The Wireless Constructor

6D MONTHLY

EDITED BY
PERCY W. HARRIS

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By E. Redpath.

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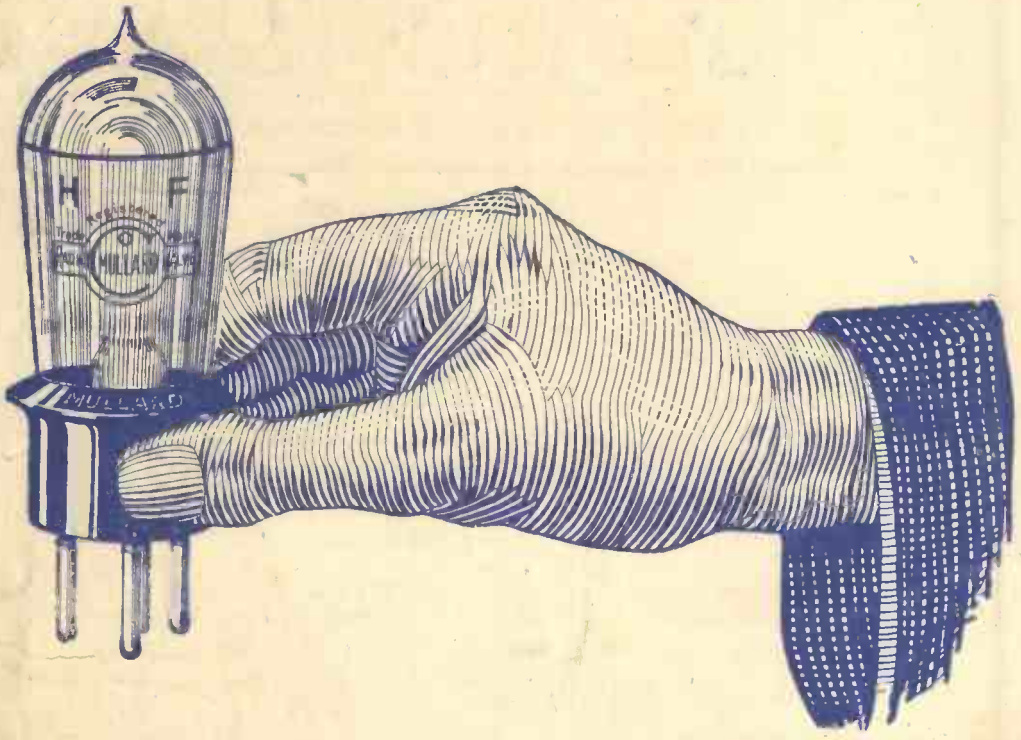

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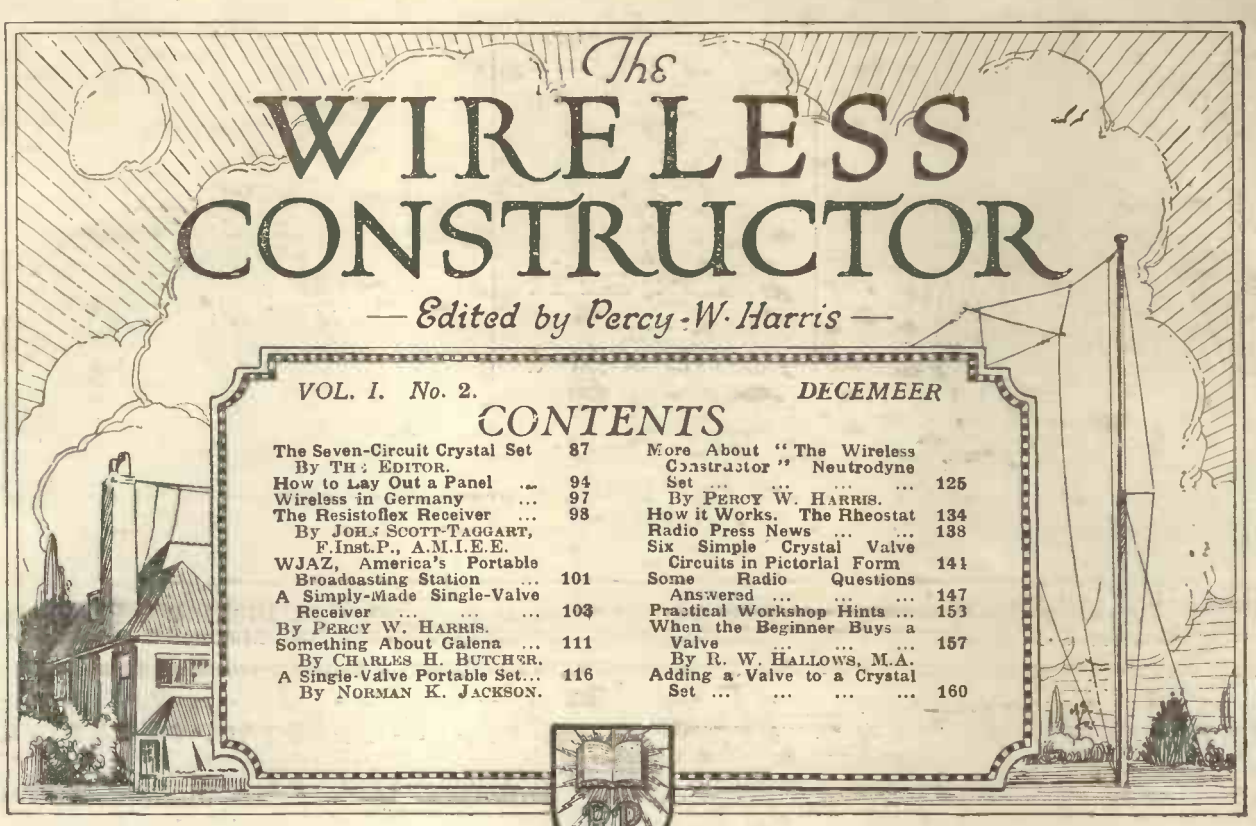

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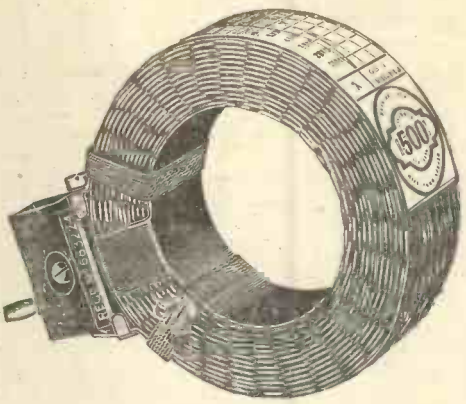

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A. D. Cowper, M.Sc.
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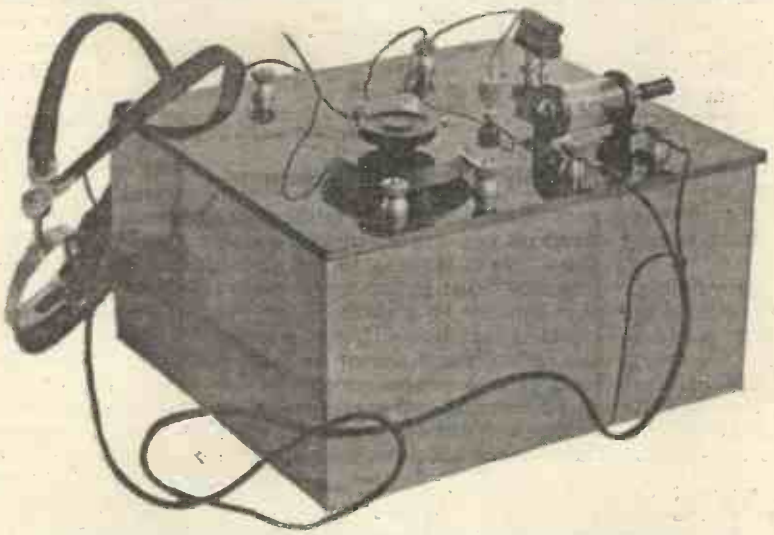
Vol. 1. DECEMBER, 1924. No. 2

THE "SEVEN-CIRCUIT" CRYSTAL SET

By the Editor.

I WONDER how many designs for crystal sets have been published since first the broadcasting boom began? We have had crystal sets with sliders, crystal sets with variometers, crystal sets with plug-in coils, crystal sets *without* plug-in coils, and even crystal sets in match boxes. Every design has had its adherent and many people will swear by a form of circuit which others condemn as inefficient. With so many designs available and such a wealth of advice proffered, the beginner in wireless may well feel puzzled as to which set to make.

In this article I am going to show you how to build a crystal receiver which you will find on building is distinctly more efficient than the average crystal receiver, while its construction is of the simplest character. In this very simplicity there are certain virtues, not all obvious even to the more advanced experimenters. When you have built the set you will probably find it is better than any you have previously tried. Any crystal receiver can be divided into two parts. We have, on the one hand, the apparatus which enables us to tune the aerial to the wavelength we desire to receive, and on the other hand, we have to provide a detector and a pair of telephones; if signals are strong, of course, we can operate several pairs of telephones. The tuning apparatus can take a variety of forms and in this case takes the shape of a coil of thick wire and a variable condenser. There are no sliders to give trouble, and tuning is effected by varying the knob of the variable condenser. In the past it has been customary to wind the coil with fairly thin wire so as to occupy a small space, but experiments lately have shown that distinct virtues rest in the use of thick wire, and my own work goes to show wire of No. 16 gauge double cotton covered is preferable to practically any other.



This set is designed to give the highest efficiency on any aerial.

A good crystal receiver should be so adjustable that any wavelength within the British broadcasting band can be received with ease, for while it is generally not possible to receive more than one station (the nearest) it must be remembered that THE WIRELESS CONSTRUCTOR goes to every part of the country and the design must suit any of the B.B.C. stations.

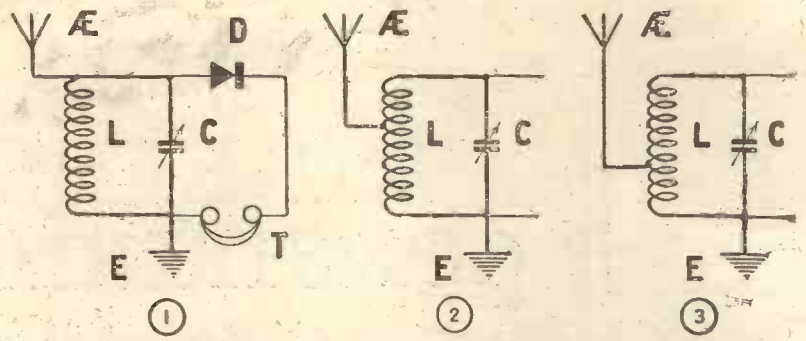
Now, if we tune a given coil with a variable condenser, the width of the wavelength band which can be covered with the condenser depends upon the size of the condenser. Thus a coil may tune from 200 to 300 metres with one condenser, while a larger

condenser may tune the same coil from 200 to 350 metres. It is not advisable to have a very large condenser with a tuning coil, for when the value is great the signal strength tends to suffer. I have therefore provided certain tappings on this coil and a simple arrangement of plugs and sockets so that a wide wavelength range is coverable with a reasonable sized variable condenser.

A Novelty

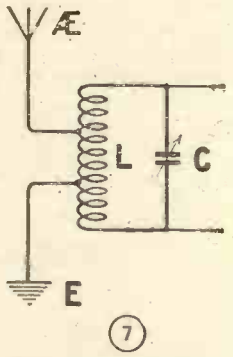
The particular virtue of this instrument, however, is its ability to serve for a number of different kinds of tuning circuits, out of which the experimenter can choose that which best suits his own aerial. I can say from experience that an arrangement which is effective on one aerial is quite unsuitable on another, which accounts to a very large extent for the various preferences shown by different people. In *Modern Wireless* for September last I published a description of a crystal receiver which has achieved remarkable popularity, largely, I think, owing to the several different kinds of circuit that are possible with it. I have received hundreds of letters from all parts of the country speaking in the highest terms of the set, and a large number of readers have given me particulars of the arrangement which best suits their own conditions. Many readers have obtained the best results on an arrangement which on my own aerial proved the poorest. In the present receiver even more variations are possible.

If you examine the collection of circuits on this page you will see in diagrammatic form the various arrangements possible. We may, for example, include all of the inductance in both aerial and detector circuit. Another arrangement enables us to use two-thirds



Three useful circuits. For simplicity the crystal and telephones are shown only in the first diagram.

and still another one-third of the total inductance. The last of these arrangements will only be used on very large aerials or with very short wavelengths. Another arrangement which many people will find effective uses only



A highly selected arrangement.

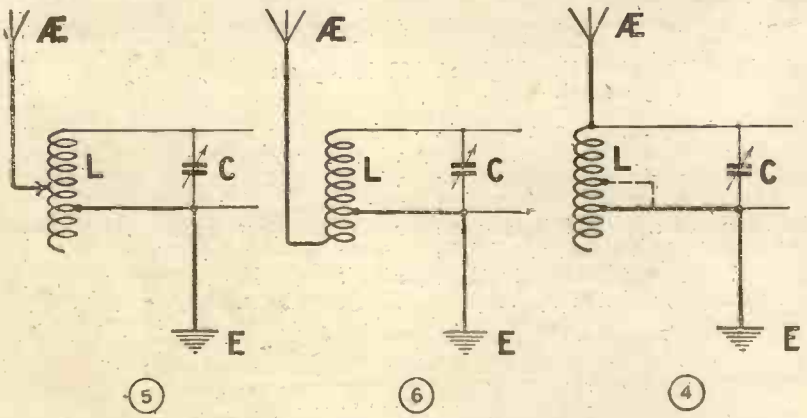
part of the inductance (either one-third or two-thirds) in the aerial, the whole of it being in the closed circuit. In those cases where the listener is disturbed by the interference from ship's signals, the arrangement shown in Figs. 3 and 7 will prove excellent, for these circuits are particularly selective and cut out a great deal of interference which would otherwise be received. With some aerials louder signals would be obtained with this arrangement, and in those cases, of course, the additional selectivity is a further advantage.

The appearance of the instrument is quite pleasing and should vie with the best of the commercial sets. The components are relatively few and the cost quite low, while the work should not tax the abilities of the veriest tyro. Let us see what we need.

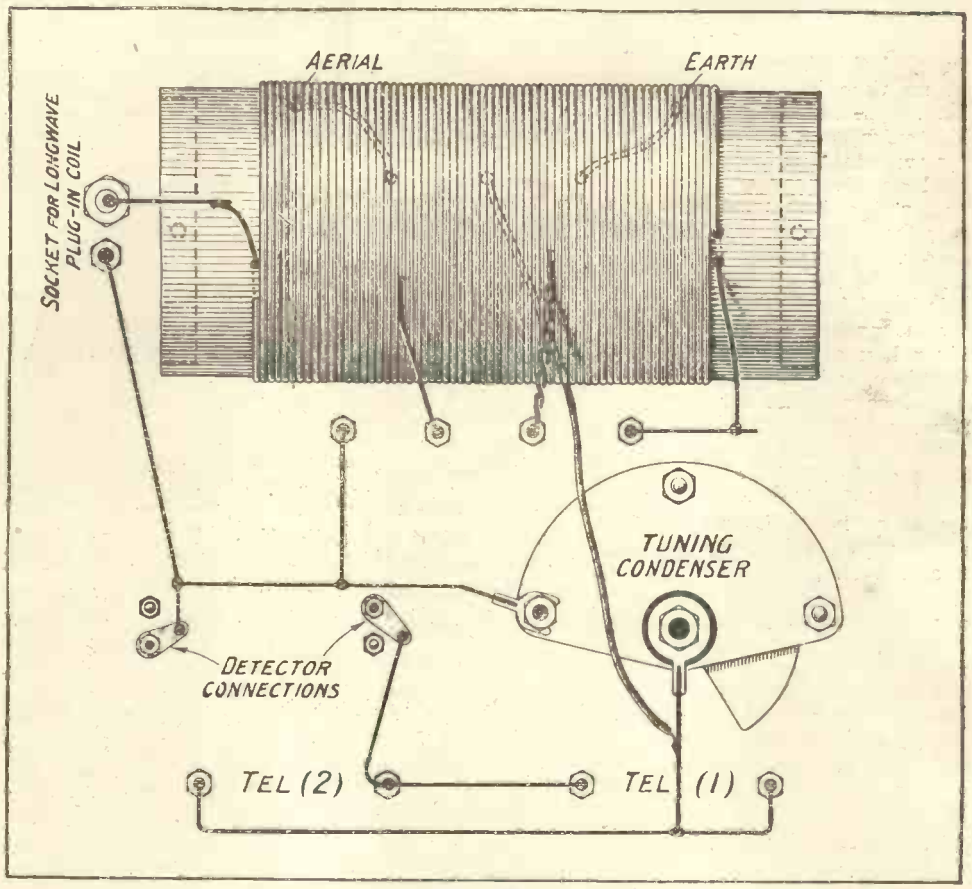
Components

Both appearance and efficiency are improved by mounting the parts on an ebonite panel, provided, of course, the ebonite is of good quality. The only real safeguard is to purchase ebonite of a well-known make, being sure that it is guaranteed free from leakage by the makers. New recruits to the wireless ranks may wonder why I lay emphasis on this point, but the more experienced know that much of the ebonite sold is made in such a way that the surface conducts electricity instead of preventing its flow. The surface layer with such ebonite has to be removed by the laborious process of rubbing it with sand or emery paper. Guaranteed ebonite is free from the need of this preliminary treatment, and whilst it may cost a little more than the cheap varieties of unguaranteed ebonite, it is well worth the additional cost. In the instrument under description I have used a high-grade insulated material known as "Radion Mahoganite." It has a beautifully finished surface and a grain resembling rich mahogany. Any of the guaranteed ebonite advertised in this journal can be used with certainty of satisfaction. The size of the panel is 10 in. by 9 in.

A suitable box for this will be needed, and I recommend you to buy this ready made. A number of dealers will supply a box to these measurements, and



Three more interesting circuits. In Fig. 4, the dotted line shows an alternative connection.



The back of panel wiring is very simple.

the quality, of course, will depend on what you care to spend.

The remaining components are:

One cardboard tube 3 in. diameter, measuring 7 inches long.

About ¾ lb. No. 16 D.C.C. wire (don't be put off with anything smaller, if you want to get as good results as I have obtained).

Two small pieces of wood cut as shown to support the tube against the panel.

Four Clix sockets.

Three Clix plugs.

One variable condenser square law ·0005 mfd. (I have used a "Fallon" here. There are a number of square law condensers on the market of good quality, so that you will have a wide choice of make.)

Six terminals. (There are two pairs of terminals for telephones as most people use at least two pairs.)

One crystal detector. (I have used a Burndept glass enclosed. Here, again, you have a wide choice, as any good crystal detector will do. If you buy a detector to stand without a crystal then you will need to fit one of the modern crystals marketed under a trade name ending with "ite." There are so many good makes available that there is no point in naming any particular one.)

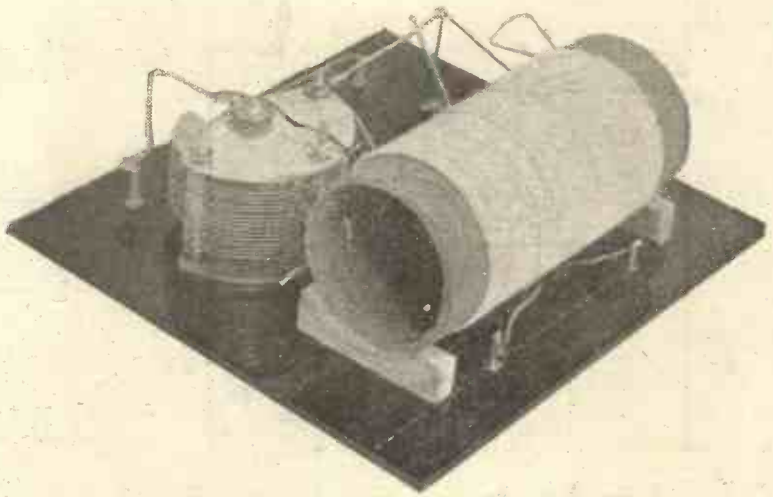
One socket for plug-in coils.

One short-circuiting plug for this socket.

Notice I do not specify a telephone condenser which forms a part of so many designs. I have found such condensers unnecessary and no longer incorporate them in my crystal set designs. If you have any doubt on the subject, try connecting such a condenser across the telephones. You will probably find it makes no difference whatever, either in quality or strength of signals.

The Cabinet

The simplest way to start, of course, is to buy a cabinet ready fitted with an ebonite panel, but if you buy a piece of ebonite not exactly of the size needed, you will have to cut it to shape, which you can do with the aid of a hacksaw. Hints on marking out and drilling ebonite panels are given



A perspective view.

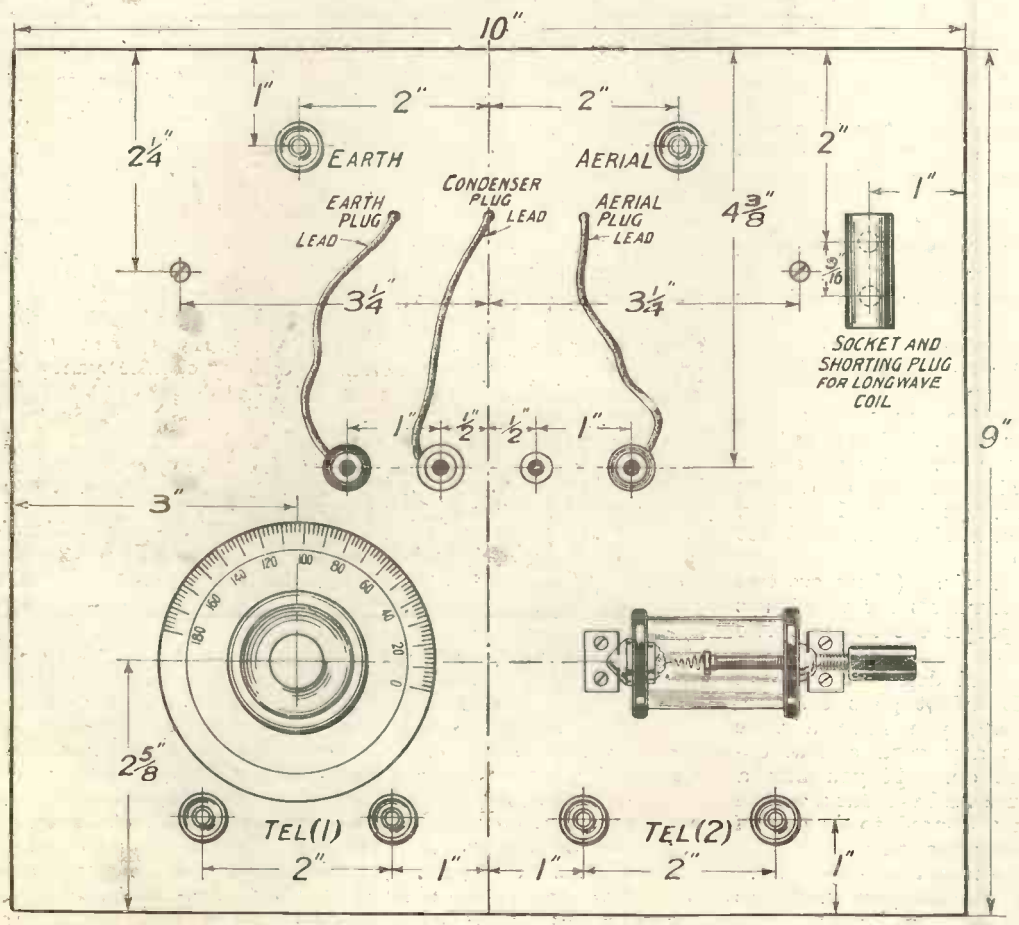
on another page of this issue, so I need spend no time in giving particulars here. Make all the holes needed in your ebonite, including one or two small ones to hold the panel to the cabinet, and mount your terminals and crystal detector together with the variable condenser. If your variable condenser should not be of one of the makes designed for one-hole fixing, you will probably find in the container box a paper or cardboard template, which you lay on the panel as a guide for drilling. Here, again, I would refer you to the article on laying out and drilling panels. When the terminals, crystal detector and variable condenser have been mounted on the panel, this can be laid aside and work begun on the coil.

None of the work in making this receiver is difficult, but winding the coil is certainly not the easiest. Until you have the knack, No. 16 wire is liable to give some trouble and you must, at all costs, avoid making kinks. The best way is to buy the wire in a hank of about a foot in diameter, and to enlist the help of some other member of the family in winding the coil.

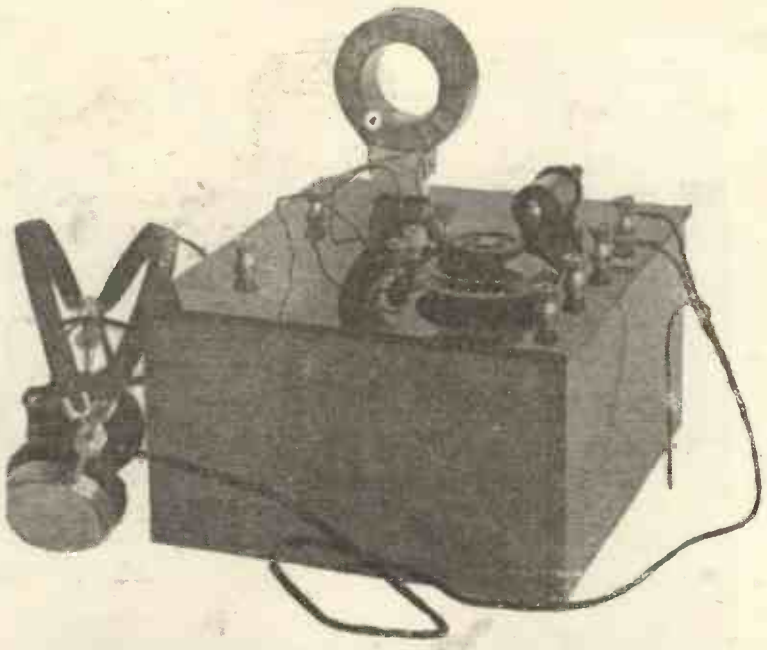
How to wind the coil. Keep the turns close to one another with the thumb, and wind tightly.

Winding the Coil

Take the cardboard former and at about 1 in. from one end make two holes about ½ in. apart of a size that the No. 16 wire can pass through. Push one end of the wire through one hole and bend it round so as to bring it up through the second hole, leaving about 6 in. projecting. The bends will secure the wire in place, as it is quite stiff and does not easily slip out of the securing hole. Now get someone else to hold the hank of wire and to pay it out to you by rotating the hank as you wind the wire on to the former.



Drilling diagram of the receiver. One or two pairs of telephones are provided for.



When it is desired to hear Chelmsford, the shorting plug is withdrawn, and a number 150 coil inserted.

You will see from the photograph how to wind this, your thumb being used to hold the wire firmly in place and against the adjacent turns. Carry on with your winding until you have wound 60 turns, then, without leaving go of the wire, pierce two other holes and thread the end of the wire in one hole and out of the other, giving a slight bend as before to secure in place. Leave at the end about 6 in. free for connecting.

A Warning.

Your coil will now be finished as far as winding is concerned. Do not shellac or paraffin wax this coil or treat it in any way with paint or varnish. I am inclined to think that any slight advantage gained by waterproofing the coil is lost in other directions. Now take two pieces of ½-inch wood and shape them as shown in the picture, using two small wood screws at each end to hold the cardboard former to its wooden support.

When you have done this count 20 turns from one end and at the 20th turn raise the wire slightly by pushing a pocket knife underneath it. With another knife, or in some similar fashion, scrape away the cotton covering from this 20th turn for about ½ in. A match pushed underneath this turn will cause it to stand out from the other turns. Treat the 40th turn in the same way.

Now solder two short lengths of wire to the 20th and 40th turns; do not worry about the exact length of these wires at the moment, 6 in. will do. Now take a smooth file and file the ends of the terminals and the Clix sockets and tin these carefully with solder. The variable condenser will probably have terminals or it may possess soldering lugs. If these latter are provided then the lugs can be tinned at the same time.

Fixing

With all the points tinned, secure your coil to the panel as shown by a couple of wood screws through the top, and begin your wiring up. A half scale wiring diagram is given on page 89, and this will be sufficient guide for you. Solder the four coil connections to the four Clix sockets as shown, cutting off any superfluous wire when you find out how much you want. You can use either flexible wire in insulating sleeving, or square section tinned copper wire as you will. The square section tinned wire is better and is probably slightly more efficient, although in this receiver you will not notice the difference between the two kinds of wire. All other wiring connections are obvious.

Flexible Leads.

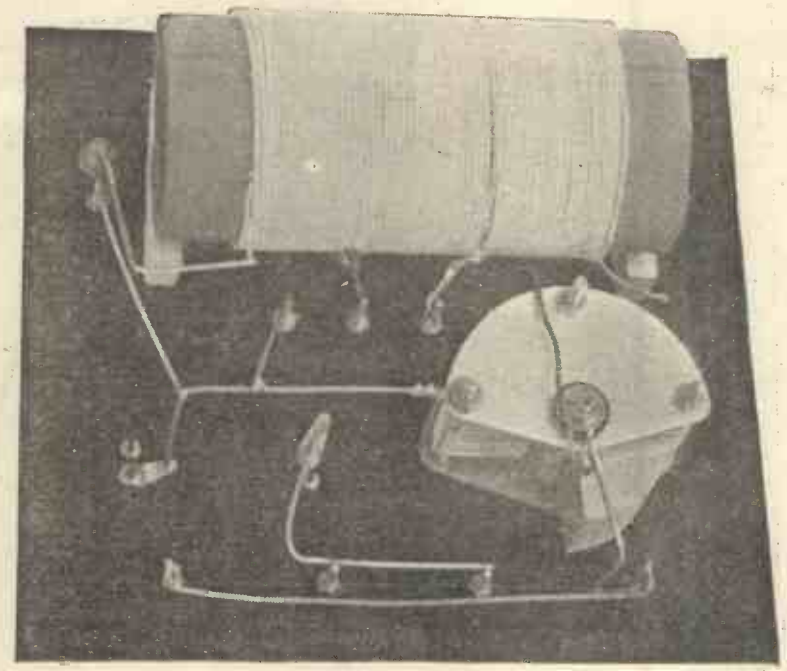
You will notice there are three holes in the panel through which I have passed three flexible leads, which on the underside of the panel are joined to the points shown. These are made from untwisted electric lighting flex. You will see there are three of these flexible wires, one joined to aerial, the second to earth, and the third to the moving plates of the variable condenser. These wires are passed through the panel and are cut off to such a length that the Clix sockets which are attached to the end of them will just reach nicely into any of the sockets shown. In attaching the ends of the wires to the Clix plugs you need not use solder. It will be quite sufficient if you use the gripping screw provided. Do not pass the wire through the top hole as this will be needed as a socket in some arrangements. When you have finished wiring up and fitting the plugs and sockets, secure the panel to its cabinet and join aerial and earth wires to the terminals shown. A pair of high resistance telephones should be connected to either pair of telephone terminals, and the catwhisker of the detector placed in contact with the crystal.

The various combinations of plugging are very fascinating.

