radiation, such wiring as indicated on the drawing thus . The wire supplied for the heater wiring is thin green plastic and will lend itself very readily for the purpose .

Tinned copper wire is supplied for the main wiring and this should be bent and cut and then sleeved as necessary before fitting into the chassis.

Wiring shown dotted - - - - on drawing indicates that it runs underneath the components.

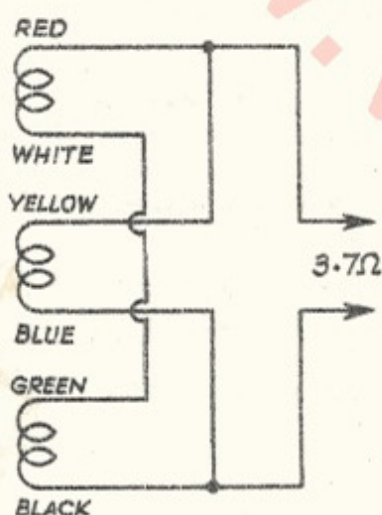
Plastic Connecting wires must be handled carefully and attention given to rapid soldering to avoid overheating which would cause damage to the plastic insulation.

LOUDSPEAKER MATCHING ...

The stage drawings and all references throughout the Manual show the output stages arranged for 15 ohm loudspeaker loads. If loudspeakers of a different impedance are to be used, the output transformer SECONDARY connections, and the FEEDBACK networks (Tagboard 3&4) must be modified to allow for the altered operating conditions. The changes illustrated should be carefully followed and RECHECKED before switching the Amplifier ON.

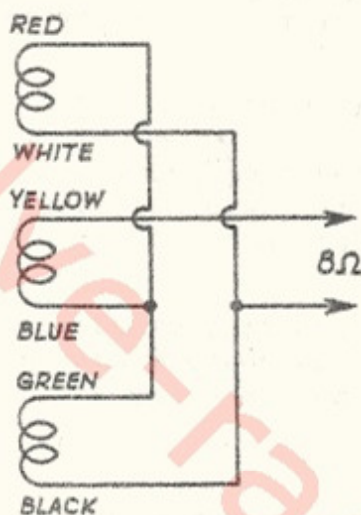
SECONDARY CONNECTIONS

FOR 3.7Ω OUTPUT



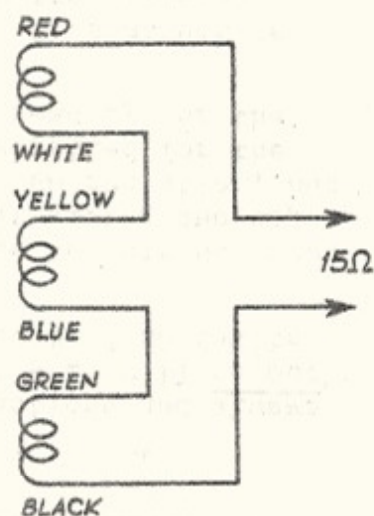
Join RED to YELLOW.
Join WHITE to GREEN.
Join BLUE to BLACK.
Connect RED to "A"
(Tagboard 3 & 4).
Connect BLACK to one
pole of each loud-
speaker socket (as
shown).

FOR 8Ω OUTPUT



Join RED-BLUE and GREEN.
Join WHITE to BLACK.
Connect YELLOW to "A"
(Tagboard 3 & 4).
Connect BLACK to one
pole of each loud-
speaker socket (as
shown).

FOR 15Ω OUTPUT



No Change.
Precisely as illustrated

FEEDBACK NETWORKS. Tagboards 3 & 4.

R6 As drawn.
R22 12K Brown-Red-Or.
R23 18K Brn.-Grey-Or.
C12 22OpF. 350v S.
Mica.
C13 22OpF. 350v S.
Mica.

R6 As drawn.
R22 18K Brown-Grey-Or.
R23 27 K Red-Mauve-Or.
C12 15OpF. 350v S. Mica.
C13 15OpF. 350v S. Mica.

No Change.
Precisely as illust-
rated.

All components 5% Tolerance. Resistors $\frac{1}{2}$ Watt Rating.

TECHNICAL SPECIFICATION. POWER AMPLIFIER

POWER RESPONSE WITH FEEDBACK AT 10 WATTS -3dB at 20c/s and 60Kc/s.
FREQUENCY RESPONSE WITH FEEDBACK AT 50mw Flat within 3dB from 5c/s.
to 60Kc/s.
TOTAL HARMONIC DISTORTION (INPUT SIGNAL OF 1Kc/s) ... At 10 WATTS 0.2%
INTERMODULATION DISTORTION Carrier & Modulating Freq. 10Kc/s & 50c/s
respectively ... At 10 WATTS 0.6%
SENSITIVITY WITH FEEDBACK 23mV FOR 10 WATTS.
SENSITIVITY WITHOUT FEEDBACK ... 2.3mV FOR 10 WATTS.
NEGATIVE FEEDBACK 20dB.
OUTPUT TRANSFORMERS GILSON ULTRA LINEAR WITH 20% TAPS.
SECTIONALISED SECONDARIES FOR 3.75 or 8 or 15 OHM LOUDSPEAKER MATCHING.
EFFECTIVE OUTPUT IMPEDANCE AT 15 OHM TERMINATION ... 1.4 ohms for
1 WATT output at 1Kc/s.
HUM AND NOISE 65dB BELOW 10 WATTS.
CROSS TALK 60dB FROM 20c/s to 20Kc/s.
VALVES MULLARD - TWO 6F86, FOUR 6CL86, ONE GZ34
DIMENSIONS OF AMPLIFIER 14" x 6 $\frac{1}{2}$ " - 6 $\frac{1}{2}$ " High.
WEIGHT OF AMPLIFIER 14 lbs. 14 ozs.
FINISH HEAVY SILVER HAMMER.
OPERATION 200/250 VOLTS A.C. 50 Cycles. (Other
Voltages to Order)
POWER CONSUMPTION APPROX. 100 WATTS.
HT & LT AVAILABLE FOR PRE-AMPLIFIER. HT + 300V at 6mA. MAX.//
LT 6.3V at 1.5A MAX.//

4 EF 86 = 4 x 3.6 ma.
@ 250V

TECHNICAL SPECIFICATION. PASSIVE CONTROL UNIT.

CONTROLS.... DUAL GANGED.
VR1 CONTINUOUSLY VARIABLE TREBLE. + 14dB -15dB at 15 Kc/s.
VR2 CONTINUOUSLY VARIABLE BASS. + 12dB -11dB at 30 c/s.
VR3 BALANCE
VR4 VOLUME
S1 4 POSITION INPUT SELECTOR SWITCH RADIO, TAPE REPLAY, GRAM 78.
GRAM I.P.
S2 MAINS ON/OFF SWITCH.
INPUT SENSITIVITY 230mV TO DRIVE POWER AMPLIFIER TO 10 WATTS.
INPUTS TWIN MINIATURE CO-AXIAL ... RADIO, TAPE REPLAY, CRYSTAL PICK-UP.
IMPEDANCE APPROX. 500K.
DIMENSIONS OF CONTROL BOX 14" x 2" x 2" High.
WEIGHT OF CONTROL BOX 1 lb. 14 ozs.
FINISH CONTROL BOX HEAVY SILVER HAMMER With Fixing Wings
For easy attachment to Power Amplifier, or separate fixing to cabinet work
DIMENSIONS OF FRONT PANEL 15 $\frac{3}{4}$ " x 2 $\frac{3}{4}$ " x $\frac{1}{8}$ " Thick
FINISH FRONT PANEL HIGHLY POLISHED PERSPEX (a) WHITE with
BLACK ENGRAVING or (b) BLACK with
GOLD ENGRAVING.
PILOT LAMP 6.5 Volt 0.2 Amp MINIATURE LILLIPUT.

