MODERN WIRELESS

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SPECIAL Birthday Number

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Contents

MODERN WIRELESS

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Editorial

TWELVE months ago the first issue of MODERN WIRELESS appeared on the bookstalls. Was such a magazine really wanted? Would it appeal to the public? What was the circulation likely to be? These were a few of the questions which exercised the minds of the proprietors. The emphatically affirmative answer of the public soon set aside all doubts, and the first issue of 20,000 copies disappeared in a few hours. The actual number of copies sold was so great that after a few months the publishers issued what few magazines can give—a certified net sales certificate showing an average net sale of over 100,000 copies a month. The three-fold ideal of MODERN WIRELESS—to give the right articles by the right authors in the right way—has animated us from the beginning. We believed that the public wanted a magazine such as MODERN WIRELESS, and we knew that if we gave them such a magazine we could count upon wide support. In fact, such was the value given in the early issues of MODERN WIRELESS, that many people thought that it could not possibly be maintained. The answer will be found on looking back over the first twelve issues—not only has the value been maintained, but it has been increased.

Of course, there have been criticisms. We invite and welcome them. No magazine can succeed if it adopts an attitude of false superiority and ignores the wishes of its public and the changing conditions of the times. Because we have been bold enough to state frankly the names of the various component parts used by our authors (information of great help to readers), we have sometimes been accused of using our editorial pages for advertising purposes. We take this opportunity of stating bluntly that our editorial pages are not, never have been, and never will be for sale. Advertisers who take space in our pages do so because they know they reach the right people. We accept no advertising which is conditional upon mention of a firm in the editorial pages, nor shall we ever do so.

In another part of this issue will be found a Questionnaire in which once more we ask the opinion of our readers on a number of special points. Some months ago when we published a similar form the thousands returned to us by our readers were of immense help in improving the magazine. Since that time we have added a very large number of new readers to our circle, and these in particular we ask to fill in the form and return it to this office.

The contents of the present issue will, we hope, prove of exceptional interest, articles on theory, practice and of general interest being published.

We have not forgotten that thousands of broadcast listeners are beginning to take a wider interest in radio matters, and we think that they will find much to help them in our pages. The more advanced experimenter, too, is well catered for, both in circuits and in experimental data. In closing these notes, we would take the opportunity of assuring our readers that no effort will be spared to make the coming issues even better than those of the past.

Heard 7,300 Miles Away

STRIKING ACHIEVEMENT OF CHICAGO STATION

Those readers who have difficulty in hearing Aberdeen in London will envy the operator in Samoa who recently heard WJAZ over 7,000 miles away.

All records were broken the other day when the Zenith-Edgewater Beach Station WJAZ was heard fully 7,300 miles away—almost half-way around the earth. At midnight, Central Standard Time, each Wednesday, Station WJAZ changes to its experimental call 9XN for the purpose of broadcasting messages and news to Dr. Donald B. MacMillan and his exploration party aboard the *Bowdoin*, now frozen in within 11 degrees of the North Pole. Wednesday night they call "MacMillan Night."

On Thursday morning at 1.45 a.m. the regular programme was being put on for Dr. MacMillan and his crew, and E. F. McDonald, Jr., of the Zenith-Edgewater Beach Station and President of the National Association of Broadcasters, was delivering the many messages to them from their friends and relatives, together with the news of vital interest to the explorers, who, on previous expeditions, have been entirely shut off from news of the outside world. At this time, way down in Samoa, 12 degrees south of the Equator, Operator Roberts of the Naval Station VMG was listening for news from the world abroad when he picked up Station WJAZ and sent the following message to the Director of Naval Communications at Washington D.C., who, in turn, forwarded it to the station.

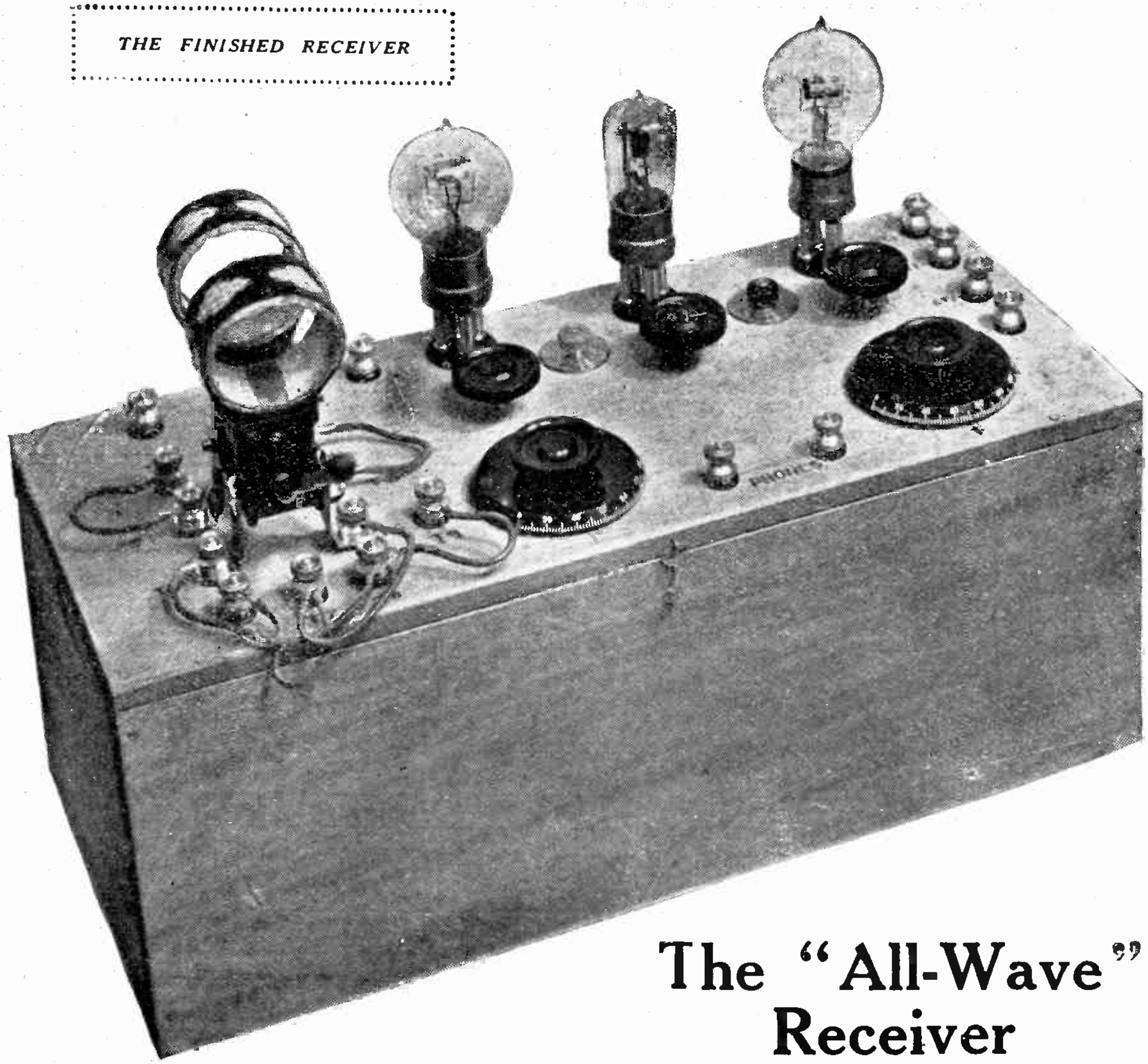
"Please inform Zenith-Edgewater Beach Hotel Radio Station that Chicago messages and music to MacMillan, North Pole, were received by me at 7.45 Samoa Time, December 19th.

"ROBERTS."

It is of considerable interest to note that a message intended for Donald MacMillan, now within 11 degrees of the North Pole, should be heard by Mr. Roberts in Samoa, 12 degrees south of the Equator in the Western part of the Pacific Ocean.

The studio at WJAZ (Zenith-Edgewater Beach Station). This station has been heard off Samoa.

THE FINISHED RECEIVER



The "All-Wave" Receiver

By JOHN SCOTT-TAGGART, F.Inst.P., Editor

Preliminary Remarks

THE receiver described in the following pages is not only an extremely efficient one, but possesses some unique features which will commend the set to experimenter and broadcast constructor alike. The following are some of the advantages of the receiver.

1. It is simple and cheap to make.

2. It may be used for all wavelengths.

3. It may be used for the reception of wireless telephony, spark signals or continuous wave signals.

4. It is designed for use with bright or dull emitter valves without the necessity of any alterations.

5. When dull emitter valves are used, the filament and high-tension batteries may be accommodated inside the box.

6. A special method of preventing undesirable self-oscillation is incorporated.

7. Tuned anode coupling may be used for any wavelength.

8. Resistance coupling may be used to couple the first and second valves when long-wave signals are to be received.

9. The set may be used as a single valve, two-valve or three-valve receiver, and may be adapted to half a dozen different circuits without altering the internal wiring.

10. Circuits using an aperiodic reaction coil may be employed with the set.

11. The reaction coil may be reversed without alteration of the permanent wiring.

12. Provision is made for constant aerial tuning, ensuring foolproof operation of the set.

13. External terminals are provided so that external high-tension and filament batteries may be used.

14. The underneath side of the panel and wiring may be inspected at any time in a few seconds.

Principal Circuits Used

The set is a three-valve receiver, and although single-valve and two-valve circuits of various sorts may be used with the set, yet it is essentially intended as a three-valve receiver.

Three principal circuits may be used, and in each case the constant aerial tuning system may be employed.

Fig. 2 shows the circuit for general use. It will be seen that the aerial circuit contains a plug-in coil L_1, which for broadcast purposes may be a No. 50 coil. A variable condenser C_1 of 0.0005 μF capacity is connected in parallel

In this article full constructional details are given of a three-valve set which may be used for broadcasting, spark signals, or C.W. signals of all wave-lengths.

with L_1, while the condenser C_2 is fixed and has a capacity of 0.0001 μF. The explanation of the constant aerial tuning system is given elsewhere. When long waves are to be received, it is preferable to connect the aerial as shown in the dotted lines, instead of to the top of the condenser C_2. This more ordinary connection may be used, of course, for the reception of broadcasting or shorter wavelengths.

The filament rheostats R_1, R_2 and R_3 are of the compressed carbon type. This type of rheostat is used because it is suitable for use either with dull emitters or bright filament valves. By using these rheostats the valves may be mixed, or either type used at will. Arrowheads are shown passing through the resistances to indicate a perfectly smooth continuous variation. In the anode circuit of the first valve is the inductance L_2, which will be a No. 50 plug-in coil for broadcast purposes. A No. 75 coil may, with advantage, be used both in the place of L_1 and L_2 when the broadcasting station has a wavelength over 400 metres.

An unusual feature is the use of a 100,000 ohm variable resistance connected across the circuit L_2 C_3. This resistance is for the purpose of preventing self-oscillation of the first valve, and it may also be used for obtaining a fine adjustment of reaction without having to move the coils relatively to each other. This idea is of great value, and may be adapted to numerous other types of circuits. The anode of the first valve is connected through the grid condenser C_4 of 0.0003 μF capacity, to the grid of the second valve. Across the grid and filament of this valve is a gridleak R_5 of 2 megohms value; a variable gridleak may be used if desired. In the anode circuit of the second valve is the primary T_1 of the step-up intervalve transformer T_1 T_2, the secondary of which is connected across the grid and filament of the third valve. In the anode circuit of this valve we have the telephones T, which may be replaced by a loud-speaker, shunted by a condenser C_5 of 0.002 μF capacity. A 6-volt accumulator B_1 is used, but a 4-volt accumulator or three large dry cells may be used if dull emitters are employed. The battery B_2 has a voltage of about 72 volts.

Operation of the First Circuit

The operation of this circuit is very simple. The first valve acts as a high-frequency amplifier, the tuned anode circuit L_2 C_3 being tuned to the same wavelength as the aerial circuit. The 100,000 ohms resistance R_4 has its value varied in order to obtain the best adjustment which will prevent the first valve from oscillating, as it will tend to do.

The second valve acts as a detector in the usual way, and the third valve acts as a low-frequency amplifier.

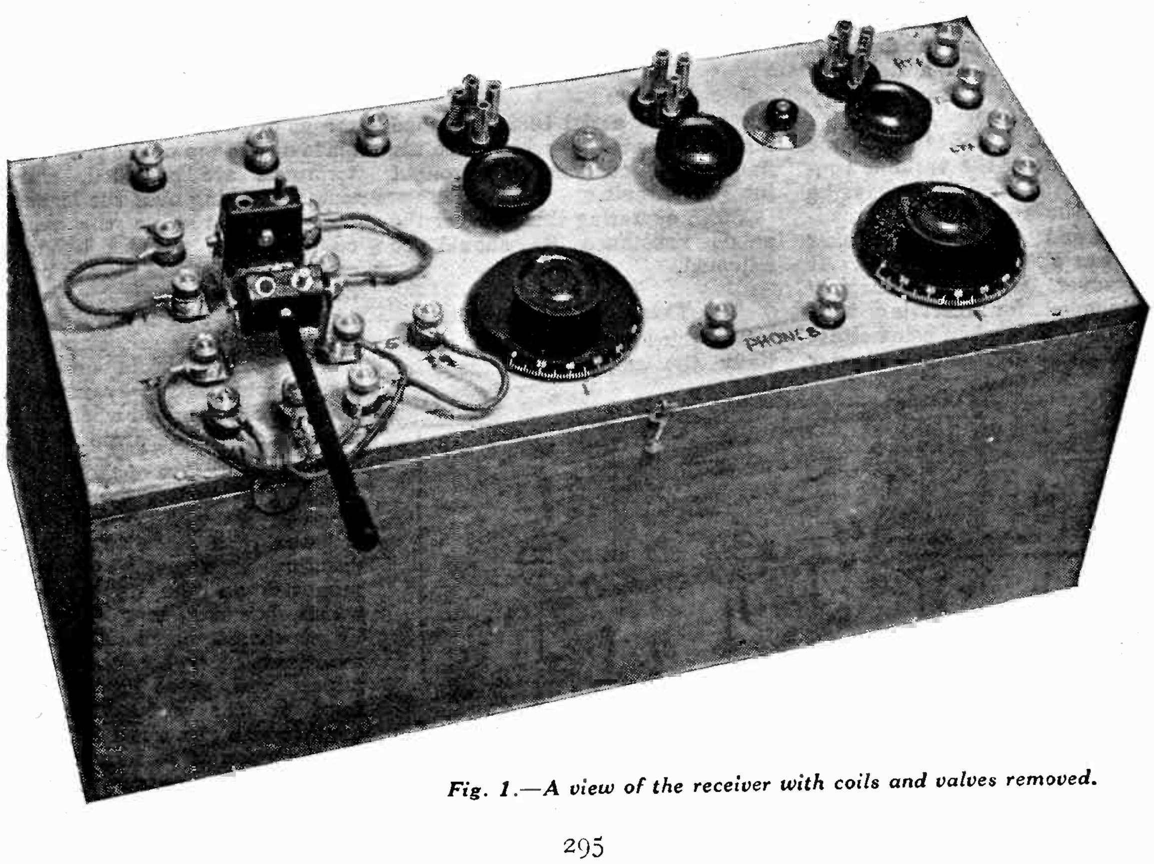


Fig. 1.—A view of the receiver with coils and valves removed.

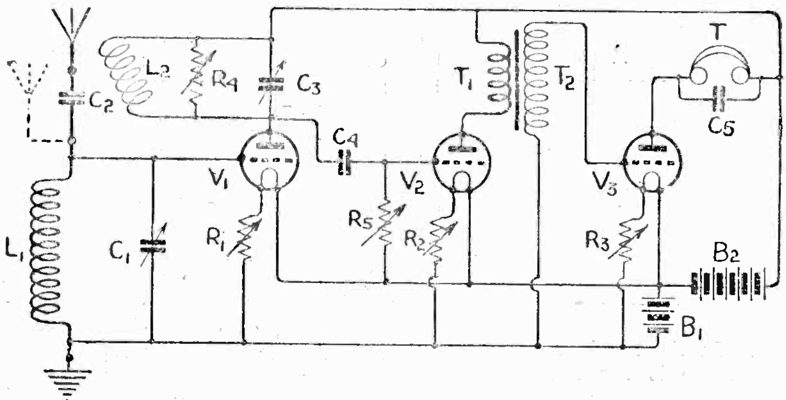


Fig. 2.—A circuit for general use.

This circuit is recommended for the reception of all broadcasting, continuous wave signals and even signals on long wavelengths. In the latter case, however, the aerial should be connected as shown in the dotted line.

The Second Circuit Explained

The second circuit is illustrated in Fig. 3, and the three-valve set may be arranged to conform to this circuit in about 5 seconds without altering the internal wiring in any way.

In Fig. 3 the ordinary parallel tuning condenser is employed, and the first valve acts as a high-frequency amplifier as before, but this time the stablising 100,000 ohm resistance R_4 is used as an anode resistance for coupling the first and second valve, acts as a detector, and the third as a low-frequency amplifier, as before.

This circuit involves only one control—namely, the variable condenser C_1. The circuit may be used for the reception of broadcasting, and good loud-speaker results are obtainable with it. It is, however, to be particularly recommended for receiving such stations as Paris, when using either spark or telephony. On the shorter wavelengths, such as those on which broadcasting takes place, the first valve is not very efficient as an amplifier. On these wavelengths the constant aerial tuning method may be adopted, in which case the fixed aerial condenser is brought into the circuit.

When operating this receiver the anode resistance R_4 should be adjusted.

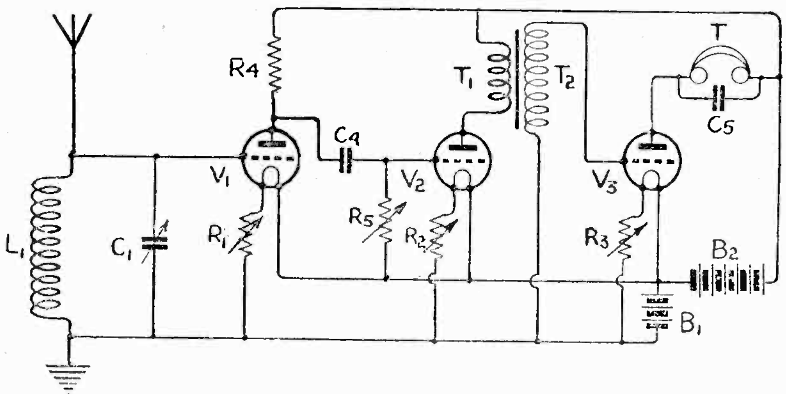


Fig. 3.—A resistance coupled circuit.

The Third Circuit Explained

The third circuit, which is essentially the same arrangement as Fig. 3, contains in addition a reaction coil L_2, which is included in the anode circuit of the second valve, in series with the primary T_1 of the step-up intervalve transformer T_1 T_2. The reaction coil L_2 is coupled to L_1, and introduces reaction into the aerial circuit, thereby greatly increasing the signal strength.

Although the circuit may be used on short wavelengths, yet its particular usefulness is in the reception of longer waves, spark and telephony signals. It may be used for the reception of continuous waves, but the results obtainable are not as loud as those in the case of Fig. 2.

Reversing the Reaction Coil

The reaction coil L_2 in Fig. 2 and Fig. 4 may be reversed by means of two small rubber-covered leads on the top of the panel. Four terminals are provided, and by simply crossing over the leads it is possible to reverse the reaction coil. This is a great boon, and enables all kinds of plug-in coils to be tried. The constructor will try reversing his reaction coil when he first operates his set, although he will probably obtain quite good results whichever way round the reaction coil is joined when the two inductances are separated.

Construction of the Set

Fig. 1 illustrates the completed receiver. It will be seen that it is made with a wooden box, the different components being mounted on the wooden panel, which, however, may be replaced by an ebonite panel without much increased cost, because the terminals and valve holders are so fixed to the wood that direct contact with the wood is avoided. In the case of a terminal, little ebonite bushes are provided; these may readily be purchased.

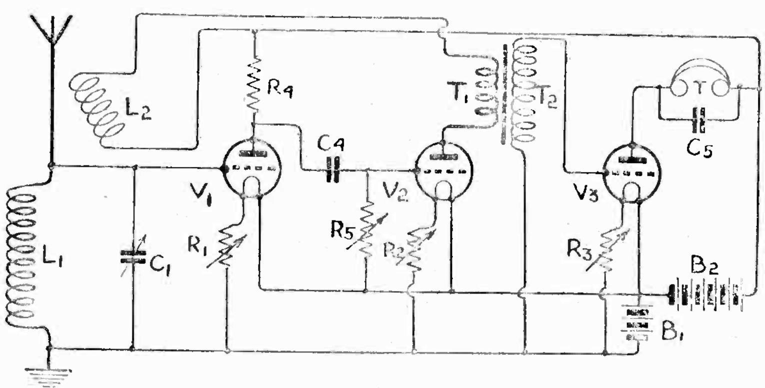


Fig. 4.—The Fig. 3 circuit used with reaction.

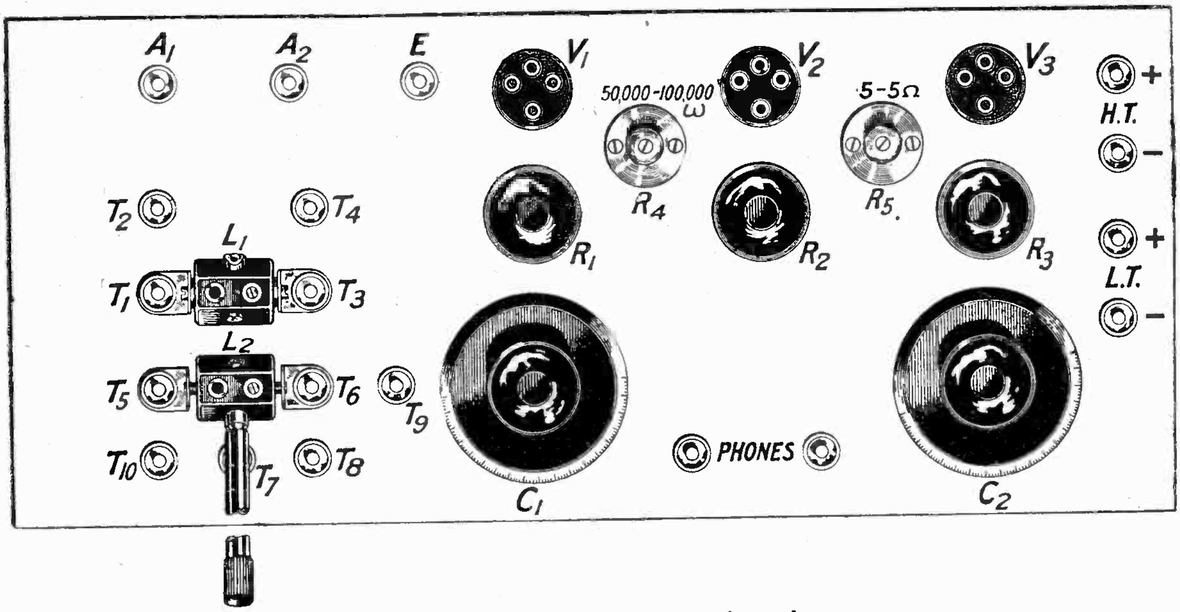


Fig. 5.—Scale drawing of top of panel.

It will be noticed that there are three terminals at the back of the panel. These three terminals are for alternative aerial connections and for the earth connections. The terminals at the extreme right of Fig. 1 are for the high-tension battery and for the low-tension battery; the two terminals in front, to the right, are for the telephone receivers, or loud-speaker. The terminals on the left are switching terminals, and by means of short, rubber covered leads, it is possible to obtain a variety of circuits, including Figs. 2, 3 and 4, as well as enabling us to reverse the reaction coil.

The Top of the Panel

The different components may be best explained by reference to Fig. 5, which is a scale drawing of the top of the panel.

When the aerial is connected to the terminal A_1, and the earth to the terminal E, constant aerial tuning is employed, an explanation of which will be found elsewhere. When the aerial is connected to the terminal A_2, the variable condenser C_1 is connected in paralled with the inductance L_1.

The knob R_4 is a 50,000 to 100,000 ohm resistance, and is used either as a damping device to prevent undesirable self-oscillation or else as the anode resistance of a resistance-coupled receiver. The knob R_5 is the variable gridleak which is always connected across the grid and filament of the second valve. The handles R_1, R_2 and R_3 control Microstat or Lissenstat filament resistances. These types of resistances depend upon the compression of carbon, and they are excellent for use with either dull emitter or ordinary valves of all kinds. These appear to be the only two types on the market at present which will serve for both types of valves.

The coil-holders shown in the illustration are of Igranic manu-

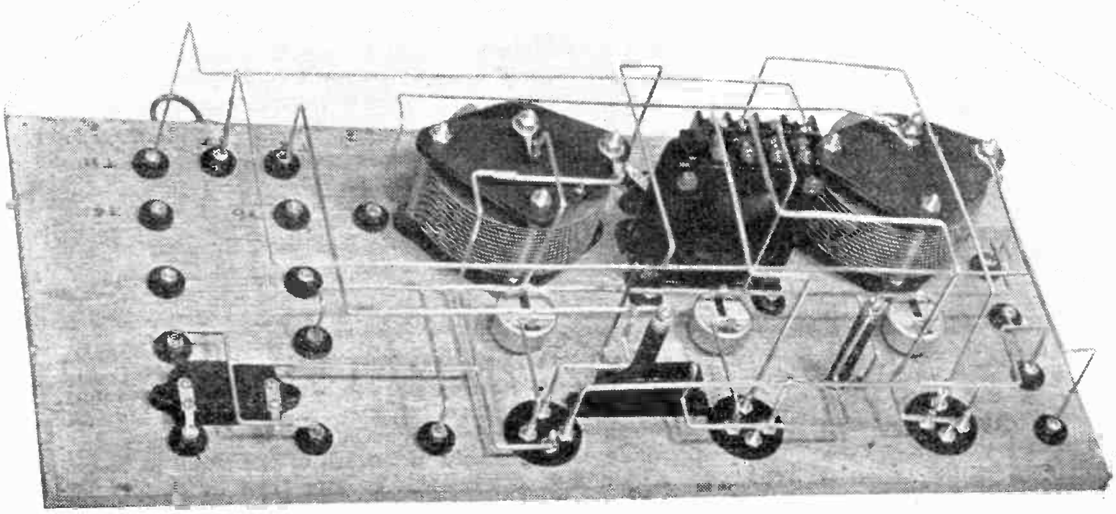


Fig. 6.—View of the underside of panel, showing wiring.

facture, but any other type might be employed. The terminals T_5 and T_6, and the terminals T_1 and T_3 secure the stands for the coil holders, and ebonite bushes are employed to prevent contact with the wood. The coil-holder L_2 has an extension handle which enables this coil to be moved up and down. The other coil holder remains fixed, or may be moved round only with some stiffness. If very loose coupling is desired, this coil-holder may be moved away from the other one, but ordinarily it would take up a vertical position.

The valve-holders V_1, V_2 and V_3 are of a type manufactured by the Bowyer-Lowe Company. A 1-in. diameter hole is made in the wood by means of a brace and bit, and these valve-holders may then be fitted into the hole. Other types of flange valve-holders may be on the market, but have not come to our notice.

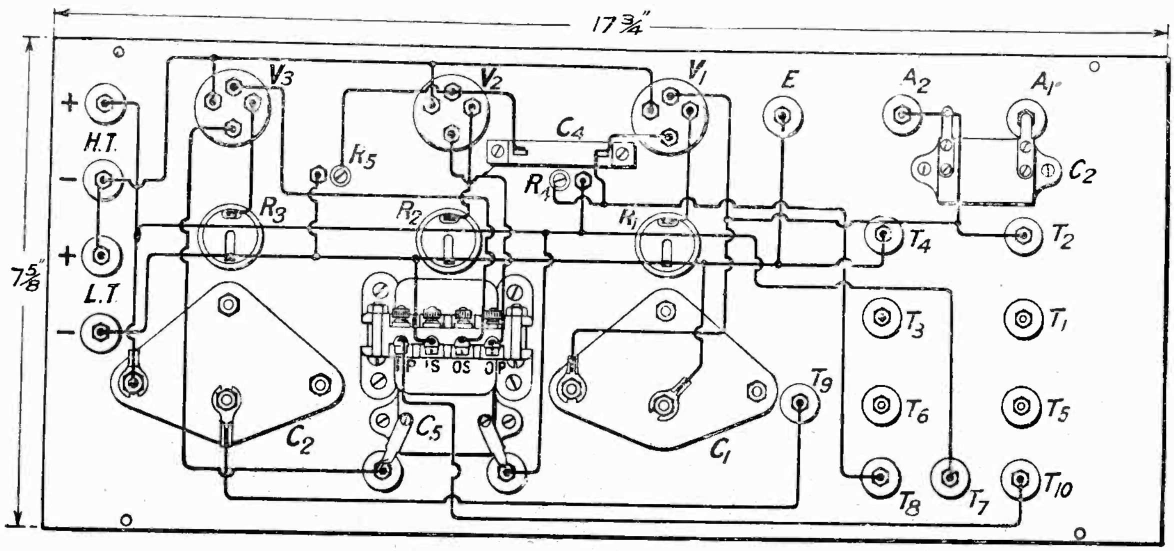


Fig. 7.—Detailed Wiring Diagram.

Underneath the Panel

Fig. 6 is the underneath view of the panel which, as stated before, is made of wood, but could be made of ebonite, in which latter case there would be no need for special valve-holders, or bushes for the terminals. The wood, of course, should be perfectly dry. No insulating bushes are provided for the different variable resistances, or variable condensers.

Fig. 7 is a detailed wiring diagram of the underneath of the panel. This wiring is accomplished with No. 16 gauge bare tin copper wire, which is soldered to the different terminals. This is undoubtedly the best method of wiring a set of this description, but the constructor can use his own discretion.

The different terminals have been given the same letters as those in Fig. 5. The circles, of course, around each terminal indicate the ebonite bushes. The terminals IP, IS, OS and OP, are those on the step-up intervalve transformer T_1 T_2, the choice of which is left to the discretion of the constructor. In a straightforward circuit of this description, the type of components used is not of vital importance. The position of the terminals of the transformer will depend upon the make used, but this should not confuse the constructor because the terminals are marked in Fig. 7.

The variable condensers C_1 and C_2 are of the ordinary type commonly used, and here again the connections to the condensers should not cause any difficulty. In each case a connection is made to the moving plates, and another connection to the fixed plates.

The terminals R_5 are those of the variable gridleak, whereas the terminals marked R_4 are those of the variable 100,000 ohm resistance. The circles R_1, R_2 and R_3 are the underneath portions of the Microstats or Lissenstats: each has two lugs or terminals to which wires are connected.

The condenser C_2 in Fig. 7 has a capacity of 0.0001 μF; the condensers C_1 and C_3 have a maximum capacity of 0.0005 μF, while C_4, which is preferably a type 600 A Dubilier condenser, stands vertically, and has a value of 0.0003 μF, being a grid condenser. The condenser C_5, which is connected across the phone terminals, has a value of 0.002 μF.

Another view of the Wiring

Fig. 8 shows another view of the wiring. Actually, in the set described, the wiring was done with square wire, which is stiffer than the ordinary round wire. Fig. 8 will give an indication of how the different wires are arranged. Fig. 7 not only indicates the connections to make, but also shows very closely how the wires are actually placed, although this is not a very important matter if the wires are kept as far as possible away from each other. In Fig. 7 slight changes of the position of the wires have been necessary to ensure that each connection is clear. A true photograph of the bottom of the panel would not indicate where all the connections go to, because some of the wires are closer to the panel than others, and in the photograph some would appear directly above others, and confusion would arise.

The Box Container

Fig. 9 shows the box on which the top panel is placed. This box, it will be seen, has four pins, S_1, S_2, S_3 and S_4, each of which fits into a hole in the wooden panel. Two hooks, H_1 and H_2, engaging with a couple of eyelets, screwed into the sides of the wooden panel. By this arrangement, which, it will be remembered, was introduced by Mr. Harris into his "All-Concert Receiver," enables the underneath of the panel to be inspected at any time by simply loosening the catches and lifting the panel off the box.

The pins are merely screws, the heads of which have been cut off with a hack saw, or filed off. The panel is first placed in position on top of the box, and then the four screws are screwed through the panel into the box, and the heads of the screws are then cut or filed off. The exact position of the pins, of course, is not important.

The right-hand side of the box, looking at Fig. 1, has four holes drilled through it, with four terminal bushes fitted to the holes (without the terminals, of course); these four holes are shown in dotted lines in Fig. 9.

The box, in the set actually being described, is made deep enough to contain two sets of batteries; one set is the high-tension battery, which has a value of about 75 volts, and the other used, and the other extremities of these wires are joined on to the terminals on the top of the wooden panel. An accumulator should never be put inside the box, because the fumes will corrode the wire, connections, etc.

Many constructors, no doubt, will prefer to leave the batteries outside the box, in which case the box could be considerably shallower, (say 4½ in. deep).

Wiring the Circuit for Broadcast Reception

Looking again at Fig. 5, and also Fig. 1, instructions are now necessary as to the connections and purpose of the various terminals T_2, T_4, T_1, T_3, T_5, T_6, T_{11}, T_7, T_8 and T_9.

Fig. 10 will help the experimenter to understand the purpose of the different terminals. The L_2; ordinarily T_5 is connected to T_8, and T_6 is connected to T_7; these connections are illustrated in Fig. 1. The terminals T_9 and T_{11} are important, and the connections necessary vary with the type of circuit employed.

Wiring up for Fig. 2 Circuit

The circuit given in Fig. 2 is the one recommended for reception of broadcasting. The aerial is connected to the terminal A_1 of Fig. 5, and the earth to the terminal E. A No. 50 plug-in coil is fitted into the fixed socket L_1 of Fig. 5, and a similar sized coil in the movable socket L_2 of the same figure. The terminals T_1 and T_2 are connected, and also the terminals T_3 and T_4 are joined by a rubber-covered wire. The terminal T_6 is joined to T_7, and T_5 is joined to T_8. The terminal T_8 is also joined to T_9, so

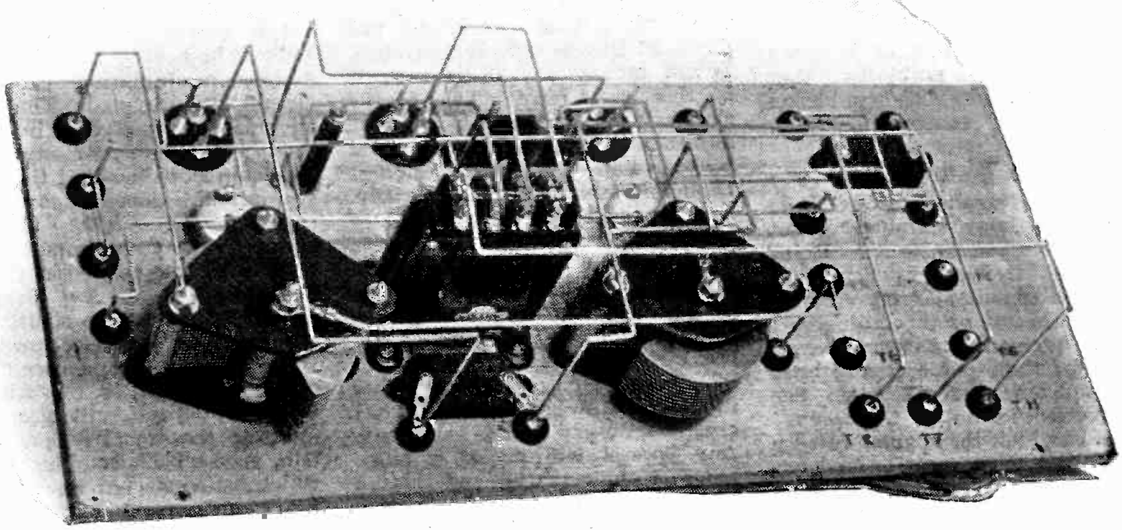


Fig. 8.—Another view of the wiring.

battery is a dry battery. The valves used in the set described were 0.06 type, and the high-tension battery was placed in one portion of the box, and the L.T. battery, consisting of three bell batteries joined in series, was contained in a right-hand compartment. Two separating pieces of wood were screwed into the box, as illustrated in dotted lines in Fig. 9. The two sets of batteries are covered over with a sheet of waxed paper, or cardboard. Two leads from the high-tension battery go through two of the holes B at the end of the box, and the two leads from the L.T. battery go through the other two. Flexible rubber-covered wires are perferably terminals T_1 T_2 and T_3 T_4 are to enable us to reverse the grid coil of the first valve, in other words to reverse the aerial inductance L_1. By this means we can reverse the reaction between L_2 and L_1. We will assume that the usual connection is for T_3 to be connected to T_2, and for T_3 to be connected to T_4. To reverse the reaction, and so test if better results are obtained, the terminal T_1 is connected to T_4, while T_2 is connected to T_3. All these connections are made with little rubber-covered wires having spade, fishtail shaped lugs on the ends. These wires are shown plainly in Fig. 1.

The terminals T_6 T_7 and T_5 T_8 also enable us to reverse the coil that the variable condenser C_2 **is** brought to shunt the inductance L_2. The terminal T_{11} is joined to terminal T_7 to complete the anode circuit of the second valve.

We are now working with the circuit of Fig. 2, the resistance R_4 being adjusted so that the maximum resistance is just in, i.e., that the resistance of R_4 is about 100,000 ohms.

Separating the two coils as widely apart as possible, tune in on the condensers C_1 and C_3, and broadcasting should be readily obtained. If the first valve oscillates too easily, the resistance R_4 should be reduced by turning the little knob, R_4, in a clockwise direction.

(Continued on page 405.)

In passing

Tact

IN case any readers should feel impelled to send warm greetings on the auspicious occasion of the first birthday of MODERN WIRELESS, may I point out that it is not tactful to wish a publisher many happy "returns."

A Birthday

"This," said the Editor, "is to be our birthday number. What are you going to do for it? Don't you think it is about time that you invented a new circuit? Something quite out of the ordinary, I mean. We've had dozens of valve circuits, but no one seems to have done much with the crystal. See what you can do in that way." When I had left the august presence it occurred to me that he had not mentioned whether he was addressing me in the capacity of a serious contributor or merely as the writer of these notes upon the less academic side of wireless. Anyhow, I resolved to do my best, and after many sleepless nights and an enormous outlay upon experimental apparatus I beg to present to readers my new duohyperanacatareflexoregenerative crystal circuit, whose advent will sound the death-knell of valves, bright, dull or medium, and will bring the crystal once and for all into its own.

The Circuit

Many circuits have already made a noise in the wireless world; in fact you can hear them making it on almost any night when you tune in a broadcasting station. Many have created a stir that lasted for a few brief weeks. But every new circuit so far produced has been found upon careful investigation to have been invented by someone else at least ten years previously. This circuit is put forward with no extravagant claims. I will merely say of it that it is the best, most efficient, the simplest to use, and that it has all others licked into the proverbial cocked hat. With this modest beginning let me describe it briefly.

A reference to Fig. 1 will show the principle upon which it works. The upper or hypo-tential end of the A.T.I. (L_1) is connected directly to the brush of the ululator or receiving felix. This joint should not be soldered, otherwise howling may be anticipated. One whisker of the felix makes contact with a crystal mounted in the usual cup. Any crystal will do at a pinch but I strongly recommend the use of an especially sensitive one such as blowmetite, wattafrite or dynamite. From the crystal a lead runs to the telephones, which should have a resistance of at least 50,000 ohms, and thence wanders back to the lower end of the aerial tuning inductance and mother earth. As the receiving felix is liable to be a little uncertain in its actions a stabilising saucer (S) should be provided. The saucer should be charged with a solution readily obtainable at any dairy. The length of time that the charge will last will depend upon the self capacity of the felix. If desired the milk may be condensed, in which case the condenser C_2 must be provided. A few drops of alcohol added to the solution will convert it into an electrotyte. If this is done the condenser C_2 will not be required, as the felix will do this by itself. In close proximity to the dorsal regions of the felix is the back coupling coil L_2 which is connected as shown to the reaction coil L_3. In shunt with the latter is a variable condenser marked C_3; a C_3 condenser will answer admirably for the purpose.

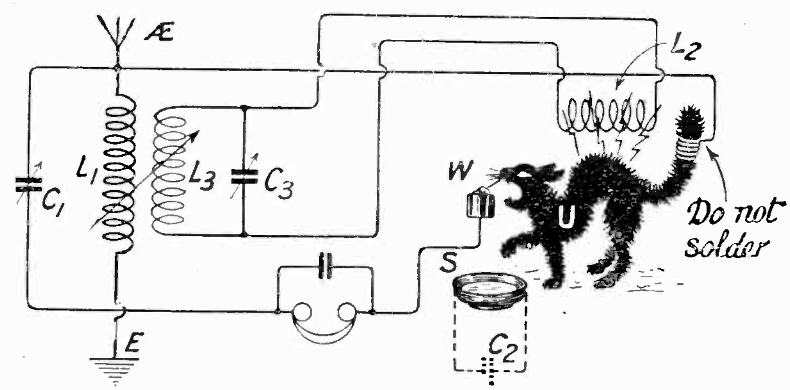


Fig. 1.—The duohyperanacatareflexoregenerative crystal circuit.

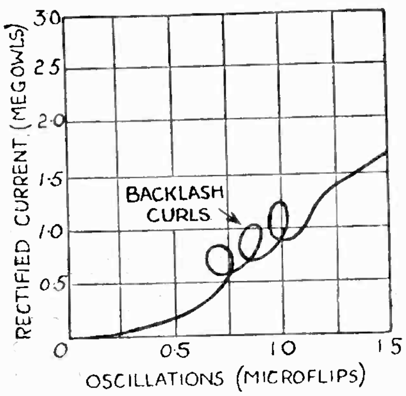


Fig. 2.—Megowl-microflip characteristic of catwhisker.

The Action of the Circuit

The circuit is delightfully simple to use. The first process is to find a thoroughly sensitive whisker. This is done by the process of trial and error. The correct whisker, usually the third from the left, will be recognised at once when found through its being necessary to recharge the stabilising saucer in order to prevent the felix from going off the deep end. The characteristic curve of a sensitive whisker is given in Fig. 2. This having been done the two tuned condensers C_1 and C_3 are actuated respectively with the right and left hands, the other hand applying gentle friction to the spine of the felix. As soon as signals are picked up the friction is increased until crackling noises are heard and sparks are seen to fly from the felix. To ensure ready sparking it is as well to wear an ebonite glove, constructional details of which are given elsewhere in this magazine under the heading Practical Notes. Care must be taken not to overdo the friction or the felix will manifest in time a deeply rooted dislike for wireless work.

The Way in Which It Works

A little explanation of the theory of the circuit may well be given, chiefly for the benefit of those experimenters who wish to add further to their stock of those long words which come in very handy at times for squashing the over-importunate beginner. The aerial is tuned to the frequency of incoming oscillations by means of the oscillatory circuit L_1, C_1. Oscillations are impressed upon the felix, after passing through which they are rectified by the whisker-crystal combination. At the same time the swinging motion of the ebonite-gloved hand upon the back of the felix generates electricstatic currents which are modulated by the oscillations passing through the felix. Hence synchronous surges of current are induced in the closed circuit formed by L_2 and L_3 and tuned by C_3. These transfer energy back to L_1 thus reinforcing the incoming oscillations with which the induced currents are in phase.

It will be seen that minute currents impressed upon the felix control the very much larger currents of the back-coupled reaction circuit. These in turn build up incoming oscillations so that a true duohyperanacatareflexoregenerative effect is obtained.

Actual Results

When the circuit was tested for the first time in the office of MODERN WIRELESS, music from 2LO no less than half a mile away was so powerful that the loud speaker was buckled, three window panes were blown out and the entire staff suffered from partial deafness for a week. At the urgent requests of other tenants in Devereux Court further experiments were conducted in the country. On a very poor aerial the strains of a pipe band transmitted from Glasgow 400 miles away were so terrific that the inhabitants of the whole street turned out believing that a Highland regiment was marching through. Unfortunately, in the course of the experiment the charge in the stabilising saucer was curdled and the sensitive whisker was fused, with the result that the felix projected itself through the window and was last seen travelling almost at the speed of light over neighbouring roofs.

As it was desired to obtain independently opinions of merit of the circuit a set was made up and sent to Professor M. A. Blow for his report. The first communication from him was sent to me obviously in error, for it contained an account of his latest invention, a self-rocking cradle with three speeds forward and reverse and a silencer. Later however I heard from him, and the report he sent me was most gratifying. "I have duly tested your wonderful set," he writes; "I can honestly say that I believe that much will be heard of it. I have already heard from my landlord, who has sent me notice to quit. I believe that you have solved the problem of wireless for the masses. Give them your duohyperanacatareflexoregenerative set and they will want no other. I am at present in correspondence with the Eugenics Society with a view to evolving a self-exciting auto-stable felix."

A New Theory in Construction

I have always felt that our wireless sets are constructed upon rather crude lines and that we do not pay nearly sufficient attention to the comfort and welfare of electrons which do so much for us. As Acting Deputy Beadle of the Society for the Prevention of Illtreatment of Electrons I take this opportunity of bringing home to all wireless men the way in which electrons have suffered and of indicating some means whereby they may fare better in the future. The most serious cases of thoughtlessness occur when a junction is made between two leads as shown in Fig. 3, so that one branch leads to the thingamejig and the other to the whatyoumaycallit. Electrons, those willing little servants always ready to do our bidding, rush at top speed down

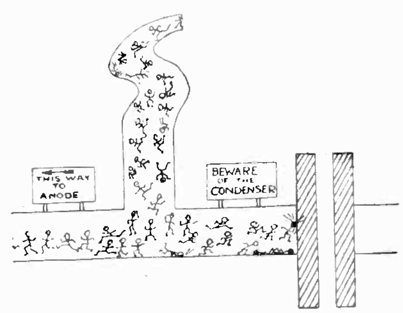


Fig. 3.—Kindness to electrons.

the main wire until they come to the junction. And what then? Not knowing which way to turn they stop for a moment and scratch their heads. Most of them eventually decide to go to the left, and with them all is well. But the others, well intentioned but lacking guidance, turn to the right. Rushing along for all that they are worth they run their noses hard against a blocking condenser and quite naturally set up a howl.

What is required, I feel, is some means of making it perfectly plain to the poor things which way they should go. For this reason I and all the members of the Society have mounted at each junction upon our sets little ivorine tablets shaped like signposts, which serve to give the right direction as well as to warn them of the consequences should they obstinately persist in taking the wrong turning. Something of the sort is also required in those wires which may be carrying two sets of currents. Here a little notice, "Keep to the left," backed perhaps by another, "Safety first, don't push," will work wonders. Little acts of thoughtfulness such as these make all the difference to the quality of one's reception.

A Cry for Help

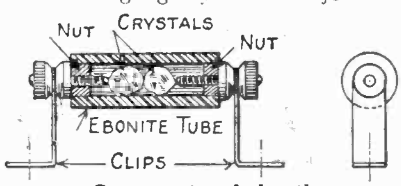
Any serious student of wireless must of course read the American radio papers in order to keep not merely up to date but even a year or two ahead. Being a fairly good linguist I can understand the language pretty well on the whole, though not having attended a course of phonetics I cannot claim to speak it in anything like the correct accent except at such times as I am afflicted with a cold in my nose. My difficulty is that though I have amassed quite a respectable vocabulary I am frequently held up by words of obscure meaning. So far I have been unable to obtain a good American dictionary which will automatically keep itself up to date. Can any reader in this country or on the far side of the Herring Pond recommend one?

At present I am seriously troubled over the word "dope," which appears to mean anything you like or nothing at all. Previously I have thought that the record for range of signification was held by the German word Zug, which covers everything from a railway train to a printing press. But dope seems to have it beat to a frazzle. Under a circuit diagram in one paper I find the caption "Complete dope about this in the text." Here it seems to mean information. In another's account of the construction of a wireless set in a tooth-paste tube by a twelve year old lad from Sloshville, Pa., I read "Some act like wireless was difficult. Clever little Jimmy got it all doped out right off the bat." Well, now, I ask you, is this kind of thing fair to the earnest student who urgently desires to read, mark and understand? What we seem to need is an international wireless language to make things easy. French of course is quite simple, for they have obligingly adopted many of our own words. Even one who is moderately endowed with a gift of tongues would, I imagine, be able to translate "La self-induction." But Germany, as one would expect, has made no attempt to make the path easy. What can you do with a people which calls a valve a "verstärker"?

THE LISTENER-IN.

Permanently Set Perikon Detectors.

ONE or more permanently set Perikon Detectors may be easily constructed as shown in the accompanying illustration. Cut off in the first instance a suitable length of ebonite tubing of ½ in. external diameter. Slightly warm one end of the tube and force in a 4 B.A. terminal nut by hammering lightly. The object of



Constructional details.

warming the tube is to allow expansion while driving in the nut. When the tube cools it contracts and consequently grips the nut firmly. From the other end of the tube drop in two crystals of a suitable size (one piece of Bornite and one piece of Zincite). Now perform a similar operation to the open end of the tube by sinking a further nut. On shaking the tube the crystals should be found to move freely inside.

Next insert a terminal into each of the nuts, and this completes the construction of the Detector itself. The final operation is to make two brass clips, as shown, into which we slip the two terminals. We have now to adjust the Detector. This is done by connecting it to the receiver and tightening up one of the terminals until a suitable pressure is brought to bear on the two crystals inside the tube. If the crystals when in this position are not found to give satisfactory signals, release the terminal and shake the crystals into a different position and tighten again. Once the most favourable spot has been found, no further manipulation will be necessary. These very useful little Detectors may be kept on hand for purposes of quick adjustment when others fail.

A further example may be made on similar lines with Zincite and Molybdenite.

H. B.

WIRELESS NOISES.

Our picture shows the interior of the studios at the London station during the recent successful performance of the "melodrama in a coal mine." It will be remembered that numerous "stage effects" were a feature of the production. Strange, yet effective, noises were produced with rolling shot, buckets, wind machines and the like, all adding to the realism.

Our Birthday

MESSAGES to "MODERN WIRELESS" FROM FAMOUS MEN

A recent portrait of Senatore Marconi.

From SENATORE MARCONI.

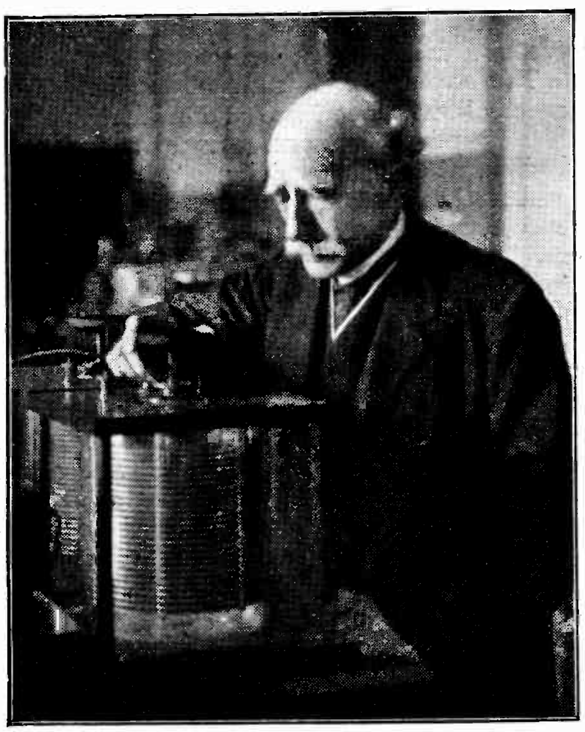
To the Editor of MODERN WIRELESS.

All best wishes for every success in your new undertaking.

I am, etc.,

G. Marconi

Strand, W.C.2.



Dr. J. A. Fleming, F.R.S., whose message appears on this page.

From Professor J. A. FLEMING, F.R.S., Inventor of the Valve.

To the Editor of MODERN WIRELESS.

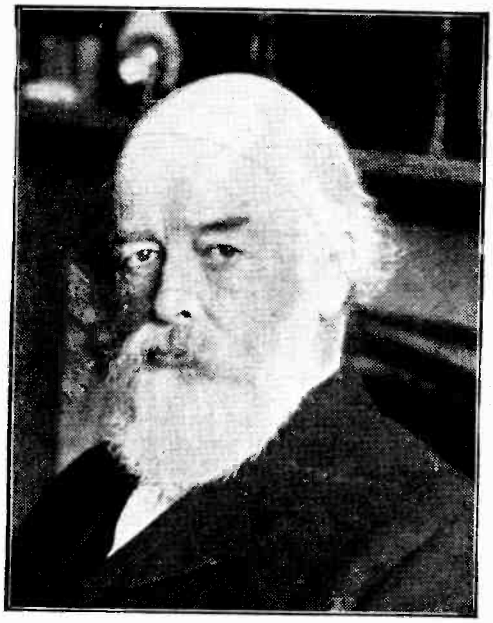
SIR,—I have pleasure in congratulating heartily MODERN WIRELESS on the success of its first year of issue. It has combined admirably the publication of sound constructional articles for the guidance of the radio amateur with the issue of more highly technical articles for the benefit of advanced readers. The wonderful progress in the amateur reception of American broadcasting shows that we are not nearly at the end of the achievements obtainable by intelligent students of the radio art, or of the intense interest and amusement, as well as scientific education, which can be derived from the amateur study of wireless telephony. The assistance of competent well-edited wireless magazines is an essential element in this progress, and I wish MODERN WIRELESS all possible prosperity in its second and future years of issue.

