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Wireless Weekly

No. 4

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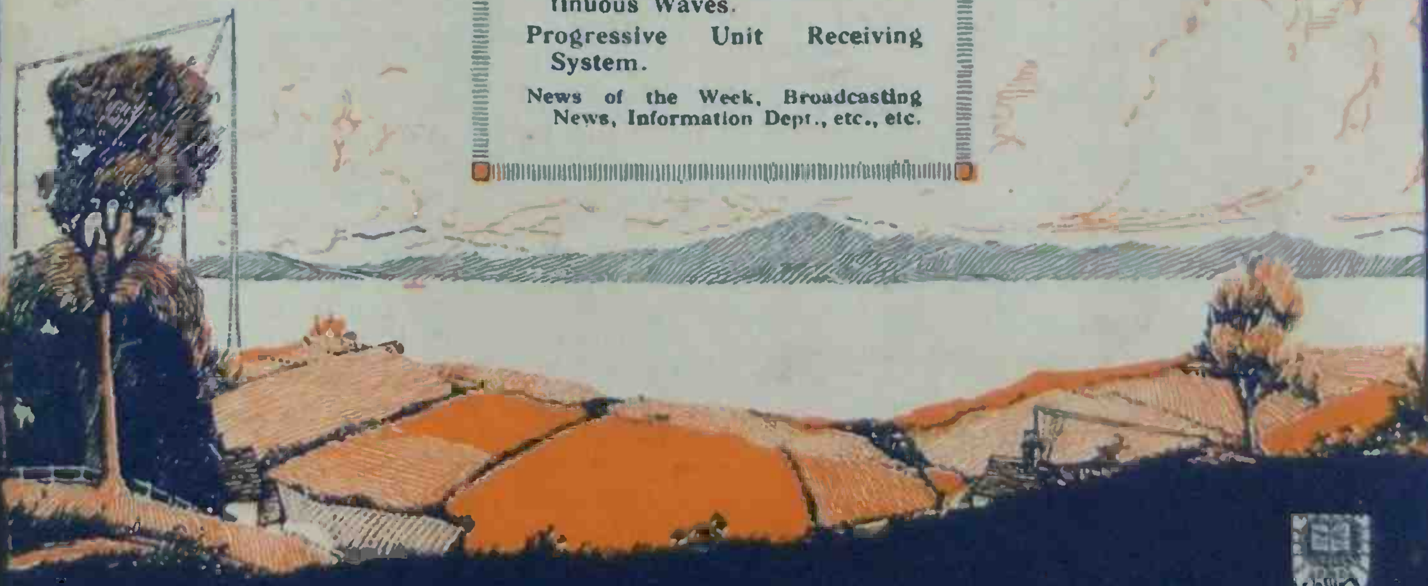

Edited by
John Scott-Taggart F. Inst. P.

Wireless Weekly

Vol. 1. No. 4.
May 2, 1923

CONTENTS

Editor: John Scott-Taggart, F.Inst.P.
Assistant Editor: E. Redpath.

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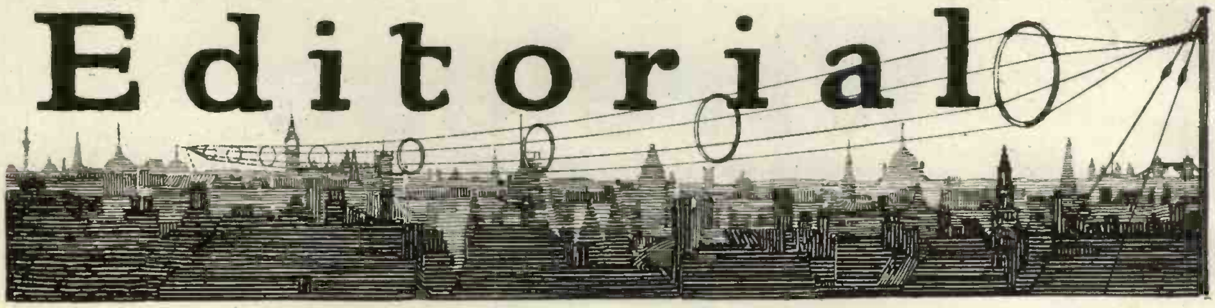


A Stop-Gap Solution

IT was with great regret that we had to announce last week that the negotiations between the Postmaster-General and the British Broadcasting Company had broken down and that in the meanwhile the P.M.G. was to re-issue Experimental Licences on, as he stated, "a wholesale scale."

A strong Committee, the names of which appear elsewhere, is considering the whole question, and it is to be hoped that they will come to a speedy decision.

The different parties have agreed as follows:—

1. That a Constructor's Licence should be issued and that a portion of the fee should be paid to the Broadcasting Company.
2. That constructors' licences should be obtainable by all and sundry.

The present position as it stands is an impossible one. If the P.M.G. issues the Experimental Licence in an indiscriminate manner, he will obviously be committing a breach of faith with the B.B.C. If, on the other hand, these experimental licences are not issued on a wholesale scale, as promised, the intense indignation which has been aroused all over the country will increase.

We have already warned those concerned in this matter that it is possible to hang out too long. From the B.B.C. point of view, it would have been far better if the Constructor's Licence had been conceded long ago. If this had been done, the Press and the general public would not have created the same disturbance. Many sections of the Press have compared the B.B.C. to the dog which, carrying a bone, saw its reflection in the water, and in endeavouring to seize the imaginary bone lost the real one and also received a ducking.

Much of the criticism of the British Broadcasting Company has been grossly unfair, but the one outstanding fact which remains is that the home constructor is not only backed by the Post Office, but also by every single newspaper in the country.

After all, it is not possible to withhold a right of this kind for an indefinite period. We are only sorry that this matter was not decided earlier. The B.B.C. would have been in a very much stronger position than they are now, and incidentally far more popular.

The British Broadcasting Company is agreeable to the Experimental Licence, but specifies that the fee should be £1, whereas the P.M.G. states that he will not charge more than 10s. The British Broadcasting Company reply to this by saying that they are agreeable to the 10s. licence fee providing that all component parts are marked B.B.C. In other words, manufacturers of component parts must be members of the British Broadcasting Company. The P.M.G. replies to this by saying that he will never force any manufacturer into a combine. So we reach a deadlock.

The B.B.C. Stamp

The question of the B.B.C. stamp on component parts is one which has been considered by the Radio Society of Great Britain. They have definitely rejected the proposal that parts should be stamped B.B.C. The general Press have also condemned the proposition. We ourselves fear that if such a regulation were carried through, licence-holders would not buy B.B.C. components if they wished to buy others.

The policy of the B.B.C. seems to be two-fold. In the first place they desire to make the transmission of broadcasting a practical paying proposition; and secondly, they desire to benefit their members in their private capacities as manufacturers. These two policies are sometimes antagonistic, and whereas the Company might be satisfied regarding its own financial position by a certain proportion of the licence fees, its individual members would not be so happy.

The B.B.C. have agreed to the licence fee being 10s., subject to parts being marked "B.B.C."; at the same time, they say that the B.B.C. stamp will not increase the price of components and will not bring in any revenue to them.

Obviously, then, the B.B.C. are not sticking out for the B.B.C. stamp on components for the purpose of financing broadcasting, but to benefit the individual members in their capacities as manufacturers. This, of course, is why the general Press have made such a fuss about "monopolies." The general public considers that the providers of broadcasting should have no other thought than the financing of the scheme. They consider the revenue should come from licence fees.

The opposite view, apparently taken by the B.B.C., is that the B.B.C. component stamp would compensate the members of the B.B.C. for any loss due to a deficiency in the revenue from licences. If, however, the B.B.C. made a loss on a year's working it would not be of much comfort either to themselves or the public to know that individual members had benefited.

It seems to us that the B.B.C., as a company, devoted to the provision of entertainment, must stand on its own legs and derive a generous revenue and give generous programmes. Their proposition to abandon the B.B.C. stamp on components but to obtain an adequate proportion of the licence revenue is eminently sound.

Whether an adequate sum would result to them on a £1 or a 10s. licence fee is a financial matter which will have to be left to the new Committee.

SOME UNUSUAL METHODS OF RECEIVING CONTINUOUS WAVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.

The following article deals with some novel methods of receiving continuous wave signals.

Usual Methods

THE usual method of receiving continuous wave signals is to use the self-heterodyne circuit in which a single valve is used both as a detector and also as a local oscillator for producing continuous oscillations which beat with the incoming continuous wave signals. The alternative method is to use a separate local oscillator unconnected with the receiving circuit, but coupled close to it so that continuous oscillations are induced into the main circuit so as to produce beats which are subsequently rectified.

Some New Arrangements

The circuits about to be described present certain advantages over the more usual arrangements, one of these advantages being that there is no radiation from the aerial when receiving continuous waves; at least the radiation, if it exists at all, is exceedingly small.

The circuits and the principles involved are described in the writer's British Patent No. 192429 of August 8th, 1921. Certain of the circuits have been described elsewhere comparatively recently, and it would seem that work on somewhat similar lines has been carried out in France with exceedingly good results, but, as stated above, the British Patent has been issued to the writer.

Fig. 1 shows a method of receiving continuous waves which involves the use of a three-electrode valve acting simultaneously as a detector and modulator. It will be seen that the circuit L1 C1 is connected across the anode A1 and filament F1 of the valve V1, the telephones T shunted by the by-path condenser C2 being connected in this anode circuit. A potentiometer resistance R3 of, say, 300 ohms is connected across the filament accumulator B1. The potentiometer is not an essential feature, as the right-hand side of C2 might be connected directly to the negative terminal of B1. Such a circuit, as it stands, would act as a detector of spark signals, the rectification efficiency equalling that of a Fleming valve or crystal detector.

In order to enable continuous wave signals to be received, I arrange a valve V2 which generates the local continuous oscillations having a frequency slightly different from that of the incoming signals. The adjustment of the frequency of the local oscillations is effected by means of the condenser C3. To the inductance L3 is coupled an aperiodic inductance L2 connected across the grid G1 and the filament. The coupling between L2 and L3 is preferably variable.

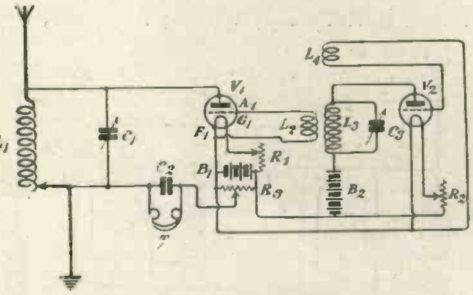


Fig. 1.—One of the new methods of receiving continuous waves.

It is not proposed to discuss here the actual technical reasons for the effective working of a circuit of this kind, as the explanation of its action is to a certain extent a controversial matter.

The Converse Arrangement

Fig. 2 shows what might really be considered the converse of Fig. 1. We have a valve V2 oscillating continuously of its own accord. Across the grid circuit L3 C3 we have the anode A1 and filament F1 of the valve V1. The incoming signals flowing in L1 C1 are applied across the grid G1 and F1 of the first valve, and it would appear that this valve acts as a modulator of the continuous oscillations set up by the valve V2, the degree of absorption by the valve V1 varying as the high-frequency potentials affect G1. The modulated currents in L3 C3 are detected by the valve V2, a leaky grid condenser C4 being provided in the grid circuit of V2. In the anode circuit of this valve we have the telephones T, shunted by the usual by-path condenser C2. The whole circuit will be found to give good results, and of the three given here it is to be preferred.

The tuning of L3 C3 is chiefly affected by the variable condenser C3 which is so adjusted that the frequency generated by the valve V2 is slightly different from that of the incoming signals. The usual C.W. beat note is heard in the telephone receivers.

The Third Circuit

In Fig. 3 we have a somewhat different arrangement, the telephones this time being connected in the anode circuit of the first valve, no high-tension battery, however, being included in this anode circuit. The second valve V2, however, acts as a generator of continuous oscillations having a frequency slightly different from that of the incoming waves, and is, therefore, provided with a high-tension battery B2, which, however, need not

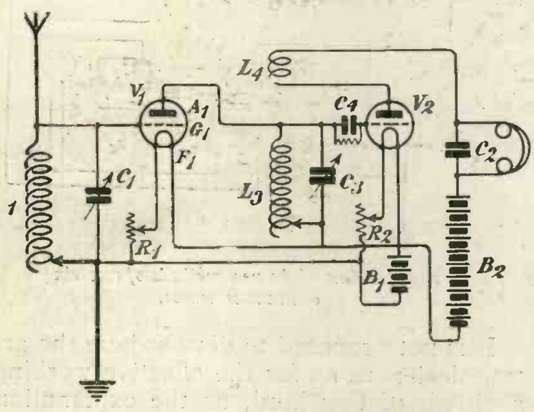


Fig. 2.—An interesting circuit for C.W. reception.

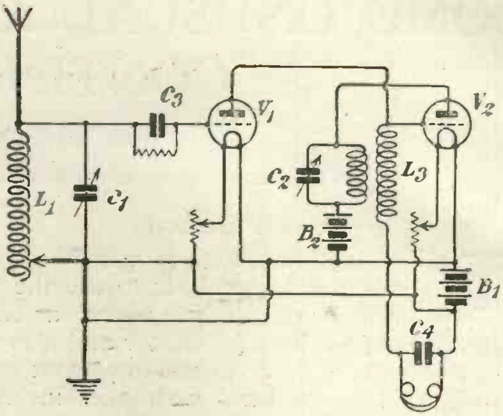


Fig. 3.—Another C.W. receiver.

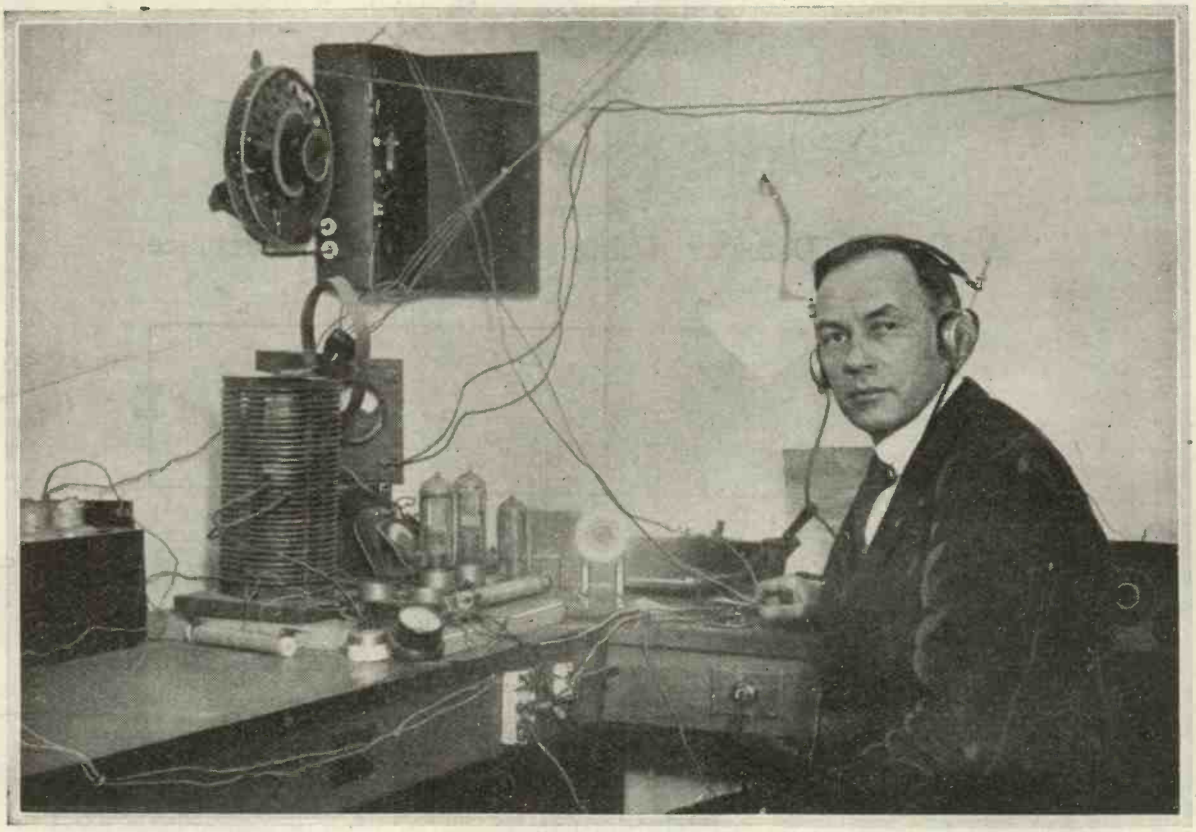
be of a very high value. A leaky grid condenser C3 may be tried in the grid circuit of the first valve. It will be seen that the telephones T, shunted by the condenser C4, are included, not only in the anode circuit of the first valve, but also in the grid circuit of the second valve.

Conclusion

These different continuous wave circuits are well worth trying out from the experimental point of view, and there will no doubt be a number of readers who will care to carry out some experiments on these lines. In the case of such readers I would suggest that Fig. 2 be tried first.

We will be interested to have an account of any experiments carried out with these circuits.

A TRANSATLANTIC EXPERIMENTAL STATION



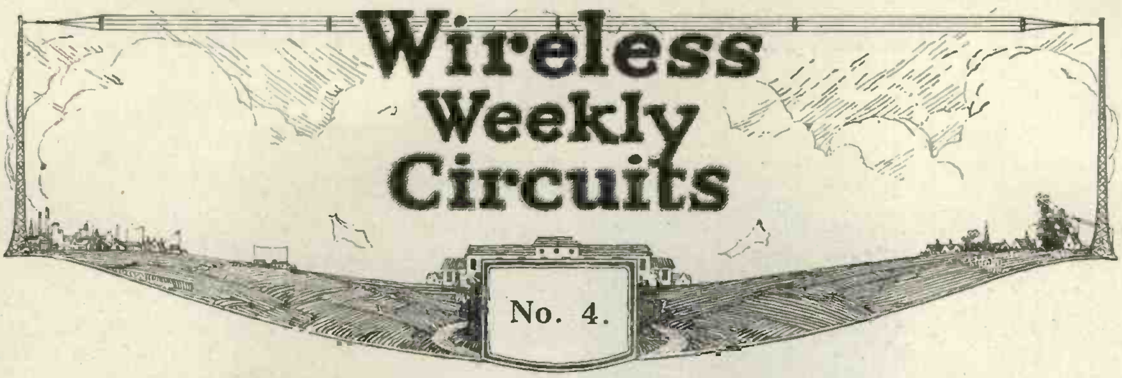
Mr. Carter seated at his apparatus.

C. J. CARTER, operator of Station 8YD of the Shaw High School, at East Cleveland, Ohio, has been notified by the American Radio Relay League that his station has been heard by stations in England and France during the recent transatlantic tests. The message did not state at what point 8YD was heard, but stated that the station was heard three times. Mr. Carter and his apparatus are shown in the above photograph.

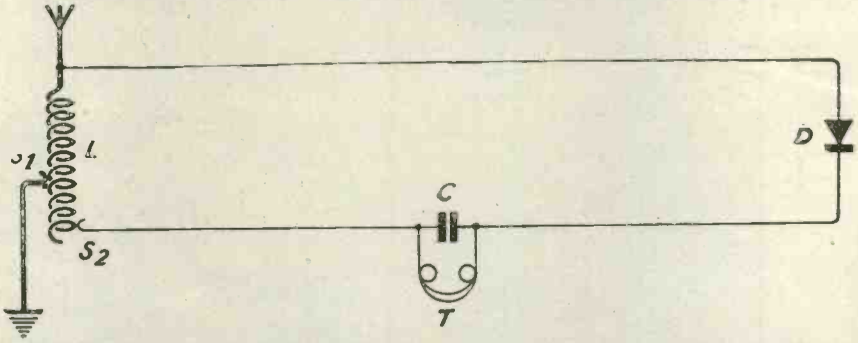
This station is one of the most efficient amateur stations in the country. The aerial is of the T type, using four wires, and is erected on towers surmounting the high school building. The wires are supported on 16ft. spreaders, and the flat top of the aerial is about 105ft. above the ground. A counterpoise of five wires is used in place of an earth. The station uses three 50 watt Westinghouse power valves for transmitting.

The station is highly directional in its transmitting qualities, and Mr. Carter has 145 letters from Pacific Coast points, ranging from Vancouver to the Canal Zone, acknowledging receipt of signals.

The greatest distance that has been reported to Mr. Carter is 5,600 miles, when operator Morrison, of the S.S. *China*, picked up the station 360 miles west of Honolulu. Mr. Morrison stated that the signals were QSA and good for another 1,000 miles. The station has been heard in Cuba and Porto Rico. Considering the low wattage of the output, this station has done remarkably good work.



A Crystal Detector Using a Two-slider Inductance.



COMPONENTS REQUIRED.

L : An inductance coil fitted with two sliders S_1 and S_2.

C : A fixed condenser of about 0.002 μF. (microfarad).

T : A pair of high resistance telephone receivers.

D : A crystal detector.

GENERAL DESCRIPTION.

Inductance coils fitted with two sliders are commonly used, and the above circuit shows how the inductance and other components may be connected together.

The advantages usually claimed for this arrangement are :

1. Greater selectivity.
2. Greater signal strength.

It is very doubtful whether the claims made for this arrangement can be substantiated in many cases. Considerable additional trouble is involved in constructing a variable inductance with two sliders, and the writer of these notes is much more in favour of a loose-coupled arrangement similar to that which will be shown in next week's issue.

VALUE OF COMPONENTS.

The value of the telephone condenser may be about 0.002 μF., and particulars of this condenser have been given in previous issues. The telephones T should be of high resistance, preferably not less than 1,000 ohms. The detector D may be of any of the usual kinds.

The inductance L may be a cardboard tube 3½in. diameter wound for 6in. with No. 24 gauge enamelled wire. This will suffice for broadcast and ship station wavelengths. For receiving up to 3,000 to 4,000 metres the inductance coil may consist of a cardboard tube 4in. in diameter wound for 9in. with No. 24 gauge enamelled copper wire.

NOTES ON OPERATION.

The best way of adjusting one of these circuits is to move the two sliders starting from the aerial end of the coil towards the other end until the signals are heard to the best advantage. The two sliders should rest on somewhere near the same turn.

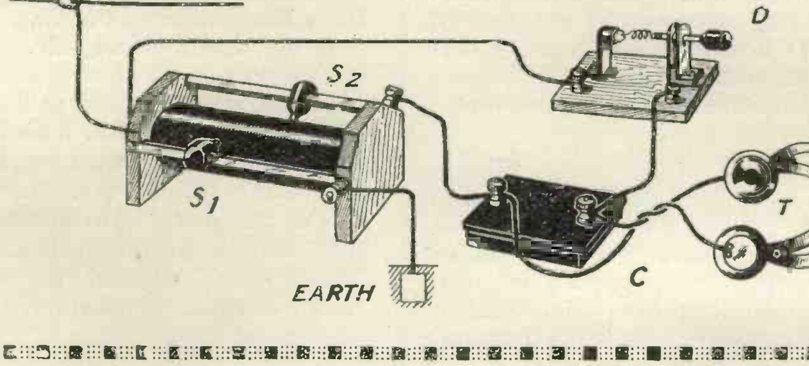
The next step is to move the slider S_2 up and down the coil until the loudest signals are obtained or until interference is lessened. A final readjustment of the slider S_1 may now be made, and then another slight readjustment of S_2. When receiving long wavelengths this circuit is no better than the ordinary circuit having an inductance with a single slider.

POSSIBLE MODIFICATIONS.

The telephone condenser C in many cases may be omitted without altering the signal strength.

METHOD OF CONNECTING UP.

The lower illustration shows how the different component parts may be wired up, the different letters corresponding to the letters on the circuit at the top.



LOUD-SPEAKING AND POWER-AMPLIFICATION

By H. DEWHURST, A.R.C.S., D.I.C.

An interesting contribution dealing with correct anode and grid voltages when using "R" valves for power amplification.

MANY experimenters, in their search for efficiency when endeavouring to increase the intensity of output of their loud-speaking apparatus, find that the addition of an extra valve does not give the same degree of amplification as do the previous valves already in circuit. Not only is this so, but as often as not the final result is worse than the first; for the chances are that distortion has audibly increased. The above remarks, of course, only apply to those experimenters who adopt a haphazard method of going to work, either through impatience and an anxiety to "get on with it," or lack of the necessary knowledge to anticipate certain results from theoretical considerations before finally putting them to the test of practice. It is true, of course, that the haphazard experimenter often obtains excellent results; but the value of such results is ephemeral, leading, as a rule, to no accession of knowledge; and as to the desirable practical results obtained, it is only too often found that they cannot be repeated when most desired. It is the intention here to indicate what method of procedure, of both a theoretical and practical nature, is most likely to lead to success.

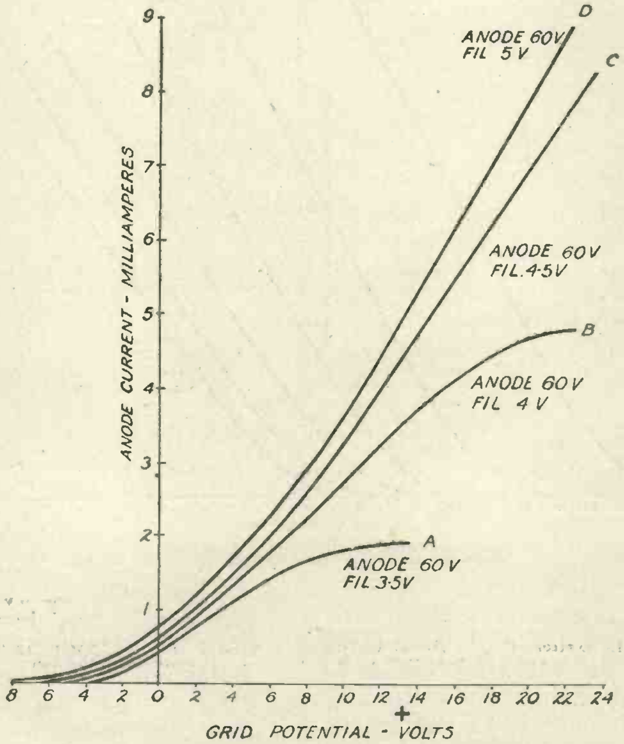


Fig. 1.—Showing effect of increasing filament voltage.

As valves are the medium of any amplification obtained, it is obvious that the characteristics of the valves being used must be studied from the viewpoint of the large final current necessary to operate the loud-speaker, remembering always that the absence of distortion is quite as important as any addition of strength in the final low frequency currents. It is as well to mention here that loud-speakers, especially of the diaphragm type, have a definite maximum output, any attempt to increase which results in rattling the mechanism. If, therefore, the room or hall to be filled with sound be of large dimensions, it will be necessary to resort to a "battery" of loud-speakers, each of which will be delivering a proportion of the total output from the amplifier so as to be working well within its own capacity.

Two sets of characteristic curves are illustrated in this article, both of which were obtained by the writer from an "R" valve in his possession. Similar curves can easily be obtained by any experimenter who has, or can borrow, a milliammeter and a set of dry cells giving an E.M.F. of $1\frac{1}{2}$ volts each. By an inspection of these curves it is a simple matter to predict what will happen under certain conditions and to pick and choose one's operating-point to fulfil what is required. If, for example, the experimenter finds that the addition of an extra low frequency valve results in little or no further amplification, it is possible that the current necessary to give the required intensity in the loud-speaker is beyond the capacity of the last valve to deliver —in fact, that the applied alternating E.M.F. overlaps the saturation point of the anode current in the last valve. Steps would therefore have to be taken to change the characteristic and also the operating-point of this valve. The following paragraphs give an insight into the various methods of doing this.

Supposing we study for a moment the curves in Fig. 1. Four curves are shown relating to the "R" valve, the applied anode voltage of which is 60 in each case, but in which the voltage applied to the filament was first 3·5, then 4, 4·5 and 5 in succession. The effect of raising the filament temperature is well demonstrated. Firstly, it should be noted that the heights of the curves are substantially increased and that *slopes* are *slightly* steeper. Secondly, it will be observed that, whereas the point of maximum curvature in curve A occurs at about −2 volts (on the grid), in the curve D it would be taken to be at about +2. The importance of these three facts will be found in the following considerations. A means of lengthening or increasing the heights of the characteristics enables us to choose a filament voltage such that we can obtain a sufficient length of the straight part from which to draw the maximum current that the loud-speaker will take without overloading its mechanism. Thus, suppose the maximum current that the loud-speaker can deal with efficiently to be 7 milliamperes. This would imply that the alternating E.M.F.s applied to the grid of the last valve would first increase the steady anode current by 3·5 milliamperes and then decrease it by a similar amount, according as the applied voltages are respectively positive and negative. In this case, therefore, a curve must be selected the straight part of which, when projected on to the anode ordinate, will exceed 7 milliamperes. We can therefore choose the right filament voltage to do this by an inspection of the curves. It should be remarked here that although the increased steepness of the curves at higher voltages implies an increased amplification, the gain is very slight. It will be observed, too, that although all four curves are similar in position and shape (the heights alone differing), those at higher filament voltages are virtually displaced to the right, which displacement, as we have seen, moved the lower bend from −2 to +2. In the same way the straight parts have also shifted to the right; and therefore if we are going to operate on this straight part, our operating-point must be moved in the same direction. As will be seen, however, this will involve establishing a large grid current, which, as is well known, will have the same effect as introducing another bend in the characteristic just at the place where a perfectly straight part was required in order to give distortionless amplification. It is obvious, then, that the operating-point on whatever curve is chosen should, for preference, correspond to some *negative* grid potential, as otherwise we cannot avoid the establishment of grid currents, and therefore of consequent distortion.

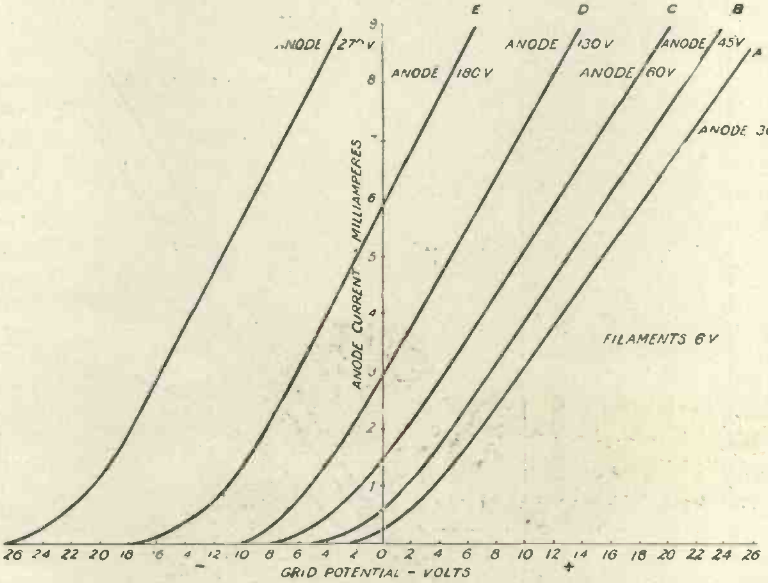


Fig. 2.—Showing effect of raising anode voltage.

Keeping this necessity in mind, examine now the curves given in Fig. 2. Here the effect is shown of increasing the anode potential whilst the filament voltage is maintained at 6 (by choosing a high filament voltage we make sure of keeping clear of any saturation point which would affect the curvature of the lower part of the curves). Here, obviously, the effect of increased anode voltage is to move the curves bodily to the right, at the same time slightly increasing the slopes. It will be noticed, incidentally, that an increase of voltage on either the filament or the anode results in a slightly enhanced amplification (owing to the increased slope), thus perhaps accounting for the great temptation to increase *both* on one's set regardless of any possible change in the operating-point. Returning to Fig. 2, as it is our intention to choose a straight part of 7 milliamperes in length (produced on to the anode current ordinate), and which at the same time is wholly on the negative side of the vertical, curve F is the only one that meets the requirements, for all the others are wholly or in part on the positive side, thus setting up grid currents. Curve F corresponds to an anode voltage of 270. If, therefore, it was our intention to use an "R" valve for the purpose in view, it would be necessary to apply a steady grid voltage of about -12 to ensure that the operating-point was on the middle of the straight portion of the curve. For this purpose grid cells are admirably adapted. One would insert, in this case, a battery of eight dry cells between the secondary of the intervalve transformer and the filament lead, which is connected to the negative of the "high tension" battery, the negative end of the grid cells being, of course, joined to the transformer.

These "grid cells" are the key to the secret of obtaining a measure of "power-amplification" from one's set without the necessity of purchasing special valves for the purpose. These methods can and should be applied to any valves which are being used for power-amplification *or any other purpose*, as it should be the object of all true experimenters to strive always for the most efficient results. If one is deliberately setting out to make a power-amplifier one can, of course, use the special valves on the market sold for this purpose. These valves are specially made to stand up to the increased anode voltage (usually from 100 to 300), but here again the characteristic curves should be consulted in order to determine what is the correct grid voltage to apply. The latter might easily be as much as -30 volts.

Lord Curzon broadcasting a speech from his house in Carlton House Terrace. The photo shows Lord Curzon speaking into the microphone.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART IV

(Continued from No. 3, page 145.)

What is a Three-Electrode Valve?

A THREE-ELECTRODE valve is a development of the original Fleming valve containing a filament and plate. In 1907 Dr. Lee de Forest, an American investigator, produced what is probably the greatest wireless invention of the century. He found that by inserting a *grid* between the filament and the plate, it was possible to obtain very much stronger signals than with a two-electrode valve. Since that date many scientific workers have developed both the valve itself and circuits in which to use it.

The essential parts of a three-electrode are shown in Fig. 1. There is a filament F, which is shown as a "loop" filament, a grid G, shown as a rectangular piece of wire gauze, and a metal plate A, which acts as the anode of the valve. In nearly all cases the grid is placed between the filament and the anode, although the shapes of these electrodes vary considerably. Although the arrangement shown in Fig. 1 is similar to that originally used, yet the modern tendency is to use cylindrical anodes, cylindrical grids, and straight filaments. Fig 2 shows the arrangement of a filament F, grid G, and a cylindrical anode A. The wires, W1, W2, W3, and W4 are for making connection with the different electrodes, and these wires are frequently used to support the electrodes inside a glass bulb, not shown.

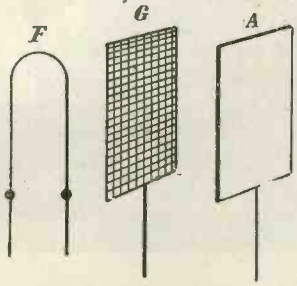


Fig. 1.—Showing valve electrodes.

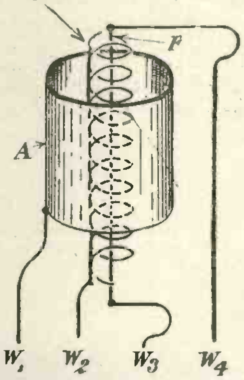


Fig. 2.—Concentric arrangement of valve electrodes.

How is a Three-Electrode Valve Represented in Circuit Diagrams?

Fig. 3 shows how a valve is frequently represented in wireless diagrams. The actual method of representation varies slightly according to the ideas of different writers or in different countries. In nearly all cases we have the grid shown as a dotted line or as a zigzag line placed between the filament and the anode.

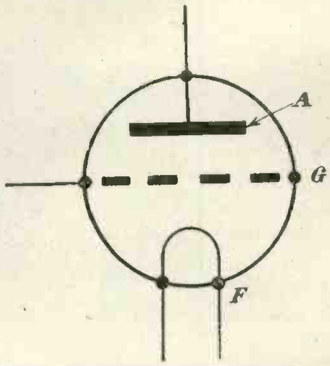


Fig. 3.—Diagrammatic representation of a 3-electrode valve.

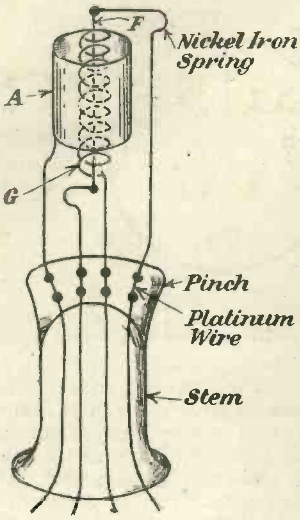


Fig. 4.—The electrodes assembled on the stem.

What is a "Hard Valve"?

A hard valve is one in which the vacuum is very high. Many precautions are taken when pumping the air out of the valve to see that as little as possible remains inside the bulb. To ensure this, the metal parts inside the bulb, which contain air in their "pores" as it were, are heated by special methods so that they give up any "occluded" gas. "Occluded" is the term used to describe the absorption of gases by metal A hard valve is therefore one which contains a minimum of gas.

What is a "Soft Valve"?

A soft valve is one which contains a relatively large quantity of residual gas, *i.e.*, gas which has been left in the bulb after pumping. A soft valve is not pumped as thoroughly as a hard valve. Soft valves are useful as detectors, but are not good amplifiers.

Explain How the Electrodes are Arranged Inside a Valve.

Fig. 4 shows how the cylindrical anode, spiral grid, and straight filament of the present-day valve are arranged inside the bulb. It will be seen that all the electrodes are supported by their own conducting wires, which are made sufficiently stiff for that purpose. It will be seen that the electrodes are mounted on a glass funnel or stem (these being the technical terms used by valve manufacturers). The "stem" is a piece of glass tubing which has been opened out at one end into the shape of a funnel and flattened at the other end to form what is known as the "pinch." Before the glass tube which forms the stem is pinched at the top, the different supports with their leading-in wires are slipped through the top end of the glass tube, which has been made red hot in a Bunsen flame. The end of the tube is then squeezed with a pair of tongs, and the ends of the supports are thereby fused into the glass.

It will be seen that in every valve there is a little bit of platinum between each leading-in wire and the support. Platinum is used because it fuses very well into the glass, air from the outside being thereby prevented from penetrating into the interior of the valve.

Fig. 5.—The bulb ready for the funnel.

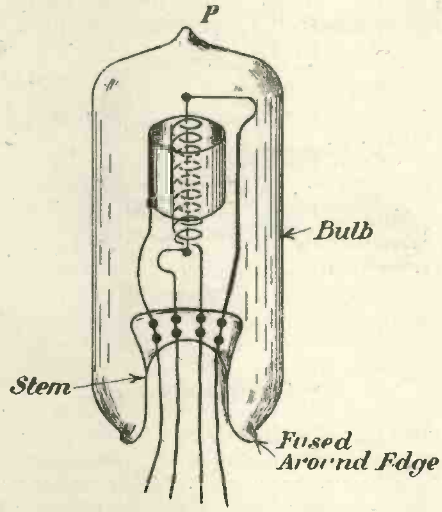


Fig. 6.—The funnel fused in place.

Another point to notice is that the top end of the filament is supported by a special spring, usually made of nickel-iron. This spring is to act partly as a shock absorber for the filament, but principally to take up any slack in the filament when the latter expands on heating.

How Are the Electrodes Inserted in the Bulb?

When manufacturing a valve, the electrodes are first mounted on a stem, as shown in Fig. 4. The bulb is now obtained and has he general shape shown in Fig. 5. Through the neck is pushed the top end of the assembled electrodes of Fig. 4. The valve now has the appea ance of Fig. 6, which shows the funnel fused to the neck .f the bulb this process being carried out by means of blow pipe. At the top of the valve there is a pip P, to which is fused a glass tube which goes to the pump.

Does Blackening of the Bulb Indicate the Quality of the Valve?

Many beginners imagine that because the inside of a valve is black the results obtainable may not be good. Used and burnt-out electric lamps are often slightly black, and the beginner sometimes wonders whether the blackness of his wireless valves is a sign of age. This, however, is not the case. The blackening on the inside of a bulb is, if anything, a good sign, as it shows that the valve has been properly exhausted. When pumping the air out of a valve, it is customary to improve the vacuum by driving off the occluded gas by heating the electrodes.

The cylindrical anode is heated by bombarding it with electrons shot off from the filament, which is rendered incandescent by passing a current through it. This "bombardment" of the anode is obtained by connecting a source of high voltage across the anode and filament, the anode potential being made positive. The electrons may be made to strike the anode with such enormous velocity that the anode is made red-hot, much in the same way as a metal target may be rendered hot by the repeated impact of bullets. Owing to the heat which the anode attains, some of the impurities in the metal are

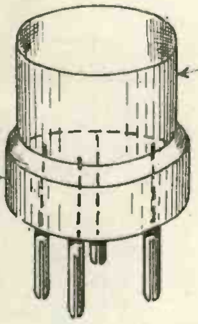


Fig. 7.—The valve cap.

driven off, and these often go to the inside of the glass bulb making it slightly black. Valves which have been very highly exhausted are usually blacker than those of poorer vacuum. Hence a black valve usually means a hard valve.

Of What Metals are the Electrodes in a Valve Made?

The cylindrical anode is usually made of nickel. The grid is usually made of molybdenum wire, molybdenum being one of the rarer metals and one which will stand a high temperature without melting. The filament is, in practically all cases, made of tungsten wire. The spring supporting the filament is usually made of nickel-iron wire, which has been passed through a roller to flatten it and increase its springiness. The different supporting wires are usually made of nickel. The leading-in wires are of copper.

What is the Purpose of the Four-pin Arrangement at the Bottom of the Valve?

This is known as the "valve cap." The four pins are connected to the different electrodes inside the valve. A wire from one of the pins goes to the anode, from another to the grid, and from the other two to opposite ends of the filament. The object of having a cap is that valves may be readily and conveniently connected in circuit or replaced in any apparatus. The pins on the valve cap fit into a socket; also, to make the connections easily, an ordinary electric lamp fits into a lamp socket.

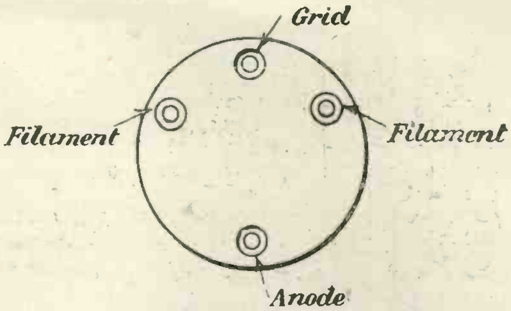


Fig. 8.—Arrangement of pins.

How is the Valve Cap Fitted to a Bulb?

Fig. 7 shows a valve cap. It is composed of brass and moulded insulating composition similar to ebonite. A disc of this composition is secured to a brass cylinder; through the disc pass four pins, which are arranged in a special manner. A bottom view of these pins is given in Fig. 8. It will be seen that they are arranged in the shape of a kite and they fit into a holder made of ebonite, having four brass tubes, also arranged in the manner of Fig. 8. The special arrangement of the pins and sockets prevents the valves being put into the holder the wrong way round. An error in fitting the valve into its holder might easily lead to a burnt-out valve.

Different leading-in wires are connected and soldered to their respective pins in the valve cap, and the latter is then fitted to the bulb and cemented to it, the cement somewhat resembling plaster of Paris.

The valve is now complete, Fig. 9 showing how the valve fits into its cap.

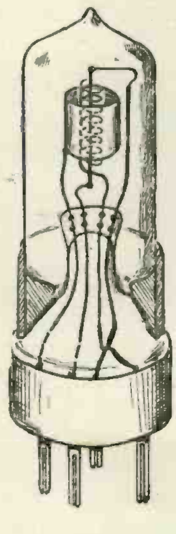
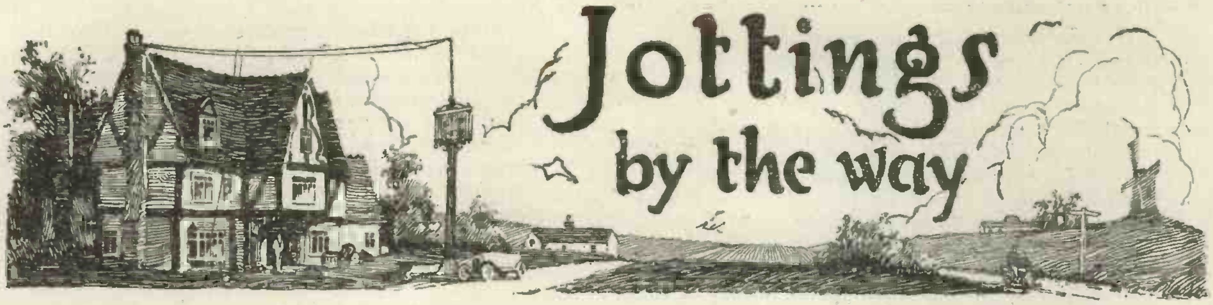


Fig. 9.—The valve completed and fitted into cap, ready for use.



Piracy.

THERE is a good deal of talk at the moment about the amount of wireless piracy that is going on. Lord Gainsford, chairman of the British Broadcasting Company, recently estimated that those who were using sets without authority of any kind to do so considerably outnumbered the holders of licences. How he arrived at his figures I don't know, but presumably he had some data upon which to base them. In any case, there can be no doubt that these buccaneers of the ether do exist in large numbers, which is an undesirable position from every point of view, save, perhaps, that of the buccaneers themselves. I believe that matters would be greatly improved if lists of wireless licence-holders were displayed in post offices. This is already done in the case of those who take out gun, game, and certain other kinds of licence, so there should be no great difficulty about it. No one whose name was not on the list would have the effrontery to decorate his back garden with an aerial for all the world to behold; and if he were so confirmed a pirate as to adopt a frame rather than pay for his entertainment, the cost of the extra valves needed would much exceed that of a licence.

Wireless Clubs.

But even if, for some reason discovered by the fertile brains of those that govern us, it were found impracticable thus publicly to sort out wireless folk into Virtuous Persons (like you and me) and Bad Hats (such as that fellow Jones over the road), is there any reason why the information should not be given to the secretaries of local wireless clubs? Many clubs have already done good work by purging the ether in their neighbourhood from the catcalls of the howling fiend; and if they received some kind of official recognition they might aid the authorities to hang the pirates—metaphorically, of course—from their own illicit aerials. The clubs deserve every encouragement on account of their splendid work. No wireless enthusiast, be he beginner or hoary veteran at the game, can afford not to belong to one. By joining your local society you are kept up to date by the exchange of views at lectures and informal discussions. If you are a beginner you are taken by the hand and initiated gently and without tears into the mysteries of wireless. If you are an old hand you will meet others of equal knowledge and enthusiasm with whom you may swop lies in all good fellowship.

Atmospherics.

The atmospheric season is upon us. I have had some already; so, no doubt, have you. Luckily, we are not quite so badly treated by them as our cousins in the States, who have a hotbed of them at their very door. Investigations are reported to show that those atmospherics which worry Americans originate chiefly in a certain area in Florida, which provides a never-failing supply during the warmer months. Conditions are frequently so bad over there that listening-in becomes impossible for considerable periods. Our own particular brand of scrapings and tearings is manufactured, it seems, largely in Northern Africa. Thunderstorms at home, of course, supply their quota, and any sudden change in the barometer which leads to the rapid rising or falling of charged clouds or air strata will do its bit towards deafening us. The worst of it is that atmospherics are at their height at night time, when conditions otherwise are most favourable to reception. Hundreds of attempts have been made to devise some means of counteracting their effects; and though some of them are moderately effective, none can be called complete success. If you want to make a large fortune, all that you have to do is to invent a way of tuning them out entirely. The trouble is that their oscillations set our aerials vibrating at their own natural frequency by sheer shock effect.

The Junk Box.

One seems to accumulate a wondrous store of discarded wireless material. Most of us are continually making alterations and improvements in our sets, with the result that odds and ends of all kinds are bought or made, only to be shed when something better turns up. What to do with it all is really a problem. One can't bear to part with this good old condenser or that well-tried coil. There is always a feeling that they might come in useful some day. And so it goes on until one's cupboards and shelves become filled, like the schoolboy's pockets, with a weird miscellaneous collection. It would be a good idea, I think, for wireless clubs to hold periodical jumble sales, whereat members might dispose of surplus gear. Not that that would empty the encumbered shelves; for who could go to such a sale without buying? Still it would often enable one to obtain some desired gadget in exchange for something for which no use could be found.

Watch Your Condensers.

It very seldom pays to buy cheap condensers unless they are of "disposals" origin and have been well treated. Some of the new goods on sale to-day at catchpenny prices are almost worthless, both materials and workmanship being of the most poisonous kind. Such crude things cannot be expected to perform well—and they don't! Many a sunny temper has been ruined by fruitless efforts to bring home to aerial, earth, batteries, or 'phones misdemeanours that were being committed all the time by some smug little condenser tucked away in the bosom of the set. If you are offered such things, look at them, marvel at their cheapness—and pass on. Or if you are lured into buying, don't fit them to the set; send them by the first post to your worst enemy. Much the same remarks apply to gridleaks. The resistance value of cheap ones is frequently unstable, varying with atmospheric conditions. And don't forget that a faulty gridleak may be the author of a variety of unwanted noises.

A Voice from the Void.

However much one uses a wireless set, one can never cease from wondering at the miracles that are performed to-day by means of ether waves. Some time ago, whilst trying to see how long I could keep in touch with a 'plane that had left Croydon for Paris, I was much impressed by one incident. The pilot called the aerodrome and informed the operator that one of his passengers had left a dispatch case containing urgently required papers in his bedroom at a London hotel. A few minutes later Croydon called up. He had rung up the hotel on the "land line"; the dispatch case had been found and would be sent to Paris by the next 'plane. Also, a telegram had been delivered at the hotel for the passenger: should it be opened and read? The wire was duly relayed on by the radiophone and a reply sent back. And all this, mind you, whilst the passenger was flying at dizzy heights over Northern France.

Cabled Wire Connections.

It is rather difficult to connect a cabled wire, such, for example, as that forming the lead-in or of the low-tension battery leads, to a terminal in such a way that perfect contact is ensured. In the case of the lead-in in particular this is an important point: high-frequency currents travel largely on the surface of conductors, and if any strand fails to make contact with the terminal a certain amount of resistance will be set up, since the current that it carries must pass into other strands before it can reach earth *via* the set. The best tip that I know is to bond the strands together at their ends by scraping them clean and dipping them, tightly twisted together, into melted solder. In this way a first-rate contact is obtained. When the low-tension battery leads are long, as, for instance, when the accumulator lives in some distant corner of the room, a considerable voltage drop may occur if connections are made in the ordinary way; if, however, their ends are soldered as recommended, the fall in E.M.F. will be less noticeable.

An Exasperating Business.

Have you ever been maddened by trying over and over again without success to identify some commercial station which is engaged in sending messages of appalling length without ever giving its call sign? You badly want to know its position, but you take down pages of messages without obtaining a single clue. Possibly you switch off and come back to it later, only to find that it is still transmitting as before. Some of the Transatlantic stations do not seem to bother to sign on or off when working with their regular "opposite numbers," hence one may go on for days in vain endeavours to discover who they are. If stations are on 4,000 metres or less one can often identify them with the aid of the wavemeter, but few of us possess meters that will measure the huge wavelengths used by a number of the long-distance stations.

French Broadcasting.

I have just been listening to a splendid programme transmitted by the Société Radio-Electrique from their station at Levallois-Perret, near Paris. The power used must be considerable, for with only four valves (one H.F. with tuned anode, rectifier, and two L.F.) the concerts came in at loud-speaker strength, though no reaction was used. I saw a headline in an American paper the other day, "English Learning French by Wireless," and there must be a good deal of truth in the statement, for thousands of people listen daily to telephony from the Eiffel Tower, Radiola, and the Ecole Supérieure des Postes et Télégraphes, to the vast improvement, no doubt, of their French accent. I've always thought German an ugly language, but you have no idea how horrible it can sound until you hear its raucous gutturals in the headphones of your receiving set. Need I say that I don't often turn to Königwusterhausen for entertainment? French, however, is delightful, and the announcer at Radiola rivals our own Mr. Burrows in clearness of enunciation.

WIRELESS WAYFARER.

THE CONSTRUCTION OF A LOCAL OSCILLATOR.

By ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."

The value of a separate heterodyne oscillator is not apparent until the upper wavelengths are reached. In order to help the experimenter to obtain the maximum efficiency over a wavelength range of from 7,500 to 24,000 metres the following constructional items will be found of use.

IN deciding the design of this instrument the determining factors were compactness and simplicity of operation. It was not thought necessary to make the oscillator function on such low wavelengths as, for instance, the broadcasting band, as there is no gain in efficiency by the introduction of such a device upon these wavelengths, and heterodyne reception is quite permissible where reaction is taken back to some circuit not directly coupled to the aerial; for instance, a tuned anode or high-frequency transformer following the first valve. The nearer to the aerial circuit reaction is taken, the greater the effect will be. That is to say, if we have four high-frequency valves and reaction is taken on to the first coupling transformer, a greater amount of control will be produced than if the reaction is taken to the transformer following the third valve.

The greatest range that it was found possible to obtain from one coil was from 7,500 to slightly over 24,000 metres. This permits of local oscillations being introduced into the waves of Bordeaux (LY 23,450 metres), and at the same time allows of heterodyning being effected of the shorter waves of Leafield, Carnarvon, Nauen, etc. The essential parts of the instrument are:—

An ebonite panel 3½in. by 7in. by ¼ of an inch thick.

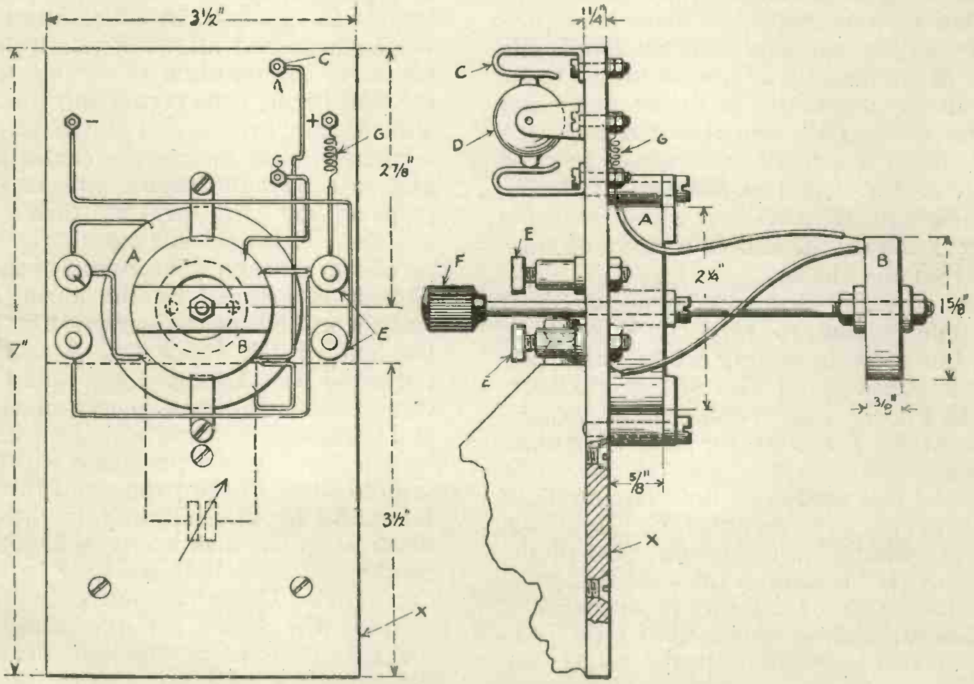


Fig. 1.—Showing back view and elevation of the instrument.

A slab, lattice or honeycomb coil of any design so long as it is reasonably compact, having 1,300 turns.

A grid or coupling coil of similar design and appearance having 450 turns.

A V-24 valve and the necessary clips.

A variable condenser of not less than 0.001 μF capacity and a small fixed filament rheostat of about 1½ ohms.

The first item to be taken in hand is, of course, the ebonite panel on which the apparatus is mounted. In the writer's case a "Polar" variable condenser was used, since this type gives much more even tuning over the scale than any other type of condenser, and also is so compact that the design followed out in this article can be readily adhered to. This panel, which should be smoothed with emery paper in the customary way and finished to taste, can be drilled out in accordance with the dimensions given in Fig. 1. This will enable the experimenter to fit the valve clips, terminals, coupling coils, etc., in their correct respective positions. The panel X, Fig. 1, is attached to the back of the condenser by means of three screws as shown, and the V-24 valve should be so mounted at the top that there is sufficient clearance for the hand to operate the coupling knob F.

The spindle upon which F is mounted, which is a piece of small B.A. brass rod, should not be very short, as there may possibly be slight capacity effects from the presence of the hand. If this is found to be so, it will be necessary to fit an extension handle to this spindle, and this can easily be done by means of a small brass sleeve screwed internally and attached in place of the knob. A further length of 4B.A. brass rod, with the operating knob on the end of it, may be then screwed into the sleeve.

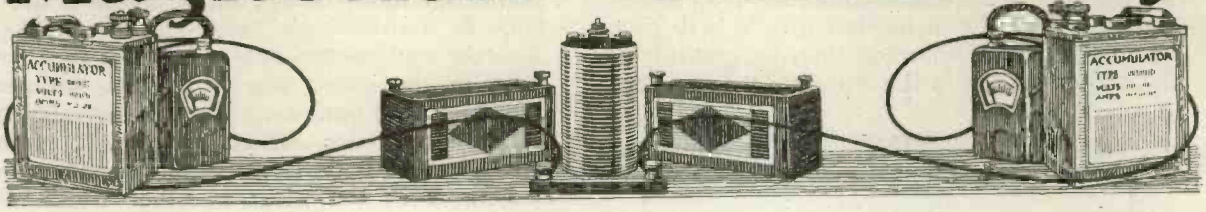
In the writer's own case none of these adverse effects due to capacity have been noticed, but it might be found that under certain circumstances, and with certain modifications of this design, they would be noticeable. This is rather a matter for the individual experimenter than for any general rule to be laid down. The necessary hole having been drilled in the back of the panel X, Fig. 1, the next thing should be the preparation of the coils A and B. If compactness of design is an essential feature, as it was in the writer's case, these should be of the slab type. On account of the long wavelengths which are being dealt with, no detrimental effects will be noticed from inherent self-capacity, and wire of No. 32 or 34 gauge can readily be used.

The actual coils as used in this instrument were wound with No. 34 gauge single silk covered wire. The process of winding ordinary slab coils is too well known for it to be necessary to enter into any details here, but it is sufficient to say that a convenient former may readily be made from a piece of ebonite or wood rod of the required diameter, fitted with two brass end-plates, between which the wire is wound. The internal diameters of the coils—that is, the diameters of the formers on which they are wound—is 2in. Brass sides are advised when using these formers, because if ebonite is used and the coils are immersed in paraffin wax to make them rigid, the sides will probably warp under the influence of the heat and slightly displace the shape of the coil. The waxing process should be repeated after every two or three layers of the coil, and when the complete thing is finished it should again be immersed in wax whilst still in the former. It should not be removed until the brass plates are thoroughly cold, when a hard, glass-like coil will be the final result. Some experimenters might prefer to wind these coils round with silk tape after they have been wound, but this is not really necessary.

The terminals used in this instrument were of a pattern which is now on the market and largely in demand, in which the top knob E when depressed allows a small hole in the centre of the terminal to come into line with the outer hole, thus permitting the connecting wire to slip in. When the knob is released a spring inside pushes the centre portion up, and so causes the centre hole to take a firm grip on the wire passing through the terminals. This grip is exceedingly secure, and no efforts can pull the wire out of the terminals once it is gripped by the spring. At this stage it will be convenient to cut a small clamp for holding the anode coil A to the back of the panel X. As seen from L and M, Fig. 1, these consist of small pieces of ebonite tube and brass strip respectively. Two screws 4B.A. by 1in. long (under the head) will be required to hold these to the panel, and the small tube L should be filed slightly in order that the brass strip M may exert sufficient pressure on the coil A to hold it firmly to the back of the panel. Great care must be taken when drilling the holes for the small fastening brackets that the centre hole through which the spindle F passes is exactly in the middle of the coil A. If this is not carefully aligned the calibration of the instrument will be slightly affected. If the anode coil has now been fixed, the next step is the cutting out of the small ebonite block Y, Fig. 1, which forms a guide member and a supporting rod for the centre spindle F. This can be cut from ⅜in. sheet ebonite to the dimensions shown in Fig. 1, and should be secured to the panel by means of two 4B.A. brass screws ¾in. long.

(To be continued.)

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART IV

(Continued from No. 3, page 157.)

WE have seen that when electricity flows from one point to another through a conductor such as a metal wire, the strength of the current depends upon the potential difference between the ends of the wire and also upon the material and thickness of the wire. If the potential difference between the ends of the wire is maintained whilst the current is flowing, we call it the electromotive force (E.M.F.), and we saw that for a given electromotive force applied to the ends of a piece of wire of a definite length and thickness, a greater current will flow if the wire is of copper than if it is of iron. This circumstance is explained by saying that the resistance of the iron wire is greater than that of the copper wire, or that copper is a better electrical conductor than iron.

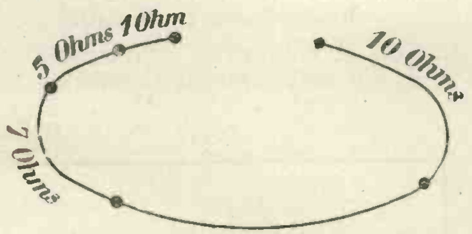


Fig. 11.

Again, if we use the same conductor—that is, the same piece of wire—but we apply different electromotive forces to it, we shall find that the strength of the current is greater the greater the E.M.F. applied.

Now I want to explain what is one of the fundamental and most important laws in connection with electricity. It is known as *Ohm's law*, and states that " the current flowing through a solid conductor is proportional to the E.M.F. applied at the ends of the conductor and inversely proportional to the electrical resistance of the conductor." Let C

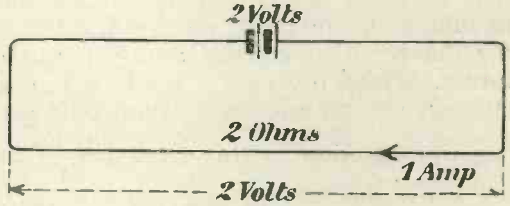


Fig. 12.

stand for the current, E for the E.M.F., and R for the resistance; then Ohm's law is expressed by the equation $C=\frac{E}{R}$. This law is so important that it will be useful to consider a number of simple examples of its application. Suppose an ordinary accumu-

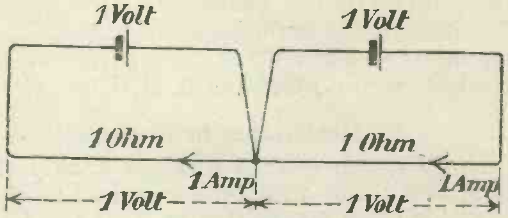


Fig. 13.

lator of E.M.F. 2 volts has a piece of wire of resistance 10 ohms connected across its terminals, what will be the strength of the current in amperes which will flow in the wire? By putting E = 2, and R = 10, in the above equation, we find that C will be equal to one-fifth, and therefore one-fifth of an ampere of current will flow in the wire. Suppose now we use five accumulators connected in series which, as we saw in the last article, will give us an E.M.F. of 10 volts, then by putting in the proper values in the equation we find that

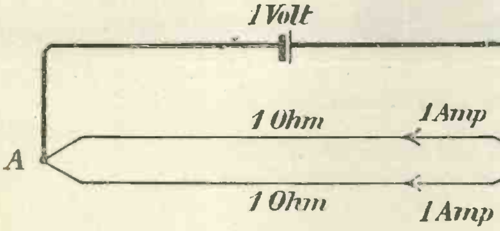


Fig. 14.

the current will now be 1 ampere, that is, using the same resistance we have increased the E.M.F. to five times its previous value, and we have produced five times the current. The reader will find it very easy to work out other examples for himself.

If we know any two of the three quantities in the above equation, we can find the third, for the equation can be changed into other forms. Thus, if we know the E.M.F. and the current, we can find the resistance by arranging the equation in this way, $R=\frac{E}{C}$, and if we know the current and the resistance we can find the E.M.F. by arranging the equation $E=CR$. Let us use this equation to find the resistance of an ordinary electric lamp consuming $\frac{1}{2}$ ampere on a 200-volt circuit. In the equation $R=\frac{E}{C}$ we substitute $E=200$, and $C=\frac{1}{2}$, and we find that the resistance is 400 ohms. Again, suppose we have a circuit of which we know the resistance, say, 10 ohms, and we find by using a measuring instrument that a current of 15 amperes is flowing in that circuit, what E.M.F. is producing the current? Taking the equation $E=CR$, we find that the E.M.F. is 150 volts.

Resistance in Series

Suppose we have a piece of wire 1 metre long and 1 mm. in diameter and its resistance is 1 ohm; that means that an E.M.F. of 1 volt applied at its ends will produce in it a current of 1 ampere. If we take a second piece of wire identical with the first, it will require an E.M.F. (or potential difference) of 1 volt, applied at *its* ends, to produce a current of 1 ampere in it. If now the two pieces of wire are connected together, end to end, we shall require a potential difference of 1 volt between the commencement of the wire and the mid-point, one metre away; and a potential difference of another volt between the mid-point and the end to maintain a current of 1 ampere in the wire; that is to say, we shall require a total potential difference between the ends of the wire, which are now 2 metres apart, of *two* volts to maintain the current of 1 ampere in the wire; in other words, the resistance of the total wire is now 2 ohms. This brings us to the rule which governs the resistance of conductors in series, and the rule is that "the resistance of a number of conductors connected in series, that is end to end, is equal to the sum of resistances of the individual conductors." In the illustration a number of conductors are shown, whose resistances are supposed to be 1 ohm, 5 ohms, 7 ohms, 11 ohms, and 10 ohms, and the total resistance is equal to 34 ohms.

If we connect resistances in series and we want to maintain the same current through the whole set of resistances, we may, according to Ohm's law, increase the E.M.F. applied to the ends so as to keep the E.M.F. proportional to the total resistances. If, on the other hand, we increase the resistances whilst keeping the applied E.M.F. constant, there will be a reduction in the current flowing through the resistance. Thus, if we make the resistance five times as great and keep the E.M.F. constant, only one-fifth of the current will flow through the conductor. All these facts will be quite obvious by continually thinking of Ohm's simple law given above.

Resistances in Parallel

Instead of connecting two resistances end to end, we may connect them side by side,

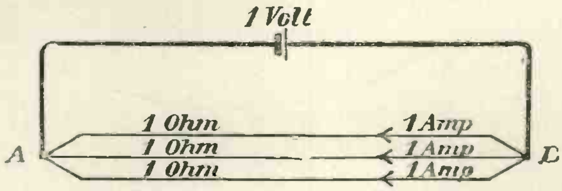


Fig. 15.

this arrangement being known as "parallel" or "shunt." In this case we see that the current which has to travel from the point A to the point B has now two paths instead of one, and consequently it is easier for it to flow; that is to say, the total resistance has been reduced. If we have two equal conductors, say, each of a resistance of 1 ohm, and connect them in parallel, the resistance between the points A and B is now ½ ohm. If three conductors, each of a resistance of 1 ohm, are connected in parallel, the total resistance is ⅓ ohm, and so on.

If the E.M.F. between the points A and

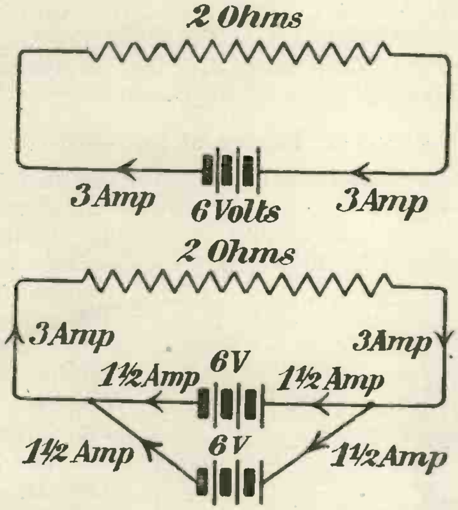


Fig. 16.

B is maintained constant (say, 1 volt), a current of 1 ampere will flow through the first conductor, in accordance with Ohm's law, and a current of 1 ampere will flow through the second conductor, and so on, so that the current will be increased by connecting the conductors together in parallel, since the total resistance is reduced.

The Resistance of a Wire Depends Upon its Thickness

From what has just been said it will be evident that the resistance of a wire will be less the greater its cross-sectional area; in fact, the resistance is inversely proportional to the cross-sectional area. It is easy to see why this should be so, for obviously a wire whose cross-sectional area is 2 sq. mm. amounts to the same thing as two wires of cross-sectional area 1 sq. mm. each laid side by side, and the resistance of these two wires connected together in parallel (as we have seen) will be half the resistance of either. In other words, the resistance of a given length of wire of 2 sq. mm. cross-sectional area is half the resistance of a wire of the same material and length and of 1 sq. mm. cross-sectional area.

The resistance of a wire is thus proportional to its length and inversely proportional to its cross-sectional area. It depends, however, upon another property, namely, the "specific-resistance," as it is called, of the *material* of the wire.

Resistance of Different Materials

The specific resistance, or "resistivity," depends upon the nature of the substance, and is defined as the resistance of a conductor of the substance 1 cm. long, and of cross-sectional area 1 sq. cm.

The relative specific resistances of a number of metals are given in the following table:—

Specific resistance at 0° C.

Platinum	10.91
Silver	1.46
Copper	1.56
Iron	9.06
Nickel	12.32
Lead	20.38

The ohm is approximately equal to the resistance of a column of mercury 100 centimetres long and of 1 sq. mm. cross sectional area at 0° C. This is known as the Siemens unit, which was adopted for practical purposes, but the ohm has since been more accurately defined and determined.

Generally, however, we think of the *conductivity* of different materials rather than their resistance. Silver has the highest conductivity of all metals, and copper has the next. Aluminium also has a high conductivity, though not quite so great as that of

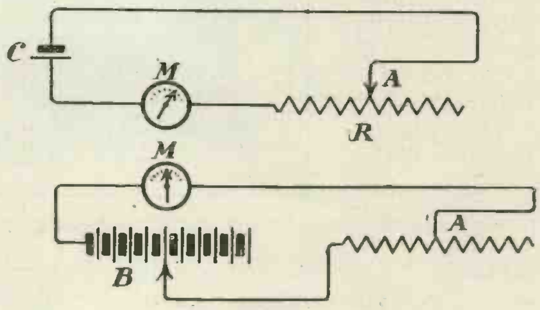


Fig. 17.

copper, and, owing to its cheapness, is coming to be very largely used for the transmission of electrical power.

(Owing to lack of space the remainder of this article is unavoidably held over until our next issue.)

A TWO-VALVE BROADCAST RECEIVER

By E. REDPATH, Assistant Editor.

The following article gives full constructional details of a two-valve receiver very suitable for long range reception of short wave telephony.

THE receiving set about to be described will be found particularly effective for long range reception on wavelengths from about 250 to 500 metres. Two valves are employed, the first functioning as a high-frequency amplifier, and the second as a detecting valve.

All necessary tuning arrangements are included, so that the complete set forms a fairly compact receiver, self-contained except for the usual filament lighting and high-tension batteries. The method of construction adopted, to be described in detail presently, is such that any reader possessing a very modest outfit of tools will have no difficulty in completing the set, whilst the total cost of materials and fittings will be found extremely reasonable.

The photograph (Fig. 1) shows the complete receiving set contained in a wooden cabinet measuring 10in. by 7in. inside. The aerial and earth terminals are fitted on the extreme left and right respectively at the back of the ebonite panel, whilst behind the right-hand valve are the H.T. battery terminals, and behind the left-hand valve the L.T. battery terminals, the two terminals to the front of the panel being for the telephone receivers. Only one filament rheostat is provided to control the filament current of both valves. The small knob to the left is the sliding contact upon the aerial tuning inductance, and that to the right the slider of a tuning inductance included in the anode circuit of the first or high-frequency valve.

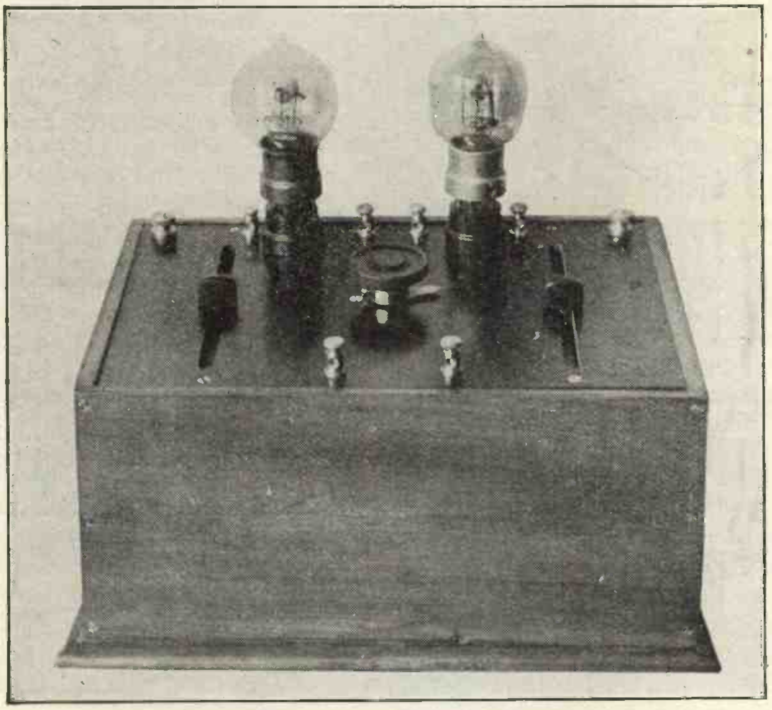


Fig. 1.—The completed set.

The Theory of the Set

Many readers will no doubt be aware that although low-frequency amplification usually gives excellent results, it can only be applied satisfactorily to signals or speech already audible in the telephones when the detecting valve only (or crystal detector, as the case may be) is in operation.

In other words, for low-frequency amplification to prove successful, the incoming signal must possess sufficient energy to actuate the detecting device, and signals which fail to fulfil this condition cannot possibly be improved by means of low-frequency amplification.

By applying the feeble incoming oscillation to the grid and filament of a valve, suitably connected so as to amplify the high-frequency current without distortion, greatly increased energy is available to actuate the detector, which, in the present case, is a valve. Having obtained the amplified oscillatory currents in the anode circuit of the first valve, it remains to transfer them as efficiently as possible to the grid circuit of the second valve. Methods of doing this are termed high-frequency intervalve couplings. Several different arrangements are possible, such as resistance-capacity coupling, which, however, is not very effective on wavelengths below about 1,000 metres; and transformer coupling, which is quite effective on the shorter wavelengths, but as the transformer has to be tuned to the frequency of the incoming waves, a variable condenser is required.

A third arrangement is known as the tuned-anode coupling, and consists in introducing in the anode circuit of the H.F. valve, a closed oscillatory circuit which may be tuned to have the same frequency as the incoming wave. When correctly adjusted the feeble incoming oscillations applied to the grid and filament of the first valve give rise to greatly magnified oscillatory currents in the tuned anode circuit. That is to say, the condenser in the tuned anode circuit undergoes high-frequency changes of potential, the potential changes being at a maximum when the circuit of which it forms a part is exactly in resonance with the aerial circuit of the receiver. These oscillatory changes of potential are applied to the grid of the detector valve by means of a small condenser connected between the latter and one side of the tuned anode condenser.

Reference to Fig. 2, which is a theoretical circuit diagram of the complete receiver, will make the method adopted quite clear.

The aerial circuit comprises the aerial itself, Æ, the tuning inductance L with slider S_1, and the earth connection E. The tuned anode circuit includes the tuning inductance L_1 with slider S_2 and the fixed condenser C_1, the anode side of which is connected to the grid of the detector valve through the grid condenser GC, whilst connected directly between the grid of this valve and the positive side of the filament battery is a high resistance or leak GL. In the anode circuit of the detector valve the telephones T are connected, with the usual telephone condenser C_2 shunted across them. R is the filament rheostat, and C_3 a large capacity reservoir condenser shunted across the H.T. terminals.

The arrangement shown in Fig. 2, although very simple, gives excellent results in practice, but it may sometimes be found that, with a certain definite adjustment of the filament brilliancy and/or anode voltage, the set may go into self-oscillation when the tuned anode circuit is exactly in resonance with the aerial circuit. Should this happen, a slight reduction of filament brilliancy will restore the set to a non-oscillating condition.

The photograph, Fig. 3, shows the position occupied by the various components.

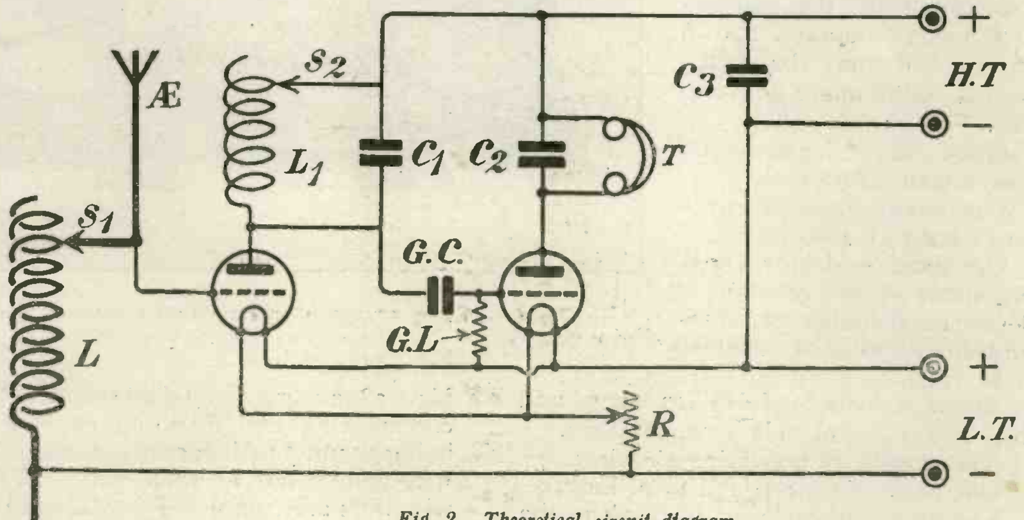


Fig. 2.—Theoretical circuit diagram.

Materials Required

The materials required for the complete receiving set are as follows:—

One containing box or cabinet made of any suitable wood to the dimensions given in Fig. 4 and stained and polished to suit the taste of the individual reader.

One ebonite panel, 10in. by 7in. by ¼in. thick.

One filament rheostat, resistance about 5 ohms capable of carrying about 1½ amps.

Two ebonite valve-holders.

Two large terminals for aerial and earth.

Six small terminals for batteries and telephone.

Two stout cardboard tubes, or "formers" (preferably impregnated), each $2\frac{1}{2}$in. outside diameter by 6in. long.

Two square brass slider rods, each $\frac{3}{16}$in. or $\frac{1}{4}$in. square by $6\frac{3}{4}$in. long.

Two sliders to fit these rods. These sliders should really be specially made to the dimensions given, but provided that good ebonite (not erinoid) sliders are obtained, the alternative construction shown in Fig. 6 may be adopted, if found more convenient.

One fixed condenser, capacity 0.0001 μF(C_1).

One fixed condenser, capacity 0.0003 μF (GC).

One fixed condenser, capacity 0.001 μF (telephone).

One fixed condenser, capacity 0.01 μF, or nearest (reservoir).

About 3oz. each of No. 20 s.w.g. and No. 28 s.w.g. enamelled copper wire.

About 2yds. of insulating sleeving.

One piece of slate pencil $1\frac{1}{2}$in. long.

Two brass brackets for gridleak to the dimensions given in Fig. 7.

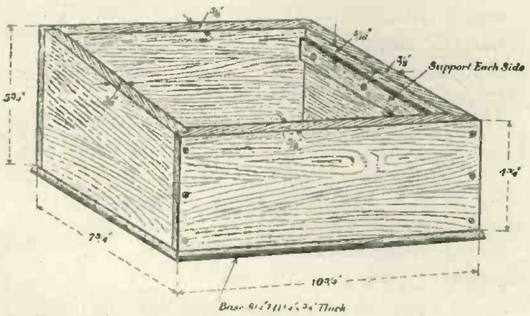


Fig. 4.—The containing box.

The Inductances

The aerial tuning inductance former is to be closely wound for 5in. of its length, that is to say, leaving a space of $\frac{1}{2}$in. at each end of the cardboard tube, with the No. 20 s.w.g. enamelled copper wire, the commencing and finishing ends of the coil being secured in place by passing the wire through two small holes in the cardboard tube. For the present a 12in. length of wire should be left projecting at each end of the coil.

The anode tuning inductance former is to be closely wound for 5in. of its length with

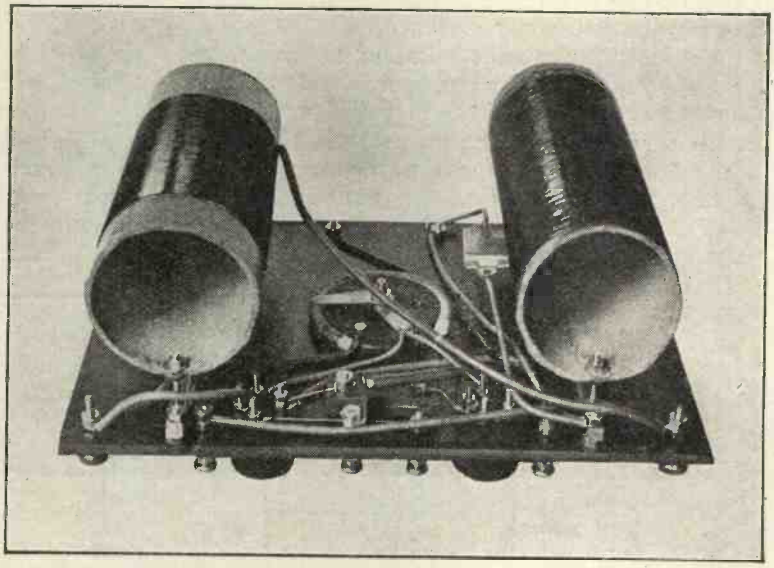


Fig. 3.—Showing arrangement of components on back of panel.

No. 28 s.w.g. enamelled copper wire, the commencing and finishing ends of the coil being secured as before and a spare length of wire being left at each end. When both windings are completed they should be given

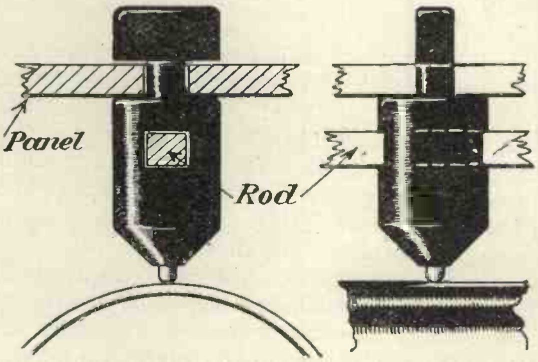


Fig. 5.—Special type of slider.

at least two good coats of shellac varnish and placed upon one side to dry.

The Ebonite Panel

Whilst the inductances are drying the ebonite panel may be marked off in accordance with the plan (Fig. 8), and all terminals, the two valve-holders, the filament rheostat, the grid reservoir and telephone condensers,

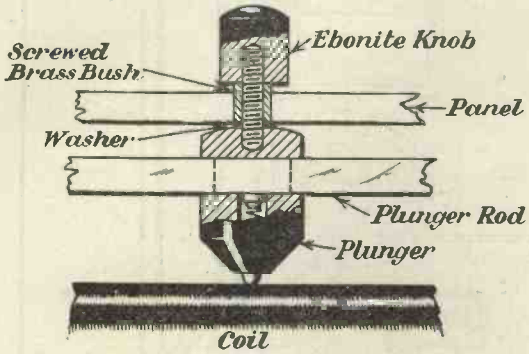


Fig. 6.—Alternative form of slider.

the brackets for the gridleak and the brass rod, complete with sliders, may all be fitted in position and be connected up in accordance with the wiring diagram Fig. 9. The slots are to be formed by drilling and sawing out with a hacksaw blade.

The Fixed Condensers

Suitable condensers of the capacities specified may be readily obtained from advertisers in this journal, but, if it is desired to make rather than purchase these items, they may be made in accordance with the particulars given in Fig. 10 (a), (b) and (c). For this purpose a supply of soft brass, say 1-64in. thick, about a dozen visiting cards or similar pieces of thin pasteboard thoroughly impregnated by being dipped in molten paraffin wax, and about 3ft. of ¾in. wide copper foil or ribbon will be required.

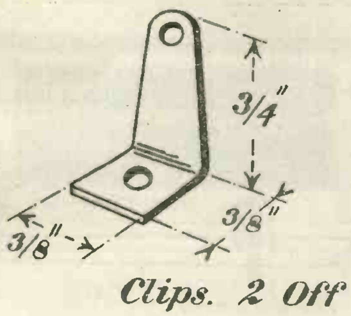


Fig. 7.—Clip for gridleak.

The condenser C_1 (Fig. 2) may consist of two pieces of foil ¾in. square, and the condenser GC of five pieces of foil of the same size. The condenser C_2 may consist of six pieces of foil each 1in. by ¾in. On account of the comparatively large capacity required for the reservoir condenser C_3, thin mica of good quality should be used for the dielectric instead of the waxed pasteboard. Ten pieces of copper foil, each 1¼in. by ¾in., separated by mica approximately 1-500in. thick, will be found satisfactory for this purpose.

Mounting the Inductance Coils

The method of mounting each of the inductance coils, complete with brass rod and slider, on the underside of the ebonite panel is shown in Fig. 11. In order to ensure a smooth movement of the slider over the turns

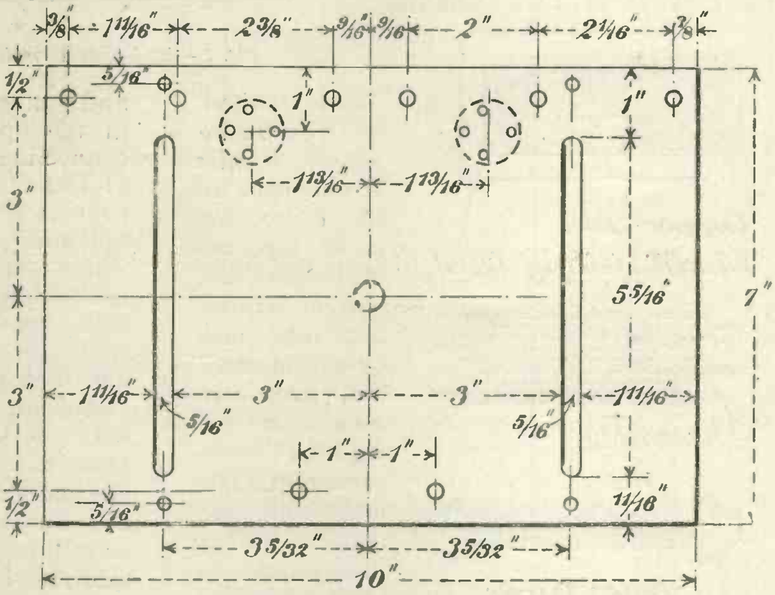


Fig. 8.—Drilling plan of ebonite panel.

of the winding it is desirable that only a short length of the brass plunger of the slider should project between the ebonite slider and the winding. By fitting small screwed studs to each end of the slider rod and securing the inductance coil upon these studs by means of two nuts and two washers, it is an easy matter to adjust the position of the inductance until the winding is perfectly parallel with the slider rods and at the correct distance from it to ensure easy movement of the slider. It will be necessary to insert the slider knob through the slot in the ebonite panel and then slip the square brass rod through the hole in the slider and secure in place.

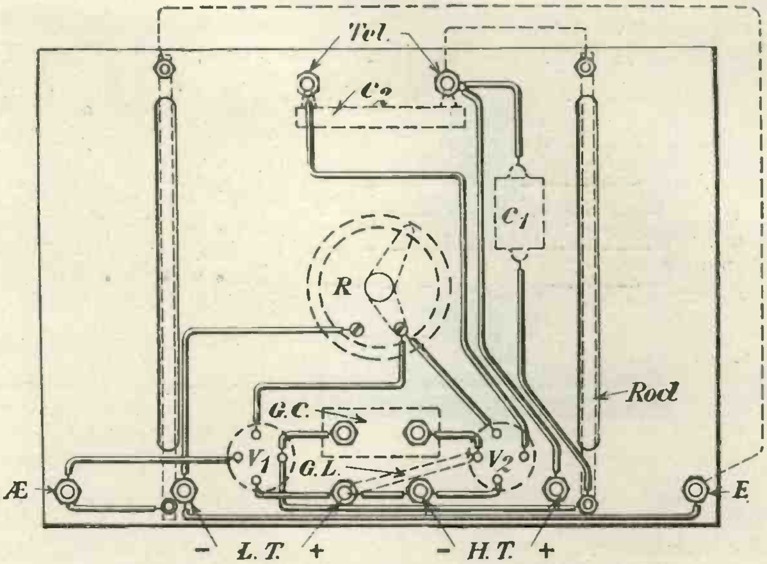


Fig. 9.—Back-of-panel wiring diagram (before coils are fitted).

When both inductances are finally fixed in position a piece of fine glass paper or emery paper should be slipped between the plunger of the slider and the turns of wire (with the working face of the abrasive towards the enamelled wire) and both slider and paper be moved vigorously to and fro until the insulation is thoroughly cleaned off the surface of the wire to enable the plunger to make good and smooth contact. Avoid sand-papering the turns unduly, however, or too much insulation may be removed and adjacent turns of the winding short-circuited. The spare length of wire at the back of the coils, that is to say, beneath the back row of terminals, may now be cut off short and the two remaining wires connected up. The end of the aerial tuning inductance is to be connected direct to the earth terminal on the right of the panel, and the end of the anode tuning inductance direct to the right - hand telephone terminal lying almost immediately beneath it.

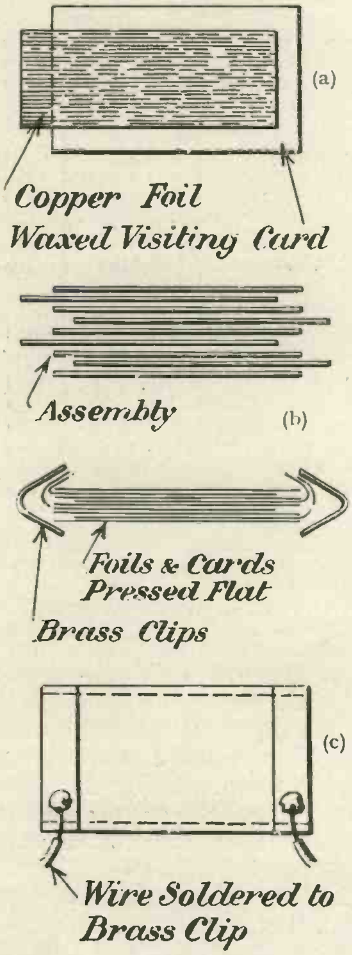


Fig. 10.

Operating the Set

This completes the construction and wiring of the set, and the panel, carrying all fittings and components, may now be secured in place in the opening of the containing cabinet; connections may be made to the aerial, earth, H.T. and L.T. batteries, and the telephones connected to the appropriate terminals. When operating the set for the first time, the two sliders should be moved along from front to back approximately together. Upon a signal being heard, vary the aerial tuning (left-hand slider) until maximum signals are obtained, and then bring the anode circuit (right-hand slider) into resonance, which will result in a very marked increase in signal strength. Once a few stations have been received, or, alternatively, the set is calibrated by means of a wavemeter, a scale either of wavelengths or of broadcast stations can be marked alongside the right-hand slider, after which it will only be necessary to set the right-hand slider to the desired station (or wavelength) and vary the left-hand slider until the station is satisfactorily heard.

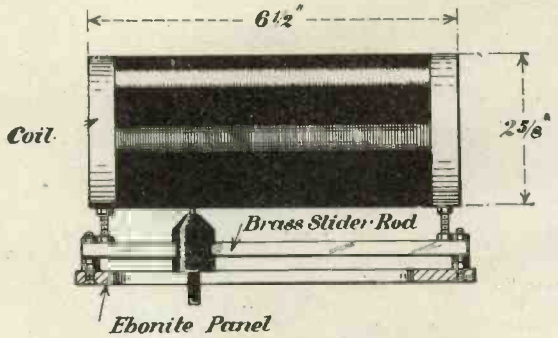
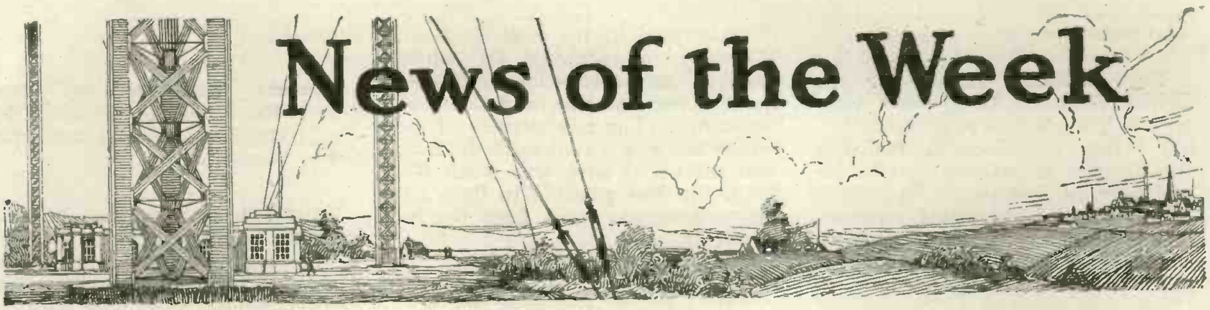


Fig. 11.—Showing method of mounting coils.

News of the Week



SIR WILLIAM JOYNSON-HICKS announced in the House of Commons on April 24th that the following Committee had been appointed to investigate Broadcasting :—

Major-General Sir F. H. Sykes, Chairman (formerly Chief of the Air-Staff and Controller-General of Civil Aviation).

Major J. J. Astor, M.P.

Mr. F. J. Brown, Assistant Secretary, General Post Office.

Sir H. Burbury, Controller and Accountant-General of the Post Office.

Viscount Burnham (Chairman of the Newspaper Proprietors' Association).

Prof. W. H. Eccles, D.Sc., F.R.S., President of the Radio Society of Great Britain.

Sir Henry Norman, M.P., Chairman of the Imperial Wireless Committee, 1920, and Vice-President to the Radio Society of Great Britain.

Mr. J. C. W. Reith, General Manager of the British Broadcasting Company.

Field-Marshal Sir W. Robertson, formerly Chief of the Imperial General Staff.

Mr. C. Trevelyan, M.P., Labour M.P. for Central Newcastle.

The above Committee will consider (1) Broadcasting in all its aspects, (2) contracts and licences which may have been or may be granted, (3) action which should be taken on the determination of the existing licences of the British Broadcasting Company, (4) uses to which Broadcasting may be put, (5) restrictions which should be placed on its use or development.

* * *

It is rather amusing to note how both Mr. Kellaway and Mr. Chamberlain desire to decline the responsibility for the agreement with the British Broadcasting Company. Mr. Kellaway was in Office as Postmaster-General when the agreement was granted, and we understand that he actually gave instructions for the licences to be printed. Mr. Chamberlain, who became the Conservative Postmaster-General, signed the Agreement as it stood.

* * *

Mr. J. W. Milan, of Donegal Street, Belfast, has been served with a summons for the alleged illegal use of a Wireless Set. Mr. Milan applied for a licence, but the application was ignored. It is to be especially noticed that this prosecution is not under the Wireless Telegraphy Act, but under the Civil Authorities Special Powers Act (Northern Ireland), 1922.

Owing to special conditions ruling in Ireland the Wireless Licence question is very different from that in this country. We desire to repeat here the request we made in our first number for immediate information in the event of any genuine would-be experimenter being prosecuted under the Wireless Telegraphy Act.

* * *

The Radio Research Board experts working at the station at Aldershot have recently been investigating the character and causes of atmospherics.

Using an aerial 1,500 ft. long, they have found that the wavelength of atmospherics is normally in the neighbourhood of 600,000 metres and that their intensity is, on the average, 40 times greater than the most powerful transatlantic signals. In some cases they were found to be almost 1,000 times stronger.

* * *

The possibilities of broadcasting were demonstrated when the Marquis Curzon, Secretary of State for Foreign Affairs, delivered a broadcast message from his house, 1, Carlton House-terrace, in aid of a ball which is being given at Lansdowne House next Thursday on behalf of the Queen Victoria Jubilee Institute for Nurses.

Lord Curzon stated that this was the first time he had been called on to speak for broadcasting purposes. Photo on page 207.

On Thursday last an extraordinarily good programme was radiated from 2LO. If such programmes could be repeated a little more often there would be not the slightest cause for any complaint.

* * *

The Irish Government are contemplating the establishment of broadcasting stations. All receiving sets had to be delivered up to the authorities last June upon the outbreak of hostilities, but when peace is restored experimental wireless will return to favour.

* * *

Yorkshire radioists are very anxious for a broadcasting station of their own, and Hull is very expectant. Yorkshire, of course, is the largest county, and the results obtained from the other broadcasting stations are not very good.

* * *

The B.B.C. are certainly making full use of their own means of propaganda. It was not without amusement that we listened to Mr. Reith recently putting forward the B.B.C. point of view from a station licenced by the very Post Office with which the B.B.C. are at loggerheads!

* * *

No exception can be taken to this form of self-justification. We ourselves have placed our columns at the disposal of the B.B.C. to state their views, but the columns of the general Press are not as easy of access, and the B.B.C have to resort to other forms of publicity.

* * *

We question whether it is dignified to read out letters of appreciation of the programmes. After all, the people who are listening to what is going on can judge for themselves without the B.B.C. telling them how much they ought to be enjoying the programmes.

Press publicity, of course, in which extracts of letters are reproduced, is a different matter, as the advertiser is attempting to get new patrons. The B.B.C. should publish extracts of their letters not to those who have sets, but to those who have not.

* * *

The National Council of the British Women's Temperance Association has passed a resolution stating "that the Council, realising the dangers consequent on the installation of listening-in apparatus upon licensed premises, recommends branches to oppose such installations." We never believed that wireless would become so closely associated with the curse of alcohol.

* * *

It is highly probable that some of the lightships off the Thames estuary will be fitted with wireless telephone sets to enable them to communicate with the land in cases of ships in distress.

The North Goodwins lightship is to be fitted first, and will communicate with the land station at Ramsgate.

* * *

How many more times are we to hear the life-history of an old shoe?

* * *

A German steamer, the "General San Martin," which sails between Hamburg and South America, will be the first German steamer fitted with wireless telephony apparatus.

* * *

The wireless penny-in-the-slot machine has arrived. A firm manufacturing these has produced a useful little instrument which supplies broadcasting for a given time for a penny. Presumably these instruments have a means for switching on and off the filament current.

* * *

The s.s. "Great Western" was fired on by men with rifles in the River Suir about three miles from Waterford. The wireless operator had a very narrow escape, a bullet passing through the cabin door near to where he was sitting.

* * *

The Manchester Broadcasting Station has been carrying out experiments with the photophone, a form of microphone using selenium cells.

The Marconi Company recently demonstrated at the new Stadium, Wembley, a receiving set which employs ten valves—four high-frequency, one detector, and five low-frequency. The compactness of the whole set was a noticeable feature, and the aerial used was about 8ft. long. It was possible to hear the programme 300 yards from the instrument.

* * *

The London Broadcasting Station attempted to send a programme across the Atlantic in the early hours of the 17th April. The test was made between 4 a.m. and 5 a.m., but we understand that the signals were not received on the other side.

* * *

Some very successful experiments have been carried out with an automatic aeroplane directed by wireless at the Villesauvage Aerodrome, near Paris.

* * *

In the course of the usual Monday evening's experimental transmission from Mr. F. Lloyd's wireless station, songs were recently rendered from the opera, "The Maid of Madrid," which was produced on the 17th April at Sheffield.

* * *

Reports were received from several listeners-in to the effect that the transmissions had been perfectly successful.

* * *

After four months of experimenting, the Express Service Company, Berlin, began on January 1st a daily service of financial and commercial news broadcasting. This company is a private undertaking, and has a limited use of the Königswusterhausen Station.

Each subscriber rents from the company the necessary receiving apparatus, paying for the service itself an annual fee of 300,000 marks, and for the apparatus an annual rental of approximately 200,000 marks.

* * *

The General Post Office authorities have decided to raise no objection to a ship using its radio apparatus in the harbours and estuaries of the United Kingdom. The permission, however, does not apply to naval harbours or the Port of London above Barking Reach. Messages must be of an urgent business nature, and must be exchanged with the nearest Post Office coast station. Only a minimum power may be used.

* * *

Both Sweden and Norway are making arrangements for the establishment of broadcasting.

* * *

The *Financial Times* announces that influential banking and motor trade interests have purchased the control of the De Forest Radio Telephone and Telegraph Company (of U.S.A.).

* * *

Plans are being prepared by the Government of Greenland for the establishment of a high-powered station there.

* * *

The proposed new amateur wavelength is 730 metres. No definite decision has yet been made.

BROADCAST TRANSMISSIONS

CARDIFF.........5 WA......353 metres.
LONDON.........2 LO......369 ,,
MANCHESTER 2 ZY......385 ,,
NEWCASTLE 5 NO......400 ,,
GLASGOW 5 SC......415 ,,
BIRMINGHAM 5 IT......420 ,,
(10.30 to 11.30 a.m. and 4.30 to 9.30 p.m. G.M.T., Sundays 7.30 to 9.30 p.m. G.M.T.)

L'ECOLE SUPÉRIEURE (Paris) 450 metres.
Tuesdays and Thursdays 7.45 to 10 p.m. G.M.T.

THE HAGUE...PCGG...1085 ,,
(Sundays only 3 to 5.40 p.m. G.M.T.)

RADIOLA (Paris).........1780 ,,
7.45 to 10 p.m. G.M.T.

EIFFEL TOWER...FL...2600 ,,
(11.15 a.m., 6.20 to 7 p.m. and 10.10 p.m. G.M.T.)

THE NEUTRODYNE RECEIVER

*This tuned high-frequency amplifier gives great amplification without regeneration, as the internal capacity of the valves is neutralised, preventing regenerative action. It is the latest invention of Professor L. A. Hazeltine, M.E.**

AT a meeting of the Radio Club of America, Professor L. A. Hazeltine, of Stevens Institute of Technology, read a very interesting paper on his latest discovery, which is an epoch-making one. In the paper entitled "Tuned High-Frequency with Neutralisation of Capacity Coupling," Professor Hazeltine related how he first used neutralisation of capacity coupling when he designed the well-known SE-1420 Navy wireless receiver. In this apparatus capacity effects were removed from between the windings of the coupler by means of an extra coil wound over the secondary and earthed so as to prevent transmission of energy from the primary to the secondary due to capacity between the windings.

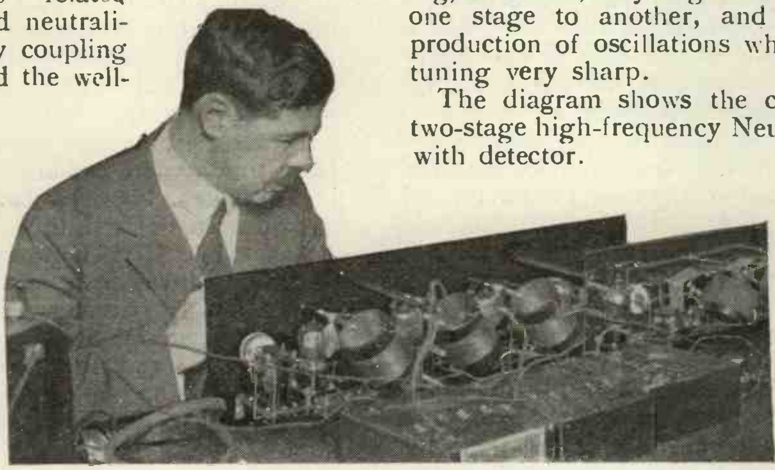


Fig. 1.—Professor L. A. Hazeltine tuning a Neutrodyne receiver.

It is well known that in tuned high-frequency amplifiers it is very difficult to eliminate undesired oscillations which take place owing to the internal capacity of the valves when the various circuits are tuned to resonance for high amplification. This limits the usefulness of such high-frequency amplifiers, as one is soon restricted in the number of stages on account of these oscillations, which are very difficult to control. It occurred to Professor Hazeltine that the neutralisation principle, which he devised for the Navy receiver, might be applied to tuned high-frequency amplifiers and, after experimenting, designed the Neutrodyne receiver, in which the internal capacity of the valves is neutralised, suppressing, therefore, any regenerative action from one stage to another, and preventing the production of oscillations whilst keeping the tuning very sharp.

The diagram shows the connections of a two-stage high-frequency Neutrodyne receiver with detector.

As may be seen the diagram is similar to that of a standard tuned high-frequency amplifier with the addition of two extremely small capacities between the grids of the various valves. These capacities, which equal about one-quarter the internal capacity of the valve, consist of two pieces of wire covered with insulation, over which slides a small piece of brass tubing. This gives a very small capacity, as it constitutes, in reality, two condensers in series. The adjustment of these condensers depends upon the type of valve used in the Neutrodyne receiver; usually, they are adjusted whilst listening to strong signals received in the aerial circuit. After the set is tuned by means of the small variable condensers connected across the secondaries of the high-frequency transformers, the filament

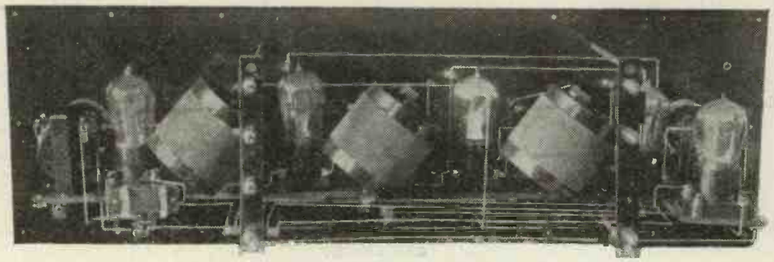


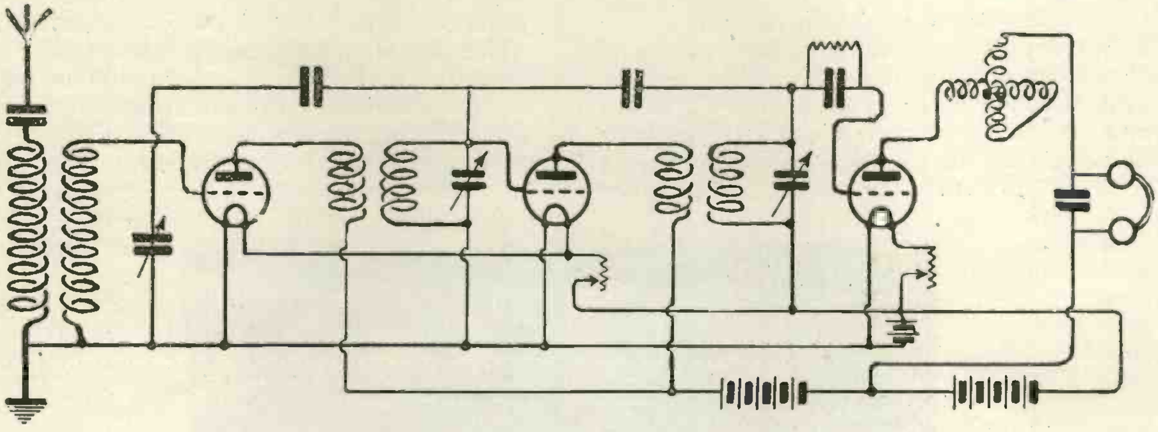
Fig. 2.—Back view of five-valve Neutrodyne receiver.

* Professor of Electrical Engineering, Stevens Institute of Technology.

current of the first valve is turned off and the small condenser adjusted until no signals are heard in the 'phones, showing that no transmission of energy occurred through the inter-electrode capacity from one stage to the next. Of course, each stage must be so adjusted, and it has been found in practice that if more than two stages of high-frequency amplification are used, it becomes necessary to shield the various stages on account of magnetic reaction occurring due to the great amplification obtained in the last stages. The other adjustments are similar to those of any ordinary receiver.

The advantage of the Neutrodyne receiver with regenerative detector is that the detector valve can be made to oscillate for the reception of continuous waves without radiating energy, which always causes interference with other receiving stations in the neighbourhood. Thanks to the Neutrodyne effect, the oscillations remain in the detector circuit, as there is no coupling between the different stages.

This is for an amplifier in which only the relay action of the valve is used, as the detector circuit may be caused to regenerate in the usual way by introducing a tuning element, either a tuned coil or variometer, in the plate circuit. This, of course, increases the amplification, although it has been found that the regenerative effect is more beneficial for shorter wavelengths than those used for broadcasting. This is of tremendous importance to amateurs who are more interested in 200 metres than in 360. We may expect now to bring in long distance stations with a two-valve Neutrodyne receiver with a regenerative detector, as this has been done by two amateurs who tried Professor Hazeltine's amplifier on a short wavelength. Both of them have been able to get every district during the same night. The Neutrodyne receiver has also proved very efficient for broadcast receiving, for, with a short aerial, an experimenter in New York City was able to copy seventeen distant stations in the same evening, including Calgary, Canada. This type of receiver provides extremely sharp tuning, although not extremely critical to adjust. Professor Hazeltine himself was able, in his laboratories in Hoboken, New Jersey, about one mile from station WEAF, to listen to Fort Worth, Texas, while WEAF was sending on almost the same wavelength, the difference being approximately 15 metres. With a 60ft. aerial and a three-valve non-regenerative receiver consisting of two stages of high-frequency amplification and a detector, Forth Worth, Kansas City, St. Louis, and Minneapolis were heard regularly with head 'phones.



Wiring diagram of a 3 valve Neutrodyne receiver composed of two stages of tuned radio frequency amplification and detector.

THE ELECTRICAL THEORY OF MATTER

By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Some of the most fundamental discoveries in physical science have been made during the past few years, largely by Sir J. J. Thomson and Sir E. Rutherford and co-workers at the Cavendish Laboratory, Cambridge, in their researches on the conduction of electricity through gases and the phenomena of radioactivity. The evolution of the wireless valve is directly bound up with this work, which will undoubtedly have further important bearings upon wireless in the future.

Dr. Roberts, who has investigated these problems at Cambridge and has collaborated with the eminent physicists mentioned above, is well known for his published researches on thermionics and acoustics. In this series of articles he is giving a simplified account of the remarkable insight which science has gained of recent years into the nature of Matter and Electricity.

PART II.—CONDUCTION OF ELECTRICITY THROUGH GASES AND LIQUIDS

(Continued from No. 3, page 172.)

Conduction Through a Gas

THE mode of conduction of electricity through a gas differs in many important particulars from that in a solid conductor. For the convenient study of the gaseous conduction of electricity it is desirable that the gas shall be reduced to a pressure of only a small fraction of that of the atmosphere: suitable conditions for the investigation are not likely, therefore, to be met with in nature, but require to be artificially created. The Geissler and such-like discharge tubes, until perhaps thirty years ago, were regarded as scientific toys, and it was little suspected that within the almost evacuated interior of such a tube intimate secrets of the nature of matter and electricity were to be revealed.

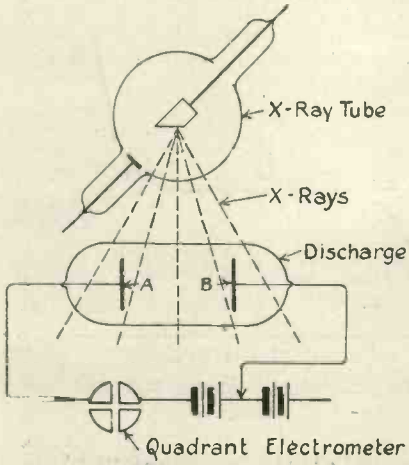


Fig. 1.—Illustrating conditions for studying current through gas at low pressure, ionised by X-rays.

Mechanism of Gaseous Conduction

It was explained in the first article of this series, when dealing with the construction of the atoms and molecules of matter, that in its normal "satisfied" condition the molecule is electrically uncharged or neutral. Such an uncharged molecule is incapable of assisting directly in the flow of the electricity; it would be impossible to pass an electric current through a gas whose molecules were all uncharged. The first essential is the presence in the gas of the electrified particles which result from the disorganisation of atomic structures and which are called "electrons" and "ions." There are various influences which may cause the separation of atoms into ions and electrons, but for the moment it will be convenient to postpone the consideration of these ionising influences. We will suppose that we have a quantity of gas, at a low pressure, enclosed in a glass vessel, two plates or electrodes being immersed in the gas as shown in Fig. 1, and that a steady ionising influence is at work (such as the rays from an *X*-ray tube), producing a few ions per cubic centimetre of the gas per second.*

Under ordinary circumstances, when no potential difference exists between the electrodes, the ions and electrons produced will wander about among the molecules of the gas, and when two oppositely charged particles meet, they will usually recombine to form a neutral system.† It will be evident

* The number of ions produced in a gas, even under intense ionisation, is small compared with the number produced in electrolysis, and the current which can be conveyed through a gas under ordinary circumstances (saturation current) is exceedingly small, perhaps 10^{-12} to 10^{-10} amperes.

† If the pressure of the gas is greater than a few mm. of mercury, the electrons usually attach themselves to atoms or molecules and form negative ions. Gases like oxygen, whose atoms have external shells incompletely filled by electrons, certainly acquire these wandering electrons, but inert gases apparently do not. At low pressures the negative particles consist of electrons unattached to atomic systems.

that a steady state will be reached when there will be present, at any instant, a certain definite number of ions and electrons in the gas, the rate of recombination being equal to the rate at which the ions are being produced by the ionising influence.

If a small potential difference be established between the plates the electrons, in addition to their haphazard motions which arise from their collisions with the molecules of the gas, will be given a directed motion or drift towards the positive plate, whilst the positive ions will be given similarly a component of velocity in the direction of the negative plate. Since negative electric charges are being delivered up at the positive plate and positive charges at the negative plate, there is a flow of current through the gas.

TABLE I.

VELOCITY OF IONS IN AN ELECTRIC FIELD OF 1 VOLT PER CM. AT ATMOSPHERIC PRESSURE.

Gas.	Velocity of Ions in cm./sec.	
	+ve ions.	−ve ions.
Air (dry)	1·36	1·87
,, (moist)	1·37	1·51
Oxygen (dry)	1·36	1·80
,, (moist)	1·29	1·52
Hydrogen (dry)	6·70	7·95
,, (moist)	5·30	5·60

Recombination of the ions and electrons is still taking place in the gas, but some of the electrified particles are now being drawn out by the action of the electric field before they have time to recombine, and the number of electrified particles which reach the two electrodes per second, together with the number which recombine in the body of the gas per second, will be equal to the number which are produced per second by the ionising influence. If the potential difference between the electrodes be increased, the component of velocity of the particles towards their respective plates will be correspondingly increased, a greater proportion of the particles will be drawn out from the gas, and a smaller proportion will recombine; the current through the gas will therefore be greater.

It has been found that under these circumstances the gas approximately obeys Ohm's law, as shown in Fig. 2 (AB). As the P.D. between the plates is further increased, however, there comes a point beyond which further increase in the electric field is not accompanied by any increase in the current. When this point is reached, it means that all the electrified particles which are being produced in the gas by the ionising influence are being drawn out to the electrodes by the electric field before they have time to recombine. This current is called the "saturation current"; evidently the saturation current will be greater the more intense the ionisation.

The amount of ionisation produced in the gas will depend, in general, upon the volume of the gas; and since the saturation current between the plates depends upon the amount of ionisation produced per second in the gas between the plates, it follows that if we use a potential difference great enough to produce saturation, the current through the gas will be *diminished* by diminishing the distance between the plates, keeping the P.D. constant. This result is in remarkable contrast to that which is observed with solid and liquid conductors, where the current would *increase* for a given P.D. with diminution of distance. Under a small potential difference, however, much less than that required to produce saturation in a gas for any given distance, the three classes of conductors would behave in the same way.

The foregoing is a simple account of the

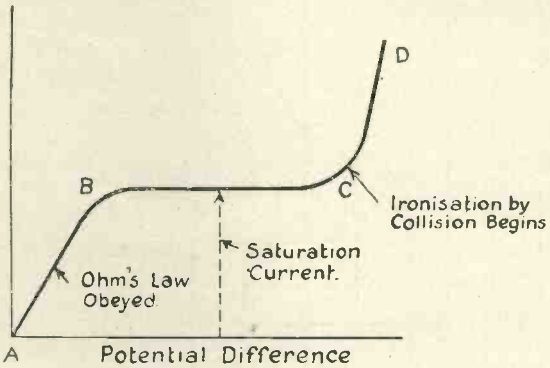


Fig. 2.—Relation between P.D. and current through a gas.

mechanism of the conduction of electricity though a gas; the important point to be observed is that no conduction can take place in the absence of some ionising agency which will provide the electrical particles or carriers of the current.

Ionisation by Collision

If the potential difference between the electrodes be still further increased the electrons, under the more intense electric field, may acquire so much energy between successive collisions with the molecules of the gas that the collisions result in the loss of electrons from the atomic systems of the molecules. If this happens, an original electron has caused the appearance in the gas of another electron and a positive ion; these at once commence to drift in their proper directions under the electric field, and they may acquire sufficient energy to produce further electrons and ions at their next encounters, and so on. The process now taking place is known as "ionisation by collision," and it will be evident that owing to this "snowball" action the total ionisation in the gas will increase with great rapidity.* The curve showing the relation between the P.D. and the current through the gas, when ionisation by collision sets in, is given in Fig. 2 (CD). This phenomenon is, in fact, what is commonly known as "electric discharge" or "sparking." When the sparking potential is reached, both the positive and negative carriers begin to ionise by collision. The mean potential gradient required to produce sparking is approximately proportional to the pressure of the gas; in air at atmospheric pressure it is about 30,000 volts per cm. and in air at 1 mm. pressure about 40 volts per cm.

Ionising Potential

The potential difference through which an electron must fall in order to acquire sufficient kinetic energy to ionise a molecule of the gas by collision is known as the "ionising potential" of the gas; for many gases it is of the order of 10 to 20 volts.† The actual distance which an electron must travel in the direction of the electric field in order to acquire a given kinetic energy will depend upon the potential gradient or space-rate of variation of potential. If it is to produce ionisation by collision, it must acquire this energy between successive collisions, and since the mean free path is inversely proportional to the pressure of the gas,‡ it follows that the potential gradient in the gas necessary for the production of ionisation by collision will be enormously greater at atmospheric pressure than at the very low pressures obtaining in discharge tubes. The potential gradient at any point in a gas through which a current is flowing is not necessarily given by the P.D. between the plates divided by their distance apart. When a discharge is taking place, the potential gradient may vary very considerably at different parts of the tube, as shown in Fig. 3.

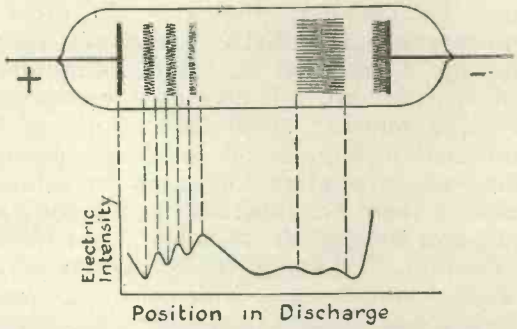


Fig. 3.—Showing variation of electric intensity at different points of a discharge tube when discharge (ionisation by collision) is taking place.

A considerable amount of experimental work has been done in the exploration of the electric field existing between the electrodes under these circumstances.

The amount of energy which must be acquired by an electron to ionise by collision a normal atom or molecule depends upon the stability of the structure of the latter. The ionising potential required for the disorganisation of a stable atom, such as that of helium or any other inert gas, will be greater than for the atom of an electropositive element such as sodium, where the electronic system of the atom is qualitatively unsatisfied and will readily part with an electron for the sake of greater stability. The ionising potential, in fact, depends upon the electronic configuration of the atom or molecule in much the same way as does the chemical valence.

The following table shows an interesting case of the mean potential gradient necessary to produce a spark between two metal spheres 9.76 cms. radius in air at atmospheric pressure; it will be noticed that the potential gradient is greater for very small distances.

Ionising Influences

Any influence or agency which is able to disturb the planetary electron system of an

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* The number of molecules in a c.c. of air at 0° C. and 760 mm. pressure is $2 \cdot 7 \times 10^{19}$; at the highest attainable vacuum (about 10^{-4} mm.) the number is about 10^{-12}. The number of collisions made by a single molecule at atmospheric pressure and 0° C. is 6×10^{9} per second

† The velocity acquired by an electron falling through 20 volts is about $2 \cdot 7 \times 10^{8}$ cm./sec. (or about 1,600 miles per sec.), which is enormously greater than the velocity of agitation of molecules. The agitation velocity of a molecule of oxygen at 0° C. is $4 \cdot 25 \times 10^{4}$ cm./sec., or ¼ mile per second.

‡ The mean free path in air at 760 mm. pressure and 0° C. is $7 \cdot 6 \times 10^{6}$ cms. or three-millionths of an inch. The mean free path in a discharge tube may be several cms.

TABLE II.

Spark Length (cm.).	P.D. (Electro-static units).	Mean Potential Gradient.
0·0066	2·63	399
0·011	3·36	320
0·1	15·00	150
0·56	63·70	114
1·07	110·78	104

atom, so as to shake out an electron, constitutes an ionising influence. In order to produce an appreciable saturation current through a gas (that is, before ionisation by collision sets in), it is necessary to employ an artificial ionising agent such as the *X*-rays indicated in Fig. 1. It is always possible, however, to produce ionisation by collision, because there are invariably a few ions produced in the gas by so-called "spontaneous ionisation." This is really due to natural ionising influences, of which there are many. Radioactive transformations* are always going on within the earth, and the rays emitted act as ionising agents, particularly in the vicinity of the radioactive substance. Gamma rays also are able to produce ionisation even at a considerable distance from their source. The light from the sun, particularly the ultra-violet portion of the radiation, which is closely allied to *X*-rays, is another important cause of "spontaneous" ionisation. Ions are also produced in large numbers by flames, and hot bodies generally.

It may be mentioned that when a current begins to flow through a gas and ionisation by collision has set in, the electrified particles may produce further ions by other means than their collisions with the molecules of the gas. For the disturbances produced in the electron system of atoms, whether those disturbances result in ionisation or not, may give rise to the emission of radiation from the atoms, some of which lies beyond the ultra-violet region, and this radiation may again cause the ionisation of easily ionised atoms upon which it falls. Further, the impact of the ions upon the electrodes may be sufficient to disrupt the atomic systems of the material of the plate and so give rise to further supplies of electrons.

* There are certain substances whose atoms are in the "dissatisfied" condition mentioned in the last article, and these occasionally emit both positive ions and electrons from the nucleus. These positive ions consist of ionised helium atoms and are known as alpha rays; the electrons are called beta rays. The ejection of these electrified particles causes a radiation to be emitted, known as gamma rays, which are similar to *X*-rays. All these three kinds of rays may produce ionisation in a gas. The transformations of radioactive atoms will be more fully considered in a subsequent article of this series.

Conduction through Liquids

It was mentioned in the last article that certain substances, on solution in a liquid, will dissociate into ions, the example given being that of sodium chloride. A considerable number of chemical compounds dissociate in this way and are known as "ionogens" or "electrolytes." If electrodes are immersed in the liquid and a potential difference established, the ions will commence to drift in appropriate directions

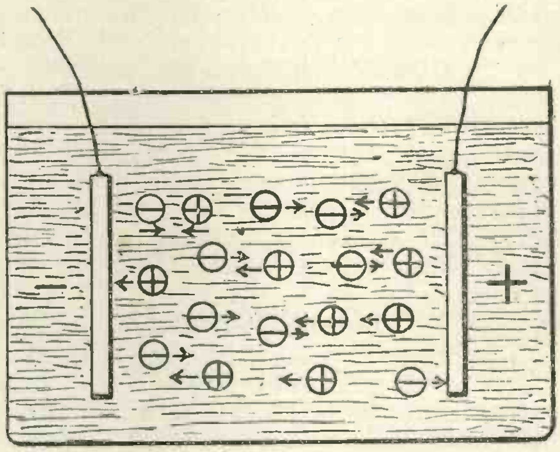


Fig. 4.—Simple illustration of electrolytic conduction through a liquid.

under the electric field, and the mode of conduction of electricity through the liquid is similar to that which has been described for a gas before the phenomenon of ionisation by collision has set in.

The substances known as electrolytes can be divided into three classes. The first of these, which are known as *acids*, give as one product of the dissociation positively charged ions, which are known as hydrogen ions (+H), and which are, in fact, protons. This will be evident since the hydrogen atom consists of one proton and one electron. An example of such an electrolyte is hydrochloric acid, HCl.

(The Editor regrets that owing to lack of space the remainder of this article is unavoidably held over until next issue.)

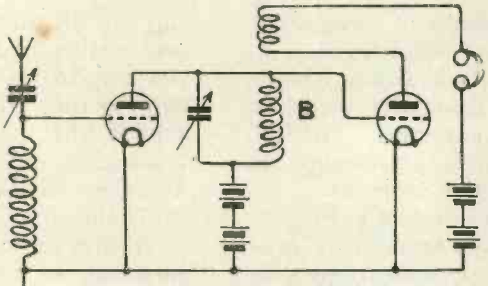
A DISCUSSION ON PRACTICAL BROADCASTING

At a recent meeting Mr. Shaugnessy, of the Wireless Engineering Department of the Post Office, opened a discussion on practical broadcasting at which a large number of experts were present, including several members associated with the work of the British Broadcasting Company.

In his opening remarks Mr. Shaugnessy gave an account of the development of broadcasting in America and read extracts from some of the American official reports on the broadcasting situation. According to such a report in 1922 it was recommended that, owing to the difficulties arising from the small number of available wavelengths, inter-communication should only be made by wireless as a last resort, that is to say, wherever possible, communication should be made by land lines and the broadcasting should finally be adopted at a number of isolated points. It was also recommended that advertising should be limited entirely to an announcement of the name and call-sign of the broadcaster.

In a similar report issued in New York in 1923, it was stated that a great deal of trouble had arisen owing to overcrowding on the available wavelengths and competition between various broadcasting stations. It was frequently found that a large and powerful station, well-equipped for providing an extensive broadcast programme, would be asked to give way at certain times to a comparatively insignificant and ill-equipped station which could not possibly provide an adequate substitute for the former. The American report concludes by pointing out very strongly the desirability, if not the necessity, for unifying the control of broadcasting in America, both as regards the practical and the financial management.

Mr. Shaugnessy drew a parallel between the position in America and that in this country, and argued therefrom the desirability of similar unity of control in Great Britain. He also made some attempt to meet and discuss the many criticisms which have been levelled at the British Broadcasting Company and at their conduct of the broadcast arrangements. He described in some detail the method adopted by the Post Office experts for the testing of wireless sets before approval and before the affixing of the official B.B.C. stamp. The sets are tested by connecting to a 100ft. aerial, and listening-in is effected upon another 100ft. aerial at a distance of 100ft. away. The receiving set connected to the second aerial is a one-valve set using reaction followed by 2 valve L.F. amplifiers and it is considered that if the set under test gives no detectable effect under these circumstances it may be regarded as harmless. The Post Office does not allow the use of adjustable reaction in amateur receiving sets on the aerial circuit, only fixed reaction being allowed which, according to Mr. Shaugnessy, is useless.

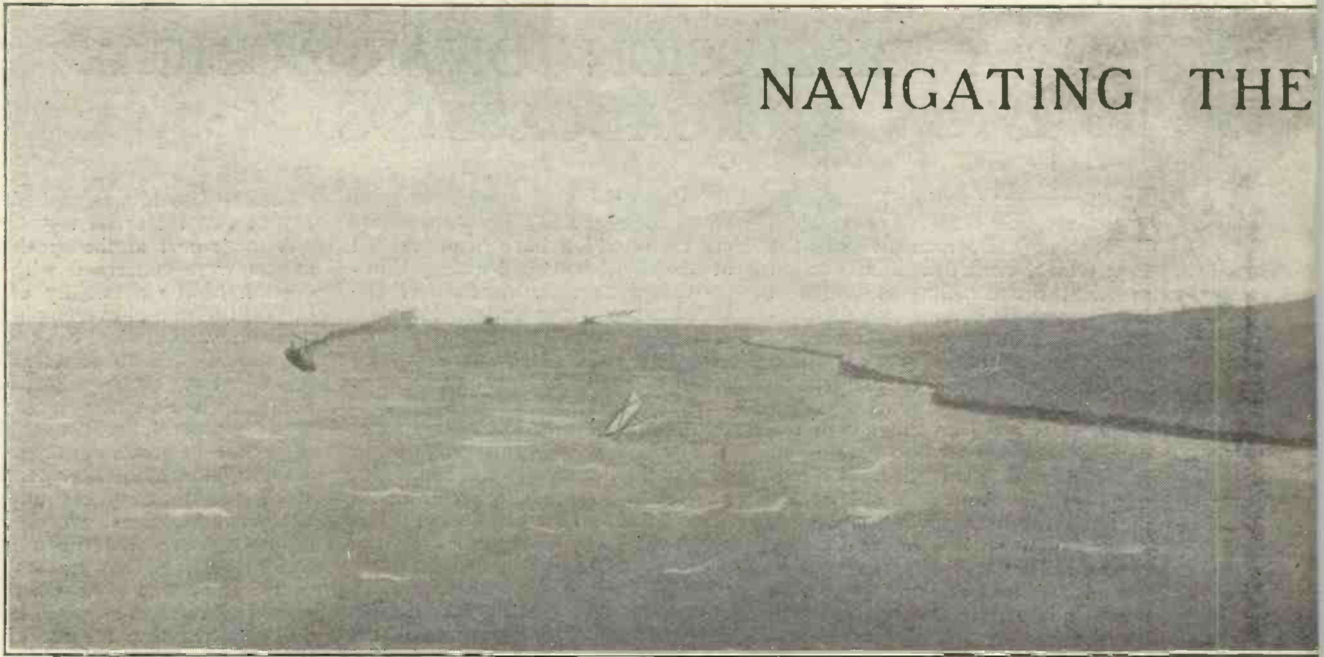


The questionable circuit referred to in the discussion.

The speaker had some hard things to say of the holders of experimenters' licences, and in support thereof he gave a harrowing account of a recent visit which he made to Bristol where, after delivering a brilliant lecture, he was about to demonstrate an elaborate receiving set tuned in for receiving Birmingham. Instead of Birmingham he received a vast amount of screeching and howling, which he attributed to the reaction of the Bristol experimenters. In this connection he gave a rather illuminating definition of an experimenter when he referred to him as anybody "able to put two tin tacks together."

A large part of the speaker's remarks were concerned with a discussion of the possibility of avoiding confusion and overlapping when using the very limited band of wavelengths allotted to broadcasting in this country. Some people, he said, complained that the transmission was too powerful whilst other complained that it was not powerful enough, and the speaker pointed out the great difficulty encountered in attempting to please everybody. He strongly deprecated the use of reaction, stating that it was wholly unnecessary and that where extra sensitiveness was required it should be obtained by means of extra valves. An interesting point which was brought out in this connection was that in many cases sets are submitted to the Post Office for inspection and approval and are turned down because they cause aerial oscillation: the makers then in some cases submit the simple circuit shown in the accompanying figure, and protest that oscillation is impossible in such a circuit. According to Mr. Shaugnessy, however, although no interaction is intended on the part of the manufacturers, the conditions are not necessarily wholly disclosed by the circuit diagram. If certain parts, for example the inductance coils A and B, are placed in certain relation to one another in the assembly, reaction may take place between them and so cause aerial oscillation even though the circuit diagram is a most innocent-looking one.

In conclusion, Mr. Shaugnessy stated that the Post Office, although they had by some been accused of adopting a "dog-in-the-manger" attitude, were most anxious not to adopt any such attitude. They were out, he said, to help the experimenter in every way they could, and provided the experimenter would take care to act strictly in accordance with the conditions of his licence, he would receive every sympathy and assistance possible.



NAVIGATING THE

WITH the development of sensitive and accurate wireless direction-finding apparatus, the problems of navigation in the air have been greatly simplified.

The pilot of an aeroplane (or airship) is no longer entirely dependent upon the accuracy of his compass observation and "drift" calculations affording him a knowledge of his position at any particular moment.

When flying at only a moderate height, observation of land-marks is sometimes prevented by the light haze which frequently prevails, so that, in the not unlikely event of a change of wind direction or strength, reliance upon the compass alone may cause the pilot to fly, quite unknowingly, several miles out of his course.

The installation of a compact radio-telephone transmitting set in the aeroplane, and the establishment of two or more ground stations, each provided with direction-finding apparatus and inter-connected by land-line telephones, one station also being equipped with radio-telephone transmitting apparatus, enables the pilot of any aircraft within range to ascertain either his bearing or his exact position with ease and promptitude.

Radio-telegraphy was originally used in this connection, but with the advent of reliable and easily operated radio-telephone apparatus, the telegraphic method, with the attendant necessity for the aeroplane pilot being a telegraphist, was soon displaced.

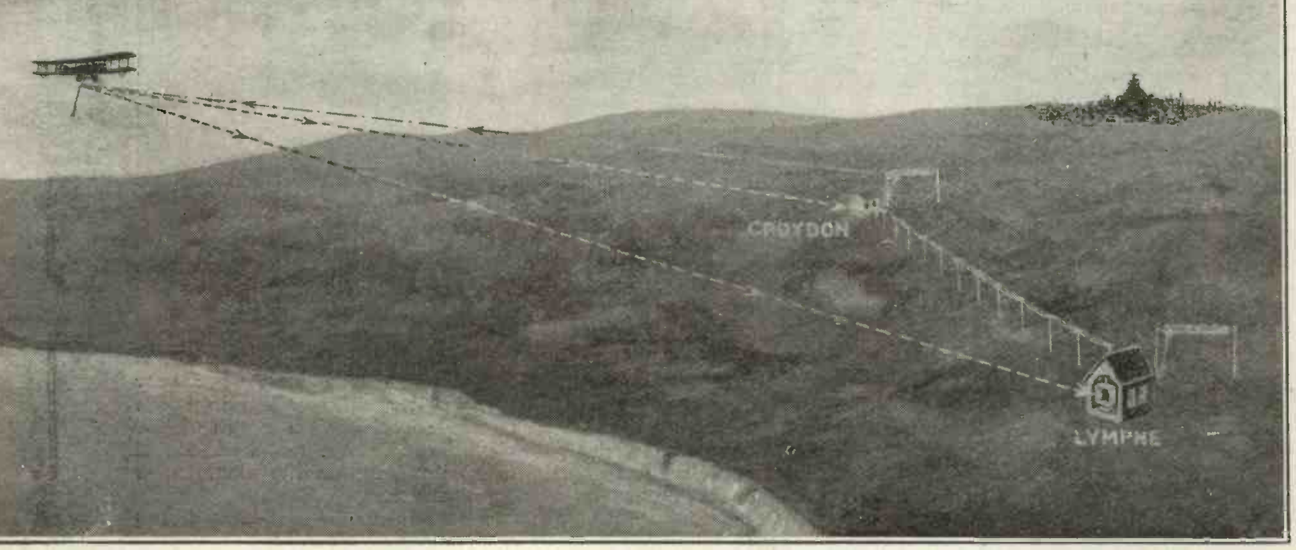
Suppose the pilot of a commercial aeroplane having crossed the Channel is proceeding in the direction of Croydon aerodrome and wishes to ascertain his "bearing" from the aerodrome—information which will indicate to him whether he is steering a correct course—he merely switches on his wireless apparatus, calls up the Croydon Aerodrome Wireless Station, and requests the desired information.

Whilst the conversation is in progress, the direction of the incoming waves is rapidly determined by the operator at the ground station, and in a remarkably short space of time the pilot is informed that his bearing from the ground station is, for instance, 152 degrees, or alternatively, he is instructed to steer a course on 332 degrees. This latter figure represents the bearing of the aerodrome from the aeroplane, one bearing being the reciprocal of the other, and being reckoned in degrees from 0° (magnetic North) clockwise to 359°.

By the foregoing method, all that can be determined is the "line of bearing," and, except for an approximate idea obtained by noting the strength of received signals, the pilot cannot tell his actual distance from the aerodrome.

As a matter of fact, there is a possibility of error amounting to 180 degrees in the bearing as measured by means of the direction-finding apparatus at the ground station. All

AIR BY WIRELESS



that the apparatus determines is the "position line" of the source of the incoming waves, and as this "position line" passes right through the centre of the receiving aerial or loop the actual source of the waves may either be due North or due South.

In order to obtain what is termed a "fix" and so determine the exact position of the aeroplane at the moment when the measurements were made, two position lines are necessary, the "fix" being at the point of intersection of the two position lines.

The method adopted is illustrated in our drawing. An aeroplane is seen making its way inland and radiating from the aerial wire hanging beneath the machine a request for information as to its position. The request is received at two direction-finding stations, which are represented in our illustration by Croydon and Lympne, and at each station the "line of bearing" of the source of the wave is rapidly and accurately determined. The operator at Lympne does not communicate with the aeroplane, but passes on the result of his observation by land-line to the operator at Croydon, who "lays off" on a map the two position lines, notes the point of intersection, and immediately informs the pilot that he is "just over Tunbridge Wells" (for instance).

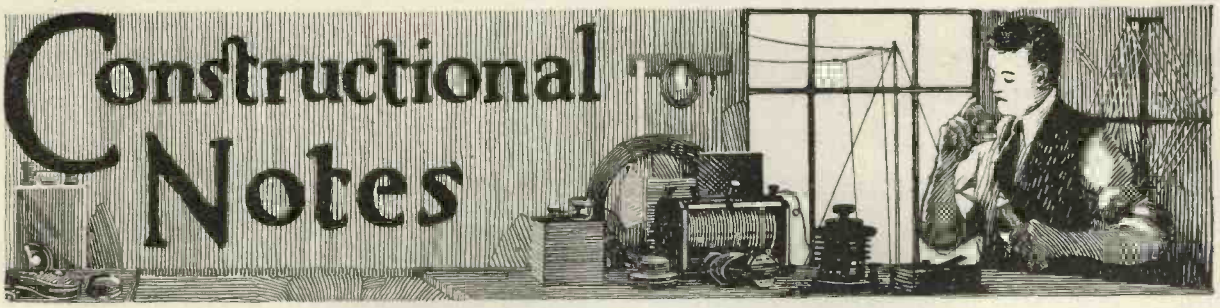
Although the operations take some time to describe, they can actually be performed with great rapidity, which is very necessary in view of the high speed at which the aeroplane will be travelling.

Nevertheless, it is surprising, when one appreciates what has to be done, to hear a wandering pilot calling out: "Hullo, Croydon. Where am I? I don't know where the deuce I am. Where am I?" and to catch the prompt response: "Hullo. Just a minute . . . You're over X——, steer on course 330 degrees."

The method of direction finding just described, and illustrated in our drawing, has the great advantage that no special direction-finding apparatus is required in the aeroplane, the full responsibility for the accuracy of the bearing, or position, resting with the ground stations.

The disadvantage, especially apparent during the recent war, is that an aeroplane ascertaining its position reveals its presence and position to any of the enemy's ground stations provided with direction-finding apparatus.

An alternative method, which overcomes this last-named disadvantage, is to fit special direction-finding apparatus in the aeroplane, by means of which the pilot is enabled to take wireless bearings on two or more ground transmitting stations (known as "beacon" stations), and can then work out his position for himself, the responsibility for the accuracy of observations in this case, of course, being with the pilot himself.



LOOKING AFTER ACCUMULATORS

By R. W. Hallows.

THE acid used must be of the kind known as "pure brimstone," for the commercial variety is obtained by a process which leaves in it impurities harmful to the plates. If you mix the solution at home remember to add acid to water, which should be distilled and not taken from the tap: never add water to acid, or an explosion is likely to occur. Pour the acid in little by little, until the right strength is reached, and be careful to use a sound vessel for mixing, as a good deal of heat is produced during the process.

A new battery requires a long, slow charge in order that a perfect amalgamation may take place on the positive plates. Charging should be continued for some time after gassing has first been noticed. The accumulator should be brought into use as soon as possible, but directly the gravity of the acid has fallen to 1.17, or the E.M.F. to 1.8 volts per cell, it should be recharged, fresh acid solution being placed in the cells. After the second charge there is no need to change the solution so long as its gravity remains correct, though a little water may be required from time to time to make good the losses caused by the flight of oxygen and hydrogen molecules during gassing.

Do not overwork a new accumulator; a safe rule is not to let the discharge-rate exceed one twentieth of the *actual* ampere-hour capacity for the first few weeks. Thus an accumulator, whose actual capacity is 50 ampere-hours, should not be used for heating the filaments of more than five valves of the Ora type, each of which consumes about .5 ampere, or three of the kinds which require three-quarters of an ampere.

One of the worst foes of the L.T. battery efficiency is the phenomenon known as "Sulphating." A certain amount of lead sulphate is normally formed on both sets of plates during discharge, as we have seen. But under certain conditions violent action between acid and lead may take place, with the result that a hard white coating appears on the plates, rendering the battery almost useless. Sulphating may be caused by having an acid solution that is too strong or too weak, by discharging at too high a rate, by letting cells run down to too low a voltage, or by allowing them to remain for some time in a discharged state. Avoid these things, then, if you would keep your battery in good condition and give it a long life.

Other points to notice are that plates may bend or "buckle" if the accumulator is short circuited, or if it is worked over hard, and that terminals, unless kept greased, are liable to be attacked by acid fumes. When terminals become corroded contacts cannot be good, and one faulty contact in the L.T. circuit is sufficient to account for all manner of noises in the telephones.

One last tip: when buying an accumulator see that there is plenty of space between the bottom edges of the plates and the celluloid case. The positive plates disintegrate as time goes on and particles fall to the bottom, forming a brown sediment. If there is not sufficient clearance this sediment may ruin the accumulator by causing a short circuit.

SOLDERING HINTS AND TIPS.

THE soldering called for in making wireless apparatus is of such an easy kind that anyone can undertake it after a little practice. People are rather apt to "funk" it and to take their jobs to a shop to be done, but there is really nothing in it to shy at, so long as a few simple tips are borne in mind.

The first thing to remember is that solder will not adhere to dirty or oxidised surfaces: therefore, whatever the job may be, always begin by cleaning up the surfaces to be joined with a piece of fine emery cloth. Don't try to use a large iron at first. A small one grows cool rather quickly, but it is vastly easier to handle. For very fine work a most useful iron can be made by driving a length of ¼in. copper rod into a tool handle and filing its end into the shape of a screw-driver.

Before it can be used a soldering iron must be "tinned." To do this heat it in a blow lamp or a gas ring until it is just hot enough to melt solder, then dip it into a little resin or fluxite in which some small pieces of solder have been placed, and work it about until the copper is covered with a bright layer of tinning.

Never heat your iron in the fire. If you do so you will find soldering difficult, for its surface is made dirty by contact with coal and ashes. A gas ring answers splendidly. Don't overheat the iron, or the tinning will be burnt off; but get it hot enough by leaving it in the gas flame until the coloured flames referred to above appear.

One of your first experiments may be to solder a wire to the shank of a terminal. Having cleaned both properly and applied fluxite, hold the wire in place with a pair of pliers; take a little solder from a stick with the iron and apply it to the joint. The flux fizzes for a moment, then a little blob of solder runs on to the metal, and as soon as it has set a firm joint is made.

At first you will feel that two hands are a quite inadequate allowance, but very soon you will be wielding the soldering iron with confidence. Your early efforts will not result in particularly neat joints, for you will somehow manage to deposit far too much solder. The excess, however, can be cleaned off with a file. Whenever possible make use of the process known as "sweating." Let us suppose, for example, that you wish to solder a strip of brass to a nut. Tin the surfaces of both by running a little solder on to them with the iron, then place them together and hold in the gas flame with pliers until the solder runs. This is much easier than the ordinary method, and it makes secure joints.

Don't use "killed spirits" for electrical work. The acid has a strong action on the copper, and unless you can remove all traces of it the metal will corrode badly as time goes on. Resin or fluxite are perfectly safe and have no after effects. Don't imagine that a great deal of solder makes a firm joint. The thinner the skin of solder you apply the better it will stick.

MAKING A TELEPHONE DISTRIBUTING PANEL

NOW that broadcasting is so popular, many wireless enthusiasts wish to employ several sets of 'phones, so that more than one person can listen-in at once. Most sets are provided with terminals for one pair of 'phones only, and the fixing, say, of three pairs of telephones to these sets is often unsightly, and at the best a makeshift arrangement. The panel about to be described obviates these difficulties and allows the 'phones to be easily plugged in and out. The one described is made for three pairs of 'phones, though, of course, it can be extended to accommodate any number. For the plugs and sockets the fittings sold as valve pins and sockets are used—they are very suitable and can be bought quite cheaply from many advertisers in this journal. Typical ones are shown in Fig. 1, though they often differ slightly in appearance.

The baseboard is best made from ebonite, though hard wood will serve if well dried and given several coats of shellac varnish. The dimensions may be altered to suit the convenience of the maker, those shown in Fig. 1 giving a rough idea of the size. There should be a space of at least 1in. between each socket—if wood is used it is better to increase this to 1½in. Holes are drilled in the base in the positions shown in the figure, those marked 1-6 being for the sockets, and the top holes for two terminals to connect the panel to the set. The six sockets and two terminals are then screwed to the panel and connections are made from top left to 1, 2 to 3, 4 to 5, and 6 to top right, by means of wires on the underside of the panel. These may be clamped to the legs of the sockets and terminals by means of extra nuts, or, better still, by soldering. To complete the panel, fillets of ebonite or wood are screwed to the underside of the panel so that any projections underneath are raised clear of the table on which the panel rests.

It remains to prepare the telephones for the panel. To do this, one of the valve pins is soldered to each of the tags of the telephone leads. If only two pairs are in use, one pair is plugged into sockets 1 and 2, and the other into 3 and 6. If only one pair is in use, it is plugged into 1 and 6. The two terminals are joined to the 'phone terminals of the set.

In this way it is quite a simple matter to plug in or remove any number of 'phones in the shortest time, without confusion. Of course, if a set is being built, the panel could be incorporated into it quite easily.

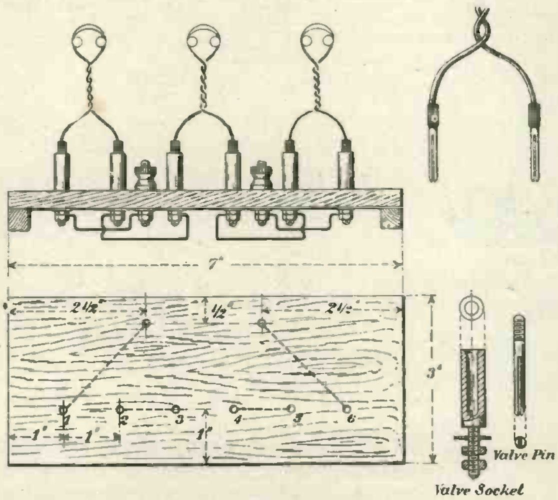


Fig. 1.

The use of valve pins and sockets can be extended to many parts of the set. If the pins are slack it is quite easy to open the prongs by inserting a screw-driver or knife between them. W. E. M.

TIPS ABOUT INSULATION

"DON'T spoil the ship for want of a ha'porth of tar" is a useful proverb. Translated into wireless parlance it reads: "Don't spoil the chances of the set you build by using poor insulating material." One sometimes sees fibre and hardwood recommended for the mountings of wireless apparatus, but neither of these is entirely to be relied upon, at any rate where high-frequency currents are concerned. These currents have one marked peculiarity—they travel not *through* substances but over their surfaces, thus giving rise to what is known as the "skin effect."

Both wood and fibre are hygroscopic, that is, they collect moisture very rapidly from the atmosphere. Now moisture is an excellent conductor of high-frequency currents, and when any material that insulates in its dry state becomes damp on the surface they will "creep" over it to an amazing extent. I had a remarkable illustration of this not long ago when using a crystal rectifier on a set consisting of two tuned anodes and a note-magnifier. At one moment, when the "cat-whisker" was making no contact with the crystal, signals were heard; a slight adjustment of the filament current of the second H.F. valve caused it to rectify, and the signals became strong. They were passing by a short-circuit through the mahogany base on which the detector was mounted!

When you are marking out ebonite for drilling, don't rule lines with a lead pencil. The graphite of which the "lead" is composed is a fairly good conductor, and these lines form high resistance leaks from terminal to terminal when the set is assembled. It is best to use a sharp-pointed scriber, and to be on the safe side it is as well to scratch a circle round each terminal. This breaks up the polished surface, which might otherwise allow a little creeping.

If your ebonite is very highly polished, take off some of its gloss by working it with the finest emery cloth lubricated with turpentine. It will then have a very much increased value as an insulator.

USEFUL TIPS IN CONNECTION WITH TERMINALS

MANY of the receiving sets now on the market are fitted with terminals which are horizontally divided. It is not always an easy matter to obtain a satisfactory grip on a wire with these, and the following wrinkles may be of value to those who have suffered in this respect.

Looking at Fig. 2, it will be seen that if the shank of the terminal is firmly gripped between soft jaws in the vice, a small flat may be filed on the centre rod at the point marked X, and in the centre of the flat a small hole may be drilled through the terminal. This must be as close to the base nut as possible, so as to avoid shearing the wire. A secure grip is thus assured on any wire passing through the hole.

If a hole is punched through the terminal strips of a flash lamp battery, and two such terminals as described above be inserted, a unit useful for many experimental purposes will be formed. (Fig. 2.)

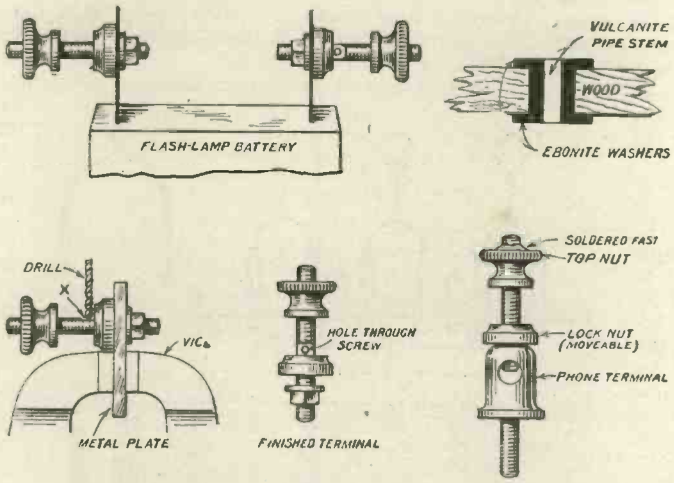


Fig. 2.

If troubled with the 'phone tags slackening, fit a lock nut to the terminals. If the existing screws are too short for this purpose, substitute a terminal with two movable nuts, the top one being soldered fast, the lower one acting as the lock nut.

File a flat in the end of the screw, which will then grip firmer than if rounded. (Fig. 2.)

Where terminals have to pass through wood, it is advisable to provide a bush of ebonite, and washers of mica or ebonite top and bottom.

For bushing, sections of vulcanite pipe stems will be found all that could be desired, the hole already provided, but being easily enlarged if necessary. (Fig. 2.)

The washers, circular or square, may be made from the ebonite of broken set-squares, this being of a very suitable thickness.

C. H. L.

WIRING UP PANELS

EVERYONE who has had a little experience of making wireless apparatus will have found, at some time or another, that circuits which work perfectly when hooked up anyhow on the bench are apt to give a good deal of trouble when assembled on or under the panels of a finished set.

The cause of this misbehaviour is to be found, as often as not, in the wiring. On the bench one has plenty of room, and leads can be kept well apart; but in the close quarters into which things must fit in the set connecting wires must frequently run very close together.

If any two conductors are separated by only a short space, considerable capacity may exist between them. Its effects are increased if they run parallel for any distance, or, if they are covered, for the insulating material provides an excellent dielectric. If the two leads belong to the same circuit, capacity will be added to that circuit with highly undesirable results for short-wave work; whilst, if they belong to different circuits, high-frequency currents may pass by capacity from one to the other and set up oscillation. In making up a panel, then, it is essential, if good results are to be obtained, to pay particular attention to the wiring. The golden rules are these: Keep all wires as short as possible; be careful that those from grid and plate in particular do not run parallel or close together; see that leads that must cross do so as nearly as possible at right angles; and do not increase capacity effects by providing a good dielectric.

The only system which enables all these things to be done is the bare wire bridging method, which is by far the best for all wireless purposes. Use stiff, uncovered copper wire of about No. 16 gauge, make your connections with bridges bent into shape on a wooden former, and solder all joints. Leave a clearance of half an inch between wires that cross. As the stiff wire "stays put," there is no fear of the short through leads coming into contact with one another.

Wiring done in this way makes the neatest possible job, and it adds considerably to the efficiency and the stability of the set.

R. W. H.

AN INSULATING VARNISH

A NUMBER of insulating varnishes have appeared on the market from time to time, each claiming some special merit. However, from the point of simplicity in preparation, and also to some extent cost, the experimenter cannot do better than employ an ordinary shellac varnish. The varnish should be prepared as follows. The shellac may be obtained from a chemist or colourman, either in the form of rough chips or small flakes, which are sometimes known as "button lac." The shellac should be broken up into small pieces and placed in a glass bottle having a wide neck. The final insulating properties of the varnish are dependent to a great extent upon the liquid used to dissolve the shellac. Methylated spirit contains a large amount of free water and, consequently, if this is used as the solvent a certain amount of water is sure to become incorporated with the article to which it is applied. It is advisable, therefore, to use absolute alcohol, which may be obtained from a chemist.

Sufficient spirit is added to cover the shellac, which may be dissolved with or without the aid of heat. If the solution is heated, great care should be exercised, owing to the liability of the evaporating spirit to "flash back," which might then cause a serious fire. It will be found that the spirit is soon soaked up, and more should be added in small quantities until all the shellac has dissolved. The resulting varnish will be very thick, but it is advisable to keep it in this condition, as it is always possible to thin it out afterwards by the addition of a little more spirit. It is a very good plan to keep two bottles of varnish, one thick and the other thin, since both are equally useful for various purposes.

A PROGRESSIVE UNIT RECEIVING SYSTEM

This forms the fourth part of our special series of articles dealing with the construction of a complete unit receiving system. Every issue will contain complete instructions for making or using another component part, and the reader will have at his disposal the whole organisation of Radio Press to help him. These articles are written by the Editor himself, and the apparatus described has been designed and fully tested. By carefully following out the instructions given, it is impossible to obtain disappointing results. Every piece of apparatus will be subsequently used when more ambitious sets are described.

PART IV.—APPARATUS FOR A ONE-VALVE RECEIVING CIRCUIT.

(Continued from No. 3, page 176.)

HAVING dealt with the necessary apparatus for a crystal receiver, it is proposed to give full details for the construction of a simple one-valve receiver. This receiver will use the valve as a high-frequency amplifier, a crystal detector being used to rectify the high-frequency amplified currents.

We will use all the component parts already made and also several more.

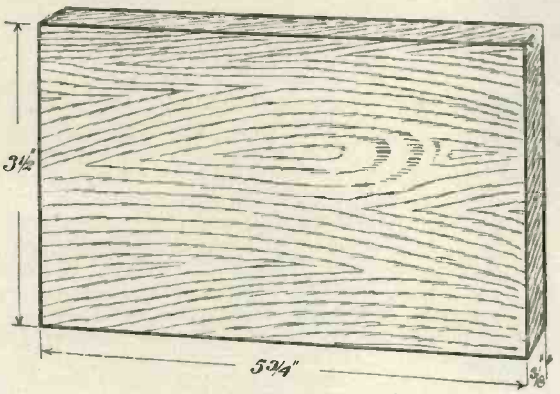


Fig. 1.—Giving dimensions of wood.

Additional Apparatus Required

We will require another 20-turn variable inductance, tapped at each turn as described in No. 1 of *Wireless Weekly.*

We will also require another variable inductance consisting of 100 turns tapped at every 20 turns, as described in No. 2 of this journal.

In addition to these extras we will need a valve panel, a high-tension battery, and a six-volt accumulator.

The Valve Panel

An essential unit in any valve receiving system is the valve panel, which is nothing more or less than a base-board on which is fitted a valve holder (fitted with four sockets to take the four pins of the valve), four terminals (one going to the grid, the other to the anode, and the other two to the filament), and a filament rheostat or variable resistance which is connected in one of the leads to the filament sockets to enable the current flowing through the filament of the valve to be varied.

Fig. 8 shows the completed valve panel, which may be made either in ebonite or wood. Ebonite, of course, is preferable, but as these articles are being written primarily for those who do not possess facilities for instrument work, the actual pieces of apparatus on which these notes are based have been made in wood.

Three pieces of wood are required. One is shown in Fig. 1, which gives the dimensions. Two ledges, dimensioned as in Fig. 2, are also provided, and these are secured, as shown in Fig. 3, to the end of the base-board, so that the latter is raised above the level of the table to enable the wiring, etc., to be clear. Fig. 3 also shows the holes which have to be made in the wooden base-board to allow terminals, valve holder, and filament rheostat to be attached to the baseboard.

The next step in the making of the panel is the attachment of four terminals, one at each corner. These terminals are preferably of the Army 4 B.A. type, although this, of course, is not important. Having fitted the terminals, the next thing to do is to screw down the valve-holder to the base-board. The actual type of valve-holder recommended is the kind shown in Fig. 4. A ledge is provided to

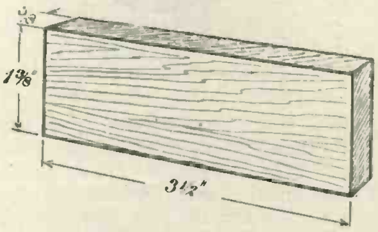


Fig. 2.—Giving dimensions of the ledge.

enable the holder to be screwed down to the base-board.

As shown in Fig. 3, a large hole is made in the base-board to allow the pins at the bottom of the valve-holder to pass through without touching the wood. The holder is then screwed down to the board. Instead of using the type of valve-holder shown in Fig. 4, any of the other kinds on the market may be used, but this type is to be preferred when using a wooden base-

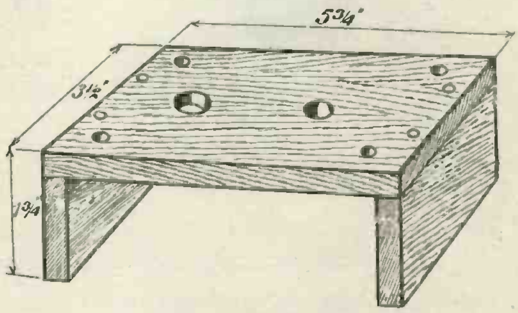


Fig. 3.—The Base-board.

board. If other types are used, there is a danger of leakage between the pins through the wood.

The valve-holder should be so arranged that the socket corresponding to the grid pin on the valve points towards the middle point between the grid and anode terminals, which are marked G and A in Fig. 5. Fig. 8 shows the arrangement of the valve-holder on the panel.

Having secured the valve-holder to the base-board, the filament rheostat should be screwed to the board in such a way that the knob projects above the board and the resistance below.

The rotary type of rheostat shown in Fig. 6 should be used,

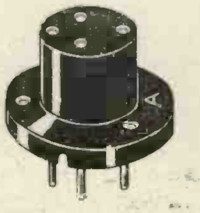


Fig. 4.—The valve-holder.

and it may be purchased from most of the advertisers in this journal.

Fig. 7 shows a cross section through the valve panel, and this figure illustrates how the rheostat and valve-holder are fitted to the base-board.

Fig. 8 shows the completed valve panel without the wiring.

Having fixed the terminals, rheostat, and valve-holder to the base-board, it is now necessary to wire up the panel. Fig. 9 shows a view from the top of the panel, the wiring, which, of course, is underneath the base-board, being shown in dotted lines. The reader should not confuse this view with an

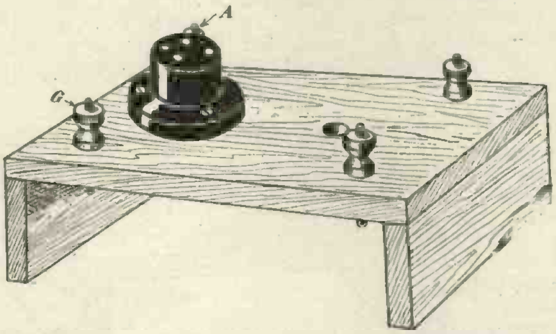


Fig. 5.—The valve-holder mounted on the base-board.

underneath view of the panel. It is a top view.

Fig. 10 is an underneath view of the panel showing the wiring.

The High-Tension Battery

The high-tension battery should preferably have a value of between 36 and 72 volts. Most valve circuits will work on as low a voltage as 36, but considerably louder signals are obtained when a higher voltage is used, in spite of the fact that valve manufacturers often specify, say, 45 volts as suitable for the valve they supply.

High - tension batteries may be bought made up in units of 36 with suitable tappings at every 9 volts. If, however, it is desired to make one's own high-tension battery, the first thing to do is to buy a number of flash-lamp batteries which consist of three cells each—the price of these batteries is quite reason-

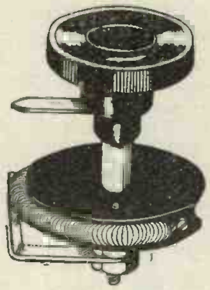


Fig. 6.—A rotary type rheostat.

able—and by connecting a number of them in series, it is possible to obtain the desired voltage.

Each flash-lamp battery gives a voltage of about $4\frac{1}{2}$, and if it is desired to have a high-tension battery of, say, 36 volts, one simply has to divide $4\frac{1}{2}$ into 36 and the result will be the number of flash-lamp batteries required. In the special case quoted, eight flash-lamp batteries will be necessary. If a voltage of 72 is desired, sixteen batteries will be more than sufficient to give the necessary E.M.F. It is, of course, necessary to allow for the batteries to drop in voltage as they are used.

We will assume that the high-tension battery is to have a value of about 72 volts. Sixteen flash-lamp batteries are bought and are arranged side by side in a wooden box, measuring internally $2\frac{3}{8}$in. wide by $2\frac{5}{8}$in. deep by 13in. long. Fig. 11 shows the complete high-tension battery.

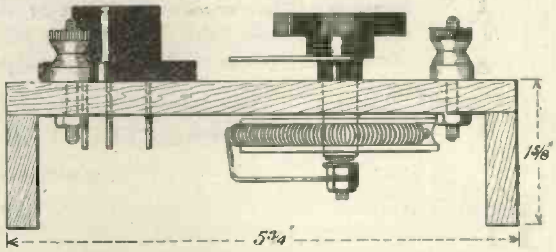


Fig. 7.—Cross section through valve panel.

The only points to notice are the terminals which are fitted at the end of the box. These terminals are not screwed into the wood, but are fitted to strips of ebonite screwed to the wood.

Fig. 12 shows in detail one end of the battery. It will be seen that a strip of ebonite S is placed across a rectangular gap in the end piece of the box. This strip is fixed to the end piece by screws passing through the ends of S. In the middle of the strip is fitted a terminal. The nut which secures the terminal at the other side of the ebonite strip S is connected to the positive terminal of the first flash-lamp battery. The positive strip of brass which acts as the terminal of the flash-lamp battery is nearly always the shorter piece, but the infallible test is to see which of the two strips of brass of the flash-lamp battery is nearest the outside. The one which is nearest to the end of the battery is the negative, whereas the brass strip which comes out of the battery about half an inch from the end is the positive terminal.

Before actually placing the batteries in the box, the latter should be carefully dried and then painted inside with paraffin wax, which should be allowed to soak into the wood. The process is facilitated by keeping the box warmed before a fire while the inside is painted with molten paraffin wax.

When the batteries are placed in position they should be so arranged that the positive terminal of one battery is next to the negative terminal of the other, and so on. The batteries are then connected in series, the positive terminal of the first going to one terminal of the complete high-tension battery and the negative terminal of that flash-

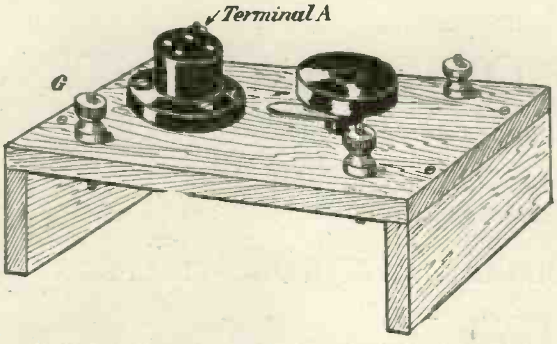


Fig. 8.—The valve-holder mounted with the filament rheostat.

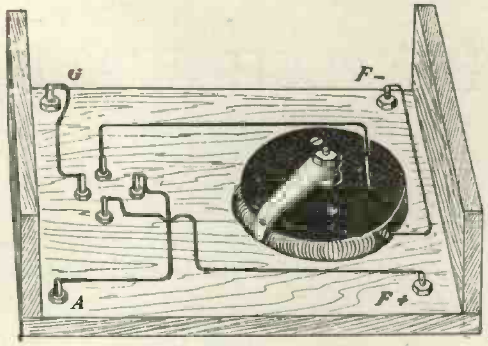


Fig. 10.—An underneath view of the panel.

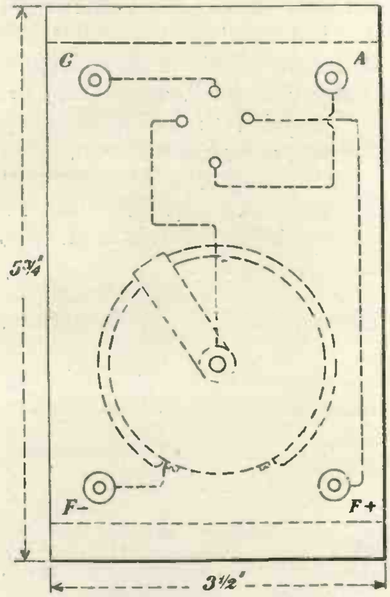


Fig. 9.—A view from the top of the panel

lamp battery being joined by means of a wire to the positive terminal of the next battery. The negative terminal of this latter battery is then connected to the positive terminal of the next one, and so on. The different batteries should be joined together by means of a wire soldered to the brass terminal strips.

The negative terminal of the last battery in the box is connected to the terminal at the far end of the high-tension battery box, this terminal being secured on the strip of ebonite as was done in the case of the other terminal.

(Next week: A Complete Combined Valve and Crystal Receiver.)

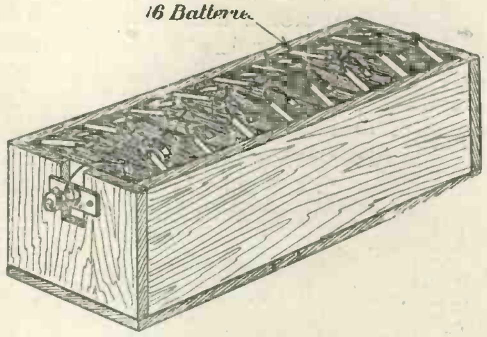


Fig. 11.—The H.T. battery.

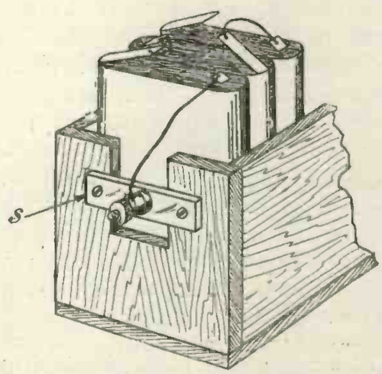


Fig. 12.—One end of the H.T. battery.

£250 PRIZE COMPETITION.

We regret that a slight error has crept into the circuit diagram of the receiver used in connection with this competition, as described in *Wireless Weekly*, No. 2, on page 124. It will be seen, referring to the potentiometer (300 ohms), that the far end of the potentiometer is not connected to anything, and that the wire from the detector valve filament passing near the free end goes to the H.T. positive terminal.

The wire from the filament of the detector valve should be joined to this end of the potentiometer and should go to the negative or common wire instead of to the H.T. positive. It is also stated that the filament control for the high-frequency valve should be fitted inside the case, and that for the low-frequency valve in the remote control. This should be reversed. It is also not clear that the coupling between the aerial and aperiodic coils may be varied if necessary. The adjustment, as pointed out, is normally fixed by means of a small screw, but for experimental purposes it is possible to move the two coils so that the coupling is altered. In connection with the transformers connecting the low-frequency valves, the wording of the description is such that there appears to be some special arrangement for giving the grids of these valves a definite negative potential.

THE TECHNICALITIES OF BROADCASTING

By P. P. ECKERSLEY, B.Sc., A.M.I.E.E., Chief Engineer of the British Broadcasting Co.

This article, the second of the series, deals with the special control circuits employed to meet the requirements of broadcasting.

PART II.—TELEPHONE CONTROL CIRCUITS FOR RADIO-TELEPHONY

(Continued from No. 2, page 96.)

Introduction

THE Patent Office has, I believe, had many patents filed for methods of telephony control for wireless telephony, and it is a remarkable fact that only two methods have really survived the searching tests of practical needs.

The two methods in question are familiarly known as choke control and grid control.

It might be well to summarise these two methods.

Choke Control

I do not wish to insult my reader's intelligence by giving too detailed a description of choke control, but I have found a certain amount of misconception exists as to the actual *modus operandi* of this arrangement.

In an ordinary "oscillating circuit" or high-frequency generator employing the valve, between limits, the high-frequency oscillations are directly proportional to the applied voltage. Thus, if the voltage applied to the oscillating circuit is varied in sympathy with the sounds to be radiated, a reliable and distortionless system of radio-telephony will be achieved.

Suppose, then, a steady voltage is applied to the oscillation generator, but that in series with this D.C. supply we connect the secondary of transformer the primary of which is energised by the voice alternating currents, then obviously the secondary voltages (alternating) will be superimposed on the D.C. steady supply.

Take Fig. 1. Here T is the transmitter and M represents a microphone for converting sound disturbances into similar electric disturbances. G is the source of D.C. supply, and superimposed on it will be the alternating current voltages in the secondary of T.

