THE "3-3 QUALITY AMPLIFIER

This circuit has been developed from the very popular 3 Valve 3 Watt Amplifier designed in the Mullard Laboratories. Its purpose is to provide Home Constructors with a simple Amplifier to construct but at the same time enjoying very high quality reproduction. In presenting it we have strictly adhered to the design created by the Mullard Technicians but we have in addition incorporated arrangements for switching Gram and Radio Inputs and we have also provided additional Power Supply to enable a Radio Tuning Unit to draw its H.T. and L.T. supply from the Amplifier Power Unit. The "3-3" circuit gives an output of 3 Watts at a total harmonic distortion of 1%. Full performance figures are given in the summary below. The engraved Front Panel is very attractively finished and is arranged for surface mounting on a Cabinet.

CIRCUIT DESCRIPTION ... The Amplifier is operated from A.C. Mains supply of 200 to 250 Volts and uses three Mullard Valves, an EF86 as the voltage amplifier, an EL84 in the output stage and an EZ80 (or EZ81) as the Rectifier. The circuit includes five controls, Volume (VR1), Treble (VR2), Bass (VR14), Selector Switch (Radio and Gram) and a separate Mains On/Off Switch.

The comparatively high sensitivity of the amplifier permits the use of all types of crystal pick-ups. The 3.75 ohm and the 15 ohm output terminations are suitable for all kinds of loudspeaker, and, although the circuit is designed to make the most effective use of the single output valve, the best possible results will only be achieved if a suitably housed high quality speaker is used.

The EF86 is used under 'starvation' conditions; the valve currents and voltages are very much smaller than they would be under normal working conditions because of the high resistance (R4 = 1.0 Meg ohm) in the anode circuit. Direct coupling from the anode of the EF86 to the control grid of the EL84 is also used. These two factors together produce a very high stage gain, and, although feedback of approximately 20 dB is used around the whole circuit, an output of only 100 mV on Radio and 100/150 mV on Gram is required to give an output of 3 Watts.

The working points of the valves are stabilised by the D.C. negative feedback provided when the screen grid feed of the EF86 is taken from the cathode circuit of the output stage.

PERFORMANCE ... With the Treble and Bass controls in their minimum effective positions, the frequency response is essentially flat from 35 c/s to 30 Kc/s (Fig.5). With maximum application of the respective controls, a treble cut of 20 dB is available at 10 Kc/s, and a bass boost of 15 dB is available at 70 c/s. The bass boost is obtained by reducing the main feedback at low frequencies by means of VR14 and C6.

The relationship between the total harmonic distortion and the output power is shown in Fig. 6. It will be seen that, for a typical amplifier, for outputs above about 3.5 Watts, the distortion increases rapidly this indicates the point at which overloading of the amplifier occurs.

CONSTRUCTIONAL ... All components should be placed as nearly as possible in the precise positions shown on the diagrams and all wiring must be kept as short and direct as possible consistent with the general layout shown in the drawings.

SUMMARY OF PERFORMANCE ...

Output Power (at 400 c/s) ... 3 Watts at 1.0% total harmonic distortion.

Power Response ... Flat from 100 c/s to 10 kc/s.

Frequency Response ... Flat within ± 1 dB (relative to the response level at 1 kc/s) from 35 c/s to 30 kc/s.

Tone Control ... Maximum Treble Cut: Approx. 20 dB at 10 kc/s.
Maximum Bass Boost: Approx. 15 dB at 70 c/s.

Hum and Noise Levels ... At least 70 dB below 3 Watts.

Sensitivity ... Radio - 100 m/V for 3 Watts.
Gram - 100/150 m/V for 3 Watts.

Selector Switch ... Provides position for Radio Tuning Unit and Gram positions for L.P. and Standard Records.

Radio Tuning Unit ... Additional power is available for this purpose, 250V at 30 m/A and 6.3 Volts 1½ amps.

