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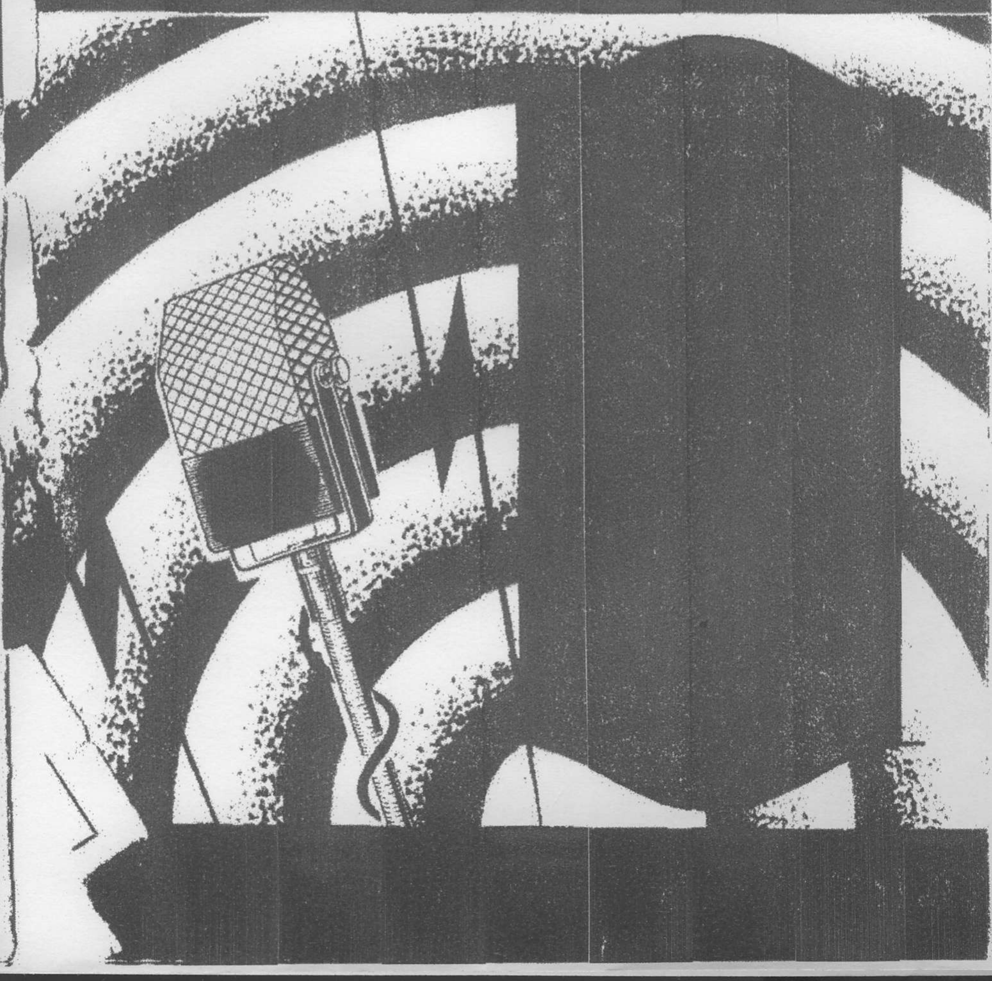

Radio Constructor

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Editorial

A FEW weeks ago saw the NFD, the National Field Day; an annual event organised by the RSGB. It is a highly competitive event, with portable transmitting stations taking part throughout the British Isles. It has come to be recognised as one of the highlights in the amateur's calendar. Apart from this National event, dozens of clubs hold their own private field days; some of them in the form of a "find the transmitter" hunt in which portable receiver teams (with DF gear) attempt to track down a hidden transmitter; some of them as a portable transmitting station pure and simple; some of them as portable receiving posts.

It is a recognised fact that amateur radio has its "seasons," the peak activity being during the long dark winter evenings. With the coming of the summer months, the average enthusiast looks longingly from the shack window and seeks to emerge from his winter hibernation and brave the hazards of our erratic summer weather in order to get as much outdoor activity as possible. With a climate such as ours, it is only natural that we should all want to make the most of it!

This transference to outdoor activity, be it strenuous as in cricket, cycling, and sports in general or more leisurely like tending the garden, all takes the thought of radio from the front row and pushes it to second place. If the choice between drilling a chassis or taking a trip down the river were put to the average radio enthusiast during a really superb summer day he would inevitably choose the latter! Of course, there are a few diehards who are more or less a permanent fixture to the shack!

With this train of thought, the writer suggests that more attention could be turned to the possibilities of "combined operations." The average radio man is dead keen and at the back of his mind always lurks the vision of that new receiver or plans for the new transmitter. But he does like his fair whack of outdoor life in the better weather.

Therefore, why not take the hint from the National Field Day?

If you belong to a local club, insist that field days be arranged at intervals during the summer

Why Not?

and autumn. If you are a lone hand, you can still combine radio with fresh air by constructing a portable receiver and taking it with you when the call of the open spaces is too strong to resist! The planning and construction of portable gear will make a pleasant change from orthodox permanent practice. It is a side of radio that many have not yet attempted, and if you feel that ideas are scarce for your next constructional job, why not tackle a portable? You will have plenty of fun planning and building it and you will also find great pleasure in operating it under portable conditions. For those whose XYL's or YL's take a dim view of radio in the general run of things, this may be a golden opportunity to bring about a conversion!

W.N.S.

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All materia used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman 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.

COMPONENT REVIEW. 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. 6579.

The Theory of Thermionic Valves

By Kenneth R. Goodley

Part 4

WE have seen that, while the Tetrode is superior to the Triode, it has a serious limitation in that only a portion of the characteristic is usable owing to the effect of Secondary Emission. To overcome this, a third grid—the Suppressor—is inserted between the screen and the anode.

This is normally maintained at cathode (*i.e.*, filament) potential and, in the case of Audio Frequency pentodes, is actually connected to it internally. RF pentodes have their suppressors taken to a separate pin.

When the electrons are flowing through the valve, they are accellerated by the screen, as usual, and on hitting the anode, cause a secondary emission. Since this secondary current is not very large, the low potential suppressor repels the electrons back to the plate, and prevents them from reaching the screen. Thus, the Tetrode "kink" is obviated. Fig. 7 shows a comparison between the anode characteristics of a Tetrode and a Pentode.

The effect of the anode voltage is further reduced by the inclusion of this extra grid, giving the valve a higher Ra and μ. This means that a larger anode swing can be accommodated, making the pentode ideal for use as an Audio Frequency power valve.

Pentodes designed for use as RF amplifiers are dealing with much higher frequencies than their AF counterparts, and therefore a greater measure of shielding between grid and anode circuits is required. This is done by making the pitch of the screen smaller (*i.e.*, spacing the turns closer together) while in the power pentode, more space is provided between the turns in order to permit a larger electron flow.

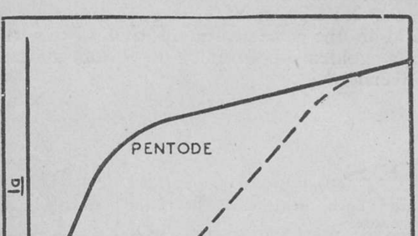


Fig. 7. Comparison of Tetrode and Pentode Anode Characteristics.

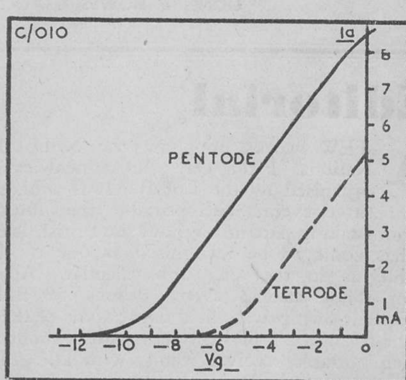


Fig. 8. Comparison of Mutual Characteristics of Tetrode and Pentode.

It can be seen, too, that an RF pentode will also have a high Ra.

A glance at Fig. 8 will show that the cut-off point of a pentode is different from that of a tetrode. The workable portion of the characteristic is from about —9 to 0 instead of —3 to 0, allowing a far greater variation in applied voltage to the control grid, *i.e.*, a larger input can be accommodated.

Other valves in common use are the Heptode (or Pentagrid), the Octode and various combinations such as the Triode-Hexode, which function as Frequency Changers in Superheterodyne circuits. In each case, these valves operate as mixer and oscillator combined.

Heptode (Fig. 9a) G1 is the Oscillator grid and controls the flow of electrons, are collected by G2 (oscillator anode), while those passing through are accellerated by G3 (screen grid—internally connected to G5). G4 (Mixer Control grid) is negatively biassed and retards the electron flow, forming a space charge which acts as a virtual cathode. The electrons are allowed to pass through G4 according to its potential when the signal is applied to it.

G2, acting as Oscillator anode, is often constructed in the form of rods.

Octode (Fig. 9b). This valve has an additional grid between G5 and the mixer anode.

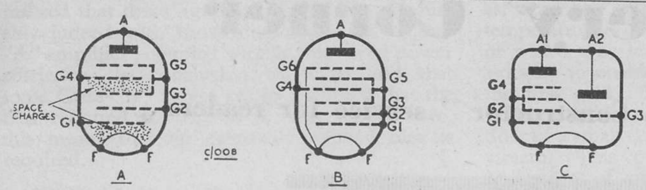


Fig. 9. "A" shows a Heptode, "B" shows an Octode, and "C" a Triode-Hexode.

It is usually connected internally to the filament, or cathode, and acts as a suppressor, turning the mixer section into a pentode.

Triode-Hexode (Fig. 9c). This takes the form of two sets of electrodes, the triode being the oscillator sections, and the hexode—the mixer section. The two sections have a common filament. This valve has the advantage that it can operate at higher frequencies than either the octode or heptode, as the capacitance between the oscillator and mixer circuits is minimised by virtue of the separate electron streams.

Variable-mu Valves.

This type of valve differs in constructional respects from the fixed-mu valves, with which we have dealt so far, in one of two respects. Either the control grid is wound in an irregular manner, or the cathode is allowed to protrude beyond the ends of the grid, causing the grid to have less control over electron flow than in a valve with a normally placed cathode and a constant pitched grid.

This means that the characteristic is curved rather than straight, and that a higher value of negative bias is required on the grip to suppress the anode current (see Fig. 10).

Variable-mu characteristics are given to a variety of valves, notably tetrodes, pentodes, hexodes and heptodes, which can be used to provide efficient volume control. As the applied grid voltage is varied, the "slope"

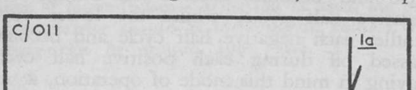


Fig. 10. Comparison between var-mu valve and fixed-mu valve. "A" curve is that of the var-mu and "B" the fixed-mu.

(anode current/grid voltage ratio) is changed too, increasing as the grid voltage becomes less negative. This, in turn, means a variation in the effective amplification of the stage.

The variable-mu characteristics are given only to valves used in RF or IF stages, as in this part of the circuit, signal strength is low and so only a small part of the characteristic is covered, which although actually curved, can be taken, for all practical purposes to be straight over the portion in use. If a valve of this type were to be used as AF amplifier, the input would cover an appreciable part of the curve and distortion would result.

CONVERSION OF SURPLUS GEAR.

For the benefit of readers who missed last month's copy, or who have forgotten the note on the above topic, we would like to mention again that we invite articles on the conversion of ex-WD receivers, transmitters, converters, etc., for normal amateur usage. If *you* have successfully converted a piece of surplus gear for amateur work, why not send us the "gen" so that others with less technical knowledge may share in the results ? We advise, however, that any prospective writer drop us a postcard before proceeding with an article since we may already be fixed up with the particular piece of gear. We have articles in preparation for some of the RF Units and the Type 37 Oscillator. We need, urgently, articles on other easily obtained surplus gear ; several readers have asked for details of the R1224. Next month we will publish an article on the conversion of the Walkie Talkie receivers.

Query Corner

A "Radio Constructor" service for readers

Class "B" Output Stage.

"Having in my possession a Class 'B' output valve, I would like to construct a low power amplifier, using it in the output stage. Can you please let me know if any precautions are required in order to obtain the best results when using this type of valve?—E. Caverley, Aylesbury.