I am, etc.,

J. A. Fleming, F.R.S.

(University Professor of Electrical Engineering).

London, W.C.2.



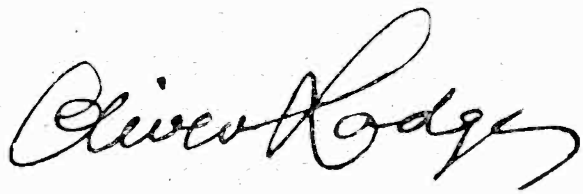
Sir Oliver Lodge, F.R.S.

From Sir OLIVER LODGE, F.R.S.

To the Editor of MODERN WIRELESS.

SIR,—I should like to congratulate Mr. Scott-Taggart on his paper, in which I have several times seen interesting articles. The great amount of interest in the subject, both in Britain and America, must lead to advances in technique, and has already had the effect of making apparatus cheaper and more accessible, as well as more efficient, than could have been accomplished in any other way.

I am, etc.,



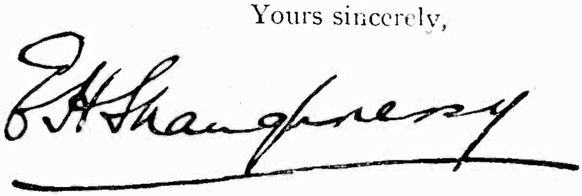
Lake, Salisbury.

From Mr. E. H. SHAUGHNESSY, Chief Engineer of the General Post Office.

To the Editor of MODERN WIRELESS.

SIR,—I have watched with interest the monthly issues of MODERN WIRELESS and congratulate you on completing a year of successful production of material both interesting and instructive to the amateur radio enthusiasts. I wish you every success for the future and hope you will be able to maintain the high standard of your magazine which fills a very useful place in radio literature.

Yours sincerely,



General Post Office,
*London, E.C.*1.

From CAPTAIN F. LORING, Inspector of Wireless Telegraphy, General Post Office.

To the Editor of MODERN WIRELESS.

SIR,—I thought when I saw the first number of MODERN WIRELESS that it was a periodical with a future, and I am glad to have an opportunity of congratulating you and your staff on your enterprise and industry.

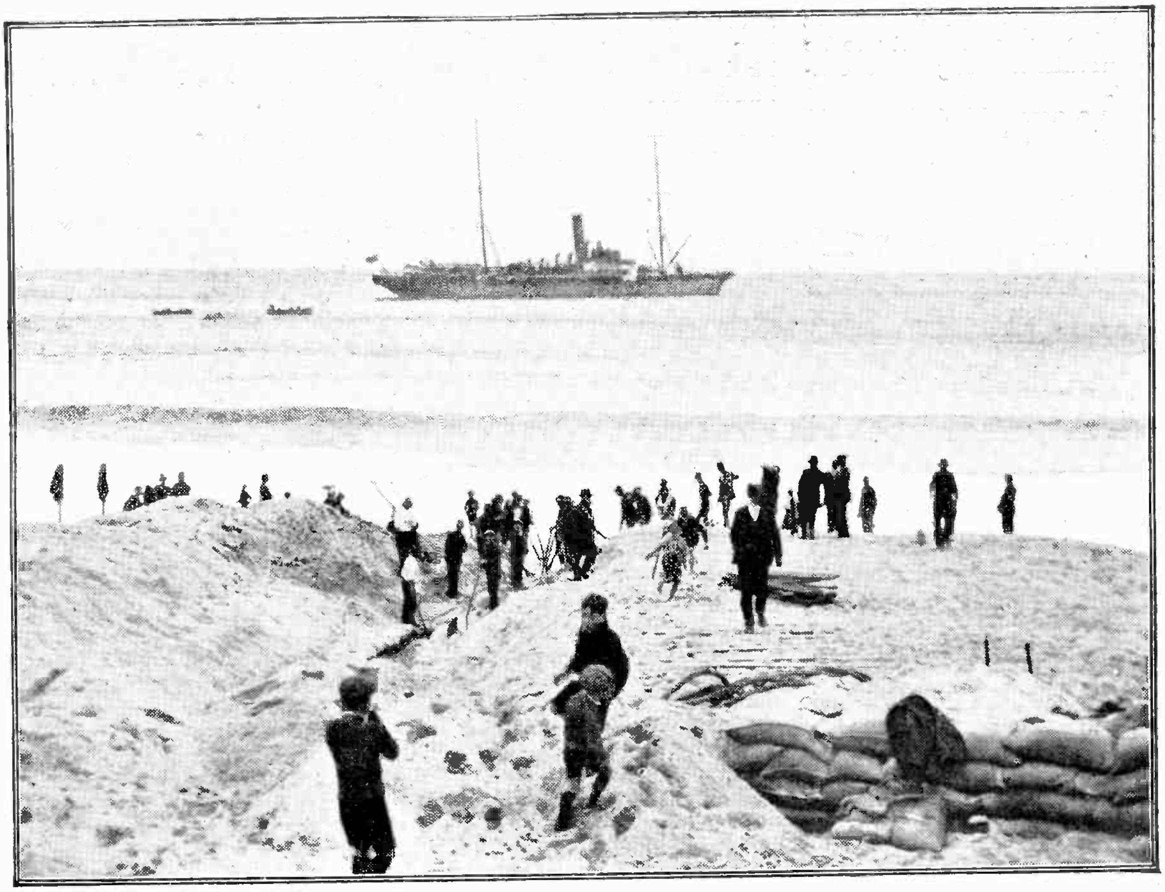
I feel sure that MODERN WIRELESS and its companion paper WIRELESS WEEKLY must have a large circulation amongst the inexpert as well as the expert. In this connection I wish that all who address themselves more particularly to the inexperienced laid more stress to the limitations and difficulties which arise in the shape of interference from the common use of the ether by all.

The professional radiotelegraphist with accumulative experience and training behind him is obliged to spend many pounds on the equipment of his receiving station and still constantly meets with difficulties. The inexpert, whether experimenter or broadcast receiver, spends as many shillings and not infrequently cries aloud to heaven when he finds that he does not get his little bit of ether all to himself.

No doubt education in wireless is what is required, and the difficulty of this is increased by the remarkable accessibility and appeal of the art to the general public. If flying had been equally accessible what a lot of crashes there would have been, though in the circumstances I fear the complaints would have been few.

Yours faithfully,
(Signed) F. LORING.

General Post Office,
*E.C.*1.



The "shore-end" of a submarine cable being laid in a trench. The cable ship is seen lying off shore.

Wireless and Submarine Cable Companies

HOW THEY HELP ONE ANOTHER

AT first thought it might appear that wireless was such an opponent of the submarine cable that they could not work in harmony.

But a little consideration will show that wireless has features that make it of the very greatest importance to the upkeep of the submarine cable.

From the time a submarine cable is laid it is subject to wear and tear. Although every precaution may be taken in plotting out the route for a new cable, at some part of its length it will cross some ridge of submarine rock on which its own weight will gradually cause wear. In the course of time a fault will develop and it becomes necessary to locate the trouble and repair it. Each cable company has a certain number of specially equipped steamers continually in readiness to undertake such repairs. The engineers by careful electrical measurement determine the distance at which the fault is located. The captain of the cable steamer is told of this distance and ordered out to commence repairs.

Before the days of wireless, once the steamer had left port there was no means of communicating with her until she had arrived at the scene of the damage, grappled for the cable, picked it up and cut in, when she would, of course, be in telegraphic communication.

In the interval far more important trouble might have developed in another part of the same cable or in one of the other cables, and it might be necessary to cancel the original orders and send the steamer to deal with this more serious matter first.

This is the first manner in which the cable companies have really come to rely on wireless, as they are now well able to move their steamers about to meet the situations that arise from time to time.

A further benefit which they are likely to appreciate soon will be the help that directional wireless will give their steamers in picking up the cable.

A submarine cable is obviously a most expensive apparatus, with its many protective coverings, and if the cable is picked up in the wrong position and tapped, the cable must be left in just as good condition as new before releasing it.

Therefore, the navigation of a cable steamer in the open sea must be more exact than that of any other kind of vessel if the cable is to be located at the right spot and repaired with the minimum of delay.

Yet in many parts of the world where such repairs are being carried out the skies may be covered with clouds for days and nights on end, thus preventing astronomical observations. Or a tropical sun may distort the horizon in such a manner as to make accurate observations impossible. Very careful triangulation by directional wireless will enable an excellent fix to be made notwithstanding these conditions.

When a new cable is being laid the navigation is even more important than at other times. If the cable-laying steamer leaves the desired course at any point, through lack of observations, not only is there a loss of money through the additional cable laid, but in addition it may cause great delay in locating the cable at some future date for urgent repairs.

Therefore, the advent of wireless has in many ways been of great value to the submarine cable.

The British Marine Wireless Service

IN contemplating "wireless" as a profession, would-be candidates, parents or guardians should very carefully examine the prospectuses of the various "Telegraph Training Colleges" and thoroughly investigate for themselves the possibilities of engagements when "training" is at an end.

At present the total number of British ships licensed to carry a wireless installation is approximately 3,388, while the approximate surplus of operators over actual requirements was 2,898.

Before securing a position as a Marine Wireless operator, all candidates must pass the P.M.G.'s examination and secure his certificate of efficiency. At the present time the number of unemployed persons holding the P.M.G.'s 1st Class Certificate in wireless telegraphy approximates to 1,800.

Wireless operators' pay and conditions of employment are governed by an agreement between employers and the Association of Wireless and Cable Telegraphists, particulars of which may be had from the Association of Wireless and Cable Telegraphists at the undermentioned address.

The commencing salary for a fully qualified Marine Wireless operator at present is £7 12s. 6d. per month, while the maximum salary after nine years' service is £18 17s. 6d. per month. In addition, and where applicable, there are small allowances, such as "Foreign and Extended Voyage Allowance," "Shore Allowance," "In Charge Allowance," "Tanker Allowance," etc. Full, complete, authentic, and up-to-date information regarding all aspects of the Marine Wireless profession may be had free of charge from the Association of Wireless and Cable Telegraphists, Lennox House, Norfolk Street, Strand, London, W.C.2, at any time.

Readers' Views

Letters on All Subjects

To the Editor of MODERN WIRELESS.

DEAR SIR,—I thought it might be of interest to you to know of my experience with "The Really Loud Crystal Set" described in December issue of the MODERN WIRELESS. Birmingham station, four miles distant, is nicely audible on loud speaker, but on Saturday and Sunday nights last 2 LO was picked up quite clearly, using 8,000 ohm. 'phones. This is by far the best I have ever had from any crystal set and I feel more elated over this performance than in picking up American stations on a two-valve dual.

I might mention I have free essential high aerial required, the end pointing to London and a good earth a few feet away.

This is only one of the good things taken from your publications, and you can count me a regular subscriber as from No. 1 of each, as I find they contain just the information and news to suit me and are up to date.—Yours faithfully,

W. D. C.

Gravelly Hill, Birmingham,
January 7, 1924.

To the Editor of MODERN WIRELESS.

DEAR SIR,—I thought it might interest you to know that on Saturday, the 5th of January, I received American transmission from the Westinghouse Electric Co. at Pittsburg. I heard several musical items from 11.40 p.m. until 12.35 a.m., when there was a lecture on Radio. At 12.45 a.m. more musical items followed; at about 2 a.m. they called Metropolitan-Vickers and said that the next items would be relayed to them. At 2.25 I closed down. The transmissions on the whole were very good, but occasionally atmospherics were bad. The set is a three-valve set as described in September issue of MODERN WIRELESS by Mr. P. Harris. You may use this as you wish.

Yours, etc.,

C. E. A.

Wandsworth, S.W.18.
7.1.24.

To the Editor of MODERN WIRELESS.

DEAR SIR,—In the January issue, a contributor gave his way of making artificial galena crystals. I am not quite of his opinion, for, since 1912, I have always made all my crystals myself, giving the recipe to my friends, who have adopted it ever since. This is the way to proceed: Take an equal quantity both of lead-dust and sulphur (about a thimbleful), mix the two ingredients together on a piece of paper so as to produce a mixture of uniform grey-yellow colour. Introduce the whole of this mixture into a glass probe. Heat it over the gas or simply over the flame of an ordinary fire until it turns red, taking great care that the glass does not break. Let it cool on a marble slab, after which your crystal will be ready. Now break off some pieces and test them. Crystals made after this simple method give excellent results and are even more satisfactory than natural "galena."—A.

The "Albright" Circuit.

To the Editor of MODERN WIRELESS.

DEAR SIR,—I read with some interest the article by Mr. Cowper in the December issue of your paper, on "Some American Valve Circuits," as similar circuits have been in use here for amateur phone reception for some time. Also at four miles from 2 LO, that station can be easily picked up on an earth lead alone, at fair small loud-speaker strength, on an exactly similar circuit to the one which you call the "Albright" circuit. It is on the question of the designation of that circuit that I would crave your ear. As far back as 1919, the circuit in exactly the same form as described in your article (complete with choke coil in the H.T. lead) was in fairly common use in the Navy, and now that the Admiralty Handbook is on sale to the public, you will, if you refer to it, see that it is fully dealt with there. I cannot give the Navy views on the circuit in full, but an analysis of the circuit may help your readers. Without the choke in the shunt H. T. lead, the circuit has long been also known in U.S.A. as the "Colpitts

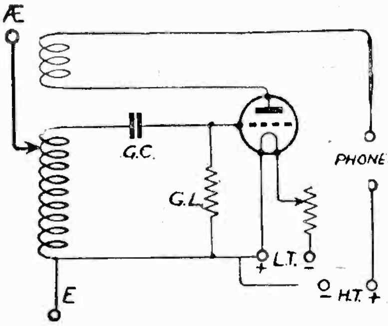


Fig. 1.

scillator." It makes an extremely efficient transmitter and is a sure fine oscillator on almost any wavelength from 100 metres up, if care is used in instrument design and correct values of inductance and capacity, and proper aerial used.

As to the circuit analysis, it is shortly as follows: FIG. 1 is our old friend the Armstrong regenerative single circuit sure howl receiver, so anathemised by Capt. Eckersley, and rightly so.

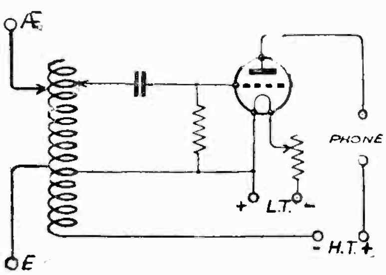


Fig. 2.

As a reaction receiver for C. W use it is, of course, so familiar to your readers that I need not dwell on it. It can equally well be re-written as in FIG. 2, if the reaction coil is transposed to the other end of the A.T.I. Incorporating the reaction coil into the tuned circuit

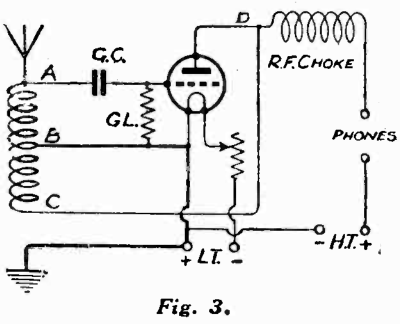


Fig. 3.

will make of this a so-called "Hartley" circuit much heralded as American, but also now passed over long ago in Navy use. If we supply the H.T. and phone leads through a choke, and take the plate lead off at point D direct to the reaction coil as in FIG. 3, we have still the same circuit as FIG. 2, but with the H.T. supply in shunt. If point B, instead of being connected direct to the middle of the common A.T.I. and reaction coil

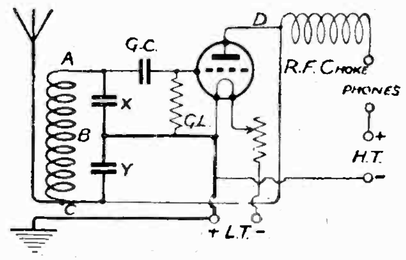


Fig. 4.

(ABC) in FIG. 3, is shunted potentiometer wise across A C by the two capacities X and Y, the effect of the circuit in FIG. 4 will remain the same as in the circuit shown in FIG. 3, except that we have transferred the aerial to the other end of the A.T.I. reversing the phase of the oscillations only. Re-write FIG. 4 as FIG. 5, which is exactly the same circuit re-drawn. It will now be seen that if X the series condenser to the A.T.I. is

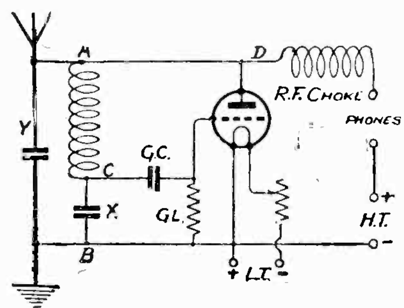


Fig. 5.

small, B is nearer C in effect and the reaction component of coil AC is small and it will be difficult to get oscillations unless condenser Y is lessened also. As capacity Y is usually the natural capacity of the aerial to earth (working on the principle that the less the capacity and the more the inductance in the tuned circuit, the stiffer and more selective it is) Y will usually be fixed and hence condenser X should not be used to form the main tuning element. Thus AC must be variable and is at best a variometer. Rewrite FIG. 5 as FIG. 6, and we have what you call the Albright Circuit. Readers using the circuit will do well to remember that aerial earth capacity must be small, all stray capacities *must* be eliminated, and the HT bridging condenser, if used to carry the audio frequency make up current, *must* be on the HT side of the choke coil. If these items are carefully carried out the series condenser may be made very small. Hence ATI variometer will be big and the circuit

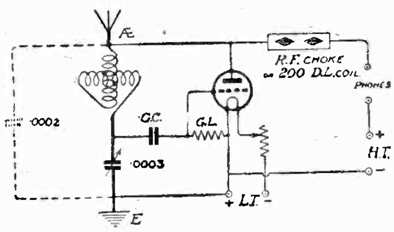


Fig. 6.

stiff and selective. The series condenser being small, the potentials across it will be large, and large variations will be applied across grid and filament, which are, of course, a *sine qua non* for efficient use of the value as a detector. With a 50 duolateral coil and a 100 turn variometer in series as the ATI a Baty variable condenser in series with it, the series condenser (X) may be as small as .0001 and 2LO still come in very strong here, using a German E V N valve. The circuit will even then oscillate, but only if about 100 volts are applied to the plate and the filament current carefully adjusted.

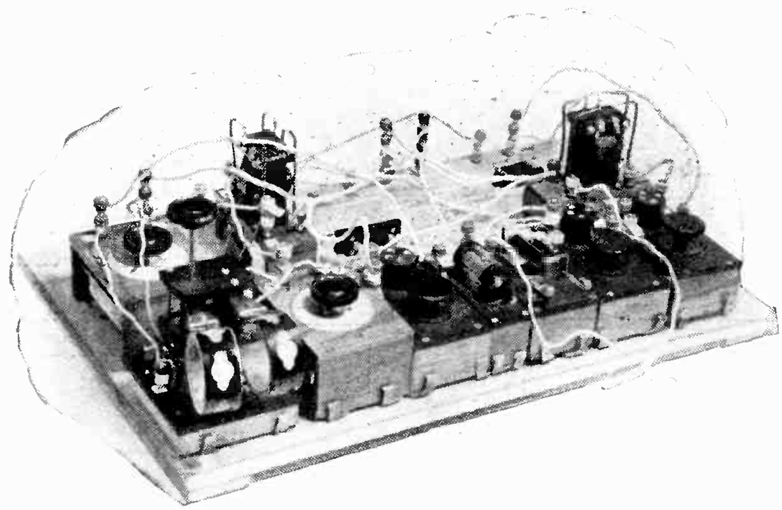
Honour, sir, to whom honour is due. Leaving out the Navy, the Albright circuit is at best a Colpitts oscillator circuit and is at least three years old (see the 1920 Admiralty Handbook on W.T.).

Yours faithfully,

A. F. C. B.

48, *Lavender Gardens, S.W.*

P.S.—As a transmitter LT+ and LT— are of course reversed, thus putting a negative bias on the grid and the grid leak. The series condenser is adjusted to exactly balance all capacity from the plate to filament, including of course the natural capacity of the aerial. The circuit is then tuned by adjusting the ATI final adjustment of the series condenser, being then made to get maximum radiation. If the series condenser is lessened in that adjustment, the ATI is then slightly increased to bring the transmitter back on the pre-determined wavelength. It can be used for choke control, but I think grid control would be difficult. You should have your readers thanks for recalling to their notice a very good circuit for all-round use.



Front of set, showing clips.

A Semi-Permanent "Quick-Change" Set . .

by

M. G. FERGUSON

AMONGST the many thousands of amateurs in this country, there are several hundreds who are real experimenters at heart, but who, for various reasons, have not so far launched out. If you are of this number, I hope the present article may incite you to make your maiden voyage.

You have, perhaps, a cabinet set, either bought or home-constructed, and after several weeks or months of use you feel that to a certain extent you have gauged its possibilities; and now you are sighing for fresh worlds to conquer. Or perhaps you have gained a local reputation as one who knows something about wireless. A beginner comes along to ask advice, but he cannot afford a 3 or 4 valve set such as yours; he can only rise to one valve and a crystal. Surely, it is very much more satisfactory if you can give him, at a moment's notice, a practical demonstration of the possibilities of the 1-valve-crystal combination. Furthermore, there is no one circuit which is equally suitable for every purpose. The popular tuned-anode H.F., detector, L.F. combination is probably still the best all-purposes circuit; but if you are only a few miles from the nearest broadcasting station, 3 valves is a sheer waste of "tubes" and current; better results, at least as far as purity of tone is concerned, can be obtained from one valve and a crystal. Do you want to receive the long-wave Continental and American stations, you will find that resistance-capacity H.F. will give you greater ease of tuning and sometimes louder signals.

Now there may be one or two difficulties with which you are faced. Your apparatus has to be packed away every night; therefore it would only be a nuisance constantly wiring and unwiring a whole number of components; you are troubled about loose connections and loss of efficiency; while the length of time taken in wiring up a new circuit gives rise to difficulty in comparing results.

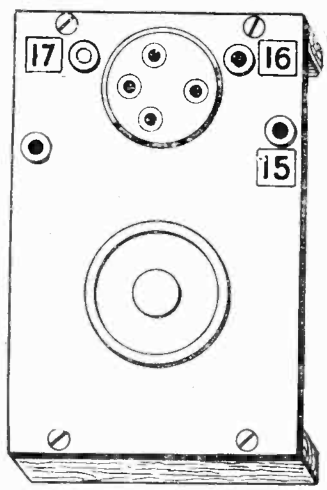
For some months I have been engaged on these problems, and the solution at which I have arrived, though by no means a final one, will, I hope, be of interest to other experimenters.

The following are some of the results obtainable from the set about to be described:

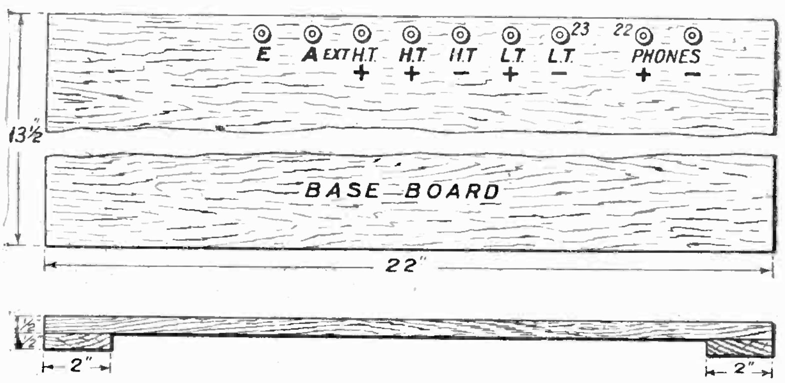
1. Any component can be removed from the set, and another substituted, in less than ten seconds.

2. The whole set can be packed in a suit case, removed to another room or house, and then be unpacked, set up, and be working in less time than is usually required for an ordinary cabinet set.

3. The change from any one circuit to any other circuit can be accomplished in a period of time varying between two seconds and two minutes. Actually, during a recent afternoon's transmission (one hour) from Birmingham—my station being in London—I tried no fewer than 12 different circuits, and gave each a 3 or 4 minutes' run, for the purpose of comparing

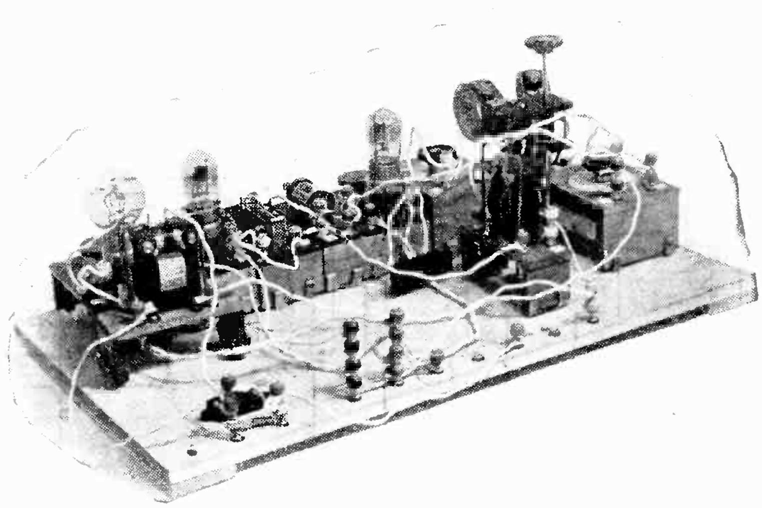


A valve panel.



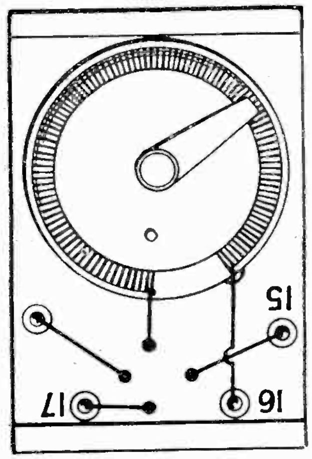
Terminal arrangements and baseboard dimensions.

With this set you can change from one arrangement of parts to another and from one circuit to another in a minimum of time.



Rear of set.

results. The following extract from my log may give some idea of the flexibility of the set: "5.30 p.m. 2LO Children's Hour; valve, crystal, dual amplification; 2 loud speakers. 6.18 p.m. Eiffel Tower; 2 valves, crystal, dual amplification; 2 L.S.; 2 seconds to change circuit. 6.32 p.m. Bournemouth; 3 valves, reaction on tuned anode, 2 L.S.; $1\frac{1}{2}$ minutes to change. 6.45 p.m. Bordeaux and Simbeek; 2 valves, H.F., Det., resistance capacity, reaction on A.T.I.; phones; 25 seconds. 6.55 p.m. 2LO; 1 valve, crystal, 3 L.S.; 35 seconds. 11.30



Wiring of valve panel—underside.

p.m., 3 valves, 2 H.F. (1st tuned anode, 2nd tuned transformer), 1 Det.; listen for America; W.G.Y. at intervals till 3 a.m.; from 3.30 to 3.55 uninterrupted programme."

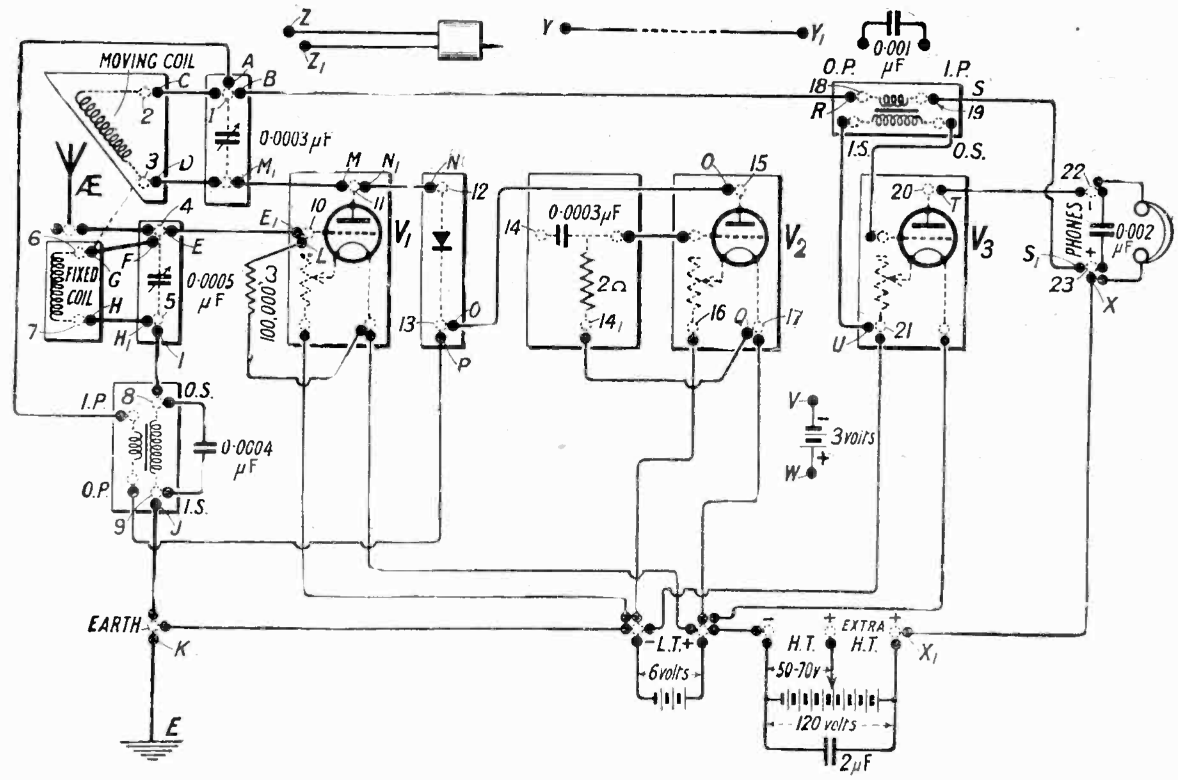
The quick change and efficient connection are both accomplished by means of the Clix terminal. Incidentally, the purchase of these Clix terminals was the only large item in my account of expenses; practically the whole of the set was made up from spare parts, scrap ebonite, a scrapped set, and the junk box. Without the Clix, a large number of switches would have had to be purchased in order to obtain anything like the same flexibility; and, once they have been bought, the terminals can be put to so many uses that they fully justify their adoption.

Ebonite was only used where necessary, some of the components being mounted on wooden panels with the terminals alone insulated with Clix bushes. $\frac{1}{4}$-in. walnut was used throughout, except for the baseboard. Panels, both of ebonite and of wood, were made of uniform length of $4\frac{3}{8}$ in., the width being suited to the individual component. They were mounted on two battens each, $1\frac{1}{2}$ in. wide (length same as width of panel); but in the case of the polar condenser panels this did not give sufficient depth, and these were therefore mounted on battens 2 in. wide.

The baseboard was the first thing to be made, and this was cut to fit inside an ordinary large suit-case. Next, the individual components were mounted on it, and one or two different circuits wired up roughly in order to find the best average arrangement. When this had been settled, clips were fitted, and the components fastened down to the baseboard. The wiring was the next thing to receive attention. Really stout lighting flex or power flex was found to be the best, its stiffness making it easy to keep the wiring well spaced. Every lead was made as short as possible, although several leads have to be long in order that they may reach to other terminals in other circuits. Various circuits were first worked out on paper and then tried out on the set. Letters and numbers were gradually added to the theoretical diagram, panels, wiring, and list of instructions, so as to speed up the process of changing over. Excerpts from this list of instructions are given at the end of this article.

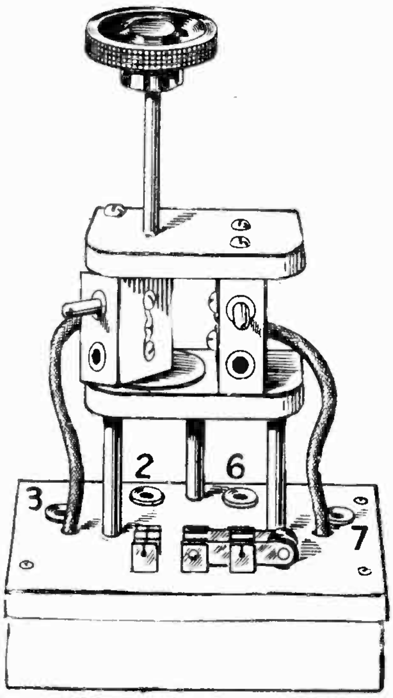
I think that the illustrations of the various components will give all the information needed for mounting and wiring. As stated before, a uniform length of $4\frac{3}{8}$ in. and a uniform thickness of $\frac{1}{4}$ in. were adopted for the panels. The various widths are: Valve panel, $2\frac{7}{8}$ in.; grid leak and condenser panel, $2\frac{1}{2}$ in.; crystal detector panel, $1\frac{7}{16}$ in.; polar condenser panel (wood), $3\frac{5}{16}$ in.; transformer panel (wood), according to type of transformer used. The two-coil holder is a polar with the bottom taken off and with clips fitted; it is also fitted with a small D.P.D.T. switch for reversing reaction, though this switch is really unnecessary when Clix terminals are used.

It will be noticed that the positions of the terminals in the theoretical diagram do not correspond with the positions on the panels in most cases; to have made them correspond would have rendered the theoretical diagram too complicated. But on the component panels the terminals have been carefully numbered, where necessary, to correspond with the theoretical diagram and the list of instructions; so that the experimenter should find no difficulty in wiring up and changing over, if he adopts the same system of lettering and numbering.



Theoretical diagram referred to in this article.

Now as to the clips. After considering and rejecting various ideas, I came to the conclusion that these clips offered the best solution, the chief consideration being that the components can be removed from the baseboard and placed on an ordinary table without any fear of inflicting damage through scratches. They were made out of scrap parts of old single-pole and double-pole switches of a very common pattern; small nails were soldered in place of the bolts, and were filed down to the length of $\frac{1}{8}$ in. These clips can, of course, be cut out of scrap sheet copper, and will be found to grip the components quite firmly.



Coil-holder mounting.

The one expensive item is the number of Clix terminals used: about 7 dozen complete Clix (includes insulator and costs 4d.), and another $3\frac{1}{2}$ dozen Clix plus locknuts (3d.). A good plan is to keep different colours of insulators for different purposes as far as possible. On the set described all L.T. + leads were given red Clix; L.T.—, black; grid circuit of first valve, yellow; plate circuit of first valve, green; grid circuit of valves 2 and 3, white; and plate circuits of valves 2 and 3, blue.

A few notes.—In practice I dispense with the aerial terminal on the baseboard, and connect the aerial wire direct to 4.

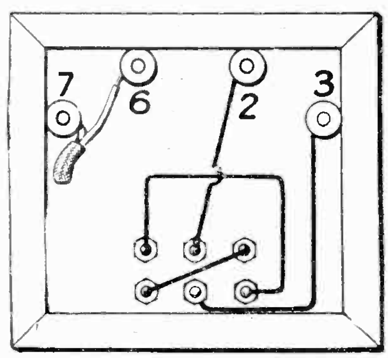
Try plugging Q into 14, 16 and 17 in turn, to determine which position gives best results.

When both transformers are functioning, as in circuits ST 100, ST 151, etc., try the effect of transferring U to V, and **W** to **21**, thus putting a grid bias of 3 volts additional on the grid of V_3. (Different voltages between V and W should also be tried.)

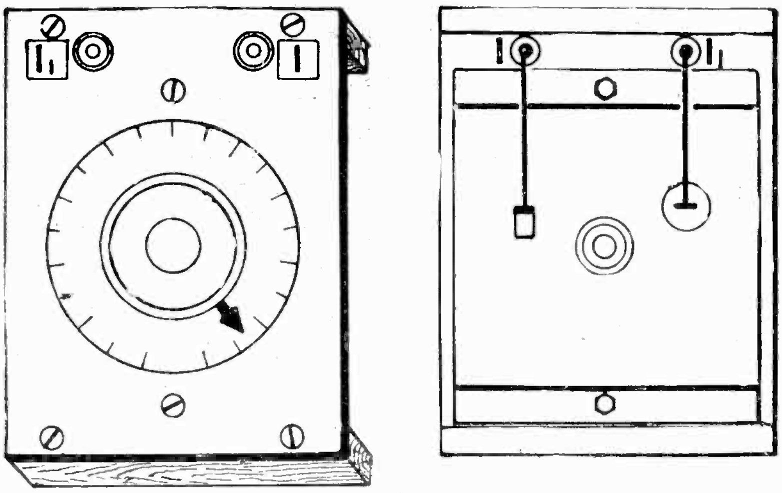
List of Instructions for Various Circuits

The circuit shown in the theoretical diagram and in the photograph of the set is the ST 100, with A.T.C. in parallel (o should be disconnected from 13 whenever valve V_2 is not functioning). To avoid taking up too much space

Connecting wire.



Base of coil-holder.


Front and rear of condenser unit.

with diagrams, the circuits below are all given numbers: the reader is referred to Mr. J. Scott Taggart's two books, "Practical Valve Circuits" and "More Practical Valve Circuits," for the theoretical diagrams.

1ST CHANGE.—Try A.T.C. in series with bigger coil in A.T.I., keeping H and I connected together, disconnect them from 5; transfer E and F together from 4 to 5.

2ND CHANGE.—ST 100 to ST 74. This is a one-valve crystal, dual-amplification circuit; probably the best circuit for local broadcasting. Disconnect L from 10, transfer R from 18 to 22. V_1, crystal in use.

3RD CHANGE.—ST 150. A two-valve, dual-amplification circuit; o connected to 13; disconnect L from 10, N from 11; transfer M from 11 to 14, T from 20 to 11, X from 23 to 1, S from 19 to 14. (Also try the effect of transferring A to H.T.+; this should be tried in the next three circuits.) V_1, V_2 in use.

4TH CHANGE.—ST 100 to ST75. This will be found to be a very efficient circuit for the reception of distant telephony; it is a form of the ST 150 circuit, but with separate reaction on the tuned anode coil. Instructions same as for ST 150, plus the following: Transfer G and H from 6 and 7 to Z and Z^1, plug A.T.I. in this coil plug; transfer o from 13 to 7, P from 13 to 6; reaction coil plugged into fixed coil. V_1, V_2 in use.

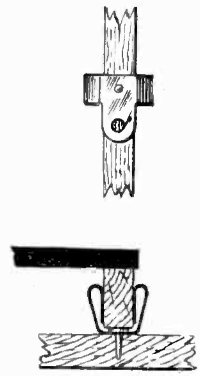
5TH CHANGE.—ST 100 to ST 151. "This is a three-valve form of ST 150." o connected to 13, disconnect L from 10, N^1 from 11; transfer M from 11 to 14, S^1 from 23 to 14, R from 18 to 23; plug in fresh wire YY^1 from 11 to 18. V_1, V_2, V_3.

6TH CHANGE.—A three-valve form of ST 75. Same instructions as for ST 151, plus special instructions for ST 75.

7TH CHANGE.—ST 100 to ST 45. This is the popular tuned anode H.F., Det., L.F. circuit. Disconnect A from 1, L from 10; transfer J from 9 to 8, N from 12 to 14, S^1 from 23 to HT +, G and H from 6 and 7 to Z and Z for A.T.I. coil, R from 18 to 19; YY^1 plugged in 6 and 18; reaction coil plugged into fixed coil. V_1, V_2, V_3.

8TH CHANGE.—ST 100 to ST 44. This is a similar circuit to ST 45, except that reaction is used on the aerial coil. Instructions same as for ST 45, with the following differences: o from 13 to 3, YY^1 plugged in 2 and 18, tuned anode coil in separate coil plug, and reaction coil plugged into moving coil. V_1, V_2, V_3.

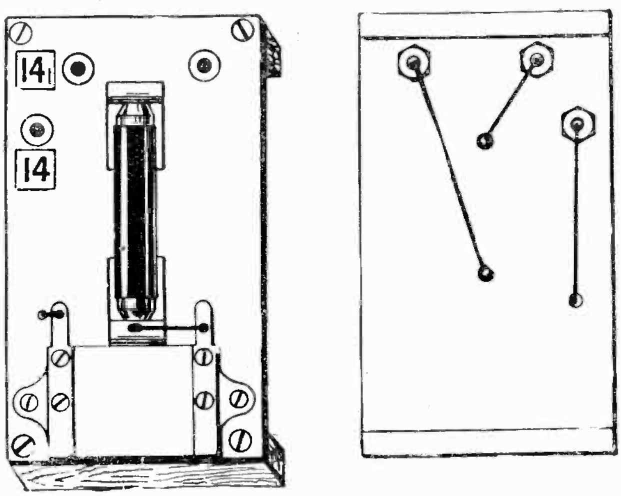
9TH CHANGE.—The following circuit, for which I cannot find a number, is one I have mentioned above, and gives good results on long wavelengths. It is a three-valve, resistance-capacity circuit. Instructions as for ST 44, except that now B and M^1 are disconnected


Clip details.

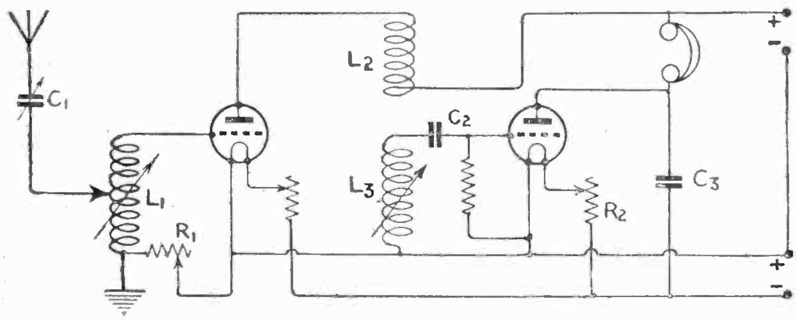
from 1 and 1^1, and reconnected to the two terminals of the 100,000 ohm resistance, which is, of course, disconnected altogether from the rest of the circuit.

10TH CHANGE.—ST 100 to ST 1. This will give some idea of the flexibility of the set. ST 1 is the simplest form of crystal circuit. Disconnect L from 10, N from 12, P from 13, X and S^1 from 23; transfer J from 9 to 8, E^1 from 10 to 12, o^1 from 15 to 23, T from 20 to earth. Crystal only.

The space allotted to me has probably already been exceeded; if enough people are interested in this set, I may be allowed to publish further circuits possible with these components. A .001 condenser should be substituted for the .0005 between 1 and 1^1 for the longer wavelengths.



Grid leak and condenser unit (front and back).



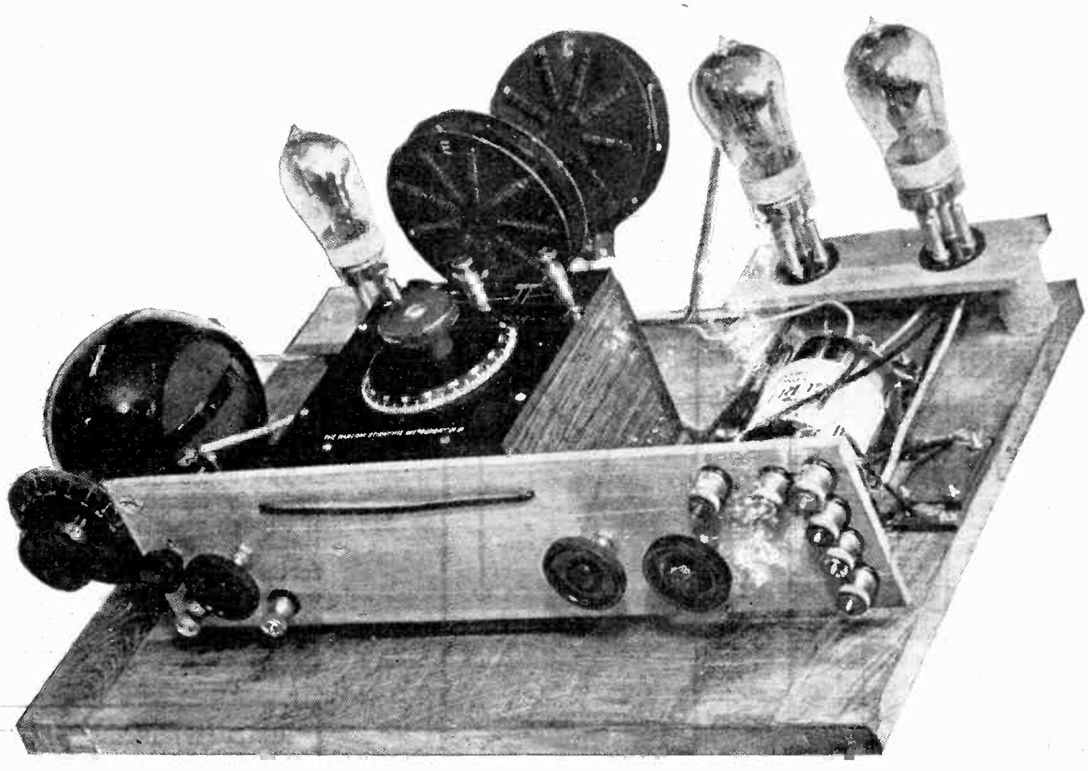
The circuit of the Grebe C.R. 13 receiver.

Some Experiments in Stable High-Frequency Amplification.

By
PERCY W. HARRIS,
Assistant Editor.

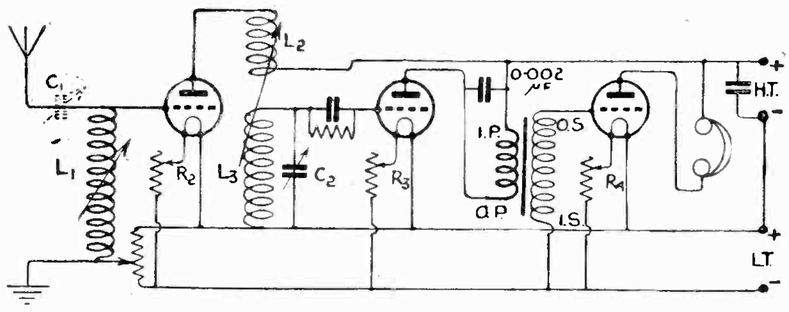
THE study of high frequency amplification is full of interest and a great deal remains to be done before we can reach that stage of efficiency which characterises low frequency amplification of the present day. A year or two ago when the "Dutch concert" was about the only telephony available to the experimenter, the resistance-capacity method of coupling high frequency valves enjoyed a great popularity. It was simple, easy to handle, inexpensive and on a wavelength of 1,000 metres or more quite reasonably efficient. With the introduction of broadcasting on wave lengths between 300 and 500 metres the resistance capacity method was abandoned for the stray capacities in a set and in particular the capacity between the grid and plate of the valve (always of importance on any wavelength) played such a large part on the shorter waves that the resistance method lost all of its virtues.

For short wavelengths work both the tuned anode and the tuned transformer method have enjoyed a great popularity, for in both of these methods the valves capacity is far less detrimental. Every student of the theory of amplification knows that if we tune both the plate and the grid circuits of a valve the inter-electrode capacity will act as a coupling and if conditions are favourable will hand back from the plate to the grid circuit sufficient energy to maintain the set in oscillation. If the grid and plate circuits of a receiver tuned to say 1,000 metres are brought into resonance with one another, the handing back of energy through the electrode capacity will not be sufficient to maintain the set in oscillation and we must introduce some other form of coupling if we are to get full benefit of reaction up to oscillation point. Provided we arrange our wiring carefully (this implies that the disposition of the parts in the receiver is such that the wiring is short and the leads in the grid and plate circuits not too close together) we shall be able to avoid self-oscillation on wavelengths much shorter than 1,000 metres. If again we use valves of special construction (valves of the V 24, Q, QX, Ora B, etc., type) in which the usual capacity between the leads of the valve where they pass through the



An experimental receiver made to try out the loose coupled H.F. coupling.

In this article practical details are given of a neglected method of high frequency coupling which gives excellent results.



A modification of the Grebe circuit which gives good results. The potentiometer was found unnecessary.

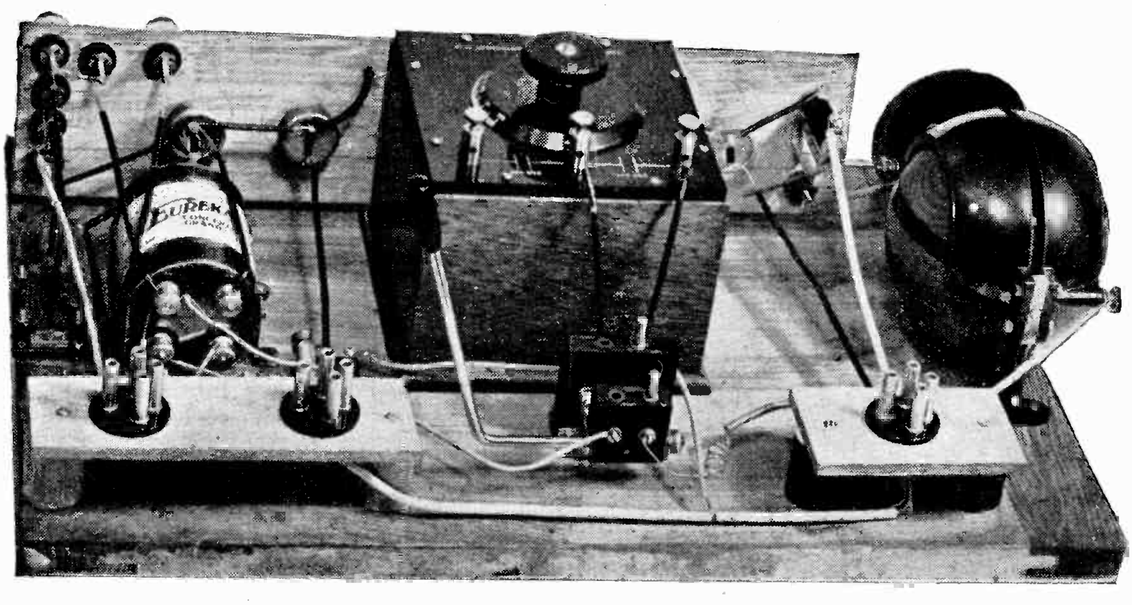
"pinch" and the capacity pins and 4-pin sockets is done away with, we can get quite favourable results on still shorter waves.

American experimenters (other than the broadcast listeners who are concerned with amplification on wavelengths similar to our own broadcast wavelengths) do most of their work round about 200 metres, and a study of their arrangements and circuits show that radio-frequency amplification is scarcely ever used in their relay work. Many of their writers go as far as to say that on 200 metres and below, a well designed detector valve with reaction gives quite as good results as when a stage of radio-frequency amplification is placed in front. It must be borne in mind that the valves used by the American experimenters on the whole oscillate much more readily than those we use here. The standard American regenerative circuit almost universally used by members of the American Radio Relay League consists of a grid circuit tuned either with a variometer or a variable condenser, and a variometer tuned plate circuit. When the plate circuit is brought into exact resonance with the grid circuit (this is almost invariably loosely coupled to the aerial) the set will oscillate freely. Reaction is controlled by de-tuning the plate circuit slightly and when one has become accustomed to handling such a circuit it is quite easy to get a very critical adjustment of reaction by careful manipulation of the two dials.

In this country the two most popular methods of arranging radio frequency amplification are by means of the tuned anode and the tuned transformer. In the latter case the transformer is almost invariably very tightly coupled. If we think for a moment we shall see that our tuned anode method is practically the same as the American regenerative receiver, *plus* the arrangement by which the second valve is tapped across the tuned anode. If then the anode and the grid circuit are accurately tuned to one another and if the grid circuit is loosely coupled to the aerial such a circuit will oscillate quite freely, so that if we wish to avoid self-oscillation we must damp the grid circuit in some way. This can be done with a potentiometer, so arranged as to place some amount of positive bias upon the grid of the valve or by connecting the grid circuit directly to the aerial, whereupon the damping effect of the aerial will tend to stabilise the set to some extent. A tuned transformer circuit will act similarly.

Recently several inventors have endeavoured to obtain the utmost amplification with a high-frequency valve by arranging something to neutralise the inter-electrode capacity which forms the "hand back."