Dimensions ... Overall size of assembled Amplifier is 10" x 6" x 6" high. The Front Panel is 11" x 3".

Fuse ... ½ inch Tubular 2 Amp. Incorporated in Voltage Adjustment Plug.

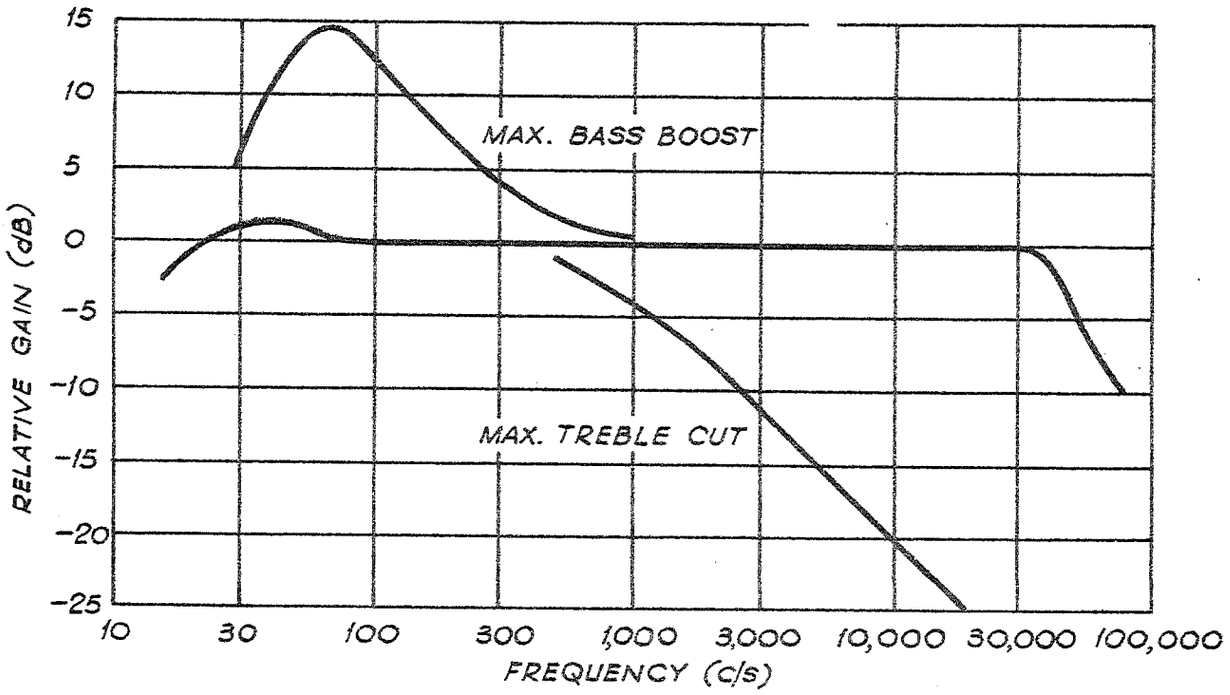

FIG. 5 FREQUENCY RESPONSE OF AMPLIFIER, SHOWING RELATIVE GAIN WITH MINIMUM TONE CONTROLS, AND ALSO WITH MAXIMUM TREBLE CUT AND MAXIMUM BASS BOOST.