The Class "B" amplifier is essentially one which operates with a bias voltage approaching the cut-off value. Under this condition the anode current drawn by the valve is low when no signal is being handled, but rises sharply upon receipt of a signal. It is because of this economy in current that the Class "B" stage proved to be so popular for battery portable receivers before the quiescent push-pull double pentode was developed. Also, because of the small standing anode current, the operating efficiency of a Class "B" stage is somewhat higher than that which it is possible to obtain with a Class "A" stage, and hence the power dissipated at the anode of the valve for a given wattage output is less. At this point the reader may wonder why the Class "B" stage has not proved to be more popular and we need hardly point out that its successful operation is not as apparently straight-forward as it at first appears. This is due mainly to the fact that in order to obtain maximum power output it is necessary to drive the valve to the full extent of the straight portion of its characteristic, and this invariably means that at the peak positive half cycle of the input drive voltage the grid of the valve is actually driven into the positive region; hence a certain amount of grid current is drawn. If the resistance of the grid circuit is high this grid current results in a voltage which tends to oppose the rise in grid voltage, a state of affairs which leads to the cutting off or flattening of the positive peaks of the input voltage. Because of this it is essential that the resistance in the grid circuit is reduced to a minimum, a requirement which necessitates the use of a driver transformer having low resistance windings. It is recommended, therefore, when contemplating the design of a Class "B" amplifier that use should be made of a driver transformer which has been specially wound for the purpose.

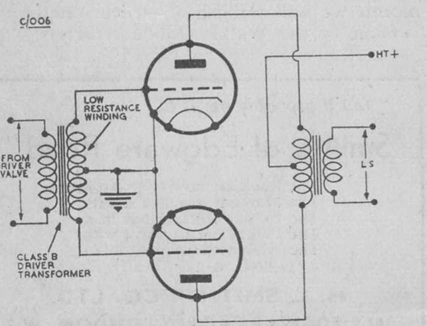


Fig. 1. Class "B" Output Stage. The output transformer should have a ratio suitable for matching the output valves.

The fact that grid current flows during part of each cycle means that a certain amount of power is expended in the grid circuit and this power must be provided by the driver valve. The American Class "B" double triode type 6N7 requires a drive power of approximately 300 milliwatts and it is absolutely essential if distortion is to be avoided that the driver valve be well capable of providing this power. So far we have considered the Class "B" amplifier only in single ended circuits, but in all normal audio frequency amplifiers it is essential to use two valves in a double ended or push-pull circuit in order that each valve may handle alternate half cycles of the signal voltage. In other words, the circuit is so arranged that the upper valve amplifies each positive half cycle and becomes biassed off during each negative half cycle, whilst the lower valve handles each negative half cycle and becomes biassed off during each positive half cycle. Having in mind this mode of operation, it will become apparent that in order to reduce distortion to a minimum the two halves of the stage must be equally balanced and in particular each valve must draw approximately the same amount of anode current. It is normal practice to incorporate both valves in one envelope, a combination known as a Class "B" twin triode. The above comments should be taken as an indication of the points which require attention when using a Class "B" stage and it should not be assumed that the use of this type of amplifier is fraught with insurmountable difficulties. Quite on the contrary, a 6N7 operating at 300 volts and drawing a maximum current of 70 mA is capable of providing an output power of 10 watts with an harmonic distortion of 10 per cent. It will at once be realised that these figures compare very favourably indeed with those obtained with a Class "A" amplifier ; coupled with an improved power efficiency. In conclusion we must add that some Class "B" valves are so designed that the bias required for cut-off is very nearly zero, this means that no externally applied bias is required.

Valve Insulation.

"Recently, suspecting the output valve in my receiver of causing faulty reproduction, I attempted to measure its insulation resistance between grid and cathode with the aid of my AVO meter, and was alarmed to find that an extremely low reading was obtained. However, upon switching off the heater of the valve and rechecking, the insulation resistance appeared to be infinitely high, and I was led to assume that the heat generated by the heater caused the cathode to expand and touch the grid. Is this possible?"
—*B. Gardiner, Sevenoaks.*

It has been our experience that faulty valve insulation has frequently been the cause of such evils as intermittent and noisy reception

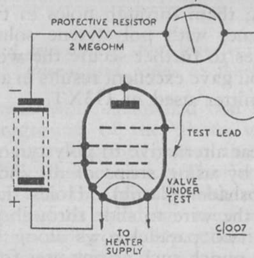


Fig. 2. Valve Insulation Test Circuit. If a meter of lower fullscale deflection is used, the protective resistor should be increased in value. The battery can be around 100 Volts.

and reduced sensitivity, and it is because of this that we are including this particular query as we feel that other readers may at some time or another wish to check the inter-electrode insulation of their valves. To be really effective the insulation should be checked with the filament or heater operating at its normal operating voltage, as under this condition the cathode approaches its working temperature and may, as a result, expand and touch the grid or other metal part of the valve assembly. This results in bad insulation, or in severe cases, a short circuit between two of the electrodes. However, merely switching on the heater and then attempting to measure the inter-electrode resistance is quite unsatisfactory as when the cathode has attained its working temperature it emits a cloud of electrons, many of which may leave the cathode with sufficient velocity to enable them to hit or pass through the first grid. Thus, if a meter is connected between grid and cathode it will indicate the flow of a small current as a result of this electron stream. This current is often taken as an indication of poor insulation. To overcome the trouble it is necessary when taking insulation measurements to employ a voltage which is negative with respect to cathode. This voltage when applied to a grid repels any electrons which may be in the vicinity of the grid and hence current due to electronic emission is reduced to zero, and any current which is present may safely be assumed to be due to poor insulation. In order that the slightest leakage might be detectable it is normal to use a voltage in the region of 100V. in conjunction with a micro-ammeter having a full scale deflection of about 50 micro-amps. Reference to Fig. 2 will make the system of connection clear, the resistance R1 being included in the circuit to safeguard the meter in the event of a short circuit. It may safely be assumed that if a reading of more than four or five micro-amps is obtained the insulation may be said to be poor. While carrying out the test it is a good plan to tap the valve gently as this will show up any intermittent faults which may be present. In the case of certain valves used as phase splitters, where the load is in the cathode circuit, and with most universal valves good cathode to heater insulation is of some importance and may be checked by the method indicated. However, a higher leakage current in the order of 10 micro-amps maximum may be permitted for this test.

"Query Corner" Rules

(1) A nominal fee of 1/- 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.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

Making Short Wave Coils

By W. Oliver, G3XT

Concluding a discussion on practical home-made coils for receiver and transmitter.

SHALL we "recap"? Right! In the first part of this article, published last month, we saw that an ideal short wave coil would combine perfect electrical qualities with perfect structural rigidity. Some ways of embodying these ideals as far as possible in home-made coils, and giving the coils a professional-looking finish, were described. All that remains to be done now is to give you the necessary winding data—number of turns, diameters, etc.—to make different types of windings for a variety of transmitting and receiving circuits.

Wire.

First, a word about the choice of wire. Enamelled copper is the most suitable for the majority of coils; but bare copper silver-plated is more efficient for ultra short wave coils. For receiving, 14 or 16 swg is suitable for 56 and 28 Mcs. 18 swg is thick enough for frequencies down to 7 Mcs., while an even thinner gauge, between 20 and 26 swg can be used for still lower frequencies. For transmitting, it is usual to employ slightly thicker wire than one uses for receiving coils. This is especially true of the PA stage in a transmitter, which usually needs a coil wound with wire of 16, 14 or even 12 swg. Copper tubing is an alternative which is frequently used, especially in higher-powered transmitters, but it makes the coils rather bulky.

Windings.

The reaction winding of a short wave receiving coil can be of quite fine wire, say, 30 swg, enamelled copper. It should be placed as close as possible to the grid winding; in fact, it may well be wound concentrically over or under the latter, so as to get the closest possible coupling and enable an adequate reaction effect to be obtained with a minimum number of turns, as this makes for smoother control.

Coil efficiency is normally at its highest when the diameter of the winding is a little greater than its length. The ratio is, however, not a critical one, and all that is needed is to take care that the coils are not unduly long in proportion to their diameter. For example, a coil 2½ inches in diameter and 2 inches in length would be an efficient size, whereas a coil 1 inch in diameter and 4 inches long would tend to be inefficient.

The self-capacitance of the winding can be reduced by spacing the turns, but no advantage accrues from overdoing this. A space of one wire-diameter between each two adjacent turns is usually best.

The method of mounting the coils will depend on whether they are for a circuit to be used on one waveband only, or whether they are required to be interchangeable to cover a number of different wavebands. In the latter case, of course, a plug and socket mounting is the most convenient.

Coils wound with very thick wire need not be fitted with separate plugs; the ends of the wire itself can be used as plugs provided that the accompanying sockets are of the resilient type, to ensure good contact. A six-turn coil in the foreground of the photograph illustrating this article was arranged in this way. The ends of the wire were passed through two holes drilled in a strip of low-loss insulating material, and locked in position with a "blob" of solder run around the wires on either side of the strip. Small metal washers formed "shoulders" on to which the solder was run, and the result was a very firm, neat job, indeed.

With thinner wire, suitable plugs or valve-pins can be used. The 7 Mcs. transmitter tank coil shown on the right at the back of the photograph is so fitted, and the turns of wire are spaced by threading them through holes in two strips of polystyrene, with polystyrene solution run into the holes to further secure the wire. This particular coil gave excellent results in a one-watt QRP transmitter used at G3XT.

Spacers.

A very neat alternative to polystyrene spacers is afforded by using strips of .01 inch acetate sheet (lampshade plastic). Holes just large enough for the wire to slide through easily are punched in two parallel rows along the strip. A plier-type punch such as one uses for leather-work or lampshade making does this job very easily and quickly. The strips are curved slightly and the wire threaded in and out through the holes, as shown in the sketch (Fig. 2). The strips are gradually coaxed round and round the spiral of wire until the whole winding has been threaded into position. Then the strips are spaced out as desired around the circumference, and locked in position with a little cellulose cementing solution.

The result is a coil of surprising rigidity considering the extent to which the supporting dielectric material has been reduced. Admittedly, the dielectric qualities of the acetate sheet are not as good as those of, say, polystyrene or ceramic material. But the actual amount of dielectric in this case is so small that the coils are virtually air-spaced, and are therefore almost as efficient in practice as an equivalent self-supporting or 100 per cent. air-spaced type would be, and in addition have the great advantage of increased structural rigidity.

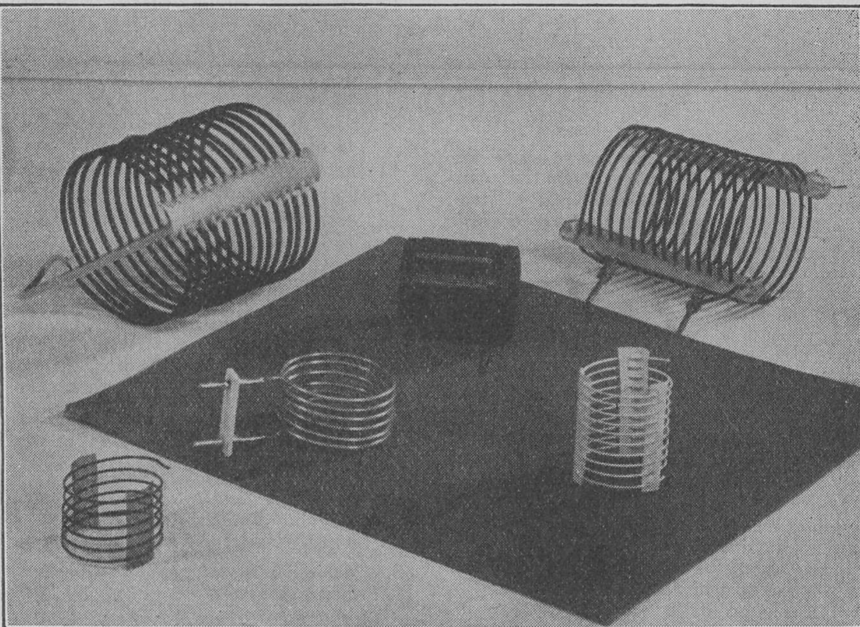


Fig. 1. A selection of short wave coils for transmitting and receiving. Finished windings, mounted and unmounted, made on the lines described in these articles, are shown in the photograph.