The Hazeltine Neutrodyne is an example of this. In some experiments recently I have, however, discovered that far greater stability than we are accustomed to in the ordinary way can be obtained by a very simple arrangement, and in the set I am about to describe I have obtained greater amplification than

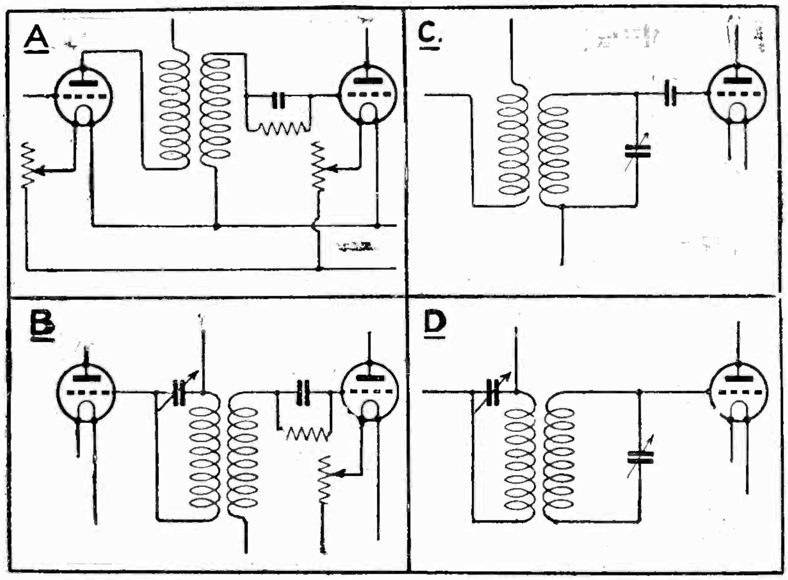


Rear view of the receiver with valves and coils removed.

by any other method I have tried with the same number of valves, plus much greater stability than I have found possible with any other simple arrangement.

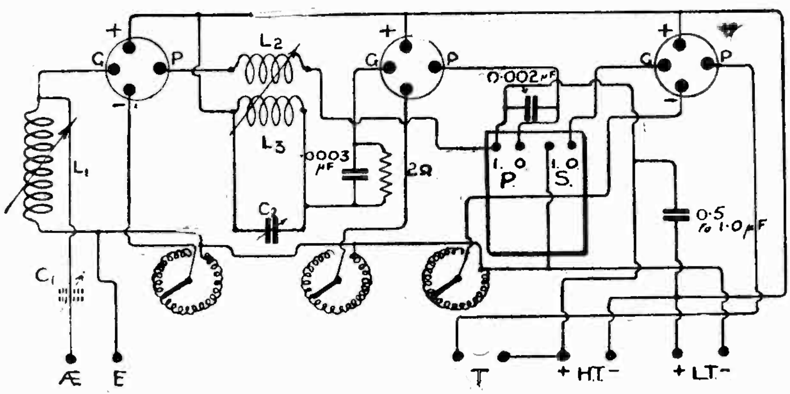
The set illustrated is not intended to be a finished design nor is it put forward as anything to be accurately followed in the lay-out. It is purely an experimental set to demonstrate the principle and to give sufficient information that other amateurs may try their hands at it.

Every one of the components is generally available and probably all of them will be in the hands of the average experimenter, so that he may try out the experiments without any delay. Before proceeding further it is well to indicate the line of reasoning followed in attempting the experiments.



Four methods of using transformer coupling: (a) aperiodic transformer; (b) tuned primary with untuned secondary; (c) tuned secondary and untuned primary; (d) both primary and secondary tuned.

Fig. 1 shows the various methods possible with transformer coupling. We can, as shown, arrange a transformer in which both primary and secondary are untuned, primary tuned and secondary untuned, secondary tuned and primary untuned and both tuned. Incidentally it is rather strange that although we are so careful to use low-resistance and low self-capacity in our aerial and grid circuits to avoid losses in our transformer grid circuits, which are surely just as important, it is the custom to use very thin wire wound without much regard for the self-capacity, and in a way we would never dream of using in the grid circuit of the first valve. Untuned transformers are very stable, but we obtain this stability at the expense of amplification. With the tight coupling generally used in high frequency transformers, it does not seem to matter much whether we tune the primary or the secondary, and certainly nothing is gained by tuning both. The reason for this is that with a very tight coupling both primary and secondary seem to act as one circuit. Loosely coupled transformers, although mentioned in practically all books on circuits, are very rarely used by experimenters. The idea seems to exist that with them such sharp tuning is obtained as to make the circuit difficult to manage.



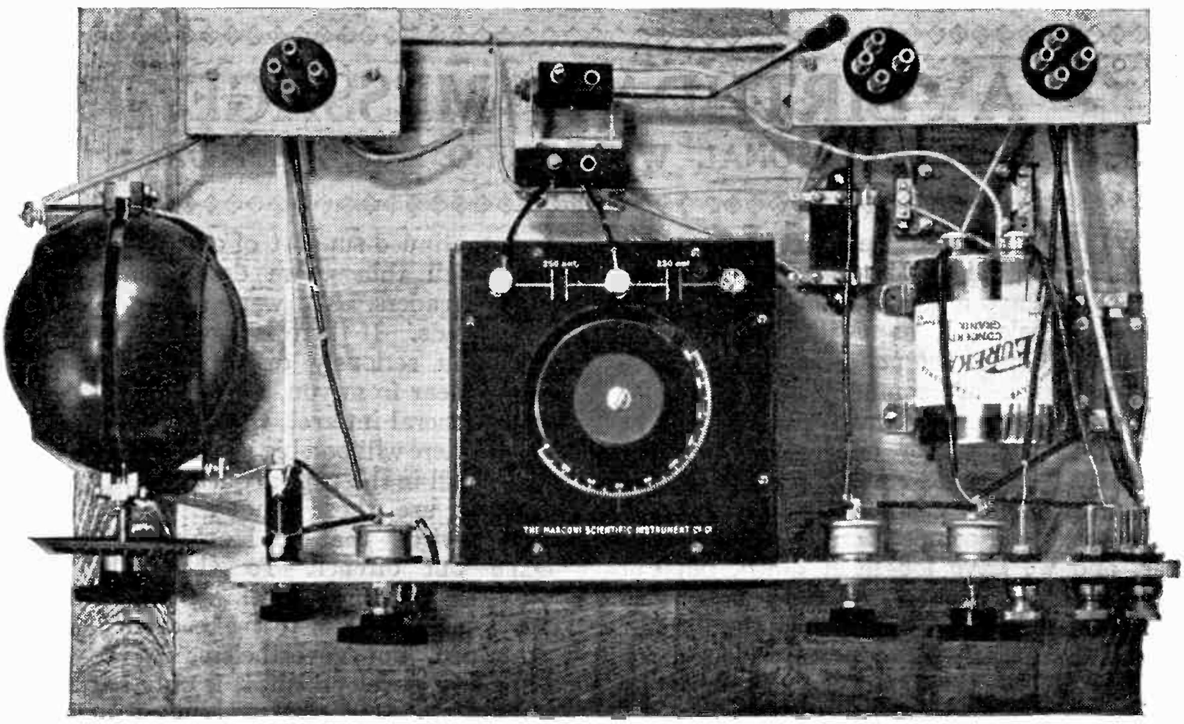
Practical wiring circuit of the receiver.

I started the experiments about to be described on seeing the circuit of the new Grebe C.R.13 receiver which has just been placed on the market in the United States and seems to be giving excellent results from reports received. Incidentally I may mention that this receiver was used by M. Leon Deloy in his recent two-way working across the Atlantic. It was also used in America on the same test. The circuit itself is shown in Fig. 2; L_1 is a variometer wound with thick wire (about No. 14 d.c.c.) to the centre of which is attached the aerial lead which contains a variable condenser V_1 which should be something less than .00025 μF. The object of this central tapping is to give something of an untuned aerial effect, which is, of course, helped by the condenser C_1. In this way a larger inductance can be used in the grid circuit than would be possible if the ordinary direct coupled arrangement were used. Notice particularly that it is the positive L.T. which is earthed. The resistance R_1 is a stabilising device, having a value of several hundred ohms and being preferably non-inductive.

The special interest in the receiver, however, is in L_2 and L_3. L_3 is another variometer also wound with thick wire to reduce losses and to this is loosely coupled the fixed inductance L_2 of a comparatively few turns (say 15) and therefore not having any natural frequency approaching that at which the receiver is being used. It was obvious to me that great importance is attached to the aperiodic coil L_2 which is only loosely coupled to L_3. It suggested that as the plate circuit was not in any way tuned either directly or indirectly (by being very closely coupled to another tuned circuit), it should be possible to bring both circuits into resonance (the grid circuits of both first and second valves) without self-oscillation taking place. It seemed inefficient to make this coupling fixed, and so I immediately ran together the circuit shown on the board in the photographs, with the 2-coil holder into one socket of which a coil could be plugged for the grid circuit of the second valve. Into the other any suitable coil for the aperiodic plate coil could be placed. Coupling could then be varied to find the best value. For tuning the first valve I used a variometer (the Pioneer) wound with good thick wire, and arranged a variable condenser to tune the grid of the second valve. The coils used were Gambrell, as these have a very low self-capacity. Subsequently, however, I tried other makes and found most of the well-known makes quite satisfactory.

Unless the variometer is specially constructed it is not an easy matter to tap at the exact electrical centre, and after unsuccessfully trying the effect of tapping off a portion only of the variometer inductance virtues in this circuit and was merely used to find the best working value. The actual circuit used is shown in Fig. 3; L_1 is the aerial variometer, and C_1, shown dotted, is a variable condenser used for certain experiments. R_1 is the potentiometer (which, as I have indicated previously is not needed). R_2, R_3 and R_4 (the filament resistances) are Microstats used because they enable either bright or dull emitters to be tried; Lissenstats could also be used here. L_2 and L_3 are the coils in a 2-coil holder; the rest of the circuit does not require any explanation, the note magnifying portion being arranged in a conventional way. The condenser across the high-themselves are carried in board mounting sockets on strips of wood supported on short feet, while the 2-coil holder is screwed on the baseboard behind the variable condenser. The intervalve transformer can be of any good make. The final wiring is shown in Fig. 4. Careful examination of the photograph will show one or two points of difference between the wiring diagram and that shown in the illustration, but the wiring diagram should be followed.

Generally the same general disposition of the parts should be followed, as in this arrangement the vital leads are quite short. Fig. 4 has been drawn in a combination of theoretical and practical diagrams



Plan view of the instrument with valves and coils removed.

to the aerial circuit I placed the whole of the variometer in the circuit in the conventional way. A potentiometer was fitted to control self-oscillation, but on finishing the instrument I found that it was no use whatever as the set could not possibly be made to oscillate, even when the grid was made fully negative. The variable condenser for tuning the grid circuit of the second valve was a double one, so that by altering the terminal connection values of .0005, .00025 or .000125 could be used at will. .00025 was found a good value, but any value from .0002 to .0005 uF should be suitable here. A double condenser has no special

tension terminals should be $\frac{1}{2}$ to 1 μF, but actually I used a lower value than this, not having the correct value available. C_2 of course is the variable condenser tuning the grid coil of the second valve.

The actual make-up of the set is, perhaps, rather crude. The base is simply an ordinary pastry board, and the terminals are carried on a strip of wood which is screwed to the variable condenser box. Ebonite bushes are used for the terminals. The variometer in the aerial circuit is seen standing on the left and the aerial and earths terminals are at the bottom of the left-hand end of the strip of wood. The valves and from it the reader will be able to see the relative positions of the wire quite readily. It is drawn in this form so that the reader can use his own components as far as possible.

The set was finished one evening a few minutes before 2LO closed down, and it took but a moment to find the right coil to give this station. Of course, being so close to London, the volume obtained was very great, much more than sufficient for a loud-speaker. As soon as broadcasting stopped I tried round among the amateurs on 440 metres and found the set surprisingly sensitive. It soon became apparent that there were one or two special points in manipulation. First of all when the potentiometer was set to the most negative position, there was no tendency to oscillate, and it was quite apparent that this device could serve no useful purpose in the circuit. Next it was found that there was an optimum coupling, and when the coupling was made tighter than this, there was reduction in strength of signals. All kinds of sizes of coil were tried and generally it was found that the coil of one or two sizes below that used in the grid circuit gave the best results, with moderately loose coupling.

The purity of speech was such that it was obvious that the set was nowhere near the point of oscillation.

After trying about on various wavelengths, just before going to bed at 1 o'clock, I adjusted the set by means of a wavemeter for the wavelength of WGY and immediately on switching off the wavemeter buzzer I heard this well-known station speaking. Fortunately he was making an announcement which included his call letters.

On the following evening I tried the effect of inserting a series condenser in the aerial and immediately there was a great improvement in signal strength, so much so that the Ecole Superieure signals were too strong to be comfortable in the telephones and were switched on to a loud-speaker. It was still evident that the set was still far from approaching the oscillation point. Re-adjustment was made and the value of the series condenser reduced down to about .0001, a value which, in ordinary cases with a tuned anode or tuned transformer circuit, would be sufficient to send the set into violent self-oscillation if the two circuits were accurately tuned. Still no self-oscillation was noticed. On 200 metre signals using about .0002 in series with the variometer (the windings of which had now been placed in parallel) admirable amplification was found, and after some difficulty on 175 or 180 metres with a capacity lower than .0001 μF the set was made to oscillate with difficulty.

A BIRTHDAY MESSAGE.

A FEW PERSONAL WORDS FROM THE EDITOR.

WITH this issue we start the second year of "MODERN WIRELESS." Perhaps it is only appropriate that, on this occasion, I, as Editor, should give some indication of the policy which I propose to adopt in the forthcoming year.

It gives me the greatest pleasure to be able to say that, not only has "MODERN WIRELESS" come to stay, but that it has come to grow.

We have had competition during the past year, and we have fought it down, but our success has only made me, and those who assist in producing "MODERN WIRELESS," more anxious than ever to increase the prestige and success of this journal. There is no resting on laurels at Devereux Court; we are all keen to improve the magazine in every way possible, and a progressive spirit permeates the whole of the staff engaged in the work.

We have many good things in store for readers. We are fortunate in having on the staff not only members who appreciate the experimental point of view, but who, by their own innovations and developments, help the progress of experimental wireless. In every village in the country, and in many villages and cities beyond the seas, "MODERN WIRELESS" designs, "MODERN WIRELESS" circuits, and "MODERN WIRELESS" ideas are the subject of interested comment. Seven foreign countries have obtained from the publishers of "MODERN WIRELESS" the translation rights of our articles, but what we appreciate most, of course, is the strong and continued support of our British readers. Above all things, we desire the good will of our readers. We want all of them to be our friends. If there is anything that we do that you seriously disapprove of, I would like to hear from you, and if your suggestions are of general interest, they will be carried out. I hope there will be a big response to our invitation to fill in the page of questions in this issue.

There are those who write and express their wish that "MODERN WIRELESS" came out oftener. To these "WIRELESS WEEKLY" should appeal. Our policy during the coming year is to make each paper self-contained, but nevertheless, in the case of some new development, it is only natural that different aspects of the same subject should be given in both journals.

We wish, on this occasion, to thank all those who have, within such a short period, helped to build up the House of Radio Press into the great organisation that it now is. The vigorous growth of our activities is proof enough that the lines on which we have worked are the right lines.

Lastly, I hope that all our readers and their friends as well, will buy the Special Spring Number which will be published at 1s. 6d. on March 1st, and will be greatly enlarged and beautifully produced.

John Scott-Taggart

Regular Programmes from British and Continental Broadcasting Stations

Times in Greenwich Mean Time.

GREAT BRITAIN.

Station.	*Call Sign.*	*Wave-length.*	*Times.*
Cardiff ...	5 WA	350	3.30 to 4.30 p.m. and 5.0 to 10.30 p.m. SUNDAYS. 3.0 to 5.0 p.m. and 8.30 to 10.30 p.m.
London ...	2 LO	365	
Manchester	2 ZY	375	
Bournemouth	6 BM	385	
Newcastle ...	5 NO	400	
Glasgow ...	5 SC	420	
Birmingham	5 IT	475	
Aberdeen ...	2 BD	495	

FRANCE.

EIFFEL TOWER. F.L. 2,600.
(Daily.)

6.40 a.m. Forecast.
10.50 a.m. Fish prices in the Paris markets.
11.14 a.m. Announcement of the time.
11.15 a.m. Regional forecast.
12.0 a.m. Livestock prices. *(Tuesdays and Thursdays.)*
3.40 p.m. Financial news.
5.30 p.m. Closing prices. *(Saturdays excepted.)*
6.10 p.m. Radio concerts.
7.0 p.m. General forecast.
10.10 p.m. General forecast. On Sundays the radio concerts and forecasts are given at 7 o'clock.

ECOLE SUPÉRIEURE DE POSTES ET TÉLÉGRAPHES (450 metres).
Concerts generally at 9 p.m. on Tuesday and Thursday.

RADIOLA (1,780 metres).
12.30 p.m., 4.30 p.m., 8.30 p.m. } Concerts.
These concerts are preceded by news items.

BELGIUM.

BRUSSELS (405 metres).
5.30 p.m., 6.0 p.m., 8.30 p.m. } Concerts and News.

HOLLAND.

THE HAGUE, PCGG (1,050 metres).
Concerts. Sundays, 3.0 to 6.0 p.m.

THE HAGUE, HEUSSEN, PCUU (1,050 metres).
Thursdays, from 7.45 to 10.0 p.m., Irregular.
Sundays, from 9.40 to 10.40 a.m., Irregular.

THE HAGUE, VELTHYSEN, PCKK.
Fridays, from 8.40 to 9.40 p.m., Irregular.

THE HAGUE, IJMUIDEN, PCMM.
Saturdays, from 8.40 to 9.40 p.m., Irregular.

SPAIN.

MADRID (2,100 metres).
Trials from 10.0 to 12.0 a.m., Irregular.

SWITZERLAND.

LAUSANNE (1,100 metres).
8.5 a.m. Meteorological forecast for Lausanne.
10.50 a.m. Meteorological forecast for Geneva and Dubendal.
1.0 p.m. Meteorological report for Switzerland.
6.55 p.m. Meteorological report for Switzerland.
4.0 p.m. Tuesdays, Thursdays and Saturdays, Concerts.
7.0 p.m. Mondays, Wednesdays, Fridays and Saturdays, Concerts.

ITALY.

ROME (540 metres).
Weekdays from 5.0 p.m. to 6.0 p.m.

Additions to List of Amateur Call Signs.

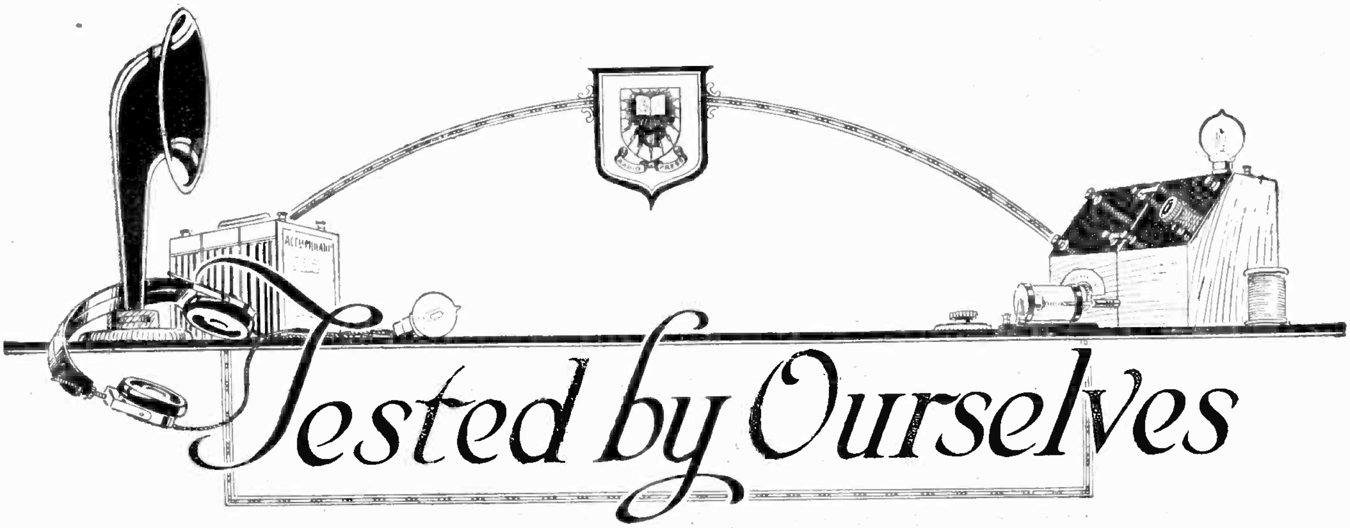
Call.	Name of Owner.	Address.
2 HM	H. B. GARDNER	129, Salisbury Road, Barnet.
2 UR	A. WHALE AND CO.	201, Powis Street, Woolwich.
2 XY	H. T. LITTLEWOOD	Eshoet, Wedgewood Drive, Leeds.
5 IB	L. H. & L. W. CARDER	5, Deeside Parade, West Kirby, Birkenhead.
5 OX	C. H. F. HUBBARD	196, Putney Bridge Road, S.W.15.
5 PR	C. RATCLIFFE	68A, Dewsbury Road, Leeds.
5 QU	L. J. DOLPHIN	23, Carless Avenue, Harborne, Birmingham.
5 SY	G. THOMPSON	East Rigton, East Keswick, Leeds.
5 TS	WALTER DEAN	Bankleigh, Ramsgreave, nr, Blackburn.
5 VB	G. C. CURTIS	33, Swindon Road, Edgbaston, Birmingham.
5 WF	D. G. BOWER	10, Ventnor Villas, Hove, Sussex.
6 IW	LEEDS Y.M.C.A. WIRELESS SOCIETY	Y.M.C.A., Albion Place, Leeds.
6 MF	S. HILL	Langford House, Langford, nr. Bristol.
6 MK	R. WILBY	93, Brudenell Road, Leeds.
6 PL	J. F. BROCKBANK	51, Palatine Road, Withington, Manchester.
6 SR	R. T. HATTON EVANS	6, Cort-y-vil Rd., Penarth, S. Wales.
6 SS	F. C. HOLLIDAY	Forest Hill, Roundhay, Leeds.
6 UM	LEEDS RADIO SOCIETY	Woodhouse Lane, U.M. Church Schools, Leeds.
6 UT	T. A. ST. JOHNSTON	28, Douglas Road, Chingford, Essex.
6 UV	G. L. MORROW	"Pen Olver," Berkhamsted.
6 VN	F. W. WELLBELOVE	37, St. John's Rd., Erith, Kent.
6 VP	H. E. NICKOLSON	42, Southsea Av., Watford, Herts.
6 XT	S. W. FARMERY	Whinfield Rd., Adel, Leeds.
2 ACP	L. NORRIS	136A, Brownhill Rd., Catford, Kent.
2 ADN	G. SYKES	13, Longford Street, Garton Manchester.

CORRECTIONS.

Call.	Name of Owner.	Address.
2 AH	A. R. TAYLOR	Hounslow.
2 IC	CAPT. O. S. STILES	Heron's Ghyll, South Harrow.
2 QA	C. F. PHILLIPS, M.I.R.E.	c/o Burndept Ltd., London, S.E.5.
2 QT	C. C. BARNETT	Winton Cottage, South Perrott, Mesterton, Somerset.
2 UZ	C. U. STEAD	29, Sholebroke View, Chapeltown, Leeds.
2 VL	D. E. PETTIGREW	37, Mexborough Av., Chapeltown Road, Leeds.
5 VC	H. LANGSTAFF	10, Piece Hall Yard, Bradford, Yorkshire.

CLOSED DOWN.

2 LA. 2 LB. 2 LK. 2 LL. 2 TJ.



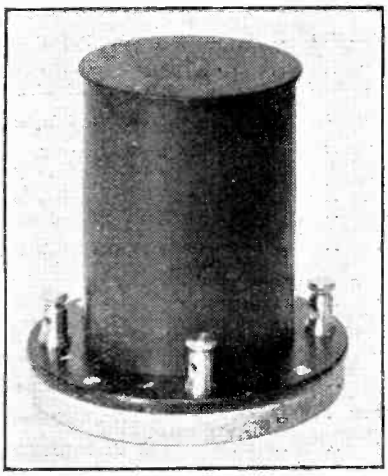
Tested by Ourselves

Selectone L.F. Intervalve Transformer.

THIS transformer, on careful test in a standard type of two-valve set, using 50 volts H.T., and in direct comparison (by means of switching gear) with standard L.F. transformers, failed to show any appreciable step-up in signal strength. The terminals were changed round, and various grid bias was tried, but to no avail.

On testing the insulation at high voltage, it was found to be excellent, both between windings and from either winding to the case; and the resistance of each winding itself was not suspiciously abnormal, though the primary showed a rather low figure.

It is not clear why this particular transformer should show so disappointing a performance, which cannot be characteristic of the make, judging from the report of the N.P.L. on samples submitted to them for test.



The miniature crystal set, with cover.

A Miniature Crystal Set.

From Burne Jones and Co. we have received for test a small crystal receiver, most of which is enclosed in a turned cover only 2½ in. diameter and 3¼ in. high, with the terminals arranged around the rim of the circular base. The tuning device is of the sliding contact type, on an inductance wound with fine silk-covered wire. The detector, of the cat's-whisker variety, is mounted in the centre of this. On trial the instrument was found to tune up to above 800 metres on a P.M.G. aerial, and local broadcasting came in clearly. The tuning was noticeably flat.

Of course, much must be sacrificed for the sake of compactness in such a tiny instrument, so that great signal strength could hardly be expected. Whilst the detector was found easy to set, if it is intended as a serious broadcast receiver, and not merely as a toy, the tiny fragment of crystal provided, in its small clip, would advantageously be substituted by a crystal and cup of more usual dimensions.

The workmanship and finish of this little receiver are far better than are usually associated with such types.

A Repaired Valve.

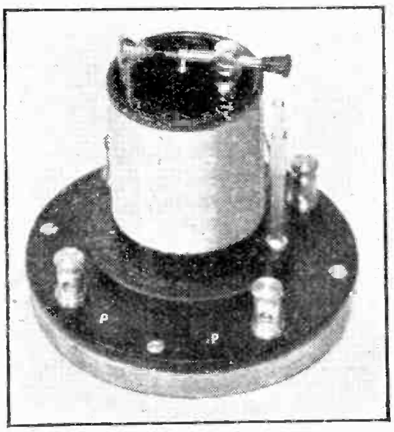
In view of conflicting reports current as to the performance of repaired valves, and the writer's own unfortunate experience with an early type, we welcomed the opportunity offered by Messrs. G.W.I. Ltd. of submitting to thorough trial a normal type of R valve in which the filament had been replaced according to their methods. On trial, the valve developed ample power with 4 volts on the filament, and took around ½ ampere at this voltage. In actual reception, none of the usual signs of softness were noticed with up to 80 volts on the plate; and in detection, H.F. and L.F. amplification, as well as in a dual circuit, it showed itself every bit as good as an excellent new French R valve, by direct comparison. Messrs. G.W.I. Ltd. are to be congratulated on having so effectively solved the problem of filament renewal in R valves.

A Dry Cell.

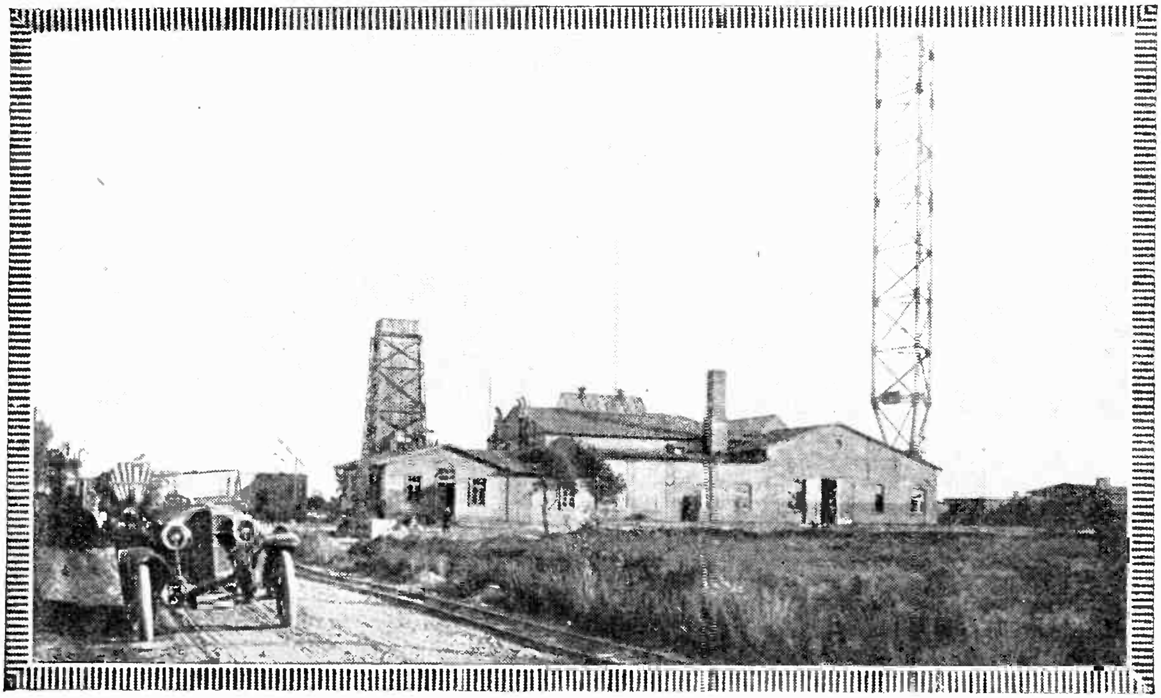
Messrs. Siemens Bros. & Co., Ltd., have submitted for test a sample of their dry cell, size 948, for use with dull-emitter valves.

This is a large cell, about 7 in. high by 3¼ in. square. The voltage

(*Continued on page 348.*)



The set open, showing crystal detector and slider.



Exterior view of the station, showing base of the triangular steel mast.

A Visit to the Eilvese High-Power Wireless Station

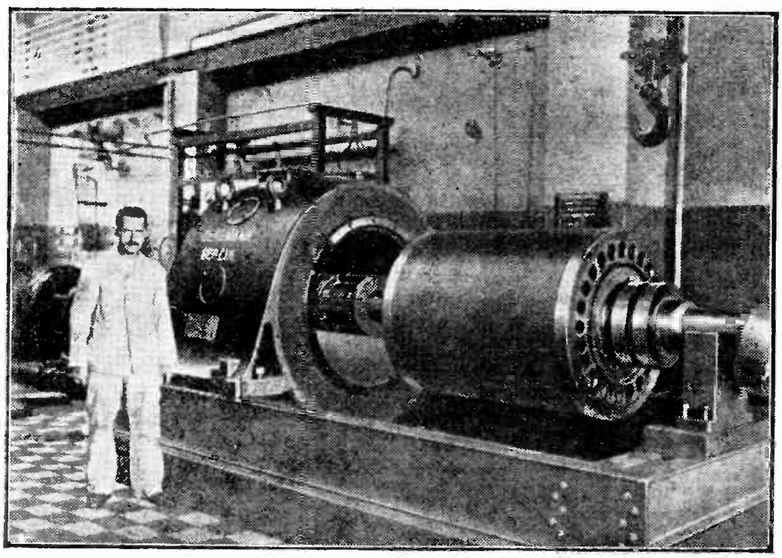
By DR. ALFRED GRADENWITZ

All long-wave listeners are acquainted with the powerful signals from the Eilvese station on about 15,000 metres. The call-sign is OUI and the station can be heard working almost any time, day and night.

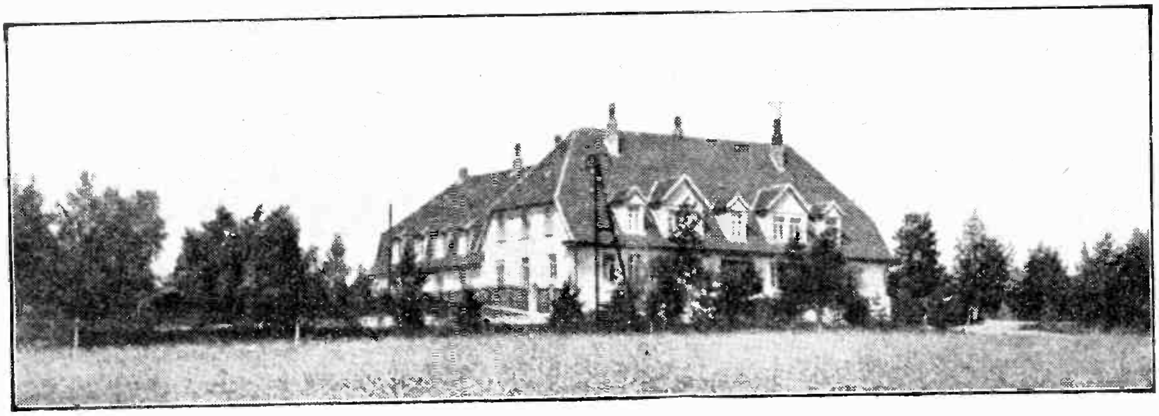
THE well-known wireless station of Nauen, near Berlin, takes care of only about one-half of the German transatlantic radio business. The other half is dealt with by a companion station situated near Eilvese, about 18 miles to the north-west of Hanover, in sandy ground surrounded by moors in the southern part of the Lüneburg steppe, an ideal location for a high-power transmitting station.

While the receiving service in the beginning was looked after by a separate station situated at Hagen, about 3 miles from Eilvese, both the receiving and transmitting services are, like the Nauen wireless business, now controlled from the Berlin Transradio Central Station.

The umbrella-shaped antenna system of Eilvese Station is carried by one central mast 820 ft. high and six masts, each about 400 ft. high, surrounding the former in a circle 3,000 ft. in diameter. The foot of the central mast, like that of the Nauen masts, terminates in a point, or rather a small hemisphere resting on a cup. The six smaller masts are made of thin-walled



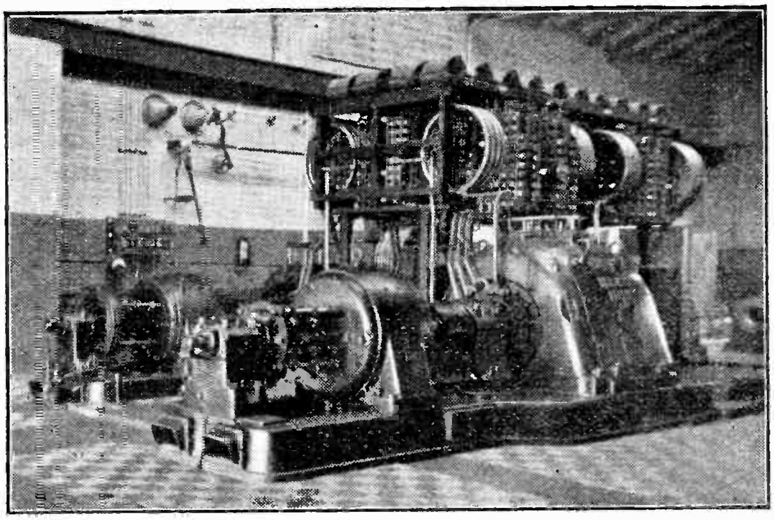
The Goldschmidt alternator in process of assembly. The rotor has been withdrawn from the stator.



Administrative buildings at Eilvese.

steel tubes, which, like the central mast, are retained by a system of ropes moored to substantial foundations.

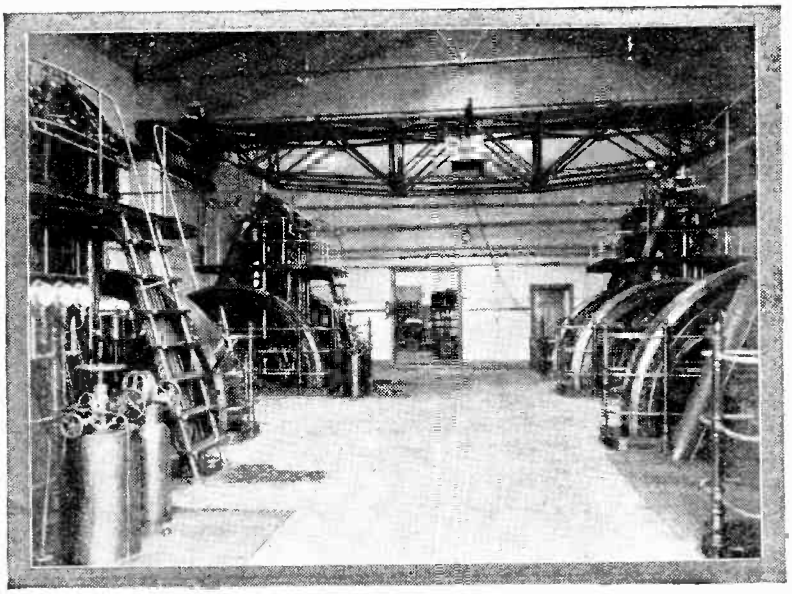
The antenna system is made up of an umbrella of .018 μF capacity and a ring of .037 μF capacity surrounding the former, the two systems being insulated from one another and fed by separate supply conductors. This arrangement is intended to facilitate a simultaneous (or "duplex") sending service on different waves, the umbrella antenna sending on a wave-length of 9,700 metres, and the ring antenna on a wave of 14,600 metres. The antenna current, using only one generator set, works out at 180 and 250 amperes respectively. However, the umbrella and ring antennæ may also be coupled together, with a view to providing greater transmitting energy, a maximum antenna current of 450 amperes with a wave of 14,600 metres being obtained by utilising the whole available high-frequency energy. Wire ropes passing over pulleys at the top of the mast are provided to carry the antenna wires, six weights, each of a ton and a half, maintaining a uniform and constant tension. The whole antenna system thus is of a remarkably simple and straightforward arrangement as well as of high elasticity and stability.



The complete Goldschmidt alternator. The patents on this form of generator expire this year.

A single hall containing the machinery has been erected at the foot of the central mast, the management building, which also comprises telegraph rooms, being situated opposite, while a spacious barrack, where spare equipment and parts are stocked, is situated behind. Six fire-proof tanks, each of about 180 cubic metres, sunk into the ground, contain the oil for the Diesel engines of the station, which, independently of the high-tension mains, ensure continuous operation.

All conductors connected to



A peep into the engine-room.

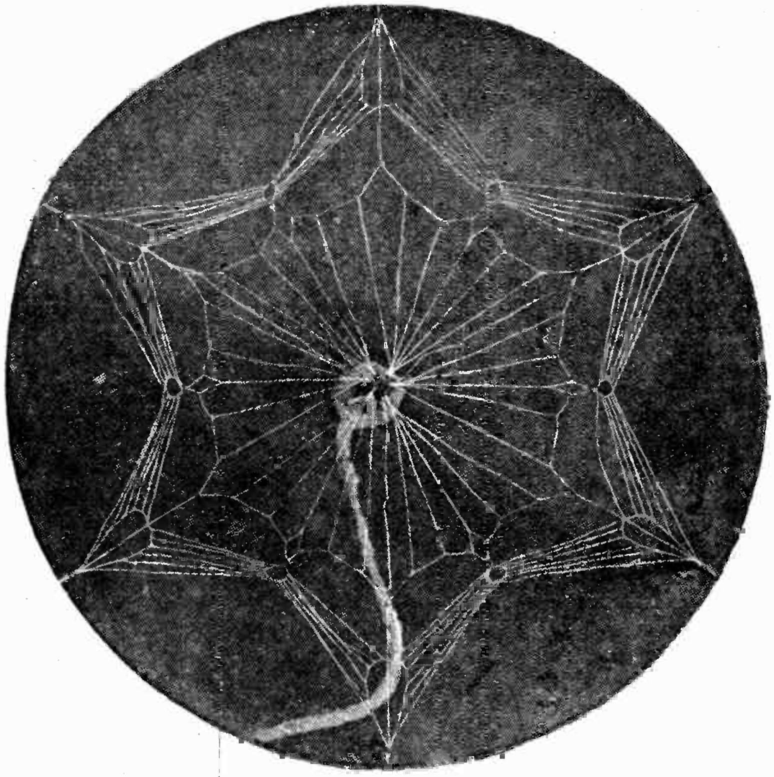
the various generator sets are led to a large switch board; 15,000 volt three-phase current is supplied from Döwerden Power Station and is stepped down by a 1,000 KVA transformer to 5,000 volts, the lighting system and auxiliary machines being fed from a smaller transformer (15 KVA at 380/220 volts). The 1,000 KVA transformer feeds a 650 h.p. three-phase current motor, coupled on the one hand to a 440 volt 1,000 ampere direct-current generator and on the other to a 220 volt 240 ampere direct current generator, the latter serving to excite the high-frequency machine and the former to drive the two direct-current motors of 184 and 165 kw. respectively, each of which is direct coupled to one of the two high-frequency sets.

The Generators

The high-frequency twin generators have been constructed on patents of Professor Goldschmidt, and are based on the use of high-frequency oscillations set up in the machine itself by the reaction of alternating currents in the rotor and stator coils to which the properly tuned oscillatory circuits are connected. Inasmuch as the rotor is made up of a very large number of paper-insulated sheet metal segments, which at the high speed of rotation (about 3,000 revolutions per minute) have to stand heavy mechanical strain, careful tending and cooling of the generators essential. A large pump and compressor plant has been provided to dispose of any heat, while the oil for the bearings passes through a cooled oil-pump.

Driving Motors

The two sets each comprising two high-frequency machines are driven at a speed of 3,150 r.p.m. by the direct current motors above mentioned of 184 and 165 kw. respectively. The generators, or rather transmitters, are tuned to two frequencies, 30,800 and 20,800 cycles respectively, which correspond to wave-lengths of 9,700 and 14,600 metres respectively. The fundamental frequency is only once transformed for generating the 14,600 metre wave and is tapped from the stator coils, whereas in the case of the 9,700 metre wave the fundamental frequency is transformed twice and tapped from the rotor coils. It is, of course, of the utmost importance that the number of revolutions of the generators should be strictly maintained. This is why a speed regulator has recently been fitted, which automatically compensates for the slightest fluctuations in the number of revolutions—down to 0.02 per cent. by altering the resistance in the exciter circuit. The improvement effected by these speed regulators has more than once been acknowledged by the American stations working in conjunction with both Nauen and Eilvese.



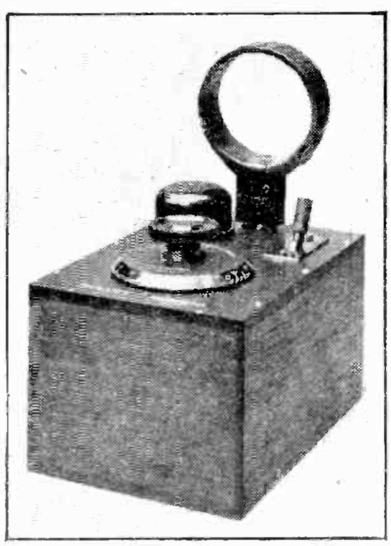
Plan view of a model of the aerial system.

Keying

The transmitting station is operated by means of a Creed air-pressure relay inserted in the exciter circuit of the high frequency machine. This controls the piston rod of an air compressor cylinder by intermittent current impulses, pressing some copper blocks against a slowly rotating copper disc or pulling them off again. As the key is pressed down, the disc will be stopped, and will resume its rotation on the key being released. A blower provides for cooling and spark extinction. The sparking is negligible with 112 amperes and 75 volts, which is quite sufficient for a rate of fifty words per minute.

The Diesel power plant above mentioned, which enables the service to be maintained, even in the case of breakdown of the current supply from the mains, is located in another room of the engine hall and comprises five Diesel engines of a total output of about 1,000 h.p., four of which (each of 200 h.p.) are each coupled to a 130 kw. direct current dynamo, while a fifth one (of 120 h.p.) is coupled to a 65 kw. direct current dynamo. Two Diesel engines each of 200 h.p. are required for operating one high-frequency twin generator set, the 120 h.p. engine serving to excite the generator.

A NEW WAVEMETER



The Dubilier wavemeter which covers all broadcast wavelengths. Plug-in coils are used in conjunction with a variable condenser and a buzzer.

A Crystal Receiver in a Pencil Box

By E. H. CHAPMAN, M.A., D.Sc. (Staff Editor).

This article will particularly appeal to our younger readers. Although the set is extremely compact, its efficiency is well up to "Modern Wireless" standards.

HERE is a description of a simple crystal receiver which may be made with materials costing not more than four shillings, which is thoroughly efficient and which may be put together in a couple of hours.

The set had its origin in the idea of making a crystal receiver in that familiar object of our school-days, the pencil box, using the sliding lid as the mechanism for tuning. There is a great fascination in making a wireless set out of something of ordinary, everyday use. Possibly the present set may suggest to you some other equally simple idea for making a crystal receiver.

The materials used in the construction of this little pencil box set, together with their cost, were as follows :—

Pencil box	1s. (with pencils, [etc.)
Crystal detector	9½d.
Crystal	6d.
4 terminals	8d.
1 yard flex	3d.
1 yard sleeving	5d.
Wire, etc., say	4½d.
Total cost	4s.

Practically any size pencil box will do provided it is deep enough to take the crystal detector. The outside measurements of the one used by the writer were 7½ in. by 3¼ in. by ⅞ in. The inside depth was ⅝ in.

The crystal detector was one of the type sold with its several parts on a card. For the crystal, any of the "sites" would do, but if a small piece of hertzite can be obtained for 6d., as was done for the set described, it will prove as good an investment as any.

Of the four terminals, those for the aerial and earth were of the usual type, while those for the phones were of the hole and screw type. Possibly the yard of sleeving could be dispensed with if care be taken not to remove any more of the insulation from the connecting wires near the terminals or other metal parts than is absolutely necessary.

Fig. 2 shows the several parts of the receiver arranged in the form of a wireless circuit. It will be noticed that there were two coils A and B connected in series (that is, the outside end of the wire

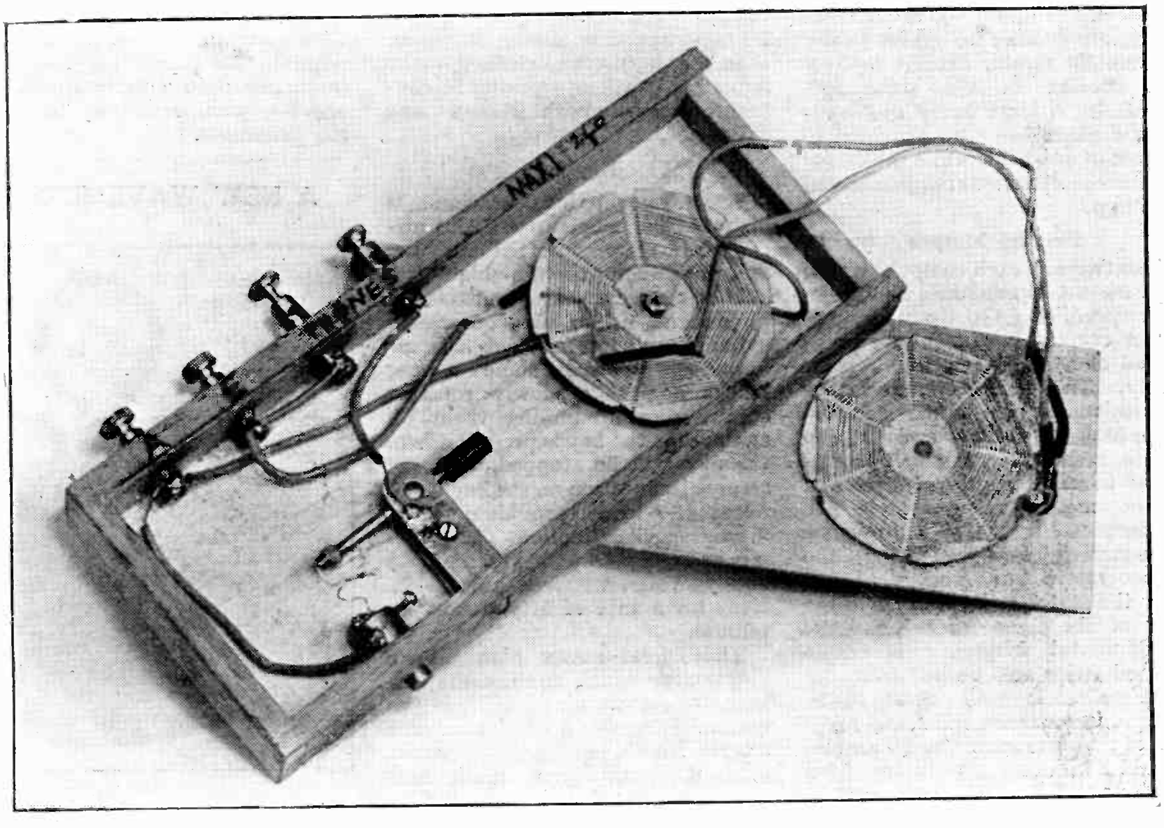


Fig. 1.—The set incorporates an ingenious adaptation of variometer tuning. The general arrangement is of the simplest character.

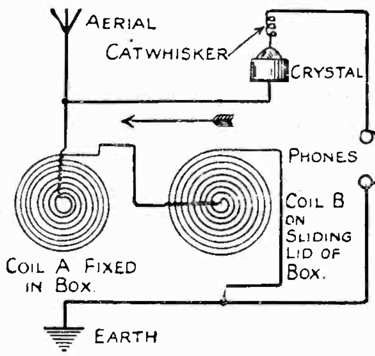


Fig. 2.—The circuit used.

on coil A was connected to the central or starting end of the wire on coil B). Coil A was fixed in the bottom of the pencil box. Coil B was fixed on the underneath side of the sliding lid.

The two coils A and B were basket coils made in the usual manner on cardboard discs of diameter $2\frac{3}{8}$ in. There were seven radial slits and the diameter of the central portion free from wire was $\frac{3}{4}$ in. On each coil there were 38 turns (19 each side) of No. 28 D.C.C. wire.

Coils of this size were found to be suitable for the reception of the London broadcasting, but for other broadcasting stations more turns would be required. Allowance could be made for more turns by choosing a wider box, or by using a finer wire for the coils. It is worth mentioning that the distance apart of the two coils when the top one B is over the bottom one A has an effect on the wave-length range of the receiver. How this distance may be varied is described a little later on.

After having cut out a cardboard disc and having made the seven radial slits, one side of the disc was marked "top" and the wire was wound on the disc in a clockwise direction with the side marked "top" uppermost. Both the start and the end of each coil were secured by passing the wire through small holes in the disc. The ends of coil A (the bottom coil) were made to come out from *underneath* the disc, while those of coil B were made to come out from the *top* of the disc.

Fig. 1, which is reproduced from

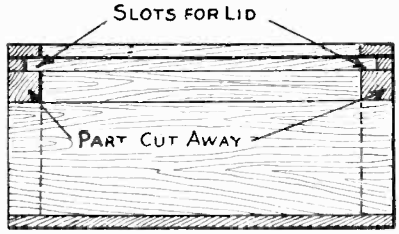


Fig. 3.—How to cut away end of box.

a photograph, shows how the several parts of the set were mounted in the box. The left-hand terminal is the "aerial," the next one the "earth," the two on the right, the 'phone terminals. The crystal detector parts were secured by screws driven right through the wooden side of the box.

Coil A, which was fixed in the box, was held in position by a screw driven through from underneath the bottom of the box. The screw head was countersunk on the outside of the box and a nut inside the box held the screw firmly in position. Coil A was held in place on the screw between a second and a third nut. By moving these two nuts up and down the screw, the height of coil A above the bottom of the box could be varied and this of course, varied the distance apart of the two coils when in use. Bringing the two coils relatively closer to each other increases the wave-length, and fixing them further apart decreases the wave-length.

Coil B was fixed in position at one end of the box-lid on the underneath (inside) by a screw through its centre. It must be very carefully noted that coil A was placed with the side marked "top" uppermost and that coil B was placed with its side marked "top" next to the wood of the lid. Thus, when the lid was in the slots for sliding in and out, the two coils had their sides marked "top" uppermost.

In order that the lid, with coil B mounted on it, could slide in and out of the box easily, it was

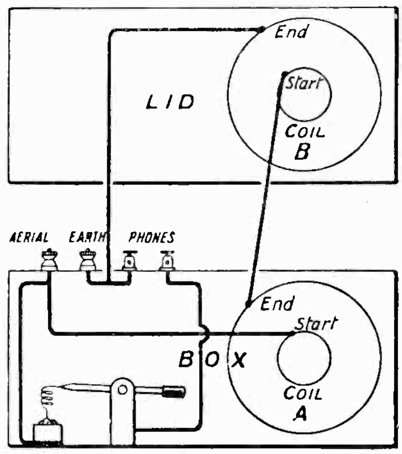


Fig. 4.—Wiring connections.

found necessary to cut away part of the end of the box as shown in Fig. 3.

Fig. 4 is a diagram showing the connections from the terminals to detector, 'phones and coils, and from coil to coil. All the connections were soldered. The two flex leads to coil B were made long enough to allow the lid to be taken right out of the slots it slides in. When in use, the end of the lid, with coil B immediately under it, was the inside end of the lid. In the maximum position, coil B directly over coil A, the lid was less than half way down the box and the crystal detector was not covered. To shut the box up, when not in use, the lid was put in the other way round, the end with coil B under it being the outer end. This arrangement allowed the box to be closed without fear of damage to coil B by its rubbing over the crystal detector or against the terminals.

