The Wireless Constructor

6D MONTHLY

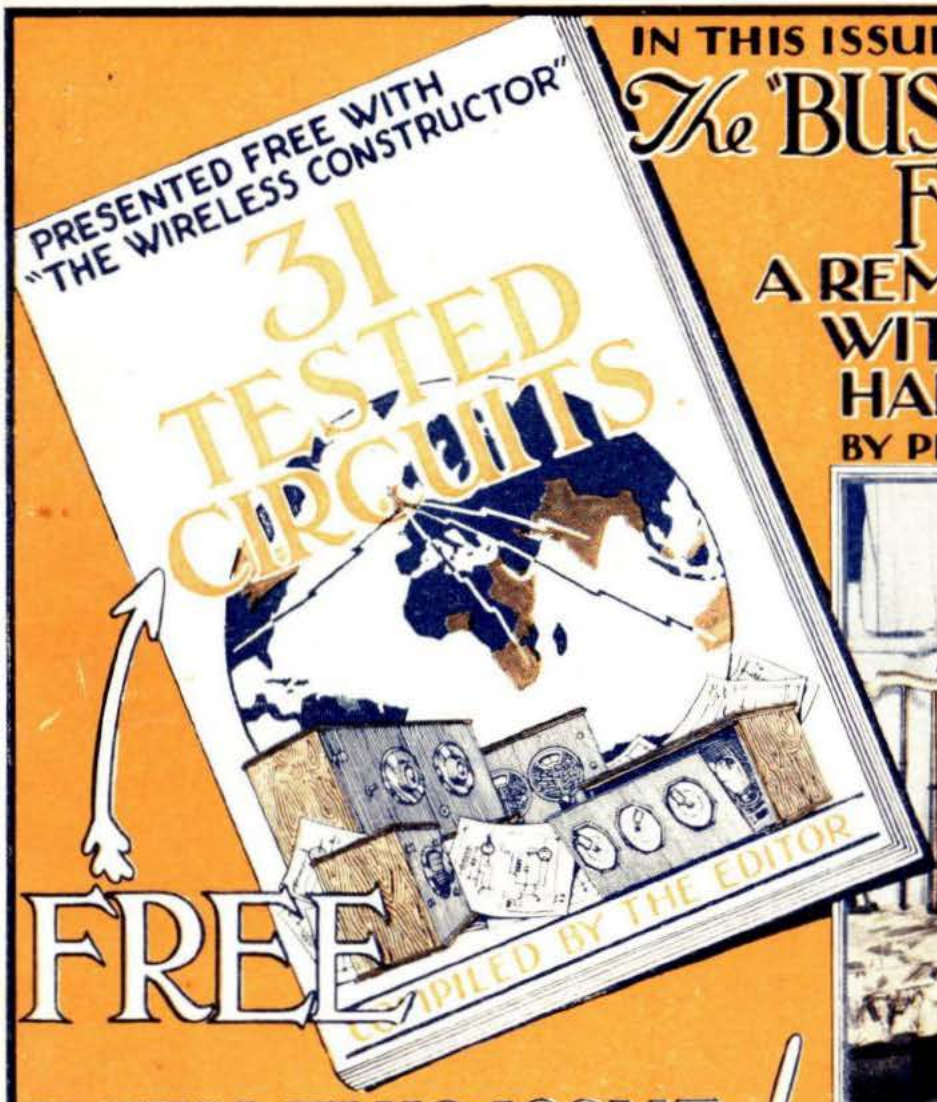
EDITED BY
PERCY W. HARRIS, M.I.R.E.
VOL. V. FEBRUARY, 1928 No. 16

IN THIS ISSUE

The "BUSINESS MAN'S FOUR"

A REMARKABLE SET WITH THE NEW HARRIS CIRCUIT

BY PERCY W. HARRIS M.I.R.E.



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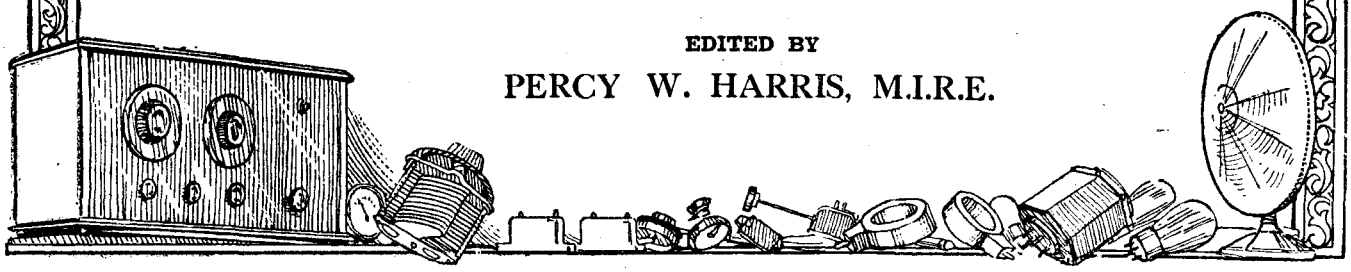

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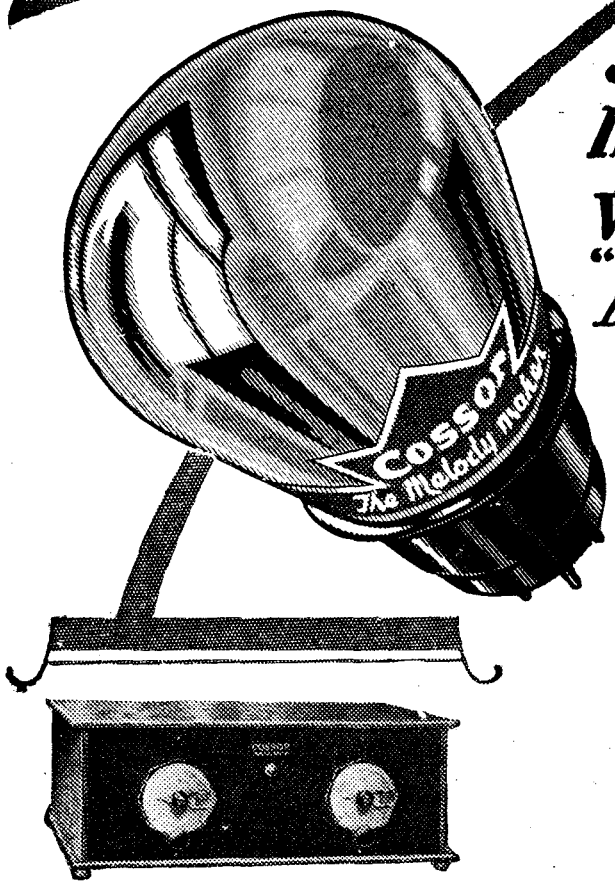
PERCY W. HARRIS, M.I.R.E.

Cossor

The valve which made possible the wonderful Cossor "Melody Maker"



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The WIRELESS CONSTRUCTOR

Edited by
PERCY W. HARRIS,
M.I.R.E.

Published by the Amalgamated Press, Fleetway House, Farringdon Street, E.C.4.

THE EDITOR'S CHAT

Percy W. Harris, M.I.R.E., the Editor of the "Wireless Constructor," discusses our Gift Booklet and other items of radio interest in this issue.

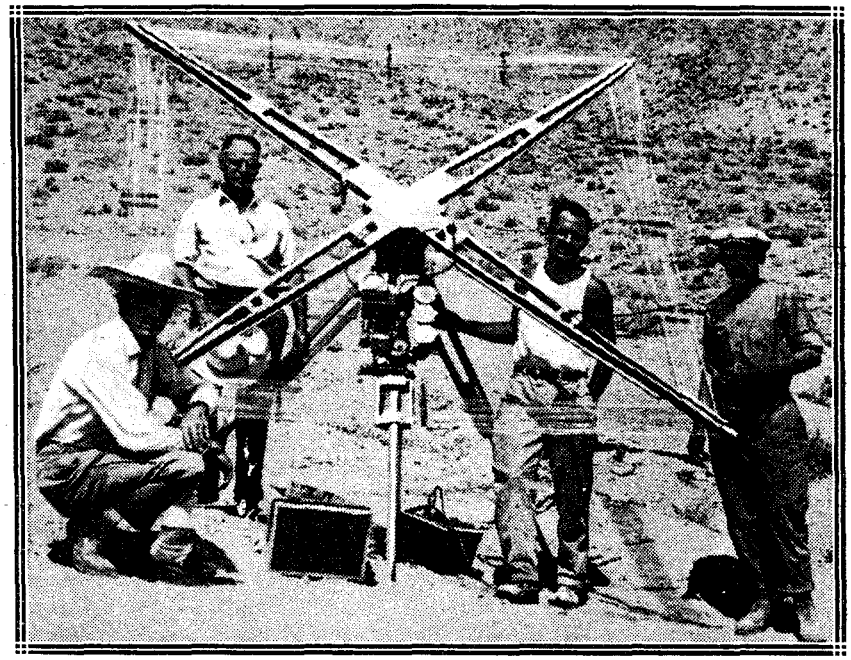
WE have great pleasure in being able to present to WIRELESS CONSTRUCTOR readers this month a valuable circuit book, the compilation of which has occupied a considerable time in the laboratory, where all circuits have been tested out under practical working conditions. This alone would make the issue memorable, but in addition we are publishing a *circuit* which is entirely new, embodying certain features which have been aimed at by designers and experimenters.

Single-Tuning Triumph

That the new circuit will have a potent influence on future design of simple receivers is a foregone conclusion. The mere fact that it is now possible to arrange a receiver with constant reaction over the whole scale and with only a single tuning condenser opens up a whole new field of experiment. At long last the simple portable set for use with a frame now becomes a practical and inexpensive proposition. Indeed, a portable set incorporating the new circuit is now in the process of development in the laboratory, and I hope to be able to give readers constructional details at an early date.

Some Special Features

While, of course, it is not suggested that the new circuit will render the tuned forms of high-frequency amplification obsolete—such a suggestion would be absurd—it really does give the unskilled user results which previously only have been obtainable by the skilled, and with more than one tuned circuit at that. A number of well-known people in the radio world have visited this laboratory recently—including some of the most important members of the wireless industry—and they have all expressed the opinion that the new circuit marks the biggest step forward in practical radio that has been made for some time.



The radio set used by prospectors in Southern California to locate mineral deposits.

There are a number of other special features in the current issue to which I would like to refer, in particular to a description of the home construction of a moving-coil loud speaker. This type of speaker, which in its basic principles is not new, has recently come to the front for two main reasons. The first is that it has been shown that the placing of a large baffle board in front of such a speaker enormously improves the reproduction of the low tones, and, secondly, that such a speaker can faithfully reproduce the low tones which we are only now able to get through our receivers.

At the same time this type has certain disadvantages which should not be glossed over when descriptions are published. First of all it is definitely less sensitive—that is to say, in the strength of sound given out for a given input—than the best horn types. The basic principle of

The Editor's Chat—*continued*

the moving-coil loud speaker requires a very intense magnetic field, in a very narrow circular gap, the small coil carrying the voice current being so arranged as to move in and out of this gap as the current through the coil varies. There are two leading forms of coil-driven loud speaker, one of which gets the magnetic field from permanent magnets which have to be extremely strong and therefore are rather expensive, and the other from an electro-magnet which requires a considerable amount of current to energise it.

31 Tested Circuits.

Special Notice *re* Gift Booklet.

In the next issue of the WIRELESS CONSTRUCTOR will begin a new series of articles on the circuits described in this month's Gift Booklet.

Tell your friends to buy this month's issue and be ready for the coming new series.

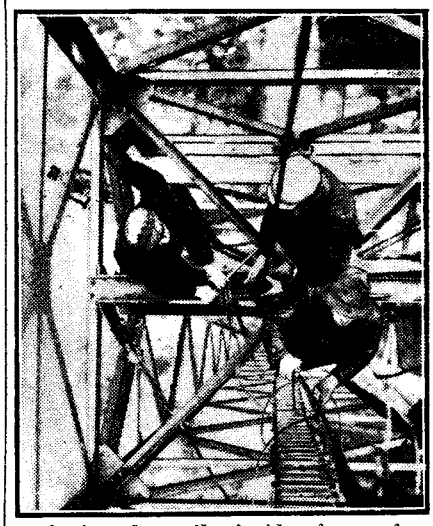
Moving-Coil Loud Speakers

Here, again, in the second class we have a type which can be subdivided. Some electro-magnetically excited coil-driven cones use a large current at a low voltage (such after half to one ampere at six volts), while others take a much smaller current at a much higher voltage, such as a 100 milliamps at 100 volts. There are advantages and disadvantages in both kinds, and probably the most popular will be the form in which a strong magnetic field is provided by permanent magnets. Such a type is described this month. We think it only right to warn readers that many very inferior sets of parts for moving-coil speakers are now being sold, the chief trouble being that, for mechanical ease of manufacture, the circular space between the moving coil and the magnet poles is made large. Speakers made up in this way are very insensitive, and it is very easy to overload the valves before sufficient volume is obtained. The parts for a good moving-coil speaker must be very well made, and for this reason cannot be sold too cheaply.

Cone Considerations

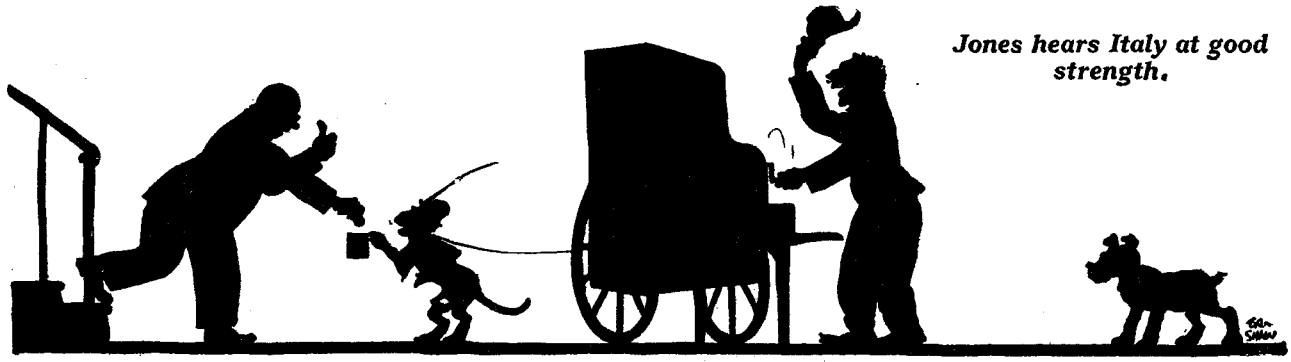
Readers should not imagine that the advent of the modern type of moving-coil speaker with a baffle in any way renders the other types of cone obsolete. It is true that the very best results in reproduction can only be obtained at the present time with the best moving coil types, but it must not be forgotten that a good ordinary cone type is capable of giving a reproduction more perfect than nine sets out of ten are capable of providing. Such speakers, too, can be attached to any ordinary set, and give very excellent results, while the moving coil type require special amplifiers of a particularly distortionless variety. Next month such an amplifier will be described in this journal, when readers can decide for themselves whether they consider the additional trouble and expense attendant upon a coil-driven speaker is justified.

No moving-coil speaker which we have yet tried is capable of giving really satisfactory reproduction when attached to the output terminals of an ordinary set, and the amplifier able to provide really distortionless energy takes so much high-tension that a mains unit is necessary, or else a large type of high-tension accumulator. The position, therefore, is that for the man who does not mind using more valves and more high-tension than usual to obtain really wonderful reproduction, the moving-coil power cone is the instrument; but for the average listener who wants the best possible reproduction with reasonable high-tension current and a reasonable number of valves, the ordinary type of cone is to be recommended.



A view down the inside of one of Zeesen's masts.

The "Sentry" Wave-meter which Mr. Hort has designed and which was promised in the last month's number for this issue is, as readers will see, a particularly interesting instrument. I have personally tested it in this laboratory, and can testify to its extremely sharp tuning and general utility. Next month a calibration curve will be published so that readers can see what the actual curve is like with the particular components used.



Jones hears Italy at good strength.

The "BUSINESS MAN'S FOUR"

A NEW SET WITH A NEW CIRCUIT

by PERCY W. HARRIS M.I.R.E.

Below are given, for the first time, constructional details of a thoroughly efficient, very useful, four-valve receiver, embodying a new method of constant reaction. So efficient is this system, that only one tuning control is required.

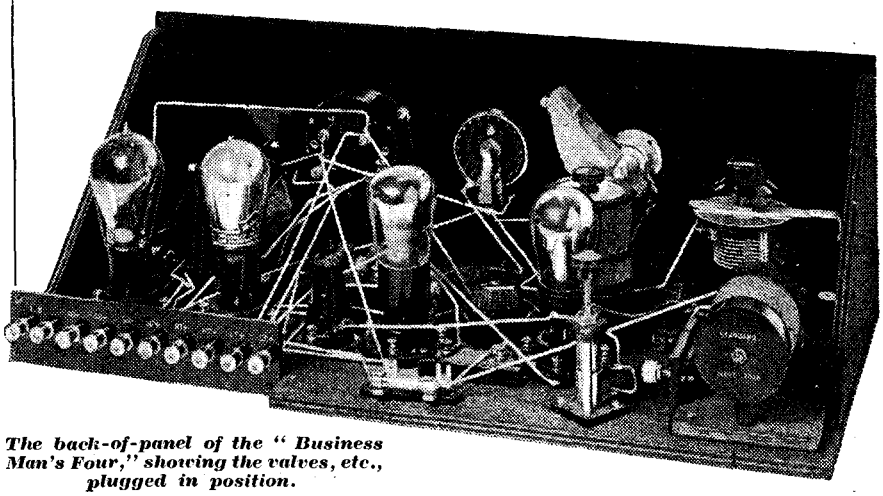
THIS month I am able to present WIRELESS CONSTRUCTOR readers with not only a new receiver design, but with an entirely new circuit, having vast potentialities. As the result of a large number of laboratory experiments I have been able to evolve that which has been aimed at by inventors for a very long time—in fact, ever since the benefits of reaction were made known—a circuit in which the reaction coupling remains constant over the whole tuning scale. thus making immediately available for the ordinary experimenter results which hitherto have needed considerable skill in manipulation.

Along New Lines

Many attempts have been made to evolve such a circuit, and some of the attempts have been more or less successful. Messrs. Loftin and White whose "constant-coupling" method aroused much interest some months ago, devised a single-valve reaction circuit which enabled a very large degree of constancy to be obtained, and, as a matter of fact, Mr. Loftin himself telephoned such a circuit to me across the Atlantic last year.

While the Loftin-White constant-reaction circuit proved to be very sensitive, practical experience with it showed that it was very tricky to handle, requiring very carefully designed and manufactured coils and a very accurate choice of valves and values to work satisfactorily. My new arrangement has none of these difficulties.

In tackling the constant-reaction problem I have proceeded along quite different lines from those followed by previous experimenters, and now the circuit has been evolved it will be seen that the idea is quite simple. Experiments began when trying the circuit which ultimately became the "Long-Wave Special." Readers will remember that in this receiver, which was designed primarily for the long waves, a stage of resistance-coupled high-frequency magnification was used with a reaction feed-back between the plate of the detector valve and the grid of the high-frequency valve, an extremely small capacity being used for the purpose.



The back-of-panel of the "Business Man's Four," showing the valves, etc., plugged in position.

The Decrease Difficulty

Attempts to use this scheme on the ordinary broadcast band showed that it was difficult to get sufficient reaction effect in this way, due to a number of factors, including the decrease in efficiency of the resistance-coupling as we increase the frequency, or shorten the wave-length.

Balancing Out

It then occurred to me that it would be possible to combine two different forms of reaction in such a way that decreasing efficiency of one could be balanced by the increased efficiency of the other. If we take the ordinary Reinartz reaction circuit shown in Fig. 1, the amount of reaction required to make the circuit oscillate when there is a small capacity across the tuning coil (or when we are tuning to the shorter waves) is less than the amount required when there is *more* capacity across the coil and we are tuning to the longer waves. If we were to draw a curve plotting the number of degrees of the reaction condenser required to give oscillation for a number of different capacities of the tuning condenser, we should see

The "Business Man's Four"—*continued*

that the curve would steadily rise, showing that progressively more capacity is required to produce oscillation when we increase the capacity across the tuning coil.

Next take the form of reaction used in the "Long-Wave Special," where a very small capacity is connected between the plate of the detector valve and the grid of the first valve. With this more capacity is required to give oscillation on the longer waves than on the short, and while a very small capacity in the neutralising condenser (or often two neutralising condensers in series) will give oscillation on, say, 600 metres, the whole of the neutralising condenser in circuit will not give sufficient feed-back on, say, 300 metres.

It then occurred to me to make a

COMPONENTS REQUIRED

SPECIAL NOTE. — WIRELESS CONSTRUCTOR Sets are designed to give the average experimenter first-class results with a wide range of components. In order that readers may have a good idea of how various makes of components can be used, the choice of these is made as wide as possible among first-class makes. All components named in WIRELESS CONSTRUCTOR sets have been carefully tested under actual working conditions, and the use of a particular component does not necessarily mean that other equally good makes cannot be used, but merely that this particular make, among others, has been found to be sound. In a very few cases where a special component is required and no substitute is possible, this is clearly indicated. The WIRELESS CONSTRUCTOR does not interest itself in any design which is introduced solely for the purpose of selling a particular make of component or valve, contenting itself with considerations of electrical efficiency and general practicability, so that the reader can exercise his own judgment in selecting components which appeal to his particular taste and pocket.

COMPONENTS REQUIRED.

1 Panel, 21 in. × 7 in., black polished (That shown is a Resiston). (Ebonart, Radion, Trolite, Becol, Pilot, and other first-class panels can be used if desired.)

1 Baseboard, 21 in. × 9¾ in. A small portion must be cut away, as shown.

1 Suitable cabinet (See note elsewhere re cabinet).

1 Straight-line frequency condenser, ·0005 mfd. with vernier dial. The Igranic Pacent S.L.F. condenser and Igranic Indigraph dial are shown. Any good standard variable condenser of ·0005-mfd. straight-line frequency type, with vernier dial, can be substituted. A vernier dial is necessary in this set owing to the sharp tuning.

1 Standard six-pin base (That shown is a Colvern. Any standard make can be substituted.)

4 Valve holders of the anti-phonic variety (Lotus, Benjamin, Ashley, Bowyer-Lowe, C.E. Precision, B.T.H., Magnum, etc.). (Those actually used in this set are the C.E. Precision.)

1 Standard six-pin Reinartz coil for broadcast band.

1 Standard six-pin Reinartz coil (if required) for Daventry range.

1 Multiple fixed condenser, ·0001 to ·0015 mfd. (C.A.V.).

2 Baseboard-mounting filament resistances. The adjustable type are required (Those shown are the Gecophone 6-ohm). (Igranic, Lissen, etc.)

1 Calibrated baseboard resistance, 30 ohms.

1 Panel-mounting combined 30-ohm rheostat and on-and-off switch (This is the Yaxley, obtainable from the Rothermel Radio Corporation). (At the moment I do not know of any other combined rheostat and on-and-off switch, but, alternatively, the set will work as well if a 30-ohm rheostat is used with a separate on-and-off switch. The combination of the two in one unit, however, is pleasing and gives convenient control.)

1 Ferranti triple meter, 0 to 7·5 volts, 0 to 150 volts and 0 to 15 milliamps. If 6-volt valves, with a super-power valve in the output, are used, then the meter should be of the type which gives 30 milliamps maximum reading. The price of the two ranges is the same, so that it is just as well to obtain the 30 milli-ampere, in any case (Ferranti flush type, R.3 F.A.).

1 Mansbridge type condenser, 1 mfd. (T.C.C., Dubilier, Lissen, Ferranti, Hydra, Mullard, etc.).

1 Neutralising condenser of the screw adjusting variety (not interleaving plate type) with a very small minimum (The Jackson is shown and is particularly suitable for this circuit. The Gambrell is another suitable make. For this particular purpose I cannot recommend many of the neutralising condensers now sold, as, excellent though they be for their particular purpose, they do not give quite a fine enough adjustment of the small capacity which is necessary here).

1 ·0001-mfd. Midget variable condenser (Peto-Scott, Cyldon, Igranic, Ormond, etc.).

1 Bracket for same (Note.—This can be a piece of Meccano strip, or any similar metal, and need not be specially purchased).

1 Fixed condenser, ·0003 mfd. (Lissen, Dubilier, Mullard, T.C.C., Atlas, etc.).

2 Grid-leak holders (Dubilier Dumetohm, Lissen Combinator, etc.).

1 ½-megohm grid leak (Lissen, Dubilier, Mullard, Igranic, etc.).

1 2- or 3-megohm grid leak (Lissen, Dubilier, Igranic, Mullard, etc.).

1 R.C.C. unit for low-frequency coupling (There are a number of these available. That shown is the Dubilier, with one ½-megohm and one 1-megohm leaks in it. The R.I.-Varley type B, Mullard, Lissen, Marconiphone B, Magnum, Atlas, Carborundum, and many other units all work excellently in this circuit. There is, of course, no special need to buy a complete unit, as the combination of a condenser of any value from ·006 up to ·02 mfd., with a ½-megohm grid leak as anode resistance and 1-megohm leak as leak proper, will suit).

1 Good low-frequency transformer. Fortunately, the home constructor is now well provided with these (That shown is the new Ferranti A.F.5 transformer. Any good low-frequency transformer can be used here without affecting the working of the circuit).

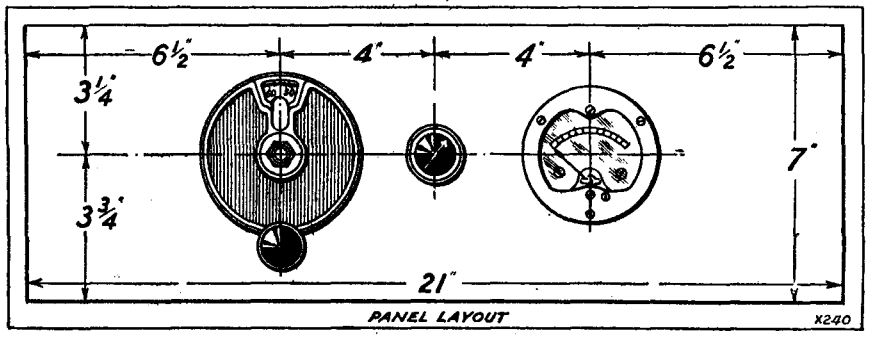
1 Good radio-frequency choke (Here again is a wide variety of makes. That shown is a Magnum, but any radio-frequency choke previously used and found satisfactory can be substituted).

1 Terminal strip with terminals for low-tension negative and positive, high-tension negative and positive 1 and 2, grid bias positive, grid bias negative 1 and 2, loud speaker negative and loud speaker positive (Note that there are no terminals provided for aerial and earth. The earth connection is made direct to the low-tension battery negative, and the aerial is brought to a plug).

1 Standard wave-trap (Magnum, Peto-Scott, etc.). (This trap has been made up to the standard specification published in "Popular Wireless" and "Modern Wireless," and is sold complete with adjustable condenser, coil, and tappings on a small baseboard. It is very convenient for building into a set. Constructional details of such a trap for those who like to make their own will be given next month, with details for the home construction of the tuning coil).

The "Business Man's Four"—*continued*

receiver with a high-frequency valve fitted with Reinartz reaction on the grid circuit, and resistance-capacity coupling to the detector valve, a small condenser being connected to the plate of this latter and the grid of the high-frequency valve. In this, I reasoned, the increasing efficiency of the feed-back from the detector valve to the high-frequency valve might be balanced by the decreasing efficiency of the Reinartz reaction as one increased the wave-length, and if values were suitably chosen a constant-reaction effect might be produced over the whole scale. If this were possible one would get a very sharp tuning circuit, very sensitive, and with that ideal of the home constructor, true single-dial tuning combined with the utmost simplicity. The addition of one or more stages of note magnification to this circuit would give loud speaking, without any other tuning controls.



Some Special Points

The experiment succeeded beyond my most sanguine hopes, so that after a time I was able to produce a receiver using all standard components which would work with 2-, 4-, or 6-volt R.C. valves and with different makes of valves in such a way that, once these preliminary reaction adjustments were made, it was only necessary to switch on the set and turn the tuning dial backwards and forwards to pick up quite a number of stations. The experimental form of this circuit was described in "Popular Wireless" for December 3rd, 1927, and a simple two-valve receiver employing this circuit in "Popular Wireless" for December 10th, 1927. Readers of the WIRELESS CONSTRUCTOR now have, for the first time, a complete design for a thoroughly efficient, very useful, four-valve receiver which I have named the "Business Man's Four," incorporating the latest ideas in this circuit, which has now reached a thoroughly practical stage in every detail.

Before we proceed farther, let me say that the full working theory of this circuit has yet to be explained. There are a number of points which are by no means clear, but as to its practical utility and reliability there are no doubts in the minds of those who have tried it. To give you some idea of the essential difference of this circuit from any previously described, let me outline some of its leading points:

1. It is a four-valve circuit with a high-frequency stage, detector, and two stages of low-frequency magnification, with but a single tuning condenser and single tuning control.

2. Special components are not required, and there is a wide range of alternatives.

3. There are no matched coils, matched condensers, or "ganging."

4. It works satisfactorily with valves of *all* the leading makes.

5. The preliminary adjustments of the reaction setting are very simple and do not require any previous experience.

6. Satisfactory results are obtained on 2-, 4-, or 6-volt valves of all the leading makes.

7. By the incorporation of a triple meter on the front panel instrument, the accumulator voltage, high-tension battery voltage, and high-tension consumption of the set can be checked in a moment.

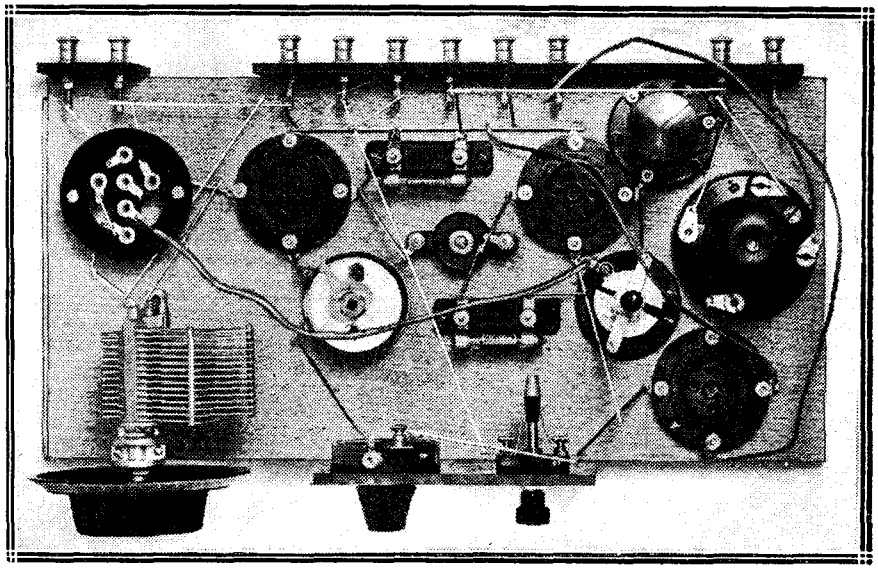
8. Further simplicity is obtained by a combined volume control and on-and-off switch.

9. Distant stations are picked up without oscillating, and thus the set is a non-radiator.

Seventeen Stations a Minute

It should be noted that the volume control is a true one, and is only used when the strength of a station is too loud to be comfortable in the speaker. It is *not*, as in some "single control" sets, a variable-reaction control masquerading as something else.

A good idea of the simplicity of the operation of the receiver can be gathered from the following. A few nights after the set shown had been completed I invited a friend into the laboratory, and, without telling him anything about the receiver or its circuit, took him over to the test table and said: "This is a single-control receiver. Turn that knob and count the number of stations you can pick up on the loud speaker."



One of the experimental boards upon which the circuit was worked out.

The "Business Man's Four"—*continued*

He immediately did as requested, and at the end of fifty-five seconds turned round and exclaimed: "Seventeen!"

These stations were not, of course, all at what is termed full loud-speaker strength. Six or eight of them were, however, obtainable at full loud-speaker strength, and the whole seventeen were easily identifiable several feet from the loud speaker. Of course, in such a short space of time it was not possible to stop on each one and identify it by name, as this would have meant waiting either for an announcement or for some distinguishing characteristic of the station. No wave-meter was used, the set was not calibrated, and the knob was simply turned without reference to any figures on the dial. There was not the slightest sign of oscillation in the receiver at any point on the scale.

Consistent "DX" Results

The aerial used for these tests is a good one, but no better than that possessed by many experimenters, and inferior to many I know that are used by readers of this journal. The night, however, was not a particularly good one, and similar tests carried out at about the same hour on seven consecutive nights gave a minimum of fifteen stations and a maximum of twenty-one. On the average night on this aerial eight or nine stations come in at good loud-speaker strength, while the quality will satisfy the most exacting.

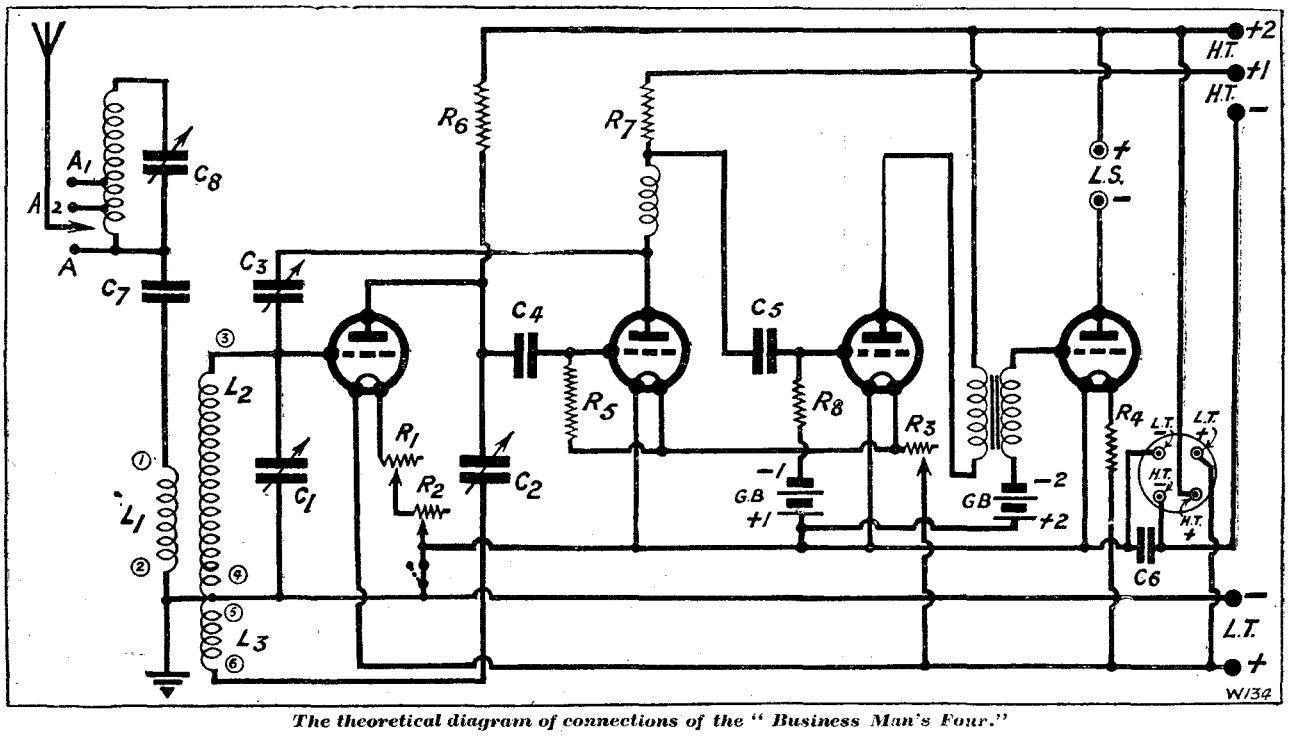
A Priceless Advantage

On the second aerial used for tests of WIRELESS CONSTRUCTOR sets, consisting of about 50 ft. of wire indoors (the maximum height above the receiver being about 12 ft., representing a very poor outdoor aerial much inferior to the average), London, 5 G B, Langenberg, Frankfurt, Hamburg, Toulouse, Rome, Vienna, Breslau, and several other Continental stations were heard on the loud speaker at first-class strength. This list varies, of course, from night to night and sometimes from hour to hour, and it is not suggested for a moment that for long-distance results this four-valve set is comparable in sensitivity with the "Straight Line Four."

For comparison purposes it may be said that results obtainable are superior to those given by the Radiano Three, even when this is most skilfully handled to get the very best out of the reaction setting; while one has the priceless advantage of picking up all the stations obtainable on the Radiano Three by simply turning one knob. Once found, the positions can be noted, and the stations picked up again at any time desired, provided conditions are favourable.

Selectivity

The circuit as it stood was not quite selective enough for the listener who dwells near a main station and wishes to receive a station such as Hamburg or Stuttgart in the London area. To overcome this slight disadvantage a standard wave-trap is built into the set, and this, as in the case of the reaction control, can be adjusted once and for all when the set is built. The set then becomes as selective as one can desire, without any loss of efficiency, the local station being completely tuned out two or three degrees on either side of the maximum point.



The theoretical diagram of connections of the "Business Man's Four."

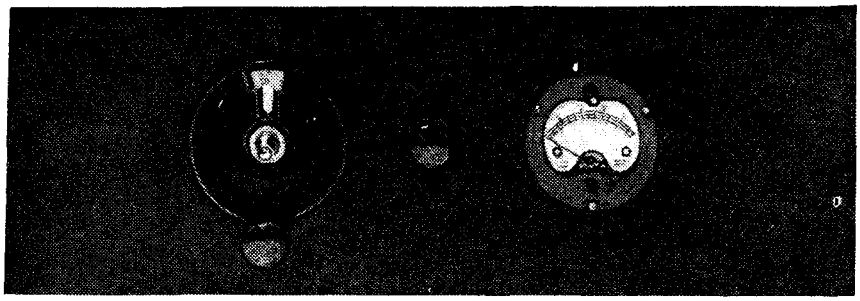
The Valves to Use

The first two valves are of the R.C. type. The third valve should be a small power valve, or if used with a low-frequency transformer with a high-impedance primary, such as the R.I.-Varley, Royal, or Ferranti, one of the so-called high-frequency valves with an impedance of 15,000 to 25,000 ohms, with a magnification factor of about 15 to 25, is better

The "Business Man's Four"—*continued*

here. The last valve should be as good an output valve as you can get. If economy in high-tension current is desired, then a small power valve can be used, but if a good supply of high-tension is available, a super-power valve should be fitted. Suitable valves are obtainable from all the leading makers in 2-, 4-, or 6-volt varieties, and, providing the first two are R.C. valves, you will have no trouble whatever in adjusting the constant reaction of the set.

A high-tension battery of at least 100 volts is required, and, better, a 120-volt. The low-tension accumulator should be of adequate size, to obviate the necessity of frequent re-charging. Naturally the filament current requirements of the valves, and the time the set will be in use, will affect this also.



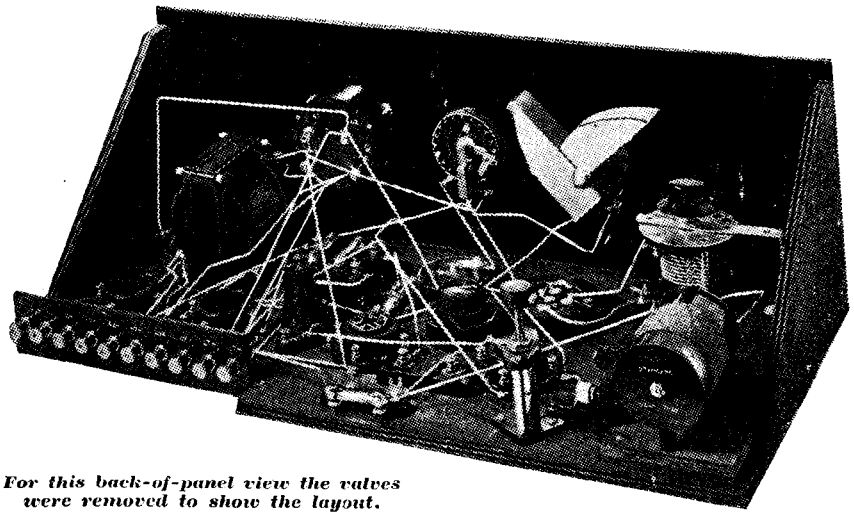
The front of the panel is very businesslike in appearance. Note the triple-scale meter, which shows at a glance the L.T. and H.T. voltages and the total H.T. current.

The Cabinet

The cabinet shown on the cover and in the illustrations with this article is a handsome type with cupboard beneath to take the batteries. It is made by Messrs. Pickett's, of Bexleyheath, and is called the "Radiola," and is obtainable in either oak or mahogany. The one actually used is in mahogany. It is provided with a drop front, so that when the cabinet is shut it has the appearance of a bureau, and will not disfigure any room; while the tuning dial and meter is immediately disclosed on dropping the front panel. Those readers who do not desire a complete cabinet of this type can obtain a convenient "American" type cabinet from any of the leading makers, such as Camco, Artcraft, Raymond, Makerimport, Caxton, etc., or from the makers of the cabinet shown.

Shunting-Condensers and Output Filters

It is always advisable to shunt the two tappings of the high-tension battery with Mansbridge condensers, and to use an output filter of some kind. A number of output filters have been described from time to time in the WIRELESS CONSTRUCTOR, but perhaps the simplest of all is to use a 1-to-1 output transformer such as those sold by R.I.-Varley, Ferranti, or Pye. Their use is quite simple, as it is only necessary to join the two loud-speaker terminals to the primary terminals of the output transformer, the secondary terminals of which are connected direct to the loud speaker. In this way the loud-speaker windings are kept free from the heavy direct current flowing through a super-power valve, and the resistance of the loud-speaker winding no longer causes an appreciable drop of voltage on the plate of the last valve.



For this back-of-panel view the valves were removed to show the layout.

In order to make the photographs as clear as possible yellow Glazite wire has been used in this set, as in this way the leads show up clearly against the dark background. A neater-looking set, however, can be made if black Glazite is used. This is obtainable from the London Electric Wireless Co. at the same price as the yellow or other colours.

Constructional work presents no special difficulties. The front panel carries just the tuning condenser, the combined volume control and on-and-off switch and the Ferranti meter. Cutting the hole for the meter is the most difficult task. The simplest way is to scratch a circle of a size to take the barrel of the meter. A few holes can be drilled here and there on the line and the disc of ebonite cut out with a fretsaw. Cutting ebonite with a fretsaw is a very easy task and a much better way than laboriously drilling a large number of holes, knocking out the centre and filing the hole smooth.

Method of Mounting

Instructions for mounting the Indigraph dial are given in the carton with the dial.

Special pains must be taken to follow the layout very carefully and particularly on the high-frequency side. The length, shape and position of the lead going from the plate of the detector valve to the top of the neutralising condenser is most important.

It will be noticed that a portion of the baseboard is cut away for the insetting of the terminal strip. This is done in order that the leads from the terminals can be taken through a hole in the cabinet and so through to the batteries, etc., underneath. Of course, if the set is used in the ordinary type of cabinet which is cut away at the back to allow for the

The "Business Man's Four"—*continued*

terminal strip, there is no need for this insetting.

Another practical point is the method of mounting the ·0001 mfd. Midget condenser. A metal strip is bent at right angles and a $\frac{3}{8}$-in. hole drilled in it so that the condenser which is of the one-hole-fixing variety can be securely fixed to this strip in a convenient position. It will be noticed that the front panel is held on wooden angle-pieces and not on the conventional brackets. The baseboard with the angle-pieces in position is as supplied with the Pickett cabinet, but if ordinary brackets are used a small wooden support can be screwed down to the baseboard in order to carry the metal strip, or this can be bent to form its own bracket. There is no need for the condenser to be placed on the front panel as the adjustment of it is made once and for all when the set is first put into commission.

The Earth Connection

If the theoretical drawing is examined, it will be seen that the earth connection is made to the negative L.T. For this reason there is no need to provide a special terminal at the back of the set for the earth, as the earth lead is taken to the negative L.T. terminal on the accumulator itself—generally a more convenient position, as the battery is, generally, either in the lower part of the cabinet or on the floor, and the earth wire is often unsightly.

Three sockets are provided on the wave-trap, marked respectively A_1, A_2 and A. The aerial wire is brought to a wander plug which can be pushed into one of these three sockets at will. When the aerial plug is in A the

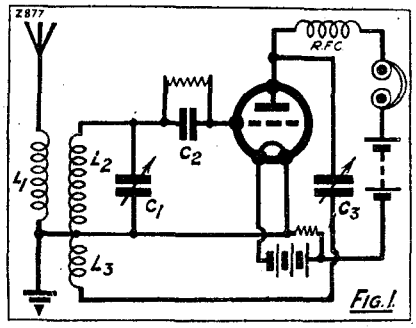


FIG. 1.

wave-trap is not in circuit; when in A_1 it is joined to one tap on the winding, and when in A_2 to the other tap. The degree of trapping will be somewhat different on each tap and you will have to try which is the better for the particular aerial with which the set is used. Readers who are more than thirty or forty miles away from a broadcasting station will probably find the trap unnecessary, but within this distance the trap is very useful in enabling a much greater degree of selectivity to be obtained for cutting out the local station.

When the set has been wired-up we come to the preliminary adjustments, which fortunately are very easily made and will not disturb your neighbours by howling if you follow out the plan suggested.

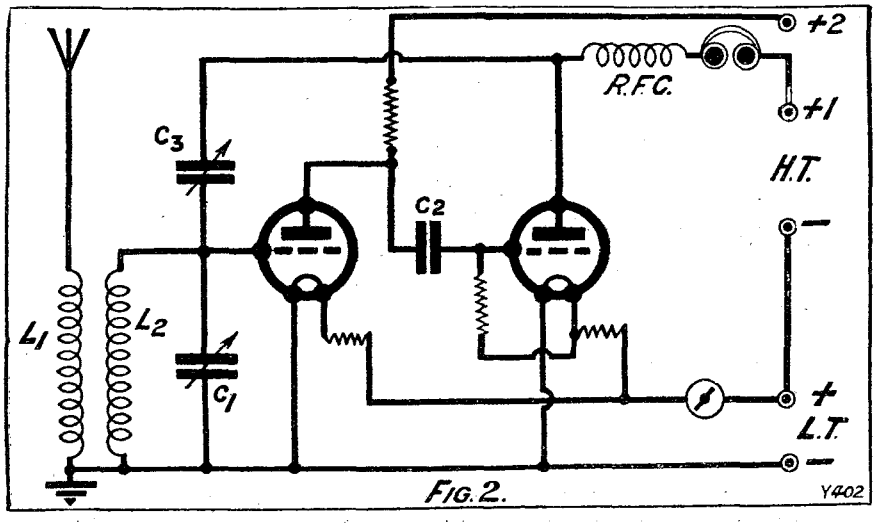


FIG. 2.

First of all, after checking over the wiring, join up your accumulator, high-tension battery and grid-bias battery, putting your maximum voltage on H.T. positive 2 (120 is a good figure) and 100 on H.T. positive 1. The H.T. voltmeter reading, by the way, will show the maximum across H.T. positive 2; there is a little switch on the front of the meter which when turned to the left shows the low-tension voltage, on the middle the total current consumption taken from the high-tension battery, and on the right the high-tension voltage.

H.T. Voltages

Insert your valves in position and before switching on make sure that you have adjusted your grid-bias battery to the correct grid bias for the voltages and valves in use. The maker's chart or leaflet in the valve box will always tell you the correct grid bias to use for a certain high-tension voltage. The two note-magnifying valves and the high-frequency valve are all connected to H.T. positive 2, while H.T. positive 1 is joined to the detector valve only. Thus in choosing your grid bias for the first and second note-magnifying valves remember that both have the same high-tension voltage, which, I suggest, should be 120, if you have this much available. In any case, do not use less than 100 volts if you want good results.

Preliminary Adjustments

The low-tension voltage will only be given when the on-and-off switch is "on," but the high-tension voltage will read whether the switch is on or off. The milliampere reading, of course, will not be obtained except when the switch is on, so when leaving the set it is as well to turn the meter switch over to the left—that is to say, to the low voltage reading. In any case, it is recommended that the meter be left on the low voltage side save when one or other of the readings have to be taken, and in this way a glance at the instrument will always show whether it is switched off or not.

Now take your neutralising condenser (I call it this for lack of a better term, although, of course, it is not used for neutralising here) and screw it upwards so that it is at its minimum capacity position. Also set the vanes of the ·0001-mfd. Midget condenser at the minimum capacity (that is to say, with the vanes "all out"). Turn the tuning condenser backwards and forwards from minimum to maximum, all the time

The "Business Man's Four"—*continued*

tapping the fixed plates with the moistened finger tip.