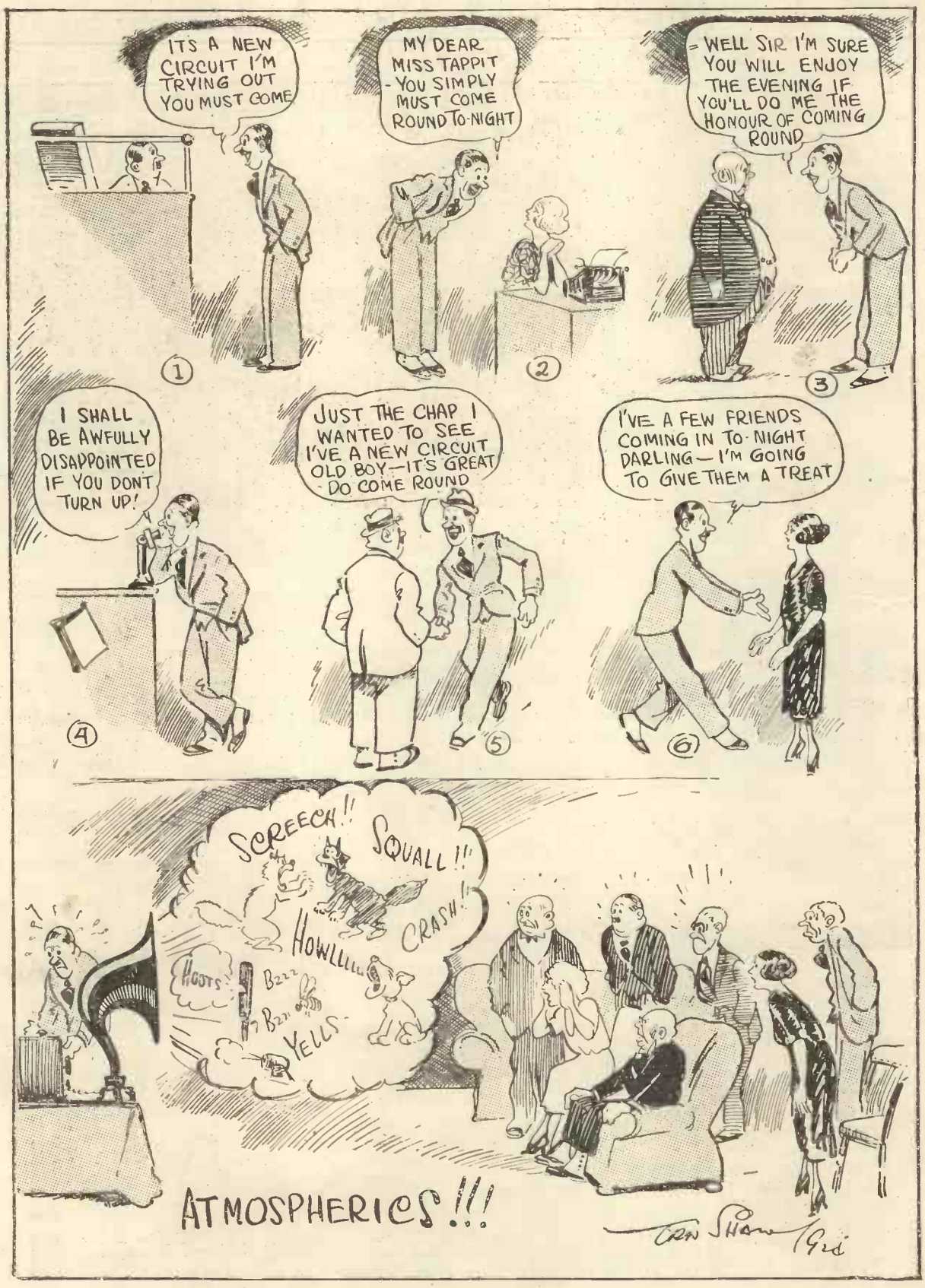
Place the aerial plug in the extreme right-hand socket, the earth plug in the second socket from the left, and the condenser plug in the back of the earth plug. This will give you the second circuit in Fig. 1, and will probably enable you to tune in your local broadcasting station quite easily. Insert the short-circuiting plug in the coil socket (this socket is only used for the loading coil used for 5XX), and turn the knob of your variable condenser. You will soon pick up the station, and a little adjustment of the crystal detector will give you good signals if you are not more than 10 or 15 miles away. If conditions are favourable, you will get strong signals at much greater distances than this, but generally I do not recommend a crystal receiver for use more than 15 miles from a station, unless the reader is willing to put up with weak signals.

Experiments

When you have satisfied yourself that the crystal is properly adjusted and that you are getting good signals and tuning properly you will probably want to experiment with the other circuits, and this you can easily do by varying the position of the plugs. The only change necessary to receive Chelmsford is to withdraw the short-circuiting plug and to plug in a No. 150 coil, tuning with the condenser dial as before. The aerial plug must be kept in the right-hand socket and the condenser and earth plugs in the last on the left. If you are pleased with the set write and tell me about it. I receive so many letters that I cannot reply to them all individually, but readers' reports of results are always welcome and in a large number of cases, when published, are of great interest to other readers in the same locality.



A further view of the panel wiring.



HAS IT EVER HAPPENED TO YOU?

HOW TO LAY OUT A PANEL.

THE series of photographs given here have been specially prepared to indicate the correct methods of marking out a panel. For the beginner the importance of correct procedure cannot be too highly stressed, and a careful perusal of the following will help to lay the foundation for consistent and accurate work in this respect.

The tools necessary for this work are few, and consist of a 12 in. steel rule, suitably engraved in inches and sub-divisions (the Metric System has not yet come into extensive use for wireless work),

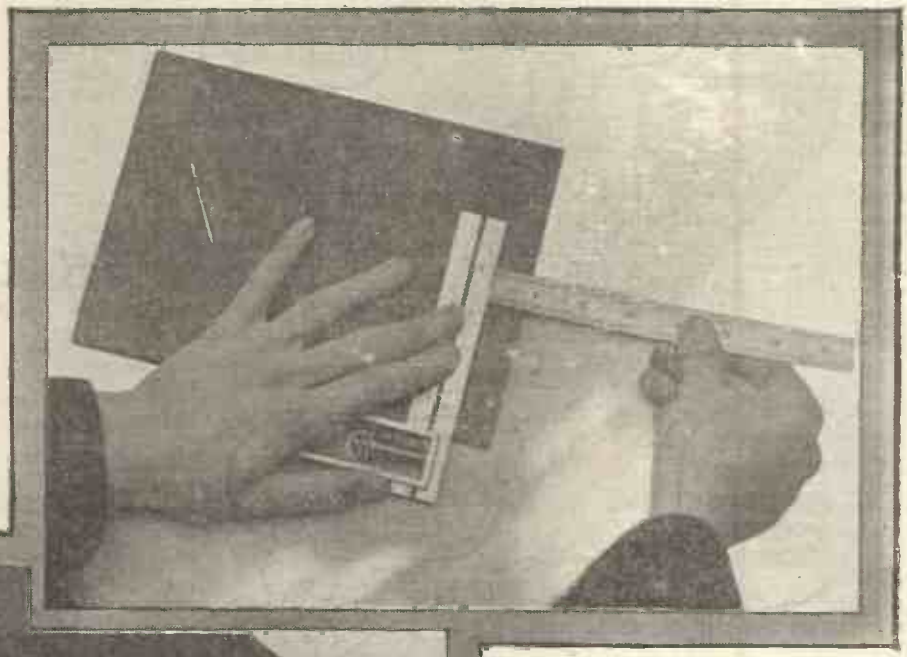


Fig. 1.—Measuring distance for Terminals.

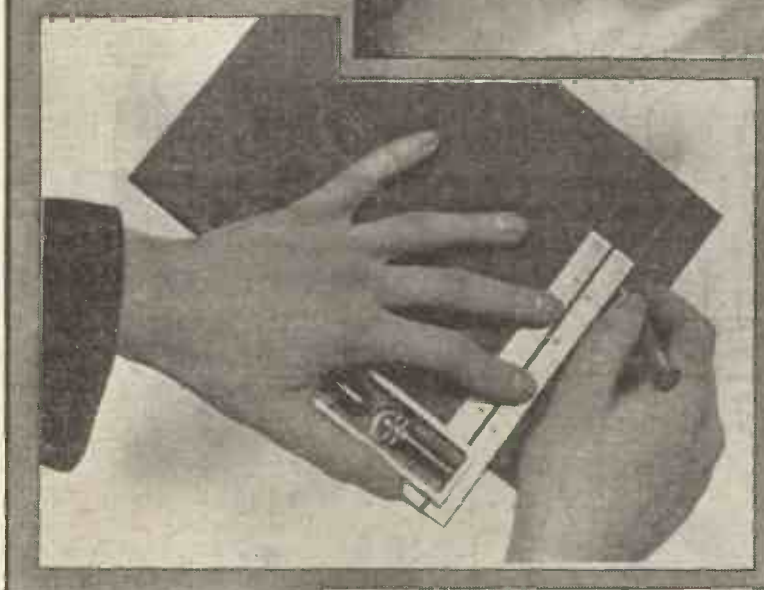


Fig. 2.—Scribing guiding lines.

an accurate square as shown, a small light hammer, a steel scriber and a centre punch.

If your ebonite is guaranteed free from surface leakage, work may begin at once, otherwise it will be necessary to remove the surface with fine emery paper, a final finish and polish being given by washing the surface with methylated spirit containing a trace of vaseline.

True up the longest edge, mark off the required length and square up the two shorter edges, finishing the last edge in the same way.

It is never safe practice to mount your terminals nearer than ¾ in. from the edge of the panel, and the photograph of Fig. 1 illustrates the correct method of marking off this distance. All such markings should be made on the underside of the panel, using the scriber. It will be observed that the square is used in the left hand.

Fig 3.—Laying out Terminal Positions.

Do not forget that on the back of the panel the order of parts is reversed.

The photograph of Fig. 2 indicates the method of marking a line parallel to the edge and at a distance of ¾ in. from it. The positions for the terminals, which should preferably be spaced not less than ¾ in., are marked out as shown in the next photograph (Fig. 3). A point to notice here is that the eye should be placed vertically over the point of the scriber to avoid errors due to parallax, and that a short line at right-angles to the marking line, and not a dot or indentation on on the panel surface, should be made.

The centre punch is then used as illustrated in the photograph of Fig. 4. The point is placed at the intersection of the lines, the punch placed vertically, and given a sharp tap on the head with the hammer. This will make an indentation sufficient to give a start for the drill in drilling the holes to accommodate the shanks of the terminals.

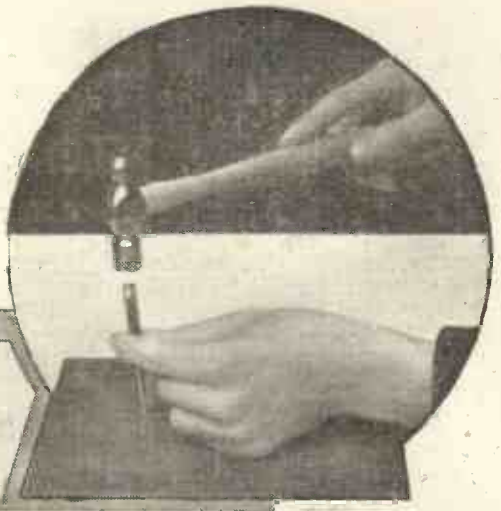


Fig. 4.—Using the centre punch.

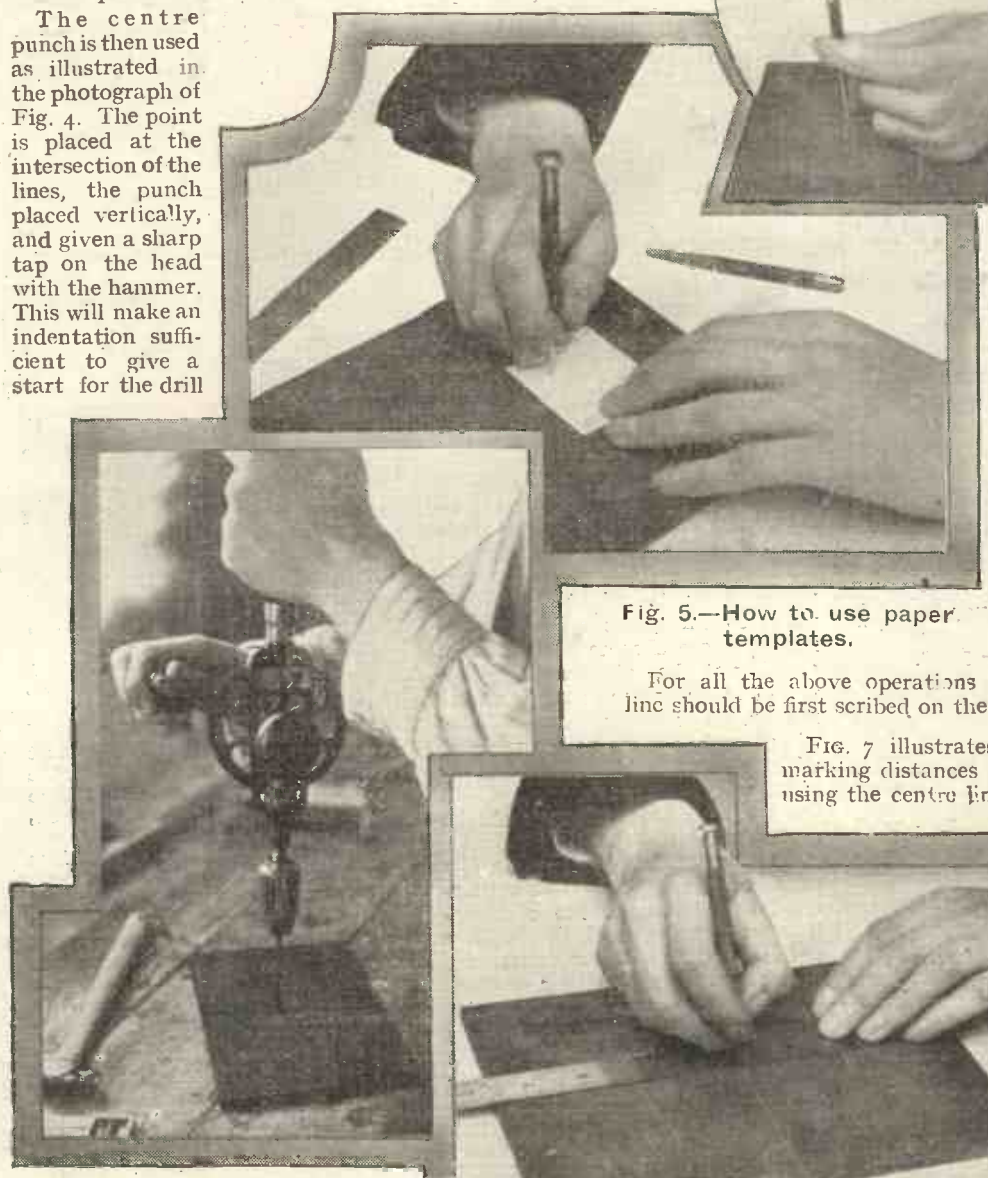


Fig. 5.—How to use paper templates.

Fig. 6.—Be sure to hold the drill vertically.

Fig. 7.—It is helpful to mark out from a middle line.

Many manufacturers are now supplying templates with certain types of apparatus to facilitate the marking out and drilling of panels, and the photograph of Fig. 5 shows the method of employing these. Some constructors place the paper or thin cardboard template in the required position on the panel and punch the necessary holes through the template. This method is not recommended, and readers are advised to prick the positions of the holes through the template with a sharp pointed scriber, subsequently removing the template and using the centre punch as described.

For all the above operations a centre reference line should be first scribed on the panel.

FIG. 7 illustrates the method of marking distances to the left or right using the centre line for reference.

Having completed the marking out of the panel, using only the tools previously mentioned (on no account should a lead pencil be employed), the drilling may be commenced. Systematic drilling of all holes of the same size is recommended, thus obviating many changes of drills, and consequent loss of time. The drilling operation is illustrated

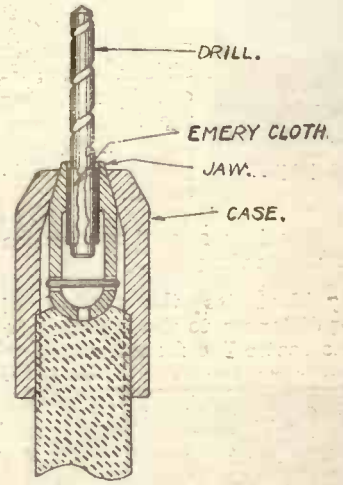
in the photograph of Fig. 6. A final clean up and polish is given to the panel after the operations of marking out and drilling have been performed.

In conclusion, one cannot be too emphatic in advising strict adherence to the methods outlined above.

Unsightly panels, lacking in symmetry, will thus be avoided, and the constructor will be amply repaid for any extra trouble incurred. Efficiency and elegance approaching that of the best commercial receivers should be the aim of every wireless constructor.

A Drilling Tip

IF drills are used in a carpenter's brace, it will be found that there is a tendency to slip. This can be obviated by wrapping a



SECTION THROUGH CHUCK.

thin strip of emery cloth round the shank of the drill before placing it in the chuck. The accompanying sketch shows the method clearly.

Receiving Broadcast without Crystal or Valve.

By J. F. Johnstone (5 LG)

SEVERAL crystal set owners seem to have made the discovery that they can sometimes still hear the local station *very faintly* with the crystal removed and the cats'-whisker making contact with a perfectly empty crystal cup.

The writer once succeeded in receiving quite good Morse signals using the contact between a telephone tag and his finger and thumb as the rectifier, and without any kind of tuning apparatus. However, on this occasion the station was *very* near and *very* powerful.

The results obtainable by the above means are in the majority of cases very poor when the nearness and power of the transmitting station are taken into account, and the signals are in no way comparable with those produced by orthodox receiving apparatus under similar conditions.

Nevertheless, it occurred to the writer that it might be worth while to carry out a few experiments to see if some such contact could not be discovered which would give some really useful results. For this purpose a tuner of proved efficiency was used, with 'phones attached and provided with two terminals to which the contacts to be tried could be connected.

As it seemed likely that in the case of the cat's-whisker-empty-crystal-cup contact the rectification was produced at the slightly oxidised surface of the brass cup, a start was made with a contact between a piece of copper wire and a piece of steel (a metal that oxidises very readily indeed). It was found that when the copper wire was laid lightly across a slightly rusty (oxidised) needle, and a good contact was made at another part of the needle, quite good rectification was obtainable. The signals were not, indeed, quite as good as those produced by a really good crystal set, but music and speech from 2ZY at eight miles distance was pleasantly clear and distinct on a moderate outside aerial.

It was found that a *very* rusty piece of iron gave, if anything, somewhat inferior results to the *slightly* rusty needle. The copper wire (about No. 22) had to be laid across a rusty place very *lightly* and then moved about until the best results were obtained.

Radio Press Information Department

OWING to the tremendous increase in the number of queries, and the policy of the Radio Press to give expert advice and not merely "paper circuits," it has been found necessary to enlarge our staff dealing with such matters. In view of the expense incurred, we are reluctantly compelled to make a charge for replies of 2s. 6d., according to the rules below.

All queries are replied to by post, and therefore the following regulations must be complied with:

(1) A postal order to the value of 2s. 6d. for each question must be enclosed, together with the coupon from the current issue and a stamped addressed envelope.

(2) Not more than three questions will be answered at once.

(3) Complete designs for sets and complicated wiring diagrams are outside the scope of the department and cannot be supplied.

(4) Queries should be addressed to Information Department, Radio Press, Ltd., Bush House, Strand, London, W.C.2, marking the envelope "Query."

THE BARGAIN.

Wireless in Germany.

The Vox Haus Station.

Now that German stations are frequently heard in England, the Article below will be read by many with interest.

DR. ING. MAX. M. HAUSDORFF called in to see us the other day and gave us some details of the Vox Haus broadcasting station in Berlin.

There are two stations operated by the same programme in the evenings. One of the stations has the power of 1½ kilowatt and the other 600 watts. The wavelengths used for these stations are 500 metres and 430 metres, respectively.

Two Stations

The high-power station is supplied by the German wireless firm Huth, while the smaller powered station is run by the Telefunken Company, another big wireless concern in Germany.

The 430-metres station is for use in Berlin and district, whereas the 1½ kilowatt station is intended to cover Germany generally.

Why there should be two stations working on wavelengths so close together seems very curious. We suggested that the 500-metres station with 1½ kilowatt could be received by Berlin listeners even better than the 600-watt station on 430 metres. The idea of having two stations of similar wavelengths and power and, be it noted, a similar programme reminds us of the professor who had a special dog-kennel made with one opening for the parent and a smaller separate opening for the puppy which inhabited the same kennel.

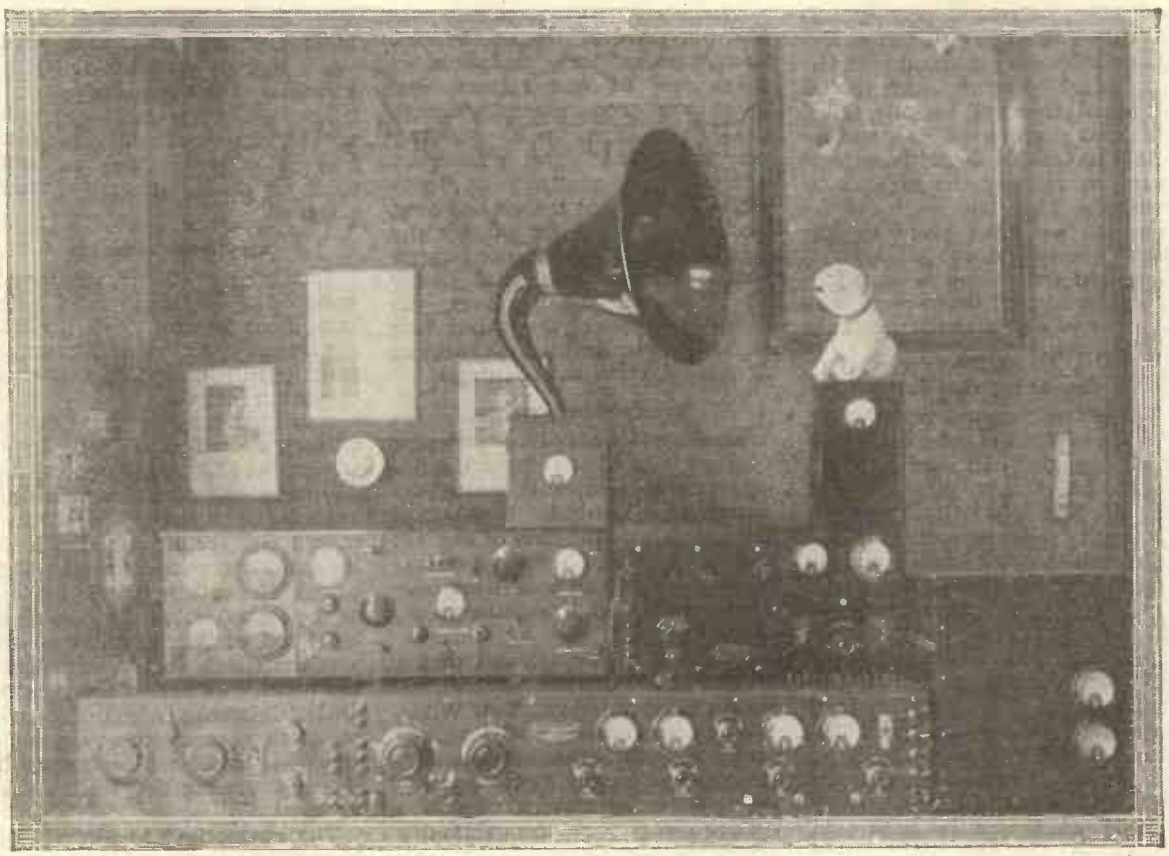
Simultaneous Work

These stations work together in the evening from a single programme, which on special occasions is also radiated from Königswüsterhausen. This latter station works on 2,600 metres with 5 kilowatts power.

Licensing

It is interesting to note that the Deutscher Radio-Club, which corresponds to our Radio Society of Great Britain, is the licensing authority in Germany; at any rate, wireless receiving licences are issued by the Government, but reliance is entirely placed on the discretion of the Deutscher Radio-Club, which actually issues the licences and decides who is competent to have an experimental licence, and to whom only a broadcast receiving licence shall be given.

This delightful arrangement contrasts with the British Post Office attitude towards recommendations for transmitting licences made by the R.S.G.B.



Dr. Hausdorff's receiving apparatus. The long cabinet at the bottom houses an American built superheterodyne.

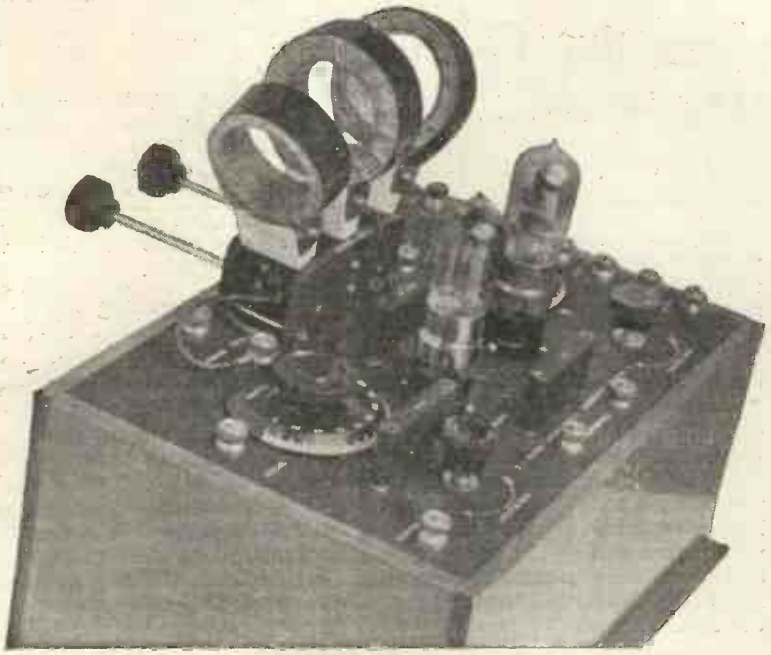


Fig. 7.—The disposition of the components on the panel is clearly shown here.

THE RESISTOFLEX RECEIVER.

BY

JOHN SCOTT-TAGGART,

F.Inst.P., A.M.I.E.E.

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The second part of an article which commenced in our November issue.

THE instructions given in the first part of this article should enable the reader to obtain a good idea of the general layout of the different components, but three additional photographs are shown in Figs. 7, 8 and 9, and the actual wiring diagram is in the form of a blue print, which should be found inserted in this issue. This blue print is full size, and by its aid no trouble should be experienced in making the right connections. The photographs of the back of the panel given in last month's issue, and also in this issue, show how the wiring is arranged. It will be noticed that square wire is employed and that the joints are all soldered.

Operating the Set

When first connecting up the set, I would advise the use of a No. 50 or a No. 35 plug-in coil in the aerial circuit, *i.e.*, the left-hand coil of Fig. 7. The middle coil may be a No. 50 or a No. 75, and the actual value will depend largely on the tendency of the receiver to oscillate. The larger the coil the more easily will the set oscillate, so that to be on the safe side it is probably as well to use a No. 50 coil in the anode circuit. The grid circuit of the second valve—*i.e.*, the right-hand coil of Fig. 7—is a No. 75 or a No. 50. The former value will usually be suitable if a ·0003 μF variable condenser is connected across the coil. For the relay stations and stations using wavelengths near 300 metres a No. 50 coil had better be used, but for the longer wavelengths, including 2LO and above, a No. 75 should be employed.

Troubles to Expect

When the ST100 circuit was first published in *Modern Wireless* there were hundreds, and probably thousands, of constructors who failed to get proper results, although the description was perfectly straightforward and accurate. Letters were received at these offices saying that the set had been made exactly as described, but the results were very inferior, or no results at all were obtained. After about six months, however, the complaints ceased altogether, and reports of excellent results came in from all parts of the country.

Faulty Components

The first instinct of a constructor of a set is to blame either the designer or the paper in which the design is published. Nothing is more unfair in the case of any set described in Radio Press publications, because the actual set may be inspected and, in suitable cases, demonstrated.

It must be remembered that a quarter of a million wireless enthusiasts have bought THE WIRELESS CONSTRUCTOR, and that out of this huge total there are bound to be some who buy faulty components or make some mistake. Troubles do not always occur through faulty wiring; this is one of the least frequent causes of a set not working properly. Faulty soldering and faulty components are responsible for a great deal of trouble. Many readers seem to be under the impression that if they go into a shop and buy something like that illustrated in a photograph they will obtain satisfaction. As a matter of fact, it is, as a general rule, extremely unsafe to buy anything which does not possess a name. It may be merely an imitation of some successful component, but made of inferior materials, such as cheap insulating "composition."

Anode Resistances

In this particular set you may be tempted to buy some weird nameless anode resistance or gridleak. An inferior anode resistance, of course, will completely spoil the operation of the whole set. A variable anode resistance which has packed up will also stop the set working at all. A faulty condenser anywhere will also give trouble.

Probably the most likely trouble with a receiver of this kind is the incorrect connections to the three coils. The coil in the grid circuit of the second valve, *i.e.*, the right-hand coil of Fig. 7, has two connections which go to terminals on the panel. It makes a very great deal of difference indeed which way round these connections are made, and you should try both ways by simply reversing the leads on the terminal.

The connections to the grid coil of the first valve (*i.e.*, the aerial coil) are, of course, equally important. When first connecting up your set, the aerial coil, the

left-hand one of Fig. 7, should be kept flat, *i.e.*, well away from the middle coil. The right-hand coil of Fig. 1, which is in the grid circuit of the second valve, should be coupled tightly to the middle coil. If, when tuning-in the two variable condensers, oscillation is

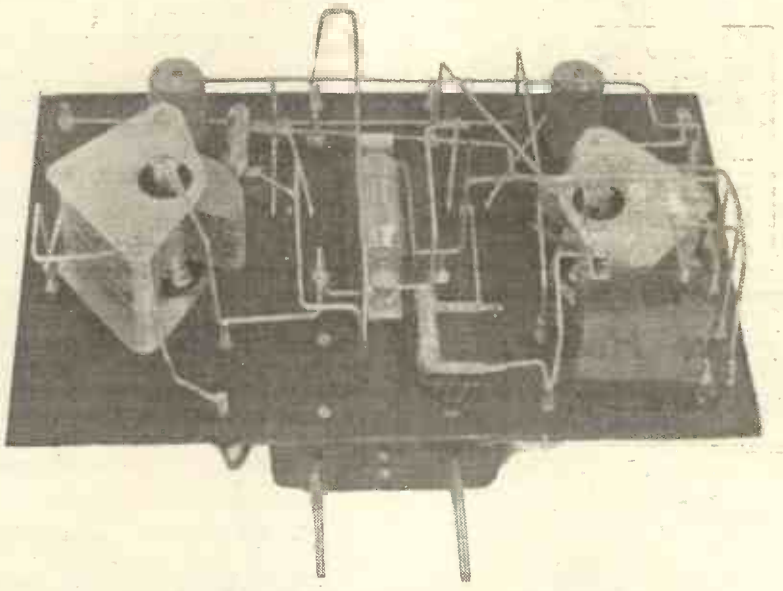


Fig. 8.—A back-of-panel view of the wiring.

set up, try reversing the connections to the aerial coil on the left of Fig. 2. The connections to this coil govern the reaction in the set, although there is always the normal reaction effect, even though the aerial coil is not near the middle coil. If this is experienced to such an extent that self-oscillation occurs, a reversal of the leads may stop the trouble.

Control of Oscillation

A surer method is to loosen the coupling between the middle coil and the right-hand coil of Fig. 7, but this coupling should not be loosened any further than is absolutely necessary to stop the set from oscillating, because it will weaken signal strength somewhat.

You will also probably be able to lessen any tendency to oscillate by turning down the filament current of the first valve, although this, of course, must also be done with caution so as to stop oscillation without affecting signal strength.

Summarising these remarks, I would advise you to try the following arrangement. Keep the left-hand coil of Fig. 7 down and the right-hand coil close to the middle coil. Provided the set does not oscillate when you are tuned in, try reversing the leads to the right-hand coil, and see if signal strength improves.

Now, leaving everything else as it is, reverse the connections to the aerial coil and note the effect. The next change, after leaving everything as in the last experiment, is to reverse the leads to the right-hand coil.

In all these cases try varying the coupling between the different coils, always, of course, re-tuning on the two variable condensers whenever any alteration is made.

Try the effect of pulling out one or both of the two plug-in condensers in the middle of the set.

