No. 107 1/6

FOUR VALVE CIRCUITS

Containing circuits for building:—

1. T.R.F. BATTERY PORTABLE USING FERRITE ROD AERIAL AND PUSH-PULL OUTPUT
2. LOCAL STATION F.M. RECEIVER
3. VOLTAGE STABILISED POWER SUPPLY UNIT

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BERNARDS RADIO MANUALS

FOUR VALVE CIRCUITS

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T.R.F. Battery Portable using Ferromagnetic Rod Aerial and Push-Pull Output

The circuit is that of a normal tuned, Radio Frequency stage followed by a Pentode detector feeding into a Push-Pull output stage.

By making use of a ferromagnetic rod aerial greater sensitivity can be obtained than by a normal frame aerial, due to the properties exerted by the rod.

For many years now designers have endeavoured to design a built-in aerial with a sensitivity comparable with that of a good outdoor aerial.

Frame aerials until recently were only suitable where large signal strengths could be obtained, and although this type of aerial has been known since the early days of radio these were usually very large in diameter; using the ferromagnetic rod the aerial can now be calculated in terms of inches.

Assembling a Single Rod Aerial.

The winding itself is in two parts one of which is moveable. Experiments have shown that the efficiency of the aerial is greatly improved by having an insulating material between the ferro-magnetic rod and the winding. This consists of layers of Sellotape, wound on the rod as shown in the diagram (Fig. 1a).

The moveable section is made from $\frac{3}{4}$ inch wide Sellotape, wound sticky side outwards, four or five layers being adequate. Winding details are given in Fig. 2a. Fifty turns of

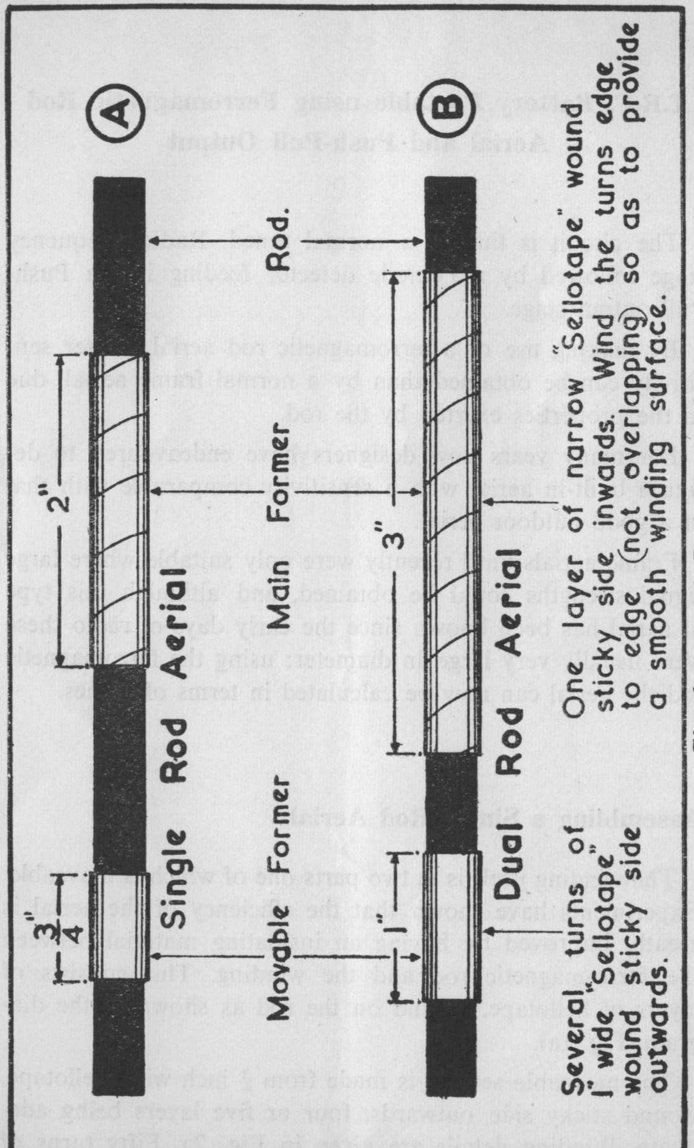

Fig. 1. Aerial Rod Preparation.

26 s.w.g. D.S.C. wire comprise the fixed coil, which is spaced to occupy about 1½ inches. Accurate spacing can be obtained by interwinding the coil proper with 36 s.w.g. D.S.C. wire, which is the right diameter.

This guide wire is removed as soon as the winding proper has been securely anchored by means of Durofix or polysterene cement.

