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# The RADIO CONSTRUCTOR

***for the Radio and Television Enthusiast***

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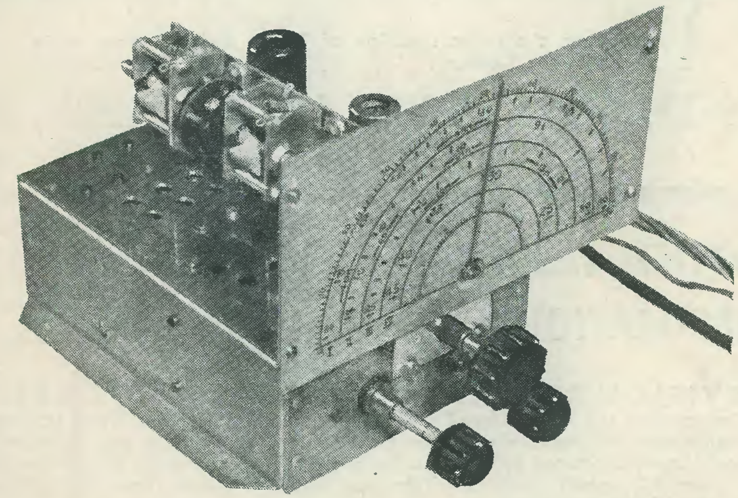

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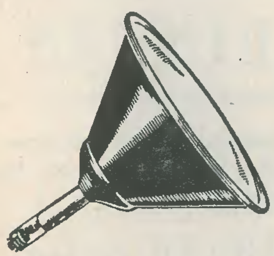

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The
# Radio Constructor

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## CONTENTS



### NOTICES



THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but relevant information should be included. All Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57 Maida Vale, Paddington, London W.9. Telephone CUN. 6518.

# Suggested Circuits for the Experimenter

*The circuits presented in this series have been designed by* G. A. FRENCH *specially for the enthusiast who needs only a circuit and the essential relevant data.*

## No. 27 A Signal Generator without Trimmings

The simple signal generator we show this month should have an especial appeal for experimenters who do not wish to incur a great deal of expense on an instrument that they may use only occasionally. For this reason the circuit has been designed with economy in view, and requires components which may, in many cases, be already on hand.

### The Design

The circuit employs a tuned-grid RF oscillator which covers three wavebands, these being the medium and long wave bands, and also the common intermediate frequencies from 450 to 470 kc/s. The output is at high impedance and is unattenuated. Modulation is optional.

1.5 volt valves are used, as it is assumed that the employment of such valves will save the expense and complication of a mains power pack. 2 volt valves could be employed instead, if so desired. As may be seen from the circuit, both the RF and AF oscillators are triodes; and valves like the 1G4 should work very well in these positions. In practice, however, almost any type of 1.5 volt valve (apart from the 1H5 or 1LH4) could be employed, multi-electrode valves having their anodes, screen-grids and suppressors, etc., strapped together to form a triode anode. For this reason, no special valves have been recommended; and the constructor may be able to use any of those which he already has on hand.

In order to obtain an adequate coverage of the medium and long wave bands, the tuning capacitor has an effective value of approximately 600 pF. This value is obtained by means of a two-gang capacitor with the sections paralleled together, with a fixed series capacitor. To obtain the requisite tuning capacitance of 600 pF, a two-gang capacitor whose sections each have a value of 500 pF will need a series capacitance of 0.0015 μF. A 450 pF tuning capacitor will need a series capacitance of 0.002 μF; and a 350 pF one of 0.005 μF. In the diagram, C2 is the series capacitor, and C3, C4 the two-gang capacitor.

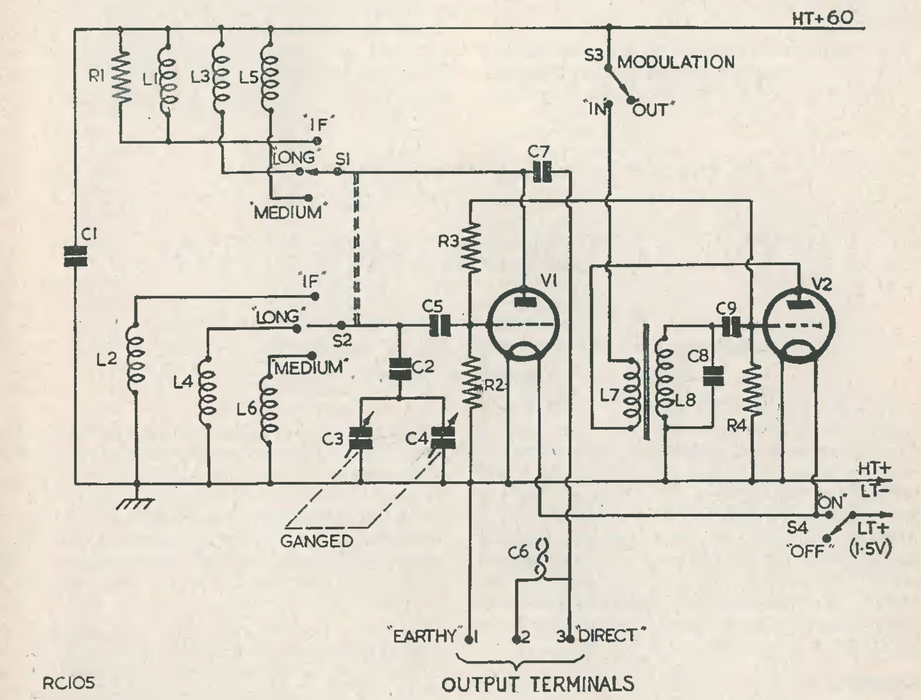
The RF oscillator employs ordinary medium and long wave coils for these two bands. It is essential that the coils chosen should have separate aperiodic coupling windings, and that they are suitable for RF coupling, (i.e. the coupling winding may be connected in the anode circuit of an RF amplifying valve). Coils designed for aerial coupling only may not be suitable. The coupling used for the IF band is discussed later.

### Setting Up

When the signal generator has been preliminarily assembled, the next step consists of getting it to work correctly. This will be best done by switching out the modulation, primarily setting the wave-band switch to the long wave position, and checking for oscillation. The presence of oscillation may be detected on a broadcast receiver by the usual indications of a strong unmodulated carrier. If the feedback coil is connected correctly the circuit should oscillate as soon as it is switched on. Squegging, denoted by a harsh hiss in the receiver, may be cured by reducing the value of the grid leak R2. Weak oscillation, or absence of oscillation over part of the band, may be cleared by increasing the value of R2; or by increasing the HT voltage to a limit of 90 volts. The medium wave circuit may then be checked; and it should be found that this will function adequately on the circuit values chosen for the long wave band.



The IF coil comes next, a modified IF transformer of the capacitor-trimmed type being employed here. (Permeability-trimmed transformers may not function well in this circuit). To carry out the modification, the transformer should have both trimmers disconnected, one of its coils being then used for feedback. If the transformer has dissimilar windings, that with the fewer number of turns can be employed for feedback. As, in any case, the coil used for feedback will almost certainly have too many turns for this purpose, a damping resistor is connected across it. The optimum value for this resistor, R1, can be found experimentally,




### COMPONENT VALUES

**Resistors**

| | |
|---|---|
| R1 | 5 to 50 kΩ. Experimental |
| R2 | 100 kΩ |
| R3 | Experimental |
| R4 | 100 kΩ |

**Capacitors**

| | |
|---|---|
| C1 | 0.1 μF. Paper |
| C2 | Pad. Mica. (See text) |
| C3, C4 | Two-gang. 500, 450 or 350 pF. (See text) |
| C5 | 200 pF. Mica |
| C6 | Twisted Pair |
| C7 | 0.001 μF. Mica |
| C8 | Experimental |
| C9 | 500 pF |

**Inductors**

| | |
|---|---|
| L1, L2 | Coils of IF Transformer (trimmers disconnected) |
| L3, L4 | Coupling and grid coils of long wave RF coil |
| L5, L6 | Coupling and grid coils of medium wave RF coil |
| L7, L8 | Primary and secondary of "inter-valve" AF transformer |

**Switches**

| | |
|---|---|
| S1, S2 | Band switch |
| S3 | Modulation, In-Out |
| S4 | On-Off |

**Valves**

| | |
|---|---|
| V1, V2 | 1G4, etc. (See text) |

and it will probably lie between 5 and 50 kΩ.

Modulation is obtained from the conventional AF oscillator shown in the diagram. The value of the capacitor, C8, needed to give the required AF tone is found experimentally, and the depth of modulation is adjusted by varying R3. R3 should, however, never have a value lower than three times that of R2.

**Operation**

Calibration on long and medium waves may be carried out by beating the generator against known stations. The IF band may be roughly calibrated by checking it with receivers whose IF's are known. More accurate calibration will need a second signal generator.

Two output terminals are provided: a direct connection to the oscillator anode, and one via the capacitance given by twisting two insulated leads together for an inch or so. If the "direct" output terminal is taken to an earthy or low impedance point in the receiver under test, the oscillator may stop working. In cases where the oscillator output is too strong for the circuits under test, reduced pick-up can be obtained by simply holding the output lead near to them, and not using a direct connection.

# IN YOUR WORKSHOP

*In which* J. R. D. *discusses Problems and Points of Interest connected with the Workshop side of our Hobby based on Letters from Readers and his own experience.*

When one considers the fact that only a small percentage of people run their domestic receivers from DC mains these days, one might be tempted momentarily to imagine that the conventional AC/DC power pack so often fitted to this type of receiver would by now be falling out of common use. This impression would, of course, be quite wrong, as the AC/DC arrangement offers important advantages even when it is intended to be run from AC mains all the time.

**Economy**

To the amateur, one of the most interesting advantages lies in the fact that the AC/DC circuit gives an immediate economy in components. Instead of having to buy a mains transformer, all that is required is a dropper resistor, which can be obtained for a few shillings only.

A further advantage is given by the compact design made possible by the AC/DC type of circuit. By using a line cord, (and a resistor instead of a choke in the smoothing circuits), the only bulky components which need be fitted to the equipment chassis are the rectifier and the smoothing capacitors.

However, the AC/DC arrangement has disadvantages as well. First and foremost, of course, is the inevitable live chassis.

In addition, there is the fact that the inclusion of a dropper causes rather a large amount of heat dissipation inside the cabinet of the equipment. The use of a resistive dropper infers also that the equipment is consuming more power than it need do. For instance, a series resistor dropping, say, 150 volts at 0.3 amps, (an outside case), is consuming 45 watts, all of which goes to waste. This is admittedly hardly enough to land us in the bankruptcy courts, but it is still sufficient to be of some interest.

There is, further, the point that equipment employing an AC/DC power circuit is more liable to pick up mains-borne interference than that which uses the conventional transformer arrangement. This does not prevent the AC/DC circuit from being fitted to something like a broadcast receiver; although, even then, a filter of some sort may be necessary when there is a large amount of interference present on the mains supply.

**AC Only**

When the AC/DC circuit is intended quite definitely for use with AC mains only, it is possible to make some alterations which can definitely improve its performance. These alterations cause the circuit to lose its AC/DC characteristics altogether, of course; and it becomes, instead, an arrangement utilising a half-wave rectifier for HT and one of several methods for supplying heater voltage.

One of the major changes which may be made consists of the replacement of the series



dropper resistor by a capacitor. So far as I am aware, real interest in the idea of a capacitor dropper started when it was reported as having been used in illegal receivers in Holland during the Occupation years. In any case, the capacitor dropper has been discussed at some length since the war; and a commercial set has been produced which uses one instead of a resistor.

The capacitor dropper has advantages when compared with the resistive dropper, these including better heater voltage regulation and the comparative lack of heat generation. The only disadvantage is given by the possible breakdown of the capacitor and the consequent damage to the valves. It is obviously necessary to choose a capacitor with a generous voltage rating for a job of this sort; and I have not read or heard of one breaking down in practice as yet.

Filament, or heater, transformers are a useful means of overcoming the voltage dropping problem whilst still maintaining the half-wave rectifier circuit. Some firms market transformers giving 6.3 volts at several Amps quite cheaply. Such a transformer would supply the heaters for a four-valve superhet together with a 6X5 or a metal rectifier quite happily. It is possible, sometimes, to take advantage of components already on hand to obtain a cheap heater transformer. Such things as large chokes, or transformers with "awkward" windings, pressed into service as heater transformers by temporarily winding a few turns on the outside of the bobbin have not been unknown amongst amateurs during times when components were scarce.

**The Reservoir Capacitor**

As the basic AC/DC circuit uses a half-wave rectifier, it becomes necessary to use an adequate value of reservoir capacitor in order to obtain sufficient rectified voltage. A value of 16 μF should be enough if the HT consumption of the equipment is around 50 mA or so, but one often sees reservoir capacitors with values as high as 30 μF and more used in practice for such cases. In America, where the lower voltage mains reduces the possible optimum HT voltage available from a half-wave rectifier, even larger values are used.

It is important to ensure that the reservoir capacitor chosen is capable of accepting the fairly heavy ripple current given by the half-wave circuit. Many manufacturers indicate the maximum ripple current of their smaller-sized capacitors, or state whether they may be used for reservoir purposes.

It is usual practice to fit a limiting resistor between the rectifier and the reservoir capacitor, or between the rectifier and the mains supply. Whilst this resistor reduces the ripple current in the capacitor it also protects the circuit especially when a valve rectifier is used against surges which may occur when the set is switched off and on quickly. During the short time that the set is switched off the reservoir capacitor may discharge almost completely by reason of the HT current taken by the valves; with the result that, when the set is switched on again, the still-hot cathode of the rectifier feeds into what is effectively almost a short-circuit. The resultant heavy current could ruin either the rectifier or the capacitor if a limiting resistor were not in circuit.

The usual values of limiting resistor are approximately 50 ohms for reservoir capacitors up to 15 μF or so, and 100 ohms for higher values. It is sometimes helpful to employ wire-wound resistors in this position, since the wire may then act as a fuse and give added protection. When metal rectifiers are used, the resistance introduced by the rectifier itself may be sufficient to obviate the necessity for a limiting resistor.

# GENERAL PURPOSE TEST METER

*By* F. G. Rayer

This multi-range meter will be found of great use for all ordinary radio work, and can, of course, be constructed at a fraction of the cost of a ready-made instrument of similar type. Provision is made for measuring DC and AC voltages up to 1,000 volts, and direct current up to 5 Amps. An Ohms range is also provided, and covers the values most frequently encountered. The various ranges are selected by switches, facilitating use, and the circuit is shown in Fig. 1.

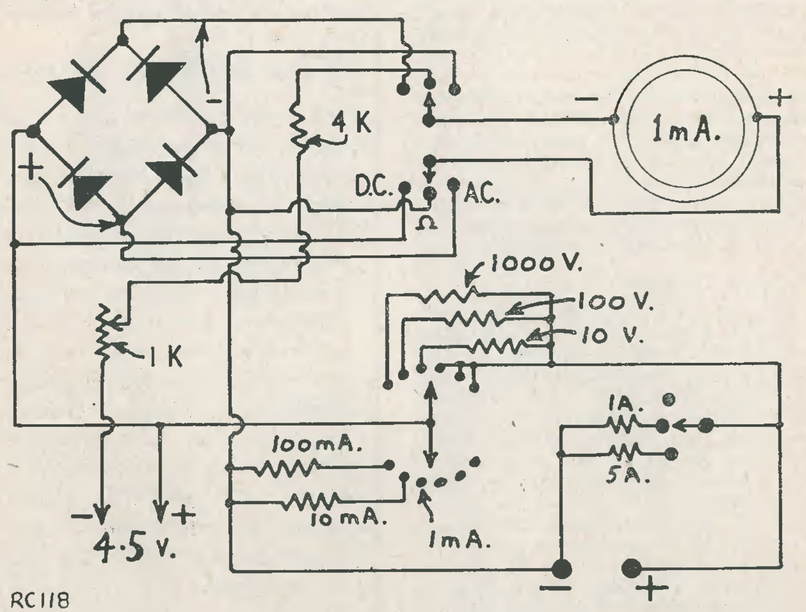



*Fig. 1 Circuit of the multi-range meter*

The instrument is built up around a 0-1 mA moving coil unit, the voltage ranges of 0-10, 0-100 and 0-1,000 being obtained by 10 kΩ, 100 kΩ, and 1 MΩ resistors. The same switch (a 2-pole 6-way type) provides DC ranges of 1 mA, 10 mA, and 100 mA, shunts being switched in for the two latter ranges. As this type of switch is not very suitable for heavy currents, a single-pole 3-way switch of heavier type is provided, introducing additional shunts for 1 Amp and 5 Amp ranges. The third switch, a 2-pole 3-way type, enables the test-meter to be set for "DC," "Ohms" or "AC" operation. The remaining control is a 1 kΩ variable resistor, required for the Ohms range. The latter is obtained by means of a 4.5 V dry battery and total resistance of 4,500 Ω, the latter value being made up from the 4 kΩ fixed and 1 kΩ variable components.



This avoids possible damage to the meter, even if the variable resistor is turned to zero, and also makes the latter easier to adjust.

A 1 mA full-wave instrument rectifier is switched in for the AC measurements.

### Constructional Details

Fig. 2 shows the layout which was adopted, the case being 4½" by 6", and a space being left to the right of the panel for test-prods and dry battery. The actual form of construction is not important, but a case with a deep lid is convenient, and protects the meter, etc. when closed. If a case is already to hand it could be adopted by cutting a panel of suitable dimensions. The panel is supported on small strips screwed inside the box.

Dimensions will also be influenced by the diameter of the meter movement. As so many such movements are available, it is not proposed to specify any particular model, though a large one will be easier to read and enable smaller scale divisions to be more readily ascertained.

### The Resistors

Meter resistors of 1% tolerance were obtained, for accuracy. It is also possible to select suitable resistors of ordinary type, if a second meter is available to measure them, or if the Ohms range be used, temporarily employing a larger battery for the 100 kΩ and 1 MΩ values. The 4 kΩ resistor may be of the usual 5% or 10% tolerance.

The shunts were wound from resistance wire. A battery (preferably of fairly high voltage) and variable resistor were connected externally, and adjusted until the meter read 1 mA. The range switch was then set to the 10 mA range, and a length of resistance wire selected which reduced the meter reading to 0.1 mA. The wire is then wound on a strip of insulating material and soldered into the circuit. Battery and resistor are then adjusted to obtain a 10 mA deflection, and the same procedure repeated to obtain the 100 mA shunt. The 1 Amp shunt was obtained by wiring the meter in series with the LT leads of a receiver. The consumption of the valves totalled 0.4 Amp, and the shunt was adjusted until this was indicated. The 5 Amp range was obtained by wiring in series with a 12V accumulator and 36 watt lamp, and obtaining a 3 Amp deflection indication.