Now the whole point I am getting at is that if a power W is required to maintain the circuit LC in oscillation, then a power W must, assuming 100 per cent. efficiency, be absorbed in controlling these oscillations.

Thus if G is giving 1 kw. to maintain LC in oscillation, M must be capable of delivering 1 kw. to control the oscillations fully. Obviously, since T is a transformer and there is a steady voltage E applied by G, the actual voltage applied to LC must vary for full control between +2E and zero.

Now we have no microphone arrangement that will control, say, 1 kw. by just talking at it, and the usual circuit pertinent to this argument is shown in Fig. 2.

Here the microphone currents are amplified and an auto-transformer arrangement used.

Now from the above argument obviously the valves V must be capable of dissipating

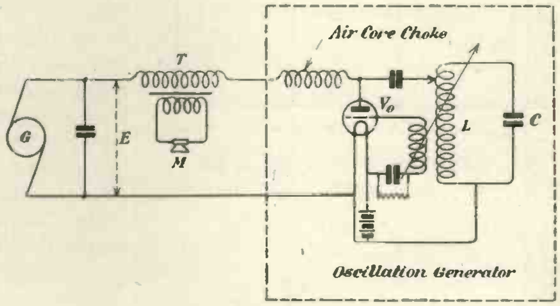


Fig. 1.—Simple choke-control circuit.

the same power at its anode as is supplied to the oscillation generator.

If 1 kw. is needed to maintain the circuit LC in oscillation, 1 kw. must be dissipated at the anode of V^c, and hence V^c must be capable of dissipating more watts than V, because V^c, the oscillating valve, only has to stand the losses in the oscillation generator.

This is an important point, and is often lost sight of in the design of choke-control systems.

Another Final Point on Choke Control.

If the ideal system as outlined above has been built up, it is obvious that the voltage variations applied to L C will vary between +2E and zero. This seldom happens in practice, and it would be inadvisable to arrange things in this way because a touch more control and "breaking" would occur, *i.e.*, the set would be stopped oscillating. But what is important is to see that the circuits L C and associated reaction coil are so adjusted that the oscillating currents are everywhere strictly proportional to the applied voltages. If, say, 2,000 volts are normally applied, it is no good if the set stops oscillating when these volts drop to 1,000. There should be, strictly speaking, oscillations in L C of Figs. 2 and 1 even if only 1 volt is applied, and if there are 2 amps oscillating current at 2,000 volts there should be 4 amps oscillating current at 4,000 volts. Many circuits give bad speech because of maladjustment of the high-frequency circuits.

Grid Control

The fundamental circuits of grid control are shown in Fig. 3. No one to my mind has really given a satisfactory explanation of how grid control really works. There is evidence to show that using the circuits of Fig. 3 much of the control is a wavelength control, but the control gets less and less effective the longer the wavelength.

Certainly, too, there is an amplitude control present. The whole action is involved, but one point is most noticeable, namely, that grid control as ordinarily applied gives a

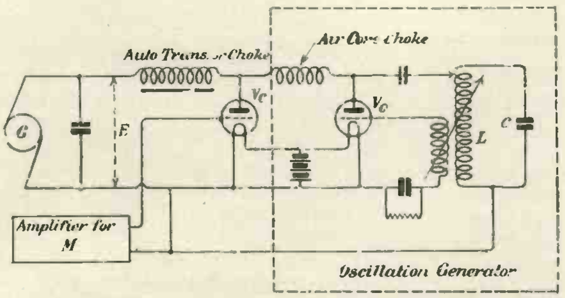


Fig. 2.—Choke-control circuit in which the microphone potentials are amplified.

"trigger control"—that is to say, energy does *not* have to be wasted in the control system anything like so much as in choke control.

The Needs of Broadcasting

The whole aim and object of the designer of a broadcast transmitter is to get perfect proportionality between the sound and the control of the radiation. It is obvious, then, that the ordinary grid control is no good at all, since the adjustment of the receiver in a wavelength control system will largely influence speech-quality and intensity. The broadcasting becomes more and more successful the more powerful and stable the transmitter, and hence the more robust and foolproof the receiver.

Choke control, then, though expensive and

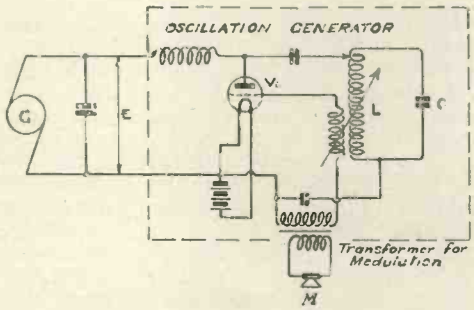


Fig. 3.—A grid-control wireless telephone circuit in which the microphone potentials are applied to the grid of an oscillating valve.

to an extent wasteful, is by far the most ideal method.

Only one proposal has been made for a trigger control that combines the above desiderata, and some trouble might be experienced in its application, although theoretically the method appears very feasible.

Forms of grid control might be used which combine robustness, deep modulation, and a constant wavelength, but it is probable that as much energy wastage in valves would be present as with choke control if precautions to obtain the above conditions were taken.

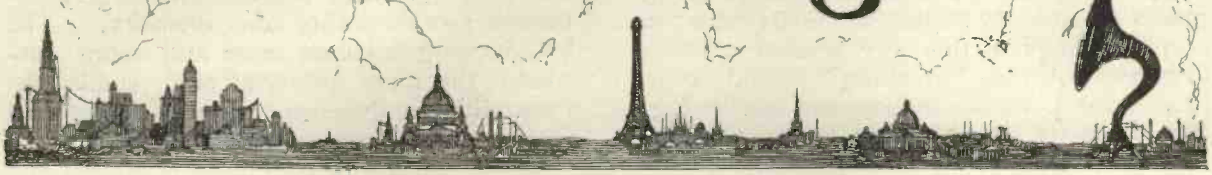
A Last Word

There is a form of control known as absorption control, which works by varying the "resistance" of a valve which has its anode and filament connected across the aerial tuning inductance.

As more and more positive is applied to the grid of the absorbers more and more energy is absorbed from the aerial, and a strictly proportional control may be obtained.

But—and here's the rub—there is a very heavy harmonic introduced in the radiation. Thus the method is open to objection on this score.

Broadcasting News



BY OUR SPECIAL CORRESPONDENTS.

THE P.M.G.'s speech in the House of Commons may be summarised briefly, "Much cry and little wool." After all the preliminary trumpetings in the Press, after all the posing as the champion of the people, and as their protagonist against monopoly, he promises to remit the applications for the experimental licences to a committee of technical authorities, and speaks of the appointment of another Committee to investigate the whole subject.

* * *

The poor constructor who was looking for a solution of his difficulties is left unprovided for. The B.B.C., to do them justice, were willing that a licence should be issued which would legalise the position of most of those who have constructed their sets; and it made some provision for those who wished to make their sets in future. Now everything will have to wait until the new Committee gets going. The B.B.C. instantly accepted the invitation to send a representative.

* * *

Mr. Rex. F. Palmer, Station Director of 2LO, has taken part in many a stirring episode in his time. He was air pilot to Mr. Lowell Thomas when that accomplished gentleman was in Palestine getting the material for his "traveloques." When in the course of a forenoon Mr. Palmer has about 25 artistes ringing up postponing or cancelling engagements, he thinks longingly of the good old days when he had nothing to do but bomb the Bosch, or bother the Bulgars, or terrify the Turks.

* * *

Amongst other things, Mr. Palmer is a B.Sc. of London University. He has specialised in acoustics, and he gets plenty of opportunity of increasing his knowledge of the subject—at the telephone, listening to the jazz maniacs, who, after some classical items, ask him to "cut out that sob stuff," or to the highbrows who, during the dance music, beseech him to give them some real music.

* * *

The Princess Alice was very gracious in accepting the offer to open the new women's hour, which is to be a feature of all the B.B.C. programmes. Some members of the Royal Family have declined on account of the publicity involved. So have some illustrious statesmen, needless to say, also from reasons of modesty.

* * *

It has been decided that the "women's hour" will be from 5 to 5.30 each evening. It will be all "talkee, talkee," about everything woman has an interest in, and there will be no music. It will be interesting to know if the women listeners-in will take this lying down. It will be so desperately hard listening to other women talking and never getting a word in edgewise, more especially when the lady at the transmitter end of the business says something obviously silly from the listener's point of view.

* * *

Perhaps if the monologue begins to pall a little, the B.B.C. will arrange to broadcast the chatter in Mrs. X.'s drawing-room what time a dozen ladies are going good and strong on the servant problem. If they could also broadcast the remarks of Mrs. X.'s guests when they get outside the door, that would be even more interesting.

* * *

The experiments which the B.B.C. made for receiving 2LO at Wembley were a brilliant success. The speakers were heard all over the Stadium with perfect clearness. The B.B.C. made a strong effort to get permission to broadcast a programme for the benefit of the crowds at the Cup Final, but the postal authority at the moment of writing is not favourable.

* * *

This is a pity, because the possibilities of this kind of broadcasting are almost limitless. It might be possible to broadcast music suitable to the play, when things were going slow and the players angling for a draw. "The Dead March" booming over the public would be very appropriate, and Rachmaninoff's celebrated "Prelude" would aptly express the feelings of the Totspur Rangers when their centre puts a penalty kick a yard over the bar.

* * *

May 20th will be a big day in broadcasting. The speeches which the Prince of Wales and Generals Foch and Haig will make to the British Legion at the Queen's Hall will not only be broadcast from 2LO, but will be relayed by landline to all the other stations and transmitted from these, so that all the country will have the pleasure of listening-in to the illustrious voices.

* * *

There will be 5 tons of canvas used in deadening the new studio of 2LO, so that the efforts to make it sound-proof should be crowned with success. No doubt the directors of the B.B.C. will hold their meetings there when the next Press "stunt" is on.

* * *

The new station director at Newcastle, Mr. Bertram Fryer, has quickly made hosts of friends in the North. His previous theatrical experience is standing him in good stead. There is no doubt that more than a touch of showmanship is necessary for a good station director.

* * *

The site of the new station in the South of England will soon be fixed. It is probable that both Southampton and Plymouth will be disappointed when the announcement is made.

* * *

The Glasgow Station continues to be heard over great distances, and many compliments have been received from Scotland as to the excellence of the programmes. Mr. Carruthers is proving an excellent station director, and he is a musician of the highest ability himself, and no man knows the musical taste of Scotland better.

* * *

Birmingham Station is also heard a surprisingly long way off, but the story of the ship's officer who received the Birmingham concerts all the way to New York and back again requires looking into. If that is the way ships' wireless installations are being used there is a neglect of duty somewhere, and an S O S call may be neglected.

* * *

The other evening there was a little competition at 2LO. A piece entitled "A Musical Switch" was submitted. It contains a few bars from exactly fifty pieces. The idea of the competition was to name as many of the pieces as possible. Four pieces were purposely left out of the selection. Some hundreds of competitors sent in replies, and five of them contained the whole fifty names. Now, how did they do it?

* * *

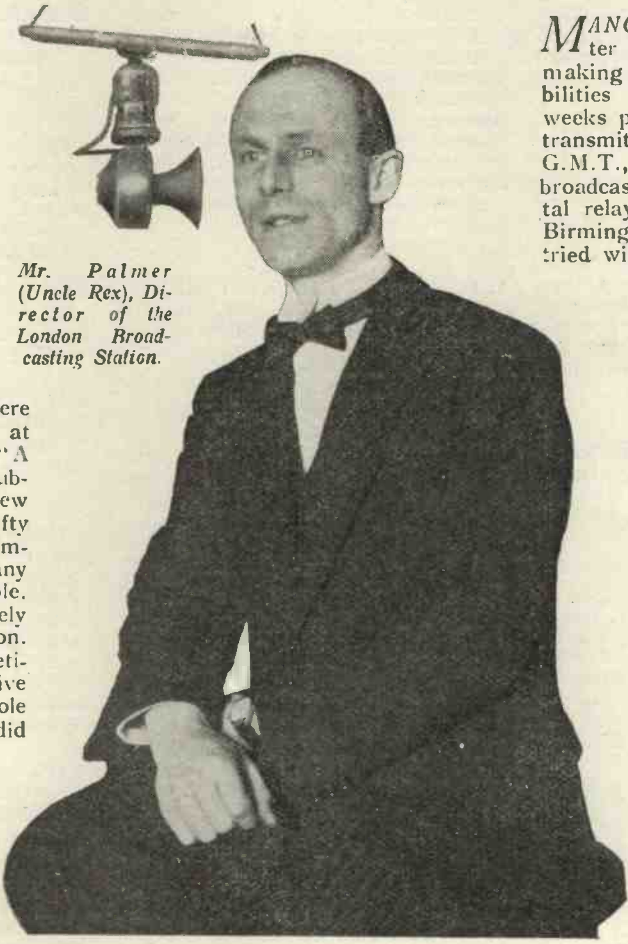
The Cardiff programmes continue to give great satisfaction, not the least attractive items of which are those which are written or composed by the station director, Major Corbett-Smith.

* * *

The station directors of the B.B.C. meet monthly in conference to exchange ideas and pool their experience. The next conference will be held in Manchester, where Mr. Wright has troops of friends.

* * *

BIRMINGHAM.—Important developments will probably take place at an early date in connection with the Birmingham broadcasting station. At the present time 5IT is housed in buildings belonging to the General Electric Co., at their Witton works, a distance of some four miles from the city. Artistes whose services are obtained for the nightly programmes have to make the slow journey to the distant suburbs. It is understood that arrangements are being made for the establishment of a studio in Birmingham itself, which will be linked up with the broadcast station at Witton.



Mr. Palmer (Uncle Rex), Director of the London Broadcasting Station.

BRISTOL.—Judging by the number of new aerials springing up, Bristol has a pretty severe attack of radio fever.

This is especially noticeable since the Cardiff station commenced operations. We learn that considerable interference is being caused in the district by amateurs who are abusing the principle of reaction. Cardiff is now received very well upon two valves, the alteration in the wavelength having minimised the interference from spark stations.

HULL.—Interest in broadcasting, and wireless generally, appears to be on the increase, but this district is rather at a disadvantage owing to its distance from the broadcasting stations. With Manchester as the nearest, and this over eighty miles away, it requires a three-valve set to give satisfactory results. The best reception appears to be obtained from 2LO, but "fading" is frequently troublesome.

* * *

MANCHESTER.—The Manchester station of the B.B.C. is making a special study of the possibilities of relaying. For some weeks past the Paris time signals, transmitted from FL at 10.45 p.m. G.M.T., have been relayed on the broadcast wavelength. Experimental relaying from the London and Birmingham stations has also been tried with very satisfactory results. One day recently listeners-in had the somewhat novel experience of hearing musical items relayed from Paris. The signal strength was considerably less than usual, but nevertheless quite good. Manchester claims the honour of having the first church choir to broadcast in this country, namely, St. John's Wesleyan Parish Choir, of Langworthy Road, Weaste, near Manchester.

* * *

SHEFFIELD. — We learn that the news announced by Capt. Eckersley in Sheffield, that the B.B.C. are to erect a relay station near the city, has caused an appreciable increase in the sale of crystal sets and parts, and a big boom in the cheaper types of receiving sets is expected during the next few weeks.

* * *

CARDIFF.—Since the opening of the Cardiff broadcasting station enthusiasm in the Rhondda Valley district has grown apace. Fears were entertained that the local screening effects would render reception very difficult, as in many towns a crystal receiving set proved practically useless unless the receiving station was situated upon fairly high ground. Despite these fears, however, the results obtained so far are proving very satisfactory indeed.

BETHNAL GREEN AND DISTRICT RADIO SOCIETY (H.Q., Men's Institute, Wolverley Street, E.2).

Hon. Sec., MR. S. A. DENNISON.

On April 17th Mr. J. H. Reeves, M.A., delivered a lecture entitled "Amplification by Valves," in which he described most clearly the action of the valve and gave hints on the design and construction of sets.

The importance of the correct value of gridleak was emphasised, and the lecturer suggested the use of one consisting of a blacklead line on ebonite, which could be adjusted during use. The best methods of H.F. amplification were then discussed in detail.

DARTFORD AND DISTRICT RADIO SOCIETY (H.Q., Dartford Grammar School).

Hon. Sec., MR. E. C. DEAVIN, 84, Hawley Road, Dartford, Kent.

On April 20th, at the headquarters, an exhibition and demonstration of home-made apparatus was proceeded with, and extremely good examples of work were on view, and were tested on the aerial. 2LO was audible throughout the proceedings by means of a "Brown" loud-speaker. The headquarters is now being equipped with a four-valve set (1 H.F., D., 2 L.F., and a frame aerial) on the unit principle, to enable experimental work to be carried out. This Society meets every alternate Friday, the next meeting being on May 4th, at 8 p.m.; all wireless enthusiasts are cordially invited to attend.

HACKNEY AND DISTRICT RADIO SOCIETY (H.Q., Y.M.C.A., Mare Street, Hackney, E.8).

Hon. Sec., MR. C. C. PHILLIPS, 247, Evering Road, Clapton, E.5.

By kind permission of the authorities a visit to Croydon Aerodrome has been arranged.

On Thursday, April 19th, Mr. O. S. Puckle lectured on "Telephone Receivers," dividing his lecture into five sections: (1) Electro-magnetic, (2) Electro-static, (3) Electro-thermionic, (4) Piezzo-electric, (5) Mechanical. Illustrations were given on the blackboard, and in turn he referred to The Johnnsen-Rahbeck loud speaker, the Thermophone, and the Stentorphone. Questions were then fired at the speaker, which showed the great interest taken. After the lecture a two-valve converted Mark III. tuner set was tested on the Society's aerial, and worked excellently with a loud-speaker.

ILFORD AND DISTRICT RADIO SOCIETY (H.Q., St. Mary's Hall, High Road, Ilford).

Hon. Sec., MR. A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

On April 19th Mr. A. G. S. Gwinn lectured on "Short Wave Reception" (waves under 300 m.), and stated that efficiency of the Aerial-Earth System was the first thing to receive attention, a single wire being recommended. The plug-in type of coil was also recommended, but the lecturer said he had obtained very good results by using the aerial coil of an "army" short-wave tuner.

He uses a ball type of reaction coil, wound in two sections, comprising fifty turns of No. 30 s.w.g. s.c.c. wire. The spindle rotates at the aerial end of the coil. For very short waves (under 150 m.) one section only of the reaction coil is used. For waves up to 2,000 metres the same efficiency is obtained with external loading coils. The lecturer thought that for H.F. amplification on S.W. "tuned anode" coupling was the only practicable method.

LEYTON RADIO CLUB (H.Q., Church Army Social Centre, Russell Mission, Goldsmith Road, Leyton, E.10).

Hon. Sec., CAPT. H. THORLEY, C.A.

This Club meets every Wednesday at 8.15 p.m., when lectures are given and discussions invited. Mr. J. D. Cassels, K.C., M.P., has become President, and several Members of the Council are Vice-Presidents. The membership fee is 1s. per month, and all those interested in wireless are cordially invited to join. Particulars may be obtained from the Hon. Secretary.

PUDSEY AND DISTRICT RADIO SOCIETY (H.Q., The Mechanics' Institute).

Hon. Sec., MR. W. G. A. DANIELLS, 21, The Wharrels, Lowtown, Pudsey.

On April 16th Mr. F. Wild gave the first of a series of lectures of an elementary nature. The lecturer explained how speech was conveyed by means of sound waves and transmitted by the throat and lips of the speaker, and detected by the ear. Such great interest was shown that Dr. Byrd kindly consented to give a discourse on "The Ear" at a future meeting.

SMETHWICK WIRELESS SOCIETY (H.Q., Technical Institute, Smethwick).

Hon. Sec., MR. R. H. PARKER, F.C.S., Radio House, Wilson Road, Smethwick, Staffs.

On March 9th Mr. R. H. Parker lectured on "The Production of Alternating Currents," and some very good lantern slides (loaned by the G.E.C., Ltd.) were exhibited. This Society, which meets every Friday, has vacancies for new members, and an excellent syllabus of lectures has been arranged. Particulars may be obtained from the Hon. Secretary.

SALE AND DISTRICT RADIO SOCIETY (H.Q., 37, School Road, Sale, Cheshire).

Hon. Sec., MR. H. FOWLER, "Alston," Old Hall Road, Sale.

The opening exhibition at the new headquarters took place on April 7th, Mr. B. Ingleby (chairman) performing the ceremony in the absence of Councillor J. U. Thornton (President). A show of amateur apparatus and that of local dealers caused a crowded attendance, making the task of inspection rather difficult. Good examples of component parts made by juvenile members, and samples of work in the Amateur Section by Mr. J. R. Burne, Mr. D. F. Owen, and Mr. G. R. Lewis were exhibited. Mr. Burne (2 K.W.), winner of last year's Transatlantic Test, showed a 7-valve set made by himself. Mr. Lewis (2 W.K.) showed a transmitter and a 6-valve receiver, which had both been made from raw material, and many other very interesting features were on view. Altogether the exhibition was a great success, and exceedingly instructive and interesting meetings at the new headquarters are anticipated.

SUNDERLAND WIRELESS AND SCIENTIFIC ASSOCIATION (H.Q., Westfield House, Sunderland).

Hon. Sec., MR. A. RICHARDSON.

On April 7th Mr. H. G. MacColl lectured at the club rooms on "Some Methods of Recording Wireless Signals," pointing out that messages were first recorded on paper tape, but reception by ear was favoured when the crystal detector was used, whilst it became possible to record messages at high speed and at great distances when the triode came into use. Circuits were described and the Turner relay was seen in actual operation, when messages were received from a Dutch station. A sensitive gas flame was shown to allow of reception of messages by its movement.

On April 4th Mr. L. A. Sayde, B.Sc., A.I.C., opened a discussion on "High-frequency Amplification," which showed that some members found "tuned anode" and "transformer" couplings equally efficient on short waves.

UXBRIDGE AND DISTRICT RADIO EXPERIMENTAL SOCIETY (H.Q., Willowbank Tea Rooms, Uxbridge High Street [Bucks End]).

Hon. Sec., MR. J. R. M. DAY,
10, Cowly Road,
Uxbridge, Middlesex.

On April 10th Mr. R. Piper lectured on "The Principles of Wireless Transmission and Reception," and illustrated his lecture with a demonstration of apparatus.

SWANSEA AND DISTRICT RADIO EXPERIMENTAL SOCIETY (H.Q., Y.M.C.A., St. Helen's Road).

Hon. Sec., MR. H. T. MORGAN,
218, Oxford Street,
Swansea.

The Swansea and District Radio Experimental Society held their usual weekly meeting at headquarters last week. Owing to the indisposition of Mr. P. W. Walters, who was to have delivered a lecture on "Transatlantic Telephony," the secretary, Mr. H. T. Morgan, installed his 5-valve set and lectured on various wireless circuits.

Many debatable points were cleared up and concerts received on a loud speaker from Cardiff, Newcastle, London, Manchester, and Paris.

THE SYDENHAM AND FOREST HILL RADIO SOCIETY (H.Q., Greyhound Hotel, Sydenham).

Hon. Sec., MR. M. E. HAMPSHIRE,
139, Sydenham Road,
S.E.26.

Very interesting lectures have been given by Mr. M. E. Hampshire on "The Sensitising of Wireless Headphones," by Mr. Cox on duolateral coils, and by Capt. S. A. Huss on elementary crystal circuits. This Society provides for persons with elementary and advanced knowledge, and anyone desiring information on anything appertaining to wireless is most cordially invited to attend the Society's meetings.

THE WARRINGTON RADIO ASSOCIATION (H.Q., Y.M.C.A., Market Gate, Warrington).

Hon. Sec., MR. W. WHITTAKER,
Brickmakers Arms,
School Brow, Warrington.

Mr. W. H. Taylor lectured recently on "Frame Aerials and their Uses," and demonstrated by means of a three-valve set (1 H.F., D., 1 L.F.), employing reaction on the secondary circuit and a frame aerial (4ft. square wound spirally with five turns of bell wire).

The directional properties of a frame were dealt with, and later 2ZY Manchester was received upon three pairs of 'phones laid on the table.

This Society meets on the second and fourth Thursday in each month at 7.30 p.m., and the Secretary would like to hear from any radio society within fifteen miles of Warrington with a view to arranging an interesting summer programme.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., The Acton and Chiswick Polytechnic, Bath Road, Chiswick).

Hon. Sec., MR. H. W. COTTON,
19, Bushey Road,
Harlington, Hayes, Middlesex.

At a meeting on April 17th Mr. T. W. Hyne Jones gave an interesting paper on "Primary and Secondary Batteries: Their Construction and Action." The following methods of producing an E.M.F. were explained: (1) Chemical, (2) Mechanical, (3) Thermal, (4) Frictional. Primary cells and accumulators were dealt with and the meanings of Polarisation, Capacity, Efficiency, etc., were made clear.

WIMBLEDON RADIO SOCIETY

Hon. Sec., MR. C. G. STOKES,
Worple Avenue,
Wimbledon.

The inaugural meeting of this Society was held at the Red Cross Hall, Wimbledon. Future meetings will take place on Thursday evenings.

WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., Camberwell Central Library).

Hon. Sec., MR. GEO. SUTTON,
A.M.I.E.E.,
18, Melford Road, S.E.22.

On Wednesday, April 18th, this Society held a discussion regarding the design and construction of variometers. The Secretary exhibited one, made from a "Sorbo" and an ordinary hollow rubber ball, having an efficiency equal to that of an expensive one and costing 1s. 6d. only.

The methods employed in winding this variometer with No. 26 d.c.c. wire, were explained and, when tested, the instrument was found extremely satisfactory. *We hope to receive constructional details of this novel variometer in due course.*

WOOLWICH RADIO SOCIETY H.Q., Y.M.C.A., Thomas Street, Woolwich, S.E.18).

Hon. Sec., MR. H. J. SOUTH,
42, Greenvale Road,
Eltham, S.E.

On March 28th, at Headquarters, the Assistant Secretary exhibited the wonders of *X*-rays, dealing with the early researches of Crookes and Lennard on vacuum tubes. With a 12-inch spark coil kindly lent by Mr. F. W. Smith, and a fine collection of his own vacuum tubes, Mr. Beeson illustrated all the phenomena associated with *X*-rays.

Will Radio Society Secretaries kindly give as many *technical* details in their reports as possible, and forward so as to reach us by first post each Tuesday morning. When notifying "Forthcoming Events" it is important that the *date, time* and *place* of the event should be stated, otherwise many interested persons are unable to attend. Thanks.

HOW TO OBTAIN AN EXPERIMENTAL LICENCE

By E. REDPATH, Assistant Editor.

DESPITE the ever-increasing demand for the issue of a special form of licence to apply to those who have made their own receiving sets, no such licence will at present be issued.

There have been numerous interviews between the Postmaster-General and the British Broadcasting Co., the former being agreeable to issuing a 10s. Constructional Licence, with the stipulation that all component parts used in the construction of sets shall be stamped "Of British Manufacture"; whilst the latter, on the other hand, although concurring in the issue of a 10s. licence, insist that certain components, including valves, telephones, condensers, transformers, resistances, and gridleaks, should be stamped "B.B.C."

The Postmaster - General has stated that he considers this last-named stipulation equivalent to effecting a very undesirable monopoly (for it must be remembered that only those manufacturing firms associated with the B.B.C. would be able to supply component parts so stamped), and, after having taken the opinion of the Law Officers of the Crown, he considers that he is not only entitled, but actually required by law, to issue Experimental Licences to all applicants who, in his opinion, are properly entitled to them.

This being the case, the "last 100,000"—whose requirements are not met by the existing broadcast licence, and who, having constructed, more or less completely their own receiving sets, thus being entitled to be considered *experimenters* in the broad sense of the term—should take immediate steps to secure an Experimental Licence.

The purpose of this present article is to assist readers in this direction by indicating the proper procedure to be followed.

Probably the best preliminary action which can be taken by any intending applicant is to become a member of the nearest experimental wireless association and talk the matter over with the secretary, whose privilege and pleasure it is to assist new members as much as possible.

Some experimental associations, fully alive to the exigencies of the situation, have formed or are forming special classes for theoretical and practical instruction, the object being, firstly, to teach new members the rudiments of the science, and, secondly, to put the association's committee in a position to support applications for experimental licences by certifying that members applying are considered reliable and capable of conducting experiments with receiving apparatus.

The next thing to be done is to write to the Secretary, General Post Office, London, E.C.1, asking to be supplied with Form A—Application for Authority to Use Receiving Apparatus. Upon receipt of the necessary form, the general questions with regard to age, whether the applicant is a British subject, etc., etc., can readily be answered. It is the questions regarding scientific qualifications, particulars of experience in working apparatus, and the nature and object of the experiments which he desires to conduct which have been the great stumbling-blocks up to the present.

It is understood, however, that the interpretation of these questions has been greatly modified, and it is now sufficient to show that the applicant has a fair knowledge of the subject and an honest intention to experiment to entitle him to receive an Experimental Licence.

For the purpose under discussion, "scientific qualifications" may be taken to comprise a general theoretical knowledge of the subject of wireless telegraphy, and several methods of acquiring such knowledge will occur to readers, such as the reading of reliable text-books, handbooks, or wireless periodicals, attendance at lectures or evening classes, etc., all of which might be summarised under the heading of "study."

With regard to the question of "experience in working wireless apparatus," there are two courses open to the would-be experimenter. He may become a member of an experimental radio association and learn how to operate the association's receiving set, or he may make arrangements to assist for a time some established experimenter.

Many readers will, no doubt, be in somewhat of a dilemma by reason of the fact that they have already made their receiving apparatus, but up to the present are unable to receive an Experimental Licence, and, of course, cannot use the home-made apparatus under the terms of the Broadcast Licence.

It should be clearly understood that there is nothing illegal in the *construction* of apparatus provided that such apparatus is not *installed and worked* without a licence or permit.

Accordingly, there need be no hesitation whatever in putting forward the fact that a complete receiving set has been constructed (and possibly tested upon the aerial of the local radio association), together with a few details indicating the nature of further developments which are contemplated later, as proof of the applicant's ability and intention to experiment.

There are simply dozens of experiments which the licensee will be able to carry out at home, and without anything elaborate in the way of apparatus or instruments. A few suggestions are given below, whilst many variations of these and further experiments will readily occur to readers:—

(*a*) Comparison of the efficiency of various kinds of crystal detectors.

(*b*) Comparison of the efficiency and selectivity of various circuits used with crystal detectors.

(*c*) Comparison of the efficiency, reliability, and cost of operation of "valves" and "crystal detectors."

(*d*) Comparison of various receiving circuits, *i.e.*, single-circuit arrangement with solenoids, separate coils, series or parallel condensers or variometers, compared to inductively coupled tuners with "tuned" or "aperiodic" secondaries.

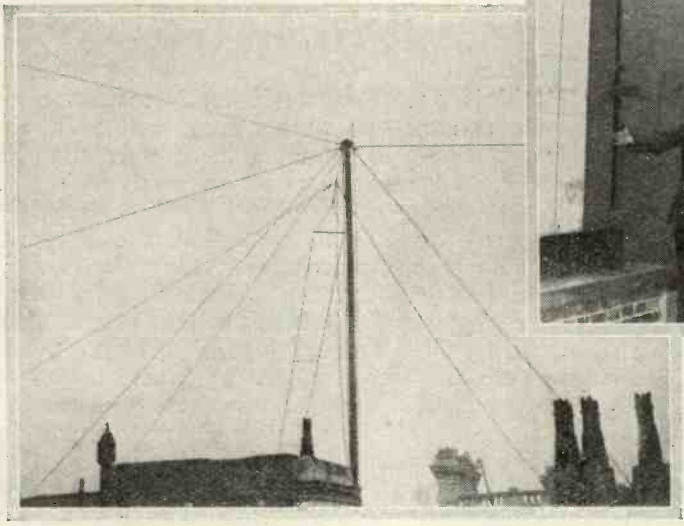
(*e*) Experiments with a view to the elimination of distortion of received "telephony" in the case of multi-valve sets.

(*f*) The study of "acoustics" with particular reference to telephone receivers and sound-amplifying devices.

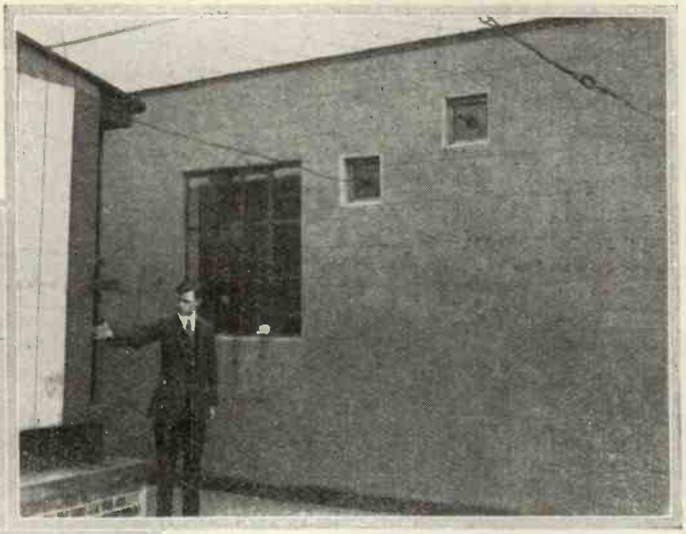
All these particulars can scarcely be given upon the official application form, but should be included in a separate and carefully written letter accompanying it. If the construction of the home-made apparatus forms the principal claim, it will be advisable to submit a carefully drawn and *technically accurate* diagram of the receiving circuit. A photograph of the completed receiving set will probably prove helpful, showing that the apparatus has actually been constructed, and should be submitted if possible.

Items which will Count.

Each applicant should make mention of any of the following items which apply to his own particular case :—



G.P.O. experimental wireless mast.



The earth wire attached to water tank on roof of G.P.O.; also shows "lead in" wires —on the left, earth; on right, aerial.

(1) Any period of service in the wireless branches of the Navy, Army, or Air Force.

(2) Professional experience in any branch of electrical engineering.

(3) Attendance at any course of technical lectures or evening classes dealing with wireless or electrical subjects.

(4) Membership of an established wireless society.

(5) Experience in the manipulation of a previously purchased "Broadcast" receiving set.

(6) Experience in connection with the construction and/or operation of the apparatus belonging to the Amateur Wireless Society, of which he is a member.

(7) Experience gained by having assisted some established experimenter. Any claims in this direction should, of course, be substantiated by a letter from the gentleman who the applicant has assisted.

(8) The actual design and/or construction of his own receiving apparatus. In support of this claim a circuit diagram and, if possible, a photograph of the complete apparatus will probably prove of assistance.

(9) A recommendation from the committee of the amateur wireless society of which the applicant is a member. If this recommendation states that the applicant (*a*) has been a member of the society for a given period. (*b*) has agreed to follow a course of theoretical and practical instruction arranged by the Committee. (*c*) is considered thoroughly reliable, with the definite intention to experiment.

The writer will be pleased to hear from any reader who, having carefully followed the suggestions given above, fails to secure an Experimental Licence within a reasonable time. In this connection it should be remembered that the authorities are at present scrutinising some 33,000 applications which have been held over.

ARMSTRONG—SUPER CIRCUITS.

It has been brought to our notice that possibly some of our readers might misunderstand our announcement regarding "exclusive" articles on the prize-winning circuits in the recent Competition supervised by the Radio Society of Great Britain.

It is to be understood that the long and detailed articles arranged for by us have no connection with the descriptions published by the Radio Society in their official organ, our private articles supplying far more information than could possibly be given at any meeting.

We mention this as some seem to have thought our notice implied that ours were the only descriptions to be published.

JUDGMENT

The following is the third section of the Judgment of the Court of Appeal in the action of the Marconi Company against the Mullard Radio Valve Company, Limited. It will be remembered that the Marconi Company sued the Mullard Radio Valve Conpany, Limited, for alleged infringement of their two Patents 28,413/13 and 126,658. Mr. Justice Lawrence held that neither of the Patents was infringed by the Defendants, ond Plaintiffs appealed against this decision.

The appeal was dismissed by the Court of Appeal with costs, and the reasons for the decision are given below.

Mr. J. Hunter Gray, K.C., Mr. James Whitehead, K.C., and Mr. W. Trevor Watson (instructed by Messrs. Coward & Hawksley, Sons and Chance) appeared for the Appellants.

Sir Duncan M. Kerly, K.C., Mr. R. Moritz and Mr. Conrtney Terrell (instructed by the Treasury Solicitor, Law Courts Branch) appeared for Respondents.

(Continued from No. 3, page 189.)

THE two conductors are called electrodes, the hot one being designated by the name "cathode" and the cold one by the name "anode." Doctor Fleming took out a patent for his valve—No. 24,850 of 1904. The valve consisted of an ordinary vacuum valve such as is used for electric light, in which were inserted a filament by way of cathode and a plate of metal in the form of an open-ended cylinder surrounding the filament. The filament was heated to a high state of incandescence by a continuous electric current. The Fleming valve operated to rectify the aerial current, but it did not amplify it. The next step was taken by one De Forest in 1908, who suggested obtaining a more sensitive valve by introducing a third electrode, which usually took the form of a grid, that is, a perforated plate inserted between the cathode and the anode. In this valve both the anode and the third electrode were flat plates. At the period of which I am now speaking, namely, 1908, and until after Round's invention, the subject of the present action, the vacuum bulbs in use were never completely evacuated of gases. The result of this was that besides the electrons radiating from the filament, others were thrown off from the particles of gas, leaving positive ions which tended to fly back to and bombard the filament with risk of its destruction. Moreover, in such valves as that of De Forest, in which all three electrodes were open, that is to say, merely placed alongside of each other, there was nothing to prevent a portion of the stream of electrons passing to the glass of the bulb and causing irregularities in the current, which had the effect of disturbing the signals unless constant adjustments were made by means of a potentiometer. These adjustments seem to be referred to in Dr. Fleming's specification No. 13,518 of 1908. The next material step was taken by Von Lieben in the invention, the subject of a patent No. 1,482 of 1911. The characteristic of this valve was that the bulb was divided by the grid into two chambers, in one of which the cathode was placed and in the other the anode, so that all the electrons had to pass through the grid. There was not provided, however, any device for preventing the electrification of the glass with the consequent necessity of adjusting the potentiometer.

This brings me to Round's invention and the construction of his specification in view of the fact to which I have referred. The title is, "Improvements in receivers for use in wireless telegraphy." The specification begins by a statement that the invention "relates to improvements in receivers for wireless telegraphy in which a vacuum tube of the type having a hot filament, a grid and a third electrode is employed." By the "third electrode" the inventor obviously means the anode. He then states that "in vacuum tubes of this type, even where the grid has entirely separated the hot filament from the third electrode"—an obvious allusion to Von Lieben's invention—"the glass has hitherto been exposed to the cathode stream and has become electrified, producing a polarising effect which necessitated varying the potential between the electrode and the filament." His object, no doubt, was to get rid of the necessity of adjusting the potentiometer, but the means whereby he sought to attain that object was by avoiding the exposure of the glass to the cathode stream. The inventor then proceeds, "To obviate this disadvantage, both the grid and the third electrode are, according to this invention, made in the form of closed cylinders which completely surround the hot filament. These cylinders effectively protect the glass from electrification and possess the capacity above referred to as desirable." Then follows a reference to drawings which throw no light on the construction of the document, which proceeds to state that in the figures "the filament, grid and third electrode are shown in a conventional manner, but, as above stated, we find it advantageous to form the grid as a closed cylinder surrounding the filament and to form the third electrode as a cylinder outside the grid." The third claim, which alone is material, is in the following terms: "A vacuum tube containing a hot filament, a grid formed as a closed cylinder completely surrounding the filament, and a third electrode in the form of a cylinder surrounding the grid substantially as described."

The question is: Does the specification, properly construed, require that the grid and the third electrode or either of them should be physically closed at the end, or is it enough that they should be of such a length as effectively to intercept the electron stream though their ends are left open? The patentee, in the passage on page 2, lines 18-21, in which he refers to the defect which he proposes to remedy, describes it as arising from the exposure of the glass to the cathode stream, and in the following paragraph states that he meets the difficulty by making the grid and the anode in the form of closed cylinders which completely surround the hot filament. Later, at lines 45-48, he speaks of the grid only as a closed cylinder, and the anode as a cylinder only. In the claim he repeats as to the grid the expression "a closed cylinder completely surrounding the filament," and as to the anode the expression "a cylinder surrounding the grid." In the first place, I am of opinion that the claim is one for a piece of apparatus and not for a principle, of which the thing described discloses the mode of application. Then, reading the claim in the light of previous knowledge and experience as disclosed by the three specifications above referred to and of the passages of description contained in the specification itself, I am of opinion that by directing that the grid should be in the form of a closed cylinder completely surrounding the filament, he meant that it should be in such a form that it should present in all directions a physical barrier to the passage of the electrons except through the interstices of the grid itself. Of course, *ex hypothesi*, the grid has openings in its circumference allowing the passage of the electrons, and, therefore, cannot be a cylinder in the strict sense, but it can be of cylindrical form, and this is, in my opinion, what is meant. When, therefore, he speaks of a "closed" cylinder he adds a quality not found in the description of cylinder, and I cannot interpret the specification of this quality in any other than a physical sense, namely, an actual closing of the ends. It is said the expression "closed" cylinder may be read not as meaning a cylinder physically closed, but one "electrically closed," that is of such dimensions and particularly of such length as, having regard to the way in which the electrons are given off from the filament, would interrupt them without having its ends closed in the physical sense. I can see no reason for so reading it; such an interpretation would be an unnatural way of reading the word, and there is nothing, in my opinion, either in the recognised phraseology of the time or in the specification itself for giving such a meaning to the word. It was suggested that there would be a difficulty in applying the natural meaning to the case of a grid surrounding a hair-pin filament, a form commonly adopted in 1913, but I see no reason why a grid in the form of a thimble covering the filament and standing on the glass foot of the bulb should not be a closed cylinder within the strict meaning of the word.

In my opinion, therefore, Mr. Justice Lawrence was right in holding that, according to the true construction of claim 3, a grid in the form of a cylinder closed at each end in the ordinary sense is an essential element in the apparatus described and claimed. As to the anode, the matter is not so clear owing to the variations in the language of the specification in this respect. With some hesitation, however, I agree with Mr. Justice Lawrence that, in the case of the anode, all that is required is that it should be in the form of a cylinder surrounding the grid. This view, however, makes no difference to the result if, as I think is the case, a grid such as I have described is an essential feature of the apparatus claimed by the patentee. It cannot, I think, be really disputed that the alleged infringement does not contain such a grid. I doubt whether the wire in the form of an open spiral can, except by a stretch of language, be described as in the form of a cylinder at all, and it certainly is not in the form of a closed cylinder. Agreeing, as I do, with the learned Judge on the question of construction, it follows in my view, inevitably, that the Defendants have not infringed, and that the judgment in that respect be affirmed.

As to validity. On the construction of the patent which, in my opinion, is the correct one, Sir Duncan Kerly did not in this Court contend that the patent is invalid for want of novelty or subject-matter, and it is enough to say that on this point, also, I agree with the learned Judge.

I now turn to Péri's patent. The invention is said by the patentee to relate to "improvements in vacuum tubes of the Audion type"—namely, the type described in De Forest's specification—"and comprised means for mounting the elements consisting of a plate, coil and filament comprised in the apparatus." and "The simple and strong construction of the device adapts it for manufacturing in quantities." It is quite unnecessary to repeat the description given by Mr. Justice Lawrence in his judgment; it is sufficient for me to read Claim No. 1, at page 2, lines 24 to 31: "A vacuum apparatus intended to serve as relay or generator of maintained oscillation in which the filament, the grating and the plate are concentrically arranged and fixed directly to the wires serving as conductors, these wires being sealed in the same glass tube soldered to the opening of the bulb, the filament placed at the centre of the system being stretched between two conductors having a certain elasticity, and the grating formed of a spirally rolled wire supported by its two ends, the plate being cylindrical and surrounding the two other elements, the said plate being attached to its conductor by one or two hooks." This is avowedly a claim for a particular apparatus containing the special features enumerated. It is said by the plaintiffs that the overriding feature of it, and that which really constitutes the invention, is found in the words "fixed directly to the wires serving as conductors, these wires being sealed in the same glass tube soldered to the opening of the bulb," and that it is in this that its value consists inasmuch as by making use of it all the elements of the apparatus are assembled and fixed in place before insertion in the bulb and then inserted as a single unit, resulting in great economy in manufacture; but in my opinion this is only one of several features treated by the patentee as of at least equal importance. I agree with Mr. Justice Lawrence that Péri's claim is an exceedingly narrow one and does not cover any forms or shapes other than those particularly described. The defendant's valve differs completely in detail from that described and claimed by Péri. I need not repeat the enumeration of these differences contained in the judgment of the learned Judge, but content myself with saying that it appears to me to be accurate. If so, then on the construction of the specification which, in my opinion, is the correct one, the conclusion that the patent has not been infringed follows, and the judgment in this respect also must be affirmed. In this case also, on the narrow construction of the patent, the attack on its validity fails.

On the whole, the appeal ought, in my opinion, to be dismissed with costs.

Lord Justice Younger (*read by Lord Justice Warrington*): I am entirely of the same opinion. Agreeing, as I do, with the construction placed upon Round's specification by my Lord, the Lord Justice and the learned Judge, I would only observe that the valves forming part of the receiving apparatus in use in wireless telegraphy at the date of Round's patent were all of them soft valves, and it is agreed that it is to such valves that his specification is primarily addressed. The evidence has satisfied me that in the case of these valves the provision of a closed cylinder, in the literal sense of these words, might well have been regarded by the patentee as an essential condition of the utility and success of his invention. The infringing valves, however, are all hard valves. In these valves closed cylinders, in the specified sense, are not required, nor are they used. The fact that the appellants' specification is directed to soft valves, while the respondents' valves are hard, furnishes, perhaps, the real reason why the latter can be completely successful without infringing the characteristic features of the Round invention. I think that both appeals should be dismissed.

Sir Duncan Kerly: There is a question of costs, about which notice has been given, though it has not been mentioned to the Court. Had my friend succeeded, the question would not have arisen; as we have succeeded, we quarrel with the judgment of the learned Judge below as to costs. He made us pay certain costs. I am going to ask your Lordships to allow it to be argued on some other day, if we might ask the Court to give us another day at some convenient time.

The Master of the Rolls: I do not know when you want it afterwards. Will it be convenient to you and Mr. Gray to take it the first day of next sittings?

Mr. Hunter Gray: Yes, so far as I am concerned, certainly.

Sir Duncan Kerly: Yes, certainly.

The Master of the Rolls: Then we will postpone the argument as to the costs, unless we hear to the contrary, till the first day of next sittings.

Mr. Hunter Gray: Both appeals are dismissed with costs?

The Master of the Rolls: Yes.

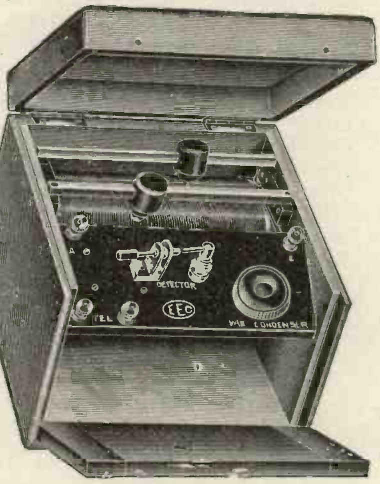
Mr. Hunter Gray: If your Lordship pleases.

Apparatus we have tested

Conducted by A. D. COWPER, B.Sc. (London), M.Sc.

Broadcast Crystal Set

WE have received from the Economic Electric Company a particularly neat little crystal set contained in a polished case with folding front and lid and providing room for a small pair of 'phones inside the case. It is of the two-slide tuner, or auto-transformer type, with a small variable condenser, for fine tuning, across the secondary part of the circuit and with an open crystal-detector, using the well-known "Rectarite" crystal. The tuning range is up to something over 800 metres on P.M.G. aerial. On actual trial with 2LO on such an aerial in the outer suburbs of London, this transmission came in very well; tuning was rather tricky for the uninitiated, but was compensated for by the greater signal strength, which was remarkably good considering the compactness of the instrument and relatively small size of wire used in the tuning inductance.



The receiver.

Signals were also quite good on a single 30-foot aerial. Ships came in strong on 600 metres with a twin 40-foot aerial. The small condenser appeared to be a real refinement in so small a set; its action was smooth and there was a good, reliable connection to the moving vanes. One of the sliders was a little erratic in contact — this can, and no doubt will, be easily remedied. The crystal detector appeared rather exposed to accidental disturbance or injury; and no provision appeared to be made for the renewal of the crystal when worn. The "cat's whisker," also, doubtlessly for mechanical reasons, is made rather too thick and harsh.

On the whole, it is a very attractive and effective little instrument, and can well be recommended to those who have ambitions above the single-knob, soulless kind of tuner, and who will take a little trouble to get good results.

Variometer

The Bowyer-Lowe Co., Ltd., have submitted to us a variometer of the open tubular type, suitable for panel mounting, fitted with a very neat knob and scale, and supporting pillars for fixing underneath the panel. This is a well-designed and most efficient piece of radio apparatus. It is mechanically and electrically sound, devoid of any needless complication, and eminently fitted for the purpose indicated. The inductance ratio, we find, is 5 to 1: from 70 minimum to 350 microhenries maximum. This ratio is not, of course, as high as is obtainable, the reason being that the coils are wound on ebonite tubes instead of moulded formers. Thus a P.M.G. aerial will tune from 280 to 600 metres; a single 30-foot aerial from 240 to 500 metres.

The efficiency, shown by measured signal strength on broadcast transmission, with crystal detector alone, is as high as that of any commercial tuning device we have tested; evidently due to the generous size and spacing of the wire, and absence of all but the minimum of metal close to the windings. The movement of the rotor is smooth, the contact with the moving parts is made by a strong, mechanical, lasting device which proves quite silent in action.

The instrument stands rather high—some 6in.—which may make it a little awkward to mount in some sets; this might be reduced with advantage. It could be suggested, too, that the insulation of the wire might be rendered damp-proof with advantage to the signal strength.

This variometer can be recommended with confidence as a thoroughly sound and efficient tuning device either for B.B.C. crystal or for more elaborate sets. It may easily be modified for use as a vario-coupler.

CATALOGUES RECEIVED

We have received from Messrs. C. F. Elwell, Ltd., an illustrated catalogue of their apparatus and accessories. The catalogue contains descriptions of sets ranging from compact crystal receivers to elaborate cabinet sets, together with various components, telephones, etc. Price 1s. on application to Messrs. C. F. Elwell, Ltd., Craven House, Kingsway, W.C.

Messrs. The Economic Electric Co., Ltd., have also forwarded for our inspection a brochure of their various manufactures. This catalogue is likely to prove of good use to those experimenters who are making their own sets and needing the small parts usually required when assembling. Application to be made to Messrs. The Economic Electric Co., Ltd., 303, Euston Road, N.W.

Book Notes

How to Make a "Unit" Wireless Receiver. By E. Redpath. (London: Radio Press, Limited. Price, 2s. 6d. net.)

This new handbook forms No. 7 of the Radio Press Wireless Series, and, as its title implies, deals with the construction of an efficient receiving apparatus of the "unit" type.

The details are very carefully worked out, and the book is arranged so that a beginner can first make a compact variometer crystal receiver and subsequently add both L.F. and H.F. amplifying valves. The complete set as described is particularly suitable for the reception of broadcast transmissions.

An introductory chapter clearly explains the underlying principles of wireless telephony, whilst a special supplementary chapter describes in detail the erection of an efficient aerial.

Wireless Licences and How to Obtain Them. By E. Redpath. (London: Radio Press, Limited. Price 1s. net.)

The object of this new handbook is to explain as clearly as possible the latest regulations with regard to the various types of wireless licences, the method of procedure to be adopted in applying for them, and the rights which are conferred upon the licensee.

It is probably no exaggeration to state that the chief difficulty at present in the way of the would-be experimenter is the question of the licence.

Mr. Redpath has assisted experimenters over their difficulties for a number of years, and we feel sure his present effort in that direction will be appreciated by his readers.

This handbook is No. 11 of Radio Press Wireless Series.

Six Successful Radio Sets. [M. B. Sleeper, Inc., 88, Park Place, New York City. (English Agents, The Wireless Press, Ltd., 12, Henrietta Street, W.C.) 46 pp. Price 50 cents.]

This booklet consists of a description of six different types of receiving set, including a Rheinartz short-wave receiver and a Sleeper circuit set. The description appears to refer to sets, and parts of sets ready for assembly, marketed by the Sleeper Radio Corporation. The booklet is well illustrated, and gives full instructions for the assembly of the sets with the parts supplied. At the end of the book is given a table showing a complete list of the parts required for making any one of the them. A "question coupon" is also included, which entitles the reader to a reduction of 25 cents in the charge for information by post. Questions concerning the circuits in the book can be addressed to M. B. Sleeper, Inc., 88, Park Place, New York City, Question Department, a charge of 50 cents per question or 25 cents for each diagram being made to cover the cost of the correspondence.

101 Receiving Circuits. [M. B. Sleeper, Inc., 88, Park Place, New York City. (English Agents, The Wireless Press, Ltd., 12, Henrietta Street, W.C.) Price 50 cents. 46 pp.]

This booklet contains about one hundred and ten circuit diagrams, including non-reaction and reaction circuits, H.F. amplification, super heterodyne, reflex, Haynes, Flewelling, Flivver, super-regenerative, ultra-regenerative, neutrodyne, and Rheinartz circuits. Explanatory descriptive paragraphs accompany the diagrams, but practical constructional details of sets embodying the circuits illustrated are not given.

An information service is available on the same terms as above.

FORTHCOMING EVENTS

May.

3rd (Thurs.).—Dewsbury and District Wireless Society, South Street, Dewsbury. Discussion on "Difficulties."

3rd (Thurs.).—Cardiff and South Wales Wireless Society Institute of Engineers, Park Place, Cardiff. Experimental work conducted by Mr. S. P. Taylor.

3rd (Thurs.) until 5th.—Lincoln and District Amateur Wireless and Scientific Society. Exhibition of members' home-made apparatus in the gymnasium, Lincoln Technical School, 6-9 p.m. Saturday afternoon, 2-4 p.m.

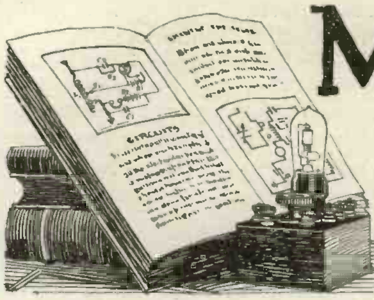
4th (Fri.).—Leeds and District Amateur Wireless Society. Discussion, "Unorthodox Circuits for Short Wave Reception," by Mr. J. Croysdale, at the Grammar School, Leeds.

5th (Sat.).—Dartford and District Radio Society. Open competition for crystal receiving sets. Prizes are to be awarded for originality of design and efficiency in reception. To be held at Messrs. J. & E. Hall's Restaurant, Dartford.

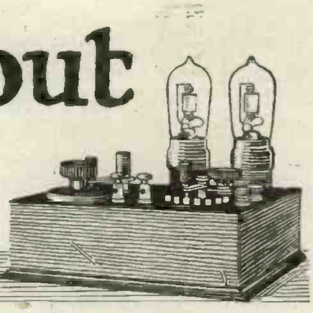
8th (Tues.).—Plymouth Wireless and Scientific Society. Plymouth Chambers, Old Town Street, Plymouth, 7.30-7.45. Buzzer practice. 8 p.m., construction of Society's three-valve set and demonstrations.

9th (Wed.).—Edinburgh and District Radio Society, 117, George Street, Edinburgh. Sale of apparatus. A series of elementary lectures to be maintained until the end of June, if possible.

9th (Wed.).—Sutton and District Wireless Society, the Adult School, Benhill Avenue, Sutton. A lecture at 8 p.m. on "Some Historical Notes on Radio Telegraphy and Telephony," and illustrated by lantern slides.



Mainly about Valves



A causerie relating to the use of valves. This feature will appear every week and will be conducted by the Editor.

Hardening Valves

THOSE readers who are not familiar with the manufacture of receiving valves will be interested to know that after a valve has been pumped it is lit up and a source of voltage connected across anode and filament. The valves, which are connected in special frames, each frame containing perhaps two hundred valves, are treated for several hours, and the process is known as "ageing." This greatly improves the vacuum in the bulb, and improves the constancy of the valve.

When a soft valve is in use the process of ageing sets in, with the result that there is a "clean-up" of residual gas, the vacuum consequently improving.

Filament Fuses

Several filament fuses are now on the market, and may be purchased at reasonable prices. To the novice they will undoubtedly be a boon, and they will prevent damage if the high tension battery is connected across the filament. A reader who was making some enquiry stated that he knew the valve was all right, because when he connected the high tension battery across the filament terminals it lit up. To such a person the filament fuse would be a veritable godsend.

It is rather awkward to fix a fuse in a suitable place when using component parts. Why does not some manufacturer supply valve panels fitted with spring clips between which a fuse could be connected? A small feature like this, costing very little, would make his valve panels different from all others, and small distinctive features of this kind make the wireless public prefer the apparatus of one manufacturer to that of another. I mean, of course, the discriminating wireless public, and not the people who buy the cheapest material simply because it is the cheapest.

Use of Soft Valves

Speaking of soft valves reminds me that some good Dutch valves are at present on the market and give excellent results as detectors, although of little use as amplifiers. There is nothing to beat a British-made valve for general reception purposes, but where a valve is used as a detector, soft valves are often very much more efficient than hard valves, and in America, of course, both types are available.

Asking a British manufacturer why he did not place on the market a soft valve for detecting purposes, he replied that its life would be very short, and that complaints would constantly come in that the valve had hardened in use and was no longer efficient. Soft valves, of course, are not nearly as constant in their operation. They should, moreover, work with a potential of only about 15 to 20 volts, as they are liable to blue if higher anode voltages are used.

Double Filament Valves

As "Wayfarer" has remarked in his "Jottings by the Way," no attempt seems to have been made to introduce a valve having two filaments. The idea, of course, was tried out long ago by the Marconi Company, and was used in their soft "Round" valves, especially for transmission purposes.

The double filament valve presents considerable difficulties in the way of construction, and, like many special kinds of valves, might be just as expensive to make as two ordinary valves.

A point to notice, however, is that the possession of two filaments does not mean necessarily that the valve will have twice the life. We read the other day in a contemporary that electrons are particles of the filament, and, due to the fact that they are emitted so copiously, the filament wears away and burns out. Whilst we cannot accept this ingenious explanation, it is more than likely that, after the first filament has burnt out, the second would not survive it very long.

The same idea, of course, has appealed to inventors in regard to the ordinary incandescent lamp. Naturally the lamp makers would not welcome a lamp which lasted twice as long, but, apart from this, there is the important technical reason that when a filament burns out the vacuum is nothing like as good as it originally was, and the life of the second filament would be much shorter.

Intervalve Transformers

An example of the fight between cheapness and quality is found in the sale of intervalve transformers. There are some very poor types of intervalve transformers now on the market, and there is no part of the set which is more likely to be at fault than the low frequency transformer. The reader is well advised to think twice before allowing his anxiety to economise to overcome his desire for a really good article. These words, of course, must not be taken to mean that because an intervalve transformer is cheap that it is unreliable. Nevertheless, buy carefully when buying intervalve transformers.

Quite a number of beginners, by the way, do not seem to know what the letters I.P. and O.P. mean. The letters I.P. mean "in primary," and the letters O.P. mean "out primary." It does not matter to which terminals of a pair the connections are made. Some beginners seem to imagine that the I.P. terminal is a terminal at which the anode current from the anode should enter the primary. As a matter of fact, it would not matter if both terminals were marked P. The same remarks apply to the secondary terminals, I.S. and O.S. It is just as well to notice, however, that when more than two intervalve transformers are used, a change of connections to one of the windings sometimes results in better signals.

This appears to be largely a question of modifying the natural coupling effects between one transformer and the other.

Use of Intervalve Transformers in Series

A correspondent in Belgium suggests the use of two intervalve transformers in series, the two primaries being connected in series in the anode circuit of one valve and the two secondaries being connected in series and connected in the grid circuit of the next valve. When experimenting with this arrangement it is important to try reversing connections to one of the secondaries, as the voltages induced in the secondaries should act together in series, and not in opposition.

There seems no technical merit in the idea, as a single transformer could be built having similar characteristics. The expense of such a transformer, however, might be too great to make the instrument a saleable proposition.

We would be interested to hear if any readers get improved results by the use of intervalve transformers in series in this manner.

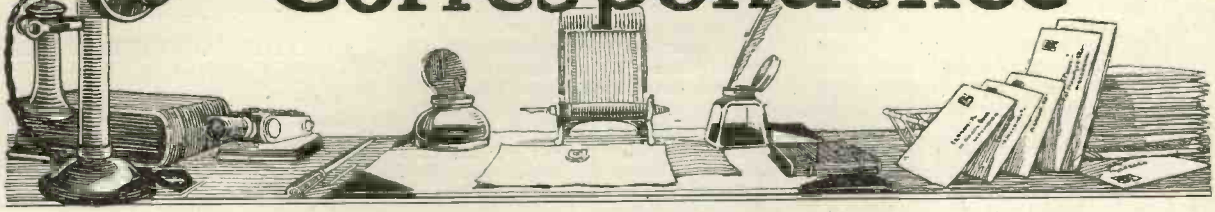
A Note on Comparing Results

One of the easiest traps to fall into is the making of dogmatic assertions regarding the efficiency of this or that circuit, or this or that apparatus. Because many experimenters on the particular set they use find that the gridleak when shunted directly across grid and filament should be connected to the negative terminal of the accumulator, will always declare that this is the best position. As a matter of fact, before being able to make any pronouncements on the relative merits of different circuits and arrangements it is necessary to have tested out the circuits on innumerable pieces of apparatus and on various wavelengths. It is so easy to jump to conclusions, that many do so prematurely.

Probably the chief cause of disagreement is that an obscure reaction effect is introduced or taken away by making some adjustment or alteration. For example, by connecting the gridleak to the negative terminal of the filament accumulator the detecting action of the valve might be improved, or might be made worse, but owing to the fact that a certain amount of natural reaction is accentuated by doing so, the increase in the signal strength would lead an inexperienced person into the error of saying that the valve was detecting better. If the experimenter had connected the bottom of the gridleak to the positive terminal of his accumulator and introduced a little more reaction in a different manner, he might have found that the results obtained were even better than before.

This only goes to show that whenever high-frequency circuits are employed, practically any variation in the circuit—whatever its kind—whether it be a variation of the high-tension voltage or the grid potential, or the filament current, the reaction effect (whether intentional or incidental) will be varied, and there will consequently be a variation of signal strength.

Correspondence



THE LICENCE QUESTION

To the EDITOR, *Wireless Weekly*.

SIR,—You may be interested in the following case of licence granting.

On February 1st I applied for an Experimental Licence. My reasons for so doing were chiefly because I wanted to make my own set, and in view of the fact that I had worked on the staff of the chief wireless telegraph company in the world.

My application was shelved for two months, and ultimately I was informed that I had to wait for a Constructor's Licence, if such are granted.

I have constructed several sets. The first I sold to a young fellow who was getting interested but without practical experience. He applied for his Experimental Licence and has been granted it, whilst I, who constructed the set and initiated the young fellow into the working of it, have been refused.

Of course, I am "listening in," and for that reason must withhold my name, and the lack of imagination of the official of the P.M.G. has added another "pirate" to the great multitude.

I am, etc.,

Clacton. WAITING.

CARBORUNDUM

To the EDITOR, *Wireless Weekly*.

SIR,—I admit it was with many misgivings I looked at No. 1 of the *Wireless Weekly*, but after careful perusal I came to the conclusion that it is well worth the extra few pence to have something really well worth reading.

I sincerely hope that the standard of the journal will keep up to No. 1, and I am certain you will be assured of many thousands of satisfied readers.

Referring to the letter of C. Mulch *re* the use of carborundum crystal without the use of any applied potential, I should like to say that I have a friend residing at South Tottenham who has been using this for some considerable time. I have listened to the London broadcasting on his set, and was surprised at the exceptional volume and clearness with which the music and speech was reproduced.

He states that on one or two occasions he has received the Birmingham broadcasting faintly. Although he has what might be considered a fairly good aerial, I think you will admit that this is a remarkable achievement, as Birmingham from here is a hundred odd miles.

Wishing your journal every success it deserves, I am, etc.,

E. J. H.

Finsbury Park, N.4.

FOR SERVICES RENDERED

To the EDITOR, *Wireless Weekly*.

SIR,—I want to thank you for the great help that I have got from your two valuable journals. I only wish that they had been published earlier. They would have saved me a lot of time, money and worry.

I built a set in January and tried several circuits, but with poor success. I was about to scrap the lot, when I got No. 1 *Modern Wireless* and tried your double reaction circuits, and I may say I never got results until then. I only use three valves, and I have not a great aerial—two 35ft. wires spaced 4ft. 6in. almost in parallel with the electric tram wires, with the result that I got a fearful lot of crackling in my 'phones—sometimes I could not hear anything else. To try and cut out this crackling I put up a small aerial 30ft. long, single wire only, about 10ft. off the ground at one end at right angles and underneath my other aerial, but with no better results. Then came *Wireless Weekly*, and in last week's you have a counterpoise earth; so at night, when ready for tuning in, instead of using my ordinary earth (which is to water pipes and a zinc bath in the ground), I put the lead-in of my small aerial to the earth terminal. I do not think that there is another one in Belfast getting the same results. Signals came in so clear and so loud, and absolutely without noise of any kind—I am no longer afraid of the trams, thanks only to your *Modern Wireless* for my circuit and *Wireless Weekly* to make it perfect. Needless to tell you I am now and for ever a regular reader of both papers.

I hope I have not made this letter too long to take up your time reading it, but my results now are so good I thought it my duty to tell you. I only wish that I had a transmitter so that I could broadcast it to other amateurs and help them to get like results.

Again thanking you and wishing your magazines every success, which I believe is assured. I am, etc.,

S. KELSO.

P.S.—I was able to pick up all British broadcasting stations last night perfectly; before, I could only get them in very faintly, with the exception of 2LO, 5SC and 2ZY. Now they all come in loudly.

EFFECTS OF NEIGHBOURING AERIALS.

To the EDITOR, *Wireless Weekly*.

SIR,—With reference to the two letters published in your first and second issues, regarding the effect of neighbouring aerials, you might be interested in some little experiments carried out between my friend next door, who uses a crystal set, and myself using valves.

My friend has always said that whilst my set is working he can get much louder signals or speech, so we decided to see if this effect would work with long-distance telephony. On Sunday afternoon, February 11th, I tuned in The Hague, using 1HF and detector, and, after adjusting the set so that it would start oscillating, left it working and went to see if my friend could receive anything. To our surprise we could hear the music and speech quite distinctly. Since then we have been able to receive Manchester, Birmingham and Newcastle on the crystal quite loud and clear, working in exactly the same manner.

When there are claims of long-distance reception of telephony on crystal sets, the above is, I think, the cause of such phenomena.

Another interesting point is, the aerials are about 12 yards apart, and if I use detector and 1LF and my friend speaks near his phones, I can hear him quite clearly. I am, etc.,

L. D. ASPLAND.

To the EDITOR, *Wireless Weekly*.

SIR,—Re the letter under the heading "Effects of Neighbouring Aerials" in your No. 1 issue, I should like to say that at this house we have two single aerials about 60ft. long. At the far end they are about 5ft. apart, and at the lead-in end about 16ft., one receiving set being on the ground floor and the other three floors above, but although this arrangement has been in use over a month we have not experienced any interference.

I have seen in a recent issue of another wireless weekly an article wherein the writer states that he has experienced fading under similar circumstances as your correspondent refers to, and I was wondering if the explanation is that the two aerials do not in my case run parallel with each other but get wider apart towards the lead-in.

I am, etc.,
Holloway, N.7. S. J. COLLIS.

To the EDITOR, *Wireless Weekly*.

SIR,—I have read with some interest the correspondence in *Wireless Weekly* with regard to "Fading" and "The Effects of Neighbouring Aerials."

My neighbour owns a crystal set, and myself a two-valve 1 detector 1 low-frequency.

When I am working, he receives 2LO with great volume, but when I am not, and my *aerial is not earthed*, he can bardly hear.

His aerial and mine run nearly parallel. Perhaps you can give some explanation of this? I am, etc.,
W. BOOKLESS.

To the EDITOR, *Wireless Weekly*.

SIR,—I would like to inform those of your readers who are interested in the above subject that a mathematical treatment is given in the *Wireless World*, vol. 1, p. 418.

In this article also a method is given of lessening the interference. It is stated that if a single wire and a multiple wire aerial interfere with one another, the energy picked up by the single wire aerial is least when the multiple wire aerial is tuned to a lower wavelength than that of the single wire aerial. Therefore if two aerials mutually interfere make one multiple-wired and one single-wired.

I am, etc.,
Liverpool. NORMAN C. KERMODE.

A CRITICISM OF BROADCASTING PROGRAMMES.

To the EDITOR, *Wireless Weekly*.

SIR,—I think your No. 2 is excellent, and I trust you will meet with the success you deserve. Whilst recognising the services of the B.B.C. and the difficulties of pleasing all tastes with their programmes, I can but regret we are to have no broadcasting competition for two years, because the heavy music selected and dullness of the general items is a serious handicap. Now we are told that one programme is to be used for the whole country, and we shall not be able to get relief from the high-brow bore of Marconi House by trying the livelier selections of the country stations, and only Paris will be left to us. If so, my 4-valve set is advertised for sale cheap.

I am getting on in years. The best item used to be the 2LO dance music from 8.25 to 9 o'clock; now they have made it 10 o'clock, and I've gone to bed. The news is put on to 9.45, just as I am closing down.

The class of "grand concert" music they give us has never yet kept a place of entertainment going permanently in this country; and yet here it is being forced on thousands of listeners-in every night, and a scientific miracle which should be a popular boon is being used for a very limited class and those not of workers who want cheerfulness and brightness.

I am a pianist of fifty years' experience. I have 15,000 pieces of music and been a theatre-goer all my life, and I should have thought it impossible for any person to have found the dull and tuneless items in such profusion as I have had to listen to the last four months.

The few intervals that 2LO give us for getting on to Manchester, Glasgow, etc., prove that there are some attractive items being broadcast, but they are almost immediately jammed out by Marconi House's Brahms, Kreisler-Chopin Etude, etc. Who wants them or understands them amongst those who work for a living and have had no time to study music as a science and not as a recreation?

Other items than the music are of much more popular appeal; but music is the chief art which lends itself to wireless, and it is tune that is the soul of music; but the B.B.C. programmes show no recognition of the fact and select technical exercises for the expert only.

Do use your influence to get the weight of boredom being foisted upon us lightened. I am, etc.,
Croydon. AN ELDERLY LISTENER-IN.

FURTHER APPRECIATIONS.

To the EDITOR, *Wireless Weekly*.

SIR,—Just a line expressing my best wishes for the success of your new journal, *Wireless Weekly*.

I have found it very helpful and interesting regarding wireless information. I have taken in regularly nearly all wireless papers, but I think your book tops the lot. I am, etc.,
L. S. BECKETT.
Hampstead, N.W.3.

To the EDITOR, *Wireless Weekly*.

SIR,—I bought the first copy of your new weekly and intend to give up my usual in order to continue *Wireless Weekly*.

The articles amply reward the extra 3d. spent. I am, etc.,
F. L. SHELTON.
Wildernesse Gardens,
Sevenoaks, Kent.

To the EDITOR, *Wireless Weekly*.

SIR,—After a very careful perusal of the journal, I am convinced that same is of a most excellent character and offer my congratulations and best wishes for its continued success.

The two journals recently commenced should meet all requirements of wireless enthusiasts and give great assistance in creating interest from an experimental and constructional standpoint.

Trusting the new paper will be a great success, I am, etc.,
EDWIN C. DEAVIN (Hon. Sec.).
Dartford and District Radio Society,
84, Hawley Road,
Dartford, Kent.

To THE EDITOR, *Wireless Weekly*.

SIR,—Thanks for the copy of your new publication.

May I be allowed to congratulate you upon it? It is great, and has been unequivocally recommended to the members of the Wireless and Experimental Association.

I am, etc.,
GEO. SUTTON.
London, S.E.22.

From "The Wireless Trader," the leading trade paper:
"Permit us to congratulate you on a very fine production."

Patent Section

The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS

(Specifications not yet published.)

9431, 9434. ABBEY INDUSTRIES, LTD.—Wireless receiving sets. April 6th.

9432. ABBEY INDUSTRIES, LTD.—Wireless crystal receivers. April 6th.

9433. ABBEY INDUSTRIES, LTD.—Wireless aerials. April 6th.

9451. ABRAHAM, R. M.—Receiving-apparatus for wireless signalling. April 6th.

9148. ANDERSON, S. J.—Intervalve transformer, etc., for wireless signalling, etc. April 3rd.

9527. BARBER, L.—Aerials for wireless telegraphy, etc. April 6th.

9486. BARNES, A. S.—Switchboards for charging accumulators. April 6th.

9053. BARTON, R. H.—Method of utilising force of attraction between two charged plates of electric condenser. April 3rd.

9098. BAYLES, E. A.—Manufacture of electric cables. April 3rd.

9536. BERESFORD. W.—Frame aerial for wireless reception. April 7th.

9098. BRITISH INSULATED & HELSBY CABLES, LTD.—Manufacture of electric cables. April 3rd.

9318. BRITISH L. M. ERICSSON MANUFACTURING CO., LTD.—Telephone receivers. April 5th.

9597. CHANDLER, C. K.—Aerials for wireless telegraphy. April 7th.

9508. CHILOWSKY, C.—Rupture of electric currents. April 6th. (France, February 12th.)

9223. CLARK, F. C.—Crystal-detector holder. April 4th.

9121. CLOTHIER, H. W.—Electric circuit-breakers, etc. April 3rd.

9600. COWPER, A. D.—Variable inductance devices. April 7th.

9172. CRABB, V.—Variable inductance for wireless receivers. April 3rd.

9153. FORBES, S. L.—Device for use with wireless receivers. April 3rd.

9335. GARRARD, C. G.—Sound-magnifiers for wireless receiving sets. April 5th.

9492. HACKETT, W. E.—Crystal detectors. April 6th.

9534. HART MANUFACTURING CO.—Electric switches. April 6th. (United States, Feb. 24th, 1922.)

9130. HARRIS, G. W.—Electric resistances or rheostats. April 3rd.

9424. HOWLETT, W.—Crystal detector. April 6th.

9367, 9402. INDEPENDENT RADIO MANUFACTURERS, INC.—Neutralising capacity coupling between electric circuits. April 5th.

9187. JUNKER, J.—Three-valve receiving apparatus. April 3rd.

9188. JUNKER, J.—Combined high and low frequency amplifying device. April 3rd.

9419. KEMP, A. J.—Valves for wireless telegraphy, etc. April 6th.

9121. LEESON, B. H.—Electric circuit-breakers, etc. April 3rd.

9499. MAITRE, A. H.—Damping device for switch contacts for electro-magnetic vibrating members. April 6th. (France, April 12th, 1922.)

9584. MARBAIX, G. E.—Crystal detector. April 7th.

9401. MARCONI'S WIRELESS TELEGRAPH CO., LTD.—Signalling systems. April 5th. (United States, April 17th, 1922.)

9490. MARTIN, V. H. G.—Damping device for switch contacts for electro-magnetic vibrating members. April 6th. (France, April 12th, 1922.)

9056. MAVITTA, W.—Earth clip for electric apparatus. April 3rd.

9353. MIDGLEY, A. H.—Coil windings for wireless reception, etc. April 5th.

9167. MORLEY, G. E.—Mounting coils for wireless telegraphy, etc. April 3rd.

9168. MORLEY, G. E.—Apparatus for wireless telephony, etc. April 3rd.

9137. MORRISON, L. D. G.—Secret intercommunication by oscillatory discharges. April 3rd.

9053. MUNN, L. C.—Method of utilising force of attraction between two charged plates of electric condenser. April 3rd.

9527. PARKINSON, J.—Aerials for wireless telegraphy, etc. April 6th.

9314. REES, D. W.—Generating electromagnetic waves. April 5th.

9326. REES, H. P.—Wireless receiving instruments. April 5th.

9121. REYNOLLE & CO., LTD., A.—Electric circuit-breakers, etc. April 3rd.

9435. RHODES, C. T.—Valves for wireless apparatus, and incandescent electric lamps. April 6th.

9042. ROBERTS, J.—Connections or terminals for electric circuits. April 3rd.

9318. ROGERS, A. G.—Telephone receivers. April 5th.

9247. ROWE, J. S.—Basket coils for radiotelephony, etc. April 4th.

9186. RUNBAKEN, J. H.—Hydrometers for testing electric accumulators. April 3rd.

9501. RUTTEN, L. VAN.—Slow-acting relays. April 6th.

9508. SAPHORES, J.—Rupture of electrical currents. April 6th. (France, February 12th.)

9130. SEYMOUR, C.—Electric resistances or rheostats. April 3rd.

9413. SKINNER ORGAN CO., INC.—Wireless broadcasting. April 5th. (United States, February 8th.)

9431, 9434. SMITH, H. MELVILLE.—Wireless receiving sets. April 6th.

9432. SMITH, H. MELVILLE.—Wireless crystal receivers. April 6th.

9433. SMITH, H. M. MELVILLE.—Wireless aerials. April 6th.

9267. SPLINDEN, M. A. E.—Trumpet for wireless telephony. April 4th.

9063. TIMMINS, A. A.—Horns, etc., for phonographs, etc. April 3rd.

9063. TIMMINS & ROGERS, LTD.—Horns, etc., for phonographs, etc. April 3rd.

9186. TORRANCE, W.—Hydrometers for testing electric accumulators. April 3rd.

9431, 9434. TYRRELL, S. J.—Wireless receiving sets. April 6th.

9432. TYRRELL, S. J.—Wireless crystal receivers. April 6th.

9433. TYRRELL, S. J.—Wireless aerials. April 6th.

9328. WALKER, H. E.—Electrically conductive clips. April 5th.

9501. WESTERN ELECTRIC CO., LTD.—Slow-acting relays. April 6th.

9502. WESTERN ELECTRIC CO., INC.—Loaded transmission systems. April 6th.

9111. WILKINS, J. H.—Aerials for wireless telegraphy, etc. April 3rd.

9153. WIRELESS AGENCIES, LTD.—Device for use with wireless receivers. April 3rd.

9435. WOOD, H.—Valves for wireless apparatus and incandescent electric lamps. April 6th.

9551. WOODS, G. F.—Receptors and inductance coils for wireless telegraphy, etc. April 7th.

9551. WOODS, R. S.—Receptors and inductance coils for wireless telegraphy, etc. April 7th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

(Copies of the full specifications, when printed, may be obtained from Mr. Gee, post free on payment of the official price of 1s. each.)

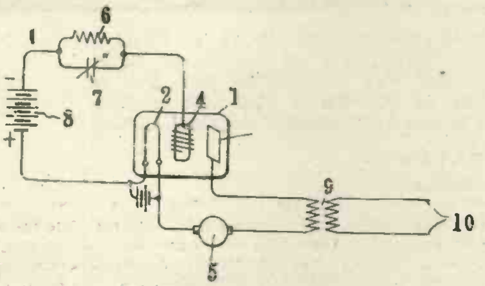
193,010. LORENZ AKT.-GES., C.—In order to prevent the amplification of undesirable frequencies, which give rise to "whistling" noises, a shunt circuit containing capacity and inductance is connected across the valve transformer windings. This circuit is tuned to the higher frequencies beyond the speech range, and consequently by-passes such energy and prevents its further amplification across the transformer. (January 10th, 1923. Convention date, February 11th, 1922.)

193,059. PFIFFNER, E.—In an electric condenser comprising a number of superposed elements, with metal coatings in intimate contact with the dielectric, coatings of like polarity are spaced apart, at least at their margins, in order to weaken the electric fields which may be formed at the margins of successive elements if the coatings do not exactly cover each other. The space at the margins may be filled with an insulating-mass, with a smaller dielectric constant than that of the condenser dielectric. (February 12th, 1923. Convention date, February 10th, 1922.)

193,060. PFIFFNER, E.—In electric condensers and other electrical apparatus in which the conducting material rests on insulating material, electrical discharges at the edges of the conducting material are prevented by providing the conducting material with marginal extensions of high resistance. These extensions may be formed of a powdered resistance material, such as graphite, mixed with a binder, or they may be in the form of a thin coating of conducting material applied to the insulating material by chemical precipitation or by heat. (February 12th, 1923. Convention date, February 11th, 1922.)

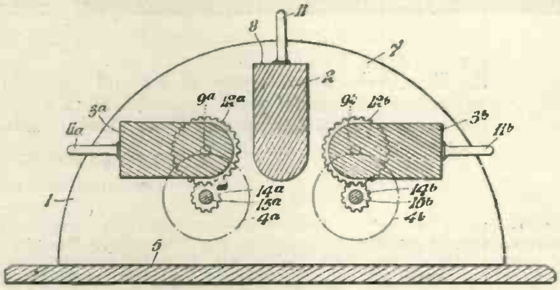
193,072. FOREST, L. DE.—Apparatus for recording sound photographically comprises a lamp to which high or super-audio frequency oscillating current is supplied, the intensity of the light being varied by and in accordance with the sound waves without varying any other characteristic of the light source, such as its size or shape. The sounds to be recorded affect a microphone producing alternating or pulsating currents, which, acting through an amplifier and a transformer connected to the oscillation generator, modulate accordingly the high-frequency currents passing through the lamp. Specification 157,441 is referred to. (August 16th, 1921.)

193,092. BRITISH THOMSON-HOUSTON CO., LTD.—In a thermionic "negative resistance" device arranged for the production of oscillations in the manner described in Specification 103,865, the electrode which emits the secondary electrons or "dynatrons" is maintained at an average negative potential. (October 14th, 1921.)



Illustrating Patent No. 193,092.

193,150. BURNHAM, W. W.—In variable electric couples or inductance devices for wireless signalling, of the kind in which the inductive distance between two coils is varied by rotation of one coil about an axis external to the coil and lying in a plane through the coil and perpendicular to its axis, the moving coil is mounted on a supporting element axially rotatable by manual rotation of a spindle operatively connected to and parallel to the axis of the supporting element, and of sufficient length to avoid approach of the hand to the coils in operation. Any number of fixed and movable coils may be used. (November 18th, 1921.)



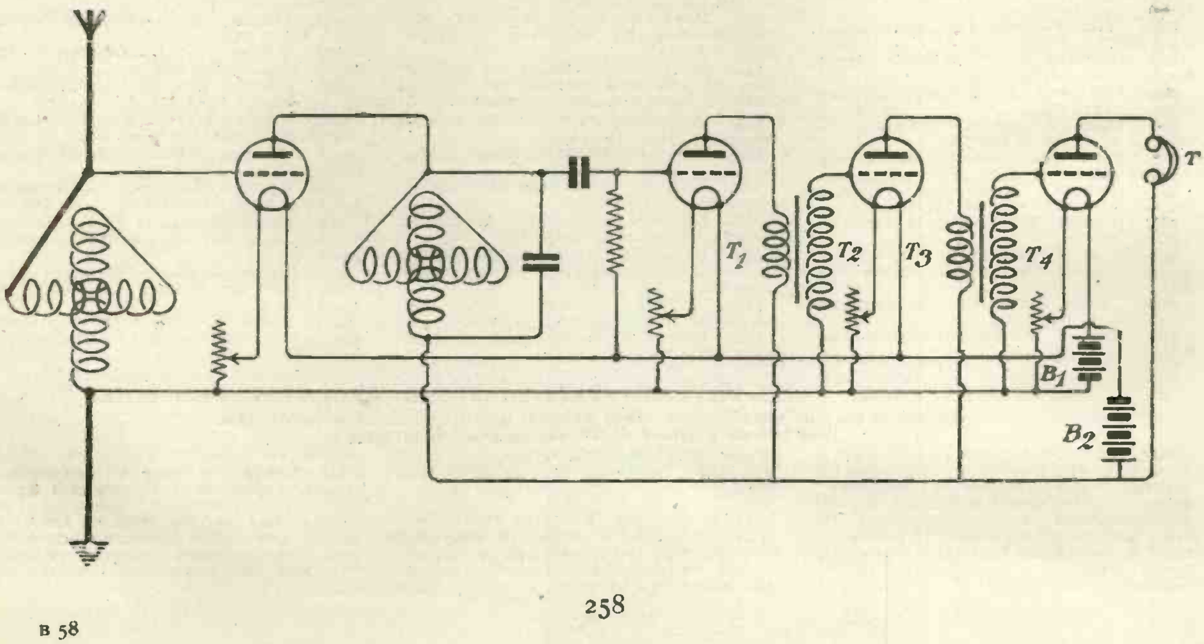
Illustrating Patent No. 193,150.

193,203. BING WERKE VORM. GEB. BING AKT.-GES.—The electrodes of a spark-gap suitable for a toy wireless set are disposed practically in contact with each other and are covered with a thin layer of badly conducting or insulating material, preferably varnish, enamel, or an oxide of magnesium, cadmium, or calcium. This allows a tension of only a few hundred volts to be used. The component parts of the toy sending and receiving set are mounted on a cardboard switchboard, the wiring being arranged underneath and being protected by a casing or box. (December 19th, 1921.)

193,241. PAYNE, M., and JEAL, W. S.—A storage battery consisting of a number of cells in series is provided with by-polar electrodes each of which has a flange projecting at right angles on both sides of the electrode and extending beyond the surfaces of the active material, adjacent flanges being concave and convex. The negative side of each electrode is formed with a vent. The electrodes are separated by perforated rubber, etc., washers, tight joints between the washers and electrodes being obtained by wedges inserted between the outer electrodes and a container or by other means. The container may be filled with wax to keep the electrodes in position, and devices may be provided to cut out one or more cells if required. (January 20th, 1922.)

A 3- OR 4-VALVE RECEIVER USING VARIOMETERS

IN response to numerous enquiries we have pleasure in publishing the complete diagram of the 3- or 4-valve receiver pictorially illustrated on page 183 of our last issue.



Information Department

Conducted by J. H. T. ROBERTS, D.Sc., assisted by A. L. M. Douglas.

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

GUNDERSEN BROS. (NORWAY) asks whether the British Broadcasting Station sometimes vary in the wavelength they use during the evening, as the tuning adjustments on their receiver do not seem to be always the same for the particular station mentioned.

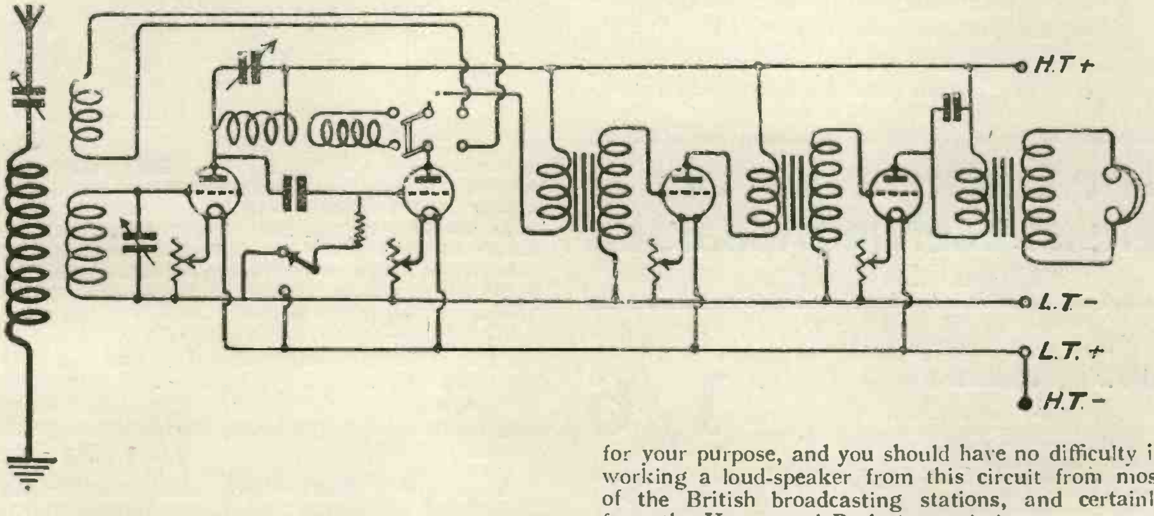
The British Broadcasting stations all work on fixed wavelengths which do not alter. Local atmospheric conditions are probably the cause of the assumed change of wavelength you mention.

B. F. C. B. (S.E.5) is making up a telephone transformer as described in "MODERN WIRELESS," No. 1, and is unable to obtain 44 gauge double silk covered wire for the high resistance winding. He asks whether No. 40 gauge would be suitable in its place, and if so, would any alteration in the number of turns be necessary.

No. 40 S.W.G. D.S.C. wire is quite suitable for this purpose and does not necessitate any alteration in the construction of this instrument.

R. H. D. C. (VILVORDE, BELGIUM) asks the following questions: Will an aerial 70 feet high and 75 feet long be suitable for receiving the British Broadcasting Station from his village, which is just north of Brussels. (2) What wavelength range would the apparatus require to be covered? (3) Would a circuit employing four valves be efficient, and, if so, what arrangement should be used?

(1) The aerial arrangement you propose is exceedingly good, and you should have no difficulty in hearing British Broadcasting and also the Hague and other Continental telephony. (2) A wavelength range of from 300 to 4,000 metres should be aimed at if you wish to embrace all the stations transmitting telephony. At the present moment the lowest wavelength in use is that of Cardiff 5 WA, 353 metres, and the highest that of Rome IDO, 3,200 metres. (3) A four-valve circuit arranged as in the accompanying diagram would prove very suitable



for your purpose, and you should have no difficulty in working a loud-speaker from this circuit from most of the British broadcasting stations, and certainly from the Hague and Paris transmissions.

F. C. M. (WALTHAMSTOW) wishes to add a note magnifier to his crystal receiver, and asks for a circuit diagram.

See reply to "Brum" (Twickenham) in this issue.

F. T. (BUDE) proposes to build an aerial as shown on page 86 of Volume I, No. 2 "WIRELESS WEEKLY," but is still confused as to the amount of wire he may legitimately use in the construction of this aerial

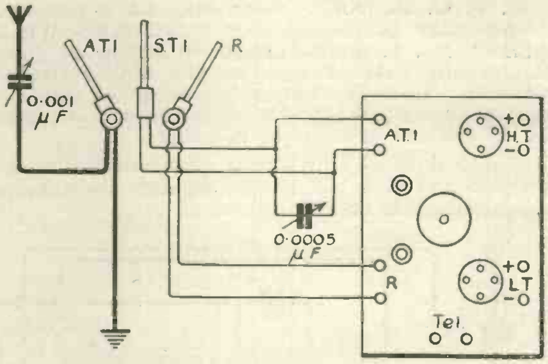
A paragraph appears in *Wireless Weekly*, No. 3, setting forth exactly the present regulations regarding the erection of aerials for experimental purposes. The attention of all our readers is directed to this paragraph, as the statements in it are quite definite and it should not be necessary to make any further reference to this subject. The total length of wire must not exceed 100 feet, including the lead-in, but as many wires as desired, each of 100 feet in length (including the lead-in as for the first one), may be used.

G. P. A. (KIRKCALDY) wishes to make a small variometer crystal set and would like to have particulars for constructing this.

An exceedingly satisfactory crystal receiver may be made using one of the variometers described in No. 2 of *Modern Wireless*, in conjunction with any of the ordinary types of crystal detectors now upon the market. The advantages of variometer tuning are shown to their best on the broadcast wavelength, and for this reason the trouble involved in making up such a variometer is amply repaid.

A. S. (ASHFORD) submits particulars of his apparatus, consisting of a three-coil holder and a valve receiver, and wishes to know how to connect them together.

The wiring arrangement you require is given below. This should make it quite clear without any further explanation being necessary.



N. B. G. (CAVENDISH SQUARE) refers to the circuit of the Armstrong super-regenerative receiver in No. 1 of "WIRELESS WEEKLY," and asks whether he can use a certain make of variometer in place of the one described on the set. He also wishes to know whether a duolateral coil of 1,250 turns will be suitable in place of the 750-turn coil described in the article.

(1) The variometer you mention is quite efficient for this purpose. (2) The 750 turn coil is essential to get the best results with this circuit, otherwise the frequency of the quenching valve circuit will be altered.

W. R. M. (DARTFORD) asks whether high-resistance telephones are more suitable for use with a Hertzite crystal detector than low resistance telephones with a transformer, and if 2,000 ohms is a high enough resistance for such telephones.

There is not a great deal of difference in the results obtained from a pair of high resistance 'phones and a pair of low resistance 'phones with a good telephone transformer in the crystal receiver circuit. If anything the high resistance 'phones are preferable, and there is no reason whatever why they should not be used. In reply to the latter part of your query, 2,000 ohms is a good value, but 4,000 to 8,000 ohms would produce more sensitive results.

W. F. T. (TIVERTON) asks the following questions : (1) Whether he could receive the Hague concerts on a two-valve receiver with one high-frequency stage. (2) What is the resistance of an R type receiving valve ? (3) What is a really good value for a grid leak and its accompanying condenser ?

(1) If your receiver is very carefully adjusted you may possibly obtain satisfactory results from Continental telephony. (2) The resistance of the filament of an R type valve is somewhere in the neighbourhood of 0.5 ohms when cold, but is very much more when the filament is heated up. (3) A suitable value for a grid leak is 2 megohms and for a grid condenser 0.0003 μF.

F. L. G. (WORCESTER) proposes to use vulcanised fibre instead of ebonite in the construction of his receiver and wishes to know if it is as good an insulator.

Generally speaking, vulcanised fibre, unless of very good quality is not such a good insulator as ebonite, and as it is in addition hygroscopic, we do not recommend its use. It is also very liable to warp.

H. B. (BRIGHTON) asks whether it is a practical proposition to use a skinderviken transmitter button in the construction of a microphone amplifier, and, if so, how much current could it safely pass.

We think that with very careful adjustment and with the use of a skinderviken button having carbon electrodes, you might obtain satisfactory results with this apparatus. A good deal of experimental work would be necessary, and the maximum current which this button can pass is only in the neighbourhood of 5 milliampères or so.

S. W. O. (BOTHWELL) wishes to know what apparatus is necessary in order to effect local heterodyning of incoming continuous wave signals.

The construction of a local oscillator for use on a considerable wavelength range is begun in this week's issue of *Wireless Weekly*. This will be found very satisfactory for your purpose, and you might commence its construction if desired without hesitation.

M. C. (EDINBURGH) submits particulars of a telephone transformer which has an iron core 7-16th of an inch in diameter with 3½ inches winding space available. He specifies certain windings and asks if they will be suitable.

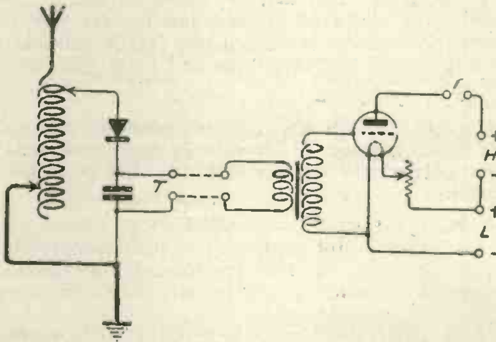
The ratio of turns you propose to use is quite useless for a telephone transformer. The primary winding might consist of 1,200 turns of No. 34 gauge single silk covered wire and the secondary winding 12,000 turns of No. 44 gauge single silk-covered wire. This transformer may be used with either a crystal or valve detector.

G. P. (W.11) has a crystal set and wishes to make the smallest possible variometer which will give him efficiency over the broadcasting band wavelength. He suggests an outside former 3 inches diameter and 2 inches long, and wishes to know the size of the necessary internal former and the windings for this variometer.

Your projected variometer is rather too small, that is to say, in order to cover the wavelength required the gauge of wire you would require to use would be so small that considerable damping would be introduced into the circuit and you would lose signal strength. We suggest you use a variometer as described in No. 2 of *Modern Wireless* on page 143. This variometer will cover the wavelength range you specify.

BRUM. (TWICKENHAM) has a crystal set and wishes to add a valve amplifier as described on page 218 of No. 3 of "MODERN WIRELESS"; he wishes to know what sort of valve and battery would be required and how the panels should be connected to his present crystal set.

Any good make of hard receiving valve would be suitable for your purpose. The high-tension battery would have a value of about 70 volts, and the accumulator 6 volts. We give herewith a circuit diagram showing how to attach this low-frequency panel to your receiver.



K. E. (PECKHAM) submits a circuit and asks the following questions: (1) Is it a practical arrangement? (2) Values for certain coils and condensers. (3) Whether the position of the potentiometer is correct.

(1) The circuit arrangement you submit is very suitable, and probably the most efficient of its kind. (2) The variable condensers A and B may both be of the same value, 0.005 μF., and the inductance C of the rejector circuit may be a No. 75 honeycomb coil. (3) The position of the potentiometer is correct.

M. P. (POPLAR) has built a receiving set exactly similar to the two-valve set described in "MODERN WIRELESS" No. 3, which gives satisfaction. The addition of two low-frequency valves which he has just made enables a loud speaker to be comfortably worked from broadcasting stations, but a loud crackling noise is experienced. He asks the reason for this and how it may be eliminated.

The probability is that if, as you say, your connections are all well soldered and your filament rheostats, high- and low-tension batteries are in order, you are using a cheap and unreliable make of low-frequency transformer. If you would let us have further details of these, we might then be able to advise you better.

J. C. (AYR) has purchased a receiving set stamped B.B.C. which has given every staisfaction, bringing in all the British broadcasting stations on one or two pairs of telephones. He wishes to use more telephones than that, however, and would like to know whether it is possible with his existing apparatus, or if not could he add a note magnifier, and how to do so.

It is probable that with the set you mention six pairs of telephones can easily be used. Should you desire, however, to increase the signal strength, a suitable note magnifier for your purpose is described in No. 2 of *Wireless Weekly*, page 148. This is a very efficient instrument, and will give you every satisfaction.

P. R. (BELFAST) asks the following questions with regard to the crystal set described on page 34 of "WIRELESS WEEKLY" Volume 1, No. 1. (1) What kind of aerial wire should be used, and whether the length of aerial makes much difference. (2) If the same wire as used for the winding of the coil could be used to wire the remainder of the set including the earth wire.

(1) When using a crystal receiver it is essential to obtain the maximum efficiency from the aerial circuit. For this reason stranded copper wire should be used, which might be enamelled to protect it against atmospheric influences. The maximum length permissible under the certain set should be used to obtain the greatest efficiency from this set. (2) The wire which has been used for winding the coil will do for the wiring of the set, but wire similar to that used for the aerial should be used for the earth-lead. The wire used for winding the inductance is far too thin for use as an earth wire.

A. A. M. (FINSBURY SQUARE, E.C.2) wishes to know the size of formers, gauge of wire, etc., to construct a loose coupler from 200 to 5,000 metres.

The primary winding may consist of 11in. of No. 24 gauge enamelled wire on a 6in. tube; a slider should be used to obtain the necessary adjustment of this coil. The secondary winding may consist of 10in. of No. 32 gauge double cotton covered wire on a 5in. tube, and should have 20 equally spaced tappings. You will not obtain very high efficiency on low wavelengths with this arrangement, owing to the large dead-end effects. Suitable condensers must, of course, be used in conjunction with this to cover the range specified.

S. W. G. (STOKE-ON-TRENT) proposes to erect the best possib'e aerial under the circumstances. He has a 40-foot mast and would like to use a three-wire aerial erected on 9-foot spreaders with a main span of 75 feet and a down-lead length 25 feet. He wishes to know whether this arrangement would be suitable or if we could suggest a better aerial arrangement.

The suggestion you make should result in a very suitable aerial. We do not think you will obtain better results on any other type of aerial. Stranded enamelled copper wire should be used.

E. B. (ACTON, W.3) refers to the broadcast receiving set on page No. 3 of "WIRELESS WEEKLY," and asks questions as to the size of the variometer employed.

The two variometers should both be of the same size, and no condenser is necessary across the second variometer to adjust the two circuits to resonance.

D. B. (CHISWICK) wishes to know the simplest wireless set which will give good results with telephones or a loud-speaker from the Cardiff Broadcasting Station, when used at a distance of from 65 to 70 miles from Cardiff.

You will need a fairly sensitive receiver to be able to work a loud speaker satisfactorily. We recommend the use of the circuit described on page 134 of No. 2 of *Modern Wireless*. This will give very good loud-speaker signals at this distance.

G. W. N. (THE BARRACKS, BEVERLEY) asks questions about certain apparatus which has been offered to him and wishes to know whether it is suitable for receiving telephony.

The amplifier you mention is not a good investment. We think you would get far greater satisfaction by spending the sum mentioned on component parts and building your own valve receiver. For an outlay of the figure you mention you would be able to obtain a range of 100 miles telephony quite easily.

Start with a Set you'll never outgrow.

BEFORE buying or building your Set, ask yourself this question: "Will this Set satisfy my requirements next year?" You want a Set not only for listening to your own Broadcasting Station, but to every one in the country. You want a Set which will enable you to use a Loud Speaker later on when you get more proficient. You want a Set which will enable you to receive on every band of wave lengths.

All these requirements — and many more which will come to your mind later—are fully met by the Peto-Scott Standardised Unit System.

This System is the only proved System for the man of moderate means, for by enabling him to commence with Units 1, 2 and 4 he obtains a complete one-valve set to which extra valves can be added later at a ridiculously low figure. Yet from the first his Set is complete and extraordinarily efficient.

If you would learn more of this cleverly thought-out System send 6d. to-day for a copy of "Radio" showing exactly how these fine Valve Units are made up.

Read this letter

Townsend House,
Presteign Rads.
12th April, 1923.

Dear Sirs,

Presteign Radio & Scientific Society.

I have completed a Three Valve Receiver built up from your "Peto-Scott" parts, and although the set was built for experimental purposes, the first test immediately after construction was for telephony, and I am pleased to report that the results were not only good, but surprising. Our engineer was present and we have had experience of 4 and 5 Valve sets, expensive and powerful sets—your set "beats the lot" both for power and clarity, and only 3 valves at that.

As an instance, music and *speech* could be distinctly heard at a short distance from the headphones when in use by another person, and when the phones were taken off, they acted as a miniature Loud speaker.

For simplicity in construction, (any lad could easily follow your clear and concise diagrams), also economy in cost, and results to be obtained in Radio Telephony in the home I can confidently say that no one could wish for or find any set better than the "Peto-Scott."

Yours faithfully,
Geo. F. Green, Hon. Secy.

Price List of Units
(In sets of parts for home construction).

No. 1.	Tuner Unit	27/6
No. 2.	Condenser Unit	42/-
No. 3.	H.F. Amp. Unit	13/6
No. 4.	Detector Unit	17/6
No. 5.	L.F. Amp. Unit	33/6

Mahogany Cabinets to fit Nos. 1, 3, 4, and 5, 3/6. To fit No. 2, 7/-.

Postage 9d. per unit extra, but paid on all orders over £2.

32-page illustrated Catalogue of all Radio Components
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PETO-SCOTT Co., Ltd.,
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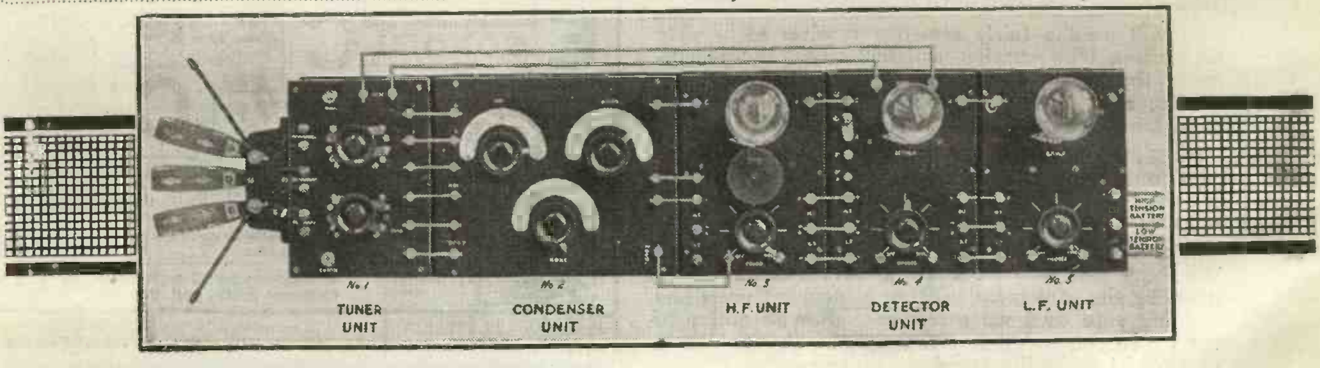
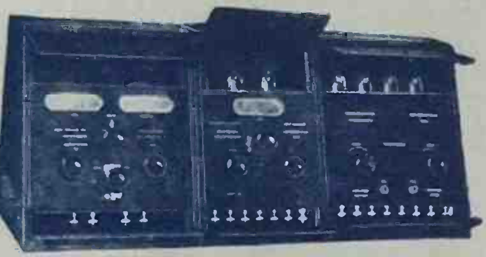


 (continued from page vi.) *the whole quality of a periodical must fall off. If "Wireless Weekly"*

"POLAR"

Music not Cacophony!

Loud Speakers are frequently condemned for faulty reproduction which would more correctly be attributed to the amplification of the receiving set. You cannot secure clear reproduction unless your set provides unstrained amplification. A demonstration of the 7 valve Polar long range Radiophone R.A. 33, 34, 35, will prove a revelation to those who have hitherto "crabbed" the loud speaker.



Both H.F. and L.F. Amplification have in this design been worked out with the greatest precision and as a result any well designed loud speaker will deliver speech and music with the purity hitherto alone associated with telephone reception.

Unequalled for range and purity the 7 valve Polar Radiophone stands supreme as the finest solution that has yet been produced for the problem of loud speaker reception—in remote districts as well as within easy range of a Broadcasting Station.

Extreme simplicity of manipulation (secured by the wave length scales) and the great selectivity resulting from the fact that no less than 5 tuned circuits are employed, are additional reasons why those who are not mechanics, but have an ear for music, as well as those who wish to secure reception on distant stations will discover, when they have tested various makes that there is only one set that freely fulfils their requirements—namely the 7 valve Polar Radiophone.

PRICES: Without accessories £58

Complete with sectional bookcase with loud speaker £90 Oak
£93 Mahogany

The most powerful set yet produced for the holder of the British Broadcasting Co. licence.

Write and arrange for a demonstration.

THE

RADIO COMMUNICATION Co. LTD.

Supplies of the G.P.O. Installations at North Foreland (G.N.F.) and Seaforth (G.L.V.), of Coastal Stations for various Colonial Governments, and of Ship's Radio for most of the Great Shipping Companies

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Wireless Weekly

and The Wireless Constructor

No. 5

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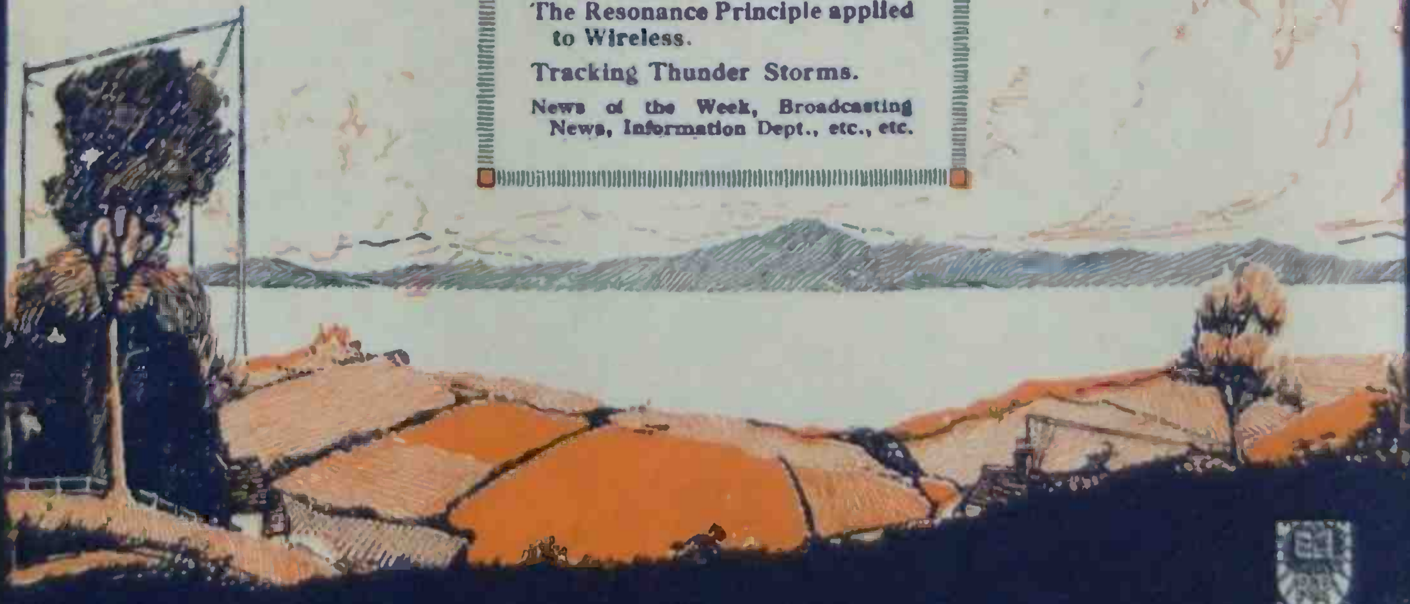

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John Scott-Taggart F.Inst.P.

Wireless Weekly

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May 9, 1923

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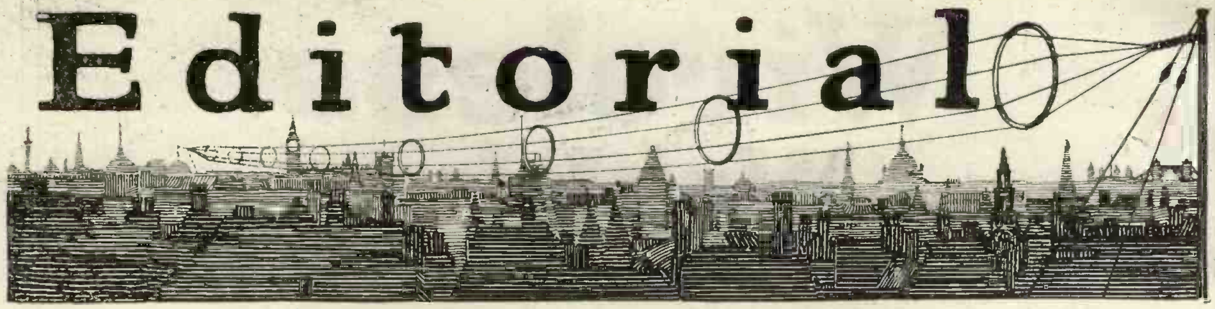


The Power of the Press

LORD Gainford's speech at the opening of the new studio of 2LO brought home very vividly the power of the Press. He stated that over 1,000 employees had been dismissed, owing to the slump consequent on the general indecision regarding licences and the attacks of the Press.

The attitude of such papers as *The Daily Express*, which has vigorously, and, in our opinion, unfairly, criticised, not only the British Broadcasting Company, but its programmes and everything to do with it, has unquestionably done a great deal of harm to the B.B.C.

Certain manufacturers imagine that they can influence the policy of a paper by threatening to withhold advertisements. This, of course, is absurd, and no self-respecting journal would allow advertisement considerations to affect its general policy. Moreover, such an attitude would only provoke the paper to further attacks.

The moral, of course, is for the B.B.C. to work in harmony with the Press, without losing its independence. The recent attacks in the Press on the B.B.C. make it perfectly obvious that the success of broadcasting in this country is entirely conditional on obtaining the goodwill of the public. Many businesses can be conducted without having to satisfy public opinion. In the case of broadcasting, however, it is essential to keep very closely in touch with the feelings of listeners-in and those who might become listeners-in.

The whole trouble, of course, is not programmes, but the antagonism of the B.B.C. towards granting constructional licences on terms which the Postmaster-General considers fair.

Whatever the merits, or demerits, of the case for the B.B.C. stamp on components may be, the B.B.C. must realise that they are fighting a losing battle, and the longer they hold out the more unpopular will they become. They must realise by now that the B.B.C. stamp, as regards components at any rate, is anathema, not only to the Radio Society of Great Britain, but also to the whole mass of would-be constructors.

At the same time, whatever regulations are put into force, we ourselves have no sympathy with those manufacturers whose sole object is to import cheap foreign components. We believe that the British manufacturer should be fully supported. Firms of all sorts, shapes and sizes have sprung up as a result of the boom in wireless. The methods of many of them are extremely questionable, as also are their products. We sympathise with the resentment of the older established firms which produced experimental wireless apparatus long before any boom was dreamt of. Publishers, manufacturers, dealers of every kind are all turning their thoughts to wireless, in spite of the fact that they have no previous knowledge of wireless.

Whatever the decision of the Committee appointed by the Postmaster-General may be, we trust that the genuine manufacturer of this country will be protected from grossly unfair competition.

The Wembley Scandal

The Post Office, we understand, declined to grant permission to the B.B.C. to broadcast an entertainment to the football crowd at Wembley Stadium. Our special correspondent, in his broadcasting news, suggests that if the B.B.C. had received this permission they would have been able to maintain a little more discipline. We doubt it, but we think that if the Western Electric Company had had their public address system installed instructions could readily have been given. The loud-speaker has infinite possibilities, quite apart from wireless.

THE POSSIBILITIES OF A NEW RECEIVING PRINCIPLE

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.

This article deals with a method of reception which has received practically no attention while affording many possibilities.

The General Principle

IN an ordinary receiver the pitch of the note heard in the telephones bears no relationship to the strength of the incoming oscillations; the only effect obtained is that the stronger the oscillations in the aerial circuit the louder the signals; the actual pitch does not in any way vary.

Moreover, the ordinary methods of reception do not lend themselves to very great degrees of amplification.

It would seem to the writer that if a high degree of amplification is to be obtained some method must be devised whereby a powerful output current may be set into operation by a minute input current by some trigger-like action.

An example of this kind of amplifier is the Turner trigger relay. Unfortunately, very powerful amplifiers of this kind are really relays; the output effects are not proportional to the input currents, and so the devices could not be used, for example, for the reception of telephony signals.

The arrangement about to be described is theoretically a very powerful amplifier or relay; it may be used for the reception of continuous waves without the continuous oscillations being heterodyned, and the most interesting effect is that the pitch of the signals varies with the strength of the incoming currents.

The idea is, briefly, that two valves are used to generate continuous oscillations at the receiving station. A telephone receiver is connected in one of the anode circuits, the grid circuit of the same valve preferably having a leaky grid condenser inserted in it. When the two oscillating valve circuits are placed close together, one will heterodyne with the other if the frequencies are made to approximate. Owing to the beats produced, a musical note will be heard in the telephones. It is possible to adjust the apparatus to the silent point by making the frequencies exactly equal. Under these conditions, nothing whatever will be heard in the telephone receivers, but if the frequency of one of the circuits is altered ever so slightly, beats will be produced, and these, being rectified by one of the valves, will cause an audible signal in the telephones.

If then we can make the incoming signals vary the frequency of one of the oscillating valve circuits, we can make them produce musical signals in the telephone receivers.

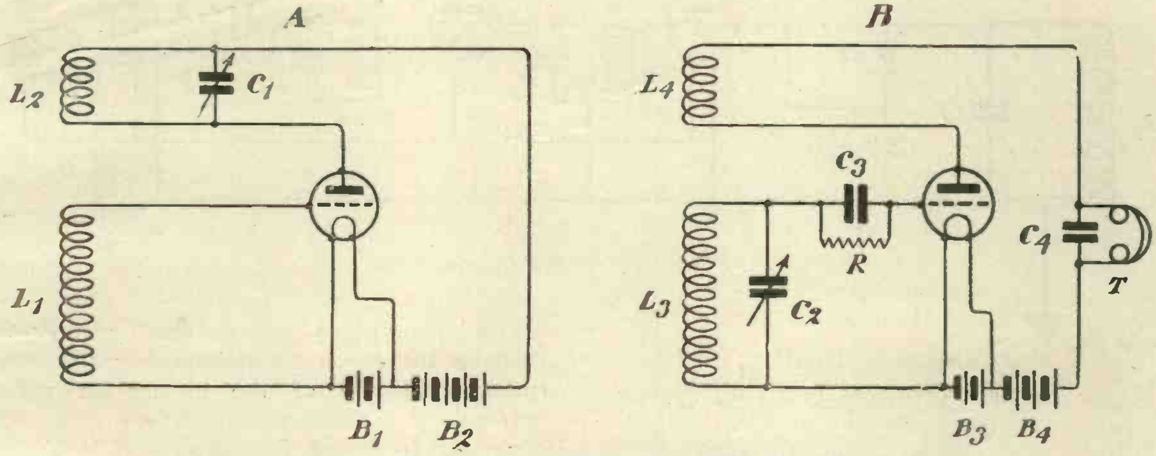


Fig. 1.—Showing two oscillating valve systems, A and B.

The two valves producing the local oscillations could, of course, be made of any size; the greater their power, the greater the response in the telephones.

Fig. 1 shows the two oscillating valve systems A and B. The apparatus marked A is simply an ordinary oscillating three-electrode valve. In the circuit L_2 C_1 we have generated continuous oscillations which are induced into the apparatus B, which is very similar to A but contains telephone receivers T in its anode circuit and also a grid condenser C_3. The beats in L_3 C_2 are rectified, and produce an audible signal in the telephones T when the frequencies of the two circuits are close together.

denser C_2. The varying potentials on the grid of the valve V_1 vary its conductivity, and so upset the balance of frequencies between the two oscillating valves V_2 and V_3. The moment the signals upset this balance, beats will be produced, and these being rectified by the valve V_3 will cause a note in the telephone receivers.

An Interesting Effect

This kind of a circuit will receive continuous wave signals which would be inaudible on an ordinary crystal circuit.

An interesting feature of the arrangement is that the pitch of the notes heard in the telephones will depend upon the strength

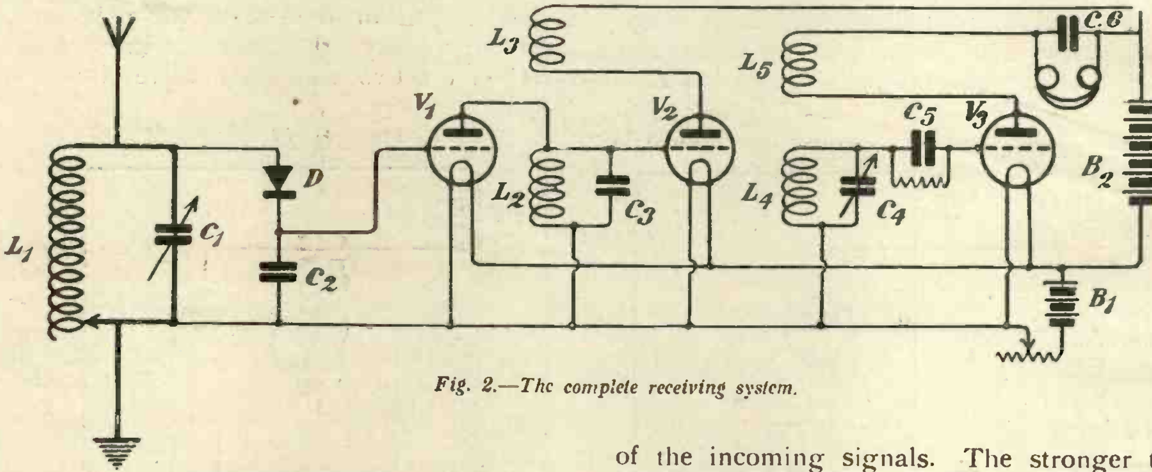


Fig. 2.—The complete receiving system.

A Complete Circuit

Fig. 2 shows a complete receiving system operating on the principle outlined above. In this system the variation of frequency is caused, not by any mechanical means, but by the expedient of connecting an absorbing valve across one of the oscillating circuits. The frequency generated depends not only upon the inductance and capacity of the circuit, but also on the resistance associated with it, and if the filament to anode path of a valve is connected across the oscillatory circuit, any variation in the conductivity of the valve will result in a slight variation of the frequency of the oscillations in the oscillation circuit.

In Fig. 2, the valve V_2 generates continuous oscillations of a given frequency. The valve V_3 also generates continuous oscillations of the same frequency. The valve V_1 is connected across the circuit L_2 C_3.

The incoming oscillations are rectified by the crystal detector D and charge up the con-

of the incoming signals. The stronger the signals, the greater will be the variation of the conductivity of the absorption valve; hence the variation in frequency of the current generated by one of the valves will be greater and the beat note will be higher.

The arrangement might be used for limiting the effects of strong signals, as these would cause such a large variation in frequency that the beats would be beyond the audible limit.

There is a great deal of scope for experimental work in these directions. The arrangement might be used for separating out two stations sending with interrupted continuous waves on the same wavelength. If there were a slight difference in the strengths of the two sets of signals, the pitch of one set of signals heard in the telephones would be entirely different from the pitch of the other set of signals.

NOTE.—Figs. 1 and 2 are based on the illustrations appearing in the author's Patent 171717.

A NEW FRENCH LOUD SPEAKER

It is claimed that this instrument with its very light diaphragm is a perfect loud speaker.

ON November 27th of last year, General Ferrie presented to the French Academy of Sciences a paper on some new developments in loud speakers.

One of the instruments described was installed in one of the corners of the large auditorium, and a demonstration was given after the lecture which convinced everybody of the great superiority of the new apparatus which had just been described. The instrument shown at the meeting was only of medium size, and was designed to amplify sufficiently so as to permit about 6,000 people to hear it. Another type of this loud speaker has been designed and installed on the top of the factory of the Gaumont Company in Paris, for the purpose of demonstrating the extraordinary carrying power of the new instrument, and to give orders which may be heard all over the plant and in the streets surrounding it within almost one-half a mile.

During the demonstration given to newspaper men, it was possible to hear music transmitted from a gramophone, and the voice of the announcer, on a large boulevard where a great number of automobiles and street cars run constantly. In spite of the noise, it was possible to hear every syllable and even the weakest notes played by means of gramophone records. The clearness of the voice was remarkable, and the "s" and "ch" were plainly heard without the whistling noise which generally accompanies these letters when heard through a loud speaker. This is due to the special construction of the diaphragm, which is made of a cone-shaped piece of varnished silk having an opening of 90°, around which is wound in one or more layers a very fine wire of aluminium. This

Fig. 1.—A photograph of the new loud speaker.

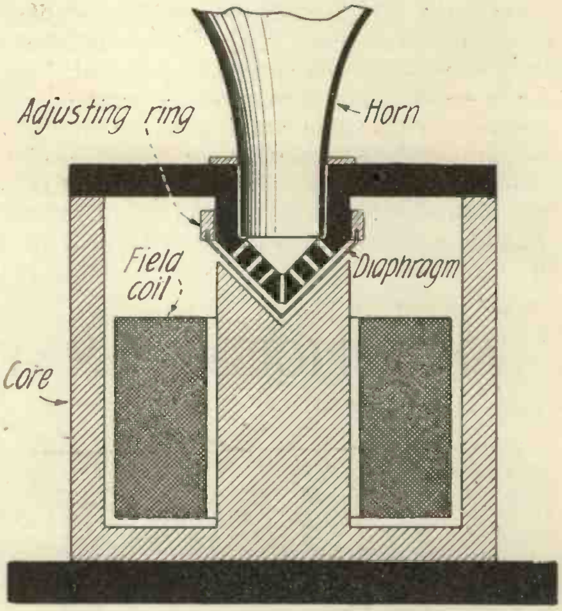


Fig. 2.—A sectional view of the instrument.

cone and coil combination is placed in a very strong magnetic field produced by an extra coil wound around the closed core, as in a well-known type of telemegaphone.

On account of the construction of the main pole-piece, the magnetic gap is extremely small, and the whole of the diaphragm and coil combination is submitted to the influence of the field, ensuring a maximum response even when very weak currents pass through the movable coil. A great advantage of this diaphragm is that it has no natural vibration period of its own, which ensures the perfect production of every vibration of whatever frequency. For the passage of sound, the inside of the pole-piece is provided with small holes, as shown in the diaphragm. These holes open directly inside the horn, which is mounted with a tight fit to the loud speaker mechanism.

The manufacturers of this new loud speaker have succeeded in making the new type of diaphragm in very small sizes which weigh less than two grams including the wire. Since the diaphragm and the coil have the same surface exposed in the field, they are both influenced over the entire surface, producing a greater effect upon the diaphragm than in the systems where they are attracted and repulsed in the centre only. With one of these loud speakers having a small diaphragm, weighing about 2 grams, as illustrated in Fig. 1, it is easy to speak to an audience of over 6,000 persons in a great auditorium so that every syllable is understood by everyone. This gives an idea of the carrying power of this instrument.

Of course, this apparatus is used in conjunction with valve amplifiers, by means of which the voice or music may be amplified up to any desired value. This instrument is the result of more than twenty years of research by the Gaumont Company, which tried to design a perfect loud speaker to be used in conjunction with their talking moving pictures. Every possible system has been tried in the laboratories by the engineers of this company who built a system using the properties of flames, compressed air, and several other systems which were not found satisfactory. The volume obtained was sufficient, but the clearness of the speech and music never satisfied these never-tiring workers, Monsieurs Gueritot and Aschel, who developed the new loud speaker. It is claimed that this instrument, with its very light diaphragm, is a perfect loud speaker.

AN EFFICIENT AMATEUR RECEIVING STATION

By A. S. HARPER.

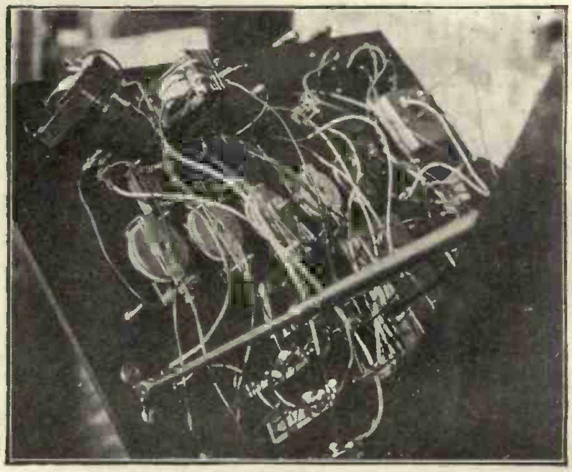
Mr. Harper sitting at his instruments.

THE following is a brief description of the wireless installation shown in the above photograph.

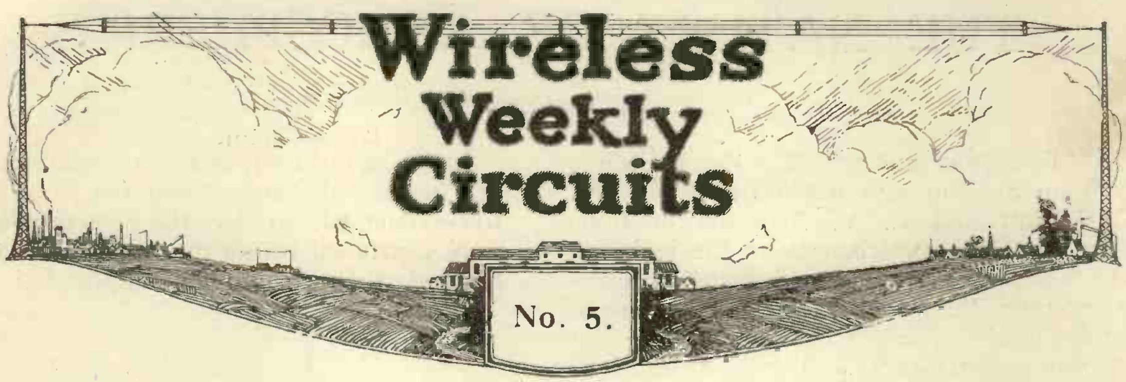
To deal first with the aerial, this is in an open space and free from any screening. It faces North and South, and at one end is supported on a 50ft. mast and at the other end on a 38ft. mast. The length between the two masts is about 40ft., and the aerial consists of a two-wire inverted L made up of 7/22 wire.

The lead-in is taken to the receiver through an ebonite tube by means of heavy rubber covered cable. The actual instrument is arranged to incorporate two high-frequency valves, a detector and two low-frequency valves. The rectifying valve is fitted with a vernier filament rheostat, which is an advantage for fine tuning. The low-frequency transformers have a ratio of 6 to 1. The circuit is so arranged that either of the low-frequency valves can be cut out independently by means of plugs and jacks, and reaction may be effected either in the aerial circuit or on to the tuned anode coil of the first valve. This latter operation is performed by means of a change-over switch. The tuner consists of a large condenser for aerial circuit tuning, a small condenser for secondary circuit tuning, and two additional small variable condensers for anode and reaction tuning. A series-parallel switch is fitted in the aerial condenser circuit. Provision is made for the use of telephones and a loud speaker, either together or separately, and the loud speaker is an home-made device adapted from an old Marine loud speaker.

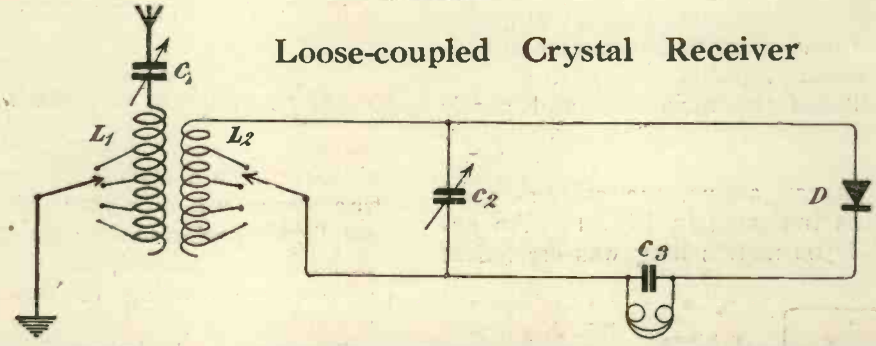
This circuit gives very good results and, even on three valves, all the British Broadcasting stations are audible. The compactness of design of this instrument will be evident from a glance at the photograph.



The internal wiring of the receiver.



Loose-coupled Crystal Receiver



COMPONENTS REQUIRED.

L_1, L_2 : A loose-coupled tuner.
C_1 : A variable condenser having a capacity of preferably 0.001 μF.
C_2 : A variable condenser having a maximum capacity of preferably 0.001 μF.
D : A crystal detector.
C_3 : A telephone condenser having a capacity of about 0.002 μF.
T · High resistance telephone receivers.

GENERAL NOTES.

This circuit employs what is commonly called a "loose-coupled" tuner. These tuners are nothing more or less than oscillation transformers having two inductance coils coupled together. The coupling should be variable. The coils, of course, might be honeycomb coils mounted in a coil-holder, or one cylindrical coil might be made to slide into another of slightly larger diameter. Various methods of constructing such a tuner are possible. Each coil is fitted with several tappings.

Circuits of this kind, if properly constructed and designed, should be more efficient than the ordinary single circuit receivers, but no advantage from this standpoint is obtained on longer wavelengths, such as that on which Paris works (2,600 metres). On the other hand, the loose-coupled tuner enables us to get greater selectivity, i.e., when being jammed or interfered with by signals of slightly different wavelength than the desired signals, it is generally possible, by means of a loose-coupler, to tune out the undesired signals.

VALUES OF COMPONENTS.

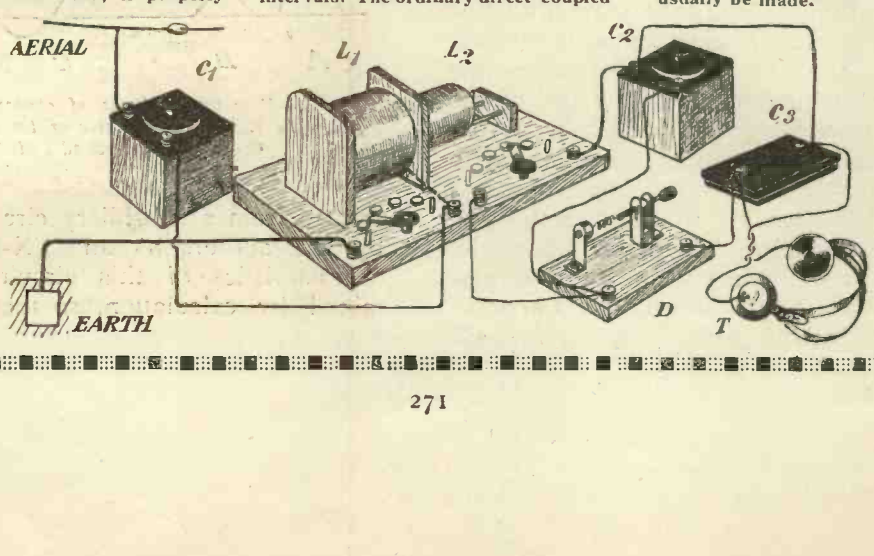
The values of the different condensers have already been given. The inductance coils for broadcasting wavelengths may be as follows :

The inductance L_1 may consist of a cardboard tube 4in in diameter wound for a length of 6in. with No. 22 gauge double cotton covered wire, 12 tappings being taken from it. The inductance L_2 may consist of a cardboard tube 3½in. in diameter wound for a distance of 5in. with No. 26 gauge double cotton covered wire, 8 tappings being taken at equal intervals. The ordinary direct-coupled circuit using a single inductance is recommended for the reception of signals from FL (Paris).

NOTES ON OPERATION.

When receiving signals, the two coils L_1 and L_2 should first of all be closely coupled, i.e., placed one completely inside the other, or, in the case of honeycomb coils, placed close together. The inductance coil L_1 and variable condenser C_1 are now adjusted, the inductance coil L_2 and condenser C_2 being also adjusted.

Considerable skill is required to pick up a station, as both the aerial circuit and the closed receiving circuit (L_2, C_2) must be tuned to the wavelength of the incoming signals. If one or other of the circuits is not so tuned nothing will be heard. Once the signals have been obtained, adjustments should be made to obtain the loudest results. The coupling between L_1 and L_2 is now decreased by separating the coils, and both circuits are slightly readjusted. If the two coils are too loosely coupled, signals will be too weak, although selectivity will be at its best ; a compromise will usually be made.



THE NATURE OF ATMOSPHERICS

Investigations with the Cathode Ray Oscillograph.

AT a recent meeting of the Royal Society an account was given by R. A. W. Watt and E. V. Appleton of some very ingenious experiments on the temporal variations of electric force occurring in radio-telegraphic "atmospherics." The general results produced in a wireless receiving set by atmospherics are well known to every wireless experimenter, but the investigation of the actual field-changes is a matter of considerable difficulty, partly owing to the extreme rapidity of the variations and partly to the smallness of the electric intensities developed.

For the investigations, the authors used the apparatus indicated in Fig. 1. An extended aerial 500 metres long was erected at

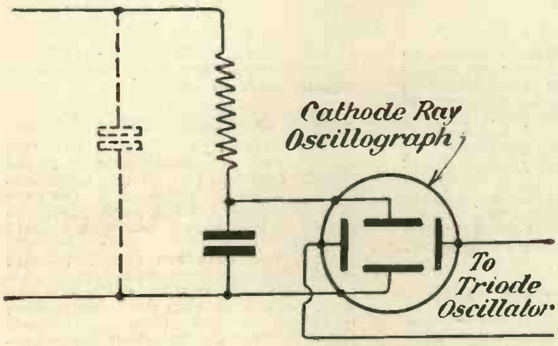


Fig. 1.—General experimental arrangements.

a height of 15 metres above the ground and connected to earth through a resistance and capacity. The terminals of the condenser were connected to two of the terminals of a cathode ray oscillograph, the remaining two terminals of the latter being joined to a triode oscillator. The outstanding feature of the experimental arrangements is the use of the cathode ray oscillograph, which is so extremely rapid in its action as to be able easily to follow variations of the quickness of atmospherics. It is probably well known that the cathode ray oscillograph depends upon the deflection of a cathode stream by a superimposed electric field. The lag in the indications of the instrument is exceedingly small.

It was found that, in order to obtain accurate results, the circuit required to be effectively damped, so that the free oscillations were concluded before the forced oscillations reached their maximum amplitude. The

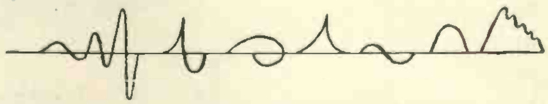


Fig. 2.—Some of the indications given by the cathode ray oscillograph, change-of-field against time.

time-constant of the circuit, in practice, was of the order of $2{\cdot}5 \times 10^{-6}$ second, the free-oscillation period of the apparatus being of the order of 10^{-5} second, and the duration of the atmospherics being of the order of 10^{-3} second.

The principal characteristics of about six hundred typical atmospherics were examined with this apparatus, and some of the characteristic curves obtained are shown in Fig. 2. It was found that about one-half of the atmospherics were quasi-periodic, consisting normally of one complete oscillation, of duration about 2×10^{-3} second, the mean change of field being $0{\cdot}128$ volt per metre, with no marked unbalanced transport of electricity on the whole group.

The faithfulness of the delineations obtained by the use of this receiving apparatus was tested by means of artificial impulses

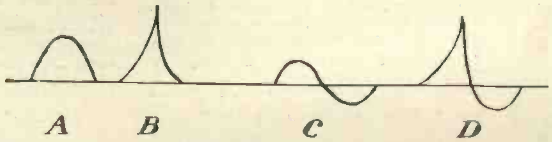


Fig. 3.—Four typical forms of atmospherics; A and B giving the E.M.F. on one side of the datum line only, C and D quasi-periodic discharges.

created from a subsidiary circuit (referred to by the authors as an "X-factory"), the characteristics of this circuit being determined by calculation, so that the expected shape of the curve was known beforehand.

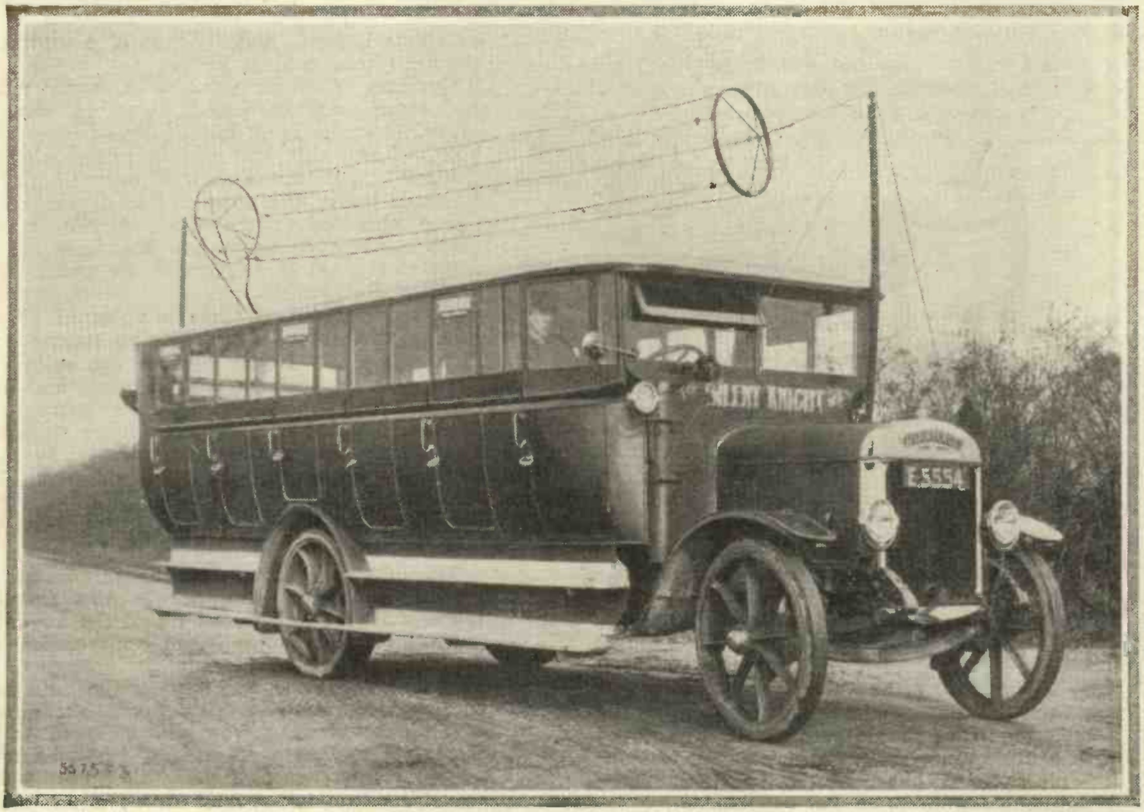
It was found that the cathode ray oscillograph apparatus gave results in good accordance with those which were to be expected.

A second group of atmospherics of almost equally frequent occurrence consists of aperiodic impulses of duration generally about $1{\cdot}25 \times 10^{-3}$ second, but frequently reaching 0·025 second, the mean change of field being 0·125 volt per metre.

An interesting observation made by the authors was that, in about one-eighth of the cases studied, the discharges were in the direction tending to carry negative electricity *from* the earth, and in the remaining seven-eighths of the cases the discharges were in the direction tending to carry negative electricity *to* the earth from the receiving antenna.

For the observations, a visual method was adopted, as it was found that no photographic plate of sufficient rapidity could be obtained.

A NEW DEVELOPMENT



Here is a chance for charabanc owners to show their enterprise and consideration for the welfare of their patrons, the travelling public.

At a relatively small cost suitable receiving apparatus, capable of receiving the broadcast programmes of the B.B.C., may be fitted to any car.

The advantages offered to the public by this novel scheme are too numerous to mention in the space allotted for this illustration Little imagination is needed, however, to understand the pleasure afforded in being able to listen-in to a broadcast concert while speeding along a country road on a warm evening of the now approaching summer.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony." "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART V

(Continued from No. 4, page 210.)

What is a Valve-Holder?

THE valve-holder corresponds to the lamp socket which holds the ordinary incandescent lamp. It usually consists of four tubes moulded into an ebonite base; the top ends of the tubes being flush with the surface of the moulded composition.

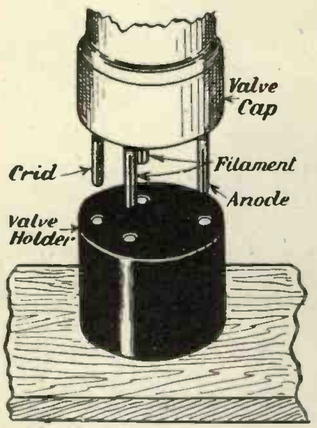


Fig. 1.—The valve legs and valve-holder.

These four sockets are arranged in such a manner that they correspond to the pins in the valve cap. Hence, it is not possible to fit the valve incorrectly into its holder.

Fig. 1 shows how the valve is fitted into a valve-holder, one type of which is shown in this illustration. When using the valve it is important to see that the pins make good contact in the sockets, and they should occasionally be scraped with a knife, and, as the pins are usually split, it is also wise to open them out a little to ensure a thoroughly tight fit in the valve-holder.

What Batteries Does a Three-electrode Valve Require?

In the three-electrode valve we have, as in the case of a two-electrode valve, a filament which is heated to incandescence and which emits electrons. We also have an anode, but the anode circuit is now kept quite separate from the circuit which applies the signals to the valves. In the anode circuit we connect a battery, usually of from 45 volts to 80 volts, across the anode and filament. This battery is known, generally, as the high-tension battery, or anode battery, and consists of a number of dry cells connected in series.

Ordinary flash-lamp batteries connected in series are frequently used, about 15 being required to make up a high-tension battery of 60 volts. When this battery is connected between the anode and incandescent filament of a three-electrode valve, the positive side of the battery being connected to the anode of the valve, a small but steady current will flow from the filament to the anode and round the anode circuit back to the filament.

This current usually has a value of about 2 milliamperes, a milliampere being 1,1,000th part of an ampere. If we increase the voltage on the anode, this current will increase, and if we decrease the anode voltage the current will decrease. We can, however, vary the anode current in a different manner, namely, by applying a voltage across the grid and filament of the valve.

Explain the Action of the Grid.

The grid in a valve is for the purpose of *controlling* the steady flow of electrons from the filament to the anode and round the anode circuit. Its control action is not a mechanical, but an electrical one. The potential voltage of the grid will determine very largely the amount of the anode current; in other words, the number of electrons flowing from the filament to the anode. The effect of the grid will best be understood by reference to Fig. 2. We have here a valve V containing a filament F, a flat grid G consisting of a disc of metal with a large number of holes in it, and another disc A which is the anode. Across the anode and the filament we have a high-tension battery B_2, a milliammeter (M) being connected in the circuit to measure the current in milliamperes flowing in the anode circuit.

An accumulator B_1 is used to heat the filament of the valve. We may assume that the accumulator B_1 has a value of six volts, while B_2 has a value of 60 volts.

It will be seen that the grid G is connected, by a piece of wire, to the negative end of the accumulator B_1. Owing to the fact that the anode A is at a potential of +60 volts, many of the electrons which are emitted from the filament F will be attracted through the holes in the grid to the anode A. Many of the electrons, however, do not get sufficiently far away from the filament to be attracted fully by the anode, and we may assume that they return again to

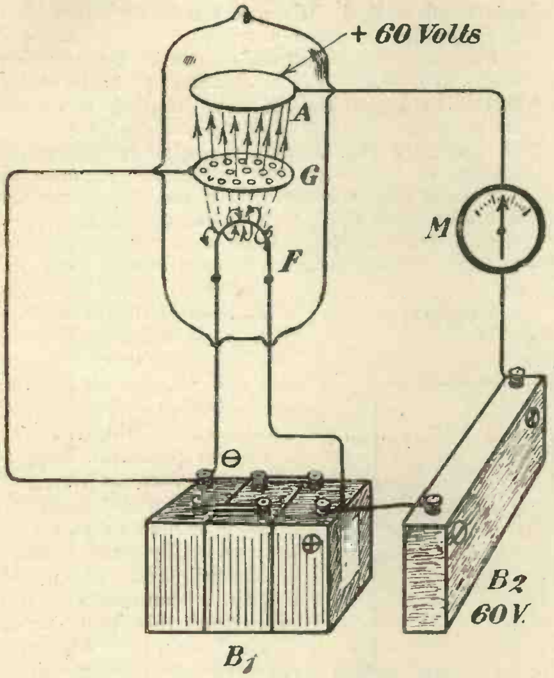


Fig. 2.—Diagram relating to grid action.

the filament. For the time being we will consider that half the electrons go to the anode and half of them return to the filament. By looking at the scale on the milliammeter M, it will be seen that an appreciable current is flowing round the anode circuit, and this current is a measure of the electrons flowing from filament to anode.

Now, leaving the anode circuit alone, we will insert a battery in the grid circuit in order to demonstrate the effect of the grid potential on the anode current.

Fig. 3 shows a similar circuit to Fig. 2, except that a battery B_3 of 4 volts has been connected in between the grid and the negative side of the accumulator B_1. The negative terminal at B_3 is connected to the grid, whereas the positive terminal is connected to the accumulator and therefore to the filament F. The grid is now at −4 volts, and it will be found that the current through the milliammeter has been considerably reduced. This is because the grid, being now at a negative potential, will repel some of the electrons which would have gone to the anode. The negative charge on the grid partially neutralises the positive voltage on A. The electrons which are prevented from getting to the anode A return again to the filament. As long as the battery B_3 is connected in the grid circuit, the anode current will remain at a reduced value.

We thus see that a negative potential on the grid will decrease the anode current. This decrease, moreover, will depend upon the voltage of the battery B_3 in the grid circuit. The greater the negative voltage on the grid, the greater will be the decrease in the anode current, and if we increase the negative grid potential to about −20 volts, we can cut off the anode current completely. This is because the grid is now so negative that it completely neutralises the attractive force of the anode A.

If now we reverse the battery B_3 and connect it so that its positive terminal is connected to the grid and its negative terminal to the filament accumulator, as shown in Fig. 4, we will get just the reverse effect. This time, the grid will be at a potential of +4 volts, and we will notice that the milliammeter M reads a high current value. The positive potential on the grid now helps the anode to draw up electrons from the filament. Some of these electrons are naturally attracted to the grid itself, but the number is very small indeed, partly owing to the fact that the grid voltage is very small compared with the anode voltage and partly because the grid is "nearly all holes." The metal framework is, in nearly all cases, only a very small proportion of the total area of the grid, and the electrons, instead of stopping at the grid, shoot through the holes in it and pass on towards the anode. If we increase the positive voltage on the grid

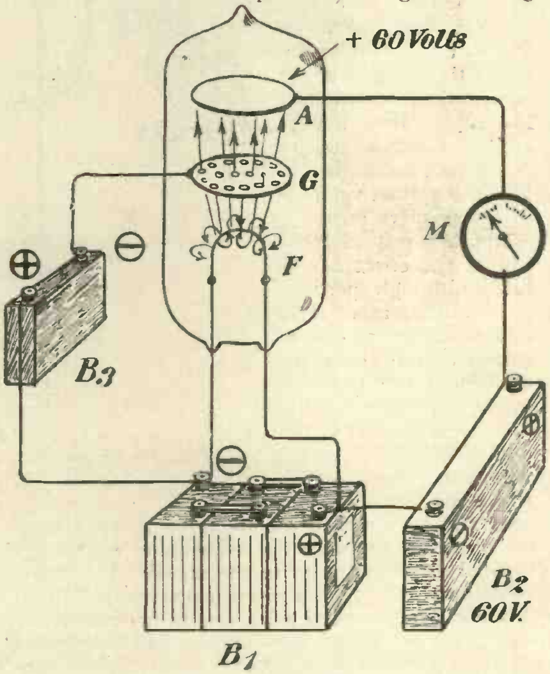


Fig. 3.—A modified circuit relating to grid action.

we will increase the anode current more and more.

What is Meant by "Saturation"?

Saturation point is reached when all the electrons emitted from the filament are going to the anode. We considered in our original Fig. 2 that half the electrons emitted went to the anode, the other half returning to the filament. If, however, we go on increasing the positive voltage of the grid, most of those electrons which reluctantly stayed behind are induced to join in the main stream and pass to the anode. If we keep on increasing the positive voltage of the grid, a point will be reached when the grid has helped all the electrons emitted from the filament to go to the anode and under these conditions the anode current is said to be saturated. Any increase in the positive grid potential will not result in any greater increase of anode current.

What is Meant by "Space Charge"?

The space charge in a valve is the electrical charge exerted by the mass of electrons on their way to the anode. The electrons being negative particles of electricity, the stream of them to the anode acts as a negative charge in the space between filament and anode, and this charge has a restraining influence on electrons which have just been emitted from the filament. Obviously, since the space charge is negative, it will tend to repel the newly-emitted electrons and to counteract to some extent the attractive force of the positive anode.

Another way of looking at the effect of the grid, although perhaps it is a little more difficult to understand, is to consider the grid as modifying the negative space charge in the valve. When the potential of the grid is made negative many electrons are turned back and help to increase the negative space charge and therefore decrease the tendency of the newly-emitted electrons to go to the anode. If, on the other hand, the grid is given a positive potential, this positive potential will largely neutralise the space charge around the filament and the newly-emitted electrons have, therefore, a greater tendency to go to the anode. A high positive potential on the grid will completely neutralise the effect of the space charge, and therefore a large anode current will be the result.

Why Does the Three-Electrode Valve Amplify?

An amplifier might be defined as a device whose output curcuit energy is greater than its input circuit energy, the two, however, having a definite relationship which is more or less maintained; that is to say, if we double the input energy we will double the output energy. As a matter of fact, the input circuit of a valve, which is the grid circuit, absorbs very little energy indeed. This is because the grid has what is known as an "electrostatic" control over the electrons. When we connect a battery across the grid and filament, there is either no current flowing in the grid circuit or one which is negligible for most purposes.

The grid, for example, might be kept at –4 volts by means of a flash-lamp battery for months without the battery running down or discharging. The flash-lamp battery is capable of causing a considerable variation in the anode current of the valve, but not at the expense of any of its own current. If, however, the battery had been used to light a flash-lamp bulb, a substantial current would have been taken from the battery which would have soon become used up.

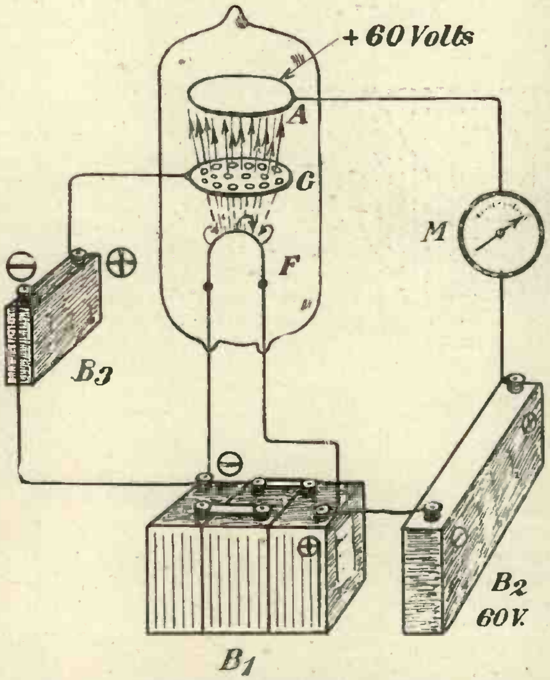


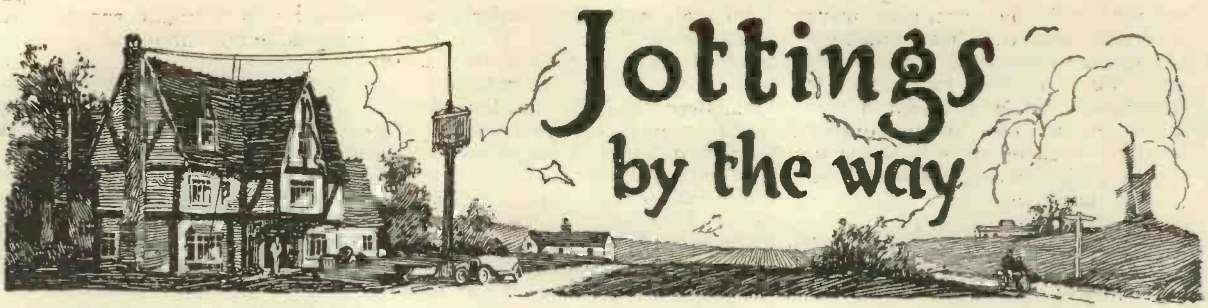
Fig. 4.—Circuit showing positive of B3 connected to grid.

Assuming that there is substantially no grid current, *i.e.*, substantially no flow of current round the grid circuit, we have to consider whether or not energy is used up in giving the grid a certain potential. As a matter of fact, as the grid is made of metal and the filament is also a conductor, the two really form a small condenser, and when the battery is connected in the grid circuit this condenser is charged up; practically no energy is used up in charging this very minute condenser owing to its capacity being so small.

We see, then, that to produce quite large changes of anode current, practically no energy is needed in the grid circuit of the valve.

The only thing that is wanted is a potential difference across grid and filament. Put a little more simply, it is volts we need in the input circuit, whereas we get current variations in the anode or output circuit of the valve. A 60 volt dynamo connected across the grid and filament of the valve would not produce any different change in anode current than a 60 volt dry battery made up of flash-lamp batteries.

The slightest change in grid voltage will cause a large variation in the anode current. We are controlling with very small forces a large force in the anode circuit of the valve. The anode battery supplies the energy for the anode circuit, but this energy does not get mixed up at all with the input energy. The anode and the grid circuits are kept absolutely distinct. In Fig. 3, the anode circuit consists of a filament, anode A, milliammeter M, high-tension battery B_2, and the filament F again. The grid circuit, however, is G, the battery B_3, the filament F.



Breaking Up the Happy Home.

THE wireless wedding has already arrived in America, where people seem to set themselves the task of devising difficult and complicated ways of tying the knot, possibly because its subsequent untying is there such a simple business. So far I have not heard of acute radiomania in either party being cited as a cause for divorce, but in a country where snoring is considered sufficient grounds it is merely a matter of time until it comes. Meanwhile, a lady of my acquaintance has begged me to convey to her sisters her warning against marrying men who show any tendency towards developing the fell disease. Many a happy home, she says, has already been broken up through its baleful influence, and hundreds of others are threatened. In acute cases, it seems, the husband sits all the evening and well into the small hours with a pair of telephone receivers clamped over his ears. The slightest attempt on the wife's part to enter into conversation is met with a frown and sometimes with bitter words of reproach. Even the rustling of a newspaper may provoke an outburst. The clicking of knitting needles goads the victim of the malady to the verge of insanity. His conversation is of a strange type, for the creature prattles incessantly of hysteresis, eddy-currents, conductivity, and things of that kind. At the table he endeavours to explain the functioning of circuits by means of combinations of knife-rests, corkscrews, salt cellars, spoons, forks, and napkin rings. What wounds the feminine heart most deeply, perhaps, is that the drawing-room, in spite of her protests, begins to look like a battlefield generously provided with wire entanglements of a most ingenious nature. Dry batteries decorate the top of the piano, accumulators nestle amidst the china on the mantel-piece, and a miscellaneous collection of such things as pliers, screwdrivers, taps, drills, punches, spanners, and soldering irons is to be found occupying every available resting place. Eventually the wife goes home to her mother, whilst the husband, too absorbed even to notice her absence, continues to tread the downward path.

Looking at the Works.

It has been remarked, too, by careful observers, that the temper of the patient grows steadily worse as the disease makes progress. One marked symptom is a reversion to childhood's fondness for taking things to pieces in order to look at the works. "Give the patient such a thing as a variometer," says a famous medical authority, "and he will at once produce a small screwdriver from his pocket and proceed to eviscerate it." This is all very sad, and I hope you and I, reader, are men of sufficient strength of character to avoid the fate that awaits our unfortunate weaker brethren. Meanwhile, I must hurry up with this writing, for I want before I go to bed to have a peep inside a note-mag. panel that a friend has lent me to try.

Odds Against.

Even for its sane votaries such as we, wireless has its trying moments. Nothing can be more nerve-racking than a visit from friends who have dropped in specially to hear what the set that you have so often extolled can do. A quarter of an hour before they came the set was giving results of unprecedented excellence. You left it tuned to 2LO's wave, so you switch on with a confident smile. The result may be all manner of things, but it is precisely 9,437,624 to 1 against its being a clear and undistorted flow of speech or music from 2LO. If during the previous week you have delivered yourself before the members of the wireless club of a speech vehemently denouncing the crime of oscillating, it will be a howl infinitely more melancholy than the wailing of the damned. As a rule, however, nothing at all happens. One proceeds on hands and knees to examine battery connections whilst the "friends," now objects of hatred and loathing, nudge one another and smile sardonically. Eventually, after half an hour of blind fury, during which portions of the set are dismantled in a fruitless search for the fault, one remembers that the earthing switch was thrown over at the end of the previous reception because it looked rather like thunder. Whenever I read an article by an expert telling me how to trace out and rectify any fault in a matter of a few seconds, I long to discover his address and to call upon him one evening for a demonstration. I picture myself sitting with a fixed grin of joy whilst he gropes and fumbles and mutters and explains how well the thing was working up to the very moment of my arrival. A beautiful thought, you will agree!

Popularity.

Perhaps the entertainment that he himself provides—"representation of a strong man battling to repress his emotions"—explains partly the rapid rise to popularity of the man who installs a wireless set. In any case, he finds he has a constant flow of evening visitors who gradually steer conversation round to wireless topics and then hint that a demonstration would be appreciated. With such people there is only one course. Explain at once that the accumulator is away being charged, that all your valves are burnt out, that the aerial fell into the greenhouse during last night's gale, or that a mysterious fault causes blue flames to spout from the receivers when the set is switched on. Do not give way; otherwise you will hear two men telling each other in the train a few days later of the excruciatingly funny experiences that Jones had when he went to hear a friend's wireless set. You will have no trouble in identifying the friend.

Ruinous Bargains.

If you want bargains (and who in these days of national impecuniosity does not?) you are likely to find them in those shops which deal in Army surplus goods. All apparatus made for the Government during the war was the best in material, design, and workmanship that could be obtained. Some of it has deteriorated considerably through being stored for long periods under bad conditions, but on the whole there is a wondrous variety of really sound stuff. I picked up a week or two ago a heterodyne wavemeter for a couple of "Fishers," some first-rate low-resistance telephone receivers at half-a-crown a-piece, and a neat little 300 ohm potentiometer for 4s. 6d. The wavemeter is worth the money even if one pulls it to pieces for the sake of the condensers, switches, plugs, and other beautifully-finished gadgets that it contains. Another bargain is to be found in the stranded steel telephone wire, thousands of miles of which were used during the war. Sixpenn'orth sufficed for the stays and halliards of my aerial. One word of warning, though. When you go to one of these shops either don't take more than a pound or two with you, or urge your wife to accompany you so that she may exercise a restraining influence. Many a wireless man's family has suffered the pinch for weeks because he well-nigh ruined himself by saving money on bargains!

Fading.

You have no doubt made the acquaintance of the phenomenon known as fading, one of those little trials in the same category as atmospherics, earth noises, and inductive effects, which have been specially designed to aid the wireless man in the development of self-restraint. If you exclaim that you have not, you had better touch wood without delay. What happens is this: A signal that has been coming in perfectly begins to lose strength, just as the noise made by a train dies away as it recedes into the distance. Naturally, you suspect the set of misbehaviour. You apply the voltmeter to the batteries and make all manner of tests, none of which discloses anything wrong—simply because there is nothing of the kind to disclose. The cause of fading is not definitely known, but it is believed that it is produced by certain atmospheric conditions. It may be due, too, to the action of an oscillating aerial in your neighbourhood. This I have proved over and over again by means of experiments conducted upon two aerials slung within 100 yards of each other. If one set is just oscillating the other's signal strength suffers a marked reduction.

Watch Your Valves.

Old valves need a certain amount of watching or they may develop a variety of undesirable traits. A senile filament will often pass an alarming amount of current, so if your accumulators seem to be journeying too frequently to the charging station it is as well to see what the ammeter has to say. A certain amount of softening is also liable to take place through the emission of gases from the metal parts within. When this occurs it brings two results in its train. The valve will not work well as an amplifier, though it may give wonderful results if it is transferred to the rectifying unit. Therefore, if after a time your signal strength begins to show signs of falling off, try the effect of inserting a new valve into each of the amplifying components in turn. If the placing of the new valve in one holder makes an improvement, the valve for which it is substituted is the culprit and should be kept thereafter for rectifying duty. The other effect of softening is to lower the impedance of the valve so that it may be passing an undesirably large amount of current in the plate-filament circuit. I suspected an old V24 the other day, and when the milliameter was applied I found it was passing 10 milliamps.

Duplex Telephony.

We are promised great developments in the way of duplex working with wireless in the near future. At present a wireless telephone is a very one-sided affair. You can call the other fellow anything you like and he cannot retaliate until you choose to switch over from "send" to "receive"; and even then he is not sure that you are listening to the winged words of his retort, since if you dislike his opening remarks you can simply switch off altogether. Dozens of systems have been tried, but none of those of which details are known has been a complete success. The first man to bring out a really reliable method of duplex working that can be installed at reasonable cost, should reap a large fortune.

Do You Howl?

The interference that one has to suffer from other people's oscillating receivers is one of the most annoying things in wireless. If only enthusiasts would realise how many people's enjoyment a single reradiating set can spoil they would, I think, be more careful about it. There are two certain tests that everyone can and should apply to his set whenever he is using it for broadcast reception. Here is the first: Wet the forefinger and tap the aerial terminal; if there is a "plop" in the 'phones whenever the finger touches or leaves the terminal the verdict is "guilty," and you must at once proceed to stop the nuisance by loosening the reaction coupling and taking such other measures as may be necessary. The second test is this: When a subdued howling is heard move the knobs of your tuning condensers a little in either direction, if by doing so you turn the tiny immature howl into a fully-fledged one, then you're it. Your set is making that howl and people within quite a large radius are heaping curses loud and deep upon your unknown but none the less offending head. Possibly you are adding to the woes of the already sufficiently distracted.

WIRELESS WAYFARER.

THE RESONANCE PRINCIPLE AND ITS APPLICATION TO WIRELESS

Readers who have any difficulty in appreciating the importance of selectivity in their receiving apparatus should not fail to read this article.

IN this article a phenomenon will be discussed which is of paramount importance, and which, in fact, is the basis of all radio design and operation of transmitting and receiving circuits. This phenomenon is *resonance.*

The idea of resonance can best be obtained and grasped from the following mechanical illustrations: If we take a pendulum and strike it with a given definite force at certain intervals the pendulum will swing through a certain amplitude. As we vary the frequency at which we strike the pendulum, all the while keeping the force the same, the amplitude through which the pendulum swings also varies, and at a certain particular frequency the amplitude is a maximum. This occurs when the frequency of striking the pendulum is the same as the natural frequency of vibration of the pendulum. This condition of equality of frequencies is known as the "resonant" condition or, simply, "resonance." The effects produced in the resonant condition are much greater than otherwise, or, in other words, resonance between the applied impulses and the natural frequency of a system leads to the maximum effects being produced. It is for this reason that at resonance the pendulum swings through a much larger amplitude than it does otherwise

The reader will perhaps recall having read of occasions when the passing of troops over wooden bridges has resulted in damage to the bridge. The reason for this is explained by the "resonance principle," and will help to clarify the idea of resonance. Every bridge has a certain natural period of vibration, and if forces are applied to the bridge it will vibrate, although the swing of it may not be perceptible. Now, when a troop of soldiers marches over a bridge the impact of the feet on the bridge is great and the bridge does vibrate. When the soldiers march in step the impact is greater than otherwise, since they strike in unison, and the bridge vibrates more strongly. Ordinarily no harm can come of this, but it sometimes happens that the natural vibration period of the bridge is equal to, or almost equal to, the frequency at which the soldiers are marching. Thus a state of resonance is obtained between the bridge frequency and the marching time of the soldiers. As a result, in accordance with the resonance principle explained in the previous paragraph, the bridge swings through a much greater amplitude than ordinarily, which is not safe for it, and damage, therefore, occurs. In order to avoid this, when soldiers march over bridges they fall out of step, thus preventing the occurrence of resonance and danger.

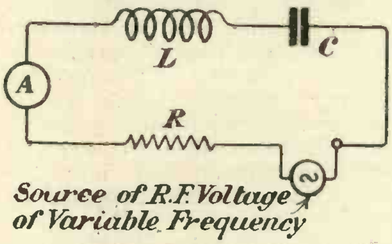


Fig. 1.—Representation of a receiving circuit, including inductance, capacity, and resistance.

From the illustrations given the reader will be able to understand the idea underlying the resonance principle: That it is a condition of harmony between the natural frequency of a system and the frequency of an applied impulse such that the effects produced have the greatest possible value.

In studying the phenomenon of resonance in a wireless circuit the effect produced, and to be considered, is most commonly the current flow in the circuit. Suppose we have in Fig. 1 a circuit consisting of an inductance L, capacity C, an ammeter A, and a variable frequency source of electromotive force. Keeping everything constant except the frequency of the applied voltage, it will be found that as the voltage frequency is varied the current registered by the ammeter also varies. At one particular frequency of the voltage it will be found that the current in the circuit is a maximum. This frequency is the "resonant" frequency; *i.e.*, the natural frequency of the circuit, and the very large current at this frequency is due to the maximum effects produced by the resonance condition.

Exactly what happens in a radio circuit, like Fig. 1, when it is in the resonant condition? We know that in a radio circuit the current is limited by the total impedance of the circuit, which includes ohmic resistance R, the indicative reactance of L, and the capacity reactance of C. As resonance is accompanied by a maximum of current, it follows that the total impedance at the resonant frequency must be a minimum. This is exactly what takes place. What happens is that at the resonant frequency the reactance of L exactly neutralises the reactance of C (since their effects are opposite), thus leaving only the ohmic resistance R to limit the current. At other frequencies there is an effective reactance which adds on to the resistance, thus resulting in lower currents.

Not only can a wireless circuit be in resonance with a generator source of voltage, but it may also be in resonance with other circuits. Thus, Fig. 2 represents two circuits coupled to each other, and if these two circuits are tuned so that their frequencies are the same, they will be in resonance with each other. The primary condition for resonance between any two systems is, therefore, equality of frequencies. As in the above case, when the two systems are in resonance there is a maximum current flow and a maximum effect produced by one circuit on the other. It will be immediately evident why in both transmitting and receiving circuits the primary is always tuned to the secondary. When you read about sets containing two or three circuits and are told to tune each circuit to the same incoming frequency, the principle underlying this design and operation is the resonance principle. Tuning to the same frequency brings all the circuits of a set into resonance, hence produces maximum effects and currents, and in this way maximum radiation from a transmitting aerial or maximum signal in the telephones will result. It should be borne in mind that nothing is done in the design and operation of good sets without some real substantial basic reasons.

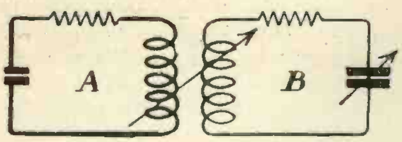


Fig. 2.—Circuit B may be tuned to resonance with circuit A.

Resonance will be found to be one of the main corner-stones of the radio art.

In order to visualise what this resonance is and means, we can plot graphically a so-called "resonance" curve. If in the circuit of Fig. 1 we measure the currents corresponding to different frequencies of the voltage, while the value of the voltage remains constant, and then plot current against frequency, a curve such as Fig. 3 will be obtained. This curve is very instructive. It will be seen hat at one frequency, namely, f_0, the current is a maximum. This frequency is the resonant frequency, and is the natural frequency of circuit Fig. 1. The point on the curve showing this resonant condition is called the resonance point. As soon as the frequency is altered, so that it is somewhat removed from the natural frequency of the circuit, the current in the circuit is immediately reduced to much lower values. This will at once make clear how in practice tuning out is accomplished. Suppose it is desired to receive 200-metre experimental transmission and to eliminate interferences from special stations transmitting near this wave. The receiver is tuned to resonance with the 200-metre wave, and hence is operating on the resonance point of the resonance curve of that particular receiver, and is receiving at maximum intensity on account of resonance. Now if a 250-metre wave strikes the aerial and receiver, it will be in the position of f_2 or f_4, and hence will produce a very small current in the receiver, and will be very small compared with the received current at 200 metres, namely, f_0, in Fig. 3. As a result, the signal due to the 200-metre wave is so loud that other waves are thereby drowned or produce no effect on the receiver. In this manner tuning out is accomplished in reception.