After winding the fixed section the wire should not be broken, but winding continued in the same direction for a further 24 turns to make the moveable section. This can be close wound, and note should be taken here to leave sufficient slack wire to allow the moveable section to travel to the end of the rod.

When winding is complete a coating of polysterene cement or colourless nail varnish may be painted over the windings to prevent them from moving and for anchoring any loose turns, care being taken not to cement the moveable section to the ferromagnetic rod.

As it is not possible to drill into these rods, mounting is achieved by cementing the ends into rubber grommets. The grommets must be mounted into cellulose acetate sheet or perspex. The efficiency of the aerial is impaired if it is mounted into a metal bracket, as even non-ferrous metals form a shorted turn which will produce a magnetic field. The method of mounting is shown in Fig. 2a.

Where a very high degree of sensitivity is desired, there is a decided advantage of using two ferromagnetic rods. Generally speaking the same instructions apply as for a single rod aerial, and revised details are given in Figs. 1b and 2b. It must be noted that the aerials are now connected in parallel.

Alignment Procedure.

Aerial rods are normally mounted horizontally in any convenient position. As with the frame aerial the ferromagnetic

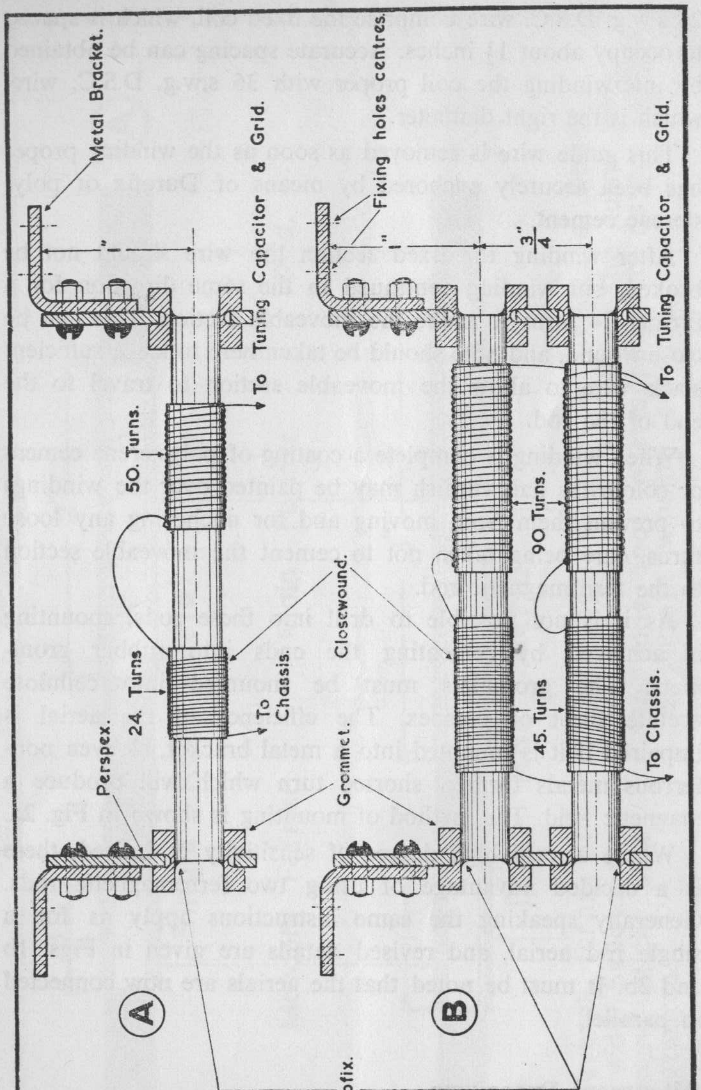

Fig. 2. Aerial Winding Details.

aerial rod replaces the normal input tuned circuit and is tuned by a variable capacitor in the normal way.

When the rod has been fitted and wired in, tune in a local station at the high frequency end of the medium wave-band 1500-1250 Kc/s or 200-250 metres and adjust T.C.1. for loudest signal. Return to a station at the low frequency end of the band 600-500 Kc/s or about 500 metres and adjust the moveable section for best results. Do not touch the moveable winding with the hand, because of capacity effect, but use a plastic knitting needle. Return to the high frequency end of the scale adjusting T.C.1. again, and then back to the 500 metre mark again, repeating the procedure several times until no further improvement can be obtained. The moveable winding can now be cemented into position. With dual rod assemblies both moveable sections must be positioned.

The circuit diagram, suggested top chassis and under chassis layouts are shown; given a little care and patience an efficient battery receiver can be constructed.

Component for Battery Receiver.

TSL Capacitors except where stated otherwise.