You will hear a slight click in the loud speaker when you touch the plates, but not when you remove the finger. Remember that during this test the aerial and earth are not connected, so you will not hear any signals. Now turn the moving plates of the ·0001-mfd. Midget condenser so that they are half interleaved with the fixed plates, and repeat the movement of the condenser from top to bottom, all the time tapping with the moistened forefinger on the fixed plates. The set will now probably be oscillating, an indication being given by a sharp "plock" not only when you touch the fixed plates of the tuning condenser with your finger, but when you *remove* your finger as well.

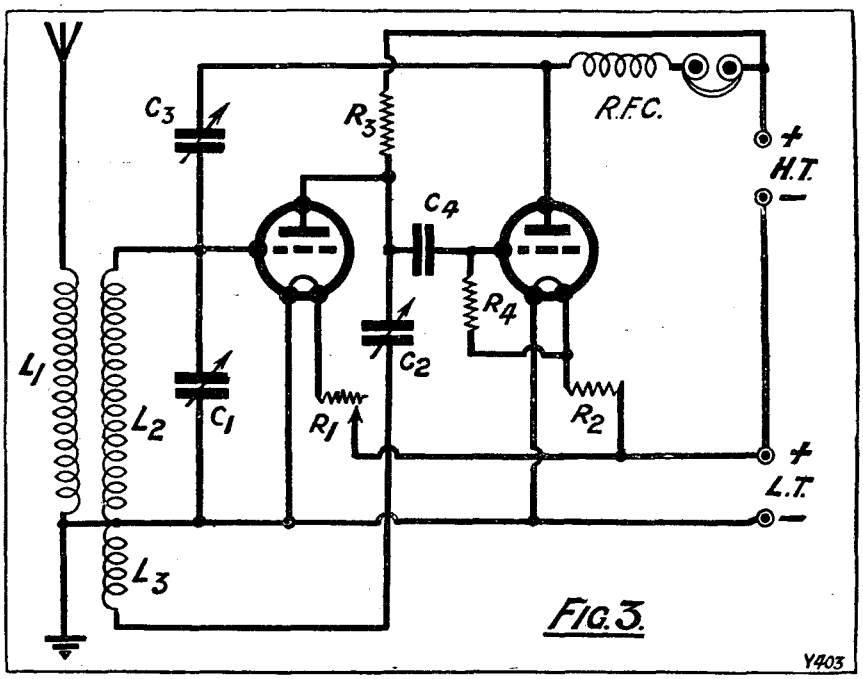


FIG. 3.

The Baseboard Rheostat

This may happen over the whole of the tuning scale or only over a portion and it will probably happen over the first half of the scale, the double "plock" ceasing when you reach about fifty and upwards. If by any chance (and this may happen with some makes of valves) the set is oscillating over the whole of the condenser, reduce the capacity of the ·0001 mfd. until you get the double "plock" over only about half of the scale.

Now, leaving the Midget condenser at this setting, slowly screw in the neutralising condenser, still continuing the wet forefinger tapping. You will find that after a few turns the reaction effect will increase and the double "plock" will extend over a wider band of the scale, and soon over the whole of the scale. Next reduce the capacity of the Midget condenser slightly and again readjust the neutralising condenser by reducing its capacity slightly, and after a few experiments you will find a position where you just do not get the double "plock" over the whole band. In arriving at this setting you will probably find a condenser setting which:

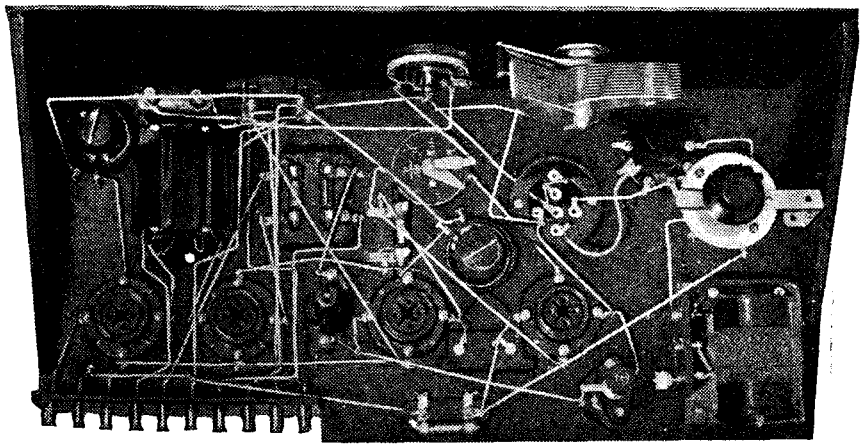
1. Will give you the double "plock" at the top of the scale and not at the bottom; and
2. Will give you the double "plock" at the bottom of the scale and not at the top.

If you get oscillation at the top and not at the bottom it is an indication that not quite enough of the Midget condenser is in circuit and a little too much of the neutralising condenser.

It should be explained that while these adjustments are taking place the baseboard calibrated rheostat which is in series with the volume-control rheostat should be set at zero, or with all the resistance cut out. With one or two makes of valves —and, in particular, the Cossor R.C. valve—the adjustment will only be found to be right when a little of this resistance is in series—say about 5 ohms; but with most makes of R.C. valves practically all the baseboard resistance can be cut out.

Filament Adjustment

The method of filament control on this receiver is to have a separate filament resistance mounted on the baseboard for the last or output valve and one filament resistance to control the filaments of the detector and the first note-magnifying valve, both of which should have the same filament consumption. The adjustment of the filament resistance which controls these two valves should be such that in all the preliminary tests all the resistance is cut out; in other words, they should be at the full-on position. As soon as the set is found to be working satisfactorily some amount of resistance can be put in

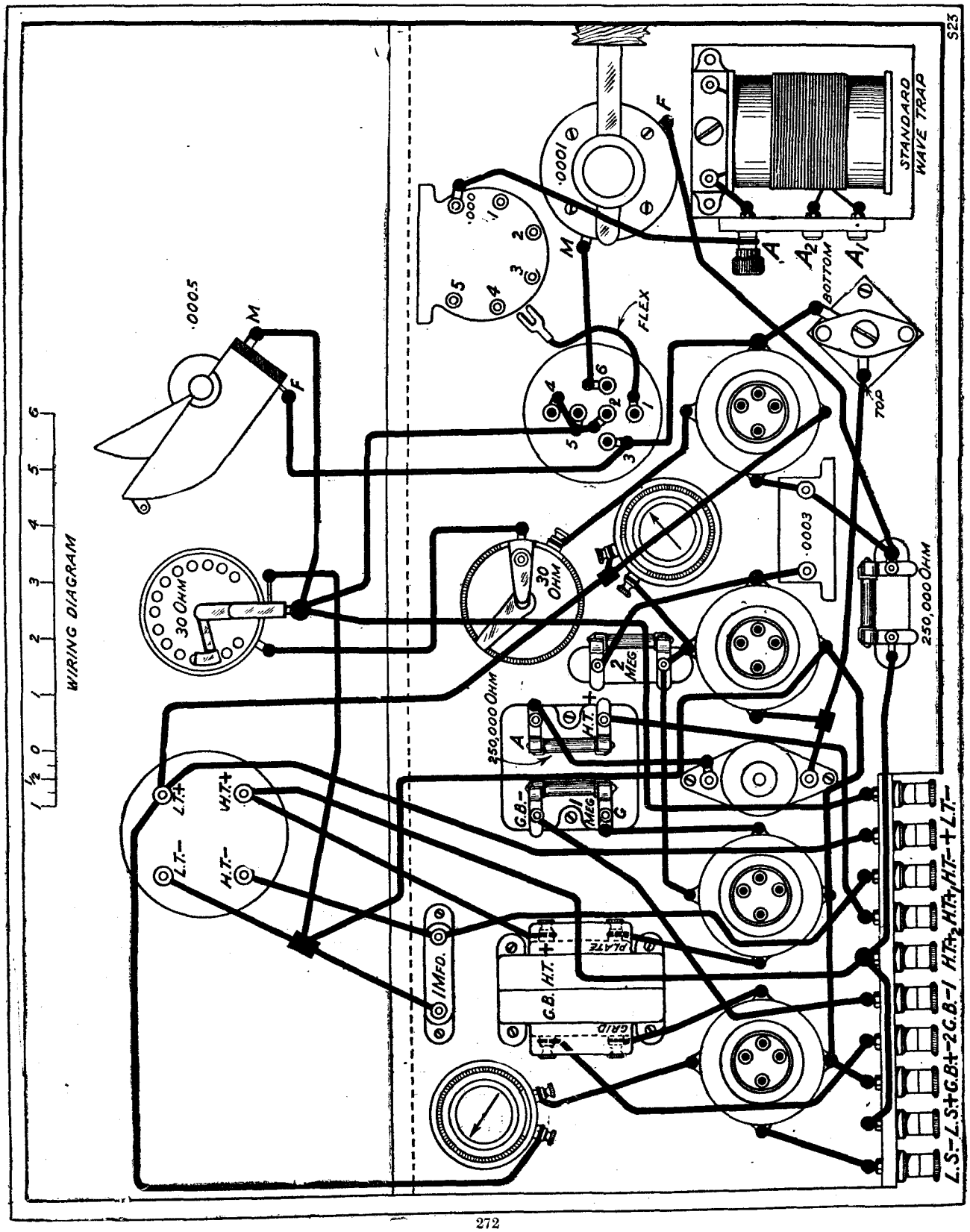


A "looking down" view of the baseboard, showing the spacing.

The "Business Man's Four"—*continued*

circuit. Adjustments should be made on a weak signal and the filaments dimmed as far as possible without reducing strength. With modern valves there is no real necessity for such a filament resistance, but by dimming the filaments slightly the valves will last longer.

(*Continued on page* 322.)

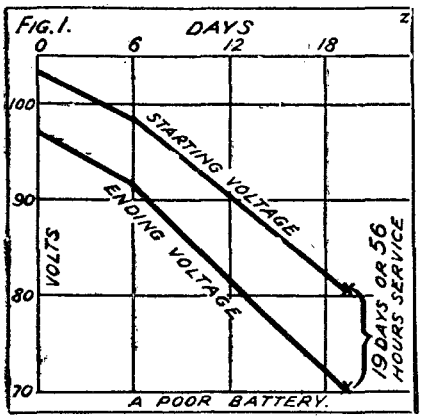


A Searchlight on the H.T. Battery

This highly important article, specially prepared for the "Wireless Constructor," should be studied by every set user.

By R. W. HALLOWS, M.A.

THE problem of high-tension supply has always been one of the most difficult in practical wireless reception. My own view is that by



far the most economical and satisfactory method is to employ dry-cell batteries, for so long as these are of good make and of a capacity adequate for the load placed upon them very little trouble of any kind is experienced. Many will agree with me; many, again, will dissent with varying degrees of violence.

Using Dry Cells

I must admit that my experience of working direct off the mains is but second-hand, since I am not fortunate enough to have electric light in the house. For the same reason I cannot charge my own high-tension accumulators, which therefore have to be left to the more or less tender mercies of the charging station. Still, when I compare my own running costs in the matter of high-tension supply with those of friends who give their sets an equal amount of use, I do not find that I am unduly extravagant.

So far as trouble is concerned—well, touching wood, I may say that I have not had any. The whole secret of success when dry-cell batteries are used lies simply and solely in the installation of units capable of standing up for a reasonable period to the load imposed upon them. This, unfortunately, is a point that is not realised by large numbers of wireless enthusiasts.

Three Main Groups

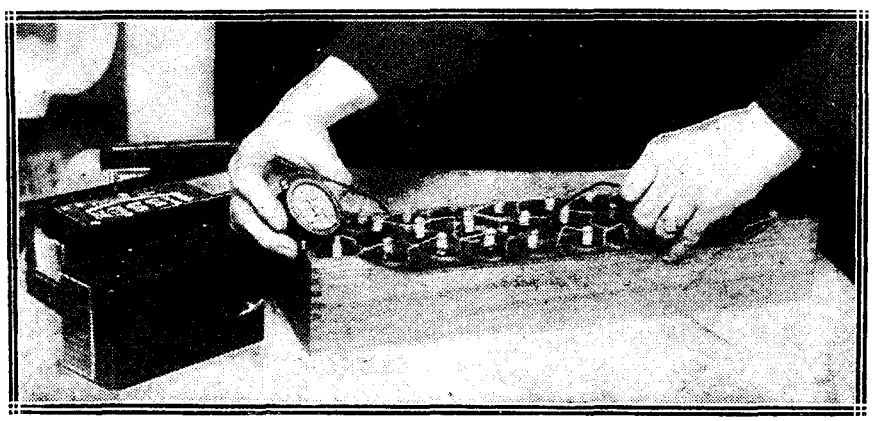
Dry high-tension batteries fall as regards capacity into three main groups. There is, first of all, what may be called the "standard capacity" battery built up of cells measuring on the average $\frac{3}{4}$ in. in diameter by $2\frac{1}{8}$ in. in height. Next comes the large capacity battery whose cells average $1\frac{1}{4}$ in. in diameter by $2\frac{1}{4}$ in. in height. Lastly there is the "super" capacity type whose cells have a diameter of $1\frac{1}{4}$ in. and a height of about $3\frac{1}{2}$ in.

Probably at least 75 per cent of the batteries sold, *no matter what the receiving set with which they are to be used*, are of the standard capacity type. In other words, the purchaser is apt to think only of the volts and not to bother about the milliamperes. When a given number of new dry cells, whether large or small, are wired in series, the potential on open circuit will always be in the neighbourhood of 1·5 volt per cell.

Rapid Voltage Drop

But whilst cells of large size can deliver a fair amount of current for a considerable time without much falling off in potential, those of small size show a rapid drop when under any but the lightest of loads. In the dry cell the fall in potential is of two kinds. There is, first of all, what may be called the temporary fall, which takes place while the battery is under load, and is due mainly to the effects of polarization. A film of hydrogen gas collects round the carbon positive element and this causes a rising resistance to be present within the cell, since the depolarizer cannot get rid of it sufficiently quickly.

When the cell is rested by being placed for a time on open circuit the accumulation of hydrogen is removed and the potential rises. It does not, however, quite reach its initial figure, and we thus have a second or permanent falling off in the voltage. From the wireless man's point of view both



Testing the voltage of a wet Leclanche type of H.T. battery.

A Searchlight on the H.T. Battery—*continued*

kinds of voltage drop are enormously important. We shall go more fully into the reasons in a moment.

There can be no doubt that for the single-valve set or for the two-valve or even three-valve set employed only for telephone reception the use of the standard capacity battery is quite sound practice. Such batteries will stand up to an intermittent load of from 3 to 5 milliamperes for a very long time. But matters are rather different when the receiving set is required to work a loud speaker.

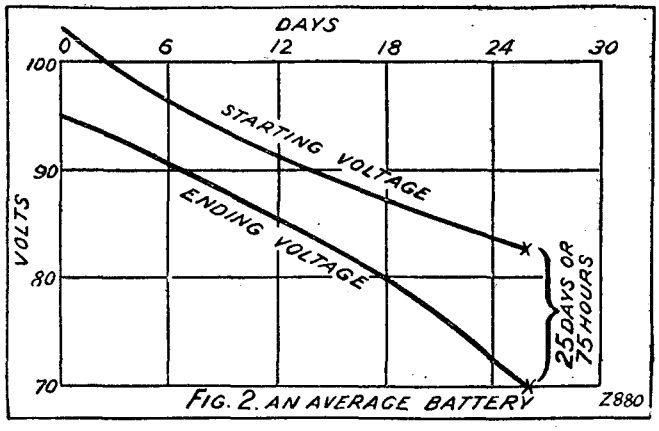


FIG. 2. AN AVERAGE BATTERY

This graph, denoting the life of an average H.T. battery, should be compared with Figs. 1 and 3.

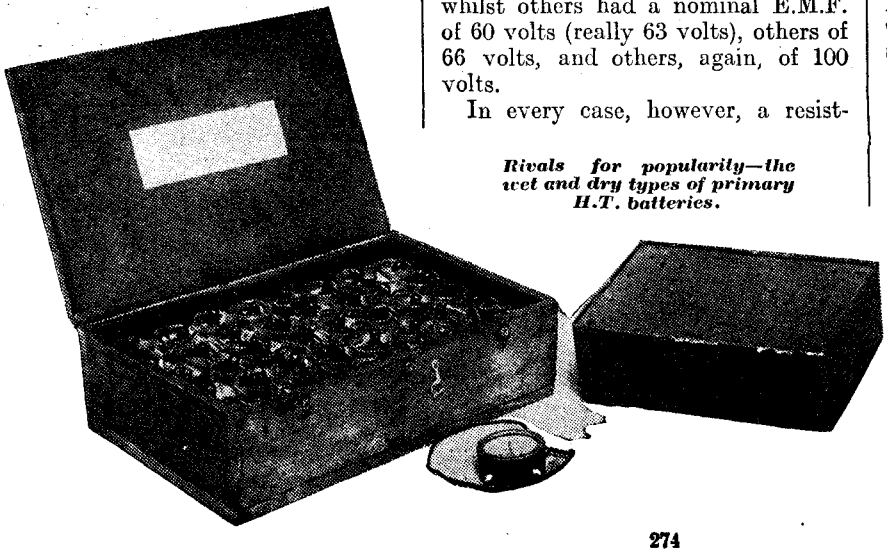
Heavier Loads

If anything like quality is desired a small power valve must be used in the last holder, and for really faithful reproduction a super-power valve is indicated. Both power valves and super-power valves impose heavy loads upon the battery, and the current required is likely to be from 8 to 20 milliamperes, according to the size of the receiving set. It is probably fair to take the current passed by the average loud-speaker set when the high-tension battery is in good condition at about 10 milliamperes. How will the standard capacity battery deal with this load? The question is an important one, and the best way of finding the answer seemed to be to undertake a series of tests under laboratory conditions. A load of 10 milliamperes when a battery is up to its full nominal E.M.F. is imposed when it is discharged through a resistance of 150 ohms per cell.

A Standard Resistance

This, then, was made the standard resistance for the tests. Since batteries differ considerably in the number of their cells and in the tappings provided the total terminal voltage was not by any means the same in all of those tested. Some, for example, were 36-volt units, whilst others had a nominal E.M.F. of 60 volts (really 63 volts), others of 66 volts, and others, again, of 100 volts.

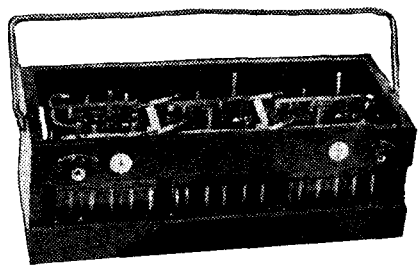
In every case, however, a resistance of 150 ohms per cell was used for the battery tested so that all were subjected to exactly the same drain. To make comparisons easier all results have been reduced to a percentage basis, an E.M.F. of 1·5 volt per cell being regarded as a hundred per cent. A battery was taken as done for when the E.M.F. had fallen to seventy per cent, or a little over 1 volt per cell.


Rivals for popularity—the wet and dry types of primary H.T. batteries.

The Test Periods

It was decided to run the batteries for three hours a day from Monday to Saturday inclusive in each week, giving them twenty-one hours' rest in each twenty-four, and a rest of forty-five hours over the week-end. The total service hours were thus eighteen per week, which is very much what is asked of the average high-tension battery. Only batteries of well-known type were selected for test and two of each make were used.

In every case the batteries were ordered specially so that there should be no possibility of their having deteriorated by having been in stock for a considerable time. The first process was to take the initial open-circuit voltage and this disclosed some interesting variations.


The H.T. accumulator is a thoroughly reliable form of anode current supply.

Big Differences

Batteries of the same make gave, as a rule, similar readings, but there were big differences between those of different makes. On the average the initial voltage was just over 1·5 per cell, but the test disclosed that it is not always the battery with the highest initial voltage that gives the best service.

For all the tests a voltmeter with a resistance of 37,500 ohms was used, for only with a high-resistance instrument can accurate readings be taken. Two of the batteries were found to have "bad spots" in them

A Searchlight on the H.T. Battery—*continued*

when received and these were immediately replaced by the makers.

Once the test was under way it proved to be full of interest—and of surprises. The first batteries to succumb (both of the same make) reached the seventy per cent mark on the nineteenth day, having given an average of fifty-six hours' service. These had the highest initial E.M.F. of any tested, and for the first week it appeared that they were going to do pretty well. At the end of that time, however, a rapid decline set in.

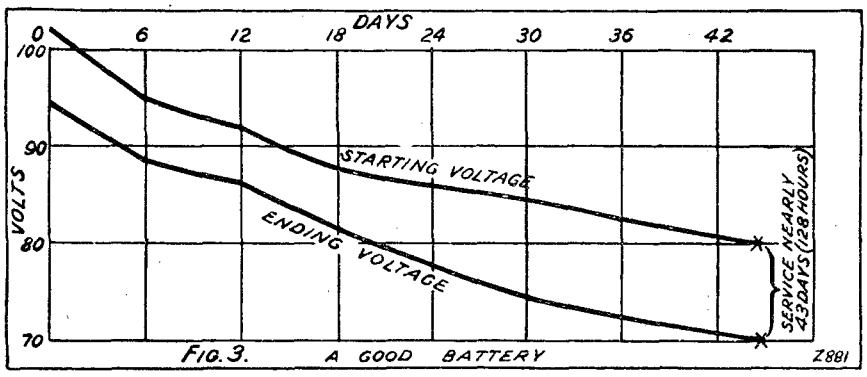


FIG. 3. A GOOD BATTERY

An Expensive Proposition

The performances of these batteries are recorded in the diagram in Fig. 1. The upper curve shows the voltage after the rest period and before the battery was placed under load; the lower curve indicates the voltage at the end of the three hours' run. The upper curves, therefore, show the permanent voltage drop, whilst the distance between them and the lower at any point shows the temporary voltage drop when the battery was under load.

It becomes clear that a battery whose performances are of the kind shown in Fig. 1 is far from being an economic proposition for high-tension supply in the multi-valve set. It would require renewal at least twelve times a year, and if the average initial cost of a standard capacity battery is taken as twopence a volt the expenditure per annum would work out at two shillings per volt, or £10 for 100 volts. If we take it that the receiving set is in use for a thousand hours during the year the running costs per hour for H.T. alone come to a little under twopence-halfpenny.

Good Average Quality

The curves of a good average battery of the standard size are seen in Fig. 2. Here the initial voltage is fairly high and the falling-off is pretty regular and not over-rapid, all things considered. It will be noticed, though, that after the end of the second week the two curves get farther and farther apart, indicating that a very big drop takes place whilst the battery is under load.

On the last day of its service this drop amounted to no less than eleven and a half per cent of the original voltage in the three hours. Batteries with performances such as those recorded in Fig. 1 are fortunately rare, and a battery of good average quality might reasonably be expected to behave as did those whose service history is shown in Fig. 2.

A Bit Cheaper

These gave exactly twenty-five days or seventy-five hours of service. Once more let us examine the financial side of the question. Approximately eleven renewals would be required in the course of a year, and taking twopence per volt as the average cost this works out at 1s. 10d. per volt, or £9 3s. 4d. for 100 volts. At a thousand hours per year the running costs for H.T. are 2·2 pence per hour.

In Fig. 3 is seen a diagram which plots the history of a good battery of the standard capacity type. It must not be imagined that these batteries are freaks. Of those tested, four other makes did quite as well and two slightly better. The batteries to which Fig. 3 refers gave almost forty-three days' service, the actual hours being 128.

The star performers amongst those subjected to the test survived for nearly forty-nine days, giving 145½ service hours. To turn once more to the financial aspect, the Fig. 3 batteries would require renewal about seven times in the year. This works out at 1s. 2d. per volt per annum, or £5 16s. 8d. per 100 volts per annum. The running costs are thus 1·4 pence per hour.

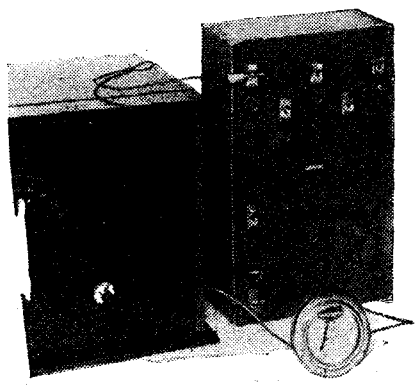
Not Good Enough

Even with the very best of standard capacities a renewal six times per annum is indicated, which is equivalent to a cost of 1s. per volt per annum, or £5 per 100 volts. At a thousand hours a year the running expenses are thus 1·2 pence per hour. This is considerably better, but it is certainly not good enough. Nor must it be forgotten that in laboratory tests ideal conditions are ensured.

The temperature is kept even and the load is varied only by the fall in E.M.F. In many valve sets a big and sudden variation of the load takes place through the throwing in or cutting out of one L.F. valve, or by the set being permitted to fall into oscillation. The load under working conditions depends also upon the condition of the grid-bias battery.

Value of Grid Bias

This is too often regarded as a fixture which requires no attention once it has been installed, and on many occasions when friends have asked me to discover why their sets were distorting badly I have found grid-bias batteries very badly run down. With a grid battery in a run-down condition the load upon the high-tension battery is enormously increased.


For multi-valve receivers a large capacity H.T. battery should be used and a milliammeter test of anode current is a valuable guide.

A Searchlight on the H.T. Battery—*continued*

Now let us see what is the effect upon the actual performances of the loud-speaker set which draws on the average 10 milliamperes of current from a small-capacity high-tension battery. Fig. 4 shows a family of curves for a typical small power valve such as is used, or should be used, in the set intended to give loud-speaker reproduction in the ordinary living-room.

The Grid-Bias Point

A new high-tension battery is installed with a nominal E.M.F. of 100 volts, and a reference to the published curves of power valves shows that the ideal working point is obtained by giving it a negative grid bias of about 6·6 volts. Since grid batteries are tapped in 1½-volt steps the grid bias applied will usually be 7·5 volts. The theoretical best working point is indicated at A in the diagram, and the practical working point at N. Now, as the plate potential falls off the whole curve is shifted bodily to the right, taking up successively the positions occupied by the 90-, 80- and 70-volt curves.

This movement to the right occurs as the potential of the high-tension battery falls off. But what of the grid-bias battery? The business of this battery is to supply not current but potential. In a properly adjusted set it is under no load whatever. Its service is therefore governed by its "shelf life." Even when it is placed upon open circuit a dry-cell battery gradually loses its original E.M.F.

The fall in potential is due to two main factors. The insulation is not quite perfect, therefore minute leakages take place, gradually sapping the original potential. In addition to this it must be remembered that no "dry" cell is really dry. The electrolyte consists of a paste containing a percentage of water.

As time goes on the water evaporates and the cell becomes less and less active. The grid battery is made up of cells of the same size as those used in the construction of standard capacity high-tension batteries. The shelf life of these is from nine to twelve months. Their usual history is that the potential remains fairly steady for a long time, and then falls off rapidly towards the end. There is no such fall as that which takes place in the case of the standard capacity high-tension battery.

Effect of Potential Drop

In Fig. 4 is shown what happens to the working point in the course of six weeks or so with a new grid-bias battery and a standard capacity H.T. battery. It moves straight downwards from A to D, and not in a slope from A to X to correspond with the movement of the curve. A little thought will convince the reader of the dire effects upon reception produced by a fall in H.T. potential,

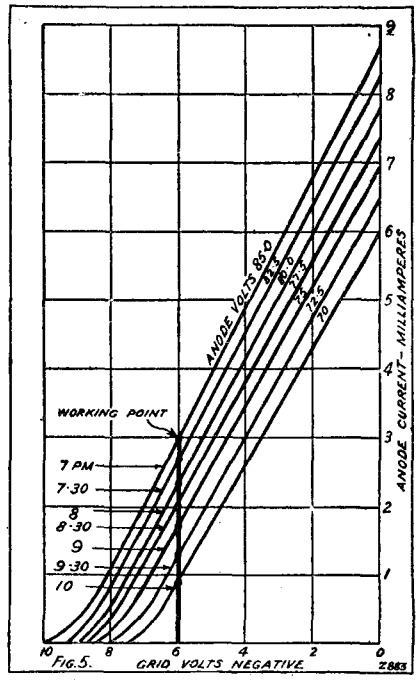


FIG. 5.

whilst the grid battery remains steady. Whilst the high-tension battery *is* giving 100 volts the working point is exactly right, and a theoretical grid swing of some 13 volts is obtainable.

With the working point at N in the diagram, the grid swing with which the valve can deal faithfully, though less, is considerable. As the H.T. potential falls off the working point assumes the position indicated by B, C and D in the diagram. When the high-tension battery is delivering only 90 volts the maximum grid swing that will not produce distortion is very much smaller, and at point C on the 80-volt curve it is very small indeed.

Partial Rectification

When point D is reached horrible distortion will result, for the output valve is turned practically into an anode-bend rectifier, which means that the lower halves of the waves reaching its grid will be terribly mutilated.

We see, therefore, that in the case

(*Continued on page* 334.)

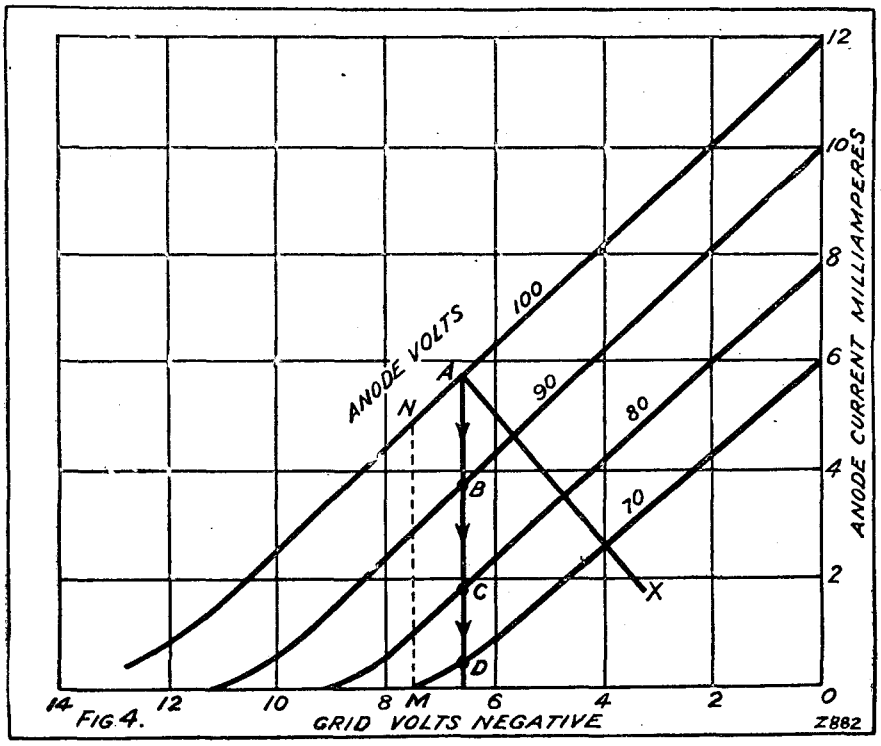
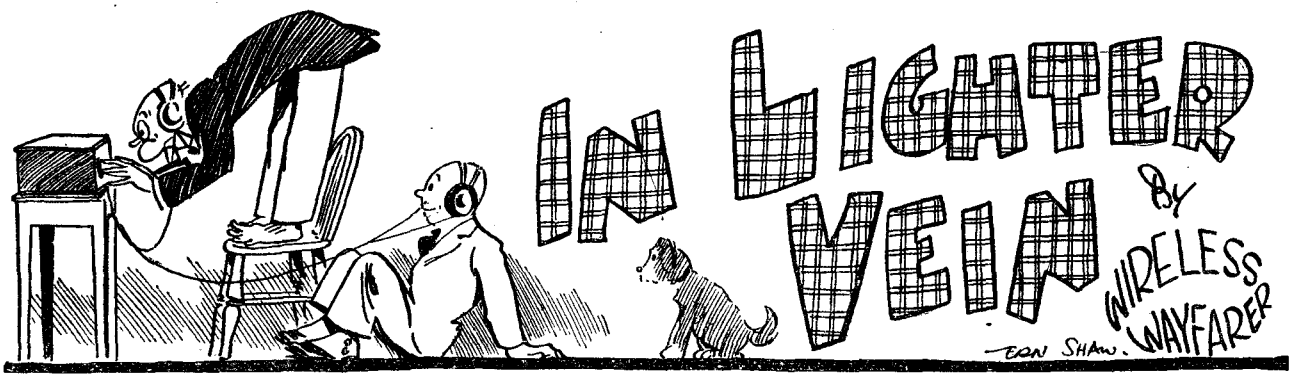
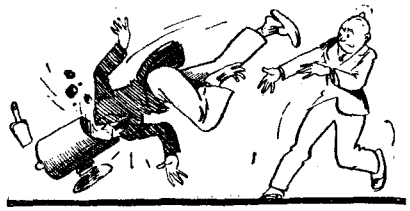


FIG. 4.



I FOUND Professor Goop having rather a hectic time with his short-wave set when I called round the other night. The poor fellow was somewhat chesty owing to the foggy weather, and he kept on mistaking the wheezes for carriers and trying unsuccessfully to tune them in.

I must admit that the professor's set was not completely immune from body-capacity effects. When I picked up and put on a second pair of 'phones that were lying on the table,



. . . seized him by the ankle and hurled him into the coal-scuttle. . . .

the thing fairly flew out and bit us. We found that in order to allow the professor to do the tuning and me to listen it was necessary for him to stand upon a chair whilst I sat on the floor.

Since he always uses rubber cushion things round his 'phones, he is completely deaf to all outside sounds whilst wearing them. With one of his pairs upon my head, I was also, of course, in the same condition. Still, we managed to communicate with one another when required by blinking our messages in the Morse code with our eyelids.

Radio "Transmission"

We could not see each other, for my back had necessarily to be towards his. But each eyelid movement produced a yelp in the receivers, and the thing worked splendidly. In fact, when he slipped from his chair and stepped on my hand, he was instantly able to Morse his remorse. I re-morsed: "Thnks for knd inquiries, O.M. Lttle dmge done. Pse don't do it again, O.M. Best 73's."

I have not the slightest idea what best 73's mean, nor do I habitually call people old man, or spell my words without most of their vowels. Still, all the worst transmitting men do it, so I thought that I had better be in the fashion.

In another moment the professor was back again, fearfully excited. He had picked up an undoubted carrier on 25 metres, and was doing his level best to resolve it. Not only the wave, but the wave-length, however, appeared to be oscillating, for just as he had nearly got it, it moved a little way first to one side and then to the other.

For the best part of half an hour he pursued it up and down the wave-band, but never managed to achieve his purpose. When he was about tired out I seized the knob of the reaction condenser and waggled it in dots and dashes to spell out: "Primpleson U ass, U and the prfssr have bn chsng each other up and down the waves, U blthrng goat O.M. QED QEF SPQR RSVP AOFB shrrp."

A New Invention

"Now," I said to the professor, when I had explained what had been happening and he had been prevailed upon to reconsider his decision to sally forth in search of Primpleson with a meat chopper, "and now I feel sure that you must have some new invention to disclose in order that I may give it to the world."

A smile spread slowly over the professor's erstwhile ruffled countenance.

"You are right," he beamed.

"Of course," I said, "I always am."

"You never are," roared the professor, "at least, this is the first time I've known it."

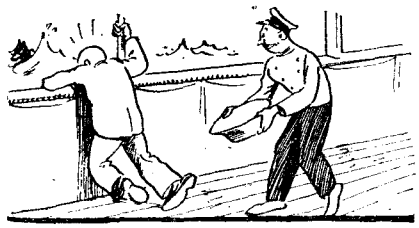
"At any rate," I riposted, "I was *half* right the other day when I told Tootle that you were a wit."

It took the professor just a little time to see that, but when it dawned upon him he went slap in off the deep end. Honestly, I believe that if the good red blood of my medieval ancestor, Sir Ethelwolf Thickith'pate, had not transmitted to me one of his most outstanding characteristics, I should have been absolutely laid out when my respected colleague whanged me three times over the head with the poker.

I Retaliate

I feel, too, that there might even have been almost a little roughness if, after he had jumped four or five times on my chest, I had not seized him by the ankle and hurled him into the coal-scuttle. How lucky it is that amongst perfect gentlemen anything that savours at all of violence is taboo. In similar circumstances I can quite imagine hooligans such as Tootle and Goshburton-Crump flipping their fingers in one another's faces, slapping hands or proceeding to similar extreme measures that simply are not done in the best circles.

When I had revived the professor with the contents of three siphons, a quart bottle of soldering fluid, and a jar of ink, which was all that I could find in his study in the way of moisture, I returned once more to my original query.



. . . the human heaving gear.

"How about this latest invention?" I asked.

Thoughtfully rubbing a bump on his chin, which was the result of a gentle pat that I had given him with a chair, and pushing aside with his disengaged hand the grandfather clock that had somehow come to rest across his little Mary, Professor Goop began

In Lighter Vein—*continued*

in a voice which for some queer reason was rather quavering:

"You will know," said he, "you will know that up to the present the position is pretty hopeless; that if you have a horn loud speaker you get distortion, and if you have a cone loud speaker you get distortion of another kind, and if you have a pleated loud speaker you get distortion of another kind, and if you have a moving-iron loud speaker you get distortion of another kind, and if you have a moving-coil loud speaker you get distortion of another kind, and if you have a coil-driven loud speaker you get your blessed head blown off unless you build a special room about the size of a church."

Scrap All Loud Speakers

"True," I sighed; "too true. But what is to be done?"

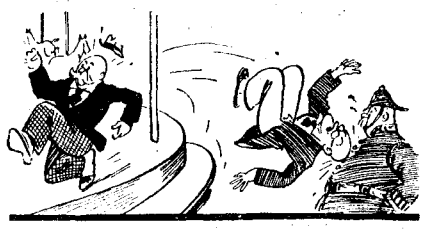
"The only thing," said the professor, "is to scrap all the old ideas about loud speakers and to start on completely fresh lines. I have just worked out the finest thing in the way of loud speakers ever conceived by the mind of mortal man. The principle, though ingenious, if I may say so, is perfectly simple. You are familiar with the calliope or steam organ which enlivens the fair-ground at Mudbury Wallow on occasions in the summer-time?"

I nodded to signify that such was the case.

"Do you remember that time when you tried to race Sir K. N. Pepper the wrong way round the roundabout and fell off?" I asked.

The professor held up his hand.

"Kindly be serious," he begged; "though, at the same time, I would



. . . fell off the roundabout.

point out that I was merely giving Sir K. N. a little explanation of the principles of relativity, and showing him that it is possible to remain in the same place whilst moving very fast."

"But——" I began.

"Ssh!" said the professor. "We are talking about my new loud speaker. We will let bygones be have-beens. Now you have probably noticed that the calliope gives its full value to every note?"

"I certainly got my twopen-n'orth," I cooed, with a reminiscent smile.

"No, no," barked the professor. "I am not talking of mere sordid cash. What I mean is that there was no suppression of the bass, or of the higher frequencies."

"And now," said the professor, "I will explain to you the working of the Goop Calliope loud speaker. You understand the principle of the steam steering gear aboard ship?"

I told him that aboard ship the only thing of which I had had any real experience was the human heaving gear.

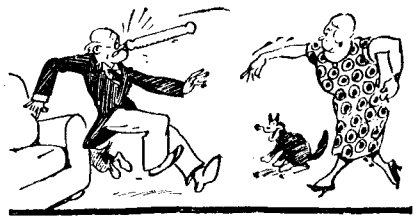
With a sigh of resignation the professor proceeded to explain that when the wheel was moved it did not haul the rudder round direct; it merely controlled a neat little steam engine, which did—if, or, rather, he, may be pardoned for saying so—all the donkey work. In the Goop Calliope loud speaker steam once more proves its usefulness.

The principle, I gathered, was this. The speaker itself consisted of a number of organ pipes, ranging from the squitty little chap that produces the squeaks to the great big fellow which makes you feel all funny inside when he is turned on. Fitted to the kitchen range is a special boiler in which a head of steam at about 180 lb. to the square inch is generated by the aid of the fire.

The "Works" of the Calliope

To each of the loud-speaker pipes runs a tube from the boiler, and in each tube is a valve. Not one of those glass things that you borrow from Tootle when you have burnt out those that you borrowed from Captain Buckett, but a kind of tap affair which opens and closes the tube and so regulates the supply of steam to the pipe. Roughly speaking, about one hundred and fifty pipes are required, and each of these is fitted as regards its valve with a special actuating mechanism operated by the output of the receiving set.

Attached to the output terminals is a neat and compact little contrivance about the size of a billiard table, containing one hundred and fifty oscillating circuits each tuned to a musical frequency. When the note C1, for example, is spoken, scraped, thumped, blown, chanted, caterwauled, hummed, whistled, banged, whacked, or otherwise delivered to the microphone in the studio the corresponding frequency is pushed out from the plate of the last valve in the receiving apparatus.



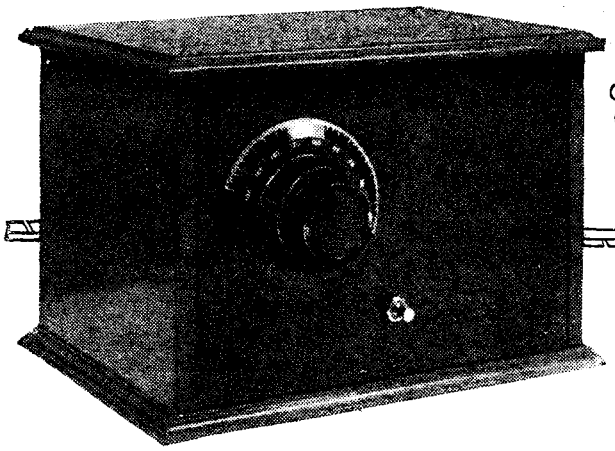
. . . Mrs. Goop . . . armed herself with a rolling-pin. . . .

This brings into action the circuit tuned to C1, which energises a large magnet and opens the valve (really I must drop calling the glass things tubes to avoid confusion in this lucid explanation, and refer to the other things as valves), opens the tube then in the tube—no, this won't do. The output from the last tube then causes the magnet to become energised and so opens the valve in the tube.

I am trying to be as simple as I can, and I find that a valve means two things, and a tube also means two things, both of which I want to use. Anyhow, you can see what I mean, or if you can't you had better chuck wireless and take up knitting, if that is not casting purls before swine. The steam rushes down the thingametite, and sets the C1 organ pipe going, and you hear the note properly brought out. Similarly, if C3 is played you hear a C3 note.

Mrs. Goop Intervenes

Speaking from actual experience, I can vouch for the fact that the Goop Calliope loud speaker is absolutely distortionless—so far as reproduction is concerned. It was, however, responsible, I must admit, for a little distortion of a physical nature when first tried out, for Mrs. Goop, on finding her drawing-room furniture pushed out into the garden to make room for the Calliope, armed herself with a rolling-pin, with the result that the right side of the professor's nose is now just under the lobe of his left ear.



A Screened-Grid Valve Unit for Your Set

This compact unit, which is a "follow-up" of certain experiments carried out in the WIRELESS CONSTRUCTOR laboratory in evolving the "Straight Line Four," makes an admirable addition to the "Radiano Three," and similar receivers, enormously increasing their range and sensitivity.—Editor.

By HARRY P. WOOTTON.

THE writer has been informed that a number of inquiries have been received for a single-valve H.F. unit, utilising the new screened-grid valves, for addition to existing sets. The construction of such a unit is

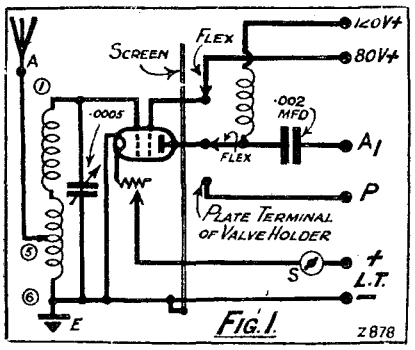


FIG. 1.

quite simple, providing certain precautions are taken, and the circuit chosen by the writer is one which the Editor has found particularly useful in connection with the screened-grid valve, i.e. the "parallel-feed."

With only one stage of screened-grid high-frequency amplification, elaborate screening of the receiver itself is not necessary, and provided the first grid coil is astatic or of the "fieldless" variety and that a suitably proportioned screening (of metal, earthed) is used, it is not necessary to enclose the stage in a complete metal case.

Astatic Aerial Coil

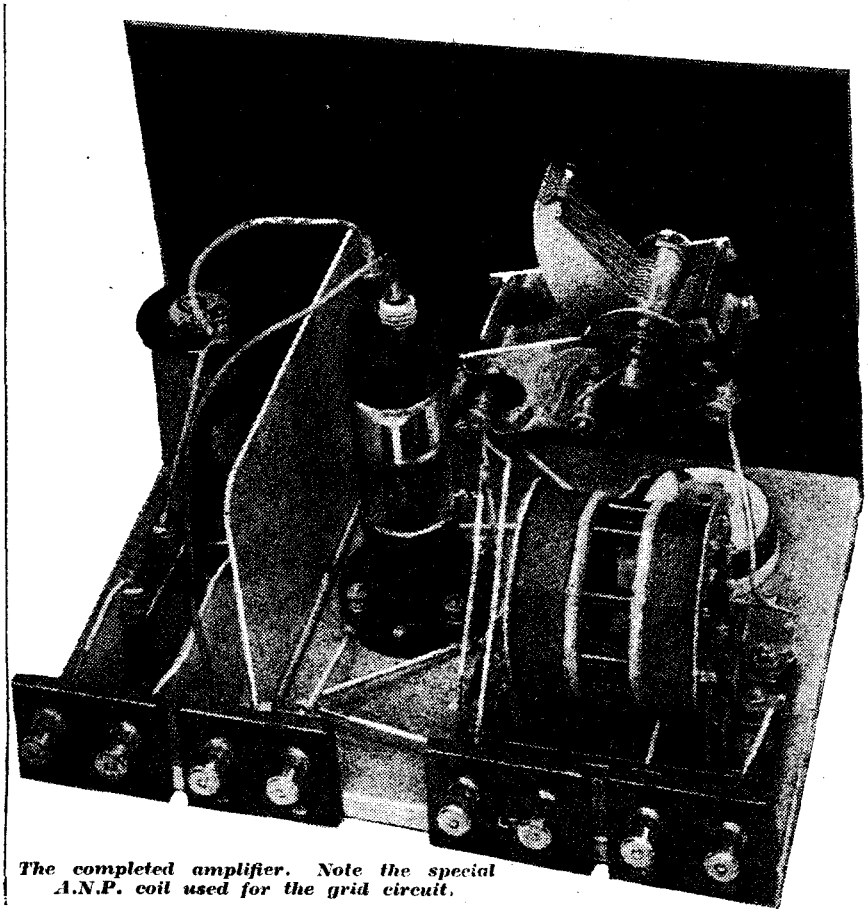
Examination of the theoretical diagram in Fig. 1 shows that the aerial is tapped on to the first grid coil, the two halves of which are wound in opposition, so as to produce an "astatic" effect. The actual coil used for this purpose is that manufactured by the Cosmos people and is known as the "Astatic Non-Parasitic" coil. The "non-parasitic" winding is designed to prevent unwanted short-wave oscillation in centre-tapped circuits of the neutrodyne variety, and as in this particular use of the coil we are not using a centre-tapped circuit, it is not necessary to make use of the non-parasitic winding.

There are six terminals on the coil base—Nos. 1 and 6 being the ends of the coil, and the Nos. 2, 4 and 5 the taps. The No. 5 tap is used in the receiver described, giving quite a good degree of selectivity.

Connection to the control grid and filament of the screened-grid valve is made in the usual way, while the screening grid itself is connected to an 80-volt tapping on the high-tension battery. The plate of the valve is connected to a radio-frequency choke of good quality, and through this to a 120-volt tapping on the high-tension battery, while a connection is also made to the plate direct from one side of a ·002-mfd. fixed mica condenser, the other side of which is connected to terminal A_1.

H.T. Neg. Connection

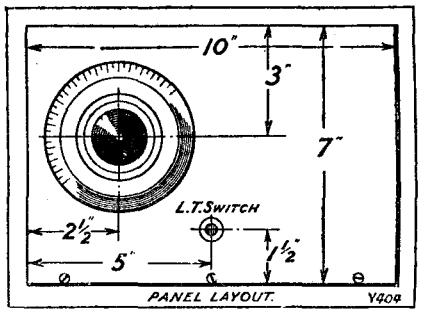
The switch for controlling the filament is in the positive L.T. lead, and it will be noticed that there is no H.T. terminal. This is because the unit cannot be used by itself, only in conjunction with a receiving set in which the high-tension negative connection is already made.