Results of sufficient accuracy can, with care, be obtained in this way. Care should be

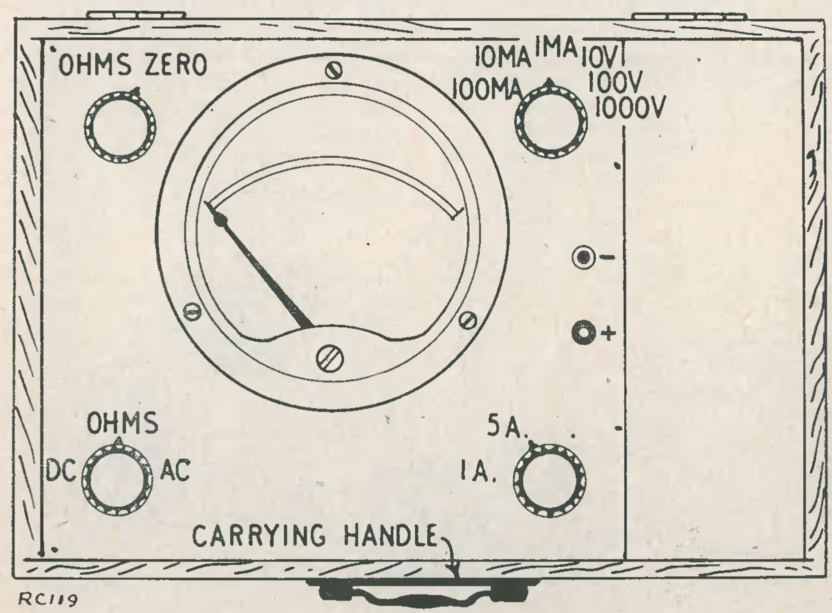



*Fig. 2. Layout of panel and controls*

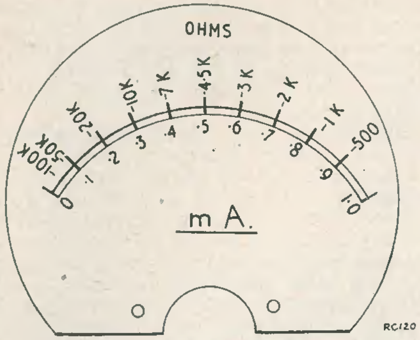



*Fig. 3. Scale, showing "Ohms" range*

taken that a heavy current is not passed through the meter when the latter has no shunt connected. It is only necessary to check at one point on each range, very low deflections being avoided.

### The Ohms Range

Scale readings for this are shown in Fig. 3. If further intermediate readings are wanted these can be worked out from Ohm's Law.

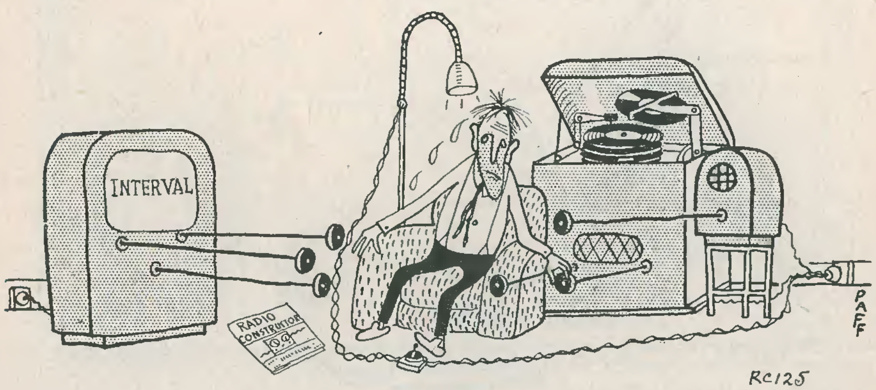
As the other ranges were multiples of 10, no further scales were required, since the reading of 0-10, 0-100 and 0-1000 is very obvious and easy. (The 100 small scale divisions present are omitted from this diagram).

When measuring Ohms, the test prods are held together and the " Ohms Zero " control adjusted until the meter shows Zero Ohms, or 1 mA. The prods are then applied to the resistor or other component being tested.

### Final Points

Wiring is very straightforward, good connections and sound insulation being most important. The panel should be marked so that the controls may be set at once for any desired range.

It will have been noted that the same resistors are used for both DC and AC ranges. This is accurate for DC. The amount of error on AC will depend upon the waveform factor of the rectifier and upon the type of AC reading required. The effective, or root mean square voltage is usually that considered, and is approximately 70% of the instantaneous peak voltage. The peak value may be obtained from the RMS by multiplying by 1.414. To avoid using further resistors of lower value to obtain such ranges the scale itself may be marked with a special AC range with divisions calculated from this factor.




*The Enthusiast*



# VALVES AND THEIR POWER SUPPLIES

Part 4

*By* F. L. Bayliss A.M.I.E.T.

### Modern AC/DC Receivers

There are a very wide number of valve types, indeed, for AC/DC working, and new valves are constantly being introduced.

Broadly, these valves may be classified by heater current rating, and there are four main groups:

(a) 0.3A, (b) 0.2A (c) 0.15A (d) 0.1A.

Valve bases within these groups also vary widely, although for any given rating of one manufacturer, the " set " of five superheterodyne valves all have similar base types.

There are international octal, Mazda octal, B8A, B8B, B8G, and British 4 pin, 5 pin and 7 pin bases among the groups, and care is necessary when choosing valves for a receiver, although, of course, it is not essential with a new design to adhere to the principles of one type of base throughout.

Neither is it necessary to adhere to one heater current rating throughout the valve chain, for judicious series-parallel arrangements may often be used to incorporate, say, two 0.15A valves in an 0.3A chain.

The beginner, however, should exercise care when doing this; mistakes can be costly to him.

It is worth noting that B8B and B8G valve holders are interchangeable, the only differences being points about spigot material and taper which do not affect the fitting of the valve into either valve holder.

### AC/DC Circuits

Modern AC/DC power pack circuits are all very similar in broad outline and principle. differing only in minor circuit details, component values and component types.

A typical arrangement incorporating five Mullard 0.2A valves is shown in Fig. 11.

$R_1$ is the minimum rectifier series resistance specified; $R_2$ is the resistor required to drop the mains voltage to a value suitable to be connected to the valve heater chain; $R_3$ is a shunt resistor across the dial pilot lamp to bypass some current during the initial warming-up time and thus prevent the lamp fusing (initially, a much heavier current flows, the rating of 0.2A etc. only becoming stable when the valve heaters have reached maximum heat).

The valves in this chain are of different heater voltages though all of similar current rating. V1, V2, and V3 have 6.3 volts heaters, V4 33 volts and V5 20 volts. The dial lamp is 6.3 volts, 0.2A (an 0.3A type may be used, in which case $R_3$ may be omitted).

The voltage across the heater chain plus dial light is thus 78.2 volts; $R_2$ is now calculated to give this voltage, to the simple formula:

$$R_2 = \frac{E_s - E_c}{I_h}$$

where $E_s$ = the mains supply voltage, $E_c$ = the voltage (78.2) across the heater chain, and $I_h$ = the chain current, in this case 0.2A.

For this circuit, therefore, and assuming 230 volt mains, the value of $R_2$ is

$$\frac{230-78.2}{0.2} \text{ Ohms} = 759\ \Omega.$$

A standard 750 Ω mains dropping resistor would thus fill the bill admirably, the 1.3% overload being well within the usual makers' tolerance figure of 5% for valve heater current. (In any case, these days, the mains voltage cannot be relied upon to remain constant).

The wattage rating of $R_2$ is important, and, in view of heat inside the cabinet in the case of a vitreous enamel resistor, should amply cover the wattage dissipated. Again, the calculation is quite simple:—

$R_w = E_s - E_c \times I_h$, where $R_w$ is the wattage dissipated in $R_2$, and $E_s$, $E_c$, and $I_h$ are the supply and chain voltages and chain current respectively, as before.

In this case, the wattage dissipated works out to 30.36 watts, and a standard 30 watt resistor will be suitable, although one of 40 watts would be far better and cooler in working.

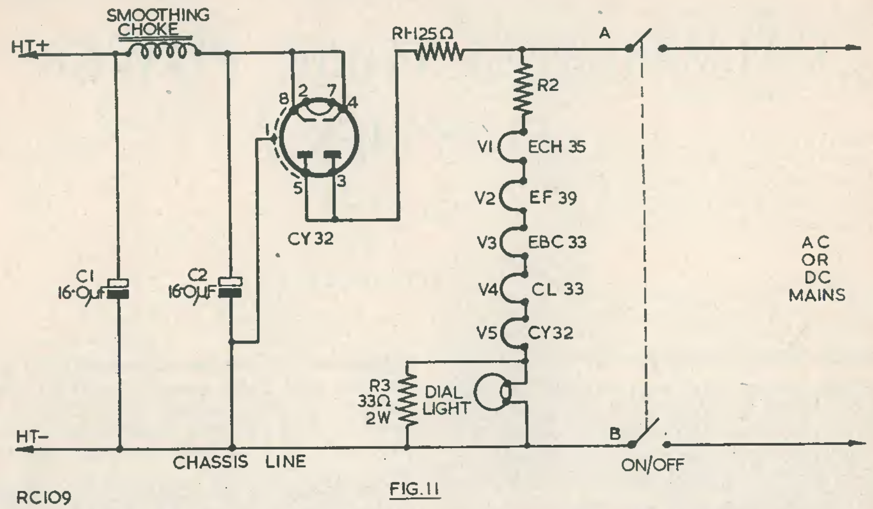



FIG. 11

### Line Cord

When it is not wished to incorporate $R_2$ in the receiver cabinet, a length of 3 way line cord may be used, instead of a wirewound vitreous enamel component.

This line cord consists simply of ordinary red and black twin flex plus a third cable, an asbestos-string core upon which is wound a nickel-chrome resistance wire.

Line cord is obtainable in various ratings —0.3A, 0.2A, 0.15A etc—in both two-way and three-way kinds. Three-way, as shown in Fig. 12, is normally used for receivers. It is connected as shown in the figure; note that, when line cord is used, the upper (A) contacts of the on/off switch are omitted.

When connecting the resistance wire to the valveholder heater tag, first unwind a short length, half-an-inch, of the resistance-wire covering of asbestos wool. Now clip on to the exposed core of spiral wire a small piece of sheet metal—steel, copper or brass—to form a soldering tag. Thus terminated, the rather delicate resistance wire will remain firm, on its asbestos core, and not dangle and perhaps easily break as it would if unwound and merely soldered in.

### Valve Types

The Mullard CY32 rectifier shown in Fig. 11 is typical of many other and similar types of different make. It is of the type known as a voltage doubler, but in this circuit its voltage doubling potentialities are not used, the two anodes and two cathodes being strapped to give the effect of single anode and cathode. (Its companion type, the CY31, has only one anode and cathode).

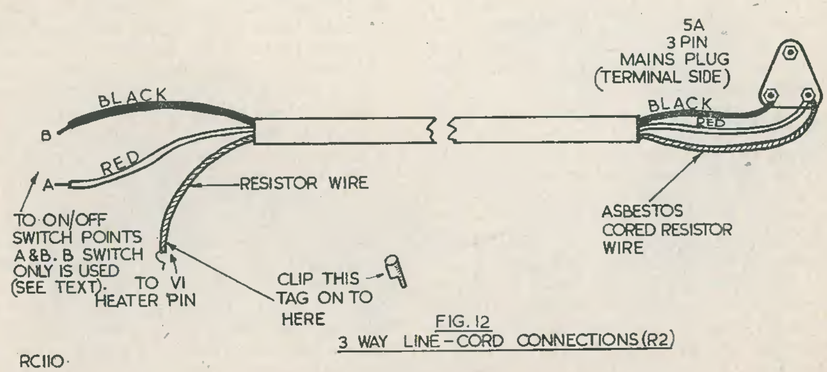



FIG. 12
3 WAY LINE-CORD CONNECTIONS (R2)



As with the full wave AC rectifier, the maker's recommendations with regard to minimum series resistance and reservoir capacitance must be adhered to; the series resistance in this case, however, is usually inserted into the valve anode circuit ($R_1$). An 0.1μF capacitor may be wired between either the anode and chassis or point A and chassis, to reduce rectifier hum.

There are well-known and popular "sets" of valves within each heater current group and, as a possibly useful guide to the inexperienced constructor, one typical set from each group is given:—

| | 0.3A | 0.2A | 0.15A | 0.1A |
|---|---|---|---|---|
| V1 | 6K8 | TH233 | 12A8 | UCH42 |
| V2 | 6K7 | VP133 | 12K7 | UF41 |
| V3 | 6Q7 | HL133DD | 12SQ7 | UBC41 |
| V4 | 25L6 | PEN3520 | 35L6 | UL41 |
| V5 | 25Z4 | U201 | 35Z4 | UY41 |

The first and third groups are American types. The 0.2A group are Mazda equivalents of the Mullard group given in Fig. 11. The last group are a comparatively recent addition to the Mullard range.

There are many other groups of various makes, and one very recent Mullard group is perhaps well worth mentioning on account of the unorthodox and economic valve arrangement. This is a 0.1A group, with B8G bases: V1—UCH21, V2—UCH21, V3—UBL21, V4—UY21.

The valve economy is effected by using V2 as combined IF amplifier and audio amplifier, the two diodes being accommodated in the output valve V3.

### Cord Resistance

One final note on line cord. The resistance of this cord is usually specified as so many ohms per foot; e.g., 0.3A, 60 Ω per foot. Be careful, then, to specify the resistance per foot, as well as the current rating and way (or wire) number. As an instance, $R_2$ of Fig. 11 is 750 Ω; 0.2A cord, however, is often 80 Ω or 100 Ω per foot.

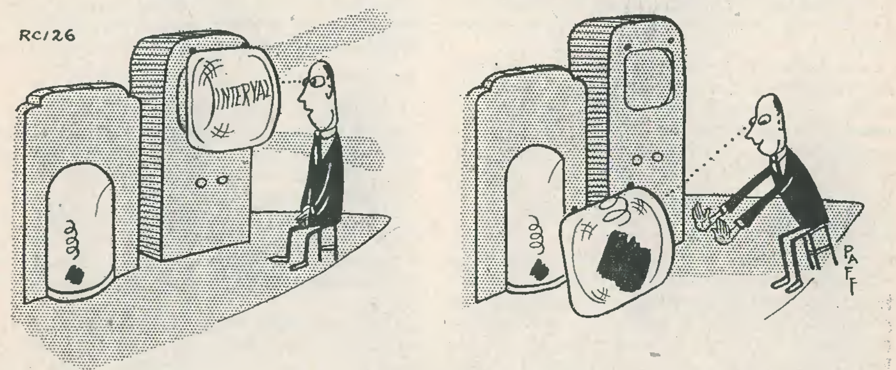
The retailer's catalogue usually gives this resistance figure, and it is only necessary to divide the total resistance figure (750 Ω) by the resistance in ohms per foot (80) to arrive at the answer of the length in feet required; in this case it is 9.4 approximately, and ten feet of cord would be bought, the surplus 0.6 of a foot being trimmed off.

### Fuses

Although not shown in Fig. 11, fuses are an undeniable asset in an AC/DC circuit. Two 1A fuses each inserted into one leg of the mains lead will do much to protect both the constructor and the components. Remember, guard with a fuse, and nothing you'll lose.

* * *

(*Note*: There was a draughtsman's error in Fig. 9 in the last instalment, resulting in the heater chain being shown connected on the wrong side of the metal rectifier. Our apologies.—Ed.).




*The Optimist*

# RADIO CONTROL EQUIPMENT

PART 1

*By* RAYMOND F. STOCK

Although most radio control enthusiasts are established model makers, many radio amateurs are turning to this fascinating branch of their hobby.

The readers of this magazine will find nothing complicated about the electronic gear used, which is generally very simple if only for reasons connected with size and weight; the accompanying electro-mechanical components may however introduce some new ideas to pure radio enthusiasts, and the purpose of this series is to explain various systems of control and to indicate ways in which the components may be made. Only those units which can be made with the assistance of simple hand tools will be described, and no high degree of skill in their use is necessary; it is realised that most amateurs whose primary interest has hitherto been in straightforward chassis construction are not likely to own a lathe. In many cases it will be seen that a wide variety of oddments can be pressed into service to save work and time, such things as alarm clocks, watches, old electric bells and spring driven toys being particularly useful.

## THEORY

All simple radio control systems may be divided into four units, two at the transmitting end and two within the model. These comprise, firstly, the transmitter and the receiver; in addition to the transmitter and preceding it there must be a unit which we shall call the **Control Box.**

At its simplest this may be no more than a switch or press-button, but its function is always to convert the operator's movements into electrical signals which can be handled by the radio link.

The extra unit in the model, following the receiver, we shall call the **Operating Gear,** and its function is to translate the incoming amplified signals back into movements of the appropriate controls.

The Control Box and the Operating Gear are inter-related and depend upon the system used, and it is the construction of these two items with which the present series is concerned.

## RELAYS

Relays are generally regarded as a 'radio' item and invariably mounted upon the chassis, but the following notes on their construction may be useful since good sensitive relays are not always easy to get.

The American type SCR522 and the Siemans High Speed relays are both useful in radio control and are still available (though with decreasing frequency) from government surplus sources.

Several small relays are being offered by concerns specialising in radio control gear, but these are mostly designed with a view to their use in model aircraft, and consequently their construction tends to be rather light; when several valve stages of amplification are used, either direct coupled (as in Mr. Judd's circuit of the October issue of this magazine) or in an audio frequency chain (with a modulated signal) the choice of a relay becomes less critical. The single valve super-regenerator is still, however, very popular on account of its simplicity and small size and with a receiver of this class a really good relay is essential; its in-and-out ratio virtually determines the range of the set.

Fig. 1 shows plan and side elevation of a simply made component. **A,** the magnetic frame, should be cut with a fretsaw from a good grade of iron, and a suitable source of material is comparable members of other surplus relays. It should be 1/16 inch thick (or 3/32 inch thick if weight is no object) and can easily be bent to shape in the vice; if possible an additional strip of iron should be riveted against the pole piece which lies inside the coil, increasing the section at this point to 5/16 inch by 1/8 inch. Two holes **B** are drilled and tapped 6 BA and the wider end of the frame is filed to a edge with an included angle of about 45°. This edge need not be very sharp, but it must be absolutely straight; if convex, the armature will rock from side to side. The armature is cut to shape as at **C,** and has a groove filed across it to enable it to pivot on the knife-edge.

Use a small jeweller's file to cut this groove, and finish it off to as near a V shape as possible with a single edge razor blade. When completed the armature should balance nicely on the pole piece, rocking easily in the correct plane but showing no tendency to tilt laterally or to rotate about the end of the pole piece.

A small silver rivet is soldered through the tip of the armature to form a contact, and below it is a small hole to take the end of a very fine steel or phosphor bronze spring. The end of the spring is pushed through the hole, turned over at 90° for 1/16 inch, and secured with solder to the front face of the armature.

The contact block **D** can be cut with a fretsaw from any piece of thermo-setting plastic such as Bakelite; generally a useful piece can be taken from an old electrical or household appliance.

