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Wireless Weekly

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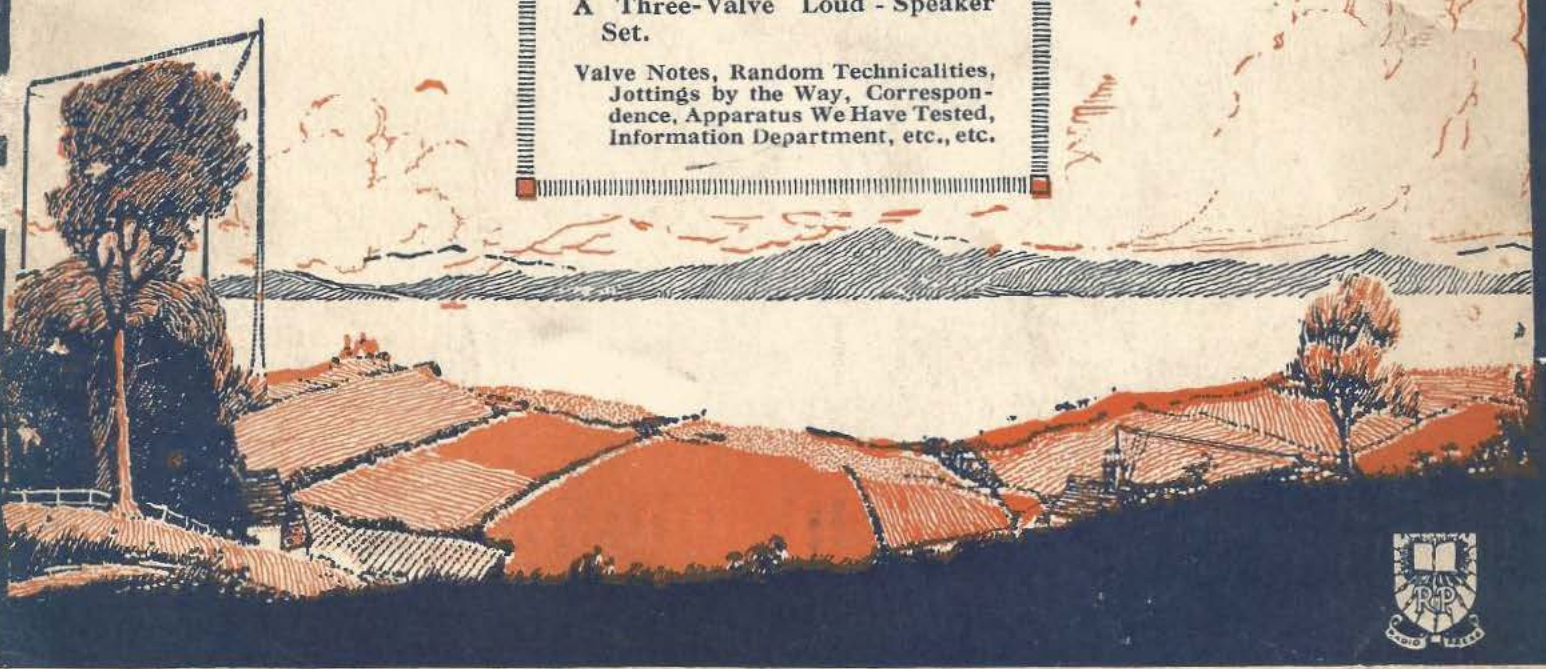

12 Page Photogravure Supplement

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Wireless Weekly

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Our Photogravure Supplement

WE are pleased to be able to present to readers of *Wireless Weekly* a new feature unique in British wireless journalism. The twelve pages of photogravure reproduction which appear in this issue, represent the latest advance in reproduction and show in a way heretofore impossible the minutest details of the wireless sets for which Radio Press, Ltd., are so well known. It is perhaps unnecessary to add that never before in any British wireless periodical has the photogravure process been used.

So far as we are concerned, the use of this process is by way of an experiment. The process is extremely expensive, and the high cost of production is one of the reasons why such supplements have never before been given in British wireless periodicals. It is our present intention to present a series of these photogravure sections in alternate issues, and the next will therefore appear in *Wireless Weekly* for November 5. The process, of course, from the reader's point of view, has many advantages—it enables him to see every detail of the apparatus in almost stereoscopic relief, just as if he had an original photograph before him. It is, in fact, the nearest that can be reached to delivering sets for inspection with every copy of the paper! We therefore cordially invite readers to give us their opinion on the matter, and to state whether they consider that the reproduction is a decided advantage. If we feel that the new method of reproduction is widely appreciated we will see whether it is possible to make this feature permanent. It should be pointed out that, in any case, until the cost of photogravure reproduction is considerably reduced, it will not be practicable to print the whole of *Wireless Weekly* by this process.

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The Supersonic Heterodyne

Readers will welcome, we are sure, the commencement of a new series of articles on Supersonic Heterodyne reception. This method, unlike many freak methods which have been presented with great claims within the last few years, is steadily gaining in popularity throughout the world, whereas many schemes which promised well in the first few months of their history have now been relegated to the limbo of forgotten things. As it is quite impossible to give practical instructions for the building of a Supersonic Heterodyne receiver until the reader is fully acquainted with the principles involved, the first one or two articles will be of a theoretical nature, and should be carefully studied by every experimenter who intends to begin work in this fascinating field. Much of the present popularity of Supersonic Heterodyne receivers in the United States is due to the fact that really efficient dull emitter valves are now obtainable. In the early days of the Supersonic receiver—and it should be remembered that the principle does not begin to show real merit until a number of valves are used—it was impracticable for the average experimenter to supply the necessary filament current, for with, say, eight valves, using up to an ampere each, the low-tension supply was a serious problem. Nowadays, using the .06 ampere valves, a 10-valve set can be run from an accumulator which, a year or two ago, would have been barely large enough to run a single valve set.

The Design of Resistance— Capacity Coupled Low Frequency Amplifiers

By H. J. ROUND, M.C.

A most important contribution to radio work by the famous research engineer of the Marconi Company.

I AM going to consider that useful wireless device called the resistance amplifier, and chiefly that part of it which comes before the last or power valve, and I hope to show how easy it is to consider the device quantitatively and, in fact, design it on paper with every expectation of its performance agreeing with the calculation.

Certain practical precautions, in addition to those calculated, have to be taken, such as shielding when using many valves, anti-microphonic mounting, etc., but these have no doubt been

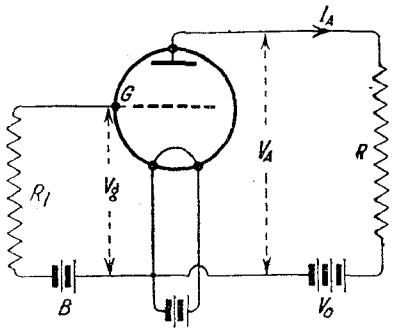


Fig. 1.—A resistance amplifier unit.

dealt with elsewhere, and if not can be handled later on.

As I cannot, of course, give characteristics for all valves in common use, these will either have to be obtained from the maker or experimentally determined—quite an easy job, if you have milliammeters and voltmeters. The makers may possibly send you the characteristic of the valve as a series of curves plotted between grid volts and plate current at a fixed value of plate volts.

An Interesting Conversion

A little consideration will show you how to convert and redraw to the much more useful characteristic which I am going to use.

The unit of a resistance amplifier (Fig. 1) consists of a valve the plate of which is connected to a resistance. The other end of the resistance is connected to the high-tension battery Vo. In most cases the grid will be connected to a resistance R1, this in turn to a grid bias battery B. Sets of units are coupled together by condensers, as shown in Fig. 2.

Voltage Drop

We will always assume that the grid can be set at any required static potential by means of B (Fig. 1), and that on this potential as a base point the variable potential to be magnified can be applied. Suppose G is set at such a potential Vg that a current of IA amperes is flowing through the plate circuit of the valve, then this current flows through R, and, reasoning directly from Ohms law, there is a voltage drop down the resistance R of IAR. If the voltage of the H.T. battery is Vo, obviously what voltage is left is Vo−IAR, which is the voltage VA across the valve. If G is raised positively in potential then IA is increased and IAR is increased, and the voltage VA

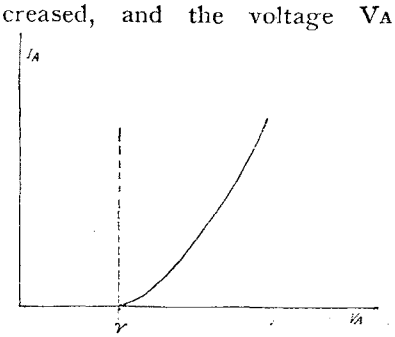


Fig. 3.—The first curve.

across the valve is reduced. This is the chief peculiarity of nearly all valve circuits—as the voltage of the grid is raised then the voltage across the valve falls.

I am going to show how you can determine, more or less exactly, what this change of voltage across R is for any change of voltage on the grid, and, incidentally, how you can compare different valves, different values of resistance, and also determine the grid negative bias to use with any particular arrangement.

Three Variables

We have dealt with three variable quantities—the grid voltage Vg, the plate voltage VA, and the plate current IA. Suppose we fix Vg by means of a dry-

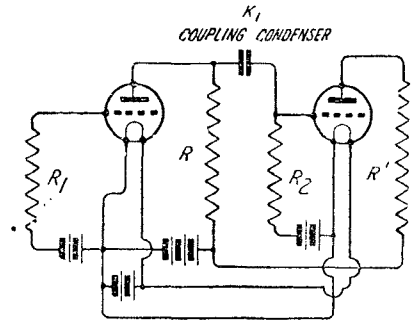


Fig. 2.—How units are coupled.

cell battery at some arbitrary potential—a negative one, as we shall see, is more useful—and now remove or short circuit our resistance, and step by step alter Vo (the battery voltage and the plate voltage now are the same), in each case taking by means of a milliammeter the value of IA. A curve shown in Fig. 3 is obtained. The valve does not start conducting until we reach a value v of the plate voltage, and then the current rises with increasing rapidity.

Suppose we alter Vg to another value, again taking a curve, we shall end up with a series of curves against each of which we can mark the value of Vg (Fig. 4).

Now Fig. 5 is a concrete curve

which I drew for an ordinary R valve. You will notice that in all cases I have the filament sufficiently bright to prevent saturation within the limit of working. All the curves are similar and parallel as long as Vg is zero or negative, but they get more and more away from this standard

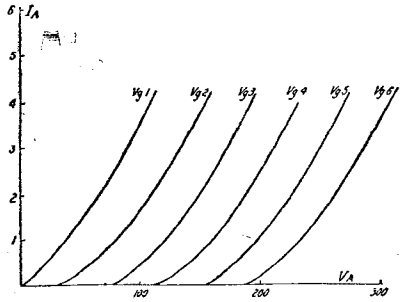


Fig. 4.—A series of curves for different values of Vg.

shape as Vg becomes more and more positive. I have drawn one curve at Vg = +4. As in general we keep the grid of a resistance amplifier always negative, for reasons which I will later show, we need only consider those curves to the right of the one marked Vg=O.

A Simple Calculation

Let us now go back to the unit circuit with battery voltage Vo and resistance R in the plate. If we fix on some value of IA we can calculate IAR, which is the voltage across the resistance, then we can say that the plate voltage VA is Vo–IAR, and plotting on our sheet of curves IA and Vo–IAR we find a point from which we can read off Vg. If we assume a number of values of IA we shall plot a number of points which will be found to lie on a straight line which crosses the horizontal and vertical axes when

IA = O and therefore VA = Vo – IAR = Vo and

VA = O and therefore O = Vo – IAR, that is when

$$I_A = \frac{V_o}{R}$$

Careful plotting will show that the line is always straight. Now we can definitely state that whatever change of Vg we make we shall always be on this line unless Vo or R are changed. If Vo is changed to a smaller value our working line will be parallel, but underneath the line, and *vice versa,* but if R is changed we shall change the slope of this line, the slope being less if R is greater. We can now read off from the valve characteristics and the line our amplification.

The "M" Value

By taking two points on the line (Fig. 6) at two different values of Vg we can, by dropping perpendiculars on the VA axis, determine the change of VA for a definite change of Vg (of course, the change of VA is the same as the change of voltage across R), and now we can see clearly that

Increase of R increases the ratio of $\frac{\text{change of VA}}{\text{change of Vg}}$

and this arrives at a maximum when R = ∞, that is, when the resistance line becomes a horizontal line.

In general, several practical considerations prohibit going too high with this resistance. Leakage, ionisation in the valves, capacity effects, and incorrect manufacture of valves are amongst these, but 50,000 or 100,000 ohm resistances are useful values to work with, and if

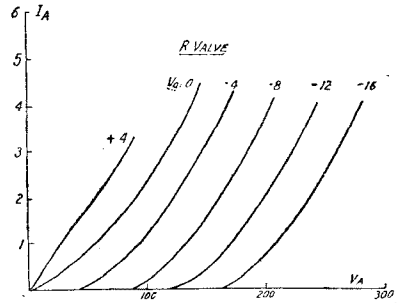


Fig. 5.—Curves for an R valve.

wire wound produce very stable results free from spurious noises.

We will take the case of the R valve first and then that of the D.E.5 B, and see what the results are, and what resistances and voltages are necessary.

I have drawn 4 lines at a voltage Vo of 150 volts (Fig. 7) :—

Vo U is for 10,000 ohms
Vo X ,, ,, 20,000 ohms
Vo Y ,, ,, 50,000 ohms
Vo Z ,, ,, 100,000 ohms

then, noting that the grid lines are 4 volts apart, so that we have to divide the horizontal length by 4 :—

Vo U change of VA for 1 volt change Vg is $\frac{10}{4}$ = 2.5

Vo X change of VA for 1 volt change Vg is 3.5

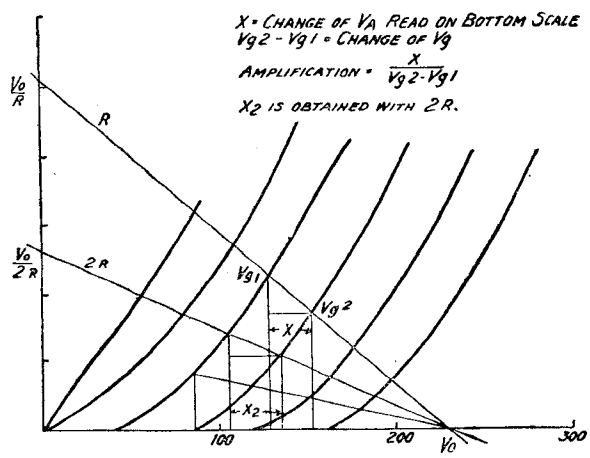


Fig. 6.—Calculating "M" value.

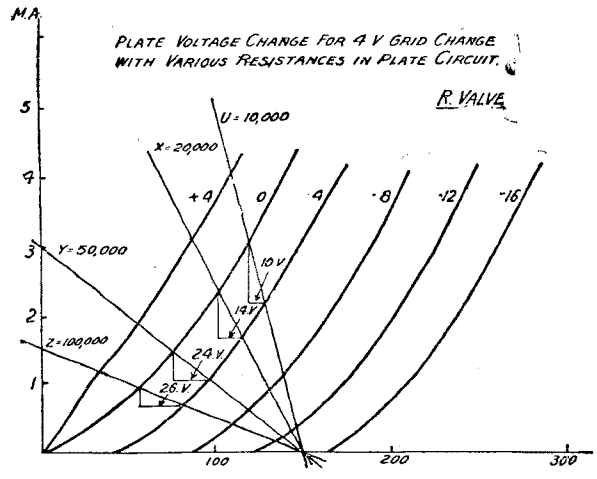


Fig. 7.—Plate voltage change for 4-volt grid changes with various resistances.

The ratio of $\frac{\text{change of VA}}{\text{change of Vg}}$ in this extreme case is called the "m" value of the valve.

Vo Y change of VA for 1 volt change Vg is 6.

Vo Z change of VA for 1 volt change Vg is 6.5.

The maximum possible change with an infinite resistance (or its equivalent, the choke) is about 9.

Suppose we choose the 100,000 ohms as our working resistance,

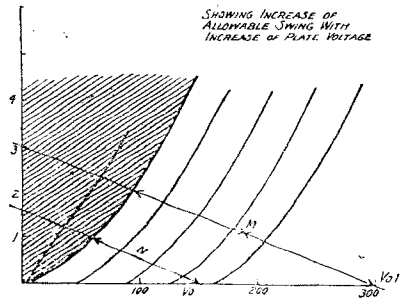


Fig. 8.—Relation of allowable swing and plate voltage.

what influence has Vo on our reception?

In Fig. 8 I have shaded an area to the left of Vg = O. We must not work in this area because current to the grid will flow there and will usually disturb the potential applied. It is also obvious that we must not try to work below the VA axis (where no current flows), therefore, in general, if we pick on points M and N halfway on our resistance lines between the horizontal axis and the curve Vg = O, it will give us a grid bias setting with an equal swing of grid potential either way before running into danger. Now the top line is the same resistance as the bottom line, but Vo1 is smaller than Vo, and obviously Vo gives possibilities of a greater swing without running into danger. Our magnification is not much more, but we can put a bigger signal into the valve and get it out magnified and undistorted by raising our plate volts with suitable resetting of the grid bias.

As another example we will take a D.E.5 B valve, which is a tube with a very high " m " value, but because of a more modern construction of grid and plate is almost as low a resistance as the R valve (Fig. 9). Here we see that we get in the output circuit with 100,000 ohms resistance a voltage swing about the same as the R valve, but the applied volts to the grid need only be less than half of our previous value. We have a much better valve for voltage amplification, as with 1 volt grid change and 100,000 ohms resistance we get 13 volts change in the plate.

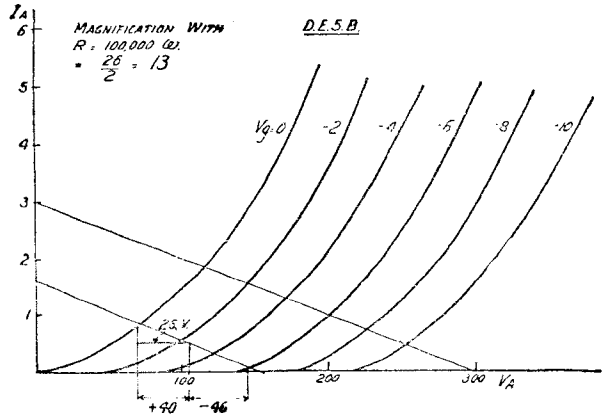


Fig. 9.—Curves for the D.E.5B valve.

The maximum swing possible is 18–20 with infinite resistance.

It is interesting to speculate and follow out on the diagram the effect of steadily increasing R to infinity, then from infinity (or – infinity) to – R; as this is not entirely a theoretical speculation, certain circuits using the Hull dynatron and more commonly tuned anode circuits with reaction (over limited ranges of frequency) can be reasoned out this way.

The simple case of the one valve having been worked out, let us work out two valves in cascade. In Fig. 2 coupled to R is a condenser K1 and a leak R2. The impedance of the condenser K1 $\frac{10^6}{2\pi nC}$ where C is in mfds., is made so low, compared with R2, at whatever frequency one uses the set, that it can be neglected, and R2 can be considered as in parallel for all alternating changes with R. This effectively lowers R for calculating purposes, but by making R2 250,000 ohms or .5 megohms it can very nearly be neglected, and we can assume that our calculated changes of potential in R are directly applied to the grid of the second valve.

We can say that our total amplification is the two separate amplifications multiplied together.

(To be Continued.)

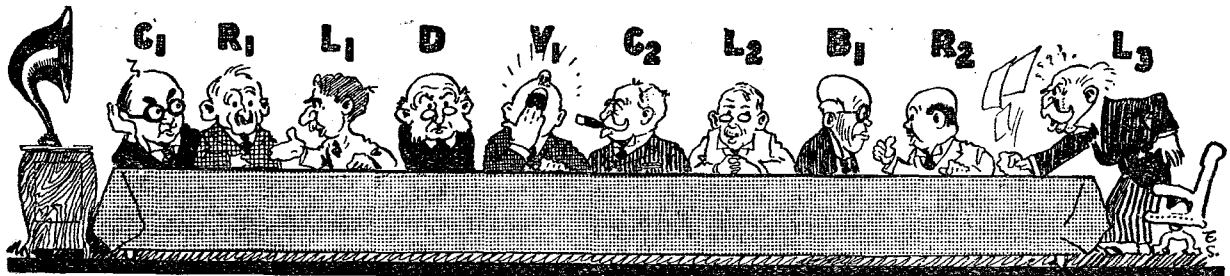
□ □ □

Will Valves Work from Dry Cells?

IT all depends upon what is meant by dry " cells," by " valves " and by " work." Ordinary bell cells are not specially designed to give a steady current, and if they are called upon to deliver more than a fraction of an ampere for any length of time, the output becomes unsteady owing to the effects of polarisation. Dull emitter valves are of various kinds, and the current required by their filaments varies from .06 ampere to .4 ampere. The " 06 " valves can be used quite satisfactorily with bell cells; in fact, three of these wired in series so as to give a total maximum potential of 4.5 volts will work two or three of the smallest dull emitters quite well. With valves requiring more than about .2 ampere I do not think that dry cells, unless they are of very large size, are ever really satisfactory. Those who are so situated that they *must* use dry cells because they cannot get accumulators charged should, I think, confine themselves to the " 06 " valve. It is better if you can possibly manage it to use an accumulator, which gives a perfectly steady output until it is discharged. After all, a 2-volt accumulator with an actual capacity of 40 ampere hours is not a very heavy thing to move about, and will give 80 hours' service with a couple of Wecovalves. Supposing that the set is in use for two hours a day, this means that the accumulator will require recharging only once in three weeks. For " 06 " valves two tiny cells with an actual capacity of 10 ampere hours apiece can be used in series. This will give over 80 working hours with two valves.

R. W. H.

□ □ □

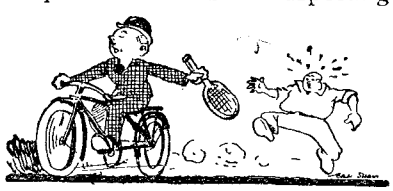


JOTTINGS BY THE WAY

By Wireless Wayfarer

Sympathy

"DON'T you pity me?" I said to Poddleby the other day, as I was taking my departure from the tennis courts at Little Puddleton. "You can stay here and pat balls about until you are blue in the face or any other colour you like, but I have got to go home and work, and the worst of it is that I cannot think of anything to write about." "You never can," said Poddleby, "so far as I can see; that's generally my grouse about the pages that you spoil every week." I took no notice at all of this hateful piece of rudeness, but merely seized Poddleby's racquet from his unsuspecting



Just ahead of stout Poddleby . . . .

grip, leapt on to my bicycle, and rode off, keeping just ahead of the stout figure that panted down the road after me, explaining amidst gasps that he was booked to play in two minutes in the men's doubles. I went severely on to my own house, at the gate of which I dismounted and walked to meet the faint but pursuing Poddleby. "I think you must have dropped this just now," I said, "and you look as though you had been hurrying. At your age and with your figure you should really be more careful. But I must thank you anyhow for one thing, which is that you have given me a theme for one paragraph at any rate." Then with a courtly bow I bolted in, shutting the door in Poddleby's face.

A Blow

Did I hear you say that this is not wireless? Really, reader, you are getting almost as unkind as Poddleby. If you go on in this way I shall have to find some means of dealing with you even as I dealt with him. Still, if you want wireless, very well, wireless you shall have, for I got it all right as soon as I had closed my door upon the secretary of the Little Puddleton Wireless Club. I was just preparing to do a bit of pen-chewing in an effort to work out an idea when there entered to me the handmaiden. "If you please, sir," said she, "your eerial's been and gone and

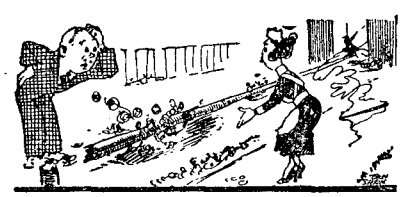
List of Components.