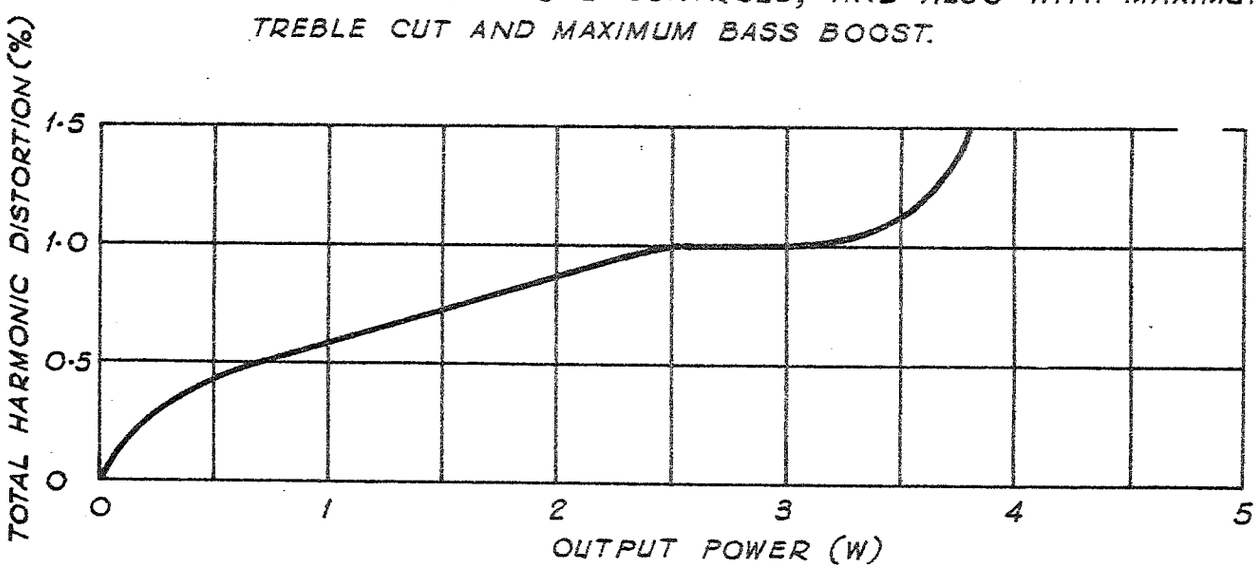

FIG. 6 TOTAL HARMONIC DISTORTION PLOTTED AGAINST OUTPUT POWER.

BUILDING THE AMPLIFIER ...

PACKING ... Unpack the Kit carefully and check the individual items against the parts list. This should be done before the packing material is thrown away as small components and valves are often protected by wrapping paper to prevent damage in transit.

Every effort is made to ensure that the Kit is packed complete, but should a shortage exist it is IMPORTANT to advise us immediately giving full details of the missing items.

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

Ensure that each connection is effected with a neat and positive solder joint and that 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 Multicore cored solder.

COMPONENTS ... The wire ends of Condensers and Resistors should be trimmed to the required length by first arranging the component in it's 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 with 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 solder joints. We recommend therefore that a small electric Soldering iron of the instrument type be used. Use a good flux-cored solder, such as Ersin Multicore 18 s.w.g. The best method is where possible to first secure the component or wire to the tag so that it will remain in position without having to hold it, and 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 component 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 lightly scraped with a small blade, and then the cleaned part should be well 'tinned' before actually soldering to the 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 are heated simultaneously and 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 fault-find 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 is indicated on the drawing thus  . The wire supplied for the heater wiring is thin green plastic, and will lend itself readily to 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 the drawing indicates that it runs underneath components.

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

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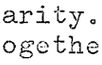
It will be observed that as the stage wiring progresses the wiring shown in the previous stage has been omitted for clarity. The heater wiring and any wires carrying A.C. must be lightly twisted together to avoid hum radiation, such wiring is indicated on the drawing thus  . The wire supplied for the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