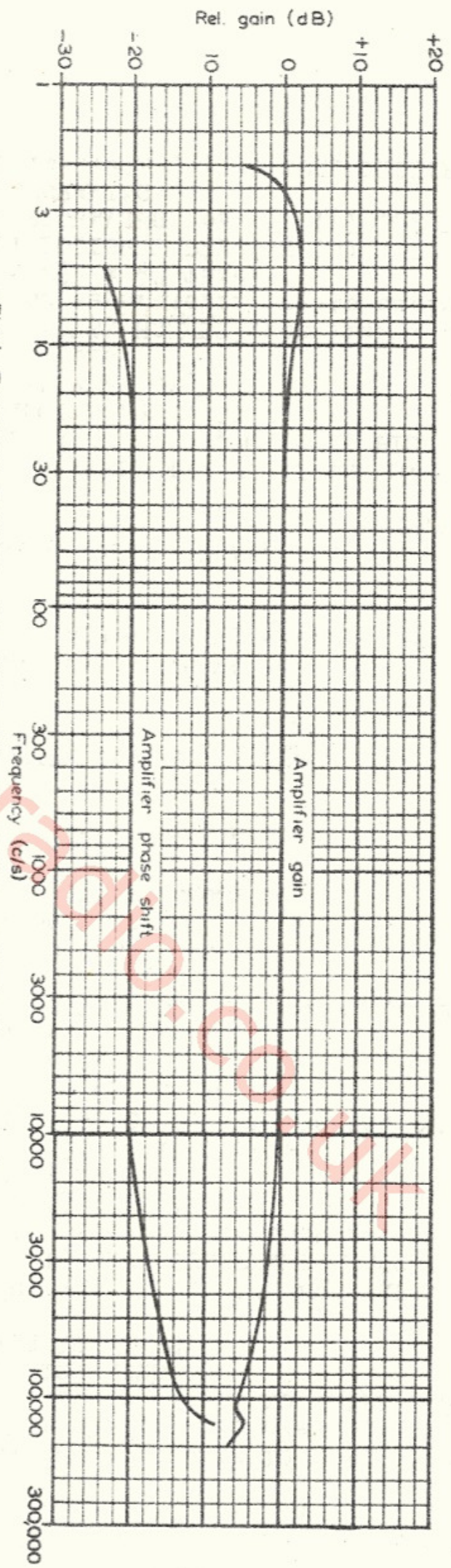


Fig. 1 Frequency response and phase shift of amplifier without tone controls

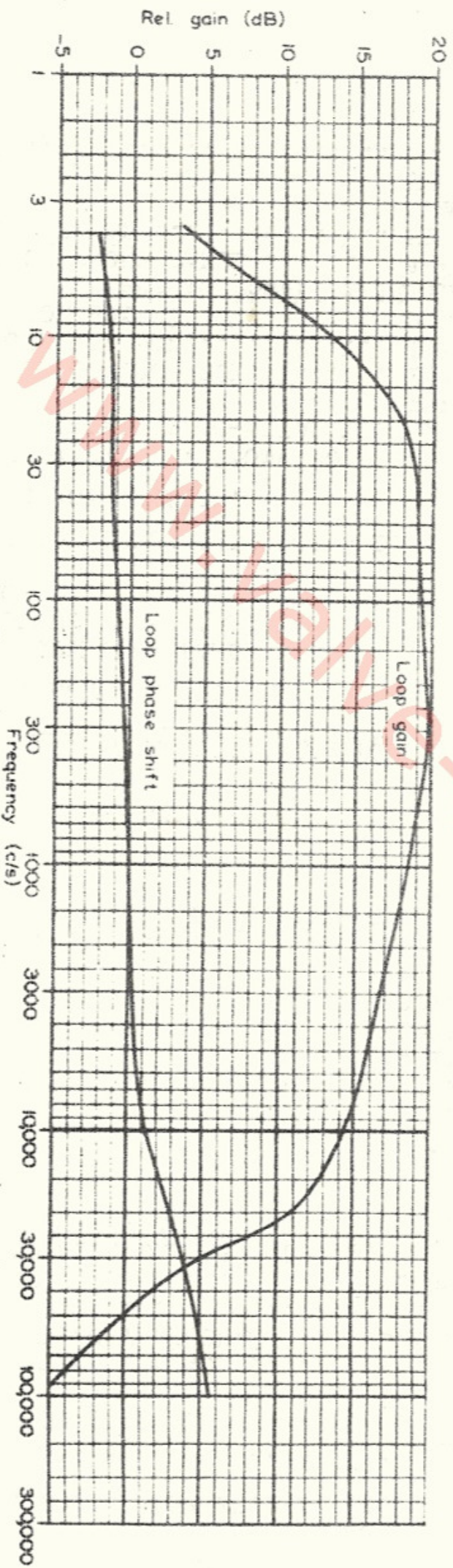


Fig. 2 Loop gain and phase shift

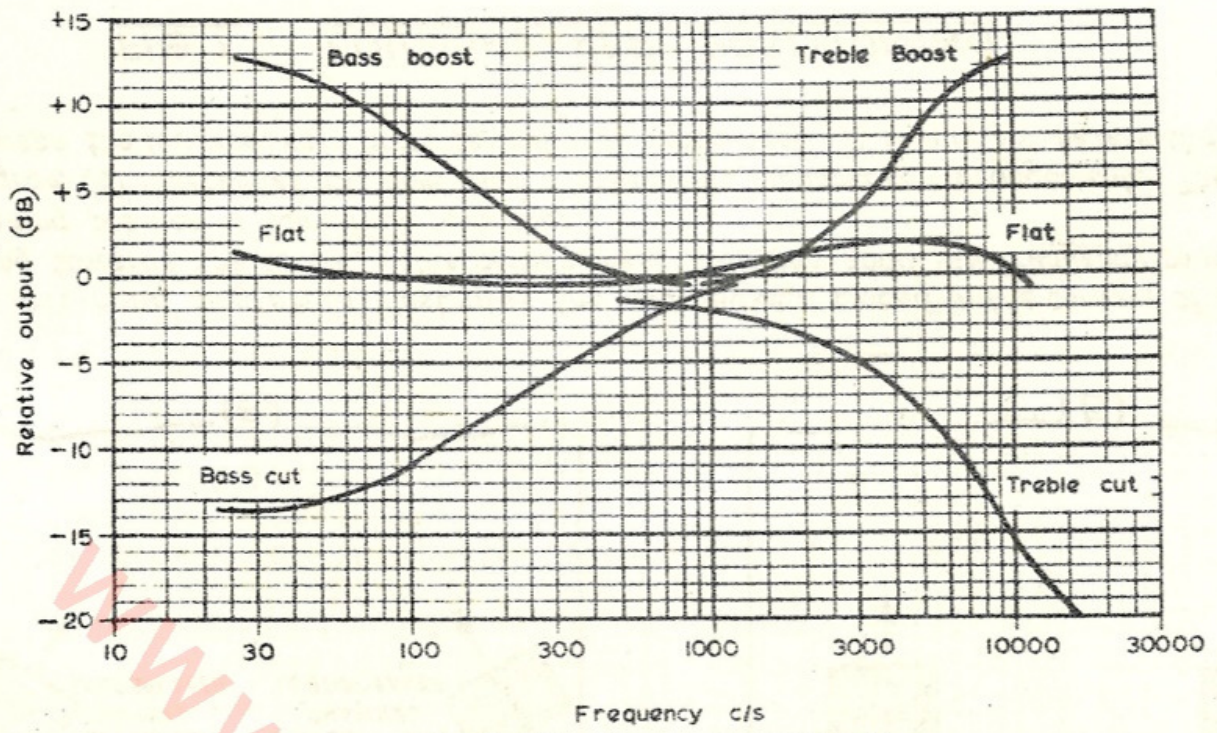


Fig.3 Tone control characteristics

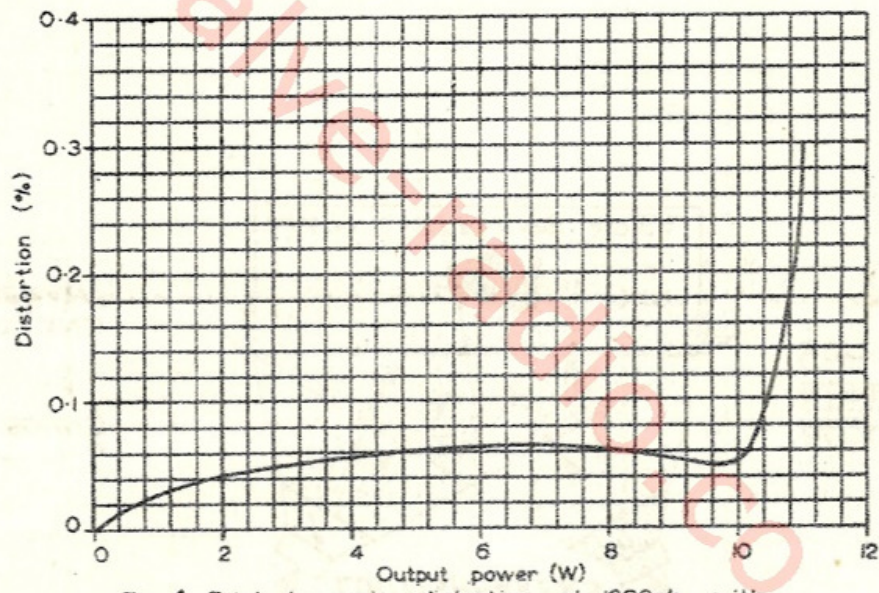


Fig.4 Total harmonic distortion at 1000c/s with feedback

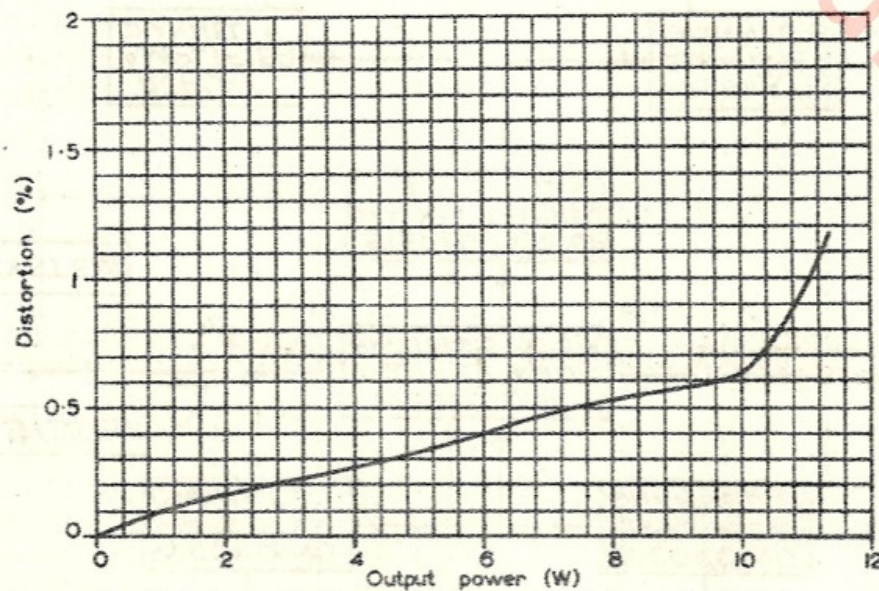


Fig.5 Intermodulation distortion (10kc/s and 50c/s)

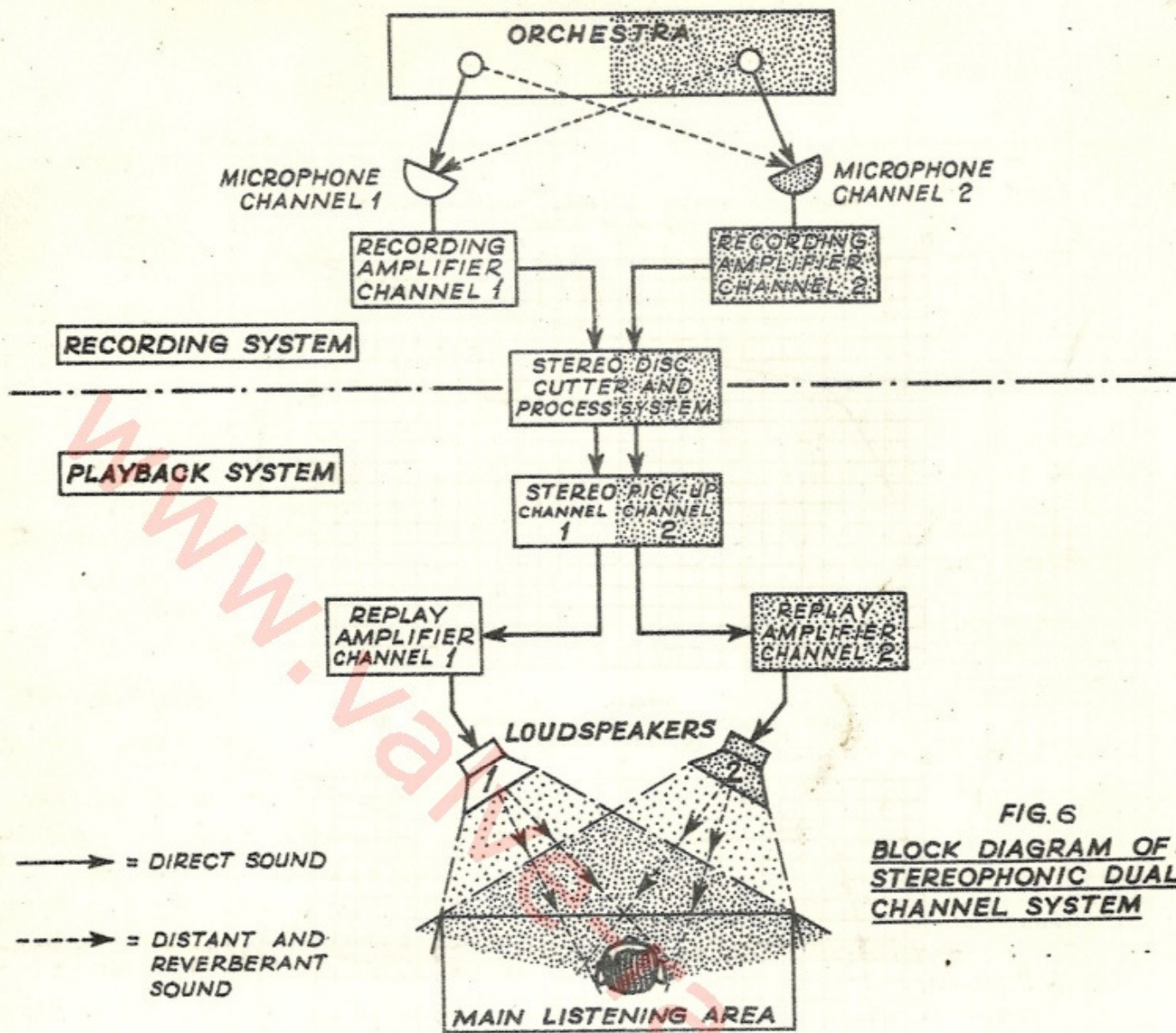
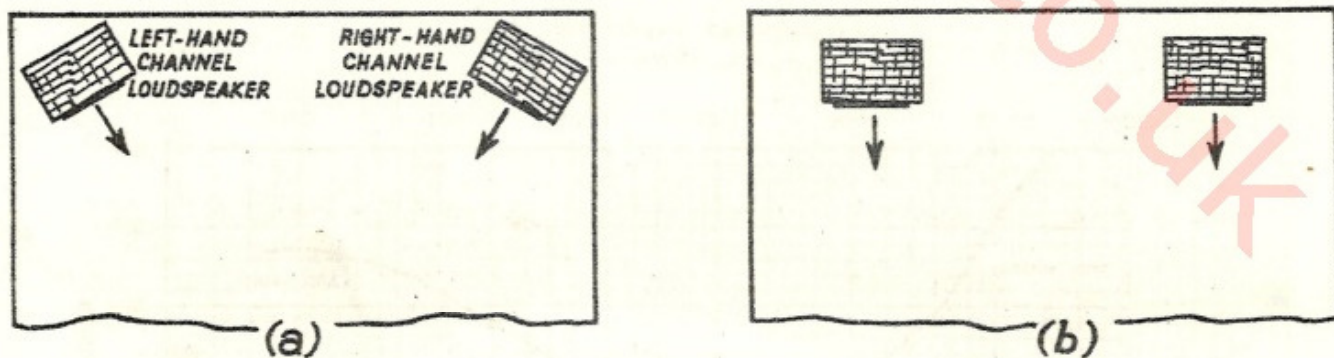