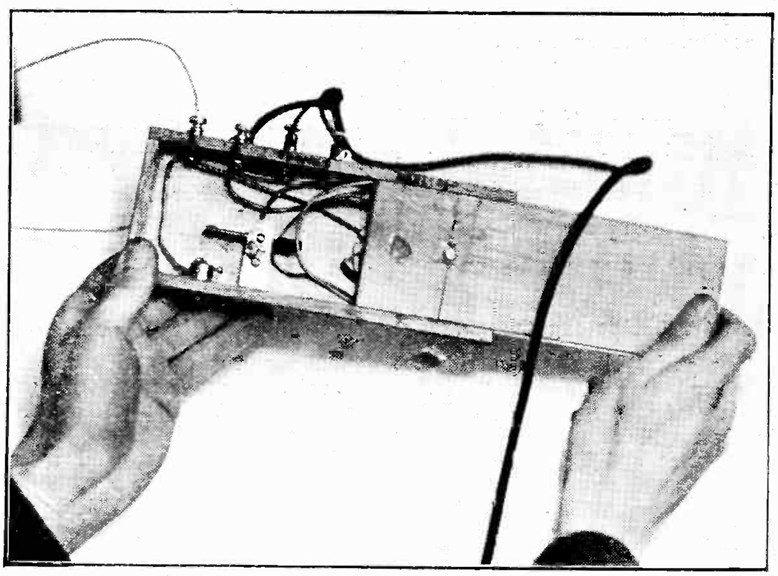
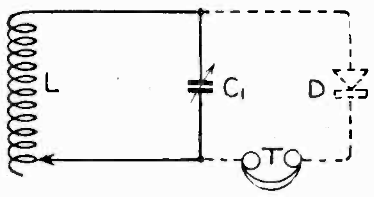


Fig. 5.—The receiver in operation.

Aerial Circuit Tuning

By John Scott-Taggart, F.Inst.P., A.M.I.E.E., Editor.



No. 1.—An oscillatory circuit.

Introduction

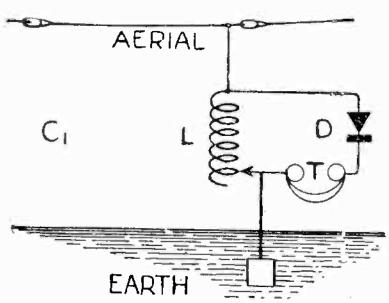
THE aerial circuit in a wireless receiver, for some reason or other, receives scant attention; probably because the average experimenter regards the aerial circuit as such a simple affair that developments of it do not matter.

In this article I propose to outline different methods of tuning the aerial circuit, and to explain the advantages and disadvantages of each method. I also propose to give details of so arranging matters that a set will work on any aerial, including gas pipes, fences, indoor aerials, etc., without necessitating any material change in the tuning arrangement.

The Need for Constant Aerial Tuning

The average beginner nearly always makes the mistake of not having his aerial circuit properly tuned. A set will, for example, be fully described by a writer, and yet the chances are that only 75 per cent. of the readers of the article will get good results with the set. The other 25 per cent. either alter the author's design or else find with their particular aerials the tuning is entirely different. This is one reason why very often a set will work well on one aerial and badly on another. It is not merely a question of the efficiency of the aerial, but its capacity and its damping. On one aerial a set will oscillate violently, while on another it will behave perfectly.

As editor of two wireless journals, I am naturally most anxious to publish articles dealing with the construction of sets which would give perfect results on all sizes and shapes of aerials. I therefore set to work to find out the best method of compensating for the differences between various aerials. It is impossible to make everybody have exactly the same size of aerial; the alternative is to so design the set that no matter what aerial is used, the tuning and the size of coils, etc., will remain the same. How this is achieved is described below, and the result is that it is now possible to state with accuracy what sizes of coils to use for a given station, and almost the exact number of degrees on the condenser. Moreover, it is possible to obtain a much wider range of wavelengths with a given variable condenser and a given coil.



No. 2.—A simple wireless receiver.

Differences in Aerials

Aerials differ in direction, height, length, numbers of wires, etc. These factors vary the efficiency of the aerial, but they also vary the capacity of the aerial. The efficiency of the aerial governs the strength of signals obtained, while the capacity of the aerial affects the tuning of the aerial circuit.

When we say that the aerial has capacity, we mean that the aerial wire forms one side of a condenser, the earth and surrounding objects forming the other plate of the condenser.

The greater the number of wires used in the aerial, or the longer the aerial, the greater will be the capacity of it, and this capacity will affect the tuning of the aerial circuit.

An Oscillatory Circuit

The aerial circuit of a wireless receiver is an oscillatory circuit.

An oscillatory circuit is shown in Fig. 1, which illustrates a variable inductance coil L, shunted by a variable condenser C_1. This circuit will pick up oscillatory currents, that is to say, currents which flow rapidly first in one direction and then in another, provided the right values of L and C_1 are chosen, so that the circuit L C_1 is *in tune* with the wavelength of the oscillations. We can, for example, say that the circuit L C_1 is tuned to a wavelength of 365 metres. Rough tuning may be accomplished by means of tappings on the inductance L, whereas a finer adjustment may be obtained by a correct manipulation of the variable condenser C_1. The wavelength of the circuit L C_1 depends upon the value of the inductance L and that of the condenser C_1. The wave-

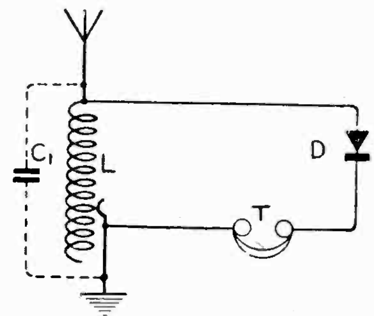


Fig. 3.—The conventional way of depicting Fig. 2.

length, in fact, is proportional to the square root of the inductance L and the capacity C_1 multiplied together. The beginner must not be alarmed at this; it simply means that the greater the inductance, that is to say, the more turns in L, the greater will be the wavelength to which the circuit L C_1 is tuned. If, on the other hand, we do not alter L, but increase the value of the condenser C_1, we will also increase the wavelength of the circuit. Similarly we can decrease the wavelength of the circuit by decreasing L or decreasing C_1, or by decreasing both.

It will be readily appreciated that for a given adjustment of wavelength we can either have a large amount of inductance and a small value of condenser, or small value of inductance and a large value of condenser.

In Fig. 1 a crystal detector D and telephones T are shown connected across the circuit L C_1. This circuit does not interfere with the tuning of the oscillatory circuit

An Article of Interest to every type of Wireless Enthusiast, dealing with the new Constant Aerial Tuning Systems.

L C_1, and any oscillations set up in L C_1 will pass a rectified current through the telephones which will then be operated. In practice, in wireless receiving circuits, we always endeavour to keep the value of the condenser C_1 as small as possible, because if we use a large value of condenser C_1 and a small value of the inductance L, the voltages across C_1 will be much smaller and the signals obtained will not be as loud.

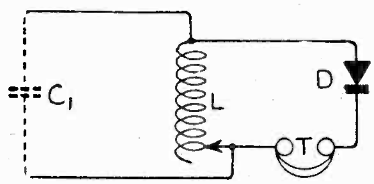


Fig. 4.—The oscillatory circuit of Fig. 2.

The Simple Aerial Circuit

Fig. 2 shows a simple wireless receiver in which the aerial circuit consists of the aerial, a variable inductance L, which consists of a coil of wire along which moves a slider, and the earth. Across the inductance L we have the crystal detector D and the telephones T. At first sight it might be thought that there was no oscillatory circuit, but reflection will show that the condenser in this case consists of the aerial and earth, this condenser being connected in parallel with the inductance L. In this case the capacity is kept small, and the inductance L is large. This is why this circuit is very popular with crystal users, apart from the fact, of course, that it is very simple to construct. Really accurate adjustment, however, is not possible by means of a slider, and unpleasant noises usually attend the movement of the slider when a valve set is in use. Nevertheless, for crystal work the circuit is quite good, and it will be seen that in this case the capacity remains fixed and that adjustments of the aerial circuit, so as to tune it to the incoming wavelength, is accomplished solely by means of the inductance L.

Fig. 3 shows the usual method of illustrating the Fig. 2 circuit, and in Fig. 3 a capacity C_1 is shown in dotted lines. This phantom condenser C_1 represents the capacity of the aerial, and it will be seen that the only capacity across the coil L_2 is this aerial capacity.

We now come to the great disadvantage of this type of simple circuit. If the receiver is tried on different aerials it will be found that the adjustments on the inductance L will be widely different. One aerial, for example, will have twice the capacity of the other, and this means that the tuning will be entirely different, because this is equivalent to connecting a condenser across L having twice the capacity, in one case than in the other.

The capacity of a condenser or an aerial is usually measured as a fraction of a microfarad (the abbreviation for which is μF, pronounced "mew-eff"), which in turn is a millionth part of a farad, which is the unit of capacity. The capacity of one aerial we will suppose is 0.0002 μF, while the capacity of another aerial is 0.0004 μF. If an experimenter is accustomed to receive a certain station with the slider almost at the far end of his coil, and his aerial has a capacity of 0.0004 μF, and he then lends his receiver to a friend who has an aerial having a capacity of 0.0002 μF in order that he may hear the same station, it will be pretty obvious that he will not be able to do so, for the simple reason that since his aerial has a much smaller capacity, he would need about half as much inductance again; this he cannot obtain with the coil, with the result that the station cannot be heard or heard only weakly.

When a coil with a slider is used, it may be that one experimenter will get signals with the slider halfway along, and another experimenter with the slider at the extreme end. This is simply because the two aerials have different capacities. Aerials, by the way, also have a small amount of inductance, which is distributed along the length of the wire, but as this inductance is so extremely

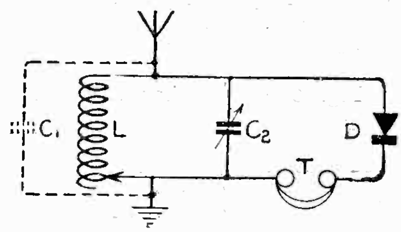


Fig. 5.—Tuning with parallel capacity.

small, it may be left out of consideration.

What we desire to do is to have an aerial circuit which will not necessitate a wide variation of tuning to pick up a given station.

Fig. 4 shows the simple oscillatory circuit which represents the ordinary arrangement of Fig. 2.

A point which one cannot too often emphasise is that, when tuning into a station, do not be satisfied until you can tune the station out on both sides of the best adjustment, whether it is a slider inductance, a variometer, or a variable condenser that is being adjusted. Do not be satisfied if you can weaken signals on one side of the adjustment alone; the chances are that you are not properly tuned in. If you find that your condenser is full in, try using a larger inductance coil and come back to a smaller value on the variable condenser.

The Use of Variable Condensers

Variable condensers are of great use in wireless circuits, because they enable plug-in coils to be used, and because a very fine adjustment in tuning is possible without any undesirable noises.

There are two ordinary methods of tuning an aerial circuit; these are: (1) the use of a parallel condenser which is shunted across the aerial inductance, as shown in Fig. 5; (2) a series variable condenser is connected in series with the aerial inductance, as shown in Fig. 7.

In both these cases the inductance coils may be fixed or variable, according to the wavelength range to be covered. The modern tendency is towards plug-in coils, and these are certainly extremely convenient and to be recommended.

In both Fig. 5 and Fig. 7 the

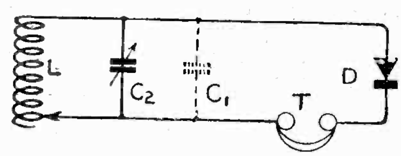


Fig. 6.—The Figure 5 circuit simplified.

condenser C_1 represents the capacity of the aerial. This is very important and must always be taken into account.

Fig. 6 shows what the Fig. 5

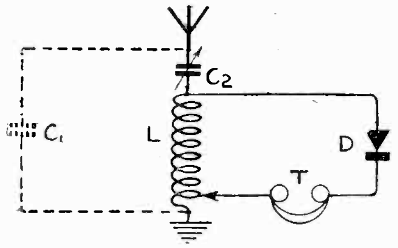


Fig. 7.—Tuning with a series condenser.

circuit really resolves itself into. The inductance L is shunted by a variable condenser C_2 and also by the fixed capacity of the aerial. A crystal detector D and telephones T are shunted across this oscillatory circuit, but although a crystal detector is shown in all the diagrams in this article, yet the oscillatory circuit might equally well be connected across the grid and filament, of a valve in a valve circuit.

The Parallel Condenser

The parallel condenser has certain advantages, but on the other hand it must be remembered that across the inductance L there is always the fixed capacity C_1 of the aerial, and this will prevent us obtaining the same range of wavelength with a given variable condenser as we would have obtained if the capacity C_1 were absent.

Valve users and those who use a loose-coupled transformer will tell you that a much wider range of wavelengths can be obtained with a given coil and a given variable condenser in the anode circuit of a valve, or in the case of a secondary of a loose-coupled transformer than when the same coil and same condenser are used in an aerial circuit, as shown in Fig. 5. We take an extreme case by supposing that the capacity of the aerial C_1 were 1 μF ; obviously any variation of the condenser C_2 having a capacity of 0.0005 μF would produce practically no change in the total capacity across the inductance L, and practically no change in tuning would result. Consequently the larger the capacity of the aerial, the shorter the range of wavelengths obtainable with a given variable condenser connected in parallel with the inductance.

The other important point which forms part of the subject of this article is that when a parallel condenser is employed, as shown in Fig. 5 and Fig. 6, changes in aerials will result in an entire change of the tuning of the circuit. If an aerial of large capacity, for example, is used, the condenser C_1 of Fig. 6 will be large, and consequently the condenser C_2 must be adjusted to a smaller value to give a certain wavelength. If, on the other hand, an aerial of small capacity is used, the condenser C_1 will be small, and C_2 will have to be adjusted to a higher value; consequently the same station might be heard in one case with an adjustment of 5 degrees on the condenser, and in the other case with 100 degrees on the condenser. Where trouble usually begins is when an entire change of coils becomes necessary. If, for example, one is working with a No. 50 honeycomb coil, and the condenser C_2 is adjusted to 5 degrees and an aerial of small capacity is being employed, when the same set is used by another experimenter on a larger aerial having a larger capacity, it is necessary for that experimenter to use a smaller plug-in coil, because he cannot get down to the wavelength on his variable condenser. This change in the plug-in coil will frequently alter the operation of the set, parti-

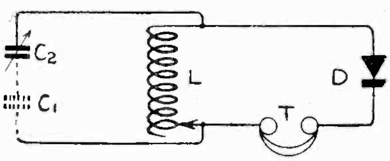


Fig. 8.—The Figure 7 circuit simplified.

cularly when reaction is being used.

With this method of tuning we need a larger number of different sizes of inductance coils or a larger number of tappings than in some of the other cases given in this article.

The arrangement of Fig. 5, however, using a parallel variable condenser, is not nearly as bad as the Fig. 3 type of circuit, or a similar circuit using a variometer instead of the inductance and slider. In the case of Fig. 3 different capacities of aerials produce enormous differences in tuning. That is why I am always suspicious of variometer crystal sets, especially those of home-made construction, because although they may cover the desired band of wavelengths on one aerial, the waveband will be entirely different on another, and may just be outside the station you want to hear.

The Fig. 3 circuit is therefore the worst as regard changing adjustments for different aerials. Fig. 5 comes next. Actual figures are given later in this article.

Series Tuning

Fig. 7 shows the method of tuning an aerial circuit by connecting a variable condenser C_2 in series with the inductance L, across which is connected the crystal detector or the grid circuit of the valve.

Fig. 8 shows how Fig. 7 may be resolved into a simple oscillatory circuit. This time a condenser C_1 represents the aerial capacity, and it will be seen that the variable condenser C_2, which is used for tuning purposes, is connected in series with C_1. The inductance L is now shunted by two condensers in series, whereas in Fig. 6 the two condensers were in parallel. The natural result is that when a series condenser is used, a larger inductance is necessary.

When two condensers are connected in series, as in Fig. 8, they may be replaced by a single condenser, but in order that the capacity should be the same, this condenser would need to have a value of less than the value of either C_1 or C_2.

The equivalent capacity of two condensers in series is found by multiplying the two capacities together and dividing the result by a figure obtained by adding the two capacities together.

As regards efficiency, the series tuning arrangement of Fig. 7 is but little different to the arrangement of Fig. 5 on short wavelengths. When wavelengths above 1,000 metres are being received, the parallel arrangement is much to be preferred, but on the broadcast waveband both methods have their adherents. Valve users will find that greater reaction, and consequently a greater tendency to oscillate, accompanies the use of a

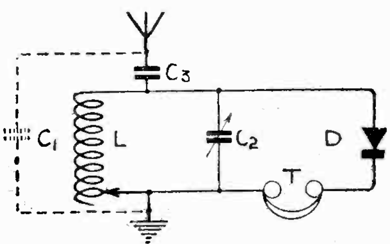


Fig. 9.—The constant aerial tuning system.

series condenser for tuning purposes. When a series condenser is being used, the larger the capacity the better, *i.e.*, use the condenser well up the scale if possible, but exactly the opposite advice must be given with regard to the parallel circuit of Fig. 5.

(To be continued.)

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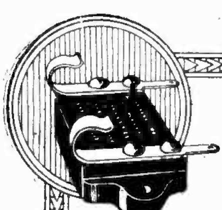
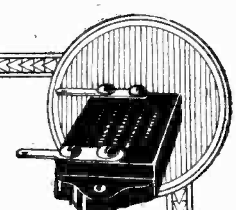


DUBILIER CONDENSERS



Constructional Chats

By PHILIP R. COURSEY, B.Sc.

No. 3.

SOME USES OF CONDENSERS IN A RADIO RECEIVER.

We have dealt with the uses of fixed and variable condensers in the tuning circuits of radio receivers. The fixed condensers employed in the grid circuit of a valve detector and those for the similar use of coupling a tuned anode circuit to the grid of the next valve have very different functions to perform. In addition to proper capacity value, a high insulation resistance is of the greatest importance in these and similar uses. This is particularly the case when the condenser is used for coupling the stages of a radio frequency amplifier, when any leakage would mean the subjection of the valve grid to a considerable positive potential from the high tension battery. This would very much impair its proper working. In general, the capacity value for such use is not critical and any value between 0.00015 to 0.00035 microfarad will meet the requirements. For use in a grid circuit the condenser is called upon to act as a storage of D.C. charge, as it is this action which causes the valve to function as a detector when a grid condenser and leak is used, and it is for this reason that high insulation resistance (i.e., absence of leakage) is important.

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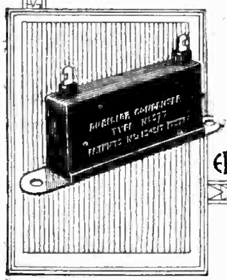

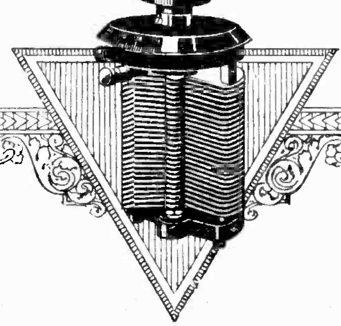

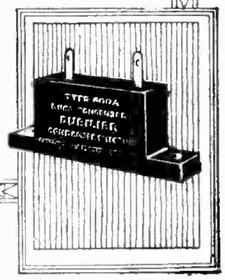

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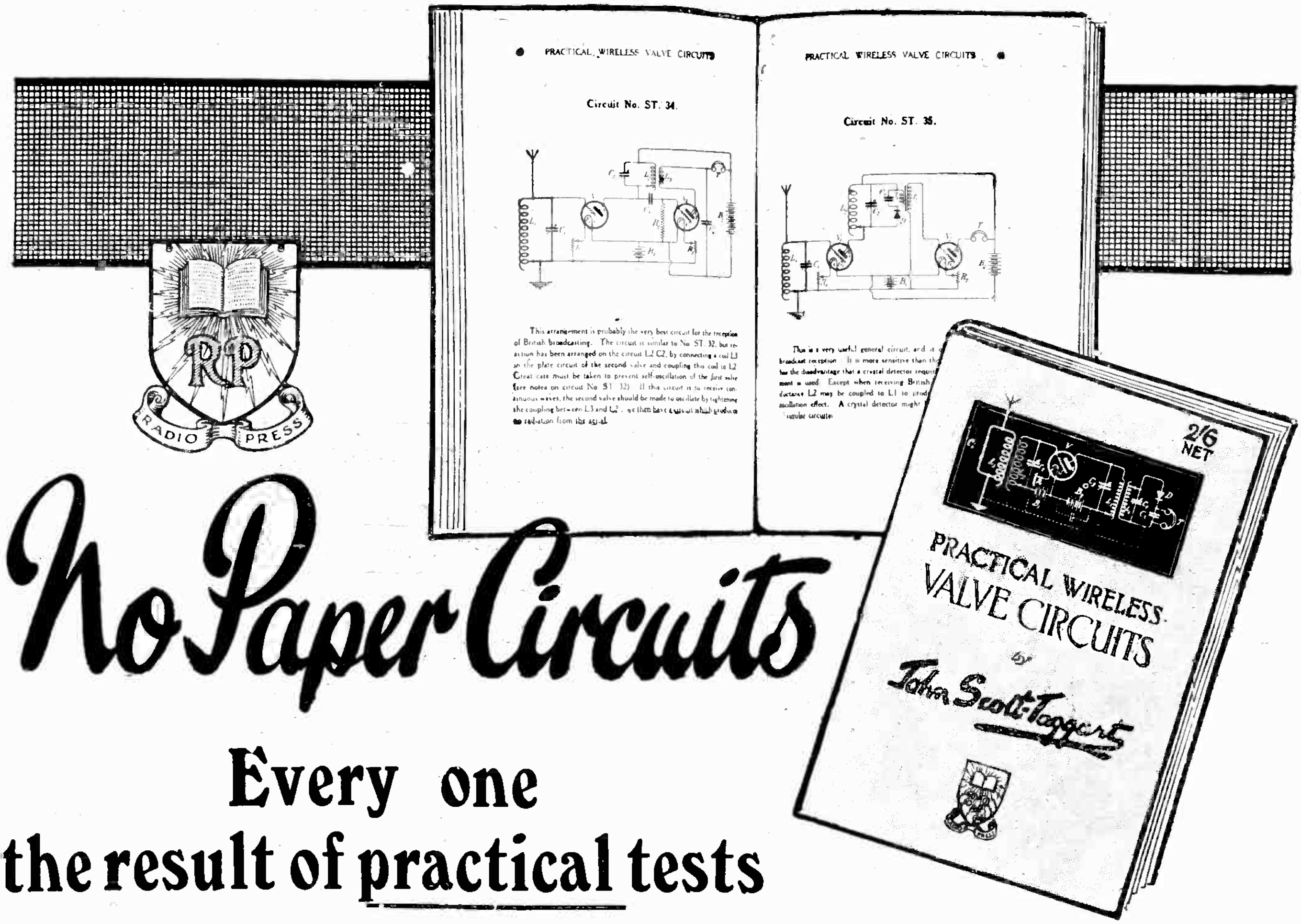

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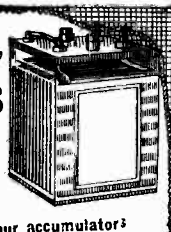

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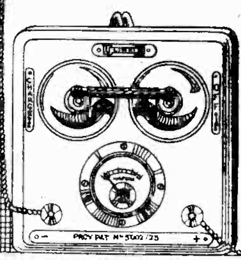

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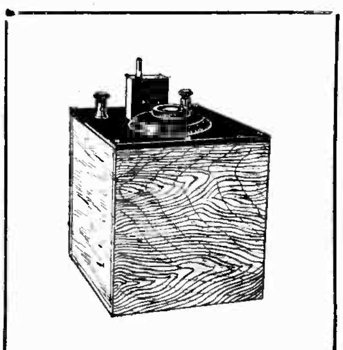

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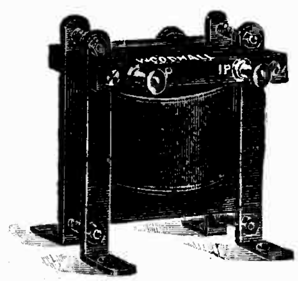

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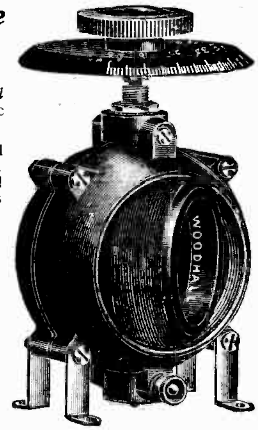

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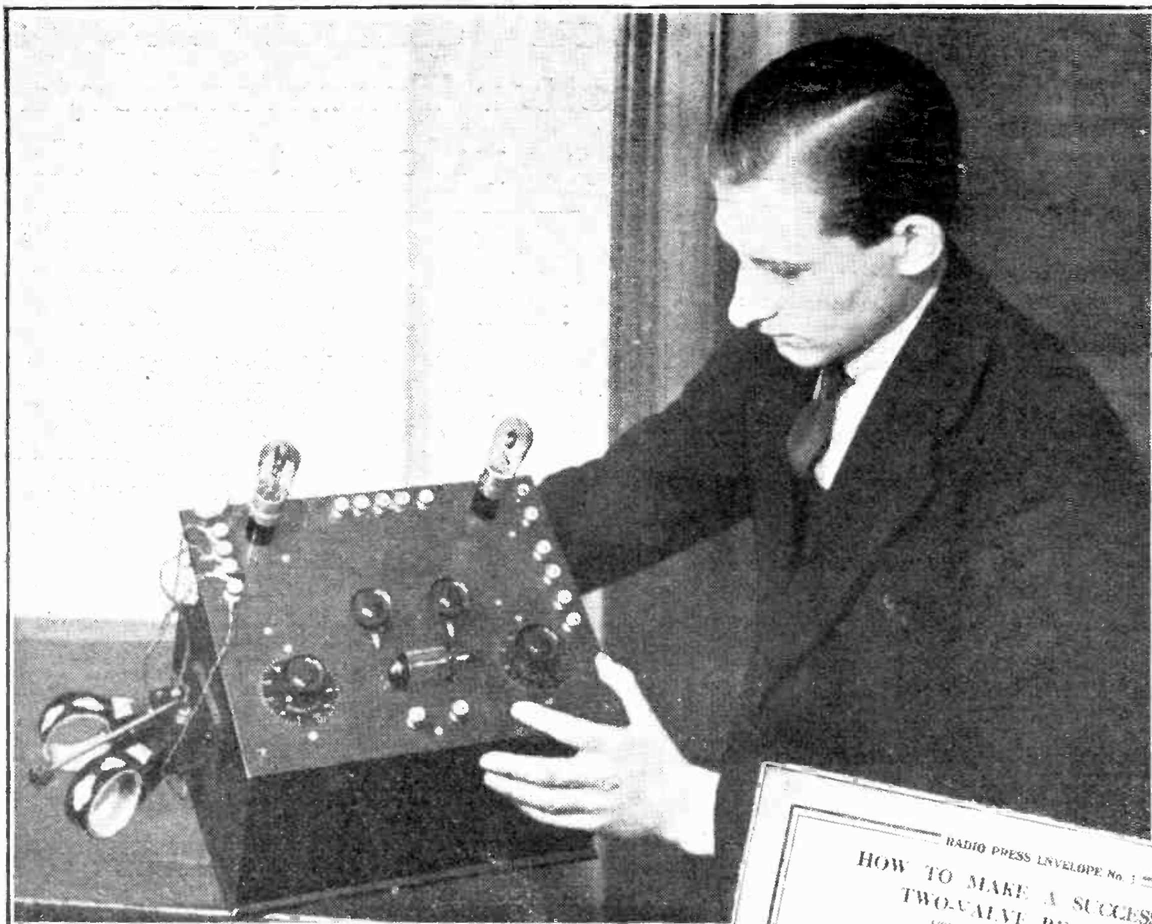
To mount on panel, you need to drill *one hole only*, and lock the nut on the surface of the panel. For board mounting, four brackets are supplied, which allow the Variometer to be mounted either horizontally or vertically (as illustrated). Price, including Knob and Dial **17/6**

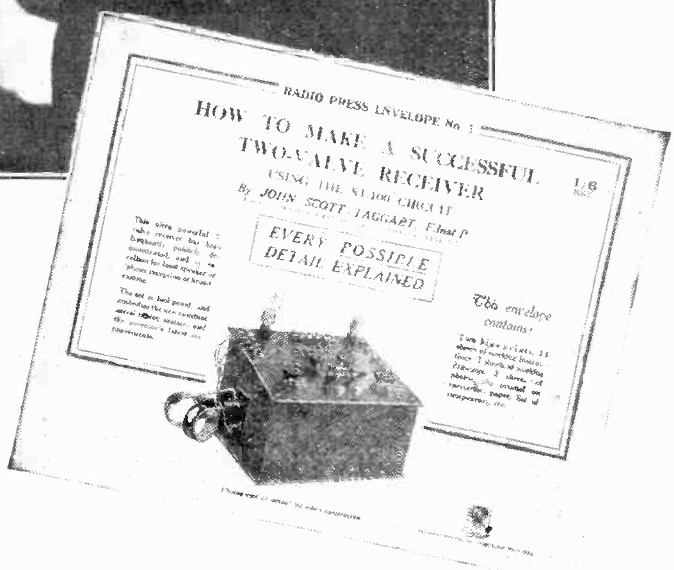
Write for Leaflet giving full descriptions of Woodhall-Wireless Components, Variable Condensers, Fixed Condensers, Rheostats, Detectors, Coil-holders, etc.

WOODHALL-WIRELESS Components are obtainable from any leading Wireless Dealers. Dealers should specify WOODHALL-WIRELESS Components in ordering from their usual Factors or Wholesale Distributors.

In any case of difficulty in obtaining, Experimenters or Dealers should communicate with

The Woodhall-Wireless Mfg. Co.,
55, Cardington Street, Euston, N.W.1
Telephone: Museum 8566. Wholesale only.





Full instructions for building this fine S.T. 100 Set:

THE tremendous success which followed the publication of constructional articles dealing with the S.T. 100 Circuit and the heavy demand from our readers for further articles on the same subject, has led us to place on the market an Envelope containing the fullest details about it.

This Envelope can be bought by anyone in full confidence that with the least amount of mechanical ability he can build a really first-class Receiver—similar in every respect to the one illustrated above.

But even more important, this Envelope contains working hints and instructions which will prove invaluable to anyone operating a Reflex Set for the first time.

We have aimed, in fact, to make the material contained in this Envelope as comprehensive as possible. Why not get one to-day and start building this most fascinating of Receiving Sets?

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SIMPLEX RADIO CHARTS.

WE have just published a further series of envelopes, each of which contains a full size chart for building a Valve Receiver (see below) together with a booklet which explains exactly the components which are required for the construction of the Set.

No. 1.—**A Two-Valve Receiver** 1/-
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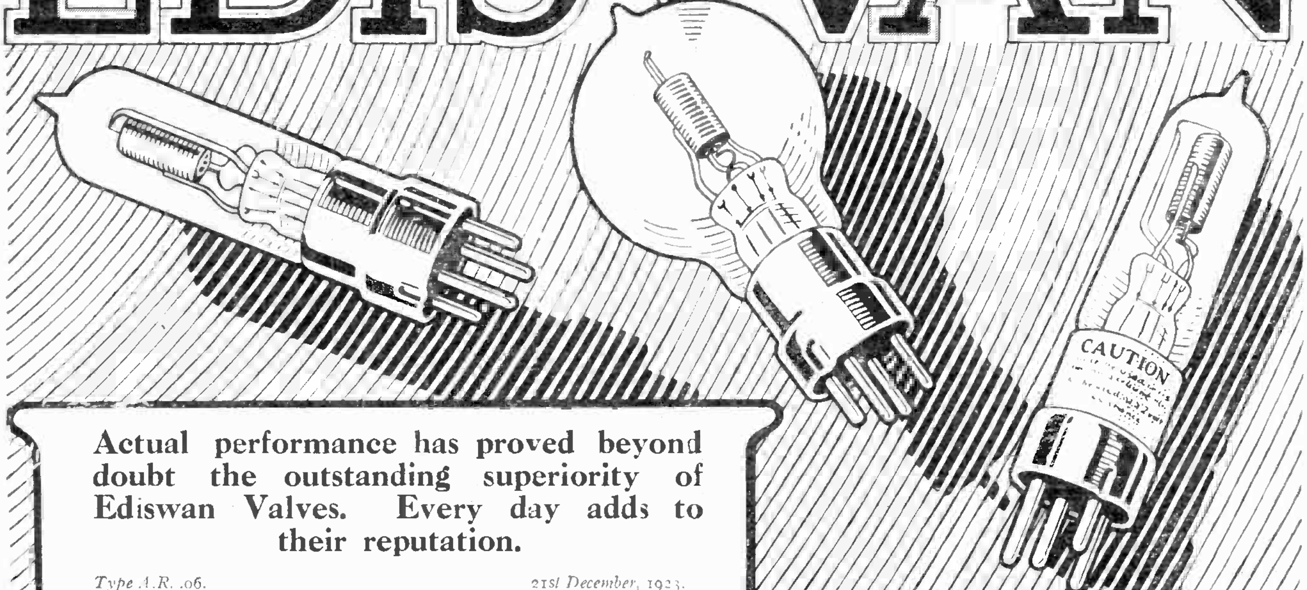
EDISWAN



Actual performance has proved beyond doubt the outstanding superiority of Ediswan Valves. Every day adds to their reputation.

Type A.R. .06. *21st December, 1923.*

Allow me to compliment you on the excellent performance and satisfaction which they give. Using three valves, 1 H.F.D., 1 L.F., with filament voltage 2.5 and plate voltage 50, I can receive all the B.B.C. stations on a large loud-speaker without any distortion or microphonic effect from the valves.

FRANK S. VALENTINE,
Hon. Sec. Exeter and District Wireless Society.

Tring, Herts.
23rd December, 1923.

I received the full Dance Programme this morning from WGY. The set is a home-constructed one, 3 Valves, 1 D. and 2 L.F., and I am using "Ediswan" "A.R." Valves. I have previously tried three times to pick up American Stations with other well-known makes of valves, but did not meet with any measure of success. I received this morning results on both 'phones and loud-speaker, and, considering the fact that I did not employ High Frequency. I cannot speak too highly of your "A.R." Valves, for it is to these that I acknowledge my success.

R. J. KETTLE.

Type "A.R." & "R." 12/6

Type "A.R.D.E." 21/-

(Dull Emitter)

Type "A.R. .06" 30/-

THE LATEST DULL EMITTER.

This Valve can be run off dry cells, reducing upkeep costs to a minimum. The current consumption at a filament voltage of 2.5 is only .06 of an ampere.

Have you had your FREE copy of Illustrated Booklet, "The Thermionic Valve"? If not, send a postcard to-day.

Your Dealer holds stocks to supply you. If not, write us direct, giving his name and address.

THE EDISON SWAN ELECTRIC CO., LTD.,

123/125, Queen Victoria St., E.C.4, and 71, Victoria St., S.W.1.
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Contractors to H.M. Admiralty, War Office, Royal Air Force.

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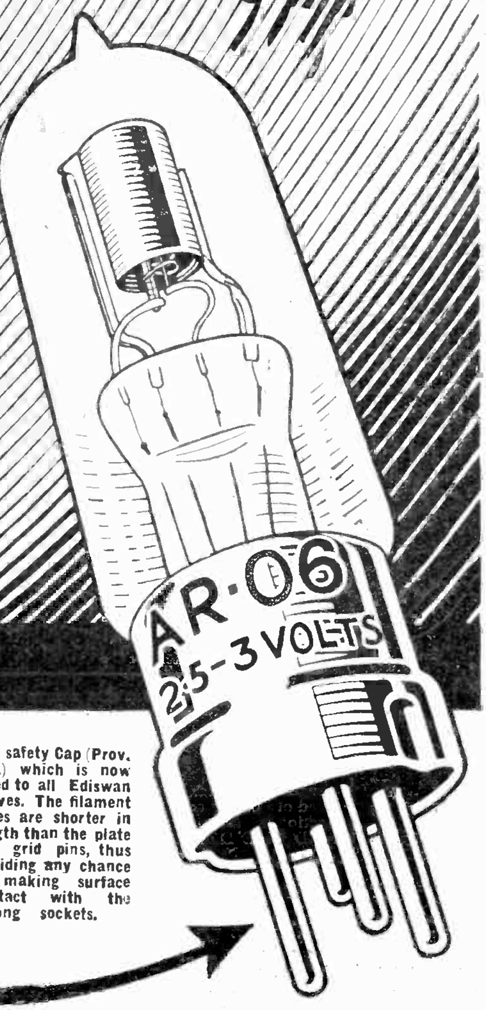

The safety Cap (Prov. Pat.) which is now fitted to all Ediswan Valves. The filament pines are shorter in length than the plate and grid pins, thus avoiding any chance of making surface contact with the wrong sockets.

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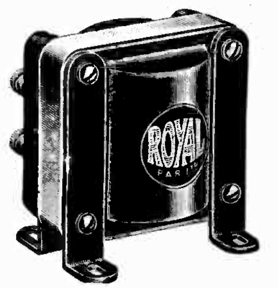
is astonishing

The "Royal" Intervalve Low Frequency Super-TRANSFORMER

VOLUME WITHOUT DISTORTION.



The outcome of eight years' intensive research work.

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Can you get that Tone Purity you desire. Why not have the Latest and Best?

"Royal" **TRANSFORMERS give wonderful results on all the latest Reflex Circuits.**

LIST PRICE £1 : 0 : 0 each.

2⅝ in. high x 2⅜ in. wide x 1⅞ in. deep over all. Nominal ration 4½ to 1.

EVERY FEATURE of the design of this transformer sets it apart as a superior product. High-grade silicon alloy steel is used for the core; the windings are VACUUM IMPREGNATED; a metallic shield covers the general assembly, preventing any effect from near-by wiring. Convenience as well as safety is served in this transformer by the wide separation of the terminal blocks, which are made of CETEC, a high dielectric moulded composition developed in our own laboratories. This separation not only eliminates any possibility of leakage between terminals, but also permits greater ease in making connections. The transformer is packed in corrugated carton.

Dealers.– "Royal" Transformers are easy to sell because they LOOK THE BEST and ARE THE BEST.

Agencies open in all Provincial Districts and Ireland.

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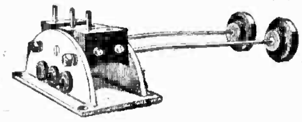

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No.	Prices D.C.C.	per lb. D.S.C.	Enamelled.
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20	2/6	3/9	2/3
22	2/8	3/11	2/6
24	3/4	4/4	2/6
26	4/–	6/6	3/–
28	4/6	7/6	3/4
30	5/4	8/–	3/9
32	7/2	8/6	3/11
34	8/–	8/10	4/4
36	8/6	11/6	4/8

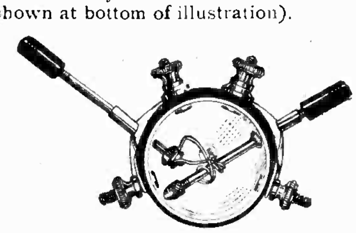
All sizes in stock.
1d. extra for reeling under 1 lb.

ALL TYPES OF VALVES IN STOCK. **All goods sent off same day as ordered.**

Enclose sufficient for postage, extra postage will be returned.

A NOVEL CRYSTAL DETECTOR.

Ebonite casing with Bevel Glass Top, easily removed. Crystal adjustable to all points. Cat-whisker also adjustable. White inside to facilitate adjustment. There are two Tension adjusting screws (shown at bottom of illustration).



5/6

SERIES or PARALLEL or SERIES - PARALLEL

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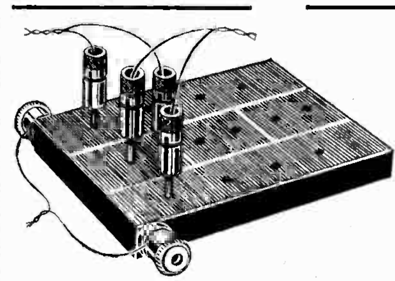
DOMINOE CONNECTOR



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3d. each for KWIKPINS

Trade enquiries invited.

The Spring Contact ensures a firm grip of the KWIKPIN. Yet a change, say, from parallel into series is made in a moment. THE DOMINOE CONNECTOR will save time and trouble and is indispensable to the experimenter. Other applications—such as connecting up cells, condensers, inductances, etc.—in fact wherever the need of a clean, quick, and simple change of connection is present you should use the KWIKPINS AND THE DOMINOE CONNECTOR.

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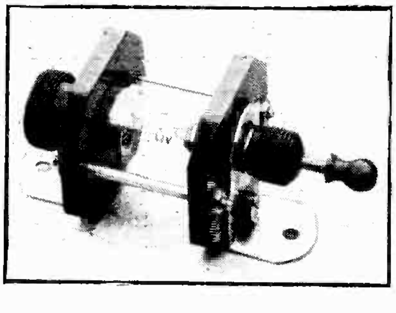
This instrument is micrometrical in principle and ensures a perfectly adjusted and rigid contact between crystal and contactor. By a combination of movements between the three knobs, any portion of the exposed part of the crystal may be contacted. To use one of these detectors is to realise the value of a crystal set. To be obtained at most wireless repositories, or direct of the manufacturers on receipt of 6/– postal order.



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		28	28	28	26	25	Burning Hours.
		33/6	**48/-**	**63/-**	**78/6**	**89/-**	Price.
Type "R" Dull Emitter	..	1 HZ 2	1 HZ 2	1 HZ 3	1 HZ 4	1 HZ 4	Battery Type.
		100	40	40	40	30	Burning Hours.
		17/6	**17/6**	**21/-**	**24/6**	**24/6**	Price.
Pea-Nut Dull Emitter	..	1 DTG	1 HZ 2	1 HZ 2	1 HZ 3	1 HZ 3	Battery Type.
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		5/-	**17/6**	**17/6**	**21/-**	**21/-**	Price.
.06 Amp. Dull Emitter	..	2 DTG	2 DTG	2 DTG	2 DTG	2 DTG	Battery Type.
		290	106	60	38	27	Burning Hours.
		10/-	**10/-**	**10/-**	**10/-**	**10/-**	Price.

Prices are uncharged, without acid, save the DTG type, which is supplied fully charged and needs only acid adding to be ready for service.

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USE CHLORIDE BATTERIES FOR HOUSE LIGHTING.

Brown

Brown Featherweight Headphones shown here turn the scale at just six ounces, including cords. They are, therefore, ideal for ladies and children where weight is an important consideration

Where Light-weight Spells Economy—

THE design of the F. type headphone is the natural outcome of the experience gained during the last few years.

To many Radio enthusiasts comfort and lightweight are the pre-eminent factors in selecting suitable headphones. To this end, therefore, the F. type headphone is shorn of every particle of unnecessary weight—the earpieces are reduced to the smallest practicable size, and, of course, duralumin (an aluminium alloy) is used throughout.

As a result **Brown** F. type headphones, complete with cords, turn the scale at only 6 ozs.—being ideal for ladies and children.

By reducing weight, and simplifying construction, costs of production have also been considerably lowered. Thus it is now possible for you to buy a pair of high-resistance headphones for 25s. which exhibit the same thoroughness of manufacture which characterises all **Brown** products.

4,000 ohms:

25/-

per pair,

120 ohms:
22/6 per pair,

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Wholesale: **Victoria Road, N. Acton, W.3.**

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Featherweight
Brown Headphones

If you have the good *GOODS*, then——

Wireless Weekly

is the *GOOD* medium through which to *SELL THEM*

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reaches both the Trade and the Public

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Notes on the Construction of the "Wireless Weekly" Omni-Circuit Receiver

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

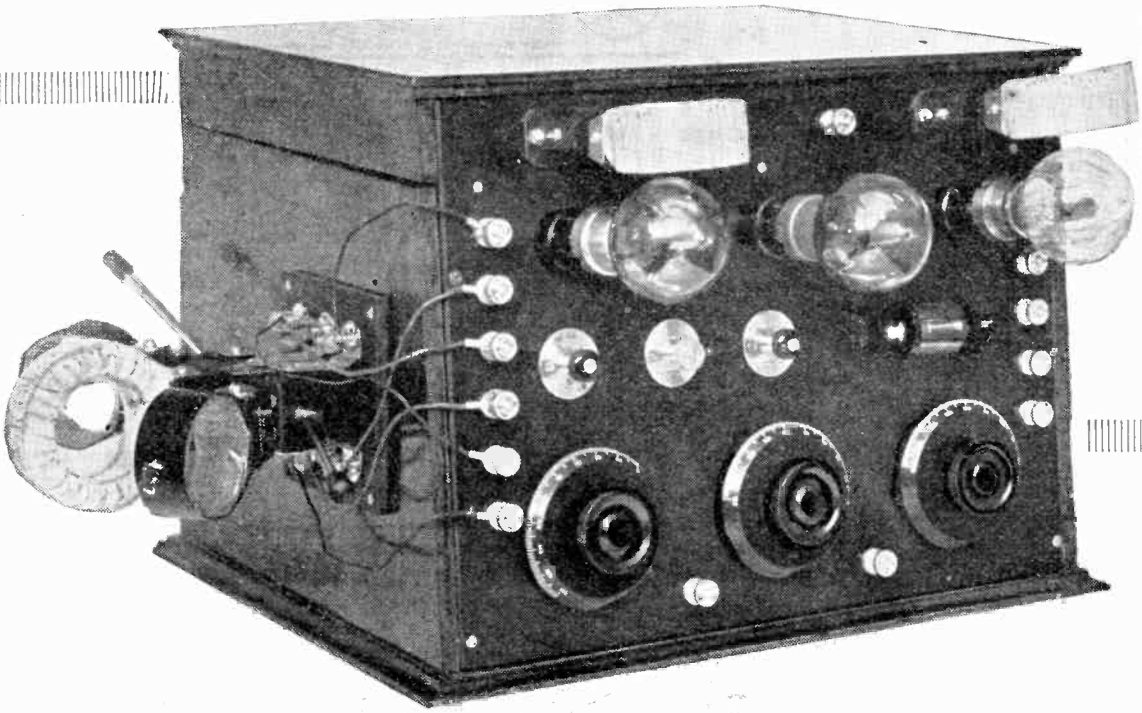


Fig. 1.—The Omni-Circuit Receiver ready for work.

FOR the benefit of the large number of additional readers who will be reading this issue of MODERN WIRELESS, it will only be necessary to explain in a few words the general principle of my "Omni" receiver.

The idea, briefly, is that a terminal board, which may be covered over, has on it a considerable number of terminals, each of which goes to different component parts, which are usually placed behind an ebonite panel. For example, in the case of a variable condenser, the two leads are taken to two terminals on the terminal board. The same is done with all the other components, except the filament connections, which are all joined in parallel, a rheostat being connected in the negative lead to each filament.

The terminal board preferably has drawn on it the conventional signs for the different components, and numbers are given to the various terminals, so that any circuit may be readily wired up by the use of a list simply stating the numbers of the terminals which have to be connected up.

A description of this receiver was first given in *Wireless Weekly*, and it is proposed to give two or three constructional articles in consecutive issues of this weekly journal, commencing with the issue of February 6th. In view, however, of the importance of the receiver, it was thought desirable to give some explanation to those readers of MODERN WIRELESS who have not yet become regular readers of *Wireless Weekly*.

The finished receiver is illustrated at the head of this article, and it will be seen that it presents an ordinary appearance. If, however, the lid is raised, a terminal board will come into view.

This is illustrated in Fig. 3, and the terminal board itself is shown in Fig. 2. It will be seen that the different components have been shown conventionally in the instrument described. The terminal board had secured to it a sheet of paper on which the different conventional signs had been drawn in Indian ink. For the benefit of those who desire to make the "Omni" receiver, a number of printed sheets are available from the offices of the Radio Press, Ltd., at the price of 1s. 6d. each.

It will be noticed that the terminal board has been slightly altered since it was described in the last issue of MODERN WIRELESS. So many readers have written to me stating that they desire to have two transformers in the receiver that I have decided to incorporate one in the set, and this means the provision of two more terminals, numbered 55 and 56, and the removal of the choke coil in the set. Those who desire to use a choke circuit can use the secondary of the transformer, which will work perfectly well. The numbers of the other terminals have not been altered in any way, so that those who have already made the set will not be confused. The

(*Continued on page* 343.)

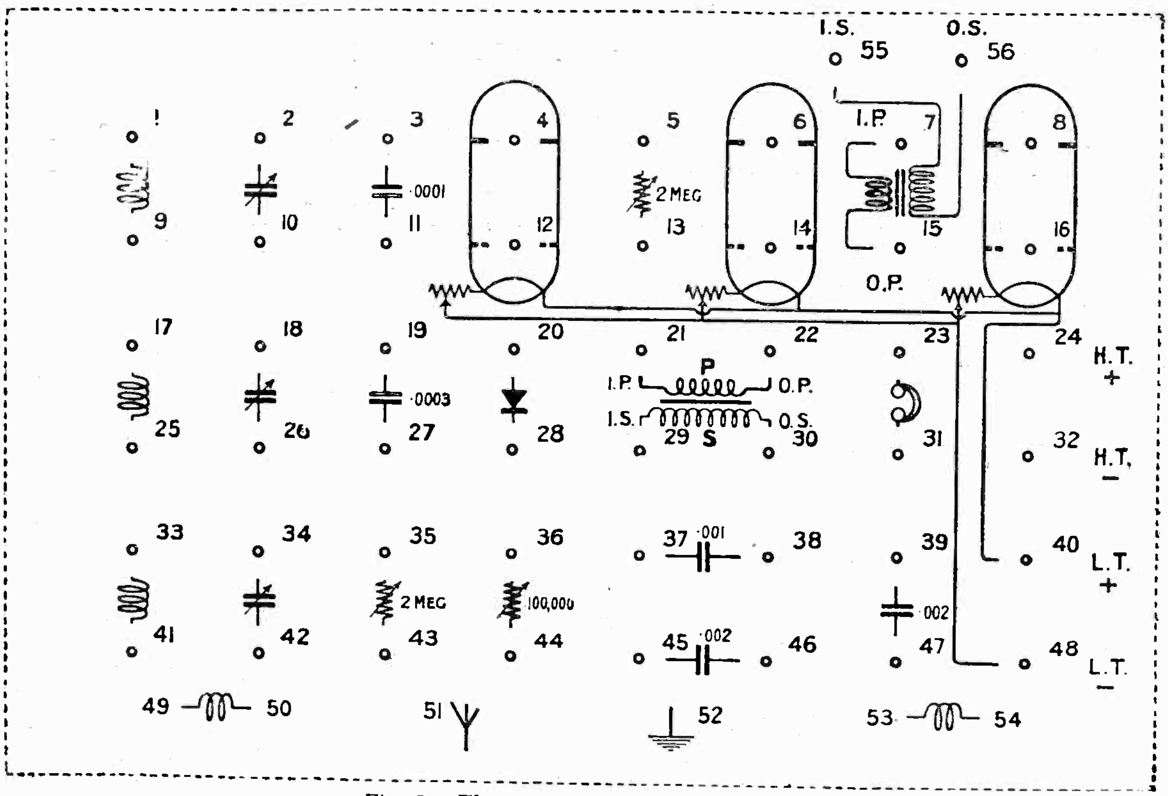


Fig. 2.—The terminal board connections.