The completed amplifier. Note the special A.N.P. coil used for the grid circuit.

A Screened-Grid Valve Unit for Your Set—*continued*

Terminal P needs a little special explanation. Screened-grid valves are now available from Marconi, Osram, Cossor and Mullard. The Marconi, Osram and Cossor have the



same pin arrangements, being double-ended valves with three pins at one end and two at the other. At the three-pin end, as readers already know, the plate pin is missing, the two filament pins being connected normally with the filament and the grid pin to the ordinary or control grid. At the opposite end of the bulb the two filament pins are missing, the grid pin being connected to the screening grid and the plate pin to the actual plate of the valve. This arrangement applies to the Marconi, Osram and Cossor valves only.

The Mullard screened-grid valve, on the other hand, has an ordinary four-pin base on which the filament pins are normal, the grid pin normal, but the plate pin different. This pin is connected, not to the plate as in an ordinary valve, but to the screening grid, the plate connection being made to a single terminal at the opposite end of the valve. It is rather a pity that all the valve manufacturers could not have standardised on their pin arrangements for the new screened valve, since these are destined to play a very important part in future wireless sets, but as they have not done so we must make the best of it.

Universal Arrangement

In the present receiver the author has managed to arrange matters so that without constructional alteration the Marconi, Osram and Cossor and Mullard valves can all be used. This is done by using an ordinary valve holder, the filament and grid sockets being connected as usual, but the plate socket being connected to a special terminal marked P.

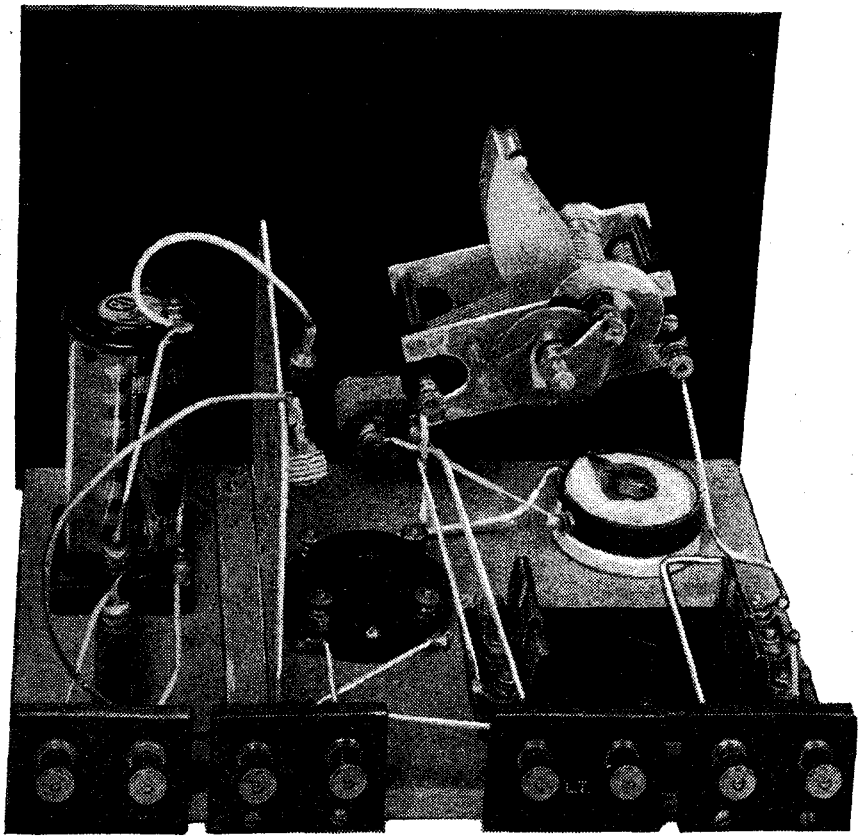
Flexible leads from the 80-volt terminal and the R.F. choke are taken to "Clix," which it is found fit perfectly over the two pins of screened-grid valves of the double-ended variety and make a good sound contact. The plate socket of the valve holder and the terminal P are thus idle when the double-ended valve is used.

When using the Mullard valve the flexible lead connected to the screening-grid socket of the double-ended valve is not used, and the 80-volt terminal is simply joined to the terminal P, the other flexible lead connected through a radio-frequency choke to the 120-volt terminal being connected to the top terminal

LIST OF COMPONENTS.

The components required are as follow :

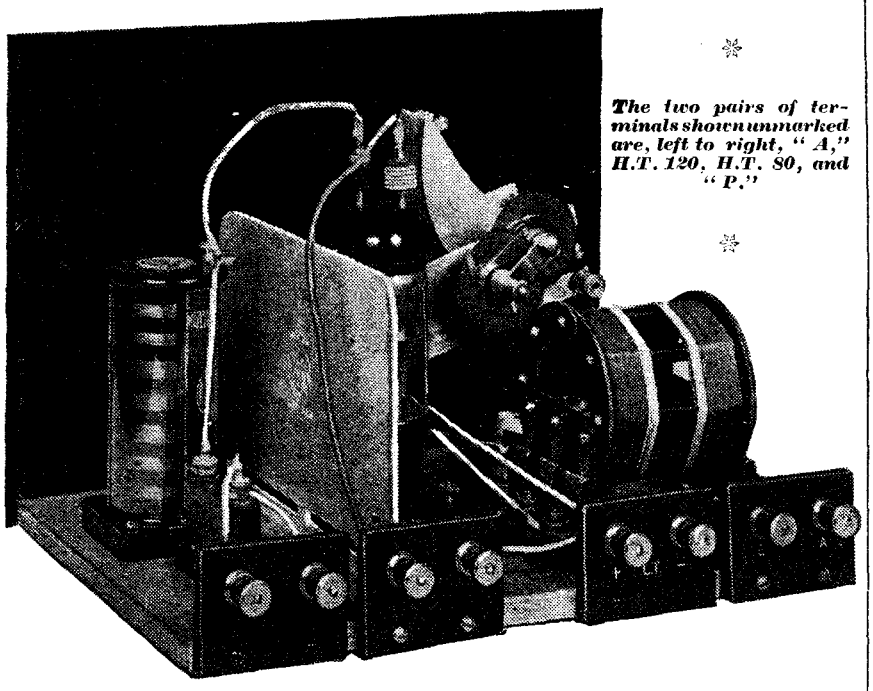
1 Panel 10 in. × 7 in., with baseboard 7 in. deep (Ebonart, Radion, Resiston, etc.).
1 Cabinet for same (Arteraft, Carrington, Caxton, Makerimport, Pickett, etc.).
1 Variable condenser, ·0005 mfd., with vernier (Any good make, the one actually illustrated is a Jackson, but any other standard make can be substituted).
1 On-and-off switch (Igranic, Lissen, Benjamin, Bowyer-Lowe, etc.).
1 Cosmos A.N.P. coil, 200 to 600 metres (also 1,000 to 3,000 if Daventry is required).
1 Standard anti-phonic valve holder (Lotus, Benjamin, Igranic, Bowyer-Lowe, W. & M., etc.).
1 Baseboard-mounting filament resistance, variable pattern of 10 ohms (Igranic, Lissen, Magnum, Raymond, etc.).
1 Alcoa screen (Rothermel Radio Corporation) or a sheet of aluminium or copper measuring 6 in. × 4 in., with lugs for mounting on baseboard as shown in the photographs. The Alcoa screen, being of heavy gauge aluminium ready to mount, is quite convenient.
1 Radio-frequency choke of good quality (R.I.-Varley, as shown, or McMichael, Eddystone, Lissen, Bowyer-Lowe, Magnum, etc.).
1 ·002-mfd. mica condenser (Dubilier, T.C.C., Igranic, Lissen, Atlas, Mullard, Peto-Scott, etc.).
8 Terminals and ebonite strip to take same. One long strip can be used of the length of the back of the cabinet, or, as illustrated, small pieces of ebonite which happen to be handy.
2 Clix plugs.
Glazite or Junit wire for wiring-up.



Simplicity is the keynote in the construction of this amplifier, and you cannot fail to get results from it.

A Screened-Grid Valve Unit for Your Set—*continued*

of the Mullard valve. The unit is thus universal for all the screened-grid valves now available.



The two pairs of terminals shown unmarked are, left to right, "A," H.T. 120, H.T. 80, and "P."

As the unit lends itself admirably to use with the now famous "Radiano Three," care has been taken to select all components with terminals so that those readers who like the Radiano method of connecting up can use it in this set. The unit illustrated is shown with soldered connections and stiff wiring. The screen, which consists of a piece of aluminium or copper, is connected to the negative L.T. and to earth, and together with the astatic coil gives all the stability required.

Little Screening Required

While, as pointed out above, a great deal of screening is not required with only one stage of screened-grid amplification, the actual screening provided in the present instrument will only be adequate if the layout of parts is followed. The writer has found a number of experimenters who are in the habit of taking some existing cabinet or panel and endeavouring to adapt a published design to suit that cabinet or panel regardless of the actual layout.

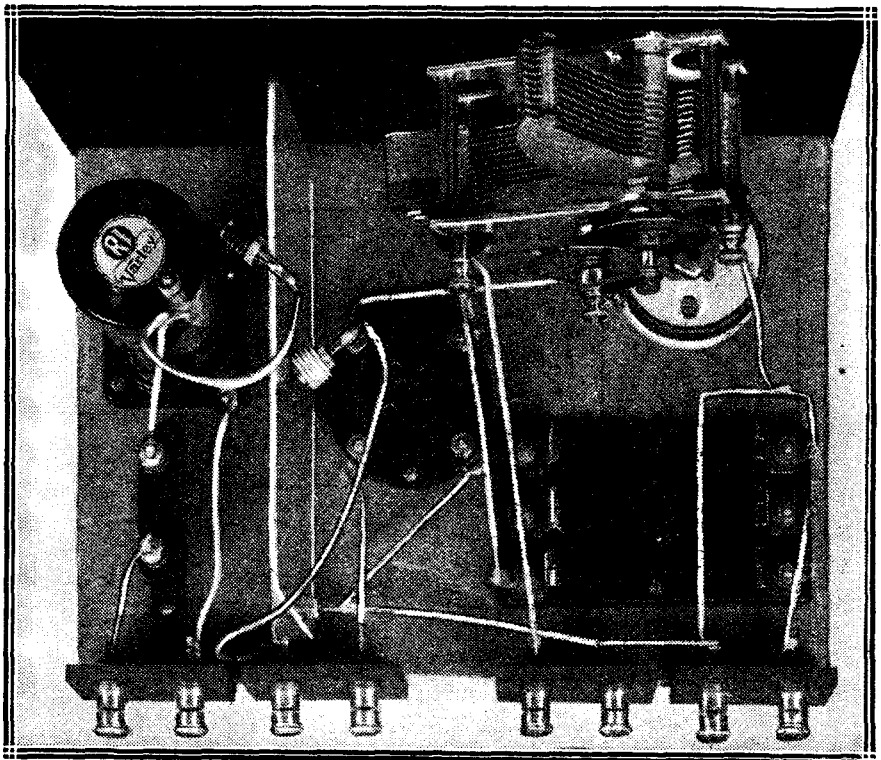
In one case which came to his notice recently, the whole effect of a particular layout of components to avoid interaction had been nullified by the constructor placing the aerial and earth terminals on the right of the panel and the output on the left, thus bringing leads right through portions which should have been completely free from any such wiring. The present layout has been carefully worked out, and experiments have verified it as being thoroughly satisfactory.

The actual make-up of the instrument is so simple that very little need be said regarding the actual work. It has been found possible to make the grid connections (fixed plates of condenser, grid terminal, valve holder and terminal 1) very short. The only terminals on the base of the A.N.P. coil actually in use are 1, 5 and 6. The A.N.P. coil is reversible in the holder, but with the particular connections used it does not matter which way round it is inserted.

The Flexible Leads

If your screen is of aluminium you will not be able to solder on to it, therefore it is advisable to pass a metal screw through a slot or hole in the screen, lock it into position with a nut and then solder to it a lead from the negative L.T. As the negative L.T. is itself joined to the earth terminal the screen is thus at earth potential.

Flexible leads are taken from the terminals marked 80 volts to a Clix which fits over the screened-grid pin of the valve. Similarly a flexible lead is taken from the top terminal of the radio-frequency choke (the terminal



With this photograph and the diagram on the next page it should be impossible to make a mistake when you are wiring up.

A Screened-Grid Valve Unit for Your Set—*continued*

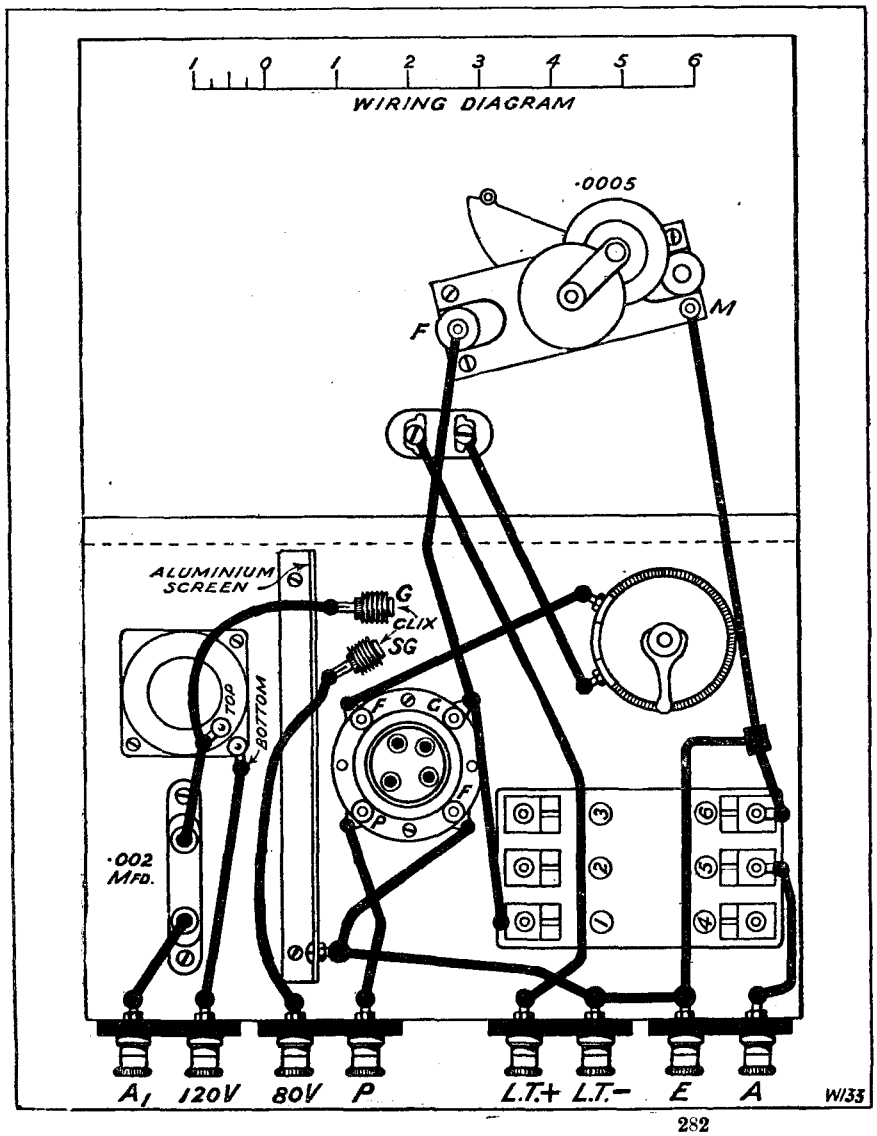
which runs also to one terminal of the fixed condenser) and is joined to another Clix which fits over the plate terminal of the screened-grid valve. It will be found convenient to choose the two Clix of different colours, and the writer uses a white Clix for the screen-grid and a black Clix for the plate. This enables the user to be sure to make the right connections without checking his wiring.

Connecting Up

When the construction of the receiver has been finished the next point to consider is how to join it to the existing set. The aerial and earth connections are first of all removed from the set on which they have been used and connected to the aerial and earth terminals of the unit. The L.T. negative and positive terminals of the unit are now joined to the same battery as that used for the set with which it is to be coupled, and the same high-tension battery used for both sets.

Be sure that the 80-volt terminal is connected to 80 volts on the high-tension battery. This must be really 80 volts and not just a tapping marked 80 which may not be giving the actual value at that time. It is best to test the voltage with a meter which should be of a fairly high resistance, and not a very cheap one which has a low resistance. Weston, Sifam, A. H. Hunt, and other firms all sell very good high-tension battery voltmeters at reasonable prices. The 120-volt value is not critical, and slight variations either side of this value do not much matter.

If you are using an Osram, Marconi or Cossor screened-grid valve the terminal P will be left free, and the two Clix will be joined to the two top pins of the valve. If you use a Mullard screened-grid valve the terminal P must be connected to the terminal marked 80 volts. Thus you will not need the flexible lead terminating in the white Clix. The flexible lead from the top of the radio-frequency choke will be joined to the top terminal of the Mullard valve.



An Important Point

The next point we must consider is the actual connections to the receiver. There is a terminal marked A_1 on the unit, which must be joined to the grid terminal of the first variable condenser of the set with which the unit is to be used and *not* to the aerial terminal of the set unless this, itself, is joined to the grid (or grid condenser) of the first valve. The reason for this is that we require the whole of the tuned circuit connected to the first grid in the receiver to be connected to terminal A_1, and if we use a tapping or an inductively coupled winding we shall not get proper amplification. It is best, therefore, to examine your receiver carefully and see where the grid connection is made. The most convenient point is generally the fixed plates of the variable condenser.

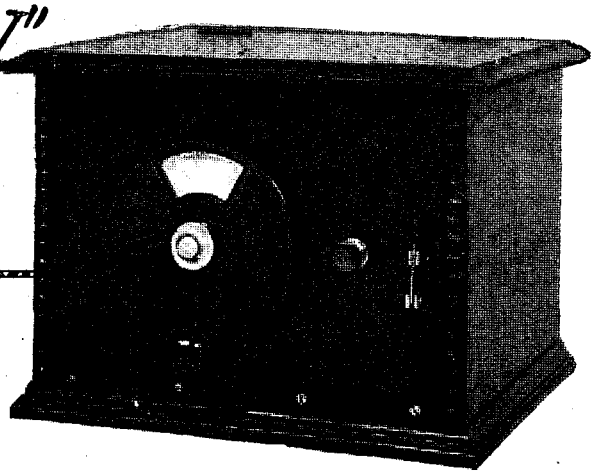
With the Radiano Three, terminal A_1 on this unit should be connected to the aerial terminal A_1, and the flexible lead from A_1, which is generally connected to one or other of the tappings on the X coil, should now be taken to terminal C_1 (which will be seen on examining the diagram is itself connected to the grid condenser of the first valve).

Value of Reaction

When only one stage of screened-grid high-frequency preceding a detector is used, as is the case when the unit is used with the Radiano Three, reaction on the detector is really needed to get the best results, and it will be found that the reaction control on the Radiano Three will bring up signals enormously. Screened-grid valves vary among makes in the degree of reaction that can be used, and it seems that more reaction is necessary with the Cossor screened-grid valve than with the Marconi and Osram.

(*Continued on page* 332.)

The "SENTRY" WAVEMETER



An easily made instrument that "mounts guard" over your set and tells you the names of the stations to which you are listening.

By A. V. D. HORT, B.A.

A WAVE-METER can be such a help in searching for stations and in identifying transmissions that it is little wonder that anyone who obtains the loan of a wave-meter from a friend is sure to break the tenth commandment at once. A really accurate wave-meter is an instrument which is beyond the means of most of us, either to buy or to construct. But reasonable accuracy and constancy, giving readings within a metre or two, are not so difficult of attainment.

COMPONENTS REQUIRED.

- 1 Ebonite panel, 8 in. × 6 in. × ¼ in. ("Trolite").
- 1 Cabinet to suit, with baseboard 7 in. deep (Arteraft).
- 1 ·0005 variable condenser (Cyldon Log Mid-line).
- 1 Slow-motion dial (Igranic "Indigraph").
- 1 1-mfd. fixed condenser (T.C.C.).
- 1 ·001 fixed condenser with clips for leak (Dubilier).
- 1 2-megohm leak (Dubilier).
- 1 100,000-ohm resistance with mount (Dubilier).
- 1 No. 1 Dimic coil with base (McMichael).
- 1 35-ohm baseboard-mounting rheostat (Lissen).
- 1 Valve holder (Benjamin).
- 1 Push-pull panel on-off switch (Benjamin).
- 1 Panel knife switch.
- 1 Battery clip.
- Stiff wire for connections, a short length of flex, battery plugs, screws, etc.

NOTE.—The makes of components actually used are named in order that an exact duplicate set can be constructed. Substitution of other equally good makes will not alter the efficiency, but may, in the case of the tuning components, alter the calibration curve, which will not then match that given by the author.

Assists "Searching"

With such an instrument all the troubles connected with the search for stations vanish. There is no longer any need to guess at the identity of a weakly audible station. You can check its wave-length in a moment and then look it up in a table of stations.

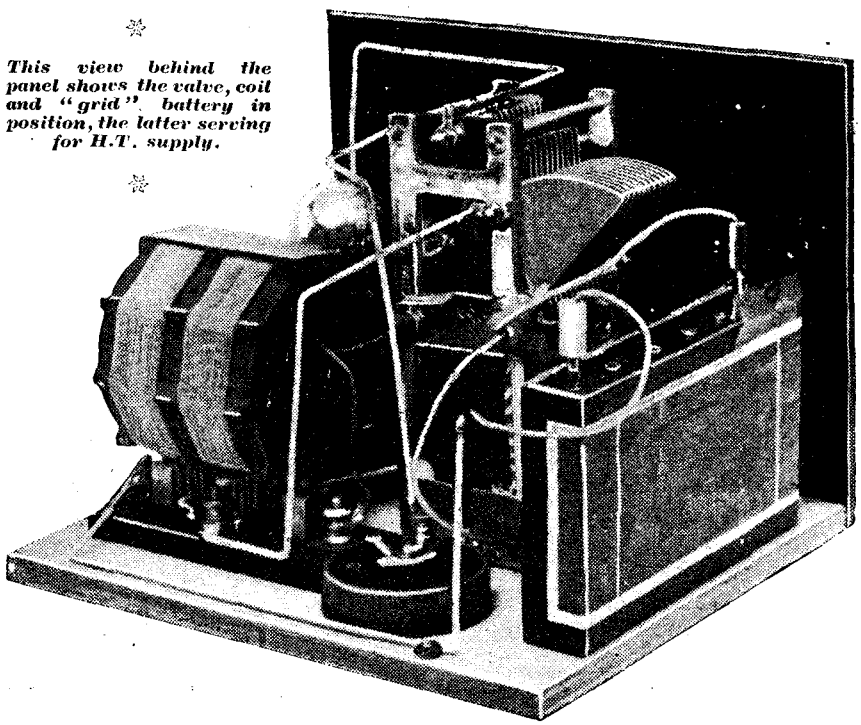
Again, if you are trying out a new receiver, one with home-made tuning coils, for example, there is no need to make a shot at the wave-length range which they will cover, or even to work out a complicated sum for the same purpose. You just switch on the wave-meter and check the top and bottom settings of your tuning dials.

For cheapness and simplicity of construction buzzer wave-meters hold the first place. Their bad characteristic is flat tuning, a disadvantage which cannot be overcome without special provisions which increase the cost and the difficulty of construction at once. The oscillating wave-meter gives far sharper tuning, but it again lacks something which the buzzer instrument possesses: it does not normally produce a sound audible in a non-oscillating receiver.

To see the reason for this let us consider for a moment the phenomenon known as heterodyning.

Disadvantages of Heterodyne Type

You know that if you set your receiver oscillating and tune it to a broadcasting station—a crime of which it is to be hoped you are innocent!—when the wave-length to which the receiver is tuned approaches that of the broadcasting station you will hear the carrier-wave of the latter. This carrier-wave begins as a high-pitched whistle, falls to inaudibility when the point is reached where the receiver is exactly in tune with the station, and rises again to a high



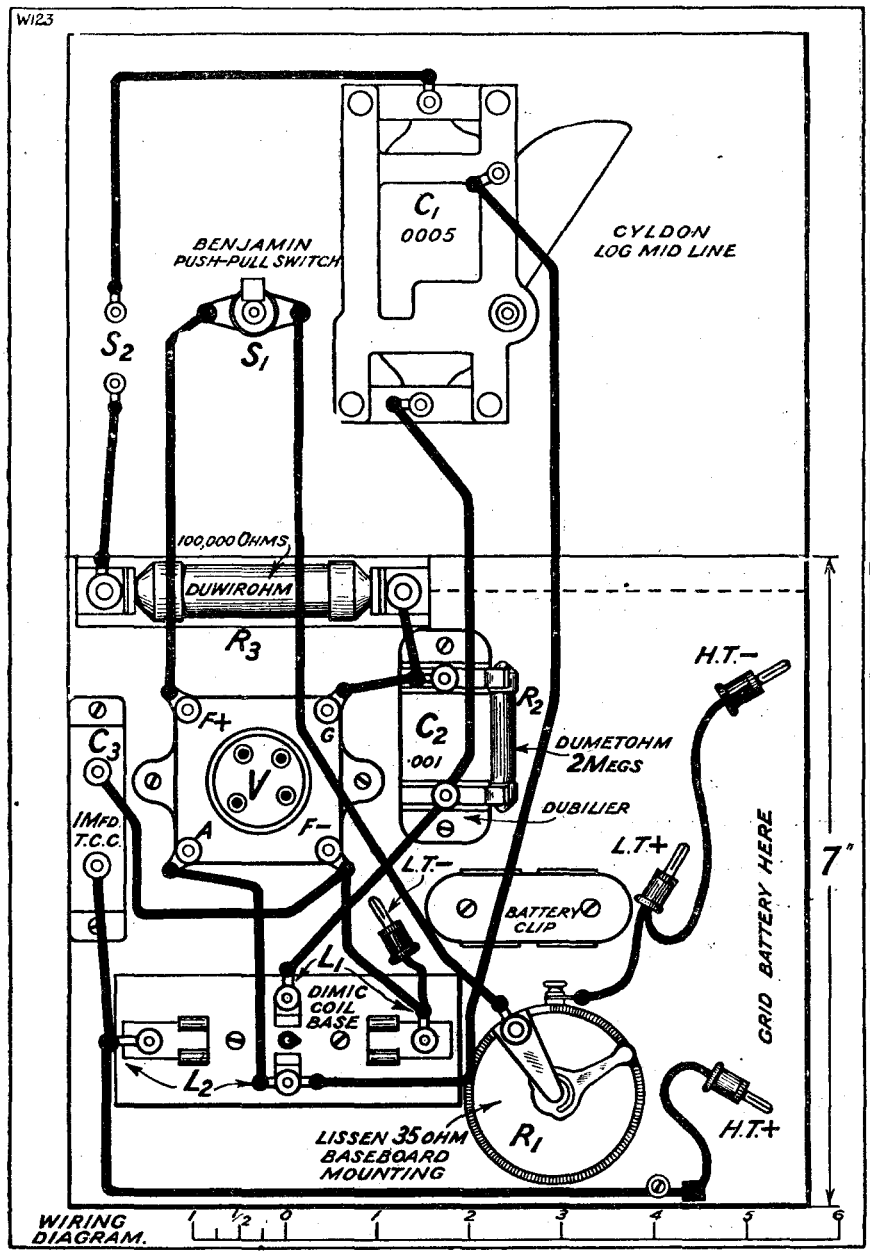
This view behind the panel shows the valve, coil and "grid" battery in position, the latter serving for H.T. supply.

The "Sentry" Wavemeter—*continued*

note as you turn the tuning dial still farther in the same direction.

If your receiver is not oscillating when you tune in the station, you will hear the transmission grow louder and louder until it reaches its maximum at the point of exact resonance, after which it gets weaker as you tune it out again. The difference between this state of affairs and that just described is that you will not hear any trace of the carrier-wave, unless one of your neighbours happens to have his receiver in an oscillating condition on that wave-length, when you will hear the beat note produced by the combination of his radiated wave and the carrier-wave of the broadcasting station.

Now for the broadcasting station substitute an oscillating valve wave-meter. When your receiver is in an oscillating condition, you will be able to pick up the "carrier-wave" emitted by the wave-meter, the energy radiated from the receiver and the wave-meter combining to produce the audible beat note. Decrease reaction on the receiver so that it is no longer oscillating, and the beat note will cease.



Herein lies the difficulty in the use of the heterodyne wave-meter for the broadcasting wave-lengths, that there must be some source of oscillations external to the wave-meter to combine with the oscillations which it radiates before any audible note can be picked up by a non-oscillating receiver.

Beat Note Method

Do not suppose that it is therefore impossible to get a beat note with the help of the wave-meter with a receiver which is not oscillating. If you tune the wave-meter so as to produce a beat note with the carrier-wave of the broadcasting station, you will be able to pick up that beat-note with a non-oscillating receiver. (In this case the wave-meter has replaced the "oscillating neighbour" mentioned above.) This, in fact, is the method employed for identifying stations whose transmissions are picked up on the receiver. We shall come back to it again later on.

You will sometimes wish to find a station whose wave-length you already know. It would be possible to do this by setting the wave-meter to the correct point and then searching for the beat note produced by the wave-meter and the station. But such a method would be almost as tedious as searching for the transmission without the aid of the wave-meter, especially as the wave-meter would actually have to be set just off the exact wave-length of the station in order to produce the required beat note. If the station was not working on its correct wave-length, you might search for it for hours without success.

A Useful Scheme

To get over this difficulty we must find some means of making the wave-meter emit a note audible in the receiver under any conditions. This is accomplished in the present instrument by making use of a "grid-leak howl," that is to say, an audio-frequency howl produced by using a high value of grid leak. The grid condenser, instead of discharging smoothly and continuously, discharges at regular intervals at an audible frequency, so that the continuous waves radiated by the wave-meter are interrupted at this audible frequency.

They can then be heard on a crystal

The "Sentry" Wavemeter—*continued*

receiver just as easily as on a non-oscillating valve receiver. It is not claimed that this method is anything new, as it has already been described and utilised by the Editor of this journal in a wave-meter known as the "Buzzerdyne."

I have given this wave-meter the title of The "Sentry," and I think

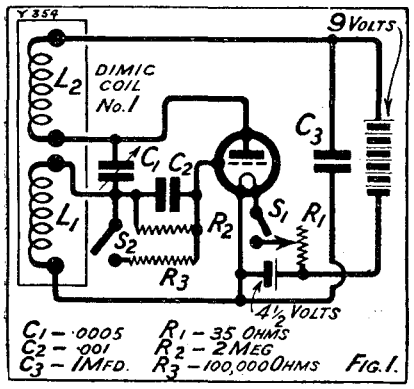


FIG. 1.

that you will appreciate the appropriateness of the name when you come to use the instrument. It will mount guard over your receiver, telling you the name of the station to which you are listening, and showing you the quick way to find the stations that you wish to hear. Furthermore, it will make it quite unnecessary for you to use any more the "carrier-wave method" of searching for distant stations, keeping the receiver "out of mischief," so to speak.

Self-Contained Meter

The circuit of the wave-meter is given above. This is a straightforward type of oscillator circuit, the deviation from normal consisting in the inclusion of a larger value of grid condenser than usual, and the provision of two leaks for shunting it. When the howl is wanted—it is in reality a musical note of quite pleasant pitch and quality—the grid condenser, which has a value of ·001, is shunted by a 2-megohm leak. The closing of a knife switch, mounted on the panel for convenience in operation, places in parallel with this leak a second one of 100,000 ohms resistance. Ordinary radio-frequency uninterrupted oscillations are then produced.

Since a ·06-ampere valve is employed, the wave-meter can be self-contained as regards its batteries. This is a point in its favour, as the use of external batteries with a wave-meter may upset its calibration unless special precautions are taken to guard against this fault. A flash-lamp battery is used for L.T., with a rheostat to obtain the drop to 3 volts, while the H.T. is supplied by a 9-volt grid-bias battery. The total amount of H.T. is thus 13½ volts, which is enough to produce oscillations over the whole scale if the correct type of valve is used.

Constructional Details

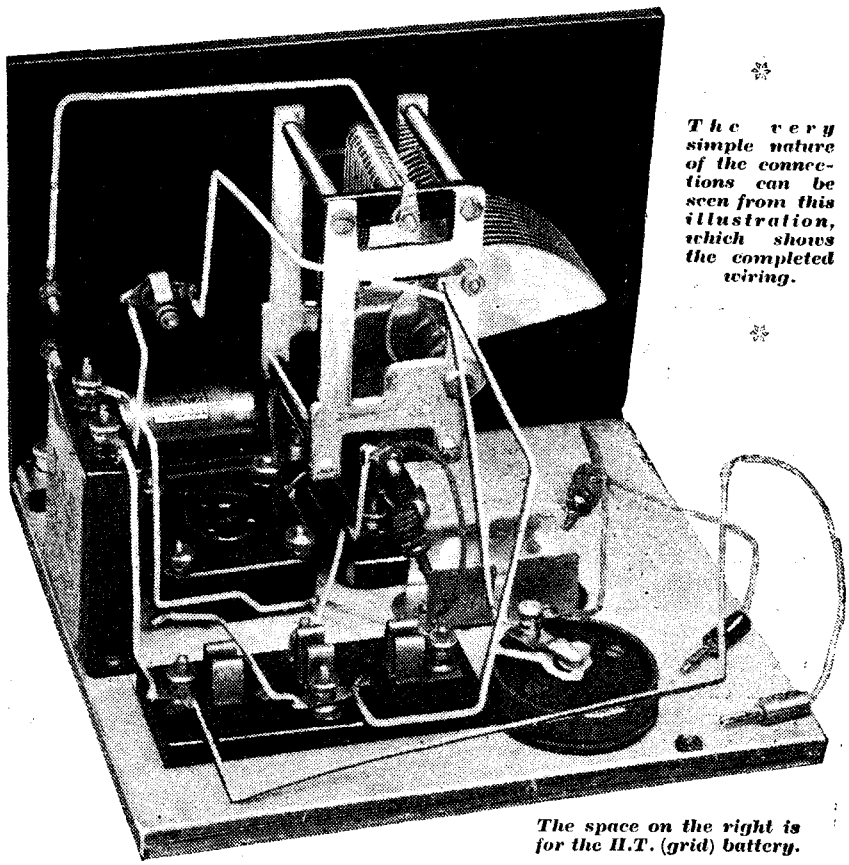
Follow the diagrams carefully in drilling the panel and laying out the components on the baseboard, as there is not a great deal of room to spare. If you choose a different make of variable condenser from that used in the original wave-meter, select one of robust construction. Fix the components on the baseboard first, and when they are completed and wired up as far as possible, attach the panel carrying the variable condenser and the two switches.

The connections to the batteries are made with flex leads, terminating in plugs. Battery plugs with split ends can be clipped on to the brass connection strips of the flash-lamp battery. The flex leads should be only just long enough to reach the batteries easily, in order to avoid stray loops of wire.

Suitable Valves

The rigid lead from the anode end of the coil to the flex lead, which connects it to the positive end of the grid battery, is rather long; it is, therefore, anchored to the baseboard at its free end with a screw and a fibre washer.

The valve to use with the wave-meter is a ·06-ampere valve, a D.E.3, B.5, A.R. 0·6 L.F., or similar, or the new ·075 valves of the L.F. variety (Mullard or "Six-Sixty"). The coil for the lower broadcasting band of wave-lengths is a Dimic No. 1. This coil will give you a wave-length range from about 170 to above 550 metres with the ·0005 condenser in parallel. See that the ebonite peg fits between the centre clips when inserting the coil, as a short here would have disastrous results.



The very simple nature of the connections can be seen from this illustration, which shows the completed wiring.

The space on the right is for the H.T. (grid) battery.

To test the wave-meter insert the valve and coil and connect the batteries. Set the rheostat just on

(*Continued on page 330.*)

WITHIN THE VACUUM

By KEITH D. ROGERS.

New ranges of valves—An interesting innovation—A good H.F. amplifier.

IN these days of a multitude of valves it is becoming increasingly difficult to choose between them when one wants new valves for any particular job, or to keep sufficient data in the way of characteristics and curves without filling huge chests with bits of paper.

Valve-box slips are very useful while they can be found, but I personally can never keep them for any length of time, and short of entering everything up in an album, or filing all the little slips provided by the makers, I have found it impossible to keep sufficient data about valves to enable me to use them to their best advantage.

A Novel Idea

Characteristic curves are pretty-looking things; they are not, as published, over accurate; they cannot be, because they are taken as averages for average valves and one curve has to represent a whole class of valves. But they have their uses, and as rough guides form a ready means of showing what any particular type of valve should do.

It was with relief, then, that I found a parcel awaiting me with a few of the new Radion valves for test, for these enterprising manufacturers have hit on what now seems an obvious plan—they transfer the characteristic curves and other data on to the bulbs of their valves, so that while you have the valve you have its identification marks. It is a scheme upon which I can heartily congratulate Messrs. Radions, and though the printed descriptions of the various valves on the boxes—especially of one particular class—are rather wide in their application, I find the valves do their best to live up to the laudatory remarks made about them.

Let us take the three valves I have received for test in the order in which they were tested.

First of all, the 4-volt H.F. valve, rated at 3·75 filament volts with 0·1 amp. consumption. On test it gave quite good results as H.F. or L.F. valve, or as a leaky-grid detector. It has an impedance of round about 28,000 ohms and an amplification factor of 13. For L.F. purposes, therefore, it has to be used in the first stage, preferably transformer-coupled, for the magnification factor is not really high enough for efficient resistance-coupling unless used in the *second* stage where the valve acts quite moderately well. The makers recommend resistance values of 20,000 to 200,000 ohms, but I have found marked falling off (as would be expected) in the amplification when a resistance below 50,000 was used.

For general use I prefer 100,000-150,000 ohms for this valve if it is decided to use it for R.C. coupling.

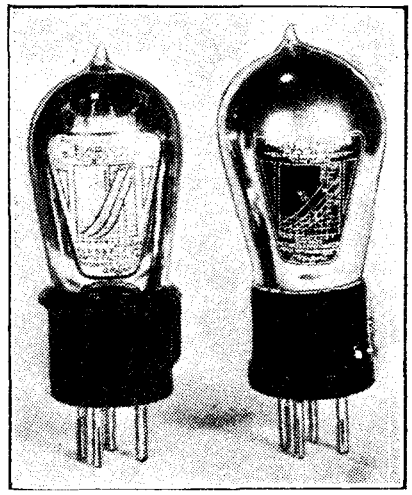
Three Further Radion Valves

Another one tested was the 2-volt Radion, taking ·15 amp. at 2 volts and having an impedance of 18,000 ohms. The amplification factor is 9 and the valve can almost be termed a general-purpose valve. It can be used in most H.F. stages, as detector and as first note-magnifier, with satisfactory results, though it was designed primarily for the latter position in a set.

Finally, the power and super-power types, designated "Super L.F." and "Super-Power" respectively. These both take ·34 amp. at 5·5 volts, and the former has an impedance of 6,000, while the latter is naturally less. The amplification factor of the L.F. valve is given as 7·4, while that of the Super-Power worked out at about 4.

More Two-Volters

These two are very useful little valves, and can be recommended for general L.F. work in the case of the former, and for last-stage work in that of the latter. This super-power valve will carry a grid voltage swing of about 10 volts either side of the grid-bias point of 12 volts at 150 volts H.T. quite successfully, so it is a useful last stager if it is not required to carry too much volume.



The "Super L.F." and "Super-Power" Radion valves mentioned above.

Other valves, new to my experience, that I have had an opportunity of testing are the Beriton, British-made valves sold by The Merchant Manufacturers Co., Ltd., and consisting of two 2-volters taking 0·1

(*Continued on page* 333.)

COMMENTS *from* CONSTRUCTORS

A few of the many letters from all parts giving readers' experiences with "Wireless Constructor" sets.

The "Straight Line" Four

SIR,—I offer congratulations to the designer of the "Straight Line" Four. However, it is Capt. Round—or, I should say, his valve—that has enabled Mr. Percy W. Harris, M.I.R.E., to produce a set capable of giving distance and unequalled purity of reproduction with more than ample volume while employing but four valves. From the moment that I connected up the set, that purity was forthcoming without any searching.

I am using a 6-ft. exponential horn, and I consider that it is no longer necessary to envy the Rice-Kellogg as regards reproduction.

Progress is such that ere these lines are dry I may find a two-valve set capable of equal performance to the "Straight Line" Four, and, having followed wireless since the 1900's, I have been ever slow to praise.

Yours faithfully,
H. W. A. B.

Dublin.

Short-Wave Results

SIR,—I thought that it might be of interest to you to know that I received 2 F C Sydney, 28·5 metres, on "The Radiano Short-Wave Two." I first heard the station at 5.30 p.m., and managed to "hold it" till the end of the broadcast at about 7.10. By the addition of an amplifier, the 'phone strength was very good, and at times it was almost possible to work a loud speaker.

One strange thing was that the tuning was not so critical as that of 2 X A F, a station which I have only failed to get once since I constructed the set in June. I picked up the broadcast of the "Tunney-Dempsey" fight from this station, and had my letter reporting the reception published in the "New York Evening Telegram." The result of this caused an American radio enthusiast to write to me asking how he could build a set like it.

My coils are wound on an ebonite former, with valve-pins and sockets as connections, and 4-volt "Cossor" valves are always used.

Yours truly,
W.C.1. J. L. S.

"Beats Elstree Six"

SIR,—As a past owner of your old "Four-valve Family" receiver, I was delighted to see you bring out your latest "New Family Four." I disposed, almost at once, of my Elstree Six receiver, and have now the "New Family Four" going strong. Allow me to congratulate you on the result. The sensitivity, selectivity, quality and volume are really amazing, and I consider I am getting better results now, and more economically, than with my last 6-valver. I find its size very convenient after a large receiver, and I have never constructed a more easily-made receiver; the new wiring making a very neat job. I am within 3 miles of 2 R N, the Dublin station, but can get Manchester without any interference from the former station. I have also received Hilversum, Berlin, Motala, Daventry, and Radio Paris at very good strength using 2-volt valves (D.E.2H.F., S.P.18 B, S.P.18 R, D.E.215).

In conclusion, please accept my heartiest congratulations and thanks for a really excellent and handsome receiver.

Yours sincerely,
CAPT. J. S. MORROW.

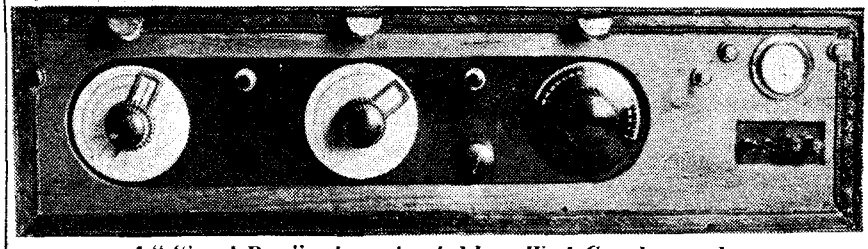
Merrion, Co. Dublin.

An Old Circuit in New Clothes

SIR,—I have constructed an "Old Circuit in New Clothes," described in the March issue of the WIRELESS CONSTRUCTOR, and I get excellent results with it: Liverpool (eight miles) coming in almost too loud for comfort on the 'phones. I have also received, at good 'phone strength, Manchester, London, Birmingham (before Daventry Junior started transmitting), Nottingham, Stuttgart, Hamburg, a French and another German station. With the aid of the "Radiano Wave-trap," Stoke, Belfast, and Dublin were also tuned in.

Wishing your excellent magazine more and more popularity.

I am, Sir,
Yours truly,
Blundellsands. J. P.



A "Signal Box" set constructed by a West Croydon reader.

Comments from Constructors—*continued*

Astonished Argentines!

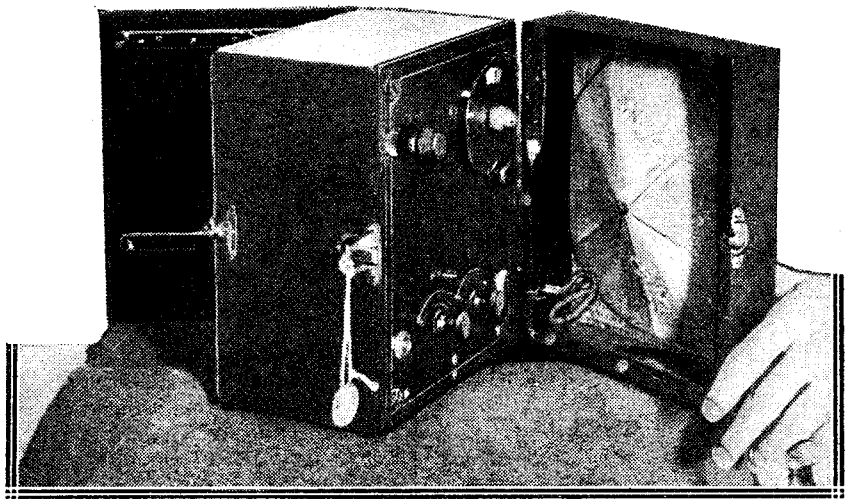
SIR,—At last I am able to give you some sort of a report on the "Australia on Two Valves" set, which was described in the WIRELESS CONSTRUCTOR in August of last year, and which I had built about three to four months ago.

In order to obtain as far as possible equal results to those got by the author, I have had to get all the original parts from England, which naturally took some time. Well, with the exception of quite unimportant pieces, all the components are the same as those originally used, and I have also built up the whole set exactly as described. Unfortunately I have not had as much time to spare as I would have desired to give the set a good and thorough test, but all the same, right the first station I got in telephony was one amateur in Tucuman, about 1,200 kilometres from here. That evening I listened to a conversation between three amateurs in Tucuman, one in Goya, one in the province of Corrientes (distance about 700–800 kms.), and two others here in Buenos Aires. After that, I often heard amateurs in all parts of the country; distances varying considerably, according to the atmospherical conditions.

The Cossor valves I am using behave remarkably well, and I have astonished all my radio friends telling them about the exceedingly small filament consumption of these valves, as I can use my 2-volt accumulator for nearly a month and a half without damaging it through over-using it. I must say that all the other components are excellent as well. I have been able to receive K D K A, as the only really distant station up to now, with great regularity, but I have never been able to get it with a good effect, as reaction is a difficult thing to manage, with the awful statics which so often prevail. Now and then the transmission is so clear that I am able to understand the words of the speaker, but far more often this is not the case, and only the musical items come through somewhat good. Perhaps I have not had any success so far with W G Y and P C J J because I have not been able to listen-in at the right times.

Yours faithfully,
B. VERMEHREN.

Olivos (F.C.C.A.),
Argentina.



A home-made five-valve portable, with built-in cone, entered in a New York competition for constructors.

"Really Precious"

SIR,—I have the pleasure to announce to you the splendid results obtained with the receiver, The "Chummy" Two, described by Harry P. Wootton in the number of November, 1927, of your valued review. Working with a little bird-cage aerial, I have been able to eliminate the local station (kw. 1½) also when it did the technical prouves with 7 kw. of aerial I received perfectly under all the aspects: Breslau (m. 315,8) Barcelona (m. 344,8), Praga (m. 348,9), London (m. 361,4), and twenty other stations. The local has never disturbed me; it was completely eliminated.

I am very satisfied of the results obtained with this good two-valver and I should not need to recommend it to my friends and knowings unitedly to your review, that is really precious for the radio-amateur.

With esteem,
EBERTO GRASSI.

Milan.

A Bagful!

SIR,—Recently I constructed the "Radiano Three," and I must say the results astounded me. I have logged the following stations: Eiffel Tower, Radio Paris, Daventry (5 X X and 5 G B), Motala, Koenigswusterhausen, Munich, Vienna, Brussels, Porsgund, Berlin (Witzleber), Lyons (La Doua), Langenberg, Rome, Bruenn, Frankfurt-on-Main, Seville, Hamburg, Toulouse, Stuttgart, Madrid (Union Radio), Leipzig, London, Cardiff, Prague, Barcelona, Bournemouth, Breslau, Dublin, Newcastle, Belfast, Nuremberg, Dortmund, Lille, Munster, Kiel, and several others I have not yet identified. On November 25th I succeeded in getting K D K A on 63·8 metres (this wavelength was announced, but the wavelength published is given as 62·5) at *good loud-speaker strength.*

My friend, who is the same age as myself (I am only 15 years of age), has the "Radiano Three" and he also gets good results, including K D K A on loud speaker. I can also get that new Italian station (Como, I believe, is the name) which transmits on a wave-length of about 545 metres.

Wishing the WIRELESS CONSTRUCTOR great success.