Remember to connect the battery terminals correctly. To begin with, you can connect H.T.$_1$ to H.T.$_2$, and join these two terminals to the positive terminal of the high-tension battery of about 100 volts; the negative of this high-tension battery terminal is connected to the H.T. – terminal. The L.T. + and the L.T. – terminals are, of course, connected to your accumulator, and to begin with, if you like, you can join G.B. + and G.B. –, the grid bias terminals, by a piece of wire. Don't forget these terminals, as many readers often do; either short-circuit them or connect a battery between them so that the positive terminal of the grid battery is connected to G.B. + and the negative terminal to G.B. –. With the ordinary general purpose valves I have found that about – 3 volts on the grid of the first valve is desirable.

Tuning

Many a beginner makes the mistake regarding correct tuning. Remember that you should not only be able to tune in a signal, but tune it out. In other words, if you get a station on 30° of your variable condenser, you should be able to tune the station out below 30° and also tune it out above 30°. Unless you are able to tune out on both sides, you do not know that you are getting the signal at its maximum strength. Another point to remember is to work on as low a value of your variable condenser as possible, and rather than use a small coil and 150° on your variable condenser, use a larger coil and, say, 20° on your condenser; your signal strength will be louder on the latter adjustment in nearly all cases.

Signal Strength

Remember that this set involves only a single stage of low-frequency amplification, whereas the ST100 involves two stages of low-frequency amplification. You must con-

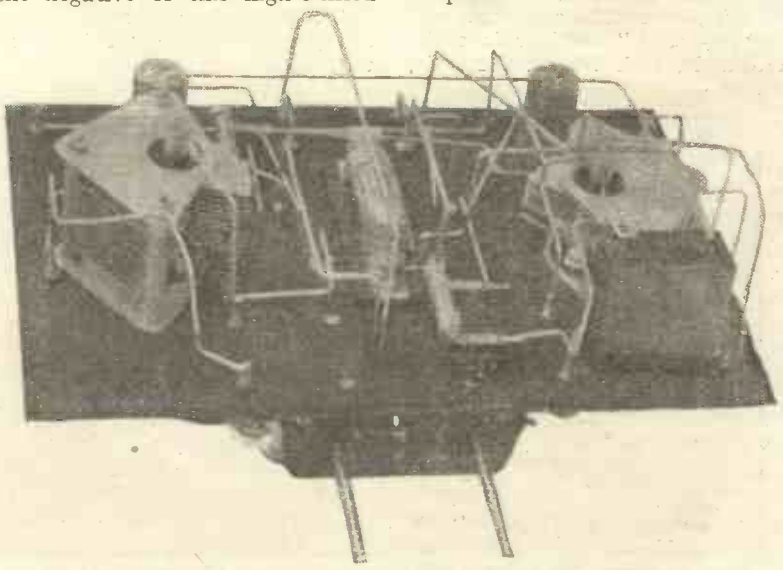


Fig. 9.—The components are adequately spaced.

sequently not expect the same degree of signal strength. Moreover, the resistance method of low-frequency coupling does not give as strong signals as a transformer. These facts, of course, must be borne in mind when the set is being used.

High-Tension Voltage

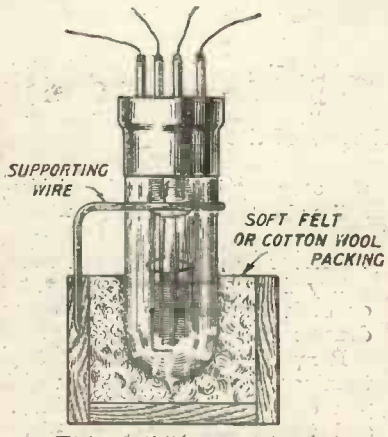
The high-tension voltage is very important, and I very strongly recommend using nothing short of 100 volts with this receiver. Many readers, I know, will use lower voltages and perhaps be disappointed in the signal strength.

If you like you can try different anode voltages on the two anodes. There are two high-tension positive terminals on the set, H.T. $+_1$ and H.T. $+_2$. You can have two Wander plugs in your high-tension battery, each being connected to one of these high-tension terminals, and you can consequently vary the anode voltage applied to each valve.

An Improvised Valve Holder: with very low capacity.

MANY improved forms of valve sockets have been placed upon the market with the object of reducing the capacity present between the valve-pins. One hint for instance is to drill a number of holes through the panel between the valve-sockets, allowing an air-space and so reducing the capacity.

A great improvement on all such methods is the simple one illustrated in the sketch. The valve is mounted upside down in a small wooden box packed with soft felt or cotton-wool, and supported by a wire loop. The connecting wires are then soldered directly to the valve-pins. This method of mounting is, of course, not suitable for a cabinet type of receiver, but the experimenter's "bread-board" receiver is easily adaptable, with improved results, especially where, say, two stages of high-frequency amplification are used and the set is at all unstable.



This diagram shows how the valve is held.

The writer even goes a step further in order to reduce all unwanted capacity. The metal cap round the base of the valve is removed by applying heat from a Bunsen burner, rotating the valve slowly and taking care that the flame does not touch the glass. When the cement softens the cap can be removed and the moulded filling cut away, leaving the glass valve only with its four connections protruding, to which the wires to the set are directly soldered and the valve mounted as described above.

In addition to greater stability on ordinary wavelengths, a very great improvement is, of course, experienced on the extra short wavelengths.

"2 AUH."

FAME!

A letter from Czechoslovakia has been delivered to us with the following on the envelope :—

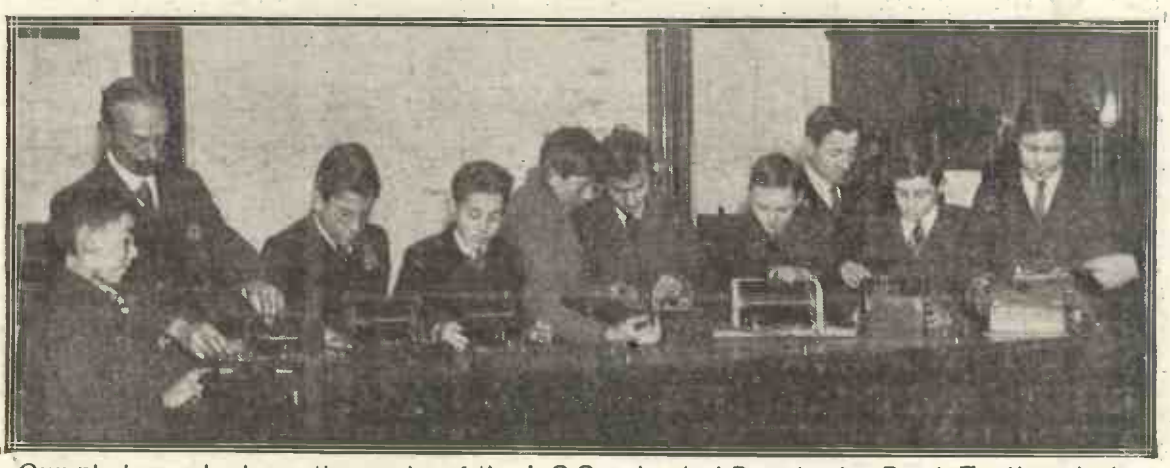
PRAHA VII.
Belskeho Trida Cislo 58.
Czechoslovakia.

To

The scientist and Constructor of Radio receivers, among others, the famous ST 100.

SIR SCOT-TAGARD,
in
LONDON.

I beg the English post to be kind enough and to find the man of the unknown address as soon as possible for which I beg to receive my heartiest thanks in advance. Surely some of the radio enthusiasts will have his plans and constructions at hand and with it the name of the publisher with which the whole riddle will be solved at once.



Our photograph shows the pupils of the L.C.C. school at Broadwater Road, Tooting, during a wireless lesson. This subject now forms part of the school's routine.

WJAZ, America's Portable Broadcasting Station.

A description of a station which is arousing great interest among American broadcast listeners.

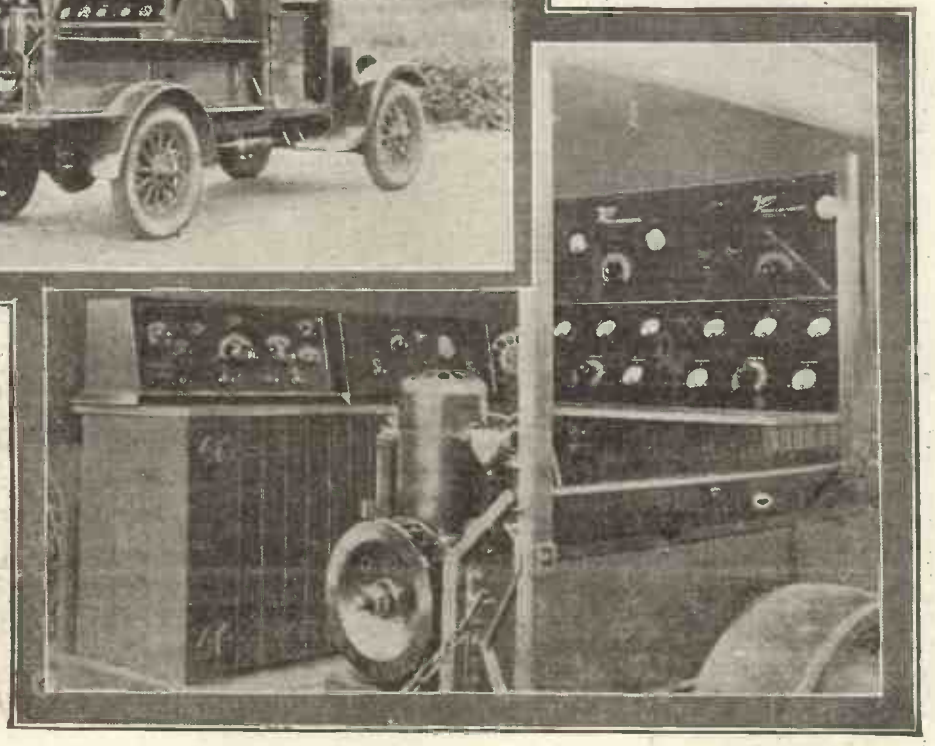
THE Zenith Portable Broadcasting Station, WJAZ, is a complete self-contained, self-sustaining, battery operated broadcasting station, able to function entirely without any external sources of supply and carrying its own collapsible aerial. The station can be set up in the middle of a field without any other power supply than its own and without any supports other than its own aerial mast, and can operate indefinitely, since it is equipped with a complete gas engine generator charging outfit which is able to charge the batteries while the station is in broadcasting operation.

The set is of 100-watt power, and uses four 50-watt valves, two as oscillators and two as modulators. All the apparatus is completely panel-mounted. The inductances, capacities and other apparatus are mounted behind these panels in a cabinet equipped with glass sides, allowing easy observation of the entire construction and interior of the set. Electric lights are provided inside the set for the same purpose.

The entire truck is electrically lighted with spot-lights on the panels, as well as a number of spot-lights designed to illuminate the aerial mast, which is of sectional type such as was used by the Army during the war, and 53 ft. in height.

The aerial is certainly novel, consisting of four heavily braided copper cables made of extremely fine wire, this making them extraordinarily flexible. These wires are provided at each end with snap-hooks which are attached to rings which fasten to two spreaders. Clips are provided on each spreader for connection purposes.

The station is mounted on a lorry.



Inside, the apparatus is very neatly arranged.

The entire framework and body of the car, including the iron strips on the floor, are connected together and grounded, the grounding strips all being brought to one point at the side of the car, where a heavy connection lug is attached.

The battery supply is 24 volts with a total capacity of 320 ampere hours. This battery arrangement operates a 24-volt to 1,500-volt direct-current generator, which, of course, is equipped with the necessary filter system to eliminate all generator hum. Standard broadcasting microphones, line amplifier, etc., are used. Three microphones may be used, one for announcing,

This handsome Primax loud-speaker was one of the features of the recent Albert Hall Exhibition.

one for orchestra and one for studio purposes, where these are necessary. A switching control arrangement is provided whereby each one of these or any of them at once may be used at the will of the announcer. Special armoured cable is provided whereby the microphones can be placed as far as 300 ft. from the truck, allowing the broadcasting of performances in halls, etc., with the car parked outside.

The wave-length is 268 metres. The call letters are WJAZ, and the average aerial current is 4 amperes with an upward modulation of about 1 ampere.

Switching Arrangements

Special switching arrangements are provided whereby the generating outfit not only charges the 24-volt battery but also charges the lighting and ignition batteries of the truck at the same time and also operates a 24-volt to 350-volt motor generator which serves to charge the high-tension accumulators used on the line amplifier. In this way the one engine charges the complete set of batteries, high and low voltage, all simultaneously. This can be done while the set is in actual operation without in any way disturbing it.

The entire wiring of the set is of the bus-bar type, using gold-plated copper bus-bar.

Three stages of amplification are used in the line amplifier, and the output of this is connected to a 5-watt speech amplifier, and from this connection is made to the two 50-watt modulator valves.

A complete receiving set with loud-speaker is provided for checking the modulation and also for maintaining communication if this is desired at any time.

In the transmitter proper the Hartley oscillator circuit is used, with Heising modulation.

HINTS ON READING A BLUEPRINT

Remember that a blueprint of a wiring diagram represents a plan of the underside of the panel, and therefore the order of things is reversed.

Note also that where wires are intended to cross that part of one wire which crosses the other is shown as a small semi-circle.

Intersecting wires intended to be joined or soldered are marked with a small white circle at the intersection.

Since a plan only is given, wires which are parallel and vertically above each other, are shown conveniently spaced side by side, and thus the actual disposition of the wiring is not necessarily as represented. Here the perspective photographs of the descriptive article are a help.

Components such as valve and coil holders, variable condensers, fixed condensers, fixed grid leaks and anode resistances, etc., are shown pictorially, as far as is possible.

Always aim at keeping parallel wires well spaced.

Be very careful not to let adjacent wires touch one another.

A Simply Made Single-Valve Receiver.

By PERCY W. HARRIS.

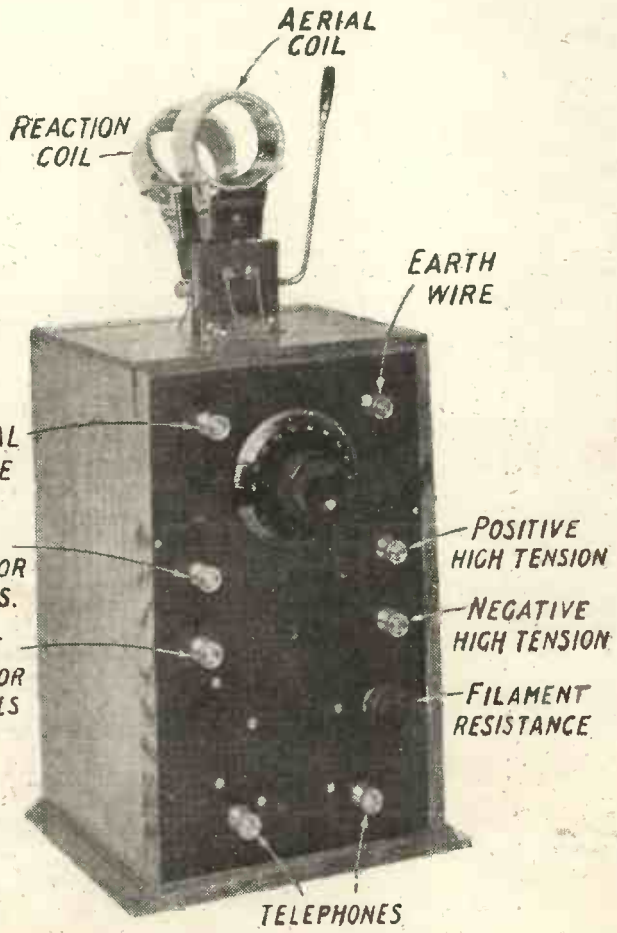
Last month, in the "Crusoe" Set, we saw how easily a single-valve circuit can be arranged from a few odd parts. This month the construction of a simple, yet efficient and handsome, single-valve receiver is described in full.

FOR the man who is just beginning wireless, the single-valve set has many charms. It can, for example, be run quite economically from a small accumulator, or, if we purchase one of the newer type of valve, burning only .06 of an ampere, even three dry cells of the electric bell type will suffice. The sensitiveness of a good single-valve set, particularly when reaction amplification is used, is considerably higher than that of the best crystal receiver, while the operation is so simple that even the most unskilled can soon learn how to get results. The one disadvantage of such a set—that it may cause interference with one's neighbours' reception — is easily overcome when attention is paid to a few simple rules.

Several pairs of 'phones

Furthermore, from such a single-valve set, which will operate several pairs of headphones on the nearest broadcasting station, the experimenter may proceed by easy stages to a more elaborate set. Next month, for example, we shall describe the construction of a two-valve amplifier, which when added to this receiver will enable a loud-speaker to be operated at good volume from the nearest station, provided this is not more than 30 or 40 miles away. I am not saying that a loud-speaker cannot be worked by a single-valve set followed by two note magnifiers at a greater distance than that given, but that one is certain to obtain good results at this distance, after which results are less certain.

If you look at the photographs you will see that the set is mounted in vertical cabinet with the rather unusual feature that the valve is mounted inside the cabinet out of harm's way. Plug-in coils, fitted to a two-coil holder on the top of the instrument, enable a rapid change of wavelength to be made, so that not only is it possible to receive any of the stations on the lower broadcast band, but also Eiffel Tower, Radiola and Chelmsford. Being primarily a receiver for use with headphones on the nearest station, it is yet sufficiently sensitive to give several others when conditions are good, and occasionally all of the others may be received, when adjustments are carefully made to the best advantage.



How the terminals are used.

Components

Let us now see what parts we require to make this set. They are as follows:—

One vertical oak cabinet to take a panel 10 in. by 6¼ in. (that illustrated is a standard line of Peto Scott, Ltd.).

One ebonite panel, 10 in. by 6¼ in. by $\frac{3}{16}$ in. or ¼in. (It does not much matter which thickness. This panel should be of guaranteed ebonite of one of the well-known brands.)

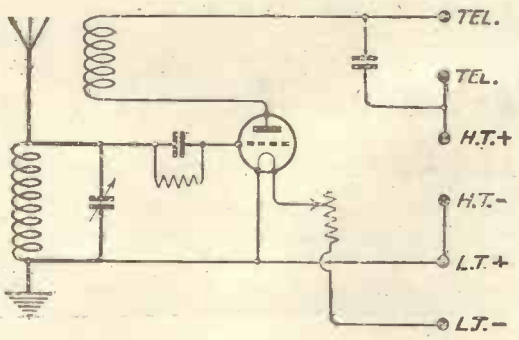
Eight terminals with nuts.

One filament resistance for bright or dull emitters. (That shown is a Lissenstat. There is scarcely room on the panel for the larger disc type of filament resistance.)

One grid condenser ·0003 μF and one grid leak 2 megohms (Dubilier).

One fixed condenser ·002 mfd. (Dubilier).

One two-coil holder of good make. (There are so many reliable types of two-coil holder for mounting in this fashion that there is no need to specify any individual make.)



The theoretical diagram is quite simple.

One variable square law condenser ·0005 mfd. (This is preferably of the single hole mounting type if the set is being made by a beginner. That shown was purchased from K. Raymond. Any good square law variable condenser will do here.)

The valve holder

One special valve holder for mounting behind the panel. (That shown is known as the Aermonic, made by V. R. Pleasance, of Sheffield. To the best of my knowledge it is the only make of this type at present sold in this country. In America there are a number of suitable sockets, made, however, to fit their own valves and not ours.)

Accessories.

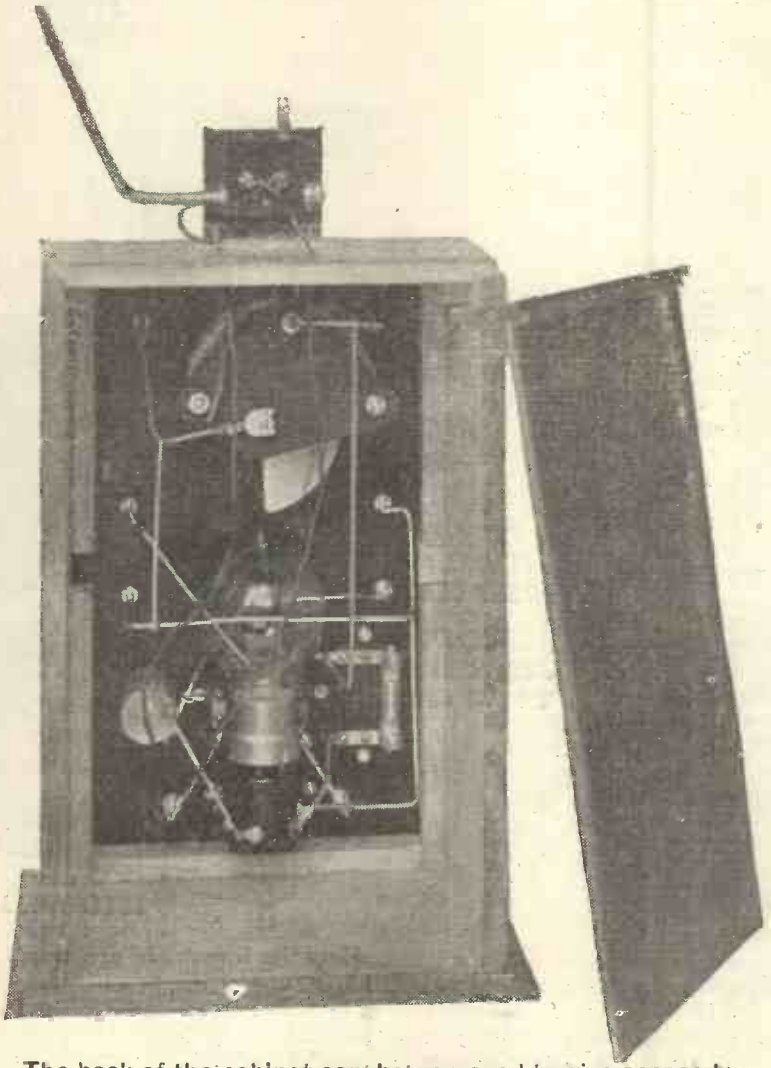
If you have no other apparatus you will need the following accessories :—

One valve. This may be a bright or dull emitter. There is an excellent article in this issue by Mr. R. W. Hallows, M.A., entitled "When the Beginner Buys A Valve." You will find many useful hints and explanations there. An accumulator, or dry cells, will be required to run the filament of the valve, and one high-tension battery which should be of 60 volts, tapped, so as to use different voltages for adjustment. One or more pairs of telephones will be needed. These should be of the high resistance variety, of which there are many excellent makes at reasonable prices. It is no good buying a loud-speaker for this set as it is not sufficiently powerful to operate one even on a near-by station. If you want to run a loud-speaker from it you must add a valve amplifier of the kind which will be described next month.

Having assembled your parts you should lay them out on the panel to see that they will go into the space indicated. If you use parts of a size similar to those illustrated you will have no difficulty. The first step is to mark out the panel according to the dimensions given (working, of course, on the back so as to avoid spoiling the front surface) and to drill the various holes to take the different components. When you have mounted all of these, take a fine file and file the tops of all screws that have to be soldered. Tin the points carefully, as described in THE WIRELESS CONSTRUCTOR for last month, and wire up carefully from the drawings. The wires which should have particular attention are those which pass between the valve and the panel. These wires must be very carefully placed and should go as close to the panel as possible so as to avoid fouling the valve. At the same time they must be so bent as not to touch one another, or they will tend to short circuit. If you find difficulty in using the square section wire you may wire up the set with thinner wire, covering it with insulated tubing which can be obtained quite cheaply from any wireless dealers

Wiring hints

There is one other point in wiring which I must mention. Notice, particularly, that the wire which goes from the right hand telephone terminal (this is looking from the back) is connected to one of the soldering lugs of the .002 mfd. condenser *and also* to the positive high-tension terminals. Notice, too, that long flexible leads are soldered to the plate socket connection of the valve holder, and to the left-hand telephone terminal (looking from the back). These flexible leads are subsequently passed to the top of the cabinet, through holes drilled in the top, and are connected to the two contacts of the movable plug from the two-coil holder. Two other flexible



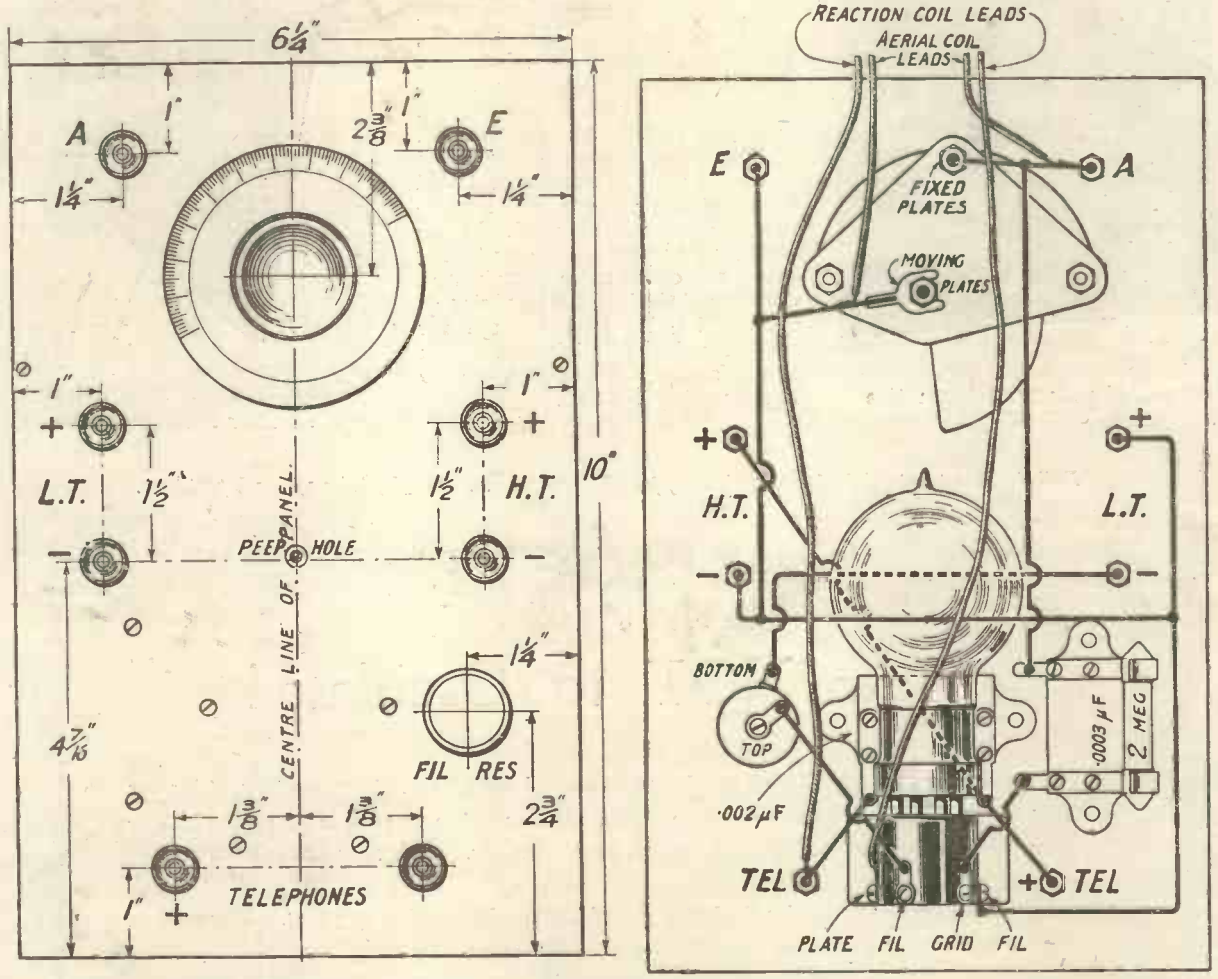
The back of the cabinet can be removed to give access to the valve and wiring.

leads are soldered to the points shown and also pass through the top of the cabinet to the fixed coil of the two-coil holder. These are not connected until the panel has been placed in the cabinet. The fact that in the present cabinet the whole back is removable by sliding upwards, is an advantage when making the final adjustment.

The Aermonic valve socket has four screws passing through holes in the base. These make electrical contact with the filament pins and grid and plate connections. You will find it useful to screw behind these four short soldering lugs.

top of the cabinet as shown. When you have connected up these wires, place the valve in its socket, turn the cabinet round (turn the knob of the Lissenstat anti-clockwise until it comes out almost as far as it will go), and connect the battery wires to the low-tension terminals as indicated. Now turn the Lissenstat gradually in a clockwise direction until the valve begins to light up; this will indicate that all is well with the filament wiring. Turn the valve off again, connect leads from the positive and negative plugs of the high-tension battery to the terminals indicated, and con-

listen in by the telphones. Alter the position of the tuning dial of the variable condenser until you hear signals from your local station, when if all is well you will come in quite clearly. Now with very great care move the moving coil in the coil-holder slowly towards the fixed coil, and unless your station is very near, there should be an increase in strength. In a short time you will hear a " plop " and a breathing in your earpieces, which will indicate that your set is oscillating. Immediately open out the moving coil until it is well away from the fixed coil holder, and try



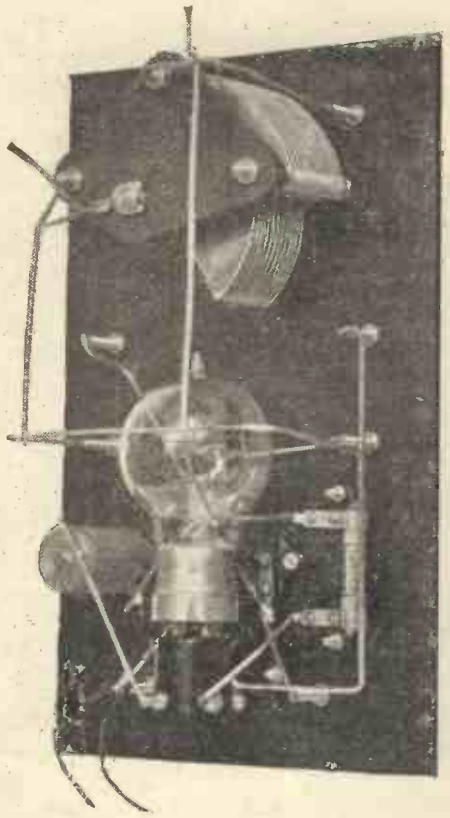
These two pictures show the front and back details quite clearly The + telephone terminal should be connected to the telephone tag marked with this sign. All telephones, however, are not so marked. If one tag is marked red, this is the + lead. If the 'phones are not marked in any way, try which lead gives better results here.

This will greatly facilitate wiring up with stiff wire. If, however, you are using tinned flexible wire and insulating tubing you can pass the wire behind the screws without fitting any lugs.

As soon as you have wired up the back of the panel push it into the cabinet and thread the four flexible leads through holes made in the top of the cabinet just by the two-coil holder, which is screwed to the

nect your telephones. A pair of coils will now need to be plugged into the two-coil holder. The front coil should be a number 25 or 35 for the British Broadcasting band, and the back coil can be a number 35 or 50. For Chelmsford a number 150 should be put in the fixed socket and a number 200 in the moving. Open up the coil holder so that the coils are at right angles, connect the aerial and earth and

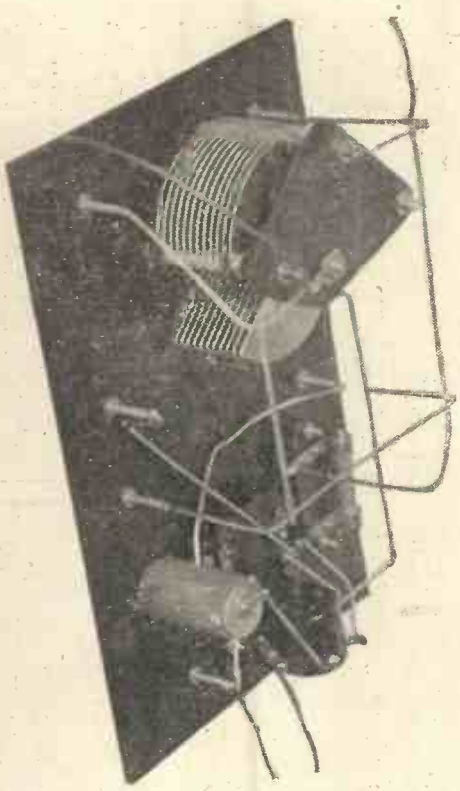
again, very slowly this time, stopping your adjustment a little before the point where the set will break into oscillation. If you have any doubts whether the set is oscillating or not, wet your forefinger and tap it on the aerial terminal. If there is a " plonking " noise when you touch, and also when you withdraw your finger, the set is oscillating, and the reaction coupling should be opened up until it stops. If there



The panel removed from the cabinet.

is no "plop" and if bringing the coil right up against the fixed coil still does not make the set oscillate or does not increase the strength of signals, then reverse the connections to the moving coil and repeat the experiment. One way round is correct, you will find which way by trial. Do not use reaction if the signals are good without it. It is best to take no risks of disturbing your neighbours.