The two holes **E** are tapped 6 BA and the hole **F** is 3/16 inch diameter. Two long 6 BA bolts pass through holes **G** and into holes **B** in the relay frame, thus securing the plastic block firmly.

A 6 BA contact screw and a locknut are required for each tapped hole in the plastic, and these might be obtained from an old relay; if not, take two ½ inch 6 BA brass screws and solder to their tips small pieces of silver rod (or other similar contact alloy). When the joint is cool, the silver can be filed to a 45° point (*slightly* rounded at the end).

The coil may perhaps be taken from another item of equipment, provided it has a suitable resistance and reasonable dimensions. If a useful coil is on hand, the dimensions of

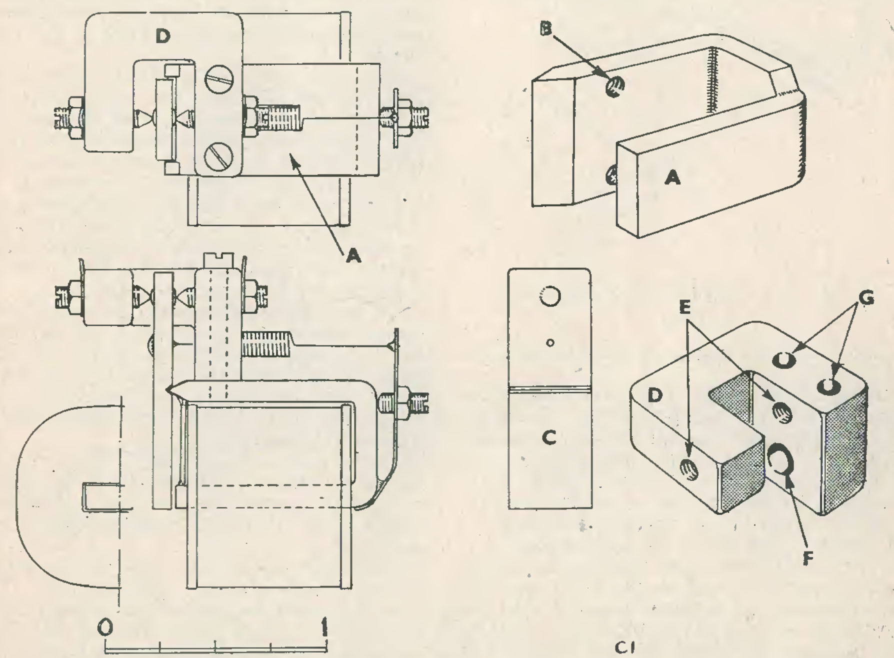



*Fig. 1. Details of sensitive relay. Scale in inches*

the frame can be altered to suit it, as none of the dimensions is critical.

Failing this, it will be necessary to wind the coil to suit, and as a start a small bobbin should be made up from celluloid or thin card cemented together. The wire, terminated by a few inches of thicker, silk covered conductor, can then be laid on by any means available. Very fine wire is not easy to handle

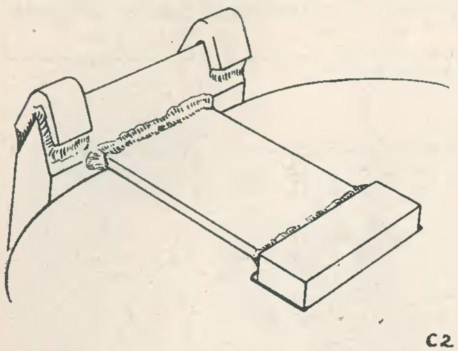



*Fig. 2. Pole pieces of sensitive relay*

at first, but given care it should be possible to put the turns on without breakage. Some sort of winding machine is obviously necessary in view of the number of turns required, and I have used Meccano parts to build up a suitable rig; alternatively, a sewing machine can be pressed into service, adapting the bobbin winding device for the purpose.

The turns required vary with the anticipated anode current. Most simple super-regenerative detectors use between 1 and 2 mA, and a 5000 Ω winding is suitable here. This can be obtained by filling the coil former with 46 gauge enamelled wire, which will involve approximately 17,000 turns.

The completed coil is secured over the core by a touch of sealing wax, and a strip of brass ¼ inch wide soldered between the two poles as shown in Fig. 2. This braces the ends of the frame rigidly apart.

Fig. 2 also shows two small scraps of brass sheet, each bent into a V and soldered to the sides of the armature pivot; these are filed after soldering until the space between them is *just* wider than the armature and they prevent the latter from moving sideways.

The spring, attached to the armature at one end, is pushed through the 3/16 clearance hole in the plastic and secured with a touch of solder to a brass strip. The strip is cut from one of the springy connections on a torch battery, (or similar material) and one end is soldered to the relay frame. Halfway along is a ⅛ inch hole, and soldered over it a 6 BA nut. A small grub screw through the nut bears on the end of the frame and forces the strip away from the relay; this tightens the spring for adjustment purposes.

## ADJUSTMENT

The two contact screws should be connected to flash lamp bulbs, connection being made by small soldering tags under the locking nuts. Both lamps are supplied from a battery and the return lead is soldered to the relay frame.

The coil is connected in series with a battery and variable resistor; the values of these will depend on individual cases, but the idea is to enable one to pass between 80% and 120% of the normal working current through the relays. Typical values for a normal Ia of 1.5 mA would be a 5000 Ω potentiometer and a 10V. battery. A more sensitive control can be obtained by using a high resistance potentiometer across a lower value fixed resistor. Fig. 3 shows the complete set-up.

To commence adjustments, the two contact screws should be turned until the armature has less than a thousandth of an inch free play between them; this means that its movement when touched is inappreciable by eye or ear, hence the need for indicator bulbs to register its movement.

At the same time, the tip of the armature should be about 5/1000 inch from the end of the pole, or even less, but on no account should it be allowed to touch the pole when attracted.

The main battery can now be connected, in series with a meter reading mA. The current should be set by the potentiometer to about 0.1 mA below normal Ia. The spring tension on the armature is then slowly increased until the armature just moves away from the pole, as shown by the indicator lamps changing over.

Now the potentiometer is turned up until the armature moves home and the current value is noted; this is the 'in' value. The current is then decreased until the armature moves away again and this value of current is noted; the new figure is the 'out' value. The positions of the two contact screws, and the spring tension, can all be successively adjusted, the object being to bring the 'in' and 'out' values as near as possible.

Moving the tip of the armature away from the pole tends to improve the in-and-out



ratio, but at the same time it causes the forces acting on the armature to be reduced and therefore makes the action less positive. Check that the contact is good, both in and out, by tapping the relay to ensure that it is reasonably vibration proof in either position. Obviously a compromise must be made in the final adjustment and, as an example to aim at, the in and out values can be adjusted to 1.20 mA and 1.28 mA a difference of only 0.08 mA, the relay being quite vibration-proof in either position. These figures were obtained by careful adjustment of a relay made as in Fig. 1.

It will be noted that no means of fixing the relay have been shown. It is intended that

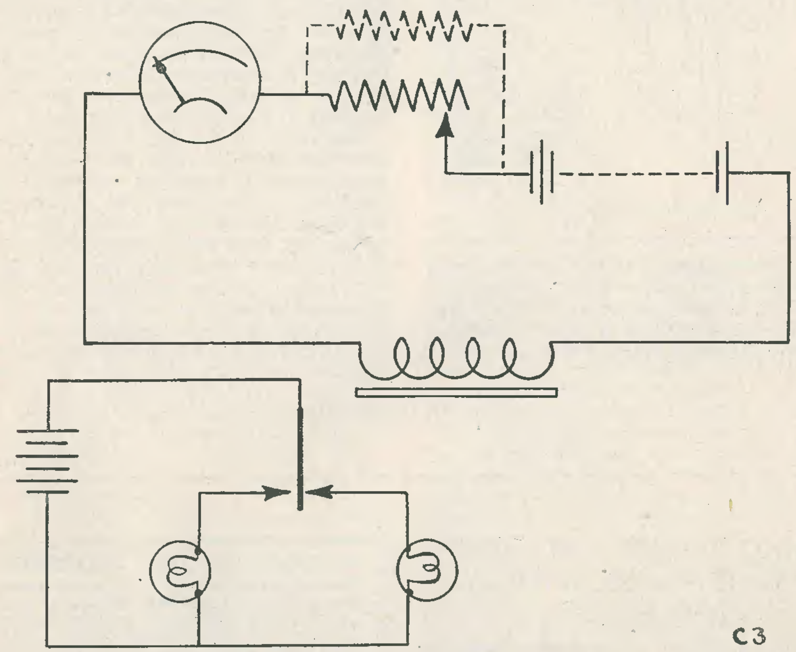



*Fig. 3. Relay test circuit; the resistor shown in pecked line may be inserted to improve sensitivity (see text)*

two pieces of foam rubber—such as accompanies some types of surplus headphones—should be glued with seccotine to the protective binding over the coil. The rubber is itself glued between two wooden brackets on the radio chassis.

This method reduces vibration and also supports the heaviest part of the relay—the coil—thus relieving the frame of loads and preventing distortion. It will be appreciated that such details are important when the adjustments on the relay must be held to fine limits.

When completed and installed, the various bolts may be locked with varnish.

## SECONDARY RELAYS

The very small forces available to operate a sensitive relay mean that a pointed or rounded contact must be used against the armature in order to break through any oxide film etc. and so ensure positive operation. Naturally such small contact areas can carry only light currents, and it is then often necessary to use a second relay with more robust contacts before a piece of 'heavy' equipment can be controlled.

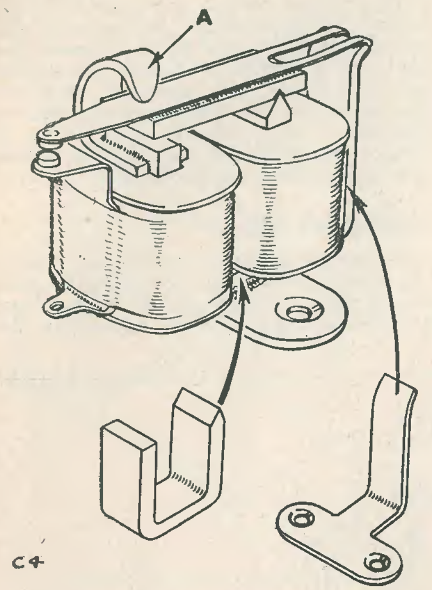



*Fig. 4. Secondary relay*

This process appears to add to the complication, but a very simple relay will suffice.

Fig. 4 is an easily made unit of this type. The coils can be 1000 Ω bobbins from headphones or Siemens relays, and the core is of any good magnetic material. The armature is pivoted on a knife-edge, as described earlier, and in this case is soft-soldered to a piece of springy copper foil which carries a silver contact on its extension.

A similar contact is soldered to a bracket made up from a scrap of brass sheet, and the latter is held in position by a binding of thread around the bobbin, secured with shellac.

The other end of the foil strip is cut into two arms and the ends of these are soldered to the bent brass bracket. The latter is soldered to the base of the U-shaped core, and the drilled cross-portion acts as a mounting lug.

A small strip of brass is bent and filed to shape, and soldered to the free pole; this member A acts as a back stop to the armature, and is bent until the armature has about 1/100 inch movement before the contacts close. The latter must be adjusted so that the armature can never touch the free pole. If the secondary relay is required to be two-way, this back stop is replaced by another contact made similarly to the one already described.

The values of the coils are not critical and obviously depend upon the voltage of the supply; such a relay will work well on 9V. using two 1000 Ω bobbins in parallel, and thus uses only 18 mA. This is quite a safe current to pass through the contact points of a sensitive relay and the coils are not sufficiently inductive to cause any sparking at make or break.

The contacts of the secondary relay can be almost flat, and will easily handle 2A.

*(To be continued)*

## RADIO TUNER UNIT FOR MAGNETIC RECORDERS

(February issue).

Dear Sir, as a result of enquiries about the crystal radio, I would like to point out the following:

*A* Coupling coil of L2 is 65T, as text, and NOT 95T as sketch.

*B* Formers are Aladdin PP5892 (F804). Diameter approx. $\frac{13}{32}$″.

*C* Wire is litz of 7-9 strands 45-48 swg enamelled wire.

Yours faithfully,

L. F. Sinfield.





# PICTURE TUBE DEFECTS

By **GORDON J. KING,** A.M.I.P.R.E.

One of the most alarming symptoms for both set owner and constructor is when a television receiver suddenly cuts off with a loss of vision only. The situation is aggravated if, by advancing the brilliance setting, a raster cannot be resolved on the blank screen. We immediately become concerned about the health of the picture-tube, and many tests are devised to ascertain, as rapidly as possible, that the tube still lives.

Actually, a blank screen should not prompt one to immediately suspect the picture-tube, for a sympton of this nature—in the large majority of cases—can be diagnosed to a fault in the receiver itself; nevertheless, such a reaction is understandable, especially in these days of double purchase-tax.

About the only tube fault that could suddenly give rise to a blank screen is an open circuit heater, and out of hundreds of tubes handled by the writer, no more than two or three abruptly ended their lives through this cause. Indeed, it is the converse effect that should cause alarm—a tube which manifests uncontrollable brilliance.

### Heater to Cathode Short

Some receivers—mainly the older ones—use the picture-tube grid as video signal input electrode, see Fig. 1 (a); although now it is more common to employ the cathode for this purpose, see Fig. 1 (b). In both cases however, the same process occurs—the grid receives a positive going video signal and, therefore, the instantaneous brilliance on the picture-tube is dependent on the video signal magnitude.

Connected in both circuits is also a brilliance control network, which sets a black level limit to the picture by means of a variable bias network. A study of Fig. 1 will make these factors clear. Referring to the circuit at (a), we can see that a heater to cathode short would have the effect of short circuiting the brilliance control system, so that the control grid is heavily positive with respect to cathode. A similar effect would occur in circuit (b), but here the positive potential on the grid would be derived from the brilliance control potentiometer, and in both instances the control grid would always be more positive than the cathode irrespective of brilliance control setting. Conditions are thereby created for an uncontrollable brilliant raster. Heater to cathode shorts are unfortunately one of the most common of picture-tube faults, and can prove really exasperating to the constructor, particularly if the tube is perfectly sound otherwise.

### Using Faulty Tubes

Sometimes the internal short is of intermittent nature, and by a gentle tap on the neck of the tube it is frequently possible to remove the short, although it usually occurs again after a short respite. The writer has successfully removed heater to cathode shorts on a number of occasions by a process known as "flashing." The tube heaters are allowed to function, and a potential is applied between heater and cathode very rapidly. A 120 volt HT battery, for instance, tapped at about 50 volts is swiftly flashed across the two electrode pins on the tube base, and in a fair number of cases this procedure has been known to permanently disunite the internal short.

It should, of course, be borne in mind that this method is not one hundred per cent safe, for in certain cases there is a possibility of the tube heaters "blowing"; and it should, therefore, be attempted only as a last resort, or if the tube is considered useless under fault conditions.

If we refer again to the circuit at (a), we shall observe that the only reason why the tube cannot be used under fault conditions is because the heater transformer is in direct connection to the receiver earth line. Quite probably the tube heater power is taken from a common heater transformer, or heater winding on the mains transformer, and since it is necessary to earth the valve heaters, the picture-tube heater is earthed as a result.

One way of overcoming this difficulty is by energising the picture-tube heaters from a

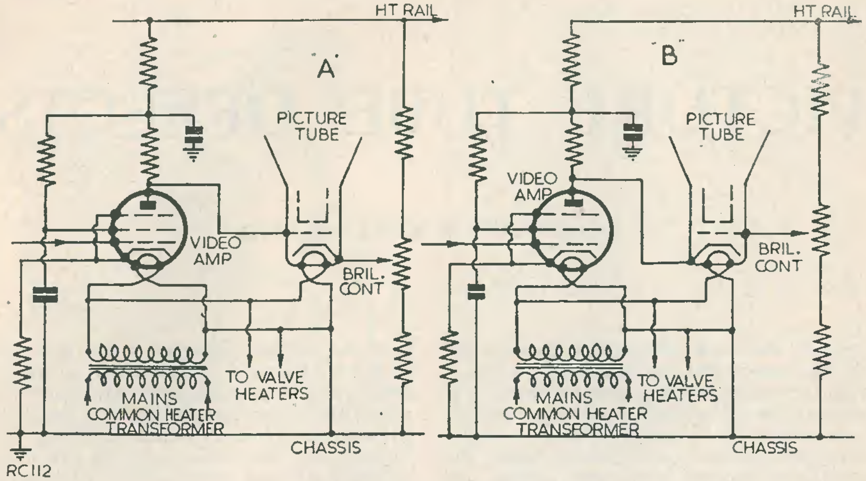



*Fig. 1. Methods of modulating a picture tube:*
*(A) Grid Modulation*
*(B) Cathode Modulation*

separate isolated heater transformer, and this is frequently practised by home constructors, the modification producing no marked deterioration in picture quality.

The circuit at (b), however, presents a more complicated problem; for here, although an isolating transformer would serve the purpose so far as the tube potentials are concerned, the cathode receives the video frequencies direct, and, owing to loss-inductance and capacitive effects of the transformer, a noted deterioration in picture quality is bound to occur. These undesirable factors will obviously be in shunt with the picture signal, and will tend to by-pass its higher frequency components, resulting in a reduction of definition.

**Another Method**

Now, it appears that the only satisfactory way we can continue employing a tube with a heater to cathode short, is by modifying the circuit to grid modulation. This is, unfortunately, a little more involved than it first seems, for grid modulation demands a positive going video signal, whereas when the signal is applied direct to the cathode it must be negative going; a simple change-over would, therefore, result in a negative picture. Changing the phase of the vision detector would help in this respect; but, then, the video amplifier which has been designed to receive positive going detector signals would tend to work in the region of cut-off on peak-white picture signals. Furthermore, the sync pulses from the video amplifier would be of converse phase, demanding also a modification in this connection.

The circuit shown at Fig. 2 illustrates a method, employing two extra valves, by which the phase of the picture signal may be inverted suitable for grid modulation, while the sync pulses remain unchanged in both amplitude and phase.

The negative going picture signal from the video amplifier is conveyed, via C1, to the grid of a pentode valve strapped as a triode—the signal appearing at its anode is, therefore, positive going. The diode V1 is employed solely for D.C. restoration to facilitate the method of coupling. An isolated heater transformer is, of course, necessary, and the brilliance control network is altered to the cathode of the tube. Sync pulses are fed to the line and frame generators as normal. The valves, V1 and V2, may be a D77 and Z77 respectively, or ex-government valves such as the VR92 and VR65 are of suitable class.

**A Dim Tube**

After a hard and normal life the picture-tube brilliance gradually falls-off, until a stage is reached when the tube is considered no



longer serviceable, and it is, indeed, a reluctant constructor who takes his tube " down to air " with the strike of jemmy or similar implement.

A tube ending its natural existence by going " dim " is first observable by the manifestation of flyback lines. Quite probably viewing is not done in complete darkness, and in an endeavour to combat ambient illumination a more advanced setting is given to the brilliance control. This procedure is, of course, incorrect, but since picture brilliance reduces very gradually a progressively advanced setting on the brilliance control is usually unwittingly performed.