C.1.	100 pF. Silver Mica.
C.2. } C.5. }	500 pF. Variable. Jackson Bros.
C.3.	0.1 μF. Paper Tubular.
C.4.	0.1 μF. Paper Tubular.
C.6.	100 pF. Silver Mica.
C.7.	0.1 μF. Paper Tubular.
C.8.	8 μF. 150V wkg. Electrolytic. T.C.C.
C.9.	0.001 μF. Moulded Mica.
C.10.	0.05 μF. Paper Tubular.
C.11.	8 μF. 150V wkg. Electrolytic. T.C.C.
C.12.	25 μF. at 12V wkg. Electrolytic. T.C.C.

TSL Resistors.

R.1.	1 Megohm.
R.2.	39 K ohms.
R.3.	4.7 K ohms.
R.4.	4.7 K ohms.
R.5.	1 Megohm.
R.6.	100 K ohms.
R.7.	4.7 K ohms.
R.8.	50 K ohms.
R.9.	100 ohms.
R.10.	150 ohms.

Transformers.

T.1.	Small Intervalve P.P. Transformer.
T.2.	Small P.P. Output Transformer Ratio 90:1

Valves.

V.1. V.2. DF96 Mullard.

V.3. V.4. DL94 Mullard.

Valveholders.

4 B7G Valveholders.

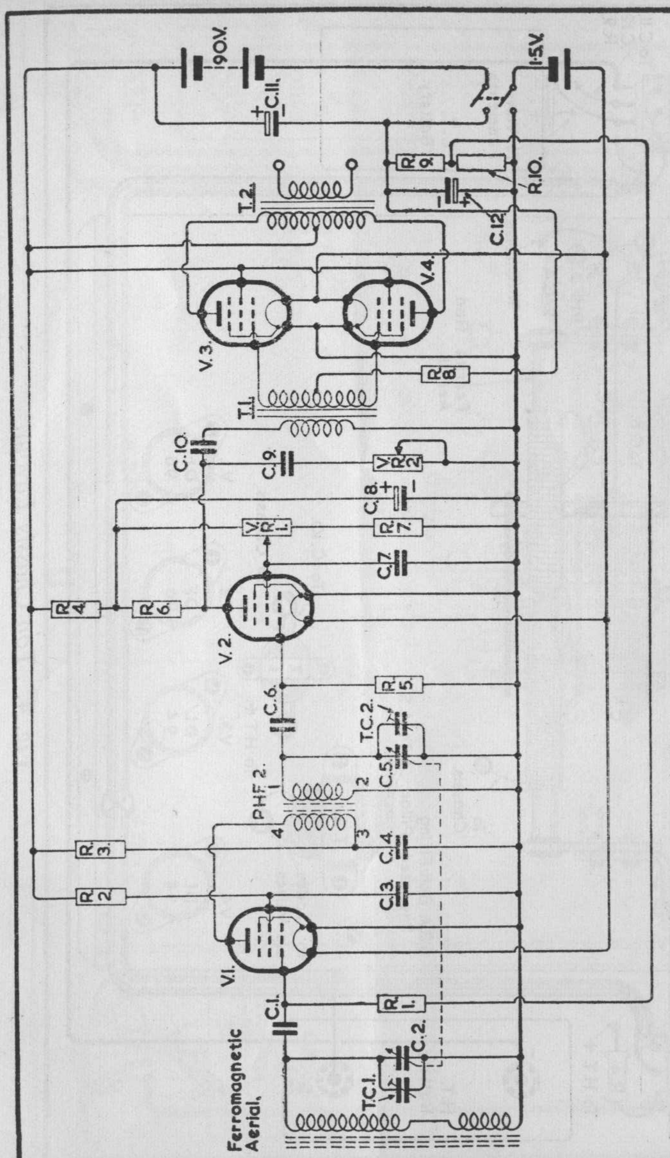

Fig. 3. Circuit Diagram Battery T.R.F. Push-pull Receiver.