C_1	.. ..	Breadsnapp
R_1	.. ..	Snaggsby
L_1	.. ..	Dippleswade
D	.. ..	Gubbsworthy
V_1	.. ..	Wayfarer
C_2	.. ..	Admiral
L_2	.. ..	Bumpleby Brown
B_1	.. ..	Professor Goop
R_2	.. ..	Poddleby
L_3	.. ..	General

tumbled down." Being, as you no doubt know, a man of action rather than of words, I said nothing but merely strode out with squared jaw and a grim and determined look upon my face to view whatever disaster Providence had seen fit to inflict upon me. It was really rather a sad sight that met my eyes as I opened the French window and stepped further into the grounds. I like that word, don't you? It sounds much better than garden or backyard, and I don't in the least see why 30 yards by 20 yards should not be so described. I should explain that this summer my better half had decreed that the garden, that is to say, the grounds, should be a blooming mass. She wrote this to me in a letter whilst she was away at Easter, and her handwriting is a little difficult at times to decipher. I replied by return saying that it was already a blooming mess (for that is how I read the words), and that I was quite sure that she would be more than satisfied Anyhow, during the spring and the early summer the man Bugsnip, of whom I have told you before—he is the father, if you remember, of the lad Edward, who is inclined to ask posers—had laboured and toiled, digging here, planting there, until flowers were growing in profusion.

Havoc

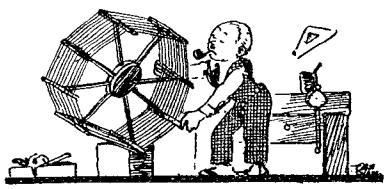
When I gazed further I saw that most of our garden was to



"Your eerial's tumbled down."

be counted among the has beens (or should one say the have beens?). Frankly, I do not know but as I like to please the most fastidious of grammatical tastes will you kindly take your choice and delete whichever you do not like? In other words, the garden (or grounds) was (or were) a was-er, a washout, a scene of havoc, desolation and ruin. Across two of the choicest beds lay my aerial mast, which had apparently bounced several times before it finally came to rest. The spreaders and the accompanying wires had played the very dickens with a fine bed of geraniums, and the insulators at the house end, swinging in glorious freedom as the pole fell, had pushed in effectively a very large and expensive window. About the garden I was, of course, sorry, though so far as I can remember no special

tear coursed down either cheek on its account. After all, the man Bugsnip would be able to repair to some extent the damage that had been done, and he would undoubtedly be the gainer, for would he not be able to spend several days on full pay in telling my wife exactly what ought to be done without having the hard work of doing it? The pole itself was a very different matter. It had broken off just at ground level, as poles will on occasion, and there was nothing for it but to obtain a new one, for the old one, if re-erected, would now be too short to qualify me to tell tall stories. It is, of course, generally accepted amongst wireless men that no man is really justified at drawing the long bow unless his aerial is at least forty feet in height.



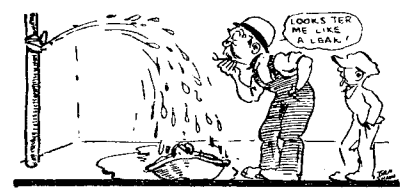
Gustavus, my trusty frame aerial.

The Hidden Hand?

What exercised me was to discover how all this had come about. The hurricanes and snowstorms of the typical English summer had, of course, been raging, but they had done so before, and the pole had merely smiled at them bowing gracefully before any particularly violent gust. No, I reasoned, it is not Nature that has smitten me in this way; some enemy has been at work. Of course, if one has a set that can be relied upon to bring in on any night of the week America, or even Timbuctoo if need be, there is bound to be a certain amount of local jealousy. I have noticed this before now at the wireless club, when I have been engaged in telling some particularly interesting story of my achievements in reception. More than once I have heard General Blood Thunderby remark in what he imagines to be a whisper, "I wish I could tell 'em like that." I have also caught at times stray words such as barefaced, unblushing, case-hardened, and the like. From this you will see that the worst form of jealousy was obviously rampant in the locality, and I therefore felt quite sure that some enemy had done this thing. Did I burst into tears? Did I tear my hair? Did I fling myself on the ground and gibber in an access of despair? Did I go out into the garden (or grounds) and eat worms? I did not. I merely surveyed the wreckage with a shrug of the shoulders, then went in and telephoned to Messrs. Guffle and Snarp, at one time plumbers of the plummiest kind, but now the leading professional experts in wireless in Little Puddleton. To them I said in an airy way (and remembering that they send in their bills only once a year), "My aerial mast has collapsed. Would you very kindly get me a new fifty-foot pole and put it up as soon as you can?" That was precisely that.

Resolution

I was determined that even though the hidden hand had thus played the dirty upon me I would not be defeated by its machinations. I pulled out Gustavus, my trusty frame aerial, who had never yet brought in an audible signal, and told him that now was his chance to do or die. With the aid of a couple of good high-frequency valves I managed to persuade Gustavus to bring in 2LO at such strength that he was audible with the phones on the table, provided that your head, or rather mine, was inside them as they lay there. Then, having dined lightly, as befits a brain worker, I went round to the wireless club where most of the members were assembled. Without saying too much I let it be clearly understood that some enemy had cut down my aerial, and that I was pretty sure I knew who had done it in a contemptible fit of jealousy. On the following evening I told them that I was rather glad that my aerial had been cut down for I had never before investigated the possibilities of the frame. "You will hardly believe me," I said (I *think* I heard the General murmur, "We don't"), "when I tell you that with a 2-foot frame I got WGY, WJZ, WHAZ, and KDKA on the loud-speaker early this morning. And so I went on telling the tale of Gustavus's prowess, some admiring, some gaping, some merely raising the eyebrows of scorn. I was getting on quite well when Snaggsby, who lives next door to me, came in. "Hullo, Wayfarer," he said, "I have not seen you for days. I see your jolly old aerial has come down. I am very much relieved that the wind was blowing nor-nor-east instead of sou-sou-west, for otherwise it would now be resting in my greenhouse. I have been expecting the crash for months, and I actually saw it happen." "Oh," I said, "oh, and perhaps you can tell us who it was who did this thing?" "Well," said Snaggsby, "I can, I think. You know the five swallows that usually sit on it in the evening?" "Yes," I replied, "I know them well, but



Plumbers of the plummiest kind.

what of them?" "What, indeed?" said Snaggsby; "they were quite comfortable until a sixth, an entire stranger to me, settled beside them on the wire. That did it. No sooner had his little feet grasped the wire than the whole thing immediately crashed to earth."

WIRELESS WAYFARER.

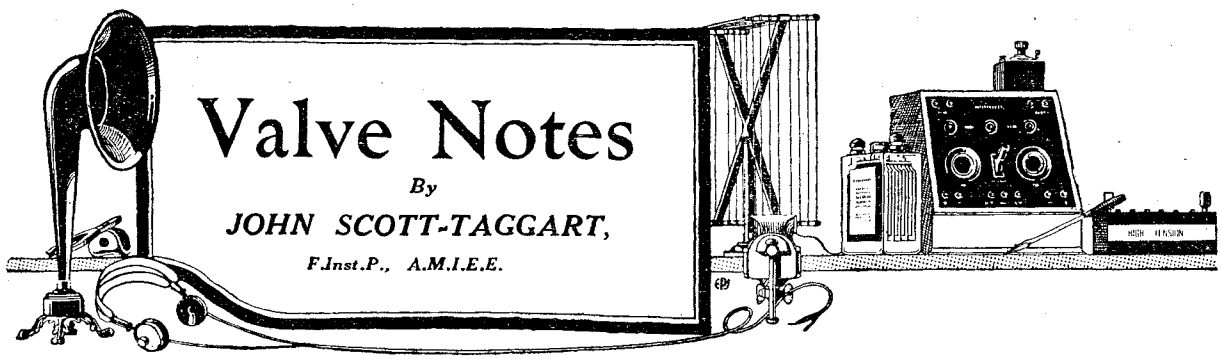
The Vienna Broadcasting Station.

The official opening of the Vienna station took place on October 1. All the local prominent personalities of the political and scientific world were present.

The station is now working regularly on a 530 metres wave, using 1 k.w.

Listeners were asked to send in suggestions for an identification call. That finally adoped is Radio-Wien, which carried 86 per cent. of votes. The next was Sender-Wien, and others suggested included Dorian-Radio, Wiener - Musik - Radio, etc. The identification call of the station is "Hallo, Hallo, Hier Radio-Wien, Welle 530."

Particulars of hours of transmission may be found in the Continental time table in this issue.



Valve Notes

By

JOHN SCOTT-TAGGART,

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

Liquid Valves

EVERY now and again, in the semi-technical press, appear reports of a liquid valve which will amplify, detect and do all the other sorts of things that a vacuum valve will do.

Unfortunately, these reports, although so definite and precise, are based on foreign reports. I have investigated the position thoroughly through scientific friends in these countries, and have not found any evidence of any amplification having been obtained with a liquid valve.

Colloidal Solutions

I have also tried colloidal solutions in combination with electrodes for the purpose of seeing what effects are obtainable. No results, however, have been obtained which in any way would encourage any work to be accomplished with such a liquid (so-called) " valve."

Whether a valve will ever be produced which will work with a minimum of " internals " is a doubtful question, but much can be done by reducing the filament consumption and lowering the anode voltage. Excellent progress has been made in the direction of reducing the filament current consumption, but valve manufacturers have not done much to reduce the anode voltage, except in the case of power valves.

As Detectors

Liquid valves, of course, may be used as detectors, and this form of detector was one of the very first to be used about 20 years ago. The crystal detector, however, displaced the liquid rectifier. By liquid rectifier I am not referring to the detector commonly known as the electrolytic detector, which depended principally for its action on a small globule of gas on the end of a fine platinum point. I am referring simply to the detector which consists of metallic electrodes dipped in some form of electrolyte.

A New Neutrodyne Type of Circuit

Readers of *Wireless Weekly* will be interested to hear that Mr. A. D. Cowper, M.Sc., has produced a very effective scheme for neutralising undesirable reaction in a wireless receiver, and

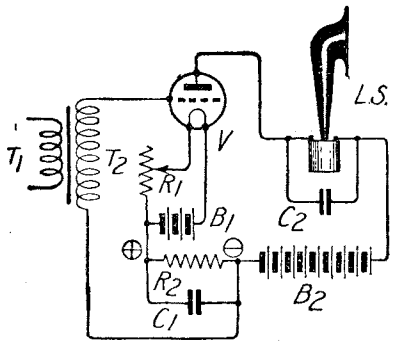


Fig. 1.—An interesting method of obtaining grid bias.

this ingenious circuital arrangement will be described in the next issue of *Wireless Weekly*.

The arrangement is particularly applicable to a two-valve circuit, and loose coupling is employed on the aerial side without any tendency for the valve to oscillate.

Obtaining Grid Bias

Two years ago the average experimenter did not bother about applying grid bias to his low-frequency amplifying valves, but the growing tendency to improve purity is resulting in greater interest being taken in methods of applying a negative grid potential.

The usual method is to use three or four volts obtained from a dry battery.

Many weeks ago I explained the use of including an anode resistance between the negative terminal of the anode battery and the filament of a low-frequency amplifying valve. This arrangement is shown in Fig. 1, and it will be seen that the steady anode current flowing through the resistance R2 will set up a potential difference across this resistance, resulting in the right-hand side of R2 being made negative with respect to the left-hand side. In other words, the grid of the valve will be given a negative potential depending upon the value of R2 and the value of the steady current flowing through it.

Use of Condenser

If the valve were a power valve, and the steady anode current were 10 milliamps, and we desired to give a bias potential of − 5 volts to the grid, the resistance R2 should have a value of about 500 ohms. The condenser C1 has a large capacity of the order of 2 μF, and is for the purpose of obtaining a substantially steady normal voltage on the grid. If the condenser C1 were not in place there would obviously be a low-frequency reverse reaction effect, the anode current variations through R2 causing varying low-frequency potentials to be communicated to the grid of the valve.

Even a large condenser in the position of C1 will not altogether overcome a small ripple of low-frequency, and it is therefore interesting to note British Patent

220727 of E. A. Graham and W. J. Rickets.

These inventors propose to use an iron-choke coil in the grid bias circuit for the purpose of smoothing out any low-frequency ripple.

A New Arrangement

Fig. 2 shows a circuit in which the idea is shown incorporated. I have shown simply the ordinary detector with reaction followed by two stages of low-frequency amplification. The resistance R2, it will be seen, is connected between the negative terminal of the high-tension battery and the negative terminal of the filament accumulator. Across the resistance is shunted the iron-core choke coil Z1 and the condenser C1 of about 2 or more microfarads capacity. The grid connections are taken to the point Y.

The condenser and choke coil smooth out any low-frequency ripple, the principle being that the potential variation across the condenser will be considerably less than those across the choke-coil, and that therefore the potentials across the condenser will only be a negligible fraction of the total potential variations across the resistance R2. This resistance may, in addition, have shunted across it a big capacity fixed condenser.

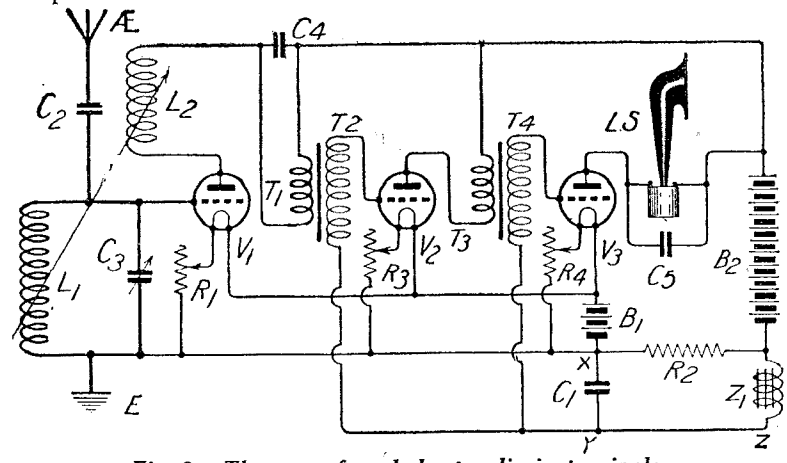


Fig. 2.—The use of a choke to eliminate ripple.

□

Telephone Leads

SEVERAL amateur constructors are not acquainted with the method which should be employed when mending or making telephone leads. The writer

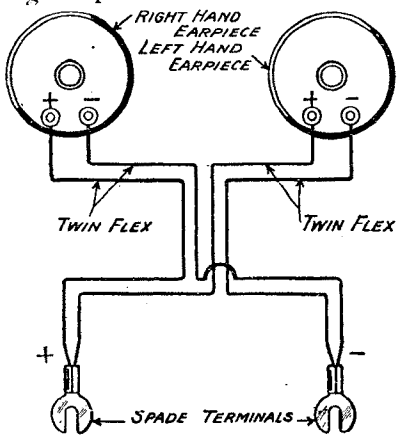


Fig. 1.—Telephone lead connections.

intends this article to be helpful to those who are so placed. The theoretical connections of a pair of head 'phones are shown in Fig. 1. It will be seen from the drawing that both the right-hand and left-hand ear pieces are equipped with two terminal connections each. In each case one is a positive connection and the other a negative connection. If it is intended to make a pair of leads, some silk-covered twin flex will be required. On removing the outer covering of the flex it will be found that one strand is wrapped with red cotton and the other with white. This is to

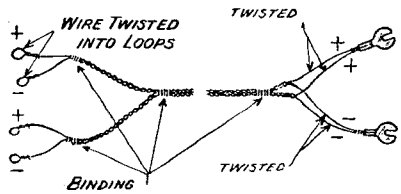


Fig. 2.—Method of making phone leads.

facilitate the recognition of the leads at the other end, the red representing the positive lead and the white the negative lead. First proceed by baring the end of the flex and twisting into loops, as shown in Fig. 2. Connect the red-covered lead of one length of twin flex to the positive connection of the right-hand earpiece and the white-covered lead to the negative connection. Repeat the process with another length of twin flex on the left-hand earpiece. Now bind all four strands together at about 18 in. from the earpiece connections, with some cotton or silk thread. Twist the strands together from this point for a length corresponding with the length of lead desired, and bind once more as before. Now pick out the two red-covered flex leads and secure to a spade terminal in the usual manner, and finish by binding with red silk to indicate that this is the positive connection. The two remaining will be the white-covered ones. These are connected to a further spade terminal and bound with white silk to indicate the negative connection.

It should be noted that the above method connects the earpieces in parallel, which in the case of a pair of 2,000-ohm earpieces makes the total resistance 1,000 ohms—quite a good value for crystal sets using the modern treated galena crystals. For valve sets the leads are better in series, i.e., the lead goes from the positive tag to the positive terminal of one earpiece, another lead from the negative of this earpiece to the positive of the next, and a third lead from the negative terminal to the negative tag.

H. B.

Filling Panel Holes

WHEN a panel has been erroneously drilled, the problem of filling the hole up presents itself. This may be done by dissolving some beeswax in turpentine, adding lampblack until the mixture is fairly stiff, when the hole in the panel may be filled in, and smoothed off with a flat scraper. Old panels may be treated with this mixture, which hardens with time.

H. B.

Supersonic Heterodyne Reception in Theory and Practice

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

The first of a series of general and constructional articles on a most fascinating type of receiver, the operation and design of which has never been really tackled in this country.

I
Introductory Remarks

MULTI-STAGE high-frequency amplification is one of the most fascinating problems in radio to-day. The reason is not far to seek. It is due almost entirely to the inefficiency of the average detector and to the peculiar property of detectors which results in them being more sensitive to strong signals than to weak. Hence the importance of having the signals sufficiently strong before they are applied to the detector which, in most modern receivers, will be a three-electrode valve.

Signal strength depends upon the output of the rectifier, and this output is proportional to the square of the amplitude of the incoming signals. To take a simple case, if we double the amplitude of the incoming signals we will get four times the output from the rectifier. This rule is not an absolutely exact one, but is approximately so, and it is borne out in practice. One would expect that if the amplitude of the incoming high-frequency oscillations were doubled, the final signal strength would be doubled, whereas actually it is quadrupled, due to the peculiar action of detectors.

Another important factor to remember is that there is a kind of minimum threshold amplitude below which a detector will not operate. This threshold depends very largely upon the curvature of the characteristic curve of the detector.

Any experimenter has proved for himself that once a signal is obtained, however weak, it may be strengthened by low-frequency amplification, but if a signal is "not there" without low-frequency amplification, the latter process, even if carried to several stages, will frequently not bring in the desired signals.

Under these circumstances, the only solution is to bring up the amplitude of the high-frequency oscillations to a sufficiently large value to operate the detector valve effectively.

High-frequency amplification is consequently indispensable if long ranges are to be obtained, but unfortunately high-frequency amplification technique is only beginning to be studied now, and even at this stage the more ordinary methods of amplification are not by any means at a stage of perfection.

Particularly great obstacles stand in the way of the amplification of very short wavelengths, i.e., current of very high frequency. The higher the frequency of the currents to be amplified, the greater are the difficulties which have to be overcome. A multi-stage high-frequency amplifier designed to work on short wavelengths will oscillate more readily than a long wave amplifier. Not only is trouble experienced through self-

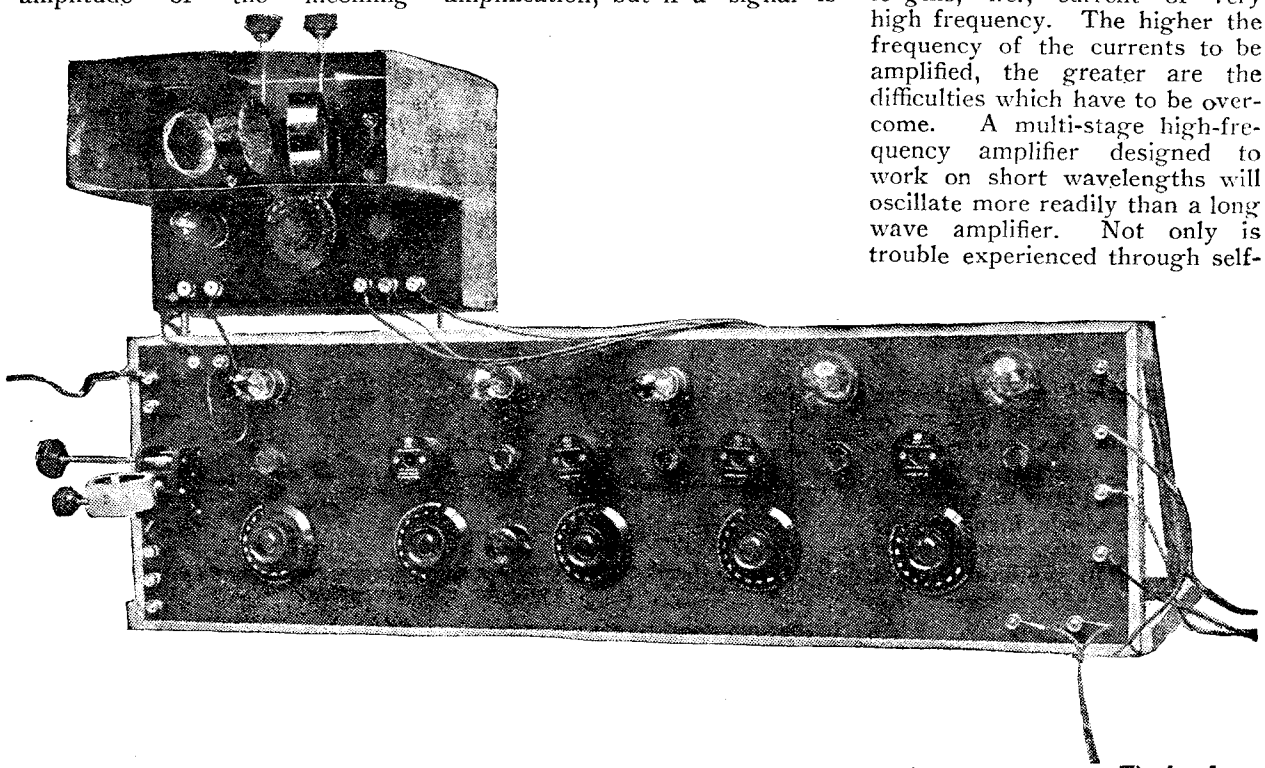


Fig. 1.—An experimental supersonic heterodyne receiver used by the author in his experiments. The local oscillator is contained in the metal screened box on top of the instrument.

oscillation, but, what may conveniently be termed leakage effects, are very much more prominent, and also losses due to inefficient coils, unsuitable fixed and variable condensers, etc., arise.

It is therefore not surprising that a great deal of the reception

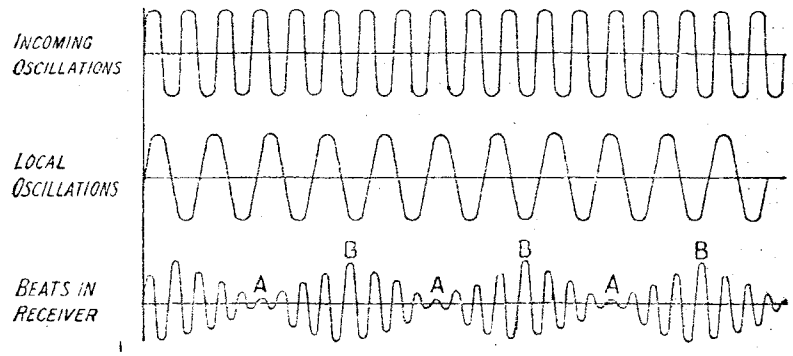


Fig. 2.—Principle of " beat " production.

on very short wavelengths of the order of, say, 60 metres to 150 metres, is carried out by means of a simple detector valve using reaction followed by one or two stages of low-frequency amplification. This is not because high-frequency amplification is undesirable, but simply because such amplification is being shirked because of the difficulties attending its use.

It was chiefly the troubles of high-frequency amplification on short wavelengths which led to the development of what is generally known as the " supersonic heterodyne " method of reception.

I do not propose to go into the patent history of this method of reception, but the invention is generally attributed to E. H. Armstrong, whose name has been so closely associated with several very practical developments in radio.

" Supersonic " means : Above the ordinary audible frequency which the ear can conveniently hear, while " heterodyne " is the peculiar name given to a method of reception which involves the combination of two sets of varying currents to produce a third varying current of different frequency.

The system, briefly, consists in combining incoming oscillations in a wireless, or similar, receiver, with locally produced oscillations of a different frequency. These two frequencies interfere with each other and produce a third frequency, which is of an alternating wave form but of a peculiar nature.

The third type of varying current produced is not useful until it has been rectified, and the output of the rectifier, which output is of a varying nature, is then used as the final signal current to be amplified and employed in the usual way.

Ordinary Continuous Wave Reception

Before dealing specifically with supersonic heterodyne circuits, I propose to give a brief explanation of what are known as " beats," together with a broad outline of the ordinary method of receiving continuous waves, i.e., waves which resemble ordinary alternating currents of fine wave form. There are, of course, numerous continuous wave transmitters in the country, such as those at Leafield, Northolt and other stations, and, of course, the carrier wave of a broadcasting station is a continuous wave transmission until this wave is modulated by the speech or music. Similarly, the waves radiated from a receiving station which is " oscillating " are continuous waves, and I propose to explain the usual method of receiving these waves, which is known as the heterodyne system. This explanation will be old to the experienced reader, but many will require to study the following notes carefully before a technical explanation of supersonic heterodyne reception can be clearly understood.