In order to maintain a correct contrast ratio it is necessary also to advance the contrast control setting to suit, and as the picture-tube continues to decline in brilliance, a point is reached when it is severely over-driven, which is indicated by the picture tending to resolve in negative form; for instance, the peak white picture components going darker, and the black components going lighter in tonal value.

These conditions are aggravated, in a large number of cases, by the spotter diode which is frequently shunted across the video amplifier. The circuit at Fig. 3 illustrates a typical example of such a device, where the spotter diode is biased by virtue of R1 and R2 so that the diode is held non-conductive during normal picture signals. If, however, the peak white picture level is exceeded, due to an interference pulse, for instance, the diode cathode swings less positive than the anode, and the valve conducts, which effectively by-passes the interference pulse through C1.

Sometimes R2 is made adjustable, and labelled limiter control; this allows—within a fixed limit—an adjustable bias potential to be applied to the diode anode, and thus determines its conductive level.

Now when, due to a dim tube, a heavy picture signal is applied to the spotter cathode, the diode is prompted to conduct during a peak-white signal level, irrespectively of spotter control setting. Furthermore, since the resistor R2 is returned to the slider of the brilliance control, a more advanced setting of brilliance will result in the diode anode going even more positive, thereby assisting further diode conduction during a potential level representing peak-white signals or less.

We can see, therefore, that not only does the picture-tube tend to be overloaded as its brilliance deteriorates, but that the spotter diode also suffers from the same cause, and since both factors are of synonymous nature the overall effect is unduly stimulated. Tube life may be often enlarged by disconnecting the spotter circuit in a receiver exhibiting the symptoms of a dying picture-tube—for in this case, the tube itself satisfactorily performs the function of limiting interference pulses without the aid of a diode.

**Prolonging Tube Life**

The general cause of a dim picture-tube is a fall-off in the quantity of electrons emitted from its cathode (low emission). In many cases this state of affairs can be alleviated and additional life gained from an otherwise useless tube.

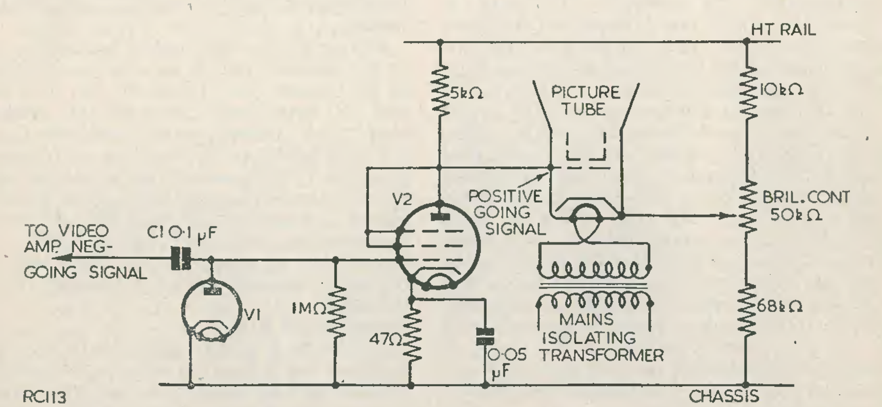



*Fig. 2. Circuit changed to grid modulation enabling a faulty tube to be used*

First of all, though, it may be constructive to consider the process to which a picture-tube cathode is initially subjected so that it is endowed with the property of emitting electrons. The cathode itself takes the form of a cylindrical tube through which an adequately insulated heater is threaded. Imparted on the cylinder is a chemical coating comprised mainly of the barium or strontium oxide salts. The tube heater current is initially exceeded by about plus 25% of its nominal rating, and the cathode is arranged to pass current. After a while, depending on the precise process employed, the chemical coating becomes highly electron emissive, and the heater is then operated for a short time at its normal working temperature. This operation is known as cathode activation, but throughout the normal life of the tube the cathode gradually de-activates, resulting in a fall-off in beam current, with a consequent reduction in brilliance.

At this stage it is frequently possible for the constructor to endow the tube with a fresh lease of life, by a means similar to that used during manufacture—a treatment sometimes called re-activation. The tube is connected into a circuit after the style of Fig. 4, which by virtue of a tapped heater transformer makes it possible for the tube heater to be over-run by about 25%. A potential of about 120 volts is connected between cathode and grid in series with a protective resistor and a 0-5 mA meter movement. The meter is, therefore, indicative of electron flow, and thus provides a means of observing the re-activating capability of the cathode.

After the circuit has been in operation for a while the meter reading will gradually increase, and should be allowed to continue until a maximum limit is reached—the time taken will, of course, vary between tubes, although a too rapid rise is a sure indication that excessive gas resides within the tube, and little can be done to re-activate it. When the current reading has reached a maximum and settled down for a few minutes, the heater voltage should be switched to normal and left for a few hours. The same process should then be recommenced with an aim of achieving maximum grid current reading on normal heater voltage. You can be assured that a little patience while re-activating will be more than compensated for later, when the tube is re-inserted into the receiver and fervently tested.

Increasing the tube heater voltage in steps as the emission falls is another successful way of prolonging the " brilliant " life of a tube, and is extensively practised in America. Employing a tapped heater transformer enables the tube heater to be switched on to various overload voltages as soon as a marked reduction in tube brilliance is noted; usual overload figures are plus 10, 25, and 33% of normal, commencing with the lowest value, and progressing in stages—as the tube brilliance further deteriorates—to a maximum of 33% overload.

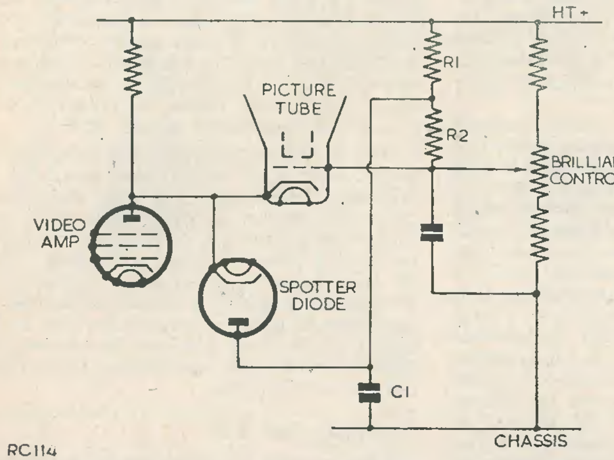



*Fig. 3*
*A typical spotter circuit*

### Symptoms of Gas

In theory a perfect picture-tube would be one that has a total vacuum, but for obvious reasons such an attainment is an impossibility; nevertheless, manufacturers of picture-tubes to-day are employing more efficient exhaust techniques in an endeavour to obtain as near-perfect a vacuum as possible within the tube. Excessive gas inadvertantly introduced either by a fault during manufacture, or by incorrect subsequent operation, tends to become ionized by collision with the high speed beam electrons, and results in the tube having a poor focus performance.

Vertical definition may not be at a maximum when the tube is focused for optimum horizontal picture definition. When focusing on the horizontal scanning lines, for instance, the vertical bandwidth bars of test card ' C ' tend to be blurred and out of focus; a compromise focus setting is about the only remedy for the continued employment of a tube in this state.

A more advanced state of gas prevents the tube from focusing altogether, for the horizontal scanning lines become so thick that they merge into one completely unfocused raster.

### Ion Burns

The diminutive trace of gas that must exist within any picture-tube tends to give rise to what are known as ions. These are of two types—positive and negative. The positive ions are created by the high-speed electrons, comprising the tube beam, colliding with and decomposing the gas atoms, so that they lose a few of their electrons. The electrons thus lost contribute to the beam, while the remaining portions of the positively charged gas atoms, which are comparitively large and slow moving compared with the high velocity beam electrons, tend to travel away from positive—towards the cathode. These positively charged bodies—or ions—possess, in virtue of their velocity and mass, a comparitively large quantity of kinetic energy, which is immediately liberated when they strike the cathode. This positive ion bombardment is, apart from other effects, a large contributory factor to cathode deterioration.

### Negative Ions

Negative ions are produced by a form of secondary emission when the positive ions strike the cathode, and being of opposite charge they, therefore, travel in the direction of the beam towards the fluorescent screen, but owing to their greater mass they are affected less by magnetic than electrostatic fields. This means, then, that while the electron beam is being focused and deflected magnetically during its journey through the tube, the ions continue moving in their original direction, and converge outwards, to strike an area of the screen near its centre.

By the time the negative ions arrive at the screen, however, they are possessed with a large quantity of kinetic energy and, therefore, penetrate deeply into the fluorescent phosphors, which over a period of time has the effect of reducing the luminescent property of the screen.

It is, therefore, clearly seen why the small portion of screen, less bright than the rest, always resolves in the centre. Constructors will, no doubt, have observed that electrostatic tubes suffer less from a concentrated effect of ion burn. The reason is, of course, the fact that with this style of tube the ions are focused and deflected with the beam, so that the burn is spread over the entire area of screen, and is generally put down as ageing of the tube instead of what it really is—an enlarged ion burn !

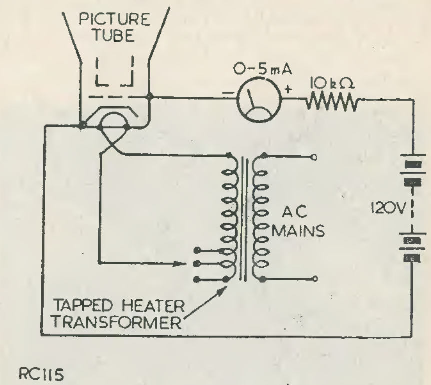



*Fig. 4. An experimental re-activating circuit*

### Screen Protection

Tube manufacturers are today adopting palliative measures to provide, in most cases, a large degree of screen protection. The aluminized screen is becoming extremely popular in this respect. This mode of protection consists of a thin aluminium backing to the screen, which effectively shields the delicate phosphors from the more massive ions, but offers little resistance to the high speed electrons, so that they energise the tube in the usual way. Apart from this function, the aluminium coating has the effect of reflecting forward some of the light from the inside of the screen, resulting in a brighter picture.

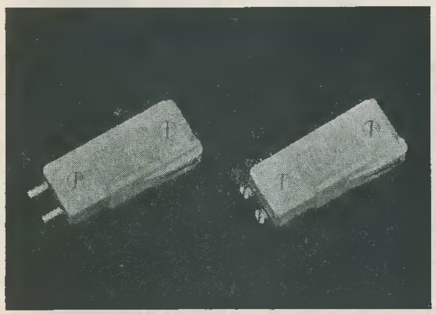
Another method is the ion trap, which is formed by a twisted gun assembly in conjunction with a suitably positioned magnetic field. The beam is bent by the field so that it travels through an aperture in the final anode, and continues its journey in the normal way. The ions, however, being unaffected by the field, travel at an angle to the tube axis, and end up by being collected by the final anode, where their stored energy is easily absorbed without any damage to the screen.

Once the negative ions have actually shown their mark, the constructor is powerless to rejuvenate the burnt portion of screen; nevertheless, it is within the power of the constructor or experimenter to prevent early screen degeneration from this cause.

In the first place he should ascertain that the tube heater is not being under-run—surprisingly low voltage readings are often indicated directly across the heater pins on the tube base—owing to excessive volts drop across the heater connecting leads, or a high contact resistance between tube base and socket.

A tube which is consistently used with little negative bias (a high brilliance setting), for instance, will hasten the effects of the ion burn. In this respect it is advisable to employ —if considered desirable—a dark screen filter only when conditions demand, for its use is, of course, pointless during viewing times when the ambient illumination is low anyway.

---



# *Trade Review*

## THE RONETTE CRYSTAL PICK-UP

This Pick-up was subjected by us to a most searching examination. The particular model placed on test was the type with interchangeable heads, thus N.50/4 for 78 r.p.m. and LA 50/4 for long-playing.

A frequency response of up to 14,000 c/s was claimed by the makers,* and this was fully substantiated in the laboratory. It remained, then, to check this response taking into account the natural aural channel. The reliability of laboratory findings as related to the effect on the human ear has long disturbed the experts, due to the undeniable factor that a clarinet, for instance, playing top G differs only from the flute performing the same sound or frequency by reason of the harmonic content. It is for this reason that one will often see, after elaborate technical claims, that a designer will state that a famous musician has passed an approving opinion. In this test, therefore, we decided upon the human ear.

A specially prepared record was used which employs an array of various musical instruments found in the orchestra. Cymbals, and triangles were reproduced with convincing realism and, generalising, these particular instruments are mentioned because of the average difficulty in reproducing with any assimilation of the original.

The String-bass was similarly recognised as a sincere reproduction.

The N50/4 head produces about 0.5 volts, which is of some considerable importance in the design of high-fidelity apparatus. Many high quality pick-ups give a much lower output, and although it is a fairly simple matter to raise the gain there is always the ever-present problem of hum suppression when using these other types.

A very strong argument in favour of the Ronette is its weight. At only 7½ grams, this must attract possessors of expensive records. The amount of wear being so reduced, the life-expectation for a disc is greatly extended.

A first class pick-up, easily fitted and adapted, and one which we thoroughly recommend to hi-fi enthusiasts.

*Distributed by E. and G. Distributing Corporation Ltd., 33 Tottenham Court Road, London, W.1.



# OBTAINING SMOOTH REACTION

By JAMES S. KENDALL, ASSOC. BRIT.I.R.E., M.I.P.R.E.

One of the easiest ways of increasing the gain of a radio receiver is by using reaction; this is incorporated in most straight receivers, and can be the cause of quite a few headaches. Some circuits have a tendency to be very "Ploppy," and suddenly burst into oscillation. There are various reasons for this. One of the main causes is found in the fact that the filaments of battery valves are not the same potential all over, but negative at one end and positive at the other. This means that the grid will not conduct so well for a small voltage as a large, so that at the point of oscillation the impedance of the grid of the valve suddenly alters, allowing the valve to plop into oscillation. The most simple answer to this is to connect the grid leak to the positive end of the heater instead of the negative; in this way there is always a small grid current flowing.

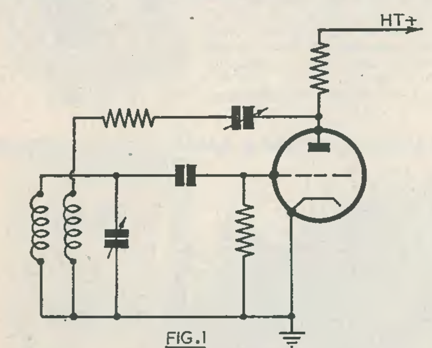



FIG.1

RC121

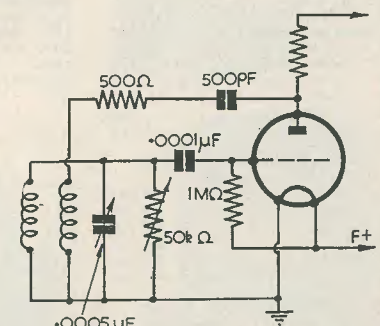


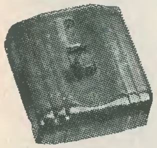

FIG.2

Fig. 1 shows a useful modification to the reaction circuit, which just consists of a resistor joined between the reaction condenser and the reaction coil. The effect is to alter the phase angle instead of the amplitude of the feedback. The result is very much the same, but is very much smoother. The value of the resistor can be almost anything between 100 and 5,000 Ω; if it is too high the reaction circuit will not oscillate. The experimenter can best find a value that will suit his particular circuit by trial and error.

Another type of circuit is shown in Fig.2. In this, the circuit is set so that it will oscillate freely, but not too vigorously. The control is to a certain extent set by the value of the series resistor between the reaction coil and the reaction condenser. The size of the component can be found quite easily by substituting various values; the writer has found that for most purposes a 500 Ω resistor is suitable. The variable resistor across the circuit is a 50 kΩ, and should for preference be non-inductive and can quite well be of the carbon type. The action of the circuit is that the valve tends to neutralise the dynamic resistance of the tuned circuit, and if it over-neutralises the circuit, oscillation will start. If, then, a variable resistor is in the circuit it will reduce the dynamic resistance. The dynamic resistance is given by the formula Rd equals L/RC and is a resistive quantity, i.e., an in-phase quantity. The R used in the formula is not the DC resistance, but the HF resistance which is very much higher. The variable resistor shunts this and reduces its value so that control can be obtained.

## ELECTRICAL BARGAINS

In addition to our large range of radio accessories we also carry a good stock of electrical wiring accessories, details of a few of these and of cable can be found below:—



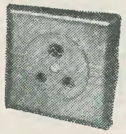
### 5 AMP SURFACE SWITCHES —HICRAFT

Oblong Brown Plastic 1-way, 1/3 each.
Oblong White Plastic 1-way, 1/3 each.

| | |
|---|---|
| Oblong Brown Plastic 2-way ... | 1/6 each |
| Oblong White Plastic 2-way ... | 1/6 „ |
| Round Brown Plastic 1-way ... | 1/3 „ |
| Round White Plastic 1-way ... | 1/3 „ |
| Round Brown Plastic 2-way ... | 1/6 „ |
| Round White Plastic 2-way ... | 1/6 „ |

### SOCKETS— HICRAFT

Flush type for skirtings 5 amp. 3-pin shuttered, 1/3 each; ditto with switch, 2/3 each.