FIG. 6
BLOCK DIAGRAM OF STEREOPHONIC DUAL CHANNEL SYSTEM



The left-hand diagram (a) illustrates the loudspeakers placed in the corners of the room, and facing towards the centre. This arrangement produces good low frequency sound, but the listening position is somewhat restricted.

Diagram (b) illustrates the most used stereophonic loudspeaker arrangement. The distance between the loudspeakers must be found by experiment. It should not be less than 6 feet.

FIG. 7 LOUDSPEAKER POSITIONING

PARTS LIST & COMPONENT PRICES - POWER AMPLIFIER.

RESISTORS. All $\frac{1}{2}$ Watt Rating 10% tolerance unless otherwise stated.

2xR1	1 Meg High Stability 5%	2.0
2xR2	1 Meg Brown-Black-Green	8
2xR3	150K Brown-Green-Yellow	8
2xR4	150K High Stability 5%	2.0
2xR5	2.7K Red-Mauve-Red 5%	1.0
2xR6	100ohm Brn-Black-Brn 5%	1.0
2xR7	560K Green-Blue-Yellow 5%	1.0
2xR8	1 Meg Brown-Black-Green	8
2xR9	150K Brn-Green-Yellow 5%	1.0
2xR10	100K High Stability 5%	2.0
2xR11	100K Brown-Blk-Yellow	8
2xR12	100K High Stability 5%	2.0
2xR13	1 Meg Brown-Black-Green	8
2xR14	1 Meg Brown-Black-Green	8
2xR15	33K Orange-Orange-Orange	8
2xR16	4.7K Yellow-Mauve-Red	8
2xR17	4.7K Yellow-Mauve-Red	8
2xR18	300ohm 5Watt 5% As marked	3.0
2xR19	300ohm 5Watt 5% As marked	3.0
2xR20	47 ohm Yellow-Mauve-Black	8
2xR21	47 ohm Yellow-Mauve-Black	8
2xR22+	27K Red-Mauve-Orange 5%	1.0
2xR23+	33K Orange-Orange-Or 5%	1.0
1xR24*	5.6K Green-Blue-Red 1 Watt	6

+ Values for 15 ohm loudspeaker impedance. Alternative values for 3.75 and 7.5 ohm loudspeaker. Matching shown on Page 6

*Only necessary with Dual Channel Pre-Amplifier or similar Pre-Amp. drawing H.T. Current from the Power Amplifier.

TRANSFORMERS.....

T1L	OUTPUT TRANSFORMER GILSON W01796A or PARTRIDGE TF7782.	£2:5:0
T1R	OUTPUT TRANSFORMER GILSON W01796A or PARTRIDGE TF7782.	£2:5:0
T2	MAINS TRANSFORMER F9576 PARTRIDGE TF7781	£2:7:6

VALVES B.V.A.Guaranteed

V1L	MULLARD EF86	15.9
V1R	MULLARD EF86	15.9
V2L	MULLARD ECL86	14.7
V2R	MULLARD ECL86	14.7
V3L	MULLARD ECL86	14.7
V3R	MULLARD ECL86	14.7
V4	MULLARD GZ34	17.6

CAPACITORS

2xC1	8mfd 350V Wkg. Elect.	5.6
2xC2	0.05mfd 150V Wkg Tubular	2.0
2xC3	0.5mfd 150V Wkg Tubular	3.0
2xC4	100mfd 12/25V Wkg Elect	5.6
2xC5	0.1mfd150/350V Wkg Tub	2.0
2xC6	0.25mfd 350V Wkg Dubilier 460	3.0
2xC7	0.25mfd 350V Wkg Dubilier 460	3.0
2xC8	100mfd 25V Wkg Elect	5.6
2xC9	100mfd 25V Wkg Elect	5.6
2xC10)	Triple Electrolytic	
1xC11)	50-50-50mfd 350V Wkg.	9.6
2xC12+	100pF 350V S.Mica 5%	1.6
2xC13+	100pF 350V S.Mica 5%	1.6
1xC14*	16mfd 350V Wkg Elect.	3.9

MISCELLANEOUS ...

6	B9A Valve Base with Skirt.	4.6
2	Int. Octal Valve Bases	1.4
2	Twin Loudspeaker sockets	10
1	2 Way Input Socket Clix 79/841	9
1	2 Way Insulator Plate Clix 79/861	1
1	Voltage Selector Panel	1.4
4	Wander Plugs 2 Black 2 Red	1.0
2	B9A Valve screening Cans.	1.6
1	Small Cable Clip	2
1	Paxolin Condenser Base.	2
1	Pkt Nuts, Bolts, Grommets.	4.0
3	yds 3 Core Circular Mains Lead	2.3
4	yds 2mm. Sleeving.	1.0
5	yds 20/22 swg Tinned Copper Wire	3
2	ft. 14/16 swg Tinned Copper Wire (Bus-Bars)	2
18	inches Single Insulated Screened Cable	8
4	ft. Single Green Plastic Wire (Heaters)	2
1	Instruction Manual	3.0
2	5 Way Tagboard Denco	2.4
2	15 Way Tagboards Denco	4.6
2	Single Tag Strips (2 x Right)	4
2	2 Way Tag Strips (1 left - 1 right)	6
1	2 Way Choc Connection Block	6

CHASSIS WORK ...

1	Main Chassis) £1:5:0
1	Mounting Strip	

PARTS LIST & COMPONENT PRICES - PASSIVE CONTROL UNIT...

RESISTORS All 1/2 Watt Rating 10% tolerance unless otherwise stated.

2xR1	1 Meg	Brown-Black-Grn	8
2xR2	680K	Blue-Grey-Yellow 5%	1.0
2xR3	68 K	Blue-Grey-Orange 5%	1.0
VR1	2 Meg	Dual-Log Pot. Q2B	6.9
VR2	2 Meg	Dual-Log Pot. Q2B	6.9
VR3	2 Meg	Dual-Log Pot. QB/QB*	6.9
VR4	2 Meg	Dual-Log Pot. Q2B	6.9

* Balance Control. Anti-Log (QB) Connected in Right-Hand Channel.

CHASSIS WORK

1	Box Chassis	}	12.6
1	Under-Cover Plate		
1	Dual Lamp Bracket		

FRONT CONTROL PANEL

1	Perspex Penl. Engraved (Choice of Black or White)	9.6
---	---	-----

CAPACITORS

2xC1	33pF	350V Wkg S.Mica	1.6
2xC2	150pF	350V Wkg S.Mica 5%	1.6
2xC3	1000pF	350V Wkg S.Mica 5%	1.6
2xC4	680pF	350V Wkg S.Mica 5%	1.6
2xC5	4700pF/5000pF	350V Wkg S.Mica 5%	2.6

MISCELLANEOUS ...

1	Selector Switch 2 Bank-SCU/1S (S1)	6.6
1	Rotary ON/OFF Switch (S2)	2.9
2	3-Way Phono Sockets Clix 79/842	1.9
2	3-Way Insulation Plates 79/862	1.9
6	Phono Miniature Plugs	2.3
1	5-Way Tag Strip Centre Earth	4
1	Miniature Lilliput Lampholder	9
1	6.5V 0.2A Lilliput Lamp	1.1
6	Control Knobs, Black or White	4.6
1	Cable Clip	2
1	pkt. Nuts, Bolts etc..	2.9
1 1/2	yds. 2 mm. Sleeving.	5
5	ft. 22swg Tinned Copper Wire	1
1	ft. 16/18 swg Tinned Copper Wire	1
18	inches Single Insulated Screened Cable	8
18	inches 4 Core Cable	8

SPECIAL PRICE OFFERS

**** COMPLETE KIT OF PARTS - to build ****

(a)	The Passive Control Unit <u>ONLY</u>	£4 : 5 : 0
(b)	The 10 plus 10 Power Amplifier <u>ONLY</u>	£16 : 0 : 0
(c)	The 10 plus 10 Power Amplifier <u>TOGETHER WITH</u> the Passive Control Unit.	£20 : 0 : 0
(d)	The 10 plus 10 Power Amplifier <u>TOGETHER WITH</u> the Dual Channel Pre-Amplifier	£27 : 0 : 0

**** COMPLETELY ASSEMBLED and TESTED ****

(e)	The Passive Control Unit <u>ONLY</u>	£4 : 15 : 0
(f)	The 10 plus 10 Power Amplifier <u>ONLY</u>	£20 : 0 : 0
(g)	The 10 plus 10 Power Amplifier <u>TOGETHER WITH</u> the Passive Control Unit	£24 : 0 : 0
(h)	The 10 plus 10 Power Amplifier <u>TOGETHER WITH</u> the Dual Channel Pre-Amplifier	£34 : 0 : 0

**** HIRE PURCHASE TERMS AVAILABLE on ****

(f)	Deposit £4:0:0 and 12 monthly payments of £1:9:4
(g)	Deposit £4:16:0 and 12 monthly payments of £1:15:3
(h)	Deposit £6:16:0 and 12 monthly payments of £2:9:11

When ordering please include 7/6 to cover carriage and insurance.