The principle on which heterodyne reception depends is briefly as follows : Let us imagine two sets of alternating currents flowing in a certain circuit. Each set of alternating currents will tend to cause a current to flow in the circuit, first in one direction and then in the other. If the two currents are in step or *in phase*, the currents will always be flowing in the same direction at any given moment. If the currents each had a value of 1 ampere, the resultant current would be 2 amperes. If the currents are a half-cycle out of step (or 180° out of phase) one set of alternating electromotive forces will be trying to pass a current in a certain direction, while the other will try to pass a current in the opposite direction at the same moment; consequently, the two sets of alternations will neutralise each other and no current will flow through the wire. If one set of alternations is less than half a cycle ahead of the other, the result will be an alternating current of constant amplitude having a value between zero and the sum of the two individual currents,

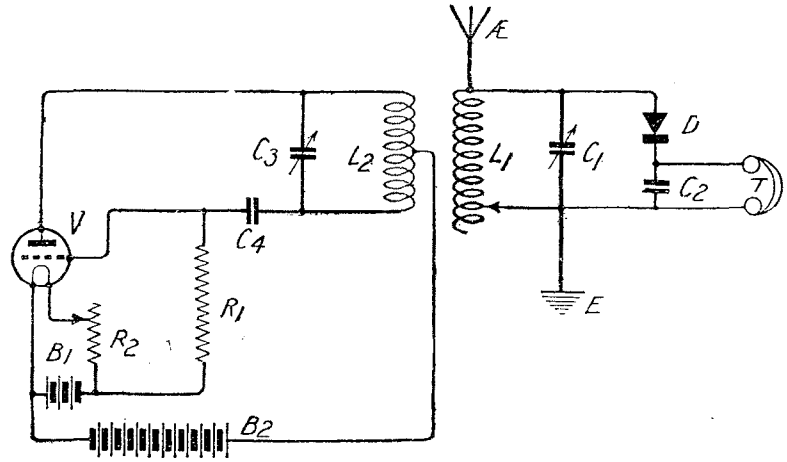


Fig. 3.—A crystal receiver using a valve oscillator to produce beats for c.w. reception.

according to the *phase difference* between the two sets of alternations. The phase difference will always remain the same, and because of this the resultant current will be a constant alternating one. If we had two sets of alternating currents of different amplitude the resultant current would be a constant alternating one, which would have a value somewhere between the difference between the individual amplitudes and the sum of the individual amplitudes; the least value of resultant current would be produced when the two sets of currents always opposed each other, that is to say when they were 180° out of phase; if the two currents have an amplitude of 1 ampere and 3 amperes respectively, when the phase difference is 180° the resultant current will be 2 amperes. If the currents are absolutely in phase the resultant current will be 4 amperes. Intermediate phase differences will give intermediate amplitudes of resultant current.

These rules only apply when the two sets of alternations are of the same frequency. When the frequencies are different the phase difference never remains the same; the currents will at some moments be helping each other, while at other moments the currents will be opposing each other. There is, however, a certain amount of regularity in the way the two sets of alternations *interfere* with each other. The resultant current is of an alternating nature, but it rises and falls in amplitude at regular intervals. At certain points the resultant current amplitude falls to zero, and at other times the current rises to a maximum. Fig. 2 illustrates the action; the top line shows one set of alternations, while the second line shows alternations of slightly different frequency, the third line showing the resultant current produced by the interaction of the two sets. It will be seen that there are points, *A*, where the current amplitude falls to zero, and that there are regular points, *B*, where the amplitude increases to a maximum; these latter points are known as *beats*. The same phenomenon is obtained with sound; if two notes of slightly different pitch be struck at the same time a resultant beat note will be produced. Fig. 2 shows the conditions when the two sets of alternating currents have the same amplitude. The beats have a maximum amplitude equal to the sum of the individual amplitudes. The same sort of beats are produced if the two sets of alternations have different amplitudes. This time, however, the amplitude at the *minimum* points *A* is not zero but equals the difference between the two individual amplitudes. The frequency with which the beats occur is equal to the difference in frequencies between the two sets of alternating currents. If one of these sets of alternating currents has a frequency of 500 cycles and the other a frequency of 400 cycles, the resultant *beat* frequency will be 100; that is to say, there will be 100 points of maximum amplitude per second.

The phenomenon of beats is obtained when dealing with radio-frequency currents as well as with low-frequency alternating currents. We take advantage of this effect to receive continuous waves. The incoming oscillations are combined with oscillations locally produced at the receiving station and having a frequency slightly different from the incoming frequency. Fig. 3 shows a simple crystal receiving circuit in which a crystal detector *D* and telephones *T* are connected across the oscillatory circuit *L*1 *C*1. Coupled to the inductance *L*1 or placed near it is a valve *oscillator* which, as we have explained, is capable of producing continuous oscillations; the frequency of the oscillator may be adjusted. A valve has an oscillatory circuit *L*2 *C*3 connected across grid and anode. A middle connection is taken from *L*2 through the high-tension battery *B*2 to the positive side of the filament accumulator *B*1. A grid condenser *C*4 and leak *R*1 are provided so as to avoid a high positive grid potential. A circuit of this character will oscillate of its own accord and produce continuous oscillations which are caused to affect the receiving circuit *L*1 *C*1.

When signals are not arriving, the detector *D* does not respond to the continuous oscillations from the valve oscillator. When continuous wave signals are received, however, they combine with the local oscillations induced into *L*1 *C*1 and produce a resultant current which takes the form of the third line of Fig. 2, and which is now split up into groups rather similar to those obtained when receiving spark signals, except that a very much larger number of oscillations are found in each group. The beats are rectified by the detector and pro-

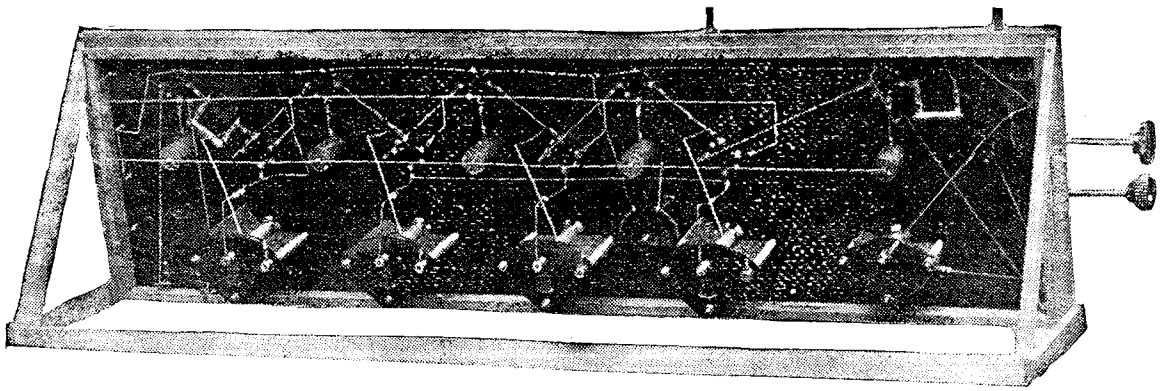


Fig. 4.—Rear view of the supersonic receiver with local oscillator detached.

duce pulses of current through the telephones *T*. A musical note is in this manner produced and the pitch of the note may be adjusted by altering the frequency of the local oscillations supplied by the circuit *L2 C3*. If the local oscillations only differ in frequency from the incoming oscillations by, say, 100, the beat frequency will be 100 and a low note will be the result. If the local frequency be made different from the incoming frequency by 1,000 cycles per second, the pitch of the note heard in the telephones will be equivalent to 1,000 beats per second; that is to say, a high note will be obtained.

Audibility Limits

The human ear will only respond to a certain range of note frequencies. This range, in extreme cases, is from 30 to 40,000. In most cases, however, the human ear can only respond to a much narrower range of notes. The lower limit may remain at 30, but the upper limit may be taken as 10,000. These figures vary a great deal in textbooks and the actual figure does not really concern us. Signals above 3,000 frequency produce no material effect on the human ear, but 10,000 may be taken as the *limit of audibility* for the purpose of the explanations.

Fig. 5 shows the scale of the variable condenser, *C3*, which controls the frequency of the oscillations produced by the valve of Fig. 3. The scale is shown divided into 180 divisions or degrees as is frequently the case. An increase in capacity of the condenser *C3* is indicated by a higher figure opposite the arrow-head in Fig. 5. It is now proposed to show the effect on the telephones *T* of gradually increasing the capacity of the condenser *C3*.

We will assume that the incoming signals have a wavelength of 1,000 metres. This is equivalent to a frequency of 300,000 (300,000,000—the speed of electric waves in metres per second—divided by 1,000). Let us suppose that the condenser *C3* is first set to 100°. The local frequency, we will now suppose, is equal to 265,000. This frequency will combine with the incoming frequency of 300,000 to give beats of 35,000 frequency. These beats will be produced, but when rectified will not give an audible signal in the telephones; they are *above audibility*. Let us now gradually decrease the capacity of the condenser, *C3*; when we get to 90° we can begin to hear a very high weak note; the local frequency will now be about 290,000. This frequency will produce beats of 10,000 which are just audible. As we continue to turn the condenser round, the local frequency increases and approaches 300,000; the result is that the note of the signals gradually becomes lower although still very high. At 85° we get a very clear note of 1,000 frequency which is probably most suitable for general reception purposes; this is produced when the local frequency is 299,000. If now we continue to turn the condenser round so as to decrease the

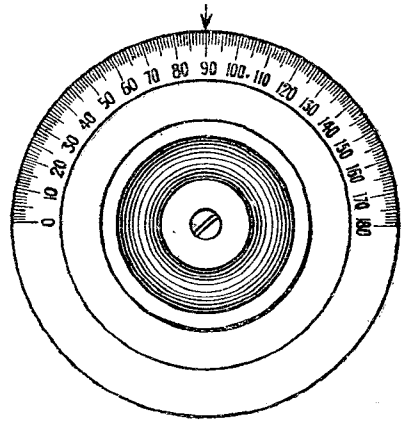


Fig 5.—Variable condenser scale.

capacity and therefore increase the frequency of the local oscillations, the note becomes lower and lower until it reaches the lower audible limit, beyond which nothing is heard in the telephones. For example, when the condenser is at 81° the local frequency is 299,975 and the beat frequency is only 25. As we very gradually turn the condenser round the beats are still produced, but remain inaudible. At 80° the local frequency is 300,000; this frequency being equal to the frequency of the incoming signals produces no beats at all and we continue to hear nothing in the telephones. As we decrease the capacity of the condenser further, beats are once more formed, but are of such low frequency as to be inaudible; for example, at 79° the local frequency is 300,025, the beat note being consequently only 25. If we decrease the capacity of the condenser still further, the beat note increases in frequency and becomes audible. A low note is heard which gradually rises as the condenser is turned round further. At 75° we once more get a good note of 1,000 frequency, the frequency of the local oscillations being 301,000. At 70° the local frequency is 310,000 and we obtain a very high note at the upper audible limit for practical purposes. At 60° the local frequency is 335,000 and the beats of 35,000 frequency are inaudible.

The effect, then, of turning round the condenser of our local oscillator is to bring in gradually a very high note which decreases until it becomes inaudible for a fraction of the scale on the condenser, and then becomes audible again as a very low note, which gradually rises as we turn the condenser, until the note becomes too high to be audible. We adjust the condenser so as to give, preferably, a beat note of about 1,000, and we will see that we can obtain this note at two points on the condenser, one on each side of the silent interval, since we obtain the beat note with two different values of local frequency. If we turn the condenser rapidly a note like a " chirp " is heard.

NOTE.—*A further instalment of this interesting series will appear in next week's issue.*

□ □ □

FOREIGN NOTES

Germany

We are informed that the latest arrangements installed at Konigswusterhauzen, the high-powered Berlin station, permit this station to send out 21 messages simultaneously.

United States

The American station, WEAF, of New York, is making arrangements to broadcast the important football matches this season. A chart will be distributed to listeners to help them to follow the speaker, who will be on the field.

LISSENIUM

THE RIGHT WAY TO JUDGE Low Frequency Amplification

PURITY FIRST—VOLUME AFTERWARDS. All too readily moderate tone quality has been accepted as good, but sooner or later the right means of obtaining pure low frequency amplification will be used universally, instead of by those who are sufficiently discriminating, as at present.

The right way to obtain pure low frequency amplification is to use a coupling at each stage which has been designed to meet the technical requirements of the position. For instance, the importance of the first stage transformer cannot be over-estimated, for any distortion here is magnified many times with each succeeding stage. But the expensive transformer which is ideal for the first stage need not be used throughout unless superlative amplification is desired, for it is not so necessary to have such high impedance in the second and third stage transformers as in the one used for the first stage. Where power amplification is used, however, the first stage transformer should be employed.

Apart from the usual transformer coupling, another interesting coupling to use is the LISSEN L.F. CHOKE COUPLING. To the keen enthusiast the comparisons possible are very instructive. One can, for instance, see how many stages of LISSEN CHOKES can be used in cascade.

Each requirement of low frequency amplification is met by the following parts. In the design of these couplings, PURITY OF TONE QUALITY HAS BEEN THE FIRST CONSIDERATION—PLEASING VOLUME THERE IS, TOO, BUT AFTERWARDS.

IN BUYING A LISSEN TRANSFORMER OF ANY TYPE, YOU CAN BE SURE YOU ARE GETTING PURITY AND POWER—and the best transformer value.

IMMEDIATELY BEHIND THE DETECTOR VALVE

Use the LISSEN T1. If you contemplate buying an expensive transformer, be sure you can get none better than this. **30/-**

FOR REFLEX CIRCUITS

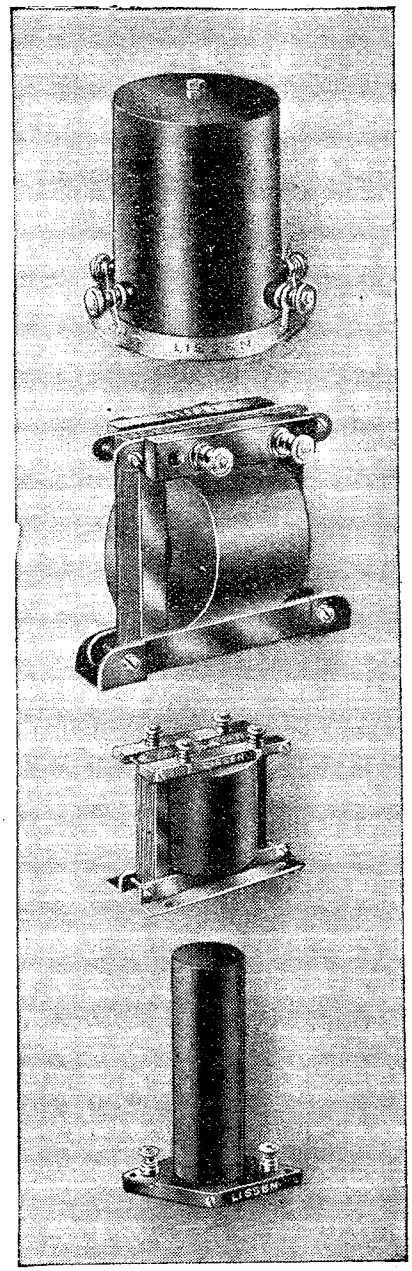
Under all conditions the LISSEN T2 is one which will give very pure and powerful amplification in these circuits. **25/-**

FOR SECOND and THIRD STAGES

Where the LISSEN T1 is not used throughout, the LISSEN T2 is recommended. Price as above.

A POPULAR TRANSFORMER

This is the best light transformer made. Because of its skilfully balanced design, it actually compares with many expensive transformers **16/6**



LISSEN L.F. CHOKE COUPLING

The new LISSEN L.F. CHOKE is becoming very popular—for quality of tone it ranks with the best Resistance Capacity Coupling, without the disadvantage of using the large H.T. voltage necessary with the latter. Its price makes it very economical also.

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The construction of an L.F. amplifier using LISSEN L.F. CHOKES instead of transformers is quite simple. The connections are as follows:— One terminal of the LISSEN CHOKE is connected to the plate of the preceding valve, the other terminal to the H.T. Battery. A fixed condenser of .01 capacity is connected between the plate of the preceding valve and the grid of the L.F. valve, and a grid leak (preferably the LISSEN Variable Grid Leak) is connected between the grid of the L.F. valve and the L.T. negative. Grid cells should be introduced between the grid leak and L.T. negative if they are found necessary. Each succeeding stage is connected in the same manner.

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PARTS THAT PULL TOGETHER—BUILD WITH THEM.

Random Technicalities.

By PERCY W. HARRIS, Assistant Editor.

Some Notes of interest to the Home Constructor and Experimenter.

A CORRESPONDENT, who is kind enough to express appreciation of the criticisms I have been making in these columns, asks me if I have noticed that even in the best makes of high-tension batteries the sockets are often very dirty, corroded, and at times filled with wax, in such a way that it is impossible to make contact with them. By a strange coincidence, I had experienced just the same trouble myself about a couple of days before receiving his letter—at least, as far the presence of wax in the sockets is concerned. So many thousands of dry batteries are made in these days that inevitably a few get through in which the waxing has been carelessly done. If you seem to have a disconnection in your circuit, and the set is apparently all right, make sure that your wander plug is making contact with the socket and is not insulated from it by a layer of wax.

One More Grumble

Looking back over what I have recently written, I have the uncomfortable feeling that this column is degenerating into a catalogue of grumbles, and so I must try and think of something more cheerful. However, here is just one more. When is some manufacturer going to give us a really serviceable and large change-over switch for disconnecting the aerial and connecting it to earth? I know there are a lot of switches designed for this purpose, but all of them, without exception, are far too small. The ordinary copper battery switches on china bases are quite convenient, but for short wave work it is most undesirable to bring the earth connection so near to the aerial. What we want is a blade at least six inches long, so that when the aerial is connected to the set it is well away from the earth connection on the other contact. You may think I am carrying matters to an absurd extreme in asking for a switch of this size. If you work on very short waves, such as those which are coming into popularity for long-distance transmission (well below 100 metres), you will be astounded how much energy can be bye-passed through tiny stray capacities.

Strange Aerials

Of late there has appeared on the market a large number of strange aerial devices for which equally strange claims have been made. Many of these claims are based on a complete

misunderstanding of the subject, so that it is perhaps worth while to explain one or two matters in relation to aerials.

The Strip Variety

We have, for example, a number of strip aerials of various kinds. These are quite satisfactory, although mechanically they sometimes give trouble through twisting and breaking at the bent part. When, however, we find claims made that these aerials must be superior to ordinary wire because " they intercept a much greater quantity of the waves," we are on very dangerous ground. Experiments quite early in the history of wireless showed conclusively that an aerial wire absorbs energy not only from the part of a wave which impinges directly on it, but from quite an appreciable space around that part. This is proved by the fact that a number of wires placed vertically and separated a foot or so from one another can act as a complete screen to oncoming wireless waves. Any virtues which strip aerials may possess are due to their having a lower high-frequency resistance than some other forms. Then, again, take the question of the stranding of aerial wire. It has been proved quite conclusively by experiments made at the Bureau of Standards in the United States that for wavelengths of the order of those used for broadcasting solid wire is just as good as the most elaborate stranded product, and unless this latter is most carefully made, and has every separate strand soldered to the others, the high-frequency resistance may be even higher than the solid wire of equivalent gauge.

The ordinary 7/22 aerial wire is a good sound job easy to handle. The stranding is valuable in giving flexibility, although it is doubtful whether such wire is electrically more efficient than the equivalent gauge in solid wire.

Non-Directional Frames

I notice that frame aerials hoisted from the top of a pole are being used here and there, there being only one down lead from one end of the frame winding. A frame aerial used this way ceases to be a frame aerial so far as directional properties are concerned, and we are simply concentrating inductance at the top end of the aerial, thus lessening that available in the tuner. Personally, I cannot see why such an aerial arrangement should be superior to a single vertical wire of the same height, but long experience in the game

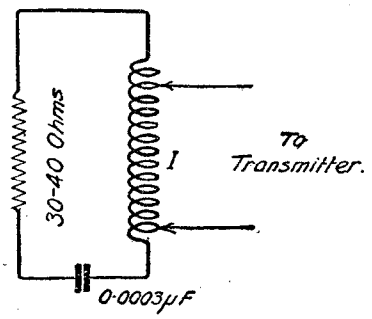
has shown me that theorising on such matters is of very little use, and it is quite conceivable that virtues may exist in this arrangement which at present are unexplainable in theory. If this paragraph should meet the eye of any reader who has erected such an aerial and can give a clear opinion as to whether or not it is superior to a vertical wire I should certainly like to hear from him. It is no use writing that such an aerial gives better results than a previous one which was half the height but horizontal; the only true comparison is between a vertical wire of the same height in the same position, and the frame scheme.

Upstairs Efficiency

Using a frame aerial in this way must not be confused with using it on the upper floor of a house. Very often it is found that a frame aerial will work far better upstairs than down; this being due to the fact that upstairs rooms are generally less screened than downstairs.

Madrid

The extraordinary way in which the Madrid transmissions are now coming in is a topic of conversation in all experimental circles. On any reasonable outdoor aerial Madrid is easily audible on a single valve, and in several cases, for which I can personally vouch, it has been heard clearly on a crystal. The modulation is very good, and if



A non-radiating Antenna Embodying Inductance, Resistance, and Capacity Commonly Known as an "Artificial" or Dummy Aerial.
I. - The Dimensions of the Inductance should not exceed 3 sq. ft.

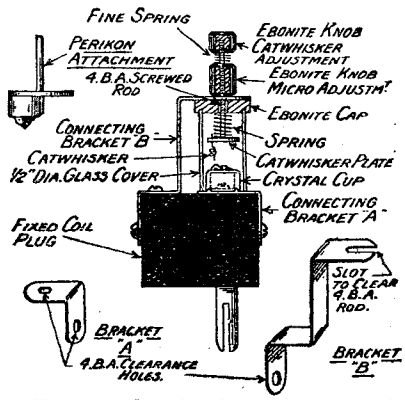
you know the language every word can be clearly understood. The wavelength is slightly shorter than that of Newcastle, so that the station can be heard by leaving the set adjusted at the Newcastle wavelength and then searching just below this point after London closes down. It is a good exercise in long-distance reception, as the station transmits for some time after the British stations have closed down. Unfortunately the Hamburg station works on the same wavelength, and frequently one station heterodynes the other.

It was rather surprising that Capt. Eckersley's broadcast from KDKA failed to be received by the British Broadcasting Company on Sunday evening, the 12th inst., as this was an extraordinary good night for American reception. After 1 o'clock in the morning WGY on the ordinary broadcast wavelength came through with extraordinary power, and on a new receiver which I have just completed for *Modern Wireless* (H.F. detector and one note-magnifier) was audible all over the house on a loud-speaker. Although atmospherics are rather troublesome these days, the speech broadcast was so clear that every little intonation of the speaker's voice was audible. When I went to bed soon after half-past two, WBZ (Boston) was coming through strongly. Two or three friends of mine who were listening on only one stage of high-frequency reported that they got the programmes quite well at the same time.

□

A Crystal Detector with Novel Points

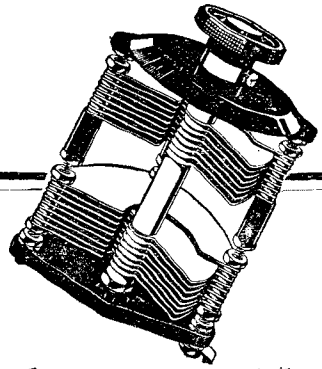
A CRYSTAL detector with some novel points is shown in the accompanying diagram. It is built up on an ordinary coil plug. This is a distinct advantage, as it may be readily plugged into a fixed coil holder. The diagram shows how the idea may be adapted to either a perikon or a catwhisker detector. Two brass brackets should first be made, as shown, one being secured by the existing coil plug screw, which makes contact with the socket. This bracket also holds the glass cover in place. The other bracket is also secured by the coil plug screw which makes contact with the pin. The other end of the bracket secures the crystal cup in the manner shown in the drawing. An ebonite cap is made to fit over the glass cover, and both are adjusted in position underneath the first bracket. The ebonite cap should have a centre drilling, to clear 4 B.A. rod, The micro adjusting knob should be of ebonite, having a centre hole drilled and tapped 4 B.A. The catwhisker adjusting knob should also be of ebonite, with a centre



Showing details of construction of the crystal detector

hole drilled and tapped 4 B.A. half-way down. A short length of 4 B.A. rod will next be required, to one end of which is soldered a round brass disc, to which the catwhisker in turn is also fixed. This may be done by soldering, or, alternatively, by drilling a fine hole and wedging the catwhisker in it by means of a taper pin peg. Over the other end of the 4 B.A. rod pass a fine spring, next place the ebonite cap over, and then pass the free end of the rod through the slot in the bracket, having the glass cover ready in position. Now screw on the micro adjusting knob, slip over a further fine spring, and finally secure the catwhisker adjusting knob. The alternative suggestion for a perikon fitment is made by soldering a large condenser spacer washer on to the brass disc, in place of the catwhisker. The spacer washer acts as a crystal cap, the crystal being secured with Woods metal. To operate, the catwhisker knob is held with the left hand, while the correct tension is applied with the right hand by means of the other knob. The position of the catwhisker is changed by turning the upper knob.