The small white-enamelled coil in the right-hand foreground of the photo was made in the way just described; also the one in the left-hand bottom corner. The large tank coil (back, left, in the photo) with a polystyrene base-strip had its windings reinforced with an acetate strip along the top, effectively locking the turns in position.

Number of Turns.

Although it is impossible, in the present general discussion of the subject, to give any exact data on the precise number of turns to wind into coils for different circuits, owing to the varying effect of stray capacitances, etc., in any individual sets, here are some figures which will serve as a useful starting point. Allowing a trifle more than the specified number of turns in each case, a little judicious pruning on the " cut and try " principle can be adopted to arrive at the precise value for optimum results over a given waveband in a given circuit.

For the ultra-short wavebands of 4 to 11 metres, interchangeable coils wound with 14 swg copper wire (bare, enamelled, or better, silver-plated) to a mean diameter of three-quarters of an inch, the turns spaced one diameter apart, can be 3, 4, 6 and 8 turns respectively. The 3-turn coil can be used for aerial coupling; the 4-turn one in the grid circuit will cover about 4 to 6 metres with a suitable variable capacitor (say 20 $\mu\mu$F or 40$\mu\mu$F at most). The 6-turn coil will cover 6 to 8 metres, and the 8-turn one should go up to 10 or 11 metres.

To cover a wavelength range of about 10 to 100 metres in four stages (say, 10 to 25, 20 to 40, 35 to 65, and 60 to 100 approximately), a set of eight windings could be tried, as follows: 3 G with 3 R turns; 5 G with 4 R; 7 G with 5 R; and 10 G with 7 R, the G figure relating to the grid winding and the R figure to the reaction winding.

These coils could be space-wound, about 2½ inches in diameter, and tuned with a 150 $\mu\mu$F variable capacitor, another of similar or slightly smaller capacitance being used for reaction.

Switched Coils.

In modern short wave receivers, switched multi-range tuners have tended to supercede plug-in coils. Although the latter are a little easier to get working successfully, the switched tuner type of inductor is much more convenient, and worth the little extra initial trouble involved.

There are various ways of avoiding the few snags that one is liable to encounter in designing and making a short-wave switched tuner. Switching losses have been largely eliminated by some of the very efficient wave change

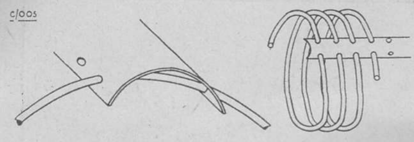


Fig. 2. Showing how acetate spacer strips are threaded on to the coil windings. The coil wire is rotated in a clockwise direction, the ends "picking-up" the holes in the strips as they are reached.

switches available nowadays at reasonable prices, so one can easily dispose of that bogey by just choosing a switch made expressly for the job. Dead-end effects, etc., can be avoided also, one rather novel method used successfully at G3XT being a coil wound in sections, these sections being placed at right angles to one another so as to minimise inter-action between the section or sections in use and those that are shorted out by the switch..

Regarding aerial coupling coils, I am in favour of using a very small coupling coil—just one or two turns, even for frequencies as low as 7 Mcs. I find that any loss of signal-strength is far outweighed by a tremendous gain in selectivity, stability and constancy of calibration even on a simple receiver such as an O-v-1.

Transmitting Coils.

Turning now to transmitting coils, here again the data given below should be regarded as approximate rather than as an exact guide. Slight adjustments can be made to the sizes of the finished windings to give optimum results in any individual transmitter.

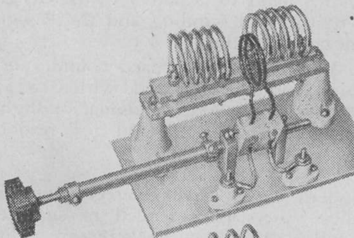


Fig. 3. A commercially made split tank coil, with swinging link. In the foreground is a plug-in coil for a different frequency coverage. With a little ingenuity, the home constructor can build up a similar unit.

For the anode circuits of triode or pentode crystal oscillators, the following should prove suitable :—

3.5 Mcs. 100 $\mu\mu$F. 36 turns. 18-22 swg. 1½ inches diameter.

7 Mcs. 50-100 $\mu\mu$F. 16 turns. 16-18 swg. 1½ inches diameter.

14 Mcs. 40-50 $\mu\mu$F. 8 turns. 16-18 swg. 1½ inches diameter.

28 Mcs. 40-50 $\mu\mu$F. 4 turns. 14-16 swg. 1½ inches diameter.

For the cathode coil in a tritet or ECO circuit, the following are proposed :—

3.5 Mcs., 17-18 turns on a 1 to 1½ inch diameter former ; 7 Mcs., 6 turns ; 14 Mcs., 4 turns ; and 28 Mcs., 2 turns, the variable capacitor being 300 $\mu\mu$F in each case.

The cathode tap in an ECO circuit can be one-third to one-fifth of the way up the winding from the "earthy" end.

The following details will serve as a guide for buffer and doubler grid and anode coils, tritet or ECO anodes and p.a. grid windings :—

3.5 Mcs. 36 turns. 18-22 swg. 1½ inches diameter former.

7 Mcs. 18-20 turns. 18-22 swg. 1½ inches diameter former.

14 Mcs. 10 turns. 16-20 swg. 1½ inches diameter former.

28 Mcs. 5 turns. 16-18 swg. 1½ inches diameter former.

These figures are for a 40-50 $\mu\mu$F variable capacitor. For push-pull circuits using split-stator capacitors, more turns are required—try a 50 per cent. increase. If a larger capacitor is used, the turns can be correspondingly reduced. For 3.5 Mcs., for instance, about 25 turns of 20 swg close-wound on a 1½ inch former will suffice with a 160 $\mu\mu$F capacitor.

Finally, we come to the tank coils for PA anode circuits. The following are suggested :—

7 Mcs. 15 turns. 3 in. diam. 14 swg. or 20 turns. 2 in. diam. 14 swg.

14 Mcs. 10 turns. 2 in. diam. 14 or 12 swg.

28 Mcs. 4-5 turns. 2 in. diam. $\frac{3}{16}$ in. copper tubing, or 12 swg.

Suitable link couplings are 1 or 2 turns for 14 Mcs., 1, 2 or 3 turns for 7 Mcs., 2-4 turns for 3.5 Mcs.

Care should be taken to see that the plugs, sockets and any tapping clips used in the PA anode circuits are substantial and firm enough to give good low-resistance contact. The same applies to the aerial turning circuit of a transmitter ; and as regards dimensions for the latter, a coil resembling the PA anode coil is generally suitable, with an appropriate capacitor, for aerial tuning.

A Useful Signal Generator

Describing an audio oscillator and methods of testing and aligning receivers.

By L. F. Sinfield

MOST constructors find that a signal generator or audio oscillator would be a valuable asset at one time or another and yet surprisingly few seem to possess one of these instruments. The piece of test equipment described herewith was constructed by the author entirely from "junk" parts and it is likely that most enthusiasts will find the requisite parts lying around in their respective junk boxes. No sizes will be given as the layout is not particularly critical and, in any case, the best layout will be determined in each individual case by the parts available.

The unit constructed utilised two 2-volt battery valves, type 210 SPT and 210 HL, although almost any valves of this type would serve equally well. At present, the writer is modifying his oscillator to suit 1S5 button-base valves but these are rather reluctant to oscillate and are definitely not recommended for the beginner.

Basically, the circuit consists of a reacting detector, transformer coupled to an LF amplifier. The RF coils are all *Wearite* PA types and may be of any number of ranges according to requirements. Suggested types are PA4, PA5, PA6, PA7 and PA1. In the writer's unit, the coils are selected by a 6-way push-button switch and are so arranged that on the extreme low range and additional capacitor of 500 $\mu\mu$F is connected in parallel with the grid winding of the previous range (the coil) in order to go down to 100 kcs.

The main tuning capacitor should be of rigid construction with heavy gauge vanes and ample spacing between them to ensure adequate stability. The reaction control is on the screen, thereby making the signal generator output independent from the tuned circuit. The RF output control is in the form of a 500 Ω carbon potentiometer in the anode circuit. The first valve, the detector, is made to oscillate merely by turning the reaction control to maximum. The screen grid is fed via an RF choke and the primary of an ordinary LF coupling transformer. A switch in the LF valve anode circuit changes it from an LF amplifier to an audio oscillator.

The audio oscillator, being already coupled to the screen-grid of the RF valve, forms a convenient method of modulating the RF. The capacitor from anode to earth is a tone corrector for the LF amplifier but it also controls the frequency of the audio output when the valve is oscillating. Its value, will, therefore, depend on the audio frequency desired by the individual constructor. A phone jack is provided for use in the LF amplifier position.

The oscillator has the following uses:—

- Switch position "A"—Working as a leaky grid detector with reaction and followed by an LF amplifier. Can be used as a receiver or as a wavemeter to detect RF signals.
- Position "B"—For modulated or unmodulated RF output.
- Position "C"—For use as a 2-stage LF amplifier.
- Position "D"—For use as a one-stage LF amplifier. By switching the audio oscillator on, it can be used to provide an audio output signal.

It will be noted that both output leads are isolated by suitable capacitors so that they may be used with AC/DC equipment. The whole unit should be enclosed in a screened box, including batteries, with a screened and insulated output lead.

When used as a detector, the live lead should be terminated by a small ceramic capacitor of around 1-2 $\mu\mu$F right at the point to be tested. This will reduce the loading on the circuit under test. If possible, tests of this type should not be taken direct from the tuned circuit but from a point of lower impedance such as an untuned coupling winding, or more preferably from a point coupled through the valve electron stream (*e.g.*, there is often enough voltage at the anode of a frequency changer, at the local oscillator frequency, for indication). Usually, it is sufficient to put the test lead *near* the circuit under test.

RECEIVER TESTING

By using a general-purpose test set as described and a multi-range DC or AC/DC meter, such as most constructors already possess, almost all fault-finding and testing required for amateur construction can be accomplished.

Preliminary Precautions.

We will consider that the set is completely "dead." First of all, check the filaments or heaters to see that they are OK and then check the main HT supply. See that no wires are disconnected or that there are no dry-joints (a common source of trouble). Care should be taken to minimise the risk of shocks, particularly with AC/DC equipment which has the chassis connected to one side of the mains. When running such equipment, from AC mains, ensure that with the set running the chassis is at the neutral side of the mains. With DC mains, of course, these precautions need not be observed since the set will only work with the mains plug correctly inserted.

Tests should be carried out on a bench which is clear for working, except for the meter, oscillator, and the set under test. It is advisable to have no earthed metalwork or fittings on the bench as this increases the risk of shock or short circuits due to the chassis coming into contact with one another. If possible, stand the gear on wooden slats, a rubber mat or any other good insulator. The test prods should be completely insulated except for about ¼in. at the tips, which should be brought to a sharp point in order to "bite" into the point of test and to ensure good contacts to be made. After these precautions, tests can be carried out on the receiver whilst it is still running.

Procedure.

A complete survey of receiver faults and set testing would take a complete book to fully explain and would involve many test instruments which are beyond the financial means of the average constructor. Therefore, the following data is merely a brief stage-by-stage survey of the receiver to outline the applications of the test set already described.

Always commence tests from the speaker end and work backwards, stage by stage, to the aerial. Even before this, heaters and HT should be checked as already mentioned. Smoothing capacitors (electrolytics), the rectifier and valve heaters are probably the commonest source of trouble.

The LF stages can be tested by two methods with the test set: (*a*) by injecting an audio voltage into grids or anodes—if the tone is heard in the receiver loudspeaker it indicates that the circuit is in order between the test point and the speaker; (*b*) by using the test set as an LF amplifier to replace the receiver LF stages and by listening for broadcast signals in headphones or a speaker plugged into test set. This assumes, of course, that there is only one fault and that the RF stages and detector are both OK. If the signals are heard, it will prove that this stage and all stages *before* the test point are correct.

It is apparent, then, that when a voltage is injected into a set, (this also follows for modulated RF), that stages *after* the test point are checked. When used as a detector and/or LF amplifier, the stages *before* the test point are checked, the test set merely replacing the following receiver stages.

Loudspeakers.