TAGBOARD No 1

(Right Hand Channel)

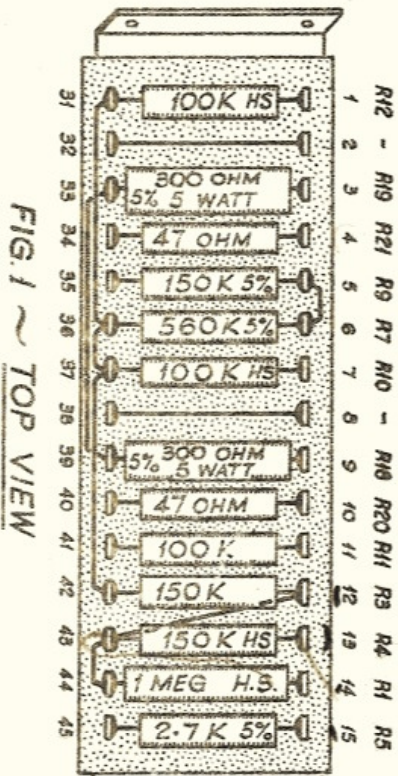
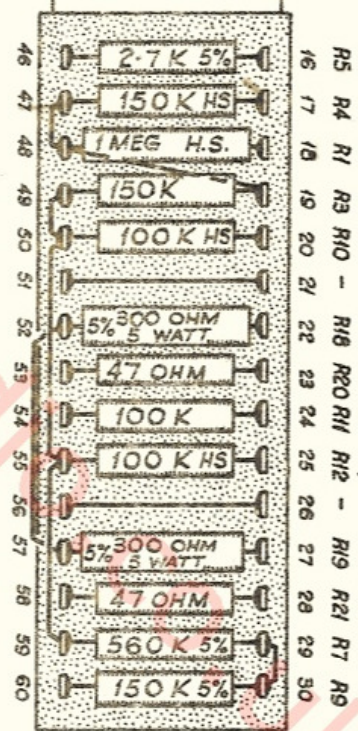


FIG 1 ~ TOP VIEW

TAGBOARD No 2

(Left Hand Channel)



CONNECT TO TAGBOARD 4 (STAGE 3)

VOLTAGE ADJUSTMENT PANEL

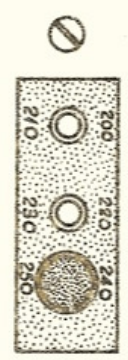
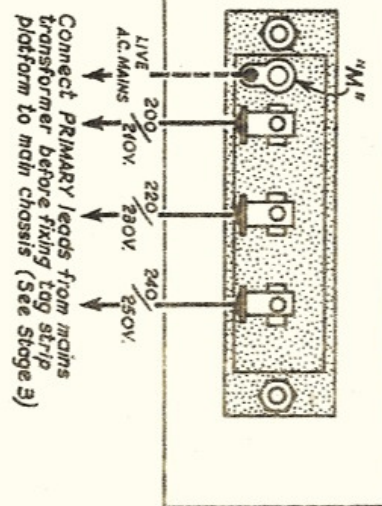
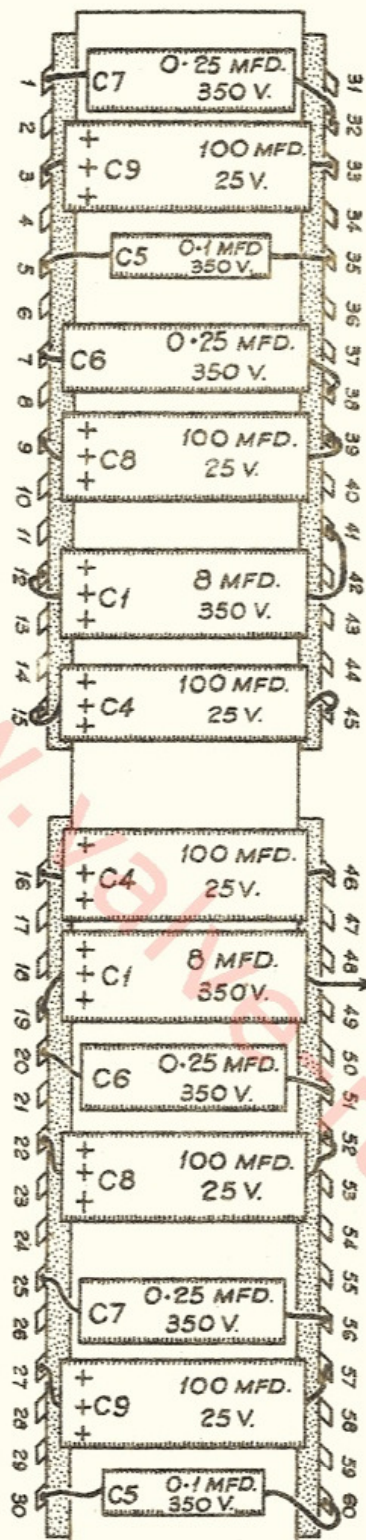


FIG 2 ~ UNDERSIDE VIEW

STAGE ONE - MAIN TAGBOARD ASSEMBLY



Connect PRIMARY leads from mains transformer before fixing tag strip platform to main chassis (See Stage 3)

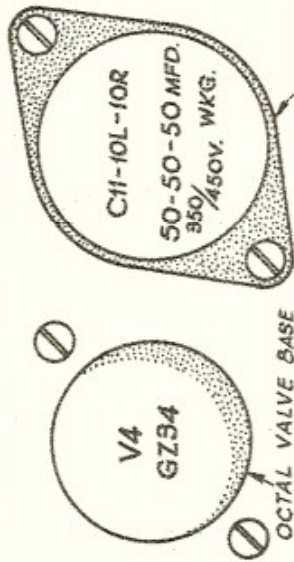
SPECIAL INSTRUCTIONS (STAGE ONE)

1. Assemble Tagboards on to mounting platform. Use only short $\frac{1}{4}$ inch 6 BA bolts for this purpose otherwise damage to the component above the fixing bush may result. Fit resistors and condensers precisely as shown in Fig. 1 (TOP VIEW). Note carefully the minor differences in the Right and Left hand tagboard assembly and wiring.
2. Wiring shown thus ----- should be connected first, insulated with sleeving and run flat on Tagboard. Very short direct links thus ∇ need not be sleeved.
3. Resistors are $\frac{1}{2}$ Watt rating 10% tolerance unless otherwise stated.
4. Connect condensers shown in Fig. 2 (UNDERSIDE VIEW). Ensure correct positions and POLARITY. It is advisable to insulate the wire ends with sleeving to prevent short circuits to the mounting platforms.
5. CHECK MOST CAREFULLY ALL COMPONENT VALUES AND POSITIONS ON TAGBOARDS. ENSURE PERFECT SOLDERING & PROCEED TO STAGE TWO.

POWER SUPPLIES

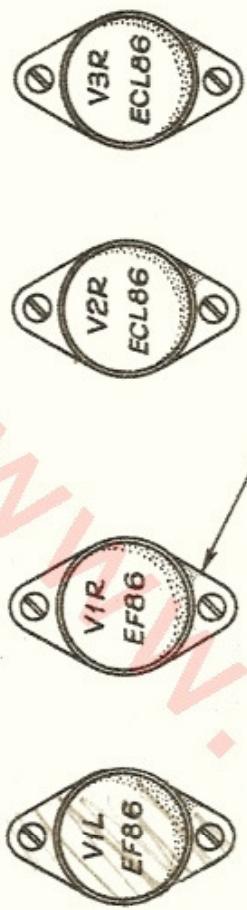
LEFT HAND CHANNEL

RIGHT HAND CHANNEL

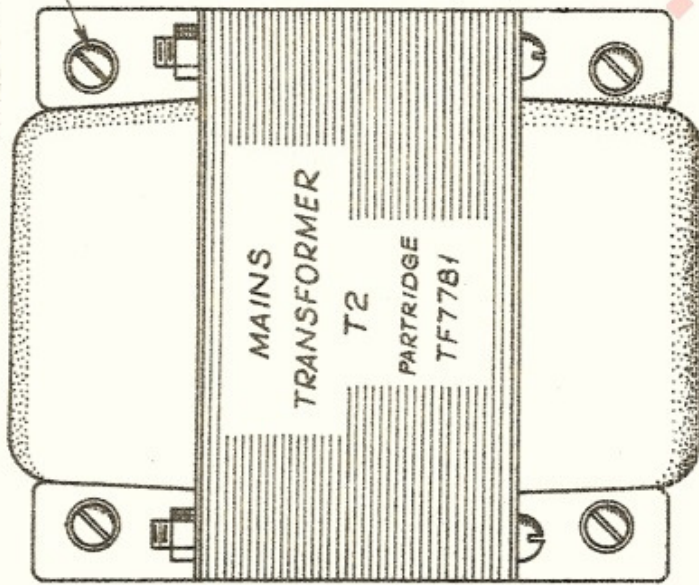


INSULATED CONDENSER MOUNTING PLATE. FITTED ON TOP OF CHASSIS.

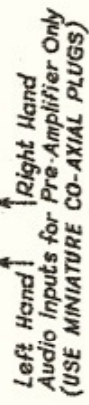
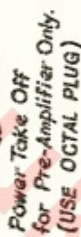
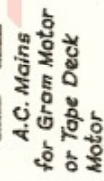
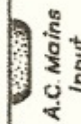
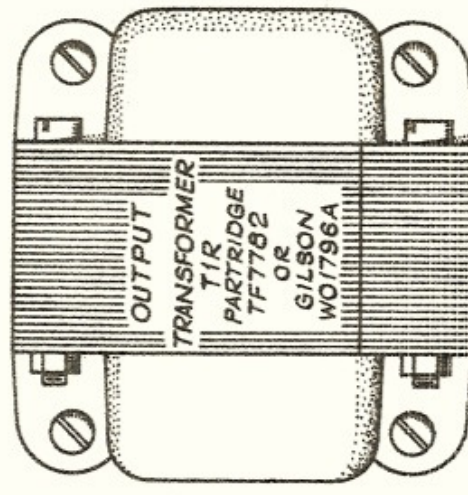
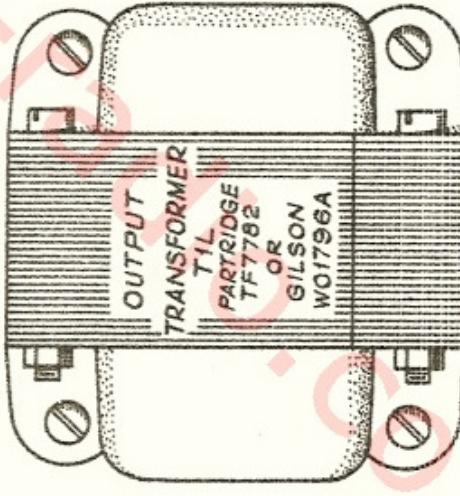
IF NECESSARY USE WASHERS UNDER BOLT HEADS