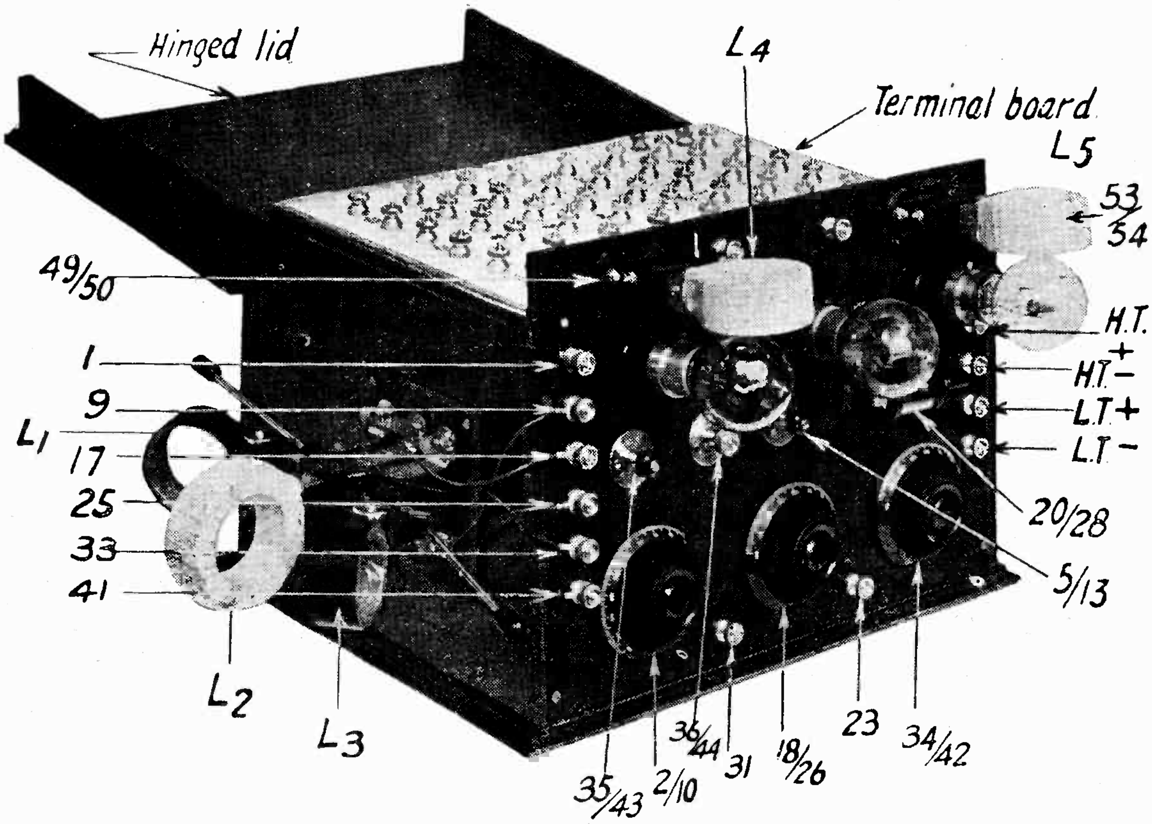
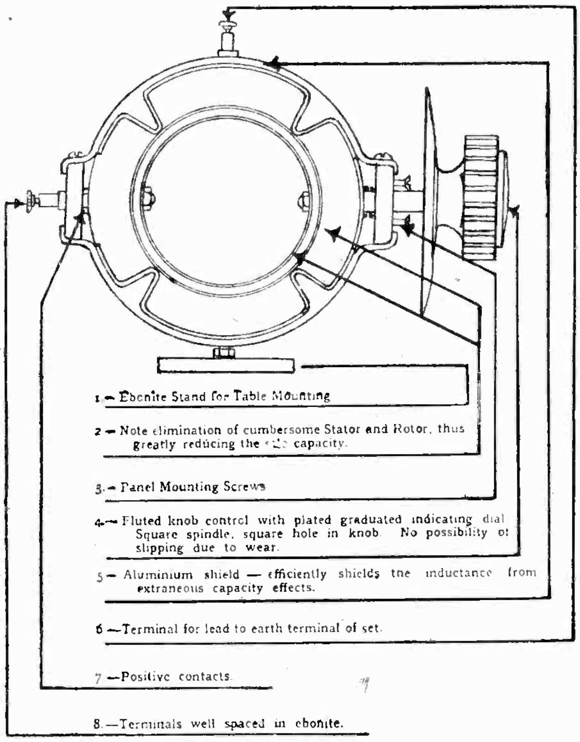
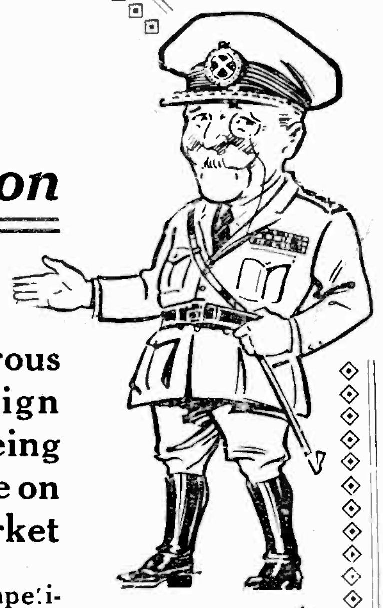


Fig. 3.—A photograph showing the relation of parts to the terminal board connections.



Killing Foreign Competition



There are numerous inefficient foreign Variometers being sold at a low price on the British Market

To overcome this competition, which is doing much to injure both Dealers and their Customers, we are offering the famous G.R.C. 71 Shielded Variometer at half its former price.

General Radio

Proof!

National Physical Laboratory, Teddington.

REPORT ON G.R.C. 71 VARIOMETER.

For: Messrs. General Radio Co., Ltd.

We have measured the Inductance of the Variometer at the scale readings indicated below, using alternating voltage of sine wave form at a frequency of 800 cycles per second. The zero was arbitrarily chosen at the minimum value. The results are given in the following table:

Variometer	Frequency	Temperature	Scale reading	Inductance Int. microhenries
G.R.C. 71	800	16°C	0°	100
			30°	204
			60°	384
			90°	626
			120°	900
			150°	1,094
			180°	1,230

(*Signed*) J. E. PETAVEL, *Director*.

Date, November 5, 1923.
Reference E. 119, 136.

To enable us to do this, we have increased production to the extent that we are now making more Variometers than any other manufacturer.

You can now buy the BEST Variometer at the lowest price.

Complete with full instructions and mounting **15/-** screws, template & various latest circuits.

Guaranteed to be the most efficient Variometer on the market.

RATIO 12·3 to 1.

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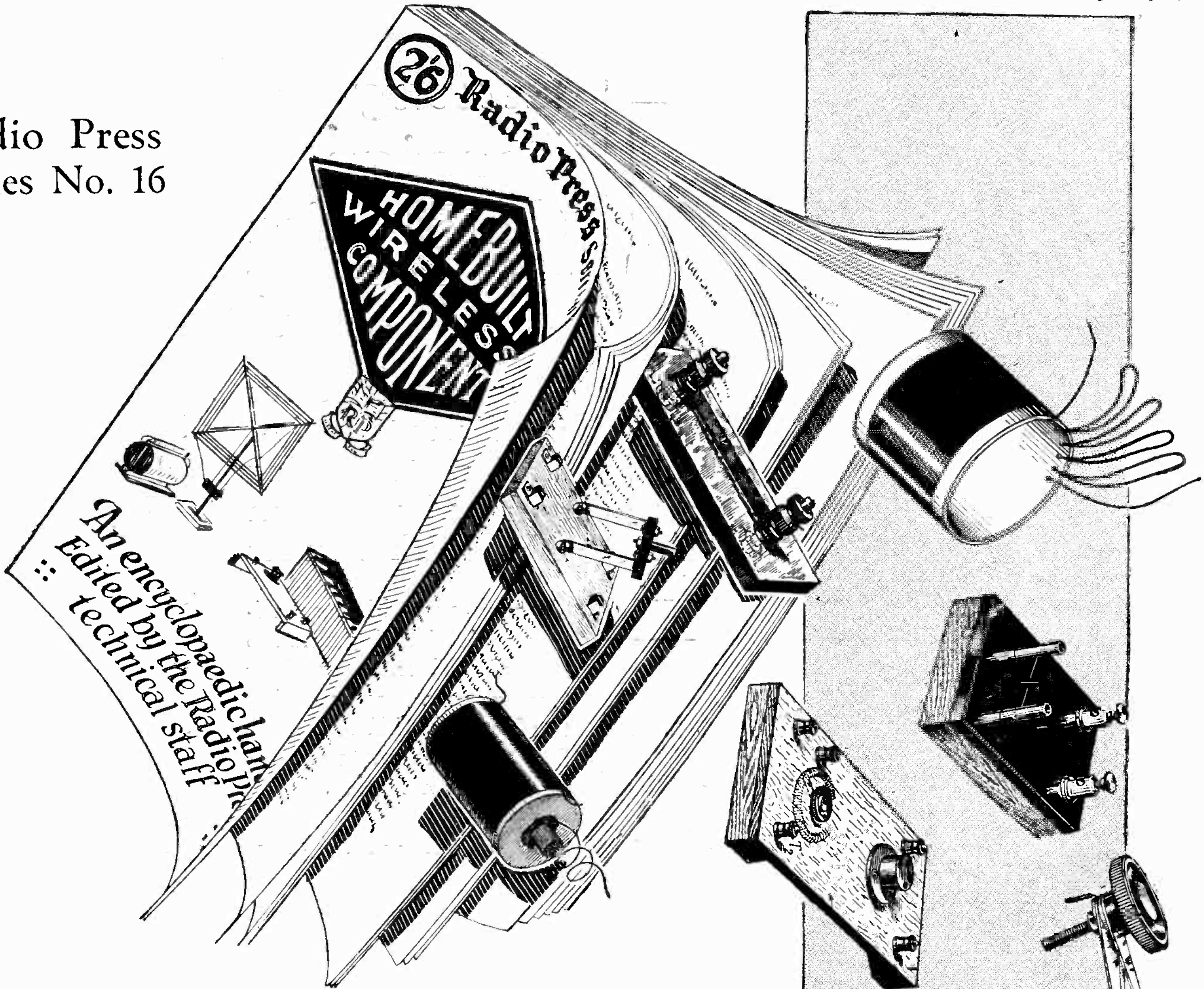
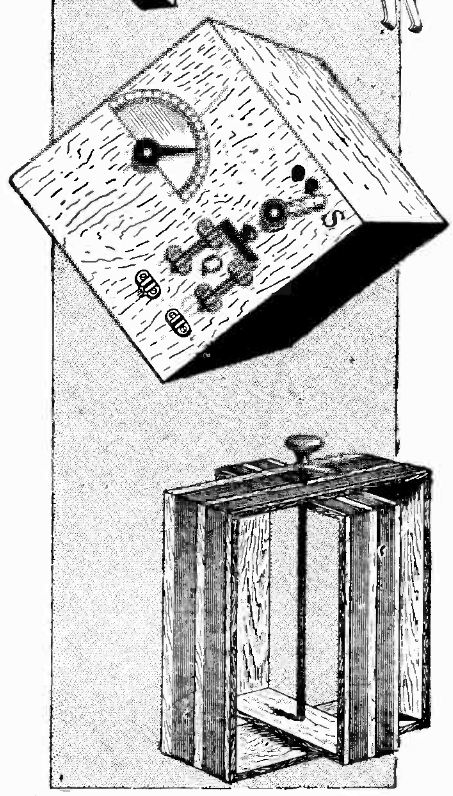


Build all these Components and more besides——

EVERY real wireless enthusiast becomes obsessed with the idea of making his own components. Some he should not attempt, but there are very many which, when made with ordinary care, give practically as good results as factory-made articles.

Some, such as gridleaks, switches, solenoid coils, valve panels, variometers, etc., are shown here and are fully described, with many diagrams, in "Homebuilt Wireless Components."

Why not invest half-a-crown now?—you will probably save more than this on the very first piece of apparatus you make. From all Booksellers, or 2/8, post free, from RADIO PRESS, LTD., Devereux Court, Strand, W.C.2.



Homebuilt Wireless Components

Over 130 pages and **2/6** over 180 diagrams

GILBERT AD.

(Continued from page 339.)

additional transformer is fixed on the bottom of the box, and four flexible leads go to the four corresponding terminal ends on the back of the terminal board.

Components Required.

The components required are as follows:

1 ebonite panel measuring 14in. by 10in.

1 ebonite panel measuring 14in. by $9\frac{1}{4}$in.

3 variable condensers of 0.0005 μF capacity.

2 intervalve transformers.

1 100,000 ohm variable resistance.

2 variable grid-leaks.

68 terminals.

1 0.0001 μF capacity fixed condenser.

1 0.0003 μF capacity fixed condenser.

1 0.001 μF capacity fixed condenser.

2 0.002 μF capacity fixed condensers.

1 three-way coil holder.

2 coil sockets, suitable for fixing to a panel.

3 variable resistances, suitable for dull emitter or ordinary type valves (Lissen type illustrated).

A quantity of No. 16 gauge tinned copper wire.

Assembling the Set.

The first thing to do is to mount the components on the panel which goes in the front of the set. How these components are mounted is shown in Figs. 4 & 5. It will be noticed that nearly all the components require only a single hole fitting, which is, of course, an important advantage. The Lissenstat filament resistances are employed, as these have been found to be very effective in use and suitable for all types of dull-emitter and ordinary valves; thus the general adaptability of the set is increased.

The next thing to do is to fit the terminals on the terminal board, and to add the various fixed condensers, which are most conveniently mounted on this panel. Fig. 7 illustrates the reverse side of the terminal board, showing the arrangement of the condensers. These condensers have legs which may be soldered directly on to the backs of the terminals, which will be found very convenient.

The Next Step.

The next step is to screw the two panels together; Fig. 6 indicates how the front panel is fixed to the terminal board. It will

(Continued on page 347.)

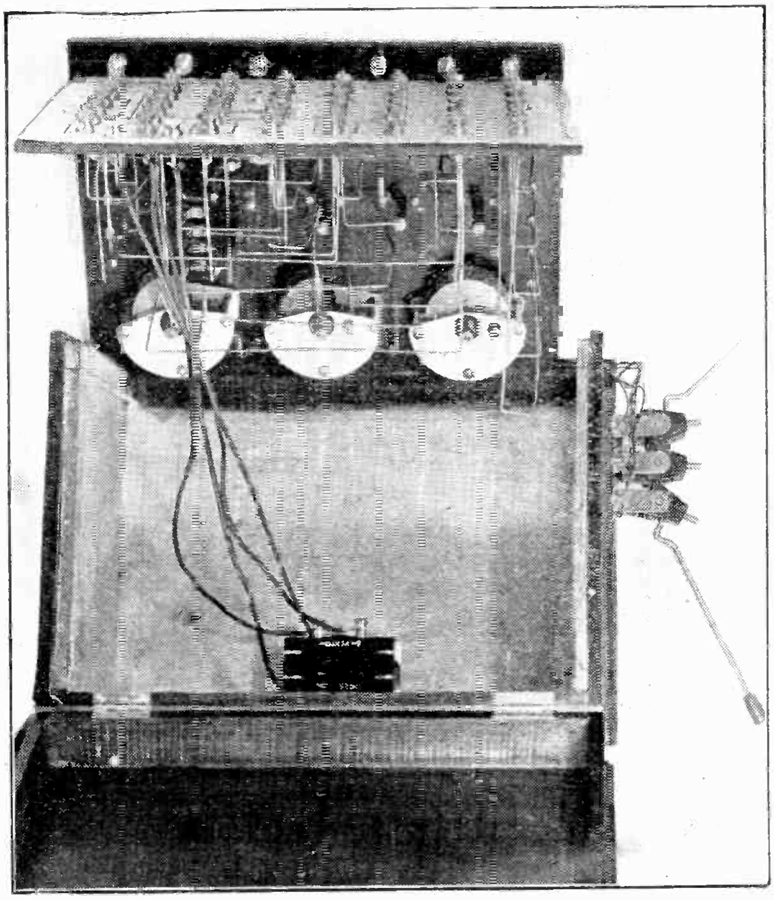


Fig. 4.—The panel removed from the cabinet. Notice the second transformer attached to the base of the cabinet.

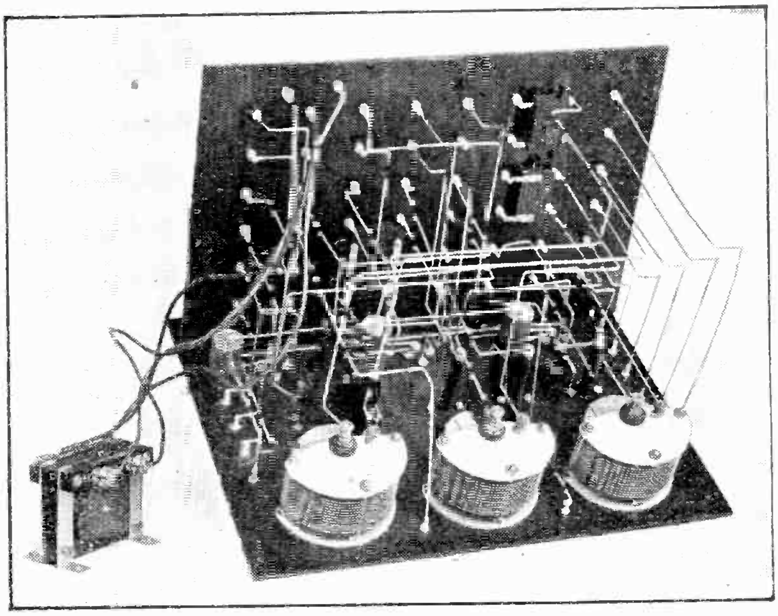


Fig. 5.—Another view of the dismounted instrument. In this case the second transformer has been removed and placed on the left.

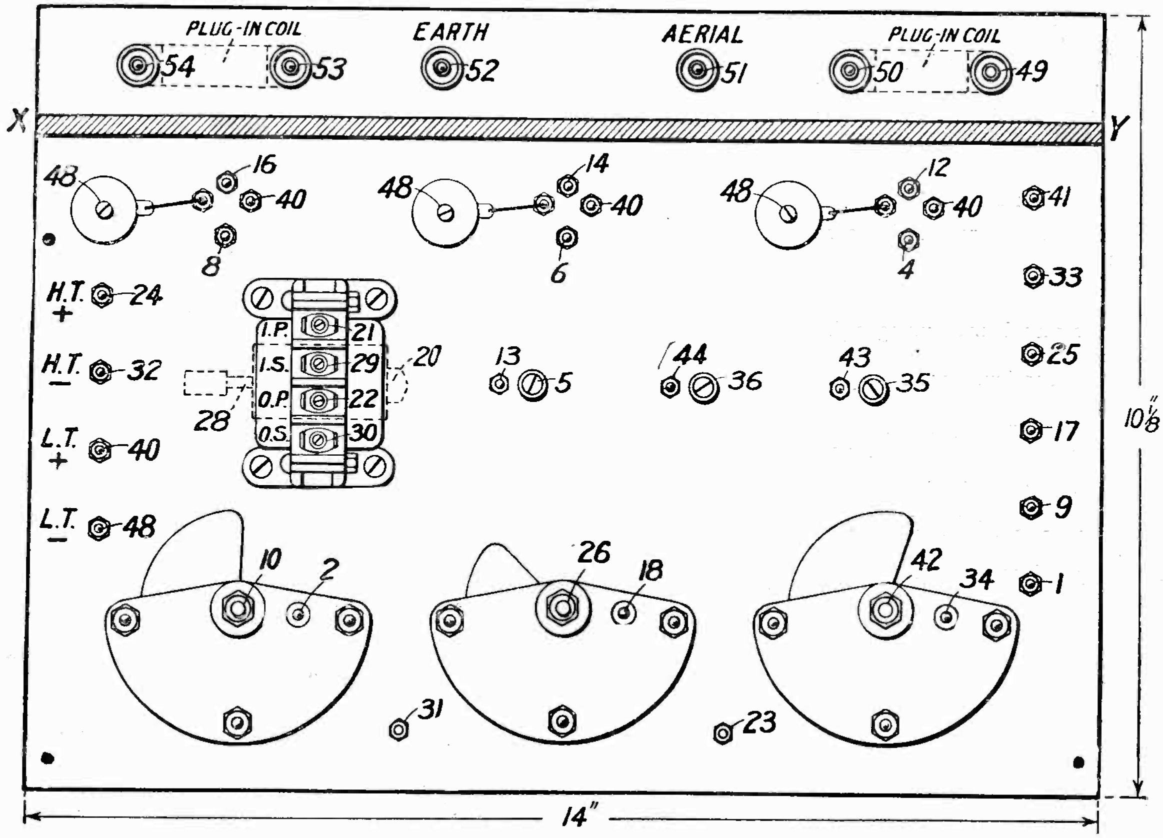


Fig. 6.—Disposition of parts on rear of front panel, showing method of attaching terminal board.

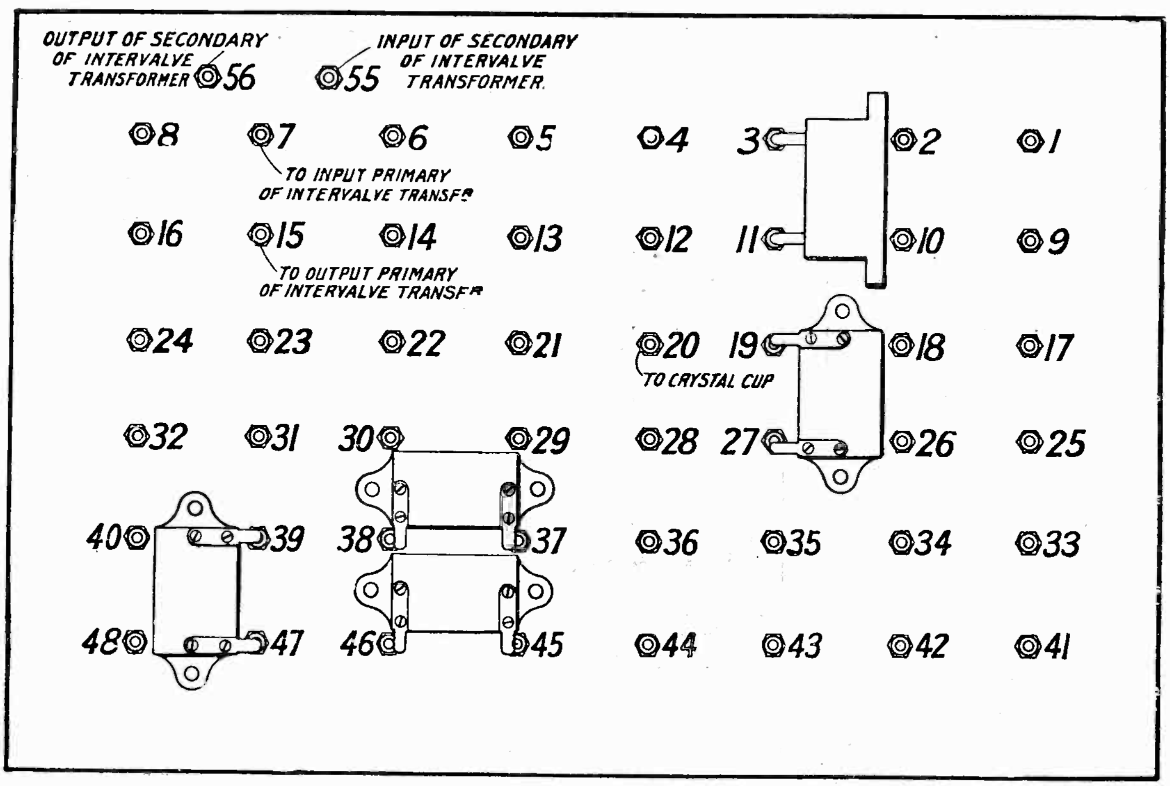


Fig. 7.—Reverse of terminal board, showing method of attaching fixed condensers.

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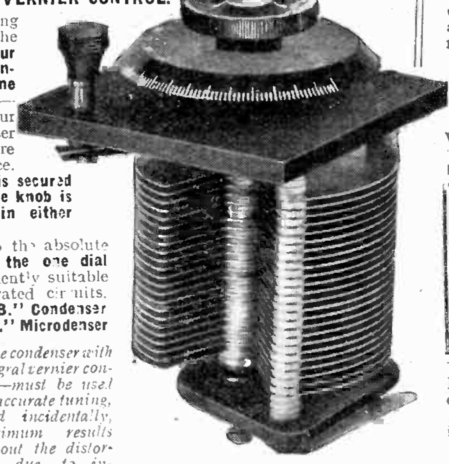

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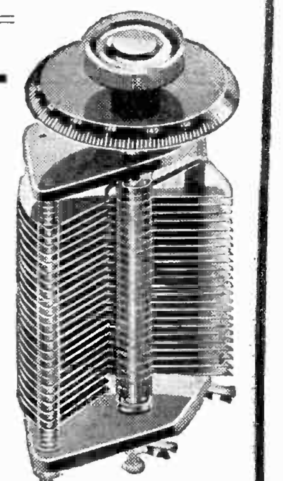

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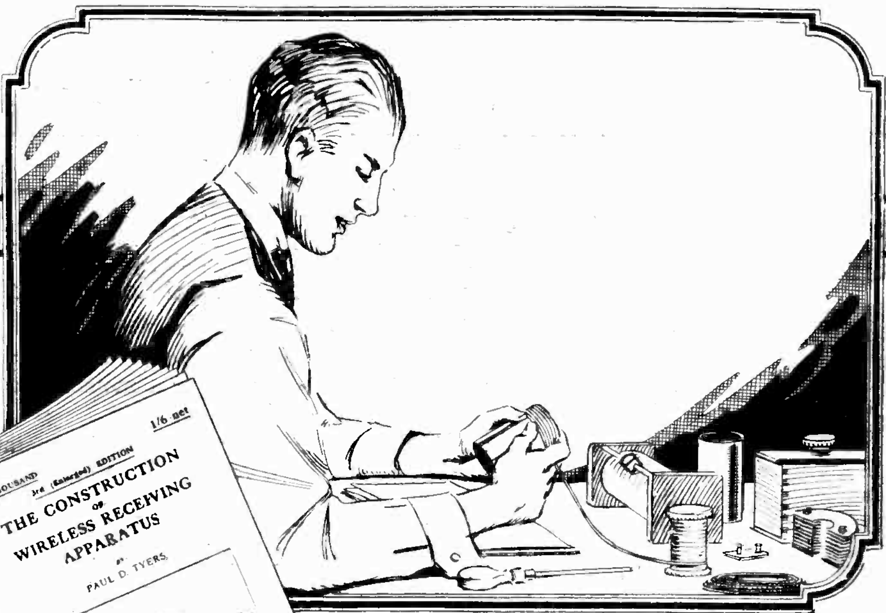

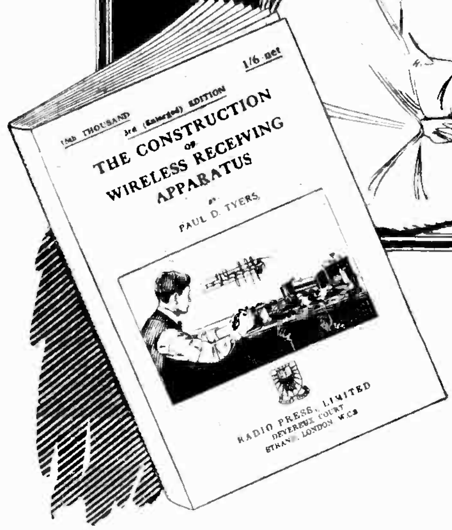

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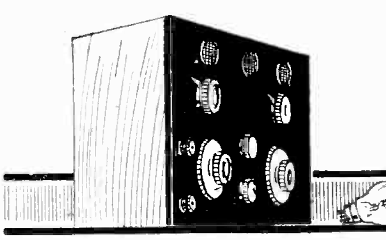
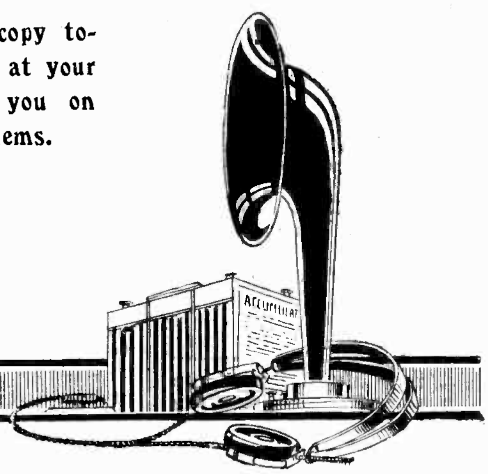




Gilbert Ad.

(Continued from page 343.)

be seen that there is a portion of the front panel which, in the finished instrument, is higher than the level of the terminal board. This is the portion above the line XY in Fig. 6.

Having screwed the two panels together securely by means of three screws, the next process is to wire the components to the corresponding terminals. Fig. 3 gives some indication as to how the terminals are connected, but references to Fig. 4 and Fig. 5 will indicate how the terminals should be connected to the components. It is more a matter of common sense and judgment than anything else. The wires may be soldered, or otherwise secured to the terminals and the components.

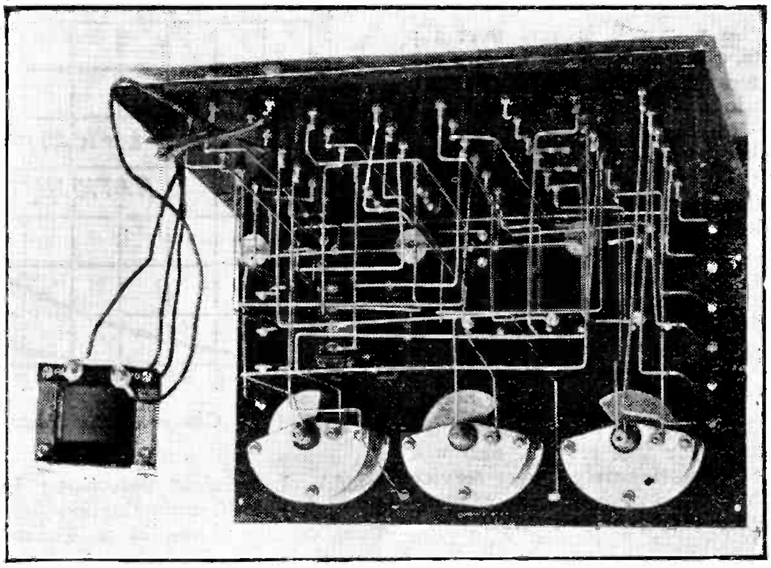


Fig. 8.—The dismounted receiver viewed from another angle.

The Box

The containing box is preferably made of mahogany, but other wood can be used. When the box is ready, the two panels, which are fixed together, are slipped into position and secured by means of screws. The three-way coil holder is now mounted on the left-hand side of the box, as illustrated in Fig. 3. Leads from each of the coils are taken to the three pairs of terminals on the left-hand side of the front panel; these terminals are connected to the terminals, 1, 8, 17, 25, 33 and 41 on the terminal board.

The second intervalve transformer is screwed to the bottom of the box in one corner away from the other transformer. Flexible leads go from this transformer to the underneath of the terminal board.

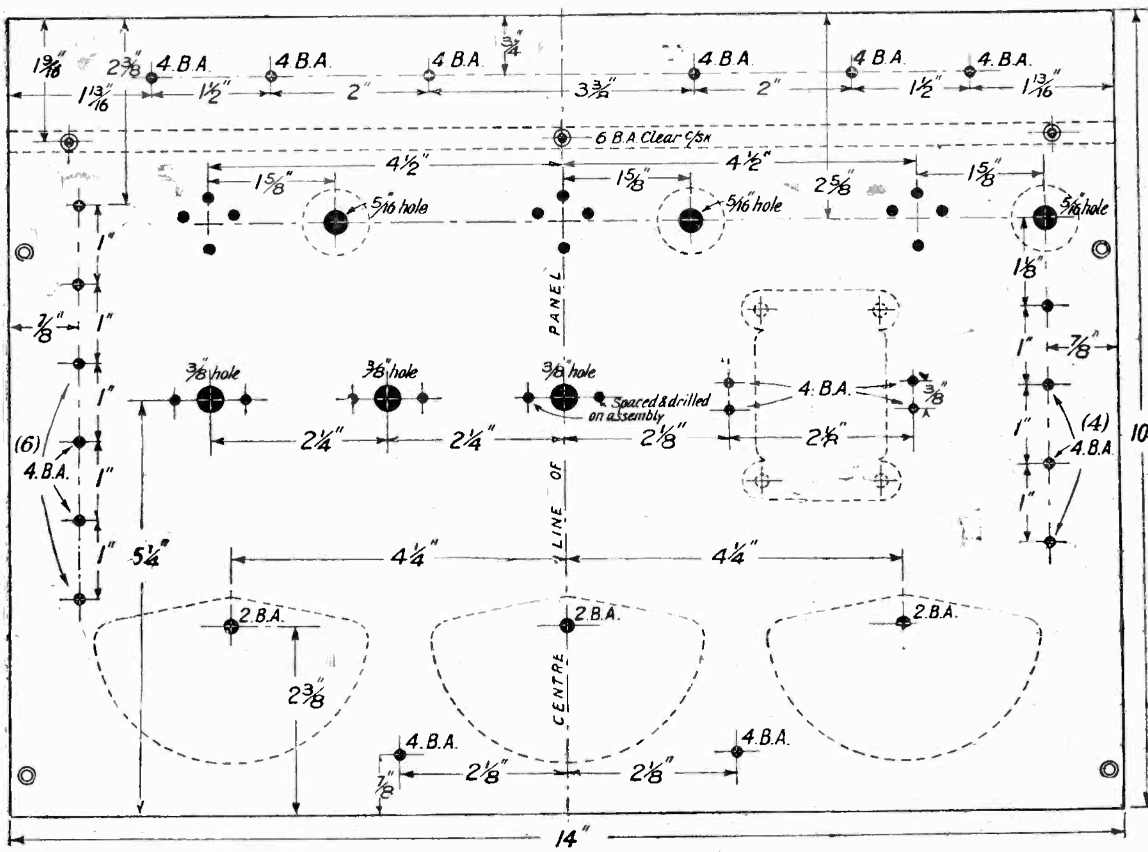


Fig. 9.—Drilling diagram of the front panel.

(*Continued from page* 318.)

of the new cell is just over 1.4 volts, and it gave some 10 amperes on momentary short-circuit, showing low internal resistance. In the course of a thorough and prolonged trial in connection with a pea-nut valve in daily broadcast reception, this cell gave satisfactory and silent service. After some weeks of such use the voltage was still just over 1 volt, and the short circuit current 8 amperes, while there was no sign of dying down or distress whilst supplying the ¼ ampere demanded by the valve.

This large type is eminently suitable for this service, and will give proportionately longer service with the .06 ampere type of dull-emitter valve.

Myers Valves.

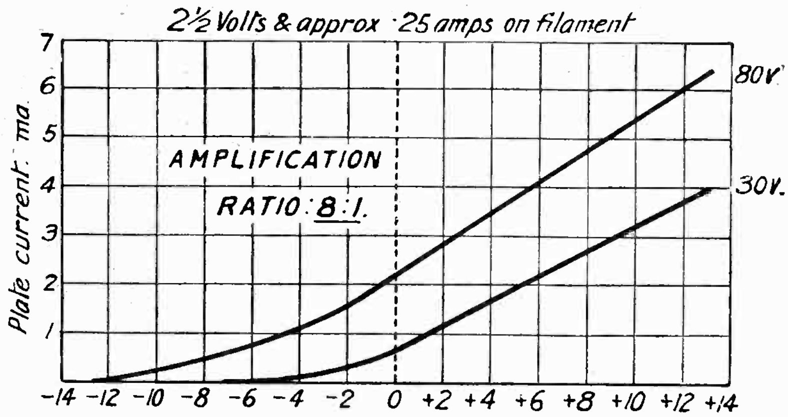
Messrs. Cunningham and Morrison have submitted for test samples of the Canadian Myers Valve, which they are placing on the English market. There are two types: the "Universal," which requires about ¼ ampere and 4 volts on the filament; and the "Dry Battery," which takes about the same current at 2.5 volts, and can therefore be run from two large dry cells in good condition.

Both are of the tubular variety, with grid and anode connections brought out of opposite ends; and are mounted in special clips on the panel. The clips, with drilling template, are supplied with each valve; and it proved an exceedingly easy task to mount the valve, either directly on the panel or on an adaptor made of 1/16 in. ebonite, 4 in. by 1¾ in., to plug into the usual 4-leg socket. The internal capacity of this form of valve, of course, is sensibly less than that of the more usual form, which makes these valves the more valuable for H.F. amplification on the short waves.

The characteristic curves, as determined by the writer, showed in each case a long straight portion with moderate plate voltage, and a remarkably high filament emission. The amplification factor was around 8: quite a satisfactory figure. The curves indicated good amplification with normal plate voltage and small or zero grid bias.

On test in actual reception, no signs of distress were noticed with the highest plate voltage that was available. (The makers claim that up to 300 volts can be used.) In straight detection; in H.F. and L.F. amplification; in dual circuits; and in a "super" circuit, both types operated admirably and gave the impression of high power. With the "Universal" type, reception of local broadcasting on a single valve with reaction was uncomfortably noisy; in one test with the other type, running it from two dry cells with 50 volts H.T, the Paris École Supérieure transmission was picked up easily in London on an Armstrong fliver circuit with "capacity" aerial alone.

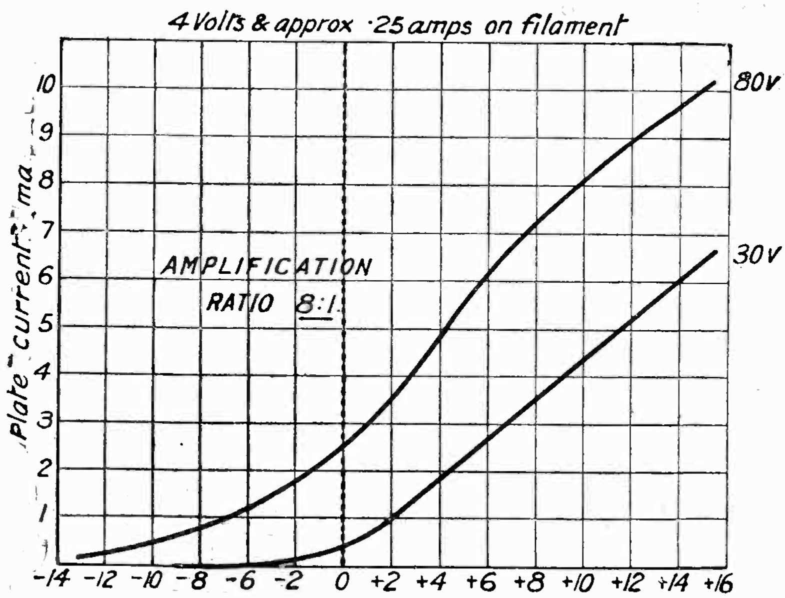
Microphonic effects are but slight. As the valve is of most sturdy construction as well as very compact, it is eminently suitable for portable sets, using dry batteries for L.T. Actually, the 2½ volts type was deliberately thrown on the table several times and exceedingly roughly treated before the characteristic was determined in order to test this point. No bulbous type of valve would have survived this treatment. The unusually high plate current available in the 4-volt type promises a useful application in power amplifiers.



Characteristic curve of dry battery valves.

A Telephone Head-Set.

Messrs. Ediswan Electric Company, Ltd., have submitted for test a telephone headset of 4,000 ohms total resistance. This has the usual double steel band with sliding adjustment and universal joint mounting of the receivers, but is unusually free from projections which catch in the hair. On trial it proved comfortable to wear and easily adjusted. The cords are of ample length and the positive end is clearly marked. In actual use the 'phones proved to be really sensitive both in crystal and valve reception.



Characteristic of "Universal" valve.

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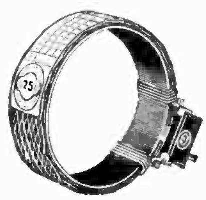

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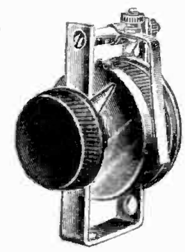

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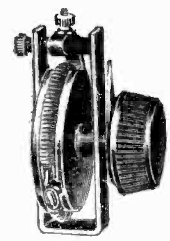

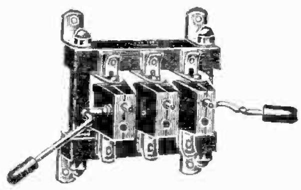

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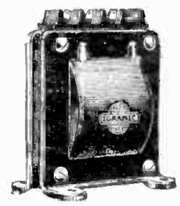
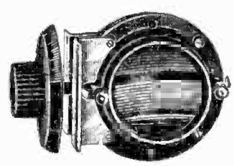
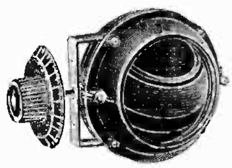




Type H.



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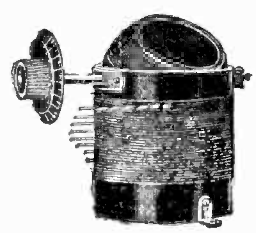

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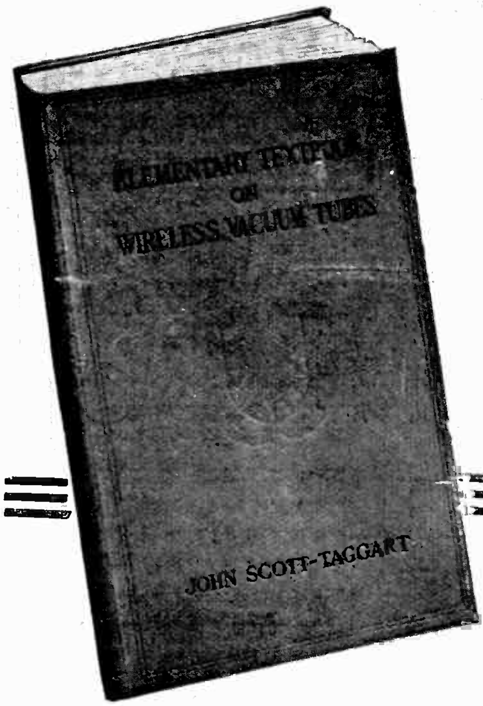

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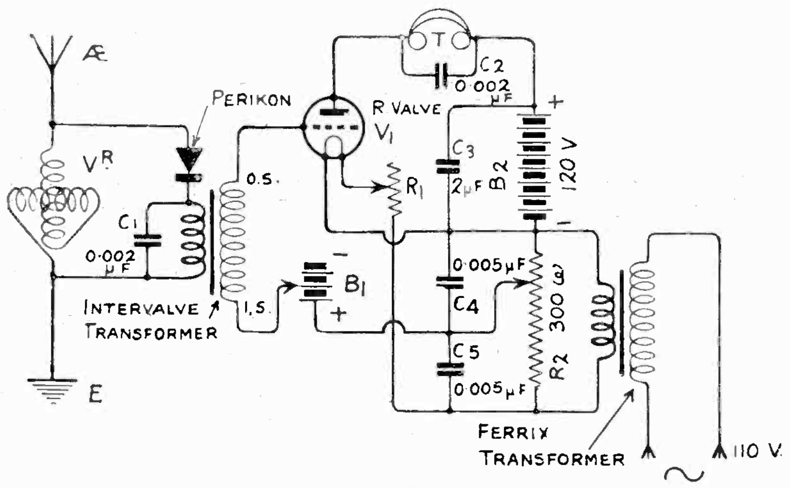
Lighting Valve Filaments off A.C. Mains

By A. D. COWPER, M.Sc., Staff Editor

This article explains how, in certain circumstances, low-tension batteries can be entirely dispensed with.

FOR those who have continuous-current electric-light mains in their houses, the problem of supplying the necessary current for lighting the valve-filaments is comparatively simple—a charging-board with a plain lamp-resistance in series with the accumulator is all that is necessary (if the rather high cost of this method is ignored) or if the lamp is put to other use at the same time, the cost of the current is not chargeable to Radio.

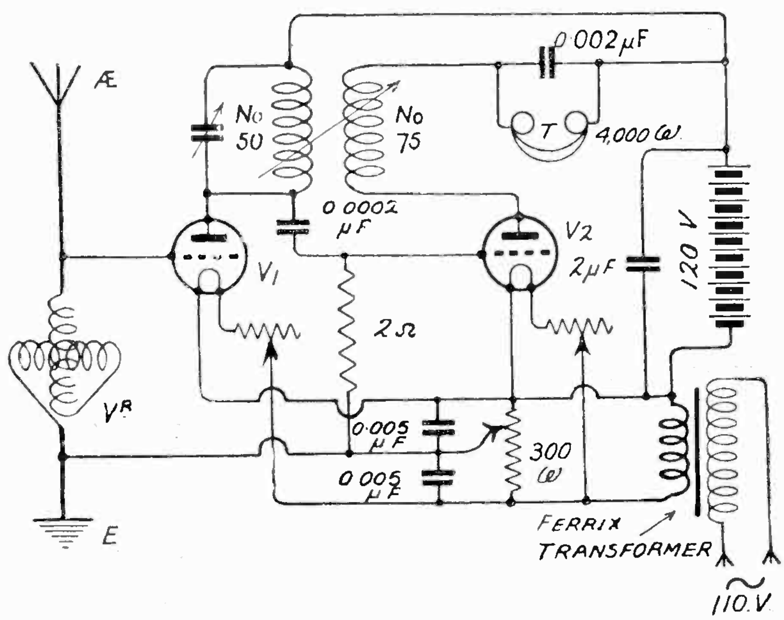
But with an A.C. supply, there is no such simple method available: some sort of rectifier or converter is necessary, so that accumulators can be charged by rectified current. The efficiency of such devices is often small, and the cost of all is such as to be almost prohibitive for the single-valve man. We will not enter into the dubious field of discussion of the relative merits of different rectifying devices: the method indicated here is one that has been tried a good deal in the States, where domestic A.C. supply is very common and radio installations universal. It is the old trick of putting a potentiometer across secondary of a step-down A.C. transformer, and finding the effective "zero" point for use as an earth connection and grid-connection point. Any necessary grid-bias is then obtained by grid-cells. The small transformer used in these tests was the "Ferrix," reference to which is made in the "Apparatus We Have Tested" page. It gave several amperes at over 6 volts in the combined secondary, the primary being wound for 110 volt A.C. mains, from which it drew about the same amount of power as an ordinary lamp, when in operation. Accordingly, the cost of running is extremely moderate; and of course no accumulator is needed.



A crystal set with single-valve note magnifier.

On actual trial on broadcast reception at a dozen miles from 2LO with detector valve alone without reaction, the A.C. hum was as loud as the signals, with optimum adjustment of the potentiometer. The latter was bridged for H.F. currents by two .005 μF condensers (of Grafton Electric Co.'s make), one on each side.

A conventional B.B.C. type of receiver circuit, one H.F. and detector, tuned plate coupling, and reaction from the detector-valve anode circuit on the tuned plate (plug-in duo-lateral coils being used, in a 2-coil stand) was set up and by careful adjustment of potentiometer and filament resistances, with two R valves and



A two-valve broadcast receiver worked from the mains.

filaments fairly bright, it was possible (by critical adjustment of the reaction up to just on the oscillating point) to tune out the hum almost completely, so that (with fair aerial and efficient variometer tuning) a very satisfactory measure of loud-speaking was obtained, audible all over the house; whilst the A.C. hum was inaudible a few feet away from the loud-speaker (small claritone).

With detector-valve and note magnifier, the hum was excessive, so that no grid bias could be used.

A trial was then made with one valve as note-magnifier following a particularly efficient variometer crystal-tuner and perikon crystal, using an R valve with 120 volts on the plate and bright filament. Some 4-volts negative grid-bias was used (grid-cells connected to potentiometer "zero-point"), applied through the L.F. intervalve type of transformer linking crystal and valve, and good enough loud-speaking was obtained for one or two listeners in a quiet room, without an amount of hum that was actually objectionable.

For regular broadcast reception on the loud-speaker of the local station, there is very evidently an opening for a self-contained set with fixed adjustments for operation off the A.C. mains; the method, however, does not recommend itself for long-distance reception on the head-phones.

Note.—A slight improvement might result if the H.T. minus were attached to the potentiometer zero-point instead of to one side of the transformer secondary; it was not considered worth the extra complication in these tests.

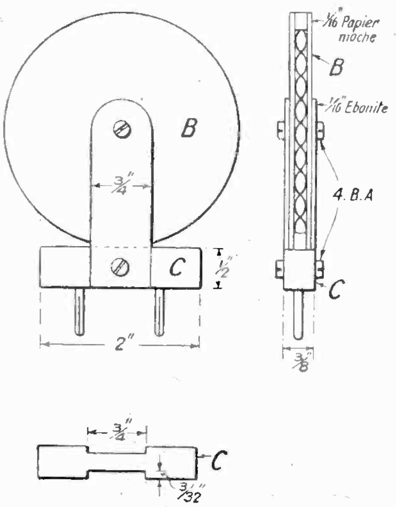
Basket Coil Holders.

By C. C. PEET.

BASKET coils are one of the cheapest forms of tuning inductances, and in the author's experience are very efficient for telephony on wave-lengths below 5,000 metres. The great drawback of this form of inductance is its mechanical weakness and the difficulty of fixing to quick change mountings. The method of mounting here described overcomes both these difficulties, and should be within the scope of any experimenter fairly handy with his tools.

The figure shows the complete arrangement of the holder. The bases C are cut from a piece of ebonite 2 in. wide and $\frac{3}{8}$ in. thick, and of length according to number of holders to be made, always remembering to leave extra for saw cuts and filing. The ebonite uprights are fitted tight into slots cut across base C as shown in the figure. Mark out your slot and cut with a hack saw just inside the lines to the required depth, removing the ebonite by means of the edge of a coarse file. These uprights are also kept in position by means of a 4B.A. bolt passing through the lot as shown. B in figure are protecting sides cut from $\frac{1}{16}$ in. thick papiermache by means of large scissors; they must be cut to a diameter $\frac{1}{2}$ in. larger than the corresponding coil. Another 4B.A. bolt passes through the ebonite sides, through the papiermache circles and through the centre hole of the coil, but this must not be put in until the coil has been placed in position, and it will be found easier to slack back the lower 4B.A. nut and open the ebonite sides before introducing the coil.

The pins in base C are ordinary split valve pins threaded into the ebonite, a nut being first tightened up on to the plane part and a washer introduced. The connections from the coil come down each side of the ebonite upright



Constructional Details.

under these washers. The length of the uprights varies according to the coil to be mounted, and should be equal to radius of coil plus $1\frac{1}{4}$ in. To those who would wind their own coils, a good set of seven can be made up by using eleven $\frac{3}{32}$ in. diameter pins fixed equidistant round the circumference of a $\frac{3}{4}$ in. diameter rod, and winding to the following diameters with No. 32S.W.G. D.C.C. wire. (1) $1\frac{1}{2}$ in. (2) $1\frac{3}{4}$ in. (3) 2 in. (4) $2\frac{1}{2}$ in. (5) $2\frac{7}{8}$ in. (6) $3\frac{1}{2}$ in. (7) $4\frac{1}{4}$ in.

These can be wound with 2 oz. of above gauge, and remember to shake quite free of all excess paraffin wax as the papiermache sides maintain the strength of coil. Material required for holders for above set:

Papiermache 16 in. × 10 in. × $\frac{1}{16}$ in.

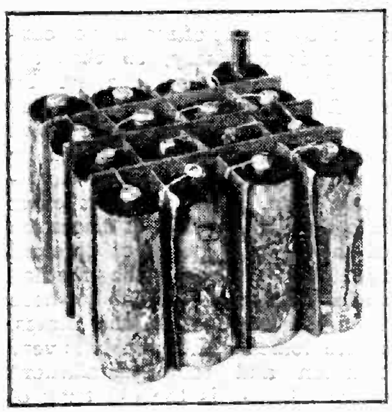
Ebonite 6 in. × $5\frac{1}{2}$ in. × $\frac{1}{16}$ in., $4\frac{1}{2}$ in. × 2 in. × $\frac{3}{8}$ in.

14 valve legs (split).

14 $\frac{3}{8}$ in. B.A. bolts and nuts.

The holders will be found to be very neat and light, but quite strong.

WHAT IS IT?



A section of a worn-out high-tension battery with wax removed. Notice the waxed card partitions.

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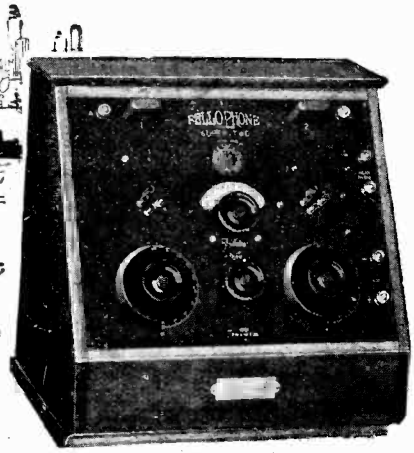

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Extract from letter.

Long Melford,
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"This morning from 1 a.m. I received the whole programme transmitted from W.G.Y. General Electric Coy., New York, with the addition of your 2-Valve amplifier. One or two of the items were coming through so loudly that I removed the amplifier, and received one or two songs, etc., on the 2-Valve Fellophone only. One song item transmitted, 'Asleep in the Deep,' was perfectly audible. I have received American telephony on several occasions, and can always get them when I get up for the purpose, so that it is not a freak of reception."

(*Signed*) ALFRED WOOD.

The original of this letter may be seen at

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"The Outside Wire"

TYPES OF AERIALS AND THEIR USES

By G. L. MORROW

Many new readers will welcome this informative article on aerials, which shows them why so many newly-erected aerials are inefficient.

IT has been the writer's experience over a period of nearly twelve years that amongst amateur workers, in a large percentage of cases, the design of the aerial is given very little of the attention which it not only deserves, but necessitates, if the highest efficiency is to be obtained from the knowledge and facilities at the disposal of the owner.

It is an unalterable rule that the highest overall efficiency in any machine can only be obtained if the various component parts which go to make up that machine are all functioning at their highest respective efficiency.

For any Set

Whether the amateur has a crystal, a single-valve or a multi-valve receiver, if he is a true experimenter his aim should be efficiency, and this cannot be obtained while the aerial is, as it is in very many cases, given very little consideration. It has surprised the writer on many occasions when he has been endeavouring to help friends of his in tracing faults in their stations to find that the aerial, as a possible cause of failure, is very often left until all the other parts of the receiver or transmitter have been tested through.