On test this set gave excellent signals from the nearest broadcasting station, and good signals from several others. On a night when conditions were very good all B.B.C. stations, as well as two or three on the Continent, were heard quite clearly in the 'phones. In most circumstances, however, the set is not sufficiently sensitive, save with a very good aerial, to receive all the stations, but two or three other than the local station should be heard quite clearly where a reasonable outdoor aerial is used. On a small indoor aerial made by taking a wire out of the room upstairs and once round the loft, the local signals were still quite loud enough for several pairs of 'phones, when tested seven miles from the 2LO Broadcasting Station.



Panel without valve, showing further wiring details.

Full size Blueprints of the front and back of panel (C 1003A and C1003B) price 1/6 each post free).

How NOT to Oscillate!

If when you turn your tuning dial, you hear howls which vary their note as you turn, it is your set that is oscillating. Look at once to see if your reaction coil is too close to the tuning coil, or if your "intensifier" or "reaction" knob is turned too far. This may be the cause.

Don't try to force your set to give the last ounce of strength by reaction coupling. You will get distortion and run a grave risk of becoming a local nuisance.

Don't play with the reaction coupling "to see what happens." If you use reaction at all, use it with the greatest discrimination.

Don't fail to touch the aerial terminal occasionally with a moist finger. If you hear a "plonk" when you touch it and also when you withdraw your finger, the set is oscillating. Loosen reaction immediately.

LISSENIUM

IS YOUR LEAK RESISTANCE RIGHT?—

You can put a resistance in circuit whose value will be so inaccurate and fluctuating that the leak is useless. Though some circuits and valves are not so susceptible to variable grid control as others, it is reassuring to know that one has the means to control grid potential so that the correct value is obtained for any circuit or valve, or the particular conditions under which a valve may be working. With the LISSEN VARIABLE GRID LEAK fitted, the receiver will yield the utmost sensitivity which correct grid potential under all conditions implies.

LISSEN ONE-HOLE FIXING, OF COURSE 2/6

LISSEN VARIABLE ANODE RESISTANCE, 20,000 to 250,000 ohms, same outward appearance as LISSEN Variable Grid Leak 2/6

TO SMOOTH OUT LOUD SPEAKER DISTORTION PUT A LISSEN VARIABLE GRID LEAK ACROSS THE SECONDARY OF THE LAST TRANSFORMER, OR ACROSS THE LOUD SPEAKER ITSELF. FIRST POSITION IS BEST. THE DIFFERENCE WILL BE VERY NOTICEABLE.

PARTS THAT PULL TOGETHER

Use LISSENAGON COILS for sharp tuning—for strong tuning.

Use LISSEN TRANSFORMERS and LISSEN CHOKE for fine tone and pleasing volume.

Use LISSEN H.F. Parts for extending range.

Use LISSEN TUNER for conveniently covering a wide wave-length.

DON'T MIX YOUR PARTS

A Receiver built with all Lissen parts will give results which would never be possible if you used mixed parts.

LISSEN LIMITED

24-30, Woodger Rd., Goldhawk Rd., Shepherd's Bush, London, W.12.

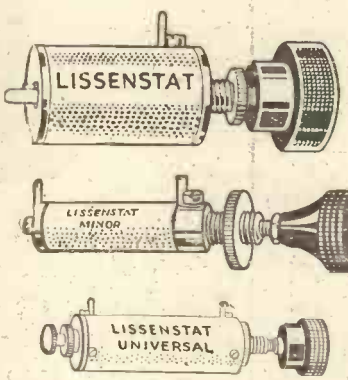
Telephones: 3380, 3381, 3382, 1072 Riverside.

Telegrams: "Lissenium, London."

PARTS WITH HIDDEN POWER—BUILD WITH THEM.

COAXING THE VALVE—AT NIGHT TIME

SIGNALS THAT PASS IN THE NIGHT!—You get them stronger and from farther away if you are using LISSENSTAT control. After you have tuned in as far as you can go with every other control on your receiver you can still do a great deal more—IF YOU ARE USING LISSENSTAT control. When at last you realise that you are on to an unknown station there is a thrill in the thought that it has been brought in to you by nursing the valve with the turn of a knob that stands out so simply above your panel.



The secret is in the structure of the LISSENSTAT and its composition—so critically is it possible to control electron emission of the valve that you can get right on to the very spot necessary for the finest detection of long distance telephony.

LISSENSTAT (patent pending)—gives the most acute tuning possible 7/6

LISSENSTAT MINOR (patent pending)—is replacing many thousands of discarded and inefficient rheostats. Provides LISSENSTAT control at a popular price 3/6

LISSENSTAT UNIVERSAL (patent pending)—with its protective device for dull emitters .. 10/6

All types have LISSEN ONE-HOLE FIXING, OF COURSE.

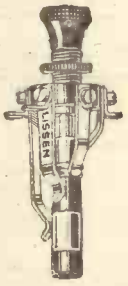
You can feel for fine detection—if you use LISSENSTAT Control

USE A RADIO SWITCH

Many switches sold are undesirable for radio work—they have been designed from the purely electrical point of view, which is not good enough for radio.

LISSEN SWITCHES, on the contrary, have been designed primarily for radio, but they are useful also for other switching purposes. You just gently pull or push them, and you hear them make with a reassuring "click"—and you know they are free from capacity effect.

WHAT LISSEN 5-POINT SWITCH DOES



A. Switches off one stage of L.F. without touching the filament control—a separate switch for each stage.

B. Connects the telephones to the plate of whichever valve it is desired to use, and at the same time switches off the L.T. current from the unused valve.

C. Cuts out a stage of H.F. in the same way as it does L.F. (we do not recommend any switching in H.F. circuits where it can be avoided, but where it is decided to use a switch, this is the switch to use).

D. Will also disconnect both the H.T. and L.T. batteries, and short the aerial to earth so that the receiver can be left adjusted ready for switching instantly into commission next time. With diagram. 4/-

LISSEN REVERSING SWITCH

Particularly useful when the LISSEN 5-point switch is used for cutting out one stage of H.F. When a H.F. stage is cut out, and reaction is being taken off the aerial circuit, it is necessary to reverse the reaction coil connections for each H.F. stage cut out, and this new LISSEN switch conveniently does it. Can also be used anywhere when it is necessary to reverse the connections of a battery, a coil, or a condenser, for instance. VERY USEFUL FOR COMPARATIVE TESTS. With diagram .. 4/-

TWO OTHER LITTLE SWITCHES.

LISSEN 2-way switch .. .. 2/9 LISSEN Series-parallel switch .. 3/9

Native Galena (much magnified).

Something about Galena:

How Modern "Ites" are Made.

By CHARLES H. BUTCHER

What it is—Where to find Sensitive Spots—Selecting a Crystal by Appearance—How to fix it—How to Keep it in Good Condition—Contacts for the Best Results—Treated Galena.

The author of this article is an expert mineralogist and has done much research work on crystals for wireless.

GALENA is a natural sulphide of lead crystallising in both cubic and octahedral crystals. In the massive form it occurs widely distributed throughout the world, as primary metallic veins in limestone or as irregular deposits. Almost all natural galena is radio-sensitive to a certain degree.

Hard Crystals

Hard specimens of the mineral are generally more sensitive than softer ones, and those with a slightly striated surface will be found remarkably so. The most sensitive spots are to be found at the very angles of cubic crystals or cleavages, or on minute octahedral cleavage planes. At these points there is a strong unbalanced electrostatic field, very probably due to the presence of atoms of only one kind, either sulphur or lead. In the case of cubic crystals where one particular face is highly sensitive, it will often be found that the adjacent faces are quite insensitive. If therefore a crystal gives poor rectification on one face, a spot on an axis at right angles should be tried in preference to one on the face directly opposite.

Crystals of galena with a brilliant silvery lustre and fine granular appearance are generally considered to be the most highly sensitive, but this is by no means invariably the case. There are many types of natural galena with a smooth dull grey surface, showing distinct cleavage, which are quite equal and in many cases better than the most sensitive of fine grained crystals now obtainable. In a good crystal sensitivity should be constant and permanent, and should not fall off after a few weeks' continual use. The best results are obtained by connecting the crystal itself to the earth side of the circuit, and the "cat's whisker" or wire contact to the aerial side. This may be explained more clearly by reference to the diagram on the next page.

Fixing

The use of solder is generally considered the most efficient and most desirable method of mounting the crystal in its cup. In this operation, however, considerable care must be exercised to see that the temperature of the molten solder is not too high. However low its fusion point, solder is *liable* to seriously impair or perhaps entirely destroy the sensitivity of a crystal, though the risk at temperatures up to 65° C is small. Wood's metal, an alloy of tin (1 part), lead (1 part), bismuth (4 parts) and cadmium (1 part), melting at 60·5° C is generally used. Malleable solders have sometimes been employed, the metal being lightly punched into contact with the crystal and its cup. This method of fixing is very undesirable, as the shock occasioned in the process of punching tends to shatter the structure of the galena.

A magnified piece of hertzite. Notice the pin's head which indicates the degree of magnification.

Spring Clips

Spring clips are sometimes used for holding crystals. They will be found more satisfactory than cups with set-screws, with which it is not always possible to hold the crystal in any and every position. Where spring clips are used, the pressure exerted on the galena must not be too great owing to the possible presence of weak lines of cleavage. The principal advantage of a spring clip lies in the fact that crystals are readily changed with a minimum of trouble. Highly sensitive natural galenas are liable to become over-exerted by continual use, and if such a specimen is put aside for a week or so it will regain its original rectifying power.

Don't Touch!

On no account should sensitive galena be touched with the fingers, as a minutely thin film of grease is readily imparted to the surface of the crystal. A small pair of forceps should be used to handle crystals where necessary. Should the surface of a crystal become dull by accidentally being touched, or by the accumulation of dust particles, it should be washed in a little ether or alcohol and allowed to dry spontaneously on a piece of clean blotting paper. The surface of galena should never be scraped or scratched in order to expose a fresh sensitive face. If necessary, break off a portion of the crystal by cleavage with

Yesterday

—the explorer braved hardships to chart the seas.

While the explorer of long ago had to set sail and face almost incredible hardships in his praiseworthy efforts to chart the globe, his successor sits by the fireside and logs Foreign Broadcasting Stations with almost absurd ease. From America to the borders of Russia and from Scandinavia to the shores of the Mediterranean the ether is available for his exploration.

But the man who is enthusiastic over long distance reception will see that he is not handicapped either by his Set or his Valves. His Set should employ at least one stage (and two for preference) of high-frequency amplification, and for his Valves he should use those which have been specially developed for the work.

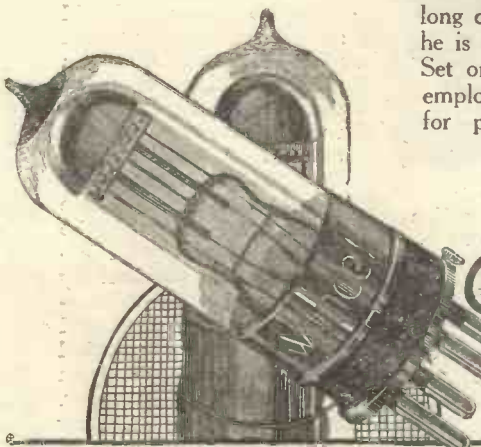
Undoubtedly the most popular high-frequency amplifier to-day is the Cossor P2—the valve with the red top. Hundreds of thousands of these valves are in use at this moment among all grades of wireless enthusiasts—from the expert to the novice—and everywhere it is giving the most complete satisfaction.

Its striking success is undoubtedly due to its design. As every wireless enthusiast knows, the working of a valve depends upon the correct use being made of its electron emission.

WUNCELL DULL EMITTERS

W.1. (For Detector and L.F. use). Operating at 1.8 volts .. 21/-
W.2. (With red top) for H.F. use. Operating at 1.8 volts .. 21/-
Types W.R.1 and W.R.2 as above but with resistance incorporated in base to operate off 2, 4 or 6-volt accumulator .. 23/-

The Wuncell is fully described in a comprehensive Folder which will be sent post free to any experimenter on receipt of a postcard. Don't invest in a Dull Emitter Valve until you have read about the Wuncell.



Cossor

Get Cossor Valves—they cost no more

Advertisement of H. C. Cossor, Ltd., Highbury Grove, London N. 5

To-day

—he charts the ether from the comfort of his fireside.

You must have noticed that when your accumulator begins to fail and the filaments of your valves grow dim that your Set falls off in sensitiveness and volume. A clear case that the emission from the filaments has decreased.

Obviously, therefore, the quantity of the electron emission is an important factor in valve efficiency.

Now compare the Cossor P2 with an ordinary Valve. Instead of a hood-shaped Anode and Grid totally enclosing an arched filament and almost completely entrapping its electron stream, we see that at each end of the tubular Anode the filament is exposed and that a large proportion of the electron stream is obviously leaking away. Remember that for high-frequency use you cannot afford to risk inefficiency—feeble oscillations from Stations thousands of miles away will strike your aerial and you'll be none the wiser if your Valves are not sensitive to them.

The remedy is in your hands—for high-frequency use select the Valve specially developed for the purpose and chosen by the vast majority of Valve users in this country—the wonderful Cossor P2.

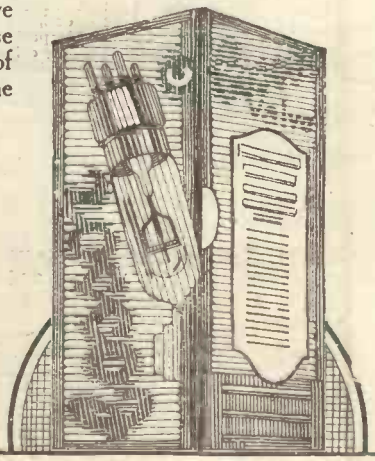
COSSOR BRIGHT EMITTERS.

P.1. For Detector and Low-Frequency use **12/6**

P.2. (With red top). For H.F. use only .. **12/6**

TO THE TRADE:

Have you received copies of the new Cossor Electrical Testing Showcard? If not, send in your application at once.



Valves

but what a difference in results!

Gillett Ad. 1693

Representatives of Messrs. Heinz, the pickle manufacturers, listening at Bristol to speeches received by wireless.

pressure from the blade of a pocket knife, as this will usually ensure the exposure of sensitive planes.

Stiff "Cat's-whiskers"

The use of the commonly stiff single-pointed contact as "cat's-whisker" is very detrimental to the surface of galena crystals. Most metals have at one time or another been employed as contacts. There is nothing to be said in favour of gold except its non-oxidisable character, as it is only reasonably efficient. Platinum, silver, and pure tin give far better results. Pure aluminium wire, 30 S.W.G., will be found very effective if a slight pressure is applied at the point of contact. Brass wire varies considerably in its composition and hardness, and gives varying results with the same piece of galena. Clean copper wire, 40 S.W.G., gives excellent results when carefully adjusted.

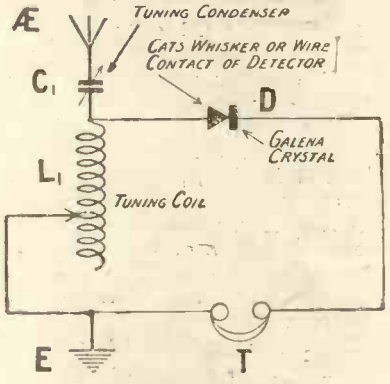
The best contact for use with galena is unquestionably a short length of ordinary copper flex stripped of its protective covering and scraped clean with a knife. This will form a kind of brush with a large number of fine copper points grouped closely together. The brush should be allowed to touch the crystal very lightly, sufficient pressure being found by allowing the free ends of the wire to fall on the surface of the galena by reason of their own weight.

Treated Galena

Crystals of galena which show but slight signs of radio-sensitivity are generally rendered entirely insensitive by artificial treatment. But many quite insensitive specimens may be treated to give crystals of high rectifying power. Artificial sensitive surfaces may be obtained by heating in a sulphur flame, or in sulphur dioxide at a temperature of 350° C, preferably in the presence of nitrogen. In a current of air at high temperature sensitivity is readily destroyed. From this it would appear that the sensitiveness of natural galena is due to the presence of sulphur atoms on the surface of the lead sulphide.

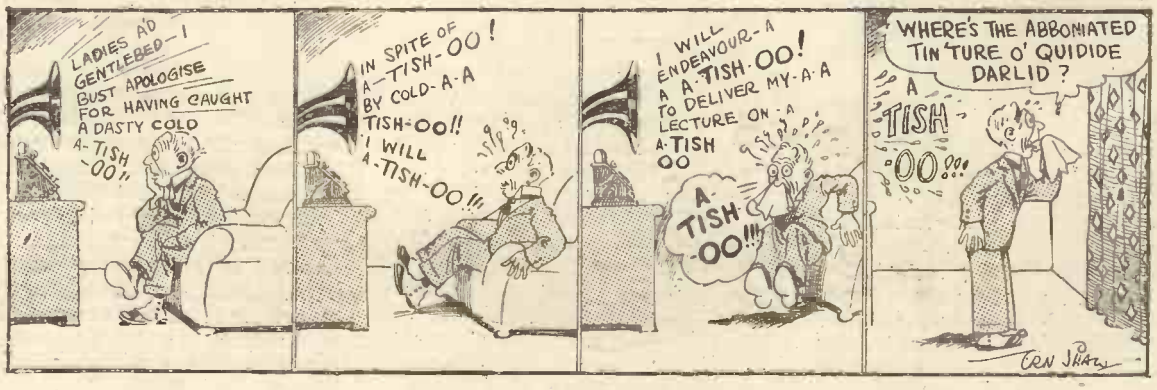
Surface Sensitivity

Good crystals should be sensitive throughout, yielding equal results wherever fractured. By heating insensitive galena with sulphur in a covered crucible for about thirty minutes it is possible to obtain crystals with a good rectifying power. Finely powdered rock or roll sulphur, and not flowers of sulphur, should be used, as the impurities in the former seem desirable for



Best connections

the process. Fusion and recrystallisation at a temperature of 1120° C to 1150° C will also sensitise natural insensitive galena. The material should be roughly crushed and placed in a fireclay crucible and just sprinkled over with powdered sulphur to prevent undue oxidation. The cover of the crucible should be luted on with clay, and the whole is then heated up in a small gas furnace or in a fire, maintained at the temperature of fusion for about thirty minutes, and cooled as slowly as possible.



Horrible effects of auto-suggestion.

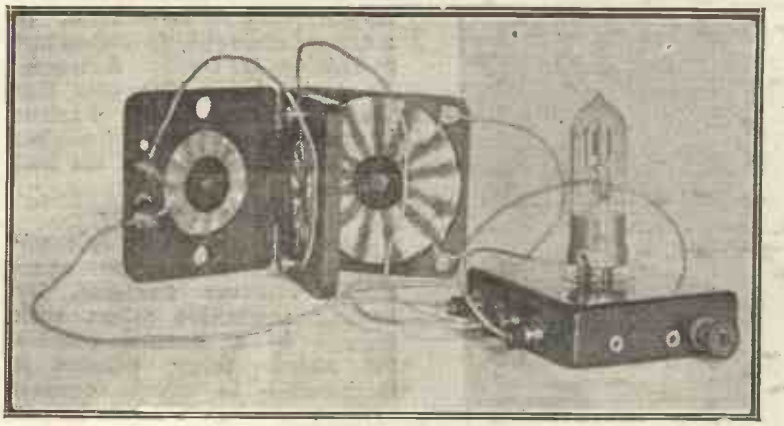


Fig. 1.—The complete set.

A Single Valve Portable Set

by

Norman K. Jackson

An essentially portable broadcast receiver.

A PORTABLE set which can be easily carried on any occasion, and disposed of in any odd corner of one's bag, is a useful addition to the wireless kit.

This design was worked out with that end in view, and the set can, as a matter of fact, be carried in the jacket pocket, without, of course, the H.T. and L.T. batteries and valve, which can easily be stowed away in one's bag when a dull emitter is used.

The various components are designed in such a manner that the principal parts of the set are, in a practical manner, pocketable, and, with that end in view, a variometer was chosen as the tuning component, so avoiding the bulk of a coil and condenser.

For the same reason, and to enable either bright or dull emitter valves to be used at option, a Lissenstat Minor filament control was used in the valve circuit, and also " Clix " terminals and flexible connections.

The Complete Set

The photograph Fig. 1 shows the complete set ready for use, and it will be seen that the variometer used for tuning consists of two basket coils connected in series by a flexible lead, the other leaf of the component being the reaction coil.

Fig. 2 shows the circuit used, being a straight circuit with reaction on to the aerial.

In the photographs Figs. 4 and 5 and drawing Fig. 7 the variometer unit is shown in detail.

It is made up of three wooden leaves hinged together like a book.

This is made in mahogany $\frac{3}{8}$ in. in thickness, and has each coil sunk into the thickness of the wood, the aerial and reaction coils being let in flush with the surface of the piece; the centre coil is secured in place in a hole of the required diameter, which is bored right through the wood, and the coil held in position by painting the edge of the hole with thick shellac, and when this is " tacky " pressing in the coil.

When dry it will be found to be very firmly held in position.

The aerial and reaction coils are held in place by shellacked card-

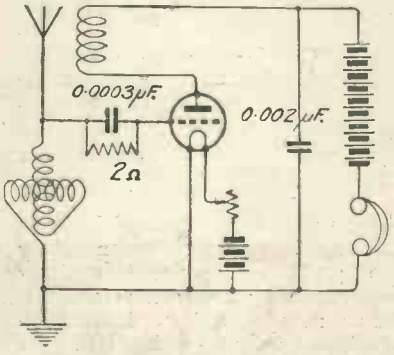


Fig. 2.—Theoretical circuit diagram of the set.

board washers, secured to the wood with a small round-headed brass screw.

The ends of the two aerial coils which form the variometer, and which have to be connected with a flexible wire, are marked with a white or coloured dot made with the point of a drill and filled with paint,

Fig. 3.—The valve unit ready for use.

and the ends of the various coils secured under their various terminals.

The terminals are mounted in $\frac{1}{4}$ in. ebonite bushes let in flush with the surface, a tight fit in the wood leaf, and tapped to receive the terminal shank, a corresponding hole being bored in the adjoining leaf to allow the unit to close flat.

The three leaves are hinged together with small brass hinges.

The edges and corners of the three leaves are rounded, and the whole unit carefully glass-papered and finally french polished.

With the flexible connection to the variometer removed, the whole unit can be closed up like a pocket-book as shown in the photograph.

The Coils

The coils used are designed for reception of 2LO and consist of basket coils wound on a 1 in. former having thirteen spokes.

They are wound with No. 22 D.C.C. wire, and are not shellacked except for a touch at each spoke for ease when removing the former.

The coils have the following number of turns: aerial coil (first leaf) 20 turns, single basket type, (*i.e.*, over one spoke and under next), the inner end being connected under the " aerial " terminal, and the outer or finishing end under the other terminal: this terminal is to be marked with a white dot.

This terminal is to be connected by a flexible lead to the terminal connected to the inner end of the centre coil (also marked with a white dot), which is of 20 turns single basket wound, the finishing end of which is connected under the other or " earth " terminal: the ends of the coil windings should be sunk

This portable receiver is essentially practical and will appeal to the constructor who desires extreme portability in his receiver, or who is interested in unique designs.

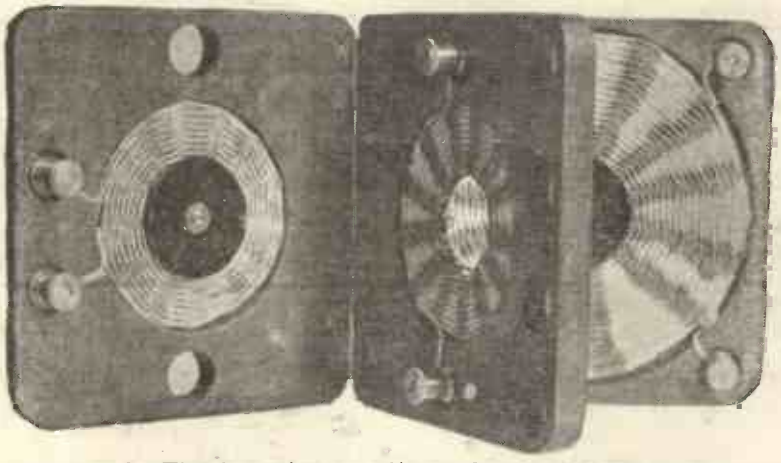


Fig. 4.—The ingenious method of mounting the coils is clearly shown.

in a shallow groove cut in the wood leaf.

The reaction coil (the largest of the three coils) is wound with the same gauge of wire on the same size of former, and has 19 turns wound double basket fashion, *i.e.*, over and under two spokes of the former, to reduce the diameter of the coil.

As each turn counts as four in a coil wound double basket fashion, this coil is equal to a .75 turn single layer coil.

The valve unit is built up in the form of a small box, as shown in Fig. 9 and the photograph Fig. 3; it is made in ¼ in. mahogany french-polished, and with rounded edges and corners, and the bottom is

Fig. 5.—The variometer unit closed, with connections detached.

made with a sliding lid, like a child's pencil box, to enable the wiring to be examined.

The valve holder is let in flush with the surface, and consists of a disc of ¼ in. ebonite with four valve sockets pressed into the holes a really tight fit; these should have their screwed shanks cut off to reduce the depth, and the wiring soldered to the actual socket. It is secured in the wood forming the box by making the hole for its reception a tight fit for the disc and the edges shellacked and driven in.

The Lissenstat Minor is provided with a one-hole fixing, making it an easy matter to fix this component.

The "Clix" terminals are just as easily fixed in position, having small ebonite bushes for insulation, one on each side of the hole in the wood sides of the box, and which may be obtained in various colours for their appropriate terminals, red for positive, black for negative, etc., and the "Clix" socket secured in them with the milled nut provided on the shank.

Tabs marking the various connections should be fixed to the sides of the box with shellac, under their proper bushes.

The .0003 condenser (a "Dubilier") and two megohm grid leak, and also the .002 condenser, should next be fixed to the bottom of the box in the positions shown.

Before fixing the "Clix" terminals, etc., the ends should be well cleaned and tinned in readiness for wiring up.

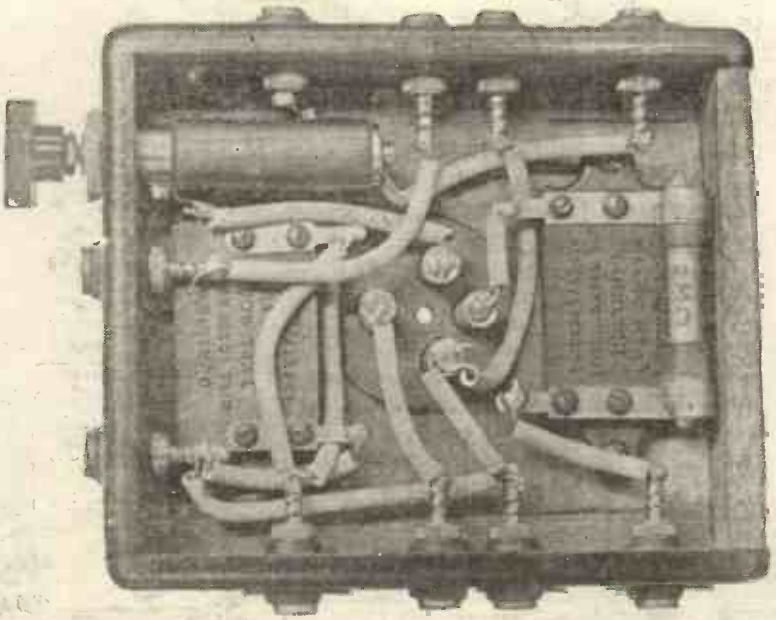


Fig. 6.—The underside of the detector unit, showing the systoflex wiring.

Wiring

The wiring is done with soft copper wire cased in systoflex, and in so small a unit requires care, but an examination of the drawings and photograph Fig. 6 of the inside of this unit should make the wiring up quite easy to follow.

The connections between variometer and valve units are made with flexible connections, ordinary

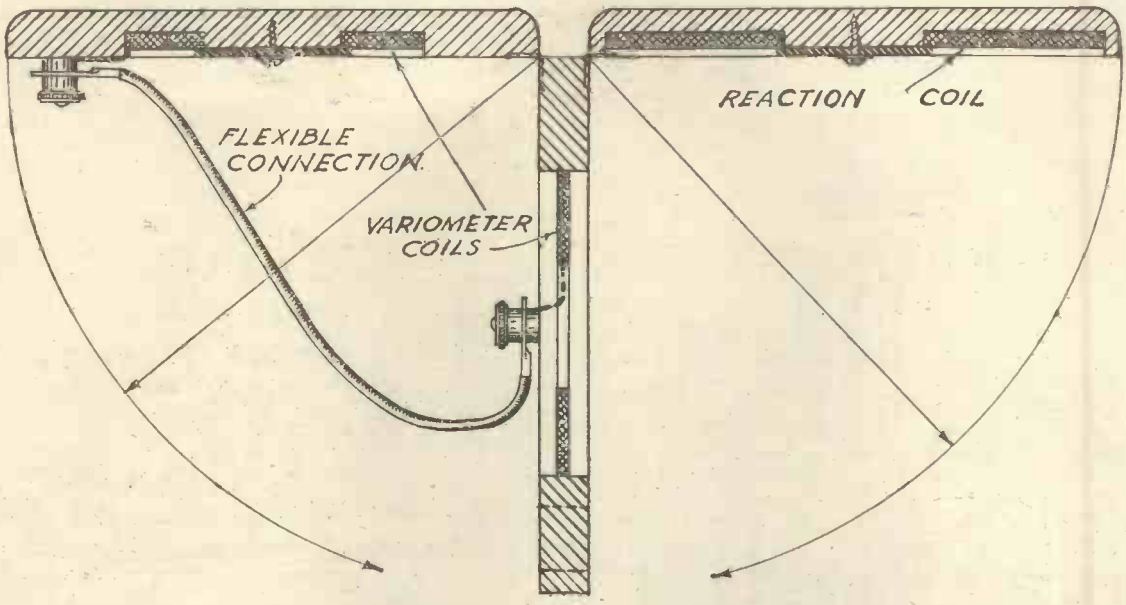


Fig. 7.—The method of mounting the coils in the variometer unit is clearly shown.

single lighting flex being used, with the silk or cotton covering removed.

The ends connected to the valve unit are fitted with " Clix " sockets, and the other ends have spade terminals to go nnder the screw-down terminals of the variometer and the L.T. battery.

The H.T. connections are, of course, fitted at the battery end with the proper wander plugs.

Operating the Set

The set having been connected up and a valve inserted in its holder, adjust the Lissenstat to the brightness appropriate to the type of valve used.

Keep the leaves of the variometer well apart at first, particularly the reaction coil leaf,to avoid interference with near-by listeners, then adjust the variometer by bringing the two leaves closer to each other until the best position is found : then carefully bring the reaction coil leaf closer to centre leaf (without moving the other or aerial leaf of variometer) until the best strength is obtained without oscillation, and finally slightly adjust the variometer as may be necessary.