The reader will immediately stop to wonder why some particular sets which he has heard did not tune out other signals. This question is a pertinent one, and will now be considered. In order to understand why some sets do tune out undesirable signals and others do not, let us consider for a moment the effect of resistance on the resonance curve of a circuit.

Suppose we take a resonance curve for Fig. 1 for three different values of R, say 2 ohms, 7 ohms, and 13 ohms. These curves will have the appearance of Fig. 4, in which each curve is properly labelled. It will immediately be seen that there is a marked contrast between these curves. When the resistance of the circuit is low, 2 ohms, the resonance curve is very "sharp," the peak is very conspicuous, and a small variation in frequency from the resonant frequency produces a large drop in current. Hence in such a receiver it will be possible to tune out stations which are only slightly different in frequency from the resonant frequency to which the receiver is tuned. Maximum, or nearly maximum, current is only received over a small range of frequency. Any other frequency of incoming waves produces a smaller

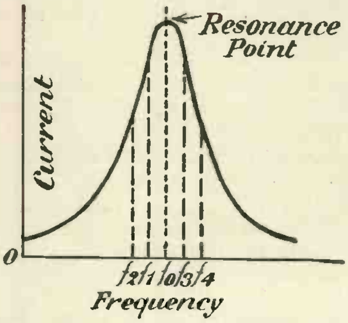


Fig. 3.—A curve illustrating the current that would flow in circuit Fig. 1 at different frequencies.

effect on the receiver, and hence will not be heard. In other words, low damping gives a highly desirable resonance curve and permits of very selective tuning.

The resonance curve for 7 ohms resistance is seen to be not so "sharp." It will be observed that the peak is spread over a considerable range of frequencies, so that even if you are tuned to 200 metres, say, a wave of 240 or 160 metres may produce almost as great an effect on the receiver, and hence will not be tuned out. Thus a high damping produces "broad" reson-

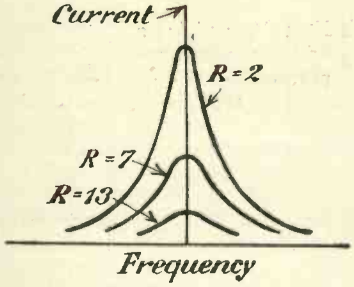


Fig. 4.—A resonance curve for Fig. 1 with three different values of R.

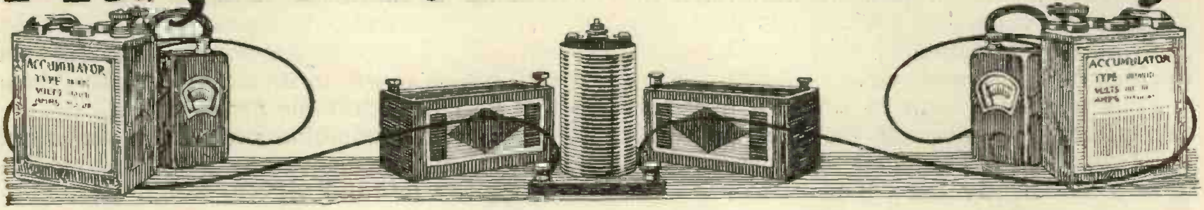
ance curves, and does not permit of very selective tuning. The resonance curve for 13 ohms brings this out more vigorously, for it will be seen that it is almost flat, there being hardly any peak.

This, then, is the difference between a good set and a bad set. The highly selective set, the set that enables you to tune anyone out you do not want to hear, is the set with the very sharp resonance curve. It is the set that is extremely well designed and has a very low damping. The set that does not permit you to tune out any station you do not want to hear is the set with the broad resonance curve, the set that has high damping. The set with a sharp resonance curve is the best. In fact, the very best sets are those that permit very selective tuning.

Almost all measurements which are made in radio are based either directly or indirectly upon the resonance principle. In fact, the most important measuring instrument used in wireless is based on this principle, namely, the wavemeter. The wavemeter consists practically of a coil and condenser, and is tuned to different frequencies and calibrated. All measurements are based upon bringing the measured circuit into resonance with the wavemeter and noting the frequency of the wavemeter. Measurements of capacity, inductance, resistance, decrements, coupling coefficients, and so on, are made by means of the resonance principle.

Another important application of the resonance principle is in the design of filter circuits.

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART V

(Continued from No. 4, page 217.)

THE terms "conductor" and "resistance" are used more or less indiscriminately. Any material body which conveys electricity is a conductor, but always possesses the property of electrical resistance. It is just the same whether we speak of connecting conductors or connecting resistances together, except that in the latter case we are definitely thinking of their electrical resistance. Conductivity and resistance are inversely proportional to one another, just as "lightness" and "weight" are inversely proportional. Thus we may say that aluminium is lighter than lead, or lead is heavier than aluminium, and, similarly, copper is a better conductor than iron, or iron has a higher resistance than copper.

Batteries in Series

The arrangement of cells in series was briefly referred to in the last article, and it was shown that on connecting the negative plate of the first cell to the positive of the second, and so on, the E.M.F. of the whole battery is equal to the sum of the E.M.F.'s of the individual cells.

It is not always convenient to keep connecting or disconnecting cells for the purpose of making up a battery of the exact E.M.F. required for any particular purpose, and so in practice we generally have the cells permanently connected together. A permanent connection is made to one end of the battery, and a movable connection may be attached at any suitable point so as to embrace a sufficient number of cells to give the required voltage. This is the arrangement which is used in the "high-tension" battery of a wireless valve circuit.

Batteries in Parallel

Just as resistances may be connected side by side or "in parallel" as it is called, so electric cells can be connected with the positive terminals all together and the negative terminals all together. In this case the cells are equivalent to one large cell having the same E.M.F. as each of the individual cells (assuming that the cells are of the same kind, and therefore all have the same E.M.F.). The

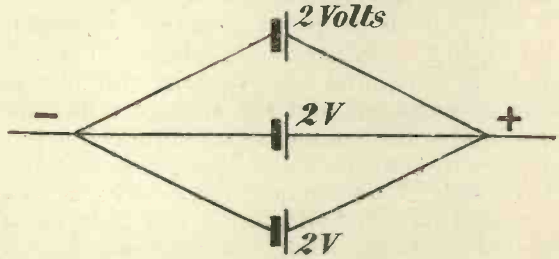


Fig. 1.—Showing cells connected in parallel.

reader may think that since the E.M.F. is not increased by connecting cells in parallel, there is no advantage to be gained. The advantage, however, is that the battery of cells in parallel has a correspondingly *larger current capacity*. For example, suppose we had an electric accumulator of E.M.F. 2 volts which was of such a size that its normal output was 2 amperes, and we wished to supply a current of 10 amperes at a voltage of 2 volts. If the accumulator in question were connected to the circuit it would give a current of 10 amperes for a short time (since it has the necessary E.M.F.), but as the current would be much in excess of the normal rate of output for the cell, the latter would quickly be damaged; but if we have four other such cells, and we connect the five cells together in parallel in the circuit, we still have the necessary 2 volts, but each cell is now only contributing 2 amperes, and is, therefore, working at its normal rate.

Thus when we wish to produce a certain current through a circuit, we must (if necessary) connect cells together in series until we have a sufficiently high E.M.F. to send the required current through the resistance of the circuit, but as the same current goes through each cell we must be sure that each cell is capable of delivering that current. When, on the other hand, the resistance of the circuit is such that the voltage of one cell is sufficient to produce the required current, but that current is beyond the normal power of the cell, we must connect other cells in parallel so that each contributes such a proportion of the total current as is within its power.

Series—Parallel Arrangement

Of course, there are some cases where we have to adopt a mixture of these two methods of connecting cells. For example, suppose we had a number of 2-volt accumulators, each rated for a normal output of 2 amperes, and we had a circuit of 2 ohms resistance, in which we wished to produce a current of 3 amperes. By Ohm's Law it will require an E.M.F. of 6 volts to produce 3 amperes through a resistance of 2 ohms. Thus the amperage required is beyond the normal capacity of each cell and the voltage required is also above the voltage of a single cell. How are we to connect the cells for this purpose? Obviously if we connect three cells in series we shall have 6 volts which will give the required current, but the current flowing through each cell will be 3 amperes, which is above its normal rating. If, however, we take a second set of three cells in series and connect the second set in parallel with the first set, we now have 6 volts producing 3 amperes, but only $1\frac{1}{2}$ amperes are passing through each cell, which is within its rating and, therefore, this will be a suitable arrangement.

By various combinations of the series and parallel arrangements, any particular requirements can be fulfilled.

The reader should now work carefully through the following exercises, so as to accustom himself to the application of Ohm's Law, and to the arrangements of batteries and resistances. Other examples can easily be made.

EXAMPLES.

1. What current will be produced in the following cases:—10 volts in a circuit of resistance of 3 ohms; 5 volts on a 25 ohms circuit; 1 volt on a 2,000 ohms circuit; 2 volts on a 10,000 ohms circuit? Ans.: $3\frac{1}{3}$ amperes, $\frac{1}{5}$ ampere, $\frac{1}{2}$ milliampere, $\frac{1}{5}$ milliampere.
2. What are the resistances of the circuits when:—4 volts produces 2 amperes; 10 volts produces 25 amperes; 6 volts produces 1 ampere; 1 volt produces 1 milliampere (that is, one-thousandth of an ampere)? Ans.: 2 ohms, $\frac{2}{5}$ ohm, 6 ohms, 1,000 ohms.
3. What E.M.F.'s would be required to produce 2 amperes through 4 ohms; $\frac{1}{2}$ ampere through 40 ohms; 1 milliampere through 2,000 ohms; $\frac{1}{2}$ milliampere through 30,000 ohms? Ans.: 8 volts, 20 volts, 2 volts, 15 volts.
4. How many 2-volt accumulators will be necessary to produce 3 amperes through a resistance of 12 ohms? Ans.: 18 accumulators in series.
5. If primary cells of 1 volt and an output of 1 ampere were substituted for the accumulators in the last question, how many would be required (neglect the resistance of the cells themselves) and what would be the arrangement? Ans.: 108 cells in three batteries, each battery containing 36 cells in series, and the three batteries being arranged in parallel.
6. If three pieces of nickel wire, each of a resistance of 10 ohms, are connected in parallel, what is their combined resistance when connected in series and in parallel? Ans.: $3\frac{1}{3}$ ohms, 30 ohms.
7. If a piece of copper wire has a resistance of 39 ohms, what would be the resistance of a piece of iron wire of the same dimensions? Ans.: 226.5 ohms.

ELECTROSTATICS

Before proceeding further with the study of current-electricity and electro-magnetism, it will be useful to retrace our steps now and give some attention to electricity at rest, or "electrostatics," as it is called.

It is usual in text-books on elementary electricity to deal with electrostatics and with current-electricity in entirely separate sections of the book. In lecturing to students, however, I have found that this practice, although no doubt convenient to the authors, frequently leads to confusion in the minds of their readers. The beginner is apt to get the impression that the electricity which is stored upon a charged ebonite rod (for example) is something different from that which flows from an electric battery. This idea, of course, is entirely erroneous. The electric current which flows along a conducting wire connecting two oppositely charged spheres—in the classical electrostatic illustration—is identical with the current which flows along the conducting wire between the poles of a battery, and is attended by precisely the same phenomena, such as heat-production and the establishment of a magnetic field, which we were considering in the last article. I want the reader, therefore, to free his mind of any idea that so-called "frictional" or "static" electricity is in any way different in nature from voltaic or current electricity.

Electrical Attraction and Repulsion

The simple facts of electrical attraction and repulsion are too well known to need much consideration here. If two bodies are charged with electricity of opposite sign they attract one another, and if charged with electricity of the same sign they repel one another. A simple instrument based upon this principle may be used for indicating the potential to which a body is raised by an electric charge upon it. This instrument is known as the electroscope, and consists essentially, as shown in Fig. 2, of a strip of gold leaf about four inches long, sitting across a wire support so that about two inches of the leaf hangs down on each side. The wire is conveniently mounted by being inserted through a rubber stopper into a wide-mouth glass bottle, which protects the gold leaves from air-draughts. If a charge of electricity is communicated to the wire, and therefore to the gold leaves, the latter will repel each other, since they are similarly charged, and they will also be attracted towards the walls of the bottle. The greater the amount of the electric charge communicated to the wire and gold leaves, the higher the potential to which they will be raised, and the greater will be the divergence of the leaves.

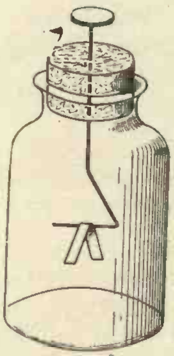


Fig. 2.—Simple form of gold-leaf electroscope.

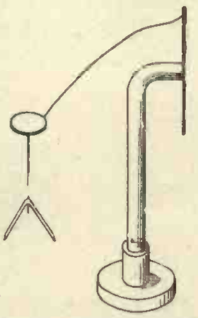


Fig. 3.—Charged metal plate on insulating stand connected to electroscope, showing divergence of leaves.

This simple instrument is very useful for studying the potential of a body under different circumstances. Suppose we have a circular metal plate supported on an insulating stand as shown in Fig. 3, and connected by means of a wire to the gold-leaf electroscope. If an electric charge be communicated to the metal plate, the charge will distribute itself over the whole system, including the gold leaves.

Electrical Capacity

Now any material system has the property known as "electrical capacity"; without going into an exact definition of capacity, we may say that the larger the electrical capacity of a system, the greater the amount of electricity which must be communicated to it to raise its potential by a given amount. This will be easy to understand if we think of the temperature analogy. If we wish to raise the temperature of a pint of water 1 degree, a certain amount of heat must be communicated to it. If we have a gallon of water and we wish to raise its temperature 1 degree, it will be obvious that each of the eight pints of water in the gallon will require the same amount of heat as the first pint, so that the gallon will require eight times as much heat as the pint to raise its temperature 1 degree, or in other words the heat capacity of a gallon of water is eight times that of a pint of water.

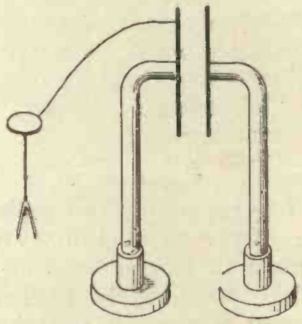


Fig. 4.—A second plate close to the first increases the capacity, and lowers the potential for the same charge, as shown by smaller divergence of leaves.

The *electrical* capacity of a body, however, has the very peculiar property that it depends not only upon the body itself, but upon the proximity of other bodies, and the capacity of a body is increased when other bodies are brought near to it. If the metal plate in Fig. 3 has a certain electrical charge communicated to it, the leaves of the electroscope will diverge to a definite extent, indicating the potential of the plate. Now let another similar plate be brought up and placed near to the first plate, as shown in Fig. 4. According to what has just been said, the capacity of the plate which is connected to the electroscope will be increased and, therefore, it will require a larger charge of electricity to raise its potential to the same degree as originally. Or, to look at the matter in a different way, the same charge as was originally given to it will not now be able to raise its potential to the same degree. If, therefore, no further charge be given to the plate, its potential will fall when the second plate is brought near to it and the divergence of the gold leaves will be diminished, as shown in Fig 4.

It will be seen that a body may be made to store a much larger charge of electricity by bringing it into close proximity with other

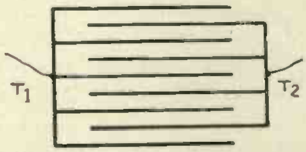


Fig. 5.—Arrangement of parallel plates forming a condenser. T_1 and T_2 represent the terminals.

bodies. This property is very useful in many practical applications of electricity, and is of fundamental use in wireless telegraphy. An arrangement of material bodies in close proximity with one another, for the purpose of increasing their electrical capacity, is called an "electrical condenser," or more simply, a "condenser."

Capacity of a Condenser

The capacity of a simple condenser consisting of two parallel metal plates, such as those shown in Fig. 4, depends upon the area of either plate, their distance apart and the nature of the material between them. The larger the plates, the greater the capacity; the closer together the plates, the greater the capacity. This is conveniently expressed by saying that if K is the capacity of a condenser,

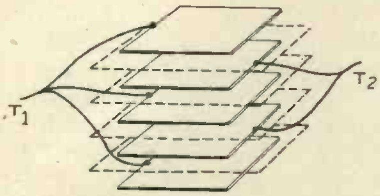


Fig. 6.—Showing method of construction of a fixed condenser. Sheets of tin-foil are interleaved with sheets of waxed paper or mica.

A the effective area of the plates, and d the distance between them

$$K \text{ is proportional to } \frac{A}{d}.$$

It is not usually convenient to make a condenser with large plates, but a condenser of considerable capacity may be made by interleaving a number of small plates connected together in parallel, alternate plates being connected to one terminal of the condenser and the remaining plates to the other terminal. The separate plates are insulated from one another by means of suitable insulating material. A type of condenser frequently used in wireless apparatus is that illustrated in Figs. 5 and 6, which consists of layers of tin-foil separated by sheets of waxed paper or mica. The arrangement of sheets of tin-foil and paper or mica can be compressed and, owing to their very small thickness, a condenser of considerable capacity may be made to occupy only a very small space.*

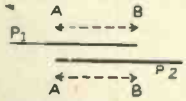


Fig. 7.—Two plates of a condenser P_1 and P_2. The "effective area" is approximately represented by AB.

Variable Condensers

The type of condenser just considered is of fixed capacity, but variable condensers may be made, and these also are of great importance in wireless. It has been stated that the capacity of a condenser is proportional to the effective area of the plates; this means, roughly speaking, the areas of the plates which are opposite to each other. For example, in Fig. 7 the effective area would be approximately AB. This circumstance provides a convenient method of making a condenser whose capacity may be varied. For if a number of parallel semi-circular metal plates (or "vanes") be fixed in position and another set of parallel semi-circular vanes be connected to a spindle as shown in Fig 8, it will be evident that by rotating the spindle, the area of the movable set of vanes which

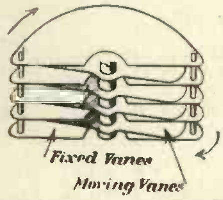


Fig. 8.—A common form of variable air condenser. One set of semi-circular vanes may be moved in and out of a set of similar fixed vanes.

is interleaved with the fixed set of vanes may be varied and the capacity of the condenser may thereby also be varied.

* The unit of capacity is the farad. This is much too large for ordinary purposes, however, and the common unit is one-millionth of a farad, which is called a microfarad and is written μF. Condensers used in amateur wireless receiving sets are frequently of a capacity of about one-thousandth of a microfarad.

AN INDUCTIVELY COUPLED CRYSTAL RECEIVING SET

By E. REDPATH, Assistant Editor.

Readers who are not entirely satisfied with the results afforded by their direct-coupled crystal set, especially in the matter of selectivity, will find the following article of considerable assistance.

IN this present article the writer intends to depart somewhat from the usual methods adopted in describing the construction of a set of any kind by explaining the considerations which determine the design of the principal components of the set.

Probably many readers will, at some time or other, have desired to construct a receiving set which would be particularly efficient for a certain purpose. Although there is at present a comparatively large amount of literature available on the subject, it frequently happens that the designs given do not entirely meet the requirements of the case.

In describing the construction of an inductively coupled crystal receiving set suitable for the reception of broadcasting, the preliminary considerations and methods of testing will be described, so that for any other similar set which it might be desired to construct later, readers will be enabled to do the necessary experimental work.

General Considerations

In the case of the receiving set now to be described, the first consideration, of course, is that of "range of wavelengths." The broadcasting wavelengths range from 353 to 425 metres; so, allowing a reasonable margin at either end of the scale, the tuning range of the set should be capable of adjustment between about 300 and 600 metres.

These data, therefore, determine the dimensions of the tuning components of the set—that is to say, the inductance value of the tuning coil or coils and the capacity of any variable condensers associated with them.

Selectivity

The second consideration is that the set shall be selective, which is another way of stating that the receiving set shall not be responsive to any incoming wave other than that to which it is accurately tuned.

Under these conditions full advantage is taken of the principles of resonance—as dealt with very fully upon another page of this issue—so that interference from other stations operating upon only slightly different wavelengths is minimised.

The remaining considerations are that the detecting device is to consist of a crystal detector, the components are to be fairly easy of construction by the average experimenter or assembled from standard parts readily obtainable, the operation of the completed set must be fairly simple, and its total cost as reasonable as possible.

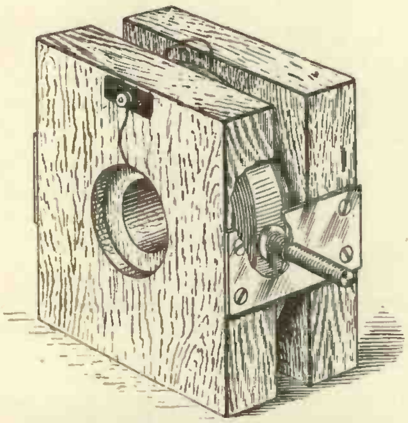


Fig. 1.—The completed variometer.

The Aerial Circuit

There are several methods by which the aerial circuit may be tuned. A variable inductance, such as a single-slider tuning coil, may be used; a fixed inductance with a variable condenser, either in series or in parallel with the inductance; or a fixed condenser (series or parallel) used in conjunction with a variable inductance.

The single-slider inductance, though a very useful piece of apparatus, has the disadvantage that the tuning effected can only be accurate to the nearest complete turn, and on the short wavelengths with which we are dealing more accurate tuning than this is desirable.

There is also the question of the unused portion of the coil, or "dead-end" as it is termed. When receiving the shortest broadcast wave about half of the inductance would not be in circuit, but would be absorbing energy from the turns actually in use.

As it is very desirable to keep the capacity of a receiving circuit as low as possible, a parallel variable condenser should not be used. A series variable condenser, connected between the aerial itself and the inductance coil, might be used with advantage provided its capacity is fairly large, but in this present case is ruled out as introducing an unnecessary piece of apparatus.

The Variometer

As a means of affording a smooth and continuous variation of the wavelength of an aerial circuit, a variometer is excellent. The wavelength range for broadcast reception can easily be covered merely by the rotation of a knob or dial through 180 degrees. The whole of the turns of wire are usefully employed so that there is no "dead-end" effect. Excellent variometers, either in wood or moulded ebonite, are obtainable at reasonable prices from advertisers in this journal.

A complete variometer, including ebonite dial and knob, is shown in Fig. 1. For the purpose of preliminary trials two terminals are fitted, to be removed later when the variometer is fitted into the containing box of the set. The variometer consists of a rotor made to the dimensions given in Fig. 2, and closely wound with 50 to 52 turns of No. 24 S.W.G., d.c.c., copper wire. First drill two small holes at F and S in Fig. 2, and insert a temporary securing screw as shown at M in this same figure; then, having threaded a few inches of the copper wire through the hole F from the outside and secured it there, wind on the wire closely and evenly until the half-winding is completed, securing the finishing end of the wire by twisting it round the small screw at M.

Repeat the process exactly with the other half of the winding, fastening the ends of the wire as before. The direction of the complete winding must be the same from the hole S (*the start*) to the hole F (*the finish*).

Make an oblique saw-cut across the uncovered centre portion of the

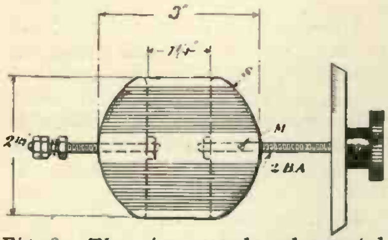


Fig. 2.—The rotor, wound and mounted upon spindles.

rotor, close to the screw M, of sufficient depth and in such a direction that the bared ends of the wire removed from the screw and cut to the correct length will lie in the saw-cut, in which position they are to be carefully soldered together.

The two lengths of screwed brass (No. 2 B.A.) are now to be screwed tightly into place until each projects about ¼ in. inside the rotor,

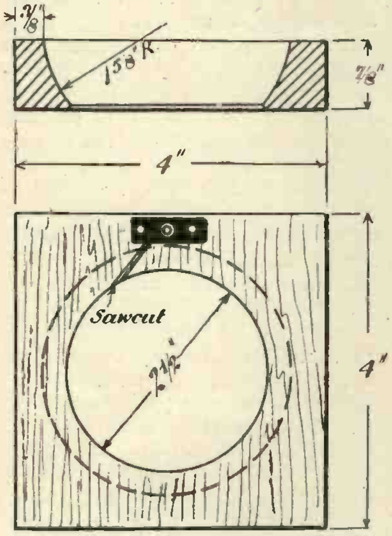


Fig. 3.—One of the half stators.

and the two ends of the rotor winding are to be soldered to them, one to each spindle.

One of the two halves of the variometer stator is illustrated in Fig. 3. In this case the wire cannot be wound upon the inner surface of the stator, where it is ultimately to be secured, but must be wound upon a special "former."

This former is shown in Fig. 4, and before it is made use of, it should be well soaked in molten paraffin wax, the reason for which will be apparent presently.

Secure temporarily the starting end of the No. 24 S.W.G., d.c.c., wire to the small screw S, wind on 48 to 50 turns, and secure the finishing end of the wire to the small screw F.

Coat the inner or concave circuit of the stator former, also the outer surface of the winding with especially thick shellac varnish, and, when thoroughly "tacky," press the winding into its place, remove the ends of the wire from the small screws, and withdraw the winding former, leaving the winding itself secured inside the stator former.

The reason for impregnating the winding former with wax is to prevent unavoidable touches of varnish causing the wire to stick to it.

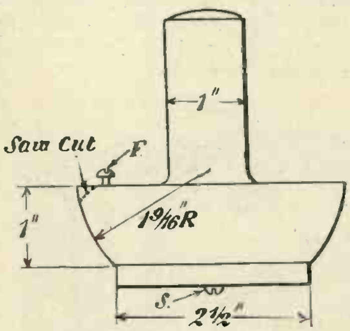


Fig. 4.—The former for stator coils.

Two bearing plates are required, as shown in Fig. 5, together with an ebonite dial and knob or merely a knob and brass pointer, according to individual taste, and the complete variometer may be assembled as shown in Fig. 1. The circuit through the variometer is to be as follows. Commencing at the left-hand terminal, through one half stator winding from small diameter turn to large diameter, across the air gap to the second half stator winding, and through this (from large to small diameter) to the rear bearing plate, and thence *via* the spindles through the rotor winding to the front bearing, and from there direct to the second terminal.

Testing

By connecting one of the terminals of the variometer to the aerial and the other to earth, and connecting a crystal detector and telephone receiver (in series with one another) right across the two terminals, the variometer may be tested under actual working conditions. In fact, for those who do not care to proceed further, the arrangement forms a very simple, but quite effective, crystal receiving set suitable for broadcast reception.

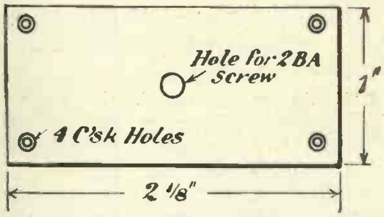


Fig. 5.—One of the two bearing plates.

There are several distinct advantages in the use of inductive coupling. Firstly, the secondary coil may be made to consist of a very much larger number of turns than the primary coil coupled to it, which means that a step-up effect is obtained and higher potentials are available to operate the detector.

Secondly, by using a loose coupling, full advantage may be taken of the principle of resonance as, under this condition, effective oscillations are produced in the secondary circuit only when that circuit is exactly in tune with the aerial circuit.

Thirdly, the absorption of energy by the secondary circuit is more gradual, consequently the damping of the aerial circuit is reduced, or, in other words, the oscillations in the aerial circuit are more persistent.

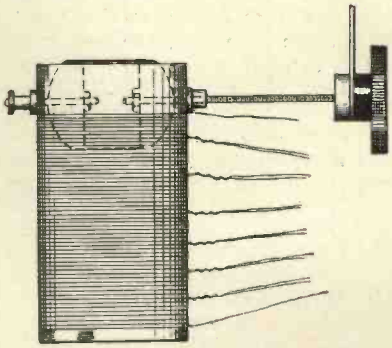


Fig. 6.—The secondary coil, showing tappings and coupling coil in place.

The foregoing items illustrate the type of considerations which should be kept in mind when designing and constructing sets to fulfil varying conditions. How these considerations have determined the design, and been complied with in the set now being described, should be observed as the description proceeds.

The Secondary Circuit

The secondary or closed circuit inductance, together with the primary coupling coil, is shown in Fig. 6. Further details of the

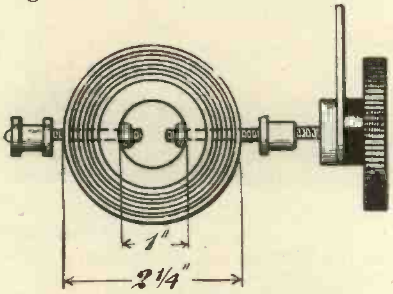


Fig. 7.—Details of the coupling coil.

coupling coil itself are given in Fig. 7.

The secondary inductance itself consists of 200 turns of No. 36 S.W.G., d.c.c., copper wire wound upon a stout cardboard tube 2½ in. in diameter by 5 in. long, the winding commencing 1 in. from one end of the coil and being "tapped" at 50 turns and each subsequent 30 turns, the winding terminating about ⅜ in. from the end of the cardboard tube.

The method of winding the primary coupling coil upon its wooden former is similar to that adopted in the case of the variometer rotor, but the winding is to consist of 26 turns only of No. 24 S.W.G., d.c.c., copper wire, the starting and finishing ends of the winding being secured by means of nuts or by soldering to the projecting inner ends of the brass spindles. In the event of the cardboard tube upon which the secondary coil is

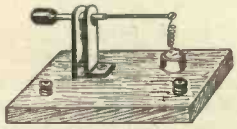


Fig. 8.—A "cat-whisker" detector.

wound being of slightly smaller diameter than that specified, the diameter of the primary coil former should be slightly reduced to suit it.

The Crystal Detector

This may be of the wire-and-crystal type illustrated in Fig. 8 or of the two-crystal type shown in Fig. 9. For the former, Hertzite, Electronite, Stapleite, or Kaynite may be used, and for the latter zincite-bornite is recommended. If preferred, a complete detector may be purchased quite cheaply from any reliable wireless dealer.

Testing the Tuner

The variometer, secondary and primary coupling coils, a crystal detector, and any variable condenser having nine or more plates should now be temporarily assembled upon a baseboard and be connected up for testing, as shown in Fig. 10. The aerial circuit, it will be seen, comprises the aerial itself, the coupling coil, the variometer, and the earth connection. The upper end of the secondary coil is connected to one side of the variable condenser, whilst a flexible lead from the other terminal of the condenser is to be connected to each of the tappings from the secondary coil in turn.

Across the variable condenser are to be connected the telephone receivers and the crystal detector. Commence by connecting 50 turns

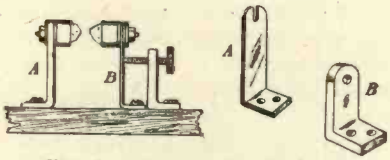


Fig. 9.—A zincite-bornite detector.

only of the secondary coil across the variable condenser, the latter being set to its minimum capacity.

Turn the coupling coil until its winding is in the same plane as the secondary coil winding—that is to say, until the turns upon the primary coil lie close beneath those upon the secondary coil, in which position the "coupling" between the two is said to be tight.

Having carefully set the crystal detector, preferably by means of a buzzer operated at a little distance

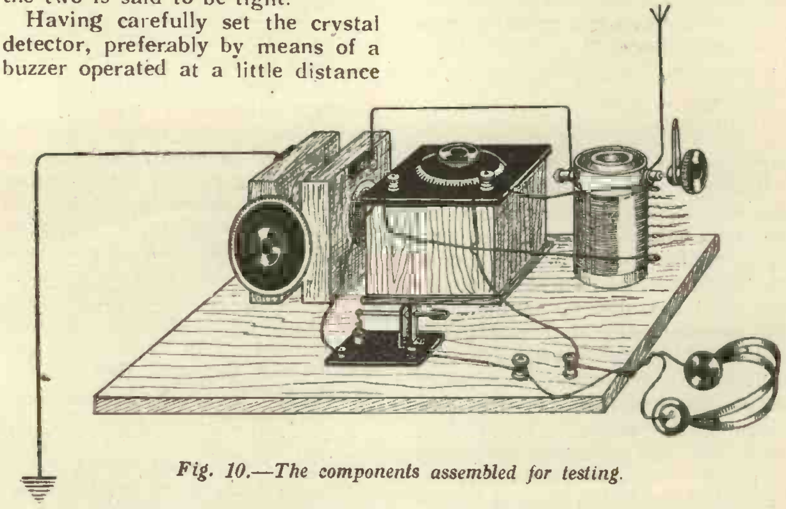


Fig. 10.—The components assembled for testing.

from the receiving set, slowly turn the knob of the variometer. If signals are heard, bring the secondary circuit into resonance with the aerial circuit by adjusting the variable condenser, which should have the effect of making the signals much louder.

Now rotate the primary coupling coil through about 60 or 70 degrees, carefully retune the aerial and secondary circuit, and note the amount of condenser movement necessary for resonance.

Move the flexible lead from the condenser from one tapping on the secondary coil to another, retuning and noting the condenser movement on each occasion, until 140 turns of the secondary coil are in use, when, on the short broadcast wavelength (such as the 369-metre wave of 2LO) best results should be obtained with the condenser almost at minimum capacity.

In the absence of a wavemeter it is necessary to tune the aerial circuit (and subsequently the secondary circuit, as already described) until signals are received, which can be identified as proceeding from a ship or coast station working on the 600-metre wavelength, and the amount of the capacity necessary for resonance should again be noted. If the condenser in use has, say, 18 plates and the secondary circuit is tuned to 600 metres when the moving plates are only half-way into the fixed plates, a nine- or ten-plate condenser with plates of the same dimensions will be adequate for the new set.

A condenser of the size required may be purchased complete or built up from standard parts.

The concluding portion of this article will appear next week, and will deal with the assembly into a neat containing box and the operation of the completed set.

News of the Week

THE Marconi Company have appealed against the decision of the Court of Appeal which recently upheld the views of Mr. Justice Lawrence, that a Mullard valve did not infringe the Marconi Patent No. 28413/13 and 126658. The case will be fought in what, in legal parlance, is known as the House of Lords.

* * *

We hear, incidentally, that the Marconi Company paid £2,000 for the French Valve Patent 126658.

* * *

Following closely on the reported success of a French aeroplane piloted by wireless, the *Daily Chronicle* announces that the initial difficulties of controlling aircraft from a ground station by means of wireless have been overcome in this country.

They understand that, at a lonely spot near Feltham, a pilotless 'plane has been kept on a predetermined route, and has been made to land at a desired spot.

* * *

The *Mauretania* has just been fitted with direction-finding apparatus.

* * *

With regard to the announcement that the B.W.T.A. had denounced the installation of listening-in sets in licensed premises, a correspondent has suggested that objections of this kind are absurd, as many of the items broadcast are edifying and full of moral uplift. He suggests that temperance addresses might be included in the programme, the probable effect then being that the receiving apparatus would be dismantled by the proprietors. The alternative would be for the set to be closed down for five minutes during such homilies.

* * *

Speaking of five minutes, are the B.B.C. returning to their old practice of "In one minute, please"; after three minutes, in five minutes, etc., etc. Most listeners-in get most horribly sick and tired of the continual dangling process.

* * *

As we go to press we learn that the conference arranged between the British Broadcasting Co. and the representatives of the entertainment industry has been postponed for a day.

* * *

We understand that it is proposed to arrange for the reception of wireless concerts at the Hornsey Bandstand. Experiments are progressing, and the members of the Town Council have already had a demonstration of the scheme, which, we feel sure, will be much appreciated by visitors to the grounds.

* * *

The Aeroplane gives further details of the recent tests in France with an aeroplane flying under wireless control. An automatic stabiliser is used, and the rudder and elevator controls are operated through relays as a result of wireless signals received on the machine. So equipped, a number of successful flights have been made during the last few years, but it has always been necessary for the pilot to intervene for landing purposes. The machine has now been fitted with a hinged rod some 12 ft. long hanging below the under-carriage and coupled up to the elevator, so that when the rod touches the ground the machine is automatically flattened out.

On April 10th last, at Villa Coublay, the machine was flown with two passengers and with the pilot's control sealed, the whole flight being controlled by wireless, plus the landing stick. The trial appeared to be quite successful.

* * *

A member of 2LO's vast audience sent a bottle of gargle to one of the Uncles the other day.

* * *

A wireless paper recently stated that Mr. Godfrey Isaacs was strongly opposed to home-made wireless receivers, and said that it was not possible to make an efficient receiver one's self. Taking this matter up with Mr. Godfrey Isaacs, he informs us that these are not the views held by him, and that he did not state them as reported to a body of Press representatives. We feel sure that nothing of the kind has been in his mind, and, even if it had been, we feel equally sure that he would not have given expression to his views.

* * *

There is some possibility that, owing to a dispute about broadcasting from the Queen's Hall, the speeches of the Prince of Wales and Marshal Foch will not be radiated on May 20th. It will be a great pity if, through some jealousy on the part of the concert promoters, the speeches of such distinguished broadcasters should be withheld from the ether public.

* * *

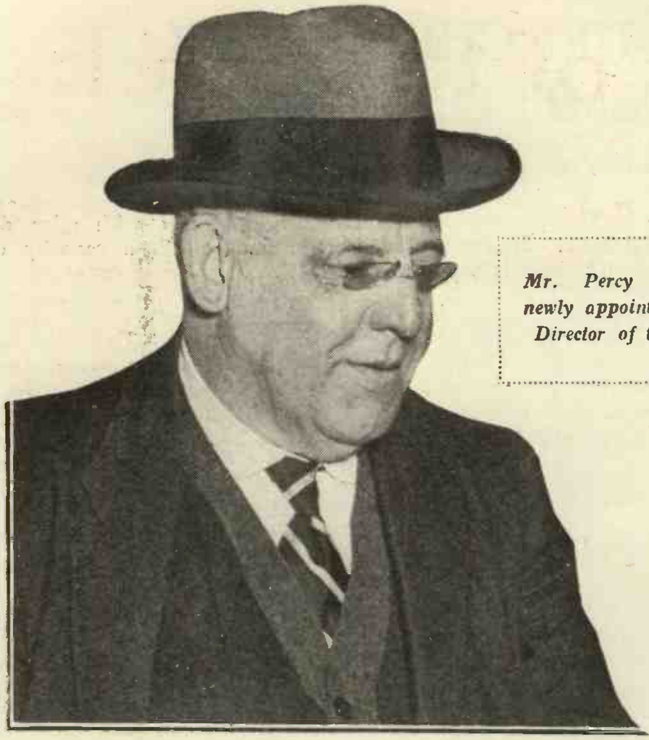
There is no further information regarding the proposed new licence for experimental transmitters. We are considered as having committed a *faux pas*, together, presumably with the other wireless papers which made a similar announcement to ours in suggesting that the wavelength was to be altered. So please forget about it.

* * *

Have you noticed the additional words on the cover of *Wireless Weekly*? I wonder why they have put them there?

* * *

Major-General Sir Frederick Sykes (Chairman), Major Aston, M.P., Mr. F. J. Brown (Assistant-Secretary, G.P.O.), Sir Henry Bunbury (Comptroller and Accountant-General, G.P.O.), Viscount



Mr. Percy Pitt, the newly appointed Musical Director of the B.B.C.

Burnham, Mr. W. H. Eccles (President of the Radio Society), Sir Henry Norman, M.P., Mr. J. C. W. Reith (General Manager, British Broadcasting Company), Field-Marshal Sir William Robertson, and Mr. C. Trevelyan, M.P., were present at the first meeting of the Committee appointed to consider the agreement between the Post Office and the British Broadcasting Company and the future of broadcasting, which was held at the General Post Office.

Procedure was discussed, and it was arranged to meet again, when evidence in explanation of the present position will be given by representatives of the Post Office.

* * *

We hear that the new Committee is to sit twice a week. We may expect the constructor's licence question to be settled any month now. In the meanwhile tens, or even hundreds, of thousands are acquiring a new kind of conscience, a particularly dangerous thing. The man who is a pirate has at least the defence that he has applied for a licence and not received one. Long months of listening-in without a licence will, no doubt, develop a conscience which may refuse to carry out its proper duties when the listener-in really can obtain a suitable licence. That still, small voice may then be dead, particularly if the Press continues to pamper the pirates.

* * *

Up to the time of going to press no actual developments have taken place with regard to the issue of constructional licences, except that the first meeting of the special committee has taken place. Meantime, the authorities at the General Post Office are scrutinising some thirty-three thousand applications for experimental licences, which have accumulated. The question is, of course—why have they been allowed to accumulate to such an extent?

* * *

At the time of going to press the dispute between the B.B.C. and the theatrical profession is coming to a head. As regards concert artistes it is highly likely that the B.B.C. will be able to hold its own. We regard with something akin to horror the idea that the British Broadcasting Company should have a concert staff of its own, which will provide all the items. The listening-in public probably appreciates most those artistes which it only hears on the rarest occasions. Even Dame Nellie Melba singing every evening from 2LO and other stations would soon pall.

We must have variety, and unless the B.B.C. can come to some arrangement with other entertainment-providing organisations, programmes will not be nearly as fascinating as they might be. We hope that an amicable settlement will be made, but fear, in any case, that the B.B.C. will have to pay for their privileges.

BROADCAST TRANSMISSIONS

CARDIFF.........5 WA......353 metres.
LONDON.........2 LO......369 ,,
MANCHESTER 2 ZY......385 ,,
NEWCASTLE 5 NO......400 ,,
GLASGOW 5 SC......415 ,,
BIRMINGHAM 5 IT......420 ,,
(10.30 to 11.30 a.m. and 4.30 to 9.30 p.m. G.M.T., Sundays 7.30 to 9.30 p.m. G.M.T.)

L'ECOLE SUPÉRIEURE (Paris) 450 metres.
Tuesdays and Thursdays 7.45 to 10 p.m. G.M.T.

THE HAGUE...PCGG...1085 ,,
(Sundays only 3 to 5.40 p.m. G.M.T.)

RADIOLA (Paris).........1780 ,,
7.45 to 10 p.m. G.M.T.

EIFFEL TOWER...FL...2600 ,,
(11.15 a.m., 6.20 to 7.p.m. and 10.10 p.m. G.M.T.)

A 1½ KW. QUENCHED-SPARK TRANSMITTER

A description of the latest type of Marconi ship set.

THIS apparatus is of the panel type and usually stands upon the operating table. On the front of the panel are mounted the jigger primary, wave change switch, aerial hot-wire ammeter and shortcircuiting switch, quenched - spark gap, and a short-circuiting switch for the short-wave condenser. Behind the panel, the jigger secondary, aerial tuning inductances, short-wave condenser, main condenser, and air-core choke coils are mounted. The complete transmitter is shown in the photograph, Fig. 1.

The normal wave adjustments of this set are 450, 600, and 800 metres, though its actual range is from 220 to 800 metres. The alterations for these wavelengths are carried out by means of a special wave-change switch, the necessary adjustments occurring simultaneously in both the closed and open circuits. While the fundamental circuits of this set are similar to those of the old type 1½ kw. set the design of the various components is different.

Alternating current at 500 cycles is obtained from a motor-generator and is led to the primary of a step-up transformer. In the A.C. or primary circuit there is a power regulator and a manipulating key. The transformer secondary is connected through the air-core chokes to the main condenser. This is a Dubilier condenser with mica dielectric and it has a capacity of 0.01 μF.

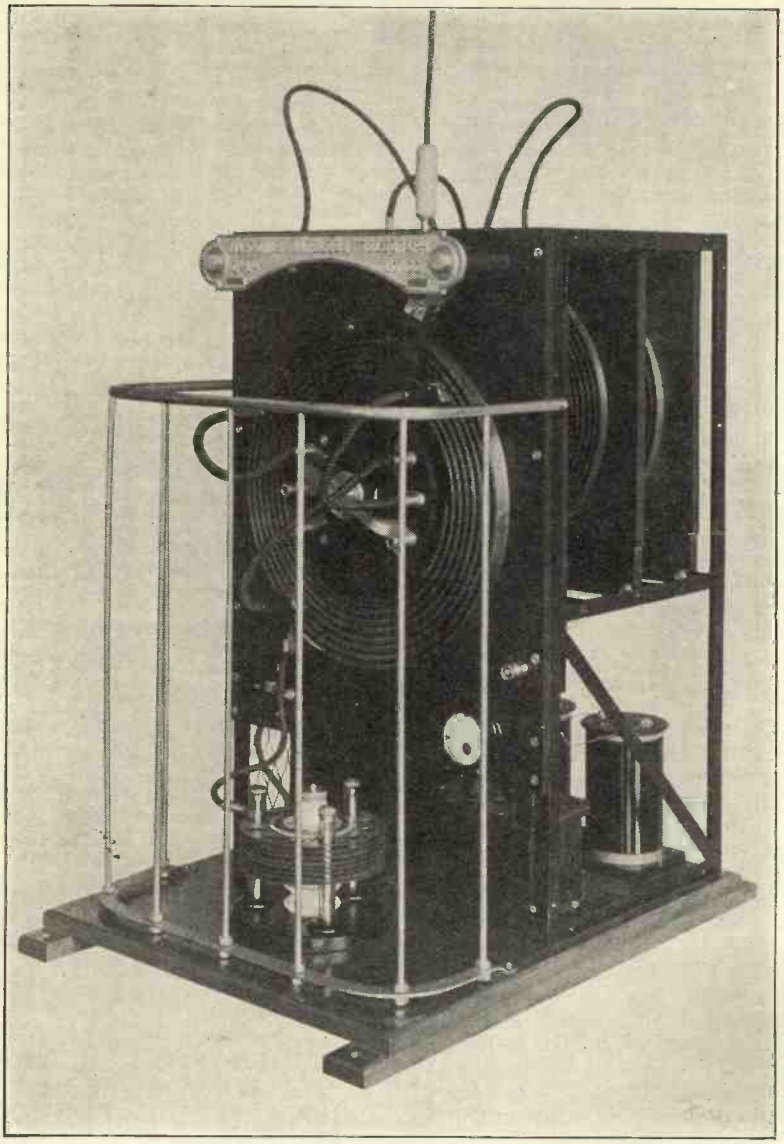


Fig. 1.—The complete transmitter.

The closed oscillatory circuit consists of main condenser, quenched gap, and the jigger primary. The jigger secondary, A.T.Is., S.W. condenser and hot - wire ammeter constitute the aerial circuit. All the inductances are made of flat double spirals of copper strip embedded in ebonite. The S.W. condenser is similar to the main condenser, but its capacity is only 0.00044 μF. This condenser may be cut out by means of a switch when not required. The hot - wire ammeter which is used instead of the old type tuning lamp, gives largest reading when the set is radiating maximum power, namely, when all the circuits are in resonance.

Fig. 2 is a theoretical diagram of the connections, while Fig. 3 is a detailed wiring diagram. Fig 4 is one of the many schemes employed for the D.C. and A.C. circuits.

The quenched-spark gap which is the principal feature of this set consists of a number of heavy

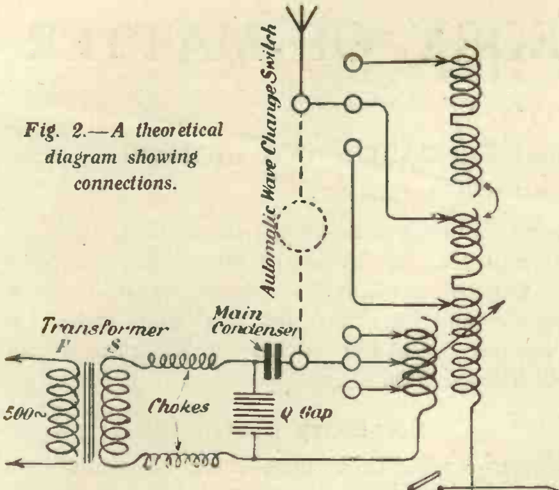


Fig. 2.—A theoretical diagram showing connections.

copper discs having silvered ring sparking surfaces, these surfaces being truly plane. The edges of the copper discs are slightly curved so that there is a gradual decrease in the intensity of the electro-static field where the gap widens. The discs are kept in position by means of three heat resisting alignment rods made of an insulating material,

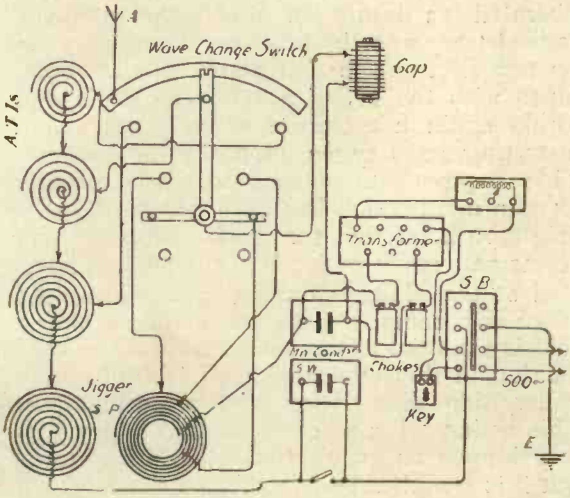


Fig. 3.—A wiring diagram of the transmitter.

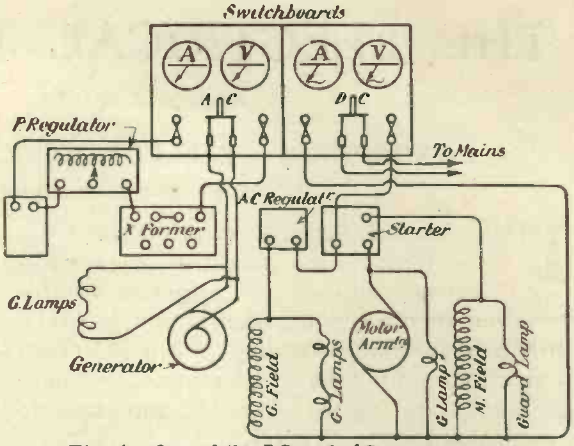


Fig. 4.—One of the DC and AC arrangements.

and they (the discs) are kept from touching by mica washers. Two brass end plates are insulated from the discs by heavy fibre insulating material. These plates together with a copper rod, which passes through a clearance hole in the centre of the discs, clamp the discs tightly together. A number of holes are provided to allow of the circulation of air through the gap. The arrangement of this gap is shown in Fig. 5.

Power may be varied in two ways, namely, by reducing the number of discs in operation, by means of a clip, or by means of the power regulator in the A.C. circuit.

By means of this new transmitting set very efficient working is obtained, whilst the characteristic note of the quenched-spark system renders the reading of received signals, through atmospheric disturbances and interference from other stations, a less difficult matter than is the case with the ordinary type of spark transmitter, even when a rotary synchronous spark-gap is employed.

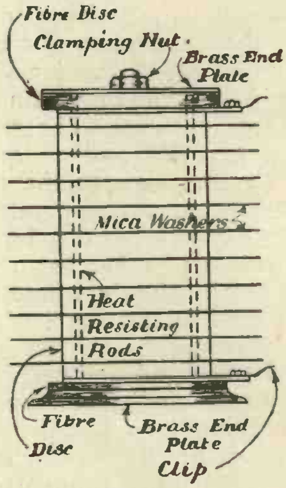


Fig. 5.—The quenched gap used in the apparatus.

ERRATUM

The circuit diagram of the 3- or 4-valve Variometer Receiver, on page 258 of our last issue, is incorrectly given. The common filament lead from the first three valves should be joined to the positive side of the L.T. battery and not looped over as shown.

We trust the error has not caused our readers any serious inconvenience.

THE ELECTRICAL THEORY OF MATTER

By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

CONDUCTION OF ELECTRICITY THROUGH GASES AND LIQUIDS

(Part II.—Continued from No. 4, page 230.)

THE second type of electrolytes yield upon dissociation negative ions composed of one oxygen and one hydrogen atom in molecular combination (–OH), which have retained one extra electron from their previous compounds. These substances are known as *bases*, an example being caustic soda, NaOH.

The other type known as *salts*, of which sodium chloride (NaCl) is an example, result from the mixture of solutions of an acid and a base. Under these conditions, the positive and negative ions, +H and –OH, whenever they meet combine together to form water (H_2O), and the other ions form molecules of the salt, which may or may not be soluble in the liquid.

In the case of the conduction of electricity through a liquid, it is unnecessary that there shall be any ionising influence as in the case of the conduction through a gas. We saw that in a gas the ionising influence was required for the provision of the electric carriers of the current. The essential difference between a gas and a liquid, however, is that whereas in a gas the molecules are in free flight and are separated by comparatively large distances, in a liquid the molecules are so close together as to be within the sphere of each other's attraction. When a dissociable substance, such as sodium chloride, is introduced into the liquid, the attracting influences of the neighbouring water molecules are sufficient to separate the salt molecules into ions, and the electric carriers for the current are thereby provided without the aid of any external influence or agency.

When a current flows through the liquid and the ions eventually reach the electrodes, thereby satisfying themselves by acquiring or yielding electrons, their quantitative "unsatisfaction" vanishes. They therefore become uncharged atoms or molecules, and may be deposited upon the plates, as in electrodeposition, or may be liberated (when a sufficient number have accumulated) as bubbles of gas.

Secondary Reactions

There are certain electrolytes, of which sulphuric acid, H_2SO_4, is an example, in which secondary chemical reactions take place on the passage of a current, so that the substance liberated at the plate is not that which travelled towards the plate in carrying the current through the liquid. If sulphuric acid is dissolved in water, the H_2SO_4 separates into two hydrogen ions, each +H, and a sulphate radical, – –SO_4. The two hydrogen ions travel to the negative plate and are there liberated as hydrogen gas: the sulphate radical travels to the positive plate and gives up two electrons to that plate. It then combines with the H_2 of a water molecule and forms again a molecule of sulphuric acid, liberating an oxygen atom in the process. This oxygen atom takes to itself another oxygen atom which has been produced in its neighbourhood by the same process, and forms an oxygen molecule, O_2, which is liberated at the plate as oxygen gas. Thus the water is decomposed, although the sulphuric acid is essential to the mechanism of the conduction in this case and itself is continually undergoing dissociation and recombination. This action takes place in the secondary battery known as an electrical "accumulator," but it is complicated by other reactions which cannot be conveniently dealt with here, the net result of which is that the concentration of the solution is *decreased* by the passage of current.

A NEW MEMBER OF OUR STAFF.

Readers will be interested to hear that our already strong Editorial Staff has now been supplemented by the acquisition of Mr. Stanley G. Rattee, a former Editor of the "Wireless World."

A SIMPLE METHOD OF MAGNIFYING SIGNALS

By J. F. JOHNSTON.

Describing an arrangement for satisfactory amplification of signals of fair initial strength without the use of valves.

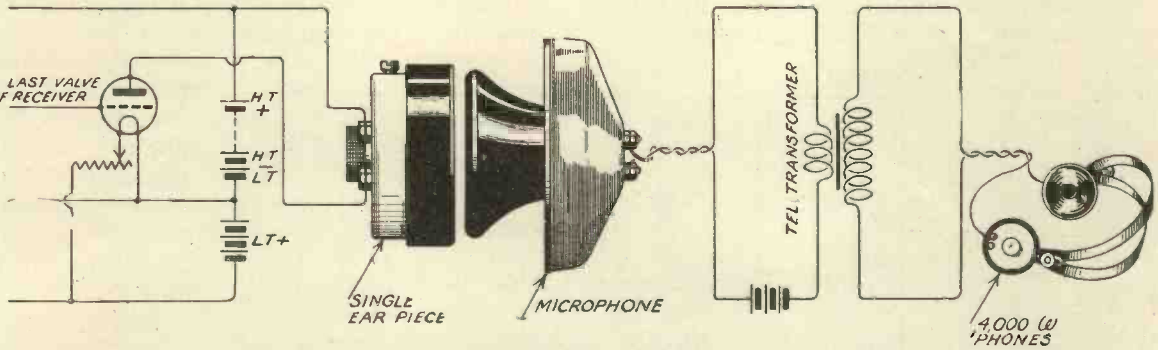
THE following is a description of a simple, inexpensive, but remarkably effective way of magnifying moderate or fairly strong signals so as to render them easily audible without wearing the head-'phones.

The only articles required in addition to the usual receiving apparatus are an extra single ear-piece, an ordinary microphone, a telephone transformer, and a few dry cells.

The single ear-piece, which should be as sensitive as possible, is connected in the plate circuit of the last valve in place of the usual double head-'phones. It is so arranged that when the diaphragm vibrates, the ear-piece "speaks" directly into the mouthpiece of the microphone.

The microphone is connected in series with the low resistance winding of the telephone transformer, a small battery (two or three dry cells) being also included in this circuit. A pair of high resistance 'phones (or a loud-speaker) is connected to the secondary terminals of the transformer.

This arrangement requires a certain initial signal strength to operate it. With very weak signals no results at all are obtainable, but with signals of moderate strength a considerable amount of amplification (equal to that given by two or three L.F. valves) is possible.



Wiring diagram, showing how the microphone circuit is placed in relation to the telephone and receiver circuit.

It works very well on speech or music, being wonderfully free from distortion. Its unresponsiveness to signals below a certain critical strength is often useful for completely eliminating interference from weak atmospherics or spark stations.

The ear-piece and microphone should be mounted very rigidly, as any vibration produces a scratching noise in the 'phones.

WONT IT WORK?

Then send your troubles to our Radio Information Dept. for the attention of our Staff.

The reason for our being here is to assist the experimenter and, where possible, to extend his knowledge, in addition to improving his present results.

AN AMATEUR'S FOUR-VALVE RECEIVER

By A. P. COOPER.

A receiver that can be built by an experimenter which covers wavelengths between 300 and 25,000 metres.

THE receiving set described and illustrated in the following article was designed in order to meet certain definite requirements, and as these are considerations which have to be borne in mind by the vast majority of builders of home-made sets, it is hoped that this description will be of interest and assistance to many enthusiasts.

Firstly, cost was to be kept at a minimum owing to the smallness of the maker's resources in this direction, and the cheapest material consistent with reliability was to be used throughout.

Secondly, the set was designed to cover the whole range of wavelengths from about 300 to 25,000 metres, so that it is capable of receiving broadcasting or Nauen's time signals, ship traffic or Paris concerts. It was also desired to make the change from one extreme to the other as easy as possible.

Again, four valves were to be used, but they were to be connected in such a way that any number or combination of valves could be switched in easily and quickly up to the maximum of one high frequency valve, the rectifier and two note magnifiers. Thus it is as easy to listen on one high frequency valve and the rectifier as on, say, the rectifier and two note magnifiers.

The high frequency valve was included for three reasons:—

1. To bring in long-distance signals;
2. To permit the use of reaction during broadcasting hours without the risk of radiation; and
3. To make the set more selective in tuning,

each of which result *alone* is well worth the slight extra trouble involved in the use of high frequency amplification.

The final point considered in the design of the set was that it was to be made of parts already on hand or on the market. Many experimenters will be in a similar situation in this respect, and it is an advantage rather than otherwise, for it is not considered wise for a beginner in wireless to tackle the comparatively complicated circuits of a four-valve receiver without having had previous experience in the manipulation of simpler layouts. In the writer's case a crystal set was first built, and much amusement and instruction obtained from it. Incidentally, as telephony was impossible on the crystal set, owing to the distance from any transmitting station, it proved a strong incentive to acquiring a good working knowledge of Morse—always a useful accomplishment.

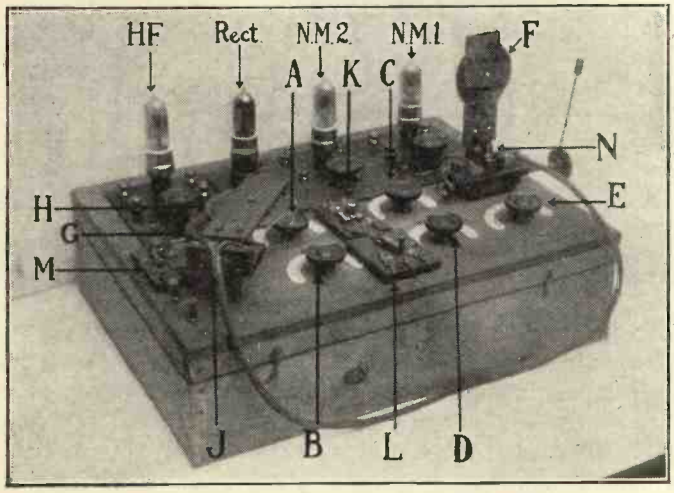


Fig. 1.—The complete instrument.

The next step was the construction of a one-valve set to which a high frequency valve was subsequently added. Later a note magnifier was built as a separate unit. By this time transmissions from 2MT (Writtle) and 2LO (Marconi House) were sometimes to be heard, so it was decided that a fourth valve should be added for the operation of a loud speaker, and it was thought advisable to rebuild the whole apparatus into one compact set rather than to add a fourth separate unit. The instrument described herein is the result.

Perhaps it should be explained at this stage that the writer's station is more than 100 miles from the nearest broadcasting station, being, in fact, in Norwich, and a glance at a map of the British Isles with 50-mile circles round each station will show that East Anglia is one of the worst-served districts in this respect. Also it is close to the sea at a point where many ships regularly pass, and for this reason extra selectivity is particularly desirable to help to eliminate some of the interfering spark signals on the wavelengths between 300 and 600 metres.

The Receiving Apparatus

The complete set is contained in a box, the sides and bottom of which are of inexpensive wood, as they are not visible when in position in the large containing cabinet. The lid, however, should be of better quality material, as on it all the components are mounted. This arrangement is to be recommended, as by lifting the lid all connections are visible, and —even more important—easily accessible.

The photograph (Fig. 1) will give some idea of the general appearance of the finished instrument. It will be seen that the four valve panels are mounted at the back. The valve on the extreme left is the high frequency valve, the next is the rectifier, the third is the *second* note magnifier, and the one on the extreme right is the first note magnifier. It will thus be seen that when using the high frequency valve, rectifier and one note magnifier, the valve not in use is the second from the right, not the extreme right-hand one. This may perhaps seem a rather curious arrangement, but a glance at the diagram (Fig. 2) will show that this is the most convenient method from the point of view of wiring up.

Each valve has a separate filament resistance, which enables critical adjustments to be made and also forms a convenient method of switching off any valves not in use. It will be noticed that five variable condensers are fitted. In each case they were made up from the parts now on sale so cheaply, thus effecting a considerable saving in cost. The condenser marked A in Fig. 1 is for tuning the primary of the high frequency transformer (radio-frequency transformer coupling being used by the writer instead of, say, tuned anode, this, of course, being merely a personal preference), whilst the condenser in front of it, lettered B, is a single-plate one connected in parallel for fine adjustments. The condenser C on the right centre is the main aerial tuning condenser (having a value of 0.001 μF), with corresponding vernier D in front of it as in the case of the high frequency condenser.

The remaining condenser marked E has a capacity of 0.0003 μF, and is connected between the earth and one side of the reactance coil. It was found to be a very convenient method of controlling oscillation, more particularly when high frequency amplification is not in use. It gives the effect of very fine adjustment of the distance between the reactance coil and the high frequency transformer, or, when high frequency amplification is not in use (*i.e.*, when broadcasting is not in progress or on long waves) between the reactance coil and the A.T.I.

The aerial tuning inductance, lettered F, will be seen standing upright on the right of the set. The coils used are slab and basket coils, a set of ten covering the whole range from 300 to 25,000 metres with a 0.001 μF condenser, and the method of mounting may interest those readers to whom cost is an important point. The coil which it is desired

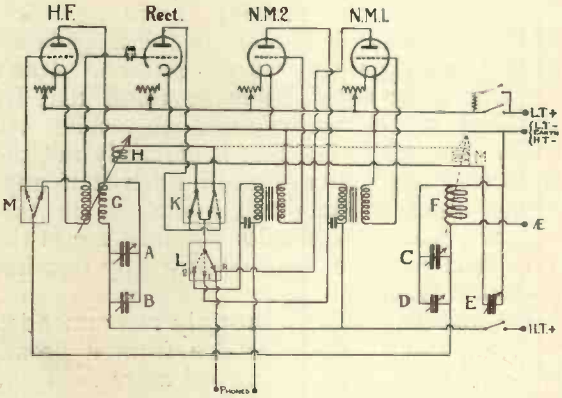


Fig. 2.—Wiring diagram of the receiver.

to mount is placed on a strip of wood, say, 5in. × 2in., and a small strip 2in. × 1in. is then screwed to it so as to clamp the coil in position.

Connection is made by two strips of brass about $1\frac{1}{2}$in. × $\frac{1}{4}$in. × $\frac{1}{32}$in. screwed to the bottom of the wood, to which the ends of the coils are attached. The photograph will, it is hoped, make this arrangement clear. On the set are then mounted two contacts from an old knife switch (visible at N in the photograph). This gives an effective plug-in arrangement at practically no cost. Theoretically, of course, all these connections should be on ebonite or some such insulator, but ebonite is expensive, whilst wood is cheap. The writer has tried both without being able to notice any difference whatsoever in results. The wood used should be perfectly dry.

Similar arrangements have to be made for the reaction coil, but the contacts from the knife switch in this case have to be mounted on a strip which is pivoted in order that the distance between the reactance and the A.T.I. may be varied. The rod on which the reactance is fitted is provided with an ebonite knob for rapid adjustments and an extension handle for finer variations.

The high frequency transformer (of the plug-in type) is just visible on the left-hand side (marked G in Fig. 1), and a set of five (which may be purchased quite cheaply unmounted, and mounted according to taste and pocket) will cover all wavelengths from 300 to 3,000 metres quite easily with a 0.0005 μF condenser.

When high frequency amplification is in use it is, of course, always advisable to react on the H.F. transformer so as to minimise the possibility of radiation should the set oscillate, for nothing is more annoying to listeners-in than to hear the continual and senseless whistling caused by others in the neighbourhood allowing their sets to oscillate. Many beginners, however, seem to think that by working in the way suggested results will suffer somewhat, but this is certainly not the case, and the writer himself finds it if anything easier to manipulate the set in this manner, whilst the results obtained are at the very least *equal* to those obtained by reacting on to the A.T.I.

For this reason it is strongly recommended that anyone at any distance from a broadcasting station who can afford more than one valve should make the first-stage valve a high frequency amplifier. These arguments in favour of this method are, of course, in addition to the fact that it is one of the P.M.G.'s regulations that the reaction coil shall not be coupled to the A.T.I. during broadcast hours on broadcast wavelengths.

In order to use reaction in this way it was necessary to fit a holder for the reaction coil arranged so that the coupling between that coil and the high frequency transformer could be varied. The photograph shows the coil (H) in this holder (J), which is pivoted on an upright rod so that the coil can be swung round over the transformer for tight coupling or away to one side for loose coupling. A long flexible lead is shown connected to the clips of the holder, and the wires at the other end of the lead are soldered to small strips of brass similar to those used on the coil-holders, these being simply plugged in to the other reaction coil-holder on the right of the set. The connections could be made permanently on the inside of the box containing the set if desired, but the arrangement shown works quite well, and when in use the lead is practically hidden in the large containing cabinet.

Various switches will be noticed in the photograph (Fig. 1), and the use of each will be mentioned in turn. The one in the centre marked K is a double-pole change-over switch used for reversing the connections to the reaction coil, as it is necessary to do this whenever high frequency amplification is added. If the reaction coil is to be coupled to the high frequency transformer and the flexible lead arrangement is used, there is no need to fit this switch, as the necessary reversal of direction can be accomplished by changing over the two brass strips, but if it is (say, on long wavelengths) desired to have the reaction coil coupled to the A.T.I. when the H.F. valve is in use, some such change-over arrangement must be embodied in the circuit.

The three-way switch L in Fig. 1 is the switch which cuts out the note magnifiers not in use. Omitting the H.F. valve for the moment, when the switch is in the right-hand position the rectifier only is in circuit, in the centre position the rectifier and one note magnifier are connected, whilst in the left-hand position the rectifier and both note magnifiers are in use. Slight readjustments of the tuning may be found to be necessary when note magnifiers are added or cut out.

Immediately on the left of the H.F. transformer is a two-way switch M (visible in Fig. 1), which is used to add the H.F. valve. In the left-hand position this valve is in circuit; in the right-hand position it is disconnected. At the same time it is necessary when cutting out the H.F. to pull out the H.F. transformer (hence the use of the 4-pin type of transformer), and to reverse the connections of the reaction coil.

The grid condenser and leak are inside the box and of quite normal design, the condenser being composed of mica and tin-foil, the leak being a pencil line. The thickness of this was varied until the best results were obtained, and the line was then sealed with a generous coating of shellac varnish. The other small condensers in the set are similarly made.

With appropriate terminals for the aerial and earth, telephones and batteries, the set is complete so far as essentials are concerned, but three other switches, not visible on the photographs, are fitted, the first of which cuts out the high tension battery (which should always be done when valves are being inserted or removed); the second controls the 6-volt low tension battery, whilst the third serves the same purpose except that a small fixed resistance is included in the circuit when this switch is used. Hence when a newly charged accumulator is in use and only one or two valves are lighted, it is still possible to control the filament brilliancy right down to a dull glow.

A circuit diagram of the complete set is given in Fig. 2.

The high tension and low tension batteries are external to the set, but in the writer's case the whole are contained in a kind of flat-topped bureau made for the purpose.

The high tension battery consists of flash-lamp batteries mounted in a box, on one side of which a switch is fitted to vary the voltage between 15 and 45 volts. In this connection it is worth while fitting a "dead" stud between every two live ones, so that the switch arm cannot short-circuit sections of the battery.

It is also advisable to connect a 2-volt flash-lamp bulb in series with the H.T., to serve as a fuse should this battery be accidentally connected across the filaments of the valves at any time. A large capacity tin-foil and mica condenser is connected directly across the high tension supply.

Perhaps a word as to the total cost would not be out of place, and the following list will give a fairly good idea, actual present-day prices being given in each case for components identical with those described here.

	£	s.	d.
Four valves at 15s.	3	0	0
Four valve panels at 5s. 6d.	1	2	0
Set of coils		12	6
Accumulator, 6 volts, 60 amp. hours. ...	1	15	0
High-tension battery		6	0
Condenser parts	1	3	0
H.F. transformers and mountings ...	1	0	0
Two L.F. transformers at 15s.	1	10	0
Two ex-Government single ear-piece 'phones at 4s.		8	0
Valve holder for H.F. transformer ...		1	0
Switches		5	0
Wire, terminals, etc.		2	6
Parts for small fixed condensers		5	0
Wood for box hinges, etc.		4	0
Sundry screws, etc.		1	0
	£11	15	0

It is always difficult to compare results, so many factors beyond the set itself having a bearing on them—height and length of aerial, position, direction, skill of the operator and so on. With the set described, however, and a rather badly screened aerial 35ft. long and 25ft. high, perfectly good reception is possible from any of the British broadcasting stations (indeed, Glasgow and Cardiff, though farther away, seem better than Manchester, Newcastle, or even Birmingham), whilst telephony from the Paris stations, the Hague and LP is quite good. London is, of course, always too strong for comfort with more than three valves in use, and two are usually ample. All the usual Continental stations come in quite well, whilst the American high-power stations are audible on two valves, and of quite good strength on three.

Undoubtedly a good pair of high-resistance 'phones would improve matters considerably, but several cheap 'phones have been bought instead, so that more people could listen in, a loud-speaker having been found less satisfactory acoustically. Indeed, as many as 14 of these single ear-pieces are regularly used without any appreciable loss of signal strength.

In conclusion, do not be discouraged if results at first are not quite all that might be expected. Anyone making a set of this type must be the holder of an experimental licence, so let him experiment until the results are really good. Try different values for the condensers (especially the grid condenser) and the gridleak, and your efforts will be finally justified. Should any fault subsequently develop, it is usually fairly easy to trace with a circuit arranged in this way.

Crackles which persist even with the aerial disconnected may occur. Switch out all but the rectifying valve and see if they are still there. If they are, you know immediately that they are not due to either the high frequency circuit or to either of the note magnifiers. On the other hand, if they are not audible on one valve, add one more at a time and notice when they commence, and you then know at once to which part of the circuit they are due. If possible solder all connections.

The set has been described here exactly as it has been made and as it is in use, but doubtless various modifications will occur to experienced readers.

TO the wireless enthusiast the thunderstorm is usually nothing more than a noisy disturber of an otherwise well-behaved and orderly ether. It is not often that the wireless experimenter gives any more thought to the electric storm of Nature than to the problem of devising a means to minimise the disquieting noises caused by such storms in the telephones of his receiving set. Yet the thunderstorm is a phenomenon which presents a most fascinating problem to anyone who is really interested in the wider aspects and applications of wireless science. Tracking thunderstorms has already become a part of the routine work of some of our best equipped weather observing stations, and it seems as if the wireless experimenter has a most excellent opportunity of helping in this very interesting scientific work.

Thunderstorms are the "big game" of the ether, and there is much of the excitement of the hunt in running one of these storms literally "to earth." Probably the simplest method of hunting thunderstorms is with a frame aerial used as a direction finder. Such a frame aerial must have a large wavelength, since more thunderstorms are picked up on the higher than on the lower wavelengths.

The weather observing station at the London Terminal Aerodrome, Croydon, possesses a frame aerial and an eight-valve amplifier for use in the detection of thunderstorms. The apparatus is installed in a small square building consisting of two rooms (see Fig. 1, on the next page). In the lower room are the amplifier and various other instruments familiar to the wireless experimenter. The frame aerial is in the room above, and since the room is only just big enough to allow the aerial to rotate and access is gained only by a small door, it is a difficult matter to photograph the aerial. The frame is 9ft. long, 5½ft. high, 1½ft. wide, and there are no less than 140 turns of wire (18 gauge) round it. Sixteen tappings connected to a switch on the baseboard of the aerial give variations in wavelength from 2,000 to 25,000 metres (see Fig. 2). The whole thing is beautifully made, and perhaps the most striking feature is the wonderful balance obtained about its vertical pivot. By means of a wheel, about the size of the steering-wheel of a motor car, the frame aerial can be rotated from the room below to any desired point of the compass. The amplifier consists of 5 H.F. valves, 1 detector valve, and 2 L.F. valves (see Fig. 3). The circuit is of the usual type, resistances of 100,000 ohms being used to couple the H.F. valves. Observations are taken at least four times a day, 1 a.m., 7 a.m., 1 p.m., and 6 p.m. being the usual hours of observation.

The first attempt to track thunderstorms in this country was made in June, 1915, at the Meteorological Office Radio Station, Alder-

Thunderstorms

shot. Initially the apparatus consisted of a Bellini-Tosi radiogoniometer and a Mark I. tuner with crystal detector. One of the two triangular aerials was placed in a north-south vertical plane, the other being placed similarly in an east-west plane. The base wires of the aerials were each 280ft. long, and they were fixed horizontally 10ft. above the ground. The height of the top of the mast where the aerials met was about 60ft. A wavelength of 600 metres was not found to be very satisfactory, but on increasing the wavelength of the apparatus to 5,000 metres it soon became possible to detect the occurrence of thunderstorms 50 miles away.

With wireless apparatus of this type, the method of observation is to count the number of atmospherics heard per half minute, say, with the goniometer set for various directions, and so work through to the direction for which the minimum number of sounds is heard. This minimum is generally well marked and the direction of maximum intensity is at right angles to the minimum direction.

As with all the earlier types of direction finders the Bellini-Tosi apparatus at Aldershot failed to determine from which side of the receiving station the signals came. Thus, if a reading of south-west was obtained, the thunderstorm was just as likely to have been to the north-east as to the south-west. When three or more wireless stations are working in conjunction with one another this ambiguity with regard to direction is easily overcome.

Immediately the success of the Aldershot apparatus was assured, a number of the coastal direction-finding stations were instructed to take observations of atmospherics at regular intervals. The results of these observations were telegraphed to Aldershot and were charted on a large scale map of North-West Europe. How the exact position of a thunderstorm was located is best understood from an example.

Suppose that the following directions of maximum intensity of atmospherics were obtained:—Aldershot, E.S.E.; Berwick, N.E.; Flamborough, W.S.W.; and The Lizard, N.W. When these directions are charted on a map (see Fig. 4) it is at once evident that the Berwick and Aldershot directions should be the opposite to those given. Correcting these two directions we have on our chart four lines meeting over the mouth of the Shannon, very clear evidence of a thunderstorm in that locality.

The first storm to be located in England in this way was nearly 300 miles from the most distant wireless station which helped in its detection. On one occasion, two coastal direction-finding stations gave correct bearings of a thunderstorm at Venice, over 1,000 miles away.

By far the most interesting side of this

B 33

Fig. 1.—The house containing the apparatus.

work, however, is the following of a thunderstorm as it travels along across sea and land. The Aldershot station, with the help of the coastal stations, early one morning located a thunderstorm entering the Bay of Biscay due west of Bordeaux. By the afternoon the storm had been followed as it travelled in a north-easterly direction to Rochefort. In the evening that same storm was located after it had travelled eastwards towards Lyons, and during the night the observations showed that the storm was still hanging about over the south of France.

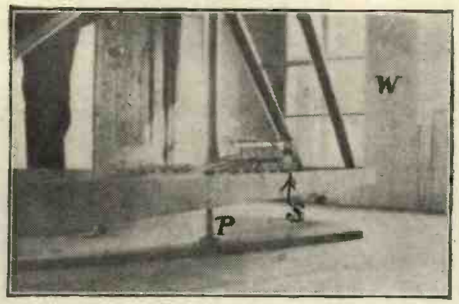


Fig. 2.—The aerial switching.

Although the tracking of thunderstorms in our islands has for its immediate object the issuing of a warning to aviators and others of the approach of a storm, the results observed may be put to a much wider use. Some day it may be possible to obtain observations for the greater part of the globe, and to deduce from them the origin of atmospherics and the most usual tracks of thunderstorms. Such information would be of the greatest value in choosing the position of a high-power wireless station, and would make it possible to avoid operating wireless traffic along the most frequent lines of travel of thunderstorms and the resultant atmospherics.

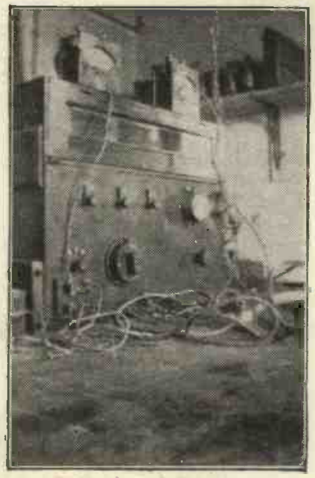


Fig. 3.—The five-valve amplifier.

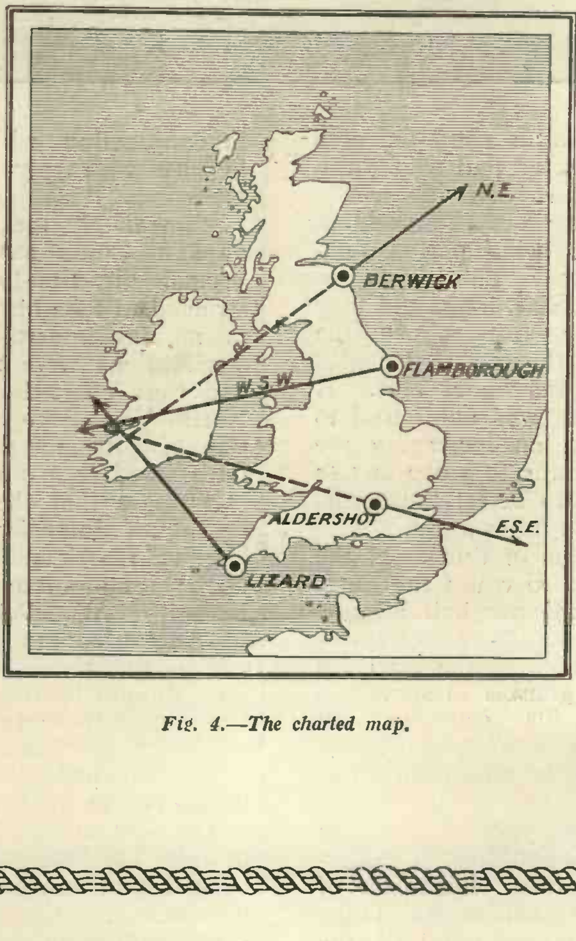
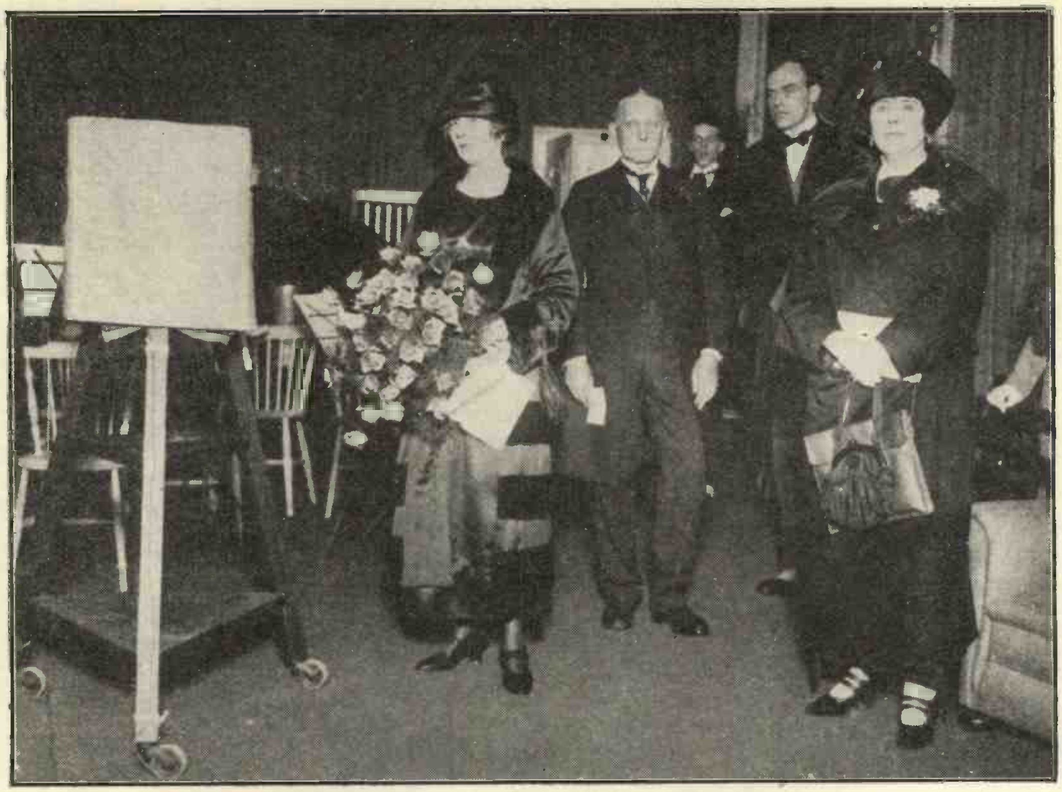


Fig. 4.—The charted map.

2 LO's NEW STUDIO

2LO was transferred to its new and luxurious quarters last week. Captain Eckersley received about forty journalists in the studio, and, in his own inimitable fashion, gave the technical details about the padded walls, etc., which have already been noted in our columns. The journalists were specially interested in the standard time clock, which is regulated by time signals from Paris. It is the intention of the B.B.C. to give the standard time at stated intervals for the benefit of rural listeners-in.

Lord Gainford gave a spirited defence of the B.B.C. He stressed the fact that the dividend is limited to $7\frac{1}{2}$ per cent. and that it was the Post Office which insisted that the manufacturing members of the company should contribute to the expenses of the company by means of a small tariff on their sales. Over a thousand people had been discharged owing to the depression of trade due to the recent agitation and controversy. Broadcasting was not going to stop. Contracts were made until the end of the year. They had not given up hope of an amicable understanding with all the interests opposed to them.



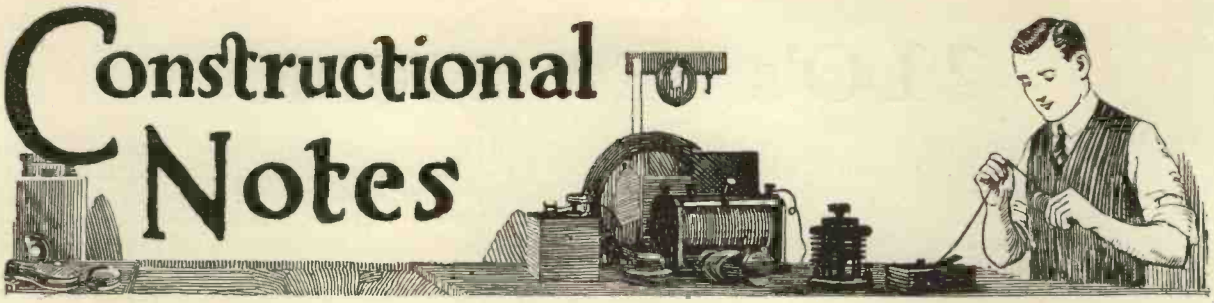
WOMEN'S WIRELESS HOUR.
Princess Alice, Countess of Athlone, inaugurated the first women's hour at the British Broadcasting Company's new premises at Savoy Hill. Picture shows Princess Alice (with bouquet) about to broadcast her message. Next to her is Lord Gainford, Chairman of the B.B.C.

Everyone was much impressed by the absolute elimination of echo. It makes singing and speaking exceedingly difficult. In the course of the evening Lord Birkenhead, in a brilliant short speech, referred to the unsympathetic nature of the instrument into which he was talking. Obviously he was missing the inspiration of an audience. Lord Birkenhead also said that it was incredible that any difficulties which the B.B.C. had with other interests should not be capable of adjustment.

Sir William Bull had his first experience of broadcasting, and in the course of a bright and breezy speech said the newspaper proprietors, theatre managers and the gramophone people could no more keep back broadcasting than Mrs. Partington could sweep back the Atlantic with a mop.

A fine programme was given by the Guards Band and several capable artistes.

Constructional Notes



TAGS

NOTHING makes the wireless set look worse than untidy wiring. If leads are left with the outer insulation loose and ragged at the ends there is always the danger that it may unravel far enough to make a short circuit possible either with another wire or with some material whose poor insulating qualities provide a ready path to earth for high-frequency currents. Nor can one feel sure that all connections are above suspicion if the bared ends of the various leads are simply twisted round terminals and screwed down; this is particularly the case when "flex" leads are used, since its fine strands soon give way under this kind of treatment. To tidy up the wiring of the set is a very simple business that can be carried out in odd moments when no more pressing jobs are on hand.

Fig. 1.

Fig. 1 shows how a forked end may be made on the wire itself; this is an easy method, but it uses a good deal of wire, for about two inches must be bared and bent to make each end connection.

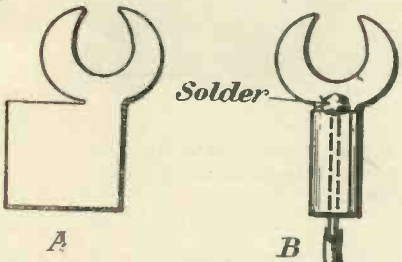


Fig. 2.

Figs 2 and 3 show forked tags made from thin sheet brass. To cut them out use an old pair of strong scissors if tin-snips are not available. The flap of the type seen in Fig. 2 is rolled into a tube with the aid of a pair of round-nosed pliers. The bared end of the wire, with a dressing of fluxite, is now inserted as shown at B, the tube being pinched up as tightly as possible with pliers. A small piece of solder is cut off and placed at the top of the tube. The tag is now held in the flame of a spirit lamp or Bunsen burner until the solder runs. As soon as it has set you have a firmly fixed tag upon which you can rely.

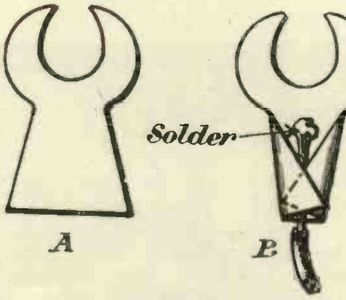


Fig. 3.

The second type (Fig. 3) can be made without the use of round-nosed pliers. The corners are bent up and folded tightly over the wire, solder being run in as before. Tags of shapes which can be fixed in the same way are seen in Figs. 4 and 5.

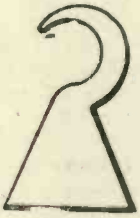


Fig. 4.

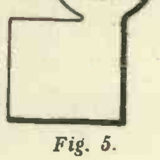


Fig. 5.

To make a neat tag for leads that have to be fixed to "push-in" terminals, where the connection is made by inserting the lead into a hole in the terminal and fastening it with a binding screw, is rather more of a problem. A solution that answers well is seen in Fig. 6. The body of the tag is a ¾in. length of brass tubing with an inside diameter of ⅛in. Into one end of it is inserted a short length of ⅛in. round brass rod, ½in. being left protruding. The tube is now filled with small pieces of solder, on top of which is placed a "blob" of fluxite. This having been done, grasp the protruding rod with a pair of pliers and hold the tube in the flame of a gas ring until the solder melts. Then dip the bared end of the wire into fluxite and push it into the solder. When it has set the solder will hold both wire and rod firmly in place.

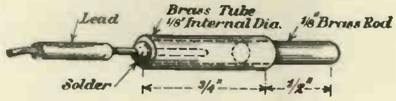


Fig. 6.

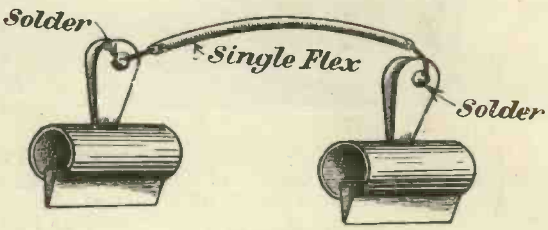


Fig. 7.

If you frequently try new circuits or make fresh combinations of your apparatus, you will appreciate connections which can be slipped into place in a moment and yet hold tightly without any screwing down. One of the most useful of these appears in Fig. 7. It is nothing more than a pair of spring paper slips of the smallest size joined by a length of flex, one end of which is soldered by each.

Fig. 8 shows a most convenient quick-fastening terminal which can be used with either forked or hook-shaped tags. To make it, unscrew the top nut of an ordinary terminal and slip over the screw first a loosely fitting flat washer then a spring washer. Next screw the top

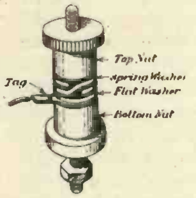


Fig. 8.

nut lightly down. Either of the tags mentioned can be slid instantly between the flat washer and the lower nut, and as the spring presses the flat washer down a good firm contact is assured. No terminals are more convenient than these for the valve panel and for the inductance coil holder.

A USEFUL HIGH-TENSION BATTERY

A CHEAP but quite satisfactory unit for supplying the high voltage and tiny current required by the anode circuits of the receiving set can be put together very easily by means of pocket flashlamp batteries and some of the parts of an H.T. battery that has been discarded as of no further use.

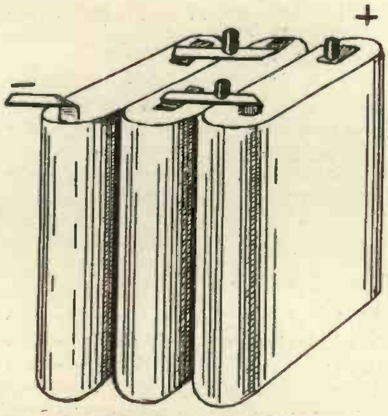


Fig. 9.—The H.T. battery.

My own, made in this way, has now been in daily use for four months on a five-valve set. Run together in the first instance as a makeshift in an emergency, it proved so satisfactory that it has remained in position. After all this time the average potential under load of the batteries of which it is made up is still in the neighbourhood of 4 volts apiece—their original reading was 4½ volts, and it has never given any trouble by producing unwanted noises.

Most wireless men have one or two old H.T. batteries knocking about amongst their miscellaneous gear. These should be despoiled of both their wax and of the small sockets for wander-plugs with which they are provided.

From a dozen to eighteen flashlamp batteries are now procured and connected in series as shown in Fig. 9. In most makes the long strips are negative, the short ones positive. Bend one of the long strips back on itself, as shown, and solder its end to the short strip of the next battery. Proceed until all are joined up.

Now take the sockets, soldering one to the free strip at either end of the row of batteries, and the rest to the bridging strips. A dozen batteries thus provide a 54-volt H.T. unit with 4½-volt steps up.

Melt down the wax, and pour some of it into a suitable box. Place the cells on the layer so formed and arrange them so that their sides do not touch each other. Then pour in the remainder of the wax available and allow it to cool.

R. W. H.

HOW TO MAKE A SPRING TERMINAL BLOCK

A SPRING terminal block for connecting several pairs of 'phones in parallel is a very useful addition to any receiving outfit, and the necessary materials and parts for its construction are easily acquired. The 'phones may be quickly plugged in or withdrawn without making adjustments, and if the 'phone leads should be suddenly jerked they simply slide out of circuit instead of breaking or pulling the receiver on the floor. The terminal block to be described will accommodate from one to six pairs of 'phones.

Two pieces of round brass rod, each about 3in. long and large enough in diameter to slide comfortably through an ordinary large spacer washer, are slotted by means of a hacksaw and threaded at each end, as shown at A, Fig. 10.

A length of brass or copper wire is cut up into short lengths and soldered inside each spacer washer, as shown at B. These bridges engage the slots in the rods and prevent the spacer washers from

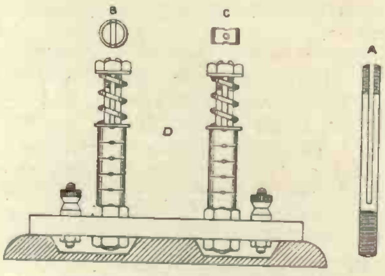


Fig. 10.—The terminal block.

turning. A groove, slightly smaller than a semi-circle, is cut across both edges of the spacer washers on a direct line with the wire bridges. This will be clearly understood by referring to the sectional diagram C, which represents B cut through the diameter.

The rods are mounted about 2½in. apart on a piece of ⅜in. ebonite, 4in. long by 1in. wide, and clamped firmly by means of a nut at each side of the ebonite. Two terminals may be included, one connected to each of the rods. The prepared spacer washers are now slipped over the rod (five on each), and an ordinary brass washer is placed over the rods on each tier. The springs may be made of brass wire wound round a pencil, the correct tension being ascertained by a little experimenting.

Final adjustments are made by adjusting the nuts at the top of the rods, which may have one or more washers placed between them and the tops of the springs.

The general arrangement of the device is shown at D. The ebonite base may be screwed down to any suitable wooden baseboard recessed to receive the nuts.

O. J. R.

A USEFUL METHOD OF TAPPING COILS.

THERE are numerous ways of taking tappings during the process of winding an inductance coil; each of them no doubt has its own particular merits, but

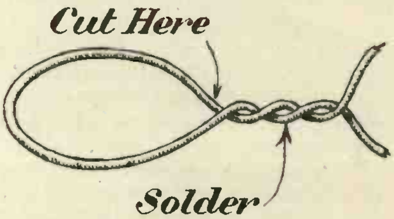


Fig. 11.—A coil tapping.

the one about to be described has always been found simple in use and perfectly satisfactory. It can be employed for tapping basket coils as well as single-layer inductances.

We will suppose that a coil of the latter type is being wound and that tappings are desired at every tenth turn. Begin at the left-hand end of the former and wind away from you. When the tenth complete turn is reached, hold the turns on the former in place by means of the left thumb and let the loose part of the wire pass between the first and second fingers of the same hand. With the right hand bare about ½in. of the wire just above the place where the left thumb is holding all secure, and then do the same thing four inches further on. Lay the two bared parts together and give them a twist with a pair of flat-nosed pliers. Then go on with the winding.

Never remove the insulation from fine copper wire by burning it off, as one sometimes sees recommended. Copper is hardened by being heated and allowed to cool slowly. The heat of a match flame is quite enough to make fine wire brittle, and if wire is treated in this way it will probably break during the twisting process.

Proceed in the way described at each tapping point; then anchor the far end of the wire and return to the tappings. These will now be in the form of loops two inches long. Give the wire another twist if necessary, apply a little solder, then cut. This gives a four-inch wire for making connections from each tapping point. The joints should be coated with shellac varnish.

The ordinary soldering-iron will be found too clumsy a tool for this kind of fine work. It is better to make up a special one from a piece of ¼in. round or square copper rod, one end of which is driven into a tool-handle, whilst the other is filed to a flat point. Such an iron cools rather quickly, but it saves so much time and trouble by its handiness that one does not mind this. A spirit lamp should be kept burning on the table for heating it.

R. W. H.

AN INEXPENSIVE FRAME AERIAL.

THE experimenter who is engaged in trying out new circuits, such as those containing double reaction or some other form of super-regeneration, is almost bound to have a frame aerial amongst his wireless gear, otherwise he will run the risk of causing serious interference with others' reception during his tests, if he attempts to use broadcasting wavelengths. A frame will also be found very useful by those whose stations are so situated that jamming by local transmissions is the rule rather than the exception, for this type of aerial is so markedly directional in its action that unwanted signals can usually be tuned out without difficulty.

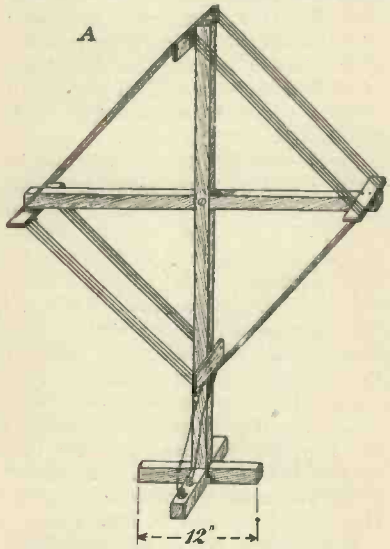


Fig. 12.—The frame aerial complete.

A frame with two-foot sides will be found a very convenient size, since it does not take up too much room. With it, an ordinary set will give signals of about one-third the strength of those brought in by the outdoor aerial; to obtain anything like the same strength and range, high frequency amplifying valves must be added to compensate for its lower efficiency.

Fig. 13.—One of the cross feet.

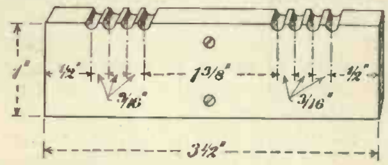


Fig. 14.—The ebonite spreader.

To obtain two-foot sides, the diagonal pieces must have a length of approximately 34in. The upright one is cut 40in. long to allow of its being mounted on a stand (Fig. 12). These diagonals are of pine 1½in. broad and 1in. thick. They are joined together by being slotted and fastened with a couple of screws. The upright is fixed to a cross-shaped stand.

It is not desirable to tap a frame aerial, since to do so produces dead-ends which give rise to a marked loss in efficiency. It is best, therefore, to adopt a number of turns that will tune with a 0.001 μF condenser in parallel to wavelengths useful for experimental purposes. Eight turns on the two-foot frame with $\frac{3}{16}$in. spacing give a wavelength range of approximately 300 to 800 metres—a very rough rule of thumb which may be found useful is that on this sized frame, the minimum wavelength with a 0.001 μF condenser equals the number of turns multiplied by 40.

The spacing is done by making ebonite spreaders of the size shown in Fig. 14 and fixing them by means of screws to the arms. Stout bell wire of good quality will be found excellent for making the windings. Its ends are attached to a pair of terminals mounted on a small ebonite block fixed to one of the arms of the stand.

IMPROVING CHEAP RHEOSTATS

THE most common type is fitted with a top nut, which keeps, or, rather, should keep, the spindle so adjusted that the arm makes firm contact with the spiral of resistance wire. What actually happens is that when the knob has been rotated a few times this nut works loose and the arm revolves in a crazy way, making contact only here and there. The knob is supposed to screw down on to this nut so that the two may lock, but it is so difficult to hold the nut whilst tightening up that a real locking effect is almost impossible to obtain.

The best remedy is to drill a 6B.A. tapping hole through one face of the nut, and to fit a set-screw. Adjustment then becomes as easy as could be desired.

On the lower side of the rheostat the arm is held between a pair of nuts; but here again it is by no means an easy job to get them to lock properly. The following tip will save a great deal of trouble. Secure the arm to the nut by means of a "sweated" joint made with a little solder, then screw on nut and arm to the right height, and solder them to the spindle.

Another fault frequently occurring in cheap rheostats is that the spiral is wound with either too little wire, or with stuff of too large gauge; hence there is not sufficient resistance to enable one to properly control the supply to the valves. Spirals with a value of 5 ohms can be bought for about 6d. apiece from wireless shops, and it is an easy matter to fit one of them in place of the old coil. If desired, a new resistance spiral may be made at home by winding 3 yards of No. 24 Eureka wire tightly round a slate pencil. R. W. H.

A SIMPLE KEY SWITCH

THERE is a certain amount of fascination in possessing something in the nature of a mystery, and when small brothers cultivate the habit of interfering with receiving sets the possession

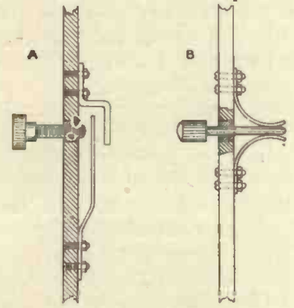


Fig. 15.—The switch terminals.

of a master key is indeed something to be proud of.

At A, Fig. 15, a strip of fairly stout brass is bent Z shape and provided with two holes for attaching same to the inside of the panel by means of small screws or bolts. A strip of spring brass about 3in. long and cut to the same width as the thicker piece is similarly attached to the panel in the position shown. Near the top of this strip and in a direct line with its centre a hole is drilled through the panel and a 4B.A. nut is carefully fitted in same and secured (if it is necessary) with a little seccotine. The key comprises a short length of 4B.A. screwed brass rod rounded off at one end and fitted with a small knob at the other end.

The two brass strips are connected in series with one of the battery leads; thus it will be seen that by screwing in the key the lower strip makes contact with the upper one and closes the circuit.

B in Fig. 15 shows a still less complicated arrangement, although perhaps this method is not quite so reliable, owing to the spring brass strips having a tendency to sag and close the circuit when the key is withdrawn. To overcome this difficulty, however, it is only necessary to place the strips a little farther apart and use a key or plug of a correspondingly larger diameter. The panel is drilled and bushed with a small spacer washer, and the key is made from a short length of round brass rod which will slide freely through the bush. One end is slightly tapered and a small knob is attached to the other end. If desired, a small ring or the top of an old key may be soldered on in place of the knob. The switch is connected in series with one of the battery leads, the connecting wires being preferably soldered to any convenient part of the brass strips. O. J. R.

A HOME-MADE POTENTIOMETER

A GRID potentiometer is almost an essential part of any wireless set provided with high-frequency amplification. Such

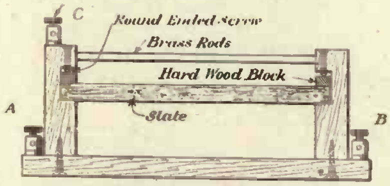


Fig. 16.—The wood former, mounted.

a gadget costs a good deal to buy, but it can be made at home at very little cost indeed.

POTENTIOMETER.
Table for former 1in. wide by ¼in. thick.

S.W.G.	Ohms per lb.	Turns per inch.	Res. in ohms per inch of windings.	Turns wound by 1 oz.
30	4,000	73	33	540
32	6,900	83	50	708
34	12,000	98	75	960

To carry the windings we require a rectangular slate former which may be of any desired size, according to the gauge of wire used and the resistance required. A convenient section is 1in. wide by ¼in. in thickness, and the table hereunder gives wiring data for a former of these dimensions.

It will be seen that to provide a resistance of 300 ohms the windings will occupy 9in. with No. 30 wire, 6in. with No. 32 and 4in. with No. 34. An extra 1½in. must

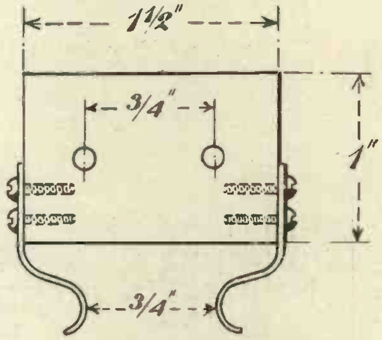


Fig. 17.—Dimensions for slider.

be allowed in every case, since at each end ½in. is needed for mounting purposes, and a ½in. must be left bare.

Slate can be cut quite easily with a stiff-backed saw, and trimmed with a medium file.

Whatever gauge of wire is chosen, it should be enamelled, as the turns can thus be wound on as closely together as possible. Wind them as tightly and as evenly as you can, and when all the wire is on give the turns a coat of enamel or shellac, which will serve to keep them in place.

Fig. 16 shows one method of mounting the wood former, but if preferred holes can be bored in the slate with a breast drill and the former screwed down directly to the supports. The latter, as well as the baseboard, should be of mahogany, teak or seasoned oak. The ends of the windings are taken to the two terminals A and B.

Between the supports are fixed two parallel rods of $\frac{3}{16}$in. round brass to carry the sliding contact, details of which are given in Fig. 17. The body consists of a brass block 1½in. × 1in. × ⅜in. thick in which two holes are drilled to fit the rods. Two springy strips of brass, bent as shown, are screwed to the slider. R. W. H.

A PROGRESSIVE UNIT RECEIVING SYSTEM

This forms the fifth part of our special series of articles dealing with the construction of a complete unit receiving system. Every piece of apparatus described will be subsequently used in more ambitious sets.

PART V.—A COMBINED VALVE AND CRYSTAL RECEIVING SET.

(Continued from No. 4, page 239.)

LAST week we described the construction of the high-tension battery and the valve panel. It will, of course, be necessary to buy the six-volt accumulator before being able to make up the first valve set.

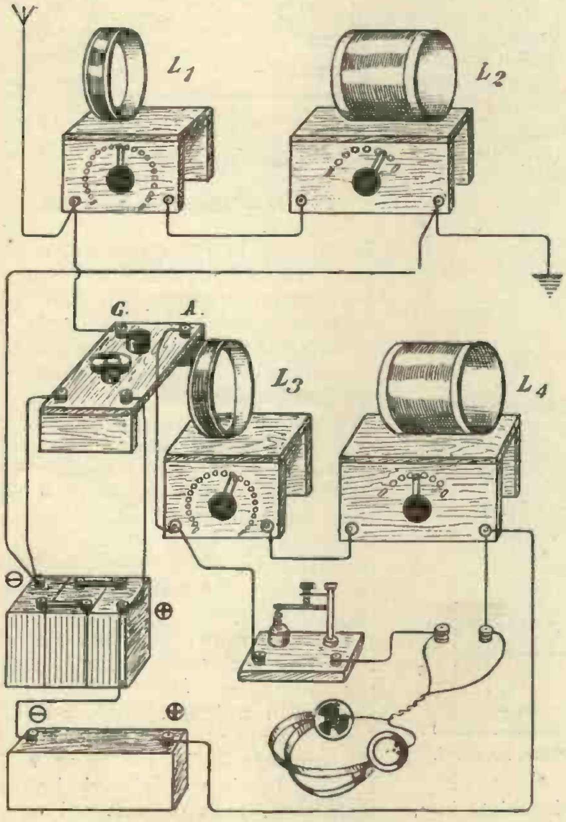


Fig. 1.—The complete set, showing connections.

If you have not already bought an accumulator for this purpose, I would advise you to buy a six-volt 30-ampere-hour accumulator. It is to be noted that some makers specify the capacity of their accumulators in *ignition* hours, which are always twice the actual hours owing to the fact that the current for ignition purposes is intermittent. Take care, therefore, that your accumulator is rated by its actual capacity, which, as stated above, should preferably not be less than 30 ampere hours. An accumulator of this kind may be bought for about £2 10s. Do not, under any circumstances, buy a cheap inferior accumulator. See that the plates are thick, preferably not less than $\frac{3}{16}$in. thick. Accumulators are sold at all prices, but I have never yet met a good one sold cheaply.

Assembling the Apparatus

Having made or bought the different component parts, connect them up in the manner shown in Fig. 1. This pictorial representation should enable even the veriest beginner to get good results.

L_1 and L_3 are 20-turn inductances, as described in No. 1 of *Wireless Weekly*. L_2 and L_4 are 100-turn inductances, made in accordance with the instructions in No. 2 of this journal.

Fig. 2 shows the circuit used. It will be seen that the valve acts as a high-frequency amplifier, the crystal detector and telephones being connected across the two inductance coils L_3 and L_4 connected in the anode circuit of the valve.

Operation of the Receiver

The receiver here described will give very good results on all wavelengths from about 150 to 700.

Probably the best way of operating the set is to place all the inductance in L_3 and L_4 in circuit. Adjust the crystal detector very carefully and adjust the handles on the inductances L_1 and L_2 in the same way as if tuning the crystal detector circuit previously described.

Having obtained signals, carefully adjust the detector, and adjust the aerial circuit by moving the knob on L_1 and L_2 until the maximum response is obtained. Next adjust the handles on L_3 and L_4 in a systematic manner until signals are at their best.

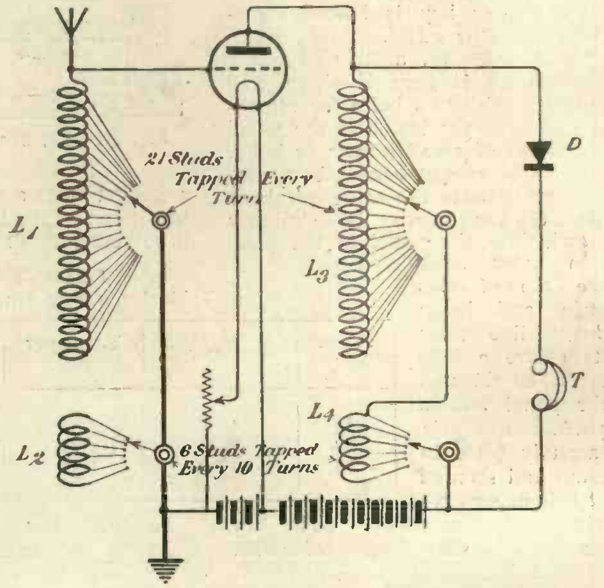


Fig. 2.—Wiring diagram of the receiver.

LONG-DISTANCE AMATEUR TRANSMISSION

Some unusual distances obtained by an experimenter.

ON Friday, April 20th, about 9.0 GMT, 8BM was heard calling CQ by British 2KW (W. R. Burne, Sale, Cheshire). This call he answered, and listened for a reply. A further call from 8BM was again answered, which brought a receipt from 8BM.

The signals from 2KW were reported QRZ, though the call sign was evidently read correctly by 8BM.

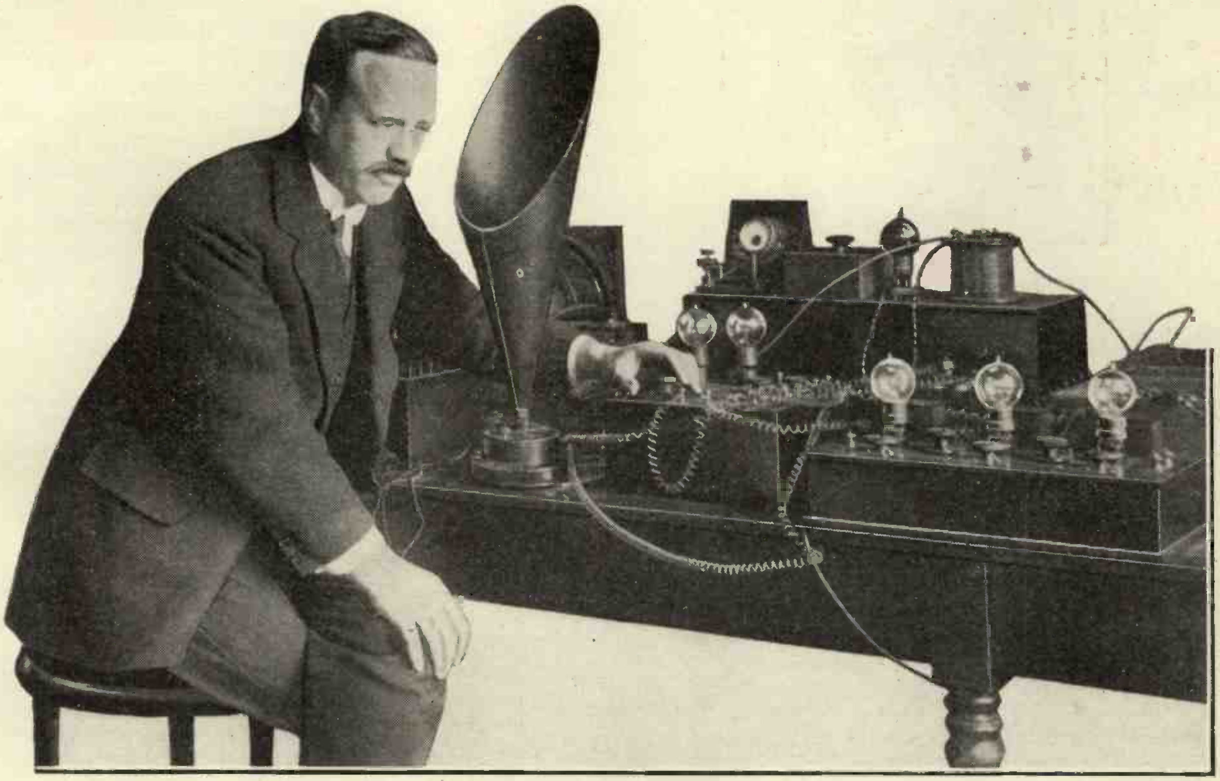
The stations are about 350 miles apart, and the power input at 2KW was then 20 milliamperes at 250 volts, giving a power of 5 watts.

With an input of 11 milliamperes at 150 volts 2KW succeeded in raising 2GG last week.

On April 23rd, about 10.15, 2KW was again successful in raising 8BM. Communication was then successfully established, and the stations worked together for a considerable time. Signals at 8BM were reported QSA at times, though they faded now and then. The power input at 2KW was then 4.8 watts.

It is felt that this constitutes something of a record, and reports of reception of 2KW's signals will be greatly appreciated. He may be heard working most nights up to 12.0 midnight on 200 metres.

WIRELESS AND THE LAW



Extensive experiments have recently been carried out at Scotland Yard with a view to ascertaining whether wireless telephony would afford a quicker means of inter-communication between stations. The photograph shows the apparatus installed at Scotland Yard.

THE CONSTRUCTION OF A LOCAL OSCILLATOR

By ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."

The value of a separate heterodyne oscillator is not apparent until the upper wavelengths are reached. In order to help the experimenter to obtain the maximum efficiency over a wavelength range of from 7,500 to 24,000 metres the following constructional items will be found of use.

(Continued from No. 4, page 214.)

THE general appearance of the instrument will be apparent from an examination of the photograph, Fig. 2. This shows the actual oscillator, and it will be noticed at once how compact and portable the design is.

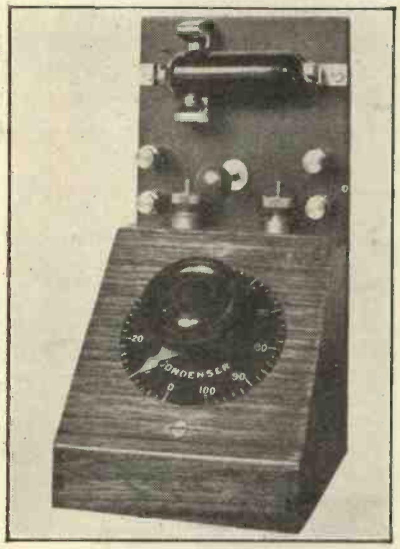


Fig. 2.—Photograph of the oscillator.

Fig. 3 shows the various component parts dissected, so that the experimenter can obtain the necessary measurements for making them up himself. Fig. 4 shows a perspective view of the arrangement of the grid and anode coils, so that there will be no difficulty in following the letters referring to the various parts of the instrument.

The grid coil can now be mounted in position on the spindle F, which has been passed through the panel X, when the two strips H, Fig. 3, have been cut out. These consist of ⅛in. ebonite cut to the dimensions shown, and are held in place one on each side of the grid coil by means of 4B.A. nuts threaded on to the spindle X. The purpose of these strips is, of course, to hold the grid coil in place, and it may be mentioned at this juncture that it does not matter if the grid coil slightly rotates as the handle F is pulled out or pushed in. A sufficient length of wire should be left out from the grid coil to connect to the necessary terminals as shown in Fig. 4, and this should be encased in rubber tubing such as is used for bicycle valves. Systoflex tubing is a little stiff for the movable coil, and it might in time cause a fracture of the leads where they enter the coil B. These points should be bound round with silk thread to prevent the wire tearing away from the surface of the coil.

If preferred, the V-24 valve clips C (Fig. 3) may be purchased, but if the experimenter wishes to make them up he can cut them out of $\frac{3}{8}$th by $\frac{1}{16}$th phosphor-bronze strip, the dimensions being clearly shown at C, Fig. 3. They should be mounted in position on the panel as shown in Fig. 2, so that the anode of the valve is uppermost and so that the valve lies horizontally across the panel. At this point it may be mentioned that if the operator does not like the glare from the fila-

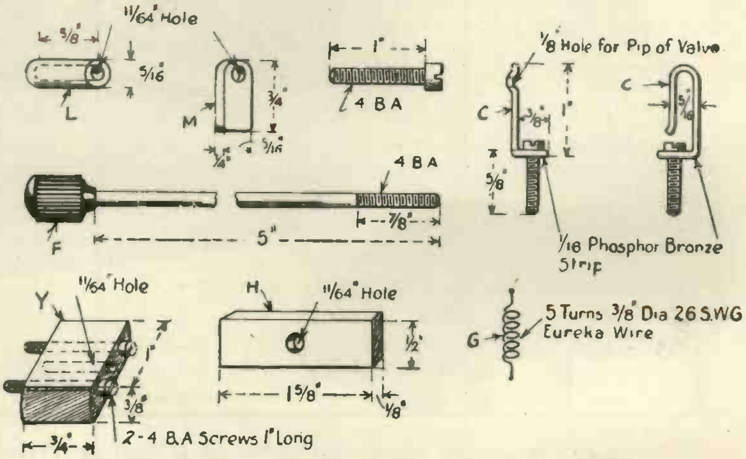


Fig. 3.—The various component parts, showing dimensions.

ment of the valve, the glass may easily be painted over with a coating of lamp stain of any desired colour. In the photograph the

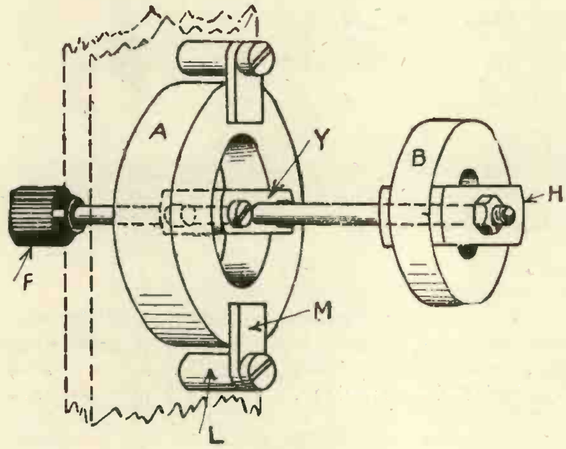


Fig. 4.

valve looks as if it were black; this is because it is coated with green lamp stain. After a considerable series of experiments, it has been found that this green colour is the most restful to the eye, and the experimenter who frequently uses a large number of valves for long periods at a stretch will appreciate this remark.

In order to keep the oscillations constant over the necessary range of wavelength, the small filament resistance G, Fig. 3, is inserted directly in the positive filament lead. This allows about 5 to $5\frac{1}{2}$ volts to pass to the filament of the valve, and keeps it burning at a constant temperature, which is not so great as to cause the valve to have a short life only. A variable filament resistance might be incorporated if desired, but would necessitate a considerable amount of adjustment in order to obtain satisfactory working over a range of wavelengths, and would upset the calibration of the instrument altogether. The "Polar" condenser, as already explained, was selected on account of its great constancy of operation, and has been found to be exceedingly suitable. This oscillator, when completed and when fed with about 20 volts on the H.T. terminals, will produce continuous waves freely over the specified band of wavelengths. The necessary adjustments are effected by altering the coupling of the grid coil B and to capacity of the variable condenser. With a very little practice the experimenter will learn to manipulate this apparatus to the best advantage, and it may be said here that it will produce oscillations when placed at a distance of 3ft. to 4ft. from a receiver. In practice, however, it is as well to have it fairly close to the receiver, because the strength of the oscillations can always be controlled by means of the coupling handle F. Fig. 5 shows a circuit diagram of the complete arrangement, and it will be found that it well repays any time and expense involved in putting it together.

The advantages of local heterodyning on long wavelengths do not seem to be fully appreciated, but one has only to use such a local oscillator as described in this article to immediately notice the increase in signal stength upon the higher wavelengths. Several modifications of this design may present themselves to the reader, and, of course, the wavelength range may be extended by means of suitable fixed condensers added to the circuit and suitable tappings taken from the coil. The writer, however, has not found any of these expedients necessary, as it is not essential to produce local oscillations to obtain high efficiency on wavelengths much below the minimum figure covered by this instrument.

The disadvantage of the Townshend pattern of buzzing wave-meter is that it radiates all sorts of harmonics and produces direct induction effects, which upset the readings on the shorter wave-lengths. It is also liable to cause trouble if used for any length of time, and there is no buzzing wave-meter on the market which compares in any way with the heterodyne pattern.

Where it is possible to obtain one, the Army pattern of heterodyne wave-meter

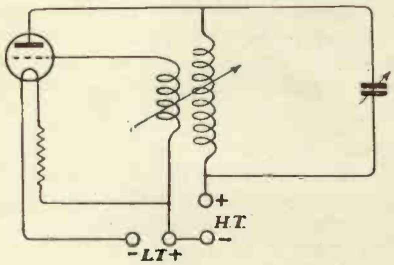
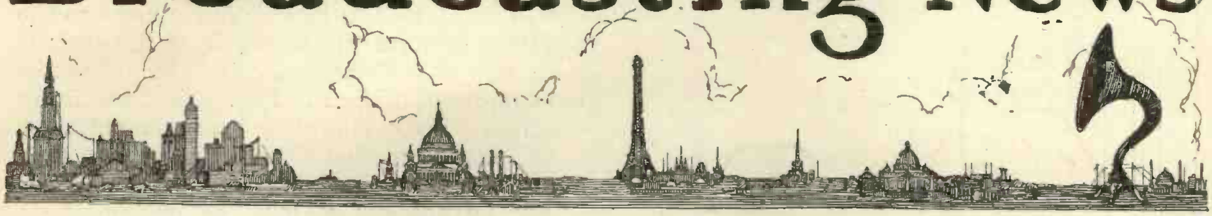


Fig. 5.

should be used to cover the shorter wavelengths, as it will be found that the beat note from both wave-meters is very similar in characteristics.

Broadcasting News



By OUR SPECIAL CORRESPONDENTS

The Boomerang

AFTER a particularly hectic time at the instigation of the popular press, the B.B.C. is enjoying an unwonted spell of that blessed state, tranquillity. The theatrical ban on broadcasting was in a large measure responsible for this swing round of press opinion. The last thing the theatrical managers wished was to popularise broadcasting, but this is just what they have succeeded in doing.

Musical Controller of the B.B.C.

The appointment of Mr. Percy Pitt as Musical Controller of the B.B.C. gave rise to the erroneous but somewhat natural impression that Mr. L. Stanton Jeffries had been superseded. Mr. Jeffries still continues his excellent work as Musical Director of the B.B.C. There are, however, some important new developments maturing, and Mr. Pitt will be responsible for those. Mr. Pitt would perhaps be more accurately styled as Consultant Advisor. He will advise the company generally on all matters of prime musical importance. He will be responsible for an operatic night once a fortnight, a male voice quartette twice weekly, and a string quartette once weekly.

Sunday Programmes

He will also develop the musical side of the Sunday programmes, and will organise groups of singers and players who will be sent on tour throughout the provinces. This still leaves Mr. Jeffries with an enormous amount of work to do, including the hundreds of additions of new artistes who wish to broadcast.

The New Studio

The new studio at 2LO is a gorgeous room in gold and blue. All echo has been completely eliminated, but the effect of speaking or singing is, at first, most disconcerting. The canvas on the walls absorbs all resonance, and the voice is the same as speaking in the open air. The announcers find it very exhausting, and the singers are apt to feel at first that they are off form. However, there is no doubt that the studio is a triumph in broadcasting acoustics.

Broadcasting and Distress

The S.O.S. call for help from 2LO the other evening, as a result of which a mother was rushed up from the Midlands in time to be present at the death of her son in the Middlesex Hospital, was one of the most thrilling and touching incidents that wireless has produced. Even hardened listeners-in state they were indescribably thrilled when Mr. Burrow's mellow tones made the appeal. Over thirty cars raced to Flitwick, some of them from London.

The B.B.C. will be willing to render help in life and death cases of this nature, but obviously great care would have to be exercised in acceding to similar requests. The Scot who has lost a saxpence cannot expect to have his misfortune borne on the waves of the ether.

Broadcasting and the Cup Final

The deplorable Stadium scandal might possibly have been avoided if the desire of the B.B.C. to broadcast an entertainment for the benefit of the crowds attending the Cup Final had been granted. The B.B.C. were anxious to transmit a special performance from 2LO, and had made experiments with extra loud speakers which were very successful, but in the end the red tape merchants triumphed and the proposal was turned down.

There is no doubt at all that the crowd could have been kept more in hand with the aid of loud speakers. Whenever the break-in began a message could have been telephoned to 2LO and broadcast with sobering effect back to the crowds. For all that the authorities could do, there might have been hundreds of persons crushed to death in the *mêlée*.

It is to be hoped that someone will find out who was responsible for turning down the B.B.C. proposals.

When constabulary duty is to be done the policeman's lot is not a happy one, particularly on a Cup Final, and the authorities cannot afford to ignore any precaution which would tend to alleviate the lot of the police.

Cave Exploring as a Sport

Dr. Baker, Director of the University of London School of Librarianship, will give a talk from 2LO on Cave Exploring as a Sport. If he would also give one on house-hunting as a pastime, he might be able to bring a measure of relief to that jaded section of the community which has no home to call its own.

Miss José Collins is giving six talks on Beauty Culture from 2LO. At least, no one will ever be able to say to Miss Collins, "Physician, heal thyself," because she has discovered the secret of perennial beauty. She will probably talk about the effect of mind upon the appearance. "A contented mind is a blessing kind." It is to be hoped that some of the theatrical managers will listen-in to her remarks, because rumour has it that they are losing their beauty sleep over the effect of broadcasting on the theatres.

But surely the theatre managers are asking for trouble when they seek to impede the whole progress of wireless science. All their new contracts are to contain a clause preventing their artistes from broadcasting, and refusing engagements to those artistes who have broadcasted. This has been followed by a threat of listeners-in to boycott the plays, and if such a regrettable thing should happen, the theatrical managers will have the sombre consolation of knowing that they have themselves to blame. It is the old case of George Stephenson and the "coo" again. If the theatrical "coo" will insist in getting in the way of the wireless train, then it is going to be "vera inconvenient for the coo." Broadcasting is going on, and the sooner the theatrical managers realise this the better.

Miss Dixon (Auntie Sophie of 2LO)

It's an Ill Wind——

As a result of the recent Press attacks and of the uncertainty of the licences, thousands of employees have already been dismissed in the wireless trade.

A Wireless Achievement

After much experimenting, Messrs. Harrods decided upon a very efficient system of sound distribution in connection with wireless broadcasting in their extensive Georgian Restaurant. This system was utilised on the occasion of the recent Royal wedding, when twelve Magnavox loud speakers entertained over 4,000 people with the songs and musical items transmitted by many well-known artists from 2LO.

No further comment regarding the absolute success of the evening need be made beyond that given in the *Daily Express*, as follows: "Every member of the audience heard perfectly. It was a great technical triumph."

It will be of interest to readers of *Wireless Weekly* to know the method of operating so many instruments over such an expanse of floor space; for undoubtedly it was the largest exhibition of perfect wireless reception ever attempted under one roof.

Seven Magnavox loud speakers were installed in one restaurant hall and five in a slightly smaller hall adjoining, the instruments being equally distributed. Two receiving circuits were employed, working off separate aerials; in one instance a Sterling two-valve set was used, and in the other a single-valve set. The outputs from these instruments were connected through inter-valve transformers to two Magnavox three-stage power amplifiers using L.S.2 valves. The low-tension terminals were wired in parallel and operated from one 6-volt 66-ampere-hour (actual) accumulator, but each high-tension circuit was separately supplied with 300 volts from dry batteries. The output terminals of these power amplifiers fed the loud speakers through two circuits; in one room seven inputs were wired in parallel, and in the other five. Each Magnavox field was separately excited from 6-volt accumulators placed beneath the instruments, all battery leads being kept as short as possible. The valve filaments in the receiving instruments were carefully adjusted and the amplifier filaments gradually stepped up, and at no time were they full on. By this system of distribution and valve adjustment perfect reproduction was obtained without the necessity of overloading each instrument, which only produces distortion. Furthermore, no matter where one was throughout the two great halls, every item could be distinctly and enjoyably heard, which was amply testified by the continued applause of the audience.

President Harding and Broadcasting

The largest audience ever addressed by an American President will listen to President Harding's speech, to be delivered at the Metropolitan Opera House on the evening of May 10th, on the occasion of the celebration of the twenty-seventh anniversary of the Volunteers of America.

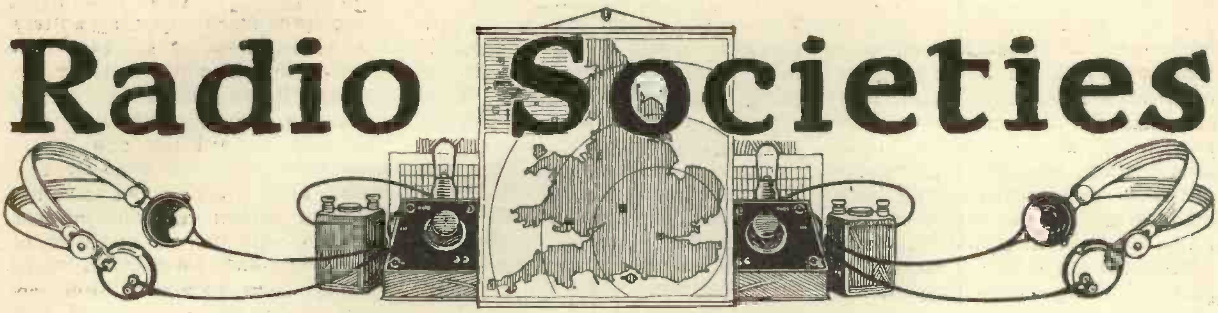
The speech will be picked up by sensitive microphones and broadcasted through the American Telephone and Telegraph Company's wireless station in New York. Under favourable conditions this station has been heard in the Hawaiian Islands and in Europe, and is within range of high-grade receiving sets in any State of the Union.

This will be the first time that the President has spoken through a broadcasting station in this manner.

The Women's Hour

A new feature of the broadcasting programmes is to be the Women's Hour—or rather half-hour—which was inaugurated on Wednesday last by Princess Alice, Countess of Athlone, whose photograph appears on page 301. Lady Duff Gordon will discuss fashions, and further items of especial interest to ladies will be "radiated" in due course.

This will reward the long-suffering wives of wireless enthusiasts for their patience.



The Radio Society of Great Britain.

RADIO SOCIETIES

To the EDITOR, *Wireless Weekly*.

19th April, 1923.

SIR,—In view of the impending issue of the new form of wireless licence, making it possible for amateurs and experimenters throughout the country, without previous knowledge, to make up their own wireless receiving sets from parts and accessories, may I draw your readers' attention to the advantages gained, particularly by those who have at present little or no wireless knowledge, by joining one of the many Radio Societies in London and the provinces.

The Radio Society of Great Britain has affiliated to it now upwards of some 250 such Radio Societies throughout the country. Practically all these Radio Societies are giving weekly or monthly lectures to their members, and those of your readers just commencing this interesting new science would do well to get in touch with their local Society. If for no other reason, it is of the utmost importance that those making up their own sets should be educated in how they may make such sets and use them without risk of interference to their neighbours by re-radiation from their aerials. The Radio Society of Great Britain has, since Broadcasting commenced, formed a new class of members known as Associates. No previous knowledge of wireless is necessary to join this class, the subscription is a nominal one of 5s., and there is no entrance fee. Special elementary lectures are arranged each month for Associates.

If any of your readers are in doubt as to the nearest Radio Society in their district, I shall be pleased to give them the necessary information if they will kindly enclose stamped addressed envelope, or to those who desire to join the Radio Society of Great Britain, application forms and full particulars of the different grades of membership will be sent.

Yours, etc., L. McMICHAEL,
Hon. Sec.

ADDISCOMBE AND DISTRICT RADIO CLUB.

Hon. Sec., MR. L. S. DAVIS,
156, Cherry Orchard Road,
Addiscombe, Croydon.

On Wednesday, April 18th, the first meeting of this Club took place at Leslie Park Hall, Leslie Park Road, a Committee being appointed and preliminary arrangements made.

Meetings will be held weekly, and membership is extended to all ladies and gentlemen interested. All communications should be addressed to the Hon. Secretary.

DEWSBURY AND DISTRICT WIRELESS SOCIETY (H.Q., South Street, Dewsbury).

Hon. Sec., MR. F. GOMERSALL,
1, Ashworth Terrace,
Dewsbury.

Mr. F. Dransfield gave a lecture on April 19th entitled "Tuning," and was able by means of various analogies to explain the whole matter clearly.

On April 24th Mr. Townend (of Messrs. Burndept, Limited, Leeds) gave an interesting explanation of the Burndept "Ultra IV."—a *de luxe* model four-valve receiving set. Members were allowed to examine the internal wiring and arrangements and take notes. The set was afterwards operated by members of the Society, who stated that they had not had better reception in the Society's rooms, but, owing to the proximity of trams and high-voltage lines, reception is somewhat marred by extraneous noises.

KENSINGTON RADIO SOCIETY (H.Q., 2, Penywern Road, Earl's Court).

Hon. Sec., MR. J. MURCHIE,
2, Sterndale Road,
West Kensington, W.14.

On April 12th, at 8.30 p.m., Mr. G. C. Blake, A.M.I.E.E., gave a lecture on "History of Radio Telegraphy." A simple explanation of electricity and its relation to matter and ether was first given, after which the development was traced from Clerk Maxwell's time to the latest uses of the vacuum valve. The action of the valve was splendidly demonstrated by a model invented by the lecturer, and which is used in Technical Schools of the Royal Air Force; lantern slides served to illustrate the lecture.

The Hon. Secretary will be pleased to forward particulars of the Society to anyone desirous of joining.

LEEDS AND DISTRICT WIRELESS SOCIETY (H.Q., Woodhouse Lane, United Methodist Church School, Leeds).

Hon. Sec., MR. D. E. PETTIGREW,
37, Mexborough Avenue,
Chapeltown Road, Leeds.

Mr. A. F. Carter, A.M.I.E.E., recently lectured on "Junk," and commenced with a few remarks on regenerative receivers and radiation. He recommended the use of at least one H.F. valve, the regenerative effect being obtained by coupling the anode circuit of the second, with the anode circuit of the first valve, a suitable positive potential being applied to the first grid to prevent self-oscillation of that valve and consequent radiation. The lecturer then dealt with the relationship between L.F. inter-valve and power transformers, and it seemed probable that the phase relation of E.M.F. and current might solve the question of "burn out."

In a lecture on "The Use of Inter-valve Impedance or Reactance Coils," by the Hon. Secretary, the use of this system was recommended for both H.F. and L.F. couplings. On short waves the coupling is most efficient and is to be preferred to H.F. transformer coupling. For L.F. work, it seems to be quite efficient for the whole range of audio frequencies, the main difficulty being the construction of grid condensers of high dielectric strength and having a capacity of from 0.05 to 0.5 μF.

On April 13th Mr. R. E. Timms (Hon. Treasurer) lectured on "The Construction of a Relay," and his remarks on the uses of the magnetic relay with ordinary recording apparatus and with the Turner trigger relay were greatly appreciated.

Mr. T. B. Thomson lectured on "Detectors, Ancient and Modern," dealing with almost every known type, including the Coherer, Magnetic Dector, the Hertz "spark-ball" device, Electrolytic and Thermal detectors, and Thermionic and Crystal detectors. The lecturer concluded with the statement that he would endeavour to solve the loud-speaker problem by free use of his sciatic nerve, as suggested by the frog's leg detector.

LEYTON AND DISTRICT WIRELESS CLUB (H.Q., The Leyton Tabernacle Church Hall, High Road, Leyton, E.10).

Hon. Sec., Mr. W. G. Peacock,
73, Frith Road,
Leytonstone, E.11.

This newly-formed Club will hold meetings on every alternate Monday commencing April 23rd at 8 p.m.

NORTH LONDON WIRELESS ASSOCIATION (H.Q., Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.).

Hon. Sec., Mr. J. C. Lane.

On April 23rd Mr. F. C. Angel gave his seventh paper on "The Elementary Principles of Wireless," and, after giving a brief outline of valves, past and present, the action of the valve was explained. Curves were drawn showing the correct points to work at for maximum results, and also the means of retarding the saturation point. The action of the potentiometer in circuit with the grid was explained and illustrated, showing how the passage of electrons to anode is assisted when the grid becomes too negative to function correctly.

The lecturer concluded by saying that it would be a great benefit to users if each make of valve were accompanied by its characteristic curve.

OLDHAM WIRELESS SOCIETY (H.Q., St. Thomas' Schools, Coppice, Oldham).

Hon. Sec., Mr. G. Halbert,
16, South Hill Street,
Oldham.

On Saturday, April 21st, at the headquarters, the above Society gave the first wireless exhibition and demonstration ever held in the town. Exhibits were varied and interesting, one receiver consisting of two honeycomb coils, a thimble crystal detector, and a pin for a cat-whisker. This receiver cost only 6d., and had received signals over a distance of seven miles.

Manchester, 2ZY, was received on a Magnavox in the demonstration room; two Amplions were carried into the exhibition room, and another Magnavox was installed in the Café. The exhibition was highly successful, and it is hoped that the proceeds will exceed £100.

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY (H.Q., Paddington Technical Institute, Saltram Crescent, W.9).

Hon. Sec., Mr. L. Bland Flagg,
71, Burlington Road,
Bayswater, W.2.

Mr. G. W. Lloyed gave a lecture on April 26th entitled "Proboscopy." He handled the subject very ably, illustrating his remarks with the aid of the blackboard and an experimental Proboscope built on novel lines; an exceedingly interesting discussion then followed.

This Society has vacancies for fifty more members, and all enquiries should be addressed to the Hon. Secretary.

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION (H.Q., John Pile Memorial Rooms, Fratton Road, Portsmouth).

Hon. Sec., Mr. S. G. Hogg,
9, Pelham Road,
Southsea.

Mr. R. J. Turner gave, on April 11th, an unorthodox but interesting lecture entitled "The Construction of Cabinets for Wireless Apparatus." The lecturer stated that teak, mahogany, walnut, and well-seasoned oak are the best woods to use. Methods of jointing were then fully discussed, including dove-tailing, glueing, lap jointing, and fixing by screws.

On April 18th Mr. A. G. Priest lectured on "Crystal and Valve Circuit," and for beginners gave a practical demonstration of induction coil winding, and also the construction of a crystal set. The explanations were extremely clear, and the lecturer advised beginners to master "tuning" before dealing with valve circuits.

THE SUNBEAM (MOORFIELD) WIRELESS SOCIETY (H.Q., The Sunbeam Motor Co., Limited, Moorfield Works, Wolverhampton).

Hon. Sec., Mr. C. E. Beresford,
c/o The Sunbeam Motor Co.,
Moorfield Works,
Wolverhampton.

On April 23rd a two-valve set with Western Electric loud-speaking equipment kindly lent by Messrs. Burns & Doddeon, of Dudley Street, was installed at the headquarters, and about 200 persons were given an interesting demonstration.

WIMBLEDON RADIO SOCIETY (H.Q., Red Cross Hall, 59, Church Road, Wimbledon, S.W.19).

Hon. Sec. (*pro tem.*),
Mr. C. G. Stokes,
Worple Avenue,
Wimbledon.

On April 26th, at the headquarters, a demonstration of the special broadcasting concert from 2 LO was given by Mr. J. A. Partridge (2 KF). An efficient aerial-earth system has now been installed, facilities for testing apparatus are now available, and application for a transmitting and receiving permit has been made.

The Hon. Secretary will welcome applications for membership.

WORKSHOP PRACTICE

By C. W. OSBORN.

All who construct their own apparatus will appreciate these practical hints upon methods of working various kinds of materials.

(Continued from No. 3, page 154.)

How to Work Ebonite

WHEN working in ebonite, for instance finishing a square or oblong panel, see that the edges are left square and the corners sharp. To finish the surface after all marks have been removed, wrap a piece of fine emery cloth round the end of a flat-ended file handle and work this with a circular motion all over the surface. The circles must be small and the emery cloth may be moistened with a little oil. This will give a matt surface, the best finish. All oil or moisture must, however, be entirely removed before the panel is put to use.

Taps and Dies—How to Use Them

B.A. screws, nuts, and fittings are usually used in wireless work, and the experimenter will find a small set very useful. Taps and dies ranging from 2B.A. to 6B.A. are most frequently required. One tap with a long taper for each size is quite sufficient. The hole to be tapped should be of a size just sufficient for the tap to enter, and the hole should be slightly countersunk at each side. Put the tap in the hole and work it slowly to the right, about half a turn at a time, but keep reversing it so that it clears the waste material from the cutting edges of the tap. See that the tap is in correct alignment with the hole and apply a little oil (for metals) or tallow (for ebonite). When using a die to cut a screw-thread on a rod, slightly taper the end of the rod for a short distance, and proceed in a similar manner to that described above. Do not try to force, and never try to cut a thread on a piece of rod that is too thick or "tap" a hole that is too small. This will mean either the stripping of the thread or damage to the tools. When drilling ebonite every care should be taken in this direction, as force will result in the ebonite splitting at the drilling one is working on. Of course, most articles can be bought ready tapped, but it will occasionally be found that a screw or nut, etc., that purports to be a certain gauge is either too large or too small, and if one is without taps and dies great inconvenience is caused.

Soft Soldering

One will not have proceeded very far in experimenting and constructing before finding out that soldering is essential. This may be done in various ways. The first method is to use a soldering iron or bit. Two irons are recommended, one of medium size, and a small one made of ½in. or ⅜in. copper rod fixed to a piece of iron or steel rod, fitted into a wood handle. Hammer the copper end to a wedge shape, putting it in the fire occasionally to anneal it during the process. To tin the bit for use, place in the fire and heat to a dull red heat. Then give the end a rub with an old file to clean it, dip it into the soldering flux, and on applying a stick of solder the bit should become covered with a silvery coating of solder. Do not overheat the bit, or the process will have to be gone through again. Should a green flame be observed when heating the iron remove it from the fire at once. See that the

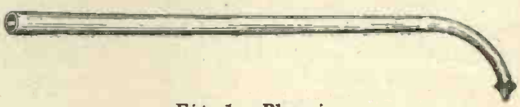


Fig. 1.—Blowpipe.

articles or parts to be soldered are perfectly clean, and apply sufficient flux to prevent oxydisation. Small soldering jobs can readily be done by holding the work over the flame of a spirit lamp or a Bunsen burner. If not possessed of the latter, one can easily be made from an upright incandescent gas burner. Two twisted wires or similar small articles are easily soldered in this way. Clean the wires and apply a thin coating of flux to the parts to be united. Hammer the end of the stick of solder extremely thin, cut off a narrow ribbon, and roll this round the wires. Put on a little flux, hold over the flame, and it will be found that a neatly soldered joint results. Experience only will teach what is the exact amount of solder to use. If one is not the possessor of a steel stake on which to hammer the solder thin, take one of the homely family flat-irons, place it inverted between the knees, and hammer away. Should it be desired to join two flat pieces of metal, this can be done in a similar manner. Clean them, and, placing a small piece of solder and a little flux on one of the plates to be joined, hold it over the flame until the surface required is covered. Apply flux to the other plate, and placing this in position on the first plate, hold tight with a pair of tweezers. Hold this over the flame, and a firm joint will result. Sometimes it will be found difficult to use either the soldering iron or the Bunsen flame, and it is useful then to have a blowpipe (Fig. 1). This is an inexpensive tool to buy, and the flame can be directed to any position required. When in use, blow gently without jerking, keeping a continuous flame on the spot desired. An expert using a blowpipe can blow a flame for an extraordinary length of time, breathing through the nose meanwhile, but a beginner will certainly not do this. When using any flame for soldering, avoid placing the flame directly on the solder. Make the parts to be united hot enough for the solder to run freely. Any excess of solder may be wiped away with a piece of rag or an old brush, but try to avoid any excess.

The fluxes used in the above processes are as follows: For the wireless panel or electrical instruments, use resin. In soldering zinc—for instance the zinc of the batteries—ordinary hydrochloric acid (sometimes called muriatic acid or spirits of salts) may be used. Chloride of zinc, commonly called "killed spirits," made by dissolving pieces of zinc in hydrochloric acid, is useful for ordinary work, but is quite unsuitable for small wireless work owing to its corrosive and other bad qualities. Some of the proprietary fluxes on the market are quite good for wireless work.

Hard Soldering

Occasionally it will be found that a soft-soldered joint is not suitable or will not be strong enough for the purpose for which it is intended. In that case the work will have to be hard soldered, not a very difficult matter, but more so than soft soldering. The articles and materials required for this process are a gas bracket (with the burner removed) placed parallel with and on the bench, a good supply of gas, a blowpipe, a block of prepared charcoal or a piece of asbestos, a piece of slate about 3in. square, a small quantity of lump borax, a small camel hair brush, and some hard solder. The latter is made of two parts of silver and one part of brass by weight, melted together and rolled or hammered to a thin plate. It can be bought cheaply ready for use, but if desired it may be made by melting the metals thoroughly using borax as a flux. When preparing to hard solder, place a few drops of water on the slate, and, using a lump of borax, make a thin paste of the latter by rubbing. Clean the articles to be soldered, and if necessary fasten them together with fine iron binding wire which is untinned, as it is impossible to hold articles to be hard soldered with tweezers. Cover the parts to be joined with the borax paste, using the small brush. Cut a few small pieces of solder, and taking each piece in the tweezers dip in the paste and then place on the part to be soldered, which has previously been put on the charcoal block. Using the blowpipe, blow gently at first, or the small pieces of solder will be dislodged. With a steady flow of flame, blow until the solder melts. A considerable amount of heat is required, and at first the novice may melt a part of the article he is soldering, but with care this will not happen. Examine the work, and if the joint is not quite satisfactory, apply more borax and a little more solder, and blow again. When a good joint has been made, and whilst the article is still hot, drop it into a solution consisting of one part of sulphuric acid and ten parts of water. This will clear off the scale and surplus borax. Take it out of the acid solution and rinse thoroughly in water. It may then be finished off to requirements. This method of soldering makes a very strong joint and may be used for most metals and alloys in ordinary use, with the exception of aluminium, lead, and tin.

Mainly about Valves

Our weekly causerie relating to the use of valves. This feature is conducted by the Editor.

Improving the Results from a Loud Speaker

CONSIDERABLY improved results may often be obtained from a loud speaker by connecting a fixed condenser across its terminals. This tends to mellow the sounds emerging from a loud speaker horn, and some of the harsh notes due to higher harmonics are cut out. A reduction in the signal strength is usually to be noticed. The condenser across the loud speaker will have a value varying between 0.002 μF and 0.05 μF. Different values give different results with various loud speakers, and the only reliable rule is to try out different sizes of condensers and to note their effects.

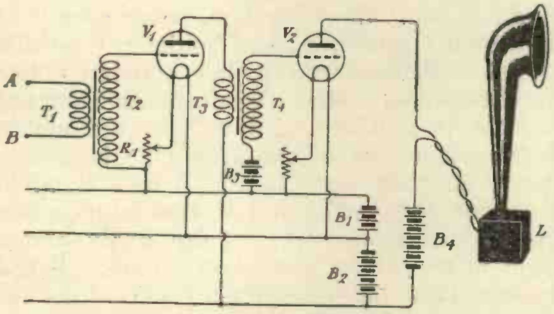


Fig. 1.—A power-amplifier circuit.

In order that an ordinary receiving valve should not be overloaded, it is preferable to use a small transmitting valve, or one specially designed for loud speaker use, at the end of a chain of valves for reception. This last valve, being a power valve, will enable the loud speaker to deal with greater amounts of energy, and there will be no distortion as would occur with smaller valves.

Fig. 1 shows a power amplifier circuit suitable for use with a loud speaker. The terminals A, B are connected in the anode circuit of the detecting valve, and the secondary T_2 of the step-up intervalve transformer T_1, T_2 is connected across the grid of the first valve and the negative terminal of the six-volt accumulator B_1. It is important to notice that the filament rheostat R_1 is connected in the position shown in order that the first grid shall receive a negative potential, which will largely prevent the introduction of damping into the grid circuit of this valve. The anode circuit of V_1, which may be an ordinary receiving valve, contains the primary T_2 of another intervalve transformer T_2, T_3, the secondary of which is connected in the grid circuit of the loud speaker valve V_2, which will be preferably of larger size than V_1. In the grid circuit is connected a battery B_3, which should preferably be variable between, say, 5 and 20 volts. In the anode circuit of the valve V_2, we have the loud speaker L and an additional battery B_4, which may have a value of anything from 36 to 200 volts. The battery B_2 will have the normal voltage for ordinary reception purposes, which will be between 40 and 100 volts.

Values of Grid Condensers and Leaks

It is surprising how often beginners send in queries asking what should be the values of grid condensers and gridleaks in different circuits. It might as well be stated here, once and for all, that a grid condenser should have a capacity of about 0.00025 μF or 0.0003 μF, while the gridleak may have a value of 1½ or 2 megohms resistance.

These values apply whether the gridleak is connected in parallel with the condenser or is connected directly across grid and filament as in the case of amplifiers using "tuned anode" coupling.

Reaction and Distortion

There is no doubt that reaction, if carried too far, results in a considerable amount of distortion. This is partly due to the fact that reaction tends to run wave trains together, and partly because the reaction effect increases the selectivity of the receiver and so accentuates the response to waves of a certain length. Although the carrier wave of a broadcasting station may be specified as 369 metres, yet actually the wavelengths radiated vary both below and above this wavelength. The wavelengths differing most from the carrier wavelength will not be strengthened by reaction to the same extent as the wavelengths approximating to the carrier wave. It is very difficult to estimate to what extent reaction causes distortion in this way, but the effect would certainly be noticeable on telephony transmissions on longer wavelengths.

Frame Aerials and Reaction

When receiving signals on a frame aerial it is frequently desirable to apply reaction to the frame circuit, and three methods of doing this are described below.

One of them is illustrated in Fig. 2. This is a two-valve circuit working off a frame aerial L_1. It will be seen that the aerial consists of the frame L_1—which is really a large inductance coil—another small induc-

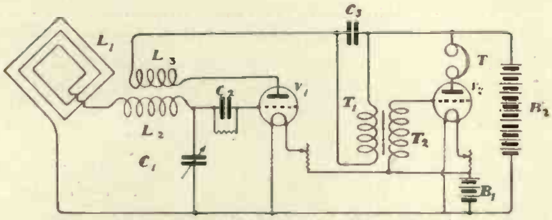


Fig. 2.—One method of reacting into a frame aerial.

tance coil L_2, such as a honeycomb coil, and a variable condenser C_1.

In the anode circuit of the valve V_1 we have an inductance coil L_3, which is coupled to the coil L_2. If the coupling between L_3 and L_2 is the right way round, reaction will be introduced into the frame aerial circuit, and the damping of this circuit will be greatly reduced, with the result that there will be an increase in signal strength and selectivity. Reaction is always more easily introduced into a frame aerial circuit than into an ordinary aerial circuit, which latter usually has a much greater decrement.

Fig. 3 shows a good alternative arrangement. The frame aerial L_1 is now connected in parallel with the inductance coil L_2, a variable condenser C_1 being in parallel with both coils. The reaction L_3 is coupled to the coil L_2, and through this coupling introduces reaction into the whole aerial circuit.

Fig. 4 shows another method, and one which is probably the best of all. The reaction coil is now a large coil which is actually placed close to L_1, and is therefore coupled to it. Very frequently the inductance coil L_3 may be a smaller frame hinged on to the larger

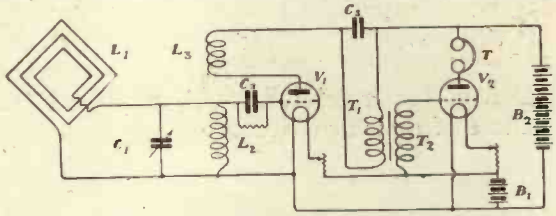


Fig. 3.—An alternative arrangement.

one so that a variable coupling may be obtained.

A High-tension Battery Condenser

There appear to be very few experimenters who make use of a condenser of very large capacity across their high-tension batteries.

It is, nevertheless, in many cases an advantage to connect a condenser having a capacity of from 1 μF upwards across the terminals of the high-tension battery. This is not merely to act as a by-path condenser, but is for the purpose of ensuring a steady voltage on the anode of the valve. The effect of connecting a condenser of large capacity across the battery is to render innocuous any slight variation in the E.M.F. of the battery. When using a high-tension battery, various hisses frying noises, and even clicks are traceable to internal troubles in the high-tension battery. The cells of these batteries are very small and their E.M.F.s are very likely to vary, particularly after the battery has been in use some time. The condenser, which may be bought quite cheaply, is preferably of the Mansbridge type, and acts as a reservoir.

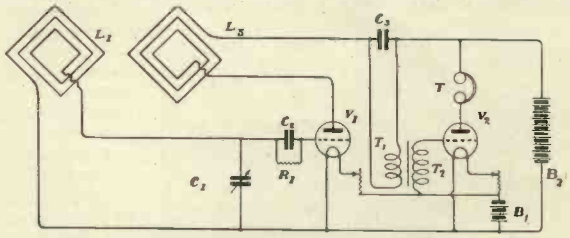


Fig. 4.—Still another method, and one which is probably the most efficient.

Such a condenser also serves as a by-path for low-frequency as well as high-frequency currents. The internal resistance of a high-tension battery is considerable, and as the anode current from all the valves would normally flow through this battery, it is obvious that all sorts of undesirable reaction and reverse reaction effects must take place as the varying currents, when they pass through the battery, produce E.M.F.'s across it which may be communicated to the other anodes.

It will be found that the use of a large condenser of this kind will very often lessen the tendency for receivers and amplifiers to oscillate of their own accord.

The Use of By-path Condensers

Whenever a low-frequency amplifier valve follows one acting as a detector on the leaky grid condenser principle, it is safe to say that a condenser of 0.002 μF may be connected across the primary of the intervalve iron-core transformer. This condenser is particularly desirable if the anode circuit of the detector valve contains a reaction coil.

In most cases there will not be any noticeable increase in strength of signals as a result of inserting the by-path condenser, unless, of course, the reaction effect cannot be made sufficiently strong without it.

If the primary of the intervalve transformer were not shunted by a condenser, it would offer a high impedance to the high-frequency currents, and these high-frequency currents through the reaction coil would be considerably less than if a by-path condenser were provided as a short circuit to these currents across the primary of the intervalve transformer.

If, however, the high-frequency currents in the coil are strong enough without the aid of the by-path condenser, the latter may usually be omitted without any serious disadvantage. The arrangement, however, is not so flexible, and signal strength will vary if the apparatus is rearranged or the hand is placed near to the transformer. This, of course, is because stray capacity effects result in a variation in the current through the reaction coil.

It will very often be found that stronger signals are obtained without the by-path condenser. This occurs when no reaction coil is used, and is due to an obscure reaction effect due to the potential of the anode of the detector valve varying at high frequency, these high-frequency potentials being communicated by stray capacities to the grid circuit of one of the valves. A reaction effect results, which increases the strength of the signals. This, of course, also applies to a circuit where telephone receivers are connected in the anode circuit of the detector valve. The addition of a by-path condenser effectively prevents the potential of the anode of the detector valve varying at high-frequency, and consequently the obscure reaction effect disappears with a consequent reduction of signal strength.

These explanations should furnish the reason for the effects obtained.

FORTHCOMING EVENTS

May.

9th (Wed.).—Edinburgh and District Radio Society. Sale of apparatus at 17, George Street, Edinburgh.

9th (Wed.).—Sutton and District Wireless Society, Adult School, Benhill Avenue, Sutton. Lecture on "Some Historical Notes on Radio Telegraphy and Telephony," illustrated by lantern slides.

10th (Thurs.).—The Sunbeam (Moorfield) Wireless Society, The Sunbeam Motor Co., Ltd., Moorfield Works, Wolverhampton. Lecture on "Broadcasting," at 7 p.m., by a representative of the Birmingham Broadcasting Station (if it can be arranged).

10th (Thurs.).—Cardiff and South Wales Wireless Society. Institute of Engineers, Park Place, Cardiff. Lantern lecture, "The Electron Theory," by Mr. N. M. Drysdale.

10th (Thurs.).—Stoke-on-Trent Wireless and Experimental Society, Y.M.C.A., Marsh Street, Hanley. Discussion on "Reaction: Its Use and Abuse," at 7.30 p.m., opened by Messrs. F. T. Jones and F. J. Goodson, B.Sc. (Hon. Secretary).

11th (Fri.).—Leeds and District Amateur Wireless Society. Lecture by Mr. A. M. Bage (President), "Aerials: Outdoor, Indoor, and Loops," at the Grammar School, Leeds.

12th (Sat.).—Cardiff and South Wales Wireless Society. Wireless Exhibition and Conference at the Capitol Theatre.

14th (Mon.).—North London Wireless Association. Mr. F. S. Angel will lecture on "Elementary Principles of Wireless—Part VIII.," at the Physics Theatre, Northern Polytechnic Institution, Holloway Road, N.

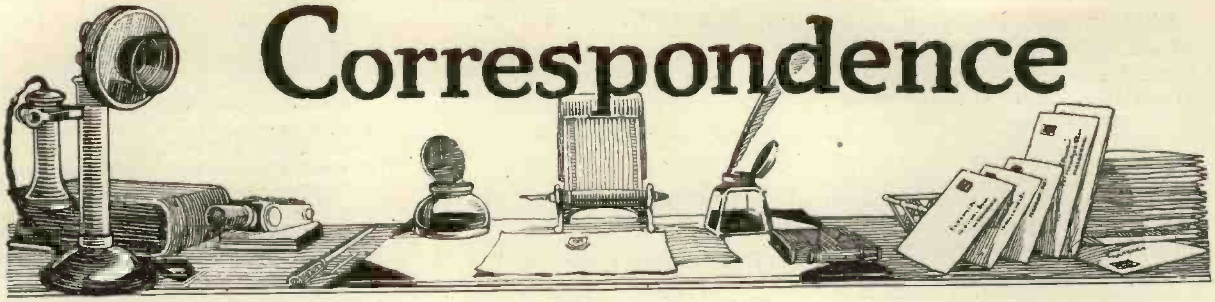
14th (Mon.).—Radio Society of Great Britain. Meeting of Associate Members at the Institute of Electrical Engineers at 6.30 p.m. Mr. P. W. Harris will lecture on "Pitfalls for Beginners in Wireless."

15th (Tues.).—Plymouth Wireless and Scientific Society, Plymouth Chambers, Old Town Street, Plymouth. 7.30—7.45 p.m., buzzer practice. At 8 p.m. Mr. Monk will give a paper on "Magnetism."

17th (Thurs.).—Redhill and Reigate Radio Society, Y.M.C.A., Station Road, Redhill. Mr. Pope will lecture on "Loud-speakers," at 8 p.m.

17th (Thurs.)—Ilford and District Radio Society, St. Mary's Church Schools, High Road. Mr. A. P. Welch will lecture on "Ebonite."

17th (Thurs.)—Cardiff and South Wales Wireless Society, Institute of Engineers, Park Place, Cardiff. Experimental work will be conducted by Mr. C. H. Watkins.



Correspondence

WAVE-REFLECTING ROOFS.

To the EDITOR, *Wireless Weekly.*

SIR,—I was interested in your article in this week's *Wireless Weekly* on "Wave-reflecting 'Roofs' in the Atmosphere."

This may be a fact, and I am one who occasionally picks up Newcastle on a crystal set: but where I beg to differ from the theory, as regards Essex anyway, is that I always get Birmingham or Manchester (on the crystal only), and I have not missed so doing each evening for over three weeks.

My own theory is that London's carrier wave, coming strongly here, carries back the weaker waves from other stations with it.

My reason for this theory being that I only get other stations while 2LO's wave is switched on. When 2LO switches off any of the others sympathetically go off also.

I am, etc.,
JAMES M. WATT.
Woodford Green, Essex.

INTERFERENCE FROM POWER LINES.

To the EDITOR, *Wireless Weekly.*

SIR.—I noticed in this morning's issue of your paper your remarks anent electric trains. I am a sufferer in this respect. One can hear the train proceeding from one station to another, gradually getting louder until the crackling absolutely drowns the music. My aerial is about 20ft. to 30ft. away from the train lines and is at right angles to it. I do not know what the result would be if the aerial were parallel to the trains—a regular inferno, I expect.

I am, etc.,
W. G. WALDHURST.
Herne Hill, S.E.24.

NEIGHBOURING AERIALS.

To the EDITOR, *Wireless Weekly.*

SIR,—I have read with much interest the letter by Snooks, Basingstoke, published in No. 1 *Wireless Weekly.* The trouble this reader is experiencing is one I have experienced for a long time, that is, up to three weeks ago. My aerial is 65ft. long, 38ft. high at one end, and 42ft. at the other. My friend's (?) was about the same. I was puzzled for some time with the constant fading of 2ZY two miles away, and sometimes I would be cut off in the middle of an item. I discovered, however, that the trouble lay next door. My neighbour was using reaction, and if he oscillated slightly it cut my signal strength down considerably. Of course, my set had the same effect on my neighbour's. This theory contradicts that of Snooks, and I think, if he will investigate further, he will find his trouble lies in the same direction. To prove my theory was correct I arranged with a friend living some 30 yards away that I would oscillate at an arranged time slightly and then more so, and the slight oscillation was not heard by him. Three weeks ago my friend (?) put two new poles up, having a height of 52ft., and with careful (very careful) use of the reaction we are both able to enjoy the various concerts broadcast.

I am sure there is quite a lot of interesting matter to be written on oscillating, and I should be glad to have your views.

I would suggest that Snooks either raises his aerial or lowers it, and adds one or two more wires.

My aerial is screened at one end. and I intend to raise it and employ three wires, as per your article in No. 1 *Wireless Weekly.* I am, etc.,
Manchester. AERIAL.

THE PROPOSED NEW WAVE-LENGTH.

To the EDITOR, *Wireless Weekly.*

SIR,—I read in your issue for April 25th that it is proposed by the General Post Office to raise the amateur wave-length to 730 metres.

I scarcely think that this will meet with much approval except, perhaps, during broadcast hours, for the following reasons:—

730 metres is very near to the ship band of wavelengths, 600 metres, and long distance work could not be carried on with satisfaction.

Those who remember the 1,000 metre wavelength, and who worked on it, will not go back willingly to something approaching it, as they have found that much less power is necessary for the same distance worked on very short waves. As an example, the recent Transatlantic Tests may be quoted.

Wishing your weekly every success ins the future. I am, etc.,
A. S. WOOD.

TWO-VALVE RECEPTION.

To the EDITOR, *Wireless Weekly.*

SIR,—While tuning in on two valves last evening, I was surprised to find I was in touch with the Glasgow Broadcasting Station, and heard the announcement that the orchestra would give a fox trot—"Touch them on the Ivories" (or some such title). This selection we heard quite clearly, and also a further announcement thanking those who had sent in letters and the hope that more would be sent. The proceedings then closed with the National Anthem.

As Glasgow must be at least 430 miles distant as the crow flies, is this not a particularly good performance for two valves? I was using an Ediswan on the detector and a Mullard on the amplifier. We could hear quite as clearly as London. As a matter of fact we hear Manchester better than London. Why should this be? I might mention I use a single aerial, about 25ft. high and 70ft. long. Have tried a double aerial, but results are not so good. I am, etc.,
Hove. A. A. GIBSON.

DRILLING EBONITE AND FIBRE.

To the EDITOR, *Wireless Weekly.*

SIR,—Re "Workshop Practice," page 153 this week's issue, it may interest your readers to know that drills made from hard drawn brass rod flattened and shaped with a fine file or carborundum wheel will cut ebonite and fibre, are quick to make, and easy to sharpen.

The "grit" or whatever it may be which blunts a steel drill does not seem to act so severely on the brass, and there is no tempering required.

Your paper is excellent. Have cancelled my order for "another" and substituted yours. I am, etc.,
Harrow. W. E. GIBSON.

A SUCCESSFUL SET.

To the EDITOR, *Wireless Weekly*.

SIR,—Whilst not wishing to take up your valuable time, I thought you might like to hear about a two-valve set, built practically as described in your No. 1 issue, *Modern Wireless*, "A Two-Valve Broadcast Receiver."

On the above I can hear all the Broadcasting stations in this country and also local amateurs, and I can hear Paris (School of Posts and Telegraphs) comfortably, though not very loudly. 2ZY and 5IT have been heard on a frame aerial, though, of course, not very loudly, but very clearly. My outdoor aerial is only 18 feet high and 53 feet long. I think these results are very good myself, and should like your expert opinion. I am, etc.,

W. CLOCKLEY.

A CHALLENGE.

To the EDITOR, *Wireless Weekly*.

(See No. 3, page 161.)

SIR,—Much as the Wireless and Experimental Association deplores the necessity of disputing the claim of Mr. H. P. Ford, of the Nottingham and District Radio and Experimental Association, we feel that we cannot allow him to get away with it.

The Wireless and Experimental Association existed long before the Wireless Society of London, and, indeed, was started as the Amateur Wireless Alliance to endeavour to co-ordinate the efforts of Wireless Amateur Associations, which duty the Radio Association now so ably carries out.

In 1914 we had to close down, as all our members had gone to ply their wireless craft for the direct benefit of their country, but in 1919 those left and available recommenced activities under the new title of the Wireless and Experimental Association.

This title has been so much admired that it has been extensively adopted, but we hereby register our claim to have originated it. We are the W. and E.A. in the sense that King George was King George till King George II. came along and necessitated a distinction.

There is no merit in being the oldest Society, but there is in being the most up-to-date and vigorous, and No. 15 of *Amateur Wireless* of September 16th, 1922, will testify to our first having taken up the cudgels on behalf of the amateur, when he was in danger of being submerged by the B.B.C., and forbidden to continue to use the receiving set which had become almost a part of himself.

We also claim the distinction of being alone in recommending that the licence fee should not be raised above 10s., the announcement of which determination on the part of the P.M.G. recently occasioned considerable surprise.

I am, etc.,

GEO. SUTTON,

A.M.I.E.E., F.R.A., Hon. Sec.

CLOSED AERIALS AND HARMONICS.

To the EDITOR, *Wireless Weekly*.

SIR,—I was interested in the letter by "Pre-war" in to-day's issue of your paper *re* aerials. I have been making notes for some time on the relative merits and demerits of closing the ends of aerials in transmitting, and the result is as follows. In every known case of a closed aerial, on 440 metres there has been a very powerful harmonic on 220 metres, sometimes as loud as the fundamental. It is found that a slight increase in radiation is usually obtained, but the true efficiency of the transmitter is reduced as a large proportion of the aerial current is being radiated on a shorter wave. I think it would be a good idea if some of the 440 metre workers investigated the subject of their harmonics, as they are often one-third fundamental strength, and in one or two special cases have been as loud as the fundamental.

A method of finding out accurately whether a transmitter has harmonics is as follows:—An artificial circuit is placed between aerial and earth terminals on the transmitter, with a reversing switch for the inductance. A tuned circuit is fairly loosely coupled to this, shunted by a crystal and galvo, or a valve with sensitive plate milliammeter, etc. On making the transmitter circuit a "kick" will be seen on the galvo. The magnitude of this kick is noted, and the coil reversed without altering coupling. The kick is now found to be much smaller or much greater if the emitted wave is impure. It is also possible to get a rough idea of the magnitude of a harmonic by coupling a tuned circuit with R.F. milliammeter or similar indicator to the transmitter, and tuning to the transmitter wave. The deflection is noted and the tuned circuit tuned to the first harmonic. The ratio of the readings gives an idea of the strength of the harmonics.

I hope these notes will be of interest, and perhaps start some investigations by certain stations who make such a row on 200 metres every night as well as 400.

May I congratulate *Wireless Weekly* on not being an entirely "B.C.L." paper—and I hope it will so continue. Let us have something for the more advanced—or rather *true*—experimenter. I am, etc.,

F. L. HOGG.

London, No.6. (2SH).

THE BROADCASTING WAVE-LENGTHS.

To the EDITOR, *Wireless Weekly*.

SIR,—I agree with you that the B.B.C. have laid the foundations of broadcasting and are deserving of some protection and every encouragement, but the programmes seem to ignore the fact that tens of thousands support the musical comedy and revue order of entertainment night after night all the year round, whilst the concert hall audience are not reckoned by as many hundreds for a few performances over a season, but the B.B.C. are pouring out this heavy music over the largest audience in the world every weekday and worse on Sundays.