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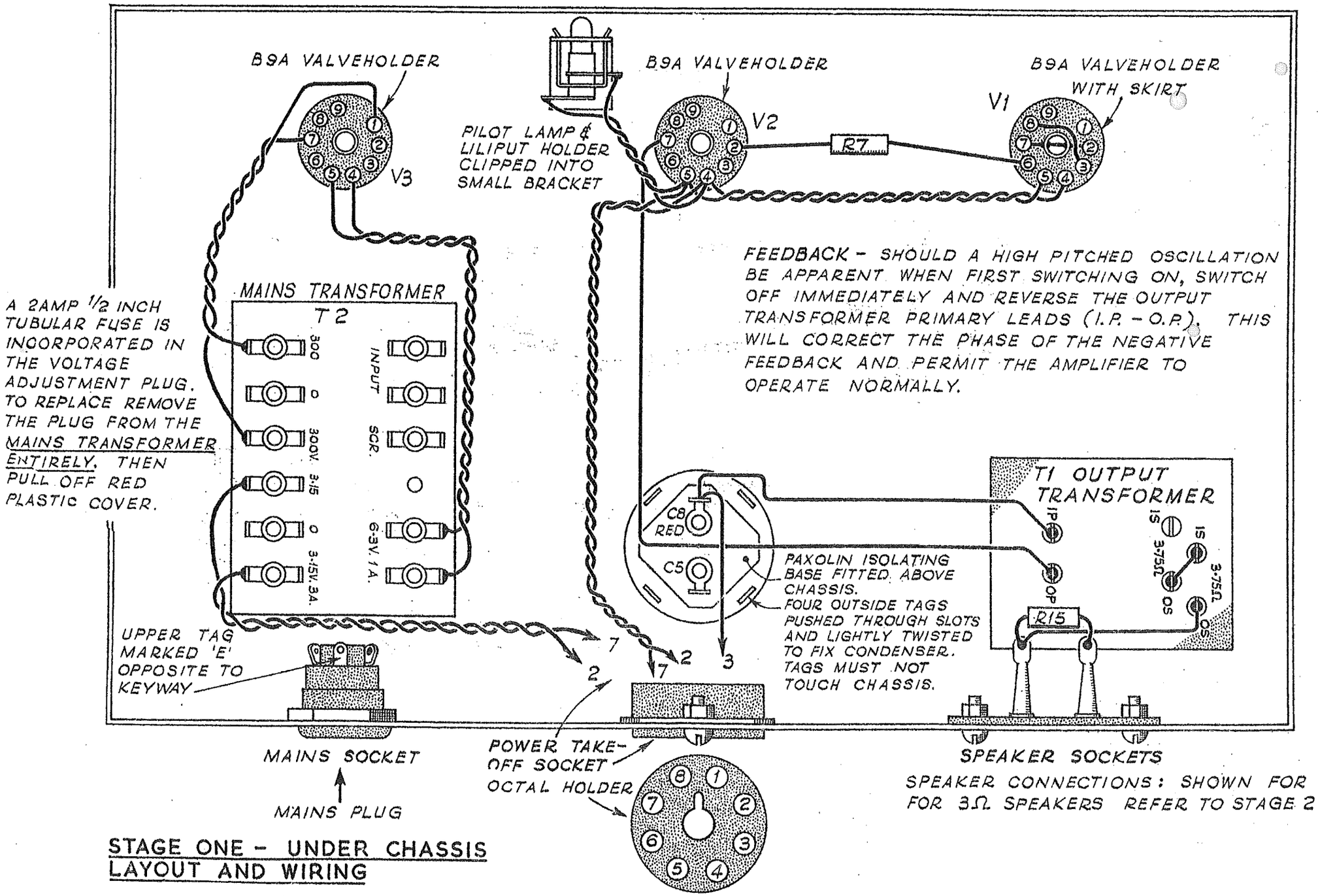