B9A VALVE BASES ALL WITH SKIRT. SCREENING CANS FITTED TO V1L & V1R ONLY



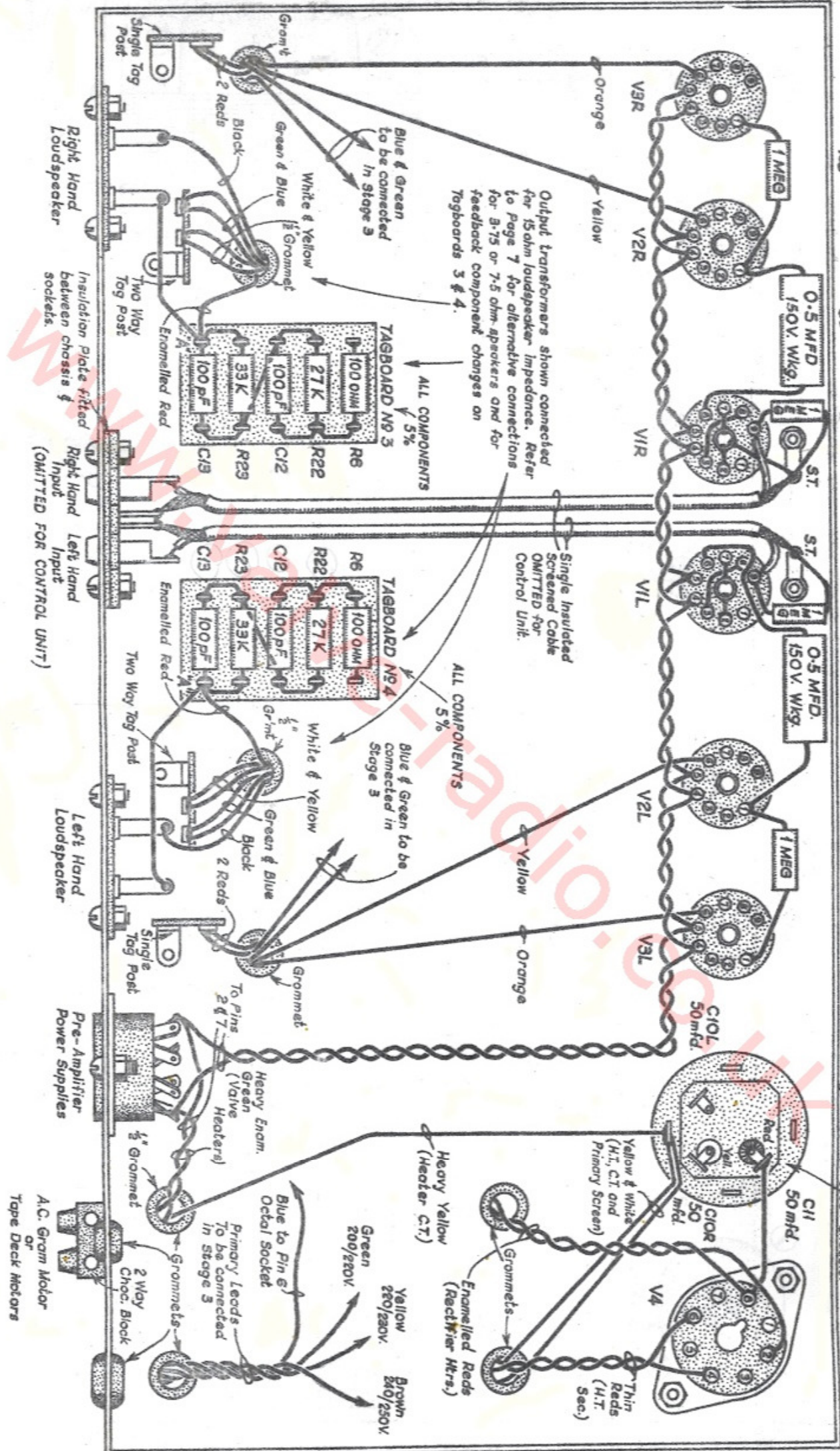
Take all transformer fly leads carefully through grommet holes provided.



STAGE TWO - COMPONENT MOUNTING - TOP VIEW

R8 C3 R2 R2 C3 R8

Paxolin isolating base fitted above chassis. Outer lugs pushed through slots and lightly twisted to retain the condenser. Togs must not touch chassis.



Output transformers shown connected for 15ohm loudspeaker impedance. Refer to Page 7 for alternative connections for 3-75 or 7.5 ohm speakers and for feedback component changes on Tagboards 3 & 4.

Single insulated screened cable OMITTED for Control Unit.

ALL COMPONENTS 5%

ALL COMPONENTS 5%

Blue & Green to be connected in Stage 3

Green 200/220V Yellow 220/230V Brown 240/250V

Blue to Pin 6 of Octal Socket

Primary Leads To be connected in Stage 3

Right Hand Loudspeaker

Left Hand Loudspeaker

Right Hand Input

Left Hand Input

Pre-Amplifier Power Supplies

A.C. Gram Motor or Tape Deck Motors

STAGE TWO - COMPONENT MOUNTING & BASIC WIRING (UNDERSIDE VIEW)

SPECIAL INSTRUCTIONS (STAGE TWO)

1. Mount transformers and valve bases as shown on TOP VIEW drawing, and smaller components as illustrated on the UNDERSIDE VIEW. The transformer fly leads must be carefully fed through the appropriate rubber grommets. Make sure to position the insulation plate between the twin input socket and chassis.
2. Make the various connections shown and ensure that all wiring is run in precise positions illustrated.
3. It will be more convenient to fit the resistors and condensers to Tagboards 3 & 4 before actually fitting the Tagboards to the chassis. Use only $\frac{1}{4}$ inch short bolts for this purpose. Tagboards 3 & 4 carry the feedback components which vary with the loudspeaker impedance. If speakers other than 15 ohms are to be used refer to page 7 for value changes and alternative output transformer connections.
4. The solder tags S.T. are the single point EARTH connections to the chassis. It is therefore important that any paint deposit around the solder tag fixing bolt be lightly scraped off and cleaned to ensure a positive and sound electrical contact.
5. The wiring shown in this stage should be run flat on the chassis and all A.C. carrying leads shown thus ~~XXXX~~ should be lightly twisted to prevent hum radiation.
6. If the amplifier is to be used with the CONTROL UNIT (Stage Five) the two screened cables & the twin input socket together with resistors R2L & R2R are unnecessary and should be omitted entirely.

8.

CHECK CAREFULLY THAT ALL CONNECTIONS ARE CORRECT. WITH PARTICULAR ATTENTION TO THE COLOURED LEADS FROM THE TRANSFORMERS, AND TO VALVE BASE WIRING. ENSURE PERFECT SOLDERING AND THEN PROCEED TO STAGE THREE.

7. Where Partridge Output Transformers are supplied, the Primary Windings are coded in reverse and should be connected as follows:

Red or Light Brown ... As shown ... Stage Two.

Note: Red (Centre Tap) is single lead. Windings strapped internally.

Yellow to pin 6 of V3. Both Channels. (Stage 2).
Orange to pin 6 of V2. Both Channels. (Stage 2).
(Orange leads, due to varnishing, may appear as dark brown or violet).