Instead of land transmissions from one broadcasting station to another, what is wanted is a greater variety of programmes and more popular items everywhere, and, above all, some alteration in the wavelengths so that a selection can be made of which station those who have powerful sets desire to hear. My own experience is that this is quite impossible, as 2LO drowns everything except Paris, and now summer time has put their starting hour to 10 p.m. in England, which is too late for me.

I first had a crystal set—it was good, but weak—then I had a 2-valve set and the accumulator trouble and valve accidents detracted from it. I got 2LO well, but the promise to get other British stations was not fulfilled, and 2 valves were extravagant for London only. Then I got a 3-valve set and spent near £50 on it. It is quite good—I can hear all the British stations fairly, and with a 1-valve amplifier plainly, but 2LO will not let me make any use of the power I have, and I might as well have saved my money and stuck to a crystal set with a valve amplifier which gives me London quite well.

This condition cannot be advantageous to the manufacturers forming the B.B.C. and should be promptly dealt with. I am, etc.,

Croydon. GEORGE E. HOLLOWAY.

CONGRATULATION.

To the EDITOR, *Wireless Weekly*.

SIR,—I am a wireless enthusiast and I have felt for some time the need of a reliable weekly journal. Allow me to congratulate you on *Wireless Weekly* as having filled this long-felt want. Your paper is absolutely superb.

Wishing you, your staff and your paper all the best of luck.

I am, etc.,

Baker Street, W.1. R. A. GEE.

Patent Section

The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS

(Specifications not yet published.)

10168. BEAUMONT, T. E.—Star coils for receiving wireless telephony, &c. April 14th.

9910. BRADBURY, E. A.—Wireless telephone receivers. April 11th.

9862. BRAMALL, E. E.—Electric switches. April 11th.

9695. BRITISH THOMSON-HOUSTON CO., LTD. —Systems for producing electric oscillations. April 9th. (United States, April 10th, 1922.)

9805. BRITISH THOMSON-HOUSTON CO., LTD. —Wireless signalling systems. April 10th. (United States, April 10th, 1922.)

9885. BRITISH THOMSON-HOUSTON CO., LTD. —Telephone receivers, &c. April 11th.

10117. BRITISH THOMSON-HOUSTON CO., LTD. —Telephone receivers, &c. April 13th.

9781. BROOKER, T. H.—Binding-posts or terminals for electrical apparatus. April 10th.

9690. BROWNE, R. C.—Telephone receivers. April 9th. (United States, September 9th, 1922.)

9816. BURGOYNE, L.—Tuning or resistance coil. April 11th.

9783. BURNDEPT, LTD.—Variable electric condensers. April 10th.

10117. BUTCHER, J. H.—Telephone receivers, &c. April 13th.

9698. GATHERWOOD, W. A.—Means for connecting wires, &c., in electric circuits. April 9th.

9652. COLEMAN, C. J.—Headphones. April 9th.

9868. COLEMAN, C. J.—Loud speakers for wireless telephony, &c. April 11th.

10075. COLEMAN, C. J.—Wireless crystal rectifiers. April 13th.

10076. COLEMAN, C. J.—Horns for gramophones, &c. April 13th.

9642. CRAWFORD, J.—Electric signalling-apparatus. April 9th.

9751. CUTHBE, C. L.—Earphones or telephone-receivers. April 10th.

9869. DELL, R.—Electric signalling-apparatus for railways, &c. April 11th.

9847. DREY, N.—Electron discharge devices. April 11th.

10136. DUBILIER, W.—Variable electric condensers. April 13th. (United States, September 16th, 1922.)

9641. DUNWOODIE, L.—Headpiece telephones. April 9th.

9735. DUNWOODIE, L.—Headpiece telephones. April 10th.

9899. EDWARDS, W. F. M.—Electric terminals, &c. April 11th.

9899. EDWARDS, W. M.—Electric terminals, &c. April 11th.

10095. ENGINEERS (PENGE), LTD.—Loud speakers for telephony, &c. April 13th.

9711. FAGELSTON, I. — Transmission of radiant energy. April 9th.

10083. FISHER, A. W.—Wireless detector. April 13th.

10121. GAYDON, H. A.—Electric resistances and switches. April 13th.

10103. GES. FUR DRAHTLOSE TELEGRAPHIE.—Wireless transmitters. April 13th. (Germany, April 13th, 1922.)

9739. HINGSTON, W. H.—Variable electric condenser. April 10th.

9539. HUNT, W.—Inductance, &c., coils. April 9th.

9858. HUNTER, F. A.—Amplification of electro-magnetic impulses. April 11th.

9782. JOHNS, W. H.—Loud-speakers for wireless telephones. April 10th.

10112, 10113. JOHNS, W. H.—Loud-speakers for wireless telephony. April 13th.

9782. JOHNSON & PHILLIPS, LTD.—Loud-speakers for wireless telephones. April 10th.

9989. LANGRISH, N. G.—Electric resistances. April 11th.

9954. LEESON, B. H.—Electric circuit-breakers, &c. April 12th.

9787. LIDDELL, E. P.—Variable electric condensers. April 10th.

9974. LUCAS, J. G.—Series-parallel condenser switch arrangements. April 12th.

9542. MCKILLOP, E.—Electric signalling-apparatus. April 9th.

10208. MACLENNAN, A.—Wireless receiving-apparatus. April 14th.

10095. MARR, G.—Electric switch. April 13th.

9860. MEDLAM, W. B.—Radio receiving circuits. April 11th.

9889. METROPOLITAN - VICKERS ELECTRICAL CO., LTD.—Electric resistances. April 11th.

10196. M. L. MAGNETO SYNDICATE, LTD.—Electric transformers. April 14th.

9780. MORISON, O. C.—Wireless receiving-apparatus. April 10th.

10196. MORRIS, D. K.—Electric transformers. April 14th.

9869. PETER, L. H.—Electric signalling-apparatus for railways, &c. April 11th.

10194. PHILLIPS, A. — Inductance coils. April 13th.

9783. PHILLIPS, C. F.—Variable electric condensers. April 10th.

9628. PILKINGTON, B. A.—Electro-magnetic sound apparatus. April 9th.

9988. PRICE, S. L.—Wireless detectors or amplifiers. April 12th.

9616. RAEBURN, C. E.—Electric variable condensers. April 9th.

9954. REYROLLE & CO., LTD., A.—Electric circuit-breakers, &c. April 12th.

10012. RICHARDS, L. E.—Holder for telephone headpieces. April 12th.

10093. ROTHSCHILD, A.—Electric terminal. April 13th.

9615. SHARP, A.—Wireless receiving-apparatus. April 9th.

9711. SMITH, F. E.—Transmission of radiant energy. April 9th.

9860. STAVE, C. H.—Radio receiving circuits. April 11th.

9731. STEPHENS, P. C.—Aerials for wireless telephony, &c. April 10th.

10014. STEPHENSON, G.—Wireless receiving-apparatus. April 12th.

9753. SUTHERLAND, H. E.—Cases for electric fuses, switches, &c. April 10th.

10170. TAYLOR, J. L.—Electric terminals, &c. April 14th.

9616. TAYLOR, W. E.—Electric variable condensers. April 9th.

9740. WAITE, R. T.—Electric plug switches. April 10th.

9762. WALLACE, R. T.—Coupling, &c., telephonic instruments. April 10th.

9904. WALLACE, R. T.—Crystal cup and cover for wireless telegraphy. April 11th.

10069. WALTER, W. G.—Aerials, &c., for wireless apparatus. April 13th.

9369. WESTINGHOUSE BRAKE & SAXBY SIGNAL CO., LTD.—Electric signalling-apparatus for railways, &c. April 11th.

9781. WILLIAMS, L. E.—Binding-posts or terminals for electrical apparatus. April 10th.

10178. WOODS, G. F.—Inductance coils for wireless telegraphy, &c. April 14th.

10178. WOODS, R. S.—Inductance coils for wireless telegraphy, &c. April 14th.

9885. YOUNG, A. P.—Telephone receivers, &c. April 11th.

10117. YOUNG, A. P.—Telephone receivers, &c. April 13th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

(Copies of the full specifications, when printed, may be obtained from Mr. Gee, post free on payment of the official price of 1s. each.)

193339. SOC. DES ETABLISSEMENTS GAUMONT. —An apparatus for the production and reception of sound, a diaphragm having disposed therein a wire coil is arranged in the air gap of a magnet, so that the movements of the various elements of the surface takes place in an oblique direction, *i.e.*, neither in their own plane nor perpendicular thereto. The apparatus may be used as telephonic transmitter or receiver. June 30th, 1922. (Convention date, February 17th.)

193379. GES. FÜR DRAHTLOSE TELEGRAPHIE.—A tuned circuit in the output path of a thermionic generator is coupled through an intermediate circuit to the heating circuit of the filament. Owing to the back-coupling, the electron stream from the filament is controlled in rhythm with the oscillations occurring in the tuned circuit. Preferably the two electrodes have large surfaces and

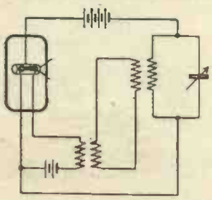


Fig. 1.—Illustrating No. 193379.

are arranged close to each other, and the cathode is formed of a coiled wire having as small heat-capacity as possible. In this way a two-electrode valve will function as an oscillation generator. If a third electrode, or grid, is employed, the back-coupling from the tuned circuit is linked with both grid and filament. November 7th, 1922. (Convention date, February 14th.)

193387. GES. FÜR DRAHTLOSE TELEGRAPHIE.—A negative potential is applied to the grid of a thermionic generator by means of a resistance, shunted by a condenser, and inserted in the plate circuit between the cathode and the negative pole of the high-tension supply. The value of the resistance may be varied by keying, or through a microphone. January 30th, 1923. (Convention date, February 14th, 1922.)

193438. WILSON, W. H.—In a method of signalling adapted to reduce interference between stations, a type of radiation is used in which each half wave has a different length from that of the half waves before and after it. Waves of this type may be used in wireless or wired wireless signalling, and may be of audible frequency for use in alternating current telegraphy. August 29th, 1921. (Cognate application, No. 16305/22.)

193525. FROST, S. G.—In a thermionic valve, a grid serves as the only or main support for a filament. November 30th, 1921. (Cognate application, 17265/22).

193566. ONWOOD, A.—Modulating-apparatus for wireless transmission of the kind in which the modulating-valve connected in series in the plate circuit of the oscillation generator is so arranged that the filament of the modulator and the microphone or key are at earth potential. The specification also describes a panel mounting for the apparatus. September 14th, 1922.

193628. PRESTON, L. G. and HODGSON, B.—The leading-in wires and metallic supports

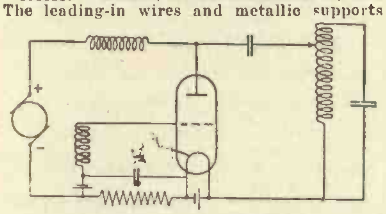


Fig. 2.—Illustrating Patent No. 193387.

for the electrodes of a thermionic valve are shielded from the discharge, so that conduction takes place wholly or almost entirely between the electrodes. January 24th, 1922.

193629. PRESTON, L. G. and HODGSON, B.—The electrodes of a thermionic valve or other

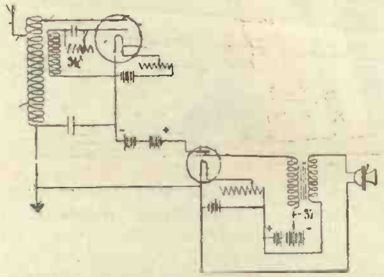


Fig. 3.—Illustrating Patent No. 193566.

vacuum tube are fixed substantially rigidly with respect to each other, and mounted resiliently in the envelope so as to allow play or movement between the electrodes and the envelope. January 24th, 1922.

193690. REES, H. P. P.—A loud-speaking instrument is located within the casing of a valve receiver, and is adapted to be switched into circuit alternatively with the usual head-phones. The specification describes the wiring and mounting of a three-valve set. March 7th, 1922.

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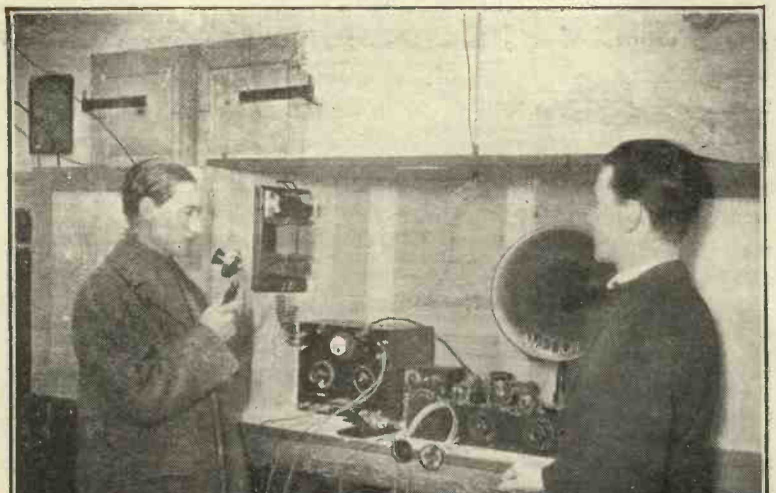


The President of the Leicester Radio Society broadcasting his inaugural address.

Information Department

Conducted by J. H. T. ROBERTS, D.Sc., assisted by A. L. M. DOUGLAS.

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

J. W. D. O'B. (GREAT YARMOUTH) is constructing a receiver on the lines of the "Progressive Unit Receiving System" described in "WIRELESS WEEKLY," and asks the following questions: (1) Whether the variable inductance may be used in a vertical position instead of the horizontal one. (2) Whether the second inductance may be wound with 150 turns instead of 100 as suggested, and (3) Whether a "Ducon" in place of the ordinary aerial would be satisfactory with this set at a distance of 10 miles from the broadcasting station.

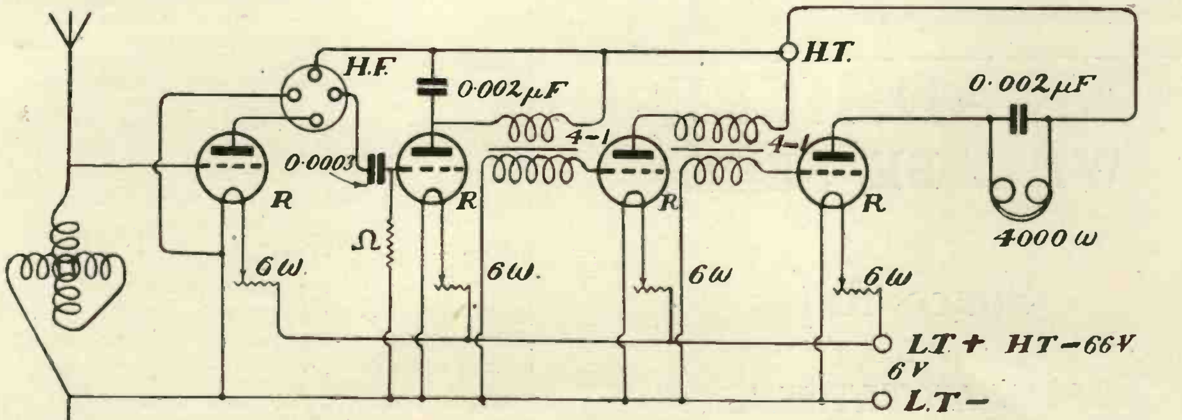
(1) The position of the inductance makes no difference to its working. (2) 150 turns might be used if desired; this will not interfere with any subsequent additions or alterations to the apparatus. (3) You might get results with a "Ducon" attachment, but it is rather doubtful at this distance.

R. J. (KEIGHLEY) refers to the variable inductance described on page 48 of "WIRELESS WEEKLY," Vol. 1, No. 1, and queries the number of turns, as he does not think it possible to take 20 tappings on so short a tube.

It is quite easy to take 20 tappings on 20 turns of wire, and you will find that if the tappings are properly arranged, each one being taken a little further round the tube than the one before it, it is quite easy to take 20 tappings from a tube $1\frac{3}{16}$th inches long. The cardboard tube and other parts may be obtained from any dealer in wireless accessories.

D. G. (BAKER STREET, W.1) asks for a circuit for a receiver embodying one high-frequency stage followed by a rectifier and two note magnifiers. He wishes to use certain apparatus in his possession, and asks whether with the above combinations he should be able to receive all the British Broadcasting stations, as well as Continental telephony.

We give herewith a suitable wiring diagram for the



circuit you propose to use. If your aerial is very good and you are favourably situated, you may be able to hear all the British Broadcasting stations and probably Continental telephony as well.

F. C. H. (CAMBERWELL) submits a diagram of his circuit and asks: (1) The necessary values of A.T.C. and S.T.C. to cover the largest possible range of wavelengths. (2) Whether the circuit is liable to oscillate when in the stand-by position. (3) What would be the probable range of wavelengths for such an instrument.

(1) The aerial condenser may be about 0.0015 μF capacity and the secondary condenser 0.0005 μF capacity. (2) A crystal circuit cannot oscillate. (3) The wavelength range of this instrument depends naturally upon the size of inductances in the aerial and detector circuit. With suitable coils it should

be possible to cover every range from about 80 metres to the uppermost limit.

C. R. L. H. (MEIFOD) is constructing the progressive unit system as described in "WIRELESS WEEKLY," and wishes to know whether he may use a 4½-inch inductance tube instead of a 5-inch tube.

We do not recommend departures from the dimensions of apparatus given in our publications.

G. G. (SAFFRON HILL, E.C.2) is building a 3-valve set employing a triple coil-holder and wishes to know the correct sizes of coils to use for (1) the London Broadcasting station, and (2) the Eiffel Tower station at Paris.

(1) Primary 50, secondary 75. (2) Primary 200, secondary 250. Reaction 100.

H. A. T. (MOSS SIDE) wishes to wind a 4-foot frame aerial with No. 26 gauge single cotton-covered wire for the reception of American Broadcasting stations and asks for details.

Seven turns of wire, spaced ⅜ of an inch apart, on a frame would be suitable when tuned by means of a small variable condenser of 0.00025 μF in parallel with the frame. We would recommend the use of stranded wire for winding this frame, such wire to have, perhaps, 36 strands of No. 40 s.w.g. copper wire.

G. H. (CLAPHAM COMMON, S.W.11) has a set of basket coils and asks questions as to the mounting of them.

The suggestion you make is quite a satisfactory one. There will be no radiation from the aerial circuit when using this arrangement.

I. H. (MALINO, SWEDEN) wishes to know whether the condenser C_1 in circuit ST34 is necessary for good results if honeycomb coils are used with an inductively coupled tuner. (2) Whether certain coils are covered by patents. (3) How to design apparatus employing reaction, but of an approved type: that is, not reacting directly back into the aerial circuit.

(1) The condenser C_1 which you refer to is essential to obtain a wide range of tuning. (2) The coils in question are covered by several patents, and manufacture would only be permitted under licence from the patentees. (3) There are no definite rules on this subject published. "Practical Wireless Valve Circuits," Radio Press, Limited, and "Wireless Valves Simply Explained," Radio Press, Limited, will furnish you with all the necessary information you require for designing such circuits.

J. H. C. (ERDINGTON) has constructed a receiver as shown in Fig. 7, page 89, of the March issue of "MODERN WIRELESS," and wishes to know whether the following values for condensers as indicated in this circuit will be suitable. C_1—0.001 μF; C_2—0.0005 μF; C_4—0.0002 μF. He also wishes to make two honeycomb coils, one to cover the British Broadcasting range of wavelengths and the other for Paris telephony.

The values you indicate are suitable. Condensers C_2 and C_4 may, however, have equal values. Using the former you suggest, 70 turns will cover the British Broadcasting band of wavelengths, and 250 turns will enable you to reach the wavelength of Paris.

F. L. A. W. (BRIXTON, S.W.2) wishes to make up the long range receiver described in No. 1 of "MODERN WIRELESS," but queries the use of a ball reactance former. He wishes to know whether a small tube would be equally satisfactory.

A small ebonite tube would be satisfactory, but it would be difficult to get a sufficient amount of wire on to such a tube as would rotate inside the A.T.I. to produce reaction effects over the full range of wavelengths. The ball referred to can be obtained from almost any accessory dealer, and the method of winding wire is fully described in Mr. Redpath's article entitled "A Compact Broadcast Receiving Set," described in No. 2 of *Modern Wireless*.

A. G. (LEEDS) wishes to know what literature to buy in order to find out the best type of wireless set to receive all the British Broadcasting stations and, in addition, Continental telephony.

"Practical Wireless Valve Circuits," Radio Press, Limited, will give you all the necessary circuits; and "Wireless Valves Simply Explained," Radio Press, Limited, will give you full particulars and explain the functioning of each independent part of these circuits in detail.

W. R. C. (LINCOLN) has some valves in which the black composition base has become loose inside the metal casing, and he wishes to know what can be done with this.

If the wiring inside the base of the valve set is intact, and the base has not loosened sufficiently to twist round and interfere with the wiring, it should be quite easy to pinch the metal cap up slightly by means of a pair of pliers. If carefully done, a small dot can be made with a centre-punch on the metal cap in one or two places where it bears upon the composition, which will hold the two firmly together. We do not think the makers will be able to help you in this matter.

S. C. J. (SPENNYMOOR) is going abroad and will be about 500 miles from the nearest English Broadcasting station. He wishes to know how to construct a receiving set so as to allow him to listen to British Broadcasting.

We think you will find it rather difficult to design a satisfactory set for use at such a great range, but would suggest three high-frequency valves, one rectifier, and two low-frequency valves. An additional low-frequency valve might be added if carefully applied to still further increase the strength. As large an aerial as possible should be erected, and the height is particularly important for long-distance reception. We think that using this circuit you should be able to hear the London Broadcasting station and probably one or two of the others. Continental telephony would be quite good with such a receiver.

A. A. (ST. LUKES, E.C.1) wishes to know (1) the length of slider rod for an inductance. (2) Whether the telephone condenser described on page 28 of the Radio Press Series No. 3 (HOW TO BUILD YOUR OWN BROADCAST RECEIVER) would be suitable for use with the above crystal set, and (3) Whether this set would be satisfactory for the reception of broadcasting from 2LO.

(1) The length of the slider rod should be 14in. for use with this coil. (2) The telephone condenser you mention is quite suitable, and no further addition will be necessary; and (3), this apparatus is quite satisfactory when used in or near London.

J. H. (HEBDEN BRIDGE) asks the following questions: (1) Using two ebonite tubes, each 12in. long, one 4½in. diameter and the other 3½in. diameter, it is proposed to construct an inductively-coupled tuner with a wavelength range of about 200 to 3,000 metres. Particulars are requested as to winding, etc. (2) What windings should be put

on an ebonite bobbin with a winding space of $\frac{7}{16}$in. for use as a low-frequency transformer. A closed iron circuit is to be used. (3) Whether certain windings specified for a high-frequency transformer are suitable.

(1) The tubes you specify would be suitable if wound with No. 22 s.w.g. d.c.c. wire and 28 s.w.g. d.c.c. wire for ten inches of their length respectively. (2) We suggest filling one-third of the winding space with No. 40 s.w.g. single silk-covered wire, and the remaining two-thirds with No. 44 gauge s.w.g. single silk-covered wire. (3) The proposed winding of 200 turns per slot would be quite suitable. Tappings should be taken out at frequent intervals from both primary and secondary, so as to obtain the maximum amplification at the various wavelengths.

J. L. (WOODFORD GREEN) is erecting an aerial similar to that on page 8 of No. 1 "WIRELESS WEEKLY," but in order to get a length of 50ft. about 10ft. of his aerial has to pass over a roof. He asks whether it is advisable to attach the lead-in to the end of the aerial or to a point such that his down-lead will be clear of the roof, and also whether the wires should be joined together at the point where they leave the aerial or at the point where they enter the leading-in tube.

Your lead-in should be attached to a point so that it will clear the roof. The leading-in wires should be joined at the point where they enter the leading-in tube in preference to immediately below the aerial.

A. F. (ASTLEY, MANCHESTER) has completed building a three-valve amplifying receiver with one high-frequency valve, a rectifier and a note magnifying valve. He obtains excellent results from Manchester when using telephones, but cannot operate a small size Brown loud-speaker.

If your receiver is properly adjusted, it should be capable of operating a large loud-speaker when at such a short distance from the broadcasting station. We suggest that your loud-speaker is incorrectly adjusted, and you should experiment with the small knob underneath the receiver case in order to find the most sensitive point. A fixed condenser of a value between 0.002 and 0.005 μF might be shunted across this loud-speaker; the inclusion of such a condenser generally improves the results from a high-resistance loud-speaker. Your high-tension battery is of ample value.

C. W. B. (ANDOVER) sends us a diagram of his receiver, and complains that he cannot stop it from oscillating. He asks for any possible remedy that we can suggest.

We have carefully examined your circuit diagram, and see no reason for its persistence of oscillation. As a matter of fact, it should not be capable of oscillating at all, but we suggest that you substitute a smaller condenser across your tuning coil and try different values of grid condenser and high-tension battery. It should be possible to obtain critical control of oscillation by adjustment of the filament rheostat, but probably you would find varying the voltage of the H.T. battery a more satisfactory method in your case.

T. C. (MIDDLETON PARK) asks a question about a variometer receiver described in "MODERN WIRELESS," and whether it would give him good results from London and Birmingham.

There is no crystal set on the page you mention. We think you probably mean the "Compact Broadcast Receiving Set," described by Mr. Redpath on page 143 of *Modern Wireless*, No. 2. This set would not, however, enable you to hear two broadcasting stations so far apart as London and Birmingham, except under extraordinarily favourable conditions.

J. O. W. (HEATON) has made the two-valve set described in No. 3 "MODERN WIRELESS," page 412, but instead of using the inductance coil specified he has used in place of L_1 and L_2 anode reactance coils made by two well-known manufacturers and does not obtain very satisfactory results. He asks our advice.

The first anode reactance coil you mention is quite suitable in the position of L_2, but the introduction of another anode reaction coil in place of the aerial tuning inductance L_1 is not at all satisfactory. We do not recommend alterations from the design specified in our article.

P. K. (PAWLEY) wants to buy the necessary components to construct a wireless set to receive the London broadcasting, but knows nothing whatever about it. He asks what is necessary and how he could connect them together.

We believe that Southampton is what is known as a "blind" spot, and therefore, even if you were an expert, you would not obtain satisfactory results. A good set stamped "B.B.C." by a reliable maker will fill your requirements. We do not recommend you to attempt to construct a multi-valve set yourself, but you should buy "Practical Wireless Valve Circuits," Radio Press, Limited, and "Wireless Valves Simply Explained," Radio Press, Limited, and "The Construction of Wireless Receiving Apparatus," Radio Press, Limited. These books will supply you with the necessary knowledge to subsequently construct your own apparatus.

C. W. (SCARBOROUGH) wishes to know of a good receiver described in either "MODERN WIRELESS" or "WIRELESS WEEKLY" which will enable him to listen to any of the British Broadcasting stations. He also has an 8-volt dynamo and the necessary power to drive it, and wishes to know whether this might be used in place of an accumulator for heating the filaments of his valve.

We suggest the four-valve Universal receiver described in *Modern Wireless,* No. 3. This is quite suitable for your purpose. Referring to the use of a dynamo for heating the filaments, we cannot advise this, as, unless the supply were very carefully smoothed out, it would cause an undesirable hum in the receiver all the time. It would also probably be a distinct economy to use a six-volt accumulator and charge it from your dynamo when required as you have the power to do so.

J. G. L. (EVESHAM) has obtained exceedingly satisfactory results from the crystal broadcast receiver described in "HOW TO MAKE YOUR OWN BROADCAST RECEIVER," Radio Press, Limited. He now wishes to know: (1) How to make the results louder. (2) What causes curious noises at about 1,000 metres wavelength. (3) How many pairs of telephones he can conveniently use, and whether a loud-speaker might be used.

(1) The addition of a one- or two-valve low-frequency valve amplifier will increase the signal strength by a very considerable amount. A suitable instrument for this purpose is described in No. 3 of *Wireless Weekly.* (2) The sound you heard on your crystal receiver at 1,000 metres wavelength is probably due to some "backwash" from an arc station. (3) Two pairs of telephones could probably be easily used with this receiver, but if the note magnifier referred to is attached to it, it will then be possible to operate a large number of telephones or loud-speaker.

Advertisement issued by Peto-Scott Co., Ltd.

My home-assembled Set

—the interesting experiences of an Amateur's first steps in Wireless

ALWAYS being fond of mechanics—in a mild sort of way—I fell an easy victim to the fascination of wireless. After reading one or two little books on the subject I made up my mind to build up my own set. A timely article in a wireless paper describing a simple crystal set seemed to me to show just the instrument which would fill the bill.

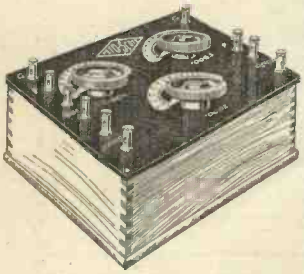
A Crystal Set

It was simple and consisted of few parts—a great advantage to a novice—and could be constructed for a few shillings. I well remember the thrill experienced when I heard my first telephony on it—the excitement of other members of the household at hearing this " music through the air." But this set, good though it was, later on began to pall. My interest seemed to wane; I wanted to hear more than the nearest broadcasting station and the few amateurs in my neighbourhood. In short, I had tired of this crystal set and wanted a more ambitious valve receiver.

After looking around I found that to buy a ready-made instrument was far beyond my means, and constructional articles in the wireless papers seemed hard to understand and to require rather more skill in the use of tools than I possessed.

A Unit Valve Receiver in sets of parts

There seemed no alternative until by chance I discovered just the type of receiving set I had in mind. It was in units—that is to say, it could be made to expand and more valves could be added just as often as one's purse permitted, until eventually a super-sensitive multi-valve receiver is obtained. Just like a certain expanding bookcase, in fact, " always complete, yet never finished." And the greatest advantage of all, perhaps, was that it was supplied in complete sets of parts all ready to assemble at home.

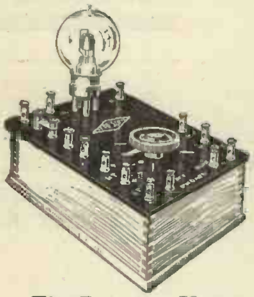


The Condenser Unit

The manufacturers and designers of this clever set were the Peto-Scott Co., Ltd., of 64, High Holborn, London, W.C.1, and having found that they issue a little sixpenny booklet describing the whole system—as well as giving an interesting description of the whole principles of wireless—I lost no time in getting a copy and studying it.

Making a start with one Valve

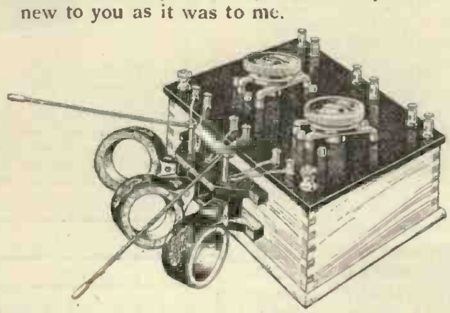
I found that I could make an excellent start—using the tuning coils from my old crystal set—with the Detector Unit (No. 4) alone. Having bought the complete set of parts for the modest sum of 17s. 6d., and followed the directions contained in a six-page illustrated instruction folder, a couple of hours' work gave me a complete valve unit. There were no holes to drill; all I had to do was to insert the parts as shown. Although my valve now gave me much better results than I had ever been able to obtain with my crystal set, I found that my primitive tuning arrangements had very serious drawbacks, therefore I decided that my next step would be to invest in a proper tuner.



The Detector Unit

A Tuner for all Wavelengths

An outlay of £3 9s. 6d., therefore, procured for me all the requisite parts for a really first-class tuner in two units suitable for all wavelengths. The tuner unit itself is most ingenious. Besides a three-coil holder it has two rotary switches; one is for putting the condenser in series or in parallel with the primary coil, and the other is for " Stand by " or " Tune." The advantages of the former are probably very well known to you, but the latter may be as new to you as it was to me.



Tuner Unit

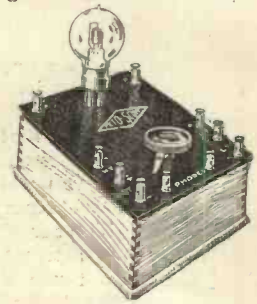
It operates like this: When the switch is at " Stand by " the tuning is done on one coil only—the other one for the time being is not in use at all. The result is that the tuning is quite " broad " and non-selective. This has advantages: for instance, if you are searching for a station you can find it so much quicker on a non-selective circuit. Also, if you are listening to a couple of amateurs talking to one another, you can hear them both without having to re-tune each time, supposing they are not exactly on the same wavelength.

When the switch is at " Tune," you are operating two circuits at once and are able—by separating the coils and adjusting the condensers—to cut out all interference from near-by stations.

Every Broadcasting Station heard on this Set

I was now on the high road to success. These three units enabled me to pick up all the broadcasting stations with ease from London to Newcastle, as well as the splendid Eiffel Tower concerts from Paris.

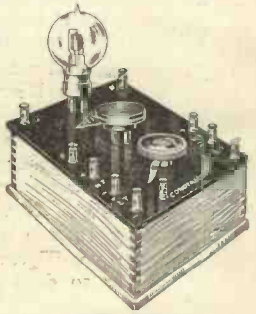
In due course—and as funds permitted—I added a high frequency amplifying unit (at the moderate cost of but 13s. 6d.) enabling me to pick up the Hague, and a low frequency unit which gave me the necessary strength to use my headphones attached to an old gramophone horn as a loud speaker.



L.F. Unit

Building the Set into an old Bureau

You will observe that I have said nothing about cabinets. Although I could have purchased suitable mahogany ones from Peto-Scott, Ltd., for as little as 3s. 6d. each, I did not do so; instead I bought at a local auction sale a fine old bureau which I am now converting as a suitable receptacle for all these five units. The result of my efforts, I am convinced, will be a three-valve set worthy of any home, and one which would have cost me probably three times as much had I bought it ready made. It will certainly be an investment I shall never regret. E. R. G.



H.F. Unit

PRICE LIST of SETS of PARTS

(Complete for Home Assembling)

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No. 2 Condenser Unit	—	42/-
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No. 5 L.F. Amplifying Unit	—	33/6
Cabinets for 1, 3, 4 and 5	—	3/6
Cabinets for No. 2	—	7/-
Catalogue of all Radio Components, 32 pp.	—	3d.

Postage 9d. per Unit extra, but paid on all Orders of £2 or over.

¶ We are always pleased to receive from our customers similar interesting experiences. Any photographs of Peto-Scott Units built into special cabinets or into articles of furniture will be liberally paid for upon acceptance.

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Featherstone House, 64, High Holborn, W.C.1

 (continued from page vi) *whether you mention the paper or not. What does matter*

VARIABLE AIR CONDENSERS OF PRECISION.

To meet the abnormal demand for these condensers we have put a specially equipped department down for their manufacture and are now able to offer same at 25/-.

High insulation, permanent calibration. Sound mechanical design, fully guaranteed. Low Cost.

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The result of 25 years' successful wireless experience.

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CAPACITY.—Note the high capacity range:—.000025 to .0011 microfarads.

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Wireless Weekly

and The Wireless Constructor

No. 6

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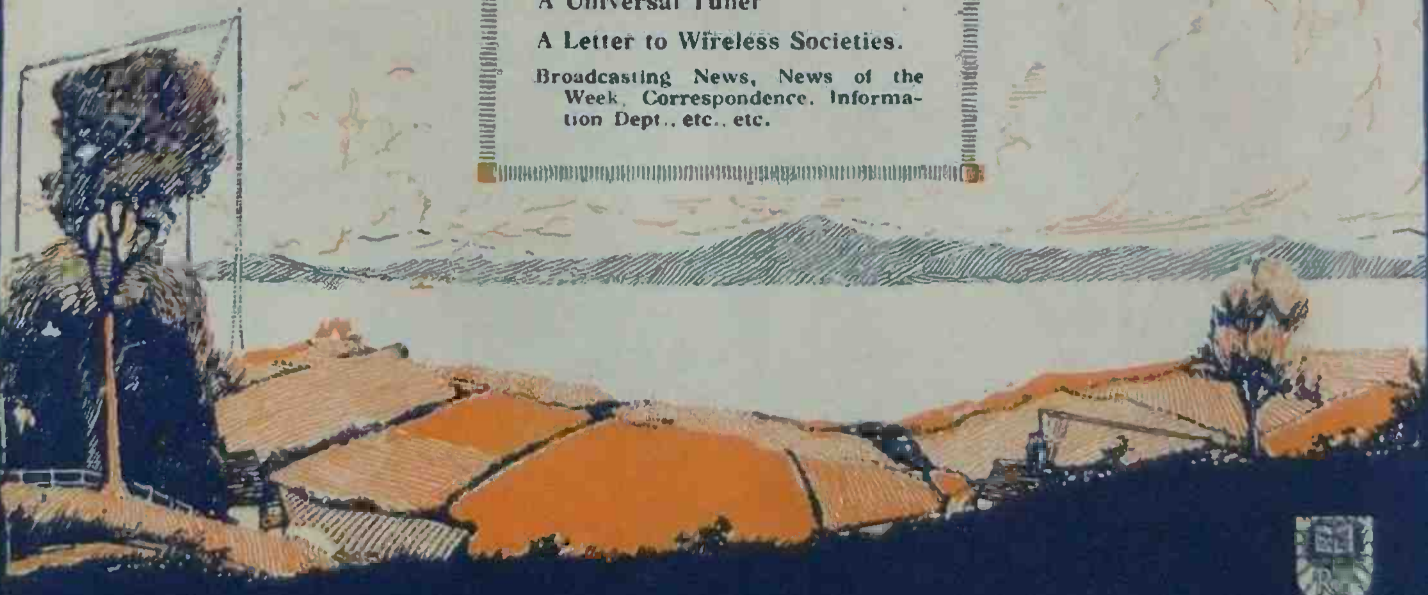

Edited by
John Scott-Taggart F. Inst. P.

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May 16, 1923

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Assistant Editor: E. Redpath.

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All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

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Re the B.B.C. Stamp on Components

PENDING the full investigation of the subject, we have hesitated to state our own views on the question of the B.B.C. stamp on component parts.

We have now had an opportunity of considering very carefully the pros and cons of the arrangement, and while we do not agree that a satisfactory solution would be merely the adoption of this stamp without any safeguards, yet we cannot help feeling that much misunderstanding has arisen regarding both the B.B.C. and the National Association of Radio Manufacturers who have been taking up the cudgels in the general press.

In the first place, there are those who criticise the B.B.C. stamp. It should be noted that the Postmaster-General who drafted the agreement with the B.B.C., stipulated that he would grant them half the licence fees, but that they, in their turn, would have to obtain from manufacturers 10 per cent. royalty on the apparatus. This proposition came from the Post Office, and the B.B.C. tried to reduce the percentage to 5 per cent., but this the Post Office declined. The responsibility, therefore, for the B.B.C. stamp, in the first place, rests with the Post Office.

The British Broadcasting Company, it must be remembered, started on a very ambitious scheme without any guarantee from the Government. Not only was money invested in the construction of all the stations, but the individual firms spent huge sums in training unemployed in the manufacture of wireless sets and parts. It is only natural, therefore, that they should have material advantages over those so-called manufacturers who simply stood by to see which way things were going, and, when a boom took place, made a great shout about monopolies. Not only have the original firms who joined the B.B.C. gained no particular advantage thereby, but it is a fact that any manufacturer may now join the B.B.C. on the same terms as the pioneers. There is, therefore, no justification for the silly cry of a monopoly. Many do not realise that it is within the power of any new body of manufacturers to obtain the controlling interest in the British Broadcasting Company. Not only is there no monopoly, but there is no fixed control. New firms banded together could now join the British Broadcasting Company, and not only come in on the same footing as those who risked their money when there was no definite promise of a boom, but may actually take control of the Company.

We hold no brief for the B.B.C., and we intend to criticise them whenever we think fit. At the same time, we intend to defend them as we would defend any other body against misinformed criticism.

As regards the B.B.C. stamp, we believe that the royalties on sets should be lower, and we have no doubt that the B.B.C., if they see sufficient revenue coming to them from licences, will agree to a reduction, provided the Post Office, which initiated the scheme, will also agree.

As regards the B.B.C. stamp on components, the manufacturers maintain that only by having the B.B.C. stamp on the components will it be possible to combat effectively the unfair competition of foreign-made articles. German and Austrian factories can obviously turn out wireless parts much more cheaply than we can in this country, yet we feel that competition and the fact that the B.B.C. in no way attempts to prevent price cutting amongst its members, will bring the level of prices to a reasonable one. After all, there must be very few who do not desire to increase the prosperity of this country and to reduce unemployment. The British manufacturers were promised protection for two years, and under this promise they took steps which have resulted in a most beneficial state of affairs in many trades, and thousands of unemployed have been absorbed in the industry. Had the companies not been protected in this way, they would simply have established factories in those countries where labour was cheap, and, while making large profits themselves, would have benefited British labour in no way whatever. We certainly would consider it a breach of faith if the protection promised to the B.B.C. were withdrawn without their consent.

Having come to the conclusion that the promotion of British industry is to be striven for, we next have to consider whether this would be effected best by making it compulsory to stamp apparatus "B.B.C." or "British Made." The B.B.C. stamp, of course, would be an absolute safeguard against foreign importation. On the other hand, no one will agree to this stamp if the price of components is to be increased. The manufacturers undertake that the price will not be increased. This difficulty being removed, will the stamp force manufacturers into a combine? The reply to this is that the B.B.C. is a combination which will promote the welfare of its individual members, and the industry as a whole. The B.B.C. does not, and will not, interfere in any way with the price of apparatus. Are the conditions for joining the B.B.C. onerous? If so, let the new Committee investigate the matter closely.

(*Continued on page* 334.)

THE CHOICE AND OPERATION OF VALVE RECEIVING CIRCUITS.

By JOHN SCOTT-TAGGART, F.Inst.P., Editor of "Modern Wireless."

The transcript of an address to wireless enthusiasts, "radiated" from 2LO on the evening of Friday, March 2nd, 1923.

IT is only with considerable misgiving that I have taken as my subject to-night "The Choice and Operation of Valve Receiving Circuits." It is because I know that none of you can answer me back that I have had the courage to speak on such a controversial topic. As I stand here, there are those who are adjusting their combined valve and crystal sets; those who are obtaining excellent results from a set which uses two high-frequency valves and a detector valve; and those who, with some special dual amplification circuit, are telling their friends that the signals they are now receiving are not nearly as loud as they were yesterday. Incidentally, let me tell such friends that it is a well known but curious wireless phenomenon that signals are never as loud when visitors are present as when one is working alone.

When so many different kinds of circuits are being used it is difficult to give advice which would apply to all cases. I am often asked: "I want to arrange a three-valve set, what is the best circuit to use?" Before giving an answer, it is essential to know more, and I propose first to mention some of the general considerations governing the choice of a practical wireless valve circuit.

The three-electrode valve, as used in a receiver for broadcasting, is employed as a high-frequency amplifier, as a detector, or as a low-frequency amplifier. In every receiver there are flowing two kinds of current. In the aerial circuit we have the high-frequency oscillations which are set up by the wireless waves striking, as it were, the aerial. These high-frequency oscillations, which change direction perhaps one million times per second, are unable, directly, to influence the telephone receivers which require comparatively slowly changing currents to operate them; currents changing direction or changing in magnitude at low-frequency. The problem is, therefore, to change the high-frequency oscillations into low-frequency currents capable of operating the telephones.

To effect this, we use a detector which, in many cases, is a valve. A single valve, however, used in this capacity is hardly worth the expense and trouble of upkeep. A good crystal, while not giving quite as loud results, will be found a more desirable proposition. The range of a crystal set, however, is very limited, and many desire to be able to work a loud-speaker, in which case a crystal detector is not sufficient by itself. When loud signals are desired, or when a long distance is to be covered, we bring into action the versatile three-electrode valve. We can either use the valve to magnify or amplify the high-frequency oscillations before applying them to the detector, or we can pass the low-frequency currents which are obtained after detection, not through telephone receivers, but to one or more valves acting as low-frequency amplifiers. In some circuits we therefore have a high-frequency stage of amplification followed by detection, and, in others, detection followed by low-frequency amplification.

Sometimes we use one or more stages of high-frequency amplification followed by detection, the final currents being then amplified by one or more valves acting as low-frequency amplifiers.

In all these circuits, we can use either a crystal detector or a valve to rectify the high-frequency oscillations and produce low-frequency currents.

It will be found that, although the crystal detector gives quite good results, louder signals are obtainable by using a three-electrode valve. From these remarks you will appreciate that, whereas the single valve as a detector is not of much use by itself, yet the same valve when used in combination with a crystal or another valve may be used with advantage.

Let us now consider the different kinds of circuits using one, two, three, four, and five valves, and examine which circuits are the most useful for any given purpose.

There is one important regulation which somewhat limits the nature of a receiving circuit, but the observance of which is imperative if the listener-in is to receive his musical items, etc., without interruption. This regulation forbids the use of reaction on to the aerial circuit or closed receiving circuit of the receiver.

Reaction is a phenomenon by the use of which signals may be strengthened. When this phenomenon is carelessly utilised, the receiving set is said to "oscillate." It produces feeble oscillations which are communicated to the aerial and produce feeble waves which, however, may travel several miles and interfere with the reception of broadcasting. The incorrect use of reaction, which usually consists in bringing two inductance coils in the receiver too close to each other, is nothing short of criminal, and it is the height of selfishness to adjust your set so that you hear whistling noises in your telephones or loud speaker. This is an almost infallible sign that your set is oscillating, and the unpleasant noises which you hear yourself are probably being reproduced in every wireless receiver within several miles. Even those who use a permissible circuit should guard against letting their sets oscillate.

Now to return to the consideration of different classes of circuits. If you have only one valve you should use it in combination with a crystal detector, either amplifying the low-frequency currents by the aid of a step-up transformer, or by using the valve as a high-frequency amplifier with a tuned anode circuit across which the detector and telephones may be connected. Certain dual amplification circuits will give good results, but I would advise beginners to use a circuit of a more straightforward character.

The valve is probably best used as a low-frequency amplifier when the distance from the broadcasting station is only a matter of a few miles, but when the receiving station is farther out, it is usually preferable to use the valve as a high-frequency amplifier.

When two valves are used, several interesting circuits may be arranged. If within a few miles of a broadcasting station and a loud speaker is to be employed, I would suggest a crystal followed by two low-frequency amplifying valves. This, however, is not a very good general type of circuit, and I would recommend, in nine cases out of ten, to use one valve as a high-frequency amplifier, and the other either as a detector or as a low-frequency amplifier.

A good combination is a high-frequency amplifier with a tuned anode circuit across which a detector and primary of a step-up transformer are connected, the secondary of the transformer being connected to the grid and filament of a valve acting as a low-frequency amplifier. For reliable work, it is very difficult to beat a circuit in which the first valve acts as a high-frequency amplifier, the anode circuit consisting of an inductance shunted by a condenser, the anode of the first valve being connected through a grid condenser to the grid of the second valve which acts as the detector. In the anode circuit of the second valve there is an inductance coil which is coupled to the inter-valve oscillation circuit to obtain reaction effects. This class of circuit was first published by myself some years ago, although it has only recently come into popular favour, both amongst experimenters and manufacturers. I have just published a further development of this circuit, in which the two valves are used for amplification, rectification, however, being obtained by a crystal detector connected across the tuned anode circuit. Reaction is obtained from the second valve.*

When the receiving station is a very long distance away from the broadcasting station, I would advise using both valves as high-frequency amplifiers, with a crystal as rectifier. For coupling high-frequency valves I strongly recommend a single tuned anode circuit in preference to inter-valve high-frequency transformers, unless special selectivity is desired, in which case a loose-coupled transformer with tuned primary and secondary may be used with advantage.

For general work, three valves may be strongly recommended as a minimum. The two-valve circuits I have mentioned may have an additional low-frequency amplifying valve added. An excellent three-valve circuit consists of one high-frequency valve having a tuned anode circuit; a detecting valve in the anode circuit of which is a reaction coil coupled to the tuned anode circuit of the first valve, and a third valve as a low-frequency amplifier.

This circuit will easily work a loud-speaker up to twenty miles from a broadcasting station, and I frequently use this circuit at home myself. For very long range work, the first two valves may be used as high-frequency amplifiers, the third valve acting as a detector. If desired, a crystal detector might be inserted between the second and third valves, in which case the third valve might be used as a low-frequency amplifier.

Four valves should give very good results in all circumstances. The circuit I would

* Described in No. 2 of *Modern Wireless*.

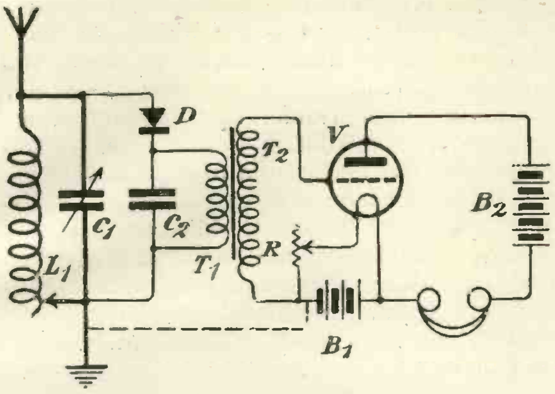


Fig. 1.—Use of valve to amplify low-frequency signals from a crystal detector receiver.

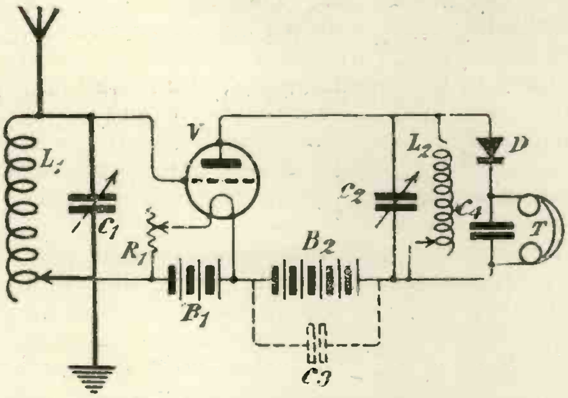


Fig. 2.—Valve used as a high-frequency amplifier followed by a crystal detector.

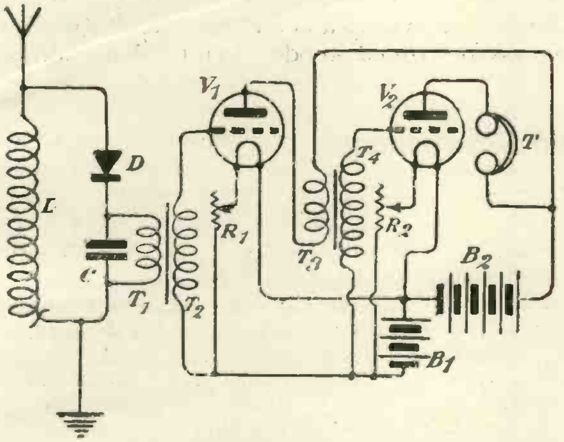


Fig. 3.—Circuit suitable for receivers near a broadcasting station.

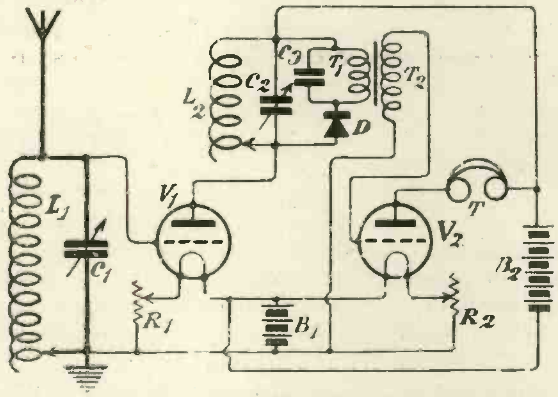


Fig. 4.—Circuit having the first valve as a high-frequency amplifier followed by a crystal detector and a L.F amplifying valve.

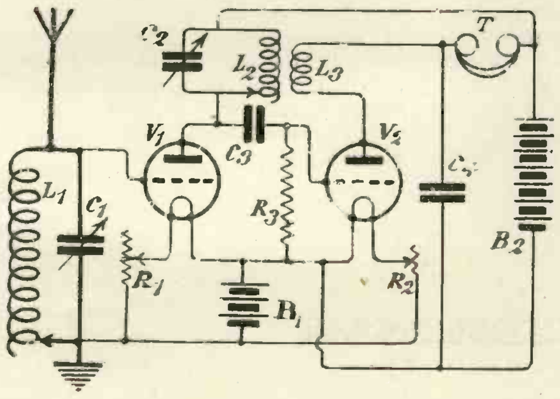


Fig. 5.—The now highly popular circuit for broadcast reception.

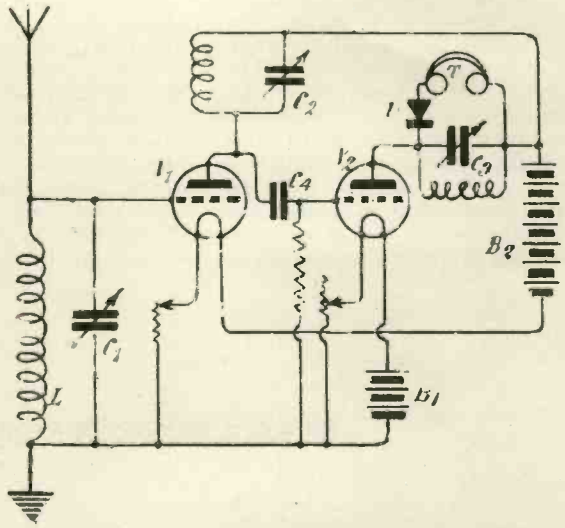


Fig. 6.—Two high-frequency valves followed by a crystal detector.

here recommend is: One high-frequency amplifying valve with a tuned anode circuit, one detecting valve with a reaction coil coupled to the tuned anode circuit of the first valve and two low-frequency amplifying valves. For long range work use the first two valves as high-frequency amplifiers, the third as a detector, and the fourth as the low-frequency amplifier.

Coming to five-valve circuits, I would here unquestionably recommend using the first two valves as high-frequency amplifiers using tuned anode coupling, the third valve as a detector, and the last two as low-frequency amplifiers. Reaction might be produced by coupling a coil in the anode circuit of the third to the tuned anode circuit of the first valve.

If the beginner thinks that my remarks have become somewhat involved, I can only apologise for not being able to reproduce the circuit diagrams I have in my mind.

In conclusion, I would like to ask if listeners-in could send me particulars of the manner in which they have heard me, together with a very brief statement of the kind of circuit they have used. A table of results should prove of great interest.

Numerous reports have been received and it is hoped to publish in a future issue, a table shewing the types of apparatus used.

Re the B.B.C. Stamp on Components

(Continued from page 330.)

We believe that the B.B.C. would be willing to amend its rules, so that objections to joining the B.B.C. would only be raised by those desiring to import foreign apparatus.

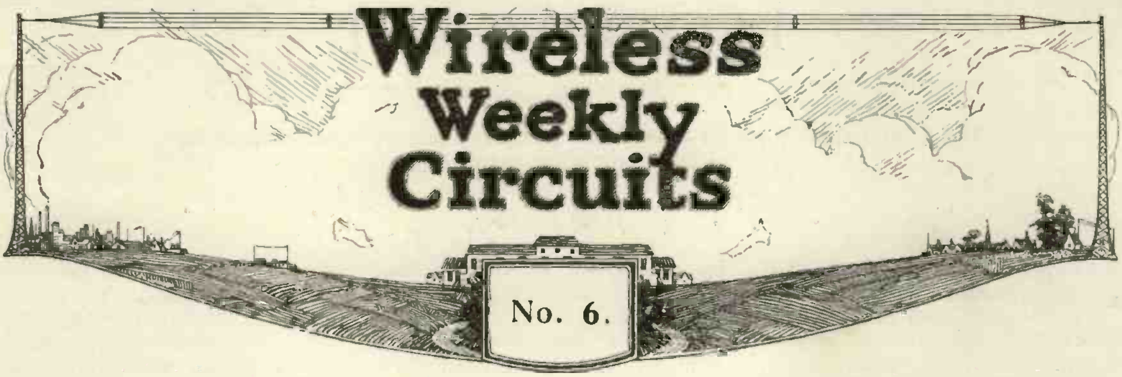
Would the ban on foreign apparatus hold back science? No, because enterprising British firms would be the first to acquire British manufacturing rights of any new inventions of value. The B.B.C. exercises no right whatever of interfering with the private enterprise of its members in this direction.

It seems, therefore, to us, that the B.B.C. stamp scare will turn out to be a bogey if some of the outstanding difficulties are smoothed over. It should surely be within the scope of the new Committee to ensure that the organisation of the B.B.C. acts in no sense as a combine or monopoly.

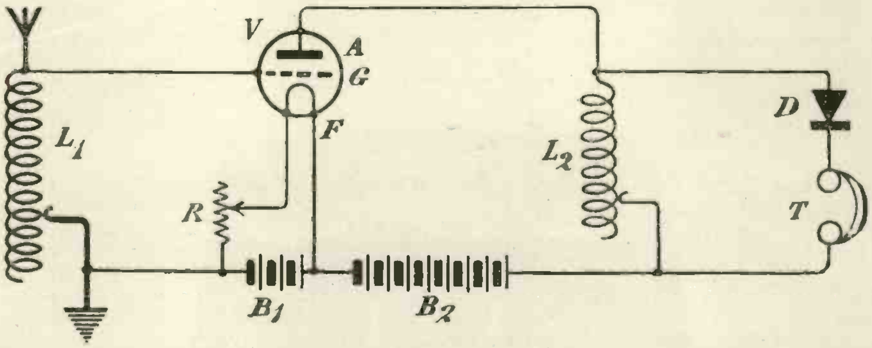
If regulations have to be changed, let them be changed, rather than that a system, which offers the only real protection to the British manufacturer, should be scrapped.

If parts had to be stamped "British Made," foreign importation would not be prevented. If 25 per cent. of an article only is British made, the whole article may be stamped "British Made." Moreover, there would always be a great difficulty in tracing the origin of apparatus marked "British Made," whereas the B.B.C. will always take effective steps to prevent the misuse of its trade mark. Again, if foreign headphones are fitted with headbands marked "Entirely British Made," there would be no illegality in the proceeding, and yet the public would be deceived.

It therefore seems to us that, while we would prefer the stamp "British Made," yet no such scheme of marking would produce the desired results. It therefore seems that the B.B.C. stamp is the only alternative. Nevertheless, it is vital, if the stamp is adopted, that ample guarantees should be forthcoming from the Broadcasting Company that there would be no abuses of any kind of its privileges. The industry must be free, the public must not pay more, and the genuine British manufacturer must receive adequate protection. That is our opinion.



A High-Frequency Amplifier Receiver



COMPONENTS REQUIRED.

- L_1 : A slider type inductance.
- L_2 : A larger slider type inductance.
- R : A filament rheostat of about 7 to 10 ohms resistance.
- V : A three-electrode valve.
- B_1 : A six-volt accumulator.
- B_2 : A 40- to 80-volt high-tension battery.
- D : A crystal detector.
- T : High-resistance 'phones.

GENERAL NOTES.

This is a high-frequency amplifier receiver, in which a three-electrode valve is used to amplify the high-frequency oscillations before they are detected. The anode circuit contains the inductance L_2, the circuit being completed, partly by the self-capacity of the coil, and partly by the capacity between filament and anode of the valve. Instead of having the slider type inductances, variometers might be employed.

VALUES OF COMPONENTS.

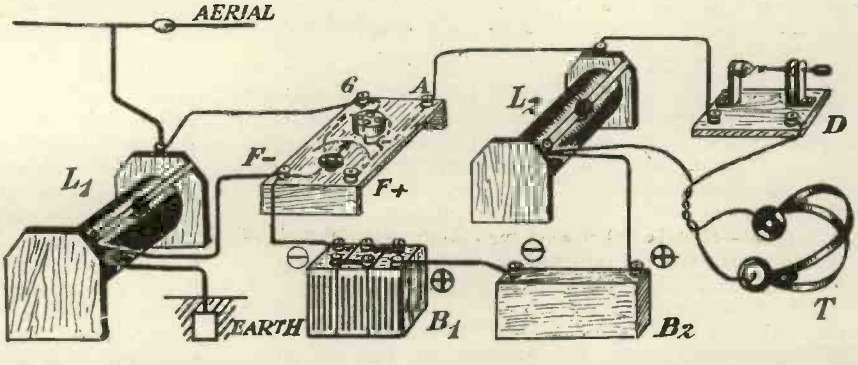
The inductance L_1 will vary according to the wavelengths to be received. To receive broadcasting the coil may consist of a tube measuring 4in. diameter by 5in. long, wound for a distance of 4½in. with No. 24 enamelled wire.

The other inductance, L_2, should be considerably larger. A cardboard tube measuring 4in. diameter by 8in. long, wound for a distance of 7in. with No. 24 enamelled copper wire, will be found suitable.

In order to receive up to Paris (2,600 metres), the inductance L_1 may be wound on a cardboard tube measuring 4in. diameter by 11in. long, wound for a distance of 10½in. with No. 24 enamelled copper wire. The inductance L_2 may be of similar size, but it will be found that the loudest signals are not obtainable unless some additional inductance be connected in series with L_2. It is, therefore, to be recommended to connect in series with this variable inductance, a coil of exactly the same size, but without a slider, the whole of the coil being therefore in circuit.

NOTES ON OPERATION.

The two inductances, L_1 and L_2, are adjusted until the loudest signals are obtained. Careful adjustment of the rheostat R and the detector D will improve signals.



AN INDUCTIVELY COUPLED CRYSTAL RECEIVING SET

By E. REDPATH, Assistant Editor.

This is the concluding portion of the article describing a selective crystal receiving set, which appeared in our last issue.

PART II

HAVING completed the various components as described in the first portion of the article, fitted them temporarily upon a base-board and tested them upon actual signals, it remains to assemble them complete into a suitable containing box or cabinet.

During the preliminary test it will have been discovered that the tuning of both the aerial and the secondary circuit is much sharper—that is to say, more critical—when the primary coupling coil is adjusted so as to give a "loose" coupling between the aerial and secondary circuit.

It will also have been noticed, no doubt, that although signals are possibly somewhat stronger when the secondary circuit comprises a large amount of inductance and a small amount of capacity, the tuning is further sharpened by the use of a fewer number of turns of the secondary coil and an increased amount of capacity.

For instance, suppose that good signals are being received with the secondary tuning switch upon the fourth or fifth stud; the secondary condenser at about 40 degrees and the coupling at 70 degrees—that is to say, only 10 degrees short of the tightest possible coupling—and that some interference is experienced from a spark station operating upon a wavelength fairly close to that to which the receiving set is tuned.

By moving the secondary tuning switch on to the third, or even on to the second, stud and increasing the condenser value to compensate, it will be found that the couplings can be further reduced, say to 50, or even to 40, degrees with scarcely any loss of signal strength, and that a slight adjustment of the aerial tuning variometer will greatly reduce, if not entirely eliminate, the interference from the spark station.

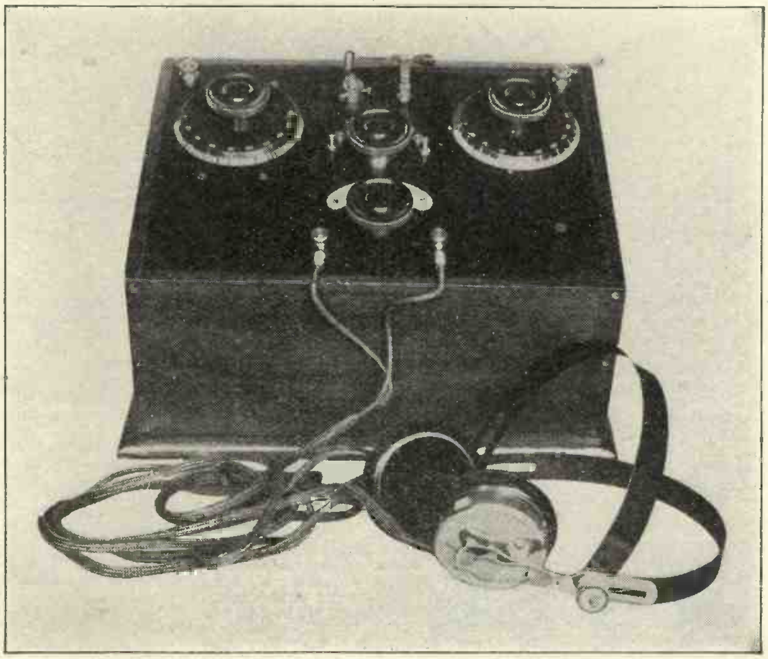


Fig 11.—The completed set.

In this connection it should be noted that, following any appreciable adjustments in the secondary circuit, particularly of the secondary tuning switch or the coupling between the circuit, a small final re-adjustment of the aerial tuning the variometer will be necessary.

Assembling the Set

The photograph, Fig. 11, shows the completed set. Apart from the crystal detector, there are four adjustments provided. The knob with engraved dial to the left operates the variometer which tunes the aerial circuit, whilst that on the right controls the secondary tuning condenser. Between the two dials and immediately in front of the crystal detector is the 6-point secondary tuning switch which selects the number of turns of the secondary inductance. With the switch upon the left-hand stud 50 turns only are in circuit, and, moving to the right, each subsequent stud includes an additional 30 turns of inductance. In front of the secondary tuning switch is the coupling knob, provided with a small pointer moving over a scale graduated from 0° to 90°, and right in front of the set are the two telephone terminals.

The Containing Box

Details of the containing box or cabinet are given in Fig. 12. The present writer has rather a preference for the sloping top-type of containing box, although its use in the present instance necessitates sawing a corner piece off the aerial tuning variometer, which otherwise would touch the back of the box. Readers who may desire to avoid the necessity for cutting the variometer should make the containing box 5in. deep at both front and back.

The ebonite top panel should be carefully cut to size and marked off and drilled in accordance with the details given in Fig. 13.

The Secondary Tuning Switch

Fig. 14 (*a*) and (*b*) show plan and elevation respectively of the 6-point secondary tuning switch, the com-

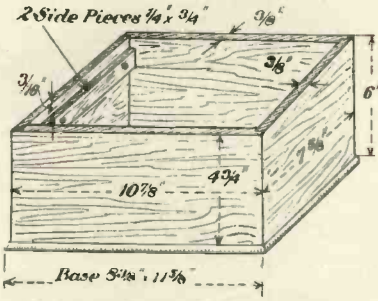


Fig. 12.—Details of the containing box.

ponent parts of which—namely, six contact studs with nuts, two brass stops also with nuts, and laminated switch arm with brass-bushed ebonite knob and lock-nuts—may be purchased from any wireless dealer.

Mounting the Secondary and Coupling Coils

Before further components are fitted in place behind the panel the secondary and coupling coils should be mounted as shown in Fig. 15, and the tappings from the secondary coils should be carefully soldered to the shanks of the respective contact studs. The 50-turn tapping should be connected to the first or left-hand contact stud, and each of the 30-turn tappings, in proper

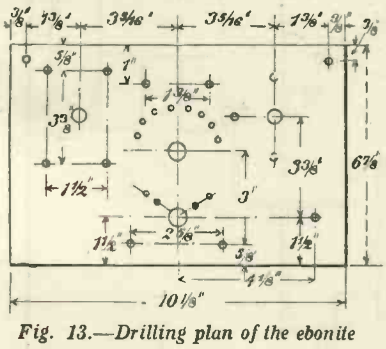


Fig. 13.—Drilling plan of the ebonite panel.

order, to the succeeding contact studs. The last stud will, of course, be occupied by the wire from the end of the secondary coil furthest from the coupling coil. Provided that care is taken not to remove the insulation from the connecting wires except at the point where each is soldered to the contact stud, there is no necessity to employ insulating sleeving in this case.

The Secondary Condenser

The assembly of the secondary condenser is shown in Fig. 16. This condenser is built up entirely from standard parts, and consists of five fixed and four rotary vanes, the former being 3¼in. and the latter 2½in. across the diameter. The spring on the condenser which makes contact with the moving plates is to be connected to the starting end of the secondary coil—that is to say, to the end turn adjacent to the coupling coil—whilst

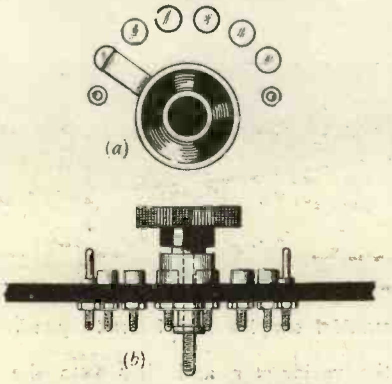


Fig. 14 (a) and (b).—The 6-point tuning switch.

the fixed plates are to be connected to the spindle of the tuning switch.

The Coupling Coil Connection

Close to each projecting end of the coupling coil spindle a small countersunk-headed brass screw is passed through the cardboard secondary tube from the inside and fitted with a washer and two nuts. A small piece of flexible wire soldered to the brass bush on the spindle, or to the spindle end itself, wrapped once round the spindle and secured beneath the washer on the

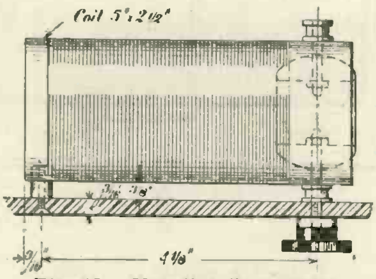


Fig. 15.—Mounting the secondary and coupling coils.

small screw just mentioned, ensures good contact with the end of the coupling coil and affords a fixed point from which connections can subsequently be taken to one side of the variometer and to the aerial terminal respectively.

The Telephone Condenser

A small fixed condenser, capacity 0·001 to 0·002 μF, should be fitted between the two telephone ter-

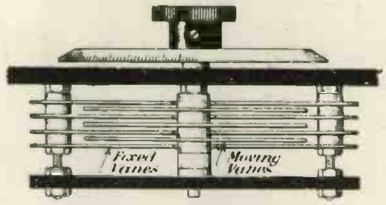


Fig. 16.—The secondary condenser.

minals and securely connected thereto. The condenser actually fitted to the original set is a Dubilier, capacity 0·0015 μF.

Mounting the Variometer

Reference has already been made to the necessity for cutting the variometer in order to enable it to be fitted into a small sloping top cabinet. The amount of cutting required and the method adopted for mounting the variometer to the back of the ebonite panel will be seen on reference to Fig. 17. Four brass wood screws passed through the ebonite panel into the wooden stator of the variometer, the distance pieces employed being eight spacer washers as used for variable condensers, two at each screw.

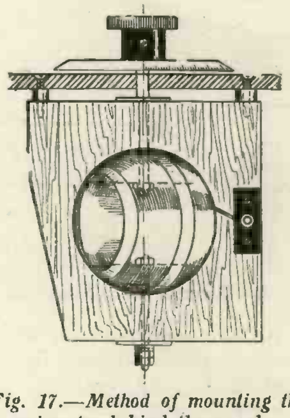


Fig. 17.—Method of mounting the variometer behind the panel.

In last week's issue the number of turns of wire to be wound upon the winding former for the stator coils was inadvertently given as 48 to

50, this being the correct number for the *complete* stator, each half stator winding therefore requiring only 24 or 25 turns. In order to obtain the greatest useful range of a variometer, the total number of turns on the rotor should be the same as on the stator.

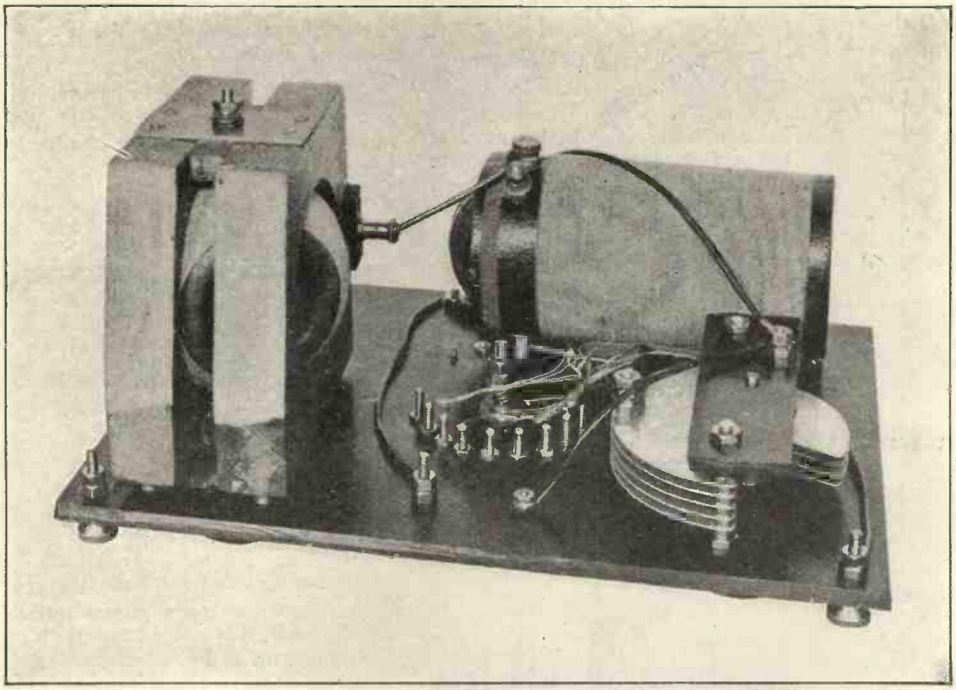


Fig. 18.—Components assembled complete behind ebonite panel.

Connecting up

With all these components secured in place upon the back of the ebonite panel, as shown in the photograph, Fig. 18, and the tappings from the secondary coil duly connected to the respective contact studs as already described, it remains to complete the connections in accordance with the wiring diagram, Fig. 19.

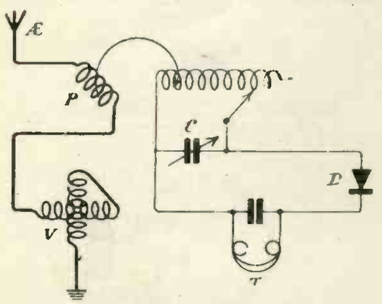


Fig. 19.—Complete circuit diagram.

The aerial terminal is to be connected to one side of the coupling coil, from the other side of which a direct connection is to be taken to the variometer and thence to the earth terminal.

The moving plates of the variable condenser are to be connected to the starting end (close to the coupling coil) of the secondary coil and to one side of the crystal detector, whilst the fixed plates are to be connected to the spindle of the tuning switch and to one of the telephone terminals, the remaining detector and telephone terminals being connected together.

In a receiving set of this description, therefore, there are really three circuits, namely, the aerial or open circuit, the secondary or closed circuit, both of which are oscillatory circuits; and, thirdly, the detector circuit, including the crystal detector itself and the telephone receivers. The last-named is what is known as an aperiodic or non-oscillatory circuit.

Results Obtainable

With a set of this nature, having several more or less critical adjustments, the results obtained will be considerably improved as the owner gains experience in the manipulation of the set. A few preliminary trials of the original set, however, show the tuning to be quite selective even in the case of signals received from coast stations and shipping operating upon the 600-metre wavelength.

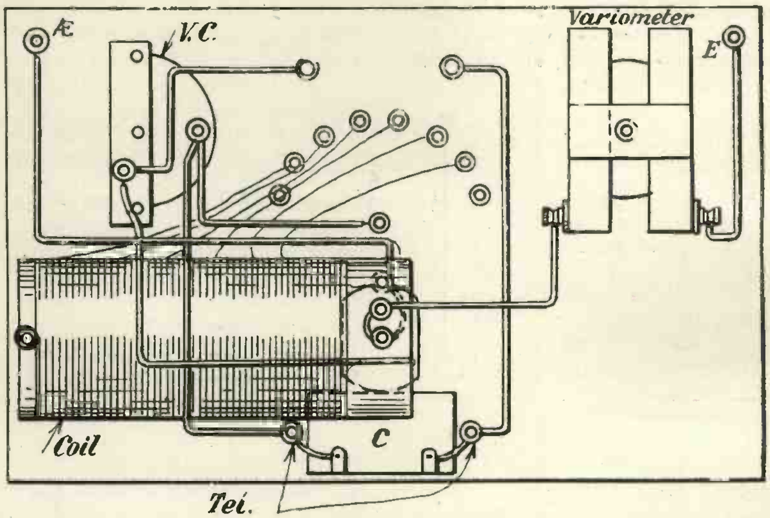


Fig. 20.—A back-of-panel wiring diagram.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART VI

(Continued from No. 5, page 276.)

A Water Analogy for Explaining the Action of the Three-electrode Valve.

FIG. 1 shows an analogy which has been used a number of times, both in America and in this country, and helps the beginner to understand how the three-electrode valve works as an amplifier. In this figure we have a propeller B_4 driving water out of a vessel W up into a rose F, which might be a rose of a watering-

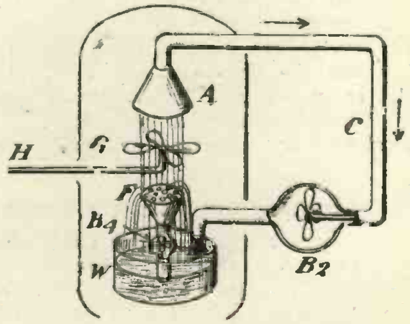


Fig. 1.—A water analogy.

can. The water is sprayed out from F, and some of it falls back into the vessel W, while some of the water is sucked up into the inverted funnel A, owing to a strong suction draught, caused by propeller B_2, the lower end of which is placed just above the water in W.

The suction created by the propeller B_2 is not sufficient to draw more than about half the water sprayed out from F. The water that is drawn up into the funnel A passes round the tube C and falls back again into the vessel W.

The third propeller G is placed in between the rose F and the funnel A. This propeller may be rotated by turning the handle H. If this handle be turned in a right-hand direction the propeller G increases the upward draught, and so helps the inverted funnel A to collect more water. The increased flow of water, of course, passes round the tube C.

In this analogy the rose F corresponds to the filament of the valve, the inverted funnel A corresponds to the anode, the propeller B_2 corresponds to the high-tension battery, the propeller B_4 corresponds to the filament battery which causes electrons to be emitted from the filament, and the propeller G corresponds to the grid. Turning the handle H round in a right-hand direction so as to cause an increased flow of water round through C corresponds to placing a positive potential on the grid of a three-electrode valve.

If we reverse the handle H, and therefore the propeller G, although there is an upward draught, which tends to cause water from F to go to A, yet the propeller G will now exercise a downward draught, which will tend to oppose, more or less, the upward draught into A.

The result will be that a smaller proportion of the water coming from F will go to the inverted funnel A and round the water circuit C. This decrease in the flow of water round C corresponds to a decrease in the anode current of a three-electrode valve when a negative potential is applied to the grid.

What is a Filament Rheostat?

A filament rheostat is a variable resistance usually having a maximum value of about 7 ohms, which is used for varying the current flowing through the filament. By its means it is possible to vary the temperature of the filament, and therefore the number of electrons emitted from it per second.

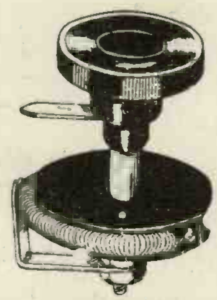


Fig. 2.—A filament rheostat.

The usual type of filament rheostat is that shown in Fig. 2. A rotary type is now universally employed, and it consists of a coil of wire having a relatively high resistivity, and a switch arm which moves round, so that a smooth variation of resistance is obtainable.

Where is the Filament Rheostat Connected?

The filament rheostat is connected between one of the pins on the valve going to the filament and one terminal of the six-volt accumulator used for heating the filament. The other filament pin of the valve is connected to the other terminal of the accumulator.

Whether the rheostat is connected in the negative lead to the accumulator or the positive one depends upon the circuit to be employed. Where the valve is used as an amplifier the rheostat is best connected to the negative lead.

Fig. 3 shows, pictorially, where the filament rheostat R is connected. It will be seen that it is placed between one of the filament pins F and the negative terminal of the six-volt accumulator B_1. It does not matter whether the moving arm or the end of the resistance of the rheostat is connected to the negative terminal of the accumulator, nor, of course, does it matter which of the two pins on the valve, which go to the ends of the filament, is considered the negative pin.

The other pin, F+, is connected to the positive terminal of the accumulator B_1.

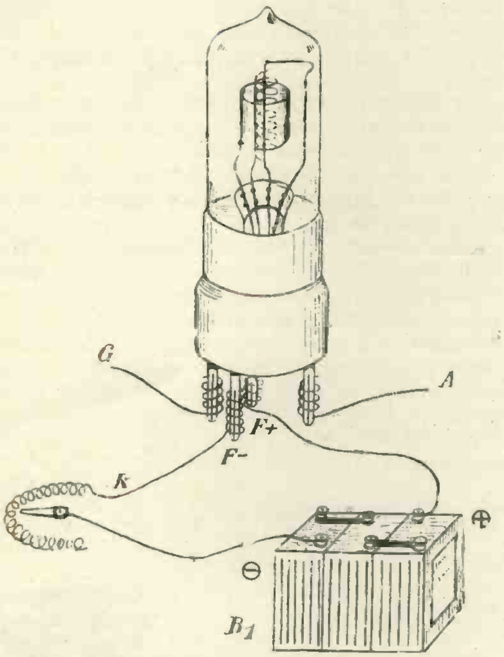


Fig. 3.—Use of rheostat.

Although in this figure the leads are shown twisted on to the actual valve pins or legs, yet in most cases the valve would actually be fitted into a valve holder, which, however, is supplied in pins arranged in a similar way to those on the valve itself.

Fig. 4 shows how the arrangement represented in Fig. 3 is shown in a circuit diagram.

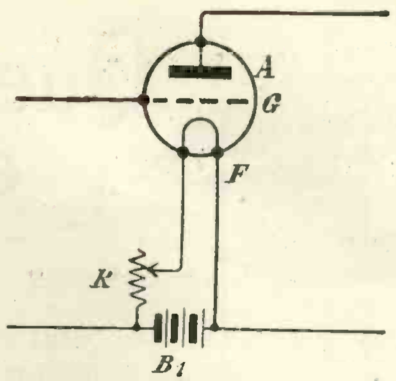


Fig. 4.—Circuit representation of rheostat, etc.

What are the Two Kinds of Amplification?

In a wireless receiver there are two kinds of currents flowing. We have, in the first place, the high-frequency currents in the aerial circuit before it is applied to the detector, and we also have the low-frequency currents which work the telephones.

We may either amplify the original high-frequency currents in the aerial circuit before applying them to the detector, or we can amplify the currents which normally would have gone to the telephones. Very often we use both forms of amplification.

The kind of amplification in which the original high-frequency currents are amplified before being applied to a detector, is called "high-frequency amplification," or "radio-frequency amplification." The kind of amplification employed when the low-frequency currents are amplified is known as "low-frequency amplification," "audio-frequency amplification," "note magnification," or "note amplification."

When is High-frequency Amplification Employed?

High-frequency amplification is used when it is desired to receive over long ranges, or to receive signals on a small aerial, or loop. Weak oscillating currents will not operate a crystal detector, and it is therefore important to strengthen up the oscillations in order that the detector will work effectively. High-frequency amplification is particularly useful for bringing in signals which could not otherwise be heard.

Another advantage of high-frequency amplification is that, owing to the circuits employed, a greater degree of selectivity is obtained. In other words, it is easier to separate out signals from one which would interfere with them.

When is Low-frequency Amplification Employed?

This form of amplification is used for strengthening signals which may already be comfortably heard. The chief value of low-frequency amplification is in enabling a large volume of sound to be obtained, and this form of amplification is almost essential if a loud-speaker is to be used.

Describe How a Three-electrode Valve May be Used to Strengthen the Signals from a Crystal Detector Receiver.

Fig. 5 shows the arrangement of the apparatus for receiving signals by the aid of both a crystal detector and a three-electrode valve.

The portion of the circuit to the left of the diagram shown is an ordinary crystal receiver circuit. The letter C represents the telephone condenser which gets charged up with rectified pulses. Instead of connecting high resistance telephones across the condenser C, we connect the top terminal of C to the grid terminal of the valve holder. The other side of the condenser C is connected to the negative terminal of the filament accumulator B_1. To the terminal F–, which goes to one side of the filament, is connected one side of the filament rheostat R, while the other side of this rheostat is connected to the negative terminal of B_1. The terminal F+ is connected to the positive terminal of B_1. To the pin A is connected a wire from one side of the telephones T, the other side of which is connected to the positive terminal of a high-tension battery B_2 of about 60 volts. The negative terminal of B_2 is connected to the positive terminal of the filament battery B_1.

The operation of this circuit will be readily understood by those who have read previous instalments of this series. The varying potentials across the condenser C are of low-frequency, and are applied across the grid and filament of the valve V. The variations in the potentials of the grid cause large changes in the anode current of the valve, with the result that the sound in the telephones is much greater than it would have been had the 'phones been connected directly across the condenser C.

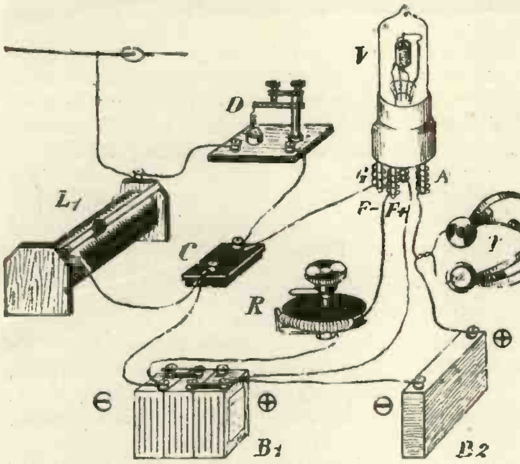


Fig. 5.—Crystal and valve receiver.

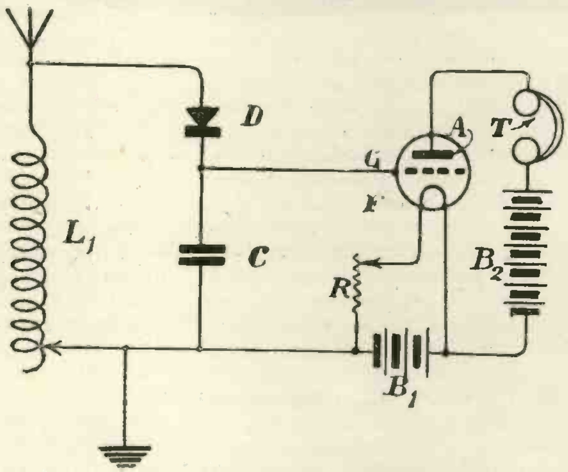


Fig. 6.—Simple valve amplifier circuit.

Draw a circuit corresponding to the pictorial arrangement of Fig. 5.

Fig. 6 shows the circuit diagram of Fig. 5. Similar letters are used for the different parts.

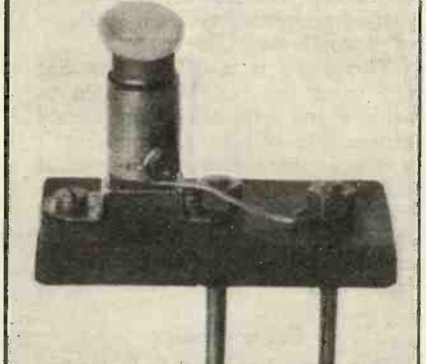
In actual practice the condenser C is usually omitted, as there is sufficient capacity between the grid G and the filament F inside the valve.

A NOVEL TEST LAMP

A RATHER interesting device which should interest beginners and which may prevent the burning out of a valve is shown in the accompanying photograph.

The idea of the device is to fit it into the two valve sockets provided for the filament pins on the valve and to see whether the circuit is correct before placing the valve in position. It not infrequently happens that when a beginner is trying his circuit there is a sudden flash and 15s. has disappeared. The device here illustrated will result in a small flash lamp being burnt out if there is anything wrong with the circuit.

The whole arrangement may be made for a little over a shilling, and only uses parts which may be bought at any wireless dealers.

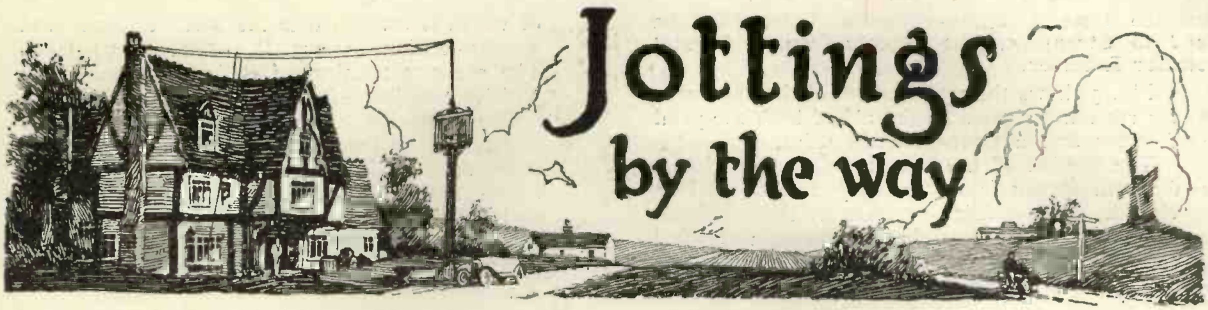


The test lamp with its mounting.

The two valve pins shown are mounted on a piece of ebonite ¼in. thick, 1in. by 2in. long. The distance between the plugs is such that they will fit into the filament sockets in the valve-holder.

An ordinary flash-lamp holder is fixed to the ebonite base on one side by the nut securing one of the plugs, and on the other side by by a small nut and bolt. The connection to one of the plugs is thereby affected, while the other connection is made by taking a lead from the screw F on the lamp holder to the upper nut of the other plug.

A device of this kind has many other applications. For example, it might be used as a fuse to be connected in series with the high-tension battery.



Valve of the Future.

THE low-temperature valve is gaining rapidly in popularity, and if any maker could put one on the market at a moderate price, say £1, he would, I believe, capture nearly all the trade. Though it is a vast improvement upon the ordinary type as regards comparative efficiency, we cannot look upon even the low-temperature valve as the last word. The E.M.F. required on the filament runs from 1½ to 3 volts according to type, and there are valves that consume no more than one-tenth of an ampere in the way of current, but we must regard these figures, remarkable though they now seem, merely as indications of what the valve of the future will be like. Inventors are hot on the trail of a filament that will emit when cold or nearly so. Once they have found it, and find it they surely will, we shall have valves whose filaments are heated to so low a temperature that not even a red glow will be visible. Probably some slight energising current will be necessary, but this will be of the kind that a single small dry cell can supply.

Another direction in which considerable progress has already been made is in the reduction of the anode potentials necessary for efficient reception. A valve is made to-day which works quite well with only 15 volts on the plate, and readable signals can be obtained with as little as 10 volts.

The "Distance Itch."

The oscillation fiend continues in his wickedness providing nightly a series of farmyard imitations that are not in the Broadcasting Company's programmes. At times his activities are so poisonous that one switches off in despair. Reradiation, or rather the finding of some means of putting an end to it, is one of the problems of wireless to-day. Conditions are very bad in some places, and what they will be like next autumn, when we may reasonably expect the number of owners of sets to have doubled, one hesitates to imagine.

The cause of about nine-tenths of the trouble is, I think, what the Americans poetically term the "itch for distance." You have—no, no, some other fellow has, let us say, for you, no doubt, lead a blameless life with never a shiver of oscillation—he has, then, a single valve set of which he is inordinately proud.

Several of his friends have similar sets and similar feelings about them. They meet; they talk. You may imagine what they say. The spirit of emulation is roused in their breasts, and each and every one of them sets himself the task of obtaining receptions that will make the others blush for very shame.

The net result is that the whole coterie indulges in an orgy of reaction, using large coils coupled as tightly to the A.T.I. as the ivy is to the oak, and pushing up the pointer of the reaction condenser to its very limit. This is not wireless, for there is no merit in receiving distorted transmissions, even though they come from vast distances. The true art is to obtain perfect reception free from any sign of "woolliness."

Therefore, if a fellow has but one valve he should not strain to achieve the impossible, but should concentrate rather upon making it a thoroughly efficient receiver of stations within its range. If the "distance itch" persists try one of the new super-regenerative circuits and use a frame aerial until you have obtained thorough control of it.

Gramophonics.

One often hears levelled at wireless the criticism that its receptions are "gramophony," and in, perhaps, the majority of cases such comment is fair and just. Many people make a fetish of mere noise and are not satisfied until their loud-speakers belch forth a raucous, discordant, ear-splitting medley of distorted sound. You can get as much noise as would satisfy even a nigger camp meeting, merely by piling note-magnifier on note-magnifier; but it won't be nice noise; in fact, if produced in the neighbourhood of the oyster's breeding grounds during these R-less months, it would, I imagine, seriously annoy the mollusc, since, as everyone knows, a noisy noise is anathema to him.

Now the wireless set should not be gramophony. If it is there is something wrong with it. It may be that one of the H.F. amplifiers is oscillating; it may be that the rectifier is not working on the proper portion of its curve; it may be that the note-magnifier is calling for an extra dry cell or two to supply a negative potential and suppress grid current. The fault may lie in the L.F. transformer, or it may be found in the loud-speaker itself.

Wherever it has its secret lurking place there *is* a fault, and your real enthusiast will arm himself with pliers and screw-drivers and other implements of his craft, resting not until he has found it and corrected it. Hasty men with ultra-musical ears have been known to adopt swifter methods with a sledge hammer.

"Soft Sawder."

In your early days you were no doubt lured on by articles written by criminal optimists such as myself, which described the utter simplicity of soldering. "This," said you, "is child's play. I will no longer pay out good money to the cycle shop for the joining together of this and that. I will provide myself with a trusty soldering iron and will accomplish my own jobs!"

You bought the iron and a thick stick of solder, also some horrible messy compound which had to be smeared over the joint-to-be as a preliminary to operations. And then the solder wouldn't run, or if it ran it wouldn't stick; and when you tried to attach a wire to the end of a terminal that projected through a panel the ebonite around it straightway began to dissolve into a loathsome stickiness.

Probably you hurled the iron through the window or used it thereafter as a poker or a case-opener, and expressed your opinion in no polite terms of those who said that soldering was easy. At the risk of driving you to further frenzy I repeat that it is, but not if you use the solder that comes in fat sticks. This has too high a melting point for wireless purposes. Buy some thin blow-pipe solder, and I venture to predict that you will reinstate the soldering iron in its place of honour, no longer regarding it as a villainous implement that no decent man can handle without loss of self-respect.

Spaghetti.

People have been puzzled over the advertisements that appear in American wireless papers offering unlimited quantities of spaghetti for sale. Some have concluded that wireless enthusiasts in the New World have decided to pay homage to Senatore Marconi by making the national dish of his country their staple article of diet. A beautiful and touching thought, but unfortunately Uncle Sam's "radio fans" have no such fine intentions.

"Spaghetti" is, with them, wireless slang for the insulated rubber sleeving, which we prosaically term systoflex. The name has, however, been responsible for one of those little episodes that come as gleams of sunshine in a dull world. One constructor did actually insulate his entire set with genuine macaroni, spending hours in threading wires through its tortuous lengths, and then sent an S.O.S. letter to brighten the otherwise monotonous lot of an editor. Possibly it was the same optimist who, living in a thirty-fourth-floor flat, buried his earth in a window box.

Youthful Experts.

One of the most curious points about wireless is the avidity with which schoolboys have swallowed every fact in connection with the new science. Years ago, when wireless was unthought of, such things as ohms, amperes, and microfarads aroused the same feelings of bored disgust in the boy's breast as did Euclid's strange thirst for constructing complicated designs, or the eccentricities of Greek irregular verbs. Now all is changed. Mention such a topic as eddy-currents in the hearing of a schoolboy and he will bombard you with eager questions until he has profited by all your knowledge—or exposed your lack of it.

Wireless owes much of its popularity to the youngsters. Their staid parents, having read something about its possibilities, invested a shilling or so in a handbook, but gave it up as a bad job after looking through the illustrations and seeing that they were full of mysterious curls and zig-zags and things with arrows shot through them like hearts after a visit from Cupid.

But the schoolboy reads, and having read imparts the fruits of his knowledge in simple language to his parents. Then, when he had explained everything, paterfamilias fared forth and bought a set, or provided little Willie with the necessary parts for the making of one. Now Willie has taught his sire so well and so truly that he is capable of operating the set all by himself and even of dealing with it when it jibs, though the youngster has gone back to school and is no longer there as a present help in time of trouble.

They Know.

But seriously, the degree of knowledge attained by some boys is remarkable. I had a visit a few days ago from a sixteen-year-old who is making—and making jolly well—a five-valve set. He was not quite sure which form of high-frequency amplification to adopt, so he came to ask if he might test various kinds on my experimental set.

He knew the subject really well, and when it came to handling the set he took to it as a duck takes to water. The designs which he showed me were first-rate; everything had been calculated out to a nicety, and the result when the job is finished will be a set fit to take its place besides most of those constructed by people of maturer years and far wider experience.

It's rather hard lines, don't you think, that such a youngster, and he's only one of thousands, can't legally hold any form of receiving licence until he is twenty-one years of age.

But These Don't.

Quite a different sort of "expert" is the fellow who, last month selling tripe or engaged as a sartorial artist, is now in business as an authority on wireless. You know the sort of man I mean. He will erect your aerial (probably minus insulators), install your set, and give you advice when it goes wrong. He knows little or nothing about the job, and, despite his assurance, he is a man to beware of.

A friend of mine who has had trouble with his set recently confided it to the ministrations of one of these, who, after getting the wiring into the most appalling mess, sent it back saying that he could do nothing with it as it had apparently been struck by lightning! The underside of the panel looked far more as if a madman had been having a game of cat's cradle with the wires.

Be careful, too, how you buy high-tension batteries from these people. They have an engaging little way of using them for long periods for demonstration purposes and then putting them back on the shelves for sale as new goods. Personally, I can't think why the makers don't adopt for H.T. batteries a paper seal like that used for pocket flash-lamp batteries.

A New Game.

One writer I notice has been recommending wireless hare and hounds as a new pastime. The hare rides in a sidecar and transmits little messages of encouragement or defiance on a pre-arranged wavelength whilst the hounds follow on motor bikes, cars, donkey carts and what-not fitted with receiving sets. I suggest as an alternative the game of Hunt the Squealer played with direction-finders during broadcasting hours. On being run to earth the culprit is, of course, clubbed to death. His aerial neatly coiled up is awarded as a trophy to the first hound home. *I* would like to play that game!

WIRELESS WAYFARER.

Magnetism & Electricity

By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART VI

(Continued from No. 5, page 284.)

Dielectric Constant or Specific Inductive Capacity.

IT has been stated that the capacity of a condenser depends, amongst other things, upon the nature of the insulating material between the plates. If in a simple condenser a slab of (say) paraffin wax be inserted between the plates, the capacity of the condenser will be increased. The property of an insulating material upon which depends its power of affecting the capacity of a condenser in which it is used as the insulating medium is called its "specific inductive capacity." As the insulating medium between the plates is sometimes called the "dielectric," another name for the specific inductive capacity is the "dielectric constant." Since a condenser has a greater capacity when the dielectric is paraffin wax than when the dielectric is air, we say that the specific inductive capacity (or dielectric constant) of paraffin wax is greater than that of air. The specific inductive capacities of various insulating substances differ very considerably.

There are many other interesting matters connected with electrostatics which may perhaps be described on some other occasion, but for the present, as this Course is intended to prepare the reader for the study of wireless, I will only deal with those which are of most direct utility in that connection. Some of the subjects which are here treated in an elementary way will be dealt with in greater detail in a course of "Principles of Wireless" in this journal.

The fundamental principle underlying the production of wireless waves illustrates in a striking way the identity of static and current electricity. For, as the reader will find later, the "wireless transmitter" consists essentially of a condenser whose plates are connected together by means of a conducting wire. The charge upon one plate flows along the wire to the other plate, and whilst the flow is taking place the electrostatic charge appears as current electricity in the wire. Under special conditions, the charge overshoots itself, as it were, and stores itself up on the opposite plate of the condenser, so charging the condenser the opposite way round: whilst this is taking place, the current electricity is re-appearing as electrostatic charge. The reverse action then sets in and the charge begins to flow back along the wire to the first plate, and so on. It is because this arrangement, which is fundamental in wireless transmission and reception, has, as it were, one foot in the domain of "electrostatics" and the other in that of "current electricity," that I have specially emphasised the identity of electricity, whether it be in motion or at rest. Remember that potential difference has just the same meaning when applied to the terminals of the electric light mains as when applied to two oppositely charged spheres; that the resistance of a conductor is the same property whether it be involved in the passage of a current through the filament of an electric lamp or the discharge of a body by touching it with the finger; and that the electric current which flows from a "frictional machine" is the same as that which flows from an electrical accumulator. There may be differences in the *strength* of the current, and in some cases the current is *maintained*, whilst in others it falls to zero as the electrification is discharged, but these are merely incidental circumstances and do not affect the identity of its nature.

Lightning Conductors.

Under some circumstances a cloud may become electrically charged to a very high potential (as compared with the zero potential of the earth), and if such a charged cloud drifts into the vicinity of an elevated conductor, such as a church spire or a wireless aerial, a discharge may take place through the conductor, the electrification on the cloud escaping into the earth so as to equalise the potentials of the two bodies—the cloud and the earth. Owing to its large dimensions, the cloud may possess considerable electrical capacity, and if it is at a high potential, the quantity of electricity stored upon it may be very great. When the discharge commences to take place, the current which flows probably depends upon the potential difference and the resistance of the conductor. In the case of a church spire the resistance may be very large, but it must be remembered that the potential of the cloud may be extremely high (many hundred-thousand volts). Once the discharge commences, the heating effect may diminish the resistance of the electrical path to the earth (which then probably includes the *air* in the vicinity), and a current will flow of short duration but of enormous ampere-strength. The heat produced by this current is very great, and as it is evolved in an extremely short space of time, the material of the conductor as well as the air in the vicinity may expand with explosive rapidity and violence.* In order to obviate such disruptive discharge, it is usual to protect elevated projections such as towers, spires, etc., by attaching to them strips of high-conductivity copper with a number of sharp points at the upper extremity, the lower end of the strip being deeply embedded in the earth. Such a strip is known as a lightning conductor, and provides an easy path for the discharge to earth. In a wireless aerial it is desirable to have an arrangement for enabling a lightning discharge to travel direct to earth, so that damage to the indoor apparatus may be averted.

ELECTROSTATIC INDUCTION

NOT only do two oppositely charged bodies attract one another, but a charged body may attract an uncharged body. At first sight it appears that these are two separate phenomena, but in reality they are of the same nature in both cases. For when an uncharged body is brought into the vicinity of a charged body, a separation of electrification upon the uncharged body takes place, and electrification exhibits itself upon the body in the regions nearest to, and remote from, the original charged body. Fig. 1 indicates the conditions under consideration. The electrification in the region C will be of the opposite sign to that of A, and the electrification in the

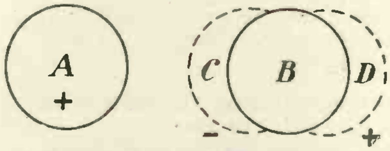


Fig. 1.—Showing induced charges C, D produced on uncharged body B by presence of charged body A.

region of D will be of the same sign as that of A. This effect is known as "electrostatic induction," for the two charges on B have been *induced* by the presence of the charge on A and they are only evidenced so long as A is present. It should be noted that there is no *free* charge created upon B, for the two induced charges which are temporarily called into evidence are equal in amount and opposite in sign.

Law of Inverse Squares

Two opposite electric charges attract one another with a force which is inversely proportional to the square of the distance between them; thus the attraction when they are separated by a distance of 2ft. will be one-quarter of the attraction when their distance apart is 1ft.; if they are separated by a distance of 3ft., the attractive force between them will be one-ninth, and so on.

Returning to the bodies A and B in Fig. 1, it will be seen that the distance between the charges on A and C is less than the distance between the charges on A and D. Therefore, the *attractive* force between the charges A and C will be greater than the *repulsive* force between the charges A and D (these latter charges are of the same sign, and therefore repel one another). The net result is that, owing to the induced charges upon B, there is a *resultant attractive force* between the bodies A and B.

Thus it is clear that the attraction between a charged and an uncharged body is really the same in nature as the attraction between two charged bodies, because the uncharged body in the vicinity of a charged body has an electric charge induced upon it and the conditions are then similar to those of two charged bodies. The attraction, in fact, is preceded by induction.

Lines of Electric Force

The electrostatic force between two charged bodies consists really of a strain in the invisible medium called "the ether." It will be impossible to say much about the ether at present, although more will be said on that subject elsewhere. We may remark, however, that the ether is supposed to be an invisible, intangible medium which exists in and through all matter and all space. Electrostatic, magnetic, and many other effects are best considered as being manifestations of disturbances in this invisible ether medium.

Imagine two equal oppositely-charged spheres as shown in Fig. 2, A being positive and B negative, and suppose we had a tiny body, say the size of a pin's head, with a small positive charge upon it (both the body and the charge which it carries being so small that they did not disturb the electric field between A and B) and we could release the small particle at the point P_1 on the surface of A. Owing to its positive

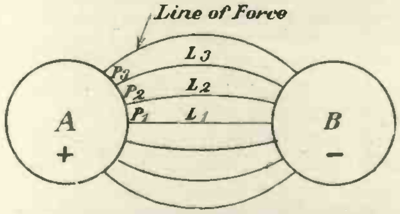


Fig. 2.—Showing direction in which minute positive charge would travel towards B if starting from various points on A.

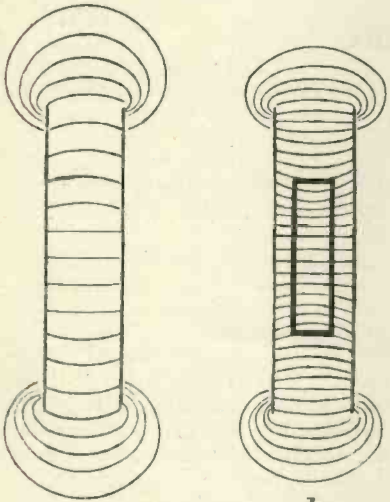
charge, it would be repelled from A and attracted to B, and it would follow a path from A to B along the line L_1. If, however, it were released at the point P_2, it would not now follow a straight path towards B, but would travel along the line L_2.† If it started from the point P_3, it would travel along the line L_3 and so on. Thus the lines drawn in Fig. 2 indicate, at each point, the direction of the electrostatic force existing in the ether, due to the two charged bodies. These imaginary lines are called "lines of electric force." In the figure only certain

* The mechanism of a disruptive lightning discharge is very complicated, but the above is a simple description of what happens. It is probable that in many cases the discharge is oscillatory, and therefore the resistance offered by a conductor is greater than its ohmic resistance owing to the "skin-effect." This is the reason for making a lightning conductor in the form of a flat strip rather than of circular cross section.

† It is assumed that it travels slowly, so that it does not "fly off at a tangent."

individual paths have been indicated, but it will be understood that we could draw an infinite number of lines from an infinite number of points on the surface of A, ending upon the surface of B.

The conception of these lines of force is due to Faraday, and is ex-



a b

Fig. 3.—(a) Lines of force between plates of charged condenser. (b) Effect produced by introducing paraffin-wax slab.

tremely useful in enabling us to form a mental picture of the character and properties of an electric field. It is convenient, for example, in the diagrammatic representation of an electric field, to indicate an intense field by crowded lines of force, and a weak field by just a few lines.

Lines of Force in Dielectric

A good example of this may be given by considering the effect of a slab of paraffin wax inserted between the plates of a condenser, as mentioned in a previous article. If the two plates are separated by air, and a charge is given to one plate, the lines of force will be somewhat as represented in Fig. 3a. It is convenient to regard each line of force as being in a state of tension and to imagine, further, that the lines of force repel one another. In a substance such as paraffin wax, whose dielectric constant is greater than unity, the mutual repulsion between the lines of force is less than in air; consequently, when a slab of paraffin wax is inserted between the plates of a condenser, the lines of force are more readily crowded together in the region between the plates (Fig. 3b), and the electrostatic capacity of the system is increased.

Magnetism

The reader will be already familiar with the simple facts of magnetism, the attraction of *unlike* magnetic poles and the repulsion of *like* magnetic poles. Magnetic force, like electric force, is a manifestation of ether-strain, and many of the above remarks apply, in a general way, to magnetic effects. If a piece of magnetisable but unmagnetised material, such as soft iron, is brought into the vicinity of a permanent magnet, such as a magnetised steel bar, the attraction between the two is preceded by the *induction* of magnetism in the soft iron. The attraction, therefore, is as between two magnets and not as between a magnet and an unmagnetised body.

Lines of Magnetic Force

The magnetic field existing between two poles may be diagrammatically indicated in a similar manner to that which has been described for an electrostatic field. Thus, in Fig. 4, a magnetic field exists between the poles of a bar magnet and is indicated somewhat as shown by the lines. The strength of a magnetic field is conveniently referred to as the "number of lines of force" passing

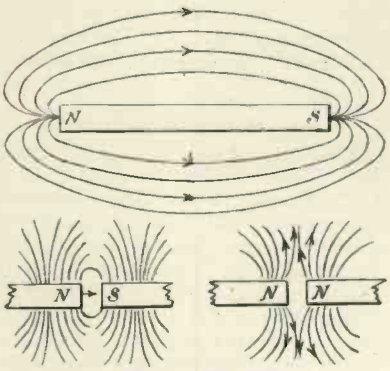


Fig. 4.—Showing disposition of magnetic lines of force in various cases.

through the region under consideration.

Perhaps the reader may feel that the existence of these lines of force is very imaginary and that the conception of the shape or distribution of the field of force is somewhat speculative. But in the case of a magnet, a very simple experiment may be made to demonstrate that the idea is correct. For if a magnet is laid upon a piece of cardboard, and iron filings are distributed upon the surface of the cardboard round about the magnet and the cardboard then gently tapped, the filings will set themselves in definite directions under the influ-

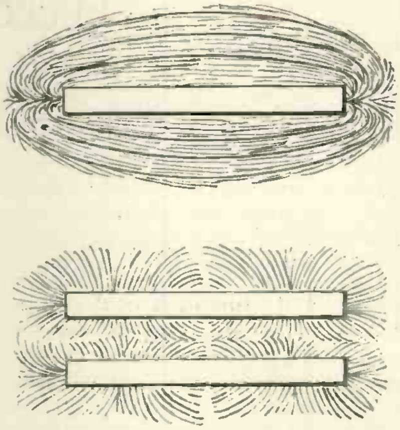


Fig. 5.—Magnetic fields as mapped out by iron filings.

ence of the magnetic field. It will then be found that the field as mapped out by the filings themselves will be as shown in Fig. 5, which is a striking verification of the theory.

Concentrating Magnetic Lines of Force

Magnetic lines of force appear to repel one another, just as electric lines of force, and the degree of this repulsion depends upon the nature of the substance in which the magnetic field exists. In the so-called magnetic substances, such as iron, the mutual repulsion between magnetic lines of force is very much less than in air. If a piece of iron be introduced into a magnetic field most of the lines of magnetic force will forsake the air region and will crowd together into the iron, or, in other words, the field will be largely concentrated in the iron. This is expressed by saying that iron is more "permeable" to magnetic lines of force than air, or that the "magnetic permeability" of iron is greater than that of air Various substances differ considerably in their magnetic permeability, but, generally speaking, the permeability of the so-called magnetic substances (iron, steel, nickel, etc.) is enormously greater than that of other substances.

A UNIVERSAL TUNER

By A. JOHNSON.

A useful article for the experimenter, describing a complete tuner which may be used for all possible purposes.

WHILST all the technical journals dealing with radio are full of descriptions and designs of detectors, valve panels, amplifiers, etc., very little appears about tuners. The writer, after being content for years with loose coils, baskets, slabs, condensers, etc., finally decided that some more definite and precise means of tuning was essential, and the following was the result.

First, a mahogany box of the size shown in Fig. 1 was procured. It was at first decided to fit an ebonite panel to take the place of the front of the box, but on taking into account that this part had to carry only the condensers and change-over switches the idea was given up. The writer's home-made condensers are built up on $\frac{1}{2}$-inch ebonite sheet, and the only metal passing through this is the $\frac{1}{4}$-inch spindle for the rotating vanes. The positions for these spindles were marked off on front of box, taking care to provide plenty of clearance when the condensers were fixed inside; $1\frac{1}{4}$-inch diameter holes were then put through the front for the spindles, thus keeping them well away from any woodwork. The ebonite top plates of condensers were then fixed with four brass bolts and nuts to the inside of the front of the box, the spindles projecting through the centre of the $1\frac{1}{4}$-inch holes; and no other metal work was therefore near any part of the wooden box.

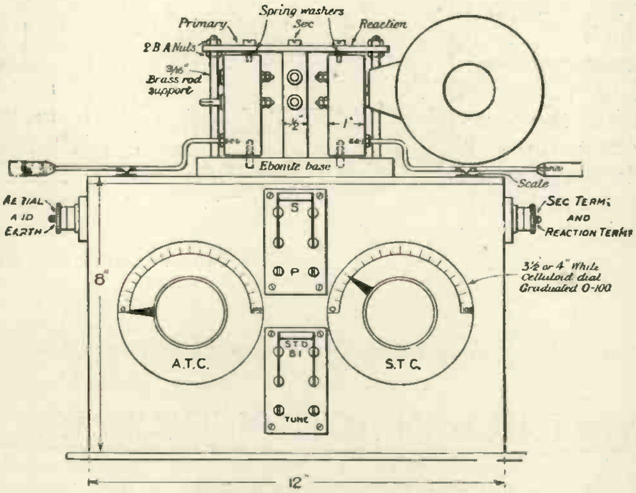


Fig. 1.—Front view of tuner.

In some cases it might not be quite so simple to fix the condensers available in the required position, still a little scheming would probably get over the trouble.

Two discs 4 inches in diameter were next cut from glossy white (opaque) celluloid, and as the condensers were 0.001 μF capacity, the half circle was divided into 100 parts; that is, every five divisions was indicated and tens numbered.

The divisions and numbers were scratched on the celluloid with a sharp scriber and filled up with Indian ink. It will be found that this will only take where the glossy surface has been destroyed by scratching.

Holes were made just large enough to clear the condenser-spindles in the centre of each disc, and finally the discs were screwed to the front of the box with small round-headed brass screws. Extra large ebonite knobs and black enamelled pointers were fitted to each condenser. The aerial condenser "series-parallel" and "stand by-tune" switches were already mounted on ebonite, so these were fixed in the positions indicated, after marking off and cutting away the woodwork underneath the ebonite base by means of a $\frac{7}{8}$in. centre bit. This type of change-over switch was chosen because it was simple, reliable, and has all contacts, etc., in full view; further, it would appear to have much less capacity effect than most of the more complicated kinds.

A three-coil holder was next made up from odds and ends of brass and ebonite to the design shown in Fig. 1. This, of course, may be purchased, if the experimenter so desires.

The whole job is simple and straightforward if the reader desires to build the holder himself, and is shown in sufficient detail in the figures. Care should be taken that the pivot screws at top on which holders turn do not come in contact with the sockets underneath.

A small brass pointer was soldered to the long operating rods, and scales, cut out of glossy celluloid, fixed after being graduated in the positions shown in Fig. 2. Six holes were bored through the wood top of case and bushed with small porcelain collets to allow

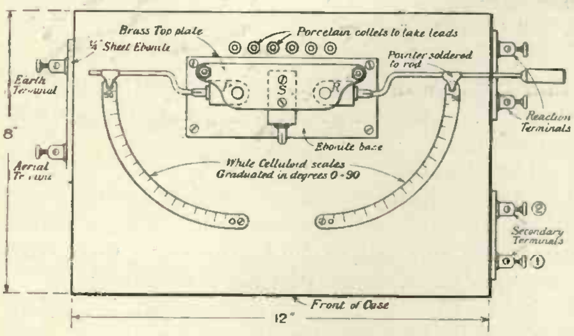


Fig. 2.—Plan of tuner.

the various leads to pass inside and provide good insulation.

Ebonite terminal plates were fixed in the positions shown for aerial, earth, reaction, and secondary. The wood was again cut away from under each terminal hole as before.

The wiring is shown in Fig. 3, and should be carried out with 18 s.w.g. tinned copper wire, except, of course, the wires which lead up through lid of box to the movable coil holders. These should be vulcanised rubber lighting flex with the braid removed. Sufficient slack must be allowed in these flexible leads to enable the holders to move through the required distance without becoming taut.

This completes the construction, but a few words with regard to its use may help to justify the title. The design, or a modification of it, should appeal to the out-and-out experimenter, as he probably possesses all the parts, and the arrangement allows of any circuit being used—direct or loose coupled, with or without reaction, any type of coil, plain single layer for short waves, slab, basket, Burndept type, honeycomb, etc., etc., so long as coil mounts can be fitted. It will give excellent results with crystal, single valve, or amplifier. (The reaction coil, of course, is not used when receiving on simple crystal.) It will cover all wavelengths by simply plugging in suitable coils.

The beginner with a crystal will find it fairly simple and much more reliable than the old type slider coil or pushing one slab coil over another laid flat on the table, which he is so often advised to do.

Practically all the parts may be purchased ready made, and only need assembling in and on the case if desired. It has the further advantage that all adjustments may be recorded and results duplicated.

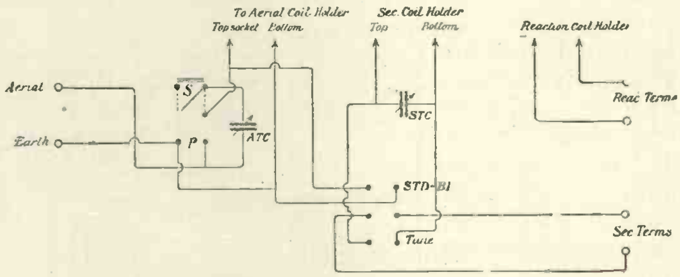


Fig. 3.—Circuit diagram of tuner.

COPPER WIRE

By GEO. SUTTON.

An article which gives the wireless enthusiast an insight into the manufacture of the most important components of his apparatus.

ALTHOUGH it may seem paradoxical, it is a fact that the only thing really indispensable in the practice of wireless is wire.

You may substitute ebonite by wood, cardboard, or even warmed-up old gramophone records; make valves from "conked out" motor lamps, and use a bit of coke for a crystal; but it is no good stiffening a bit of thread with shellac varnish and thinking that you will get electrical impulses along that way.

An aerial may be run round the garden, round the attic, round the kitchen, round a picture frame, or even round itself, and still operate, but it must be copper wire.

The tuning inductance may be round, spherical, cubical, oblong, pancake or honeycomb coils, but it cannot be anything other than wire.

Yet there are very few people, even among those who use the material most, or those whose living depends on copper wire, who realise how delicate is the material with which they work.

They may have an idea that copper wire must be of great purity to be useful, but how much or how little foreign matter will render it useless they do not know.

Copper ore is associated with nearly every conceivable foreign element.

It will enter into the closest alliance with many very undesirable companions. Not even fire will cleanse it, as it would become contaminated with the products of the purifying flames, and may come out of the furnace worse than it went in.

As a kind of reciprocation of ideas, copper is used to conduct electricity, and electricity is the only means usable for making copper conduct itself at all in the way it should.

Copper of a purity at all acceptable for electrical work has to be refined by electrolytic means; that is, the electrical current, in passing between the electrodes in a copper solution bath, tears out the pure copper from amongst its gross comrades at the "anode," and deposits it as fine metal at the "cathode" of this refinery.

The standard of purity of the copper, taken from the cathode deposited mass, will be of the order of 99.98 or 99.99 per cent. pure, and after being re-smelted may fall as low as 99.96 per cent. pure.

An analysis of a melt may be:—

Pure copper	99.9600
Oxygen	.0200
Silver	.0100
Sulphur	.0030
Arsenic	.0015
Antimony	.0020
Nickel	.0015
Iron	.0020

To take one impurity only as an example.

Arsenic as a poison has been found in nearly everything nowadays, but associated with copper it has a very deleterious effect.

A convenient method of expressing the specific purity of copper is by percentage conductivity; that is, an arbitrary standard is set up: a copper wire of certain dimensions has to be able to carry a certain specified current with a certain loss owing to resistance, and a high electrical purity is stated as 100 per cent. conductivity.

It is not unusual to find copper upon test to give a higher conductivity than this, and this fact exemplifies the unwisdom of setting oneself too low a standard of perfection.

If arsenic is present to the extent of .001 per cent. it alters this percentage conductivity very little. The copper may still show 100 per cent. conductivity.

If arsenic is present to the extent of .01 per cent. it reduces the conductivity of the copper to 97.6 per cent.; while if the amount of contained arsenic is .1 per cent. the conductivity is reduced to 76.2 per cent.

Copper of slightly above the high standard of purity of 100 per cent. conductivity is imported from the United States and from Australia in bars, about 3ft. 6in. long, pointed at each end, and about 3½in. square, each ingot weighing about 140lb.

After being satisfied, by test, that the metal is up to standard, the ingots are put into a muffle furnace, where they are brought up to a bright red heat, and then seized by tongs and passed on to the rolls.

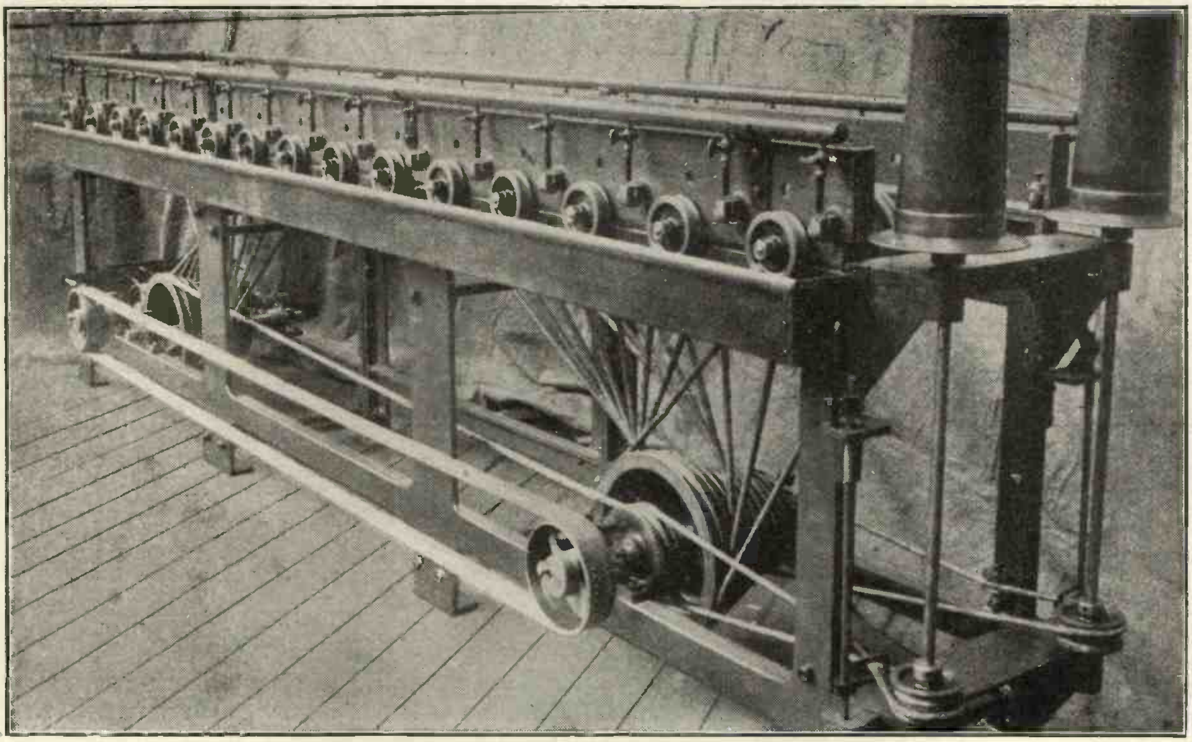


Fig. 1.—The wire-drawing machine. Small gauge wires are drawn through dies formed of diamonds.

The rolls are built up of three polished steel rollers pivoted between massive standards and driven at a uniform speed.

The middle roller has grooves corresponding with those above and beneath it. The red-hot ingot is passed between the two top rollers where two V-shaped grooves correspond, and these reduce the section of the ingot.

Without turning it round, end for end, the ingot is fed back between two grooves which coincide in the middle and bottom rollers, which still further reduces it, and here is seen the necessity for pointing the ingot at each end.

This first battery of rollers is called the "roughing" rollers, and the ingot is ejected from the last pair of grooves, longer and thinner, the 15in. rolls revolving at the rate of about 100 revolutions per minute.

Still red-hot, the attenuated ingot is seized by means of tongs and dragged across the polished steel floor to the intermediate rollers, where it begins to take on a more snaky form.

Here it takes seven passes backwards and forwards through the rolls, which in this case are 12in. in diameter and make 200 revolutions per minute.

It is then passed along the steel floor to the finishing rollers, which are revolving at the rate of 400 per minute, where there is also one "tonger" on each side of the mill.

One of these dexterously seizes the red-hot rod as it emerges towards him, and, using his feet as a pivot, turns completely round, throwing out the loop on the floor; he then reinserts the point into the rolls on its next squeeze down.

So that now the poor rod is catching the squeeze in two places at once.

The loop in between, while straggling over the floor, is looked after by boys, each armed with steel hooks, to see that no kinks occur in the rod in its swift course, and enters the rolls concentrically, else "fins" would be made on one side or the other of the rod and render it useless for further attempts to make it round.

This is work which needs a considerable amount of training, and when dexterously performed is very exciting to watch.

With separate gangs going at the roughing, the intermediate and the finishing rolls, the work is continuous, but so exacting that two men out of three work while one stands off to rest awhile before taking his next turn.

The copper emerges from the finishing rolls as a quarter-inch rod, which is coiled up on an iron frame, from which it is taken, bound in a coil, to the pickling vats, where the scale and oxide acquired during the rolling stages are dissolved off in strong acids.

According to its subsequent destined use, the treatment is now slightly varied.

If the wire is to be of a fairly large size, say No. 16 s.w.g., or thereabouts, it is threaded up in a wire-drawing machine where there are nine holes in chilled iron dies, each hole smaller than the preceding one, and all arranged in tandem with a tractor drum in between each. The rod, going in at one end of the machine, emerges at the other as No. 16 wire.

It is then annealed, as the rough treatment of cold-drawing has hardened it and made it short tempered.

The annealing is done in a Bates & Peard muffle, which, originating at Prescot in Lancashire, where its inventors still use it, has become the standard method of annealing bright copper wire.

This machine deserves a word to itself.

A chain conveyor driven slowly by means of worm gearing conveys the coils on the top of the chain rollers down into a water tank, the water in which forms the seal preventing free oxygen getting into the muffle furnace further on, and also providing some of the water-vapour with which the furnace is charged, to the exclusion of ordinary air.

If air came into contact with the heated copper wire it would blacken and disfigure it, or even cause it to form a hard scale on the surface, rendering it useless.

Coming up on the chain out of the water into the interior of the furnace, the coils of copper wire soon get red hot.

This heat is maintained in the steam-laden atmosphere till the iron band conveys the wire down into another similar water-tank at the other end of the machine, where the heat is quenched out, and the coils, rising again on the chain at the far end beyond the furnace, are as bright on the surface as when they went into the furnace. But they have been made quite soft and ductile again, suitable for instant use as soft copper wire, or to go on to a further stage of drawing down.

The little blocks on the upright board of a multiple-die wire-drawing machine (Fig. 1) hold the dies under the pipes which carry a stream of lubricating soap and water to keep down the heat of friction and prevent the wire from tearing and pinning up, and so blocking the diamond holes.

You could not, of course, pull the wire through sixteen dies all at once; it would break. So a tractor drum is fitted between each pair of dies to exert its separate pull on the wire and act as the puller on the rope in a tug-of-war game.

In the bench underneath the machine is the gearing of belts which makes the tractor drums revolve faster as the wire gets smaller and longer, as it obviously cannot travel at the same speed all through the machine.

Wires smaller than .080, or No. 14 s.w.g., are diamond drawn—that is, a hole is drilled in a diamond, and polished inside, forming a die which determines the size of the wire drawn through it.

The diamonds for No. 14 s.w.g. wire average about ten carats in weight, and are set in a brass collar inside a steel block. Smaller diamonds are used for smaller sizes of wire, as little as one-eighth of a carat sufficing for wires of the No. 50 s.w.g. range.

Even diamonds wear away with the friction of the soft copper rushing through them, and rarely wear round in the hole, so that they are continually being taken out of the wire-drawing machine for attention by the lapidary.

The automatic machines for drilling and polishing these diamond dies deserve a volume to themselves, they are so delicate and ingenious. A staff of jewellers is kept whose sole duty is diamond die repairing.

The end of an old diamond is to form dust for polishing new stones.

In copper products there is a great deal of waste and scrap metal produced at various stages.

It is always necessary, in starting to roll, or draw down, a bar or rod that the starting end threaded into the machine should be reduced in size in order to enter the rollers or drawing-down die. This is done roughly by swaging or rolling, as filing or hammering would be much too slow and wasteful of material. In any case these rough ends have to be trimmed off.

There is a corner in the factory where these odds and ends of wire and other scrap are shovelled into the container of a hydraulic press, and squeezed into the smallest compass possible.

The bales of scrap so produced are built into the interior of a remelting furnace and reduced to a molten state for pouring into ingot moulds and restarting their factory life again.

While the charge is still molten, at the bottom of the furnace, long poles of thick

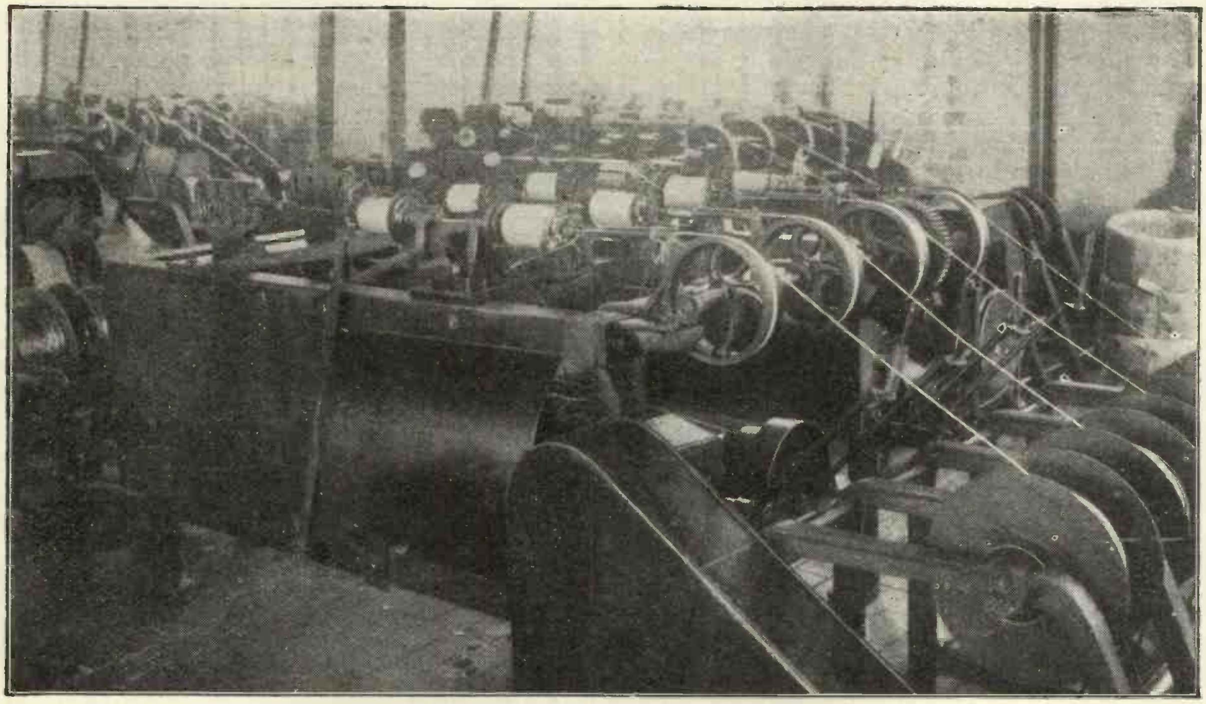


Fig. 2.—Machinery for double-cotton-covering heavy gauge copper wires.

green timber or cordwood are thrust into the mass, and the steam and other vapours burnt from the green wood rise through the melt and, combining with the occluded gases in the copper, come out in bubbles at the surface. It is quite easy to overdo this operation, and the charge has to be reoxygenated by forcing air into it again.

The expert responsible for the amount of this "poling" has a "copper sense," that is, a kind of instinct, for what he does. He could probably not explain why, but he knows that he is right because he is right.

He also makes a little button of the metal, by dipping a small charge out of the furnace with a long-handled ladle, and, fixing it in a vice, after nicking it with a chisel, breaks off the end with a sideways blow with a hammer, then examines the fracture and confirms his judgment.

In any case, the copper has to possess certain physical properties as well as those indispensable electrical ones, and an expert can tell whether the metal has been poured at the right heat and at the proper time by examination of the top surface, which has cooled in contact with the air at the top of the mould. A charge of this remelting furnace weighs about fifteen tons, so that any mistake might be pretty costly to the firm.

Fig. 2 shows a machine for double-cotton-covering heavy gauge copper wires for motor or dynamo or transformer winding. The bobbin of bare wire in front of the machine may easily hold over a hundredweight of copper (Fig. 1), and the two "cops" of cotton wind the two threads on the wire in opposite directions in one passage through the machine. The drum in front of the picture "takes up" the wire as it is covered.

Not all wires are drawn round. A great deal of flat and other-sectioned strip is also produced.

Copper electric light or power cable making machinery has to be very massive to stand the live loads and resist the centrifugal forces exerted by tons of copper wire or strip, revolving at a high rate of speed during manufacture.

The writer is indebted to the courtesy of the British Insulated and Helsby Cable Co. for facts, figures, and photographs.

THE situation of the South Coast Broadcasting station has now been decided upon. It is to be at Bournemouth, and the B.B.C. are now only awaiting the formal sanction of the Post Office authorities before going ahead with the work. If no delay occurs in granting the necessary permission, it is hoped to have the station in operation in about three or four weeks' time.

* * *

On Sunday last all the broadcasting stations were linked together by land-lines for experimental purposes. It was desired to ascertain whether items rendered in London could satisfactorily be radiated from all of the stations simultaneously. If successful, it is intended to adopt the scheme on the occasion of the Prince of Wales's speech to the British Legion at the Queen's Hall, London, on Whit-Sunday. We regret to learn that up to the time of going to press, the proposal to broadcast this important event is in abeyance owing to the action of the entertainment managers, but we hope that an agreement will be arrived at in time to permit an event which will do so much to reinstate broadcasting in public opinion, to take place.

* * *

A report has been received at Amsterdam that the high power wireless station at Malaba, in the Dutch East Indies, has been seriously damaged by lightning. A new wireless service with Holland was to have been commenced from this station.

* * *

We are pleased to be able to report that the broadcast appeal of Princess Alice, Duchess of Athlone, whose photograph appeared in our last issue, appears to have evoked a satisfactory response. The appeal, it will be remembered, was on behalf of the National Children's Adoption Society of Sloane Street, London.

* * *

Our readers who jazz will doubtless disagree with the optimist who, writing in one of the daily papers, states that there *are* certain advantages to be gained in the event of the B.B.C. being restricted to broadcasting music that is more than fifty years old.

* * *

We learn that a sensational discovery has been made on the Continent, by means of which motor cars may be stopped by wireless waves. Scientists are engaged in investigation; experiments have been tried, and everything worked strictly according to plan. We await the publication of technical details with considerable interest, but seem to remember something of this nature being whispered in the "hush-hush" days of the war. De-magnetisation of the magnetos of an aeroplane was then mentioned, but perhaps this new scheme is something quite different.

* * *

The question of the installation of a wireless receiving set and aerials affecting the liability of the tenant or owner in case of fire is extremely important. We learn that in some cases an existing fire insurance policy requires endorsing and that the insurance company require certain reasonable precautions to be taken with regard to the earthing of the aerial.

* * *

We suppose it is only a sign of the times that increasing numbers of daily papers are devoting space to the technical side of wireless. They now examine, test, and criticise home-made apparatus, answer questions, and frequently give constructional articles, and yet they objected to the B.B.C. broadcasting the results of such a national event as the boat race.

Wireless entertainments at hospitals and sanatoriums should prove a great boon to both inmates and staff. Not only can entirely suitable items be selected at will, but the concert can be commenced or shut down at a moment's notice without giving offence to anyone.

* * *

The B.B.C. will no doubt be pleased to learn that there are some places in the world where broadcasting is fully appreciated. Farmers in isolated districts of Canada find their loneliness greatly relieved by the reception of music and lectures transmitted from the chief cities of Western Canada or the United States. The range of these broadcasting stations is really remarkable, and the music transmitted frequently entertains the crews and passengers of vessels hundreds of miles distant.

* * *

Television has always been a fascinating problem to the wireless experimenter; but hitherto a practical solution has appeared as far off as ever. We now learn, however, that by means of additional apparatus used in conjunction with the ordinary wireless transmitting and receiving set, television, not only of a photograph or stationary object but of moving objects, has been accomplished by a London wireless firm. We have been in touch with the firm in question, but they are not yet in a position to make a public announcement.

* * *

Replying to a question relating to the desirability of arranging for the broadcasting of emergency calls, such as that which recently enabled a mother to visit her dying son in hospital, the Postmaster-General, Sir W. Joynson-Hicks, stated that he did not think it desirable to make a permanent arrangement of the kind suggested, but that the question of the uses to which broadcasting should be put is receiving the attention of the special Broadcasting Committee. The latest photograph of the Postmaster-General appears on page 373.

* * *

The *Financial Times* publishes a humorous paragraph regarding the possibilities of broadcasting Stock and Share quotations and financial advice. Well? Why not?

* * *

We learn that a British wireless company have received an enquiry for the installation of receiving apparatus in a fleet of boats on the Yangtzse-Kiang River in China, to be used in conjunction with a radio telephone transmitter in the Head Office on shore. Good business.

* * *

We understand that the evening performances of "Love in Pawn" at the Kingsway Theatre, London, are preceded by a short wireless concert.

* * *

We note that *Nature* concludes an excellent article dealing with the licence problem by comparing the present situation to that existing at the beginning of the 18th century in connection with the attempted suppression of the so-called "Common Law Companies," for which purpose the famous "bubble" Act, 1718, was passed.

* * *

The Act proved a dead letter; and arrangements had to be made to regulate what it was found could not be suppressed. The present situation with regard to the amateur worker in the wireless field is almost identical with that which existed in relation to the Joint Stock Company, and it behoves the authorities to bear in mind the teaching of history.

* * *

Apropos of our remarks in last week's issue regarding the installation of wireless receiving apparatus upon licensed premises, we note that a certain Chief Constable who opposed the application for a music and singing licence intended to cover the use of wireless apparatus, has had his objection overruled by the magistrate, who granted the necessary licence.

* * *

Wireless telegraphy has once again expedited the course of justice. Instructions for the arrest of a man wanted by the police at Cherbourg, were received by wireless just in time to prevent the man sailing for America.

* * *

According to the *Daily Express* an experimenter at Dronfield, near Sheffield, has received a letter from the G.P.O. stating that it has been reported that he is installing wireless receiving apparatus, and, as no licence appears to have been issued, requesting an explanation. The letter naively concludes by stating "that broadcast licences may be obtained at the local head or branch Post Office of the district in which the apparatus is installed." Smart work. And we thought our G.P.O. slow.

* * *

We learn of the arrival of the wireless consultant who is prepared to visit the owners of wireless receiving apparatus and solve their difficulties on the spot. Communities troubled by local "oscillating fiends" will perhaps be agreeable to subscribe so that the consultant's energies may be directed into the proper quarter.

* * *

There are to be special dance programmes on Saturdays from all the stations. It is hoped that this will be of particular interest to tennis clubs and the like, who hold flannel dances on Saturday evenings. Vocal items of a popular nature will be interspersed with the dance music. Sentimental maidens will be content with songs like "All that I ask is Love," but those who are really out to play tennis will want a much higher score than love.

* * *

Some of the instalments of the "Fairy Dustman" stories for children are being brought from the Isle of Wight by carrier pigeon.

* * *

The following are the new nominations for the Wireless Section Committee of the I.E.E.:—Mr. C. F. Elwell, Prof. G. W. O. Howe, D.Sc., Admiral Sir H. B. Jackson, G.C.B., K.C.V.O., F.R.S., and Mr. C. F. Trippe. The Chairman is Mr. E. H. Shaughnessy, O.B.E., and the following will continue to serve as members of the Committee:—Messrs. B. Binyon, O.B.E., S. Brydon, D.Sc., Dr. W. H. Eccles, F.R.S., G. H. Nash, C.B.E., C. C. Paterson, O.B.E., J. St. Vincent Pletts, Captain H. R. Sankey, C.B., C.B.E., R. L. Smith-Rose, M.Sc.

BROADCAST TRANSMISSIONS

CARDIFF.........5 WA......353 metres.
LONDON.........2 LO......369 ,,
MANCHESTER 2 ZY......385 ,,
NEWCASTLE 5 NO......400 ,,
GLASGOW 5 SC......415 ,,
BIRMINGHAM 5 IT......420 ,,
(10.30 to 11.30 a.m. and 4.30 to 9.30 p.m. G.M.T., Sundays 7.30 to 9.30 p.m. G.M.T.)

L'ECOLE SUPÉRIEURE (Paris) 450 metres.
Tuesdays and Thursdays 7.45 to 10 p.m. G.M.T.

THE HAGUE...PCGG...1085 ,,
(Sundays only 3 to 5.40 p.m. G.M.T.)

RADIOLA (Paris).........1780 ,,
7.45 to 10 p.m. G.M.T.

EIFFEL TOWER...FL...2600 ,,
(11.15 a.m., 6.20 to 7 p.m. and 10.10 p.m. G.M.T.)

THE DEWAR SWITCH—ITS CONSTRUCTION AND USE

By ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."

A constructional article showing how to make an efficient switch of the well-known "Dewar" type which is so useful to experimenters.

IN spite of the widespread use of ex-Government Dewar switches for wireless work amongst experimenters in this country, very little seems to have been written on the subject of actually constructing these switches. At first sight it might appear a rather difficult matter to make a satisfactory job of such a complicated-looking article, but in reality, if the commercial design is slightly modified, it will be found very easy to counterfeit it. Fig. 1 shows a photograph of a standard pattern of Dewar switch, having four contacts on each side. Such a switch has very many uses in experimental wireless gear, and there are few out of the thousands of experimenters in this country who have not at least one such switch in their apparatus.

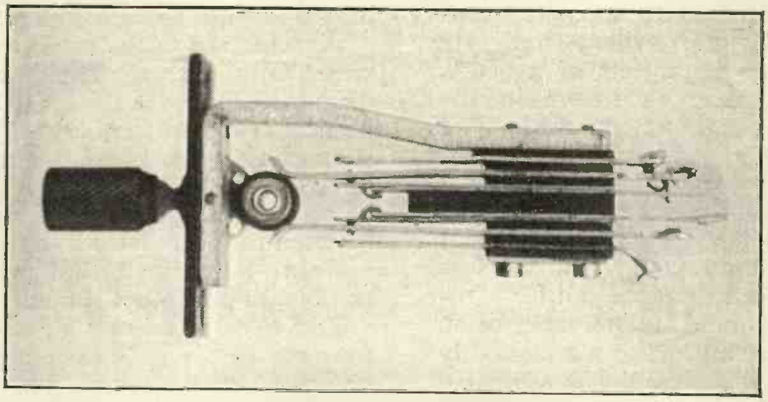


Fig. 1.—Dewar switch.

Now that the supply of these switches is running rather low, the experimenter finds that their new price is rather prohibitive, as such a switch as shown in Fig. 1 will probably cost from 15s. to 17s. 6d. This is more than he wants to pay, of course, and for this reason the following short article describing how Dewar switches may easily be made, with very few tools, will be welcome.

Fig. 2 shows the complete switch and illustrates the sizes, so as to make clear the amount of space such a device will occupy on the back of the panel. This type of switch has been designed so that it will be found to be efficacious when used for controlling high-frequency circuits in wireless receivers, whereas the ordinary Army pattern of Dewar switch sometimes has the contacts rather closely spaced together which, in consequence, introduces slight capacity effects and on very short waves may be sufficient to upset the tuning arrangement, particularly if the tuned anode method of high-frequency amplification is used. The drawings, as a matter of fact, are practically self-explanatory, but there are one or two points which should be noted in assembling this type of switch. Fig. 3, which shows various components detailed for constructional purposes, should be examined. Looking at A (the face-plate), this of course, whilst adding some degree of finish to the switch after it has been mounted on the panel, is not absolutely necessary. It does not, however, present much difficulty to the average constructor, as it may easily be cut with a pair of shears or tin-snips from $\frac{1}{16}$th brass strip which is $\frac{3}{4}$in. in width. This strip can be bought for so much a foot, and therefore a number of these plates can be cut out at a very low cost. They should be carefully flattened by hammering on a hard metal object, such as an upturned flat-iron. The finished article would look considerably better if, after the holes have been drilled and the edges possibly bevelled to taste, the plate is nickel-plated. This may be done at a surprisingly low cost, and an estimate should be obtained from any local cycle dealer or some such person for the plating of, say, a dozen of these face-plates. When buffed up to a high finish they look exceedingly attractive on a set, and in conjunction with different coloured Erinoid knobs to designate the various functions which the switches are performing, make the whole receiver very much more interesting to look at. This is a point which every experimenter appreciates when demonstrating his apparatus to friends and others.

Fig. 3 (B) shows a perspective view of the little switch arm which is used to cause the upper and lower sets of springs to contact with each other, whereas B_1 shows an elevation of the same thing. This should be cut from 3-32nds brass strip $\frac{1}{4}$in. in width, and may have small holes drilled in the centre and at one end to take $\frac{1}{8}$th and 6B.A. rods respectively. Small ebonite washers cut from $\frac{5}{16}$th ebonite rod or tube may be used to space the contactor portions of the switch, and are readily held in place by means of a 6B.A. screw, nut and washer, as shown in the drawing. The other end of B should be filed down until it can be tapped with a 4B.A. thread. This will enable any convenient form of knob or handle to be attached to it, but the ordinary type of Dewar switch handle is not difficult to obtain, and your local wireless dealer should be asked to quote you for turning up a few from Erinoid of different colours. This Erinoid can be finished to a remarkably high polish, and looks exceedingly attractive when mounted on a receiver, as already pointed out.

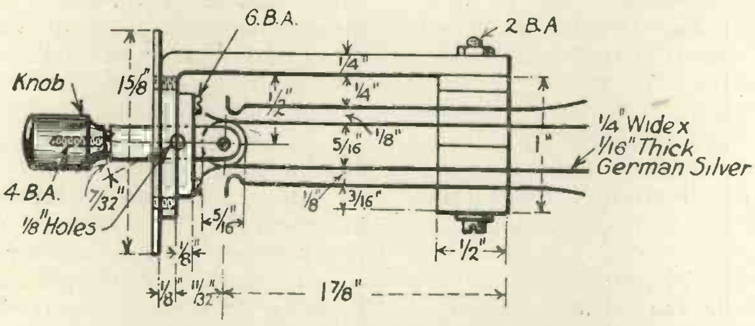


Fig. 2.—Giving the dimensions of the switch.

Fig. 3, C and D, shows the long and short contact springs of the switch respectively. In order to avoid the difficulty of attaching silver or platinum contacts to these springs, they may be made from German silver $\frac{1}{4}$in. wide and $\frac{1}{16}$in. thick. This German silver strip can be bought from most large accessory dealers and is not at all expensive. Great care must be taken when bending the longer contact to get the radius at the end of them correct, for it is on this that the action of the switch depends. When the switch knob is depressed the roller should travel outwards from the centre to a distance of 7-32in , and at that point it should have run over the shoulder of the longer spring caused by the radius, thus tending to press the spring outwards and so lock the switch in that position. A little experimenting in this direction with a simple model and brass strip instead of German silver will soon enable the experimenter to make very accurate switches. The more accurate the radius of the long switch arm the more secure will the contact be. The German silver strip should also be of at least $\frac{1}{16}$in. in thickness, in order to retain the springiness necessary to infallibly return the switch arm to its central position. In this connection it should be noted that when the switch arm is central, for the sake of obtaining a really workmanlike job, both long springs should bear upon the ebonite rollers.

Fig. 3 F shows the small rod on which the switch arm moves. This should be $\frac{1}{8}$in. in diameter, and after the small brass plate has been attached to the back of the main brass supporting plate by means of small-headed screws, as shown in Fig. 2, the $\frac{1}{8}$in. hole may be easily drilled with an ordinary hand drill between the two plates so as to take the bearing pin. After the central switch arm B is in position, a punch-dot should be made on each end of this central arm F, so as to prevent it from moving at all in the hole should the hole be drilled a little large. This will ensure the switch having a "tight" action at all times, otherwise it feels rather unpleasant after a time, and one's friends are inclined to think the switch a shoddily-made article. The next item to consider is the means by which the springs are spaced apart at the correct distances. The arrangements for this purpose are shown at F(3), and, as will be seen, consist of a number of ebonite washers $\frac{1}{8}$in. in thickness. It is sometimes an advantage to have these washers of varying thicknesses, but if the switch is carefully constructed according to Fig. 2, washers as dimensioned in Fig. 3 will be found to be quite suitable. Care should be taken, in making this switch a multi-contact one, to keep the German silver springs well to the outside of the washers, so that they will not tend to short-circuit on the centre screw which holds the whole assembly together. This arrangement of circular washers is the easiest for the experimenter to make, as they may be readily cut off $\frac{5}{16}$in. ebonite tube. If, of course, he wishes to make the switch an exceedingly neat job, he may cut them out of ebonite sheet in the form of square distance pieces, and thus secure a slightly higher insulation resistance. For all general purposes, however, the insulation afforded by the ebonite discs will be found absolutely ample. The remainder of the sketches are, practically speaking, self-explanatory, and no further description is really needed. If desired, of course, the face-plate A, Fig. 3, may be omitted and the switch bracket attached directly to the panel by means of the small tapped holes indicated. If the face-plate is used, these small holes can be used both to attach the face-plate to the switch and the switch to the panel. Care should be taken that the screws are not so long that they foul the movement of the arm B when assembled.

If the drawings shown here are carefully adhered to no difficulty will be experienced in making a satisfactory switch of this type. It is obviously only a matter of extending the sizes of the spacing pieces F (3) and the length of the rollers on B (3) to obtain as many contacts each side as one wishes. If the switch is carefully made and $\frac{3}{16}$in. wide German silver used instead of $\frac{1}{4}$in. strip, as many as 12 contacts on each side may be successfully mounted in this manner. The ebonite spacing bar for a 12-contact switch would be about 2in. long and should be $\frac{1}{2}$in. wide, so as to exercise a firm enough grip upon the end strip. Considerable leverage is, of course, put upon these when the switch is moved into either the up or down position.

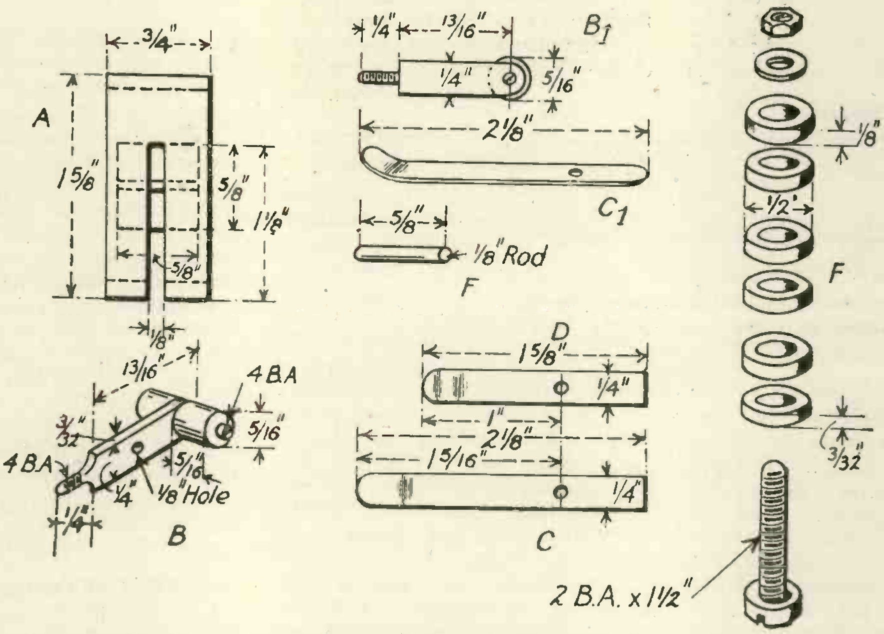


Fig. 3.—Showing the different parts of the switch mechanism separately and in detail.

The uses to which a Dewar switch may be put are manifold, but there is always plenty of room for ingenuity in this direction, and the reader will probably find a number of modifications of this design presenting themselves to him. The general framework and roller structure will hold good for almost any type of Dewar switch, but the number of contacts and springs and, in consequence, the thickness of the spacing washers, can be altered to suit individual requirements quite easily.

CONDUCTION OF ELECTRICITY THROUGH SOLIDS

By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

PART III.—ELECTRICAL THEORY OF MATTER

SINCE metals are distinguished from other substances by their high electrical conductivity, the fact that metals are also the substances whose atoms are most prone to part with electrons is one of considerable significance.

The essential difference between a solid and a fluid conductor is that in the former the atoms are packed closely together, so that they retain their mean positions relative to one another, whilst in the latter the atoms or molecules may wander about and are separated from one another by comparatively large distances. It has been explained that in fluid conductors both electrons and ions may take part in the carrying of the current, but in a solid conductor, owing to the close packing and stable relative positions of the atoms, the latter are not able, when ionised, to assist in the direct carrying of the current. The current through a solid conductor is carried, in fact, entirely by a stream of electrons.

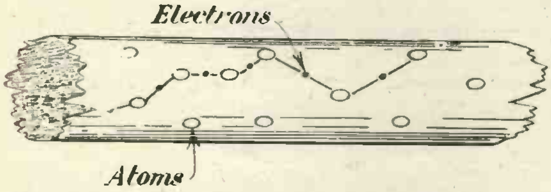


Fig. 1.—Section of conducting wire at ordinary temperatures showing electrons traversing relatively large inter-atomic spaces.

It might appear, at first sight, that the closer packing of the atoms in a solid would offer a greater obstruction to the flow of electronic carriers between the atoms than would be offered in the case of a fluid conductor, and that the electrical resistivity of solid conductors should therefore be greater than that of fluids. A little consideration will show us why this is not the case. For the function of the electric field in causing the passage of a current is not merely to drive the electrons across the inter-atomic spaces; it is principally to separate electrons from the spheres of influence of the atoms. When the atoms are widely separated, as in a fluid conductor, the electric carriers of the current must be provided either wholly by ionising influences, or partly by such influences and partly by the added action of the electric field in causing ionisation by collision.

Ionisation in Metals

In a solid conductor, however, the atoms are in such close proximity with one another that an electron of the planetary system of one atom may serve a dual function in relation to two adjacent atoms, thus allowing an electron to be spared from the pair. The very proximity, therefore, of the atoms is itself a cause of "equivalent" ionisation, and the net result is that in a solid conductor, such as a metal, there is always a copious supply of electrons which are so little under the influence of any particular atomic system that they are ready to drift through the body of the conductor under the smallest applied potential gradient. It seems probable that when a current flows through a wire, the electrons which commence to drift at one end of the wire are not necessarily those which eventually arrive at the other end of the wire, for they may enter into the planetary systems of atoms, and other electrons may be displaced. But for practical purposes, since it appears that all electrons are identical, it makes little difference whether we consider that the electrons flow freely (like the molecules of a gas drifting through a tube under a pressure gradient) or whether the atoms of the metal receive certain electrons and give up others (see Fig. 1).

Surface Restriction

The only region in the conductor in which the motion of the electrons is restricted is at the surface, and here the phenomenon is analogous to that of surface-tension in the case of a liquid. If an electron arrives at the surface of a conductor, the attraction of the surrounding atoms is no longer uniform in all directions, since there are atoms of the substance on one side only of the surface boundary (Fig. 2). An electron attempting to pass outwards through the surface-boundary is therefore subject to a resultant force tending to keep it within the body of the conductor. For this reason the electrons (at ordinary temperatures) never leave the conducting wire, but travel through it as through a tube.

Effect of Temperature

It is well known that the resistance of metals increases with rise of temperature, and that the curve (Fig. 3) showing the relation between temperature and electrical conductivity for pure metals is such as to indicate that at a certain very low temperature (about $-273°$ C.) at which it is supposed all thermal agitation of the atoms would cease, the electrical resistivity of the

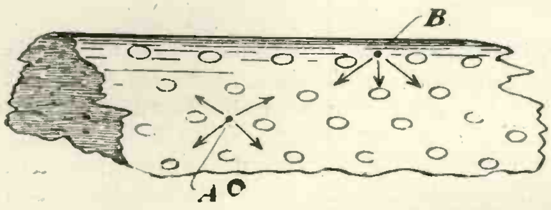


Fig. 2.—Section of conductor showing atoms at surface boundary. Electron A, within conductor, is attracted uniformly in all directions. Electron B, at surface, has a resultant attraction tending to prevent escape through surface boundary.

material would be zero. This observation supports the theory which we have been considering above, for under these conditions the atoms would be still more closely packed together and an electron could pass from one to another without ever being beyond the influence of an atomic nucleus (Fig. 4). Conversely, raising the temperature will increase the agitation of the atoms and increase their mean distance apart, and the electrons will pass with less freedom; the potential gradient required to produce a given rate of drift of electrons will, therefore, be greater; in other words, the resistivity of the metal will be increased.

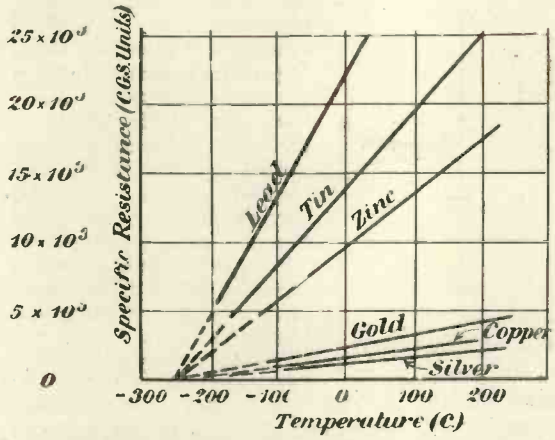


Fig. 3.—Relation between temperature and resistivity of various metals, showing how resistance becomes approximately zero at about −270° C.

Super-conductivity

Super-conductivity is the name which has been given by Prof. Kammerlingh Onnes, of the University of Leiden, to an abnormally increased conductivity which occurs with certain pure metals when reduced by means of liquid helium to temperatures in the neighbourhood of the absolute zero. The temperature range in question is from about 6° abs. to 1.5° abs. The apparatus necessary for obtaining these extremely low temperatures is only available at the Cryogenic Laboratory at Leiden. It has been found that with mercury (which was chosen because of the ease with which it could be obtained in a pure state) there was a sudden disappearance of resistance at a temperature of 4.2 deg. abs. Certain other metals have also been found to exhibit this property at about the same range of temperatures.

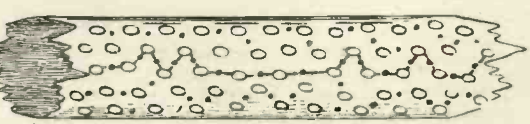


Fig. 4.—Portion of conducting wire at low temperature, illustrating closer packing of atoms and easier progress of electrons.

The classical theory of conduction of free electrons, which we have been discussing, seems to require some modification under these extreme conditions. To account for the great increase in conductivity it is necessary to assume either a number of electrons very large compared to the number of atoms, or a mean free path larger than the dimensions of the apparatus. Onnes has suggested a modification of this theory which, combined with the quantum theory, yields a more possible explanation. Without entering into this in detail, it may be stated that it assumes a "freezing up" of the slower modes of vibration.

Lindemann has advanced a theory based upon the existence of a definite space-lattice of atoms in each crystal of metal, such as those studied by Bragg in various salts. Lindemann further assumes that the electrons also form a similar but independent space-lattice, and that an electric current results from the relative motion of these inter-penetrating lattices.

A more fruitful theory, however, is that of J. J. Thomson, who postulates the existence in the metal of a large number of electric doublets (probably each atom is such a doublet). It is impossible to enter into a detailed account of this theory, but reference may be made to it on another occasion.

Diminution of Resistance with Rise of Temperature

There are certain substances, however, whose electrical resistance diminishes with rise of temperature, and the foregoing simple theory has to be modified to account for the experimentally observed facts. An example of such substance is the carbon filament of an electric lamp, whose resistance is higher when cold than it is a moment after the current has been switched on and has raised it to incandescence. In such cases,[1] the atoms of the substance do not part with electrons so readily as do the atoms of a metal. The increased agitation of the atoms, due to the rise in temperature, may increase the tendency to ionisation, and by bringing the atoms into occasional closer proximity, owing to the greater amplitude of their vibratory motions, may facilitate the passing on of the electrons in the way we have described. It is important to note that substances of this kind are usually of relatively poor electrical conductivity as compared with metals: this is in agreement with the theory.

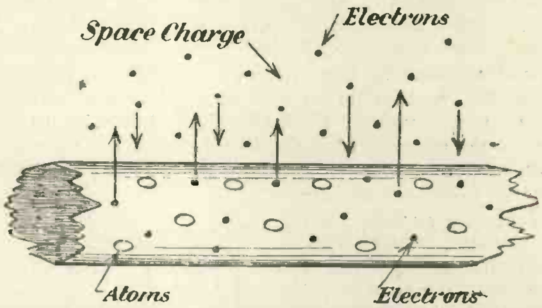


Fig. 5.—Portion of hot wire surrounded by "space charge." Electrons are being emitted from wire and other electrons are re-entering wire.

Electrical Heating of Conductor

Although the electrons may drift through the inter-atomic spaces in a metallic conductor with such comparative facility, they nevertheless, by their collisions with the atoms, yield up a portion of the kinetic

[1] According to a recent theory developed by Bridgman.

energy which they have acquired under the electric field which maintains the current, and some of this energy reappears in the increased agitation of the atoms; in other words, heat is generated in the substance and the temperature is raised. If the agitation is further increased, the atoms commence to emit light-radiation, and at a still further increased amplitude of vibration they may separate so far that the normal force of cohesion is broken down, and the substance is reduced to the liquid form.

Emission of Electrons from Heated Substances

When a substance is raised to a red heat or incandescence, a phenomenon occurs which is in striking support of the foregoing theory. Suppose the substance is in the form of a metal wire (enclosed in a highly exhausted vessel, so as to avoid complications due to the surrounding gas molecules) and is heated by means of an electric current. As the temperature is raised, the violence of the haphazard motions of the electrons is increased, and some of the electrons may escape through the surface-boundary of the wire into the free space beyond, in spite of the resultant attraction at the surface tending to prevent their egress. Electrons emitted in this way are sometimes called thermions (*ions* produced by *heat*): the effect is analogous to the evaporation of the molecules of a liquid. If the molecules which escape through the surface of a liquid are continually removed, the evaporation is uniform (at a constant temperature), but if the space above the liquid is confined, the escaped molecules accumulate as vapour, and some of them re-enter the liquid. Eventually a state is reached in which the number re-entering the surface of the liquid per unit time is equal to the number escaping per unit time. The pressure of the vapour is then said to be the "saturation" pressure for that temperature.

The same effect is observed with the electrons from a hot wire in an evacuated vessel. If the emitted electrons are allowed to accumulate a "space charge" is created in the region round the wire, and a negative potential is set up. When the space charge has become sufficiently great, the number of thermions returning to the wire per unit time is equal to the number emitted per unit time, and a condition of "statistical equilibrium" exists (Fig. 5).

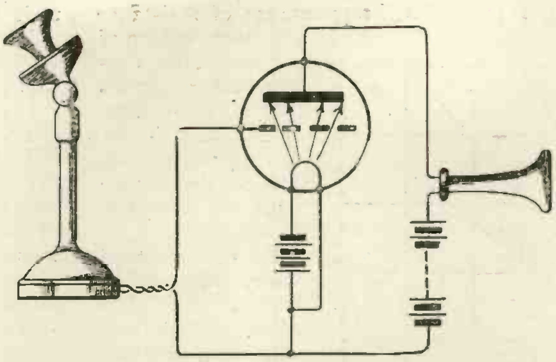


Fig. 6.—Illustrating amplifying action of three-electrode valve.

If, however, another wire or plate be introduced into the vessel and made positive with respect to the hot wire (*e.g.*, by means of a battery), the equilibrium is displaced, and the electrons will stream across the space from the hot wire to the positive plate, and so on through the battery circuit. This phenomenon was observed by Edison many years ago, and is the principle involved in the modern wireless valve. If a third electrode is introduced between the wire and the anode (Fig. 6) the electron stream is, under certain conditions, extremely sensitive to changes in the electrical potential of this third electrode, and the arrangement may obviously be used as an amplifier.

The valve-amplifier constitutes an electric relay, and owing to the infinitesimal mass of the moving parts (the electron stream) it is easily able to follow variations of the enormous frequency used in radio transmission.[2]

Forces Between Electron Streams

Although electrons repel one another (in accordance with the simple law for "like" charges), two parallel streams of electrons flowing in the same direction attract one another. Since the flow of electrons through a metal wire is guided by the wire, two parallel wires carrying current in the same direction are attracted together. This phenomenon, unfortunately, is up to the present as much without explanation as is the attraction of two opposite electrical charges.

The effect depends upon the length of the wire in question and the intensity of the electron stream. It may be enhanced by arranging the wire in the form of coils, and also by inserting a core of magnetic substance, such as iron, cobalt, or nickel. Magnetic effects are very mysterious and complicated, and no completely satisfactory theory of magnetisation has yet been adduced.

Theory of Magnetism

According to the electronic theory the magnetisation is due to the rotation of planetary electrons in the atoms and to the orientation of the atoms or molecules so that the electro-magnetic fields produced by individual atoms are parallel and in the same direction. The equivalence of a bar magnet and a current-carrying solenoid, and the consequent forces between the two, are indicated on this theory in Fig. 7.[3]

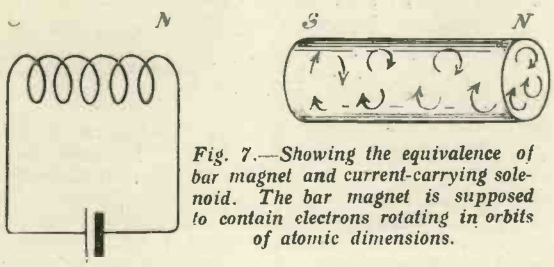


Fig. 7.—Showing the equivalence of bar magnet and current-carrying solenoid. The bar magnet is supposed to contain electrons rotating in orbits of atomic dimensions.

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[2] The application of this phenomenon to wireless has made possible wireless telephony and broadcasting. It is therefore, of the greatest interest and importance, and will be discussed in a separate article.

[3] In applying the well-known "corkscrew rule" to Fig. 7, it should be noticed that the direction of the current, as indicated, is the direction of motion of the electrons. The polarity of the magnetic field is therefore opposite to that which would be given by the conventional application of this rule.

THE TRUTH ABOUT THE P.M.G./B.B.C. BROADCAST CONTROVERSY

By GUY BURNEY (Chairman of the National Association of Radio Manufacturers).

As an entirely impartial organ, we have pleasure in publishing this statement. Our own views will be found in the Editorial columns.

WHILST the present deadlock between the Postmaster-General and the British Broadcasting Company is causing great inconvenience to the public, and also inflicting hardship and considerable loss upon the radio industry, a brief and concise statement of the position as viewed by the National Association of Radio Manufacturers may be welcomed by your readers, and at the same time assist in clearing the air.

Profiting by the experience gained in America, and with a view to avoiding chaos so prevalent in that country, due to lack of Government regulations, restrictions as to the number and character of broadcast stations, and the design of receiving sets, British manufacturers completed a contract with the Postmaster-General whereby a single broadcast authority was set up—now known as The British Broadcasting Company, with a membership of 564 manufacturers. The manufacturers joined the Broadcasting Company on the strength of the protection afforded by the P.M.G.'s Agreement with the B.B.C., viz., that under the Broadcast Licence only British broadcasting sets should be used. This meant British manufacture by British workmen.

It soon became evident that thousands of persons were using home-made sets without licences, and therefore without paying any contribution to the British Broadcasting Company. In other words, these users were obtaining service for absolutely nothing. This brought out the P.M.G.'s proposal to issue a third licence to cater for a grade below the experimenter, now known as the constructor.

The P.M.G. offered:

(*a*) To charge a fee of 10s. per annum for the third or Constructor's Licence, half of this fee to go to the B.B.Co.

(*b*) All components used under the Constructor's Licence to be of British manufacture and to be marked "British-made."

The B.B.C. agreed to the 10s. licence fee, but insisted upon the components being marked "B.B.C."—hence the deadlock.

The P.M.G.'s offer (*b*) "British-made" implies a valuable measure of protection, but is, *in fact, no protection at all,* for the following reasons:

The Board of Trade is unable to make an official statement as to what proportion of labour and material renders an article British-made owing to the fact that the proportion has never been settled by Statute.