Yours faithfully,
L. E. L.

London, N.22.

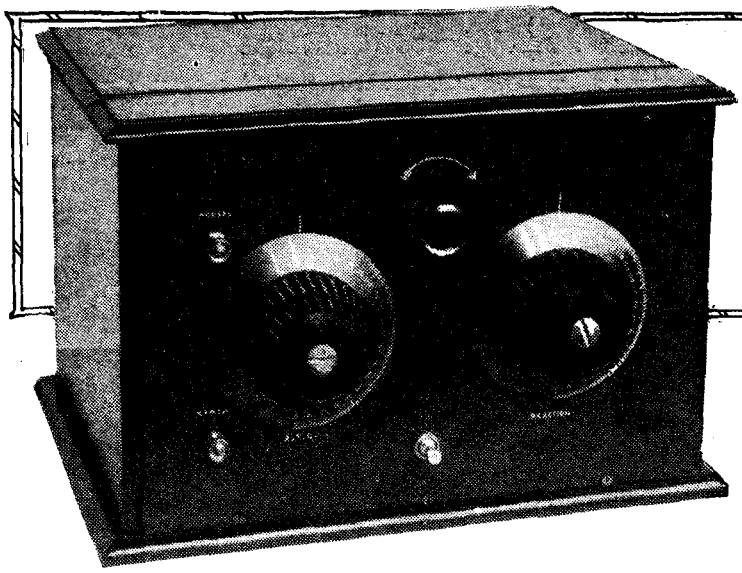
Radiano Again

SIR,—I constructed the "Radiano Three," designed by you in the WIRELESS CONSTRUCTOR, and am very pleased with same. I have also built the "Radiano" H.F. unit, and find that I can bring in stations with much volume which were previously very faint.

Trusting to hear of the "Radiano Four" in the near future.

Yours truly,
L. J. A.

E. Dulwich, S.E.15.



Improving the Single Valver

by L.H.THOMAS

A super-efficient one-valve receiver capable of remarkably good results.

IT is probably more difficult to evolve new single-valve circuits which are really "worth while" than to design any other type of wireless circuit. In the single-valver

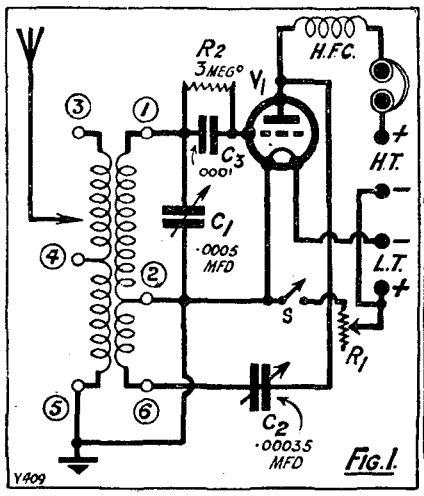


FIG. 1.

one has such limited opportunities for originality that anything novel must really prove its worth and create a big improvement before it is incorporated in the set.

Many Improvements

It is the writer's opinion that the perfectly "straight" single-valve receiver, preferably incorporating capacity-controlled reaction, gives results as good as we are likely to obtain for some time to come, and that time is better spent on trying to improve and refine this type of circuit than on attempting to make startling changes in it.

The first point that struck the writer was this: that a single-valve set designed and tested on one particular aerial only was very prone to give indifferent results when tried on another, unless the other was of identical type with the first. It is, therefore, desirable in designing a set of this type to make provision for the use of widely varying types of aerials, and this is most easily done by allowing for the use of several different methods of coupling the aerial to the set. The chances then are that anyone constructing a replica of the set will be able to duplicate the results obtained by the designer.

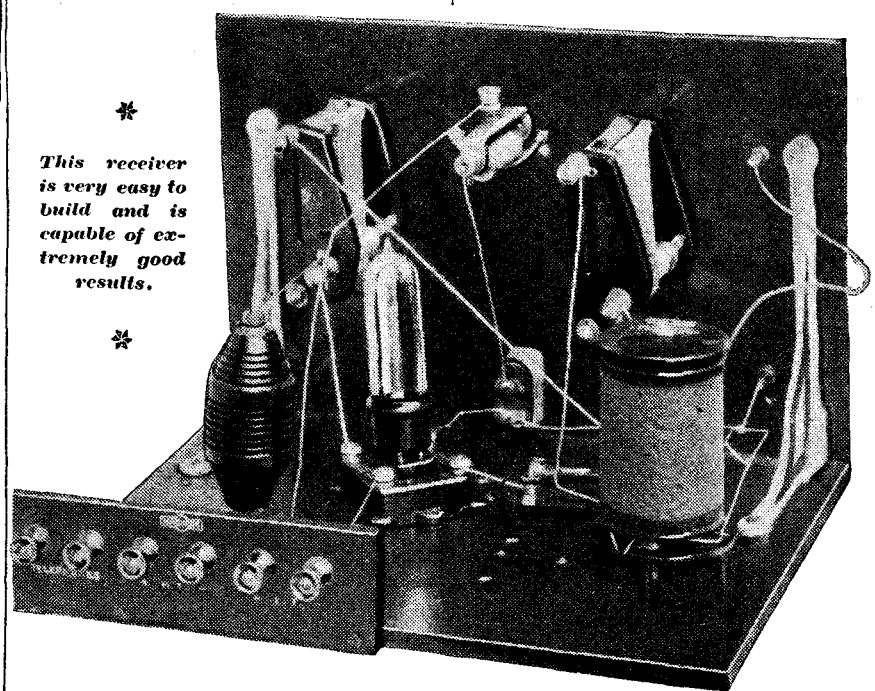
Secondly, in the writer's opinion the filament and H.T. voltages, and also the values of the grid-leak and condenser, are much more critical than they are generally imagined to be. The improvement derived from an alteration in the gird-leak value is often so slight as to be practically unnoticeable at first. When, however numerous other small improvements are "piled up" on this, the total effect is observed at once.

Standard Coils

The circuit diagram of the set described in this article appears in Fig. 1. Leaving the aerial circuit out of consideration for the time being, it will be seen that the standard "Reinartz" arrangement has been used. One of the chief points to note is that all the couplings are *fixed*. There are no "flopping coils" to mutilate the received signals by untimely vibrations, and the total number of controls is *two*.

A standard "split-primary" coil (*not* aerial coil) with six-pin mounting is used, the primary winding with its centre-tap providing the aerial circuit, and the secondary winding with its continuation the reaction winding

This receiver is very easy to build and is capable of extremely good results.



A standard six-pin split-primary transformer is used for the aerial, grid, and reaction circuits.

Improving the Single-Valver—*continued*

being used in the normal manner. Reaction is controlled by a condenser of ·00035 capacity placed between the end of the reaction winding and the anode of the valve. In this connection, a point of interest may be raised.

The Reaction Condenser

It has become the fashion of late to connect this condenser so that one side of it is at filament potential, this being arranged by splitting the coil and placing the condenser between the two sections, i.e. between the grid winding and the reaction winding. At first sight this appears to be an obvious advantage on account of the impossibility of trouble with hand-capacity effects, one side of the condenser being definitely earthed.

The writer has decided, however, after careful trial of both methods, and after being a devotee of the "split-coil method" for some time, that there is really more in it than meets the eye, and that on the whole the method adopted in this set is preferable. The chief reason for this is that in this position it appears to affect the tuning of the main circuit to a much lesser degree.

It is possible to tune in a C.W. station with the receiver in an oscillating state, and to bring it right down to the verge of oscillation by means of the reaction condenser without having to alter the setting of the main condenser by more than about half a degree. This is, of course, a very great advantage.

The hand-capacity effect does not seem at all troublesome, and seems least noticeable when the moving plates are connected to the anode of the valve.

The low value of grid condenser (·0001) should be noted.

The wiring has been made as short as possible throughout, and neat right-angled bends have been sacrificed in order to made it "get there." As will be seen from the photograph in which the set is viewed from above, hardly any wire is necessary!

Well-spaced Components

The panel carries the two condensers, the rheostat, a switch, and the aerial and earth terminals. The switch is, of course, not strictly necessary, but it is useful, in that one can set the rheostat so that the filament is receiving the best voltage for rectification, and then switch the set on and off without disturbing this setting.

The baseboard looks almost deserted, the only components carried being the valve holder, H.F. choke, coil-base and grid condenser. The set might easily have been accommodated in a smaller cabinet, but this was not thought worth while, as ample spacing of components always proves beneficial.

LIST OF COMPONENTS.

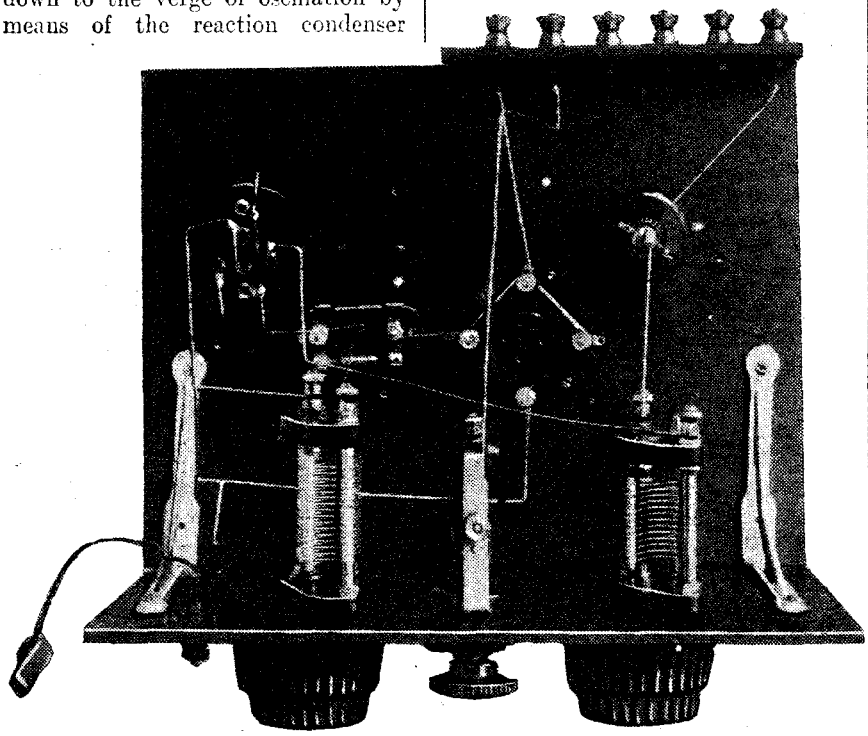
1 Ebonite panel, 12 in. by 8 in. by ¼ in. (Any good branded material).
Cabinet to take above, with loose baseboard 9 in. deep (Cameo). (Artcraft, Caxton, Pickett, Raymond, etc.)
1 ·0005 and 1 ·00035 variable condensers, ebonite end-plate type (Ormond). (Any good make.)
1 Non-microphonic valve-holder (Ashley, Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, G.E.C., Igranic, Lotus, W.B., etc.).
1 ·0001 condenser and 3-megohm leak (Clarke, Dubilier, Lissen, Mullard, T.C.C., etc.).
1 Six-pin coil-base (Colvern). (Bowyer-Lowe, Burne-Jones, Lewcos, Peto-Scott, etc.)
1 H.F. choke (McMichael). (Bowyer-Lowe, Burne-Jones, Colvern, Lissen, Ormond, R.I.-Varley, etc.)
1 6-ohm rheostat (C.A.V., etc.).
1 Push-pull switch (Any good make).
8 Terminals.
Strip of ebonite 6 in. by 2 in.
1 Split-primary transformer for 250–550-metre band.
Spare ribbed formers for short-wave coils.
Screws, tinned copper wire, etc.
Pair of panel brackets.

There is no need to give instructions for the wiring of the set, since practically every wire takes the shortest path between the two points to be joined. The only exception is the lead from the rheostat to the L.T. + terminal, which is "arched" to clear the valve.

The wiring having been completed, the set should be checked over in the usual way, a voltmeter being applied across the filament terminals with the H.T. connected up. Not that it is usual to make a serious mistake in the wiring of so simple a set as this, but the constructor's motto is usually "Safety First," especially after a batch of valves has been burnt out!

Varied Aerial Tappings

The H.T., L.T., and 'phones should now all be connected to their allotted terminals at the rear of the set, and the aerial and earth to the terminals on the front panel, and a standard 250-550-metre spilt-primary transformer should be inserted in the socket. It will be seen that four positions are really available for the spring clip which is affixed to the end of the flex lead from the aerial terminal. If it is connected to "1,"



A bird's-eye view of the set which shows how very simple the wiring is.

Improving the Single-Valver—*continued*

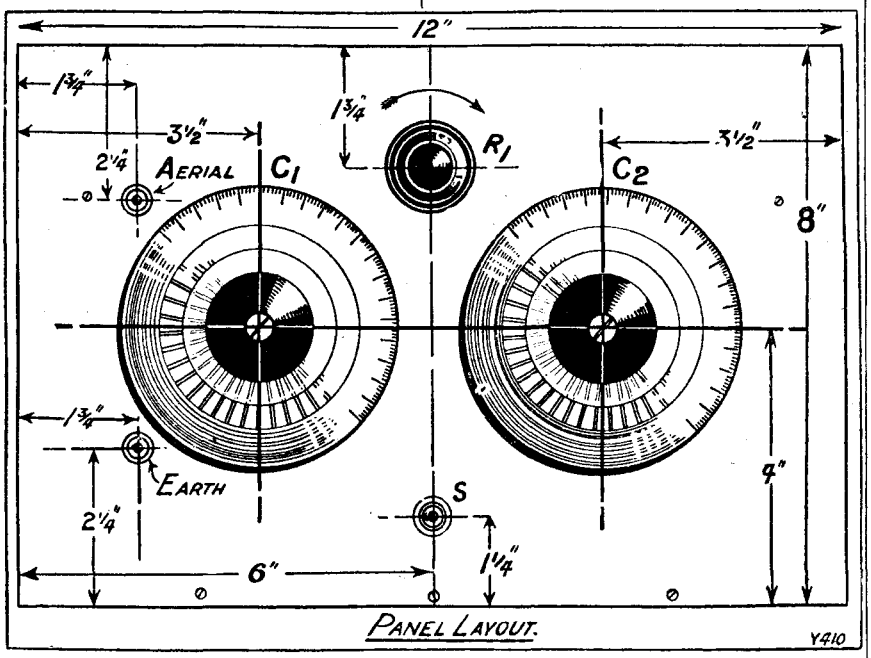
a direct-coupled aerial circuit is obtained; "3" and "4" both give what is usually termed a "tight-coupled" or "aperiodic" effect; while "6" also gives a form of inductive coupling.

It will, of course, be impossible to say definitely which of these systems will be the most suitable for a particular aerial, but in nearly all cases one will be found which gives distinctly better results than the others. It should be borne in mind, however, that the direct-coupled system given by connecting the aerial to "1," has distinctly poor properties as far as selectivity is concerned.

Operating Details

This should only be used in conjunction with very small aerials, indoor aerials, or in cases where it is desired to receive the local station only. Very often it will be found that the local station will be strongest on this position, but it will be far from ideal for DX work; "3" will probably be the best position for the aerial clip when a moderate-sized outdoor aerial is in use, and "4" will usually give the best results with aerials of very high capacity, i.e. either very long or very low

Setting the reaction condenser at or near zero, the local station should be found without the slightest difficulty by rotating the dial of C_1. The reaction control may now be slowly brought up towards its maximum. Detune from the local station and note whether the set glides smoothly into oscillation, as it should.



There should not be the slightest need to tap the grid or aerial terminal to ascertain whether it is oscillating, as the slight hiss obtained when it is just on the verge of oscillation should be quite sufficient guide. The filament voltage should be adjusted with about 30-35 volts H.T. in use, with a small power valve in the socket, until a smooth "flowing into oscillation" is obtained.

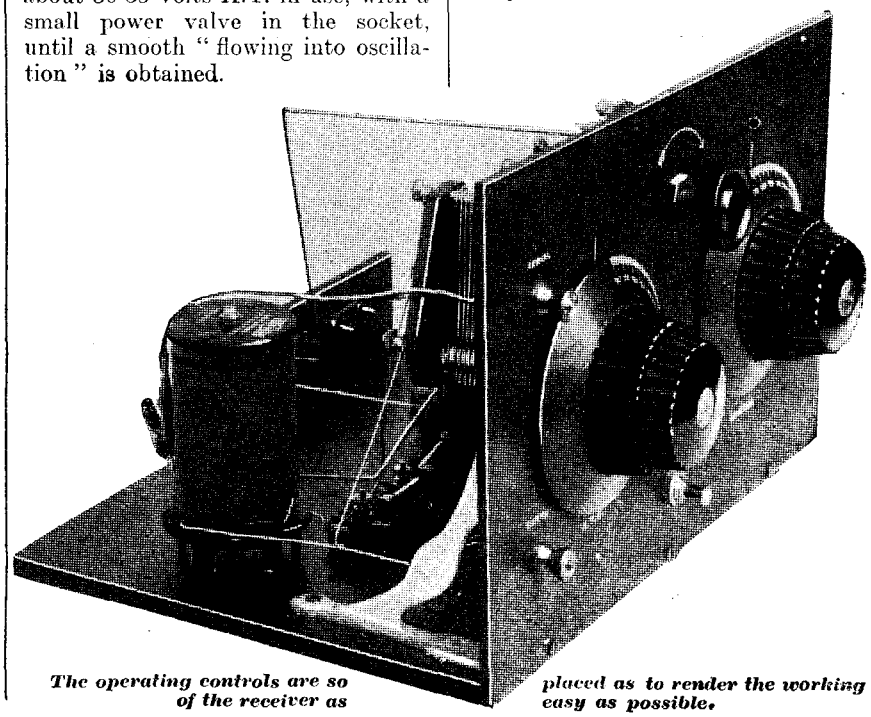
The best results obtained by the writer were with a small power valve and a value of H.T. as low as 28 volts. If another type of valve is used, however, the high-tension voltage may need to be increased to about 60.

There should be no difficulty in tuning-in many distant stations fairly late in the evening simply by intelligent use of the two controls. Do not search with the set in an oscillating condition, reducing the capacity of the reaction condenser when a signal is found, but rather reverse this procedure. Search, by all means, with the set as near as possible to this point, but without actually oscillating. Then, when a station is found, it will be easy to increase the reaction control by that infinitesimal amount which makes so much difference on a well-operated set.

Short-Wave Coils

All the above remarks apply, of course, to the reception of telephony. The set may quite well be used for the reception of continuous-wave signals on the shorter wave-lengths, simply by the substitution of a suitable home-made coil for the split-primary transformer in use on the broadcast band.

Suitable coils to cover all the most interesting bands of wave-lengths in use below 250 metres may conveniently be found on the standard six-



The operating controls are so placed as to render the working of the receiver as easy as possible.

Improving the Single-Valver—*continued*

pin formers at present on the market, and the following windings are suggested:

150-200 *metres*.—Aerial winding 25 turns tapped at centre, secondary 30 turns, and reaction 15 turns.

A Tuning Refinement

32-60 *metres*.—Aerial winding 4 turns (tap not necessary), secondary 8 turns, reaction 4 turns.

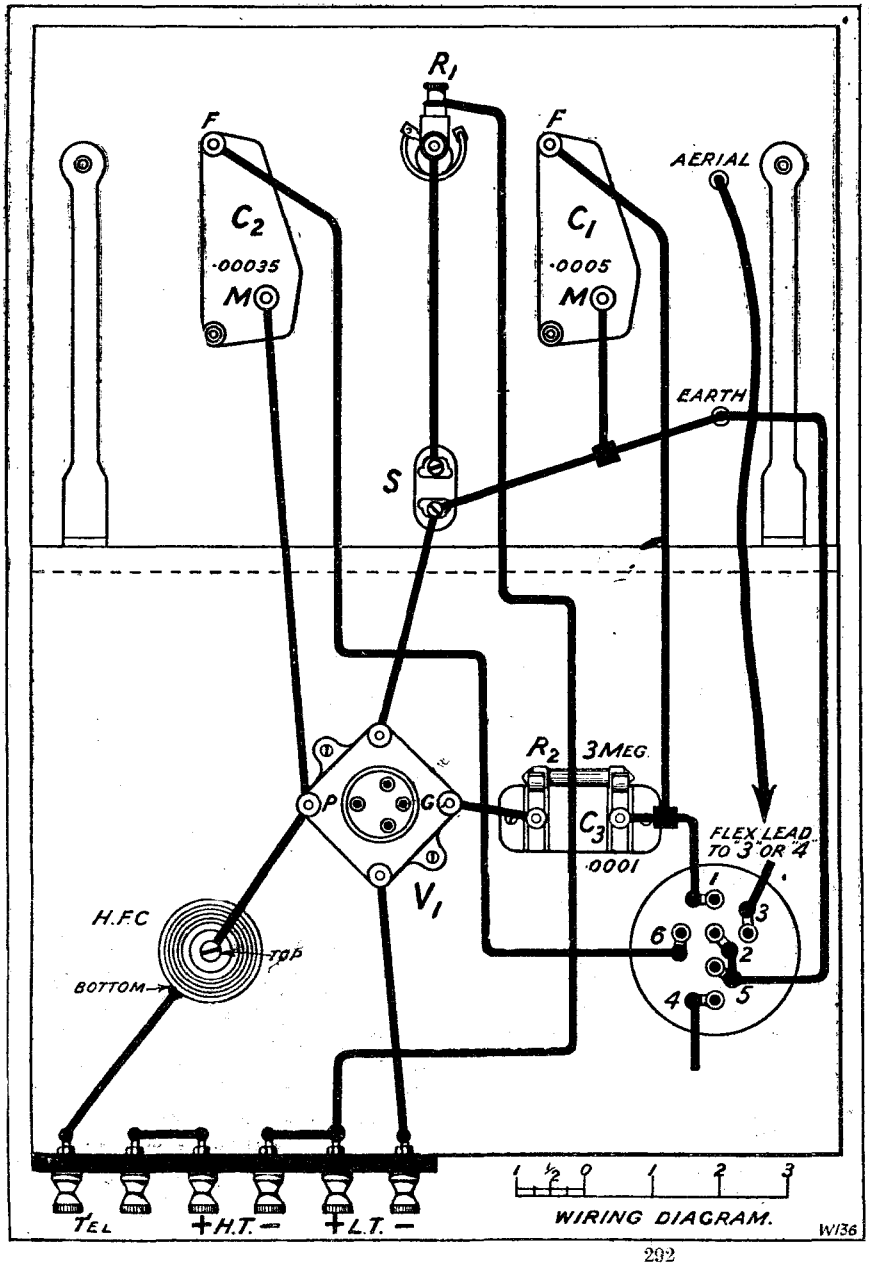
15-32 *metres*.—Aerial winding 3 turns, secondary 5 turns, reaction 4 turns.

In each case the aerial winding should be wound at the top of the former, and the secondary and reaction (really one winding, tapped) below it. As will be seen from the theoretical diagram, the following are the correct connections: Top end of aerial winding to pin 3. Bottom to pin 5. Tap to pin 4. Top end of secondary winding to pin 1. Bottom end of secondary and top end of reaction to pin 2. Bottom end of reaction to pin 6. No. 30 D.S.C. is suitable for the 150-200-metre coil, but a larger gauge, such as No. 22, is preferable for the short-wave coils.

The ·0005 condenser will be rather too large for convenient "searching" on the shorter waves, and if the set is to be used for this purpose to any great extent it is advisable to connect a fixed condenser of ·0002 capacity between the fixed plates of the ·0005 condenser and the grid condenser to which these plates are normally connected.

Many Stations Heard

This will reduce the effective capacity of the variable condenser to about ·00015. K D K A, W G Y, and numerous North and South American amateurs may be heard every night on this set with very little trouble.



READERS' RESULTS

The "Radiano Three"

SIR,—I feel impelled to write and inform you of the excellent results I have obtained from the "Radiano Three." This set was in use on a well-known pleasure steamer during last summer, and on it, in daylight, I received most of the well-known European stations at loud-speaker strength.

I am,
Yours faithfully,
A. S. K. (Master).

Greenwich, S.E.10.

The "Chummy Two"

SIR,—I feel I must write to you to tell you what an excellent set the "Chummy Two" is. I put on the 'phones one evening at 6.35 to see how many stations I could get, and these are the stations:

1. Langenberg, loud on loud speaker.
2. Cardiff, fair loud speaker strength.
3. 5 G B, very loud on loud speaker.
4. 2 L O, too loud on loud speaker, had to detune.

And fourteen other stations unknown to me—lots German.

Thanking you very much for your splendid circuit,

I remain,
Yours truly,
E. J. B.

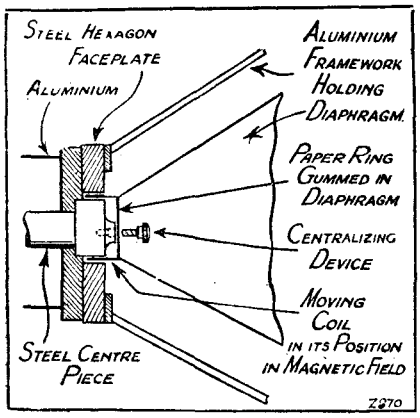
Kensington, W.8.

A MOVING-COIL LOUDSPEAKER

A full description of one of the greatest improvements in the technique of radio reproduction.

By G. V. COLLE.

IT would not be incorrect to state that with the development of the "free-edge" cone loud speaker, radio reception has become increasingly popular. Many people now indulge in listening who hitherto refrained from doing so, simply because they could not bear the unnatural reproduction which they had come to look upon as typical of a loud speaker of the old horn type.



The first big step in the right direction was made with the marketing of the now well-known "Kone" loud speaker, which certainly brought about a new era in the art of listening-in.

An Early Success

Although the principle on which this loud speaker operated was well known for many years previous to its introduction, yet it was never popular until it was made a *mechanical* success.

For the same reasons the "moving-coil" loud speaker was left in abeyance until quite recently.

Before the inception of the modern moving-coil loud speaker, Sir Oliver Lodge had tackled the problem of reproduction. With the aid of a fairly powerful magnet, one pole of which was arranged inside the other without touching, and a coil of wire fitted between the poles, also without touching, he could make the coil vibrate when a current of varying amplitude was passed through it.

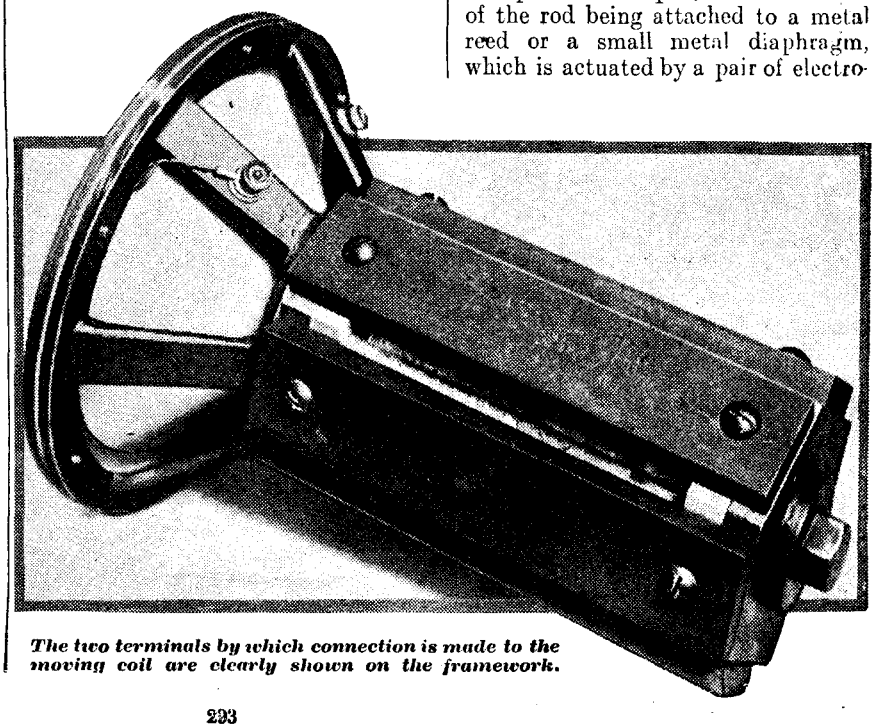
The results of these experiments were given, it is believed, in "Popular Wireless" some years ago, but for reasons not clear to the writer, the experiments were dropped.

However, it is interesting to note that the original magnetic system is now on view in the loud-speaker case in the South Kensington Science Museum.

The chief feature which differentiates a moving-coil loud speaker from the ordinary cone type is the method of supporting and operating the diaphragm.

The Cone Loud Speaker

Generally, a cone loud speaker consists of a paper or other diaphragm of fair size, usually 12 to 15 in. in diameter, supported on its periphery by a metal or wooden ring. A metal rod of quite small diameter is clamped to its apex, the other end of the rod being attached to a metal reed or a small metal diaphragm, which is actuated by a pair of electro-



The two terminals by which connection is made to the moving coil are clearly shown on the framework.

A Moving-Coil Loud Speaker—*continued*

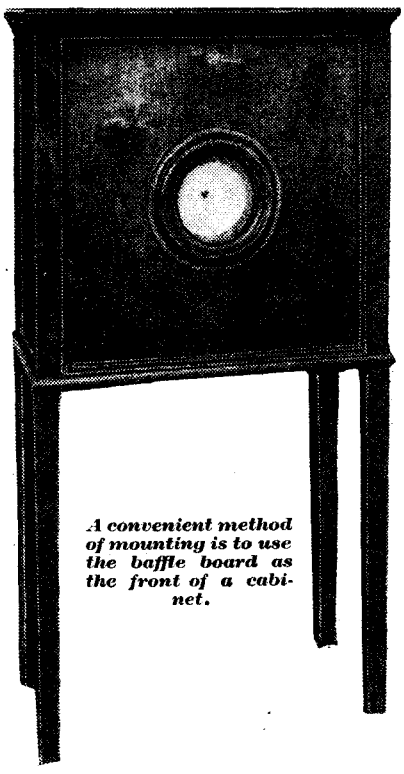
magnets connected in the plate circuit of the last valve in the receiver.

The vibrations set up in the reed, caused by the currents in the electro-magnets, are transferred to the cone diaphragm via the connecting rod. Such vibrations are given out as sound waves from the cone surface.

The Floating Diaphragm

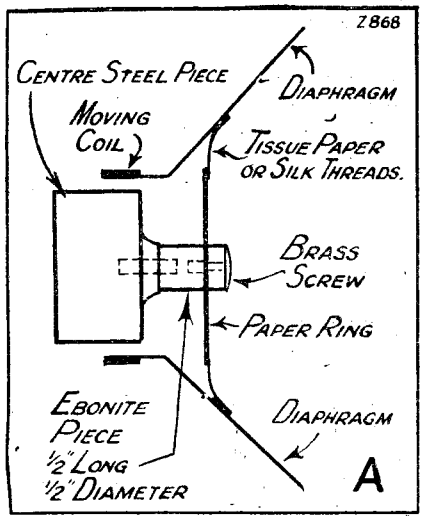
Inherent troubles with this type of loud speaker are (1) a tendency for the connecting rod to vibrate at an audible frequency; (2) uneven distribution of the sound waves over the cone diaphragm, and therefore unequal volume on all audible frequencies; (3) tone values depend on the material of which the cone diaphragm is constructed; (4) serious distortion sometimes occurs owing to the restraint put upon the diaphragm by clamping it at its periphery.

Most of the troubles named above have been overcome to some extent by



A convenient method of mounting is to use the baffle board as the front of a cabinet.

the various manufacturers, and considerable ingenuity has been displayed in the choice of diaphragm material, "doping" and suspension. Reed pitches have been either lowered below the lowest frequency responses of the loud speaker, or else raised above the limits of audibility. It is now quite usual to find the diaphragm peripheries self-supporting, arranged in metal rings and separated by felt, or else fixed to boards by various



materials, such as oiled silk, rubber, etc.

In fact, loud speakers of this type can be obtained which give a very great measure of enjoyment, but, unfortunately, they still possess a fault, namely, they have definite tone values which limit the faithfulness of reproduction.

Essentially, a moving-coil loud speaker consists of a paper or similar diaphragm of fairly small diameter, say 6 to 10 in., on the apex of which is stuck a small coil of fine wire.

The diaphragm and coil, which can be considered as one piece, are suspended so lightly that they can be said to "float."

A powerful magnet having a circular formation and a gap between the poles corresponding to the diameter of the coil on the diaphragm, except that it is of sufficient width to just pass the coil without touching the pole pieces, is introduced.

A Piston Action

Now, if the moving coil on the diaphragm is connected to a source of current having a varying amplitude, as in the plate circuit of low-frequency valves, then it will take on a kind of "piston" action, owing to the interaction of the magnetic fields of the coil and the magnet, the coil field varying, of course, with the variations of plate current.

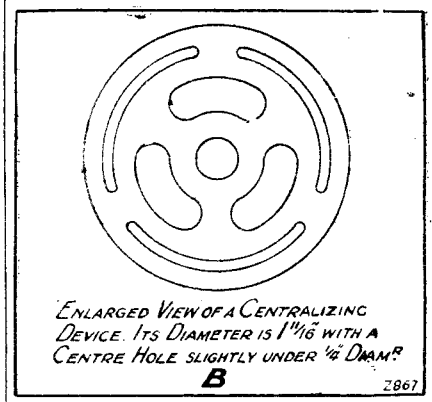
Naturally, the diaphragm moves exactly the same amount, since it is fixed to the coil, and although the movement is very small, yet this is sufficient to cause a fairly large air disturbance round the diaphragm, and thus create a large volume of sound.

Theoretically, as the diaphragm moves backwards and forwards as a whole, it should reproduce exactly what is passed through the coil and give no distortion on its own account, since it is supposed to respond equally to all frequencies.

Effect of Suspension

Actually, this is nearly impossible, as so many factors enter into the question. There is, for instance, the restraint exercised by the material on which the diaphragm and coil are suspended. If the diaphragm is to "float" correctly, it must have no apparent weight—but here we have a weight of several grammes, reckoning the wire on the moving coil and the weight of paper for the diaphragm itself.

A further factor which may prove troublesome is diaphragm resonance. This takes the form of a hissing on the letter "S," and from experiments conducted by the writer would appear to be due to several causes, including (1) the use of too thin a

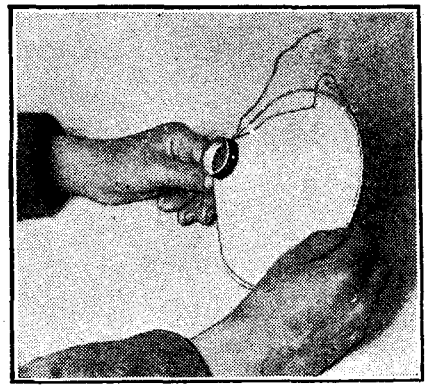


paper for the diaphragm; (2) unsuitable paper—material such as parchment will tend to resonate; (3) stretching the material supporting the diaphragm at its periphery too tight. (A typical example is rubber, which will "twang" if stretched unduly.)

The last and most important part of the moving-coil loud speaker is the "baffle," which has been mentioned previously.

A Moving-Coil Loud Speaker—*continued*

In order to understand the function of the baffle, as applied to this loud speaker, it must be remembered that sound waves are created both on the inside and outside surfaces of the small cone diaphragm. To ensure a good bass register the waves given out at low frequencies—corresponding to deep notes from the organ—from both surfaces of the diaphragm must be kept separated until they have fully developed themselves. This usually means that a board (sufficiently



The diaphragm with the moving coil mounted upon it. Note the fine-wire connecting leads.

thick not to vibrate on its own accord, and large enough to ensure the waves do not meet until after a certain period) must be used in front of the mouth of the diaphragm.

Naturally, a hole of the diameter of the diaphragm must be provided so as to allow the waves given off to be released.

The Baffle Board

A very good size of board is 4 ft. by 4 ft. by $\frac{5}{8}$ in. or $\frac{3}{4}$ in. thick, but a smaller one can be used without any appreciable loss in quality on low tones. A good size for the home is 2 ft. 6 in. by 2 ft. 6 in. with a thickness of $\frac{1}{2}$ in.

The writer uses a special cabinet constructed for the purpose, which has no back, and which is supported on legs so as to obtain a good air-space around it. The cabinet measures 3 ft. 3 in. by 11 in. deep, making an effective area measuring 4 ft. 2 in. by 4 ft. 2 in.

There is little objection to using a baffle of this description other than a slight distortion on the lower tones (which can barely be detected except by the experienced) and, of course, it makes a more compact arrangement.

The loud-speaker unit in both cases can be clamped to the baffle by means of wing nuts, or bolts passing through the wood from the front and clamped by washers and nuts to the edge of the aluminium ring holding the diaphragm (in the case of the loud speaker described in the following paragraphs). Failing the above, special brass screw insets can be obtained, together with long thin steel screws. Other methods will appeal to those of an ingenious turn of mind.

Three Types

Having covered but briefly some of the features of this class of loud speaker, it would not be out of place to give some idea of its performance.

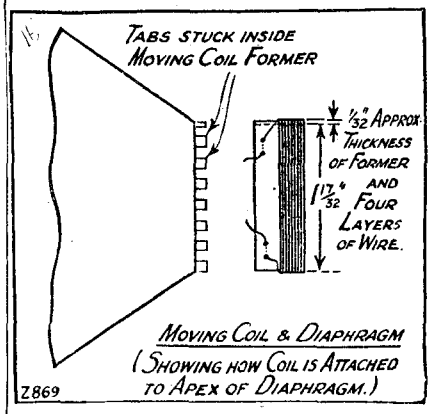
It is, of course, without question the finest loud speaker as yet designed, and though it is by no means perfect, it is far superior to anything that has hitherto been invented.

With a suitably designed set capable of giving first-class quality it is possible for the critical listener to deceive himself into believing the small diaphragm and baffle are a first-rate orchestra playing a few yards away.

Parts for the home construction of three types of this loud speaker are on the market at present, one for use with D.C. mains or rectified A.C., one for operating direct from an L.T. accumulator, and a third to work from a magnetic system provided by a series of permanent magnets.

Since the latter will appeal to those who have no electric-light mains and do not wish to utilise the L.T. accumulator to supply ·75 to 1 amp., a few constructional tips will not be out of place.

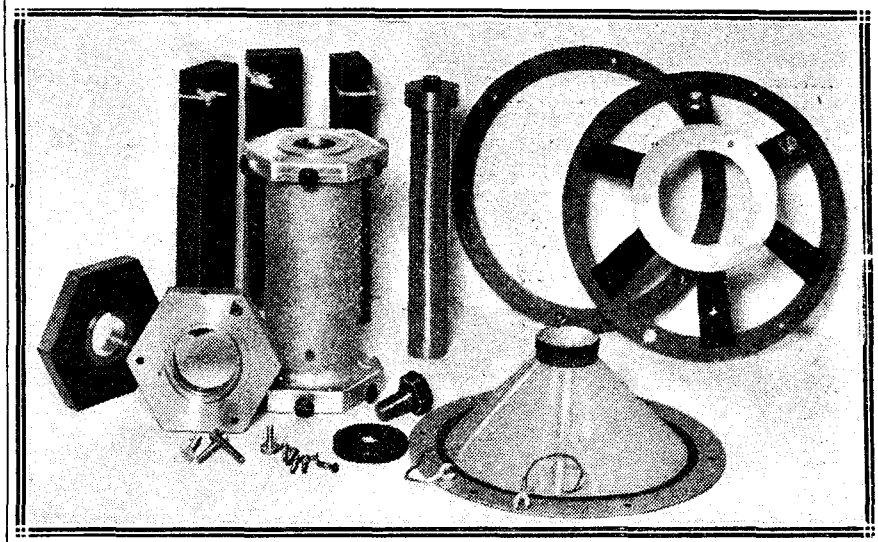
The writer does not wish to decry the value of the other types, for it



can be admitted at once that they can be, if well designed, more efficient than permanent-magnet loud speakers.

A Quick Comparison

As a matter of interest, it may be mentioned the one below described is about 15 to 20 per cent less efficient than a first-class electro-magnet loud speaker, the difference in the volume of the two, quickly changing over from one to the other, hardly being discernible. The prospective constructor need not worry on this point, however, if he remembers a permanent-magnetic type can give a far greater volume than ever he will require for home use.



The various parts employed in the construction of a moving-coil loud speaker.

A Moving-Coil Loud Speaker—*continued*

The construction of the loud speaker is quite simple, if good parts are used, since most of the work consists in assembly. It is necessary, of course, to construct the diaphragm, although the moving coil can be obtained ready wound.

Complete Set of Parts

The complete set of parts for the loud speaker described was obtained from the Cromwell Engineering Co., of Merton Park, S.W.20, and includes three pairs of best cobalt steel magnets, an aluminium centre framework on which the magnets can be bolted, an aluminium framework for the diaphragm, an aluminium ring to clamp the latter, two hexagon steel end-pieces, a steel centre rod which fits the aluminium centre framework and which constitutes the north pole of the magnetic system, a steel hexagon nut to clamp it to the back steel end-piece, twelve steel round-head metal screws for holding the magnets, a 1½-in. diameter moving coil ready wound on a paper former, a disc of special "Kraft" paper 8½ in. in diameter for the diaphragm, and six screws for clamping the aluminium ring and diaphragm to the framework.

Powerful Permanent Magnets

The complete set of parts are shown in the photograph on another page, and the diaphragm, a disc, a piece of "Kraft" paper corresponding to the portion removed from it after it has been cut, and the moving coil are also shown in another photograph.

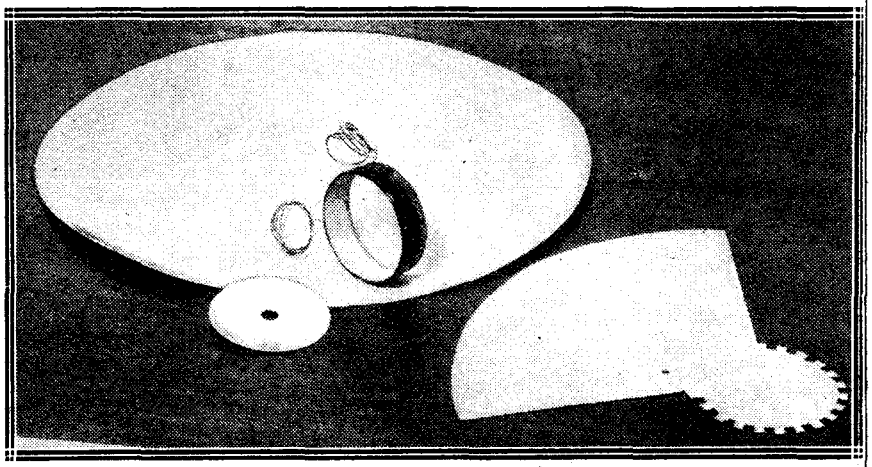
Before commencing construction, it is as well to place the pairs of magnets carefully in a safe place where they cannot be dropped, and so ruined, because a violent blow will in most cases rob them of 50 per cent of their magnetism. See that the pairs do not touch each other, and keep them in twos until they are required for use. These magnets, which are enormously powerful, must be treated with the greatest care until they are finally fixed in place. Observe *all* the precautions named in the article in this regard.

Construction can be commenced by first marking out the disc of paper supplied according to the diagram given elsewhere, and as it is necessary to get the moving coil accurately placed on the apex of the diaphragm, care should be taken to see that the marking is done neatly and to plan.

The serrated edge for holding the moving coil can be cut by means of a sharp and pointed penknife, and the remaining portion by the same means, or by a sharp pair of scissors.

Use a tube of good gum for sticking the overlapping portions of the diaphragm together. The writer suggests Seccotine as being suitable. The *overlapping* portion on the one edge of the diaphragm can be stuck inside the cone that is produced.

When dry, pull out the serrated edges on the apex of the cone gently with the fingers and carefully gum their outside surfaces. If the gum is left for a few minutes it will possess greater adhesive powers, and the moving coil can be stuck on, the serrated portions fitting inside the coil former, with the coil farthest away from the diaphragm (the coil is wound on the end of a paper former which is about twice as wide as the coil itself). Press the serrated edges of the diaphragm firmly against the inside wall of the moving-coil former with the fingers, taking great care not to press the coil out of shape. The job is best done in the hands and not against any hard substance. Then leave the gum to "set."



A comparison between this photograph and the diagram on the following page will show how the cone is cut out.

The Leather Support

A strip of thin suede leather, about 2 in. wide, can next be procured and should be sufficiently long to cover the periphery of the diaphragm. It can be glued to the *inside* surface of the cone diaphragm by means of the Seccotine, applied for ½ in. depth all round the periphery. When "tacky," the suede leather can be pressed against the gummed surface with the diaphragm laying on its side on a solid surface, such as a table—again taking great care not to damage the moving coil nor the leads from it.

The next step is to obtain some fairly stiff cardboard, and clamp it between the aluminium ring and the framework which will contain the diaphragm. It is best to place all the screws in the ring so as firmly to secure the cardboard, and then cut out the centre and outside portions with a sharp knife, so as to leave a ring of cardboard having similar dimensions to the aluminium ring. The cardboard ring will, of course, have holes through it corresponding to the holes in the ring.

If the suede leather has firmly adhered to the diaphragm it can be laid on a flat surface with the moving coil uppermost.

An Important Point

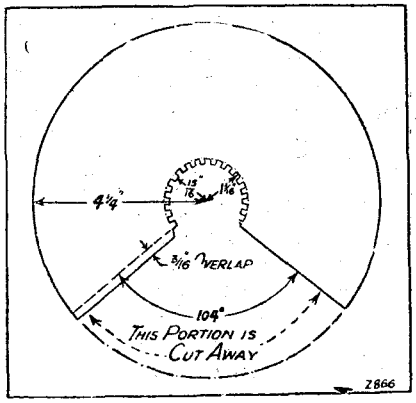
One surface of the cardboard ring can now be smeared with the gum, and when "tacky" passed over the moving coil and pressed into position on the suede leather, making certain it is equidistant from the diaphragm edge all round the periphery.

While in this position the overlapping portions of the leather (the part projecting beyond the outside edge of the ring) can be gently pulled to prevent the leather creasing and from being more slack in one position than in another. Do not

A Moving-Coil Loud Speaker—*continued*

do this so that the cardboard ring is inclined to warp, as this will distort the diaphragm.

The best tension is denoted by the diaphragm being free, yet without any sign of drooping when the ring is held in a vertical position. It



should be capable of "giving" when pressed by the hand against the moving coil. A good connection between the leather and the cardboard ring can be facilitated by opening up holes in the leather facing the holes in the cardboard, and clamping the whole temporarily in the aluminium framework with the magnetic system removed.

When dry, the diaphragm can be removed from the framework, and the leads from the moving coil stuck along the outside surface to within $\frac{1}{8}$ in. approximately of the periphery, where stranded wire can be soldered on to the ends of the thin wire, and the joints covered over with small pieces of gummed paper pressed over the wire and to the diaphragm surface. The thin wires from the moving coil can also be covered with strips of thin paper.

Completing the Diaphragm

To complete the diaphragm, open up the holes in the cardboard ring to about twice the diameter of the screws by means of a leather or hollow punch. This is done to allow movement of the diaphragm when centralising it.

The magnetic system can be easily assembled, and constructors should refer to the photographs and diagrams for assistance. The framework containing the diaphragm must be screwed to the front steel hexagon face-plate before the diaphragm is fixed as the screws cannot be got at afterwards.

When all is ready the diaphragm can be picked up by the cardboard ring and the moving coil on the apex carefully dropped into the annular gap in the magnetic system, taking care that the fine wire on the moving coil does not scrape on the magnet walls.

Centralising the Coil

Drop the aluminium ring on top of the cardboard ring, making certain the holes in it correspond to those below on the aluminium ring of the framework, and place the screws in position, but do not tighten them up fully.

The cardboard ring can be moved about slightly so as to allow the moving coil to be centralised in its gap. This will have to be done carefully, as there is only 1/64th in. clearance between each side of the coil and the magnet wall adjacent; when adjusted, the screws can be tightened up on the ring.