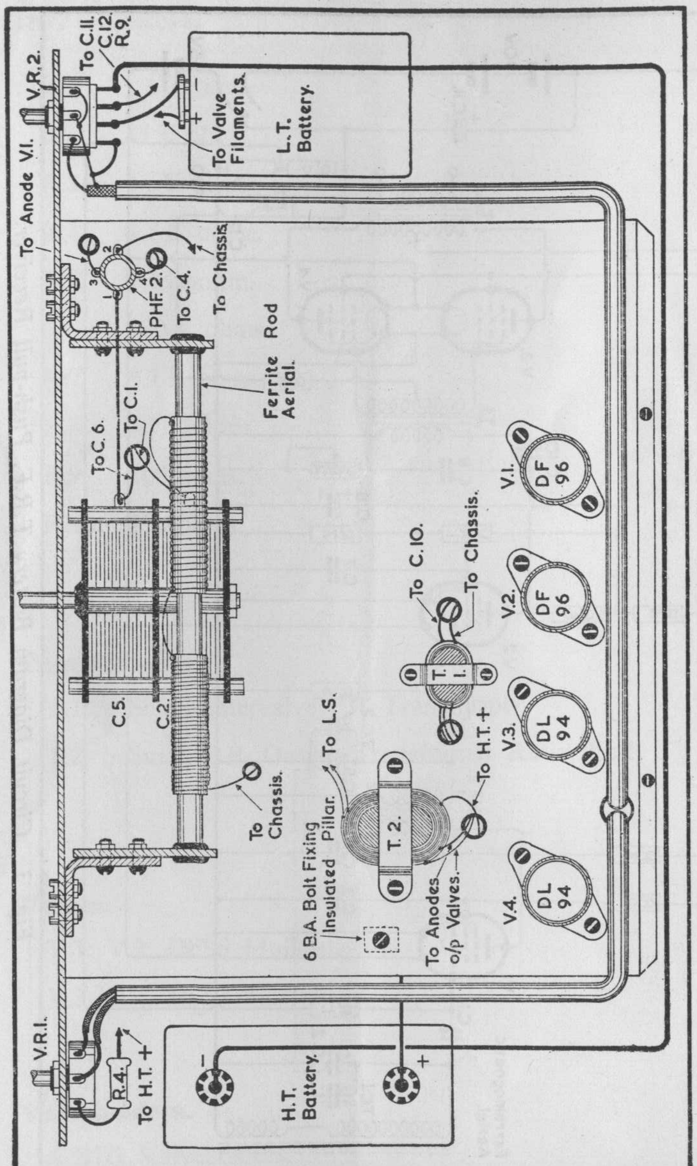

Fig. 4. Top Chassis Layout.

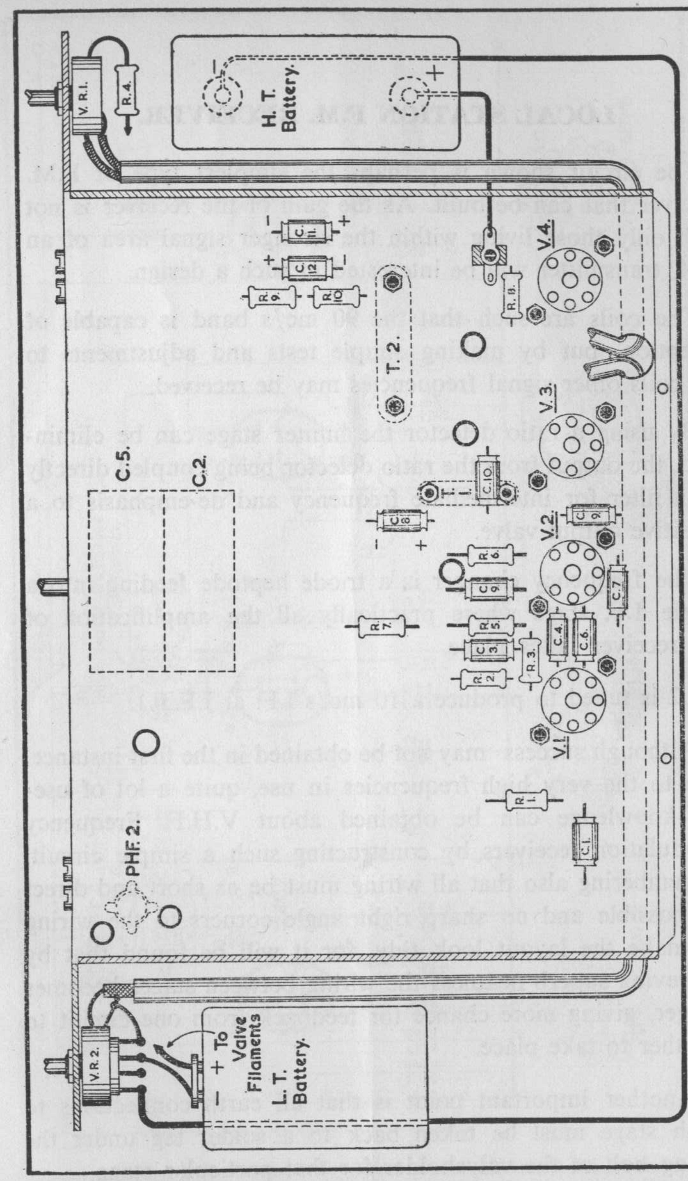

Fig. 5. Under Chassis Layout.