H. B.



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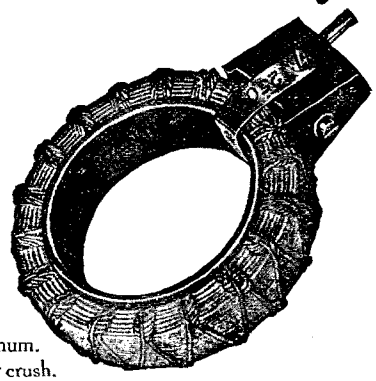

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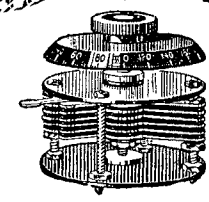

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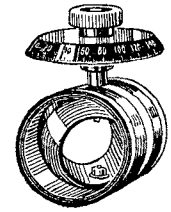

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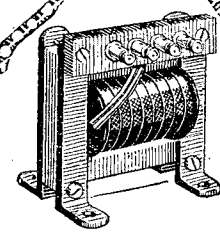

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Telephony except when otherwise stated. Corrected up to October 15th, 1924.

Edited by CAPTAIN L. F. PLUGGE, B.Sc., F.R.Ae.S., F.R Met.S.

W=Weather forecast. N=Stocks, Shares, Markets and/or News. T=Time Signal. C=Concert, Dance Music, Children's Stories.

Ref. No. of Transmission.	G.M.T.	Name of Station.	Call Sign and Wave-length.	Locality where situated.	Nature of Transmission.	Closing down time or approx. duration of Transmission.	Approx. Power used.
			WEEK DAYS				
	a.m.						
1	6.25	Hamburg	—— 392 m. ...	Germany ...	T ...	5 minutes	700 Watts.
2	6.40	Eiffel Tower ...	FL 2600 m. ...	Paris	W ...	5 minutes	5 Kw.
3	6.55	Munster	—— 407 m. ...	Westphalia ...	T ...	5 minutes	1.5 Kw.
4	7.05	Lausanne	HB2 850 m. ...	Switzerland ...	W ...	5 minutes	500 watts.
5	7.55	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
6	9.00	Voxhaus	—— 430 m. ...	Berlin	N ...	3 minutes	700 Watts.
7	9.15	Voxhaus	—— 430 m. ...	Berlin	N ...	10 minutes	700 Watts.
8	9.23	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	3 minutes	—
9	9.55	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
10	10.00	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	5 minutes	—
11	10.30	Lyons	YN 470 m. ...	Lyons ...	C ...	Until 11 a.m.	500 Watts
12	10.30	Kbel	—— 1150 m. ...	Czecho-Slovakia.	N ...	10 minutes	1 Kw.
13	10.44	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	3 minutes	—
14	10.55	Eiffel Tower ...	FL 2600 m. ...	Paris	N ...	10 minutes	5 Kw.
15	10.55	Frankfurt	—— 467 m. ...	Frankfurt ...	T ...	10 minutes	1 Kw.
16	11.00	Stuttgart	—— 437 m. ...	Wurtemburg ...	N ...	10 minutes	1 Kw.
17	11.10	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	Until 11.30	2 Kw.
18	11.14	Eiffel Tower ...	FL 2600 m. ...	Paris	T ...	5 minutes	5 Kw.
19	11.15	Konigsberg ...	—— 460 m. ...	East Prussia ...	T ...	5 minutes	1 Kw.
20	11.15	Voxhaus	—— 430 m. ...	Berlin	N ...	5 minutes	700 Watts.
21	11.55	Voxhaus	—— 430 m. ...	Berlin	T ...	15 minutes	700 Watts.
22	11.55	Leipzig	—— 452 m. ...	Germany ...	N ...	10 minutes	700 Watts.
23	11.57	Nauen	POZ 3100 m. ...	Berlin	T (spark)	8 minutes	—
	noon						
24	12.00	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
25	12.00	Kbel	—— 1150 m. ...	Czecho-Slovakia.	N ...	10 minutes	1 Kw.
	p.m.						
26	12.15	Geneva	HB1 1100 m. ...	Switzerland ...	N ...	One half-hour.	400 Watts.
27	12.30	Lausanne	HB2 850 m. ...	Switzerland ...	W T & N	15 minutes	500 Watts.
28	12.45	Radio-Paris ...	SFR 1780 m. ...	Clichy	N ...	15 minutes	8 Kw.
29	12.45	Kbel	—— 1150 m. ...	Czecho-Slovakia.	N ...	10 minutes	1 Kw.
30	12.45	Stockholm	—— 440 m. ...	Sweden ...	W ...	5 minutes	500 Watts.
31	12.45	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
32	1.00	Radio-Paris ...	SFR 1780 m. ...	Clichy	C & N	2 p.m.	8 Kw.
33	1.00	Haeren	BAV 1100 m. ...	Brussels ...	W ...	5 minutes	150 Watts.
34	1.00	Munich	—— 485 m. ...	Bavaria ...	N ...	10 minutes	1 Kw.
35	1.00	Komarow	—— 1800 m. ...	Czecho-Slovakia.	N ...	10 minutes	1 Kw.
36	1.00	Stockholm	—— 440 m. ...	Sweden ...	T ...	3 minutes	500 Watts.
37	1.15	Voxhaus	—— 430 m. ...	Berlin	N ...	5 minutes	700 Watts.
38	2.40	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
39	2.45	Eiffel Tower ...	FL 2600 m. ...	Paris	N ...	8 minutes	5 Kw.
40	2.45	Munster	—— 407 m. ...	Westphalia ...	C ...	Until 4 p.m.	1.5 Kw.
41	3.00	Centocelle	ICD 1800 m. ...	Rome	W ...	10 minutes	1.5 Kw.

Ref. No. of Transmission.	G.M.T.	Name of Station.	Call Sign and Wavelength.	Locality where situated.	Nature of Transmission.	Closing down time or approx. duration of Transmission.	Approx. Power used.
	p.m.		**WEEKDAYS (Contd.)**				
42	3.30	Frankfurt	—— 467 m. ...	Germany ...	C ...	Until 5 p.m.	1 Kw.
43	3.30	Konigsberg ...	—— 460 m. ...	East Prussia ...	C ...	One hour	1 Kw.
44	3.30	Voxhaus	—— 430 m. ...	Berlin	C & N...	5.30 ...	700 Watts.
45	3.30	Munich	—— 485 m. ...	Bavaria ...	C ...	Until 4.30 p.m.	1 Kw.
46	3.30	Leipzig	—— 452 m. ...	Germany ...	C ...	Until 5 p.m.	700 Watts.
47	3.35	Eiffel Tower ...	FL 2600 m. ...	Paris	N ...	5 minutes	5 Kw.
48	3.55	Persbureau M.S. Vaz Dias.	PCFF 2125 m. ...	Amsterdam ...	N ...	10 minutes	2 Kw.
49	4.0	Kbel	—— 1150 m. ...	Czecho-Slovakia.	N ...	10 minutes	1 Kw.
50	4.0	Hamburg	—— 392 m. ...	Germany ...	N ...	30 minutes	700 Watts.
51	4.30	Radio-Paris ...	SFR 1780 m. ...	Clichy	N C & N	Until 5.45 p.m.	8 Kw.
52	4.30	Eiffel Tower ...	FL 2600 m. ...	Paris	N ...	8 minutes	5 Kw.
53	4.45	Stuttgart	—— 437 m. ...	Wurtemberg ...	C & W	Until 6 p.m.	1 Kw.
54	5.00	Radio-Belgique ...	SBR 265 m. ...	Brussels ...	C & N	6 p.m. ...	2.5 Kw.
55	5.55	Lausanne	HB2 850 m. ...	Switzerland ...	W & N	10 minutes	500 Watts.
56	6.00	Zurich	—— 650 m. ...	Switzerland ...	W & N	10 minutes	1.5 Kw.
57	6.15	Kbel	—— 1150 m. ...	Czecho-Slovakia.	C & N	Until 7.15 p.m.	1 Kw.
58	7.00	Eiffel Tower ...	FL 2600 m. ...	Paris	W ...	8 minutes	5 Kw.
59	7.00	Munster	—— 407 m. ...	Westphalia ...	C & N	Until 8.30 p.m.	1.5 Kw.
60	7.00	Radio-Wien ...	—— 530 m. ...	Vienna	C ...	Until 9 p.m.	1 Kw.
61	7.00	Konigsberg ...	—— 460 m. ...	East Prussia ...	C & N	Until 8.30 p.m.	1 Kw.
62	7.00	Hamburg	—— 392 m. ...	Germany ...	C & N	Until 9.50 p.m.	700 Watts.
63	7.00	Stuttgart	—— 437 m. ...	Wurtemberg ...	C & N	Until 9.30 p.m.	1 Kw.
64	7.15	Zurich	—— 650 m. ...	Switzerland ...	C & N	9.15 p.m.	1.5 Kw.
65	7.15	Leipzig	—— 452 m. ...	Leipzig	C & N	8.35 p.m.	700 Watts.
66	7.15	Lausanne	HB2 850 m. ...	Switzerland ...	C ...	8.30 p.m.	400 Watts.
67	7.30	Frankfurt	—— 467 m. ...	Frankfurt ...	C & N	Between 9 and 10 p.m.	1 Kw.
68	7.30	Stuttgart	—— 437 m. ...	Wurtemberg ...	C & N	Until 8.30 p.m.	1 Kw.
69	7.30	Breslau	—— 415 m. ...	Silesia	C ...	Until 10 p.m.	1.5 Kw.
70	7.30	Leipzig	—— 452 m. ...	Germany ...	C & N	Until 10 p.m.	700 Watts.
71	7.30	Zurich	—— 650 m. ...	Switzerland ...	C & N	9.15 p.m.	1.5 Kw.
72	7.30	Voxhaus	—— 430 & 500 m....	Berlin	C N & W	Until 9.15 p.m.	700 Watts and 1.5 Kw.
73	7.30	Munich	—— 485 m. ...	Bavaria	C & N	8.40 p.m.	1 Kw.
74	8.15	Radio-Belgique ...	SBR 265 m. ...	Brussels... ...	N C & N	Until 10.10 p.m.	2.5 Kw.
75	8.30	Ecole. Sup. des Postes et Telegraphes.	FPTT 450 m. ...	Paris	C ...	Two or three hours.	500 Watts.
76	8.30	Radio-Paris ...	SFR 1780 m. ...	Clichy	N ...	One half hour.	8 Kw.
77	9.00	Radio-Paris ...	SFR 1780 m. ...	Clichy	T & C	9.50 p.m.	8 Kw.
78	9.30	Radio-Iberica ...	—— 392 m. ...	Madrid	C ...	Until mid-night.	3 Kw.
79	10.00	Eiffel Tower ...	FL 2600 m. ...	Paris	T ...	5 minutes	5 Kw.
80	10.10	Eiffel Tower ...	FL 2600 m. ...	Paris	W ...	5 minutes	5 Kw.
81	10.44	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	3 minutes	—
82	11.57	Nauen	POZ 3100 m. ...	Berlin	T (spark)	8 minutes	—
	a.m.		**SUNDAYS**				
83	7.00	Frankfurt	—— 467 m. ...	Germany ...	C ...	One hour ...	1 Kw.
84	7.55	Hamburg	—— 392 m. ...	Germany ...	T ...	5 minutes	700 Watts.
85	8.00	Leipzig	—— 452 m. ...	Germany ...	C ...	One hour ...	700 Watts.
86	9.00	Komarow	—— 1800 m. ...	Czecho-Slovakia.	C ...	One hour ...	1 Kw.
87	9.23	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	3 minutes	—
88	9.50	Konigswuster-hausen.	LP 680 m. ...	—	C ...	One hour ...	6 Kw.
89	10.00	Eiffel Tower ...	FL 2600 m. ...	Paris	T (spark)	5 minutes	—
90	10.00	Kbel	—— 1150 m. ...	Czecho-Slovakia.	C ...	One hour ...	1 Kw.

3 Additional models to the AMPLION "Dragon" range.

Representing a most important advance in the production of small and medium size Loud Speakers, the three new AMPLION models illustrated and briefly described will be found of exceptional interest to the Technician, the Wireless Enthusiast and to the Listener-in desirous of "Better Radio Reproduction."

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AR101, 120 ohms; AR102, 2000 ohms; diam. of trumpet, 5½"; over-all height, 9".

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AR110, 120 ohms; AR111, 2000 ohms; diam. of trumpet, 10"; over-all height, 15½".

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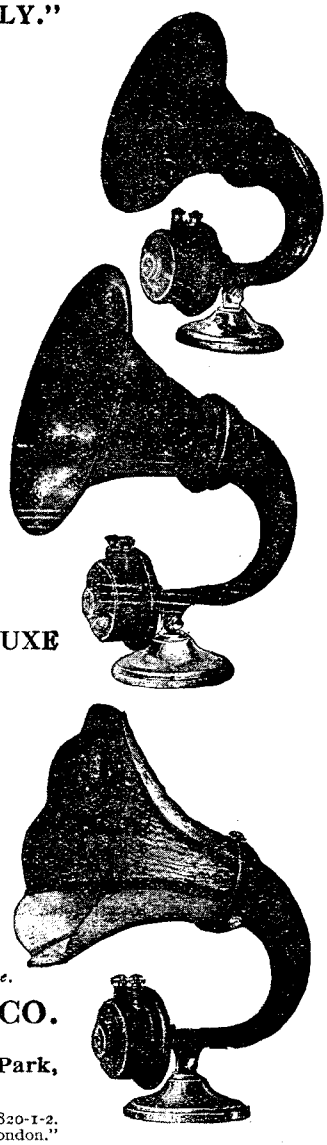

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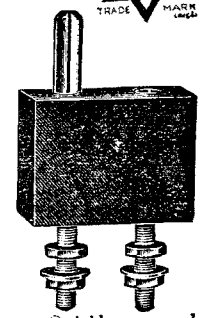

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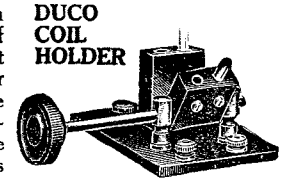

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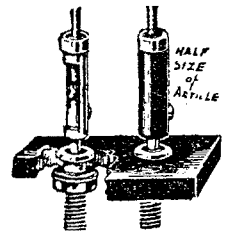

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Ref. No. of Transmission.	G.M.T.	Name of Station.	Call Sign and Wavelength.	Locality where situated.	Nature of Transmission.	Closing down time or approx. duration of Transmission.	Approx. Power used.
			SUNDAYS (Contd.)				
	a.m.						
91	10.00	Breslau	—— 415 m.	Silesia	C	1 hour	1.5 Kw.
92	10.00	Radio-Wien	—— 530 m.	Vienna	C	2 hours	1 Kw.
93	10.30	Lyons	YN 470 m.	Lyons	C	Until 11 a.m.	500 Watts.
94	10.30	Stuttgart	—— 437 m.	Wurtemburg	C	1 hour	1 Kw.
95	10.44	Eiffel Tower	FL 2600 m.	Paris	T (spark)	3 minutes	—
96	10.50	Konigswusterhausen.	LP 2800 m.	Berlin	C	Until 11.45 a.m.	6 Kw.
97	10.55	Eiffel Tower	FL 2600 m.	Paris	N	5 minutes	5 Kw.
98	11.00	Stockholm	—— 440 m.	Sweden	C	Until 12.15 p.m.	500 Watts.
99	11.10	Zurich	—— 650 m.	Switzerland	C	1 hour	1.5 Kw.
100	11.15	Konigsberg	—— 460 m.	East Prussia	T	5 minutes	1 Kw.
101	11.57 p.m.	Nauen	POZ 2800 m.	Berlin	T (spark)	8 minutes	—
102	1.00	Radio-Paris	SFR 1780	Clichy	C & N	2 p.m.	8 Kw.
103	3.00	Ned. Radio Industrie.	PCGG 1070 m.	The Hague	C & N	Until 5.20 p.m.	1.3 Kw.
104	3.00	Breslau	—— 415 m.	Silesia	C	Until 3.45 p.m.	1.5 Kw.
105	3.00	Stuttgart	—— 437 m.	Wurtemburg	C	Until 5 p.m.	1 Kw.
106	3.00	Radio-Wien	—— 530 m.	Vienna	C	2 hours	1 Kw.
107	3.00	Frankfurt	—— 467 m.	Germany	C	1 hour	1 Kw.
108	3.30	Munich	—— 485 m.	Bavaria	C	Until 5 p.m.	1 Kw.
109	4.00	Hamburg	—— 392 m.	Germany	C	30 mins.	700 Watts.
110	4.45	Radio-Paris	SFR 1780 m.	Clichy	C & N	5.45 p.m.	8 Kw.
111	5.00	Radio-Belgique	SBR 265 m.	Brussels	C	6 p.m.	2.5 Kw.
112	6.00	Eiffel Tower	FL 2600 m.	Paris	N	10 mins.	5 Kw.
113	6.00	Voxhaus	—— 430 m.	Berlin	C	30 mins.	700 Watts.
114	7.00	Radio-Wien	—— 530 m.	Vienna	C	Until 9 p.m.	1 Kw.
115	7.00	Stockholm	—— 440 m.	Sweden	C	Until 10 p.m.	500 Watts.
116	7.00	Munster	—— 407 m.	Westphalia	C	Until 9.30 p.m.	1.5 Kw.
117	7.00	Voxhaus	—— 430 & 500 m.	Berlin	C	Until 9.15 p.m.	700 Watts.& 1.5 Kw.
118	7.00	Konigsberg	—— 460 m.	East Prussia	C	Until 8.30 p.m.	1 Kw.
119	7.00	Hamburg	—— 392 m.	Germany	C	Until 9.45 p.m.	700 Watts.
120	7.00	Eiffel Tower	FL 2600 m.	Paris	W	8 mins.	5 Kw.
121	7.15	Lausanne	HB2 850 m.	Switzerland	C	Until 8.30 p.m.	500 Watts.
122	7.15	Zurich	—— 650 m.	Switzerland	C & N	Until 9.15 p.m.	1.5 Kw.
123	7.15	Leipzig	—— 452 m.	Germany	C & N	Until 8.40 p.m.	700 Watts.
124	7.30	Breslau	—— 415 m.	Silesia	C	Until 10 p.m	1.5 Kw.
125	7.30	Stuttgart	—— 437 m.	Wurtemburg	C	10.30 p.m.	1 Kw.
126	7.40	Ned. Seintoestellen Fabriek	NSF 1050 m.	Hilversum	C	Until 10.10 p.m.	1 Kw.
127	8.15	Radio-Belgique	SBR 265 m.	Brussels	N C & N	Until 10.10 p.m.	2.5 Kw.
128	8.30	Radio-Paris	SFR 1780 m.	Clichy	N	Until 9 p.m.	8 Kw.
129	8.30	Ecole Sup. de Postes et Telegraphes	FPTT 450 m.	Paris	C	Between 10.30 and midnight	500 Watts.
130	9.00	Radio-Paris	SFR 1780 m.	Clichy	C	Until 10.45 p.m.	8 Kw.
131	9.30	Petit Parisien	—— 340 m.	Paris	C	Until 12.30 a.m.	400 Watts.
132	9.30	Radio-Iberica	—— 392 m.	Spain	C	Until 12.30 a.m.	3 Kw.
133	10.00	Eiffel Tower	FL 2600 m.	Paris	T (spark)	5 mins.	—
134	10.44	Eiffel Tower	FL 2600 m.	Paris	T (spark)	3 mins.	—
135	11.57	Nauen	POZ 3100 m.	Berlin	T (spark)	8 mins.	—
			SPECIAL DAYS				
	p.m.						
136	3.00	Radio-Wien	—— 530 m.	Vienna	Mon., Wed. Fri. C	Until 5 p.m.	1 Kw.
137	4.00	Lausanne	HB2 850 m.	Switzerland	Wed., C	1 hour	400 Watts.

Ref. No. of Transmission.	G.M.T	Name of Station.	Call Sign and Wavelength.	Locality where situated.	Nature of Transmission.	Closing down time or approx. duration of Transmission.	Approx. Power used.
			SPECIAL DAYS (Contd.)				
138	4.30	Ecole.Sup.des Postes et Telegraphes.	FPTT 450 m ...	Paris	Thurs., C	2 Hours	500 Watts.
139	5.00	Komarow	—— 1800 m. ...	Czecho-Slovakia	Thurs., C	1 hour	1 Kw.
140	5.15	Zurich	—— 650 m. ...	Switzerland ...	Mon.,Wed., Fri., C	Until 5.50 p.m.	1.5 Kw.
141	5.15	Zurich	—— 650 m. ...	Switzerland ...	Thurs., Sat., C	1 half-hour	1.5 Kw.
142	5.40	Ned. Seintoestellen Fabriek.	NSF 1050 m. ...	Hilversum ...	Mon., C	Until 6.40 p.m.	1 Kw.
143	6.00	Eiffel Tower ...	FL 2600 m. ...	Paris	Mon.,Wed., Fri., & N	Until 6.50 p.m.	5 Kw.
144	6.00	Eiffel Tower ...	FL 2600 m. ...	Paris	Tues., Thurs., Sat., N	10 mins.	5 Kw.
145	6.00	Voxhaus	—— 430 m. ...	Berlin	Wed., C	30 mins.	700 Watts.
146	7.00	Svenska	—— 470 m. ...	Stockholm ...	Tues., Thurs., C	Until 10 p.m.	300 Watts.
147	7.00	Stockholm	—— 440 m. ...	Sweden	Wed.,Fri., Sat., C	Until 10 p.m.	500 Watts.
148	7.40	Smith & Hooghoudt	PA5 1050 m. ...	Amsterdam ...	Wed., C	Until 9.40 p.m.	500 Watts.
149	8.10	Middelraad ...	PCMM 1050 m. ...	Ymuiden ...	Sat., C	Until 9.40 p.m.	300 Watts.
150	8.40	Ned. Radio Industrie	PCGG 1070 m. ...	The Hague ...	Mon., C	Until 10.10 p.m.	1.3 Kw.
151	8.40	Amsterdam ...	PX9 1050 m. ...	Holland... ...	Tues., C	Until 10.40 p.m.	600 Watts.
152	8.40	Ned. Seintoestellen Fabriek.	NSF 1050 m. ...	Hilversum ...	Fri., C ...	Until 9.40 p.m.	1 Kw.
153	9.00	Le Matin	SFR 1780 m. ...	Paris	2nd and 4th Sat. of month, C	Until 10.50 p.m.	10 Kw.
154	9.30	Petit Parisien ...	—— 340 m. ...	Paris	Tues., Thurs., C	11.30 p.m.	400 Watts.
155	10.00	Radio-Paris ...	SFR 1780 m. ...	Clichy	Wed., Fri., C	Until 10.45 p.m.	8 Kw.

TEST REPORT ON "A USEFUL THREE-VALVE RECEIVER."

The receiver to which this refers is described on p. 21.

This set was tested about 9 miles from 2LO on a 75-ft. twin aerial 45 ft. high.

Using constant aerial tuning, with a No. 50 coil in the aerial socket and a No. 50 in the reaction socket, good loud-speaking was obtained from London (2LO) with the condenser set at 44°.

A high-tension voltage of approximately 80 v. was used, and a grid bias of 3 volts. Very good and very clear speech was obtained in the loud-speaker, being audible outside the house with doors and windows shut. Louder results were obtained by the use of series condenser and a No. 75 coil in the aerial socket and a 75 in the reaction socket. The condenser dial read 120°. The same values of H.T. and grid bias were used.

Manchester was received very well on the 'phones, being audible in the loud-speaker, and speech read at 5 and 6 ft. The aerial coil used was a No. 50, constant aerial being employed, a No. 50 being used for reaction. The condenser reading was 24°.