STAGE ONE - UNDER CHASSIS LAYOUT AND WIRING

STAGE TWO

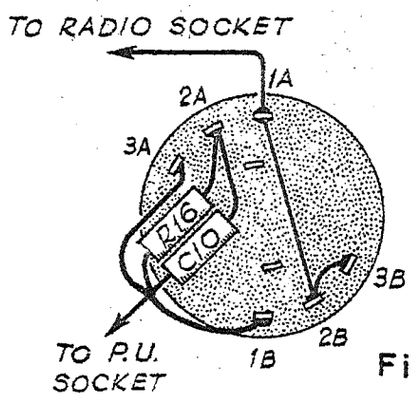


Fig. 1

SWITCH WAFER VIEWED FROM REAR

WIRING OF SELECTOR SWITCH BEFORE ASSEMBLY TO CHASSIS

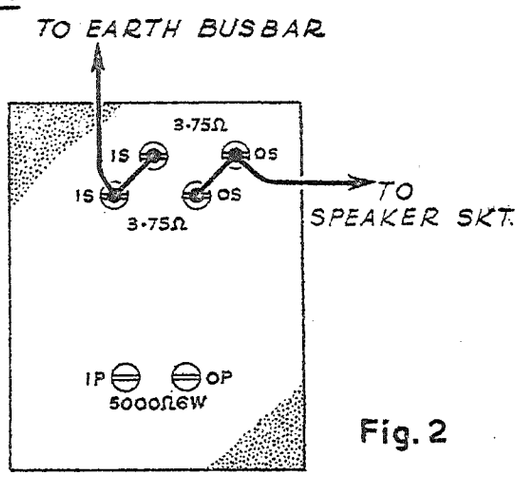


Fig. 2

NOTE CHANGE R5 * TO 150Ω

OUTPUT TRANSFORMER CONNECTION FOR 3 OHM LOUDSPEAKERS