It is very seldom that faults occur in the speaker itself as this is usually well protected mechanically. Check that the cone is not damaged and that it does not rub on the pole pieces. Sometimes dust or metal filings collect in the gap and give rise to distortion. Next test for continuity of the speech coil with an ohmeter, with the matching transformer for the speaker having its secondary disconnected. While still disconnected, the continuity of the secondary winding can be checked, although the wire used is so thick that an open circuit is indeed a rare occurrence.

The Output Valve.

Test the anode and screen voltages of the output valve with the DC voltmeter. Since the anode HT feed is usually derived through the primary of the output transformer, this will automatically prove continuity of this winding. A click should be heard in the speaker on touching the anode connection with the test prod during the voltage measurement. The absence of HT voltage usually indicates either an open-circuited primary or the anode shorting to earth; the latter is often due to a short-circuited tone correction capacitor when such circuits are included in the anode side of the valve. The test set may be used as an audio oscillator or an audio amplifier at the anode connection.

The grid of the output valve can also have the test set applied. Check that there is no positive voltage at the grid due to breakdown or leakage in the coupling capacitor. With transformer coupling, this need not, of course, be checked. See that the grid leaks away to earth or that it has its correct bias where no cathode bias is used. A click should again be heard in the speaker on touching the grid—this should occur at all grid and anode points in the LF stages. There is one exception here; in the case of cathode followers, and cathode driven amplifiers. These are not likely to be encountered by beginners, however, and so can be conveniently forgotten.

If cathode bias is used, measure the cathode voltage and see that it is correct for the type of valve used. Switch the set off and measure the resistance in the cathode. Next work out the cathode current as a check for emission. If the valve has a low emission, and has been in use for some considerable time, then a replacement is indicated. If, however, the valve is comparatively new then there is a fault in the circuit which has caused it to pass too much current. This fault must be traced. Often, the electrolytic in the cathode of an LF valve becomes short circuited or, alternatively, open-circuited due to drying up. If s/c it can be checked by shunting with another capacitor of like value and listening to see if any marked increase in receiver output is obtained.

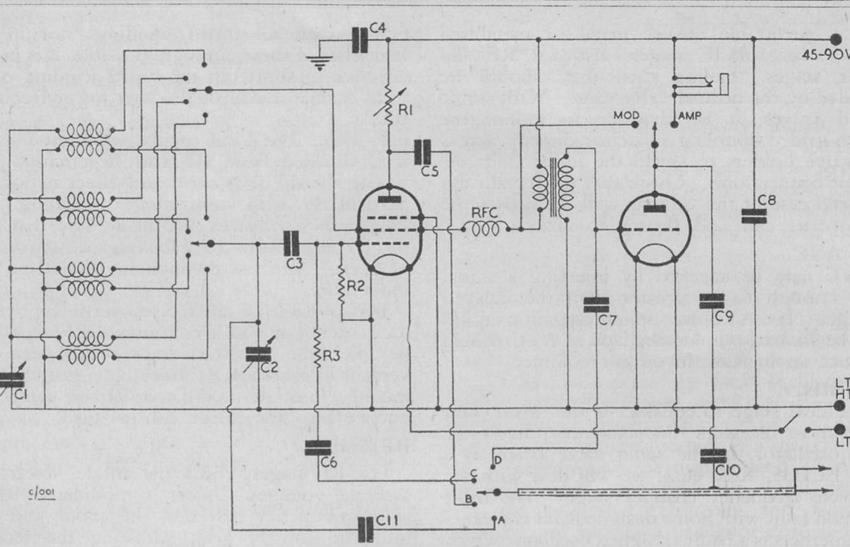


Fig. 1. Theoretical Circuit of the Signal Generator.

COMPONENT VALUES.

Resistors :—

R1	500 Ω	R2	1 MΩ	R3	100 KΩ

Capacitors :—

C1	300 μμF	C4	0.1 μF	C7	0.005 μF	C10	0.01 μF
C2	500 μμF	C5	100 μμF	C8	2.0 μF	C11	50 μμF
C3	100 μμF	C6	0.002 μF	C9	See text (approx. 500 μμF)		

Other LF Stages.

The same tests may be applied to all receiver LF stages, with the following reservations :—

(*a*) Remember that, when a high value anode resistor is used, the actual anode voltage will be higher than the measured voltage due to the current passed through the meter. It is often better to measure the drop across the anode load resistor.

(*b*) Do not bother with current or emission tests other than for the output valve, since anode load limits the anode current and will give rise to a wrong impression. To check the valve, see the amplification due to injecting an audio note first at its anode and then at its grid.

Before leaving LF stages, there is one point regarding output pentodes. Some valves will pass a heavy screen current if taken direct to HT as the anode voltage will be lower due to the drop caused by the DC resistance of the primary of the output transformer. The author has always found it advisable, with mains output pentodes, to include a screen dropping resistor, with a minimum value, of some five or six times the DC resistance of the output transformer primary. Then the anode and screen voltages will be approximately equal at the normal anode and screen currents. The screen grid should be decoupled in this case by a suitable capacitor.

The Detector Stage.

The detector stage : either diode, leaky grid, anode or infinite impedance types, can be checked by injecting a large modulated RF voltage and listening for the modulation note in the receiver speaker. For superhets, the RF input should be of the *same* frequency as the IF stages. For straight receivers, it should be the same frequency to which the set is tuned.

IF Stages.

Now for some notes on IF stages. For straight set constructors, just ignore data on IF's, local oscillator and mixer, and jump direct from detector to RF stages.

The anode, screen and bias voltages of the IF stages can be checked. Inject modulated RF into the anode connection and then into the control grid ; checking increase in output due to IF gain, the injected RF being the same frequency as the IF. The anode voltage check will ensure continuity of that winding, but check the diode and grid windings with an ohmeter. Instability in IF's is due to :— (*a*) poor screening, (*b*) inefficient RF decoupling or bypass, (*c*) a faulty valve, (*d*) feedback between anode and grid circuits in the wiring, (*e*) too high a gain, due to positive feedback, (*f*) incorrect IF alignment and (*g*) faulty AVC.

It is preferable to use metal or metallised type valves for IF stages—also for RF and mixer stages. Failing this, they should be shielded by the normal valve cans. With single ended valves, it is advisable to mount the screen-grid decoupling capacitor directly across the valve holders to shield the input from the output connections. Check that the metallising or metal case of the valve is well bonded to the appropriate pin and thence to chassis.

The AVC.

AVC may be checked by injecting a signal large enough to be greater than the delayed voltage. The AVC decoupling capacitor should then be shorted out and the lack of AVC should produce an increase in output volume.

The Mixer.

The next stage to consider is the mixer, but, as on most receivers this also incorporates the local oscillator, in the same valve (such as a 6K8, ECH35, X65, etc.), we will deal with the complete frequency changer stage. The most common fault with home designed and constructed superhets is a badly designed oscillator which either produces parasitic oscillations or an uneven amplitude output. The latter fault will result in instability, whistles, dead-spots and so forth. Many constructors are either disappointed after building a superhet or are reluctant to build one due to insufficient knowledge on how to ensure it working efficiently. The RF and IF stages are subject to the same precautions as a straight set and the whole difficulty is in the local oscillator.*

(*a*) *Parasitics*: These can be cured by installing a small ¼-watt non-inductive carbon resistor direct to the oscillator grid pin; other grid connections being taken to the other side of the resistor. The usual value is about 33 Ω.

(*b*) *Uneven Amplitude* of oscillation can be checked by inserting an O-1 mA meter at the earthy end of the oscillator grid leak and measuring current through the leak. This will give roughly the peak oscillator voltage at the grid. For the triode-hexode, the average optimum figure for good mixing, as given by various valve manufacturers, is 10 volts. There can be allowed a variation within, say, 5 and 15 volts, but the variation must be gradual; if greater, it should be reduced by inserting a limiting resistor in series with the coupling coil of the local oscillator coil in use. If low, the coupling will have to be increased.

(*c*) *Dead Spots*: These are invariably due to a sudden drop in oscillator amplitude at that particular spot. This is usually due to nearby coils being tuned by their trimmer and stray capacitances and absorbing the oscillator voltage at their resonant frequency. It can be cured by shorting out all coils not in use; failing that, all tuned windings not in use. If neither of these cures are possible, it is usually effective to short out the tuned winding of the local oscillator coil of the next lower frequency band.

General: The local oscillator circuit must be well shielded from RF and IF circuits. The wiring should be as short and direct as possible, particularly with multi-range switching. Use only carbon resistors and make sure that fixed padder capacitors or blocking capacitors are of mica. All these components should be non-inductive.

It is possible to use the test set to replace the local oscillator and a continuous RF signal can be injected; this sometimes being very convenient in checking RF tracking. For checking mixing, inject a modulated RF of signal frequency into the mixer control grid.

RF Stages.

For RF stages, check the anode, screen and cathode voltages. Inject a modulated RF of signal frequency first into the anode and then into the control grid, adjusting the receiver tuning for maximum gain. The tests and requirements of RF stages are the same as those for the IF's, the only difference being the frequency involved.

The last test is, of course, injecting modulated RF of signal frequency into the aerial, but by this time the trouble or troubles should have been diagnosed!

RECEIVER ALIGNMENT

Since the most involved alignment is connected with the superhet type of receiver, this will be the main theme of these notes. For straight receiver, the data on the local oscillators and IF stages may be ignored.

Preliminaries.

For the application of receiver alignment, the test set is used as a modulated RF oscillator, or signal generator. To avoid errors due to excessive AVC, the input should be kept low enough to keep the detected voltage below the AVC delay level. As a general guide, the output should be kept less than 50 milli-watts, when measured across the primary of the speaker transformer. All RF and LF gain controls should be set to maximum gain. Reaction, if used, should be set at minimum. The tone control should be set at maximum top-cut. The BFO is switched off and the AVC left on.

As alignment progresses, and receiver gain thereby increases, keep turning the signal generator output down in order to prevent the output overloading the AVC. For maximum efficiency, it is best to connect an AC voltmeter in series with a 1 μF paper capacitor across the speaker transformer primary as this gives a more accurate measurement of output than judging volume by ear.

* *An article on the practical design of local oscillators will be published in in our next issue.*—Ed.

Tools.

The tools needed for the process of alignment are (*a*) a non-metallic screwdriver or an insulated non-metallic rod with a tiny piece of metal at the end to serve as a blade, (*b*) a tuning "wand"; this consists of a piece of plastic rod some six inches long and about $\frac{1}{4}$ inch diameter. At one end is fixed an iron dust core from an old RF coil former and at the other end a piece of brass rod of about the same size as the dust core. The wand is very simple to make and is used to check the accuracy of alignment.

Aligning the IF Stage.

Disconnect the signal grid lead to the frequency changer and connect signal generator lead with a leak of around one Meg Ω from the grid to the grid lead connection to ensure bias will be normal. Next, short out the local oscillator section of the tuning gang with a short piece of wire. If this section has HT across it, use a 0.1 μF capacitor instead of a shorting link.

Set the signal generator at the correct IF frequency for the particular set and adjust the IF transformers, starting from the detector and working back to the mixer anode, for maximum output. If they are a long way off, repeat complete sequence but always adjust transformers in the correct order.

When the IF's have been aligned, remove the shorting link on the tuning gang, replace signal grid lead as normal and transfer the signal generator lead to the aerial socket. It is advisable, although not essential, to feed via a dummy aerial circuit such as the all-wave circuit shown in Fig. 2.

For best results, however, it is usually better to give a final small adjustment of the aerial trimmer with the set working on its correct aerial, the trimming being done on an actual broadcast signal.

Calibration.

To obtain the greatest degree of dial calibration accuracy and tracking accuracy, it will normally be found that it is best for the padding to be done with the tuning gang $\frac{1}{4}$-way open and trimming with it about $\frac{3}{4}$-way open. It should *not* be done at the extreme ends as many people seem to think, as this gives disappointing results in the centre of the bands. Many manufacturers specify the padding and trimming frequencies to be used in their servicing data.

Start on the low frequency end of the lowest frequency band. Tune the receiver to a dial calibration corresponding to the tuning capacitor vanes when approximately a quarter open. Set the signal generator to the calibrated frequency. Then adjust the padder capacitor for the local oscillator coil in use until maximum output is obtained. In cases where fixed padders are used, with iron dust cored coils, the core will have to be adjusted.

If iron dust core coils are used in the RF stages, adjust the cores of the coils in use for maximum output. If the cores are not adjustable, then there is usually no provision for adjusting the RF coils at this end of the band and they must be assumed to be correct.