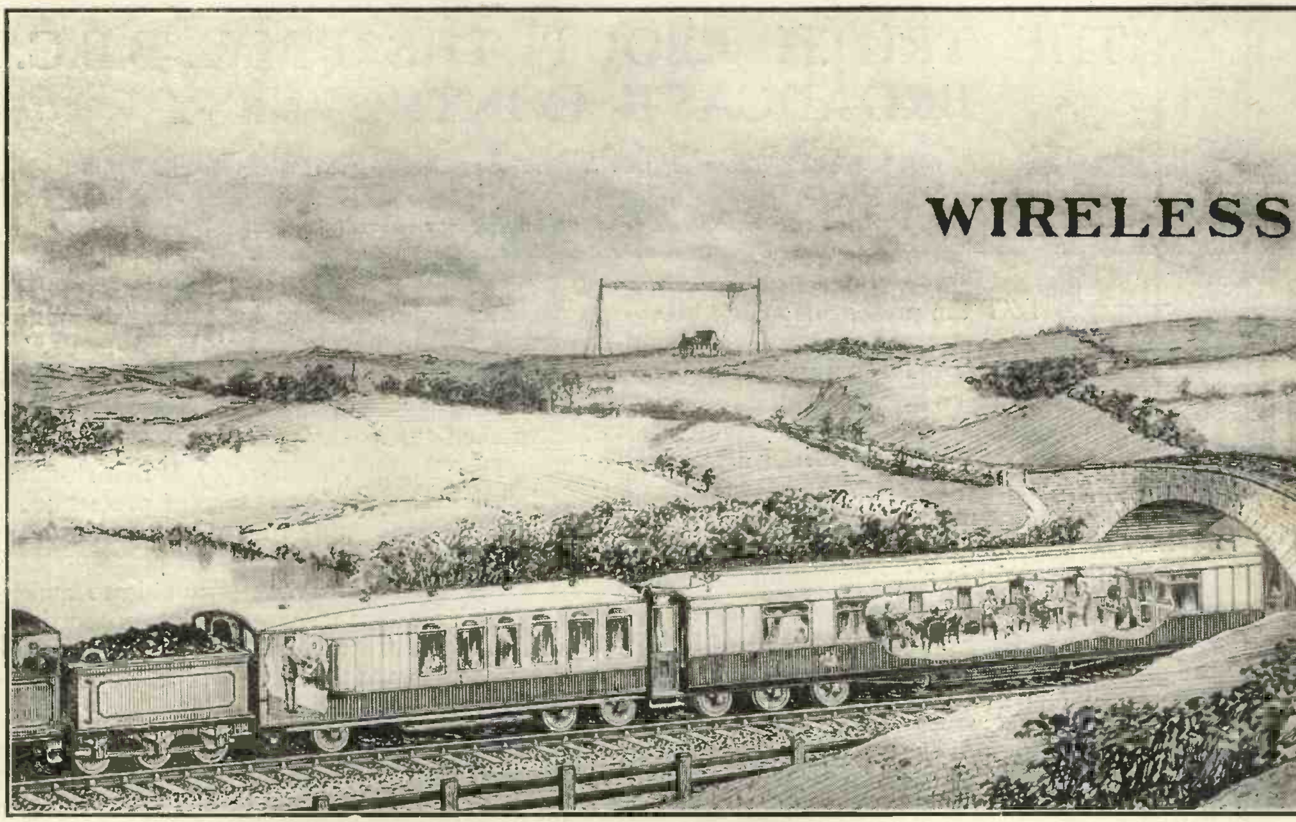
This statement surely disposes once and for all of the "British-made" myth, and proves conclusively that such marking on goods affords no protection to the British manufacturer, and the application of the words for this purpose is a positive farce.

The fear has been expressed that should the P.M.G. agree to the B.B.C. marking of components, the price of these would be unduly increased by the amount of tariff to be paid to the B.B.C. by the manufacturer. It can be definitely stated that the tariff payable by the manufacturer to the B.B.C. would only be a nominal one, and having regard to the fact that the N.A.R.M. is a *no price-maintenance organisation,* a free and open competition between manufacturers will automatically have the effect of reducing rather than increasing the prices of components.

The foregoing should convince the fair-minded public that the only way to exclude foreign-made radio components is to mark the parts "B.B.C.," and to make it an offence to buy any parts not so marked.

The offer of the P.M.G., if accepted, would inflict grievous injury upon a new industry and throw thousands of workers out of employment. *This must not happen.*

WIRELESS



WITH the advent of wireless telephony, and the introduction of broadcasting into this country, many things have been made possible, and not the least of them is the listening to a noted singer whilst speeding in a train to some far distant destination.

Few there are who have not experienced that tired feeling so common with long train journeys; few there are who need telling of the boredom of having to sit still; in the case of night travelling, seeing nothing beyond the confines of the saloon compartment.

Imagine then the enjoyment, the distraction, that broadcasting is able to give, say, on a journey from London to Newcastle.

Starting from the south we hear the programme of 2LO until, left far behind, London fades away in favour of 5IT.

A new station, a new programme provides us with further entertainment, until in turn Manchester and Newcastle claim their own.

To the strains of music and song we sit down to dine in the same comfort of sound as though dining at a hotel. The jolting, rattling noise of wheels is lost to us in the notes of a musical air.

The highly successful experiments that have been carried out recently with radio on trains forecast a further development not only in the comfort of passengers, but also in safe travelling.

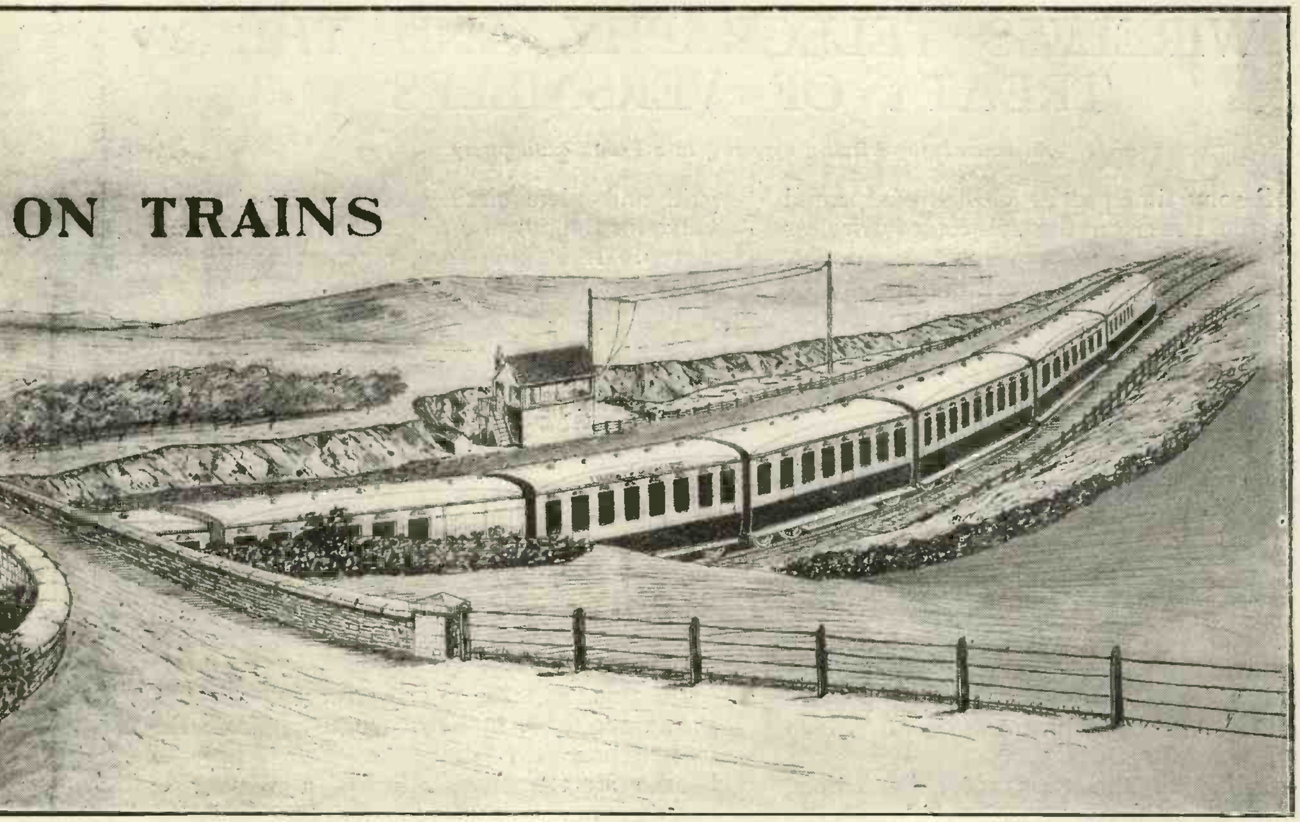
The time is not far distant when an express train hurling along the metals at a speed in the neighbourhood of a mile a minute will continually communicate by wireless with distant stations, other trains, and the main termini.

Again, exclusive of the factor of safety that such an innovation introduces where the avoidance of collisions is concerned, illness can be speedily attended to. Should it be necessary, a radio call could be sent for a doctor or an ambulance to await the arrival of the train at a station some distance ahead.

Further, with Scotland Yard devoting so much time to introducing radio into their system, the tracking of criminals escaping by train would be greatly assisted by a service of communication which hitherto never existed beyond experiment.

Even long before the war wireless served its part in tracking fugitives with success, and

ON TRAINS



by its means more than one criminal has been brought to justice.

Useful as radio is at sea, to the same good use can it be put ashore. The air services admit their indebtedness in the constant use of direction-finding apparatus, and before very long railways will also adopt wireless as part of their equipment.

For some time past American railroads have been conducting most exhaustive experiments towards developing this new field of utility, and on both the Lacawana and Delaware Railway and on the Union Pacific Railroad some measure of success has been attained.

In that country, where train journeys often extend over a period of days, the subject of providing entertainment for passengers is even more important than is the case in this country; notwithstanding this fact, however, the rate of progress is much the same as here.

About the year 1885 T. A. Edison, together with others, also experimented in this direction, using some of the earlier methods of communication based on the principle of induction, but nothing came of the experiments owing to lack of commercial support and enterprise.

The aerial system fitted to the train is usually supported in a horizontal position a short distance above the roofs of the coaches, and the wheels and rails form the earth system.

Another method of aerial system so far as receiving is concerned is the frame aerial, though it is contended that for the best results the former type of aerial is the most practicable.

A matter of a few weeks ago the Marconi Wireless Telegraph Co., Ltd., demonstrated the possibility of wireless on passenger trains by receiving the broadcast programmes of the B.B.C. whilst the train proceeded on its journey. The results, we are given to understand, left nothing to be desired, the volume of sound produced on a loud-speaker being sufficient to permit anyone in the Pullman to hear.

There is a possibility of considerable use, outside broadcasting, for such installations, especially on the "business" expresses between important cities. S. G. R.

WIRELESS TELEGRAPHY AND THE TREATY OF VERSAILLES

An interesting contribution appearing in a French contemporary.

FOR some time past articles have appeared in the Press on the subject of wireless patents. Our readers have, no doubt, read such articles, and we think it may be useful to give some information on this question.

To begin with, since wireless telegraphy is a comparatively new science and the three-electrode valves have only been recently introduced, the radio-electric industry is particularly interested in questions of patents.

Some of the important French patents relating to the use of valves are German property. During the war such patents have been used in the national defence.

The Treaty of Versailles, by Article 306, lays down on broad lines the new regulations regarding French patents which are of interest to Allied Governments and which belong to enemy citizens.

According to the terms of this Article, "each of the Allies or Associated Powers has the option of enforcing its rights in regard to industrial property acquired by Germans before the war or during the war, or which would ultimately be acquired by Germans, in respect of the exploitation of the patents, in respect of any licences for the exploitation, and in respect of any limitations, conditions, or restrictions which they may consider necessary for national defence or the public interest."

Further, "each of the Allies or Associated Powers reserves the option to consider null and void any licence, whole or partial, of the rights in industrial property which would come into operation since the 1st April, 1914, or which would be made in the future and which would interfere with the objects of the Article in question."

An important patent coming under Article 306 of the Treaty of Versailles is that known as the Meissner patent, French No. 467747, under the name of the "Gesellschaft für drahtlose Telegraphie" (Wireless Telegraph Company).

This patent relates to the coupling of the grid and plate circuits of a three-electrode valve for the purpose of producing continuous waves. It is, therefore, of considerable importance, both for transmission and for the reception of waves by the heterodyne method.

Following the Treaty of Versailles, Acts have been made in France in view of the application of Article 306; the last of these Acts, dated October 31st, 1922, stipulates clearly, in paragraph 7, that any contract made, or about to be made, with the holders of patents subject to the limitations, conditions, or restrictions of Article 306 of the Treaty cannot be upheld, in any case, against the right of the French Government to control any patents which come under the Article in question (306).

In this connection a powerful wireless group acquired, in February, 1921, from the Gesellschaft für drahtlose Telegraphie a licence for the exploitation of a number of patents, amongst which was the Meissner patent already referred to. This licence was made in favour of the Wireless Telegraph Company and the French Radio-Electric Society.

Quite recently a Government Sub-Committee, set up under the Act of October 31st, 1922, to enquire into the application of Article 306 of the Treaty of Versailles, has expressed the view that the Article applies to the Meissner patent, and, therefore, in virtue of Article 7 of the 1922 Act, to the contracts and licences which would be made between German proprietors of patents and French citizens.

The Committee has also expressed the view that licences for the exploitation of the said patent should be given to French manufacturers on demand, the revenue secured by the exploitation of the patent being devoted to the reparation of devastated areas.

At the moment the question is whether the recommendations of the Committee will be upheld. It may be necessary for a new Act to be passed for the retention of the Meissner patent by the French Government.

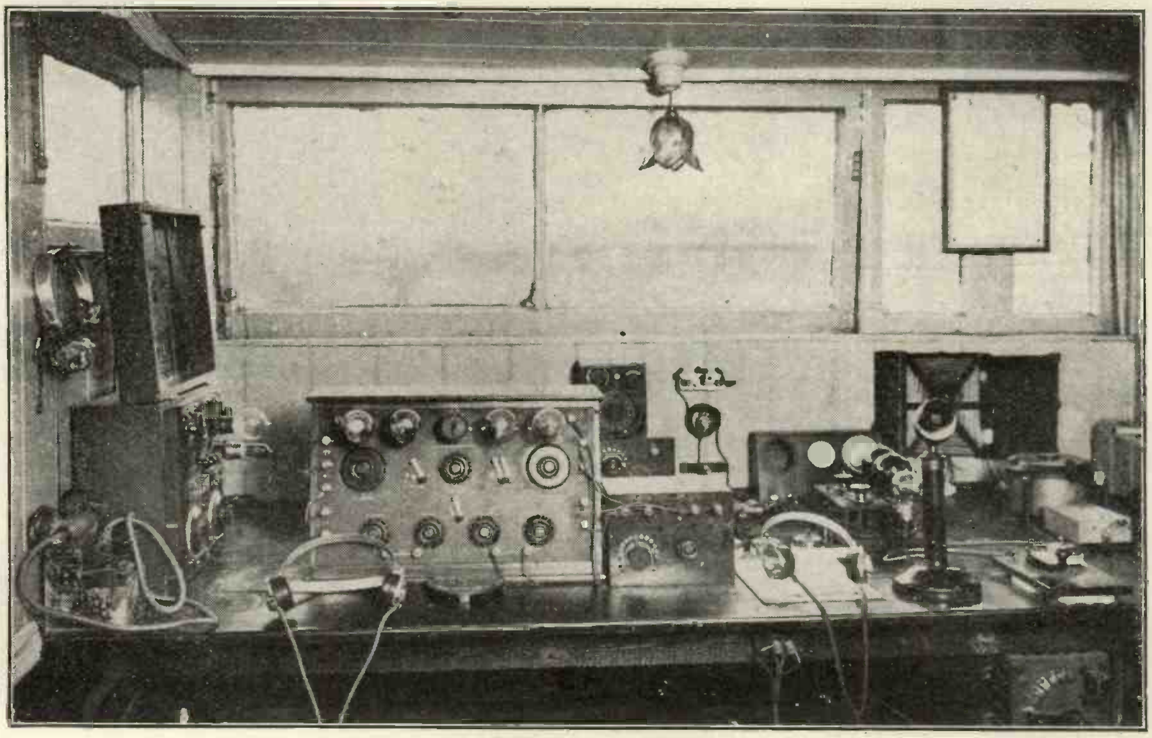
EXPERIMENTAL STATION 2KF

By J. A. P.

An efficient experimental station.

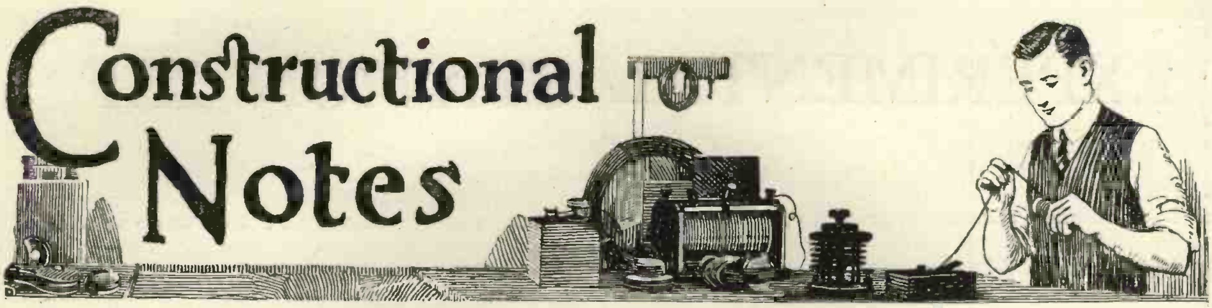
THE station 2KF is situated at Merton, on the Surrey boundary, and the surrounding land is low and flat. The aerial is entirely unscreened by neighbouring houses and is supported by two steel masts each 50ft. in height. It is of the twin wire inverted "L" type, and the distance between the masts is also 50ft. The operating cabin is situated directly beneath the aerial and contains the receiving apparatus and the transmitting controls. The earth system consists of three copper gauze mats buried 3ft. in the garden beneath the aerial. The transmitting apparatus may be used for telephony C.W. or T.T., and is equally efficient on 160, 200 or 440 metres. Grid control is employed for telephony and gives very clear and good modulation. The valves employed are:—Power-2-A.T.40, for Control-1-"R" type receiving valve. The H.T. is supplied by a B.T.H. generator giving a maximum output of 600 volts D.C., and is coupled by a belt to a ½ h.p. motor driven from the house mains. The voltage is 100 volts and is taken from the house lighting plant. This consists of a 3½ kw. Austin petrol engine coupled to a Holmes dynamo, having a maximum output of 150 volts at 40 amperes. The storage battery is of D.P. make with an actual capacity of 100 ampere hours, and from this source the house is lighted and the whole station operated.

The receiving equipment consists of a main four-valve panel, having one valve at radio-frequency and two valves at audio-frequency, with switching arrangements facilitating the use of any number or combination of valves. Two tuners enable all wavelengths to be covered, and these appear to be more efficient than plug-in type coils. As a stand-by receiver a converted Mark III. S.W. tuner is used, having been re-wired as a tuned anode receiver, with one H.F. valve crystal detector and one L.F. valve. This tuner is very efficient and the weekly concert from PCGG is received comfortably on the loud-speaker, the music and speech coming in very clearly. C.W. transmissions from 2KF have been received at Nice, Brussels and Glasgow on a detector valve only, and speech has been heard on three valves at York, Southampton and Leyden, Holland.



A general view of the station.

Constructional Notes



MAKING A DOUBLE-POLE CHANGE-OVER SWITCH.

THE double-pole change-over switch has many uses on the wireless set. Two of the handiest are seen in Figs. 1 and 2.

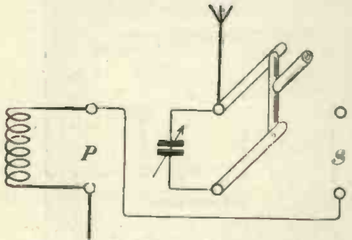


Fig. 1.—Showing use of switch.

The series-parallel switch enables the aerial-tuning condenser to be placed in either relation with the inductance in a moment, a most useful arrangement when the set is used sometimes for long-wave reception and sometimes for short. For the latter it should always be in series in order to avoid the serious damping effects upon high-frequencies of a parallel capacity.

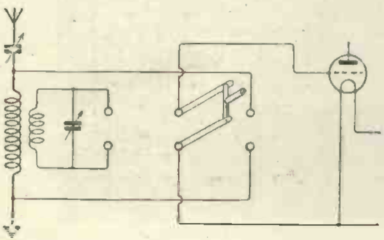


Fig. 2.—An alternative arrangement.

The "tune"-"stand by" arrangement greatly facilitates searching where several tuned stages of high-frequency amplification are employed. Throw the switch over to the right and the primary alone is in use, thus making the tuning as unselective as possible. When the desired transmission has been found and tuned-in with A.T.C. and the condensers of transformers or tuned anodes, the switch is turned right over, bringing the secondary into play.

The making of a switch of this kind is by no means a formidable undertaking. The materials required are a piece of $\frac{1}{4}$in. ebonite 2in. wide by 4in. long, a smaller piece measuring 2in. by $\frac{1}{2}$in. by $\frac{1}{4}$in., two "push-in" terminals, a few 4 B.A. screws and nuts, a supply of sheet brass, and a short piece of ebonite tubing the bore of which will just pass a 4 B.A. screw.

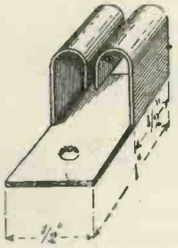


Fig. 3.—Showing dimensions of clips.

Four clips of the size and shape given in Fig. 3 are first made out of sheet brass. Next the two terminals are treated as shown in Fig. 4, a hacksaw cut being made in each, and widened a little if necessary with a thin, flat file. Clips and terminals are mounted on the ebonite base (see Fig. 5) in two rows each $1\frac{1}{2}$in. apart. The distance between the terminals and the clips is also $1\frac{1}{2}$in.

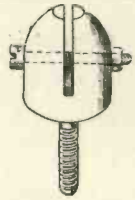


Fig. 4.—One of the two middle terminals.

In Fig. 6 is seen the double blade of the switch, which is so simple to make that no further explanation will be needed. It is mounted on the slotted terminals, each blade being secured by a 4 B.A. screw and nut. The ends of these screws may be lightly riveted to prevent them from working loose.

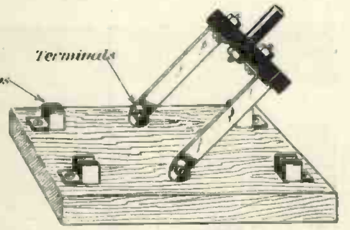


Fig. 5.—The complete D.P.C.O. switch.

The whole switch is now fixed to a polished baseboard, leads being secured by means of the nuts which hold clips and terminals in place.

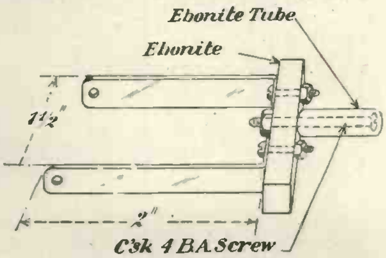


Fig. 6.—The double blade.

Apart from the uses given above, the switch may be very conveniently used as an earthing switch for the aerial.

In this latter case the two terminals on the left are connected to the receiver, whilst the two centre terminals are connected one to aerial and one to earth.

The terminals on the right should be fitted with a short-circuiting strap, so that when the switch is thrown to the right the aerial is earthed.

R. H. W.

HOW TO MAKE A HIGH-TENSION BATTERY.

THERE is nothing to be said against the commercial high-tension battery of reputed make. It is usually a sound investment, but in spite of this there are a great many enthusiasts who prefer to built up their own.

If a number of cheap, foreign pocket-lamp refills have been acquired for this purpose, trouble will inevitably follow. These refills are rushed on the market at a competitive price, the latter being the principal asset from the manufacturer's point of view. They are usually faulty, and the slightest leak in any one of the cells will create an almost endless source of trouble by causing that mysterious "frying" noise often wrongly blamed to static. If the reader, therefore, wishes to benefit by another's experience, he will purchase dry cells of the very best quality obtainable.

The ordinary 4.5 volt pocket-lamp refill comprises three small 1.5 volts primary cells connected in series so as to bring the total voltage up to 4.5. The long contact strip represents the negative pole, and the short strip the positive pole. Being made up from a series of cells, each one is a battery of cells complete in itself, so that we have to refer to each one as a battery, and not as a cell. A very serviceable high-tension unit can be built up from a dozen or so of these batteries in the manner shown in Fig. 7. The batteries are joined together in series, and tappings are taken from junctions to the studs of a multiple switch.

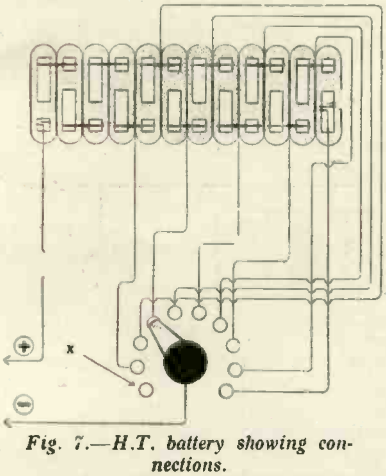


Fig. 7.—H.T. battery showing connections.

To connect the batteries in series, it is only necessary to bridge the negative strip of one to the positive strip of the next. This is done by soldering short lengths of copper wire to the strips as shown. The total E.M.F. of the twelve batteries will be $4.5 \times 12 = 54$ volts. The first tapping is taken from the fourth junction, and connected to the first "live" stud of the switch. Proceeding from the first battery on the left, it will be seen that this junction covers four complete batteries, so that the voltage or E.M.F. at this point will be $4.5 \times 4 = 18$, since the batteries are all connected in series. A lower value than this is seldom required, but if desired every junction may be tapped, in which case a corresponding number of extra switch studs will be required. The first stud X is left disconnected. This, when engaged by the switch arm, will act as a switch for cutting off the current when the receiver is not in use. This stud should be marked "off," and, as we have a tapping from every junction after the first four, the other studs from left to right should be marked 18, 22½, 27, and so on up to 54, adding another 4½ at each one.

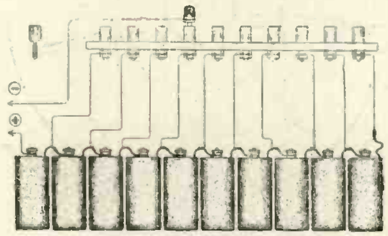


Fig. 8.—H.T. battery fitted with wander-plugs.

The batteries should be placed in a perfectly dry box, and the multiple switch mounted on an ebonite panel attached to one end. Two terminals may also be provided for connections to the circuit. It should not be necessary to add that all connecting wires should be well insulated.

Fig. 8 shows a number of 1.5 volts primary cells connected in series, with tappings taken off at every junction. These cells are usually round, and the centre contact or terminal will be the positive pole and the short piece of wire soldered to the zinc container the negative pole. Ten cells are shown, therefore the total voltage or maximum E.M.F. of the battery will be $1.5 \times 10 = 15$ volts. Such a unit will be useful for some types of valves, but it is advisable to include several more cells in the circuit. The main object of the diagram is to illustrate the high selective value of this arrangement. It is here possible to select 1½ volts at each adjustment, whereas in the former method it was not possible to obtain an intermediate value between each 4½ volts battery.

It is difficult to say which is the more convenient mechanical device for making the necessary adjustments—the multiple switch or the wander-plug—and as this is often a matter of taste, the wander-plug is here shown for the sake of variety. The sockets are made from contact studs drilled to a depth of about ¼in., and the wander-plug may either be purchased or made from a piece of brass wire slightly tapered and fitted with a nut, washer, and small ebonite knob, which is screwed down to clamp the connecting wire between the nut and washer. The studs are marked from left to right, 1½, 3, 4½, and so on, adding 1½ volts each time.

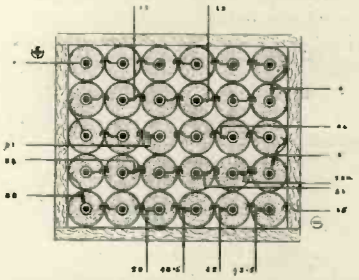


Fig. 9.—H.T. battery made with 1·5 volts per cell.

To cut off the current, it is, of course, only necessary to disconnect the wander-plug from the sockets, thus saving the expense of a switch. The studs, or sockets, as they may now be termed, are attached to an ebonite panel secured to the top of the cabinet containing the cells.

Fig. 9 shows the method of connecting up a battery of 30 primary cells, each having an E.M.F. of 1.5 volts. Intermediate values between 9 and 45 volts are obtained by taking off tappings as shown. It will not be necessary to tap lower than 9 volts, and two 4.5 volt pocket-lamp batteries may replace the first six cells if desired. The tappings may be modified at will and connected to the studs of a multiple switch or to the sockets of a wander-plug.

This battery, as shown, will make an ideal unit for the experimenter.

O. J. R.

WINDING BASKET INDUCTANCES.

On account of the ease with which they can be made, their low self-capacity, and the close coupling which can be obtained between them, basket coils are very useful to the enthusiast who is given to making up experimental circuits. Ready-made coils, which can be bought very cheaply, have two main drawbacks: in the first place, the wire used for the smaller sizes is too fine, and in the second one finds that no two sets can be relied upon to be exactly equal in inductance value.

These defects are readily remedied if coils are made at home. The cure for the first suggests itself, the second is dealt with by adhering always to a former of the same internal diameter, with the same number of slits cut in it, and by winding the coils with great care.

A further blemish on the escutcheon of the ready-made variety is that they are made self-supporting by liberal doses of shellac or paraffin wax, which, by providing a good dielectric between turns, increases the self-capacity of the coils. This can be avoided by winding the coils on cards, and by leaving the formers in position when winding is done. Fig. 10 shows a convenient size for these formers. The hole is ¾in. in diameter, and the inside ends of the slits lie on the circumference of a circle 1¾in. in diameter. The outside dimensions of the card will depend, of course, on the wavelengths which the coil is designed to cover.

There must always be an odd number of slits, otherwise the windings will not criss-cross as they should. If a protractor is available marking out is easy, the slits, nine in number, being 40° apart. Without a protractor, measurement can still be done. If a fraction over one-third of the diameter of the card is measured off with a pair of dividers, the nine divisions can be marked out with quite even spacing by simply travelling round the circumference with the dividers and making pricks with their points. Failing even dividers, use the dial of your watch. A mark made to correspond with every fourth minute will give fifteen equal spacings, or eleven can be obtained by pricking off at each 5½ minutes, and then making the tiny adjustment necesary.

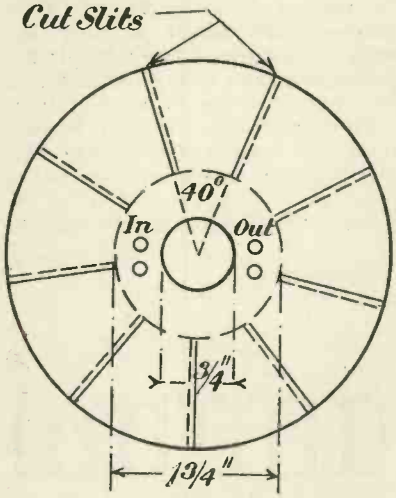


Fig. 10.—Showing dimensions of former.

When winding, anchor the end of the wire by passing it two or three times through a pair of holes on the left of the former, which should be marked "in" in ink. Carry the wire to the first slit, and wind clockwise, holding the former in the left hand and the wire in the right. The wire is woven in and out of the slits like basket-work, hence the name given to these inductances.

When winding is finished, pass the end of the wire from the outside to the inside of the coil through one of the slits, and anchor it as before, but on the right-hand side, marking this pair of holes "out." One will never have to puzzle out which end is which, or be in doubt as to the direction of the windings, for you know that they run from "in" to "out" in a clockwise direction.

For short-wave work a set of coils should be wound with No. 24 or 26 gauge wire; these will be found far more efficient than those that are made with the very fine wire usually employed. O. J. R.

IMPROVING RECEPTION.

An extraordinary improvement in the quality of one's receptions can be made by shunting the secondaries of low-frequency transformers with resistances of the order of 70,000-100,000 ohms. In some cases it pays also to shunt their primaries, and if high-frequency transformers are used it is worth while to try

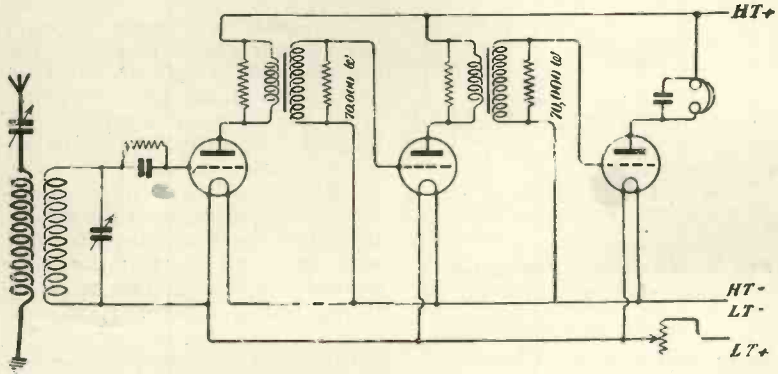


Fig. 11.—Showing positions of resistances.

the same experiment with them. Fig. 11 shows the connections for a three-valve set containing two low-frequency stages.

It will be found that the insertion of the resistances cuts down slightly the volume of sound produced by the set, but their damping effect is far greater on the mush then on the genuine transmissions; the former almost disappears, whilst the latter, freed from its unpleasant accompaniment, come through with a purity and a clarity that adds enormously to one's pleasure in listening to them.

Further, the harshness that was previously noticeable at times is now conspicuous by its absence. Apparently note-magnifying transformers in the "unshunted" state respond better to some frequencies than to others. There is thus a "peak effect" which is flattened out by the insertion of the resistances, with the result that the transformers pass all audio-frequency impulses almost equally well.

There are several other places in the set where resistances might possibly be used with beneficial effects, and these will suggest themselves to readers who are fond of making experiments. So far I have confined my tests to high and low frequency transformers only, but when time permits I hope to experiment with shunting as applied to other circuits of the receiving set.

R. W. H.

INCREASING THE RANGE OF THE CRYSTAL.

THOSE who use the crystal detector obtain one great advantage: the crystal is a nearly perfect rectifier, and gives practically none of the distortion that is sometimes present when rectification is done by means of a valve.

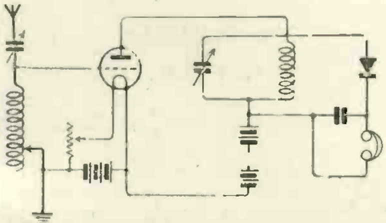


Fig. 12.—Wiring diagram showing the addition of valve.

The ideal combination for the reception of wireless telephony is to use a valve or valves for amplification and a crystal for rectifying purposes. The rectifying properties of the crystal improve enormously if the currents passed through it are strengthened: in fact, if we double their strength the efficiency of the crystal is increased four-fold. Hence we may expect excellent results if we magnify the impulses received in the aerial circuit before passing them on to the detector. This we can do by making use of a valve as a radio-frequency amplifier.

To add a valve to a crystal set increases its range by about three-fold. It is a job that anyone can tackle, and it is by no means an expensive one.

Although in Fig. 13 a No. 75 Igranic honeycomb coil is shown shunted by a 0.0002 μF condenser, yet in many cases a No. 50 coil shunted by a 0.0005 μF variable condenser will be preferred. The wavelength range of the latter combination will include all the broadcasting stations.

A small saving can be effected, if expense has to be considered, by using a four-volt accumulator without a rheostat (this will answer quite well with an Ora valve) and by substituting a basket coil for the more expensive type. The smaller accumulator is, however, not recommended, since it is always advisable to have six volts, so that there may be plenty in hand.

The wiring diagram of the circuit is given in Fig 12, whilst Fig. 13 shows how the set is assembled. It will be noticed that every part of the original crystal apparatus is made use of.

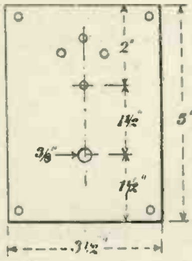


Fig. 14.—Dimensions for valve panel.

The ebonite for the valve panel is trimmed up, laid out, and drilled. The hole for the bush of the rheostat is ⅜in. in diameter; the others, Fig. 14, are preferably made with a No. 35 drill and tapped 4 B.A., but if taps are not available a No. 26 drill may be used, which makes a clearance hole for the 4 B.A. terminals. The wiring is so straightforward that nothing need be said about it.

The condenser shown in series with the aerial is not absolutely necessary if an inductance with sliding contact is used, though its presence may be a help to fine tuning. The smaller condenser can be made from one of the complete sets of parts supplied by advertisers in this journal.

R. W. H.

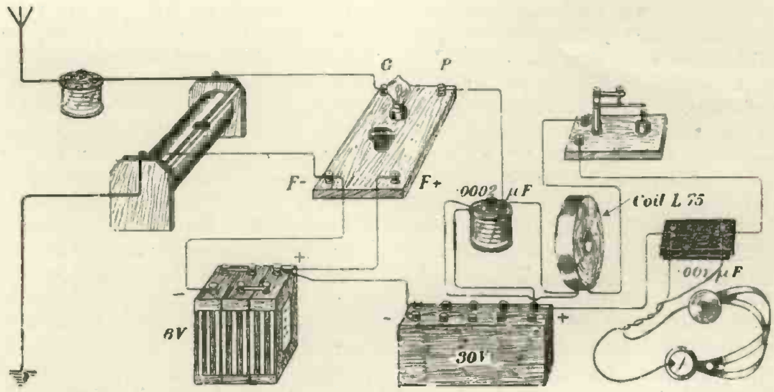


Fig. 13.—The completely wired apparatus, note the valve panel is made of wood instead of ebonite. If the former is used the terminals should be bushed with ebonite.

WORKING IN EBONITE.

EBONITE is one of the most delightful of all materials to work in, for the beautiful finish that can be given to it without much labour results in jobs that are pleasing to the eye and flatter one's ability as a wielder of tools. It is just hard enough to cut and drill cleanly, but not so hard as to make special tools or great skill necessary for working it.

If reasonable care is exercised and ebonite of not less than $\frac{3}{16}$in. in thickness is used, it will not display any undue tendency to crack. Very thin, hard ebonite is, however, a different pair of shoes altogether, especially if it is highly glazed on both sides: it will split on the slightest provocation, and it usually chooses to do so, to the detriment of one's temper, just as the last of many holes is being drilled.

When buying ebonite do not, if you can help it, purchase material with a glossy mirror-like surface. Beauty is but skin deep, and in this case the skin, whose very smoothness ruins its insulating qualities, is just what we do not want in the panels of the wireless set. High-frequency currents are difficult enough to keep in their proper places anyhow, and to provide them with a highly polished path between terminals that must of necessity be set close together is to ask for trouble. The best material is that which has a semi-finish: besides looking well it can be relied upon to be thoroughly efficient. If you find that you cannot obtain this quality the highly polished ebonite may be robbed of its undesirable glossiness in the workshop. The process is simple and does not demand a great deal of time. Rub the surface of both sides with a worn piece of the finest emery cloth until it takes on a greyish hue. Then make a thin paste of knife powder and turpentine and rub it on with a rag. This gives exactly the finish that we require—dead black and quite smooth, but not shiny.

Ebonite may be cut very easily with a hacksaw, but where long straight edges are needed a stiff-backed wood saw will be found the handiest tool. It may be blunted a little in the process, but if it is lubricated with turpentine the damage will be slight. The writer has had one in use for this purpose for months, and though it must have cut up many pounds of ebonite, it is still in quite respectable condition. Having marked out your edges with a set-square, lay a piece of wood with perfectly straight sides along the line to be cut and hold it firmly in place with the left-hand so as to act as a guide for the saw. This will save the panel from disfigurement by preventing the saw from slipping. Never draw pencil lines on the ebonite when marking out your panels. Graphite lines provide paths along which high-frequency currents are only too ready to wander.

A scriber will be found quite satisfactory so long as marking is done on what will be the underside of the panel: the method preferred by the writer is to stick strips of stamp-edging on to the ebonite and then to mark on them with a pencil. A long strip goes on to each edge in the place where the terminals will be, other patches are put approximately in the positions to be occupied by valve-holders, rheostats, condensers and so on. One then marks on the paper with a pencil, by the aid of ruler and set-square, centre-punches for drilling and washes off the stamp edging.

For cleaning up the edges of your panels use first of all a medium file, then rub with a fine emery cloth, and finish off by means of the turpentine and knife powder process.

For making holes twist drills should be used, and if they are to keep their cutting edges they must be well lubricated with turpentine. Holes up to about $\frac{3}{16}$in. diameter may be made with an ordinary hand-drill: for the larger sizes, unless the drill-chuck is specially big, a brace will have to be used—supposing, that is, that a lathe or drilling machine is not available. It is not easy to bore straight with either hand-drill or brace without a certain amount of practice, but the process can be facilitated considerably by the use of guide-blocks, pieces of hard wood containing holes through which any particular size of drill will just pass comfortably. If clamped to the ebonite immediately over the punch work, a guide-block enables one to keep the drill vertical without great difficulty.

For general purposes it is best to use B.A. screws and bolts. Though these are supposed to be made to an exact standard, they are apt to vary a little, especially, for some strange reason, in the odd-numbered sizes. The experimenter will find that most, if not all, of his needs are met if he provides himself with clearing and tapping drills for 2, 4, 6, and 8 B.A., and a $\frac{3}{8}$in. drill for making holes to take the bushes of condenser and rheostat spindles.

Tapping is an art that comes by practice. The essential thing is to start the tap straight: if that is accomplished it will continue of its own accord in the way in which it should go. To begin with, at all events, you may find it easier to make use of the guide-blocks already recommended for drilling purposes. Lubricate your taps with turpentine, don't run them in too quickly, and clear them frequently from the ebonite dust which clogs their threads. R. W. H.

A NOVEL SLIDER.

A SIMPLE form of slider suitable for potentiometer control or the control of tuning coils, etc., can be easily made by slipping an ordinary fountain pen clip on to the square brass rod and hammering the clip square. The back of a small cheese-headed brass screw is soldered on to the back of the clip and a threaded ebonite knob screwed on to this. This type of sliding contact will afford a very easy movement, and does not tend to wear away the surface of the wire.

The uses that may be found for a slider, in a receiver, are many, and though there are some dozens of various types, manufactured and home-made, the one described above serves its purpose as well as any the writer has seen.

AN EXPERIMENTER'S SINGLE VALVE PANEL

By A. JOHNSON.

A practical article giving particulars of the starting point of all valve receivers.

THE following is a description of a single valve panel which will be found capable of being put to a variety of uses, either alone or in combination with other valve or crystal apparatus. The construction will be dealt with first. The ebonite panel, about 6in. by 5in. by ¼in. thick, forms the lid of a shallow box about 2½in. deep. The bottom must be left out until all connections are made. A valve holder is fitted in centre of top of panel as shown in diagram. Eleven terminals are fitted in positions indicated. The potentiometer must

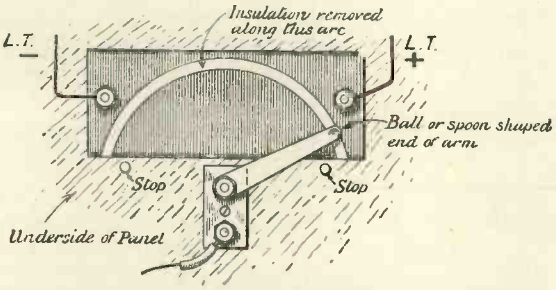


Fig. 1.—Showing construction of potentiometer.

now be made up. This consists of a close winding of about No. 38 s.w.g. single silk-covered Manganin or Platinoid resistance wire on a slate former about 2½in. long, 1in. wide, and ½in. or ¾in. thick. Two holes are drilled through the ends of the slate to take long brass screws, which form a means of fixing to panel and also the terminal ends of the winding, as shown in Figs. 1 and 2. After winding, the wire should be given a coat of shellac varnish, and the whole fixed in the desired position. A moving contact arm is now made of light phosphor-bronze, the actual contact being made to present a ball surface to the winding by knocking a blunt centre punch on the extreme end of arm whilst it is supported on a piece of fairly soft wood, as shown in Fig. 1. Stop pins should be fitted to the potentiometer to prevent the contact arm jumping off the winding if the knob is turned too far in either direction. It remains now to fit the customary knob and pointer. A filament resistance of usual type is fitted on the same level as the potentiometer knob. The grid condenser and 2 megohm leak are fitted between the two terminals A and B, Fig. 3, and a connection taken from B to the grid socket of valve holder. The scales for potentiometer and filament resistance may be cut direct on the ebonite if desired by means of a strong pair of dividers, and the lines filled in with white oil paint.

It is not proposed to describe the internal wiring in detail, as this is clearly shown in Fig. 3. The wiring should be carried out with fairly stiff copper wire in insulating tubing. The insulation of the potentiometer winding must now be removed by means of fine emery cloth held under the ball point of the contact arm. This is rather a tedious job, but if care is taken and a slight extra pressure applied to the arm, the actual wire will soon become visible on the arc of the circle which the ball point describes. Having finished the construction, a few hints as to use in various circuits will be given.

Single Valve Detector with Grid Condenser and Leak

Connect a suitable accumulator to the terminals indicated. The terminals A and C are to be connected to the tuner and terminals

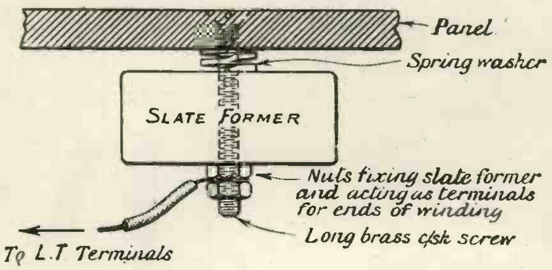


Fig. 2.—Attachment of potentiometer former.

R, R to the reaction coil if used; if not, short these two with copper wire. The usual anode battery connections are to be made to D and E (positive to D), and the telephone or step-down transformer connections to F and G. The potentiometer may now be adjusted to give the best rectifying potential to the grid of the valve through the tuning inductance and leak.

Single Valve without Grid Condenser or Leak

Connections as above, but change the lead from A to B. The potentiometer adjustment is important with this arrangement. It may be pointed out that the telephones are on the low-potential side of the high-tension battery, which is a much better arrangement.

H.F. Amplifier with Crystal Detector

Connections as above, *i.e.*, tuner leads remaining at B and C. Transfer the H.T. battery leads to F and G (positive to F) after removing 'phones. Across D and E connect a suitable inductance, with variable condenser in parallel, to tune to same wave-length as aerial circuit, and across this condenser connect crystal detector and 'phones in series. The potentiometer allows the best amplifying position to be easily found.

This panel may also be used as a rectifying panel after one or more H.F. amplifying valves, the potentiometer being used to control the grid potentials of all of them.

Its use as a low-frequency amplifying panel in conjunction with an inter-valve L.F. transformer will be apparent to most experimenters. It has not been considered necessary to go into minute details of the construction and assembling of the various parts, as the mode of procedure is well known.

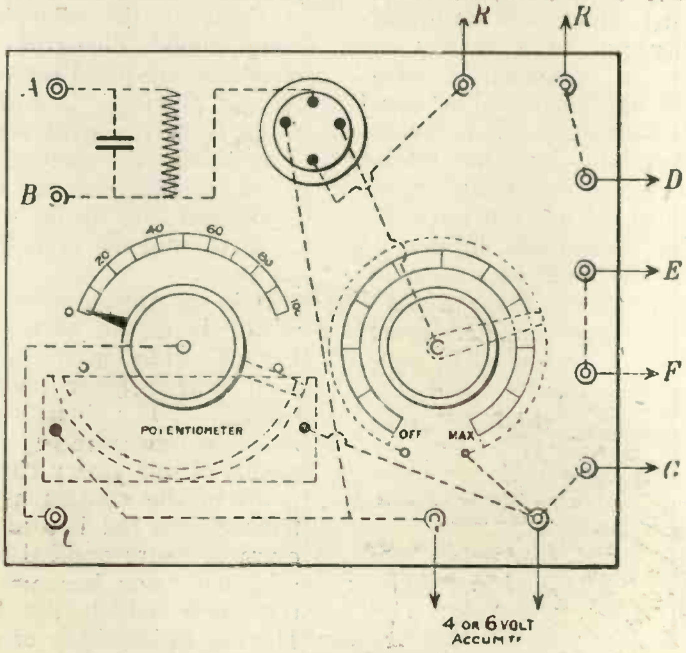
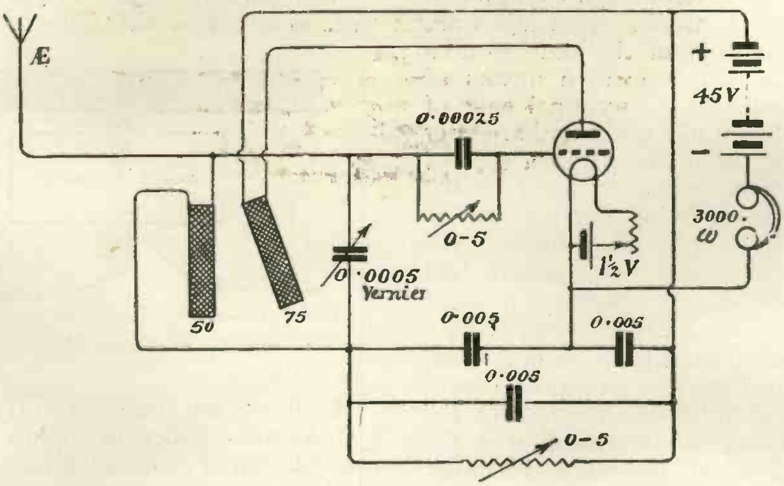


Fig. 3.—Wiring of panel.

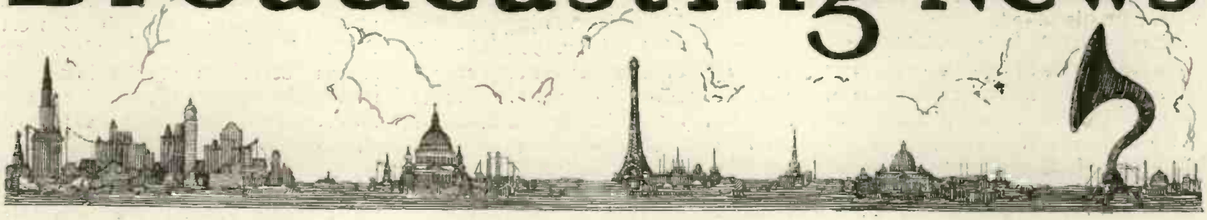
A NEW CIRCUIT

THE circuit illustrated herewith is what is known as the Flewelling circuit, and bears a reputation of no mean order. We have not yet had an opportunity of testing its virtues ourselves, but we are given to understand that the circuit possesses remarkable abilities, and for the information of our readers the circuit is here given.



The capacities of the condensers shown in the diagram are given in microfarads, and the "leak" resistances in megohms. The coils are of the De Forest or Igranic type, whilst the valve is evidently a 1½-volt dull emitter, for which an ordinary receiving valve requiring four or six volts on the filament might be substituted.

Broadcasting News



By OUR SPECIAL CORRESPONDENTS

PRINCESS ALICE seemed to be extremely shy while broadcasting her talk on the Adoption of Babies. There were several lady journalists who would have liked to listen to the speech in the studio, but Her Royal Highness preferred to have the place practically empty. Perhaps if she had allowed the journalists to report her speech, she would have got a better Press.

* * *

Miss José Collins was exceedingly modest about broadcasting a talk about beauty, and preferred to sing a couple of songs instead, so that her listeners-in did not lose in the transaction. She says it is much easier singing than speaking into the microphone.

Miss Collins is quite a practised hand at singing into the microphone, and she has ideas of her own as to the best way to do it. She wanted to sing a high note very softly, so in order to do this with the greatest effect she ran from a distance of 6ft. away from the microphone close up to it.

Had she not done so, she sang it so softly, that the probability is that it would not have been heard at all. It was quite a revealing intimate touch, and it gave one a glimpse of Miss Collins' consummate powers as an artist. She sings not only with her voice but with her brain.

Sir Wm. Joynson-Hicks, M.P.
Postmaster-General.

Lord Birkenhead's speech at the opening of 2LO was a very brilliant affair, and has been very freely commented on, although, owing to the lateness of the hour, it was inadequately reported in the Press. He was inclined to drop his voice too much, and some of his polished sentences were not heard to advantage.

* * *

The new cookery lessons which are a feature of the Women's Hour are giving much satisfaction to those for whom they were intended. Communications have been received asking that they be read more slowly in order that the details may be written down. It is to be hoped that those who are listening-in have their receiving sets in good order or there may be some confusion as to the quantities of ingredients. We don't want anyone to start a League of Dispeptic Husbands whose wives are cooking by wireless.

* * *

It is an extraordinary thing how some newspapers find it difficult to give the B.B.C. fair play. The meeting between the representatives of the company and the Concert Artistes' Association was lively and interesting. There was some good cut and thrust work by Mr. Jimmy Glover and others, but a harmonious settlement was reached, that representatives of the Concert

Artistes' Association should meet with Mr. J. C. W. Reith, the General Manager of the B.B.C., when matters of mutual interest, including a minimum fee for artistes, would be discussed.

In spite of this decision, which was reported in most of the morning papers, the particular organ which is leading the stunt against the B.B.C. came out with a scare heading that the Concert Artistes' Association had joined in the attack on broadcasting. A paper is entitled to express any views that it likes, but surely the readers are entitled to accuracy in the news.

* * *

As a matter of fact the Concert Artistes' Association displayed great reasonableness and moderation, and they left their artistes with an entirely free hand. If all the interests which are opposed to the B.B.C. are equally fair-minded and reasonable in their demands, then there will soon be a happy issue out of all the broadcasting troubles.

* * *

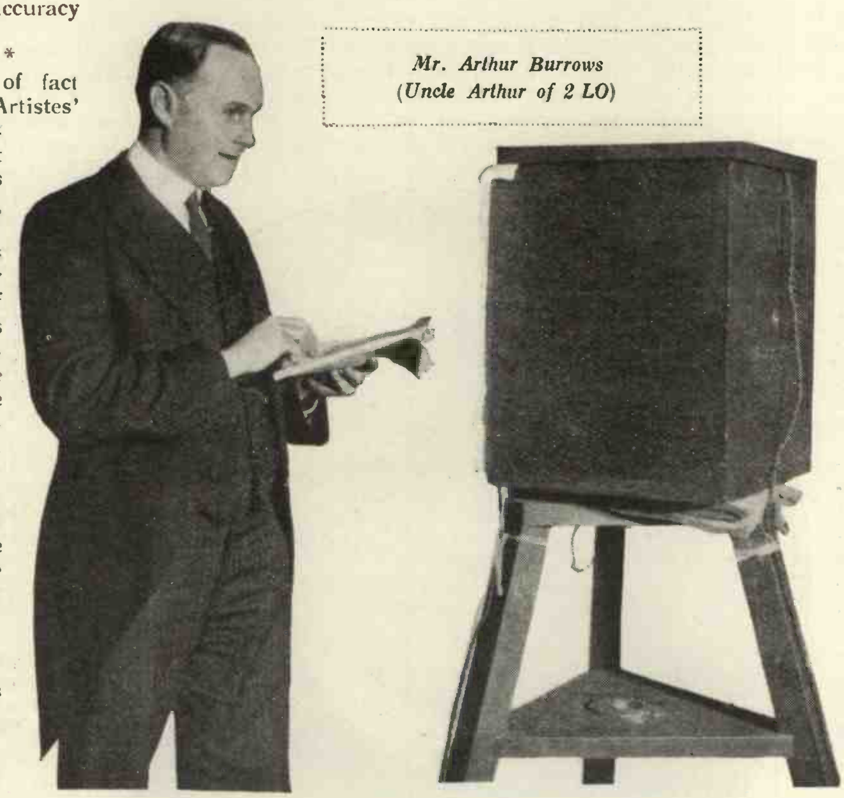
Mr. C. B Cochran thinks that what wireless wants is a super-showman. The theatrical industry has all the super-showmen, but they don't seem to be very good at their job, otherwise the rôle of Jeremiah wouldn't be so popular in the profession. Wireless doesn't require any more showmen, but the showmen would be none the worse for the help that wireless could give them, in order to bring their productions before the widest possible audience.

* * *

Efforts are being made to fix a site for the permanent studio of the Birmingham station. The new transmitting station will probably be at the electrical power station.

* * *

Now that the summer season is here it would be interesting to know if those who are responsible for catering for outdoor entertainment will be sufficiently alive to avail themselves of the possibilities of wireless. There is no reason why seaside resorts should not have loud-speakers for the reception of popular musical programmes. Hints on swimming could be broadcast for the benefit of those who go in for bathing for some other purpose than displaying their fetching costumes, without in any way interfering with the employment of the many deserving artistes who make a living as pierrots and seaside entertainers. There are many occasions in which the help of wireless could be enlisted to brighten Brighton, make Margate merry, and, in general, to ensure that when the question "What are the wild waves saying?" is asked, the answer will be something always merry and bright.



Mr. Arthur Burrows (Uncle Arthur of 2 LO)

Mr. Arthur Burrows, the premier voice at 2LO, has so long been accustomed to speaking continuously without interruption that has was considerably disconcerted at the meeting of the Concert Artistes' Association, when on several occasions very pointed interjections were made by the audience. In the early days of broadcasting Mr. Burrows received a letter from an octogenarian as follows, "I die happy. I have found a man who can get the last word with a woman."

* * *

The B.B.C., by arrangement with the British National Opera Company, will broadcast excerpts from the Grand Operas playing at Covent Garden during the six weeks' season commencing in the second week of May. The operas from which selections will be played are provisionally as follows:—Valkyrie, Thursday, May 17th; Faust, Saturday, May 19th; Aïda, Monday, May 21st; The Magic Flute, Wednesday, May 23rd; Phœbus and Pan, Saturday, May 26th; Hansel and Gretel, Wednesday, May 30th; La Bohême, Friday, June 1st; Cavalleria Rusticana and Pagliacci, Saturday, June 2nd.

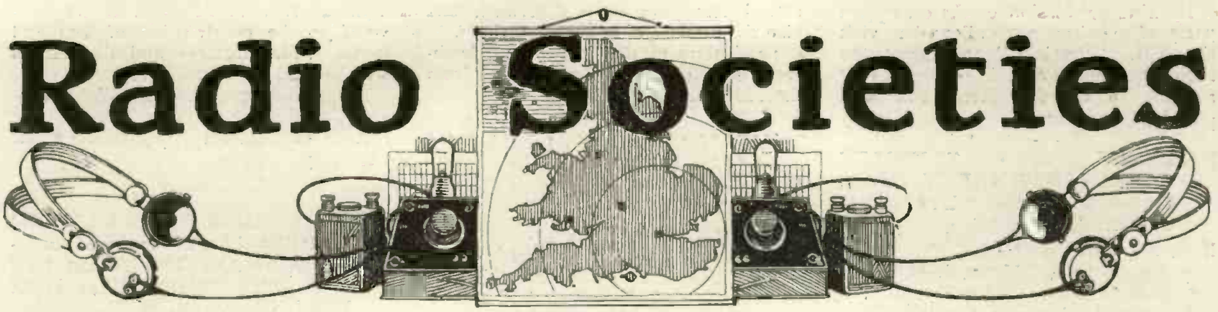
* * *

The Cardiff Sunday Classical programmes still continue to attract great attention. One wonders if this is not really the solution of the Sunday programme.

* * *

Mr. Percy Edgar is keeping the Birmingham station well to the fore. He has the showman-like touch in its best sense that Mr. C. B. Cochran so desires.

Radio Societies



BIRMINGHAM EXPERIMENTAL WIRELESS CLUB (H.Q., Digbeth Institute, Birmingham).

The remarkable advances recently made in amplification of wireless signals were demonstrated by Mr. C. F. Bayton, who exhibited a fine collection of apparatus. Stations were tuned in on an ordinary crystal receiver, and were just audible in the 'phones. These signals were then passed on to a two-valve power amplifier, using 300 volts H.T., the results being absolutely deafening in the loud-speaker and free from distortion. The lecturer then showed experiments, using valve receivers instead of the crystal, and stated that crystal detectors had still a large field of usefulness, owing to their distortionless qualities. He was of the opinion that for local broadcasting, used in conjunction with power amplifying valves, they would find considerable favour in the near future.

BOURNEMOUTH AND DISTRICT RADIO AND ELECTRICAL SOCIETY.

Hon. Sec., Mr. A. Reynolds,
Town Hall,
Bournemouth.

On April 27th a discussion was held on "Difficulties and Experiences of the Week." The difficulties were dealt with as they arose by Mr. E. T. Chapman, A.M.I.R.E.E., a member of the Society, and the programme proved such a success that further discussions on similar lines are being looked forward to.

CAMBRIDGE AND DISTRICT RADIO SOCIETY (H.Q., Liberal Club, Downing Street, Cambridge).

Hon. Sec., Mr. J. Butterfield,
107, King Street,
Cambridge.

On April 30th Dr. E. V. Appleton, M.A., D.Sc., gave a lecture entitled "Recent Investigations on the Elimination of Atmospherics." He described the Kathode-Ray Oscillograph used in the Cavendish Laboratories for recording wave forms of atmospherics, and stated that they lasted from 1-500ths to 1-1,000th of a second, being most common after dusk and until sunrise. The usual direction of reception of these disturbances is from South to North, and, although the stream of maximum atmospherics is steadily directional from sunset to sunrise, this direction gradually changes to a south-easterly course from sunrise to noon and then reverts to the south.

It seems to be a rule that the nearer the receiving station is to a storm the longer are the atmospheric disturbances, and, although thunder may not be heard, all atmospherics are probably due to lightning discharges. The lecturer stared that on the average five storms are in existence at some point of the earths surface at any moment, and are sufficient to create disturbances all round the globe.

DARTFORD AND DISTRICT RADIO SOCIETY (H.Q., Dartford Grammar School).

Hon. Sec., Mr. E. C. Deavin,
84, Hawley Road,
Dartford.

The usual general meeting was held at headquarters on Friday, May 4th, when the first unit of the Society's four-valve set—namely, the detector panel, coils, etc.—was presented. This panel is wired up on the three-coil principle, and is designed for the experimental addition of high- and low-frequency amplification. It is anticipated that the remaining units will be completed by the next meeting. A discussion on crystal receiving sets furnished interesting information with regard to the methods adopted in the home construction of apparatus.

All interested in wireless are cordially invited to communicate with the Hon. Secretary.

DEWSBURY AND DISTRICT WIRELESS SOCIETY (H.Q., Central Liberal Club, Bond Street, Dewsbury).

Hon. Sec., Mr. F. G. Gomersall,
1, Ashworth Terrace,
Dewsbury.

This Society held their first "Difficulties" night on May 3rd, several members bringing up radio trouble for discussion. A temporary aerial was erected, and the programme from Manchester and part of that from London were received. The receiving sets used were lent by Mr. F. Dransfield (a three-valve home-made set) and Mr. J. T. Foggo (Gecophone and two-valve note magnifier).

This Society has decided to hold their future meetings and demonstrations at the Central Liberal Club, where reception is distinctly more favourable than at their rooms in Church Street.

GORTON AND DISTRICT WIRELESS SOCIETY (H.Q., Gorton Villa, Hyde Road, W. Gorton).

Hon. Sec., Mr. T. E. Rowe.

On April 19th an interesting lecture on "The Valve: Its Functions, etc.," was given. Meetings not devoted to lectures are mainly for answering questions on members' troubles with regard to their sets.

The members are building a three-valve set in such a way that further apparatus may be added; this set is to be used for demonstrations and for the use of members.

A hearty welcome is extended to all enthusiasts in the district, and all particulars will be forwarded on application to the Hon. Secretary at the headquarters.

HACKNEY AND DISTRICT RADIO SOCIETY (H.Q., Y.M.C.A., Mare Street, Hackney, E.8).

Hon. Sec., Mr. C. C. Phillips,
248, Evering Road,
E.5.

On April 26th Mr. F. G. Francis, B.Sc., gave a lecture entitled "The Characteristic Curves of Valves." Graphs were used in conjunction with pictorial representations of damped and continuous waves to explain amplification and rectification, the operation of the valve being shown by the aid of its characteristic curve.

The lecturer, aided by characteristic curves, kindly lent by Messrs. Negretti & Zambra, then proceeded to explain the relative merits of French "R" and Cossor C.V.C. valves as detectors and amplifiers, and gave a short explanation as to the use of valves as note magnifiers. After a large number of questions had been answered Mr. Francis promised to lecture on the "Dual Amplification Circuit" at a later date.

By kind permission of the owners, a party of members were allowed to visit the S.S. "Patricia" to inspect the radio equipment, and it is hoped that a visit to Croydon Aerodrome will shortly take place.

HORNSEY AND DISTRICT WIRELESS SOCIETY (H.Q., Queen's Hotel, Broadway, Crouch End, N.8).

Hon. Sec., Mr. H. Hyams,
188, Nelson Road,
Hornsey, N.8.

A demonstration was recently given with the Society's new receiving set, which was constructed by a member of the Committee, Mr. W. Trotman. The set is built on the "unit" system and contains five panels connected by brass strips. The first panel contains three condensers, and is followed by high-frequency, detector, and two low-frequency panels. The whole is mounted on a baseboard 3ft. long by 15in. wide, and each panel may be detached to enable members to inspect the wiring. When not in use the whole set is enclosed by a polished mahogany cover. On May 27th this set will be taken to the Wigmore Hall, when 500 disabled soldiers will be present and messages broadcast by celebrities in aid of the Adair Wounded Fund will be received.

NORTH LONDON WIRELESS ASSOCIATION (H.Q., The Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.).

Hon. Sec., Mr. J. C. Lane.

Mr. V. T. Hinckley gave, on April 30th, a lecture entitled "The Experimenter's Workshop."

Easy methods for making one's own tools and parts were given, and some were actually made at the meeting. The correct methods of soldering, easy ways of handling and marking ebonite and lacquering were explained. This practical lecture resulted in the enrolling of new members.

Particulars as to membership may be obtained on application to the Hon. Secretary.

RADIO SOCIETY OF HIGHGATE (H.Q., Highgate 1919 Club, South Grove, Highgate, N.6).

Hon. Sec., Mr. J. F. Stanley,
B.Sc., A.C.G.I., F.R.A.,
49, Cholmeley Park,
Highgate, N.6.

Mr. H. Andrewes, B.Sc., gave, on April 27th, the fifth of a series of elementary lectures. He stated that, unless reaction were employed, a single valve (detector) was little better than a crystal, and consequently a waste of good "juice." Reaction, the reception of C.W., and the cure for "howling" were dealt with, and mention was made of the Armstrong super regenerative receiver. Wavemeters and separate heterodynes were described, and also the method of calibrating them.

Particulars of the Society and forthcoming lectures may be obtained from the Hon. Secretary.

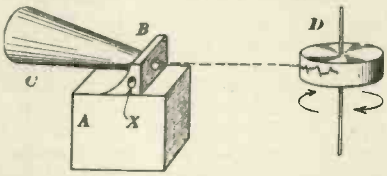
TOTTENHAM WIRELESS SOCIETY (H.Q., The Institute, 10, Bruce Grove, Tottenham, N.17).

Hon. Sec., Mr. S. J. Glyde,
137, Winchelsea Road,
Tottenham, N.17.

On April 25th Professor A. M. Low gave a lecture on his recent invention, the Audiometer, which photographs sounds and enables measurements to be taken to determine their purity. The two main difficulties in obtaining purity of sound from a diaphragm were explained, namely (1) the need of a heavy diaphragm to overcome the comparative solidity of the air; (2) making the diaphragm reasonably free from distortion. Wave forms of various sounds were thrown on the screen, and in the demonstration which followed many members were shown the wave forms of their own voices. The lecturer then concluded by explaining the construction of a home-made Audiometer.

The Audiometer.

The instrument consisted of a horn focussing the sound on a very thin diaphragm of celluloid which carried a tiny piece of silver. Light was reflected from this mirror on to a revolving screen or drum carrying photographic film. Vibration of the diaphragm caused corresponding fluctuations of the reflected beam of light, and the quality of the sound could then be carefully examined. Sounds of a frequency up to 20,000 could be studied by this machine.



A, Box containing source of light X and carrying frame.
B, Ebonite frame having a celluloid diaphragm on its sloping face.
C, Cardbord horn covered with insulated tape to reduce self resonance.
D, Drum carrying screen or film.

New members will be welcome, and should communicate with the Hon. Secretary.

TREHARRIS AND DISTRICT RADIO AND SCIENTIFIC SOCIETY (H.Q., Mr. D. Osborne's Studio, Perrott Street, Treharris).

Hon. Sec., Mr. D. D. Richards,
"Mametz House,"
Bontnewydd Terrace,
Trelewis, Glam.

This new radio society will hold meetings at 6.30 p.m. on Tuesdays and Thursdays. Tuesdays will be devoted to the construction of sets and parts, whilst lectures and discussions will be held on Thursdays.

All intending members will be welcomed and given every assistance. For further information apply to the Hon. Secretary.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., The Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4).

Hon. Sec., Mr. H. W. Cotton,
19, Bushey Road,
Harlington,
Hayes, Middlesex.

Mr. T. W. Hyne Jones gave, on April 24th, a further paper on batteries entitled "Charging Accumulators," which was the result of many questions asked at the previous meeting. Points dealt with were—the ammeter and its uses, lamps and potentiometer resistances, results of incorrect charging rate, back pressure, etc. Afterwards a discussion took place relating to the proximity of aerials.

Particulars of objects, subscriptions, and membership of this Society will be gladly sent upon application to the Hon. Secretary.

WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., Camberwell Central Library, Peckham Road, S.E.15).

Hon. Sec., Mr. G. Sutton,
A.M.I.E.E.,
18, Melford Road, S.E.22.

A demonstration was given, on April 26th, by Mr. P. Voigt, B.Sc., four Amplion loud-speakers, kindly lent by Messrs. Graham, of Brockley, filling the hall with ample volume of melody. Only a crystal detector and a single valve employing dual amplification were used.

An exhibition of members' home-constructed apparatus proved that this Association is an experimental one, and only the Experimental Licence is suitable in this case.

We regret that a number of reports received late are unavoidably held over until next week.

Will Radio Society secretaries kindly arrange for reports to reach us by first post each Tuesday, if possible.

THANKS.

THE WIRELESS SOCIETY WHOSE MEMBERS HAVE COLD FEET

By AN ANONYMOUS SECRETARY.

We frequently hear of the decreasing attendance of Radio Societies, and it is hoped the hints given herein may prove of assistance.

EVEN in the present boom of wireless, and the constant additions to the list of wireless societies, it is a melancholy fact that, for some reason or other, the members of some of the older established societies have what is known as "cold feet."

The writer of the following article, who is a successful secretary of a successful Wireless Association, submits these remarks in the hope that other Societies may benefit by his experiences.

An old-established, well-connected, brilliantly officered Wireless Society was on its last legs. One attendance had been recorded as comprising the secretary and his assistant.

The despondent secretary, a friend of the writer's, appealed to him for assistance, even going so far as to suggest the amalgamation of his Society with the successful, lively and crowded one.

Now, why should one Society be crowded and continually growing and the other losing ground?

It all turned on the "new blood" element.

No Society, unless continually enrolling new members, can hope to make progress, for Wireless Society life is like a man on a bicycle: he must either go on or go off.

In the foregoing case, the writer appealed to his Association. Might he be allowed to go to the rescue of the sick Society?

His members gave him their enthusiastic consent to act in their name in any way he deemed necessary to effect the purpose of infusing new life into the old concern.

The following letter was then written and dispatched:—

"DEAR X.—

"My Association, at last night's meeting, was unanimous in giving me full powers to assist the Y. Society in their name, to any extent and in any direction which may be deemed necessary.

"You suggested amalgamation, but I think it is a pity that your Society should lose its locality, particularly as we, at Z, are already overcrowded at our meetings, and would only be able to offer an equivocal hospitality, so, as a preliminary, I would venture to suggest a reconstitution under the new name of the Y. Wireless and Experimental Association.

"I would also deferentially suggest that as your spare time is so much occupied with practical experimental work, you find it incumbent on you to resign the Secretaryship, but hope that the new Association will take advantage of your freely offered assistance in a technical way, as adviser and helper.

"Choose a man of outstanding energy and resolution for your successor, and another man, not necessarily a 'big noise,' but one who would consider it his duty to turn up regularly, as a Chairman. The Treasurer also should be a regular attendant.

"Having these three officers popularly and properly elected, anybody else is more or less 'makeweight,' and can be called Presidents or any other old name.

"Reappoint your 'Agenda Committee' and post them at the doors to enquire personally of each member if he has any difficulty which he would like to have discussed. Any points on his set or his reception upon which he is not quite clear.

"Could he suggest anything which would add to the comfort of the meeting or the edification of the members?

"You have proved your goodwill and attachment to the Society by remaining its Secretary for so long a time, and you can still solicitously watch over its destinies while another Secretary wields the pen.

"I will do anything in my power to assist you or the Society, for the sake of the wireless interest which I have so much at heart.

"I beg that you will give the foregoing your earnest consideration, and let me know how the ideas set forth appeal to you.

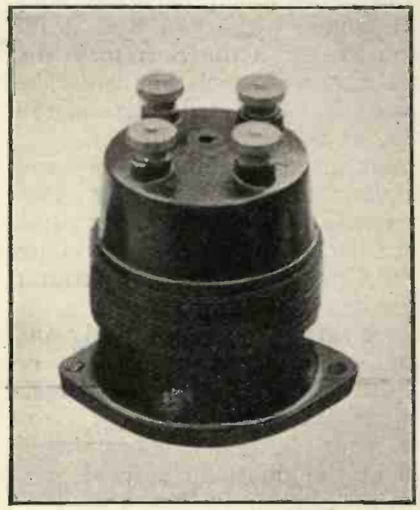
"I am, etc."

Apparatus we have tested

Conducted by A. D. COWPER, B.Sc. (London), M.Sc.

An Intervalve L.F. Transformer

Messrs. "M-L" Magneto Syndicate, Ltd., have submitted for test a low-frequency intervalve transformer of very neat and compact design, and well finished. A special claim is that it is completely protected, and dust



The M-L transformer.

and damp proof. On actual trial it showed very fair amplification in view of its small dimensions, and little distortion. No doubt it will find a ready sale amongst those to whom appearance and finish make a strong appeal.

A Tuned Anode Circuit Adapter Plug

Messrs. Peto-Scott Co., Ltd., have submitted for examination an adaptor by means of which the tuned anode, rejector, or "reactance-capacity" form of high-frequency intervalve coupling can be introduced, without further changes than simply plugging this adaptor in, in the place of the ordinary tunable transformer mounted on a valve-socket.

This "Tunode Plug" is fitted with the standard split-plug-and-socket for mounting coils of any form desired. On account of the different wiring of some sets, the connections in the plug are left adjustable; the makers wire it up to suit the purchaser's circuit for

The tuned anode adaptor plug.

a nominal fee. This is a very convenient, well-finished device, which will enable many to make the change from tuned transformer to the more selective reactance-capacity coupling with the minimum of trouble, and greatly facilitate experimentation with these different circuits.

A Drawing-room Loud-speaker

We have for some time been of the opinion that the time is ripe for the development of a radio sound-reproducing device that will fit in with the furnishings of a refined home, and will be as free as a good cabinet gramophone from that strident rasp and bellow that daily turns people away in disgust from so-called "Loud - speaker" demonstrations, while finally releasing folks from the tyrannical head-phones.

Accordingly, we welcomed an opportunity of giving a thorough trial of the remarkable loud-speaker, with the suggestive name of "Violina," placed on the market by Messrs. the City Accumulator Co. This is claimed to work on a different principle to others; in place of the trumpet it presents the form of an elegant polished wood cabinet, with a gracefully curved top of thin veneer; a Brown telephone receiver being placed inside the cabinet. There is a door in the front, but the finest tone is obtained when this is closed.

The reproduction was extremely free from distortion, whilst with the front open the volume of sound compared favourably with that of the more conventional trumpet type. By actual tests on the same transmission, with the front closed, the tone was softer and more pleasant, while it was entirely free from the blatant blare of many instruments. The impression received of the adequately loud and clear stream of speech and melody coming from this instrument, without any visible horn or wires, was distinctly pleasing, and it marks a very real advance in the development of the drawing-room radiophone.

We understand that the adjustment of the Brown reed is to be rearranged in the newer models, so that it can be regulated from the outside, and by a slow motion. This will be a decided improvement. Criticism might be offered as to the finish and mounting of the front door, which in the model examined was hardly in keeping with the good appearance of the rest of the instrument. Most people would, we feel sure, prefer to have hinged shutters like those on gramophones, so that for dance music, for instance, the maxi-

The "Violina."

mum intensity could be obtained. The top of the cabinet must be unencumbered whilst receiving.

Wireless Map of Great Britain. (Philip and Son, Ltd., 32, Fleet Street, E.C. 2s. 6d.)

This map is about 3ft. by 4ft. in dimensions, and is compiled from information supplied by the Wireless Press, Ltd., 12, Henrietta Street, W.C. It gives a large amount of geographical information as to the location of various towns, villages, geographical features, etc., and, in addition, has all the amateur and experimental wireless transmitting stations clearly marked. A list is given of these stations, together with their call signs, and a reference number for locating them on the map. The broadcasting stations are also listed together with commercial and official stations. The commercial stations, Admiralty, Naval and Trinity House stations, broadcasting stations, aviation stations, direction-finding stations, and amateur and experimental stations are all indicated on the map by different signs, so as to be readily distinguishable. Around each of the broadcasting stations circles are drawn at intervals of ten miles; the latter give some interesting information as to the relative intensities to be expected at certain places situated within the range of two or more broadcasting stations. Directional diagrams are printed on the map in relation to particular districts, indicating the direction in which signals come in from various distant stations such as Newark, N.J., Eiffel Tower, Hague, Nauen, and so on. A much enlarged map of the London district is included, which will be found very useful to wireless experimenters. The whole map is an excellent production, and is one of the most complete wireless maps suitable for general purposes which we have yet seen. The map can be obtained on paper, mounted on cloth folded in a case, or mounted on cloth and varnished, with rollers. They are obtainable from Radio Press, Ltd., prices 2s. 8d., 5s. 9d., and 8s. 3d. respectively, post free.

The Radio Experimenters Handbook. (Part 2: Data and Design.) P. R. Coursey. (Wireless Press, Ltd., 12, Henrietta Street, W.C. 72 pp. Price 3s. 6d.)

This book is particularly intended for the experimenter, and provides him with a considerable amount of most useful data, much of which is not readily available elsewhere in so compact a form. The subjects dealt with include the measurement of high-frequency currents and voltages; aerials and tuning circuits, tuning coils, and inductances; condensers; valves and their constants; and measurements with valve circuits. In connection with the measurement of H.F. currents and voltages, a description is given of the thermo-ammeter and the Einthoven galvanometer, together with several circuit diagrams showing the method of experiment. The Moullin H.F. voltmeter is also treated and illustrated. Some fundamental formulæ are next given in connection with frequency, wave-length, and circuit-constants, together with the effect of resistance of acceptor and rejector cirsuits, and H.F. resistance. Tuning coils and inductances are given a special chapter, with useful charts for the simplifying of the calculations in connection with coils, etc. A table of measurements on the valve is also supplied in the appropriate chapter, showing inter-valve resistance and amplification factor, and full instructions are included for conducting measurements with valve circuits. The book is well written and well illustrated, and should certainly prove invaluable to the serious wireless experimenter.

How to Build Amateur Valve Stations. P. R. Coursey. (Wireless Press, Ltd., 12, Henrietta Street, W.C. 67 pp. 1s. 6d. net.)

The purpose of this book is to help the wireless amateur in constructing his own valve receiving apparatus. Since broadcasting commenced, a large number of dealers have specialised in supplying component parts for the erection of valve sets, and it is possible, with the assistance of some accurate information and guidance, to build up very useful receiving sets in this way at comparatively small cost. The author has devoted much space to the consideration of the more important of such components, which are described and illustrated, and their use in the building up of the various types of sets is fully explained.

Several different arrangements of receiving units are described in detail, as this method of building radio sets enables a number of different receiving combinations to be obtained. Wireless diagrams are included wherever necessary, together with explanatory sketches in connection with such matters as aerial construction. The book is well illustrated, and should prove very interesting, as well as very helpful, to the experimenter who wishes to make his own valve set.

J. H. T. R.

THE NEW STUDIO AT 2LO

The photograph above shows the new studio at 2LO, particulars of the opening of which were given in our last issue.

FORTHCOMING EVENTS

May.

16th (WED.).—Swansea Radio Experimental Society. Mr. R. G. Isaacs, B.Sc., A.M.I.E.E., at the Y.M.C.A., St. Helen's Road, Swansea.

17th (THURS.). — Derby Wireless Club. Lecture by Mr. F. J. Cowlishaw, at 7.30 p.m., at the Shaftesbury Restaurant, Tenant St., Derby. "Radio Gadgets."

17th (THURS.).—Cardiff and South Wales Wireless Society. Institute of Engineers, Park Place, Cardiff. Experimental work will be conducted by Mr. C. H. Watkins.

17th (THURS.).—Ilford and District Radio Society, St. Mary's Church Schools, High Road. Mr. A. P. Welch will lecture on "Ebonite."

17th (THURS.).—Redhill and Reigate Radio Society, Y.M.C.A., Station Road, Redhill. Mr. Pope will lecture on "Loudspeakers" at 8 p.m.

19th (SAT.).—Cardiff and South Wales Wireless Society. The last day for exhibition and conference at the Capital Theatre.

19th (SAT.).—Cardiff and South Wales Wireless Society. A lecture entitled "Short Wave Reception," by Mr. A. G. S. Gwinn, at The Engineers' Institute, Park Place, Cardiff.

22nd (TUES.).—Plymouth Wireless Scientific Society. Plymouth Chambers, Old Town Street, Plymouth, 7.30-7.45 p.m., Buzzer Practice. 8 p.m. Demonstration on Society's Set.

23rd (WED.).—Radio Society of Great Britain. Prof. E. W. Marchant, D.Sc., of the Liverpool University, will give a paper on the "Method of Preventing Interference in Wireless Receiving Sets," at the Institute of Electrical Engineers.

24th (THURS.).—Cardiff and South Wales Wireless Society. A Lecture on "Navigation and Wireless as an Aid to It," by W. H. McClure, Esq., at The Engineers' Institute, Park Place, Cardiff.

26th (SAT.).—Cardiff and South Wales Wireless Society. Discussion on "Valve Circuits and H.F. Couplings," to be opened by H. F. A. Sanderson, Esq.

Mainly about Valves

Our weekly causerie relating to the use of valves. This feature is conducted by the Editor

Testing the Resonance Effect in a Loud-Speaker

PRACTICALLY every loud-speaker on the market tends to resonate at a certain frequency. When the current passing through it has a certain frequency, the response from a loud-speaker is particularly pronounced and the horn may actually begin to vibrate. When listening-in, it is frequently to be noticed that certain sounds are more pronounced than others. When listening to music, it may be a little difficult to state specifically at which frequency the loud-speaker is resonating; it may be that the general effect is not as good as it might be, but the exact trouble cannot be located.

It is, however, a very simple matter to test when a loud-speaker is particularly resonant to a given note. This may be done by connecting up the circuit shown in Fig. 1. It will be seen that the arrangement is simply an ordinary oscillating valve receiver with a separate oscillating valve arranged to produce a beat note which will be heard in the loud-speaker.

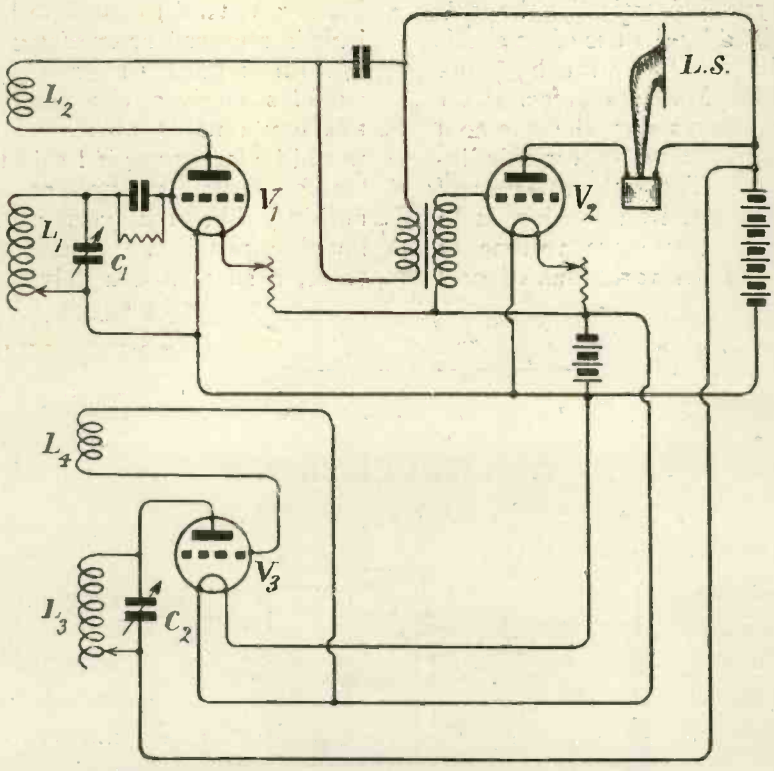


Fig. 1.—Showing the arrangement for introducing the separate oscillating valve.

Any receiving circuit using reaction may be used for this purpose, but the aerial should be first disconnected and the set then made to oscillate by tightening the reaction. The local oscillating valve now has its circuit tuned to a frequency slightly differing from that at which the other valve is generating. A heterodyne note will be obtained which may be varied at will by altering the tuning of one or other of the two circuits. The note may be varied from an exceedingly high one of, say, 10,000 to one that is very low.

By varying the tuning of one of the circuits, and so obtaining different notes on the loud-speaker, it will usually be found that, at a certain frequency, the response from a loud-speaker is very much greater than before, and this will be the frequency at which the loud-speaker resonates.

To remedy this effect it is desirable to try connecting different large condensers, such as Mansbridge condensers, across the terminals of the loud-speaker. It will then be found that the resonating effect may be largely eliminated.

High-tension Batteries for Operating Loud-Speakers

It has always been a puzzle to the writer why such high anode voltages are so often recommended for operating loud-speakers. I have tried every loud-speaker on the market, except the kind used by the Western Electric Company to broadcast to several thousand people, and I have always found that a high-tension battery of 100 volts is ample for all domestic purposes. An excellent effect may be obtained with 100 volts and an ordinary ORA valve. After all, practically the sole advantage to be gained by the use of an anode battery of high voltage is that a much greater output is obtainable. Merely increasing the anode voltage and increasing the filament current does not give any appreciable increased amplification. The only real use of special valves and extra high tension is in those cases where a very large volume of sound is required and the variations of grid potential of the last valve are too great for an ordinary receiving valve.

When it is desired to fill a very large hall, I can understand anode voltages of 200 and 300 being used, but for domestic purposes a 100-volt battery is ample.

Natural Leaks

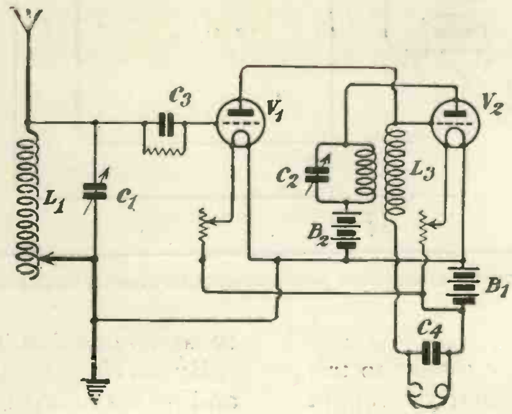
In the case of many pieces of apparatus constructed by experimenters, the removal of the gridleak makes no difference. This, of course, is due to the fact that the insulation is imperfect and there is a natural leakage of current from the grid either through the grid condenser or across the surface of the valve holder or some other part of the apparatus.

In reaction circuits, the introduction of a gridleak will introduce a certain amount of damping which will lessen the reaction effect. Many sets tend to oscillate badly if the gridleak is removed or is of too high a value.

With regard to gridleaks generally, I would strongly advise readers to buy a particularly reliable make. I do not think I would be far wrong if I said that seven out of ten gridleaks at present in use possess nothing like the correct resistance. The horrible pencil-line production is, in most cases, a snare and a delusion.

A CORRECTION

IN connection with the article entitled "Some Unusual Methods of Receiving Continuous Waves," which appeared in our No. 4 issue, we regret that an error occurred in the circuit diagram, Fig. 3, on page 202. The connection from the earth end of the A.T.I. to the first filament rheostat is incorrect and should be deleted. Herewith we give a corrected circuit diagram.



Correspondence

CURIOUS RECEPTION

To The Editor, *Wireless Weekly*.

Sir,—I have read with great interest the correspondence in *Wireless Weekly* concerning the reception from distant broadcasting stations on simple crystal sets; and the effects of neighbouring aerials.

The other morning, in order to investigate for myself, I rigged up (temporarily, of course) a single valve set embodying aerial reaction, and connected this to the outdoor aerial. Putting another pair of 'phones on to a crystal set I connected the latter to a small indoor aerial, and tuned it to what I judged to be 385 metres. Listening in the 'phones of the crystal set and setting the valve set oscillating, I was able to tune in 2ZY by means of the A.T.C. of the valve set. The music, etc., was very good, even when the valve set was just off oscillation point. In fact, it was almost as good in the crystal set 'phones as in those on the valve set.

Imagine my surprise when, on tuning the valve set to 2LO, 5NO and 5IT, the announcements, etc., from the stations also came in splendidly.

With the crystal set thus working, reception did not seem quite as good on the valve set as when the indoor aerial was disconnected. A further point of interest lay in the fact that I was able to tune the valve set to some extent by means of the A.T.C. crystal set (so when signals fade out and you find a slightly different setting is necessary, probably your neighbour has just " tuned " in). Another most interesting observation was that by speaking into one of the *crystal* set earpieces the speech was quite audible in the valve set 'phones; and *vice-versa*. The two aerials are far from parallel, and only the leads from them are close together. It would appear that a strained condition of the ether exists in the immediate neighbourhood of the aerial of the valve set, whereby the latter is able to relay the incoming signals.

Might I suggest that your correspondents, and others, who have received from distant broadcasting stations on crystal sets have not received from them at all, but have received their signals relayed by the oscillating valve set of some neighbour who has been " tuned-in " to them?

Naturally, as the valve set included aerial reaction, such an experiment should be conducted on the morning transmission and then carefully handled.

Further experiments, using a 2-valve tuned anode H.F. set " versus " the single valve reaction, gave the phenomenon only to a very slight degree.

Wishing your excellent paper the best of success.
I am, etc.,

Sheffield. Frank M. Cooper.

P.S.—There may be inductance between the A.T.I.'s as the two sets are about six feet apart.

LOW-FREQUENCY AMPLIFICATION

To The Editor, *Wireless Weekly*.

Sir,—With reference to your statement on page 254 of No. 4, *Wireless Weekly*, *re* the use of two intervalve

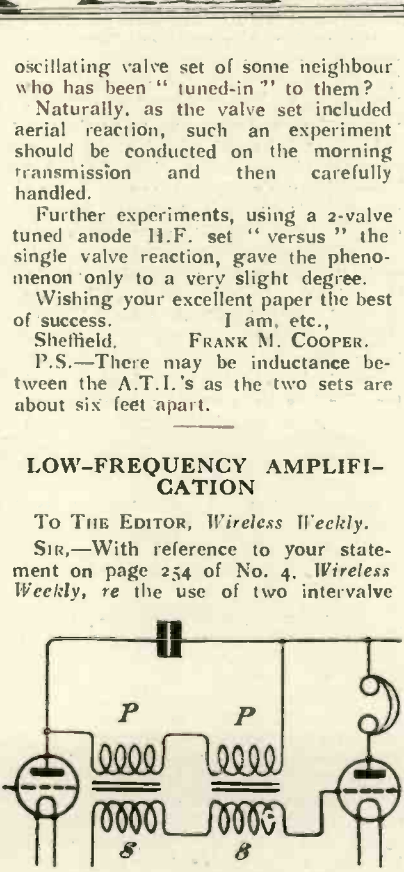


Fig. 1.

transformers in series, my experiences may interest you.

Some weeks ago I tried connecting the transformers as suggested by your Belgian correspondent (Fig. 1), but found no increase in the strength of signals. I then tried the arrangement in Fig. 2.

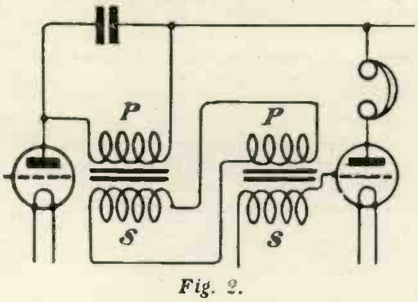


Fig. 2.

This reduced the strength considerably, but speech was remarkably clear. The direction of any winding did not seem to matter much. One of the transformers was of the ex-army type, the other being a home-made one having an open core and a turns ratio of 1 : 2. It is wound with 90 layers of No. 40 enamelled copper wire, and is just as good as the ex-army transformer.

Congratulating you on publishing such an excellent journal,
I am, etc.,

London. Experimenter.

CONCERNING LICENCES

To The Editor, *Wireless Weekly*.

Sir,—I think if " Waiting " and others who write in your columns were to follow your advice and join a Radio Society before applying for experimenter's licences, they would not be complaining so much about the P.M.G.'s slowness.

In January of this year I applied for a licence on the lines advocated in your companion paper, *Modern Wireless*, giving as a third reference that of the Secretary of the local society, in which he stated, after satisfying himself, that I was capable of manipulating wireless apparatus and genuinely interested in the science.

A technical drawing of my proposed set, together with a description, was enclosed, showing where the reaction was to be coupled during prohibited hours, etc.

Permission to use apparatus was granted in about three weeks, which was due to the lay-out as advised in your magazine and the fact of my belonging to a club which caters for " radio fans."

My best thanks are due to both you and the club. I have thanked them, and now wish to thank you, and wish the greatest success to the latest publication of the Radio Press.
I am, etc.,

Bexhill-on-Sea. Satisfied.

COMPLIMENTARY

To The Editor, *Wireless Weekly*.

Sir,—I am pleased to state that your splendid new magazines *Modern Wireless* and *Wireless Weekly* are recognised by Danish experts to be of extreme value to the earnest experimenters. Your investigations in the matter of transformer and "tuned anode" coupled H.F. amplifiers are of a special value for the Danish experimenters, as we shall have to pick up our broadcastings from foreign countries, our own Government declining to permit erection of broadcasting plants.

I am, etc.,
George W. Olesen.

Copenhagen, F. Denmark.

ON CRYSTALS

To The Editor, *Wireless Weekly*.

Sir,—As many people seem to be writing to say that carborundum crystal can be used without any applied potential, I thought that perhaps my own experiments might be of some interest.

I have been for some time conducting experiments with regard to relative sensitivity and stability of crystals, and have tried most of the known kinds, and also a few unknown kinds. My best results were obtained with "Hertzite," until the other night I happened to try a combination of carborundum and graphite. To my amazement the signals were much louder than before. I immediately investigated and discovered :—

(1) Carborundum-graphite is extremely sensitive.

(2) It is exceedingly stable.

I have tried various pieces of carborundum and graphite, with the same results. For the graphite point I find a piece of Venus H pencil gives the best results.

In conclusion, thanking you for putting such an excellent paper upon the market, and wishing you every success,

I am, etc.,
G. A.

P.S.—I live 13½ miles from Manchester, 2ZY.

APPRECIATION

To The Editor, *Wireless Weekly*.

Sir,—I take this opportunity of expressing my sincere appreciation of your general publications on this subject, and of your two periodicals, *Modern Wireless* and *Wireless Weekly*. There can be little doubt, I think, that the reception which has been, and will continue to be, accorded to these splendid efforts on your part will easily enable you to maintain the very high standard that you have evidently set yourselves.

I am, etc.,
Newport, Mon. G. Riches.

BROADCASTING PROGRAMMES

To The Editor, *Wireless Weekly*.

Sir,—Your publication of a letter in your No. 4 from "An Elderly Listener-in" is, I suppose, to draw comment from other readers. "A.E.L.I." gives us seven paragraphs in his letter, but there is only one paragraph which is really of interest. It is the first, or part of the first. In spite of all his grumblings, to my mind not worthy of publication, he thinks your No. 2 is excellent. I should like to say that your No. 1 is the excellent one, and that your No. 2 is more excellent, that your No. 3 is most excellent, and that if your No. 5 and subsequent issues keep up to the standard of No. 4, No. 3 will no longer be the most excellent.

Until the issue of your No. 1 I knew no more about wireless than the living know about death, but to-day I have my crystal set, and I should like to say that the B.B.C. programmes are fine. They are only dull to the dull, and, thank goodness, the dull are in the minority in this country. I think A.E.L.I. should sell his four-valve set cheap, as he proposes, and by the time he has played through his 15,000 pieces of music he will have no further need for Wireless Broadcasting programmes and its ever rapidly increasing strides towards perfection.

A.E.L.I. says that music is the chief art which lends itself to wireless—a remark which reflects upon his singular lack of appreciation of the present standard of education. I believe that all the items, as varied as they are, of the B.B.C. programmes approach the ideal solution of the difficulties of pleasing all tastes.

A.E.L.I. further complains about having to go to bed before items which interest him are broadcasted. While this is a purely individual complaint it is one which is so easily overcome. It was from *Wireless Weekly* that I got the tip that the length of lead from the telephone terminals to the 'phones made no difference in the volume of sound. I have therefore run wires from my set to terminals in more than one position, and also to another room, which latter enables me to place a 'phone under my pillow in my bed. What more could an early-rester desire?

Lastly, why do your correspondents, as in the case of A.E.L.I., speak of items being foisted upon them by the B.B.C.? Surely it is simply a case of voluntary reception. We still have our 15,000 pieces of music, and also the theatres, which A.E.L.I. seems to have forsaken. This is the man the theatre managers are missing—he is certainly not a worthy possessor of a 4-valve set.

The opinions above are only my own, and are, perhaps, rather rudely expressed, but I believe they will reflect the opinion of the majority.

The marvellously rapid evolution of the aeroplane is only surpassed by the ultra-rapid strides of the application of wireless, so why impatiently criticise the B.B.C. programmes? Let us show our appreciation with the same fervour as your readers appreciate your *Wireless Weekly*, and all will be well, but don't let us forget to make complaint when there is real need.

I am, etc.,
London, W. Ernest Tucker.

AN EXPERIMENT

To The Editor, *Wireless Weekly*.

Sir,—I am sending you details of an experiment I made the other night, hoping it will be of interest to your readers, i.e., a novel inside aerial.

I attached a length of 16 s.w.g. bare copper wire to the terminals of an electric bell in the house; passed it round the top of the sideboard, and thence across the room over the clothes rack, after which I attached it to the aerial terminal of my three-valve set. I found, to my astonishment, I could get London quite easily; hitherto I could not cut Manchester station out. It was far more easy to get London by this simple aerial than the outside one. Only 16 feet of copper wire were used. All doors were closed, and the nearest approach to outside was 10 yards.

I am, etc.,
H. D. Hargreaves.

Chorley, Lancs.

BROADCAST MUSIC

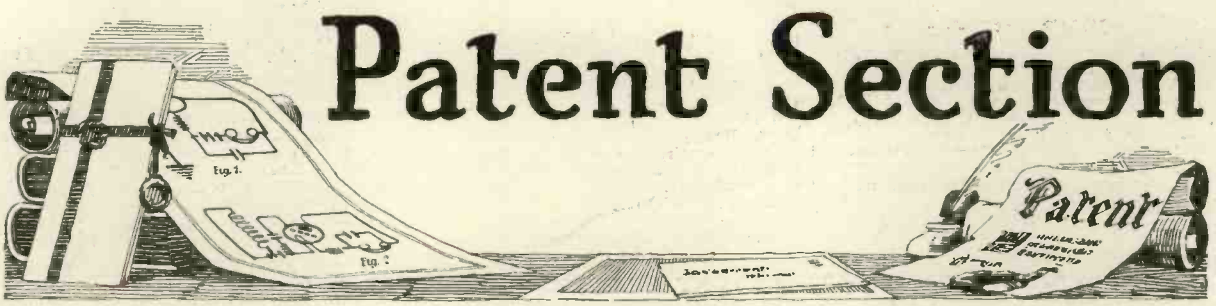
To The Editor, *Wireless Weekly*.

Sir,—The opinions of "Elderly Listener-in" cannot pass without comment. His main "grouse" against the B.B.C. is that the music is too good for him. He wants more cheap stuff, presumably to round off his 15,000 piano pieces. He does not see that his criticism of the B.B.C. condemns his own bad taste. What ground has he for identifying his own tastes with those of listeners-in in general? To my mind the assumption savours of conceit. Your correspondent's second grumble is that the times of which the dance music and the news items are given do not suit him. Can the B.B.C. be blamed because he wants to go to bed? Of course, we all have our own ideas in this matter, but let us be fair. I feel sure that the general wish is that whatever music is given, be it operatic, classical, dance, or lyrical, shall be the best of its kind. None of us want rubbish. And oh! those entertainers!

I am, etc.,
A. W. Scott.

Hatton Garden, E.C.1.

Patent Section



The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS
(Specifications not yet published.)

10252. BAILEY, H.—Inductance tubes for wireless apparatus. April 16th.
10559. BARKER, W. K.—Lightning-arresters, &c. April 18th.
10445. BARNARD T. K.—Variometer inductances. April 17th.
10579. BARNES, H.—Electric converting-apparatus. April 18th.
10290. BEGIN, J. L.—Radio telephony. April 16th.
10890. BOYDEN, N. L.—Plug connectors for electric circuits. April 21st.
10441. BRADMAN, A. R.—Telephone receivers. April 17th.
10880. BRITISH RADIO-WIRELESS MANUFACTURING CO., LTD.—Terminal connections for electric circuits. April 21st.
10333. BRITISH THOMSON - HOUSTON CO., LTD.—Sound - emitting, &c., instruments. April 16th.
10714. BRITISH THOMSON - HOUSTON CO., LTD.—Sound - emitting, &c., instruments. April 19th.
10231 BROWN, A. C.—Telephone receivers. April 16th.
10382. BROWN, W. H.—Crystal cups for wireless receiving sets. April 17th.
10427. BUER, S. T.—Wireless receiving circuits. April 17th.
10373. BUNTING, R. S.—Switching for multi-circuit radio receivers. April 17th.
10693. BURNETT, J. M.—Accumulator grids. April 19th.
10333. BUTCHER, J. H.—Sound-emitting, &c., instruments. April 16th.
10714. BUTCHER, J. H.—Sound-emitting, &c., instruments. April 19th.
10616. CAM, F. A.—Thermionic valves. April 18th.
10569. CARPENTER, R. E. H.—Sound-reproducing apparatus. April 19th.
10271. CARTIER, H.—Circuit-breaker. April 16th. (France, May 9th, 1922.)
10641. CLEMMEY, W. J. S.—Gramophones, &c., adapted for use with loud-speaking, &c., apparatus. April 19th.
10562. COLEMAN, C. J.—Rectifier crystals for wireless telephony. April 18th.
10700. COOLEY, A. K.—Headpieces and telephone mountings. April 19th.
10552. COTSWORTH, G. W.—Combination connector for electric fittings. April 18th.
10528. CRABTREE, J. A.—Electric switches. April 18th.
10414. CUBITT, A. S.—Electric terminals. April 17th.
10491. CUTLER-HAMMER MANUFACTURING CO. —Potential control apparatus. April 17th.
10763. CUTLER-HAMMER MANUFACTURING CO. —Regulation of electric circuits. April 20th.
10623. DAVEY, W. C.—Receiving-apparatus for wireless telegraphy. April 18th.
10853. DAVIES, W. LANGDON-.—Alternating-current utilisation. April 21st.
10499. DAVIS, B. M. J.—Method of producing a direct current of a required tension from a direct current supply of a different tension. April 17th.
10869. DAVIS, T. C. — Lead-in insulator for wireless apparatus. April 21st.
10791. DORER, E. O.—Electric switches. April 20th.
10581. DOYLE, O. R.—Filaments in thermionic valves, &c. April 19th.
10364. DREW, A.—Masts for wireless aerials. April 17th.
10315. EDEN, C. G.—Electric discharge tubes. April 16th.
10579. ENGLISH ELECTRIC CO., LTD.—Electric converting-apparatus. April 18th.
10254. EVANS, A. J.—Hydrometers for testing electrolyte in electric storage batteries. April 16th.
10255. EVANS, A. J.—Methods for treating sulphated plates of electric storage batteries. April 16th.
10435. GARRETT, P. A.—Sound-amplifying devices for telephone, &c., receivers. April 17th.
10522. GATES, P. J.—Apparatus for localisation of faults in electric storage battery cells. April 18th.
10882. GELDEREN, F. M. VAN.—Insulating cap for electric cable joints. April 21st.
10315. GENERAL ELECTRIC CO., LTD.—Electric discharge tubes. April 16th.
10559. GOODMAN, J. W.—Lightning - arresters, &c. April 18th.
10615. GRAHAM, E. A.—Cabinets for wireless apparatus. April 18th.
10269. GUNSTONE, A. C.—Gramophone device for wireless reception. April 16th.
10693. HADDON, W.—Accumulator grids. April 19th.
10273. HARRISON, H. E.—Connector for making electric contact between telephone tags and terminal. April 16th.
10359. HELFENSTEIN, A.—Forming continuous electrodes. April 16th.
10537. HEUGHAN, W.—Electric switches. April 18th.
10471. HOLLISTER, F. L.—Wireless telephone receivers. April 17th.
10500. HUNTLY, J. N.—Pocket wireless receiving-apparatus. April 18th.
10491. IGRANIC ELECTRIC CO., LTD.—Potential control apparatus. April 17th.
10763. IGRANIC ELECTRIC CO., LTD.—Regulation of electric circuits. April 20th.
10435. IRWIN, E. W.—Sound-amplifying devices for telephone, &c., receivers. April 17th.
10291. JACKSON, B.—Crystal detectors. April 16th.
10292. JACKSON, B.—Inductance and resistance coils, &c. April 16th.
10488. JOHNSEN, F. A.—Arrangements for responding to or detecting small variations of electric current. April 17th.
10559. JONES, S. G.—Lightning-arresters, &c. April 18th.
10334. KOLN-ROTTWEIL AKT.-GES.—Manufacture of filaments, &c., from viscose. April 16th. (Germany, June 1st, 1922.)
10711. LEA, N.—Reception of wireless signals. April 19th.
10712. LEA, N.—Wireless reception, &c., apparatus. April 19th.
10890. LEWIN, C. M.—Plug connectors for electric circuits. April 21st.
10616. LIDDELL, E. P.—Thermionic valves. April 18th
10524. LINSE, R.—Electric regulating resistance. April 18th. (Sweden, April 18th, 1922.)
10382. LLOYD, A. FORD-.—Crystal cups for wireless receiving sets. April 17th.
10570. MACCULLUM, A. H. S.—Wireless receiving-apparatus. April 18th.
10512. MARR, A.—Means for tuning inductance coils. April 18th.
10297. METROPOLITAN - VICKERS ELECTRICAL CO., LTD.—Electric circuit - interrupters. April 16th. (United States, April 18th, 1922.)
10568. MICKELWRIGHT, W. R.—Gripping-device for crystals, &c., for wireless telegraphy. April 18th.
10388. MORRIS, G. A.—Sound-amplifying and directing appliances. April 17th.
10345. OBOUKHOFF, N. — High-frequency alternators. April 16th.
10373. PARKINSON, W. — Switching for multi-circuits radio receivers. April 17th.
10825. POLLOCK, E.—Signalling systems. April 21st.
10641. PULFORD, E. G.—Gramophones, &c., adapted for use with loud-speaking, &c., apparatus. April 19th.
10875. PYNE, R. W.—Three-electrode valve. April 21st.
10711. RADIO COMMUNICATION CO., LTD.—Reception of wireless signals. April 19th.
10712. RADIO COMMUNICATION CO., LTD.—Wireless reception, &c., apparatus. April 19th.
10880. READ, H. A. M.—Terminal connections for electric circuits. April 21st.
10748. RENISON, M. A.—Terminal binding posts. April 20th.
10537. ST. HELEN'S CABLE & RUBBER CO., LTD.—Electric switches. April 18th.
10308. SAUNDERS, W. T.—Wireless telephone apparatus. April 16th.
10540. SERSHALL, S. H.—Electric terminals. April 18th.
10524. SHARMAN, A. W.—Loud-speakers for radio telephony. April 18th.
10532. SHELDON, S.—Pad for head telephones. April 18th.
10422. SILVER, J. H.—Sound-reproducing machines. April 17th.
10895. SOULIER, D. A.—Electric installations comprising condensers. April 21st. (Belgium, May 17th, 1922.)
10606. STILLMAN, R. C. B.—Interlocking switch. April 18th.

10522. SUDBURY AUTO ELECTRICAL SERVICE.—Apparatus for localisation of faults in electric storage-battery cells. April 18th.
10552. SUMNER, W. H.—Combination connector for electric fittings. April 18th.
10373. TAYLOR, E. A.—Switching for multi-circuit radio receivers. April 17th.
10373. TAYLOR, L. E.—Switching for multi-circuit radio receivers. April 17th.
10437. TOOMEY, E. J.—Tuning wireless telephone circuits. April 17th.
10241. TURNOCK, G.—Telephone cord terminals. April 16th.
10671. UPWARD, A. R.—Voltaic cells and batteries. April 19th.
10374. WALTON, J.—Telephone, &c., receivers. April 17th.
10668. WATKINSON, J. E.—Wireless coil-holders, &c. April 19th.
10267. WEST, F. J.—Storage batteries. April 16th.
10427. WESTERN ELECTRIC CO., LTD.—Wireless receiving circuits. April 17th.
10551. WESTERN ELECTRIC CO., LTD.—Oscillation generators. April 18th. (United States, April 18th, 1922.)
10479. WIEGAND, E. L.—Terminals for electric conductors. April 17th.
10512. WILLIAMS, J. H.—Means for tuning inductance coils. April 18th.
10437. WISEMAN, S.—Tuning wireless telephone circuits. April 17th.
10490. WIRELESS EQUIPMENT, LTD.—Method of producing a direct current of a required tension from a direct current supply from a different tension. April 17th.
10333. YOUNG, A. P.—Sound-emitting, &c., instruments. April 16th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

(Copies of the full specifications, when printed, may be obtained from Mr. Gee post free on payment of the official price of 1s. each.)

193873. AMERICAN RADIO & RESEARCH CORPORATION.—Inductance coils with low distributed capacity and low energy losses for use, for example, in wireless receiving apparatus, comprise spherical skeleton supports having spaced curved arms and wire wound on the supports, so that the turns engage each other at only a small number of points, the wires preferably passing in and out about opposite sides of the arms to form a basket mesh with the turns crossing between the arms. February 26th, 1923. (Convention date, February 24th, 1922.)

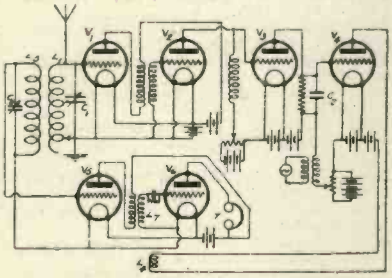


Fig. 1.—Illustrating Patent No. 193882.

193882. TAGGART, J. SCOTT, and RADIO COMMUNICATION CO., LTD.—In a wireless receiving system operating on the heterodyne principle, the local oscillations are set in operation, or are controlled in magnitude or frequency, by the received signals. The system may be used for eliminating interfering signals which are weaker or stronger than the desired signals, and for reducing interference from atmospherics and damped waves. August 30th, 1921.

194007. LORENZ AKT.-GES., C.—In a method for increasing the freqnency of an alternating current, an oscillatory circuit is charged by impulses from a generator circuit, the curve of energy output of the generator being so distorted that it lies for a prolonged part of each period along the zero line. The oscillatory circuit is tuned to an integral multiple of the generator frequency, and the total time of each impulse is limited to the time during which it is of like sign with the free oscillation in the oscillatory circuit. December 9th, 1921.

194070. POLLOCK, E.—A combined transmitting and receiving set is so arranged that the receiving circuits are rendered insensitive during the period when transmission is taking place, thermionic tubes energised by the microphone current being variously employed to achieve this result. In certain cases, radiation from the transmitting-aerial can only occur when, and for as long as, the microphone is being spoken into. January 14th, 1922. Cognate application. No. 1848/22.

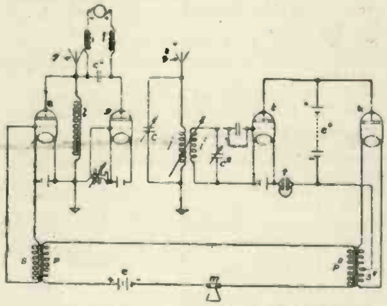


Fig. 2.—Illustrating Patent No. 194070.

194185. SOC. ANON. LE CARBONE.—A galvanic battery consisting of zinc and carbon electrodes in an electrolyte such as a solution of ammonium chloride has the perforated zinc electrode arranged horizontally below the carbon in a porous vessel, a space being provided below the zinc to receive the zinc chloride formed during the action of the cell and so prevent it from coming into contact with the carbon electrode or electrolyte. April 21st, 1922.

194279. BRITISH THOMSON-HOUSTON CO., LTD.—In a thermionic or like device the

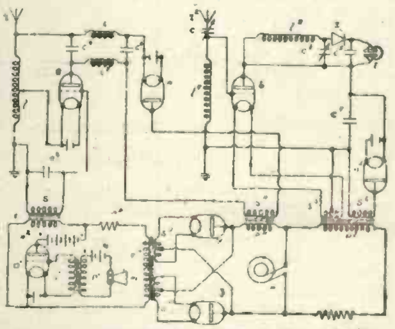


Fig. 3.—Illustrating Patent No. 191070.

cathode leading-in wires are sealed into re-entrant tubes which are spaced apart during manufacture to maintain the desired tension in the cathode by means of arms supporting another electrode, such as a grid or anode or both, the arms being embedded in or clamped to the tubes, which are then sealed into the container. February 14th, 1923. (Convention date, February 28th, 1922.)

WIRELESS ON FISHING VESSELS

THE fitting of English fishing vessels with wireless apparatus by the Marconi Company, as recently reported, is proving of considerable value to owners from a commercial point of view, and the utility of the installation in another direction has been demonstrated in connection with the rescue of the crew of a sailing vessel by one of the trawlers recently fitted with wireless. This trawler, the "Harlech Castle," owned by the Consolidated Steam Fishing and Ice Co., Ltd., of Swansea, rescued the crew of a sailing vessel, the "Foam," just before that vessel sank. By means of its wireless equipment the "Harlech Castle" informed the owners of the incident and the rescued crew were enabled to advise their relatives of their safety and so allay their anxiety.

Information Department

Conducted by J. H. T. ROBERTS, D.Sc. (F.Inst.P.), assisted by A. L. M. DOUGLAS

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

E. M. K. (WANDSWORTH COMMON) proposes to build fixed condensers of the following values: 0.005, 0.001, and 0.0003 μF. He wishes to know if it is possible to calculate the capacity by some simple formula.

The formula for calculating the capacity of a condenser is

$$C = \frac{AK(n-1)}{4\pi t\ 900{,}000}$$

A = the area of the plates.
K = the dielectric constant.
n = the number of plates.
t = the dielectric thickness (that is, the thickness of the insulating material separating the plates).

From this equation you can readily work out your own condenser values with a high degree of accuracy.

C. W. B. (THE SCHOOL HOUSE, COVE, FARNBOROUGH) asks for the name and address of the manufacturers of Siemens-Halske valves.

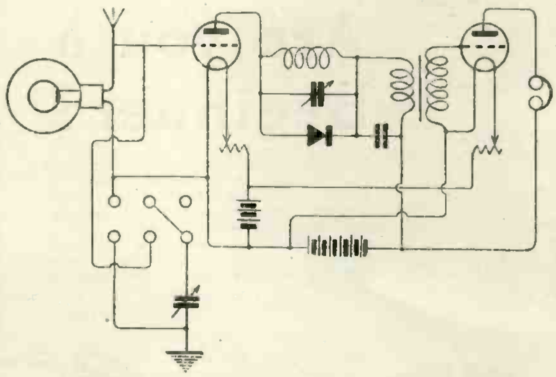
Siemens-Halske valves are made by the German branch of Siemens Bros., and are obrainable from the great majority of accessory dealers in this country. They are very soft valves, and have a filament consumption of 0.36 ampere at about 2.1 volts. They are suitable for rectifiers and as low-frequency amplifiers, but do not give very much magnification. It is possible, however, to use a much greater number of them in cascade than the ordinary type of valve.

B. T. (SOUTHALL, MIDDLESEX) sends a diagram of his three-valve receiving set and asks the following questions: (1) Whether the wiring is correct, and especially whether the high-frequency valve is as efficient as it might be. (2) Particulars for making honeycomb coils for the A.T.I. anode and reactance circuits for wavelengths of 1,000 metres and 2,600 metres. (3) Whether this apparatus should be capable of receiving all British broadcasting and possibly Continental telephony in his locality.

(1) We have carefully examined your wiring diagram, and consider the high-frequency valve is employed in a very efficient manner. A separate high-tension supply to this valve and also to the detector valve might improve results somewhat. (2) On a 2in. diameter former with 27 spokes, you will require the following number of turns for the A.T.I., anode and reaction coils respectively for 1,000 metres:—100, 150, and 75. For 2,600 metres the number of turns should be, respectively, 250, 300, and 150. (3) This apparatus should be sufficient to bring in almost all the broadcasting stations on telephone headgear if used at your home.

AJAX (STRATFORD) has a crystal receiver and wishes to know how to add a high-frequency valve amplifier to it so as to increase the range.

We give herewith a circuit diagram showing how a valve amplifier may be added in the most efficient manner to your existing crystal set.



G. L. N. T. (HAMPSTEAD, N.W.3) has purchased a crystal receiving set stamped "B.B.C.", and now wishes to know whether if he makes up a low-frequency amplifier and adds it to his set, will he be liable to get into trouble.

If the licence for which you have applied is an Experimental Licence, you are entitled to do whatever you like.

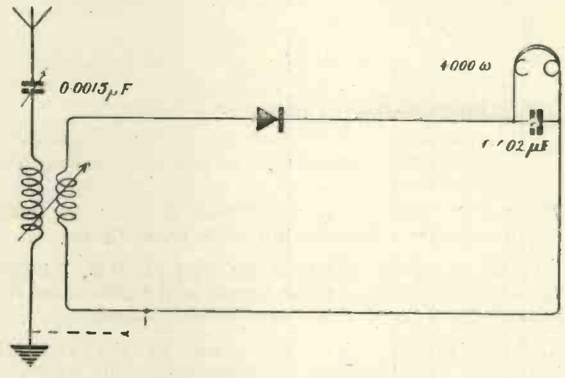
F. W. F. (PONDERS END, N.) proposes to use the circuit shown in Fig. 6 on page 89 of "MODERN WIRELESS" No. 2. He asks the relative sizes of coils L_2, L_3 and L_4.

These coils might all be the same size, the actual number of turns depending to a certain extent upon the wavelength you wish to receive. We suggest No. 24 s.w.g. double cotton-covered wire as being a suitable gauge for winding these coils, and probably 50 turns; using the formers you mention on each coil would be satisfactory.

D. McC. (LOCHAWE) has constructed the valve receiver described on page 151 of "MODERN WIRELESS" No. 2, but does not get any results. He asks for any helpful information which we can give him.

We are afraid you have either connected something wrongly in your circuit or else not completed the wiring. We note you suggest that the connections to the low-frequency transformer may be incorrect. In order to help you in this matter, we may say that if the same make of transformer is used as shown in the diagram you refer to, the point I.P. should be connected to the anode of valve V2, O.P. to the high-tension positive wire, I.S. to the low-tension negative wire, and O.S. to the grid of V3. We think that if you follow out the wiring diagram carefully, and adhere to the instructions we have given you, you will find this an exceedingly satisfactory receiver. You should be able to work Glasgow comfortably on a loud-speaker with this set.

J. J. B. (SPARKBROOK, BIRMINGHAM) has an Igranic vario-coupler and wishes to construct a crystal receiver for broadcasting, using this apparatus. He asks whether it should be more efficient than the loose-coupled receiver described in No. 3 of "MODERN WIRELESS," and whether we could recommend it for the reception of local broadcasting.



We give herewith a circuit diagram of the scheme you suggest. This is not, of course, by any means as selective as the loose-coupled receiver referred to, but is very satisfactory for the reception of broadcasting.

J. W. (WIDNEY MANOR) wishes to know where he can secure full details of the construction and design of power amplifiers and loud-speakers working on the Johnson-Rahbeck system.

A useful article on "THE USE OF VALVES AS POWER AMPLIFIERS" appeared in "WIRELESS WEEKLY" No. 4.

Reference to this subject has also been made in the column devoted to "Mainly About Valves" in this journal. We are not aware of any publication dealing exclusively with the Johnson-Rahbeck loud-speaker and its construction.

B. S. McI. (OATLANDS, GLASGOW) asks certain questions about a condenser, the exact size of which he queries.

The correct number is four plates and four sheets of tinfoil, and the capacity of this condenser is about 0.001 μF. The circuit you indicate would be passed by the Postmaster-General, and is quite suitable for your work. The value of condenser on your sketch might be 0.001 μF., and that of condenser B 0.0003

μF. The condenser C should be 0.002 μF., or slightly smaller.

H. G. L. (ECCLESTON SQUARE) has a certain transformer bobbin and wishes to know the windings and the core values for an ideal transformer.

We are afraid you cannot make an ideal intervalve transformer from the materials that you have on hand. Quite a good instrument could, however, be made by filling one-quarter of your winding space with No. 44 s.w.g. single silk-covered wire, and the remaining three-quarters with No. 42 s.w.g. single silk-covered wire. The core should be filled with 7in. lengths of iron wire, tightly packed, which should then be bent round the outside so as to form a closed core. The wire should be bound tightly in position by means of string or thread after the transformer is completed.

G. B. M. (WESTCLIFF-ON-SEA) submits a circuit diagram of certain components he has, but omits to letter various necessary terminals. He asks our opinion as to the best method of wiring up this set, using various apparatus that he has in his possession.

We regret that, without the necessary marking on all the terminals of your unit, we are unable to advise you, as there is no internal wiring diagram given showing how the various components are arranged in the panels themselves. If you will supply this information, we shall be pleased to answer your questions.

E. C. S. (LEYTON, E.10) asks certain questions about two circuits which he encloses, and also wishes to know various condenser values.

The circuit lettered " A " is the better of the two. The four fixed condensers might have values between 0.001 and 0.002 μF., and the variable condenser should have a value not greater than 0.0005 μF. The high-tension battery may be about 60 volts, and any standard pattern of crystal detector can be used. Your circuit " B " is also good, but will not yield such good loud-speaker signals at the short distance.

H. M. (PRESTWICH) notes that several firms make anode reactance coils which are self-tuned over a wide range of wavelengths, and wishes to know how they do this without the use of a tuning condenser.

The design of the reaction coils you mention is so proportioned that the inherent self capacity on each tapping is sufficient to cover the intermediate wavelengths between each stud. These coils are also wound in such a way as to be rather aperiodic, and therefore, whilst giving equal tuning over a wide range of wavelengths, do not give such sharp amplification in any particular wavelength. Greater selectivity can usually be obtained by the addition of a variable condenser in the ordinary way.

D. H. (BRIDGWATER) asks the following questions : (1) Does a variometer used in the aerial circuit necessarily give reaction ? (2) How is the necessary size of a condenser arrived at ? (3) How should switching be so arranged to efficiently control one, two or three valves at will ?

(1) A variometer in the aerial circuit does not produce any reaction effects. (2) The necessary size of a condenser is arrived at by the characteristics of the circuit that it is used in. If an aerial circuit tuning condenser, when in series the value should not be less than 0.001 μF., and in parallel not less than 0.0003 μF. If used as a tuning condenser across a reaction coil or rejector circuit, its value

might be from 0.0002 to 0.0005 μF. These are practically the only uses for variable condensers in receiving circuits. (3) The most economical arrangement of switching is that in which the filaments of the valve not in use are extinguished as well as all the associated circuits broken. If, for instance, switching in and out of low-frequency valves is contemplated, and the end circuit wire from each low-frequency transformer is broken, if the plate circuit wire of the previous valve is not broken as well a marked loss in signal strength will result.

L. M.O. (WIMBLEDON PARK, S.W.) is interested in our reply to H. V. (HULL) in "WIRELESS WEEKLY," and wishes to know how a microphone and valve amplifier might be easily applied to the existing land-line telephone in order to let a deaf person hear telephone conversation. He asks for further details.

Your suggestion that a microphone, connected to a suitable step-up transformer such as an ordinary microphone transformer for wireless telephony, should be connected to the grid of the first valve of a two-stage low-frequency amplifier, is the most suitable one under the circumstances. A step-down telephone transformer of the ordinary pattern should be included in the anode circuit of the last valve, when you will be able to work a 20-ohm earpiece quite satisfactorily, although not so well as if a special transformer were used. If you are able to obtain an "earth-to-valve" ex-Army pattern of transformer, this might be connected in the plate circuit of the last valve in place of the telephone transformer. The resistance of the primary of this transformer is variable by means of a five-stud switch, and in consequence can be suited to the resistance of your telephone, whatever it may be.

A. W. F. (HATTON GARDEN, E.C.1) asks with reference to the condenser C_4 illustrated in Figure 6, page 89, "MODERN WIRELESS" for March, whether 0.001 μF. would be a suitable capacity.

From 0.001 to 0.002 μF. is suitable for this condenser, which should be well insulated.

E. V. E. (LEEDS) wishes to charge accumulators from the A.C. main, using a static transformer and a large Nodon valve, employing half-cycle rectification only. He asks for details as to certain transformers and other circuit arrangements which he proposes to use for various outputs.

We regret that a detailed answer of the type you require would occupy the greater portion of one issue of this journal. We would advise you to get in touch with any well-known manufacturer of A.C. transformers with multiple windings, who would be able to quote you for a suitable piece of apparatus.

F. T. McI. (QUEEN VICTORIA STREET, E.C.4) is about to install a receiver in his house which looks on to an electric railway, and his aerial will be upon about the same level as the overhead electric wires and within 100 yards of the same. He asks whether he is likely to experience much interference.

You should make every effort to erect your aerial at right angles to the power lines, otherwise we are afraid you will get a considerable amount of interference if you are using a valve set, particularly if you use much low-frequency amplification.

C. J. C. D. (NEWTON ABBOT) proposes to construct the inductively coupled crystal receiver described in the April issue of "MODERN WIRELESS," and wishes to know the maximum range

that this instrument is capable of giving good results over.

The maximum range of this instrument under favourable conditions is in the neighbourhood of 30 miles.

S. D. (MITCHAM JUNCTION) has built a circuit embodying one high-frequency valve, one low-frequency valve and a crystal rectifier, but does not get such satisfactory results as he expected. He asks whether he should expect five times the signal strength by the addition of another valve, and whether with this apparatus he should be able to hear the Hague and Paris concerts.

The addition of another valve will probably not give you an increase in signal strength of 5 times. We think 2 to 2½ times the original strength would be as much as you would be likely to obtain. With this apparatus you should be able to hear the Hague and Paris transmissions under favourable circumstances.

H. F. (EAST DULWICH) is making up a three-valve set, and wishes to know the best values of certain condensers.

The secondary circuit condenser should have a value of about 0.0003 μF., and the vernier condenser less than half that value. A circuit diagram showing how to add a note magnifier to a receiver was given in *Wireless Weekly*, No. 2, in the Questions and Answers. We think this will fill your requirements.

H. H. (SOUTHSEA) proposes to construct a dual amplification circuit, and wishes to know (1) the size of certain coils, (2) How one stage of low-frequency amplification should be added.

(1) To cover the range you mention, a series of plug-in coils will be required. These should be of any standard make, preferably honeycomb or duolateral. (2) Circuits for dual amplification embodying note magnification have been given in *Modern Wireless*, Nos. 2 and 3.

W. T. (AMSTERDAM) asks certain questions about proposed designs of aerials for reception.

Of the three sketches you have submitted, there is practically nothing to choose between them. The best of the three aerials is probably that shown in your third sketch, but the points " A " and " B " should not be connected until they reach " X." We suggest, if you have the facilities for erection, you should use this design of aerial.

C. H. T. (IPSWICH) sends us a sketch of an automatic switching device which overcomes " dead-end " effects, and asks certain questions.

Your switch does not appear to us to be an idea worth patenting. There are many other " dead-end " switches of a much more economical design on the market just now. The best circuit for your purpose is ST. 35 " Practical Wireless Valve Circuits," Radio Press, Limited, and a very good text book of an elementary nature on valves is " Wireless Valves Simply Explained," Radio Press, Limited, or " Elementary Text Book on Wireless Vacuum Tubes," Radio Press, Limited. Both of these books deal with the subject in an exhaustive manner.

D. R. (HITHER GREEN, S.E.) asks the minimum and maximum wavelength of certain variometers.

The exact wavelength range of these instruments varies slightly according to the type of aerial on which they are used, but a general value may be taken to be from 250 to 600 metres. In conjunction with the condenser you mention, unless we know in what position in the circuit you intend this condenser to be connected we cannot advise you any further.

 (continued from page vi) *whether you mention the paper or not. What does matter*

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Wireless Weekly

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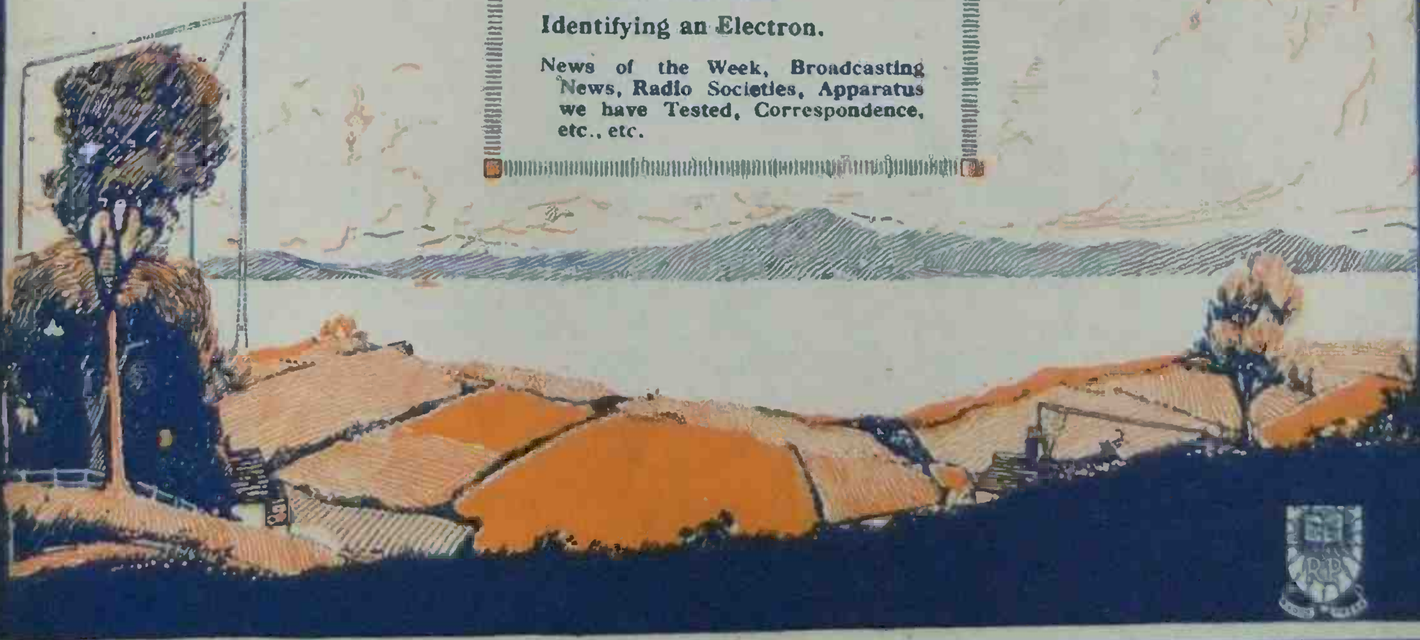

A Super-Sensitive Valve Crystal Receiver

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Editor: John Scott-Taggart, F.Inst.P.
Assistant Editor.: E. Redpath.

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Scientific Adviser:
Prof. G. W. O. Howe, D.Sc., M.I.E.E.
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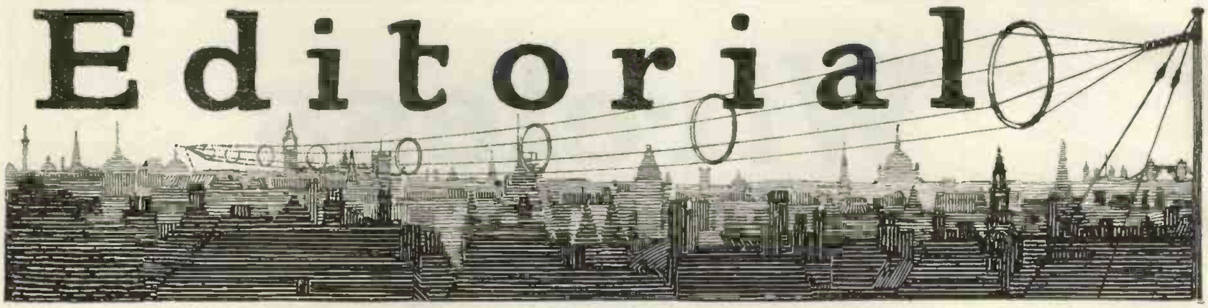


In the Melting Pot

UP to the time of going to press no decision has been arrived at by the special Committee appointed by the Postmaster-General to investigate the general question of broadcasting.

As a direct consequence of the triangular tug-of-war now in progress between the British Broadcasting Company, the Postmaster-General and the Theatrical Managers, public confidence has been badly shaken and the new and important wireless industry has received a very serious set back.

Compared to other countries, our wireless industry and its patrons—the British public—have always had to contend with a lot of unnecessary red tape, despite which, however, remarkable progress was being made.

Now we have the whole matter practically in the melting pot, and the public who have already bought or who contemplated buying apparatus or components, the B.B.C. and the manufacturers who have invested capital and, incidentally, given employment to very many British workpeople, are more or less awaiting to see which way the cat will jump next.

The British Broadcasting Company are carrying on their programmes and endeavouring to make them satisfactory to all members of their vast audiences—a by no means easy task.

Probably the majority of the general public who contemplated the purchase of apparatus have now adopted a policy of "wait and see." Those who have already bought apparatus, especially high-priced apparatus, are wondering whether their investment is going to prove unfortunate despite the repeated assurances of the B.B.C. that broadcasting will continue.

In the case of the experimenter or home constructor—call him what you will—the difficulties of the licence problem have either frightened him off entirely or driven him, however unwillingly, into the ranks of the "pirates." His only hope at present is to apply for an experimental licence. The delay which has occurred in issuing this type of licence should soon end, as the P.M.G. has had sixteen wireless experts from all parts of the country examining and classifying the 30,000 applications, and the task is now completed.

Amongst the wireless manufacturers and traders the reduction in the volume of business done is regarded with considerable apprehension.

To add to the difficulties of the situation, the theatrical managers and, in some quarters at all events, members of the theatrical profession decided to oppose the broadcasting of plays, etc. This particular difficulty, however, will, we feel sure, be amicably settled to the mutual advantage of both sides. Despite contrary views which have been expressed, we consider that the B.B.C. and the theatrical managers could pull together with mutual advantage.

In our opinion a prompt settlement of the question with regard to the 10s. licence authorising the construction of a receiving set from British-made components, the immediate issue of constructor's or experimenter's licences by the General Post Office authorities, followed by an amicable settlement between the B.B.C. and the theatrical and musical profession—and nothing less—will save the situation.

A FLEMING VALVE RELAY DEVICE

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.

This is a description of a novel use of the two-electrode valve usually only considered as a rectifier of alternating currents.

Previous Uses of the Two-electrode Valve

THE Fleming valve has many possibilities which have not yet been fully realised. Quite apart from its usual functions as a rectifier, it has found applications both in wireless telephone transmission as a modulator and in wireless receiving circuits as a limiter and relay.

The Brown Amplifier

S. G. Brown has proposed to use a Fleming valve as an amplifier by passing a varying current through the filament and so causing variations in the currents round the anode circuit which contains a high-tension battery. Such an amplifying arrangement, of course, is not very practicable owing to the fact that the filament temperature will only respond to very low-frequency changes in the current flowing through it. It is not possible to obtain very rapid temperature fluctuations, and therefore emission variations, even when a very thin filament is employed.

This very fact of the sluggish action of the filament is taken advantage of in the devices about to be described and which are given in the present writer's British Patent 168,394.

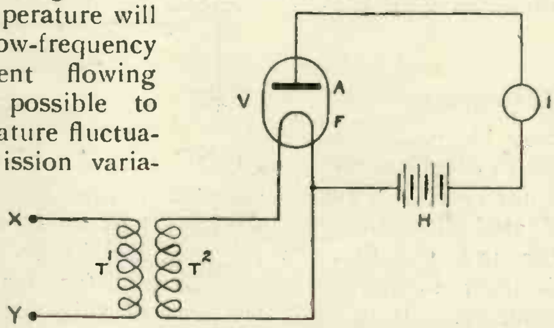


Fig. 1.—Showing how the 2-electrode valve may be used to operate a relay or other recording device.

The New Arrangement

Fig. 1 shows the basic arrangement, which is shown operating off alternating current. These currents may be either of high- or low-frequency, and they are applied through the intermediary of the transformer T^1 T^2 to the filament F of the valve V. Across the anode and filament of this valve is the usual high-tension battery H of, say, 60 volts, and the indicating apparatus I which works off direct currents; this might, for example, be an ordinary Post Office relay or some recording device.

When no signals are coming in, the filament of the valve is cold, and there is obviously no current flowing in the anode circuit. When, however, signals arrive, the high- or low-frequency currents are passed to the filament F and heat it to incandescence. Electrons are given off from the filament, travel to the anode A, and so round the anode circuit, operating the indicator I. When the signals cease, the filament, of course, no longer remains incandescent, and the whole arrangement therefore acts as a very convenient method of causing alternating currents to operate a direct current device.

If the currents to be applied to the filament are of an alternating nature, the transformer T^1 T^2 would be of the iron-core type; and if the terminals X Y were connected in the anode circuit of a low-frequency valve amplifier, the impedance of T^1 would be made great, while the number of turns of T^2 would be small.

Improving the Sensitivity of the Apparatus

Fig. 2 shows a method of improving the sensitivity of the arrangement when high-frequency currents are used to operate the relay. The high-frequency currents are led to the filament through the transformer T^1 T^2. The circuit C F T^2 is a high-frequency one, and may be tuned to the high-frequency currents. To enable this to be done the condenser C may conveniently be a variable one.

The filament F is normally heated by a current from the battery B through the variable resistance R to the point immediately preceding that at which electrons begin to be emitted from the filament.

Under these conditions, although there is normally no anode current flowing through I, yet it requires far less high-frequency current to bring the filament up to a suitable degree of incandescence than in the case of the Fig. 1 circuit.

In order to prevent the battery B and the resistance R acting as a short circuit for the high-frequency currents, a choke-coil Z of low resistance is included in series with the filament as shown.

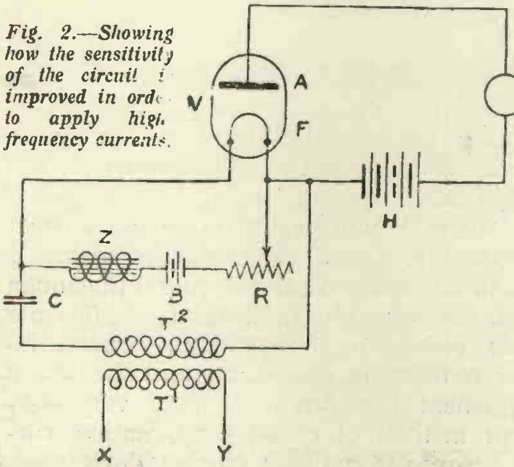


Fig. 2.—Showing how the sensitivity of the circuit is improved in order to apply high frequency currents.

Use as a Measuring Instrument

The two-electrode valve may be used as a means of measuring the strength of pulsating alternating or oscillating currents. The apparatus may itself be graduated with direct currents actually passed through the filament. The anode circuit now contains, instead of a relay, a milliammeter. It is a simple matter to draw up a table, or arrange a curve, showing the different values of anode current which correspond to definite currents through the filament.

Fig. 3 shows the use of the valve as a high-frequency ammeter in a valve transmitting apparatus. It is assumed that the energy of an oscillating valve is communicated to the aerial *via* the transformer L^2 L^1. A portion of the current in the aerial circuit is supplied by the transformer T^1 T^2 to the filament F of the valve V. The degree of brilliancy of the filament will depend upon the current supplied by T^2, and therefore the direct current indicated by the milliammeter I will be a measure of the high-frequency current in the aerial circuit. By varying the coupling between T^1 and T^2 it is possible to make the device act as an aerial ammeter over a wide range of aerial current. The same apparatus may be used for measuring aerial currents in the case of ship spark sets. Owing to the fact that the arrangement is rather sensitive to varying currents, the device employed as an aerial ammeter is best suited to a continuous wave transmitting set.

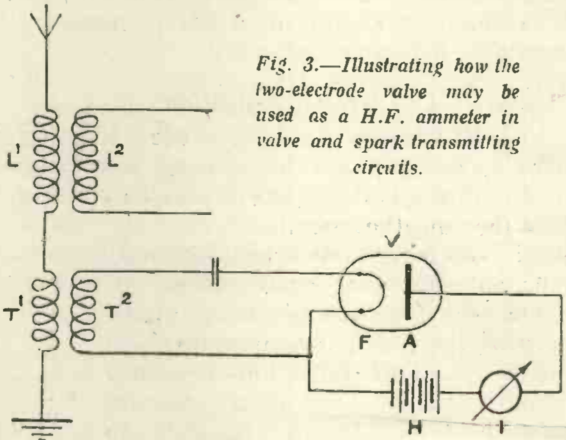


Fig. 3.—Illustrating how the two-electrode valve may be used as a H.F. ammeter in valve and spark transmitting circuits.

TELEPHONE MANUFACTURING CO., LTD.

We understand that the T.M.C. are taking strong action in all cases of price-cutting on their products which are brought to their notice. This action is highly desirable, as there is no doubt that it is in the best interests of the public and the trade that, a fair price having been fixed, it should be maintained by all concerned.

HIGH-POWER VACUUM TUBES

By Dr. IRVING LANGMUIR.
Assistant Director Research Laboratory, General Electric Co.

The following article deals with the developments of the high-powered valve and gives details of many interesting facts.

THE recent tests at Rocky Point, L.I., using 20 kw. pliotrons as a source of high-frequency power, have demonstrated the practical operation of high-power valves. The Alexanderson Multiple-tuned aerial was used, supplied by high-frequency current from six 20-kw. pliotrons in parallel, and during a sixteen-hour test, signals were transmitted to, and received from, Nauen, Germany. These signals were in addition to those usually transmitted with the Alexanderson alternator.

The valves used in this test, like the ordinary valves used for receiving wireless signals, contained three electrodes, the filament, the grid and the anode, and to this extent they incorporate the principle first brought forward by de Forest. By the use of a very high vacuum and by special features of construction, ionisation due to a gas residue is reduced to negligible value, and in this way it has been possible to develop pliotrons capable of operating at higher and higher powers. The present 20-kw. valve marks simply one step in this development. The original de Forest audion operated with currents of at the most a few milliamperes and at voltages of 30 or 40, so that the power which could be controlled was about 0.1 watt or 0.2 watt.

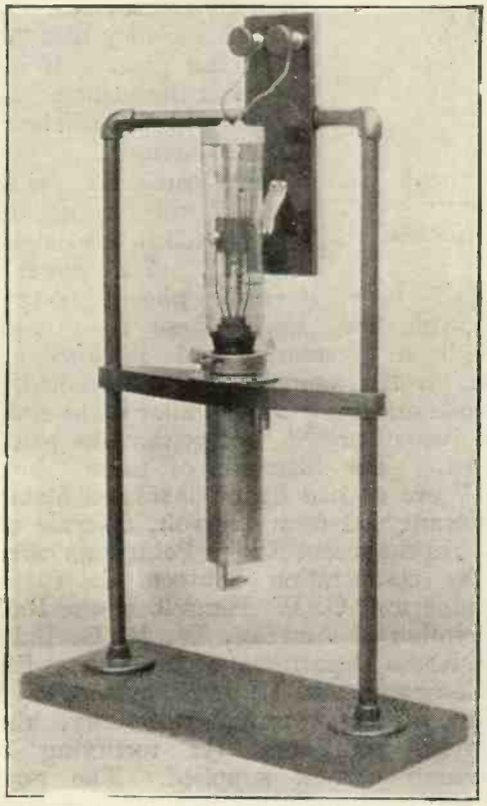


Fig. 1.—Outside view of a 20 kw. valve.

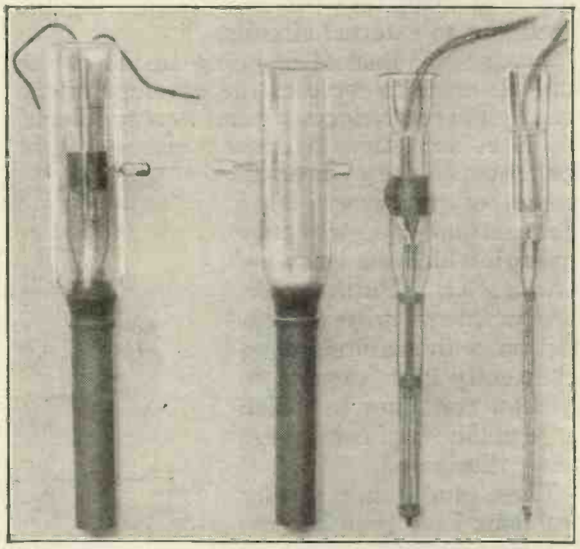


Fig. 2.—Interior construction of a 20 kw. valve, the tungsten filament of which consumes 1 kw.

By using the new principle of a pure electron discharge, independent of gas ionisation, it was possible to develop valves for transmitting purposes. Those were used widely during the war for small wireless telegraph and telephone sets. Gradually valves of 50 watts and 200 watts were developed, using tungsten filaments as cathodes, and with anodes of metallic molybdenum, capable of operating at such high temperatures that they could dissipate by radiation relatively large amounts of power. During the last few years valves of this type of 1-kw. and 5-kw. capacity have been developed. The molybdenum anodes in these larger valves are of cylindrical form and operate at high temperatures, so that they can radiate the heat through the transparent glass wall of the bulb.

For larger powers it becomes difficult to make an anode of sufficient size to radiate the energy dissipated, and therefore resort has been made to water-cooling. In this way the glass bulb was avoided entirely, except as a means of insulating the leads connecting the electrodes to external circuits.

The anode, instead of being inside of the tube, is made to serve as the envelope of the tube. This introduces several new problems, for it is necessary to make a vacuum-tight seal between the cylindrical anode of relatively large diameter and the glass tube through which the leads are brought. Furthermore, new problems arise in connection with maintaining a sufficiently high vacuum in a metal container in which large amounts of energy are being dissipated.

These and other similar problems have been worked out largely as a result of several years' work on the part of W. C. White and H. P. Nolte.

Fig. 1 is a photograph of the outside of the 20-kw. tube, which has already been manufactured in relatively large numbers, and is commonly known by the type number UV207. It can be seen that the lower part of the tube consists of a copper cylinder of about 1.9in. outside diameter and about 8in. long. This is sealed to a large glass tube of about 2.75in. diameter by means of a conical thin-metal portion consisting of copper-covered nickel steel, this material acting as a substitute for the very expensive platinum which might otherwise be used. The upper glass portion of the tube is about 10in. long, and serves merely to support and insulate the filament leads from the grid and anode.

Fig. 2 is a photograph illustrating the interior construction of the tube. The cathode is a heavy tungsten filament of about 0.04in. diameter bent in the form of a "W" and supported on stout tungsten rods. It requires about 50 amps. heating current at about 20 volts, thus consuming about 1 kw. The anode operates at about 15,000 volts direct current with respect to the cathode. The outside of the anode cylinder is directly in contact with running water supplied at the rate of about 2 gal. to 3 gal. per minute.

Because of the possibility of dissipating a large amount of power from the water-cooled anode it is possible to make this anode relatively smaller—in fact, much smaller than is used in the 5 kw. valve. This aids greatly in overcoming the space-charge effect which is a feature limiting the efficiency of thermionic valves. These 20-kw. tubes have, therefore, a rather higher efficiency than the low-power tubes with molybdenum anodes.

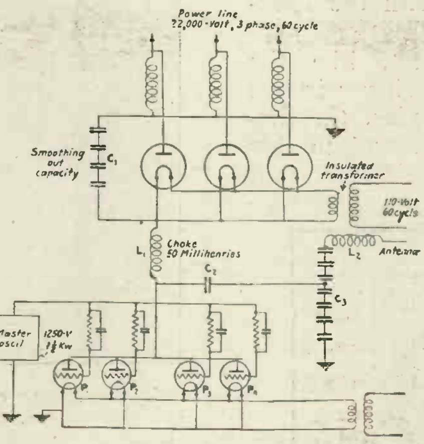


Fig. 3.—The circuit used in recent tests.

In the production of high-frequency power these tubes give an output of 20-kw. in an aerial with an anode efficiency of 75 per cent., the filament loss of 1-kw. reducing the over-all efficiency to about 70 per cent. This is by no means the limit of efficiency that these valves can give. If used for lower frequencies considerably higher efficiencies may be obtained.

The particular circuit used in the recent tests is illustrated in the diagram (Fig. 3). The power is supplied from a three-phase, 60-cycle, 22,000-volt line. Each phase is grounded through a "reactor," and is also connected to the anode of a water-cooled, 2-electrode rectifying valve similar to the 20-kw. valve just described, except that the grid is omitted. The filaments of these "kenotrons" are excited by an insulated filament transformer fed from 110-volt, 60-cycle current. In the recent Rocky Point tests carried out by co-operation between E. F. W. Alexanderson, C. W. Hansell, of the Radio Corporation of America, W. R. G. Baker, of the Radio Department of the General Electric Company, and H. J. Nolte and W. C. White, of the research laboratory, three kenotrons were used for rectifying the alternating current supplied. The power obtained was smoothed out by a capacity C_1, shown in the diagram. This direct-current power supply was further smoothed out by the choke coil L_1, of 50 millihenries. The direct current ranging from 10,000 volts to 15,000 volts was then applied to the anodes of six pliotrons operating in parallel. The grids of these pliotrons were excited by a master oscillator giving about 1,250 volts and capable of delivering about 1.5-kw. of high-frequency power. The grids were operated in parallel, each grid being provided with a grid-leak and condenser. The connection to the aerial from the anode circuit was made by means of the condenser C_2, which was connected to the aerial circuit at a point in a series of condensers C_3, connecting with the ground. The aerial itself, which was of the multiple-tuned type, was connected to the condensers C_3, through the tuning coil L_2. In the tests recently made where signals were transmitted to Nauen, the aerial current was about 310 amps., which is about one-half that used ordinarily with the Alexanderson alternator. No particular effort was made to obtain the full output of the valves in these tests, and undoubtedly more than twice as much power will soon be obtained from a similar number of valves. The tests have demonstrated on a larger scale what we have already known from laboratory studies of individual valves, that they are capable of thoroughly satisfactory operation with an output of about 20 kw. The filament design is conservative, so that the life of the valves should average several thousand hours in actual operation.

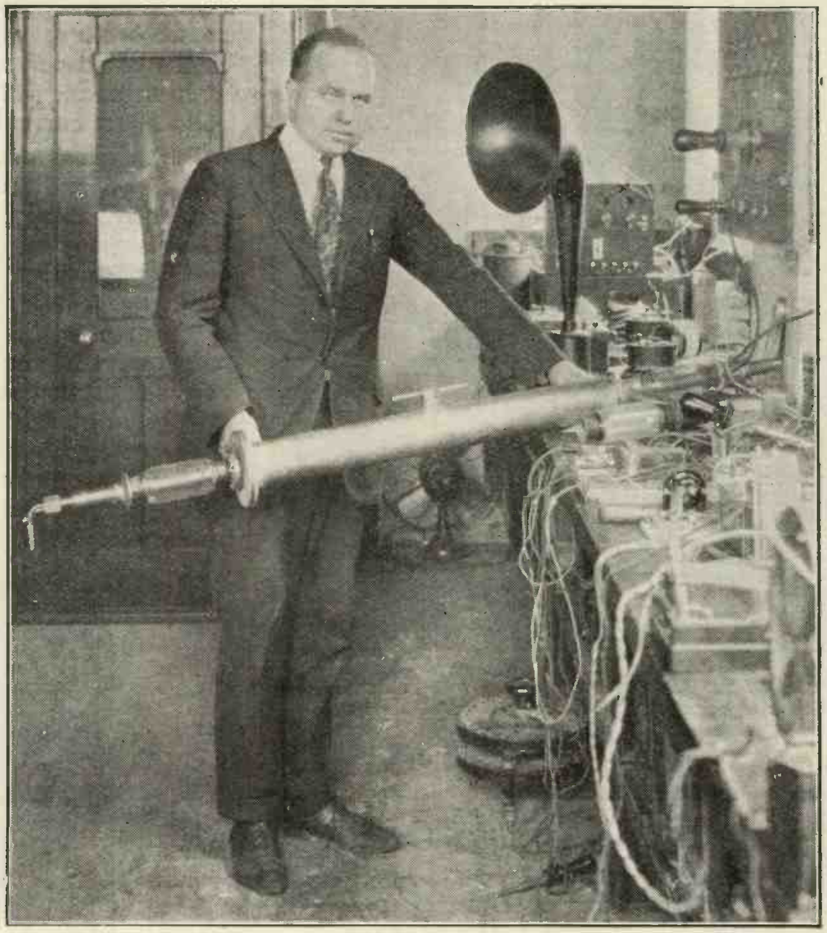


Fig. 4.—One of the 1,000 kw. magnetrons recently developed. The filament of this valve is 0·4 inch in diameter and 22 inches long. It is excited by a current of 1,800 amperes at 10,000 cycles.

The practical utilisation for wireless purposes of these 20-kw. valves marks merely a step in the application of the basic principle of the pliotron. Since 1912, when this development was first begun, the energy controlled by the three electrode tubes has been increased from the 0.1 watt or 0.2 watt of the original audion up to more than 20,000 watts, an increase of more than a hundred-thousand-fold.

This has been accomplished as the result of a careful study of the fundamental principles involved in the conduction of electricity through high vacua. The writer's own work in this field was published in 1918 in the *Physical Review*, and the first work in applying this principle in the construction of vacuum valves was described before the Institute of Radio Engineers in 1915.

Larger tubes than those rated at 20 kw. are being constructed. A 100-kw. tube of nearly the same type as the present 20-kw. tube is now being developed by W. C. White and

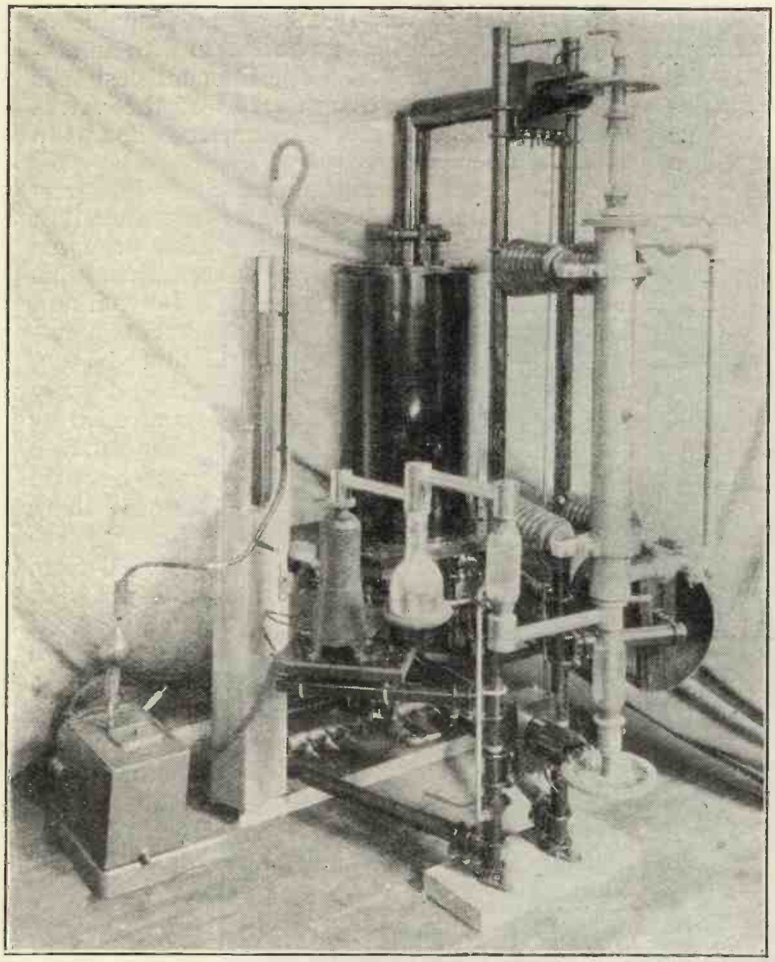


Fig. 5.—The space occupied by this 1,000-kw. valve is very small when compared with that required by a high-frequency alternator of the same capacity.

taking the place of that of the grid in the three-electrode valve. The electron current to the cathode is thus interrupted 20,000 times per second. By the use of properly tuned circuits this can be used for the production of high-frequency power for wireless or any other purpose. The particular type shown in Fig. 4 will supply 1,000 kw. of 20,000-cycle power at an efficiency of 70 per cent., operating with an anode voltage of 20,000 volts direct current.

For wireless purposes efficiencies of 70 and 80 per cent. are eminently satisfactory, but for other engineering purposes they are not so high as would be generally desired. Another line of development is therefore in progress, viz., the production of valves of higher efficiency as well as valves of larger output.

The energy loss in heating the filament can be reduced to one-tenth, or even less than one-twentieth, of that necessary with a pure tungsten cathode by employing a "thoriated" tungsten filament under special conditions which have been the subject of study during the last few years.

The advantage of the thoriated filament is due to an absorbed film of metallic thorium on the surface of the filament, this film consisting of a single layer of atoms. As fast as the thorium evaporates off the surface it is supplied by diffusion from the interior

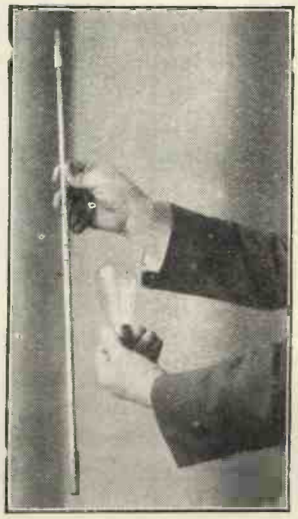


Fig. 6.—The filament of a 1,000-kw. valve as compared with an ordinary electric bulb.

H. J. Nolte, and promises to be fully as successful, in addition to having the advantage of somewhat higher efficiency.

Another quite different type of valve involving the principle of magnetic control, proposed by Dr. A. W. Hull and called by him the magnetron, has been constructed by J. H. Payne. This valve, a photograph of which is shown in Fig. 4, consists essentially of a water-cooled cylindrical anode 30in. long and 1¾in. in diameter. At the axis of the anode is a tungsten filament 0.4in. in diameter and 22in. long. This filament is excited by a current of 1,800 amp. at 10,000 cycles, the filament excitation requiring about 20 kw. The magnetic field produced by this large heating current is sufficient to "cut off" the electron current from the cathode to the anode during a portion of each half-cycle of the current passing through the cathode, this action of the filament. In utilising this effect a particularly high degree of vacuum is desirable, or at least the absence of those gases which would oxidise or otherwise combine with the very fine film of thorium. For this purpose the vapours of various reducing materials, such as magnesium, or alkali metals, such as potassium substances containing carbon, have been used. Very successful results have been obtained in adopting this thorium filament in power valves. At present the necessity of using this more efficient cathode is not very pressing, but with a future demand for high efficiency it will be possible not only to cut the energy necessary for filament excitation down to a small fraction of what it now is, but at the same time the life of a cathode can be increased enormously, so that the practical application of electron valves of large power will certainly not be limited by an unduly short life.

These developments will come gradually, for the practical construction of powerful valves giving thoroughly satisfactory operation requires a great deal of development work. It would be rash, however, to predict the limitations of the ultimate use of vacuum valves in the power field.

(*Abstract from the " Electrical World."*)

A FEW NOTES REGARDING DEMONSTRATIONS OF WIRELESS TELEPHONY

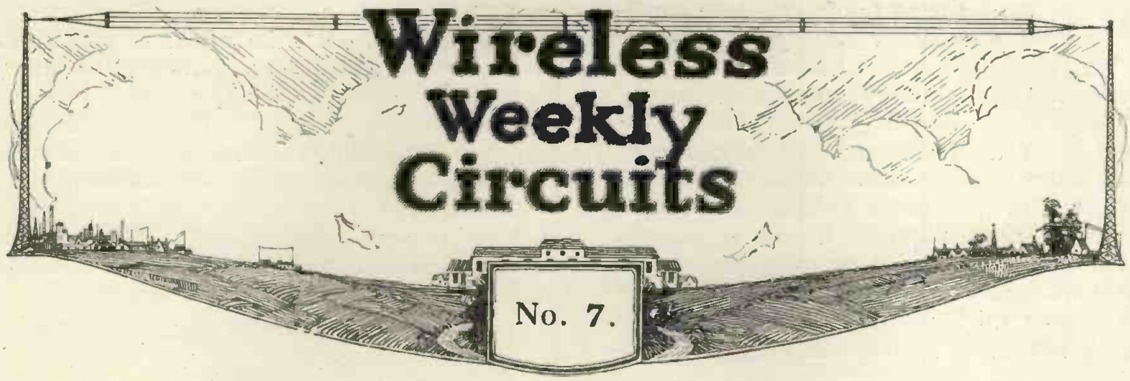
By L. B. POWELL.

PUBLIC demonstrations of wireless telephony and music are becoming more and more common, and nothing seems to have exemplified the arrival of the wireless age—for such it might be called—so much as these demonstrations, wherein loud-speaking equipment has reproduced concerts, often from many miles away, for the entertainment of large audiences. The progress which has been accomplished is all the more wonderful when one reflects upon the comparatively brief time which has elapsed since the early experiments in wireless set scientists off upon research, the results of which were probably never guessed at. It is not yet half a century since David Edward Hughes, an Anglo-American electrician, was mystified by the sensitivity of microphones to what he called "sudden electrical impulses," issuing, he presumed, from frictional machines in his workshop.

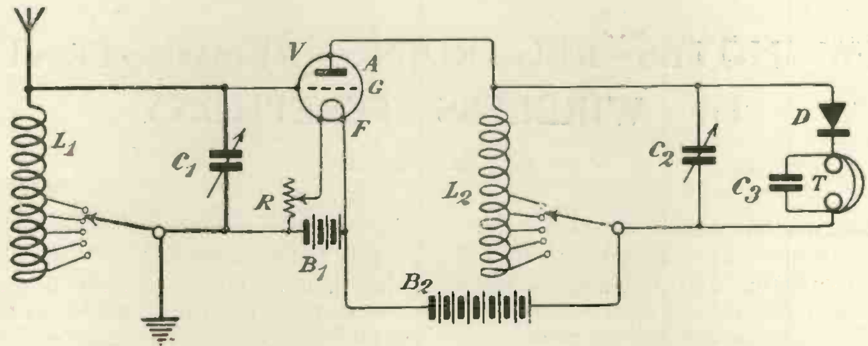
But to revert to the public demonstrations of wireless concerts. It is unfortunately true that often these performances have been disappointing to the audience, so far, at least, as the accuracy of reproduction was concerned. Much depends, of course, upon the attitude of mind in which the demonstration is approached—by people, that is, who are to hear wireless for the first time. Some people are incapable of appreciating the wonder of the thing, and if technical success is lacking there comes the grunt of disapproval and the deprecating remark, " It's just like a gramophone, isn't it? " On the other hand, there are people who, on being initiated to wireless, would be just as thrilled to hear a donkey braying as to hear the finest of tenors singing.

It is rather unlucky for those who assume the task of giving public demonstrations that invariably each of these types is to be found in the audience, and, if the results are not good, quite a percentage of those present go away with the impression that wireless is, after all, far from being the delightful wonder that it is said to be.

Such an impression is unfair, in a way, to the people who are now operating the broadcasting stations. Generally the disappointing results are due entirely to excessive amplification. Why demonstrators should be at pains to produce raucous shouts from the loud-speaker is something of a mystery. The penalty of excessive amplification is pronounced distortion, which often renders music and speech quite unrecognisable. It can be avoided, not only by manipulation, but by the right choice of apparatus also, and demonstrators, before they make these ventures, should be sure, as far as possible, that everything is done to produce the right results; and better have quiet but clear reproduction than noisy, unintelligible jargon.



Another One-valve High-frequency Amplifier Receiver



COMPONENTS REQUIRED.

L_1 : A tapped inductance.
L_2 : A tapped inductance of about the same size as L_1.
C_1 and
C_2 : Variable condensers having a maximum capacity of about 0.001 μF.
R : Filament rheostat of about 7 ohms resistance.
B_1 : 6-volt accumulator.
B_2 : High-tension battery of 40 to 80 volts.
D : Crystal detector.
C_3 : Fixed condenser of 0.002 μF capacity.
T : High resistance telephone receivers.
V : Three-electrode valve

GENERAL NOTES.

This circuit is of the same kind as the preceding one, No. 6, but, instead of using slider inductances, tapped inductances are employed.

VALUES OF COMPONENTS.

Inductance L_1 and the inductance L_2 may both be the same, and they consist of a cardboard tube 3½in. in diameter, wound for a distance of 5in. with No. 26 gauge double-cotton-covered wire, eight tappings being taken at equal intervals.

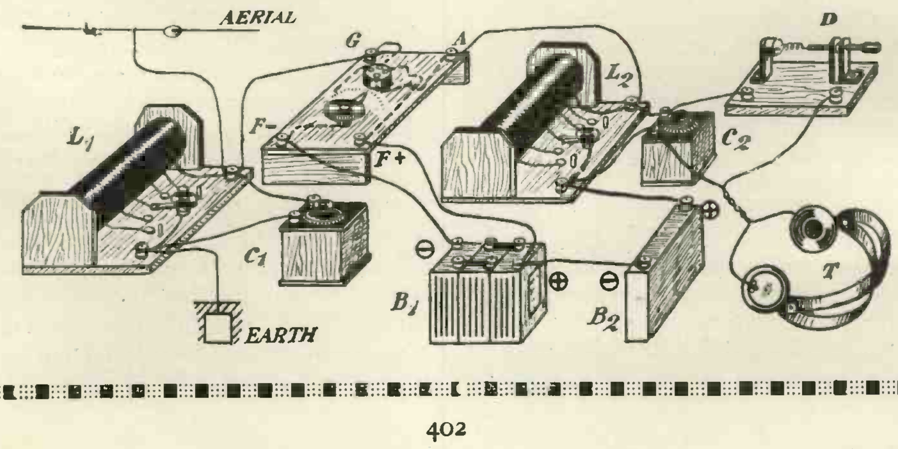
The condensers C_1 and C_2 preferably have a capacity of about 0.001 μF.

The values of other components have already been given.

NOTES ON OPERATION.

Probably the simplest way to operate a circuit of this kind is to disconnect the condenser C_2, have the full inductance L_2 in circuit and, having adjusted the crystal detector, adjust the circuit L_1 C_1 by placing the selector switch on the first stud and swinging the dial of the condenser C_1 backwards and forwards.

Then try stud 2, carrying out the same operation with the condenser, and so on, until signals are heard at their loudest. Then connect C_2 in circuit, and carry out similar operations with the circuit L_2 C_2. Final adjustments on the rheostat R and detector D will be found advantageous.



IMPERIAL WIRELESS

By *GODFREY C. ISAACS.*

A full discussion of this vitally important subject and its relation to Empire communications.

THIS subject has a special importance at the present moment, having regard to the statement of policy made by the Prime Minister in the House of Commons on March 5th last. The Prime Minister said:—

"The policy to be adopted with regard to Imperial wireless communications has recently been under review by the Imperial Communications Committee, under the chairmanship of the First Lord of the Admiralty, and the recommendations of that Committee have now been approved by the Government.

"In view of developments in the science of wireless telegraphy and other circumstances which have arisen since the late Government decided upon the policy of a State-operated wireless chain, it is not considered necessary any longer to exclude private enterprise from participation in wireless telegraphy within the Empire.

"The Government has therefore decided to issue licences for the erection of wireless stations in this country for communication with the Dominions, Colonies, and foreign countries, subject to the conditions necessary to secure British control and suitable arrangements for the working of the traffic.

"At the same time the Government has decided that it is necessary in the interests of national security that there should be a wireless station in this country capable of communicating with the Dominions and owned and operated by the State. A station of this kind will therefore be erected as early as possible and it will be available for commercial traffic as well as for service messages."

The terms upon which licences are to be issued by the Post Office and the arrangements which may be made between the Post Office and private enterprise for the working of traffic is at the present moment under negotiation between the Post Office and my Company, and I understand that when an arrangement has been come to the papers will be placed upon the table of the House, and it may be that a discussion may follow.

It is necessary to a full appreciation of the present position that I should give a short history of the development of commercial wireless services before the war, during the war and subsequent to the war. The services originated with the erection of stations at Clifden, Ireland, by my Company, and Glace Bay in Canada, and a commercial service between this country and Canada followed. This service was first started in 1909.

In 1910 I submitted to the Government a proposal that my Company should be granted licences to erect stations in all the Dominions and Colonies for the purpose of conducting wireless telegraph services. This proposal was highly approved by the Government of the day, but it felt that the stations should be erected and worked by the State in partnership with the Company. Finally an agreement was entered into in 1912, and ratified by Parliament in 1913, between the Government and the Company, under which six stations were to be erected in the first instance by the Company on behalf of the Government, the Company being interested therein. From the moment this information was published other countries at once set about equipping themselves with efficient wireless services.