Should no increase in the strength of signals occur when the reaction

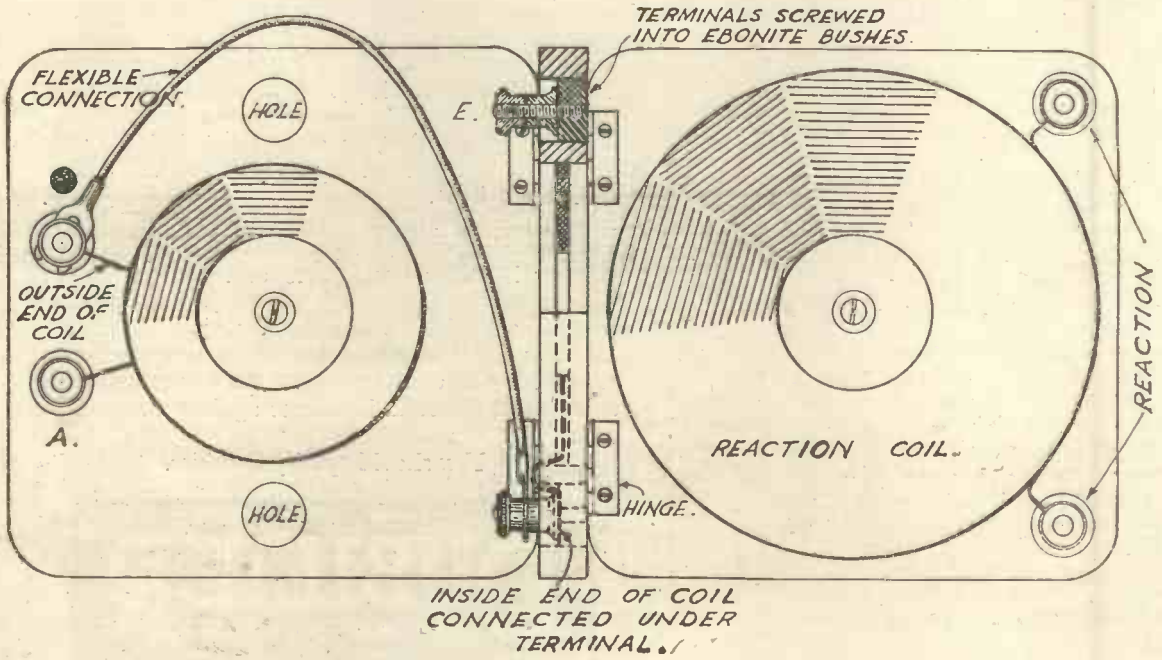


Fig. 8.—Showing the method of mounting the reaction and stationary aerial coils.

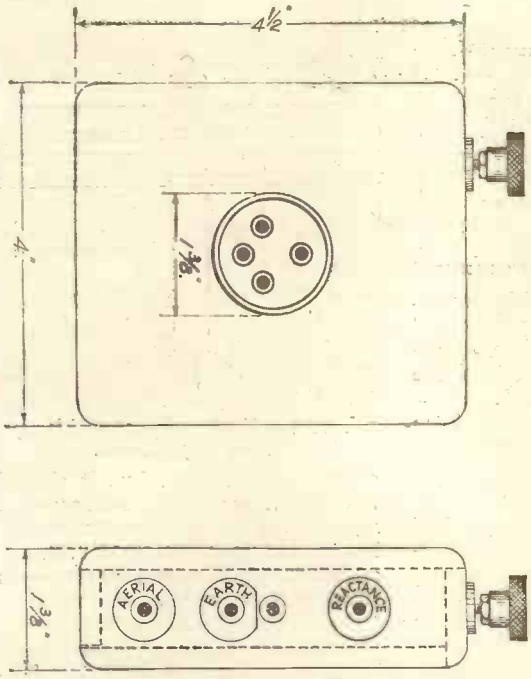


Fig. 9.—Front and side elevations of the detector unit.

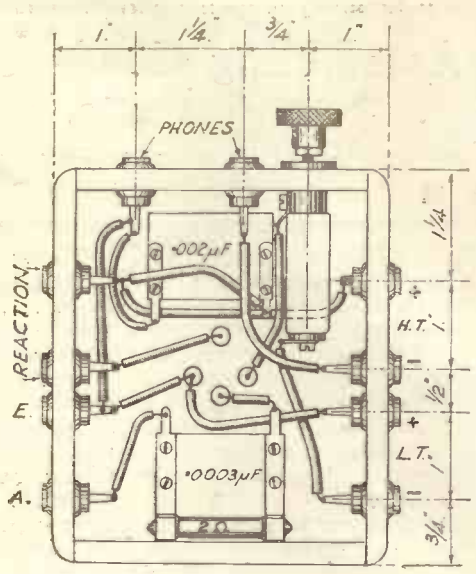


Fig. 10.—The underside of the valve unit, showing wiring.

coil is brought closer to the variometer coils (showing that the reaction coil is connected the wrong way), reverse the ends of leads, when the desired effect should be obtained.

At twelve miles from 2LO excellent reception is obtained with this set; and its compactness, to say nothing of its portability, should recommend it to those who like tidiness at home.

[EDITOR'S NOTE.—Although designed for 2 LO, this set should suit all waves between that of Cardiff and Newcastle. For longer wave stations we suggest increasing both variometer coils by 6 or 7 turns.]

The S.T. 100 Set

To the Editor of THE WIRELESS CONSTRUCTOR.

SIR,—A short time ago I made up a set as instructed in the Radio Press Envelope No. 1. Using dull emitter valves (B.T.H. B5) with ninety volts on the plates and a three-volt battery across the grid bias terminals, I get all the B.B.C. main stations at splendid signal strength, London, Bournemouth, Manchester and Newcastle coming in especially well. Both Bournemouth and 5XX come in at good loud speaker strength. This is, of course, after sunset, although 5XX comes in equally well by day and night. By day I get Radio Paris at good strength on two pairs of headphones. By night I also get Lyons, Ecole Superieure and Madrid quite comfortably. The new Belfast station comes in, of course, very well. The other night I picked up Nottingham (testing) direct, which, taking into account the low power of this station, speaks volumes for the set. My aerial is none too good, being rather badly screened by trees.

I have no hesitation in saying that the ST100 is the best two-valve set I have ever heard.

Yours truly,
A. J. S. BRADY.

Macroom,
Co. Cork.

Professor Branley, inventor of the wireless coherer, who has just celebrated his eightieth birthday.

Assembling Condensers from Parts.

An article which will assist the constructor who is keen on making his own components.

ALTHOUGH so many excellent condensers are on the market that the wants of the average constructor are amply supplied, yet for reasons of economy or for enthusiasm over home-made apparatus, the amateur may desire to construct his own variable condenser from the many sets of parts that are now available.

Modern parts are more accurate, and the constructor may commence building a variable condenser in

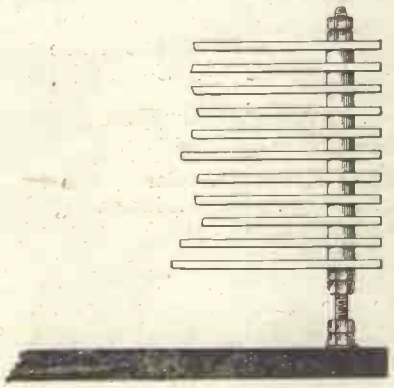


Fig. 1.—Showing how fixed plates are secured.

full confidence that it will, on completion, compare favourably with commercial products.

Fortunately the parts that are now produced may be assembled to form a condenser that has a capacity value at least approximate to the correct theoretical value. This in early sets of parts was not so, and a 0.001 μF condenser assembled from parts often proved on test to have a maximum capacity of only 0.00075 μF.

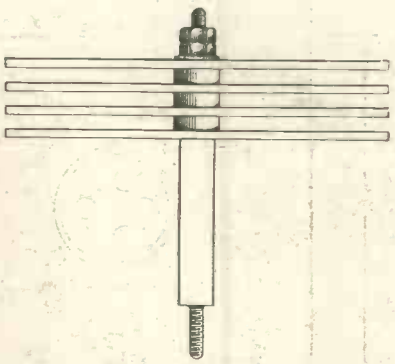
The fixed vanes should be assembled first in the manner indicated in Fig. 1, and the square centre spindle may be inserted into the framework, when mounted.

Connection to the moving plates may be made by a short length of flex—this being the simplest method—but care must be taken that permanent contact is not destroyed by undue rotations of the vanes.

Condenser stops, mounted either on the panel or on the condenser frame, will obviate this difficulty.

Care should be taken when choosing sets that the top and bottom bearing plates are of considerable strength and are accurately drilled, since these plates form the foundation of the condenser. End plates may be either square or triangular; the use of this latter shape of end plate economises space, which is very desirable where panel mounting is considered.

The lengths of the supporting rods and centre spindle will, of course, vary with the number



The method of assembling moving vanes.

of plates necessary, but it should be noted that only the best screwed rod should be used, since cheap, light rod will often have the threads stripped off if much pressure is brought to bear on the end nuts.

In Fig. 1 it will be noted that although the holes in the end bearing plates are drilled, additional security and strength is given by the lock nuts screwed in hard against the end piece.

The table given below shows the necessary sizes and number of parts for condensers of the more usual capacities, constructed with plates of 1¼ in. radius and ⅛ in. spacing washers:—

The moving spindles may, of course, be any length, but it will be found most convenient to make them about 1½ in. longer than the corresponding side supports.

Capacity.	No. of plates.		No. of washers.		Length of side rods.
	Fixed.	Moving.	Fixed.	Moving.	
					Inches.
.0015	43	42	126	41	8
.001	29	28	84	27	6
.0005 ..	15	14	42	13	4
.0003 ..	10	9	27	8	3½
.0002 ..	7	6	18	5	3
.0001 ..	4	3	9	2	2
.00005 ..	2	1	6	0	2

Drilling Valve Socket Holes. An Emergency Tip.

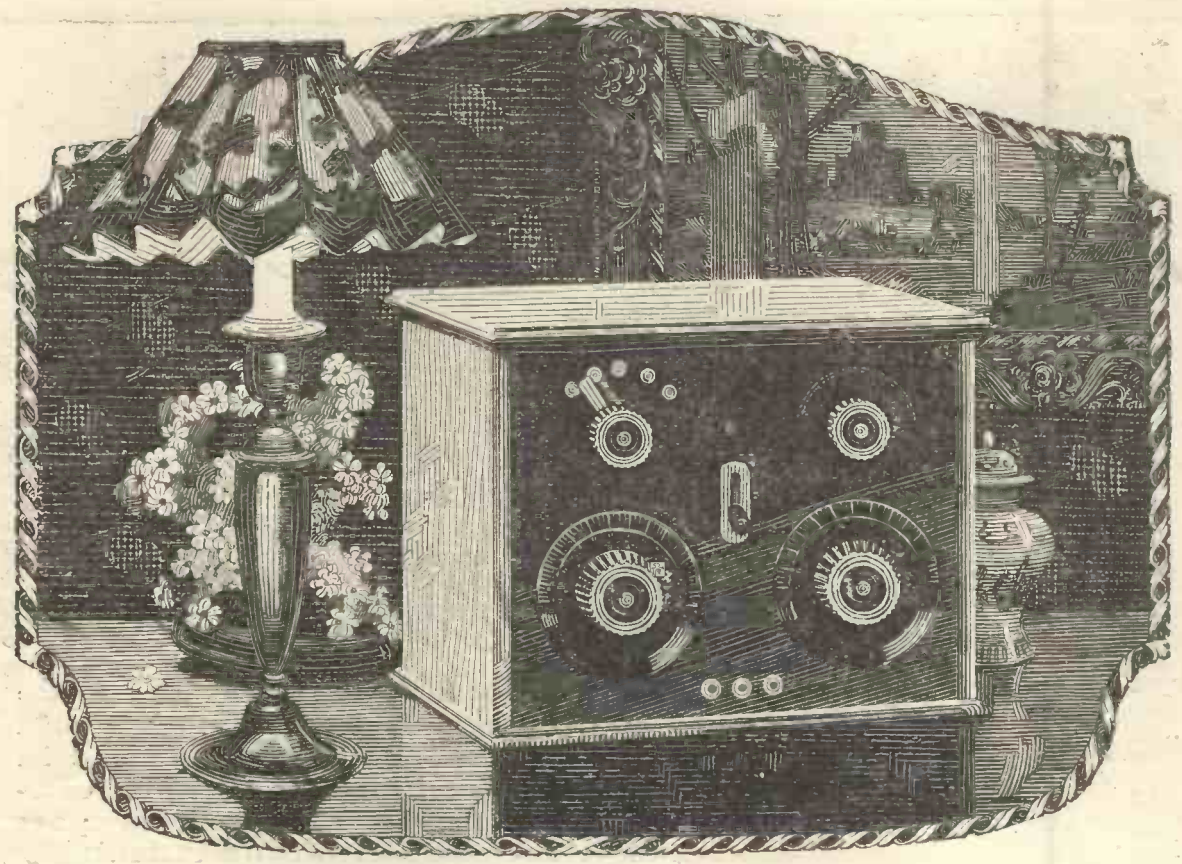
ALTHOUGH many excellent valve holders that are suitable for all general occasions are obtainable and will obviate difficult drilling of panels, the constructor is sometimes faced with the problem of drilling holes in a panel for valve sockets.

The "staggered" unequal spacing of British valve legs, although conducive to safety when the valve is inserted, renders the task of drilling difficult. Unfortunately templates are not supplied with valves, and, although a good template is an invaluable possession, there will come a time when a hurried job is on hand, and no template is available.

The simplest method to adopt on such an occasion is to construct a simple template by pressing a valve firmly on to some soft paper and to drill through these indentations on to the panel.

Trouble may be experienced in fitting, since, unfortunately, valves are not made absolutely to a standard, and considerable displacement of the pins of another valve may be necessary before easy insertion is possible.

There are on the market, however, several excellent templates which greatly facilitate this operation, and the serious constructor is advised to have one always handy.



A cheap Panel—

may be the most expensive part of your Receiving Set.

NOT everything masquerading as ebonite is worth using as a panel—in fact, it is difficult to conceive a greater test for any insulation material than to use it in a Wireless Set. The extremely weak impulses received upon your aerial, when conveyed to your Set, so readily leak away that the greatest care must be taken to preserve them if you are going to receive any signals at all. That is why a cheap panel can be easily proved to be a waste of time and money. Radion is the highest grade of insulation in the world, and has been specially developed for wireless use. Its highly-polished surface, which need not be removed before use, enhances the appearance of the finished instrument and prevents the formation of dust.

Radion is sold in black and mahoganite—a beautiful colour, very similar to old mahogany—with dials and knobs to match. It is packed in stout envelopes in the convenient sizes shown below. For your next set choose Radion—every panel is stamped—then you can be certain that it will look better and work better.

Size	Black	Mahoganite	Size	Black	Mahoganite	Size	Black	Mahoganite.
6″×7″	3/6	4/3	7″×14″	8/–	10/3	8″×26″	17/6	21/3
6″×10½″	5/3	6/6	7″×18″	10/6	12/9	9″×14″	10/8	12/9
6″×14″	7/–	8/6	7″×21″	12/3	15/–	10″×12″	10/–	12/–
6″×21″	10/6	12/9	7″×24″	14/–	17/3	12″×14″	13/3	16/–
7″×9″	5/3	6/6	7″×26″	15/–	18/6	12″×21″	19/9	24/3
7″×10″	5/9	7/3	7″×30″	17/9	21/6	14″×18″	19/9	24/3
7″×12″	7/–	8/6	7″×43″	28/–	34/6	20″×24″	39/6	48/–

Special Note:—All $\frac{3}{16}$″ thick—quite sufficient owing to Radion's tremendous strength.

¶ *Dealers: If you have not yet received particulars of the Radion proposition write to us to-day.*

FROM ALL DEALERS

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Gilbert Ad. 1691

More About "The Wireless Constructor" Neutrodyne Set.

Hints on Adjustment and Tuning.

By PERCY W. HARRIS.

(Continued from page 37 last month.)

FOR testing purposes it is just as well to join the three high-tension positives together as shown, a lead being taken from any one of them to the positive side of the high-tension battery, the negative side of which, of course, is connected to the negative H.T. terminal indicated. Connect a pair of telephones to the correct terminals and short the grid bias terminals, or, if you are using a grid bias battery, connect in cells of the right value. Plug in to the secondary socket a suitable coil for the wavelength range (a number 50 coil is recommended for most of the British broadcasting), and short circuit the reaction terminals, without inserting the reaction coil in the socket for the moment. The shorting of the reaction terminals is easily effected by joining a wire between them. Plug in the "Clix" plugs into the sockets so as to obtain the .0005 μF value in the aerial tuning condenser, and the .00025 in the secondary or closed circuit. Put the switch on the "tune" position.

Neutralising

Set the closed circuit condenser at some intermediate value, say at 30°, plug into the transformer socket of the valve panel a suitable transformer for the wavelength range desired, turn the knob of the neutrodyne condenser in an anti-clockwise direction as far as it will go (this will be upwards). Read the previous remarks through again to make sure you perform these actions in correct order, as this part of the process is important. Now turn the knob of the anode condenser backwards and forwards a few times. You will find that the set will burst into oscillation and will remain in oscillation over a wide range of the condenser readings, perhaps coming out of oscillation again towards one or both ends. When you have found that the set oscillates over this wide range of condenser readings, turn the knob of the neutralising condenser two or three times and observe that the width of the band over which the oscillation tunes will be reduced. Now turn the condenser knob again and once more rotate the anode tuning condenser. For each adjustment of the neutralising condenser you will find the band over which the anode condenser will oscillate becomes narrower and narrower. As this band reduces in width turn your neutralising condenser more carefully until a point is reached when perhaps the anode condenser will only oscillate at one degree in its setting. You can tell when the set is oscillating by touching the grid terminal of the valve panel with your wet finger. If the set is oscillating there will be a loud "plonk" both when you touch the terminal and when you withdraw your finger. If the set is not oscillating there will be only a slight click when you touch it and not at all when you withdraw your finger. Now, having reached the point of adjustment when the set will oscillate on just one degree, give a very slight turn more and you will find the set will not oscillate at all. Leave the neutralising condenser in this position; it will not need to be touched again so long as you are using a particular valve and a particular transformer, although, of course, if you are curious you will adjust it sometimes just to see what happens! If the neutralising condenser has no effect you may need to reverse the leads to primary of the plug-in H.F. transformer. This is occasionally necessary as transformers are not all wound the same way.

The aerial mast on a lifeboat of the s.s. "Aquitania" fitted with wireless.

The set is now "neutralised"; the

Winding basket coils at the Broadwater Road L.C.C. School, Tooting.

All the boys are keen wireless "fans."

next step is to remove the short circuiting wire from the reaction terminals of the valve panel and to plug in a small reaction coil (say a 25). You will now need to insert a coil in the aerial socket and connect the aerial and earth to the set. A 25 or 35 plug-in coil will do in the aerial socket when the condenser is in parallel and a 50 or 75 when the condenser is in series. Some coils are not numbered 50, 75, etc., but have letters such as A, B, C, or S1, S2, etc.

If you are working on the "tuned" side you will need a very small reaction coil, say 25 or its equivalent.

The next step is to see whether the set will oscillate when you move the reaction coil towards the aerial coil. If it does so, well and good; it should do so if you have followed my connections. If it does not, try reversing the leads between the reaction terminals.

The method of operation of the set is rapidly found by trial. Set the anode tuning condenser at about 20 deg. and then vary the aerial and secondary condensers until you pick up the local station. Keep the reaction coil well away from the aerial coil for the moment. When you have obtained the best adjustment for A.T.C. and C.C.C. circuits, readjust the anode tuning condenser for best results. A slight amount of reaction can then be applied. The potentiometer will give final adjustment and once the best position of this latter has been found it can be left set so long as this particular valve is used.

To pick up other stations, follow the same procedure. I advise you to keep to the tune side, and to work with the secondary coil well away from the aerial coil. If the secondary coil is fairly close to the aerial the set is easier to tune but not so selective. If "standby" adjustment is used you will tune only on aerial and anode condensers. The reaction leads will need to be reversed when using this method.

Results.

The results I have obtained on this set have been distinctly better than on any other three-valve set I have designed. At various times I have had all the B.B.C. stations on the loud-speaker, and any evening three or four can be heard in this way. Selectivity is very high. For example, Madrid can be heard on the loud-speaker with no interference whatever from Newcastle. This is a difference of only eight metres. London at seven miles can be cut right out when receiving all but Manchester. German stations are frequently of loud-speaker strength and Ecole Superieure is always receivable at L.S. strength. American broadcasting is also heard quite regularly.

Hector and the Witching Waves.

ANYTHING from ANYWHERE

The DUODYNE III

A Genuine Long-Distance Receiver of Exclusive Merit

Two Stages of High-Frequency Amplification

Automatic Tuning

IN the Duodyne III the fullest advantage has been taken of the extraordinary virtues of the Curtis Constant-Tuned High-Frequency Amplifier. The first valve functions through the Curtis High-Frequency Amplifier, the second as an orthodox tuned anode, and the last as a rectifier. Guaranteed perfect reception at full power and of extraordinary purity from anywhere in the United Kingdom of any broadcasting station from Aberdeen to Madrid.

Used in conjuction with the CURTIS EJECTOR will tune in any Broadcasting Station at will!

In spite of a multiplicity of stations operating on a congested wave band, the Duodyne and Curtis Ejector regains that true fascination of wireless of "listening-in" at—where you will and when you like.

PRICE £10

The DUODYNE V

Combines the Duodyne III with a two-stage power Amplifier and constitutes a Receiver of remarkable power and receptivity.

Liverpool or Manchester on a Loud Speaker with 2LO cut out! The DUODYNE V is obviously an ideal demonstrator.

The exquisite purity of loud-speaker (Amplion) reproduction with a Duodyne V is a positive revelation and has never been equalled by any professional model.

PRICE £18 18 0

The DUODYNE Receivers, with their extraordinary range and power make an irresistible appeal to those countries where Broadcasting Stations are not so plentiful as they are in the United Kingdom. The DUODYNE brings the pleasure of "listening-in" to all, wherever situated throughout the world.

Average range in miles of Duodyne Receiver under average conditions on P.M.G. aerial:

	Headphones.	Loud Speaker.
DUODYNE III ..	3/4,000 ..	—
DUODYNE V ..	4/5,000 ..	1,000/1,200

WAVETRAPS HAVE FAILED.

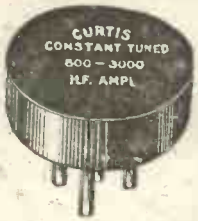
BUT *not* because of any inefficiency of the wavetrap, but rather because the receivers with which these were used did not have sufficient reserve of power to stand the loss inherent with a wavetrap and yet "fetch in" the more distant stations.

On a conservative basis the Curtis Ejector with the Duodyne III will cut out principal station (1½ kw.) at one mile and bring in 25 per cent. of the stations; at four miles and bring in 50 per cent. of the remaining stations; at six miles and bring in all British Stations at will.

THE CURTIS EJECTOR - - - - 35/-

PRACTICALLY ELIMINATES MORSE AND MUSH

THE CURTIS CONSTANT-TUNED HIGH-FREQUENCY AMPLIFIER



NO CONTROLS
NO CONDENSER

ABSOLUTELY AUTOMATIC TUNING

IT is quite possible for a signal, practically inaudible on headphones with even one high-frequency and detector valves, to become positively deafening when passed through two stages of low-frequency amplification, but the reproduction will be far more distorted than if the detector signal strength had been twice as loud, when only somewhat less than half the amount of low-frequency amplification would be required to yield the same volume of audibility.

It is axiomatic that the louder the signal strength at the detector valve, the less low-frequency amplification required for any given volume of audibility, and correspondingly more natural and tuneful reproduction will result.

YOU CANNOT USE TOO MUCH HIGH-FREQUENCY AMPLIFICATION NOR TOO LITTLE LOW-FREQUENCY AMPLIFICATION FOR PERFECT REPRODUCTION.

BUT the use of more than one stage of high-frequency amplification has hitherto proved to be commercially impracticable, because of the extreme difficulty in tuning, and the need for considerable skill and patience to obtain results which, even at best, would be erratic and unreliable.

Designers and Manufacturers have therefore been compelled to rely on the employment of excessive reaction and low-frequency amplification to make up for the weakness of the received signal, with consequent comparative distortion.

The Curtis "Constant Tuned" High Frequency Amplifier is the only automatic high-frequency amplifier on this or any other market which, when connected in circuit, guarantees high efficiency for two stages of radio amplification on any wavelengths between 300 and 3,000 metres, and requires no additional controls, NOR MORE EFFORT, SKILL OR PATIENCE IN TUNING, THAN IS REQUIRED FOR THE OPERATION OF THE USUAL ORTHODOX SINGLE STAGE TUNED ANODE CIRCUIT.

THE CURTIS CONSTANT-TUNED HIGH-FREQUENCY AMPLIFIER CHANGES THE WHOLE CHARACTER AND QUALITY OF WIRELESS REPRODUCTION.

WITH its automatic simplicity, combined with increased selectivity and power, is predestined to make two stages of high-frequency amplification a sine qua non of every Wireless Receiver for the Experimenter and Home Constructor, or the purchaser who prefers to buy a professionally constructed instrument.

For the greater convenience of the constructor, and so as to conform with existing panel design, the Curtis Constant-Tuned High-Frequency Amplifier is designed for use and must be connected up in exactly the same way in which an ordinary High-Frequency Transformer is used.

The Curtis High-Frequency Amplifier may be instantly substituted for any High-Frequency Transformer in any existing circuit or instrument where such is used, but the corresponding condenser of such transformer must be turned to zero or any one wire disconnected therefrom.

The Curtis Constant-Tuned High-Frequency Amplifier guarantees such a reserve of receptivity as to permit the efficient use of a suitably designed wavetrap.

TEN DAYS' FREE TRIAL

So as to give all an immediate opportunity of testing the efficiency of the Curtis Constant Tuned High-Frequency Amplifier, **without cost, we undertake to refund your money in full if the Amplifier is returned to us,** postage paid, within 10 days of your receipt.

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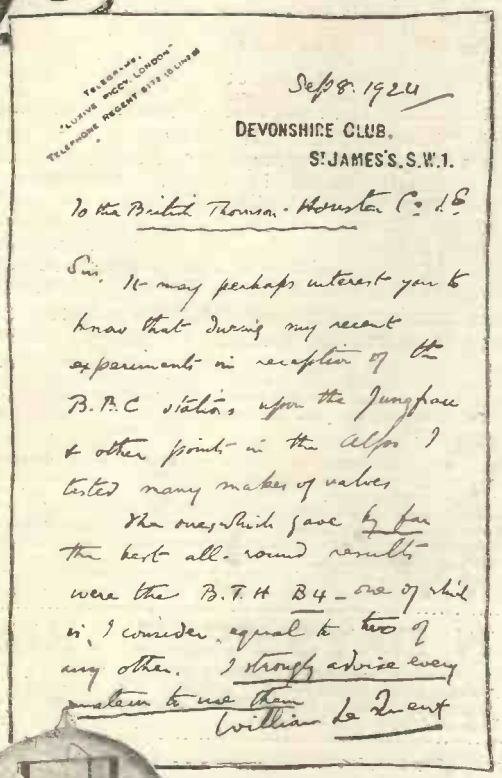
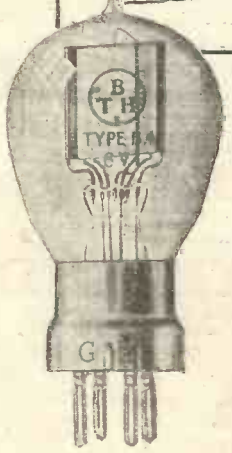
In conjuction with

THE PARAGON RUBBER MFG. CO. LTD.

What Mr William Le Queux thinks of the B.T.H. B4 Valve





Sir,

It may perhaps interest you to know that during my recent experiments in reception of the B.B.C. stations upon the Jungfrau and other points on the Alps I tested many makes of valves.

The ones which gave by far the best all-round results were the B.T.H. B4 —one of which, I consider, equal to two of any other. I strongly advise every amateur to use them.

(Signed) WILLIAM LE QUEUX

B4 Valve

6 VOLTS—0.25 AMPS.

MR. WILLIAM LE QUEUX, the famous novelist, is equally famous in the world of radio technics. He was one of the pioneers of wireless, and has been experimenting for 20 years. His transmitting station 2.A.Z. at Guildford was the first station in the world to broadcast regularly every night.

Mr. William Le Queux, as a result of his Jungfrau experiments, has proved the superiority of the B4 Valve—the first of its kind, and the best . . . . .

The B.T.H. Type B4 Valve was the first valve taking only 0.25 amperes at 6 volts sold in this country. It is acknowledged as the supreme valve for use as a low frequency power amplifier.

Obtainable from all Electricians & Radio Dealers

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B T-H

2234

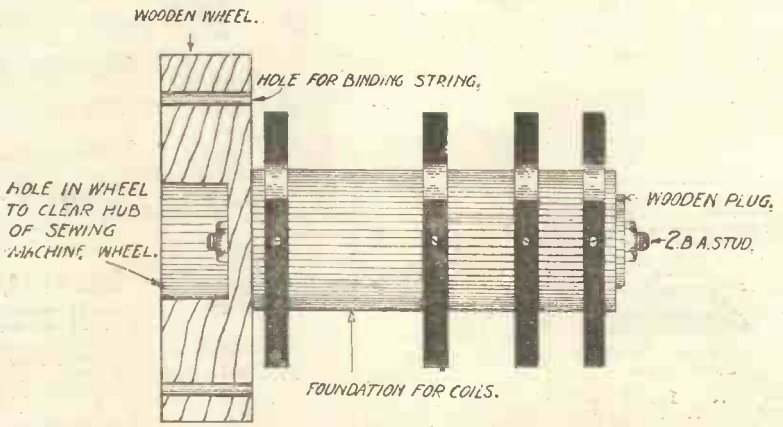
A Simple and Efficient Method of Winding Coils

By P. BYE

ONE of the most common tasks of the enthusiastic experimenter is the winding of various kinds of coils, such as tuning coils, choke coils, windings for transformers, resistances, etc. Many—probably the majority of amateurs—do not possess winding instruments, and hence have to wind their coils by hand, a process which can hardly be considered satisfactory.

The winding of coils of many turns of fine wire by hand is extremely tiring and the necessity of counting each turn very irksome.

We, therefore, exert our energies towards seeking a cheap and efficient method of winding coils and means of ascertaining the number of turns without mental effort.



The illustration shows the construction of the wooden block, which is attached to the machine, and a coil former in position.

When looking for a cheap method we usually try to adapt to the purpose some instrument already in our possession. The author has long employed an instrument, some make of which is to be found in most homes, and it is hoped the following hints will be useful to many readers.

Those amateurs who are fortunate enough to have the use of a treadle sewing machine have an excellent instrument for both winding and counting.

Adapting the Machine

An improvised wooden wheel (see Figure) about 1 in. thick is made, having a hole about 1½ in. in diameter cut in the centre of it to a depth of about ¾ in. The purpose of this hole is to make a clearance for the hub of the sewing machine wheel. It is immaterial whether the hole is round or square, provided it is large enough to clear the hub. Many readers will find it most convenient to cut a square hole.

Several holes about ¼ in. in diameter are drilled all round the wheel about ½ in. from its edge. These holes are for the binding string to pass through.

Mounting the Former

The foundation of the coil to be wound is mounted on the wheel by means of a short length of 2 B.A. rod passed through the centre of the foundation and through a hole in the exact centre of the wheel. Nuts are put on the ends of the rod and screwed up tightly.

It will be seen that the tubing of the coil foundation illustrated has been plugged with wood. Readers will understand that this process is necessary when tube of large internal diameter is used.

Method of Attachment

The wooden wheel is bound tightly to the spokes of the sewing machine wheel by means of stout string. It is essential that the end of the 2 B.A. rod should be exactly opposite the centre of the hub of the sewing machine wheel, in order to prevent any wobbling of the coil foundation.

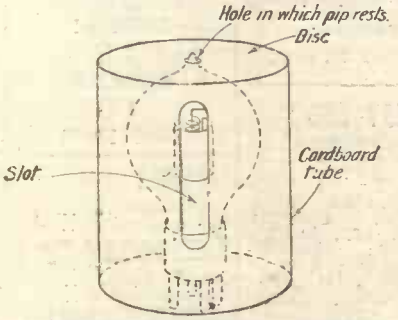
It will be found that on treadling the whole contraption turns very smoothly.