It is the intention of this article, in as simple a manner as possible, to deal with the fundamental principles of the design of various types of aerials considered from the experimenter's point of view, and to show from these principles of design how the amateur may utilise to the best advantage the particular type which is best suited either to his locality or to the class of work he wishes to undertake.

Receiving Aerials

Since probably the greater number of the readers of this article will be interested in it from the reception side only, the aerial as used for receiving will be dealt with more particularly, but the various factors which influence the transmitting properties will also be considered.

Let us first consider the function of the aerial. All movements of the ether are produced by alternating magnetic and electric forces, the effect of which is to produce an outward moving disturbance in the ether known as an electro-magnetic wave.

These electro-magnetic waves are not only radio waves; in fact, the latter only constitute quite a small percentage of the whole band of ether waves, the others being, in the case of those having the highest frequency, the Gamma and X rays, followed by the various light rays which make up the spectrum, until after the ultra-red rays we come to the various wave-lengths which we utilise in radio signalling.

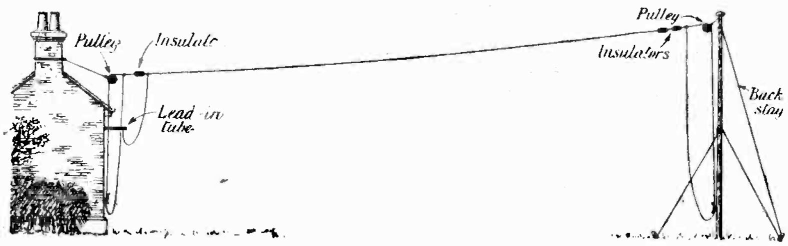


Fig. 1.—The single-wire aerial. It is easy to erect and less costly than many forms

A Simple Analogy

In order to appreciate fully the part played by the radio aerial, let us consider a simple analogy, namely, that of audible signalling by means of a siren.

In this case the siren is set into vibration, and in so doing sets the intervening medium, the air, into vibration, which in its turn sets the receiver, the ear, into vibration, thus conveying the sense to our brain.

In radio telegraphy or telephony the ether is set into vibration by means of the aerial, which receives its energy from the transmitting plant, and similarly these ether vibrations are intercepted by the receiving aerial, which supplies energy to the receiver, and in some ray or other—generally by means of audible sounds in a pair of telephones—are made perceptible to the human senses. In its simplest form a radio aerial consists of a single metallic wire elevated at a suitable height above the ground by means of a mast, chimney or building. Whether considered from a transmitting or a receiving point of view, it must be remembered that the aerial is part of the oscillation circuit, and that therefore any alteration in its values will necessitate a corresponding adjustment of either inductance or capacity for a given wavelength in the receiving oscillation transformer or transmitting jigger, as the case may be.

Before proceeding to discuss the various types of aerials in detail, it may be convenient at this point to consider such components of all types of aerial as aerial wire and insulators.

Aerial Wire

Since the oscillations occurring in the aerial in both transmission and reception are high frequency currents, it is necessary to design the aerial wire in such a manner that it offers the lowest impedance to such currents.

Now, high frequency currents flow only on the surface or skin of the conductor which carries them, therefore it is more efficient to use a wire which consists of several small wires insulated one from another and stranded together than a single wire of thicker gauge. It may be of interest to point out in passing that if *bare* wires are stranded together the high frequency or surface resistance is greater than that of a single wire of the same surface area.

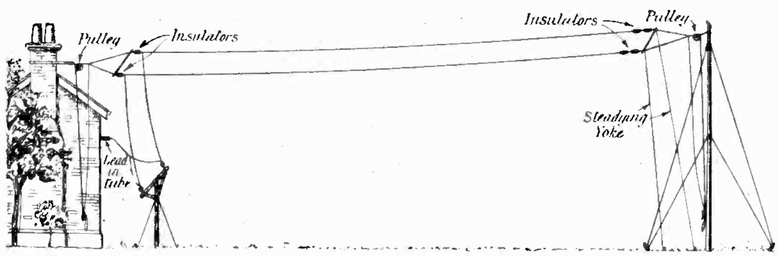


Fig. 2.—The twin or "ship-type" aerial, useful when the garden is rather short.

As regards the material of the aerial wire, since the currents it has to deal with travel only on a very thin skin on the surface, it is not of such great importance to have such a low "ohmic resistance" wire for the construction of the aerial as it is in a circuit which has to carry direct current or alternating current at commercial frequencies.

The chief material to be avoided at all costs is a magnetic substance such as iron or steel, since owing to its permeability it will offer an extremely high resistance to high frequency currents. Phosphor bronze wire is probably the most efficient, but its high cost precludes its general use amongst amateurs.

The writer's experience is that for all-round amateur use, both for transmitting and receiving, 7/22 stranded copper wire, with each strand enamelled, is as good as any.

Insulators

The efficient insulation of an aerial is a matter of the very highest importance. If the aerial is used for transmission, poor or defective insulation will cause a great loss in efficiency, particularly by a phenomenon known as "brushing." Brushing, which must not be confused with sparking, can be noticed on a dark night, especially if the insulators are moist or wet from rain, by a silent bluish discharge from the points in the aerial which are at a high potential to the nearest earthed object. This discharge will be found to take place usually from the ends of the aerial and from sharp points and angles. From a receiving point of view, bad insulation in the aerial will cause a marked decrease in the strength of received signals, especially in receiving waves whose wavelengths are much longer than the fundamental wavelengths of the receiving aerial itself.

As regards the material of which the insulators are made, a point which should be remembered by those amateurs who use their aerial for transmitting is that many insulators of materials such as ebonite, rubber and vulcanised fibre, which are quite satisfactory with the high maximum potentials present with spark transmitters, break down very rapidly when exposed to the strain of continuous wave sets, due to a form of fatigue of the insulating material caused by the persistence of the oscillating potential.

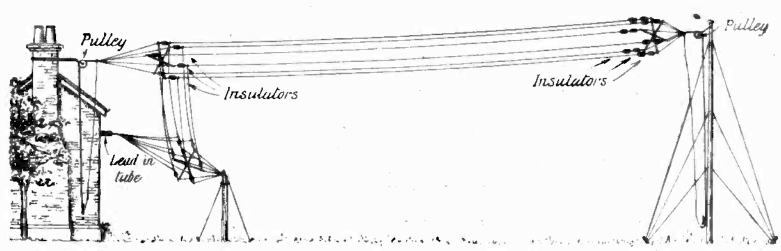


Fig. 3.—The multiple-wire aerial.

For all forms of amateur aerial insulation glazed porcelain cannot be too highly recommended, although insulators should not be used whose size is so small as to present very little leakage path.

Large insulators throw more mechanical strain on the aerial and mast owing to their greater weight, but it will always be found that the greater insulation obtained by the use of moderately large insulators will amply repay a little more care in rigging the aerial and in staying the mast.

Preliminary Points in Design of Aerial

Every aerial, since it possesses localised inductance and capacity, has its own fundamental or natural wavelength, which is given by the formula:

$$\lambda_m = 1885 \sqrt{L.C.},$$

the units being metres, microhenrys and microfarads respectively.

If, however, the aerial is tuned to some other than its natural wavelength (as is practically always the case in amateur stations) by the addition of inductance or capacity—or both—we have a circuit consisting partly of distributed and partly of localised inductance and capacity, and the resultant wavelength must be calculated from a formula which takes into consideration this ratio of localised to distributed values.

Such a formula is that due to Dr. L. Cohen, and is shown below:

$$\lambda = \frac{1885\sqrt{L_0C_0}}{K_{L_1}}$$

where $\cot K = K_{L_0}$

$$K = \frac{\pi}{2}\frac{\lambda_0}{\lambda_1}$$

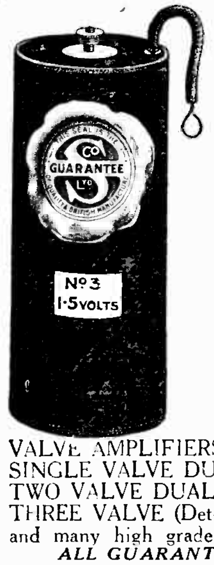
where L_1 = added inductance (microhenrys)
L_0 = inductance of aerial
λ_0 = natural wavelength of aerial (metres)
λ_1 = wavelength of aerial when inductance L_1 is put in series.

The calculation of the capacity of any given aerial is somewhat involved, but should any reader wish to attempt this he will find various methods in the papers read by Prof. G. W. O. Howe before the British Association in 1914-15.

Very briefly, the capacity of an aerial depends on three factors:—

(1) The number of wires.
(2) The distance between them.
(3) The distance from earth.

(Continued on page 359.)



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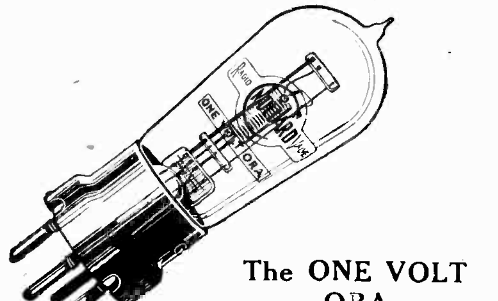

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For low aerials such as are employed in amateur stations the capacity decreases as the height increases, and an increase in the number of wires, provided they are spaced at least 3 ft. apart, gives an increase in capacity.

The chief essentials for the amateur to aim at in the design of his aerial are :—

(1) *Height.*—The higher the aerial is the further will energy be radiated from it, and the reception range will be greatly increased, though height alone is not the chief consideration in the reception of signals.

(2) *The more wires there are in it*, the larger will be its capacity, and therefore, if it is used for transmission, the more energy can be oscillated for a given voltage.

(3) *Insulation.*—The insulation from earth must be as good as possible.

added inductance being less due to the greater capacity of the latter type.

With regard to position—and these remarks apply equally well to all types of aerial—naturally the amateur is, in most cases, dependent on already existing conditions, but as far as possible the aerial should be erected in an open space, well away from large earthed masses such as trees, buildings, etc., and special attention should be paid to the position of the lead-in or feeder.

The lead-in should, in all cases, be run as far away from walls, etc., as is possible right up to the point of actual entry to the building, otherwise bad capacity effects will be set up, especially if the aerial is used for transmission.

Again, some method of yoking should be adopted to prevent the lead-in from swaying, otherwise, when transmitting on C.W., serious changes of wavelength (especially on the very short waves of 180 metres and thereabouts which are now allotted for amateur working) will be experienced due to changing aerial capacity.

The single-wire aerial offers several important advantages for amateur work, one of which is that owing to its lightness the aerial can be strained tauter and thereby giving a slightly greater height than in the case of the twin or multiple, other factors being equal. The natural wavelength of a standard Post Office single-wire aerial with an average mean height of 30 ft. will be found to be just slightly under 100 m., and therefore the lead-in should, for general purposes, be taken from one of the two ends.

It can be laid down as a general rule that in all aerials in which the lead-in is taken from the end this end should be that which is nearest to the operating room.

In nine cases out of ten, bringing the lead-in from the end remote from the operating room will necessitate a considerable amount of lead-in wire directly beneath the main aerial or "roof" at a converging angle, which tends to lower the efficiency to a considerable degree.

Where an aerial is used for transmission the point of maximum potential strain is at the free end, *i.e.*, the end farthest away from the actual oscillating plant; therefore the insulation at this end should have special attention paid to it.

Generally speaking, for a single wire aerial, two good insulators, when placed in series, will be found sufficient for transmission purposes, and if only used for reception, one will maintain the aerial insulation at an efficient point.

If, however, the experimenter does not mind the slight extra expense, two insulators in series at this point will, even under bad conditions of rain or snow, be sufficient to ensure that for reception the aerial insulation resistance will approximate to infinity.

As a rule, one insulator of reasonable dimensions will suffice at the house or lead-in end, but here again a greater margin of safety may be obtained by the use of two.

Summing up, we can say that, where circumstances permit the amateur to utilise the full 100 ft. granted him by the Post Office authorities for reception work, the single-wire aerial offers several advantages.

If, however, a 100 ft. run cannot be obtained, better results are usually ensured by the use of the

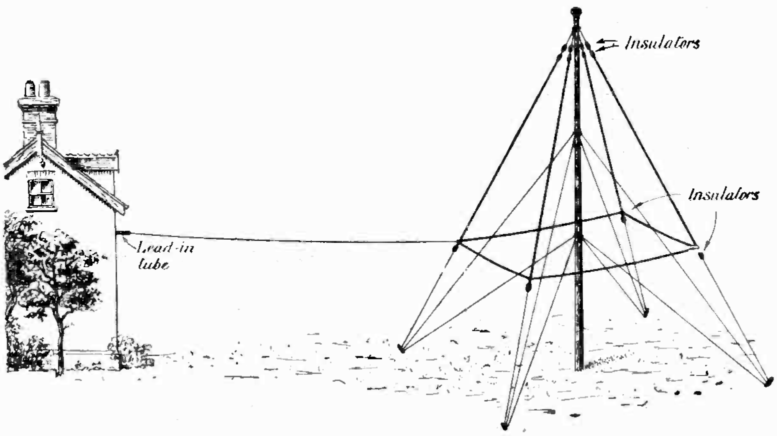


Fig. 4.—The "umbrella" aerial.

(4) *Mechanical strength.*—It is essential that the aerial must be strong enough to withstand its own weight and the greatest wind pressure which it is likely to be called upon to withstand.

In discussing briefly the various types of aerial which are useful from the amateur point of view, it should be remembered that such aerials are in each case considered as conforming to the regulations laid down by the Post Office restricting the size of such experimental aerials.

Single-Wire Aerial (Fig. 1)

The single-wire aerial is the most easily erected and the least expensive, and for general reception there is little to choose between it and the twin or multiple types, except where very long wavelengths are required to be received, in which case the multiple type is to be preferred, owing to the amount of

Twin or "Ship-Type" Aerial (Fig. 2)

In this case it has been the writer's experience, in a somewhat lengthy trial between the respective merits of a 100 ft. single wire and a 70 ft. twin aerial, that the latter is to be preferred for the following reasons.

Where a clear run of 100 ft. cannot be obtained, a shorter *single* wire aerial of, say, 70 ft. is not as efficient as a twin 70 ft. aerial, since in the latter case the greater capacity owing to the use of two wires is approximately the same as a 100 ft. single wire.

Where an aerial has to be "loaded" up to receive a given wavelength by means of a large amount of localised inductance, the results obtained will be less efficient than where the greater natural wavelength of the receiving aerial permits a less amount of localised inductance to be used for that given wavelength. Now, since the capacity of a twin aerial is, other things being equal, slightly greater than that of a single wire, its natural wavelength will also be slightly greater, thereby permitting less localised inductance to be added at its base to receive a given wavelength.

A most important point to be noticed is that if this extra aerial capacity is to be obtained, the wires should be separated by at least 5 ft., which will necessitate practically 6 ft. spreaders being used.

With regard to the insulation of a twin aerial it should be borne in mind that if each wire is insulated from the spreader and the spreader bridle insulated from the halliards, then the wire insulators will be in parallel and the whole insulating system a series-parallel arrangement.

Since the insulation resistance of insulators in parallel is less than when in series, it is preferable to do away with the bridle insulator and to ensure that each wire is efficiently insulated from the spreaders.

The lead-in should also consist of twin wires separated at the same distance apart as the roof to as near a point as possible to the lead-in tube, somewhat on the lines as shown in Fig 2. Since the writer first commenced radio experiments in 1912, it has always been a controversial point with this type of aerial as to whether the remote end of the aerial should be joined or not. Personally, he has not been able to detect any marked difference in either case, provided each wire constituting the roof is of *exactly* equal length, but as a general rule it is preferable to leave them unjoined.

Where a twin or multiple aerial is used, the mast staying arrangements must be correspondingly strengthened to withstand the extra weight.

A useful means of preventing aerial sway in high winds is to yoke the spreaders down to the foot of the mast by light *rope* yokes as shown in Fig. 2.

If a wooden mast is used, and the length of stays is not exceptional, there is no real need, in reception work, to break these stays with insulators; in fact, in many cases where these stays have been broken by insulators harmonics from high-power arc stations have been rendered less troublesome by short-circuiting these insulators.

A development of the twin or "ship-type" aerial is the

Multiple-Wire Aerial (Fig. 3)

This usually consists of three or four wires run parallel on spreaders as in the twin type, a greater number being impracticable if the spacing is maintained, owing to the great length of spreaders necessitated.

Usually a multiple-wire aerial has its wires spaced equally round the periphery of light wooden hoops or an arrangement of star-shaped spreaders.

Excepting in very extreme cases, this type of aerial does not offer the amateur any advantages over the twin; it is more costly and the erection is rendered considerably more tedious.

From a transmitting point of view, however, the multiple-wire aerial offers this advantage: owing to the wires being in parallel its resistance to high frequency currents is decreased, thus reducing the tendency to "brush" in wet weather.

It should also be noted that a multiplicity of wires decreases the aerial inductance, and therefore the natural wavelength and L.C. value are correspondingly reduced; but it will generally be found that owing to the increase in capacity obtained by the multiple-wire type the net result is an increase of natural wavelength and L.C. value.

Regarded from a purely receiving standpoint, however, the writer is of opinion that the extra weight with its corresponding strain on the mast and stays, coupled with the difficulty of preventing this type of aerial from swaying in the wind, does not give any more efficient results than the twin type, and it is doubtful whether the experimenter will gain anything by its adoption in place of the latter.

The "Umbrella" Type of Aerial (Fig. 4)

It is rather remarkable that this type of aerial is in use in so few a number of amateur stations, for where transmission is carried out it has one marked advantage over the other types.

This advantage is its slow radiation. Where a continuous wave system of transmission is being used, this slow radiation property is very advantageous, since it makes for increased sharpness of tuning and consequently less jamming at the receiving station.

The "umbrella" type aerial, however, should not be used where the transmitter is of the ordinary spark type.

In this case the duration of the wave train in the aerial is short, and therefore very little energy will be radiated per wave train.

As a receiving aerial, provided the mast is not under 40 ft. in height, the "umbrella" type will be found to be no less efficient than the ordinary twin type of somewhat lower height, and in addition has the advantage that the aerial wires serve also as supporting stays.

This latter property makes it extremely useful for portable stations and in summer months it will well repay those experimenters and Radio Societies who possess "portable" licences to carry out tests with this particular type of aerial.

RESULTS.

To the Editor of MODERN WIRELESS.

DEAR SIR,—I venture to bring to your notice the fact that I have built at home the "Old Folks" receiver described in the October number of your excellent journal, strictly in accordance to your specification. I am glad to say that I have attained better results with this set than I have been able to attain previously with larger sets.

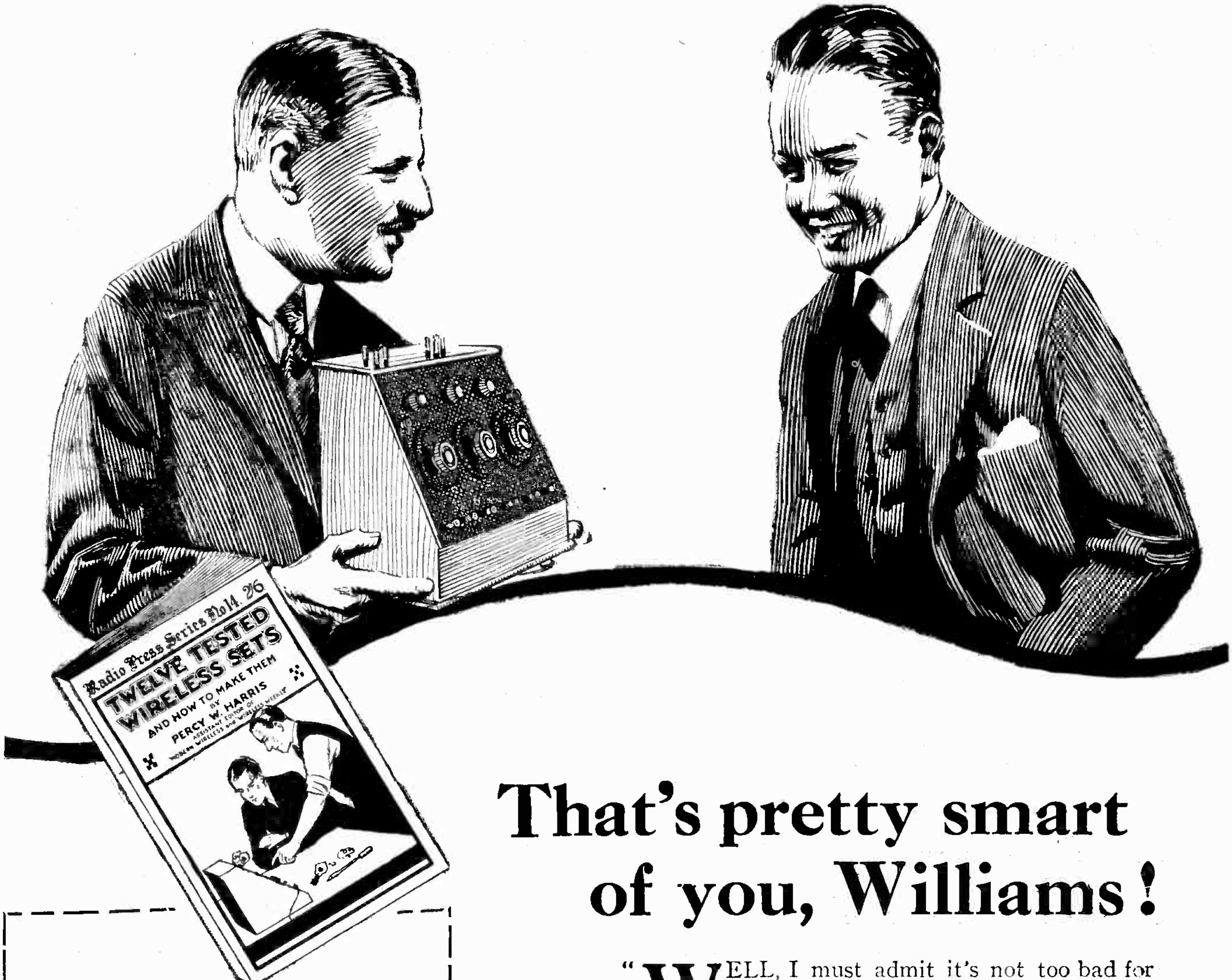
Living twenty miles south-west of London, I have been able to hear clearly "L'école Superieure de Postes Telegraphes" at Paris. This I think is exceptional, seeing that no high-frequency valves are used. I can also hear several other British stations, London coming in uncomfortably loud on the loud speaker. Yours truly,

C. T. WILKINS.

Caenwood, Ashstead, Surrey.

Constructing Air Space Variable Condensers.

With reference to our note on this subject, page 271 of the January issue, a reader has pointed out that if care is not taken contact may be made between the bent-up capacity indicator scale and the brass plate in which a slot is made. He has therefore substituted for the bent-up strip a strip of ebonite, which obviates any chance of a short circuit. So using the condenser he finds it extremely useful.



That's pretty smart of you, Williams!

"WELL, I must admit it's not too bad for a first attempt. I'm getting excellent results from it, too."

"Tell me, how did you obtain your knowledge and skill? I suppose you have had some sort of engineering training?"

"Oh, no. My job is in the insurance line—I've never been in any works in my life. As a matter of fact, it was Garnett who put me up to it. He told me how simple it was to build up a really good Set from ready-made components."

"It is a very creditable piece of work—I must congratulate you. I suppose Garnett showed you how to make it?"

"Not a bit of it. He merely advised me to get a copy of a book called *Twelve Tested Wireless Sets* and to follow the instructions. By the way, your boy is keen on that sort of thing, why not spend a couple of evenings or so with him making up a good Set?"

"That's not a bad idea. He'll sure to be at a bit of a loose end. Let me make a note of the book and I'll call in at the bookshop on the way home for a copy."

Twelve Tested Wireless Sets.

By Percy W. Harris.

Assistant Editor of "Modern Wireless" and "Wireless Weekly."

One of the most practicable constructional books yet published. Mr. Harris' reputation as a bright and informative writer of constructional books is well known and his latest book is easily the best he has written.

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Book Notes

Radio Valves and How to Use Them. By JOHN SCOTT-TAGGART, F.Inst.P. (Radio Press, Ltd., 2s. 6d.)

Readers will be interested to learn that the publishers now hold an ample stock of this new book and can execute orders promptly.

This, the latest book on valves by Mr. Scott-Taggart, bids fair to be one of the most useful and popular of all his works on the subject. Arranged upon the general lines of his much-appreciated instructional course, "Questions and Answers on the Valve," the book starts from the elementary principles, and covers the whole theory and practice of the wireless valve in a most comprehensive manner. It is thoroughly practical, in that it will enable the most advanced experimenter to make more effective use of his valves, and yet it is also a really complete course of instruction in valve theory.

A particularly valuable and helpful feature of the book is the use of *both* theoretical and practical (*i.e.*, pictorial) diagrams to illustrate each circuit, so that the beginner may learn to appreciate the relation between a circuit diagram and the wiring of the corresponding receiving set.

This is the largest book published by Radio Press for 2s. 6d.

Pictorial Wireless Circuits. By OSWALD J. RANKIN. (Radio Press, Ltd., 1s. 6d.)

As was announced recently, the first edition of this book is out of print, and the publishers are now able to announce that a reprint is available, and withheld orders can be forwarded.

This book seems admirably designed to help the beginner over the stage in his existence when he finds it very difficult to wire up a receiver from the circuit diagram alone, containing as it does a good collection of standard circuits.

Wireless Sets for Home Constructors. By E. REDPATH. (Radio Press, Ltd., 2s. 6d.)

A volume of great interest to the amateur set builder is "Wireless Sets for Home Constructors." Mr. Redpath is well known to the wireless public as a writer of sound and practical constructional articles, and as this book contains a collection of his most successful sets, together with previously unpublished descriptions of several new sets of original type, it should meet with a ready welcome. The original constructional articles have been enlarged to include explanations of the theory and operation of the sets, and much useful and interesting matter has been added.

The Broadcast Listener's Year Book. (Radio Press, Ltd., 1s. 6d.)

A new publication of special attraction to all interested in broadcasting is this novel year-book which has been prepared for the ever-growing listening public.

The book treats a wide range of subjects relating to the broadcasting service in a most readable and interesting manner and gives much useful information regarding the practical side of broadcast reception. Well-known B.B.C. personalities contribute articles bearing upon their own particular subjects, and a specially interesting section is that containing biographies of the principal members of the B.B.C. staff, with numerous new portraits. The titles of some of the articles follow :—

- *The B.B. Co., Ltd. : Its Aims and Objects.* By J. C. W. REITH, Managing Director, B.B.C.
- *What Has Been Done. A review of the first year's broadcast.* By A. R. BURROWS, Director of Programmes, B.B.C.
- *How It Is Done.* By P. P. ECKERSLEY, Chief Engineer, B.B.C.
- *A Visit to 2LO, the London Broadcasting Station.* By E. ALEXANDER.
- *Apologia of an Announcer. Some of the problems which have to be dealt with in a Broadcasting Station.* By REX PALMER, Director of the London Station.
- *The Importance of the Musical Programme.* By DAN GODFREY, Jnr., A.R.A.M.
- *The Children's Corner.* By UNCLE CARACTACUS.
- *In and Out of the Studio.* By JOHN HENRY.
- *The Wireless Musical Cinema : a Peep into the Future.* By R. W. HALLOWS, M.A.
- *How to Listen to and Appreciate Musical Broadcast.* An article by D. HOPKINS, A.R.C.O.
- *Buying a Broadcast Receiver.* By G. P. KENDALL, B.Sc., Staff Editor, Radio Press.
- *The Future of Wireless.* By J. SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.
- *How to Look after Your Set.* By PERCY W. HARRIS, Assistant Editor of MODERN WIRELESS and WIRELESS WEEKLY.

Taken as a whole, the Year-book constitutes a most valuable exposition of the whole "how and why" of modern broadcasting by writers who are the foremost authorities. Its date of publication has been fixed for February 7.

The Measurement of Wireless Quantities

By E. H. CHAPMAN, M.A., D.Sc., Staff Editor.

IV.—Inductance.

Previous articles of this series appeared in the July, August and December issues.

CONSIDER for a moment a coil of wire through which an electric current is flowing. If the current in the coil increases in strength, an opposing electromotive force is immediately set up which tends to prevent this increase in current. Again, if the current in the coil decreases in strength, an assisting electromotive force is immediately set up which tends to prevent the decrease in current. This electromotive force which, in either case, tends to prevent any *change* in the current flowing through the coil, is said to be due to the *inductance* of the coil.

Probably a better idea as to what is meant by inductance is conveyed by the equivalent term *self-induction*. It is important to note that these *self-induced* electromotive forces in a coil of wire can never prevent, but can only delay, changes in the strength of the current passing through the coil.

Every length of wire, whether wound into the form of a coil or not, has certain inductance values according to the type of current flowing in the wire. Thus a straight piece of No. 18 wire, one metre long, has an inductance value of 1.47 microhenries when the current passing through it is continuous, but when alternating current of high-frequency flows in the came piece of wire, the inductance value is slightly less, 1.42 microhenries.

So long as we are dealing with direct current, inductance is perhaps not of very great importance, since, while a steady current is flowing through a conductor, inductance has no effect. Immediately the current in a conductor changes, however, inductance springs to life, as it were, and manifests its presence by the self-induced electromotive force referred to above. How important inductance is in wireless may be gathered when it is recollected that the high-frequency alternating or oscillating currents used in wireless are not only changing rapidly in strength, but are also rapidly changing in direction.

Since in wireless we are so largely concerned with alternating currents of high frequency, we can safely confine our attention to those values of inductance which are applicable to such high-frequency currents. Throughout the remainder of this article, then, the word inductance must be taken as meaning inductance when carrying alternating currents of high frequency.

Perhaps the most important thing about inductance is that it depends largely on the shape into which a given length of wire is wound or bent. We have already stated that a straight length of one metre of No. 18 wire has an inductance value of 1.42 microhenries. Suppose that a similar length of the same kind of wire is bent into the form of a square. Its inductance value would be 1.06 microhenries. Again, suppose that another metre of the same gauge wire is bent into the shape of a circle. Its inductance value would be 1.13 microhenries. If, however, another metre length of No. 18 wire be doubled back on itself to form two straight pieces running parallel and near to each other, its inductance value would be practically zero. These four inductance values (*see* Fig. 1) will show how a number of equal lengths of the same gauge wire can be bent into different shapes so as to have different inductance values.

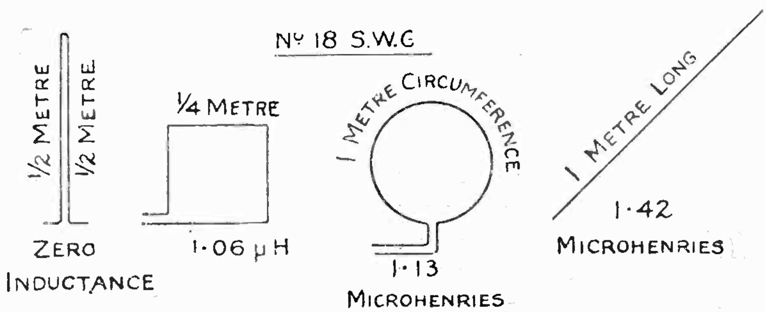


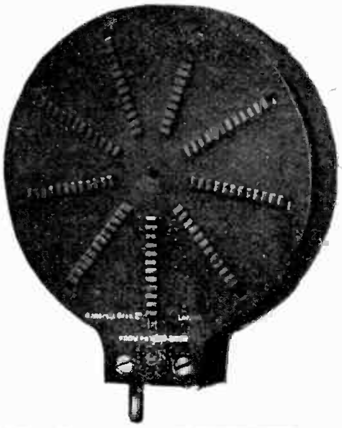
Fig. 1.—Some inductance values.

With a simple configuration, such as a circle, inductance depends on the diameter of the wire used. As we have already seen, one metre of No. 18 wire bent into the form of a circle has an inductance value of 1.13 microhenries. A similar circle of No. 28 wire would have an inductance value of 1.38 microhenries, while a similar circle of No. 38 wire would have an inductance value of 1.55 microhenries.

It will be rightly judged from the numerical examples given that inductance, depending as it does on the shape into which a given length of wire is bent, is not likely to be as easy an electrical quantity to deal with as are capacity and resistance. As a matter of fact, the mathematical formulæ for inductance are so complicated that it is only by adopting one or other of the many approximations to those formulæ that it is at all possible in many cases to calculate inductance with facility.

Turning our attention now to the important case of a single-layer coil of wire wound closely on a cylindrical former, it is a difficult matter to work out the inductance of such a coil made in haphazard fashion. It is quite a simple matter, however, to work out and make use of inductance values for such coils when the obvious expedient is adopted of fixing the relationship of length of coil-winding to diameter of coil.

Let us first of all restrict ourselves to single-layer coils of which the



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E	690	,,	2875	.000008	9/6
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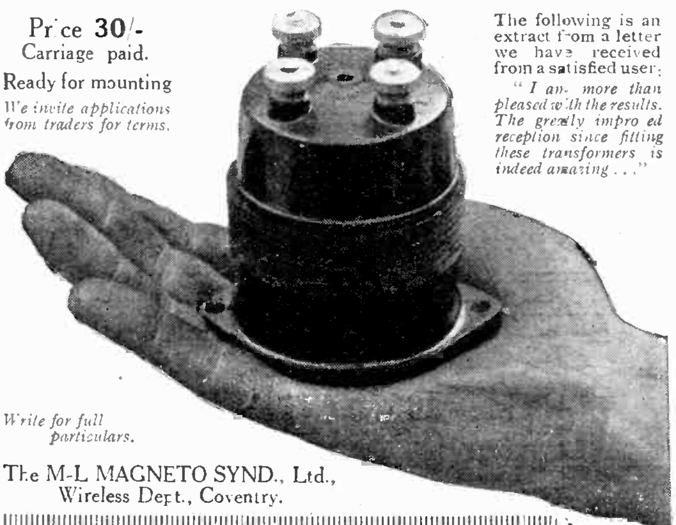

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WORKS . DAGENHAM, ESSEX.

(*Continued from page 36[illegible].*)

length of the winding is one-fifth of the diameter (*see* Fig. 2). This restriction is by no means a heavy one, for we not only have at our choice the size or diameter of our

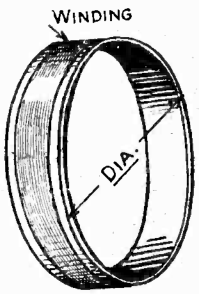


Fig. 2.—The coil discussed.

cylindrical former, but, in addition, the type of wire we put on that former. By making use of wires of different gauges and with different kinds of insulation covering, it is possible to cover a considerable range of inductance values with these coils, in which the length of winding is one-fifth the diameter of the coil.

For such coils, an extremely simple rule for calculating the inductance value is given here, it is believed, for the first time. A coil of diameter 2½ in. is taken as standard, the length of winding on the cylindrical former being ½ in. To work out the inductance in microhenries of this standard coil, the following simple rule may easily be remembered :

Square the number of turns of wire on the coil, divide the resulting number by 10, *the answer is the inductance of the coil in microhenries.*

Thus, if the coil has 15 turns on it, our calculation is :

Square 15, we get 225 ; divide by 10, we get 22.5, which is the inductance of the coil in microhenries.

With this standard coil of 2½ in. diameter and ½ in. of winding, we can get a considerable range of inductance values. No. 20 D.C.C. closely wound would give us an inductance of about 10 microhenries. With some of the finer wires we should be able to get 50 turns in the ½ in. at our disposal. The inductance value for a standard coil of 50 turns would be found thus : 50 squared gives 2,500, divide by 10, we get 250 microhenries as the inductance of the coil.

Having now established the simple rule for calculating the inductance of our standard coil of 2½ in. diameter, we may pass on to a simple rule by which we can determine the inductances of coils of larger diameters, always remembering, of course, that the length of the winding must be exactly one-fifth of the diameter of the coil. The rule is :

Find the inductance as for the standard coil of 2½ in. diameter. Then for every ¼ in. the diameter of the given coil is above 2½ in., increase the standard coil answer by a tenth.

An example will make the working of the rule clear. Suppose that we have 40 turns on a coil of 3¼ in. diameter. Using the rule for our standard coil, we work as follows : 40 squared, 1,600 ; divide by 10, 160 microhenries. Now 3¼ in. exceeds 2½ in. by *three* quarter-inches. Hence we increase our answer 160 by *three* tenths. A tenth of 160 is 16, three-tenths 48, adding 48 to 160 we get 208 microhenries as the inductance of the coil of diameter 3¼ in.

In order to facilitate the working of the "square" rule for the inductance of these coils of diameter 2½ in. and over, a table of the squares of numbers is useful. One such table is given in Table 1.

Table 1 is used in this way. To find the square of 43, find 40 in the left-hand column and then look along the row until the number under the column headed 3 is seen. This number 1849 is the square of 43.

One of the most useful features of the rules and table given is that they enable us to work out quickly the specifications of a coil which shall have a given inductance value. For example, suppose that we wish to make a coil with an inductance value of 250 microhenries on a former of diameter 3 in. The question is, what number of turns will be necessary in the three-fifths of an inch winding on the former. We first remember that 3 in. exceeds 2½ in. by *two*-quarters of an inch. Hence, whatever the inductance value of the corresponding standard coil of 2½ in. diameter, it must be such that, on increasing it by two-tenths of its value, it must give 250. Let us try 200. A tenth of 200 is 20, two-tenths 40. Adding 40 to 200 gives us 240. This is too small. Try 210. A tenth of 210 is 21. Two-tenths of 210 is therefore 42. Adding 42 to 210 gives us 252. This is near enough to 250 for all practical purposes, so we take 210 as the inductance in microhenries of the standard coil of 2½ in. diameter with the same number of turns on it as the coil we require.

Working our first rule backwards, we multiply 210 by 10 and so get 2,100. Looking in the body of Table 1, our table of squares, we find 2,116 is the nearest number to 2,100. This number 2,116, the table tells us, is the square of 46. Hence, there must be 46 turns on the coil we wish to wind on the 3-in. former. These 46 turns must wind closely into a space three-fifths of an inch (one-fifth of the diameter 3in.). This works out at about 77 turns to the inch, No. 32 S.S.C. would therefore be a good choice of wire to use.

It may not be always possible to make use of a coil of which the length of winding is one-fifth of the diameter. Simple rules for other coils of different specifications can, however, be given. For example, for coils of which the length of the winding is twice the diameter, the following simple rule may be used :

Square the number of turns on the coil, multiply this square number by the diameter of the coil in inches, divide the result by 100, *and the answer is the inductance of the coil in microhenries.*

As an example of the working of this rule, suppose we have a coil 3½ in. diameter, the length of the winding on it being therefore 7 in. To find the inductance of this coil, count the number of turns. Suppose this to be 200. Square 200, we get 40,000. Multiply 40,000 by the diameter 3½ and we get 140,000. Divide this number by 100 and we

TABLE I.—TABLE OF SQUARES.

	Units.									
Tens.	0	1	2	3	4	5	6	7	8	9
10	100	121	144	169	196	225	256	289	324	361
20	400	441	484	529	576	625	676	729	784	841
30	900	961	1,024	1,089	1,156	1,225	1,296	1,369	1,444	1,521
40	1,600	1,681	1,764	1,849	1,936	2,025	2,116	2,209	2,304	2,401
50	2,500	2,601	2,704	2,809	2,916	3,025	3,136	3,249	3,364	3,481
60	3,600	3,721	3,844	3,969	4,096	4,225	4,356	4,489	4,624	4,761

get 1,400 microhenries as the inductance of the coil.

For coils for which the length of the winding is fixed as being twice the diameter, it is easy to give a rule for finding the number of turns to be put on such a coil as to give a certain inductance value. The rule is:

Multiply the given inductance value in microhenries by 100, divide the number thus obtained by the diameter of the coil in inches. The result is the square of the number of turns.

Suppose we are asked to construct a coil with an inductance value of 3 millihenries, that is, 3,000 microhenries on a former the diameter of which is 3 in. Using the rule given, we multiply 3,000 by 100 and so get 300,000. We then divide this number by 3, the diameter of the coil in inches and obtain 100,000. This is the *square* of the number of turns required. We can either find the required number of turns from a table of squares, or we can work it out in the following manner: Try 300. Squaring 300, we get 90,000, which is too small. Try 310; squaring we get 96,100. This is still too small, but we are getting nearer. Try 320; squaring we get 102,400. This is now too large, so we go back to 315 and try that. Squaring 315, we get 99,225. This is near enough for our purpose, so we take it that our coil must have 315 turns on it. As the winding on the coil must extend for 6 in., the number of turns per inch must be 315 divided by 6, that is, 53 No. 28 S.S.C. would do this easily, and 26 enamelled wire would give a value of inductance very little below that required.

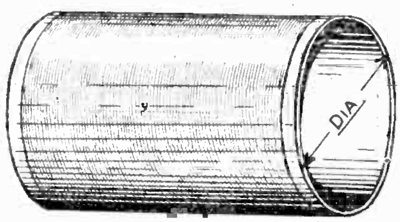


***Fig. 3.**—A coil of a length equal to twice the diameter.*

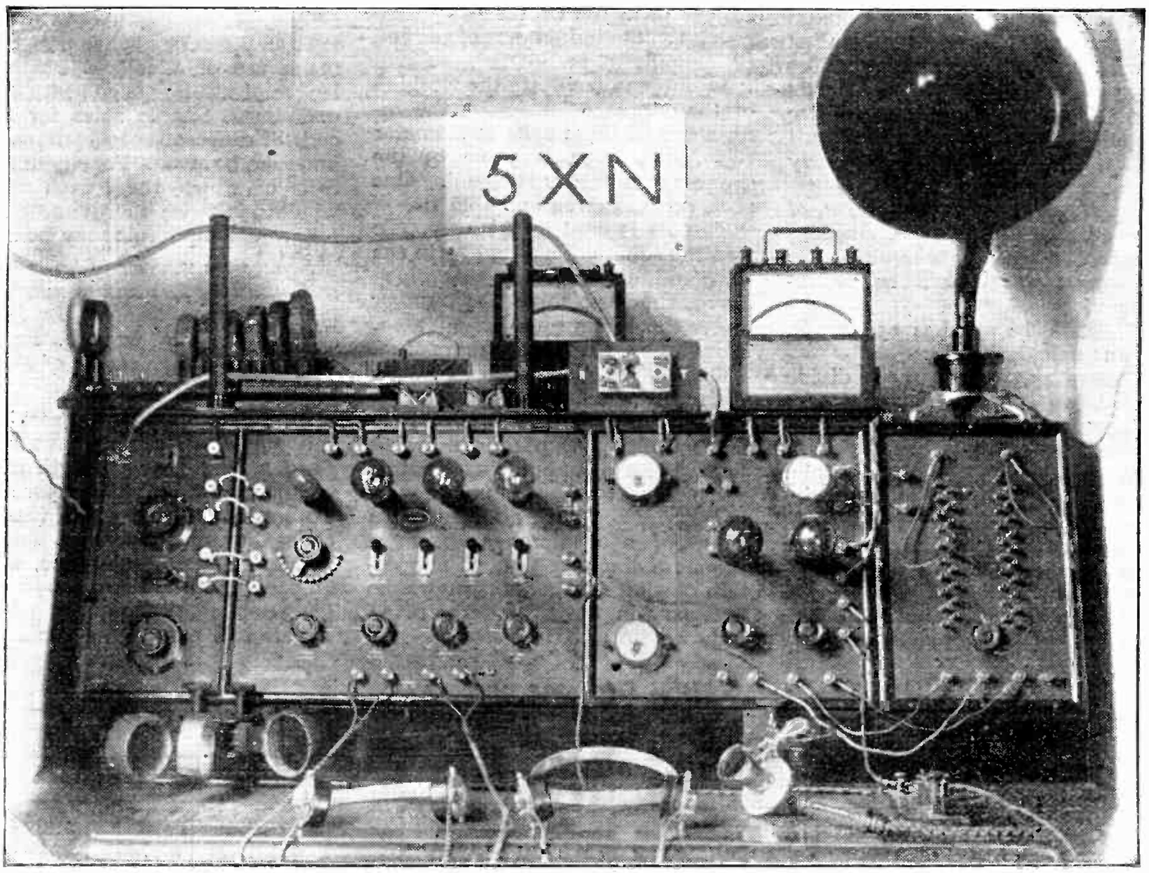
Simple rules have now been given for coils for which the length of winding is:

(i.) One-fifth the diameter, and
(ii.) Twice the diameter.

With these two types of coil all reasonable values of inductance for single-layer coils may be obtained.

The measurement of the inductance of a single-layer coil made in a haphazard manner is much more complicated.

A WELL-DESIGNED AMATEUR STATION.



Our photograph shows the transmitting and receiving station of Mr. Everitt, of Eltham, S.E.9. The microphone is seen by the side of the transmitting key. The receiver (on the left) is a standard Burndept instrument.

Handling a Multi-Valve Set

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

Sets with several valves are often disappointing when first tried, particularly in the hands of beginners. Practical hints and advice are here given so that the best possible results can be quickly obtained.

MANY a man who advances from the simple single-valver to the large set, embodying from three to five valves, experiences the utmost disappointment when he comes to handle his new acquisition. Even if he has had the experience of working with a small outfit, and has a very fair knowledge of the theory of wireless, he may fail to get anything like the expected results; and even harder is the case of the man who advances into the mysteries of the subject, not by gentle stages from crystal to single valve and from single valve to a bigger set, but in one great leap by either building or purchasing a large receiver straight away. Anyone who has had a few demonstrations or a little coaching from an expert friend can handle a big set in some kind of way, but he will not get the best out of it until he realises what a delicate and easily affected piece of mechanism it is.

Some wireless books give one the idea that a wireless set, like an expanding bookcase, can be increased quite easily in range and power by the simple process of adding either high-frequency or low-frequency valves, or both. Circuits are drawn which appear to be perfectly straightforward, and too often the beginner sets to work to make up a large boxed-in set, only to find when it is finished that it is a noisy, cranky thing, difficult to control and not at all pleasant to listen to. As a matter of fact, the addition of valves is a business which cannot be done in any haphazard kind of way. On the high-frequency side the bugbear of the wireless man is oscillation, which is encouraged if the wiring is not carefully carried out, and if components such as tuned anode inductances and high-frequency transformers are not so arranged that interaction between them is prevented. With note magnifiers we have to guard against both distortion and howling. The former may be due to bad transformer design, to incorrect plate and filament potentials, or to the fact that excessive grid current is flowing through the valve being operated upon the wrong portion of its curve. The latter is nearly always to be traced to interaction between note-magnifying transformers.

Let us consider the high-frequency side of the set first. Unless we are using some special circuit, such as the Armstrong, we can never hope to obtain quite the full amplifying power of each valve. Were we to connect the grids of our high-frequency valves to the negative low-tension busbar, and to tune either our high-frequency transformers or our anode inductances as sharply as possible, terrific oscillations would be the immediate result. We can stop this in several ways. We may introduce a certain amount of extra ohmic resistance into our circuits, thereby flattening the tuning, we may detune a little, or we may make use of the damping effect of applying a positive potential to the grids. When we flatten our tuning we reduce simultaneously both the selectiveness and the amplifying power of the valves, whilst the damping effect of a positive grid potential cuts down the amplification considerably. Hence if we strive to kill oscillation by the extensive use of any one method, the set becomes as it were numb, and will not give its best. In the well-handled set a compromise is effected. The user knows that he cannot work his high-frequency valves at their fullest power, but at the same time he does not fly to the other extreme by making use of excessive damping. In this, as in so many other things, the happy mean must be aimed at.

It is most difficult for the beginner at multi-valve work to

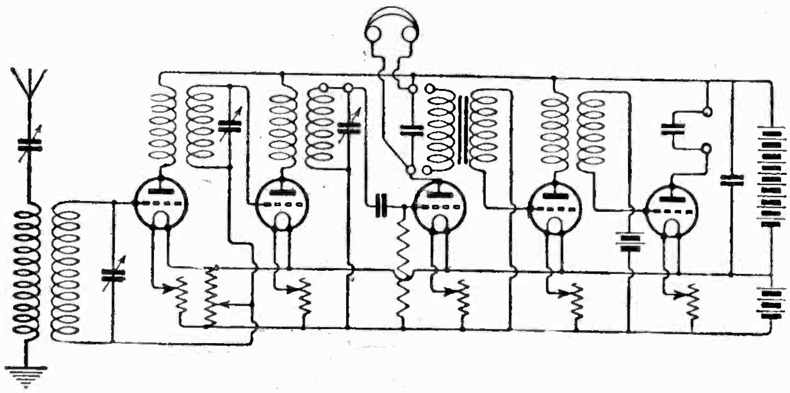


Fig. 1a.—Using high-frequency and rectifier only.

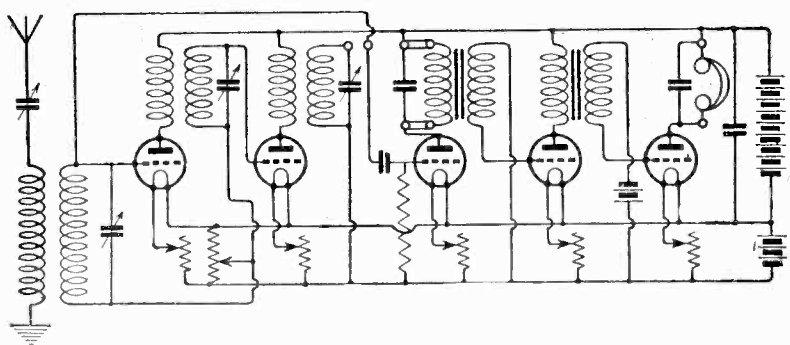


Fig. 1b.—Using rectifier and low-frequency only.

learn to handle his set properly, if he is to deal with both high- and low-frequency sides simultaneously. For this reason it is a good plan to make some such arrangement

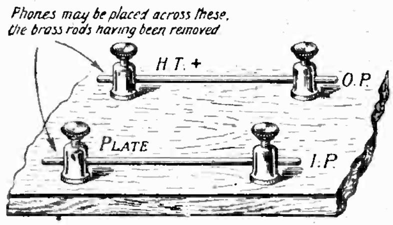


Fig. 2.—Simple device using telephone terminals and lengths of ⅛ in. brass rod, enabling the low-frequency valves to be cut out.

as that shown in Fig. 1, whereby either the high-frequency valves and the rectifier or the rectifier and the note magnifiers may be used by themselves. One can then study the idiosyncrasies of the two kinds of amplification, and learn to make each do its best work. Even with a boxed-in set, it is not usually difficult to arrange something of this kind either by means of switches, or by making use of the simple method with telephone terminals shown in Fig. 2. Many sets are difficult to handle because the same high-tension voltage is used for both high-frequency and low-frequency valves. High-frequency amplifiers do not as a rule require anything like the same anode voltage as note magnifiers. A set arranged in the way shown in Fig. 3 may be difficult to handle for this reason. Fig. 4 shows the way out of the difficulty. Here the high-frequency side of the set is first tried out, and the voltage of the battery B_2 is arranged to suit its requirements. The extra high-tension battery B_3 is in series with B_2 only so far as the note magnifiers are concerned.

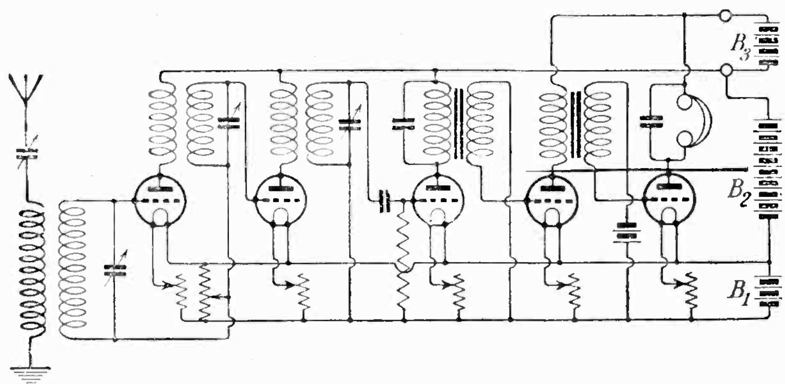


Fig. 4.—A set with extra high tension for low-frequency valves.

The potentiometer is a very present help in time of trouble with high-frequency valves. Its use must not be overdone. Occasionally one sees a set being worked with potentials of from four to six volts positive upon the high-frequency grids. This certainly has the effect of killing oscillation, but it generally means that if there are two high-frequency valves, they are doing no better work than would be done by one working properly. The addition of a second high-frequency valve has increased the tendency to oscillation. This has been counteracted by the use of a high-positive potential applied to the grids of both valves, with the result that as each is working far below its proper power, their combined amplifying effect is little or no greater than that of one alone. It may be stated as a good working rule that one's aim should be not to have the grids more than two volts positive with respect to the negative end of the filament, and if possible even this potential should be reduced. Much can be done by experimenting until the proper adjustments of filament and plate potentials are found. If the filament voltage is either too high or too low there will be a tendency to oscillation, and a similar result will be found if the anode voltage is excessive. A little experimenting will show just how sharply the high-frequency circuits can be tuned. As a rule, when two high-frequency valves are used, it is not possible to obtain absolute sharpness with both. A little of the signal strength may have to be sacrificed here. What we must endeavour to find is the combination of plate, grid and filament potential that will allow the sharpest tuning and will give the loudest and clearest signals.