LOCAL STATION F.M. RECEIVER.

The circuit shown is perhaps the simplest type of F.M. receiver that can be built. As the gain of the receiver is not high only those living within the stronger signal area of an F.M. transmitter will be interested in such a design.

The coils are such that the 90 mc/s band is capable of reception, but by making simple tests and adjustments to the coils other signal frequencies may be received.

By using a ratio detector the limiter stage can be eliminated, the output from the ratio detector being coupled directly by a filter for intermediate frequency and de-emphasis to a sensitive output valve.

The frequency changer is a triode heptode feeding into a single I.F. stage where practically all the amplification of the receiver takes place.

L2 is tuned to produce a 10 mc/s I.F. at I.F.T.1.

Although success may not be obtained in the first instance, due to the very high frequencies in use, quite a lot of useful knowledge can be obtained about V.H.F. Frequency Modulation receivers by constructing such a simple circuit, remembering also that all wiring must be as short and direct as possible and no sharp right angle corners to the wiring to make the layout look tidy, for it will be found that by achieving superb neatness the wiring between stages becomes longer, giving more chance for feedback from one circuit to another to take place.

Another important point is that all earth connections to each stage must be taken back to a solder tag under the fixing bolt of the valveholder for that particular stage.

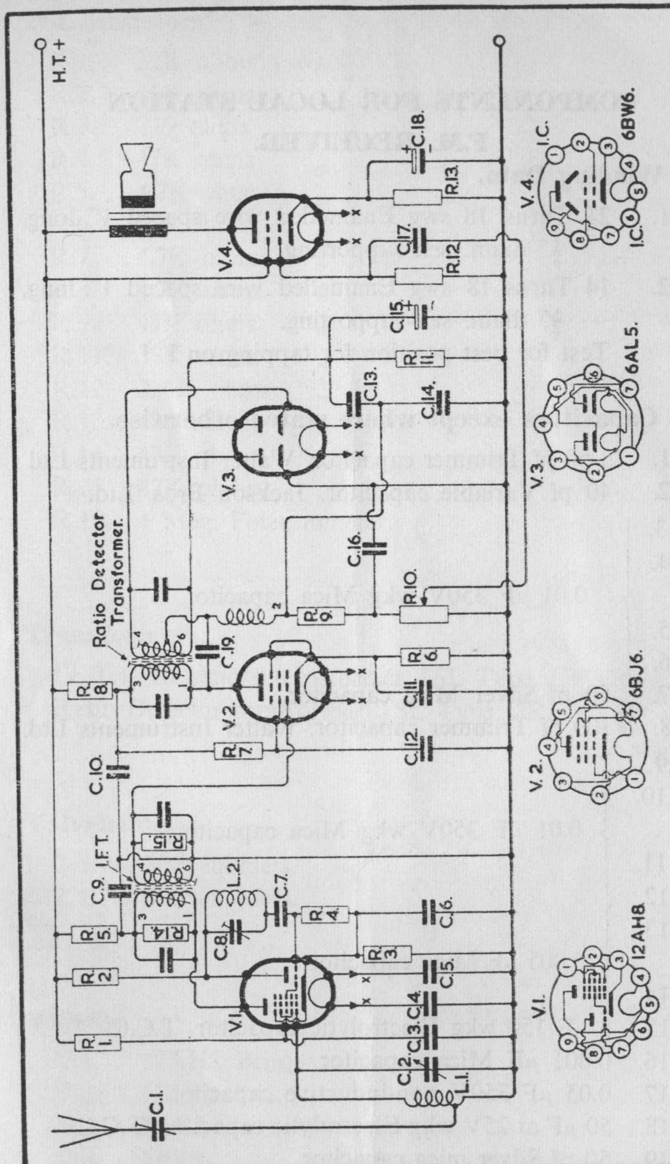

Fig. 6. Circuit of Local Station F.M. Receiver.

COMPONENTS FOR LOCAL STATION F.M. RECEIVER.

Coil Winding Data.

L.1. $2\frac{1}{2}$ Turns 18 swg Enamelled wire spaced $\frac{1}{2}''$ long, $\frac{1}{2}''$ diam. self-supporting.

L.2. 14 Turns 18 swg Enamelled wire spaced 1″ long, $\frac{1}{2}''$ diam. self-supporting.

Test for best position for tapping on L.1.

TSL Capacitors except where stated otherwise.