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### T.R.S. CABLES, 250 v. CLASS

| | |
|---|---|
| 1/.044 Twin flat ... ... ... | 9d. |
| 3/.029 Twin flat ... ... ... | 1/- |
| 3/.029 Twin with earth ... ... | 1/3 |
| 3/.029 3 Core flat ... ... | 1/6 |
| 3/.036 Twin flat ... ... ... | 1/4 |
| 3/.036 Twin with earth ... ... | 1/7 |
| 3/.036 3 core flat ... ... | 2/- |
| 7/.029 Twin flat ... ... ... | 1/6 |
| 7/.029 Twin with earth ... ... | 1/11 |
| 7/.036 Twin flat ... ... ... | 2/9 |
| 7/.036 Twin with earth ... ... | 3/3 |
| 7/.064 Twin flat ... ... ... | 4/9 |

### LEAD COVERED CABLES, 250 v. CLASS

| | |
|---|---|
| 3/.029 3 core ... ... | 2/3 *yard* |
| 3/.036 3 core ... ... | 3/8 *yard* |
| 7/.044 Twin ... ... ... | 3/3 *yard* |
| 3/.036 Twin ... ... ... | 2/- *yard* |
| 7/.029 Twin ... ... ... | 2/9 *yard* |
| 7/.064 Twin ... ... ... | 5/- *yard* |

### WAR EMERGENCY TYPE CABLES, 250 v. CLASS

These are P.V.C. or rubber insulated, laid flat then braided with cotton and compounded:

| | |
|---|---|
| 7/.029 3 core flat ... ... | 2/- *yard* |
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| 7/.064 Twin flat ... ... | 3/3 *yard* |

### MULTICORED FLEXIBLES

All are suitable for mains work as the separate conductors are very well insulated, then they are covered overall either with hard rubber, plastic or waterproof braiding:—

| | |
|---|---|
| 10 core ... ... ... | 2/6 *yard* |
| 7 core ... ... ... | 2/- *yard* |
| 5 core ... ... ... | 1/- *yard* |

## MAGNETICTAPE RECORDER KIT— YOURS FOR £11/14/6

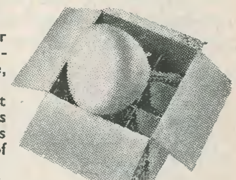
Total cost, **£35**
Cabinet only, **£4/17/6**
Tape Deck only, **£16/10/-**

**Tape Deck.** Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft tape. Tape, **35/-** *per reel*.

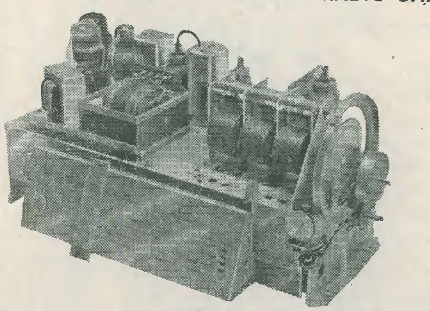
**Amplifier.** High gain enables recording to be made from microphone, pick-up, or loudspeaker. Separate bass and treble lift controls.
**Cabinet.** Portable, is rexine covered, table model is polished walnut.
**Instruction Booklet.** Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at **5/-** (credited if you buy kit or complete recorder).
**Price £35.** Complete kit of parts, including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required), or **£11/14/6** deposit and 12 monthly payments of **£2/6/3.** *Carriage/insurance* **10/-** *extra.*

### 15" MAGNETIC TELEVISION TUBE

By famous maker, as used in many popular Television receivers (list on request). Specification Blue/White screen 9Kv. ion trap triode, heater 6.3v at .55 amp, 50 deg. deflection.
New, with written guarantee offered at approximately half price, **£12/10/-** each plus 10/- carriage and insurance. H.P. terms **£4/4/-** deposit and 12 monthly payments of **18/3.**
Limited quantity so order immediately.



### 7 VALVE 5 WAVEBAND RADIO CHASSIS



**GIVE AWAY PRICE only £6/19/6**

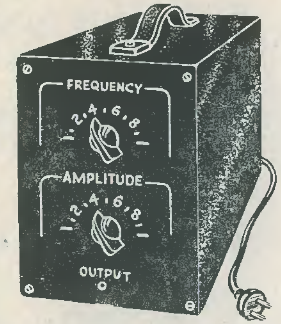
A famous set by a famous manufacturer. Undoubtedly a serious listener's receiver. Among many special features are an H.F. stage and tuning indicator. Tunes up to 11 metre band. Price complete with valves but less speaker, **£14/19/6.** H.P. terms **£5** deposit and 12 monthly payments of **£1/1/9.**
We have a few left, less valves and power pack, otherwise in good condition; they definitely have never been used. Price **£6/19/6**, or **£2/7/-** deposit and 11 monthly payments of **10/9**, plus **15/-** carriage.



### T.V. SIGNAL AND PATTERN GENERATOR

**Cost of all components, valves, etc., only 29/6**

Although this generator can be built and used by any beginner it is at the same time a most useful instrument for the more advanced worker.
It can be tuned to the vision channel and will produce a pattern on the face of the C.R. tube. Alternatively if tuned to the sound channel it will produce an audible signal in the loudspeaker.
Thus its owner will become independent of B.B.C. transmissions and can fault-find or test at any time. It operates entirely from A.C. mains and is quite suitable for use with superhet or straight receivers.
A complete kit of parts (in fact everything except the cabinet) with full constructional and operational data will be supplied for **29/6**, plus **2/6** post and insurance, alternatively data is available separately, price **2/6** (credited if you buy the kit later).



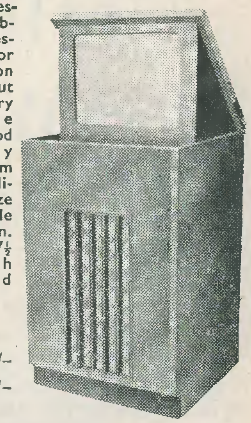

**NOTE.** Cabinets as per the illustrated prototype now available at **17/6** each.

### CABINETS LESS THAN COST

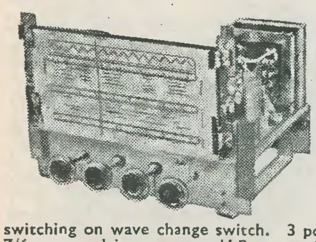
Due to works changing over to defence production we are able to offer these beautiful cabinets at below cost.

An impressive cabinet designed for projection T.V. but also very suitable for a good quality radiogram or amplifier, Size 23in. wide x 22 in. deep, 37½ in. high with lid closed.

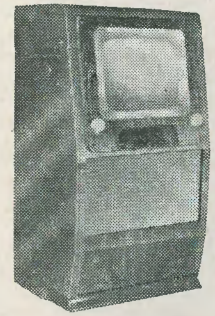
Price **£9/15/-** plus 15/- carriage.



### OUTSTANDING VALUE OF NEW PRODUCTION



**Model B.** Six wavebands, 11-15 metres continuous in 5 ranges (4 Bandspread) and M.W. 185-550 metres. Six position Tone Switch (3 Radio - 3 Gram). Price **£15/5/-** plus 7/6 carr. and insurance or H.P. terms **£5/9/-** deposit.
**Model B3.** Three waveband, Long, Medium, Short. Gram. switching on wave change switch. 3 position Tone. Price **£12/12/-** plus 7/6 carr. and insurance or H.P. terms **£4/6/-** deposit.
Both chassis 11½" x 7" x 8½" high. Lates type valves 6BE6, 6BA6, 6AT6, 6BW6, 6X4. A.C. mains operated, flywheel tuning, negative feedback over entire audio section, engraved knobs, fully guaranteed.
BUILT TO HIGHEST PERFORMANCE STANDARD AND SPECIFICATION

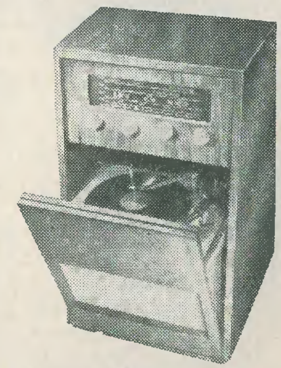


A 12 inch console T.V. fitted with castors and front flap for controls. Size 19in. x 35in. x 15½in. deep.

Price **£7/10/-** plus 10/- carr.

### THE P.T. "ARGUS" TELEVISION RECEIVER

Although this televisor costs only about £20, it does not involve the conversion of ex-Government units, and had been designed for construction by the novice. The circuits have been kept straightforward and devoid of "frills" though nothing has been sacrificed which would assist in its efficient and stable operation.
We can supply the 21 valves, C.R. Tube and all the parts for **£20/10/-**. H.P. terms are available, deposit being **£6/17/6**, balance 12 monthly payments of **£1/9/9** each. Carriage and packing 10/- extra.
A reprint of the data, by permission of the Editor of "*Practical Television*" together with some additional diagrams and notes produced by our Television engineers are available as a constructor's envelope. Price **5/-** post free.



A sensible radiogram—will take the Collaro 3 speed changer RC511 etc. Size 18in. x 30in. x 11in. to 16in. deep. Price **£7/10/-** plus 10/- carriage.
*Note.*—For the radiogram metal chassis, 3 colour glass scale pan, drive, pulleys, etc. are available. Price **15/-** complete.

**ELECTRONIC PRECISION EQUIPMENT LTD.**
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# THE "CORONET" S W CONVERTER

## Covering 5-45 Mc/s in 4 Bands

*By* **G. BLUNDELL**

This article describes a simple four band short wave converter for use with a normal medium wave superhet receiver. The results from this combination outclass any normal short wave receiver, especially as regards sensitivity, freedom from whistles and second channel interference.

Plug-in coils were thought of, but they are not so convenient as switched ones, and are always likely to be damaged when not in the set. On considering this point, it was decided that, by carefully planning the layout, switched coils could be employed without unduly lengthening the coil leads.

The converter connects to the aerial and earth terminals of the receiver, and these are the only connections required unless the power supplies are taken from the receiver. This is a practical proposition, as the unit takes only some 15 mA. Alternatively, of course, a separate small power pack could be used.

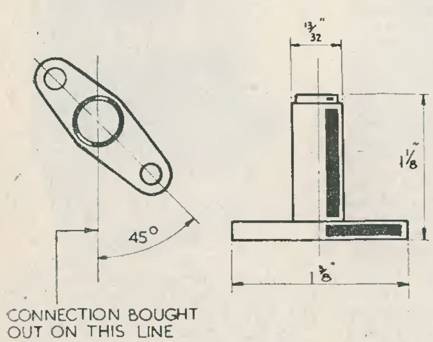



FIG. 1

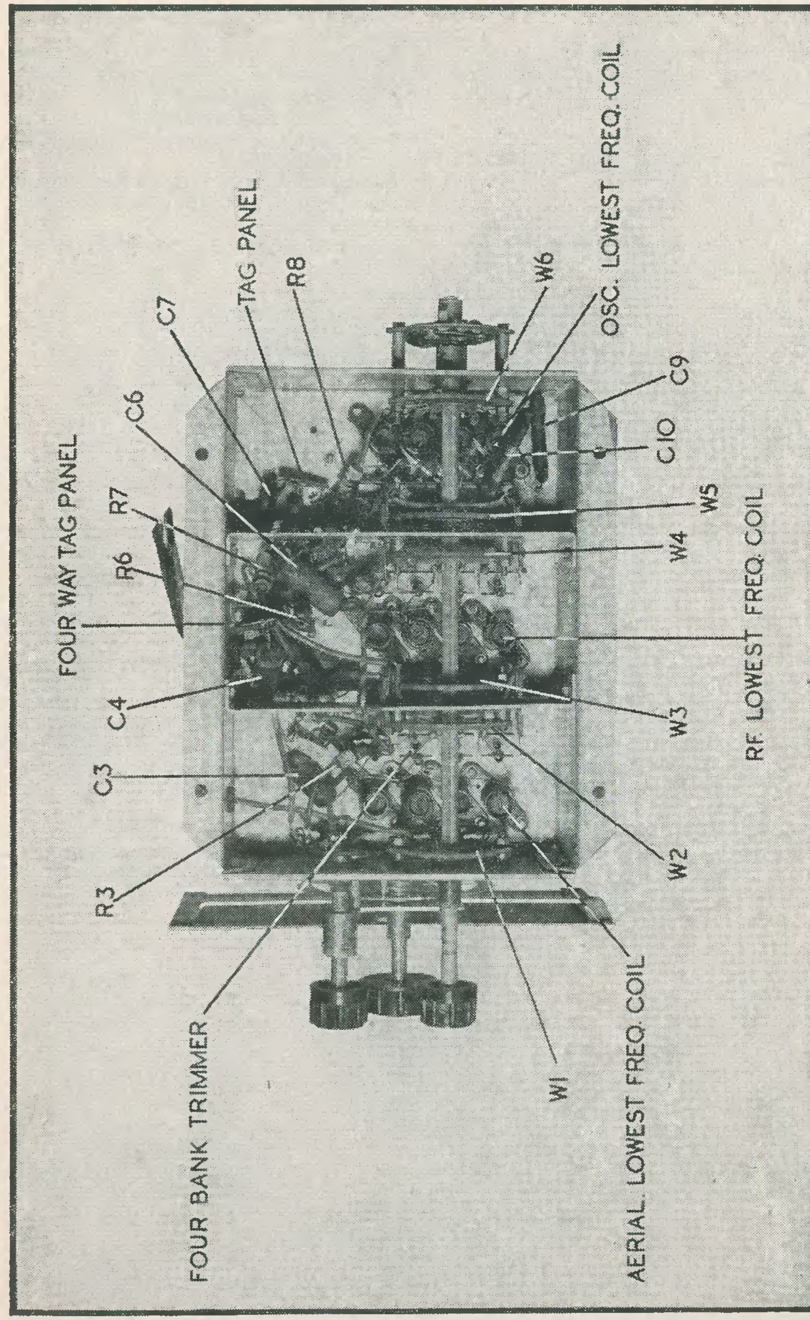
RC 96

The medium wave set is tuned to the high frequency end of the band, so that the first IF is around 1.5 Mc/s. This set should preferably have an RF stage with 3-gang tuner in order to get good second channel rejection, although the converter works well with the ordinary "four plus one" receiver. Alternatively, an energetic constructor could make up a special double IF strip consisting of the following stages, for example: IFT1 at 1.5 Mc/s, 6K7—Frequency changer, 6K8—IFT2 at 110 kc/s, 6K7—Detector and audio, 6Q7. A low final IF of 110 kc/s would be chosen in order to achieve good selectivity.

The converter plus the medium wave set is, then, acting as a double superhet. This feature is found on all the more expensive communications receivers, and has many advantages.

It is obvious that a straight or TRF set can have only one response—that to which the set is tuned. The response, though, is not likely to be very good, and so a frequency changer is employed. The IF is, of course, chosen so that good selectivity can easily be achieved and extra tuned circuits can be added without increasing the number of sections of the gang condenser as would be necessary in the case of the TRF receiver. The snag lies in the fact that the superhet has two responses, the second of which usually occurs at twice the IF above the wanted signal. On medium waves this is not troublesome. Take the following example of a superhet tuned to the London Home Service. The incoming signal is 908 kc/s (330 metres). The oscillator is tuned to 1373 kc/s, and the difference of the two gives the IF of 465 kc/s. The second response is at 1838 kc/s, and the






*UNDER-CHASSIS ARRANGEMENT. COVER ILLUSTRATION SHOWS TOP-DECK LAYOUT*

## PARTS LIST

### Valves

RF Stage—Brimar 6BA6, Osram W77
Frequency Changer—Brimar 12AH8, Osram X79

### Dial

Jackson Bros. (London) Ltd. type 2154 fitted with scale type 4838

### Waveband Switch

6-pole 4-way on 6 separate wafers plus extra way on one wafer as drawing

**Resistors**

| | Brimar type valves | Osram type valves |
|---|---|---|
| R1 | 100 kΩ ¼W Erie type 8 | 100 kΩ ¼W Erie type 8 |
| R2 | 33 kΩ ½W Erie type 9 | 10 kΩ ½W Erie type 9 |
| R3 | 68 Ω ¼W Erie type 8 | 270 Ω ¼W Erie type 8 |
| R4 | 100 kΩ ¼W Erie type 8 | 100 kΩ ¼W Erie type 8 |
| R5 | 100 kΩ ¼W Erie type 8 | 100 kΩ ¼W Erie type 8 |
| R6 | 22 kΩ 1W Erie type 1 | 22 kΩ 1W Erie type 1 |
| R7 | 10 kΩ ½W Erie type 9 | 10kΩ ½W Erie type 9 |
| R8 | 22 Ω ¼W Erie type 8 | 22 Ω ¼W Erie type 8 |
| R9 | 47 kΩ ¼W Erie type 8 | 47 kΩ ¼W Erie type 8 |
| R10 | 68 Ω ¼W Erie type 8 | 68 Ω ¼W Erie type 8 |
| R11 | 220 Ω ¼W Erie type 8 | Not required—cathode connected to chassis |

### AVC Switch

2-way 1-pole
12 Aladdin coil formers $\frac{11}{16}$" long, as drawing, with high grade dust iron cores.
1 B7G Holder and screen
1 B9G Holder and screen
3 4-way banks of trimmers, 4-40 pF, Cyldon type MT/16/GA4
3 Tuning condensers, Jackson Bros. (London) Ltd. type U101, 10 plates on rotor, 9 on stator.
Condenser Couplers, Jackson Bros. (London) Ltd.

**Condensers**

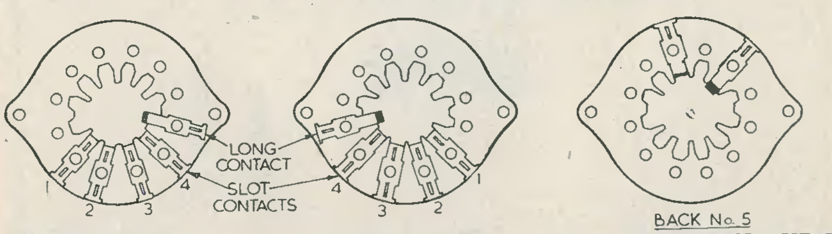
| | |
|---|---|
| C1 | 0.05 μF 350V paper, T.C.C. type 343 |
| C2 | 0.05 μF 350V paper T.C.C. type 343 |
| C3 | 0.01 μF ceramic or mica T.C.C. type M3N |
| C4 | 0.05 μF 350V paper T.C.C. type 343 |
| C5 | 0.05 μF 350V paper T.C.C. type 343 |
| C6 | 0.05 μF 350V paper T.C.C. type 343 |
| C7 | 100 pF silvered mica T.C.C. type 101 SMP |
| C8 | 47 pF silvered mica T.C.C. type 101 SMP |
| C9 | Tracking, 300 pF silvered mica T.C.C. type 425 SMP |
| C10 | Tracking, 450 pF silvered mica T.C.C. type 501 SMP |
| C11 | 0.05 μF 350V paper, T.C.C. type 343. not required when using Osram X79 |

set will be more responsive at this frequency, as can easily be verified with a signal generator. This second response, though, is so different in frequency to that of the required signal that one tuned stage in front of the frequency changer can easily reject it.

On short waves the position is very different, as the following example of a set tuned to the 31 metre band will show. Suppose the station is on 10 Mc/s. The oscillator will be tuned to 10.465 Mc/s and the second channel will be on 10.930 Mc/s. The frequency difference between wanted and unwanted response is no longer so great, and one tuned circuit can no longer adequately separate them. The position is only a little better when using two tuned stages in front of the frequency changer, and the whole position rapidly deteriorates as the frequency increases.

The remedy is to raise the IF, and 1.5 Mc/s is a usual value. The second channel when receiving a 10 Mc/s station is now at 13 Mc/s, and the unwanted response can more easily be rejected. Unfortunately, the higher the IF the worse the adjacent channel selectivity, and so to make full use of the superhet principle for short wave work, two IF's are needed —a low one for good adjacent channel selectivity and a high one for good second channel rejection.