Bournemouth could be heard when London was quiet with the same coils, and C.A.T. with the condenser set at 52°.

Birmingham was received with the condenser set at 128°, using the same coils as above, at rather weak signal strength, but speech was perfectly intelligible. On changing the coils to 75's little better results were obtained, the condenser reading then being 60°.

Aberdeen was received with the same coils in position, the condenser dial being set at 92°.

A LONG-RANGE TWO-VALVE SET

SIR,—In reference to the "Long-range Two-valve Set," by Mr. Underdown, details of which were given in your excellent paper of September 17, as soon as I read of it I started to assemble it. I did not keep strictly to instructions in that I did not use square-law condensers and I did not mount the coil-holder on the panel. Well, as soon as I turned on the filaments I started to receive signals. So far I have logged all B.B.C. stations, except Aberdeen and Newcastle, the latter being very difficult to hear in this district; Brussels, Radio Paris, Ecole, Berlin, and at this moment I have got another German station I do not know the name of. To-night or, to be more correct, to-morrow morning, I am going to try for America. I will let you know results later.

B. ALCOCK.

Bedford.

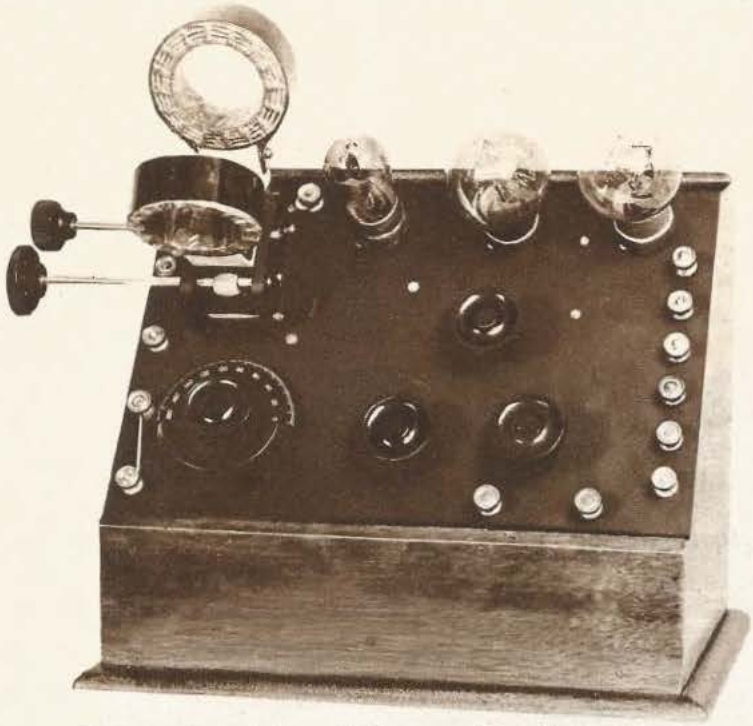


Fig. 1.—Any of the well-known makes of plug-in coils and valves may be used.

A Useful Three-Valve Receiver

By HERBERT K. SIMPSON

Simplicity of adjustment and purity of reproduction are outstanding features of this instrument.

MANY readers, while preferring the purity of tone and absence of distortion produced by the resistance-capacity method of low-frequency amplification, deplore, to some extent, the fact that an extra valve is needed to produce the same effect as when transformer coupling is used, two stages of resistance coupled note magnification being, roughly, equal to 1½ of transformer coupling.

The effect of using one stage of transformer amplification and one of resistance was tried, and the results obtained justified the making of the receiver to be described.

The full benefit of a stage of transformer coupling is obtained, but the second stage of note magnification, consisting, as it does, of resistance coupling, prevents any trouble arising due to interaction between transformers, or any extraneous noises which are quite common with some of the cheaper transformers when used in two or more stages.

Owing to the voltage drop across the anode resistance, separate terminals for the application of high-tension voltage must be provided for the first and second valves. The last valve, in the anode circuit of which are the telephone receivers, may have a higher anode potential than the other two valves, as it is the last low-frequency amplifier; therefore, the same tapping on the H.T. battery will suffice for this valve as for the second, in the anode circuit of which we have a 100,000 ohm resistance which cuts the plate voltage down.

The Receiver

Some idea of the appearance of the finished receiver may be gathered from the photograph, Fig. 1, which shows the set complete with valves and coils. On the left of the receiver are seen four terminals, these being in the aerial circuit, and enabling series, parallel, or constant aerial tuning to be employed at will. At the back of the two-way coil holder are two more terminals, by means of which the connections to the reaction coil may be reversed. The valves are situated at the top of the panel, with the resistances in front, that at the top controlling the second valve.

The battery terminals are seen on the right of the receiver, the order being: two separate high-tension terminals, common H.T. negative and L.T. positive, L.T. negative and positive of grid biasing battery; while the last two terminals are for separate application of negative bias to the second and third grids. The telephone receivers or loud-speaker are joined up to the terminals in the front of the panel.

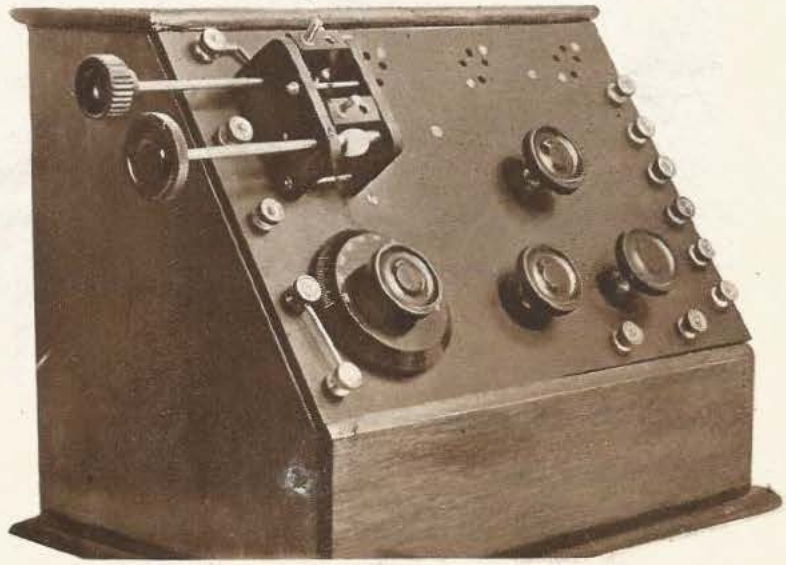


Fig. 2.—The set with valves and coils removed.

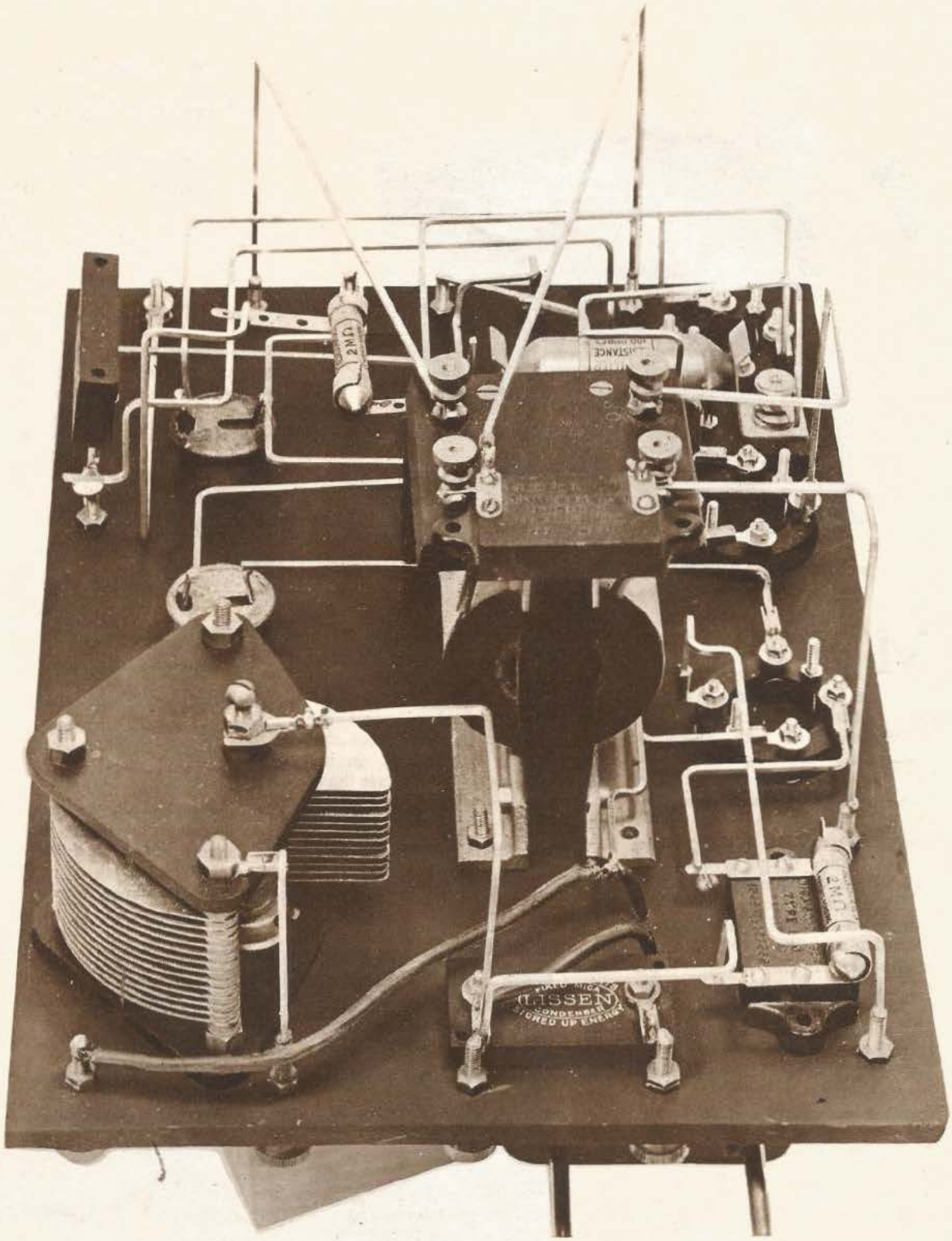


Fig. 3.—Low-capacity valve sockets and filament resistances for bright or dull emitters are refinements of value here.

The Circuit

Fig. 4 is a drawing of the circuit arrangements, and it will be seen that the first valve, V1, acts as a rectifier, the coil L2 serving to introduce reaction by coupling with L1 in the aerial circuit. A low-frequency inter-valve transformer constitutes the coupling between V1 and V2, while a 100,000 ohm resistance, R5, and a condenser, C4, of 0·2 μF capacity serve to couple the valves V2 and V3 together.

Constant Aerial Tuning

By connecting the aerial lead to terminal A, leaving A1 free, joining C and E together, and earthing the terminal E, constant aerial tuning, with parallel aerial tuning condenser, is applied to the circuit, while by joining the aerial lead to A1, leaving A free, and the earth to E, C and E being joined together by a piece of wire, ordinary parallel tuning is applied, the constant aerial tuning condenser, C.A.T., being omitted from the circuit In both these cases tuning is carried out by variation of the condenser C1, which is in parallel with the aerial tuning inductance L1.

Series Tuning

On the shorter wave-lengths it is often desirable to have the aerial tuning condenser in series with the coil L1. This may be effected in the present receiving set by joining the aerial lead to C, leaving both A and A1 free, and connecting the terminal E to the earth. For a given wave-length, a larger coil will be required when using series tuning than when the ordinary parallel connection of the aerial tuning condenser is employed.

Supply Arrangements

The arrangement of terminals for battery supply can be followed from the circuit diagram. It will be seen that the terminal H.T. +1 supplies the anode of the first valve, while H.T. +2 serves both the second and third valves. Two separate terminals for grid bias are provided, that labelled G.B.–1 being joined to the I.S. of the low-frequency transformer, the O.S. of which is connected to the grid of V2, while G.B.–2 is joined to the lower end of a 2-megohm leak, the upper end of which is connected to the grid of V3. By this means suitable grid voltage may be applied to the grids of each valve, and the experimenter may be sure that he is operating his valves to the best advantage.

Components Required

The components required are as follows :—

1 Ebonite Panel, 12 in. by 8 in. by ¼ in. (Paragon, Peter Curtis, Ltd.).
1 2-way coil holder (Goswell Eng. Co., Ltd., Cam Vernier).
3 Filament Resistances (Microstat, Wates Bros.).
1 L.F. transformer (Tangent).
1 0·0005 μF variable condenser.
3 valve holders (H.T.C. Electrical Co., Type C).
1 0·0001 μF fixed condenser (Lissen, Ltd.).
1 0·0003 μF condenser and 2-megohm leak (Dubilier, Ltd.).
2 0·002 μF fixed condensers (Dubilier, Ltd.).
1 0·2 μF T.C.C. condenser.
1 100,000 ohm resistance (Dubilier, Ltd.).

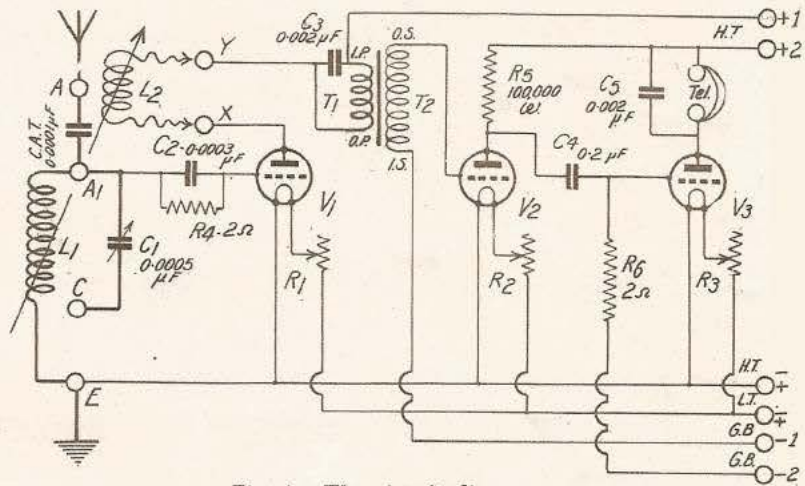


Fig. 4.—The circuit diagram.

1 2-megohm resistance, with clips (Dubilier, Ltd.).
14 terminals.

The names of the makers are given in the above cases; but it is not of essential importance that the parts used should be of the make specified, and the constructor may use such parts as he may already possess, provided these are of a good reliable make, and in proper condition.

The beginner who has any doubts about the matter is advised to follow the author's list if he wishes to obtain the same results.

Constructional Details

Fig. 6 shows the top-of-panel layout, and the necessary dimensions for drilling will be found thereon. In some cases the positions of screws are not dimensioned. This is because the component which they hold in place is likely to require different spacing when another model is purchased. For example, if the constructor drilled the holes in a dimensioned place for the transformer, he might quite conceivably find that his transformer would not fit, and he would, in the majority of cases, blame the drawing. In many cases, drilling templates are supplied, and these should be used where possible, as they make accurate drilling a much easier task.

The remainder of the construction is straightforward, and calls for no comment. Wiring, which is carried out in square section tinned copper wire, will be clear from the wiring diagram, Fig. 7, while the back-of-panel photographs will also prove of assistance to the constructor in his work.

The Containing Box

The panel, when completed, may be mounted in any suitable form of box or cabinet, to suit the needs of the individual. In the present case, a cabinet of the sloping front or desk type was chosen, and the whole presents a neat appearance.

Operating Details

Almost any good make of receiving valve will be found suitable for this receiver, and possibly the constructor may already possess three which will be found satisfactory. A voltage of 60 to 70 volts should be applied to the terminal H.T.+ 1, while about 100 volts may be required at the terminal H.T.+ 2. The voltage of the low-tension accumulator should be suited to the valves used, but either bright or dull

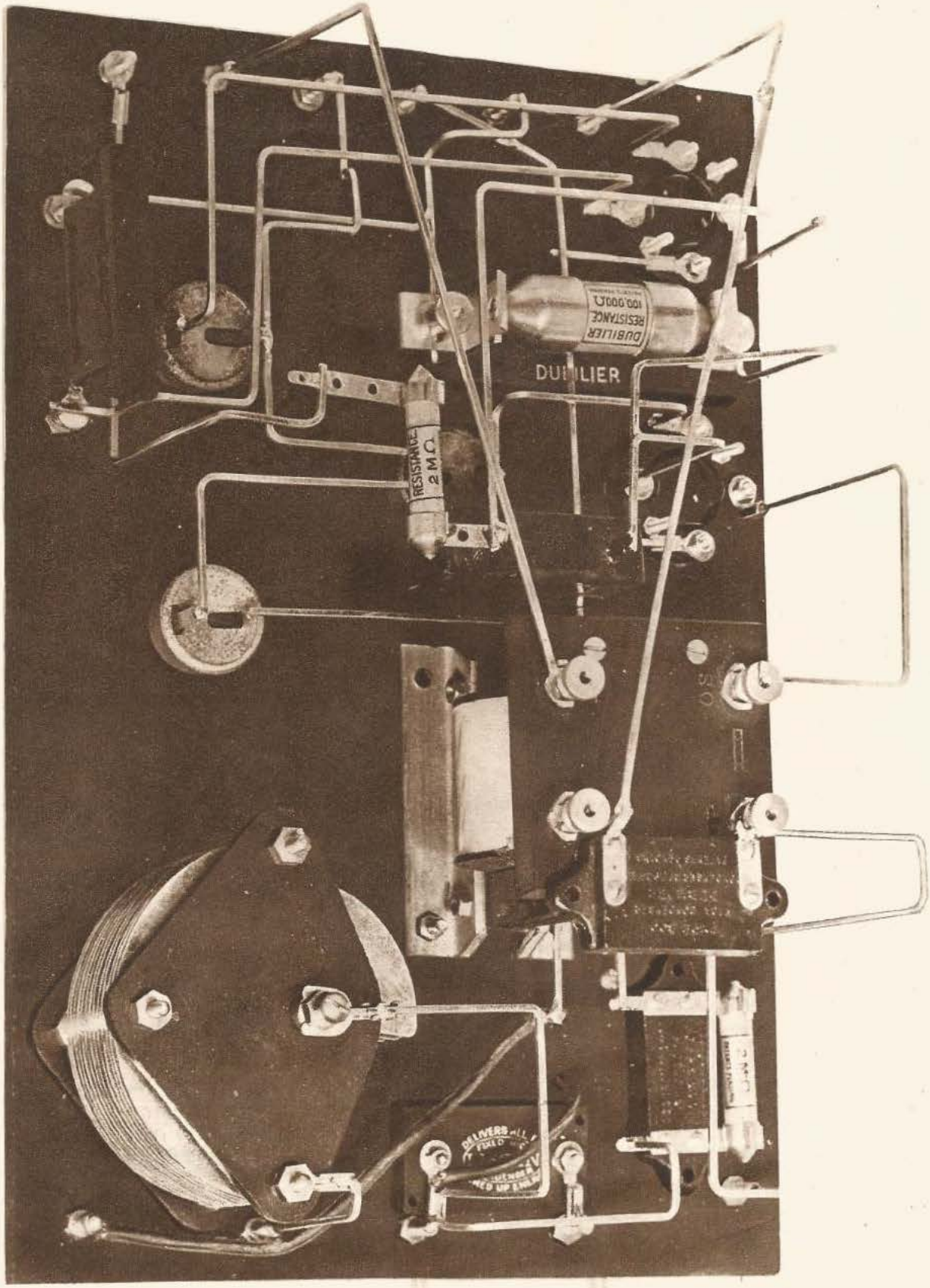


Fig. 5.—This view, from another angle, will give further assistance in wiring.

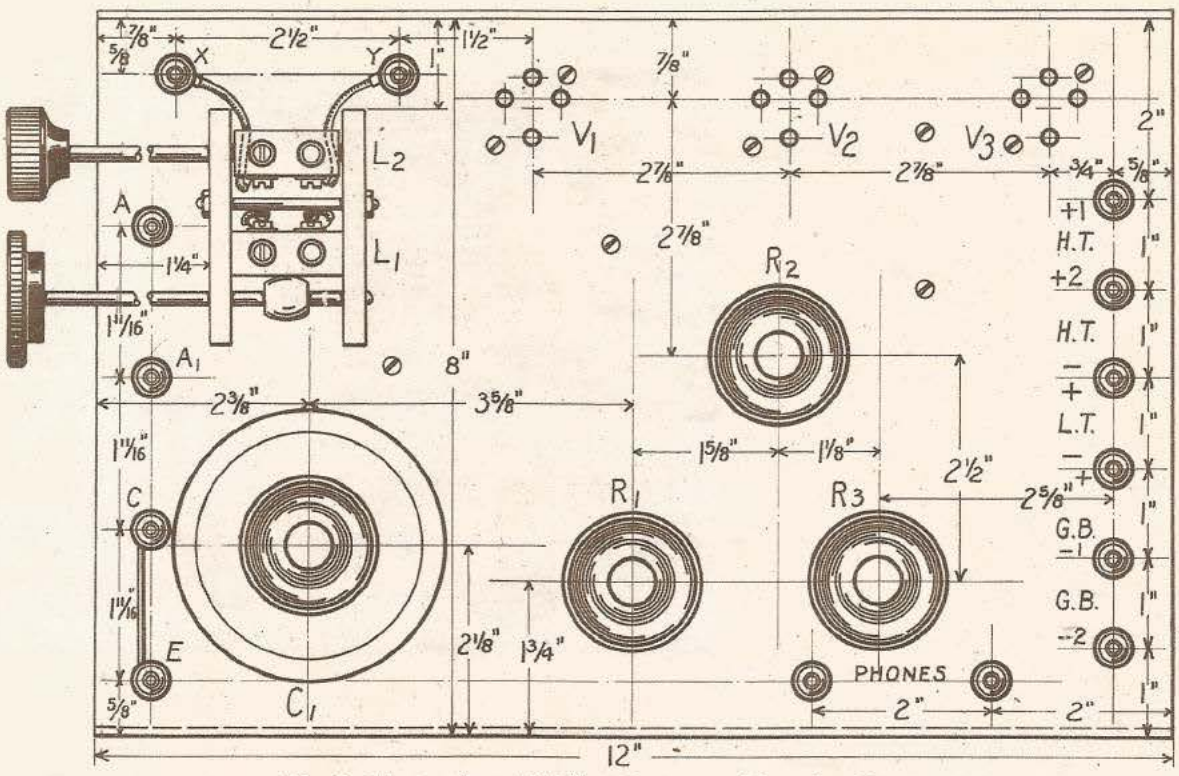


Fig. 6.—Front of panel drilling diagram. Blueprint 68a.

emitter valves may be used, as the filament resistances provided are capable of dealing with both patterns.