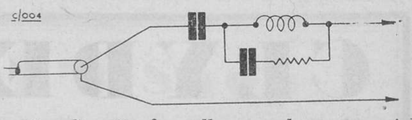


Fig. 2. Circuit for all-wave dummy aerial. Typical values are 20 μH for the choke, 400 Ω for the resistor, 400 μμF for the capacitor in series with the resistor, and 200 μμF for the capacitor connected to the lead. The line containing the components is connected to receiver aerial and the other line goes to receiver earth terminal.

Always start from the local oscillator, then the mixer grid and then any RF stage—with the aerial tuned circuit coming last. The next stage is to tune the receiver to a dial calibration corresponding to the tuning gang when about three-quarters open. Set the signal generator to the calibrated frequency and adjust the trimmer of the local oscillator coil in use for maximum output. Then adjust the trimmers of RF coils in use, again for maximum output.

Since the padders and trimmers are interdependent it will be necessary to repeat the complete alignment process over and over again in exactly the same method and sequence. The error, naturally, gets less each time and after two or three sequences both points will be dead accurate and also intermediary points will be accurate within negligible limits.

The procedure is the same for each band and they should be each aligned in the order of frequency, the highest frequency range being the last to be tackled. When completed, the adjustments are all sealed with a *small* blob of high grade wax or high frequency lacquer; leave, however, the aerial trimmers. The latter trimmers are not sealed until they have been adjusted on actual radio signals.

The accuracy of alignment can be checked by inserting each end of the tuning wand, in turn, into the formers of the coils in use. The dust core should increase the inductance and, therefore, it should throw the alignment out and decrease the gain. If the gain increases instead of decreasing, it indicates that the alignment has not been correctly carried out.

Points to Remember.

Padders and dust cores adjust the low frequency limit of the coils and are adjusted at the low frequency end of the band; tuning gang about $\frac{1}{4}$-way open.

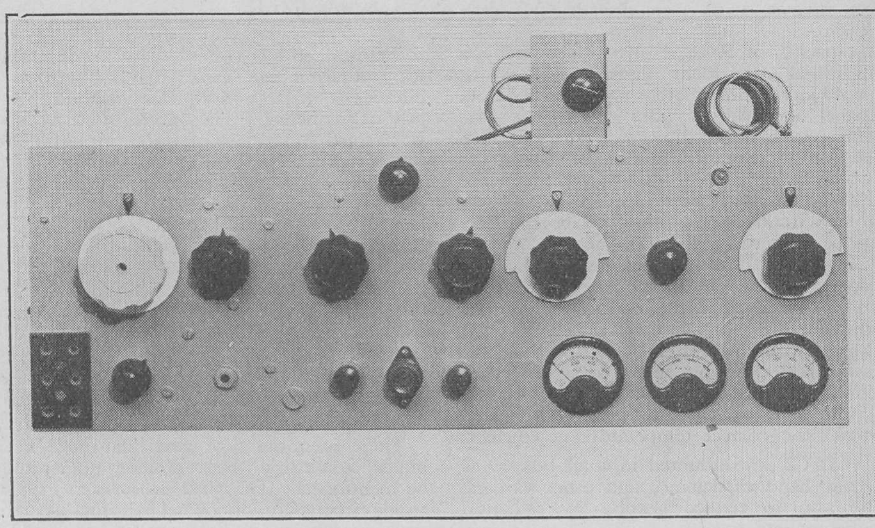
Trimmers adjust the high frequency limit of the coils and are therefore adjusted at the high frequency end of the band; tuning gang about $\frac{3}{4}$-way open.

This is about the simplest alignment method by which accurate calibration and tracking can be obtained.

COPPER WIRE DATA

	BARE COPPER WIRE				ENAMELLED		S.C.C.		D.C.C.		S.S.C.		D.S.C.	
Standard Wire Gauge	Diam. in inches	Approx. safe current	Length per Ohm.	Weight per 1,000 yd.	Turns per inch approx.	Yards per lb. or oz.	Turns per inch approx.	Yards per pound	Turns per inch approx.	Yards per pound	Turns per inch approx.	Yards per lb. or oz.	Turns per inch approx.	Yards per lb. or oz.
		Amps.*	Yds.	Lbs.		Lb.						Lb.		Lb.
10	.128	12.9	535	148.8	—	—	7.35	—	7.04	—	7.64	—	7.55	—
12	.104	8.5	353	98.2	9.26	—	8.93	—	8.47	—	9.35	—	9.22	—
14	.08	5.0	208	58.1	11.9	—	11.4	—	10.6	—	12.1	—	11.8	—
16	.064	3.2	135	37.2	14.8	26.4	14.1	26.1	13.2	25.6	15	26.4	14.7	26.1
18	.048	1.8	53.4	20.9	19.7	46.9	18.3	46.3	16.9	45.4	20	46.8	19.6	46.3
20	.036	1.0	42.4	11.8	26.1	83.3	24.1	81.7	21.3	79.2	26.3	85.3	25.6	82.5
22	.028	.61	25.6	7.12	33.3	137	29.8	134	25.6	129	33.3	137	32.2	134
24	.022	.38	15.8	4.4	42.1	221	37.0	219	31.2	203	42.1	222	40.0	218
26	.018	.25	10.6	2.94	50.6	330	43.5	311	35.7	294	50.6	332	48.8	325
28	.0148	.17	7.18	1.99	61.4	488	50.5	452	40.2	422	60.4	488	57.8	478
30	.0124	.12	5.03	1.40	73.3	694	57.5	634	44.7	587	72	695	67.1	675
32	.0108	.09	3.82	1.06	83	915	63.3	835	50.5	755	81.3	912	75.2	887
34	.0092	.07	2.77	.77	98	1,202	70.5	1,280	54.9	1,024	93.4	1,250	85.5	1,220
36	.0076	.05	1.89	.52	116	1,840	86.2	1,610	64.1	1,477	110	1,815	99.0	1,730
38	.006	.03	1.18	.33	143	2,810	100	2,550	71.4	2,287	133	2,871	117	2,760
		mA	inches	ozs.		oz.						oz.		oz.
40	.0048	18	27.15	3.35	180	286	112.5	3,910	78.1	3,456	159	276	137	258
42	.0040	12.6	18.87	2.32	217	411	—	—	—	—	192	387	161	358
44	.0032	8.0	10.77	1.49	270	642	—	—	—	—	227	599	185	536
45	.0028	6.0	9.24	1.14	303	835	—	—	—	—	250	752	200	675
46	.0024	4.5	6.78	.83	357	1,128	—	—	—	—	278	1,000	217	871
47	.0020	3.1	4.71	.58	—	1,630	—	—	—	—	312	1,375	238	1,190
48	.0016	2.0	3.02	.37	—	—	—	—	—	—	—	—	—	—
49	.0012	1.1	1.70	.21	—	—	—	—	—	—	—	—	—	—

* At 1,000 amps. per sq. in.



150 Watt. V.F.O. or Crystal Controlled Transmitter for 7, 14, and 28 Mc/s.

By Denis Heightman, G6DH.

General.

THE following is a description of a general purpose transmitter recently put into operation at G6DH. The equipment was designed for use with a separate modulator which can be rapidly switched to any one of three RF units.

Requirements were: (*a*) particularly good performance on the 28 Mcs. band, (*b*) the facility of fairly rapid changing from this band to 14 or 7 Mcs., (*c*) VFO operation with the alternative of crystal control, (*d*) CW with a note of high stability and quality.

It was decided to construct the whole of the oscillator, buffer doublers and power amplifier on one chassis as compactness, with a reasonable accessibility for quick service, was desirable. There does not appear to be any particular advantage in, as is frequently done, building the PA as a separate unit: in fact, possibility of losses through link couplings, etc., is incurred.

In view of the unavoidably large amount of space required for an efficient turret arrangement for band changing in the final circuit it was decided to use plug-in coils in the PA stage, the latter inevitably providing the most efficient arrangement, particularly on 28 Mcs., where the extra space occupied by a turret introduces losses due to longer leads and higher circuit capacitances.

Since band changing can be accomplished in the buffer and doubler stages by comparatively simple and low loss switching this arrangement was adopted in the exciter portion of the transmitter.

Circuit.

Considering first the oscillator, several tests showed that, provided strict attention is paid to robust construction and sensible layout, the simple type of oscillator shown in the circuit was capable of giving VFO stability of quite a high order. In fact, since the transmitter was put in use only T9 reports have been obtained on VFO and the optional crystal positions are seldom used. The high stability is achieved by the use of a very small inductance L1 consisting of only nine turns, spaced $\frac{3}{16}$ in. on a 1 in. diameter ceramic former, together with capacitors C1, C2, which were specially chosen, air-spaced, of very solid construction and with large spacing between vanes so as to avoid mechanical vibration troubles. C1 has fairly high capacity, of 500 $\mu\mu$F maximum, and acts as an initial adjustment of frequency, whilst C2, of 40 $\mu\mu$F approximately, is controlled from the panel and just provides coverage of the amateur bands, either direct on 7 Mcs., which is the VFO frequency, or multiplied up to the other bands. C1 is pre-set and does not need to be adjusted unless a valve is changed, or some circuit alterations have been made. It will be observed that in the oscillator circuit only air-spaced capacitors are used, with the exception of the 200 $\mu\mu$F capacitor C3, which is only a series grid capacitor, and minor variations of which would not affect frequency stability. The use of air-spaced capacitors avoids the necessity for choosing fixed capacitors with a suitable temperature co-efficient. With fixed capacitors it is always somewhat complicated to obtain the correct temperature co-efficient.

L1, C1, C2, are mounted in solid box so as to avoid hand capacitance and other variable effects, also to reduce heating by radiation from valves, etc.

Tests with the transmitter operating on 28 Mcs., when switched on from cold, have shown that over a 5 minute period the total drift is rather less than 400 cycles at 28 Mcs. (*i.e.*, four times the fundamental frequency) and most of this drift occurs in the first few seconds of the warming-up period. This performance is considerably better than that of very many crystal controlled signals heard on the 28 Mcs. band.

The oscillator valve is a 6V6 but can be a 6L6 with almost no alteration to the circuit. Both the screen and anode are run at the same potential, *i.e.*, 110 volts, which is maintained constant by a stabiliser tube. This stabilisation is essential, not only because it removes any trace of rectified AC modulation in the power supply but, during keying, holds the HT to the oscillator quite constant. Hence, there is no "ploppiness" in the note. It is quite enlightening to remove the stabiliser tube and observe the deterioration in the oscillator note when listened to in a monitor.

Regeneration in the oscillator stage is controlled by C4, an air-spaced trimmer of approximately 50 $\mu\mu$F maximum. This capacitor is normally operated at something like 30 $\mu\mu$F and is adjusted to give optimum oscillator output with good stability. The keying arrangement is very simple but quite effective and very free from clicks. When the key is up, an additional bias is applied to the oscillator grid through R1 and R2 which stops the valve oscillating.

Switch S1, which changes various crystal frequencies or to VFO, should be a high quality "Oak" or similar type, and due attention should be paid to solid mounting and vibrationless wiring to this switch. It is particularly necessary to see that none of the "hot" wiring runs too close to the chassis so that outside mechanical vibration can cause minor variations in circuit capacitance and thus instability of the output frequency. The output of the oscillator is coupled by means of a 2.5 mH RF choke through another 50 $\mu\mu$F trimmer to the grid of V2, which acts as a buffer. The choke coupling arrangement was used because, whilst rather more output can be obtained with a tuned circuit, the tuned circuit suffers from the disadvantage that it reflects variations on the oscillator grid circuit when tuning is carried out. Hence, in the interests of ease of operation and stability, the choke coupling was used.

The output of the oscillator tube was insufficient to drive direct the push-pull triode power amplifier, hence V2 was used as a buffer and, like V3 and V4, is an 807.

There is nothing of particular note in the buffer circuit but the following points might be mentioned. The 50 Ω resistors in grid and anode circuits are, of course, parasitic oscillation stoppers, it being more necessary to guard against this form of oscillation in the buffer stage since this valve is operating with considerably less bias than the following doubler stages. The bias to this stage is provided by the cathode resistor of 200 Ω plus, under operating conditions, the additional bias, due to small amount of grid current through the grid resistor R6 47 K Ω.