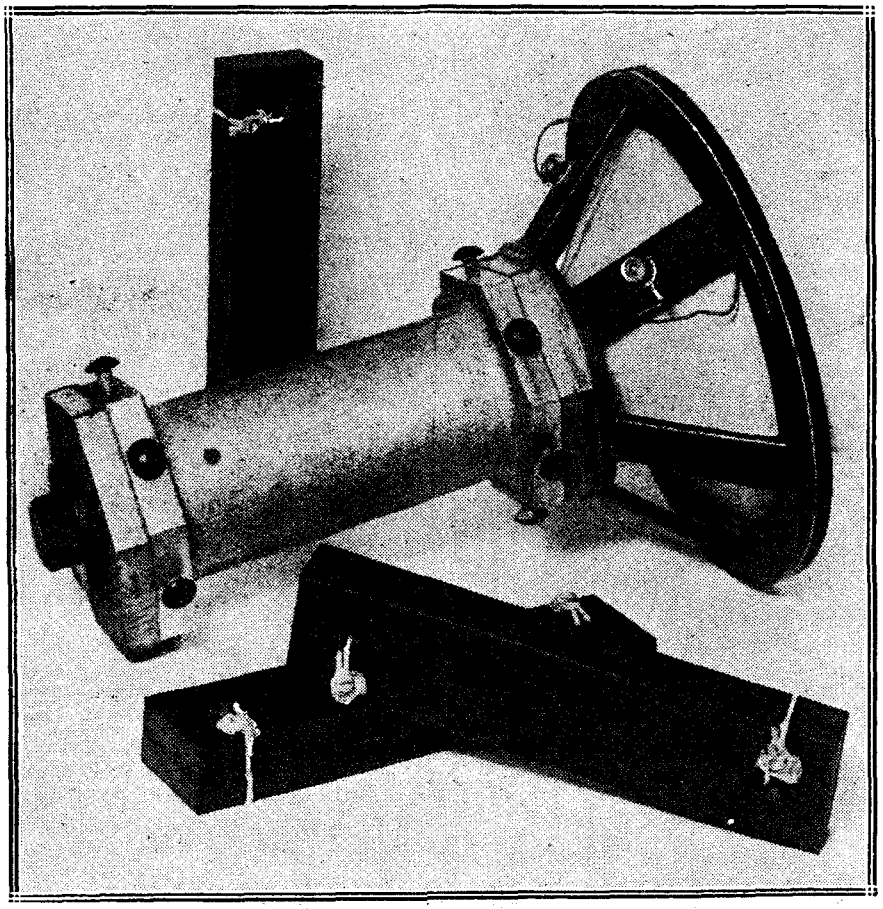
Constructors have the choice of three systems of keeping the coil permanently centred in its gap, and two of them are shown in diagrams given on another page.

The third system which can be tried is of attaching three silk threads to the edge of moving coil nearest the diaphragm, at 120 degrees apart, and fixing the remaining ends of the threads to brass rods projecting from the back of the bottom aluminium ring holding the diaphragm, or from the back of the wood "baffle." Such threads should be made at least 6 in. long, so that in the event of their vibrating they will do so at a very low frequency and not interfere with the loud-speaker responses.

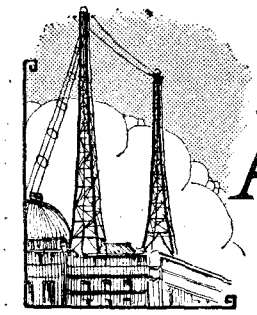
The Other Method

Although this method of suspension is known to be very good, the writer uses the one shown in diagram B, owing to the small gap allowed for centralising the coil. A piece of Bristol card is cut to the shape shown and stuck in the apex of the cone

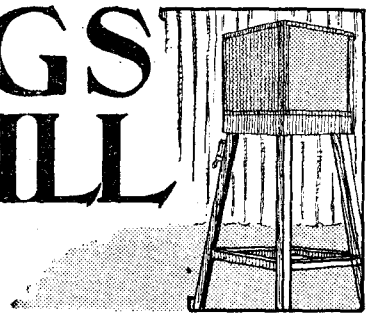
(*Continued on page* 326.)



This photograph shows the three pairs of permanent bar magnets ready to be fitted to the framework.



HAPPENINGS AT SAVOY HILL



By OUR SPECIAL COMMISSIONER.

Where are the Governors?

SEVERAL of the regular B.B.C. contract artists have been mentioning to me lately, without any collusion, that the aloofness of the Governors from all that has to do with entertainment is the cause of a good deal of adverse comment among microphone artistes. According to my informants, not one of the Governors of the B.B.C. takes the slightest interest in the human side of the work.

When I put this complaint to them, the information people at Savoy Hill tried to explain it away by emphasising two things, the first that the Governors followed the customary procedure of Boards of Directors in confining their attention to general policy and in leaving all executive work to the regular staff. The second was that for the Governors to be in constant attendance at the studios would be to invite a lot of unnecessary difficulty through encouraging "wangles" and undermining the authority of the executive staff.

I must say that there is some cogency in these answers, but they do not entirely meet the objection. The broadcasting business should be run on intensely human lines, and those who are responsible for it are expected to give some social recognition to those who do the work.

Restoring the "Peaks"

It is splendid news that Savoy Hill has definitely established a section of the programme department whose sole purpose it will be to think out and to frame special programmes. This section, under the capable control of Mr. V. Wellington, has already yielded some conspicuous results.

The B.B.C. Orchestra

There seems to be general agreement among those competent to judge that the B.B.C. Orchestra for this year's national concerts is not nearly as good as the orchestra last year at the Albert Hall series. What is wrong remains a mystery; but it is up to the B.B.C. to restore the prestige of their orchestra by measures however drastic.

The Status of Broadcasting

The insecurity of tenure of those who have jobs with the B.B.C. has become the subject of some controversy. It is complained, on the one hand, that our broadcasters are forced to combine the disadvantages of the Civil Service with the disadvantages of business, and are deprived of the advantages of either.

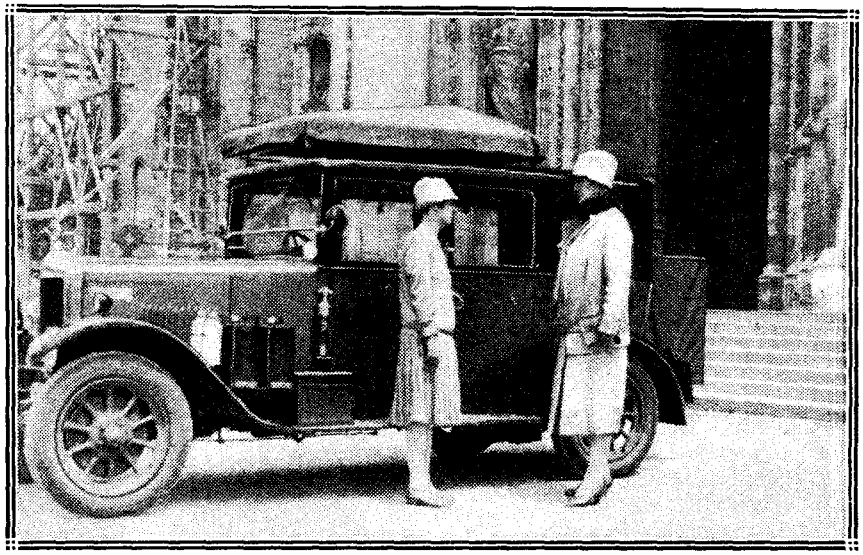
It is retorted, on the other hand, that whatever the status of our broadcasters may be, they enjoy in practice far more security than is really good for the broadcasting service. The position certainly needs clarifying. The B.B.C. has said it so often and so emphatically that it is not a Government Department, that people have begun to believe it. There was no need to convince anybody that the B.B.C. was not a trading concern in the ordinary way.

What then is the status of the staff of the B.B.C.? It seems to be something quite new. This being the case, and in view of the fact that those who leave the B.B.C. find great difficulty in getting employment elsewhere, a more generous measure of security of tenure might well be granted without detriment to the service.

Sir Thomas Beecham and the B.B.C.

The public utterances of Sir Thomas Beecham since the launching of his great appeal for opera have been curiously free from condemnation of broadcasting. This undoubtedly has some significance. The management and business control of the new Imperial Opera League rests with Messrs. Lionel Powell and Holt, who are known to be in much closer contact with the B.B.C. than ever before.

There is more than a vague possibility of a new and far-reaching *rapprochement* between the microphone and the concert hall. This would be an enormous advantage both to the B.B.C. and to the opera promoters.

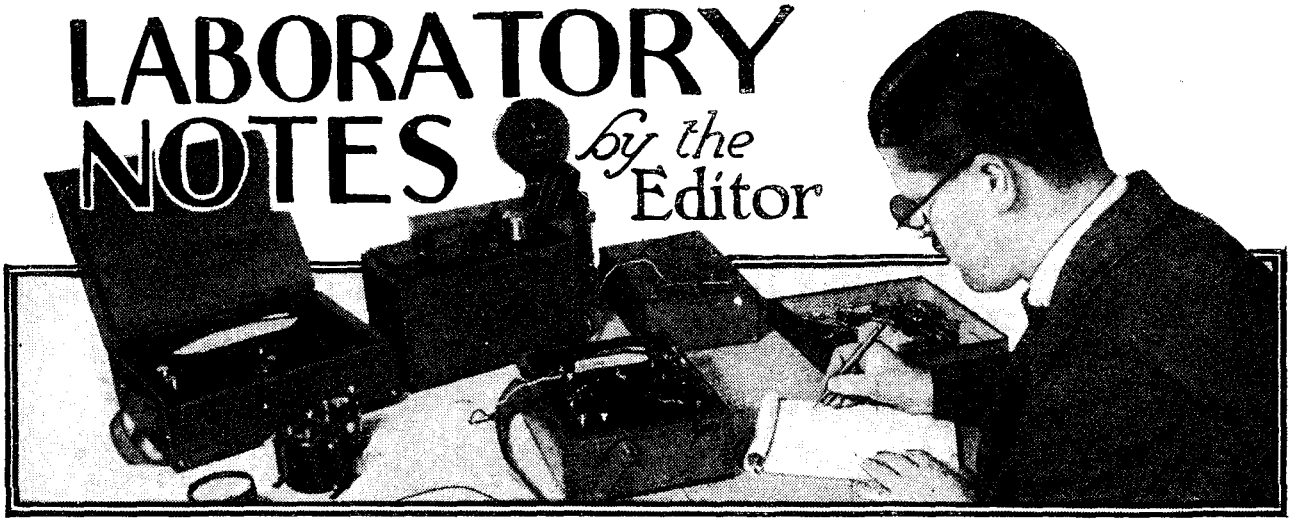


One of the wireless-equipped cars used during a recent tour in Europe when much interesting data upon reception conditions was collected.

To have Sir Thomas Beecham and his artistic following incorporated in the B.B.C. programmes would give to the latter a special flavour of distinction and richness of design. To enlist the B.B.C. on behalf of the campaign for the Imperial Opera

(*Continued on page* 331.)

LABORATORY NOTES by the Editor



Under this heading the Editor discusses some of the many interesting points revealed during experiments in the "Wireless Constructor" laboratory.

THE measurement of values is not only one of the most important, but certainly is one of the most interesting, sections of our laboratory work. The quantities with which we have to deal most are capacity, inductance and resistance (at both high and low frequencies).

Unfortunately some of the simplest tests require the most costly apparatus. For example, the measurement of large inductances, such as are found in radio-frequency chokes, calls for a most complex arrangement of instruments if real accuracy is to be obtained. Part of the apparatus used for this purpose in the WIRELESS CONSTRUCTOR laboratory is shown in the photograph on this page, and the outfit cost over a hundred pounds.

Capacity Measurements

The accurate measurement of capacity calls for similar apparatus, and indeed a modification of the arrangement shown is also in use for the most accurate measurement of capacity by the Carey-Foster method. Rapid tests of a slightly lower degree of accuracy are made on a smaller capacity "bridge." Many hours have been spent recently in measuring, not one or two specimens of fixed condensers, but dozens from different manufacturers. These tests have revealed the fact that many makers of fixed condensers are very careless with their markings. It stands to reason, of course, that a fixed condenser sold at a very low price cannot be expected to have the same degree of accuracy as a laboratory standard, and for most of the uses to which these condensers are put by wireless constructors quite wide variations of value are permissible without our finding any detrimental effect. For example, a nominal ·0003-mfd. fixed condenser can be any value from ·00025 to ·00035 without any noticeable difference in results.

Few makes of condenser can be relied on to have an accuracy closer than 20 per cent. It is also interesting to note that one of the most popular makes of fixed condensers in the low-priced class has on the average a degree of accuracy at least as good as that of another popular make sold at an appreciably higher figure.

Mr. Percy Harris at work in the "Wireless Constructor" laboratory.

A Bad Case

When we come to specimens which give about ·00015 or ·0002 mfd. for a nominal ·0003 we are going beyond reasonable limits of variation. Such degrees of variation are particularly important in the case of the nominal ·0001 condenser so frequently used in series with the aerial. The value of ·0001 mfd., generally, is the smallest that can be effectively used in such a position, as values below this bring about too great a diminution of signal strength. In the "lab." we prefer ·0002 mfd. for such a series condenser.

A maker of fixed condensers recently sent some for test, and advertised them as having an accuracy within five per cent. In one specimen marked ·0001 mfd. the measured capacity was ·00005 mfd.! Out of a batch of about fifteen of these condensers, "guaranteed to be within five per cent," there were variations as wide as forty and fifty per cent, and in one case of a hundred! Communications from this laboratory have been sent to several manufacturers, asking that they will revise their methods and supply their fixed condensers with a reasonable degree of accuracy.

Grid Leak Discrepancies

The measurement of grid-leak values also reveals wide discrepancies in the lesser-known makes, but it is satisfactory to find that the well-known brands average very well, and it is rare to find a variation from the marked value sufficient to make any practical difference in the working of the set. Too high a grid-leak value may give trouble on loud signals,

Laboratory Notes—*continued*

while a value much too low will reduce the sensitivity of the circuit and flatten the tuning. Noisy grid leaks, which at one time gave a good deal of trouble, are now comparatively rare, and, in general, the grid-leak position can be said to be much more satisfactory than that of the fixed condenser.

H.F. Chokes

Radio-frequency chokes have improved a great deal during the last few months, although one or two manufacturers are still sending out radio-frequency chokes which are only satisfactory on the lower broadcast band of 200 to 600 metres, and are hopeless for use on the Daventry range. A radio-frequency choke is, of course, an inductance, and this inductance, together with its self-capacity and associated capacities, forms a tuned circuit. If the inductance value is such that, combined with the capacity in the choke itself and the associated circuit, its resonance frequency comes anywhere near the wave-length it is desired to receive, the set will burst into uncontrollable oscillation.

The mere measurement of the inductance of a choke will not indicate whether it possesses undesirable characteristics in this regard, and some chokes with a very large self-inductance have several nasty "peaks" giving oscillation at several points on the tuning scale. Low self-capacity in a radio-frequency choke is very important, but unless it is combined with high inductance we still do not get what we want. One make which was obviously a copy of another gave on tests precisely the same faults as the one copied!

Variable condensers, on the whole, are now turned out satisfactorily from the point of view of maximum and minimum capacity and low high-frequency resistance. In very few cases have the losses in the condenser under test proved to be unduly high, but in a few instances the maximum capacity has been below that marked. This is a very important point, for some of the tuning coils marked "250 to 550 metres with a ·0005-mfd. condenser" will only just reach this range with a full ·0005-mfd., and if, as in the case of a condenser recently submitted, the actual value on measurement is ·00045 instead of the nominal ·0005 mfd., the tuning range of the set will be considerably restricted.

The measurement of grid leak has to be conducted carefully, and erroneous results can easily be obtained by the use of a wrong testing method. I have heard of many cases of grid leaks being measured on a piece of apparatus known as a "Megger," which is designed for insulation tests and calibrated to show megohms on a scale. The voltage applied by the instrument to the apparatus under test in most models is in the neighbourhood of five hundred volts, which is quite an unfair pressure to inflict on a grid leak designed for use in receiving circuits with but low voltages applied to them.

Grid-Leak Tests

The maximum voltage impressed on a grid leak even in an amplifier circuit does not, with the strongest of signals, reach a figure approaching fifty volts, much less five hundred, and therefore the measurements of values of high resistances which are to be used as grid leaks, and not as anode resistances, should always be conducted on very low voltages.

As our old friend, Ohm's law, indicates that the current in amperes passing through a resistance is equal to the pressure in volts divided by the resistance in ohms, it will be seen that the current through a 1-megohm grid leak, when a voltage of 20 is applied, is 20 micro-amperes, or twenty-millionths of an ampere. Current-measuring instruments to read to this degree of sensitivity with accuracy are both expensive and delicate, needing the most careful use.

R.C. Coupling

At the same time, it must not be forgotten that with the new high-magnification, resistance-coupled valves, grid leaks of a quarter of a megohm are often used as anode resistances. The voltages to which the leaks are then subjected are, of course, much higher and such leaks need to be of good quality to stand up to them; which means, briefly, that a grid leak which may be satisfactory for use with a grid condenser may be hopeless when used as a anode resistance for an R.C. valve. At the same time, it will be found that a grid leak which will not operate satisfactorily as an anode resistance with 120 volts, generally develops trouble in time when used as an ordinary grid leak.

A trouble which has been experienced during the last few months with quite a number of different makes of valves is a tendency to looseness in the valve cap. Quite a number of valves have come adrift lately due to a loosening of the cement, whereas six months ago this trouble seemed comparatively rare.

The Corn Loud Speaker

Some typical faults and remedies reviewed.

By P. R. BIRD.

The Froth-blower!

"I PICKED the accumulator up cheap, and thought it was a bargain. But apparently it is nothing more nor less than a 'Froth-blower,' for every time it is charged it develops a fine head of lather," writes a cheery but puzzled correspondent. He wants to know how this unexpected tendency can be overcome, and what causes it?

The trouble is one not infrequently found when the battery has a celluloid container, and it is due to the decomposing action of the charging current upon unsuitable celluloid. Generally, a pinch of Hudson's soap stops the frothing, like magic. If the trouble is not very bad it is sometimes cleared by emptying the cell and renewing the electrolyte. In bad cases an ounce of "DAR" to each pint of new electrolyte is recommended.

(If celluloid separators are incorporated in the accumulator it may be necessary to replace them with wooden separators.)

Short-Wave Dead-Spots

Writing in praise of the article "Secrets of Short-Wave Success," which appeared in the November issue of the WIRELESS CONSTRUCTOR, a reader raises a point that may prove of great help to other workers new to the short waves.

Using a modified Reinartz-type circuit (Det. and L.F.) he found only one trouble with reaction. On two of the coils it was perfect, but on the 45-metre coil the set would not oscillate except when the tuning condenser was near the top or near the bottom of its range. When it was set half-way or thereabouts, reaction seemed to have little or no effect, and even with a large reaction coil the set would not oscillate.

The trouble, which doubtless experienced readers will have recognised, was a "dead spot." Such a spot will occur with any short-wave set, when the grid circuit is brought into resonance with the aerial circuit to which it is coupled. And the remedy is an extremely easy one—simply "un-tune" the aerial circuit.

All that is necessary is a variable condenser in series with the aerial lead. (Either a neutrodyne, or a tuning, condenser will do.) Normally, this need not be adjusted during reception, all the tuning-in and reaction being controlled exactly as before, upon the respective dials.

But when it is desired to tune over that part of the dial which seems to be a "dead spot," re-set the extra variable condenser in the aerial circuit. The effect will be to move the "dead spot" to a different part of the tuning dial. Consequently, the space formerly occupied by it can be tuned-over in the ordinary way, with good, smooth reaction control.

Later, when the tuning is changed, the "dead spot" may be discovered in a new place—say, at the top or near the bottom of the dial.

But a single readjustment of the aerial's variable condenser will "move it on" again to a part of the tuning range not in use, and the set can be made to tune smoothly to all the stations within the wave-length range of the coil employed.

The "Soggy" Loud Speaker

If you happen to use a horn-type loud speaker you will be interested in a curious fault that bothered a neighbour of mine recently. He uses a three-valver—a "Radiano Three," as a matter of fact—and one day he fancied his reception was falling off.

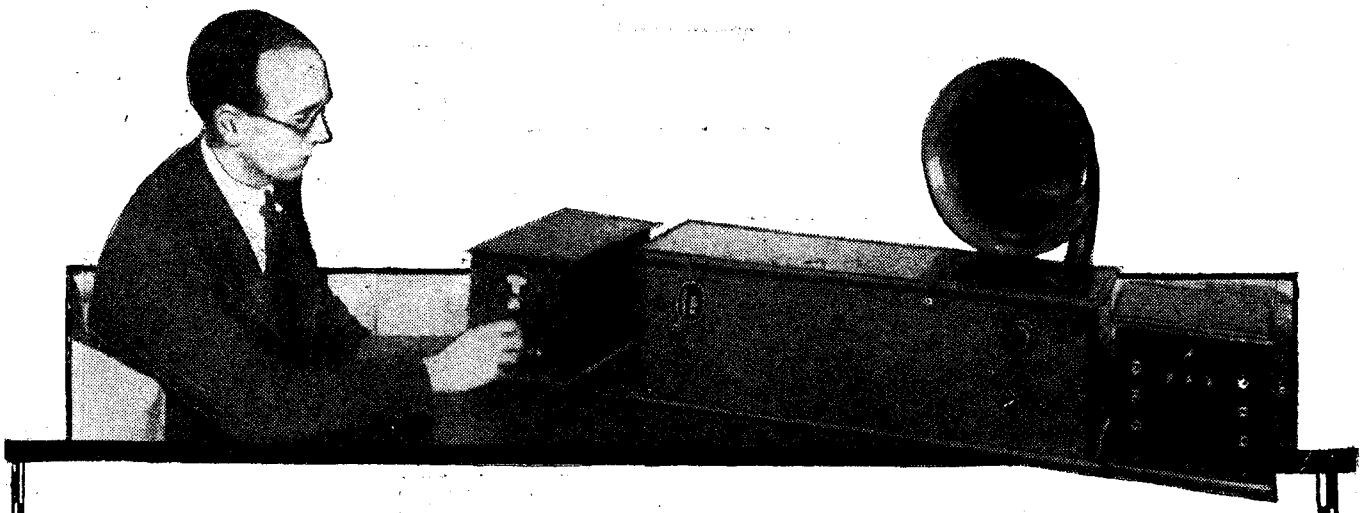
Two or three days later he was sure of it—the strength seemed to be below par on both speech and music, and there was no clearness or crispness about the reproduction.

All the batteries were O.K., according to the voltmeter, so his suspicions turned to the valves. At the first opportunity they were all three tried in a friend's set. And there they worked so well that they returned to their own set without a stain upon their characteristics.

Finally, the loud speaker itself was suspected, tried upon another set, and found guilty of "sogginess." It gave poor volume, the music was muffled, and all the announcers seemed to have plums in their mouths! What was the trouble?

An examination of the loud-speaker's "works" disclosed the fact that electrically the instrument was all right, but domestically it wanted spring cleaning! It had been in use for nearly three years, and during that time dust and fluff had blown into its open mouth, and found their way down on to the diaphragm.

In the course of time they formed a little wad there, and it was this, hampering the movement of the diaphragm, that had caused the "cotton-wool" effect! As soon as the wad was removed, reproduction became normal again.



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3. 1-VALVE L.F. AMPLIFIER.
4. CRYSTAL DETECTOR WITH L.F. AMPLIFIER.
5. H.F. (Tuned Anode) AND CRYSTAL, WITH REACTION.
6. H.F. AND CRYSTAL (Transformer Coupled, without Reaction).
7. 1-VALVE REFLEX WITH CRYSTAL DETECTOR (Tuned Anode).
8. 1-VALVE REFLEX AND CRYSTAL DETECTOR (Employing H.F. Transformer, without Reaction).
9. H.F. AND DETECTOR (Tuned Anode Coupling, with Reaction on Anode).
10. H.F. AND DETECTOR (Transformer Coupled, with Reaction).
11. DETECTOR AND L.F. (with Switch to Cut Out L.F. Valve).
13. 2-VALVE REFLEX (Employing Valve Detector).
14. 2-VALVE L.F. AMPLIFIER (Transformer Coupled, with Switch to Cut Out Last Valve).
15. 2-VALVE L.F. AMPLIFIER (Transformer-Resistance Coupled, with Switch for Cutting Out Last Valve).

P.W. BLUE PRINT Number

16. H.F. (Tuned Anode), CRYSTAL DETECTOR AND L.F. (with Switch for Last Valve).
17. CRYSTAL DETECTOR WITH TWO L.F. AMPLIFIERS (with Switching).
18. 1-VALVE REFLEX AND CRYSTAL DETECTOR, with 1-VALVE L.F. AMPLIFIER, Controlled by Switch.
19. H.F. DETECTOR AND L.F. (with Switch to Cut Out the Last Valve).
21. THE 2-VALVE LODGE "N."
22. "THE GUARANTEED REFLEX."
23. THE 1-VALVE "CHITOS."
24. THE "SPANSPACE THREE." Three-Valve Receiver employing 1 Neutralised H.F. Valve, Detector with Non-Radiating Reaction Control, and 1 L.F. Valve.
26. A "STRAIGHT" 4-VALVER (H.F., Det., and 2 L.F. with Switching).
28. A "MODERN WIRELESS" 5-VALVER (H.F., Det., and 3 L.F.).
29. AN H.T. UNIT FOR DIRECT-CURRENT MAINS.
30. A REINARTZ ONE-VALVER.
31. A STANDARD TWO-VALVER (Detector and L.F.).
32. THE "CUBE SCREEN" THREE (H.F., Det., and L.F.).

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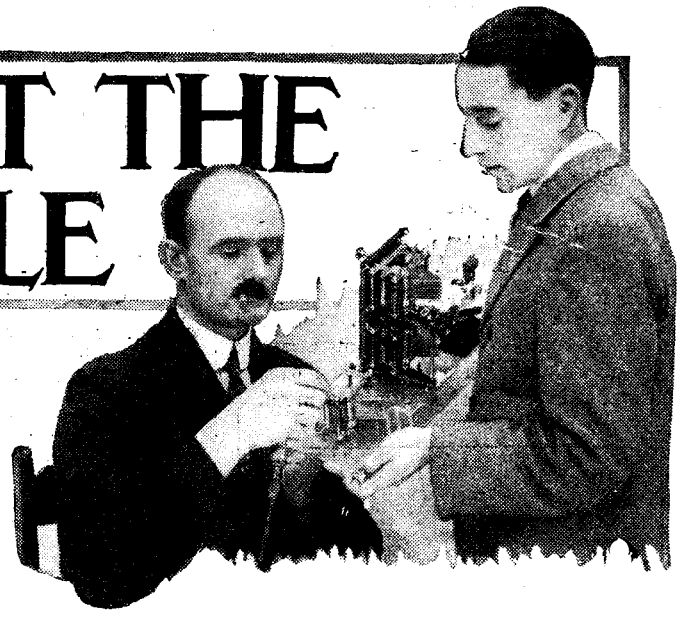
CHATS AT THE WORK-TABLE

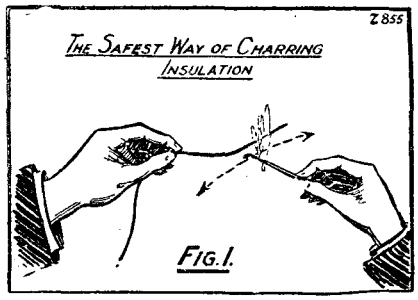


Many points of practical interest to all radio constructors are dealt with this month, including The Treatment of Litz Wire—Simplifying Constructional Work — The Treatment of Soldering Irons, etc., etc.

By R. W. HALLOWS, M.A.

Burning Off Insulation

IN a previous note I mentioned that it was rather a risky business to burn the insulation off very fine silk- or cotton-covered wire. There is a very great temptation to use a match for the purpose, for the business of removing the coverings of fine stuff



either with a knife-blade or with the finger-nails is a distinctly fiddling one.

Lately I have been making some experiments to see how far one could be safe in burning off the insulation. There appears to be no risk with wire of good quality down to gauges as fine as No. 40, provided—and this is a very important provision—that the wire is not placed under any tension. Should there be any pull upon the wire it is liable to draw when it becomes hot and soft, and to break incontinently.

Make a test for yourself. Attach the end of a piece of comparatively stout wire, such as No. 26, to a nail driven into the bench, apply a light pull and hold a match to the insulation near the mid-point of the length. You will find that a very small amount of tension is required to break the wire at the point where it is hot. If wire such as No. 26 draws out and breaks thus easily it is obvious that quite a tiny pull applied to, say, No. 40 when the insulation is being burnt off will suffice to make the wire give way. By far the safest method of removing insulation with the help of a match is that illustrated in Fig. 1.

The wire is held between the finger and thumb of the left hand and its end free so that there is no tension whatever upon it. A lighted match is then moved to and fro beneath it so as to char the silk or cotton covering but not actually to set it on fire. When this has been done the insulation can be removed without any trouble at all.

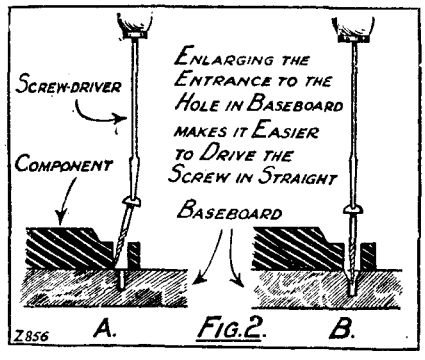
The same method is recommended to those who do not care about the trouble of scraping individually with a knife-blade the strands of Litz wire. Splay the strands out fan-wise, and wave a match about an inch or so below them until the covering becomes charred. The remains can then be removed from each strand quite easily, and there is practically no risk of breaking any strand in the process.

Screws in Awkward Corners

It not infrequently happens when one is making up a receiving set that some component which really ought to have been mounted upon the baseboard early in the proceedings is somehow overlooked with the result that the job of screwing it down is quite an awkward one to tackle. A similarly difficult job may crop up if one has to add such a small component as a fixed condenser to a set that has already been made up and wired completely.

One manages somehow or other to make a hole with a bradawl for the first screw, but the wretched thing simply refuses to go in straight and one cannot get at it to guide it. One or two tips for dealing with such patience-trying little jobs may be found useful. Make your holes in the ordinary way first of all, using the component to be mounted as a jig. Do not try straight away to drive the screws in. Remove the component for a moment and enlarge the entrances to the holes. Fig. 2 shows the advantage of doing this.

If the hole is very small the point of the screw is apt not to go into it very willingly, and even if it does the screw shows a tendency to turn over to one side or the other as shown at A. With a wider entrance the screw readily goes in and no difficulty is found in starting it properly.

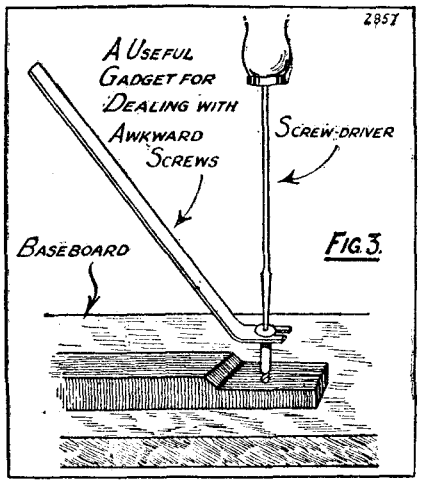


Once it has been started, of course, the rest is easy. I find it very handy in awkward corners to use a magnetised screwdriver and steel screws. These can be obtained with a copper covering so that they do not rust and become unsightly. The blade of the screwdriver is fitted into the notch in

Chats at the Work-Table—*continued*

the screw head; the screw will not fall off, and it is thus easily inserted into the hole prepared for it.

A tool that I would not be without is illustrated in Fig. 3. It consists simply of a strip of sheet brass bent upwards a little at one end. In the bent-up part is filed a slot about $\frac{3}{16}$ in. wide, which can be fitted over the shank of either a wood or metal



screw. The screw can thus be held in place whilst the screwdriver turns it until it has got properly started.

A Drilling Problem

Realising that they will be called upon to make a good deal of use of $\frac{3}{8}$-in. and even larger-diameter drills most constructors provide themselves with hand or bench drills whose chucks have a maximum gape of $\frac{3}{8}$ in. or more When they are new such chucks will, as a rule—at any rate, if they are of good quality—hold little drills quite well.

When they have been in use for some considerable time the edges of the jaws are apt to become rounded and the consequence is that small drills cannot be gripped firmly. Sometimes it is extremely difficult to make them run true when they are held in a large chuck that has seen a good deal of wear.

Fig. 4 shows a tip that is extremely useful. Instead of mounting the little drill straight into the large chuck, use a small chuck in the way shown. This can be gripped firmly and properly centred up in the big fellow, and the small drill runs true and is securely gripped. Spare chucks to take drills up to $\frac{3}{16}$ in. or $\frac{1}{4}$ in. in diameter can be obtained from any good tool shop, and they are by no means costly.

Breaking in a New Soldering Iron

Too often the soldering iron never has a fair chance in life simply because it is ill-treated, or at any rate not too well treated, when it is first brought into use. It goes without saying that the most important part of the iron is its point.

Now if you examine the point of an iron as it comes from the shop, you will nearly always find that it shows a number of tool marks, for they are generally only roughly finished with a coarse file. Each of these marks takes the form of a scratch of greater or less depth, and the metal both at the bottom and the sides of this is naturally oxidised by contact with the air.

Now suppose that you take an iron in this state and tin it, just what happens? By heating it up and using killed spirits you can remove most of the oxide from the surface, and the solder which forms the tinning of the point flows on beautifully to all appearances. But all is not really well beneath the surface.

The oxide has not been removed from the tool marks, and the solder does not run into them; it merely forms a covering over them rather like a snow bridge over a crevasse. As the iron is used, being frequently heated-up and allowed to cool, these untinned tool marks cause pits to form which are frequently not obvious until they are of considerable extent.

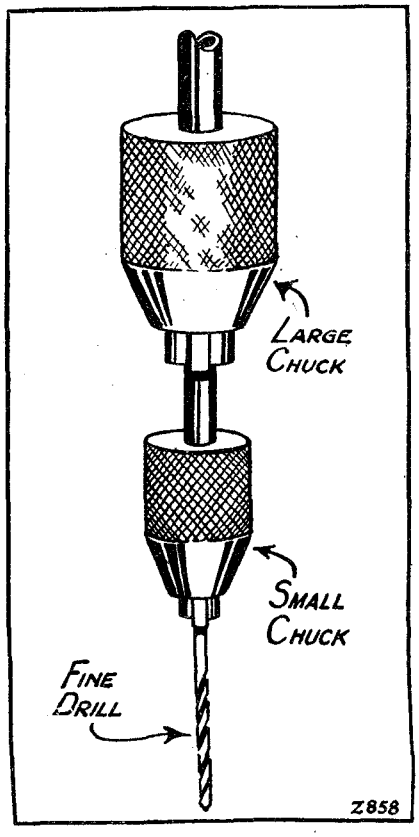
Sooner or later the iron ceases to work properly, and a resolve is made to trim it up. When the work is undertaken it is found that there is extensive pitting which necessitates cutting away a good deal of the metal before a bright, smooth surface can be obtained.

In the case of a big iron this may not matter, but it is rather a serious business with a small, fine tool; for a few such trimmings so reduce its size that it becomes useless. If a little care is taken of a new iron, pitting of this kind may be almost entirely avoided. Before you tin the point, rub out all the tool marks.

You may begin by using an old file of fairly fine cut. Do not use a good one, or you will quickly spoil it, for soft copper is second only to aluminium as a clogging metal. This having been done, give each face of the point in turn a dressing with fine emery cloth until it is smooth and polished.

It is by no means a long job to treat an iron in this way; ten minutes will usually suffice, and the time so spent is a good investment that will save hours of future work, and it will mean that if proper care is taken of the iron subsequently, one very rarely has to throw up a soldering job in the middle in order to carry out re-tinning.

When the point has been made quite smooth, heat up the iron in a smokeless flame, such as that of a gas-ring, if it is of fair size, or of a spirit lamp if it is small. Before tinning any of the faces give it a good preliminary rub on a piece of waste, so as to get it as bright as possible; then take a little blob of solder on to the face of the iron and spread



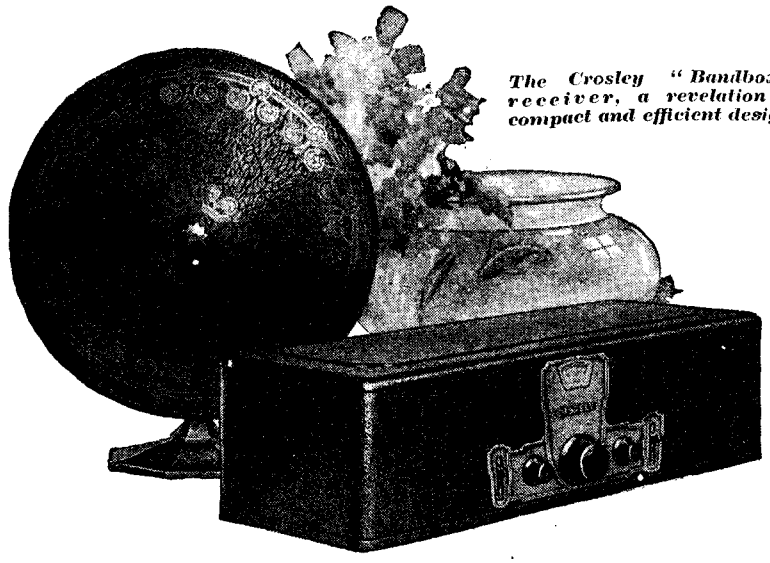
it—the process is very like buttering bread!—with a piece of tinned wire dipped in killed spirits. See that every part of the face has a thin, even covering of solder. Treat each face in the same way.

TRANSATLANTIC TENDENCIES

A brief description of the latest American wireless-receiver designs.

By THE EDITOR.

A FEW months ago, under the same title as that which adorns the present article, I reviewed the general progress of wireless technique in the United States, and in particular the one or two special circuits which had aroused a good deal of interest at that time. A general tendency towards the use of more valves in commercial receivers was indicated, and whereas at the beginning of the broadcasting era in the U.S.A. the standard was a three-valve set consisting of a regenerative detector with two transformer-coupled note-magnifiers, these were rapidly abandoned owing to their howling tendencies in favour of five-valve sets with two stages of neutralised high-frequency, a detector and two transformer-coupled note-magnifiers.



The Crosley "Bandbox" receiver, a revelation in compact and efficient design.

Big Multi-Valvers Popular

Five-valve sets now, however, seem steadily on the decline, and the general standard among the higher-class makers is a six or even eight-valve set. Two typical American receivers of the six-valve variety were recently purchased for test and experiment for the WIRELESS CONSTRUCTOR laboratory. They have many points of interest to the home constructor, and some of the British set manufacturers would *not* find time spent in studying them to be wasted.

The first impression one gets on trying a modern American factory-built receiver is that no attempt has been made to get the maximum efficiency out of each valve used. By this I mean that in sensitivity and selectivity any average American six-valver can easily be beaten by a carefully designed laboratory set with a number of controls, but this is not to say that the six valves are not used to the best *practical* advantage, bearing in mind all the conditions under which the set is to be worked.

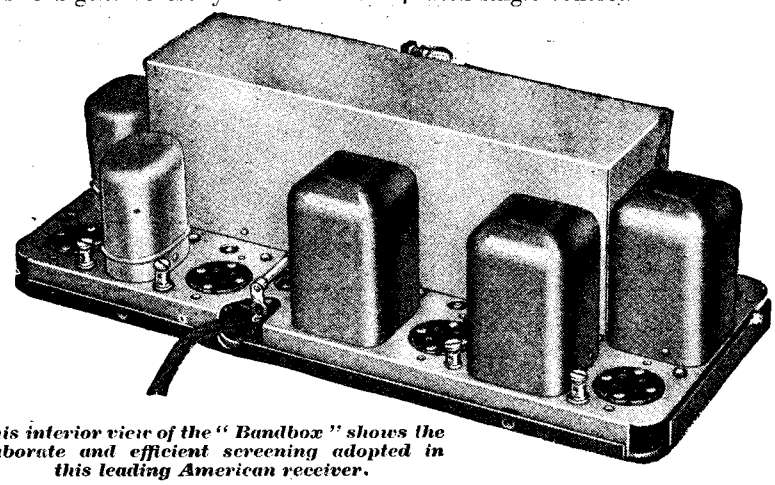
The urgent necessity for standardisation has led all the set manufacturers in the United States to design their receivers to take the UX201A type of valve for every part of the receiver except the output stage, for which special super-power valves similar to our own are available.

Large L.T. Consumption

This is, of course, advantageous from the commercial point of view, but it is not one which commends itself to the British experimenter who has available a large range of valves superior in their electrical characteristics to those sold in America. Furthermore, the American valves are greedy in filament current compared with our own modern standard, a six-valve set of the type we are discussing (using the valves recommended by the makers—five 201A's and a super-power valve as output) taking one and three-quarter amperes. Here we can get valves with similar characteristics (indeed, I have actually used a set of English valves in the set in question), the total filament consumption being then about a third of the previous amount.

Several Good Points

The general efficiency of the modern American six-valve sets, however, is particularly good. They are very simple to operate, they give excellent quality reproduction (providing you use enough high-tension), and have a reasonably high degree of selectivity with single control.



This interior view of the "Bandbox" shows the elaborate and efficient screening adopted in this leading American receiver.

Transatlantic Tendencies—*continued*

The two sets referred to as having been purchased for test in the WIRELESS CONSTRUCTOR laboratory are the "Fada Special" and the "Crosley Bandbox." Both are six-valve receivers, both have three stages of radio-frequency neutralised, a detector and two stages of transformer-coupled note-magnification; both are designed to use five 201A valves and a power output valve.

Constant Tuning Control

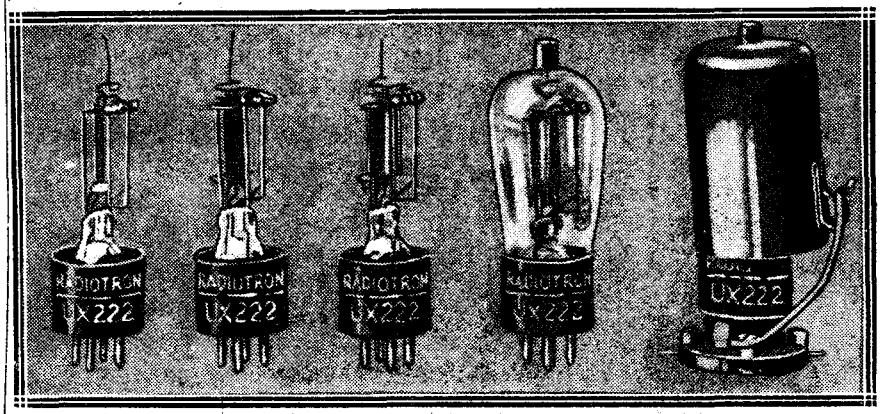
Other points of similarity are the enclosing of the radio-frequency transformers in metal shields, the construction of the set as a whole on a metal "chassis" and the use of a "pigtail" battery cord with tags clearly marked instead of terminal strips with a multitude of terminals. In each receiver, too, a common grid bias of four and a half volts is applied to the grids of the radio-frequency valves and the first audio-frequency valve. Detection in the Fada case is anode-bend without any special grid-bias battery, the particular portion of the curve being found by using the specified plate voltage for the detector valve as indicated by the makers. On the Crosley, leaky-grid detection is used.

It might thus appear that the two sets are similar generally, but actually they differ quite considerably in detail, while in external appearance they are quite different. Of particular interest is the method of coupling the radio-frequency valve in each case.

The Fada Special has one untuned and two tuned radio-frequency stages. The untuned stage, which is placed between a pair of tuned stages, has such characteristics that the energy transfer in this stage increases with increase of wave-length to compensate for the drop in energy transfer which occurs in the tuned stages as one increases the wave-length. One thus gets a more uniform transfer of energy over the whole tuning scale. The first grid circuit is tuned, and in order to allow for differences in aerials the tuning condenser in this circuit is not "ganged" with the others. The other tuned stages are "ganged" so that one has two tuning controls.

On the laboratory aerial, which is of good average type, both drum dials read identically over the whole scale so that tuning in distant stations is extremely easy. Sensitivity proved of a high order and between twenty and thirty stations could be picked up on any night on the loud speaker, the strength varying between weak loud speaker and such a huge volume that it had to be decreased by a volume control (consisting of the filament rheostat for controlling the radio-frequency stages).

The method of neutralising is what we term the "split-primary." Small neutralising condensers are adjusted with a screwdriver when the set is sent out from the factory or service station. It was found very simple to re-neutralise the set for Mullard P.M.6 valves and also for Cossor 610L.F., which both makers kindly provided on American bases. The P.M.6 Mullard and the Cossor 610L.F. sufficiently resemble the American 210A valve to be usable in any American circuit employing these valves, although personally I think that both of the valves named are better than their American equivalents.



The various steps in the construction of the Radiotron screened-grid valve. Note the external screening cap.

A Compact Instrument

The Crosley Bandbox differs considerably in general appearance from the Fada, and is a very small, neat and compact instrument, measuring only 17 in. long by 5½ in. high and 8 in. deep! It is contained in a metal cabinet finished in a brown crystallised lacquer, with only one tuning control, the dial being of the vernier type, and illuminated as soon as one turns the on-and-off switch to the "on" position. Volume control is provided as in the Fada set by a filament resistance controlling the radio-frequency stages.

Condensers and radio-frequency transformers are separately shielded, and the way the whole receiver is packed in a small space complete with its six valves, condensers, transformers, etc., is a marvel of ingenuity.

(*Continued on page* 336.)