Testing the Set

When complete, the receiver may be joined up to an aerial and tested. Connect the accumulator and grid biasing batteries to the correct terminals, as shown in Fig. 6, and turn the filament

(Concluded on page 32)

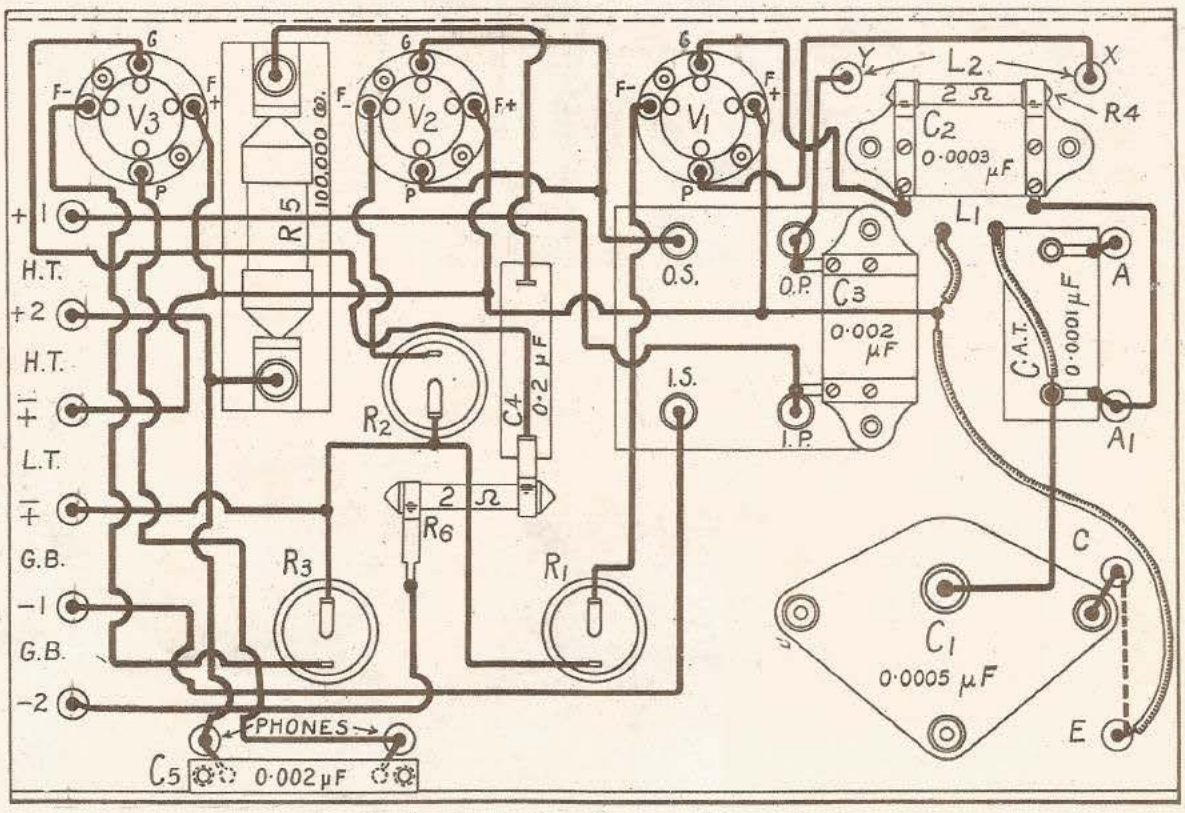
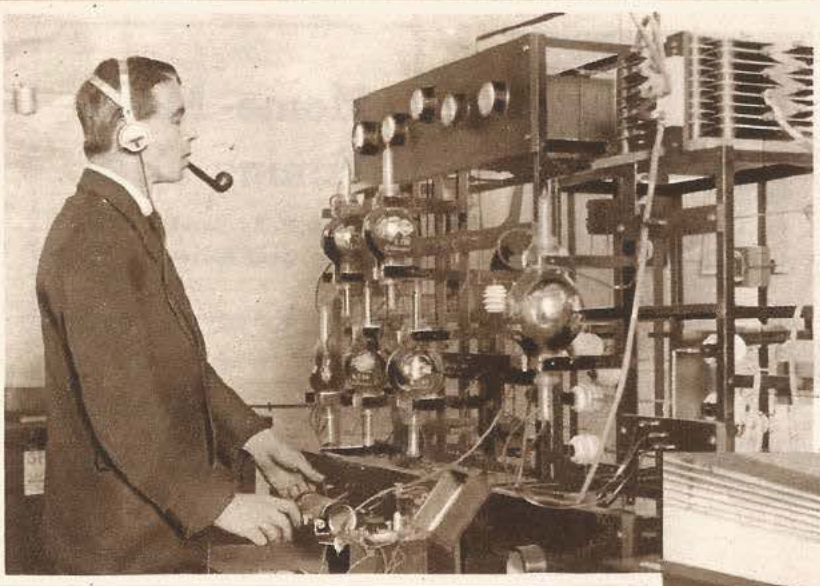


Fig. 7.—Practical wiring diagram. Blueprint 68b.

Our photograph shows Mr. G. P. Fox, the Director of the Leeds Relay Station, reading the news bulletin. Note the microphone on the right, resting in its crepe rubber cradle.

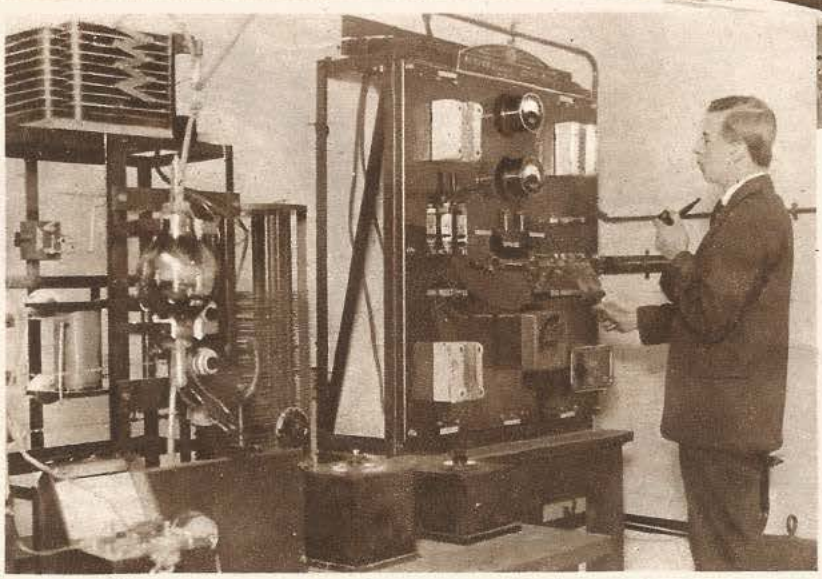
The Children's Hour at the Hull Relay Station in which Uncle Jerry (left), Auntie Ida, and Uncle Leslie are participating. This Station is becoming increasingly popular with the local children.

Mr. Harvey, the Engineer-in-Charge of the Leeds Relay Station, is here seen standing before some of the apparatus in the control room.



Mr. P. H. Cook, Assistant Engineer at the Hull Relay Station, adjusting the transmitter. This photograph gives a good idea of the size of valves used.

An American amateur building his neutrodyne receiver. This photograph clearly shows how the coils are staggered in relation to each other. Balancing the condenser values is a difficult matter in this design.



Another view of the Hull Relay Station showing Mr. Cook at the switchboard.

Home-Made Tuning Coils

By G. P. KENDALL, B.Sc.
Staff Editor.

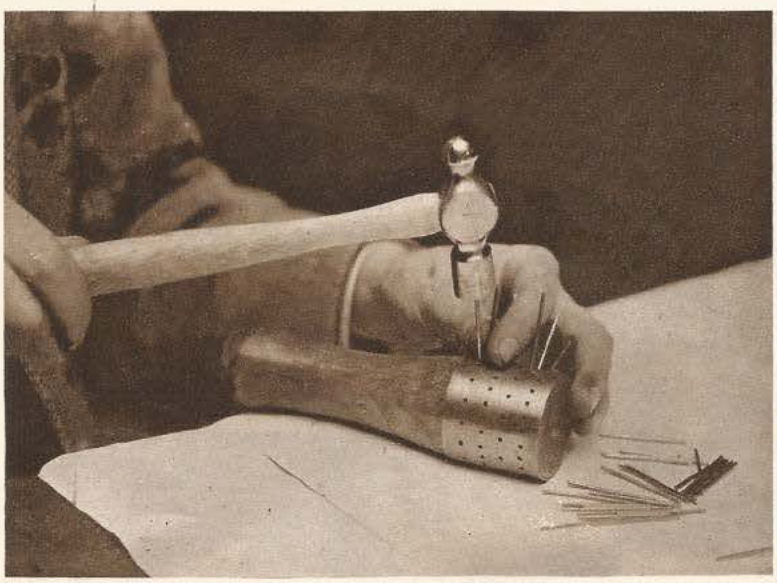
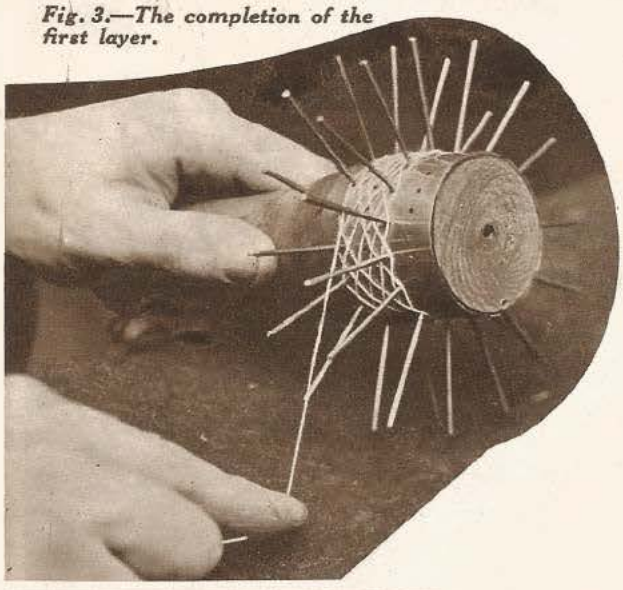


Fig. 1.—Preparing the former for use. The one illustrated is a commercial product known as the "E.C."

Fig. 3.—The completion of the first layer.



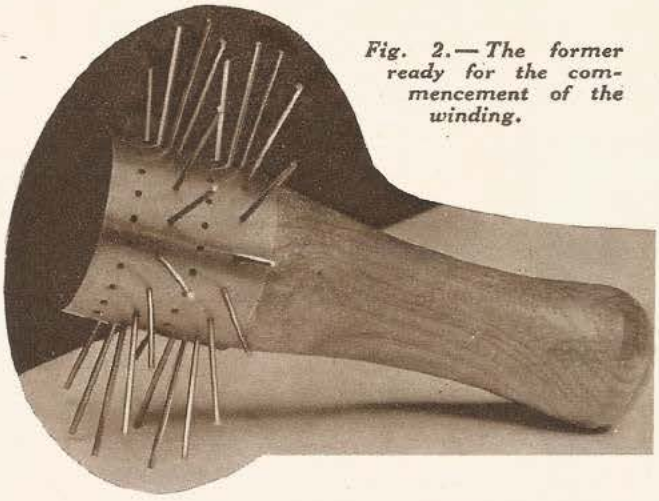


Fig. 2.—The former ready for the commencement of the winding.

Fig. 4.—Soldering the ends of the winding to the pin and socket of the plug.

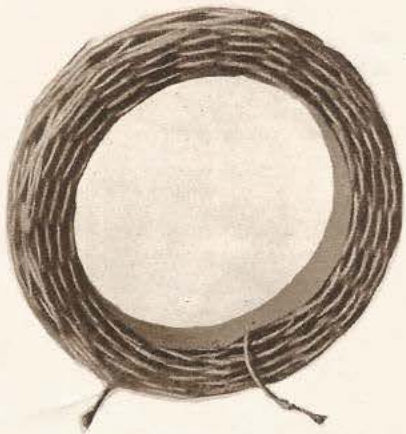


Fig. 5.—When the coil is complete it is impregnated with paraffin wax and taken off the former.

Home-made coils possess many virtues, and provide a most interesting line of research for the keen experimenter.

This series of illustrations gives a complete guide to the winding of a honeycomb coil.

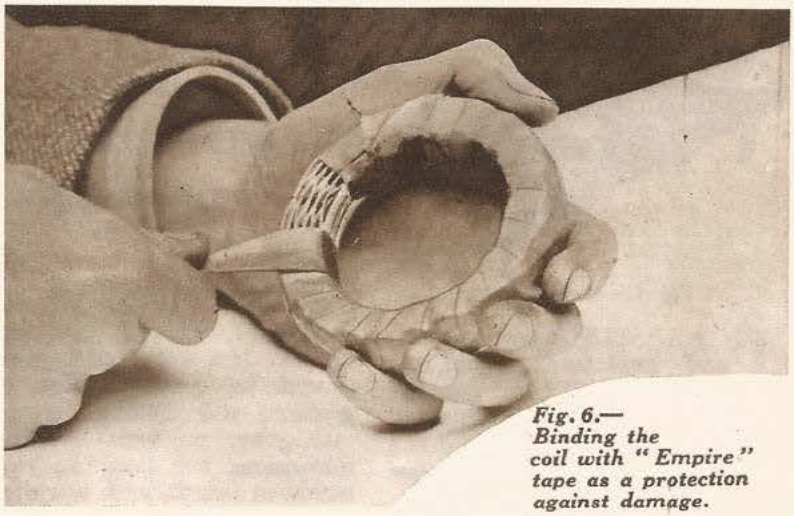
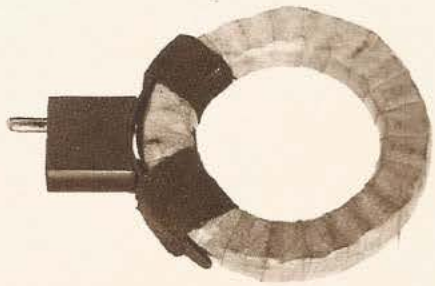


Fig. 6.—Binding the coil with "Empire" tape as a protection against damage.

Fig. 7.—The end of the tape is secured with Chatterton's compound.

Fig. 8.—The coil may be attached to the plug by means of a band and two screws.



Figs. 9 and 10.—This is a good method of attachment (covered by Burndept patents) employing a binding of adhesive tape and a segment of fibre.

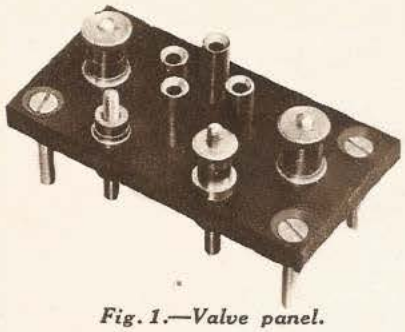


Fig. 1.—Valve panel.

A Useful Layout Board

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

INTERESTING new circuits and improvements on, or modifications of, old ones are always being published which all wireless enthusiasts keenly desire to try out. The difficulty is that

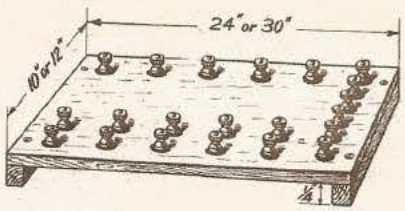


Fig. 2.—How the board is made up.

even if we have all the components required such as transformers, condensers, resistances, gridleaks, inductances, and the like, these things have to be mounted in some sort of way, and this takes time.

The layout board to be described in this article meets all the requirements of the experimenter. Both the board itself, and its fittings, are easy and cheap to construct, and once they have been made up one has at hand an outfit which is invaluable for experimental work of all kinds.

The board itself is merely a plank of ¾-inch wood—plain deal will do quite well, though polished hard wood, of course, looks much better. If a soft wood is used it should be ¾ inch thick, but ½ inch will suffice for oak, mahogany, or teak. Suitable dimensions are from 24 to 30 inches in length, with a width of 10 or 12 inches. A 24-inch board will enable practically any combination containing up to four valves to be wired up without crowding, whilst a 30-inch board gives ample room for five or six valves. Fig. 2 shows the way in which the board is made up. It

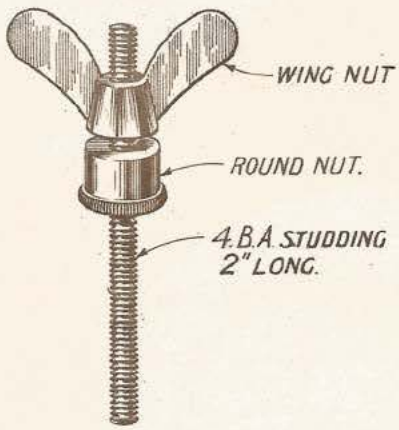


Fig. 4.—How terminals can be improvised.

is simply raised upon battens at either end, 1¼ inches deep, so that

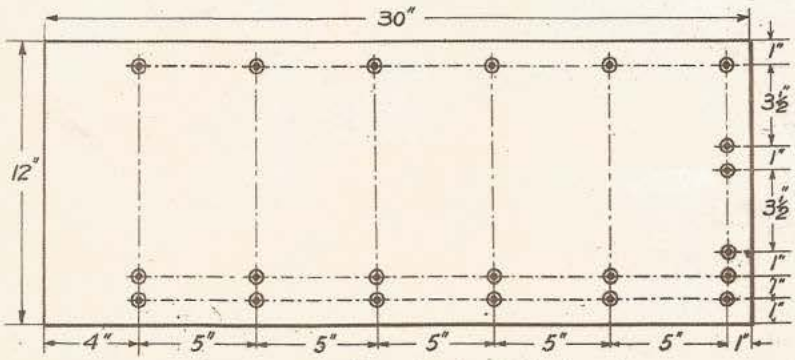


Fig. 3.—Drilling details of the board.

Fig. 5.—A gridleak unit.

there is plenty of clearance between its underside and the table upon which it stands.

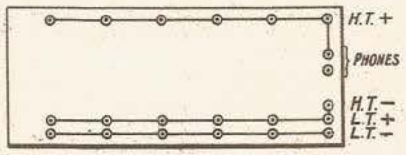


Fig. 6.—Wiring of terminals.

All holes shown are made with a ½-inch bit, preferably of the auger type. Each hole is provided with a pair of 4B.A. panel bushes in which a terminal of medium size is mounted.

Some difficulty may be experienced in obtaining ready-made terminals with shanks sufficiently long to enable them to be used in ¾-inch wood. The minimum length of shank required in this case is 1¼ inches. Terminals can,

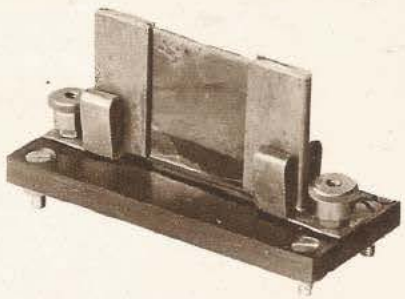


Fig. 7.—Clip-in condenser unit.

however, be made very easily and cheaply in the workshop from 2-inch lengths of 4B.A. studding, and milled-edged, or wing, nuts which are obtainable from any good tool shop. A simple home-made terminal is shown in Fig. 4. The round nut should be run on to the studding until its top is about ⅜ inch below the end of the rod. The nut should then be fixed firmly in position as shown by "prick-punching" with a fine-pointed centre punch.

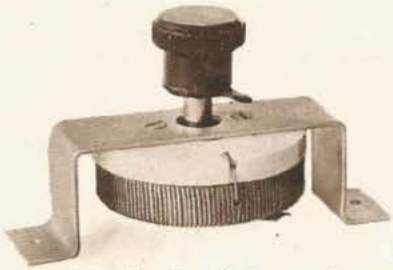


Fig. 8.—A mounted filament resistance.

Milled headed nuts may, of course, be used instead of the wing pattern for the top portions of the

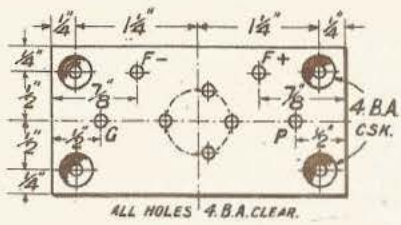


Fig. 9.—Drilling details of valve panel.

terminals, but I think personally, that wing nuts are to be preferred on a board designed for quick layouts, since they enable one to make sound-tight connections very quickly, and to undo wires in a moment. Fig. 6 shows the way in which the board is wired.

We now come to the various components and the mountings which are made up for them. The photograph shows a very useful type of valve holder which occupies little space and is not liable to be upset. It is made

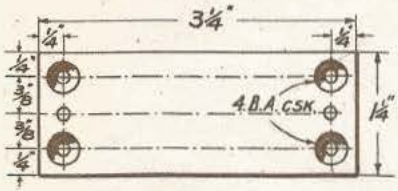


Fig. 10.—Base for anode resistances, etc.

from a piece of ¼-inch ebonite, 3 inches long and 1½ inches wide, laid out and drilled in the way shown in Fig. 9. All holes are 4B.A. and may be made tapped or clearance, according as the constructor prefers to screw in his terminals or valve legs or to fix them with nuts. The countersunk holes at the corners are for 1-inch 4B.A. screws, which serve

This article fills the requirements of the experimenter in a unique fashion, greatly simplifying the trial of new circuits.

as legs for the holder, raising it above the board upon which it stands and insulating the shanks of valve legs and of terminals.

Succeeding photographs show variable gridleaks and anode resistances ready for use on the circuit board. The various makes of these components differ slightly in design and in dimensions, but the same type of mounting will do for the majority of them. To make such a mounting we require a piece of ¼-inch ebonite 3½ inches in length and 1½ inches

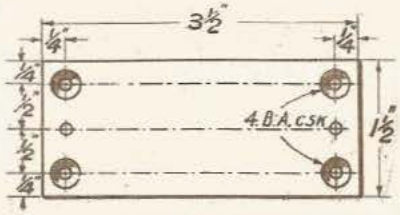


Fig. 11.—Base for clip condenser stands.

wide, the drilling layout of which is given in Fig. 10.

Clips which will suffice for practically every type of variable gridleak or anode resistance are shown in Fig. 14. These are made from sheet brass or German silver. Nearly every kind of anode resistance or gridleak of

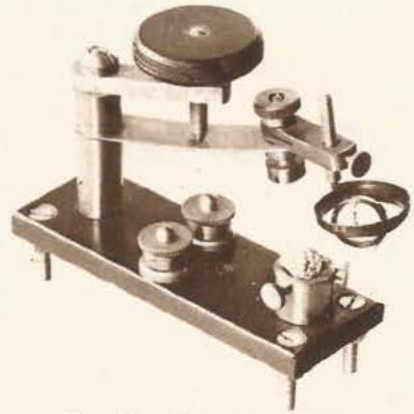


Fig. 13.—The crystal-detector stand.

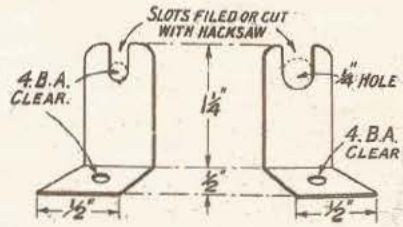


Fig. 14.—Resistance clips.

the variable pattern has one contact consisting of a 4B.A. screw inserted into the cap at its lower end, and the other is usually made with the bush through which the threaded plunger, actuated by the knob, passes. We can, therefore, make one of our clips with a 4B.A. clearance hole for the end contact screw, but in the other it is best to make a ¼-inch hole to be on the safe side. In some of these components the bush is made from 2B.A. material, but in others, it is 0B.A., or even a little larger. A slot should be filed from the top of each clip into the holes made as shown in Fig. 14, so that the resistance may be slipped into

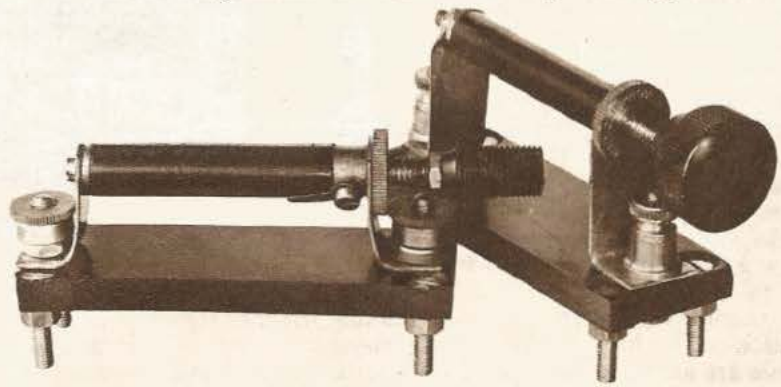


Fig. 12.—Mounted resistance units.

place by merely loosening the 4B.A. screw, and the collar which acts as a "one-hole" fixing. As these components vary a little in length it might be as well also

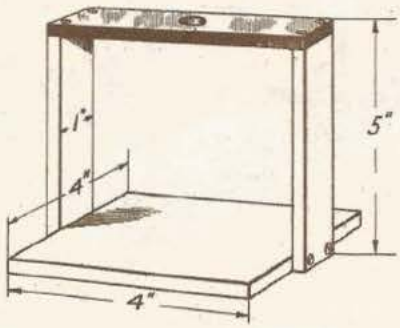


Fig. 15.—Stand for "one-hole" fixing components.

to file slots running into the 4B.A. clearance holes through which the terminals are passed. When this is done the distance between the clips can be adjusted to suit any particular leak or resistance without difficulty.

For fixed gridleaks and anode resistances a simple mounting is that shown in Fig. 5 photograph. Here, again, the holes in the clips through which the terminals pass may have slots cut into them so that the distance between the clips may be adjusted and components of various lengths securely held. The dimensions of the ebonite required for making mountings for fixed leaks and resistances are exactly the same as those given in Fig. 10, but there is no need to make the clips so high; from $\frac{5}{8}$ inch to $\frac{3}{4}$ inch will be found sufficient for them.

Undoubtedly the best kind of fixed condenser to use with the layout board is the type with a mica dielectric made with metal ends which fit into clips.