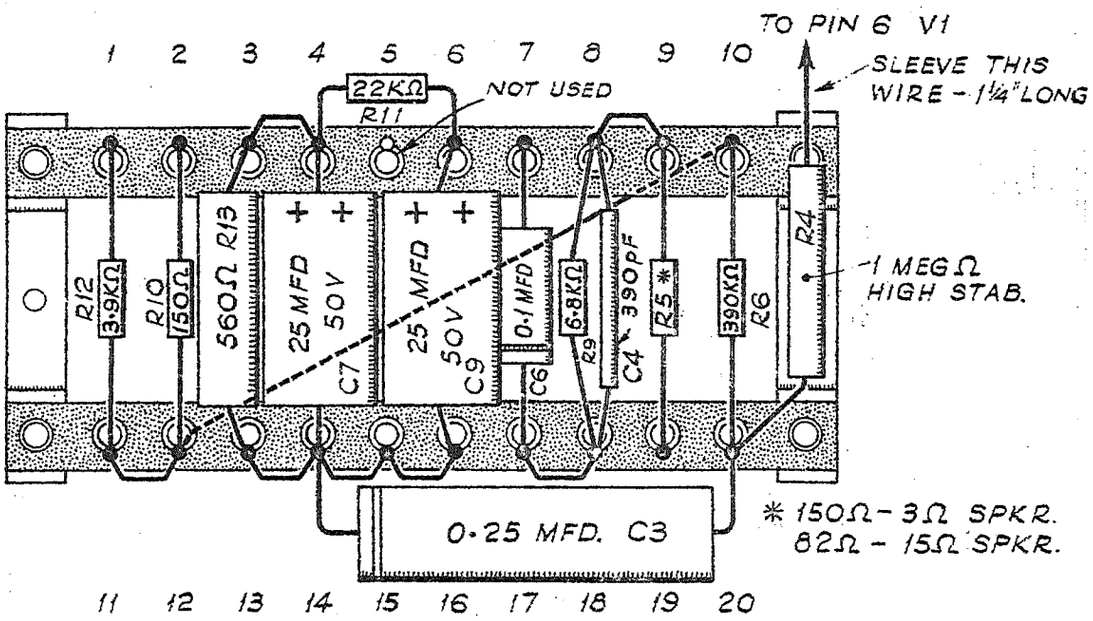
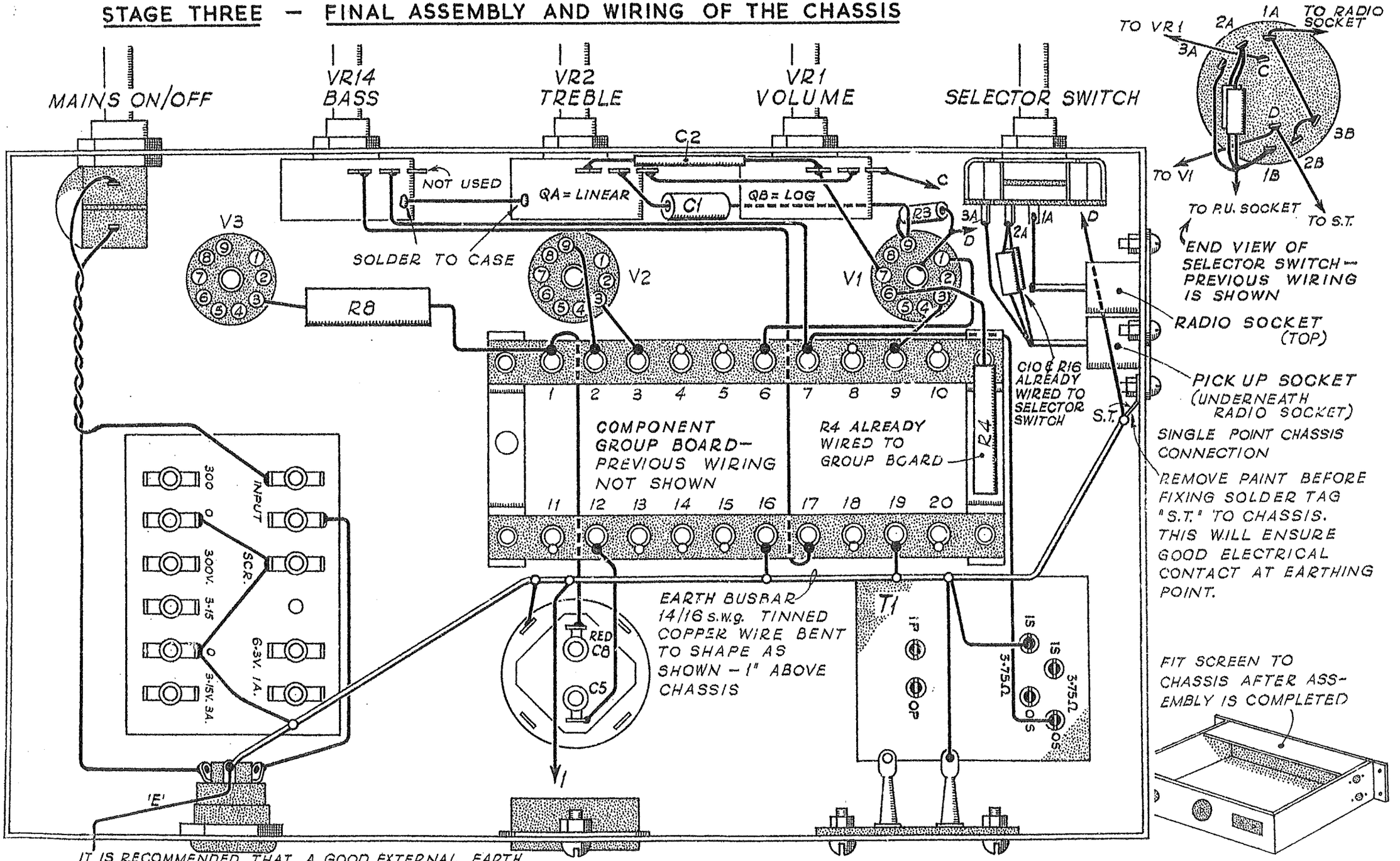


Fig. 3

WIRING OF COMPONENT GROUP BOARD BEFORE ASSEMBLY TO CHASSIS

STAGE THREE — FINAL ASSEMBLY AND WIRING OF THE CHASSIS



IT IS RECOMMENDED THAT A GOOD EXTERNAL EARTH CONNECTION BE MADE TO THE EARTH PIN 'E' ON THE MAINS PLUG. THIS WILL ENSURE MINIMUM HUM LEVEL.