In Germany two powerful stations were erected, and in their Colonies stations were constructed in Togoland and at Windhuk and Dar-es-Salaam in West and East Africa respectively.

The Marconi Company in the meantime had obtained a licence for the erection of a station at Carnarvon for trans-Atlantic service between America and this country.

Under the terms of the contract my Company started the erection of three of the Government stations—one at Leafield, one in Egypt, and one in India.

The French Government equipped the Eiffel Tower with a powerful station, and built another at Lyons.

The Americans built stations in the vicinity of New York and at San Francisco and Hawaii, for service between America and England, and America and Japan.

We obtained a concession from the Argentine Government, and were making preparations to erect a station in Buenos Aires. This work was unable to proceed in consequence of the outbreak of war.

During the war the Americans built a high power station at Bordeaux, which was subsequently taken over by the French Government.

The Germans obtained a concession from the Argentine Government, and the Germans of South America subscribed substantial capital for the erection of that station in Buenos Aires.

The Japanese erected a powerful station at Tokio and commenced the building of a station in Pekin. My Company has agreed with the Japanese that this station shall be taken over and controlled by an English Company.

After the war, the Germans increased the power of their stations and built a number of small stations throughout the country, opening up services with most European countries and with America.

The French gave a licence to private enterprise which has built a group of powerful stations at Sainte Aisse from which they are to-day conducting services with America, the French Colonies, and other European countries.

The Americans built a powerful group of stations on Long Island, and are now conducting a number of European services, besides a service across the Pacific. It will be remembered that in America the telegraph services are free from all Government control.

In this country the Imperial Chain of stations was not proceeded with after the outbreak of war, the contract with the Marconi Company being ended. The Government stated that the principal factors which had actuated it in arriving at that decision were the altered circumstances resulting from the war, and especially from the prospect that hostilities might be prolonged, and they stated they were of opinion that the present and prospective naval and military requirements, which were the governing factors in determining the scheme for the Imperial Wireless Chain, could be better met by means other than by the construction of stations of the character and in the situations contemplated by the contract for the Imperial Chain.

After the war they completed the Leafield station and the station in Egypt. Then there were appointed a number of

Committees to consider the Government policy with regard to further erection of the Imperial Chain of Wireless stations.

There was the Imperial Wireless Telegraph Committee appointed on the 21st November, 1919, the Wireless Telegraphy Commission appointed on the 23rd December, 1920, the Imperial Communications Committee appointed on the 5th July, 1921, who had the matter under their review, and the Committee of the Cabinet appointed in December, 1922. Whilst these several Committees dealt with the subject, foreign Governments gave a free hand to private enterprise, and considerable wireless telegraph services abroad have resulted. In short, whilst Great Britain pioneered wireless in the world, the Government appointed Committees, and foreigners built stations.

This history of the position brings us to the present day, and to the decision of the Government announced by the Prime Minister on the 5th March, to which I have referred.

I should explain that in the meantime the Australian Government had declined to follow the recommendations of the Home Committees and had entered into an agreement with private enterprise in Australia, taking 50 per cent. plus one of the shares of the Australian Company and passing to that Company the whole of the Australian Wireless Telegraph services.

The Snuth African Government gave a concession to the Marconi Company fnr the erection of stations in South Africa.

The Indian Government declared its intention of granting a licence to private enterprise.

The Canadian Government granted to the Marconi Company of Canada a licence for stations to be erected in Montreal and Vancouver.

Fnllnwing the announcement by the Prime Minister the Marconi Company has applied for a general licence to conduct services from this country with all parts of the world. When this licence is granted it is their intention to erect a group of six high power stations in the Midlands, and directly they commence the erection of these stations they will simultaneously erect stations on behalf of the Australian Company in Australia, stations in South Africa, in Vancouver and Montreal, and they fully expect to erect, through an Indian Company which they have undertaken to create, a station in India.

The home stations, it is estimated, will cost approximately £2,000,000 sterling, and from the moment the licence is granted the Company will make a great endeavour to complete the erection of the whole of the stations both at home and in the Dominions in approximately 12 months. It is proposed that the home stations shall, in the first instance, conduct commercial services with each of the Dominions, with Argentine, Brazil, and other South American countries, to the United States of America, China and Japan.

Mr. Godfrey C. Isaacs, Managing Director of Marconi's Wireless Telegraph Co., Ltd.

I want here to break off for a moment to explain what has taken place in the Argentine, for there would seem to me to be some confusion as to the arrangements which the Marconi Company have made with regard to South America. I previously told you that the Company had to cease the erection of its station in Buenos Aires in consequence of the outbreak of war, that the German Company had obtained a concession from the Argentine Government, had formed a powerful company with German capital in the Argentine, and had started the erection of a high-power station. The French and Americans had also obtained concessions. All the four companies, including the Marconi Company, were endeavouring to obtain concessions from other South American Governments, the Germans having the advantage in consequence of their having been able to proceed with the construction of their station during the war, which gave them considerable prestige throughout the whole of the South American Continent. It must be quite obvious that four Wireless Companies, with four high power stations in each of the South American countries, dividing the traffics which could be best handled by one station under one organisation, was an unsound economical proposition. The four Companies therefore came together, took over the German station in the Argentine, and together proceeded to complete it and to erect other stations in South America in partnership, agreeing that the management of each of the stations would be in the hands of the four Companies, the traffic pertaining to the country of each company being conducted by a staff employed by that Company.

Returning now to the programme of the Marconi Company at home, this awaits the issue of the licences. The licences are awaiting the completion of the arrangements between the Postmaster-General and the Company. The Post Office is to erect a powerful station which will also conduct commercial services, and the question which has yet to be settled is that relating to the handling of the traffics, and this is a matter which is being considered by the Post Office and the Company. The Company has proposed that the traffics of the Government station and of the stations erected by the Company should be handled by one central organisation, using each station indiscriminately as circumstances might from time to time direct for the most efficient distribution of the traffic.

It would appear to me that there are but three possible methods of conducting the Wireless services of this country. They are :—

1. A joint control of the allocation of traffics over all stations indiscriminately, whether Government or privately owned, with one transmitting centre.

2. The regional division of traffics; that is to say, an exclusive allocation of particular countries to particular stations.

3. Free competition between the different enterprises over the whole world.

Let us examine each of these alternatives. The first would have the advantage of using the capacity of each of the stations to its fullest extent, enabling several stations to concentrate on the traffics destined to any particular part of the world during the peak load hours. It will be borne in mind that each of the stations erected in the Dominions will have four receiving stations, so that at busy times of the day, which are mostly between 11 a.m. and 4 p.m., an accumulation of traffic shall not be created. There would be facility for every message being immediately despatched, arriving the same day, and enabling a reply to be received the following morning. This, to my mind, is the great essential to all commercial houses. Under this method four stations could be transmitting simultaneously to India or South Africa, or Australia or Canada, as the case might be, if the amount of traffic necessitated it. The importance of this will be appreciated when the difference of time between the Mother Country and the several Dominions is considered. Greenwich noon is 4 o'clock in the morning on the Pacific side of Canada, it is 8 o'clock in the morning on the Atlantic side of Canada, it is 2 in the afternoon in South Africa, it is 5.30 p.m. in India, 8 o'clock in Western Australia, 9.30 p.m. in Southern Australia, 10 p.m. in New South Wales, and 11.30 p.m. in New Zealand. There are, of course, also great discrepancies between Greenwich time and that of the several South American countries, China and Japan. If the whole group of stations, therefore, is available to handle the traffic for each of the several countries during the two or three hours which are material every day, the whole of the stations can be kept employed and the whole of the traffic can be dealt with very expeditiously, in all cases allowing for the possibility of replies being received overnight. There is also a further consideration: although wireless telegraphy has made great strides in recent times, there are nevertheless in tropical countries, in certain seasons, periods when the reception of traffic becomes very slow and difficult, sometimes not exceeding 8 or 10 words per minute. There are even periods, possibly during tropical storms, when traffic cannot be received at all. Such conditions make it all the more necessary, in my opinion, that during the satisfactory working period of the day there should be a means of handling the traffic with the greatest possible despatch.

Now let us examine the second alternative of regional division of countries. Let us suppose that a single station in this country is allocated to the traffic of India. If that traffic be heavy, as it usually is between the hours of 11 a.m. and 4 p.m., and the atmospheric conditions in India are excellent during two hours of that period, and very unsatisfactory during the remainder, such traffic as can be transmitted during the good period will be received, and the remainder will stand over until conditions improve. Considerable delay can be occasioned in this way; but not only that; if India cannot receive during some hours from the station which is allocated for its traffic, that station stands still during that period, with the whole of the staff unemployed. Under such conditions, in my view, no station with the heavy cost of construction and the heavy staff its working entails can do other than make substantial loss. Further, one of the great advantages of wireless telegraphy is lost from the moment this practice is adopted, viz., its elasticity; but it is, on the other hand, reduced to the disability of the cable, which has but two ends, and can therefore communicate only between two points.

The third possibility would consist of free competition between all who conduct wireless services from this country to all parts of the world. This would entail the handicap upon private enterprise of competition with a State subsidised service. This, however, although very undesirable, would be preferable in my view to the many disadvantages of the regional division.

These are questions which will no doubt be duly considered by the Postmaster-General. They are matters which we cannot decide, but until they are decided the development of this country's wireless telegraph service is paralysed.

We are asking that we may be given a free hand to develop our telegraph services. We think it would make for the efficiency of these services if there were one central control of the allocation of traffic, but should this be deemed to be inacceptable we still ask for a free hand to develop our own services.

I wish it to be clearly understood, however, that we do not ask the Government to grant us any exclusive right. We ask only for that which has been freely given to the Cable Companies; and I believe I am right in saying that any Cable Company which could satisfy the Government that it could conduct a serious telegraph service would be granted cable landing rights to-day, and would be given every facility to develop its business. We ask that we should be similarly treated now that the Government's policy has been defined by the Prime Minister.

It is very essential, in my opinion, that there should be no further time lost. This country, which I repeat was the pioneer of wireless telegraphy, has allowed itself to fall seriously behind its great commercial competitors. Prompt, accurate and cheap communication represents serious factors in the competition for world trade. America, Germany and France have this considerable advantage over us to-day, and I would like to give two examples.

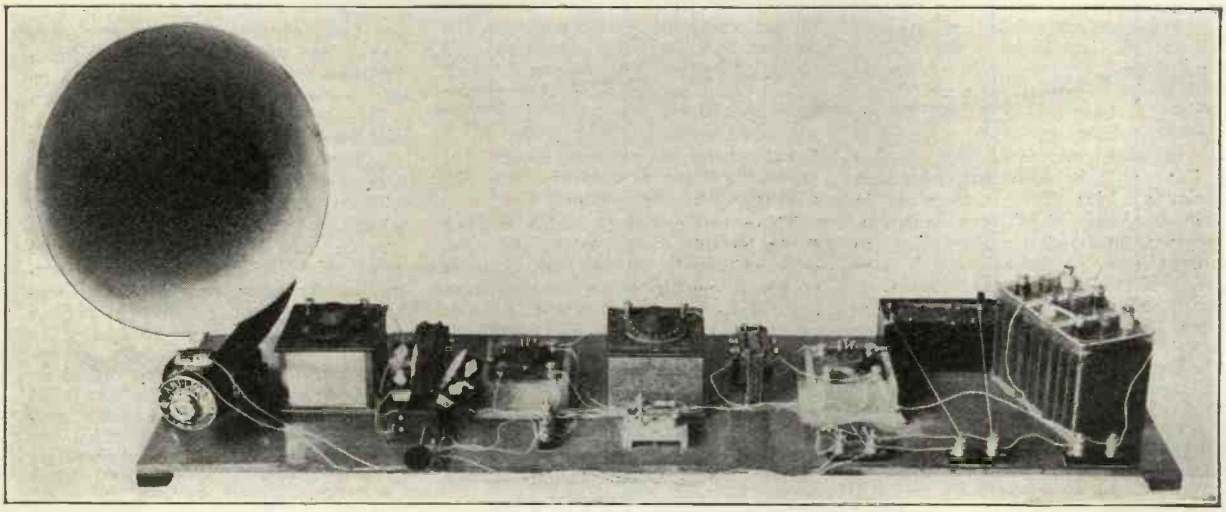
In recent weeks Mr. Newcomb Carlton, President of the Western Union Telegraph Company, stated in his Annual Report that wireless telegraphy in the past year had handled 20 per cent. of the transatlantic traffic. In parentheses, I would say that he was mistaken—it handled over 30 per cent. Immediately after he issued this report all the transatlantic cable rates were reduced to the wireless rates. This had the immediate effect of the transatlantic wireless rates from France and Germany being further reduced in exactly the same rate as that in which wireless stood to the cables prior to the cable reduction. We have not yet followed suit, for the reason that with our single station, built before the war, we are not up to date and our traffic is so great with the present tariff, which is now the same as that of the cable, that we dare not at the moment give any further inducement to attract more traffic, nor shall we be able to do so until we have the licence issued to us enabling us to erect the new station with our latest wireless improvements, which will immensely enhance the capacity of our transatlantic service. Meantime, the French and Germans will continue to have a substantial advantage over this country in telegraphic rates between Europe and America. I believe I am right in saying that for many years the Cable Companies have been urged without avail to reduce their rates. In so far as the transatlantic telegraph service is concerned, wireless has accomplished in this direction what everything else failed to do; but so far it is limited to transatlantic cable tariffs, the reduction has not extended to countries where there is no wireless service.

The other case has not yet been experienced, but will be very shortly. I have already stated that the four Wireless Companies are constructing, and have very nearly completed the construction of, a powerful station in Buenos Aires to conduct services with Europe, and that they are erecting stations at Rio de Janeiro and Pernambuco. When these stations are opened for service at substantially reduced tariffs, the Americans, the French and the Germans will have all the advantages of the prompter, cheaper and more accurate telegraph services because they have erected their stations, whereas we, having had no licence, have not been able to erect our stations in this country to conduct these services; and until this question of licences is settled, this advantage will continue with our principal trading competitors. If communications to this country should be sent by wireless they will have to be routed through America, Germany or France, instead of coming direct.

There is one thing further which I desire to explain in connection with the Marconi Company's programme. The conception in most minds, I believe, of an Empire Wireless Service has been limited to the thought of facilities for communication between the Mother Country and each of the Dominions. The Marconi Company conceives a greater service and are designing the whole of their stations in the Dominions to provide not only a service between the Dominions and the Mother Country, but between Dominion and Dominion, and Dominion and other parts of the world. If this programme be carried out, it will furnish to the Dominions for the first time an opportunity of direct communication between themselves. That this has considerable importance for the development of the trade of the Dominions, there can be no doubt; but it has another great object which is perhaps not less material, and that is of enabling each of the Dominions to have some better knowledge of what is transpiring in different parts of the Empire. How much do we know in this country of what is taking place in Australia or in South Africa, New Zealand, Canada or India? How much do we read in our morning papers? I had personally the greatest difficulty in learning during the recent Australian elections how they were proceeding or what were the issues. If that be the extent of the information which we have at home of what transpires in the Dominions where we have direct communication, what do the Dominions who have no direct communication know of the daily life of each other? In my view there is no more important question than this, and if the Marconi Company rendered no other service in constructing its wireless telegraph stations, this object alone is worthy of the greatest consideration. In time of emergency, it will be remembered, the whole of the Company's stations and their complete organisation would immediately pass into the hands of the State; the value to the Empire of such a system of communication in the time of need cannot be over-estimated.

Abstract of an address to Members of the Industrial Group of the House of Commons, May 8th, 1923.

THE NEW CIRCUIT—S.T. 100



A photograph of the apparatus used in the new circuit S.T. 100, particulars of which will be given in "Modern Wireless," No. 5, out on June 1st.

The results obtained with this circuit are nothing short of marvellous, and readers should be sure to avail themselves of the opportunity of learning its secrets.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART VII

(Continued from No. 6, page 341.)

How may Fig. 6 of the Preceding Instalment be Improved so as to give Stronger Signals?

It may be improved by the addition of what is known as a step-up transformer between the crystal receiver and the amplifying valve.

What is a Step-up Transformer?

A step-up transformer is a transformer in which there are more turns in the secondary winding than in the first, so that the potentials across the primary winding are stepped-up or increased in the secondary.

The primary winding consists of insulated wire wound on an iron-core, such as a bundle of iron wires, while the secondary consists of, perhaps, five times as much wire, wound over the primary winding. If the voltage across the primary winding were 1 volt, due to alternating current flowing through it, the currents in the secondary winding would have a voltage of 5 volts.

What is the Object of a Step-up Transformer in a Low-frequency Amplifier?

The object is to change the currents applied to the amplifier into currents of higher voltage, as the valve is a voltage operated device; as previously explained in this series, it is voltage on the grid which counts. Using a step-up transformer, we obtain a weak current in the secondary, but one of high voltage. The higher voltages applied to the grid of a valve cause much larger changes of anode current than would result by the use of a circuit not containing the step-up transformer.

Sketch an Arrangement of Apparatus in which an Iron-core Transformer is Used.

Fig. 1 shows a complete crystal receiver in which a step-up transformer is employed. It will be seen that around the bundle of iron wires IC, which may be called the iron core of the transformer, we have two windings, one marked P, consisting of a relatively small number of turns, and a secondary S which has a much larger number of turns. The primary winding, for example, might contain 5,000 turns, while the secondary contained 25,000 turns. It will be seen that the primary terminals, or the ends of the primary winding, are connected where the telephones would normally be connected, namely, across the condenser C. The

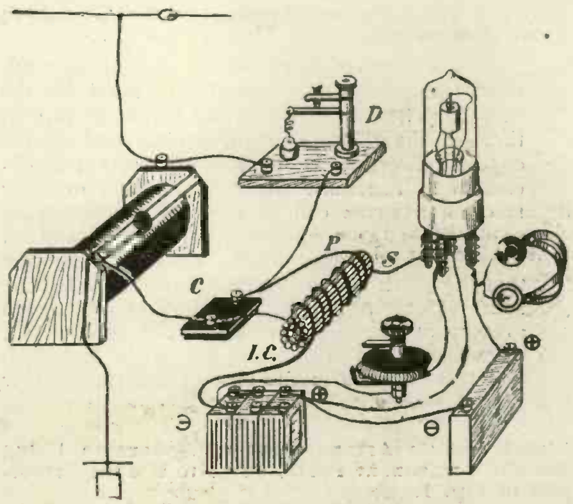


Fig. 1.—Pictorial representation of circuit using step-up transformer.

ends of the secondary windings are connected to the grid and negative terminal of the filament accumulator respectively.

How Does the Fig. 1 Circuit Operate?

The high-frequency currents in the aerial circuit are applied to the detector and cause pulsating currents to flow through the primary winding of the transformer. These pulsating currents set up alternating currents of high voltage, which are applied to the grid of the valve. The transformer acts very much in the same way as an ordinary spark coil for increasing the voltages. These alternating potentials on the

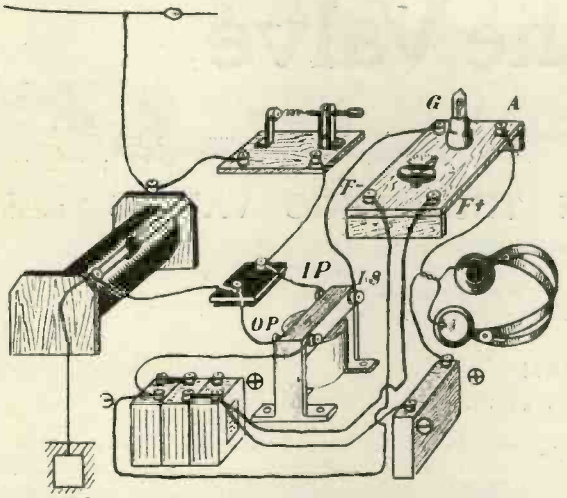


Fig. 2.—New arrangement using bought components.

grid of the valve cause alternating currents of greater intensity in the anode circuit of the valve, and these operate the telephones.

Why are the Currents Applied to the Grid of a Valve Alternating?

This is because those passing through the primary are pulsating, and the currents in the secondary flow in one direction while the current through the primary is increasing, and in the opposite direction as the primary current is decreasing. The same effect is obtained, more or less, on a spark coil, a spurt of current being produced in the secondary at the make, and an opposite spurt at the break. Owing to the fact that the break is more sudden than the make, the spurt of current in the secondary is very much greater at the break than at the make, but, nevertheless, an alternating current is produced, and this happens in the case of the transformer here described.

Sketch Out an Arrangement of Apparatus Using Bought Component Parts, so as to Use the Principles of Fig. 1.

Fig. 2 shows such a circuit. It will be seen that a bought transformer is used. This transformer usually has terminals marked IP, OP, IS, OS. The letters IP and OP stand for "in primary" and "out primary," and the letters IS and OS stand for "in secondary" and "out secondary" respectively. There is no particular significance about the words "in" and "out," but they serve to identify terminals on the transformer. Sometimes the letters P and S are simply marked on the transformer to show the primary and secondary terminals.

In this figure we also show a valve panel which is an exceedingly useful piece of apparatus to possess. There are four terminals on this panel, one going to the grid marked G, one to the anode marked A, and two filament terminals marked F. The rheostat is underneath the panel and is connected in series with one of the filament connections.

In the case of some valve panels, the rheostat is connected to the terminal marked positive. It is always best to look underneath the panel and, if this is so, the terminal should be altered to "negative," and the other terminal marked "positive." This, of course, need not be done if it is remembered which terminal is connected to the rheostat. In nearly all cases, however, it is desirable to have the rheostat in the negative lead.

Draw the Circuit Diagram Corresponding to the Arrangement of Apparatus Shown in Figs. 1 and 2.

Fig. 3 shows the circuit diagram. It will be noticed that there are four terminals, T_1, T_2, T_3, T_4. The terminals T_1 and T_2 are the tele-

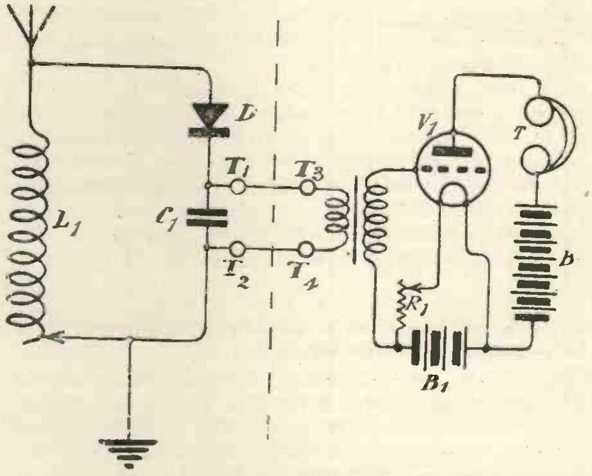


Fig. 3.—Low-frequency amplifier circuit.

phone terminals on the crystal receiver, while the T_3 and T_4 are the terminals going to the primary of the intervalve transformer. The terminal T_1 is connected to T_3, and T_2 is joined to T_4.

Jottings by the way

Wireless Wayfarer Makes his Bow.

YOU will observe—that is, if you are indulgent enough to read these notes—that a different pen name now appears beneath them. Some of you no doubt will exult unfeelingly, saying, "Well, that's a good thing anyhow; that other ass has got the sack." Much as I appreciate these sentiments, and, loth as I am to be a harbinger of disappointing news, I feel that I must tell you that 'tis not so. It appears all unwittingly I adopted the pseudonym of another writer who for many years has plied a facile pen in the columns of a journal devoted to a pursuit quite other than wireless.

To him I tender my most profound apologies for having, so to speak, pinched his call sign. You, reader, have my heartfelt sympathy, for the "Wireless Wayfarer" of this and (*I*, at any rate, hope) future issues is that same person whose brilliant wit (or arrant drivel, if you will have it so) has beguiled (or bored) you in weeks gone by. For my own part I have the comforting knowledge that I am still a name and nothing more, so that those who would seek me out and rend me limb from limb, must be sleuth-hounds indeed if they can succeed in tracking me to my lair.

Mysteries.

Would any of you like to make me an offer for a receiving set for which the owner has no further use, having given up wireless and taken to collecting cigarette cards? That is how I am feeling after two days of frenzied search for a fault that refuses to be found. This is what has happened. Reception was so good up to forty-eight short hours ago that I was a proud and happy man. You asked me for a distant station; I twiddled a knob here and a knob there, and you had him at full loud-speaker strength in a jiffy.

Possibly I boasted. Possibly I forgot to touch wood. I do not know. Now, if you suggest that I should give you even 2LO, I perform prodigies of tuning, and the result is but a tiny, thin voice—the merest ghost of its former self. Valves, batteries, aerial, earth, 'phones, condensers, coils and leads are apparently all that they should be. The set, I firmly believe, has been taken possession of by some demon with a distorted sense of humour, possibly one of those "elementals" of whom we have read quite a lot recently. I must delve in ancient books to discover some terrible form of words wherewith to exorcise him, for no ordinary methods will prevail.

This sort of thing does happen at times, as you no doubt have discovered. Nothing is apparently wrong with the set, but it does everything that it shouldn't; yet in a week's time, though you touch not a wire of it, it may be its old sweet self once more. These things are mysteries that none can explain.

The H.T. Battery Plays Up.

High-tension batteries can be a pretty fruitful source of trouble when they like. One of their meanest and most soul-destroying tricks consists in the "conking out" of one cell somewhere near the middle of the battery. Cracklings of wondrous variety salute your suffering ears owing to the resistance of varying value that is set up amidships in the battery. Signals grow weaker, some horrid thing has obviously happened, but how shall one locate it?

All the usual tests indicate that nothing is amiss with the circuits. One hauls down and cleans the aerial; digs up and scrapes the earth. Inductances, condensers and transformers are suspected of misbehaviour, but come through all tests with flying colours. Growing warmer, one seizes the voltmeter and applies it to the accumulator; warmer still, one puts it across two or three pairs of plug holes in the H.T. battery. Each of them shows a satisfactory voltage. The H.T. battery is exonerated. In fact, one may go on for hours, bamboozled all the while by that one "dud" cell lurking in the bosom of the battery.

A Friend in Need.

The moral of this is that, if you want to save yourself trouble when the set becomes recalcitrant, you should beg, borrow, buy, or steal a milliammeter, which is certainly one of the most useful of all instruments for the wireless man's den. When the set is working as it should, wire the milliammeter into each plate circuit in turn, and make a note of the current recorded.

Jot down also the total current passed by the combined high-tension circuits of the set. This is done by inserting the milliammeter between the H.T. lead and the terminal on the set to which it is connected. Armed with these facts, you need no longer burst into scalding tears or reach for the coke hammer when the set goes on strike. Test the total current first of all. If it is below normal, suspect the battery, and try each cell with the voltmeter. Supposing that no cell is over low, one of the valve circuits is at fault. Take the current passing in the output circuit of each. If any one shows a big falling off you are hot on the scent. If all are about equally poor the trouble lies either in the secondary circuit or in the primary of the tuner. No, I will never be without a milliammeter; unless the fellow from whom I—er—borrowed mine should happen to see it lying on my wireless table, and be mean enough to claim it.

Do You Borrow?

The psychology of "borrowing" is deeply interesting. Umbrellas, of course, do not count, for even the best and most pure-souled people frequently acquire theirs in absent-minded moments. Of books I am not quite sure. I had a friend once who loved them. His claim was that one was always justified in borrowing a book permanently from any man who could not properly appreciate it. That, I think, is a standpoint that will do very nicely for wireless gadgets. What is the use of a first-rate variometer to Snooks, who uses nothing but a three-coil holder? It lies on his shelf growing daily more dusty. Is it not a kindly act to borrow it, to clean it, and to give it the work for which it is pining? I think so. The safest course to adopt after this is to build it permanently into a set, for then not even Snooks will have the heart to demand its return. So long as these habits are confined to the *élite*, such as you and I, all is well. But matters come to pretty pass when creatures like Snooks and others of his kidney steal—that is the word—steal one's condensers, inductances, valves and other priceless gadgets. It is no argument for them to say that the things have lain unused in the cupboard for months. Serious experimenters, like ourselves, must always have a reserve supply ready to hand. I am sure that you will agree.

Mixed Feelings.

I cannot say that I was altogether plunged in sorrow when I read that a ban has been placed upon broadcasting by the High Powers that control the destinies of music-hall artistes, for wireless somehow cannot enable these apostles of mirth to be their real selves. Until we have discovered a way of broadcasting at the same time his arching eyebrows, his chaste *décolleté*, and his expressive right hand, Mr. George Robey's talks and songs will remain merely funny—they are not Robey. And this applies to most of the others, who, though they rouse us to paroxysms of laughter when we see them on the boards, fail to provoke more than a fleeting smile when their witticisms come to us through the cold, sedate throat of the loud-speaker. But most people will regret that it means that we are not to have, for the present, at any rate, any of the extracts from theatrical performances that have been one of the best features of broadcasting in this country. "The Lady of the Rose," "The Last Waltz," and the incidental music of "Robin Hood," delighted thousands of listeners-in in far-away places, and there can be little doubt that many who heard them on the wireless set straightway resolved to book seats at the theatres. Still, there is a ray of hope. The B.B.C. is to have a theatre of its own, from which some fine performances are promised.

In France.

No such ban exists in France. Artistes from the Opéra, the Conservatoire, the Comédie Française, and all the best theatres and music-halls transmit regularly from both Radiola and the Eiffel Tower. The former, for instance, has recently had Mademoiselle Cécile Sorel, one of the most famous of French actresses, and the world-renowned Marthe Regnier. Did you happen to hear the latter's reading of the cabbage story a few Sundays ago? It was a sheer joy to listen to her perfect articulation, every word coming through clean cut and distinct. The French, by the way, have a difficulty in transmission to contend with that does not worry our designers of microphones. With us it is sufficient to provide a special apparatus to "boost up" the S's which would otherwise hardly come through at all. French has a most difficult sound in ch, which they pronounce much more sharply than we. During Marthe Regnier's reading, this sound was rather over-accentuated, as possibly you noticed.

The Lewis Touch.

Even the clear-voiced announcers who speak to us from 2LO may nod at times. Captain Lewis's surname does not suggest Hibernian extraction, whilst his avuncular "Caractacus" coupled with the Lewis might lead one to believe that he hailed from the principality where bulls, such as those that abound in Ireland, are unknown as fauna of everyday speech. Yet but a few minutes ago, as I sat driving my quill, I heard him state that the next waltz would be a fox-trot; which reminds me somehow of the Irish M.P. who complained in the House that the hot water was always cold, and what was more there wasn't any!

Jaw-Breakers.

Those breathless news items provided for our delectation by a perfect galaxy of agencies must, I think, be prepared by someone who has what we may term an ingrowing sense of humour. His chief delight is to serve up to the unfortunate announcer the world's most appalling names, which that much-tried person is called upon to pronounce publicly at an instant's notice. How would you like to be confronted by a paragraph headed, "Terrible Disaster at Czrblpf-choff"?

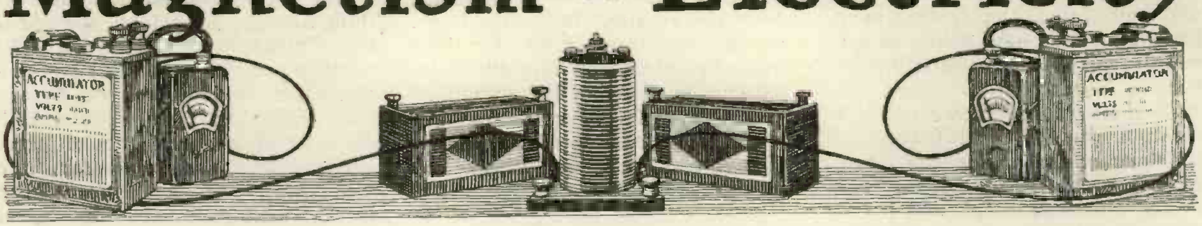
Could you face the microphone whilst holding in your hand a note that must be read on the recent discovery of a *dolichocephalic steatopygous* tribe in the wilds of Central Africa? Were I placed in such an unthinkable position, I would slap the microphone smartly with my open hand (thus temporarily deafening my audience), open and close the control switch as violently as possible two or three times, mumble something unintelligible, wait two minutes, and then apologise for a breakdown in the transmitting gear. But the heroes of the broadcasting stations act in no such cowardly manner. They plunge straight in and let the consequences go hang. I must confess that when some real jaw-breakers occur I promptly tune in to the other broadcasting stations in the hope of intercepting the same news bulletin from them. Even our British names can be puzzling enough at times.

Relay Stations.

Sheffield, it seems, is to have some kind of a relay station. Though it is fifty miles from Manchester, and not a vast distance from either Birmingham or Newcastle, reception is by no means good. Possibly this is due to the vast accumulation of slag heaps, which are to be seen everywhere in the surrounding districts. All of these contain a largish percentage of metal, and, owing to their size and height, they may act as deflectors of ether waves.

WIRELESS WAYFARER.

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics.)

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART VII

(Continued from No. 6, page 346.)

Permanent Magnetism and Electromagnetism

It was said in a previous article that when a current of electricity passes through a coil of wire magnetic effects are produced, and the coil behaves, whilst the current is passing, as though it had a bar-magnet at its axis. The magnetism produced in this way is called "electromagnetism," and the phenomenon is known as "electromagnetic induction," since the magnetism is *induced* by the electric current. A substance such as steel, however, may be permanently

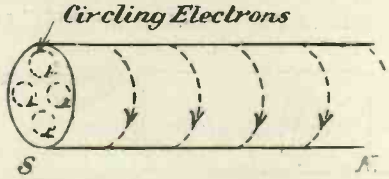


Fig. 1.—Permanent magnetism due to rotating electrons.

magnetised, and its magnetic properties persist in the absence of any coils or electric currents. It might seem that there were two kinds of magnetism, namely, the magnetism associated with permanently magnetised bodies, and the temporary magnetism induced by the passage of a current through a conductor. Although the nature of permanent magnetism is not very well understood, it seems likely that in reality it is identical with the magnetism which is produced by an electric current. For, according to recent theories, it appears that the atoms of matter contain minute electric charges, which may be rotating in orbits, just as the earth rotates round the sun. These minute charges of electricity are called "electrons," and it may be that an atom of iron, for example, with its rotating electrons is equivalent to a miniature coil of wire carrying a current. It will thus be equivalent to an elementary magnet, and if some means can be found to turn all the atoms in a bar of iron into the same direction, so that all these elementary magnets help one another (which is what happens when the bar is "magnetised"), the bar will exhibit magnetic properties. This theory is too complicated to discuss in detail for the present, but it is mentioned in order to show that the permanent magnetism of a substance such as steel is probably identical with the electromagnetism produced by a current in a coil of wire. This theory of magnetism is illustrated in a simple way in Fig. 1.

Action of Galvanometer or Ammeter

The magnetic effect produced by the passage of a current through a coil of wire is the principle employed in most instruments used for indicating the strength of an electric current. Such instruments are called "galvanometers" or "ammeters," the term "galvanometer" being generally restricted to delicate instruments suitable for measuring very small currents, and the term "ammeter" being applied to instruments used for measuring heavier currents, such as are employed in various industrial applications.

If a small magnetic needle be pivoted upon a suitable support, it will set itself so that it is parallel to the direction of the earth's magnetic field, the end of the needle which points towards the north being called the north pole, and the other the south pole. If a flat coil of wire be arranged in a vertical north and south plane, the magnetic field created by the passage of a current in the coil will be at right

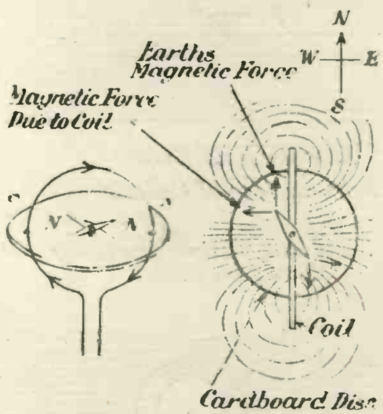


Fig. 2.—Illustrating principle of galvanometer.

angles to the earth's magnetic field. A pivoted compass needle placed at the centre of the coil (Fig. 2) will be acted upon by two magnetic forces at right angles to one another; it will therefore be deflected from its original north and south direction and will take up a new position, in which the force due to the electromagnetic field, tending to turn it away from its original position, is balanced by the force due to the earth's field, tending to restore it to its original position. The angle through which the needle is displaced, when it comes to rest, will depend upon the strength of the electromagnetic field, which in turn will depend upon the strength of the current flowing in the wire. By passing currents of known strengths through the coil and noting the positions of the needle, the instrument may be graduated, or "calibrated" as it is called, and it may afterwards be used for the measurement of currents of unknown strengths.

Electrical measuring instruments used in practice are not quite so simple as that which has been described; methods have been introduced for increasing the sensitiveness of the instrument and for rendering it independent of variations in the earth's magnetic field in different localities.

Magnetic Shielding

In some cases it is desirable to shield electrical apparatus from the effects of stray magnetic fields; for example, if a delicate galvanometer were used in the neighbourhood of a dynamo there would be stray

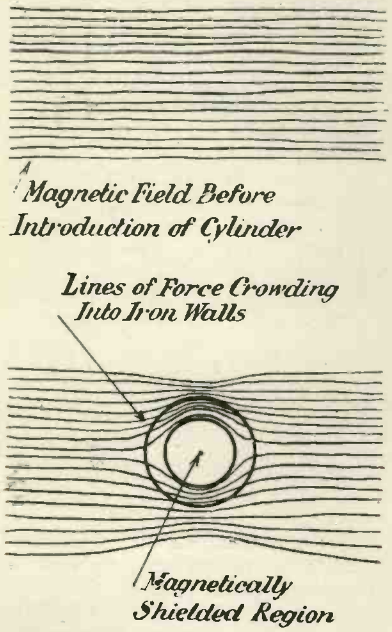


Fig. 3.—Showing how interior of iron cylinder is shielded from magnetic field.

magnetic effects from the machine which would cause irregular deflections of the galvanometer needle.

In order to provide magnetic shielding, use is made of the permeability of iron, which has been mentioned above. In Fig. 3 a magnetic field is indicated by the lines representing magnetic force. If a hollow iron cylinder with thick walls be introduced into the field, the interior of the cylinder will now be a region of very small magnetic intensity, because most of the lines of magnetic force will forsake the

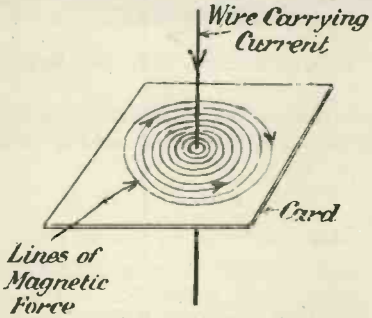


Fig. 4.—Magnetic field around straight conductor made evident by iron filings.

air region and will crowd together into the iron walls of the cylinder. Thus the cylinder has a magnetic shielding effect upon any instrument which is placed within it.

A similar shielding from an *electric* field may be obtained by surrounding an instrument with an electrically conducting cover, such as a brass or tinplate case, the explanation being similar to that which has been given for the magnetic shielding. In the case of electrostatic shielding, however, the conducting cover does not require to be of any considerable thickness, as in magnetic shielding. Any conducting material will serve for electrostatic shielding, but for magnetic shielding a substance of high magnetic permeability must be employed.

Electrostatic and magnetic shields are frequently employed in connection with wireless apparatus.

Magnetic Field due to Current

As we will deal further with the important subject of electromagnetic induction in the next article, it will be useful to give here some illustration of the magnetic lines of force which are produced by the passage of a current through a conductor. Fig. 9 shows a piece of wire passing through a sheet of cardboard and carrying a current in the direction indicated by the arrow. If a magnetic field exists in the vicinity of the wire, it ought to be possible to indicate it by means of iron filings, as in the case of the permanent magnet. If iron filings are sprinkled on the cardboard sheet, they will be found to arrange themselves in circular formation, as shown in the figure, thus indicating the existence and direction of magnetic lines of force.

Fig. 5 shows a coil, or "solenoid," as it is sometimes called, arranged with the turns threading through a piece of cardboard, the upper portions of the turns of wire being indicated by black lines, and the portions below the cardboard by dotted lines. If a current is passing through the coil and iron filings are sprinkled upon the cardboard, the filings will arrange themselves as shown in the figure. It will be noticed that the distribution of the lines of magnetic force is the same, for all practical purposes, as it would be if the coil were removed and a permanent bar-magnet were substituted.

The Corkscrew Rule

The direction of the magnetic field (that is to say, the "polarity" or the arrangement of the north and south poles) depends upon the direction of the current. If the coil is looked at endwise, as indicated in Fig. 6, and the current is flowing clockwise, the end nearest to the observer will be the south pole of the equivalent magnet. If

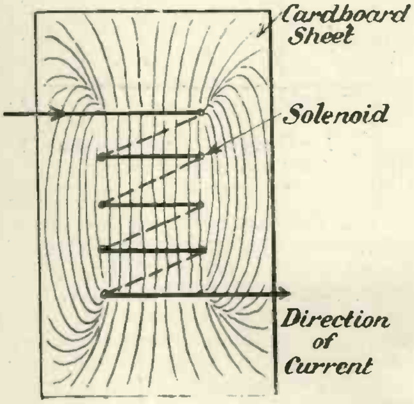


Fig. 5.—Iron filings on cardboard show magnetic field due to coil of wire carrying current.

the current be reversed, the polarity will also be reversed and the end nearest to the observer will become the north pole. This gives us a simple rule for finding the relation between the direction of a current in a coil and the direction of the magnetic field. The rule is known as the "corkscrew rule"; it states that the relation between the direction of a current and the direction of the resulting magnetic field is the same as the relation between the direction in which an ordinary right-handed corkscrew is turned and the direction in which it moves through the cork.

If the current through the wire is increased in strength, the strength of the electromagnetic field is also increased, and if the current ceases, the electromagnetic field vanishes.

Again, if we have a solenoid and we insert into it a bar-magnet, that is, if we create within it, or induce into it, magnetic lines of force, a momentary current will be created in the wire. This current is induced by the creation of the magnetic field and is called an induced current. An important point to notice, however, is that so long as a current is maintained in the coil, the electromagnetic field is also maintained, whereas if we start the other way round, and create a current in the wire by inserting a magnet in the coil, we shall find that the current in the wire does not exist during the whole time that the magnet is within the coil; it exists, in fact, only whilst the magnet is being introduced into the coil or being withdrawn. To put the matter more generally, a current is only induced in the coil whilst the strength of the magnetic field is *changing*. So long as the strength of the magnetic field remains constant, no current will be induced in the surrounding coil.

We see, then, that in order to induce current in a coil, all we have to do is to set up, or destroy, or vary, a magnetic field threading through the coil. Now we may produce a magnetic field either (1) by means of a magnet, or (2) by means of a coil in which current is maintained by a battery. Thus, we may expect that if we have a current-carrying solenoid and we insert it into another coil of wire, a current will be momentarily induced in the second coil when the first coil approaches it or recedes from it. Another way in which induced current may be produced in the second coil is to place the first coil in the vicinity of the second and then to switch the current in the first coil on or off. It will be evident from what has been said that this will cause induced currents in the second coil, because when the current in the first coil is switched on a magnetic field is created, some of which passes through the region of the second coil; and again, when the current in the first coil is switched off a magnetic field which was existing in the region of the

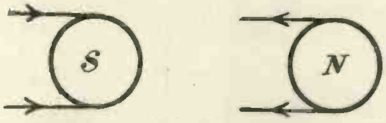


Fig. 6.—End view of coil illustrating "corkscrew rule."

second coil is destroyed, with the consequent production of a momentary induced current in the second coil.

These effects as between one coil and another are known by the general name of "mutual induction." But induction is also observed even in the case of a single coil, and is then known as "self-induction." For example, if a battery is connected to a solenoid so as to produce a current, and, therefore, to set up a magnetic field, a current is induced in the coil by the establishment of the magnetic field just as would have been the case if the battery had been omitted and a bar-magnet had been inserted into the coil.

Now a remarkable feature of all these induction effects is that the induced current is always in such a direction that the magnetic field produced by it tends to *oppose* any *change* in the existing magnetic field. This property has sometimes been described as "electromagnetic inertia." It will be easy to see why it should be regarded as inertia. For consider a boat floating on the surface of the water (neglect friction). If the boat is at rest, it is necessary to exert force in order to set it in motion, and the boat offers resistance to the force which is applied to it. Again, once the boat is in motion, if it is desired to bring it to rest, force must again be exerted. In other words, the boat tends to continue in its existing state, whether that be a state of rest or a state of motion, and it requires force to alter the state in either case.

Now let us turn to the consideration of the electromagnetic field. If there is a coil of wire and no current is flowing in the coil, there will be no magnetic field. As soon as a battery is connected to the coil and a current commences to flow, a magnetic field will *begin* to be created. An induced current will then arise in the wire tending to prevent any change in the magnetic condition in the region, that is to say, in this case, tending to prevent the establishment of a field. Since the current from the battery is setting up a magnetic field, the induced current will need to be in the opposite direction, in order to produce a magnetic field opposite to that produced by the battery current. This is found to be what actually happens, and it is stated by saying that when a current in a coil is "made" (that is, switched on) the self-induction causes the production of a momentary current in the *opposite* direction to that of the applied current.

Of course, the applied battery current soon wins the day, so to speak, the opposition set up by the induced current being of extremely short duration.

ADDING AMPLIFIERS TO CRYSTAL SETS

By E. REDPATH, Assistant Editor.

We receive numerous letters from readers who wish to add valves to their existing crystal sets. The following article explains various methods of doing this.

HAVING commenced his wireless career with a crystal receiving set—probably the best possible manner — the experimenter very soon wishes to add to the interest and utility of his apparatus by the addition of valve amplification.

In wireless, as in any other scientific hobby, the inexperienced experimenter will be well advised to proceed carefully, step by step. By so doing he will not only save himself disappointment but will have the great satisfaction of mastering the technicalities of each stage of advancement, and will be in a position to judge from practical experience the values of various methods and devices employed.

Low-frequency Amplification.

To actuate the crystal detector of a receiving set, a certain minimum amount of electrical energy is necessary. Incoming signals which cause the requisite potential differences to be set up across the tuning coil or condenser to which the detector is connected will give audible, though perhaps rather weak, signals in the telephone receivers, and, where such is the case, low-frequency amplification may be profitably applied.

The photograph (Fig. 1) shows a direct-coupled crystal receiving set with a single valve low-frequency amplifier added.

The crystal set shown is the broadcast receiver sold by the Economic Electric Co., whilst the amplifier is one of the very compact Elwell units. The addition of a single valve low-frequency amplifier may be made to any type of crystal receiving set, and will normally result in increasing the signal strength some four or five times.

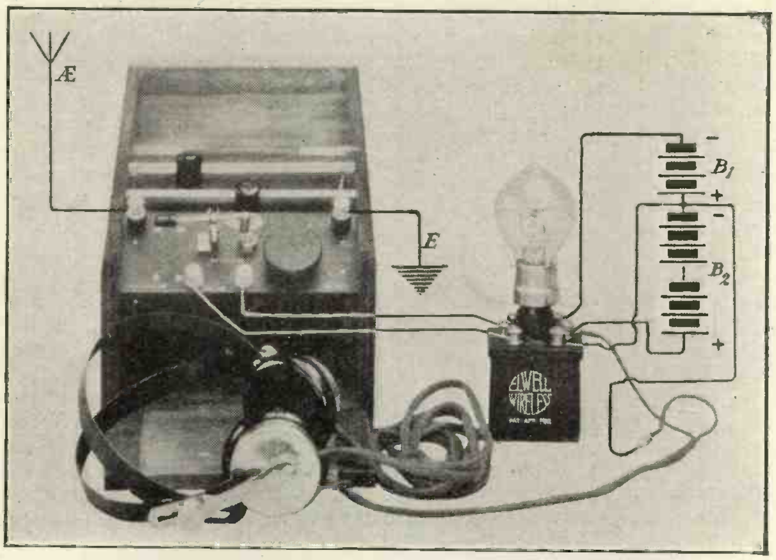


Fig. 1.—Crystal receiving set with one low-frequency amplifying valve.

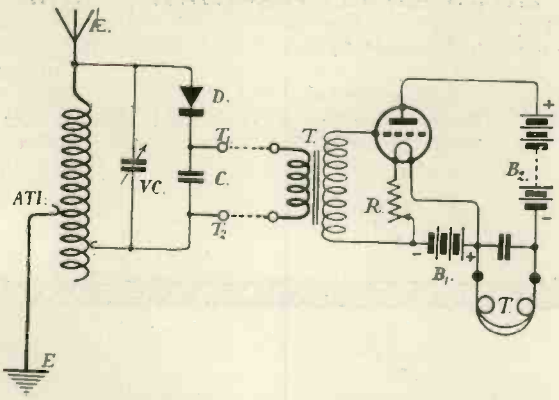


Fig. 2.—Circuit diagram of the arrangement shown in Fig. 1.

The Circuit Arrangement.

Fig. 2 is a typical circuit diagram showing a single valve, acting as a low-frequency amplifier, connected to a crystal receiving set. In the diagram, AE represents the aerial; ATI the aerial tuning inductance, and E the earth connection of the crystal set; whilst VC is the variable condenser in the closed oscillatory circuit. The crystal detector is shown at D, and the usual telephone condenser at C.

The output or telephone terminals of the crystal set (marked T_1 and T_2 in the diagram) are connected to the primary winding of an iron core step-up transformer (T), the secondary of which is connected to the grid of the valve and the negative side of the filament lighting battery.

The filament circuit of the valve comprises the 6-volt battery B_1, the rheostat R, and the filament itself, whilst the anode circuit comprises the anode itself, the high-tension battery B_2 (45 to 60 volts), with the telephone receivers now connected between the negative side of this battery and the positive side of the filament lighting battery.

The small condenser shown shunted across the telephone receivers is optional and may usually be omitted.

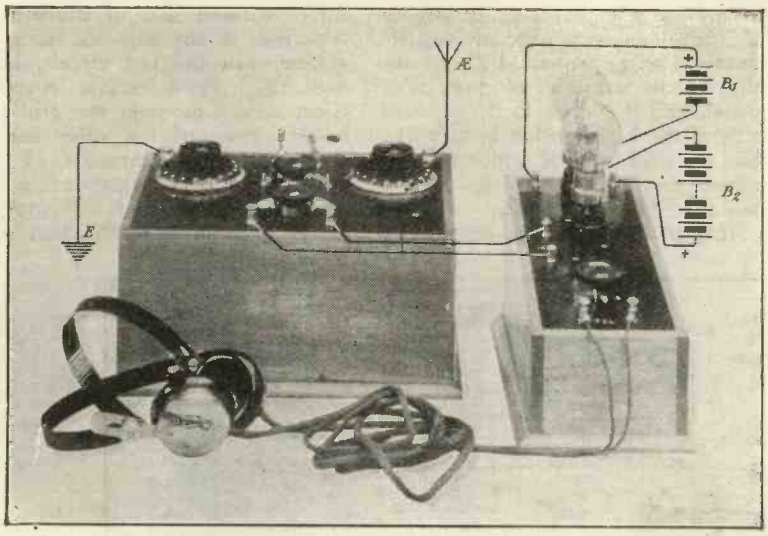


Fig. 3.—A two-valve low-frequency amplifier used in conjunction with an inductively coupled crystal set.

Two-stage Amplification.

Although the arrangement just described will give excellent results in two or three sets of telephone receivers at distances up to 25 or 30 miles from one of the British Broadcasting stations, the output energy available will usually be found inadequate to operate satisfactorily a loud-speaker, and for this purpose two stages of low-frequency amplification are recommended.

The photograph (Fig. 3) shows an inductively coupled crystal receiving set, together with a two-valve low-frequency amplifier, constructional details of which have already appeared in previous issues of this journal, and all that has to be done to enable the two sets to be used together is to connect the telephone terminals of the crystal set to the input terminals of the amplifier, the telephones themselves being connected to the two terminals in the front of the amplifier as shown.

A complete circuit diagram of this arrangement is given in Fig. 4, in which AE represents the aerial, P the primary coupling coil, V the aerial tuning variometer, and E the earth connection, comprising the aerial circuit of the inductively coupled crystal receiving set. The closed oscillatory circuit includes the secondary coil and the variable condenser, whilst across the latter are connected the crystal detector D and the telephone terminals T_1 T_2, the latter being shunted by the telephone condenser.

The input terminals of the amplifier, shown connected to terminals T_1 and T_2 by dotted lines, are connected to the primary winding of the iron core step-up transformer T_3, the secondary winding of this transformer being connected to the grid and negative side of the filament of the first amplifying valve V_1. In the anode circuit of this first valve there is another iron core step-up transformer T_4 with its secondary winding connected to the grid and negative side of the filament of the second valve V_2, in the anode circuit of which (this time between the anode itself and the positive side of the high-tension battery B_2), are connected the telephone receivers. The valve filaments are both in parallel across the filament lighting battery B_1, and are controlled by the rheostat R.

Apart from the valves themselves, the satisfactory operation of an amplifier of this description, both as regards the strength of signals and freedom from local noises and absence of distortion of received music, etc., depends upon the quality of the transformers, and any little extra outlay expended with a view to obtaining really good transformers will be well repaid.

High-frequency Amplification.

From the statement, in the beginning of this present article, regarding the operation of the crystal detector, it will be appreciated that the addition of even several stages of low-frequency amplification will increase the strength of signals only and not the receiving range of the set.

For this latter to be accomplished, some means must be provided whereby the incoming signals are amplified before being applied to the crystal detector, and for this purpose high-frequency amplification is especially adapted.

In addition to its undoubted efficiency, the "tuned-anode" method of coupling the high-frequency valve may be very conveniently applied to an existing crystal receiving set, the additional apparatus required being an aerial tuning inductance which may be a single slide inductance, a tapped coil or a variometer, a small valve panel

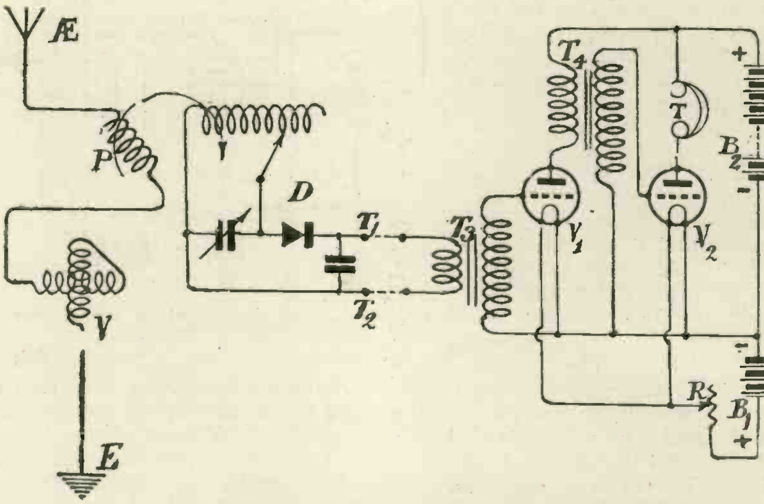


Fig. 4.—Circuit diagram of the arrangement shown in Fig. 3.

complete with four terminals and usual filament rheostat, together with filament lighting and high-tension batteries.

The arrangement of the apparatus is shown in the photograph (Fig. 5), and comprises a McClelland variometer, a standard valve panel and a crystal receiving set made by Radio Instruments, Ltd.

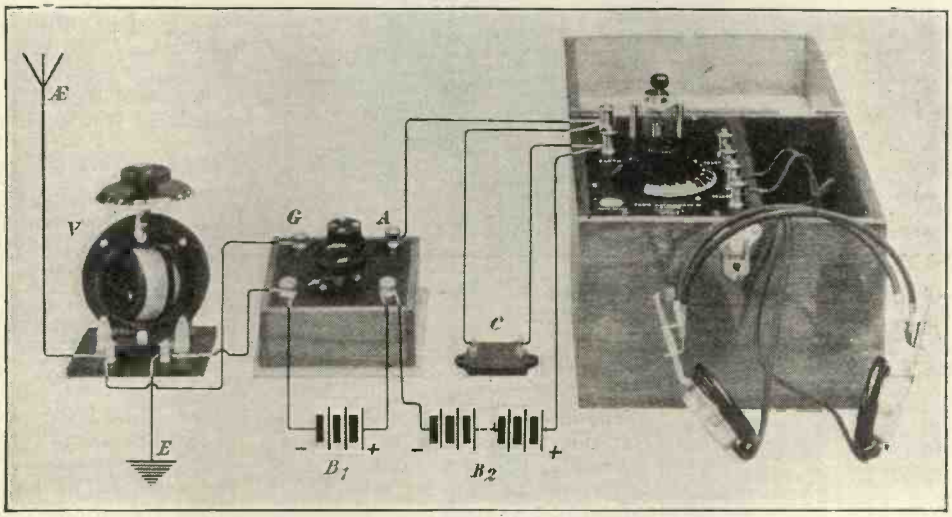


Fig. 5.—A simple method of adding H.F. amplification to a crystal set.

As the average crystal receiving set is designed to tune over a range of wavelengths from about 250 to about 600 metres when used in conjunction with a standard aerial, it is necessary to connect a compensating condenser across the aerial and earth terminals of the crystal set so that it may be accurately tuned to the required wavelength. This condenser (Dubilier, capacity 0.0002 μF) is shown in the photograph.

Fig. 6 is a typical circuit diagram of the arrangement. The aerial circuit comprises the aerial Æ, the variometer V and the earth connection E, the aerial and earth ends of the variometer being connected to the grid and negative side of the filament lighting battery respectively. The crystal receiving set comprises the tuning inductance L, connected to the aerial and earth terminals of the set A_1, E_1, and shunted by the detector D and the telephone receivers.

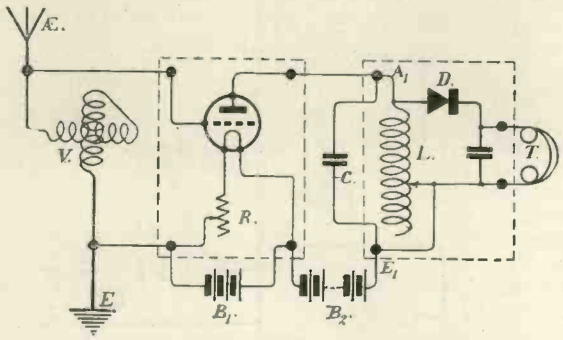


Fig. 6.—Circuit diagram of the arrangement shown in Fig. 5.

Across the aerial and earth terminals of the receiving set is connected the compensating condenser C (capacity 0.0002 μF), the former terminal being connected directly to the anode terminal of the valve panel, and the latter to the positive side of the high-tension battery B_2, the negative side of which is connected to the positive filament terminal of the valve panel.

In practice, very good results are obtained with this arrangement, which, under favourable conditions, not only approximately doubles the receiving range, but gives a satisfactory amplification of previously received signals, and, by reason of the additional tuned circuit now introduced, affords very selective tuning with consequent comparative freedom from interference.

It will be noticed that, in the previous circuits, no reaction effect has been introduced, and therefore the beginner can experiment quite safely without fear of causing interference to any adjacent receiving station. In the last circuit, however (Fig. 6) a certain coupling effect occurs between the grid and anode circuit of the valve due to the electrostatic capacity of the valve itself, and, with certain adjustments of filament brilliancy or anode voltage, self-oscillation *may* occur when the closed oscillatory circuit (LC) is brought exactly into resonance with the aerial circuit. More especially is this the case when a very sensitive "cat-whisker" type of detector is employed. Should self-oscillation occur, evidenced by an increase in strength and accompanying distortion of received speech, etc., or by the peculiar "cluck" heard in the telephone receivers when the aerial terminal is touched with the moistened finger, the filament brilliancy should be slightly reduced.

If the set appears particularly liable to self-oscillation, possibly on account of its being used in conjunction with a small aerial, a permanent cure can be effected by reversing the connections of the filament lighting battery, though at the expense of some reduction in signal strength.

H.F. and L.F. Amplification.

From the illustrations and diagrams (Figs. 1 to 6) it will be seen

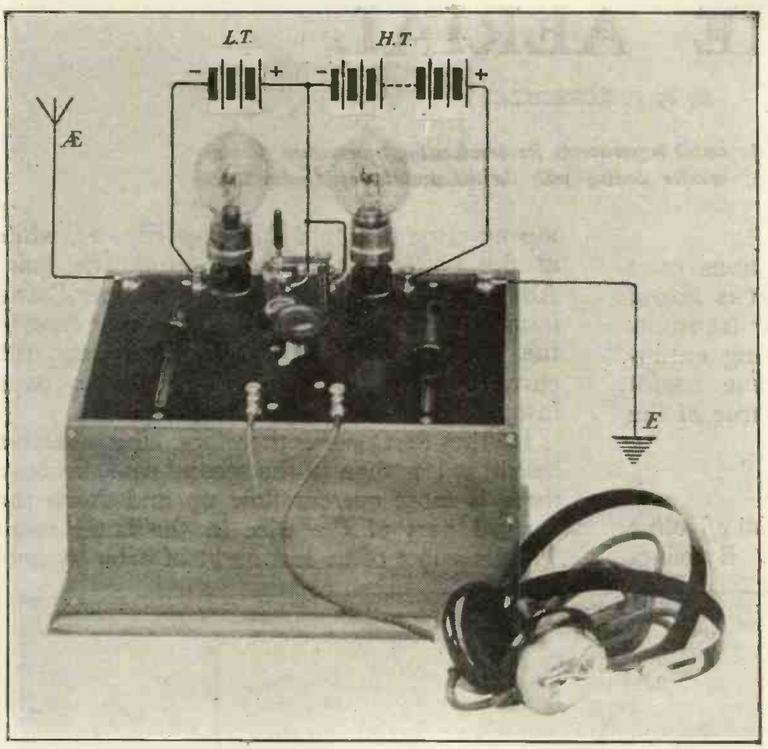


Fig. 7.—The two-valve broadcast receiver modified to give H.F. amplification, crystal rectification and L.F. amplification.

that it is not by any means a difficult matter to improve the performance of a crystal receiving set by the addition of amplifying valves. Low-frequency amplification, though probably giving the greatest actual amplification per valve, can only be applied in the case of signals already audible upon the crystal receiver alone. High-frequency amplification, whilst giving an appreciable increase in strength, is particularly applicable to the reception of signals too weak to operate the crystal detector.

A combination of the two methods therefore can be recommended as being extremely satisfactory for all-round work, and, provided the components employed are good and the necessary adjustments are carefully carried out, a receiving set comprising one high-frequency valve, a crystal detector and one low-frequency valve may be made to give results almost equal to a three-valve set. The photograph (Fig. 7) shows the two-valve broadcast receiving set as described in *Wireless Weekly*, No. 4, modified by the addition of a crystal detector and one iron core step-up transformer, the internal wiring of the set also being altered so that the right-hand valve, which previously functioned as a detector, now follows the crystal detector and acts as a low-frequency amplifier.

The crystal detector can be seen in the photograph, between the two valves, whilst the step-up transformer is secured to the underside of the ebonite panel just a little behind the two telephone terminals.

Fig. 8 is a complete circuit diagram of the set. L is the aerial tuning inductance with slider S_1, connected to the grid of the first valve V_1, the earth end of the coil being connected to the negative side of the filament lighting battery. In the anode circuit of the first valve are the closed circuit inductance L_1, with slider S_2, and the fixed condenser C_1, capacity 0.0001 to 0.0002 μF.

Shunted across this condenser are the crystal detector D and the primary winding of the step-up iron core transformer T, the secondary winding of which is connected to the grid of the second valve V_2 and the negative side of the filament battery. The telephone receivers are connected in the anode circuit of this second valve and shunted by the usual telephone condenser C_2, capacity 0.001 to 0.002 μF.

The telephone receivers illustrated are of high resistance (4,000 ohms). If low-resistance telephones (120 ohms) are to be used, a step-down transformer will be required.

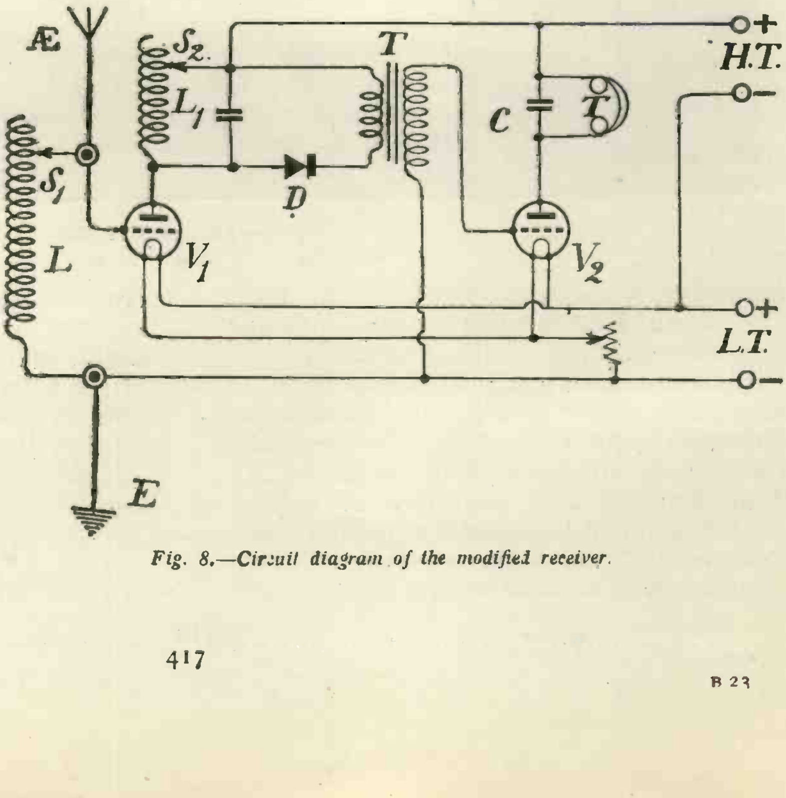


Fig. 8.—Circuit diagram of the modified receiver.

THE AERIAL

By P. P. ECKERSLEY

This discussion as to the aerial requirements for broadcasting transmitters forms the third of a series of articles dealing with the technicalities of broadcasting.

Introduction

A LOT of popular misconceptions exist on the subject of aerials. It is hoped that in discussing aerials for transmitting broadcast, the average receiving enthusiast may be able to glean some useful information, because much that is true of the one applies to the other.

Effective Height

In general, to get an efficient aerial *effective* height is the most desired quantity. By effective height is meant the height from "effective" earth of some point on the aerial that represents a definite centre of capacity.

It is well known that what is required is an alternating current flowing up and down in the vertical part of the aerial. Now consider a long wire suspended vertically in the air. If an ammeter were connected at varying heights, it would be found that the old motto applied, *i.e.*, "The higher the fewer." That is to say, with a plain vertical aerial, at the top no current would flow (see Fig. 2), while at the bottom full current would be read. Add now, as in Fig. 3, a "top hamper," and immediately there would be a current flow at the point A because, to put it crudely, the current would have a further hole to pour into.

In the first case, therefore, the effective height is less than in the second case, because there is more current flow up and down the vertical part of the wire in the latter case. This is a fact often lost sight of even by persons who ought to know better—the effective height of an aerial is by no means its vertical height, and in an L aerial only equals its vertical height when the horizontal part of the aerial is infinitely long. The ideal to be aimed at is, of course, a tremendous height, with plenty of top hamper to make use of the height.

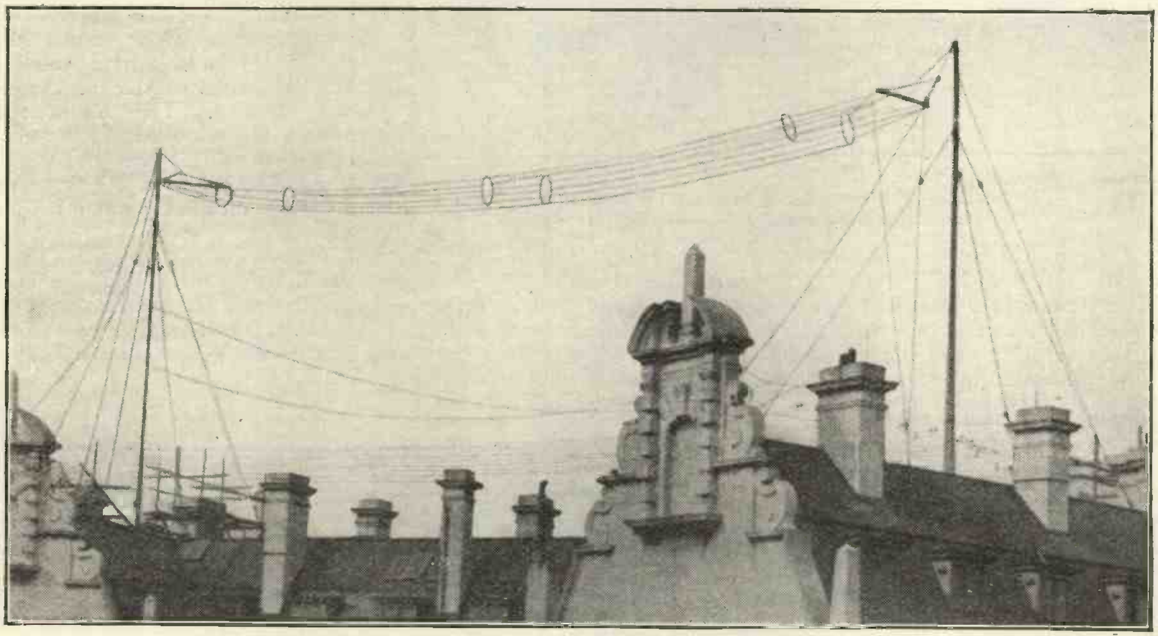
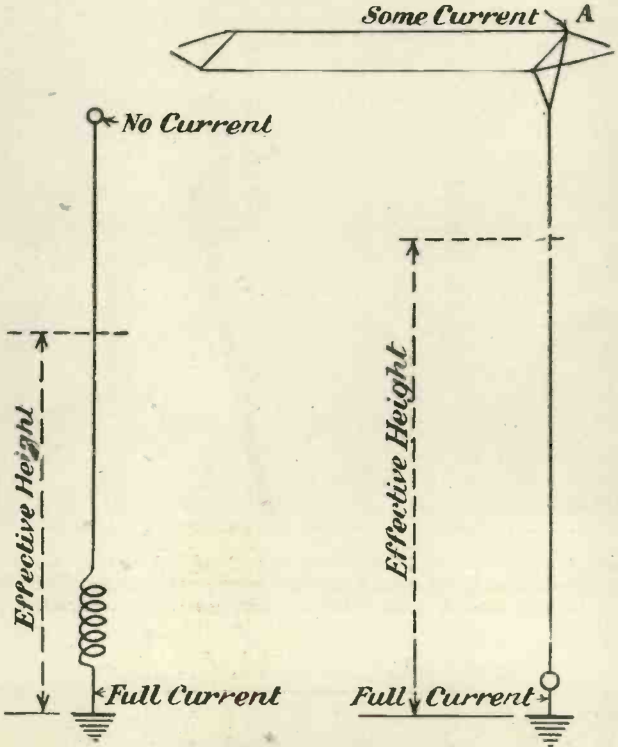


Fig. 1.—The aerials at 2LO.

Radiation Resistance

In any aerial there is a certain loss which can be measured purely as a Resistance—power in the aerial can be expressed as R i^2, where R is the aerial resistance total and i is the current. Many people think that the capacity and inductance of an aerial directly affect the current that is set up in it. As a matter of fact, except in so far as the inductance influences the resistance of the system, no such effect takes place—when resonance is present, only the ohmic resistance counts.

Of this ohmic resistance a certain proportion is useful and a certain part wasteful. The useful resistance is called radiation resistance, and varies as the square of the *effective* height and inversely as the square of the wavelength. Thus a given aerial with 10 metres effective height may have a radiation resistance of 2 ohms at 400 metres. At 800 metres this useful resistance will be only half an ohm; doubling the wavelength has quartered the radiation or useful resistance. Thus for short wavelengths the aerial need not be anything like so high for a given radiation resistance as for a long wave.



Figs. 2 and 3.—Illustrating the flow of current in an aerial system.

Carnarvon works on 15,000 odd metres, has an aerial 400 ft. high and 1 mile long. 2LO has an aerial 70ft. high and perhaps 120ft. long, but works on 370 metres. Roughly speaking, the radiation resistance, taking these figures as being only approximate as they are, the radiation resistance of Carnarvon works out at a fraction of an ohm, while 2LO works out at 2 to 3 ohms. Thus, in spite of the vastly different sizes of aerials, 2LO has a greater useful radiation resistance than Carnarvon.

This is not to say that 2LO is a more efficient station than Carnarvon. There are a multitude of other factors to be taken into consideration; what I am driving at is that for a given aerial it is easier to make it have a good radiation efficiency the shorter the wave.

Broadcast Problems

This is very useful for broadcasting, because it would not be easy to erect ten or twenty 800ft. towers in the heart of London! Thanks to the short wavelength, comparatively small aerials are suitable for broadcasting. The problem of choosing a site is, however, not easy. From the artistic point of view, the "Studio" where the artists and speakers have to perform must be in the centre of the town. Many have suggested having a central studio and putting the actual wireless gear and aerial at some distance outside the town. But this is impossible, because it pre-supposes a long land-line connecting studio and wireless, and in almost all large towns land-lines are buried. Buried land-lines, thanks to their distributed inductance and capacity, cut off the high sounds and make it impossible to get really good broadcast without all sorts of special and impracticable schemes of loading. Thus the wireless site must be not more than a mile from the studio, and in the centre of the town.

A colleague of mine, who has chosen a few broadcast sites, says that the best plan is to climb on a roof and cast the eye round for a pair of good high smoke stacks. These make ideal aerial supports, provided they "stand in beauty side by side." Two together are very desirable, because they allow of the easier erection of a top or horizontal part to increase the effective height.

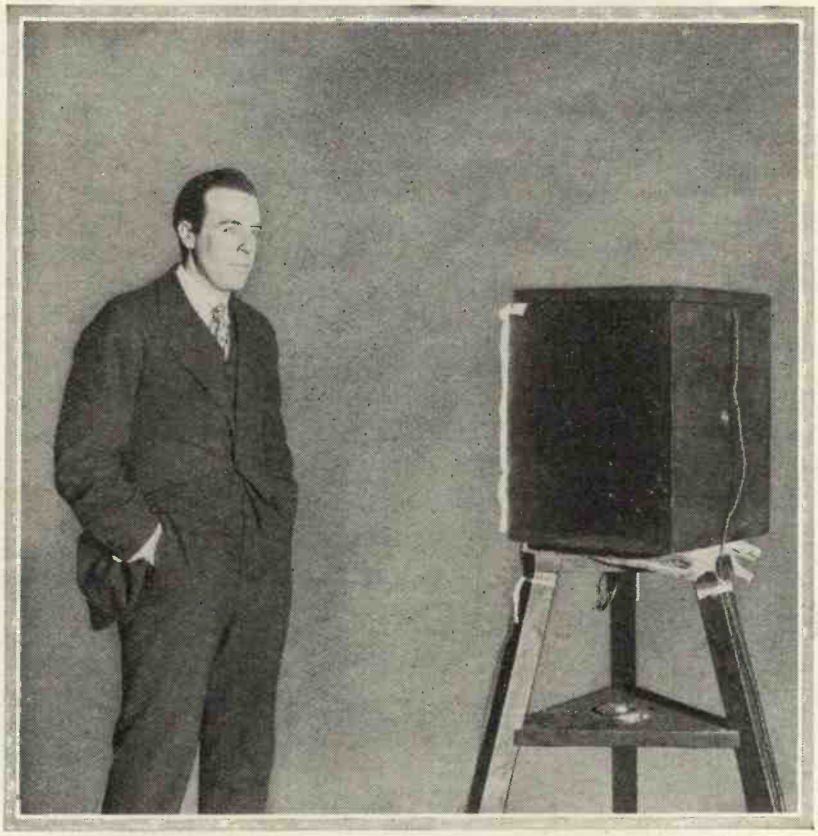
Sometimes one is involved with the trouble of heavy losses in iron frame-works of the building. A good cure is to strap everything together to earth—water pipes, gas mains, frame-work, everything metal one can find.

The great point is to cut down the dead resistance and to put up the radiation resistance.

There is a point that may be amusing to those who have followed my arguments from the beginning.

If an aerial could be built that had *no* resistance except radiation resistance, it would not matter, obviously, how high it was! Thus one can conceive of a broadcast aerial 1ft. high giving signals all over England! In practice, of course, the greater the height probably the greater the radiation, because the ideal above is never approached in practice.

A last point to receiver enthusiasts. An aerial is only "directional" if its length is about ten times greater than its height. Obviously, if its length is great compared to its height, it approaches having the properties of a frame aerial which, as everyone knows, is very strongly directional in the plane of its winding.



The photograph shows Mr. P. P. Eckersley, the Chief Engineer of the B.B.C, whose jolly entertainments from 2MT will be remembered by many of our readers. His easy attitude when before a microphone is to be envied.

WIRELESS TELEGRAPHY ON THE BATEAUX-PARISIENS
(Paris S. S. Company)

M. ISAMBERT, Director of Technical Services of the TCRP, has kindly given us some details of the receiving set recently installed on one of the ships of the above company.

The aerial is a T-aerial and runs from one end of the ship to the other, the total length being about 30 metres. The earth is made by simply connecting to the metal hull of the ship. A four-valve set is used with a two-valve low-frequency amplifier; the latter was found to be necessary to operate the four loud-speakers which are employed. The loud-speakers are situated one in the fore cabin, one in the aft cabin, the third on the forward bridge, and the remaining one on the smoke-room landing.

M. Isambert states that the reception is good, but that interference is experienced from the Eiffel Tower arc station, the reception of pianoforte music being particularly distorted. Another point, which will be easily understood by wireless amateurs, is that the reception becomes very faint when the ship passes under a metal bridge, and it is curious to note that the reception generally improves as the ship gets further and further away from the bridge.

It is noted that no weakening of the reception has been found due to the direction of the ship in relation to the transmitting station.

This first set has proved so successful that the company is considering installing sets on their other boats, in particular on the boat which makes the Sunday services between Paris and St. Germain.

News of the Week

THE celebrated Eiffel Tower Wireless Station was put out of commission temporarily some days ago owing to a lightning storm which damaged the aerial. Repairs were put in hand promptly, however, and the regular programme resumed.

* * *

We have seen several references to the Church and Wireless, but consider that the difficulties of a certain minister are rather novel. The minister in question was unable to complete his visiting round because he found so many of his parishioners listening-in, and, on being invited to join them, was obliged out of common courtesy to do so.

* * *

In view of a rumour which has become current in the district regarding the difficulties of wireless reception, the Bath Radio Society have caused to be announced in the local press that Bath is not a "blind spot." Thus does the Amateur Wireless Society prove of service to the community.

* * *

Enthusiasm for wireless is strongly evident in the North of Ireland, especially in the Belfast district. As the nearest broadcasting station, however, is Glasgow, a distance of over 100 miles away, reception is not a very easy matter. There is a possibility of a local broadcasting station being in operation in the near future. The Ulster Minister of Commerce declared in the Northern Ireland Parliament last week that they only awaited an application to be made to them by the British Broadcasting Co., to signify their willingness to co-operate.

* * *

We learn that the French Musicians Union will shortly hold a meeting for the purpose of determining its attitude towards the question of broadcasting. It is feared that musicians who have hitherto gained a livelihood by playing in cafés and dancing halls will find themselves without employment.

* * *

French theatre managements, on the other hand, do not think that broadcasting is likely to affect theatres. The advent of the cinema, which has not diminished the number of theatre-goers in France, is taken as an example of the little to be feared from a new attraction.

* * *

The *Daily Chronicle* reports that plans are being considered for a wireless controlled, pilotless aeroplane flight across the Atlantic between Europe and America. It is stated further that special means are to be provided by which the pilotless aeroplane will automatically signal its own position during the flight.

* * *

An action of considerable interest in connection with news distributed by wireless is now engaging the attention of the Dutch Courts. One Dutch news agency sued another for intercepting and sending to its newspaper subscribers news sent to the first agency by wireless from a third agency in Berlin. The President of the Hague Court ordered the defendant agency to cease intercepting the wireless messages until it has been decided whether such interception is illegal or not.

* * *

In view of the importation into Australia of considerable quantities of wireless apparatus to meet the demands of experimenters and others, the Customs Department have issued a special list of import duties. Condensers, detectors (crystal and electrolytic), rheostats, inductance coils, intervalve transformers, valve circuits, and complete tuning sets are to be charged 27½ per cent. under the British Preferential Tariff, 35 per cent. under the Intermediate Tariff, and 40 per cent. under the General Tariff. Valves will be admitted free under the British Preferential Tariff, but duties of 5 per cent. under the Intermediate Tariff and 15 per cent. under the General Tariff will be applied to them.

* * *

Arising out of a report published in Shanghai that the Japanese were trying to obtain control over radio communication in China in contravention of the principle of the "open door," we understand that such is not the case. The misunderstanding appears to have arisen over an agreement regarding the construction of a high power wireless station, seven miles east of Pekin, for the Chinese Government by a firm of Japanese contractors.

* * *

The case against the Secretary of the Electrical Trades Union, Belfast, for being in unlawful possession of apparatus capable of being used for sending or tapping wireless messages, has been dismissed. The apparatus was stated to have been made by the defendant, who also stated that his application to the Postmaster for an experimenter's licence had been refused. The prosecuting constable admitted that the apparatus was not assembled when he visited the defendant's office, also, that he (the constable) could not prove the instrument to be efficient for either sending or receiving.

* * *

We learn that the Committee of the Empire and Press Union on Cable and Wireless Communications have adopted a resolution approving that proposals have been submitted to the West Indian Colonies for the laying of additional cables and the establishment of wireless stations in Barbados, the Windward Island and Leeward Island.

* * *

A very natural disappointment will be felt by residents of Plymouth upon learning that the British Broadcasting Co. have selected Bournemouth as the broadcasting centre for the South Coast. We understand that the final decision was made after carefully considering, firstly, the population to be served, and, secondly, the engineering and wireless difficulties.

* * *

A suggestion has been made regarding the establishment of a relay station at Plymouth, but we understand that the present somewhat restricted band of wavelengths presents a difficulty.

The important question of Imperial wireless communications is engaging a good deal of attention just now. Mr. Godfrey C. Isaacs, Managing Director of the Marconi's Wireless Telegraph Co., Limited, recently gave an address to the industrial group of the House of Commons on this subject.

* * *

According to the daily Press, the latest development of wireless telephony is in the direction of wireless controlled racehorses. Apparently each racehorse is to be provided with a wireless receiving set and directed by his jockey from a distance. In fact, a revised version of "his master's voice."

* * *

We have occasionally published illustrations showing the wireless receiving apparatus in use at boys' schools. We now observe that a suggestion has been made with regard to a centralised wireless bureau controlled by the educational authority for the district, from which specialists in various subjects could address the classes of several schools at the same time.

* * *

There is a possibility that the learning of foreign languages, and especially the difficulties of pronunciation, will be rendered easier by the good offices of wireless. We gather that the French Government are considering a scheme for broadcasting lessons in French. This would doubtless prove a boon to English students who possess the necessary wireless receiving apparatus.

Miss José Collins broadcasting a song from 2LO.

THE BROADCASTING CONTROVERSY

(Reply by B.B.C. to recent charges)

CERTAIN sections of the entertainment industry and their supporters would have you believe that a deadly blow has been dealt to the British Broadcasting Company. If such a blow has been made, it has failed to reach us.

The British Broadcasting Co. will keep faith with its many thousands of listeners-in, and will continue to provide ever-improving programmes of entertainment.

Here are some facts, as distinct from the fears upon which the opponents of broadcasting are building their fabric.

The theatrical managers have suggested that they cannot allow the British Broadcasting Company to steal their entertainments, and a cartoon appearing in a weekly journal pictures the Broadcasting Company as a little boy crawling beneath the tent walls of a circus. The same managers suggest that as a result of broadcasting the theatrical industry has suffered and will suffer injury.

The facts are that in every instance where a theatrical play has been broadcasted the suggestion that the Broadcasting Company should do this has originated with the theatrical interests themselves.

As the result of the broadcasting of a pantomime and three or four musical plays, we possess some 28 foolscap pages of summarised letters bearing names and addresses of persons who have booked seats for these plays, and in one instance up to 21 stalls for a single production. In these letters alone we have evidence that between 2,000 and 3,000 seats have been booked by listeners-in, and it is impossible for us to judge how many other seats have been booked by persons who have not troubled to write and acquaint us of the fact. We do know that amongst those who have written are persons who have not been to a theatre for ten years.

Certain persons closely associated with the entertainment world have suggested that the British Broadcasting Company is badly in need of showmen. The British Broadcasting Company has showmen who have probably made a closer study of the problems of broadcasting and of the needs of the public in this direction than any of the critics. If they are not giving what the public wants, this is not their fault, but the fault of the many people who are leading the attacks upon broadcasting, and are placing every possible obstruction in the way of the development.

It is hardly necessary for us to refer to the several important events that this Company would have broadcast in the last few months, had they not been forbidden to do so by opposing interests.

We have already told you what were our intentions with regard to the Boat Race and the Royal Wedding, and with regret I have to inform you that whilst the British Legion (an organisation of ex-soldiers and ex-sailors), and H.R.H. the Prince of Wales, and also Field-Marshal Earl Haig, who are addressing the British Legion at their annual meeting on Whit Sunday, were agreeable to the broadcasting of that meeting as held in London (and we were arranging that the speeches should be broadcasted simultaneously from the six stations extending from Glasgow to Cardiff), the proprietors of the Queen's Hall have refused permission for the installation of the necessary microphone.

It would be interesting to hear what the showmen, recommended by certain of our critics, would do under these circumstances.

The entertainment industry seems to have the mistaken belief that broadcasting exists for entertainment purposes only. This is not the case. The nightly talks now radiated from London and the other stations are proving intensely popular, and indicate the extraordinary possibilities of broadcast telephony in the provision of information which can enlarge human outlook and increase enjoyment of life. The British Broadcasting Company has already arranged that in many departments of human interest the greatest authorities of the day will shortly talk; a form of activity that so far has never been attempted by the entertainment industry, despite its national value.

Gramophone Industry Friendly

Another step in the campaign against British broadcasting was the publication of a suggestion that the gramophone industry had forbidden artistes who are accustomed to making records to take part in broadcast concerts. We have pleasure in stating that this is not the case, that the Gramophone (His Master's Voice) Company, the Columbia Company, and Æolian Company are all friendly towards us, and have never refused permission for their artistes to broadcast, and that the manufacturers of the Edison Bell and Winner Records state that they would be willing to do anything in their power likely to assist the British Broadcasting Company. This company states that the progress of broadcasting should undoubtedly stimulate business in many directions and reduce to a very great extent the unemployment in the country.

With regard to the concert artistes, the British Broadcasting Company officials met the Concert Artistes' Association at St. George's Hall on Sunday last, when the Manager of this company offered to meet a committee of the Concert Artistes' Association with a view to establishing a minimum rate for artistes. This committee has already met in a most friendly spirit, and it is anticipated that an agreement will be reached immediately with this Association which will have the approval of this company and be welcomed by concert artistes.

At the same time certain agents and agencies, whether working independently or under pressure from elsewhere, are straining every nerve to prevent bands and artistes with which they are associated from broadcasting even though in many instances the artistes themselves would like to do so. In the case of a number of leading bands, these have decided to broadcast, despite losses of contracts threatened in other directions.

The public undoubtedly realise by now that the present campaign is taking the form of an attempted denial to them of certain entertainment, which by the march of science they are entitled to, and is being given in South America, the United States, Canada, France, and other countries.

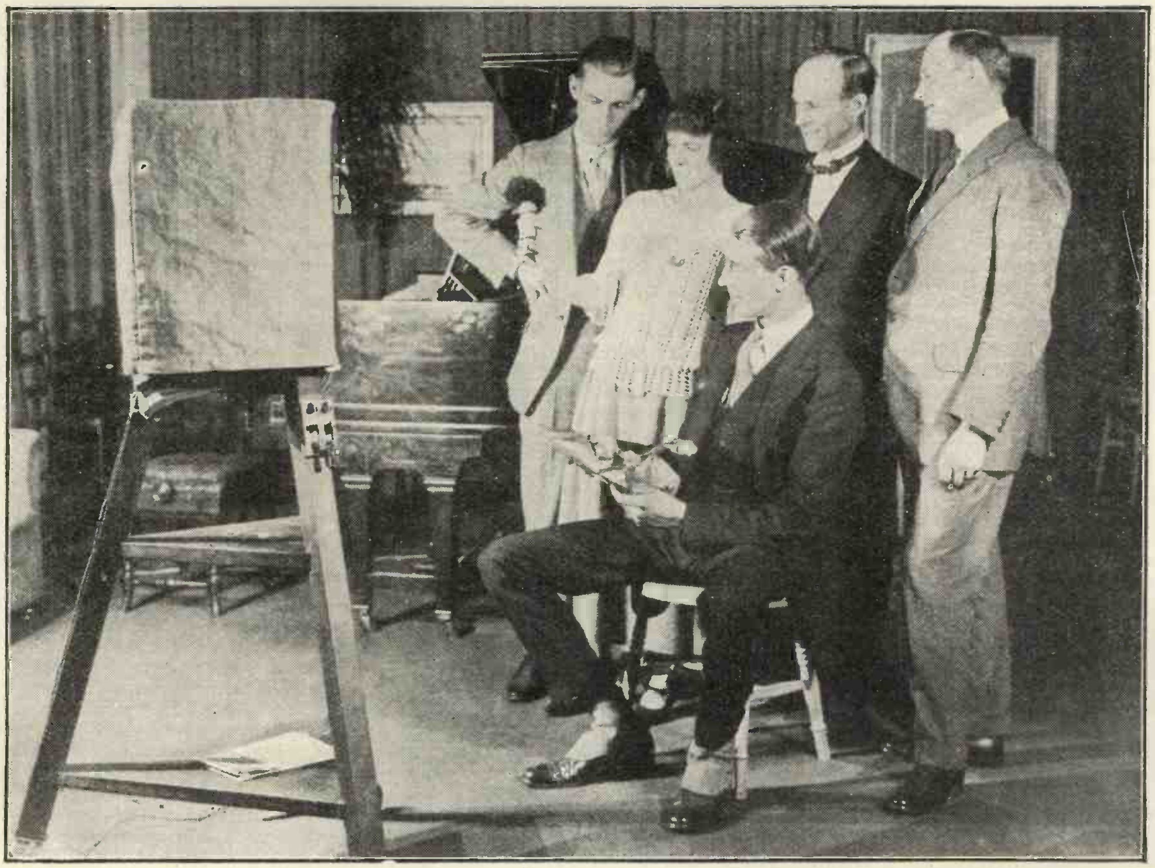
Happily there are many able artistes who have indicated to us that they will not submit to the treatment proposed, and there are also a number of enlightened persons in the entertainment world who are not sympathetic to the methods at present being employed with a view to crippling us. These argue that where a man has talents and a fair offer is made for the use of these talents, no third party should be allowed to forbid the enjoyment of these talents by the general public. The services of these people will still be available for broadcasting. At the London Station alone, no less than 72 artistes were given auditions yesterday, and the average for the last three or four weeks have been over 250 artistes per week.

Over 3,000 Thrown Out of Employment

Before concluding we feel it our duty to all listeners-in and to the British electrical industry in general to give an explanation of our silence during the past week. The sale of instruments has declined and employment in the electrical trade been materially affected. In fact, no less than 3,347 have been thrown out of employment within the last few weeks. When the British Broadcasting Company entered into conferences with the Entertainment Joint Broadcasting Company a few days ago, it was agreed between all parties that nothing should be broadcast or appear in the press relative to the subject of the conference until the conference had dissolved. Despite our rigid adherence to this compact, articles attacking the Broadcasting Company have followed in daily succession, and we have distinct evidence that an effort was made during the period of this compact in endeavouring to rope in on the side of the theatres organisations then outside the controversy. The British Broadcasting Company still hopes for a friendly settlement of this astonishing affair.

We are satisfied that the British love of fair play has not disappeared. We feel that our immediate duty is to reassure everyone that we are going forward with redoubled energy. We are erecting two new stations, one immediately in Bournemouth, and another at a later date in the North of Scotland. We are enlarging our contracts with big military bands. We are organising groups of players of our own for the production of British dramatic masterpieces. We are leaving no stones unturned to prove that even in the development of a new industry Britain *is still a free country.*

JUVENILE GENEROSITY



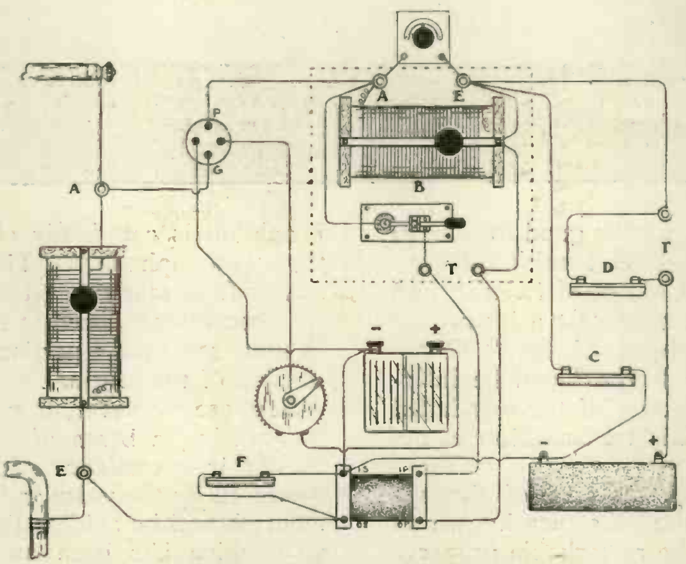
Auntie Sophie and the Uncles are interested in the opening of a parcel from one of the young listeners.

A SUPER-SENSITIVE VALVE-CRYSTAL RECEIVER

By OSWALD J. RANKIN.

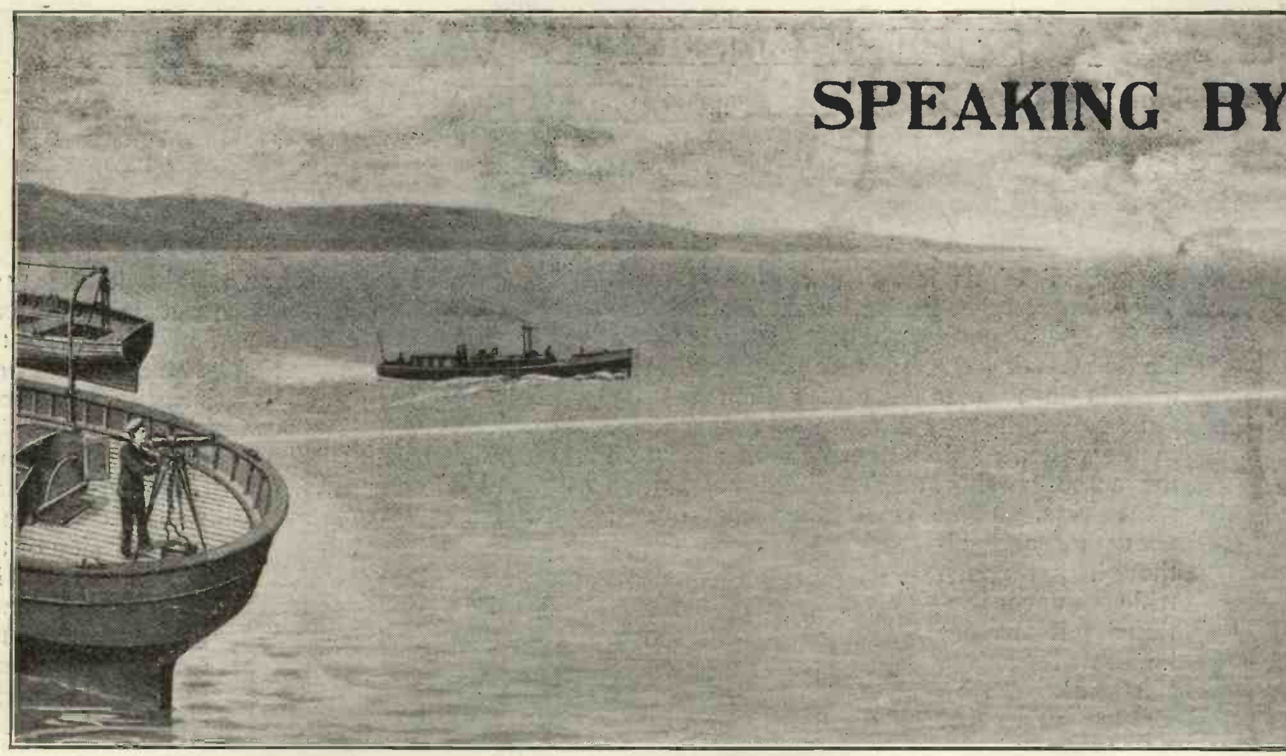
A novel circuit economical in its use, easy to operate, with distortionless results.

MOST of us know how to wire up a simple regenerative circuit for the purpose of getting the last ounce out of a single valve. One seldom reckons these matters in smaller quantities than literary ounces, but if we get down to drams then, in the writer's opinion, the circuit shown in the accompanying diagram will cut things rather fine. There is nothing complicated about it, and although perhaps a trifle unconventional, it cannot be rated as a "freak." The single valve is here made to function as a high- and low-frequency amplifier simultaneously, rectification being accomplished by a crystal detector. The existing crystal receiver is brought into service and the telephone condenser D is transferred to the extended telephone terminals which are now in series with the high-tension battery and the terminal on the crystal receiver formerly used for the earth connection. The wiring is clearly shown in the diagram. The inductance coil A on the left is of the same size and capacity as the coil on the crystal receiver B. To enable both coils to be tuned to the same frequency a variable condenser (maximum capacity 0.0005 μF) is to be connected in parallel with the active turns of the coil B. Alternatively, a fixed condenser, capacity 0.0003 μF, may be used. The coils used by the writer were each 6in. × 3in. in diameter, wound with No. 24 enamelled wire. C is a fixed condenser connected in shunt with the high-tension battery and telephones, and here is scope for a little experimenting with condensers of various capacities. The value should be somewhere in the neighbourhood of 0.01 μF. The telephone terminals of the crystal set are to be connected to the primary side of the low-frequency intervalve transformer, and the secondary winding is in series with the earth lead and the negative side of the low-tension battery, which is common to the negative side of the high-tension battery. F is a fixed condenser of 0.001 μF capacity placed in shunt with the secondary winding of the transformer. This should also be tried across the primary winding.



Showing the method of wiring the super-sensitive valve-crystal receiver.

The most admirable feature in this circuit is the entire absence of distortion and perfect ease of manipulation. The signals are first amplified in the aerial circuit, then rectified very effectively by a well-adjusted crystal, then fed back into the valve again, to be amplified at low-frequency, and finally delivered to the telephones at a greatly increased strength. It represents the last word in economy, and is particularly suitable for portable sets. The writer would recommend all experimenters to give it a trial.



SPEAKING BY

THOSE who had not the good fortune to listen-in to Prof. A. O. Rankine, D.Sc., of the Imperial College of Science and Technology, when he broadcast a lecture on April 25th on the subject of the "Transmission of Speech by Light," will be interested to have some account of the wonderful invention by which this transmission is accomplished.

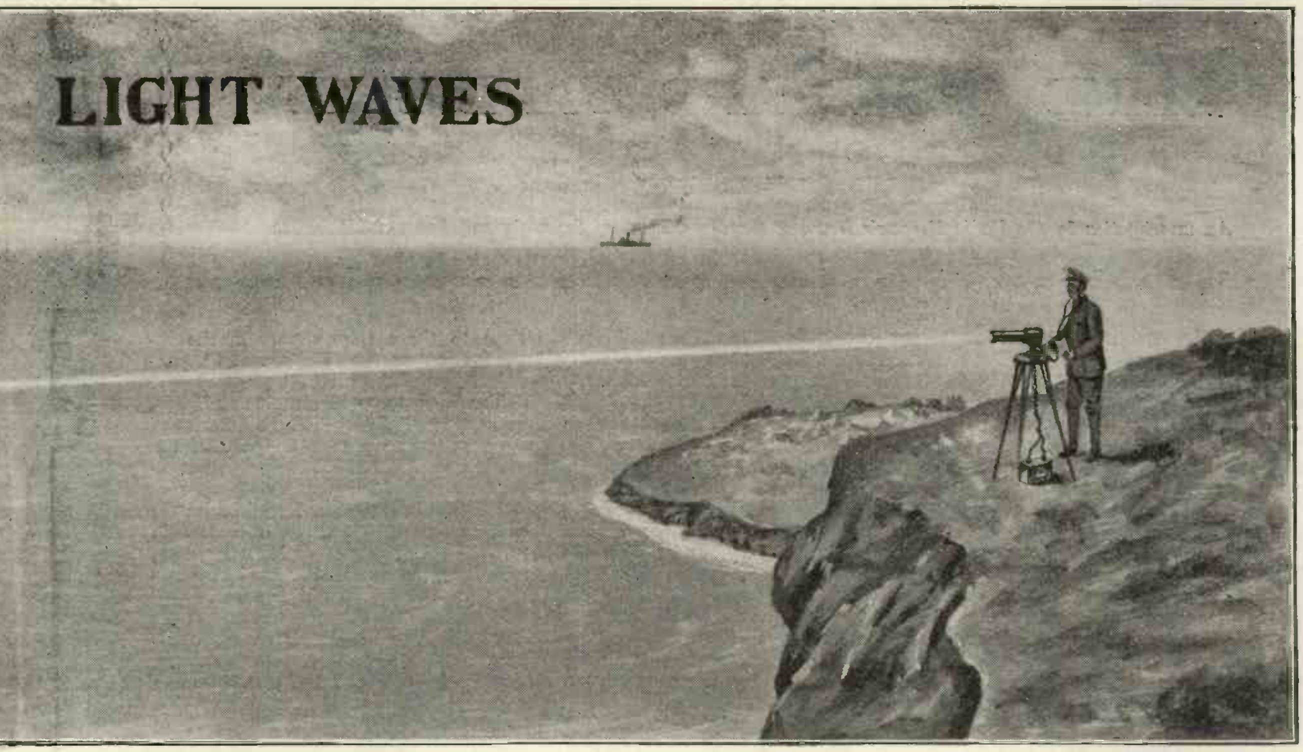
One of the essential features of the apparatus is the use of the substance known as selenium, which has the remarkable property that its electrical resistivity is changed when light falls upon it. If a beam of light of fluctuating intensity falls upon a piece of selenium mounted between metal contacts (the latter arrangement being known as a "selenium cell"), the selenium will introduce a fluctuating resistance into any circuit in which it is included, and it will be obvious that an electric current may be readily obtained in this way which fluctuates in strength in accordance with the variations in the intensity of the original light-beam.

In transmitting speech by wireless telephony or line telephony it is necessary first of all to transform the energy of the sound-waves produced by the voice into electrical energy, and the device by which this transformation is commonly effected is known as the "microphone." The latter, however, suffers from many defects, and it is found that the speech reproduced at the remote station is in some cases not a particularly faithful reproduction of the original.

Suppose, however, a method can be found for causing a beam of light to vary in intensity in accordance with the sound-waves produced by the voice or by a musical instrument; it will be evident that the selenium device which has been mentioned above will then permit of the production of electrical variations corresponding to the sound-waves, and the whole arrangement will be equivalent to a microphone. This is one of the important results which Prof. Rankine has achieved: with his apparatus the electrical variations correspond to the sound-waves with a much greater degree of faithfulness than has been found to be the case with any ordinary type of microphone.

It is curious to note that although the apparatus employed is of extreme simplicity, it differs little, if at all, from the form in which it was originally devised. The method was thought out in a single night and tried with complete success the next day—a history in remarkable contrast with that of most scien-

LIGHT WAVES



tific inventions. A beam of light from a special electric lamp passes through a lens which concentrates the beam upon a tiny mirror, about a quarter of an inch diameter, secured to the diaphragm of a small sound-box (after the manner of a gramophone sound-box; in fact, a gramophone sound-box has been successfully used). The light-beam on its way from the source to the mirror passes through a screen in the form of a vertical grating. After reflection from the mirror the image of the grating is thrown upon a second grating at such a distance from the mirror that the image is exactly the same size as the second grating. Matters are so arranged that if the mirror vibrates, the image vibrates at right-angles to the direction of the bars of the grating. It will be evident that if the light-strips of the image rest upon the *opaque* strips of the second grating, no light will pass through, whilst if the light-strips of the image coincide with the *open* strips of the second grating, the maximum of light will pass through. In practice, the image is adjusted so that in its normal undisturbed condition it occupies a position on the second grating intermediate between the positions corresponding to maximum light and total extinction. When sound-waves fall upon the diaphragm the mirror vibrates and the intensity of the beam which passes through the second grating is varied in accordance with the sound-waves. This beam may then be projected a considerable distance (in some cases five miles or more), where it is received by a lens system, and concentrated upon the selenium cell as already described. Head telephones then enable the sound to be reproduced, or, with the usual amplifying devices, a loud-speaker may be employed.

Records have also been taken upon kinematographic films and the sound subsequently reproduced therefrom, by similar arrangements, with perfect success.

The device is known as the "Photophone," and is the joint invention of Sir W. H. Bragg and Prof. Rankine. It is interesting to note that the photophone has been in operation, in place of the usual microphone, at the Manchester broadcasting station for the past six months. Further developments in this direction will no doubt enable the necessary synchronism to be obtained between projected pictures and the reproduced voice.

Note.—A complete and illustrated account of the Photophone will be given by Prof. Rankine in "Modern Wireless" of July 1st. —[ED.]

BLIND SPOTS AND FADING OF SIGNALS

An investigation by the Radio Research Board of the Department of Scientific and Industrial Research.

AT their last meeting the Radio Research Board recommended that an investigation should be undertaken into the occurrence of "blind spots" and "fading of signals" observed in connection with the Broadcasting Stations, and it was suggested that observations on these points by amateurs might be invited through the Radio Society of Great Britain (Minute of Eighth Meeting, § 216).

The Chairman of the Board has brought the proposal before the Officers of the Radio Society, with the result that the Society will be willing to cooperate in the investigation.

A conference was held on April 10th at which were present: Admiral of the Fleet Sir Henry Jackson; Dr. Eccles (President of the Radio Society of Great Britain); Professor Howe; Mr. Campbell Swinton (Chairman of the Commission of the U.R.S.I. dealing with amateur co-operation in research); and Dr. Rayner (Chairman of Sub-Committee A of the Radio Research Board).

The attached memorandum was discussed and agreed to, and it was further agreed that copies of a communication embodying the proposals made in the memorandum should be forwarded to the Secretary of the Radio Society, who would circulate them to secretaries of 160 affiliated societies, with the request that they would forward to the Secretary of the Board the names of six to ten of their members who would be willing to carry out observations on behalf of the Radio Research Board. It was agreed that the secretaries of societies should be asked to select members widely scattered over the district from which the particular society drew its members. It also was further agreed that no useful results could be expected from observing stations situated within five miles of a broadcasting station.

The general approval of the Board is requested to the steps proposed.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

Radio Research Board.

Investigation into the cause of reported fading of signals during broadcasting and to irregularity in the strength of signals in different localities which are not attributable to the distance of the receiving from the transmitting stations.

The Radio Research Board are of opinion that the above phenomena are worth careful investigation, and, in order to carry out this satisfactorily, a considerable number of receiving stations in different localities in the country are necessary, and systematic reports from those stations willing to co-operate should be obtained, stating accurately the time and local weather conditions, and indicating that the irregularity cannot in any way be attributable to faulty working of the receiver employed.

These reports should be forwarded monthly on the first of each month, addressed to :—

The Secretary,

Department of Scientific and Industrial Research,
(For Radio Research Board),
16-18, Old Queen Street,
London, S.W.1.

If so addressed no postage stamp is necessary.

They will be analysed and compared by the appropriate Sub-Committee of the Board, and brief abstracts of the results will be forwarded from time to time to those taking part in the investigation or the results will be published in the Scientific Press.

The form to be filled up is as below, and pads of forms will be forwarded to anyone ready to take part in the work who is fitted with a valve receiving set.

The Radio Research Board invite the co-operation of all those interested in radio telegraphy and telephony, especially the amateur experimentalists who have experimental licences.

The Radio Society of Great Britain are willing to be associated with this investigation.

The time recorded in Column 2 should be standard time at various periods of the year, i.e., G.M.T. in winter and British Summer Time when this is introduced.

In order to indicate a fading effect three or more observations should be made. The time at which the signals were last heard to be of normal strength should be given in Column 2 and their strength in Column 6. The strength at various intervals during the period in which the fading effects were observed should then be given with their corresponding times, and, if possible, the time at which the strength became normal again. In the remarks column should be recorded: The

(*Continued on page* 448.)

Form.

Name ....

Address ....

Any special qualifications of the observer ....

Local surroundings of station ....

....

Town, Country, Hill, Valley, etc. If situated near any large metallic masses, trees, buildings, etc., the distance from them to be stated.

Receiving Apparatus. Brief Description ....

The above information need not be repeated after the first report unless any change is made in it.

1	2	3	4	5	6	7
Date.	Time Standard.	Station Transmitting.	Wave-length.	C.W. emission.	Signal Strength at time indicated.	Remarks.

Signature ....

RADIO CONDENSERS

This article explains many of the important points in connection with both receiving and transmitting condensers and should be of interest to the experimenter and novice. Many hints are given which are useful to the experimenter, and will help him to choose well when buying. Also, much information is given which will be a guide to the construction of an efficient set.

Introduction

A CONDENSER consists essentially of two or more conducting plates with an insulating medium between the plates, which is called the "dielectric."

By virtue of its construction this apparatus has the ability to store in the dielectric between its plates a certain amount of energy. The measure of its ability to store electric energy is called the "capacity" of the condenser, and this capacity is directly proportional to the energy it can store. The capacity of a condenser is also dependent upon other factors: in general it is directly proportional to the area of the plates, to the number of plates, and to a constant K called the "dielectric constant" which depends upon the material of the dielectric. For air this factor is unity, but for all other dielectrics this factor varies generally between 1 and 10.

The capacity is also inversely proportional to the spacing between the condenser plates, the closer the spacing the greater the capacity. A condenser so built by design to have a capacity is called "lumped" or "concentrated" capacity, in contradistinction to "stray" or "distributed" capacity, which arises accidentally between metallic parts of a circuit which are at different potentials.

Types of Condenser

Condensers may be classified in a number of ways, but for our purposes they may be divided as follows:

I. Transmitting condensers.
II. Receiving condensers.

Each of these classes may be further subdivided into the following groups:

(*a*) Fixed condensers.
(*b*) Variable condensers.

Generally it will be found that transmitting condensers are seldom, if ever, variable, while receiving condensers may be either fixed or variable, depending upon the purpose for which they are intended.

Losses in Condenser

The ideal condenser would have absolutely no losses due to any cause, and its capacity would remain constant over a wide range of temperature and voltage conditions. Such a condenser does not, of course, exist, but the nearest approach to it is the air condenser, the losses of which are very small. It is for this reason that air condensers are generally used as capacity standards.

The causes for the departure of practically built condensers from the ideal lie mostly in the imperfections of the dielectric. There exist losses, of course, also in the plates and plate leads of the condenser due to their resistance, but these losses are very small. The chief imperfections will be taken in order.

Leakage

The current flowing through a condenser should be a true capacity current flowing by virtue of the capacity effect and not by virtue of any conductance. However, due to the imperfection of the dielectric, it may have some conductivity, and hence there will be some flow of current which is a conduction current through the resistance of the dielectric. This current means leakage and results in a total loss of energy. Not only may there be leakage of current through the dielectric, but there may also be leakage of current across the surface of the dielectric between the plates.

Dielectric Absorption

This is really the chief and most important source of condenser losses. When a voltage is applied to an ideal condenser it is charged instantaneously, and when it is discharged it is also discharged instantaneously. In the case of imperfect dielectrics something else happens. When the voltage is applied to the condenser an instantaneous charge flows into it, but immediately afterwards there is a small continuously decreasing current in addition, which flows into the condenser and which seems to be absorbed by it. This represents an energy loss which appears as heat.

Brush and Corona Losses

These occur only in the case of transmitting condensers which are operated at high voltages. At these voltages ionisation of the air occurs and leakage of current takes place at points favourable to it, namely, where there are sharp edges, at corners, points, etc. This leakage is made evident by a thin bluish discharge, and when this brushing is really powerful, the ionisation is accompanied by the generation of ozone, which can be detected by its peculiar odour.

The above imperfections exist in both transmitting and receiving condensers, but the last is, of course, solely a transmitting condenser phenomenon, since high voltages are not present in receivers. They all result in increasing the effective resistance of the condenser, hence in increasing the losses. The extent to which they increase the losses depends upon the frequency of the current, and may generally be represented as increasing with the wavelength. The importance of minimising these losses is at once apparent when we consider that a poor transmitting condenser may increase the resistance of its circuit by several ohms and thus reduce radiation, and in the case of reception, where incoming energy is extremely small, it will reduce the audibility factor.

Reducing Losses and Leakage

The problem of reducing the losses in condensers then is one of reducing the losses in the dielectric. The resistance due to plates

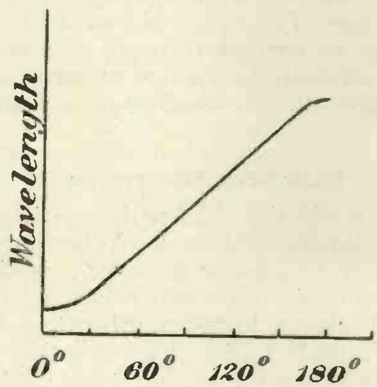


Fig. 1.—Capacity curve of semi-circular plate condenser.

and plate leads may, of course, be reduced by using good conducting material for these and making the leads as short as possible. If air could be used efficiently and economically in transmitting condensers this would be the best type of dielectric to use. Air has a low dielectric constant, hence would require great bulk to give high capacities. Furthermore,

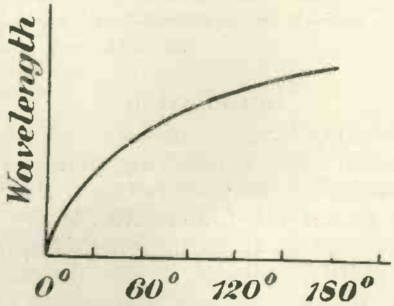


Fig. 2.—Wavelength curve of semi-circular plate condenser

its dielectric strength (ability to withstand high voltages) is not great. Compressed air has a larger dielectric strength, but these condensers are bulky. Glass condensers used to be very popular, as in the case of the well-known Leyden jar, but they have high brush losses and are easily breakable, thus requiring frequent renewal. The most suitable dielectric for transmitting condensers is mica. This dielectric has been found to have very low dielectric losses, less than any other dielectric, excepting air, and it approaches air very closely. Also it has a high dielectric strength which enables condensers to withstand high voltages. Its high dielectric constant also permits the construction of high capacity condensers in very small space, which makes these condensers very convenient since they may be built in small units.

In the case of variable transmitting condensers, liquid oil is usually used as the dielectric. A good grade of mineral oil has fair dielectric properties, and it has one further advantage which makes it a favourable type, namely, its self-healing properties. When the voltage between condenser plates becomes too great a breakdown occurs, and an arc takes place between the plates. If the dielectric is a solid one it is pierced by the arc and is spoiled. It will never be able to withstand the high voltage again, since it will spark at the injured part. In the case of the oil dielectric this does not happen. When the arc occurs new liquid oil flows into the space and the dielectric is immediately healed.

(*To be continued.*)

IDENTIFYING THE ELECTRON

By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

PART IV.—ELECTRICAL THEORY OF MATTER

ELECTRONS have played such a prominent part in modern wireless development, and to-day are spoken of so familiarly, that we are perhaps apt to forget their extreme intangibility, in the ordinary sense, and the laborious researches which led to their discovery and identification. The electrostatic charge of an electron is about 4.7×10^{-10} electrostatic units or 1.6×10^{-20} electromagnetic units; its mass is about 10^{-27} grammes, and its radius is of the order of 2×10^{-13} centimetres.

A popular idea of the enormous numbers of electrons involved in the passage of an electric current of ordinary magnitude has been given by saying that the number of electrons which pass in a *single second* through the filament of a 16-candle-power electric lamp, when the current is switched on, is so great that it would take 50,000 people, counting at the rate of two per second and working twenty-four hours a day, 1,000,000 years to count an equivalent number. The size, weight and electric charge of the electron are thus of almost inconceivable minuteness, and the reader who is unacquainted with the extraordinary power and ingenuity of modern methods of physical research may well wonder

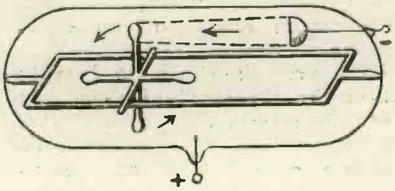


Fig. 1.—Crookes' electron mill.

how these quantities could have been determined.

Cathode Rays

It was explained, in the article on the conduction of electricity through gases, that if a quantity of gas be reduced to a very low pressure in a discharge tube, the mean free path of the electrons in the gas may be such that they acquire, between successive collisions with the molecules, sufficient energy to cause ionisation by collision. The electrons rush towards the positive electrode and the positive ions towards the negative electrode. If the pressure of the gas is sufficiently low and the electric field between the plates sufficiently intense, the positive ions will acquire so much energy in the electric field that when they strike the cathode they will disrupt the electronic systems of some of the atoms of the material composing it, and will liberate large numbers of electrons. These will at once rush away from the surface of the cathode in the direction of the electric field in the vicinity of its surface. This direction will usually be normal to the surface, and thus the "cathode rays" (as these emitted electrons are called) will usually proceed normally from the surface of the cathode (Fig. 1).

A discharge tube containing gas at a suitably low pressure is a convenient means of providing a stream of cathode rays or electrons, the velocity of which may be controlled by the potential difference applied between the plates. It was largely by the study of the behaviour of such cathode rays, when subjected to electric and magnetic influences, that the characteristic quantities in relation to the electron were determined.

Deflection of Electrons

Since the electron possesses an electric charge, it will suffer deflection in an electric field. If the cathode stream be allowed to pass through the space between two parallel metal plates, across which an electric field is set up, the cathode stream will be deflected towards the positive plate, as shown in Fig. 2.

Again, it has been explained in a previous article that a stream of electrons constitutes an electric current. A conductor carrying a current is surrounded by a magnetic field, and is deflected if placed in another magnetic field: we saw that a current-carrying conductor placed in a magnetic field is deflected in a direction at right angles to its length. It is natural to expect, therefore, that the cathode stream, if allowed to pass through a magnetic field, will be deflected across the lines of magnetic force.

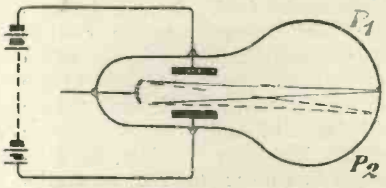


Fig. 2.—Cathode stream passing through electric field between metal plates, showing deflection.

The cathode-ray discharge tube used by J. J. Thomson in some of the earliest experiments upon the *charge* and *mass* of electrons is shown in Fig. 3, C being the cathode and A the anode. The anode is perforated by a narrow hole or tunnel, and a second portion of the discharge tube is entered by the cathode rays which stream through the hole in the anode. The vessel V is a small metal cylinder connected to an electroscope. When no electric or magnetic field is applied to the cathode stream, the latter proceeds in a straight line and impinges upon the glass of the tube at the point P_1. If an electrostatic field is applied in the direction E_1 E_2, or if a magnetic field is applied at right angles to the plane of the paper, the cathode stream will be deflected, and when the field is sufficiently strong, the stream will follow the curved path indicated by the dotted line, entering the vessel V and giving indications in the electroscope.* Another discharge tube used by J. J. Thomson is that shown in Fig. 4, where two electrodes J, K are introduced

* If an electrostatic field is applied, the path will be deflected, but will be straight after the particles have passed between the plates; if a magnetic field is applied, the path will be curved as shown in the figure.

into the vessel for the establishment of the electrostatic field.

If the electric intensity in the transverse field is X, and e is the charge of an electron, the transverse force acting upon an electron, due to the electrostatic field, will be Xe in the direction of the field. If H is the strength of the magnetic field (at right angles to the plane of the paper, in the illustration) and v is the velocity of the electrons, the magnetic force upon an electron will be Hev, and this will be in the direction across the lines of magnetic force—that is, parallel to the direction of the force due to the electrostatic field. It will be evident that by applying an electric force across the plates J, K, and a magnetic force perpendicular to the direction joining J, K, and to the undeflected direction of the cathode stream, it will be possible, by suitable adjustment of the strengths and directions of the electric and magnetic fields, to balance the two forces so that the beam is undeflected. In these circumstances we have—

$$\mathrm{H}ev = \mathrm{X}e$$

or

$$v = \frac{\mathrm{X}}{\mathrm{H}}$$

which determines the velocity v, since X, the intensity of the electric field, and H, the intensity of the magnetic field, can easily be measured.

Having determined the velocity of the electrons in the cathode streams under given conditions, the electric field is removed and the deflection produced by the magnetic field alone is measured. From this, and the dimensions of the apparatus, the radius of curvature of the stream in the magnetic field can be calculated, thus giving a value for $\frac{e}{m}$. This ratio $\frac{e}{m}$ has been determined by a considerable number of observers and by various methods, and has always been found (within the errors of experiment) to have a constant value, independent of the nature or pressure of the gas in the tube. The average value of $\frac{e}{m}$ is about 1.76×10^7 electro-magnetic units per gramme. The electrons upon which observations have been made have been obtained from a variety of sources, and it is therefore a most striking and significant fact that the value of the ratio of the electrostatic charge to the mass should be a constant.

The ratio of $\frac{e}{m}$ for the hydrogen ions which take part in electrolytic conduction in liquids had already

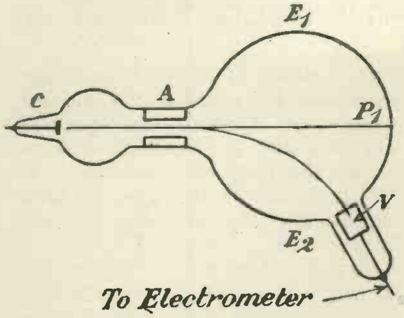


Fig. 3.—The cathode ray tube used by J. J. Thomson in early experiments.

been determined by other methods, and it is found that the value of $\frac{e}{m}$ for the particles in the cathode stream is about 1,700 times the corresponding ratio for the hydrogen ion in electrolysis. Assuming that the electric charge carried by the hydrogen ion is equal to that of the electron, this means that the mass of the electron is about $\frac{1}{1700}$ of that of the hydrogen atom: this ratio between the mass of the electron and the mass of the hydrogen atom has been verified by various other methods.

Measuring the Electron Charge

Since the ratio $\frac{e}{m}$ is known, it is only necessary to determine the value of e, when the value of m will also be determined.

The earliest direct determinations of the value of e were based upon

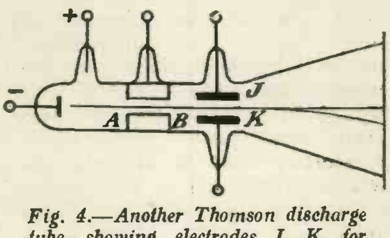


Fig. 4.—Another Thomson discharge tube, showing electrodes J, K for producing electric field.

the discovery of C. T. R. Wilson that a charged ion was capable of serving as a nucleus for the condensation of super-saturated vapour. It had previously been shown by Aitken that if a gas super-saturated with water-vapour has present in it any floating particles, such as dust particles, the latter will serve as nuclei for condensation, and the super-saturated condition of the vapour will be relieved by the formation of drops around the dust particles. If all such nuclei are removed, a very considerable degree of super-saturation may exist in the vapour without the formation of any drops.

Wilson showed, however, that even in a dust-free gas condensation could be produced upon gaseous ions if the super-saturation exceeded a certain definite value, and he devised a special form of apparatus which enabled a desired degree of super-saturation to be instantly produced in an enclosed volume of water-vapour with considerable accuracy.

This result can readily be applied to determine the charge on a single ion. The small drops, which are formed when condensation takes place upon the gaseous ions, commence to fall through the gas under the action of gravity, and they quickly assume a maximum vertical velocity which depends upon the radius of the drops, their density, the viscosity of the gas and the value of the acceleration due to gravity. This velocity can easily be observed by means of a microscope in a small chamber in which the super-saturation is produced, and the radius of the drops can be calculated. Knowing the degree of super-saturation, the total mass of water-vapour which is condensed upon the drops can be calculated, and since the mass of each drop is known, the total number of drops can be determined.

The total electric charge brought down by the cloud of drops can next be measured by allowing the cloud to settle upon a horizontal surface connected to an electrometer, and it will be evident that the total charge divided by the number of drops in the cloud will give the charge upon each condensation nucleus, that is, *the charge upon each negative ion*.

It need hardly be mentioned that although the description of this experiment is so simple, the experiment itself called for the highest degree of ingenuity and manipulative skill, and ranks as one of the masterpieces of experimental achievement.

More recent experiments have been made by Millikan by means of the apparatus shown in Fig. 6. Instead of condensing drops around the ions, Millikan formed the drops mechanically by a high-pressure sprayer S and allowed them to fall through the small hole H into the air in the vessel V, saturated with the vapour of the liquid. The vessel was closed at

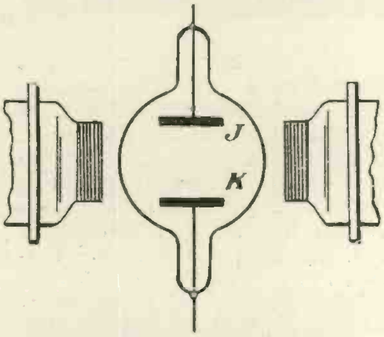


Fig. 5.—End view of tube in Fig. 4, showing magnet poles producing magnetic field at right angles to electric field between plates J, K.

the top and bottom by a pair of plates which could be charged to any required potential difference, thus producing a vertical electric field across the space; alternatively, the two plates could be connected together, allowing the drops to fall under gravity alone. By suitable adjustment of the vertical electric field, Millikan was able to concentrate attention upon a single drop and to keep the drop under observation for several hours. Initially the drops are not electrically charged, but if the air in the vessel is ionised the drops acquire charges by collisions with the charged ions. Since the diameter of a drop is large compared with that of an ion, its potential rises comparatively slowly, and the drop may accumulate several charges of the same sign before its potential becomes sufficiently high to prevent other like charges from reaching it.

The charge *e* on the drop was determined by observing the rate of fall of the drop under the action of gravity, and then observing the electrostatic field required to balance the effect of gravity and so keep the drop stationary. A very large number of charges were measured by Millikan in this way, using drops of various sizes and of various liquids, and ions produced by different ionising agents, and the very striking result was found that, *in every case, the charge upon the drop was found to be an integral multiple of the number* $4{\cdot}774 \times 10^{-10}$ electrostatic units, to a very considerable degree of accuracy. These experiments of Millikan bring out very clearly the fact that *an electric charge must consist of a collection of fundamental unit charges*, and that the magnitude of this unit charge is that which is given above.

Determinations of the value of *e* have been made by a variety of other methods, and in all cases have given results agreeing well with the value found by Millikan. His experiments are a beautiful illustration of the correctness of the concept of the electron as "an atom of electricity." They "place beyond all question the view that an electrical charge, wherever it is found, whether upon an insulator or a conductor, whether in elec-

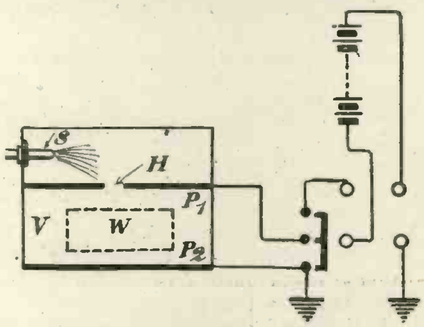


Fig. 6.—Millikan's apparatus for determining electronic charge. Spray is produced by nozzle S, and drops fall through hole H and between plates P_1, P_2. W, window for viewing drops through microscope.

trolytes or in metals, has a definite granular structure, and that it consists of an exact number of specks of electricity (electrons), all exactly alike, which in static phenomena are scattered over the surface of the charged body, and in current phenomena are drifting along the conductor."

CATALOGUES RECEIVED

Grafton Electric Co.—This firm has forwarded for our inspection an illustrated catalogue of various parts of wireless apparatus, switches, and other electrical goods. This catalogue should prove of utility to experimenters.

Radiophones, Ltd.—We have received from this company an illustrated booklet describing their cabinet receivers. Those who are desirous of acquiring a complete apparatus in a self-contained cabinet could read this booklet with advantage.

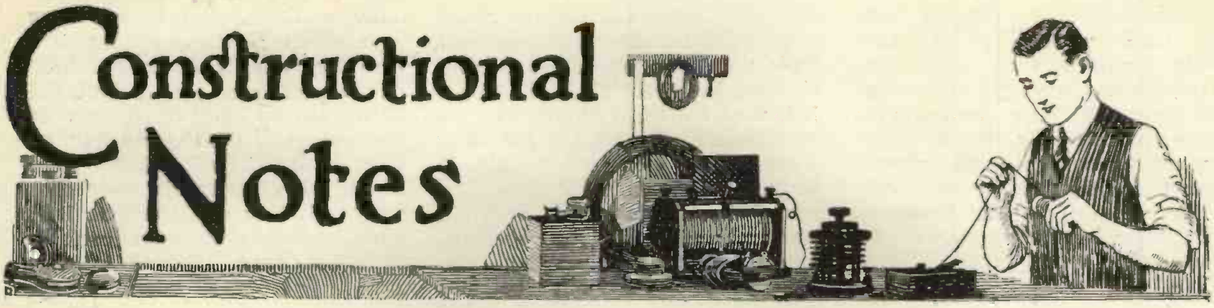
Sterling Telephone Electric Co., Ltd. — This illustrated brochure deals *inter alia* with the Sterling unit system, describing its compactability and advantages. In cases where a unit system is desired this brochure should make clear many points of doubt.

Rogers, Foster and Howell, Ltd.—We are in receipt of a copy of Catalogue No. 50, containing illustrations and particulars of this firm's new reaction sets (used under B.B.C. licence). The catalogue illustrates a wide range of apparatus at reasonable prices.

Car Hire Service (Radio Specialists).—This company advises us that they undertake the business of installing complete sets, erecting aerials and masts, tracing faults, in general, assisting the experimenter when in difficulties. They also manufacture various types of apparatus.

Electrical Apparatus Co., Ltd.—We have received a booklet describing the various wireless apparatus of this firm's manufacture, which booklet should prove useful to any reader who is thinking of acquiring either a receiving set complete or component parts.

Constructional Notes



USES FOR VALVE LEGS

VALVE legs and valve pins are amongst the most useful of the small parts that lie ready at the wireless constructor's hand. With them he can make a whole heap of time and trouble-saving devices at trifling cost.

Fig. 1.—A valve pin used as a terminal.

For experimental purposes, when wiring changes are continually being made, the tip illustrated in Fig. 1 will be found most useful. The screw of an ordinary telephone terminal is removed, a valve leg, with its shank cut down if it is too long, being inserted in its place. If valve pins are attached to the ends of leads, temporary connections can now be made in a moment by simply pressing the pins into the legs. When, however, a more solid attachment is desired, the pin is inserted into the hole of the terminal and secured by screwing the valve leg tightly down.

For coil mounting, valve legs and valve pins are most convenient. Fig. 2 shows a useful device for baskets and slabs, which can be put together very quickly. It will be found particularly handy for the inductances of tuned anodes or for loading coils. The pins fit into a pair of valve legs mounted on the panel of the set itself.

Many other applications of the valve-leg idea will occur to the reader once he has realised the usefulness of these small parts. He may, for instance, employ them for making plug and socket connections for both H.T. and L.T. batteries. For this purpose pairs of pins are mounted on small blocks of ebonite. The positive pin should be indicated by a large —I— made with white paint, so that one may be sure of connecting up always in the proper way. The sockets are, of course, made with pairs of valve legs similarly marked

One last suggestion for a gadget that will be found extremely handy. Provide a fixed condenser of 0.0005 μF capacity with a pair of valve pins, and fit corresponding sockets on your A.T.C., connecting them to its two terminals. By plugging in the fixed condenser you add its capacity to that of the A.T.C., since the two are in parallel.

It is best to use an A.T.C. with a maximum capacity of 0.0005 μF

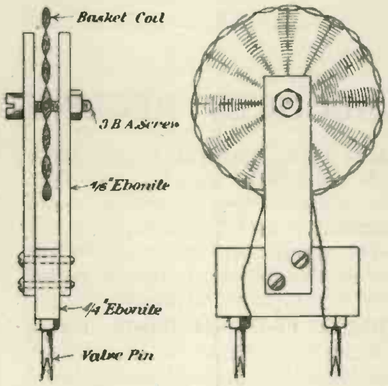


Fig 2.—Showing how to fit valve legs to basket coils.

and an auxiliary fixed condenser of the same size. This makes for very finer tuning, since to raise the capacity from its minimum to 0.0005 μF the knob is rotated through 180 degrees; and if it is now turned back to zero and the fixed condenser plugged in, a second turn of 180 degrees will be needed to reach 0.001 μF. Hence one obtains the equivalent of a degree scale 360 degrees in length between the minimum and maximum capacities of a 0.001 μF condenser.

The constructor with an inventive turn of mind can, with a little thought, conjure innumerable devices for valve legs, and since a "push-in" arrangement is so much more convenient and easier than a screw movement, constructors may do much worse than develop gadgets along these lines. R. W. H.

MAKING WIRELESS CABINETS

AS soon as any home-made set has given satisfactory performances in a rather untidy state upon the bench, it is not unusual to want to put it into a neat cabinet, so that it may be as pleasing to the eye as it is to the ear. Cabinets are rather expensive things to buy, but they are quite easy to make if one can use such simple wood-working tools as plane, tenon saw, and chisel.

The best material for general all-round use is perhaps oak, which is neither expensive nor difficult to work, and takes a splendid finish if properly treated. For small cabinets, such as those which contain single valves and their accompanying transformers or inductances, wood 3/16in. in thickness will suffice; but where a whole set is mounted in a cabinet it is advisable to use wood from 3/8in. to 1/2in. thick.

The first point to decide is

whether the ebonite top shall completely cover the wood, as in Fig. 3, or whether it shall be let in so as to lie flush. The former is the easier method, since the ebonite can be mounted first, and then trimmed up with emery paper until it is an exact fit. The second is the neater. To make a good job of it the panel must be cut and trimmed exactly to size, for any gaps, however small, between wood and ebonite will strike the

Fig. 3.—The cabinet fitted with ebonite top

eye at once and be most unsightly. The panel should rest on a beading (see Fig. 4) placed ¼in. from the top of the wood. There is just one hope for those who make rather a mess of things when fitting panels in this way, and that lies in the use of black sealing wax to botch up any places where there are gaps between wood and the ebonite. The wax can be run in hot and moulded into shape with a *wet* finger, afterwards it can be rubbed down with knife powder and turpentine; the result

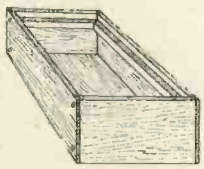


Fig. 4.—Method of supporting ebonite panel.

will be that, as it is hardly distinguishable from the ebonite, the botching will scarcely show.

The corners of cabinets may be dove-tailed in the conventional way if you are sufficient of a carpenter to be able to tackle the job, and to accomplish it neatly; but a much easier method of joining the corners is shown in Fig. 5. This will be found to answer quite as well as the more difficult way, and it looks very neat indeed when the cabinets are finished.

A splendid surface can be given to oak cabinets if a little trouble is taken with them. Once they have been put together they should be rubbed as smooth as possible with the finest glass paper; a good dressing of linseed oil should then be applied and allowed to soak in thoroughly. When the oil is dry the grain of the wood will be found to have risen a little. A further sand-papering and a second dressing of oil will produce a smooth surface. When this has become dry it may be polished with beeswax and turpentine.

If panels are mounted in the way shown in Fig. 3, their "in-

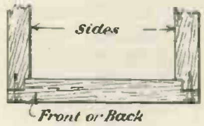


Fig. 5.—An alternative way to dove-tailing the corners.

wards" can be made readily accessible for inspection, or for changes in the wiring, by hinging the ebonite top to the cabinet. This is really a useful tip for those who are engaged in experimental work, for it allows such things as gridleaks, condensers, resistances, and other small parts, usually confined to the underside of the panel, to be changed in a moment.

R. W. H.

A POSITIVE CONTACT FOR MOVING PARTS

One of the weakest points in the design in variable condensers and some types of variometer is the rubbing contact between the spindle of moving plates or rotor and the brass bush through which it passes. When the instruments are new no trouble is experienced, but after a few months of use the contact ceases to be anything like positive owing to the wear which has taken place. Something can be done by the use of spring washers, but this has often the disadvantage of introducing stiffness or jerkiness into the working of the moving parts.

A tip that will save endless trouble is shown in Fig. 6. The job is such a simple one that anybody who can use a soldering-iron can carry it out successfully. A strip of thin sheet copper ⅛in. wide and 3in. long is cut out with scissors. One end of it is soldered to the protruding end of the spindle, round which the whole strip is next wound as tightly as possible.

As soon as it is released, the strip will uncoil to some extent until it looks something like the hair-spring of a watch. The free end should now be soldered to a

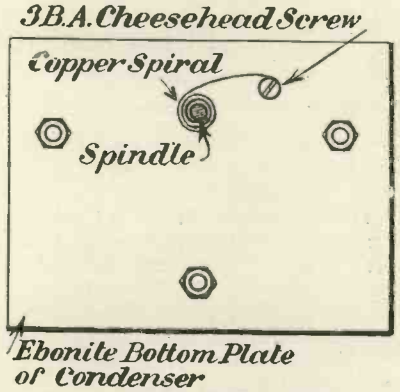


Fig. 6.—Showing how the positive connection is made

3 B.A. cheesehead screw, which is passed through a hole in the ebonite end-piece, and secured by a nut. If a lead is taken from this screw to the appropriate terminal of condenser or variometer, an absolutely reliable and unvarying contact with the moving parts will result.

The copper spring simply uncoils when the knob is turned in one direction, and coils up when it is moved in the other. If the instrument is not provided with a stop pin, it is advisable to fit one, so as to render it impossible to break the copper by turning too far in either direction.

If the strip is made long enough it will form a very weak spring, not powerful enough to move plates or rotor of its own accord, provided that the instrument is adjusted in the usual way so as not to make movement too free.

Various devices have been used for the purpose of making positive contacts, and not a few types may be seen on the market.

Where the experimenter is inclined towards making his own "gadgets" here is a field for amusement.

R. W. H.

A SIMPLE RHEOSTAT FOR PANEL MOUNTING

THERE are some who are well able to afford to purchase elaborate apparatus, yet they will construct their own to satisfy that desire to own a unit which is entirely self-made. Here is a very simple and efficient filament rheostat which should appeal to this class as well as to those who are forced by circumstances to make their own components.

A piece of good, dry hard-wood,

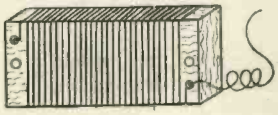


Fig. 7.

$2\frac{1}{2}$in. long by 1in. wide and about $\frac{5}{8}$in. in thickness, is first prepared by soaking it in melted paraffin wax, and then wound, as shown in Fig. 7, with about 12ft. of No. 26 "Eureka" resistance wire. The turns should be just separated and wound on very tightly. The ends of the winding are attached to small screws, and a free end of 6in. is left at one end for connecting up purposes. Two small holes are drilled through the wooden former in the position shown for the purpose of attaching same to the panel by means of two screws or bolts.

A small distance piece (Fig. 8, left) should be placed over each bolt be-

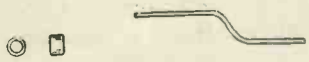


Fig. 8.

tween the former and panel. The arm consists of a strip of spring brass about $2\frac{1}{2}$in. long, tapered as shown (Fig. 9) and bent to the shape indicated in Fig. 8 (right). A hole is drilled in the widest end large enough to slip over the shank of an ordinary terminal F, Fig. 10. The knurled nut is then screwed on so that the arm will revolve with the terminal. A hole is drilled through the panel to take the other shank of the terminal, which will be the longest one; and if desired

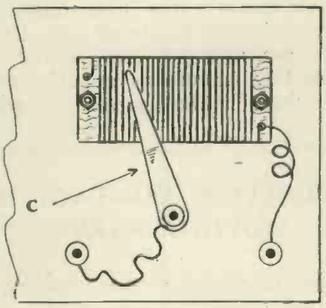


Fig. 9.

this may be bushed with a small spacer washer. The terminal and arm are then placed in the position shown in Fig. 10, and an ordinary washer and two lock-nuts are fitted as shown, allowing only sufficient play for the terminal and arm to revolve freely. A pointer G, Fig. 10, may be clamped between the two nuts if desired. A small wooden or ebonite disc is screwed down over the projecting portion of the terminal shank. The free end of the winding and the flexible lead from the arm are connected to ter-

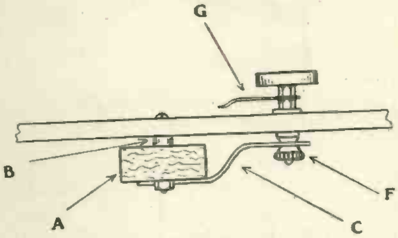


Fig. 10.

minals attached to the panel. This is clearly shown in Fig. 9. When soldering the short flexible lead to the end of the arm, it is as well to place some solder between the terminal nuts to prevent them from working loose. The nuts, or projecting ends of the bolts which hold the rheostat to the panel, will act as stops for the arm; and, if it is desired to embody the function of a switch, one of these nuts should be let in flush with the former so that the arm may be turned until it passes the first turn of the winding. O. J. R.

DETECTOR HINTS AND TIPS

ONE sometimes sees it recommended that the crystal should be fixed in its cup by being set in molten solder. There could be no worse piece of advice, for excessive heat is fatal to the efficiency of most kinds of rectifying crystal. Solder, even the soft "blowpipe" kind, has too high a melting point for the purpose. If the seating is done by means of molten metal—and this method certainly makes by far the most solid and satisfactory job—Wood's metal should be used.

Cut off small pieces of it sufficient almost to fill the cup; then, with a pair of pliers, hold the latter in the flame of a spirit lamp, or a gas ring, until the metal runs. Withdraw it; then, just before the metal begins to set, place the crystal in it. In this way the heat to which the crystal is subjected is not intense enough to have any adverse effect upon its sensitiveness.

The screw, by means of which the cat whisker is pressed against the surface of the crystal, sometimes demands a little attention. In some cheap types of detector the arm supporting it is too thin; hence the threads cannot obtain a proper grip, and the screw rapidly becomes "wobbly." The best remedy is to fit a new arm, but if the material or the tools are not available there is another cure which is simpler to effect.

Choose a nut (usually 2 B.A. or 3 B.A.) which is a tightish fit on the screw and solder it by means of "sweating" on to the upper side of the arm immediately over the original threaded hole. If the screw itself is too small, either through wear or because it was badly cut in the first instance, no nut will be found to fit it properly. In this case one must be made tighter by placing it on edge on a block of metal and giving it a blow or two with a hammer.

Never handle crystals more than necessary. R. W. H.

MAKING THE MOST OF NOTE-MAGNIFIERS

THE usual method of wiring the note-magnifying unit in a multi-valve set, though quite satisfactory for ordinary purposes, does not get the most out of a valve, since it must, perforce, work on the same anode voltage as that supplied to high-frequency amplifiers and rectifiers. If, therefore, it is desired to use a loud-speaker the circuit should be slightly altered in order that the greatest possible current may be obtained.

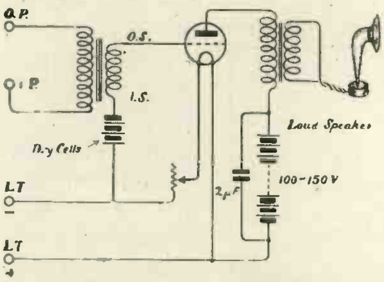


Fig. 11.—Arrangement for using note-magnifier with grid-battery.

Most of the general utility valves now on sale are pumped to such a high degree of vacuum that they will stand a considerable voltage on the plate without taking much harm. Both the "Ora" and the "R," for example, can be used with as much as 150 volts, and an anode potential of this nature will effect a marked increase in the current available for the loud-speaker.

A separate H.T. battery is used for the note-magnifier, the arrangement being as shown in Figs. 11 and 12. The employment of a higher voltage has the effect of shifting the characteristic curve of the valve bodily to the left: hence we must supply a compensating influence by placing an extra negative voltage in the grid circuit.

The simplest way of doing this is shown in Fig. 11. Here dry cells are added between the negative L.T. lead and the inside secondary of the transformer, being inserted one by one until the best potential for the valve in use is found. A great advantage of this method is that, since the current flowing is very small, the cells will last for many months.

Fig. 12 shows a way of obtaining finer adjustments. Here three or four dry cells are shunted by a potentiometer, the sliding contact of which is connected to I.S. With this arrangement it is necessary to provide some kind of switch for cutting out the potentiometer when the set is not in use, otherwise the cells will soon run down, since the current passing is comparatively large. If the potentiometer has a resistance of 400 ohms, and four dry cells are in use with an E.M.F. of 1.5 volt, the current will be 15 milliamperes.

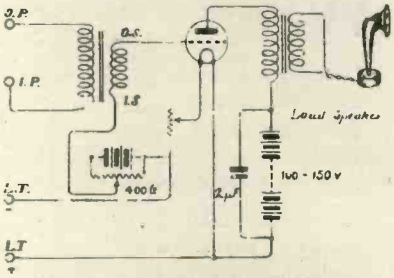


Fig. 12.—Circuit same as Fig. 11, but with potentiometer added.

If the set contains more than one note-magnifier, the arrangement suggested should be applied to the last of them. Still greater amplification can be obtained if a small transmitting valve or a power valve such as the L.S.2 is used, but in this case it will usually be necessary to use an 8-volt accumulator for filament lighting purposes.

R. W. H.

A DEVICE FOR USING SEVERAL SETS OF 'PHONES

IT often happens that one wants to be able to attach a second, a third, or even a fourth pair of 'phones to the set in order to enable a number of friends to listen to the signals or the music that is coming in. Where more than one pair of telephones are used it is desirable, when resistances are varied, that they should be connected in series, otherwise, owing to the differences in their windings, results will not be equal. One does not want, as a rule, to keep more than one pair permanently connected in this way, for when one is alone one naturally wishes signals to be at their best. What is required is some simple device which will allow any reasonable number of 'phones, say, from one pair to four, to be brought into use at will.

Fig. 13 shows how this can be accomplished without great difficulty. The materials needed are an ebonite panel, 8in. × 4½in., ten terminals, a rotary switch-arm, and four studs. The ebonite, having been properly squared up, and finished at the edges, is marked out as shown in Fig. 13. For the terminals and the studs 4 B.A. clearance holes are drilled. A ⅜in. hole will be required for the bush of the switch-arm. The latter can be obtained from advertisers in this journal for about 1s. 6d. The arm should be laminated, consisting of several strips of brass or copper, set closely together.

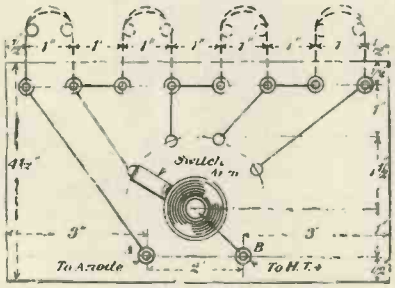


Fig. 13.—The wiring of the telephone board.

The two terminals on the base are for the output connections from the set. That to the plate is wired directly to the first of the terminals. The H.T. terminal is connected to the spindle of the switch-arm, and the four studs are wired respectively to terminals 2 and 3, 4 and 5, and 6 and 7 are connected together.

It will be seen that if the switch is placed on the first stud, only one pair of 'phones is brought into action. The second, third, and fourth studs each bring in another pair joined in series. One can thus keep the telephones wired to the terminals, but use as many or as few pairs as are required at any particular time.

STRUCK BY LIGHTNING

By STANLEY G. RATTEE

The effects of a direct hit by lightning are curious at all times, but when the objective is a wireless station the results are indeed strange.

WE have of late both read and heard many wise remarks relative to the possibilities of a wireless aerial being struck by lightning. Indeed, certain insurance companies have introduced into their Agreements a Clause having considerable bearing upon the subject when the aerial is to be erected on insured property.

It is stated that lightning is attracted only by points, and for that reason "lightning conductors" invariably carry a three-pronged device at their head. In the following instance, however, nothing resembling a point was sought after, in spite of the presence of quite a number.

With the now approaching summer we shall within a few weeks become further acquainted with the crackling sound of lightning interfering with our otherwise pure reception. In view of this, then, the facts relating to a direct hit by lightning may prove of interest.

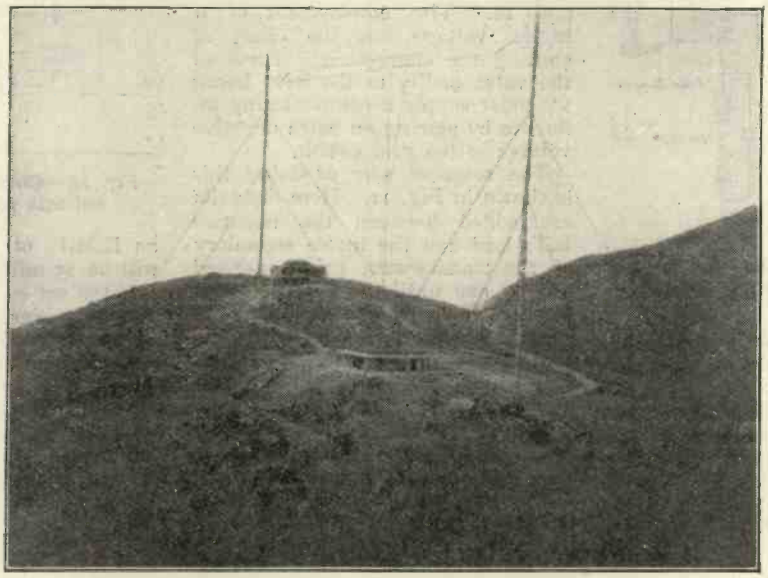


Fig. 1.—General view of the station, the building containing the apparatus being the lower one.

The incident in question took place during the year of 1918 in the Crown Colony of Hong Kong. A glance at the geographical position of this island will show that it is not far removed from the Tropics, and, owing to this fact, is sometimes subjected to the fearsome storms of rain and lightning so common in hot climates.

One is hardly justified in comparing the fierceness of tropical lightning with the more or less mild variety experienced in this country, and for this reason the chances of damage arising from the presence of an aerial during a thunderstorm, at any rate in England, are somewhat remote.

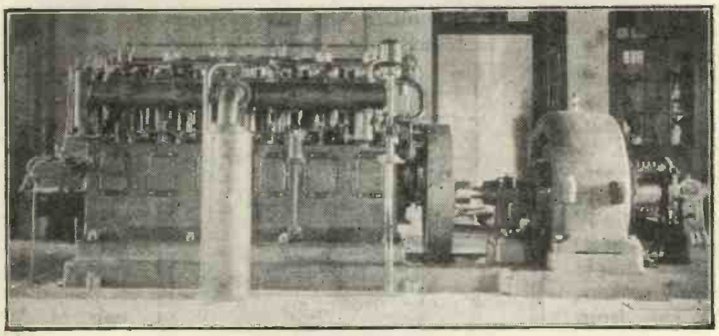


Fig. 2.—Gardner engine used as a prime-mover.

The station struck was one built for the Admiralty at the point in Hong Kong called Cape d'Aguilar (V.P.S.). For the purpose of this article the apparatus at the station needs little or no description, but, where necessary, details will be given. The site of the station was an open space free from trees and houses for some five miles round. Its height above sea-level was 300ft., and its two masts, of the Marconi sectional type, were 220ft. high, the aerial being a twin T of 7/22 phosphor-bronze.

During an evening when there were few "atmospherics" there came a flash of lightning which sought its passage to "earth" by way of the aerial and its inductances. Nothing preceded it; nothing gave warning of its coming; nothing but a deafening report announced its presence.

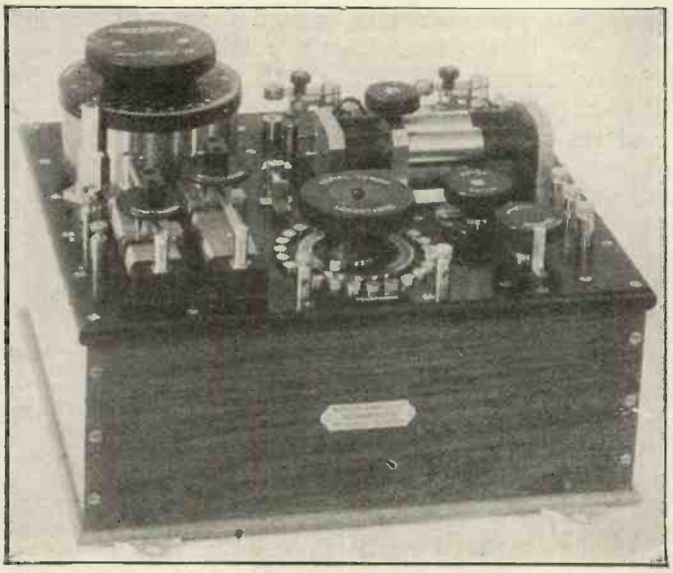


Fig. 4.—Marconi Crystal Receiver Type No. 16.

At the time, the operator on watch had removed the telephones in order to exchange a few remarks with the writer, when suddenly a report of inexpressible volume made one totally deaf for some eight to ten minutes.

The point from whence the report seemed to emanate was the "earth - arrester," and examination of this eventually showed that it was completely burned out.

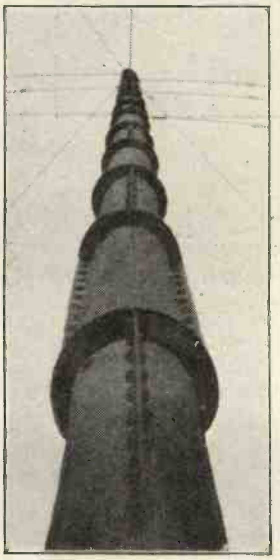


Fig. 3.—Looking at one of the masts from the base. To appreciate this photograph hold above the head.

The station, which was put into darkness so far as generated light was concerned, gave one the impression of being a gigantic "Geissler" tube, with its long, thin lines of light. The walls, windows, everywhere appeared to be discharging sparks.

When, subsequently, a lamp was procured, an inspection of the damage was made, but not until daylight was one able to gain any material idea of what had really taken place. The aerial was completely gone; the spreaders lay on the ground split and broken, whilst attached to these were the very smallest particles of insulator that one could recognise.

The masts appeared to be free from damage beyond the fact that a few of the intercepting insulators on the mast guys were badly cracked.

The station building was cracked across the roof, though not seriously, whilst a concrete pathway leading to the station, immediately below where the aerial originally was, showed a hole some few inches deep and wide. As is reasonable to expect, the apparatus showed signs of rough usage.

The "earth-arrester," of the two-plate type, was fused. The receiver connected to the aerial at the time was a Marconi Crystal Type No. 16, and this, though damaged, gave results when tested, which in itself is a peculiar fact, and speaks well for the receiver.

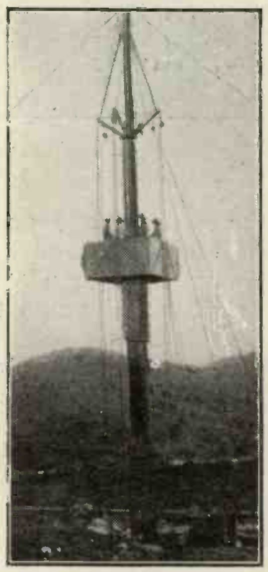


Fig. 5.—Showing how Marconi sectional masts are built up section by section.

The land-line instruments connecting the station with the Colonial Telegraphs, involving some eight miles of overhead wire, were completely dead.

The transmitting

gear in use, though not running at the time, was a Marconi 5 kw. "Special" set, and this bore signs of considerable damage after the station had been struck.

The jigger primary, with its seven turns, was deprived of its insulation, though nothing more. The jigger secondary, also with seven turns, was completely destroyed, together with the box that originally contained it. Condensers, transformers, etc., were all untouched. The alternator of the set was also subjected to some rough usage, for several of the windings upon examination were disconnected though not too badly damaged. The switches on the main switchboard, which were of the safety type, were "thrown out," and it is probable that the inclination of these switches to "jump" caused the accumulator battery and dynamo to be freed from considerable harm.

The photograph Fig. 6 shows the various units comprising the Marconi 5 kw. "Special" spark transmitting set. Reading from the left may be seen the alternator and motor, on the spindle of which rotates the electrodes of the disc discharger, seen to the right of the machine.

On the right-hand side of the photograph may be seen the transmitting jigger, whilst to the rear is seen the high-frequency primary tuning inductance. In the foreground of the illustration is shown the field regulator and starter.

The condensers and transformer may be seen to the right and centre respectively, with the "chokes" shown resting on the transformer.

The jigger secondary, which was so badly damaged, is shown with the screw for varying its coupling.

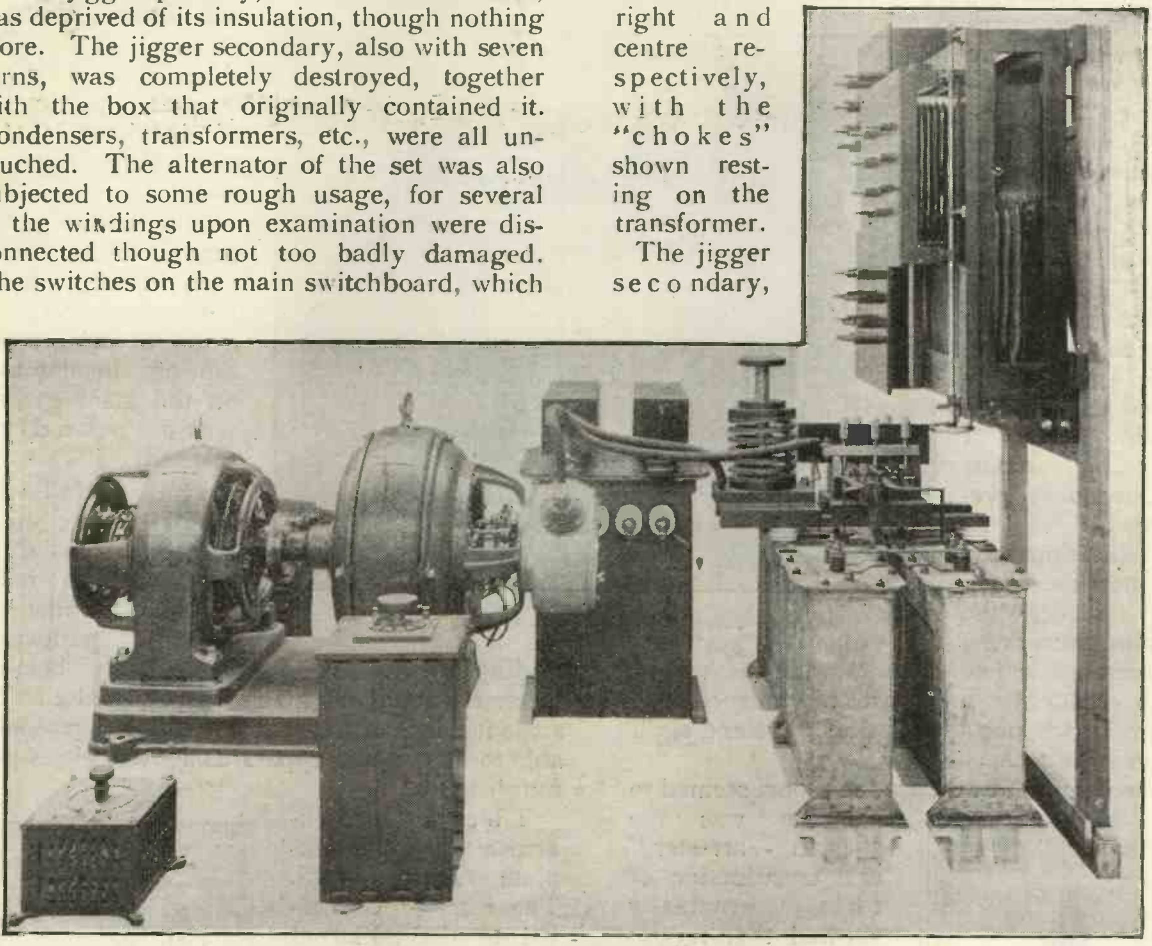


Fig. 6.—Marconi 5 kw. 'Special" transmitting set.

In spite of a varied experience in most parts of the world, never before or since has the writer ever heard or known of a similar direct hit by lightning, and since the occasion of the only known case was coincident with one of the worst storms in Hong Kong, it is almost safe to assume that aerials offer very little attraction to the elements, so far as direct passages to earth are concerned.

It has been remarked that a wireless station is safer than most places during a lightning storm, and, since sometimes it takes an exception to prove the rule, it may be so.

Broadcasting News

By OUR SPECIAL CORRESPONDENTS

IT is quite impossible to say anything about the dispute between the B.B.C. and the various sections of the entertainment world because the situation changes so rapidly. In the words of the hymn that was popular in our remote childhood days, "the early dew of morning has passed away at noon." The story which appears in the morning paper has to be corrected in the evening paper and *vice versa*. What things will be like by the time this appears in print no one can say.

* * *

However, time will not have affected this fact, that the promoters of various well-known concerts have not only stopped various artistes from broadcasting directly, but they have indicated to outstanding members of the British National Opera Company that if they appear in any operas which are broadcast they need look for no further engagements from the promoters of the concerts referred to. One result of this ban has been that it has stiffened the backs of several artistes who have refused to be dictated to in this way.

* * *

At a meeting of the British National Opera Co.'s artistes on May 15th, the attitude of the various promoters opposing broadcasting was discussed. The artistes concerned decided not to allow anyone to dictate to them in the matter under discussion.

Our readers will be pleased to learn therefore that the members of the British National Opera Co. will honour their contract with the B.B.C., allow operas to be broadcast, and, further, the artists will broadcast individually when requested to do so.

* * *

As a rule, concert artistes are not nearly so well-organised as bands, orchestras and other combinations of musicians, and the result is that they are more or less at the mercy of one or two concert agents. But some of them are beginning to realise that they must make a stand if they are to call their souls their own. Whoever suffers by the advent of broadcasting, the artistes stand to gain. The B.B.C. are out in the open market for the best talent they can get. It is all a question of terms, and the artistes should decide it for themselves without fear of intimidation from anyone.

* * *

Meanwhile, the battle between the entertainment caterers and broadcasting threatens to be of international dimensions and importance. The Paris theatre managers are waging an even more strenuous fight against wireless entertainments. The statement has been made that in France, thousands of musicians who might otherwise be giving public concerts find their services no longer needed. If this statement can be proved true obviously it will greatly strengthen the case against broadcasting in this country. Equally strong statements have been made in London, but not a vestige of

THE LONDON WIRELESS ORCHESTRA.
Known to every wireless enthusiast in and around London, the wireless orchestra of 2LO is seen above before commencing one of its evening programmes.

proof has been adduced in support of the statements. Facts are "chiels that win a ding," and so far few facts have been given regarding employment of artistes which carry much conviction.

* * *

Now that 2LO has got comfortably settled in its luxurious quarters at 2, Savoy Hill, the next question is to find a new home for the transmitting station. Marconi House is rather near the Air Ministry, and while the relations between the Air Ministry and 2LO have been most cordial, perhaps, like young married couples and their relations, they should be a little bit apart. The new wireless station is to be on the top of the building belonging to Messrs. Shaw and Kilburn, the well-known motor dealers in Wardour Street.

* * *

One would have thought that even Wardour Street made 2LO and the Air Ministry rather near neighbours, but it seems that the latter are satisfied, so the former are gratified. It is possible that when the new transmitting station is working it will be possible to use stronger power than is permitted at present.

* * *

The test which was made linking up 2LO with all the other stations and simultaneously broadcasting speech was like the curate's egg—excellent in parts. The transmission was heard quite well in every station, but not continuously. More than once it was cut off, and occasionally the reception was very faint. But it was demonstrated beyond a doubt, that simultaneous broadcasting is possible. Further experiments will be made on Sundays with a view to eliminating all defects.

It is to be hoped that those who are making the experiments will exercise great care as to the matter they transmit. Some of the stories which were told and which would be considered most humorous in London would shock the "unco' guid" in the north. Perhaps the ideal matter for transmission would be for Mr. Burrows to read with all his accustomed articulation and emphasis the whole of the agreement between His Majesty's Postmaster General and the B.B.C.

* * *

There was one unrehearsed item during the test which caused a great deal of comment. A Guards' band happened to be passing at the time and someone opened the window and took the microphone to it with the result that the music was transmitted to all the stations. Of course, the Press started the story that this was all arranged, and in one quarter it was unkindly stated that this was another instance of the way the B.B.C. got things for nothing. Of course, the whole thing was quite unpremeditated.

* * *

The Royal Air Force and the Grenadier Guards' bands have already had contracts cancelled because they are playing for the B.B.C.; they have, however, pluckily decided to stand by the Broadcasting Co. After all, what else could we expect but courage from soldiers.

* * *

Miss Cathleen Nesbitt and Co. will perform "Twelfth Night" on 28th of May. The play will take fully two hours, and if it is successful will be followed by similar ventures which may tour the broadcasting stations.

* * *

Miss Ellen Terry will say a few words on the 31st of May on behalf of a cause which she has very much at heart. One would have preferred, however, if she had donned the motley once again and delighted us as in the old days.

* * *

At the moment of writing the Society of Authors seems to be on very friendly terms with the B.B.C., and arrangements have been made satisfactory to all parties.

* * *

Recently, while searching Birmingham through for as perfect a site as possible for a new broadcast studio an attractive suite of rooms were inspected and found to be ideally situate and desirable. The parties got down to practical details, but the interruption of the city's Big Ben abruptly brought the conference to a close.

* * *

By securing a site in the heart of the city for the Broadcasting Station there has at last been realised a hope which the company have had since the inception of 5IT last November. By the change, the greatest difficulty that the Birmingham station has had to contend with—that of inaccessibility—will be done away with.

BROADCAST
TRANSMISSIONS

CARDIFF.........5 WA......353 metres.
LONDON.........2 LO......369 ,,
MANCHESTER 2 ZY.......385 ,,
NEWCASTLE 5 NO......400 ,,
GLASGOW 5 SC ......415 ,,
BIRMINGHAM 5 IT ......420 ,,
(10.30 to 11.30 a.m. and 4.30 to 9.30 p.m. G.M.T., Sundays 7.30 to 9.30 p.m. G.M.T.)

L'ECOLE SUPÉRIEURE (Paris) 450 metres.
Tuesdays and Thursdays 7.45 to 10 p.m. G.M.T.

THE HAGUE...PCGG...1085 ,,
(Sundays only 3 to 5.40 p.m. G.M.T.)

RADIOLA (Paris).........1780 ,,
7.45 to 10 p.m. G.M.T.

EIFFEL TOWER...FL...2600 ,,
(11.15 a.m., 6.20 to 7.p.m. and 10.10 p.m. G.M.T.)

OPERA SYNOPSES

The following are short stories of the operas to be broadcast from 2LO, telling their plots and meanings.

THE MAGIC FLUTE.

(*Wednesday*, MAY 23RD.)

This opera by Mozart is an allegorical fantasy illustrating the reward of constancy. It tells the story of one Prince Tamino and an imprisoned girl. The scene is Egyptian, the time Antiquity.

Cast:

Sarastro, Priest of Isis.
The Queen of Night, a sorceress.
Pamina, her daughter.
Tamino, a prince.
Papageno, his attendant.
Papagena, the last-named's sweetheart.
Monastratos, a Moor.

Act I.—Opens with Prince Tamino lost in a forest, being pursued by a serpent. His calls for aid bring three fairies to his side, who slay the serpent with their spears.

Papageno, a braggart, claims the honour of having slain the serpent and has his lips sealed with a padlock by the fairies, as punishment for his lies.

A portrait of Pamina is shown to the Prince by the fairies, who advise him that this lovely maiden is in the power of Sarastro at the Temple of Isis. The Queen of Night, the mother of Pamina, now appears and invokes the aid of the Prince in effecting a rescue, and upon the Prince gladly consenting to the adventure, a magic flute is given him with which to ward off danger. Papageno is to accompany the Prince, and the padlock is removed, to be replaced by a chime of bells.

Act II. Scene 1.—The Palace of Sarastro.—The Moor, Monastratos, has annoyed Pamina as a result of his persistent attentions, but is frightened away by Papageno, who brings news of the Prince's coming and plans with Pamina that she shall escape with them.

Scene 2.—Entrance to the Temple.—Prince Tamino approaches, but is at first denied admittance. Sarastro appears and orders the Moor to be punished, greets the two lovers kindly, telling the Prince that he must show himself worthy of Pamina's love by passing through certain ordeals of the Temple

Act III. Scene 1.—A Palm Grove where it is agreed that Tamino and Pamina shall be united, subject to the Prince successfully undergoing the ordeals.

Scene 2.—A Courtyard wherein is enacted the first ordeal, to wit, that of Silence. Tamino and Papageno must not utter a sound, and, though tempted by three attendants of the Queen of Night, they remain firm.

Scene 3.—A Garden.—The Moor attempts to approach Pamina while sleeping, but is again prevented by Sarastro.

Scene 4.—A Corridor in the Temple.—Papageno and Tamino are still under the ordeal of Silence, and though Papageno breaks down the Prince remains silent. Pamina expresses disappointment that the Prince leaves her endearing remarks unanswered.

Act IV.—The Pyramids.—The Prince, ordered to wander in the desert, sadly leaves Pamina behind. Papagena, feeling, too, that he would like a wife, observes an old hag. As he is about to run away she changes to the young and beautiful Papagena, but Papageno, like the Prince, must also prove the worthiness of his love.