A further bad point about the normal superhet is that the tuning condenser has too large a value for short wave work. This causes the sensitivity to vary considerably




WAFER SWITCHES FIG.2

RC97



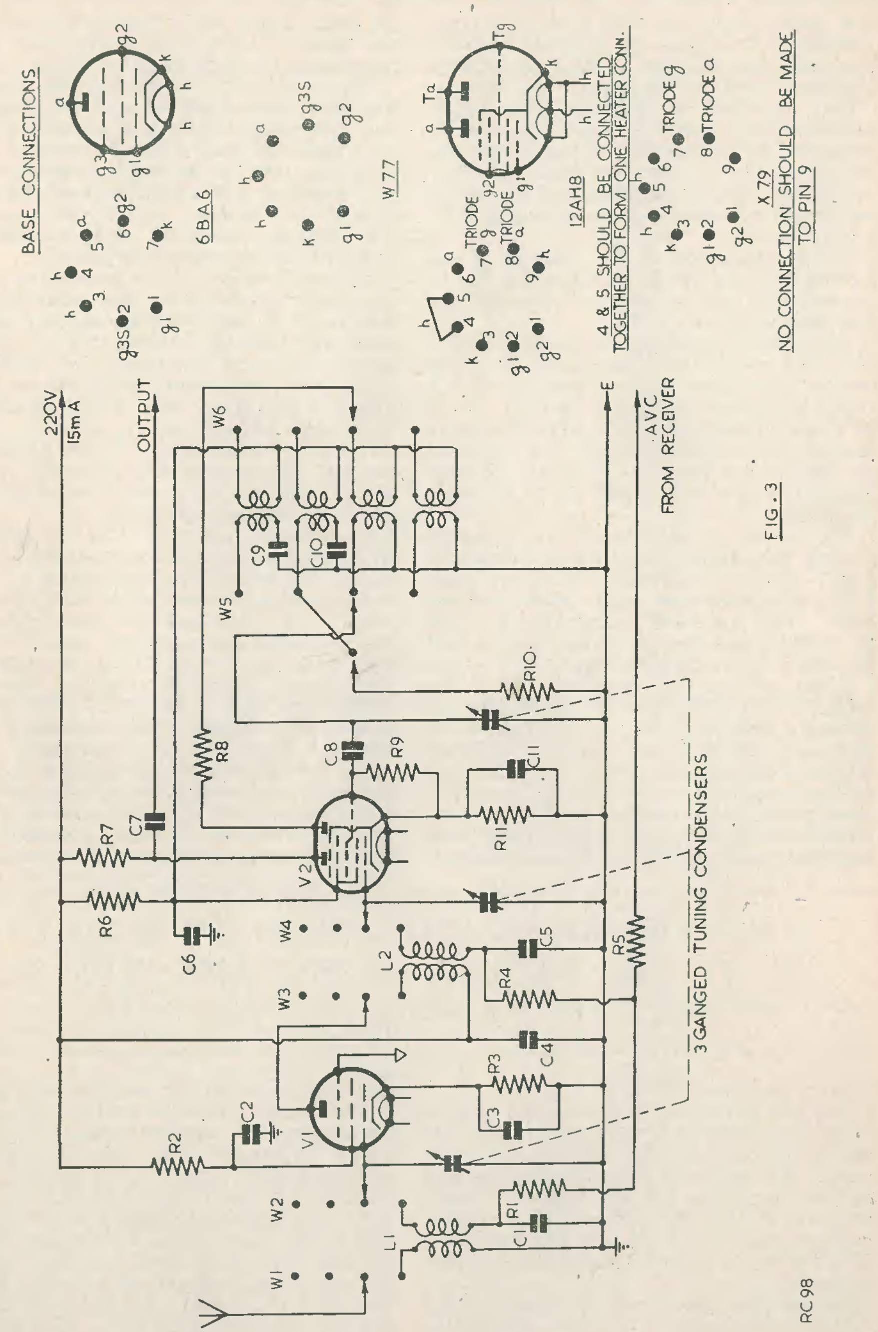



FIG. 3

RC98

over each range, and also a very accurate mechanical drive must be used because the bands are very cramped. The bigger tuning condensers are also more prone to microphony.

The converter described in this article overcomes all these defects. The tuning condenser has a maximum value of 80 pF, and this helps to keep the gain relatively constant, as well as spreading out the tuning so that an expensive high ratio tuning drive is not required.

The output circuit of the converter is not too efficient, but this is not important due to the very high gain of the combination of the unit and a receiver.

To prevent overloading on stronger stations the AVC should be taken from the radio receiver to control the converter valves. A switch is included to switch this off, if the AVC should upset the stability of the frequency changer. This effect has not been detected on the writer's set, but it would probably happen if a more selective IF at 110 kc/s were employed.

The layout of the chassis was designed around the Aladdin coil former shown in Fig. 1 and the Jackson Bros. condenser, type U101, which has nine stator blades and ten rotor. The four-bank trimmers are made by Cyldon, and this particular type is best as there is not much spare space.

Wafer switches as shown in Fig. 2 are required. Extra contacts are needed on the oscillator wafer in order to short circuit one particular coil when not in use. If this coil is not so shorted, it interferes with the scale calibration and also reduces the sensitivity considerably. The switches could have been built on to less wafers, but all leads would have been lengthened and this would have adversely affected the performance.

The switches should be mounted so that the switch rod slides in easily, to reduce the mechanical strain on the switches to a minimum. The condensers must also be mounted so that they are in line, and carefully ganged together so that they are all at maximum capacity together. Take care over this point, or it will not be possible to align the converter correctly.

Because the leads are so short, most of the tuning inductance is in the coils and not in the leads, and it was a source of surprise to the writer to find how many turns were required on the high frequency bands.

The scale should be glued to the Jackson Bros. dial and the set can then be aligned to this. Although the converter could be aligned to known stations, a signal generator is a great help. Any of the excellent designs which have appeared in this magazine could be used. Firstly, the oscillator should be made to approximately follow the scale, and the RF and aerial circuits should be peaked.

The oscillator should now be made to follow the scale accurately by first adjusting the inductance at the low frequency end of the scale, and then the trimmer at the high frequency end, and this procedure should be repeated until no improvement can be made. The RF and aerial coils should be aligned in the same way.

Tracking condensers C9 and C10 are required on the two low frequency ranges, and the values given should be adhered to or incorrect tracking will result.

If the signal generator does not cover 50 Mc/s, the highest band can be aligned on the second harmonic of the generator.

And now a few odd details about the converter. C3, the cathode bias condenser of the mixer, should be a ceramic or a stacked mica to avoid any possibility of instability. The Osram frequency changer does not require bias, and so the cathode is connected directly to chassis. The oscillator anode voltage is taken from the screen supply of the mixer through R6, and this helps to keep the oscillator anode voltage more constant. R6 has a larger wattage rating than is strictly necessary in order to avoid frequency drift through undue heating of this component and consequent voltage variations across it.

Co-ax cable should be used for the output lead in order to keep the capacity across the output reasonably low. C8, the oscillator grid condenser, must be a silvered mica condenser of good quality so that its value does not vary and cause frequency drift. The switch wafers should be mounted so that the long contacts are near the valves. Single tag panels are mounted on the same screws that hold the wafers. These tag panels are used for the coil connections. Although the

A READY-CALIBRATED SCALE, WHICH MAY BE PASTED ON TO THE SPECIFIED JACKSON DIAL, WILL BE FOUND ON THE INSIDE OF BACK COVER



## COIL WINDING DATA

| COIL | FREQ. RANGE | TUNING COIL Turns | TUNING COIL Gauge | COUPLING COIL Turns | COUPLING COIL Gauge | SPACING |
|---|---|---|---|---|---|---|
| Band 1 Aerial | 5-8 Mc/s | 24 | 32 DSC | 7 | 38 DSC | 1/16" |
| RF | | 24 | 32 DSC | 7 | 38 DSC | 1/16" |
| Osc | | 22 | 32 DSC | 10 | 38 DSC | 1/16" |
| Band 2 Aerial | 8-14 Mc/s | 15 | 32 DSC | 5 | 38 DSC | 1/16" |
| RF | | 15 | 32 DSC | 5 | 38 DSC | 1/16" |
| Osc | | 13 | 32 DSC | 6 | 38 DSC | 1/16" |
| Band 3 Aerial | 14-25 Mc/s | 10 | 20 Enam | 4 | 38 DSC | Inter-wound, see text. |
| RF | | 10 | 20 Enam | 4 | 38 DSC | |
| Osc | | 9 | 20 Enam | 4 | 38 DSC | |
| Band 4 Aerial | 25-45 Mc/s | 5 | 20 Enam | 2 | 38 DSC | |
| RF | | 5 | 20 Enam | 2 | 38 DSC | |
| Osc | | 5 | 20 Enam | 2 | 38 DSC | |

effect has not been found in this converter, it might be necessary to bridge C5 with a ceramic or mica 0.01 μF condenser if instability is experienced. As can be seen in the photograph, the switch clicker-plate is mounted at the back of the chassis and an extension switch rod has been added. This was done to use up some switch parts, but the clicker-plate should be mounted outside the chassis in any case, so that the rod can be withdrawn to check the alignment of the wafers. The middle wafers are, of course, mounted on the screens using $\frac{3}{16}$" spacers. The bush to act as a bearing for the switch rod at the front of the chassis can be taken from an old volume control. The dial is mounted away from the chassis on $\frac{11}{16}$" spacers. The screens should be mounted so that they pass directly over the middle of the valveholders. The B7G holder is of the $22\frac{1}{2}°$ type.

**Coil Winding Notes**

The method of anchoring the wires on the two low frequency band coils is shown in Fig. 4. The coil is wound over a strip of card, and the end turns anchored underneath this piece of card. When coated with distrene varnish the anchoring becomes very firm.

It is more difficult to anchor the 20 swg wire used on the higher frequency coils, and the best way is to wind the coil on a smaller mandrel ($\frac{11}{32}$" diam.) and then slip it over the former and stretch to the correct length. Wind on the coupling coil, and then anchor the whole with a hard glue such as cellulose or shellac. The Band 3 tuning coils should be pulled out to a length of $\frac{9}{16}$", and the Band 4 coils to a length of $\frac{3}{8}$". This slight spacing of the turns increases the Q of the coil considerably.

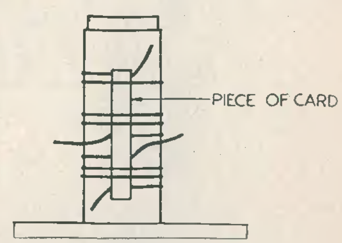
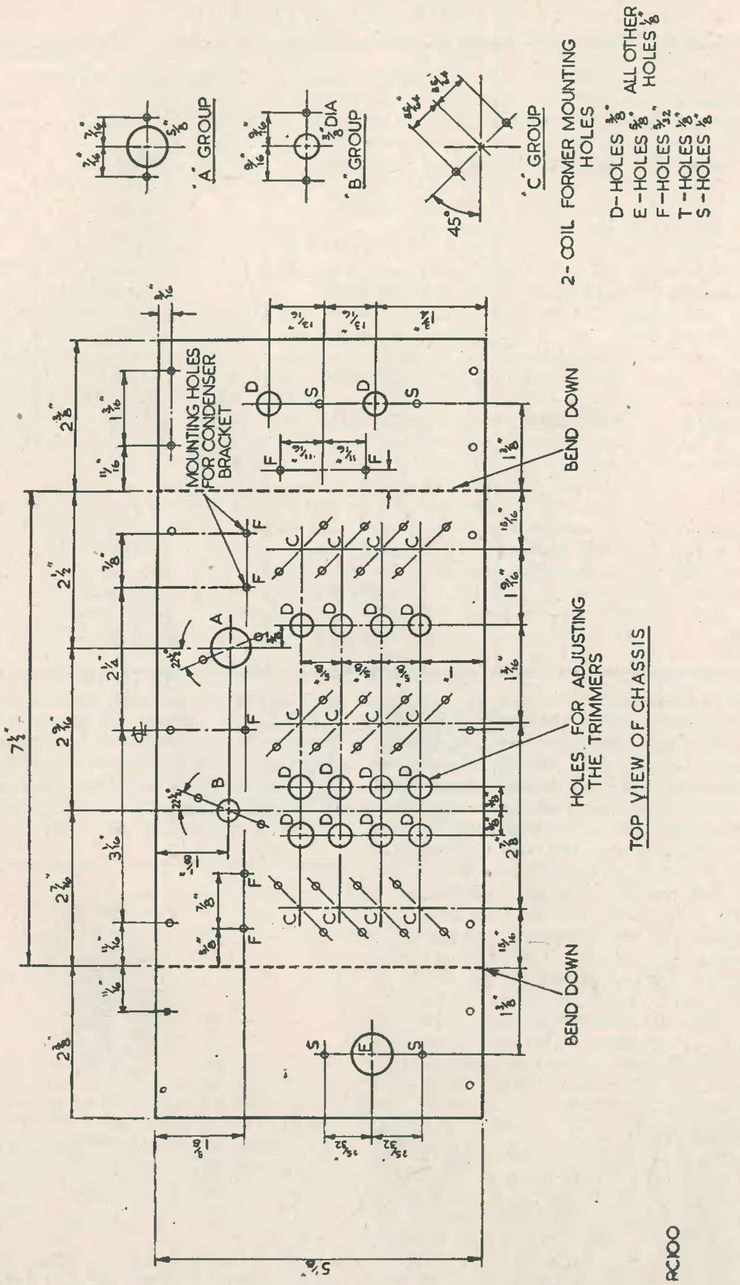
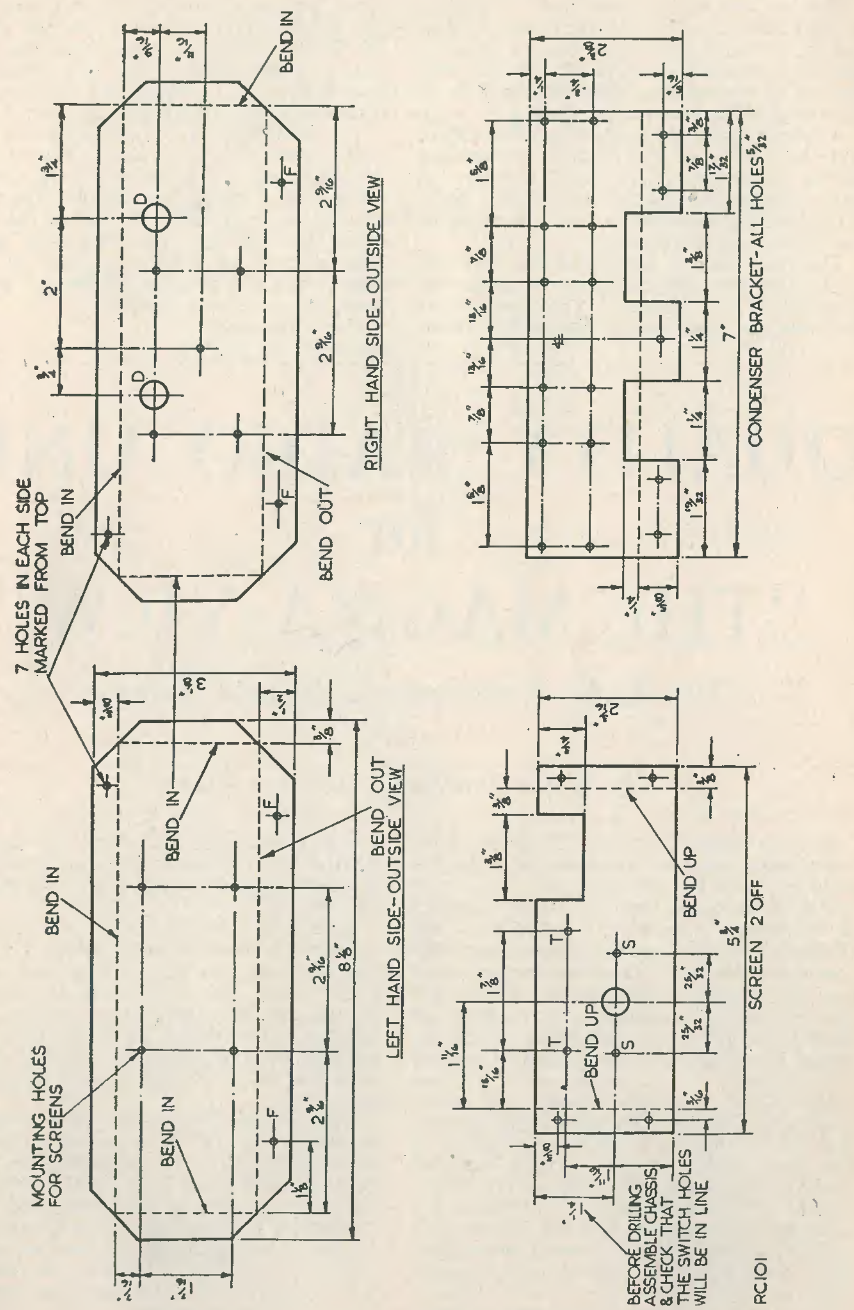



FIG.4
METHOD OF ANCHORING LEADS ON TWO LOWEST BANDS

RC99


'A' GROUP
'B' GROUP
'C' GROUP
2-COIL FORMER MOUNTING HOLES
ALL OTHER HOLES 1/8"
MOUNTING HOLES FOR CONDENSER BRACKET
BEND DOWN
BEND DOWN
HOLES FOR ADJUSTING THE TRIMMERS
TOP VIEW OF CHASSIS
RC100




BEND IN
RIGHT HAND SIDE-OUTSIDE VIEW
7 HOLES IN EACH SIDE MARKED FROM TOP
BEND IN
BEND OUT
CONDENSER BRACKET-ALL HOLES 5/32"
BEND IN
BEND OUT
LEFT HAND SIDE-OUTSIDE VIEW
MOUNTING HOLES FOR SCREENS
BEND IN
BEND UP
BEND UP
SCREEN 2 OFF
BEFORE DRILLING ASSEMBLE CHASSIS & CHECK THAT THE SWITCH HOLES WILL BE IN LINE
RC101

The last two turns of the Band 3 coupling winding are interwound with the tuned winding, and the last turn only of the Band 4 coupling winding is similarly interwound. In each case the rest of the coupling winding should be as close as possible to the main winding.

All windings should be in the same direction, and then the top and bottom connections will be the switch connections, while the two inner connections will be the "dead" ones. If the connections are not correct, the oscillator coil will refuse to function.

The coils should, of course, be mounted so that the top grid connection is as near as possible to its trimmer. The connections to the coils are best made by the coil leads themselves, and these should be left long enough for this purpose (2" minimum). In the case of the 20 swg windings, these ends should be bent at right-angles to the coil former and cut off short ($\frac{3}{8}$"). Clean and tin these ends before applying the varnish or other fixative.

The best method of anchoring the cores is by means of a thin piece of elastic, about $\frac{1}{32}$" diam., put down the side of the core. A rubber band should not be used, as this is usually too thick and will result in the screw-driver slot in the core becoming broken. This method of anchoring cores is much cleaner than the usual sticky "wug," and yet holds the cores very firmly.

Good listening !

# QUALITY RADIO UNIT for "THE MAGNA-VIEW"

## *The Radio Constructor's 16 inch Televisor*

PART 1

*By* A. S. TORRANCE, A.M.I.P.R.E., A.M.T.S.

An early analysis of the circuit of the above will at once reveal to the student that there is nothing new to be seen here.