The method of counting the turns is as follows:

For every revolution of the sewing machine wheel a stitch is made, so all we have to do is to proceed as if sewing and count the stitches. The easiest way of doing this is to take the cotton off the machine and adjust the latter to make large stitches. Take a long piece of plain paper and sew from one end to the other in a straight line, count off from one end one hundred holes thus made and cut off the surplus paper beyond the hundred holes. All one has to do then is to sew straight up and down the paper, counting a hundred turns for each complete journey up or down. By this means thousands of turns can be wound in a few minutes and the number of turns is found without calling for any mental effort.

A Valve Shield to Obviate Glare

THE glare of bright emitter valves is often found trying to the eyes. By putting these simple protectors over the valve the glare is reduced to a minimum. A piece of cardboard tube of sufficient diameter to slip over the valve and of sufficient length to just clear the panel is cut, and a circular piece of cardboard glued or seccotined to the end. This disc has a small hole cut in the top, which rests on the pip of the valve. The accompanying sketch illustrates the idea.



This diagram shows how the shield encloses the valve.

A narrow slot is cut up one side of the tube so that the brilliance of the valve may be examined by turning the device round. The slot can, of course, be turned away from the eyes when required.

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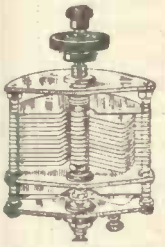

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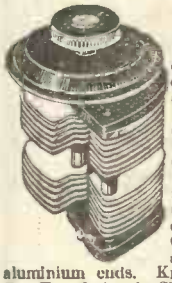

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How it Works.

1.—THE RHEOSTAT.

Every beginner should make a point of understanding the purpose of the components in his set. This article clearly explains the why and wherefore of the filament resistance.

ONE of the most important laws in electricity and wireless is that known as Ohm's Law, which tells us that the amount of current flowing in any circuit is governed directly by the voltage applied and by the resistance encountered. We can find the current passing in a circuit by dividing the voltage applied by the resistance of the circuit. In other words, amperes equal volts divided by ohms.

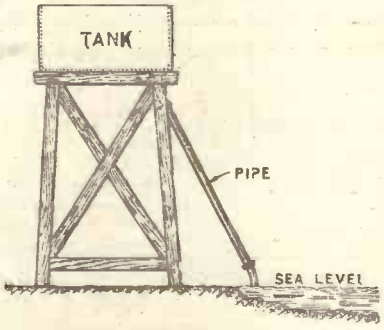


Fig. 1.—The water in the tank flows to the sea because of the pressure.

It will perhaps make an explanation of the working of the rheostat more simple if at the moment we regard the voltage at the positive terminal of the battery as a pressure equivalent to the head of water in a raised tank. Water raised to any height, as in Fig. 1, exerts a downward pressure since its natural tendency is to flow to sea-level. The water in the tank then has a head or potential which falls to zero when it reaches sea-level. Actually electricity flows, as we know now, not from the positive terminal to the negative, but in the reverse direction; but as all the old laws were founded on the assumption that the positive terminal was the point of highest pressure, it is convenient to retain this idea whilst thinking of electrical pressure. Fig. 2 is the electrical equivalent of Fig. 1. Here the pressure at the positive terminal is six volts, whilst at the negative it is zero. There is thus a voltage drop of six volts round the circuit. It does not matter whether a resistance in the circuit is in millions of ohms or only a tiny fraction of an ohm, the voltage drop will still be the same between positive and negative terminals.

Two Resistances

Now suppose we place in the circuit two resistances of equal value in series as R_1, R_2 in Fig. 3, using for our connections wire of such stout gauge that its resistance is negligible. Then the total resistance of the circuit is the sum of these two—that is, 12 ohms in all. Between point A and point D the voltage drop is six volts, and we shall find that the voltage drop is equally distributed between the two resistances. The drop across each will be three volts. At point A the potential will be six volts, and at B three volts. At C it will be three volts, and at D zero.

A typical filament rheostat for bright emitters.

But suppose that we have two resistances of unequal value as in Fig. 4. Again the total value is 12 ohms and the voltage drop six volts, but eight-twelfths of the total drop will take place between A and B and four-twelfths between C and D. That is, the drop between A and B will be four volts and that between C and D two volts. If now we make R_1 a fixed resistance and R_2 variable, we can vary the voltage drop between A and B by altering the resistance between C

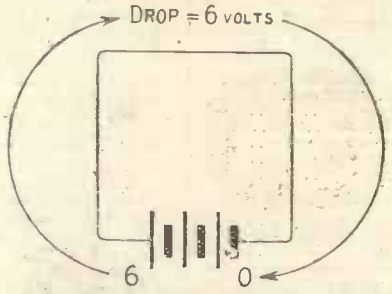


Fig. 2.—A flow of electricity is due to a higher pressure at the positive terminal.

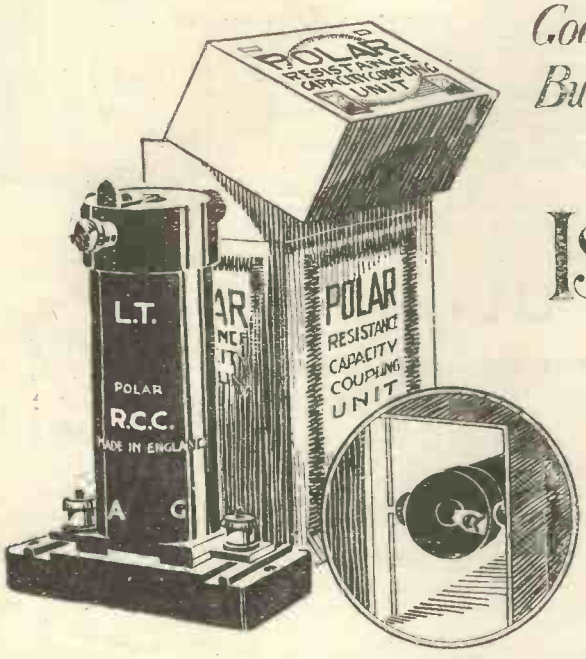
and D. Suppose, for example, we move the slider of R_2 until this resistance has a value of nine ohms, the drop between A and B and between C and D will be three volts. If, however, we give R_2 a value of six ohms, then the total resistance will be 15 ohms and the drop across AB will be 9/15ths of six volts, or 3·6 volts. If the maximum value of R_2 is equal to the value of R_1, we can make the voltage drop between AB anything between three and six volts by adjusting the slider.

Valve Resistance

Now in the valve we have a fixed resistance in the shape of the filament. This is, strictly speaking, not quite a true state-

"Cold is for the Mistress-Silver for the Maid
Copper for the Craftsman cunning at his trade
Good! said the Baron, sitting in his hall
But Iron-Cold Iron-is master of them all."
Rudyard Kipling.

IS IRON YOUR MASTER?



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ment, for the resistance of the filament varies to a certain extent with its temperature, but for our purposes, however, we may take it as constant. In the standard bright emitter valve the filament resistance may be taken as six ohms. If the proper working potential is four volts, we shall require to put a resistance of three ohms in series with the filament when a six-volt accumulator is used. This we can do, as shown in Fig. 6, by means of the rheostat. The drop across the filament will then be 6/9ths of six volts, or four volts, whilst that across the rheostat will be 3/9ths of six volts, or two volts. The rheostat thus enables us to adjust the pressure

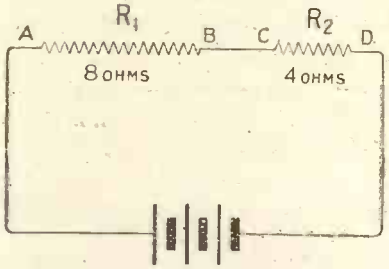


Fig. 4.—Although the resistances are of different values to those in Fig. 3, the potential drop is the same.

exactly until the proper working point is reached.

What would be the effect of using too high a potential? Voltage drives current through a circuit, and the higher the potential we use the greater will the current be. If the current is excessive the filament will be over-burdened by the load which it is called upon to carry, and though it may not burn out immediately, it will do so long before its time. If the resistance of the filament is six ohms a potential of four volts will, as Ohm's Law shows us, drive 4/6ths of an ampere, or ·66 ampere through it. If we increase the potential to five volts the current will be 5/6ths, or ·83 ampere, and at six volts a whole ampere passes. The rheostat, then, by regulating the voltage drop across the filament, controls the amount of current passed, and it enables us to make sure that no overloading takes place.

What Resistance ?

The next question about rheostats is: What should the maximum resistance be? This, as we shall see, depends entirely upon the type of valve that is in use and the voltage of the battery employed to heat its filament. With the bright emitter valves which we have been discussing hitherto a

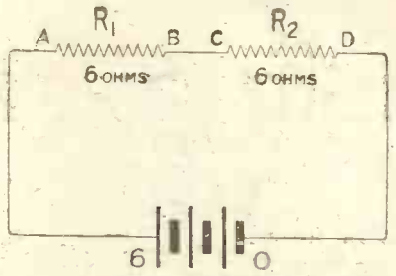
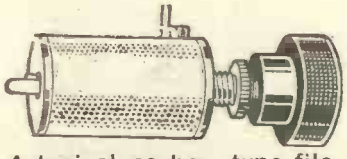


Fig. 3.—The potential drop across the two resistances is 6 volts.

rheostat with a maximum resistance of four ohms will suffice, for this will enable us to cut down the filament potential to 6/10ths of six volts, or 3·6 volts. But with dull emitters things are quite different. Take, for example, a valve rated to work at a potential of one volt and to pass ·25 ampere. By applying Ohm's Law we can see that its filament resistance (volts divided by amperes) is 1/·25, or four ohms. If now we were to use such a valve with a six-volt accumulator and a six-ohm rheostat the greatest resistance that we could throw into circuit would be the four ohms of the filament plus the six of the rheostat; that is,



A typical carbon type filament rheostat for bright or dull emitters.

10 ohms in all, and the current passed would be 6/10ths of an ampere, or ·6 ampere. This would certainly ruin the valve by destroying the coating of its filament, even if it did not cause an immediate burn out. To find the proper size of the rheostat we

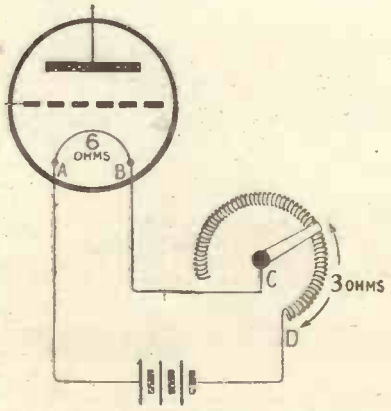


Fig. 6.—Showing how voltage drop across the filament is regulated.

must take the voltage available at the battery terminals and discover the resistance necessary to cut it down to ·25 ampere. With a six-volt accumulator the total necessary resistance would be 6/·25, or 24 ohms. The filament provides four of this, so that the rheostat, to be on the safe side, will have to have a resistance of rather more than 20 ohms. With a four-volt accumulator the total resistance needed is 4/·25, or 16 ohms, which indicates a 15-ohm rheostat, and with a two-volt accumulator we require 2/·25, or eight ohms, so

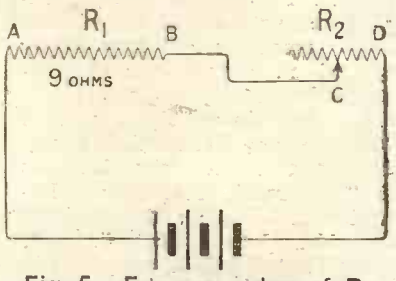
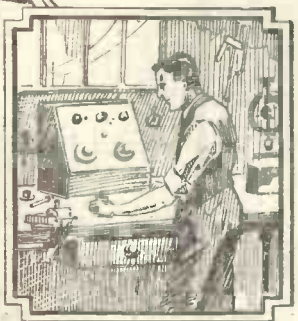


Fig. 5.—For any value of R_2 the potential drop is 6 volts.

that the rheostat should have a resistance of five or six ohms. Working on the same lines, it is easy to discover the amount of added resistance required to cut down the voltage of any low-tension battery to suit a particular dull emitter. The "·06" valves need great care, since their filaments are very easily damaged. Most of them are rated to pass ·06 ampere at three volts, hence the filament resistance is 3/·06, or 50 ohms. Simple calculations on the lines indicated will show that with a six-volt accumulator a rheostat must have a resistance of not less than 50 ohms, and that if the battery has an E.M.F. of four volts, the proper value for the rheostat is not less than 20 ohms, and better 30 ohms.

Radio Press News

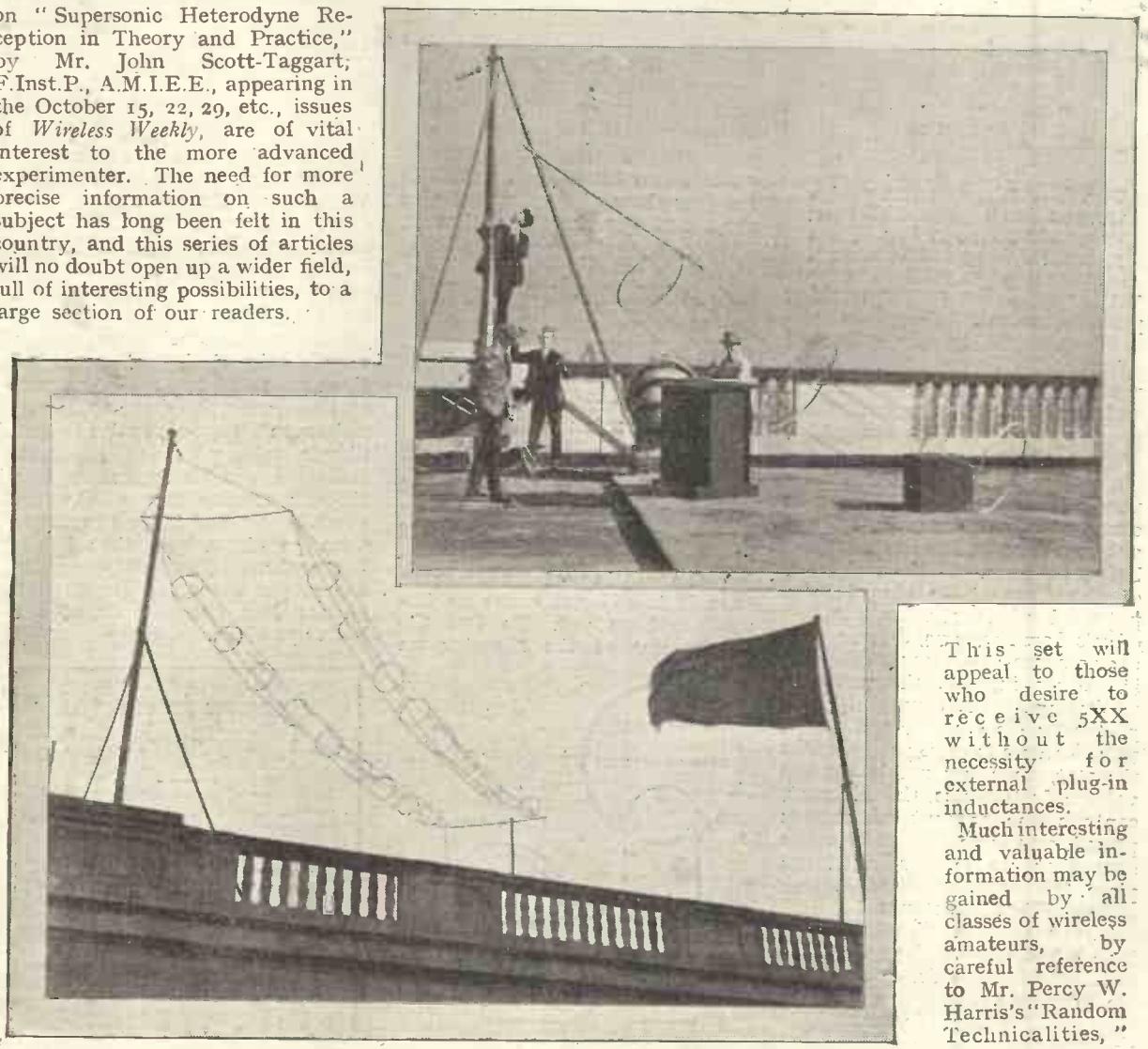
A Talk about our other publications.



MANY experimenters, constructors and wireless amateurs are now busily engaged in preparing and constructing various sets and pieces of apparatus in anticipation of an interesting and fruitful time during the winter. A new series of articles on "Supersonic Heterodyne Reception in Theory and Practice," by Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E., appearing in the October 15, 22, 29, etc., issues of *Wireless Weekly*, are of vital interest to the more advanced experimenter. The need for more precise information on such a subject has long been felt in this country, and this series of articles will no doubt open up a wider field, full of interesting possibilities, to a large section of our readers.

Equal attention has been concentrated on the requirements of those who lack such advanced experience, and full details of an efficient single-valve receiver were given by Stanley G. Rattee in the issue of *Wireless Weekly* of October 15.

The November issue of *Modern Wireless* contains full details for the construction of a Crystal Set for both short and long wavelengths.



Erecting the Radio Press aerial on Bush House.

This set will appeal to those who desire to receive 5XX without the necessity for external plug-in inductances.

Much interesting and valuable information may be gained by all classes of wireless amateurs, by careful reference to Mr. Percy W. Harris's "Random Technicalities,"

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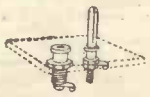

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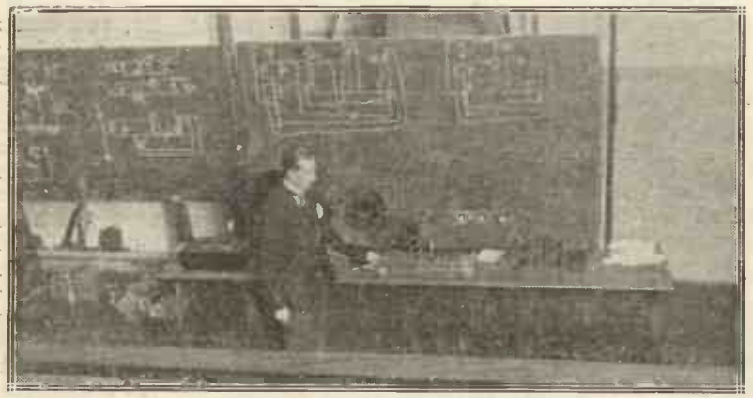
which are a distinctive feature of *Wireless Weekly*.

The name of Capt. Round appended to an article is in itself a sufficient guarantee of excellence, and in his articles on "The Design of Resistance-capacity Coupled Low Frequency Amplifiers" in *Wireless Weekly* recently aroused much interest. Those readers who realise the limitations of low-frequency transformer coupling would be well advised to concentrate their attention on these articles.

Efficient high-frequency amplification, combined with stability and ease of control, is the aim of every experimenter requiring satisfactory long-distance reception, and a marked advance in this direction has been provided by Mr. A. D. Cowper, B.Sc., M.Sc., who hands on his information to our readers in an article on "Neutral-Grid Coupling," to be found in the October 29 issue of *Wireless Weekly*. Practical working details of a 2-valve short-wave broadcast receiver are given in this article.

Mr. Percy W. Harris contributes an article on "A Wavemeter for Amateur Transmitters" in the same issue. This instrument is simple to construct and manipulate, and for those who take advantage of this opportunity to make a reliable wavemeter, it will provide a solution in clearing up the ambiguity which often exists as to the exact value of their wavelength and of that of the station with which they are working.



Mr. John Scott-Taggart, F.Ins.P., A.M.I.E.E., demonstrating his 3-valve dual receiver at Cambridge.

In this issue some accurate information is given regarding the remarkable work of some of our British amateurs in establishing two-way communication with three New Zealand amateurs.

Mr. Percy W. Harris has made a further addition to his long-list of efficient receiving sets, by introducing a new modification of a popular design, which forms the subject matter for a complete article in the November issue of *Modern Wireless*. Those who study efficiency combined with neat and attractive appearance will be interested in this receiver. Long-distance reception will always continue to fascinate a large section of the wireless public, who would be well advised to study the article on a "Long-Range Neutrodyne Receiver," by John Underdown, contained in the same issue.

Multi-Stage H.F. Amplification

A new and highly important

method of multi-stage high-frequency amplification, known as the T.A.T. system, was introduced in the November issue of *Modern Wireless* by John Scott-Taggart, F.Inst.P., A.M.I.E.E. This will no doubt be of considerable interest to our readers.

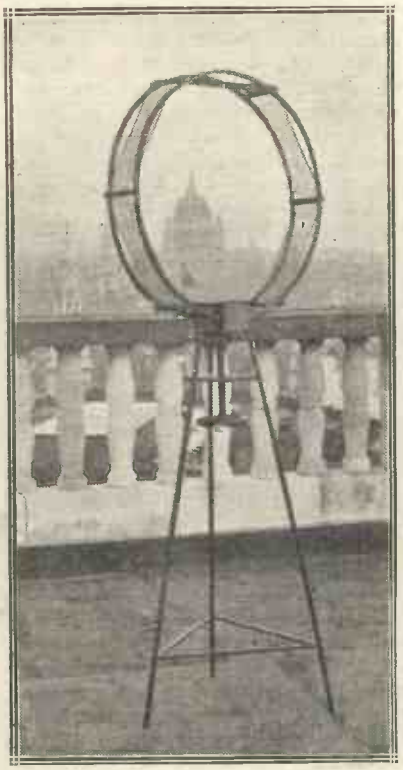
A revised and enlarged list of regular programmes from the Continental broadcasting stations, prepared at great trouble, is also to be found in that issue.

Radio Press Envelopes

A further feature of the Radio Press activities is to be found in the Envelopes, four of which are already on sale. When we say that it is not possible to give more detailed information of the construction and manipulation of the set referred to in the Envelope, readers will appreciate the exceptional value of the latter. In fact, we guarantee, that if the set is made up strictly in accordance with the instructions given, perfect results will be obtained.

The Service Department

Should some slight deviation from the original be made, or some small error or fault introduced with consequent failure of efficient operation, constructors would be advised to consult the Radio Press Service Department, a highly efficient organisation for dealing with defective sets, whose work comprises the thorough examination of sets submitted for test, the location of faults, and the preparation of a complete report on such sets. This work is carried out for a small fee, and constructors have, therefore, a double guarantee that their sets will give good results.



A circular frame aerial of novel design.

Construction of Sets

A recent innovation of special interest to the set constructor is the Radio Press Panel Card System. Each Panel Card comprises a flat cardboard model of the panel of the set itself, printed upon one side with a photograph of the top of the panel, and upon the other side with a fully detailed drawing of the underside, showing the disposition of the components, and all the wiring, etc. Complete instructions for the building of the set, and a drilling template for the panel are also provided with each Panel Card, No. 1 of which may now be obtained from the usual sources.

Simplex Charts

Yet another aid to the building of a receiver with great ease is furnished by the Simplex Series of

Charts, three of which are now on sale, price 1s. each. The basic principle of the Simplex Chart is a diagram giving the layout of the panel upon which all the parts are allotted reference numbers. A wiring key is provided which gives, in the clearest possible manner, the connections to each other of all the different parts, simply by quoting the numbers. By this means, the terrors of wiring which the beginner experiences, are materially lessened, and the operation is, in fact, reduced to a mere mechanical process, in which the probability of error, provided a normal amount of care is taken, is practically negligible.

Panel Transfers

Our characteristic attention to the smallest details is reflected in the issue of Radio Press Wireless Panel Transfers, which eliminate the necessity for engraving or otherwise marking a finished panel, and enable the keen constructor, who desires to impart the best possible finish to his work, to do so at the minimum of expense. For the sum of 6d., a set of Radio Press Panel Transfers, sealed in an envelope, can be obtained. A most comprehensive collection of the usual words, lettering, and symbols used for marking panels, is included.

Other Publications

Apart from our periodicals and the publications briefly outlined above, a large number of authoritative books on the many aspects of wireless, books on the design and construction of components, on valves, circuits and many other subjects of vital importance, written by members of the technical staff of the Radio Press, Ltd., and published by us, are available for the amateur. A progressive organisation such as Radio Press, Ltd., never lacks movement in the right direction, and our readers may rest assured that we will continue to advance their interests in every possible way.

Use a Reservoir Condenser.

MANY a high-tension battery can be made to last much longer if you use what is known as a reservoir condenser. This is a condenser of about two microfarads capacity which is connected across the high-tension terminals of the set.

There are two reasons for using a reservoir condenser of this value. One is that your high-tension battery, when it is running down, gets crackly owing to small fluctuations in its voltage. Rather than discard your battery you may prolong its useful life by evening up these little fluctuations, and the way to do it is to connect a condenser of large capacity across the battery terminals.

A Helpful Analogy

The effect is very similar to that of an ordinary reservoir into which a stream may be running. If there were no reservoir there, our water supply might come straight from the stream, and the flow of water from the stream might be very irregular. On a rainy day there would be a rush of water, but on a fine day there might be only a trickle. To even things up we run the water into a big pond, or reservoir, and draw our supply from this by means of pipes. There is consequently a big reserve of water always there to draw from, and the irregularities of the stream do not affect the steady outward flow of water from the reservoir.

Internal Battery Resistance

Another reason for using such a condenser is that a high-tension battery has a certain amount of internal resistance. This may amount to say 100 ohms in some cases, and, when it is remembered that perhaps several valves are all run off a single high-tension battery, the currents flowing through this battery, if it possesses a substantial internal resistance, will interfere with each other and may affect the operation of the set by causing peculiar reaction or reverse reaction effects.

A Useful Remedy

If however, we shunt the battery by a condenser of large capacity, as far as any varying currents are concerned the condenser will act as a short-circuit to them. A condenser of large capacity acts very much like an ordinary wire connection to currents of varying character, even though the condenser will not allow the passage of direct currents. The internal resistance of the high-tension battery is rendered non-effective by connecting a big-capacity condenser across the battery for this reason.

THANK YOU!

A quarter of a million copies of the first number of the WIRELESS CONSTRUCTOR *were sold; yet at least thirty thousands of people were disappointed. Letters of congratulation, far too numerous for individual reply, have poured in from all parts of the country.*

THE WIRELESS CONSTRUCTOR—*The wireless magazine with a new appeal—has proved conclusively that the British public appreciates sound articles, common sense explanations, and really expert advice.*

You can rely on the CONSTRUCTOR *as you can rely on all Radio Press publications.*

Will you please tell your friends who are just beginning wireless that the CONSTRUCTOR *is the paper they need? THEY will thank you, too!*

PERCY W. HARRIS.

Six Simple Crystal -Valve Circuits in Pictorial Form

A Guide to Wiring for the New Experimenter

THE first step from a crystal receiver involves the addition of a valve, and Fig. 1 shows in pictorial form the addition of a note-magnifying valve, in which reaction is also introduced into the aerial circuit. Constant aerial tuning is employed, C_1 being a fixed condenser of 0.0001 μF in series with the A.T.I., L_1, across which is shunted a variable condenser C_2 which may conveniently have a value of 0.0005μF. Where the telephones would be in a simple crystal receiver is connected the primary T_1 of a step-up intervalve transformer, across the secondary of which is a fixed condenser C_3 of 0.001μF. The OS of T_2 is connected through L_2 to the grid of the valve V_1; and the plate circuit includes the coil L_3 and the 'phones T, shunted by

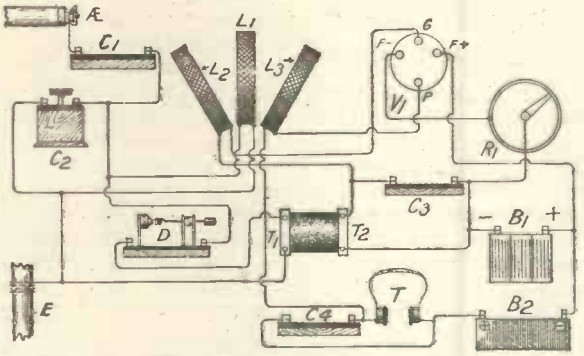


Fig. 1.—A note-magnifier and reaction added to a simple crystal set.

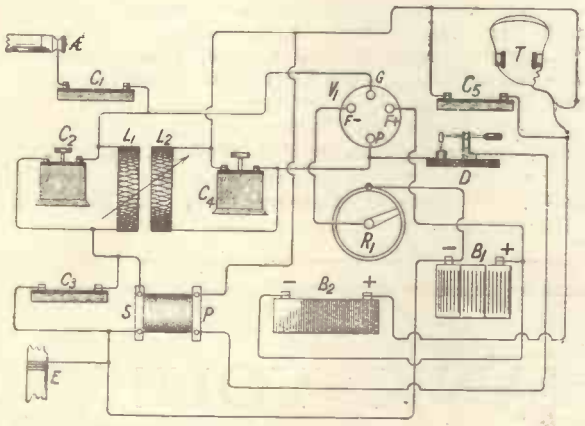


Fig. 2.—A simple reflex circuit.

C_4 of 0.002μF. In this, and in all the following circuits, R_1, B_1, and B_2 represent the filament resistance, fil. battery, and H.T. battery respectively. For broadcast wavelengths L_1, L_2 and L_3 may be No. 50 honeycomb coils. For 5XX, L_1 may be a No. 200, and L_2 and L_3 both No. 150. Reaction is introduced by varying the coupling between L_3 and L_1 or L_2 and L_1.

A Reflex Circuit

Proceeding a stage further we come to a reflex circuit illustrated pictorially in Fig. 2. Constant aerial tuning is provided as before by the 0.0001μF condenser C_1 in series with the aerial. The incoming oscillations are amplified at high frequency by the valve V_1, rectified by the crystal D1, the resulting low frequency currents being fed back into the grid circuit through the primary P of the step-up transformer PS, and subsequently amplified as such by the valve. For each of the variable condensers C_2 and C_4, 0.0005μF is a suitable value, whilst the fixed condensers C_3 and C_5 may be 0.001μF and 0.002μF respectively. The aerial coil L_1 may be a No. 50 coil, and the reaction coil L_2 a No. 75. These values will give efficient reception on the broadcast wavelengths.

A Modification

Fig. 3 illustrates pictorially a slightly modified form of the Fig. 2 circuit, the only essential difference being that the high-frequency oscillations, after being rectified by the crystal D1, are fed back to the grid currents as low frequency currents through the transformer T_1 T_2 and the air core choke coil L_3, which, for broadcast wavelengths, may be a No. 200 honeycomb coil. The fixed condenser C_3 in Fig. 2 is omitted, and a fixed condenser C_3, of 0.0003μF, is connected in the grid circuit as indicated.

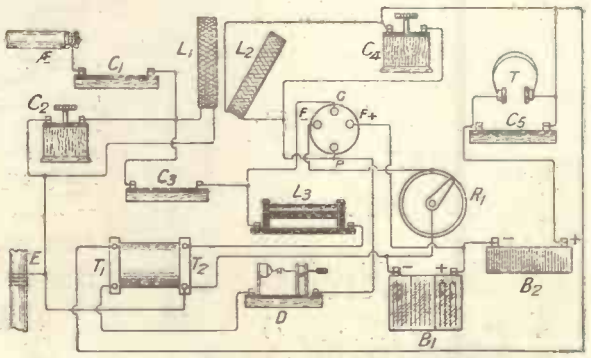


Fig. 3.—A modified form of the Fig. 2 circuit.

An Interesting Circuit

In Fig 4 is illustrated pictorially an interesting circuit incorporating yet another method of reflexing. The amplified H.F. oscillations are passed on to the crystal detector D through the transformer L_2 L_3, rectified, and the resulting L.F. currents fed into the joint aerial and grid circuits via the condenser C_3 of 0·0003μF capacity. If the

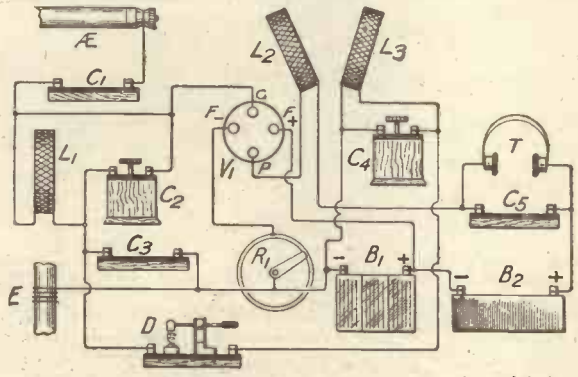


Fig. 4.—An interesting reflex circuit which dispenses with the L.F. transformer.