C.1.	3-50 pf Trimmer capacitor. Walter Instruments Ltd.
C.2.	40 pf Variable capacitor. Jackson Bros. Ltd.
C.3., C.4., C.5., C.6.	0.01 μF 350V wkg Mica capacitor.
C.7.	50 pf Silver Mica capacitor.
C.8.	100 pf Trimmer capacitor. Walter Instruments Ltd.
C.9., C.10., C.11., C.12.	0.01 μF 350V wkg Mica capacitor.
C.13., C.14.	0.005 μF Mica capacitor.
C.15.	8 μF 150 wkg Electrolytic capacitor. T.C.C.
C.16.	0.001 μF Mica capacitor.
C.17.	0.05 μF 350V non-inductive capacitor.
C.18.	50 μF at 25V wkg Electrolytic capacitor. T.C.C.
C.19.	50 pf Silver mica capacitor.

TSL Resistors.

R.1.	22K ohms $\frac{1}{2}$ watt
R.2.	47K ohms „
R.3.	220 ohms „
R.4.	47K ohms „
R.5.	4.7K ohms. „
R.6.	150 ohms „
R.7.	4.7K ohms „
R.8.	4.7K ohms. „
R.9.	47K ohms „
R.11.	33K ohms „
R.12.	330K ohms „
R.13.	180 ohms. „
R.14.	47K ohms „
R.15.	47K ohms. „
R.10.	1 Meg. Potentiometer.

Transformers.

I.F.T.1. 10.7 mc/s transformer TSL Type. UF.376.

Ratio Detector transformer TSL Type URF.377.

Valveholders.

2 B9A Valveholders.

2 B7G Valveholders.

Valves.

V.1.	12AH8 Brimar.
V.2.	6BJ6 „
V.3.	6AL5 „
V.4.	6BW6 „

A VOLTAGE STABILISED POWER SUPPLY UNIT.

Quite often in the experimenter's workshop a reliable and constant source of H.T. supply is necessary. A power unit of the type to be described will maintain a constant H.T. voltage at the output terminals of the unit over a relatively wide range of current drain.

The circuit employs a conventional choke-capacity input filter, but due to this the mains transformer must be one of high quality with very few losses in itself. This is followed by a valve whose effective resistance is changed by a variation of its grid-cathode potential, this potential being fed and varied by a pentode valve which compares the H.T. output voltage with that appearing across the voltage regulator valve.

The output of the unit should give a controlled voltage over a range of approximately 170 volts to 250 volts, with a maximum current drain of about 120 milliamps. Resistor values have been chosen carefully and should give very little trouble during use.

A 350-0-350 volts mains transformer supplies A.C. voltage to the anodes of a 5Z4 rectifier which feeds via the smoothing filter to the anode of a 6L6 output tetrode.

In operation the circuit functions due to the fact that the regulation of the H.T. supply to the 6L6 is poor, and to maintain a constant voltage at the output terminals the effective resistance of this valve is varied to compensate for this poor regulation.

To understand the operation more fully imagine the unit to be delivering a certain H.T. voltage at a particular current, for some reason or other the H.T. commences to fall, due perhaps to an extra current drain being taken or drop in the main supply. This drop in voltage is reflected back into the grid of the 6J7 pentode valve via the pententiometer chain R4, VR1, R6.

The cathode of the 6J7 is held at a constant potential by the regulator valve VR105, and is not disturbed greatly by the fall in the H.T. voltage. The grid voltage of the 6J7 is proportional to the output voltage of the power unit and therefore becomes less positive, the resulting anode current fall of this valve will cause a lower voltage to appear across R3. This voltage across R3 is that which biases the grid of the 6L6, with the effect that when it decreases, the effective resistance of the output valve also decreases, and the voltage appearing at the output terminal will rise to approximately its previous value. Therefore the output voltage always endeavours to maintain itself at this level, the reference voltage being provided by the regulator valve VR105.

The potentiometer VR1 allows any desired fraction of the main output voltage to be applied to the grid of the 6J7. By adjusting VR1 the stabilised output voltage from the unit can be varied.

To be of any use in the workshop or laboratory the regulated output voltage should be capable of handling changes in load current which occur at high frequencies. If the changes occur too rapidly it is possible for the unit to oscillate at a very high frequency when connected to a load other than purely resistive.

Should this happen at any time, a resistance equal in value to R5 can be inserted between the anode of 6J7 and the grid of the 6L6. At very high frequencies these values can be lowered if necessary to as low as several hundred ohms.

As current passes through VR105, which is a voltage regulator, and not a reference valve, the power unit reference voltage may alter slightly though not enough to result in an extremely large change at the output terminals. The current passing through this valve should be between limits of 10-30 milliamps which should not cause any serious change in the reference voltage.