Do not, however, be led away by the lure of mere loudness. A set that is just upon the verge of oscillating may develop very great signal strength indeed, but this will usually be accompanied by a certain woolliness in the reception of speech and music, and by a considerable amount of parasitic noises that entirely mar the quality of the recep'ion.

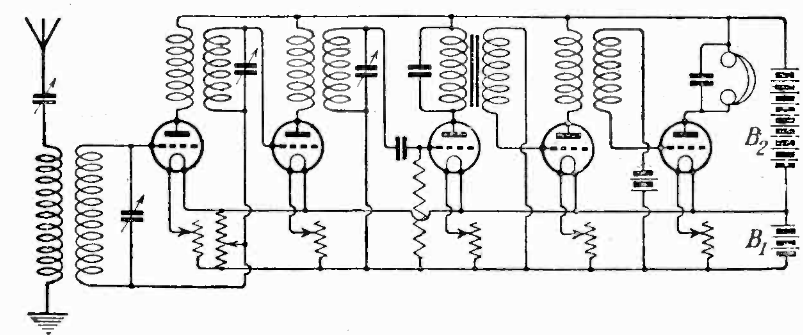


Fig. 3.—How to use the same high tension for high- and low-frequency valves. (This is not always a good method.)

The occurrence of what are known as "capacity effects" is usually a sign that oscillation is present. Should you find that as your hand approaches the controls signals either vanish altogether or become very much stronger, then the high-frequency side of the set is not properly adjusted. The only time when capacity effects may legitimately make themselves noticeable is when one is working upon the reception of very faint distant transmissions, in which it is almost necessary to bring it to the verge of oscillation (though it must not be allowed actually to oscillate) in order to obtain the maximum sensitiveness.

Once the high-frequency valves have been properly adjusted they should be cut out temporarily, attention being paid to the note magnifiers. Here again it is necessary to find the most desirable potentials for both filaments and plates by means of actual experiment. The next step will be to discover the amount of negative bias required by the grid of the second note-magnifying

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valve, at any rate in order to produce undistorted reception. Personally, when two or more stages of high-frequency amplification are in use, I prefer to fit a grid biasing battery even to a single note magnifier, or to both if a pair are in use. No harm can come of this, and it does ensure that even the strongest signal is not distorted. Many ready-made sets are turned out without provision for grid bias. These can never give really good reception; such a battery should therefore be fitted by the user, being placed as shown in Fig. 5. One of the best ways of making up a grid biasing battery is to purchase a couple of the refills sold for the long cylindrical pocket torches. Inside the cardboard case of each will be found three round cells of respectable size, which can be slipped out by removing the bottom of the case. If wires are soldered both to the positive elements and to the zinc pots of these, it is easy to make up a battery giving any desired voltage. While tests are being carried out the cells should be inserted one at a time until the best potential is found.

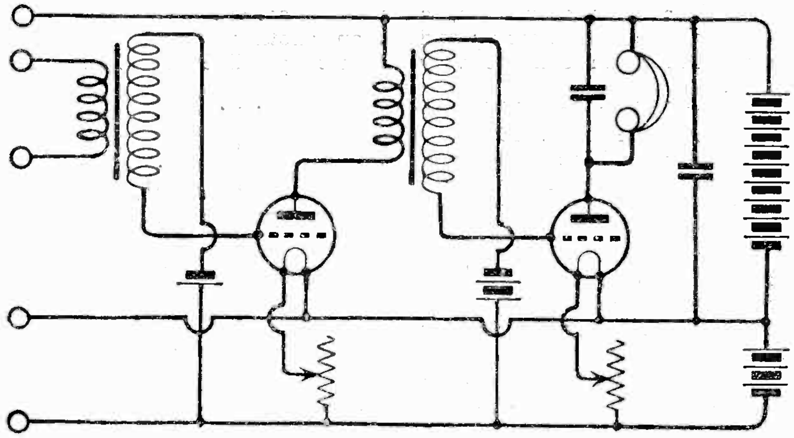

Fig. 5.—Negative bias placed on grids.

Another very common fault with both home-made and bought sets is that the secondary circuit, where there is a double-circuit tuner, is left with the batteries and all the large components isolated from earth. This means that there will probably be a potential difference between it and earth, and therefore a capacity effect which is likely to produce noises in the set. Luckily this difficulty is very easily overcome in no matter what type of set. All that one has to do is to solder a lead from the low potential side of the secondary to the earth side of the primary coil. The whole secondary is then earthed, which in most cases makes both high- and low-frequency sides noticeably easier to control. Instead of the lead mentioned, a small single-pole single-throw switch may be used so that the secondary may be either earthed or not at will.

It is desirable in any case to earth the cores of both note-magnifying transformers, and this can be done very easily if the secondary is already earthed by running leads from the cores as shown in Fig. 7. Earthing is a simple cure for howling caused by interaction between low-frequency transformers. Another excellent method of eliminating all interaction noises is to encase the transformers in metal-lined boxes, earthing the lining.

With the multi-valve set the process of searching is very much more difficult than it is with a single-valver owing to the increased number of tuned circuits. If the set is provided with a double circuit tuner and with tune

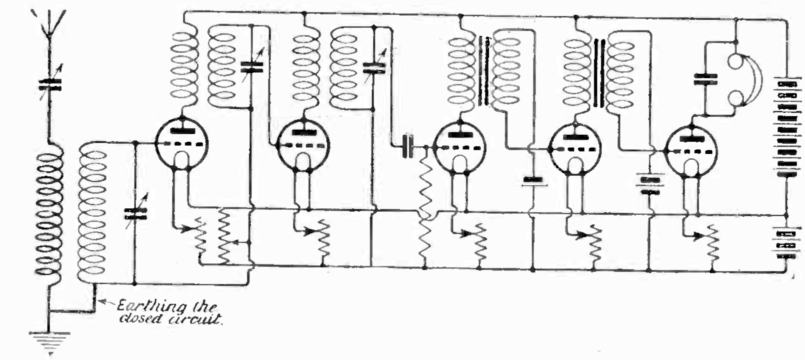

Fig. 6.—Earthing the closed circuit.

couplings between the high-frequency valves, there will be no fewer than four condensers to adjust even if reaction is altogether cut out. In order to be able to pick up any desired signal rapidly with a large set it is desirable that it should be possible to make it for the time being as unselective as may be. For this reason we can dispense for the time being with the secondary circuit and the variable coupling which it entails. This can be done by means of a tune-standby switch, a handy form of which is shown in Fig. 8. We may also replace one of the anode inductances, if tuned anode coupling is used, by a resistance of 50,000 to 100,000 ohms. This will leave only two circuits to be tuned—the aerial and one of the anodes. Searching can thus be quite quickly done, and as soon as the desired transmission has been picked up, we can first of

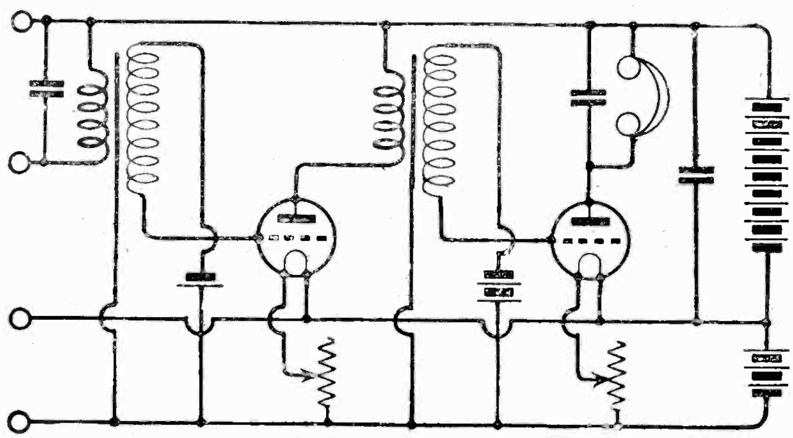

Fig. 7.—Transformer cores earthed.

all replace the second anode inductance and tune the circuit, and then throw in the closed circuit of the tuner and adjust this finally.

There is another use for the tune-standby switch which is not very generally known. If we are

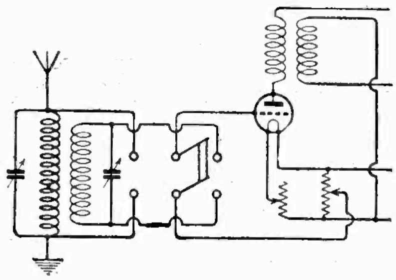

Fig. 8.—Tune-standby switch.

trying to separate two sets of signals upon almost the same wavelength, we can obtain very great selectivity by working with the loosest possible coupling between primary and secondary circuits. There is, however, at times the drawback that the very loose coupling may tend to make the set oscillate. Elimination can be accomplished to a very satisfactory extent in quite a different way. Turn the switch over so that the set is working upon a single circuit. Couple the A.T.I. and the C.C.I. very closely together, and after having tuned the former to its best point, move the closed circuit condenser's knob gradually first in one direction and then in the other. It will often be found possible to tune out the unwanted signal in this way, the secondary circuit acting as a wave-trap and absorbing the frequencies that are not desired.

Another most desirable component of the multi-valve set is the series-parallel switch seen in Fig. 9. This enables the aerial-tuning condenser to be placed in series for short-wave reception, and in parallel when one is working upon the higher wavelengths. In this connection it should be remembered that it is always most undesirable to use too low a capacity when the condenser is in series. Oscillations from the aerial must pass through it; hence if its capacity is very small the reactance to high-frequency currents will be great, from which two results will follow: signals will be weak and the set will show a distinct tendency to oscillation. It is a good general rule so to regulate the inductance and capacity of the aerial circuit that the series condenser's value is never below .0003 μF. When the condenser is parallel the conditions are different.

The quality of the earth is of very great importance with the multi-valve set. Should it be bad or should the lead to it be of thin wire with a poor connection, a large resistance will be set up and the set will again oscillate very readily.

The conclusions to which one comes, then, are these. It is not wise to tackle a big set until you have had considerable experience with a single-valver. When you do become the possessor of a multi-valver the best course is to get used to it by stages, becoming perfect in the use of high frequency and rectifier or rectifier and low frequency alone before you endeavour to handle the combination. There are few sets that cannot be improved by the addition of such devices as have been mentioned in this article. All of them are quite easy to fit, and there is none that entails any great outlay of either time or money. Do not imagine that the fewer controls a set has the easier it is to work. Exactly the opposite is, as a matter of fact, the case. It may surprise you when I say that on the four-valve set that I use for broadcast reception there are no fewer than twenty-three controls; yet this set is far easier to handle than another provided with the fewest possible number. The

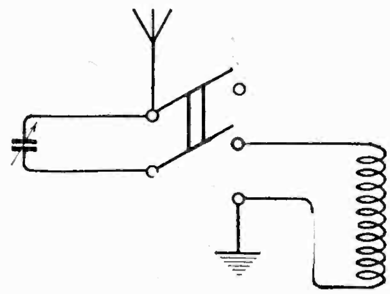

Fig. 9.—Series-parallel switch.

reason is that one has at hand a means of checking any undesirable exuberance, no matter what form it may take or in what part of the set it may be situated. Though a large array of knobs in sets may look forbidding at first sight, it is by far the easier to work with once you have got used to it.

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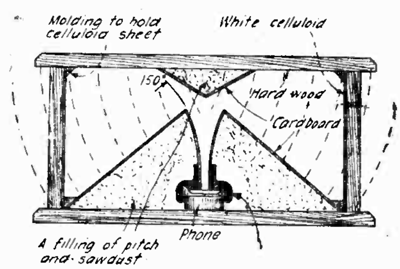

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down and outwards, striking the surface of the table upon which the reproducer is placed. To give the producer the advantages of a solid horn, all hollow spaces were filled with a mixture of melted pitch and sawdust before setting into place. The appearance of a finished article is greatly increased after the customary finishing of all wood work, by placing between the four uprights sheets of white celluloid. With a fine fret saw, the pattern was cut (before setting in position) and coloured paper mounted on the back to improve the appearance. As places in this celluloid sheet showed a tendency to vibrate at certain audible frequencies, small pieces of celluloid were cemented on the backs of these portions.

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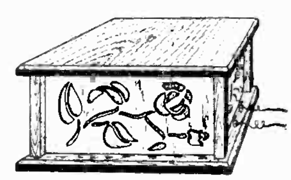

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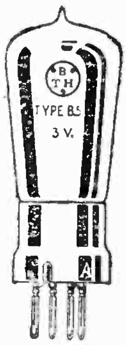

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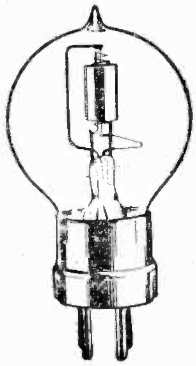

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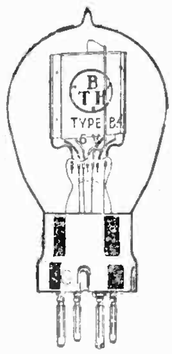

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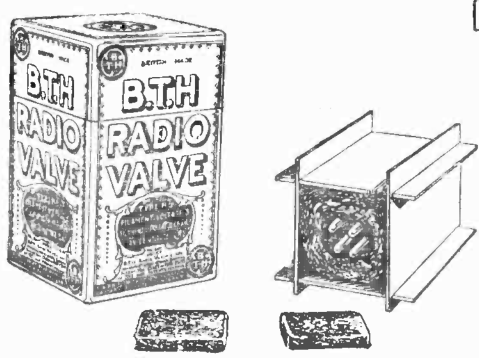

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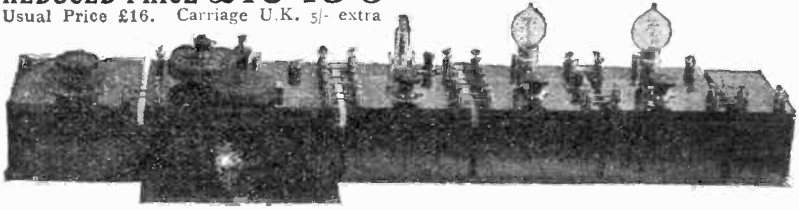

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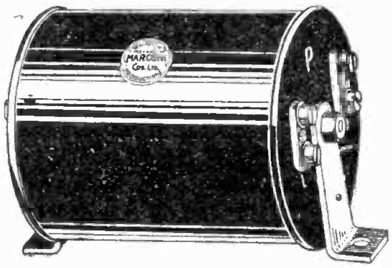

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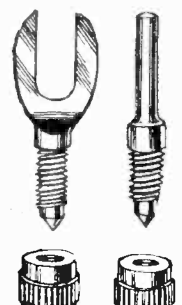

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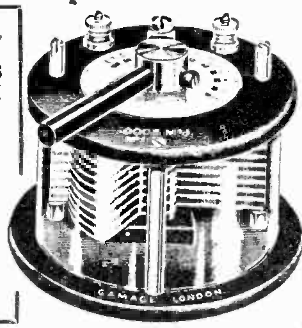

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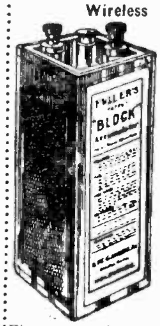

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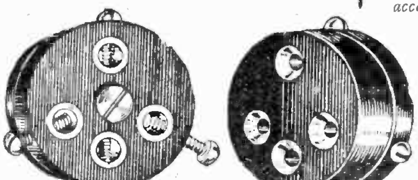

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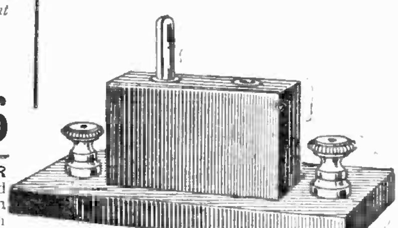

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Some Further Notes on "A Useful Three-Valve Receiver."

By M. G. FERGUSON.

So much interest has been aroused by the article on "A Useful Three-Valve Receiver" in our December issue, that the following additional notes will be welcomed.

As there has been some considerable correspondence about this receiver, concerning which an article appeared in the December issue of Modern Wireless, I have ventured to write these further notes, in the hope that it may be of interest to those who are constructing, or who have constructed the set. One or two correspondents have written to know if the set could be made more flexible. This is a perfectly simple matter, and can be achieved without any alteration to the set, though improved results will be obtained if very slight alterations are made.

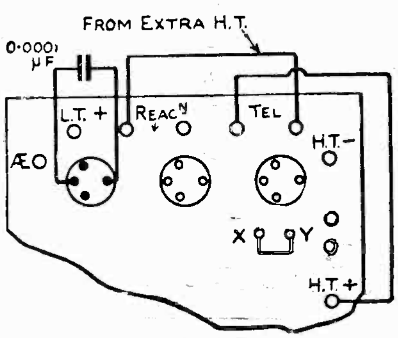


Fig. 1.—How to cut out first valve.

The following combinations can be accomplished with the set: (1) three valves; (2) two valves, detector and L.F.; (3) two valves, H.F. and detector; (4) one valve, detector only.

(2) Detector and L.F.—Switch off master rheostat; remove H.F. valve (left-hand valve on panel); connect a .0001 fixed condenser across plate and grid sockets of H.F. valve holder (see left-hand portion of Fig. 1). Clix terminals will be found to be of service here, as they fit tightly into the sockets. If you live within a few miles of a B.B.C. station you will find this a distinctly useful current—and valve-saver, as no diminution in signal strength will probably be noticed with the removal of the H.F. valve. The circuits will have to be retuned.

(3) H.F. and Detector.—Switch off master rheostat; remove L.F. valve (right-hand valve on panel); *disconnect extra H.T.+from phones +terminals* (it is of utmost importance that this should be done before any fresh wiring is added, otherwise you will short circuit your H.T. battery); connect by short lengths of flex the H.T.+ terminal to *phones+*, and *phones−* to *reactance+* (see right hand portion of Fig. 1, which shows clearly the disconnected *extra H.T.* wire and the fresh external wiring).

(4) Detector Only.—Combine instructions for (2) and (3).

Now there is one drawback to methods (3) and (4); the primary of the intervalve transformer is left connected in the H.T. circuit and in shunt with the phones. As the resistance of this primary is different from that of the 4,000 ohm phones or telephone transformer, you will be losing an appreciable portion of the plate current through the primary winding, and signal strength will suffer considerably. Therefore it is advisable to find a method of cutting this primary out when not using the L.F. valve. This can be done quite simply without upsetting the simplicity of the wiring of the set. Two fresh terminals are added to the panel in the positions shown in Fig. 1 (marked X and Y). Fig. 2 shows the alteration in the wiring (it is copied from p.123 of the December Modern Wireless, and shows the bottom left-hand corner of the back of the panel). First, the wire connecting the O.P. of the transformer to the Polar condenser is cut and removed between the points A and B; the wire connecting Z and O.P. is also cut and the two ends of the wire soldered to X and Y; and finally a fresh wire (shown dotted) is soldered to H.T.+ and Y. In practice, when the L.F. valve is functioning, X and Y should be connected by a short piece of wire or copper strap; this should be disconnected when the L.F. valve is taken out of its socket; by this means the primary of the transformer is cut out of the circuit. I have carried out these alterations on my own set, and can testify to its adequate working under the foregoing conditions. In Hampstead, Birmingham, Bournemouth and Glasgow have all been heard on detector only, and with very pleasant strength in the phones with H.F. added. A word of warning: when the H.F. valve is out, if reaction is being used on what was the tuned anode coil with H.F. in, this reaction should be used with still greater caution on broadcasting wavelengths, as it is now much easier to energise the aerial.

The advantage of the master

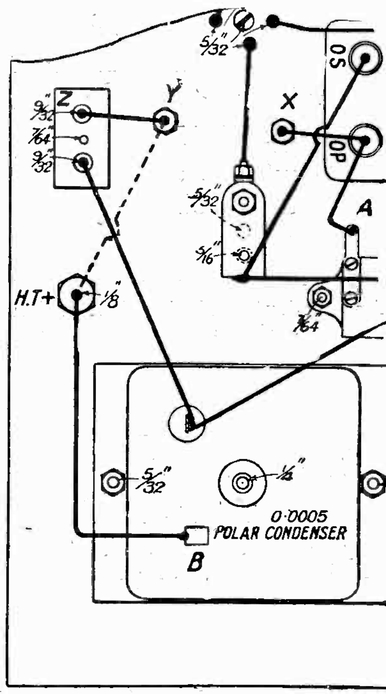


Fig. 2.—Alteration of wiring.

rheostat will be appreciated in these experiments. As soon as the best positions of the separate filament rheostats with regard to one another have been found, they should be left alone, and the control worked entirely on the

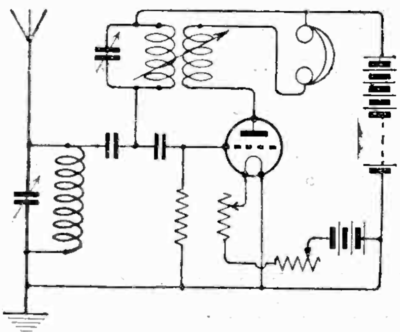


Fig. 3.—The circuit when using one valve.

master rheostat; thus the removal of one or two valves simply means a little more resistance on the master rheostat thrown into the circuit.

For those who study the theory of wireless, the circuit arrived at by the removal of the H.F. valve may be of interest, and Fig. 3 is given to show the actual circuit. Although this circuit is by no means a new one, as many people have tried cutting out H.F. valves, it is rarely mentioned in print.

I owe an apology for two errors in the December article tha I overlooked; in the detailed wiring diagram the left-hand Polar condenser should be .0003, and not .0005; also in the middle of the first column on page 123 "(the middle terminal on the top of the panel)" should read "(the second terminal . . .)."

Celluloid Varnish for Self-Supporting Coils

By Raymond P. Wales

An excellent insulating fluid which can be easily made by the experimenter has for its base celluloid. Drying very quickly, more so than shellac, it combines high insulating qualities with a beautiful gloss, strong body, not masking the original colour of the coil or instrument treated. The composition is made by dissolving scrap celluloid such as photograph film in acetone, which can be purchased very cheaply. The photographic film should be first scraped of its gelatinous emulsion by immersion in lye water, hot water or household "ammonia." The coating is then easily removed by scraping. The cleaned cuttings of the film are then shaken in a corked bottle with the acetone, more acetone being added if the mixture becomes too thick, or more celluloid if it has a tendency to flow too easily.

A New Crystal Detector

By A. E. STONE.

THE first essential of a Crystal Detector is ease of adjustment. By ease of adjustment is meant, not only finding the sensitive spot, but keeping the point on this spot when the hand is taken away. With many detectors it is easy to find the sensitive spot, but as soon as the adjusting knob is released, either the pressure on the point alters, or the spring causes the point to shift and the whole operation has to be performed again, to the detriment of the point and of one's temper.

With the arrangement shown in the accompanying drawings the adjustment is very easily made, and once it is made the point cannot move unless actually knocked or very heavily jarred. Also the pressure on the point is easily adjusted and is not influenced by the weight of the hand on the adjusting knob. This detector is very simple in construction and can be made by any amateur possessing a drill brace and some taps and dies.

The following description will be found helpful, the part numbers being shown in circles on the sketches.

Parts 1 are brass pillars $\frac{3}{8}$ in. diameter by about $1\frac{1}{4}$ in. long; clamped between these pillars and the ebonite base are soldering tags Part 2 for the connecting wires. Near the upper end of each of these pillars is a hole through which the rods Parts 3 and 4 can pass freely.

Part 3 is a brass rod $\frac{1}{8}$ in. diameter by about 2 in. long to one end of which is soldered the crystal cup which can be bought anywhere for about 3d. This cup should not be soldered centrally on the rod but about $\frac{1}{8}$ in. off the centre.

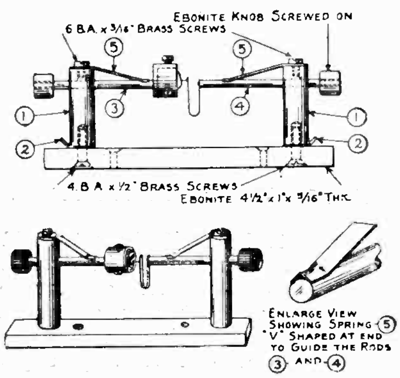
Part 4 is also a $\frac{1}{8}$ in. diameter brass rod $2\frac{1}{4}$ in. long to one end of which is soldered a piece of copper strip $\frac{1}{8}$ in. wide by about .003 in. thick bent into "U" shape, as shown in sketch. To this copper strip is soldered the contact point, which is a piece of copper wire about 44 gauge. The gauge is not important so long as the wire is fairly fine. This point should be about $\frac{1}{8}$ in. off the centre line of the rod.

With the crystal cup and the point thus mounted off the centre line, the point can be made to touch almost any spot on the face of the crystal by rotating the rods judiciously.

It is essential that these rods rotate and slide to and fro freely; but there must also be enough pressure on them to maintain them in any position. This is achieved very simply by the springs, Part 5. These springs are plain strips of phosphor bronze, $1\frac{1}{4}$ in. long by $\frac{1}{4}$ in. wide by .020 in. thick, secured to the top of the pillars by 6 B.A. screws and having the end which presses on the rod bent to a "V" shape, as shown in the enlarged view. They should be made to bear on the rod with a good pressure. By this means a very simple but efficient adjustment is obtained.

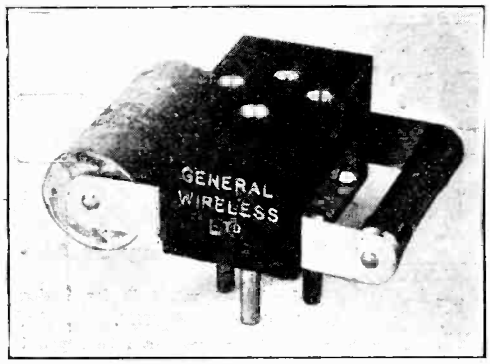
The following is a list of the material required:—

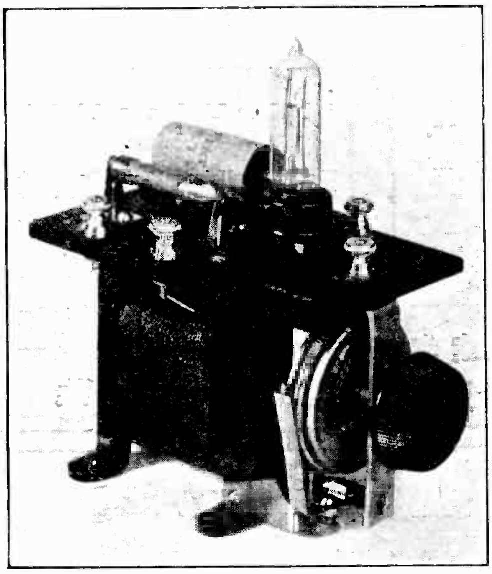
1 piece ebonite, $4\frac{1}{2}$ in. by 1 in. by any thickness desired.
2 pieces brass rod, $\frac{3}{8}$ in. dia. by $1\frac{1}{4}$ in. long.

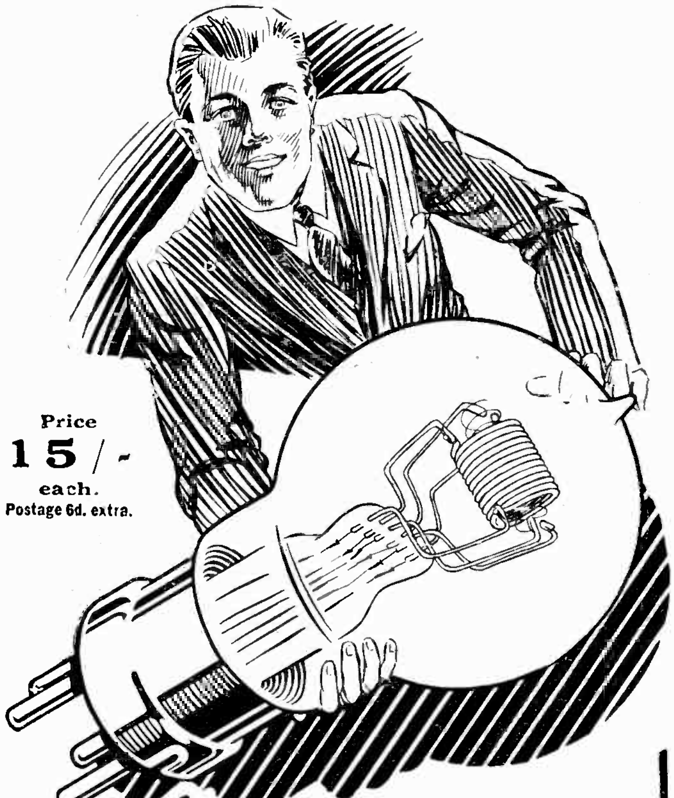


Constructional details.

1 piece brass rod, $\frac{1}{8}$ in. dia. by 2 in. long.
1 piece brass rod, $\frac{1}{8}$ in. dia. by $2\frac{1}{4}$ in. long.
2 pieces ebonite rod, $\frac{5}{8}$ in. dia. by $\frac{5}{16}$ in. long.
2 pieces phosphor bronze, $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. by .020 in. thick.
1 piece copper strip, $1\frac{1}{2}$ in. by $\frac{1}{8}$ in. by .003 in. thick.
2 4 B.A. soldering tags.
1 crystal cup.
2 4 B.A. by $\frac{1}{2}$ in. countersunk head brass screws.
2 6 B.A. by $\frac{3}{16}$ in. cheese head brass screws.
Small piece fine copper wire for the point. Gold-silver wire is better for the point as it does not tarnish, but is slightly more expensive.







The "Junior Wireless" Attaché Case Reflex Set

By PERCY W. HARRIS, Assistant Editor.

A very simple and inexpensive set for portable use.

IN last month's *Junior Wireless* a number of simple experiments were given by which the reader could gain experience in dual amplification reception. This month I want to describe the practical details of the attaché case set, so that the experiments can be carried one stage further and the complete set made up. It will be remembered that the set is one that is to be completely self contained, *i.e.*, not only the apparatus but both high and low tension batteries must be included in the case. Owing to its great filament strength a Peanut valve is used, the low-tension current being supplied by a large dry cell.

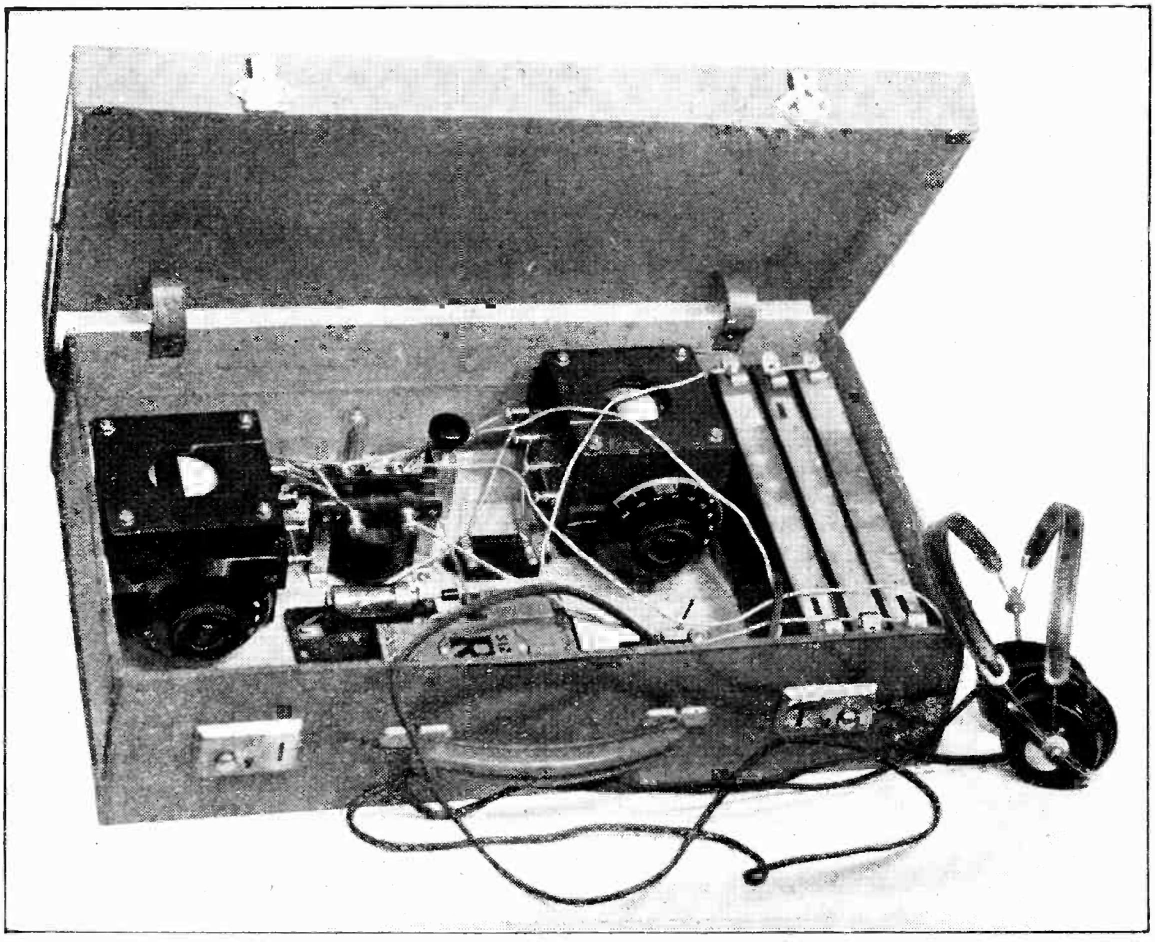
The attaché case used for the particular set described measures 16 in. by $9\frac{1}{2}$ in. by 4 in. deep. If the various components are mounted on a board there is no need to spoil a case, for when it is not desired to carry it about in this fashion the whole may be easily removed. To make up the set we require first of all a piece of board about $\frac{3}{8}$ in thick, measuring the inside length of the case by any thing from 7 in. up to the width of the case. If you have not by you a set of components you wish to use for this particular set, the following list will help you.

Components required

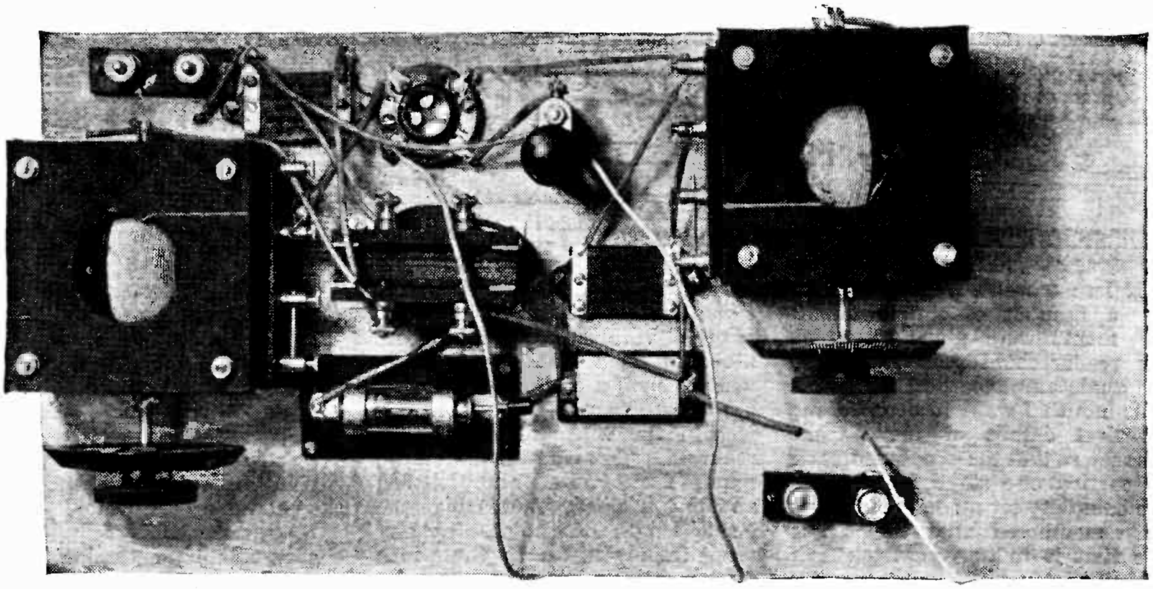
2 variometers. (Those shown were made by Peto-Scott, Ltd.).
1 crystal detector. (Enclosed). (Raymond).
1 valve socket.
1 Peanut valve. (Wecovalve).
1 filament resistance. (T.C.B.).
4 terminals for board mounting.
2 fixed condensers, 0.001 μF.
1 fixed condenser, 0.0003 μF.
1 intervalve transformer (that shown was a "Magnum.")
1 large dry cell.
3 15-volt high-tension No. 22 copper wire and insulating sleeving.

Constructional Details

First of all rub the board down with sand or emery paper and, if you desire, give it a coat of varnish stain. Place the variometers in the position shown,



This single-valve reflex receiver is simple to make, and yet will operate a loud speaker within four or five miles of a broadcasting station. The valve works off a single dry cell.



Plan view of complete receiver

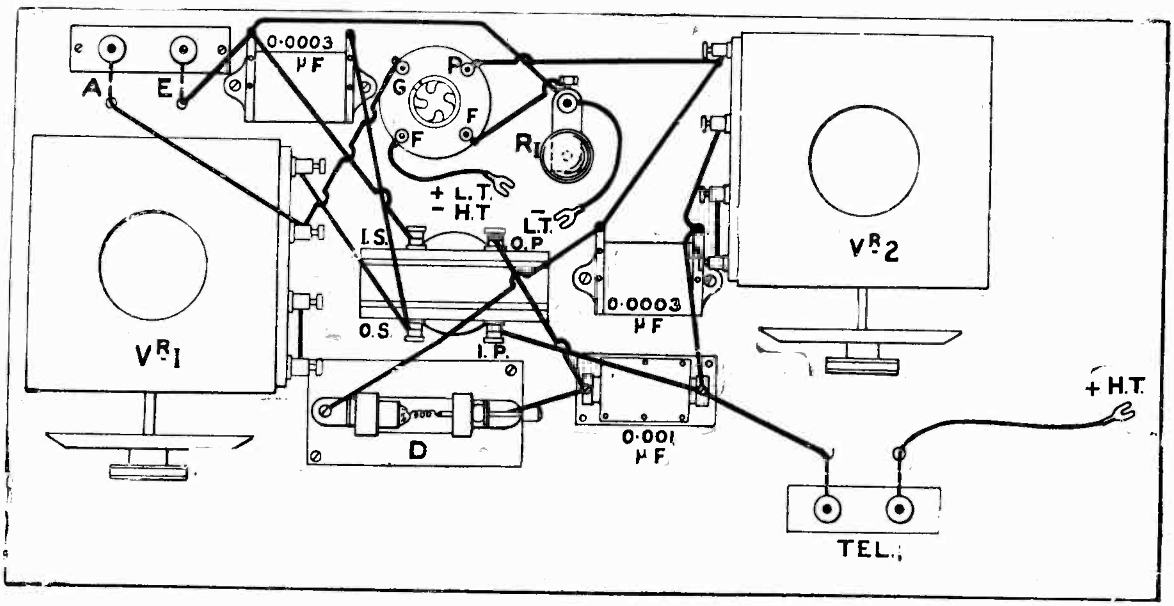
securing them by wood screws passing through from the underside of the baseboard into the wood of the variometers. Be sure that these screws are not too long or they will penetrate into the windings. The valve socket must be suitable for board mounting and can either be the conventional form of a 4-pin socket (if you buy a Peanut valve with the 4 pins) or the special form of socket sold with the Peanut having the American type base. It is an advantage to use the 4-pin socket as you will be able to try the set with other dull emitter valves in this way. Actually, in the set described, the special form of base was used because I had one handy.

In laying out your parts, see that you adhere to the arrangement shown, for this has been worked out to keep the leads as short as possible. You will notice that certain of the leads are flexible. These are the leads taken to the batteries. The flexible wire should be rubber covered and if you take some lengths of ordinary electric lighting flex, untwist them, and remove the cotton or silk covering, you will find this just the kind of wire most suitable.

About the Circuit

There is not much to add about the circuit, for it has been fully described in *Junior Wireless* for last month. Of course, you could use a fixed inductance with a variable condenser in both the aerial and the plate circuits if you so desire, but if you do so you will have to choose condensers and inductances which will fit into the comparatively limited space. You will notice that the variometers are so arranged that their dials are vertical and not horizontal, as this is the only way they will fit into the attaché case. If you have a case large enough it is preferable to arrange that the dials are horizontal. This will enable you to manipulate the set more easily.

The aerial and earth terminals are taken to the variometer as shown and a fixed condenser of



Wiring diagram. When used with small aerials it is advisable to connect a fixed condenser of about .0003 μF across the aerial variometer.

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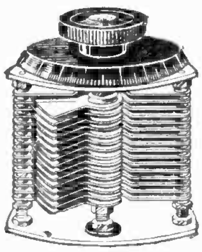

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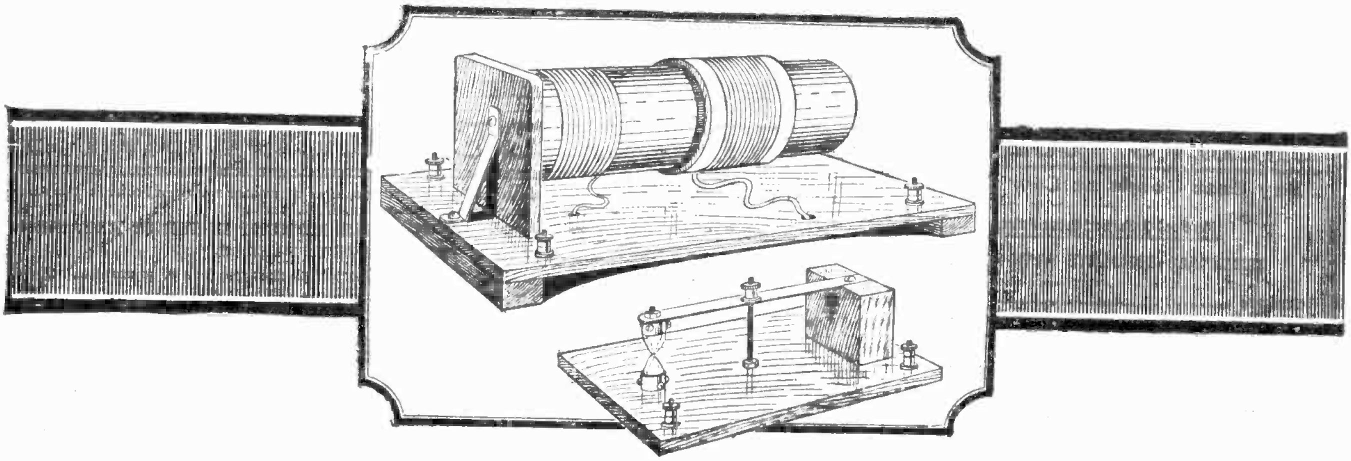


A Crystal Set is always useful—

No. 3
of the
RADIO PRESS
Series

WHEN your Accumulator runs down, or your Valve burns out, or your H.T. Battery suddenly develops noises—these are the occasions when you would give almost anything for some means of "carrying on." Why not forestall these possibilities by making a Crystal Set now?

This new Book by John Scott-Taggart, Editor of "Wireless Weekly" describes three useful Sets which can be made by anyone without special skill in the use of tools. In fact, the simplest of them (illustrated above) can even be constructed of material you would find around the house.

All have been designed to give good results with a range of, say, 25 miles from your nearest Broadcasting Station.

Get a copy of this Book to-day—even if your present Set seems immune from breakdown, you will never regret the time spent on building a Crystal Receiver.

Contents

Some General Principles.
The Question of Licences.
Parts of the Wireless Receiver.
Crystal Detectors.
Inductance Coils.
The Construction of the Crystal Detector.
Connecting up the Receiver.
Operation of the Set.
The Variable Inductances.
The Telephone Condenser.
Operation of the Circuit.
Erecting your Aerial.
Insulating your Aerial.
General Dimensions of the Aerial.
Constructional Details when using Masts.
The Down-lead and Lead-in.
Adjusting the Span of the Aerial.
Twin-wire Aerials.
The Earth Connection.
The Aerial-earth Switch.
Some remarks on Tuning.
Receiving Paris Signals.

Radio Press, Ltd.
PUBLISHERS OF AUTHORITATIVE WIRELESS LITERATURE
DEVEREUX COURT. STRAND. W.C.2.

From all Booksellers and Newsagents, or 1/7½ post free direct

How to make your own Broadcast Receiver

1/6

By John Scott-Taggart, F.Inst.P.

.0003 μF is placed across the second variometer. The reason for this is that the capacity of the aerial is absent from the plate circuit and as the average aerial has a value of about .0003 μF a condenser of this value compensates for the absence of the aerial.

Wiring up

When wiring up, solder all the leads and make them as short as you possibly can. Also make sure that you slip over the wire a suitable length of insulating sleeving, for you do not want two wires to come into contact with one another and so short circuit the batteries.

Using the Set

When you have finished wiring up, place the high-tension batteries in the positions shown, joining them up in series with one another. The positive side goes to the telephones and the negative is connected to the positive of the dry cell which is also connected to the filament. The negative of the dry cell goes to the remaining flexible lead. Place the Peanut valve in the socket and slowly turn on the filament resistance until the filament glows a dull red. Particularly note that the Peanut valve does not burn with anything like so bright a filament as many other dull emitters, and indeed in broad daylight you may have difficulty in seeing whether it is alight at all. Now place the cat-whisker on the crystal at what seems to be a suitable place, place the telephones on the head and, having set the right-hand variometer about half way round, turn the left-hand of aerial variometer until you pick up signals, from your local station. Now readjust the second variometer until best signals are obtained. When this has been done you will need to readjust the crystal to find the most sensitive point. If signals are very strong de-tune them somewhat to find the best setting on the crystal, for it is easier to set a crystal on weak signals than on those which are very strong. It you are within six or ten miles of a broadcasting station you should try the experiment of running a single wire round the picture rail of your room and using this as an aerial. The ordinary earth connection can be used. This will require some re-adjustment of the aerial variometer, but the plate variometer will have about the same position as when used on your outdoor aerial. Six miles away you should get quite good signals in the telephones with eight or ten feet of wire in this way and at greater distances a bigger indoor aerial can be used. On a good outdoor aerial you should be able to work a loud-speaker sufficiently well to be comfortably heard in a small room and I should not be surprised to hear that a loud-speaker can be worked at a much greater distance in this way. I do not suppose you will hear the other broadcasting stations on an indoor aerial unless it is taken up into the roof, but on an outdoor aerial you should be able to hear one or two others at least, although I do not claim that the set is very selective. With very small aerials a fixed condenser of .0003 μF across the aerial and earth terminals will improve signals.

IMPORTANT NOTICE.

Announcement regarding Next Month's Special Spring Number of "Modern Wireless."

Next month's issue of MODERN WIRELESS (March) will be a Special Spring Number. There will be 50 per cent. more text than usual and the price will be 1s. 6d. This price will only apply tc this enlarged issue, after which it will be 1s. as usual.

Not only will this extra large issue be the largest wireless journal yet published, but the contents will be of an extraordinarily interesting character. Every endeavour has been made to make the number particularly attractive, and the publishers anticipate that there will be more than an ordinary demand for this issue. Those who are accustomed to buy MODERN WIRELESS casually from a bookstall would be well advised to make sure that a copy of the Special Spring Number is reserved for them.

The articles, illustrations, printing and paper will be of the highest quality, and the members of the editorial staff are using their best endeavours to make the next issue of MODERN WIRELESS a superlatively fine production.

Many new ideas and developments will appear for the first time in the Spring Number. For example, there will be full details of the "ST. 100 Star" circuit, and detailed instructions for making a two-valve receiver using this circuit so adapted as to be self-contained. Because of its purity of speech and loudness of signals attainable, this simply constructed set will have a very wide appeal. This development of the ST. 100 circuit is absolutely fool-proof, and tens of thousands of those who have become interested in the ST. 100 will look forward with eager interest to this circuit and set.

Another important circuit described by John Scott-Taggart, F. Inst. P., A.M.I.E.E., which gives two stages of high-frequency amplification, and two stages of note magnification, with only two valves, will be found extremely effective for obtaining loud signals over long ranges. The extra stage of high-frequency amplification which is introduced without the addition of another valve enhances the value the more ordinary type of dual circuit greatly. To many, this article will undoubtedly be the most attractive feature of the whole issue.

Another two contributions by the pen of the Editor will consist of an article on "Dual Amplification Circuits I can Recommend," and the first long instalment of a series of articles dealing in a very detailed and comprehensive manner with the theory and practice of dual amplification. Each article will deal with a section of the subject. It is only because of the large number of text pages in MODERN WIRELESS that it will be possible to give this information in serial form.

Mr. Percy W. Harris is describing a very successful three-valve Reinartz receiver for broadcast reception, embodying some novel ideas. Fullest details are given in Mr. Harris's usual lucid style and he is also contributing an important article on a receiver using three valves, the first two acting as high-frequency amplifiers. Many experimenters find difficulty when using two stages of H.F., but this article will make matters very simple. Mr. Harris's reputation as a writer of really sound constructional articles, dealing with sets he has fully tried, is unrivalled and he is giving of his best in this special issue.

Mr. Kendall is describing a successful two-valve power amplifier of simple design, which may be used in conjunction with the other sets described in the issue.

Numerous tables of highly useful technical data will also be a feature of the issue, and there are one or two surprise items which we do not, at this stage, desire to disclose.

The whole issue is well worth five shillings, and this would be the ordinary price were the edition limited to 20,000 copies. On the 100,000 scale, however, the cost of production is greatly reduced and the benefit is passed on to the reader.

ON NO ACCOUNT SHOULD YOU MISS THIS SPECIAL SPRING NUMBER.

Pittsburg-Manchester Relay Broadcasting Experiments

An Explanation

THE Metropolitan-Vickers Company have a cablegram from Mr. H. P. Davis, Vice-President of the Westinghouse Company of Pittsburg, wishing to correct a possible impression that might be gathered from statements made to the Press that the Westinghouse "KDKA" Station was and is making no special effort to be heard in Great Britain. The cablegram continues: "Westinghouse America have co-operated with Metrovick daily since early October to improve transmission reception conditions so that re-radiation KDKA may be possible. 31st December personally sent from KDKA through 2AC Greetings and Wishes for a Happy and Prosperous New Year to all English-speaking peoples. Have every hope work of KDKA and 2AC will bring about reception of American programmes in Great Britain and even Continent as readily as is now done in America.—H. P. Davis, Vice-President, Westinghouse."

The enormous amount of preliminary work which has been necessary for these tests has probably not been realised. As long ago as September, 1923, the Westinghouse Company inaugurated their 100-metre transmissions, with a power of 1½ k.w., and the Metropolitan - Vickers Company, who are in close technical association with Westinghouse, commenced to receive and report on these broadcasts. Since that date the power input has been considerably increased and the strength of reception has improved accordingly. There appears to be considerable misconception on this point. The power of the KDKA station, while small in comparison with commercial radio-telegraphy stations for long distance work, is now greater than the combined power of all the B.B.C. stations, and not very small, as has been previously stated in the Press. The increase of power referred to raised some fresh difficulties, as it was now found that the reproduction of speech and music was usually so distorted as to render it unintelligible. This was due to the phenomenon of "night distortion," and is caused by slight changes of wavelength.

To overcome this difficulty the associated companies arranged special experimental transmissions taking place in the early hours of the morning after 4 a.m. Greenwich time, when the normal American broadcast programme had ceased. By this means the best adjustments of the transmitter were arrived at, with the result that the first intelligible programmes began to come through in time for successful re-radiation here before the close of the old year. There is still, of course, a great deal to be done in the way of improving the quality of the speech and music and of eliminating static interference. On Saturday, January 5, the entire evening programme from Pittsburg was re-radiated, from the very first item by the Westinghouse Employees' Band to the relaying of the Arlington time signals at 3 o'clock on Sunday morning.

A large number of letters has been received by the Metropolitan-Vickers Company from listeners in all parts of the British Isles, France, Belgium, Switzerland and Scandinavia, commenting on the surprisingly good quality of the re-radiation. One correspondent in London even went so far as to declare that the quality was as good as, if not better than, he had experienced a fortnight previously when listening in Pittsburg itself to KDKA.

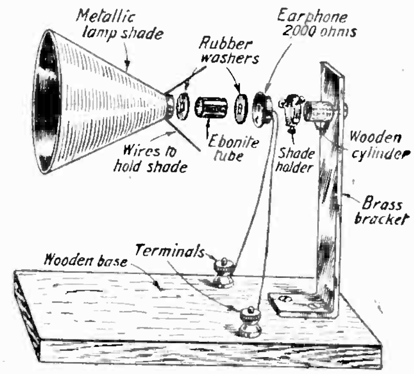
In Next Month's "Modern Wireless":

HOW TO MAKE A REINARTZ RECEIVER FOR BRIGHT OR DULL EMITTERS

Making a Loud-Speaker from a Lampshade.