C.A.T. condenser C_1 is made 0.00025μF, this will, in conjunction with C_3, produce a resultant approximate capacity of 0.0001μF in series with the aerial. The transformer L_2 L_3 may consist of two coupled plug-in coils as indicated, L_2 being a No. 50 or a No. 75, and L_3 a No. 50.

Tri-Coil Circuits

The pictorial diagram Fig. 5 illustrates how reaction may be introduced into the aerial circuit by means of the tri-coil method, using however the same method of feed-back as in Fig. 4. The honeycomb coils L_1, L_2, L_3, may consist of Nos. 50, 75 and 50, which will provide ample wavelength range for the reception of broadcast. L_1 is tuned by the variable condenser C_2 of 0.0005μF capacity, L_2 is aperiodic, and L_3 is tuned by C_5, also 0·0005μF. Reaction is provided by coupling L_1 and L_2, while the coupling between L_2 and L_3 is usually tight, and may be loosened, but only at the expense of signal strength. In other respects Figs 4 and 5 are identical.

Reaction Control

The tri-coil system provides for an easy control of reaction, but it should be observed that a variation

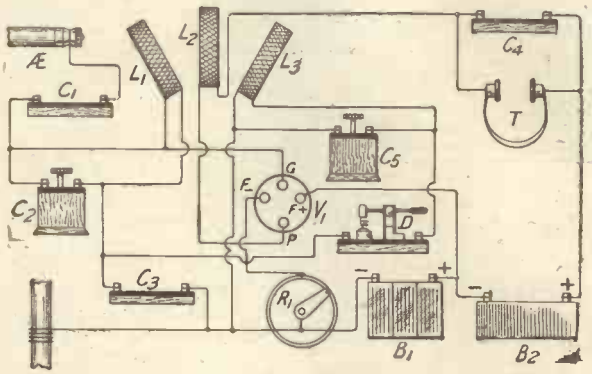


Fig. 5.—The introduction of reaction into the aerial by the Tri-Coil System.

in the coupling of the three coils must be accompanied by a corresponding retuning on C_2 and C_5.

Fig. 6 shows pictorially another application of the tri-coil system to a reflex circuit employing transformer feed-back. The step-up L.F. transformer T_1 T_2 functions in place of the condenser C_3 of Fig. 5. In other respects Figs. 5 and 6 are identical.

The beginner would be well advised to try-out these circuits in the order given, using an experimental panel. By this means a valuable insight into the principles and manipulation of reflex circuits may be obtained. For the benefit of those to whom the symbols and abbreviations used in the foregoing are unfamiliar, the following list is appended :—

μF—microfarad,
A.T.I.—Aerial tuning inductance.
C.A.T.—Constant aerial tuning.
L.F.—Low frequency.
H.F.—High frequency.
H.T.—High tension.

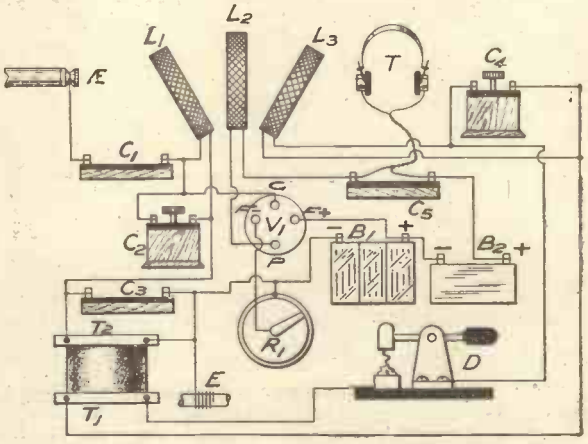
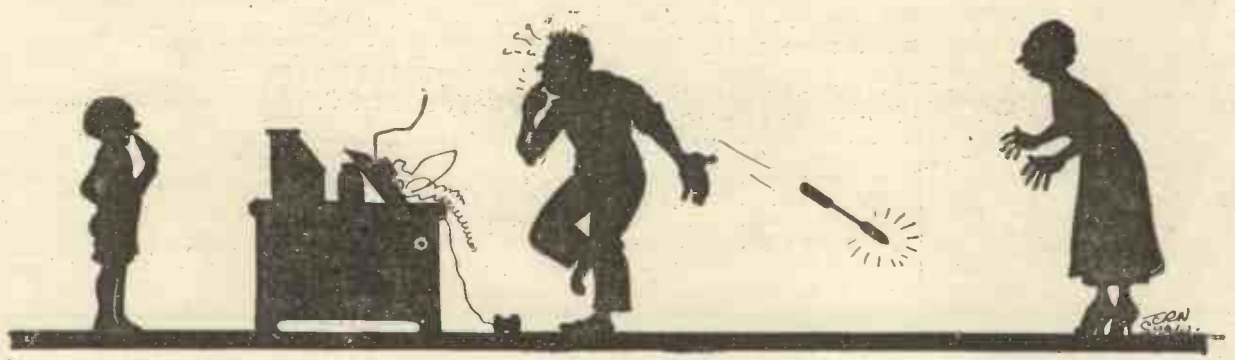


Fig. 6.—A tri-coil reflex using an L.F. transformer.



Some Radio Questions Answered

Help for the New Experimenter.

What is meant by a hard valve?

A hard valve is one having a particularly high degree of vacuum. That is to say, that no appreciable amount of gas remains within the valve, under which condition the current flow through it depends entirely upon the number of electrons passing between the hot filament and the anode. Hard valves may be operated satisfactorily with very much higher anode voltages than soft valves.

How can one test a pair of 'phones suspected of being defective?

Place their tags across a single dry cell, or two of the adjacent sockets of an H.T. battery, and note whether a click is produced at make and break of the circuit. No click indicates a break in either cords or windings. Replace the cords with temporary leads and try again. If there are still no clicks the fault is in one or both of the earpieces. Short-circuit first one and then the other with a piece of wire, and repeat the test. If shorting one earpiece enables clicks to be heard in the other, the shorted one is at fault. If no result is obtained by shorting either, both are faulty.

What is the best all-round combination for three Valves?

Taking the expression "all-round" to mean good average reception of near-by, medium and long-distance signals, a combination consisting of one H.F. detector, and one L.F. valve is constantly

recommended. The H.F. valve enables satisfactory reception to be obtained from signals which without it would be too feeble to actuate the detector valve, whilst the L.F. valve gives a reliable and satisfactory amplification of whatever signals come through the detector valve. If it is desired to increase signal strength in order to operate a loud speaker, the addition of a further L.F. amplifying valve is recommended.

What is reaction and what purpose does it serve?

Reaction, sometimes called retroaction and reactance, although the last-named is incorrect, affords a means of reducing the resistance of an oscillatory circuit, not only to zero point, but beyond that, in which case "negative resistance" is said to be introduced. The received currents in an aerial circuit, connected to the input side of a three-electrode valve, are damped out by the resistance of the circuit and the damping action of the valve. By introducing an additional inductance coil and coupling it to the aerial circuit, some of the amplified energy in the anode circuit may be transferred back to the aerial grid circuit, and provided the direction of the winding of the reaction and aerial tuning coils is correct, the losses in the aerial circuit are to a large extent compensated for, with consequent increase in signal strength.

A giant crystal set at the Plymouth show.

What is the best method of preventing interference from a near-by broadcasting station so that distant stations can be received?

It can scarcely be said that there is one infallible method of accomplishing this, but provided the receiving apparatus is fairly selective in itself, one or other of the following arrangements will no doubt meet the requirements. 1. Much can be done in the avoidance of this type of interference by selective tuning only. By this is meant the use of an inductively coupled tuner, operated always with a very loose coupling between the aerial and closed circuit, and one high-frequency valve with a carefully tuned anode circuit. (See Mr. Harris's neutrodyne.) 2. If careful tuning alone will not eliminate the interference, owing to the comparative closeness of the transmitting station, alternative arrangements of "wave traps" should be tried. In using any of these devices, carefully tune in the desired station with the "trap" in

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Any constructor purchasing a complete set of parts either direct from us or through any of OUR AGENTS for any published circuit whatsoever and experiencing any difficulty therewith may send his effort to the Constructor's Department, Peter Curtis, Ltd., together with a postal order to cover the nominal charge of 2/6 per valve holder. For this sum we shall examine the set, rectify any errors and return carriage forward in perfect order tested under average conditions on P.M.G. Aerial.

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45 to 50 ohms; Eureka wire; the smooth micrometer adjustment of this Curtis Rheostat places it above any high-resistance rheostat on the market, and assures the finest possible degree of filament control. One hole fixing.

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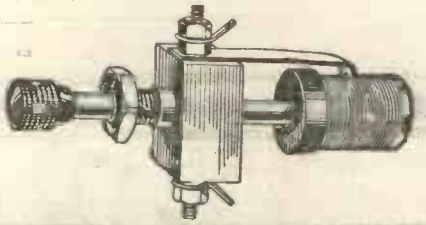

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12 × 10 × ½	7/3	18 × 6 × ½	6/9
12 × 12 × ½	8/6	12 × 8 × ½	6/-
14 × 12 × ½	10/-	10 × 8 × ½	6/9
16 × 12 × ½	11/6	7 × 5 × ½	2/3
18 × 12 × ½	13/-	10 × 9 × ½	5/8
24 × 10 × ½	14/6	9 × 5½ × ½	3/5
24 × 12 × ½	17/6	10 × 5 × ½	3/3
8 × 5½ × ½	2/9	12½ × 9½ × ½	7/6

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circuit, but not correctly adjusted, and then vary the trap condenser until the unwanted station is satisfactorily tuned out.

What expedient can be adopted to stop self-oscillation in high-frequency amplifiers ?

Assuming that the amplifier has been properly designed, and that the wiring has been carried out so as to separate the various circuits as much as possible, all that is necessary is to adopt one of the methods of stabilising, such as the use of a potentiometer.

What are the respective uses and advantages of the different methods of high-frequency intervalve coupling ?

The method which commonly gives the greatest amplification per valve is that known as the tuned anode method, which consists of a tuning coil and condenser connected in the plate circuit of the valve, tuned to the received wavelength, and coupled to the grid of the succeeding valve by means of a small grid condenser and leak. For a single high-frequency valve this method is probably the best, since it is uniformly efficient upon all broadcast wavelengths and is easy to handle. Where more than one high-frequency valve is used, however, this type becomes somewhat unstable and difficult to operate, and it is then usually preferable to employ the tuned transformer method, which consists of a high-frequency transformer, one of whose windings, either primary or secondary, is tuned by means of a very small variable condenser. Such transformers can be easily designed to introduce a certain amount of damping in the intervalve circuits, and thereby one can stabilise the receiver to any desired degree. Where more than two high-frequency valves are employed, or where it is desired to have a receiver of extreme simplicity, it is usual to employ the semi-aperiodic type of transformer, which is wound with very fine resistance wire to flatten the tuning of the windings so that no tuning condenser is needed. This type does not give so much amplification, but it is very easy to handle. For long wave reception above about 1,000 metres the resistance-capacity method is extremely useful, since it is very stable and easy to handle, there being no tuned intervalve circuits. This method operates by virtue of the fact that if high resistances are connected in the anode circuits of the valves, fluctuations in the plate current caused by incoming signals will produce fluctuating voltages across the ends of these resistances, which can be transferred to the grid of the next valve by the usual grid condenser and leak. The amount of amplification given by this method, however, is not very high.

How is it possible to tell when the valve set is radiating ?

In the first place, the possibility of actual radiation depends upon the point in the circuit at which the reaction effect is introduced. Reaction, electro-magnetic or electrostatic, may be applied to the aerial or aerial secondary circuit, or there may be one or more valves between the aerial circuit and the point at which reaction is applied. From this it will be gathered that a valve receiving

set may be oscillating and yet not radiating, although it is certainly the safest and most considerate plan to avoid oscillation of any kind on broadcasting wavelengths during broadcast hours. If radiation is suspected, remove the reaction coil to a distance or short-circuit it and touch the aerial terminal with the moist finger tips. Note carefully the sound in the telephones. Replace the reaction coil in its normal position and again touch the aerial terminal. If radiation is occurring a noticeably different sound will be produced in the telephones. (See also a note in this issue on "How not to oscillate.")

Why is it that a continuous subdued rustling and crackling noise is heard in the intervals of the programme of a Broadcasting Station ?

Various phenomena may assist in producing this sound, such as microphone-rustles at the broadcasting station, or "line noise" from induction effects in the underground cables used in broadcasting public entertainments, but the usual cause is partial heterodyning of the more or less continuous stream of minor atmospherics by the carrier wave. A similar faint rustling is heard when a receiver is kept in continuous oscillation by means of reaction. If the noise is very pronounced, and is accompanied by occasional louder clicks and bangs, it may indicate either a defective H.T. battery or a bad night for atmospherics. To distinguish between these possible causes, disconnect aerial and earth from the set and note whether the noise continues ; if it does the H.T. battery may be implicated, although it may also be due to a loose or otherwise faulty connection somewhere, leaky insulation or a defective grid leak.

What is "double reaction" ?

In simple circuits reaction is applied at only one point, but it is possible to react into two or more of the circuits in a receiver with beneficial effects upon the signal strength. Such receivers are apt to be difficult to handle, however.

What is meant by saying that an accumulator is of 60 ampere hours capacity ?

This indicates that the battery is of such a size that it will deliver a current of one ampere for 60 hours, 2 amperes for 30 hours, 4 amperes for 15 hours, and so on, before requiring re-charging.

The capacity is sometimes given in "ignition" ampere-hours, which is double the "actual" capacity. Thus, if an accumulator is described as being of 50 amp. hours ignition capacity, it will only give one amp. for 25 hours.

What is meant by negative grid bias ?

When using fairly high voltages upon the anode of an amplifying valve, it is desirable to apply an additional negative potential upon the grid (by means of one or two dry cells included in the grid circuit), to ensure that the average steady current through the valve corresponds to a point about halfway up the straight part of the characteristic curve. This additional grid potential is always negative, and is known as "negative grid bias."

What precautions should be taken to ensure the clearest reproduction by a loud-speaker ?

Assuming that distortion has been eliminated as far as possible in the circuits of the receiver itself, first turn the adjusting screw of the loud-speaker until the best result is obtained, and then experiment with various sizes of fixed condenser across its windings. In the case of a low-resistance instrument the requisite capacity will be quite large, an average value being 0.25 μF, and it will greatly improve the performance of the loud-speaker when provided. The effect is less marked with the high-resistance type, but is nevertheless present, and should be taken into account. A good value in this instance is 0.005 μF.

A very important adjustment to obtain the most satisfactory results is that of the volume or loudness of the signals ; it is utterly useless to apply an input power large enough for a Magnavox Senior to one of the "baby" or "junior" varieties of loud-speaker, for the inevitable result is severe distortion from the ruthless overloading. Always adjust the strength of the signals to such a point that the loud-speaker is taking just as much as it will carry without beginning to distort seriously, and never give it more. It is a most senseless proceeding to pile on valve after valve until the diaphragm is rattling against the pole-pieces and the horn is ringing with all sorts of notes and their harmonics, and yet it is all too common. If it is necessary to reduce the signal strength even when a moderate number of valves are in use, it should be done by slightly de-tuning the receiving circuits, which often reduces distortion, rather than by turning down the valve filaments, which may increase it.

Practical Workshop Hints.

Ebonite—A Panel Tip—Simple Tapping—The Breast Drill

DON'T try to work ebonite with wood tools. You *can* cut it with a chisel, and you *can* plane its edges; but both plane and chisel suffer severely in the process. Ebonite, which is made from india-rubber, is an exceedingly tough substance, which blunts even metal tools very rapidly unless care is taken. A little oil or turpentine used as a lubricant when drilling, for example, adds considerably to the useful life of one's twist drills. Never try to put wood screws into ebonite. Amongst other things the pitch of their thread is far too steep to enable them to work their way into it, and if you try to use them you will most certainly twist off their heads and be unable to extract them. The only wood tool which may legitimately be used for ebonite working is the tenon or stiff-backed saw, which is very useful for cutting it, since it enables you to make a perfectly straight edge.

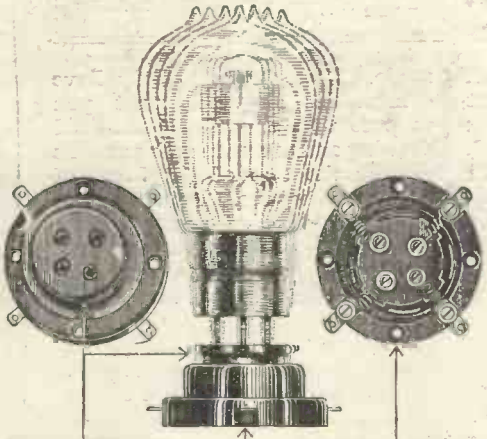
* * *

When you are laying out the panel either of a complete set or of some smaller piece of apparatus, it is always best to make a full-sized drawing, unless, of course, a blue print is available. By doing this you avoid any possibility of making mistakes in the positions of holes and so on which you may very easily do when taking your measurements off small drawings. Even the blue print will not be completely satisfactory unless you are using exactly the same components as those with which it is made. Should you already have components in stock that you propose to use, make a full-sized drawing and cut out paper patterns exactly the size of the bases of these components. You can then move your paper patterns about on the drawing until you find the best positions for fitting them in. A full-sized drawing is very easily made with the aid of a drawing board, a T-square, and a foot-rule. It need not be a beautifully finished piece of work so long as its dimensions are correct.

* * *

A beginner at constructional work is often rather at a loss when it comes to marking out ebonite panels. The first thing to do is to cut the panel absolutely square with perfectly straight edges and right-angled corners. This may be done with the help of a set-square and a medium file. There are three quite distinct methods of marking out, each of which has much to recommend it. Perhaps the best of all, at any rate for those who have not had much practice in the workshop, is this. Take a piece of thin white paper and stick it on to the panel with stickphast or some other adhesive. Press the paper well down round the edges and trim it off with a pair of scissors or a sharp knife. Now make use of the set-square and a pencil to do the marking out. When you have got the positions of their centres mark each with a centre punch, and then wash off the paper. In this way there is no chance of injuring the panel by

Mr. John Scott-Taggart, F. Inst. P., A.M.I.E.E., writing about the Anti-Phonic Valve Holder in the "Wireless Weekly," said, "I consider this new component as an example of enterprise which is curiously lacking in the industry to-day."



The Anti-Phonic Valve Holder.

THE Anti-Phonic Valve Holder prolongs the life of any type of valve and eliminates the microphonic noises usually associated with the dull-emitter type. In the long run, the use of this component means less expenditure on valves. As will be seen from the above illustration, the valve holder proper is insulated from mechanical shocks by a four-point spring suspension. The centre sketch shows how a valve vibrates at a touch of the finger. The valve sockets are countersunk, so eliminating the risk of short circuits, and there is no capacity between the sockets, as there are no nuts on them.

The advantages of fitting Anti-Phonic Valve Holders are many, and for use in portable sets they are ideal.

No. 401. Anti-Phonic Valve Holder, diameter 2⅛ in., height just over 1 in. For panel or base mounting. In carton, with screws, 6s.

Burndept coils for long-distance short-wave reception

MANY experiments have proved that stations transmitting on short waves can be received at very great distances, and this year more wireless enthusiasts than ever are building receivers for short-wave reception. Burndept Coils are ideal for use in such instruments because their high-frequency resistance and self-capacity are extremely low. The efficiency of Burndept Coils is well known. The complete range covers all wavelengths from 80 to 25,000 metres. The spring socket fittings of Burndept Coils are non-reversible and make perfect electrical contact.

Set of 4 Extra Short-Wave Coils (8–150 metres)	16s.
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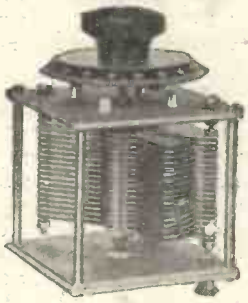
Set of 9 Coils, S. 5 to 1,000 (750–20,000 metres) ..	£3 16s. 6d.

Prices of single Coils on application.



Burndept Standard Condensers

THE actual capacity of Burndept Standard Variable Condensers is guaranteed to be within a very small percentage of the stated capacity, and of the power applied to them only 0.05 per cent. is lost. Tuning is very sharp and signal strength greatly increased when these efficient condensers are used. Slight wear is automatically taken up without the capacity of the condenser being changed. The movement is very smooth. Steel snap-on dust covers eliminate hand-capacity effects. The upper illustration shows a Standard Condenser without dust covers and the lower illustration, with them.

BURNDEPT STANDARD CONDENSERS

No.417, capacity .0005 mfds., £1 2s. 6d.
No.417, capacity .001 mfds., £1 7s. 6d.

Write for full particulars of the newly-designed Burndept Wireless apparatus to Head Offices or to the nearest Provincial Branch:—LEEDS: 12, Basinghall St. (near City Square); CARDIFF: 67, Queen St.; NORTHAMPTON: 10, The Drapery.

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Telegrams: Burndept, Westrand, London.

scratching it, and marking out can be very neatly and accurately done. The second method is to use a lead pencil for marking on the ebonite itself. This is not completely satisfactory for two reasons. In the first place the graphite of which pencil "leads" are composed is a good conductor of high frequency current, and unless it is entirely removed, the set may not work properly. Secondly, it is not easy to see pencil marks on ebonite in certain lights, and they may become blurred or obliterated by handling. If you wish to use a pencil for marking directly on to the ebonite, do so before removing the shiny outer surface. You are then certain of getting rid of all the graphite when the finishing process takes place. The third method is to make use of a scriber. When this is done marking out should always take place on the underside of the panel, for if it is done on the top the removal of the scratches will be found to be a very laborious business.

* * *

In the last paragraph the removal of the polished surface of ebonite was mentioned. It is essential to do this unless you are using some brand which is guaranteed to have a non-conducting surface. Much of the commercial ebonite on the market receives its high polish by being pressed between sheets of tin foil. In the process some of the metal is apt to adhere to the ebonite, making the surface leaky. The best way of removing the gloss is to use a piece of the finest emery cloth which has previously seen a good deal of wear. New emery cloth is too keen and is apt to make deep scratches. Wrap it round a large flat cork and work over the panel in one direction only, that is, don't go first of all straight away from you and then from side to side. A very little labour will suffice to remove the polish and the panel may then be finished up in the following way. Make a piece of rag into a pad, moisten it with oil and sprinkle it with knife powder. Then work it in the same direction as the emery cloth was worked. When the process is completed wash the panel well to ensure that all fragments of emery and of knife powder are removed. To show how serious are the effects of allowing the glossy surface to remain, let me mention the results of some tests made recently with various samples of ebonite just as they came from the shop. The method used was to drill pairs of holes an inch apart into which terminals were inserted. A "Megger" (insulation tester) was then attached to the terminals and the insulation resistance read. Of four samples the best resistance found was just under one megohm and the worst rather less than 30,000 ohms. A set made up with ebonite of this kind could never have worked satisfactorily, since there would have been high resistance leaks everywhere between valve legs, terminals and so on. The same tests were repeated with the glossy surface removed, and in every case an "infinity" reading was obtained.

I warned you in an earlier paragraph against attempting to use wood screws in ebonite. Metal screws of the B.A. sizes should always be used, holes for them being threaded with a tap. It is possible to drive metal screws into ebonite by making the holes for them two sizes less than the clearance size. Drilling sizes, by

the way, are a purely arbitrary series, running from 1 to 60. The clearance size, for example, for a 4 B.A. screw—this is the screw most commonly used in wireless constructional work—is No. 26. By making a hole with a No. 24 drill and going carefully, a screw can be turned straight in without any tapping. The process is made easier if turpentine or oil is used as a lubricant. For tapping we require to drill holes a good deal smaller than those through which the screw will pass easily. The tapping size for 4 B.A. is No. 34. The tap to use is of the type known as second cut. Many people think that threading holes is a difficult business. This is probably because they have never tried to do it. If you arm yourself with a tap fixed in a wrench and a few odd pieces of scrap ebonite, you will find that a very small amount of practice enables you to tap holes most successfully.

* * *

One of the wireless constructors' most important allies is the breast drill, with whose help he can make in ebonite or brass any hole required for wireless work. When you are buying a breast drill get the best that you can obtain. It is very poor economy to pass by a really good drill and to purchase something inferior for a couple of shillings less. A badly made breast drill is a source of endless trouble, for its bearings become loose after a little while and the jaws of its chuck are too soft to stand up properly to the work that they have to perform. When it has been in use for some time they refuse to grip the drill tightly and you may have quite an amount of trouble in getting the drills correctly centred up in them. Exceedingly good work can be done with a breast drill if one takes proper care. Never try to make a hole in ebonite or brass without first of all making a punch mark to indicate its centre. If you omit this precaution the drill will probably slip, with the result that when the hole is made it will be slightly out of place. See that the drill is vertical as it goes in, and do not exercise too much pressure. If you push too hard upon the handle the drill on coming out on the underside of the panel will break away small pieces of the ebonite, making a rough, ragged-looking hole. Don't turn the crank too fast. Ebonite demands medium speeds. It heats it rapidly if the drill is turned too fast, to the detriment both of the drill and of its insulating qualities. The smaller drills may be run through very quickly, but the larger ones, such as those ⅜ in. in diameter, required for making the holes for condenser and rheostat spindles, must be allowed to do their work quite slowly.

When the Beginner Buys a Valve.

By R. W. Hallows, M.A.,
Staff Editor.

ONE of the first difficulties which confronts the beginner is to select a valve suitable for his receiving set. I do not know exactly how many different receiving valves there are available at the present moment, but the number is certainly a large one, and as each of them is, of course, "the best," the beginner's task is apt to be rather bewildering. To start with, he must decide whether he is going to use an accumulator or dry cells for heating the filaments.

Choice of Batteries

On this point let me say that if you can possibly use an accumulator do so, for, though dry cells will give passable results, no receiving set will work quite as well with them as with a secondary battery. The reason is that a dry cell of good make starts with a voltage of usually rather more than 1·5 across the cells, and that as soon as it is brought into use its voltage begins to fall off because the resistance within the cell increases

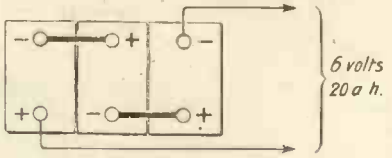


Fig. 1.—3 cells connected in series to give 6 volts.

as current is taken from it. This means that at the end of, say, a couple of hours' use the voltage of the filament battery has decreased to an extent which depends upon the amount of current drawn from it. Reception has, therefore, been growing slowly less and less good, though its decline and quality is so gradual that it is hardly noticeable. If the battery is given a good rest before being brought into use again, it will pick up until it almost reaches its original voltage. Then as it delivers current to the filament its E.M.F. will fall off until at the end of the second period of two hours it is rather lower than it was after the first. And so it goes on falling off and picking up as it is worked and rested, until finally a point is reached at which it cannot supply the necessary voltage. With an accumulator things are quite different.

Accumulator Voltage

Almost as soon as it is brought into use the voltage falls to a value of approximately two volts per cell, and it remains there without any further drop until the battery is almost discharged. Then it declines rapidly and provides a sure indication that a visit to the charging station is necessary. If you live in the depths of the country where it is impossible to get accumulators charged, then you must perforce decide upon dry cells, ; but supposing that you *can* get charging done, even though it may entail a little inconvenience, then plump for the accumulator in preference to the dry battery.

Actual Capacity

Now with a six-volt accumulator you have the voltage necessary for operating any ordinary type of receiving valve. Your choice here will be covered only by the capacity of your battery and the number of valves that you desire to use. The capacity of the battery is reckoned in ampere hours, and for wireless purposes we require to know not the intermittent or ignition rating, but the *actual* capacity. The actual capacity is half the intermittent.

Discharge Rates

The safe discharge rate for any well-made accumulator is on the average about one-tenth of its actual ampere hour capacity. Thus we can take two amperes from a 20 a.h. accumulator, five from a 50, and so on. If you already possess, or contemplate buying, a 20 ampere-hour accumulator, then the maximum amount of bright emitter valves that can be used with it is three, and it will be best not to use more than two. Most bright emitters have a filament current consumption when new of about ·7 ampere. Should you desire to work a four or five-valve set from an accumulator of the size mentioned, it will be best to go in for valves of the low-consumption type with a rating of not more than ·4 ampere apiece. Or, again, we may make certain alterations in your accumulator.

Battery Connections

The cells are usually connected in series as shown in Fig. 1, so that the voltage at the terminals is six. If, however, the connections are made by means of metal strips fixed to terminals, it

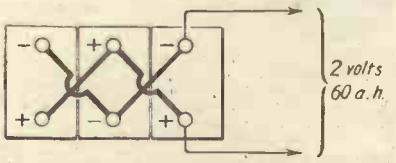


Fig. 2.—3 cells in parallel to give 2 volts for dull emitters.

is quite easy to alter them in the way shown in Fig. 2, so that they are in parallel, in which case the voltage will be two, but the rating of the battery in ampere hours will be practically trebled. With the battery arranged in this way you can make use of low-voltage dull emitters such as the D.E.R., the A.R.D.E., the L.F. Ora, the Cossor "Wuncell," and the B.T.H. B3, all of which require between 1·6 and 2 volts and consume from ·3 to ·4 ampere. These are all robust and efficient valves, very long lived

owing to their comparatively stout filaments and to the low temperature at which they work. There are, again, valves with still smaller requirements such as the Wecovalve, the One Volt Ora, and the Dextraudion, all of which can be used economically from a two-volt battery. Any of these last three will also function with a single dry cell for filament heating purposes. As both the Wecovalve and the One Volt Ora draw ·25 ampere, it is desirable that the single cell, if used, should be of large size; a quarter of an ampere is too great a load for any small dry cell to stand up to for more than a short period on end. The Dextraudion, which consumes only about ·1 ampere, can be worked satisfactorily off a single bell cell of good make.

Dry Battery Valves

I think, though, that the man who must necessarily use dry cells for providing his low-tension current would do best to confine himself to valves of the "06" type. These are the D.E. 3, the D.F. Ora, the A.R. 06, and the B. 5. All of these require a filament potential of between 2·5 and 3 volts, and take a current of only 60 milliamperes. (A milliampere, by the way, is a thousandth of an ampere.) They, therefore, place a very small strain upon dry cells and can be worked quite well with three of them in series provided that a rheostat with a maximum resistance of about 30 ohms is used.

All of the valves previously mentioned are of the "general purpose" type, that is they can be used in any part of the set and will give good results there. The general purpose valve is most convenient since only a single spare need be kept. If a valve in any part of the set goes wrong the spare can be used to replace it without detriment to results. The beginner would, I think, be well advised to confine himself to general purpose valves, to start with at any rate. Having decided upon the type of valve he requires to suit his purposes, he will not go wrong if he purchases one made by any reliable and well-known firm of makers.

Buy Good Valves

In valves, as in all other wireless goods, you get what you pay for. It is therefore a poor kind of economy to "save" a shilling or two by purchasing cheap or foreign made valves which are usually very greedy in their current requirements, unstable in use, and short lived.

Special Valves

Later on, when the beginner has learned something about the way in which valves work and has had some experience of handling them, he may go in for special valves, such as those designed to function solely as either high-frequency amplifiers or rectifiers. When he is no longer satisfied with head telephones and yearns for a loud-speaker, he may take to the power valve for low-frequency amplifying purposes, and here he will find something to match, in its requirements from the low-tension battery, valves which he already possesses. Such is the range of small-power valves nowadays that whether you use in the rest of the set bright emitters, low-voltage dull emitters or "06" valves, you can obtain a power valve operating at about the same filament voltage and drawing only a little more current from the battery.

ANOTHER FREE BLUEPRINT NEXT MONTH!

Adding a Valve to a Crystal Set

By E. REDPATH.

An instructive article of particular interest to all readers who contemplate improving the performance of their crystal sets by the addition of a valve.