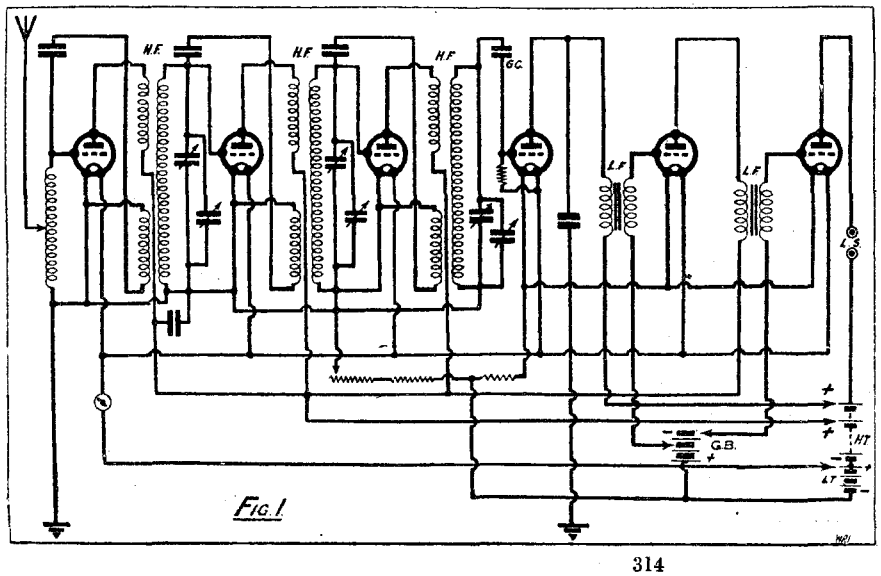
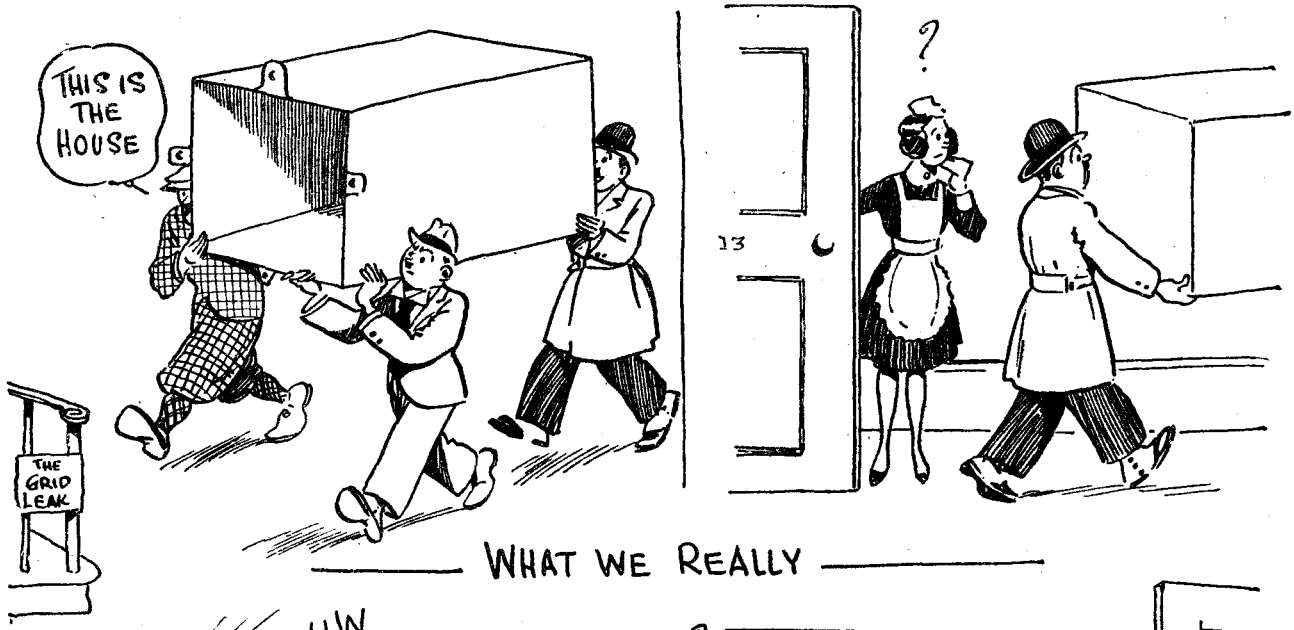


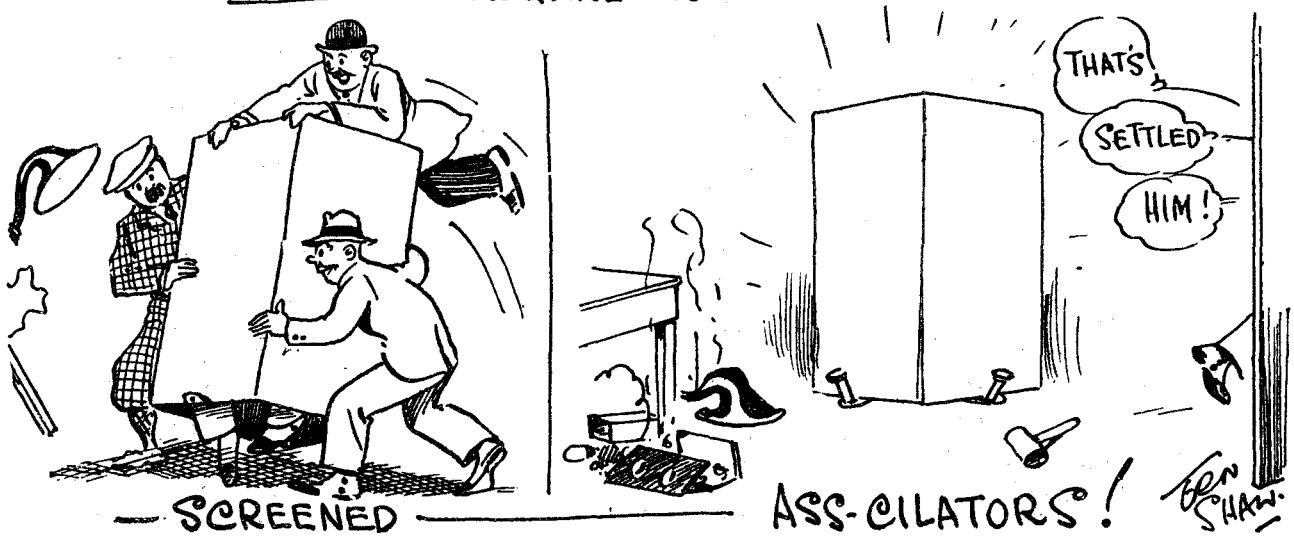
FIG. 1

AT A MEETING OF OUR WIRELESS CLUB IT WAS DECIDED THAT—ALTHOUGH SCREENED VALVES—SCREENED CIRCUITS AND SCREENED SETS WERE USEFUL INVENTIONS——



—— WHAT WE REALLY ——

—— REQUIRE IS ——



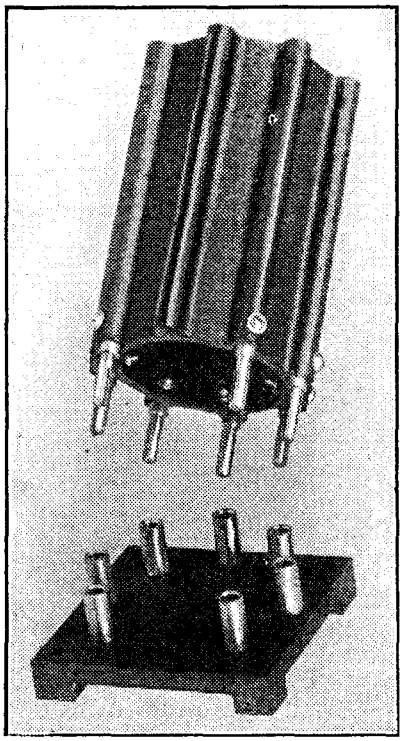
—SCREENED—— ——ASS-CILATORS!

BEN SHAW.

Useful Crystal Detector

A YEAR or two ago we were told by some prophets that the crystal detector and the crystal receiver would soon be dead, but the humble mineral still holds an important place in the affection of many listeners, for crystal receivers are easy and cheap to manufacture and most economical of all to run. Many of the disadvantages of the earlier crystal receivers are now past, the chief of these being the trouble of maintaining a good contact of the cat's-whisker. The advent of the practical form of two-crystal detector with contact under pressure has done much to keep the crystal detector alive, for such two-crystal detectors, generally called " permanent," maintain their adjustment for very long periods, even for months, without any attention.

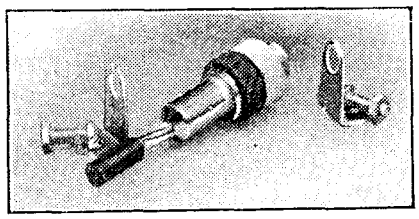
A good example of a well-made



An " Ebonart " coil former and base, of the type referred to in " What's New " last month.

A MONTHLY REVIEW OF TESTED APPARATUS

(NOTE: All apparatus reviewed in this section each month has been tested in the Editor's private laboratory, under his own personal supervision.)



The " Brownie " Permatector.

crystal detector is the " Brownie Permatector," this being totally enclosed and complete with clips for half a crown. The general appearance of the instrument can be gathered from the accompanying photograph. A test on a number of samples showed it to be thoroughly satisfactory. The Brownie Permatector can be substituted very easily for the cat's-whisker type in any crystal set without alteration of wiring, and can be recommended.

Handsome Cone Speaker

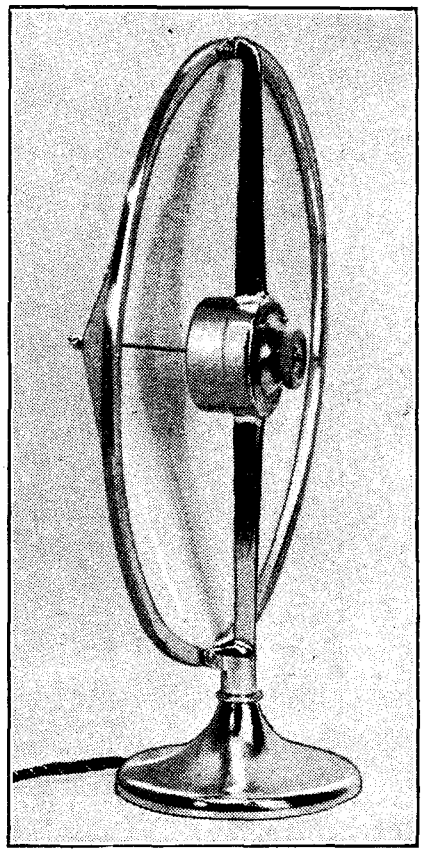
The Sferavox cone loud speaker, an improved model of which has been submitted for test, has a particularly smart appearance with its bright polished nickel stand and silvered cone. Although generally resembling in appearance its predecessor, the present model is really a free-edged cone, the edge itself resting lightly on a ring of rubber, without being fixed to it.

Practical tests of the instrument on broadcast signals, using a very good receiver, showed that the reproduction was of good quality, the low notes seeming to be better reproduced than by the earlier model. The output to input efficiency is not so high as with the horn type of loud-speaker, and those readers who have very little volume to spare might be disappointed on testing the Sferavox with their receiver. This disadvantage is one under which practically all the cone types labour, regardless of price.

In those cases, however, where ample volume of signal is available, the Sferavox gives very good results, providing it is not overloaded.

Cone Loud-Speaker Paper

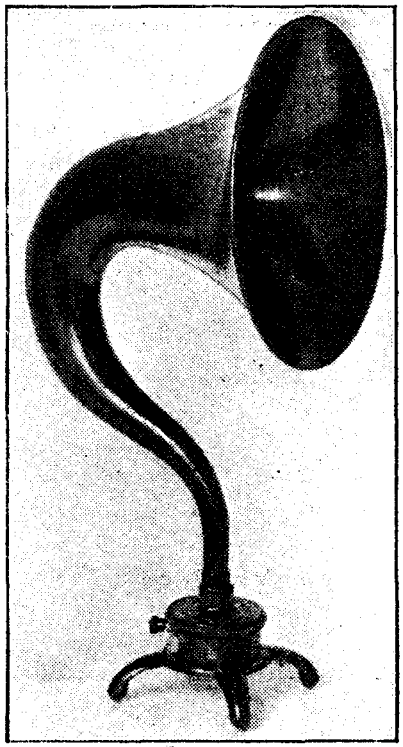
The Electron Company, Ltd., of London, are now supplying, and have sent us for inspection and test, specially prepared cone loud-speaker paper, so that amateurs may build up their own cones. The importance of this paper, its thickness and general texture, is not generally realised, and it is very satisfactory to find that this paper is now easily available, particularly as satisfactory driving units (for vibrating the cone) are available at



A handsome loud speaker—the "Sferavox."

What's New—*continued*

reasonable prices. One of these driving units, together with the "Six-Sixty" cone loud-speaker paper, will enable any reader of this journal to make a thoroughly satisfactory cone. The paper is supplied ready marked for cutting, and with full instructions for making the cone itself. It is identical with that used by the majority of makers of cone loud speakers in America, and it is just the right weight and texture for the purpose for which it is designed. Two sizes of this paper are sold, one packet at half a crown containing a sheet for a small cone, and one at



An "Orphean" loud speaker.

three-and-sixpence for a cone of larger size. The smaller size cone is 12 in. and the larger 19 in. diameter. This paper and the well-known Lissenola unit make an excellent combination.

A Horn Loud Speaker

Although the cone type of loud speaker is rapidly gaining favour, there are many who still pay allegiance to the horn type, if only for the relatively high input to output efficiency which is very useful when a limited number of valves is used. Much of the distortion for which horn loud speakers have been condemned in the past has been due to the unsatisfactory amplifier used with them, and a well-designed horn speaker properly supplied can give a really excellent reproduction. The Orphean horn type loud speaker illustrated on this page is an example of an inexpensive horn type loud speaker of pleasing appearance and good volume. Selling for thirty shillings, it certainly represents good value, and on practical test reached a high standard of reproduction.

Good Panel Transfers

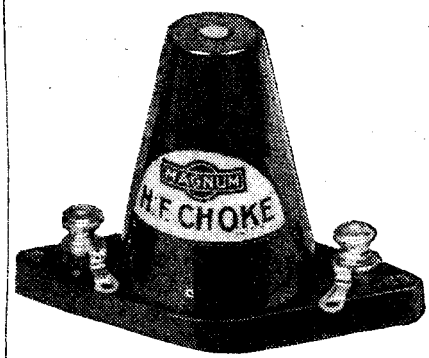
From Messrs. Webb & Yeo we have received specimens of the "Komplete" brand of panel transfers which can be affixed very easily to ebonite panels, giving the appearance of engraving. The range of labels provided is sufficient to meet the needs of all home constructors, and contains a number which has not been previously obtainable. Practical tests on these transfers show that they adhere easily and firmly, and they can be recommended.

Marconiphone R.C. Unit

The latest recruit to the manufacturers selling small resistance-capacity-coupling units for use with the new high-magnification valves is the Marconiphone Company, Ltd., who have sent us for trial and report two of their units designated types A and B respectively. Type A is apparently designed for use with reaction, while Type B will give a somewhat higher "mag." with R.C. valves. The units are metal-cased, provided with good terminals, and are particularly compact, measuring only $2\frac{3}{4}$ in. by $1\frac{3}{4}$ in., by about $1\frac{1}{4}$ in. deep, both units being the same size. The resistances used, as is the case in practically all the small-sized units, is of the carbon type, this giving quite satisfactory service with the anode currents handled.

High-Grade Ebonite Tubing

The American Hard Rubber Company has sent us specimens of Radion variometer tubing. This is particularly suitable for the home construction of single-layer tuning coils. Unlike most ebonite tube, which has a rough surface and a wall of varying thickness, the special Radion variometer tubing, as it is called, has a polished surface and a thin wall of uniform thickness with, of course, the highest electrical properties. It can certainly be recommended to those readers who wish to make an efficient job of their coils. The tubing is sold in lengths of 4 in., with a $3\frac{1}{8}$ in. external diameter and an $\frac{1}{8}$-in. wall,

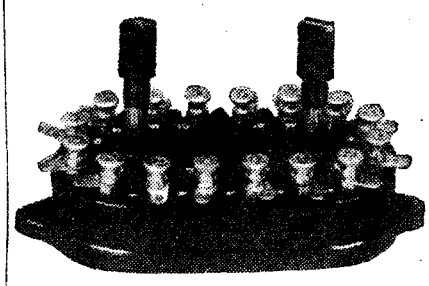


The "Magnum" H.F. choke, a review of which appeared in last month's "Wireless Constructor."

a former of this size thus serving excellently for a single-layer coil of Litz or solid wire for the ordinary broadcast wave-length.

Useful Experimental Unit

For use in conjunction with their new straight-line transformer, Messrs. R.I.-Varley, Ltd., are now selling a very convenient and compact unit comprising condensers and resistances so that the transformer can be used in a number of different ways as the experimenter desires. Space does not permit us to detail the many forms of low-frequency coupling which this little unit will permit, in conjunction with the R.I.-Varley low-frequency transformer. Like other products of this firm it is well-made, and should certainly be obtained by every user of the R.I.-Varley transformer.



The useful unit described above.

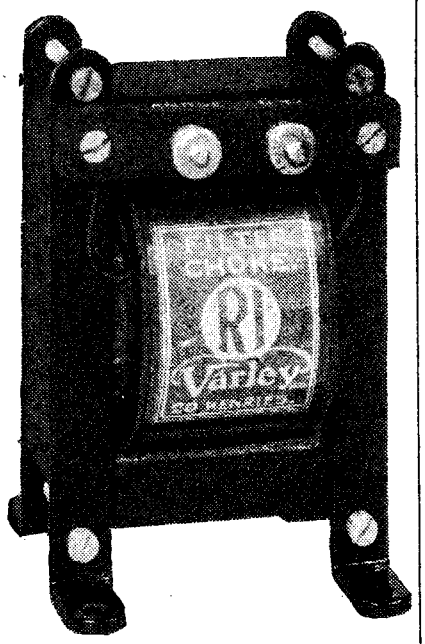
A Two-Stage R.C. Unit

The ever-increasing popularity of resistance-capacity coupling for pure reproduction in note-magnifying stages has led to the production of

What's New—*continued*

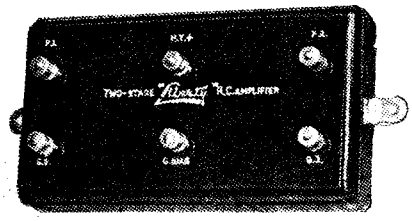
a number of resistance-capacity units for use with the modern high-magnification valves. Comparatively rare, however, is the two-stage type, of which the "Liberty," illustrated in the accompanying photograph, is an example. This unit, which is quite compact, has six terminals for connection to the plates of the first and second valves, the grid of the second and third valves, a high-tension positive (common to both valves) and a grid bias negative.

In view of the fact that quite a different value of grid bias is required



The R.I.-Varley filter choke referred to in last month's "What's New."

on the two valves, the makers recommend the insertion of a grid-bias battery between the G_3 terminal (grid of the second valve) and the grid itself. We do not much care for this arrangement and it would be much better to provide two grid-bias terminals, which could quite easily have been done, since the presence of a large grid-bias battery with quite a considerable capacity to earth directly in the grid lead of the third valve is not one which commends itself for an efficient layout. Apart from this point, however, the unit is quite useful, and the values of the coupling condensers, anode resistances and grid leaks are such that we should recommend for use in the positions. The cost of the double unit is but 10s. 6d., and is another example of how cheap a



The "Liberty" R.C. amplifier.

resistance-capacity-coupled amplifier for use with the new high-mu valves can be made.

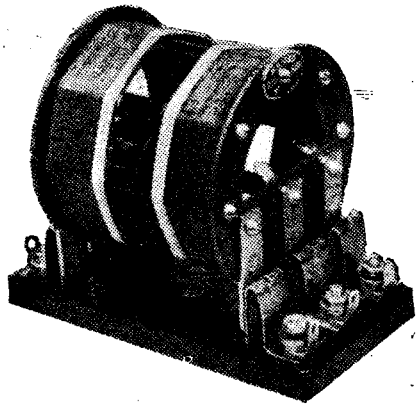
A Useful Coil for the Experimenter

The Cosmos A.N.P. coil submitted to this laboratory for test is a very useful contribution to the list of good components now available for set builders. The letters "A.N.P." stand for "Astatic Non-Parasitic," and the claims to the coil are certainly justified.

The coil itself—or perhaps we should say, the four separate coils which go to make up the unit—are wound on a skeleton former made up of eight insulating rods held in position by two circular end-pieces which also carry six contact blades which fit into a special base. The two main coils are wound in opposition, and are spaced about an inch apart. When connection is made to the base in the correct manner, the two halves of the coil are joined in series in such a way that their fields are in opposition, this giving an astatic effect, the field of the whole coil being thus very restricted.

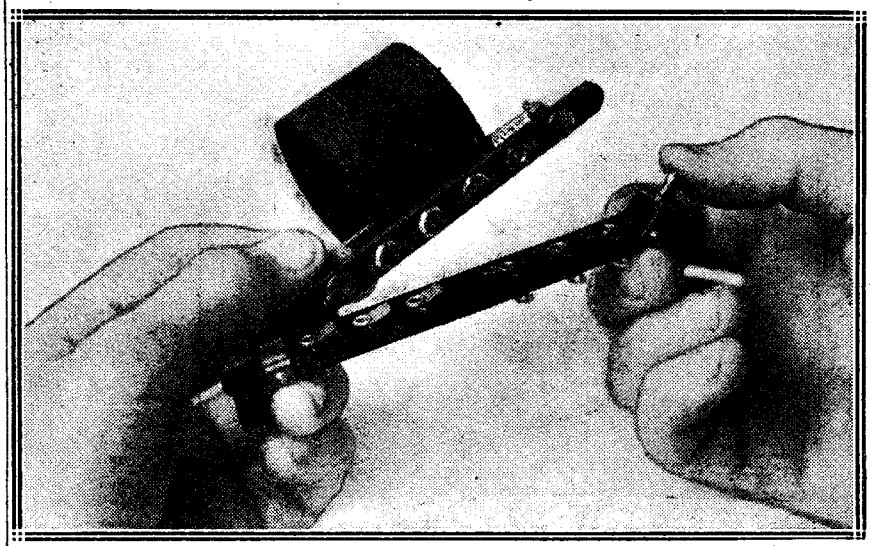
In addition to these two coils, two separate windings of resistance wire, containing relatively few turns, are overwound. In split-secondary circuits or others where the generation of parasitic oscillation is a trouble, this special non-parasitic winding (the two halves of the non-parasitic coil are joined together in practice) serves to damp parasitic oscillation without absorbing any appreciable energy at the main frequency.

Measurements show that the coil,



A "Cosmos" A.N.P. coil and base.

which is rated as being 200 to 600 metres with a ·0005-mfd. condenser, actually covers the range with a good margin to spare, while the high-frequency resistance of the coil is reasonably low. The six connecting pins enable a number of changes to be tried on the lines suggested on a diagram which accompanies the coil. In a test using the coil in a high-frequency unit for screened-grid valves the coil proved quite satisfactory.



This ingenious coil and holder (Formo) was reviewed in our January issue.

THE "BUSINESS MAN'S FOUR"

—*continued from page 272*

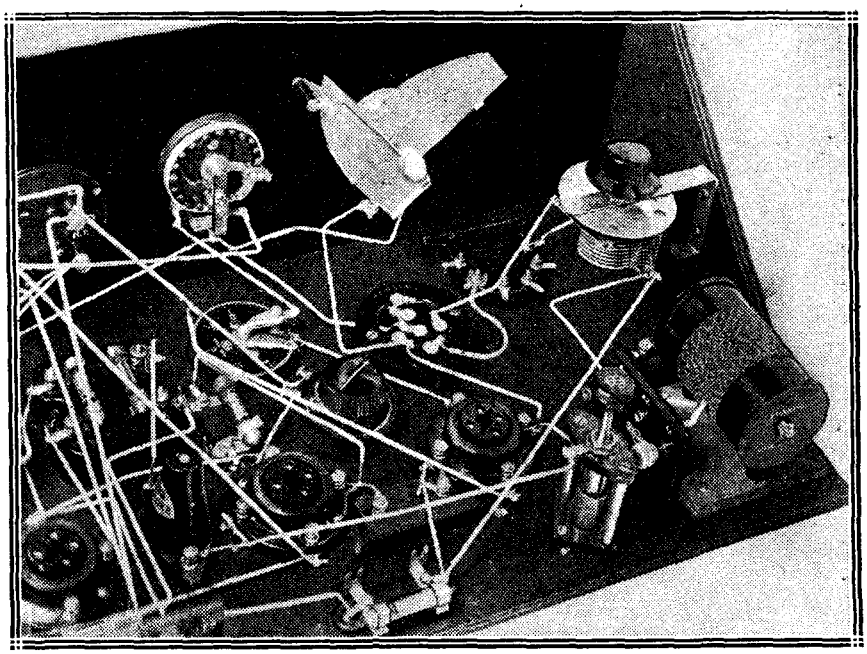
The filament of the high-frequency valve is controlled by two rheostats in series, one being the volume control and the other a calibrated resistance on the baseboard. The object of having the two in series is to enable one of them to be used as a volume control to reduce the sensitivity of the high-frequency valve on very loud signals while still obtaining the most sensitive and best adjustment of the filament when the volume control is at the full on position, or, in other words, when the variable resistance on the panel is at the full on position. Volume control by dimming the high-frequency filament is now known to be one of the most satisfactory methods of reducing strength without introducing distortion.

Connecting Up

It will occasionally be found that you get the double "plock" in the last degree or two on the top of the condenser scale and at the first degree or two at the bottom. If this state is found, introduce just a little more resistance by the calibrated variable resistance on the baseboard **until the** set just ceases to oscillate or give the double "plock" at the top or the bottom of the scale. When you have arrived at this adjustment the set is in the most sensitive state and is ready for connection to aerial and earth.

Join your earth lead, as previously explained, to the negative L.T. terminal of your accumulator and plug the aerial into socket A of the wave-trap. For test it is presumed that the volume control is at the full on position. Now turn the dial backwards and forwards and if you have

(*Continued on page 324.*)



Note the wiring of the neutralising condenser, and the method of mounting the Midget condenser. The wave-trap is shown to the right.

THE "BUSINESS MAN'S FOUR"

—*continued from page 322.*

a reasonably good aerial you will hear several stations, the local coming in, of course, at tremendous strength (as the trap is now out of circuit) over a number of degrees on the scale. When you have tried receiving several stations and have found how very sensitive the set is, tune to the local station and place your aerial in terminal A_2. Now take a piece of wood, cut at one end like a screwdriver, and insert it in the cut in the knob of the adjustable condenser on the wave-trap, and slowly turn this condenser backwards and forwards until the strength of the local station is reduced to its lowest value.

Typical Results

Now try running over your tuning scale again and you will find that you will hear a number of stations you did not notice previously and that the tuning of the local station will be very sharp. The final adjustment of the trap is to tune to a station about ten degrees away from the local and slightly readjust the trap condenser until the local station is cut out altogether.

The following typical list of stations received within a very short period on an average evening on a good aerial will give the reader who desires to make the set some idea of where the stations fall on the dial. All were quite free from London at eight miles.

WHERE THEY COME ON THE DIAL.

Munich ..	86	London ..	58
Vienna ..	84	Dublin ..	46
5 G B ..	81	Newcastle ..	43
Langenberg	77	Belfast ..	41
Brunn ..	74	Hanover ..	40
Frankfurt ..	70	Lyons ..	35
Berne ..	66	Dortmund ..	33
Hamburg ..	63		

A LEAK ADAPTOR

THE usual cartridge type of high resistance is designed to fit into small clips, and has a value of anything from ·5 megohm upwards. Resistances of 100,000 ohms or thereabouts, on the other hand, are commonly much larger, especially if they are wire-wound. The various sizes are thus not interchangeable, and if you want to try widely differing values you find that you have to change the holder as well as the resistance.

An adaptor which will enable you to fit the small cartridges into a big holder is illustrated in Fig. 1. The length of a large cartridge is $2\frac{1}{2}$ in., and of a small one $1\frac{3}{4}$ in. The adapter fits on to one end of the small cartridge, and consists of a $\frac{7}{8}$ in. length of copper or brass rod, of slightly larger diameter than the cartridge. One end is filed to a blunt point, and the other end is hollowed out with a drill to accommodate the point of the cartridge. This device is easily handled, and it holds the cartridge quite rigidly in the clips.

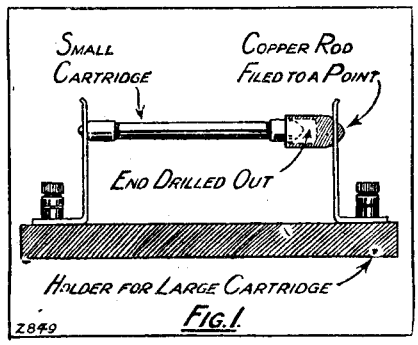


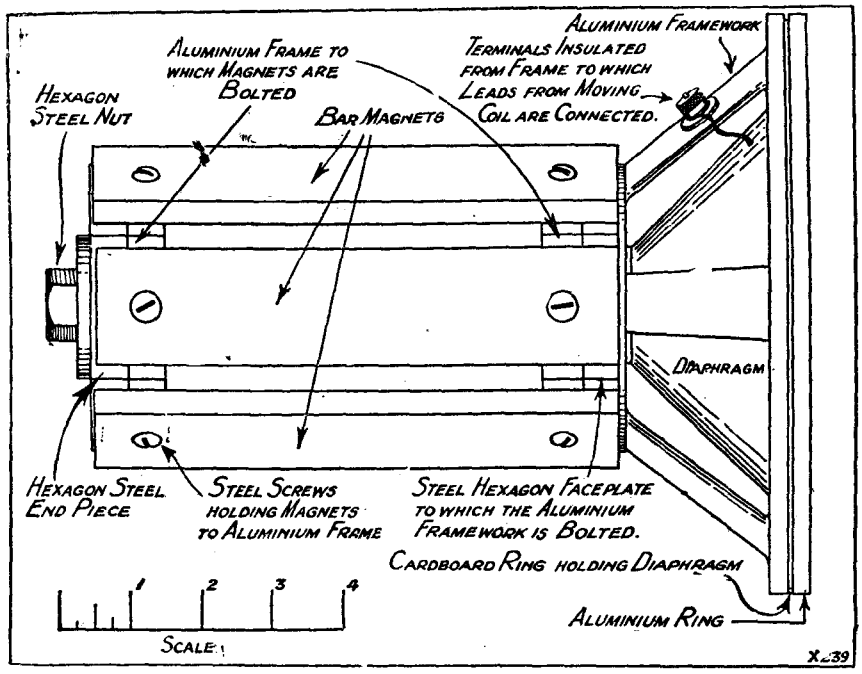
FIG. 1.

A MOVING-COIL LOUD SPEAKER

—*continued from page 299*

diaphragm while in position in its cage. A brass screw is passed through a hole in its centre and screwed into a projection from the steel centre-piece constituting the north pole.

To complete the construction of the loud speaker, it is necessary to fit the permanent magnets. Before parting them, take all screws out of the surfaces on the hexagon aluminium pieces and keep them at hand.



The *north* poles of the magnets must be fitted to the bottom end of the loud speaker, with the south poles nearest the diaphragm.

Take a pair of the magnets and *pull* them apart. *Under no circumstances must they be scraped or slid apart*, as this will lower their efficiency. As soon as they are separated, look for their north poles (which are marked), place them straight on the steel and aluminium hexagon surfaces, and fix them with the screws.

The Question of Cost

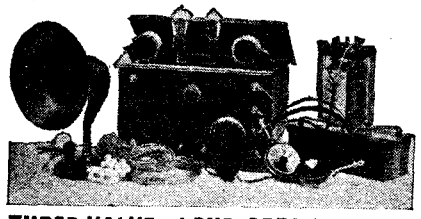
The loud speaker is now complete, but as it is of low ohmic resistance (11·5 ohms D.C.) it is necessary to employ a 25 to 1 ratio step-down transformer. Both the Ferranti 25 to 1 and R.I.-Varley 25 to 1 are eminently suitable for the purpose.

Naturally, cost enters greatly into the question, and though this particular type will be necessarily more expensive than those of the electro-magnetic type, owing to the expensive cobalt steel magnets, which are 14s. each, thus adding another £4 4s. to its cost (its total cost being £9 9s.), yet the fact must not be overlooked that it has no running expenses.

PERSONAL SHOPPERS

WE ARE OPEN TWO SHOPS if one is closed the other is open.

ALL DAY SATURDAY
ALL DAY THURSDAY
ALL DAY EVERY DAY
Hours 9 a.m. to 8 p.m.
Sat. 9 a.m. to 9 p.m.
Sunday morning 11-1



THREE-VALVE LOUD-SPEAKER SET

NOTE THE WONDERFUL VALUE. TRY ONE OF THESE!
(The set shown is two-valve.)

Gets Local, Daventry and many Continental stations.

THIS MAGNIFICENT 3-VALVE SET (D. & L.F.), includes Handsome Polished American-Type Cabinet (all parts enclosed), 3 Dull Emitter Valves, Tuning Coils, H.T. & L.T. Batteries, Aerial Equipment, Leads, Loud Speaker or 'Phones. Tax paid.

£ s. d. **6/6/0** Nett.

JUST THINK of a 3-Valve Set at £6/6/0! It sounds unbelievable, doesn't it?

TWO-VALVE SET £5 5 0 exact to above specification CARRIAGE AND PACKING 5/-

MARCONI, EDISWAN, OSRAM, B.T.H., COSMOS VALVES at USUAL PRICES.

UNITS and **PICK-UPS**, all makes.
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LOW LOSS SQUARE LAW. ·0003 ·0005 **4/11** each. This variable condenser is simply marvellous value. By Post 5/11 It cannot be equalled in price or quality. With VERNIER 1/- extra.

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Try our NEW VARIABLE CONDENSERS, made on the Log-Mid-Line principle. ·0005 or ·0003, with a 4-in. Triolite Dial, the best you can buy, for the moderate price of post **5/11** each, free.

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Valve-Holders, 1/-; Fixed Con., 1/-, 1/6; Leaks, 1/-; Switches, 1/6, 2/6; Latest 2-way Cam Vernier, 4/6; Rheostats, 2/6; B.B., 1/6; Lissenola, 13/6; L.F. Transformers, 8/6; 100 v. H.T., 12/11; 60 v. H.T., 7/11; Coils, 60 X, 6/4; 250 X, 9/9.

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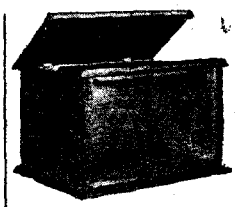

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10 x 8 x 8 ...	8/11
12 x 8 x 9 ...	11/6
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Carr. & Packing 2/6 extra.

MAHOGANY POLISHED 5/- EACH EXTRA.

IT IS IMPOSSIBLE TO ADVERTISE ALL THE WIRELESS PARTS NOW ON SALE BUT IF YOU WANT THEM

TRY RAYMOND'S FIRST!

BE SURE YOU VISIT THE Bargain Window.

New 100-page Catalogue. Profusely illustrated Price 1/- Post FREE, allowed off first 10/- order

SET OF THE SEASON

COSSOR MELODY MAKER

COMPONENTS FOR SAME £4 10 0 Kit.

2 Ormond ·0005; 2 Do. S.M. Dials; 6 T.C.C. Condensers, ·001, ·002, two ·0003, ·0001, 2 mfd.; 2 Grid Lk. Clips, B.B.; 1 Var. B.B. Rheostat; 3 Dubilier Leaks, ·25, 3, 4 meg.; 3 Lotus V.H.; 1 Ferranti A.F.3; 2 Panel Switches; 1 Cossor Melody Wound Coil; Terminals, Name Tabs, Glazite, 9-v. Grid Bias (all as specified).

NOTE Drilled High-grade 21 x 7 Polished Panel, with Radion Strip, FREE with above kit.

NOTE Handsome American Cabinets, hinged lid, baseboard. List: Oak, 25/-, for 18/11; Mahogany, polished, list 32/-, for 22/6, if purchased with above kit. ALL CARRIAGE AND PACKING EXTRA.

"MULLARD MASTER THREE"

NO SOLDER—ONLY 20 WIRES TO CONNECT.

COMPLETE SET OF COMPONENTS

The components specified:

1 Terminal strip, 2½ in. x 2 in. x ¾ in.
1 Coil base (Lewcos).
1 S.L.F. variable condenser, ·0005 mfd. (J.B.)
1 S.L.F. variable condenser, ·00035 mfd. (J.B.)
1 H.F. choke (Climax).
3 Anti-vibratory valve holders with terminals (Pye).
1 Pair panel brackets (Magnum).
4 Terminals—A., E., L.S.—, L.S.+ (Belling-Lee).
1 Set of A B C connecting links (Junit).
2 Spade terminals — 1 red, 1 black (Eelex).
1 Broadcast wave Master Three coil (Colvern).
1 Long-wave Master Three coil (Colvern).
1 On and off switch (Bulgin).
1 R.C.C. unit, type A (R.I.-Varley).
1 L.F. transformer, G.P. (R.I.-Varley).
1 Combined grid leak, 2 megohms, and condenser, ·0003 mfd. (Mullard).
8 Wander plugs—4 red, 4 black (Eelex).
Suitable length of red and black flex.
1 Ebonite bush, ¾ in. diam., ⅜ in. hole, 5/16th in. thick.

And 3 Mullard P.M. Valves.

ABOVE KIT **£6 17 6**

FREE. High-grade Aluminium Panel (drilled), G.B. Battery and 120 volt H.T. given free with above. All carriage and packing extra.

Special Prices for Kits of Parts for "Radiano Three" and all Sets in this issue.

OAK CABINETS

American type, opens at back, compartment underneath for batteries, etc.

12 by 8 by 9 in. deep **18/11**
16 by 8 by 9 in. „ **25/11**
Case and Carriage **2/6**
Solid Oak, glass finish, beautifully made.

DARIO VALVES

(Genuine Radio Micro) Best in the World.

BIVOLT 2-v. ·05, **7/6**; Loud Speaker Valve, **10/9**; R.C. ·05 1-8, **7/6**; 3-5 ·05, **7/6**; Loud Speaker Valve, **10/9**; 3-5 R.C. ·07, **7/6**. Post 6d. each.

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MAGNIFICENT VALUE
Sold to Callers only when buying other goods. See matter at side.

LOUD SPEAKER UNITS

IF YOU SPEND 20/- further in ORDINARY full list priced goods, you can at the same time (only) buy one of these WONDERFUL UNITS, handsome appearance, make lovely presents. JUST THINK, ONLY 5/-.

BRAND NEW. LIST PRICE 9 11 OUR PRICE **5/-** With other goods only

DOUBLE READING VOLTMETERS

For H.T. & L.T.

A VOLTMETER is always useful and acceptable. If you want one for **3/11**, you need only make up a little order value of a further **20/-** at ordinary list prices and it is yours!

BRAND NEW. LIST PRICE 7 11 OUR PRICE **3/11** With other goods only

GRAMOPHONE PICK-UPS

EVERYBODY is wanting to buy one, but the prices are still high. We could not afford to *sell* one at 16/11 alone, but if you can see your way to buy some more goods value **50/-** (at usual prices), you can purchase one of these at the same time (only). Sold as part of our advertising scheme.

BRAND NEW. LIST PRICE 36/- OUR PRICE **16/11** Complete with Cord and Needle. With other goods only

ACCUMULATORS, 2 v. 40 amps.

OF COURSE, you say there is a catch in it—but where? Well, there is NO CATCH. It's simply we want *all* your business, and in return we help YOU. In the case of your wanting this high-class Accumulator for **4/11**, just give an order for a further **20/-** of ordinary goods and it is yours.

BRAND NEW. LIST PRICE 8/11 OUR PRICE **4/11** Other sizes equally cheap. With other goods only

LOUD SPEAKERS

THESE LOUD-SPEAKERS are really wonderful value. And you can purchase at same time with other goods value from **20/-** up to **50/-**. Many well-known non-proprietary makes are shown in window.

BRAND NEW. With other goods only.
LIST PRICES: 16/11, 20/-, 21/-, 25/-, 30/-, 40/-, 50/-.
OUR PRICE **8/11, 10/6, 12/11, 15/-, 21/-, 30/-**

HIGH TENSION BATTERIES

JUST AS MANY HIGH-TENSION BATTERIES are being sold (but they *must* be good). These are a first-class make. Buy a 60-volt for **3/6** with your 20/- order, and a 100-volt for **5/11** with **25/-** order. LOOK WHAT YOU SAVE!

60 volt. BRAND NEW. LIST PRICE 6 11	OUR PRICE **3/6**	100 volt. BRAND NEW LIST PRICE 11 6	OUR PRICE **5/11**

With other goods only

SLOW MOTION DIALS for fine tuning

THESE ARE WONDERFUL DIALS, and you must have one to make your set more selective. Make up your order for a further **10/6** worth ordinary goods and it is yours for **2/3.**

BRAND NEW. LIST PRICE 4 6 OUR PRICE **2/3** With other goods only

VARIABLE CONDENSERS

(LOG MID-LINE BALL BEARINGS.) No dial.

THIS IS A FIRST-CLASS CONDENSER for true tuning (and with the addition of a vernier dial you have as good an article as can be bought elsewhere for treble). It only needs you to purchase **12/6** worth of ordinary goods to secure one for **2/3.**

·0003, ·0005 BRAND NEW. LIST PRICE 4 11 OUR PRICE **2/3** With other goods only

AMERICAN CABINETS

(Mahogany Polished) Hinged Lid, Baseboard.

NO WIRELESS SET is complete without a cabinet, is it? So just to help you on the way, you can buy a 12 in. by 8 in. for **5/-** with **25/-** worth of ordinary goods, and 14 in. by 8 in. for **7/11** with **35/-** worth.

12 x 8 BRAND NEW. LIST PRICE 10 9	OUR PRICE **5/-**	14 x 8 BRAND NEW. LIST PRICE 15 11	OUR PRICE **7/11**

With other goods only.

INDOOR AERIALS

With Lead-in and Insulators

A SPLENDID LITTLE AERIAL, copper, special design. You can buy one for 1/- with a further 5/- worth of goods at usual prices.

BRAND NEW. LIST PRICE 2/- OUR PRICE **1/-** With other goods only

SIX-PIN H.F. Transformer, long or short wave. Split Primary or Split Secondary

THESE are a first-class make and need only to be seen to be appreciated. A purchase of a further **15/-** worth of goods entitles you to buy one at **3/6.**

BRAND NEW. LIST PRICE 7/6 OUR PRICE **3/6** With other goods only

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K. RAYMOND

27 & 28a, LISLE St., LONDON, W.C.2.
'Phone: Gerrard 4837.

COME TO **LEICESTER SQ. TUBE** (Important)
Ask for *back* of Daly's Theatre
This address is opposite.

OUR NEWS BULLETIN

Some of the More Interesting Happenings in the Radio World this Month.

Musical Howls

A GOOD deal of nonsense and a good deal of hyperbolical comment has been indulged in with regard to the apparatus recently demonstrated by Professor Theremin. Before me at the moment I have several newspaper cuttings, some of them bearing headings like this: "Music from the Ether," "Wireless Howls as Music," "Magical Melody," and so on.

As a matter of fact, Professor Theremin uses an apparatus probably similar to a super-heterodyne circuit, which just "howls its head off," but admittedly in a melodious way, and by electro-static capacity effects with his hands the Professor can play tones and control the volume of the musical howls emitted by the apparatus.

Try It Yourself

Professor Theremin's apparatus consists of what appears to be a four-valve wireless circuit with two small aerials, a loud speaker, and the usual accumulators, etc. With this novel stunt apparatus he is certainly proficient, and at the Savoy Hotel a few days ago I attended a demonstration where, with his right hand moving as a violinist moves when moving it over the strings, and with his other hand moving to and fro near a second little aerial for controlling the volume, he played some simple airs such as "Ave Maria" and "The Swan" in a very attractive way.

But the amusing part about it is that many famous people have expressed almost incredulous amazement at this wonderful invention. For instance, Professor Einstein has said:

"It is next to impossible to form an idea of the quality of the elementary tones Theremin produces, for this sound brought freely from space is a new phenomenon which affects our nerves considerably."

The latter sentence is perfectly true, as anybody with a howling wireless set knows! If you want to repeat Professor Theremin's experiments in a crude way set your receiver howling—make it early in the morning when you won't worry anybody—and then move your hands backwards and forwards near the set. The capacity effect of your hands will affect the pitch of the howl

(*Continued on page* 329.)

OUR NEWS BULLETIN

—continued from page 328

and, with a little proficiency, you will soon be able to play simple tunes just as anyone, after a little practice, can play simple tunes on a one-string violin.

A Star "Turn"

One more comment, and I have done with this ingenious stunt. At the Savoy Hotel demonstration I met several well-known people who had been invited. They included Sir Oliver Lodge, Mr. Bernard Shaw, and others. Talking to them afterwards, I gathered that they were not particularly impressed and yet the following comment was published in the "Daily Express":

"The audience sat entranced. A look of extraordinary interest overspread the face of Sir Oliver Lodge. Mr. Bernard Shaw sat with folded arms and eyes immutably fixed on the performer. Mr. Arnold Bennett craned his neck round a pillar in order that he should miss no part of the player's movements. Sir Gerald du Maurier's face was filled with admiring wonder. Sir Henry Wood and Sir Frederic Cowan sat in rapt attention."

As a matter of fact, the impression I got was that the majority of people present were rather bored, and certainly, in my talks with Sir Oliver Lodge and Sir Henry Wood, I got the impression that these two eminent people were more amused than amazed, although, like myself and everybody present, they admired the cleverness of Professor Theremin in controlling the oscillations and the expert way in which he produced various tunes. If Professor Theremin tours the music-halls with this apparatus I have no doubt he will be a great success.

Amateur Radio

At a recent meeting of the General Committee of the Manchester and District Association of Radio Societies, a decision of considerable importance was arrived at. It was decided that at its next General Meeting the Association is to be recommended to change its title to: "Association of British Radio Societies," and to launch a campaign to bring in other radio societies, particularly in the North and Midlands.

P.O. Revenue

Listeners are certainly doing their share in helping to increase the Post Office revenue, for I have just heard that a rough estimate of the total number of letters received at Savoy Hill this year, apart from purely business matter, is 60,000, and to every listener who asks a legitimate query, or offers a sensible and constructive criticism, a reply is sent.

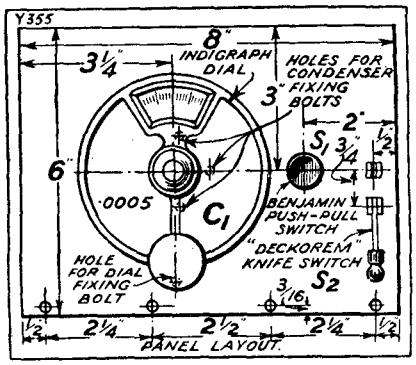
THE "SENTRY" WAVE-METER

—continued from page 285

and pull out the on-off switch. Set the dial about half-way round and leave the knife switch open, in order to get the howl. Put the wave-meter close to the aerial or earth lead of your receiver, listen on the receiver headphones, and tune it till you pick up the howl. On closing the knife switch the howl should cease and you should hear nothing from the wave-meter.

Testing the Instrument

To test the wave-meter for uninterrupted continuous-wave oscillations, tune your receiver to a broadcasting station, switch on the wave-meter with the knife switch closed



and rotate its dial until you hear the beat note in the receiver headphones. Do not turn the dial of the wave-meter too fast or you may miss the beat note. If you find any difficulty in picking it up, open the knife switch, tune the wave-meter till you hear the howl and then close the switch, when the beat note will be audible.

Finding Stations

With the help of the instructions and diagrams given you should now be in a position to build the wave-meter. You can also use it as a check to enable you to find again any stations which you may pick up. When you find a station on the receiver, switch on the wave-meter and locate the beat note, noting the reading of the wave-meter dial. You can then find that station on another occasion with the assistance of the howl. The methods of calibrating the wave-meter and using it will be dealt with in a further article.

HAPPENINGS AT SAVOY HILL

—*continued from page* 300

League would be to guarantee the success of the campaign. As for listeners in general, such a *rapprochement* would be gladly welcomed.

London's Twin-Wave Station

The first of the new permanent Regional Transmitters has at last reached the "bricks and mortar" stage. I hear that the B.B.C. is going in for rather elegant designs in the architectural plans. But it is not this aspect that interests listeners. There is a growing impatience at the delay in the carrying out of the change-over to the long-talked-about regional scheme of transmission.

The B.B.C. should be under no illusions about the urgency of making haste with their new plans. Licence revenue figures are dangerously near the fatal downward curve. A great effort should be made to put in hand simultaneously the whole five of the new Regional Stations. If the accounts given of the results of 5 G B are accurate, then there seems little reason for anticipating radically different conditions in other parts of the country.

Calm in Scotland

After a year of tumults, and "confusions," Scottish broadcasting appears to have settled down and is now accepted with much more general satisfaction then ever before. Mr. Cleghorn Thompson has extricated the B.B.C. from most of its difficulties North of the Tweed, and has made it possible for Sir John Reith to look forward with growing pleasure to his occasional visits to his native heath.

The Private Affairs of Broadcasters

When two young B.B.C. engineers harmlessly motoring through the vales of Tooting side-slipped into a fire alarm, their misadventure became the subject of a news story of interest to all the agencies. Which is another indication that our broadcasters cannot divide their lives into two parts like most people do.

For those who work at Savoy Hill, be they Directors or office boys, the duty day is twenty-four hours. Broadcasting is of such intense general interest that those concerned in it may be said to have none of the ordinary privileges of secluded private life!

A SCREENED-GRID VALVE UNIT FOR YOUR SET

—continued from page 282

This appears to be due to the fact that some of the amplification in the Marconi and Osram screened-grid valve is obtained by a very slight feedback in the valve, whereas the feedback in the Cossor valve is reduced to a greater degree. The ultimate results with both valves are practically the same, but when the reaction condenser is at zero on the Radiano Three, a greater amplification appears to be taking place with the Marconi or Osram than with the Cossor. On the other hand, when the reaction control is used, the strength of both types of screened-grid valves appears to be practically the same.

If this unit is used in front of a receiver which already has a high-frequency stage, the same precaution must be taken, namely, to see that terminal A_1 of the unit is connected not to a tapping or an inductive winding coupled to the first grid circuit of the receiver, but to the plates of the variable condenser, which are connected to the grid of the first valve.

Greatly Increased Sensitivity

Practical tests with this receiver show that in front of a receiver of the type of the Radiano Three enormous improvement in sensitivity is obtained, while the selectivity also goes up very appreciably. Tuning, of course, is a little more difficult when this unit is used owing to the fact that one more tuning control is added, but the handling is quite simple, and the reader will soon become accustomed to handling the additional dial.

It is very interesting to make a test on this unit to see to what extent the screened-grid valve has really reduced interaction, that is to say, how the unwanted capacity effects of the valve itself have been nullified. The test can be very simply made by connecting the terminal marked P to the top terminal of the radio-frequency choke (the terminal which is normally connected to the plate of the screened-grid valve). The 80-volt tapping will, of course, not be used. We can now use any H.F. valve as an ordinary high-frequency valve, and it will be found impossible to use the receiver at all, owing to oscillation caused by the feedback due to the valve capacity. The set will be completely uncontrollable!

WITHIN THE VACUUM

—*continued from page 286*

amp. each. One was an H.F. valve having an impedance of 29,000 ohms and a magnification factor of 13, while the other, the L.F. type, had an impedance of 15,000 ohms with an amplification factor of 7·5.

These useful characteristics were borne out on test, and both valves give better results than are usually obtainable from valves of the same price, namely 6s. 6d. each. Provided the "life" of each of these valves is reasonably long, they should command a ready sale, and especially did I like the L.F. valve when used as a leaky-grid detector.

Another Good Valve

I believe there is a very good little valve that I have not written about yet, although I have had it under test for some time. I refer to the Ediswan 2-volt H.F. valve (H.F.210). This valve is "intended solely for H.F. amplification," and adds one more to the little group to which the D.R.2, G.P.2, R.C.2 and P.V.2 already belong. Whether the L.F.210 will be coming along I do not know, but if so this would complete a useful 2-volt series.