In order to avoid over-driving the doubler stages, the grid connections to these stages are tapped down the preceding anode circuit. The full output of the buffer and doublers is only required for driving the final stage. Coupling to the final stage is, in each case, by a small link coil, the link coupling from any particular buffer or doubler being selected by switch S2.

Thus, when operation is required on 7 Mcs., switch S3 is opened (this switch disconnects the drive to V3 from V2) and switch S2 is turned to the 7 Mcs. position. Similarly, in cases where 14 or 28 Mcs. operation is required, switch S2 is turned to the appropriate frequency and switches S3 or S4 are closed.

Since switches S3 and S4 are at RF potential, the insulation should be good and the switches placed as near to the respective grids as possible. It is, of course, necessary to operate them via an insulated extension spindle. Apart from this minor disadvantage, the system of switching has several advantages for rapid changing from band to band and is quite simple. When either of the switches are open, the succeeding stages, since they are biassed to beyond cut off, draw no anode or screen current.

An added advantage of switch S3 has been found in "VFO-ing" or "netting" on to any station's frequency for calling purposes, etc., on 14 or 28 Mcs. Normally, the output of a doubler stage is too strong for the receiver used at the normal gain position but, with a

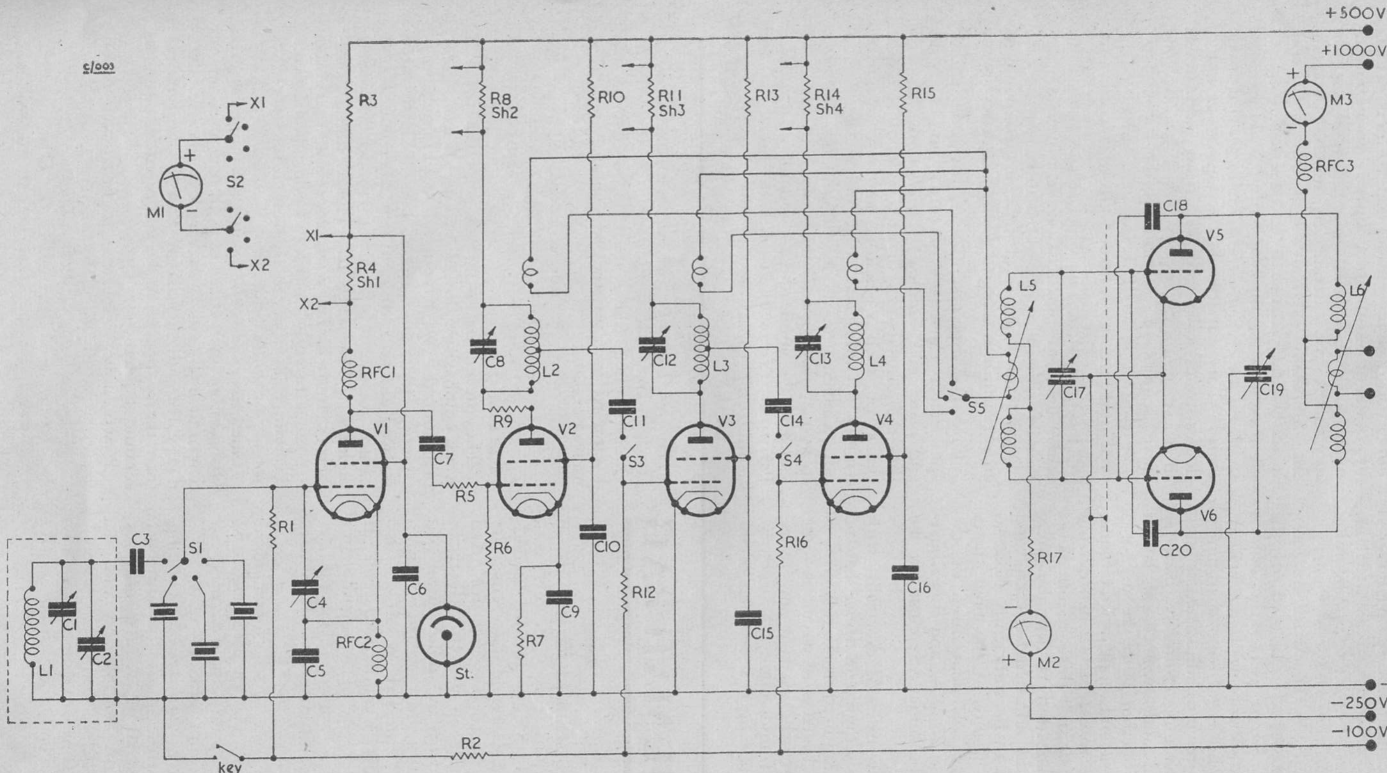


Fig. 1. *Theoretical diagram of the* 150 *watt transmitter.*

COMPONENT VALUES.

Capacitors.

C1, 2 : See text
C3, 11, 14 : 200 μμF
C4, 7, 8, 12 : 50 μμF
C5 : 100 μμF
C6 : 0.01 μF
C9, 10, 15, 16 : 0.005 μF
C13 : 25 μμF
C17, 19 : Split stator type 50 μμF per section.
C7, *shown as a fixed capacitor, should be drawn as a trimmer.*
C18, 20 : Neutralising capacitors

Resistors.

R1 : 100 K Ω
R2 : 500 K Ω
R3 : 10,000 Ω 20 watt
R4, 8, 11, 14 : Meter shunts
R5, 9 : 50 Ω
R6, 12, 16 : 47,000 Ω
R7 : 200 Ω
R10, 13, 15 : 30,000 Ω
R17 : 5,000 Ω

flick of S3, only the harmonic of the buffer is received and this is sufficiently weak to enable one to zero beat the VFO on to an incoming carrier.

As will be noted from the circuit diagram, triode valves in push-pull are used in the output or PA stage. Those used at the writer's station were Standard Telephones type 4304 CA.

In order to allow for rapid band changing it was desirable not to have to adjust neutralizing capacitors when changing from one band to another. By careful and symmetrical layout of the final stage, together with the use of a screen between the grid and anode tuned circuits, it was found possible to use pre-set neutralizing capacitors which satisfy this requirement. Actually, the neutralization is not absolutely perfect unless critically adjusted for each band but can be arranged to be sufficiently close so that there is no instability in the final stage. In practice, the stage was neutralized on the highest frequency, *i.e.*, 28 Mcs., and this adjustment was found to be sufficiently close for the lower two bands.

It is not generally realised, especially with triodes needing a fairly high grid drive, that the actual value of coupling used in the link circuits from doubler to PA tuned grid circuit is quite critical. The arrangement used in this transmitter, which was found highly satisfactory, was a pre-set link coupling coil on each of the buffer or doubler anode coil formers which, by means of S2, can be connected to a continuously variable "swinging" link coil coupled to the PA grid circuit. By suitably choosing the dimensions and turns of this latter coil, it was found possible to use the same coil for all three bands, thus obviating coil changing (with the exception of the final grid and anode coils). This variable link coupling definitely demonstrates the need for ready adjustment in these coupled circuits. A mere two or three degrees of rotation on the "swinging" link control knob will vary the drive to the final grid circuit by a very appreciable amount.

The final stage, in other respects, follows fairly standard practice. A link coil is provided for coupling the aerial direct in the case of low impedance feeders or for coupling to an aerial tuning unit for lower frequency work.

Care should be taken to see that good quality split stator capacitors are used in the grid and plate final circuits. It frequently happens that the capacitances of each side of the split stator of such capacitors are not balanced, leading to unbalanced drive to the grids and poor efficiency in the anode circuits. In order to avoid "flash-overs" the spacing of capacitor vanes in the anode circuit should be adequate. Particular care should also be given to the neutralizing capacitors in this respect.

FROM THE MAILBAG

Dear Sirs,

I would like to see standard test reports on all the communications type receivers (*i.e.*, HRO, AR77, AR88, SX24, BC348, BC312, S2OR, etc.). These tests would state Sensitivity (microvolts input at aerial terminal, for fixed audio output), Selectivity in cycles or kilocycles (crystal in or out) drop in audio output on maximum selectivity as against normal operation at wide bandwidth expressed in dB's. Also Accuracy of frequency calibration, etc. If possible, photograph to be shown with letter key attached, with description, beneath the controls, and full circuit diagram. In short: just like a motor car test report!

I would also like to see crystal sub-standard wavemeters, based on 1,000 or 100 kcs. bars. To be shown as AC, battery and DC versions. Other wants are DC transmitters, "universal" modulators, the latter with speech clipping incorporated. The stressing of the universal or DC angle is because at my last five addresses two have had no mains, one had AC and one DC. My present abode is "completely wired" and ready *but* DC mains are half-a-mile away and the Grid is seven miles distant. *DC* will win!

Though I do not care for non-constructional articles, apart from Centre Tap, I do enjoy Query Corner, and in the true Scottish fashion I sampled it *before* the one shilling fee came into operation!

Yours sincerely,
G. H. Heppel, GM2DRB
(Sutherland).

Dear OM's,

The present-day tendency in constructional work emphasising low-loss components is very pronounced. We have low-loss (ceramic, polystyrene, etc.) coil formers, coil holders, valve holders, and so forth, and it has become second nature to use this type of component when building a piece of gear. This is highly satisfactory, but a rather confusing thought crossed my mind recently in that no one manufactures receiving valves with low-loss bases—at least, not to my knowledge.

One has only to apply the time-proved observation that the strength of a chain is determined by its weakest link to see that if a valve with a bakelite base is satisfactory, then there appears to be no point in using a ceramic holder!

It would be interesting to hear what other readers have to say in this matter.

Best wishes,
E. J. Clarke, G10,
(Brentford, Middx.).

Radio Simplified

Part 3. By A. J. Duley

IN the previous articles, we have often needed to measure voltages or currents, and although it is possible to service quite an amount of radio without measuring instruments, it is much easier if such an instrument is available. Let us see the various types of instruments commonly met with in amateur radio work.

The application of Ohms Law makes it possible to use one instrument for many ranges of current and voltage. Let us see how this is done. Suppose we have an instrument with a total deflection of 1 milliamp, and an internal resistance of 100 Ω. If we want to make a multirange meter with such an instrument, we must first decide on the ranges we are going to cover. Since the scale is marked off from 0 to 1, it would be best to have our ranges in multiples of ten, that is, 0-1 milliamp, 0-10 milliamps, 0-100, and 0-1,000 milliamps, the voltage ranges from 0-1, 0-10 and 0-100 volts. Of course, these ranges need not be adhered to, but I am using these values to illustrate the principles. In Fig. 1, the meter is shown connected for the 1 milliamp range, and the maximum current that the meter will pass is 1 milliamp, so that if we want to measure a current of 10 milliamps, only 1 milliamp can go through the meter, hence we have to by-pass 9 milliamps, and this is done by means of a resistance in parallel with the meter. The means of calculating this resistance is as follows, the voltage across the meter is given by the product of current and resistance, that is,

$$\frac{1}{1{,}000} \times \frac{100}{1}$$

that is 0.1 volts.

The voltage across the resistance must be the same, and since the current in this resistor is 9 milliamps, the resistor value is given by :—

$$\frac{0.1}{9} \times 1{,}000 = 11.1\,\Omega$$

From this example it will be seen that the values of the parallel resistors or shunts as they are called, are very low.

Similarly, the resistor for the 100 milliamps range is given by taking the current in the resistor as 99 milliamps :—

$$\frac{0.1}{1} \times \frac{1{,}000}{99} = 1.01\,\Omega$$

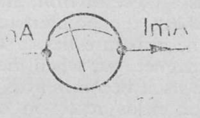


Fig. 1. Maximum current in meter is 1 mA.

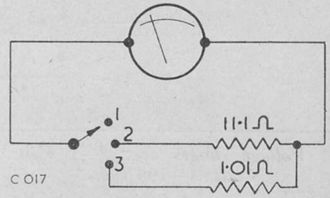


Fig. 2. Maximum current in meter is still 1 mA. Switch positions are: 1—1 mA; 2—10 mA; 3—100 mA.

The circuit of the meter for the three current ranges is shown in Fig. 2. The shunts are switched in independently in this case, but the method used in many types of commercial meters is shown in Fig. 3. The method of finding this resistance is rather difficult, and the best method of using this means of switching is to compare the instrument with a standard.