The great advantage of using them is that once a suitable mounting has been made up condensers of any capacity between ·0001 μF and ·01 μF can be inserted into the clips upon it in a moment. To change the capacity of any condenser in circuit, therefore, no connections or disconnections need be made. To make a stand for condensers

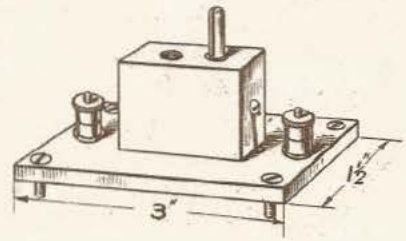


Fig. 16.—Anode or choke coil stand.

of this kind we require a piece of ebonite 3½ inches in length by 1½ inches wide. The drilling layout is shown in Fig. 11. It will not be necessary to make clips since these can be purchased so cheaply from makers of clip-in condensers.

(To be concluded)

A Useful Three-Valve Receiver

(Concluded from page 25)

resistances to the off position. The valves may now be inserted and the resistances just turned on to see if the filaments light correctly. If all is well, the H.T. battery may be joined up.

For an initial test, it may be found simpler to join the terminals H.T.+1 and H.T.+2 together, connecting them by a piece of wire to the high-tension battery. Also, when first using the receiver, the terminals G.B.—1 and G.B.—2 may be shorted to L.T.—G.B.+.

Commence testing on the local broadcasting station, using constant aerial tuning. Connect the aerial lead to A, join C to E and to earth. Insert a No. 50 coil in the socket L1, if the wave-length of the station to be received is below 420 metres, above which a No. 75 may be tried. A No. 75 coil should be inserted in the reaction-coil socket L2. The telephones are joined to the terminals indicated.

Turn on the filaments now, keeping L2 well away from L1, and vary the condenser C1 slowly. When signals are heard, bring L2 closer to L1, and retune on C1, noting whether signals increase in strength. If not, reverse the leads to the reaction coil by changing over the rubber-covered leads to the terminals X and Y.

When a little practice has been obtained in operating the receiver the effect may be tried of varying the voltage applied to the high-tension positive terminals. Take separate leads from each of these positive terminals to different tapping points on the battery. Also, about 3 and 6 volts negative may be applied to the grid bias terminals 1 and 2 respectively, when using fairly high anode voltages. With a little patience, the operator will be able to find the best values of high-tension and grid voltages to apply for the particular types of valve used.

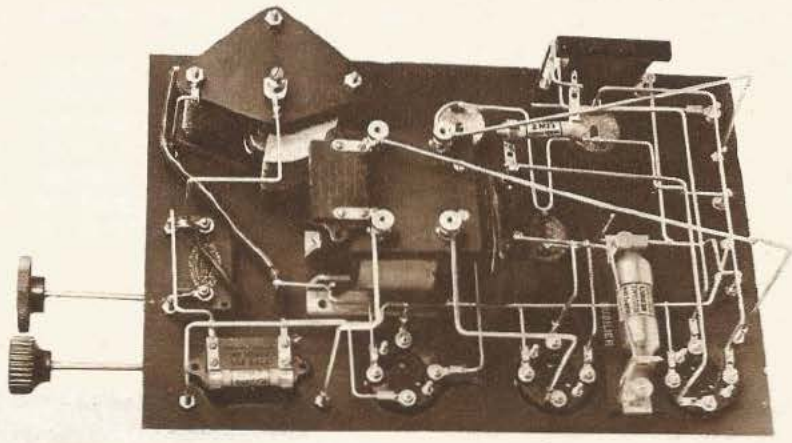
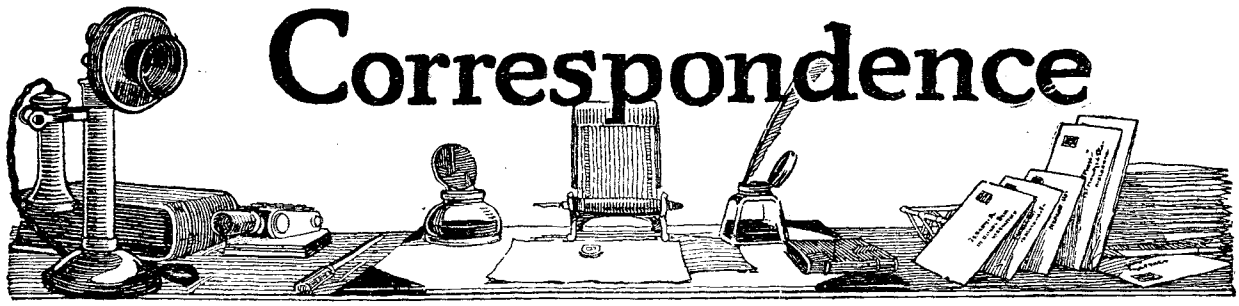


Fig. 8.—A further back-of-panel photograph.



IS THIS A RECORD?

SIR,—As you will remember, I sent you some of my results a short time ago which you published in No. 19, *Wireless Weekly*, but this time I should like to go further by asking you if I can claim a record for long-distance *overland* broadcast reception on a small frame aerial using four valves.

To give a description of apparatus and results I should like to point out first of all that my flat is situated on the bottom floor of a five-storey building and my set and frame are in the centre of the flat.

The set which gave the following results has nothing "super" about it, and was made entirely by hand, including the variable condensers. The receiver, 3H.F. and rectifier:—

Coupling between first and second valves tuned anode.

Coupling between second and third valves resistance capacity.

Reaction coil swings inside anode coil.

The frame, which hangs over the set, is tuned by a 0.0005 μF condenser.

The results:—

On September 27 I received the whole programme from 5XX, which continued till 2300 hours G.M.T. and finished up with Big Ben striking the time signal.

On Sunday, September 28, I was late opening up on 1,600 metres, and at 2145 G.M.T. I tuned in 5XX and heard a vocal chorus which finished after ten minutes.

2200 G.M.T.—A series of piping dots.

2205 G.M.T.—Weather report.

2210 G.M.T.—Latest news items, some of which I remember as being about Lloyd George speaking at Portsmouth. The American world fliers, etc. A fire breaking out in ? Hospital whilst three operations were taking place, etc., etc.

2215-2219 G.M.T.—Silence.

2220 G.M.T.—Hullo! 5XX calling, followed by next week's programme.

2225 G.M.T.—Good-night everybody.

All this came through very distinctly on the 'phones, and after reading all the reports in *Wireless*

Weekly and *Modern Wireless* on reception of 5XX, I have not yet come across a case of better results than my own.

Receiving across Europe, with its many jamming stations, is, I think, more difficult than Transatlantic reception.

I should be exceedingly pleased to know whether I can claim the record for 5XX under the conditions I explained earlier in my letter.

Congratulating Radio Press on its deserving success and prosperity,—Yours faithfully,

D. T. L.

Constantinople.

P.S.—This may be of special interest to "Mr. Brown."

A SOCIETY'S RECEIVER

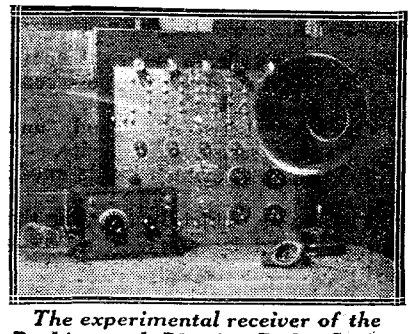
SIR,—Enclosed please find photograph of the under-named Radio Society's experimental receiver, and I trust same is of interest to your readers. My only regret is that photo is rather distorted and a copy of *Modern Wireless* does not appear in same, as I send all my copies to U.S.A.—Yours faithfully,

For the BARKING AND DISTRICT RADIO SOCIETY,
A. M. GIBBS, Hon. Sec.

GRAMOPHONE v. WIRELESS

SIR,—In support of Mr. P. W. Harris I should like to bear testimony to the immeasurably better reproduction of a loud-speaking receiver by wireless over the commercial gramophone, however good.

As one who is conversant with the performances of both, both from private and professional use, I feel that what is wrong is Mr. Brockway's receiver, his loud-speaker, his manipulation, or all three of these factors.



The experimental receiver of the Barking and District Radio Society

It is incontestable that the gramophone is lacking in control when compared with a wireless receiver and L.S. reproducer. Few music lovers would slam on a record, jab in a needle, run the motor in any manner and claim they were operating a gramophone. These three points are the cardinal factors in the gramophone, and when sympathetic attention is paid to the motor (with correct speed adjustment), the sound-box well-chosen, the needle also selected to the type of record, even the first-class machine gives up its control factors. The record (beyond cleanliness) is a thing apart, and is bought as it stands, good or bad, and nothing can be done to alter it (except its volume, which should be controlled by the needle and sound-box and not by a pair of muffling doors). The eternal snags in the records are (1) surface noise owing to friction of needle; (2) *uncontrollable* resonance at certain frequencies, which are recorded in some cases on the actual disc itself. What chance has the operator to get over this? The partial answer to No. 1 is the new scratchless record of to-day. But it is sheer folly to pretend it is noiseless. At the very best and in brand new condition there is an unmistakable hiss. The second problem still remains intact.

In the case of wireless reception, there should not be the least sound in an L.S. other than the transmitted item. The worst one has to contend with is atmospherics as extraneous noises, and England does not appear to be pestered with this trouble. If the L.S. produces sounds other than this on local broadcast reception (which are not X's or temporary interference from other stations), the trouble is in the

WIRELESS WEEKLY SMALL ADVERTISEMENTS.

BATY Condenser, High Max., Low Min., High insulation, Min. weight, 5/3 postfree. Coil to match, 230/4,000 metres, 6/9 post free. Combined space 4"x1", weight 2 oz. Suitable for all circuits. Technical reprints giving circuits, 1/3 post free. Ernest L. Baty, Luton.

HEADPHONE REPAIRS. — Rewound, remagnetised, readjusted. Lowest prices quoted on receipt of telephones, Delivery three days. Est. 26 years.—Varley Magnet Co., London, S.E.18.

TELEPHONE RECEIVERS and Loud, Speakers Rewound, 2,000 ohms. 3/6.–A Roberts & Co., 42, Bedford Hill, Balham, S.W.12.

FOR SALE.

1 Omni Receiver made on Mr. Scott-Taggart's instructions by a London firm of standing, complete with 3 coil holder and 50 connecting links.
2 pairs Sterling de Luxe Headphones.
1 Peto Pan Loud Speaker.
1 Ever Ready 108 Volt H.T. Battery.
3 Marconi R Valves.
1 B.H.T. R. Valve.
3 Mullard Valves.
2 Cossor Valves.
3 Wecovalves (Dull emitter).

All in good condition.

The whole lot cost £40. £28 in cash accepted. Free delivery upon receipt of remittance. Apply "Woodfield House," Penryn, Cornwall.

INVENTIONS are required. I can sell your wireless inventions. Payment by results. Box A23. Barclays, Bush House, Strand, London, W.C.2.

FOUR-VALVE A.J.S. Wireless Receiver for Sale. Complete set with all accessories, condition good as new, just overhauled by makers. Cost £27, take £15, or £10 without accessories. Box A24 "Wireless Weekly." Barclays, Bush House, Aldwych, W.C.2.

receiver or etc. as before stated. I have stuck to L.S. reception and have got something I can *enjoy*, and there is no reason why everybody sufficiently enthusiastic cannot do the same. The result is (for all practical purposes) perfect reception, distortionless reproduction, absence of extraneous noises, *and the instrument needs no attention to provide a complete evening's entertainment.*

The artistic value of the last is worth much alone. Compare, then, the adjustability of the wireless receiver and its scope is boundless, the control upon volume and tonal value minute, and to him that will specialise in L.S. reproduction the reward is a " perfect " copy.

The question of the record *v.* programme *matter* is dead mutton. There are many records (and by far the majority, too) whose standard of performance is not so good as its prototype in wireless. The gramophone keeps its " past masters " indefinitely, wireless brings forth the topical authority, and the ever-present artist is with us yet. The value from an artistic sense of the Master record is marred by the " snags " already referred to; and who shall say that the programme of yesterday *has* gone for ever?

The sole remaining asset of the gramophone is that it does not work to a scheduled time, and for this reason, if no other, the gramophone will not pass into disuse.

With best wishes and looking forward to your winter programme,
—Yours faithfully,
S.E.5. H. SHEARMAN DYER.

THE SIMPLICITY RECEIVER

SIR,—I have completed building the Simplicity three-valve set as contained in your Radio Press Envelope No. 3.

In view of the extreme satisfaction it gives, I feel that it is only right to acknowledge my thanks to Mr. Kendall for the good circuit, clear photographs and diagrams, and the complete and concise instructions and to yourself for placing them within the reach of all.

I am using the set on an indoor aerial which is as follows: Three strands of copper wire (bare) 12 ft. long and 2 ft. apart across a second floor landing. These wires are joined and brought down two flights of stairs on insulated hooks at a distance of ½ in. from the wall to the ground floor.

The landing across which the aerial is slung has only one outside wall, and we have high buildings adjacent on two sides and over 50 telephone wires on high steel masts on another side.

My earth is 20 ft. of bell wire to the water tap.

You will therefore agree that the set is not by any means working under good conditions.

The results so far are as follows, although I have not had time to do much searching for stations:—

Leeds.—Can be got too loud to be comfortable.

Hull.—Ditto.

Manchester.—Very loud.

Newcastle.—Loud.

Sheffield.—Ditto.

Bournemouth. — Comfortable phone strength usually.

London.—Ditto, but fades badly.

Chelmsford.—Comfortable phone strength.

Petit Parisien.—Good strength.

Madrid.—Music clear, speech readable.

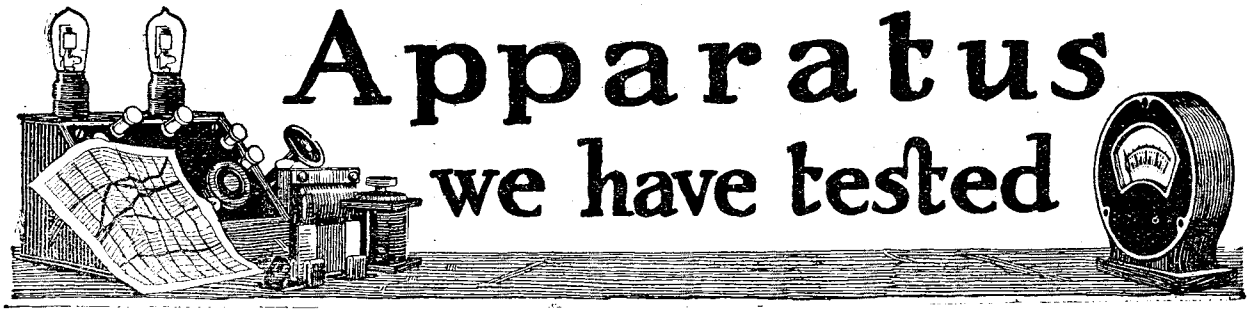
Aberdeen and Edinburgh have been picked up and are quite good at times, speech being clearly readable.

I am sure more stations will be got when I have time to search for them. At present I hardly know where to put the condenser and what coils to use for a given wavelength.

I may say that this set is my first venture in wireless.

My wireless friends, two of whom are in the trade, testify to the excellence of the set, and quite agree that the results are beyond any three-valve set they have tested.

The valves used are Marconi D.E.3 for H.F. and L.F. Ediswan .06 for rectifier.—Yours faithfully,
Selby, Yorks. ERNEST PIERCY.

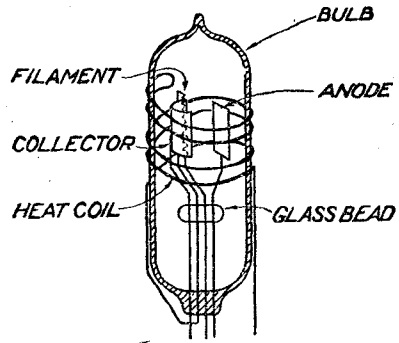


Conducted by A. D. COWPER, M.Sc., Staff Editor.

"Sodion" Valves

Messrs. R. A. Rothermel, Ltd., have recently submitted a sample of the "Sodion" valve and holder, a report on an earlier sample of which (kindly sent us by a correspondent) was published in these columns some time ago.

This is quite a unique type of valve, in which sodium metal plays a part, the usual grid being replaced by a trough-like element placed behind the filament on the side remote from the anode plate, and called a "collector." There is also a small external heating-coil in series with the filament, wound on the tiny bulb, which is enclosed in an obscured-glass outer jacket. The makers state that it sometimes takes half a minute for the "tube" and batteries to settle down when first switching on. As indicated in the earlier report, the valve is for use as a detector only,



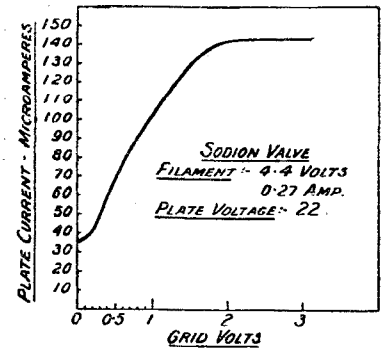
no normal amplification or reaction-phenomena being available with this type. The principal claim for it seems to be that of exceedingly good detection, without risk of interference.

The rating given is 3.8 volts and .24 ampere, four dry cells, or a 6-volt accumulator with a high-value filament-resistance being indicated. The dry cells would evidently require to be of the monster variety, if long continuous operation in daily broadcast reception was in question. With this sample, at the rating given, the results were poor; at 4.2 volts and .25 ampere better results were obtained, the optimum being with 4.4 volts and .27 ampere. The older sample showed on repeating the test the best conditions at 4.2 volts and .31 ampere. The tube gave then a bright yellow light. The makers warn against running the filament so hot that a white light is given. The plate voltage is given as 16.5

to 22.5 volts; tests were made at 22 volts.

Since detection only is indicated, the characteristic was determined only for 4.4 and 22 volts respectively; and as the instructions with the valve require a small positive grid-bias by potentiometer at all times, no grid-leak or condenser being used, there was no point in determining the negative portion of the characteristic.

The plate-current was very small—0.14 milliampere maximum. The characteristic showed an extremely sharp bend upwards just above zero grid volts, and then a gently sloping portion up to a little below 2 volts plus. By adjusting by means of the potentiometer (arranged across the L.T. battery as usual), so that the mean grid potential falls in the neighbourhood of this sharp bend, it is evident that extremely good rectification should result, the modulation of the plate-current in the phones being of considerably greater amplitude upwards for an *increase* of the grid-potential than downwards for a *decrease*, to the same extent, of the grid-potential. Actually the efficiency of rectification is quantitatively greater than with a good galena crystal; in actual test, in reception of 2LO at 35 miles away on quite a moderate aerial, by careful setting of the potentiometer (best just below .6 volt plus) the signals were just comfortably audible in the phones, whereas with the same tuning device—one of low resistance and high efficiency—it was a decided strain to hear the words in ordinary speech and in daylight with a sensitive galena crystal. A series-condenser of .0002 μF and corresponding increase in tuning inductance gave slightly better signals, unlike ordinary crystal



reception; but the tuning was noticeably flat, and of course the reception in no way compared with what was readily obtainable with an ordinary valve with the same order of filament-watts consumption, and making use of the invaluable aid to efficient and selective reception, properly controlled reaction.

As a substitute for the somewhat fickle crystal in certain circuits, where reaction in the detector is not desired, this "Sodion" valve has some possibilities.

It was found an easy matter, by mounting it on a slip of insulating material 2½ in. by 1⅝ in., to transform the American type of valve-socket supplied into a four-pin plug-in adapter for use on ordinary panels.

A Fine-Adjustment "Vernier" Condenser

A tubular type of one-hole-fixing fine-adjustment or so-called "vernier" condenser has been submitted by Eric J. Lever. The outer of the two concentric brass cylinders which make up the condenser is about ⅝-in. diameter, the overall length below the panel when fully extended being 3 ins. A 3-16 in. diameter hole is required for fixing the instrument to the panel. Two small terminals, which will come very close behind the panel, provide electrical connections to the two cylinders, and the position of the inner one is controlled by a sliding spindle and small knob. The clearance between the cylinders is extremely small, but on trial there were no signs of accidental short-circuits due to this feature, and the condenser was silent and reliable in operation. The controlling spindle slid quite

stiffly in its bearing, fine adjustments being best made by a combination of rotational and progressive motions. Extremely fine tuning was obtained when this condenser was placed in parallel to the usual A.T.C. in a sensitive receiver. The specimen submitted showed .00011 μF maximum and .000018 μF minimum. We should like to have seen a somewhat lower minimum, as one of some 20 micro-microfarads is too high for certain capacity-reaction and neutrodyning applications for which such a small variable condenser should be useful.

Audio-Choke and Transformer Coils

We have received from Messrs. Leslie Dixon & Co. samples of a type of audio-choke and L.F. transformer coil made to Government specification, of which they hold, we understand, a large stock, and which are available at an extremely moderate price. These are mounted in a substantial wooden box, with a heavy ebonite panel on one side fitted with four large terminals, marked primary and secondary, I and II.

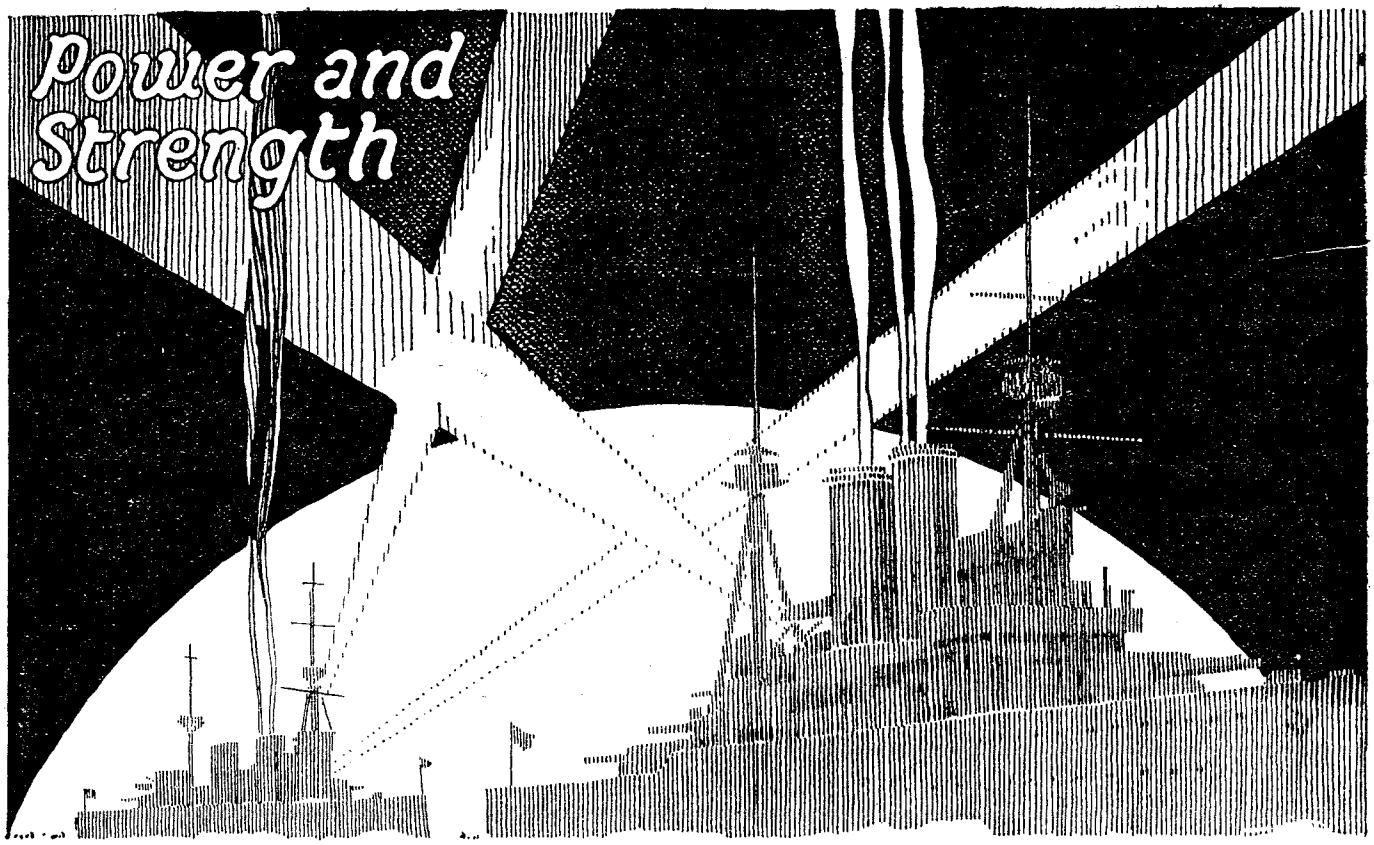
Tested in actual reception as an inter-valve L.F. transformer with the primary and secondary coil connected up in the usual manner, it was observed that the primary impedance was too low for good distortionless amplification following an R valve of high impedance; but that when used as a second-stage transformer with small power valves (in power amplification) the build up of signals in this second stage was quite satisfactory and the tone was good.