Blue to Tag 40 on Tag-board No.1 Right

Green to Tag 34 on Tag-board No.1 " Channel Only

Blue to Tag 53 on Tag-board No.2 Left Channel

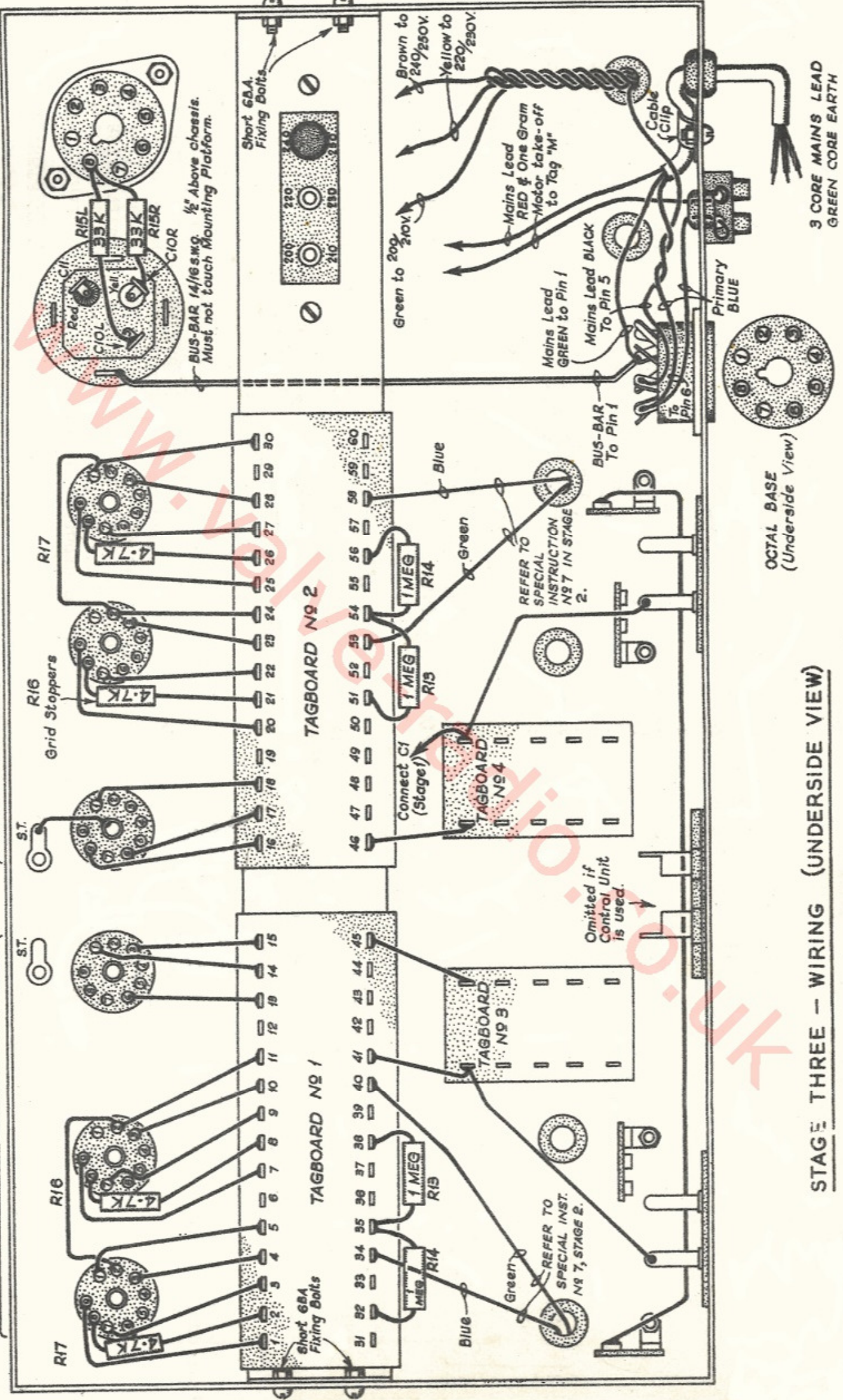
Only

Green to Tag 58 on Tag-board No.2 Left

See Stage Three

RIGHT HAND CHANNEL

LEFT HAND CHANNEL



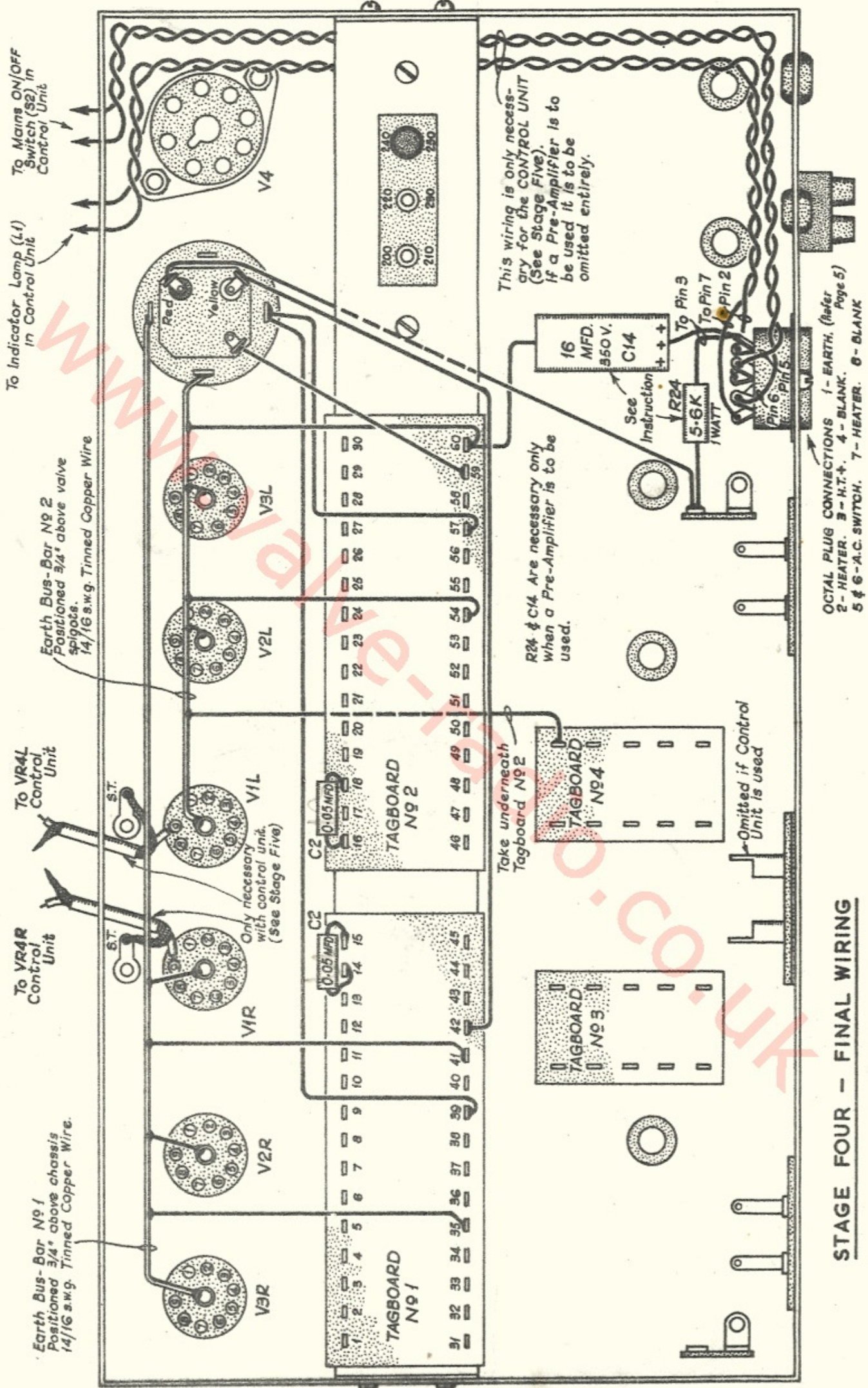
STAGE THREE - WIRING (UNDERSIDE VIEW)

OCTAL BASE (Underside View)

3 CORE MAINS LEAD GREEN CORE EARTH

SPECIAL INSTRUCTIONS (STAGE THREE)

1. It will be observed that as the stage wiring progresses the previous details are omitted for clarity.
2. Connect the mains transformer PRIMARY LEADS to the appropriate tags on the voltage adjustment panel, also one pole of the MAINS LEAD together with one pole of the GRAM MOTOR take off before fitting the TAGBOARD mounting strip into the chassis.
3. Complete the wiring precisely as illustrated. It is most important to ensure short and direct connections, particularly to the valve bases. Use sleeving wherever necessary to prevent short circuits.
4. Grid stopper resistors R6/7 must be wired as close as possible to the valve bases (pln 8).
5. The BUS-BAR must not contact with the tagboard mounting platform. This is because a single point earth system is maintained throughout the amplifier. Each BUS-BAR must only join the chassis at the specific earth points.
6. CHECK CAREFULLY ALL CONNECTIONS, PARTICULARLY TO THE VOLTAGE ADJUSTMENT PANEL. ENSURE PERFECT SOLDERING AND THEN PROCEED TO STAGE FOUR.

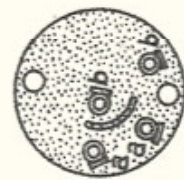
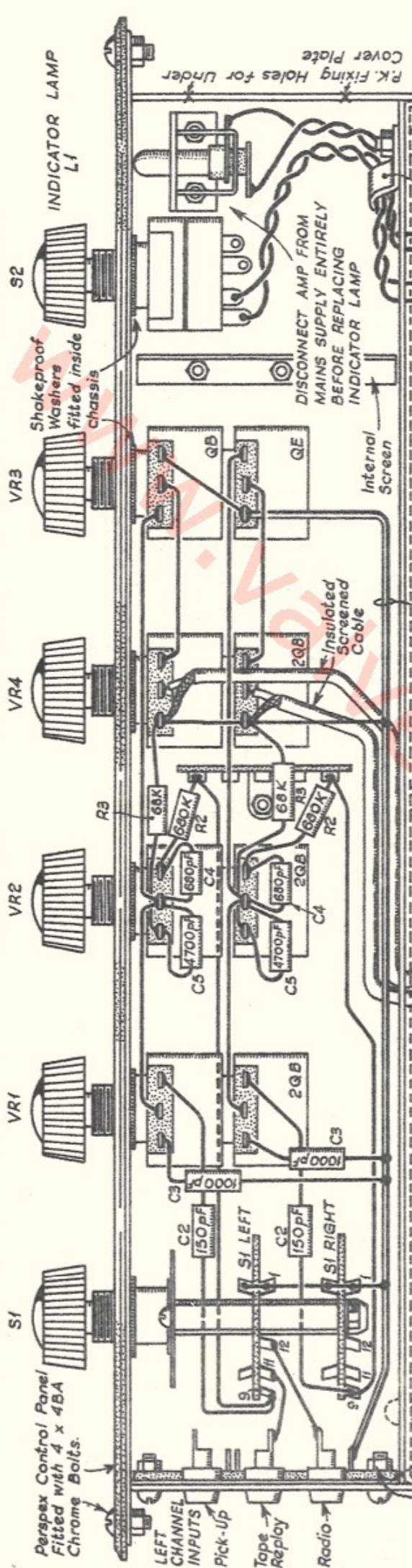


STAGE FOUR - FINAL WIRING

SPECIAL INSTRUCTIONS (STAGE FOUR)

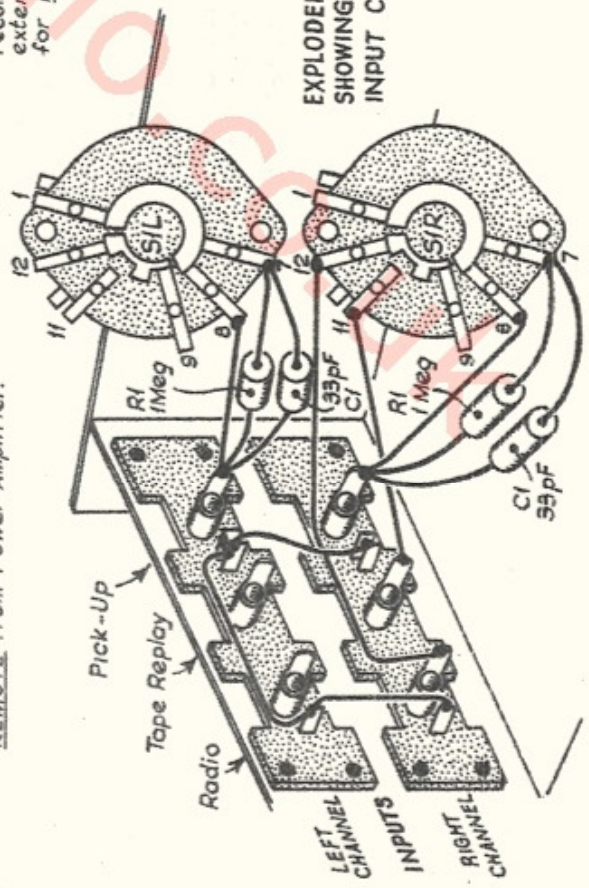
1. Complete the wiring precisely as illustrated.
2. The 14/16 S.W.G. earth BUS-BARS must be positioned $\frac{3}{4}$ inch above the chassis. It will be seen that separate BUS-BARS are incorporated for each channel. It is most important that this system be maintained, therefore ensure that ALL earth connections are made precisely as shown in the drawings.
3. Careful attention to the drawings will show that certain additions and/or omissions are necessary depending on the choice of the CONTROL UNIT (Stage Five) or our DUAL CHANNEL PRE-AMPLIFIER. It will be seen for instance, that when the CONTROL UNIT is to be used the input connections (Screened leads from pins 9 VI L&R) are taken through the front of the chassis to VR4 L & R instead of to the TWIN SOCKET on the rear of the amplifier. Similarly two pairs of leads are added to the OCTAL socket to feed the pilot lamp and the control unit OFF/ON switch. When the DUAL CHANNEL PRE-AMPLIFIER is to be used additional filter components R24 & C14 are necessary. All changes are clearly illustrated and therefore will be easily followed.
4. The AMPLIFIER has now been completely assembled and wired. CHECK CAREFULLY ALL connections & COMPONENT VALUES, ensure PERFECT SOLDERING and then proceed to Stage Five, The CONTROL UNIT.

SELECTOR SWITCH TREBLE CONTROL BASS CONTROL VOLUME CONTROL BALANCE CONTROL MAINS SWITCH



S2 ON/OFF SWITCH
If a double pole Switch is supplied use either tags a and a or alternatively b and b.

Co-Axial Cable is recommended when extending audio leads for REMOTE use



Fit Solder Tag and connect to BUS BAR if unit is to be used REMOTE from Power Amplifier.

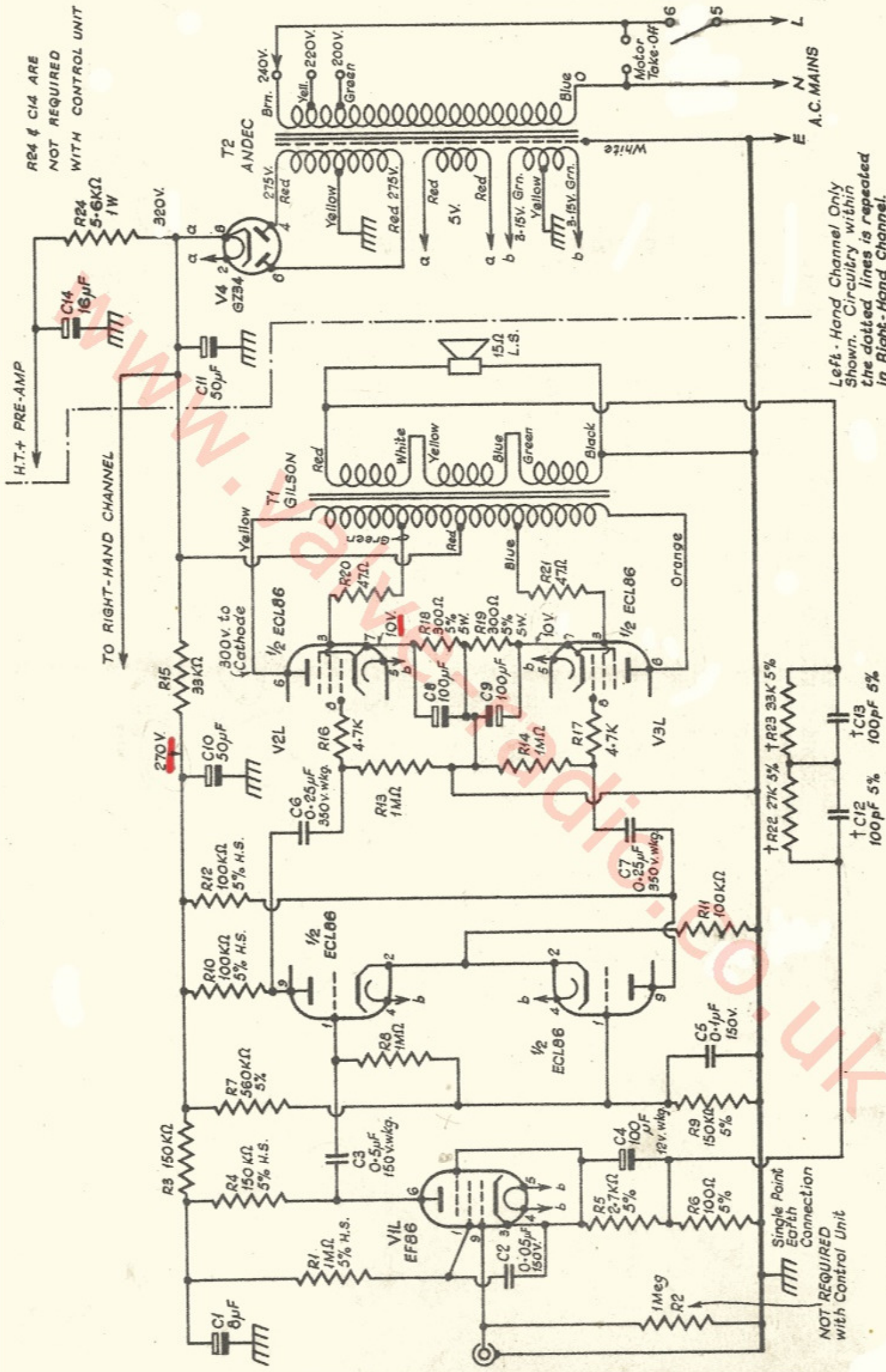
STAGE FIVE — PASSIVE CONTROL UNIT (UNDERSIDE VIEW)