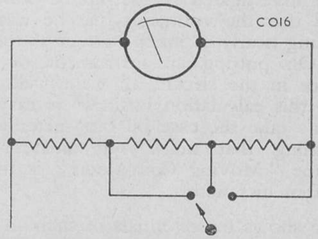


Fig. 3. Many commercial instruments are shunted in this way.

For voltage ranges, we use a similar circuit to the voltage dropping circuit. As the resistance of the meter is so low, the series resistor can be taken to be 1,000 Ω per volt, that is, for the 1 volt scale, a series resistor of 1,000 Ω is needed, and for the 10 volt scale, 10,000 Ω. Let us see how the accurate resistor is arrived at. Now full scale reading is 1 milliamp, so that the total resistance in the circuit for 10 volts is given by :—

$$\frac{\text{voltage}}{\text{current}} = \frac{10}{1} \times 1{,}000 = 10{,}000\,\Omega$$

This 10,000 Ω is the total resistance in the circuit, and since the meter is in series with the external resistor, the value of the latter is reduced by 100 Ω. This discrepancy is small.

As the meter is shown in Fig. 4, the voltage ranges can be measured by the switching as shown, the total resistor is 100,000 Ω, and tappings are taken at 1,000 and 10,000 Ω.

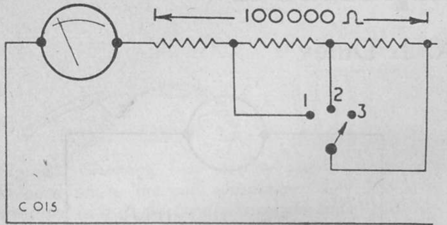


Fig. 4. Voltage ranges are: 1—1 Volt: 2—10 Volts: 3—100 Volts.

When the meter is used as a voltmeter, it is connected in parallel with the circuit, and consequently it takes a portion of the current flowing in the circuit. It is essential therefore that the meter consumes as little current as possible, otherwise inaccurate results are obtained on the dial reading.

My pet nephew had a meter, with which he was measuring the characteristic curve data of a valve. The makers had supplied a typical set of figures, and PN was not getting anything like the results the makers said he should. When I investigated the set-up he was using, I found that the voltmeter that he was using was taking nearly as much current as the valve itself. On putting an instrument of higher resistance in the circuit, all went well. After making this calculation business as easy as all that, let's take the case off our meter and see "the thing that ticks." In amateur radio work, the "Moving Coil Meter" is the type most often met with.

Fig. 5 shows the essentials of such an instrument, the magnet M, the pivoted coil C, hairsprings H1 and H2, and pointer P.

We have already seen that a current flowing in a coil of wire causes a magnetic field, and this fact is the basis of the moving coil instrument. The coil is suspended freely between the poles of a powerful magnet, and current is fed to the coil by means of the hairsprings. When the current flows, a magnetic field is set up by the coil, and this field's reaction to the field of

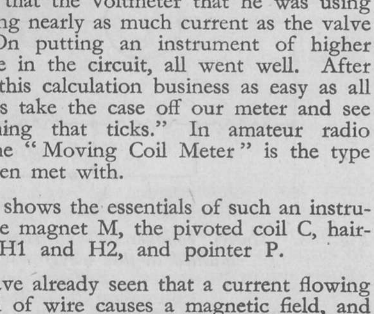


Fig. 5. The essentials of a moving coil meter.

the permanent magnet, causes the coil to take up a different position, and hence the coil swings in its pivots. The stronger the current, the more the magnetic effect of the coil, and hence a larger swing. The scale of a moving coil instrument is linear, that is, the deflection of the needle is dependent directly on the current flowing so that a current of 8 milliamps makes twice the deflection of 4 milliamps.

In the case of the moving iron instrument, which I am describing next, the deflection is dependent on the square of the current flowing, so that a deflection of 8 milliamps is $\frac{64}{16}$ times the deflection of 4 milliamps or 4 times as much (theoretically!).

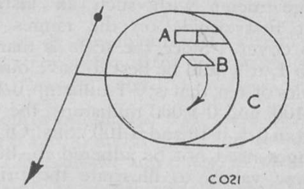


Fig. 6. The current in the coil magnetises A and B with the same type of magnetism, causing this moving iron meter to deflect.

The moving iron instrument is shown in Fig. 6. The coil C is fixed, and the piece of iron A is fixed too. Piece of iron B is free to move and is attached to the pointer as shown. When the current flows the two pieces of iron become magnetised, and being alike in magnetism, that is both the same pole, they repel one another, thus making the needle move. One big advantage of this type of instrument is that it can be used on an alternating current as well as a direct current, for whether the current is direct or changing direction of flow, the two pieces of iron are always magnetised with similar poles. The disadvantages of the instrument are that it is not very sensitive (full scale deflections of less than 20 milliamps are rare) and the scale, owing to its square law characteristic is crowded at the ends. The fact that the high end of the scale is crowded is due to the fact that the square law is counteracted by the distance apart of the iron pieces. A moving iron instrument of superior design is available, and in this case it is designed as close to the moving coil system as possible. A permanent magnet has a coil between its poles, and mounted in the coil is a piece of iron, an armature, free to pivot, taking the pointer across the scale. Normally, the armature lies in the field of the permanent magnet, but when the current flows, the armature itself becomes magnetised, and the two magnetic fields react on one another to restore equilibrium and to do this the armature moves, causing the pointer to cross the scale. The force returning the movement to zero in the previous cases was applied by hairsprings, but in the last case, the returning force is the field of the permanent magnet. This last instrument can only be used on DC, but the sensitivity is much better than the previous instrument.

For very high voltages, an electrostatic voltmeter can be employed, especially where it is essential to consume very little current. Theoretically there is no consumption of current in an electrostatic type, as there is no actual path for the current to take. Fig. 7 shows the essentials, and it will be seen that the construction is very similar to that of a moving capacitor, which, in fact, it is. One set of plates is fixed, and the other set free to take up any position in the line of its pivots. When a voltage is applied across the plates, the electrostatic forces are not in equilibrium, and the moving vanes take up a position where peace exists.

A type of instrument often used in aerial circuits to measure aerial currents is the thermal type. The circuit has a heating wire incorporated in the aerial lead, and the heating wire has attached to it a thermo-couple, a device which generates a small current when it is heated. Across the couple is connected a moving coil milliammeter, which actually records the current generated by the hot wire. This current is proportional to the current flowing in the aerial circuit.

A meter not often met with is the one shown in Fig. 8. This is known as the hot wire instrument, and depends for its action on the heating effect of the current making the wire expand. The expansion of the wire is magnified mechanically, and the pointer is returned by the hairspring. The working of this instrument is possible on both AC and DC, but the results are not in the same class as that of the moving coil instrument.

Usually, it can be assumed that the lower the resistance of an ammeter and the higher the resistance of a voltmeter, the better the instrument is, and undoubtedly the best meter of the

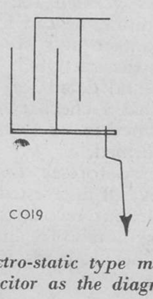


Fig. 7. This electro-static type meter is similar to a variable capacitor as the diagram will show.

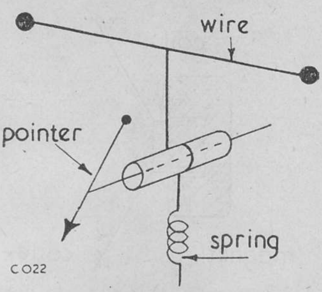


Fig. 8. The "Hot-Wire" type instrument. The wire responds and the movement is amplified mechanically.

types discussed here is the moving coil type. The greatest disadvantage of this type is its DC—only operation. When it is necessary to measure AC supplies, a small metal rectifier is included in the circuit. The operation of this type of rectifier is dependent on the fact that a certain oxide of copper offers a path to an electric current one way, and a very high resistance the other, therefore this limits the passage of current around the circuit to one way only. A bridge type of rectifier unit is usually employed using 4 single unit rectifiers, this type of circuit will be dealt with when the subject of bridges is tackled.

From this talk on measuring instruments, let us look at the apparatus which turns our voltages into audible sound—the loudspeaker. The similarity between this type of instrument and the meters we have just discussed. Starting at the first type of loudspeaker known, the headphone, we unscrew the cap, and find a set up similar to that shown in Fig. 9. The sheet of thin soft iron, known as the diaphragm, is pulled towards the poles of the permanent magnet, and the two coils cause the magnetic field to vary when a current passes through them, this alters the pull exerted by the magnet, and being thin metal, the diaphragm alters its position accordingly. When this occurs several times a second, the fluctuations of the diaphragm consist of a series of vibrations, which constitute a musical note, or a vocal sound. This type of instrument corresponds to the moving iron instrument movement in the fact that the diaphragm replaces the armature, and both these actions depend on a fluctuation of a magnetic field of a coil against that of a permanent magnet.

The corresponding speaker to a moving coil movement is the one shown in Fig. 10. The permanent magnet is cylindrical, and in the ring space between the poles there is a coil suspended on the end of the speaker cone. Current is fed to this coil from a transformer to the output stage of the set.

The current variations, which correspond

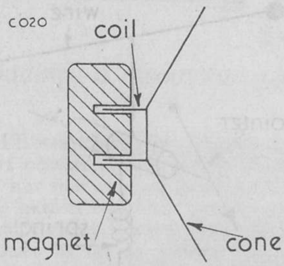


Fig. 9. Sectional sketch of an earpiece. The headphones are very similar to a moving iron loudspeaker.

to the speech received, cause a field to be built up in the coil which is varying all the time. This varying field acts against the field of the permanent magnet, and as it is free to move, the coil and cone are vibrating in sympathy with the varying current. With a moving iron speaker, or headphone, the instrument has a high resistance, 2,000 Ω is usual for each headphone, making a total of 4,000 in all. In this case, the connection can be made directly in the anode circuit of the valve, but the resistance of a moving coil speaker is only the resistance of the coil, and its operation depends on current variation, hence the need for the transformer. A transformer is usually a most efficient piece of apparatus, and its efficiency can be taken for all practical purposes as 100 per cent. Now, if our transformer has a ratio of 20 : 1, and the voltage across the primary is 80 volts, and the current 15 milliamps, the output to the speaker assuming 100 per cent. efficiency is :—

$$\frac{80 \times 1}{20} = 4$$ volts, so that the current will be given by

$$\frac{80 \times 15}{4 \times 1{,}000} = \frac{1{,}200}{4{,}000} = 300$$ milliamps secondary current.

The permanent magnet can be replaced by a field coil, which is connected in the smoothing circuit. This coil is in the DC supply line to the set, and it is therefore always magnetised in the same direction.

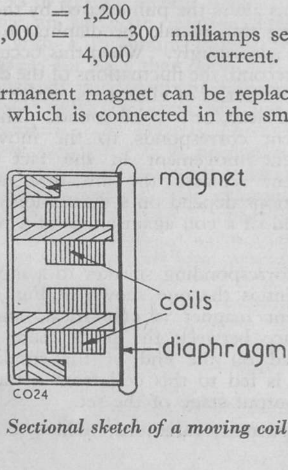


Fig. 10. Sectional sketch of a moving coil speaker.

The next article in this series will help to smooth out those little difficulties concerning valves and their operation and circuits.

APOLOGIES.

In the circuit of the 6-valve receiver (page 285) in the last issue the leads from R12 and R15 are shown taken to earth, whereas they should be connected together and NOT earthed.

NEXT MONTH YOU WILL READ . . .

. . . The Practical Design of Local Oscillators, by L. F. Sinfield ; An AC Five-Valve TRF Receiver, by F. K. Parker ; A Resistance and Capacitance Decade Box, by A. M. Coppin ; Radio Miscellany, by " Centre Tap " ; Query Corner ; Trade Notes ; Part 4 of Radio Simplified, by A. J. Duley ; Part 5 of Thermionic Valves, by K. R. Goodley ; also details of converting Walkie Talkies.

FILE YOUR DX !

We are pleased to announce that the promised Amateur Station Record Cards are now available. These file cards, measuring 6in. x 4in., enable either the amateur transmitter or the short-wave listener to keep a handy and permanent record of contacts or reception notes. Using one card for each station, it is possible to file such data as address, name, power, TX, RX, details of when QSL cards were sent and received and so on. A table is also included on these cards so that a cross reference may be obtained of the major details when a station has been worked or heard on more than one occasion. The reverse side is set aside for general notes of interest.