THE necessary parts for a neat-looking home-made loud-speaker, as illustrated below, can usually be found in the box of "gadgets" of a radio experimenter.

First a brass bracket, ⅛ in. by ¾ in. by 6 in. high, is screwed to a wooden base measuring 9 in. by 3 in. by ½ in., in the centre of which two terminals have been screwed. At ½ in. from the top of the bracket a hole (⅛ in.) should be bored. Next a cylindrical block of wood 1 in. in diameter and a brass cup, for example, the holder of the lampshade which is to serve as a horn, are fastened on to the bracket by means of a 1½ in. bolt. The screws of the shade holder will serve to keep the earpiece in place.



A novel loud-speaker.

Over the face of the phone place a rubber washer with a centre opening slightly larger than the exposed part of the diaphragm. Next, an ebonite cylinder, 1½ in. in diameter, and 1 in. long, is placed on the rubber washer and a similar washer is placed at the other end of the cylinder.

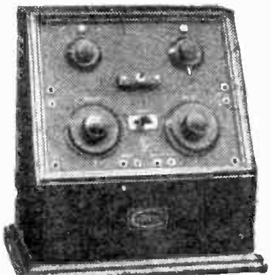
Finally a lampshade is fixed by wires to the end of the ebonite cylinder, as in diagram, the wires being bound round the tops of the screws of the shade holder.

A CORRECTION.

We regret that owing to a printer's error in the advertisement of the Igranic Electric Co., in the January issue, the price of the Vernier friction pencil was given as 7/-. The price should be 2/-.

THE "CURTIS REFLEX" 2 VALVES

300 MILES ON A LOUD SPEAKER



Price, £12 (Royalties, £2 . 2 . 6)

"...... and I get Newcastle on a loud-speaker strong enough to be heard eight feet away." J. T. C. Purley.

WE CLAIM FOR THE CURTIS REFLEX the following combination of characteristics which places this truly remarkable instrument in a category exclusive to itself.

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A simplicity of control which is practically instantaneously automatic in operation.

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Will receive all British Broadcasting Stations,

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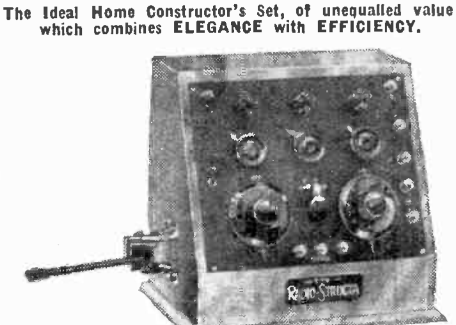
The Ideal Home Constructor's Set, of unequalled value which combines ELEGANCE with EFFICIENCY.



Includes complete equipment for the high-frequency tuned anode coupling, with intervalve reaction circuit of the Simplex Radio Chart, as professionally used for reception of **All-British, Continental and American Broadcasting.**

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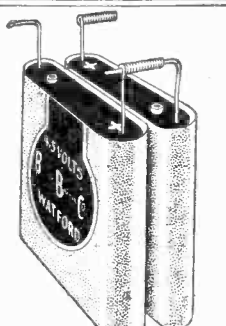

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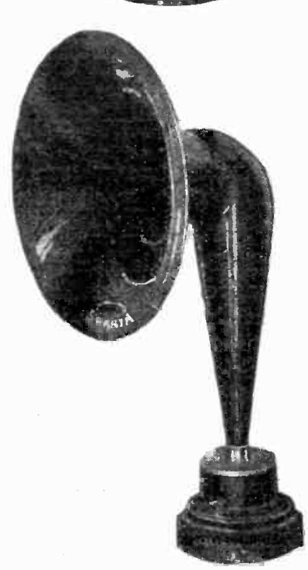

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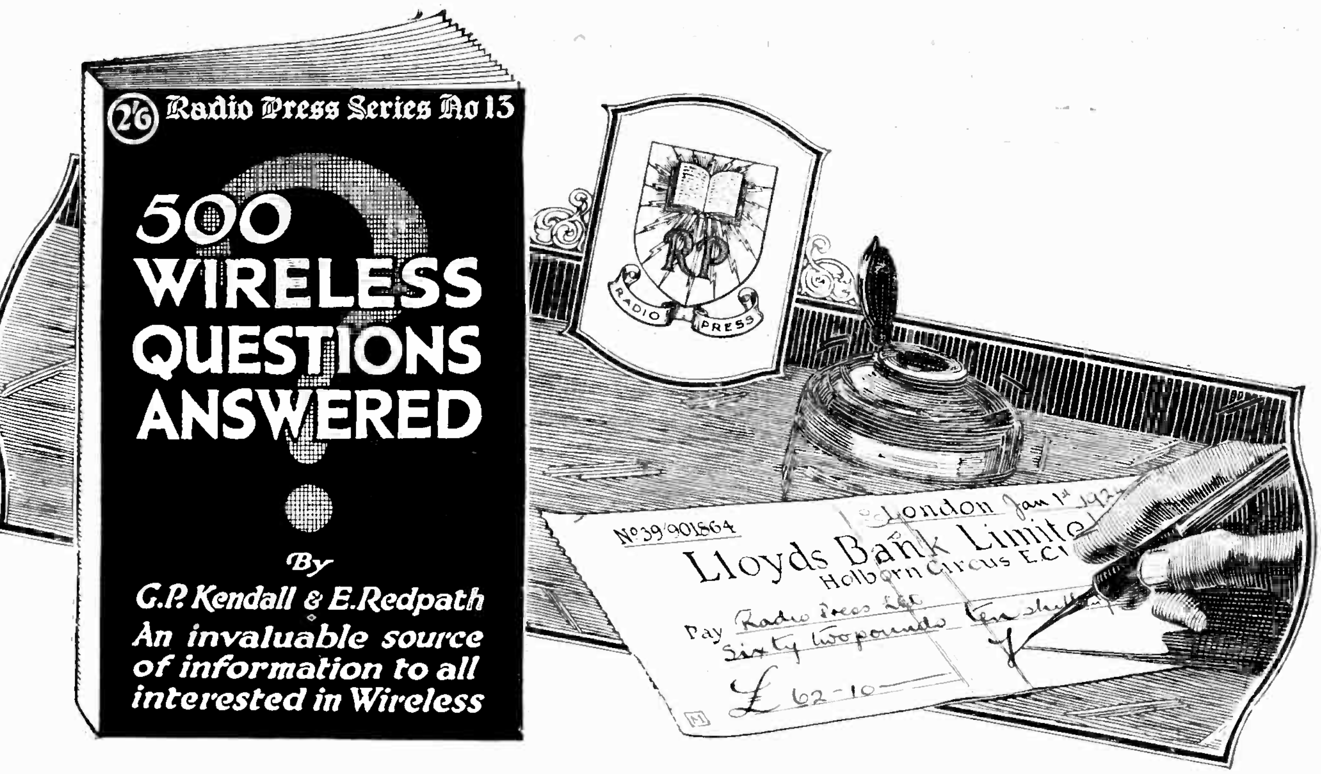

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RADIO PRESS SERIES No. 13

Gilbert Ad.

Makeshift Tools

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

An article of particular appeal to the new constructor.

SOME people are fortunate enough to have very large outfits of tools so that anything required for a special purpose is always at hand when needed; but most of us are not so well off as this. There are some tools which are so seldom required that it seems hardly worth while to provide them for emergencies that will not often occur. Still, when they are needed they are needed very badly, and unless we either have them to help us or can improvise something to take their place, the job in hand cannot be

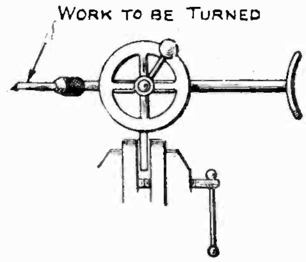


Fig. 1.—An improvised lathe.

completed. There is an old saying that necessity is the mother of invention, and one can often manage to devise something with the help of the tools already in the workshop which will do almost as well as the special tool or apparatus that is called for.

Suppose, for example, that you are faced with the problem of reducing the diameter of a bush or of some other round component made of ebonite or brass. A lathe is what you obviously need to do the work, for even the most careful filing will not enable you to keep it round during the process of reduction. We have not got a lathe. What are we to do? After all, a lathe is simply a machine which grips the work so that it turns true and allows it to be rotated at a considerable speed. Have we anything in the workshop that may be used? Well, there is the breast drill, which will do all this. Its chuck will usually take things up to ⅜ in. or rather more in diameter, and by means of the bevelled wheels whatever is held in the chuck can be made to revolve at any desired speed by turning the crank. Here is a way in which a breast drill may be turned into a small lathe in an emergency. It has a horizontal handle which screws into a boss in its frame and is intended to be gripped by the left hand when one is using the drill in the ordinary way. Unscrew this handle and place the boss between the jaws of a vice. Then get the drill quite horizontal and screw it up tightly as seen in Fig. 1. Nothing remains now but to contrive an emergency tool rest which can be made from a block of wood or of metal fixed down in a convenient position upon the bench.

A small cutting tool for use with this improvised lathe can be bought quite cheaply from any shop which deals in such things; but even this we can manage to do without in an emergency by using first of all a very coarse file and spinning the work at high speed. A finish may be given by using a finer file and lastly emery paper. Ebonite should be lubricated with turpentine whilst it is being turned, otherwise it will rapidly blunt any

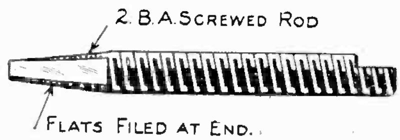


Fig. 2.—For tapping holes.

kind of tool. Brass on the other hand, is best worked with no lubricant at all.

Here is another emergency that may arise quite frequently. You purchase the parts of a variable condenser or some other piece of apparatus and find that to make it up you must be able to tap 2B.A. holes in ebonite. No tap of this size is available, and as you very seldom have a call for one you don't wish to purchase such a thing. There is no need at all to do so. Somewhere in your scrap box you are sure to find a piece of 2B.A. screwed rod, or a longish screw of the same size. Taper off one end of this slightly and file four flats upon it so that

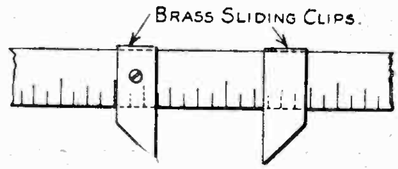


Fig. 3.—Emergency callipers.

at the end the threads are almost removed, whilst higher up they are less and less filed away (Fig. 2). This will give you as good a tap as you could want for ebonite working. You can either mount it in the tap wrench by filing a small flat at the other end and fixing it with the screw, or you can place it in the chuck of the breast drill. This is a most useful tip, for it enables one to tap holes of any size and with any kind of thread in ebonite. The improvised taps will cut this soft material very well indeed, though they are, of course, of no use for brass or other metal. Even here one can manage fairly well if a piece of steel studding or a steel screw of the right size is available. This should be filed as before and then hardened by heating it and dipping in water.

Here is a third little difficulty. You want to know the diameter of a spindle, a bush or some other round part and you have no calipers. If you try to measure it by

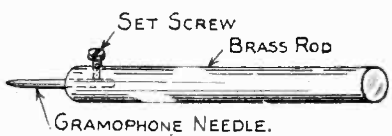


Fig. 4.—Home-made scriber.

simply placing it upon a foot-rule and trying to read the divisions you are pretty sure to make an error which may be rather serious. Still a foot-rule can be used if we make a small addition to it. This consists of a pair of sliders made of sheet brass with perfectly

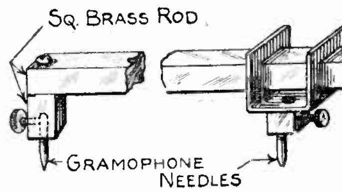


Fig. 5.—Improvised beam compass.

straight edges (Fig. 3). It is best to fix one of these in position by drilling a small hole through it and the ruler and passing a suitable bolt through the two—it can always be removed in a moment when it is not needed. It should be so mounted that its inner edge coincides exactly with an inch mark. The object to be measured is now held firmly against this edge and the other slider is pushed up until it makes contact. The exact diameter can then be read off at a glance.

A scriber can be made by fixing a gramophone needle into a holder made of wood or metal (Fig. 4). These needles will also be found most useful if you have to mark out a large circle on ebonite and have no tool suitable for the purpose. Fig. 5 shows how a beam compass can be made very easily with two of them and material from the scrap box.

If a screw sticks and refuses absolutely to be moved a great deal of force can be applied with the help of a spanner. Place a screw-driver in the nick of the screw and press hard upon it so that it gets a firm hold. Then take a screw spanner and adjust it so

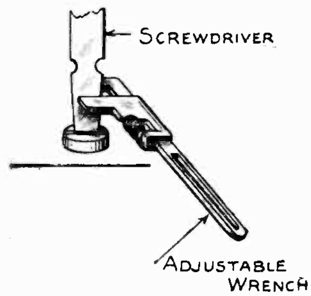


Fig. 6.—How to remove an obstinate screw.

that it grips the flat blade of the screw-driver. The handle of the spanner will now give you a lever which will enable you to move almost any screw. (Fig. 6).

An awkward soldering job turns up. A wire has to be fixed to a terminal in a position in which there is no room at all for the large soldering-iron. The best way is to make up a small one which will afterwards be found useful for all kinds of fine jobs. Take a piece of copper rod, either round or square (it does not matter which), and fix it into a tool handle. File the end to a blunt point and tin with solder in the usual way. You will then have an instrument which will do all that is required of it. (Fig. 7).

If you have no hacksaw, ebonite can be cut quite well with a kitchen meat-saw, and use of this kind will not damage the saw at all. For making fine cuts or for cutting on a curve a fretsaw may be pressed into service, though one has to go very carefully with it. Blades for cutting metal can, however, be bought to fit fretsaw handles, and if one of these is used cutting work of almost any kind can be done without any difficulty.

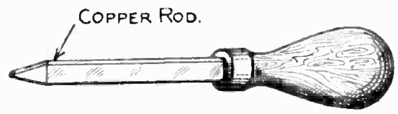


Fig. 7.—A small soldering-iron.

Annual Report of the Bureau of Standards, 1923

We publish below the section of the Annual Report dealing with Radio Communication. It has many points of interest.

Radio Interference

WITH the increasing use of radio communication it becomes more important to reduce the interference between radio waves. This means that all transmitting stations must operate exclusively on the frequencies assigned them, must use as small power as required to reach the necessary distance, and must use waves which are as sharp as possible. One of the immediate objectives of radio research generally, and of the Bureau's radio work particularly, is the reduction of radio interference in each of these respects. The requirement of a sharp wave means that the radio wave must occupy as narrow a band as possible in the wave-frequency spectrum. The breadth of the wave is therefore a measure of its interference-producing quality and for this reason a research has been started on the measurement of the breadth of waves. The particularly difficult problem of correction for the effect of the receiving circuits used in any such measurements is being studied. Experiments have been commenced also on the effects of modulation and frequency variation on the breadth of waves.

Electrical (non-radio) interference with radio reception is becoming increasingly important. While the Bureau has done little experimental work on the subject, it has made a preliminary study of it and has had much correspondence on the matter. The National Electric Light Association, Institute of Radio Engineers, American Radio Relay League, and many other radio and electrical interests have urged that the Bureau undertake a comprehensive study of the problem, but the necessary means have not yet been provided. Radio reception is frequently interfered with and in some cities almost entirely prevented by electrical disturbances from such sources as series arc circuits, battery chargers, power lines containing sparking commutators, leaky insulators, telephone bell ringing magnetos, and electrical precipitation processes.

Statistical Study of Distance Range (Jansky, Engel)

Along with the study of methods of measurement of interference, work has been conducted to determine the actual extent and effect of interference in radio reception as experienced by broadcast listeners. A statistical study of distance range of radio transmission from broadcasting stations has been made, the observations being taken by about 100 volunteer observers. The Bureau had the co-operation of the American Radio Relay

League, the Westinghouse broadcasting station at Pittsburgh, and the University of Minnesota in selecting observers and editing the observation forms, about 7,200 of which were received. These are being analysed by the sorting and counting machines of the Bureau of the Census. The results show the effect upon distance range of the distance, wave frequency, type of receiving apparatus, and various sources of interference. The analysis of results to date shows that the principal obstacle to reception is interference from broadcast stations other than the one which the listener desires to hear. The next greatest obstacle is fading of signals (except in the summer when atmospheric disturbances are worse), and the smallest of the observed obstacles to reception is interference from power lines. The results showed that there is a region of minimum reception about 100 miles from a transmitting station, such that louder signals are received both nearer to and farther from the transmitting station than in this region. The distance of this region from the transmitting station is roughly proportional to the wavelength.

Radio Fog Signalling (Dunmore)

Co-operation with the Bureau of Lighthouses in the improvement of the radio fog-signalling service was continued. An automatic transmitting set of Bureau of Standards type was adjusted in a new beacon station near Baltimore. Preliminary specifications were prepared for an automatic transmitting set of electron-tube type. Such sets will give rise to much less interference with other radio communication, will modernise the beacon system, and will have greater distance range. Some consideration was given to the improvement of design of direction finders for use on shipboard.

Radio Recorders

A radio time-signal relay was designed and constructed for the recording of Arlington time signals by the section of the Bureau dealing with time standardisation. This relay is essentially a receiving set adjustable to a single frequency and is very rugged and positive in action.

Aircraft Radio Problems (Dunmore, Engel)

Work was carried out for the Air Service on the development of an altimeter utilising variations of capacitance detected by radio methods. Reports on this subject were furnished to the Air Service. Special work on the application to aircraft of radio communication on 3,000 kilocycles was also done (see "Short-wave radio communication" below).

Radio Wave Phenomena (Whittemore)

A paper describing the Bureau's work on the fading or fluctuations of short wave radio signals was sent to press. This paper is to be issued as a scientific paper of the Bureau and an abbreviated version is to appear in QST. A paper has also been prepared on the methods of statistical analysis used in the foregoing work and in the study of distance range.

The Bureau is represented on the committee on earth currents and polar lights of the American Geophysical Union, which is making a study of the effect of aurora on radio transmission. Observation forms for radio and aurora conditions were prepared for the McMillan Polar Expedition in co-operation with the American Radio Relay League and Carnegie Institution. The purpose of these forms, to be filled out by observers on the expedition and on land in the northern parts of North America, is to reveal relations between radio and auroral phenomena.

Assistance was given in the preparation of programmes and general organisation of work on radio phenomena in connection with the International Union of Scientific Radio Telegraphy (see paragraph on this subject below).

Short-Wave Radio Communication (Dunmore, Engel)

A research has been under way for the Air Service of the Army on the practicability of radio communication at higher frequencies than those used in the past. The use of such frequencies, largely neglected heretofore, has been found to have a number of important advantages. Interference is less because a much narrower percentage band of frequencies is utilised by radio telephony or any given type of modulation than at lower wave frequencies.

Apparatus was developed for both transmission and reception on a frequency of 3,000 kilocycles per second (100 metres). Both telegraphy and telephony on this frequency were found to be thoroughly practicable. In two-way tests between Washington and Pittsburgh it was found that the fading was materially less than in communication at lower frequencies.

When the experiments were carried to a frequency ten times the foregoing, namely, 30,000 kilocycles per second (10 metres), it was possible to concentrate the waves in a desired direction by means of a parabolic cylindrical reflector of parallel wires. Both telegraphy and telephony were accomplished under these conditions. Special 100-watt generating apparatus was developed, and the signals were received by a small loop antenna.

Electron Tubes (Joilffe)

A study was made of the effect of regeneration in receiving sets. It was found that the amplification due to regeneration decreases with increase of signal strength and that the effect of regeneration is not strictly equivalent to a negative resistance for different values of current in the circuit. A study was made of various means of preventing re-radiation from regenerative receiving sets. This is an important phase of the interference problem, since the disturbance radiated from such sets gives rise to annoying noises in the receiving sets of near-by users. A brief experimental study was made of super-regeneration.

Life tests were undertaken on the newer types of receiving tubes. This work is in progress in co-operation with the tube manufacturers and the Navy and Army. It has involved a selection of properties for periodic measurements and the establishment of a time schedule for the routine of the life tests.

A study of the power rating of power tubes is under way. Two radio telephone sets for general laboratory use and for the transmission of standard frequency signals have been constructed.

Insulating Materials (Preston, Strock)

Measurements of radio-frequency properties were made on a number of samples of phenolic insulating material, hard rubber, celluloid, and miscellaneous materials.

Work was also carried out on the standardisation of methods of testing the properties of electrical insulating materials in co-operation with the American Society for Testing Materials, the Bureau being represented on committee D-9, insulating materials. The Bureau's methods of measuring radio-frequency properties were adopted by this committee as tentative standards.

Radio Measurements

In co-operation with the Radio Inspection Service a number of improvements were made in the wave meters used by the radio inspectors. Specifications were drawn up for the design and construction of two coils to increase the frequency range of the wavemeters. Improvements were made in the resonance indicators. A special scale was designed for use with the instrument which increases the precision of reading frequency or wavelength by a factor of 6. This work has been essential in view of the increasing use of continuous-wave radio-transmitting apparatus and the closer spacing of wave frequencies assigned to radio stations.

A differential measurement device for rapid radio-frequency measurements was designed and constructed. The cathode-ray oscillograph tubes used in connection with fundamental frequency standardisation were improved by evacuation by special apparatus, and measurements were made on the radio-frequency impedance of a number of telephone receivers.

Design of Radio Standards (Preston)

A number of improvements were made in the design of the variable air condensers used as radio-frequency standards. A series of special inductance coils was designed which gives a comprehensive set of standards for inductance and frequency measurement in a radio laboratory.

The Radio Inspection Service was assisted in the design of a very compact wave meter for the broadcast range of frequencies. Two designs were prepared for a frequency indicator; that is, a non-adjustable wave-meter which indicates at one frequency only. This device is for use in a broadcast transmitting station to set the frequency accurately on the assigned frequency. The use of a device of this type was recommended by the Second National Radio Conference.

(To be continued.)

NOTICE.

JUNIOR WIRELESS

is discontinued as a separate section, but similar matter will be distributed throughout the ordinary pages.

Wireless under the Microscope

Mysteries of the Telephone Headpiece

By Dr. J. H. T. ROBERTS

Do you realise how little energy is required to make a noise in your receivers? This article will tell you.

HAVE you ever thought how tiny are the movements which take place in your wireless set when you are listening to a broadcast concert ? If you investigate, you will find that they are of almost inconceivable minuteness. Let us take the case of the diaphragm of the telephone receiver. As you know, this vibrates when set into operation and strikes the air particles which, in turn, operate upon the drums of your ears. But if you examine the diaphragm of the telephone, even when it is emitting quite a loud sound which can be heard with perfect ease, you will find that it is utterly impossible to perceive any movement, the diaphragm appearing to be actually at rest. In reality, however, the central portions of it are moving up and down perhaps 1,000 times per second, and not only that, but the diaphragm is vibrating in *different modes,* according to the sounds which it is emitting, a singer's voice or the notes of an orchestra. And although you cannot see any motion, your ear immediately perceives the slightest change in the character of the vibrations.

The motions of the diaphragm are imperceptible to the eye partly because they are so rapid and partly because they are so extremely small. For example, suppose you are using a crystal set, the diaphragm of the telephone moves to and fro perhaps one hundred-millionth of an inch. It is almost impossible to conceive what is meant by such a small distance. But we can arrive at some idea of it in this way. Suppose it takes one hundred pages of this Journal, laid one upon another, to make a thickness of one inch. Then one page is one-hundredth of an inch in thickness. If you could split a page at the edge, by means of a knife, until you had one million pages, each page would be one hundred-millionth of an inch in thickness: its thickness would then represent the distance which the diaphragm of the telephone of a crystal set moves to and fro when you are listening to the broadcast music!

Even this does not represent the limit of sensitivity of the human ear. For Lord Rayleigh and other scientists have made careful measurements of the smallest vibratory motion in the air which the ear can perceive, and they have found that a motion as small as about a millionth of a millionth of an inch can just be heard by a normal ear. If you split this page into one million sheets and then took one of these million sheets and split it into ten thousand further sheets, each of the final sheets would be a millionth of a millionth of an inch in thickness, and a vibratory motion in the air of an extent equal to the thickness of such a sheet would be just audible. When you consider that many wild animals can hear sounds which are far beyond the sensitiveness of the human ear, you will realise to what extremely small air-motions these animals' ears are susceptible.

Power Received

The amount of power received by your aerial also takes us into the region of almost infinite smallness. Suppose the transmitting station is radiating one horse-power of energy and that your aerial picks up an amount of energy corresponding to fifty square yards. If you are at a distance of ten miles you will receive an amount of energy considerably less than one hundred-millionth of one horse-power, and owing to a variety of losses, the power which you eventually make use of is probably a small fraction of a millionth of a millionth of a horse-power, or, in fact, a very small fraction of a "*fly-power*"!

Again, let us consider the amount of electric current which flows through your telephones when using a crystal set. The current which is required to operate an electric bell is, say, 1 ampere. This means that a million million million electrons rush through the bell every second. Probably you do not regard 1 ampere from a small battery as representing a very large amount of power, but this power is prodigious when compared with the power in the aerial circuit of your wireless set. A pocket flash-lamp uses millions of times as much power as your aerial brings in, and many times the power required to operate a loud-speaker.

Even when this minute quantity of energy is passed through the telephones, a great amount of loss occurs and only an extremely small fraction of the power is actually converted into sound. In fact, if we could have a really perfect telephone receiver, which converted the whole of the electrical energy supplied to it into sound-energy, and if we used this perfect telephone in connection with a crystal set, the sound produced would be as loud as the sound which is given out from an ordinary telephone connected with a *five-valve set.*

Another interesting fact about a wireless set is the speed with which the wireless waves travel from the broadcasting station. Wireless waves move with a velocity of 186,000 *miles* per second, whilst sound-waves move with a velocity of about 1,100 *ft.* per second. Suppose the microphone at the transmitting station is 1 ft. away from the singer. The sound takes about one-thousandth of a second to travel from the singer to the microphone. It is then transformed into electrical energy, flashed by wireless to your receiver, and re-transformed into sound energy probably well within the space of another one-thousandth of a second. You then receive the sound in the same time that it would have taken to travel 2 ft. from the singer's throat. If the concert room is 100 ft. across, people sitting on the opposite side from the singer will hear the sound in about one-tenth of a second, whereas you, with your wireless set, have heard it in about one-fiftieth of a second, or, in other words, the sound took fifty times as long to reach a person sitting in the actual room as it took to reach, by wireless, a person perhaps 200 miles away!

Sidelines in Wireless.

By Lt.-Col. CHETODE CRAWLEY, R.M.A., M.I.E.E.
Deputy Inspector of Wireless Telegraphy, G.P.O.

UNTIL quite recently the transference of energy by wireless waves could only be considered, from the commercial point of view, as a new means of telegraphic s.gnalling, applicable to the mobile communications of ships and aircraft, as well as to the point-to-point communications, already catered for, to a great extent, by cables and land lines. This telegraphic application of wireless waves is still a child, and a very robust child, but it may be of interest to glance at other applications which as yet are only infants, some thriving, some weakly, but all of promise.

Broadcasting

First and foremost among the infants is the application of broadcasting words and music for entertainment and instruction. There is no need to expatiate here on the rapid growth of broadcasting in this country, as it is common knowledge that what was a year ago theoretical possibility is now looked upon as a popular and almost commonplace form of entertainment. Not that we can yet grasp the potentialities of broadcasting. We are indeed only groping on the fringe of the most far-reaching discovery of our time, possibly of any time, and it would be as easy as it would be futile to let our imagination run riot on a world knitted together, through broadcasting, by a bond of universal intercourse and understanding. The most terrible war in history has given us, after all, only a League of Nations, such a league as may well sink into nothingness compared with a League to be born of wireless broadcasting. Just think of the great area and population of the United States of America, and realise that even now, after only a couple of years' experience of broadcasting, every man, woman, and child in that vast country could listen with simple inexpensive apparatus to the words spoken by a single individual in Washington. What is to be the outcome of this? Are there not indeed good grounds for saying that broadcasting is the most far-reaching discovery of our time in more senses than one?

But we must leave broadcasting visions for a brief consideration of other sidelines branching off from the mainline of telegraphic communication.

Position Finding

The sideline which is most developed at the moment is that of determining the positions of ships and aircraft by wireless waves, and the great potential advantages of such an arrangement for navigational purposes are obvious. The position is determined by the operator in the ship or aircraft taking bearings, by means of special wireless receiving apparatus, on two or more fixed stations which are transmitting wireless waves, the point of intersection of the lines of the bearings, plotted on a chart, giving the position of the craft. Many ships and aeroplanes are now being fitted with this apparatus, and as experience is gained so are results attaining to greater reliability.

Positions can also be found by any ship or aeroplane fitted with an ordinary wireless installation. In these cases, however, the bearings can only be obtained from such fixed wireless stations as are fitted with directional receiving apparatus. All aerodromes have a station so fitted, but in this country there are at present only three stations, viz.: Berwick, Flamborough and Lizard, available for giving bearings to ships. For ship work, bearings sufficiently accurate for navigational purposes can usually be obtained, in the present state of development, up to distances of about 100 miles by day and 50 miles by night. The results obtained by the apparatus when it is fitted in a ship or aircraft are less reliable than when fitted in a fixed station, but, as already mentioned, experience in the use of the system in ships is rapidly producing greater accuracy, and demonstrating to ship owners the great value of this new aid to navigation.

Wireless Beams.

There is another form of directional apparatus of which only one example is yet in use, and that experimentally, viz., at Inchkeith in the Firth of Forth, though another is being installed on the South Foreland lightship. From this station a rotating beam of wireless waves can be radiated, specified letters being signalled to signify the various directions of the beam. By this means a ship fitted with special wireless receiving apparatus coming within range of the beam, at present about 10 miles, can determine accurately its bearing from the station, and, roughly, its distance, the station acting, in fact, like a wireless lighthouse.

Experiments for sending beams of wireless waves over long distances are now in progress, and are producing very promising results. The advantages of such an arrangement would be, first, that as the radiated energy is concentrated in one direction, instead of being emitted in all directions, less power, and therefore less money, would be required to signal from one place to another, and secondly, that communication would be more secret, as the messages could only be intercepted by stations situated in the line of the beam, instead of, as at present, by any station within range, irrespective of its position.

Wired Wireless.

A sideline of wireless telegraphy and telephony which has considerable possibilities is "Wired Wireless," an anomalous but expressive title, so anomalous indeed that many prefer to use some other title such as "Carrier Current" telegraphy or telephony. This system of communication was first achieved in 1911 by Major-General Squier in the United States of America, and it is there and in Germany that it has been chiefly developed, though much has been accomplished with it in this country during the last few years. In fact it is really only during the last few years, *i.e.*, since the development of the thermionic valve, that the arrangement has become of commercial value. "Wired Wireless" consists, broadly speaking, of transmitting energy along a wire in the form of high-frequency currents similar to those used in wireless signalling. For instance, a line already in use for ordinary telephony may have a high-frequency current generated and modulated in it by a wireless telephone transmitter, the speech being received at the other end of the line by a wireless telephone receiver, and a number of transmitters and receivers can be used simultaneously on the same line by employing different frequencies for each communication. This system is being found of great value for providing additional communications along ordinary telephone lines loaded to their maximum capacity, so far as ordinary telephonic working is concerned, and it is also coming into use for communication along lines which are being used for the transmission of electrical power. In fact, so far its chief practical application has been for communication along lines already in use, either for other forms of communication or for some other purpose.

Wireless Pictures.

"Wireless Pictures" is a heading which has often appeared in the Press of late, and a very interesting sideline it is, though it cannot yet be considered as a commercial proposition. One of the most promising systems of this transmission of pictures or writing by wireless signals is that of the French scientist M. Belin, who succeeded, two years ago, in sending a telephotographic message across the Atlantic. The transmission by M. Belin's method occupies some minutes in building up the picture or message, so that it cannot rightly be called "television," which is the term used to signify the practically instantaneous transmission of a picture, etc., as a whole, a problem which is still unsolved, though unlikely to remain so for long. M. Belin uses at the transmitting station a cylinder on which the picture is engraved in relief. The cylinder is rotated and a needle pressing on it rides up and down the little hills and valleys, like a gramophone needle, the alteration in pressure at the other end of the needle being arranged so as to alter correspondingly the strength of an electric current, which, in its turn, alters or modulates the continuous stream of wireless waves which are being radiated from the station. At the receiving station, these modulated waves are made to influence a beam of light which is directed on to a rotating cylinder, covered with photographically sensitised paper, so as to produce light or dark shades corresponding to the little hills and valleys of the picture on the transmitting cylinder. Both cylinders are made to rotate at the same rate, and to move at the same rate along their axes, so that at the transmitting station the needle traverses the area of the picture as does the beam of light in producing a replica of the picture on the receiving cylinder.

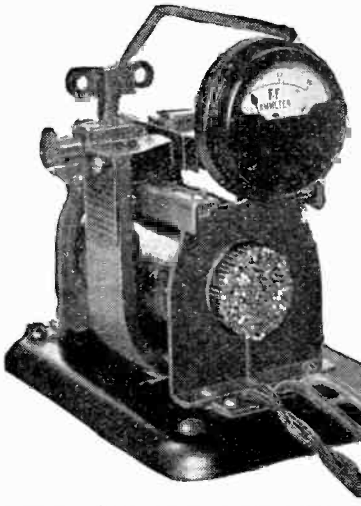
Wireless Control.

There are also many interesting sidelines which may be grouped together under the heading of "wireless control." First amongst these in popular interest, if one may judge by the frequency of reports in the Press, are methods of navigating ships and aircraft by wireless signals. Much has been written of the horrors of the next great war, when this country, it is said, will be invaded by hordes of aircraft navigated by wireless from the enemy country, these aircraft releasing in the same way bombs of hitherto unheard of destructive power whenever desired. At the same time, apparently, all our ships will be sunk by torpedoes similarly guided by the master brain of the enemy. But even if such arrangements were to become practical on a large scale for one side, it must not be forgotten that in war there is always "the other fellow" who can use his wireless too, and it would be just as easy, and unprofitable, to write at length of the facility with which the enemy's plans could be annihilated by wireless signals sent from our own stations. The following paragraph from a newspaper of September 11 last shows strikingly how wireless interference may prevent navigation by wireless.

"The seven destroyers which went ashore on Saturday night at Pedernales, California, with the loss of twenty-three sailors, were unable to find their bearings in a dense fog, because the air was filled with wireless messages about a freight steamer which had gone on the rocks at San Miguel Island, a few miles away.

"It is customary during a fog for warships to secure wireless bearings, but, lacking these, the destroyers continued in line-ahead formation at twenty knots by dead reckoning."

But the fact remains that more or less successful experiments *have* been carried out with bombs loosed by wireless signals from aircraft navigated by wireless signals, and with torpedoes fired by wireless signals from ships navigated by wireless signals, and there can be no doubt that such things *will* be done in the next great war, if there is to be a next great war, but certainly not on the large scale so often predicted.



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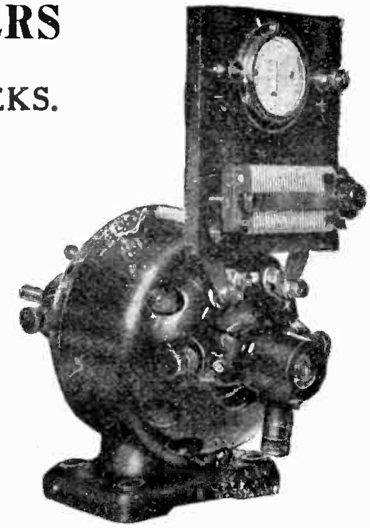

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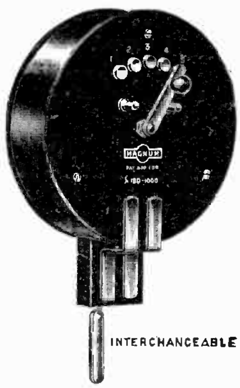

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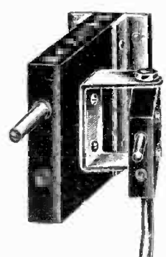

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No effort has been spared to make these instructions clear and lucid and any man can commence building his Set with every confidence that he will achieve complete success.

Envelope No. 1.

Containing instruction Booklet, full-size working drawings, complete list of all components, etc., for building up a 2-Valve Reflex Receiver employing the well-known S.T. 100 Circuit. Designed by John Scott-Taggart, F.Inst.P. **2/6**

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Containing instruction Booklet full size working drawings, complete list of all components, for building up a family 4-Valve Receiver for use with headphones or loud-speaker and embodying a large number of entirely new features. Designed by Percy W. Harris (assistant editor *Modern Wireless*). **2/6**

RADIO PRESS LTD.
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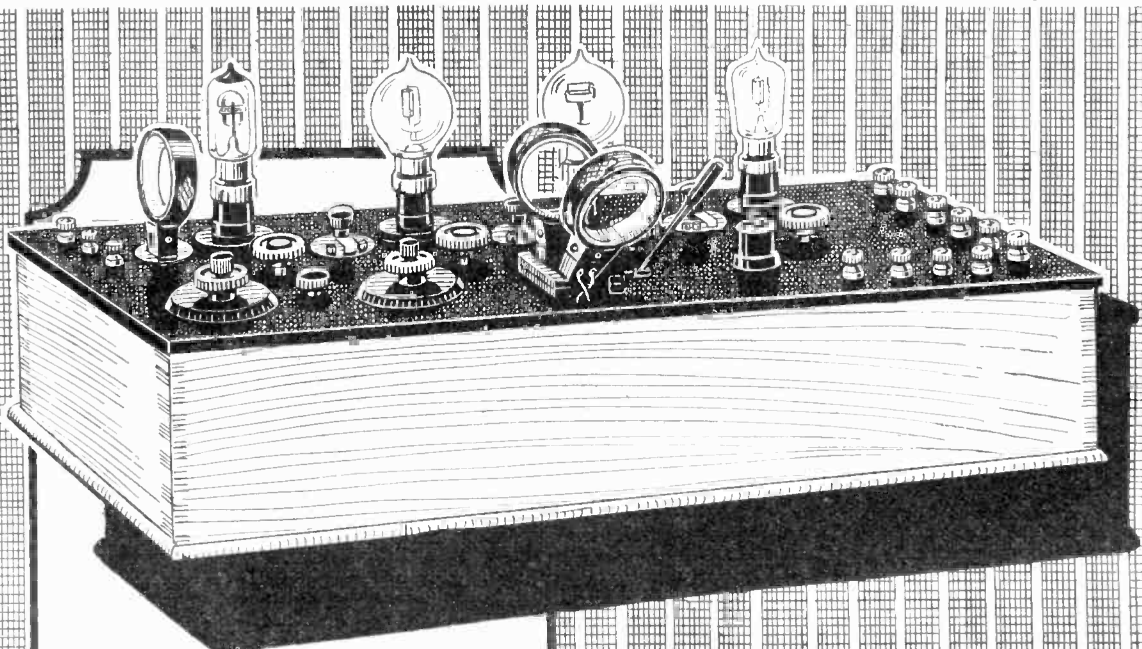

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It contains one H.F. Valve and one Detector followed by two Note Magnifiers. By an ingenious and simple method of switching any combination of Valves from one to four can be used at will. Reaction is used on to the tuned anode coil while a potentiometer makes the Set very stable and really easy to tune.

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(Continued from page 299.)

The gridleak R_1 will not be found to be critical, but care should be taken that the resistance is in because in these types of gridleaks and anode resistances it is possible by rotating the knob in an anti-clockwise direction sufficiently far to cut out the resistance altogether, which, of course, is a desirable advantage in some cases.

Connecting Up the Fig. 3 Circuit

The Fig. 3 circuit is useful for the reception of broadcasting, but is primarily intended for the reception of longer waves, such as those on which the Paris Time Signals are sent. The resistance R_4 will act now as a resistance coupling, but this is not very efficient on wavelengths below 1,000 metres. When receiving such stations as the Eiffel Tower, it is desirable to cut out the constant aerial tuning fixed condenser C_1, mentioned in connection with previous figures.

The aerial is now connected to the terminal A_2 of Fig. 5, instead of to A_1, as was previously the case. The plug-in coil is now connected in the coil holder L_2 of Fig. 5, while nothing whatever is put into the coil holder L_2. Assuming that no leads have been used to connect up the various terminals surrounding the coil holders, we make the following connections:

T_1 is joined to T_2 and T_3 to T_4. T_6 and T_5 are left unconnected, as also is T_9. The terminal T_{11} is connected to T_7.

It is desirable to try adjusting the value of the resistance R_4 when using this circuit.

Trying Out the Fig. 4 Circuit

The circuit in Fig. 4 is similar to that shown in Fig. 3, but this time a reaction coil L_2 is coupled to L_1, but the reaction coil is not tuned. The connections to the various terminals are as follows:—

T_1 is connected to T_2, and T_3 to T_4. The aerial is connected to A_2, and the earth to E. The terminal T_{11} is connected to T_5, and T_6 is connected to T_7. The terminals T_8 and T_9 are left unconnected.

A coil is inserted in L_1 and another in L_2. If it is found that on bringing the moving coil closer to the other, and retuning on the left-hand condenser of Fig. 5, i.e., C_1, the signal strength does not increase, then try connecting T_1 to T_4, and T_2 to T_3, instead of the previous connections to these terminals.

When using the circuits of Fig. 3 and Fig. 4, the variable condenser C_3 is not, of course, in circuit, and the right-hand condenser of Fig. 5 need not be touched.

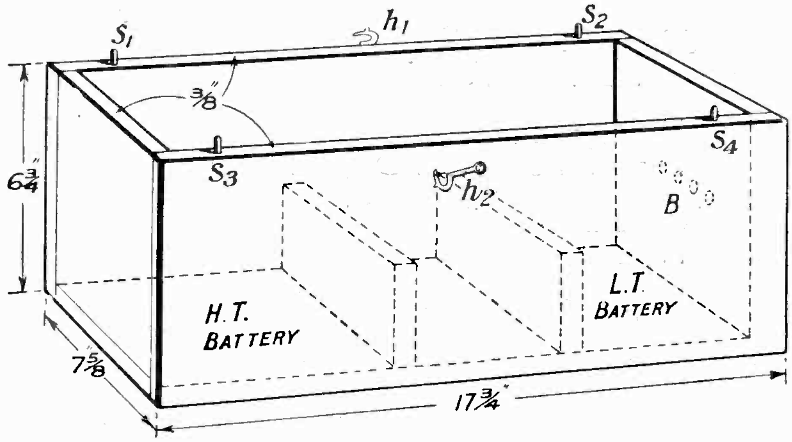


Fig. 9.—Details of Box.

Sizes of Coils

The sizes of the coils suitable for different wavelengths will be supplied by the coil manufacturers. Coils having 50 turns are suitable for receiving 2LO, using the constant aerial tuning system, but for receiving the broadcasting stations using longer wavelengths, two coils, each of 75 turns, are recommended.

Reception of Continuous Waves

Continuous wave signals may be received with the circuits of Fig. 2 and Fig. 4, the latter figure being only used when longer waves are being received. In any case, the arrangement of Fig. 2 is the better for continuous wave reception, but no attempt should be made to receive continuous waves on wavelengths near those employed by the broadcasting stations, because the self-oscillation of the first valve will completely spoil the reception of those listening to broadcasting.

In any case it is essential that the coils L_1 and L_2 should be kept as far away as possible, and if there is a tendency to oscillate when receiving broadcasting, this may immediately be stopped by turning the knob of the resistance far more in a clockwise direction. The circuit will then operate effectively and very faithfully.

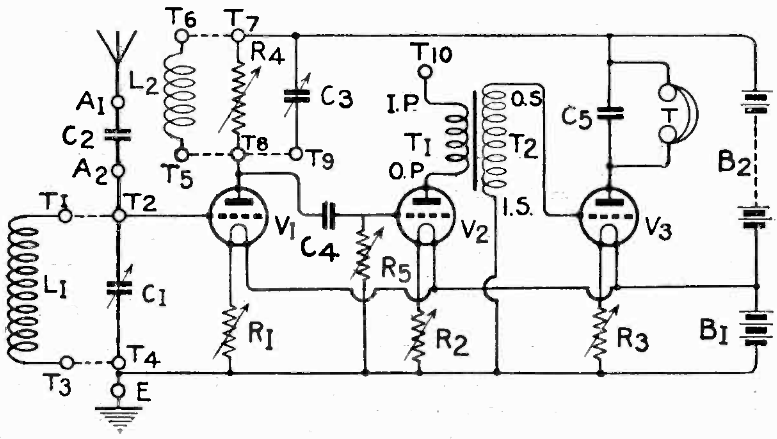
Special Note

Full details have been given in this article for making and using this three-valve receiver. By virtue, however, of the fact that several terminals are fitted on the panel to enable different circuit combinations to be obtained, it is impossible to detail these in this issue.

Next month, further circuits will be fully described, and further operating details given.

Blue Prints

Two full size blue prints of the top of the panel, and of the underneath wiring, are obtainable from Radio Press Limited, Devereux Court, Strand, London, W.C.2, the publishers of MODERN WIRELESS and WIRELESS WEEKLY, for 1s. 6d. each. Readers desiring to take advantage of this should distinctly specify blue prints Nos. 16A and 16B. An additional 2d. should be included for postage.



Fiy. 10.—Numbered theoretical diagram.

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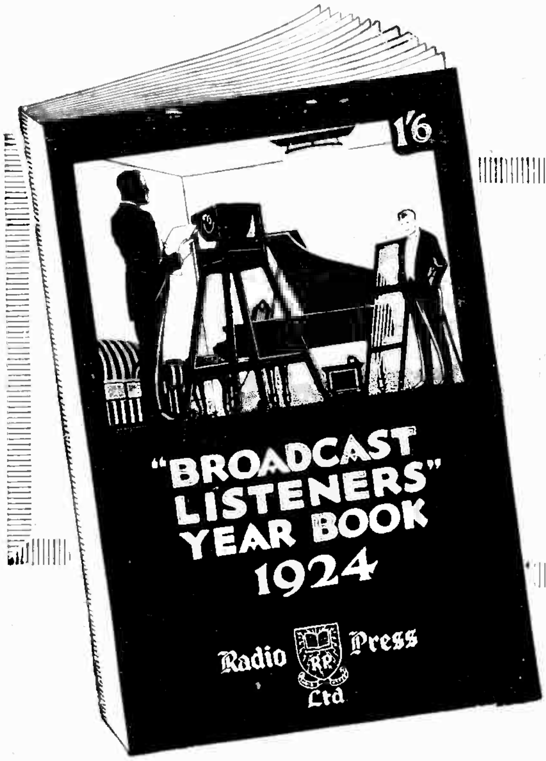

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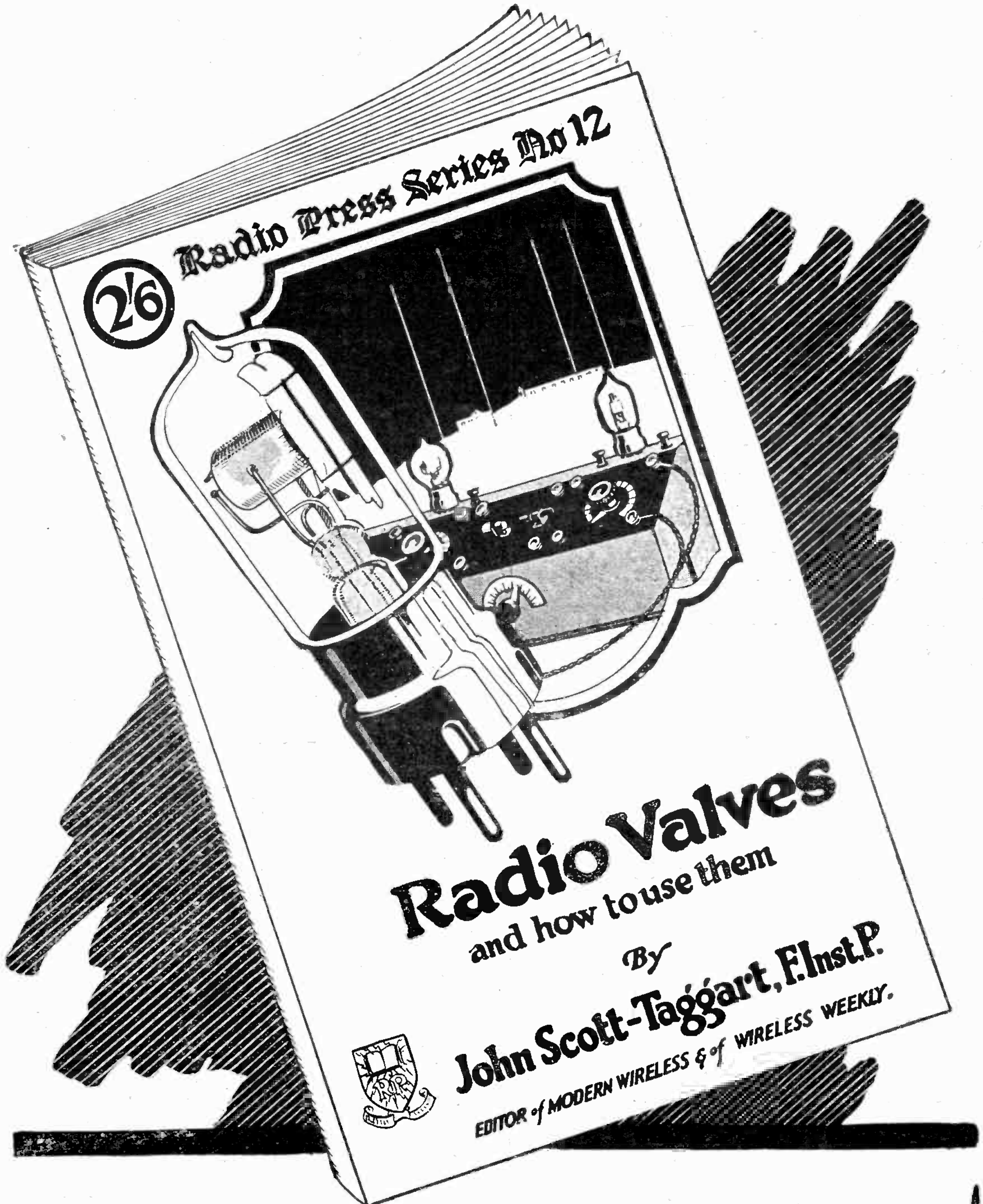

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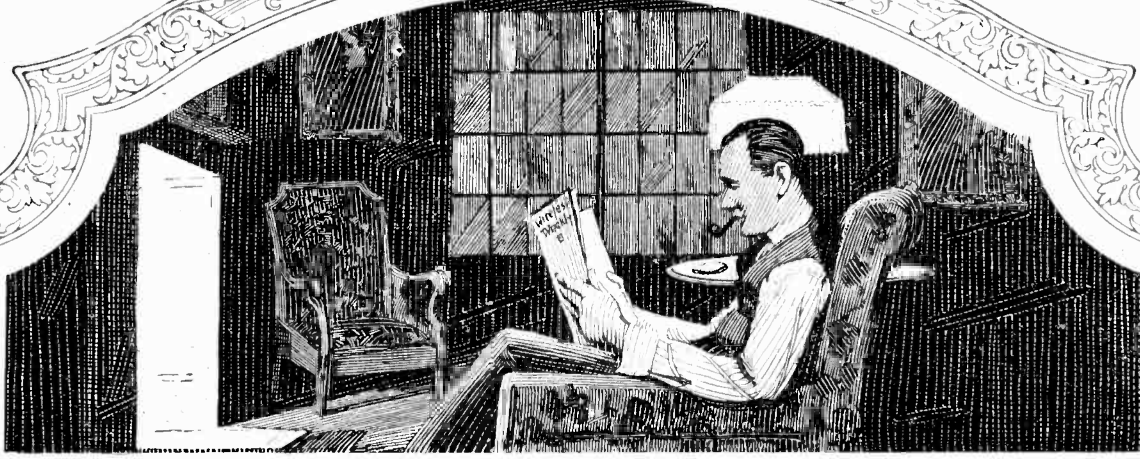

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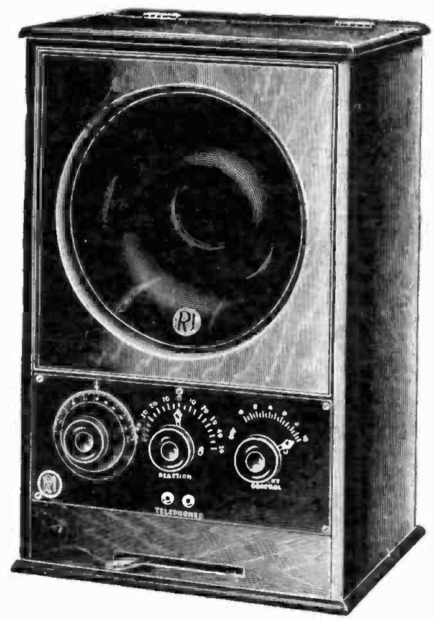

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