In conclusion the L.T. windings of the 6L6 should be capable of withstanding a high voltage, due to the fact that the heaters of the valve cannot be connected to chassis in the normal way which would increase the chances of a heater-cathode failure in the valve.

A circuit diagram of the unit is shown at Fig. 7 with top chassis and under chassis layouts at Fig. 8 and 9 respectively.

Components for Stabilised Power Pack.

Capacitors.

C.1. 8 μF. 500V wkg. Electrolytic. T.C.C.
C.2. 1 μF. 350V wkg. Paper. T.C.C.
C.3. 1 μF. „ „ „ T.C.C.
C.4. 1 μF. „ „ „ T.C.C

TSL Resistors.

R.1. 22 K ohms.
R.2. 15 K ohms.
R.3. 1 Megohm.
R.4. 22 K ohms.
R.5. 100 K ohms.
R.6. 33 K ohms.
VR.1. 50 K ohms. Wire Wound. Colvern Ltd.

Valves.

V.1. 5Z4 Brimar.
5 Y3 GT
V.2. 6J7 Brimar.
V.3. VR105 Brimar.
V.4. 6L6 Brimar.

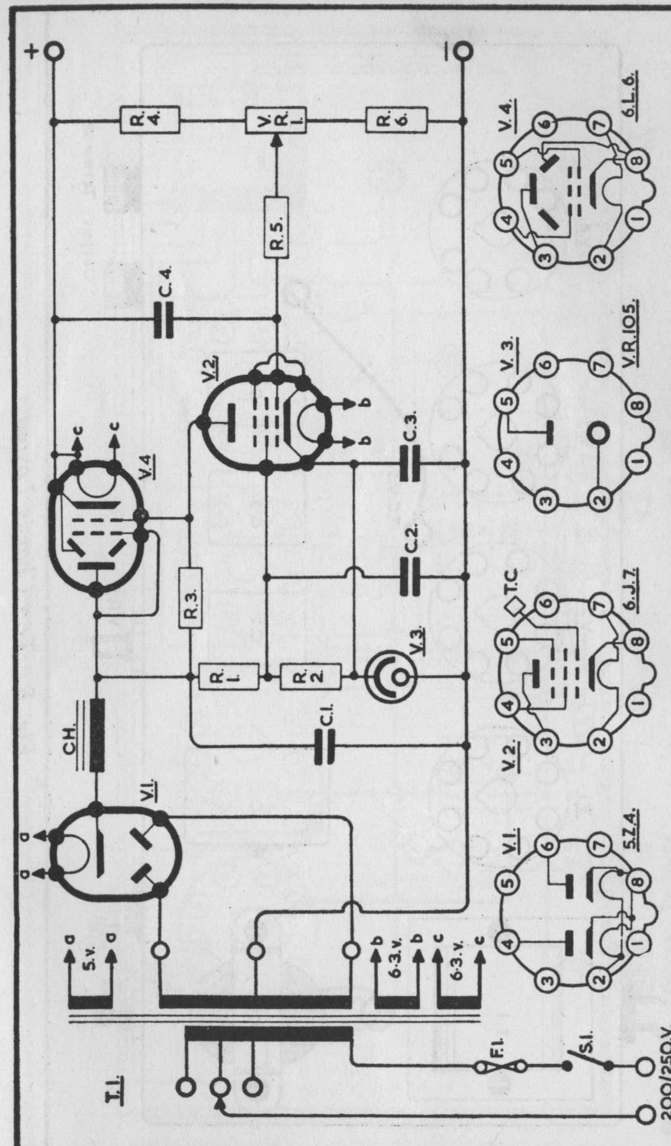

Fig. 7. Circuit Diagram Voltage Stabilised P/P.