Scene 2.—Pamina, believing the Prince to be faithless, attempts to stab herself, but is prevented. Papageno, despairing over the loss of Papagena, finds that he can summon her by ringing his chimes.

Scene 3.—A Fiery Cavern.—Tamina is seen undergoing the last of his ordeals. Threatened by waterfalls and tongues of flame, he calls for Pamina, and they are re-united. A few strains upon the magic flute and the remaining dangers vanish.

Scene 4.—The Temple of Isis.—Sarastro, welcoming the Prince and Pamina, unites them. Papageno and Papagena are married, whilst the Queen of Night and Monastratos, the Moor, are vanquished.

PHŒBUS AND PAN.

(*Saturday*, MAY 26TH.)

Details of this opera being difficult to procure, we can do no other than relate the story which is more beautifully described in music than in mere common-place words.

The story, founded on an old Greek myth, relates the struggle for musical supremacy between Phœbus, god of the Lyre, and Pan, with his merry pipe.

The opera opens with choruses introducing delightful ballet music.

The contest between Phœbus and Pan is presided over by Mercurius, whilst Timolus and King Midas are appointed judges.

The prize is claimed by Timolus, on behalf of Phœbus, while, on the other hand, Midas, in a jolly, rollicking song, laudates the virtues of Pan's less tutored accomplishments. During his singing Midas is presented with a pair of asses' ears in appreciation of his judgment. Timolus wins the day, and the prize so ably won is presented to Phœbus.

The opera is played in one act and was written by Johann Sebastian Bach.

HANSEL AND GRETEL.

(*Wednesday*, MAY 30TH.)

This well-known opera, written by Engelbert Humperdinck, is played in three acts, the scene being a German forest, the time the 17th century.

Cast.

Peter, a broom-maker.
Gertrude, his wife.
Hansel, his son.
Gretel, his daughter.
The Crunch Witch.
The Sand Man.
The Dew Man.

Act 1.—The Broom-maker's Cottage.—Hansel and Gretel, hungry and tired with work, dance about to forget their appetites. Their mother, by way of punishment, turns them into the woods of Ilsenstein, where dwells the Crunch Witch.

Act 2.—In the Forest.—The children, afraid to return home, sink down beneath a tree, where the Sand Man comes and sprinkles the sand of sleep in their eyes. In answer to their prayers, angels descend from Heaven and guard them.

Act 3.—The Witch's Gingerbread Hut.—Awakened in the morning by the Dew Man, the children find themselves before the gingerbread hut, which they start to eat. The witch comes out and seizes them. Hansel she locks up in a cage to fatten, whilst Gretel, who presents a stouter figure for eating, is called upon to help prepare for the witch's feast. As the witch looks in at the oven door Hansel escapes from the cage, and he and Gretel push the witch into the open oven.

As the witch bakes, the oven cracks open and a row of gingerbread children transform to live children, who thank their deliverers for their escape.

PITFALLS FOR BEGINNERS.

A Lecture to Associate Members of the Radio Society of Great Britain by Percy W. Harris.

AT the meeting of the Radio Society of Great Britain on Monday evening, May 14th, Mr. Maurice Child being in the chair, Mr. Percy W. Harris delivered a lecture to the Associate Members entitled "Pitfalls for Beginners." Some of the most awkward pitfalls, said the lecturer, were not to be found explained in textbooks, and perhaps the worst of all were the mental pitfalls.

Every possessor of a listening-in set sooner or later wants to know how his apparatus works, and fortunately he has readily available both periodicals and textbooks to smooth the path for him. Later he will probably want to build some apparatus for himself, and here again he is well provided for. There is within everyone of us what Edgar Allan Poe has called the "Imp of the Perverse," and so it is more than likely that, having chosen a design from which to build his apparatus, the beginner will be seized with a desire to alter it, and, not knowing the precise reason why the author has shown the various parts disposed in a particular way, he will alter the disposition of things so that when the set is finished it will either give no signals whatever, or may perhaps set up a howl which will be the envy of every dog for miles. The lecturer strongly advised all beginners who constructed apparatus from published designs to follow the author's instructions at every point, and even slavishly until the apparatus was made to work according to plan. Once it had been so constructed and satisfactorily operated, experiments might be conducted in altering the design, and possibly improvements might be discovered.

It was important that every beginner should beware of being dissuaded from his experiments by those who would give a hundred and fifty reasons why the proposed experiment would not be successful. Nine times out of ten these critics would be right, but the tenth time was when the beginner scored. As an example of how easy it is to be dissuaded from carrying on important experiments, Mr. Harris instanced the case of Hughes, who, seven years before Hertz published his monumental work and the results of his experiments on electric waves, had himself worked on similar lines and had actually given demonstrations up to one hundred and fifty yards from the transmitter, using as a receiver a telephone earpiece attached to a microphone which was acting as a form of coherer. Sir William Crookes and a number of other scientists witnessed the demonstrations, and the President of the Royal Society together with the two honorary secretaries spent three hours at a demonstration. These gentlemen, however, seemed to think that everything could be explained by the laws of induction, and Hughes was so discouraged that he refrained from publishing his work. Years later Hughes found that others were rediscovering the facts, and with the publication of Hertz's brilliant experiments he decided it was too late to make reference to them then. Finally, he was persuaded to publish his results, and we now see that, had he not been discouraged at that early date, he would probably have anticipated Hertz, and perhaps Marconi, by many years.

Marconi himself was hardly more than a boy when he produced his first working wireless telegraph, and he was scoffed at by many experienced scientists. His attempt to bridge the Atlantic was taken to prove his thorough lack of understanding of elementary principles. Armstrong, the American discoverer of reaction, failed to persuade his father to lend him the money to take out a patent; but, being a persistent young man, he wrote out a description of his invention with diagrams, and had it witnessed by a notary public. In later years these witnessed papers enabled him to establish the priority of his invention.

Many beginners placed too much importance on "theory." Theory was not an absolute thing, but was deduced from the facts then available. It needs constant modification as new facts were discovered. A well-known radio scientist, Mr. N. M. McLachlan, had recently produced a new form of relay consisting of a shoe of iron under which ran an iron cylinder which could be magnetised by the incoming signals. When magnetised this cylinder attracted the shoe and dragged it forward. The amount of drag was far greater than could be accounted for by existing theories, and showed once more that constant experimenting was needed. From the way some people talked one would think that there was no need for experimental work, as they could always tell you beforehand exactly what would happen in any given set of circumstances!

Mr. Harris then went on to deal with a number of pitfalls in practical work, such as the troubles which arise from the use of poor quality ebonite, and from failure to remove the high polish from the surface. In the manufacture of some ebonite it was rolled hot between sheets of tinfoil, and a microscopic film of this conducting substance was sometimes left on the surface causing leakage. The surface should therefore always be removed with fine emery.

Speaking of valves, the lecturer explained how easy it was to misjudge them. Inferior results were often attributable to the use of the wrong plate voltage. R valves, for example, could not be expected to give results on such low voltages as were practicable with some other types. The speaker then dealt with a number of other pitfalls in valve work.

Loud-speakers, said Mr. Harris, were frequently blamed for distortion, which really arose from the note-magnifying apparatus. Unless distortionless speech and music were delivered to the loud-speaker, it could not possibly give distortionless results. The dangers of overloading loud-speakers were referred to, and hints given on the management of these instruments.

On the proposal of Mr. J. H. Reeves, who said he wished he had such advice when he started his experiments, a hearty vote of thanks was accorded the lecturer.

Radio Societies

CITY OF LEEDS YOUNG MEN'S CHRISTIAN ASSOCIATION (H.Q., Albion Place, Leeds).

Hon. Sec., Mr. H. Whiteley.

On May 4th and 5th the Society held its first exhibition which was opened by Alderman C. H. Wilson in the presence of a large number of people. The exhibits were many and varied, almost all the local dealers showing.

A particularly interesting feature was the display of old and new apparatus kindly loaned by courtesy of the O.C. 29th W.R. Signals (T.A.). This ranged in date from about 1900 to the present time.

On the first evening the chief event was a lecture by Professor R. Whiddington, of the Leeds University, entitled " The How and Why of Wireless." This was greatly appreciated by all, and was illustrated by a number of unusual experiments, including the boiling of water by wireless.

The Committee wish to tender their thanks to all who assisted them in making the exhibition the undoubted success it was.

DARWEN WIRELESS SOCIETY (H.Q., Arch Street, Darwen).

Hon. Sec., Mr. T. H. Mather,
8, Hawkshaw Avenue,
Darwen.

On April 26th, at headquarters, Mr. T. Burton gave a lecture on " The Construction of Apparatus," and dealt very fully with the many difficulties experienced by experimenters, illustrating his remarks with many examples.

On May 2nd, Mr. C. Field, B.Sc., gave a very interesting lecture on " Tuning," and, after a quick survey of magnetism, explained in detail the action and effect of inductance and capacity in a circuit.

Particulars of membership will be forwarded upon application to the Hon. Secretary.

DEWSBURY AND DISTRICT WIRELESS SOCIETY (H.Q., South Street, Dewsbury).

Hon. Sec., Mr. F. Gomersall,
1, Ashworth Terrace,
Dewsbury.

The atmosphere at our meeting on Thursday, May 10th, was a great improvement, and such that the Committee had no hesitation in deciding to hold all future meetings in the Central Liberal Club (top floor). Arrangements have, therefore, been made to hold meetings, etc., there each Thursday—instead of twice weekly.

Any member caring to give a lecture should send a P.C. to the Hon. Sec. Only elementary lectures are required.

THE FULHAM AND PUTNEY RADIO SOCIETY (H.Q., Fulham House, Putney Bridge, S.W).

Hon. Sec., Mr. J. Wright Dewhurst,
52, North End Road,
West Kensington, W.14.

At a crowded meeting held at headquarters on Friday, May 4th, Mr. H. B. Gardiner gave a lecture on " High-frequency Alternators and the Production of Wireless Waves." He first described the principles employed and illustrated his points with models and diagrams. Various types of commercial machines in use and devices employed to overcome mechanical difficulties were also described.

The lecture was very instructive and much appreciated by the members.

HACKNEY AND DISTRICT RADIO SOCIETY (H.Q., 275, Mare Street, Hackney, E.8).

Hon. Sec., Mr. C. C. Phillips,
247, Evering Road, E.5.

By kind permission of the owners (Swedish Lloyd Line) an enjoyable and interesting event was spent on Wednesday, May 2nd, by several members of the above Society on board the S.S. " Patricia " (lying in Millwall Dock) inspecting the ship's radio installation. The radio cabin was of fair size (about 12ft. × 8ft.) and beautifully equipped. On entry into the cabin the sweet strains of 2LO music could be heard quite loudly, but there were no visible signs of a valve set or even a loud speaker. On investigation it was discovered that the music emanated from an ordinary pair of 'phones lying on the operator's table, connected to a Telefunken *crystal* set. It was hardly believable that a crystal could give such loud signals (the crystal used was called " Radiocite ").

Another noteworthy and perhaps smile-provoking feature was the method of tuning-in, not by varying the number of tappings or the " swinging " of a condenser, as in English sets, but by turning a handle as when ringing up change on a cash register!

The Society wish to thank the owners of the ship for their permission, and the captain and wireless operator for the courtesy shown to the visitors. It was certainly a most enlightening experience.

The ordinary meeting of the Society on Thursday, May 3rd, at the Y.M.C.A., Mare Street, E.8, was suspended on the occasion of a concert and gymnastic display arranged by the Y.M.C.A. boys, at whose request the Society gave a special radio demonstration, the apparatus used belonging to the Vice-President, Mr. E. Cunningham. The results were very fine, and the Society was complimented and thanked by Lady Malcolm, M.B.E., who distributed prizes to the Y.M.C.A. boys.

On Thursday, May 10th, the Borough Electrical Engineer of Hackney, Mr. L. L. Robinson, M.Inst.C.E., etc., gave a lecture on " Electrical Currents, Minute and Large," illustrated with lantern slides and experiments. The Mayor of Hackney, who is President of the Society, presided especially for this lecture.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY (H.Q., The Council House, Treaty Road, Hounslow).

Hon. Sec., Mr. A. J. Myland,
291, Hanworth Road,
Hounslow.

On Thursday, May 3rd, this Society held its usual weekly meeting; after the business of the meeting had been discussed, the Chairman, Mr. A. R. Pike, demonstrated a Fellow-phone " Super 2 " with a 2-valve amplifier, kindly lent by Mr. D. V. L. Fellows, the " Super 2 " employing one high-frequency valve followed by the detector. All the broadcasting stations were picked up during the evening.

Meetings are held every Thursday from 8-10 p.m., and all who are interested in wireless are cordially invited to attend. Particulars of membership may be obtained from the Hon. Secretary.

LOWESTOFT AND DISTRICT WIRELESS SOCIETY (H.Q., St. Margaret's Institute, Alexandra Road, Lowestoft).

Hon. Sec., Mr. G. W. Barker,
The Cottage,
Normanston Hall,
Lowestoft.

At the headquarters, on April 10th, Mr. C. Chipperfield gave a lecture entitled "Hertzian Waves." He described the development of radio communication from the days of Hertz, and gave demonstrations with a spark coil and coherer.

On April 17th Mr. R. S. Hudson gave the first of a course of fortnightly lectures entitled "The Elementary Principles of Radio Communication," clearing up difficulties which are often encountered by the radio enthusiast. Mr. H. C. Trent (President) gave a lecture, on April 24th, entitled "High-frequency Amplification," explaining most clearly all types of H.F. amplification in detail by means of diagrams.

NORTH LONDON WIRELESS ASSOCIATION (H.Q., Physics Theatre, Northern Polytechnic Institute, Holloway Road, N.).

Hon. Sec., Mr. J. C. Lane.

On May 7th Mr. A. G. Hill lectured on "Experience in Radio Reception." Going back to earlier days he described the difficulties experienced in obtaining supplies of material, also lack of data available. He then dealt with crystal reception and also the bulky nature of apparatus as compared with that of the present day; how he obtained the P.M.G.'s permission to purchase and use one thermionic valve.

The Hon. Secretary will be pleased to forward particulars to anyone desirous of joining the Society.

THE SOUTHAMPTON AND DISTRICT RADIO SOCIETY (H.Q., Y.M.C.A., Ogle Road, Southampton).

Hon. Sec., Mr. P. Sawyer,
55, Waterloo Road,
Southampton.

On May 3rd, at headquarters, Mr. Bateman gave an instructive lecture dealing with various circuits, the most interesting item being a dual amplification circuit which he had devised, and with which excellent results are obtainable. The lecturer then concluded by giving a demonstration with a set embodying his novel circuit.

The Hon. Secretary will be pleased to hear from local enthusiasts desirous of joining the Society.

STOKE-ON-TRENT WIRELESS AND EXPERIMENTAL SOCIETY (H.Q., Y.M.C.A., Marsh Street, Hanley).

Hon. Sec., Mr. F. J. Goodson, B.Sc.,
Tontine Square,
Hanley.

Mr. A. Whalley recently delivered his interesting and practical lecture on "Faults and Fault Tracing." The lecturer described faults which were most likely to occur, and explained how sets could be tested by intelligent use of the 'phones and batteries.

He showed, by means of coloured diagrams, how the set should be treated as a number of different circuits, and how it could soon be determined in which the trouble lay. It was then a simple matter to locate the fault, but if one did not systematically test the circuits, it might become a difficult task.

SUTTON AND DISTRICT WIRELESS SOCIETY (H.Q., Adult School, Benhill Avenue, Sutton).

Hon. Sec., Mr. E. A. Pywell,
"Stanley Lodge,"
Roseberry Road,
Cheam, Surrey.

A meeting of the Society was held on Wednesday, May 9th, when a very interesting and instructive lecture was given by Mr. G. G. Blake entitled "Some Historical Notes on Radio Telephony and Telegraphy."

Mr. Blake dealt very fully with the early work of various scientists, and also went into considerable detail on the theory of electrons and the general principles of radio communication. The lecture was illustrated by a number of lantern slides, and all present had a thoroughly enjoyable evening.

Meetings are held on the second and fourth Wednesdays in the month, and the Committee hope to arrange regular lectures of interest on every first meeting in the month, the second meeting taking the form of a practical evening and discussion on practical work.

SWANSEA AND DISTRICT RADIO EXPERIMENTAL SOCIETY (H.Q., Y.M.C.A., St. Helen's Road).

Hon. Sec., Mr. H. T. Morgan.

The Swansea and District Radio Experimental Society held their usual weekly meeting at headquarters last week, a lecture being given by Mr. McNamara entitled "Elementary Principles of Wave Motion," Mr. A. T. Sage presiding. The lecturer compared in a simple manner the differences of waves in water, air and ether, his chief object being to cater for the non-technical man, and the lecture proved to be of exceptional interest to the experimenter.

A further series of elementary lectures will be given at a future date, and all beginners in wireless theory are cordially invited to attend.

THE WIRELESS SOCIETY OF HULL AND DISTRICT (H.Q., Co-operative Social Institute, Jarratt Street, Hull).

Hon. Sec., Mr. H. Nightscales,
47, Wenlock Street,
Hull.

In the unavoidable absence of Mr. Jones, of the *Hull Evening News*, who should have lectured on April 27th on the "Creed System," a discussion took place on the quickest and most efficient way of acquiring a good working knowledge of the Morse alphabet. Prior to some buzzer practice the Chairman (Mr. W. J. Featherstone) pointed out the great advantage accruing from a knowledge of Morse both to the experimenter and listener-in. By reading the various call letters of different stations one can ascertain the range and capabilities of his set. For instance, GBL (Leafield) offers really good practice in Morse reading each evening, and the Chairman urged members to make a point of taking this station down and so improving their knowledge.

At the usual weekly meeting on May 4th a number of topics were discussed, the principal being whether Hull should be made into a broadcasting station or a point for relaying.

Members are specially invited to attend the meeting on Friday, May 25th, when a sale of members' surplus apparatus will be held.

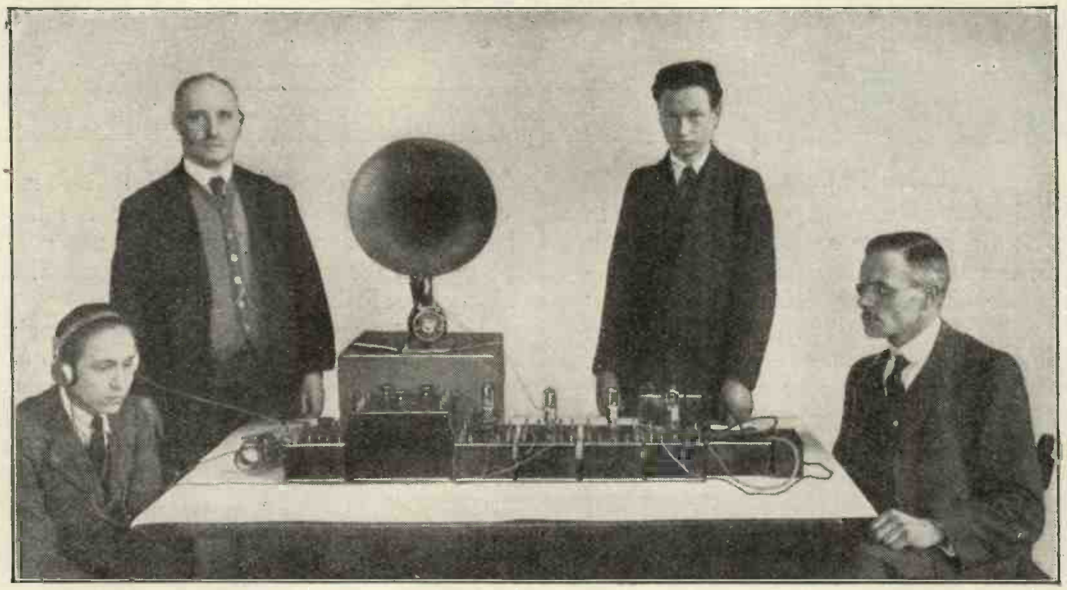
Applications for membership should be made to the Hon. Secretary.

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY (H.Q., 26, King Street, Wolverhampton).

Hon. Sec., Mr. J. A. H. Devey,
232, Great Brickkiln Street,
Wolverhampton.

A lecture on "Inter-valve Couplings" was given by Dr. Harvey-Marston, the advantages and disadvantages of high- and low-frequency amplification being very clearly explained. Transformers of types in common use, and also those of earlier types, were fully detailed, and Dr. Marston produced some excellent parts of his own construction. The tuned-anode system was dealt with and its liability to self-oscillation pointed out. The lecturer then exhibited sets constructed by himself, which, together with diagrams, enabled him to illustrate the various points of his discourse and make the lecture of real value to the experimenter.

WIRELESS IN SCHOOLS



THE above photograph is a further illustration of the good work which may be done in schools in connection with wireless. The set shown has been assembled from component parts by the boys of the Battersea Central School.

The contributor to whom we are indebted for the photograph suggests that science teaching in the schools may receive an immense impetus from the introduction of wireless, and that the old academic method of dealing with scientific subjects may well be displaced, at any rate, in the teaching of those who are not to become specialists.

FORTHCOMING EVENTS

May.

22nd (TUES.).—Plymouth Wireless and Experimental Scientific Society. An Extraordinary General Meeting will be held at Plymouth Chambers, Old Town Street, Plymouth, to consider changing to more convenient premises and alterations to existing rules, etc.

23rd (WED.).—The Stockport Wireless Society, Mersey Chambers, King Street East, Stockport. Mr. C. W. Watling. Lecture Demonstration on "Characteristics of the Valve."

24th (THURS.).—Liverpool Wireless Society. A meeting will be held at Liverpool Royal Institution, Colquitt Street, when a display of apparatus will be held. A demonstration will also be given in conjunction with the above on new type Frame Aerial by Messrs. Leslie McMichael, Ltd.

28th (MON.).—North London Wireless Association. Mr. V. J. Hinkley will lecture on "Practical Demonstration of Valve Characteristic Curves," at the Physics Theatre, Northern Polytechnic Institution, Holloway Road, N.

29th (TUES.).—Plymouth Wireless Scientific Society, Plymouth Chambers, Old Town Street, Plymouth, 7.30-7.45 p.m., Buzzer Practice. 8 p.m. General Discussion.

30th (WED.).—The Swansea and District Radio Experimental Society, 218, Oxford Street, Swansea. Lecture arranged by Mr. Guy Hodge, of the B.B.C.

30th (WED.).—The Stockport Wireless Society, Mersey Chambers, King Street East, Stockport. Lecture on Wireless Calculations by S. G. Leigh.

31st (THURS.).—Derby Wireless Club. Comparative test of loud-speakers at residence of Mr. S. G. Taylor (Vice-President), at Littleover, at 7.30 p.m. One only of each make required, and members with loud-speakers for comparison should communicate with the Secretary.

Mainly about Valves

Valve Panels

I HAVE always had two complaints to make about most valve panels. One is that, in the case of some of the panels, the terminals are not arranged in an intelligent manner, and the other is that, as far as I am aware, there is no valve panel on the market which gives the experimenter any idea as to which side the filament rheostat is connected.

It is an important point, nevertheless, and in nine cases out of ten it is desirable to have the filament rheostat in the negative lead; that is to say, between the negative terminal on the valve panel and one of the filament sockets on the valve holder.

Why could not the manufacturers place the letter R in a circle above the terminal to which the rheostat is connected, this terminal being the negative terminal?

If the experimenter wants to have the rheostat in the positive lead, he simply regards the existing negative terminal as the positive one, and connects it to the positive terminal of the accumulator.

Another point, as regards the arrangement of the terminals. I prefer myself to have the grid terminal at the left-hand top corner, the anode terminal at the top right-hand corner, and the two filament terminals to the front. As nearly all panel circuits are wired up from left to right, it is much more natural to have these terminals in these positions.

Another point is: Why does not some manufacturer or other connect a pair of filament fuse clips on his panel? A very good filament fuse is at present on the market, which will absolutely guarantee the filament against any accident. Such a fuse could be placed in between the clips, and filament safety would be ensured.

If some manufacturer of valve panels will adopt these suggestions and point out the merits of these refinements, he might sell thousands. I make him a present of these suggestions!

A High Tension Battery Fuse

It is almost as important to have a fuse in the high-tension battery circuit as in the filament circuit. Personally, I have adopted a very neat fuse placed on the market by an enterprising firm of battery makers. This fuse is simply a flash lamp screwed into a specially large wander plug, which fits into the high-tension battery socket. Anyone who experiments should make use of this valuable device, which in no way complicates the apparatus required, but which, nevertheless, prevents those inevitable short circuits which ruin the life of a high-tension battery. The price of the latter being usually in the neighbourhood of that of a valve, the battery should be taken care of just as diligently. If the high-tension battery of 50 or more volts is short-circuited, the current passing through each cell is enormously greater than that for which the battery is designed. One faulty cell in the battery, and the battery is temporarily out of order.

BLIND SPOTS AND FADING OF SIGNALS

(Continued from page 428)

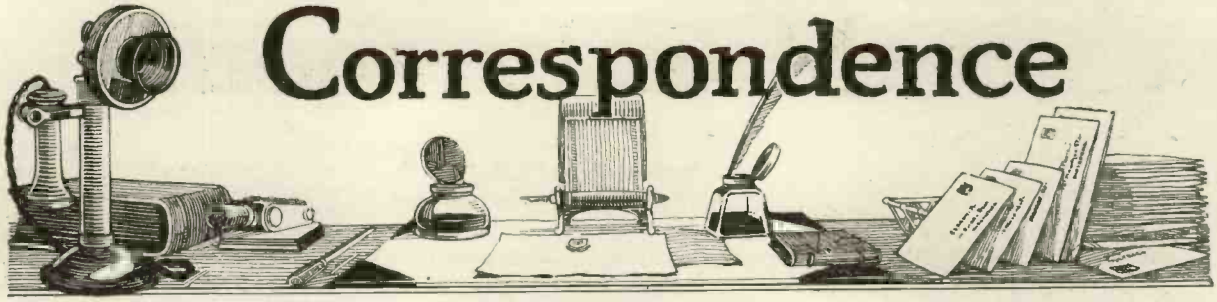
weather conditions, strength of atmospherics, and whether the bearing of the transmitting station, if observed, varied during the fading period, whether changes in the adjustment of the receiving apparatus were made in the period. If accumulators or batteries were changed this should be recorded, and also, in short, any indication that the fading might be traced to the instruments in use, or whether the phenomenon could be accounted for by any local occurrence.

The strength of signals should be recorded according to the following scale:—

0. Inaudible. 1. Just audible. 2. Very faint, unreadable (speech indistinguishable). 3. Just readable (in speech words just distinguishable). 4. Faint. 5. Rather faint. 6. Fair. 7. Good. 8. Strong. 9. Very strong.

Accurate recording of signal strength will, it is hoped, be of considerable assistance in locating districts in which signals are abnormally strong or weak from particular stations.

Correspondence



IN GENERAL

To the EDITOR, *Wireless Weekly.*

SIR,—I had intended before now expressing my appreciation of *Wireless Weekly* and also *Modern Wireless*, but at last take this opportunity of doing so.

If you can only maintain the standard you have at present set you will, I feel sure, have an assured success.

I should like to take this opportunity, if I may, of drawing your attention to several points. Cannot manufacturers standardise such parts as, for instance, coil plugs? I have found Burndept, Peto-Scott, Auckland, etc., to have each a different spacing between centres, and it is impossible, except perhaps after unduly forcing, to have them interchangeable. This point has arisen when various students have brought coils along for testing.

Further, I have seen no attempt to reduce the price of sets, either for home construction or otherwise, by eliminating ebonite panels. It is really a waste of money to use large ebonite panels when teak or oak can be used and stained with some such stain as "Solignum," for example, all necessary terminals being bushed with ebonite. Perhaps an article would draw the attention of amateurs to this saving.

Also I feel it is bad practice to place the valves in so unprotected a position as is usually found in English sets. The Yanks have us beat there.

Lastly, and perhaps the most important, is: Cannot something be done to reduce the interference from "spark"? Personally, I find it very bad, and should like to know how other coast towns are affected, as I have seen several references to this matter already. The ordinary ship messages are bad enough, but when in addition you hear operators "sitting" on their keys or sending V's for quite a fair time, or sending "Hello, old man," etc., umpteen times, it makes you wish for some control.

I am, etc.,

Southampton. C. E. CHESTER.

L.-F. TRANSFORMERS

To the EDITOR, *Wireless Weekly.*

SIR,—I have experimented with a good number of cheap low-frequency transformers, and have come to the conclusion that the majority are inefficient when coupled to a crystal set. I have also discovered how an inefficient transformer may be made quite efficient when connected to crystal sets. The method is to wire the transformer as shown in Fig. 1, and I think you will be surprised at the great increase of signal strength.

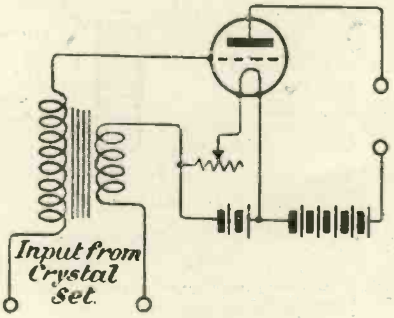


Fig. 1

I am, etc.,

W. J. WISEMAN.

Forest Gate, E. 11.

LONG-DISTANCE CRYSTAL RECEPTION

To the EDITOR, *Wireless Weekly.*

SIR,—I have a B.B.C. crystal set made by the —— Co. With this set I can receive Manchester Station quite clearly, which is at least forty miles distant from where I live (in the Wirral Peninsula). This, I believe, is quite a long range for a set of this type, but last week I was amazed to hear the strains of an orchestra (after 2ZY had closed down for the night). I tuned this in and received 2LO with great clearness, and was able to hear every word which was transmitted; since then I find I can get London fairly well on any fine night, although I can only pick up very faint messages from Birmingham. I think this must be rather unusual, judging from the letters which are published in *Wireless Weekly.*

I am, etc.,

W. O. BRETHERTON.

BROADCAST PROGRAMMES

To the EDITOR, *Wireless Weekly*

SIR,—Although a keen critic of the B.B.C. concerts, I must say I entirely disagree with "An Elderly Listener-in" with regard to the "high-brow" music which is being broadcast.

Broadcasting is the finest chance there has ever been of educating the musical tastes of the nation.

I am a keen dancer myself, and like the so-called "jazz" music in a ball-room, but nothing is more boring than listening to it by "wireless."

I also am sorry that 2LO has made its dance music later, as previously it was given at a time I could not often listen-in, and therefore did not hear it much.

I do not think the musical director of the B.B.C. rings the changes sufficiently. I have noticed on more than one occasion that pieces and songs have been repeated once or twice within a very short period.

I suppose there are many people who listen-in every night, but I find, from talking to people, that a larger number listen-in two or three times a week only, and who prefer certain evenings, say from 8-10.30 p.m., to be devoted to different classes of entertainment, e.g., chamber music, orchestral, operatic, choral, dance music, etc.

I am, etc.,

Teddington. F. D. V. GOODALL.

EXPERIMENTAL TRANSMISSIONS

To the EDITOR, *Wireless Weekly.*

SIR,—May I make an appeal to amateur transmitters through your pages.

I think it would greatly help experimental work (amateur) if transmitting amateurs would give their call signs more frequently when working.

I take great interest in amateurs, and sit up every night after broadcasting to listen to them, while I listen-in all day on Sunday, but I am often disappointed when, after tuning an amateur in during the middle of his speech, all I hear at the end is a curt "over." It would be very much better if they gave their sign always at the end as well as at the beginning of a transmission. I am, etc.,

L. G. FULLER.

Wanstead, Essex.

ON MUSIC

To the EDITOR *Wireless Weekly*.

SIR,—A correspondent in a recent issue of the *Wireless Weekly* makes a plea for brighter music. His plaint is that the B.B.C. compels him to listen to the Chopin études, nocturnes, and all the rest, whether he likes them or not. The writer of the letter echoes something that is very common in all branches of art. What pleases one taste is unsatisfactory to another. In literature the mind that revels in Tarzan finds no delight in the exquisite fantasies of a Barrie. Similarly, in a more domestic sense, the meal that satisfies the hungry navvy is repulsive to the more delicate appetite of the epicure.

But our correspondent, who would be perfectly delighted by a musical procession of "Limehouse Blues," "The Bells of St. Mary's," and "In a Monastery Garden," should remember that of the thousands of "listeners-in" there would be at least 50 per cent. who would be bored to distraction by such pieces, pretty and tuneful as they undoubtedly are. It all shows how very difficult it is to cater for the tastes of such a large and varied audience. The only solution of the problem is to "mix it." One could wish, however, that the broadcasting artistes would choose pieces of a less severely academic nature—the pianists especially. There is no limit to the number of solo pieces that are both bright and tuneful, and, generally speaking, the majority of listeners-in can find no particular delight in reflecting on the ease with which the artiste is surmounting difficulties of technique. Tune is the first essential, rhythm the second, and the rest matters not.

I am, etc.,

Twickenham. H. O. TEBB.

CONCERNING 5SC

To THE EDITOR, *Wireless Weekly*.

SIR,—Referring to the query of F.A.F. (Dalmellington) in your issue of 25th April. The querist will probably be interested to know that 5SC (Glasgow) comes in clearly here on 2 slide coil and crystal detector ("Permanite"). We are 120 miles from Glasgow as the crow flies, and the aerial is a twin 60 foot high. The results appear to be consistent and are obtained without difficulty.

I am, etc.,

W. A. HAYES, Hon. Sec.,
Portadown Radio Association.
Co. Armagh.

TELEPHONE LEADS

To THE EDITOR, *Wireless Weekly*.

SIR,—I am enclosing herewith a sketch (Fig. 2) of a simple piece of home-made apparatus which has proved so uncommonly useful, that I feel sure it would be sufficiently interesting to publish.

The sketch is self-explanatory, the arrangement consisting of an empty

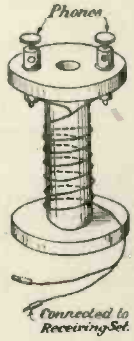


Fig. 2.—The reel showing how the leads are connected

reel, two terminal connectors and about a dozen yards of silk flex.

In use, the ends of the flex may be left permanently connected to the set, and the reel with the telephones attached may be taken away and the broadcasting enjoyed under the most comfortable conditions.

I am, etc.,

JOHN H. HARE.

Hendon, N.W.

ON DRILLS

To THE EDITOR, *Wireless Weekly*.

SIR,—It is, of course, quite correct that a drill made from hard drawn brass will pierce ebonite as stated by Mr. W. E. Gibson in your issue of May 9th, but a steel drill if correctly made will last much longer and is a more practical proposition.

With a steel drill the main thing is to get the right temper after hardening. This depends on the quality of the steel used to a certain extent, a dark blue temper in one class of steel equalling a lighter blue in another variety. When a drill has been made and used the cutting edges should be examined. If the edges are unduly blunted or turned over, the drill is too soft and requires hardening and tempering again. If, however, the edges are chipped the drill should be tempered a little more. A glance through a magnifying glass will quickly show the state of the edges, and after a trial drill has been used and tested a number of others may be made at the same time.

The greatest defect of these fan-shaped drills is that each time they are sharpened the size is slightly reduced, but this can be obviated to a certain extent by getting the correct temper suitable for the material to be drilled.

I am, etc.,

Leeds. C. W. OSBORN.

THE OLDEST CLUB

To THE EDITOR, *Wireless Weekly*.

SIR,—With reference to the statement in the *Wireless Weekly*, No. 3, page 161, and subsequent letter from Mr. Sutton, I beg to deny having ever stated that the Nottingham Wireless Society was the oldest in England. I intended denying this at an earlier date, but owing to pressure of business omitted to do so.

The remark actually made by me at the meeting was, "I *believe* that the Nottingham Wireless Society is *one of* the oldest in England, and even senior to the Wireless Society of London." This was not meant as a challenge in any way, and I regret any controversy caused thereby.

I can assure you that I do not wish to tread on anyone's corns in this matter, and I am very pleased to be able to say that the amateur wireless societies are remarkably free from those petty jealousies which so mar many other associations.

As Mr. Sutton so ably remarks, "there is very little credit in being the oldest society in England—what counts is the liveliness of the Society in question," and I think I can safely say, without throwing out another challenge, that the Nottingham Society certainly ranks with the liveliest in England. Wishing your journal the success it deserves.

I am, etc.,

HECTOR FORD,
Chairman of the Nottingham and District Wireless and Experimental Association.
Nottingham.

(We quite agree regarding the avoidance of petty jealousy. This correspondence is now closed.—ED.)

Patent Section

The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS

(Specifications not yet published.)

11331. Akt.-Ges. Brown, Boveri, et Cie.—Apparatus for taking direct-current voltage free from higher harmonics from a rectifier. April 26th. (Germany, April 26th. 1922.)

11426. Aktiebolaget Birka Regulator.—Regulating-devices for electrical apparatus. April 27th. (Sweden, September 1st, 1922.)

11066. Angel, E. J.—Time-setting device for controlling maintenance of an electric circuit for a variable period. April 24th.

11056. Angel, E. L.—Time-setting device for controlling maintenance of an electric circuit for a variable period. April 24th.

11125. British Thomson-Houston Co., Ltd.—Vibrating converters. April 24th. (United States, August 24th, 1922.)

11513. British Thomson-Houston Co., Ltd.—Sound emitting, &c., instruments. April 28th.

11461. Brown, A. C.—Telephone receivers. April 28th.

11350. Brown, D.—Composition for coverings or insulation. April 27th.

11462. Burton, H. A.—Hertzian wave detector. April 28.

11513. Butcher, J. H.—Sound-emitting, &c., instruments. April 28th.

11043. Chapman, H. H.—Valve-protector for circuits employing thermionic valves, &c. April 24th.

10947. Coleman, C. J.—Telephone receivers. April 23rd.

10948, 10949. Coleman, C. J. — Loud speakers for wireless apparatus. April 23rd.

11515. Coomes, J. A.—Holders for thermionic valves, lamps, &c. April 28th.

11515. Coomes & Co., Ltd., J. A.—Holders for thermionic valves, lamps, &c. April 28th.

11497. Crewdson, E.—High-tension electric switches. April 28th.

11462. D. A. S. H. Wireless Service.—Hertzian wave detector. April 28th.

11521. Dawson, R. H. N.—Controlling circuits of thermionic valves, &c. April 28th.

11522. Dawson, R. H. N.—Tuning-devices for radio telephony, &c. April 28th.

11300. Day, W. J.—Crystal-holders for wireless receivers. April 26th.

11218. Dubilier, W.—Electric condensers. April 25th. (United States, October 25th, 1922.)

11410. Eastick, J. C. N.—Electric knife switch. April 27th.

11285. Edgeworth, K. E.—Supply of power to wireless transmitters. April 26th.

11208. Edison-Swan Electric Co., Ltd.—Thermionic devices. April 25th.

11097. Elwell, Ltd., C. F.—Wireless receiving-devices. April 24th.

11518. Ferguson, Pailin, Ltd.—Electric switches. April 28th.

11518. Ferguson, S.—Electric switches. April 28th.

11924. Fisher, W.—Electric storage batteries, &c. April 23rd.

11208. Freedman, P.—Thermionic devices. April 25th.

11026. Gaydon, H. A.—Variable gridleaks. April 23rd.

11448. Gaydon, H. A.—Plugs, &c., for electric batteries, &c. April 27th.

10987. General Electric Co., Ltd.—Combined electric switch and plug connectors. April 23rd.

11083. Gleason, L. R.—Adjusting-devices for wireless instruments. April 24th.

11440. Graham, E. A.—Cabinets, &c., with aerial systems for wireless reception. April 27th.

11292. Gramostyles, Ltd.—Detectors for wireless instruments, &c. April 26th.

11208. Greetham, E.—Thermionic devices April 25th.

10939. Hubble, H. — Electric switches. April 23rd.

11411. Igranic Electric Co., Ltd. — Switches and adjustment devices. April 27th.

11066. Jarvis, W. A.—Time-setting device for controlling maintenance of an electric circuit for a variable period. April 24th.

11292. Jenkinson, H.—Detectors for wireless instruments, &c. April 26th.

11354. McLennan, D.—Telephone receivers. April 27th.

11294. M. L. Magneto Syndicate, Ltd.—Transformation of electrical energy. April 26th.

11117. Morley, G. A.—Electric primary batteries, &c. April 24th.

11118. Morley, G. A.—Apparatus for testing batteries, &c. April 24th.

11244. Naamlooze Vennootschap Philips Gloeilampenfabrieken. Electric discharge tubes. April 25th. (Holland, October 21st. 1922.)

11462. Onions, A. H.—Hertzian wave detector. April 28th.

11518. Pailin, G. — Electric switches. April 28th.

11050. Parsons, A.—Insulator for wireless aerials. April 24th.

11300. Pattenden, A. L.—Crystal-holders for wireless receivers. April 26th.

11093. Pepper, D. — Electric batteries. April 24th.

11135. Powell, J. E. G.—Telephone receiving instruments. April 24th.

11199. Preen, A.—Crystal detector. April 25th.

11200. Preen, A.—Condenser for wireless receiving-sets. April 25th.

11210. Richardson, P.—Aerials for wireless installations. April 25th.

11449. Ricketts, W. J.—Cabinets, &c., with aerial systems for wireless reception. April 27th.

11043. Robins, Chapman, & Co.—Valve-protector for circuits employing thermionic valves, &c. April 24th.

11043. Robins, E. T.—Valve-protector for circuits employing thermionic valves, &c. April 24th.

11408. Robinson, E. Y.—Electric vacuum tube devices, &c. April 27th.

11204. Rogers, A.—Coil-holders for wireless, &c., instruments. April 25th.

11140. Rojas, F. A.—Rheostat. April 24th.

11112. Schweitzer & Conrad, Inc.—Circuit-controlling devices. April 24th.

11439. Scintilla.—High-voltage connexion device. April 27th. (Germany, June 16th, 1922.)

11428. Sharp, T. B.—Wireless telegraphy, &c. April 27th.

11056. Shortt, J. A.—Variable resistance for wireless telephony. April 24th.

11370. Simmons, B. R.—Crystal-holder for wireless systems. April 27th.

11309. Thomson, R. W. M.—Electrical contacts. April 26th.

11123. Twine, L. H. G.—Receivers for wireless telephony, &c. April 24th.

11137. Waller, P. H.—Electric trip switch devices. April 24th.

11294. Watson, E. A.—Transformation of electrical energy. April 26th.

10969. Western Electric Co., Inc.—Signalling systems. April 23rd.

11097. Wilson, K.—Wireless receiving-devices. April 24th.

11521. Woodroffe, F. K.—Controlling circuits of thermionic valves, &c. April 28th.

11522. Woodroffe, F. K.—Tuning-devices for radio telephony, &c. April 28th.

11411. Wright, S. R.—Switches and adjustment devices. April 27th.

11513. Young, A. P.—Sound-emitting, &c., instruments. April 28th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

(Copies of the full specifications, when printed, may be obtained from Mr. Gee, post free on payment of the official price of 1s. each.)

194341. Bardt, H.—The electrolyte of a storage battery consists of a solution of the perchlorate of the metal forming the active material, the support for the active material consisting of a metal or alloy such as ferro-silicon, which is inert with respect to the electrolyte. The electrolyte consists of a solution of lead perchlorate of a concentration corresponding to 40 per cent. of metallic lead. October 10th, 1921.

194365. Dornig, W.—An aerial of the horizontal loop type, wherein the capacity be tween the aerial and earth is not utilised, comprises a single loop of a width equal to substantially half the wavelength, and with its ends connected to a source of oscillations or to a receiving apparatus. The loop may be provided with equally distributed tuning condensers. Waves of different lengths may be transmitted or re-

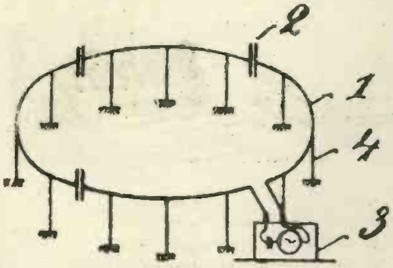


Fig. 1.—Illustrating Patent No. 194365.

ceived simultaneously by providing a separate loop for each wavelength, and these loops may be arranged concentrically. December 5th, 1921.

194378. McLachlan, N. W. and Langridge, A. W.—The receiving circuit of wireless receiving-apparatus contains a direct-current relay or recorder arranged so as to be shielded from alternating currents. December 7th, 1921.

194424. Sykes, A. F.—Consists mainly in the provision in sound-recording apparatus, as claimed in the parent Specification No. 160223, of an intervalve transformer comprising, in addition to the usual windings, a tertiary winding forming part of a circuit containing resistance, inductance, or capacity, or combinations thereof. Such a transformer, which is of the kind described in Specification 190840, can be used in place of the inductance, resistance, and condenser distorting-devices described in the parent Specification. A further feature of the invention consists in the use of specially designed recording sound-boxes of the moving-coil type. December 16th, 1921. (Cognate application No. 25141/22. Addition to 160223.)

194459. Voigt, P. G. A. H.—Relates to circuit arrangements in thermionic detectors and relays which permit of simultaneous high- and low-frequency amplification, and consists in an attachment for back-coupling a low-frequency valve to a high-frequency amplifier. January 10th, 1922.

194480. Gates, P. J.—A system for charging a number of accumulators of varying sizes comprises a main source of supply, a main accumulator normally in series with the accumulators to be charged, variable resistances in the circuit of each accumulator, means for varying the number of cells in the main accumulator, a voltmeter and an ammeter adapted to be placed across and in series with the accumulators respectively, and switching means whereby the main accumulator may be employed to charge the smaller accumulators when the main source is disconnected. January 25th, 1922. (Cognate application 23823/22.)

194510. Brown, S. G.—An expanding sound horn for use, for example, in a gramophone or in a loud-speaking telephone receiver, comprises a base portion cast in aluminium or other light metal or alloy, and a bell mouth of spun sheet metal secured to the casting, for example, by rivets. The horn is provided with one or more holes arranged at distances of one-half, one-quarter, one-eighth, &c., of the length of the horn from the narrow end, in order to relieve nodal pressure at these points, and so prevent the formation of stationary waves in the horn. February 10th, 1922.

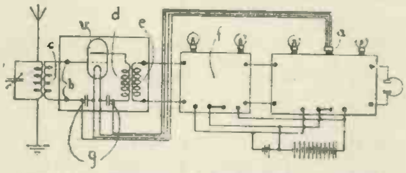


Fig. 2.—Illustrating Patent No. 195459.

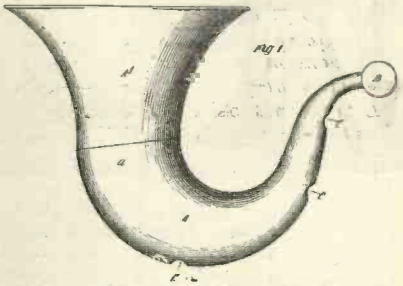


Fig. 3.—Illustrating Patent No. 194510.

194574. Chloride Electrical Storage Co., Ltd.—A storage battery electrode consists of a frame surrounding parallel diagonally arranged bars directed towards the corner of the electrode carrying the terminal post. Horizontal bars disposed alternately on opposite sides of the electrode are provided to retain the active material during the forming process, but they are sufficiently thin to be destroyed by chemical action when the electrode is in use in the battery. April 13th, 1922.

194595. Frost, S. G.—A fusible element is connected inside the bulb of a thermionic valve or other vacuum tube between one or more electrodes or an internal member and an external circuit, so that the electrodes or other part may be heated by passage of current during exhaustion of the bulb, the fuse being afterwards blown by increasing the current. May 19th, 1922.

AN IMPORTANT ANNOUNCEMENT

It is with great pleasure that we are able to announce that Mr. Percy W. Harris, a former Editor of the "WIRELESS WORLD," and more recently Editor of "CONQUEST," will join the staff of "WIRELESS WEEKLY" and "MODERN WIRELESS," as from the 1st June.

Mr. Harris is the author of "A.B.C. of Wireless," "Broadcast Receivers and How to Use Them," "Practical Wireless Sets for All," "Crystal Receivers for Broadcast Reception," and other works. His name has become a household word amongst all experimenters, and his services will henceforth be at the disposal of the 100,000 readers of "WIRELESS WEEKLY" and "MODERN WIRELESS."

As publishers, we have done everything possible to strengthen our organisation. It is only because we are the largest publishing house devoted solely to wireless interests, that we have been able to gather together the principal writers in the country. We want our readers to realise that here, at Devereux Court, all the energy, skill and experience of a strong editorial staff are being placed at their disposal. Our whole efforts are directed to producing thoroughly reliable, up-to-date and instructive wireless information. The reputation of the Radio Press Ltd., and also of its individual members, depends solely on our wireless publications.

The boom in wireless has tempted general publishers, without any experience whatsoever of wireless, to launch out into the new field. It is our intention, for the benefit of new readers, to point out periodically the advantages of buying publications which bear the hall mark of authority. Only by our having a strong editorial staff can readers feel that confidence which is so essential. Perhaps a little more has to be paid for the privilege, but it is well worth while. In welcoming Mr. Harris, we can say, on his behalf, that it is his intention to uphold and enhance the reputation which Radio Press Ltd. possesses amongst those interested in wireless in this country.

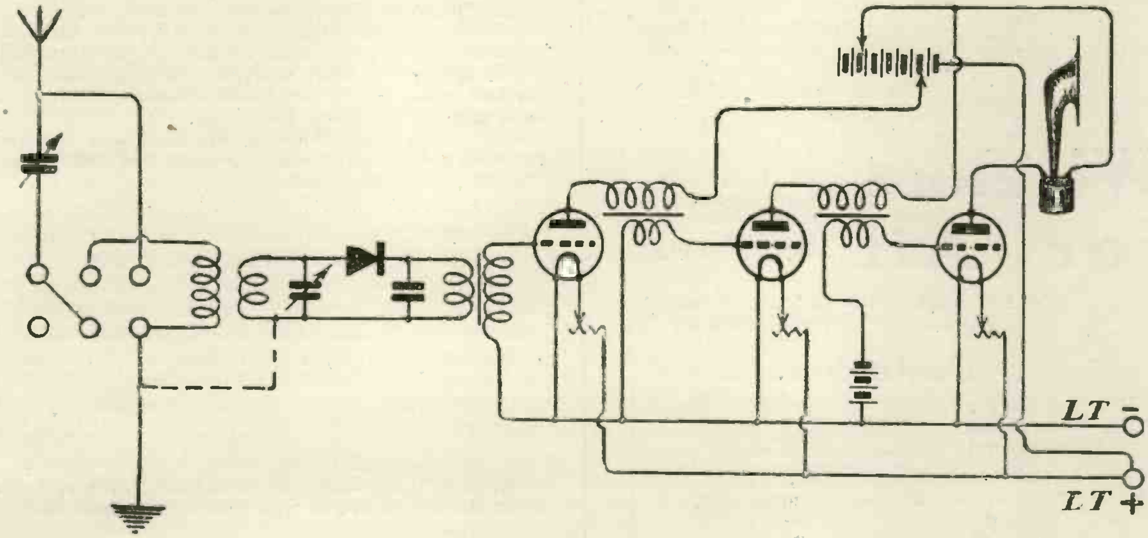
Information Department

Conducted by J. H. T. ROBERTS, D.Sc. (F.Inst.P.), assisted by A. L. M. DOUGLAS

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

W. B. (BEESTON) asks for a circuit showing a crystal rectifier and a three-stage low-frequency amplifier, the last valve being used for power amplification.

We reproduce herewith a circuit diagram of the type you require, as we have had a number of enquiries for the same arrangement.



H. E. O'S. (CHELSEA) is making up the variometer crystal receiver described in "MODERN WIRELESS," No. 2, but does not know whether to use high-resistance telephones or low-resistance telephones with a transformer. Some have advised him to use one, some the other.

High-resistance telephones will probably give you slightly better results than low-resistance 'phones used with a transformer, although there is not the loss in efficiency that is generally thought to be the case when a transformer is used, and it will always be useful when you add valves as you evidently propose to do for amplification purposes.

W. H. G. (CLAPHAM ROAD, S.W.8) has a four-valve receiver in which the rectifier is a very soft valve, and finds that he is unable to raise the anode voltage to the necessary value for satisfactory working of the low-frequency valves, which are hard. He asks our advice.

The particular make of valve you mention is satisfied with about 24 to 30 volts on the plate, and therefore becomes readily saturated. You should use a separate high-tension battery for your detector valve, otherwise your low-frequency valves are working too far down the lower bend of their characteristics. Your circuit diagram is correct.

"LOUD-SPEAKER" (TAUNTON) asks whether it would be a practicable proposition to have an aerial consisting of three parallel wires, with some device so that he could put into circuit either one, two or three wires according to the wavelength he wishes to receive.

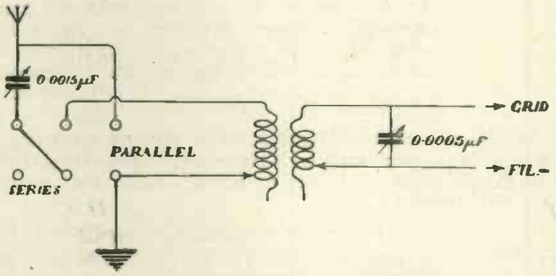
The arrangement you suggest could not be conveniently used, and would not as a matter of fact vary the wavelength in the manner you imagine it would.

J. H. (MAIDA VALE) asks for particulars of a three- or four-valve receiver.

See *Wireless Weekly*, Vol. 1, No. 3.

H. W. (BOOTHAM, YORKS) proposes to wind two formers each 4in. long by 3½in. diameter with Litz wire, a sample of which he encloses, to cover a wavelength between 100 and 800 metres. He wishes to know the necessary number of turns.

Each tube will require to be wound for its entire length with the wire you submit. Ten tappings should be taken from each tube at equal intervals so that the wavelength may be accurately adjusted. We do not think you will get very satisfactory coupling by mounting them in the manner suggested; it would be much better if you made one tube sufficiently small to slide inside the other one, as there will not be sufficiently tight coupling upon the lowest wavelengths. The wiring of a series-parallel switch is given herewith.



E. M. L. (WANDSWORTH) asks (1) whether a high-frequency transformer wound on a 1¼in. diameter ebonite former with 250 turns tapped at certain points, would be suitable to cover a range from 300 to 3,000 metres. (2) He has found basket coils to be the most efficient form of inductance for tuning purposes. He asks if this should be so. (3) Whether the thickness of former on which the baskets are wound has any bearing on the inductance value.

(1) If your transformer has eight slots, you should wind 100 turns in the first two slots and 200 turns in each of the others. The primary and secondary should be wound in alternate slots. Tappings may then be taken from both primary and secondary, when you will find this transformer will cover the range required. (2) Basket coils are very efficient as inductances in oscillatory circuits. (3) The thickness of former has little or no bearing on the inductance value.

W. B. (AMERSHAM) refers to the 3-valve panel in No. 2 of "MODERN WIRELESS," and asks what is necessary to make this into a complete receiver.

A tuning coil stand with holders for aerial and secondary circuit coils will be necessary, and two variable condensers to tune the circuits. For the reception of Broadcasting the coils might have fifty and seventy-five turns respectively, and the aerial tuning condenser (which should be in series) might have a value of 0.0015 μF, the secondary circuit condenser (which is in parallel) having a value of 0.0005 μF.

A. E. H. wishes to know what kind of valve amplifier would be necessary for the reception of all the British Broadcasting and Continental telephony when used with an inductively coupled crystal receiver.

Two high-frequency valves will render the telephony audible, and one or two note-magnifiers might be added if loud-speaker signals are desired. The alternative sizes of tubes you mention are quite suitable.

E. M. (GROSVENOR ROAD, N.5) sends us a sketch of a loud-speaker which he has constructed, but from which he does not obtain satisfactory results.

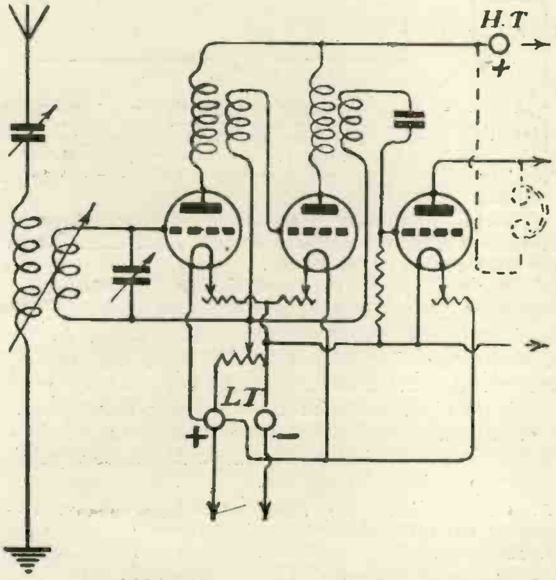
It is evident that the method of mounting the ear-piece is not satisfacory. Your diaphragm is much too large and will rattle at the slightest provocation, and your trumpet is incorrectly shaped. We do not think that even with great care you would be able to obtain very good results from a loud-speaker extemporised from a tobacco tin.

H. W. T. (CHESHIRE) asks questions about a loud-speaker which he wishes to construct. He has facilities for metal turning and so forth at his disposal.

We are shortly publishing an article on this subject.

H. K. (FOREST GATE) asks for the connections of a high-frequency panel, embodying a suitable tuner.

We reproduce herewith a circuit diagram showing the arrangement you require. It is impossible to predict the range of your set accurately, but it should be at least 200 miles for Broadcasting.



W. B. M. (ST. LEONARDS) asks questions about interference likely to be caused by neighbouring tramcars.

We do not think that at the distance you are from the tramlines you will experience any trouble.

W. R. B. (ENFIELD LOCK) is using a dual amplification circuit as described in "MODERN WIRELESS," and asks whether certain alterations would be advantageous.

We do not recommend alterations from the design of this instrument, upon which a considerable amount of experimental work has already been done.

T. L. (FINSBURY PARK) asks questions about a dual amplification circuit.

See reply to "W. R. B." (Enfield Lock).

W. T. (SHEPHERD'S BUSH) asks with reference to circuit ST 45 how coils should be constructed to cover a wavelength range of from 200 to 3,000 metres.

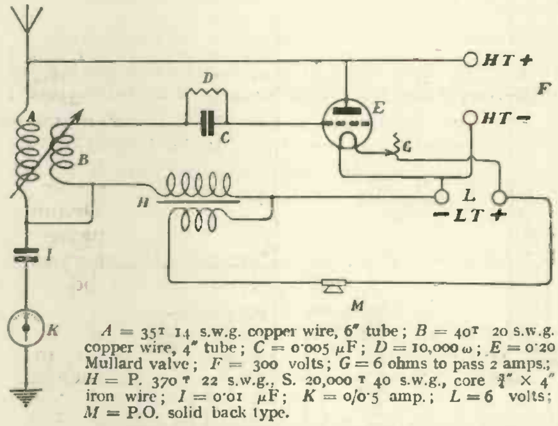
If you propose to wind basket coils and your former has an external diameter of 2in., with 27 spokes, you will require a series of coils having the following numbers of turns :—35, 60, 90, 130, 200, 260.

J. B. J. (WEST HAMPSTEAD) asks questions about certain commercial apparatus.

It is obviously impossible for us to give a recommendation of any particular firm's products in these columns. A question like this should be taken up with the manufacturers direct.

R. T. G. (NEW CROSS, S.E.14) asks for a diagram of a telephony transmitter with one valve which gives good control.

We submit herewith a suitable circuit diagram giving you the necessary values for inductances, condensers, etc.



A = 35T 14 s.w.g. copper wire, 6" tube; *B* = 40T 20 s.w.g. copper wire, 4" tube; *C* = 0·005 μF; *D* = 10,000 ω; *E* = 0·20 Mullard valve; *F* = 300 volts; *G* = 6 ohms to pass 2 amps.; *H* = P. 370 T 22 s.w.g., S. 20,000 T 40 s.w.g., core ¾" × 4" iron wire; *I* = 0·01 μF; *K* = 0/0·5 amp.; *L* = 6 volts; *M* = P.O. solid back type.

W. H. T. proposes to make variable condensers out of brass tubes sliding inside each other, and asks the necessary sizes, etc.

We are afraid it is not a practicable composition to make variable condensers of the large capacity you would require from brass tubes. You would do far better by adopting the standard type of moving vane variable condenser. With reference to your second question, notes on the operation of valve receivers appear from time to time in *Modern Wireless* and *Wireless Weekly*, which will form the best guide for the operation of your set.

J. C. (GLASGOW) asks questions about the winding of inductances.

No. 22 s.w.g. wire is preferable to No. 27, although at your distance from 5SC you would possibly not notice any difference. In order to obtain sufficient selectivity, the inner tube should slide at least 4in. away from the outer one. The sensitiveness of this type of tuner increases as the diameter of the tube becomes smaller, therefore it is an advantage to adhere to the original dimensions, and not shorten the tube and increase the diameter. The secondary winding must, of course, be able to go right inside the primary winding.

T. H. C. wishes to know of a book which will give him full constructional details for building a good set for general reception of Broadcasting.

" How to make a Unit Wireless Receiver," by E. Redpath (Radio Press, Limited), will give you full constructional details.

D. L. J. (CARDIFF) wishes to know what material to use for preserving wooden poles used for aerial and mast erection and where to obtain it.

We think that any manufacturer of varnishes and paints for woodwork would be able to supply you with a satisfactory substance for this purpose. You should, however, obtain sufficient protection by simply painting the poles.

E. B. C. (WEYMOUTH) has constructed a valve set on which he is unable to hear any British Broadcasting. He submits particulars of his duolateral coil which he has himself made, and asks our advice.

For the reception of British broadcasting the aerial tuning inductance should have 50 turns of No. 26 d.c.c. wire, the secondary 75 turns of No. 26 d.c.c., and reaction is not permitted. The aerial circuit condenser would be in parallel with this coil. You will probably obtain satisfactory results from the addition of one high-frequency valve, and we would recommend you to add this, as shown in Circuit ST 32 "Practical Wireless Valve Circuits," Radio Press, Limited. Your circuit diagram is correct.

T. C. T. (LONDON, S.W.16) asks with reference to a circuit shown on page 284 of No. 4 "MODERN WIRELESS," whether he can use two basket coils in place of the inductance L_1. He also wishes to know what is meant by detuning the circuit L_2 C_2.

The basket coils you have if of suitable size will be just as efficient as the inductance L_1. Detuning the circuit L_2 C_2 means that the high-frequency amplifier is not strictly in resonance with the oscillatory circuit. This arrangement will give good results.

T. T. F. (YOKER) refers to a 4-valve circuit in "MODERN WIRELESS," and wishes to know whether he can add a loading coil to tune to 1,800 metres.

If plug-in coils are used, there will be no necessity to insert a loading coil as the plug-in coil can easily be selected to have a sufficient inductance value to cover the range you mention. No alterations to the wiring would therefore be necessary.

J. N. (EDINBURGH) sends us a circuit diagram of his apparatus, and asks for the size of certain coils.

	A.E.	D.C.	T.A.	Re.
Broadcasting ...	75	50	75	75
The Hague ...	100	150	150	50
Radiola	150	200	200	50
Paris	250	300	300	100

If three coils only were used, the A.E. coil would remain the same, and the others might be one size less in each case.

W. W. asks certain questions.

(1) With reference to the tapped inductance you mention, the merits of the different types of connection suggested are equal. (2) The terminal you refer to is useful for experimental purposes, but has no application to the design of the set you propose to use.

J. R. T. (BOURNEMOUTH) asks (1) whether a variable condenser of 0.001 μF capacity across an inductance which he proposes to use as a tuned anode circuit is too large. (2) Whether a certain condenser is of use.

(1) The value you mention is much too high. This condenser might be not larger than 0.0003 μF. (2) The condenser referred to sometimes improves the clarity of speech and music, but is not absolutely essential.

Your Aerial!

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[Photo by Swain.
Mr. Andrew Shanks as The Count in "Figaro"
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Wireless Weekly

and The Wireless Constructor

No. 8

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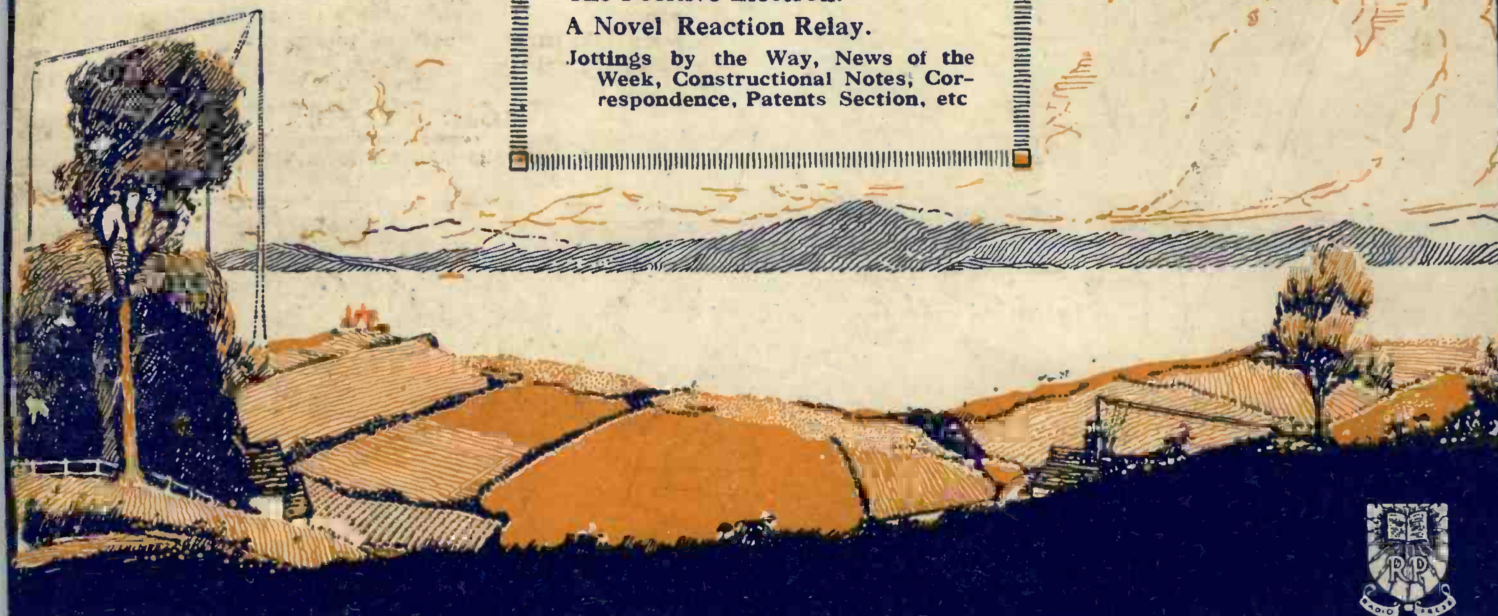

The New Flewelling Super-receiver

Are you a "Pirate"?

—the P.M.G. makes a start with the re-issuing of Experimenters' Licences.

A T last, after many delays, a large number of Experimenters' Licences are again being issued. If you have built your own Set and have not been able to obtain a Licence, we advise you to apply again. However, it is necessary for you to have sufficient wireless knowledge to meet the P.M.G's. requirements, therefore, to help all those who have previously been disappointed in getting this licence, we have prepared this new book.

This is what the P.M.G. said

"In order to ascertain my position I felt it my duty to place the whole facts before the Law Officers of the Crown, and I have just received the opinions of the Attorney-General and the Solicitor-General.
These are that I am not only entitled, but compelled by law to issue an experimenter's licence to those applicants in regard to whom I am honestly satisfied that they are genuine experimenters.
This being so, while it would be wrong to issue an experimenter's licence to the man who is obviously merely a broadcast listener-in, it would be equally wrong to decline to issue such licences on a wholesale scale."

To a Representative of the Press.

Radio Press Series No. 11

Wireless Licences

and how to obtain them.

By E. REDPATH (*Assistant Editor of "Wireless Weekly"*).

Many keen amateurs — whilst possessing the requisite amount of wireless knowledge—have had their applications turned down because they did not conform to the Post Office requirements. If you get this Book you will find the whole question of Licences fully explained. Buy a copy to-day—an Experimenter's Licence will give you much greater freedom than a Constructor's Licence (even if the latter is issued) and your position is legalised once and for always.

Radio Press, Ltd.
PUBLISHERS OF AUTHORITATIVE WIRELESS LITERATURE
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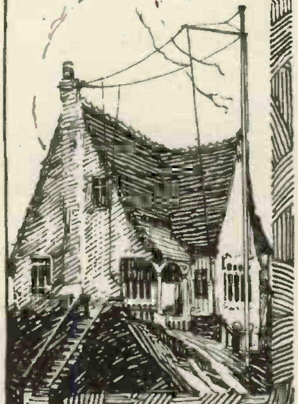

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Scientific Adviser: Prof. G. W. O. Howe, D.Sc., M.I.E.E.
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RADIO PRESS

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The Broadcasting Committee

ELSEWHERE in this issue we give a *portion* of the evidence submitted to the special Committee now sitting to investigate the whole position of broadcasting. Whilst it is no doubt very desirable that the whole position should be thoroughly investigated, it will be apparent that the mass of evidence is likely to assume such proportions as to cause considerable delay in the announcement of a decision.

At this juncture, delay should be avoided at all costs. There is no necessity whatever to hold up everything until all aspects of the case are settled. Let us have an interim report from the Committee.

The Licence Question

Let us at any rate have an announcement with regard to the licence question. For a long time now applications for licences have simply been pigeon-holed by the Post Office Authorities.

Recently, however, the accumulated applications, numbering over 30,000, have been carefully examined and classified by a special staff of sixteen Post Office wireless experts brought to London from all parts of the country for the purpose.

Applicants who have established a reasonable claim are to be granted Experimental Licences with as little delay as possible. Whilst this is certainly a step in the right direction, the claims of the thousands of applicants who desire to use home-made receiving apparatus for the reception of broadcasting are held in abeyance pending a decision of the Committee.

Here, then, is one item which the Committee should dispose of immediately. An interim report and a recommendation with regard to the Constructor's Licence is urgently needed.

Reaction

We publish in this issue a full account of a most interesting interview with an American Authority on Broadcasting. Although we are naturally very pleased to be told that the British plans are sound, we must remember that it is probably better to have rapid development and risk a certain amount of "chaos" than to deliberately restrict progress in fear of producing chaos—a fear which, after all, is probably exaggerated.

The real danger lies in the unskilful, and sometimes we fear unscrupulous, use of valve receiving sets provided with reaction. We seriously doubt whether regulations can be effectively applied to prevent this nuisance, and consider the best remedy to be the dissemination of accurate information.

We know of cases where the use of reaction is avoided altogether rather than risk causing interference.

The unscrupulous person, when detected, may be reported and may even lose his licence, but this would not prevent him using apparatus with an indoor aerial and, possibly in a mistaken spirit of revenge, causing more interference than ever.

No! Instruction with logical argument is the better method, and in this connection the Radio Societies of the country can do good work. We have done, and will continue to do, our utmost to show the fallacy of receiving loud and raucous noises, which can never by any stretch of imagination be termed music, upon a self-oscillating receiving set and at the same time spoiling the enjoyment of neighbouring listeners.

The fundamental principle of freedom, particularly applicable to the freedom of the ether, is respect for the rights and privileges of others.

AERIAL RIGGING AND MAST BUILDING

By F. H. PHILPOTT.

Practical information of particular value to all who have not yet erected an aerial.

BY way of a foreword to an article under the above title, it may not be out of place to emphasise the advantages gained by having a really good aerial.

Most wireless amateurs know the man who gets the Dutch concert in a loud-speaker with a crystal and a frame aerial. He is a familiar figure at all Radio Clubs, and has nothing to learn from the writer. Nevertheless, it is unquestionable that had he used an outdoor aerial his results would have been even more wonderful; he might, in fact, even have dispensed with his crystal!

If asked to decide between adding a high-frequency stage to a set or doubling the height of the aerial, which is now 20ft., I should unhesitatingly advise the latter.

There are probably those who will question this opinion, which is based entirely on experience, and probably has no foundation in theory, but I maintain that the trouble taken in erecting a good aerial is well repaid by increased range and volume of signals, even with the best or most expensive set; furthermore, in cases where the set is not yet installed and an indoor aerial is contemplated, time spent on the building and erection of a mast could be actually paid for in cash by the saving in the cost of the set for equal results.

There may be a few cases where it is practically impossible to have a broadcasting receiver with an outdoor aerial, but they are extremely rare. The writer has not yet seen one, as there are very few combinations of difficulties that cannot be overcome by two pairs of hands, common sense, and patience, and it is hoped that by discussing typical cases the reader's own particular trouble will be dealt with.

To begin with, it is a comparatively easy and inexpensive matter for any amateur, particularly the "handy-man" type, to build a 45ft. mast in sections, which he can, under fair conditions, erect *alone*, except for, say, half an hour at a critical stage, when an assistant (or possibly two) may be necessary. The two helpers might easily be his wife and daughter.

This may sound a "tall order," but it has been done by the writer on more than one occasion, and it is by no means so difficult as it may at first appear.

The Materials Required.

The material and methods given herewith leave many alternatives, and are only intended as a guide to the amateur "rigger," who may exercise his ingenuity in using up some of the contents of his "junk-room."

Materials used by the writer were as follows:—

Two Government surplus signal poles, 16ft. × 2⅝in., tapering to 2in.
One 13ft. ditto, 1¾in. tapering to 1⅜in.
Steel sleeve for joints, 1ft. 6in. × 2⅝in.
 ,, ,, ,, 1ft. 6in. × 2in.
Galvanised pulley, "clothes-line size."
Galvanised wire for guys—
 10 gauge— 80ft.
 12 ,, —160ft.
 14 ,, —200ft.
(A method of reducing these quantities by one-third will be shown presently.)
90ft. of cord for halyard (Italian hemp is good but expensive).
Four wooden laths, approx. 8ft. × 1in. × ½in. (These made good spreaders, and if you are erecting a double aerial two more should be obtained.)
A few assorted nails and screws.

Some form of anchorage will be required, but this item will vary with circumstances, and will be described when discussing erection. The same remark applies to tackle, such as boards, a rope, etc., that will be temporarily required during erection, but can be returned undamaged when the job is complete.

With the exception of the steel sleeves, no difficulty should be experienced in obtaining the material locally. Any tinsmith would make an efficient substitute for the steel sleeves from 18 or 20 gauge sheet iron, either "lapped and flush rivetted" or with a "grooved seam." (The tradesman will understand these expressions even if the reader does not, and they are only given because the tinsmith will probably ask which is required.)

The signal poles, which are octagonal in section, are ideal for the purpose, but any good straight poles of approximately same dimensions would serve.

Straight-grained selected pine of square section which has been selected for aeroplane spars is sometimes obtainable, and is quite

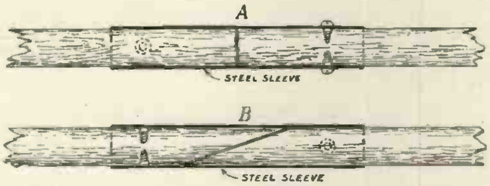


Fig. 1.—Showing how the poles should be cut.

suitable, but, of course, requires square sleeves, and is not, perhaps, of quite so good an appearance. Also these spars are not tapered, and the top section is for this reason unnecessarily heavy, and considerably increases any difficulties of erection.

Mast Construction

The first step in building the mast is to fit the two *thick* ends of the 16ft. poles into the larger of the two sockets. If necessary the pole should be shaved down to size with a spokeshave or pocket knife.

The ends of the poles should be cut square, as in Fig. 1, A, and *not* sloping, as at B. Some signal poles are cut in this way, but it is very undesirable for our purpose, as the pull of the guys, weight of the mast, etc., assisted by alternate expansion and contraction, tend to drive the wedge ends together so tightly that—particularly with a "tinker-made" sleeve—there is a possibility of the socket bursting and letting the mast down.

The poles should not fit too tightly in the sleeves, and care should be taken to see that the ends actually butt together, and that none of the weight of the mast is carried by the sockets. Also the poles should meet as nearly

Fig. 2—Mast base with laths fitted.

as possible in the middle of the sleeve (see Fig 1, A).

The 13ft. pole should then be fitted to one of the longer poles in the same way, using the smaller sleeve.

The two sleeves should then be secured to the two bottom sections by means of two, say, $\frac{1}{2}$in. screws through holes drilled in the sockets, as in Fig. 1, A.

Should you have no means of drilling the socket it may be prevented from slipping down out of place by a screw in the pole, placed below the socket. It should here be noted that it is of the utmost importance that the sleeves cannot slip away from the joints, as, should this happen at all, it would most probably be during erection, and there is the possibility of your bereaved family losing interest in wireless.

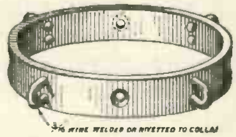


Fig. 3.—Ring for guy ropes.

It will by now be apparent that the base of the completed mast will be the *smaller* end of one of the 16ft. poles, and not, as might have been expected, one of the thick ends.

Almost the only objection to this is the somewhat "odd" appearance, and this is effectually overcome by nailing the four wooden laths on opposite sides of the pole at the base (Fig. 2).

This gives the mast the appearance of being heavier at the bottom, and if the laths are planed so as to be slightly thinner at the top than the bottom it is even more effective. In any case it completely camouflages the slight taper of the pole and imparts a finished workmanlike look to the mast.

Provision for Guy Ropes

The next step in building is to provide some means of attaching the guys and halyards to their proper sections in as neat and convenient a way as possible, consistent with safety. The one wrong way is to twist the wires round the poles and leave them with no additional security.

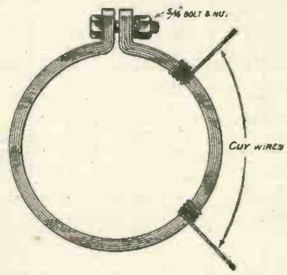


Fig. 4.—An alternative method of securing guy ropes.

The writer has used a ring, forged by a local blacksmith, of $\frac{1}{4}$in. × $\frac{3}{4}$in. iron bar, with $\frac{3}{16}$in. wire eyes riveted or welded in, as shown in Fig. 3. It is inexpensive and safe. Three of these collars are, of course, required, of $2\frac{5}{8}$in., 2in., and $1\frac{5}{8}$in. *internal* diameter. The smallest one should have an extra lug or eye for carrying the halyard pulley.

Holes should be drilled in the collars large enough to take ⅞in. or 1in. screws for attaching the collars to the poles.

Unless the collar is a particularly good fit the attaching screws will be taking the strain of the guys. They are, however, capable of doing this if properly secured. This type of collar must, of course, be fitted before the sleeves are fixed, as the guys should be attached immediately below the joint.

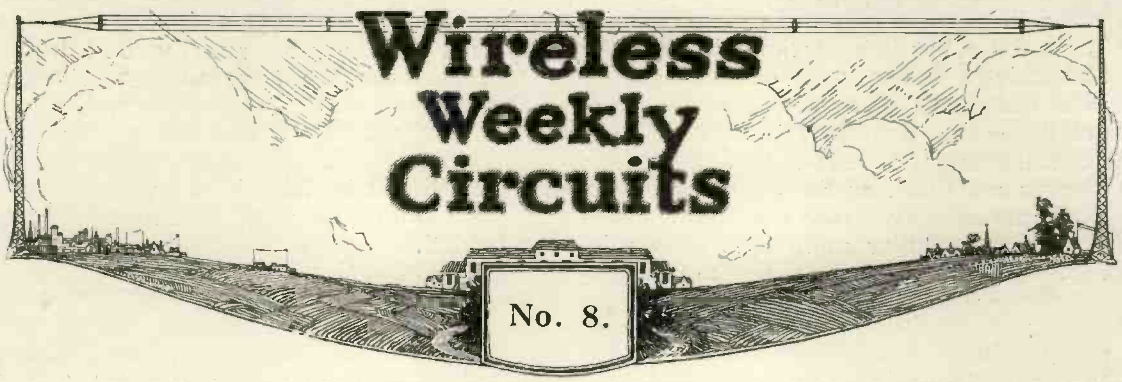
Another and similar method is shown in Fig. 4. In this case no lugs are necessary, as the guy wires can be given one or two turns round the ring as shown, the ring placed on the pole, and the bolt tightened up, securing the ring and guys together. No screws should be necessary.

By means of the free use of staples it is possible to bind the guy wires round the mast, but it is difficult to make a neat and safe job in this way, and it is not recommended.

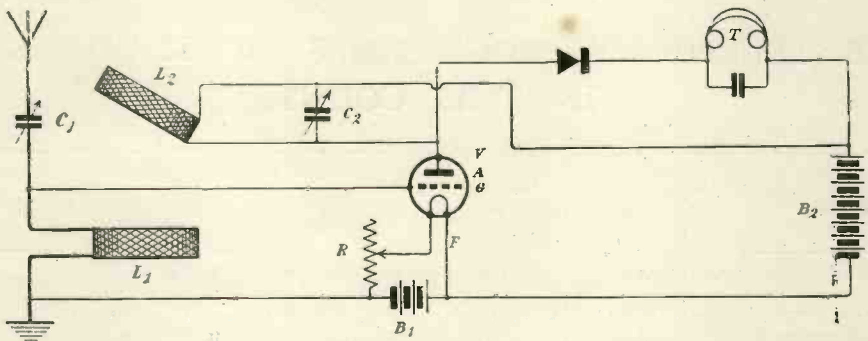
(To be continued.)

WIRELESS TELEPHONY PROGRAMMES OF STATIONS AUDIBLE IN THIS COUNTRY

Station.	Call Sign.	Wave-length (Metres).	Transmissions.
London Broadcasting Station	2 LO	369	11.30–12.30 every morning, 5–10.30 every evening, Concerts, News, etc. Sundays, 8.30–10.15
Newcastle Broadcasting Station	5 NO	400	Usually 6–10.30 p.m.
Manchester Broadcasting Station	2 ZY	385	10.30–11.30 a.m. Usually at 4–10 p.m.
Birmingham (Witton) Broadcasting Station	5 IT	420	10.30–11.30 a.m. Usually 4.30–10 p.m.
Glasgow Broadcasting Station	5 SC	415	10.30–11.30 a.m. 4.30–9 p.m.
Cardiff Broadcasting Station	5 WA	353	10.30 a.m.–11.30 a.m. 4.30–9.30 p.m.
Paris (Eiffel Tower)	FL	2,600	11.15 a.m., Weather Reports. 6.20–7 p.m., Weather Report and Concert. 10.10 p.m., Concert.
Königswusterhausen	LP	3,200	4–5.30 p.m. and at intervals during day.
The Hague	PCGG	1,085	3–5.40 p.m., Concert. 8.40–9.40 p.m. (Mons. and Thurs.), Concert. On Mondays Concerts are sometimes on 1,300 metres, notice given on previous Sunday.
Haren (Brussels)	OPVH	1,100	12 noon, Telephony. 4.50 p.m., Weather Report.
		900	11.20 a.m.–4.20 p.m., Miscellaneous.
Radio-Electrique, Paris		1,780	5.5 p.m., News. 5.15 p.m., Concert. 8.45 p.m., News. 9–10 p.m., Concert. 2–3 p.m. (Saturdays), Concert.
L'Ecole Supérieure des Postes, Télégraphes, et Téléphones de Paris		450	7.45–11 p.m. Daily. 4.30–7.30 p.m. Saturdays.
Belgium (Brussels)	BAV	1,300	6 p.m., Sun., Tues., Thurs.
Lyons	YN	3,100	10.45 a.m.–11.15 a.m. (Sundays excepted), Gramophone Records.
Amsterdam	PCA	1,800	Daily, 1.10 p.m.
Rome	ICD	3,200	10 a.m. and throughout day at intervals.
Bar Lightship, Liverpool		450	7 a.m., 9 a.m. and 11 a.m., 12 noon, 1 p.m., and every two hours until 9 p.m.
St Inglevert	AM	900	
Le Bourget	ZM	900	
Croydon	GED		
Castle Bromwich	GEC	900	Telephony communication with aeroplanes on main air lines.
Didsbury	GEM		
Lympne	GEG		
Renfrew	GER		
Pulham	GEP		
Cranwell	GEL		



A Reaction Circuit Using a Crystal Detector



COMPONENTS REQUIRED.

C_1 and
C_2 : Variable condensers having a maximum capacity of about 0.001 μF.
L_1 and
L_2 : Two honeycomb coils.
D : Crystal detector.
A fixed condenser, 0.002 μF.
T : High-resistance telephone receivers.
B_2 : High-tension battery.
B_1 : 6-volt accumulator.
V : Three-electrode valve.
R : Filament rheostat, of about 7 to 10 ohms resistance.
1 two- or three-way coil holder.
1 valve panel.

GENERAL NOTES.

Duo-lateral honeycomb or similar coils have many points to recommend them, and their chief merit is that they are so readily interchangeable. In this circuit high-frequency amplification is obtained, and also a reaction effect is employed to strengthen further the received signals. If the reaction between L_2 and L_1 is sufficiently great, the valve will oscillate and continuous waves may be received.

The variable condenser C_1 may be connected either in series with the coil L_1 or in parallel with it.

It is important to see that the connections to L_2 are the right way round. If the signals are not strengthened as L_2 is brought closer to L_1, even after slighter adjustments of C_1 and C_2, the connections to L_2 should be reversed.

VALUES OF COMPONENTS.

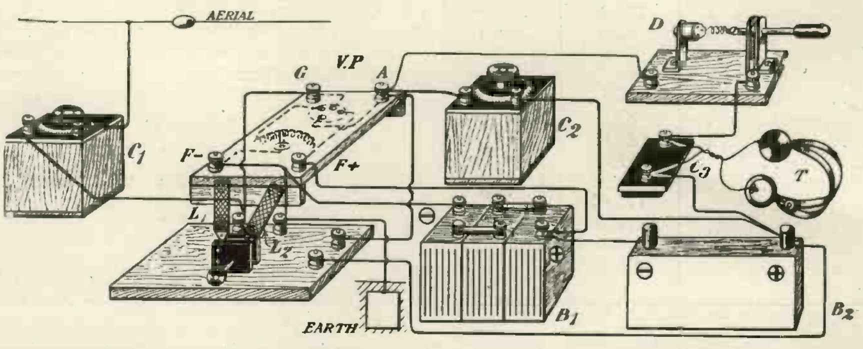
The only values not given in this circuit are those of the coils L_1 and L_2. It is not possible to state what coils should be used, as different makes have different values. The makers of these coils, however, will give any advice necessary.

NOTES ON OPERATION.

This circuit should be tuned in first with the coil L_2 a considerable distance away from L_1, the two condensers C_1 and C_2 being adjusted until the loudest signals are obtained. The coil L_2 is then brought closer to L_1 and the condenser is readjusted. This process is repeated until the loudest signals are obtained. If the coupling is too tight the valve will commence to oscillate of its own accord, and a rushing sound will be heard. The coupling should immediately be loosened.

When continuous waves are to be received, the coils should be kept tightly coupled.

It is to be noted that this circuit must not be used for the reception of British broadcasting, as reaction is introduced into the aerial circuit.



A NOVEL REACTION RELAY DEVICE

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.

This article deals with a form of reaction which has very rarely been used.

THE principle of the relay device about to be described is that variations of anode current in a three-electrode valve produce by direct mechanical means a smooth variation of the grid potential of the valve, this variation being in such a direction as to increase the effect taking place in the anode circuit.

In the accompanying figure a three-electrode valve V has connected in its anode circuit a high-tension battery H, and a galvanometer, or milliammeter, A. In the grid circuit we have two input terminals I N and a potentiometer, which consists of a liquid resistance R and a battery B. The liquid resistance may be a trough of mercury or of a dilute solution of copper sulphate. To the ends of the trough we have connected the poles of the battery B. If the terminals I N were bridged by a strap, and if we moved the contact S, which might be a wire dipping into the trough, the grid potential would vary. As the contact S was moved up the resistance R the grid would become more positive. This would cause an increase in the anode current flowing through the milliammeter A, and this would move the needle N of the milliammeter upwards so as to give a higher reading.

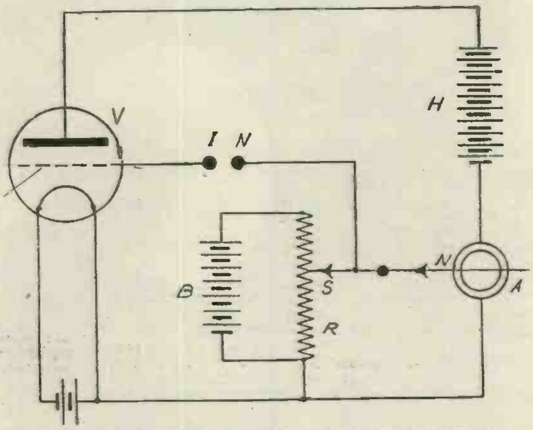


Fig. 1.—Illustrating the writer's Patent No. 172757.

In the present arrangement the end of the needle is connected by an insulating substance to the moving contact S. As the needle N moves upwards, so does the contact S, and this causes an increase in the positive potential applied to the grid of the valve. This in turn causes an increase in the anode current, and this causes the needle N to move upwards still more. This in turn causes a still greater positive potential to be applied to the grid, and so the process goes on until the contact S moves right to the top of the resistance R, and a maximum current is flowing through the ammeter A.

The input signals which will work this device need only be very minute. The slightest positive potential applied to the grid G will cause a slight movement of the needle of the milliammeter A, and the moment this moves a fraction of an inch the mechanical reaction effect sets in and the needle swings round almost instantaneously.

The only limits to the sensitivity of this arrangement are the sensitivity of the milliammeter itself and the inertia introduced by the wire dipping into the trough of liquid conductor R. The anode current variation must be sufficiently great to enable the milliammeter, or other delicate instrument, to move the wire through the liquid in the trough R.

To lessen the inertia effect the wire S should only just enter the surface of the liquid.

A practical disadvantage of the arrangement is the necessity for the liquid trough, but some of the most sensitive relay devices at present in practical use employ liquids, and there seems to be no real practical reason why the highly successful laboratory tests should not be reproduceable in the case of a commercial product.

Apart from its use as an amplifier, the arrangement described has possible uses as a low-frequency oscillator.

A COMPACT SINGLE VALVE RECEIVER

By ALAN L. M. DOUGLAS (Staff Editor).

This article describes a novel type of single valve set which may be used for the reception of British Broadcasting, and, by the introduction of a loading coil and a reaction coil, for Paris telephony.

THE following description of a single valve receiver which may be used for many purposes will be of interest to experimenters. A glance at the photograph Fig. 1 will show the general outlines of the instrument, while Fig. 2, which shows the back of the panel, will indicate how the components are placed. From this latter photograph the simplicity of the receiver will be evident, and the panel type of construction adopted will also be noticed. In the author's case this instrument was originally intended to fit into a wooden cabinet, but the design might be so modified as to allow of its being mounted vertically on brackets or incorporated in a unit receiving system if desired.

The first essential is the ebonite panel on which the apparatus is mounted, and this should measure 8in. by 6¼in. by ¼in. thick. If it can be obtained with the edges already rounded a great deal of trouble will be saved, but if the apparatus is going to be sunk flush into a wooden case it will not be necessary to do more than simply trim the edges off square.

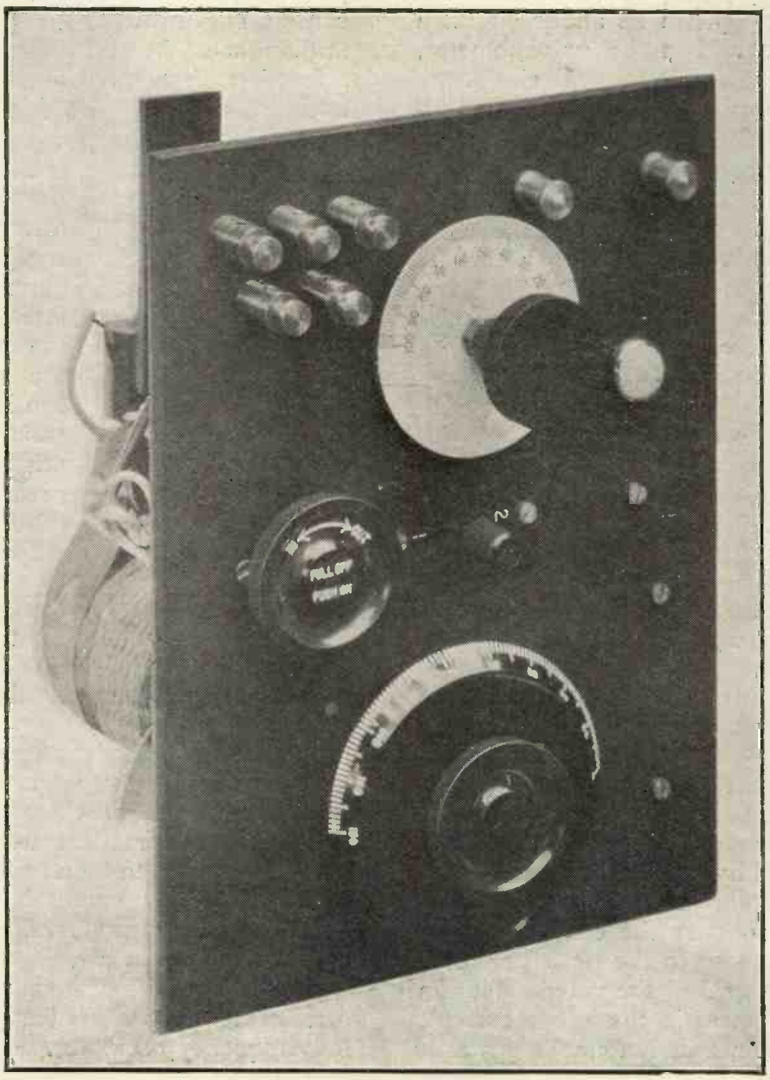


Fig. 1.—The front of panel.

The actual placing of the components, so far as a matter of ¼ of an inch one way or another is concerned, is not of great importance in this receiver, and therefore it has not been thought necessary to give an accurate drilling plan for the face of the instrument. It is only necessary to have three sizes of drills to complete the making of the apparatus, and this will appeal to the experimeter who has limited workshop facilities.

List of Materials

The actual materials and component parts required are as follows:—

1 ebonite panel 8in. by 6¼in. by ¼in. thick.

1 variometer, covering the British Broadcasting band of wavelengths.

1 multi - layer coil of low self-capacity having about 250 turns.

1 multi - layer coil of low self-capacity having about 150 or 100 turns.

1 Dewar switch, which should be of the five-pole double-throw pattern.

1 gridleak and

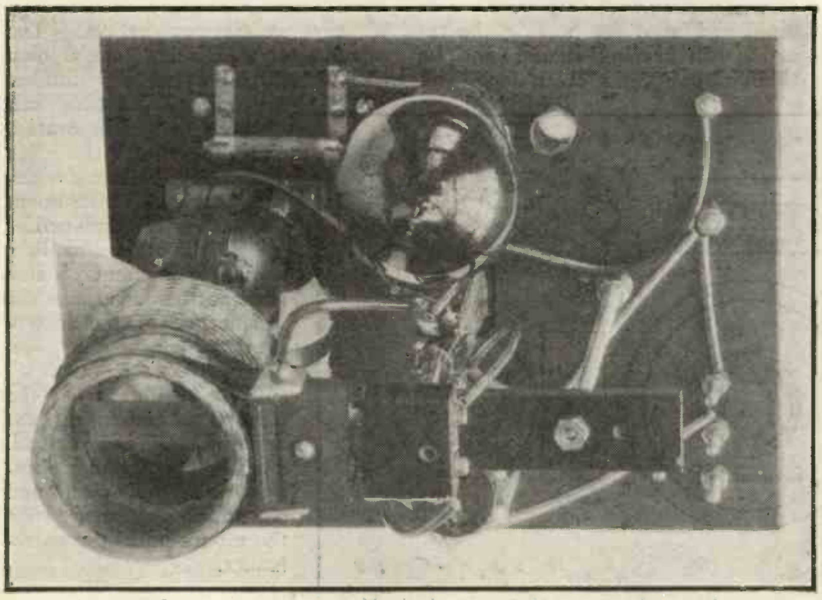


Fig. 2.—Showing back of panel.

condenser (which should be of a good make).

1 filament rheostat, and, if it is desired to mount the apparatus in a case, 1 valve window.

In addition to this there will be required :—

7 terminals, and the necessary screws, nuts, washers, etc., for completing the assembly of the instrument.

The sizes of drills necessary to complete the apparatus are :—

1 6B.A. (clearing).

1 ¼in. Whitworth.

1 $\frac{5}{16}$in. Whitworth.

The Variometer

As the variometer is the instrument with which the average experimenter is most concerned, he will possibly prefer to purchase one of the standard patterns now on the market, but if he wishes to make up his own, a suitable design for an efficient variometer appeared in *Modern Wireless* No. 2, page 143. The use of the variometer should be confined to the reception of short wavelengths, as there is no great advantage to be gained from such an instrument above a few hundred metres. The range of wavelengths aimed at should be in the neighbourhood of from 200 to 600 or 700 metres, as, if it is also possible to hear Morse signals with this receiver, they will form not only a useful method of adjusting the receiver to obtain the maximum sensitivity, but also of practising the code itself.

In this connection it is interesting to note that the only control over the signal strength in this instrument is provided by the filament rheostat. An examination of the photograph will show that this is of a special pattern, inasmuch as a switch is also incorporated in the circuit which is operated by pulling out or pushing in the rheostat knob. This pattern of rheostat is to be recommended where fine control of the oscillation point is required, as the very gradual movement of the resistance strip allows fine control of the reaction to be effected.

The variometer illustrated is of a commercial pattern which has proved to be exceptionally efficient, and which can be obtained from advertisers in the pages of this journal. It should be rigidly attached to the back of the panel by means of four No. 6B.A. screws, the ebonite base supplied with the instrument serving as a drilling template. This constitutes the method of adjusting the circuit for the Broadcasting band of wavelengths.

The Loading and Reaction Coils

The next step is the introduction of the loading coil, together with reaction, for the reception of Paris telephony. The circuit diagram Fig. 3 shows how this extra coil is connected in circuit electrically; a glance at the photograph Fig. 2 will show how it is actually attached mechanically. The coil used for loading the aerial circuit to the required wavelength was a honeycomb coil of the "Igranic" pattern. A multi-layer coil of the type described in *Modern Wireless* No. 4 might, however, be used with advantage, the only drawback being that its size would result in a rather bulky instrument. If the instructions given in *Modern Wire-*

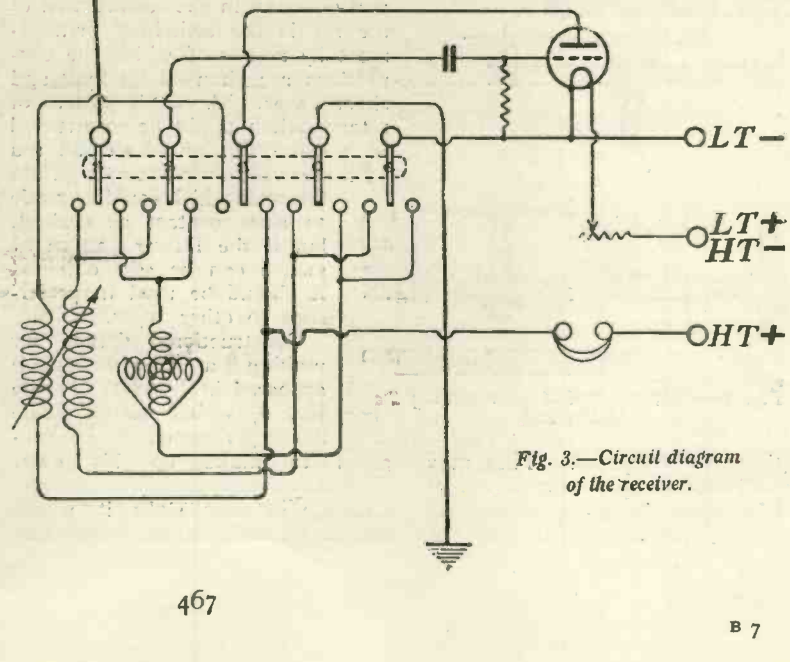


Fig. 3.—Circuit diagram of the receiver.

less No. 4 for winding these coils are closely followed out, and the gauge of wire is reduced in size, it would be possible to construct suitable coils. With some aerials a small variable parallel condenser (0.0003 μF) may be found necessary.

It will be observed that the reaction coil which swivels on a spindle controlled by a knob on the face of the panel, is fitted with a plug so that various sizes of interchangeable coils may be used. The object of this is to enable reaction to be effected with the smallest possible coil, thus obtaining the most delicate control over the speech.

Regarding the mounting of the control mechanism for this reaction coil, any convenient type of dial or scale and pointer might be used to indicate the degree of coupling. The arrangement used by the author is very satisfactory, as it is easy to read black figures on a white background, and a neat final appearance is presented. The mechanical arrangement of the reaction control spindles will be quite clear from the drawing. The friction necessary to lock the coil in any particular position is provided by a spring washer which is held in position by means of two lock nuts at the rear of the panel. These may be adjusted to give any degree of tension upon the spring washer so that the operating point may be varied to suit individual taste. The brass rod used for holding the reaction coil bracket should not be thinner than $\frac{3}{16}$ths of an inch, and may with advantage be $\frac{1}{4}$ of an inch in diameter.

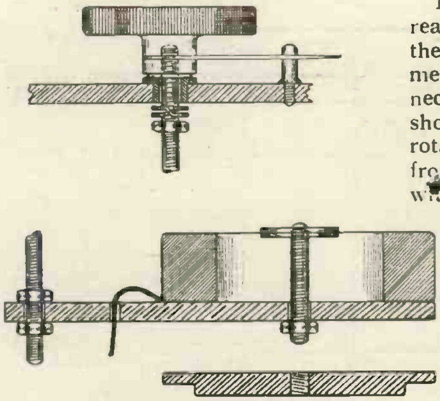


Fig. 4.—Showing method of mounting the reaction coil.

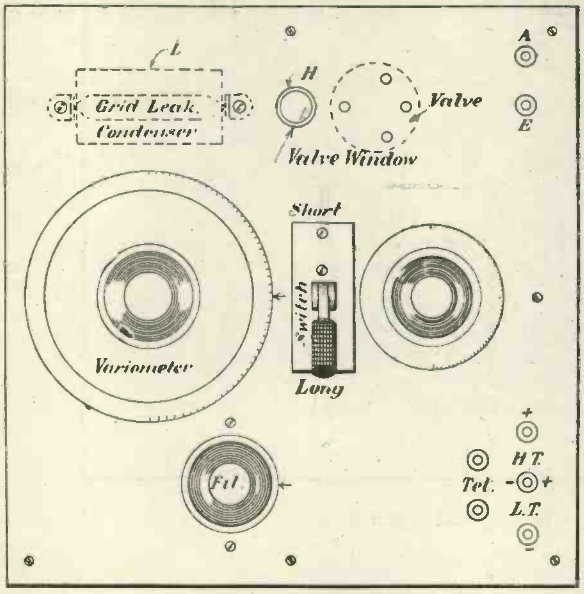


Fig. 5.—Plan of the panel.

The bracket used for mounting the reaction coil might be of any pattern which the experimenter found most convenient to construct, but some arrangement for readily disconnecting the reaction coil will be found useful.

Switching Arrangements

The only point presenting any real difficulty in the construction of the set is the switching arrangement by means of which the connections are changed for long and short waves. A simple pattern of rotary switch might be constructed from some 1in. round ebonite rod with screws inserted at appropriate intervals which could be made to close contact as desired, but if the Dewar pattern of switch can be still obtained it should be used in preference to other types.

Constructional details for making a Dewar switch appeared in *Wireless Weekly* No. 6, which should guide the experimenter if he proposes to make up his own. This is not really a difficult matter, although at first sight it would appear so, and nothing more than a little care is required to construct a very satisfactory article. The advantage of making one's own Dewar switch is that any number of contacts per side can readily be incorporated, and therefore the five double-pole switches necessary for this instrument can be easily combined.

The valve window is a small refinement which need not be added, but the appearance of the instrument is considerably improved if one is fitted.

Fig. 4 illustrates the method of mounting the reaction coil and control, and Figs. 5, 6 and 7 show the panel in plan and elevation, together with the mounting of the valve-holder.

Operation

In connection with the operation of this instrument, it should be noted that a rather hard valve seems to give the best results. This implies an "R" type valve, which may be obtained from any of the leading manufacturers. The high-tension battery should have a value of not less than 60 volts, and if the valve is sufficiently hard, up to 100 volts may be applied. A 6-volt accumulator must, of course, be used, and the telephones should be of high resistance, that is, not less than 2,000 ohms. In this connection it might be mentioned that it is very little use buying cheap

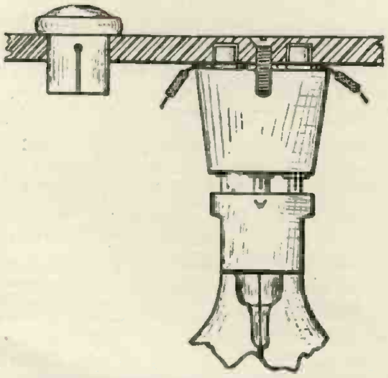


Fig. 6.—Method of mounting valve-holder.

(*Continued on page* 478.)

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART VIII

(Continued from No. 7, page 408.)

What are the Advantages of High-frequency Amplification ?

High-frequency amplification has two main advantages over low-frequency amplification. These are :—

(*a*) Better results are obtainable on high-frequency amplification when the initial signals are very weak.

(*b*) Nearly all methods of high-frequency amplification improve the selectivity of the receiver and enable the operator to tune out, more readily, interfering signals. This does not apply at all in the case of note magnification.

Explain How you Would Adapt High-frequency Amplification to a Crystal Receiver.

This is done by applying the potentials across the aerial inductance to the grid of a three-electrode valve. In the anode circuit of this valve is a tuned circuit, which is adjusted to correspond to the wavelength to be received. Across this tuned circuit we connect the detector and telephones, just as we would have connected them across the original aerial circuit.

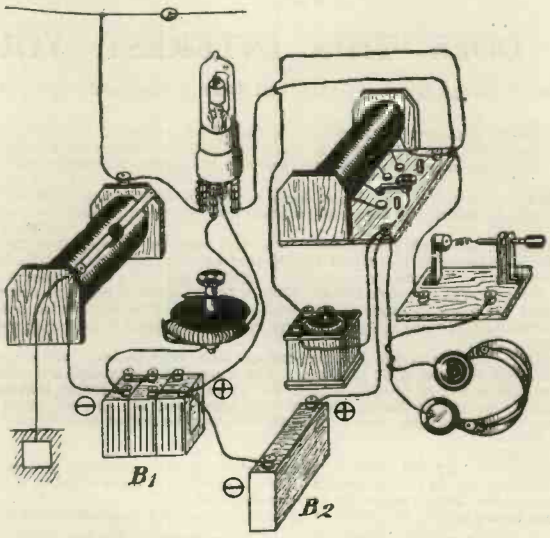


Fig. 1.—High-frequency amplifier circuit.

Fig. 1 shows a simple arrangement, in which a three-electrode valve is used as a high-frequency amplifier. It will be seen that the aerial terminal on the inductance L_1 is connected directly to the grid of the three-electrode valve. A wire is taken from the slider to the negative terminal of the filament accumulator B_1, which supplies the current for the filament in the usual way. The anode terminal of the valve is connected to one end of the variable inductance L_2, which is tapped off in several places, a selector switch being provided. This switch is connected to the positive terminal of the high-tension battery B_2, the negative terminal of which is connected to the positive terminal of the filament accumulator B_1. A variable condenser C is connected across the used portion of the inductance L_2, and serves to complete an *anode oscillatory circuit* which is adjusted to the same wavelength as the aerial circuit.

The high-frequency potentials across the inductance L_1 are communicated to the grid of the valve and cause amplified current variations in the anode circuit of the valve, which includes the oscillatory circuit L_2 C_1. A maximum current will flow in L_2 C_1 when this current is tuned to the incoming wavelength. The currents in this circuit are identical with those in the aerial circuit, but are several times stronger. We now connect the crystal detector D and telephones T across the oscillation circuit, treating it as we would the original aerial circuit.

Describe One or Two Modifications of the Arrangement shown in Fig. 1.

The variable inductance L_1 might be, of course, a variometer or an inductance tapped in sections and shunted by a variable condenser.

The inductance L_2 might be of the slider type, if sufficiently large, in which case the variable condenser C might be eliminated.

It is to be noted that any of the oscillation circuits may be made up of variometers, or any other kind of variable inductance, with or without a condenser across it. If no condenser is used, we have to rely on the self-capacity of the coil for tuning purposes, and very much more inductance will be required. It is desirable to use an inductance tapped in sections, with a variable condenser, or to use honeycomb coils.

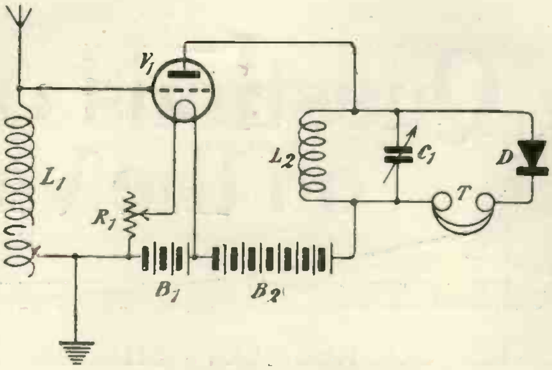


Fig. 2.—High-frequency amplifier receiver circuit.

Draw a Circuit Corresponding to the Arrangement of the Apparatus Shown in Fig. 1.

Fig. 2 shows the circuit arrangement, comprising the aerial circuit L_1, the filament lighting circuit B_1, R_1, the plate or anode battery B_2, the oscillatory circuit L_2, C_1, the detector D, and telephones T.

The telephones are, of course, of high resistance. Low-resistance telephones may be used, however, and quite satisfactory results obtained, provided that a step-down transformer is fitted. The fine-wire winding of the transformer is to be connected in the detector circuit, whilst the 'phones are connected to the ends of the thick wire winding of the transformer.

DOES THIS INTEREST YOU?

A printed letter we have received from a German "patent agent."

"Dear Sir and Inventor.

"I kear with the greatest interest from my bulseness friends, that jou have been active as an inventor, and that you have had a plain success in pushing through your patents, while we are here and in other foreign States hungry for patents, but also to give bread to the thousands nf workless people. Tn alleviate a little this hunger for industrial works in the States of America and Europe **your inventions** have also to be introduced.

"The **Westeuropean Ingineer office** has thousands of firms at hand and nearly all States of the world, to assure the inventor a **brilliant getting up**, and theretore your invention has not to remain concealed in no State and before no peopte, even when the matter in question is a trifling object.

"The **Westeuropean Ingineer office** will bring all **your patents** in a short time on the market in the needful States of industry, without you having large expenses because the inventor has once to **be paid rightly** that he may create new works for the world.

"Unfortunately is this hinderd by law because the inventor has at first to pay the patent charges in the respective States; therefore the money holders can always fill their purses and create new things. No, it has no more to go on in this way, one has also to help you.

"The **Westeuropean Ingenieer office** charges itself from to day with all your inventions, granted patents or not yet granted, and will bring them in a short time on the world market, supposed, that aur central office has the right to take from every patent selling 5 % from the ob-tained sum as profit and to cover the charges.

"**A guarantee** will be sent directly to you if you will join aur concern with your orders. We carry to your account only the charges for the **first** application at the patent court **for the sum of 50 Shillings.** You have only to pay **once** and receive every thing else **gratis.** How many patents you like to sell under our protection and in which States is left to you. **You are saving thousands by this system and earning millions.**

"Send still to-day the trifling sum of 50 S. in a **money letter** to our address and join **all your orders** to that sending. If you like, you may ask before to **your own safety** a guarantee by sending 10 S. This amount may be settled with the rest payment of 40 S. But time is money for you, as well as for the buyer, as for us.

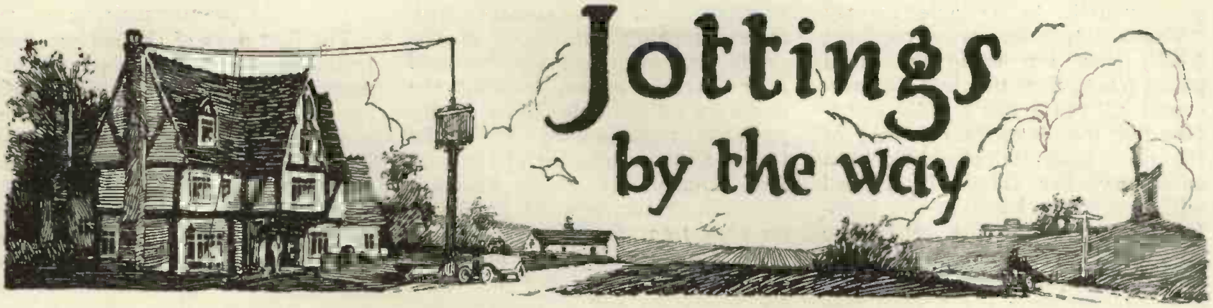
"Testimonials of a patent office keeper!

"I am an inventor since many years and an old proffesed patent-keeper In the inventor's concern. I have been in buiseness connections with nearly all patent offices; but without any further hesitation I would give you a share of 30 % of your profit through my office, putting all my orders of my inventor'ship for inland and foreign conntries at your disposal. Yours J o s. M e y e r.)

"This **Patent office** is still sending to-day nearly all orders to us and have opened their own book-account in our office.

We commend the above to those of our readers who are inventors and who desire a brilliant getting up and who want to save thousands and earn millions (of marks, we presume). You also, be it noted, have an opportunity of giving this gentleman 30% of his own profit—a great inducement.

We ourselves prefer the British type of patent agent to this "old proffesed patent-keeper in the inventor's concern."



A Super-howl.

THE howling nuisance on broadcasting wavelengths is very bad in some districts at the moment. Two nights ago I had the most poisonous experience of it that has ever come my way. The weather was so delightful that we were sitting in the garden with the loud-speaker's business end turned towards the open window of the wireless room. Save for a few cat-calls, which betokened that a couple of previously "D-F'd" condenser-wanglers were continuing their experiments with the largest possible reaction coils tight coupled to their A.T.I.'s, all was well. Suddenly pandemonium broke loose. 'Tis difficult to find words to describe it. Have you ever heard yodellers at work amongst the mountains of Switzerland? Have you ever been to a canary show? Have you ever . . . No, I will not elaborate the questionnaire. Single chirps, wails, moans or shrieks one can put up with. But this was none of these. It was an ear-piercing scream, a scream with a rattle in it like the note of a steam whistle containing a gigantic pea. Nothing would stop it; even when one changed over to Birmingham it was still audible. Reacting Reginald and Heterodying Hubert—these are our pet names for the delightful pair—had, I take it, each got their sets into a state of continuous oscillation wild enough to satisfy even their ambitious hearts, and the two being at slightly different frequencies were heterodying each other and 2LO to beat the band.

R-r-r-r-revenge!

Indignation runs high in Little Puddleton, for so we will call the scene of these atrocities, and schemes are afoot for exacting horrid vengeance. In Reginald's case it is proposed that a raiding party, a kind of wireless Ku Klux Klan, shall enter his garden at dead of night and silently establish a connection between his aerial and the lighting mains. That, I think, should do the trick. For Hubert a still worse fate is designed. A piece of covered wire exactly like that which forms his lead-in will be specially treated. The covering will be opened carefully about midway, the wire will be cut, and about two inches of it extracted. Then the wound will be healed by skilled fingers. This diabolical contraption is to be substituted, also at dead of night, for Hubert's lead-in. 'Tis sweet to think of Hubert's frenzied antics when next he switches on. Can you not see him calm at first, but growing steadily more ruffled, examining his batteries, testing now this circuit, now that, pulling his set to pieces and behaving in a manner generally satisfying to the victims of his precious efforts! It should be some time ere Hubert discovers the secret of his troubles and our contentment.

Don'ts.

Seriously, though, there should be no such thing as bad howling if people would only exercise a little care when using their sets. Ninety-five per cent. of it is due to ignorance, four per cent. to unskilful handling, and perhaps one per cent. to sheer selfishness. Many a person finds it hard to believe that the little squeals that his set produces can be heard by another soul, though he is ready to heap imprecation on the heads of those who interfere with him. If you would be sure that you are not causing others to tear their hair bear in mind and act upon these "don'ts": Don't have filaments too bright; don't use too high a voltage on the plates; don't make couplings tight; don't be continually adjusting your condensers; don't search with the reaction coil close coupled; don't make a fetish of mere noise; don't try to make the set perform wondrous feats of which it is not capable. It is best to do the preliminary searching and tuning with the reaction coil shorted, and then to bring it gradually into play, watching carefully for the rushing noise that betokens the beginnings of oscillation. If you are making experiments with special reaction circuits use the longer waves, on which there are plenty of telephonic transmissions.

The Useful Variometer.

Those who find difficulty in obtaining satisfactory results on short waves with tuners of the ordinary type will do well to try the variometer. Like cocktails, jazz bands, and Tin Lizzies, this is an American importation, or, at any rate, it became popular across the Herring Pond long before it was widely used here. It is simple to use, and it gives remarkably fine tuning. If it acts well in the States, it should certainly do so here, for its task is a lighter one. Over there there are seven hundred broadcasting stations, no less, the overwhelming majority of which work on 360 metres. 'Tis hard enough in this country at times to separate two stations whose wave differs by thirty or forty metres. Birmingham has a way of blotting out Manchester or Newcastle, whilst 2LO performs the same kindly office for Cardiff. What it must be like to have five or six stations all high-powered and all in one town transmitting on the same wavelength and at the same time goodness only knows.

Switchitis.

Some people have a perfect passion for providing their sets with all manner of switches which enable it to employ numbers of different circuits by the mere touching of a knob here, a lever there. It is very jolly to be able to say "That's transformer coupling; (click) Now I'm using the tuned plate; (click, flop) this is resistance-capacity," but I don't think somehow that it adds to the efficiency of the set. Like spring onions in a salad, switches should be applied with a sparing hand to the high-frequency side of the set. The slightest imperfection in the contacts of any switch in a grid circuit will certainly result in a loss of signal strength, and it may give rise to noises of the most exasperating kind, whose cause may not be discovered without many painful searches accompanied by those naughty words which score bad marks with the Recording Angel. He, I think, must have had a particularly busy time of it since wireless became the hobby of the day. There is, too, a considerable amount of capacity between the various parts of any switch, which may be responsible either for damping, or for mysterious and persistent oscillation. Do not give way to the passion for switches; it is as demoralising, every whit, as drug taking or the playing of Mah Jongg.

A Tragedy.

I witnessed a sad little tragedy the other day. There were two of us in the train, myself and a little man who had placed his neatly folded overcoat on the seat beside him. At the next stop there entered a whole family whose stout sire sat fairly and squarely on the folded garment. Came a sound as of a breaking egg and a cry from the little man. A cherished ORA was in one of the pockets, and it had gone west with a completeness that baffles description. It is bad enough when your young hopeful connects L.T. – to H.T. + in your absence and does in a valve with a display of fireworks. But then, somehow, one feels that the valve died fighting. To have one crushed by a fat man in a railway carriage is a bad business with no ray of consolation about it. Moral: don't carry valves loose in your pockets, or, if you must do so, don't sit next to fat men.

The Thirst for Knowledge.

Curious how some of the most unscientific people of one's acquaintance take with enthusiasm to wireless, and, not content with merely turning the knobs of the safety set, wrap wet towels round their feverish brows, burning the midnight oil until they have a very passable acquaintance with the theory and the practice of the subject. One of my friends who but a month or two ago did not know an ohm from a condenser is now quite an authority; he has read everything wireless that he could lay hands on, and he really understands what he reads. All of which shows that wireless is an excellent thing in every way, since it induces many who previously scoffed at any form of science to scrape up at any rate a nodding acquaintance with such things as the ether and the electron. 'Tis a form of study, too, in which, as the French say, the appetite comes whilst one is eating. The more you know the more you want to know.

Microphone-fright.

Quite a number of those who are making their bow in the broadcasting studio forget that the microphone does not automatically switch itself off when the speech is ended. As they move away after saying "Good-night," or having wound up their peroration in some neat and effective way they step away (one imagines them mopping their brows) and remark to the announcer ere he can leap to the switch, "Thank goodness that's over," or "Was it all right?" or something of that kind. The old hands, of course, know all about it. Most people are in a terrible state of nerves when they face the microphone for the first time. Even those who are as cool as ice on the lecture platform or the stage find their courage ebbing away as the time for their appearance draws near. With a visible audience one can always tell how things are going. They may laugh or applaud or go to sleep or walk out according to the quality of the entertainment that you provide. But the microphone is a cold unresponsive instrument which does none of these things. You make your best joke; it remains unmoved. Your most passionate words will not evoke the slightest response. It is like talking or singing at a brick wall. The only consolation is that if you are not doing well it cannot throw eggs or decayed tomatoes.

Cr-r-r-r-rackle.

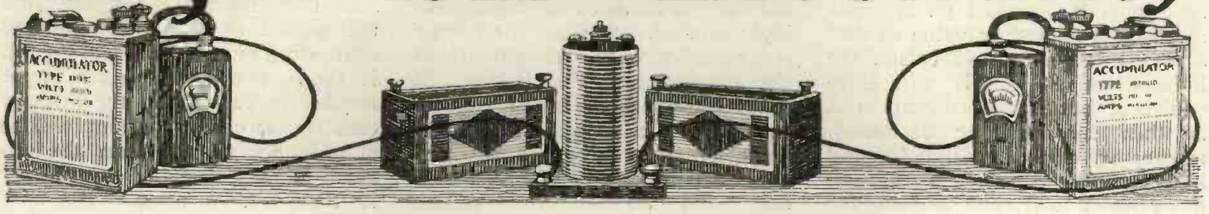
The first days of the hot weather produced the finest crops of atmospherics that it has ever been my lot to listen to. To-night, for example, it was impossible in Little Puddleton to receive any broadcasting station, for their intermittent spluttering was loud enough to make speech almost inaudible and to spoil musical items completely. Some places seem to be more visited than others by Nature's own contribution to broadcasting. Here they are distinctly bad, but in other localities they are neither so violent nor of such frequent occurrence. I have an idea that the shape of the ground has something to do with it, and that if you live, as I do, in the lowest part of a long deep valley, you may expect to receive more than your fair share. Even in winter time they are often quite troublesome in this neighbourhood. The annoying part of it is that one can do absolutely nothing if the ordinary type of aerial is used. My own tip, which usually works quite well, is to stick on one more high-frequency valve and to change from the outdoor aerial to the frame. In this way one gets the broadcasting stations with almost the same strength, and one is less bothered with interference either from local howlers or from the "mush" of big stations.

A New Profession.

There would, I believe, be quite good prospects for any bright young men who cared to set up in business in populous districts as what the Yanks call "trouble-hunters." Do not be misled by the name; those who adopt the new profession would not spend their time in seeking for coat tails on which to tread, or making themselves unduly agreeable to other fellow's best girls. Their mission in life would certainly be to look for trouble, but not in any of those ways. They would be there in times of stress to rush to the assistance of any suffering wireless man, who, having exhausted his patience, his supply of biting words and his ideas, was still utterly at a loss to fathom the secret of the muteness of his rebellious set. Think how glorious it would be if one could ring up one of these ministering angels when every effort has failed.

WIRELESS WAYFARER.

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART VIII

(Continued from No. 7, page 413.)

THE net result of electromagnetic inertia or induced current opposition is that the electromagnetic field eventually produced by the applied current in a coil of wire is not produced instantaneously, but takes a certain amount of time to reach its full strength. This is a characteristic of all systems where inertia plays a part. If we return to the simple illustration of the boat floating upon the surface of water, we shall see that, were it not for the fact that the boat possesses inertia, the smallest force would set the boat instantly into motion. Owing, however, to the boat's inertia, a certain definite time must elapse, during which the force is operative, before the boat

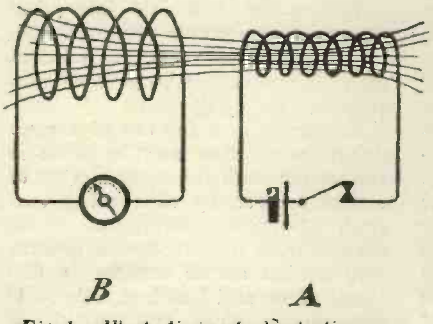


Fig. 1.—Illustrating mutual induction. Lines of force from A pass through B, induced current in B being shown by galvanometer when current in A is made or broken.

reaches a definite velocity. In the case of the establishment of an electric current through a coil, the time required for the current to reach its maximum value is usually extremely small; it may be of the order of one-millionth of a second. When the current has reached its full value, the opposing induced current has, of course, vanished and a steady magnetic field exists in the region of the coil and a steady current is flowing through the coil, the value of which depends simply (according to Ohm's law) upon the applied E.M.F. and the resistance of the coil. In some cases the time required for the current to attain its maximum value may be quite appreciable, that is when the inductance of the coil is exceedingly high. A coil having a very high inductance would be one consisting of a very large number (some thousands) of turns of wire wound upon an iron core.

The applied current, then, before it can instal itself, so to speak, has to overcome opposition, as master of the situation to the establishment of a magnetic field. We may regard the magnetic field as representing a store of energy, namely, the energy which was used in establishing it.

Now we come to the question of switching off the applied current, and we find that here again opposition is met with, just as when trying to bring the boat to rest after it had been set in motion with a definite velocity. When the applied current is switched off, there will be nothing to maintain the established magnetic field, and, according to the general principle which has been enunciated above, a momentary current will be induced in the coil tending to *maintain* the magnetic field. In order to maintain the field, the induced current will need to be in the *same* direction as the applied current which has been flowing through the wire. Thus it is found that when a current through a coil of wire is broken, a momentary current is induced in the *same* direction as the *original* current. It is chiefly this induced current which causes a spark at the key or switch when a current through a coil is broken, particularly if the coil has a large inductance.

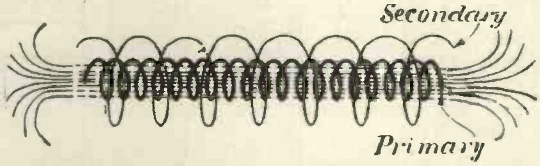


Fig. 2.—Principle of spark coil. Primary coil inserted into secondary, so as to pass the maximum magnetic field (due to primary) through secondary.

Now let us consider two adjacent coils A and B, Fig. 1, A being provided with a battery, a resistance, and a switch, so that the current in A can be made or broken or varied. According to what has already been said, when the current is switched on in the coil A, a magnetic field will be established and some of the lines of force will pass through the coil B. A momentary current will therefore be induced in coil B, tending to oppose the introduction of this field, and, again, when the current in coil A is broken, a momentary current will be induced in coil B in the opposite direction to that which was produced when the current in A was made. If the current in A is switched on and has reached its maximum value so that a steady magnetic field exists, the induced current in B will have vanished, but if the current in A is then increased or decreased, momentary currents will be induced in B creating in all cases magnetic fields which will tend to keep the existing magnetic field constant. Evidently, if the current in coil A is repeatedly made and broken, induced currents will be repeatedly produced in coil B, being in one direction every time the current in A is made and in the opposite direction every time the current in A is broken. Thus, by rapidly making and breaking the current in A, we may produce an *alternating* current in B. This is the underlying principle of the so-called "induction-coil" or "spark-coil," such as is used in connection with X-ray tubes and for many other purposes (Fig. 2). Before describing the spark coil in any detail, however, let us consider the question of the relative number of turns of wire in coils A and B. It is found that the E.M.F. created between the terminals of coil B when the current in A is made or broken depends, amongst other things, upon the E.M.F. in the coil A and upon the relation between the number of turns in coil A and the number of turns in coil B. If A and B are in very close proximity (in fact if A is actually inserted into B) so that practically all the lines of magnetic force produced by A pass through B, the E.M.F. produced in B will bear the same ratio to the E.M.F. in A as the number of turns in B to the number of turns in A. Thus, if there are 1,000 turns of wire in B and 10 turns in A, the E.M.F. of the induced current in B will be 100 times that of the current in A. This, then, is a convenient method of raising the E.M.F. or voltage of a current, which we frequently require to do for special purposes. It should be mentioned, however, that the total *energy* which is produced in the second coil is not greater than that in the first coil, for, although the E.M.F. may be considerably higher, the current obtained is correspondingly smaller, and since the energy is proportional to the product of the current and the E.M.F., it follows that there is no gain in energy. As a matter of fact, in actual practice, there is a considerable loss in energy, due to resistance and various other causes which need not be dealt with at present.

In the example which we have just been considering, the current in the first coil is alternately made and broken, with the consequent production of alternating current in the second coil. Thus an *intermittent direct* current produces an *alternating* current.

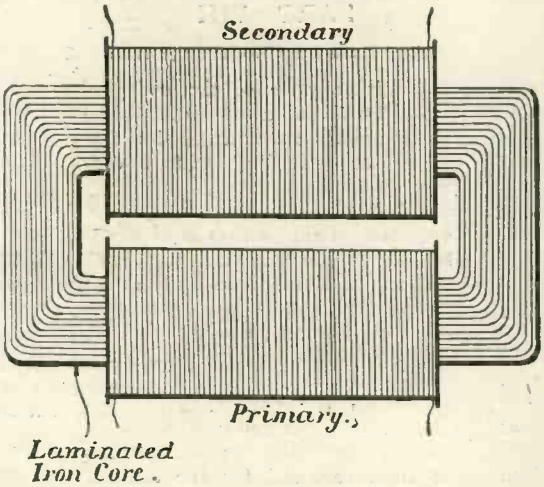


Fig. 3.—Principle of transformer. The magnetic flux is concentrated in the laminated iron core, and so is conducted from primary into secondary.

Now suppose instead of applying an intermittent direct current to the first coil we supply alternating current (for example, from an alternating-current electric generator). It will be easy to see that the effect in the second coil will be the same as before, for every time the current in A rises, or falls, or is reversed, opposing currents are produced in B.

Thus, only alternating current is produced in the second coil, whether the current in the first coil be alternating current or intermittent direct current.

This is the principle of the static transformer, commonly called simply a "transformer." A transformer consists essentially of two coils of wire, usually called the "primary" and the "secondary" coils, into the first of which an alternating current is fed, and from the second of which the induced alternating current is taken (Fig. 3). If the secondary coil has a larger number of turns than the primary coil, the secondary current will be of a higher voltage than the primary current, and the transformer is then known as a "step-up" transformer, because it steps-up the voltage. Of course, a transformer may be used the opposite way round, current being fed into the coil with the larger number of windings and secondary current being taken from the lower winding, in which case the transformer is used as a "step-down" transformer.

An example of a step-up transformer is the spark coil, which has already been referred to. The resistance of an X-ray tube is usually extremely high, and in order to drive any appreciable current through it, it is necessary to apply some thousands of volts to its terminals. It would be inconvenient to employ thousands of electric batteries in series, but all we have to do is to use a spark coil or a step-up transformer and apply, perhaps, 10 volts producing 5 amperes in the primary coil and obtain, perhaps, 5 milliamperes of current through the X-ray tube at 10,000 volts.

The reader will find later that step-up transformers are used considerably in wireless work, particularly in connection with valve amplifiers. (See Fig. 3a.)

An example of the use of a step-down transformer may be given in connection with the transmission of electric power by alternating current. Suppose power has to be carried from a water-power generating station across country a distance of several hundred miles. If the power were transmitted at a low voltage (for example, 100 volts), it might be necessary to transmit a considerable amperage and this would require heavy cables. If, however, the alternating current is stepped-up in voltage, the same power may be transmitted with a much lower amperage and, therefore, with lighter cables, permitting of a considerable capital saving in expenditure on copper. In some cases power is transmitted in this way at a voltage of 10,000 to 100,000 volts. At the other end of the line, however, it would obviously be dangerous to employ current for household and factory purposes at this high voltage, and, therefore, a step-down transformer is introduced, the current being finally issued at a voltage of, perhaps, 100 or 200 volts.

Transformers are sometimes used with a 1 : 1 ratio, but the purpose here is not to produce any change in voltage (for it will be obvious that the voltage of the secondary current will be the same as that of the primary), but to enable electric power to be transferred from one circuit to another without any direct electrical connection between them. An example of a case where a 1 : 1 ratio transformer might be used is as follows. If we had a circuit through which a steady current was flowing and in which an alternating or variable current was super-added to the steady current, it might be inconvenient to interpose a telephone receiver in the circuit, as the strong steady current might overpower the receiver and render it inoperative. If, however, a coil be introduced into the first circuit as shown in Fig. 4, and constitute one coil of a transformer, the second coil being connected to the telephone receiver, it will be evident that the steady current in the first circuit will produce no effect in the second coil of the transformer, but any fluctuations or alternating current which may pass through the first circuit will induce corresponding currents in the second circuit which may be detected in the telephones. Thus the 1 : 1 ratio transformer simply has the effect of cutting out from the telephones the steady current and allowing only the variable current to be indicated. Of course, a transformer which is arranged as a step-up or step-down transformer still has this property of cutting out from the secondary circuit any steady current which may be flowing from the primary circuit.

It will be seen from all that has now been said that a transformer is only available for operating on variable or alternating current; it does not transfer energy which exists only in the form of direct current.

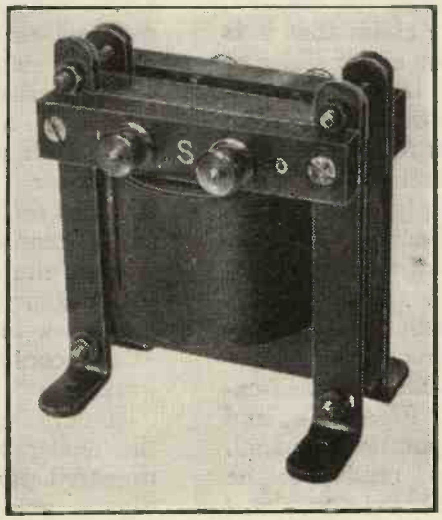


Fig. 3a.—Intervalve transformer (Radio Instruments, Ltd.)

Iron Core and Air Core Transformers

It has been explained that the so-called magnetic materials, such as iron, have a greater magnetic permeability than air, so that if a piece of magnetic material is introduced into a magnetic field, the lines of magnetic force tend to forsake the air-region and crowd together in the iron. This effect is utilised in the design of certain kinds of transformers, known as "iron-core" transformers. It was mentioned above that the primary coil produces the greatest effect in the secondary coil when all the lines of magnetic force produced by the primary coil pass through the secondary coil. In the absence of any magnetic material, a considerable proportion of the lines of magnetic force spread away from the region of the coils and thus are not available. But by introducing an iron core into the primary, the magnetic field is very much more concentrated and the efficiency of the transformer is correspondingly increased.

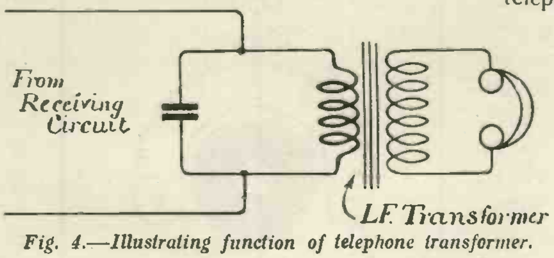


Fig. 4.—Illustrating function of telephone transformer.

The inductance of such a transformer is, however, much greater than that of a similar transformer without any iron. This will be understood in view of what has already been said about the establishment of an electromagnetic field and the overcoming of the electromagnetic inertia. If an alternating current of comparatively low frequency (for example, 50 to 1,000 alternations per second) be passed into the primary of an iron-core transformer, the development and destruction of the magnetic field, and the consequent production of alternating current in the secondary of the transformer, are able to follow the alternations of the primary current with sufficient faithfulness. But if the frequency of the alternations in the primary circuit be largely increased, the response of the induction effects becomes correspondingly reduced, so that an iron-core transformer becomes of less and less use the higher the frequency of the alternating current supplied to it. Eventually, when we come to deal with alternating currents of the frequencies employed in radio-telephony (round about 1,000,000 alternations per second), we find that it is impossible to pass any appreciable current at this frequency through an iron-core transformer of the ordinary kind.

For use in connection with these very high frequencies, it is necessary to employ transformers without iron in the core, so as to reduce the inductance to a suitable amount. There are other reasons, also, for omitting iron from the core of a transformer intended for high-frequency currents, but these need not be dealt with at present.

A VARIOMETER TUNED CRYSTAL SET

By SPARK.

Describing the construction of a variometer and how it may be used on crystal receivers.

IT is an established fact that the variometer is a very efficient, if not the most efficient, form of inductance; some claim that it is 20 per cent. more efficient than either slider or tappings. It has this advantage, it does not require a condenser for fine tuning; it can, therefore, be made more cheaply than other forms of tuners.

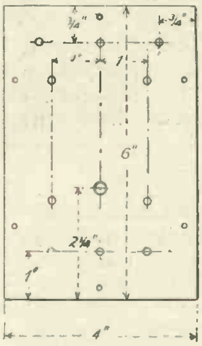


Fig. 1.—The dimensions for panel marking.

The following article endeavours to show how one may be made and adapted for crystal reception.

The sketches are self-explanatory. Figs. 1, 2, and 3 show preparation of panel. Dimensions need not be strictly adhered to, and may be improved on by readers or adapted to materials on hand.

The variometer is wound on two formers, the rotor being 2in. in diameter and 1¼in. in length, with two holes drilled to fit 2B.A. rod. The stator is 3in. in diameter and from 2½in. to 3in. long, with two holes big enough to take small spacer washers and two slits about ⅛in. wide. Well shellac both formers and let them dry.

During the drying process we may proceed with the detector. Obtain a piece of 2B.A. rod about 2in. long, three 2B.A. nuts, a washer, a 2B.A. bush or nut about ⅜in. deep, a piece of brass tubing of any kind about ⅞in. long, for the detector standard. Two strips of springy brass, about ½in. wide and 2in. and 2½in. long respectively, into which holes are drilled to fit on to the standard; in the smaller one a hole big enough to allow 2B.A. rod to pass through easily; on the underside of this solder a 2B.A. nut; and in the longer strip a hole is required to take a small screw and nut to hold the catwhisker.

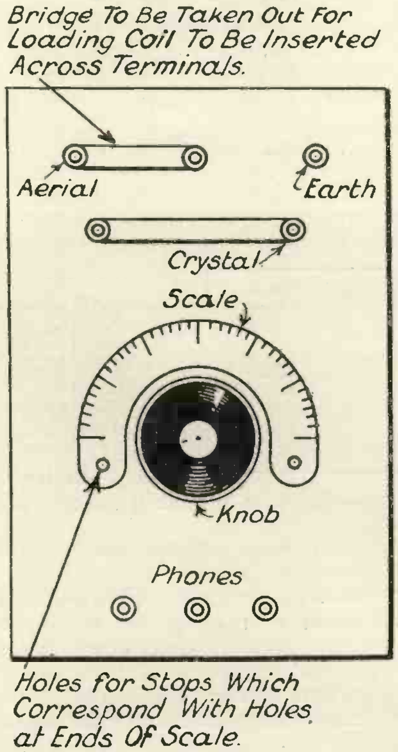


Fig. 2.—The panel.

The screw for adjusting is 2B.A. rod about 1½in. long, with an insulated accumulator terminal nut fastened on in the following simple manner:—Make one end of the screw hot, dip it into some powdered resin, and screw into the terminal. When cool it will be quite firm.

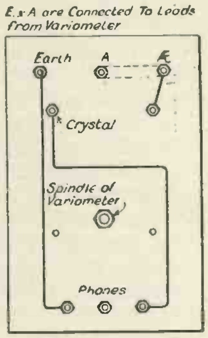


Fig. 3.—The panel wiring.

It only remains now for the reader to assemble the prepared parts as shown in Fig. 8, using a catwhisker suitable for the crystal.

Now to the winding of the variometer. Place two pieces of 2B.A. screw rod, 1in. and 2¼in. long respectively, through the holes in the rotor former with nut and washer inside; if the holes were made correct size, the rods will not slip about. Take some 30 d.c.c. wire, insert through a pin hole near the edge and place the bared end between one of the washers and nuts. Wind on carefully 36 turns, 18 on each side of the screws—if they come close to the screws it does not matter—finish off by placing the wire through a pin hole and the bared end between the other nut and washer. Now put another nut and washer on the outside end of each screw and screw up tight; if the wire comes under the washers, interpose a fibre or cardboard washer. See that the bared ends are in place and not broken off by too much pressure. A coat of shellac varnish completes the rotor.

When dry, place it inside the stator former, straining the slits a little. Now put three or four small spacer washers, a flat washer, and a nut on the spindle screws; see that the small washers go right through to the rotor and that the latter is quite free to rotate.

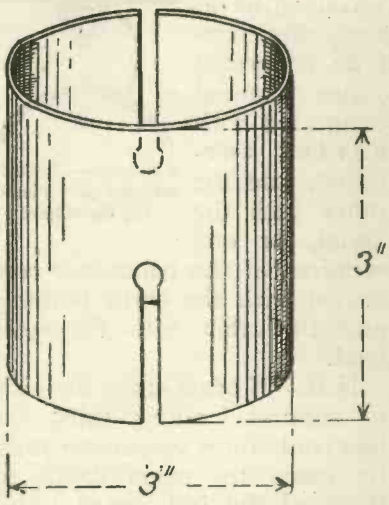


Fig. 4.—The stator.

To wind stator, make a pin hole about 1in. from spindle hole, allow 6in. or 7in. spare for connections, and wind on 15 turns of 30 d.c.c. wire, allow about 12in. spare and cut. Twist the spare temporarily round one of the spindles, and wind on 15 turns from the other side; leaving the spare at each end as before. There are now two spare ends about 12in. long in the middle of the former. Now follow very closely. Bare and twist these two wires together, so that the twist touches the former and carefully solder; wind the remaining ends of the wire on a knitting needle, so as to make two small springs; secure one end, previously bared, between the nut and washer of one spindle, and the variometer is complete. It is hardly necessary to add that all the wire both on stator and rotor must be wound in the same direction, and a coat of shellac on the finished stator will be advantageous.

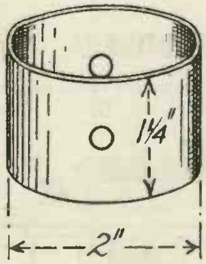


Fig. 4a.—The rotor.

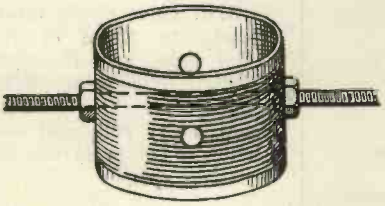


Fig. 5.—The rotor fitted with rod.

Now for fixing the variometer to panel. A 2B.A. washer, a spring washer, and another 2B.A. washer are placed on the long end of the spindle, which is now passed through the panel, and has another washer, a nut, a pointer, and knob fitted to it.

Fix the pointer so that it points to 90° for the medium wavelength, that is, when the winding of the variometer is as Fig. 6. The shortest wavelength is obtained when the rotor is turned in an anti-clockwise direction 90 degrees.

To prevent the stator from moving it will be found that if a big pin is bent and attached to the middle 'phone terminal, so that it passes through the stator former where there is no wire, it will fix it quite securely (Fig. 10).

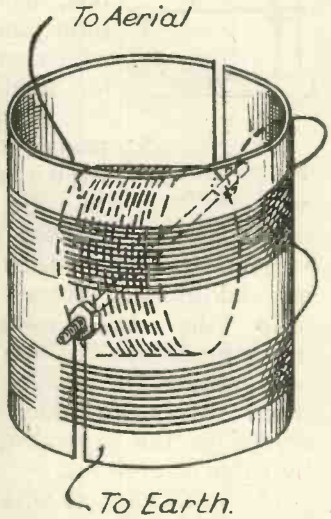


Fig. 6.—The stator with rotor fitted in position.

The reader can use his own discretion in making a nice box to contain the variometer, and if he has made a good job of everything he will have an instrument which will receive broadcasting on a normal aerial most efficiently. The wavelength of this instrument varies between 250 and 500 metres.

Loading Coils.—Perhaps the reader has in the early stages of his career as a wireless amateur constructed an inductance coil with slider. Remove the brass bridge (Fig. 2) and connect one end of the coil to the bridge terminal and the slider to the aerial terminal. This loading coil will enable one to tune to all wavelengths up to the sum of the wavelengths of the variometer and coil.

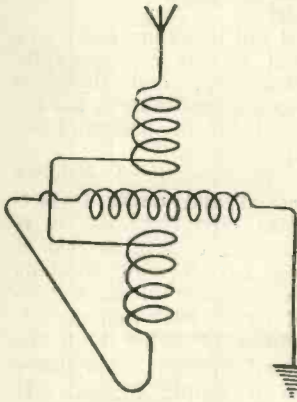


Fig. 7.—The variometer winding.

If any reader does not possess

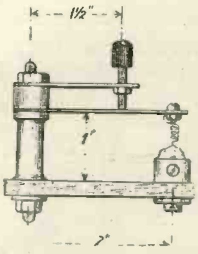


Fig. 8.—The crystal detector.

such a coil, I advise him to turn to pages 215 and 216 of No. 3 *Modern Wireless,* where he will find two inductance units described which are admirably suited for loading coils with this variometer. The terminals of these inductances should be made to correspond with those on the variometer, and then with an additional brass bridge strip the two units can be joined. All these units will always be useful either when valves are added to the crystal or the crystal replaced by valve as detector.

Use of Condenser with Variometer.—If the reader should desire to tune to 600 metres or a little over, a 0.0002 μF variable condenser may be used, connected in parallel—that is, with the terminals of the condenser connected to the earth and aerial terminals.

For shorter wavelengths of, say, 180 metres, the condenser should be connected in series, *i.e.,* one terminal of condenser connected with aerial terminal, and the other with the aerial, or one terminal of the condenser connected with the earth terminal and the other with the earth lead.

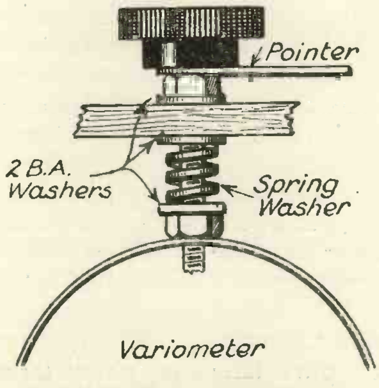


Fig. 9.—Turning handle and pointer for variometer adjustment.

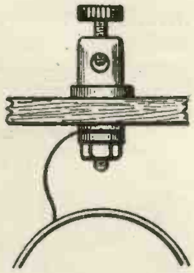


Fig. 10.—Method adopted for securing the stator.

N.B.—If brass strips are used to connect loading coils, the box containing variometer must be made the same depth as those of the inductance units, or it must be supported on something so that the depths are equal.

A COMPACT SINGLE VALVE RECEIVER

(Continued from page 468.)

telephones. It is quite possible to hear signals with almost any kind of headgear, but the receiver is often blamed for faults which are not there.

It will sometimes be found an advantage to shunt the telephone terminals with a fixed condenser having a capacity of not less than 0.001 μF, but this is not generally necessary, and therefore such a condenser is not included in the design of the instrument.

With a good outdoor aerial and under favourable circumstances, it is possible to hear several of the Broadcasting Stations with this receiver, and its design is such that the addition of either high- or low-frequency amplifiers is a simple matter. If used with a dull emitter valve, the whole receiver might be conveniently put into a case measuring 8in. by 6¼in. by 10in., which measurements would include space for the filament heating accumulator and the high-tension battery.

If the reader should contemplate the use of a dull emitter valve at any time it might be said that the characteristics of the D.E.V. valve approximate closely to those of the "R" type, and therefore this will be suitable. Such valves can be operated from a dry cell, and are, therefore, of great use for portable sets.

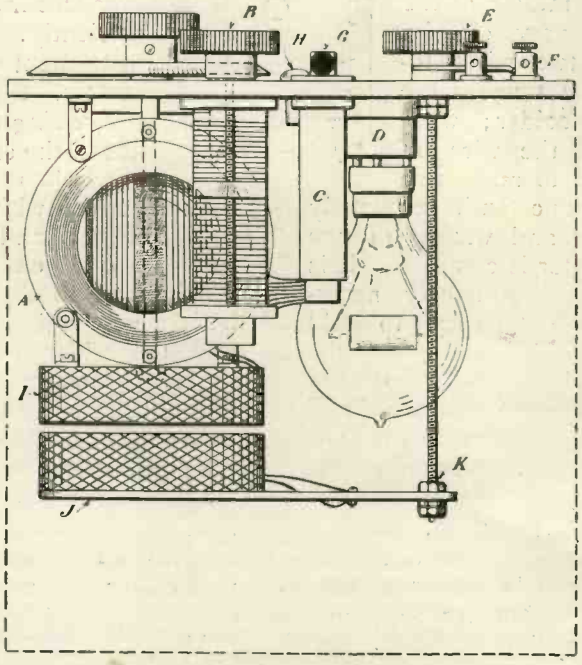


Fig. 7.—Elevation of the complete receiver.

[In an early issue of this paper suitable high- and low-frequency amplifiers for attaching to this receiver in order to extend its range and usefulness will be described.—ED.]

BROADCAST RECEPTION AND SPARK INTERFERENCE

An article by an anonymous but nevertheless responsible correspondent.

COMPLAINTS have been made both in the Press and in the House of Commons of the interference experienced by listeners-in to the Broadcast programmes which arises from the spark transmissions of coast stations and ships.

This interference is particularly bad in the East of Kent, owing to the large number of ships of all nationalities which pass through the Straits of Dover combined with the fact that the district is sixty miles distant from the London Broadcasting station, and that the signals received from that station are consequently weak as compared with the interference it is desired to eliminate.

It is difficult to suggest a practical remedy, and, in fact, it is to be feared that there is little immediate prospect of any substantial improvement.

Highly selective circuits will do something, but this remedy is not within the reach of all, either because the listener-in has not the technical skill to construct and manipulate the apparatus, or, more likely, because he is not prepared to incur the necessary expenditure connected with its installation. Nor, even if it be installed and properly worked, does it effect a cure when the spark station is within a few miles of the receiver, and especially so when the Broadcasting station itself is at a considerably greater distance, and its signals are weak. The root of the trouble lies in the nature of "spark" transmission itself. One effect of this, often called the shock effect, is to impress a voltage on all aerials in the neighbourhood of the transmitting station which is practically independent of wavelength and, consequently, of "tuning," and which causes a current to flow through the detector, thus giving rise to an interference which becomes the more serious as the vicinity of the spark transmission is approached.

Fig. 1.—Illustrating the first Marconi short-wave tuned transmitter.

Another effect is due to the fact that though all spark stations under the International Convention are obliged to have reasonably loosely coupled transmittors, there is a practical limit to the looseness of the coupling as well as a natural tendency on the part of operators, whose apparatus may not be well tuned, to tighten the coupling if they find they are not getting their range. This effect can be very easily represented graphically (Fig. 2).

If OA represents the wavelength over which the etheric disturbance of a certain 600 m. wave installation spreads and OB represents the energy of the disturbance and its effect on a distant receiver, it will be seen that, at the best theoretical coupling the installation sends at a maximum of energy on 60 m., with comparatively small effect on wavelengths, say, less than 590 and more than 610. If, on the other hand, the circuits are too tightly coupled, the installation spreads its energy over a wide band of waves between, say, 550 and 650 metres, affecting them all seriously, whilst never attaining as good an effect on 600 m. as the correctly coupled circuit. If the circuit is too loosely coupled it will affect only the immediately adjacent waves, say, 595 and 605, but the installation will have only a poor range.

These effects are practically absent in continuous wave transmission and the suggestion naturally presents itself that all spark transmission should be prohibited, and the ship and shore wireless service conducted on the continuous wave system.

Now it is a fact that, though for all practical purposes, except the ship and shore wireless service, the spark system is obsolete, it will unfortunately be a long time before it can be abandoned in this connection. There are several reasons for this, but there are two in particular which are readily appreciable.

Firstly, twenty years ago, when wireless telegraphy was in its infancy and the spark system was the only system, the chief, if not the only, application of the science was to communicate with mobile stations, *i.e.*, ships. The first two International Conventions, Berlin, 1906, and London, 1912, did no more than suggest that there was any other method than spark, or any other application of wireless telegraphy than to ships. It is true that Poulsen gave a demonstration of his arc to the Delegates at Berlin in 1906, but the continuous wave system made but slow progress until the strategic necessities of the Great War forced the pace, though without affecting wireless telegraphic communication with ships as regards safety of life at sea.

Since 1901, therefore, a large organisation of ship stations has been growing up, based on spark, until at present there appear to be about 12,000 ships and 1,000 coast stations in existence organised for the

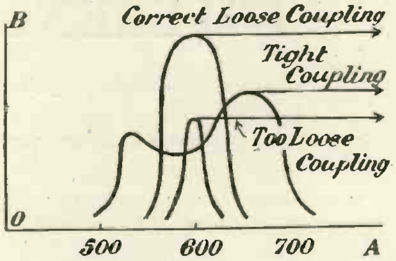


Fig. 2.—Illustrating the effect of incorrect coupling.

purpose of intercommunication on the spark system (see Marconi Year Book).

If it be assumed that the cost of the spark apparatus at each of these stations is valued at £750—not a very high valuation—it is obvious that a capital sum of about £10,000,000 is involved. Since intercommunication is the basis of the organisation, practically the whole of this plant would have to be scrapped, and u.c. plant, costing at least as much, would have to be substituted. Thus we are faced with a very large capital expenditure by the wireless companies and shipping interests before we can rid ourselves of the spark system for ship communication.

As well as this capital expenditure a change to u.c. apparatus will involve somewhat higher charges for maintenance as compared with spark apparatus.

Secondly, the broad tuning inseparable from the spark system has certain great advantages for ship work, always bearing in mind that the chief reason for the wireless equipment of ships is safety of life at sea.

An operator on watch on board a ship listens for spark signals on a nominal 600 m. wave, but on the "stand-bi" adjustment of his receiver he would hear almost equally well spark signals from other ships on any wave between 580 m. and 620 m. If he desires to establish communication with any particular ship he can improve the strength of signals and obtain a certain amount of selectivity by tuning; the essential point, however, is that when keeping his watch he has not to be constantly searching for distress calls or for signals that may be intended for him, as he would have to do if a continuous wave was employed.

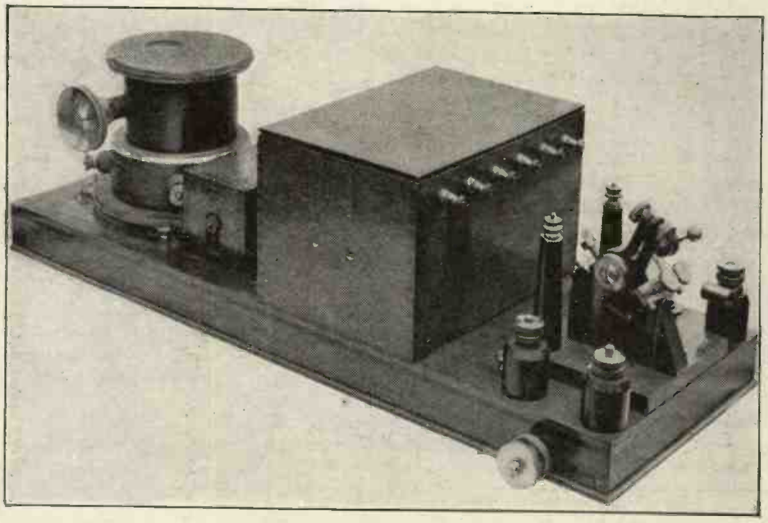


Fig. 3.—An early type of Marconi receiver for a long time used by ships and coast stations. Reading from left to right are the relay, tuner, and coherer "tapper."

It ought, perhaps, to be explained that operators employed on ship services are specially trained in reading through interference. It is astonishing how far training can be carried in this direction, as those who are familiar with the wireless conditions on the Western Front during the war, or with those now prevailing in the Straits of Dover or off Land's End to-day well know. Spark stations rarely emit identical notes, and the skilled operator takes advantage of this. In fact, he employs a very practical form of audible note frequency tuning in addition to electrical tuning.

It is absolutely impossible in an

international organisation of the kind under consideration to insure that all stations are accurately tuned. The rolling of the ship, alterations in the position of derricks, stays, etc., etc., all affect the wavelength even if the installation has been accurately tuned in the first instance, which it very often is not, owing to errors and variations in wavemetres and to the personal equation.

If a spark system is used it is obvious that considerable latitude in tuning may exist without affecting the efficiency of the organisation, either in regard to the safety of life at sea or to ordinary maritime business.

If, however, a continuous wave system were adopted, with its much more precise conditions of reception, it is equally obvious that the operator on watch would have to be extraordinarily and persistently diligent in searching, if calls are not to be missed. On long voyages and in unfrequented waters such concentration would be more than could be reasonably expected of the unfortunate operator.

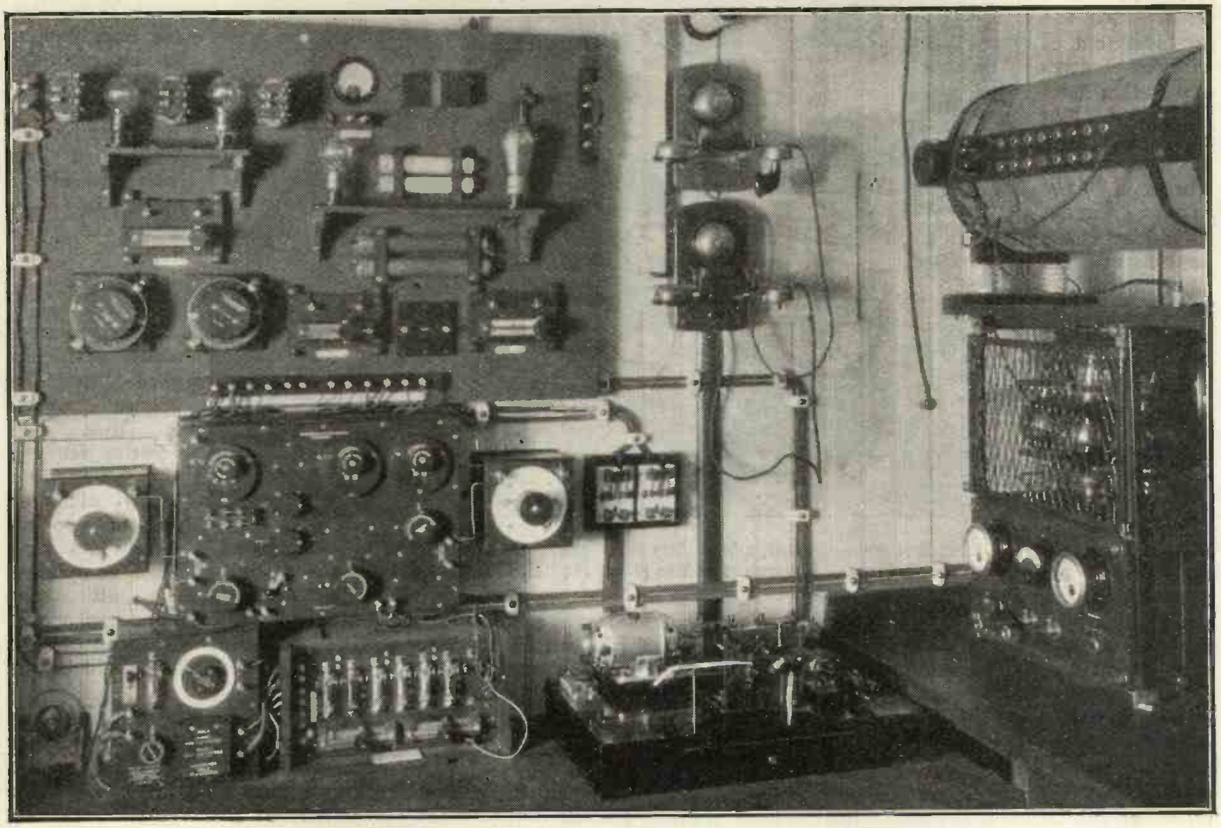
The foregoing are the two chief reasons why there is no immediate prospect of the abolition of spark transmission in connection with ship services. If it is desired to protect the broadcast listener-in from spark interference something substantial could possibly be effected by adopting a considerably longer mean wave for the broadcast band of waves, but even then listeners near to a spark station would still be affected. It would be interesting if some information could be collected on this point.

It would probably, however, be no easy matter to find a band of waves higher up the scale that would be available for broadcasting without seriously interfering with other existing services, and, moreover, it is quite easy for a person who is suffering from spark interference to lose his sense of proportion when considering his grievance.

The Administration has to consider the requirements of communication with mobile stations—the oldest and, in many respects still, the most important public application of wireless telegraphy, as well as the claim of the Naval, Military, Air Force, and Public services, and weigh them against those of the comparatively small number of private individuals whose enjoyment of the broadcast programmes is being interfered with.

It should always be kept in mind that wireless telegraphy is the *sole* means of maintaining communication with a moving station, whether it be a ship or an aircraft, and that consequently, the mobile services ought always to be the first consideration.

SS. "MAJESTIC"



The wireless cabin on board the White Star liner "Majestic."

News of the Week

THERE is a growing demand for mid-day broadcast transmissions which would enable industrial workers to "listen-in" during the meal hour. No doubt many employers would be agreeable to provide the necessary equipment which would enable their workers to take their mid-day meals in canteen or messroom, to the accompaniment of good music.

* * *

The Copenhagen authorities have under consideration a scheme for the establishment of wireless communication with Greenland. At present it has not been decided whether the management should be in the hands of the Government or of a private company. Several companies have offered to install and operate the necessary plant.

* * *

The control man at 2LO, whose duty is to check the transmission and the musical balance. Picture shows him giving the "O.K." signal to the studio.

There have recently appeared in the daily Press accounts of people who profess to be sensitive to wireless waves and who claim to be able to receive broadcasting without the use of instruments. This raises the question as to whether such receivers should take out a licence. Obviously, the broadcaster's licence is out of court since no self-respecting person would submit to being tattooed—"B.B.C."

We learn that residents in Sierra Magre, California, have made a formal complaint to the local authorities with regard to interference caused by local loud-speakers attached to wireless receiving sets, which, operating late at night, prevent sleep. It is proposed to introduce regulations preventing the use of loud-speakers after 9 p.m.

We may expect to see broadcasting inaugurated in Australia shortly. On May 24th the Postmaster-General will open a Conference on wireless broadcasting, at Melbourne.

* * *

During the past year the United States Public Health Department have caused Health Bulletins to be broadcast. It is estimated that the information thus radiated has reached, and no doubt benefited some 25,000,000 people. Our authorities might note that this important public service has been rendered at practically no expense to the Health Department.

* * *

A statement has been made by the Theatrical Managers' Association to the effect that in a certain period *they* have paid enormous sums in Entertainment Tax. We are enlightened, as we certainly thought the public paid the Entertainment Tax just as each broadcast listener-in pays a tax of 5s.—half of his licence fee.

* * *

The latest news with regard to the licence question is that the scrutiny (to use the official term) of over 30,000 applications has now been completed. To all those who have established a reasonable claim, Experimental Licences will be granted with as little delay as possible.

* * *

It appears that applications for Experimental Licences have been received from individuals who have constructed their own receiving sets, but whose stated object is merely to receive the broadcasting. These are evidently cases for Constructor's Licences and cannot be dealt with until the special Committee on Broadcasting have completed their investigations and come to a decision.

* * *

According to the *Electrical Review*, under the terms of Article 306 of the Versailles Treaty, the French Government has assumed the working of the German Meissner patent in France, by granting licences, etc. The patent in question relates to thermionic valves and is of first importance in the technique of radio telephony. The rights to work it hitherto granted to German nominees in France have, in the Government's action, become void.

* * *

Major - General Squiers, of the United States Signal Corps, is understood to be considering a scheme of broadcasting, employing the ordinary electric light mains.

* * *

In the House of Commons recently, Sir W. Joynson-Hicks, the Postmaster - General, stated that a number of wireless experts, under the direction of the Pacific Cable Board, had proceeded to Vancouver Island and Fiji to undertake wireless research work.

* * *

We learn that a special Sub-Committee has been appointed by a certain Borough Council to consider the question of permitting wireless experimenters to erect aerials across public thoroughfares. It appears that a number of aerials have already been erected, and the possibility of them collapsing and causing injury to individuals in the street is to be investigated.

* * *

The Cardiff Wireless Exhibition is proving very successful. A special transmitting licence, covering the period of the Exhibition, has been granted by the P.M.G. This enables good demonstrations to be given with the receiving apparatus on the various Stands. Broadcast transmissions from the Exhibition have been received at places over twenty miles distant.

* * *

Next summer, Poland will be in direct wireless communication with every country in the world. A new station, an exact replica of that at Rocky Point, U.S.A., is to be built by the Radio Corporation of America, at a cost of 2,000,000 dollars. The wavelength to be employed will probably be in the neighbourhood of 18,000 metres.

Miss Jessie Kenney, who has just succeeded in gaining the P.M. first class certificate of proficiency in Wireless Telegraphy at a Government examination held at the Wireless College, Colwyn Bay. She is the first woman who has passed the new examination, which has been operative since January 1st, 1921.

The Union Government of South Africa have entered into a contract with the Marconi Company for the erection of a new high-power station in South Africa. Up to the present the exact locality for the new station has not been decided, but the Marconi engineers are looking for a suitable site.

* * *

We are given to understand that Admiral Sir Henry Jackson, K.C.V.O., is the Chairman of a special Committee appointed by the Postmaster-General to consider the practical developments of Transatlantic wireless telephony.

* * *

We recommend our readers to consider the desirability of taking out a wireless insurance policy. Many of the leading Insurance Companies have now undertaken this type of business, and quite a small premium covers loss of, or damage to, apparatus and claims for personal injury up to £500.

* * *

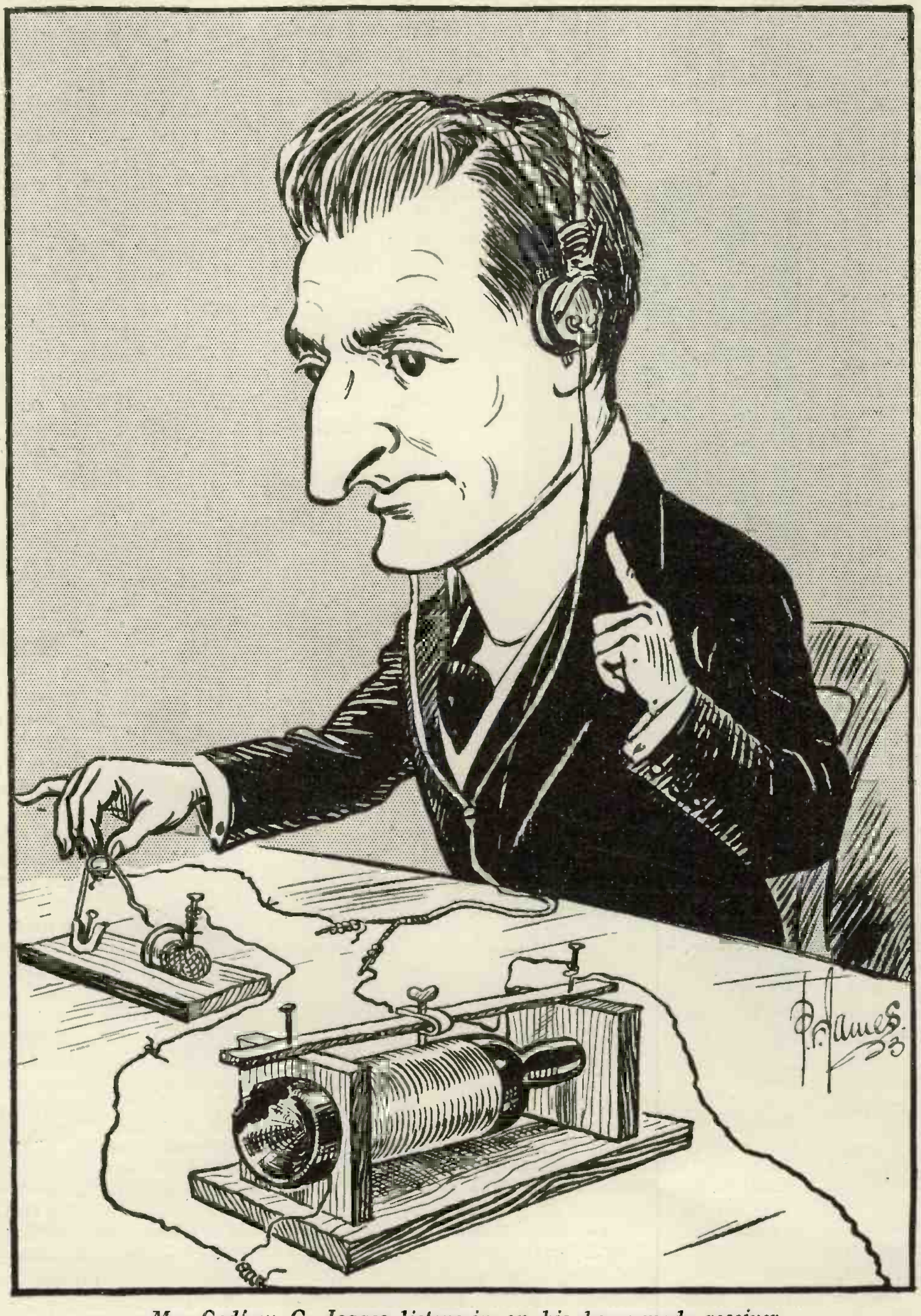
We observe that the recent refusal to permit broadcasting from the Queen's Hall has brought forth protests from many listeners-in and petitions are stated to have been sent. We doubt whether petitions on a small scale will do much real good, but, if the state of affairs continues, the question of a national petition, signed by all British wireless enthusiasts, will have to be considered.

* * *

Referring to the photograph of the wirelessly equipped char-a-banc which we published recently, considerable interest was caused in the London streets a few days ago by the arrival from the Provinces of a similarly equipped char-a-banc full of passengers. The apparatus was claimed to have worked satisfactorily.

EVENTS WE NEVER EXPECT TO WITNESS.

No. 1.