SPECIAL INSTRUCTIONS . . . Stage Five

- (1) Mount components in the precise positions shown. Ensure that the correct potentiometer, 2 Meg QB/QE is used as the Balance Control VR3.
- (2) Make the connections between the Selector Switch (S1) and the 5 way tag-strip together with resistors R2 L & R first, continue by wiring the Selector Switch and then complete the potentiometer wiring progressively working towards the Mains ON/OFF switch.
(Note! The connections shown in the "Exploded View" must of course be short and direct.)
- (3) The Control Unit may be used REMOTE from the Power Amplifier by extending the AUDIO, SWITCH, and INDICATOR LAMP leads. In order to keep the High Frequency losses, due to lead capacitance to a minimum the AUDIO LEADS must not be extended to exceed 3 feet.
- (4) Finally fit the under-cover screen with the PK. self tapping screws. It will be observed that one end of the screen is cut away. This is to prevent SHORT CIRCUITING to the INPUT sockets.
- (5) Good quality insulated screened cable MUST be used for all Input connections. The screened braiding must be connected to the outer case of the Input plug.
Gramophone Motors should be separately earthed to the mains earth and NOT the screened braiding of the pick up leads.

WARNING!

Disconnect the equipment from the MAINS SUPPLY entirely before replacing or adjusting the INDICATOR lamp. This is to avoid the possibility of an ELECTRIC SHOCK should the hand come into contact with the MAINS ON/OFF SWITCH (S2).



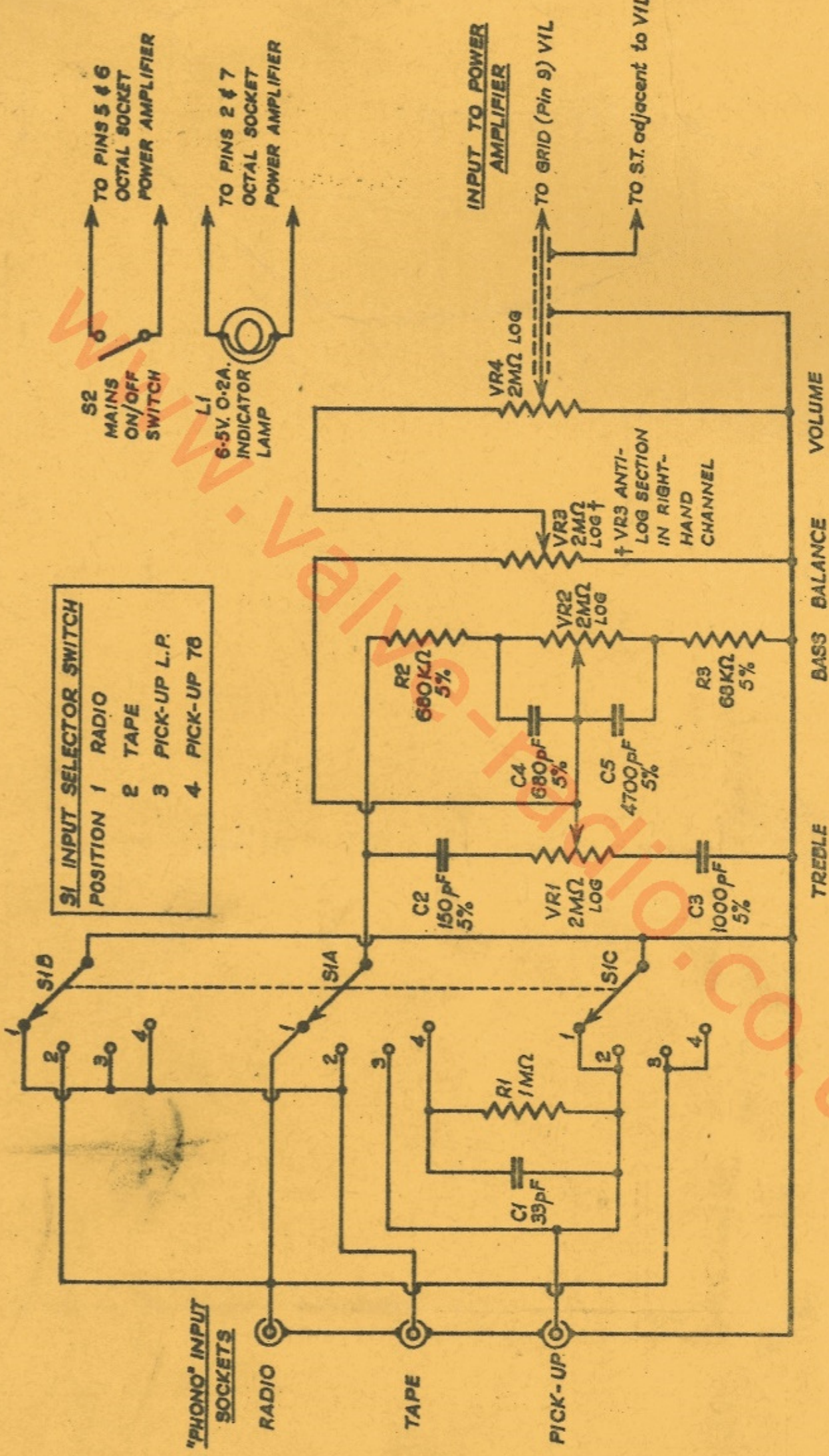
Left-Hand Channel Only Shown. Circuitry within the dotted lines is repeated in Right-Hand Channel.

THEORETICAL DIAGRAM POWER AMPLIFIER

† Values depend on loudspeaker impedance. H.S. High Stability Resistors.

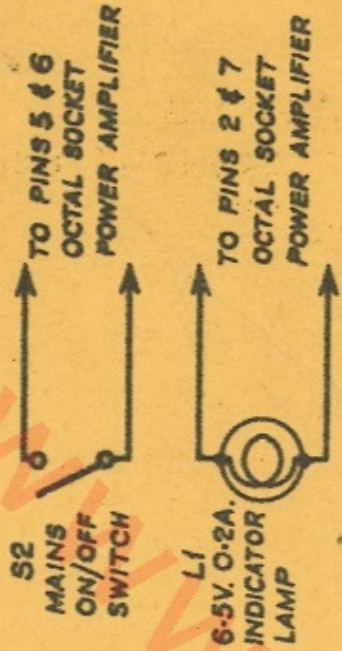
NOT REQUIRED with Control Unit

Single Point Earth Connection



S1 INPUT SELECTOR SWITCH

POSITION 1	RADIO
2	TAPE
3	PICK-UP L.P.
4	PICK-UP T8



INPUT TO POWER AMPLIFIER
TO GRID (Pin 9) VIL
TO S.T. adjacent to VIL

TREBLE BASS BALANCE VOLUME

LEFT-HAND CHANNEL ONLY SHOWN, REPEATED IN RIGHT-HAND CHANNEL EXCEPTING MAINS ON/OFF SWITCH (S1) AND INDICATOR LAMP (L1)

THEORETICAL DIAGRAM PASSIVE CONTROL UNIT

Amendments to Instruction Manual Issue 4/64

In the latest models it has been found that an improvement in signal/noise ratio can be improved by using an ECC83 valve (double triode) in lieu of 2 - EF86 valves shown in the assembly drawing and theoretical diagram. The modifications for triode inputs are as follows:

STAGE 1.

REMOVE R1	(1M ohms)	on TAGBOARD No.1.	TAGS 14 and 44	Not required.
CHANGE R3	(150K	" "	No.1. "	12 and 42 to 33K
" R4	(150K	" "	No.1. "	13 and 43 to 47K and add 270pf +
" R5	(2.7K	" "	No.1. "	15 and 45 to 2.2K
REMOVE R1	(1M ohms)	" "	No.2. "	18 and 48 Not required.
CHANGE R3	(150K	" "	No.2. "	19 and 49 to 33K.
" R4	(150K	" "	No.2. "	17 and 47 to 47K and add 270pf +
" R5	(2.7K	" "	No.2. "	46 to 2.2K

+ THE 270pf CONDENSERS ARE CONNECTED IN PARALLEL WITH THE RESISTOR 4.

STAGE 2.

TOP VIEW.

VIL and VIR will become one valve only Type ECC83 and will be mounted in the VIR position.

UNDERSIDE VIEW:

CHANGE R22	(27K	on TAGBOARD No.3.	to 15K ohms)	
" R23	(33K	" "	No.3. to 18K ohms)	REPEAT THESE ON
" C12	(100pf)	" "	No.3. to 180pf	TAGBOARD N.4.
" C13	(100pf)	" "	No.3. to 180pf)	(LEFT HAND CHANNEL)

REMOVE THE LINK BETWEEN PIN 7 AND PIN 2 ON VIR VALVEHOLDER.

" " " " " 3 " " 8 " VIR " "

DISCONNECT R2 AND THE SCREENED LEAD INNER CORE FROM PIN 9 on VIR VALVEHOLDER.

" HEATER WIRING CONNECTED TO PIN 4. RECONNECT TO PIN 9 AND ADDA LINK BETWEEN PIN 4 & 5 ON VALVEHOLDER VIR.

DISCONNECT C3 (.5mfd) LEFT HAND CHANNEL FROM PIN 6 VIL AND CONNECT TO PIN 1 VIR VALVEHOLDER.

DISCONNECT R2 AND THE SCREENED LEAD INNER CORE FROM PIN 9 VIL VALVEHOLDER RECONNECT TO PIN 2 ON VIR VALVEHOLDER.

CONNECT R2 AND SCREENED LEAD TO PIN 7 ON VIR VALVEHOLDER. THIS WAS PREVIOUSLY CONNECTED TO PIN 9 OF VIR.