The H.F.210, like the other of its series, with the exception of the P.V.2, takes ·1 amp. at 2 volts and it has an impedance of 30,000 ohms, with the useful mag. of 20. Thus it has an "efficiency factor" (or mutual conductance) of ·66, a useful figure for an H.F. valve.

With the H.F.210 a three or four-valve set could be run (H.F., Det. and 1 or 2 L.F. stages) with a very low L.T. current consumption, the other valves of the series above mentioned enabling a 2-volt battery to be employed with a total filament consumption of between ·3 and ·45 amp.

Popular Series

This series should be extremely popular, and in fact is already widely known, for the tendency to use 2-volt valves is rapidly increasing and I believe the sale figures of 2-volters are far and away above those of the other classes of valves.

As an R.C. valve for first or second stage with a resistance of 100,000 to 250,000 ohms the H.F.210 will operate very well, and can be confidently recommended to the attention of 2-volt supporters.

A SEARCHLIGHT ON THE H.T. BATTERY

—continued from page 276

of an average battery giving just over four weeks of service there would be a fairly rapid deterioration in the quality of reproduction. The user would probably worry over this and would most likely find that an improvement was produced by making the grid bias 6 volts instead of 7·5 volts during the third week.

Rapid Voltage Drop

Even in the course of a single evening a multi-valve set whose plate current is supplied by a small capacity battery may indulge in antics that at first sight are exceedingly perplexing. An examination of the curves seen in Figs. 1, 2, and 3 will show that the drop in potential during a three hours' run, or, at any rate, when the battery has been in use for a little time, may easily reach 10 volts, whilst in some cases it is considerably more.

With one pair of batteries tested (by no means the worst) the potential drop on a percentage basis was nearly 15 volts towards the end of their useful life. Fig. 5 illustrates what would have happened to reception in one evening had these batteries been used. In the diagram appears a family of curves drawn at every $2\frac{1}{2}$ volts of plate potential from 70 to 85 volts.

In the diagram, for the sake of simplicity, I have shown the fall in potential during the evening as taking place with absolute regularity. This would not actually be the case; there would be a very rapid fall during the first three-quarters of an hour, followed by a less rapid but very pronounced drop during the ensuing two hours and a quarter. Since the grid-bias battery retains its potential, the working point drops straight downwards.

Reduced Grid-Swing Capacity

By half-past eight the permissible grid swing is reduced to less than 2 volts, and by 10 o'clock it is under $1\frac{1}{2}$ volts. Any signal producing a bigger swing on the grid of the last valve will cause horrible distortion due to bottom bending. It will, though, appear that the quality of the transmission is falling off rapidly as the evening goes on.

The curves in both Figs. 4 and 5 are admittedly static, and do not therefore show exactly what happens under working conditions. What

(*Continued on page 335.*)

A SEARCHLIGHT ON THE H.T. BATTERY

—continued from page 334

occurs in any case is that the whole curve is moved to the right as the anode voltage falls, and the working point travels straight downwards at the same time. The static curves, therefore, serve to give a pretty good idea of the way in which distortion can be caused by a declining plate potential.

It will be noticed that the curves have been drawn for a small power valve with an initial battery voltage of 100. Many people use a great deal more than this, and the higher the plate voltage—which means a correspondingly greater grid bias—the more appalling will be the results produced by a drop in the actual terminal voltage of the high-tension battery.

Summing Up

To sum up, the standard capacity battery is quite unsuited for working any set that is required to give greater volume than that produced either by head telephones or by a midget loud speaker. In fairness to manufacturers it must be said that the majority of them do not recommend small cell types for any such purpose, whilst many state quite clearly that the maximum economical discharge is of the order of 5 milliamperes.

It is evident that batteries of larger capacity are likely to be far more economical. Exact data upon this point must be given later since the tests that I am conducting with bigger batteries are not yet complete. Speaking generally, though, one may say that where the load exceeds 5 milliamperes, but does not exceed 10, a battery of the large-capacity type is likely to prove a much more profitable investment. The permanent fall in voltage is much less rapid, and the temporary drop during a three hours' run is far smaller. Figures of the running costs will be given in a later article.

A Distinct Economy

With a load of 10 milliamperes or more it undoubtedly pays to purchase batteries of the super type. Those on the British market are made up in 45-volt or 50-volt units. The weight of these varies between 14 lb. and 20 lb. The initial cost may appear rather high since it ranges between 21s. and 25s. per unit. There is a very distinct economy in their use.

TRANSATLANTIC TENDENCIES

—continued from page 314

All three condensers are ganged and close matching is made possible by the use of an untuned aerial stage. The aerial here is connected to an untuned coil by a tapping. The three tuned stages are thus each preceded by a valve of the same general characteristics, so that matching condensers and transformers is a much easier task than would at first be thought.

Three Controls

The characteristics of the transformers are such that the tuning of each individual stage is not particularly sharp, but the overall selectivity of the receiver is all that could be desired for general work. When a particularly fine and accurate adjustment is required small vernier levers can be used, but on test it was found possible to pick up fifteen stations on the speaker without touching the vernier in any way

The theoretical circuit of the receiver is shown elsewhere but for simplicity the grid-bias connections for the H.F. stages have been omitted. The neutralisation method is different from that used in the Fada in that it consists of a separate neutralising coil connected as shown to a small neutralising condenser. The whole set is wired-up underneath the metal chassis with insulated wire, and the general appearance of the wiring can be seen in the accompanying photographs The three knobs shown on the front of the cabinet are for tuning (centre large knob), on-and-off switch (small knob on left), and volume control (small knob on right). Two small levers project each side of the knob and are used for sharpening up tuning when necessary. The makers call them "acuminators," a ghastly word which was apparently coined to indicate a device for sharpening up the tuning. The "Bandbox" is certainly a very fine set for the price charged.

Both these sets are available on the English market, the first from the Fada Radio Company, Ltd., of Kingsway, and the second specially prepared for the British market from the Rothermel Radio Corporation, being known as the Rothermel-Crosley.

The original screened-grid valve brought out by Dr. Hull, of the General American Electric Co. research laboratories, was not placed on the market in the United States, and the first practical form of screened-grid valve available to the experimenter was that designed by Captain Round and now available in this country. The Radio Corporation of America, however, have now placed on the market

a modified form of Dr. Hull's valve, its external appearance much resembling the Mullard screened valve, but its interior construction differing somewhat from either the Mullard, Marconi-Osram, or Cossor.

American Screened Valve

A series of photographs showing the valve construction accompanies this article, but I have not yet had an opportunity of trying this particular valve. The electrical characteristics seem generally to resemble those sold over here, but I cannot report on any comparative tests. It is interesting to note, however, that good screened-grid valves were available to the British amateur several months before the American experimenter was supplied with a similar valve. A tuned-anode circuit is recommended.

In the general development of components in the United States there has been no startling progress during the past few months, although a new type of astatic called the Torusoloid has recently been described. Resistance-capacity-coupling does not seem to have caught on at all in the United States, the reason being that most of the schemes described there are worked out for the ordinary 201A type of valve, which is considerably inferior to the R.C. types of valves we have here. Furthermore, the development of low-frequency transformers in the States along lines which enable the low tones to be produced has been very rapid.

New Moving-Coil Unit

The remarkably faithful reproduction given by the Rice-Kellogg loud speaker has stimulated development of coil-driven loud speakers generally, and it is interesting to see that the Magnavox Company, which was the first to sell a coil-driven loud speaker in the United States, is now producing a complete coil-driven cone unit for the home constructor.

No loud speaker other than the moving coil type can handle much power without distortion, and although the ordinary cone type of loud speaker can give exceedingly faithful reproduction of the low and high tones with moderate outputs such as are used in ordinary sitting-rooms, it cannot compare with a coil-driven type when large halls are to be filled with music or when the very best reproduction of low tones with volume is desired.

All communications concerning advertising in "Wireless Constructor" must be made to John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Telephone: City 7261.

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31 TESTED CIRCUITS

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31 TESTED CIRCUITS

Compiled by Percy W. Harris M.I.R.E.

In which the Editor of the "Wireless Constructor" gives practical details of a representative collection of reliable and efficient "hook-ups."

In presenting this booklet of thirty-one tested circuits, all of which have been thoroughly tried out in the WIRELESS CONSTRUCTOR laboratory, I have borne in mind the numerous requests received by the WIRELESS CONSTRUCTOR Query Department for theoretical diagrams giving values of the components used. A very large number of readers from time to time require circuits of what may be termed a "practical" make-up, and are frequently at loss to know where to look for such circuits in a collected form. In "Thirty-one Tested Circuits" such a book of reference is now available, and should find a place on the table of every experimenter in the fascinating art of radio.

In order to give a representative collection, the thirty-one circuits given in this book have been sorted out from the many hundreds available so as to give the widest range of utility. The circuits, as it will be observed, are both lettered and numbered. The letter indicates the general class and the number the particular circuit in that class. For example, the letter F indicates three-valve circuits, of which four thoroughly sound arrangements are given in the book. Readers comparing notes among themselves or writing to the journal can easily refer to a particular circuit by its letter and number. Thus F3 means at once a three-valve circuit, being the third in the series in this book.

The numerous "freak" circuits which appear from time to time in wireless literature have been studiously avoided, and only those which can be guaranteed to give the best results in the hands of the average experimenter are included in this book. Under each diagram will be found the values suggested and one or two special hints where such are required for the handling of the circuit.

Of course, the circuits vary considerably in the skill required to get the best from them, and some circuits, although easy to put together and to handle once they are properly adjusted, present certain difficulties in, for example, neutralisation; while no circuit, however thoroughly tried and tested in the laboratory, can be satisfactory if shoddy and inferior components are used. In "Notes On Circuits" the reader will find many helpful suggestions and much guidance in regard to the uses of circuits in general and their construction in practical form.

Complete wiring diagrams, photographs of finished sets from many angles, recommended components, and practical hints appear in every issue of the WIRELESS CONSTRUCTOR, which specialises on constructional articles which give excellent results with a wide variety of components.

Any correspondence or questions relating to these circuits should be addressed to: WIRELESS CONSTRUCTOR Query Department.

PERCY W. HARRIS.

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NOTES ON CIRCUITS

The circuits given in this book can, of course, be made up in many forms to suit the particular layout chosen by the experimenter. Certain precautions are, however, necessary, and in these notes an attempt will be made to indicate the chief troubles the new experimenter may encounter.

In general and in all circuits, whether crystal or valve, the moving plates of the condenser should be connected either to the "earth" side of the coil (if one side is earthed), or to the side nearer point to earth H.F. potential if the coil is not directly earthed. Two practical examples of this can be found by referring to B3, a single-valve reflex circuit. Condenser C1 has one side connected to earth. This side should be the moving plates. Condenser C2 has neither side connected to earth, but one side is connected to the plate of the valve (which is at a high-frequency potential to earth); the other side is connected to the telephones and the H.T. battery. Although at a direct current potential above earth, this point is virtually at earth potential for high-frequency current. The moving plates should, therefore, be connected to the telephones in this circuit.

Concerning Wiring

In practically all circuits there is no difficulty in seeing which side is nearer earth potential. The reason for connecting moving plates to earth is that hand-capacity effects are less when the condenser is joined up in this way. In the split-secondary high-frequency circuits the grid sides of the variable condensers should be the fixed plates.

In all circuits, and particularly in high-frequency amplifier circuits, make the leads connected to the grid of the valve as short as possible. Almost invariably two leads go to the grid terminal of the valve, one from the fixed plates of the variable condenser and the other from one connection on the tuning coil or transformer.

Leads from the plate of the valve should also be kept short, and should not run parallel or close to any grid lead.

In low-frequency transformers the O.S. is almost invariably connected to the grid, and the I.S. to grid bias. I.P. is generally connected to the plate of the valve, and O.P. to positive; but these connections can often be reversed with advantage. If your transformer is marked "Grid," "Grid Bias" (or L.T.−), "H.T.+" and "Plate" (or "Anode"), the above note will serve to interpret the diagrams.

Anti-phonic valve sockets are always an advantage, as there is less chance of straining the valve or breaking the base when pulling the valve out of its holder. In many, if not all, cases they reduce the microphonic noises. It has been found, however, that in so far as the reduction of microphonic noises is concerned the detector socket is the most important; the high-frequency and note-magnifying sockets do not give much trouble with microphonic effects.

In laying out a circuit, endeavour to arrange the components so that they are in the order of progress of the circuit. Expressed in another way, let the circuit start on the left of your baseboard and progress to the right, and do not "double back" here and there just to suit the particular cabinet. The ideal layout is one in which all leads are as short as possible without bringing components too close to one another, so that there is a minimum of unwanted interaction between parts.

In all wiring-up avoid running parallel wires close to one another, unless these are filament leads, which can be as close as you like, providing they do not touch.

The use of ready-insulated wire, such as Glazite, is a great advantage in experimental circuits quickly put together.

R.F. Chokes

In all circuits where radio-frequency chokes are specified, these should be of good standard make of a type approved by tests in the wireless journals. Unfortunately, a number of radio-frequency chokes are now sold which do not function properly over the whole tuning scale. Satisfactory radio-frequency chokes should be quite efficient from 200 to 600 metres, and also from 1,000 to 2,000 metres. Some chokes are quite good on the lower band, but are hopeless on the upper wave-band. If those radio-frequency chokes which have been specified in WIRELESS CONSTRUCTOR sets are used, the reader will have no difficulty in this regard.

In circuits where two transformer-coupled note-magnifiers are adopted the low-frequency transformers should not be placed too close together. In such cases, too, some pairs of transformers will show a tendency to howl. This howling can often be stopped by reversing the connections to the primary of one or both of the low-frequency transformers; that is to say, the two wires which go to I.P. and O.P., or to Plate and H.T. terminals (if they are so marked), should be changed over.

Special Note

It is always an advantage to connect shunting condensers of 1 mfd. or more across each high-tension tapping, and, to avoid crowding, these condensers are not included in all theoretical circuits shown. The method of using them, however, is the same in all cases, and while they are not indispensable, if the set is being permanently made up it is just as well to include them. Where there is only one high-tension tapping shown the Mansbridge condenser should be joined between the *positive high-tension* and the *negative low tension*. If more than one tapping of high-tension is shown, then a *separate* condenser should be joined between *each* high-tension positive terminal and the low-tension negative lead.

In all the circuits given, the substitution of

larger coils will enable 5 X X to be received. In home-made coils 250 turns of No. 28 D.C.C. on a 3-in. tube will serve for secondary circuits, and 150 turns of No. 28 D.C.C. on a 3-in. tube, tapped at every 30 turns, can be used for an aerial coil. Try the aerial on various tappings to see which is best.

For centre-tapped aerial Daventry coils 200 turns is a good value. In plug-in coils a No. 150 for aerial, No. 250 for secondary, and No. 100 for reaction will generally suit.

For untuned aerial windings try 50 or 60 turns. The standard six-pin coils are all available in the Daventry range.

Filament Resistances

Fixed or variable resistors can be used in any of the circuits as desired. Values are not given, as these must be chosen to suit valves used.

When endeavouring to make up the circuits in practical form, readers should always remember that a really successful instrument is the result of skill both in circuit design and in the actual layout of the whole receiver. It is thus possible to make two receivers both with the same circuit, one of which functions excellently with good quality, while the other seems to give every kind of trouble. It is not always realised how much care is taken and how lengthy are the experiments made by the designers of sets appearing in the leading wireless journals. The practical interpretation of a circuit may necessitate half a dozen different sets being made up before the best arrangement of parts is found. For this reason the new experimenter should not be discouraged if a particular circuit in this booklet does not work well the first time he makes it up.

Common Troubles

One of the troubles with which the constructor has to contend when he is making up a set for himself and is not following a complete layout scheme as published by a reputable designer, is the leakage of high-frequency current through the audio-frequency side of a receiver, resulting in distortion, oscillation, audio-frequency howls and grunts, etc., which are most distressing. If, for example, he finds, with two stages of note magnification, that as soon as the reaction control comes near the oscillation point a burbling noise, a grunt or an ear-splitting shriek occurs (not the usual hiss of oscillation or the whistle of a carrier-wave), in nine cases out of ten this will be due to radio-frequency current getting through the audio-frequency side, being magnified there and feeding back into the aerial circuit.

A very useful way of eliminating this trouble, should it occur (and always presuming it is not due to overcrowding of parts and a general bad layout), is to insert a grid leak of half or one megohm, immediately next to one or other of the low-frequency-valve grids. If you examine the multi-valve diagrams given in this book you will find such grid leaks placed here and there. Such leaks are, of course, quite apart from those used as grid-leaks proper, and they do not in any way reduce the strength of signals obtainable, for they permit a free passage of the varying potentials applied to the grid and only become really active if oscillatory currents tend to flow. In such cases they damp them out.

In most cases, however, such leaks can be dispensed with, and their inclusion in several of the circuits is not due to the fact that they are essential, but merely to show the home constructor where he can put them should the trouble occur. In any case they do no harm.

Every reader who contemplates trying his hand at practical interpretations of circuits in this book is advised to obtain a voltmeter, preferably of a double scale type, so as to give him both low- and high-tension readings. The type of meter specially recommended is one reading up to, say, 150 volts and 7½ volts for the low. Many meters read only to 6 volts, which is too low to give an accurate indication with a newly-charged 6-volt battery. The resistance of the voltmeter, too, should be reasonably high as otherwise it will be impossible to get accurate readings of voltage on the high-tension battery, for low-resistance meters (which incidentally are much cheaper) take so much current to make them operate that they cause the voltage of the battery to drop and give a false reading. Very useful meters of good quality are obtainable from half a guinea upwards.

Testing H.T. Voltages

When reading the high-tension voltage in a set in which the high-tension negative is connected to the low-tension positive, the voltage should be tested between the *low*-tension negative and the high-tension positive, as when high-tension negative is connected to low-tension positive the voltage of the accumulator is added to that of the high-tension battery. It is particularly important when we are dealing with screened-grid circuits to use a real 80 volts on the grid for proper functioning. A reading of 80 volts measured between high-tension negative and high-tension positive may actually mean 86 volts when correctly measured.

In those circuits which are provided with a variable reaction control, smooth control of reaction requires a careful choice of valves, high-tension voltage, and grid leaks, etc. In the "Reinartz" type of circuit, or, to be more accurate, in those circuits in which reaction is controlled by a condenser, it is generally found that the type of valve known as "high-frequency," having a magnification factor of 15 to 25, and an impedance of 15,000 to 25,000 ohms, gives best results for smooth reaction. In those cases where a high resistance is inserted in the plate circuit of the detector valve, an R.C. type of valve should be used.

The Detector Valve

The detector valve generally works best with a lower voltage than that applied to the note magnifiers, save where a resistance is inserted in the plate circuit, when the same voltage can be applied to the detector as to the note magnifiers quite satisfactorily, the drop of voltage in the resistance being all that is required to bring the voltage down to the point required.

Grid-leak and grid-condenser values can often

be changed with advantage, and the experimentally inclined reader is recommended to use the interchangeable type of grid condenser so that both this and the grid leak can be altered in the endeavour to get the best results. Generally speaking a high grid-leak value, such as 4 or 5 megohms, is better on the weak signals and gives smoother reaction, but tends to "pack up" on the loud signals such as those received from the nearest station. For short-wave work a higher value of grid leak is generally the most satisfactory. Four megohms is quite a good value to try, although such sets often work quite well with the conventional two megohms.

Methods of Neutralising

Grid condensers can be of any value from ·0002 to ·0004 mfd., and on a set designed for Daventry only, ·0005 is not too high a value. For very short-wave work ·0001 mfd. can be recommended, but here again experiments can be made by the reader himself.

The question is often asked, which is the better way of neutralising—the "split-primary" or the "split-secondary" method? If ready-made coils of high quality are obtainable, then I would recommend the split-primary method, for this gives very satisfactory results and quite free from hand-capacity effects and with a good gain per stage. The home-construction of split-primary coils is, however, much more difficult than that of the split-secondary type.

Use of Screening

Split-secondary high-frequency circuits such as that shown in circuit No. H2 will give sharper tuning than the corresponding split-primary circuit in No. H1, partly because the valve damping is placed across only half of each coil, an important point in the detector circuit. On the other hand, both sides of the variable condenser are above earth potential, so that one is liable to get bad hand-capacity effects unless due precautions are taken.

In all cases where more than one stage of high-frequency is used, the screening of each high-frequency stage as a complete stage is recommended rather than screening the coils alone. Screened coils certainly prevent a good deal of interaction, but a really efficient high-frequency circuit needs totally enclosing if feed-back is to be properly eliminated. The amount of screening can, however, be cut down appreciably if astatic or binocular coils are used. In such cases a sheet of copper or aluminium between each stage serves excellently.

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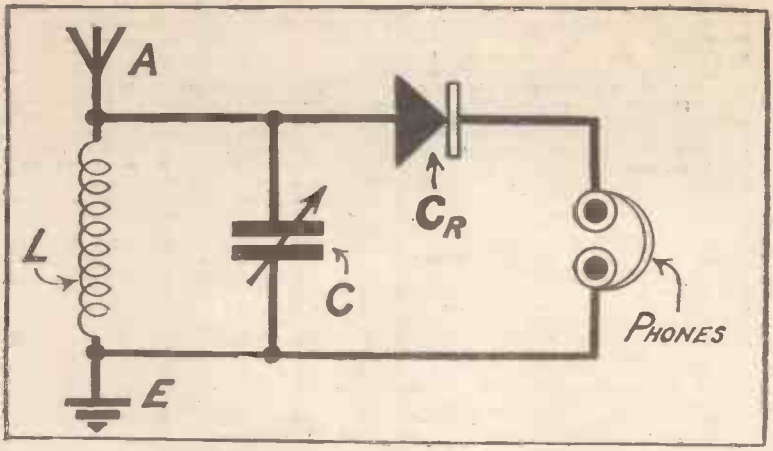
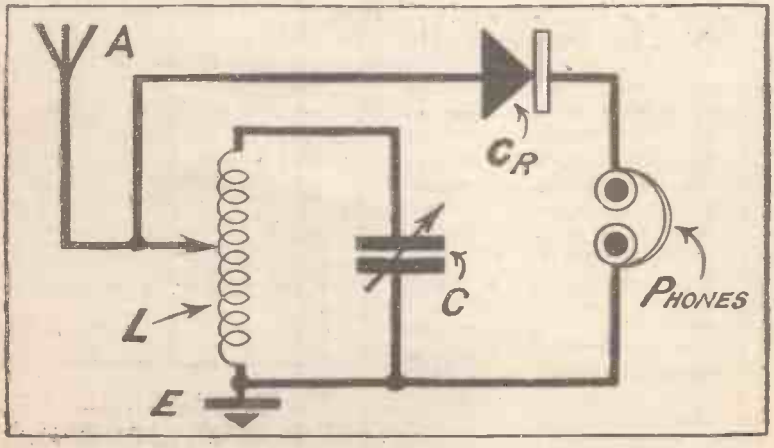
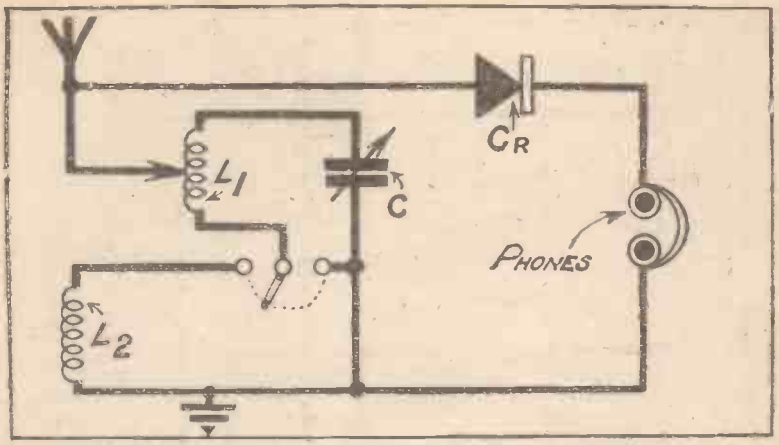


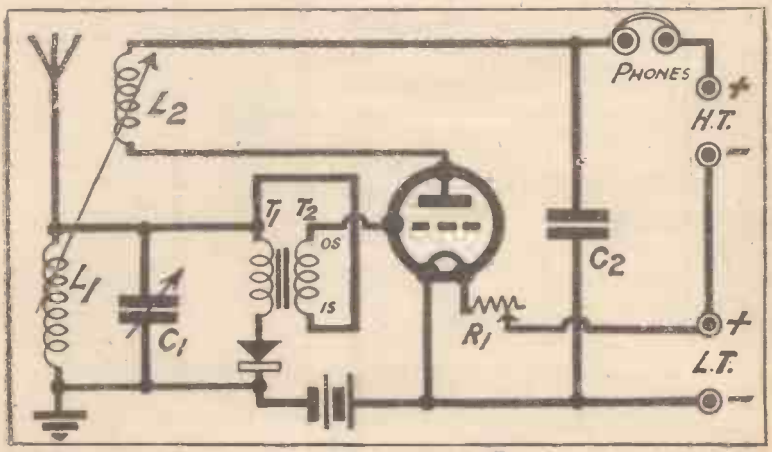
A1.—L = 25, 35, or 50 plug-in coil, according to your particular aerial and station it is desired to receive, or single-layer coils of same numbers of turns as above, of No. 24 D.C.C. wire on a 3-in. tube, can be substituted. C = ·0005 mfd. maximum. This circuit is simple but unselective. With a poor aerial A2 circuit is often better.



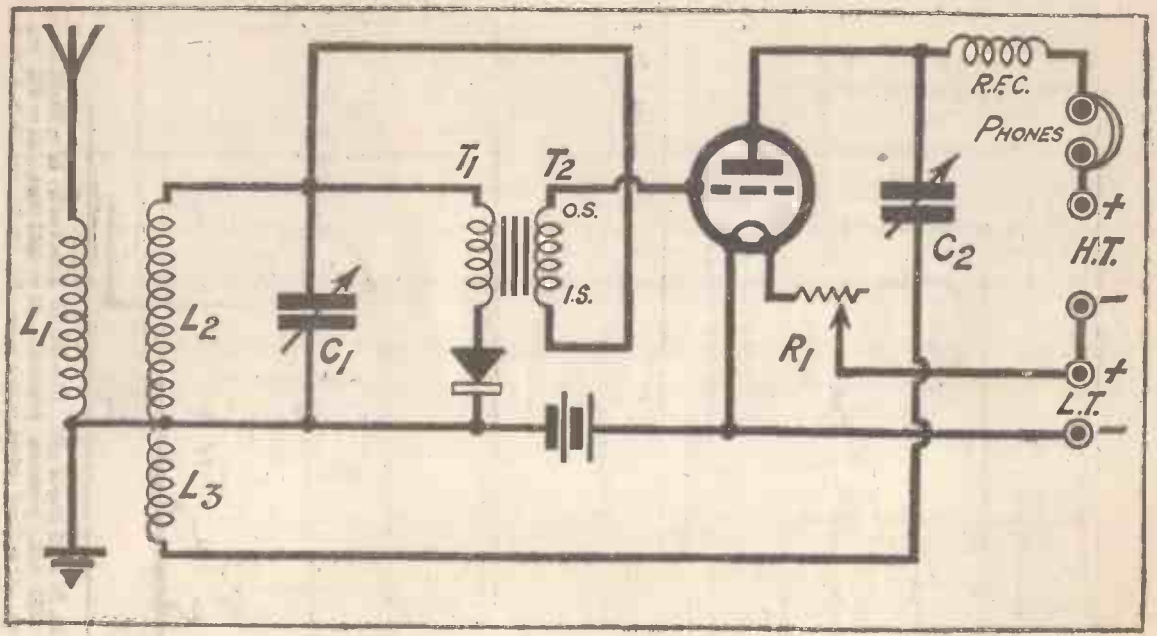
A2.—L = 60 turns No. 24 D.C.C., on 3-in. diameter tube, tapped at 30 turns. C = ·0005 mfd. maximum. A very useful and selective crystal circuit.



A3.—A circuit for local or Daventry (5 X X) which does not necessitate a change of coils. L1 = 60 turns No. 24 D.C.C. on 3-in. former, tapped at centre. L2 = 150-turn plug-in coil. C = ·0005 mfd. maximum. The switch can be any single-pole double-throw switch with good contacts.

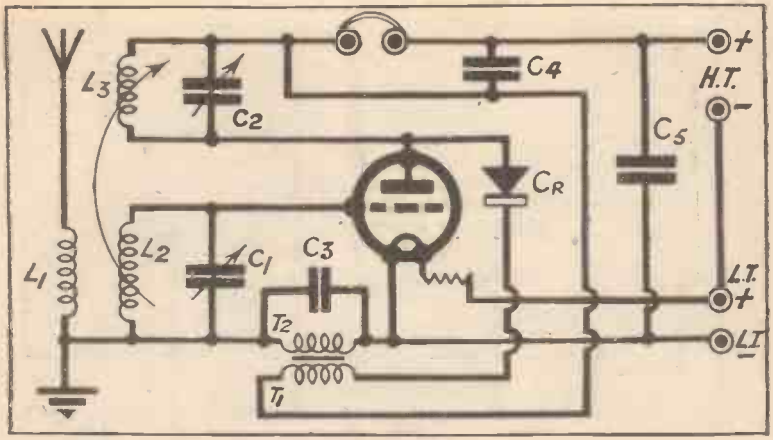


B1.—The Hale Circuit with swinging-coil reaction and plug-in coils. L1 = No. 25, 35, or 50 plug-in coil for ordinary waves, or 150 for 5 X X. L2 = No. 50 or 75. C1 = ·0005 mfd. maximum (variable). C2 = ·001 mfd. (fixed). Mount L1 and L2 in two-coil holder. T1, T2 = good L.F. transformer.

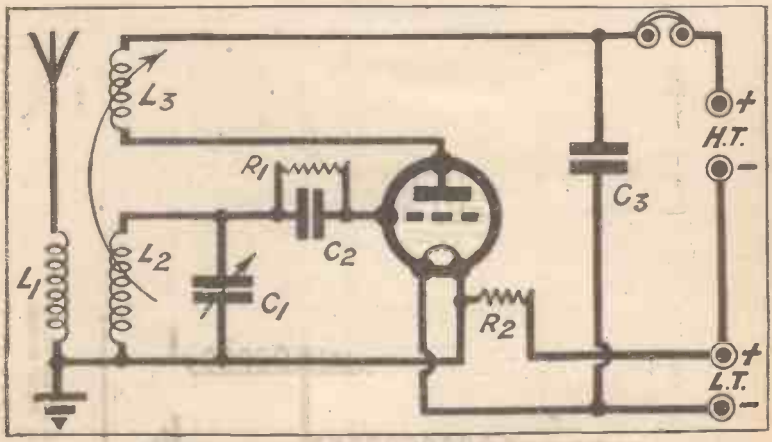


C1: THE MOST POPULAR "HALE" ARRANGEMENT.

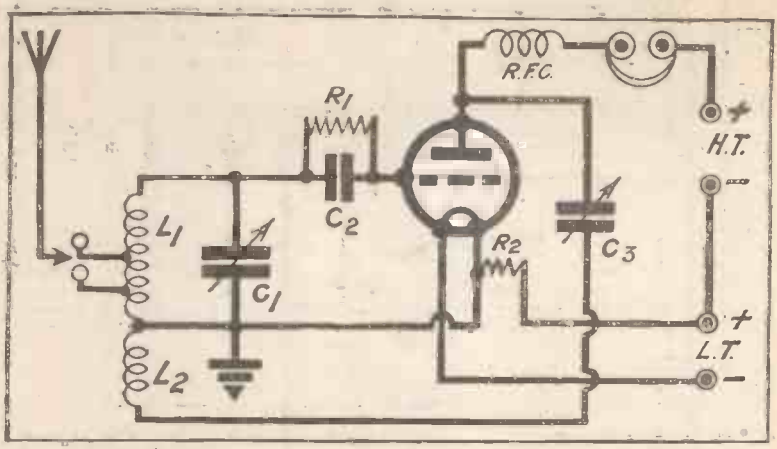
B2.—L1, L2, and C1, as in diagram C3. L3 = 35-turn plug-in coil. C2 = ·0003 mfd. max. (variable). T1, T2 = L.F. transformer. Try reversing input terminal connections (I P and 0 P) for best results. Use about 75 to 100 volts, an H.F. valve, and about 3 volts grid bias.



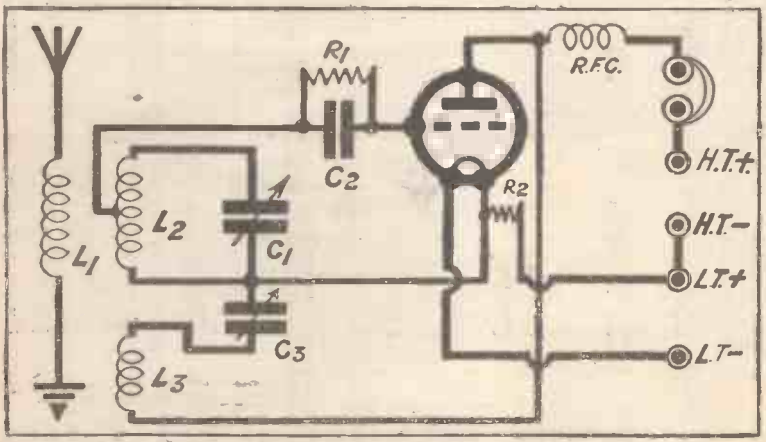
B3.—Single-valve Reflex. L1 = No. 25, or 35 plug-in coil. L2 = No. 60 plug-in coil. L3 = No. 60 plug-in coil. C1 = ·0005 mfd. maximum (variable). C2 = ·0005 mfd. maximum (variable). C3 = ·0003 mfd. (fixed). C4 = ·0001 mfd. (fixed). C5 = 1 mfd. Mansbridge. Still popular, but not recommended owing to howling tendencies and instability. Best with a general-purpose valve.



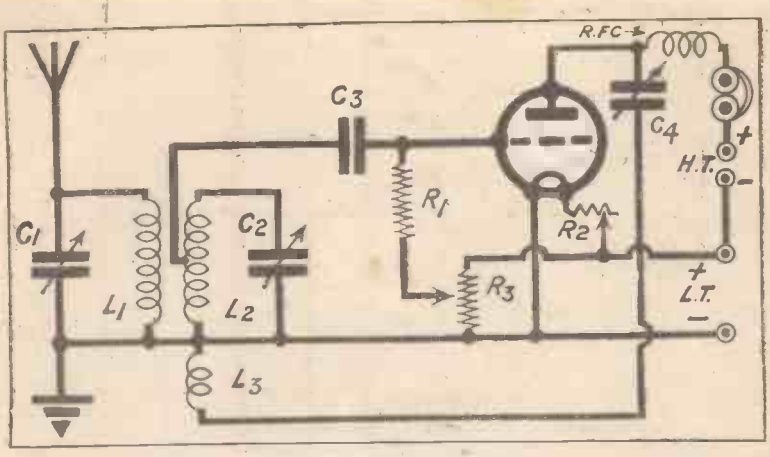
C1.—L1 = No. 25 or 35 plug-in coil. L2 = No. 60 plug-in coil. L3 = No. 50 or 75 plug-in coil. C1 = ·0005 mfd. maximum (variable). C2 = ·0003 mfd. C3 = ·001 mfd. R1 = 2 megohms. R2 = Fixed resistor to suit valve. Use L1, L2, and L3 in 3-coil holder.



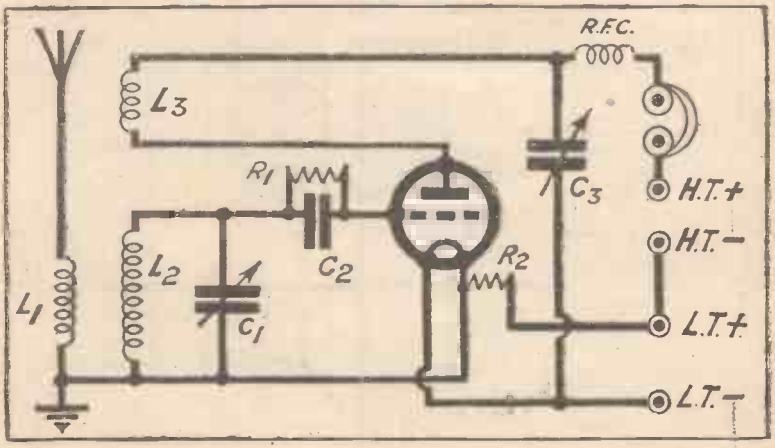
C2.—The popular Reinartz arrangement. L1 = 60-turn "X" coil, or 60 turns No. 24 D.C.C. on 3-in. tube, tapped at 6 and 10 turns. L2 = No. 35 or 50 plug-in coil, or 20 turns No. 30 D.C.C. wound close to L1 on end of same tube. C1 = ·0005 mfd. maximum (variable). C2 = ·0003 mfd. fixed. R1 = 2 megohms. C3 = ·0003 mfd. maximum (variable). R.F.C. = Radio-frequency choke.



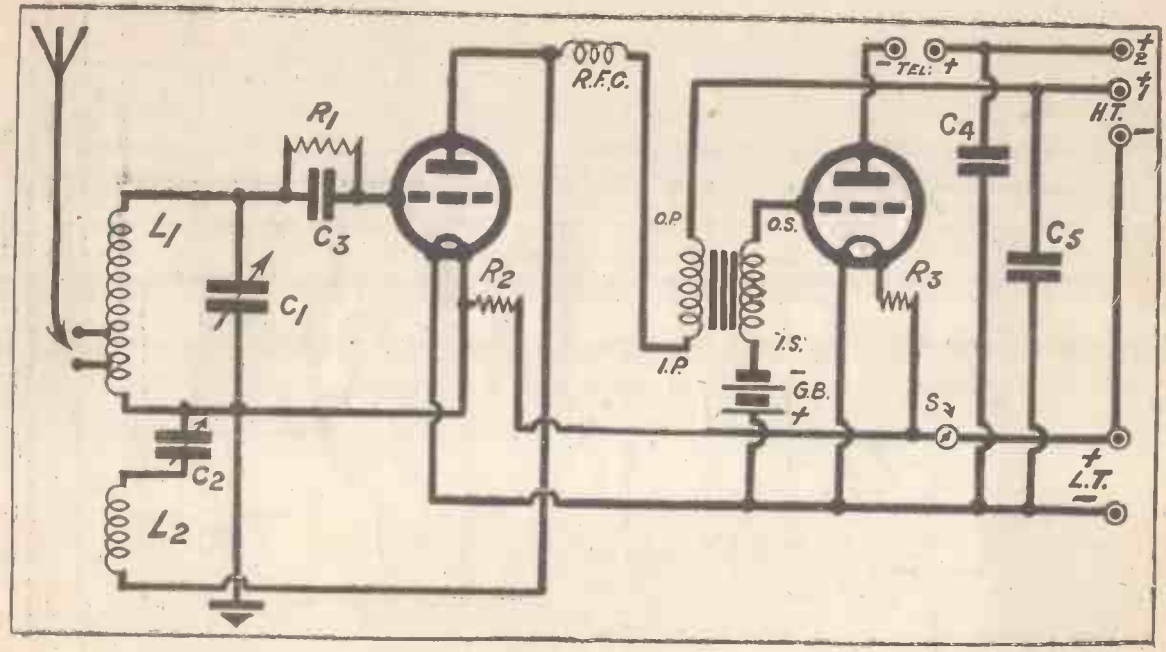
C3.—Another very selective circuit. L1, L2, C1, C2, C3, R1, R2, as in Circuit C1. L3 = No. 35 plug-in coil. C3 = ·0003 mfd. variable. L1, L2, and L3 can be arranged in fixed sockets with coils about ¾ in. apart. It is an advantage to swivel L1 until best angle is found.



C4.—Very selective circuit. C1 = ·0005 mfd. maximum (variable). L1 = 25, 35, or 50 plug-in coil, according to wave-length and aerial. L2 = centre-tapped No. 60 plug-in coil. L3 = No. 35 plug-in coil. C2 = ·0005 mfd. maximum (variable). C3 = ·0003 fixed. R1 = 2 meg. R3 = Potentiometer. C4 = ·0003 mfd. maximum (variable). R2 = Variable filament resistance. Couple L1 to L2 very loosely.

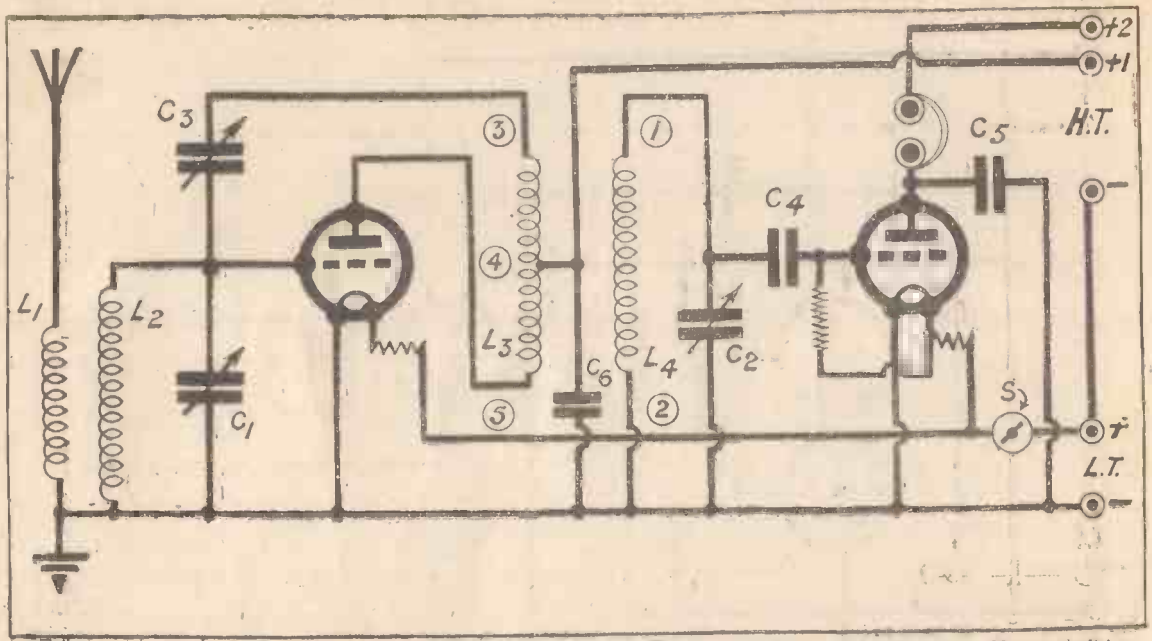


C5.—L1, L2, and L3, R1, C1, C2, R2, as in Circuit No. C1. C3 = ·0003 mfd. maximum (variable). Once best relation of L3 to L2 is found, control of oscillation and reaction on C3. Better general circuit than C1, but not so good as C2 or C3 in general practice. Try various values for L3.



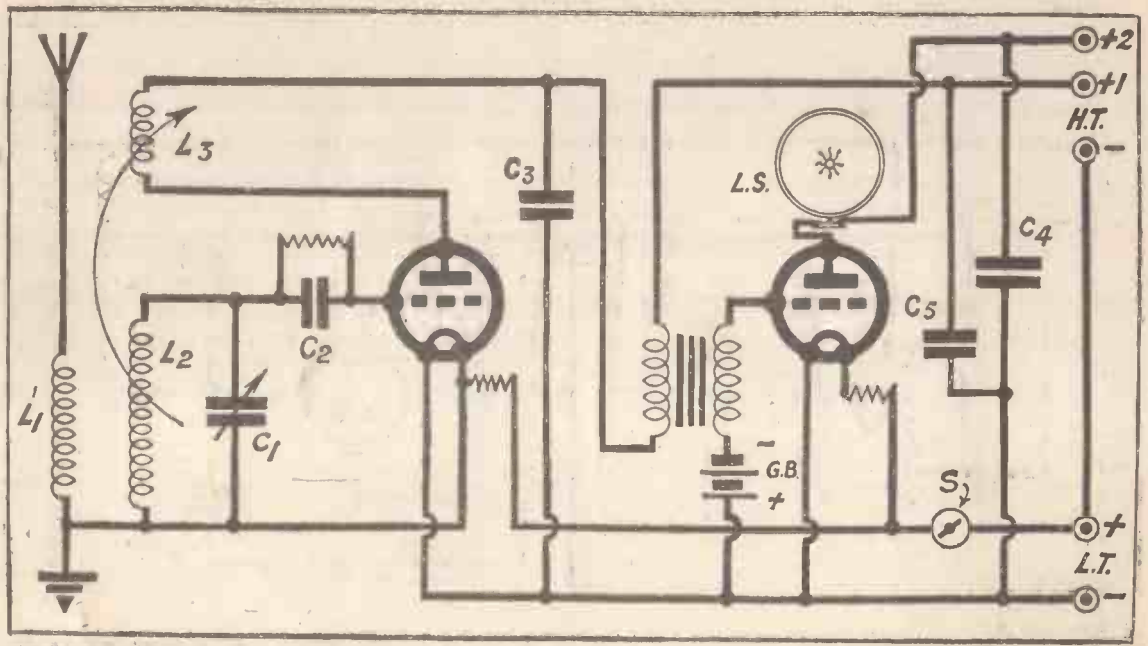
GOOD GENERAL-PURPOSE TWO-VALVER.

D1.—L1 = No. 60 "X" coil, tapped at 6 and 10 turns. C1 = ·0005 mfd. variable. C2 = ·0003 mfd. variable. L2 = No. 35 or 50 plug-in coil. R1 = 2 megohms. C3 = ·0003 mfd. C4 and C5 = 1 mfd. Mansbridge type. Try aerial taps for selectivity and sensitivity. 10 turns usually gives louder signals but with less selectivity. S = On-and-off switch.

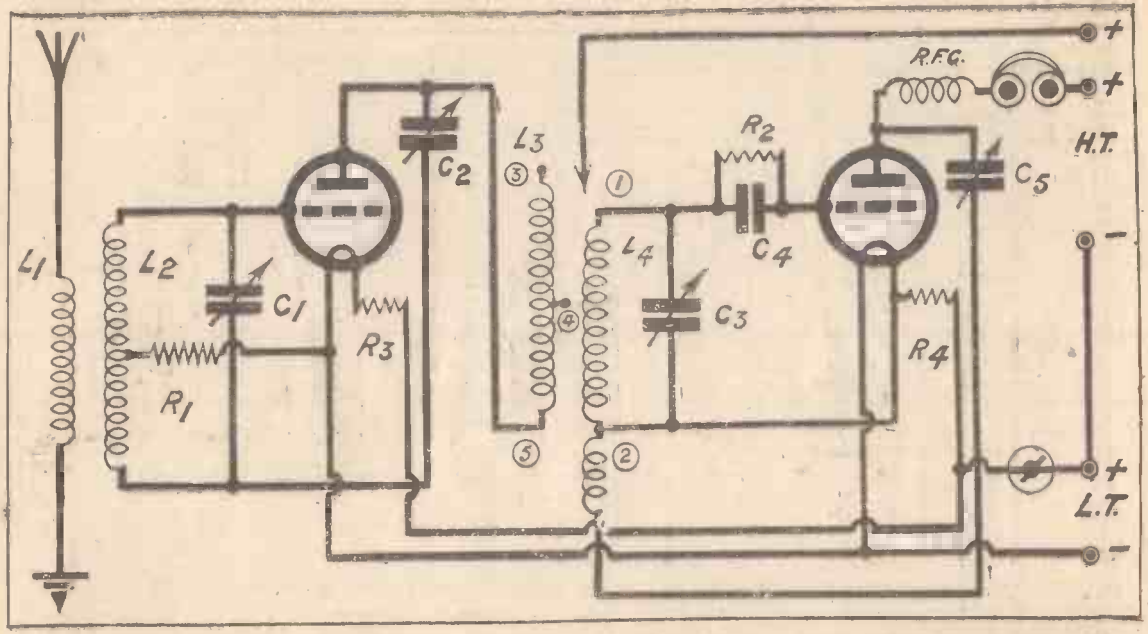


D2, L1, L2 = Binocular aerial coil. L3, L4 = Standard split-primary transformer. C1, C2 = ·0005 mfd. each. C3 = neutralising condenser. C4 = ·0003 mfd. C5 = 001 mfd. C6 = 1 mfd.