Mr. Godfrey C. Isaacs listens-in on his home-made receiver.

(This is the first of a series of cartoons which will appear at irregular intervals.)

THE IDEAL RADIO SOCIETY

By *A. B. GINNER.*

Although the following article is mostly fiction, it contains many useful and practical suggestions which could profitably be adopted by amateur radio societies.

I BECAME interested in wireless, and following the usual procedure adopted by the majority of beginners, I bought some handbooks and one or two wireless periodicals and proceeded to devour them.

I made a set—two sets, one a crystal and the other a valve set—and made the acquaintance of a regular experimenter and had my handiwork tested upon his aerial.

The set worked ("functioned," I believe is the proper word) quite well and, naturally, I was very pleased. The next step, obviously, was to secure a licence and erect an aerial of my own. I commenced to make enquiries and for this purpose visited two or three local experimenters—or rather, two or three local gentlemen who had wireless apparatus and aerials erected.

One possessed a Broadcast Licence and a B.B.C. receiving set to which (this is confidential) he had added a single-valve amplifier of his own construction.

Another possessed an Experimental Licence and a smart-looking and apparently efficient four-valve receiving set which, however, he appeared to use principally for the reception of broadcast transmissions. Very loud Morse signals were received whilst I was present. Shipping, I was informed, but—he didn't know the Morse Code.

At my third calling place I discovered a young man who apparently did not have a regular receiving set. He had a useful work bench, however, and a good stock of various component parts which, so I gathered, formed a receiving set an hour or two before my arrival.

He was experimenting. He was re-arranging his apparatus in order to test a new circuit which . . . I did not understand it, of course, but I felt sure it was frightfully interesting. In a corner he had a complete (more or less) low-power transmitting set with a great number of connecting wires visible. These, I was informed, were only temporary, and as soon as time permits, the set is to be properly finished off.

This was the experimenter I had been looking for, and I poured forth my string of eager questions. He advised me. "Like everything else worth while," he said, "You must serve your time to it. You cannot expect to play Chopin without the preliminary five-finger exercises." The statement appeared reasonable. I agreed.

After further conversation he invited me to visit the local Radio Society with a view to becoming a member, and I arranged to call for him the following evening for that purpose.

Morse Practice

Upon entering the Club Room I discovered some twenty members, in two groups, each group seated around a long trestle table at opposite sides of the Club Room. The Club Secretary came forward to greet me and, after the usual preliminaries, he explained what was going on.

The members, he said, were qualifying in accordance with a scheme drawn up by the Club Committee, before making application for Experimental Licences. Compliance with the first part of the scheme demanded an ability to send and receive Morse Code at a speed of not less than 12 words per minute.

The two groups of members represented the elementary and the advanced Morse classes. The elementary class, under an instructor, were provided with a long wooden batten, hinged in four sections and carrying two conducting wires and 10 pairs of terminals. To 9 pairs of the terminals were connected, by means of short flexible wires, 9 cheap transmitting keys, apparently ex-Government stock, whilst to the remaining two terminals, approximately in the centre of the wooden batten, were connected a buzzer and dry battery. The arrangement is shown in Fig. 1 (top) and, from results obtained, it appears excellent for rapidly learning the actual sound of the letters of the Morse alphabet. The instructor simply *sends* each letter two or three times, which is repeated right round the table, and, as soon as ten letters are thus learnt, and transmitted consecutively several times round the table, practice code groups, including only those letters, are sent by the instructor and written down by the learners. Three weeks of this tuition, in conjunction with home practice, either with a key and buzzer or merely by humming the Morse sounds from the text of a newspaper during spare moments, appears to be sufficient to enable an absolute beginner to master the alphabet, and to identify letters by the *sound*.

The group of members around the second table were provided with a similar wooden batten in four sections, but this time it carried three conducting wires and 36 terminals in 12 groups of 3. Twelve transmitting keys and twelve sets of ex-Government 40-ohm telephone receivers, a buzzer, dry cell battery and a pair of coupling coils were also provided and arranged as shown in Fig. 1 (bottom).

Each key position was allotted a call sign, and the complete arrangement permitted excellent practice in the interchange of signals between the 12 "stations."

Each member at this table was provided with a copy of the Postmaster-General's Handbook for

Wireless Operators. The regulations regarding the prevention of interference and the correct procedure to be adopted in calling up or in answering a call had been read, discussed and actually practised on the buzzer circuit and, at the time of my visit, the abbreviated Code signals (QRA, QSA, etc.) were being learned and practised.

The Club Secretary explained to me that the scheme or course mapped out by the Committee included, in addition to the Morse requirements, instruction in elementary principles of wireless, the theory, construction and operation of both receiving and transmitting apparatus. Only those members who actually wished to install an experimental transmitting set would actually make application (per the Club Secretary) to undergo the necessary examination which, it was hoped, might take place upon the Club premises. The remainder would have their applications for Experimental Receiving Licences supported by a strong letter of recommendation from the Club Committee. So far, five members desire to install transmitting apparatus, and a sixth, though unable to install his own apparatus, intends to qualify and pass the examination with a view to becoming the official Club operator.

These six members were also engaged, under the guidance of an experienced member, in constructing a low-power C.W. and telephone transmitting set for the Club, which thus benefited considerably.

Lectures

On enquiring with regard to the type of lectures, etc., given during the hour following the Morse practice, I was informed that this matter, too, had received the attention of a thoughtful Committee, and upon three evenings of each month there were two short lectures or "talks," one elementary and one more advanced, each of half an hour's duration. These lectures were planned out in proper sequence, allotted to and delivered by the more experienced Club members, who, although only few in number, had agreed to undertake this pioneer work.

The fourth meeting night of each month was reserved for any special attraction such as a visiting lecturer from a neighbouring Society, a "members and friends" demonstration night, or a similar purpose.

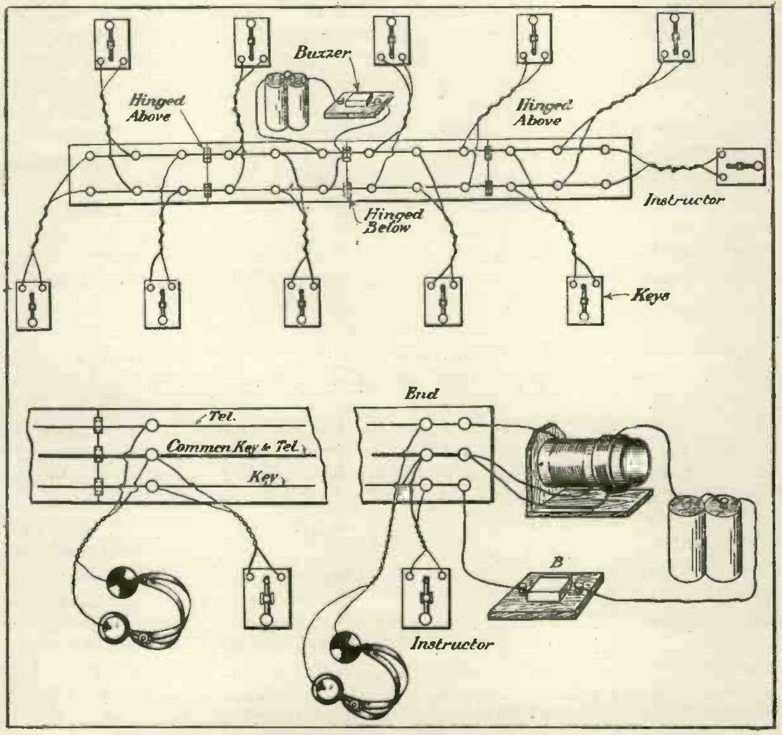


Fig. 1.—The sending and receiving arrangements at the Ideal Wireless Society for teaching the members the Morse code.

Demonstrations

Instead of laying out precious capital upon a complete receiving set, the Committee have invested it in a useful collection of standard components, by means of which, assembled upon a table or a convenient wooden baseboard, the results obtained with various arrangements of apparatus may readily be demonstrated by the lecturer without having to transport his own gear.

It is also possible by this means to give a prompt trial of almost any new circuit as recommended in any of the wireless periodicals.

The components in question, which include standard valve panels with valve-holder, rheostat with four terminals, variometers, single slide inductances, L.F. intervalve transformers, variable condensers, an assortment of small fixed condensers, one or two crystal detectors, a 60-volt tapped H.T. battery and a 40-ampere hour, 6-volt accumulator, are all looked after by two members of the Committee who are capable of seeing that the apparatus is in order and available when required.

Subscription

Frankly, I was so pleased with the business-like organisation of the Society, and anticipated deriving such considerable benefit from membership, that the question of subscription rates appeared to me quite a secondary matter. I quite appreciated, however, that possibly in the case of some of the junior members this might not be so, and I mentally commended the forethought which provided for their entering at half fee and the payment of a reduced subscription, by weekly instalments if desired.

I joined the Society. Weekly I transmit and receive signals in the Morse Code with zest and, I believe, fair accuracy. I supplement the club lectures by home reading, drop into the box provided my questions on any technical points which puzzle me, and feel that I am on the highway to becoming a competent experimenter.

THE NEW FLEWELLING "SUPER" RECEIVER

By E. H. CHAPMAN, M.A., D.Sc. (Staff Editor).

At the time of publishing the "Flewelling" circuit in No. 6, page 372, we had not experimented with this circuit. The following article, however, speaks well for its virtues and abilities.

THE Flewelling super-regenerative circuit is one which will provide the experimenter with a basis for a good deal of interesting experimental work. A receiver built on the Flewelling principle is easily put together, and what will no doubt appeal to the wireless enthusiast is that the extra parts required are by no means costly. If home-made, the cost of these extra parts is almost negligible.

Apart from its low cost and the ease with which it can be built, the Flewelling receiver has one or two distinct advantages over the better-known Armstrong super-regenerative receiver. The first point in its favour is that it is easy to work, and a second point which will be appreciated is that it does not require a large high-tension voltage.

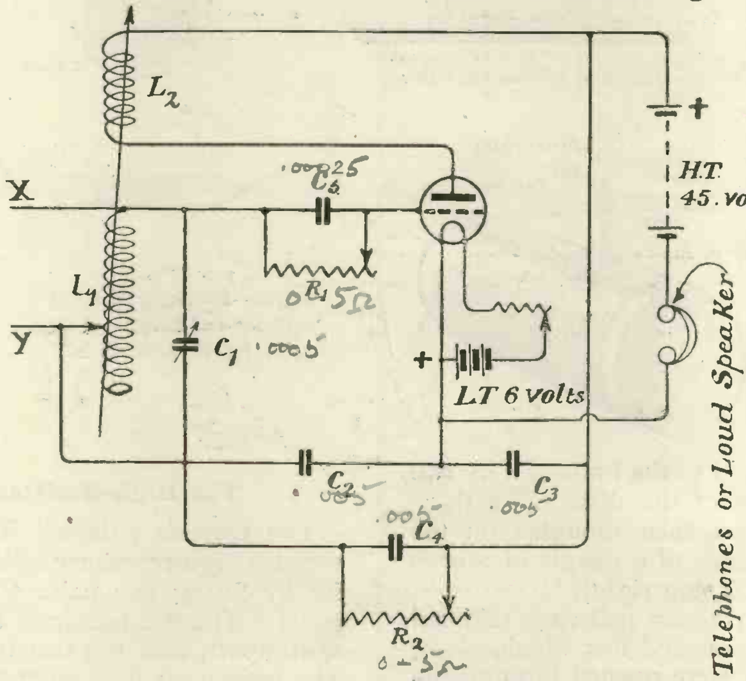


Fig. 1.—The Flewelling circuit.

A glance at the circuit diagram of Fig. 1 will show that the Flewelling circuit is a one-valve regenerative circuit to which is added a group of fixed condensers of the rather high capacity of 0.005 μF. It will also be noticed that there are two variable high-resistance leaks, one in place of the usual fixed gridleak and the other across the group of condensers.

The circuit may be used with an outdoor aerial connected at X and an earth connected at Y. Either the aerial or the "earth" may be used alone, but if the "earth" is used alone it must be connected at X. A frame aerial may also be used across XY.

In the circuit given in *Wireless Weekly* No. 6 (May 16th, 1923), page 372, L_1 and L_2 are De Forest or Igranic coils numbered 50 and 75 respectively. These coils are mounted on a two-coil holder providing variable coupling. C_1 is a variable condenser of maximum value 0.0005 μF. C_2, C_3, C_4 are fixed condensers 0.005 μF each, and C_5 is a grid condenser of 0.00025 μF. R_1 and R_2 are variable high-resistance leaks having a range of 0 to 5 megohms.

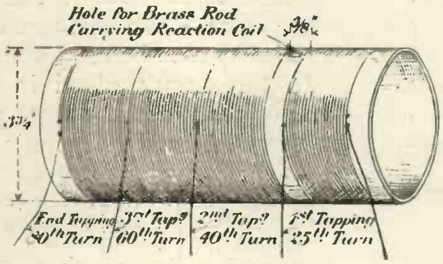
It is stated that the circuit will work with any kind of hard valve, and it will function with the dull emitter valve which only requires a battery of 1½ volts.

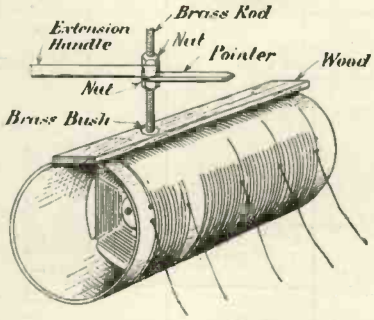
Vario-Coupler

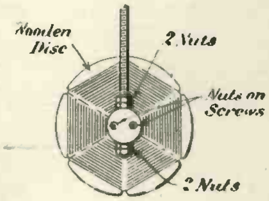
To turn to the Flewelling receiver made by the present writer, the first point of interest is that a vario-coupler was substituted for coils L_1 and L_2. In this vario-coupler the aerial tuning inductance was wound on a cardboard cylinder 3¼in. in diameter, the wire used being 24 d.c.c. A first tapping was taken off from the 25th turn, and after this tapping a space of ⅜in. was left for the spindle of the reaction coil. Subsequent tappings were taken off about the 40th and 60th turns (see Fig. 2, left). The tappings and end of the winding (80 turns in all) were taken to the contact studs of a selector switch.

The reaction coil was made of three spider coils wound on cardboard discs, the three being connected up in series. The wire was again 24 d.c.c. Each disc had an outside diameter of 3⅜in. and the inside diameter was 1in. There were 30 turns of wire on each card.

To mount the three coils, a circular piece of hard wood 1in. in diameter and ¼in. thick was cut. Through this piece of wood a hole was made and a brass rod 4in. long was pushed through the hole. The wooden disc was securely fastened to the brass rod by two nuts at either edge of the disc. The three cardboard discs were then mounted on the wooden disc by means of a couple of screws and nuts (see Fig. 2, top right).







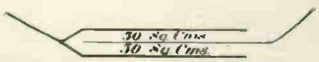


Fig. 2.—Reading from left to right, top and bottom, are the figures referred to in the text.

The ends of the reaction coil were soldered to pieces of rubber-covered flex which, along with the brass rod, were pushed through the hole left in the cylindrical former. After this was done, a strip of wood provided with a metal bush to take the brass rod was screwed on to the outside of the cylindrical former, the wood projecting an inch at each end. Fig. 2 (bottom left) shows the complete vario-coupler. The extension handle and pointer were not fitted, of course, until the coupler was mounted on the panel.

The Condensers

The fixed condensers C_2, C_3, C_4 were made in the usual way with copper foil and mica. Each condenser consisted of three pieces of copper foil having an effective (overlapping) area of 50 square centimetres. The *total* effective area in each condenser was therefore 100 square centimetres (see Fig. 2, bottom right). As the mica used was 0·12 millimetres thick, the capacity of each condenser worked out at about 0·006 μF.

The condensers were assembled between thin pieces of wood 3½in. square, faced inside with waxed paper. All three condensers were screwed to a block of wood ⅜in. thick. By means of three screws this piece of wood was firmly fixed edge on to the panel. The variable condenser C_1 and the grid condenser C_5 were also constructed by the writer. In the variable condenser there were 14 moving vanes, and in the grid condenser there were two pieces of copper foil each having an effective area of ⅞in. by ⅞in.

The High-Resistance Leaks

The variable gridleak R_1 and the second variable high-resistance leak R_2 were provided for by fitting two pairs of terminals on the panel. The two terminals for R_1 were placed 2½in. apart, and the two for R_2 1½in. apart. The resistances used were strips of thin cardboard soaked in Indian ink and afterwards well dried. Trials were made with a number of strips cut to different widths. A good width for R_1 proved to be ¼in. wide, while for R_2 the best width was 1in.

Fig. 3 shows the lay-out of the panel as seen from underneath.

High-Tension Voltage

Various trials proved that 45 volts as given in *Wireless Weekly* was the best value, the valve being an Ora.

Results

In the experiments carried out with the Flewelling receiver here described, a frame aerial consisting of 10 turns of bell-wire 18 s.w.g., spaced $\frac{1}{4}$in. round a square of side 2ft., was used. With this frame aerial 2LO was loud enough to give loud-speaker signals just audible across a room 12ft. wide. This was at a distance of 14 miles from 2LO.

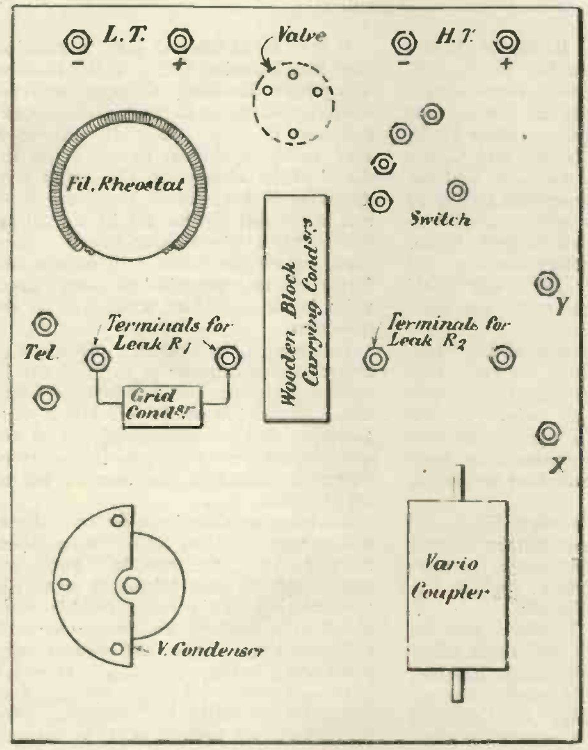


Fig. 3.—The lay-out of the panel

The speech was noticeably clear. Attaching the earth wire to the terminal X, no aerial being used, resulted in signals almost as strong as those from the frame aerial.

Using an outside aerial and "earth" after 2LO had closed down, several London amateurs were heard as strongly on the one valve Flewelling set as on a two-valve Reinartz set employing one detector valve and one note magnifier.

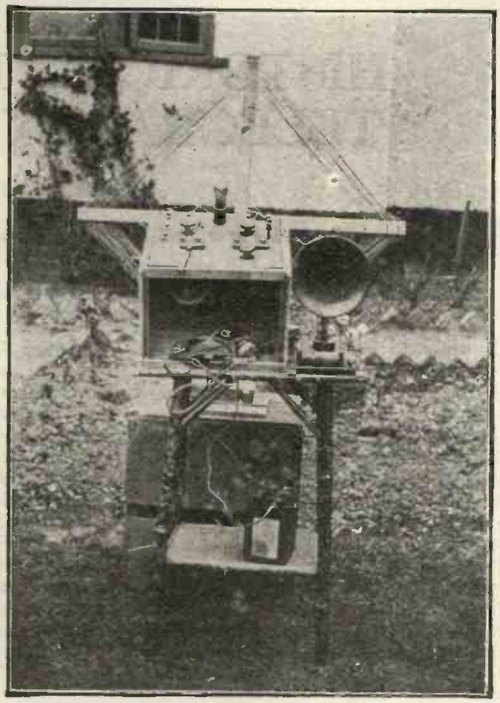


Fig. 4.—A general view of the apparatus described herein.

To sum up, a Flewelling one-valve receiver will accomplish as much on a frame aerial as a single-valve circuit with reaction will accomplish on a good outdoor aerial.

A Flewelling receiver is not only worth making, but is worth making well.

Fig. 4 is a photograph of the apparatus, the front of the box having been removed for purposes of permitting the interior to be examined at will.

The frame aerial is seen behind the set with the loud-speaker, of the Baby Brown type, on the right.

Experimenters wishing to try this circuit for themselves should experience little or no difficulty, for with a little thought and intelligence its construction is perfectly simple and straightforward.

In the opinion of the writer experiments in this direction should open unlimited scope and provide considerable interest.

We regret that, owing to the demands upon our space, our feature "MAINLY ABOUT VALVES" is unavoidably held over until next week.

HISTORICAL NOTES ON RADIO-TELEGRAPHY AND TELEPHONY

By G. G. BLAKE, M.I.E.E., A.Inst.P.

A Paper read before the Radio Society of Great Britain on April 25th, 1923.

In order to give a really complete history of Radiotelegraphy and Telephony, it would be necessary to go right back to the earliest experiment in electricity conducted by Gilbert, during the reign of Queen Elizabeth, and record the great discoveries of Ampère, Volta, Faraday, Cavendish, Kelvin, and all the other great men of science, who by their work and discoveries first brought the science of electricity to a sufficient state of advancement for radiotelegraphy to be even thought of.

Probably the first suggestion of making use of electricity for the wireless transmission of signals is to be attributed to Professor Steinheil of Munich, who had been carrying out a test (in the year 1838) in line telegraphy between Nuremberg and Fürth, endeavouring to use the railway lines in the place of properly insulated telegraph wires. Although this proved a failure, it led to a most important discovery.

Attributing the failure to leakage of electricity through the earth between the rails, the idea occurred to him that if the earth were so good a conductor of electricity, it could be used for the return of a current after it had passed along a single telegraph line, in place of the return wire which had always been employed up to that time. The experiment proved entirely successful and is one of the most important contributions towards successful telegraphy.

Steinheil then continued his experiments and endeavoured to trace out the area covered by the current, as it returned through the earth, and he was able to detect earth currents, which he picked up in another circuit having no metallic connection with the transmitting circuit. I will quote a paragraph from his own account of these experiments. " For distances up to 50 feet, I have found the possibility of such electric communication by experiment; for greater distances we can only conceive it feasible by augmenting the power," and again, " It only holds good, however, for small distances, and we must leave it to the future to decide whether it will ever be possible to telegraph to great distances entirely without metallic connections."

In 1842, Prof. S. F. B. Morse (Superintendent of Telegraphs to U.S.A. Government), when giving a demonstration of line telegraphy at the request of the American Institute of New York, between Governor's Island and Castle Garden, a distance of one mile, had the demonstration entirely spoiled owing to a vessel weighing its anchor, and in so doing cutting his submerged cable. Owing to this accident the idea occurred to him that possibly the water itself might be employed to carry the electricity across.

This experiment proved entirely successful. Metallic plates on each side of the river had to be placed, however, further apart than the width of the river, necessitating the use of considerably more wire than would have been needed for a direct connection across the river.

In Great Britain, in 1845, Cook and Wheatstone carried out similar experiments and used an instrument (a forerunner of Lord Kelvin's Syphon Recorder) designed by Wilkins.

In 1843, Bowman Lindsay, who by the way predicted the universal adoption of electricity for lighting, heating, and power, successfully carried out experiments very similar to those of Morse, across the Tay, where the river was three-quarters of a mile wide, and by placing his line wires at an angle he eliminated any effects due to induction.

We now come to an American dentist, Mahlom Loomis, who took out a patent in 1872 (four years after the introduction of the high bicycle). He speaks of his discovery as a means of turning natural electricity to account for " establishing an electrical current or circuit of telegraphic or other purposes without the aid of wires, batteries, or cables." By this method he hoped to telegraph from one continent to another. He ran up two kites on adjacent mountain tops and succeeded in signalling from one to the other by discharging electricity collected from the atmosphere to earth from his transmitter; but nothing further appears to have come of his scheme although it is interesting to note that Mahlom Loomis was the first to employ vertical conductors or antennæ for the transmission of signals to a distance.

It may be of interest here to mention that Mr. Maurice Child, of the London Telegraph Training College, successfully carried out a somewhat similar experiment in 1909. One day during a very heavy hailstorm he used the induced static charge on the aerial produced by a dense black cloud overhead and succeeded by its aid in signalling three miles (to Charminster). The cloud raised the aerial (which was 180 feet high) to a potential of some 25,000 volts for a period of some five or six minutes.

In about 188n Professor Trowbridge carried out a number of experiments in radio communication between ship and ship, similar to those of Morse and Lindsay, and he also made use of an entirely different principle, i.e., electromagnetic induction, in another set of experiments.

To communicate between two ships, a wire was stretched ten or twelve times to and from the vessels' yardarms and connected to a telephone or to his transmitting instruments (which consisted of a battery, an interrupter and a Morse key). The coils would only work when in the same plane. Here we have suggested, I believe, for the first time, the possibility of " direction finding " between vessels when in a fog.

This method proved unpractical, as the induction effects were only workable over very short distances.

We now come to the work of Professor Hughes.* Unfortunately, none of his investigations were published until 1899, although he gave a private demonstration in 1879 to several members of the Royal Society, Sir Wm. Crookes, Sir Roberts Austen, Sir Wm. Preece and Professor Adams. In February, 1880, he gave a similar demonstration to Mr. Spottiswoode (President of the Royal Society), to Prof. Huxley, and to Sir Geo. Stokes, and again in 1888 to Professor Dewar and Mr. Lennox, so that his work is fully authenticated.

Briefly the following were his discoveries. When engaged on some work with an induction balance, he noticed some peculiarities in the behaviour

* An account of his experiments, by Mr. A. A. Campbell Swinton, appears in the *Journal of the I.E.E.*, 1922.

of a loose contact in the circuit. This caused him to carry out a series of experiments with loose contacts, and he discovered that on the sudden interruption of a current in any coil the extra current at break caused the emission of "invisible electric waves," which became evident if a microphonic joint were used as a receiver with a telephone, and he showed that these waves penetrated through solid walls and apparently travelled to great distances. He transmitted signals in this manner to a distance of about 60 feet about his house, and on several occasions he walked up and down Great Portland Street with the telephone to his ear, and heard signals to a distance of 500 yards. He also noticed that the waves were reflected by some of the buildings. The following statement appeared in the *Globe* of May 12th, 1899. "Hughes' experiments of 1879 were virtually a discovery of Hertzian waves before Hertz, of the coherer before Branley, and of Wireless Telegraphy before Marconi and others."

Speaking of the work of Professor Hughes, Mr. Munro says, "Professor Hughes had, step by step, put together all the principal elements of the wireless telegraph as we know it to-day, and, although groping in the dark before the light of Hertz arose, it is little short of magical that in a few months, even weeks, by using the simplest means, he has forestalled the great advances of Marconi by nearly twenty years."

Mr. Campbell Swinton collected a quantity of Hughes' early apparatus, which is now deposited in the Science Museum at South Kensington, and he has very kindly borrowed it to illustrate this lecture.

In an article which appeared in the March number of the *Telegraph and Telephone Journal* for 1923, Mr. J. J. Tyrrell describes the tests of Hughes' Type-printing Telegraph now proceeding on a duplex system between the G.P.O. London and Berlin. There is another route working the other way direct from Königswusterhausen to an aerial on the roof of the G.P.O. in London. The writer says: "Hughes' wireless trial between London and Berlin has been succeeded by two or three weeks working live traffic, several hundreds of telegrams having been successfully and expeditiously dealt with for the first time by means of this printing system. There is no doubt in the writer's opinion that the Hughes apparatus lends itself well to wireless transmission owing to the practical absence of any lag due to long submarine or other metallic conductors."

I have since ascertained that this duplex system commenced handling serious traffic in an auxiliary service on January 23rd, working between 11 and 4. Twenty-five messages an hour are handled each way simultaneously.

Three or four years after I first became infatuated with the study of wireless I succeeded, in 1907, in signalling from my father's house to that of a friend (a distance of some 200 yards), using the spark at the contacts of an electric bell to energise the aerial, and receiving the signals by aid of my iron sulphide detector and a telephone. I described the transmitter and detector in the *Model Engineer and Electrician*, November 26th, 1908, and October 7th, 1909, and afterwards succeeded in transmitting signals from a primary spark to a distance of one mile.

In 1882, long before the publication of the work of Professor Hughes, Professor A. E. Dolbear, of Tuft's College, Boston, America, almost achieved success in radiotelephony. He succeeded in telephoning to a distance of half a mile, and, it is said, telegraphing nearly twelve miles.

With his arrangement the earth was charged to 100 volts or more positive by a coil, at the transmitting end, and to 100 volts negative at the receiving end. At first he used condensers, but later he used aerial wires to kites. He suggested using this method for communicating between vessels at sea. He also used a Morse key and replaced the microphone by an interrupter.

When we come to speak of the early Marconi system a little later in the lecture we shall see how very near Dolbear got to complete success, yet, being before the time of Hertz's discovery of the means of propagating electro-magnetic waves or the invention of Righi's oscillator, he just missed the one essential part of the apparatus, *i.e.*, the spark-gap, which, had he connected it across his coil between the aerial and the earth, would have converted his electro-static effects into electric-magnetic waves, which would then have travelled far into space, and instead of only being able to work to short distances he might have achieved the astounding results of Marconi.

At the conclusion of Professor A. E. Dolbear's book, "The Telephone," published in 1878, the following striking phrase occurs: "Mechanism is all that stands between us and aerial navigation, all that is necessary to reproduce human speech in writing and all that is needed to realise completely the prophetic picture of the *Graphic* of the orator who shall at the same instant address an audience in every city in the world."

In 1885 Edison invented a system for telegraphing to and from trains in motion, making use of existing telegraph lines, running parallel to the track, and he was able to signal along them simultaneously with the ordinary messages, which they were conveying across the country, without interfering with them in any way, and without any interference from them. This was the forerunner of our wired wireless.

Referring to later days, it is well known that on November 3rd, 1922, the Lord Mayor of Bristol spoke from Bristol to Marconi House, from whence his voice was broadcast far and wide. He did this by wired wireless over the ordinary trunk telephone lines between London and Bristol, and all the while ordinary conversation was carried on along the same lines without any mutual interference. Of course, the system used was very different, Edison's scheme being only the germ of the idea.

Charles A. Stevenson, in 1892, signalled from the mainland to the North Unst Lighthouse on the isle of Muckle Flugga by an induction method between two coils, one consisting of five or six turns of wire supported on telegraph poles around the circumference of the island and the other on the mainland.

In March, 1882, the telegraph broke down between the Isle of Wight and Hurst Castle, and while the cable was being repaired Preece succeeded in signalling across the Solent, using earth plates in the water at Portsmouth and Ryde, and again at Sconce Point and Hurst Castle. Having succeeded in this, he experimented further in the Bristol Channel in 1892, between Lavernock Point near Cardiff, and the two islands of Flatholm and Steepholm.

A wire about 1,500 yards long was run along the mainland and earthed at each end. In the length of this wire a dynamo was included, which supplied a steady current of some 15 amperes, broken into pulsations by an interrupter, and the signals were sent by a Morse key. A similar wire was stretched right across each island in a position parallel to that on the mainland, and signals were picked up on a telephone receiver inserted in the line.

Willoughby Smith's method was suggested in 1887, and on the recommendation of the Royal Commission for Lighthouse and Lightship Communication, was adopted in 1896 for communication between Crookhaven in Ireland and the Fastnet Rock Lighthouse. This lighthouse is situated off the extreme S.W. corner of Ireland, in a very exposed position; consequently every time a submarine cable was laid across, it was quickly chafed against the rocks by the rough seas and broken. To remedy this, Willoughby Smith laid a cable from the mainland which entered the sea in a sheltered cove and was laid to within about 100 feet of Fastnet Rock, where it was connected to a large mushroom-shaped anchor of metal. The two ends of the cable across Fastnet Rock were let down into grooves specially cut in the rock to protect them from the seas, and made electrical connection with the sea by means of metal plates cemented to the rock. On the rock fifteen Leclanché cells were employed, giving a current of 1.5 amperes, and the current received at Crookhaven was 0.15 milliamperes.

(*To be continued.*)

ONE of the most interesting things which have been brought to light by observations made in various parts of the world on the electrical condition of the atmosphere is the so-called air-earth current. Although this current of electricity which passes from the air to the earth is extremely small at any one place, it amounts to something like 1,000 amperes when the whole surface of the globe is considered.

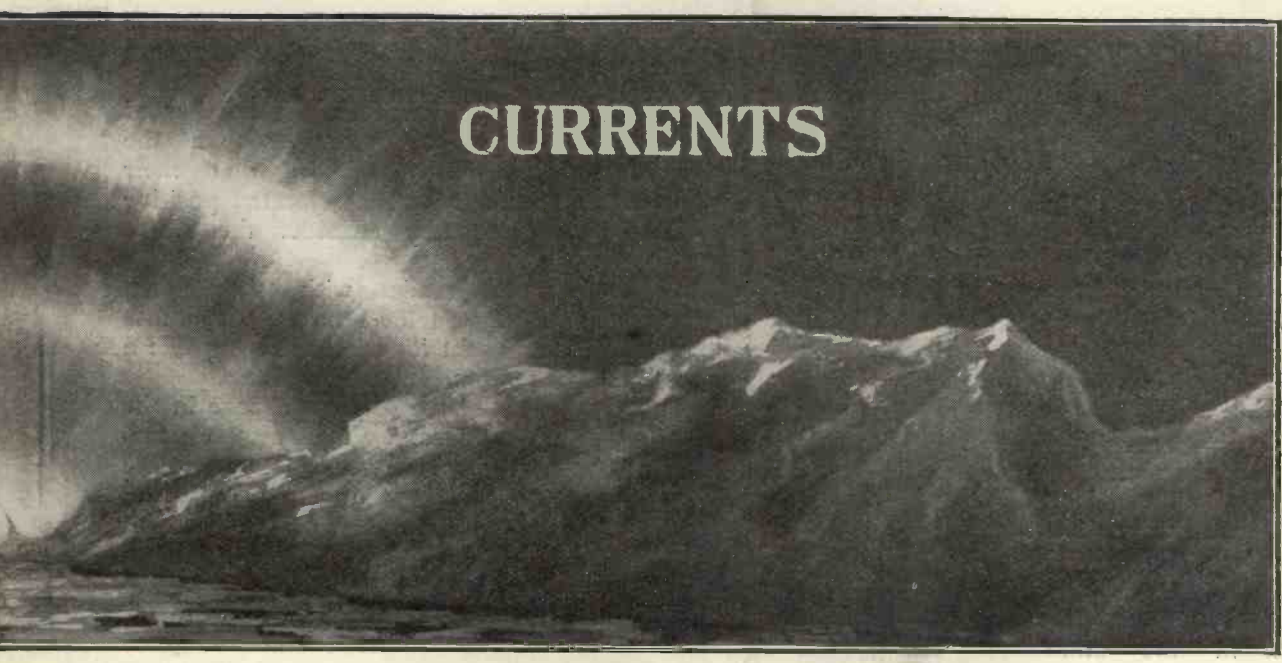
How this current is maintained is a mystery. It is as difficult for the modern scientist to explain the air-earth current as it was for the philosopher of long ago to explain why the rivers could keep on pouring their water into the sea without the sea becoming fuller.

In order to understand something of the nature of this air-earth current let us carry our minds back to a familiar experiment of our schooldays, the electrolysis of water. When water is subjected to the electrolytic action of an electric current, the water molecule is split up into hydrogen ions and oxygen ions. The hydrogen ion, charged with a definite quantity of positive electricity, travels *with* the electric current to the metal conductor by which the current *leaves* the water. The oxygen ion, charged with an equal quantity of negative electricity, travels *against* the current to the metal conductor by which the current *enters* the water.

In the electrolysis of water the electric current produces the ions. There is in the atmosphere some agency or other which is continually producing ions. This agency may be sunlight or it may be radio-active substances in the soil, for there is something present in all rocks and minerals which gives off, in greater or less amount, a supply of electricity to the air. In addition to giving off electric charges, some radio-active substances give off a gaseous material called an *emanation*, and this emanation has the property of making ions in the air.

Whatever this agency is, there is no doubt as to the presence of ions in the atmosphere. The Ebert apparatus for the measurement of the ionic charge in the atmosphere has been in use for many years.

Observations at ground-level usually give a decided excess of positive ions over negative ions. These positive ions and the negative charge on the earth attract each other. We are apt to look upon air as a non-conductor of electricity, and we are wrong in doing so. Air is a very bad conductor when compared with copper, but it is a conductor to some extent. If air were a perfect non-conductor there would scarcely be an appreciable air-earth current. The attraction between the positive ions in the atmosphere and the negative charge on the earth causes what amounts to the passage of an electric



current from the air into the earth. By reason of this current the earth is apparently gaining positive charge and losing negative charge. Yet the charge on the earth remains negative and the air-earth current continues to flow all the year round, being in England at a maximum in summer and at a minimum in winter.

From where does the earth get its negative charge and how is this charge maintained against the constant loss caused by the air-earth current?

One theory after another has been advanced to answer these two questions, but in spite of their ingenuity these theories have invariably been disproved by subsequent observations. At one time it was thought that rain brought down negative electricity, and so not only replenished the earth with water but also with negative charge. Unfortunately for this theory, soon after it was evolved, proof was given that in more than one part of the world rain is charged with positive electricity about four times as often as it is charged with negative electricity.

It was only natural that lightning should be looked to for an explanation of the maintenance of the negative charge on the earth, but an English physicist not long ago showed that the electricity brought to earth by lightning was at least as often positive as negative, so the lightning theory was abandoned.

The discovery that when ionised air is passed through capillary tubes the escaping air is positively charged and negative ions are left on the sides of the tubes led to a most ingenious theory. This theory was that the ionised air escaping through small cracks in the soil behaved in the same way as ionised air escaping through capillary tubes in that it left negative ions in the soil and carried positive charge to the atmosphere. If this ingenious theory were true we should expect to find more positive charge in the atmosphere when atmospheric pressure stood at 14 lbs. to the square inch than at 15 lbs. to the square inch, since more air would escape from the soil the less the pressure. In other words, we should expect the positive charge in the air to increase as the barometer fell and to attain a maximum at times of low barometer. Experiments have failed to show any decided preponderance of positive electricity in the air at times of low barometer, so this most ingenious capillary theory is not supported by evidence just where we should expect it.

Here is a new theory to account for the earth's constant negative charge and the air-earth current. When an electrically charged body is in rapid motion, its mass appears to be greater than when it is uncharged. The converse of this has been put forward as an explanation of the earth's negative charge.

The earth, originally uncharged, by reason of its rapid motion through space behaves as if it were negatively charged. Think it out, and when you next feel bored because of the ease with which you have mastered the double reaction circuit, or the super-regenerative "hook-up," or "S.T. 100," sit down and work out quietly a new theory as to the sustenance of the air-earth current and the earth's negative charge; but be careful that your theory is not one which can be tested by experiment.

The Ions in the Atmosphere

It will be seen from what has already been said, that the air-earth current is intimately connected with the presence of free ions in the atmosphere. The state of the atmosphere with respect to the number of free ions present is a thing of great interest to the wireless scientist. Much has been written on the effect of these free ions on wireless waves, and mathematical proof has been given that the presence of mobile ions in rarefied air helps the propagation of the electro-magnetic waves of wireless.

There are at least two kinds of ions in the atmosphere, *light* or *mobile* ions and *heavy* ions. The latter are also known as *Langevin* ions, being so named after their discoverer, Professor Langevin.

Heavy or Langevin ions are more numerous than light ions. Near a smoky town the preponderance of heavy ions is very pronounced. Langevin ions move very slowly, and their importance as carriers of electricity is nothing like so great as that of the light or mobile ions. Moreover, since the number of positive Langevin ions is about equal to the number of negative Langevin ions in the atmosphere, such ions neutralise each other as far as the total electric charge in the atmosphere is concerned.

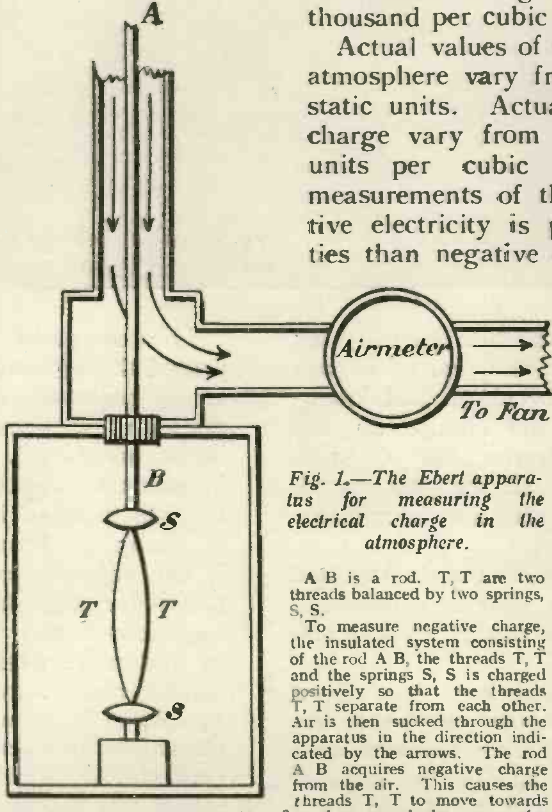


Fig. 1.—The Ebert apparatus for measuring the electrical charge in the atmosphere.

A B is a rod. T, T are two threads balanced by two springs, S, S.

To measure negative charge, the insulated system consisting of the rod A B, the threads T, T and the springs S, S is charged positively so that the threads T, T separate from each other. Air is then sucked through the apparatus in the direction indicated by the arrows. The rod A B acquires negative charge from the air. This causes the threads T, T to move towards each other. Their movement is measured on a scale by means of a microscope, the scale being at the focus of the eyepiece of the microscope. The movement of the threads measures the acquired charge. To measure positive charge the insulated system is originally charged negatively.

With light ions, however, the number of positive ions is usually greater than the number of negative ions, so that their presence in the air accounts for the positive charge which we may consider the air to possess.

Measurements made with the Ebert apparatus at ground level have shown that the number of light ions is something like a thousand per cubic centimetre.

Actual values of the *positive* charge in the atmosphere vary from 0·30 to 0·45 electrostatic units. Actual values of the negative charge vary from 0·25 to 0·40 electrostatic units per cubic metre. Practically all measurements of this kind show that positive electricity is present in larger quantities than negative electricity.

It is interesting to note that both kinds of electricity are present in the atmosphere in larger amounts in summer than in winter, and that mid-day values show a tendency to be higher than those for early morning and late evening.

The number of ions in the atmosphere increases as temperature increases, and an increase of dampness is usually associated with an increase in the number of ions.

In the higher regions of the atmosphere the number of ions is relatively greater than at the surface. This is due to the upper layers of the atmosphere absorbing more of the ionising rays from the sun than do the lower layers.

VALUES OF THE AIR-EARTH CURRENT.

Europe	$2{\cdot}9 \times 10^{-16}$ to $4{\cdot}4 \times 10^{-16}$ amperes per sq. cm.
India	$3{\cdot}6 \times 10^{-16}$ amperes per sq. cm.
Antarctic Regions	$7{\cdot}1 \times 10^{-16}$ amperes per sq. cm.

E. H. CHAPMAN, M.A., D.Sc.

AMERICAN VIEWS ON BROADCASTING

By M. C. RYPINSKY.

The Vice-President and Director of Canadian Brandes, Limited, and Chairman of the Radio Associated Manufacturers of Electrical Supplies, discusses the development of Broadcasting in U.S.A. and criticises our British Methods.

HAVING been privileged to be one of those officiating at the birth of Broadcasting in America, I have been asked to address you briefly on this subject, and in order that I may confine my remarks to matters of the greatest interest to you at this time, one of my London friends has kindly prepared for me a list of questions which I will now endeavour to answer.

Q. 1.—How did Broadcasting begin in America?

A.—In November, 1920, out of a public spirited desire to give the countryside the unique privilege of immediate and first hand information, the Westinghouse Electric and Manufacturing Co. at Pittsburg, Pennsylvania, broadcast the returns of President Harding's Election, moment by moment, as they came in by wire from all parts of the country. As a result many thousands who were prepared with receiving sets through newspaper announcements of the event were given a new thrill and the opportunity of hearing in their very homes the progress and the result of this important event before they went to their beds that night. The wonderful success of this demonstration, and the tremendous interest which it excited, brought forcibly to the attention of the officials of the Westinghouse Co. the importance of this new agency Broadcasting. Arrangements were soon made to continue in a regular and organised way the operation of the Pittsburg Station, quickly followed by the opening of another Westinghouse Station near New York, known as the Newark Station, call letters WJZ.

About this time other electrical companies became interested in the establishment of Broadcast stations, notably the Radio Corporation of America, the General Electric Co., the American Telephone and Telegraph Co., and other interests such as the newspapers, the department stores, the amateurs, and the Government itself took a hand in this new activity. Transmitting aerials sprang up all over the country with their corresponding myriads of receiving aerials, and Broadcasting became a by-word in more than one sense of the term.

Q. 2.—What is the relation of the American Government to Broadcasting?

A.—The Government, through the Department of Commerce, exercises a degree of control over Broadcasting, but not to the extent enjoyed by His Majesty's Postmaster-General.

Licences are required before one can operate a transmitting station, but are not necessary if one only desires to receive.

The transmitting licences are issued rather freely, under simple regulations designed primarily to prevent interference with peacetime military activities and the saving of life at sea.

For a time all Broadcasting stations were assigned the same wavelength, namely, 360 metres, but so much interference resulted that the Secretary of Commerce, Mr. Hoover, was moved to seek a solution of the difficulty and appointed an Advisory Committee made up of Government officials, radio engineers, and other interested radio authorities, to bring in recommendations.

The Committee recommended legislation giving the Secretary of Commerce increased control and discretion, and the setting aside of a wave band for Broadcasting to be allocated to the various stations under the discretion of the Secretary.

Secretary Hoover thereupon pressed for the enactment of this legislation, and Bills are now pending in the Senate, having passed the House at the last session of Congress. Meantime, Secretary Hoover created an additional wavelength of 400 metres for Broadcasting stations of 500 watts power, acceptably regulated equipment and high calibre programmes in an attempt to provide a place of minimum confusion in the ether for the better class higher power station.

This has not helped much, due to overlap interference from poorly regulated stations in the 360 metre class.

Q. 3.—Did the Broadcasting Companies begin voluntarily, or by arrangement with the Government?

A.—Broadcasting began spontaneously with the Broadcasters, and almost before the Government realised the situation it had grown out of hand, due, however, entirely to lack of discretionary power under the existing laws.

Q. 4.—How many Broadcasting Stations are there in America?

A.—There are about 700 licensed Broadcasting stations and about 3,000,000 unlicensed receiving stations.

The latter figure is, however, only an estimate, as no exact data is available.

As data bearing on this point, I offer the information that my Company, Canadian Brandes, Ltd., of London, Toronto, and New York, which is only one of about twenty makers of radio head telephones supplying that country's demands, has put out in America over 500,000 telephones since Broadcasting started there. It is estimated that the average receiving set includes two pairs of head telephones even where a loud-speaker is also installed.

Q. 5.—Is it a Fact that Two Broadcasting Stations may Exist in the same block on the same wave length and functioning at the same time?

A.—Unhappily, yes, as there is no regulatory control over the proximity of Broadcasting stations. Fostered by the Department of Commerce, however, steps have been taken to get the Broadcasters in a given area of interference to agree on an allocation of Broadcasting hours. This prevents absolute chaos, but it has the disadvantage that small 5 to 50 watt stations are given recognition equal to 500 watt stations and give inadequate Broadcasting over the area when they are operating.

Q. 6.—Have the Broadcasting Conditions in America produced chaos?

A.—To a degree, yes, although the public spirit of the Broadcasters and the influence of pending legislation are controlling in some measure to give passable, though by no means perfect, Broadcasting. Interference due to re-radiation, or reaction, as you call it here, makes reception difficult in certain localities at times, but the public is being educated up to the operation of their sets so as to minimise this effect, and the manufacturers are striving to eliminate re-radiation possibilities through improved design.

Q. 7.—What do you think of the British System of Broadcasting?

A.—I believe you have a much better plan than we in America, and one which we may have to approximate to if we are to solve our interference difficulties and provide a permanent source of revenue for Broadcasting. As you may know, the expense of Broadcasting now falls in part upon a few of the larger radio manufacturers, who write a small part of it off against the profits from the sale of radio apparatus, while the greater part is charged off to advertising. In the case of the newspapers, the department stores and others, all of it is borne as an indirect expense charged off probably to advertising. I cannot avoid, however, commenting unfavourably on the fact that your plan as at present carried out does not appear to protect the unsuspecting public from being offered merchandise which cannot be legally used, because it has not met with the approval of the Postmaster-General. I refer particularly to the poorly made and, no doubt, inferior merchandise of foreign make which appear in such quantities in the dealers' windows.

Q. 8.—Do you Approve of the formation of a single Broadcasting Authority?

A.—I do, and I am sure that we will welcome the day in America when the Secretary of Commerce may be made such an authority as the pending legislation proposes.

Q. 9.—Do you think that there should be more than one Broadcasting Authority in Britain?

A.—No.

Q. 10.—Do you think that the British Broadcasting Company is a monopoly when its membership is open to all *bona fide* British Wireless Firms? (It has already 485 members.)

A.—If I am correct in understanding that any *bona fide* British manufacturer is eligible for membership and in that you already have 485 members, I say most assuredly not.

Q. 11.—What is the attitude of the Theatre Managers of America to Broadcasting, and do they allow extracts from their plays to be broadcast?

A.—Originally some of the managers took a narrow view of Broadcasting, assuming that it would hurt their business, but now it is fairly well recognised as an excellent advertising medium, and the more progressive managers are permitting a single act, or parts of an act, to be broadcast, and are experiencing quicker general recognition of the merits of a production.

Q. 12.—Do they allow Theatre Artists to Broadcast from the various studios?

A.—Yes.

Q. 13.—What fees are the Artists paid?

A.—None, but it is usual to provide suitable transportation and dinner or supper, as the case may be.

Q. 14.—Is there any attempt on the part of the entertainment world in America to boycott Broadcasting?

A.—No. The boycott is in bad odour in America as our laws do not permit it in most cases.

Q. 15.—Do you think that Broadcasting will prejudice the Entertainment Industry?

A.—Does the production of gramophone records interfere with the production of grand opera or music publishing? Grand opera became popular in America only after the great artists were permitted to sing for record purposes.

So Broadcasting will serve to popularise still further the entertainment industry and to encourage the people isolated in their homes to make further tribute to this industry as new features are brought to their attention by radio Broadcasting.

Q. 16.—What is the attitude of American music publishers to Broadcasting?

A.—Recently they decided that they would attempt to collect against their copyright for Broadcasting rights. The Broadcasters denied their request and for a time eliminated copyrighted music from their programme. A vigorous protest was made by the public, and my latest information is that the association has decided to permit the free Broadcasting of copyrighted music for the present.

Q. 17.—What is the attitude of the American Society of Authors towards Broadcasting?

A.—I do not know definitely what action has been taken by them, but I am inclined to think they are awaiting the result of the music publishers' request, which has only just been announced.

After becoming more or less accustomed to adverse criticism of our methods, it is very refreshing to find them so heartily approved by one who is in a good position to know the difficulties attendant upon the establishment and development of Broadcasting.

THE POSITIVE ELECTRON

By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

PART V.—ELECTRICAL THEORY OF MATTER.

IN the last article we described how the negative electron, which is all-important in the conduction of electricity through solids and across the evacuated interior of a wireless valve, has been identified and how its electrical charge and its mass have been accurately determined.

Since matter is ordinarily uncharged, the electron exists under normal conditions in association with its electrical complement, the elementary positive charge known as the "positive electron" or "proton." The latter has a positive charge equal in amount to the negative charge of the electron, but its mass is that of the hydrogen ion; a hydrogen atom consists of one proton and one electron; a positive hydrogen ion (that is, a hydrogen atom having lost an electron) is in fact a proton or positive electron. According to present-day views, four protons, together with the same number of electrons, compose the atom of helium, and the atom of any element of higher atomic weight consists of a definite number of atoms of helium, if its atomic weight is divisible by four, or otherwise includes, in addition, one, two, or three protons.

Now these positive electrons are of considerable interest and importance in wireless; for, although in a hard rectifying valve the current is carried almost entirely by electrons, the action in soft amplifying valves depends largely upon the ionisation in the gas, and the proton here plays a vital part. The conduction of electricity through gases is also dependent upon the production of positive ions, and it is likely that future developments of wireless valves and possibly of other forms of wireless apparatus may involve the employment of fast-moving streams of positive gaseous ions.

Our knowledge of the elementary positive charge has come partly from a study of the phenomena of radioactivity and partly from a study of the conduction of electricity through gases. The wireless enthusiast is accustomed to read descriptions of the emission of electrons from heated substances, and accounts of the manner in which both negative and positive electrons may be manipulated by means of electric and magnetic fields. But since both are infinitesimal in dimensions, he may be excused for feeling sometimes that their existence and motions are rather in the nature of a speculation. It is therefore all the more striking to be able to reproduce pictures indicating the actual flight of an electron or proton through the molecules of a gas, and to show that the mental image which one forms of the motions and general behaviour of these electrical charges is substantially correct.

Fig. 1—The trail of the beta particle, indicated by water drops formed upon ions which are produced during its flight through a gas. (Reproduced from original memoir by C. T. R. Wilson.)

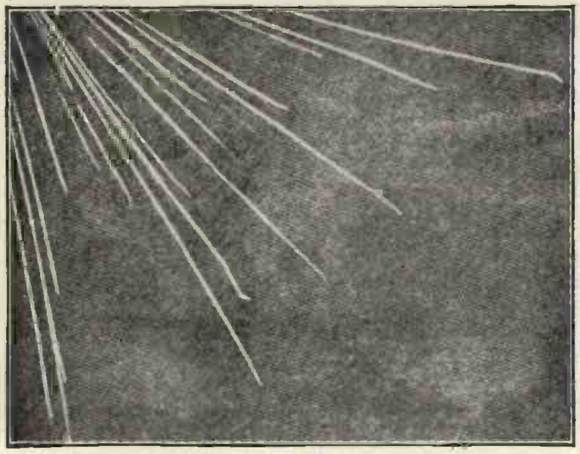


Fig. 2.—The trails of alpha particles, as indicated by their ionisation of the molecules of a gas through which they are projected. (Reproduced from memoir by C. T. R. Wilson.)

It will be remembered that C. T. R. Wilson has shown that both positive and negative ions act as centres for the condensation of super-saturated water-vapour, and that if super-saturation be suddenly brought about in a gas containing ions, each ion will be indicated by the formation round it of a minute water-drop. If we arrange conditions such that electrons or protons are projected into a gas in such a way as to cause ionisation by collision with the molecules of the gas, it ought to be possible, by producing super-saturation of water-vapour in the gas, to reveal, by the resulting water-drops, the track of each ionising particle, which leaves behind in its train the wreckage of the molecular or atomic systems with which it has been in collision. It will be appreciated, at the outset, that an experiment having such an ambitious object as the rendering visible of the tracks of ionising particles in this way will call for the highest degree of patience and manipulative skill. It has, however, been successfully accomplished by Wilson after years of toil. The method which he employed was to use a speck of radioactive substance emitting alpha and beta rays, the alpha rays being helium ions and the beta rays negative electrons. It should be explained that the velocity with which both alpha and beta rays proceed from radioactive substances is much higher than that which these particles acquire in a discharge tube or in a wireless valve, and it is largely on this account and on account of their greater ionising power that they are suitable for use in the experiment which we are about to describe.

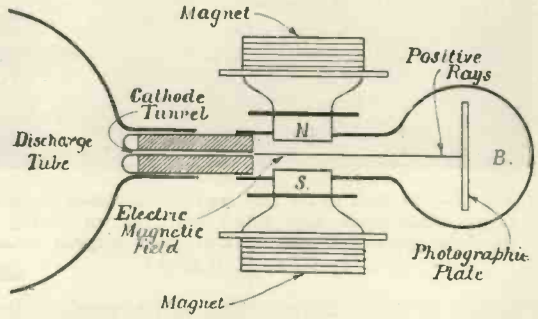


Fig. 3.—Diagram of apparatus used by J. J. Thomson for analysis by the method of positive rays.

The method of experiment was as follows :—The speck of radioactive substance was introduced into a gas saturated with water vapour, the gas being enclosed in a vessel with a flat glass top and a piston below which could be suddenly lowered through a definite distance. When this was done, the cooling produced by the adiabatic expansion caused a condition of super-saturation to be produced, and the next instant a flash photograph was taken of the gas in the chamber. Figs. 1 and 2 give examples of some of the results obtained. In Fig. 1 are shown the trails of beta particles (electrons) and in Fig. 2 the trails of alpha particles are shown. These pictures illustrate in a very striking way the projectile nature of the negative and positive electrons which are shot out from the radioactive substance. By careful examination of the tracks of the particles many interesting results may be deduced. It will be noticed, first of all, that the beta particle only produces an ion here and there. This is because the beta particle moves with such an enormously high velocity (sometimes between one-tenth and one-half the velocity of light), and does not remain sufficiently long in the neighbourhood of any particular electron, belonging to one of the atomic systems, to displace it permanently from its parent atom. It has been found that such a beta particle ionises about 1 out of every 10,000 gas molecules through whose systems it passes.

The alpha particles, however, cause a much greater ionisation in their track, and ionise millions of gas molecules in each centimetre of their progress. This is partly due to their greater mass and partly to their smaller velocity. In some cases it will be noticed that the track of the alpha particle is sharply deflected just before its conclusion. This is due to the reduction in the kinetic energy of the particle and its collisions with the nucleus of a gas molecule. It is probable that it has suffered similar collisions during the early part of its career, but its kinetic energy was then so great that it was not appreciably deflected.

Further experimental work of a somewhat different kind has been carried out on the proton by means of what are now known as "positive rays." The first important investigations on these rays were made by J. J. Thomson, by means of the apparatus shown in Fig. 3. A represents the discharge tube which contains gas at a very low pressure, whilst B is a chamber in which the highest possible vacuum is maintained. It will be noticed that the chambers A and B are connected by the narrow tunnel through the cathode, but the pressure of the gas in A is so exceedingly small that the flow of gas through the tunnel in the cathode (which may be one-tenth mm. diameter and five cm. long) is negligible. At the end of the second chamber is a photographic plate, facing the rays. When the discharge takes place, rays stream through the tunnel in the cathode and impinge upon the corresponding point on the photographic plate. If electric and magnetic fields are established across the poles N, S, the particles will be deflected and will strike the photographic plate at different positions. It can be shown by calculation that all particles of the same mass and electric charge will strike the photographic plate at some point on a parabolic curve, the particular position on the curve depending upon the velocity of the particle. Particles of a different mass and the same charge will distribute themselves, according to their velocity, upon another parabolic curve (Fig. 4). The important point is that the passage of the positive rays through the electric and magnetic fields has the effect of sifting them out according to their mass and electric charge; and, since these rays are ionised atoms or molecules of the gas in the discharge tube, their mass is approximately their atomic or molecular weight. The resulting set of curves on the photographic plate is thus an index of the atoms or molecules in the discharge tube and of their atomic or molecular weights. The positive-ray tube is, in a sense, a method of chemical analysis of extreme delicacy—a delicacy far transcending that of any method known to chemistry.

If the particles in the positive rays differ, not only in mass, but also in the electrical charge which they have acquired by ionisation in the discharge tube, the analysis becomes very complicated. For example, two particles, one having twice the mass of the other and twice the electric charge, will behave similarly under the electric and magnetic fields, and will not be distinguishable on the photographic plate. An important point for the present purpose is that the hydrogen atom has never been known, under any circumstances, to lose more than one electron, the remaining ion representing the isolation of the positive electron.

A recent and very searching analysis by the positive ray method has been made by Aston, who devoted himself particularly to certain lines which appeared to be in duplicate for a single element. The classical example is that of the gas neon, which gives two parabolic lines on the photographic plate, one representing an atomic weight of 20 and the other an atomic weight of 22. This means that neon, as prepared and purified by chemical methods, is really a mixture of two elements of atomic weights 20 and 22, which have identical chemical properties. More recently, many other cases of apparently pure chemical elements have been found to consist of mixtures of elements of different atomic weights but the same chemical character, and such elements are now known as "isotopes." Aston's method was very ingenious, and his results are probably accurate to less than one-tenth of 1 per cent. He made a very exact determination of the mass of the positive electron, and compared it with that of the hydrogen molecule and also with that of the helium atom.

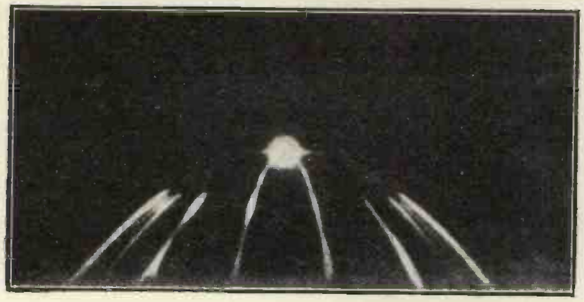


Fig. 4a—Example of the parabolic curves produced upon a photographic plate by the impact of the positive rays corresponding to different elements. (From original memoir by J. J. Thomson.)

By chemical methods the atomic weight of helium has been found to be 4.00 (oxygen = 16.00), whilst that of hydrogen has been found to be 1.008. Since the helium atom contains four positive electrons, it follows that the mass of the positive electron when built into the nucleus of an atom is slightly less than when free. Aston's method was as follows :—He exposed a photographic plate successively to ions of a given mass, then to ions of double mass but deflected by an electric field nearly, but not quite, double the intensity, and thirdly, to ions of double mass deflected by an electric field a little more than double the intensity, the field in the last case being as much over the double amount as it was under the double amount in the second case. In this way he obtained records for helium ions and for ionised atoms and molecules of hydrogen. His results are indicated in Fig. 5.

In the case of hydrogen alone, it will be seen that the deflection of the hydrogen molecule is exactly midway between those for the hydrogen atom, showing that the mass of the hydrogen atom is exactly half the mass of the hydrogen molecule; in other words, when the positive electron (the hydrogen ion) is built up into a hydrogen molecule it suffers no loss in mass.

In the case of helium, however, it was found that the mass of the helium atom was less than four times the mass of the positive electron; in other words, as has already been mentioned, a loss of mass occurs when the positive electrons are in association with negative electrons in the formation of an atom of any substance other than hydrogen.

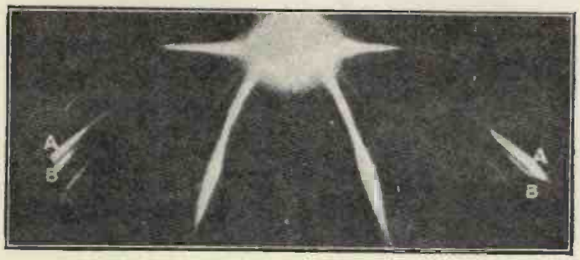


Fig. 4b—As in Fig. 4a. Lines A B represent the neon isotopes. (From original memoir by J. J. Thomson.)

These results are very striking, and constitute definite evidence of the existence of the element of positive electricity, complementary to the negative electron, and, when isolated, equivalent in mass to the hydrogen atom.

There is now a mass of evidence that the positive electron is a constituent of the nuclei of all atoms, and in the case of nitrogen, as was discovered by Rutherford in 1921, there is direct evidence that the positive electron is one of the units which make up the atomic nucleus.

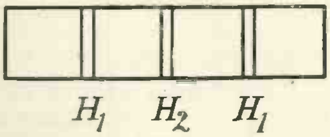


Fig. 5a.—Positive ray comparison of hydrogen atom and molecule.

The disappearance of mass, which in a sense may be called the "destruction" of matter, is rather a shock to some of the fundamental ideas which have prevailed for generations. The invariability of mass was one of the foundations of scientific belief. It is known also from direct experimental evidence that the disruption of a helium atom into positive and negative electrons requires the expenditure of energy, and one of the results is that matter is "created" (for the total mass of the four positive electrons knocked out of the helium atom is 4.032, whereas the mass of the original atom was only 4). Thus it appears that the extra 0.032 represents the creation of matter. It must be remembered, however, that in the process of this "creation," energy has disappeared, and it may be that matter and energy are, to some extent at any rate, manifestations one of the other.

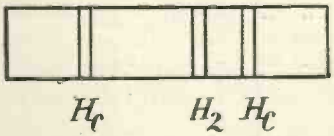


Fig. 5b.—Comparison of helium atom and hydrogen molecule.

The converse process, namely, the building up of a helium atom from positive electrons, has not yet been experimentally accomplished. If the hydrogen contained in a pint of water could be so transmuted, the energy liberated would be sufficient to propel a liner across the Atlantic and back again at full speed.

RADIO CONDENSERS

This forms the second and concluding part of an article dealing with properties of condensers.

(Continued from No. 7, page 430.)

Cumulative Effects and Causes of Breakdown

AN interesting point in connection with transmitting condensers is the breakdown voltage. This voltage depends upon the dielectric, of course, but is subject to different conditions from breakdown at constant voltage. A condenser may withstand a high voltage direct current indefinitely, but it may not withstand such high voltage at radio-frequencies indefinitely. After a while it breaks down, and this breakdown is due to a cumulative effect. As time goes on the losses heat the dielectric, and this heating deteriorates the insulating properties, so that it heats up still more, and the cycle repeats itself until a point is reached where the insulating properties have deteriorated to such an extent that it can no longer withstand the voltage. Experimenters do not generally understand this and think that breakdown is always due to poor dielectric or excessive voltage. This cumulative effect will explain many breakdowns.

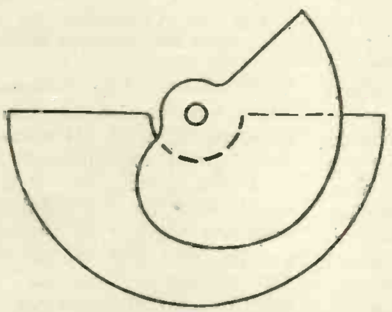


Fig. 3.—Specially shaped plates for wavemeter condenser.

Transmitting Condensers

The above details apply particularly to transmitting condensers. In purchasing transmitting condensers the only sensible thing to do is to buy one of the standard reliable makes, employing mica as dielectric for fixed condensers. Inquire about the voltage it will withstand if it is not marked on the condenser; reliable manufacturers have no hesitation in giving the maximum voltage and current carrying capacity.

If the amateur builds his own condenser made of mica he should observe the following: If high voltage is to be applied, build the condenser so that there are a large number of sections in series; in this way the voltage will be distributed over a larger number of condensers in series, thus reducing the possibility of breakdown. If high current-carrying capacity is the chief requirement, the condenser should be built of a large number of sections in parallel, distributing the current so that the heating effect is a minimum. If both requirements of high voltage and current-carrying capacity have to be met, then the condenser should be built of sections in series and in parallel. When using oil variable condensers, the chief precaution to observe is that the oil is a good grade of mineral oil with no particles of grit in it.

Receiving Condensers.

Receiving condensers do not withstand great voltages; nevertheless, they must be just as good as transmitting condensers, since the receiving energy is so small, and every fraction of energy lost in the condenser means so much weaker signals. Air and mica are the chief dielectrics used in receiving condensers. Paper and paraffined paper are frequently used for the cheaper types of equipment. The chief source of losses in air condensers is in the dielectric. The dielectric losses are not confined to the dielectric itself between the plates on the condenser, but also to the dielectrics and insulating material in any part of the electric field of the condenser. Insulating bushings, end plates, and supporting posts are dielectrics, and unless these are of the very best the losses in them will be considerable.

The variable air condenser most commonly used consists of the usual type of semi-circular plates, half of which are fixed and the other half movable, these plates interleaving. Maximum capacity is obtained when they are completely interleaved, minimum when they are not at all interleaved, and intermediate values in between. Such condensers are rated by their maximum capacities, as 0·0005 μF. The semi-circular plate condenser gives a straight line variation of capacity as shown in Fig. 1,* and when used in conjunction with an inductance coil as a wavemeter it gives a wavelength curve as in Fig. 2.* From this curve we learn that for small increases in capacity at the lower end of the scale there are large increases of wavelength, while at the upper end of the scale small increases in capacity give smaller increases in wavelength. Thus the wavelength scale is crowded at the lower end, open at the upper end, and non-uniform throughout the length of the scale. This results in inaccuracies when used in a wavemeter.

A Specially Shaped Wavemeter Condenser

In order to secure a uniform wavelength scale and hence greater accuracy in wavemeter measurements, it becomes necessary to use another type of condenser with specially shaped rotary plates. This is shown in Fig. 3, and is the so-called wavemeter type of condenser employing semi-circular fixed plates, but specially formed rotary plates, with the shaft eccentrically located. This particular type of condenser does not give a straight line capacity curve, but, in conjunction with an inductance coil, does give a straight line wavelength curve, as in Fig. 4. This shows that the scale is uniform and not crowded at any part, hence accuracy in measurement can be secured.

Hints on Purchasing Condensers

The prospective purchaser of variable condensers would do well to examine the condenser carefully and see that it meets with most of the following requirements. In the first place, if a receiving condenser is desired, the semi-circular type is preferable. If, however, the condenser is desired solely for wavemeter use, the special shaped plate condenser above mentioned should by all means be used. The experimenter might just as well become educated to the use of the proper instruments for each purpose in hand. The first requisite in construction is rigidity. All parts should be securely fastened, so that motion of plates will produce no loosening of parts. Some manufacturers to-day are so intent upon turning out as much junk at as cheap a price as possible that their manufacturing and assembling methods are not the most commendable, and disgraceful rickety affairs are to be seen everywhere. If loosening of the parts occurs there will be a variation of capacity of the condenser. The parts used in the assemblage should be substantial. It is preferable not to buy a condenser with stops, for when the rotary plates strike against the stops, jarring is produced which ultimately may result in loosening of nuts and hence altering the spacing of plates and also the capacity. Plates used in the construction of the condenser should be robust and not too thin, and should be level and not warped. Otherwise one plate which is warped may just strike its neighbour and produce a short circuit. Likewise the spacing washers should be examined to see that they are uniform.

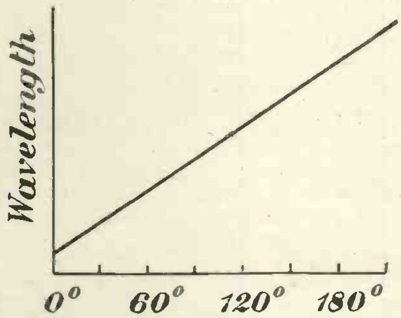


Fig. 4.—Wavelength curve for specially shaped wavemeter condenser.

The spacing between the rotary and fixed plates is small enough as it is, and any variation in washer thickness may result in the plates touching, and hence producing short circuit. End plates should be of the very best insulating material, rigid, and not warped. For a warped end plate will also produce short circuit, since the fixed plates are attached to it. Turn the knob on the condenser and listen carefully to hear whether there is any scraping or brushing of plates. A short or touching of the plates is easily detected that way. Note whether the movement of the rotary plates is jumpy, or smooth and regular, and avoid those condensers whose movements are jumpy.

The smooth motion of the condenser permits you to tune better, since you can cover the entire range of capacity by turning the knob. The jumping or hopping motion does not permit of good tuning, for when you turn

* See previous issue for Figs. 1 and 2.

your knob the plates jump over a large angle, due to poor mechanical design. There are many such condensers on the market. Be sure that the condenser has lugs attached for soldering your connections to it. Select the condenser which has a minimum of insulating material in its construction. This material should be ebonite. Fibre or composition end plates should always be avoided. Avoid, if possible, the choice of a condenser which has insulating material for bearings. Such a bearing is likely to wear with time, resulting in displacement of the shaft holding the rotor plates and hence resulting in alteration of the capacity and loosening of the shaft in bearings. These are the chief things to look after when buying a condenser, and are worth while remembering. Radio is a more complicated affair than one is apt to imagine after listening-in on one of these simple sets, and the best is not too good for one who wants to build a good radio set.

OPERA SYNOPSES

The following short stories are those of the operas to be broadcast from 2 LO on the dates given herein.

LA BOHÊME.

(*Friday*, June 1st.)

An opera of Bohemian romance played in four acts; composed by Puccini, scened in Paris 1830.

Cast:

Rudolph, a poet.
Schaunard, a musician.
Marcel, a painter.
Collins, a philosopher.
Benoit, a landlord.
Mimi, a flower girl.
Musetta, a grisette.
Parpignol, a toy vendor.
Alcindoro, a wealthy Parisian.

Act I.—Rudolph, Schaunard, Marcel, and Collins are living happily together in a Parisian garret amidst extreme poverty. The landlord arrives and claims his rent, but is discreetly got rid of. Rudolph is left alone and is visited by Mimi, seeking a light for her candle. Experiences and confidences are exchanged, resulting in Rudolph and Mimi deciding to share their lots together.

Act II.—The Bohemians are feasting and making merry and introduce to us Musetta, an old love of Marcel.

Act III.—Mimi, having quarrelled with Rudolph and also suffering from consumption, seeks Marcel, with a view to sharing her misery. She tells how, as a result of the quarrel, she cannot live with her former lover, and how also she cannot live without him. Marcel goes to fetch Rudolph, who, with Mimi once in his arms, quickly becomes reconciled. Marcel meanwhile quarrels with Musetta in a fit of jealousy.

Act IV.—In this act we return to the garret in which the opera opened to find Marcel and Rudolph at work. The other two Bohemians arrive and try to make merry over a frugal meal. Musetta comes in to tell of Mimi's extreme illness, and all hasten to help the invalid. They bring her in and place her upon a cot whilst all but Rudolph go out to buy food and stimulants for the sick girl. Mimi, however is beyond all human aid, and, lying in Rudolph's arms, she passes away.

I PAGLIACCI.

(*Saturday*, June 2nd.)

This dramatic opera, played in two acts, was composed by Leoncavallo. It is scened at a place near Montalto, in Calabria, during the 15th day of August, 1865.

Cast:

Canio (Clown), Chief of a troupe of strolling players.
Nedda (Columbine), his wife.
Tonio (Taddeo), a player.
Beppo (Harlequin), a player.
Silvio, a peasant.

Act I.—Canio and Nedda arrive at the village in Calabria, and, addressing the beholders of their arrival, tell them to be sure and see the evening performance. Tonio, another member of the troupe, makes the most of a quiet moment to plead his love for Nedda. The latter resents his attentions, having in her own heart a secret love for a villager by name Silvio. Tonio learns her secret, and in revenge for his rejection tells Canio, the husband. Canio surprises Silvio and Nedda together, but is unable to catch Silvio. Against his will, Canio is induced to make peace with his wife by the villagers.

Act II.—The show commences, and we see a play dealing with a jealous husband, who returns to find that his wife has been entertaining another man at supper.

The visitor escapes by the window, but the injured husband reproaches his wife.

The play-part so much expressing his personal feelings, Canio forgets his lines and jealousy claims his every thought. He seizes a knife and stabs Nedda to the heart. Silvio, who has seen the tragedy, rushes to assist Nedda; Canio, seeing him, again raises his knife, and Silvio falls dead. Canio, now a prisoner in the hands of the villagers, murmurs, as he quietly gazes at his two victims, "The play is over."

CAVALLERIA RUSTICANA.

(*Saturday*, June 2nd.)

This renowned opera, by Pietro Mascagni, is played in one act and scened in Sicily in the present time.

Cast:

Turidda, a farmer.
Lucia, his mother.
Alfio, a carter.
Lola, his wife.
Santuzza, a peasant girl.

Singing before the curtain rises, Turidda is heard declaring his former love. Lola, "lovely as the spring's bright blooms."

Alfio, whilst Turidda was away with his regiment at the wars, married Lola. Turidda turns for consolation to the peasant girl Santuzza, of whom, however, he quickly tires, and returns to Lola, in spite of her marriage to Alfio. On their way to church at Eastertide Santuzza meets Lucia, her lover's mother, and acquaints her with the position of affairs.

Turidda, appearing with Lola, treats Santuzza with contempt. The latter, in despair, tells Alfio of his wife's conduct, when subsequently Alfio challenges Turidda to a duel and kills him.

THE BROADCASTING COMMITTEE

Memorandum of evidence submitted to the Committee appointed to consider the agreement between the Post Office and the British Broadcasting Company, and the future of Broadcasting, by the Executive Committee of the London Labour Party.

1. In submitting this Memorandum of Evidence on the complicated problems which form the subject of your enquiry the Executive Committee of the London Labour Party desires frankly to intimate that it stands for the interests of listeners-in and the community as a whole. Having regard to those interests, other interests cannot be ignored, but in our view no monopoly must be allowed to stand in the way of the progress of wireless and the conferment of its advantages on the greatest possible number of the community at the lowest cost consistent with efficient service and due regard to the legitimate interests of all trades and professions.

2. At the moment the undoubted pleasures and benefits of broadcasting are in a state of confusion. It would appear that the public has only recently become aware of the provisions and implications of the Agreement between the Postmaster-General and the British Broadcasting Company, and there exists wide misunderstanding as to the obligations of the listeners-in in regard to licences and the character of the different classes of licences.

3. The theatrical profession, concert artists, etc., and to a less extent the Press, are apprehensive and uncertain as to the effects of broadcasting upon their interests; that co-operation which is clearly desirable is either being withheld or impeded consequent upon a feeling of mutual fear and suspicion. Yet it is clear that broadcasting has come to stay, and that in the end nothing can stop its progress.

4. The programmes of the British Broadcasting Company would appear to have deteriorated, partly no doubt in consequence of the fear and mistrust to which reference is made. In fighting for its interests it showed a complete want of artistic discrimination a few nights ago in radiating during one evening orations by Lord Birkenhead, Lord Gainford, and Sir William Bull, M.P., in defence of the British Broadcasting Company and the economics and ethics of private monopoly. The listeners-in themselves are in a state of irritation consequent upon the conflicts and confusion of the general wireless situation.

It is not suggested that these shortcomings can be traced to the personal incompetence or wilful misdeeds of the British Broadcasting Company and its staff. It is suggested, however, that they largely arise from the fact that neither the public as a whole nor even the trade and professional interests can have confidence in a new undertaking possessing the enormous possibilities of wireless when such an undertaking is in the hands of a private monopoly.

5. The private broadcasting monopoly involves political dangers, using that term in its literal and not in any party sense. Already accusations have been made that announcements and subjects of a party political or anti-Labour character have been radiated, and, however true or untrue these allegations are, it is, nevertheless, obvious that in view of the subtle and obscure character of modern commercial publicity the extension of that psychological treatment of political and industrial questions in connection with broadcasting work involves great dangers to democracy.

6. With the extension and increasing power of wireless radiation it would appear also to be clear that increasing practical difficulties will be experienced. The clashing of the wireless of ships at sea with the inland wireless, possibly also in time the overlapping of the wireless in foreign countries with wireless in our own, the problems of the use and control of wireless in cases of public danger and emergency—all of these are difficulties which it should not be outside the scope of science and regulation to control. But wise control in the public interest will be much more difficult than it need be when the ownership and operation of the broadcasting operations is in the hands of a private company.

7. From the first it has been seen that it would be necessary to exercise some form of control over broadcasting operations. The British Broadcasting Company itself has frequently pointed out that it is by no means a free agent in its operations. The principle has therefore been established that broadcasting cannot be left to unfettered private enterprise, but that important considerations of public policy make it necessary that the State should have some voice in wireless activity. The danger of State control of private enterprise always is, however, that it being an undertaking neither of public ownership and operation nor of unfettered private enterprise, the full advantages of neither system are obtained.

8. In these circumstances the Executive Committee of the London Labour Party ventures to submit in connection with the present enquiry a proposal which does not appear to have had appreciable public attention so far. This proposal is that broadcasting, instead of being in the hands of a partially controlled but otherwise irresponsible private monopoly, should be publicly owned and controlled. However novel this proposal is regarded at first sight, it is earnestly trusted that the Committee will give serious and responsible consideration to it, and to the reasons advanced for the proposal in this Memorandum of Evidence.

9. The very fact that broadcasting would come fully under the control of the community would remove a substantial measure of the fear and mistrust on the part of the amusement industry, the Press, and the listeners-in.

10. One of the reasons why private undertakings receive less articulate criticism than publicly owned and controlled services is not that private enterprise is more efficient, but that the criticism of privately owned undertakings over which the public has no control is regarded as futile, whereas criticism of public concerns is almost inevitably followed up by representatives on the public authorities concerned. In the interests of the progress of wireless itself it is exceedingly desirable that criticisms and suggestions should be encouraged, that they should be examined, and that a Minister should be responsible to Parliament for adequately meeting such criticisms or instituting the necessary improvements.

11. The first advantage of State ownership would, therefore, be that criticism would be stimulated, and that it would have to be met by a Minister responsible to Parliament. In a new enterprise like wireless it is particularly important that complaints and ideas should be encouraged in every possible way instead of being evaded and discouraged.

There is no reason associated with the technical character of the industry why broadcasting should not come under public ownership and control. The British Broadcasting Company is a financial organisation employing technical experts, staffs, musicians, artists, and workpeople, and there is no more difficulty in the Government employing such persons than there is in the case of the company's board of directors. The various "Uncles" could tell children's stories at 5.30 p.m. just as ably and cheerfully for the community as they can on behalf of Lord Gainford and the British Broadcasting Company, Ltd.

12. Quite a number of enterprises already under the control of public authorities no less complicated than the affairs of the British Broadcasting Company are conducted with a standard of ability and consideration for the users of the service much superior to that displayed, for example, by great railway companies in this country.

13. One of the first functions of the broadcasting concern when it came under public ownership would be to establish amicable relations between wireless and the amusement industry and the Press. It is rather difficult to understand the hesitating and nervous attitude of many newspapers towards wireless, because the Press has the reputation of being enterprising. It would appear to us that there is no sign of wireless becoming a source of serious competition to the Press. No newspaper reader, so far as we know, would cease buying a newspaper because he preferred to be bored by the weather reports and the news which are broadcasted. In most cases they have already read the news distributed by the wireless, and in any case they can "skim through" a whole newspaper during the time it takes for the broadcasting voice to read a few items of news, in half of which the average listener-in will be quite uninterested.

14. So far as the amusement industry is concerned, on the face of it more serious considerations arise, but even here the effect on the listener-in who has heard part or even all of a theatrical or musical performance which he likes will be to set up a desire to see or hear it done at the place itself.

Apart from these considerations, however, it is submitted that both the Press and the amusement industry would have more confidence in coming to an agreement with the Government than it would in the case of a private monopoly which is serving sectional rather than communal interests. This would be particularly so if the proposal made in the following paragraph were adopted.

15. With a view to stimulating enterprise and smooth working and to ensure that the complaints of the public were properly considered, it is suggested that if the agreement with the British Broadcasting Company is terminated and public ownership is instituted, a Broadcasting Advisory Committee should be set up, vested with some real measure of control, but, nevertheless, responsible to the Minister, who in turn would be responsible to Parliament. The last word must obviously rest with Parliament as representative of the general body of citizens.

16. It is suggested that the Advisory Committee should be representative of:

(a) The higher and lower grades of the staff, including certainly a representative of the section responsible for the programme.

(b) The listeners-in, probably through some form of federation of the radio societies which are now springing up.

(c) The amusement industry; and

(d) The Press.

17. It is not desired to be dogmatic as to which Government Department broadcasting should come under, or whether it should come under a new department. In view, however, of the very wide operations of the Post Office in connection with telegraphy and telephony, and having regard to the importance of some form of State control with a view to avoiding clashes between different broadcasting and transmitting installations on land and sea, and of dealing with the different situations that might arise in case of emergency, there is much to be said for His Majesty's Postmaster-General being the responsible Minister in this connection. There is already accumulated in the Post Office records, and among the various grades of the postal staff a very valuable knowledge of wireless and associated services.

18. So far as the manufacture of accessories and parts is concerned, the effort to establish a private monopoly in this connection appears to be thoroughly bad, and in a great measure the effort to prevent manufacture other than by members of the British Broadcasting Company has been a failure. Wireless and broadcasting is a new industry and has enormous possibilities; it is important that research and experimenting should be encouraged in every possible way subject only to the limitation that it shall not conflict with public safety or the interests of the community as a whole. Whilst we would certainly desire that the public broadcasting undertaking should establish a well-equipped research department animated by a vigorous desire for efficiency and enterprise, and whilst it should be open for the State to manufacture sets, parts and accessories, and to undertake installations, private enterprise in such work should not be forbidden any more than the humble experimenting of the ordinary citizen in his own home. The individual experimenter has been and will be responsible for much progress.

19. It is universally agreed that if chaos is not to result broadcasting itself must be a monopoly. The only question is whether that monopoly should be in private hands or in the hands of the community. Without hesitation our submission is that such a monopoly, in view of its character and importance, should be in public hands, and that there should be public accountability either for inefficiency or for political or class misuse of the great publicity powers of modern wireless.

20. The question of the licences clearly requires simplification and putting upon a firm basis. The present position of "broadcatchers" is uncertain and chaotic. It would appear that it is realised that it would be almost impossible for the British Broadcasting Company to collect its own licences; the organisation of the State has, therefore, been sought for this purpose through the machinery of the Post Office. Even so there may be difficulties, but the State, possibly with the assistance of the local authorities, is in a much better position to solve the licence problem than is private enterprise.

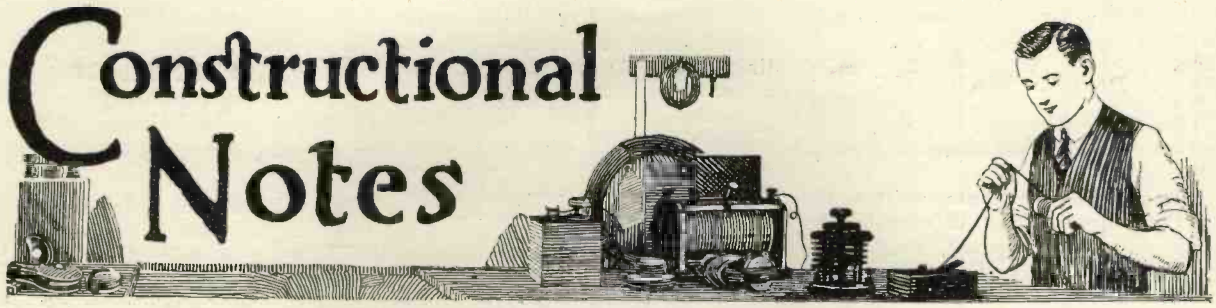
21. It is perfectly obvious that in some form or other the listener-in must contribute to the cost of the broadcasting service if a broadcasting service is to continue. The licence method worked out on a basis of justice, and intelligibly administered, would appear to be the most appropriate method of collecting the cost of the service; there are strong objections both from the point of view of finance and enterprise to imposing taxes, whether by a company or the State, on sets, parts or accessories.

22. The potential revenue from licences alone is very large. According to Lord Birkenhead there are already 10,000,000 receiving sets in use in the United States of America. The U.S.A. has a population 120 per cent. higher than that of Great Britain, so that applied to our smaller population the U.S.A. figure would be 4,545,000. Even if we assume that these modern appliances are more readily taken up in America, and we take 25 per cent. off the British figure so secured, we get 3,408,000 sets. At 5s. a year 3,408,000 sets would produce £852,000; at 10s. a year, £1,704,000. Even if we take the more modest figure of 2,000,000 sets, 5s. a year would produce £500,000, and 10s. a year £1,000,000. This is a very large revenue, and with the facts before it the Committee will be able to decide whether or not it is sufficient to provide a really good quality service including an adequate margin for research and experiment.

HERBERT MORRISON,
Secretary.

9th May, 1923.

Constructional Notes



MAKING CONDENSERS OF ANY CAPACITY.

ONE needs quite a number of fixed condensers about the set, and they are expensive little things to buy, for it is of no use to purchase cheap ones, which are often made with dielectric material of very poor quality, and whose stated capacity cannot be relied on as accurate. To make them at home is really one of the simplest jobs that the wireless constructor is called upon to tackle, and the saving is considerable, for a neat reliable condenser of definite capacity can be put together at the cost of a few pence.

For the plates copper foil should always be used. Tin foil is apt to contain impurities, and it is not pleasant stuff to work with owing to its flimsiness. It is convenient to adopt a standard size of $1\frac{1}{2}$in. × $\frac{3}{8}$in. for all one's plates, for, by so doing, we can make up, as we shall see, any given capacity without calculation. Foil is sold in sheets measuring 6×6in. at 1s. per dozen. As a sheet will cut into 16 strips each $\frac{3}{8}$in. wide, and each strip will make four plates, a pennyworth of foil gives a supply of 64 plates.

The dielectric must be the best quality ruby mica 0.002in. in thickness. For 1s. 8d. we can obtain a dozen sheets measuring 2×3in. If a standard size of $1\frac{1}{2}$×1in. is adopted for the mica dielectrics, each sheet will make four of them.

The convenience of adopting standard sizes such as those mentioned will be seen when it is said that two plates with an overlap of $1\frac{13}{16}$in. give a capacity of 0.0002 μF, and that each additional plate increases the capacity by 0.0002 μF. If, therefore, we want to make up

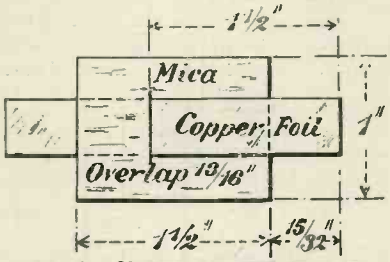
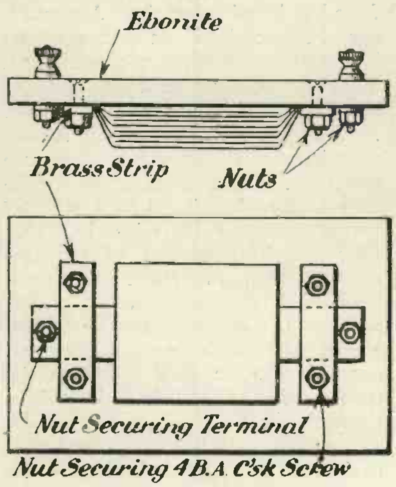


Fig. 1.—Showing how the strips are placed in position.

a condenser of any value we have a simple working rule: halve the capacity, add 1 to the fourth decimal place, and you know the number of plates needed. Thus, 0.001 halved = 0.0005; 5 + 1 = 6 plates; or, 0.002 halved = 0.001; adding 1 in the fourth decimal place we have 11 plates.

A



B

Fig. 2—Method of mounting the condenser.

It will be noticed that the overlap given allows only capacities ending in even numbers (0.0002, 0.004, and so on) to be made up. Odd numbers can be obtained by using plates measuring 2in. × $\frac{3}{8}$in., and making the overlap $1\frac{3}{16}$in. In this case two plates give 0.0003 μF, and each plate added increases the capacity by the same amount.

Now for the process of making up the condenser required. Begin by cutting out the mica and the foil, and place the pieces in two separate piles on the table. Provide yourself also with some shellac varnish.

Coat a piece of mica with the varnish, and lay a foil strip upon it so that just under $\frac{1}{2}$in. protrudes beyond it towards your right. Touch the copper with shellac, and lay a second piece of mica exactly over the first. Shellac again, and place another piece of foil on it so that the overhang is to your left. Continue with alternate pieces of mica and foil until the desired number is reached; then place a final piece of mica over all. Now lay the pile under a warm flat iron, and leave it to set hard.

Fig. 2 shows a good way of mounting the condenser. Each set of strips is clamped tightly together by the pressure of a brass strip, in which three holes are drilled. Two receive countersunk 4B.A. screws, the third the shank of the terminal, all of them being secured by nuts. Condensers mounted directly on to panels will not, of course, need the terminals, connections being soldered to the brass strips.

R. W. H.

PANEL MARKING

MUCH has been written on the working of ebonite for receiving panels, and in the majority of instances the experimenter is advised not to attempt engraving, but to send his panel to a firm who specialises in such work, or to compromise by attaching celluloid labels, etc., to the various terminals.

In most cases all that is required is to indicate positive and negative H. and L.T. terminals, aerial, earth, and the direction of rotation of rheostats to indicate increase of filament current.

This can be done as follows:—With a ⅛in. flat drill, drill holes 1/16in. deep about ⅛in. from each terminal. These are then filled with colour—enamel, artists' oil colour, or even ordinary paint will do. For positive terminals use scarlet or vermilion; for negative, cobalt blue; for aerial, a light blue made by adding Chinese white to cobalt; and for earth, burnt sienna. 'Phone terminals should be coloured as positive and negative, as some makes require to be correctly connected.

To differentiate between H. and L.T. the panel can be cut as follows:—First draw two pencil lines ⅜in. apart between the H.T. terminals and parallel with the edge. A ⅜in. wood chisel that has been carefully sharpened on the oil stone will be required. Placing the panel on a solid surface and commencing with the left leg of the "H," hold the chisel perfectly upright between the two pencil lines, and with the bevelled edge to the right, and give it a fairly hard single blow. Reverse the chisel so that bevel is to the left and repeat, holding it about 1/16in. from the first cut. In nine cases out of ten the ebonite will fly out; if it does not, repeat the process. Then cut the other leg, spacing so that overall width of letter is ⅜in.; and, lastly, cut the connecting stroke. Never mind the rough appearance of the bottom of grooves, as these are to be filled flush with Chinese white. Stops can be formed in similar manner, using a 1/16in. drill.

For rheostats describe a short arc with the hole for spindle as centre with a sharp pair of dividers, cutting as deeply as possible. An arrow is then cut at the "increase" end and the whole filled with Chinese white as before. A panel marked in this way looks much neater than with the usual labels or tags.

T. H. R.

NEW TYPE OF TERMINAL

IT may be thought that there is little room for improvement in the existing types of terminals; nevertheless, there is not a terminal on the market which enables one to make a series of quick connections, except those of a very elaborate and expensive type. The terminal described in the diagram (Fig. 3) is quite simple to make from the existing type, and will be found to be of great use. Any number of connections can be made, and if a number of wires are connected, a further one can be added without disturbing those already in place. A in Fig. 3 represents the terminal complete. The arrows show the direction and positions in which the tags C are placed. B is a strip of springy brass, a little less in width than the knurled nut of the terminal. This strip of brass should be folded, over and under, alternately, before drilling the holes. When the folds are made and pressed over, a hole to clear the thread of the terminal is drilled through the centre as shown at D. The folded strip is then placed over the screw of the terminal, and the bottom face soldered to the lower nut. C shows the type of tag suitable for use with this terminal. The tag is slipped in as shown by the direction of the arrows when the top nut is loosened.

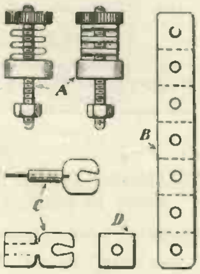


Fig. 3.—Parts of Terminals.

H. B.

MOUNTING CRYSTALS.

THERE is more in the mounting of crystals than one might think at first sight, and the quality of their performances depends very largely upon the way the job is carried out.

In some books you will find a recommendation that the cup should be filled with solder, and held in a Bunsen flame until the metal runs, the crystal being then plunged into the liquid solder and held until it sets. Heat is very bad for the constitution of certain types of crystal, and if the solder method is adopted they will probably be found quite "dead" when brought into use on the set. Woods metal melts at a much lower temperature than solder, and should therefore be used in preference. It is usually obtainable from wireless shops, but should none be available, ordinary tinfoil should be melted down in the cup and used in the same way.

Some crystal cups are provided with three set-screws arranged at equal distances apart. So long as you are using a fairly hard crystal of more or less rectangular shape this mounting will hold it pretty tightly, but there is one point about it that often escapes notice.

You know what a search is sometimes necessary with the cat-whisker in order to find a really sensitive spot on the upper surface of the crystal. It is just as necessary that one of those three screws should make contact with a "ticklish" spot. As often as not none of them does, with the result that we obtain either signals weaker than they should be, or none at all.

This difficulty can be overcome by wrapping the crystal tightly with tinfoil, which should be moulded into all the irregularities of its lower surfaces by being carefully rubbed with the handle of a pocket knife. The tinfoil now makes contact with a considerable area of the crystal, and therefore in all probability with several sensitive spots. Delicate adjusting will give more efficient results.

R. W. H.

DRILLING EBONITE PANELS

THE drilling of ebonite panels is an operation which requires accuracy in marking out and good workmanship if a neat finish is to be obtained. In the first place, a few tools should be purchased which will easily pay for themselves when the difference in the cost of plain and drilled panels is considered. In any case they will serve many purposes, and no home is complete without a good set of tools. A breast or hand drill, a few twist drills of convenient sizes, a centre punch, a pocket scriber, a pair of dividers, and a countersink bit are all the tools required.

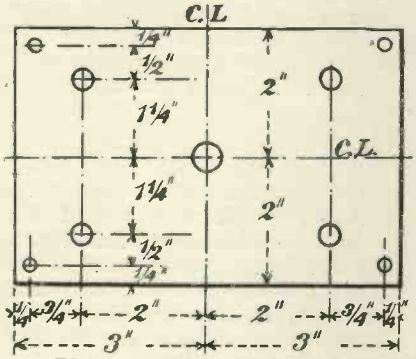


Fig. 4.—Panel marked correctly.

The principle point in drilling is accurate marking out, and it would be well for those not proficient in the operation to observe the following rules:—All centres should be marked from a centre line and not from the edges of the panel. In marking carefully from a centre line no mistake is possible, but in marking from an edge any slight discrepancy is multiplied, and in the case of fitting parts together the job is utterly spoilt.

The two diagrams given (Figs. 4 and 5) will explain this clearly. Fig. 4 is a panel marked correctly, Fig. 5 a similar panel marked incorrectly.

Having marked out the centres in the correct manner with a pocket scriber an indent should be made by placing a sharp centre punch on the point to be drilled and giving it a smart tap with a hammer. This ensures getting the correct point when drilling. The breast drill should be kept quite vertical when in use. For making countersunk holes, the hole is drilled first to suit the screw to be used, then a countersink bit is inserted in the drill and used in the same way. For recessed holes, the smaller hole is drilled first and then a larger drill is used and drilled to the depth desired.

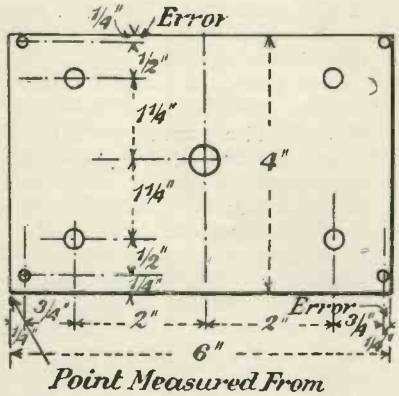


Fig. 5.—Incorrect marking of panel.

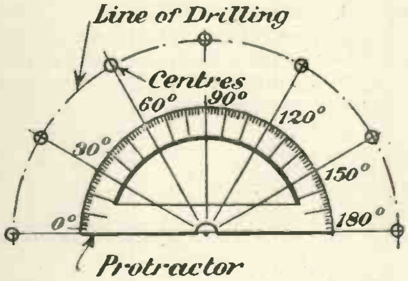


Fig. 6.—Showing how to use protractor.

Radii are described with sharp dividers. The circle, or semi-circle, is divided into equal parts by the use of a protractor which is divided equally into 360° for a complete circle; therefore if a semi-circle is to be divided into six equal parts making seven holes, each hole would be 30° apart as shown in Fig. 6. H. B.

DO YOU RADIATE?

SO much has been said recently by the Postmaster-General and by wireless clubs on the subject of the interference caused by re-radiation that some people are quite nervous about using their sets for fear that they should unwittingly cause interference with others' reception. Everybody detests the howling fiend, who often spoils some of the best items of a broadcast programme with his unwelcome accompaniment of cat-calls, squeaks and chirps, and nobody wants, if he can help it, to imitate his performances.

There is practically no such thing as a completely foolproof set, for many even of those that bear the P.M.G.'s stamp of approval can be made to oscillate if they are badly used, and if a receiver sets up oscillations it becomes temporarily a weak transmitter, causing annoyance to all listeners-in in the neighbourhood.

Do not be misled by a statement which is often made that the set is not re-radiating unless you hear howls or squeaks in your receivers. These are *audio*-frequency noises, and they are signs of L.F. oscillation; the set may be oscillating and therefore spoiling the pleasure of others long before they occur.

Here are some of the signs of oscillation that should be watched for so that immediate action may be taken directly they occur. Speech and music become loud but indistinct, rushing or rustling noises are heard in the 'phones; spark signals lose their musical note and sound like ineffectual attempts at whistling; a low murmur or "sing-song" noise, barely audible, may be detected in the 'phones. When these symptoms, or any of them, are present it will usually be found that tuned anode coils, high-frequency transformers and the secondary coil of the A.T.I. set up howling when they are touched, and the tuning of the last-named inductance will become suddenly abnormally critical. If your set exhibits "capacity effects," so that you have to use extension handles in order to be able to adjust the condensers, then oscillation is probably present. The most certain test of all is to tap the aerial terminal with a wet finger; oscillation will be disclosed by the occurrence of "tocks" or clicks in the 'phones whenever the finger makes or breaks its contact.

And what should be done if the set is oscillating? In the first place loosen the coupling of the reaction coil and reduce the capacity in parallel with it. If oscillation still persists, reverse the leads of the coil. Even when no reaction at all is used, a set with tuned-anode coupling may oscillate if the tuning is too sharp; the cure is obvious: don't tune the anode circuits too finely. Other remedies consist in lessening the plate potential supplied by the H-T battery, and in varying the filament current by means of the rheostats. Some valves, by the way, will oscillate very readily if the voltage of the accumulator falls off; the L.T battery should be tested if the set refuses to behave as it should.

Do not have the coupling between primary and secondary coils of the A.T.I. too tight. Stronger signals are often obtained by loosening it, and there is a considerable gain in selectivity, as well as a diminished tendency to oscillate. For good reception oscillating is far from desirable.

R. H. W.

EMERGENCY INSULATORS

It sometimes happens when one is in need of aerial insulators that no supply of the orthodox article is available. A friend asks you, perhaps, to help him to rig up his new set—he has bought everything but insulators. Or at a picnic there may be a wireless set, wire for the aerial, convenient trees whereon to hang it, but, again, no insulators.

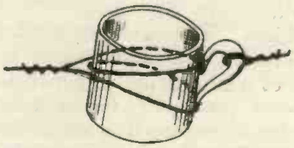


Fig. 7.—The "tea-cup" insulator.

In these cases the handy man is by no means done; he proceeds to improvise something from material ready to hand. Old bottles are usually to be found. They can be turned into quite efficient substitutes for shells and reels by the simple process of breaking them at the shoulders and then fixing the wires.

At a picnic, or on the river, a tea cup may be pressed into service. Wind a piece of string tightly round it, making the turns pass both above and below the handle, but not through it. Then fasten the aerial wire to the string and the supporting wire or cord to the handle.

Another method is to use an unbroken bottle. Here the aerial wire is made fast to the neck, being afterwards brought back along the bottle and secured in place by a binding of string. The supporting cord is attached to a piece of stiff wire whose length is slightly less than the bottle's greatest internal diameter. This is passed down through the neck into the inside of the bottle, and when the cord is pulled it jams itself firmly across the shoulders.

A fourth insulator, so good that it may be adopted even as a permanent fitting, can be made from a salad oil bottle, or any bottle that has a foot. This type of insulator is more efficient than the ordinary shell or reel type, since as the wires are so far apart there is practically no capacity between them. Capacity between the aerial wires and a supporting wire or wet rope provides almost a free path for high-frequency currents, and is a fruitful source of lost efficiency in the aerial.

Fig. 8.—The "broken-bottle" insulator.

R. W. H.

WOOD FINISHING

In making wireless cabinets an important factor is how to obtain a pleasing finish with as little trouble as possible. The wood used should be well planed. It is, in fact, advisable to buy timber ready planed, at a very little extra cost. The box should be sandpapered until quite smooth. Some plaster of Paris mixed with water and vinegar should then be rubbed well into the grain of the wood and allowed to dry, after which it should be once more sandpapered.

There are several kinds of stain which may be used, or a plain wood finish with such woods as mahogany or oak looks quite nice. Logwood chips boiled in water give a reddish-brown result. The amount of chips to be used depends upon the density of colour desired. The stain should be applied while warm.

Many people do not like the highly glossy appearance which results; also, the surface shows all marks and scratches, and any faulty application looks very bad. The most practical finish is obtained by dissolving pure beeswax in turpentine until the solution is about as thick as condensed milk. This is rubbed on to the stained surface until a good dull polish is obtained. The process entails a little hard work, but is well worth doing. Water stains are in every way preferable to oil stains.

H. B.

A PROGRESSIVE UNIT RECEIVING SYSTEM

This forms the sixth part of our special series of articles dealing with the construction of a complete unit receiving system. Every piece of apparatus described will be subsequently used in more ambitious sets.

PART VI.—A CRYSTAL RECEIVER WITH VALVE AMPLIFIER.

(Continued from No. 5, page 306.)

In the last article of this series we dealt with the use of a three-electrode valve as a high-frequency amplifier preceding the usual crystal detector. An alternative method of using a valve in conjunction with a crystal receiving set is as a low - frequency amplifier (sometimes termed a note - magnifier). Employed in this manner, the valve amplifies the low-frequency impulses after rectification by the detector. In other words, the impulses which, in an ordinary crystal set, actuate the telephone receivers are now applied to the grid or input circuit of a three-electrode valve and the telephones are actuated by the magnified low - frequency impulses in the anode circuit.

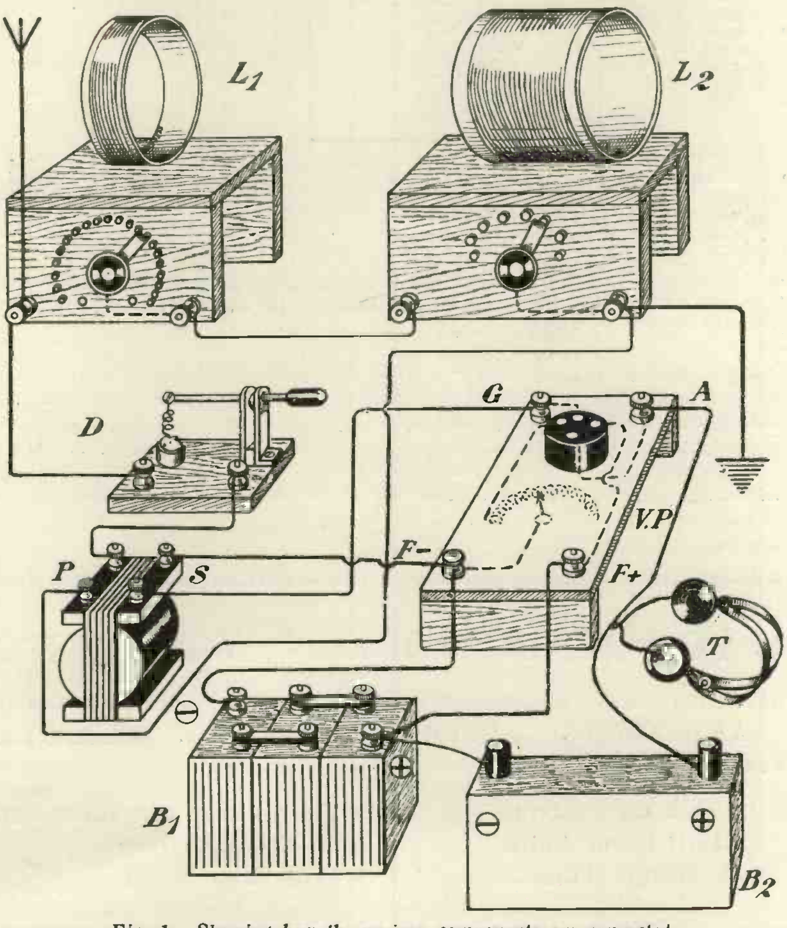


Fig. 1.—Showing how the various components are connected.

Components Required.

The components required and the method of assembling and connecting them up are shown pictorially in Fig. 1. It will be seen that the two inductances L_1 and L_2 are the 20-turn and 100-turn coils described in previous articles, connected in series.

D is the crystal detector, the left-hand terminal attached to the crystal cup being connected to the aerial side of the coil L_1. VP is the valve panel complete with filament rheostat and 4 terminals G, A, F−, F+, the permanent connections beneath the panel being shown by means of dotted lines.

T represents the high - resistance telephone receiver, B_1 the 6 - volt filament lighting accumulator battery, and B_2 the high-tension dry cell battery, 45 to 60 volts.

All of the foregoing components were required for the circuit arrangement described in Part V. of this series. The only additional component required is the low - frequency iron core transformer shown immediately beneath the crystal detector in Fig. 1.

The construction of a satisfactory transformer of this type calls for a considerable amount of skill, and although we hope to publish constructional details of such a transformer later, we advise the use of a really well-made bought transformer on this occasion. In purchasing this transformer, a "step-up ratio" of 1 to 4 or 1 to 5 should be specified. This means that, if the primary or input winding of the transformer consists of 2,000 turns, the secondary or output winding will require to consist of 10,000 turns, thus producing a step-up in the voltage of 1 to 5. As the output winding of the transformer is to be connected to the grid circuit of the valve, the advantage gained by the increased voltage will be appreciated.

The Circuit Arrangement.

Fig. 2 is a complete circuit diagram of the arrangement. Reference to this will show that there are in reality five distinct circuits, as follows: — *The aerial circuit*, comprising the aerial itself, the 20-turn inductance, the 100-turn inductance and the earth connection. *The detector circuit*, including the crystal detector D and the primary or input winding of the iron core transformer, this circuit being shunted across the active turns of the two inductances. *The grid circuit*, which includes the grid of the valve (via the terminal G), the secondary winding of the iron core transformer and the negative side of the filament lighting battery (via terminal F−). *The filament lighting circuit*, consisting of the valve filament, the rheostat (connected to the terminal F− and filament socket), and the 6-volt accumulator B_1. *The anode circuit*, which includes the anode of the valve (permanently connected to the terminal marked A), the high-resistance telephone receivers T and the high-tension battery B_2, the positive side of which is connected to the telephones T and the negative to the positive side of the filament.

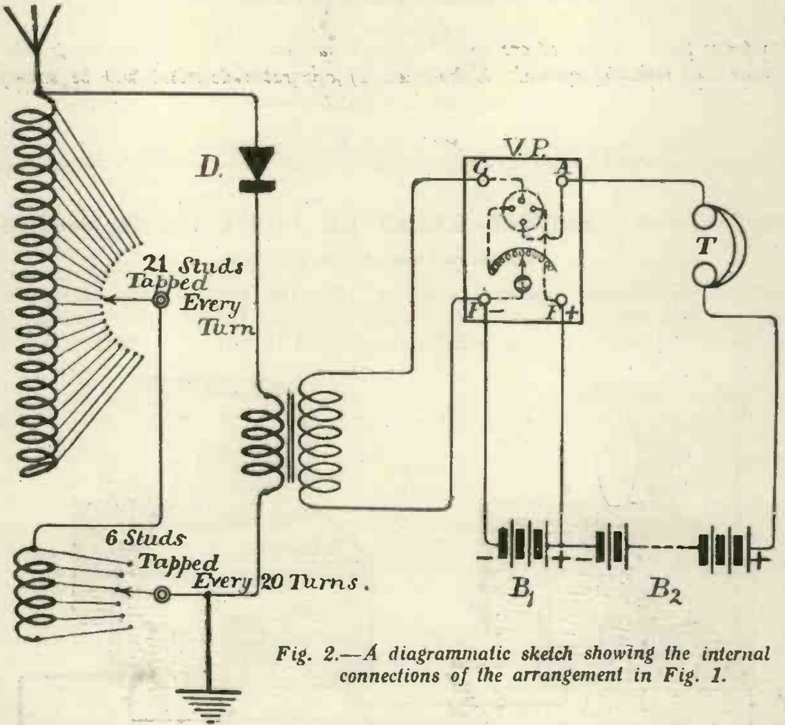
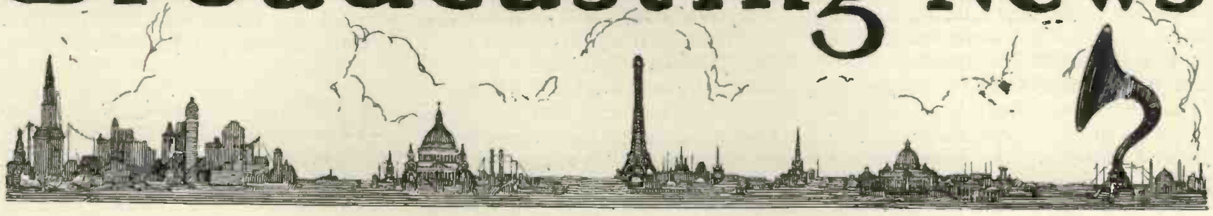


Fig. 2.—A diagrammatic sketch showing the internal connections of the arrangement in Fig. 1.

Operation.

Probably the best way to ascertain the advantage gained by the low-frequency amplifying valve, is to tune in signals in the usual way with the telephone receivers T connected in place of the primary winding of the iron core transformer. When the necessary tuning is completed and the detector D adjusted to its most sensitive point, remove the telephones from their temporary position and substitute the primary winding of the transformer, the telephones now being placed in the position shown in Fig. 2. Complete the battery circuit and adjust the rheostat until the loudest signals are obtained.

Broadcasting News



By OUR SPECIAL CORRESPONDENTS

THE address of Mr. M. C. Rypinsky is reported in another column of this issue, but those who were present at the roundtable discussion with him in the Board Room of the B.B.C. were impressed by his sincere admiration of the British system of broadcasting. We are so accustomed to hear America cited as being infinitely ahead of the Old Country in everything relating to wireless that it was quite consoling hearing him give such an excellent unsolicited testimonial to the Old Country and to the B.B.C.

* * *

Privately he expressed himselt more strongly on the serious question of the revenue of the American radio manufacturing companies. In that land of protection there is so much freedom in everything wireless that it is difficult to make broadcasting pay. If the licence question is satisfactorily solved in this country we may perhaps find that it will be adopted in America.

* * *

It will be worth while keeping an eye on Ireland to see how broadcasting develops there. The B.B.C. has a say in the establishment of stations in the Northern Counties, but its position is uncertain with regard to the Free State. Perhaps the only way for the B.B.C. to make headway in the South of the Green Isle would be to broadcast a statement that under no circumstances would they have anything to do with broadcasting in the Free State. That would probably make the bhoys sit up and take notice and send over a contingent to raid 2, Savoy Hill, shillelagh in hand, to demand the immediate establishment of broadcasting stations in South Ireland.

* * *

Mr. Bertram Fryer, Director of the Newcastle Broadcasting Station (on right, with microphone).

The B.B.C. is to be congratulated on its brilliant victory in connection with the broadcasting of opera. The fact that the outstanding British singers have definitely ranged themselves on the side of broadcasting has great strategic significance. It has been welcomed by artistes throughout the country who did not feel themselves strong enough to break through a very powerful concert ring. Most of the leading British National Opera Company artistes will also broadcast individually.

The average number of auditions at 2LO alone is more than 250 per week, and on one occasion before the Whitsun holidays 93 would-be broadcast stars were heard in one day. There is evidently no dearth of musical talent in London. In the provinces, of course, the supply is much more limited, even in proportion to the population. The trouble there is that whenever an artiste gets fairly well known the tendency is to come to the Metropolis to swell the very crowded ranks of the musical profession. If they would stay in their own centres most of them would have an equally good chance of making a decent income.

* * *

The B.B.C. made a last-minute attempt to change the venue of the British Legion meeting in the Queen's Hall to Covent Garden Opera House, where the speeches of the Prince of Wales and the other distinguished notables could have been broadcast to all the stations. The British Legion, however, could not see their way clear to make the change, although they would have been indemnified against any loss.

* * *

A clever sub-editor made his headings announce that "artistes who broadcast would be outcast," but the experience of those who tried to stop the broadcasting of opera would suggest as more appropriate headings, "those who would stop the broadcast shall be downcast."

* * *

The London theatrical managers are endeavouring to give an international aspect to their quarrels with the B.B.C. by linking up with the French theatrical managers. Perhaps before we are done the matter will be referred to the League of Nations, that body which promised so well and has done so little. The B.B.C. are not joining up with the French broadcasting authorities, as they believe in the policy of "ilka herrin' hangin' by its ain tail."

* * *

There was great excitement in Glasgow the other evening as the strains of "Valkyrie," which were transmitted by land line from 2LO to Glasgow, were heard not only by the owners of sets but by a number of people who have the ordinary telephone installed. These canny Scots were overjoyed to think that they were getting first-class opera from London without troubling about wireless at all. However, the performance was of the "secured at enormous expense for one night only" variety, and although some of the Scots have since been listening-in at their telephones until they have got the earache, there has been nothing doing.

* * *

The new Jazz Orchestra which has been established at 2LO is already proving most successful. Many tennis clubs are taking advantage of the Saturday night jazz transmissions to run impromptu dances.

* * *

The B.B.C. is doing everything in its power to accede to the request of the Industrial Welfare Societies to provide music during the workers' meal hour. Many large firms have expressed their willingness to establish loud-speakers in their works. At present the B.B.C. is limited to one hour for its daylight transmission, and efforts are being made to get this hour changed and extended. If tips were given as to likely horses to win the afternoon races the popularity of the venture would be assured. The newspaper proprietors could not object to this, for no one could describe racing tips as news.

* * *

BIRMINGHAM. — Mr. Percy Edgar, the announcer at 5IT, has a pronunciation which is generally faultless and a sheer delight to listen to. He has never been known to falter, not even over that lovely tongue-twister which prefaces the weather report—"specially prepared by the meteorological department of the Air Ministry for the British Broadcasting Company"—although one does feel that he can hardly resist saying "Here's the jolly old weather forecast" instead. But when he departs from English, Mr. Edgar must confess that he is sometimes beaten. He came up against a real poser the other day—the name of a Japanese professor! It was in the news bulletin, of course. "Uncle" broke down in the middle of it, and there followed a hurried conference with other members of the staff before the name was finally broadcast. It sounded horrible.

* * *

MANCHESTER.—2ZY was to be sympathised with the other evening when they complained that they could not hear 2LO for the "ether hogs." There was so much jamming that scarcely any telephony could be heard, and it was even doubtful whether 2LO was actually transmitting. All listeners-in thoroughly agreed with 2ZY's complaints. There was the consoling thought that the closed-in cars, fitted with direction-finders, which were reported to be in the town, would be very busy, and it was hoped that they would be able to locate the worst offenders. 2ZY's proposal to change the time of their trade concert from the morning to the afternoon will not only be of interest to those for whom the transmissions are principally intended, but also they will tend to enliven the afternoon tea parties of the listener-in.

The "Seven-and-sixpenny Single-sided" concerts promised us by Mr. Percy Pitt, the new musical director of the B.B.C., are being eagerly awaited.

* * *

NEWCASTLE.—The first transmission, other than from the Studio, has been made by the Newcastle Broadcasting Station during the past week. One of the chief events of the year for the musical Tynesider is the Northern Musical Tournament (a festival on the lines of a Welsh Eisteddfod), and choral and orchestral items have been broadcast from the Newcastle Town Hall each evening from 7 to 7.30 and 9 to 9.30, thus not interfering with the usual concert. The transmission was remarkably clear, and many congratulatory letters have been received by the station director. The writer observed that, when the switching over from Studio to Town Hall occurred, a considerable diminution in signal strength took place, but that full intensity was again obtainable by decreasing H.T. from 36 to 24 volts.

Radio Societies

THE WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., Central Library, Peckham Road, Camberwell, S.E.5).

Hon. Sec., Mr. Geo. Sutton,
A.M.I.E.E.,
18, Melford Road,
S.E.22.

At the meeting of the Wireless and Experimental Association at headquarters on Wednesday, May 16th, Mr. Voigt (member) outlined a scheme whereby it should have been possible with two small choke coils and two small fixed condensers to utilise the two suspended wires feeding the loudspeaker at the far end of the Hall and make them do duty as a twin aerial.

Another member brought along a small crystal receiving set with which he got unaccountable fading of signals. Some of the Association's experts put the faults down to the use of dry cotton insulation on the coil windings, the fluffy free fibres being hygroscopic and leaky.

The Dulwich and District Branch of the Wireless and Experimental Association met at the Montessori School, Lordship Lane, on Monday, May 7th, and proceeded to elect a committee on management and agenda matters. Messrs. Faulkner, King, Sinclair, Munday, and Barrett were declared duly elected, and consented to serve.

Mr. Geo. Sutton then delivered an elementary lecture on crystal and valve sets, with variometer tuning devices.

THE RADIO SOCIETY OF HIGHGATE (H.Q., Highgate 1919 Club, South Grove, Highgate, N.6).

Hon. Sec., Mr. J. F. Stanley, B.Sc.,
A.C.G.I., F.R.A.
49, Cholmeley Park,
Highgate, N.6.

Mr. H. Andrewes, B.Sc., continued his series of lectures on Friday on "C. W. Transmission." He pointed out that a C. W. heterodyne was really a low-power transmitter, ordinary transmitting sets differing only in the matter of the amount of power dealt with. A receiving set of the aircraft type has been used for transmission over a range of fifty miles by means of "R" type valves, but in such cases it is necessary to overload the filaments, thereby reducing the life of the valves. Various examples of British, French, and German transmitting valves were exhibited, and their characteristic features explained. The usual methods of obtaining the necessary high voltage direct current supply for transmitting purposes were described, and the lecturer then went on to describe in what respects the inductances used differ from those in receiving sets. Transmitting condensers were also dealt with, it being mentioned that the capacity of an ordinary variable condenser can be approximately doubled by immersing it in good quality insulating oil. Various transmitting circuits were then drawn on the blackboard, special mention being made of the Colpitt circuit. This circuit hails from America, and in the lecturer's opinion is very efficient and easy to adjust. Methods of keying and modulation were then dealt with, and the lecturer concluded with a few remarks on the subject of microphones and speech amplifiers.

SOUTH NORWOOD AND DISTRICT RADIO ASSOCIATION (H.Q., Stanley Halls, South Norwood).

Hon. Sec., Mr. C. H. P. Nutter,
Radio Corner,
243A, Selhurst Road,
South Norwood, S.E.25.

On May 3rd, at headquarters, the meeting of the above Society opened with buzzer practice under the supervision of the Secretary, after which Mr. J. L. Jeffree, F.R.A. (5FR) explained a new theory for wireless transmission and reception. A discussion followed, many interesting points being raised.

The Hon. Secretary will be pleased to forward particulars of the Society to anyone desirous of joining.

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION (H.Q., The Acton and Chiswick Polytechnic, Bath Road, Chiswick).

Hon. Sec., Mr. H. W. Cotton,
19, Bushey Road,
Hayes, Middlesex.

At the meeting held on Friday, May 18th, an article from one of the wireless publications dealing with "Crystal Reception" was read by Mr. A. Labram, and questions were then raised and answered by various members. The meeting was then thrown open for general discussion; Mr. A. P. Dobson outlined a circuit on the blackboard with which he had been experimenting and afterwards gave a full description and data for constructing a tapped plug-in anode coil with a range of 150-1,100 metres for use in a tuned anode circuit.

Mr. P. Usher then gave data for making a solenoid inductance coil with variometer attachment at the end for fine tuning. Members are asked to turn up in full strength on June 5th, when Mr. O. S. Puckle will lecture upon "Radio Switching." Full particulars regarding membership of the Association will be gladly sent to all enquirers by the Secretary.

THE ILFORD AND DISTRICT RADIO SOCIETY (H.Q., St. Mary's Church Schools, High Road, Ilford).

Hon. Sec., A. E. Gregory, Esq.,
77, Khedive Road,
Forest Gate, E.

On May 3rd a discussion on "Low-frequency Amplification" was held. Mr. J. F. Payne opened the discussion by enumerating the advantages and disadvantages of this method of amplification. Mr. A. E. Gregory (Secretary) then lectured, stating that he recommended the use of iron-core chokes instead of the customary L.F. intervalve transformers. He said that he had found the choke method less prone to produce distortion, more silent in working, and cheaper to construct than the transformer method. Another great advantage of this type was that it lent itself to the employment of many stages of amplification without the production of howls. A 500-ohm "Fullerphone" choke was found to be quite suitable for the purpose.

Mr. J. Nickless, A.M.I.E.E., stated that in his opinion the question of the employment of open-cored L.F. transformers had not received sufficient attention. Considerable discussion took place on this point.

LEYTON AND DISTRICT WIRELESS CLUB (H.Q., The Leyton Tabernacle Church Hall, High Road, Leyton, E.10).

Hon. Sec., Mr. W. G. Peacocke,
73, Frith Road,
Leytonstone, E.11.

A very successful meeting was held at H.Q. on Monday, May 7th, when, after the usual Morse classes, an interesting lecture and demonstration was given by one of the members, Mr. P. J. Slade, on "Valves."

At the close of the lecture the Chairman, Mr. W. Bassett, operated his 3-valve set with great success.

Meetings are held fortnightly, and the Secretary will be glad to hear from any persons interested.

LINCOLN AND DISTRICT AMATEUR WIRELESS AND SCIENTIFIC SOCIETY (H.Q., Lincoln Technical School).

Hon. Sec., Mr. F. T. James, M.I.M. and CY.E.,
126, West Parade,
Lincoln.

An exhibition of members' home-made apparatus was held on Thursday, Friday, and Saturday (May 3rd, 4th, and 5th) in the Technical School Gymnasium. Three prizes were offered for the best panel as regards workmanship and design. Mr. C. R. Laurence gained first prize, Mr. R. Bates second, and Mr. H. Beson third. Mr. P. Grant and Mr. H. W. Elsey kindly acted as judges, and found their task a very difficult one.

In addition to members' apparatus, there were also well-set out trade stands by the following enterprising firms in the city: Howard, Silver Street; Western, Sincil Street; and the Wireless Co., Newland. Mr. Elliott, of Monks Road, had a good display of radio publications.

Demonstrations of receiving broadcast music, etc., were given, three loud-speakers being fixed in different parts of the building. The Society's own transmitter was also working with other amateur transmitters in the district.

Applications for membership should be addressed to the Hon. Secretary.

SMETHWICK WIRELESS SOCIETY (H.Q., Technical Institution, Smethwick).

Hon. Sec., Mr. R. H. Parker,
Radio House, Wilson Road,
Smethwick, Staffs.

A most successful meeting was held at headquarters on Friday, April 20th, when Mr. C. Grew (Technical Advisor) gave a most interesting lecture and demonstration, illustrating a well-made three-valve experimental receiver, incorporating a special circuit, which was illustrated with blackboard diagrams.

A Western Electric power amplifier having been attached, loud signals were received throughout the building from all the broadcasting stations.

The Society would welcome all experimenters interested in wireless who would like to join its ranks, and all communications should be addressed to the Hon. Secretary.

SOUTH SHIELDS AND DISTRICT RADIO CLUB (H.Q., Edinburgh Buildings, 34, King Street South, South Shields).

Hon. Sec., Mr. J. A. Smith,
66, Salmon Street,
South Shields.

On Friday, April 20th, a lecture on "Directive Transmission and Reception and its Value" was delivered by Mr. R. Oliver.

Commencing with a brief description of the usual forms of inverted "L" and "T" type aerials, which, he stated, were only slightly directional, the lecturer then went on to describe aerial systems of stations such as Leafield, Cairo, etc., which were true types of directional aerials, in which little added capacity or inductance was inserted, the aerial itself being of the required wavelength. Mr. Oliver mentioned that the familiar method of explaining the radiation from an aerial by comparison with the dropping of a stone into a pond was not, in the case of ordinary aerials, correct, and that radiation from such aerials was always partly directional. The lecturer then proceeded to describe methods of duplex working, and their advantages both with regard to non-interference with near-by stations and operation in conjunction with particular stations.

Dealing with reception, Mr. Oliver discoursed upon the subject of frame aerials.

In conclusion, he dealt with the tremendous value of directional wireless during the war, both with regard to shipping and the location of enemy craft.

The Club held its first Annual Exhibition from April 24th to 28th inclusive. Seven trade firms in the district exhibited, and experimental apparatus was a large feature of the exhibition. In the latter section a 19-valve set, built by the Club's Chairman, attracted considerable attention. The set employed nine high-frequency valves, allowing the use of tuned anode, transformer, or resistance-capacity coupling at will; a 4-valve detector panel permitting the use of either soft or hard valves of various designs, grid potentiometer or leak control, etc., and a 6-valve low-frequency amplifier. Each valve having separate control and combination could be used at will. Tuning, apart from the high-frequency portion, was accomplished by the usual plug-in coils, a Mark III., tuner being employed for lower wavelengths.

The Club is desirous of increasing its membership. Particulars may be obtained from the Hon. Secretary.

THE STOCKPORT WIRELESS SOCIETY (H.Q., Mersey Chambers, King Street East, Stockport).

Hon. Sec., Mr. C. Froggatt,
194, Turncroft Lane,
Stockport.

A successful lecture demonstration was held at the headquarters of the above Society on Wednesday, May 9th, when Mr. H. A. Woodyer lectured on "Transmitting and Receiving," Mr. A. Roberts presiding.

The Hon. Secretary will be pleased to hear from persons desirous of becoming members.

THE STOKE-ON-TRENT WIRELESS AND EXPERIMENTAL SOCIETY (H.Q., Y.M.C.A., Marsh Street, Hanley).

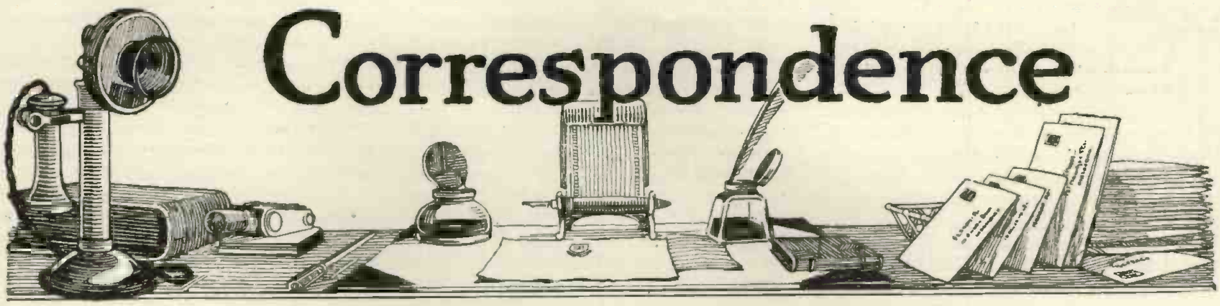
Hon. Sec., Mr. F. J. Goodson, B.Sc., M.I.Mech.E.,
Tontine Square,
Hanley.

An interesting discussion on "Reaction: Its Use and Abuse," opened by Messrs. F. J. Goodson, B.Sc., and F. T. Jones, took place at a meeting of the above Society on May 10th. Mr. Goodson first dealt with re-radiation, what it is and how it is caused, Mr. Jones dealing with its detection and prevention.

To detect re-radiation, touch the aerial terminal with a damp finger, and if this produces a twang or a more or less musical note in the 'phones it shows that the set is re-radiating. If only a click is produced this is due to capacity effects and not to re-radiation. The best methods of detecting re-radiation is to employ another receiving set some distance away.

In order to prevent re-radiation which will interfere with other stations in the vicinity, reaction should be dispensed with altogether, this being the most sure method. Another method is to employ a tuned anode circuit and couple the reaction to the anode coil, or, if high-frequency transformer coupling is used, to couple the reaction coil to the transformer. Such a set would not re-radiate to any appreciable extent.

Several members disagreed with Mr. Jones as to the non-radiating properties of the tuned anode circuit, and instances were cited in which such circuits were found to be re-radiating seriously when the aerial coil was separated from the reaction coil by several feet.



COAST TOWN RECEPTION

To the Editor, *Wireless Weekly*.

Sir,—I have read with interest as a new reader of your paper the various correspondence appearing in your columns, in particular about a successful set.

As most people know the South is notorious for bad reception, thanks to ships and other spark stations (these ought to be abolished by law), which are most difficult to cut out entirely. I have, however, on a quiet night received all Broadcasting Stations on one valve; Glasgow was faint but clear. This was done as an experiment. I usually use two valves with quite satisfactory results.

London has fading attacks which have quite regular periods, and are most interesting to observe; Cardiff comes in best here, and I get all the French stations fine.

My set is nothing to shout about, just a home affair, but goes O.K. The tuning is critical, but with care all broadcasting can be picked up. If some of my unknown wireless friends in this town will take my tip about tuning they will get better results. I find that if the coupling is made fairly slack and more condenser used, ships can be to a large extent cut out, but signals are, of course, weaker. If three coils are used jambing can be cut down to a minimum, but tuning becomes very critical indeed. I generally use my set with the secondary shorted on to the A.T.I. which gives good results and easier tuning if the spark row is not objected to.

Wishing you success.

I am, etc.,
J. P. J. Chapman.

Bournemouth.

TELEPHONE ADAPTOR.

To the Editor, *Wireless Weekly*.

Sir,—I think the following hint will be found useful by your readers. It is often desired to "listen-in" in a different room to that in which the instruments are installed, and the method of running wires to the different rooms is wasteful of wire, takes time, and can hardly be accomplished without some damage to the decorations, etc. Those who have electric bells fixed (the large majority have, nowadays, I think) can utilise these very easily.

The output from the telephone transformer is connected to the two contacts of the bell-push in the room where the instruments are. Disconnect one of the wires from the *bell battery* and you can at once connect the telephones to any other bell-push in the house. The writer has used this method with both crystal and valves (loud-speaker), and there seems to be little or no loss providing the bells are in working order—if they are not—well, the remedy is obvious.

I am, etc.,
Cheshire. E. M. Wainwright.

2OF.

To the Editor, *Wireless Weekly*.

Sir,—I have recently received reports of the reception of telephony from 2OF by wireless experimenters in the London district. This reception has been reported at times when I have not been transmitting, and by persons using crystal sets. It is therefore obvious that some unauthorised person in that neighbourhood is using my call sign, probably because he has no transmitting licence.

I should be glad of any information which would lead to the detection of that person, as such use is both unfair to the receivers of the telephony and to myself, and also, of course, illegal.

I am, etc.,
H. C. Trent (2OF).

Lowestoft.

CRYSTAL RECEPTION.

To the Editor, *Wireless Weekly*.

Sir,—As a reader of your journal I wonder whether the under-mentioned would be of any interest to your many other readers.

I have a crystal set *multum in parvo* working on a 50ft. single wire aerial about 35ft. from the ground. In the flat above me a gentleman possesses a 2-valve H.F. and detector panel, with an additional L.F. panel (which was not in use when the experiments given below were carried out).

I was receiving 2LO very strong; in fact, standing near the headphones on another person, one could hear 2LO faintly.

1. I changed over aerial wire and earth wire, making the earth system my aerial, and *vice versa*—results perfect.
2. Replaced on proper terminals, but disconnected earth, and still heard distinctly.
3. Replaced earth on to terminal and disconnected aerial wire from head. In holding the 4ft. or 5ft. of wire in my hand the reception was still perfect after altering tuning slightly. Thus I was working with no aerial except the few feet held in my hand.

In the ordinary way I get fair reception with my bell wire as an aerial, when the valve set is not working, and when it is, the reception is as good as with an outdoor aerial.

My single aerial is neither parallel with my friend's from a horizontal point of view nor looking end-on, and is certainly 20 feet below, and stretches down the right-hand side of the garden, where the other aerial stretches along the left-hand side. Further, I get amateur stations as far away as Brentford, Middlesex.

I am, etc.,
Charles Collins.

Wexford Road, S.W.12.

AMATEUR TRANSMISSION.

To the Editor, *Wireless Weekly*.

Sir,—Allow me as an experimenter to congratulate you on your latest periodical *Wireless Weekly*. I, and I am sure many others, am glad to see that in both your papers, *Modern Wireless* and *Wireless Weekly*, you have not forgotten the amateur transmitter. The amateur transmitter of to-day has been very badly hit. With the advent of broadcasting, the experimenter has only a very limited time for experiments, especially when 2LO works very nearly all Sunday morning and afternoon. DX communication under these conditions is rendered impossible. I certainly think that 2LO imagine they own the ether. May I say one word to the broadcast radioist? Numerous complaints have apparently been received by many gentlemen holding transmitting licences, accusing them of transmitting during broadcasting hours. It may interest the broadcast radioist to know that the amateur transmitter is perfectly entitled to transmit during the broadcasting hours if he chooses. The only reason he does not is, being a gentleman, he wishes to give the broadcast radioists as much pleasure as possible. It must not be forgotten that it is the amateur transmitter who has made broadcasting what it is to-day. The London experimentalists have to put up with a lot. They don't mind people listening to their transmissions, but they would prefer the "canaries" to go to bed. Hoping I have not occupied too much of your valuable space.

I am, etc.,
D. G. BOWER (5WF).
Upper Richmond Road, S.W.15.

RE 2-VALVE RECEPTION, BY A. A. GIBSON, HOVE.

TO THE EDITOR, *Wireless Weekly.*

SIR,—Having experimented in the same locality (supposed to be poor for reception) as Mr. Gibson for a considerable time, with many different combinations of valves and circuits, my own experience of long distance reception with a minimum of valves might be interesting.

On one valve I have received (when jamming and the "howlers" in the Preston district will permit) the following stations on many occasions, and all on speech and music.

FL, Radiola, L'Ecole Superieure, 5WA, 2LO, 2YZ, 5NO, 5SC, 5IT, 2MT (when operating), 2OJ, 2FQ, 5MC, 2KA, and Croydon. Once only, I have received "The Hague" on one valve, and have never been able to get it since on less than two valves (1HF), but in any case the reception of this station is poor. On two valves (when conditions are favourable) one L.F. and Brown H2 loud speaker, I can receive 2LO, 2YZ, 5SC, and 5IT, L'Ecole Superieure, Radiola and FL sufficiently loud to be clearly heard in any part of the room, 12ft. square, and on three valves (one H.F., one L.F.) Radiola and 2LO are so loud that we can dance to the music without worrying about the shuffling of the feet. In fact, this is how we learn new steps.

Regarding valves, I use Ediswan A.R. for high-frequency and detector, and Ediswan R for low-frequency amplification. H.T. about 60 volts for short waves and about 48 volts for long. Circuits are quite ordinary, but particular care has been taken regarding values and, naturally, several important points have been studied with a view to reaction, the coil often being laid on the floor and tuned.

My aerial is 26ft. high, twin, 28ft. long, and below the house top, clear from North and South but screened from the East, hence the poor results from Holland. The whole outfit is arranged anyhow, some wires being squeezed in together tightly, and others being loose and laying about all over the table. On Christmas Eve seven pairs of headphones and one single one were used with one valve, and 2LO was received loud and clear, despite the fact that the leads were straggling all round the room. I am, etc.,

Brighton. O. J. S. RUSSELL.

HUSTLE!

TO THE EDITOR, *Wireless Weekly.*

SIR,—With reference to the present controversy re the licence question, my recent experience may be interesting.

On April 19th last I applied to the Secretary, G.P.O., London, for an application form for an experimental licence, and received it by return of post. I filled in the required particulars and posted it on April 23rd. On the 25th a notice arrived, requesting that 10s. should be sent, when my licence would be granted. I sent the money by return, and on the 27th received a letter from the G.P.O. giving me full authority to use wireless receiving apparatus for experimental purposes pending the issue of a formal licence.

I may say that I am just an ordinary experimenter, with a fair knowledge of wireless, and a keen desire to conduct genuine experiments. All my apparatus is home-made. I have no exceptional qualifications so far as wireless is concerned, and no influence.

I am, etc.,
LONDONER.

INDOOR AERIAL RECEPTION.

TO THE EDITOR, *Wireless Weekly.*

SIR,—It may interest you and some of your readers to know that, using only one valve, and with an indoor aerial, I hear all the British Broadcasting stations with the exception of Cardiff. I can get Cardiff's carrier wave, but up to the present have heard no telephony.

In listening to the News Bulletin every word is quite audible from any station. Tuning, of course, is very critical, and fading is common, but it is interesting to note that Glasgow is more easily tuned in than Newcastle.

As I live in a flat I am obliged to use an indoor aerial. This consists of 9 wires, each 12 feet long, stretched across the ceiling of a room. They are spaced 15 inches apart and are 1 foot from the ceiling. My earth wire is connected to a gas pipe at present.

An interesting point is that the addition of a L.F. valve makes but little difference, this being due to the initial weakness of the signals.

Wishing your journal the best success. I am, etc.,
L. E. WAREHAM.
Barnes, S.W.13.

A NOVEL POLARITY TESTER

TO THE EDITOR, *Wireless Weekly.*

SIR,—In the April edition of *Modern Wireless* there was an interesting article on "A Lamp Resistance for Accumulator Charging." This gave a very simple, yet plain, system for those interested in wireless who wished to charge their own batteries.

However, many persons not acquainted with electricity are apt to get confused in finding which is the correct terminal for the positive side of the battery, and through ignorance are liable to do great damage, and I therefore venture to add a little pole finding test which will be useful not only to the non-electrician but also to some electricians.

The test simply requires a potato cut into two, and the feed wires of the live circuit for charging the battery, with lamps, etc., in series.

Insert the bare ends of the wires into the inside portion of the potato, taking care that the wires are not too close together; turn on the current, when a chemical action will at once take place.

One terminal will turn a greeny-blue, similar in colour to that of copper sulphate. This one will denote the positive side of the service, which should be connected to the one marked + on the battery.

The other terminal will begin to gas, this denoting the negative side of the service. I am, etc.,
H. THORNTON.
Halifax.

Patent Section

The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS

(Specifications not yet published.)

12011. Akister, F.—Manufacture of inductance coils for wireless telegraphy, &c. May 4th.

11747. Automatic Electric Co.—Electromagnetic relays, &c. May 1st.

11747. Automatic Telephone Mfg. Co., Ltd.—Electro-magnetic relays, &c. May 1st.

12124. Bertelsen, H.—Head-bands for telephones. May 5th.

11881. Beswick, R. E.—Panel boards for wireless apparatus. May 2nd.

12160. Breeze, H. W.—Electric fuse, &c., fittings. May 5th.

11907. Bunting, R. S.—Collapsible frame aerials. May 3rd.

11793. Burnside, G. B.—Electromagnetically-actuated acoustic diaphragms. May 2nd.

11830, 11831, 11832. Case, T. W.—Apparatus for electrically translating sound waves into light waves and for producing a photographic record of such waves. May 2nd.

11795. Castellan, C. E.—Inductance coils for wireless receiving sets, &c. May 2nd.

11795. Chapman, E. H.—Inductance coils for wireless receiving sets. &c. May 2nd.

11876. Coates, A. W.—Thermionic valves. May 2nd.

11691. Collins, W. H.—Variometers, &c. for wireless receiving sets. May 1st.

12064. Coursey, P. R.—Electric switches. May 4th.

12064. Dubilier Condenser Co. (1921), Ltd.—Electric switches. May 4th.

12046. Edwards, G.—Wireless crystal-holders. May 4th.

12161. Edwards, W. M.—Crystal detectors for wireless reception. May 5th.

11986. Electric Productions Co., Ltd.—Transmission or reproduction of sound May 3rd.

11881. Ferguson, R.—Panel boards for wireless apparatus. May 2nd.

11711. Garrard, C. C.—Electric switches. May 1st.

11865. Gaynor, T. F.—Crystal detector. May 2nd.

12171. Granat, E.—Electric transmission systems. May 5th. (France, May 24th, 1922.)

11843. Grimes, D.—Receiving-circuits for wireless telegraphy. &c. May 2nd. (United States, September 19th, 1922.)

11982. Hale, G. W.—Interlocking devices for controlling electric circuits. May 3rd.

12020. Harrisson, J. A. G.—Tumbler switch attachment. May 4th.

12160. Henley's Telegraph Works Co., Ltd., W. T.—Electric fuse, &c., fittings. May 5th.

12051. Jaffs, J. S.—Wireless receiving apparatus. May 4th.

11865. Johnson, E. S.—Crystal detector. May 2nd.

11681. Jones, A. S.—Microphone relays, receivers, &c. May 1st.

11682. Jones, A. S.—Loud-speakers, receivers, &c. May 1st.

11683. Joyce, G. J. R.—Wireless direction-finding systems. May 1st.

11588. Kinman, T. H.—Wireless systems. April 30th.

12132. Lloyd, A. Ford-.—Wireless receiving-apparatus. May 5th.

11869. Lumiere, L.—Loud-speakers. May 2nd.

11819. McCarry, P. A.—Means for winding electric coils. May 2nd.

11896. McCarthy, A. J. P.—Electric circuit-connecting devices. May 2nd.

11870. McGown, R. O.—Outdoor aerial wires for wireless telephones. May 2nd.

11907. Parkinson, W.—Collapsible frame aerials. May 3rd.

11684. Pearce, H. W.—Loud-speaking wireless sound-box. May 1st.

12051. Phillips, R. W. R.—Wireless receiving-apparatus. May 4th.

12034. Pollard, H. B. C.—Time switches and signalling devices. May 4th.

11684. Pollard, J. F.—Loud-speaking wireless sound-box. May 1st.

11957. Polyblank, W. J.—Insulators. May 3rd.

11564. Poole, W. E.—Crystal detectors for wireless current. April 30th.

11837. Portway, A. P.—Thermionic valves. May 2nd.

11881. Radio Communication Co., Ltd.—Panel boards for wireless apparatus. May 2nd.

11711. Railing, A. H.—Electric switches. May 1st.

11864. Rice, R. H.—Means for connecting wires to terminals, &c. May 2nd.

11683. Robinson, J.—Wireless direction-finding systems. May 1st.

11842. Rotherham, K.—Connecting-devices for electric conductors. May 2nd.

11979. Runbaken, J. H.—Charging electric accumulators, &c. May 3rd.

11711. Searle, A. F.—Electric switches. May 1st.

11699. Shaftesbury Wireless & Engineering Co., Ltd.—Terminal for electric apparatus, &c. May 1st.

11986. Shorter, W. H.—Transmission or reproduction of sound. May 3rd.

11842. Smith, H. N.—Connecting-devices for electric conductors. May 2nd.

11876. Southgate, A.—Thermionic valves. May 2nd.

12132. Stagg, A. — Wireless receiving-apparatus. May 5th.

12159. Sykes, A. F.—Electric modulating apparatus. May 5th.

11907. Taylor, E. A.—Collapsible frame aerials. May 3rd.

11907. Taylor, L. E.—Collapsible frame aerials. May 3rd.

11657. Temple Cox Research Co., Ltd.—Means for protection and functioning of thermionic valves, &c. May 1st.

11657. Temple, R.—Means for protection and functioning of thermionic valves, &c. May 1st.

11979. Torrance, W.—Charging electric accumulators, &c. May 3rd.

11836. Watkins, R. C.—Lead-in wires for wireless, &c., apparatus. May 2nd.

11722. Western Electric Co., Ltd.—Loaded signalling-conductors. May 1st. (United States, May 2nd, 1922.)

11897. Whitehorn, H. K.—Insulation of electric conductors. May 2nd.

11986. Willson, W. J.—Transmission or reproduction of sound. May 3rd.

11827. Wilson, G S.—Loud-speakers for wireless receiving installations. May 2nd.

11982. Wireless Equipment, Ltd.—Interlocking devices for controlling electric circuits. May 3rd.

12161. Yeo, O. E.—Crystal detectors for wireless reception. May 5th.

12042. Young, E. D.—Telephone receivers. May 4th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

(Copies of the full specifications, when printed, may be obtained from Mr. Gee, post free on payment of the official price of 1s. each.)

194765. Pollock, E.—In thermionic relays the output circuit of a low-frequency alternator, is controlled by means of two or more interposed diode tubes, which are normally non-conducting because their filaments are cold. A shunt circuit across the alternator when closed by means of a key incandesces the filaments of the diodes through transformers, whereupon both half-cycles of the power supply are passed to energise the primary of an output circuit. A separate microphone circuit may replace the key-controlled shunt circuit. December 13th, 1921.

194799. Watts, H. A.—A variable electric rheostat, inductance, potentiometer or the like, of the kind comprising one or more resiliently mounted windings engaged by an adjustable contact, comprises wire or the like wound around one or more resiliently mounted formers or carriers, and a contact lever or guided contact member movable in a plane or in a straight line parallel to the axes of the formers and perpendicular to the direction of movement of the formers. The lever or guided member contacts with the windings to vary the resistance or inductance in circuit, the resilient mounting of the formers pressing the turns of the wire against the contact with efficient electrical contact and without liability of jamming. December 19th, 1921.

194800. BING WERKE VORM GEB. BING AKT.-GES.—The contact pressure against a crystal detector, or the distance between two spark electrodes, is adjusted by the movement of an eccentric or cam-shaped elastic wire or band bearing against one of the parts in question. The invention is particularly suitable for toy wireless sets. December 19th, 1921.

194859. WOLFE, H., GRIFFITHS, G., and SLACK, W.—A mould for electric insulators is formed of two parts, the inner of which is provided with a passage which is closed during the pouring operation, but can be opened afterwards to admit air for drying purposes. January 23rd, 1922.

194864. PRESTON, L. G., and SHEARING, G. —Relates to the grid coupling-coils of transmitting-valves, particularly in high-powered sets. When the grid coil of an oscillation-generator is coupled to the aerial, or when the grid coil of a power-valve is coupled to a separate exciting-valve, either sparking trouble or else an irregularity in output is liable to occur when, in order to shorten the wavelength, a portion of the coil is cut out. In order to avoid this difficulty, the grid coil, whether of disc form, or cylindrical, is split up into several sections, arranged in equal numbers on each side of the exciting-coil, thereby reducing the mutual coupling between the portions of the grid coil and the sparking potentials to earth of the corresponding tapping-points. January 24th, 1922.

194882. GENERAL ELECTRIC CO., LTD., TRIPPE, C. F., and DURDLE, O.—In a thermionic or other discharge device a glass

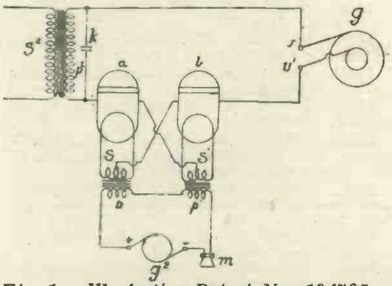


Fig. 1.—Illustrating Patent No. 194765.

or other insulating sleeve is fitted inside a re-entrant stem carrying a seal for one or more filament or other electrode leading-in wires, so as to insulate these wires from a leading-in wire sealed through the side of the re-entrant stem and connected, for instance, to the anode. One or more vent-holes may be provided in the lower end of the sleeve. February 4th, 1922.

194883. GOODE, C. S.—A thermionic valve having three electrodes arranged in planes parallel with the axis of the bulb, is provided with a permanent or electro-magnet or other means for producing a magnetic field, mounted on the bulb, and capable of rotation around the bulb so as to control the current in the valve. February 6th, 1922.

194886. DICTOGRAPH PRODUCTS CORPORATION.—A casing for galvanic batteries in

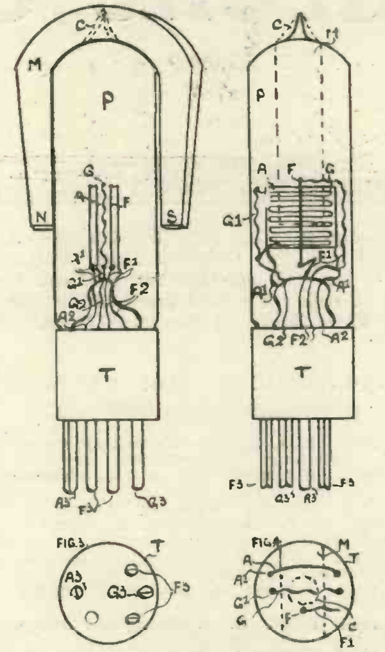


Fig. 2.—Illustrating Patent No. 194883.

which the connections are made automatically on the insertion of the cells, and the closing of a movable end is provided with open windows in one or more sides, and with a movable lid secured by means of a rotatable member, which engages in grooves in pins projecting from the casing. February 7th, 1922.

194899. PRESTON, L. G., HUGHES, H. G., and MULLARD, S. R.—In thermionic valves, a leading-in conductor for a filament or other electrode is provided with one or more auxiliary conductors to enable a large current to be carried through a seal of lead or other metal. February 15th, 1922.

194924. FULLER'S UNITED ELECTRIC WORKS, LTD., and FULLER, L.—The jelly or paste electrolyte of a dry battery comprising a positive dolly placed within a zinc container is covered with a layer of cement

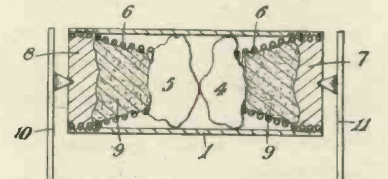


Fig. 3.—Illustrating Patent No. 194983.

or plaster containing a proportion of active salts or electrolyte. Above the plaster or the like, which is sealed with wax or other substance impervious to moisture, is placed a quantity of sawdust to trap moisture, &c. The battery is finally sealed in the ordinary manner. March 7th, 1922.

194956. SCHLEPER, J. F.—Two or more wire conductors are connected by twisting together the bared ends of the wires and screwing into a metallic sleeve provided with an internal conical or equivalent screw thread and fitted with an insulating cap. The cap may be screwed or otherwise secured on the sleeve. April 13th, 1922.

194983. R. M. RADIO, LTD., and MOORE, H. R. RIVERS.—A detector for use in wireless telegraphy and telephony comprises two crystals contained within an insulating envelope and held in contact by springs which are fixed by electrically conductive soft metal seals. Wads of cotton wool, &c., prevent the soft metal, which is poured into the envelope in a fluid state, from flowing into the space occupied by the crystals. The detector is supported on points pressed out of the resilient metal terminal clips. May 26th, 1922.

195051. MARCONI'S WIRELESS TELEGRAPH CO., LTD. (Assignees of Manley, L. L.)—A loop antenna, particularly for indoor reception of broadcast signals, comprises a coil mounted on a flexible sheet so that it can be readily folded up. Tappings from the coil may be brought out to terminals on a reinforcing strip, and the flexible sheet may be mounted on a spring blind roller which is hinged to permit adjustment in azimuth. A hook is provided for keeping the antenna extended when required.

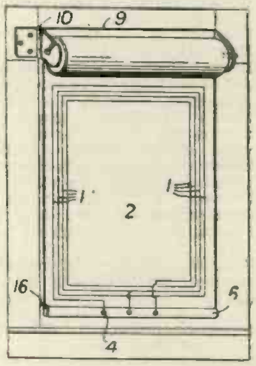
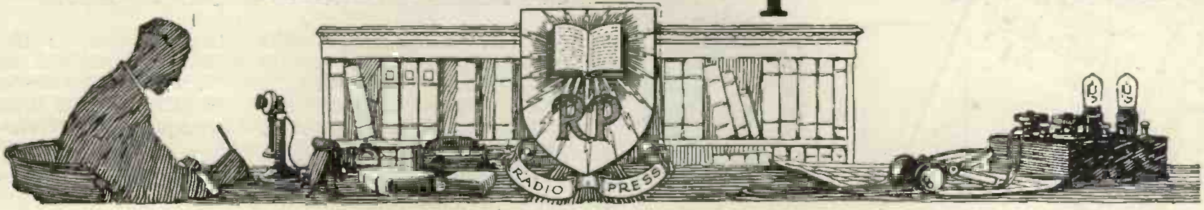


Fig. 4.—Illustrating Patent No. 195051.

February 23rd, 1923. Convention date, March 14th, 1922.

195088. SOC. INDUSTRIELLE DES PROCEDES W. A. LOTH.—Relates to means for determining the direction of magnetic or electro-magnetic fields of any frequency, applicable to the reception or emission of fields or signals in guiding moving objects along a route by means of current-carrying cables, in avoiding collisions between moving objects, in wireless telegraphy and telephony and radiogoniometry, in affording security on railways, in electro-magnetic exploration of the subsoil, and in searching for faults in electric cables. March 17th, 1923. Convention date, March 18th, 1922.

Information Department



Conducted by J. H. T. ROBERTS, D.Sc. (F.Inst.P.), assisted by A. L. M. DOUGLAS

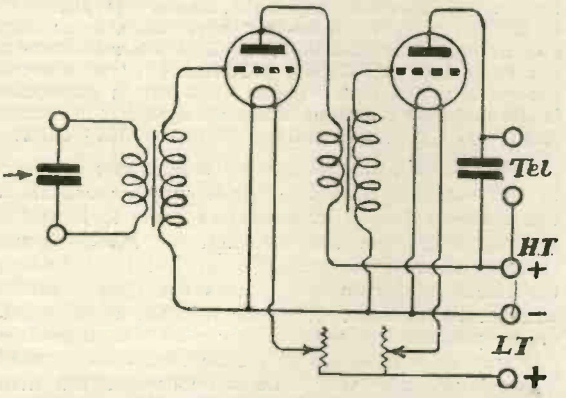
In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

G. R. (SANDWICH BAY) has constructed a low-frequency amplifying panel, and wishes to know whether this should be attached to the telephone terminals of his existing detector panel.

The input side of the low-frequency amplifier should be attached to the telephone terminals in the way you suggest. It is not necessary to have separate H.T. or L.T. batteries for this amplifier, but care should be taken that the same leg of the filament is joined to the H.T. negative in both panels.

E. K. F. (MALTON) sends us a diagram of his low-frequency amplifier, which does not give results, and asks whether it is correct.

Your wiring diagram is not correct. We reproduce herewith the proper arrangement of this circuit.



F. W. W. (WORTLEY) is winding an intervalve transformer, and asks how much wire should be necessary to complete it.

The amount of wire you have already used is sufficient to complete the winding of this transformer. If the dimensions of the core and the winding space are correct, no more is necessary to obtain satisfactory results.

D. L. J. (CARDIGAN) is about to apply for an experimental licence, and asks for advice as to the method of procedure.

"Wireless Licences and How to Obtain Them," by E. Redpath (Radio Press, Limited), will answer your questions more fully than is possible in these columns.

R. W. G. (WILLENHALL) submits a sketch of his aerial, which has a number of power lines crossing it, and asks whether he would obtain satisfactory results from such an arrangement.

We are afraid that you will experience a good deal of interference from these lines, even although you only propose to use a crystal set. To obtain satisfactory results in a position like yours is almost impossible.

W. H. (FINCHLEY) submits a circuit and asks our opinion.

Reaction on to the aerial circuit must not be used when receiving British Broadcasting.

W. W. B. (CREWE) submits a wiring diagram and asks certain questions.

Your circuit diagram appears to us to be very well designed, and will probably give every satisfaction. Referring to your question about valves, we are obviously unable to recommend any particular make of valve, but you should have no difficulty in finding suitable valves for the purposes you require in the advertisement pages of this journal. In general, we may, however, say that soft valves are the best detectors, and hard valves the best low-frequency amplifiers, unless many stages of low-frequency amplification are used, when the transformers should have low ratios and the valves be soft.

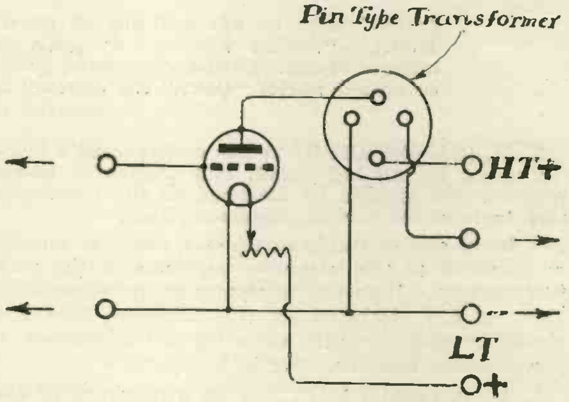
C. P. E. (EDGBASTON, BIRMINGHAM) has a crystal set to which he has added two low-frequency amplifying valves. He asks (1) why it is that when the first filament rheostat is adjusted it alters the current flowing through the second valve as well. (2) Whether a projected arrangement of brass plugs and contact plates for using one or two valves at will is suitable. (3) What size of telephone condenser should be used.

(1) As most rheostats are connected in the same battery lead, any adjustment of one is bound to slightly affect a load upon the other one. (2) Your projected arrangement of brass plugs and plates is quite suitable for controlling the valves. A double-pole changeover switch between each valve would, however, be better. (3) You should certainly have a condenser across the telephone terminals, and this might be of 0.002 μF capacity. You will probably find that by shunting the primary of the first intervalve transformer with a condenser of similar capacity, and by

spacing the transformers well apart, you will not experience so much howling. One of your rheostats appears to be wound with finer wire than the other one, since it gets much hotter than the other.

O. B. (URMSTON) asks with reference to the inductively coupled crystal receiver described in "MODERN WIRELESS," No. 3, whether he could add a stage of high-frequency amplification to this, and if so, what range might be expected for telephony.

We give herewith a circuit diagram showing how a stage of high-frequency amplification may be added



to this receiver. The range of the set should be increased to about 50 miles under these conditions.

G. F. A. (HORNSEY) asks the following questions : (1) Whether it would lessen the efficiency of the aerial if a "lead-in" was taken from each end as shown in his sketch. (2) With reference to a circuit in "MODERN WIRELESS," whether it makes any difference if the rheostat is connected in the negative filament lead or the positive filament lead. (3) Certain questions about loading coils.

(1) You should not attempt to attach two receivers to the same aerial. The aerial may be broken in the centre if desired by insulators so as to form two separate oscillatory systems, and a "lead-in" may then be taken from each end. (2) With reference to the circuit you mention, it does not greatly matter whether the filament resistance is in the negative lead or the positive lead. (3) Either basket or tapped inductance coils in series might be used as suggested. There is probably very little to choose between them in efficiency on the higher wavelengths.

H. P. Jnr. (CHURCH END) has constructed the two-valve low-frequency amplifier described in No. 3 of "WIRELESS WEEKLY," and gets good results. He wishes to add a high-frequency amplifier to this apparatus, and asks if the sketch he submits is suitable.

The arrangement you indicate is quite satisfactory, and will give you a somewhat increased range.

INTERVALVE TRANSFORMERS.

We note that, due to an oversight, diagrams appearing in our last issue show the iron-core intervalve transformers as giving a *step-down* effect. Such transformers should always be arranged so as to give a *step-up* effect, the fine wire winding being connected to the grid and filament of the succeeding valve.

"SIMPLETON" (REPTON) asks what the advantages are, beyond cheapness, of high-frequency amplification over low-frequency amplification.

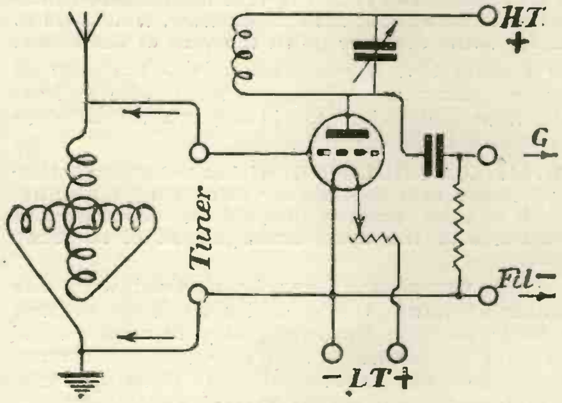
Low-frequency amplification is useful where a great volume of sound is desired, but has the disadvantage that after one or two stages it begins to introduce distortion into the received speech or music, unless very carefully handled. High-frequency amplification on the other hand can be extended to several stages and usually does not introduce distortion into speech. It also permits better rectification to take place, since the rectifying powers of a valve are almost directly proportional to the strength of the impulses applied to it. High-frequency amplification also allows one to hear distant stations, which note magnifiers alone cannot do.

M. V. H. (NORWICH) refers to the 2-valve receiver described in "WIRELESS WEEKLY," and wishes to know whether it is possible to hear Broadcasting with this.

We think this receiver would prove suitable for your purpose, especially if used in conjunction with a note magnifying valve. Very satisfactory results have already been obtained with it.

J. R. M. (NEWTON ABBOT) wishes to know how he can add a high-frequency valve to his set, which is circuit ST 39 "Practical Wireless Valve Circuits," Radio Press, Limited.

We give herewith a diagram showing how a high-frequency valve may be added to this apparatus. Basket coils could be used if a tuned anode amplifier was employed, and these should be mounted in the ordinary type of coil holder so that one can be used as an adjustable reaction coil if reaction effects are required. This circuit does not radiate to any appreciable extent.



H. R. G. (STOURBRIDGE) submits a circuit diagram and asks if it is suitable; if not, could we recommend a better one.

The circuit you submit is quite suitable, and should be very selective.

A. B. (HACKNEY) wishes to obtain a circuit using variometer tuning to cover a wavelength range of from 300 to 3,000 metres, in conjunction with a frame aerial.

A range of wavelengths such as you specify is too great to be covered with a single variometer, as you suggest. There is also very little object in constructing a frame to cover such a range, as you would not be able to receive anything on it above about 900 or 1,000 metres but Morse messages. We suggest you should limit your wavelength range from 250 to 600 metres, when a frame aerial would be fairly satisfactory, but at the same time you would find it very difficult to pick up anything but the nearest Broadcasting station.

W. F. E. (GATESHEAD) is constructing an inductively-coupled receiver consisting of two basket coils, the primary having an inside diameter of 2½in. with 60 turns of No. 26 d.c.c. wire. He asks the dimensions of an appropriate secondary coil.

100 turns of the same gauge wire on the same size former and with 10 tappings would be suitable. Your aerial is quite satisfactory.

A. J. M. (ASHFORD, KENT) is constructing a two-valve receiver and encloses a circuit diagram. He asks if it is correct, and whether the variable gridleak described in No. 1 of "WIRELESS WEEKLY" would be suitable with this set.

Your connections as sketched are quite correct, and the variable gridleak might be used with advantage, in which case it should be connected in exactly the same way as the ordinary gridleak.

F. F. W. (STOPSLEY) wishes to know what component parts would be necessary for him to construct the valve and crystal amplifier shown in "MODERN WIRELESS," No. 4.

We cannot recommend the products of any particular manufacturer, but an examination of the photograph of this apparatus should supply you with all the data you require. Valve panels, rheostats, etc., may be bought from almost any accessory dealer, and any good make of high-tension battery and accumulator will be satisfactory. The valve should be "hard."

L. T. E. (SHEFFIELD) is erecting an aerial, and asks questions about his lead-in wire, which has to run for some distance down the wall of the house.

We suggest that if you erect a horizontal arm in such a manner as to keep the aerial wire at least 10ft. from the wall of the house, you will not lose very much signal strength.

H. M. (EAST DULWICH) wishes to know whether there is any easy formula for calculating the actual length of wire required to wind an inductance, in preference to the usual arrangement of so many turns.

Much greater accuracy can be obtained when the number of turns is calculated than if an attempt be made to judge the length of wire required. If you have any difficulty with regard to the amount of wire necessary to wind so many turns upon any given tube, we can always advise you.

A. F. (BRISTOL) submits particulars of two anode and reaction coils he has constructed, and asks for our advice.

We think that, instead of tapping the coils, you should tune them with a small variable condenser having a capacity of about 0.0002 μF. From your remarks we judge that your earth lead is probably at fault, and you should carefully overhaul this, making the contact area of the wire with the ground as great as possible. A good article describing how efficient earthing may be carried out appeared in *Wireless Weekly* No. 2

C. L. F. (ECCLESALL) asks the following questions :—(1) Whether a variable condenser could be used with the crystal set described in No. 1 of "WIRELESS WEEKLY," and what would be a suitable value for it. (2) Whether it would raise

the efficiency of this set if rubber was inserted between the wood and the brass slider bar. (3) What kind of wire should be used for connecting up the circuit.

(1) A variable condenser is not of much advantage with this set on account of the fact that every turn of inductance can be easily varied by means of the slider. The condenser would require to be very small indeed to accurately tune between each individual turn of the coil. (2) Rubber inserted between the slider bar and the wood would not raise the efficiency in any way, as the brass screws would still penetrate the wood. There is practically no leakage through this arrangement. (3) Stiff tinned copper wire should be used for connecting up, No. 16 or 18 gauge being very suitable; flexible wire may, of course, be used. Referring to your question about the slider bar, this will, of course, need to be 14in. long in order to work with the 12in. tube mentioned.

F. W. W. (HARRINGAY) submits a diagram, and asks certain questions about his rectifying valve.

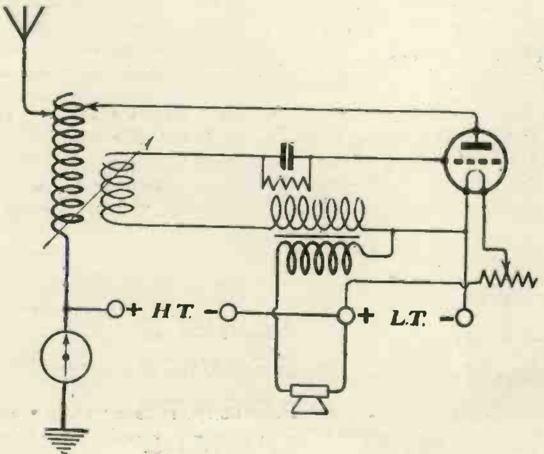
If you will let us know what make of valve you are using as a detector, we will then be able to advise you.

J. T. W. (PORT TALBOT) experiences considerable trouble when receiving broadcasting from neighbouring power lines and various wires which run near to and parallel with his aerial. He submits a plan of the locality, and asks our advice.

We are afraid you will always be troubled with this undesirable noise. It is extremely difficult to eliminate A.C. hum from cables carrying such a high voltage; but if you use a counterpoise earth you might possibly obtain some measure of freedom. Unfortunately, you are rather far away from any Broadcasting Station to use a frame aerial, otherwise you might be able to eliminate the noises by this means. Occasionally relief is obtained by wrapping the wires leading to the H.T. battery, telephones, etc., with tinfoil, and earthing them. The cores of the low-frequency transformers might also be connected together and the whole system earthed.

A CORRECTION.

WE regret that the circuit shown in the last issue of this paper in reply to "R. T. G." (New Cross, S.E.14) was incorrect. We reproduce herewith the diagram required.



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