For the methodical transmitter, or listener, these cards will present the ideal opportunity to have an easily accessible file of data on the DX stations worked or heard. For example, if the listener hears a certain PY4 station, he has only to look at the appropriate file card to see how his reception compares with previous occasions and to check up on whether or not the station has verified the reception report. For the transmitter, he can look up a card on the second contact and see how his report compares with the last QSO. He will also find the op's name and details of his rig. Another advantage is that a check can be simply made to ascertain whether or not the first contact has been confirmed.

Altogether, we foresee an extensive use of these cards by all interested on short wave reception. Use our record cards and dispense with the clumsy notebooks and scraps of paper! The price of the file cards is 4s. 6d. per 100, including postage.

A Mains Short Wave 0-V-0

Describing a simple but effective short-waver.

By P. Barratt, ISWL/G889

WITH so much ex-WD material on the market, this little receiver provided the writer with a means to dispose of some of it—to good advantage. The valves used are quite plentiful on the "surplus" market. The detector valve used is a 4D1, a triode; the one used in the original set coming from an R1124A. If a pentode output stage is added, it is well to remember that these 13 volt valves can do a good job of work. Full wave rectification is used, employing a U14 rectifier. The heaters are wired in series with a 40-watt lamp. The few components used, mainly resistors and capacitors, were taken from a stripped down surplus receiver.

The performance of the set is surprisingly good, all continents being received at good strength on both 14 and 28 Mcs. Although not tried by the writer there is no reason why television sound at one end and the lower frequency bands at the other could not be well received with suitable coils. If reception is desired lower in frequency than 14 Mcs. the value of the main tuning variable could be increased with advantage. It was found that an earth did not make any appreciable difference to the performance of the receiver on any frequency.

During a period of some three months, much in the way of DX has been logged. On 28 Mcs. such prefixes as ZS, ZL, VK, VQ4, CR9, VS7, VU7, VU2, C1, OQ5, LU, PY, ZD2, ZD4, KG6, J9, etc., have entered the log-book. All these were received on telephony, which must be admitted is pretty fair going for a one-valve receiver! The aerial in use was simply a full-wave Windom, running NW-SE.

Getting back to the circuit, reaction is obtained by variation of the grid-leak value, providing a really smooth control and having the additional advantage that tuning is not affected by reaction. The rest of the circuit is perfectly straight-forward. No reaction winding is used; instead, the grid coil is tapped, feedback being produced by variation of the grid potential. In other words, it is a Hartley detector.

Practically none of the component values are critical. The RF choke and coils are all home-made, the RF choke being 40 turns of 23 s.w.g. enamelled copper wire on a ½-in. diam. former. Details for the coils are given beneath the circuit diagram. The coil holder is made of perspex and provided with three sockets (one for the centre-tap). For frequencies above 28 Mcs. self-supporting coils are used, but below this frequency formers are used.

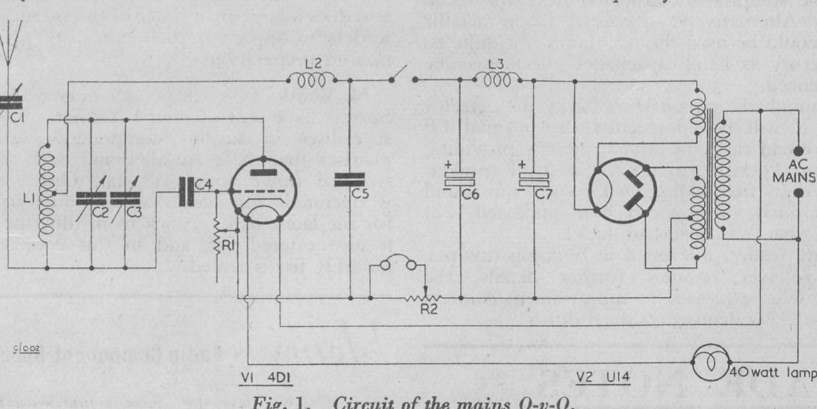


Fig. 1. Circuit of the mains 0-v-0.

COMPONENT VALUES.

Capacitors.

C1 : 100 $\mu\mu$F, variable
C2 : 70 $\mu\mu$F, variable
C3 : 5 $\mu\mu$F, variable
C4 : 300 $\mu\mu$F
C5 : 0.01 μF
C6, 7 : 8.0 μF electrolytic

Resistors.

R1 : 500,000 Ω potentiometer
R2 : 50,000 Ω potentiometer

Inductors.

L1 : See coil data
L2 : RF choke
L3 : LF choke, 20H

Coils.

28 Mcs.: 6 turns, 1in. dia., 8 turns per inch.
14 Mcs.: 6 turns, 2½in. dia., 8tpi.
50 Mcs.: 2 turns, 1¼in. dia., 5tpi.
Taps to be one-third way up from "earthy" end. Adjust where necessary.

The aerial series capacitor is shown as 100 $\mu\mu$F as this has proved to be the best value for use on 14 and 28 Mcs. On the higher frequencies a decrease in value to a 5-50 $\mu\mu$F trimmer would show an improvement. Alternatively, a turn or two loose coupling round the grid coil would suffice.

On the main tuner, a "Utility" slow-motion drive is used. The bandspread tuner is very small and has no slow-motion drive attached. The potentiometer shown across the phones is quite convenient, although for the average station it is not necessary.

The 4DI valve has the grid taken out to the top cap, and it was found to be more convenient to mount the valve on its side. The connections are as follows :—

Pin 1 : Heater.	Pin 7 : Heater.
Pin 2 : Cathode.	Top Cap : Grid.
Pin 3 : Anode.	(British 7 pin holder).
Pin 4, 5, 6 : Blank.	

Little need be said regarding operating the receiver. Once set for any particular band the receiver will hold fairly constant over the range. The aerial trimmer should be adjusted so as to allow reaction to almost cease. The maximum positions for each band should be noted as this will make initial adjustment easier when changing bands. This position of maximum sensitivity will be found to be quite constant over each band.

It should be noted that the plates of the tuning capacitors are all " live," none of them returning to earth as in the leaky grid detector. In view of this great care should be taken to ensure that the spindles are insulated from the metal panel. Alternatively, of course, a non-metallic panel could be used though this is not quite so satisfactory as hand-capacitance effects may be experienced.

Although the circuit shows only the detector stage, it will be appreciated that normal LF stages could easily be added, thereby providing sufficient "punch" to operate a small speaker. The writer tried adding an LF stage but found that a fairly pronounced hum appeared, but maybe that was just bad luck!

If any reader, interested in building this fine little receiver, requires further details, the author will be pleased to supply them. Address any correspondence c/o the Editors.

TRADE NOTES

F.B. Products of 41, Carlisle Street, Bradford, Yorks., have sent us samples of their interesting range of aluminium chassis. It is obvious that some careful thought was put into the design of these chassis as they are of a design not hitherto seen. The theme is the emphasis on rigidity—an important item when it comes to aluminium chassis, which are too often rather too flimsy for a satisfactory job.

To ensure adequate rigidity, the " FB " chassis have two features of interest. Firstly, the " ends " of the top of chassis are bent over to form a flange to prevent excessive flexibility Secondly, a novel feature is included beneath the chassis. The latter consists of two stays, both fitted to the main chassis with four bolts, countersunk so that the surface is free from protruding bolt heads which would be inconvenient when fitting a panel. The stays are also of aluminium and are bent strips, the ends of which are subjected to the same treatment as the top of chassis, *i.e.*, they have their ends bent over to provide added rigidity.

At present, three sizes are available : 5in. x 8½in., 10in. x 8½in., and 17in. x 10in., prices being 5s., 6s. 6d. and 9s. respectively. The smallest size is particularly interesting since chassis of these dimensions are not always easy to obtain. The sub-chassis in all cases is 2½in., which allows ample room for almost any need.

We are informed that holes will be drilled and punched at a nominal cost. Templates should be supplied as a guide to the required positions. Though only three sizes have been quoted, it is understood that chassis can be made to order of any size. Delivery on stock models is by return of post ; on specially made chassis, two to three days.

Barnes Rad-Elec Co. of 2, Elmdale Road, Penn, Wolverhampton, announce that they will shortly be opening extensive premises and workshops at 12, Pipers Row, Victoria Square, Wolverhampton, where constructors are invited to inspect many tons of useful gear. This firm also does a large mail order business, and invites readers to apply for their new lists which are now in preparation.

M. Watts of 38, Chapel Avenue, Addlestone, Surrey, have sent us their latest list. This firm specialises in surplus components, and emphasises that these are all brand new, and not stripped down jobs. A Mail Order Service is operated, and readers are invited to apply for the latest lists. Apart from this, the Trade is also catered for, and in this connection a monthly list is issued.

COMPONENT REVIEW

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HT/DC Stabiliser and Smoothing Units

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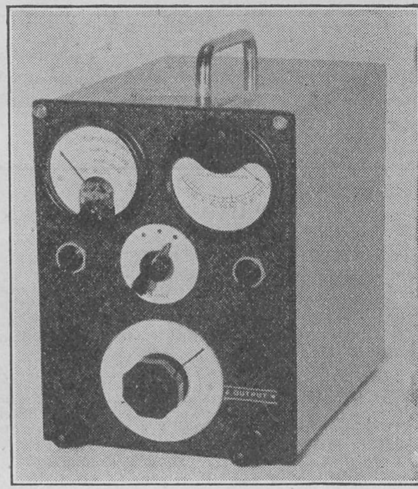
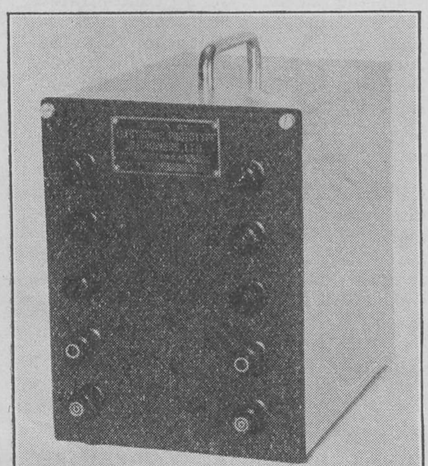


IN our March issue (page 221) we reviewed the Universal Supply Unit manufactured by **Electronic Prototype Designers, Ltd.** The two units described herewith may be used independently, or in conjunction with, the Supply Unit already described.

The Smoothing Unit is shown at the foot of the next column and it will be noticed that the dimensions for this, and the Stabiliser Unit, are exactly the same as those of the Supply Unit. The smoothing unit is designed primarily as a supplementary unit to the "USU," and allows for any DC supplies from the USU to supply a practically ripple-free voltage. The output of the USU (or any other source of DC) is simply connected to the input terminals. The series resistors employed in the circuit are of a very low range and result in a negligible voltage drop in anode supplies. The series resistors in the negative bias voltage ranges are inevitably of a higher value but a load of approx. 100,000 ohms is permissible.

The Stabiliser Unit, shown in the heading, is very interesting since the circuit is based on an entirely new system. The stabilisation of voltage is achieved by the introduction of a subsidiary load by an 807 valve and modulated by a teleion valve. Across the stabilised voltage a variable resistor is connected and in parallel with part of this resistance the teleion valve is connected. If any increase of the voltage occurs, the current flowing through the teleion valve increases. This produces the modulation of the 807 and increases the subsidiary load.



The stabiliser will stabilise any voltage between 200-500 volts, with a continuously variable voltage control (metered). The mains variation, plus or minus 15 per cent., has practically no effect on the operation of the unit. Similarly, the supply from the USU or from any other DC supply does not affect a noticeable variation. Getting down to figures it was found that the variation of output current for voltages up to 450 can be 70 mA and even then the voltage stabilisation is of the order of three per cent. The variation of output current for voltages over 450 may be 35 mA, which enables voltage stabilisation to be within three per cent. Providing that a variation of 40 mA or under is experienced with supplies under 450 and 20 mA over 450, the stabilisation reaches the high standard of around one per cent.

Both these instruments are of the same quality of workmanship as the USU and though the three units were originally designed as a "set," they can, of course, all be used independently. Messrs. E.P.D. would be pleased to supply readers with further details, if required. The address is 208, West End Lane, London, N.W.6. (Tel.: Hampstead 4667).*

W.N.S.

* *New address.*

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, minimum charge 3/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/6 will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

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TRADE

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