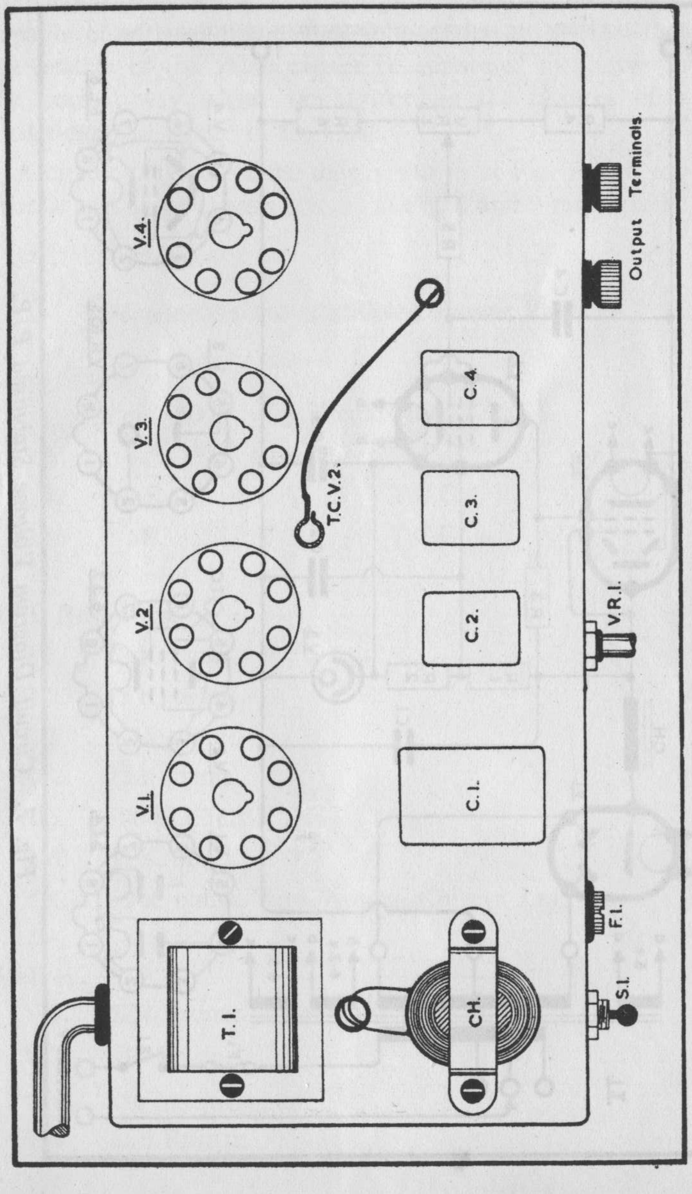

Fig. 8. Top Chassis Layout.

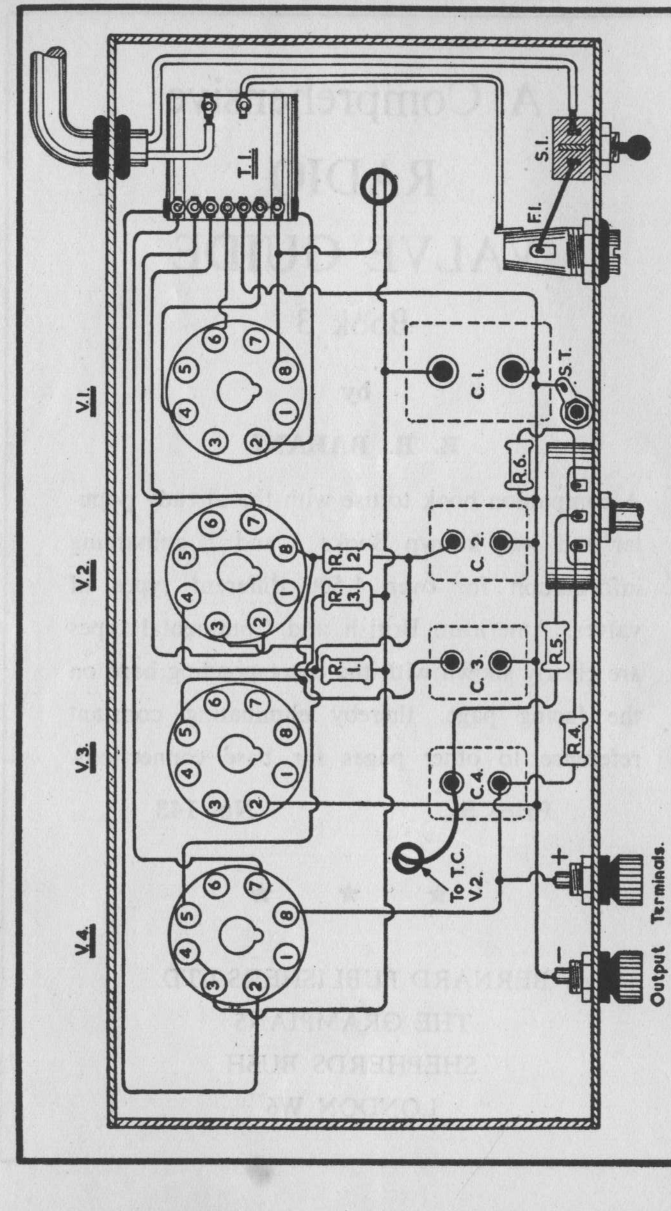

Fig. 9. Under Chassis Layout.

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