With the primary and secondary windings put in series, the whole coil was tried in a choke-capacity coupling for L.F. amplification. In this rôle, with but moderate H.T. but with the gridleak connection arranged so as to give a suitable grid-bias to the following valve, excellent amplification resulted with noticeable freedom from distortion, comparing in this matter favourably with other audio-choke coils of good design. Evidently there will be many uses for an effective audio-choke of this type; and we can safely recommend the experimenter to take advantage of the opportunity of obtaining at a very modest outlay an efficient piece of apparatus which was designed and made for serious service, and which will have manifold applications in radio experimental work; *e.g.*, for choke-capacity filter-circuits to protect the windings of the headphones or loud-speaker from heavy plate-currents, and similar purposes, this unit will be found most convenient.

"Oojah" Graphite Pile Rheostat.

A filament resistance of the carbon-compression type, but which is claimed by the makers, Messrs. Oojah, not to be a powder resistance, and to be free from packing, is the "Oojah" Graphite Pile Rheostat, a sample of which we have put to extended tests. This is an attractively-finished fitting, with a neat one-hole-fixing device of unusually good design, and provided with a large, clearly-engraved controlling-knob. It is about 1⅝ in. long beneath the panel, and 1 in. clear diameter. Small soldering-tags are provided for electrical connections.

The nominal range is from .15 to 35 ohms: the specimen submitted went from a very low value to 50 ohms in a smooth and regular manner, and with about three complete turns of the spindle. Used for controlling both dull- and bright-emitter valves, it gave exceedingly good, smooth, noiseless control, and showed no signs of undue heating; whilst the usual "creep" of the resistance value in actual operation appeared to be minimised in this resistance. There were no signs of packing during these tests.



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and
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Thousands of radio engineers and experimenters all over the world have secured for themselves the very best results by demanding Mullard Master Valves.

You can obtain that perfect reproduction of the broadcasting programmes that you have been seeking so long by choosing the same Master Valves.

Ask for MULLARD H.F. AND L.F. MASTER VALVES.

These wonderful valves have been designed for the wireless amateur who requires something better than general purpose valves.

The H.F. type are for STRONG HIGH-FREQUENCY AMPLIFICATION OR DETECTION and the L.F. type are for PURE LOW-FREQUENCY AMPLIFICATION FREE FROM ANY DISTORTION.

Note the colour distinguishing rings:

Mullard H.F. Red Ring Valves, **12/6** each.
Mullard L.F. Green Ring Valves, **12/6** each.

Write for Leaflet M 8 and take greater care of your valves by asking your dealer for the Mullard safety disc: free on request. If he cannot give you this disc, send us his name and address and we will send him a supply.

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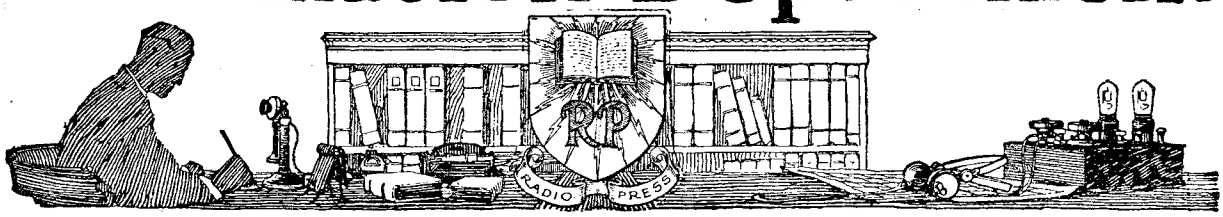
Information Department



SUPPLIED BY RADIO PRESS SERVICE DEPT., LTD.

N.G. [WEST HARTLEPOOL] is using Circuit ST45 from "Practical Wireless Valve Circuits," Radio Press, Limited, and submits particulars of a certain condenser in his possession with which he wishes to receive various wavelengths. He asks the necessary sizes of coils to use to cover a range of 1,200—1,800 metres.

Your aerial tuning condenser is of approximately 0.0006 μF, and with this in parallel with your inductance, you will require coils having 100, 250, and 200 turns respectively to cover the range you mention.

E. G. F. [ILFORD] has made a dual amplification circuit which gives very satisfactory results, but experiences trouble when using a number of pairs of telephones in series.

Your circuit diagram is quite correct as shown, and should give good results. The slight hissing sound you mention is quite in order and should be present. We do not see any reason for distortion effects being produced when a large number of telephones are connected in series, but you should shunt the telephone terminals with a condenser having a capacity not less than 0.002 μF. If the trouble is very persistent, you might raise this capacity to 0.005 μF, and try the 'phones in parallel.

J. S. [WIDNES] has a three-valve dual receiver in which he reports that the detector valve is constantly burning out, and asks for help.

Since the valve usually lasts some days, but always burns with abnormal brightness, we think the trouble is almost certainly in the filament resistance, between whose terminals there is a short circuit. This is confirmed by the fact that adjustment of this rheostat makes no difference to the brilliance of the valve.

J. T. (RAYNES PARK) is using a small c.w. transmitter on 200 metres, and finds considerable difficulty in making the set oscillate with reasonable steadiness and stability. It has a tendency to the erratic stopping of oscillation whenever adjustments are made, with a consequent sudden rise in anode current and consequent damage to his dry battery H.T. supply.

From your description, it seems that you are using a direct-coupled circuit—that is to say, one in which the anode coil is connected directly in the aerial circuit; and, further, that your aerial is of large capacity. This is often an undesirable state of affairs on the shorter waves, since it becomes difficult to maintain self-oscillation with the small amount of inductance available for coupling purposes. Try a loose-coupled circuit or a counterpoise earth.

C.N.T. (BIRMINGHAM) has a variable grid leak which he believes to be faulty, and asks how he may test it.

The grid leak is probably one of the most difficult components in the set to test, and it is often done merely by substitution even by professionals.

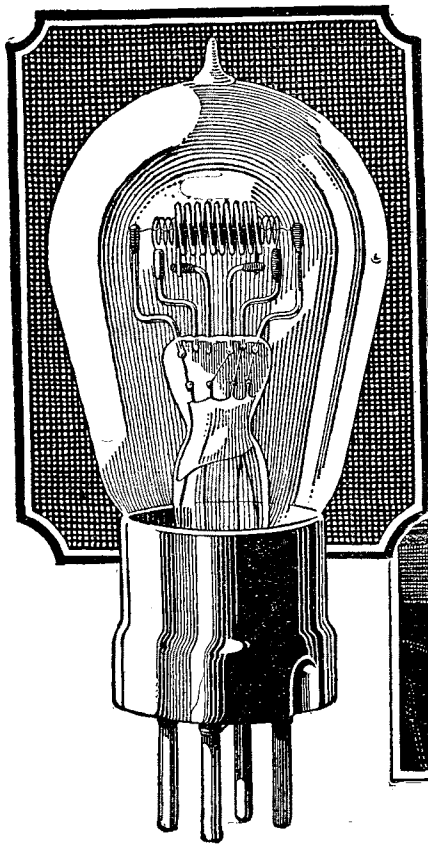
Try removing the leak from circuit altogether, and note whether any crackling sounds are reduced, or whether they persist. Further, note whether any noises are heard when the knob of the leak is rotated.

D.O.R. (SOUTHALL) asks what is a vernier condenser, and what is its use?

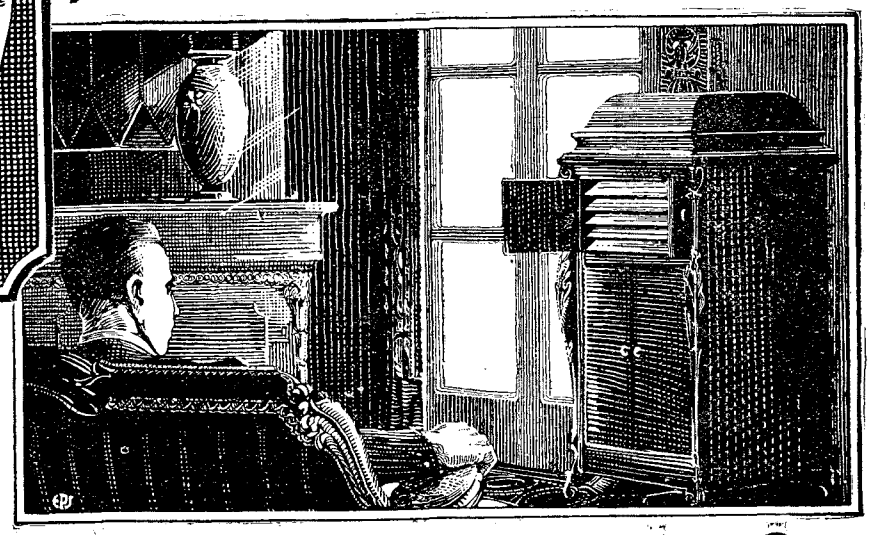
The word Vernier is being very carelessly used nowadays in connection with almost any piece of wireless apparatus which affords a particularly exact adjustment. A better name altogether would be "fine tuning" condenser. Such a condenser is simply a small variable condenser, comprising only three or at the most five plates, so that a considerable movement of the controlling knob and dial gives only a small change in capacity. By connecting a condenser of this description in parallel with a large variable condenser, the preliminary adjustments are made upon the large condenser, and then the fine tuning condenser is called into action to effect the final accurate adjustment.

F. W. P (CLAPHAM) asks what is the cause of sudden distortion in amateur telephony sometimes heard after broadcasting hours. He states that an amateur is being received perfectly well, when suddenly most violent distortion of the speech occurs accompanied by whistling.

The type of distortion to which you refer is caused by the interference with the carrier wave of the telephony by another carrier wave of the same frequency, which occurs when a transmitting amateur switches on his transmitter in the middle of the conversation of some other station, with whom he does not know he is interfering.



Louden



Have you noticed it?

10/-

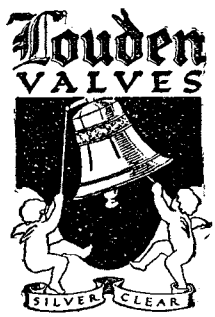
If you listen intently to your gramophone you will become aware of the light scratching of the needle. But although you hardly notice it unless you listen specially it is there all the while.

Once you could hear gramophone music against a background of complete silence you would never be content to return to the obbligato of scratches and hisses which you now cheerfully endure.

It is the same with Wireless Reception; you hardly notice the continuous breathing sound going on in your loud speaker, but—unless your set is fitted with Louden Valves—it is there, and it is preventing you from getting the best possible results from your set.

The Louden Valve has been designed specially with the object of eliminating all those "mush" or breathing sounds so prevalent with valves of the ordinary type. If you would care to know how this is achieved your dealer will supply you with a folder giving full information.

But we feel that you are concerned with *results* rather than with *reasons*, so our advice is that you should not consider your present reception perfect, but fit Silver Clear Louden Valves and see how much better it can be.



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Filament Amps. ... 0.4
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The Blue Louden for H.F. Amplification.

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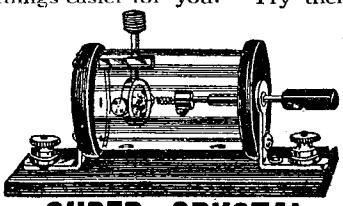

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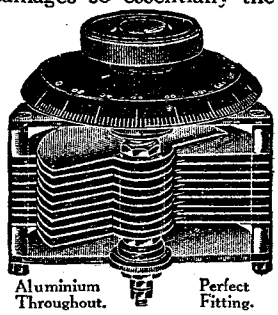

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VARIABLE CONDENSERS

Insulated Bushes. One hole *only* required for fitting. Terminals provided for making connection.

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·0005 with Vernier Panel Mounting .. **7/6**

·0003 with Vernier Panel Mounting .. **7/-**

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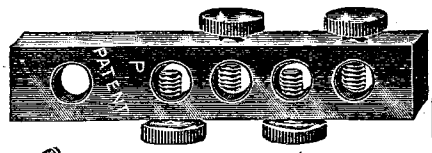
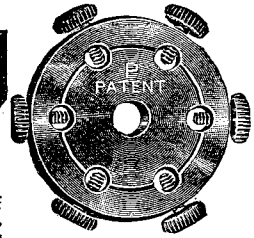
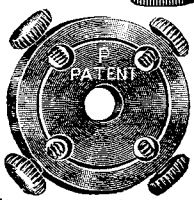
"MULTIPHONE" CONNECTORS & TERMINALS







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For using several pairs of headphones on your set, 4-way Round Type, as illustrated on left, and 4-way long type as above. Each **9D.** Post 2d.

"MULTIPHONE" CONNECTORS 6-way round type as above **1/-** Post 2d.

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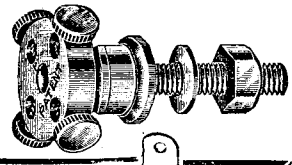
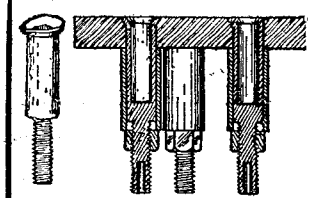


Send for yours right away — the value will amaze you.



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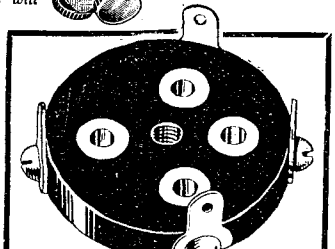

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STRIKING POINTS:—Anticapacity; Positive Contact with Valve Leg; Neat appearance; Protection from burning out valves by incorrect fitting; Low Price. In the usual high standard of quality. Price .. .. **10D.** Post 2d.

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REPAIRS TO HEADPHONES TO LOUD SPEAKERS TO COILS

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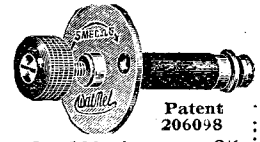
The consistent tendency of Receiving Sets to reproduce extraneous noises is, more often than otherwise, put down to that endless source of hiss, noise and bubbles—the H.T. Battery. Yet experiments show that condensers of very large capacity apparently fail to smooth out the current. It may be taken that the trouble lies elsewhere. Substitute a *Watmel Variable Grid Leak* and note the difference.

The detector valve working on an incorrect portion of the curve is found to be one contributory cause of mysterious noises, principally due to unsatisfactory choice of resistance material in the grid leak. In the ***Watmel,*** resistance is gained by a material which extended experiments has proved to be noiseless in operation. If your Set is noisy —remember the detector valve and fit a



Patent 206098

5 to .5 Megohms ... 2/6

50,000 to 100,000 Ohms. 3/6

Other Resistances to suit any circuit.

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the only NOISELESS GRID LEAK

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to intending purchasers

The Watmel Wireless Co. wish to notify the trade and public that their Variable Grid Leak Patent Application No. 206098 was contested in the Comptroller's Court, and on Appeal; in both instances the Patent Grant was upheld and costs awarded.

It is the aim of this Company to protect traders', customers', and also its own interests by securing Patent protection for the novelties in its specialities, as it is these novelties, invented by experts and exhaustively tested, which are the Hall Mark of all Watmel Products.

All goods of our manufacture bear this mark. It is your only guarantee. **Watmel**

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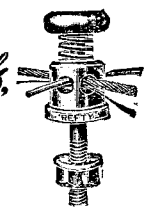

Pilot Panel Service

The Pilot Panel Service explained:

WHEN a man decides to build a good Receiving Set he immediately comes up against the difficulty of a suitable cabinet and the drilling and the engraving of the panel. Cabinet-making is a skilled man's job and many a perfectly good piece of ebonite has been spoilt by a hole in the wrong position or because it has been incorrectly cut to size.

To eliminate most of the difficulties in Set-building we have instituted the PILOT Panel Service. In future, ALL Sets described in all the principal Wireless Magazines, will be available in sets of parts for the Home Constructor with panels ready drilled, tapped, and engraved. Two types will be placed on the market—Type A, following the author's literal specification and using his actual components; and Type B, an adaptation using Peto-Scott guaranteed components. Naturally through standardisation of components and our lower manufacturing costs due to large output, Type B will often show a large saving over Type A.

Remember that if our instructions are followed we positively guarantee that all Type B receivers are the equal in every respect to the more Expensive Type A Sets. Our Service Dept. is available for all our customers and will test and rectify errors of construction at a nominal charge. We want all our customers to have the utmost confidence in every Set produced under the PILOT Panel Service.

5 exclusive Pilot advantages:

1. **Absolutely no previous Wireless skill required—the only tools necessary are a screwdriver and a pair of pliers.**
2. **Every Set when completed is quite the equal in efficiency of the original.**
3. **Provides a high-grade instrument at the cost only of the components.**
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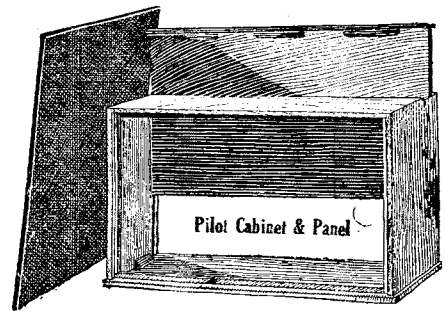
5. **Every Instrument designed by a recognised expert.**

Pilot Panels

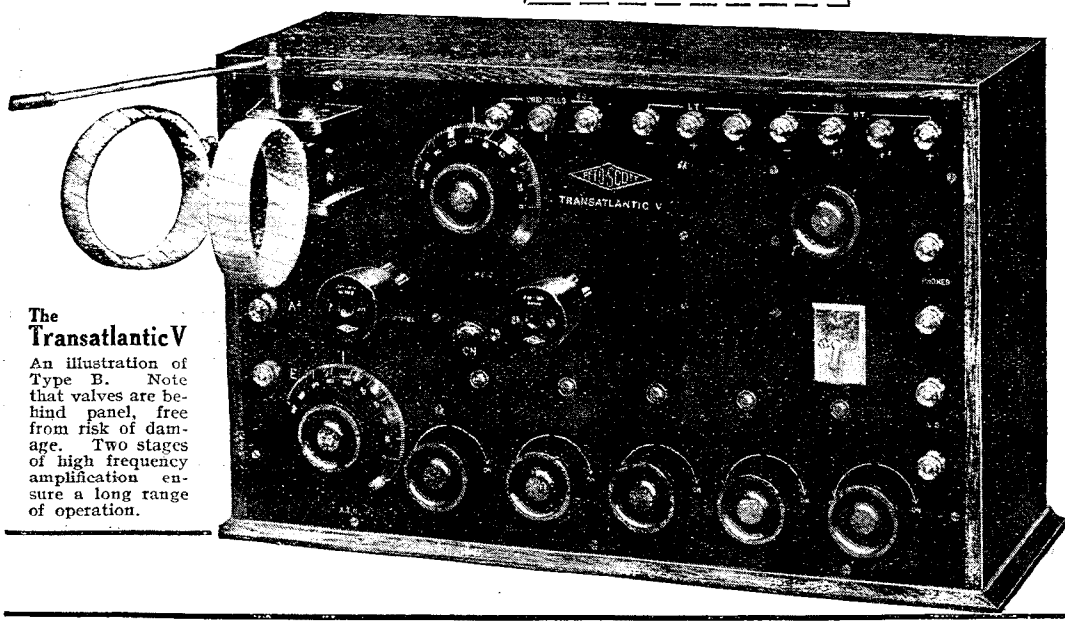
Every Wireless Receiver depends for its efficiency upon the panel. Low grade ebonite will prevent any Set from functioning properly. Every PILOT panel is manufactured from the highest grade Post Office ebonite cast accurately to size, matt finished on both sides, and with edges squarely ground. We guarantee every panel to be leak-proof and non-warping. Each panel engraved with word "PILOT," and supplied carefully packed in sealed wrapper. Standard ¼-in. thickness throughout.



All these splendid Sets now available:

The Transatlantic V (a super 5-valve long distance Receiver).
The S.T. 100 (2-Valve).
The 3-valve Dual Receiver.
The Puriflex (4-valve).
The All-Concert de Luxe (3-valve).
The 4-valve Family Receiver, and others.

All these Receiving Sets have been designed by prominent radio engineers and described in various issues of "Modern Wireless."



The Transatlantic V
An illustration of Type B. Note that valves are behind panel, free from risk of damage. Two stages of high frequency amplification ensure a long range of operation.

Write to-day:

Before building a new Set, be sure you get particulars of the wide range available under the PILOT Scheme. Our literature (free on application) will show you exactly the components you need for any Set and their price. Register your name for a free copy of a large illustrated Folder to be issued immediately.

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Gilbert Ad. 1636.

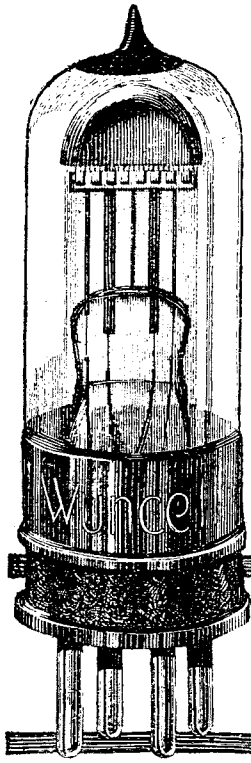
The Spirit of Progress.

THE same spirit of progress which was responsible for the design of the Cossor Valve still dominates the research workers responsible for the new Wuncell—the Cossor Dull Emitter.

The new Wuncell operates at a temperature of only 800 degrees (as against the .06 type of Valve operating at 2,000 degrees) and its filament glow is barely noticeable in daylight. Owing to its extremely low current consumption and robust filament design (in diameter the Wuncell filament is approximately the same as the standard bright Valve) its life should be almost indefinite.

But true progress does not end with Valve design—service counts for something, too. In the new Cossor packing scheme every Valve will be finally packed in its wrapping of cotton wool and *sealed in its carton*. Your dealer will not find it necessary to break the seal to prove to you that the filament is intact.

Thus every Cossor user is guaranteed an absolutely new and unused Valve.



Prices of Wuncell Dull Emitters

W.1. (For Detector and L.F. use) **21/-**
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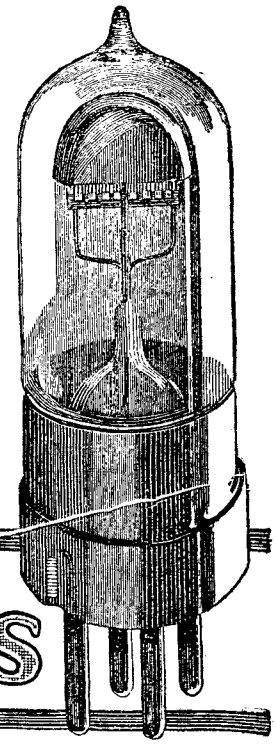

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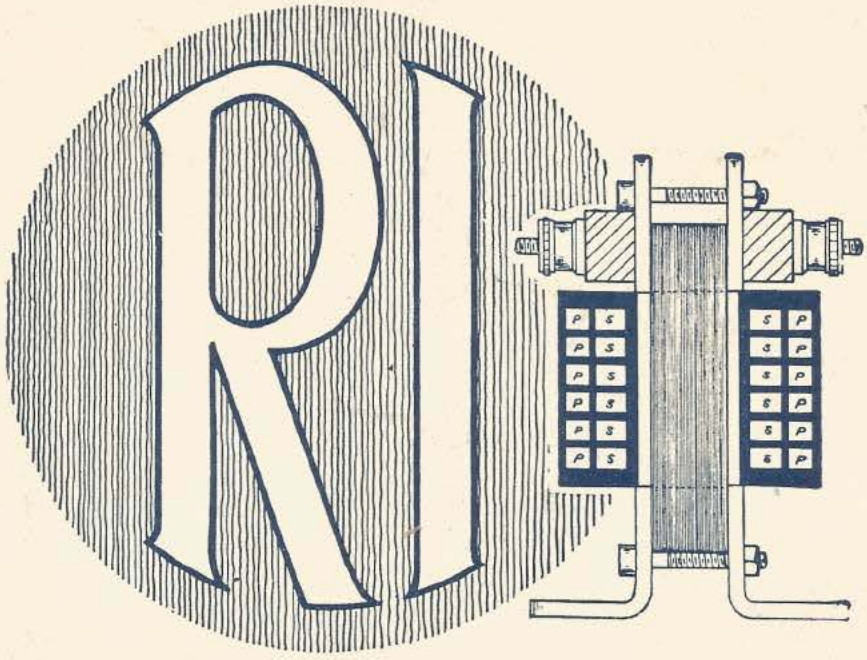

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