This is, of course, true ! The entire object of this design is to make it possible for the Magna-View televisor to finalise as the complete home entertainment. The present arrangement does not suggest a gramophone section, but this presents no problem—particularly as Messrs. Ashdown are prepared to vary the size of the additional top cabinet to suit any such requests.

The cabinet that will be shown next month in no way detracts from the original appearance of the television set, but enhances it. The tuner itself, then, is a simple super-het covering three-wave bands, but nevertheless is capable of a performance that we believe will surprise a great many. The amplifier is again probably well known in its general appearance, and is really a baby brother to a more famous one.

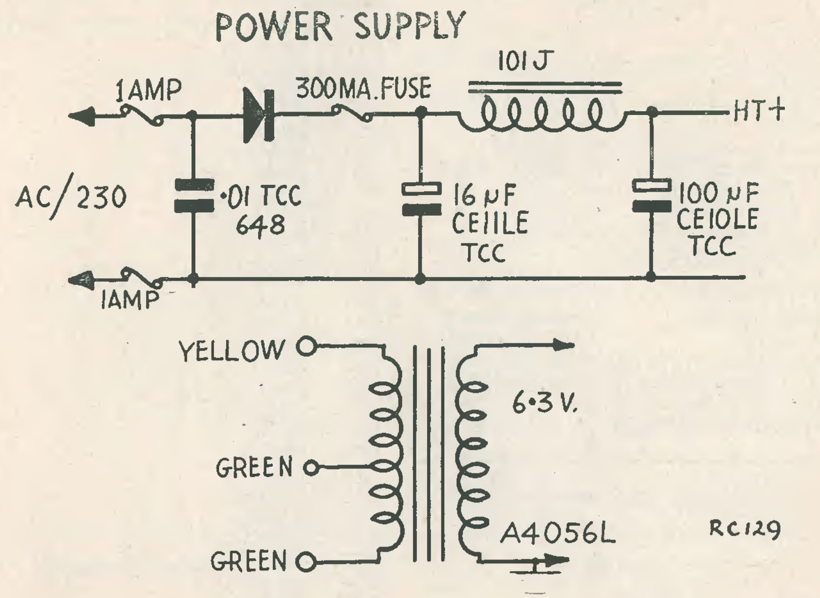
Two 6AQ5 valves as triodes produce about 3 watts without any appreciable distortion, and this power is considered reasonable for the speaker as specified earlier (The Goodman's 10" T47/1017/3.)

Some evidence of the quality obtainable may be recorded from the visit of a famous concert-hall violinist, who was so impressed with its performance that he intends to possess a version of this set. Your writer firmly believes in the human ear as the final test of any receiver, and what better ear could be used than that of a musician known by name to most of you.

This receiver is provided with a two-pole two-way mains switch ganged to a single-pole two-way section. By this means, mains may be switched to either TV or radio, while at the same time the speaker is also switched.

**Note:** It is imperative, if half-wave power packs are used, that care be exercised to ascertain that the live sides and chassis sides of mains are the same in both receivers.






*NOTE: The mains (230V AC) are connected to the two green leads of the heater transformer. The single yellow lead is ignored.*

*The chassis is, of course, at mains potential, and no direct earth connection to it should be made.*

The above note can be effectively guaranteed by using coloured-core-cables, and still further satisfaction would be expected by using three-pin mains plugs. In this way the earth pin would make definitely certain that the live side of the sets was indeed connected to the live side of mains, by acting as a location pin.

**Note:** The Earth pin is not electrically connected.

The chassis lay-out, as given, can be altered to suit individual requirements, or the set could be greatly reduced in size by using a single-ended output stage.

Alternatively, readers who would like to construct this as an ordinary home-receiver will see at once that a slightly larger chassis would provide the necessary additional room for speaker mounting.

Lining-up the receiver is always a task that really requires a signal-generator. However, with pre-set IF transformers and the maker's procedure which will be given, considerable success may be expected. The set in general, then, is so simple and usual that it is not proposed to give a technical analysis.

This has been done so many times in the pages of *The Radio Constructor* that your writer feels it would be far more beneficial to concentrate on actual constructional requirements, bearing in mind that this design was primarily intended as an addition to the "Magna-View."

The sketch of the switching is laid out block fashion to display as clearly as possible the imperative necessity of keeping the mains input to both TV and radio receivers polarized correctly to the mains.

The aerial input has been found most effective when connected to the screening of co-ax TV feed.

**Note:** This is taken to top of 100 pF blocking condenser on radio set.

Naturally, better results would be obtained if a correct all-wave aerial was available, but to repeat, this receiver is a refinement to the "Magna-View" and little beyond the usual listening source was aimed at. Despite this,

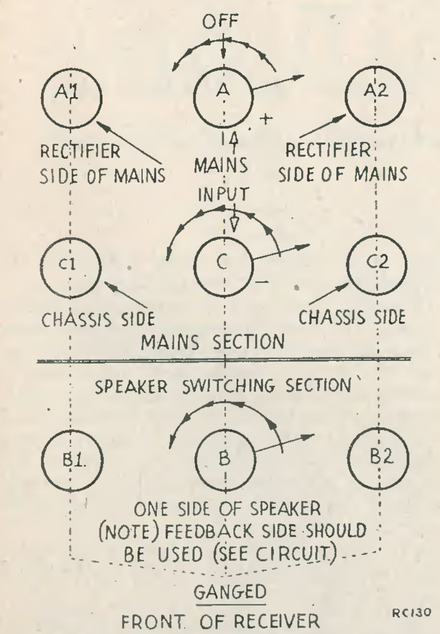
## PARTS LIST

**Power Pack**

Reservoir Condenser, T.C.C. 16 μF type CE11LE
Smoothing Condenser, T.C.C. 100 μF type CE10LE
Choke, H.L. Smith. Electrovoice 101J
Filament Trans, HENRY'S RADIO A4056L
Fuses, Double Mains 1 Amp
Fuse, Single 300 mA
Switch " Diamond H " 75AC238C
0.01 μF T.C.C. type 648

| Valves (Brimar) | | Bases (Mc'Murdo) |
|---|---|---|
| 12AH8 | Mixer | B9A (Screened) |
| 6BA6 | IF | B7G (Screened) |
| 6AT6 | Detector, A.V.C. | B7G (Screened) |
| 12AX7 | Phase Splitter | B9A (Screened) |
| 2-6AQ5 | P.P. Output | B7G |
| Metal Rectifier | DRM2B | |

SWITCHING SCHEMATIC FOR DIAMOND H" 75AC238C




*NOTE: The contact positions of this switch are at 45°, as against the 30° of ordinary Yaxley types. To suit the markings on the specified knob, the mains output from switch to radio receiver should come from A1-C1, and speaker connection from B1.*

**Resistors**

All resistors Erie No. 9, except where stated.

| | | |
|---|---|---|
| R1 | 10kΩ 1W | |
| R2 | 10kΩ 1W | |
| R3 | 33kΩ | |
| R4 | 47kΩ | |
| R5 | 220Ω | |
| R6 | 220kΩ | |
| R7 | 150Ω | |
| R8 | 47kΩ | |
| R8A | 1.5kΩ | |
| R9 | 68Ω | |
| R10 | 47kΩ | |
| R11 | 300kΩ | |
| R12 | 1 MΩ | |
| R13 | 47kΩ | |
| R13A | 220kΩ | |
| R14 | 2.2kΩ | |
| R15 | 1 MΩ | |
| R16 | 1 MΩ | |
| R17 | 520 Ω | |
| R18 | 100 kΩ | |
| R19 | 220 Ω | |
| R20 | 1.5 MΩ | |
| R21 | 4.5 kΩ | |
| R22 | 2.2 MΩ | |
| R23 | 220 kΩ | Preferably matched |
| R24 | 220 kΩ | Preferably matched |
| R25 | 100 kΩ | |
| R26 | 470 kΩ | |
| R27 | 470 Ω 2W | |
| R28 | 470 kΩ | |
| R29 | 100 kΩ | |

**Condensers**

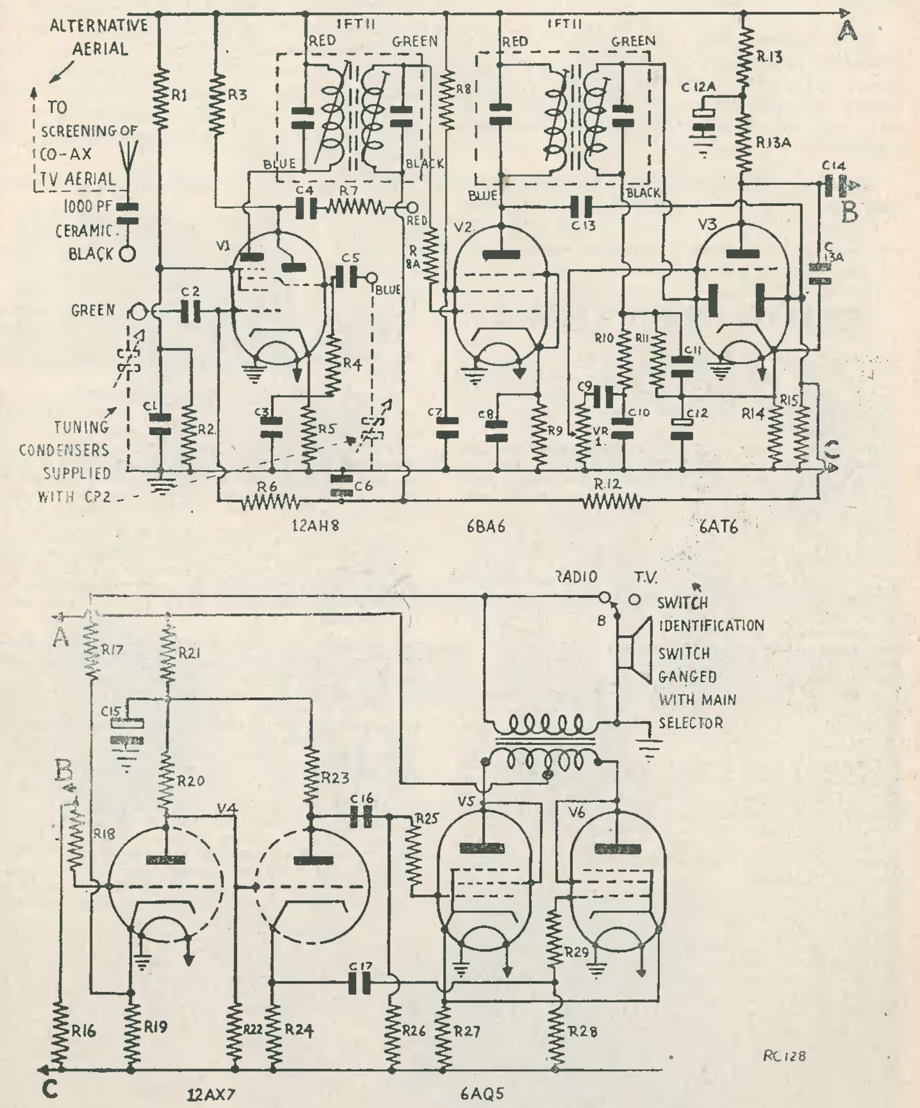
All condensers T.C.C.

| | |
|---|---|
| C1 | 0.1 μF type CP37N |
| C2 | 100 pF type SMWN |
| C3 | 0.1 μF type CP36H |
| C4 | 200 pF type SMWN |
| C5 | 50 pF type SMWN |
| C6 | 0.1 μF type CP36H |
| C7 | 0.1 μF type CP37N |
| C8 | 0.1 μF type CP36H |
| C9 | 0.01 μF type CP112H |
| C10 | 200 pF type SCT3 |
| C11 | 200 pF type SMWN |
| C12 | 50 μF type CE18C |
| C12A | 4 μF type CE18L |
| C13 | 30 pF type SMWN |
| C13A | 100 pF type SMWN |
| C14 | 0.05 μF type CP32N |
| C15 | 8 μF type CE11L |
| C16 | 0.05 μF type CP35N |
| C17 | 0.05 μF type CP35N |

Aerial condenser included to isolate mains/aerial where metal rectifier half-wave power-pack is employed, 1000 pF 1000VW

P.P. output trans   Goodmans T3/63
Coil Pack   Denco C.P.2.
I.F. Transformers   Denco I.F.T.11
½ MΩ Volume Control
Dial lamps, Mountings.






*Circuit of the "Magna-View" Quality Radio Unit* a remarkable number of stations have been noted, proving the possibilities for those so inclined.

Some readers may be surprised to see a half-wave power pack, when quality is claimed. Those who construct this receiver will be delighted at the absence of background hum, etc., and the economy effected is financially attractive.

Although the design shown is fundamentally based on 230V AC, it is not expected that very much difference would be felt at voltages (mains) varying slightly from this.

For higher local supplies the reservoir condenser could be dropped to 8 μF or even 4 μF. For lower voltages, it is not thought much loss of performance would be experienced. No doubt, by now, constructors will be familiar with their likely local difficulties, and here again we would be most happy to offer suggestions if required.

Constructional guidance will be given in the next issue.

# BOOK REVIEWS

TELEVISION. By F. Kerkhof and W. Werner. 475 pages, 360 illustrations, 28 pages of photographs and 2 folded diagrams. Price 50*s*. Distributed in England by Cleaver-Hume Press Ltd., 42a South Audley Street, London, W.1.

This is the latest addition to the Philips Technical Library, and the authors are Principals of the Television Development Laboratory of Philips Industries, Eindhoven, Holland. As with other books in this fine series of technical references, the subject is treated exhaustively in all aspects. Those who are concerned with receiver design will find the mathematical analyses of particular interest, whilst less knowledgeable readers will find that an understanding of higher mathematics is not essential in order to learn a great deal from this book.

The first chapter gives a general review of the principles of transmission and reception. This is followed by a chapter on electronic scanning, both electrostatic and electromagnetic. Various types of camera tubes, and the picture tube, are next dealt with. Following this is a chapter describing standard transmission systems, including the British, American, French and European standards. D.C restoration and sync, separation are also treated at this stage.

Chapter V goes into details of pulse generators, pulse mixing, frequency dividing and saw-tooth generators. This is followed by a chapter devoted to time-base generators for electrostatic and electromagnetic deflection. The use of efficiency diodes, both series and shunt types, is included here. Generation of EHT is covered in Chapter VII, where fly-back, RF- and Pulse-generators are fully discussed.

The treatment of wide-band amplifiers in Chapter VIII is divided into 31 sections, each dealing with a particular functional basic circuitry. Some of the aspects considered here are video amplifiers, transient response and frequency compensation, RF and IF amplifiers, band-pass filters, frequency-changers, gain control, sound and vision receivers, sound rejection and interference limiters.

Chapters IX and X deal with transmission line feeders and aerials respectively. Under the heading Picture Synthesis, Chapter XI includes some useful information on the optical features of picture reproduction for both direct-viewing and projection type tubes. A short chapter on colour television systems follows, and the final chapter describes in detail the two circuits shown on the diagram folders, one being a receiver for positive modulation and the other for negative modulation.

An Appendix provides a list of television terms, tables of rationalized units and conversion tables, an extensive bibliography of relevant literature, and an Index. Eight pages of photographs show examples of faulty picture reproduction, and certain forms of interference.

REMOTE CONTROL BY RADIO. By A. H. Bruinsma. 104 pages, 74 illustrations, including photographs. Price 8*s*. 6*d*. Distributed in England by Cleaver-Hume Press Ltd., 42a South Audley Street, London, W.1.

Visitors to the National Radio Exhibition will recall the Philips radio-controlled model boats. This paper-covered handbook describes these models and provides a great deal of information concerning the transmitters, receivers and control gear. The design of the equipment for these specific models is discussed from basic principles, and full circuit diagrams with component values are given.

It would be possible to make similar radio and control apparatus using the data found in the book, though its main purpose is more likely to be a guide to design. In this respect it is a most useful reference for those interested in radio-control of models, and can be recommended.

For those who contemplate constructing equipment based upon the circuits in the book, it should be mentioned that the Philips model boats use two systems of transmission; it is shown that the smaller boat is controlled by a 2-channel transmitter and receiver working on a carrier frequency of 100 Mc/s, amplitude modulated, while the larger boat is controlled by a multi-channel transmitter and receiver working on a 10 Mc/s pulse-modulated carrier. In the former case the modulating frequencies are 50 c/s and 2 Kc/s; for the latter case, the impulse-height system of pulse-modulation is used. It should be noticed that the carrier frequencies used do not conform to the preferred frequencies in this country for model control, namely, 26.96–27.28 Mc/s and 464–465 Mc/s for a 5-watt max. DC power input to the P.A. stage. Consequently, designs based upon circuits in this book will need to be modified accordingly.

It is rather confusing, at first sight, to find component values shown in a manner which is not in general use in this country. Taking Fig. 38 as a typical example, one finds resistor values such as R3=6K8, R21=2M2, R79÷R82=M18. Mentally placing a decimal point after the K or M will reveal that this is merely another way of saying R3=6.8KΩ, R21=2.2MΩ, R79 to R82 =0.18MΩ or 180 KΩ (the sign ÷ between R79 and R82 being read as "to"). Similarly, capacitor values such as C11=4K5, and C79÷C85=100K, should be read as C11=4,500pF, or 0.0045μF, and C79 to C85 =100,000pF, or 0.1μF. Note here that the values of 4K5 and 100K are stated in pF.

One should also warn constructors that it would not be wise to incorporate in a model sound-reproduction which is carrier-borne from the transmitter. This constitutes radio communication, for which a licence is required. To play a gramophone record, modulate a carrier and reproduce this in the model could render the operator liable to prosecution for illicit transmitting !

# RADIO MISCELLANY

CENTRE TAP *talks about*

## B.B.C. O.B's. — R.S.G.B. A.G.M.

To see a keenly fought football match from the terraces on a bright, sunny afternoon may well be better than seeing it from the comfort of one's own armchair on a TV screen. Unfortunately, we seem to get singularly few of those sort of afternoons in the British winter, and armchair viewing is certainly not only far more comfortable when the weather is bad but one also sees the details of the play infinitely better. This has been most noticeable in recent televised matches played in mist and rain, and the viewer, because the sensitive modern TV camera penetrates the gloom more efficiently than the human eye, sees very much more of the game than those actually on the scene.

No wonder the money interests behind big-time football are jittery about permitting professional games to be telecast. As a football lover, rather than a one-team-partisan, I am quite content with the very sporting and keenly contested games now being provided. They certainly prove the B.B.C. have nothing to worry about over professional football " bans." Nor have they any need to fight it out. Time is on their side and they must win sooner or later, just as they have over previous " bans." Experience should have taught them the sensible thing to do is to play a waiting game.

If I remember rightly, it was about 1927 when the F.A. Cup Final was first broadcast. It was a great success. So much so that a bigger fee was soon demanded, and by 1929 no agreement on terms could be reached. Disappointed listeners were resigned to the idea of having to put up with an eye-witness account after it was all over. Despite the breakdown of negotiations the B.B.C. continued to announce that a running commentary would be given after all.