STAGE 3.

REMOVE LINK FROM TAG 14 TAGBOARD No.1. TO PIN 1 VIR VALVEHOLDER.

" " " " 15 " No.1. " " 3 VIR " AND FIT NEW LINK

FROM TAG 15 TO PIN 8 VIR VALVEHOLDER.

THE LINK FROM TAG 16 TAGBOARD No.2. TO PIN 6 VIL SHOULD BE TRANSFERRED TO PIN 3 VIR VALVEHOLDER.

THE LINK FROM TAG 17 TAGBOARD No.2. TO PIN 6 VIL SHOULD BE TRANSFERRED TO PIN 1 VIR VALVEHOLDER.

STAGE 4.

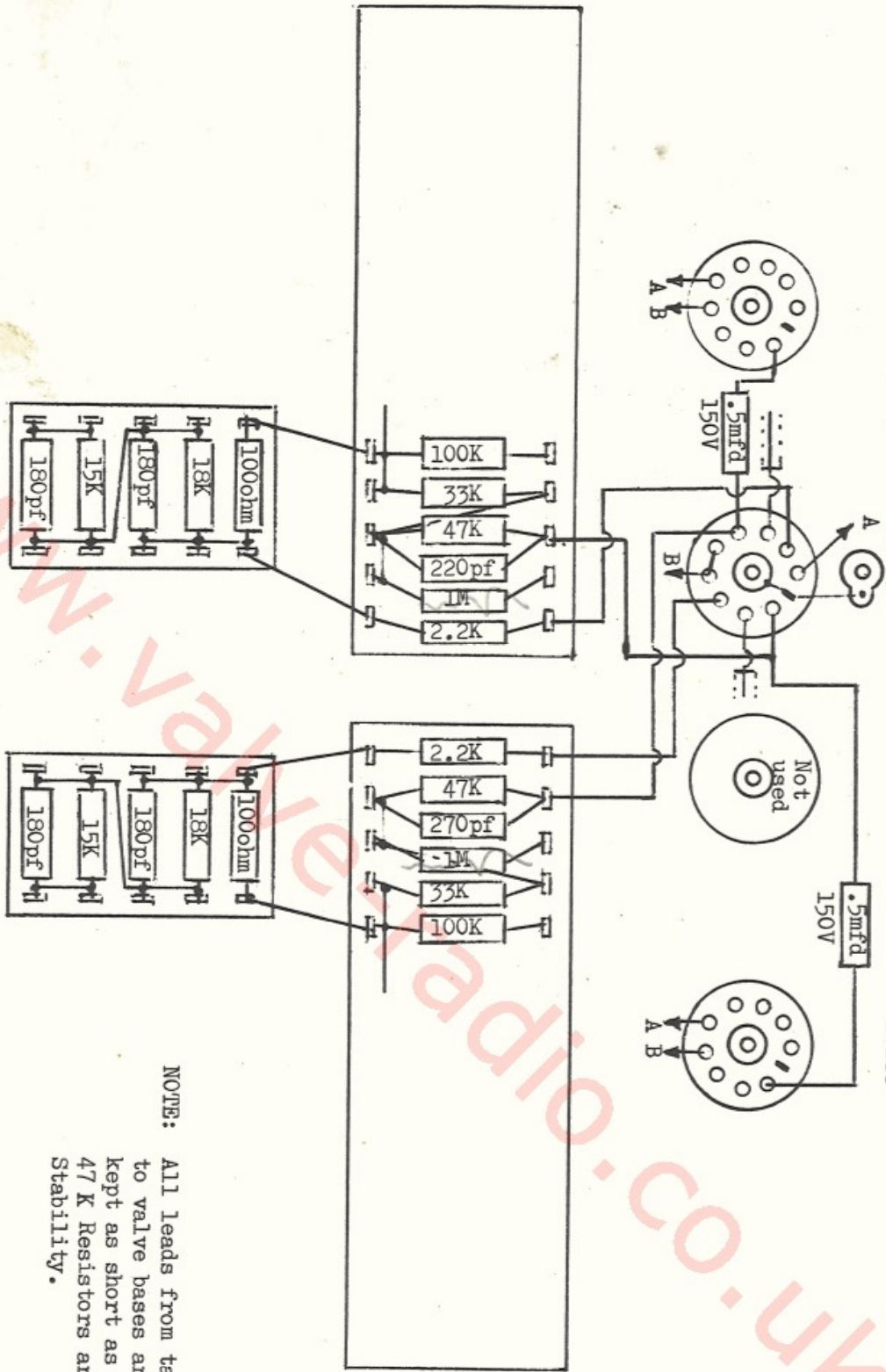
REMOVE C2 FROM TAGS 14 & 15 TAGBOARD No.1 NOT REQUIRED.

" C2 " " 16 & 18 " No.2. " "

EC186

ECC83

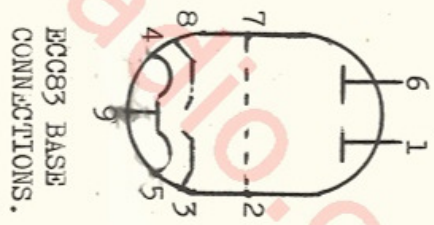
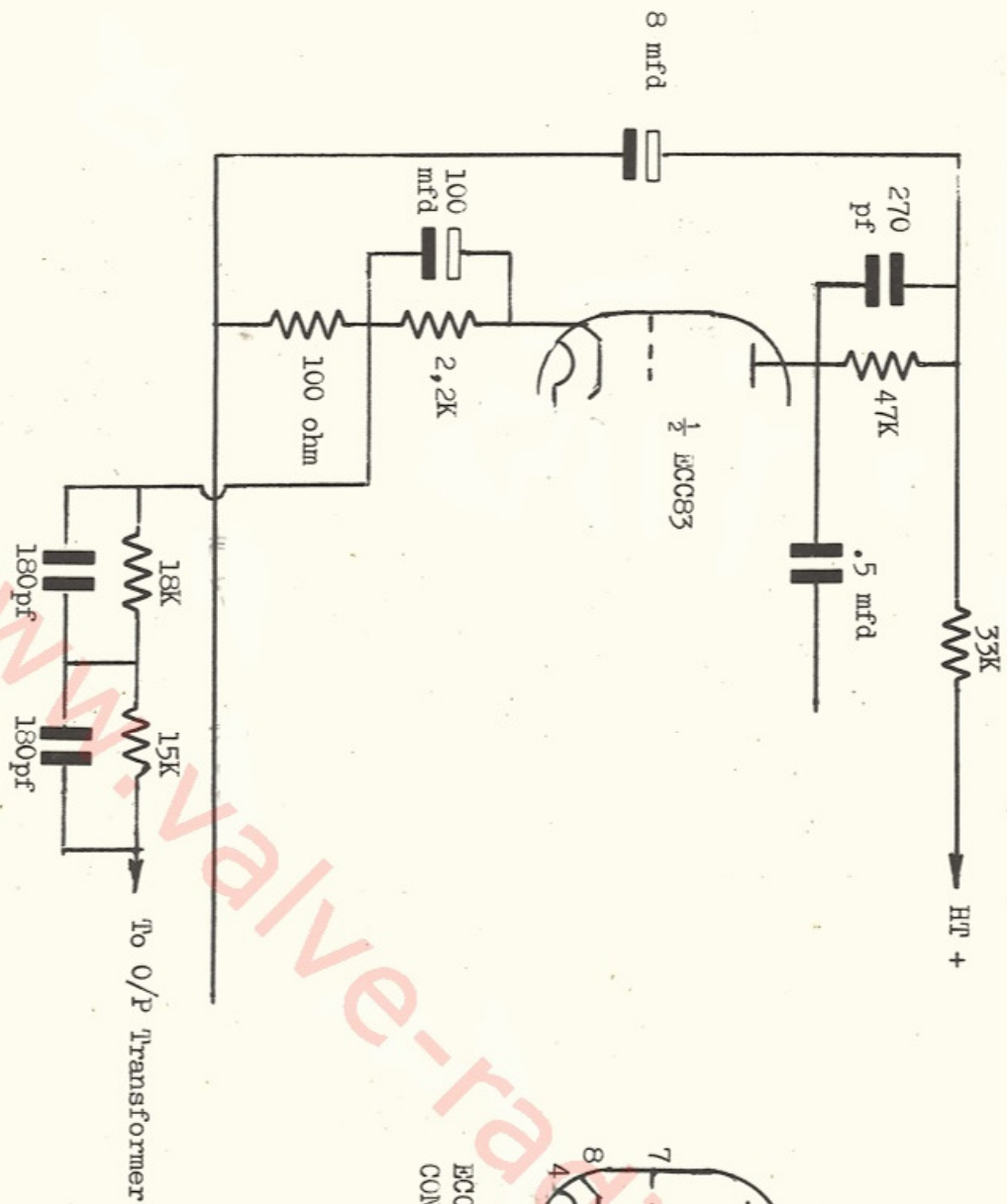
EC186



STAGE THREE - WIRING (UNDERSIDE VIEW)

Modifications for Triode inputs.

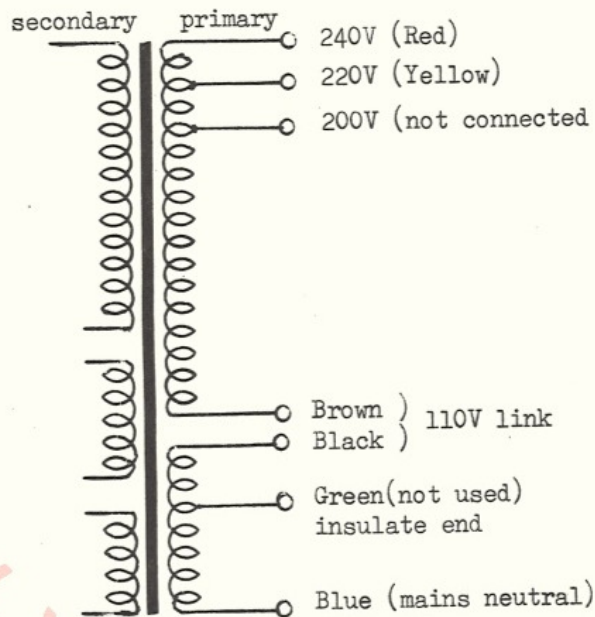
NOTE: All leads from tag boards to valve bases are to be kept as short as possible. 47 K Resistors are High Stability.



THEORETICAL DIAGRAM POWER AMPLIFIER
 Modifications for Triode inputs.

Partridge transformers referred to have been discontinued and we are now supplying Gilson Transformers or alternative types which are strictly to the Mullard specification.

Mains transformers currently supplied should be wired as follows.



Method of wiring alternative type of 10 + 10 Mains Transformer.

The credit terms referred to on page 12 have been amended and should now read as follows:

- (f) Deposit £3. 0. 0. and 12 monthly payments of £1. 11. 2.
- (g) Deposit £3. 12. 0. and 12 monthly payments of £1. 17. 5.
- (h) Deposit £5. 2. 0. and 12 monthly payments of £2. 12. 10.

In addition to the list of Showrooms on the back cover all our products can now be purchased from:

Stern-Clyne Ltd, 1-3, Eastown House, Lincoln Street, Nottingham.

Tel: Nottingham 45889

Stern-Clyne Ltd, (New-Max) 220, Edgware Road, London W.2.

Tel: Paddington 5407 & 5607