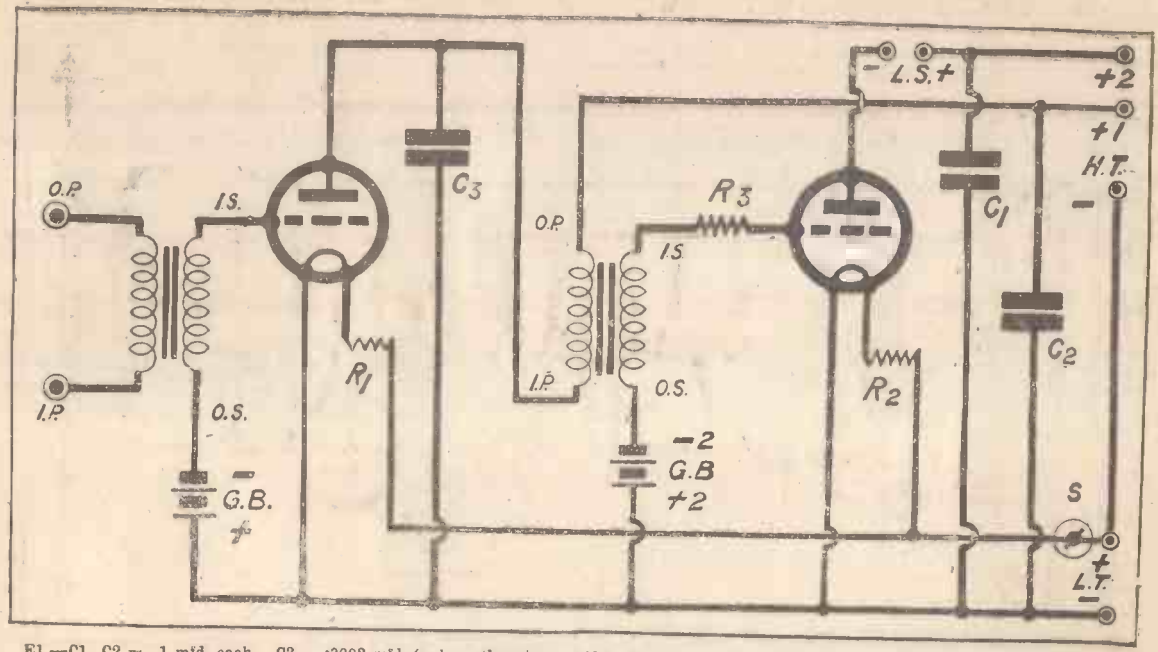
See that L1, L2 and L3, L4 are well spaced. If L1, L2 is not a binocular or similar "fieldless" coil, undesirable interaction may occur.



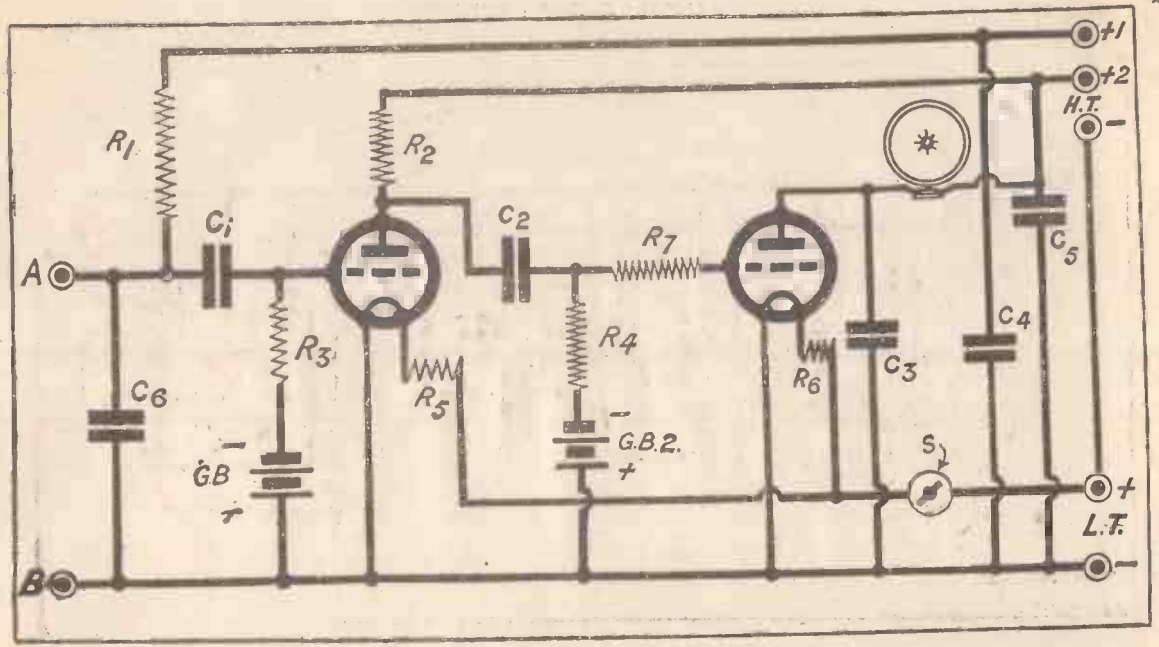
D3.—L1, L2, L3, C1, C2, C3, as in diagram C1. C4, C5 = 1 mfd. Put L1, L2 and L3 in 3-coil holder. L3 is variable reaction coil. Two-megohm grid leak usually suits best.



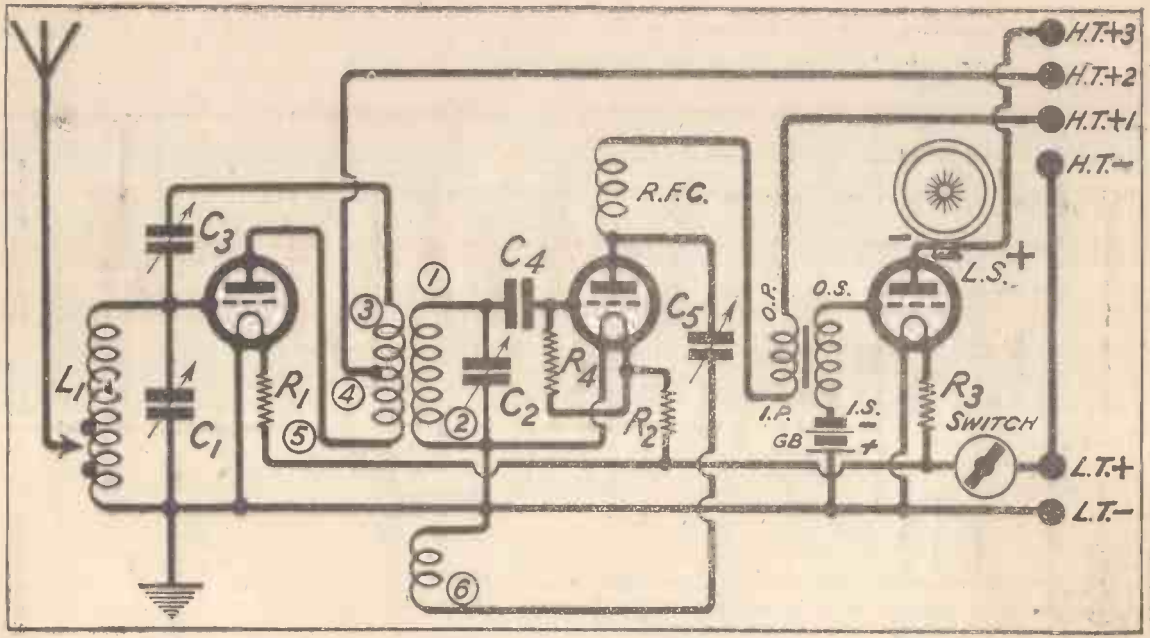
D4.—L1 = No. 25, or 35 plug-in coil. L2 = No. 60 centre-tapped. R1 = 100,000 ohms. C1, C2 = ·0005 mfd. (variable). C2 = Neutralising condenser. L3, L4, etc. = Standard split-primary transformer. R2, C4, as usual. C5 = ·0003 mfd. (variable). Connect arrow to taps 3 or 4 according to valve used. 2-volt valves usually work better on tap 3, and 6-volters on tap 4. Advisable to screen H.F. stage.



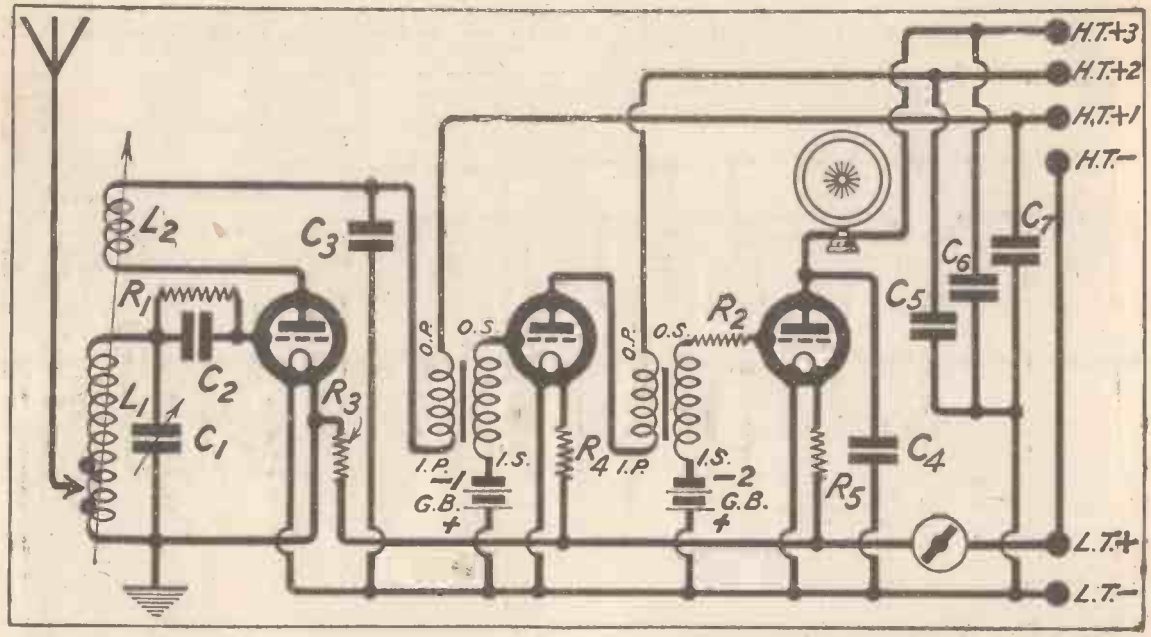
E1.—C1, C2 = 1 mfd. each. C3 = ·0003 mfd. (unless otherwise specified by transformer makers). Same value across input terminals is an advantage if no condenser already across output terminals on set. R3 = ½-meg. leak (not always necessary) stops tendency to howl. Join I P and O P to output terminals of set.



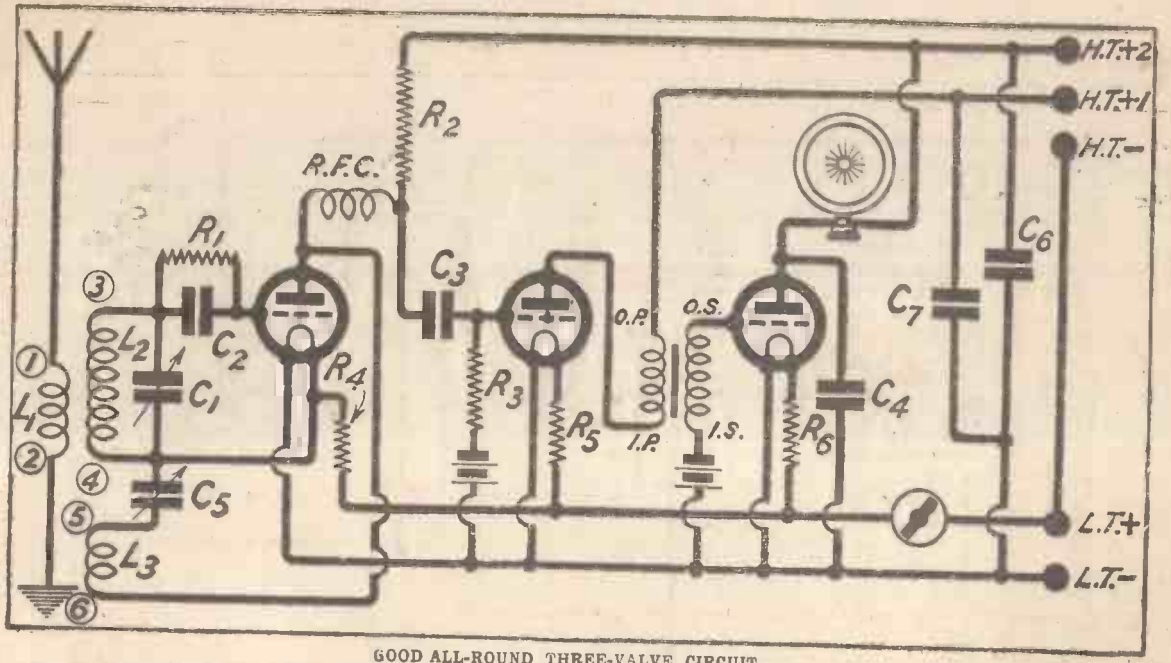
E2.—C1 and C2 = ·006 to ·02 (mica). C3 = ·001 mfd. C4, C5 = 1 mfd. C6 = ·0001 mfd. R1, R2 = 250,000 ohms. R3, R4 = ½ or 2 megohms. R7 = ½ megohm (grid leak type). Connect A to output terminal of set which is connected to plate of valve. Join B to common negative of L.T. battery for both sets. Leave second output terminal of set free.



F1.—L1 = Standard 6-pin aerial coil. C1, C2 = ·0005 mfd. variable. C3 = Neutralising condenser. C4 = ·0003 mfd. R4 = ½ megohms. C5 = ·0003 mfd. 1, 2, 3, 4, 5, 6 = Standard 6-pin split-primary transformer. If split-primary transformer is not screened, L1 should preferably be binocular or "fieldless."

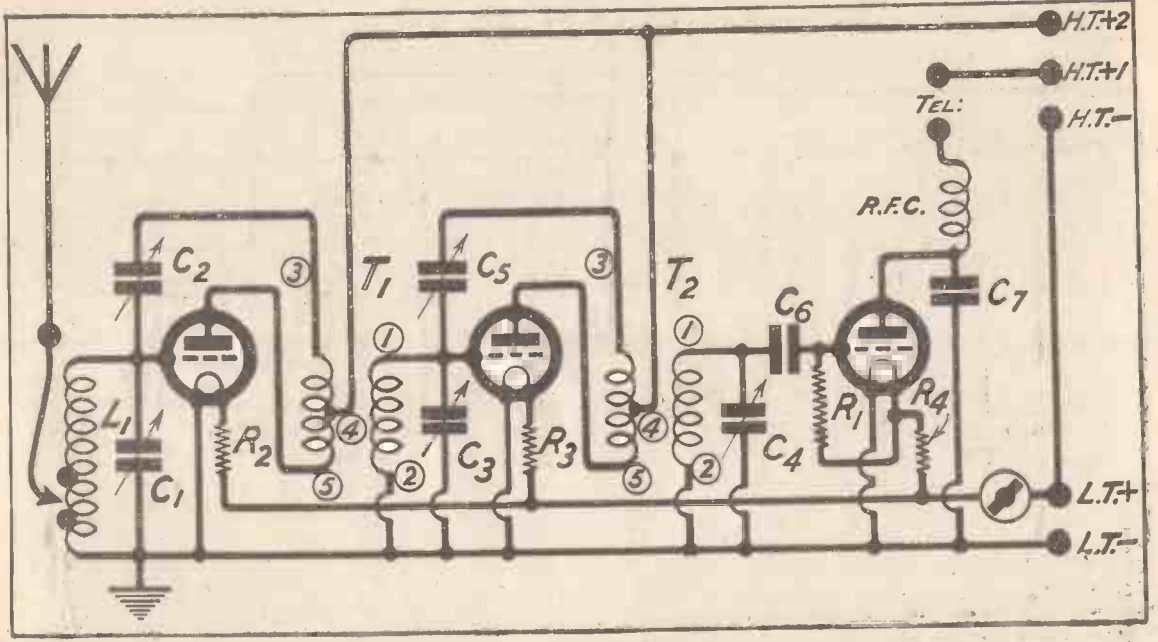


F2.—A simple and powerful three-valver, but not so selective as F3. L1 = "X" coil. L2 = 35 or 50 plug-in. C2 = ·0003 mfd. R1 = 2 megohms. C3 = ·0003 mfd. R2 = 250,000 ohms (grid leak pattern). This is precautionary and is often not necessary, in which case join OS straight to grid. C4 = ·001 mfd. C5, C6, C7 = 1 mfd. each. Use L1 and L2 in two-coil holder.

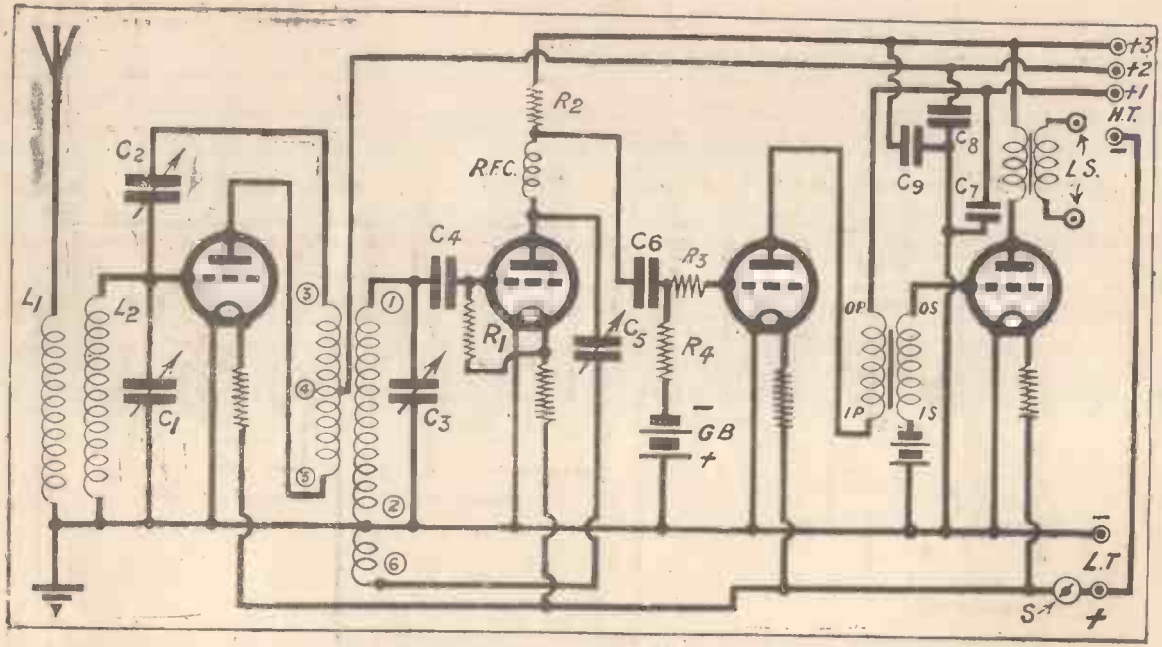


GOOD ALL-ROUND THREE-VALVE CIRCUIT.

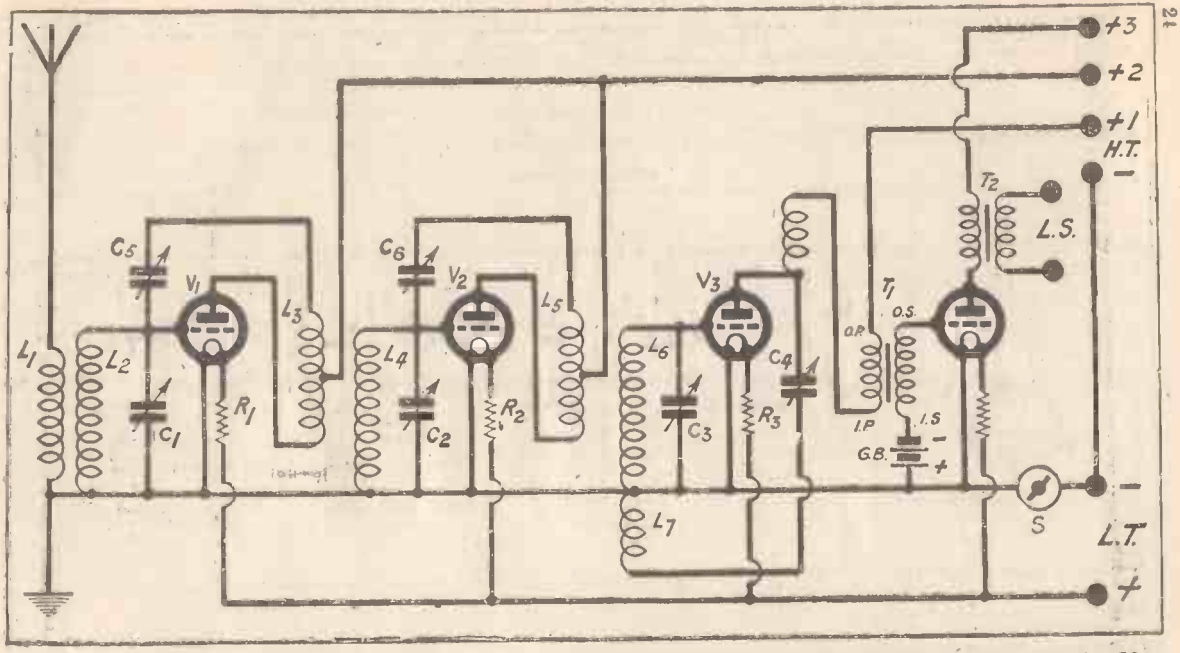
F3.—L1, L2 and L3 are the windings of a standard 6-pin Reinartz coil, numbered as shown. C1 = ·0005 mfd. variable. C2 = ·0003 mfd. R1 = 2 megohms (some valves work better with 3 megohms). C5 = ·0003 mfd. variable. R2 = 250,000 ohms. C3 = ·006 to ·01 mfd. mica. C4 = ·001 mfd. C6, C7 = 1 mfd. Use 120 volts on H.T. + 2 and about 80 on H.T. + 1. Use grid bias according to valve-maker's leaflet.



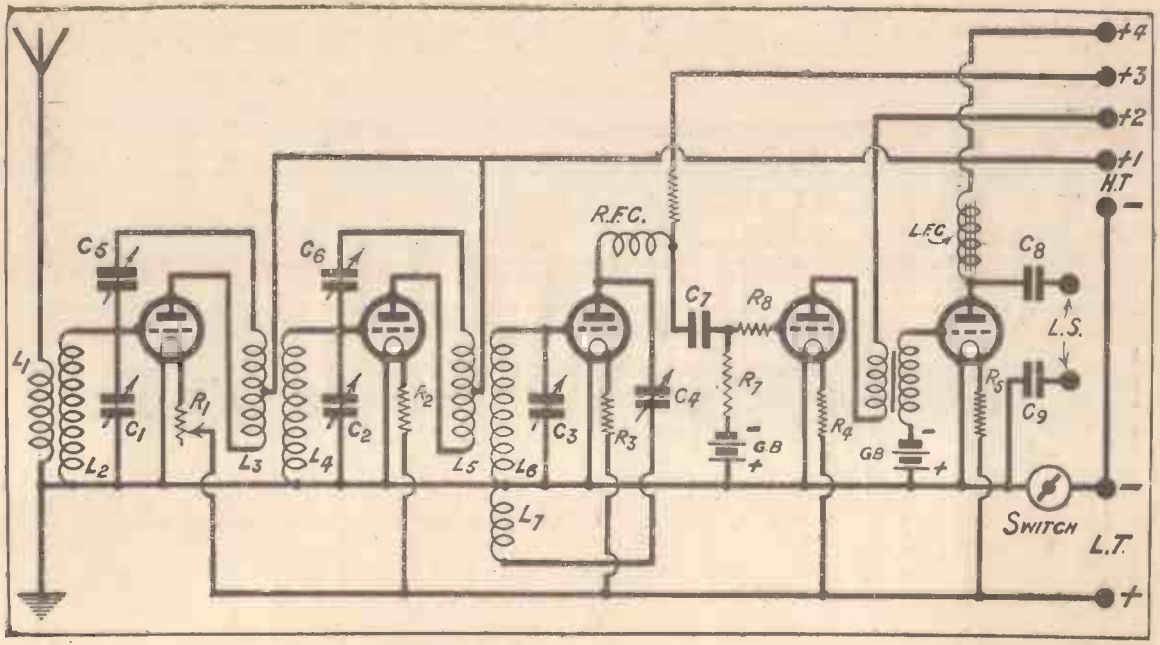
F4.—L1 = Standard 6-pin aerial coil. T1, T2 = Standard 6-pin split-primary transformers. C1, C3, C4 = ·0005 mfd. each (can be "ganged.") C6 = ·0003 mfd. R1 = 2 megohms. C2, C5 = Neutralising condensers. C7 = ·0003 mfd. All coils should be screened, or set will be unstable. Keep all leads as short as possible. Try best aerial tap.



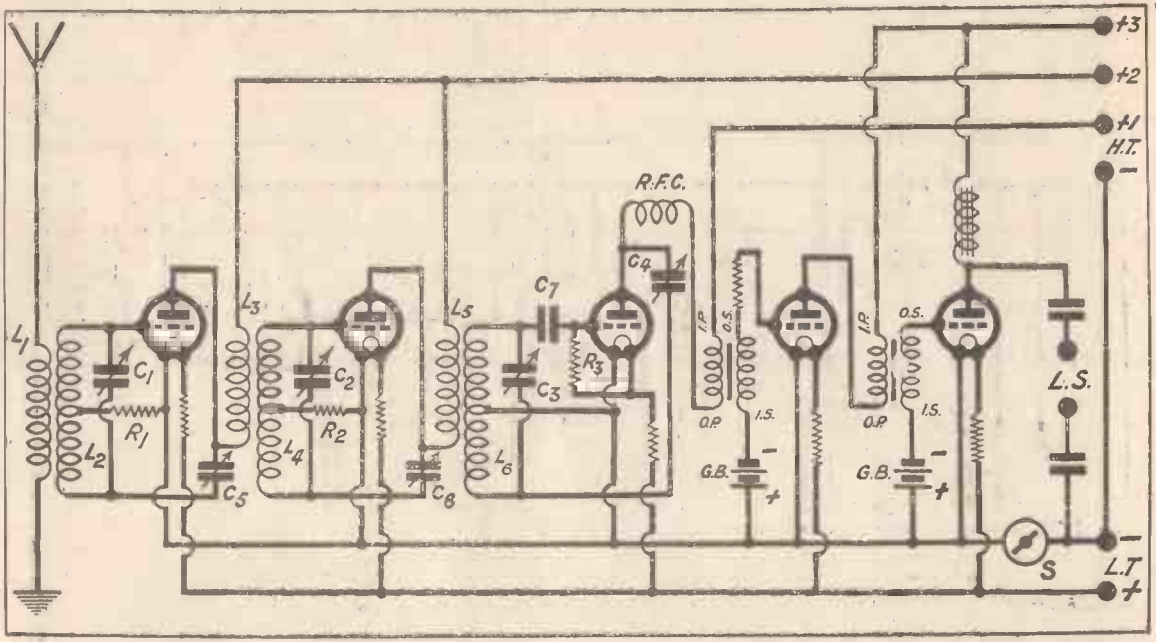
C1.—L1 = 25 or 35-turn plug-in coil. L2 = 60-turn plug-in coil. C1, C3 = ·0005 mfd. variable. C2 = Neutralising condenser. 1, 2, 3, 4, 5, 6 = Standard split-primary H.F. transformer. C4 = ·0003 mfd. R1 = 2 megohms. C5 = ·0003 mfd. variable. C6 = ·006 to ·01 mfd. mica fixed. R2 = 250,000 ohms. R3 = 250,000 ohms (grid leak type). R4 = 1 or 1½ megohms. C7, C8, C9 = 1 mfd. each. Transformer in plate circuit of last valve is "1 to 1" output transformer.



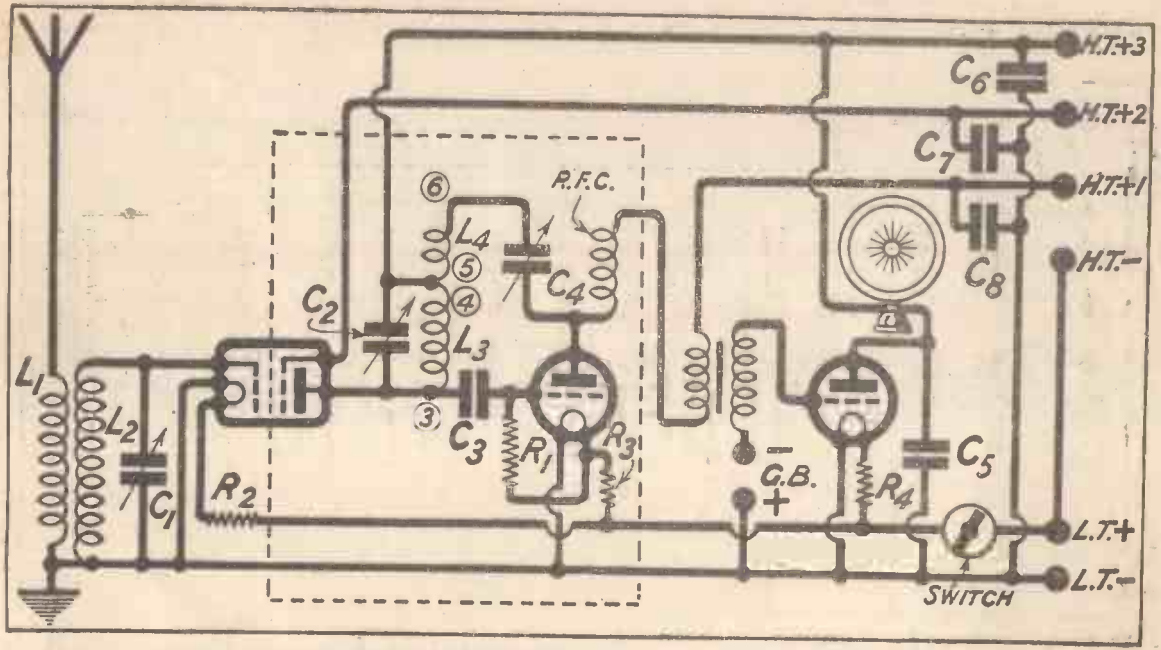
G2.—L1=15 turns No. 28 D.C.C. on 3-in. former, with L2 wound on same tube, starting a quarter of an inch from end of L1. L2 should have 60 turns of No. 24 D.C.C. L3, L4 and L5, L6, L7 are two standard 6-pin split-primary transformers. In L3, L4 the reaction winding is not used. C1, C2, C3 = ·0005 mfd. each. C5, C6 = Neutralising condensers. C4 = ·0003 mfd. H.F. stages should be screened. Output transformer "1 to 1" ratio used in plate circuit of last valve.



H1.—L1, L2 aerial coupling transformer, consisting of 15 turns No. 28 D.C.C. for L1, wound on 3-in. tube, a quarter of an inch below L2 on same tube, which latter should be 60 turns No. 24 D.C.C. L3, L4 and L5, L6 should be standard 6-pin split-primary transformers. C1, C2 and C3 = ·0005 mfd. each, C5 and C6 neutralising condensers, C4 = ·0003 mfd. Each separate H.F. stage should be screened. C7 = ·006 to ·01 mfd. Resistance in plate circuit of detector valve should be 250,000 ohms. R8 = 250,000 ohms (grid leak type). R7 = 1 megohm. L.F.C. output choke (20 henry,) C8, 2 mfd.. C9 (not essential but advisable with very long loud-speaker leads which run near lighting wires), 2 mfd.



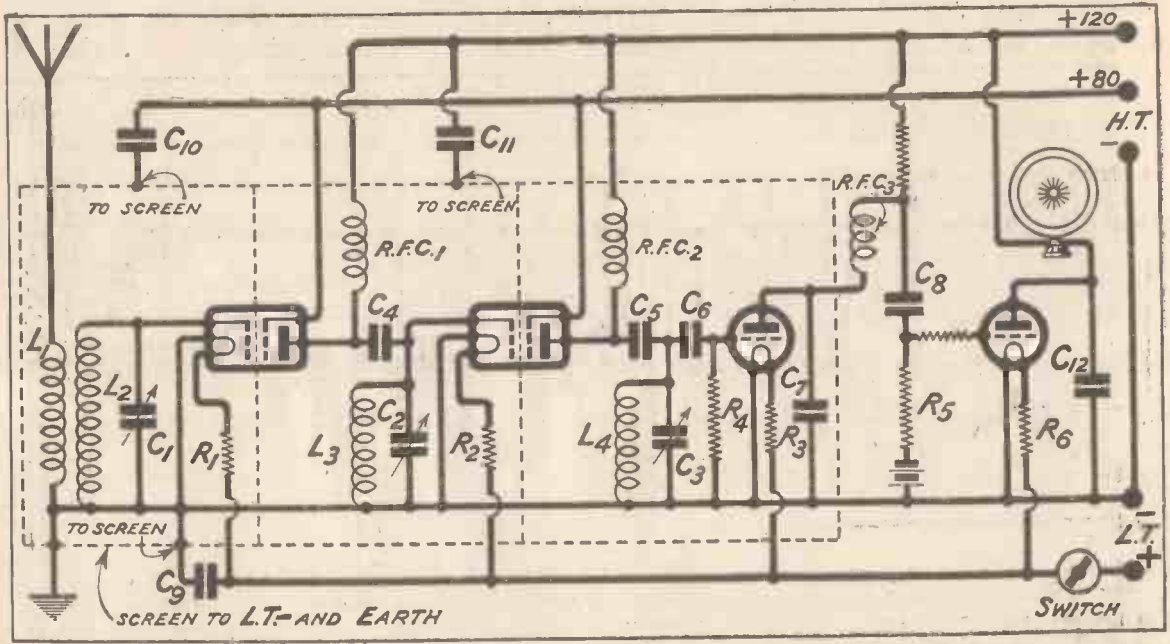
H2.—L1, L2, L3, L4, L5, L6 are three standard split-secondary transformers. C1, C2, C3 = ·0005 mfd. each. C4 = ·0001 mfd. reaction condenser. C5, C6 = Neutralising condensers. C7 = ·0003 mfd. R3 = 2 megohms. R1, R2 = 100,000 ohms each. R4 = ½-megohm grid leak. C8, C9 = 2 mfd. each. Output choke is used in plate circuit of last valve. Connect fixed plate of C1, C2 and C3 to their respective grid sides. H.F. stages must be screened, or else "fieldless" coils used for L1, L2, L3, L4, and L5, L6.



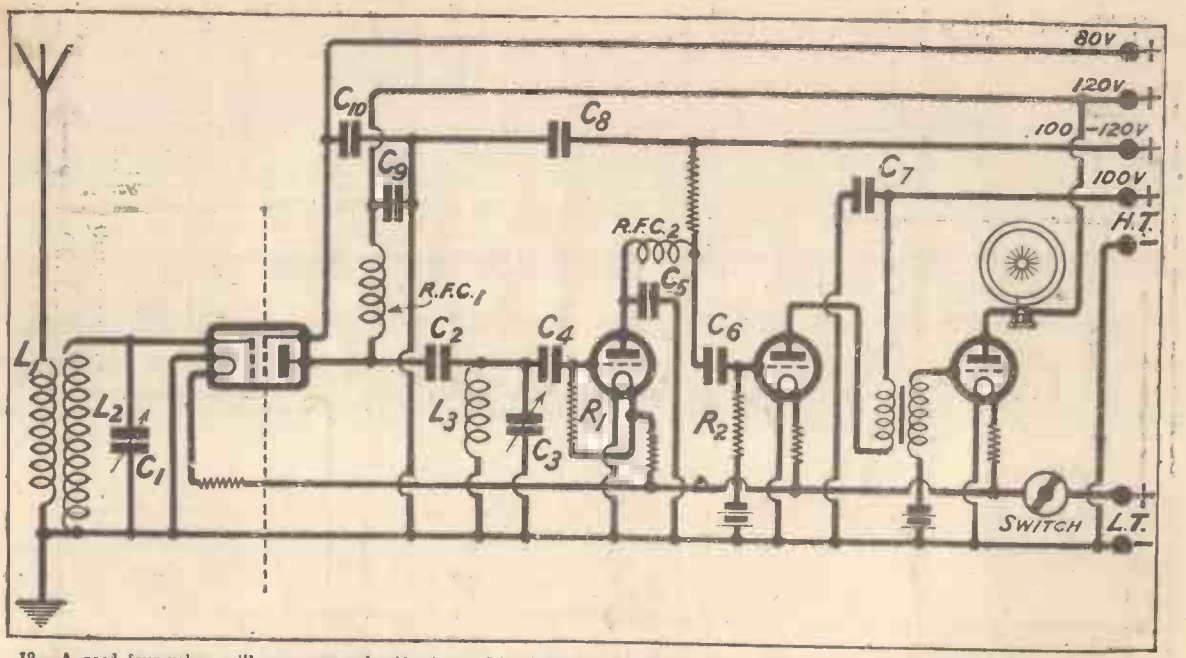
A VERY USEFUL THREE-VALVE CIRCUIT WITH ONE STAGE OF SCREENED-GRID VALVE H.F.

II.—L1, L2 = Binocular aerial coil. C1 = ·0005 mfd. variable. L3, L4 = Binocular tuned-anode coil with reaction. C2 = ·0005 mfd. variable. C3 = ·0003 mfd. fixed. R1 = 2 megohms. C4 = ·0003 mfd. variable. C6, C7, C8 = 1 mfd. each. C5 = ·001 mfd.

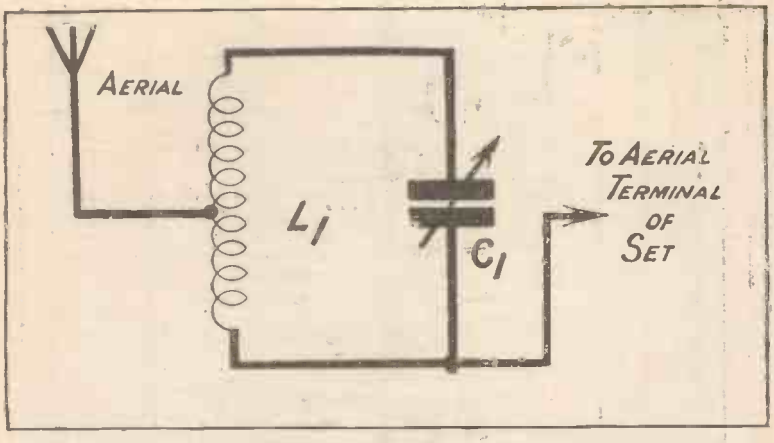
SPECIAL NOTE.—A sheet metal screen should be placed around the portions shown dotted if binocular coils are not used.



I2.—Carefully made up, this circuit is wonderfully sensitive. It must be thoroughly screened between stages. L1, L2 = Binocular aerial coil. L3, L4 = Binocular tuned-anode coils. C1, C2, C3 = ·0005 mfd. each. C4, C5 = ·001 mfd. fixed. C6 = ·0003 mfd. fixed. C7 = ·0001 mfd. fixed. C8 = ·015 mfd. fixed. C9, C10, C11 = 1 mfd. C12 = ·001 mfd. Use 120 volts on all plates and 80 volts on screening grids. H.T. − is joined to L.T.− in this set. RFC1, RFC2, RFC3 must be good quality radio-frequency chokes. Resistance in plate of detector valve should be 250,000 ohms and be preceded by RFC3. Screen as shown by dotted lines.



13.—A good four-valver with one screened-grid valve. L1, L2, C1 as in circuit 11. C2 = ·001 mfd. L3 = Binocular-tuned anode coil. C3 = ·0005 mfd. max. C4 = ·0003 mfd. R1 = 2 megohms. RFC must be a good radio-frequency choke. C7, C8, C9, C10 = 1·mfd. C6 = ·015 mfd. mica. Resistance in plate of detector valve, 250,000 ohms. C5 = ·0001 mfd. Enclose part of valve on right of dotted line, together with RFC1, C2, L3, C3, C4, R1 and detector valve, in copper or aluminium screening box.

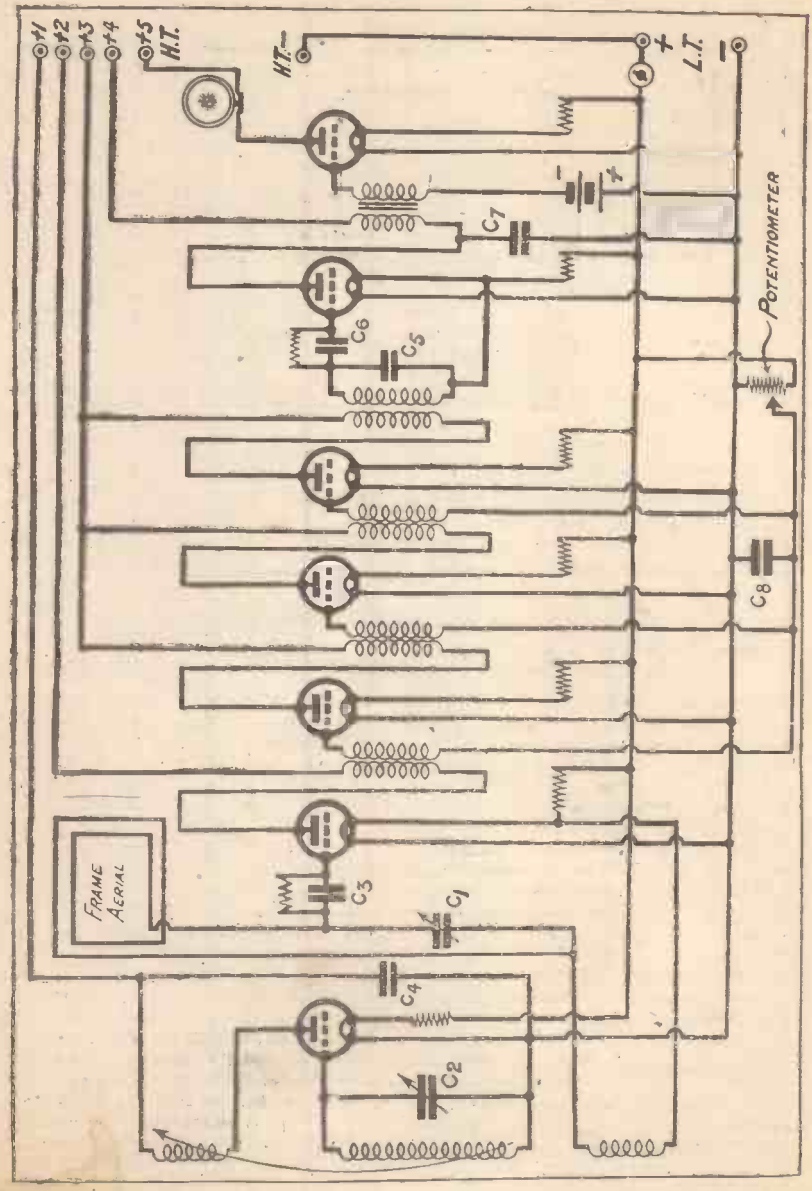


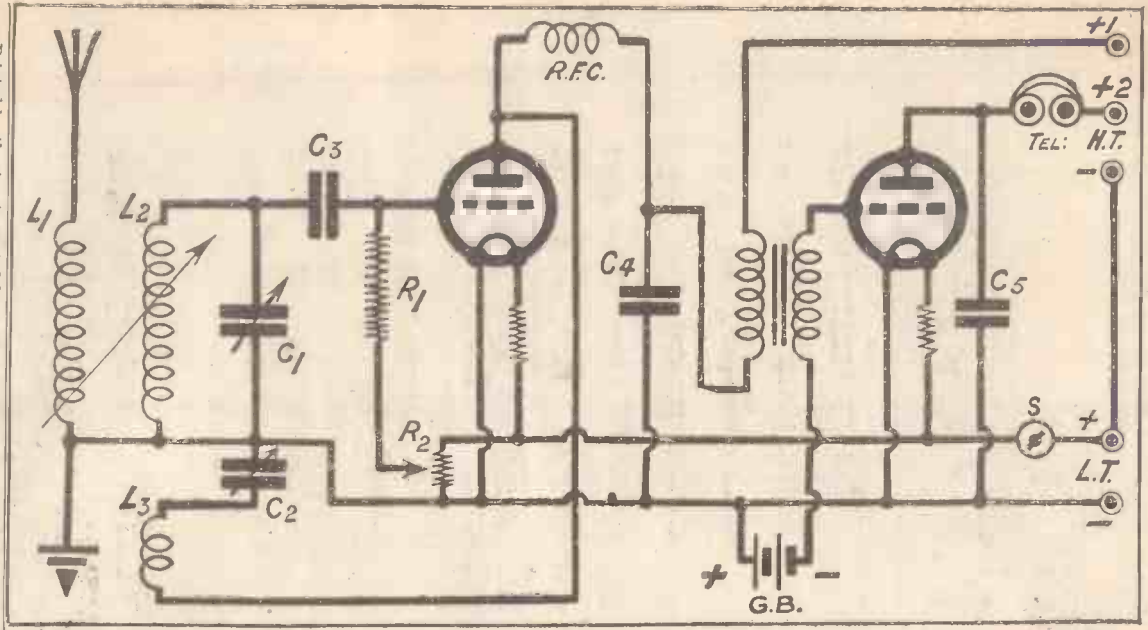
USEFUL WAVE-TRAP.

J1.—L1 = Single-layer coil No. 28 D.C.C. wire, 64 turns on a 2-in. tube 3 inches long. Tap off at 32 turns. C1 = Variable condenser, ·0005 mfd. maximum. Tune in on set to station you want to eliminate and then turn C1 until sound of station is weakest.

SEVEN-VALVE SUPERSONIC HETERODYNE RECEIVER.

K1.—Although there is a wide variety of supersonic heterodyne circuits, they can be rapidly resolved into the following classes : (1) Circuits with separate oscillator ; (2) Circuits with combined oscillator and first detector ; (3) Circuits with H.F. stage preceding the first detector. Our circuit is a typical example of Class 1. C2 is the tuning condenser of the separate oscillator, which is a plain reaction circuit in which the plate coil is tightly coupled to the grid coil so as to produce oscillation. C2 = ·0005 mfd. The oscillator coil former should be small (say, 2 in. diameter), the grid coil consisting of 65 turns No. 28 D.C.C., and the plate coil 40 or 50 turns No. 36 D.C.C. variably coupled to the grid coil. C4 = 1 mfd. C1 is the frame-aerial tuning condenser, ·0005 mfd. max. C3 = ·0003 mfd. and leak about 3 megohms. The coil in the filament lead from C1 should be variably coupled to the grid coil of the oscillator and can consist of 10 turns of No. 30 on a 2-in. tube. C5 is the filter condenser, the value of which depends on the particular filter transformer. It is generally sold with the complete set of intermediate transformers, and is sometimes built into the filter. C6 = ·0003 mfd. and 2-megohm leak. C8 = 1 mfd. C7 = ·001 or ·002 mfd. (latter value better, but rather reduces quality). Super-heterodyne receivers are rather tricky in spite of statements occasionally made to the contrary, as unless the valves are well matched, all kinds of trouble may develop. The sensitivity of the intermediate stages is controlled by the potentiometer in such a way that, IF THE VALVES ARE MATCHED, they all slide into oscillation together. Kept just below the oscillation point, the intermediate stages are very sensitive, but as no one valve must oscillate in the intermediates, it may happen that when the valve which oscillates easiest is in its most sensitive state, the rest are far below their best point. For this reason change your valves round carefully until you get the best combination in the intermediates. Oscillator coils, coupler and intermediates are generally sold as a complete kit.


+1
+2
+3
+4
+5
H.T.
H.T.–
+
L.T.
–
POTENTIOMETER
C1
C2
C3
C4
C5
C6
C7
C8
FRAME AERIAL



GOOD SHORT-WAVE CIRCUIT.

L1.—L1 = 5 turns No. 20 D.C.C. in hank and tied with cotton, mounted so as to be variably coupled to L2. L2 = single-layer coil No. 18 D.C.C. space-wound on "finned" former, 3 inches diameter, as follows: (L3 is wound of No. 30 D.C.C. on end of same former); L2 = For wave-lengths 30 metres to 70 metres, 8 turns. L3 = 6 turns very close to end of L2. For shorter waves: L2 = 3 turns and L3 = 3 turns. Longer waves: L2 = 20 turns and L3 = 9 turns. C1 = ·0003 mfd. C2 = ·0002 mfd. C3 = ·0001 mfd. C4 = ·0001 mfd. C5 = ·001 mfd. R1 = 4 megohms. R2 = potentiometer. RFC = Special short-wave choke (not ordinary broadcast-band choke). 100 turns No. 36 D.S.C. as single-layer on 1-in. tube.

Printed by the Amalgamated Press, Ltd., Sumner Street, Southwark, London, S.E.1.

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