### Rumours

Naturally a lot of silly speculation on how they were going to do it took place. It was seriously suggested that the B.B.C. meant to send up a captive balloon with the commentators seated inside watching the game through field glasses. Of course, that story was soon improved on, and it was hinted that a stack of records of crowd noises and cheering were to be used as a background. A monitor was going to turn the volume up and down as the excitement on the ground waxed and waned! Why a stack of records? To a sensible person it is obvious that one record played over and over again would serve equally well—but then rumour-mongers are rarely thoughtful people.

### Delayed Action

Actually, what the B.B.C. did was to form a squad of commentators. Each in turn struggled out of the ground at 10-minute intervals and rushed to a microphone installed in a nearby house. Thus a continuous, if somewhat belated report was provided for listeners.

Since then there has been a continuing battle of " negotiations " between the B.B.C. and " sporting " interests. The latter always want the publicity, but at the same time they are dead scared of losing any part of the gate money. So they alternate between demanding fabulous fees or simply refusing to play ball. After all, the B.B.C. only ask to put in a commentator or a TV camera—not to pay for the event.

Sometimes I wonder if I see this in quite a different light to the football fan. As an ex-(small-time)-player I enjoy seeing any well contested game. Televised games are not for the expert spectator (who has never played the game but has either simply spectated or studied the Sunday paper reports). He obviously prefers to spend his time out on the terrace bawling his head off for the home side, while I prefer the armchair—that is, if there is no new constructional work on hand or lots of DX to be worked.

### 2TV

While I approve the B.B.C.'s active and passive resistance against other monopolies, it is to be deplored when the Corporation uses its might to crush or boycott individuals or small bodies. Perhaps tenderness to criticism makes it less guilty in this respect nowadays than it has been in the past. Their unfair attitude to Baird is but one instance. As early as January 1926 Baird was giving practical demonstrations, and it was not long before he was getting vision signals into New York. By 1928 he was running experimental transmissions from Long Acre and the Crystal Palace under the call sign 2TV, having already demonstrated cinema TV in *colour* of the Derby.

Yet the B.B.C. monopolists still obstructed him. To excuse themselves they pleaded that they did not want to mislead would-be viewers into buying sets which were still experimental. If they had waited until sound broadcasting was perfect we should still be without it! The excuse might have sounded more plausible if they had not, at that same time, been actually sending out still pictures from Daventry (on the Fultograph system). When, in 1929, they were literally forced to transmit Baird programmes, they put them on at 11 a.m. on a single wavelength. First vision without sound, then sound without vision, and it was not until 1930 they put out both together.

### Pre-Recording

The big stick of monopoly was used, too, in attempting to bludgeon commercial broadcasting. Despite the fact that they whipped up all the support they could, the Post Office, the Press and political big-wigs, they never succeeded. The commercial broadcasters won a big victory for the viewers. They forced the B.B.C. to climb down over its puritanical Sunday dullness and made them put a bit more pep into the ordinary programmes.

However one feels about sponsored radio, its promoters won many a victory over a formidable alliance of opponents and they were still flourishing when the War came along. Early advertisers were diffident about buying time. Much of the Press, fearing loss of advertising revenue, was hostile. The Post Office refused the use of land lines and the B.B.C. threatened to black-list artistes who took part. Representations were made to foreign governments and the question dragged before International Conferences. But the commercial stations, despite the might and the unscrupulousness of their opponents, made steady gains in attracting listeners.

Denied access to P.O. Land Lines they developed the art of " pre-recording," so extensively adopted by the B.B.C. during, and since the War.

They showed plenty of enterprise in other respects too. It was they who broadcast the first Australian Test Matches. Such daring sent cold shivers up and down the spines of B.B.C. Directors.



In those days they had no Audience Research, and I should have loved to have seen their faces when they at last discovered that nearly every customer, before deciding upon a set, demanded a demonstration of how it received Radio Normandy or Radio Luxembourg. A threat to its monopoly still has a chastening effect on the B.B.C. high-ups, as witnessed by the recent support for sponsored TV.

### On Show

One day in November, around about noon, I happened to stroll into Lisle Street where I found the pavements in front of the radio shops teeming with jostling crowds. Concluding that something super in the way of Bargain Clearances was taking place, I lost no time in elbowing my way up to the front. To my great disappointment nothing new in the way of fresh stock or drastically reduced prices was to be seen. It was only then that the reason for the crowds came to my guileless mind. It was the R.S.G.B. Exhibition. The unusual burst of mid-week activity was caused by the influx of provincial members " up for the Show," taking a look round on their way to Woburn Place.

Naturally I, too, spent a fair time doing the rounds and meeting old acquaintances at the Exhibition, generally having an enjoyable time. I don't intend to write it up. There was nothing new on view and unhappily, the two days I was there, the Amateur TV was not fully working. However, as a social event, a good time was had by all and the continuance of this popular annual event was assured. The attendance was well up to previous years—in fact, on the Saturday the only possibility of seeing everything would have been to walk around on the heads of the seething masses squeezed into every available inch of floor space.

### Easy Stages

One event I did miss this year was the R.S.G.B. Annual General Meeting, where quite unexpectedly the now usual surprise turn of events took place. The proposal for increasing the subscription was lost in unusual circumstances—on a " proxy " majority. The proxy voters outnumbered those who were present, and had it been left to the vote of those in attendance the increase would have been carried by a large majority.

The subscription question has been " in vacuo " for a long time, and I can only imagine the opposition to the increase can be based on an imaginary " principle " rather than on a recognition of the economic necessity for an early revision. While the Society's reserves are considerable, no organisation, in face of continually rising costs, can maintain its full operational force and live on its own fat at the same time. The subscription still stands at its pre-War rate and, even allowing for the increase in membership, expenditure on many items is double or even treble the 1939 cost.

As a member of many years standing (and many to come, I hope) I appreciate the necessity to increase subscription rates. The R.S.G.B. is performing a necessary function and, but for a few minor points, is making an excellent job of it. Despite the fact that 'other interests' have sought to make capital out of their difficulties, they have acted with considerable wisdom and resourcefulness.

Nevertheless, in the matter of subscription revision, there has been an apparent lack of foresight. The subscriptions should have been raised several years ago—in gradual stages and in step with rising costs. By deferring it so long, provincial members now find themselves confronted with a proposal to double their subs at a single jump. Only a percentage of present day subscribers were members in 1939. To them it does not come as a 100 per cent increase on the pre-War rate, but a 100 per cent on what they have been used to since the day they joined. If this fact had been stressed in recent months, I am sure the voting figures at the A.G.M. would have been very different.

**On Record**

A useful hint appears in a recent issue of *Mullard Outlook* for keeping a check on valve replacements. While of primary interest to servicing engineers, it is also of considerable interest to amateurs. It suggests that the date of installation should be marked on the valve base, or envelope, with a chinagraph pencil. It thus forms a useful record, particularly in multi-valve and TV sets, where many of the same type are used.

Chinagraphs, and their ability to mark on almost any surface from glass and porcelain to polished metals, will be familiar to those who have served in many branches of H.M. Forces. I used them a lot for plotting routes on celluloid map covers, and know only too well that it is not easy to rub off the markings when you want to erase them, let alone obliterate them in normal handling. Chinagraph pencils are obtainable from any good stationers in a full range of colours, and they will also be found handy for marking out panels and chassis, etc.

**Tell Me Another One**

An enthusiast was making a short stay at a seaside hotel. At the reception desk he enquired "Have you A.C. or D.C. current here ?"

The Receptionist said she would make sure and after consulting the Hotel Register reported "I'm sorry, sir, but neither of them are registered here."

## *from our* Mailbag

**Why go Hi-Fi ?**

With regard to Mr. Piper's article on "Why Go Hi-Fi," I agree with most of his remarks in the December issue of '*RC*' concerning hi-fi, but surely the simplest way of obtaining good reproduction (I do not mean quality) is to attack the weakest point in the reproducing chain, the worst offender being attacked first etc. If the pick-up is of bad design or old fashioned i.e., weight on the point ½lb. or more ! the remedy is to cure this defect. Not a very easy proposition as Mr. Piper admits.

Assuming that a reasonable pick-up is available—there are on the market some costing between one and two pounds which are capable of excellent reproduction—the next major fault encountered in the majority of cases is the loudspeaker and its associated output transformer, the speaker usually lacks in these respects:—

(a) No top, i.e., above 8 or 10 kc/s
(b) No Bass, i.e., below 100 cp/s, and
(c) A resonance in the loudspeaker causing colouration of the reproduction.

The method of effecting a partial cure of these faults is (a) Since most people object to record hiss and surface noise then cut-off will not be objectionable, i.e., fault (a) does not matter very much to us, remedy is simple—ignore it. (b) No bass, the obvious cure is to boost bass. Yet a more subtle way is to increase the efficiency of the reproducer, i.e., Bigger and better baffles (I seem to have heard that phrase before). (c) Resonance in the speaker—this is a sticky problem but a partial cure can be obtained by using a combination of two things (1) a resonant cavity loudspeaker system. (2) Negative feed-back from the *secondary* of the *output transformer*.

Many people shy at the first two suggestions thinking that it is not worth the trouble and expense in experimenting. I believe it is since



it does give a cleaner and truer reproduction at very little outlay from the pocket. *True* bass is hard to obtain unless one approaches the problem in the correct manner. (b) and (c) are definitely such an approach.

I feel that Mr. Piper has tackled the problem in the wrong way, although he does admit that there are difficulties such as the loudspeaker and "our old chum the output transformer" etc. He does nothing to diminish the bad effects of the first two. He could, for instance, apply negative feed-back over at least the output transformer and last valve instead of over the first valve, which at the most only contributes 1 or 2% of the total harmonic distortion, whereas the output valve with a *purely resistive* load will contribute, using a 6V6 with Va=180 volts, Ia=30 mA and Ra=5,500 Ω, 8% harmonic distortion at *2* watts output !!! (10% for 25L6, 4.3 watts output, Va=200). Mr. Piper could still use his RC circuit for NFB (parallel connected instead of series) via the NFB over the output transformer, to reduce amplification at the high frequencies, since this is what he is doing in the circuit published in the January issue of *RC*.

To summarise his circuit, he cuts bass, he then cuts top by NFB (It sounds better !) He is left with the middle frequencies. He presents a variable load (via the tone control) to the pentode or beam tetrode output valve. Uses a condenser which has a reactance of approximately 300 kΩ at 100 cp/s and approximately 300 Ω at 10 kc/s to decouple the screen grid of V1. Why indeed go hi-fi; one may as well resort to the cheap commercial radiogram (at least it has good woodwork) or to the old and faithful sound box.—Edwin R. Strand, Shooters Hill, S.E.18.

# QUERY CORNER

A Radio Constructor service for Readers

**Single Valve Amplifier**

*I am enclosing a circuit diagram of a single valve gramophone amplifier, and would be grateful if you will give it your blessing before I commence construction.*

*E. Conway, Lewisham.*

This is the second letter which we have received during the past month concerning a single valve amplifier, and we feel that there are probably other readers who may be interested in this type of circuit. A single valve amplifier is something of a novelty which should appeal to those who wish to cheaply convert an ordinary sound box type of gramophone to operate with a pick-up. The unit which is described below is cheap to construct and it is doubtful whether any further substantial saving in cost could be obtained, at least until the transistor is released on the market.

The amplifier has been designed around the Mullard valve type BCL80. This is a triode pentode, the triode being used as the voltage amplifier whilst the pentode section drives the loud speaker. In spite of its diminutive size, this valve is capable of giving an audio output in the region of 1 watt, which is ample for ordinary gramophone reproduction. There are various ways of obtaining the bias for the

### *Query Corner*

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(1) A nominal fee of 2/6 will be made for each query.
(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams, for the more complex receivers, transmitters and the like.
(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.
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(6) A selection of those queries with a more general interest will be reproduced in these pages each month.

triode section, but the grid current biasing arrangement is recommended as it provides the greatest freedom from instability. When the two sections of this type of valve are used in cascade there is always a tendency for the valve to oscillate as a cathode coupled multi-vibrator. This tendency is usually overcome by a negative feedback arrangement. However, in our simple circuit the sensitivity cannot be reduced by the addition of feedback, hence the use of grid current biasing which permits the grid leak to be returned directly to the cathode. The signal earth return lead is also taken to the cathode, and thus the cathode bias resistor is only common to the pentode section and any tendency to oscillation is avoided. The voltage amplification of the triode section is about ten times, and as the pentode requires 4V RMS for full output the input voltage to fully load the amplifier is approximately 0.4V RMS. Consequently it is advisable to employ a crystal pick-up, as this type is capable of providing more than enough drive for the amplifier. The later type of crystal pick-up has an internally compensated frequency response and may therefore be connected directly to the input terminals of the amplifier. Earlier models, however, require a certain amount of compensation and this is provided by the additional R-C combination in the input leads which is shown on the circuit diagram.

The power pack follows conventional practice. A smoothing choke is recommended in preference to a resistor as the choke enables a higher H.T. voltage and thus a greater output to be obtained. The rectifier is of the selenium type capable of carrying 30mA at 250 volts. To avoid the use of a large heat dissipating resistor, the heater of the valve is supplied via a paper capacitor. A low value resistor is included in series with this capacitor, and is used as a means of adjusting the heater current to 0.3 Amps. The value of this resistor will depend upon the mains supply voltage and the exact value of the capacitor. Another method of adjusting the heater current is to make the capacitance up of a number of small components in shunt with each other, final adjustment being made by adding or subtracting one or two small value capacitors from the group.

## Sound on Vision

*I recently completed a television receiver which made use of parts of various published circuits, to suit the majority of components which I had on hand. The vision channel follows exactly the design used in the "Magna-View," but in spite of repeated checks on the alignment of the unit I still get trouble with sound on vision. In desperation I borrowed a signal generator and plotted the response of the channel, only to find that the alignment was excellent, the sound carrier being a good 40 db down on the vision pass band. Can you suggest any other cause for this trouble?*

*D. Swain, Birmingham*

The obvious cause of the sound signal giving rise to unwanted modulation of the video signal is a misaligned vision receiver. In this instance, however, the alignment has been carefully checked but still the trouble persists. The next possible cause of interaction between the two channels is insufficient H.T. supply decoupling. On loud sound passages the anode current of the sound output valve tends to fluctuate and if the impedance of the H.T. supply is relatively high, or if the decoupling is inadequate, this current change may readily result in a fluctuation of the H.T. supply to the vision amplifier. The parts of the circuit which are most sensitive to H.T. variations are the anode of the video amplifier, and the local oscillator if the receiver is a superhet. Because the C.R. tube is fed directly from the anode of the video valve any H.T. disturbances will be fed directly to the tube with very little attenuation. Effects on the local oscillator will not be so noticeable on the vision unit but may cause a form of instability in the sound channel.

The solution to this form of sound on vision lies in either increasing the value of the smoothing capacitor in the power pack, or in decoupling the anode circuit of the sound output stage. The latter arrangement is usually the most effective. The decoupling resistor is placed between the output transformer and the H.T. line and should have a value of about 1000 ohms. At the junction of this resistor and the transformer the decoupling capacitor is connected, its earthy pole being joined to the chassis. A suitable value for the capacitor is 16μF.

## Blocking Transformer Connections

*I am not certain as to the correct connections for the small transformers used in the blocking oscillator stages of television receivers. Would you please clarify this point for me?*

*D.S., Bournemouth*

The lead outs of these blocking transformers are either colour coded or lettered. The connections for the coded transformers are as follows:—Green–Grid, Blue–Earthy, Yellow–Anode, Red–HT+. With transformers employing letter identification of the leads, the following nomenclature is usually employed IP–Grid, OP–Earthy, OS–Anode, IS–HT+. Finally, of course, there is always a chance of finding a type of transformer which has no marking, in which case the



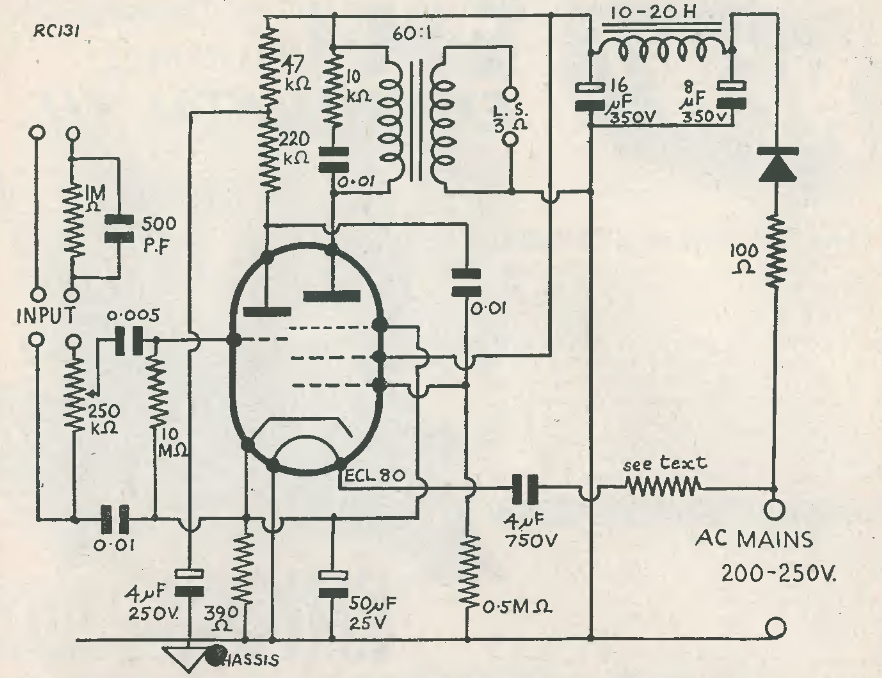


FIG.I CIRCUIT OF SIMPLE VALVE AMPLIFIER

ensuing information will assist in identifying the connections. The winding in the grid circuit is the primary and is usually of higher resistance than the secondary. Bearing this in mind, it may then be possible by examining the transformer to determine which is the 'in' and 'out' lead of each winding, the 'in' lead being nearer the centre of the bobbin. If this is not apparent, the transformer should be connected in circuit, having first determined the primary and secondary windings. If, on switching on the receiver, the stage does not oscillate, the connections to one of the windings should be reversed.

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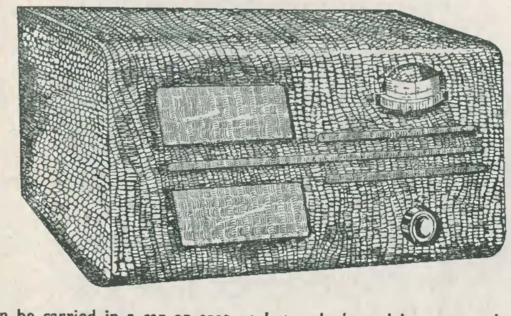

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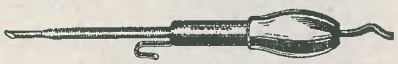

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*(Continued on page 383)*

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*continued*

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*continued*

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*(See Page 362)*