"MINE is only a crystal set, and, although it has served its purpose quite well up to the present, I should like to obtain better results. What do you recommend?"

Although the above query could be answered in a few words by saying: "Add a valve as an amplifier," there are no doubt many readers to whom the matter is not as clear as the proverbial pikestaff and who desire to obtain further information on the subject to enable them to proceed.

In the present article, therefore, the writer will explain two simple and practical methods of adding a valve to an existing receiving set either as a *low-frequency* amplifier, for the purpose of increasing the volume or strength of signals already received on the crystal set alone, or as a *high-frequency* amplifier, primarily to effect reception over a greater distance.

Low-frequency Amplification

At A, B, C and D (Fig. 1), are shewn four typical crystal receiver circuits with the various components illustrated pictorially, so that readers unfamiliar with the conventional signs or "shorthand" of wireless will have no difficulty in recognising them.

A—represents a single-circuit receiver, the aerial being tuned by means of a slider inductance coil, L.

B—represents a single-circuit receiver with variometer tuning.

C—another single-circuit receiver with fixed inductance L (usually a "plug-in" coil) and variable condenser C, by means of which the aerial tuning is varied.

D—an inductively-coupled receiver comprising an aerial circuit (A, C, L, E) and a "closed" or secondary circuit (L_1, C_1), the

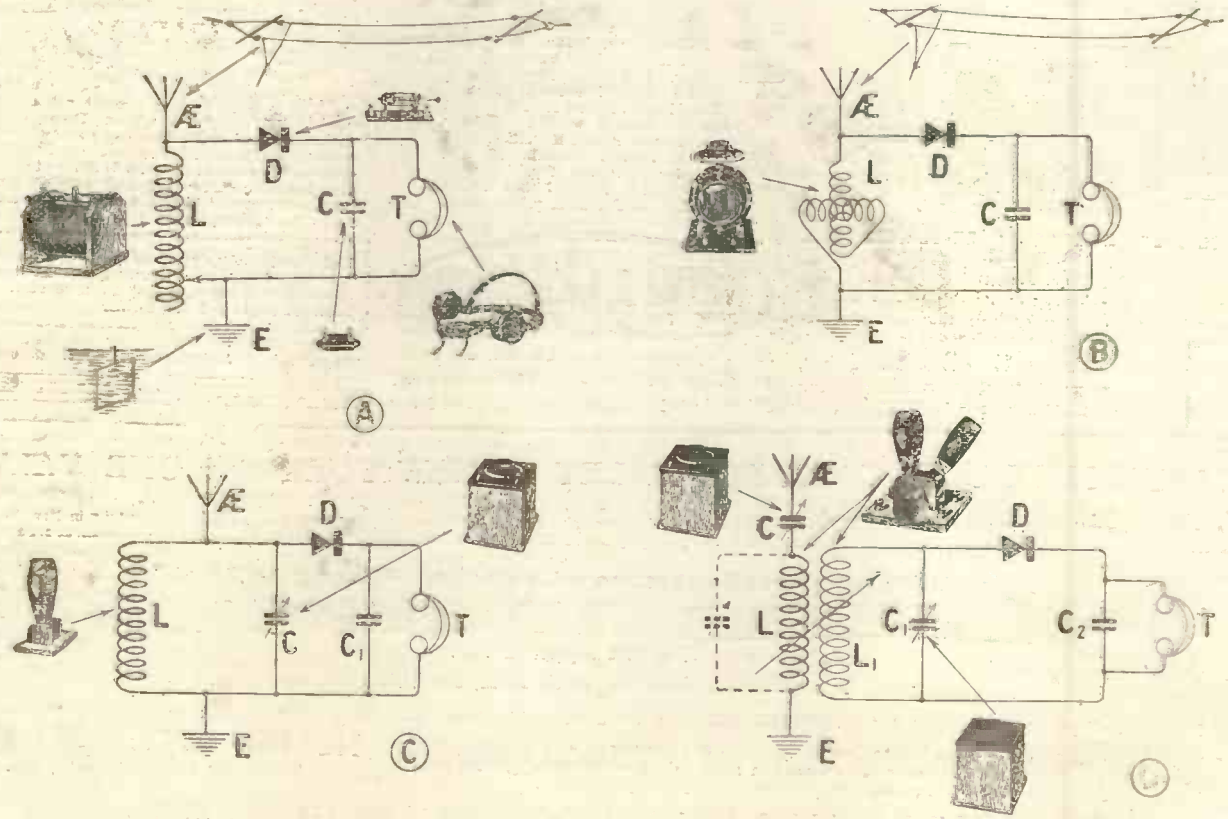


Fig. 1.—Four typical crystal circuits with pictorial representation of the components.

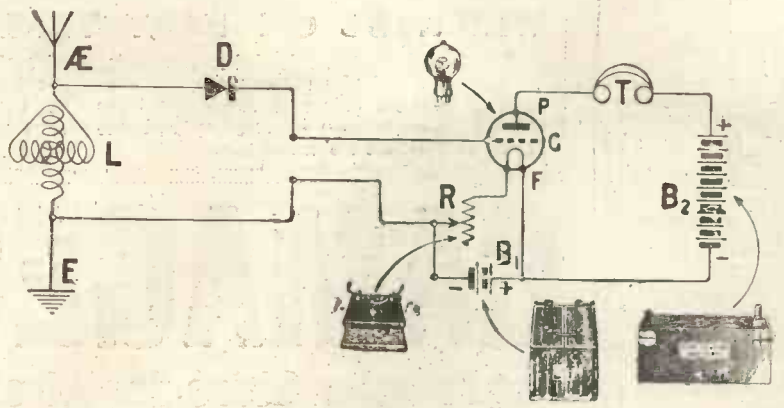


Fig. 2.—The simplest method of note magnification.

electro-magnetic coupling between the coils L and L_1 being variable, as indicated by the arrow drawn through them.

In each of the above circuits the crystal detector D and telephone receivers T (with more or less optional fixed condenser) are connected in series with one another across the aerial tuning inductance (as at A and B), or across the aerial condenser or secondary condenser (as at C and D respectively).

Your Own Arrangement

From inspection of the four diagrams of Fig. 1, the reader will be able to identify the arrangement of his own receiving set and, at the same time, he will notice that the connections of the detector and telephones are the same in each. The oscillatory currents set up in the aerial (or secondary) circuit are rectified by the crystal, and low-frequency pulses, due to the voice modulation at the transmitting station, flow through the windings of the telephones.

To any of these arrangements a valve can be added very easily. All that is necessary is that the low-frequency currents which normally traverse the telephone windings be applied to the grid-filament or "input" side of a three-electrode valve where they undergo amplification and may be made to give considerably increased signals in telephone receivers connected in the anode or "output" circuit of the valve.

The Simplest L.F. Amplifier

Fig. 2 illustrates what is possibly the simplest application of this principle. The telephone terminals of an ordinary receiving set, with telephone condenser removed, are connected to the grid and *negative* side of filament of a valve, whilst the telephones are connected between the plate or anode of the valve and the positive terminal of the high-tension or anode battery.

In this and all following diagrams depicting a valve, the reader should note the three essential "circuits" namely:—

1. The filament circuit, including the valve filament itself (F), the variable resistance (R) which controls the current flow and consequently the temperature of the filament, and the filament-lighting or low-tension battery B_1 (usually a four-volt accumulator).

2. The "grid-filament" or input circuit.

3. The "anode-filament" or output circuit, including the anode or plate (P), the high-tension battery B_2 with positive terminal always connected to the anode of the valve (in this instance via the telephone receivers T).

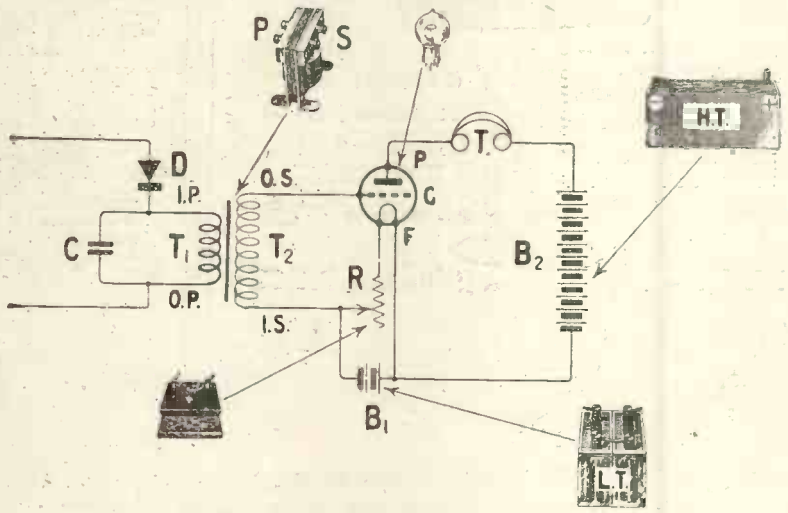


Fig. 3.—More efficient note magnification, using "step-up" transformer coupling.

With the arrangement shown in Fig. 2, the low-frequency pulses of current which originally actuated the telephones now cause a variation of grid potential and consequently, due to the action of the valve, an amplified change of anode-telephone current.

A More Practical Arrangement

It is, however, a fundamental law of the three-electrode valve that the greater the change of grid potential, the greater will be the change in anode current—within certain limits, of course, depending upon the type of valve, anode voltage, etc.

Accordingly improved results may be obtained by connecting the telephone termihals of the crystal set to the primary winding of a "step-up" transformer, the

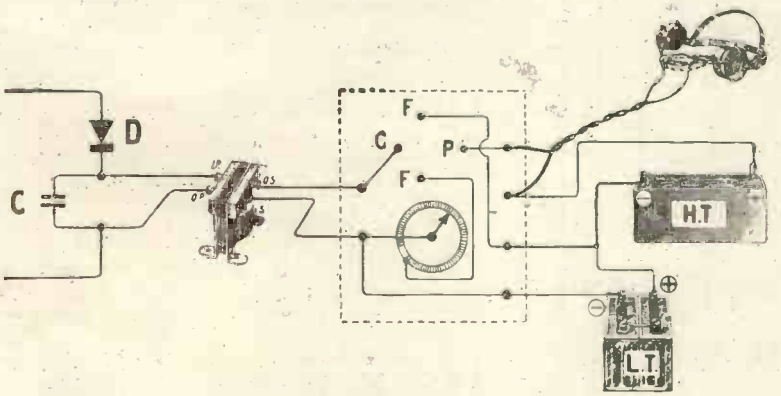


Fig. 4.—Pictorial and wiring diagram of Fig. 3 circuit.

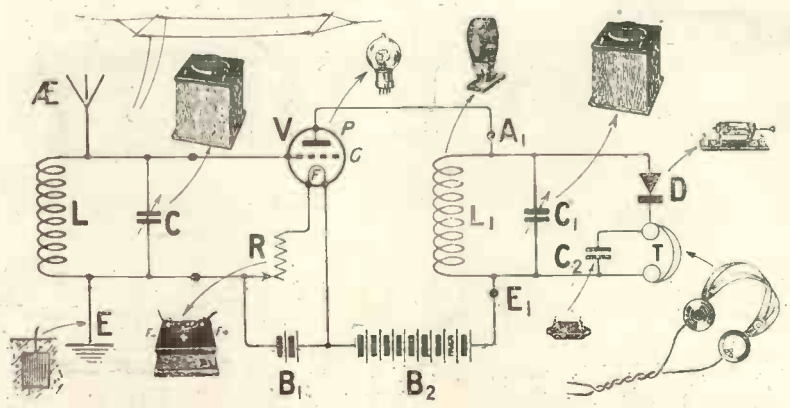


Fig. 5.—The valve used as a high-frequency amplifier.

secondary winding of which is connected to the grid and filament of the valve, as shewn in Fig. 3.

The "step-up" effect is obtained by winding the secondary of the transformer with a greater number of turns than the primary. If the ratio between the number of primary and secondary turns is too high, the variation of grid voltage may exceed the limit for the valve in use, so that the anode current does not vary in strict accordance, giving rise to distortion in the telephones.

Other Causes

There are other causes of distortion, however, and, as a result of much experimental work, several makers have evolved very satisfactory instruments, usually with a "step-up" ratio of 1 to 4, or 1 to 5. Frequently these figures are quoted the other way round, namely, 4 to 1, or 5 to 1, which, although really a "step-down," indicates the ratio between secondary and primary windings just the same.

A combined pictorial and wiring diagram of the Fig. 3 circuit is given in Fig. 4, in which the transformer is shewn with primary winding connected to the telephone terminals of *any crystal receiving set.*

Components Required for L.F. Amplifier

By means of the arrangement shewn in Fig. 4, the strength of signals may be increased some 4 to 5 times, and the items required are as follows :—

1 Iron-core Transformer of reliable make. Step-up ratio 1 : 5 recommended.
1 Valveholder. } Preferably mounted upon a small
1 Filament Rheostat. } panel. See Figs. 7 and 8.
1 Filament-lighting Battery. A 4-volt accumulator for bright-emitter valves; a 2-volt accumulator or dry-cells for dull-emitter valves, according to voltage recommended by the valve makers.
1 High-tension or Anode Battery, 40 to 80 volts.

Two Simple Rules

By careful observance of the following simple rules, readers who are about to handle valve apparatus for the first time will avoid slight mishaps which may cause considerable annoyance and, occasionally, expense.

A.—When connecting up, insert the valve in its holder *first*, then connect the filament battery and turn the rheostat so as to light the valve. Connect the high-tension battery *last.*

B.—After using the set, turn the rheostat so as to *extinguish* the filament; remove both plugs from the high-tension battery and disconnect one lead from the filament battery (*at the battery terminal*).

In some cases it may be found that the gain in signal strength is not what it should be. A reversal of the leads from the transformer secondary will probably put matters right.

High-frequency Amplification

A very effective method of employing a single-valve as a high-frequency amplifier in conjunction with an existing crystal receiving set is illustrated in Fig. 5. In this arrangement the valve amplifies the oscillatory currents *before* they are applied to the detector, so that signals which are too feeble to actuate the detector direct may be strengthened sufficiently to do so.

Two Tuned Circuits

Reference to the diagram will show that there are two tuned circuits, the aerial circuit L C and an additional closed circuit introduced between the anode of the valve and the positive terminal of the H.T. battery. The latter circuit, comprising the inductance L_1, and the variable condenser C_1, is known as the tuned-anode circuit, and the crystal detector D and telephones T (with small fixed condenser C_2) are connected across C_1, exactly as in a crystal receiving set. There is no need to disturb an existing set, *provided that it can be tuned over the desired range of wavelengths without the usual capacity of the aerial.*

Plug-in Coils

If the tuning arrangements of the original set comprise a plug-in coil and parallel variable condenser, it will be necessary merely to use a No. 50 or No. 75 coil instead of the No. 35, but if the set is of the type illustrated at A or B in Fig. 1, it will be necessary to connect a "compensating" condenser across the aerial and earth terminals in order to permit of tuning over approximately the same range of wavelengths as when the aerial was connected. A fixed condenser with a capacity of 0.0002 or 0.0003 μF will be found suitable.

Alternatively, the existing tuner (with crystal detector and telephone condenser removed) may be connected in the aerial circuit and to the grid and negative filament of the valve, whilst a plug-in coil in a fixed holder and a 0.0005 μF variable condenser may be purchased and connected at L_1 and C_1 respectively, the crystal and telephones being connected across C_1 as shewn in Fig. 5. The important point to note is, that when operating the complete arrangement, both the aerial and the closed

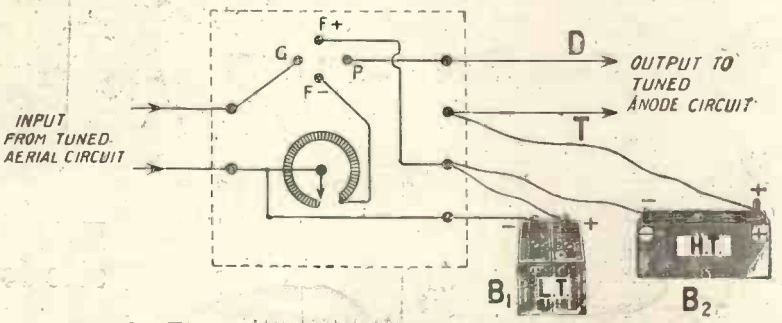


Fig. 6.—The valve connection of the Fig. 5 circuit.

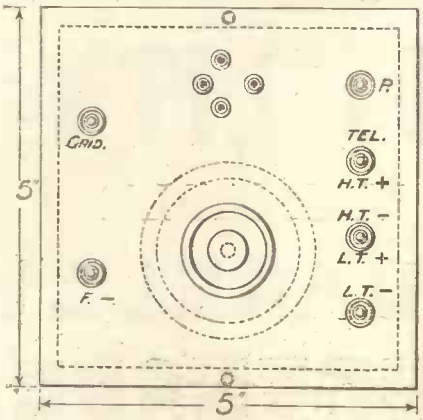


Fig. 7.—A suitable valve panel.

circuit must be tuned to the desired wavelength.

In the case of an inductively-coupled crystal receiving set, as illustrated at (D) in Fig. 1 for instance, the closed circuit L_1 C_1 will be suitably proportioned to cover the same wavelengths as the aerial circuit, and no compensating condenser or other addition will be required. A set of this type lends itself very readily to the addition of a high-frequency amplifying valve, which, as shown in Fig. 5, acts as a kind of connecting (and amplifying) link between the aerial and closed circuits of the original set.

Possibly this will be understood more clearly on reference to Fig. 6, which indicates the "input" to the valve panel from the aerial circuit; the actual panel and battery connections; and the "output" to the tuned-anode circuit (L_1 C_1 of Fig. 5).

A Convenient Valve Panel

Figs. 7 and 8, a front view and "back-of-panel" wiring diagram respectively, illustrate the construction of an inexpensive, easily constructed and effective valve panel by means of which readers may experiment in both low and high-frequency amplification as explained in this article.

The materials required for the construction of this "panel" are readily obtainable from almost any wireless dealer, and are as follows: One piece of ebonite 5 in. by 5 in. by ¼ in. thick; one filament rheostat; four valve sockets; six terminals; and a shallow containing box to carry the panel, or alternatively, four supports, such as cotton reels, one at each corner of the panel.

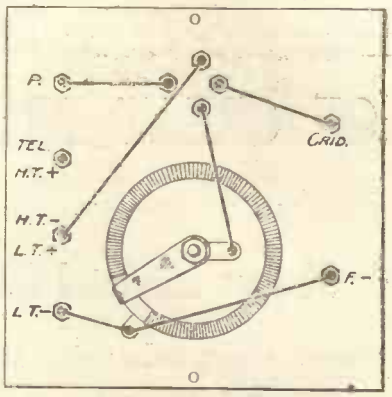
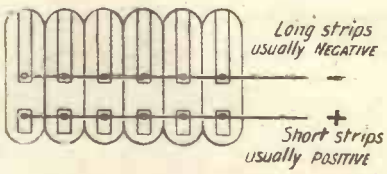


Fig. 8.—Wiring diagram for valve panel.

An Emergency Filament Battery.

IF your accumulator should run down during an interesting programme, there is no necessity to miss the rest if you have a few pocket lamp batteries handy. The H.T. battery, if made up from such cells, may be robbed.

As many cells as can be procured are connected up in parallel, *i.e.*, all the positives are joined together and connected to the L.T.+ terminal of the receiver, and the



negatives to the L.T.—. One pocket lamp cell of good make will last one valve if used carefully for about ¾ of an hour. The accompanying sketch shows such a makeshift L.T. supply ready for use.

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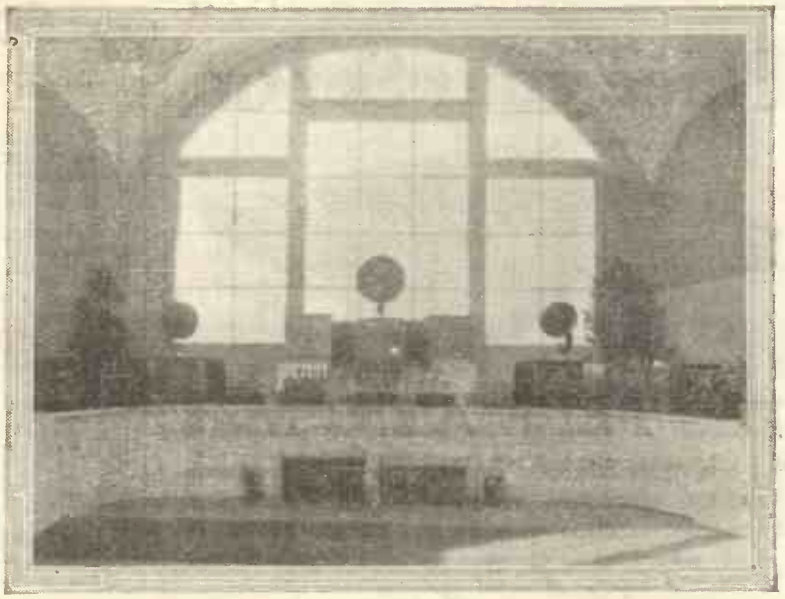

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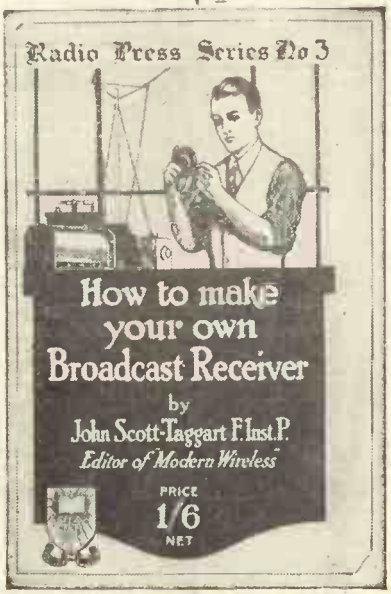

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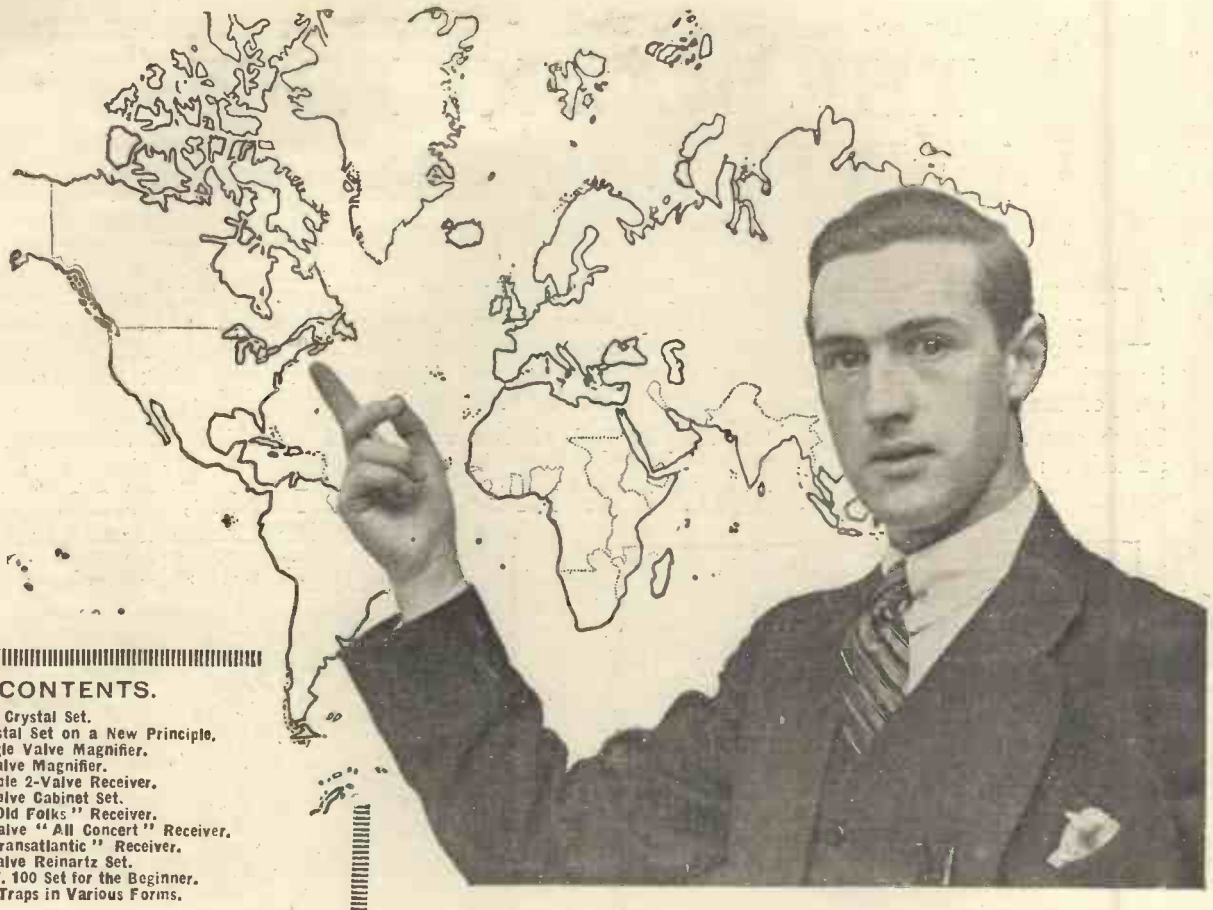

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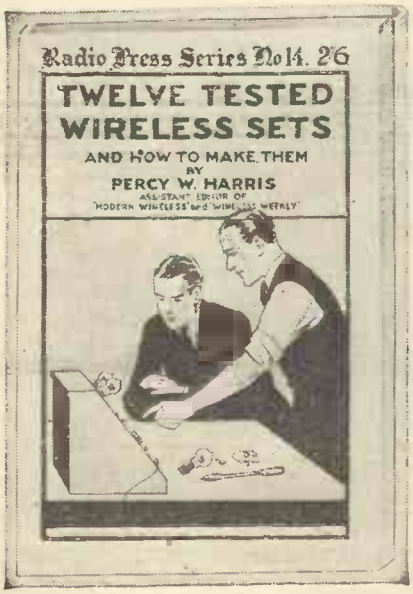

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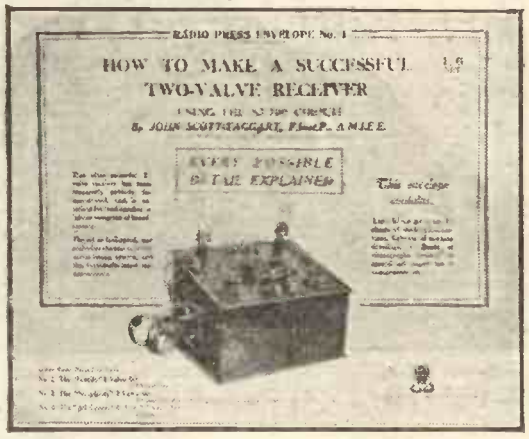

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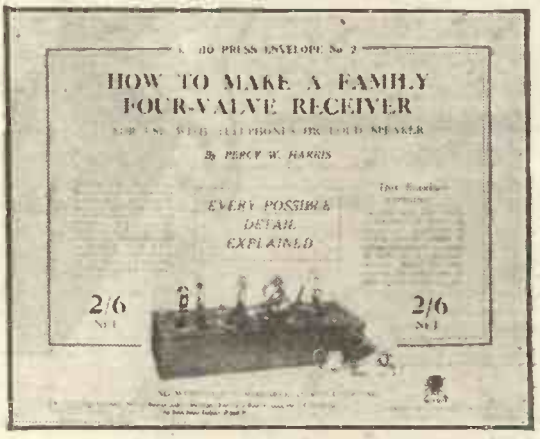

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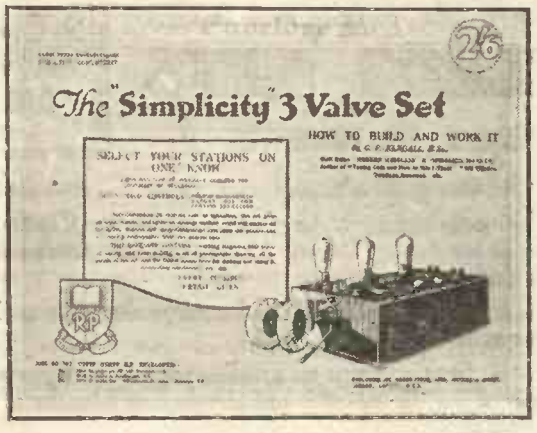

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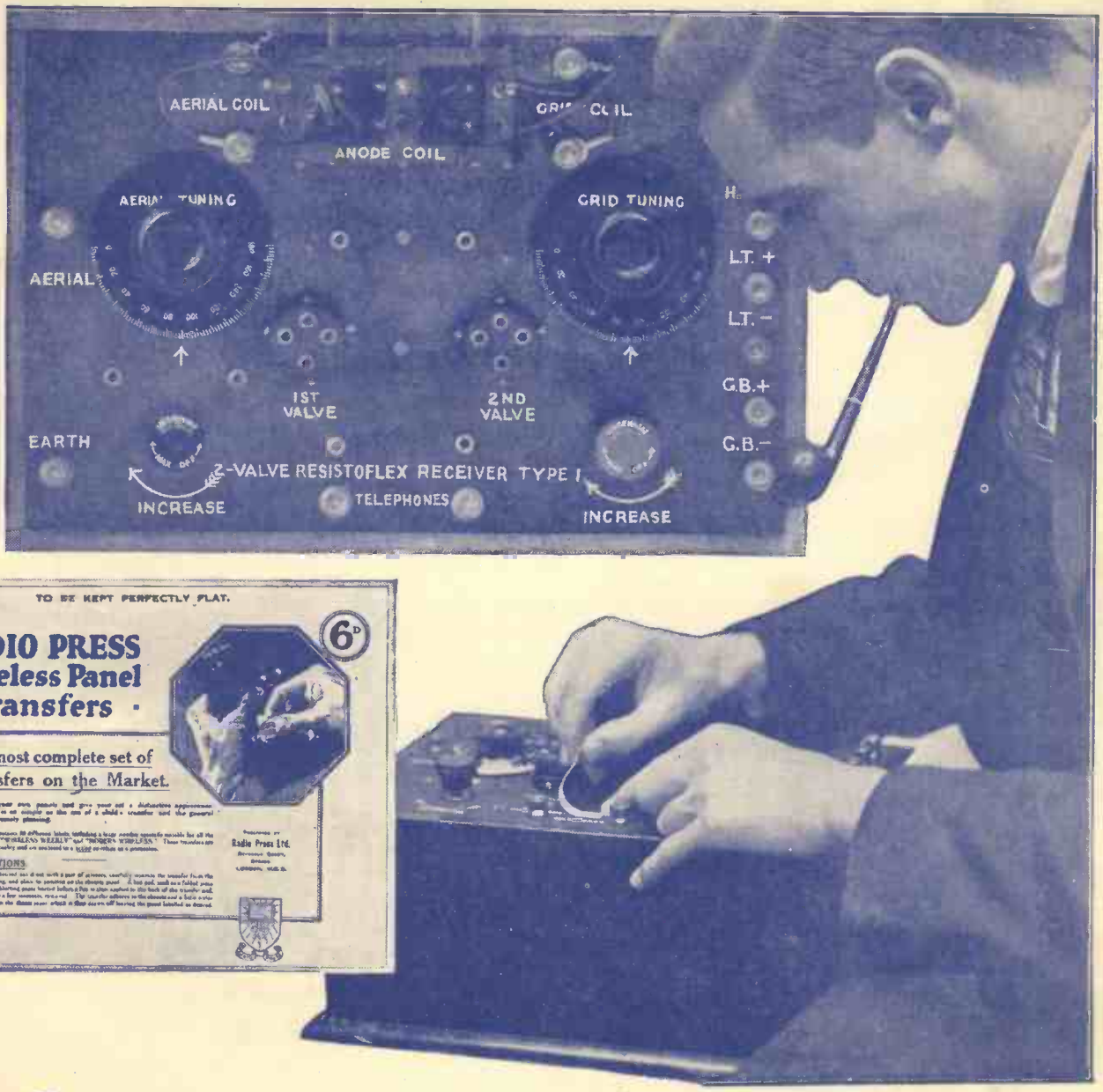

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